APPENDIX C

Rock Core Photographs

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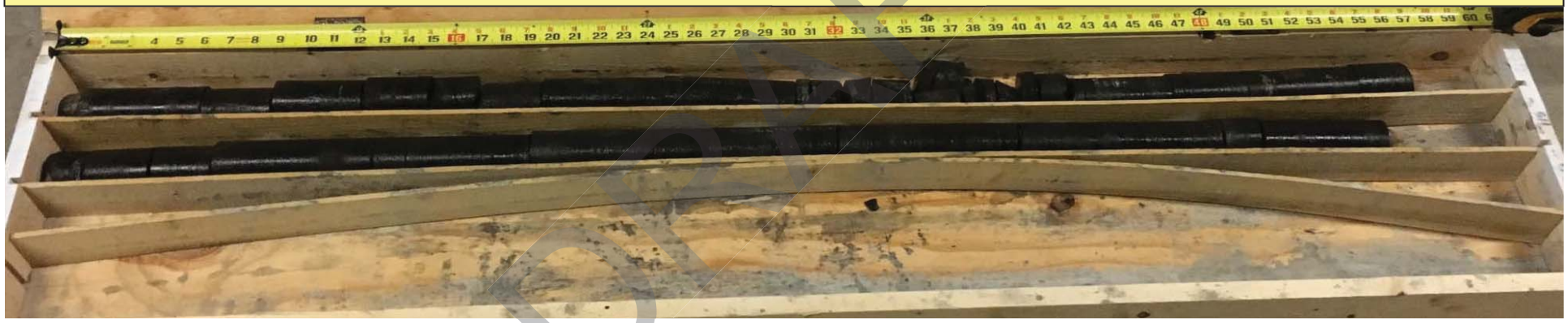
BORING NUMBER SB-03

		Run Depth (ft)		Recovery		RQD		Drill Rate
I-75 Modernization	**Run #**	**From**	**To**	**Inch**	**%**	**Inch**	**%**	**Min/Feet**
2014195C	R-1	146.0' →	150.0' = 4.0'	43"	90%	8"	17%	6.8 min/ft
SB-03	R-2	150.0' →	153.8' = 3.8'	45.1"	99%	44"	96%	4.7 min/ft
09/16/2016	R-3	153.8' →	155.8' = 2.0'	15.5"	65%	15.5"	65%	4.5 min/ft
146.0' → 155.8' = 9.8'								
Box 1 of 1								

DRAFT

BORING NUMBER SB-06

		Run Depth (ft)		Recovery		RQD		Drill Rate
I-75 Modernization	**Run #**	**From**	**To**	**Inch**	**%**	**Inch**	**%**	**Min/Feet**
2014195C	R-1	163.8' →	168.8' = 5.0'	57"	95%	46"	77%	2.4 min/ft
SB-06	R-2	168.8' →	173.8' = 5.0'	55"	92%	51.5"	86%	2.0 min/ft
10/10/2016								
163.8' → 173.8' = 10.0'								
Box 1 of 1								



DRAFT

BORING NUMBER SB-09

		Run Depth (ft)		Recovery		RQD		Drill Rate
I-75 Modernization	**Run #**	**From**	**To**	**Inch**	**%**	**Inch**	**%**	**Min/Feet**
2014195C	R-1	160.0' →	165.0' = 5.0'	55"	92%	42"	70%	2.8 min/ft
SB-09	R-2	165.0' →	166.0' = 1.0'	10.5"	88%	5"	42%	5.0 min/ft
11/11/2016	R-3	166.0' →	171.0' = 5.0'	52"	87%	49"	82%	2.4 min/ft
160.0' → 171.0' = 11.0'								
Box 1 of 1								

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BORING NUMBER SB-12

		Run Depth (ft)		Recovery		RQD		Drill Rate
I-75 Modernization	**Run #**	**From**	**To**	**Inch**	**%**	**Inch**	**%**	**Min/Feet**
2014195C	R-1	123.8' →	128.3' = 4.5'	10"	19%	4"	7%	7.2 min/ft
SB-12	R-2	128.3' →	131.0' = 2.7'	2"	6%	0"	0%	5.2 min/ft
10/04/2016	R-3	131.0' →	139.0' = 8.0'	15"	16%	5"	5%	6.6 min/ft
123.8' → 139.0' = 15.2'								
Box 1 of 1								

DRAFT

BORING NUMBER SB-15

		Run Depth (in ft)		Recovery		RQD		Drill Rate
I-75 Modernization	**Run #**	**From**	**To**	**Inch**	**%**	**Inch**	**%**	**Min/Feet**
2014195C	R-1	132.2' →	134.8' = 2.6'	8"	26%	0"	0%	15.0 min/ft
SB-15	R-2	134.8' →	136.1' = 1.3'	7.8"	50%	0"	0%	30.0 min/ft
09/09/2016								
132.2' → 136.1' = 3.9'								
Box 1 of 1								

DRAFT

BORING NUMBER SB-16

		Run Depth (in ft)		Recovery		RQD		Drill Rate
I-75 Modernization	**Run #**	**From**	**To**	**Inch**	**%**	**Inch**	**%**	**Min/Feet**
2014195C	R-1	133.8' →	143.8' = 10'	98"	82%	91"	76%	4.4 min/ft
SB-16								
09/08/2016								
133.8 → 143.8' = 10.0'								
Box 1 of 1								

DRAFT

BORING NUMBER SB-17

		Run Depth (in ft)		Recovery		RQD		Drill Rate
I-75 Modernization	**Run #**	**From**	**To**	**Inch**	**%**	**Inch**	**%**	**Min/Feet**
2014195C	R-1	138.8' →	143.8' = 5.0'	56"	93%	51"	85%	2.2 min/ft
SB-17	R-2	143.8' →	148.8' = 5.0'	58"	97%	58"	97%	2.8 min/ft
08/19/2016								
138.8' → 148.8' = 10.0'								
Box 1 of 1								

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BORING NUMBER SB-18

		Run Depth (in ft)		Recovery		RQD		Drill Rate
I-75 Modernization	**Run #**	**From**	**To**	**Inch**	**%**	**Inch**	**%**	**Min/Feet**
2014195C	R-1	138.1' →	138.9' = 0.8'	7.7"	80%	0"	0%	19.9 min/ft
SB-18	R-2	138.9' →	143.9' = 5.0'	57"	95%	46"	77%	7.6 min/ft
08/19/2016	R-3	143.9' →	148.1' = 4.2'	50"	100%	50"	100%	4.0 min/ft
138.1' → 148.1' = 10.0'								
Box 1 of 1								

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APPENDIX D

Field Vane Shear Test Results

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SOMAT ENGINEERING, INC.
GEOTECHNICAL - GEOENVIRONMENTAL - MATERIALS TESTING

VANE SHEAR TEST SUMMARY

Borehole ID	Test Number	Vane Tip Depth (ft)	Vane Tip Elevation (ft)	In-Situ Shear Strength (psf)	Unconfined Compressive Strength (psf)
TB-119	VS1	69.5	563.9	2486	4970
	VS2	77.5	555.9	2051	4100
	VS3	87.5	545.9	n/a	n/a
	VS4	93.5	539.9	1741	3480
	VS5	101.5	531.9	1958	3920
TB-06	VS1	78.5	579.0	2424	4850
	VS2	83.5	574.1	2393	4790
	VS3	88.5	569.1	2207	4410
	VS4	91.5	566.1	2486	4970
	VS5	94.5	563.1	2362	4720
TB-06A	VS1	74.5	582.9	2207	4410
	VS2	89.5	567.9	1989	3980
	VS3	103	554.4	1740	3480
	VS4	109.5	547.9	2051	4100
	VS5	115.5	541.9	1803	3610
	VS6	124.5	532.9	1865	3730
TB-118	VS1	87.5	568.4	2331	4660
	VS2	95.5	560.4	2518	5030
	VS3	105.5	550.4	2269	4540
	VS4	113.5	542.4	2704	5410
	VS5	123.5	532.4	2455	4910
SB-03	VS1	56.5	583.4	2766	5530
SB-03A	VS1	71.5	568.1	n/a	n/a
	VS2	81.5	558.1	n/a	n/a
	VS3	91.5	548.1	n/a	n/a
	VS4	103.5	536.1	n/a	n/a
TB-117	VS1	54.5	567.9	1647	3290
	VS2	65.5	559.9	1678	3360
	VS3	74.5	547.9	1399	2800
	VS4	90.5	531.9	1026	2050
SB-06	VS1	71.5	566.6	2331	4660
	VS2	81.5	556.6	2735	5470
	VS3	91.5	546.6	2082	4160
	VS4	96.5	541.6	2331	4660
SB-09	VS1	56.5	580.0	1896	3790
SB-09A	VS1	64.5	572.1	1741	3480
	VS2	74.5	562.1	1585	3170
	VS3	84.5	552.1	1461	2920
	VS4	90.5	546.1	1150	2300
	VS5	98.5	538.1	995	1990
RW-40A	VS1	61.5	568.3	2362	4720
	VS2	72.5	557.3	1678	3360
	VS3	81.5	548.3	1989	3980
	VS4	96.5	533.3	1709	3420
RW-37A	VS1	69.5	566.9	1772	3540
	VS2	77.5	558.9	1803	3610
	VS3	85.5	550.9	1430	2860
	VS4	91.5	544.9	1585	3170
	VS5	99.5	536.9	1461	2920
TB-05	VS1	69	568.0	2828	5660

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SOMAT ENGINEERING, INC.
GEOTECHNICAL - GEOENVIRONMENTAL - MATERIALS TESTING

VANE SHEAR TEST SUMMARY

Borehole ID	Test Number	Vane Tip Depth (ft)	Vane Tip Elevation (ft)	In-Situ Shear Strength (psf)	Unconfined Compressive Strength (psf)
TB-05A	VS1	71.5	565.4	2518	5030
	VS2	78.5	558.4	2362	4720
	VS3	86.5	550.4	2269	4540
	VS4	93.5	543.4	2020	4040
	VS5	101.5	535.4	1958	3920
RW-31A	VS1	56.5	569.3	1678	3360
	VS2	64.5	561.3	1958	3920
	VS3	78.5	547.3	1554	3110
	VS4	82.5	543.3	1523	3050
	VS5	92.5	533.3	2580	5160
SB-12	VS1	86.5	550.0	1222	2440
RW-25A	VS1	61.5	573.2	2393	4790
	VS2	73.5	561.2	2082	4160
	VS3	83.5	551.2	1896	3790
	VS4	89.5	545.2	2113	4230
	VS5	97.5	537.2	1865	3730
RW-20	VS1	61.5	572.6	2238	4480
	VS2	71.5	562.6	1430	2860
	VS3	81.5	552.6	n/a	n/a
RW-17A	VS1	61.5	572.5	1927	3850
	VS2	67.5	566.5	2113	4230
	VS3	79.5	554.5	1958	3920
	VS4	89.5	544.5	1989	3980
RW-13	VS1	65.5	569.7	2082	4160
	VS2	75	560.2	n/a	n/a
SB-15A	VS1	61.5	571.7	2020	4040
	VS2	69.5	563.7	2269	4540
	VS3	77.5	555.7	2176	4350
	VS4	83.5	549.7	1834	3670
RW-08	VS1	63.5	570.6	1927	3850
	VS2	79.5	554.6	2238	4480
	VS3	87.5	546.6	2176	4350
RW-08A	VS1	70.5	563.5	n/a	n/a
	VS2	85.5	548.5	2207	4410
SB-16	VS1	57	575.6	n/a	n/a
SB-16B	VS1	59.5	573.1	2300	4600
	VS2	67.5	565.1	1865	3730
	VS3	77.5	555.1	1741	3480
	VS4	83.5	549.1	1927	3850
	VS5	91.5	541.1	1336	2670
SB-17	VS1	54.5	578.3	2051	4100
	VS2	89.5	543.3	1741	3480
SB-17A	VS1	46.5	586.3	n/a	n/a
SB-17B	VS1	76.5	556.3	2362	4720
	VS2	81.5	551.3	2051	4100
SB-18	VS1	52	581.3	n/a	n/a
	VS2	67	566.3	2362	4720
	VS3	82	551.3	1709	3420

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SOMAT ENGINEERING, INC.
GEOTECHNICAL - GEOENVIRONMENTAL - MATERIALS TESTING

VANE SHEAR TEST SUMMARY

Borehole ID	Test Number	Vane Tip Depth (ft)	Vane Tip Elevation (ft)	In-Situ Shear Strength (psf)	Unconfined Compressive Strength (psf)
SB-18A	VS1	57.5	575.8	1741	3480
	VS2	65.5	567.8	1585	3170
	VS3	75.5	557.8	1647	3290
	VS4	81.5	551.8	1896	3790
	VS5	89.5	543.8	1896	3790
TB-04	VS1	38.5	594.0	n/a	n/a
	VS2	63.5	569.0	2455	4910
TB-04A	VS1	59.5	573.5	1927	3850
	VS2	69.5	563.5	1958	3920
	VS3	74.5	558.5	2424	4850
	VS4	80.5	552.5	2238	4480
TB-116	VS1	36.5	595.1	n/a	n/a
	VS2	56.5	575.1	2455	4910
	VS3	66.5	565.1	3046	6090
	VS4	75.5	556.1	2704	5400
	VS5	85.5	546.1	2642	5280
	VS6	89.5	542.1	2486	4970
TB-115	VS1	81.5	579.8	1709	3420
	VS2	93.5	567.8	1958	3920
	VS3	103.5	557.8	2362	4720
	VS4	111.5	549.8	2455	4910
	VS5	117.5	543.8	1709	3420
TB-114	VS1	53.5	579.6	2300	4600
	VS2	63.5	569.6	2300	4600
	VS3	73.5	559.6	2145	4290
	VS4	81.5	551.6	n/a	n/a
TB-113	VS1	53.5	580.2	2145	4290
	VS2	61.5	572.2	2331	4660
	VS3	75.5	558.2	2207	4410
	VS4	79.5	554.2	2145	4290
TB-03	VS1	51.5	583.1	2238	4480
	VS2	67	567.6	2020	4040
TB-03A	VS1	61.5	572.0	2113	4230
	VS2	68.5	565.0	2424	4850
	VS3	73.5	560.0	2177	4350
	VS4	78.5	555.0	1709	3420
	VS5	88.4	545.1	n/a	n/a
TB-112	VS1	53.5	579.1	2518	5030
	VS2	63.5	569.1	2145	4290
	VS3	73.5	559.1	1181	2360
	VS4	79.5	553.1	2020	4040
TB-111	VS1	56.5	575.3	2300	4600
TB-110	VS1	53.5	578.7	2518	5030
	VS2	61.5	570.7	2424	4850
	VS3	73.5	558.7	n/a	n/a
	VS4	79.5	552.7	2549	5100
	VS5	85.5	546.7	2486	4970

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SOMAT ENGINEERING, INC.
GEOTECHNICAL - GEOENVIRONMENTAL - MATERIALS TESTING

VANE SHEAR TEST SUMMARY

Borehole ID	Test Number	Vane Tip Depth (ft)	Vane Tip Elevation (ft)	In-Situ Shear Strength (psf)	Unconfined Compressive Strength (psf)
TB-109	VS1	64.5	569.3	2393	4790
	VS2	71.5	562.3	2859	5720
	VS3	76.5	557.3	2331	4660
	VS4	81.5	552.3	2424	4850
TB-108	VS1	53.5	578.5	2735	5470
	VS2	61.5	570.5	n/a	n/a
	VS3	65.5	566.5	2269	4540
	VS4	73.5	558.5	1958	3920
TB-02	VS1	43	591.8	n/a	n/a
	VS2	51	583.8	n/a	n/a
	VS3	55.5	579.3	2828	5660
	VS4	58.5	576.3	2393	4790
TB-02A	VS1	50	584.7	n/a	n/a
	VS2	54.5	580.2	n/a	n/a
	VS3	59.5	575.2	2766	5530
	VS4	63.5	571.2	2922	5840
	VS5	71.5	563.2	2611	5220
TB-106	VS1	51.5	582.6	2331	4660
	VS2	59.5	574.6	2113	4230
	VS3	67.5	566.6	2207	4410
	VS4	75.5	558.6	1803	3610
TB-105	VS1	46.5	586.4	2393	4790
	VS2	56.5	576.4	2922	5840
	VS3	66.5	566.4	2238	4480
	VS4	75.5	557.4	2735	5470
	VS5	81.5	551.4	2176	4350
TB-104	VS1	49.5	581.7	n/a	n/a
	VS2	64	567.2	746	1490
	VS3	72.5	558.7	1896	3790
TB-103	VS1	56.5	576.2	n/a	n/a
	VS2	61.5	571.2	2890	5780
	VS3	66.5	566.2	2486	4970
	VS4	71.5	561.2	2393	4790
	VS5	81.5	551.2	2984	5970
TB-102	VS1	45.5	587.0	n/a	n/a
	VS2	57.5	575.0	2393	4790
	VS3	65.5	567.0	1989	3980
	VS4	74.5	561.0	1647	3290
	VS5	79.5	553.0	1772	3540
TB-101	VS1	49.5	582.0	1803	3610
	VS2	59.5	572.0	2082	4160
	VS3	63.5	568.0	1772	3540
	VS4	69.5	562.0	1554	3110
	VS5	81.5	550.0	1896	3790

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Somat Engineering

FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/6/2017
Project No.	2014195C	**Boring No.:**	TB-119
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	A. Patterson	**Depth of Test:**	68.0 ft to 69.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.4 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	565.4 ft to 563.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	9.0	5 °	18.0
10 °	24.0	10 °	25.0
15 °	53.0	15 °	26.0
20 °	75.0	20 °	26.0
25 °	80.0	25 °	26.0
30 °	80.0	30 °	
35 °	80.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	80.0	26.0	
Applied Torque (in-lbs)	960.0	312.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2486.4	808.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4970.0		= Undist. Shear Strength x 2
Sensitivity	**3.08** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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Infrastructure Engineering Solutions

Somat Engineering

FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/6/2017
Project No.	2014195C	**Boring No.:**	TB-119
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	A. Patterson	**Depth of Test:**	76.0 ft to 77.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.4 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	557.4 ft to 555.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	34.0	5 °	5.0
10 °	57.0	10 °	5.0
15 °	66.0	15 °	5.0
20 °	66.0	20 °	5.0
25 °	66.0	25 °	5.0
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	66.0	5.0	
Applied Torque (in-lbs)	792.0	60.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2051.3	155.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4100.0		= Undist. Shear Strength x 2
Sensitivity	**13.20** Sensitive		= Undist. Strength/ Remold. Strength

NOTES:

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Infrastructure Engineering Solutions

Somat Engineering

FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/8/2017
Project No.	2014195C	**Boring No.:**	TB-119
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	A. Patterson	**Depth of Test:**	86.0 ft to 87.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.4 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	547.4 ft to 545.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	20.0	5 °	
10 °	29.0	10 °	
15 °	35.0	15 °	
20 °	78.0	20 °	
25 °	95.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	95.0		
Applied Torque (in-lbs)	1140.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2952.6		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5910.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/8/2017
Project No.	2014195C	**Boring No.:**	TB-119
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	A. Patterson	**Depth of Test:**	92.0 ft to 93.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.4 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	541.4 ft to 539.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	21.0	5 °	15.0
10 °	43.0	10 °	22.0
15 °	56.0	15 °	22.0
20 °	56.0	20 °	22.0
25 °	56.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	56.0	22.0	
Applied Torque (in-lbs)	672.0	264.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1740.5	683.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3480.0		= Undist. Shear Strength x 2
Sensitivity	**2.55** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/8/2017
Project No.	2014195C	**Boring No.:**	TB-119
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	A. Patterson	**Depth of Test:**	100.0 ft to 101.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.4 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	533.4 ft to 531.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	3.0	5 °	3.0
10 °	4.0	10 °	3.0
15 °	4.0	15 °	3.0
20 °	5.0	20 °	3.0
25 °	6.0	25 °	
30 °	8.0	30 °	
35 °	10.0	35 °	
40 °	14.0	40 °	
45 °	21.0	45 °	
50 °	35.0	50 °	
55 °	50.0	55 °	
60 °	63.0	60 °	
65 °	63.0	65 °	
70 °	63.0	70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	63.0	3.0	
Applied Torque (in-lbs)	756.0	36.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1958.0	93.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3920.0		= Undist. Shear Strength x 2
Sensitivity	**21.00** Sensitive		= Undist. Strength/ Remold. Strength

NOTES: Observed damage to vane upon test completion.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/13/2015
Project No.	2014195C	**Boring No.:**	TB-06
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	R. Calkins	**Depth of Test:**	77.0 ft to 78.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	657.6 ft
Driller:	R. Rau	**Elevation of Test Point:**	580.6 ft to 579.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	36.0	5 °	35.0
10 °	61.0	10 °	37.0
15 °	78.0	15 °	37.0
20 °	78.0	20 °	37.0
25 °	72.0	25 °	37.0
30 °	70.0	30 °	37.0
35 °	70.0	35 °	37.0
40 °	70.0	40 °	37.0
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	78.0	37.0	
Applied Torque (in-lbs)	936.0	444.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2424.2	1150.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4850.0		= Undist. Shear Strength x 2
Sensitivity	**2.11** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/13/2015
Project No.	2014195C	**Boring No.:**	TB-06
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	R. Calkins	**Depth of Test:**	82.0 ft to 83.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	657.6 ft
Driller:	R. Rau	**Elevation of Test Point:**	575.6 ft to 574.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	34.0	5 °	34.0
10 °	58.0	10 °	40.0
15 °	74.0	15 °	40.0
20 °	77.0	20 °	40.0
25 °	72.0	25 °	40.0
30 °	70.0	30 °	40.0
35 °	70.0	35 °	40.0
40 °	70.0	40 °	40.0
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	77.0	40.0	
Applied Torque (in-lbs)	924.0	480.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2393.2	1243.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4790.0		= Undist. Shear Strength x 2
Sensitivity	**1.93** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/13/2015
Project No.	2014195C	**Boring No.:**	TB-06
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	R. Calkins	**Depth of Test:**	87.0 ft to 88.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	657.6 ft
Driller:	R. Rau	**Elevation of Test Point:**	570.6 ft to 569.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	35.0	5 °	30.0
10 °	57.0	10 °	33.0
15 °	71.0	15 °	33.0
20 °	68.0	20 °	33.0
25 °	66.0	25 °	33.0
30 °	65.0	30 °	33.0
35 °	65.0	35 °	33.0
40 °	65.0	40 °	33.0
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	71.0	33.0	
Applied Torque (in-lbs)	852.0	396.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2206.7	1025.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4410.0		= Undist. Shear Strength x 2
Sensitivity	**2.15** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/13/2015
Project No.	2014195C	**Boring No.:**	TB-06
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	R. Calkins	**Depth of Test:**	90.0 ft to 91.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	657.6 ft
Driller:	R. Rau	**Elevation of Test Point:**	567.6 ft to 566.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	31.0	5 °	31.0
10 °	53.0	10 °	41.0
15 °	74.0	15 °	42.0
20 °	80.0	20 °	42.0
25 °	76.0	25 °	42.0
30 °	74.0	30 °	42.0
35 °	74.0	35 °	42.0
40 °	74.0	40 °	42.0
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	80.0	42.0	
Applied Torque (in-lbs)	960.0	504.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2486.4	1305.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4970.0		= Undist. Shear Strength x 2
Sensitivity	**1.90** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/13/2015
Project No.	2014195C	**Boring No.:**	TB-06
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	R. Calkins	**Depth of Test:**	93.0 ft to 94.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	657.6 ft
Driller:	R. Rau	**Elevation of Test Point:**	564.6 ft to 563.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	35.0	5 °	34.0
10 °	57.0	10 °	40.0
15 °	67.0	15 °	40.0
20 °	76.0	20 °	40.0
25 °	72.0	25 °	40.0
30 °	70.0	30 °	40.0
35 °	69.0	35 °	40.0
40 °	69.0	40 °	40.0
45 °	69.0	45 °	40.0
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	76.0	40.0	
Applied Torque (in-lbs)	912.0	480.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2362.1	1243.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4720.0		= Undist. Shear Strength x 2
Sensitivity	**1.90** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/5/2016
Project No.	2014195C	**Boring No.:**	TB-06A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Whoolery	**Depth of Test:**	73.0 ft to 74.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	657.4 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	584.4 ft to 582.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	14.0	5 °	27.0
10 °	17.0	10 °	32.0
15 °	27.0	15 °	33.0
20 °	46.0	20 °	32.0
25 °	64.0	25 °	32.0
30 °	68.0	30 °	
35 °	70.0	35 °	
40 °	71.0	40 °	
45 °	69.0	45 °	
50 °	66.0	50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	71.0	33.0	
Applied Torque (in-lbs)	852.0	396.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2206.7	1025.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4410.0		= Undist. Shear Strength x 2
Sensitivity	**2.15** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/5/2016
Project No.	2014195C	**Boring No.:**	TB-06A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Whoolery	**Depth of Test:**	88.0 ft to 89.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	657.4 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	569.4 ft to 567.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	29.0	5 °	26.0
10 °	51.0	10 °	32.0
15 °	64.0	15 °	32.0
20 °	63.0	20 °	32.0
25 °	60.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	64.0	32.0	
Applied Torque (in-lbs)	768.0	384.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1989.1	994.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3980.0		= Undist. Shear Strength x 2
Sensitivity	**2.00** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/5/2016
Project No.	2014195C	**Boring No.:**	TB-06A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Whoolery	**Depth of Test:**	101.5 ft to 103.0 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	657.4 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	555.9 ft to 554.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	25.0	5 °	30.0
10 °	43.0	10 °	39.0
15 °	53.0	15 °	38.0
20 °	56.0	20 °	38.0
25 °	52.0	25 °	
30 °	51.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	56.0	39.0	
Applied Torque (in-lbs)	672.0	468.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1740.5	1212.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3480.0		= Undist. Shear Strength x 2
Sensitivity	**1.44** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/6/2016
Project No.	2014195C	**Boring No.:**	TB-06A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	S. Whoolery	**Depth of Test:**	108.0 ft to 109.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	657.4 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	549.4 ft to 547.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	24.0	5 °	28.0
10 °	40.0	10 °	38.0
15 °	54.0	15 °	37.0
20 °	64.0	20 °	37.0
25 °	66.0	25 °	
30 °	64.0	30 °	
35 °	64.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	66.0	38.0	
Applied Torque (in-lbs)	792.0	456.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2051.3	1181.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4100.0		= Undist. Shear Strength x 2
Sensitivity	**1.74** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/6/2016
Project No.	2014195C	**Boring No.:**	TB-06A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	S. Whoolery	**Depth of Test:**	114.0 ft to 115.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	657.4 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	543.4 ft to 541.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	20.0	5 °	21.0
10 °	39.0	10 °	30.0
15 °	52.0	15 °	30.0
20 °	58.0	20 °	30.0
25 °	47.0	25 °	
30 °	46.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	58.0	30.0	
Applied Torque (in-lbs)	696.0	360.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1802.6	932.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3610.0		= Undist. Shear Strength x 2
Sensitivity	**1.93** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/6/2016
Project No.	2014195C	**Boring No.:**	TB-06A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-6
Somat Engineer:	S. Whoolery	**Depth of Test:**	123.0 ft to 124.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	657.4 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	534.4 ft to 532.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	19.0	5 °	20.0
10 °	37.0	10 °	25.0
15 °	52.0	15 °	25.0
20 °	60.0	20 °	25.0
25 °	51.0	25 °	
30 °	49.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	60.0	25.0	
Applied Torque (in-lbs)	720.0	300.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1864.8	777.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3730.0		= Undist. Shear Strength x 2
Sensitivity	**2.40** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	2/8/2017
Project No.	2014195C	**Boring No.:**	TB-118
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	R. Calkins	**Depth of Test:**	86.0 ft to 87.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	655.9 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	569.9 ft to 568.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	25.0	5 °	11.0
10 °	41.0	10 °	29.0
15 °	54.0	15 °	32.0
20 °	65.0	20 °	32.0
25 °	73.0	25 °	32.0
30 °	75.0	30 °	32.0
35 °	73.0	35 °	
40 °	72.0	40 °	
45 °	71.0	45 °	
50 °	71.0	50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	75.0	32.0	
Applied Torque (in-lbs)	900.0	384.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2331.0	994.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4660.0		= Undist. Shear Strength x 2
Sensitivity	**2.34** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	2/8/2017
Project No.	2014195C	**Boring No.:**	TB-118
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	R. Calkins	**Depth of Test:**	94.0 ft to 95.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	655.9 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	561.9 ft to 560.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	20.0	5 °	19.0
10 °	39.0	10 °	32.0
15 °	48.0	15 °	33.0
20 °	60.0	20 °	33.0
25 °	72.0	25 °	34.0
30 °	79.0	30 °	35.0
35 °	81.0	35 °	35.0
40 °	73.0	40 °	35.0
45 °	72.0	45 °	
50 °	71.0	50 °	
55 °	71.0	55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	81.0	35.0	
Applied Torque (in-lbs)	972.0	420.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2517.5	1087.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5030.0		= Undist. Shear Strength x 2
Sensitivity	**2.31** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	2/16/2017
Project No.	2014195C	**Boring No.:**	TB-118
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Swaminathan	**Depth of Test:**	104.0 ft to 105.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	655.9 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	551.9 ft to 550.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	25.0	5 °	22.0
10 °	40.0	10 °	36.0
15 °	54.0	15 °	38.0
20 °	71.0	20 °	38.0
25 °	73.0	25 °	38.0
30 °	67.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	73.0	38.0	
Applied Torque (in-lbs)	876.0	456.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2268.8	1181.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4540.0		= Undist. Shear Strength x 2
Sensitivity	**1.92** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	2/17/2017
Project No.	2014195C	**Boring No.:**	TB-118
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	S. Whoolery	**Depth of Test:**	112.0 ft to 113.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	655.9 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	543.9 ft to 542.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	22.0	5 °	18.0
10 °	39.0	10 °	32.0
15 °	54.0	15 °	44.0
20 °	67.0	20 °	47.0
25 °	79.0	25 °	48.0
30 °	87.0	30 °	50.0
35 °	80.0	35 °	51.0
40 °	81.0	40 °	52.0
45 °	82.0	45 °	53.0
50 °	83.0	50 °	54.0
55 °	84.0	55 °	54.0
60 °	83.0	60 °	55.0
65 °	83.0	65 °	56.0
70 °	84.0	70 °	57.0
75 °	84.0	75 °	57.0
80 °	84.0	80 °	57.0
85 °	84.0	85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	87.0	57.0	
Applied Torque (in-lbs)	1044.0	684.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2704.0	1771.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5410.0		= Undist. Shear Strength x 2
Sensitivity	**1.53** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Observed damage to vane upon test completion.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	2/17/2017
Project No.	2014195C	**Boring No.:**	TB-118
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	S. Swaminathan	**Depth of Test:**	122.0 ft to 123.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	655.9 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	533.9 ft to 532.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	23.0	5 °	29.0
10 °	38.0	10 °	39.0
15 °	51.0	15 °	43.0
20 °	61.0	20 °	43.0
25 °	71.0	25 °	43.0
30 °	79.0	30 °	
35 °	72.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	79.0	43.0	
Applied Torque (in-lbs)	948.0	516.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2455.3	1336.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4910.0		= Undist. Shear Strength x 2
Sensitivity	**1.84** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	9/12/2016
Project No.	2014195C	**Boring No.:**	SB-03
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	R. Calkins	**Depth of Test:**	55.0 ft to 56.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	639.9 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	584.9 ft to 583.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	38.0	5 °	28.0
10 °	55.0	10 °	29.0
15 °	87.0	15 °	30.0
20 °	89.0	20 °	30.0
25 °	85.0	25 °	30.0
30 °	83.0	30 °	
35 °	83.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	89.0	30.0	
Applied Torque (in-lbs)	1068.0	360.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2766.1	932.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5530.0		= Undist. Shear Strength x 2
Sensitivity	**2.97** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/11/2016
Project No.	2014195C	**Boring No.:**	SB-03A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Swaminathan	**Depth of Test:**	70.0 ft to 71.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	639.6 ft
Driller:	R. Rau	**Elevation of Test Point:**	569.6 ft to 568.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"		2 1/2"		2.59	
18"	x	3 5/8"	x	0.905	x

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	12.0	5 °	
10 °	28.0	10 °	
15 °	41.0	15 °	
20 °	51.0	20 °	
25 °	60.0	25 °	
30 °	68.0	30 °	
35 °	75.0	35 °	
40 °	80.0	40 °	
45 °	85.0	45 °	
50 °	89.0	50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	89.0		
Applied Torque (in-lbs)	1602.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1449.8		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2900.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/11/2016
Project No.	2014195C	**Boring No.:**	SB-03A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Swaminathan	**Depth of Test:**	80.0 ft to 81.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	639.6 ft
Driller:	R. Rau	**Elevation of Test Point:**	559.6 ft to 558.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"		2 1/2"		2.59	
18"	x	3 5/8"	x	0.905	x

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	10.0	5 °	
10 °	14.0	10 °	
15 °	15.0	15 °	
20 °	15.0	20 °	
25 °	18.0	25 °	
30 °	21.0	30 °	
35 °	23.0	35 °	
40 °	25.0	40 °	
45 °	29.0	45 °	
50 °	31.0	50 °	
55 °	34.0	55 °	
60 °	37.0	60 °	
65 °	41.0	65 °	
70 °	45.0	70 °	
75 °	48.0	75 °	
80 °	52.0	80 °	
85 °	55.0	85 °	
90 °	62.0	90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	62.0		
Applied Torque (in-lbs)	1116.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1010.0		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2020.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early; force gauge reached maximum dial reading.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/12/2016
Project No.	2014195C	**Boring No.:**	SB-03A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	M. Gilliland	**Depth of Test:**	90.0 ft to 91.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	639.6 ft
Driller:	R. Rau	**Elevation of Test Point:**	549.6 ft to 548.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"		2 1/2"		2.59	
18"	x	3 5/8"	x	0.905	x

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	10.0	5 °	
10 °	22.0	10 °	
15 °	34.0	15 °	
20 °	43.0	20 °	
25 °	53.0	25 °	
30 °	62.0	30 °	
35 °	70.0	35 °	
40 °	80.0	40 °	
45 °	87.0	45 °	
50 °	94.0	50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	94.0		
Applied Torque (in-lbs)	1692.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1531.3		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3060.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
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Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/12/2016
Project No.	2014195C	**Boring No.:**	SB-03A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	M. Gilliland	**Depth of Test:**	102.0 ft to 103.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	639.6 ft
Driller:	R. Rau	**Elevation of Test Point:**	537.6 ft to 536.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"		2 1/2"		2.59	
18"	x	3 5/8"	x	0.905	x

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	10.0	5 °	
10 °	14.0	10 °	
15 °	14.0	15 °	
20 °	14.0	20 °	
25 °	14.0	25 °	
30 °	15.0	30 °	
35 °	20.0	35 °	
40 °	25.0	40 °	
45 °	31.0	45 °	
50 °	37.0	50 °	
55 °	45.0	55 °	
60 °	54.0	60 °	
65 °	61.0	65 °	
70 °	68.0	70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	68.0		
Applied Torque (in-lbs)	1224.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1107.7		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2220.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	2/6/2017
Project No.	2014195C	**Boring No.:**	TB-117
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	N. Otto	**Depth of Test:**	53.0 ft to 54.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	622.4 ft
Driller:	R. Rau	**Elevation of Test Point:**	569.4 ft to 567.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	31.0	5 °	32.0
10 °	48.0	10 °	33.0
15 °	53.0	15 °	33.0
20 °	51.0	20 °	33.0
25 °	49.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	53.0	33.0	
Applied Torque (in-lbs)	636.0	396.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1647.2	1025.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3290.0		= Undist. Shear Strength x 2
Sensitivity	**1.61** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	2/8/2017
Project No.	2014195C	**Boring No.:**	TB-117
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	N. Otto	**Depth of Test:**	61.0 ft to 62.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	622.4 ft
Driller:	A. Rau	**Elevation of Test Point:**	561.4 ft to 559.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	32.0	5 °	28.0
10 °	46.0	10 °	30.0
15 °	54.0	15 °	30.0
20 °	51.0	20 °	30.0
25 °	50.0	25 °	
30 °	49.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	54.0	30.0	
Applied Torque (in-lbs)	648.0	360.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1678.3	932.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3360.0		= Undist. Shear Strength x 2
Sensitivity	**1.80** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	2/10/2017
Project No.	2014195C	**Boring No.:**	TB-117
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	N. Otto	**Depth of Test:**	73.0 ft to 74.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	622.4 ft
Driller:	A. Rau	**Elevation of Test Point:**	549.4 ft to 547.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	25.0	5 °	25.0
10 °	35.0	10 °	28.0
15 °	38.0	15 °	28.0
20 °	40.0	20 °	22.0
25 °	41.0	25 °	22.0
30 °	44.0	30 °	22.0
35 °	45.0	35 °	
40 °	45.0	40 °	
45 °	45.0	45 °	
50 °	45.0	50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	45.0	28.0	
Applied Torque (in-lbs)	540.0	336.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1398.6	870.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2800.0		= Undist. Shear Strength x 2
Sensitivity	**1.61** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	2/17/2017
Project No.	2014195C	**Boring No.:**	TB-117
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	M. Wajed	**Depth of Test:**	89.0 ft to 90.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	622.4 ft
Driller:	A. Guzdial	**Elevation of Test Point:**	533.4 ft to 531.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	23.0	5 °	16.0
10 °	29.0	10 °	18.0
15 °	33.0	15 °	18.0
20 °	33.0	20 °	18.0
25 °	33.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	33.0	18.0	
Applied Torque (in-lbs)	396.0	216.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1025.6	559.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2050.0		= Undist. Shear Strength x 2
Sensitivity	**1.83** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/6/2016
Project No.	2014195C	**Boring No.:**	SB-06
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	L. Martinez	**Depth of Test:**	70.0 ft to 71.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	638.1 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	568.1 ft to 566.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	42.0	5 °	41.0
10 °	55.0	10 °	44.0
15 °	73.0	15 °	44.0
20 °	75.0	20 °	44.0
25 °	75.0	25 °	44.0
30 °	75.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	75.0	44.0	
Applied Torque (in-lbs)	900.0	528.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2331.0	1367.5	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4660.0		= Undist. Shear Strength x 2
Sensitivity	**1.70** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Remolded test performed after 10 minutes.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/6/2016
Project No.	2014195C	**Boring No.:**	SB-06
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	L. Martinez	**Depth of Test:**	80.0 ft to 81.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	638.1 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	558.1 ft to 556.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	4.0	5 °	39.0
10 °	9.0	10 °	42.0
15 °	9.0	15 °	42.0
20 °	9.0	20 °	42.0
25 °	19.0	25 °	41.0
30 °	39.0	30 °	
35 °	62.0	35 °	
40 °	81.0	40 °	
45 °	85.0	45 °	
50 °	88.0	50 °	
55 °	86.0	55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	88.0	42.0	
Applied Torque (in-lbs)	1056.0	504.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2735.0	1305.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5470.0		= Undist. Shear Strength x 2
Sensitivity	**2.10** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Remolded test performed after 10 minutes.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/7/2016
Project No.	2014195C	**Boring No.:**	SB-06
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Swaminathan	**Depth of Test:**	90.0 ft to 91.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	638.1 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	548.1 ft to 546.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	36.0	5 °	35.0
10 °	57.0	10 °	38.0
15 °	67.0	15 °	38.0
20 °	67.0	20 °	39.0
25 °	66.0	25 °	39.0
30 °	65.0	30 °	39.0
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	67.0	39.0	
Applied Torque (in-lbs)	804.0	468.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2082.4	1212.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4160.0		= Undist. Shear Strength x 2
Sensitivity	**1.72** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/7/2016
Project No.	2014195C	**Boring No.:**	SB-06
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	S. Swaminathan	**Depth of Test:**	95.0 ft to 96.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	638.1 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	543.1 ft to 541.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	43.0	5 °	37.0
10 °	64.0	10 °	39.0
15 °	75.0	15 °	39.0
20 °	75.0	20 °	39.0
25 °	73.0	25 °	39.0
30 °	72.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	75.0	39.0	
Applied Torque (in-lbs)	900.0	468.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2331.0	1212.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4660.0		= Undist. Shear Strength x 2
Sensitivity	**1.92** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	11/7/2016
Project No.	2014195C	**Boring No.:**	SB-09
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Whoolery	**Depth of Test:**	55.0 ft to 56.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	636.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	581.5 ft to 580.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	32.0	5 °	31.0
10 °	47.0	10 °	32.0
15 °	59.0	15 °	32.0
20 °	61.0	20 °	32.0
25 °	58.0	25 °	
30 °	56.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	61.0	32.0	
Applied Torque (in-lbs)	732.0	384.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1895.9	994.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3790.0		= Undist. Shear Strength x 2
Sensitivity	**1.91** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/22/2017
Project No.	2014195C	**Boring No.:**	SB-09A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	M. Wajed	**Depth of Test:**	63.0 ft to 64.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.6 ft
Driller:	R. Rau	**Elevation of Test Point:**	573.6 ft to 572.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	32.0	5 °	33.0
10 °	50.0	10 °	37.0
15 °	56.0	15 °	37.0
20 °	53.0	20 °	37.0
25 °	53.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	56.0	37.0	
Applied Torque (in-lbs)	672.0	444.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1740.5	1150.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3480.0		= Undist. Shear Strength x 2
Sensitivity	**1.51** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/22/2017
Project No.	2014195C	**Boring No.:**	SB-09A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	M. Wajed	**Depth of Test:**	73.0 ft to 74.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.6 ft
Driller:	R. Rau	**Elevation of Test Point:**	563.6 ft to 562.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	26.0	5 °	38.0
10 °	43.0	10 °	30.0
15 °	51.0	15 °	30.0
20 °	45.0	20 °	30.0
25 °	45.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	51.0	38.0	
Applied Torque (in-lbs)	612.0	456.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1585.1	1181.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3170.0		= Undist. Shear Strength x 2
Sensitivity	**1.34** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/22/2017
Project No.	2014195C	**Boring No.:**	SB-09A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	M. Wajed	**Depth of Test:**	83.0 ft to 84.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.6 ft
Driller:	R. Rau	**Elevation of Test Point:**	553.6 ft to 552.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	24.0	5 °	21.0
10 °	40.0	10 °	28.0
15 °	47.0	15 °	28.0
20 °	47.0	20 °	28.0
25 °	47.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	47.0	28.0	
Applied Torque (in-lbs)	564.0	336.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1460.8	870.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2920.0		= Undist. Shear Strength x 2
Sensitivity	**1.68** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/23/2017
Project No.	2014195C	**Boring No.:**	SB-09A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	M. Wajed	**Depth of Test:**	89.0 ft to 90.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.6 ft
Driller:	A. Rau	**Elevation of Test Point:**	547.6 ft to 546.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	18.0	5 °	17.0
10 °	22.0	10 °	18.0
15 °	27.0	15 °	18.0
20 °	34.0	20 °	18.0
25 °	37.0	25 °	
30 °	34.0	30 °	
35 °	32.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	37.0	18.0	
Applied Torque (in-lbs)	444.0	216.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1150.0	559.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2300.0		= Undist. Shear Strength x 2
Sensitivity	**2.06** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/23/2017
Project No.	2014195C	**Boring No.:**	SB-09A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	M. Wajed	**Depth of Test:**	97.0 ft to 98.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.6 ft
Driller:	A. Rau	**Elevation of Test Point:**	539.6 ft to 538.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	21.0	5 °	18.0
10 °	26.0	10 °	21.0
15 °	32.0	15 °	21.0
20 °	32.0	20 °	22.0
25 °	32.0	25 °	22.0
30 °		30 °	22.0
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	32.0	22.0	
Applied Torque (in-lbs)	384.0	264.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	994.6	683.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	1990.0		= Undist. Shear Strength x 2
Sensitivity	**1.45** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/14/2016
Project No.	2014195C	**Boring No.:**	RW-40a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	M. Gilliland	**Depth of Test:**	60.0 ft to 61.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	629.8 ft
Driller:	R. Rau	**Elevation of Test Point:**	569.8 ft to 568.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	25.0	5 °	23.0
10 °	46.0	10 °	37.0
15 °	61.0	15 °	40.0
20 °	71.0	20 °	40.0
25 °	76.0	25 °	40.0
30 °	74.0	30 °	
35 °	72.0	35 °	
40 °	70.0	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	76.0	40.0	
Applied Torque (in-lbs)	912.0	480.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2362.1	1243.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4720.0		= Undist. Shear Strength x 2
Sensitivity	**1.90** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/17/2016
Project No.	2014195C	**Boring No.:**	RW-40a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	M. Gilliland	**Depth of Test:**	71.0 ft to 72.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	629.8 ft
Driller:	R. Rau	**Elevation of Test Point:**	558.8 ft to 557.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	23.0	5 °	20.0
10 °	38.0	10 °	28.0
15 °	49.0	15 °	28.0
20 °	54.0	20 °	28.0
25 °	54.0	25 °	
30 °	52.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	54.0	28.0	
Applied Torque (in-lbs)	648.0	336.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1678.3	870.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3360.0		= Undist. Shear Strength x 2
Sensitivity	**1.93** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/18/2016
Project No.	2014195C	**Boring No.:**	RW-40a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Whoolery	**Depth of Test:**	80.0 ft to 81.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	629.8 ft
Driller:	R. Rau	**Elevation of Test Point:**	549.8 ft to 548.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	8.0	5 °	17.0
10 °	8.0	10 °	33.0
15 °	10.0	15 °	34.0
20 °	18.0	20 °	34.0
25 °	31.0	25 °	34.0
30 °	41.0	30 °	
35 °	48.0	35 °	
40 °	54.0	40 °	
45 °	59.0	45 °	
50 °	63.0	50 °	
55 °	64.0	55 °	
60 °	60.0	60 °	
65 °	59.0	65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	64.0	34.0	
Applied Torque (in-lbs)	768.0	408.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1989.1	1056.7	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3980.0		= Undist. Shear Strength x 2
Sensitivity	**1.88** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/19/2016
Project No.	2014195C	**Boring No.:**	RW-40a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	M. Gilliland	**Depth of Test:**	95.0 ft to 96.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	629.8 ft
Driller:	R. Rau	**Elevation of Test Point:**	534.8 ft to 533.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	16.0	5 °	17.0
10 °	32.0	10 °	29.0
15 °	45.0	15 °	29.0
20 °	53.0	20 °	29.0
25 °	55.0	25 °	
30 °	52.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	55.0	29.0	
Applied Torque (in-lbs)	660.0	348.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1709.4	901.3	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3420.0		= Undist. Shear Strength x 2
Sensitivity	**1.90** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/27/2017
Project No.	2014195C	**Boring No.:**	RW-37a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	M. Hiske	**Depth of Test:**	68.0 ft to 69.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.4 ft
Driller:	R. Rau	**Elevation of Test Point:**	568.4 ft to 566.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	26.0	5 °	28.0
10 °	47.0	10 °	33.0
15 °	57.0	15 °	34.0
20 °	54.0	20 °	34.0
25 °	53.0	25 °	34.0
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	57.0	34.0	
Applied Torque (in-lbs)	684.0	408.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1771.6	1056.7	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3540.0		= Undist. Shear Strength x 2
Sensitivity	**1.68** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/30/2017
Project No.	2014195C	**Boring No.:**	RW-37a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	R. Calkins	**Depth of Test:**	76.0 ft to 77.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.4 ft
Driller:	R. Rau	**Elevation of Test Point:**	560.4 ft to 558.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	25.0	5 °	27.0
10 °	43.0	10 °	33.0
15 °	56.0	15 °	34.0
20 °	58.0	20 °	35.0
25 °	53.0	25 °	35.0
30 °	52.0	30 °	35.0
35 °	52.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	58.0	35.0	
Applied Torque (in-lbs)	696.0	420.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1802.6	1087.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3610.0		= Undist. Shear Strength x 2
Sensitivity	**1.66** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/30/2017
Project No.	2014195C	**Boring No.:**	RW-37a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	R. Calkins	**Depth of Test:**	84.0 ft to 85.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.4 ft
Driller:	R. Rau	**Elevation of Test Point:**	552.4 ft to 550.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	22.0	5 °	22.0
10 °	38.0	10 °	24.0
15 °	46.0	15 °	24.0
20 °	42.0	20 °	24.0
25 °	41.0	25 °	24.0
30 °	40.0	30 °	
35 °	40.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	46.0	24.0	
Applied Torque (in-lbs)	552.0	288.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1429.7	745.9	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2860.0		= Undist. Shear Strength x 2
Sensitivity	**1.92** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/30/2017
Project No.	2014195C	**Boring No.:**	RW-37a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	R. Calkins	**Depth of Test:**	90.0 ft to 91.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.4 ft
Driller:	R. Rau	**Elevation of Test Point:**	546.4 ft to 544.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	25.0	5 °	23.0
10 °	42.0	10 °	25.0
15 °	51.0	15 °	25.0
20 °	46.0	20 °	25.0
25 °	43.0	25 °	25.0
30 °	43.0	30 °	25.0
35 °	43.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	51.0	25.0	
Applied Torque (in-lbs)	612.0	300.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1585.1	777.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3170.0		= Undist. Shear Strength x 2
Sensitivity	**2.04** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	2/1/2017
Project No.	2014195C	**Boring No.:**	RW-37a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	R. Calkins	**Depth of Test:**	98.0 ft to 99.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.4 ft
Driller:	R. Rau	**Elevation of Test Point:**	538.4 ft to 536.9 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	21.0	5 °	22.0
10 °	33.0	10 °	26.0
15 °	44.0	15 °	26.0
20 °	47.0	20 °	26.0
25 °	43.0	25 °	26.0
30 °	41.0	30 °	
35 °	40.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	47.0	26.0	
Applied Torque (in-lbs)	564.0	312.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1460.8	808.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2920.0		= Undist. Shear Strength x 2
Sensitivity	**1.81** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/8/2015
Project No.	2014195C	**Boring No.:**	TB-05
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	R. Calkins	**Depth of Test:**	67.5 ft to 69.0 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	637.0 ft
Driller:	R. Rau	**Elevation of Test Point:**	569.5 ft to 568.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	43.0	5 °	20.0
10 °	67.0	10 °	22.0
15 °	87.0	15 °	23.0
20 °	91.0	20 °	24.0
25 °	86.0	25 °	25.0
30 °	85.0	30 °	25.0
35 °	84.0	35 °	25.0
40 °	84.0	40 °	25.0
45 °	84.0	45 °	25.0
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	91.0	25.0	
Applied Torque (in-lbs)	1092.0	300.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2828.3	777.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5660.0		= Undist. Shear Strength x 2
Sensitivity	**3.64** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/24/2016
Project No.	2014195C	**Boring No.:**	TB-05A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Swaminathan	**Depth of Test:**	70.0 ft to 71.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.9 ft
Driller:	R. Rau	**Elevation of Test Point:**	566.9 ft to 565.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	30.0	5 °	22.0
10 °	45.0	10 °	41.0
15 °	62.0	15 °	43.0
20 °	74.0	20 °	43.0
25 °	81.0	25 °	43.0
30 °	78.0	30 °	44.0
35 °		35 °	44.0
40 °		40 °	44.0
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	81.0	44.0	
Applied Torque (in-lbs)	972.0	528.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2517.5	1367.5	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5030.0		= Undist. Shear Strength x 2
Sensitivity	**1.84** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/24/2016
Project No.	2014195C	**Boring No.:**	TB-05A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Swaminathan	**Depth of Test:**	77.0 ft to 78.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.9 ft
Driller:	R. Rau	**Elevation of Test Point:**	559.9 ft to 558.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	34.0	5 °	34.0
10 °	61.0	10 °	38.0
15 °	76.0	15 °	38.0
20 °	71.0	20 °	39.0
25 °		25 °	40.0
30 °		30 °	40.0
35 °		35 °	40.0
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	76.0	40.0	
Applied Torque (in-lbs)	912.0	480.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2362.1	1243.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4720.0		= Undist. Shear Strength x 2
Sensitivity	**1.90** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/25/2016
Project No.	2014195C	**Boring No.:**	TB-05A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Swaminathan	**Depth of Test:**	85.0 ft to 86.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.9 ft
Driller:	R. Rau	**Elevation of Test Point:**	551.9 ft to 550.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	31.0	5 °	28.0
10 °	57.0	10 °	36.0
15 °	73.0	15 °	37.0
20 °	70.0	20 °	38.0
25 °		25 °	38.0
30 °		30 °	38.0
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	73.0	38.0	
Applied Torque (in-lbs)	876.0	456.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2268.8	1181.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4540.0		= Undist. Shear Strength x 2
Sensitivity	**1.92** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/25/2016
Project No.	2014195C	**Boring No.:**	TB-05A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	S. Swaminathan	**Depth of Test:**	92.0 ft to 93.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.9 ft
Driller:	R. Rau	**Elevation of Test Point:**	544.9 ft to 543.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	31.0	5 °	30.0
10 °	52.0	10 °	33.0
15 °	65.0	15 °	33.0
20 °	63.0	20 °	34.0
25 °		25 °	34.0
30 °		30 °	34.0
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	65.0	34.0	
Applied Torque (in-lbs)	780.0	408.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2020.2	1056.7	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4040.0		= Undist. Shear Strength x 2
Sensitivity	**1.91** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/25/2016
Project No.	2014195C	**Boring No.:**	TB-05A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	S. Swaminathan	**Depth of Test:**	100.0 ft to 101.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.9 ft
Driller:	R. Rau	**Elevation of Test Point:**	536.9 ft to 535.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	26.0	5 °	17.0
10 °	49.0	10 °	22.0
15 °	63.0	15 °	23.0
20 °	58.0	20 °	24.0
25 °		25 °	25.0
30 °		30 °	25.0
35 °		35 °	26.0
40 °		40 °	27.0
45 °		45 °	28.0
50 °		50 °	29.0
55 °		55 °	29.0
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	63.0	29.0	
Applied Torque (in-lbs)	756.0	348.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1958.0	901.3	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3920.0		= Undist. Shear Strength x 2
Sensitivity	**2.17** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	2/23/2017
Project No.	2014195C	**Boring No.:**	RW-31a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	N. Otto	**Depth of Test:**	55.0 ft to 56.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	625.8 ft
Driller:	A. Guzdzial	**Elevation of Test Point:**	570.8 ft to 569.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	29.0	5 °	27.0
10 °	47.0	10 °	32.0
15 °	54.0	15 °	32.0
20 °	49.0	20 °	33.0
25 °	47.0	25 °	33.0
30 °	46.0	30 °	33.0
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	54.0	33.0	
Applied Torque (in-lbs)	648.0	396.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1678.3	1025.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3360.0		= Undist. Shear Strength x 2
Sensitivity	**1.64** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	2/23/2017
Project No.	2014195C	**Boring No.:**	RW-31a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	N. Otto	**Depth of Test:**	63.0 ft to 64.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	625.8 ft
Driller:	A. Guzdzial	**Elevation of Test Point:**	562.8 ft to 561.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	29.0	5 °	25.0
10 °	48.0	10 °	30.0
15 °	63.0	15 °	31.0
20 °	59.0	20 °	31.0
25 °	57.0	25 °	31.0
30 °	56.0	30 °	31.0
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	63.0	31.0	
Applied Torque (in-lbs)	756.0	372.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1958.0	963.5	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3920.0		= Undist. Shear Strength x 2
Sensitivity	**2.03** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	2/27/2017
Project No.	2014195C	**Boring No.:**	RW-31a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	M. Wajed	**Depth of Test:**	77.0 ft to 78.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	625.8 ft
Driller:	A. Guzdzial	**Elevation of Test Point:**	548.8 ft to 547.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	24.0	5 °	17.0
10 °	41.0	10 °	21.0
15 °	50.0	15 °	21.0
20 °	46.0	20 °	21.0
25 °	39.0	25 °	
30 °	39.0	30 °	
35 °	39.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	50.0	21.0	
Applied Torque (in-lbs)	600.0	252.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1554.0	652.7	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3110.0		= Undist. Shear Strength x 2
Sensitivity	**2.38** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/2/2017
Project No.	2014195C	**Boring No.:**	RW-31a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	M. Wajed	**Depth of Test:**	81.0 ft to 82.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	625.8 ft
Driller:	A. Rau	**Elevation of Test Point:**	544.8 ft to 543.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	25.0	5 °	22.0
10 °	42.0	10 °	25.0
15 °	49.0	15 °	25.0
20 °	40.0	20 °	25.0
25 °	40.0	25 °	25.0
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	49.0	25.0	
Applied Torque (in-lbs)	588.0	300.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1522.9	777.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3050.0		= Undist. Shear Strength x 2
Sensitivity	**1.96** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/2/2017
Project No.	2014195C	**Boring No.:**	RW-31a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	M. Wajed	**Depth of Test:**	91.0 ft to 92.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	625.8 ft
Driller:	A. Rau	**Elevation of Test Point:**	534.8 ft to 533.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	11.0	5 °	25.0
10 °	32.0	10 °	52.0
15 °	51.0	15 °	74.0
20 °	68.0	20 °	77.0
25 °	79.0	25 °	74.0
30 °	83.0	30 °	74.0
35 °	80.0	35 °	74.0
40 °	80.0	40 °	
45 °	80.0	45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	83.0	77.0	
Applied Torque (in-lbs)	996.0	924.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2579.6	2393.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5160.0		= Undist. Shear Strength x 2
Sensitivity	**1.08** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/3/2016
Project No.	2014195C	**Boring No.:**	SB-12
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	C. Schroeder	**Depth of Test:**	85.0 ft to 86.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	636.5 ft
Driller:	R. Rau	**Elevation of Test Point:**	551.5 ft to 550.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"		2 1/2"		2.59	
18"	x	3 5/8"	x	0.905	x

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	3.5	5 °	12.0
10 °	10.5	10 °	25.0
15 °	19.0	15 °	36.0
20 °	26.0	20 °	45.0
25 °	33.0	25 °	46.0
30 °	39.0	30 °	46.0
35 °	44.0	35 °	46.0
40 °	48.0	40 °	46.0
45 °	52.0	45 °	
50 °	55.0	50 °	
55 °	57.0	55 °	
60 °	60.0	60 °	
65 °	63.0	65 °	
70 °	65.0	70 °	
75 °	67.0	75 °	
80 °	70.0	80 °	
85 °	74.0	85 °	
90 °	75.0	90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	75.0	46.0	
Applied Torque (in-lbs)	1350.0	828.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1221.8	749.3	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2440.0		= Undist. Shear Strength x 2
Sensitivity	**1.63** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/26/2017
Project No.	2014195C	**Boring No.:**	RW-25a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	R. Calkins	**Depth of Test:**	60.0 ft to 61.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.7 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	574.7 ft to 573.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	34.0	5 °	33.0
10 °	59.0	10 °	39.0
15 °	75.0	15 °	39.0
20 °	77.0	20 °	39.0
25 °	72.0	25 °	39.0
30 °	70.0	30 °	
35 °	69.0	35 °	
40 °	68.0	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	77.0	39.0	
Applied Torque (in-lbs)	924.0	468.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2393.2	1212.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4790.0		= Undist. Shear Strength x 2
Sensitivity	**1.97** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/27/2017
Project No.	2014195C	**Boring No.:**	RW-25a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Swaminathan	**Depth of Test:**	72.0 ft to 73.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.7 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	562.7 ft to 561.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	33.0	5 °	28.0
10 °	56.0	10 °	34.0
15 °	67.0	15 °	33.0
20 °	63.0	20 °	33.0
25 °		25 °	33.0
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	67.0	34.0	
Applied Torque (in-lbs)	804.0	408.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2082.4	1056.7	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4160.0		= Undist. Shear Strength x 2
Sensitivity	**1.97** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/27/2017
Project No.	2014195C	**Boring No.:**	RW-25a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Swaminathan	**Depth of Test:**	82.0 ft to 83.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.7 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	552.7 ft to 551.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	31.0	5 °	30.0
10 °	45.0	10 °	31.0
15 °	59.0	15 °	31.0
20 °	61.0	20 °	31.0
25 °	52.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	61.0	31.0	
Applied Torque (in-lbs)	732.0	372.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1895.9	963.5	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3790.0		= Undist. Shear Strength x 2
Sensitivity	**1.97** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/27/2017
Project No.	2014195C	**Boring No.:**	RW-25a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	S. Swaminathan	**Depth of Test:**	88.0 ft to 89.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.7 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	546.7 ft to 545.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	34.0	5 °	29.0
10 °	55.0	10 °	32.0
15 °	68.0	15 °	32.0
20 °	63.0	20 °	32.0
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	68.0	32.0	
Applied Torque (in-lbs)	816.0	384.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2113.4	994.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4230.0		= Undist. Shear Strength x 2
Sensitivity	**2.13** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	2/1/2017
Project No.	2014195C	**Boring No.:**	RW-25a
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	M. Hiske	**Depth of Test:**	96.0 ft to 97.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.7 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	538.7 ft to 537.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	20.0	5 °	24.0
10 °	26.0	10 °	43.0
15 °	40.0	15 °	54.0
20 °	52.0	20 °	55.0
25 °	58.0	25 °	55.0
30 °	60.0	30 °	54.0
35 °	57.0	35 °	
40 °	55.0	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	60.0	55.0	
Applied Torque (in-lbs)	720.0	660.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1864.8	1709.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3730.0		= Undist. Shear Strength x 2
Sensitivity	**1.09** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Observed damage to vane upon test completion.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	9/23/2016
Project No.	2014195C	**Boring No.:**	RW-20
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Swaminathan	**Depth of Test:**	60.0 ft to 61.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.1 ft
Driller:	H. Pace	**Elevation of Test Point:**	574.1 ft to 572.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	9.0	5 °	12.0
10 °	11.0	10 °	32.0
15 °	14.0	15 °	33.0
20 °	16.0	20 °	33.0
25 °	19.0	25 °	34.0
30 °	30.0	30 °	34.0
35 °	50.0	35 °	35.0
40 °	64.0	40 °	35.0
45 °	72.0	45 °	35.0
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	72.0	35.0	
Applied Torque (in-lbs)	864.0	420.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2237.8	1087.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4480.0		= Undist. Shear Strength x 2
Sensitivity	**2.06** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	9/27/2016
Project No.	2014195C	**Boring No.:**	RW-20
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Swaminathan	**Depth of Test:**	70.0 ft to 71.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.1 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	564.1 ft to 562.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	23.0	5 °	30.0
10 °	44.0	10 °	35.0
15 °	46.0	15 °	36.0
20 °	44.0	20 °	35.0
25 °	43.0	25 °	35.0
30 °	42.0	30 °	35.0
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	46.0	36.0	
Applied Torque (in-lbs)	552.0	432.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1429.7	1118.9	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2860.0		= Undist. Shear Strength x 2
Sensitivity	**1.28** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	9/27/2016
Project No.	2014195C	**Boring No.:**	RW-20
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Swaminathan	**Depth of Test:**	80.0 ft to 81.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.1 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	554.1 ft to 552.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	37.0	5 °	
10 °	50.0	10 °	
15 °	68.0	15 °	
20 °	86.0	20 °	
25 °	97.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	97.0		
Applied Torque (in-lbs)	1164.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	3014.8		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	6030.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to possible cobble.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/19/2017
Project No.	2014195C	**Boring No.:**	RW-17A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	M. Wajed	**Depth of Test:**	60.0 ft to 61.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	634.0 ft
Driller:	R. Rau	**Elevation of Test Point:**	574.0 ft to 572.5 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	29.0	5 °	32.0
10 °	51.0	10 °	34.0
15 °	62.0	15 °	34.0
20 °	56.0	20 °	34.0
25 °	56.0	25 °	
30 °	56.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	62.0	34.0	
Applied Torque (in-lbs)	744.0	408.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1927.0	1056.7	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3850.0		= Undist. Shear Strength x 2
Sensitivity	**1.82** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/19/2017
Project No.	2014195C	**Boring No.:**	RW-17A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	M. Wajed	**Depth of Test:**	66.0 ft to 67.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	634.0 ft
Driller:	R. Rau	**Elevation of Test Point:**	568.0 ft to 566.5 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	34.0	5 °	37.0
10 °	55.0	10 °	48.0
15 °	68.0	15 °	48.0
20 °	68.0	20 °	48.0
25 °	68.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	68.0	48.0	
Applied Torque (in-lbs)	816.0	576.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2113.4	1491.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4230.0		= Undist. Shear Strength x 2
Sensitivity	**1.42** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/25/2017
Project No.	2014195C	**Boring No.:**	RW-17A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Swaminathan	**Depth of Test:**	78.0 ft to 79.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	634.0 ft
Driller:	R. Rau	**Elevation of Test Point:**	556.0 ft to 554.5 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	29.0	5 °	29.0
10 °	49.0	10 °	36.0
15 °	62.0	15 °	36.0
20 °	63.0	20 °	36.0
25 °	56.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	63.0	36.0	
Applied Torque (in-lbs)	756.0	432.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1958.0	1118.9	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3920.0		= Undist. Shear Strength x 2
Sensitivity	**1.75** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/25/2017
Project No.	2014195C	**Boring No.:**	RW-17A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	S. Swaminathan	**Depth of Test:**	88.0 ft to 89.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	634.0 ft
Driller:	R. Rau	**Elevation of Test Point:**	546.0 ft to 544.5 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	21.0	5 °	23.0
10 °	32.0	10 °	32.0
15 °	40.0	15 °	32.0
20 °	49.0	20 °	31.0
25 °	57.0	25 °	31.0
30 °	64.0	30 °	
35 °	58.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	64.0	32.0	
Applied Torque (in-lbs)	768.0	384.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1989.1	994.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3980.0		= Undist. Shear Strength x 2
Sensitivity	**2.00** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	9/23/2016
Project No.	2014195C	**Boring No.:**	RW-13
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Woolery	**Depth of Test:**	64.0 ft to 65.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	635.2 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	571.2 ft to 569.7 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	34.0	5 °	33.0
10 °	55.0	10 °	36.0
15 °	67.0	15 °	35.0
20 °	62.0	20 °	35.0
25 °	61.0	25 °	35.0
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	67.0	36.0	
Applied Torque (in-lbs)	804.0	432.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2082.4	1118.9	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4160.0		= Undist. Shear Strength x 2
Sensitivity	**1.86** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	9/27/2016
Project No.	2014195C	**Boring No.:**	RW-13
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Woolery	**Depth of Test:**	73.5 ft to 75.0 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	635.2 ft
Driller:	H. Pace	**Elevation of Test Point:**	561.7 ft to 560.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	21.0	5 °	28.0
10 °	31.0	10 °	45.0
15 °	39.0	15 °	47.0
20 °	46.0	20 °	48.0
25 °	2.0	25 °	49.0
30 °		30 °	49.0
35 °		35 °	49.0
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	46.0	49.0	
Applied Torque (in-lbs)	552.0	588.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1429.7	1522.9	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2860.0		= Undist. Shear Strength x 2
Sensitivity	**0.94** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Driller noted possible cobble encountered during undisturbed condition test.
Results may be disturbed and are not reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/11/2017
Project No.	2014195C	**Boring No.:**	SB-15A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	M. Wajed	**Depth of Test:**	60.0 ft to 61.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	633.2 ft
Driller:	A. Rau	**Elevation of Test Point:**	573.2 ft to 571.7 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	28.0	5 °	32.0
10 °	50.0	10 °	39.0
15 °	65.0	15 °	38.0
20 °	65.0	20 °	38.0
25 °	62.0	25 °	38.0
30 °	59.0	30 °	38.0
35 °	59.0	35 °	
40 °	59.0	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	65.0	39.0	
Applied Torque (in-lbs)	780.0	468.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2020.2	1212.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4040.0		= Undist. Shear Strength x 2
Sensitivity	**1.67** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/11/2017
Project No.	2014195C	**Boring No.:**	SB-15A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	M. Wajed	**Depth of Test:**	68.0 ft to 69.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	633.2 ft
Driller:	A. Rau	**Elevation of Test Point:**	565.2 ft to 563.7 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	17.0	5 °	28.0
10 °	17.0	10 °	39.0
15 °	18.0	15 °	39.0
20 °	20.0	20 °	39.0
25 °	22.0	25 °	39.0
30 °	27.0	30 °	
35 °	40.0	35 °	
40 °	55.0	40 °	
45 °	70.0	45 °	
50 °	73.0	50 °	
55 °	68.0	55 °	
60 °	66.0	60 °	
65 °	66.0	65 °	
70 °	66.0	70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	73.0	39.0	
Applied Torque (in-lbs)	876.0	468.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2268.8	1212.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4540.0		= Undist. Shear Strength x 2
Sensitivity	**1.87** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/13/2017
Project No.	2014195C	**Boring No.:**	SB-15A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	M. Wajed	**Depth of Test:**	76.0 ft to 77.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	633.2 ft
Driller:	R. Rau	**Elevation of Test Point:**	557.2 ft to 555.7 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	34.0	5 °	70.0
10 °	55.0	10 °	49.0
15 °	70.0	15 °	49.0
20 °	65.0	20 °	49.0
25 °	63.0	25 °	
30 °	60.0	30 °	
35 °	60.0	35 °	
40 °	60.0	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	70.0	70.0	
Applied Torque (in-lbs)	840.0	840.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2175.6	2175.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4350.0		= Undist. Shear Strength x 2
Sensitivity	**1.00** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/13/2017
Project No.	2014195C	**Boring No.:**	SB-15A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	M. Wajed	**Depth of Test:**	82.0 ft to 83.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	633.2 ft
Driller:	R. Rau	**Elevation of Test Point:**	551.2 ft to 549.7 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	28.0	5 °	21.0
10 °	49.0	10 °	29.0
15 °	59.0	15 °	29.0
20 °	53.0	20 °	29.0
25 °	53.0	25 °	
30 °	53.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	59.0	29.0	
Applied Torque (in-lbs)	708.0	348.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1833.7	901.3	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3670.0		= Undist. Shear Strength x 2
Sensitivity	**2.03** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	9/1/2016
Project No.	2014195C	**Boring No.:**	RW-08
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	C. Kennedy	**Depth of Test:**	62.0 ft to 63.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.1 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	572.1 ft to 570.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	16.0	5 °	29.0
10 °	21.0	10 °	32.0
15 °	40.0	15 °	31.5
20 °	55.0	20 °	32.0
25 °	62.0	25 °	32.0
30 °	58.0	30 °	31.5
35 °	57.0	35 °	
40 °	57.0	40 °	
45 °	54.0	45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	62.0	32.0	
Applied Torque (in-lbs)	744.0	384.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1927.0	994.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3850.0		= Undist. Shear Strength x 2
Sensitivity	**1.94** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	9/1/2016
Project No.	2014195C	**Boring No.:**	RW-08
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	C. Kennedy	**Depth of Test:**	78.0 ft to 79.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.1 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	556.1 ft to 554.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	24.0	5 °	30.0
10 °	39.0	10 °	32.0
15 °	56.0	15 °	31.5
20 °	72.0	20 °	31.0
25 °	61.0	25 °	30.5
30 °	58.0	30 °	30.5
35 °	57.0	35 °	30.0
40 °	50.0	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	72.0	32.0	
Applied Torque (in-lbs)	864.0	384.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2237.8	994.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4480.0		= Undist. Shear Strength x 2
Sensitivity	**2.25** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Remolded test performed after 13.5 minutes.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	9/6/2016
Project No.	2014195C	**Boring No.:**	RW-08
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Swaminathan	**Depth of Test:**	86.0 ft to 87.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.1 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	548.1 ft to 546.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	19.0	5 °	31.0
10 °	24.0	10 °	39.0
15 °	30.0	15 °	39.0
20 °	42.0	20 °	38.0
25 °	43.0	25 °	38.0
30 °	44.0	30 °	38.0
35 °	46.0	35 °	
40 °	48.0	40 °	
45 °	61.0	45 °	
50 °	70.0	50 °	
55 °	61.0	55 °	
60 °	58.0	60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	70.0	39.0	
Applied Torque (in-lbs)	840.0	468.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2175.6	1212.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4350.0		= Undist. Shear Strength x 2
Sensitivity	**1.79** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/11/2016
Project No.	2014195C	**Boring No.:**	RW-08A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	J. Hoksbergen	**Depth of Test:**	69.0 ft to 70.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.0 ft
Driller:	H. Pace	**Elevation of Test Point:**	565.0 ft to 563.5 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	75.0	5 °	
10 °	80.0	10 °	
15 °		15 °	
20 °		20 °	
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	80.0		
Applied Torque (in-lbs)	960.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2486.4		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4970.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/12/2016
Project No.	2014195C	**Boring No.:**	RW-08A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Whoolery	**Depth of Test:**	84.0 ft to 85.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.0 ft
Driller:	H. Pace	**Elevation of Test Point:**	550.0 ft to 548.5 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	16.0	5 °	33.0
10 °	25.0	10 °	36.0
15 °	27.0	15 °	36.0
20 °	29.0	20 °	36.0
25 °	32.0	25 °	
30 °	36.0	30 °	
35 °	41.0	35 °	
40 °	47.0	40 °	
45 °	52.0	45 °	
50 °	57.0	50 °	
55 °	61.0	55 °	
60 °	66.0	60 °	
65 °	71.0	65 °	
70 °	64.0	70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	71.0	36.0	
Applied Torque (in-lbs)	852.0	432.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2206.7	1118.9	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4410.0		= Undist. Shear Strength x 2
Sensitivity	**1.97** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Observed damage to vane upon test completion.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	9/6/2016
Project No.	2014195C	**Boring No.:**	SB-16
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	L. Martinez	**Depth of Test:**	55.5 ft to 57.0 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	632.6 ft
Driller:	A. Guzdzial	**Elevation of Test Point:**	577.1 ft to 575.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"		2 1/2"		2.59	
18"	x	3 5/8"	x	0.905	x

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	17.0	5 °	
10 °	49.0	10 °	
15 °	65.0	15 °	
20 °	75.0	20 °	
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	75.0		
Applied Torque (in-lbs)	1350.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1221.8		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2440.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/18/2017
Project No.	2014195C	**Boring No.:**	SB-16B
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	R. Calkins	**Depth of Test:**	58.0 ft to 59.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.6 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	574.6 ft to 573.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	36.0	5 °	36.0
10 °	60.0	10 °	41.0
15 °	74.0	15 °	41.0
20 °	69.0	20 °	40.0
25 °	65.0	25 °	40.0
30 °	64.0	30 °	40.0
35 °	64.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	74.0	41.0	
Applied Torque (in-lbs)	888.0	492.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2299.9	1274.3	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4600.0		= Undist. Shear Strength x 2
Sensitivity	**1.80** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/18/2017
Project No.	2014195C	**Boring No.:**	SB-16B
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	R. Calkins	**Depth of Test:**	66.0 ft to 67.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.6 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	566.6 ft to 565.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	37.0	5 °	37.0
10 °	57.0	10 °	42.0
15 °	60.0	15 °	44.0
20 °	60.0	20 °	43.0
25 °	59.0	25 °	42.0
30 °	57.0	30 °	41.0
35 °		35 °	41.0
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	60.0	44.0	
Applied Torque (in-lbs)	720.0	528.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1864.8	1367.5	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3730.0		= Undist. Shear Strength x 2
Sensitivity	**1.36** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/18/2017
Project No.	2014195C	**Boring No.:**	SB-16B
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	C. Schroeder	**Depth of Test:**	76.0 ft to 77.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.6 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	556.6 ft to 555.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	29.0	5 °	28.0
10 °	46.0	10 °	32.0
15 °	56.0	15 °	31.0
20 °	52.0	20 °	31.0
25 °	50.0	25 °	30.0
30 °		30 °	30.0
35 °		35 °	30.0
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	56.0	32.0	
Applied Torque (in-lbs)	672.0	384.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1740.5	994.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3480.0		= Undist. Shear Strength x 2
Sensitivity	**1.75** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/19/2017
Project No.	2014195C	**Boring No.:**	SB-16B
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	R. Calkins	**Depth of Test:**	82.0 ft to 83.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.6 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	550.6 ft to 549.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	26.0	5 °	25.0
10 °	44.0	10 °	26.0
15 °	58.0	15 °	26.0
20 °	62.0	20 °	25.0
25 °	54.0	25 °	25.0
30 °	51.0	30 °	25.0
35 °	50.0	35 °	
40 °	49.0	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	62.0	26.0	
Applied Torque (in-lbs)	744.0	312.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1927.0	808.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3850.0		= Undist. Shear Strength x 2
Sensitivity	**2.38** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/19/2017
Project No.	2014195C	**Boring No.:**	SB-16B
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	R. Calkins	**Depth of Test:**	90.0 ft to 91.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.6 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	542.6 ft to 541.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	19.0	5 °	15.0
10 °	31.0	10 °	24.0
15 °	40.0	15 °	29.0
20 °	43.0	20 °	31.0
25 °	39.0	25 °	33.0
30 °	38.0	30 °	33.0
35 °	38.0	35 °	33.0
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	43.0	33.0	
Applied Torque (in-lbs)	516.0	396.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1336.4	1025.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2670.0		= Undist. Shear Strength x 2
Sensitivity	**1.30** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	8/17/2016
Project No.	2014195C	**Boring No.:**	SB-17
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Valentine	**Depth of Test:**	53.0 ft to 54.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.8 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	579.8 ft to 578.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	35.0	5 °	39.0
10 °	57.0	10 °	43.0
15 °	66.0	15 °	43.0
20 °	60.0	20 °	42.0
25 °	60.0	25 °	
30 °	60.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	66.0	43.0	
Applied Torque (in-lbs)	792.0	516.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2051.3	1336.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4100.0		= Undist. Shear Strength x 2
Sensitivity	**1.53** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	8/18/2016
Project No.	2014195C	**Boring No.:**	SB-17
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Valentine	**Depth of Test:**	88.0 ft to 89.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.8 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	544.8 ft to 543.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	29.0	5 °	24.0
10 °	45.0	10 °	40.0
15 °	56.0	15 °	42.0
20 °	56.0	20 °	42.0
25 °	56.0	25 °	43.0
30 °		30 °	44.0
35 °		35 °	44.0
40 °		40 °	45.0
45 °		45 °	45.0
50 °		50 °	45.0
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	56.0	45.0	
Applied Torque (in-lbs)	672.0	540.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1740.5	1398.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3480.0		= Undist. Shear Strength x 2
Sensitivity	**1.24** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	9/6/2016
Project No.	2014195C	**Boring No.:**	SB-17A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	L. Martinez	**Depth of Test:**	45.0 ft to 46.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	632.8 ft
Driller:	A. Guzdzial	**Elevation of Test Point:**	587.8 ft to 586.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	32.0	5 °	
10 °	62.0	10 °	
15 °	72.0	15 °	
20 °		20 °	
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	72.0		
Applied Torque (in-lbs)	864.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2237.8		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4480.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to possible cobble.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/13/2016
Project No.	2014195C	**Boring No.:**	SB-17B
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	C. Schroeder	**Depth of Test:**	75.0 ft to 76.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.8 ft
Driller:	H. Pace	**Elevation of Test Point:**	557.8 ft to 556.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	64.0	5 °	38.0
10 °	76.0	10 °	36.0
15 °	70.0	15 °	35.0
20 °		20 °	35.0
25 °		25 °	34.0
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	76.0	38.0	
Applied Torque (in-lbs)	912.0	456.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2362.1	1181.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4720.0		= Undist. Shear Strength x 2
Sensitivity	**2.00** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/14/2016
Project No.	2014195C	**Boring No.:**	SB-17B
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Whoolery	**Depth of Test:**	80.0 ft to 81.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.8 ft
Driller:	H. Pace	**Elevation of Test Point:**	552.8 ft to 551.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	66.0	5 °	37.0
10 °	65.0	10 °	36.0
15 °	60.0	15 °	36.0
20 °		20 °	36.0
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	66.0	37.0	
Applied Torque (in-lbs)	792.0	444.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2051.3	1150.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4100.0		= Undist. Shear Strength x 2
Sensitivity	**1.78** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	8/17/2016
Project No.	2014195C	**Boring No.:**	SB-18
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	C. Kennedy	**Depth of Test:**	50.5 ft to 52.0 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.3 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	582.8 ft to 581.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	48.0	5 °	
10 °	80.0	10 °	
15 °	90.0	15 °	
20 °	94.0	20 °	
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	94.0		
Applied Torque (in-lbs)	1128.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2921.5		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5840.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	8/17/2016
Project No.	2014195C	**Boring No.:**	SB-18
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	C. Kennedy	**Depth of Test:**	65.5 ft to 67.0 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.3 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	567.8 ft to 566.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	40.0	5 °	37.0
10 °	56.0	10 °	43.0
15 °	52.0	15 °	43.0
20 °	70.0	20 °	44.0
25 °	76.0	25 °	44.0
30 °	73.0	30 °	44.0
35 °	70.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	76.0	44.0	
Applied Torque (in-lbs)	912.0	528.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2362.1	1367.5	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4720.0		= Undist. Shear Strength x 2
Sensitivity	**1.73** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Force gauge slipped off holder at about 10° in undisturbed condition; fixed during test.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	8/17/2016
Project No.	2014195C	**Boring No.:**	SB-18
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	C. Kennedy	**Depth of Test:**	80.5 ft to 82.0 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.3 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	552.8 ft to 551.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	33.0	5 °	28.0
10 °	50.0	10 °	30.0
15 °	54.0	15 °	30.0
20 °	55.0	20 °	30.0
25 °	54.0	25 °	
30 °	52.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	55.0	30.0	
Applied Torque (in-lbs)	660.0	360.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1709.4	932.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3420.0		= Undist. Shear Strength x 2
Sensitivity	**1.83** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/21/2016
Project No.	2014195C	**Boring No.:**	SB-18A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	C. Schroeder	**Depth of Test:**	56.0 ft to 57.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	633.3 ft
Driller:	A. Rau	**Elevation of Test Point:**	577.3 ft to 575.8 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	27.0	5 °	29.0
10 °	46.0	10 °	35.0
15 °	56.0	15 °	36.0
20 °	56.0	20 °	36.0
25 °	54.0	25 °	36.0
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	56.0	36.0	
Applied Torque (in-lbs)	672.0	432.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1740.5	1118.9	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3480.0		= Undist. Shear Strength x 2
Sensitivity	**1.56** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/21/2016
Project No.	2014195C	**Boring No.:**	SB-18A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	C. Schroeder	**Depth of Test:**	64.0 ft to 65.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	633.3 ft
Driller:	A. Rau	**Elevation of Test Point:**	569.3 ft to 567.8 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	25.0	5 °	24.0
10 °	41.0	10 °	30.0
15 °	51.0	15 °	30.0
20 °	51.0	20 °	30.0
25 °	48.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	51.0	30.0	
Applied Torque (in-lbs)	612.0	360.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1585.1	932.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3170.0		= Undist. Shear Strength x 2
Sensitivity	**1.70** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/22/2016
Project No.	2014195C	**Boring No.:**	SB-18A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	C. Schroeder	**Depth of Test:**	74.0 ft to 75.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	633.3 ft
Driller:	A. Rau	**Elevation of Test Point:**	559.3 ft to 557.8 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	22.0	5 °	24.0
10 °	39.0	10 °	31.0
15 °	53.0	15 °	31.0
20 °	52.0	20 °	30.0
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	53.0	31.0	
Applied Torque (in-lbs)	636.0	372.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1647.2	963.5	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3290.0		= Undist. Shear Strength x 2
Sensitivity	**1.71** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/3/2017
Project No.	2014195C	**Boring No.:**	SB-18A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	S. Whoolery	**Depth of Test:**	80.0 ft to 81.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	633.3 ft
Driller:	A. Rau	**Elevation of Test Point:**	553.3 ft to 551.8 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	15.0	5 °	27.0
10 °	26.0	10 °	35.0
15 °	37.0	15 °	36.0
20 °	50.0	20 °	36.0
25 °	61.0	25 °	36.0
30 °	60.0	30 °	
35 °	56.0	35 °	
40 °	55.0	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	61.0	36.0	
Applied Torque (in-lbs)	732.0	432.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1895.9	1118.9	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3790.0		= Undist. Shear Strength x 2
Sensitivity	**1.69** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	1/3/2017
Project No.	2014195C	**Boring No.:**	SB-18A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	S. Whoolery	**Depth of Test:**	88.0 ft to 89.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	633.3 ft
Driller:	A. Rau	**Elevation of Test Point:**	545.3 ft to 543.8 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	17.0	5 °	31.0
10 °	33.0	10 °	33.0
15 °	51.0	15 °	33.0
20 °	61.0	20 °	33.0
25 °	51.0	25 °	
30 °	49.0	30 °	
35 °	48.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	61.0	33.0	
Applied Torque (in-lbs)	732.0	396.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1895.9	1025.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3790.0		= Undist. Shear Strength x 2
Sensitivity	**1.85** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/8/2015
Project No.	2014195C	**Boring No.:**	TB-04
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	R. Calkins	**Depth of Test:**	37.0 ft to 38.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	632.5 ft
Driller:	R. Rau	**Elevation of Test Point:**	595.5 ft to 594.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	35.0	5 °	46.0
10 °	38.0	10 °	81.0
15 °	42.0	15 °	
20 °	45.0	20 °	
25 °	48.0	25 °	
30 °	54.0	30 °	
35 °	59.0	35 °	
40 °	63.0	40 °	
45 °	63.0	45 °	
50 °	68.0	50 °	
55 °	68.0	55 °	
60 °	71.0	60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	71.0	81.0	
Applied Torque (in-lbs)	852.0	972.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2206.7	2517.5	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4410.0		= Undist. Shear Strength x 2
Sensitivity	**0.88** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid further equipment damage due to high force gauge readings.
Observed damage to vane.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/8/2015
Project No.	2014195C	**Boring No.:**	TB-04
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	R. Calkins	**Depth of Test:**	62.0 ft to 63.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	632.5 ft
Driller:	R. Rau	**Elevation of Test Point:**	570.5 ft to 569.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	44.0	5 °	43.0
10 °	66.0	10 °	46.0
15 °	79.0	15 °	47.0
20 °	75.0	20 °	47.0
25 °	72.0	25 °	47.0
30 °	72.0	30 °	47.0
35 °	72.0	35 °	47.0
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	79.0	47.0	
Applied Torque (in-lbs)	948.0	564.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2455.3	1460.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4910.0		= Undist. Shear Strength x 2
Sensitivity	**1.68** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/11/2016
Project No.	2014195C	**Boring No.:**	TB-04A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Whoolery	**Depth of Test:**	58.0 ft to 59.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.0 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	575.0 ft to 573.5 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	32.0	5 °	34.0
10 °	45.0	10 °	35.0
15 °	62.0	15 °	35.0
20 °	58.0	20 °	
25 °	54.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	62.0	35.0	
Applied Torque (in-lbs)	744.0	420.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1927.0	1087.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3850.0		= Undist. Shear Strength x 2
Sensitivity	**1.77** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/11/2016
Project No.	2014195C	**Boring No.:**	TB-04A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Whoolery	**Depth of Test:**	68.0 ft to 69.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.0 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	565.0 ft to 563.5 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	29.0	5 °	25.0
10 °	53.0	10 °	27.0
15 °	63.0	15 °	26.0
20 °	58.0	20 °	26.0
25 °	56.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	63.0	27.0	
Applied Torque (in-lbs)	756.0	324.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1958.0	839.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3920.0		= Undist. Shear Strength x 2
Sensitivity	**2.33** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/13/2016
Project No.	2014195C	**Boring No.:**	TB-04A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Whoolery	**Depth of Test:**	73.0 ft to 74.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.0 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	560.0 ft to 558.5 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	35.0	5 °	29.0
10 °	60.0	10 °	38.0
15 °	77.0	15 °	38.0
20 °	78.0	20 °	38.0
25 °	74.0	25 °	
30 °	71.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	78.0	38.0	
Applied Torque (in-lbs)	936.0	456.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2424.2	1181.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4850.0		= Undist. Shear Strength x 2
Sensitivity	**2.05** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/13/2016
Project No.	2014195C	**Boring No.:**	TB-04A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	S. Whoolery	**Depth of Test:**	79.0 ft to 80.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.0 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	554.0 ft to 552.5 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	32.0	5 °	33.0
10 °	47.0	10 °	41.0
15 °	65.0	15 °	41.0
20 °	72.0	20 °	41.0
25 °	67.0	25 °	
30 °	64.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	72.0	41.0	
Applied Torque (in-lbs)	864.0	492.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2237.8	1274.3	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4480.0		= Undist. Shear Strength x 2
Sensitivity	**1.76** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/4/2016
Project No.	2014195C	**Boring No.:**	TB-116
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Swaminathan	**Depth of Test:**	35.0 ft to 36.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.6 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	596.6 ft to 595.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	57.0	5 °	
10 °	77.0	10 °	
15 °	100.0	15 °	
20 °		20 °	
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	100.0		
Applied Torque (in-lbs)	1200.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	3108.0		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	6220.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to possible cobble.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/4/2016
Project No.	2014195C	**Boring No.:**	TB-116
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	L. Martinez	**Depth of Test:**	55.0 ft to 56.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.6 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	576.6 ft to 575.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	36.0	5 °	39.0
10 °	61.0	10 °	42.0
15 °	79.0	15 °	42.0
20 °	79.0	20 °	42.0
25 °	79.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	79.0	42.0	
Applied Torque (in-lbs)	948.0	504.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2455.3	1305.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4910.0		= Undist. Shear Strength x 2
Sensitivity	**1.88** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Remolded test performed after 10 minutes.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/4/2016
Project No.	2014195C	**Boring No.:**	TB-116
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	L. Martinez	**Depth of Test:**	65.0 ft to 66.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.6 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	566.6 ft to 565.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	9.0	5 °	45.0
10 °	11.0	10 °	52.0
15 °	38.0	15 °	52.0
20 °	68.0	20 °	52.0
25 °	94.0	25 °	
30 °	98.0	30 °	
35 °	95.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	98.0	52.0	
Applied Torque (in-lbs)	1176.0	624.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	3045.8	1616.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	6090.0		= Undist. Shear Strength x 2
Sensitivity	**1.88** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Remolded test performed after 10 minutes.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/4/2016
Project No.	2014195C	**Boring No.:**	TB-116
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	L. Martinez	**Depth of Test:**	74.0 ft to 75.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.6 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	557.6 ft to 556.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	16.0	5 °	35.0
10 °	75.0	10 °	42.0
15 °	75.0	15 °	42.0
20 °	87.0	20 °	42.0
25 °	87.0	25 °	42.0
30 °	87.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	87.0	42.0	
Applied Torque (in-lbs)	1044.0	504.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2704.0	1305.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5400.0		= Undist. Shear Strength x 2
Sensitivity	**2.07** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Remolded test performed after 10 minutes.
Observed damage to vane upon test completion.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/5/2016
Project No.	2014195C	**Boring No.:**	TB-116
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	S. Swaminathan	**Depth of Test:**	84.0 ft to 85.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.6 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	547.6 ft to 546.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	50.0	5 °	39.0
10 °	72.0	10 °	47.0
15 °	85.0	15 °	47.0
20 °	83.0	20 °	47.0
25 °	81.0	25 °	47.0
30 °	80.0	30 °	
35 °	78.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	85.0	47.0	
Applied Torque (in-lbs)	1020.0	564.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2641.8	1460.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5280.0		= Undist. Shear Strength x 2
Sensitivity	**1.81** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/5/2016
Project No.	2014195C	**Boring No.:**	TB-116
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-6
Somat Engineer:	S. Swaminathan	**Depth of Test:**	88.0 ft to 89.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.6 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	543.6 ft to 542.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	1.0	5 °	13.0
10 °	2.0	10 °	21.0
15 °	5.0	15 °	22.0
20 °	18.0	20 °	22.0
25 °	42.0	25 °	22.0
30 °	67.0	30 °	22.0
35 °	80.0	35 °	
40 °	80.0	40 °	
45 °	80.0	45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	80.0	22.0	
Applied Torque (in-lbs)	960.0	264.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2486.4	683.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4970.0		= Undist. Shear Strength x 2
Sensitivity	**3.64** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/9/2017
Project No.	2014195C	**Boring No.:**	TB-115
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	M. Wajed	**Depth of Test:**	80.0 ft to 81.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	661.3 ft
Driller:	A. Guzdzial	**Elevation of Test Point:**	581.3 ft to 579.8 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	15.0	5 °	21.0
10 °	35.0	10 °	31.0
15 °	39.0	15 °	32.0
20 °	41.0	20 °	32.0
25 °	44.0	25 °	32.0
30 °	48.0	30 °	
35 °	55.0	35 °	
40 °	53.0	40 °	
45 °	53.0	45 °	
50 °	53.0	50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	55.0	32.0	
Applied Torque (in-lbs)	660.0	384.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1709.4	994.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3420.0		= Undist. Shear Strength x 2
Sensitivity	**1.72** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/10/2017
Project No.	2014195C	**Boring No.:**	TB-115
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	M. Wajed	**Depth of Test:**	92.0 ft to 93.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	661.3 ft
Driller:	A. Guzdzial	**Elevation of Test Point:**	569.3 ft to 567.8 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	19.0	5 °	27.0
10 °	37.0	10 °	43.0
15 °	50.0	15 °	43.0
20 °	61.0	20 °	43.0
25 °	63.0	25 °	
30 °	59.0	30 °	
35 °	59.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	63.0	43.0	
Applied Torque (in-lbs)	756.0	516.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1958.0	1336.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3920.0		= Undist. Shear Strength x 2
Sensitivity	**1.47** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/16/2017
Project No.	2014195C	**Boring No.:**	TB-115
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	M. Wajed	**Depth of Test:**	102.0 ft to 103.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	661.3 ft
Driller:	R. Rau	**Elevation of Test Point:**	559.3 ft to 557.8 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	21.0	5 °	27.0
10 °	42.0	10 °	49.0
15 °	54.0	15 °	55.0
20 °	64.0	20 °	55.0
25 °	73.0	25 °	55.0
30 °	76.0	30 °	
35 °	73.0	35 °	
40 °	73.0	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	76.0	55.0	
Applied Torque (in-lbs)	912.0	660.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2362.1	1709.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4720.0		= Undist. Shear Strength x 2
Sensitivity	**1.38** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/16/2017
Project No.	2014195C	**Boring No.:**	TB-115
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	M. Wajed	**Depth of Test:**	110.0 ft to 111.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	661.3 ft
Driller:	R. Rau	**Elevation of Test Point:**	551.3 ft to 549.8 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	29.0	5 °	28.0
10 °	41.0	10 °	48.0
15 °	57.0	15 °	50.0
20 °	67.0	20 °	50.0
25 °	79.0	25 °	50.0
30 °	75.0	30 °	
35 °	71.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	79.0	50.0	
Applied Torque (in-lbs)	948.0	600.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2455.3	1554.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4910.0		= Undist. Shear Strength x 2
Sensitivity	**1.58** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	3/20/2017
Project No.	2014195C	**Boring No.:**	TB-115
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	M. Wajed	**Depth of Test:**	116.0 ft to 117.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	661.3 ft
Driller:	R. Rau	**Elevation of Test Point:**	545.3 ft to 543.8 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	18.0	5 °	17.0
10 °	34.0	10 °	32.0
15 °	44.0	15 °	38.0
20 °	52.0	20 °	38.0
25 °	55.0	25 °	38.0
30 °	55.0	30 °	
35 °	55.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	55.0	38.0	
Applied Torque (in-lbs)	660.0	456.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1709.4	1181.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3420.0		= Undist. Shear Strength x 2
Sensitivity	**1.45** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/31/2016
Project No.	2014195C	**Boring No.:**	TB-114
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Whoolery	**Depth of Test:**	52.0 ft to 53.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.1 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	581.1 ft to 579.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	40.0	5 °	37.0
10 °	62.0	10 °	42.0
15 °	74.0	15 °	42.0
20 °	70.0	20 °	42.0
25 °	68.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	74.0	42.0	
Applied Torque (in-lbs)	888.0	504.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2299.9	1305.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4600.0		= Undist. Shear Strength x 2
Sensitivity	**1.76** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/31/2016
Project No.	2014195C	**Boring No.:**	TB-114
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Whoolery	**Depth of Test:**	62.0 ft to 63.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.1 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	571.1 ft to 569.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	35.0	5 °	30.0
10 °	59.0	10 °	41.0
15 °	74.0	15 °	42.0
20 °	71.0	20 °	42.0
25 °	69.0	25 °	42.0
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	74.0	42.0	
Applied Torque (in-lbs)	888.0	504.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2299.9	1305.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4600.0		= Undist. Shear Strength x 2
Sensitivity	**1.76** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	11/1/2016
Project No.	2014195C	**Boring No.:**	TB-114
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Whoolery	**Depth of Test:**	72.0 ft to 73.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.1 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	561.1 ft to 559.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	29.0	5 °	31.0
10 °	51.0	10 °	35.0
15 °	69.0	15 °	35.0
20 °	68.0	20 °	34.0
25 °	64.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	69.0	35.0	
Applied Torque (in-lbs)	828.0	420.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2144.5	1087.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4290.0		= Undist. Shear Strength x 2
Sensitivity	**1.97** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	11/1/2016
Project No.	2014195C	**Boring No.:**	TB-114
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	S. Whoolery	**Depth of Test:**	80.0 ft to 81.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.1 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	553.1 ft to 551.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	34.0	5 °	
10 °	63.0	10 °	
15 °	82.0	15 °	
20 °	92.0	20 °	
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	92.0		
Applied Torque (in-lbs)	1104.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2859.4		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5720.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/9/2016
Project No.	2014195C	**Boring No.:**	TB-113
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Whoolery	**Depth of Test:**	52.0 ft to 53.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.7 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	581.7 ft to 580.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	36.0	5 °	32.0
10 °	57.0	10 °	35.0
15 °	66.0	15 °	35.0
20 °	69.0	20 °	35.0
25 °	67.0	25 °	
30 °	64.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	69.0	35.0	
Applied Torque (in-lbs)	828.0	420.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2144.5	1087.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4290.0		= Undist. Shear Strength x 2
Sensitivity	**1.97** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/9/2016
Project No.	2014195C	**Boring No.:**	TB-113
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Whoolery	**Depth of Test:**	60.0 ft to 61.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.7 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	573.7 ft to 572.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	33.0	5 °	27.0
10 °	58.0	10 °	32.0
15 °	75.0	15 °	33.0
20 °	74.0	20 °	33.0
25 °	71.0	25 °	34.0
30 °		30 °	34.0
35 °		35 °	34.0
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	75.0	34.0	
Applied Torque (in-lbs)	900.0	408.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2331.0	1056.7	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4660.0		= Undist. Shear Strength x 2
Sensitivity	**2.21** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/13/2016
Project No.	2014195C	**Boring No.:**	TB-113
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	C. Schroeder	**Depth of Test:**	74.0 ft to 75.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.7 ft
Driller:	H. Pace	**Elevation of Test Point:**	559.7 ft to 558.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	19.0	5 °	32.0
10 °	42.0	10 °	38.0
15 °	50.0	15 °	38.0
20 °	64.0	20 °	38.0
25 °	71.0	25 °	
30 °	70.0	30 °	
35 °	66.0	35 °	
40 °	64.0	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	71.0	38.0	
Applied Torque (in-lbs)	852.0	456.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2206.7	1181.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4410.0		= Undist. Shear Strength x 2
Sensitivity	**1.87** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/22/2016
Project No.	2014195C	**Boring No.:**	TB-113
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	R. Calkins	**Depth of Test:**	78.0 ft to 79.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.7 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	555.7 ft to 554.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	23.0	5 °	23.0
10 °	42.0	10 °	24.0
15 °	61.0	15 °	24.0
20 °	69.0	20 °	24.0
25 °	68.0	25 °	
30 °	66.0	30 °	
35 °	65.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	69.0	24.0	
Applied Torque (in-lbs)	828.0	288.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2144.5	745.9	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4290.0		= Undist. Shear Strength x 2
Sensitivity	**2.88** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/7/2015
Project No.	2014195C	**Boring No.:**	TB-03
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	R. Calkins	**Depth of Test:**	50.0 ft to 51.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	634.6 ft
Driller:	R. Rau	**Elevation of Test Point:**	584.6 ft to 583.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	44.0	5 °	36.0
10 °	66.0	10 °	38.0
15 °	72.0	15 °	38.0
20 °	71.0	20 °	38.0
25 °	70.0	25 °	38.0
30 °	69.0	30 °	38.0
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	72.0	38.0	
Applied Torque (in-lbs)	864.0	456.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2237.8	1181.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4480.0		= Undist. Shear Strength x 2
Sensitivity	**1.89** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/8/2015
Project No.	2014195C	**Boring No.:**	TB-03
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	R. Calkins	**Depth of Test:**	65.5 ft to 67.0 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	634.6 ft
Driller:	R. Rau	**Elevation of Test Point:**	569.1 ft to 567.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	37.0	5 °	24.0
10 °	62.0	10 °	25.0
15 °	65.0	15 °	25.0
20 °	62.0	20 °	25.0
25 °	61.0	25 °	26.0
30 °	60.0	30 °	26.0
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	65.0	26.0	
Applied Torque (in-lbs)	780.0	312.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2020.2	808.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4040.0		= Undist. Shear Strength x 2
Sensitivity	**2.50** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/28/2016
Project No.	2014195C	**Boring No.:**	TB-03A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	R. Calkins	**Depth of Test:**	60.0 ft to 61.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	573.5 ft to 572.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	34.0	5 °	32.0
10 °	55.0	10 °	35.0
15 °	68.0	15 °	35.0
20 °	64.0	20 °	37.0
25 °	62.0	25 °	36.0
30 °	61.0	30 °	36.0
35 °	61.0	35 °	36.0
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	68.0	37.0	
Applied Torque (in-lbs)	816.0	444.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2113.4	1150.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4230.0		= Undist. Shear Strength x 2
Sensitivity	**1.84** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/28/2016
Project No.	2014195C	**Boring No.:**	TB-03A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	R. Calkins	**Depth of Test:**	67.0 ft to 68.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	566.5 ft to 565.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	40.0	5 °	31.0
10 °	64.0	10 °	37.0
15 °	78.0	15 °	37.0
20 °	75.0	20 °	37.0
25 °	72.0	25 °	
30 °	69.0	30 °	
35 °	68.0	35 °	
40 °	68.0	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	78.0	37.0	
Applied Torque (in-lbs)	936.0	444.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2424.2	1150.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4850.0		= Undist. Shear Strength x 2
Sensitivity	**2.11** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/28/2016
Project No.	2014195C	**Boring No.:**	TB-03A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	R. Calkins	**Depth of Test:**	72.0 ft to 73.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	561.5 ft to 560.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	36.0	5 °	37.0
10 °	57.0	10 °	43.0
15 °	70.0	15 °	43.0
20 °	65.0	20 °	42.0
25 °	61.0	25 °	42.0
30 °	59.0	30 °	
35 °	57.0	35 °	
40 °	56.0	40 °	
45 °	56.0	45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	70.0	43.0	
Applied Torque (in-lbs)	840.0	516.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2175.6	1336.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4350.0		= Undist. Shear Strength x 2
Sensitivity	**1.63** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/28/2016
Project No.	2014195C	**Boring No.:**	TB-03A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	R. Calkins	**Depth of Test:**	77.0 ft to 78.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	556.5 ft to 555.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	27.0	5 °	28.0
10 °	46.0	10 °	29.0
15 °	55.0	15 °	29.0
20 °	50.0	20 °	29.0
25 °	48.0	25 °	
30 °	47.0	30 °	
35 °	46.0	35 °	
40 °	46.0	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	55.0	29.0	
Applied Torque (in-lbs)	660.0	348.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1709.4	901.3	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3420.0		= Undist. Shear Strength x 2
Sensitivity	**1.90** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/29/2016
Project No.	2014195C	**Boring No.:**	TB-03A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	C. Schroeder	**Depth of Test:**	87.0 ft to 88.4 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	546.5 ft to 545.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	26.0	5 °	
10 °	49.0	10 °	
15 °	68.0	15 °	
20 °	85.0	20 °	
25 °	95.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	95.0		
Applied Torque (in-lbs)	1140.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2952.6		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5910.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/7/2016
Project No.	2014195C	**Boring No.:**	TB-112
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Swaminathan	**Depth of Test:**	52.0 ft to 53.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.6 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	580.6 ft to 579.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	46.0	5 °	32.0
10 °	71.0	10 °	38.0
15 °	81.0	15 °	39.0
20 °	79.0	20 °	40.0
25 °		25 °	40.0
30 °		30 °	40.0
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	81.0	40.0	
Applied Torque (in-lbs)	972.0	480.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2517.5	1243.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5030.0		= Undist. Shear Strength x 2
Sensitivity	**2.03** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/8/2016
Project No.	2014195C	**Boring No.:**	TB-112
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	M. Hiske	**Depth of Test:**	62.0 ft to 63.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.6 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	570.6 ft to 569.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	44.0	5 °	37.0
10 °	65.0	10 °	39.0
15 °	69.0	15 °	39.0
20 °	69.0	20 °	39.0
25 °	69.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	69.0	39.0	
Applied Torque (in-lbs)	828.0	468.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2144.5	1212.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4290.0		= Undist. Shear Strength x 2
Sensitivity	**1.77** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/9/2016
Project No.	2014195C	**Boring No.:**	TB-112
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	M. Hiske	**Depth of Test:**	72.0 ft to 73.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.6 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	560.6 ft to 559.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	12.0	5 °	3.0
10 °	30.0	10 °	4.0
15 °	38.0	15 °	4.0
20 °	38.0	20 °	4.0
25 °	38.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	38.0	4.0	
Applied Torque (in-lbs)	456.0	48.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1181.0	124.3	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	2360.0		= Undist. Shear Strength x 2
Sensitivity	**9.50** Sensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/9/2016
Project No.	2014195C	**Boring No.:**	TB-112
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	M. Hiske	**Depth of Test:**	78.0 ft to 79.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.6 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	554.6 ft to 553.1 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	39.0	5 °	26.0
10 °	61.0	10 °	28.0
15 °	65.0	15 °	28.0
20 °	65.0	20 °	28.0
25 °	65.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	65.0	28.0	
Applied Torque (in-lbs)	780.0	336.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2020.2	870.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4040.0		= Undist. Shear Strength x 2
Sensitivity	**2.32** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/25/2016
Project No.	2014195C	**Boring No.:**	TB-111
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Whoolery	**Depth of Test:**	55.0 ft to 56.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.8 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	576.8 ft to 575.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	38.0	5 °	28.0
10 °	64.0	10 °	31.0
15 °	74.0	15 °	31.0
20 °	74.0	20 °	31.0
25 °	74.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	74.0	31.0	
Applied Torque (in-lbs)	888.0	372.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2299.9	963.5	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4600.0		= Undist. Shear Strength x 2
Sensitivity	**2.39** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/5/2016
Project No.	2014195C	**Boring No.:**	TB-110
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Swaminathan	**Depth of Test:**	52.0 ft to 53.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	632.2 ft
Driller:	A. Rau	**Elevation of Test Point:**	580.2 ft to 578.7 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	30.0	5 °	39.0
10 °	35.0	10 °	46.0
15 °	40.0	15 °	46.0
20 °	47.0	20 °	46.0
25 °	52.0	25 °	47.0
30 °	64.0	30 °	47.0
35 °	72.0	35 °	47.0
40 °	81.0	40 °	
45 °	81.0	45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	81.0	47.0	
Applied Torque (in-lbs)	972.0	564.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2517.5	1460.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5030.0		= Undist. Shear Strength x 2
Sensitivity	**1.72** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/7/2016
Project No.	2014195C	**Boring No.:**	TB-110
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	R. Calkins	**Depth of Test:**	60.0 ft to 61.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	632.2 ft
Driller:	A. Rau	**Elevation of Test Point:**	572.2 ft to 570.7 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	23.0	5 °	12.0
10 °	46.0	10 °	30.0
15 °	69.0	15 °	33.0
20 °	77.0	20 °	34.0
25 °	78.0	25 °	34.0
30 °	74.0	30 °	34.0
35 °	72.0	35 °	
40 °	71.0	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	78.0	34.0	
Applied Torque (in-lbs)	936.0	408.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2424.2	1056.7	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4850.0		= Undist. Shear Strength x 2
Sensitivity	**2.29** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/9/2016
Project No.	2014195C	**Boring No.:**	TB-110
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	R. Calkins	**Depth of Test:**	72.0 ft to 73.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	632.2 ft
Driller:	A. Rau	**Elevation of Test Point:**	560.2 ft to 558.7 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	34.0	5 °	
10 °	61.0	10 °	
15 °	85.0	15 °	
20 °	95.0	20 °	
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	95.0		
Applied Torque (in-lbs)	1140.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2952.6		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5910.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/9/2016
Project No.	2014195C	**Boring No.:**	TB-110
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	R. Calkins	**Depth of Test:**	78.0 ft to 79.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	632.2 ft
Driller:	A. Rau	**Elevation of Test Point:**	554.2 ft to 552.7 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	35.0	5 °	33.0
10 °	49.0	10 °	43.0
15 °	63.0	15 °	43.0
20 °	76.0	20 °	43.0
25 °	82.0	25 °	43.0
30 °	74.0	30 °	
35 °	71.0	35 °	
40 °	70.0	40 °	
45 °	69.0	45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	82.0	43.0	
Applied Torque (in-lbs)	984.0	516.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2548.6	1336.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5100.0		= Undist. Shear Strength x 2
Sensitivity	**1.91** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/9/2016
Project No.	2014195C	**Boring No.:**	TB-110
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	R. Calkins	**Depth of Test:**	84.0 ft to 85.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	632.2 ft
Driller:	A. Rau	**Elevation of Test Point:**	548.2 ft to 546.7 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	12.0	5 °	21.0
10 °	14.0	10 °	31.0
15 °	14.0	15 °	31.0
20 °	15.0	20 °	31.0
25 °	18.0	25 °	32.0
30 °	22.0	30 °	32.0
35 °	32.0	35 °	32.0
40 °	49.0	40 °	
45 °	68.0	45 °	
50 °	79.0	50 °	
55 °	80.0	55 °	
60 °	73.0	60 °	
65 °	69.0	65 °	
70 °	68.0	70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	80.0	32.0	
Applied Torque (in-lbs)	960.0	384.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2486.4	994.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4970.0		= Undist. Shear Strength x 2
Sensitivity	**2.50** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/24/2016
Project No.	2014195C	**Boring No.:**	TB-109
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Swaminathan	**Depth of Test:**	63.0 ft to 64.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.8 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	570.8 ft to 569.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	35.0	5 °	34.0
10 °	56.0	10 °	39.0
15 °	72.0	15 °	44.0
20 °	77.0	20 °	44.0
25 °	72.0	25 °	44.0
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	77.0	44.0	
Applied Torque (in-lbs)	924.0	528.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2393.2	1367.5	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4790.0		= Undist. Shear Strength x 2
Sensitivity	**1.75** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/24/2016
Project No.	2014195C	**Boring No.:**	TB-109
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Swaminathan	**Depth of Test:**	70.0 ft to 71.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.8 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	563.8 ft to 562.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	28.0	5 °	30.0
10 °	49.0	10 °	54.0
15 °	69.0	15 °	57.0
20 °	83.0	20 °	58.0
25 °	90.0	25 °	57.0
30 °	92.0	30 °	58.0
35 °	92.0	35 °	59.0
40 °	90.0	40 °	59.0
45 °		45 °	59.0
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	92.0	59.0	
Applied Torque (in-lbs)	1104.0	708.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2859.4	1833.7	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5720.0		= Undist. Shear Strength x 2
Sensitivity	**1.56** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/25/2016
Project No.	2014195C	**Boring No.:**	TB-109
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	M. Wajed	**Depth of Test:**	75.0 ft to 76.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.8 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	558.8 ft to 557.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	33.0	5 °	31.0
10 °	56.0	10 °	39.0
15 °	72.0	15 °	40.0
20 °	75.0	20 °	41.0
25 °	71.0	25 °	41.0
30 °	69.0	30 °	41.0
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	75.0	41.0	
Applied Torque (in-lbs)	900.0	492.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2331.0	1274.3	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4660.0		= Undist. Shear Strength x 2
Sensitivity	**1.83** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/25/2016
Project No.	2014195C	**Boring No.:**	TB-109
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	M. Wajed	**Depth of Test:**	80.0 ft to 81.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	633.8 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	553.8 ft to 552.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	27.0	5 °	27.0
10 °	50.0	10 °	37.0
15 °	70.0	15 °	37.0
20 °	78.0	20 °	39.0
25 °	76.0	25 °	39.0
30 °	75.0	30 °	39.0
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	78.0	39.0	
Applied Torque (in-lbs)	936.0	468.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2424.2	1212.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4850.0		= Undist. Shear Strength x 2
Sensitivity	**2.00** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/13/2016
Project No.	2014195C	**Boring No.:**	TB-108
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	M. Hiske	**Depth of Test:**	52.0 ft to 53.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.0 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	580.0 ft to 578.5 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	22.0	5 °	25.0
10 °	50.0	10 °	26.0
15 °	83.0	15 °	26.0
20 °	88.0	20 °	26.0
25 °	88.0	25 °	
30 °	88.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	88.0	26.0	
Applied Torque (in-lbs)	1056.0	312.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2735.0	808.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5470.0		= Undist. Shear Strength x 2
Sensitivity	**3.38** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Observed damage to vane upon test completion.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/13/2016
Project No.	2014195C	**Boring No.:**	TB-108
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	R. Calkins	**Depth of Test:**	60.0 ft to 61.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.0 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	572.0 ft to 570.5 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	36.0	5 °	
10 °	64.0	10 °	
15 °	97.0	15 °	
20 °		20 °	
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	97.0		
Applied Torque (in-lbs)	1164.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	3014.8		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	6030.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/13/2016
Project No.	2014195C	**Boring No.:**	TB-108
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	R. Calkins	**Depth of Test:**	64.0 ft to 65.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.0 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	568.0 ft to 566.5 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	41.0	5 °	23.0
10 °	61.0	10 °	25.0
15 °	73.0	15 °	24.0
20 °	72.0	20 °	24.0
25 °	72.0	25 °	24.0
30 °	72.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	73.0	25.0	
Applied Torque (in-lbs)	876.0	300.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2268.8	777.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4540.0		= Undist. Shear Strength x 2
Sensitivity	**2.92** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/21/2016
Project No.	2014195C	**Boring No.:**	TB-108
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	R. Calkins	**Depth of Test:**	72.0 ft to 73.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.0 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	560.0 ft to 558.5 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	48.0	5 °	22.0
10 °	62.0	10 °	22.0
15 °	63.0	15 °	24.0
20 °	63.0	20 °	24.0
25 °	63.0	25 °	25.0
30 °	63.0	30 °	26.0
35 °		35 °	32.0
40 °		40 °	45.0
45 °		45 °	49.0
50 °		50 °	51.0
55 °		55 °	51.0
60 °		60 °	51.0
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	63.0	51.0	
Applied Torque (in-lbs)	756.0	612.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1958.0	1585.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3920.0		= Undist. Shear Strength x 2
Sensitivity	**1.24** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/15/2015
Project No.	2014195C	**Boring No.:**	TB-02
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	R. Calkins	**Depth of Test:**	41.5 ft to 43.0 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	634.8 ft
Driller:	R. Rau	**Elevation of Test Point:**	593.3 ft to 591.8 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °		5 °	
10 °		10 °	
15 °		15 °	
20 °		20 °	
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)			
Applied Torque (in-lbs)			= Net Force x Torque Arm
Ultimate Shear Strength (psf)			= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)			= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/15/2015
Project No.	2014195C	**Boring No.:**	TB-02
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	R. Calkins	**Depth of Test:**	49.5 ft to 51.0 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	634.8 ft
Driller:	R. Rau	**Elevation of Test Point:**	585.3 ft to 583.8 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °		5 °	
10 °		10 °	
15 °		15 °	
20 °		20 °	
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)			
Applied Torque (in-lbs)			= Net Force x Torque Arm
Ultimate Shear Strength (psf)			= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)			= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/15/2015
Project No.	2014195C	**Boring No.:**	TB-02
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	R. Calkins	**Depth of Test:**	54.0 ft to 55.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	634.8 ft
Driller:	R. Rau	**Elevation of Test Point:**	580.8 ft to 579.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	35.0	5 °	33.0
10 °	63.0	10 °	41.0
15 °	81.0	15 °	42.0
20 °	90.0	20 °	44.0
25 °	91.0	25 °	44.0
30 °	91.0	30 °	44.0
35 °	91.0	35 °	44.0
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	91.0	44.0	
Applied Torque (in-lbs)	1092.0	528.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2828.3	1367.5	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5660.0		= Undist. Shear Strength x 2
Sensitivity	**2.07** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/15/2015
Project No.	2014195C	**Boring No.:**	TB-02
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	R. Calkins	**Depth of Test:**	57.0 ft to 58.5 ft
Drilling Company:	Brax Drilling	**Ground Surface Elevation:**	634.8 ft
Driller:	R. Rau	**Elevation of Test Point:**	577.8 ft to 576.3 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	35.0	5 °	35.0
10 °	61.0	10 °	42.0
15 °	76.0	15 °	43.0
20 °	77.0	20 °	43.0
25 °	75.0	25 °	43.0
30 °	75.0	30 °	43.0
35 °	75.0	35 °	43.0
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	77.0	43.0	
Applied Torque (in-lbs)	924.0	516.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2393.2	1336.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4790.0		= Undist. Shear Strength x 2
Sensitivity	**1.79** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/22/2016
Project No.	2014195C	**Boring No.:**	TB-02A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	J. Hoksbergen	**Depth of Test:**	48.5 ft to 50.0 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.7 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	586.2 ft to 584.7 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	45.0	5 °	
10 °	85.0	10 °	
15 °	95.0	15 °	
20 °		20 °	
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	95.0		
Applied Torque (in-lbs)	1140.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2952.6		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5910.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/22/2016
Project No.	2014195C	**Boring No.:**	TB-02A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	J. Hoksbergen	**Depth of Test:**	53.0 ft to 54.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.7 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	581.7 ft to 580.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	30.0	5 °	
10 °	65.0	10 °	
15 °	89.0	15 °	
20 °	95.0	20 °	
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	95.0		
Applied Torque (in-lbs)	1140.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2952.6		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5910.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/22/2016
Project No.	2014195C	**Boring No.:**	TB-02A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	J. Hoksbergen	**Depth of Test:**	58.0 ft to 59.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.7 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	576.7 ft to 575.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	41.0	5 °	38.0
10 °	73.0	10 °	46.0
15 °	88.0	15 °	47.0
20 °	89.0	20 °	46.0
25 °	88.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	89.0	47.0	
Applied Torque (in-lbs)	1068.0	564.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2766.1	1460.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5530.0		= Undist. Shear Strength x 2
Sensitivity	**1.89** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/22/2016
Project No.	2014195C	**Boring No.:**	TB-02A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	J. Hoksbergen	**Depth of Test:**	62.0 ft to 63.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.7 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	572.7 ft to 571.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	42.0	5 °	35.0
10 °	72.0	10 °	42.0
15 °	91.0	15 °	42.0
20 °	94.0	20 °	42.0
25 °	93.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	94.0	42.0	
Applied Torque (in-lbs)	1128.0	504.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2921.5	1305.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5840.0		= Undist. Shear Strength x 2
Sensitivity	**2.24** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/24/2016
Project No.	2014195C	**Boring No.:**	TB-02A
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	S. Whoolery	**Depth of Test:**	70.0 ft to 71.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.7 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	564.7 ft to 563.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	43.0	5 °	31.0
10 °	69.0	10 °	36.0
15 °	84.0	15 °	36.0
20 °	84.0	20 °	36.0
25 °	84.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	84.0	36.0	
Applied Torque (in-lbs)	1008.0	432.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2610.7	1118.9	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5220.0		= Undist. Shear Strength x 2
Sensitivity	**2.33** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/5/2016
Project No.	2014195C	**Boring No.:**	TB-106
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Whoolery	**Depth of Test:**	50.0 ft to 51.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.1 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	584.1 ft to 582.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	36.0	5 °	34.0
10 °	46.0	10 °	38.0
15 °	67.0	15 °	38.0
20 °	75.0	20 °	39.0
25 °	72.0	25 °	40.0
30 °	70.0	30 °	41.0
35 °		35 °	42.0
40 °		40 °	43.0
45 °		45 °	43.0
50 °		50 °	43.0
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	75.0	43.0	
Applied Torque (in-lbs)	900.0	516.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2331.0	1336.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4660.0		= Undist. Shear Strength x 2
Sensitivity	**1.74** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/5/2016
Project No.	2014195C	**Boring No.:**	TB-106
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Whoolery	**Depth of Test:**	58.0 ft to 59.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.1 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	576.1 ft to 574.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	34.0	5 °	31.0
10 °	58.0	10 °	34.0
15 °	68.0	15 °	35.0
20 °	63.0	20 °	35.0
25 °	62.0	25 °	36.0
30 °		30 °	37.0
35 °		35 °	37.0
40 °		40 °	37.0
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	68.0	37.0	
Applied Torque (in-lbs)	816.0	444.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2113.4	1150.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4230.0		= Undist. Shear Strength x 2
Sensitivity	**1.84** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/7/2016
Project No.	2014195C	**Boring No.:**	TB-106
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Whoolery	**Depth of Test:**	66.0 ft to 67.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.1 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	568.1 ft to 566.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	33.0	5 °	28.0
10 °	56.0	10 °	35.0
15 °	71.0	15 °	35.0
20 °	66.0	20 °	35.0
25 °	64.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	71.0	35.0	
Applied Torque (in-lbs)	852.0	420.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2206.7	1087.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4410.0		= Undist. Shear Strength x 2
Sensitivity	**2.03** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/7/2016
Project No.	2014195C	**Boring No.:**	TB-106
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	S. Whoolery	**Depth of Test:**	74.0 ft to 75.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	634.1 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	560.1 ft to 558.6 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	21.0	5 °	28.0
10 °	44.0	10 °	36.0
15 °	55.0	15 °	36.0
20 °	58.0	20 °	36.0
25 °	53.0	25 °	
30 °	51.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	58.0	36.0	
Applied Torque (in-lbs)	696.0	432.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1802.6	1118.9	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3610.0		= Undist. Shear Strength x 2
Sensitivity	**1.61** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/19/2016
Project No.	2014195C	**Boring No.:**	TB-105
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Swaminathan	**Depth of Test:**	45.0 ft to 46.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.9 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	587.9 ft to 586.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	6.0	5 °	40.0
10 °	6.0	10 °	41.0
15 °	6.0	15 °	41.0
20 °	9.0	20 °	41.0
25 °	16.0	25 °	42.0
30 °	36.0	30 °	42.0
35 °	59.0	35 °	
40 °	74.0	40 °	
45 °	77.0	45 °	
50 °	77.0	50 °	
55 °	77.0	55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	77.0	42.0	
Applied Torque (in-lbs)	924.0	504.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2393.2	1305.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4790.0		= Undist. Shear Strength x 2
Sensitivity	**1.83** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/19/2016
Project No.	2014195C	**Boring No.:**	TB-105
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Swaminathan	**Depth of Test:**	55.0 ft to 56.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.9 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	577.9 ft to 576.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	42.0	5 °	26.0
10 °	72.0	10 °	32.0
15 °	90.0	15 °	32.0
20 °	94.0	20 °	32.0
25 °	94.0	25 °	32.0
30 °	94.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	94.0	32.0	
Applied Torque (in-lbs)	1128.0	384.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2921.5	994.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5840.0		= Undist. Shear Strength x 2
Sensitivity	**2.94** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/19/2016
Project No.	2014195C	**Boring No.:**	TB-105
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Swaminathan	**Depth of Test:**	65.0 ft to 66.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.9 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	567.9 ft to 566.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	36.0	5 °	30.0
10 °	54.0	10 °	34.0
15 °	66.0	15 °	35.0
20 °	72.0	20 °	35.0
25 °	72.0	25 °	35.0
30 °	72.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	72.0	35.0	
Applied Torque (in-lbs)	864.0	420.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2237.8	1087.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4480.0		= Undist. Shear Strength x 2
Sensitivity	**2.06** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/21/2016
Project No.	2014195C	**Boring No.:**	TB-105
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	M. Wajed	**Depth of Test:**	74.0 ft to 75.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.9 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	558.9 ft to 557.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	44.0	5 °	43.0
10 °	74.0	10 °	50.0
15 °	88.0	15 °	50.0
20 °	88.0	20 °	50.0
25 °	88.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	88.0	50.0	
Applied Torque (in-lbs)	1056.0	600.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2735.0	1554.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5470.0		= Undist. Shear Strength x 2
Sensitivity	**1.76** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/21/2016
Project No.	2014195C	**Boring No.:**	TB-105
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	M. Wajed	**Depth of Test:**	80.0 ft to 81.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.9 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	552.9 ft to 551.4 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	34.0	5 °	35.0
10 °	56.0	10 °	41.0
15 °	70.0	15 °	41.0
20 °	69.0	20 °	41.0
25 °	68.0	25 °	
30 °	68.0	30 °	
35 °	68.0	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	70.0	41.0	
Applied Torque (in-lbs)	840.0	492.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2175.6	1274.3	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4350.0		= Undist. Shear Strength x 2
Sensitivity	**1.71** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	11/29/2016
Project No.	2014195C	**Boring No.:**	TB-104
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	C. Schroeder	**Depth of Test:**	48.0 ft to 49.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.2 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	583.2 ft to 581.7 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	43.0	5 °	
10 °	87.0	10 °	
15 °	95.0	15 °	
20 °		20 °	
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	95.0		
Applied Torque (in-lbs)	1140.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2952.6		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5910.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	11/29/2016
Project No.	2014195C	**Boring No.:**	TB-104
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	C. Schroeder	**Depth of Test:**	62.5 ft to 64.0 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.2 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	568.7 ft to 567.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	3.0	5 °	21.0
10 °	4.0	10 °	22.0
15 °	4.5	15 °	23.0
20 °	9.0	20 °	23.0
25 °	10.0	25 °	23.0
30 °	12.0	30 °	
35 °	20.0	35 °	
40 °	23.0	40 °	
45 °	24.0	45 °	
50 °	24.0	50 °	
55 °	24.0	55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	24.0	23.0	
Applied Torque (in-lbs)	288.0	276.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	745.9	714.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	1490.0		= Undist. Shear Strength x 2
Sensitivity	**1.04** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	12/1/2016
Project No.	2014195C	**Boring No.:**	TB-104
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Whoolery	**Depth of Test:**	71.0 ft to 72.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.2 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	560.2 ft to 558.7 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	21.0	5 °	19.0
10 °	56.0	10 °	20.0
15 °	60.0	15 °	20.0
20 °	61.0	20 °	20.0
25 °	61.0	25 °	
30 °	61.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	61.0	20.0	
Applied Torque (in-lbs)	732.0	240.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1895.9	621.6	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3790.0		= Undist. Shear Strength x 2
Sensitivity	**3.05** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Observed damage to vane upon test completion.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/17/2016
Project No.	2014195C	**Boring No.:**	TB-103
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Swaminathan	**Depth of Test:**	55.0 ft to 56.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.7 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	577.7 ft to 576.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	48.0	5 °	
10 °	62.0	10 °	
15 °	80.0	15 °	
20 °	82.0	20 °	
25 °	99.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	99.0		
Applied Torque (in-lbs)	1188.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	3076.9		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	6150.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/17/2016
Project No.	2014195C	**Boring No.:**	TB-103
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	M. Gilliland	**Depth of Test:**	60.0 ft to 61.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.7 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	572.7 ft to 571.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	42.0	5 °	48.0
10 °	74.0	10 °	59.0
15 °	91.0	15 °	59.0
20 °	93.0	20 °	59.0
25 °	93.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	93.0	59.0	
Applied Torque (in-lbs)	1116.0	708.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2890.4	1833.7	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5780.0		= Undist. Shear Strength x 2
Sensitivity	**1.58** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Observed damage to vane upon test completion.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/18/2016
Project No.	2014195C	**Boring No.:**	TB-103
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Swaminathan	**Depth of Test:**	65.0 ft to 66.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.7 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	567.7 ft to 566.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	37.0	5 °	29.0
10 °	62.0	10 °	39.0
15 °	78.0	15 °	40.0
20 °	80.0	20 °	41.0
25 °	80.0	25 °	42.0
30 °	80.0	30 °	42.0
35 °		35 °	42.0
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	80.0	42.0	
Applied Torque (in-lbs)	960.0	504.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2486.4	1305.4	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4970.0		= Undist. Shear Strength x 2
Sensitivity	**1.90** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/18/2016
Project No.	2014195C	**Boring No.:**	TB-103
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	S. Swaminathan	**Depth of Test:**	70.0 ft to 71.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.7 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	562.7 ft to 561.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	38.0	5 °	28.0
10 °	63.0	10 °	31.0
15 °	77.0	15 °	31.0
20 °	76.0	20 °	32.0
25 °	75.0	25 °	33.0
30 °	74.0	30 °	33.0
35 °		35 °	34.0
40 °		40 °	34.0
45 °		45 °	35.0
50 °		50 °	36.0
55 °		55 °	36.0
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	77.0	36.0	
Applied Torque (in-lbs)	924.0	432.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2393.2	1118.9	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4790.0		= Undist. Shear Strength x 2
Sensitivity	**2.14** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/18/2016
Project No.	2014195C	**Boring No.:**	TB-103
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	S. Swaminathan	**Depth of Test:**	80.0 ft to 81.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.7 ft
Driller:	J. Hurshman	**Elevation of Test Point:**	552.7 ft to 551.2 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	37.0	5 °	22.0
10 °	79.0	10 °	36.0
15 °	95.0	15 °	37.0
20 °	96.0	20 °	38.0
25 °	96.0	25 °	39.0
30 °	95.0	30 °	39.0
35 °		35 °	40.0
40 °		40 °	41.0
45 °		45 °	41.0
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	96.0	41.0	
Applied Torque (in-lbs)	1152.0	492.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2983.7	1274.3	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5970.0		= Undist. Shear Strength x 2
Sensitivity	**2.34** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	11/282016
Project No.	2014195C	**Boring No.:**	TB-102
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Whoolery	**Depth of Test:**	44.0 ft to 45.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	588.5 ft to 587.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	46.0	5 °	
10 °	77.0	10 °	
15 °	94.0	15 °	
20 °		20 °	
25 °		25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	94.0		
Applied Torque (in-lbs)	1128.0		= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2921.5		= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	5840.0		= Undist. Shear Strength x 2
Sensitivity			= Undist. Strength/ Remold. Strength

NOTES: Vane shear test terminated early to avoid equipment damage due to high force gauge readings.
Remold test was not performed.
No results reported on the soil boring log.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	11/29/2016
Project No.	2014195C	**Boring No.:**	TB-102
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Whoolery	**Depth of Test:**	56.0 ft to 57.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	576.5 ft to 575.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	37.0	5 °	32.0
10 °	61.0	10 °	39.0
15 °	75.0	15 °	39.0
20 °	77.0	20 °	39.0
25 °	73.0	25 °	
30 °	72.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	77.0	39.0	
Applied Torque (in-lbs)	924.0	468.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2393.2	1212.1	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4790.0		= Undist. Shear Strength x 2
Sensitivity	**1.97** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	11/29/2016
Project No.	2014195C	**Boring No.:**	TB-102
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Whoolery	**Depth of Test:**	64.0 ft to 65.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	568.5 ft to 567.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	15.0	5 °	35.0
10 °	16.0	10 °	41.0
15 °	18.0	15 °	40.0
20 °	23.0	20 °	39.0
25 °	26.0	25 °	
30 °	33.0	30 °	
35 °	46.0	35 °	
40 °	59.0	40 °	
45 °	64.0	45 °	
50 °	61.0	50 °	
55 °	60.0	55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

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Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	64.0	41.0	
Applied Torque (in-lbs)	768.0	492.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1989.1	1274.3	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3980.0		= Undist. Shear Strength x 2
Sensitivity	**1.56** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	11/29/2016
Project No.	2014195C	**Boring No.:**	TB-102
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	S. Whoolery	**Depth of Test:**	70.0 ft to 71.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	562.5 ft to 561.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	29.0	5 °	23.0
10 °	49.0	10 °	25.0
15 °	51.0	15 °	25.0
20 °	53.0	20 °	25.0
25 °	53.0	25 °	
30 °	53.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	53.0	25.0	
Applied Torque (in-lbs)	636.0	300.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1647.2	777.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3290.0		= Undist. Shear Strength x 2
Sensitivity	**2.12** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	11/29/2016
Project No.	2014195C	**Boring No.:**	TB-102
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	S. Whoolery	**Depth of Test:**	78.0 ft to 79.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	632.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	554.5 ft to 553.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	37.0	5 °	35.0
10 °	50.0	10 °	37.0
15 °	57.0	15 °	37.0
20 °	53.0	20 °	36.0
25 °	51.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	57.0	37.0	
Applied Torque (in-lbs)	684.0	444.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1771.6	1150.0	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3540.0		= Undist. Shear Strength x 2
Sensitivity	**1.54** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/19/2016
Project No.	2014195C	**Boring No.:**	TB-101
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-1
Somat Engineer:	S. Whoolery	**Depth of Test:**	48.0 ft to 49.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	583.5 ft to 582.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	36.0	5 °	23.0
10 °	53.0	10 °	23.0
15 °	58.0	15 °	22.0
20 °	53.0	20 °	22.0
25 °	49.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	58.0	23.0	
Applied Torque (in-lbs)	696.0	276.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1802.6	714.8	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3610.0		= Undist. Shear Strength x 2
Sensitivity	**2.52** Insensitive		= Undist. Strength/ Remold. Strength

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/19/2016
Project No.	2014195C	**Boring No.:**	TB-101
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-2
Somat Engineer:	S. Whoolery	**Depth of Test:**	58.0 ft to 59.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	573.5 ft to 572.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	32.0	5 °	28.0
10 °	54.0	10 °	29.0
15 °	64.0	15 °	29.0
20 °	67.0	20 °	29.0
25 °	67.0	25 °	
30 °	67.0	30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	67.0	29.0	
Applied Torque (in-lbs)	804.0	348.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	2082.4	901.3	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	4160.0		= Undist. Shear Strength x 2
Sensitivity	**2.31** Insensitive		= Undist. Strength/ Remold. Strength

NOTES: Observed damage to vane upon test completion.

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/19/2016
Project No.	2014195C	**Boring No.:**	TB-101
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-3
Somat Engineer:	S. Whoolery	**Depth of Test:**	62.0 ft to 63.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	569.5 ft to 568.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	33.0	5 °	30.0
10 °	51.0	10 °	33.0
15 °	57.0	15 °	34.0
20 °	54.0	20 °	33.0
25 °	52.0	25 °	33.0
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	57.0	34.0	
Applied Torque (in-lbs)	684.0	408.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1771.6	1056.7	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3540.0		= Undist. Shear Strength x 2
Sensitivity	**1.68** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/19/2016
Project No.	2014195C	**Boring No.:**	TB-101
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-4
Somat Engineer:	S. Whoolery	**Depth of Test:**	68.0 ft to 69.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	563.5 ft to 562.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	14.0	5 °	21.0
10 °	17.0	10 °	27.0
15 °	25.0	15 °	26.0
20 °	37.0	20 °	26.0
25 °	49.0	25 °	26.0
30 °	50.0	30 °	
35 °	47.0	35 °	
40 °	45.0	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	50.0	27.0	
Applied Torque (in-lbs)	600.0	324.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1554.0	839.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3110.0		= Undist. Shear Strength x 2
Sensitivity	**1.85** Insensitive		= Undist. Strength/ Remold. Strength

NOTES:

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FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	I-75 Modernization Project ORC Tunnel Design Investigation N of 8 Mile (M-102) to S of 12 Mile Road	**Date:**	10/21/2016
Project No.	2014195C	**Boring No.:**	TB-101
Client:	WSP Michigan, Inc.	**Vane Shear Test No.:**	VS-5
Somat Engineer:	S. Whoolery	**Depth of Test:**	80.0 ft to 81.5 ft
Drilling Company:	DLZ American Drilling	**Ground Surface Elevation:**	631.5 ft
Driller:	M. Schmidt	**Elevation of Test Point:**	551.5 ft to 550.0 ft

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	x	2 1/2"	x	2.59	x
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	30.0	5 °	25.0
10 °	50.0	10 °	27.0
15 °	61.0	15 °	27.0
20 °	54.0	20 °	26.0
25 °	52.0	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	
75 °		75 °	
80 °		80 °	
85 °		85 °	
90 °		90 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	61.0	27.0	
Applied Torque (in-lbs)	732.0	324.0	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1895.9	839.2	= Applied Torque x Vane Constant
Estimated Unconfined Compressive Strength (psf)	3790.0		= Undist. Shear Strength x 2
Sensitivity	**2.26** Insensitive		= Undist. Strength/ Remold. Strength

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APPENDIX E

Photoionization Detector (PID) Readings

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TABLE 1
SUMMARY OF PID SOIL SCREENING RESULTS
I-75 MODERNIZATION PROJECT
OWNER'S REPRESENTATIVE CONSULTANT TUNNEL DESIGN INVESTIGATION
NORTH OF 8 MILE ROAD (M-102) TO SOUTH OF 12 MILE ROAD
OAKLAND COUNTY, MICHIGAN
MDOT JN: 122104O; CS: 63174

Date: 01/10/2017 Somat Project: 2014195C

Soil Boring: TB-06A							
Point #	Sample ID I.D.#	Sample Depth (ft)	PID Reading (PID values reported in parts per million)	Point #	Sample ID I.D.#	Sample Depth (ft)	PID Reading (PID values reported in parts per million)
1	ST2	48	0.0	16	SS19	140	0.0
2	ST3	52	0.0	17	SS20	145	0.0
3	ST5	72.5	0.0	18	SS21	150	0.0
4	SS6	80	0.0				
5	SS7	85	0.0				
6	ST8	88	0.0				
7	SS9	95	0.0				
8	ST11	101	0.0				
9	SS12	105	0.0				
10	ST13	108	0.0				
11	ST14	114	0.0				
12	SS15	120	0.0				
13	ST16	123	0.0				
14	SS17	130	0.0				
15	SS18	135	0.0				

NOTES:

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TABLE 1
SUMMARY OF PID SOIL SCREENING RESULTS
I-75 MODERNIZATION PROJECT
OWNER'S REPRESENTATIVE CONSULTANT TUNNEL DESIGN INVESTIGATION
NORTH OF 8 MILE ROAD (M-102) TO SOUTH OF 12 MILE ROAD
OAKLAND COUNTY, MICHIGAN
MDOT JN: 122104O; CS: 63174

Date: 01/10/2017 Somat Project: 2014195C

Soil Boring: TB-116

Point #	Sample ID I.D.#	Sample Depth (ft)	PID Reading (PID values reported in parts per million)	Point #	Sample ID I.D.#	Sample Depth (ft)	PID Reading (PID values reported in parts per million)
1	SS1	2.5	0.5	16	SS17	70	0.0
2	SS2	5	0.0	2	ST18	74	0.0
3	SS3	7.5	0.0	4	SS19	80	0.0
4	SS4	10	0.0	5	ST20	84	0.0
5	ST5	15	0.0	7	ST21	88	0.0
6	SS6	20	0.0	9	ST22	91.5	0.0
7	SS7	25	0.0	1	SS23	93	0.0
8	SS8	30	0.0	2	SS24	100	0.0
9	ST9	35	0.0	3	SS25	105	0.0
10	SS10	40	0.0	4	SS26	110	0.0
11	ST11	45	0.0	5	SS27	115	0.0
12	SS12	50	0.0	6	SS28	120	0.0
13	ST13	55	0.0	7	SS29	125	0.0
14	SS15	60	0.0	8	SS30	130	0.5
15	ST16	65	0.0	9	SS31	135	0.3

NOTES:

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TABLE 1
SUMMARY OF PID SOIL SCREENING RESULTS
I-75 MODERNIZATION PROJECT
OWNER'S REPRESENTATIVE CONSULTANT TUNNEL DESIGN INVESTIGATION
NORTH OF 8 MILE ROAD (M-102) TO SOUTH OF 12 MILE ROAD
OAKLAND COUNTY, MICHIGAN
MDOT JN: 122104O; CS: 63174

Date: 01/10/2017 Somat Project: 2014195C

Soil Boring: TB-101

Point #	Sample ID I.D.#	Sample Depth (ft)	PID Reading (PID values reported in parts per million)	Point #	Sample ID I.D.#	Sample Depth (ft)	PID Reading (PID values reported in parts per million)
1	SS1	2.5	0.0	8	ST16	58	0.0
2	SS2	5	0.0	1	ST17	62	0.0
3	SS3	7.5	0.0	3	SS18	66	0.0
4	SS4	10	0.0	4	ST19	68	0.0
5	SS5	15	0.0	6	DP20	75	0.0
6	SS6	20	0.0	7	ST21	78	0.0
7	ST7	23	0.0	8	ST22	80	0.0
8	SS8	25	0.0	1	SS23	85	0.0
9	ST9	30	0.0	2	SS24	90	0.0
1	SS10	35	0.0	3	SS25	95	0.0
2	ST11	37	0.0	4	SS26	100	0.0
3	SS12	40	0.0				
4	SS13	45	0.0				
5	ST14	48	0.0				
7	DP15	56	0.0				

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