CTL Engineering, Inc.
2860 Fisher Road, P.O. Box 44548, Columbus, Ohio 43204-3538
Phone: 614/276-8123 Fax: 614/276-6377
Email: ctl@ctleng.com

June 8, 2017

Columbus Engineering Consultants, Inc.
870 Michigan Avenue
Columbus, Ohio 43215

Attention: Mr. Tom Hedrick, P.E.

Reference: Structure Foundation Exploration – Draft
Borror Road (T-266) Bridge over Patzer Ditch
Jackson Township, Franklin County, Ohio
CTL Project No. 16050169COL

Dear Mr. Hedrick:

CTL Engineering, Inc. has completed the Structure Foundation Exploration report for the above referenced structure. A pdf copy of the draft report is being submitted.

Thank you for the opportunity to work with you on this project. If you have any questions or need further information, please feel free to contact our office.

Respectfully Submitted

CTL ENGINEERING, INC.

Joe Grani, P.E.
Project Engineer

STRUCTURE FOUNDATION EXPLORATION-DRAFT

BORROR ROAD (T-266) BRIDGE OVER PATZER DITCH
JACKSON TOWNSHIP, FRANKLIN COUNTY, OHIO
CTL PROJECT NO. 16050169COL

PREPARED FOR:

COLUMBUS ENGINEERING CONSULTANTS
870 MICHIGAN AVE.
COLUMBUS, OHIO 43215

PREPARED BY:

CTL ENGINEERING, INC.
2860 FISHER ROAD
COLUMBUS, OHIO 43204
Phone 614-276-8123
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June 8, 2017

TABLE OF CONTENTS

I. EXECUTIVE SUMMARY AND INTRODUCTION

The project involves the replacement of an existing bridge that carries Borror Road (T266) over Patzer Ditch in Jackson Township, Franklin County, Ohio. It is understood that the replacement structure will be a 36 feet (clear span) by 9 feet (rise) conduit type A, precast reinforced concrete arch sections, supported on spread footings.

Two test borings, identified as B-001-0-16 and B-002-0-16, were drilled for this Structure Foundation Exploration. The borings generally exhibited gravel and/or stone fragments with sand (A-1-b), gravel and/or stone fragments with sand and silt (A-2-4), coarse and fine sand (A-3a), sandy silt (A-4a) or silt and clay (A-6a) soils to the drilled depths. No bedrock was encountered within the drill depths.

It is understood that the foundations for the proposed arch bridge will be constructed about 12.9 to 14.4 feet below the existing roadway grade (Foundation Elevation = 702.42 feet). Medium dense granular deposits or hard cohesive soils were encountered in the test borings at the anticipated foundation level. These soils are considered suitable to support foundations for the proposed structure.

II. GEOLOGY AND OBSERVATIONS OF THE PROJECT

According to the Ohio Department of Natural Resources, *Physiographic Regions of Ohio*, the site lies on the Columbus Lowland region of Southern Ohio Loamy Till Plain.

According to Bedrock Geology Map of Ohio (2006), bedrock below the site consists of Devonian age shale. No bedrock was encountered in the drilled borings.

According to web based mapping from *United States Department of Agriculture, Natural Resources Conservation Service*, the project area contains soils primarily described as Miamian Silty Clay Loam, 12 to 18 percent slopes, eroded (MID2), Sloan Silt Loam, frequently flooded (So), and Kendallville Silt Loam, 2 to 6 percent slopes (KeB) soils. According to the *Soil Survey of Franklin County, Ohio*, these soils exhibit moderately high to high permeability.

According to the ODNR Website, no underground mines have been mapped below the structure. However, active sand, gravel and limestone surface mine operations are performed about 1 mile east of the structure.

According to the Ohio Karst Areas map prepared by the Ohio Department of Natural Resources (ODNR), the project site does not lie in a Probable Karst Area.

Historic geotechnical records were searched for on the ODOT GeoMS website. No historic geotechnical records were found for this site.

III. EXPLORATION

Two (2) structure test borings, designated as B-001-0-16 and B-002-0-16, were drilled to depths ranging from 60.0 to 65.0 feet below grade.

The borings were performed with a track mounted drill rig utilizing hollow stem augers (HSA) on December 19 and 20, 2016. Standard penetration tests were conducted using a 140-pound hammer falling 30 inches to drive a 2-inch O.D. split barrel sampler. The energy transfer ratio associated with the automatic SPT hammer was 81.9 percent. The hammer was calibrated in July 2015.

Soil samples obtained from the drilling operation were preserved in glass jars, visually classified in the field and laboratory, and tested for natural moisture content. Representative soil samples were subjected to laboratory testing including grain size distribution and Atterberg limits and hand penetrometer.

The ground surface elevations, station and offset at the test boring locations were taken from the boring survey plan prepared by CEC personnel.

IV. FINDINGS

The borings exhibited 6 to 7 inches of asphalt over 8 to 9 inches of base course at the surface. Below the surface cover, the borings exhibited cohesive soils described as sandy silt (A-4a) or silt and clay (A-6a) soils and granular soils described as gravel and/or stone fragments with sand and silt (A-2-4) extending downwards to a depth of 8.0 feet. These soils exhibited standard penetration N_{60} values ranging from 10 to 51 blows per foot (bpf), with natural moisture content values ranging from 7 to 18 percent.

Below the near surface soils, the borings exhibited both granular and cohesive soils described as gravel and/or stone fragments with sand (A-1-b), coarse and fine sand (A-3a), sandy silt (A-4a) or silt and clay (A-6a) soils extending downwards to the drilled depths. The cohesive A-4a and A-6a soils encountered below 17.5 feet within this layer were further classified as glacial till deposits. These soils exhibited N_{60} values ranging from 7 bpf to 50 blows for 3 inches of penetration, with moisture content values ranging from 7 to 32 percent.

Groundwater was encountered during drilling at depths ranging from 17.0 to 20.0 feet. Upon completion of drilling, groundwater levels were measured at depths ranging from 7.8 to 17.4 feet.

V. ANALYSES AND RECOMMENDATIONS

A. Creek Bed Material

For the purpose of scour analysis, the D_{50} and type of creek bed materials encountered are shown in Table 1 below.

Table 1. D_{50} Values

Boring No.	Sample No.	Depth (feet)	D_{50} (mm)	Soil Type
B-001-0-16	SS-5	11.0-12.5	0.047	A-4a
	SS-6	12.5-14.0	0.046	A-4a
	SS-7	14.0-15.5	0.127	A-4a
B-002-0-16	SS-6	13.5-15.0	0.176	A-3a

B. Foundation Support

It is understood that the replacement structure will be 36 feet (clear span) by 9 feet (rise) conduit type A, precast reinforced concrete arch sections, supported on spread footings. It is also understood that the foundations for the proposed structure will be constructed about 12.9 to 14.4 feet below the existing roadway grade (Foundation Elevation = 702.42 feet). Medium dense granular deposits or hard cohesive soils were encountered in the test borings at the anticipated foundation level. These soils are considered suitable to support the foundations for the proposed structure.

Spread foundations may be proportioned using the bearing resistance values provided in the Table 2 below. The calculations are provided in Appendix D.

Table 2. Bearing Resistance

Boring Number	Nominal Bearing Resistance (q_n), Ksf (Strength Limit State)	Presumptive Bearing Resistance (q_r), Ksf (Service Limit State)
B-001-0-16	16.5	8.0
B-002-0-16	12.5	5.0

The applicable resistance factors for the bearing resistance and sliding are provided in Table 3 below. These values are obtained from AASHTO Table 10.5.5.2.2-1 and section 11.5.7.

Table 3. Resistance Factors

Boring Number	Resistance Factors		
	Bearing Resistance		Sliding
	Strength Limit State	Service Limit State	
B-001-0-16	0.50	1.0	0.85
B-002-0-16	0.45	1.0	0.80

Surface water and groundwater seepage should be expected during excavation and construction of the spread foundations. In such an event, the groundwater level will need to temporarily lowered to facilitate construction of the foundations. Additionally, cofferdams may need to be constructed to facilitate excavation and construction of the foundations. A mud mat consisting of a few inches of lean concrete, may be needed to provide a relatively dry surface for setting reinforcing steel and placing concrete.

For sliding and lateral earth pressure calculations for the proposed structure and any headwalls, wingwalls or temporary shoring, an equivalent friction angle of 30 degrees, and a total unit weight value of 125 pcf may be used.

C. General Construction and Earthwork

1. Site preparation and earthwork should be performed in accordance with the ODOT Construction and Material Specifications.

2. Embankment side slopes should be seeded and vegetation growth permitted to limit erosion, sloughing and slope failure.

3. Temporary excavations in excess of 4 feet in depth should be sloped or shored according to OSHA requirements.

VI. CHANGED CONDITIONS

The evaluations, conclusions, and recommendations in this report are based on our interpretation of the field and laboratory data obtained during the exploration, our understanding of the project and our experience with similar sites and subsurface conditions using generally accepted geotechnical engineering practices. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates drilled, they are not necessarily representative of the subsurface conditions between boring locations or subsurface conditions during other seasons of the year.

In the event that changes in the project are proposed, additional information becomes available, or if it is apparent that subsurface conditions are different from those provided in this report, CTL Engineering should be notified so that our recommendations can modified, if required.

VII. TESTING AND OBSERVATION

During the design process, it is recommended that CTL Engineering work with the project designers to confirm that the geotechnical recommendations are properly incorporated into the final plans and specifications, and to assist with establishing criteria for the construction observation and testing.

CTL Engineering is not responsible for independent conclusions, opinions and recommendations made by others based on the data and recommendations provided in this report. It is recommended that CTL be retained to provide construction quality control services on this project. If CTL Engineering is not retained for these services, CTL shall assume no responsibility for compliance with the design concepts or recommendations provided.

VIII. CLOSING

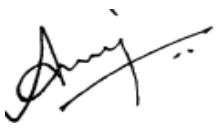
This report has been prepared for the exclusive use by the client for use only on this project. Our services have been performed in accordance with generally accepted Geotechnical Engineering principles and practices. No warranty is either expressed or implied.

CTL Engineering's assignment does not include, nor does this geotechnical report address the environmental aspects of this particular site.

Specific design and construction recommendations have been provided in this report. Therefore, the report should be used in its entirety.

Respectfully Submitted,

CTL ENGINEERING, INC.



Anuj Choudhari, E.I.
Staff Engineer

Joe Grani, P.E.
Project Engineer

APPENDIX A
STRUCTURE FOUNDATION EXPLORATION SHEETS

PROJECT DESCRIPTION

REPLACEMENT OF THE EXISTING FRA - T266 - 3.84 (BORROR ROAD) STRUCTURE OVER PATZER DITCH IN JACKSON TOWNSHIP, FRANKLIN COUNTY, OHIO. THE REPLACEMENT STRUCTURE WILL BE 36 FEET (CLEAR SPAN) BY 9 FEET (RISE) CONDUIT TYPE A, PRECAST REINFORCED CONCRETE ARCH SECTIONS, SUPPORTED ON SPREAD FOOTINGS.

HISTORIC RECORDS

HISTORIC GEOTECHNICAL RECORDS WERE SEARCHED FOR ON THE ODOT GEOMS WEBSITE. NO HISTORIC GEOTECHNICAL RECORDS WERE FOUND IN THE IMMEDIATE VICINITY OF THE PROPOSED BRIDGE.

GEOLOGY

ACCORDING TO THE OHIO DEPARTMENT OF NATURAL RESOURCES, PHYSIOGRAPHIC REGIONS OF OHIO, THIS SITE LIES ON THE COLUMBUS LOWLAND REGION OF SOUTHERN OHIO LOAMY TILL PLAIN.

ACCORDING TO THE BEDROCK GEOLOGY MAP OF OHIO (2006), THE BEDROCK BELOW THE SITE CONSISTS OF DEVONIAN AGE OHIO SHALE. NO BEDROCK WAS ENCOUNTERED WITHIN THE DRILLED DEPTHS OF THE TEST BORINGS.

RECONNAISSANCE

THE MOST RECENT SITE VISIT WAS PERFORMED ON DECEMBER 19, 2016. THE EXISTING PAVEMENT EXHIBITED SOME TRANSVERSE AND LONGITUDINAL CRACKS.

SUBSURFACE EXPLORATION

TWO (2) TEST BORINGS WERE DRILLED FOR THIS PROJECT.

THE BORINGS WERE DRILLED WITH A TRACK MOUNTED DRILL RIG USING 3-1/4 INCH I.D. HOLLOW-STEM AUGERS. DISTURBED SOIL SAMPLES WERE OBTAINED IN THE TEST BORINGS IN ACCORDANCE WITH THE STANDARD PENETRATION TEST (AASHTO T206) CONTINUOUSLY AND AT 2.5-FOOT TO 5.0-FOOT INTERVALS THROUGH THE SOIL USING AN AUTOMATIC HAMMER SYSTEM. THE HAMMER WAS CALIBRATED ON JULY 1, 2015 AND HAD A DRILL ROD ENERGY RATIO OF 81.9%.

CONTINUOUS SPLIT-SPOON SOIL SAMPLING WAS PERFORMED IN TEST BORING B-001-0-17 FOR A 7.5-FOOT INTERVAL BELOW THE APPROXIMATE STREAM BED ELEVATION. D50 VALUES WHICH HAVE BEEN CALCULATED FOR THE SCOUR ANALYSIS ARE PRESENTED ON THIS PAGE.

EXPLORATION FINDINGS

THE BORINGS EXHIBITED 6 TO 7 INCHES OF ASPHALT OVER 8 TO 9 INCHES OF BASE COURSE AT THE SURFACE

BELOW THE SURFACE COVER, THE BORINGS EXHIBITED COHESIVE SOILS DESCRIBED AS SANDY SILT (A-4a) OR SILT AND CLAY (A-6a) SOILS AND GRANULAR SOILS DESCRIBED AS GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT (A-2-4) EXTENDING DOWNWARDS TO A DEPTH OF 8.0 FEET.

BELOW THE NEAR SURFACE SOILS, THE BORINGS EXHIBITED BOTH GRANULAR AND COHESIVE SOILS DESCRIBED AS GRAVEL AND/OR STONE FRAGMENTS WITH SAND (A-1-b), COARSE AND FINE SAND (A-3a), SANDY SILT (A-4a) OR SILT AND CLAY (A-6a) SOILS EXTENDING DOWNWARDS TO THE DRILLED DEPTHS. THE COHESIVE A-4a AND A-6a SOILS ENCOUNTERED BELOW 17.5 FEET WITHIN THIS LAYER WERE FURTHER CLASSIFIED AS GLACIAL TILL DEPOSITS.

GROUND WATER WAS ENCOUNTERED DURING DRILLING AT DEPTHS RANGING FROM 17.0 TO 20.0 FEET (ELEVATIONS 698.3 FEET AND 696.8 FEET, RESPECTIVELY). UPON COMPLETION OF DRILLING, GROUNDWATER LEVELS WERE MEASURED AT DEPTHS RANGING FROM 7.8 TO 17.4 FEET (ELEVATIONS 707.5 FEET AND 699.4 FEET, RESPECTIVELY).

SPECIFICATIONS

THIS GEOTECHNICAL EXPLORATION WAS PERFORMED IN ACCORDANCE WITH THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, OFFICE OF GEOTECHNICAL ENGINEERING, SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS, DATED JULY 2016.

AVAILABLE INFORMATION

ALL AVAILABLE SOIL INFORMATION THAT CAN BE CONVENIENTLY SHOWN ON THE SOIL PROFILE SHEETS HAS BEEN SO REPORTED. ADDITIONAL SUBSURFACE EXPLORATIONS MAY HAVE BEEN MADE TO STUDY SOME SPECIAL ASPECT OF THE PROJECT. COPIES OF THIS DATA, IF ANY, MAY BE INSPECTED IN THE FRANKLIN COUNTY ENGINEERS OFFICE.

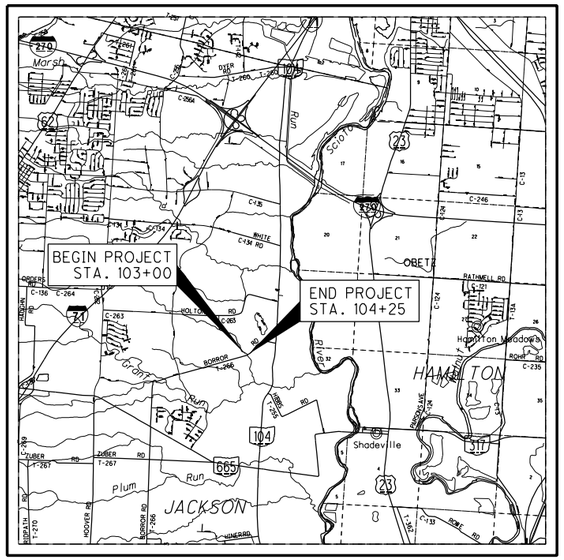
LEGEND

DESCRIPTION	ODOT CLASS	CLASSIFIED MECH./VISUAL	
GRAVEL AND/OR STONE FRAGMENTS WITH SAND	A-1-b	1	4
GRAVEL AND/OR STONE FRAGMENTS W/SAND AND SILT	A-2-4	1	0
COARSE AND FINE SAND	A-3a	2	8
SANDY SILT	A-4a	4	9
SILT AND CLAY	A-6a	2	5
	TOTAL	10	26
PAVEMENT OR BASE = X = APPROXIMATE THICKNESS	VISUAL		

- BORING LOCATION - PLAN VIEW.
- *WC* INDICATES WATER CONTENT IN PERCENT.
- N_{60} INDICATES STANDARD PENETRATION RESISTANCE NORMALIZED TO 60% DRILL ROD ENERGY RATIO.
- W— INDICATES FREE WATER ELEVATION.
- INDICATES A NON-PLASTIC MATERIAL WITH A MOISTURE CONTENT GREATER THAN 25 % OR GREATER THAN 19 % WITH A WET APPEARANCE.
- SS INDICATES A SPLIT SPOON SAMPLE.
- NP INDICATES A NON-PLASTIC SAMPLE.

D_{50} VALUES

BORING NO.	SAMPLE NO.	ELEVATION	D_{50} VALUE
B-001-0-16	SS-5	705.8' - 704.3'	0.047 mm
	SS-6	704.3' - 702.8'	0.046 mm
	SS-7	702.8' - 701.3'	0.127 mm
B-002-0-16	SS-6	701.8' - 700.3'	0.176 mm



LOCATION MAP

SCALE IN MILES

0 1 2 3 4

N

PARTICLE SIZE DEFINITIONS

BOULDERS	COBBLES	GRAVEL	COARSE SAND	FINE SAND	SILT	CLAY
12"	3"	2.0 mm (No. 10 SIEVE)	0.42 mm (No. 40 SIEVE)	0.074 mm (No. 200 SIEVE)		0.005 mm

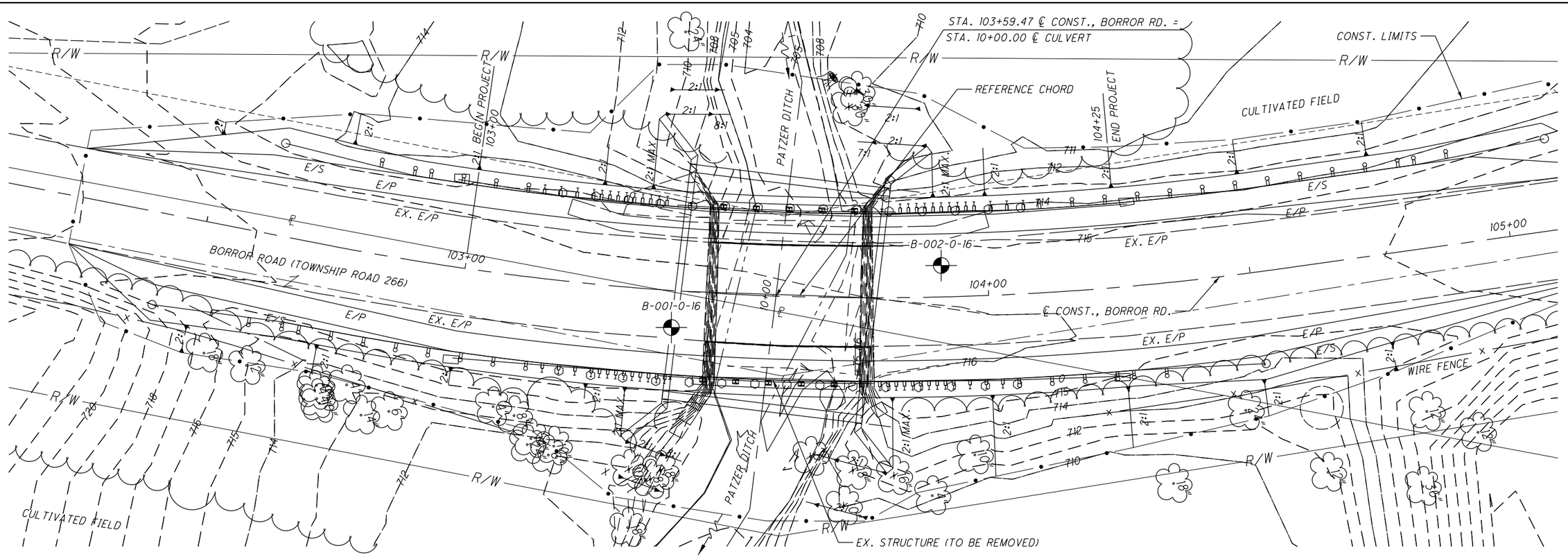
RECON. - LH 12/19/2016
DRILLING - CTL ENGINEERING, INC. 12/19/2016 - 12/20/2016
DRAWN - BRU 05/31/17
REVIEWED - JG 05/31/17

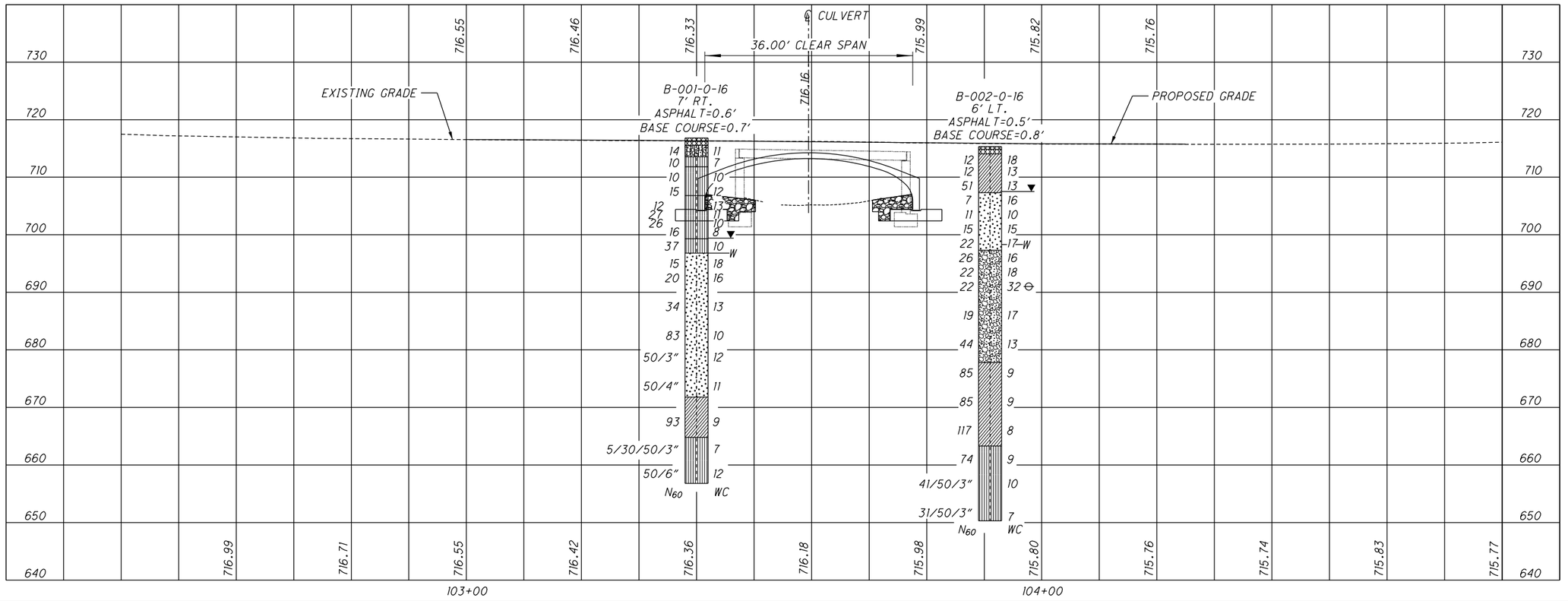
CTL ENGINEERING, INC.
2860 FISHER ROAD
COLUMBUS, OHIO 43204
PHONE:(614)276-8123 FAX:(614)276-6377

PID NO. -

STRUCTURE FOUNDATION EXPLORATION
BR. NO. FRA-T266-3.84 OVER PATZER DITCH

FRA-T266-3.84





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HORIZONTAL SCALE IN FEET

DRAWN BRJ CHECKED AC

STRUCTURE FOUNDATION EXPLORATION
BR. NO. FRA-T266-3.84 OVER PATZER DITCH

FRA-T266-3.84

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PROJECT: FRA-T266-3.84	DRILLING FIRM / OPERATOR: CTL / JW	DRILL RIG: MOBILE B-57/#487	STATION / OFFSET: 103+40, 7' RT.	EXPLORATION ID B-001-0-16
TYPE: STRUCTURE FOUNDATION	SAMPLING FIRM / LOGGER: CTL / JW	HAMMER: MOBILE AUTOMATIC	ALIGNMENT:	
PID: SFN: 2531593	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 7/1/15	ELEVATION: 716.8 (MSL) EOB: 60.0 ft.	PAGE 1 OF 1
START: 12/20/16 END: 12/20/16	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.9	COORD: 673175.6011 N, 1818095.0412 E	

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
Asphalt (7")	716.2																	
Base course (8")	715.5																	
MEDIUM DENSE, DARK BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, FILL, DAMP	713.5		9 7 3	14	44	SS-1	4.00	31	20	22	17	10	24	17	7	11	A-2-4 (0)	
STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, STONE FRAGMENTS, FILL, DAMP	711.8		3 4 3	10	33	SS-2	-	-	-	-	-	-	-	-	-	7	A-4a (V)	
VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, POSSIBLE FILL, MOIST			4 4 3	10	78	SS-3	4.00	-	-	-	-	-	-	-	-	10	A-4a (V)	
@8.5'; HARD, CONTAINS STONE FRAGMENTS	706.8		7 5 6	15	72	SS-4	4.50	-	-	-	-	-	-	-	-	12	A-4a (V)	
HARD, BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, MOIST			3 3 6	12	83	SS-5	4.50	11	10	22	34	23	26	16	10	13	A-4a (4)	
@12.5'; TRACE GRAVEL			6 8 12	27	78	SS-6	4.50	9	12	21	35	23	24	15	9	11	A-4a (5)	
@14.0'; SOME GRAVEL, LITTLE CLAY			4 6 13	26	83	SS-7	4.50	28	11	16	27	18	21	13	8	10	A-4a (2)	
			3 5 7	16	50	SS-8	4.50	-	-	-	-	-	-	-	-	8	A-4a (V)	
HARD, GRAY, **SANDY SILT**, LITTLE CLAY AND GRAVEL, TILL, DAMP	699.3 ▼		8 12 15	37	100	SS-9	4.50	17	10	19	36	18	21	14	7	10	A-4a (4)	
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, LITTLE SILT, TRACE CLAY, WET	696.8 W		4 5 6	15	89	SS-10	-	-	-	-	-	-	-	-	-	18	A-3a (V)	
			6 6 9	20	100	SS-11	-	-	-	-	-	-	-	-	-	16	A-3a (V)	
@28.5'; DENSE, GRAY, MOIST			8 10 15	34	100	SS-12	-	-	-	-	-	-	-	-	-	13	A-3a (V)	
@33.5'; VERY DENSE, DAMP			25 32 29	83	94	SS-13	-	25	16	36	14	9	NP	NP	NP	10	A-3a (0)	
@38.5'; CONTAINS COBBLES, WET			50/3"	-	100	SS-14	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
@43.5'; TRACE SILT, CLAY, DAMP			50/4"	-	100	SS-15	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
HARD, GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, TILL, DAMP	671.8		9 25 43	93	89	SS-16	4.50	8	10	24	33	25	25	14	11	9	A-6a (5)	
HARD, GRAY, **SANDY SILT**, SOME CLAY, CONTAINS STONE FRAGMENTS, TILL, DAMP	664.8		5 30 50/3"	-	100	SS-17	4.50	-	-	-	-	-	-	-	-	7	A-4a (V)	
	656.8	EOB	50	-	100	SS-18	4.00	-	-	-	-	-	-	-	-	12	A-4a (V)	

NOTES: CAVED AT 24.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 5/30/17 10:56 - J:\DEPT5\16 PROJECTS\16050169COL-CEC-BORROR RD BRIDGE\REPORTS\LOGS\16050169COL.GPJ

FRA-T266-3.84

STRUCTURE FOUNDATION EXPLORATION
BR. NO. FRA-T266-3.84 OVER PATZER DITCH
BORING LOG B-001-0-16

DRAWN BRU
CHECKED AC

C:\Users\Kumar\Desktop\16050169COL_ODOT\ZL002.dgn 6/2/2017 1:23:56 PM Kumar

PROJECT: FRA-T266-3.84
TYPE: STRUCTURE FOUNDATION
PID: SFN: 2531593
START: 12/19/16 END: 12/19/16

DRILLING FIRM / OPERATOR: CTL / LH
SAMPLING FIRM / LOGGER: CTL / LH
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: MOBILE B-57/#487
HAMMER: MOBILE AUTOMATIC
CALIBRATION DATE: 7/1/15
ENERGY RATIO (%): 81.9

STATION / OFFSET: 103+91, 6' LT.
ALIGNMENT:
ELEVATION: 715.3 (MSL) EOB: 65.0 ft.
COORD: 673209.5864 N, 1818134.7245 E

EXPLORATION ID B-002-0-16

MATERIAL DESCRIPTION AND NOTES	ELEV. 715.3	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
Asphalt (6")	714.8																	
Base course (9")	714.0																	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, POSSIBLE FILL, DAMP			4 5 4	12	67	SS-1	2.50	8	11	22	35	24	33	19	14	18	A-6a (6)	
@3.5'; STIFF, CONTAINS STONE FRAGMENTS			4 4 5	12	50	SS-2	2.00	-	-	-	-	-	-	-	-	13	A-6a (V)	
	707.3		3 4 33	51	56	SS-3	2.00	-	-	-	-	-	-	-	-	13	A-6a (V)	
LOOSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, LITTLE GRAVEL, TRACE CLAY, MOIST			1 2 3	7	67	SS-4	-	-	-	-	-	-	-	-	-	16	A-3a (V)	
@11.0'; MEDIUM DENSE			3 3 5	11	50	SS-5	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
			7 6 5	15	78	SS-6	-	11	20	38	22	9	NP	NP	NP	15	A-3a (0)	
@16.0'; WET		W	4 7 9	22	72	SS-7	-	-	-	-	-	-	-	-	-	17	A-3a (V)	
	697.3																	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET			4 9 10	26	94	SS-8	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
			4 7 9	22	83	SS-9	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
			5 6 10	22	100	SS-10	-	-	-	-	-	-	-	-	-	32	A-1-b (V)	
			4 6 8	19	100	SS-11	-	31	28	19	17	5	NP	NP	NP	17	A-1-b (0)	
@33.5'; DENSE, TRACE CLAY			9 13 19	44	100	SS-12	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
@36.0'; HEAVY COBBLES																		
	677.8																	
HARD, BROWNISH GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, CONTAINS COBBLES AND STONE FRAGMENTS, TILL, DAMP			24 26 36	85	78	SS-13	4.50	-	-	-	-	-	-	-	-	9	A-6a (V)	
			13 22 40	85	61	SS-14	4.50	-	-	-	-	-	-	-	-	9	A-6a (V)	
			21 36 50	117	72	SS-15	4.50	-	-	-	-	-	-	-	-	8	A-6a (V)	
	663.3																	
HARD, GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, CONTAINS COBBLES AND STONE FRAGMENTS, TILL, DAMP			5 21 33	74	89	SS-16	4.50	-	-	-	-	-	-	-	-	9	A-4a (V)	
@58.5'; VERY STIFF, LITTLE CLAY			41 50/3"	-	89	SS-17	2.50	-	-	-	-	-	-	-	-	10	A-4a (V)	

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 5/30/17 10:56 - J:\DEPT5\16 PROJECTS\16050169COL-CEC-BORROR RD BRIDGE\REPORTS\LOGS\16050169COL.GPJ

FRA-T266-3.84

STRUCTURE FOUNDATION EXPLORATION
BR. NO. FRA-T266-3.84 OVER PATZER DITCH
BORING LOG B-002-0-16

DRAWN BRU
CHECKED AC

C:\Users\Kumar\Desktop\16050169COL_ODOT\ZL003.dgn 6/2/2017 1:25:25 PM Kumar

PID:	SFN: 2531593	PROJECT: FRA-T266-3.84	STATION / OFFSET: 103+91, 6' LT.	START: 12/19/16	END: 12/19/16	PG 2 OF 2	B-002-0-16

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
HARD, GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, CONTAINS COBBLES AND STONE FRAGMENTS, TILL, DAMP *(continued)*	655.3	61 62 63																
@63.5'; HARD, SOME CLAY		64	31 50/3"	-	100	SS-18	4.50	-	-	-	-	-	-	-	-	7	A-4a (V)	
	650.3	EOB 65																

NOTES: CAVED AT 17.3'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 5/30/17 10:56 - J:\DEPT5\16 PROJECTS\16050169COL-CEC-BORROR RD BRIDGE\REPORTS\LOGS\16050169COL.GPJ

	5/5	FRA-T266-3.84	STRUCTURE FOUNDATION EXPLORATION BR. NO. FRA-T266-3.84 OVER PATZER DITCH BORING LOG B-002-0-16 (CONT.)	DRAWN BRU CHECKED AC

APPENDIX B
TEST BORING RECORDS

SOIL DESCRIPTION

Descriptors for soil consistency used in this report are based upon the Standard Penetration Test (SPT), ASTM D 1587, with the penetration (N) values corrected to N_{60} , based upon the efficiency of the SPT Hammer used for the soil sampling.

Descriptors for both non-cohesive and cohesive soils are presented below, with the corresponding range of corrected penetration values.

NON-COHESIVE SOIL DESCRIPTION	CORRECTED PENETRATION VALUES BLOWS PER FOOT (BPF)
Very Loose	0 – 4
Loose	5 – 10
Medium Dense	11- 30
Dense	31 – 50
Very Dense	Over 50

COHESIVE SOIL DESCRIPTION	CORRECTED PENETRATION VALUES BLOWS PER FOOT (BPF)
Very Soft	0 – 1
Soft	2 – 4
Medium Stiff	5 – 8
Stiff	9 – 15
Very Stiff	16 –30
Hard	Over 30

Moisture term descriptors for both non-cohesive and cohesive soils are presented below.

NON-COHESIVE SOIL DESCRIPTION	MOISTURE TERMS	COHESIVE SOIL DESCRIPTION
Powdery	Dry	Powdery
Some Moisture	Damp	Below Plastic Limit
Damp to the Touch	Moist	Above Plastic, Below Liquid Limit
Free Water	Wet	Above Liquid Limit

PROJECT: FRA-T266-3.84	DRILLING FIRM / OPERATOR: CTL / JW	DRILL RIG: MOBILE B-57/#487	STATION / OFFSET: 103+40, 7' RT.
TYPE: STRUCTURE FOUNDATION	SAMPLING FIRM / LOGGER: CTL / JW	HAMMER: MOBILE AUTOMATIC	ALIGNMENT:
PID: SFN: 2531593	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 7/1/15	ELEVATION: 716.8 (MSL) EOB: 60.0 ft.
START: 12/20/16 END: 12/20/16	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.9	COORD: 673175.6011 N, 1818095.0412 E

EXPLORATION ID B-001-0-16

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
Asphalt (7")	716.8																	
Base course (8")	716.2																	
MEDIUM DENSE, DARK BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, FILL, DAMP	715.5	1	9 7 3	14	44	SS-1	4.00	31	20	22	17	10	24	17	7	11	A-2-4 (0)	
	713.5	2																
STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, STONE FRAGMENTS, FILL, DAMP		3																
	711.8	4	3 4 3	10	33	SS-2	-	-	-	-	-	-	-	-	-	7	A-4a (V)	
VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, POSSIBLE FILL, MOIST		5																
		6	4 4 3	10	78	SS-3	4.00	-	-	-	-	-	-	-	-	10	A-4a (V)	
		7																
@8.5'; HARD, CONTAINS STONE FRAGMENTS		8																
	706.8	9	7 5 6	15	72	SS-4	4.50	-	-	-	-	-	-	-	-	12	A-4a (V)	
HARD, BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, MOIST		10																
		11	3 3 6	12	83	SS-5	4.50	11	10	22	34	23	26	16	10	13	A-4a (4)	
@12.5'; TRACE GRAVEL		12	6 8 12	27	78	SS-6	4.50	9	12	21	35	23	24	15	9	11	A-4a (5)	
@14.0'; SOME GRAVEL, LITTLE CLAY		13	4 6 13	26	83	SS-7	4.50	28	11	16	27	18	21	13	8	10	A-4a (2)	
		14																
		15	3 5 7	16	50	SS-8	4.50	-	-	-	-	-	-	-	-	8	A-4a (V)	
	699.3 ▼	16																
HARD, GRAY, **SANDY SILT**, LITTLE CLAY AND GRAVEL, TILL, DAMP		17																
		18	8 12 15	37	100	SS-9	4.50	17	10	19	36	18	21	14	7	10	A-4a (4)	
	696.8 W	19																
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, LITTLE SILT, TRACE CLAY, WET		20																
		21	4 5 6	15	89	SS-10	-	-	-	-	-	-	-	-	-	18	A-3a (V)	
		22																
		23																
		24	6 6 9	20	100	SS-11	-	-	-	-	-	-	-	-	-	16	A-3a (V)	
		25																
		26																
		27																
		28																
@28.5'; DENSE, GRAY, MOIST		29	8 10 15	34	100	SS-12	-	-	-	-	-	-	-	-	-	13	A-3a (V)	

PID:	SFN: 2531593	PROJECT: FRA-T266-3.84	STATION / OFFSET: 103+40, 7' RT.	START: 12/20/16	END: 12/20/16	PG 2 OF 2	B-001-0-16

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
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, SOME GRAVEL, LITTLE SILT, TRACE CLAY, WET *(continued)*	686.8	31 32 33																
@33.5'; VERY DENSE, DAMP		34 35 36 37 38	25 32 29	83	94	SS-13	-	25	16	36	14	9	NP	NP	NP	10	A-3a (0)	
@38.5'; CONTAINS COBBLES, WET		39 40 41 42 43	50/3"	-	100	SS-14	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
@43.5'; TRACE SILT, CLAY, DAMP	671.8	44 45 46 47 48	50/4"	-	100	SS-15	-	-	-	-	-	-	-	-	-	11	A-3a (V)	
HARD, GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, TILL, DAMP	664.8	49 50 51 52 53	9 25 43	93	89	SS-16	4.50	8	10	24	33	25	25	14	11	9	A-6a (5)	
HARD, GRAY, **SANDY SILT**, SOME CLAY, CONTAINS STONE FRAGMENTS, TILL, DAMP		54 55 56 57 58	5 30 50/3"	-	100	SS-17	4.50	-	-	-	-	-	-	-	-	7	A-4a (V)	
	656.8	EOB 60	50	-	100	SS-18	4.00	-	-	-	-	-	-	-	-	12	A-4a (V)	

NOTES: CAVED AT 24.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

PROJECT: FRA-T266-3.84	DRILLING FIRM / OPERATOR: CTL / LH	DRILL RIG: MOBILE B-57/#487	STATION / OFFSET: 103+91, 6' LT.	EXPLORATION ID B-002-0-16
TYPE: STRUCTURE FOUNDATION	SAMPLING FIRM / LOGGER: CTL / LH	HAMMER: MOBILE AUTOMATIC	ALIGNMENT:	
PID: SFN: 2531593	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 7/1/15	ELEVATION: 715.3 (MSL) EOB: 65.0 ft.	PAGE 1 OF 3
START: 12/19/16 END: 12/19/16	SAMPLING METHOD: SPT	ENERGY RATIO (%): 81.9	COORD: 673209.5864 N, 1818134.7245 E	

MATERIAL DESCRIPTION AND NOTES	ELEV. 715.3	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
Asphalt (6")	714.8																	
Base course (9")	714.0																	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, POSSIBLE FILL, DAMP		1																
		2	4 5 4	12	67	SS-1	2.50	8	11	22	35	24	33	19	14	18	A-6a (6)	
		3																
@3.5'; STIFF, CONTAINS STONE FRAGMENTS		4	4 4 5	12	50	SS-2	2.00	-	-	-	-	-	-	-	-	13	A-6a (V)	
		5																
		6																
		7	3 4 33	51	56	SS-3	2.00	-	-	-	-	-	-	-	-	13	A-6a (V)	
	707.3																	
LOOSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, LITTLE GRAVEL, TRACE CLAY, MOIST		8																
		9	1 2 3	7	67	SS-4	-	-	-	-	-	-	-	-	-	16	A-3a (V)	
		10																
@11.0'; MEDIUM DENSE		11																
		12	3 3 5	11	50	SS-5	-	-	-	-	-	-	-	-	-	10	A-3a (V)	
		13																
		14	7 6 5	15	78	SS-6	-	11	20	38	22	9	NP	NP	NP	15	A-3a (0)	
		15																
@16.0'; WET		16																
		17	4 7 9	22	72	SS-7	-	-	-	-	-	-	-	-	-	17	A-3a (V)	
	697.3	18																
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET		19	4 9 10	26	94	SS-8	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
		20																
		21																
		22	4 7 9	22	83	SS-9	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
		23																
		24	5 6 10	22	100	SS-10	-	-	-	-	-	-	-	-	-	32	A-1-b (V)	
		25																
		26																
		27																
		28																
		29	4 6 8	19	100	SS-11	-	31	28	19	17	5	NP	NP	NP	17	A-1-b (0)	

PID:	SFN: 2531593	PROJECT: FRA-T266-3.84	STATION / OFFSET: 103+91, 6' LT.	START: 12/19/16	END: 12/19/16	PG 2 OF 3	B-002-0-16

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
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET *(continued)*	685.3	31 32 33																
@33.5'; DENSE, TRACE CLAY		34 35	9 13 19	44	100	SS-12	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
@36.0'; HEAVY COBBLES		36 37																
HARD, BROWNISH GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, CONTAINS COBBLES AND STONE FRAGMENTS, TILL, DAMP	677.8	38 39 40	24 26 36	85	78	SS-13	4.50	-	-	-	-	-	-	-	-	9	A-6a (V)	
		41 42 43 44 45	13 22 40	85	61	SS-14	4.50	-	-	-	-	-	-	-	-	9	A-6a (V)	
		46 47 48 49 50	21 36 50	117	72	SS-15	4.50	-	-	-	-	-	-	-	-	8	A-6a (V)	
HARD, GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, CONTAINS COBBLES AND STONE FRAGMENTS, TILL, DAMP	663.3	51 52 53 54 55	5 21 33	74	89	SS-16	4.50	-	-	-	-	-	-	-	-	9	A-4a (V)	
@58.5'; VERY STIFF, LITTLE CLAY		56 57 58 59 60 61	41 50/3"	-	89	SS-17	2.50	-	-	-	-	-	-	-	-	10	A-4a (V)	

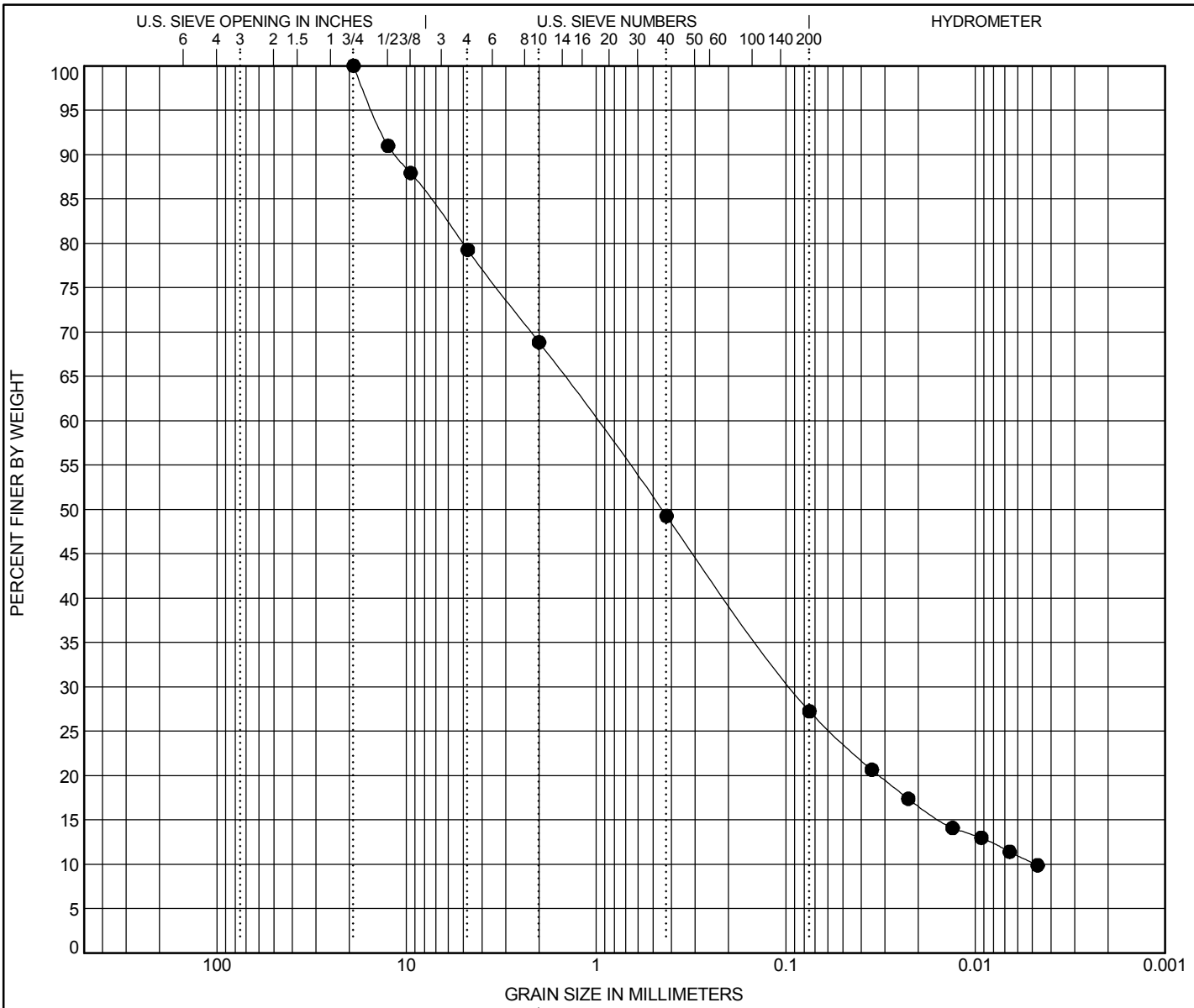
PID:	SFN: 2531593	PROJECT: FRA-T266-3.84	STATION / OFFSET: 103+91, 6' LT.	START: 12/19/16	END: 12/19/16	PG 3 OF 3	B-002-0-16

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
HARD, GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, CONTAINS COBBLES AND STONE FRAGMENTS, TILL, DAMP *(continued)*	653.1	63																
@63.5'; HARD, SOME CLAY		64	31 50/3"	-	100	SS-18	4.50	-	-	-	-	-	-	-	-	7	A-4a (V)	
	650.3	EOB 65																

NOTES: CAVED AT 17.3'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

APPENDIX C
LABORATORY TEST SHEETS



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-001-0-16	**1.5**	**A-2-4(0)**	**11**	**24**	**17**	**7**	**1.81**	**205.72**

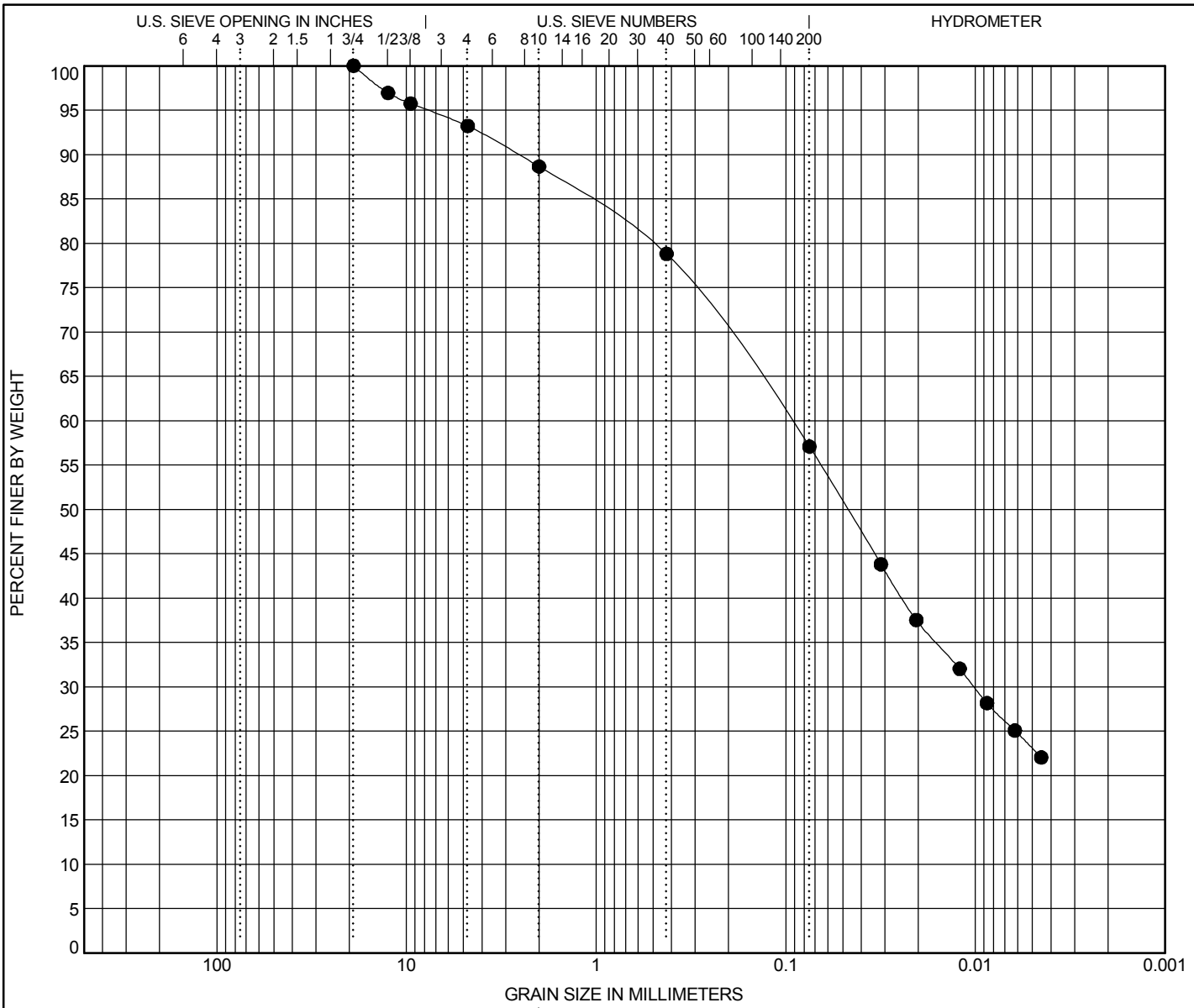
Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-001-0-16	**1.5**	**19**	**0.995**	**0.451**	**0.093**	**0.005**	**31**	**20**	**22**	**17**	**10**

CTL ENGINEERING

CTL Engineering, Inc.
2860 Fisher Road
Columbus, Ohio 43204
Telephone: 614-276-8123
Fax: 614-276-6377

GRAIN SIZE DISTRIBUTION

Project: FRA-T266-3.84
Location:FRA COUNTY
CTL Project Number:



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-001-0-16	**11.0**	**A-4a(4)**	**13**	**26**	**16**	**10**		

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-001-0-16	**11.0**	**19**	**0.095**	**0.047**	**0.01**		**11**	**10**	**22**	**34**	**23**

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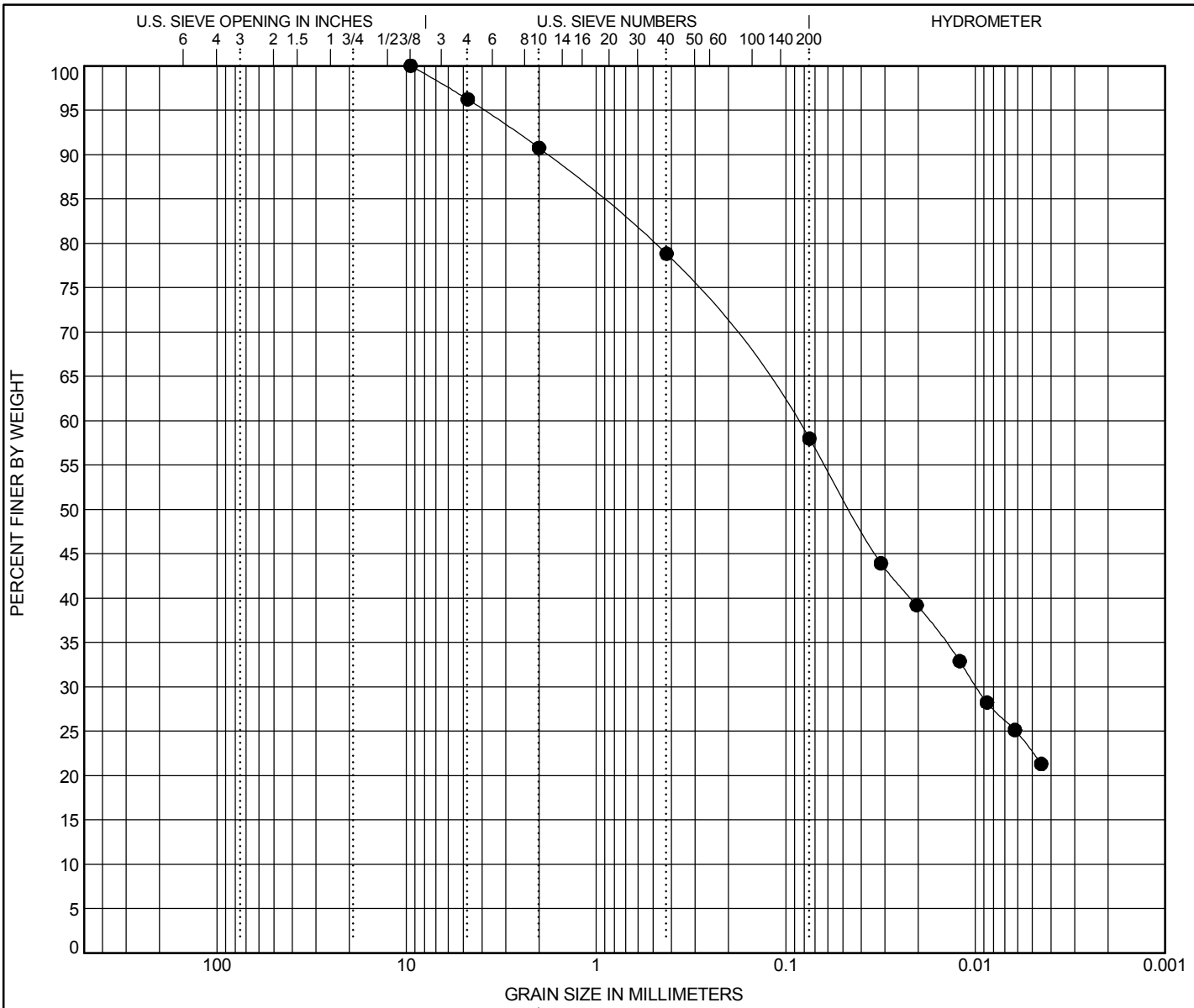
GRAIN SIZE DISTRIBUTION

Project: FRA-T266-3.84
Location:FRA COUNTY
CTL Project Number:



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-001-0-16	**12.5**	**A-4a(5)**	**11**	**24**	**15**	**9**		

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-001-0-16	**12.5**	**9.5**	**0.089**	**0.046**	**0.01**		**9**	**12**	**21**	**35**	**23**

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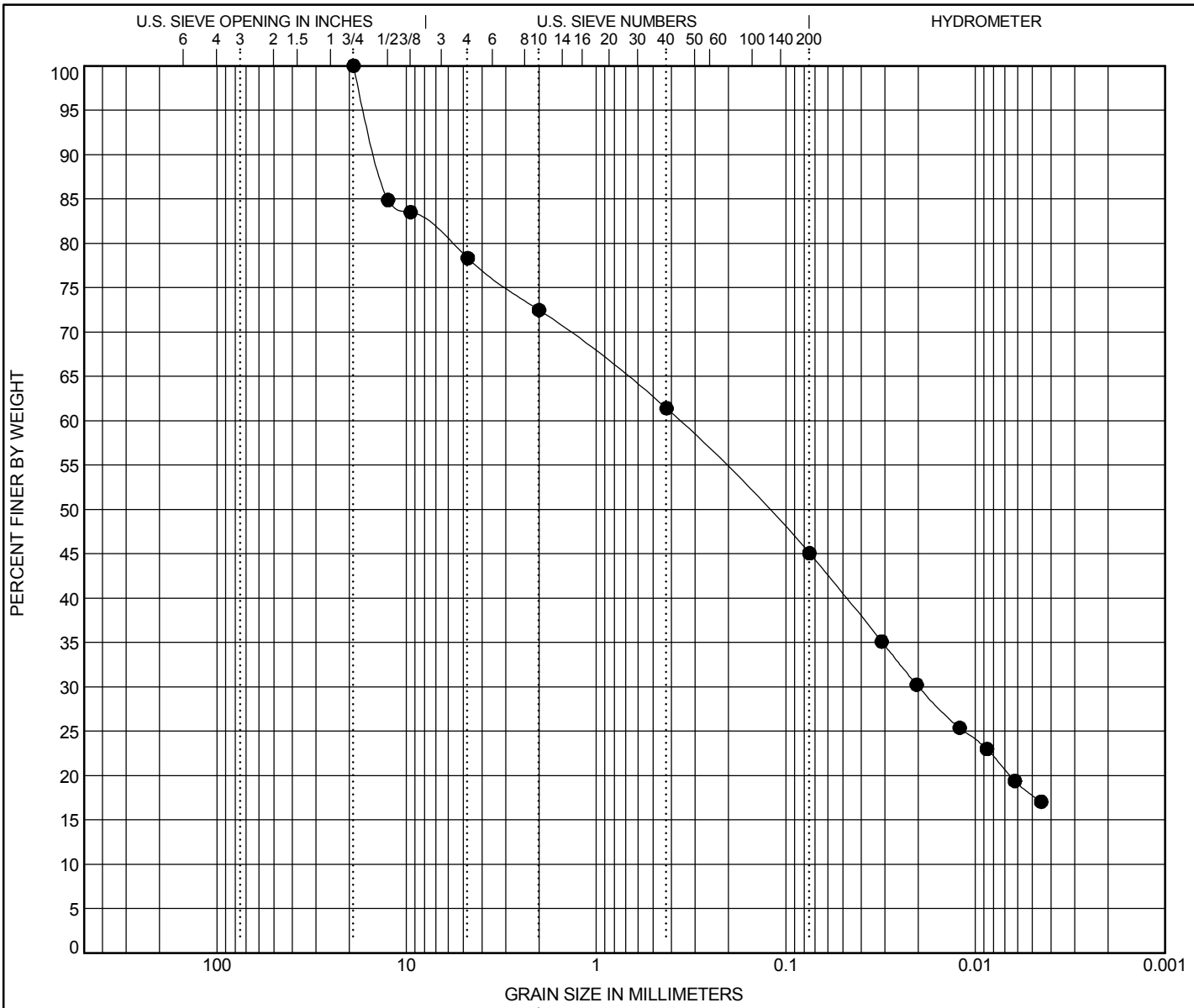
GRAIN SIZE DISTRIBUTION

Project: FRA-T266-3.84
Location:FRA COUNTY
CTL Project Number:



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-001-0-16	**14.0**	**A-4a(2)**	**10**	**21**	**13**	**8**		

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-001-0-16	**14.0**	**19**	**0.367**	**0.127**	**0.02**		**28**	**11**	**16**	**27**	**18**

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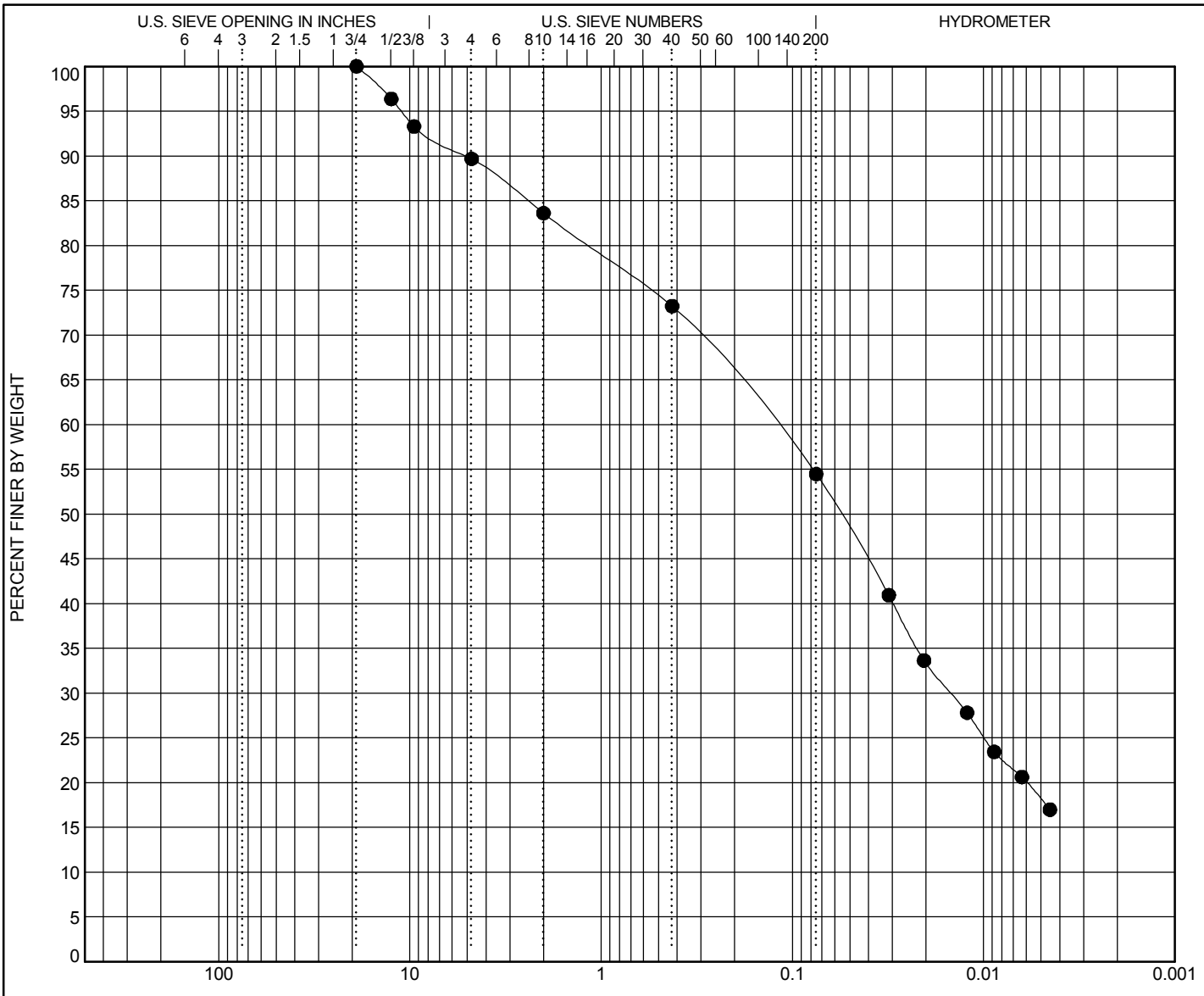
GRAIN SIZE DISTRIBUTION

Project: FRA-T266-3.84
Location:FRA COUNTY
CTL Project Number:



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-001-0-16	**18.0**	**A-4a(4)**	**10**	**21**	**14**	**7**		

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-001-0-16	**18.0**	**19**	**0.125**	**0.056**	**0.015**		**17**	**10**	**19**	**36**	**18**

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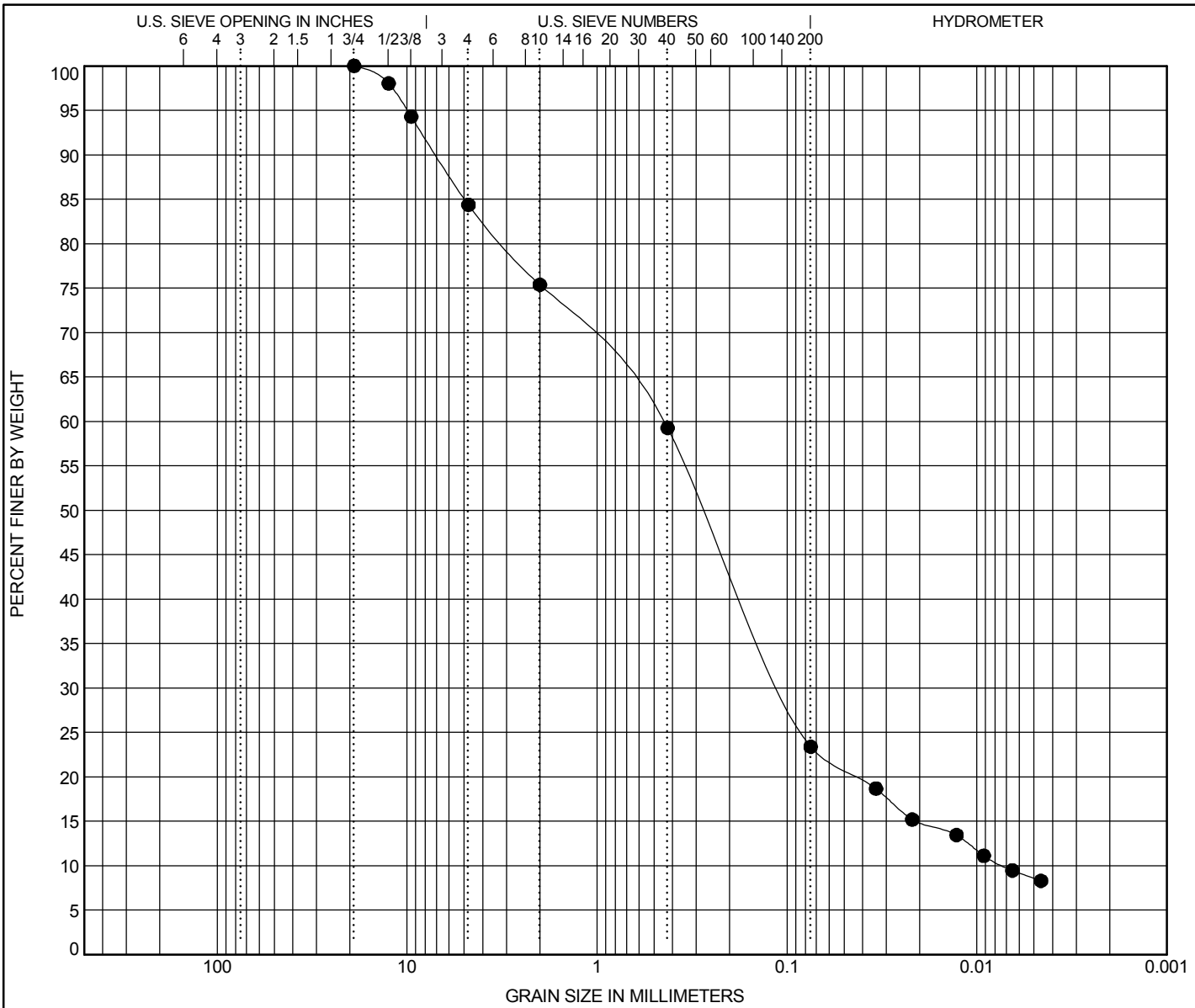
GRAIN SIZE DISTRIBUTION

Project: FRA-T266-3.84
Location:FRA COUNTY
CTL Project Number:



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-001-0-16	**33.5**	**A-3a(0)**	**10**	**NP**	**NP**	**NP**	**3.21**	**62.53**

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-001-0-16	**33.5**	**19**	**0.456**	**0.272**	**0.103**	**0.007**	**25**	**16**	**36**	**14**	**9**

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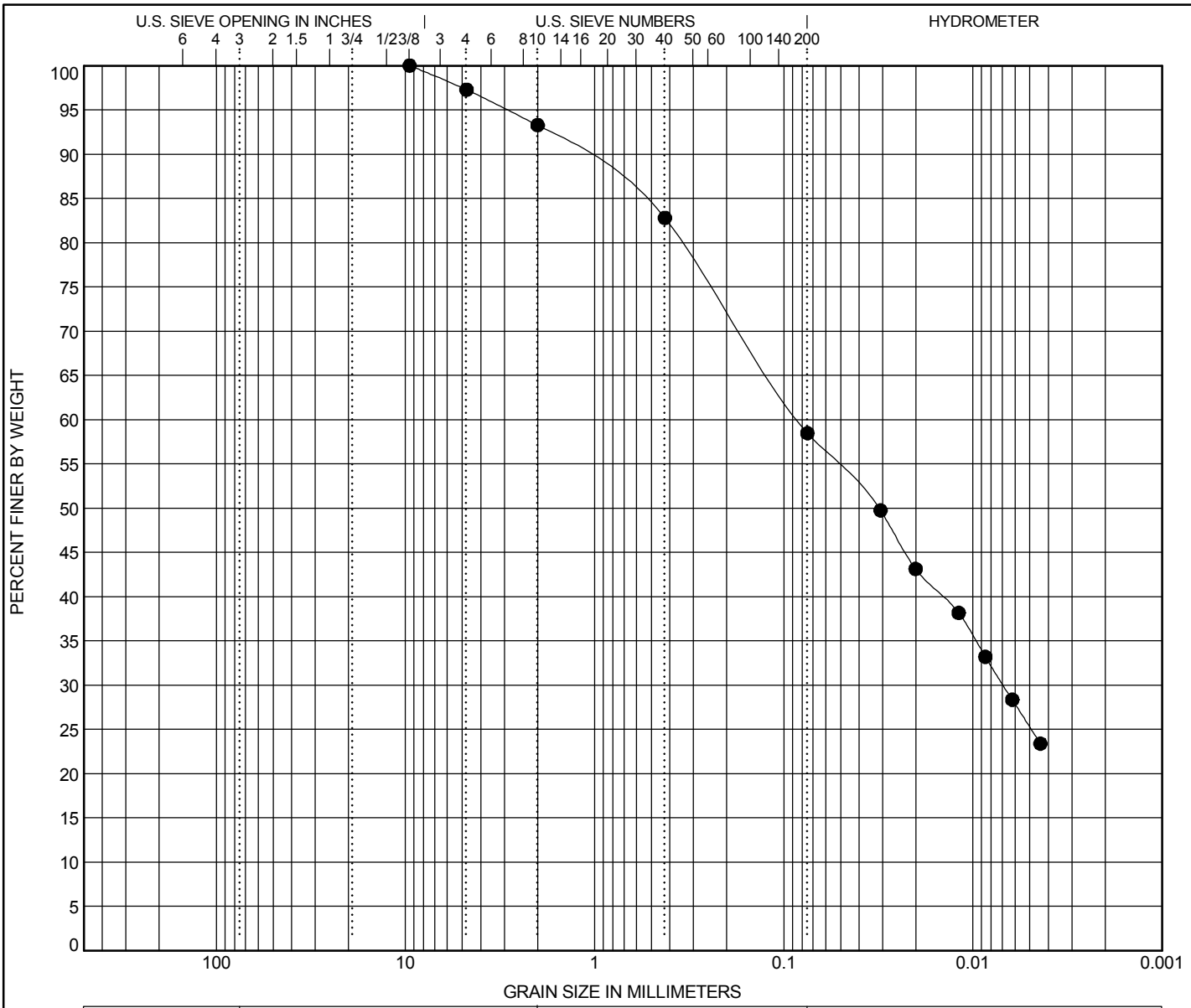
Columbus, Ohio 43204
Telephone: 614-276-8123
Fax: 614-276-6377

GRAIN SIZE DISTRIBUTION

Project: FRA-T266-3.84
Location:FRA COUNTY
CTL Project Number:



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-001-0-16	**48.5**	**A-6a(5)**	**9**	**25**	**14**	**11**		

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-001-0-16	**48.5**	**9.5**	**0.084**	**0.032**	**0.007**		**8**	**10**	**24**	**33**	**25**

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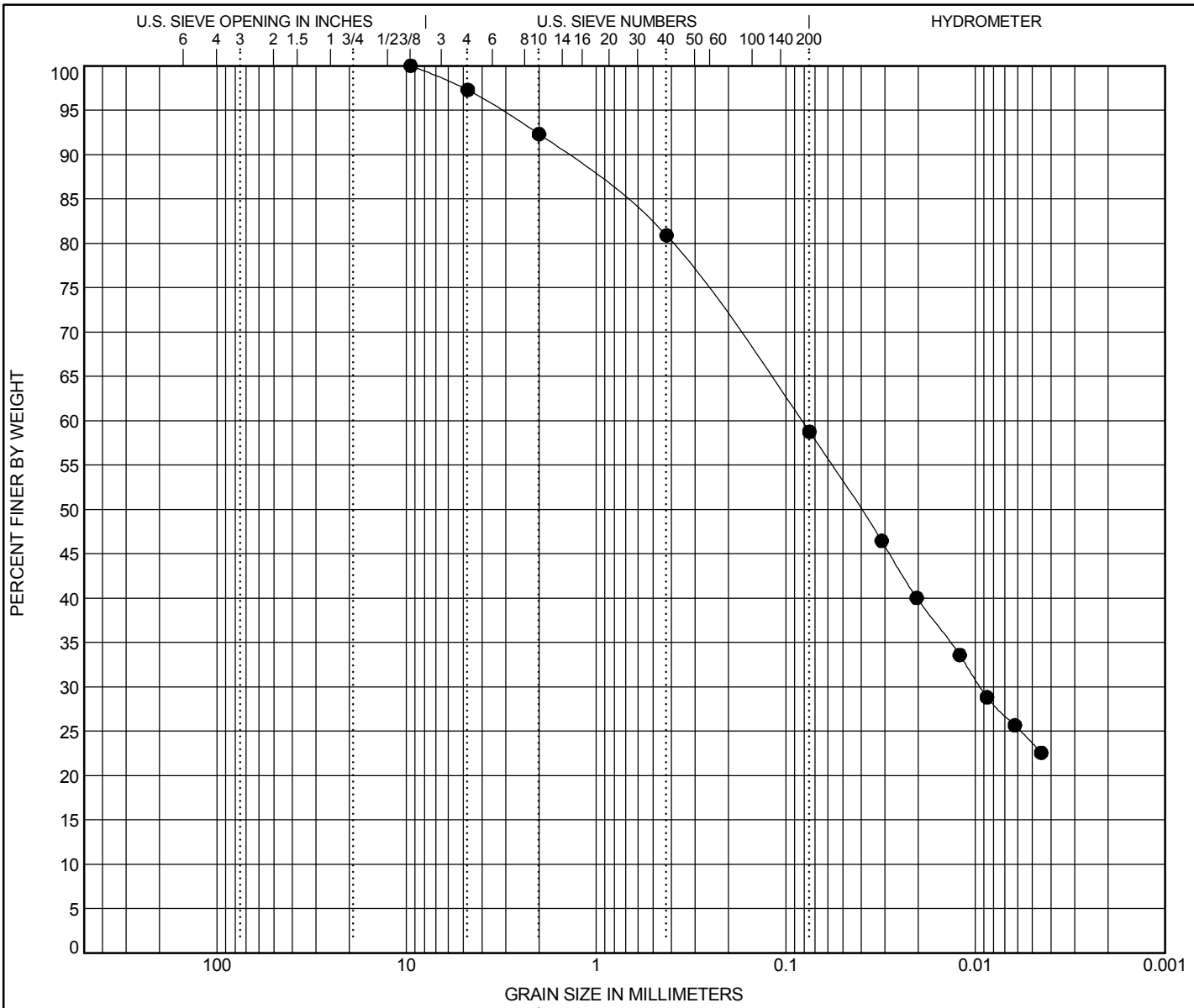

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-002-0-16	**1.5**	**A-6a(6)**	**18**	**33**	**19**	**14**		

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-002-0-16	**1.5**	**9.5**	**0.083**	**0.04**	**0.009**		**8**	**11**	**22**	**35**	**24**

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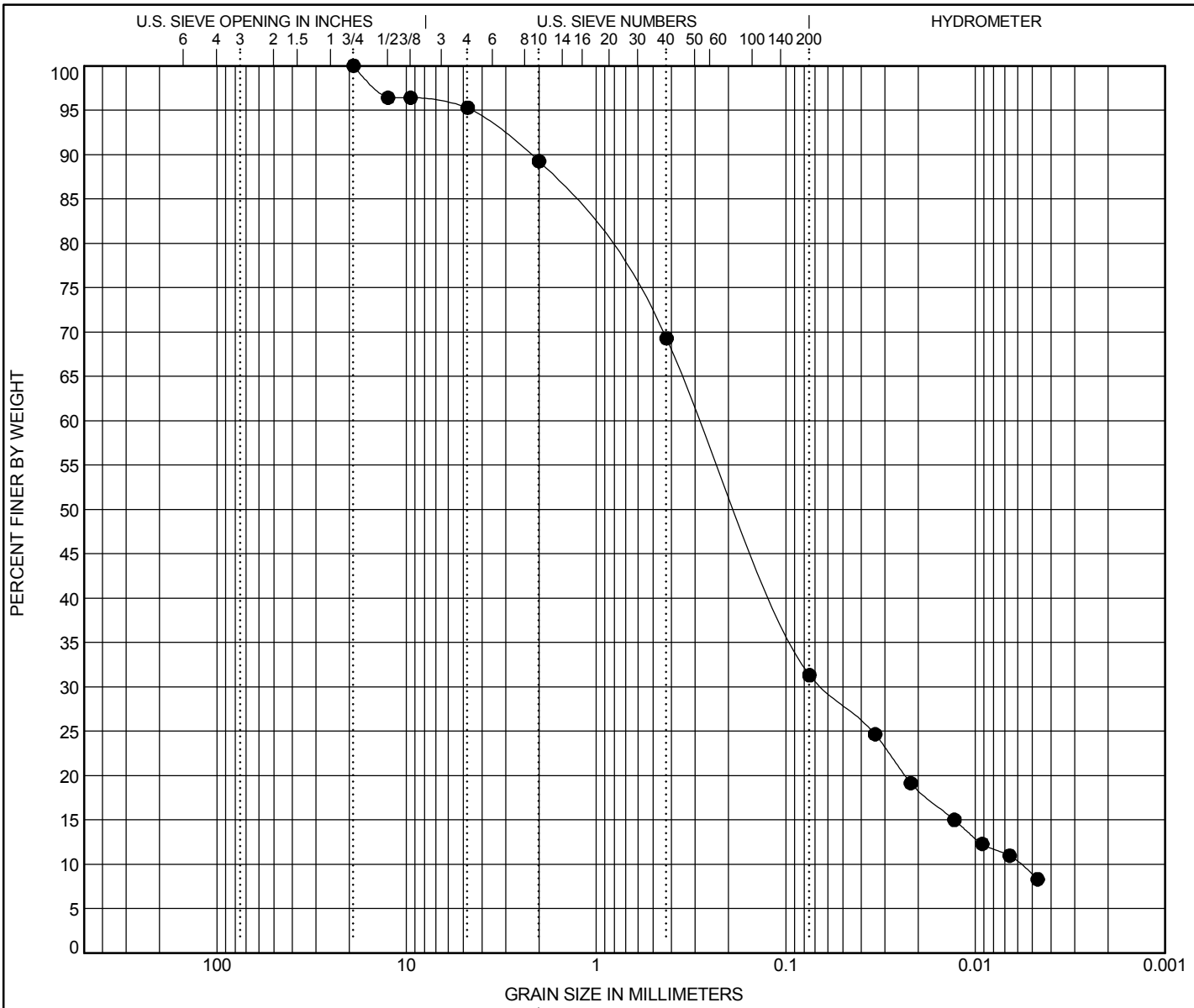

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-002-0-16	**13.5**	**A-3a(0)**	**15**	**NP**	**NP**	**NP**	**2.54**	**47.61**

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-002-0-16	**13.5**	**19**	**0.278**	**0.176**	**0.064**	**0.006**	**11**	**20**	**38**	**22**	**9**

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GRAIN SIZE DISTRIBUTION

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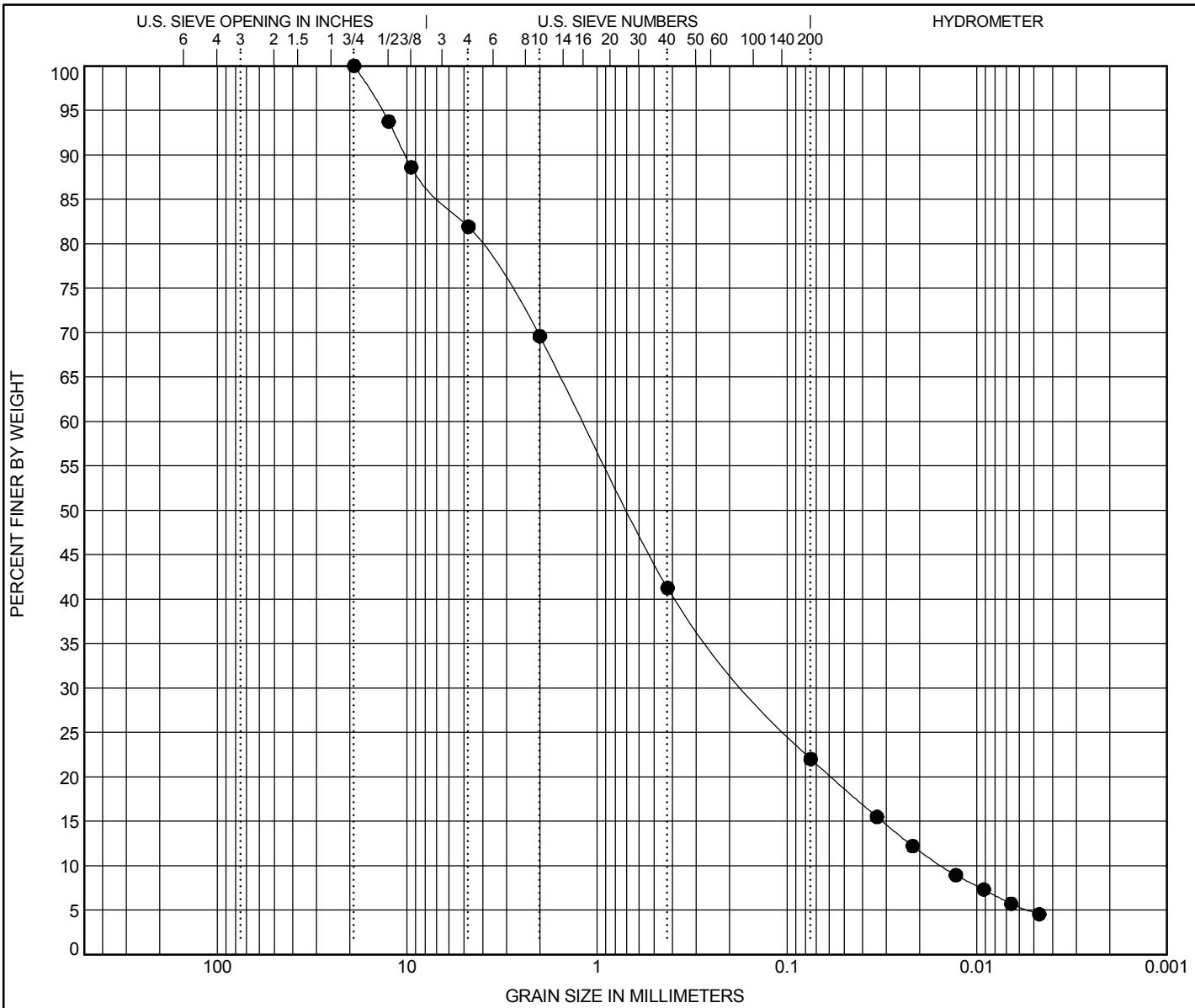

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-002-0-16	**28.5**	**A-1-b(0)**	**17**	**NP**	**NP**	**NP**	**1.31**	**77.23**

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-002-0-16	**28.5**	**19**	**1.185**	**0.686**	**0.154**	**0.015**	**31**	**28**	**19**	**17**	**5**

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GRAIN SIZE DISTRIBUTION

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Location:FRA COUNTY
CTL Project Number:

APPENDIX D
BEARING RESISTANCE CALCULATIONS

Project	**Borror Road Bridge over Patzer Ditch**
Project No.	**16050169COL**
Boring No.	**B-001-0-16**

Bearing Resistance- Strength Limit State

Cohesion, c	3.0	ksf		
Friction Angle, ϕ_b	0	Degrees		
Footing Width, B	9.00	feet		
Unit Wt. of Soil, γ	0.125	kcf		
Footing Length, L_f	35	ft		
Footing Embedment Depth, D_f	4.5	ft		
GW Depth Below Footing, D_W	0	ft		
Nom. Bearing Resistance, q_n	16.5	ksf	$=c_fN_cs_c+\gamma D_fN_qs_qd_qC_{Wq}+0.5\gamma BN_\gamma s_\gamma C_{W\gamma}$	
Where				
N_c	5.14			
N_q	1		Table 10.6.3.1.2a-1	
N_γ	0			
s_c	1.05		$=1+(B/L_f)*(N_q/N_c)$; or $1+(B/5Lf)$ for $\phi = 0$	
s_q	1.00		$=1+(B/L_f)*\tan\phi_f$; or 1.0 for $\phi = 0$	Table 10.6.3.1.2a-3
s_γ	1.00		$=1-0.4*(B/L_f)$; or 1.0 for $\phi = 0$	
C_{Wq}	0.50		Table 10.6.3.1.2a-2	
$C_{W\gamma}$	0.50			
$1.5B+D_f$	18.00	ft	For Cw Check	
D_f/B	0.50		For dq by Hansen 1970	
d_q	1.00		Hansen 1970 or Table 10.6.3.1.2a-4	
Fact. Bearing Resistance, q_r	8.2	ksf	$=\phi_b*q_n$	
Resistance Factor, ϕ_b	0.5		Table 10.5.5.2.2-1	

Bearing Resistance- Service Limit State

Pres. Bearing Resistance, qr	8.0	ksf	Table C10.6.2.6.1-1
Resistance Factor, ϕ_r	1.0		Section 11.5.7

Project	**Borror Road Bridge over Patzer Ditch**
Project No.	**16050169COL**
Boring No.	**B-002-0-16**

Bearing Resistance- Strength Limit State

Cohesion, c	0.0	ksf		
Friction Angle, ϕ_b	30	Degrees		
Footing Width, B	9.00	feet		
Unit Wt. of Soil, γ	0.125	kcf		
Footing Length, L_f	35	ft		
Footing Embedment Depth, D_f	4.5	ft		
GW Depth Below Footing, D_W	0	ft		
Nom. Bearing Resistance, q_n	12.5	ksf	$=c_fN_cs_c+\gamma D_fN_qs_qd_qC_{Wq}+0.5\gamma BN_\gamma s_\gamma C_{W\gamma}$	
Where				
N_c	30.1			
N_q	18.4		Table 10.6.3.1.2a-1	
N_γ	22.4			
s_c	1.16		$=1+(B/L_f)*(N_q/N_c)$; or 1+(B/5Lf) for $\phi = 0$	
s_q	1.15		$=1+(B/L_f)\cdot\tan\phi_f$; or 1.0 for $\phi = 0$	Table 10.6.3.1.2a-3
s_γ	0.90		$=1-0.4*(B/L_f)$; or 1.0 for $\phi = 0$	
C_{Wq}	0.50		Table 10.6.3.1.2a-2	
$C_{W\gamma}$	0.50			
$1.5B+D_f$	18.00	ft	For Cw Check	
D_f/B	0.50		For dq by Hansen 1970	
d_q	1.14		Hansen 1970 or Table 10.6.3.1.2a-4	
Fact. Bearing Resistance, q_r	5.6	ksf	$=\phi_b*q_n$	
Resistance Factor, ϕ_b	0.45		Table 10.5.5.2.2-1	

Bearing Resistance- Service Limit State

Pres. Bearing Resistance, qr	5.0	ksf	Table C10.6.2.6.1-1
Resistance Factor, ϕ_r	1.0		11.5.7