CTL Engineering, Inc.
2860 Fisher Road, P.O. Box 44548, Columbus, Ohio 43204-3538
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Email: ctl@ctleng.com

AN EMPLOYEE OWNED COMPANY

Consulting Engineers • Testing • Inspection Services • Analytical Laboratories

Established 1927

December 2, 2021

Union County Engineer
233 W. Sixth Street
Marysville, Ohio 43040

Attention: Josh Holtschulte

Reference: Drilling and Laboratory Testing Services
UNI-CR194-2.305 Bridge Replacement
Union County, Ohio
CTL Project No. 21050110COL

Dear Mr. Holtschulte:

CTL Engineering, Inc. has completed the test borings and laboratory testing for the above referenced project.

An electronic copy of this letter, test boring records, laboratory test results and photos of the rock cores are being submitted.

We appreciate the opportunity to work with you on this project. If you have any questions or need further information, please do not hesitate to contact our office.

Respectfully submitted,

CTL ENGINEERING, INC.

Sastry M.V.S

Sastry Malladi, P.E
Department Manager, Geotechnical Services

Enclosures

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

GTL ENGINEERING INC

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 12/2/21 15:09 - J:\DEPT5\21 PROJECTS\21050110COL-UNI-CR194-2.305 BRIDGE REPLACEMENT\REPORTS\LOGS\21050110COL.GPJ

PROJECT: UNI-CR194-2.305	DRILLING FIRM / OPERATOR: CTL / JS	DRILL RIG: CME 550X #489 ATV	STATION / OFFSET:
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: CTL / J.S	HAMMER: CME AUTOMATIC	ALIGNMENT:
PID: N/A SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/13/21	ELEVATION: 100.0 (MSL) EOB: 28.5 ft.
START: 11/15/21 END: 11/16/21	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 80.2	COORD: Not Recorded

EXPLORATION ID B-001-0-21

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 100.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT, (6")	99.5																	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, (FILL), DAMP		1 2	8 9 7	21	100	SS-1	-	49	18	11	15	7	NP	NP	NP	4	A-1-b (0)	
@ 3.5'; BECOMES LOOSE TO VERY LOOSE		3 4 5	5 3 3	8	100	SS-2	-	-	-	-	-	-	-	-	-	3	A-1-b (V)	
		6 7 W 92.5	3 2 1	4	100	SS-3	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
	91.5	8																
MEDIUM STIFF, BROWN, **CLAY**, AND SILT, TRACE SAND, TRACE GRAVEL, MOIST	90.0	9	0 0 1	1	100	SS-4	1.00	1	1	3	44	51	46	26	20	30	A-7-6 (13)	
VERY STIFF, BROWN, **SILT AND CLAY**, LITTLE GRAVEL, LITTLE SAND, DAMP		10 11	2 3 4	9	100	SS-5	2.25	13	6	7	36	38	34	21	13	15	A-6a (9)	
	87.0	12 13	3 3 2	7	100	SS-6	1.75	10	6	10	37	37	35	21	14	16	A-6a (9)	
MEDIUM STIFF, BROWN, **SANDY SILT**, LITTLE GRAVEL, SOME CLAY, MOIST		14 15	4 6 7	17	100	SS-7	0.50	14	9	12	42	23	24	16	8	19	A-4a (6)	
	84.0	TR 16																
SHALE, GRAY, HIGHLY WEATHERED, SLIGHTLY STRONG.		17	21 39 46	114	100	SS-8	-	-	-	-	-	-	-	-	-	9	Rock (V)	
	81.5	18	50/2"	-	33	SS-9	-	-	-	-	-	-	-	-	-	12	Rock (V)	
LIMESTONE, BROWN, HIGHLY WEATHERED, STRONG, DOLOMITIC, VUGGY; RQD 18%, REC 63%. @20.3'; GRAY, UNWEATHERED, VERY STRONG. @20.8'; BROWN, HIGHLY WEATHERED, STRONG, VUGGY. @ 21.8' - 22.1'; Qu=9,199 psi		19 20 21 22 23	23		66	NQ-1											CORE	
	75.1	24																
SHALE, GRAY, UNWEATHERED, VERY WEAK, FRIABLE; RQD 21%, REC 94%.		25 26	10		83	NQ-2											CORE	
	72.7	27																
LIMESTONE, BROWN, HIGHLY WEATHERED, STRONG, DOLOMITIC; RQD 0%, REC 97%.	71.5	28 EOB																

NOTES: CAVED AT 7.1', GROUND SURFACE ELEVATION AT TEST BORING LOCATION WAS ASSUMED AS 100 FEET

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; BACKFILLED WITH BENTONITE GROUT

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 12/2/21 15:09 - J:\DEPT5\21 PROJECTS\21050110COL-UNI-CR194-2.305 BRIDGE REPLACEMENT\REPORTS\LOGS\21050110COL.GPJ

PROJECT: UNI-CR194-2.305	DRILLING FIRM / OPERATOR: CTL / JS	DRILL RIG: CME 550X #489 ATV	STATION / OFFSET:
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: CTL / J.S	HAMMER: CME AUTOMATIC	ALIGNMENT:
PID: N/A SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/13/21	ELEVATION: 100.0 (MSL) EOB: 34.0 ft.
START: 11/16/21 END: 11/17/21	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 80.2	COORD: Not Recorded

EXPLORATION ID B-002-0-21

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)	HOLE SEALED
ASPHALT, (4")	100.0 / 99.7																	
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, (FILL), DAMP	96.5	1–2	4 5 4	12	56	SS-1	-	46	18	11	17	8	NP	NP	NP	5	A-1-b (0)	
STIFF TO VERY STIFF, BROWN, **CLAY**, AND SILT, LITTLE SAND, TRACE GRAVEL, MOIST	91.5	3–5	3 2 3	7	89	SS-2	2.50	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
		6–7	2 2 2	5	56	SS-3	1.00	1	1	14	50	34	44	25	19	30	A-7-6 (12)	
SOFT, BROWN, **SANDY SILT**, SOME GRAVEL, TRACE CLAY, MOIST	90.0	9	1 1 1	3	100	SS-4	0.50	-	-	-	-	-	-	-	-	26	A-4a (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP	88.5	11	5 5 5	13	67	SS-5	-	22	31	15	19	13	18	15	3	8	A-2-4 (0)	
STIFF, BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, CONTAINS LIMESTONE FRAGMENTS, DAMP		12	4 3 3	8	11	SS-6	-	-	-	-	-	-	-	-	-	12	A-4a (V)	
		14	5 10 12	29	33	SS-7	1.50	22	15	15	32	16	19	14	5	14	A-4a (3)	
		W 84.0																
@ 16.0'; BECOMES HARD		16–17	23 19 20	52	100	SS-8	4.50	16	11	15	35	23	22	14	8	8	A-4a (5)	
		19–20	9 17 17	45	100	SS-9	4.50	-	-	-	-	-	-	-	-	8	A-4a (V)	
SHALE, BROWN, SEVERLY WEATHERED, VERY WEAK.	78.5	TR 22	17 29 50/1"	-	100	SS-10	-	-	-	-	-	-	-	-	-	5	Rock (V)	
	76.0	24	50/5"	-	100	SS-11	-	-	-	-	-	-	-	-	-	8	Rock (V)	
SHALE, GRAY, UNWEATHERED, VERY WEAK, FRIABLE; RQD 0%, REC 94%.	75.2																	
LIMESTONE, BROWN, HIGHLY WEATHERED, VERY STRONG, DOLOMITIC; RQD 51%, REC 91%.		25–29	16		86	NQ-1											CORE	
@28.3'; CONTAINS INTERBEDDED GRAY SHALE.																		
@ 29.0'-29.3'; Qu=19,688 psi																		

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 12/2/21 15:09 - J:\DEPT5\21 PROJECTS\21050110COL-UNI-CR194-2.305 BRIDGE REPLACEMENT\REPORTS\LOGS\21050110COL.GPJ

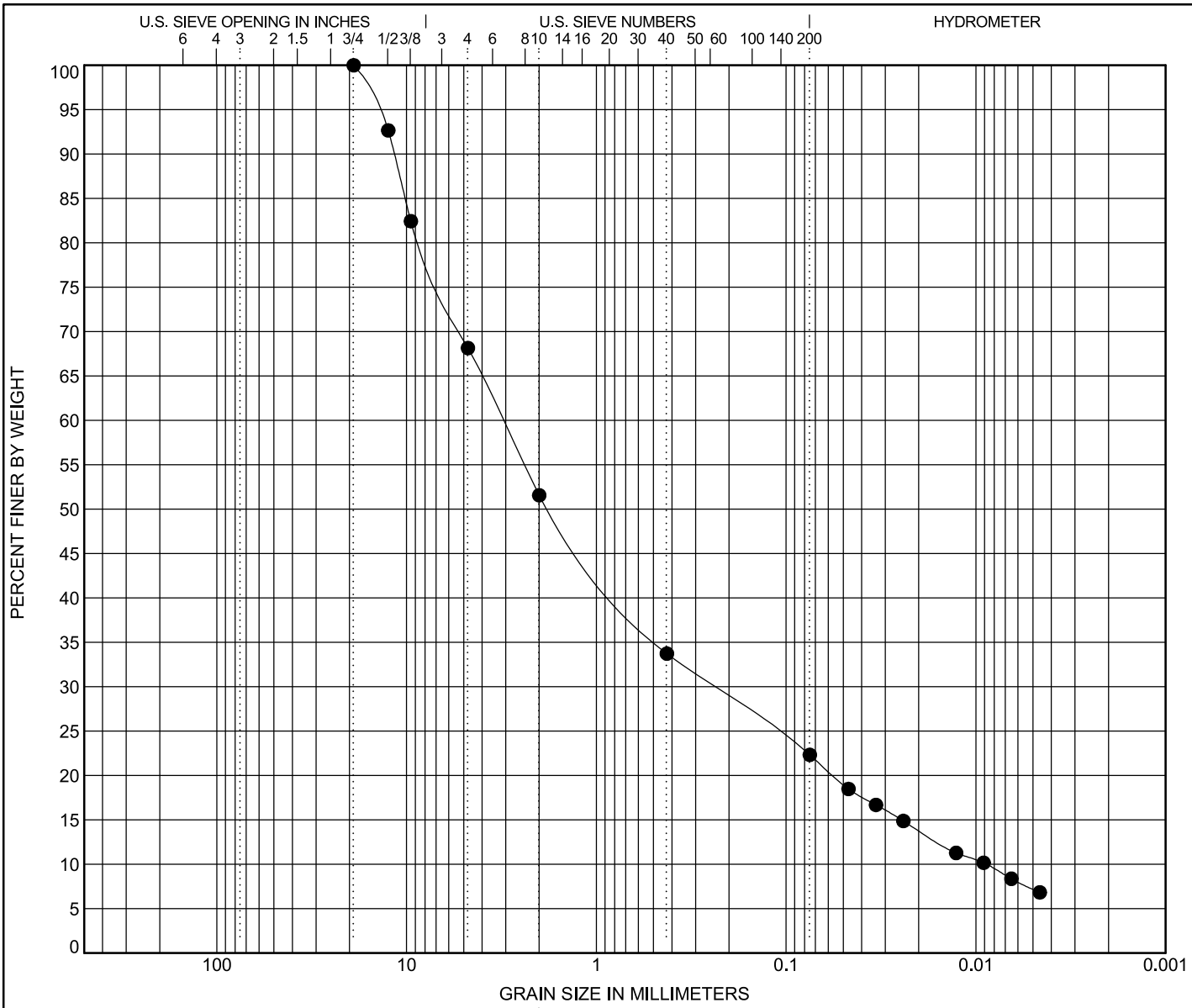
PID: N/A	SFN:	PROJECT: UNI-CR194-2.305	STATION / OFFSET:	START: 11/16/21	END: 11/17/21	PG 2 OF 2	B-002-0-21

MATERIAL DESCRIPTION AND NOTES	ELEV. 70.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
LIMESTONE, BROWN, HIGHLY WEATHERED, VERY STRONG, DOLOMITIC; RQD 51%, REC 91%. *(continued)*	66.0	31 32 33 EOB 34	78		97	NQ-2											CORE	

NOTES: CAVED AT 5.9', GROUND SURFACE ELEVATION AT TEST BORING LOCATION WAS ASSUMED AS 100 FEET

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; BACKFILLED WITH BENTONITE GROUT

LABORATORY TEST RESULTS



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-001-0-21	**1.0**	**A-1-b(0)**	**4**	**NP**	**NP**	**NP**	**2.12**	**352.33**

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-001-0-21	**1.0**	**19**	**3.106**	**1.746**	**0.241**	**0.009**	**49**	**18**	**11**	**15**	**7**

CTL ENGINEERING

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GRAIN SIZE DISTRIBUTION

Project: UNI-CR194-2.305
Location:UNI COUNTY
CTL Project Number:

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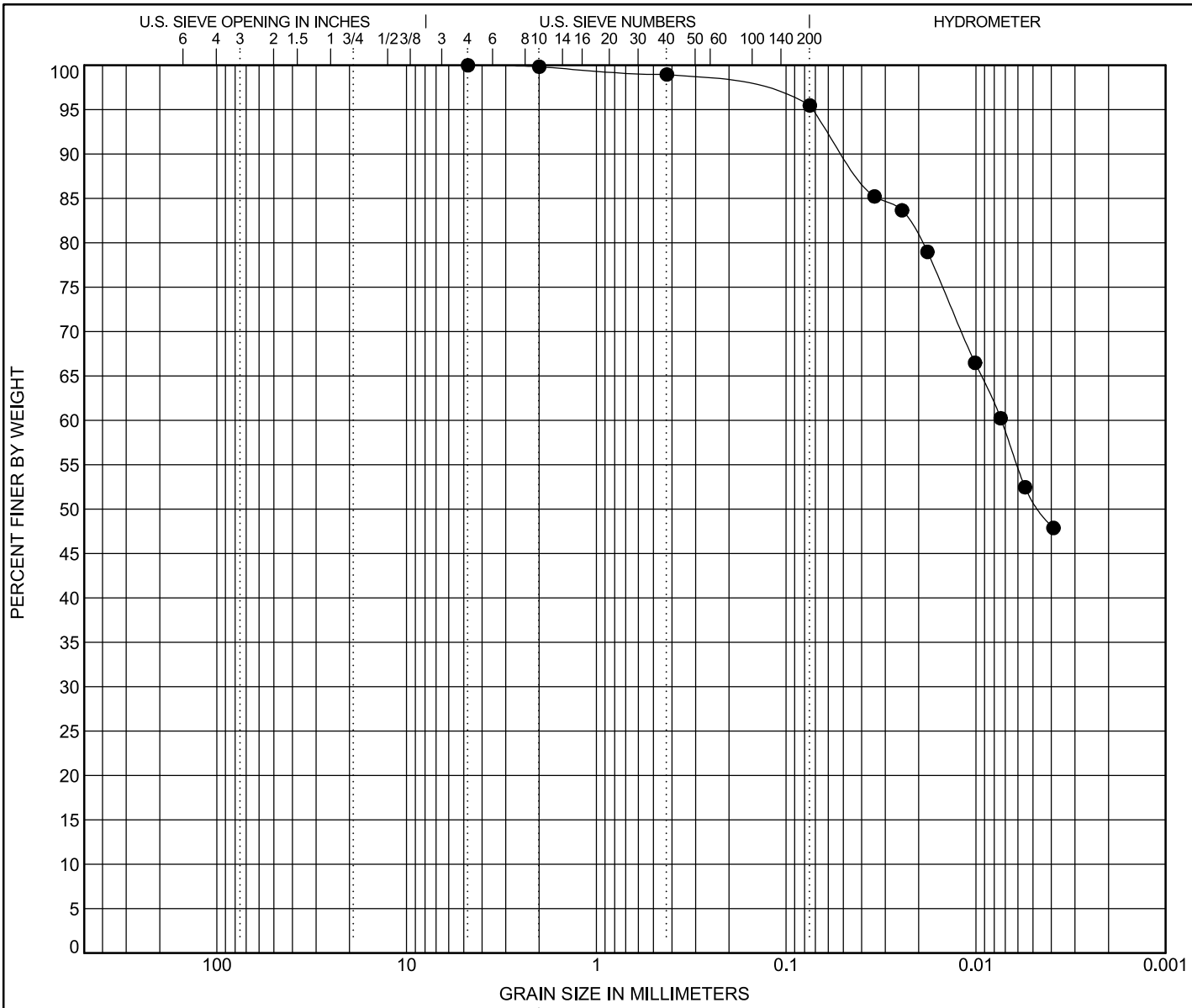

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-001-0-21	**8.5**	**A-7-6(13)**	**30**	**46**	**26**	**20**		

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-001-0-21	**8.5**	**4.75**	**0.007**	**0.005**			**1**	**1**	**3**	**44**	**51**

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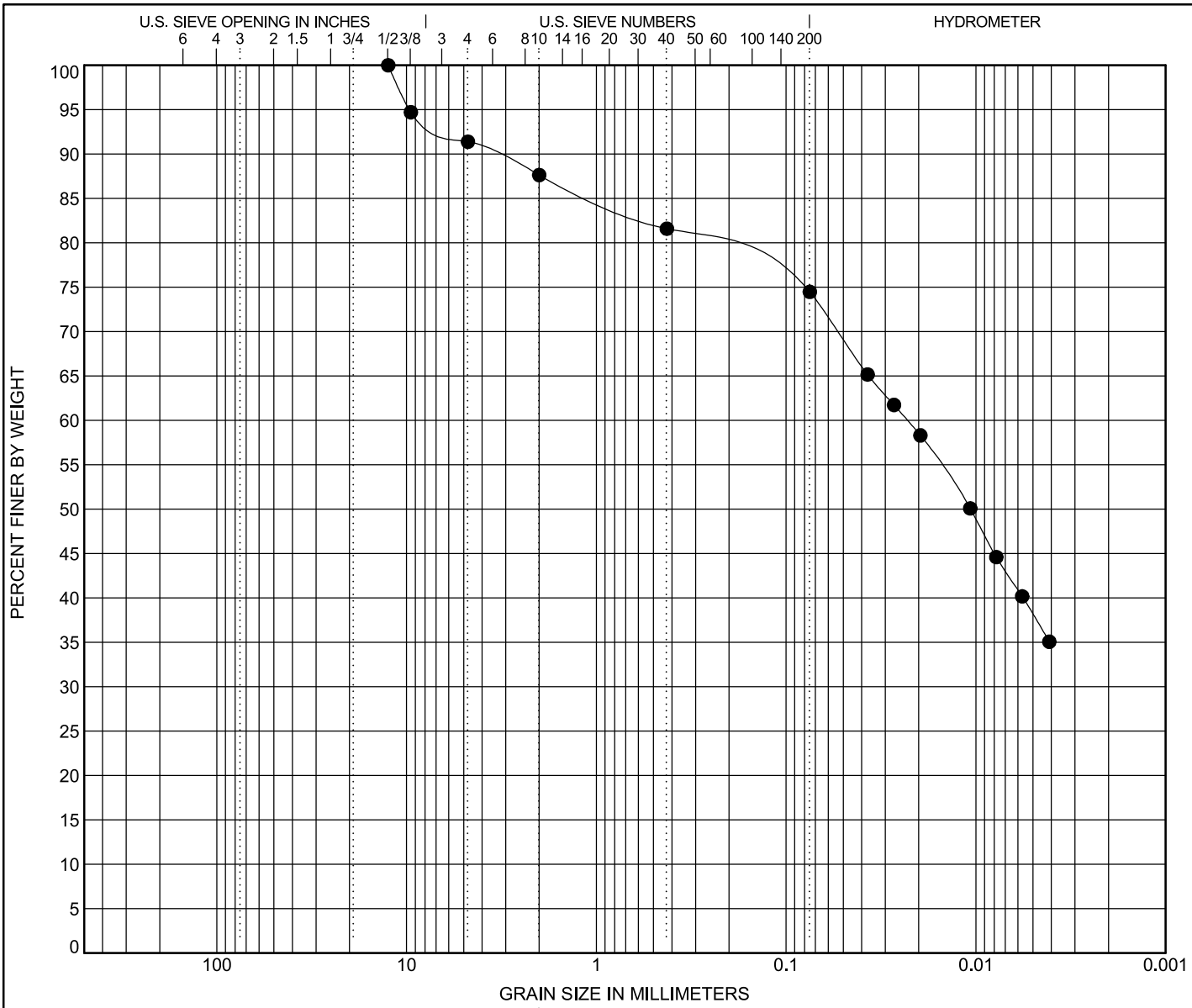

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-001-0-21	**10.0**	**A-6a(9)**	**15**	**34**	**21**	**13**		

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-001-0-21	**10.0**	**12.5**	**0.023**	**0.011**			**13**	**6**	**7**	**36**	**38**

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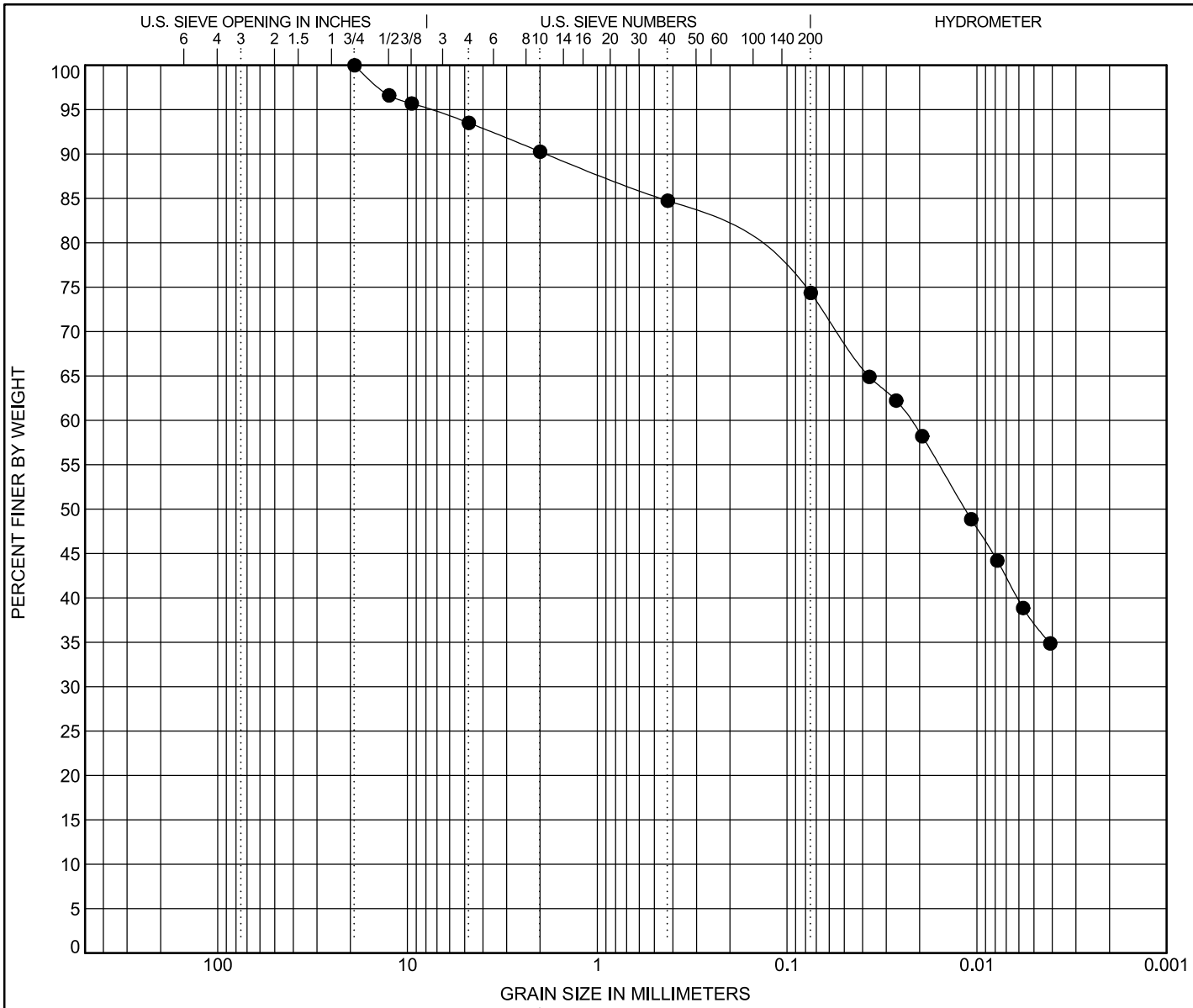

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-001-0-21	**11.5**	**A-6a(9)**	**16**	**35**	**21**	**14**		

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-001-0-21	**11.5**	**19**	**0.022**	**0.012**			**10**	**6**	**10**	**37**	**37**

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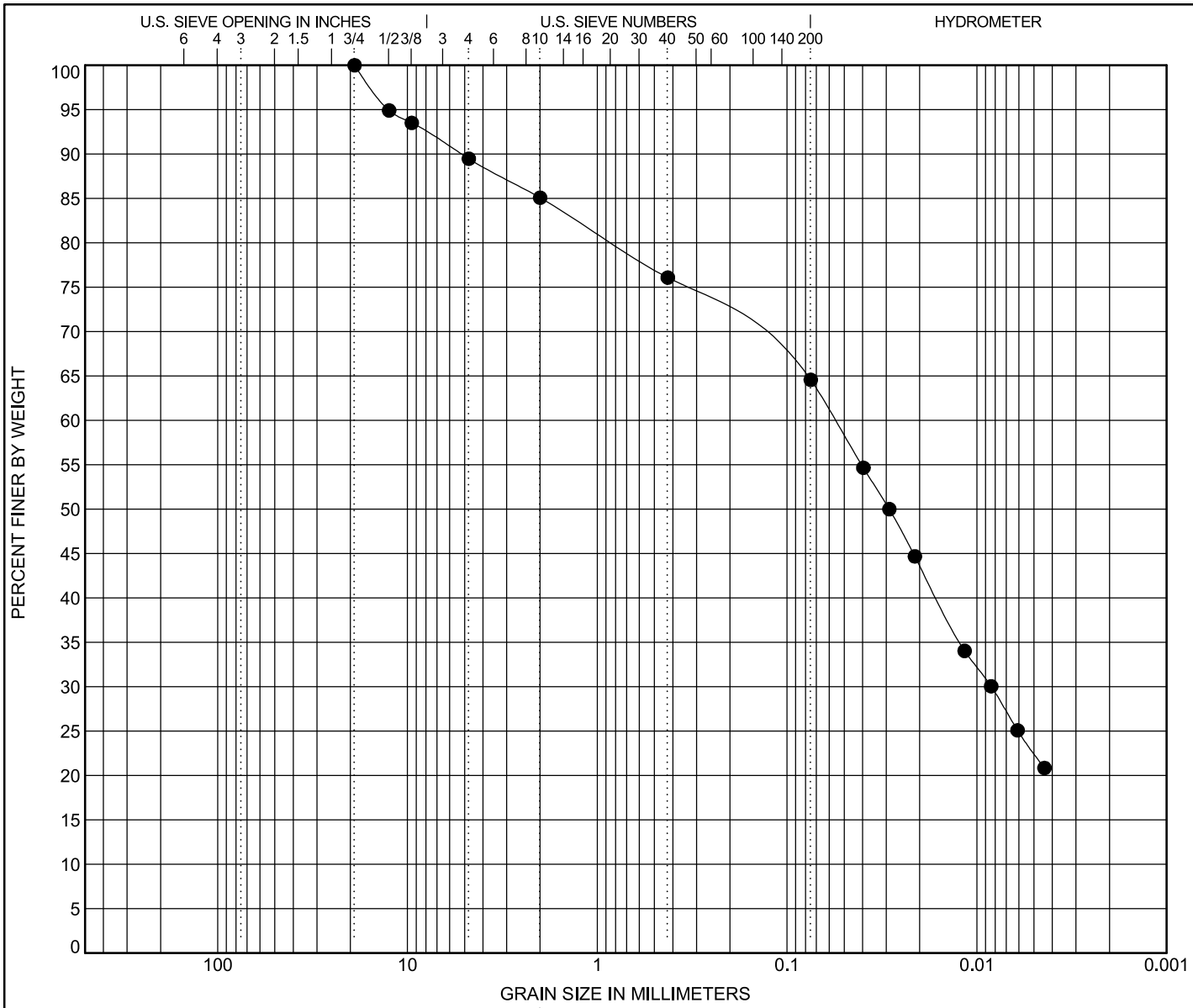

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-001-0-21	**13.0**	**A-4a(6)**	**19**	**24**	**16**	**8**		

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-001-0-21	**13.0**	**19**	**0.056**	**0.029**	**0.008**		**14**	**9**	**12**	**42**	**23**

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Location:UNI COUNTY
CTL Project Number:

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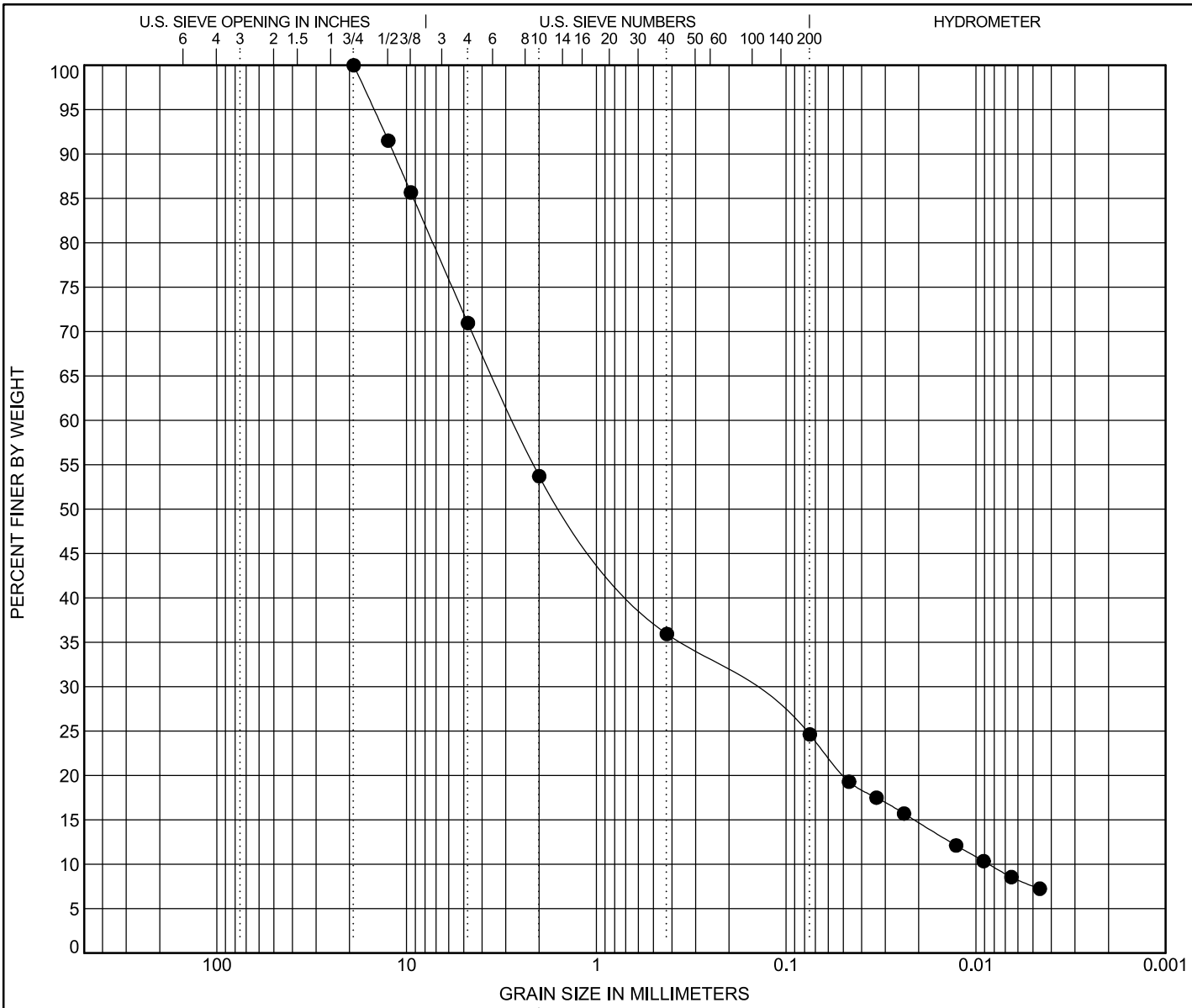

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-002-0-21	**1.0**	**A-1-b(0)**	**5**	**NP**	**NP**	**NP**	**1.25**	**321.61**

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-002-0-21	**1.0**	**19**	**2.742**	**1.448**	**0.171**	**0.009**	**46**	**18**	**11**	**17**	**8**

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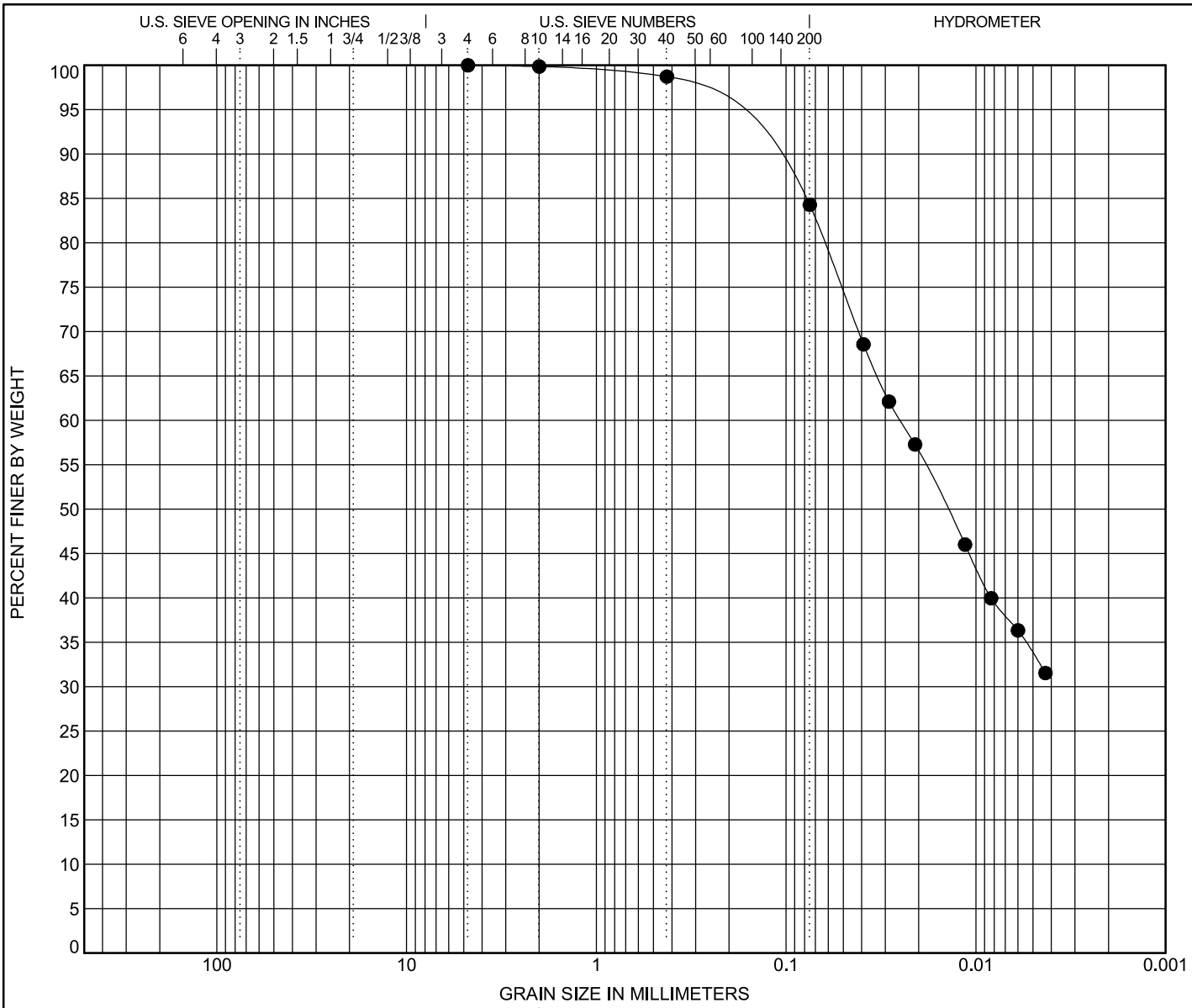

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-002-0-21	**6.0**	**A-7-6(12)**	**30**	**44**	**25**	**19**		

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-002-0-21	**6.0**	**4.75**	**0.025**	**0.014**			**1**	**1**	**14**	**50**	**34**

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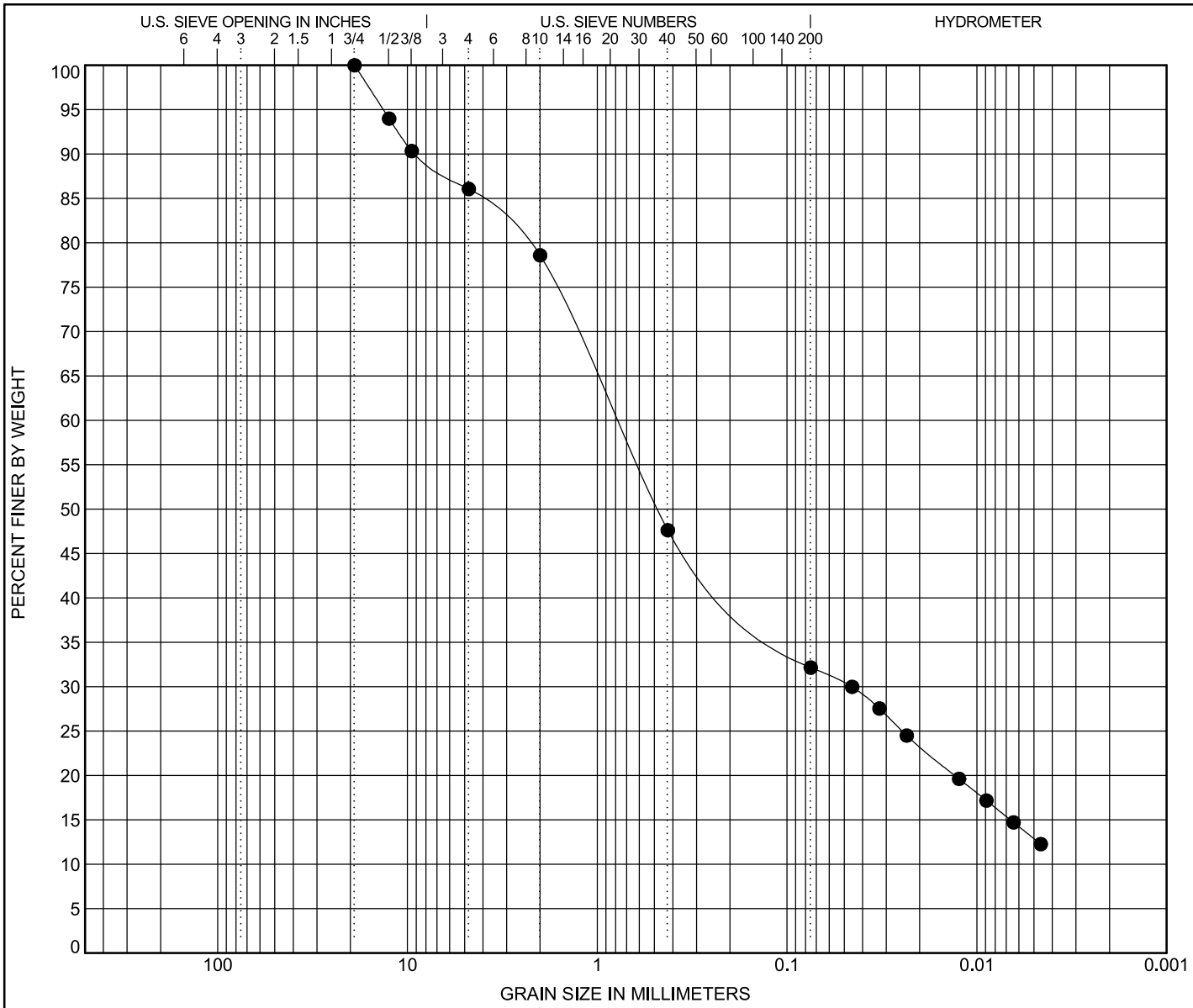

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-002-0-21	**10.0**	**A-2-4(0)**	**8**	**18**	**15**	**3**		

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-002-0-21	**10.0**	**19**	**0.789**	**0.479**	**0.046**		**22**	**31**	**15**	**19**	**13**

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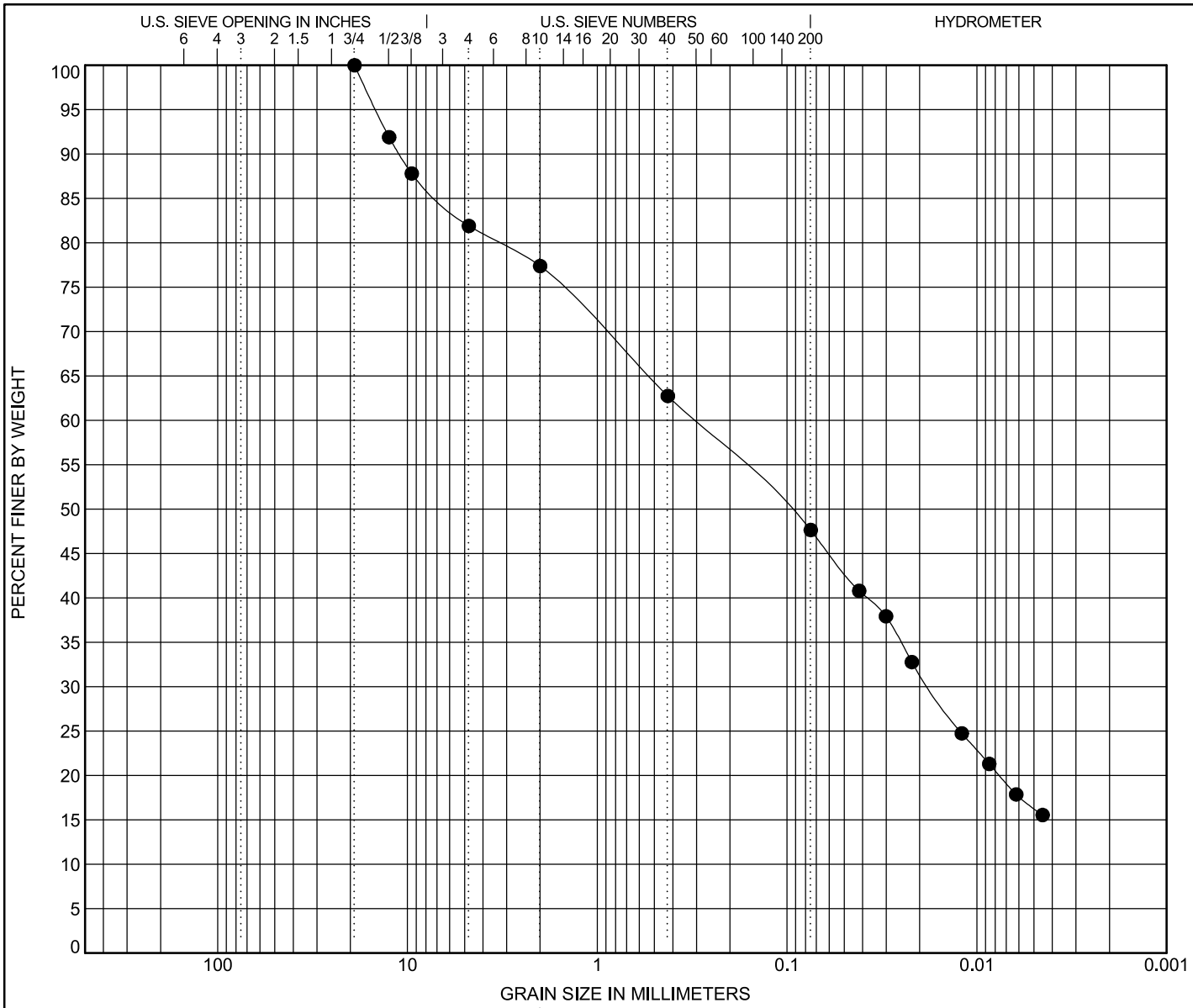

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-002-0-21	**13.0**	**A-4a(3)**	**14**	**19**	**14**	**5**		

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-002-0-21	**13.0**	**19**	**0.31**	**0.098**	**0.018**		**22**	**15**	**15**	**32**	**16**

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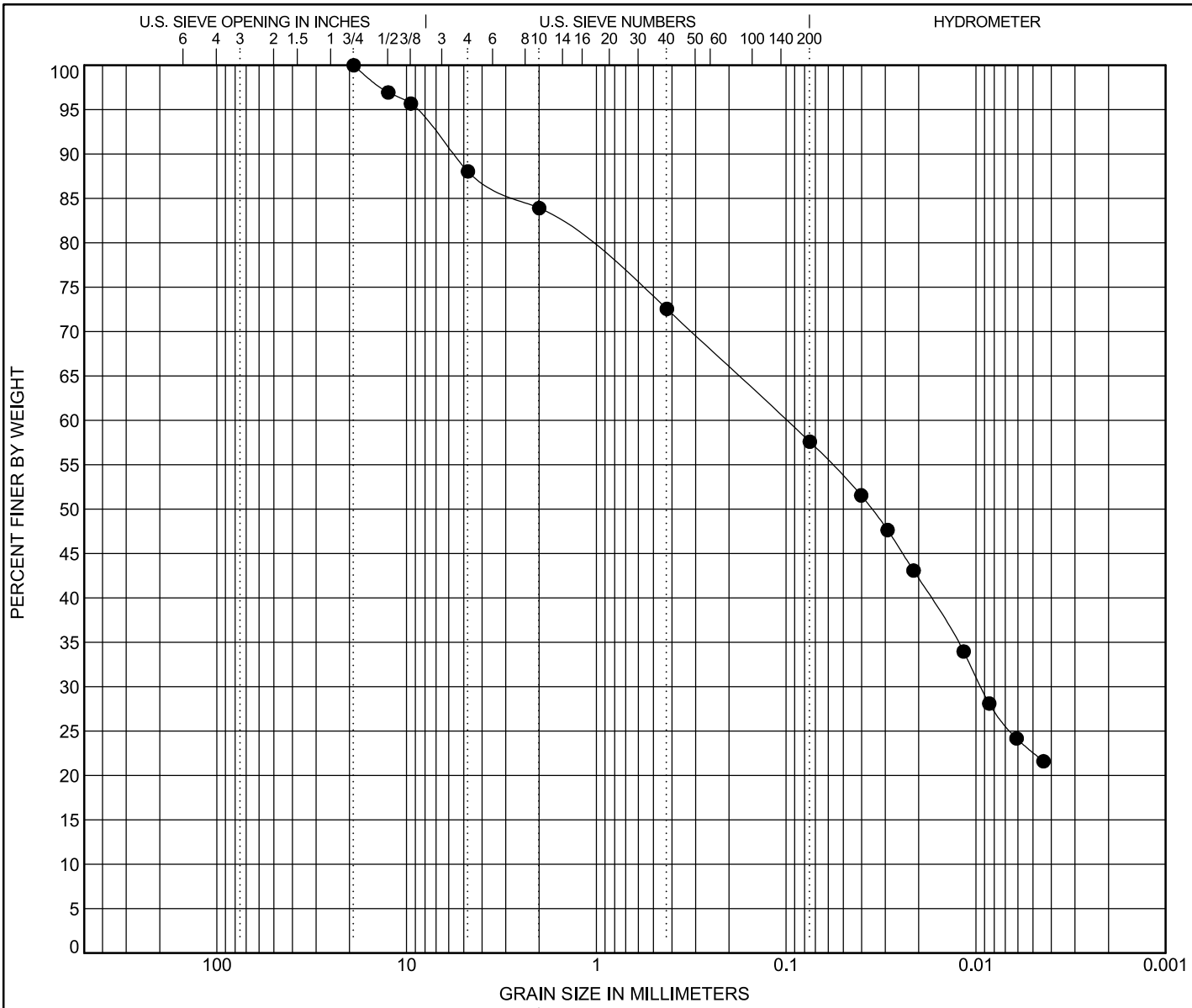
CTL Project Number:

CTL GRADATION - 2014 ODOT.GDT - 12/2/21 12:53 - J:\DEPT5\21 PROJECTS\21050110COL-UNI-CR194-2.305 BRIDGE REPLACEMENT\REPORTS\LOGS\21050110COL.GPJ



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-002-0-21	**16.0**	**A-4a(5)**	**8**	**22**	**14**	**8**		

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-002-0-21	**16.0**	**19**	**0.099**	**0.035**	**0.009**		**16**	**11**	**15**	**35**	**23**

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

GRAIN SIZE DISTRIBUTION

Project: UNI-CR194-2.305
Location:UNI COUNTY
CTL Project Number:

CTL GRADATION - 2014 ODOT.GDT - 12/2/21 12:53 - J:\DEPT5\21 PROJECTS\21050110COL-UNI-CR194-2.305 BRIDGE REPLACEMENT\REPORTS\LOGS\21050110COL.GPJ

PROJECT NO:	21050110COL
DATE:	11/23/2021

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012

Method C

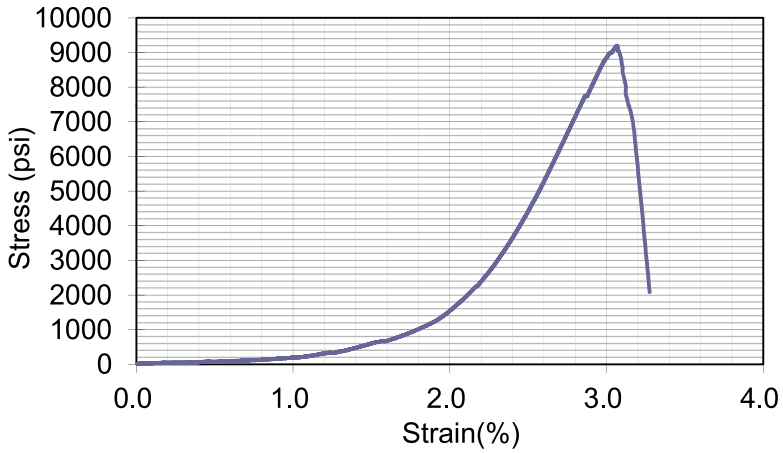
BORING NUMBER	B-001-0-21	TOP DEPTH(FT)	21.8	BOTTOM DEPTH(FT)	22.1
SAMPLE NUMBER	NQ-2	DISTRICT	6	PID NO.	NA
COUNTY	Union	ROUTE	NA	SECTION	NA

FORMATION	Pennsylvanian age, Monongahela Group
DESCRIPTION	Limestone, Brown, Highly Weathered Strong, Dolomitic
MOISTURE CONDITION	As Received

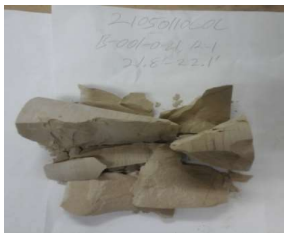
MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.059	1.974
2	4.065	1.979
3	4.059	1.979
AVERAGE	4.061	1.977

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN^2)	3.1
MASS (GRAMS)	508.8
UNIT WEIGHT(LBS/FT^3)	155.4

RATE OF LOADING (in/min)
0.09
COMPRESSIVE STRENGTH (PSI)
9,199
Equip. ID - 68897
NON-CONFORMANCES - None
TIME OF TEST (MINUTES)
1.56
LOADING DIRECTION
PERP. TO BEDDING
TECHNICIAN - MW
TEMPERATURE - Room



BEFORE TESTING



AFTER TESTING

PROJECT NO:	21050110COL
DATE:	11/24/2021

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012

Method C

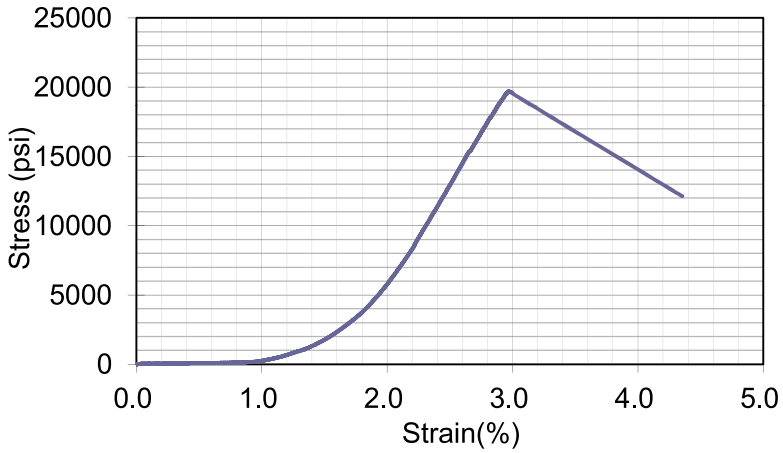
BORING NUMBER	B-002-0-21	TOP DEPTH(FT)	29.0	BOTTOM DEPTH(FT)	29.3
SAMPLE NUMBER	NQ-2	DISTRICT	6	PID NO.	NA
COUNTY	Union	ROUTE	NA	SECTION	NA

FORMATION	Pennsylvanian age, Monongahela Group
DESCRIPTION	Limestone, Light gray, Moderatley Weathered Very Strong, Dolomitic
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.069	1.980
2	4.070	1.979
3	4.068	1.984
AVERAGE	4.069	1.981

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN^2)	3.1
MASS (GRAMS)	559.0
UNIT WEIGHT(LBS/FT^3)	169.8

RATE OF LOADING (in/min)
0.08
COMPRESSIVE STRENGTH (PSI)
19,688
Equip. ID - 68897
NON-CONFORMANCES - None
TIME OF TEST (MINUTES)
2.34
LOADING DIRECTION
PERP. TO BEDDING
TECHNICIAN - MW
TEMPERATURE - Room



BEFORE TESTING

AFTER TESTING

ROCK CORE PHOTOS

B-001-0-21

Run #	Depth (ft)		Recovery (in)		RQD (in)	
NQ-1	18.5	23.5	39.5/60	66%	13.5/60	23%
NQ-2	23.5	28.5	50/60	83%	6/60	10%

B-002-0-21

Run #	Depth (ft)		Recovery (in)		RQD (in)	
NQ-1	18.5	23.5	51.5/60	86%	9.5/60	16%
NQ-2	23.5	28.5	55/60	97%	46.5/60	78%