

**CONSOLIDATED UNDRAINED TRIAXIAL TEST ON COHESIVE SOILS
AASHTO T 297 & ASTM D4767**

CTL ENGINEERING, INC.

2860 Fisher Road Columbus, Ohio 43204

Client: HDR Engineering, Inc
 PID NO. 108676
 Project: MOE-7-7.55 (10-K)
 Location: Monroe County, Ohio
 Project No. 20050114COL
 County, Rt. & Sec.: MOE-7-7.55
 Station and Offset: NA
 Sample ID: B-002-1-20, ST-18, 26'-28'
 Lab Code No. NA
 Reviewed by: SM

Sample Type	Shelby Tube		
	8/21/2020	8/21/2020	8/21/2020
Date Set-up:	8/21/2020	8/21/2020	8/21/2020
Date Sheared:	8/24/2020	8/24/2020	8/25/2020
Avg. Sample Height (in.):	5.8420	5.8333	5.7993
Avg. Sample Diameter (in.):	2.8750	2.8750	2.8750
Height-to-diameter ratio:	2.03	2.03	2.02
Wet Density (pcf):	122.1	124.5	125.3
Dry Density (pcf):	98.2	99.7	100.8
Void Ratio:	0.747	0.721	0.702
Specific Gravity (assumed):	2.75	2.75	2.75
Moisture Content (%):	24.3	24.9	24.3
Cross Sectional Area (ft ²):	0.045	0.045	0.045
Volume (ft ³):	0.02	0.02	0.02
Confining Pressure (psf):	1584	3312	6624
Rate of Axial Strain (%/min):	0.2054	0.2057	0.2069
Compressive Strength (psf):	2414	3338	4904
Minor Principal Stress at Failure (psf):	1584	3312	6624
Major Principal Stress at Failure (psf):	3998	6650	11528
Failure Criterion (%):	Deviator Stress @ 15% Axial Strain		
β:	0.99	0.95	0.97
Specimen Saturation:	Wet Method		

Grading (ASTM D422)

% Agg:	0
% Sand:	25
% Silt:	47
% Clay:	28

Atterberg Limits (ASTM D 4318)

L.L.:	29
P.L.:	19
P.I.:	10

Visual Description: Brown Sandy Silt (A-4a), Some Clay,

POST SHEAR

1584 psf



POST SHEAR

3312 psf



POST SHEAR

6624 psf



Deviator Stress & Pore Pressure vs. Strain

CLIENT: HDR Engineering, Inc

Sample ID:

B-002-1-20, ST-18, 26'-28'

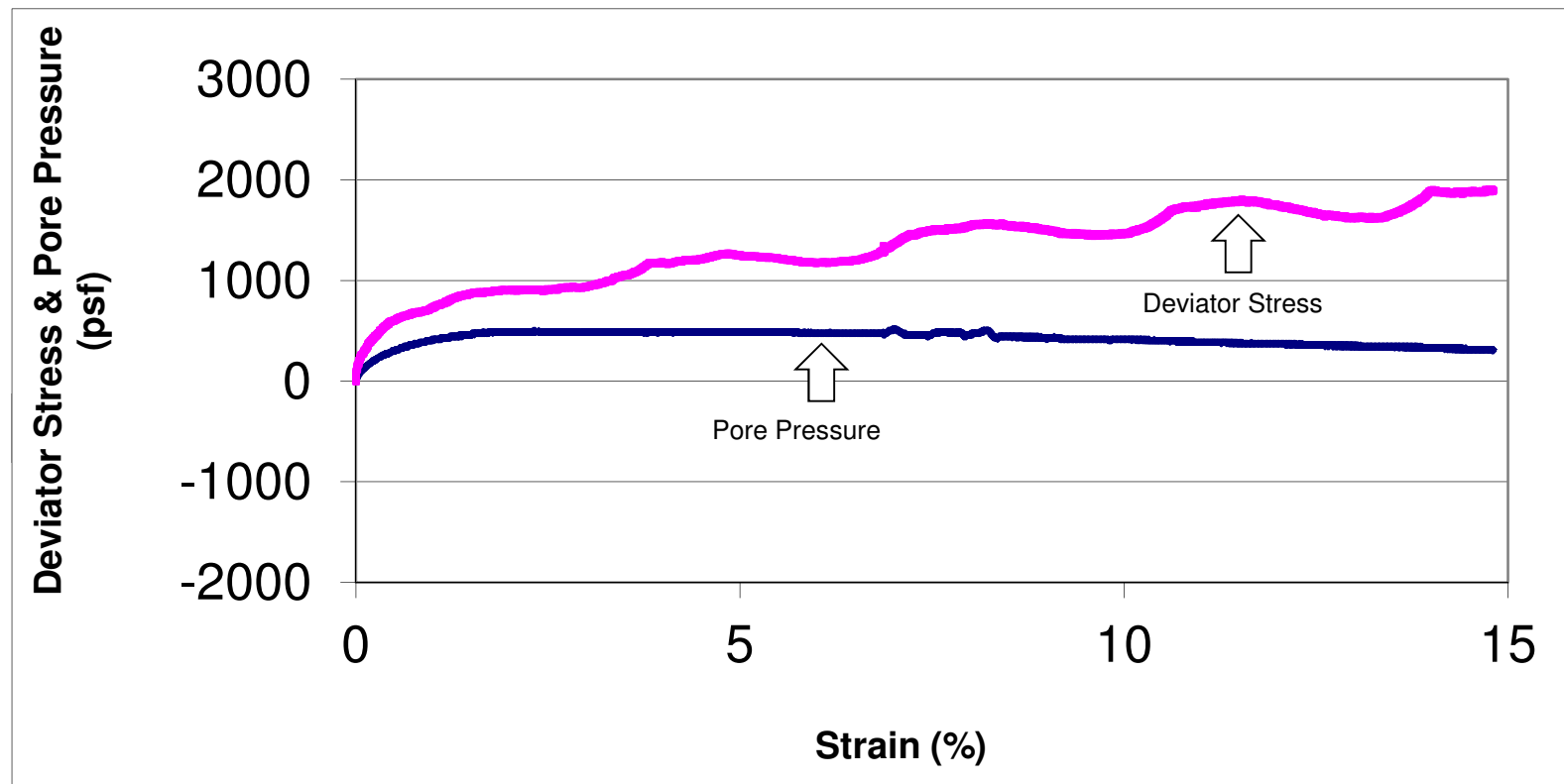
PROJECT: MOE-7-07.55 (Task 10-K)

Confining Pressure (psf):

1584

LOCATION: Monroe County, Ohio

PROJECT #: 20050114COL



Deviator Stress & Pore Pressure vs. Strain

CLIENT: HDR Engineering, Inc

Sample ID:

B-002-1-20, ST-18, 26'-28'

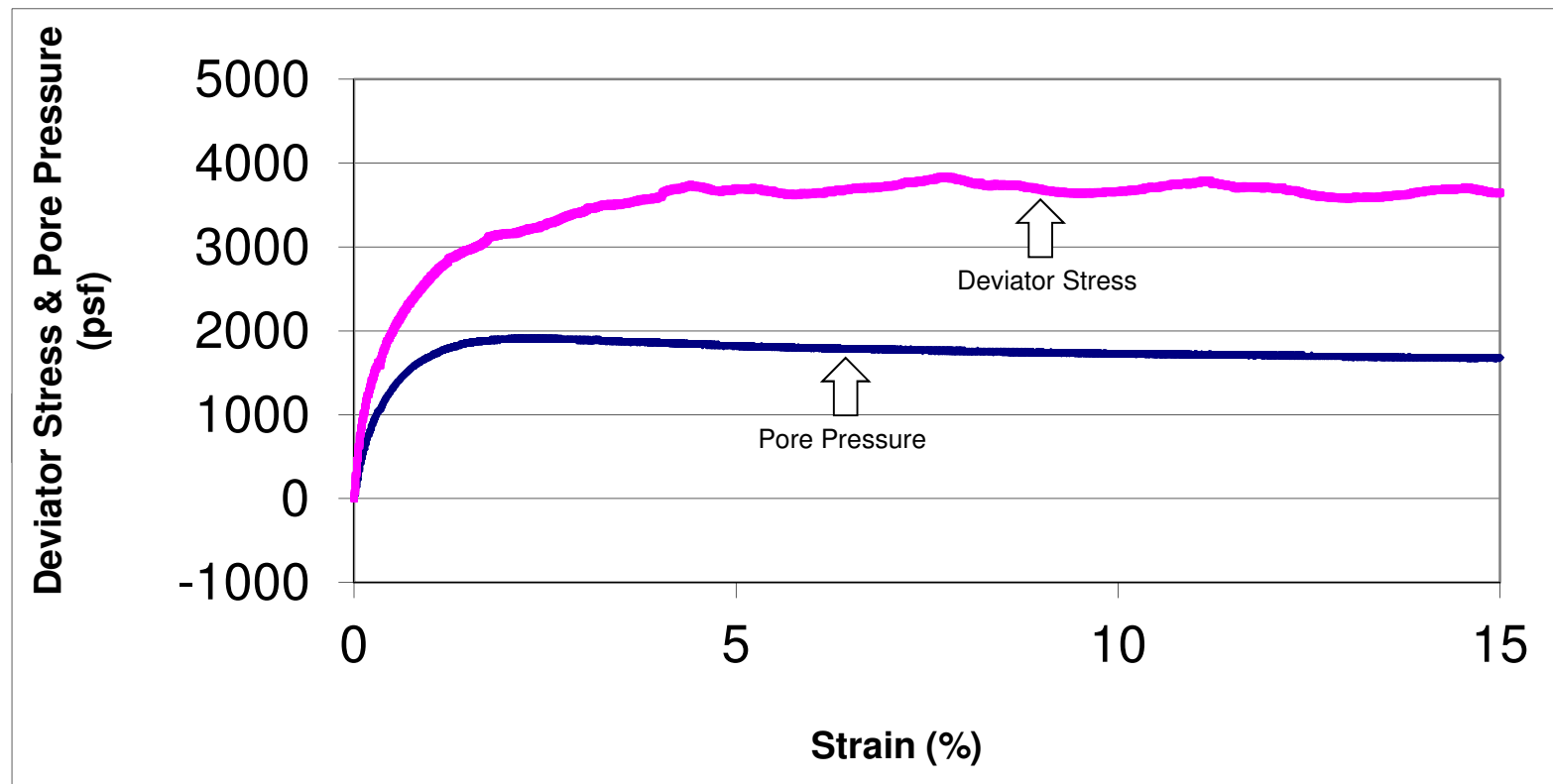
PROJECT: MOE-7-07.55 (Task 10-K)

Confining Pressure (psf):

3312

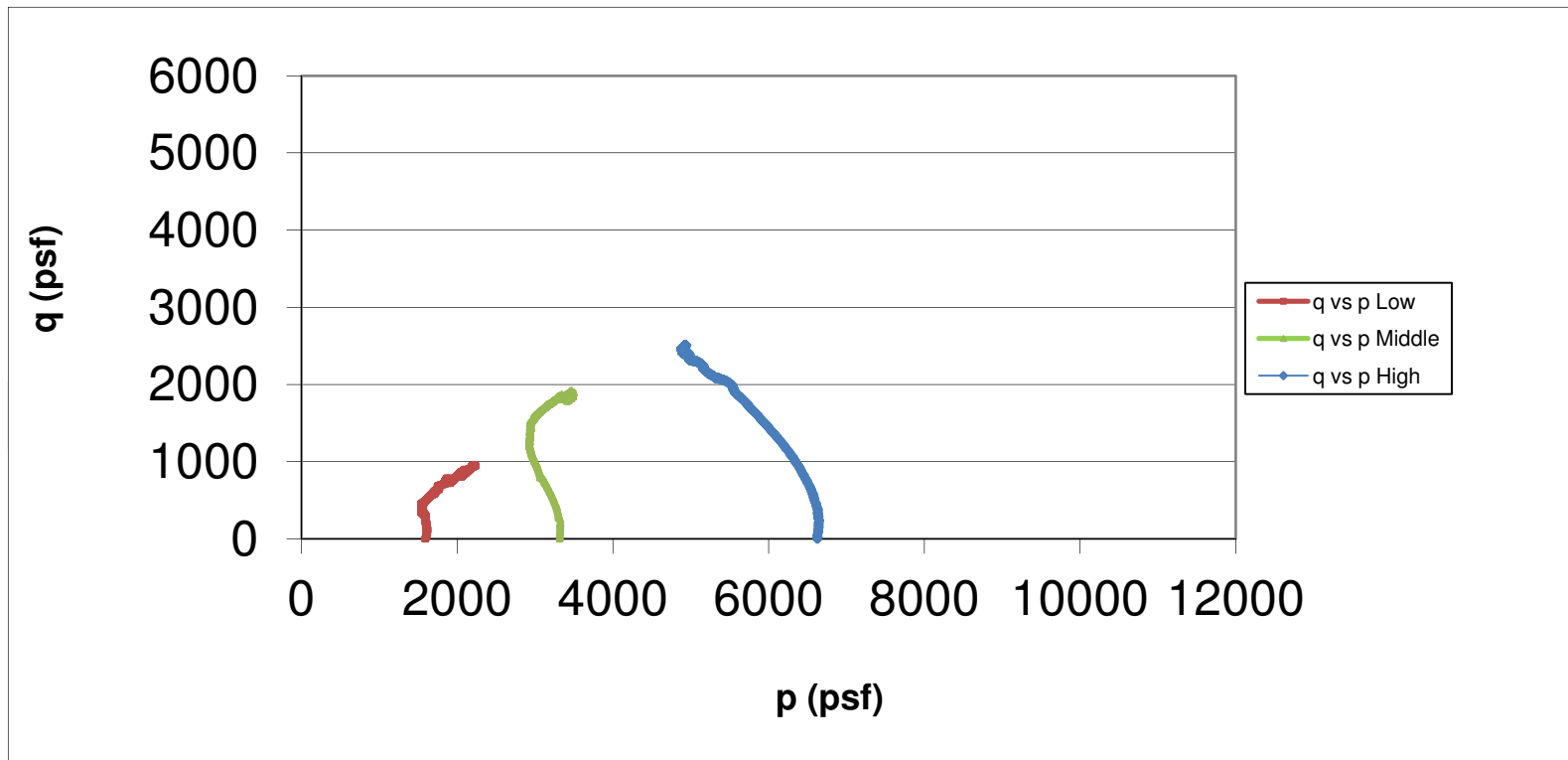
LOCATION: Monroe County, Ohio

PROJECT #: 20050114COL



q vs. p

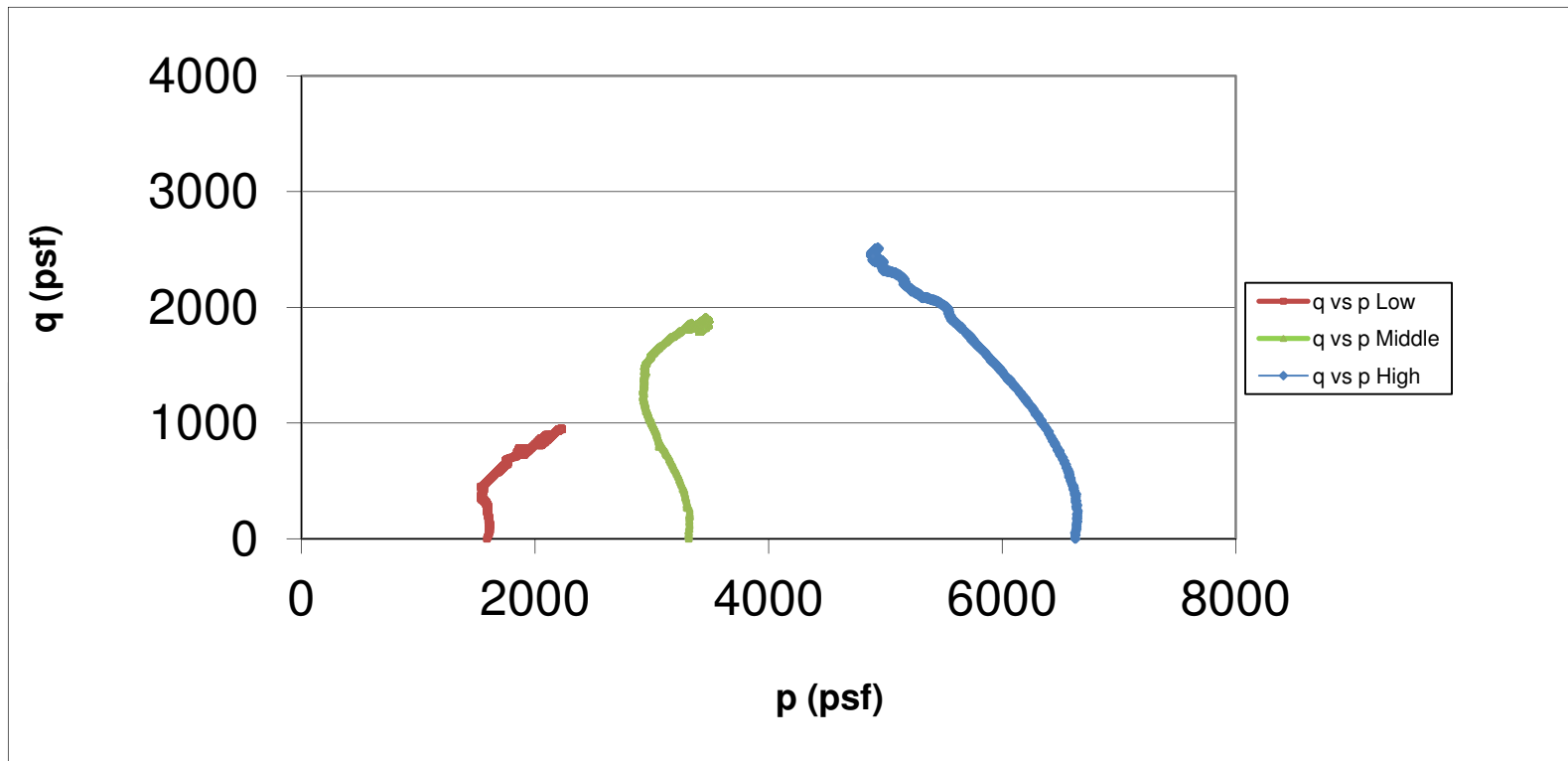
CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-1-20, ST-18, 26'-28'		
PROJECT:	MOE-7-07.55 (Task 10-K)	Confining Pressure (psf):	Low	Middle	High
LOCATION:	Monroe County, Ohio		1584	3312	6624
PROJECT #:	20050114COL				



q vs. p

CLIENT: HDR Engineering, Inc
PROJECT: MOE-7-07.55 (Task 10-K)
LOCATION: Monroe County, Ohio
PROJECT #: 20050114COL

Sample ID: B-002-1-20, ST-18, 26'-28'
Confining Pressure (psf): Low Middle High
 1584 3312 6624



Mohr Circle Effective Stress

CLIENT: HDR Engineering, Inc

Sample ID: B-002-1-20, ST-18, 26'-28'

PROJECT: MOE-7-07.55 (Task 10-K)

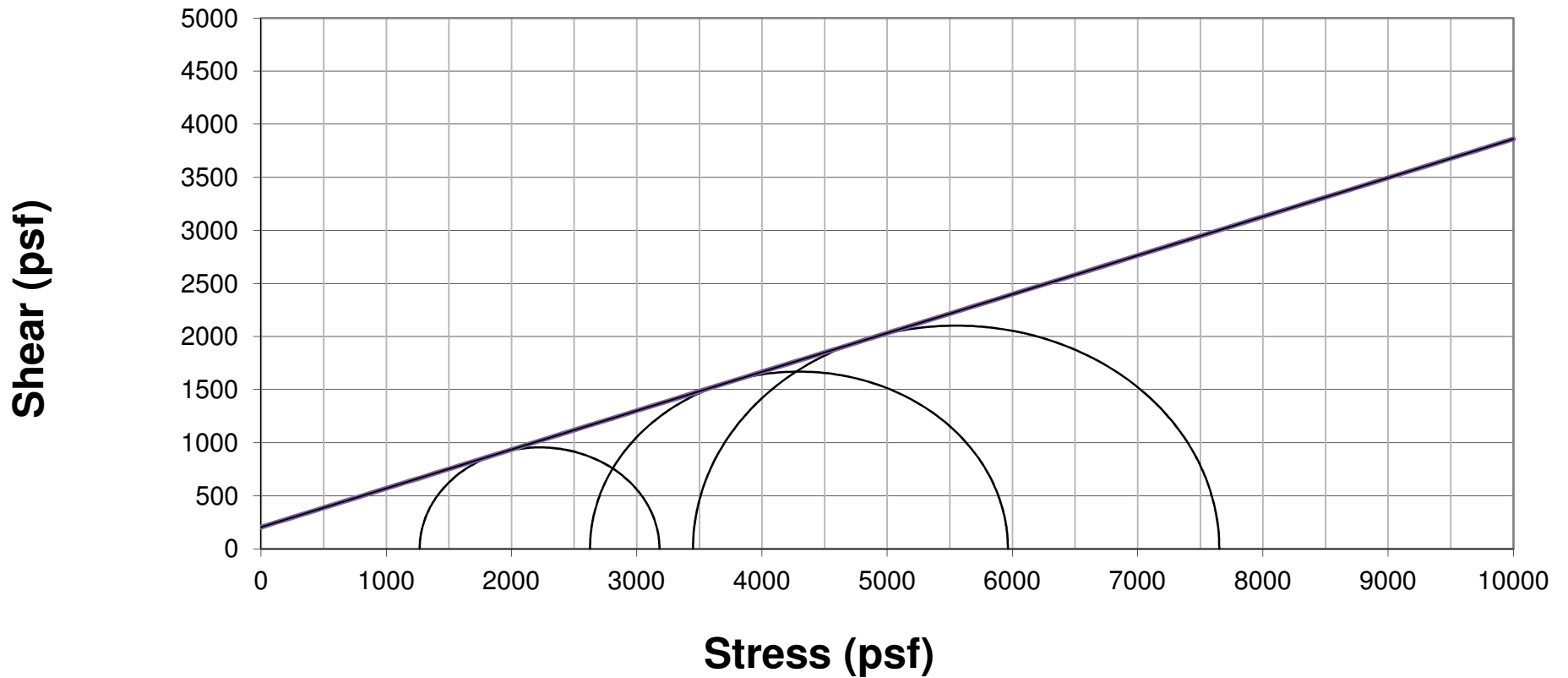
Confining Pressure (psf): 1584 3312 6624

LOCATION: Monroe County, Ohio

Cohesion(psf): 200

PROJECT #: 20050114COL

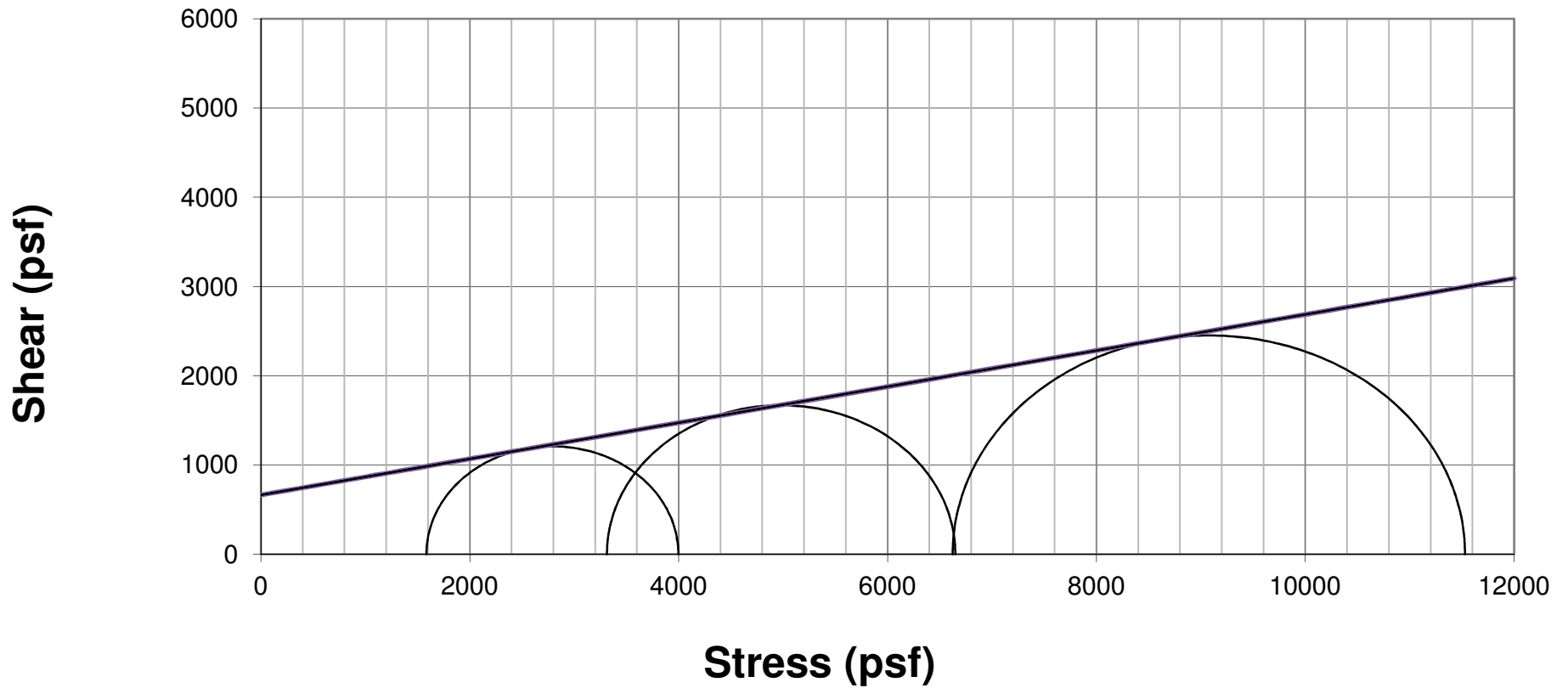
Angle of Friction(°): 20



Mohr Circle Total Stress

CLIENT: HDR Engineering, Inc
PROJECT: MOE-7-07.55 (Task 10-K)
LOCATION: Monroe County, Ohio
PROJECT #: 20050114COL

Sample ID: B-002-1-20, ST-18, 26'-28'
Confining Pressure (psf): 1584 3312 6624
Cohesion(psf): 660
Angle of Friction(°): 11



**CONSOLIDATED UNDRAINED TRIAXIAL TEST ON COHESIVE SOILS
AASHTO T 297 & ASTM D4767**

CTL ENGINEERING, INC.

2860 Fisher Road Columbus, Ohio 43204

Client: HDR Engineering, Inc
 PID NO. 108676
 Project: MOE-7-7.55 (10-K)
 Location: Monroe County, Ohio
 Project No. 20050114COL
 County, Rt. & Sec.: MOE-7-7.55
 Station & Offset: NA
 Sample ID: B-002-2-20, ST-5, 10'-12'
 Lab Code No. NA
 Reviewed by: SM

Sample Type	Shelby Tube		
	8/28/2020	8/28/2020	8/28/2020
Date Set-up:	8/28/2020	8/28/2020	8/28/2020
Date Sheared:	9/1/2020	9/1/2020	9/1/2020
Avg. Sample Height (in.):	5.7517	5.7943	5.7023
Avg. Sample Diameter (in.):	2.8750	2.8750	2.8750
Height-to-diameter ratio:	2.00	2.02	1.98
Wet Density (pcf):	126.9	124.5	126.6
Dry Density (pcf):	103.0	101.2	102.7
Void Ratio:	0.666	0.696	0.671
Specific Gravity (assumed):	2.75	2.75	2.75
Moisture Content (%):	23.2	23.1	23.2
Cross Sectional Area (ft ²):	0.045	0.045	0.045
Volume (ft ³):	0.02	0.02	0.02
Confining Pressure (psf):	720	1440	2880
Rate of Axial Strain (%/min):	0.2086	0.2071	0.2104
Compressive Strength (psf):	2805	3206	3901
Minor Principal Stress at Failure (psf):	720	1440	2880
Major Principal Stress at Failure (psf):	3525	4646	6781
Failure Criterion (%):	Deviator Stress @ 15 % Axial Strain		
β :	0.99	0.98	0.97
Specimen Saturation:	Wet Method		

Grading (ASTM D422)

% Agg:	0
% Sand:	36
% Silt:	43
% Clay:	21

Atterberg Limits (ASTM D 4318)

L.L.:	29
P.L.:	21
P.I.:	8

Visual Description: Brown Sandy Silt (A-4a), Some Clay, Moist

POST SHEAR

720 psf



POST SHEAR

1440 psf



POST SHEAR

2880 psf



Deviator Stress & Pore Pressure vs. Strain

CLIENT: HDR Engineering, Inc

Sample ID:

B-002-2-20, ST-5, 10'-12'

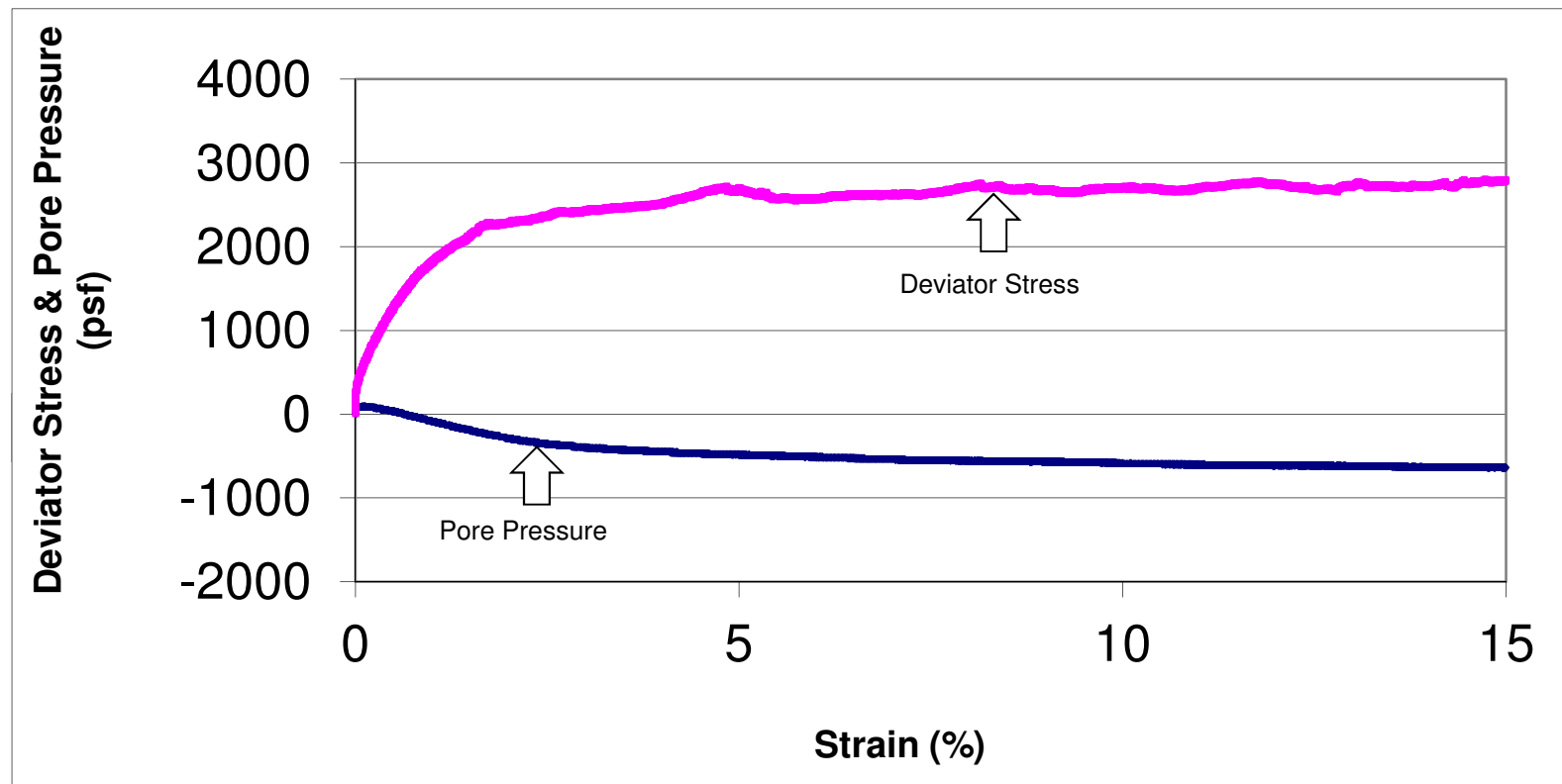
PROJECT: MOE-7-07.55 (Task 10-K)

Confining Pressure (psf):

720

LOCATION: Monroe County, Ohio

PROJECT #: 20050114COL



Deviator Stress & Pore Pressure vs. Strain

CLIENT: HDR Engineering, Inc

Sample ID:

B-002-2-20, ST-5, 10'-12'

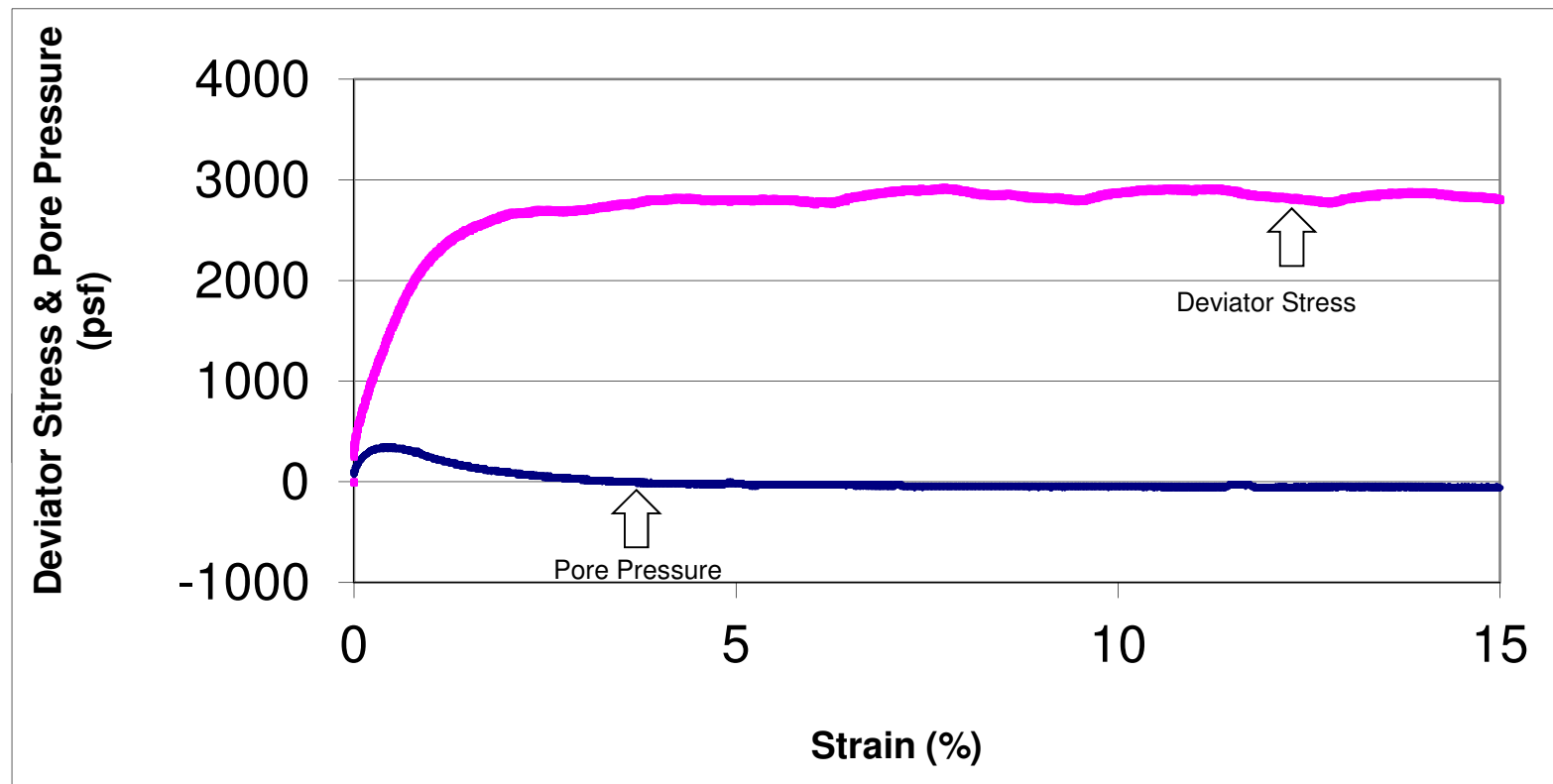
PROJECT: MOE-7-07.55 (Task 10-K)

Confining Pressure (psf):

1440

LOCATION: Monroe County, Ohio

PROJECT #: 20050114COL



Deviator Stress & Pore Pressure vs. Strain

CLIENT: HDR Engineering, Inc

Sample ID:

B-002-2-20, ST-5, 10'-12'

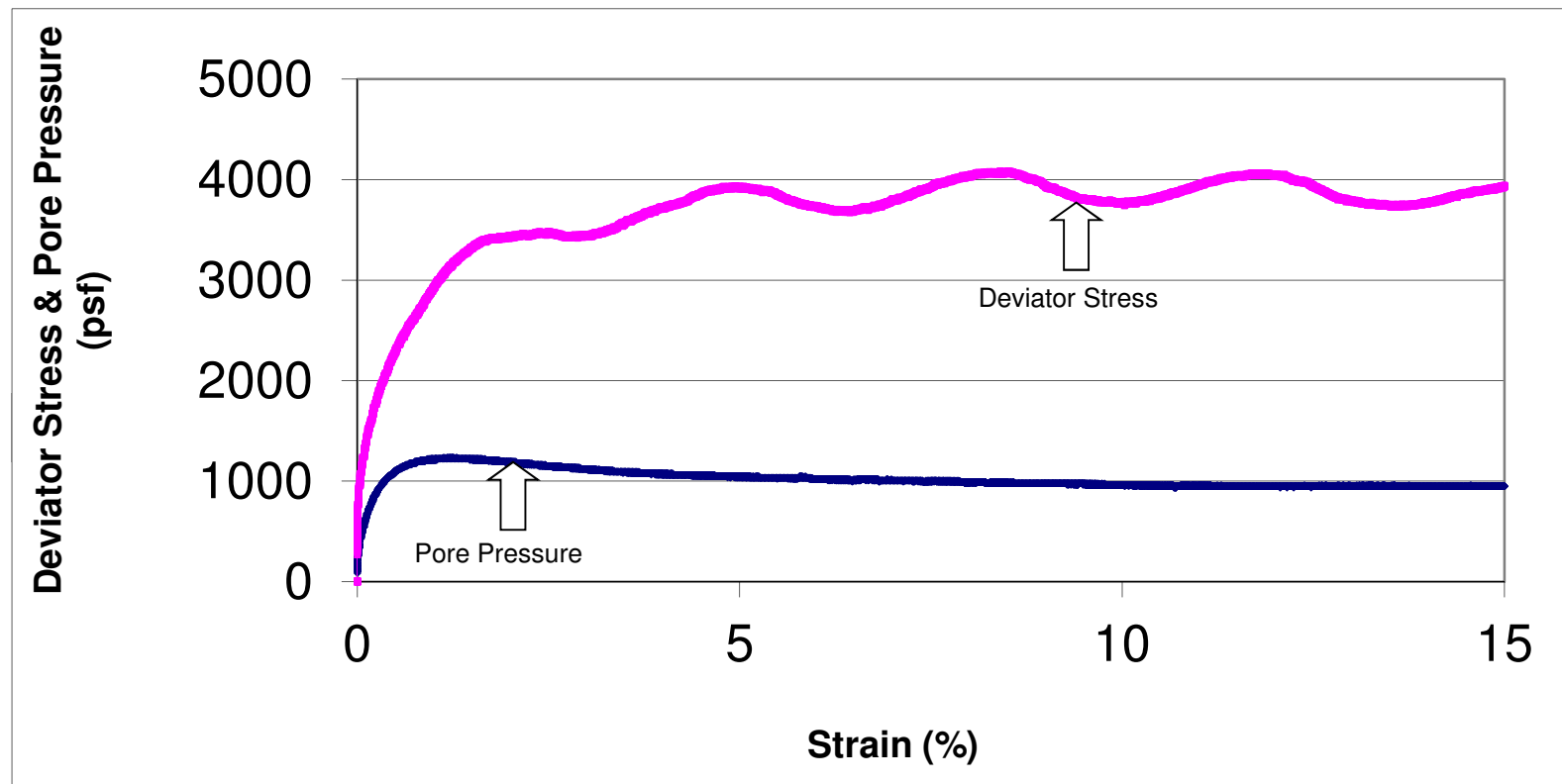
PROJECT: MOE-7-07.55 (Task 10-K)

Confining Pressure (psf):

2880

LOCATION: Monroe County, Ohio

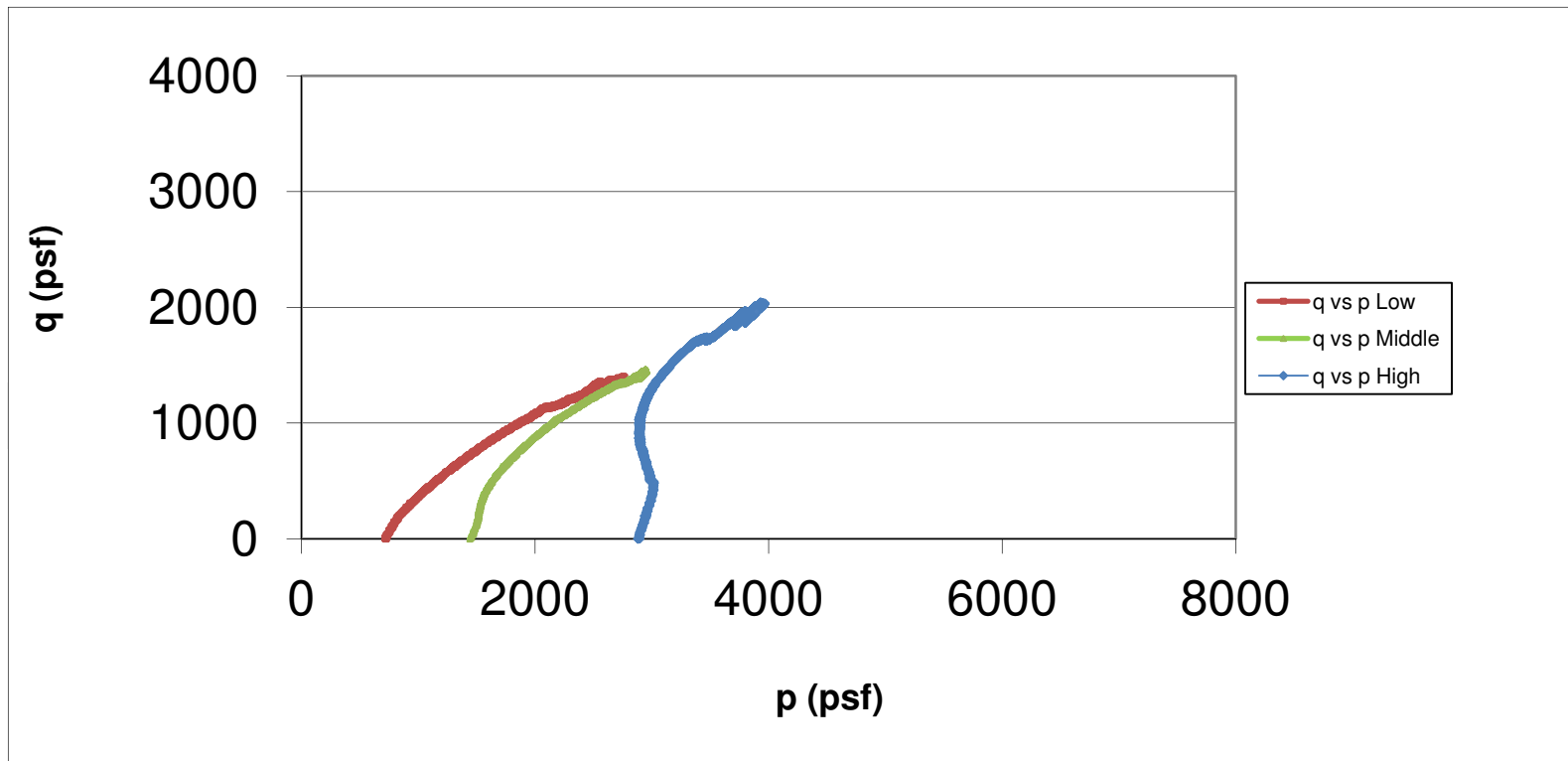
PROJECT #: 20050114COL



q vs. p

CLIENT: HDR Engineering, Inc
PROJECT: MOE-7-07.55 (Task 10-K)
LOCATION: Monroe County, Ohio
PROJECT #: 20050114COL

Sample ID: B-002-2-20, ST-5, 10'-12'
Confining Pressure (psf): Low Middle High
720 1440 2880



Mohr Circle Effective Stress

CLIENT: HDR Engineering, Inc

Sample ID: B-002-2-20, ST-5, 10'-12'

PROJECT: MOE-7-07.55 (Task 10-K)

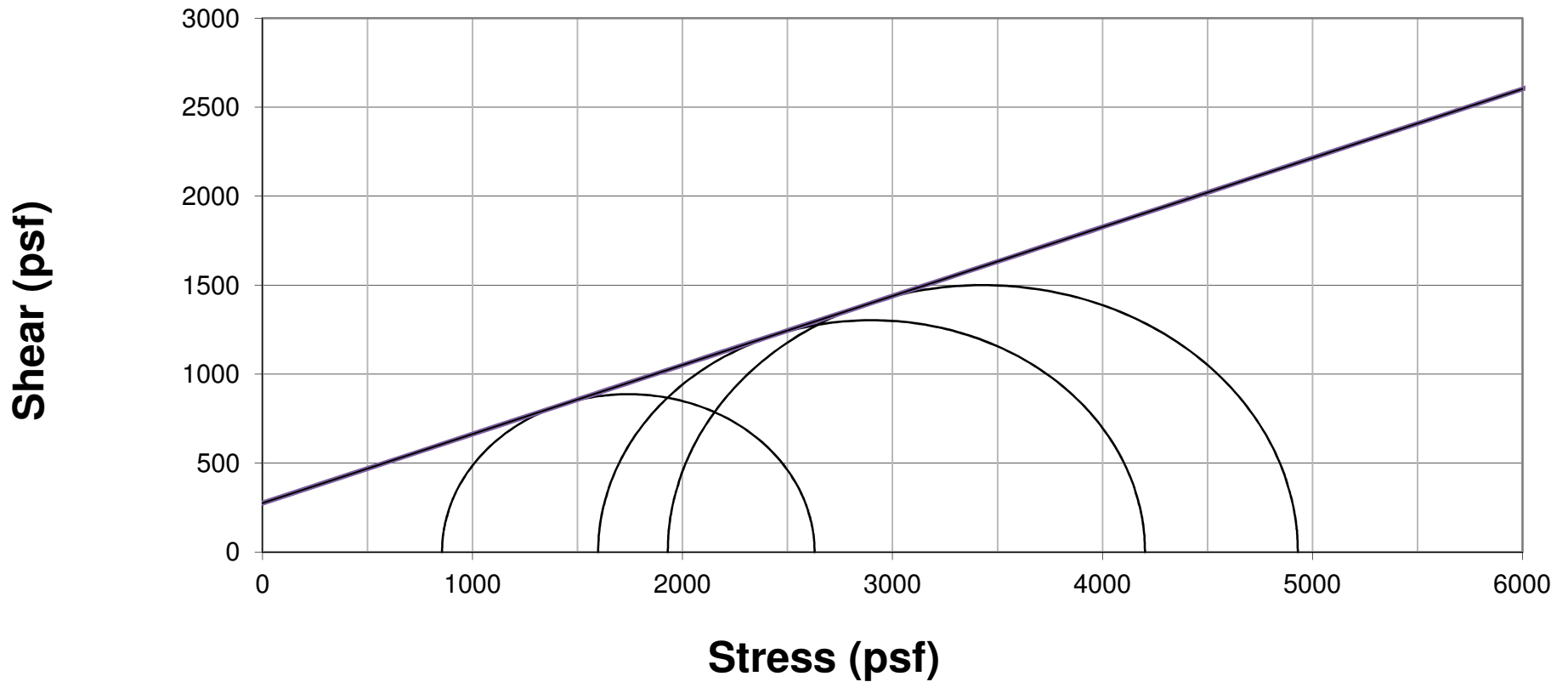
Confining Pressure (psf): 720 1440 2880

LOCATION: Monroe County, Ohio

Cohesion(psf): 275

PROJECT #: 20050114COL

Angle of Friction(°): 21



Mohr Circle Total Stress

CLIENT: HDR Engineering, Inc

PROJECT: MOE-7-07.55 (Task 10-K)

LOCATION: Monroe County, Ohio

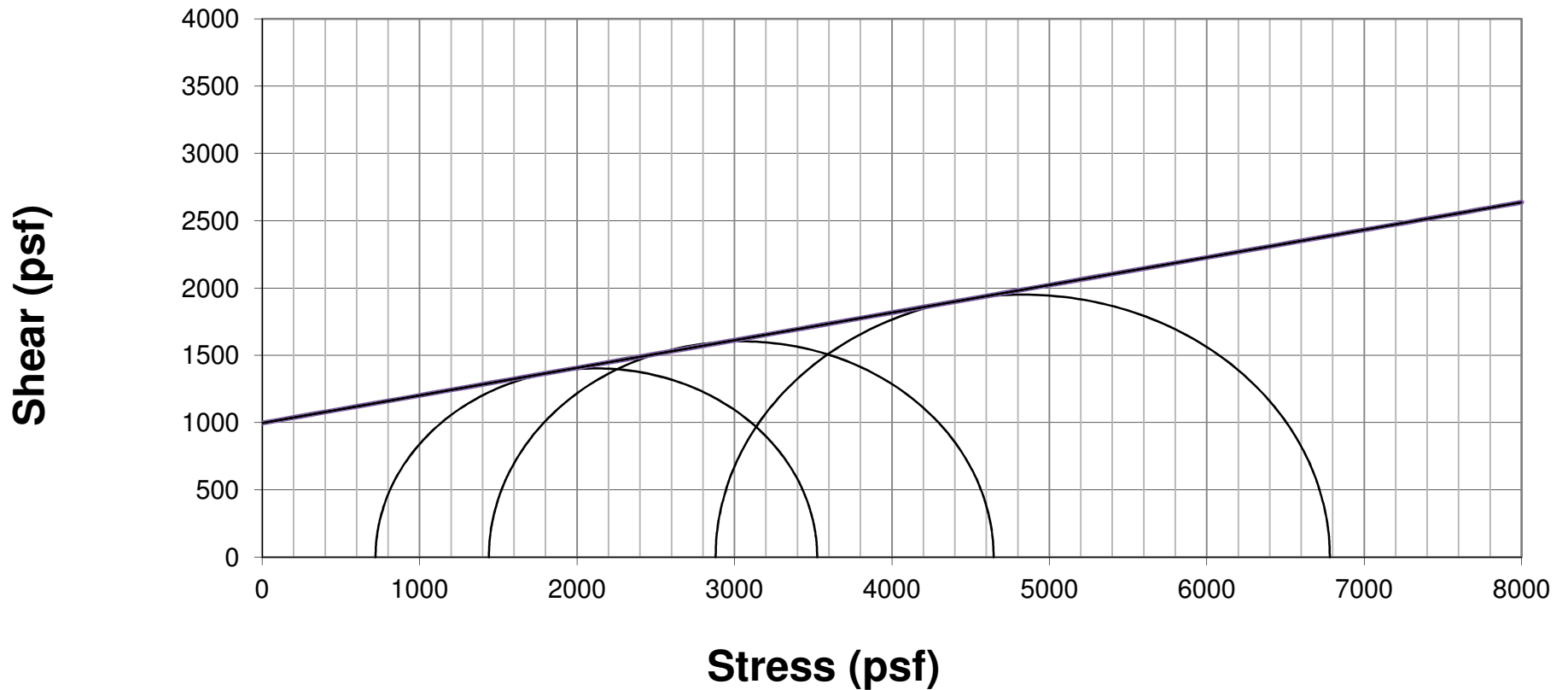
PROJECT #: 20050114COL

Sample ID: B-002-2-20, ST-5, 10'-12'

Confining Pressure (psf): 720 1440 2880

Cohesion(psf): 1000

Angle of Friction(°): 11.5



**CONSOLIDATED UNDRAINED TRIAXIAL TEST ON COHESIVE SOILS
AASHTO T 297 & ASTM D4767**

CTL ENGINEERING, INC.

2860 Fisher Road Columbus, Ohio 43204

Client: HDR Engineering, Inc
 PID NO. 108676
 Project: MOE-7-7.55 (Task 10-K)
 Location: Monroe County, Ohio
 Project No. 20050114COL
 County, Rt. & Sec.: MOE-7-7.55
 Station & Offset: NA
 Sample ID: B-002-1-20, ST-10, 13.5'-15.5'
 Lab Code No. 20050114COL
 Reviewed by: SM

Sample Type	Shelby Tube	
Date Set-up:	8/25/2020	8/25/2020
Date Sheared:	9/1/2020	9/1/2020
Avg. Sample Height (in.):	5.7957	5.7757
Avg. Sample Diameter (in.):	2.8500	2.8500
Height-to-diameter ratio:	2.03	2.03
Wet Density (pcf):	125.2	124.6
Dry Density (pcf):	103.0	103.3
Void Ratio:	0.636	0.631
Specific Gravity (assumed):	2.7	2.7
Moisture Content (%):	21.6	20.6
Cross Sectional Area (ft ²):	0.044	0.044
Volume (ft ³):	0.02	0.02
Confining Pressure (psf):	1872	3744
Rate of Axial Strain (%/min):	0.2071	0.2078
Compressive Strength (psf):	4699	5708
Minor Principal Stress at Failure (psf):	1872	3744
Major Principal Stress at Failure (psf):	6571	9452
Failure Criterion (%):	Deviator Stress at 15% Axial Strain	
β:	0.97	0.96
Specimen Saturation:	Wet Method	

Grading (ASTM D422)

% Agg:	1
% Sand:	1
% Silt:	52
% Clay:	46

Atterberg Limits (ASTM D 4318)

L.L.:	50
P.L.:	26
P.I.:	24

Visual Description: Brown, Clay, "and" Silt, trace sand, trace gravel, damp

POST SHEAR

1872 psf



POST SHEAR

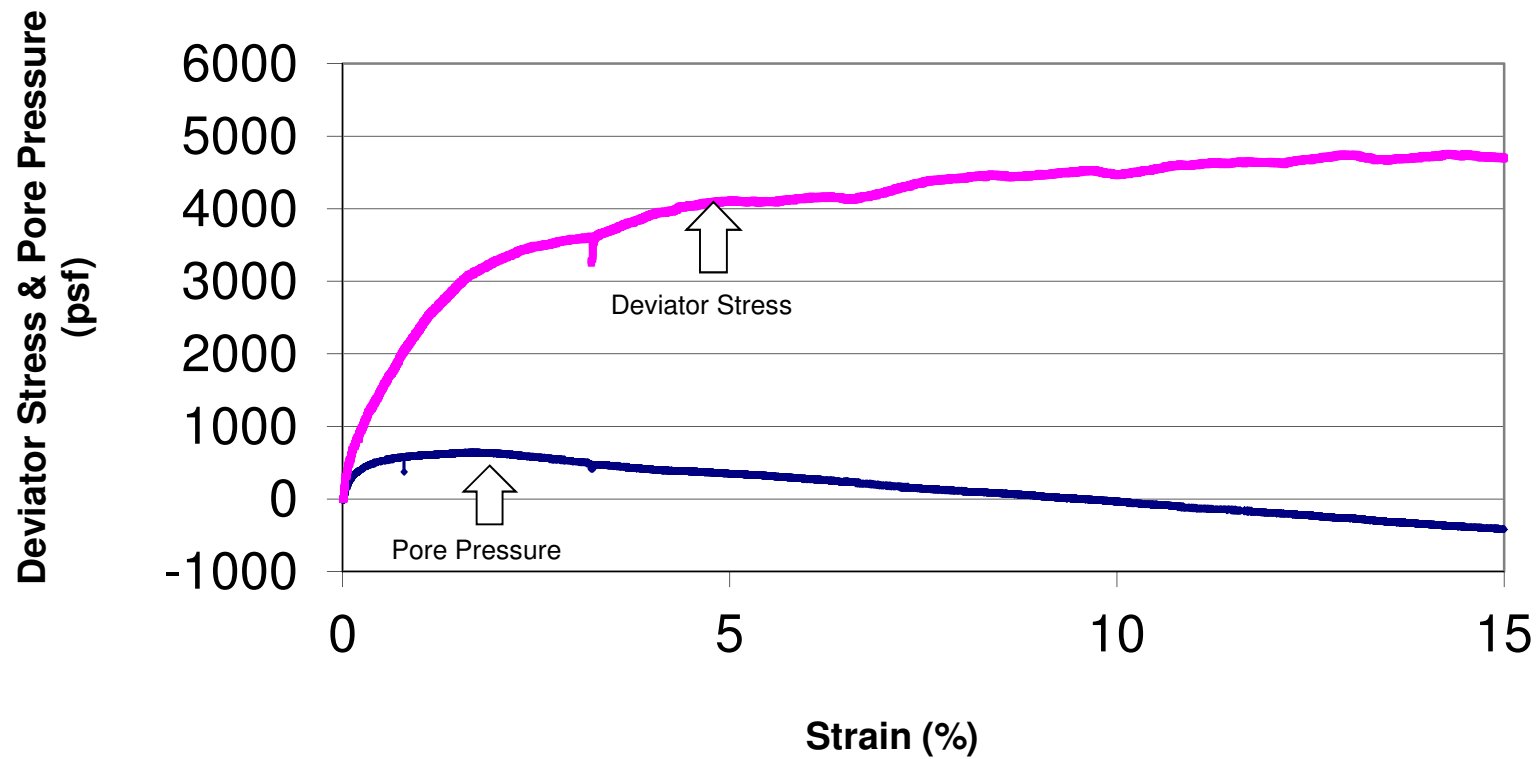
3744 psf



Deviator Stress & Pore Pressure vs. Strain

CLIENT: HDR Engineering, Inc
PROJECT: MOE-7-7.55 (Task 10-K)
LOCATION: Monroe County, Ohio
PROJECT #: 20050114COL

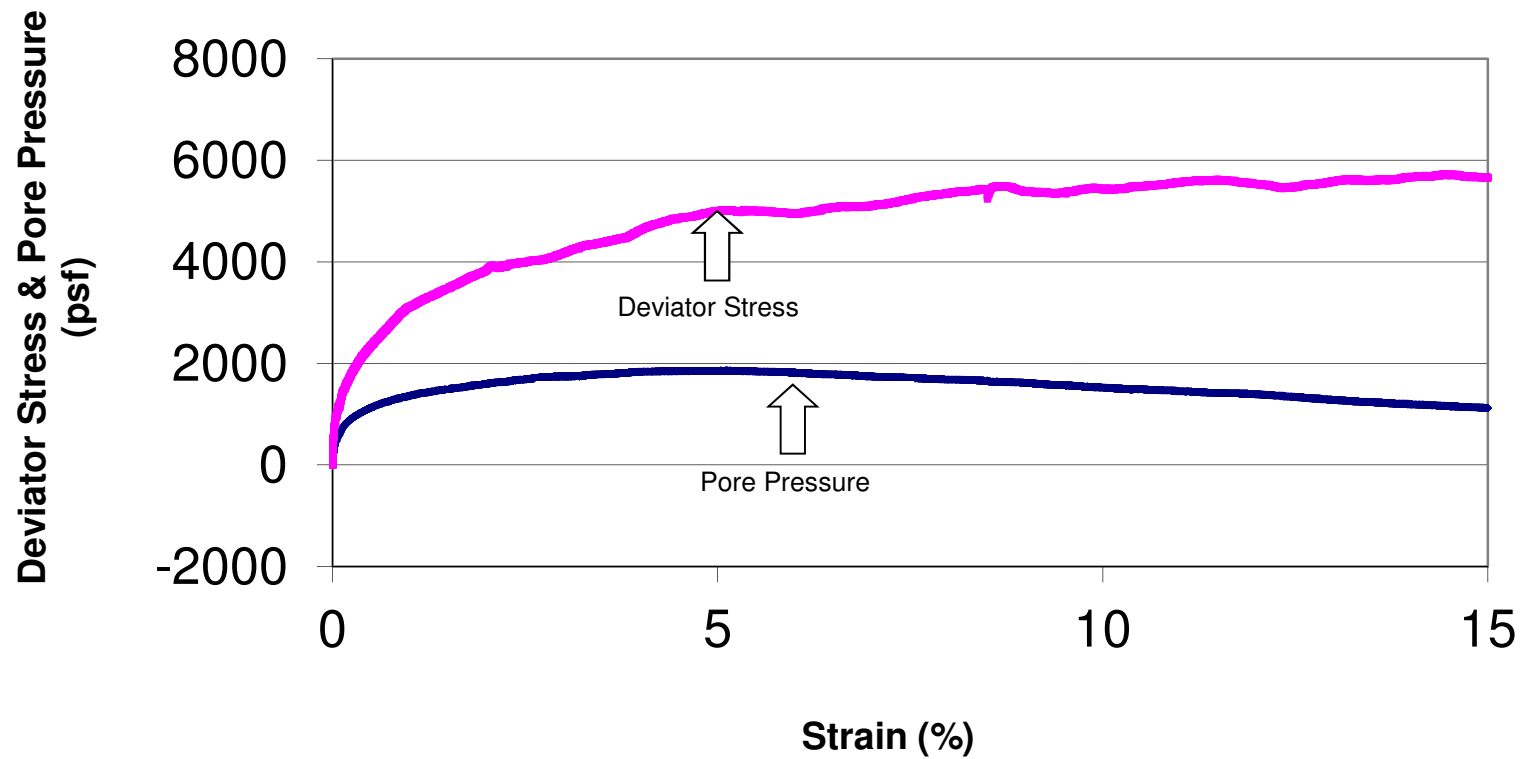
Sample ID: B-002-1-20, ST-10, 13.5'-15.5'
Confining Pressure (psf): 1872



Deviator Stress & Pore Pressure vs. Strain

CLIENT: HDR Engineering, Inc
PROJECT: MOE-7-7.55 (Task 10-K)
LOCATION: Monroe County, Ohio
PROJECT #: 20050114COL

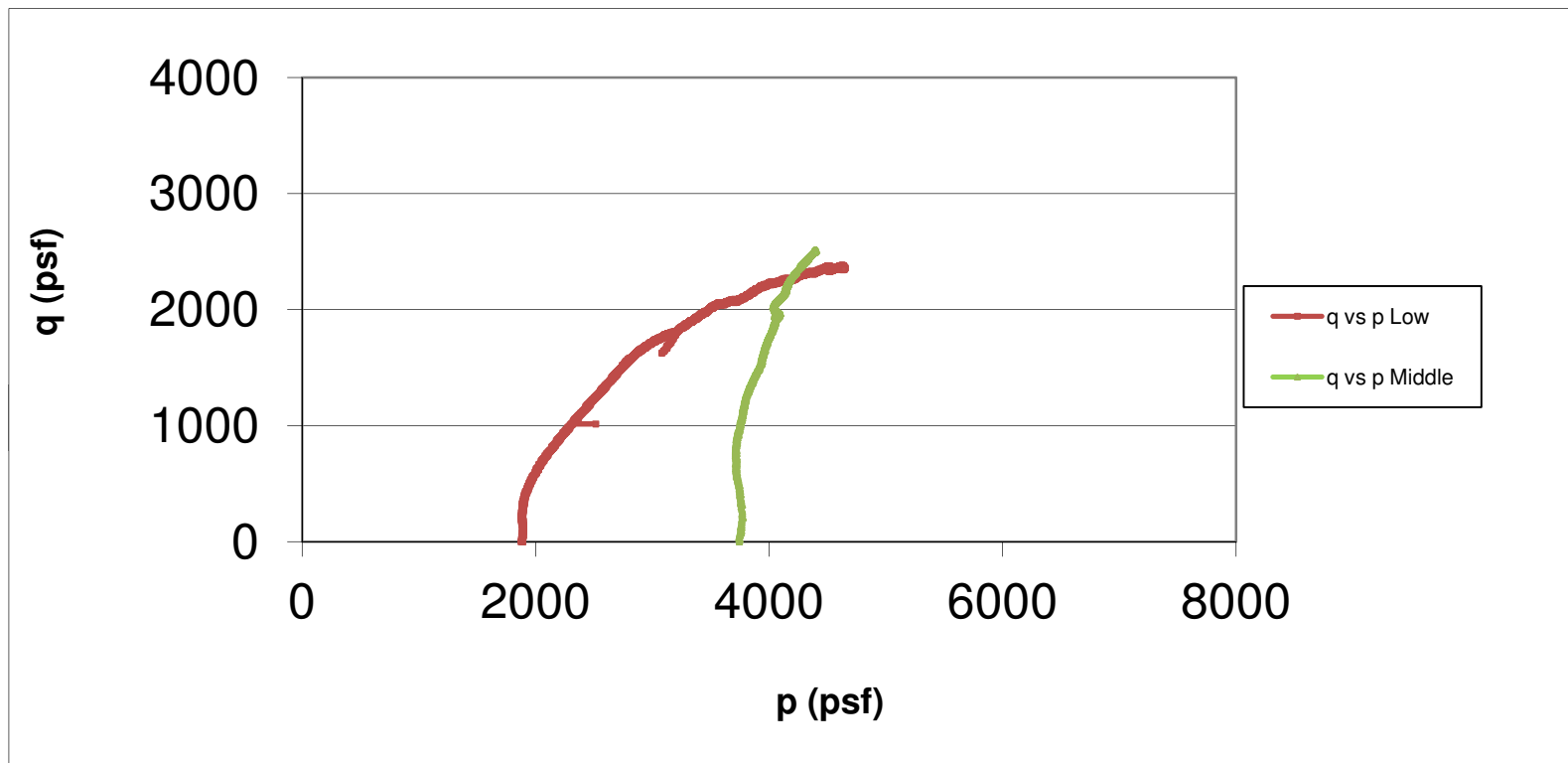
Sample ID: B-002-1-20, ST-10, 13.5'-15.5'
Confining Pressure (psf): 3744



q vs. p

CLIENT: HDR Engineering, Inc
PROJECT: MOE-7-7.55 (Task 10-K)
LOCATION: Monroe County, Ohio
PROJECT #: 20050114COL

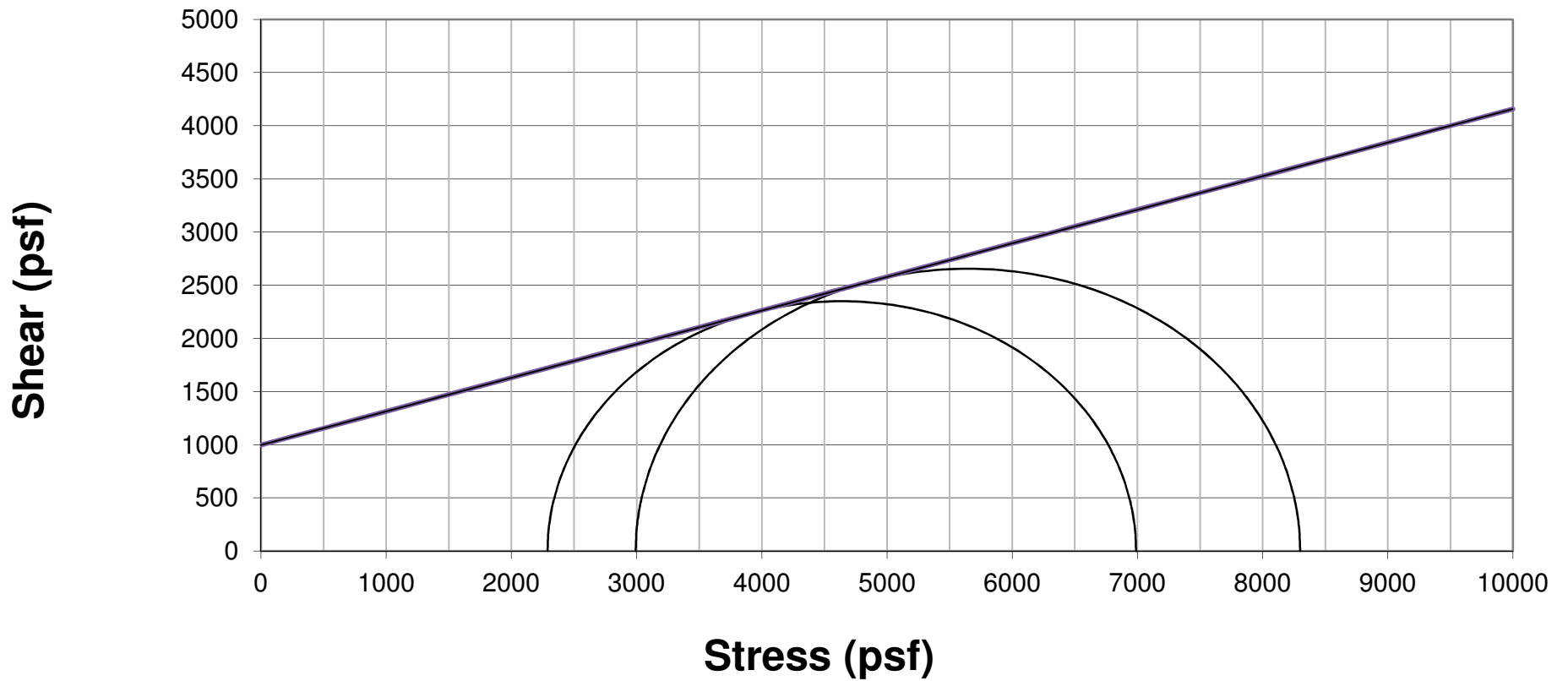
Sample ID: B-002-1-20, ST-10, 13.5'-15.5'
Confining Pressure (psf): Low Middle
1872 3744



Mohr Circle Effective Stress

CLIENT: HDR Engineering, Inc
PROJECT: MOE-7-7.55 (Task 10-K)
LOCATION: Monroe County, Ohio
PROJECT #: 20050114COL

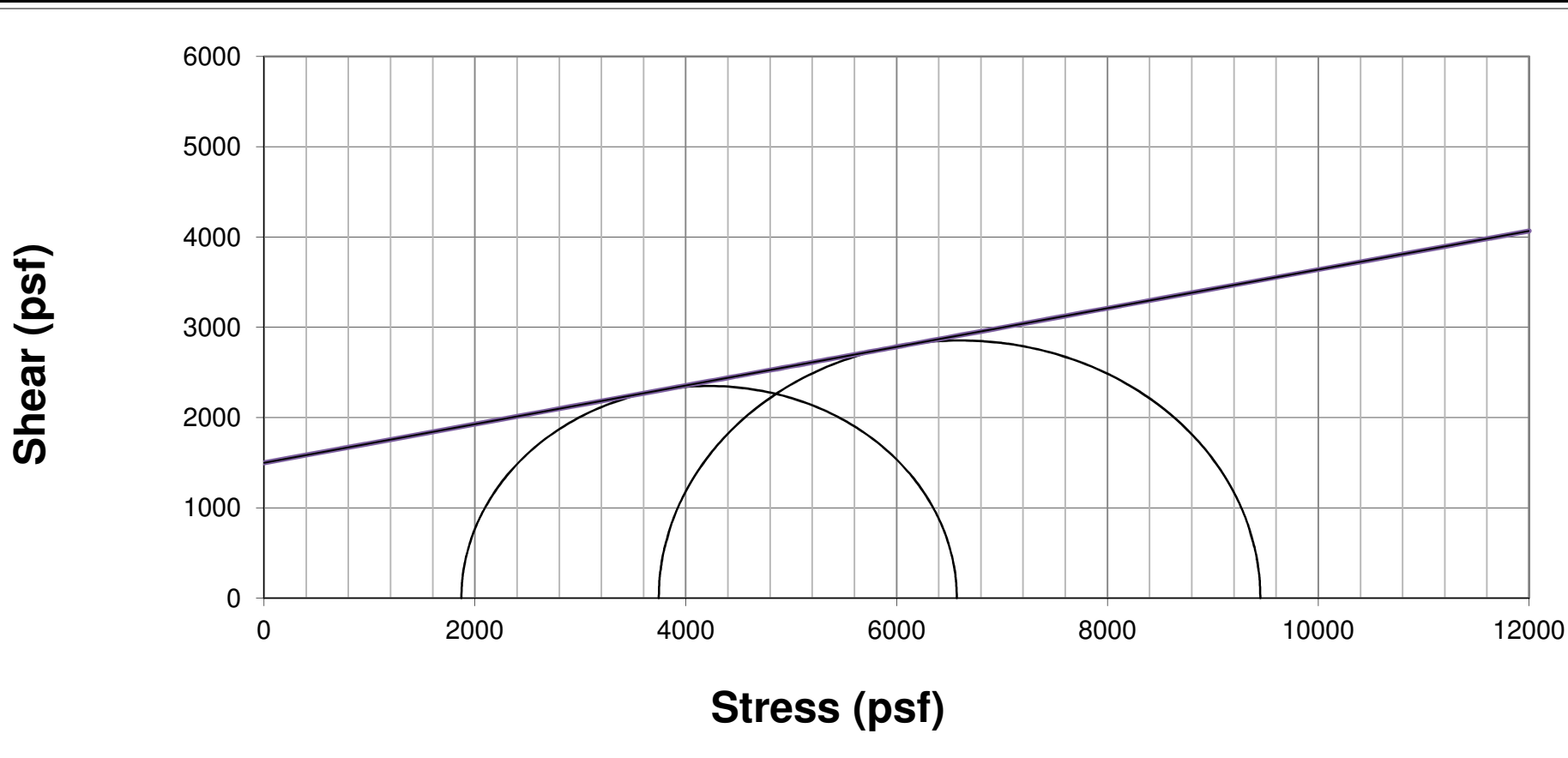
Sample ID: B-002-1-20, ST-10, 13.5'-15.5'
Confining Pressure (psf): 1872 3744
Cohesion(psf): 1000
Angle of Friction(°): 17



Mohr Circle Total Stress

CLIENT: HDR Engineering, Inc
PROJECT: MOE-7-7.55 (Task 10-K)
LOCATION: Monroe County, Ohio
PROJECT #: 20050114COL

Sample ID: B-002-1-20, ST-10, 13.5'-15.5'
Confining Pressure (psf): 1872 3744
Cohesion(psf): 1500
Angle of Friction(°): 12



**Unconfined Compression Test Results
ASTM D 2166, D 5102**

CTL ENGINEERING, INC.

2860 Fisher Road Columbus, Ohio 43204

Sample ID: B-004-1-20, ST-8, 10.5'-12.5'

Avg. Sample Height (in.): 5.79
 Avg. Sample Diameter (in.): 2.88
 Height-to-diameter ratio: 2.02
 Ultimate Strength (ksf): 2.19
 Shear Strength (Ksf): 1.09
 Avg. Rate of Strain to Failure(%): 1.93
 Strain at Failure (%): 11.70
 Initial Dry Density (pcf): 97.57
 Moisture Content (%): 27.1 (Obtained Post Shear)
 Visual Description: Brown Silt and Clay (A-6a), moist
 Degree of Saturation: NA
 Sensitivity: NA
 Failure Type: Diagonal Shear

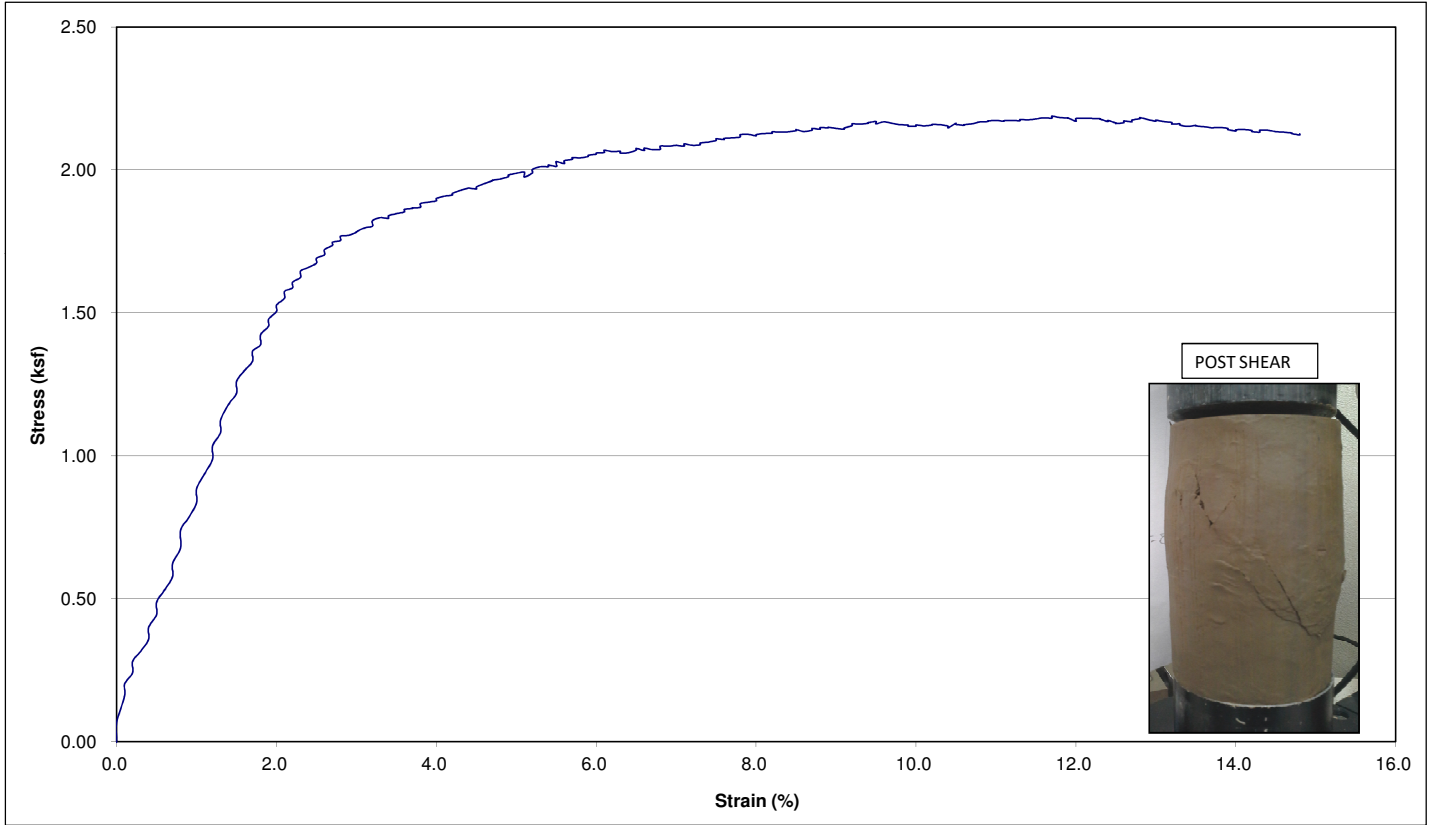
Client: HDR Engineering, Inc.
 Project: MOE-7-7.55 (10-K)
 Location: Monroe County, Ohio
 Project No. 20050114COL
 Lab Code No. N/A
 Date Tested: 8/31/2020
 Reviewed by: SM

ASTM D 4318

LL: 36
 PL: 23

ASTM D 6913

Gravel (%): 0
 Sand(%): 11
 Silt(%): 54
 Clay(%): 35



PROJECT NO:	20050114COL
DATE:	9/3/2020

**UNIAXIAL COMPRESSIVE STRENGTH OF
INTACT ROCK CORE - ASTM D 7012**



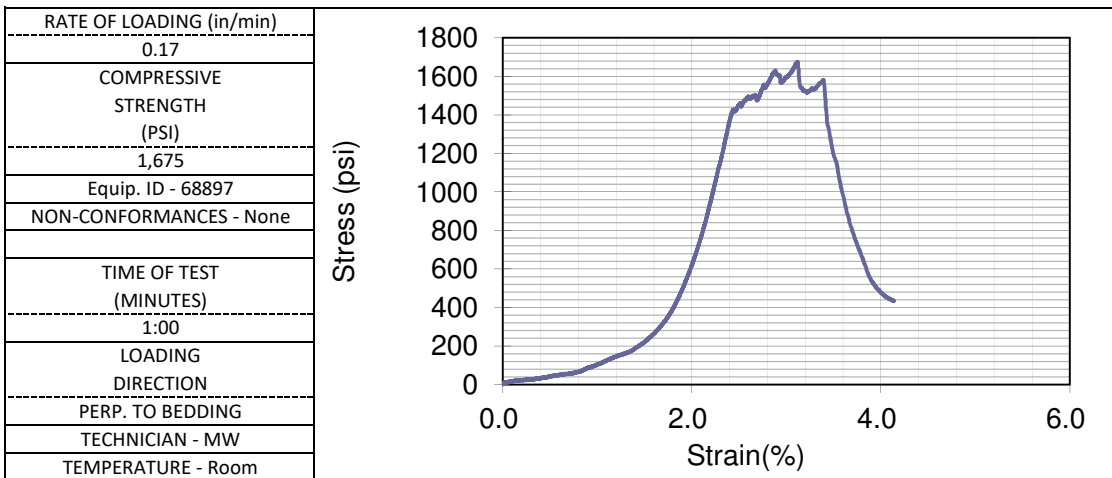
Method C

BORING NUMBER	B-002-1-20	TOP DEPTH(FT)	58.5	BOTTOM DEPTH(FT)	58.9
SAMPLE NUMBER	R-1	DISTRICT	10	PID NO.	108676
COUNTY	MOE	ROUTE	7	SECTION	7.55 (10-K)

FORMATION	Pennsylvanian Age
DESCRIPTION	Siltstone, Gray, Moderately Weathered, Slightly Strong
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.115	1.982
2	4.114	1.993
3	4.111	1.982
AVERAGE	4.113	1.986

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN ²)	3.1
MASS (GRAMS)	546.2
UNIT WEIGHT(LBS/FT ³)	163.4



PROJECT NO:	20050114COL
DATE:	9/3/2020

**UNIAXIAL COMPRESSIVE STRENGTH OF
INTACT ROCK CORE - ASTM D 7012**



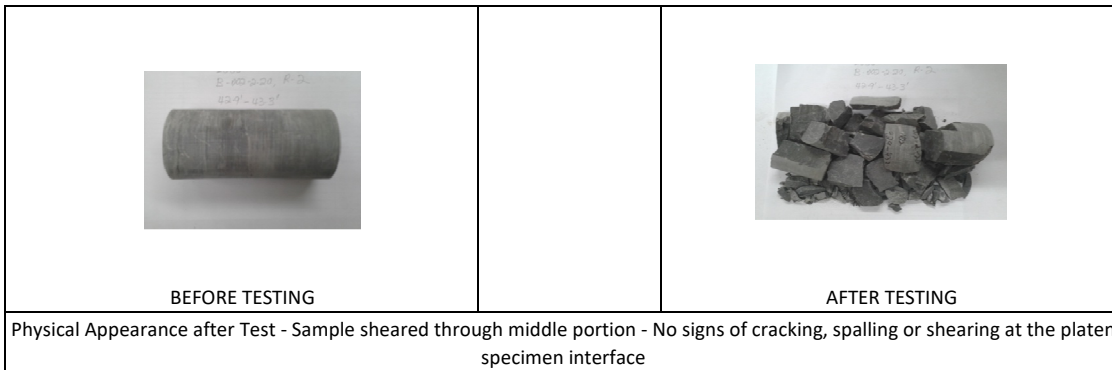
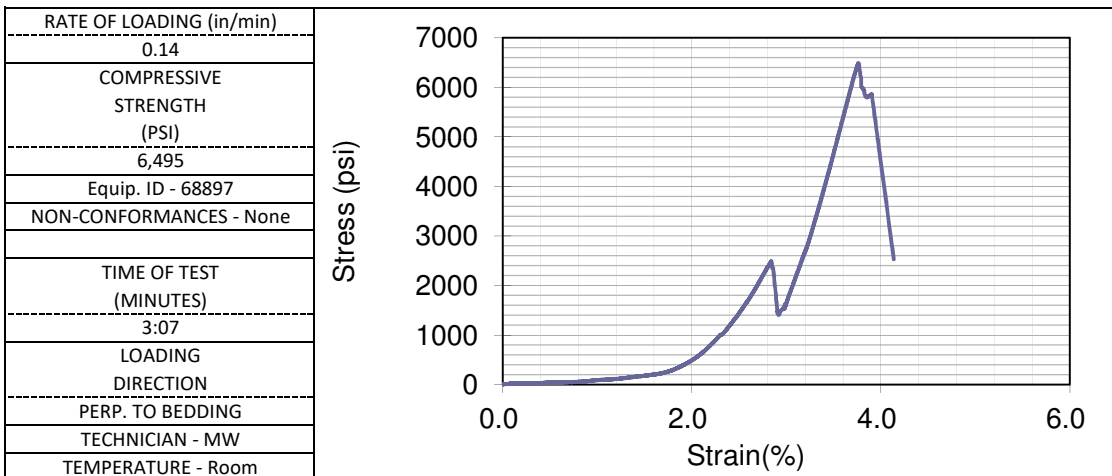
Method C

BORING NUMBER	B-002-2-20	TOP DEPTH(FT)	42.9	BOTTOM DEPTH(FT)	43.3
SAMPLE NUMBER	R-2	DISTRICT	10	PID NO.	108676
COUNTY	MOE	ROUTE	7	SECTION	7.55 (10-K)

FORMATION	Pennsylvanian Age
DESCRIPTION	Siltstone, Gray, Moderately Weathered, Moderately Strong
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.085	1.988
2	4.114	1.974
3	4.108	1.991
AVERAGE	4.102	1.984

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN ²)	3.1
MASS (GRAMS)	545.4
UNIT WEIGHT(LBS/FT ³)	163.8



PROJECT NO:	20050114COL
DATE:	9/3/2020

**UNIAXIAL COMPRESSIVE STRENGTH OF
INTACT ROCK CORE - ASTM D 7012**



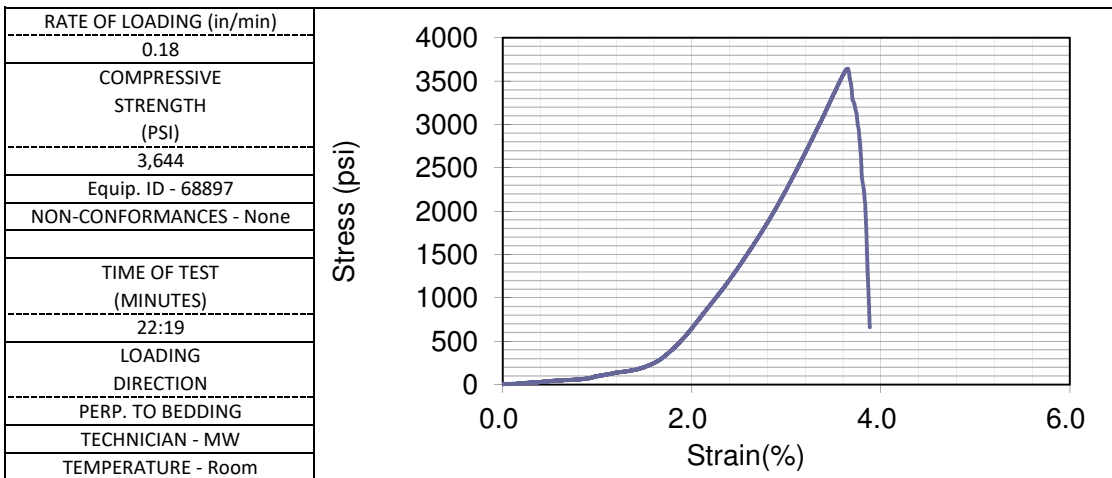
Method C

BORING NUMBER	B-004-1-20	TOP DEPTH(FT)	44.1	BOTTOM DEPTH(FT)	44.5
SAMPLE NUMBER	R-1	DISTRICT	10	PID NO.	108676
COUNTY	MOE	ROUTE	7	SECTION	7.55 (10-K)

FORMATION	Pennsylvanian Age
DESCRIPTION	Siltstone, Gray, Highly Weathered, Moderatly Strong
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.085	1.988
2	4.085	1.980
3	4.085	1.986
AVERAGE	4.085	1.985

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN ²)	3.1
MASS (GRAMS)	543.1
UNIT WEIGHT(LBS/FT ³)	163.7



PROJECT NO:	20050114COL
DATE:	9/3/2020

**UNIAXIAL COMPRESSIVE STRENGTH OF
INTACT ROCK CORE - ASTM D 7012**



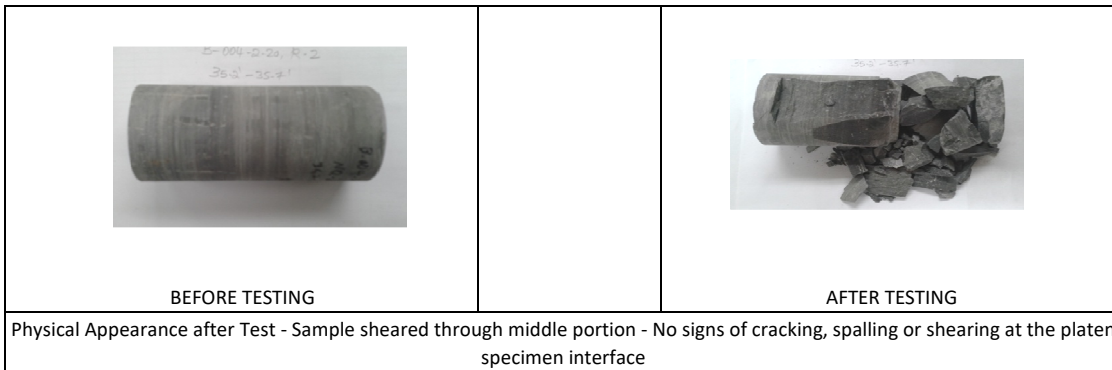
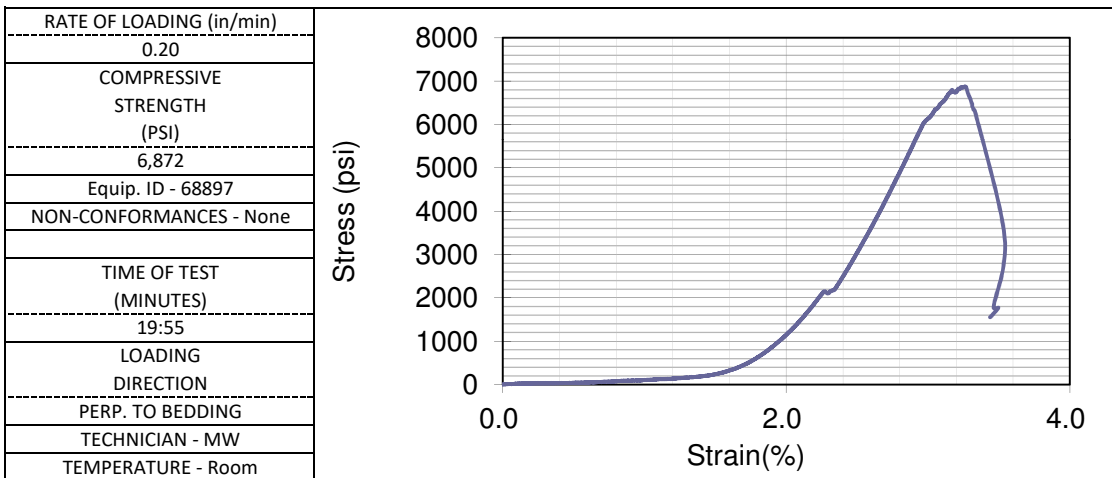
Method C

BORING NUMBER	B-004-2-20	TOP DEPTH(FT)	35.2	BOTTOM DEPTH(FT)	35.7
SAMPLE NUMBER	R-2	DISTRICT	10	PID NO.	108676
COUNTY	MOE	ROUTE	7	SECTION	7.55 (10-K)

FORMATION	Pennsylvanian Age
DESCRIPTION	Siltstone, Gray, Moderately Weathered, Moderatly Strong
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.105	1.993
2	4.102	1.989
3	4.101	1.978
AVERAGE	4.103	1.987

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN ²)	3.1
MASS (GRAMS)	546.0
UNIT WEIGHT(LBS/FT ³)	163.6



PROJECT NO:	20050114COL
DATE:	9/3/2020

**UNIAXIAL COMPRESSIVE STRENGTH OF
INTACT ROCK CORE - ASTM D 7012**



Method C

BORING NUMBER	B-004-2-20	TOP DEPTH(FT)	42.4	BOTTOM DEPTH(FT)	43.0
SAMPLE NUMBER	R-3	DISTRICT	10	PID NO.	108676
COUNTY	MOE	ROUTE	7	SECTION	7.55 (10-K)

FORMATION	Pennsylvanian Age
DESCRIPTION	Sandstone, Gray, Slightly Weathered, Strong
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.091	1.990
2	4.096	1.991
3	4.093	1.990
AVERAGE	4.093	1.990

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN ²)	3.1
MASS (GRAMS)	540.4
UNIT WEIGHT(LBS/FT ³)	161.6

