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May 22, 2015

Mr. Naiel Hussein, P.E.
Parsons Brinckerhoff
2 Miranova Place, Suite 450
Columbus, Ohio 43215

Reference: **Final Structure Foundation Exploration Report for HAN-75-14.39**
Bridge No. HAN-68-1656 over IR 75 and US 68 Ramp B
Findlay, Hancock County, Ohio
ODOT PID No. 87005 and PGI Project Nos. G13011G & G15004G

Dear Mr. Hussein:

Enclosed please find our Final Structure Foundation Exploration Report for the above referenced project. Our services included a geotechnical field exploration, laboratory testing, engineering analysis, and related design and construction recommendations. These services have been provided in accordance with our proposal dated January 16, 2013 and December 10, 2014. It is important that the items under "**Limitations**" be precisely followed and complied with.

We appreciate the opportunity of working with you on this project and we invite you to contact us at (440) 717-1415 when we can be of further assistance.

Respectfully,

PRO GEOTECH, INC.

Shan Sivakumaran, P.E.
Project Manager/Geotechnical Engineer

Walid I. Najjar, P.E.
Senior Geotechnical Engineer

Enclosure
G13005Grpt/HAN-68-1656Bridges/SS/5/22/2015

FINAL
STRUCTURE FOUNDATION EXPLORATION REPORT
FOR HAN-75-14.39
BRIDGE NO. HAN-68-1656 OVER IR 75 AND US 68 RAMP B

HANCOCK COUNTY, OHIO
ODOT PID NO. 87005

PREPARED FOR:

PARSONS BRINCKERHOFF

PREPARED BY:

PRO GEOTECH, INC.

MAY 22, 2015

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

A Boring Location Map
Drilling Logs
Test Boring Profile

B Laboratory Test Results
Unconfined Compressive Strength of the Rock Core
Rock Core Samples Pictures
Rock Mass Rating Spreadsheets
Estimation of Drilled Shaft Resistance and Settlement in Jointed Rock Spreadsheet
Subgrade Analysis Spreadsheet
Geotechnical Design Check List
Historic Information
Laboratory Test Standards
ODOT Soil Classification System

1.0 EXECUTIVE SUMMARY

This report has been prepared for the HAN-75-14.39 project which calls for design and construction of the Bridge No. HAN-68-1656 over IR 75 and US 68 Ramp B as part of redesigning the IR-75/US 68 Interchange in Findlay, Hancock County, Ohio. The design information provided by PB personnel indicates that the proposed bridge was originally to be designed as a three (3) span bridge with an approximate total length of 346 feet. As originally proposed a Mechanically Stabilized Earth (MSE) Wall System was to be used to retain the abutment fill at both rear and forward abutments. However, the proposed bridge was re-configurated due to unsuitable soils that were encountered in the vicinity of the original rear abutment location and the number of spans were changed to four (4) with an approximate total length of 510 feet. The Mechanically Stabilized Earth (MSE) Wall System will be replaced with reinforced concrete spill-through abutments with turn back wingwalls. A total of six (6) test borings were drilled in 2013 in the vicinity of the proposed bridge site. Four (4) of these identified as B-135-1-13, B-135-0-13, B-134-0-13, and B-133-0-13 were advanced for bridge foundations design purposes and two (2) of these identified as B-135-2-13 B-132-1-13 were advanced for MSE Wall foundations design purposes. After the reconfiguration of the bridge, two (2) additional test borings identified as B-132-2-14 and B-133-1-14 were drilled in 2015 at the proposed bridge site for bridge foundations design. Test boring B-136-0-13 which was advanced for the US 68 Ramp C design, was located in the vicinity of the rear abutment. Test borings B-135-0-13 and B-135-1-13 were located in the vicinity of the proposed Pier 1 while test boring B-134-0-13 was located in the vicinity of the proposed Pier 2. Test boring B-133-1-13 was located in the vicinity of Pier 3 while test borings B-133-0-13 and B-132-2-14 were located in the vicinity of the proposed forward abutment. These structural test borings were advanced to approximate depths ranging from 14.0 to 42.0 feet below the existing ground surface.

Subsurface Soil Conditions: The subsurface soils encountered in test borings B-136-0-13, B-135-2-13, B-135-1-13, B-135-0-13, B-134-0-13, and B-132-2-14 consisted of both fill materials and natural soils. The subsurface soils encountered in test borings B-133-1-14, B-133-0-13, and B-132-1-13 consisted of only natural soils. The fill materials were encountered above natural soils consisted of sandy silt (A-4a), silt and clay (A-6a), silty clay (A-6b) and elastic clay (A-7-5) and to depths ranging from 1.5 feet and 24.5 feet below the existing ground or pavement surface. Natural soils encountered above bedrock consisted primarily of cohesive soils classified as silty clay (A-6b), silt and clay (A-6a), clay (A-7-6), sandy silt (A-

4a). Bedrock was encountered in all test boring locations at approximate depths ranging from 2.8 feet to 26.5 feet below the existing ground or pavement surface.

Bedrock Conditions: The core samples consisted of dolomite of the Tymochtee/Greenfield Group. The dolomite was light gray to gray, severely to slightly weathered, and strong to very strong. Bedding within the dolomite was generally very thin to medium and was highly fractured to moderately fractured. No slickensides were observed and the fractures were typically tight to narrow and slightly rough to very rough. The Rock Quality Designation (RQD) for the core samples ranged from 0% to 69%. The compressive strength of the core specimens ranged from 9,706 psi in test boring B-133-0-13 to 23,129 psi in test boring B-132-1-13 which characterizes them as "strong" to "very strong", respectively. The Rock Mass Rating obtained for the bedrock core samples according to LRFD Table 10.4.6.4-1 varied from 36 to 42 and is classified as "Fair Rock" to "Poor Rock".

Bridge Foundation Systems: Test borings B-136-0-13, B-135-0-13, B-135-1-13, B-134-0-13, B-133-1-14, B-133-0-13, and B-132-2-14 were advanced for bridge design purposes. Soil and rock information obtained from test boring B-136-0-13 which was advanced for the US 68 Ramp C design purposes, was used to design the rear abutment. Soil and rock information obtained from test borings B-135-0-13 and B-135-1-13 was used to design the Pier 1 foundation while soil and rock information obtained from test boring B-134-0-13 was used to design the Pier 2 foundation. Soil and rock information obtained from test boring B-133-1-14 was used to design the Pier 3 foundation while soil and rock information obtained from test borings B-133-0-13 and B-132-2-14 was be used to design the Forward abutment.

Since bedrock will be encountered at relatively shallow depths at the pier locations, the proposed superstructure loads may be transferred to the underlying bedrock by means of drilled shafts. Because the embankments for bridge approaches will be constructed prior to abutments construction, bedrock will be encountered at relatively greater depths at the rear and forward abutment locations. Therefore, the proposed superstructure loads may be transferred to the underlying bedrock by means of end bearing piles at the abutment locations.

Drilled Shafts: Table 6.1.1 summarizes total factored resistance for the selected diameters and socket length at the abutment and pier boring locations. Side resistance from the soil overburden and upper two (2) feet of the shallow bedrock can be ignored. Based on the factored axial compression resistance for the

selected shaft socket length and diameter, the estimated maximum total settlement and differential settlement will not exceed one inch and one half inch, respectively.

Table 6.1.1 – Estimated Design Parameters for Drilled Shafts

Boring No.	Top Bedrock Elevation (feet)	Shaft Tip Elevation (feet)	Socket Diameter (feet)	Socket Length (feet)	Total Factored Resistance (kips)
Piers					
B-135-0-13	773.4±	763.9	5.0	7.5	950
B-135-1-13	773.4±	763.9	5.0	7.5	950
B-134-0-13	773.0±	763.5	5.0	7.5	950
B-133-1-14	773.1±	763.6	5.0	7.5	950

Driven piles: The estimated pile parameters for end bearing piles at each boring location are summarized in Table 6.1.3. The pile cut-off elevations at the abutments were extracted from the final structure site plan provided by PB personnel.

Table 6.1.3 - Estimated Design Parameters for H-Piles

Boring No.	Pile Cut-off Elevation (ft)	Pile Tip Elevation (ft)	Estimated Effective Pile Length (ft)	Pile Type	Pile Size	Maximum Factored Structural Resistance/pile
Abutments						
B-136-0-13	807.6	773.4	35.0	H-Pile	10X42	310 kips
B-136-0-13	807.6	773.4	35.0	H-Pile	12X53	380 kips
B-133-0-13	814.2	771.6	45.0	H-Pile	10X42	310 kips
B-133-0-13	814.2	771.6	45.0	H-Pile	12X53	380 kips

2.0 INTRODUCTION

This report has been prepared for the HAN-75-14.39 project which calls for design and construction of the Bridge No. HAN-68-1656 over IR 75 and US 68 Ramp B as part of redesigning the IR-75/US 68 Interchange in Findlay, Hancock County, Ohio. It represents the intent of Parsons Brinckerhoff (PB) the design engineer, and the Ohio Department of Transportation (ODOT), the owner, to secure subsurface information at the selected locations in accordance with ODOT's *Specifications for Geotechnical Explorations*, and to obtain recommendations regarding geotechnical factors pertaining to the design and construction of this project.

2.1 Project Description

Present plans call for the design and construction of the proposed Bridge No. HAN-68-1656 which will carry the US 68 Ramp C vehicular traffic over IR 75 and US 68 Ramp B. The design information provided by PB personnel indicates that the proposed bridge was originally to be designed as a three (3) spans with an approximate total length of 346 feet. As originally proposed a Mechanically Stabilized Earth (MSE) Wall System was to be used to retain the abutment fill at both rear and forward abutments. However, the proposed bridge was re-configurated due to unsuitable soils that were encountered in the vicinity of the original rear abutment location and the number of spans was changed to four (4) with an approximate total length of 510 feet. The Mechanically Stabilized Earth (MSE) Wall System will be replaced with reinforced concrete spill-through abutments with turn back wingwalls. The proposed superstructures will be continuous plate girders with reinforced concrete decking on abutments and piers. The sub-structure units will be supported on reinforced concrete spill-through abutments on capped piles and cap and column piers on drilled shafts. The bridge is to be designed based on HL-93 loading criteria and the ODOT Bridge Design Manual, issued in 2007 which includes LRFD Bridge Design Specifications. The Site Location Map is shown in Figure 2.1.

This report has been developed based on the field exploration program, laboratory testing, and information secured for site-specific studies. It must be noted that, as with any exploration program, the site exploration identifies actual subsurface conditions only at those locations where samples were obtained. The data derived through sampling and laboratory testing is reduced by geotechnical engineers and geologists who then render an opinion regarding the overall subsurface conditions and their likely reaction on the site. The actual site conditions may differ from those inferred to exist. Therefore, although a fair amount of subsurface data has been assembled during this exploration, this report may not

provide all of the geotechnical data needed for construction of this project. This report was prepared using English units.

2.2 Scope of Services

The scope of services for this project was in accordance with Pro Geotech, Inc. (PGI) Proposal Nos. PG12067 dated January 16, 2013 and PG14044 dated December 10, 2014 and governed by ODOT's *Specifications for Geotechnical Explorations* dated January 2007 and updated January 20, 2012, ODOT's Bridge Design Manual, issued in 2007, and AASHTO LRFD Bridge Design Specifications, 6th Edition hereafter referred to as ODOT Specifications. Our scope of services consisted of the execution of the following tasks:

Phase I – Planning and Marking Test Borings, which primarily consisted of planning the field portion of our subsurface exploration, performing the site reconnaissance to evaluate the proposed project site from a geotechnical standpoint, reviewing and compiling all existing geology of the project site obtained from ODOT and ODNR sources, marking the test boring locations, obtaining necessary permits, and notifying the Ohio Utility Protection Services (OUPS) about the proposed drilling operations.

Phase II - Test Boring and Sampling Program, which primarily consisted of field verification of the test boring locations with regards to the underground utilities, advancing the test borings at the site, conducting field tests, sampling the subsurface materials, and preparing field drilling logs.

Our scope of services included advancing a total of eight (8) test borings; six (6) in 2013 and two (2) in 2015, in the vicinity of proposed Bridge No. HAN-68-1656 over IR 75 and US 68 Ramp B and MSE Walls for structural foundation design purposes. These structural test borings were to be advanced to approximate depths ranging from 25.0 feet to 40.0 feet below the existing ground surface and existing Ramp IR 75 SB pavement shoulder, and included obtaining 10 to 15 feet of rock core at each boring location. All test borings were advanced in accordance with the ODOT *Specifications for Geotechnical Explorations*. The groundwater conditions were monitored during and upon completion of the drilling operations. PGI provided all of the traffic control, equipment, and personnel needed during the fieldwork.

Phase III - Testing Program, which consisted of performing soil classification and engineering properties tests on selected soil and rock samples, and classifying the soils in accordance with the ODOT Soil Classification System.

Phase IV - Geotechnical Exploration Report, which included the following:

- A brief description of the project and our exploration methods
- Typed drilling logs and laboratory test results
- A description of subsurface soil, rock, and groundwater conditions
- Discussions pertaining to earthwork considerations, groundwater management, and construction monitoring
- Foundation recommendations for the bridges and retaining walls including shallow and deep foundations
- Recommendations for MSE Walls which will include external stability analysis, settlement, drag-down forces, and lateral earth pressures
- Preparation of ODOT Geotechnical Design Checklists
- Preparation of Geotechnical Structure Foundation Exploration Plans

The scope of services did not include any environmental assessments for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater or air, on, below, or around this site. Any statement in this report or on the boring logs regarding odors, colors or unusual or suspicious items or conditions is strictly for the client's information.

3.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT SITE

3.1 Geology

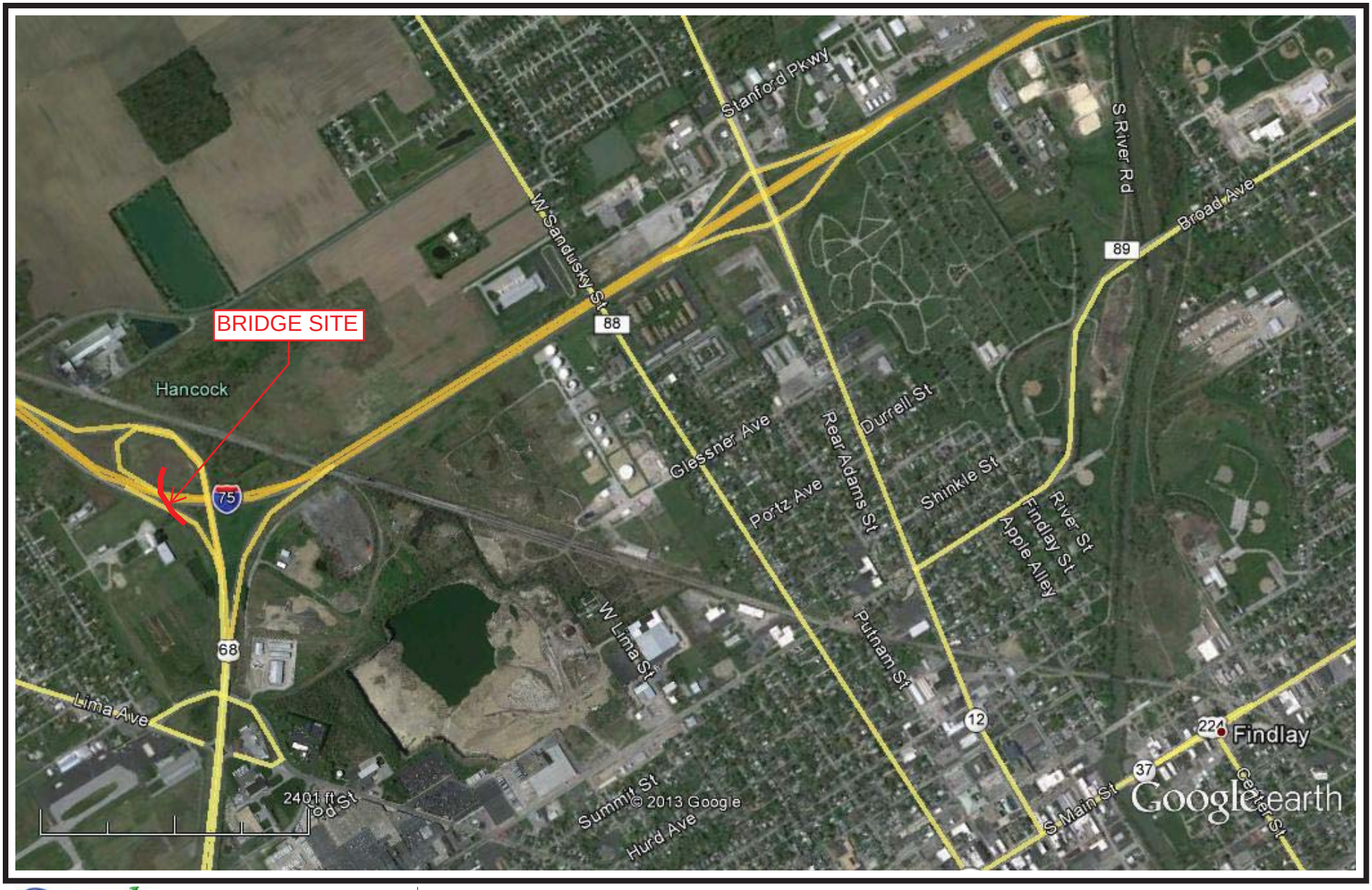
Based on information obtained from the Physiographic Regions of Ohio, the project site lies within the Huron-Erie Lake Plains Section of the Central Lowland Province. The project site is located within the Findlay Embayment District of the Maumee Lake Plains Region of the Huron-Erie Lake Plains Section. The project site is located at approximate elevations ranging from 775 feet to 800 feet. According to Bulletin 44, *Geology of Water in Ohio* (issued in 1943 and reprinted in 1968), both the Illinoian and Wisconsin Glaciers passed over the area and left a coating of drift materials less than 10 feet in thickness. The main geologic deposit of the project site consists of silty to gravelly Wisconsinan-age lacustrine deposits and wave-planed clay till; ground moraine, flat to gently undulating over Dolomite bedrock of Silurian-age. Based on the *Soil Survey of Hancock County, Ohio* and from the *U.S. Department of Agriculture, Natural Resource Conservation Service* website, the natural site soils in the vicinity of the project area consist primarily of layers of loam, clay loam, fine sandy loam, silty clay loam,

and silty clay. These soils are classified as A-4, A-6, and A-7 based on the AASHTO Soil Classification System. However, the project site has incurred cut and fill operations due to construction of existing IR-75. Thus the composition of the surface and subsurface soils has changed from natural in most areas.

Based on information obtained from the Ohio Geological Survey, bedrock in the vicinity of the project site was deposited during the Upper and Lower Silurian Period of the Paleozoic Era and is expected to consist of Tymochtee/Greenfield Group dolomite. Tymochtee Group dolomite is described as shades of gray and brown, very finely crystalline which occurs as thin to massive beds with carbonaceous shale laminae and beds. Greenfield Group dolomite is described as shades of gray and brown; very finely to coarsely crystalline which occurs as massive beds to laminae; argillaceous and locally brecciated in the lower portion. According to ODNR's Ohio Gas and Oil Wells Locator website, many active and abandoned wells are located in the vicinity of the project site. According to ODNR's Ohio Mines Locator website, no abandoned underground or surface mines are present in the immediate vicinity of the project site. Based on the Ohio Division of Geological Survey Interactive Map of Ohio Mineral Industries, an active limestone industrial quarry is located approximately 0.4 miles southwest of the project site. According to ODNR, the project site is located outside of the "Probable Karst Regions" of Ohio and outside of the "Landslide-Prone Areas" of Ohio. According to the ODNR website, two (2) earthquakes occurred within Hancock County; one in 1990 with a magnitude of 2.3 Richter Scale and another in 2011 with a magnitude of 2.4 Richter Scale. Their epicenters were located respectively approximately 8.8 miles to the northeast in Big Lick Township and 14.2 miles to the south in Delaware Township.

3.2 Observations

The reconnaissance of the project site was performed by one of PGI's geotechnical engineers in July 2013. The project site is located in a rural area with buildings within an approximate distance of 500 feet of the bridge site. The existing IR 75 NB and SB and Ramp IR-75 NB to US 68 SB run through the site. The IR 75 pavement generally appeared to be in fair condition with light to moderate longitudinal and traverse cracks observed. Tall cattail wetland vegetation in what appear to be wetland areas was observed in the vicinity of the forward abutment. This site is covered with grass, few small bushes and few trees and is relatively flat.



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PROJECT: HAN-75-14.39

BRIDGE NO. HAN-68-1656 OVER US 68 RAMP B & IR 75

SITE LOCATION MAP (FIGURE 2.1)

4.0 EXPLORATION

4.1 Historic and Project Exploration Program

Historical records of a geotechnical exploration were available from the ODOT Geotechnical Documents Management System ftp site for the existing IR 75 mainline bridges over existing Ramps US 68 NB to IR 75 SB and IR 75 SB to US 68 SB which are located approximately 500 feet east of the proposed bridge location. A total of three (3) historic test borings were advanced in the vicinity of the existing bridge. This historic geotechnical exploration performed in December 1984 consists of structure foundation exploration sheets. All of the relevant historic information discussed above is included in Appendix B.

In order to explore the subsurface conditions at the project site, drilling, sampling, and field testing operations were performed in June, July and August 2013 and April 2015. A total of six (6) test borings were drilled in 2013 in the vicinity of the proposed bridge site. Four (4) of these identified as B-135-1-13, B-135-0-13, B-134-0-13, and B-133-0-13 were advanced for bridge foundations design purposes and two (2) of these identified as B-135-2-13 B-132-1-13 were advanced for MSE Wall foundations design purposes. However, the bridge design configuration was changed from three to four spans after drilling operations were completed and the scope of constructing MSE Wall at the rear and forward abutment locations was eliminated. After the reconfiguration of the bridge, two (2) additional test borings identified as B-132-2-14 and B-133-1-14 were drilled in 2015 at the proposed bridge site for bridge foundations design. Test boring B-136-0-13 which was advanced for the US 68 Ramp C design, was located in the vicinity of the rear abutment. Test borings B-135-0-13 and B-135-1-13 were located in the vicinity of the proposed Pier 1 while test boring B-134-0-13 was located in the vicinity of the proposed Pier 2. Test boring B-133-1-13 was located in the vicinity of Pier 3 while test borings B-133-0-13 and B-132-2-14 were located in the vicinity of the proposed forward abutment. These structural test borings were advanced to approximate depths ranging from 14.0 to 42.0 feet below the existing ground surface.

The test borings were marked in the field by PGI based on boring location plans developed by PGI and after obtaining approval from PB personnel. Site geometry, utility locations, overhead height, and accessibility were also taken into account when locating the test borings**.** At the time of test boring location selection, the vertical soil sampling intervals were determined based on the needs for design and construction of the project. All Terrain Vehicle (ATV) mounted Diedrich 90, truck mounted CME 75, and truck mounted CME 45B drill rigs were used to advance the test borings. All borings were advanced using 3.25-inch inside diameter, continuous flight hollow stem augers (HSA). Representative disturbed samples of the soils were collected at intervals in accordance with the ODOT Specifications. A standard

2.0-inch outside diameter split-barrel sampler was driven into the soil by means of a 140-lb hammer falling freely through a distance of 30-inches in accordance with the Standard Penetration Test (ASTM D 1586). Where bedrock was encountered, all test borings were advanced and the rock was sampled using type NX series core barrels, water method. All test borings were monitored for the presence of groundwater during and upon completion of drilling operations. All test borings were backfilled with compacted soil cuttings and/or bentonite mix at the end of drilling operations for safety purposes.

Latitude/longitude and northing/easting coordinates, stations and offsets, and surface elevations at the drilled test boring locations were provided to PGI by PB personnel. The typed drilling logs, Boring Location Map, and Soil Boring Profiles are included in Appendix A. Northing and easting coordinates shown on the Soil Boring Profile sheets are grid. A project adjustment factor (PAF) of 1.00009818 was used to convert the grid coordinates to ground coordinates for this project. The typed drilling logs are included in Appendix A. These logs show the SPT resistance values (N-values) for each soil sample taken in the test borings and present the classification and description of soils encountered at various depths in the test borings. The N-values as measured in the field have been corrected to an equivalent rod energy ratio of 60% (N_{60}) in accordance with ODOT's *Specifications for Geotechnical Explorations*. The sample depth shown on the logs and laboratory test results indicate the top of each sampling or testing interval.

4.2 Laboratory Testing Program

All soil and rock samples obtained during the drilling and sampling operations were returned to PGI's geotechnical soils laboratory in Cleveland, Ohio. Upon arrival, the samples were visually examined and classified by a geotechnical engineer and a geologist to verify the classifications made in the field and to note any additional characteristics, which may not have been observed in the field.

Moisture content determination tests were performed on all soil samples as per ODOT specifications. Additional laboratory soil tests were performed on selected soil samples for the purpose of soil classification and for analysis of engineering characteristics. These tests consisted of Particle-Size Analysis, Liquid and Plastic Limit, Plasticity Index Determination of Soils, and Compressive Strength of Rock Core Samples. All laboratory tests were performed in accordance with the ASTM or other standards listed in "Laboratory Test Standards" located in Appendix B. The results of the laboratory tests are also included in Appendix B. The soils were classified in accordance with the ODOT Soil Classification System, a description of which is also included in Appendix B.

Upon completion of the laboratory testing, all samples were placed in storage at PGI's Cleveland facility. Unless otherwise requested in writing, the soil and rock samples will be retained through completion and ODOT approval of Stage 2 Plans.

5.0 FINDINGS

5.1 Subsurface Soil Conditions

The surficial and subsurface soil conditions in the vicinity of this proposed bridge were determined from the soil information obtained from test borings B-136-0-13, B-135-2-13, B-135-1-13, B-135-0-13, B-134-0-13, B-133-1-14, B-133-0-13, B-133-2-14, and B-132-1-13. All test borings with the exception of B-136-0-13, B-135-1-13, and B-134-0-13 were advanced through topsoil ranging from four (4) to 12 inches with average thickness of 6.7 inches. Test boring B-134-0-13 was advance through the pavement of the left lane of IR 75 NB consisting of 4.25 inches of asphalt over 11 inches of concrete. Base material consisting of 11 inches of stone fragments with sand was encountered below the pavement. Test boring B-135-1-13 was advanced through silt and clay (A-6a), however topsoil was not observed at this boring location. Test boring B-136-0-13 was advanced through five (5) inches of gravel. The subsurface soils encountered in test borings B-136-0-13, B-135-2-13, B-135-1-13, B-135-0-13, B-134-0-13, and B-132-2-14 consisted of both fill materials and natural soils. The subsurface soils encountered in test borings B-133-1-14, B-133-0-13, and B-132-1-13 consisted of only natural soils. The fill materials were encountered above natural soils consisted of sandy silt (A-4a), silt and clay (A-6a), silty clay (A-6b) and elastic clay (A-7-5) and to depths ranging from 1.5 feet and 24.5 feet below the existing ground or pavement surface. Natural soils encountered above bedrock consisted primarily of cohesive soils classified as silty clay (A-6b), silt and clay (A-6a), clay (A-7-6), sandy silt (A-4a). Bedrock was encountered in all test boring locations at approximate depths ranging from 2.8 feet to 26.5 feet below the existing ground or pavement surface.

The laboratory test results indicated that the moisture contents of the tested cohesive soil samples ranged from 10% to 80% and the consistency ranged from "medium stiff" to "hard". One of the seven cohesive soil samples tested for Atterberg Limits had a natural moisture content greater than its liquid limit, and an additional three samples had a natural moisture content greater than their plastic limits but less than their liquid limits. Normally, soils with moisture contents greater than or equal to their liquid limits are in a liquid state and have no shear strength. Soils with moisture contents greater than or equal to their plastic limits and less than their liquid limits are in a plastic state, and have the potential of volume change under certain loading conditions. All of the test borings were terminated after obtaining

rock core samples. For specific conditions at various depths, please refer to the individual test boring logs located in Appendix A of this report. For complete moisture contents and Atterberg limit test results, please refer to the laboratory test results in Appendix B.

5.2 Bedrock Conditions

Bedrock was encountered in all of the test borings. Bedrock was split spoon sampled until little or no penetration or recovery was encountered. Bedrock core samples were then obtained using NX diamond impregnated core barrels. The coring operations were performed in accordance with the procedure for Diamond Core Drilling for Site Investigations (ASTM D 2113). The core samples consisted of dolomite of the Tymochtee/Greenfield Group. The dolomite was light gray to gray, severely to slightly weathered, and strong to very strong. Bedding within the dolomite was generally very thin to medium and was highly fractured to moderately fractured. No slickensides were observed and the fractures were typically tight to narrow and slightly rough to very rough. The compressive strength of the core specimens ranged from 9,706 psi in test boring B-133-0-13 to 23,129 psi in test boring B-132-1-13 which characterizes them as “strong” to “very strong”, respectively.

The Rock Quality Designation (RQD) for the core samples ranged from 0% to 69%. The results of these measurements are summarized in Table 5.2.1. Table 5.2.2 summarizes the results of compressive strength tests performed at the laboratory on the rock core specimens at various depths. The Rock Mass Rating obtained for the bedrock core samples according to LRFD Table 10.4.6.4-1 varied from 36 to 42 and is considered as “Fair Rock” to “Poor Rock”. The Rock Mass Rating spreadsheets are included in Appendix B. Refer to the drilling logs in Appendix A and rock core photos in Appendix B for additional bedrock information. Also refer to “Bedrock Descriptions” in Appendix B for general bedrock information.

Table 5.2.1 – Bedrock Information

Boring Number	Top of Bedrock Elevations (ft)	Rock Core Run No.	Rock Core Run Elevations (ft)	Length of Core Run (ft)	Recovery (%)	RQD (%)
B-136-0-13	774.4	NX-1	773.4	5.0	93	7
B-135-2-13	774.0	NX-1	773.0	5.0	100	20
B-135-1-13	773.4	NX-1	772.8	2.5	90	0
		NX-2	770.3	7.5	89	30
		NX-3	762.8	5.0	100	20
B-135-0-13	773.4	NX-1	773.2	2.7	99	30

Boring Number	Top of Bedrock Elevations (ft)	Rock Core Run No.	Rock Core Run Elevations (ft)	Length of Core Run (ft)	Recovery (%)	RQD (%)
		NX-2	770.5	7.1	95	32
		NX-3	763.4	5.0	100	32
B-134-0-13	773.0	NX-1	772.5	2.7	80	0
		NX-2	769.8	5.2	100	28
		NX-3	764.6	7.1	85	29
B-133-0-13	772.6	NX-1	771.6	5.5	100	36
		NX-2	766.1	5.0	74	69
B-133-1-13	773.1	NX-1	772.6	0.5	100	0
		NX-2	772.1	3.5	96	32
		NX-3	768.6	4.0	98	0
		NX-4	764.6	2.0	97	22
B-132-1-13	773.6	NX-1	772.4	4.0	100	0
		NX-2	774.4	1.2	93	0
		NX-3	767.2	4.8	100	26
B-132-2-13	772.7	NX-1	772.2	1.0	92	0
		NX-2	771.2	1.5	100	0
		NX-3	769.7	1.8	100	0
		NX-4	767.9	2.7	100	22
		NX-5	765.2	3.0	100	39

Elevations were provided by PB personnel

Table 5.2.2 –Compressive Strength Test Results of Rock Core Specimens

Boring No.	Specimen Depth (ft)	Rock Type	Unit Weight (pcf)	Compressive Strength (psi)
B-135-2-13	10.8	Dolomite	164.22	22,333
B-135-1-13	21.5	Dolomite	164.46	19,546
B-135-0-13	29.0	Dolomite	171.80	11,603
B-134-0-13	36.9	Dolomite	172.05	10,250
B-133-1-14	8.6	Dolomite	170.32	16,234
B-133-0-13	13.0	Dolomite	164.90	9,706
B-132-2-14	9.5	Dolomite	171.18	11,180
B-132-1-13	10.5	Dolomite	169.09	23,129

5.3 Groundwater Conditions

Groundwater was encountered in one of the eight test borings during drilling. Groundwater was encountered in B-134-0-13 at a depth of 26.0 feet (elevation 773.5 feet) during drilling prior to rock

coring. Groundwater levels were not recorded upon completion of rock coring operations due to introduction of water for rock coring. Table 5.3.1 summarizes the groundwater measurements in the test boring locations. It should be noted that groundwater elevations are subject to seasonal fluctuations. Groundwater monitoring wells are essential to accurately define the position of the groundwater table; however, installation of monitoring wells was not included in our scope of services. All test borings were backfilled upon completion for safety purposes.

Table 5.3.1 – Groundwater Information

Boring Number	Surface Elevation (ft.)	Groundwater Depth (ft.) D.D.	U.C.	Groundwater Elevation (ft.) D.D.	U.C.
B-136-0-13	785.90	DRY	NR	DRY	NR
B-135-2-13	782.0	DRY	NR	DRY	NR
B-135-1-13	787.3	DRY	NR	DRY	NR
B-135-0-13	792.4	DRY	NR	DRY	NR
B-134-0-13	799.5	26.0	NR	773.5	NR
B-133-1-14	777.6	DRY	NR	Dry	NR
B-133-0-13	776.1	DRY	NR	DRY	NR
B-132-2-14	776.7	DRY	NR	DRY	NR
B-132-1-13	776.4	DRY	NR	DRY	NR

Elevations were provided by PB personnel D.D. – During Drilling, U.C. – Upon Completion of drilling prior to rock coring operations in bridge borings NR – No Reading

6.0 ANALYSIS AND RECOMMENDATIONS

Based upon the findings of the field exploration program, laboratory testing, and subsequent engineering analysis, the following sections have been prepared to address the geotechnical aspects related to the design and construction of U.S. Route 68 (US 68) Ramp C Bridge No. HAN-68-1656 over US 68 Ramp B and IR-75. Site plans provided by PB personnel indicates that the proposed superstructure design loads will be transferred to the underlying bedrock by means of piles at the rear and forward abutment locations and by means of drilled piers at the proposed Pier 1, Pier 2, and Pier 3 locations. Elevations of the bottom of the proposed pile caps at the rear and forward abutment locations will be 806.6 and 813.2 feet, respectively. The foundation recommendations for this bridge are provided in accordance with the ODOT *Bridge Design Manual* issued in 2007 using AASHTO *LRFD Bridge Design Specifications, 6th Edition.*

6.1 Bridge Foundation Systems

Test borings B-136-0-13, B-135-0-13, B-135-1-13, B-134-0-13, B-133-1-14, B-133-0-13, and B-132-2-14 were advanced for bridge foundation design purposes. Soil and rock information obtained from test boring B-136-0-13 which was advanced for the US 68 Ramp C design, was used to design the rear abutment. Soil and rock information obtained from test borings B-135-0-13 and B-135-1-13 was used to design the Pier 1 foundation while soil and rock information obtained from test boring B-134-0-13 was used to design the Pier 2 foundation. Soil and rock information obtained from test boring B-133-1-14 was used to design the Pier 3 foundation while soil and rock information obtained from test borings B-133-0-13 and B-132-2-14 was be used to design the Forward abutment.

As outlined in Section 5.1 - "Subsurface Soil Conditions", the top of bedrock was encountered at depths ranging from 2.8 feet to 26.5 feet below the existing ground or pavement surface. The bedrock at test boring B-134-0-13 location was encountered relatively deeper at 26.5 feet below the pavement surface, because this boring was advanced through IR-75 NB lane embankment. Bedrock at these boring locations consists of dolomite and was encountered to termination depth in all seven (7) test borings. The Rock Mass Rating obtained for the bedrock core samples according to LRFD Table 10.4.6.4-1 varied from 36 to 42 and is considered as “Fair Rock” to “Poor Rock”. Since bedrock will be encountered at relatively shallow depths at the pier locations, the proposed superstructure loads may be transferred to the underlying bedrock by means of drilled shafts. Because the embankments for bridge approach will be constructed prior to abutments construction, bedrock will be encountered at relatively greater depths at the rear and forward abutment locations. Therefore, the proposed superstructure loads may be transferred to the underlying bedrock by means of end bearing piles at the abutment locations.

Drilled Shafts: At the time this report was prepared, the factored design load per drilled shaft at the Strength and Service Limit was not available at the pier locations. However, it is assumed that the maximum factored load along a vertical direction will be on the order of 950 kips per shaft and lateral loads will control the drilled shaft design at Pier 1, Pier 2, and Pier 3 locations. Drilled shaft foundation system may be used to transfer the proposed superstructure loads to the underlying bedrock at the pier locations. The shafts can be reinforced concrete columns designed to carry their maximum factored load at the Strength Limit State. Based on the lowest un-compressive strength value obtained for the rock core specimen from test boring B-133-0-13, the unit side resistance and unit tip resistance were calculated using equations 10.8.3.5.4b-1 and 10.8.3.5.4c-2, respectively in the AASHTO LRFD Bridge Design Specifications. Based on the analyses, unit side resistance of 10.0 ksf and unit tip resistance of 48.5 ksf

were estimated for the fractured bedrock encountered at test borings. The shaft side and tip resistances and settlement calculation spreadsheets are included in Appendix B.

The nominal shaft tip resistance can be calculated for the selected shaft diameter from the unit tip resistance by multiplying with the shaft cross-sectional area. The nominal shaft side resistance can be calculated for the selected shaft diameter and socket length from the unit side resistance by multiplying the shaft length surface area. The tip resistance portion of the factored axial compression resistance is calculated from the nominal shaft tip resistance by multiplying with a resistance factor of 0.50. The side resistance portion of the factored axial compression resistance is calculated from the nominal shaft side resistance by multiplying a resistance factor of 0.55. Table 6.1.1 summarizes total factored resistance for the selected diameters and socket length at the abutment and pier boring locations. Side resistance from the soil overburden and upper two (2) feet of the shallow bedrock can be ignored. Based on the factored axial compression resistance for the selected shaft socket length and diameter, the estimated maximum total settlement and differential settlement will not exceed one inch and one half inch, respectively.

Table 6.1.1 – Estimated Design Parameters for Drilled Shafts

Boring No.	Top Bedrock Elevation (feet)	Shaft Tip Elevation (feet)	Socket Diameter (feet)	Socket Length (feet)	Total Factored Resistance (kips)
Piers					
B-135-0-13	773.4±	763.9	5.0	7.5	950
B-135-1-13	773.4±	763.9	5.0	7.5	950
B-134-0-13	773.0±	763.5	5.0	7.5	950
B-133-1-14	773.1±	763.6	5.0	7.5	950

Drilled shaft socket diameters less than 36 inches are not recommended. The drilled shafts should be spaced at a minimum of 2.5 shaft diameters on center. If drilled shafts are spaced less than four (4) shaft diameters on center, the group effect between shafts must be evaluated in accordance with Article 10.8.1.2 of the *AASHTO LRFD Bridge Design Specifications*. However, if drilled shafts are socketed into bedrock, group effect between shafts may be neglected. The diameter of bedrock sockets must be 6 inches less than the diameter of the shaft above bedrock elevation in accordance with Section 303.4.3 of the *2007 ODOT Bridge Design Manual*. The drilled shaft supported piers may experience horizontal movement caused by lateral loads and overturning moments. A lateral load analysis should be performed using LPILE computer program by Ensoft or similar computer program for selected shaft diameter and socket length to check whether lateral resistance is adequate to support lateral loads and overturning

moments. Table 6.1.2 summarizes the weak rock parameters to perform lateral load analyses by PB personnel. In lateral load analysis, bedrock socket length should be optimized to find the minimum length necessary to resist the applied lateral load based on serviceability and structural requirements and selected the maximum bedrock socket length between above value and 1.5 times the bedrock socket diameter.

Table 6.1.2 - Estimated Weak Rock Parameters for Lateral Load Analyses

Boring No.	Top Bedrock Elevation(ft)	Effective Unit Weight (pci)	Youngs's Modulus (psi)	Compressive Strength (psi)	RQD (%)	k_rm
Piers						
B-135-0-13	773.4±	0.059	200000	9706	31	0.00005
B-135-1-13	773.4±	0.059	200000	9706	22	0.00005
B-134-0-13	773.0±	0.059	200000	9706	24	0.00005
B-133-1-14	773.1±	0.059	200000	9706	45	0.00005

Selecting the construction method for installing the drilled shafts is the responsibility of the contractor. Seepage of water into the drilled shaft holes may occur within the soil overburden during installation. If water is encountered at the bottom of the hole due to seepage, care should be taken to remove all water before placing concrete. The successful performance of a drilled shaft depends on the construction method used as well as the quality of workmanship during installation. Therefore, qualified geotechnical personnel should be present during construction for inspection in order to assure the quality of the drilled shafts and to verify that the rock conditions are as per boring logs. Drilled shaft bottoms should be free of all loose material prior to placement of concrete. For detailed drilled shaft construction, refer to Item 524 – "Drilled Shafts" of the ODOT *Construction and Material Specifications* issued in January 2013.

Driven piles: Driven piles consisting of end bearing steel piles may be used to transfer the proposed superstructure loads to the underlying bedrock at the abutment locations. The construction of the bridge approach embankment must be completed before installing the end bearing piles. The end bearing piles must be steel H-piles driven to refusal on the underlying dolomite bedrock. H-pile sizes HP-10X42 or HP-12X53 may be selected for abutment foundation design. The total factored load on each HP-10X42 pile and HP-12X53 pile should not exceed the corresponding maximum structural resistance of 310 kips and 380 kips, respectively as per the ODOT *Bridge Design Manual* Section 202.2.3.2.a. Note that the above mentioned structural resistance values can be used only on the axial loaded piles that have a

negligible bending moment. The estimated pile parameters for end bearing piles at each boring location are summarized in Table 6.1.3. The pile cut-off elevations at the abutments were extracted from the final structure site plan provided by PB personnel.

Table 6.1.3 - Estimated Design Parameters for H-Piles

Boring No.	Pile Cut-off Elevation (ft)	Pile Tip Elevation (ft)	Estimated Effective Pile Length (ft)	Pile Type	Pile Size	Maximum Factored Structural Resistance/pile
Abutments						
B-136-0-13	807.6	773.4	35.0	H-Pile	10X42	310 kips
B-136-0-13	807.6	773.4	35.0	H-Pile	12X53	380 kips
B-133-0-13	814.2	771.6	45.0	H-Pile	10X42	310 kips
B-133-0-13	814.2	771.6	45.0	H-Pile	12X53	380 kips

It is recommended that the piles be spaced a minimum of three (3) pile diameters on center. Negative skin friction will develop along the pile section between the bottom of the proposed embankment and the top of bedrock due to the consolidation of the foundation soils caused by construction of the proposed embankment. Therefore, the piles should be designed in accordance with section 202.2.3.2.c – "Down Drag Forces on Piles" of the ODOT Bridge Design Manual issued in January 2007. Nominal down drag load of 65 kips per pile and 75 kips per pile may be assumed for pile sizes HP-10X42 and HP-12X53, respectively at the rear abutment location while nominal down drag load of 16 kips per pile and 19.5 kips per pile may be assumed for pile sizes HP-10X42 and HP-12X53, respectively at the forward abutment location. Pre-boring of holes may be required through compacted embankment at the pile locations in order to drive the piles to refusal on bedrock. If required, the depth of the hole should be a maximum of 10 feet below the bottom of the abutment pile cap at the rear abutment location and maximum of 15 feet below the bottom of the abutment pile cap at the forward abutment location. Pre-drilling of holes should be performed in accordance with ODOT Item 507.11 – *Prebored Holes*. All H-piles should be installed in accordance with ODOT Item 507 - *Bearing Piles,* of the ODOT *Construction and Material Specifications Manual* dated January 2013.

The pile supported abutments may experience horizontal movement caused by lateral loads. In order to prevent damage caused by lateral loads, the piles should be installed in accordance with Section 303.4.2.4 - "Piles Battered", of the 2007 *ODOT Bridge Design Manual.* During pile driving operations, damage could be caused to existing buildings within approximately 500 feet of the proposed pile driving location due to induced vibrations. Therefore, pile hammer, and pile installation techniques should be

selected in such a way to minimize the induced vibrations. The public often tends to claim that their building(s) have been damaged due to pile driving operations even though the damage was caused by something else. Therefore, PGI recommends performing a structure survey before the pile driving and monitoring vibrations during pile driving.

6.2 Lateral Earth Pressures and Abutment Drainage

The bridge abutments must be designed to resist lateral pressures exerted by both dead and live loads. The active lateral earth pressures exerted behind the bridge abutments may be approximated by an equivalent fluid weighing 40 pcf above the water table provided that level ground exists behind the abutments and that no surcharge loads are placed behind the walls. Freely draining material must be placed behind the bridge abutments in accordance with ODOT Item 518 - "Drainage of Structures". The porous backfill should be placed a minimum of two (2) feet in thickness normal to the abutment walls. It is suggested that filter fabric, ODOT Item 712.09, Type A, be placed between Item 518 porous backfill material and Item 203 embankment material. This will ensure that fine particles from within the embankment do not migrate into the voids of the porous backfill.

6.3 Approach Slab Design Parameters

It is assumed that the proposed approach slab pavement will be constructed on the fill subgrade soils with the similar character encountered in test borings. It is anticipated that on-site clay (A-7-6) fill soils will be encountered within the project limits based on the boring logs. The subgrade CBR values and the resilient modulus of the subgrade soils were estimated based on the ODOT subgrade resilient modulus estimation method, illustrated in 203-3, "Pavement, Design & Rehabilitation Manual." The pavement design parameter information is summarized in Table 6.3.1.

Table 6.3.1 – Summary of Approach Slab Design Parameters

Parameter	Fill Soils
Group Index (Avg.)	14.33
CBR	4
Soil Support Value (SSV)	3.0
Resilient Modulus (psi)	4,800
Modulus of Subgrade Reaction (K, pci)	117

6.4 Groundwater Management

Groundwater was encountered in test boring B-134-0-13 at a depth of 26.0 feet (elevation of 773.5 feet) during drilling operations. If the bottom of the excavation for the Pier 2 foundation extends below the water level at the boring location, water infiltration is anticipated. Moderate to high volume pumping or dewatering will be required. It must be noted that the groundwater levels during construction may vary due to seasonal fluctuations, and groundwater may occur where not encountered previously.

6.5 Earthwork and Construction Monitoring

All excavation and backfilling operations should be conducted in accordance with ODOT's *Construction and Materials Specifications,* Item 503 - "Excavation for Structures" issued in January 2013 and under the supervision of competent geotechnical personnel. All excavations should comply with all current and applicable local, state, and federal safety codes, regulations and practices, including the Occupational Safety and Health Administration (OSHA). Proposed embankment slopes for the structure foundation must be constructed using a two (2) horizontal to one (1) vertical slope for excavation in cohesive soils. Soil and rock excavations are expected during construction of the drilled shaft. It is expected that some harder, less weathered bedrock will be present in the shaft holes. Therefore special drilling equipment should be required.

All fill material must be approved by a qualified geotechnical engineer prior to placement. The fill materials should be placed in lifts of eight (8) inches in thickness (loose measure) and be compacted to an unyielding condition in accordance with ODOT 203.07 “Compaction and Moisture Requirements” specifications. The top 12 inches of the fill in pavement subgrade areas should be placed in lifts of eight (8) inches in thickness (loose measure) and be compacted to an unyielding condition in accordance with ODOT 204.03 “Compaction of the Subgrade” specifications. All in-place density tests should be performed as per Supplement 1015 “Compaction Testing of Unbound Materials” during earthwork construction. The tests should be performed by a qualified soil technician under the supervision of PGI or other geotechnical-engineering firm and in accordance with appropriate ASTM procedures.

7.0 LIMITATIONS

This report is subject to the following conditions and limitations:

7.1 The subsurface conditions described are based on an examination of the soil and rock samples at the sampling intervals. Varying soil deposits, including fill material, may exist between the sampling intervals and between the test boring locations. Variation in subsurface conditions from those indicated in this report may become apparent during the earthwork and/or installation of the foundations. Such variations may require changes and/or modifications in our recommendations. Such changes may cause time delays and/or additional costs. Owners must be made aware of these limitations and must incorporate them in the design budget and scheduling of the project.

7.2 The design of the proposed project does not vary from the technical information provided and specified in this report. All changes in the design must be reviewed by our geotechnical engineers. PGI cannot assume any responsibility for interpretations made by others of the subsurface conditions and their behavior based on this report.

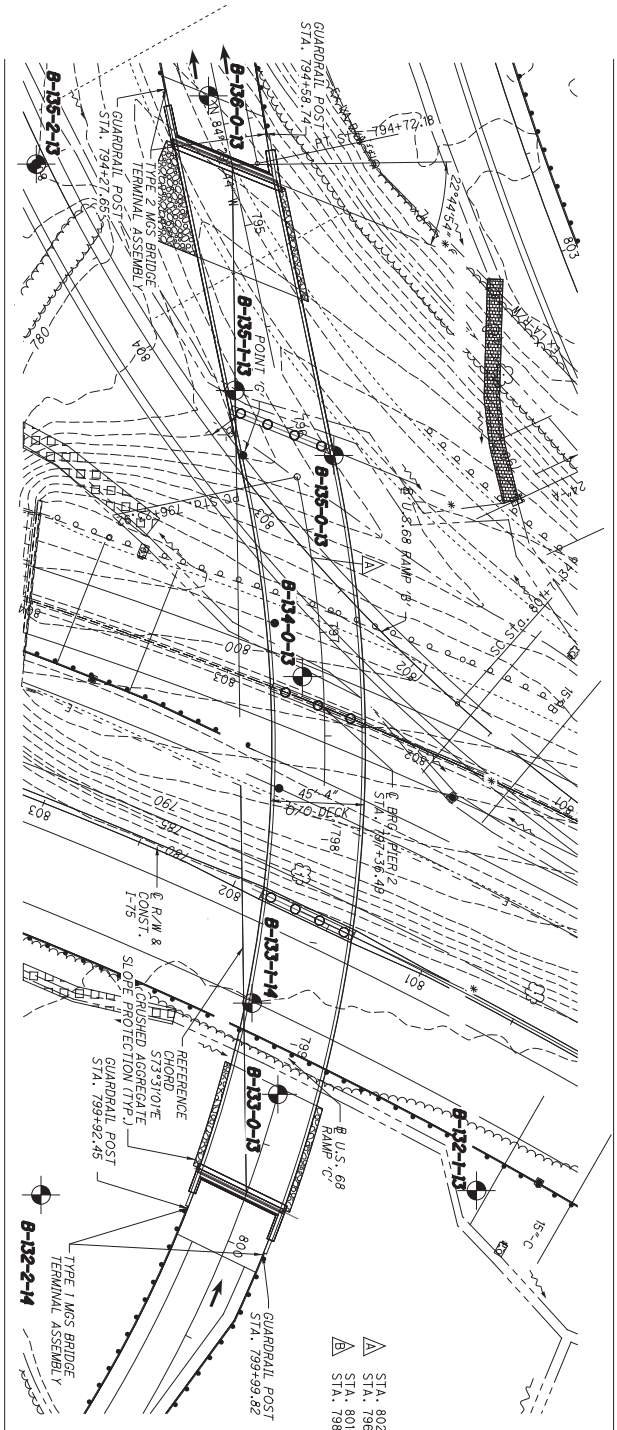
7.3 All earthwork and foundation construction must be performed under the supervision of a Professional Engineer in accordance with ODOT Construction Specifications.

7.4 The subsurface exploration for this project is strictly from a geotechnical standpoint. An environmental site assessment was not included in the scope of these geotechnical services.

7.5 All sheeting, shoring, and bracing of trenches, pits and excavations should be made the responsibility of the contractor and should comply with all current and applicable local, state and federal safety codes, regulations and practices, including the Occupational Safety and Health Administration (OSHA).

APPENDICES

APPENDIX A



	X / X	HAN-75-14.39	BORING LOCATION PLAN BRIDGE NO. HAN-068-1656 OVER I-75 AND U.S. 68 RAMP 'B'	DRAWN SS CHECKED SS	0 15 30 60 HORIZONTAL SCALE IN FEET

PROJECT: HAN-75-14.39	DRILLING FIRM / OPERATOR: BM / JOSH DEAN	DRILL RIG: DIEDRICH D-90 ATV	STATION / OFFSET: 794+35.02, 4.41 RT
TYPE: RAMP RE-ALIGNMENT	SAMPLING FIRM / LOGGER: PGI / W. NAJJAR	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: US 68 RAMP C BASELINE
PID: 87005 STR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/18/12	ELEVATION: 785.9 (MSL) EOB: 17.5 ft.
START: 8/6/13 END: 8/6/13	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.2	COORD: 41.025636310, 83.673427950

EXPLORATION ID B-136-0-13

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
GRAVEL (5" THICK)	785.5																	
STIFF, DARK BROWN TO BROWN, **SILT AND CLAY**, LITTLE SAND, LITTLE TO TRACE STONE FRAGMENTS, FILL, DAMP		1	4 4 7	15	67	SS-1	--	-	-	-	-	-	-	-	-	15	A-6a (V)	
		2																
@3.5'; TRACE STONE FRAGMENTS		3	5 5 6	15	94	SS-2	2.00	-	-	-	-	-	-	-	-	16	A-6a (V)	
		4																
@6.0'; BLACK, TRACE STONE FRAGMENTS, SLIGHTLY ORGANIC, DAMP		5	4 4 5	12	89	SS-3	3.00	3	4	15	39	39	37	22	15	18	A-6a (10)	
		6																
@8.5'; BROWN, TRACE STONE FRAGMENTS		7	2 3 4	9	94	SS-4	2.00	-	-	-	-	-	-	-	-	18	A-6a (V)	
		8																
@11.0'; PUSHED SHELBY TUBE	774.9	9																
STIFF, BROWN, MOTTLED GRAY, **SILTY CLAY**, LITTLE SAND, TRACE STONE FRAGMENTS, MOIST	774.4	10			100	ST-5	3.00	-	-	-	-	-	-	-	-	24	A-6b (V)	
		TR																
POSSIBLE DOLOMITE BEDROCK @12.5'; AUGER REFUSAL, BEGAN CORING BEDROCK	773.4	11																
DOLOMITE, GRAY, HIGHLY TO MODERATELY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, HIGHLY TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH, FEW VERTICAL & ANGULAR FRACTURES.		12																
		13																
		14																
		15	7		93	NX-1											CORE	
		16																
		17																
	768.4	EOB																

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING. NO READING WAS TAKEN UPON COMPLETION DUE TO WATER USED DURING ROCK CORING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/16/14 11:50 - M:\PROJECT FILES\13 PROJECTS\G13011G HAN-75\LAB DATA SHEETS\HAN-75 RAMPS.GPJ

PROJECT: HAN-75-14.39	DRILLING FIRM / OPERATOR: B-M / JOSH DEAN	DRILL RIG: DIEDRICH D-90 ATV	STATION / OFFSET: 794+50.37, 92.57 RT
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: PGI / F.BUSHER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: US 68 RAMP C BL
PID: 87005 STR ID: HAN-68-1656	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/18/12	ELEVATION: 782.0 (MSL) EOB: 14.0 ft.
START: 7/16/13 END: 7/16/13	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.2	COORD: 41.025880920, 83.673457020

EXPLORATION ID: B-135-2-13

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
	782.0																	
TOPSOIL (6" THICK)	781.5																	
SOFT, LIGHT GRAY, **ELASTIC CLAY**, TRACE SAND, FILL, MOIST	778.5	1 2 3	2 2 2	5	100	SS-1	0.25	-	-	-	-	-	-	-	-	78	A-7-5 (V)	
STIFF, BROWN, MOTTLED GRAY, **CLAY**, SOME SAND, TRACE STONE FRAGMENTS, MOIST	774.0	4 5 6 7	2 3 4	9	83	SS-2	2.25	1	2	20	34	43	42	22	20	25	A-7-6 (12)	
			2 2 1	12	94	SS-3	1.75	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
LIGHT GRAY DOLOMITE BEDROCK	773.0	TR 8	100/2"	-	100	SS-4	--	-	-	-	-	-	-	-	-	13	Rock (V)	
DOLOMITE, LIGHT GRAY, SLIGHTLY WEATHERED, VERY STRONG, VERY THIN TO THIN BEDDED, HIGHLY TO MODERATELY FRACTURED WITH VERTICAL FRACTURE, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH, FEW VERTICAL & ANGULAR FRACTURES. @10.8'; COMPRESSIVE STRENGTH = 22,333 psi	768.0	9 10 11 12 13 EOB 14	20		100	NX-1											CORE	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING. NO READING WAS TAKEN UPON COMPLETION DUE TO WATER USED DURING ROCK CORING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: HAN-75-14.39	DRILLING FIRM / OPERATOR: B-M / JOSH DEAN	DRILL RIG: DIEDRICH D-90 ATV	STATION / OFFSET: 795+79.96, 20.91 RT
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: PGI / F.BUSHER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: US 68 RAMP C BL
PID: 87005 STR ID: HAN-68-1656	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/18/12	ELEVATION: 787.3 (MSL) EOB: 29.5 ft.
START: 7/16/13 END: 7/17/13	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.2	COORD: 41.025713590, 83.673935660

EXPLORATION ID B-135-1-13

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND, LITTLE STONE FRAGMENTS, FILL, DAMP	787.3	1	3 4 5	12	83	SS-1	4.5+	-	-	-	-	-	-	-	-	16	A-6a (V)	
		2																
		3																
		4	4 5 6	15	100	SS-2	4.5+	-	-	-	-	-	-	-	-	12	A-6a (V)	
	781.3	5																
STIFF TO SOFT, LIGHT GRAY TO LIGHT AND DARK GRAY, **ELASTIC CLAY**, TRACE SAND, FILL, MOIST		6																
		7	5 4 5	12	100	SS-3	2.50	-	-	-	-	-	-	-	-	51	A-7-5 (V)	
@8.5'; SOFT		8																
		9	2 1 1	3	100	SS-4	0.75	-	-	-	-	-	-	-	-	46	A-7-5 (V)	
		10																
@11.0'; SOFT, LIGHT AND DARK GRAY		11																
		12	1 1 1	3	100	SS-5	0.25	0	0	2	29	69	67	52	15	80	A-7-5 (14)	
	773.4	13																
@13.5'; SOFT, LIGHT AND DARK GRAY	772.8	TR 14	100	-	100	SS-6	--	-	-	-	-	-	-	-	-	35	A-7-5 (V)	
LIGHT GRAY DOLOMITE BEDROCK NOTE: AUGERED TO 14.5' AND BEGAN CORING BEDROCK	770.3	15	0		90	NX-1											CORE	
		16																
		17																
DOLOMITE, LIGHT GRAY, SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, HIGHLY TO FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH, FEW VERTICAL FRACTURES.		18																
		19																
		20	30		89	NX-2											CORE	
		21																
DOLOMITE, LIGHT GRAY, SLIGHTLY WEATHERED, VERY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH, FEW VERTICAL & ANGULAR FRACTURES. @21.5'; COMPRESSIVE STRENGTH = 19,546 psi		22																
		23																
	762.8	24																
		25																
		26																
DOLOMITE, LIGHT GRAY, SLIGHTLY WEATHERED, VERY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH, FEW VERTICAL FRACTURES.		27	20		100	NX-3											CORE	
		28																
	757.8	EOB 29																

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING. NO READING WAS TAKEN UPON COMPLETION DUE TO WATER USED DURING ROCK CORING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: HAN-75-14.39	DRILLING FIRM / OPERATOR: B-M / JOSH DEAN	DRILL RIG: DIEDRICH D-90 ATV	STATION / OFFSET: 796+17.43, 19.43 LT
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: PGI / F.BUSHER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: US 68 RAMP C BL
PID: 87005 STR ID: HAN-68-1656	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/18/12	ELEVATION: 792.4 (MSL) EOB: 34.0 ft.
START: 7/16/13 END: 7/16/13	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 80.2	COORD: 41.025612420, 83.674093880

EXPLORATION ID B-135-0-13

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
	792.4																	
TOPSOIL (6" THICK)	791.9																	
STIFF TO VERY STIFF, BROWN TO BROWN AND BLACK, **SILT AND CLAY**, LITTLE SAND, TRACE STONE FRAGMENTS, FILL, DAMP		1	5 5 5	13	89	SS-1	4.5+	-	-	-	-	-	-	-	-	13	A-6a (V)	
		2																
		3																
		4	3 4 5	12	100	SS-2	3.00	-	-	-	-	-	-	-	-	16	A-6a (V)	
		5																
@6.0'; VERY STIFF		6																
		7	5 5 10	20	100	SS-3	3.00	-	-	-	-	-	-	-	-	17	A-6a (V)	
		8																
@8.5'; BROWN AND BLACK		9	5 5 6	15	100	SS-4	4.50	-	-	-	-	-	-	-	-	15	A-6a (V)	
	781.4	10																
MEDIUM STIFF, BLACK, **ELASTIC CLAY**, LITTLE SAND, TRACE STONE FRAGMENTS, TRACE ROOTS, FILL, MOIST		11																
		12	2 3 2	7	89	SS-5	2.50	-	-	-	-	-	-	-	-	40	A-7-5 (V)	
		13																
	776.4	14																
STIFF, BROWN, MOTTLED GRAY, **CLAY**, LITTLE SAND, TRACE STONE FRAGMENTS, MOIST		15	1 2 3	7	78	SS-6	3.00	5	5	15	38	37	55	31	24	40	A-7-5 (17)	
		16																
		17	2 4 5	12	89	SS-7	3.25	3	4	15	30	48	42	22	20	23	A-7-6 (12)	
	773.4	18																
LIGHT GRAY DOLOMITE BEDROCK	773.2	19 TR	4 100/2"	-	100	SS-8	4.5+	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
NOTE: NOTE: BEGAN CORING BEDROCK AT 19.2'.		20																
DOLOMITE, LIGHT GRAY, HIGHLY TO MODERATELY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, HIGHLY TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH, FEW VERTICAL & ANGULAR FRACTURES.	770.5	21	30		99	NX-1											CORE	
		22																
		23																
		24																
		25	32		95	NX-2											CORE	
		26																
		27																
DOLOMITE, LIGHT GRAY, SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, HIGHLY TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH, FEW VERTICAL & ANGULAR FRACTURES.	763.4	28																
		29																
		30																
		31	32		100	NX-3											CORE	
DOLOMITE, LIGHT GRAY, SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, HIGHLY TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH, FEW VERTICAL & ANGULAR FRACTURES.	758.4	32																
@29.0'; COMPRESSIVE STRENGTH = 11,603 psi		33																
		34 EOB																

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING. NO READING WAS TAKEN UPON COMPLETION DUE TO WATER USED DURING ROCK CORING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/17/14 16:28 - M:\PROJECT FILES\13 PROJECTS\G13011G HAN-75\LAB DATA SHEETS\BRIDGES\U1656 I75 FLYOVER.GPJ

PROJECT: HAN-75-14.39	DRILLING FIRM / OPERATOR: DLZ / ALAN	DRILL RIG: CME 75 TRUCK	STATION / OFFSET: 797+20.77, 9.97 RT	EXPLORATION ID B-134-0-13
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: PGI / F.BUSHER	HAMMER: CME AUTOMATIC	ALIGNMENT: US 68 RAMP C BL	
PID: 87005 STR ID: HAN-68-1656	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 1/6/12	ELEVATION: 799.5 (MSL) EOB: 42.0 ft.	PAGE 1 OF 1
START: 8/8/13 END: 8/8/13	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 70.6	COORD: 41.025735590, 83.674449340	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
	799.5																	
ASPHALT PAVEMENT (4.25" THICK)	799.2																	
CONCRETE PAVEMENT (11" THICK)	798.2																	
GRAY STONE FRAGMENTS WITH SAND (BASE MATERIAL, 11" THICK)	797.3		12 18 23	48	56	SS-1	4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
HARD, DARK BROWN, **SANDY SILT**, SOME CLAY, TRACE STONE FRAGMENTS, FILL, DAMP	795.0		5 8 16	28	67	SS-2	4.00	-	-	-	-	-	-	-	-	10	A-4a (V)	
VERY STIFF TO STIFF, DARK BROWN, **SANDY SILT**, SOME CLAY, TRACE STONE FRAGMENTS, FILL, DAMP TO MOIST			5 7 7	16	100	SS-3	4.5+	-	-	-	-	-	-	-	-	16	A-4a (V)	
@9.0'; STIFF			3 3 8	13	100	SS-4	4.5+	-	-	-	-	-	-	-	-	14	A-4a (V)	
	787.5																	
VERY STIFF, DARK GRAY TO BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE STONE FRAGMENTS, FILL, DAMP			5 8 9	20	100	SS-5	4.5+	-	-	-	-	-	-	-	-	15	A-6a (V)	
@14.5'; BLACK			3 7 10	20	100	SS-6	4.5+	-	-	-	-	-	-	-	-	17	A-6a (V)	
@17.0'; BROWN			3 7 8	18	100	SS-7	4.00	-	-	-	-	-	-	-	-	15	A-6a (V)	
	780.0																	
VERY STIFF, BROWN TO BROWN AND GRAY, **SILTY CLAY**, LITTLE SAND, TRACE STONE FRAGMENTS, FILL, MOIST			8 10 7	20	100	SS-8	3.50	-	-	-	-	-	-	-	-	19	A-6b (V)	
@22.0'; STIFF, BROWN AND GRAY			3 4 5	11	100	SS-9	4.00	-	-	-	-	-	-	-	-	18	A-6b (V)	
	775.0																	
MEDIUM STIFF, BROWN, **CLAY**, SOME SAND, MOIST	773.0	W TR	2 3 4	8	100	SS-10	3.00	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
LIGHT GRAY DOLOMITE BEDROCK NOTE: BEGAN CORING BEDROCK AT 27.2'.	772.5		50/3"	-	100	SS-11	--	-	-	-	-	-	-	-	-	2	Rock (V)	
DOLOMITE, LIGHT GRAY, SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO HIGHLY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH.	769.8		0		80	NX-1											CORE	
DOLOMITE, LIGHT GRAY, SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, HIGHLY TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH, FEW VERTICAL & ANGULAR FRACTURES.	764.6		28		100	NX-2											CORE	
DOLOMITE, LIGHT GRAY, SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, HIGHLY TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH, FEW VERTICAL & ANGULAR FRACTURES. @36.9'; COMPRESSIVE STRENGTH = 10,250 psi @37.7'; 3" VUGGY LAYER	757.5	EOB	29		85	NX-3											CORE	

NOTES: GROUNDWATER WAS ENCOUNTERED AT 26.5' DURING DRILLING AND NO READING WAS TAKEN UPON COMPLETION OF DRILLING DUE TO ROCK CORING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PAVEMENT WAS REPLACED WITH 1.0 BAG ASPHALT COLD PATCH; BACKFILLED WITH 1.0 BAG OF BENTONITE PELLETS/SOIL CUTTINGS MIXTURE

PROJECT: HAN-75-14.39	DRILLING FIRM / OPERATOR: PGI / ZEKE	DRILL RIG: CME 45B TRUCK	STATION / OFFSET: 798+84.5, 22.5' RT	EXPLORATION ID B-133-1-14
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: PGI / ZEKE	HAMMER: CME AUTOMATIC	ALIGNMENT: US 68 RAMP C BASELINE	
PID: 87005 BR ID: HAN-75-1713	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 2/20/14	ELEVATION: 777.6 (MSL) EOB: 15.0 ft.	PAGE 1 OF 1
START: 4/24/15 END: 4/24/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 61.8	COORD: 41.025922500, 83.674972400	

MATERIAL DESCRIPTION AND NOTES	ELEV. 777.6	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
TOPSOIL (4.0" THICK)	777.3																	
STIFF, BROWN, MOTTLED GRAY, **CLAY**, LITTLE SAND, MOIST		1	2 3 4	7	56	SS-1	2.00	0	1	13	32	54	52	22	30	23	A-7-6 (18)	
	774.1	2																
VERY STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE STONE FRAGMENTS, MOIST	773.1	3	7 8 50/3"	-	13	SS-2A&B	--	-	-	-	-	-	-	-	-	22	A-6b (V)	
DOLOMITE, LIGHT GRAY, HIGHLY WEATHERED.	772.6	TR 4					--	-	-	-	-	-	-	-	-	4	Rock (V)	
DOLOMITE, LIGHT GRAY, HIGHLY TO MODERATELY WEATHERED, STRONG, VERY THIN BEDDED, FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH.	772.1	5	0		100	NX-1											CORE	
DOLOMITE, LIGHT GRAY TO GRAY, MODERATELY WEATHERED, VERY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH. U.C. STRENGTH @ 8.6' = 16,234 psi.	768.6	6 7 8 9	32		96	NX-2											CORE	
DOLOMITE, GRAY, MODERATELY WEATHERED, VERY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO MODERATELY FRACTURED WITH FEW ANGULAR AND VERTICAL FRACTURES, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH.	764.6	10 11 12 13	0		98	NX-3											CORE	
DOLOMITE, GRAY, MODERATELY WEATHERED, VERY STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO MODERATELY FRACTURED WITH FEW VERTICAL FRACTURES, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH.	762.6	EOB 14 15	22		97	NX-4											CORE	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING AND NO READING WAS TAKEN UPON COMPLETION DUE TO WATER USED DURING ROCK CORING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: HOLE WAS BACKFILLED WITH 1 BAG OF BENTONITE PELLETS/SOIL CUTTINGS MIXTURE

PROJECT: HAN-75-14.39	DRILLING FIRM / OPERATOR: OTB / JOHN	DRILL RIG: DIEDRICH D-50 ATV	STATION / OFFSET: 799+25.13, 0.02 RT
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: PGI / F.BUSHER	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: US 68 RAMP C BL
PID: 87005 STR ID: HAN-68-1656	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 12/10/11	ELEVATION: 776.1 (MSL) EOB: 14.5 ft.
START: 6/25/13 END: 6/25/13	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 81.7	COORD: 41.025924040, 83.675138270

EXPLORATION ID B-133-0-13

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 776.1	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
TOPSOIL (6" THICK)	775.6																	
MEDIUM STIFF, BROWN AND GRAY, **CLAY**, SOME SAND, TRACE ROOTS	772.6	1	3	7	100	SS-1	4.00	0	6	18	32	44	42	20	22	19	A-7-6 (13)	
		2	3 2															
		3																
LIGHT GRAY DOLOMITE BEDROCK	771.6	TR	50/4"	-	75	SS-2	-	-	-	-	-	-	-	-	-	-	Rock (V)	
NOTE: AUGERED TO 4.5' AND BEGAN CORING BEDROCK		4																
DOLOMITE, LIGHT GRAY, SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, HIGHLY TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH, FEW ANGULAR FRACTURES.	766.1	5	36		100	NX-1											CORE	
		6																
		7																
		8																
		9																
DOLOMITE, LIGHT GRAY, SLIGHTLY WEATHERED, STRONG, THIN TO THICK BEDDED, SLIGHTLY TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH, FEW ANGULAR FRACTURES. @13.0'; COMPRESSIVE STRENGTH = 9,706 psi	761.6	10	69		74	NX-2											CORE	
		11																
		12																
		13																
		EOB 14																

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING. NO READING WAS TAKEN UPON COMPLETION DUE TO WATER USED DURING ROCK CORING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: HAN-75-14.39	DRILLING FIRM / OPERATOR: PGI / ZEKE	DRILL RIG: CME 45B TRUCK	STATION / OFFSET: 800+15.6, 92.0' RT	EXPLORATION ID B-132-2-14
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: PGI / ZEKE	HAMMER: CME AUTOMATIC	ALIGNMENT: US 68 RAMP C BASELINE	
PID: 87005 BR ID: HAN-75-1713	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 2/20/14	ELEVATION: 776.7 (MSL) EOB: 14.5 ft.	PAGE 1 OF 1
START: 4/23/15 END: 4/23/15	SAMPLING METHOD: SPT/NX	ENERGY RATIO (%): 61.8	COORD: 41.026263000, 83.675189400	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
TOPSOIL (12.0" THICK)	776.7																	
	775.7																	
MEDIUM STIFF, DARK BROWN, **SILTY CLAY**, TRACE SAND, TRACE STONE FRAGMENTS, FILL, MOIST	775.2	1	3				3.50	-	-	-	-	-	-	-	-	20	A-6b (V)	
STIFF, BROWN AND GRAY, **SILT AND CLAY**, SOME SAND, TRACE STONE FRAGMENTS, DAMP	773.7	2	5 7	12	100	SS-1A&B	4.00	3	7	18	38	34	30	18	12	16	A-6a (8)	
VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE SAND, MOIST	772.7	3																
DOLOMITE, LIGHT GARY, HIGHLY WEATHERED. @4.5'; AUGER REFUSAL AND BEGIN CORING BEDROCK.	772.2	TR 4	10 50/4"	-	90	SS-2A&B	--	-	-	-	-	-	-	-	-	19	A-4a (V)	
							--	-	-	-	-	-	-	-	-	3	Rock (V)	
DOLOMITE, LIGHT GRAY, MODERATELY WEATHERED, STRONG, VERY THIN BEDDED, FRACTURED TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH.	771.2	5	0		92	NX-1											CORE	
DOLOMITE, LIGHT GRAY TO GRAY, MODERATELY WEATHERED, STRONG, VERY THIN BEDDED, FRACTURED TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH.	769.7	6	0		100	NX-2											CORE	
DOLOMITE, GRAY, MODERATELY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH.	767.9	7 8	0		100	NX-3											CORE	
DOLOMITE, GRAY, MODERATELY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, FRACTURED TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH. U.C. STRENGTH @ 9.5' = 11,180 psi.	765.2	9 10 11	22		100	NX-4											CORE	
DOLOMITE, GRAY, MODERATELY WEATHERED, STRONG, VERY THIN BEDDED, FRACTURED TO MODERATELY FRACTURED W/FEW VERTICAL FRACTURES, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH.	762.2	12 13 14 EOB	39		94	NX-5											CORE	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING AND NO READING WAS TAKEN UPON COMPLETION DUE TO WATER USED DURING ROCK CORING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: HOLE WAS BACKFILLED WITH 1 BAG OF BENTONITE PELLETS/SOIL CUTTINGS MIXTURE

PROJECT: HAN-75-14.39
TYPE: BRIDGE REPLACEMENT
PID: 87005 STR ID: HAN-68-1656
START: 6/26/13 END: 6/26/13

DRILLING FIRM / OPERATOR: OTB / JOHN
SAMPLING FIRM / LOGGER: PGI / F.BUSHER
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT/NX

DRILL RIG: DIEDRICH D-50 ATV
HAMMER: DIEDRICH AUTOMATIC
CALIBRATION DATE: 12/10/11
ENERGY RATIO (%): 81.7

STATION / OFFSET: 799+41.84, 105.09 LT
ALIGNMENT: US 68 RAMP C BL
ELEVATION: 776.4 (MSL) EOB: 14.0 ft.
COORD: 41.025707770, 83.675389690

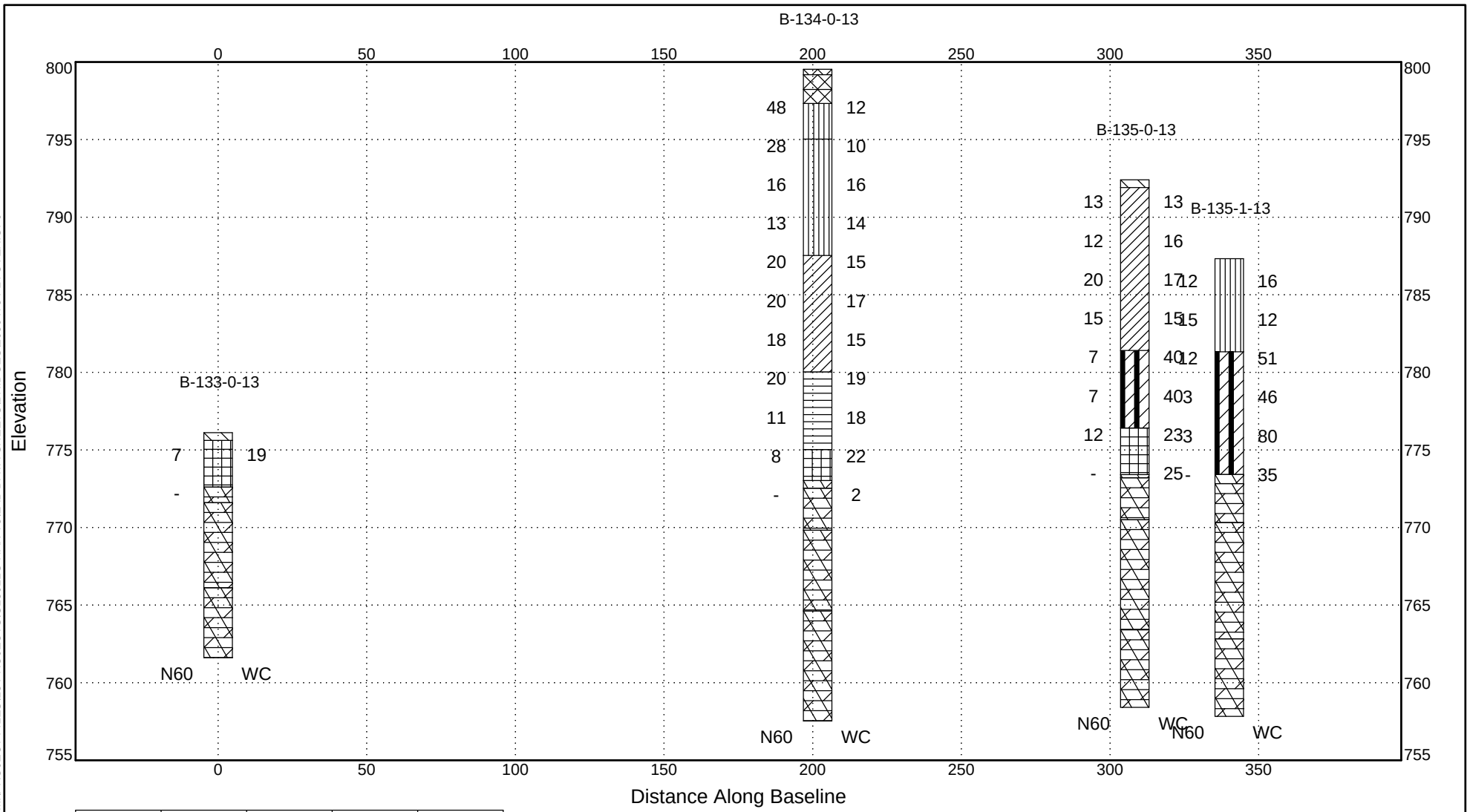
EXPLORATION ID: B-132-1-13

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 776.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
TOPSOIL (6" THICK)	775.9																	
MEDIUM STIFF, MOTTLED BROWN AND GRAY, **CLAY**, SOME SAND, TRACE ROOTS, MOIST	773.6	TR	1 3 3	8	89	SS-1	3.50	-	-	-	-	-	-	-	-	20	A-7-6 (V)	
LIGHT GRAY DOLOMITE BEDROCK	772.4		50/3"	-	100	SS-2	-	-	-	-	-	-	-	-	-	-	Rock (V)	
NOTE: AUGERED TO 4.0' AND BEGAN CORING BEDROCK																		
DOLOMITE, LIGHT GRAY, SLIGHTLY WEATHERED, VERY STRONG, VERY THIN TO THIN BEDDED, HIGHLY TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH, FEW ANGULAR FRACTURES. LIGHT GRAY DOLOMITE BEDROCK	767.2		0		100	NX-1											CORE	
			0		93	NX-2											CORE	
DOLOMITE, LIGHT GRAY, SLIGHTLY WEATHERED, VERY STRONG, VERY THIN TO THIN BEDDED, HIGHLY TO MODERATELY FRACTURED, TIGHT APERTURE WIDTH, SLIGHTLY ROUGH, FEW ANGULAR FRACTURES. @10.5'; COMPRESSIVE STRENGTH = 23,129 psi	762.4	EOB	26		100	NX-3											CORE	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING. NO READING WAS TAKEN UPON COMPLETION DUE TO WATER USED DURING ROCK CORING OPERATIONS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS



Borehole	North	East	Elev.	Depth
B-133-0-13	497393	1644279	776.1	14.5
B-134-0-13	497322	1644468	799.5	42.0
B-135-0-13	497276	1644566	792.4	34.0
B-135-1-13	497312	1644610	787.3	29.5

DISTANCES:

Beginning	0
Ending	350

VIEWING ANGLES (degrees):

Horizontal	0.0
Vertical	0.0

Position	North	East
Left, Front	497387	1644277
Right, Front	497286	1644612
Left, Back	497387	1644277
Right, Back	497286	1644612

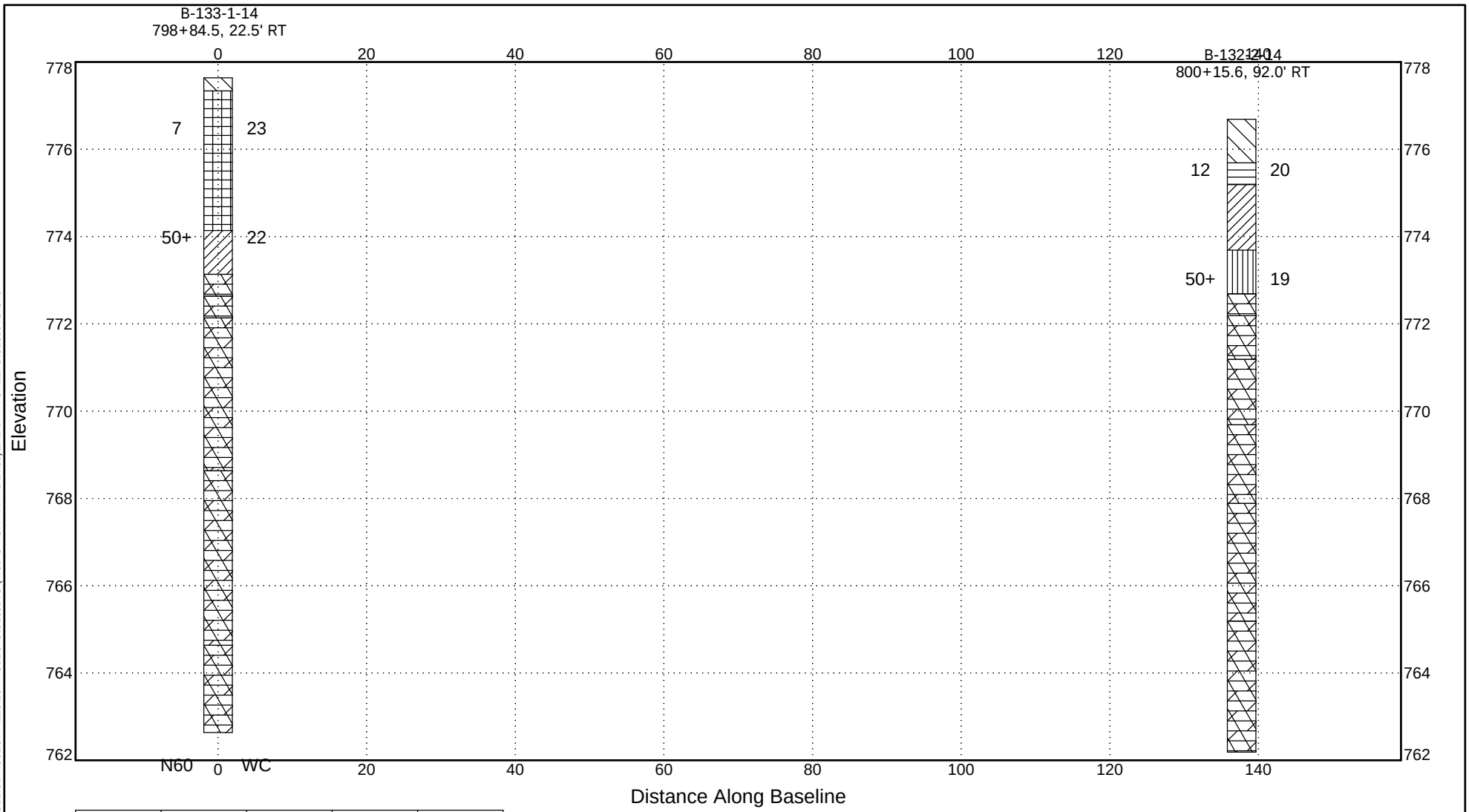
SOIL BORINGS PROFILE
BRIDGE NO. HAN-75-1656

HAN-75-14.39

FINDLAY, HANCOCK COUNTY, OHIO

PROJECT #	DATE	PLATE
87005	Jun 14	1

PROFILE ODOT - PRIMENG.GDT - 6/17/14 18:17 - M:\PROJECT FILES\13 PROJECTS\G130111G HAN-75\LAB DATA SHEETS\BRIDGES\1656 I75 FLYOVER.GPJ



Borehole	North	East	Elev.	Depth
B-132-2-14	497517	1644267	776.7	14.5
B-133-1-14	497392	1644325	777.6	15.0

DISTANCES:

Beginning	0
Ending	140

VIEWING ANGLES (degrees):

Horizontal	0.0
Vertical	0.0

Position	North	East
Left, Front	497392	1644325
Right, Front	497519	1644266
Left, Back	497392	1644325
Right, Back	497519	1644266

SOIL BORINGS PROFILE
BRIDGE NO. HAN-75-1656

HAN-75-14.39

FINDLAY, HANCOCK COUNTY, OH

PROJECT #	DATE	PLATE
87005	May 15	1

PROFILE ODOT-PRIMENG.GDT-5/22/15 14:51-\\CLEDC01\PUBLIC\PROJECT FILES\15 PROJECTS\G15004G-(MOD-3 FOR HAN-75-14.39)\LAB DATA SHEETS\G15004G.GPJ

APPENDIX B

Boring Number	Sample Number	Depth (ft)	Water Content %	Liquid Limit %	Plastic Limit %	Plast. Index	Oven Dried LL (%)	Agg. %	Coarse Sand %	Fine Sand %	Silt %	Silt&Clay Comb. %	Clay %	Soil Description	Class. Symbol
B-132-1-13	SS-1	1.0	20											MOTTLED DARK BROWN AND GRAY CLAY, SOME SAND, TRACE ROOTS	A-7-6 (V)
B-132-1-13	SS-2	3.5												LIGHT GRAY DOLOMITE BEDROCK	Rock (V)
B-133-0-13	SS-1	1.0	19	42	20	22		0	6	18	32	76	44	BROWN AND GRAY CLAY, SOME SAND, TRACE ROOTS (FILL)	A-7-6 (13)
B-133-0-13	SS-2	3.5												LIGHT GRAY DOLOMITE BEDROCK	Rock (V)
B-134-0-13	SS-1	2.0	12											DARK BROWN SANDY SILT, SOME CLAY, TRACE STONE FRAGMENTS (FILL)	A-4a (V)
B-134-0-13	SS-2	4.5	10											DARK BROWN SANDY SILT, SOME CLAY, TRACE STONE FRAGMENTS (FILL)	A-4a (V)
B-134-0-13	SS-3	7.0	16											DARK BROWN SANDY SILT, SOME CLAY, TRACE STONE FRAGMENTS (FILL)	A-4a (V)
B-134-0-13	SS-4	9.5	14											DARK BROWN SANDY SILT, SOME CLAY, TRACE STONE FRAGMENTS (FILL)	A-4a (V)
B-134-0-13	SS-5	12.0	15											DARK BROWN SILT AND CLAY, LITTLE SAND, TRACE STONE FRAGS (FILL)	A-6a (V)
B-134-0-13	SS-6	14.5	17											BLACK SILT AND CLAY, LITTLE SAND, TRACE STONE FRAGMENTS (FILL)	A-6a (V)
B-134-0-13	SS-7	17.0	15											BROWN SILT AND CLAY, LITTLE SAND, TRACE STONE FRAGMENTS (FILL)	A-6a (V)
B-134-0-13	SS-8	19.5	19											BROWN SILTY CLAY, LITTLE SAND, TRACE STONE FRAGMENTS (FILL)	A-6b (V)
B-134-0-13	SS-9	22.0	18											BROWN AND GRAY SILTY CLAY, LITTLE SAND, TRACE S/F (FILL)	A-6b (V)
B-134-0-13	SS-10	24.5	22											BROWN CLAY, SOME SAND	A-7-6 (V)
B-134-0-13	SS-11	27.0	2											LIGHT GRAY DOLOMITE BEDROCK	Rock (V)
B-135-0-13	SS-1	1.0	13											BROWN SILT AND CLAY, LITTLE SAND, TRACE STONE FRAGMENTS (FILL)	A-6a (V)
B-135-0-13	SS-2	3.5	16											BROWN SILT AND CLAY, LITTLE SAND, TRACE STONE FRAGMENTS (FILL)	A-6a (V)
B-135-0-13	SS-3	6.0	17											BROWN SILT AND CLAY, LITTLE SAND, TRACE STONE FRAGMENTS (FILL)	A-6a (V)
B-135-0-13	SS-4	8.5	15											BROWN AND BLACK SILT AND CLAY, LITTLE SAND, TRACE S/F (FILL)	A-6a (V)
B-135-0-13	SS-5	11.0	40											BLACK ELASTIC CLAY, LITTLE SAND, TRACE S/F AND ROOTS (FILL)	A-7-5 (V)
B-135-0-13	SS-6	13.5	40	55	31	24		5	5	15	38	75	37	BLACK ELASTIC CLAY, LITTLE SAND, TRACE STONE FRAGMENTS (FILL)	A-7-5 (17)
B-135-0-13	SS-7	16.0	23	42	22	20		3	4	15	30	78	48	BROWN, MOTTLED GRAY CLAY, LITTLE SAND, TRACE STONE FRAGMENTS	A-7-6 (12)
B-135-0-13	SS-8	18.5	25											BROWN, MOTTLED GRAY CLAY, LITTLE SAND, TRACE STONE FRAGMENTS	A-7-6 (V)
B-135-1-13	SS-1	1.0	16											BROWN SILT AND CLAY, LITTLE SAND, LITTLE STONE FRAGMENTS (FILL)	A-6a (V)
B-135-1-13	SS-2	3.5	12											BROWN SILT AND CLAY, LITTLE SAND, LITTLE STONE FRAGMENTS (FILL)	A-6a (V)
B-135-1-13	SS-3	6.0	51											LIGHT GRAY ELASTIC CLAY, TRACE SAND (FILL)	A-7-5 (V)
B-135-1-13	SS-4	8.5	46											LIGHT GRAY ELASTIC CLAY, TRACE SAND (FILL)	A-7-5 (V)
B-135-1-13	SS-5	11.0	80	67	52	15		0	1	2	29	98	69	LIGHT AND DARK GRAY ELASTIC CLAY, TRACE SAND (FILL)	A-7-5 (14)
B-135-1-13	SS-6	13.5	35											LIGHT AND DARK GRAY ELASTIC CLAY, TRACE SAND (FILL)	A-7-5 (V)

Pro Geotech, Inc.

TR.-TRACE, BR.-BROWN, LI.-LITTLE, S/F-STONE FRAGMENTS, SO.-SOME, RB-ROADBASE, NP-NON-PLASTIC, POSS-POSSIBLE

Summary of Laboratory Results

Client: PARSONS BRINKERHOFF
Project: HAN-75-14.39 - BRIDGE NO. HAN-75-1656
Location: FINDLAY, HANCOCK COUNTY, OHIO
Pro. Number: G13011G

Boring Number	Sample Number	Depth (ft)	Water Content %	Liquid Limit %	Plastic Limit %	Plast. Index	Oven Dried LL (%)	Agg. %	Coarse Sand %	Fine Sand %	Silt %	Silt&Clay Comb. %	Clay %	Soil Description	Class. Symbol
B-135-2-13	SS-1	1.0	78											LIGHT GRAY ELASTIC CLAY, TRACE SAND (FILL)	A-7-5 (V)
B-135-2-13	SS-2	3.5	25	42	22	20		0	2	20	34	77	43	BROWN, MOTTLED GRAY CLAY, SOME SAND, TRACE STONE FRAGMENTS	A-7-6 (12)
B-135-2-13	SS-3	6.0	23											BROWN, MOTTLED GRAY CLAY, SOME SAND, TRACE STONE FRAGMENTS	A-7-6 (V)
B-135-2-13	SS-4	8.5	13											LIGHT GRAY DOLOMITE BEDROCK	Rock (V)

Pro Geotech, Inc.

TR.-TRACE, BR.-BROWN, LI.-LITTLE, S/F-STONE FRAGMENTS, SO.-SOME, RB-ROADBASE, NP-NON-PLASTIC, POSS-POSSIBLE

Summary of Laboratory Results

Client: PARSONS BRINKERHOFF
Project: HAN-75-14.39 - BRIDGE NO. HAN-75-1656
Location: FINDLAY, HANCOCK COUNTY, OHIO
Pro. Number: G13011G

Boring Number	Sample Number	Depth (ft)	Water Content %	Liquid Limit %	Plastic Limit %	Plast. Index	Oven Dried LL (%)	Agg. %	Coarse Sand %	Fine Sand %	Silt %	Silt&Clay Comb. %	Clay %	Soil Description	Class. Symbol
B-136-0-13	SS-1	1.0	15											DARK BROWN SILT AND CLAY, LITTLE SAND, LITTLE S/F (FILL)	A-6a (V)
B-136-0-13	SS-2	3.5	16											DARK BROWN SILT AND CLAY, LITTLE SAND, TRACE S/F (FILL)	A-6a (V)
B-136-0-13	SS-3	6.0	18	37	22	15		3	4	15	39	78	39	BLACK SILT AND CLAY, LITTLE SAND, TR. S/F, SLIGHTLY ORGANIC (FILL)	A-6a (10)
B-136-0-13	SS-4	8.5	18											BROWN SILT AND CLAY, LITTLE SAND, TRACE STONE FRAGMENTS (FILL)	A-6a (V)
B-136-0-13	ST-5	11.0	24											BROWN, MOTTLED GRAY SILTY CLAY, LITTLE SAND, TRACE S/F	A-6b (V)

Pro Geotech, Inc.

TR.-TRACE, BR.-BROWN, LI.-LITTLE, S/F-STONE FRAGMENTS, SO.-SOME, RB-ROADBASE, NP-NON-PLASTIC, POSS-POSSIBLE

Summary of Laboratory Results

Client: PARSONS BRINKERHOFF
Project: HAN-75-14.39
Location: HANCOCK COUNTY, OHIO
Pro. Number: G13011G

Boring Number	Sample Number	Depth (ft)	Water Content %	Liquid Limit %	Plastic Limit %	Plast. Index	Specific Gravity	Agg. %	Coarse Sand %	Fine Sand %	Silt %	Silt&Clay Comb. %	Clay %	Soil Description	Class. Symbol
B-132-2-14	SS-1A	1.0	20											DARK BROWN SILTY CLAY, TRACE SAND, TRACE STONE FRAGMENT (FILL)	A-6b (V)
B-132-2-14	SS-1B	1.5	16	30	18	12		3	7	18	38	72	34	BROWN AND GRAY SILT AND CLAY, SOME SAND, TRACE STONE FRAGMENTS	A-6a (8)
B-132-2-14	SS-2A	3.5	19											BROWN SANDY SILT, SOME CLAY, TRACE SAND	A-4a (V)
B-132-2-14	SS-2B	4.0	3											LIGHT GRAY DOLOMITE FRAGMENTS	Rock (V)
B-133-1-14	SS-1	1.0	23	52	22	30		0	2	13	32	86	54	BROWN MOTTLED GRAY CLAY, LITTLE SAND	A-7-6 (18)
B-133-1-14	SS-2A	3.5	22											BROWN SILT AND CLAY, LITTLE SAND, TRACE STONE FRAGMENTS	A-6b (V)
B-133-1-14	SS-2B	4.5	4											LIGHT GRAY DOLOMITE FRAGMENTS	Rock (V)

Pro Geotech, Inc.

TR.-TRACE, BR.-BROWN, LI.-LITTLE,
S/F-STONE FRAGMENTS, SO.-SOME,
RB-ROADBASE, NP-NON-PLASTIC,
POSS-POSSIBLE, MOD-MODERATELY

Summary of Laboratory Results

Client: PARSONS BRINCKERHOFF
Project: HAN-75-14.39
Location: FINDLAY, OH
PID Number: 87005

Pro Geotech, Inc.

Compressive Strength of Rock
ASTM D 7012

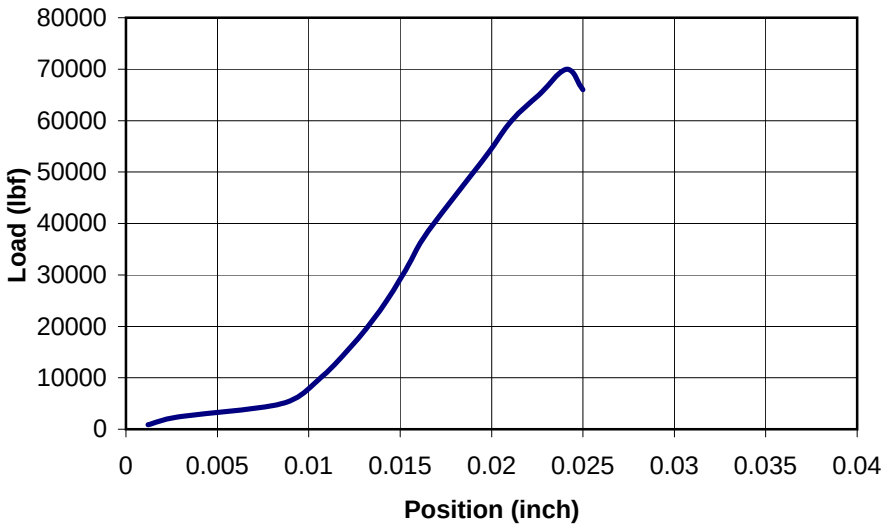
PROJECT	HAN-75-14.39	PGI PROJECT NO.	G13011G	DATE	9/6/2013
STRUCTURE	HAN-68-1656 BRIDGE over IR 75 & US 68 RAMP B				
BORING NUMBER	B-135-2-13	TOP DEPTH (FT)	10.8	BOTTOM DEPTH (FT)	11.1
SAMPLE NUMBER	NX-1	DISTRICT	1	PID NO.	87005
COUNTY	HANCOCK	ROUTE	US 68	SECTION	1656
STATION	794+50.4	OFFSET	6.0'	OFFSET DIRECTION	RT

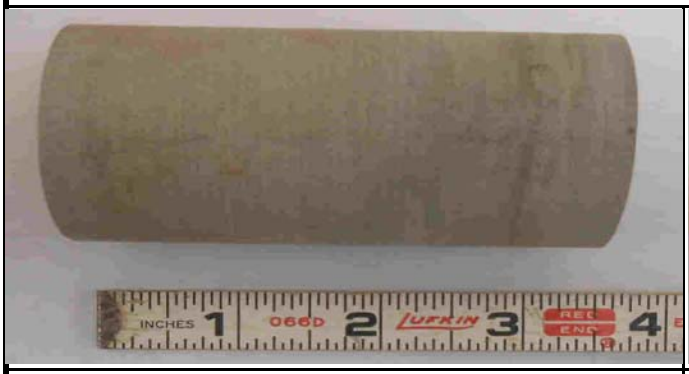
FORMATION	TYMOCHTEE / GREENFIELD GROUP
DESCRIPTION	Dolomite, light gray, slightly weathered, very strong.

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)
1	3.345	1.975
2	3.351	1.980
3	3.346	1.974
AVERAGE	3.347	1.976

LENGTH/DIAMETER	1.69
CORRECTION FACTOR	1.02
AREA (SQ. INCH)	3.068
MASS (GRAMS)	442.65
UNIT WEIGHT (LBS/FT^3)	164.22

MAXIMUM LOAD (LBS)
69996
COMPRESSIVE STRENGTH (PSI)
22333
TIME OF TEST (MINUTES)
4:20
LOADING DIRECTION
PERPENDICULAR TO BEDDING
TECHNICIAN
FBUSHER





BEFORE TESTING

AFTER FAILURE

Pro Geotech, Inc.

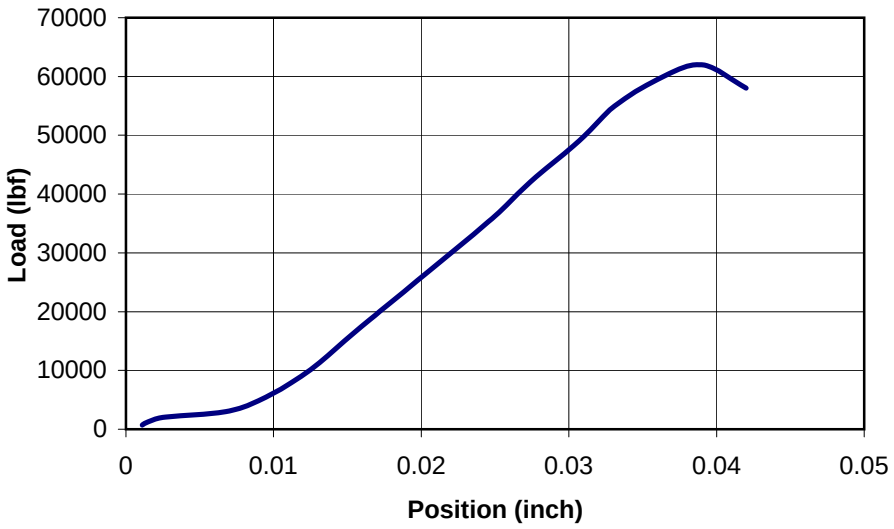
Compressive Strength of Rock
ASTM D 7012

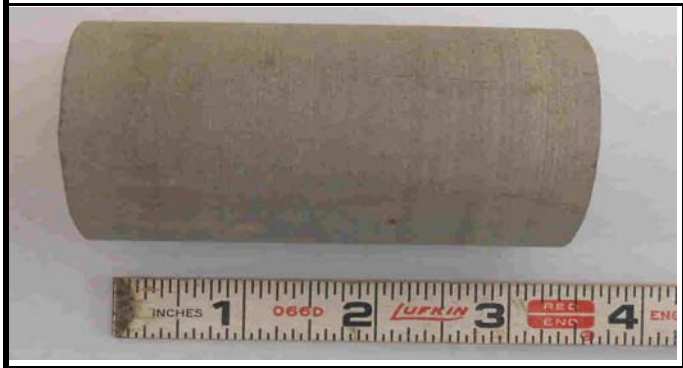
PROJECT	HAN-75-14.39	PGI PROJECT NO.	G13011G	DATE	9/6/2013
STRUCTURE	HAN-68-1656 BRIDGE over IR 75 & US 68 RAMP B				
BORING NUMBER	B-135-1-13	TOP DEPTH (FT)	21.5	BOTTOM DEPTH (FT)	21.8
SAMPLE NUMBER	NX-2	DISTRICT	1	PID NO.	87005
COUNTY	HANCOCK	ROUTE	US 68	SECTION	1656
STATION	795+80.0	OFFSET	20.9'	OFFSET DIRECTION	RT

FORMATION	TYMOCHTEE / GREENFIELD GROUP
DESCRIPTION	Dolomite, light gray, slightly weathered, very strong.

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)			
1	3.266	1.986		LENGTH/DIAMETER	1.65
2	3.271	1.991		CORRECTION FACTOR	1.03
3	3.280	1.976		AREA (SQ. INCH)	3.093
AVERAGE	3.272	1.984		MASS (GRAMS)	436.88
				UNIT WEIGHT (LBS/FT^3)	164.46

MAXIMUM LOAD (LBS)
61991
COMPRESSIVE STRENGTH (PSI)
19546
TIME OF TEST (MINUTES)
3.32
LOADING DIRECTION
PERPENDICULAR TO BEDDING
TECHNICIAN
FBUSHER





BEFORE TESTING

AFTER FAILURE

Pro Geotech, Inc.

Compressive Strength of Rock
ASTM D 7012

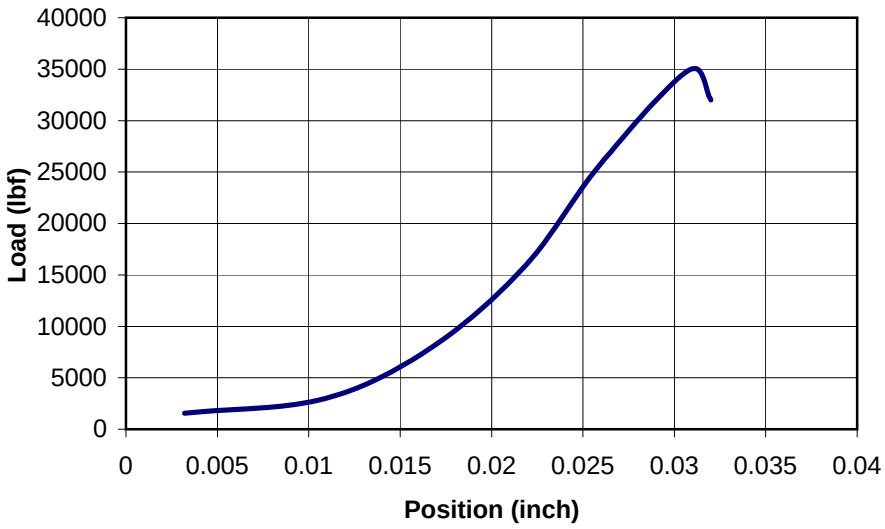
PROJECT	HAN-75-14.39	PGI PROJECT NO.	G13011G	DATE	9/27/2013
STRUCTURE	HAN-68-1656 BRIDGE over IR 75 & US 68 RAMP B				
BORING NUMBER	B-135-0-13	TOP DEPTH (FT)	29.0	BOTTOM DEPTH (FT)	29.3
SAMPLE NUMBER	NX-3	DISTRICT	1	PID NO.	87005
COUNTY	HANCOCK	ROUTE	US 68	SECTION	1656
STATION	796+17.4	OFFSET	19.4	OFFSET DIRECTION	LT

FORMATION	TYMOCHTEE / GREENFIELD GROUP
DESCRIPTION	Dolomite, light gray, slightly weathered, strong.

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)
1	3.960	1.958
2	3.955	1.952
3	3.951	1.960
AVERAGE	3.955	1.957

LENGTH/DIAMETER	2.02
CORRECTION FACTOR	1.00
AREA (SQ. INCH)	3.007
MASS (GRAMS)	536.35
UNIT WEIGHT (LBS/FT^3)	171.80

MAXIMUM LOAD (LBS)
34890
COMPRESSIVE STRENGTH (PSI)
11603
TIME OF TEST (MINUTES)
3.32
LOADING DIRECTION
PERPENDICULAR TO BEDDING
TECHNICIAN
FBUSHER



BEFORE TESTING

AFTER FAILURE

Pro Geotech, Inc.

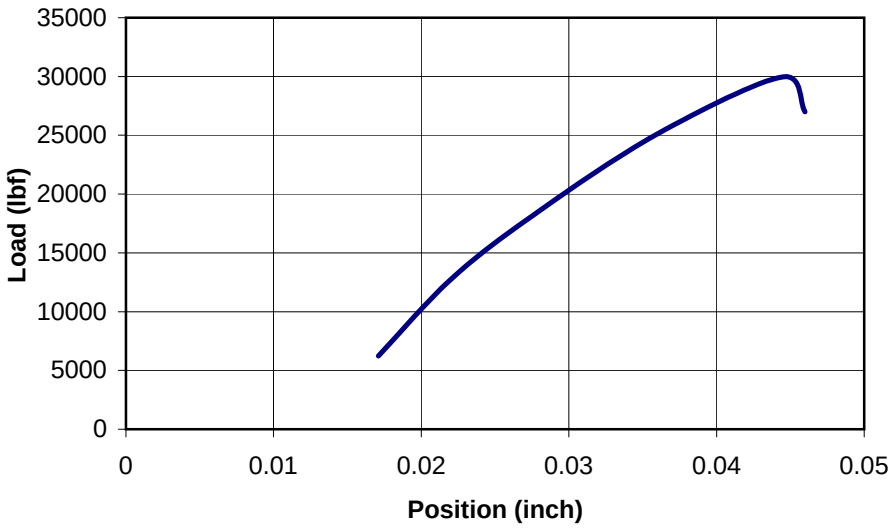
Compressive Strength of Rock
ASTM D 7012

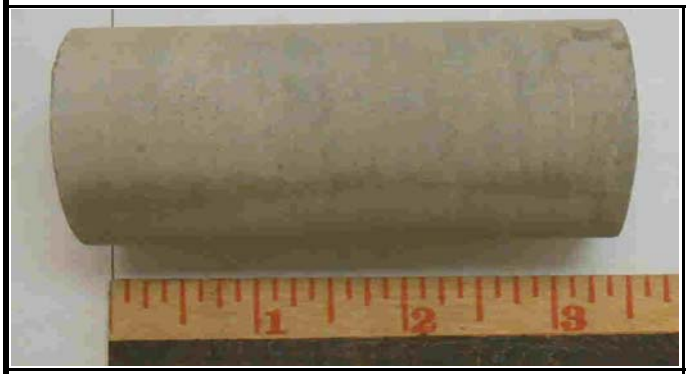
PROJECT	HAN-75-14.39	PGI PROJECT NO.	G13011G	DATE	9/6/2013
STRUCTURE	HAN-68-1656 BRIDGE over IR 75 & US 68 RAMP B				
BORING NUMBER	B-134-0-13	TOP DEPTH (FT)	36.9	BOTTOM DEPTH (FT)	37.2
SAMPLE NUMBER	NX-3	DISTRICT	1	PID NO.	87005
COUNTY	HANCOCK	ROUTE	US 68	SECTION	1656
STATION	797+20.8	OFFSET	10.0'	OFFSET DIRECTION	RT

FORMATION	TYMOCHTEE / GREENFIELD GROUP
DESCRIPTION	Dolomite, light gray, slightly weathered, strong.

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)			
1	3.641	1.923		LENGTH/DIAMETER	1.90
2	3.671	1.923		CORRECTION FACTOR	1.01
3	3.674	1.925		AREA (SQ. INCH)	2.906
AVERAGE	3.662	1.924		MASS (GRAMS)	480.66
				UNIT WEIGHT (LBS/FT^3)	172.05

MAXIMUM LOAD (LBS)
29970
COMPRESSIVE STRENGTH (PSI)
10250
TIME OF TEST (MINUTES)
2:20
LOADING DIRECTION
PERPENDICULAR TO BEDDING
TECHNICIAN
FBUSHER





BEFORE TESTING

AFTER FAILURE

Pro Geotech, Inc.

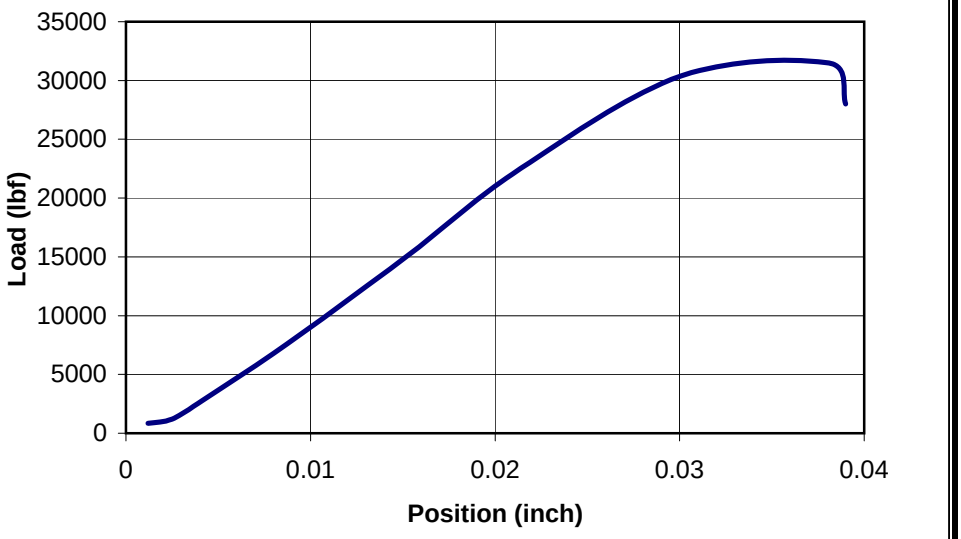
Compressive Strength of Rock
ASTM D 7012

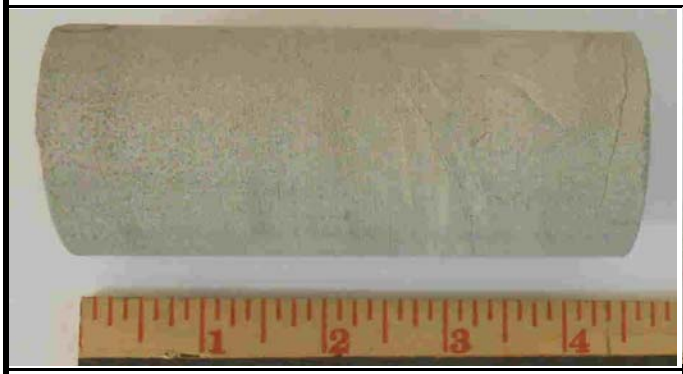
PROJECT	HAN-75-14.39	PGI PROJECT NO.	G13011G	DATE	9/27/2013
STRUCTURE	HAN-68-1656 BRIDGE over IR 75 & US 68 RAMP B				
BORING NUMBER	B-133-0-13	TOP DEPTH (FT)	13.0	BOTTOM DEPTH (FT)	13.3
SAMPLE NUMBER	NX-2	DISTRICT	1	PID NO.	87005
COUNTY	HANCOCK	ROUTE	US 68	SECTION	1656
STATION	799+25.1	OFFSET	0.0'	OFFSET DIRECTION	LT

FORMATION	TYMOCHTEE / GREENFIELD GROUP
DESCRIPTION	Dolomite, light gray, slightly weathered, strong.

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)			
1	4.220	2.039		LENGTH/DIAMETER	2.07
2	4.216	2.026		CORRECTION FACTOR	1.00
3	4.212	2.033		AREA (SQ. INCH)	3.245
AVERAGE	4.216	2.033		MASS (GRAMS)	592.19
				UNIT WEIGHT (LBS/FT^3)	164.90

MAXIMUM LOAD (LBS)
31497
COMPRESSIVE STRENGTH (PSI)
9706
TIME OF TEST (MINUTES)
3.32
LOADING DIRECTION
PERPENDICULAR TO BEDDING
TECHNICIAN
FBUSHER





BEFORE TESTING

AFTER FAILURE

Pro Geotech, Inc.

Compressive Strength of Rock
ASTM D 7012

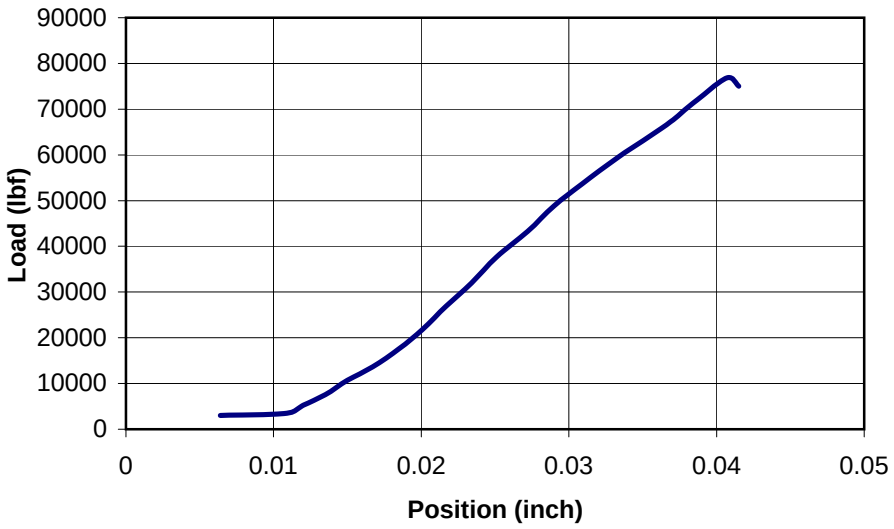
PROJECT	HAN-75-14.39	PGI PROJECT NO.	G13011G	DATE	9/27/2013
STRUCTURE	HAN-68-1656 BRIDGE over IR 75 & US 68 RAMP B				
BORING NUMBER	B-132-1-13	TOP DEPTH (FT)	10.5	BOTTOM DEPTH (FT)	10.8
SAMPLE NUMBER	NX-3	DISTRICT	1	PID NO.	87005
COUNTY	HANCOCK	ROUTE	US 68	SECTION	1656
STATION	799+41.8	OFFSET	105.1'	OFFSET DIRECTION	LT

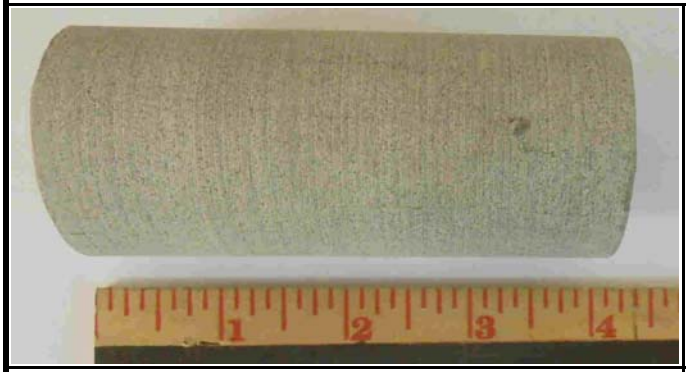
FORMATION	TYMOCHTEE / GREENFIELD GROUP
DESCRIPTION	Dolomite, light gray, slightly weathered, very strong.

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)
1	3.747	2.045
2	3.760	2.043
3	3.752	2.049
AVERAGE	3.753	2.046

LENGTH/DIAMETER	1.83
CORRECTION FACTOR	1.01
AREA (SQ. INCH)	3.287
MASS (GRAMS)	547.50
UNIT WEIGHT (LBS/FT^3)	169.09

MAXIMUM LOAD (LBS)	76841
COMPRESSIVE STRENGTH (PSI)	23129
TIME OF TEST (MINUTES)	7:40
LOADING DIRECTION	PERPENDICULAR TO BEDDING
TECHNICIAN	FBUSHER





BEFORE TESTING

AFTER FAILURE

Pro Geotech, Inc.

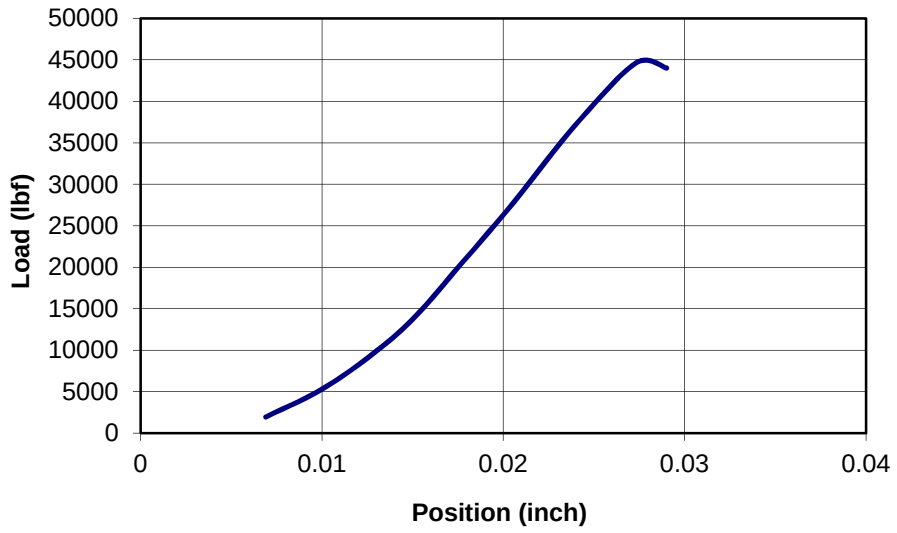
Compressive Strength of Rock
ASTM D 7012

PROJECT	HAN-75-14.39	PGI PROJECT NO.	G15004G	DATE	5/12/15
STRUCTURE	Bridge No. HAN-75-1656 over IR-75 and US 68 Ramp B				
BORING NUMBER	B-133-1-14	TOP DEPTH (FT)	8.6	BOTTOM DEPTH (FT)	8.9
SAMPLE NUMBER	NX-2	DISTRICT	1	PID NO.	87005
COUNTY	HANCOCK	ROUTE	75	SECTION	1656
STATION	798+84.5	OFFSET	22.5'	OFFSET DIRECTION	Right

FORMATION	TYMOCHTEE / GREENFIELD GROUP
DESCRIPTION	Dolomite, gray, moderately weathered, very strong.

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)			
1	4.002	1.870		LENGTH/DIAMETER	2.14
2	4.000	1.872		CORRECTION FACTOR	1.00
3	4.005	1.870		AREA (SQ. INCH)	2.748
AVERAGE	4.002	1.871		MASS (GRAMS)	491.80
				UNIT WEIGHT (LBS/FT^3)	170.32

MAXIMUM LOAD (LBS)
44617
COMPRESSIVE STRENGTH (PSI)
16234
TIME OF TEST (MINUTES)
2:19
LOADING DIRECTION
PERPENDICULAR TO BEDDING
TECHNICIAN
SS & SP



BEFORE TESTING

AFTER FAILURE

Pro Geotech, Inc.

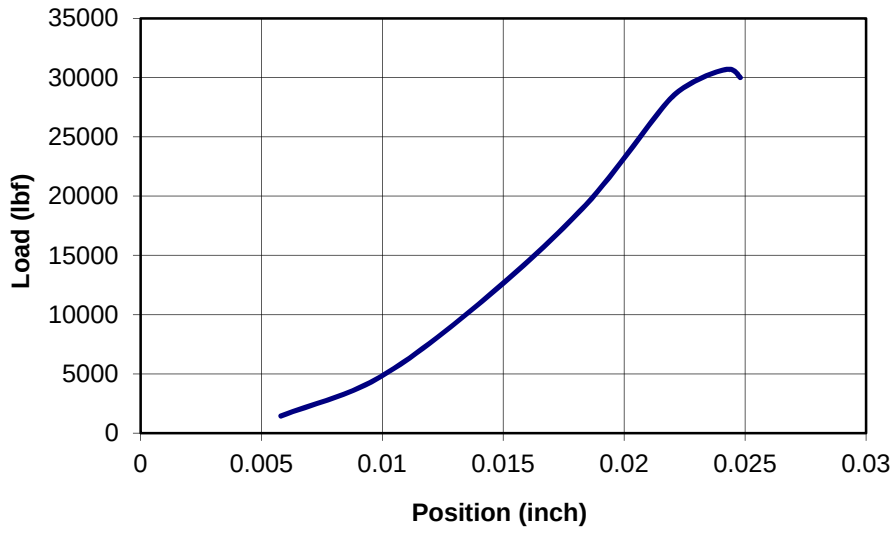
Compressive Strength of Rock
ASTM D 7012

PROJECT	HAN-75-14.39	PGI PROJECT NO.	G15004G	DATE	5/12/15
STRUCTURE	Bridge No. HAN-75-1656 over IR-75 and US 68 Ramp B				
BORING NUMBER	B-132-2-14	TOP DEPTH (FT)	9.5	BOTTOM DEPTH (FT)	9.8
SAMPLE NUMBER	NX-4	DISTRICT	1	PID NO.	87005
COUNTY	HANCOCK	ROUTE	75	SECTION	1656
STATION	800+15.6	OFFSET	92.0'	OFFSET DIRECTION	Right

FORMATION	TYMOCHTEE / GREENFIELD GROUP
DESCRIPTION	Dolomite, gray, moderately weathered, strong.

MEASUREMENT	LENGTH (INCH)	DIAMETER (INCH)			
1	3.905	1.870		LENGTH/DIAMETER	2.09
2	3.910	1.870		CORRECTION FACTOR	1.00
3	3.905	1.870		AREA (SQ. INCH)	2.746
AVERAGE	3.907	1.870		MASS (GRAMS)	482.11
				UNIT WEIGHT (LBS/FT^3)	171.18

MAXIMUM LOAD (LBS)
30705
COMPRESSIVE STRENGTH (PSI)
11180
TIME OF TEST (MINUTES)
2:20
LOADING DIRECTION
PERPENDICULAR TO BEDDING
TECHNICIAN
SS & SP



BEFORE TESTING

AFTER FAILURE

COMPANY: PGI DRILLED BY: B-M
PROJECT: HAN-75-14.39
BRIDGE NO.: HAN-68-1656 over IR 75 & US 68 Ramp B
BORING: B-136-0-13 BOX 1/1
DATE of CORING: 8/6/13
RUN-1: 12.5' - 17.5'
REC: 93% RQD: 7%

COMPANY: PGI DRILLED BY: B-M
PROJECT: HAN-75-14.39
BRIDGE NO.: HAN-68-1656 over IR 75 & US 68 Ramp B
BORING: B-135-2-13 BOX 1/1
DATE of CORING: 7/16/13
RUN-1: 9.0' - 14.0'
REC: 100% RQD: 20%

COMPANY: PGI DRILLED BY: B-M
PROJECT: HAN-75-14.39
BRIDGE NO.: HAN-68-1656 over IR 75 & US 68 Ramp B
BORING: B-135-1-13 BOX 1/2
DATE of CORING: 7/17/13
RUN-1: 14.5' - 17.0' RUN-2: 17.0' - 24.5'
REC: 90% RQD: 0% REC: 89% RQD: 30%

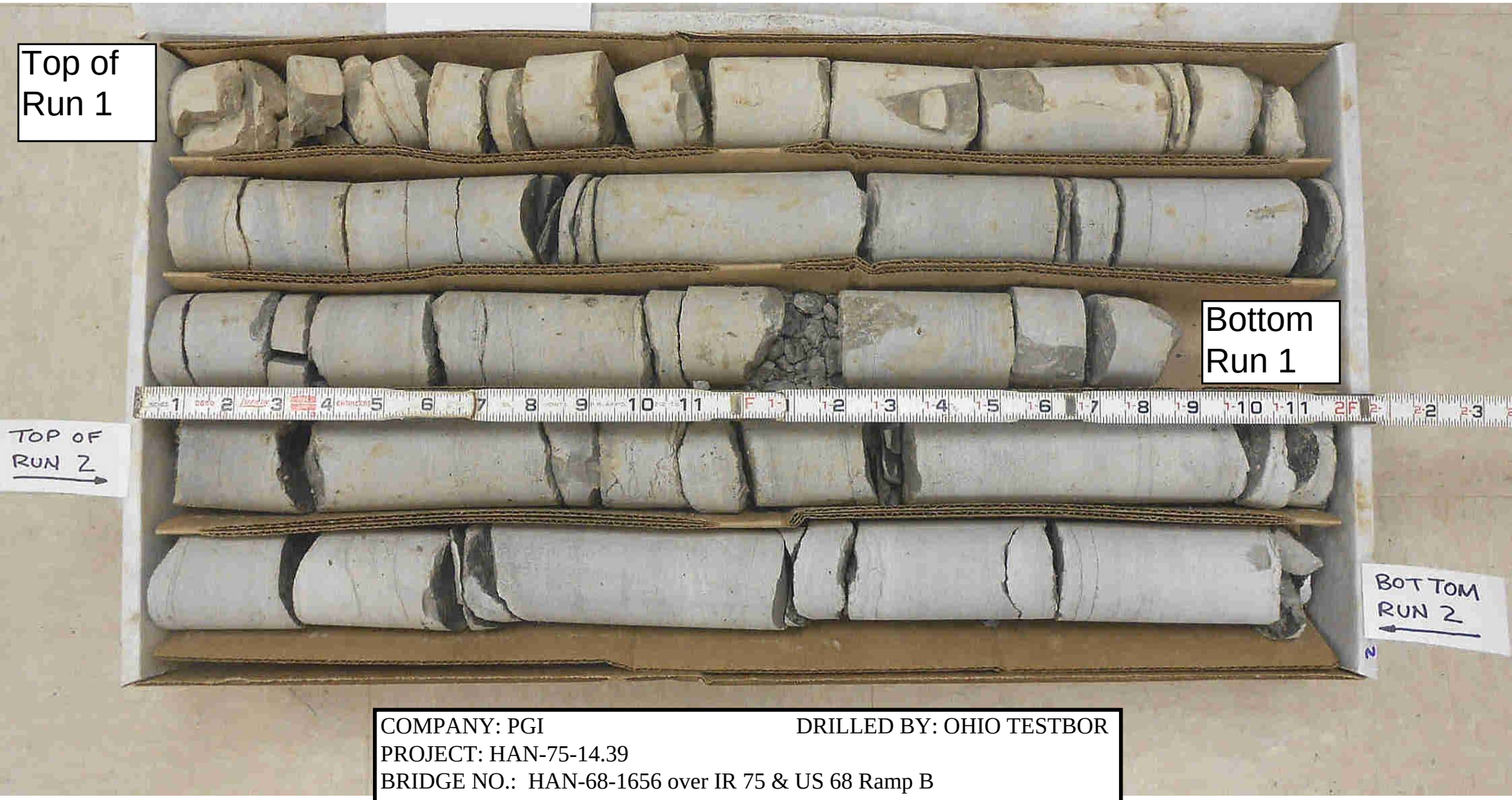
COMPANY: PGI DRILLED BY: B-M
PROJECT: HAN-75-14.39
BRIDGE NO.: HAN-68-1656 over IR 75 & US 68 Ramp B
BORING: B-135-1-13 BOX 2/2
DATE of CORING: 7/17/13
RUN-3: 24.5' - 29.5'
REC: 100% RQD: 20%

COMPANY: PGI DRILLED BY: B-M
PROJECT: HAN-75-14.39
BRIDGE NO.: HAN-68-1656 over IR 75 & US 68 Ramp B
BORING: B-135-0-13 BOX 1/2
DATE of CORING: 7/16/13
RUN-1: 19.2' - 21.9' RUN-2: 21.9' - 29.0'
REC: 99% RQD: 30% REC: 95% RQD: 32%

COMPANY: PGI DRILLED BY: B-M
PROJECT: HAN-75-14.39
BRIDGE NO.: HAN-68-1656 over IR 75 & US 68 Ramp B
BORING: B-135-0-13 BOX 2/2
DATE of CORING: 7/16/13
RUN-3: 29.0' - 34.0'
REC: 100% RQD: 32%

COMPANY: PGI DRILLED BY: DLZ
PROJECT: HAN-75-14.39
BRIDGE NO.: HAN-68-1656 over IR 75 & US 68 Ramp B
BORING: B-134-0-13 BOX 1/2
DATE of CORING: 8/8/13
RUN-1: 27.3' - 29.7' RUN-2: 29.7' - 34.9'
REC: 80% RQD: 0% REC: 100% RQD: 28%

COMPANY: PGI DRILLED BY: DLZ
PROJECT: HAN-75-14.39
BRIDGE NO.: HAN-68-1656 over IR 75 & US 68 Ramp B
BORING: B-134-0-13 BOX 2/2
DATE of CORING: 8/8/13
RUN-3: 34.9' - 42.0'
REC: 85% RQD: 29%



COMPANY: PGI DRILLED BY: OHIO TESTBOR
PROJECT: HAN-75-14.39
BRIDGE NO.: HAN-68-1656 over IR 75 & US 68 Ramp B
BORING: B-133-0-13 BOX 1/1
DATE of CORING: 6/25/13
RUN-1: 4.5' - 10.0' RUN-2: 10.0' - 14.5'
REC: 100% RQD: 36% REC: 74% RQD: 69%

COMPANY: PGI DRILLED BY: OHIO TESTBOR
PROJECT: HAN-75-14.39
BRIDGE NO.: HAN-68-1656 over IR 75 & US 68 Ramp B
BORING: B-132-1-13 BOX 1/1
DATE of CORING: 6/26/13
RUN-1: 4.0' - 8.0' RUN-2: 8.0' - 9.2' RUN-3: 9.2' - 14.3'
REC: 100% RQD: 0% REC: 93% RQD: 0% REC: 100% RQD: 26%

COMPANY: PGI DRILLED BY: PGI
PROJECT: HAN-75-14.39
BRIDGE NO.: HAN-75-1656
BORING: B-133-1-14 BOX 1/1
DATE of CORING: 4/24/15
RUN-1: 5.0' - 5.5' REC: 100% RQD: 0%
RUN-2: 5.5' - 9.0' REC: 96% RQD: 32%
RUN-3: 9.0' - 13.0' REC: 98% RQD: 0%
RUN-4: 13.0' - 15.0' REC: 97% RQD: 22%

COMPANY: PGI DRILLED BY: PGI
PROJECT: HAN-75-14.39
BRIDGE NO.: HAN-75-1656
BORING: B-132-2-14 BOX 1/1
DATE of CORING: 4/23/15
RUN-1: 4.5' - 5.5' REC: 92% RQD: 0%
RUN-2: 5.5' - 7.0' REC: 100% RQD: 0%
RUN-3: 7.0' - 8.8' REC: 100% RQD: 0%
RUN-4: 8.8' - 11.5' REC: 100% RQD: 22%
RUN-5: 11.5' - 14.5' REC: 94% RQD: 39%

ROCK MASS RATING From Table 10.4.6.4-1

Project: HAN-75-14.39 **Project No.:** G13011G

Structure: HAN-68-1656 BRIDGE over IR 75 & US 68 RAMP B

Boring No.: B-133-0-13 **Substructure Unit:** Forward Abutment

Strength of Intact Rock Material	
Uniaxial Compressive Strength	1398
Relative Rating	5
Drill Core Quality RQD	
RQD	45%
Relative Rating	7
Joint Conditions	
Spacing of Joints	2" to 1'
Relative Rating	8
Conditions of Joints	Slightly Rough Surfaces, Separation < 0.05", and Hard Joint Wall
Relative Rating	18
Ground water Conditions	
Relative Rating	4
Strike & Dip Orientation of Joint	
Relative Rating	0
Total Mass Rating	42
Class No	III
Description	Fair Rock

Boring No.: B-134-0-13 **Substructure Unit:** Pier 2

Strength of Intact Rock Material	
Uniaxial Compressive Strength	1476
Relative Rating	5
Drill Core Quality RQD	
RQD	24%
Relative Rating	3
Joint Conditions	
Spacing of Joints	2" to 1'
Relative Rating	8
Conditions of Joints	Slightly Rough Surfaces, Separation < 0.05", and Hard Joint Wall
Relative Rating	16
Ground water Conditions	
Relative Rating	4
Strike & Dip Orientation of Joint	
Relative Rating	0
Total Mass Rating	36
Class No	IV
Description	Poor Rock

ROCK MASS RATING From Table 10.4.6.4-1

Project: HAN-75-14.39 **Project No.:** G13011G

Structure: HAN-68-1656 BRIDGE over IR 75 & US 68 RAMP B

Boring No.: B-135-0-13 **Substructure Unit:** Pier 1

Strength of Intact Rock Material	
Uniaxial Compressive Strength	1671
Relative Rating	6
Drill Core Quality RQD	
RQD	31%
Relative Rating	4
Joint Conditions	
Spacing of Joints	2" to 1'
Relative Rating	8
Conditions of Joints	Slightly Rough Surfaces, Separation < 0.05", and Hard Joint Wall
Relative Rating	18
Ground water Conditions	
Relative Rating	4
Strike & Dip Orientation of Joint	
Relative Rating	0
Total Mass Rating	40
Class No	IV
Description	Poor Rock

Boring No.: B-135-1-13 **Substructure Unit:** Pier 1

Strength of Intact Rock Material	
Uniaxial Compressive Strength	2815
Relative Rating	5
Drill Core Quality RQD	
RQD	22%
Relative Rating	3
Joint Conditions	
Spacing of Joints	2" to 1'
Relative Rating	8
Conditions of Joints	Slightly Rough Surfaces, Separation < 0.05", and Hard Joint Wall
Relative Rating	17
Ground water Conditions	
Relative Rating	4
Strike & Dip Orientation of Joint	
Relative Rating	0
Total Mass Rating	37
Class No	IV
Description	Poor Rock

ROCK MASS RATING From Table 10.4.6.4-1

Project: HAN-75-14.39 **Project No.:** G13011G

Structure: HAN-68-1656 BRIDGE over IR 75 & US 68 RAMP B

Boring No.: B-136-0-13 **Substructure Unit:** Rear Abutment

Strength of Intact Rock Material	
Uniaxial Compressive Strength(Assum	1671
Relative Rating	6
Drill Core Quality RQD	
RQD	7%
Relative Rating	1
Joint Conditions	
Spacing of Joints	2" to 1'
Relative Rating	7
Conditions of Joints	Slightly Rough Surfaces, Separation < 0.05", and Hard Joint Wall
Relative Rating	18
Ground water Conditions	
Relative Rating	4
Strike & Dip Orientation of Joint	
Relative Rating	0
Total Mass Rating	36
Class No	IV
Description	Poor Rock

Boring No.: **Substructure Unit:**

Strength of Intact Rock Material	
Uniaxial Compressive Strength	
Relative Rating	
Drill Core Quality RQD	
RQD	
Relative Rating	
Joint Conditions	
Spacing of Joints	
Relative Rating	
Conditions of Joints	Slightly Rough Surfaces, Separation < 0.05", and Hard Joint Wall
Relative Rating	
Ground water Conditions	
Relative Rating	
Strike & Dip Orientation of Joint	
Relative Rating	0
Total Mass Rating	
Class No	
Description	

ROCK MASS RATING From Table 10.4.6.4-1

Project: HAN-75-14.39 **Project No.:** G13011G

Structure: HAN-68-1656 BRIDGE over IR 75 & US 68 RAMP B

Boring No.: B-132-1-13 **Substructure Unit:** FW AB MSE Wall

Strength of Intact Rock Material	
Uniaxial Compressive Strength	3331 ksf
Relative Rating	10
Drill Core Quality RQD	
RQD	13%
Relative Rating	2
Joint Conditions	
Spacing of Joints	2" to 1'
Relative Rating	8
Conditions of Joints	Slightly Rough Surfaces, Separation < 0.05", and Hard Joint Wall
Relative Rating	15
Ground water Conditions	
Relative Rating	4
Strike & Dip Orientation of Joint	
Relative Rating	0
Total Mass Rating	39
Class No	IV
Description	Poor Rock

Boring No.: B-135-2-13 **Substructure Unit:** Rear AB MSE Wall

Strength of Intact Rock Material	
Uniaxial Compressive Strength	3216
Relative Rating	10
Drill Core Quality RQD	
RQD	20%
Relative Rating	3
Joint Conditions	
Spacing of Joints	2" to 1'
Relative Rating	8
Conditions of Joints	Slightly Rough Surfaces, Separation < 0.05", and Hard Joint Wall
Relative Rating	17
Ground water Conditions	
Relative Rating	4
Strike & Dip Orientation of Joint	
Relative Rating	0
Total Mass Rating	42
Class No	III
Description	Fair Rock

ROCK MASS RATING From Table 10.4.6.4-1

Project: HAN-75-14.39 **Project No.:** G15004G

Structure: HAN-68-1656 BRIDGE over IR 75 & US 68 RAMP B

Boring No.: B-133-1-14 **Substructure Unit:** Pier 3

Strength of Intact Rock Material	
Uniaxial Compressive Strength	2338
Relative Rating	8
Drill Core Quality RQD	
RQD	16%
Relative Rating	2
Joint Conditions	
Spacing of Joints	2" to 1'
Relative Rating	8
Conditions of Joints	Slightly Rough Surfaces, Separation < 0.05", and Hard Joint Wall
Relative Rating	14
Ground water Conditions	
Relative Rating	4
Strike & Dip Orientation of Joint	
Relative Rating	0
Total Mass Rating	36
Class No	IV
Description	Poor Rock

Boring No.: B-132-2-14 **Substructure Unit:** Forward Abutment

Strength of Intact Rock Material	
Uniaxial Compressive Strength	1610
Relative Rating	10
Drill Core Quality RQD	
RQD	18%
Relative Rating	3
Joint Conditions	
Spacing of Joints	2" to 1'
Relative Rating	8
Conditions of Joints	Slightly Rough Surfaces, Separation < 0.05", and Hard Joint Wall
Relative Rating	15
Ground water Conditions	
Relative Rating	4
Strike & Dip Orientation of Joint	
Relative Rating	0
Total Mass Rating	40
Class No	IV
Description	Poor Rock

Estimation of Drilled Shaft Resistence and Settlement in Jointed Rock

Project: HAN-75-14.39 **Project No.:** G13011G & G15004G

Structure: HAN-68-1656 BRIDGE over IR 75 & US 68 RAMP B

Boring No.: B-133-0-13 **Substructure Unit:** Piers

Unit Side Resistence (q_s): 0.65*(Reduction Factor α_E)*P_a*Sqrt(q_u/P_a) <7.8*Pa*Sqrt(f'_c/P_a) (Eq. 10.8.3.5.4b-1)

Uniaxial Comp.Strength of Intact Rock, q_u (ksf): 1398 Atmospheric Pressure P_a(ksf): 2.12

Reduction Factor α_E: 0.45 (Table 10.8.3.5.4b-1) Concrete Compressive Strength f'_c(ksf): 576

Unit Side Resistence, qs (ksf): 10.22 <272.57 ksf (From Eq 10.8.3.5.4b-1

Unit Side Resistence (ksf): 10.00

Unit Tip Resistence (q_p): (Sq.root(s)+Sq.root(m*Sq.root(s)+s))*qu (Eq. 10.8.3.5.4c-2)

Fractured Rock Mass Parameters "s" and "m" m = 0.090 s = 0.000057

(From Table 10.4.6.4-4)

Unit Tip Resistence, q_p (ksf): 48.494

Calculation of Nominal Resistence of Side and Tip

Shaft Socket Diameter, Br (feet):	**3.5**	**4**	**5**	**6**
Length of Socket, Dr (feet) :	5.25	6	7.5	9
Perimeter Area of Socket As (Sq. ft)	35.74	50.27	86.39	131.95
Cross-Sectional Area of Socket, Ap (Sq. ft)	9.62	12.57	19.63	28.27
Nominal Shaft Side Resistence, Rs (kips):	365.264	513.777	883.055	1348.665
Nominal Shaft Tip Resistence, Rp (kips):	466.567	609.393	952.177	1371.134
Resistence Factor for Side from T. 10.5.5.2.4-1	0.55	0.55	0.55	0.55
Resistence Factor for Tip from T. 10.5.5.2.4-1	0.50	0.50	0.50	0.50
Factored Resistance from Side (kips)	200.9	282.6	485.7	741.8
Factored Resistance from Tip (kips)	233.3	304.7	476.1	685.6

Butt settlement of drilled Shaft : Q((Dr/Ap*Ec)+(Ips/Br*Em))

Note: Applied Axial load per shaft is obtained by limiting factored resistence to 0.4 inch of elastic settlement

Applied Axial Load on Top of Socket, Q (kips)	350	550	900	1400
Concrete Young's Modulus, Ec (kci)	3800	3800	3800	3800
Shortening of Drilled Shaft (Inches)	0.050	0.069	0.090	0.117
Rock Mass Modulus, Em (kci)	200.0	200.0	200.0	200.0
Ec/Em	19.0	19.0	19.0	19.0
Dr/Br	1.50	1.50	1.50	1.50
Influence Coefficient (Ips) from Fig 4.6.5.5.2A	0.30	0.30	0.30	0.30
(Modified after Pells and Turner (1979))				
Settlement of Base (inches)	0.150	0.206	0.270	0.350
Total Butt Settlement of Shaft (inches)	0.200	0.275	0.360	0.467

Subgrade Analysis

V. 12.00 12/30/11

Design CBR 4

Global Options		
320	R&R	?
206	CS	No
	LS	Option
	LKD	No
206	Depth	NA

Classification Counts by Sample																	
R	1a	1b	3	3a	2-4	2-5	2-6	2-7	4a	4b	5	6a	6b	7-5	7-6	8a	8b
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
															100%		
0%	0%								100%								

Surface Class		
2-5	0	
4b	0	
5	0	
7-5	0	
7-6	3	100%
8a	0	
8b	0	
R	0	

% Borings	
N_{60L}<= 5	0%
<=10	0%
>=20	0%
M+	67%
R	0%

% Surface	
0%	
0%	0%

Rig	ER
A	60
B	
C	
D	
E	
F	
G	
H	

UC @ Surface
0.0
0
0

Total Borings	3
PID	87005
Location	HAN-75-14.39 - HAN-68-1656

	N_{60}	N_{60L}	PI	Clay	M	M_{OPT}	GI
Average			24.0	48.7	21.7	18.7	14.33
Maximum			30	54	23	19	18
Minimum			20	44	19	18	12

	Boring					Subgrade		Standard Penetration						Physical Characteristics						Moisture		Class		Comments	Problem		Undercuts		Analysis
#	B #	Boring Location	Depth	To	Cut Fill	Depth	To	n_2	n_3	N	Rig	N_{60}	N_{60L}	LL	PL	PI	% Silt	% Clay	P 200	M	M_{OPT}	Ohio DOT	GI		w/ Class	w/ MN	UC Class	UC MN	
1	B-133-0-13	799+25.13, 0.02' RT	1.0	2.5	0.0	1.0	2.5				A			42	20	22	32	44	76	19	18	7-6	13						
2	B-135-0-13	812+45.8, 92.7.0' LT	3.5	5.0	0.0	3.5	5.0				A			42	22	20	30	48	78	23	19	7-6	12						
3	B-133-1-14	798+84.5, 22.5' RT	1.5	5.0	0.0	1.5	5.0				A			52	22	30	32	54	86	23	19	7-6	18						
4					0.0						A																		
5					0.0						A																		
6					0.0						A																		
7					0.0						A																		
8					0.0						A																		
9					0.0						A																		
10					0.0						A																		
11					0.0						A																		

VI.D. Geotechnical Reports

C-R-S: HAN-75-14.39- HAN-68-1656	PID:87005	Reviewer:SS	Date:5/22/2015

General			
Y [N] X 1	Has the first complete version of a geotechnical report being submitted been labeled as 'Draft'?		
[Y] N X 2	Subsequent to ODOT's review and approval, has the complete version of the revised geotechnical report being submitted been labeled 'Final'?		
[Y] N X 3	Have all geotechnical reports being submitted been titled correctly as prescribed in Section 705.1 of the SGE?		

Report Body			
[Y] N X 4	Do all geotechnical reports being submitted contain an Executive Summary as described in Section 705.2 of the SGE?		
[Y] N X 5	Do all geotechnical reports being submitted contain an Introduction as described in Section 705.3 of the SGE?		
[Y] N X 6	Do all geotechnical reports being submitted contain a section titled "Geology and Observations of the Project," as described in Section 705.4 of the SGE?		
[Y] N X 7	Do all geotechnical reports being submitted contain a section titled "Exploration," as described in Section 705.5 of the SGE?		
[Y] N X 8	Do all geotechnical reports being submitted contain a section titled "Findings," as described in Section 705.6 of the SGE?		
[Y] N X 9	Do all geotechnical reports being submitted contain a section titled "Analyses and Recommendations," as described in Section 705.7 of the SGE?		

VI.D. Geotechnical Reports

Appendices		
[Y] N X 10	Do all geotechnical reports being submitted contain all applicable Appendices as described in Section 705.8 of the SGE?	
[Y] N X 11	Do the Appendices present a site Boring Plan showing all boring locations as described in Section 705.8.1 of the SGE?	
[Y] N X 12	Do the Appendices include boring logs as described in Section 705.8.2 of the SGE?	
[Y] N X 13	Do the Appendices present reports of undisturbed test data as described in Section 705.8.3 of the SGE?	
[Y] N X 14	Do the Appendices present calculations in a logical format to support recommendations as described in Section 705.8.4 of the SGE?	

Notes:

IV.A Foundations/Structures - Non-bridge Applications

C-R-S: HAN-75-14.39-HAN-75-1656	PID:87005	Reviewer:SS	Date:5/22/2015

If you do not have such a foundation or structure on the project, you do not have to fill out this checklist.

Soil and Bedrock Strength Data			
[Y] N X 1	Has the shear strength of the foundation soils been determined? Check method used: □ laboratory shear tests [□] estimation from SPT or field tests		
[Y] N X 2	Have sufficient soil shear strength, consolidation, and other parameters been determined so that the required allowable loads for the foundation/structure can be designed?		
[Y] N X 3	Has the shear strength of the foundation bedrock been determined? Check method used: □ laboratory shear tests [□] other	List Other items:	Compression Test

Notes:

Stage 1:

IV.A Foundations/Structures - Non-bridge Applications

Spread Footings					
Y	[N]		4	Are there spread footings on the project?	
				If no, go to Question **11**	
Y	N	X	5	Has the recommended bottom of footing elevation and reason for this recommendation been provided?	
Y	N	X		a Has the recommended bottom of footing elevation taken scour from streams or other water flow into account?	
			6	Were representative sections analyzed for the entire length of the structure for the following:	
Y	N	X		a bearing capacity?	
Y	N	X		b sliding?	
Y	N	X		c overturning?	
Y	N	X		d settlement?	
Y	N	X	7	Has the need for a shear key been evaluated?	
Y	N	X		a If needed, have the details been included in the plans?	
Y	N	X	8	If special conditions exist (e.g. geometry, sloping rock, varying soil conditions), was the bottom of footing “stepped” to accommodate them?	
Y	N	X	9	Has the recommended allowable soil or rock bearing pressure been provided?	
Y	N	X	10	If weak soil is present at the proposed foundation level, has the removal / treatment of this soil been developed and included in the plans?	
Y	N	X		a Have the procedure and quantities related to this removal / treatment been included in the plans?	

Notes:

Stage 1:

IV.A Foundations/Structures - Non-bridge Applications

Pile Structures				
☒ Y ☐ N	11	Are there piles on the project? If no, go to Question **17**	
☒ Y ☐ N	12	Has an appropriate pile type been selected? Check the type selected: ☒ H-pile (driven) ☐ H-pile (drilled) ☐ Cast In-place Concrete ☐ other List Other items:	
☒ Y ☐ N ☐ X	13	Have the estimated pile length or tip elevation and section (diameter) been specified? Check method used: ☒ SPILE, DRIVEN, or equivalent software ☐ hand calculations	
	14	If required for design, have sufficient soil parameters been provided and calculations performed to evaluate the:	
Y ☒ N ☐ X		a Lateral load capacity and maximum deflection of the piles?	Lateral Load Analysis will be performed by PB
☒ Y ☐ N ☐ X		b Vertical load capacity and maximum settlement of the piles?	
☒ Y ☐ N ☐ X		c Negative skin friction on piles driven through new embankment or soft foundation layers?	
Y ☐ N ☒ X		d Potential for and impact of lateral squeeze from soft foundation soils?	
☒ Y ☐ N ☐ X	15	If piles are to be driven to bedrock, have “pile points” been recommended to assure secure contact with the rock surface, as per BDM 202.2.3.2.a?	
Y ☐ N ☒ X	16	If subsurface obstacles exist, has preboring been recommended to avoid these obstructions?	

Notes:

Stage 1:

IV.A Foundations/Structures - Non-bridge Applications

Drilled Shafts					
[Y]	N		17	Are there drilled shafts on the project? If no, go to the next checklist.	
[Y]	N	X	18	Have the drilled shaft diameter and embedment length been specified?	
[Y]	N	X	19	Have the recommended drilled shaft diameter and embedment been developed based on side friction and end bearing for vertical loading situations?	
			20	For shafts undergoing lateral loading, have the following been determined:	Lateral Load Analysis will be performed by PB
Y	[N]	X		a. maximum lateral shear	
Y	[N]	X		b. maximum bending moment	
Y	[N]	X		c. maximum deflection	
Y	[N]	X		d. reinforcement design	
[Y]	N	X	21	Generally, bedrock sockets are 6" smaller in diameter than the soil embedment section of the drilled shaft. Has this factor been accounted for in the drilled shaft design?	
Y	[N]	X	22	If a bedrock socket is required below soil embedment, have separate quantities been estimated based on shaft diameters and materials to be excavated?	Quantities estimated by PB
Y	N	[X]	23	Has the site been assessed for groundwater influence?	
Y	N	[X]		a If yes, if artesian flow is a potential concern, does the design address control of groundwater flow during construction?	
Y	N	[X]	24	If special construction features (e.g., slurry, casing, load tests) are required, have all the proper items been included in the plans?	

Notes:

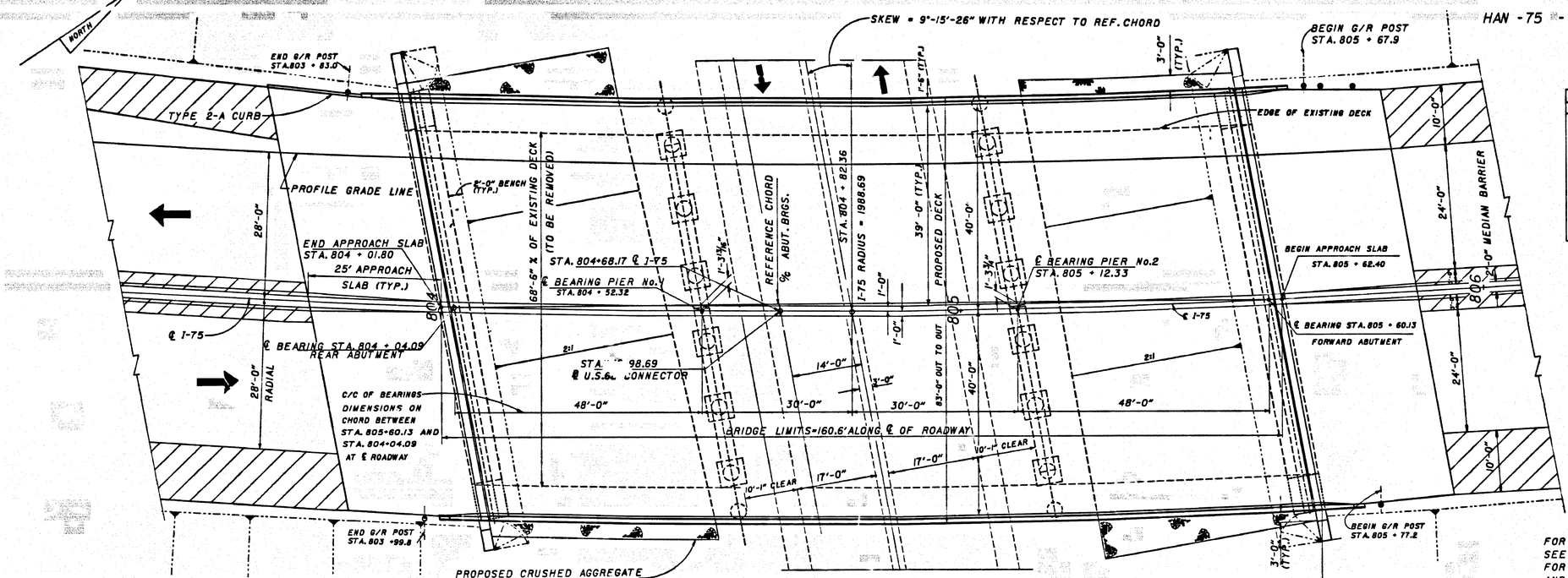
Stage 1

MICROFILMED

FED. HIGHWAY DIVISION	STATE	PROJECT	
5	OHIO		

447
533

HANCOCK COUNTY
HAN -75 -14.39

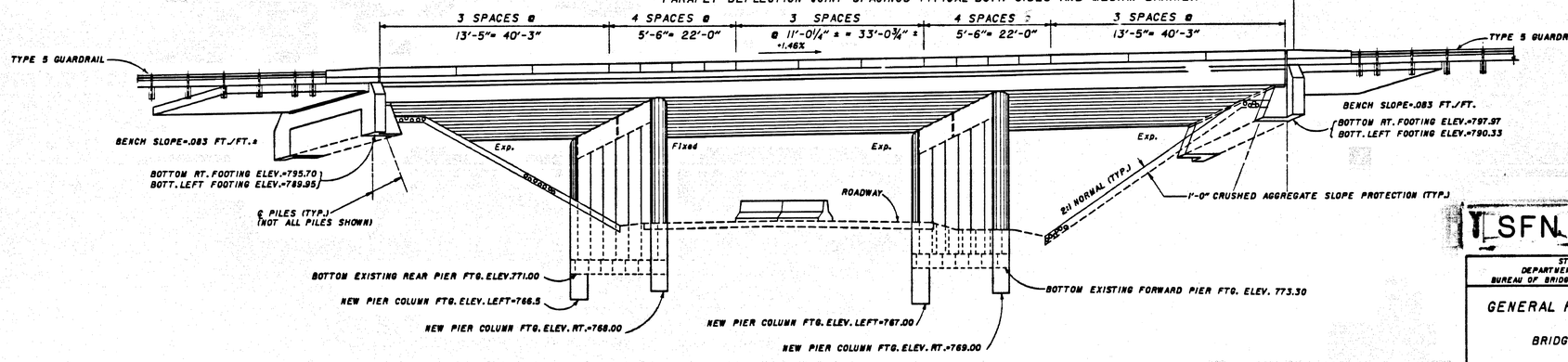


GENERAL PLAN

CURVE DATA I.R. 75
Δ = 73°-22'-31"
D_R = 2°-52'-00"
R_R = 1998.69'
D_S = 5°01'00"
L_S = 2209.60'
T_S = 1665.96'
L_R = 350'
Δ_R = 63°-20'-31"
PI = STA. 805 + 18.63
TS = STA. 788 + 52.67
SC = STA. 792 + 02.67
CS = STA. 814 + 12.27
ST = STA. 817 + 62.27

FOR APPROACH SLAB DETAILS, SEE SHEET 16/17.
FOR ADDITIONAL PARAPET AND MEDIAN BARRIER DETAILS, SEE SHEET 14/17.

PARAPET DEFLECTION JOINT SPACINGS TYPICAL BOTH SIDES AND MEDIAN BARRIER



ELEVATION

TSFN 320287

STATE OF OHIO
DEPARTMENT OF TRANSPORTATION
BUREAU OF BRIDGES AND STRUCTURAL DESIGN

2/17

GENERAL PLAN AND ELEVATION

BRIDGE NO. HAN-75-1523

OVER U.S. 68 & S.R. 15 CONNECTOR

DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED	DATE	REVISED
JC	GFJ		OHOL	WTF	9-22-88	

HANCOCK COUNTY

LEGEND

- Auger Boring Location – Plan View.
- Press and / or Drive Sample and / or Core Boring Location – Plan View.
- Drive Rod Penetration Resistance Sounding Location – Plan View.
- Capped Pile
- Footing
- Footing on Pile
- TR — Top of Rock
- Horizontal Bar on Boring Log Indicates the Depth the Sample Was Taken.
- X/Y/Z — Figures Beside the Boring Log in Profile Indicate the Number of Blows for Standard Penetration Test.
  - X = Number of Blows for First 6 inches.
  - Y = Number of Blows for Second 6 inches.
  - Z = Number of Blows for Third 6 inches.
- Drive Rod Penetration Resistance Sounding Log – Profile
- Casing
- Resistance "R" < 10,000 lbs.
- Resistance "R" > 10,000 lbs.
- Z — Indicates Final Measurement of Penetration, in inches.
- W — Indicates Free Water Elevation.
- Indicates Static Water Elevation.

SYMBOLS OF ROCK TYPES

- Coal
- Weathered Mudstone or Claystone
- Mudstone or Claystone
- Weathered Shale
- Shale
- Weathered Siltstone
- Siltstone
- Weathered Sandstone
- Sandstone
- Leached Dolomite
- Dolomite
- Leached Limestone
- Limestone
- Boulders or Cobbles

GENERAL INFORMATION

Drive Rod Penetration Sounding Tests

Drive rod penetration resistance tests constitute driving a 1.315-inch diameter steel rod, with a 45° cone point, into the ground, using a 122-pound drop-hammer with a free fall of five feet. At one or two-foot depth intervals, a measurement is taken to determine the amount of penetration achieved in three hammer drops. This reading is converted to an empirical value for capacity "R", in thousands of pounds (which is a measure of both the point resistance and frictional resistance on the rod), by using charts prepared by the Ohio Department of Highways, Bureau of Bridges, on the basis of correlation study of rod penetration with past performance of pile driving. For interpretation, a graph is prepared by plotting the value "R" against the depth at which the reading was taken, and connecting the plotted points. The curve so obtained reflects the density of subsurface materials in a manner that can be readily compared with data from similar tests at other locations on the structure site. From this comparison, the overall uniformity of subsurface condition may be evaluated.

Drive Sample Borings – Drive-Press Sample Borings

Drive sample borings are made by means of a rotary-type drill rig, employing a 2" O.D., 1-3/8" I.D. sampler, at 2-1/2 and / or 5-foot depth intervals, driven by means of a 140 – pound drop-hammer with a free fall of 30 inches. The number of blows required to drive the sampler 18 inches is considered the standard penetration test.

Drive-press sample borings are made by means of a rotary-type drill rig, employing a 2" O.D., 1-3/8" I.D. drive sampler, and 3" O.D. thin-wall press sampler. The press sampler is advanced by continuous uniform pressure, applied by the drill rig.

The boring log sheets show a graphic plot of the information obtained, including depth and elevation of the sample, number of blows for the standard penetration tests in three 6-inch increments, depth of press samples, field sample number, sample description – based on laboratory tests and the Casagrande AC classification system–and gradation, plasticity, and moisture content determinations. Results of strength and consolidation testing, if performed, appear on separate enclosures.

At depths where materials are bouldery or gravelly to the extent that the sampler can not be driven, a wash sample is procured for visual classification, in order to determine the general character of the material. These samples are not considered sufficiently representative to warrant laboratory testing.

Particle Size Definitions

Boulders	Cobbles	Gravel	Coarse Sand	Fine Sand	Silt	Clay
12"	3"	2.0mm (No. 10 sieve)	0.42mm (No. 40 sieve)	0.074mm (No. 200 sieve)	0.005mm	

NOTE – ALL AVAILABLE SOIL AND BEDROCK INFORMATION WHICH CAN BE CONVENIENTLY SHOWN ON THE STRUCTURE FOUNDATION INVESTIGATION SHEETS HAS BEEN SO REPORTED. ADDITIONAL SUBSURFACE INVESTIGATIONS MAY HAVE BEEN MADE TO STUDY SOME SPECIAL ASPECT OF THE PROJECT. COPIES OF THIS DATA, IF ANY, MAY BE INSPECTED IN THE DISTRICT DEPUTY DIRECTOR'S OFFICE, THE BUREAU OF TESTS AT 1600 WEST BROAD STREET, THE PAVEMENT AND SOILS SECTION OF THE BUREAU OF LOCATION AND DESIGN OR IN THE BRIDGE BUREAU AT 25 SOUTH FRONT STREET.

NOTE: Information shown by this subsurface investigation was assembled solely for the use in establishing design controls for the project. The State of Ohio does not guarantee the accuracy of this data and it is not to be construed as a part of the plans governing construction of the project.

OHIO DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS — TESTING LABORATORY
1600 WEST BROAD STREET, COLUMBUS, OHIO 43223

STRUCTURE FOUNDATION INVESTIGATION
BRIDGE NO. HAN-75-1523
OVER SR 15 CONNECTOR
SEC. HAN-75-14.39

CHECKED BY	REVIEWED BY	DATE
A.F.	R.D.R.	9/22/88

TSFN 3202887

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 6/1/87 Sampler: Type SS Dia. 1 3/8" Water Elev.
Date Completed 6/1/87 Casing: Length Dia.

Project Identification: HANCOCK COUNTY
HAN-75-1523
OVER SR 15 CONNECTOR
STRUCTURE FOUNDATION INVESTIGATION

Boring No. B-1 Station & Offset 803+85, 30' LT. (SOUTH ABUTMENT) Surface Elev. 798.4'

Elev.	Depth	Std. Pen. (N)	Rec. (ft.)	Loss (ft.)	Description	Field No.	Lab. Nos.	% Agg.	% Gr.	% Sa.	% Fn.	% Si.	% Cly.	L.L.	P.I.	W.C.	SHTL. Class
798.4	0				ASPHALT	-	-	-	-	-	-	-	-	-	-	-	VISUAL
797.4	2	AUGERED			BROWN SILT AND COBBLES (DRILLER'S DSCPTN)	-	-	-	-	-	-	-	-	-	-	-	VISUAL
793.4	6	5/20/21			GRAY SANDY GRAVELLY SILT WITH COBBLES	1	49807	29	7	15	22	27	29	9	18		A-4a
788.4	10	6/10/13			BROWN AND GRAY SANDY CLAY	2	49808	8	3	13	33	43	33	14	15		A-6a
783.4	16	10/13/13			BROWN WITH GRAY SANDY SILT	3	49809	9	8	18	30	35	24	10	11		A-4a
778.4	20	5/5/7			GRAY AND BROWN SANDY CLAY, TRACE OF ORGANIC	4	49810	0	4	43	16	37	26	13	22		A-6a
773.4	25	14/40			TOP OF ROCK GRAY SILTY SANDY GRAVEL	5	49811	46	10	7	12	25	24	8	12		A-4a
77. 4	28		2.1	0.4	GRAY BROKEN DOLOMITIC-LIMESTONE DOLOMITIC-LIMESTONE, GRAY, HARD, DENSE, SOMEWHAT LEACHED, EXTREMELY VUGGY, SADLY BROKEN AND JOINTED. CORE LOSS 14%.												
	30				BOTTOM OF BORING												

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 6/2/87 Sampler: Type SS Dia. 1 3/8" Water Elev.
Date Completed 6/2/87 Casing: Length Dia.

Project Identification: HANCOCK COUNTY
HAN-75-1523
OVER SR 15 CONNECTOR
STRUCTURE FOUNDATION INVESTIGATION

Boring No. B-2 Station & Offset 804+58, 73' RT. (SOUTH PIER) Surface Elev. 779.9'

Elev.	Depth	Std. Pen. (N)	Rec. (ft.)	Loss (ft.)	Description	Field No.	Lab. Nos.	% Agg.	% Gr.	% Sa.	% Fn.	% Si.	% Cly.	L.L.	P.I.	W.C.	SHTL. Class
779.9	0	AUGERED			BERM MATERIAL												
779.4	2	AUGERED			BROWN SILT AND GRAVEL (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	-	-	VISUAL
777.9	4	AUGERED			BROWN AND GRAY SILTY CLAY (DRILLER'S DSCPTN)	-	-	-	-	-	-	-	-	-	-	-	VISUAL
774.4	6				TOP OF ROCK GRAY BROKEN DOLOMITIC-LIMESTONE												
	8																
	10		4.7	0.3	DOLOMITIC-LIMESTONE: GRAY, HARD, DENSE, SOMEWHAT LEACHED, EXTREMELY VUGGY, SADLY BROKEN AND JOINTED IN TOP 5.0 FEET, BROKEN AND JOINTED IN REMAINDER. CORE LOSS 5%.												
	12																
	14		4.2	0.3													
764.4	16				BOTTOM OF BORING												

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 4/20/87 Sampler: Type SS Dia. 1 3/8" Water Elev.
Date Completed 4/21/87 Casing: Length Dia.

Project Identification: HANCOCK COUNTY
HAN-75-1523
OVER SR 15 CONNECTOR
STRUCTURE FOUNDATION INVESTIGATION

Boring No. B-3 Station & Offset 806+00, 30' RT. (NORTH ABUTMENT) Surface Elev. 805.7'

Elev.	Depth	Std. Pen. (N)	Rec. (ft.)	Loss (ft.)	Description	Field No.	Lab. Nos.	% Agg.	% Gr.	% Sa.	% Fn.	% Si.	% Cly.	L.L.	P.I.	W.C.	SHTL. Class
805.7	0	AUGERED			ASPHALT												
803.6	2																
800.7	6	8/8/8			BROWN AND GRAY SANDY CLAY	1	49389	6	4	16	35	39	30	12	20		A-6a
795.7	10	5/7/9			BROWN AND GRAY SANDY CLAY	2	49390	3	4	16	34	43	33	16	16		A-6b
790.7	16	4/9/14			BROWN AND GRAY SANDY GRAVELLY SILT	3	49391	30	4	12	24	30	30	10	18		A-4a
785.7	20	6/8/14			BROWN AND GRAY ORGANIC SANDY SILT	4	49392	1	3	17	33	46	31	8	19		A-4a
780.7	25	2/3/4			GRAY ELASTIC CLAYEY SILT	5	49393	0	0	1	29	70	58	9	56		A-5
775.7	30	3/6/10			GRAY SILT AND CLAY	6	49394	1	1	16	36	46	30	12	20		A-6a
772.2	34				TOP OF ROCK												
769.2	36		2.0	1.0	DOLOMITIC LIMESTONE, GRAY, HARD, DENSE, SOMEWHAT LEACHED, EXTREMELY VUGGY; SADLY BROKEN AND JOINTED. CORE LOSS 33%.												
					BOTTOM OF BORING												

TSFN 3202887

OHIO DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - TESTING LABORATORY
1600 WEST BROAD STREET COLUMBUS, OHIO 43223

STRUCTURE FOUNDATION INVESTIGATION
BRIDGE NO. HAN-75-1523
OVER SR 15 CONNECTOR
SEC. HAN-75-14.39

BORING DATA

TYPED BY	CHECKED BY	REVIEWED BY	DATE
S.G.	A.F.	R.D.R.	9/22/88

LABORATORY TEST STANDARDS

STANDARD **REFERENCE NUMBER**

I. Soil/Rock Testing

Description and Identification of Soils (Visual-Manual Procedures) ..... ASTM D 2488
Classification of Soils for Engineering Purposes (USCS*).* ..... ASTM D 2487
Laboratory Determination of Water (Moisture) Content of Soil and Rock ..... ASTM D 2216
Classification for Sizes of Aggregate for Road and Bridge Construction ..... ASTM D 488
Liquid Limit, Plastic Limit, and Plasticity Index of Soils ..... ASTM D 4318
Shrinkage Factors of Soils by Mercury Method ..... ASTM D 427
Moisture, Ash, and Organic Matter of Peat and Other Organic Soils ..... ASTM D 2974
Specific gravity of Soils ..... ASTM D 854
Direct Shear Test of Soils under Consolidated Drained Conditions ..... ASTM D 3080
Particle-Size Analysis of Soils ..... ASTM D 422
Unconfined Compressive Strength of Cohesive Soils ..... ASTM D 2166
Compressive Strength of Intact Rock Core Specimens ..... ASTM D 7012
Slake Durability Index of Shale/Similar Weak Rock Test ..... ASTM D 4644
Point Load Test of Rock Core Specimens ..... ISRM* / ASTM D5731
CBR (California Bearing Ration) of Laboratory-Compacted Soils ..... ASTM D 1883
Laboratory Compaction Characteristics of Soil using Standard Effort ..... ASTM D 698
Laboratory Compaction Characteristics of Soil using Modified Effort ..... ASTM D 1557
One-Dimensional Consolidation Properties of Soils ..... ASTM D 2435
One-Dimensional Swell or Settlement Potential of Cohesive Soils ..... ASTM D 4546
Ph of Soil ..... ASTM D 4972

*ISRM – International Society for Rock Mechanics

II. Concrete Testing

Compressive Strength for Cylindrical Concrete Specimens ..... ASTM C-39
Acid-Soluble Chloride in Mortar and Concrete ..... ASTM C 1152

CLASSIFICATION OF SOILS

Ohio Department of Transportation

(The classification of a soil is found by proceeding from top to bottom of the chart.
The first classification that the test data fits is the correct classification.)

SYMBOL	DESCRIPTION	Classifcation AASHTO	Classifcation OHIO	$LL_0/LL \times 100$*	% Pass #40	% Pass #200	Liquid Limit (LL)	Plastic Index (PI)	Group Index Max.	REMARKS
	Gravel and/or Stone Fragments	A-1-a			30 Max.	15 Max.		6 Max.	0	Min. of 50% combined gravel, cobble and boulder sizes
	Gravel and/or Stone Fragments with Sand	A-1-b			50 Max.	25 Max.		6 Max.	0	
	Fine Sand	A-3			51 Min.	10 Max.	NON-PLASTIC		0	
	Coarse and Fine Sand	--	A-3a			35 Max.		6 Max.	0	Min. of 50% combined coarse and fine sand sizes
	Gravel and/or Stone Fragments with Sand and Silt	A-2-4 A-2-5				35 Max.	40 Max. 41 Min.	10 Max.	0	
	Gravel and/or Stone Fragments with Sand, Silt and Clay	A-2-6 A-2-7				35 Max.	40 Max. 41 Min.	11 Min.	4	
	Sandy Silt	A-4	A-4a	76 Min.		36 Min.	40 Max.	10 Max.	8	Less than 50% silt sizes
	Silt	A-4	A-4b	76 Min.		50 Min.	40 Max.	10 Max.	8	50% or more silt sizes
	Elastic Silt and Clay	A-5		76 Min.		36 Min.	41 Min.	10 Max.	12	
	Silt and Clay	A-6	A-6a	76 Min.		36 Min.	40 Max.	11 - 15	10	
	Silty Clay	A-6	A-6b	76 Min.		36 Min.	40 Max.	16 Min.	16	
	Elastic Clay	A-7-5		76 Min.		36 Min.	41 Min.	$\leq$LL-30	20	
	Clay	A-7-6		76 Min.		36 Min.	41 Min.	>LL-30	20	
	Organic Silt	A-8	A-8a	75 Max.		36 Min.				W/o organics would classify as A-4a or A-4b
	Organic Clay	A-8	A-8b	75 Max.		36 Min.				W/o organics would classify as A-5, A-6a, A-6b, A-7-5 or A-7-6

MATERIAL CLASSIFIED BY VISUAL INSPECTION

 Sod and Topsoil

 Pavement or Base

 Uncontrolled Fill (Describe)

 Bouldery Zone

 Peat, S-Sedimentary W-Woody F-Fibrous L-Loamy & etc

* Only perform the oven-dried liquid limit test and this calculation if organic material is present in the sample.

APPENDIX A.1 - ODOT Quick Reference for Visual Description of Soils

1) STRENGTH OF SOIL:

Non-Cohesive (granular) Soils - Compactness	
Description	**Blows Per Ft.**
Very Loose	≤ 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 – 50
Very Dense	> 50

2) COLOR :

If a color is a uniform color throughout, the term is single, modified by an adjective such as light or dark. If the predominate color is shaded by a secondary color, the secondary color procedes the primary color. If two major and distinct colors are swirled throughout the soil, the colors are modified by the term "mottled"

3) PRIMARY COMPONENT

Use **DESCRIPTION** from ODOT Soil Classification Chart on Back

Cohesive (fine grained) Soils - Consistency

Description	Qu (TSF)	Blows Per Ft.	Hand Manipulation
Very Soft	<0.25	<2	Easily penetrates 2" by fist
Soft	0.25-0.5	2 - 4	Easily penetrates 2" by thumb
Medium Stiff	0.5-1.0	5 - 8	Penetrates by thumb with moderate effort
Stiff	1.0-2.0	9 - 15	Readily indents by thumb, but not penetrate
Very Stiff	2.0-4.0	16 - 30	Readily indents by thumbnail
Hard	>4.0	>30	Indent with difficulty by thumbnail

4) COMPONENT MODIFIERS:

Description	Percentage By Weight
Trace	0% - 10%
Little	10% - 20%
Some	20% - 35%
"And"	35% -50%

5) Soil Organic Content

Description	% by Weight
Slightly Organic	2% - 4%
Moderately Organic	4% - 10%
Highly Organic	> 10%

6) Relative Visual Moisture

Description	Criteria	
	Cohesive Soil	**Non-cohesive Soils**
Dry	Powdery; Cannot be rolled; Water content well below the plastic limit	No moisture present
Damp	Leaves very little moisture when pressed between fingers; Crumbles at or before rolled to $^1/_8$"; Water content below plastic limit	Internal moisture, but no to little surface moisture
Moist	Leaves small amounts of moisture when pressed between fingers; Rolled to $^1/_8$" or smaller before crumbling; Water content above plastic limit to -3% of the liquid limit	Free water on surface, moist (shiny) appearance
Wet	Very mushy; Rolled multiple times to $^1/_8$" or smaller before crumbles; Near or above the liquid limit	Voids filled with free water, can be poured from split spoon.

APPENDIX A.2 - ODOT Quick Reference Guide for Rock Description

1) ROCK TYPE: Common rock types are: Claystone; Coal; Dolomite; Limestone; Sandstone; Siltstone; & Shale.

2) COLOR: To be determined when rock is wet. When using the GSA Color charts use only Name, not code.

3) WEATHERING

Description	Field Parameter
Unweathered	No evidence of any chemical or mechanical alternation of the rock mass. Mineral crystals have a bright appearance with no discoloration. Fractures show little or no staining on surfaces.
Slightly weathered	Slight discoloration of the rock surface with minor alterations along discontinuities. Less than 10% of the rock volume presents alteration.
Moderately weathered	Portions of the rock mass are discolored as evident by a dull appearance. Surfaces may have a pitted appearance with weathering "halos" evident. Isolated zones of varying rock strengths due to alteration may be present. 10 to 15% of the rock volume presents alterations.
Highly weathered	Entire rock mass appears discolored and dull. Some pockets of slightly to moderately weathered rock may be present and some areas of severely weathered materials may be present.
Severely weathered	Majority of the rock mass reduced to a soil-like state with relic rock structure discernable. Zones of more resistant rock may be present, but the material can generally be molded and crumbled by hand pressures.

4) RELATIVE STRENGTH

Description	Field Parameter
Very Weak	Core can be carved with a knife and scratched by fingernail. Can be excavated readily with a point of a pick. Pieces 1 inch or more in thickness can be broken by finger pressure.
Weak	Core can be grooved or gouged readily by a knife or pick. Can be excavated in small fragments by moderate blows of a pick point. Small, thin pieces can be broken by finger pressure.
Slightly Strong	Core can be grooved or gouged 0.05 inch deep by firm pressure of a knife or pick point. Can be excavated in small chips to pieces about 1-inch maximum size by hard blows of the point of a geologist's pick.
Moderately Strong	Core can be scratched with a knife or pick. Grooves or gouges to ¼" deep can be excavated by hand blows of a geologist's pick. Requires moderate hammer blows to detach hand specimen.
Strong	Core can be scratched with a knife or pick only with difficulty. Requires hard hammer blows to detach hand specimen. Sharp and resistant edges are present on hand specimen.
Very Strong	Core cannot be scratched by a knife or sharp pick. Breaking of hand specimens requires hard repeated blows of the geologist hammer.
Extremely strong	Core cannot be scratched by a knife or sharp pick. Chipping of hand specimens requires hard repeated blows of the geologist hammer.

5) TEXTURE

Component		Grain Diameter
Boulder		>12"
Cobble		3"-12"
Gravel		0.08"-3"
Sand	**Coarse**	0.02"-0.08"
	Medium	0.01"-0.02"
	Fine	0.005"-0.01"
	Very fine	0.003"-0.005"

6) BEDDING

Description	Thickness
Very Thick	>36"
Thick	18" – 36"
Medium	10" – 18"
Thin	2" – 10"
Very Thin	0.4" – 2"
Laminated	0.1" – 0.4"
Thinly Laminated	<0.1"

7) DESCRIPTORS

Arenaceous – sandy	Argillaceous - clayey	Brecciated – contains angular to subangular gravel
Calcareous - contains calcium carbonate	Carbonaceous - contains carbon	Cherty- contains chert fragments
Conglomeritic - contains rounded to subrounded gravel	Crystalline – contains crystalline structure	Dolomitic- contains calcium/magnesium carbonate
Ferriferous – contains iron	Fissile – thin planner partings	Fossiliferous – contains fossils
Friable – easily broken down	Micaceous – contains mica	Pyritic – contains pyrite
Siliceous – contains silica	Stylolitic – contain stylotites (suture like structure)	Vuggy – contains openings

8) DISCONTINUITIES

a) Discontinuity Types

Type	Parameters
Fault	Fracture which expresses displacement parallel to the surface that does not result in a polished surface.
Joint	Planar fracture that does not express displacement. Generally occurs at regularly spaced intervals.
Shear	Fracture which expresses displacement parallel to the surface that results in polished surfaces or slickensides.
Bedding	A surface produced along a bedding plane.
Contact	A surface produced along a contact plane. (generally not seen in Ohio)

b) Degree of Fracturing

Description	Spacing
Unfractured	> 10 ft
Intact	3 ft. – 10 ft.
Slightly fractured	1 ft – 3 ft
Moderately fractured	4 in. – 12 in.
Fractured	2 in – 4 in.
Highly fractured	< 2 in.

c) Aperture Width

Description	Spacing
Open	> 0.2 in.
Narrow	0.05 in. - 0.2 in.
Tight	<0.05 in.

d) Surface Roughness

Description	Criteria
Very Rough	Near vertical steps and ridges occur on the discontinuity surface.
Slightly Rough	Asperities on the discontinuity surface are distinguishable and can be felt.
Slickensided	Surface has a smooth, glassy finish with visual evidence of striation.

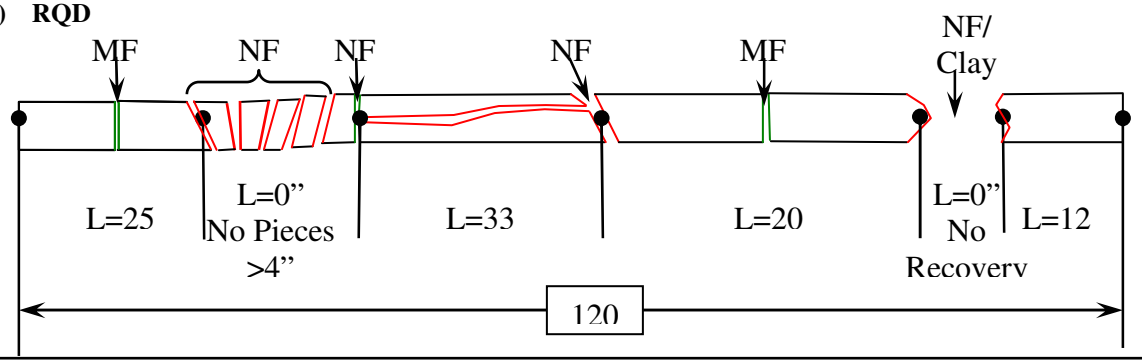
10) LOSS

$$Run\ Loss = \left(\frac{L_R - R_R}{L_R}\right) * 100 \qquad Unit\ Loss = \left(\frac{L_U - R_U}{L_U}\right) * 100$$

L_R=Run Length R_R=Run Recovery

L_U=Rock Unit Length R_U=Rock Unit Recovery

9) RQD



$$RQD = \left(\frac{\sum Length\ of\ Pieces > 4inches}{Total\ Length\ of\ Core}\right) * 100$$

$$RQD = \left(\frac{25+33+20+12}{120}\right) * 100 = 75\%$$