

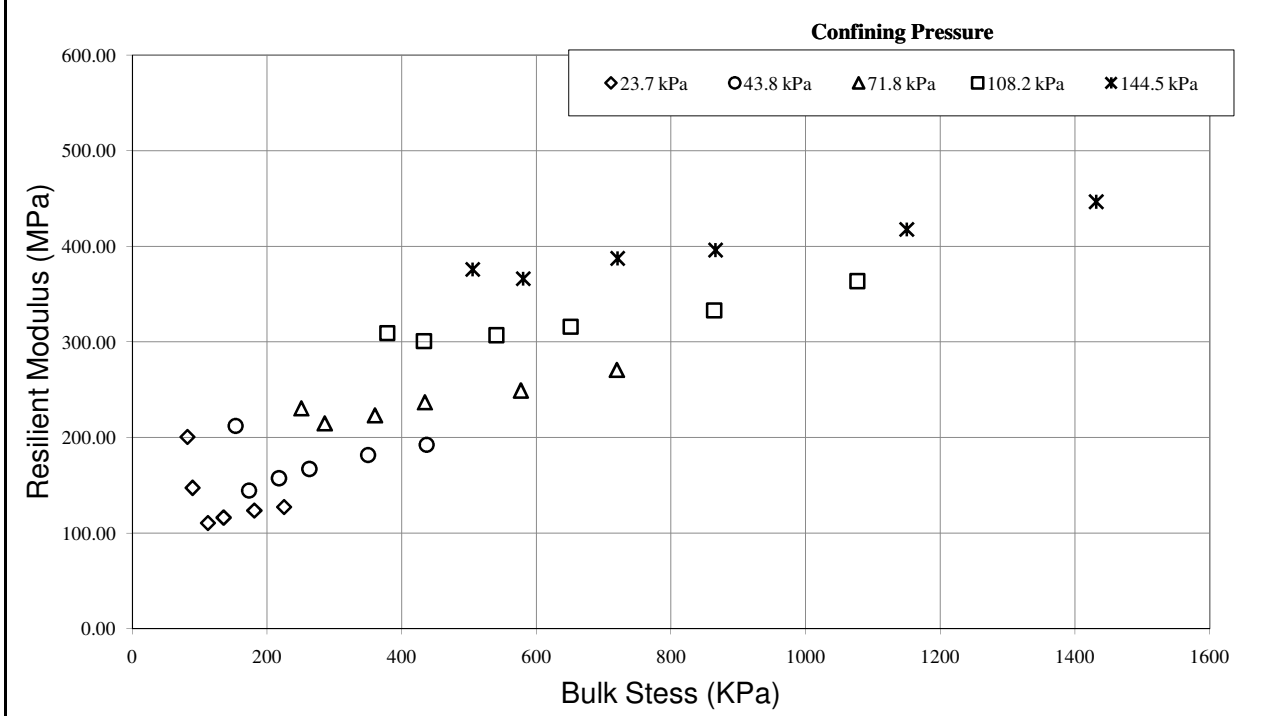
Appendix B

M_R Test Reports for UGM

Pavements Research Laboratory

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-L-17-2	Client Lab #:
Date Tested: Nov 20, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2292.27	Soil Type: A-Base Limestone with 16.0% fines
Sample Moisture (%): 6.20%	Max. Dry Density (kg/m³): 2305
Replicate #: 2	Optimum Moisture (%): 6.50%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.29	20.77	34.73	53.97	72.51	20.00	42.40	72.50
Confining Pressure (kPa)	23.88	44.07	72.11	108.16	144.21	23.14	43.52	71.13
Resilient Modulus (MPa)	200.66	212.28	230.42	309.50	376.14	147.32	144.73	214.68

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	108.93	145.13	42.06	87.43	145.51	217.38	289.19	65.05
Confining Pressure (kPa)	108.08	145.03	23.35	43.49	71.66	107.69	143.72	23.55
Resilient Modulus (MPa)	301.09	366.49	110.72	157.37	223.13	306.98	387.28	116.17

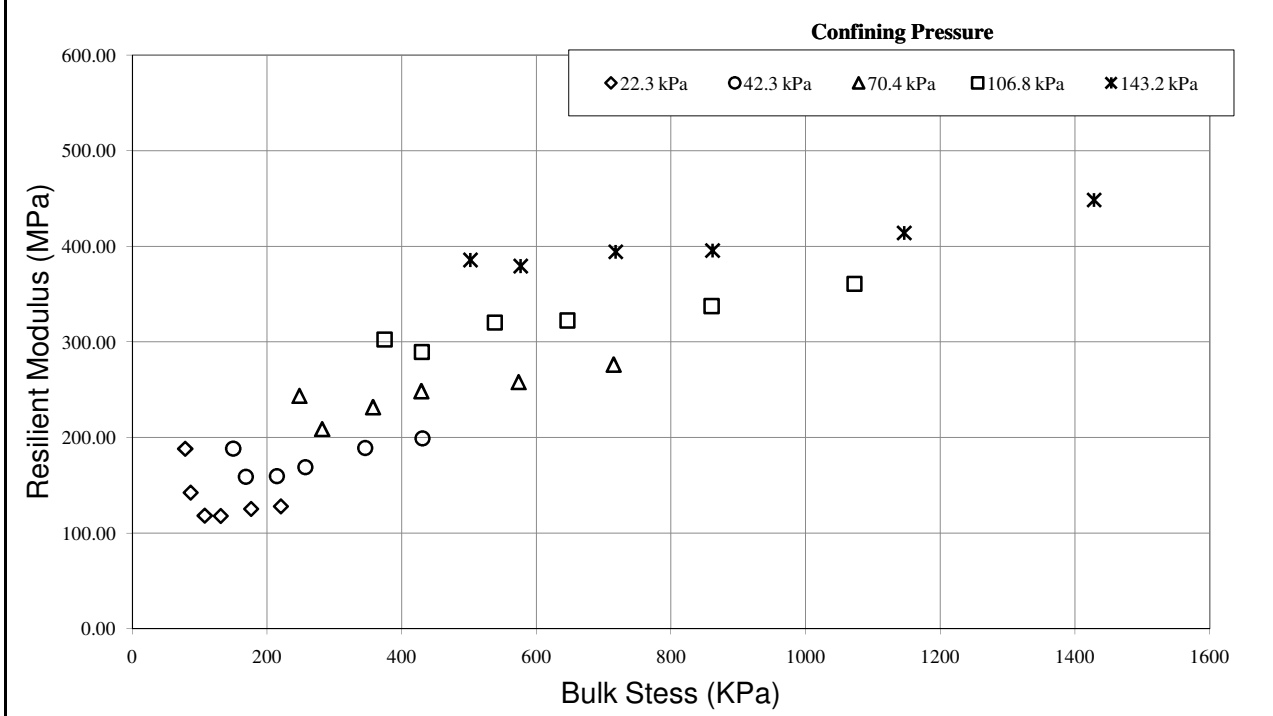
Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.34	217.51	325.02	431.53	109.27	218.04	360.87	539.09
Confining Pressure (kPa)	43.90	72.26	108.54	144.82	24.01	43.95	72.01	108.36
Resilient Modulus (MPa)	167.04	236.80	316.27	396.04	123.63	181.88	249.06	333.22

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	716.12	152.94	304.42	504.02	751.87	998.59		
Confining Pressure (kPa)	144.72	24.18	44.08	71.92	108.13	144.35		
Resilient Modulus (MPa)	418.04	127.41	192.55	270.58	363.50	446.55		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-L-17-1	Client Lab #:
Date Tested: Nov 19, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2290.08	Soil Type: A-Base Limestone with 16.0% fines
Sample Moisture (%): 5.88%	Max. Dry Density (kg/m³): 2305
Replicate #: 1	Optimum Moisture (%): 6.50%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.38	21.23	35.41	53.82	72.75	20.77	42.26	72.67
Confining Pressure (kPa)	22.76	42.92	70.93	106.99	143.04	21.96	41.97	69.80
Resilient Modulus (MPa)	188.37	188.61	243.60	302.71	385.59	142.51	159.24	208.61

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.61	146.14	42.24	87.64	145.99	218.25	289.62	64.78
Confining Pressure (kPa)	106.63	143.46	21.84	42.26	70.46	106.56	142.65	22.17
Resilient Modulus (MPa)	289.76	379.23	118.30	159.85	231.64	320.43	394.49	117.97

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.46	218.11	325.51	432.25	108.92	218.20	361.42	539.17
Confining Pressure (kPa)	41.76	70.32	106.76	143.20	22.45	42.45	70.71	107.07
Resilient Modulus (MPa)	169.17	248.41	322.39	395.75	125.35	189.40	258.00	337.45

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	716.22	152.33	304.06	503.78	751.89	998.57		
Confining Pressure (kPa)	143.42	22.74	42.16	70.35	106.76	143.17		
Resilient Modulus (MPa)	414.18	128.10	199.45	276.12	360.99	448.78		

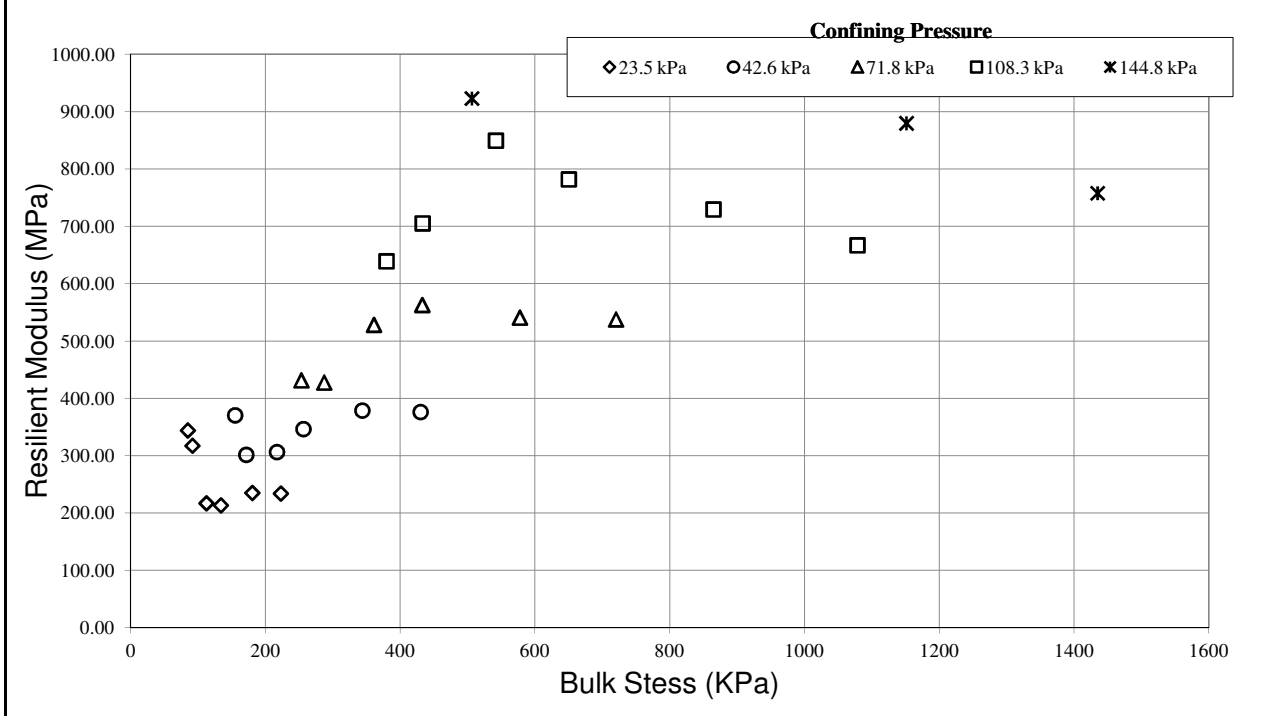
Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	



Pavements Research Laboratory

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-L-17-10	Client Lab #:
Date Tested: Jul 02, 2014	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2297.34	Soil Type: A-Base Limestone with 16.0% fines
Sample Moisture (%): 4.19%	Max. Dry Density (kg/m³): 2305
Replicate #: 2	Optimum Moisture (%): 6.50%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	11.21	21.68	36.09	54.01	72.09	21.34	42.82	72.45
Confining Pressure (kPa)	24.52	44.40	72.38	108.56	144.75	23.40	42.86	71.54
Resilient Modulus (MPa)	344.16	370.54	431.40	639.00	923.00	317.48	301.68	427.64

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	108.74	145.20	42.85	87.20	145.96	217.70	289.28	65.00
Confining Pressure (kPa)	108.11	144.68	23.17	43.24	71.67	108.05	144.44	22.93
Resilient Modulus (MPa)	705.23	1053.38	217.14	306.43	528.19	849.49	1092.73	213.48

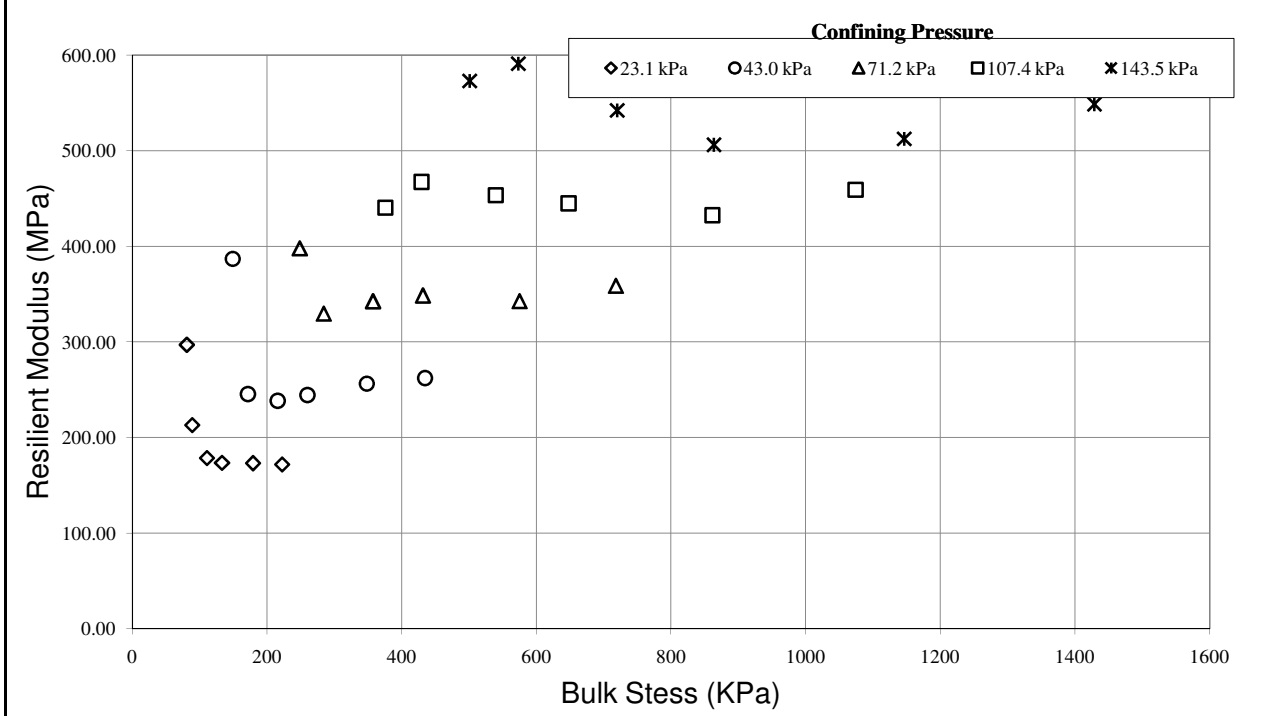
Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.23	218.25	325.29	432.16	109.23	218.48	361.77	539.94
Confining Pressure (kPa)	41.67	71.47	108.22	144.97	23.73	41.73	71.90	108.28
Resilient Modulus (MPa)	346.54	562.93	781.93	978.48	235.17	378.86	540.75	729.51

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	717.22	152.63	304.89	505.03	753.35	1000.00		
Confining Pressure (kPa)	144.67	23.36	41.74	71.72	108.36	145.01		
Resilient Modulus (MPa)	879.76	234.14	376.24	537.59	666.89	757.76		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-L-17-3	Client Lab #:
Date Tested: Dec 04, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2289.06	Soil Type: A-Base Limestone with 16.0% fines
Sample Moisture (%): 3.81%	Max. Dry Density (kg/m³): 2305
Replicate #: 1	Optimum Moisture (%): 6.50%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.75	21.57	35.38	53.88	71.68	21.09	42.72	71.96
Confining Pressure (kPa)	23.46	42.38	71.17	107.17	143.17	22.59	43.04	70.81
Resilient Modulus (MPa)	296.95	387.19	397.79	440.60	573.29	213.13	245.39	329.52

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	108.78	144.87	42.30	87.29	145.36	217.54	288.83	64.84
Confining Pressure (kPa)	106.82	142.83	22.84	42.90	70.79	107.29	143.80	22.86
Resilient Modulus (MPa)	467.27	591.25	178.49	238.29	342.46	453.70	542.44	173.56

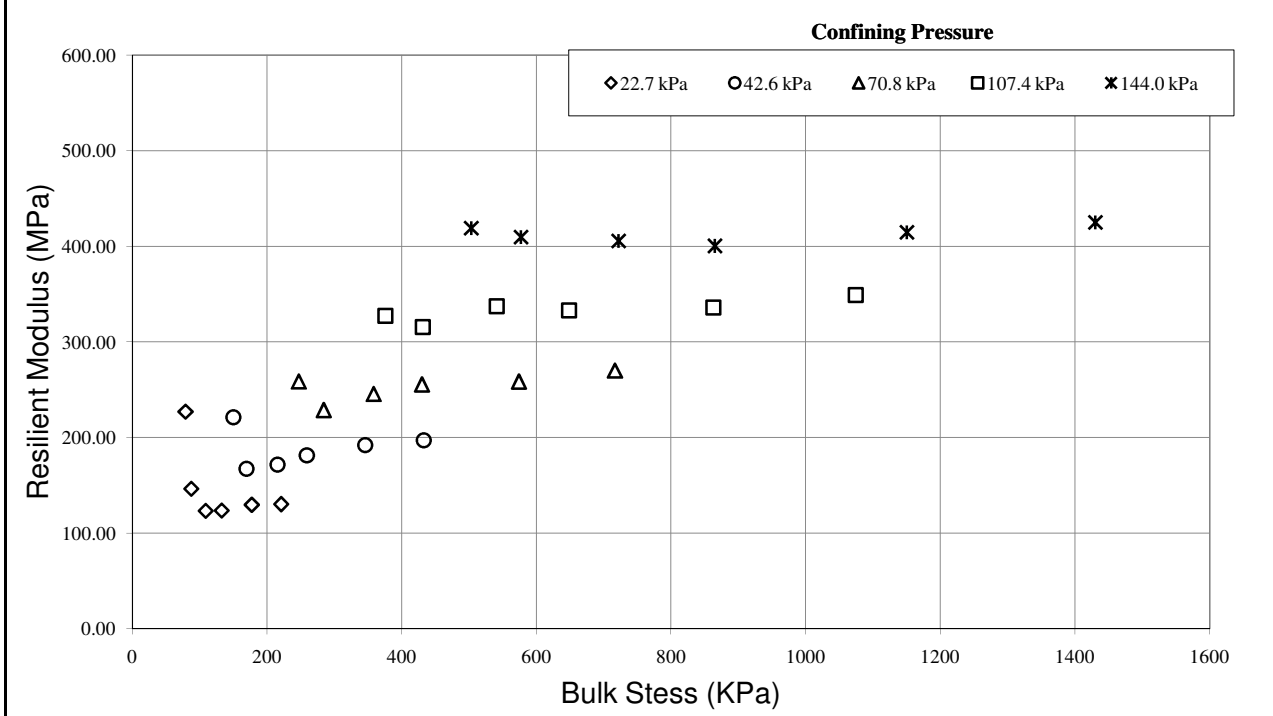
Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.15	217.38	324.64	430.98	109.09	217.92	360.53	538.32
Confining Pressure (kPa)	43.01	71.36	107.78	144.20	23.35	43.38	71.49	107.60
Resilient Modulus (MPa)	244.39	348.47	444.93	506.17	173.02	256.49	342.64	432.49

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	715.38	152.41	303.82	503.34	751.64	997.97		
Confining Pressure (kPa)	143.71	23.38	43.54	71.55	107.55	143.54		
Resilient Modulus (MPa)	512.76	171.92	262.06	358.69	459.55	548.69		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-L-12-2	Client Lab #:
Date Tested: Nov 18, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2239.29	Soil Type: A-Base Limestone with 10.5% fines
Sample Moisture (%): 7.68%	Max. Dry Density (kg/m³): 2277
Replicate #: 2	Optimum Moisture (%): 7.00%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.32	21.24	35.14	53.89	72.40	20.77	42.29	72.43
Confining Pressure (kPa)	22.97	42.86	70.71	107.22	143.73	22.30	42.33	70.61
Resilient Modulus (MPa)	227.10	221.45	258.50	327.64	419.28	146.44	167.51	228.60

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.56	146.03	41.78	87.51	146.04	218.53	289.70	64.88
Confining Pressure (kPa)	107.13	143.65	22.40	42.56	70.82	107.44	144.05	22.54
Resilient Modulus (MPa)	315.80	409.96	123.41	171.89	245.50	337.52	405.92	123.57

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.39	218.12	325.76	432.36	109.04	218.28	361.31	539.34
Confining Pressure (kPa)	42.63	70.69	107.46	144.23	22.86	42.45	70.95	107.79
Resilient Modulus (MPa)	181.53	255.37	333.21	400.34	129.53	192.38	258.44	336.23

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	716.17	152.15	303.93	503.63	751.60	998.49		
Confining Pressure (kPa)	144.62	22.99	42.89	71.09	107.44	143.80		
Resilient Modulus (MPa)	414.88	130.22	197.29	270.04	349.36	425.30		

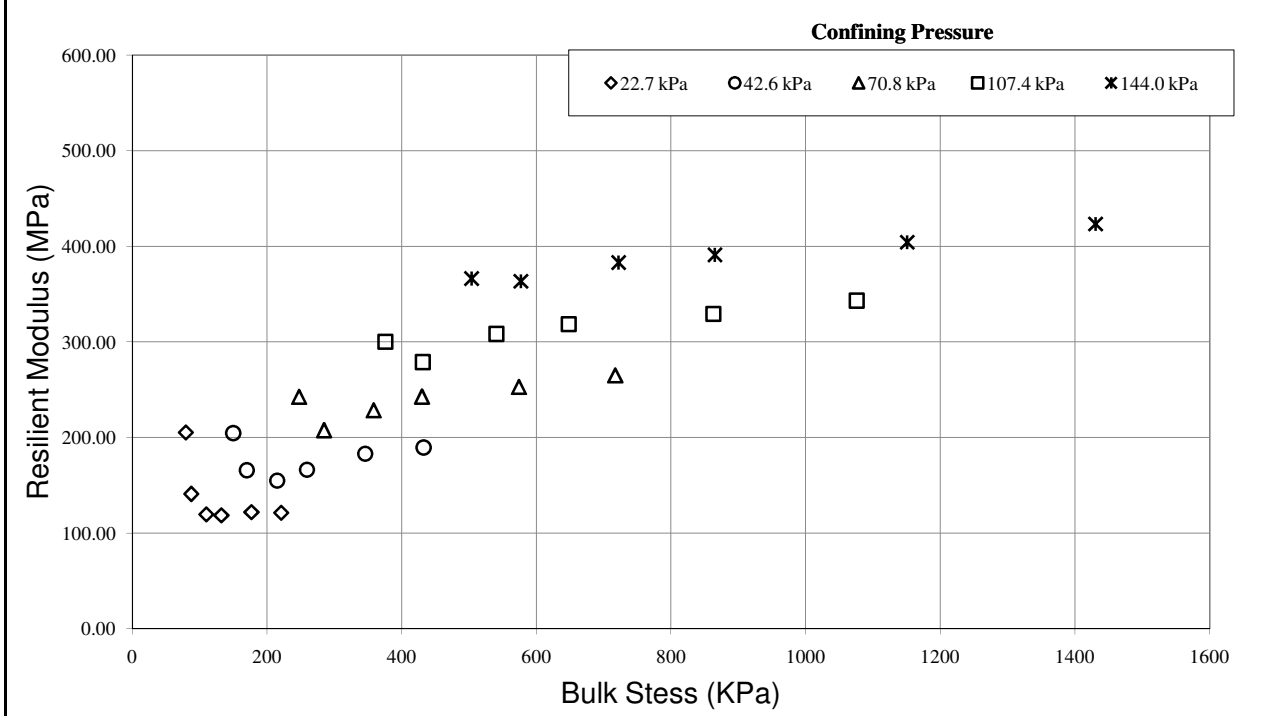
Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	



Pavements Research Laboratory

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-L-12-1	Client Lab #:
Date Tested: Nov 15, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2251.93	Soil Type: A-Base Limestone with 10.5% fines
Sample Moisture (%): 7.58%	Max. Dry Density (kg/m³): 2277
Replicate #: 1	Optimum Moisture (%): 7.00%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.38	21.36	35.56	53.95	72.92	20.74	42.62	72.80
Confining Pressure (kPa)	22.97	42.86	70.71	107.22	143.73	22.30	42.33	70.61
Resilient Modulus (MPa)	205.40	204.52	242.54	300.52	366.18	140.87	165.70	207.52

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.55	146.25	42.57	87.18	145.86	218.16	289.83	64.71
Confining Pressure (kPa)	107.13	143.65	22.40	42.56	70.82	107.44	144.05	22.54
Resilient Modulus (MPa)	278.86	363.63	119.57	155.25	228.42	308.30	382.94	118.68

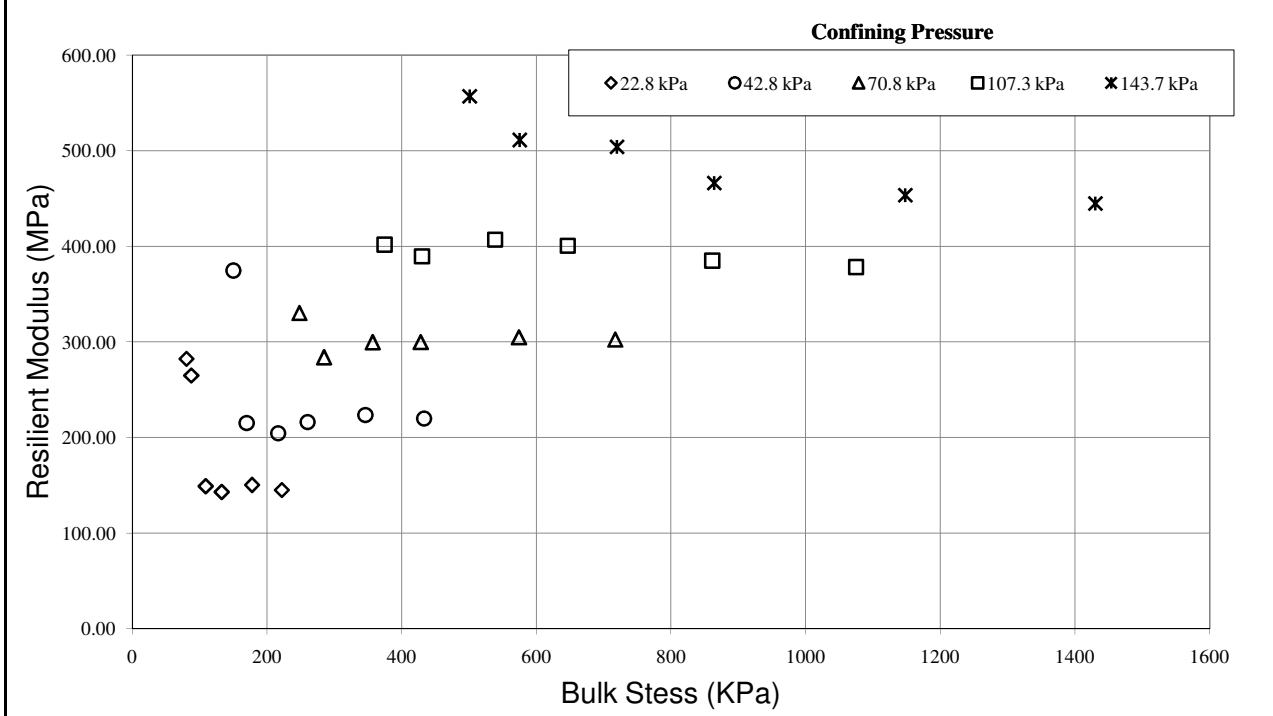
Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.21	218.08	325.42	432.30	108.51	218.08	361.27	539.32
Confining Pressure (kPa)	42.63	70.69	107.46	144.23	22.86	42.45	70.95	107.79
Resilient Modulus (MPa)	166.42	242.69	318.96	390.95	122.01	183.21	252.87	329.47

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	716.60	152.15	304.01	504.12	752.99	999.22		
Confining Pressure (kPa)	144.62	22.99	42.89	71.09	107.44	143.80		
Resilient Modulus (MPa)	404.54	121.24	189.44	264.86	343.07	423.67		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-L-12-4	Client Lab #:
Date Tested: Nov 29, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2261.66	Soil Type: A-Base Limestone with 10.5% fines
Sample Moisture (%): 4.77%	Max. Dry Density (kg/m³): 2277
Replicate #: 2	Optimum Moisture (%): 7.00%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.67	21.50	35.31	53.83	72.18	20.91	42.43	72.30
Confining Pressure (kPa)	23.26	42.76	70.96	106.98	143.00	22.30	42.51	70.80
Resilient Modulus (MPa)	282.35	374.53	330.19	401.76	557.29	264.95	215.33	283.86

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.11	144.86	41.96	87.66	145.52	217.19	288.48	64.68
Confining Pressure (kPa)	107.08	143.36	22.40	42.91	70.52	107.11	143.70	22.74
Resilient Modulus (MPa)	389.74	511.16	148.99	204.79	299.56	407.17	504.41	142.96

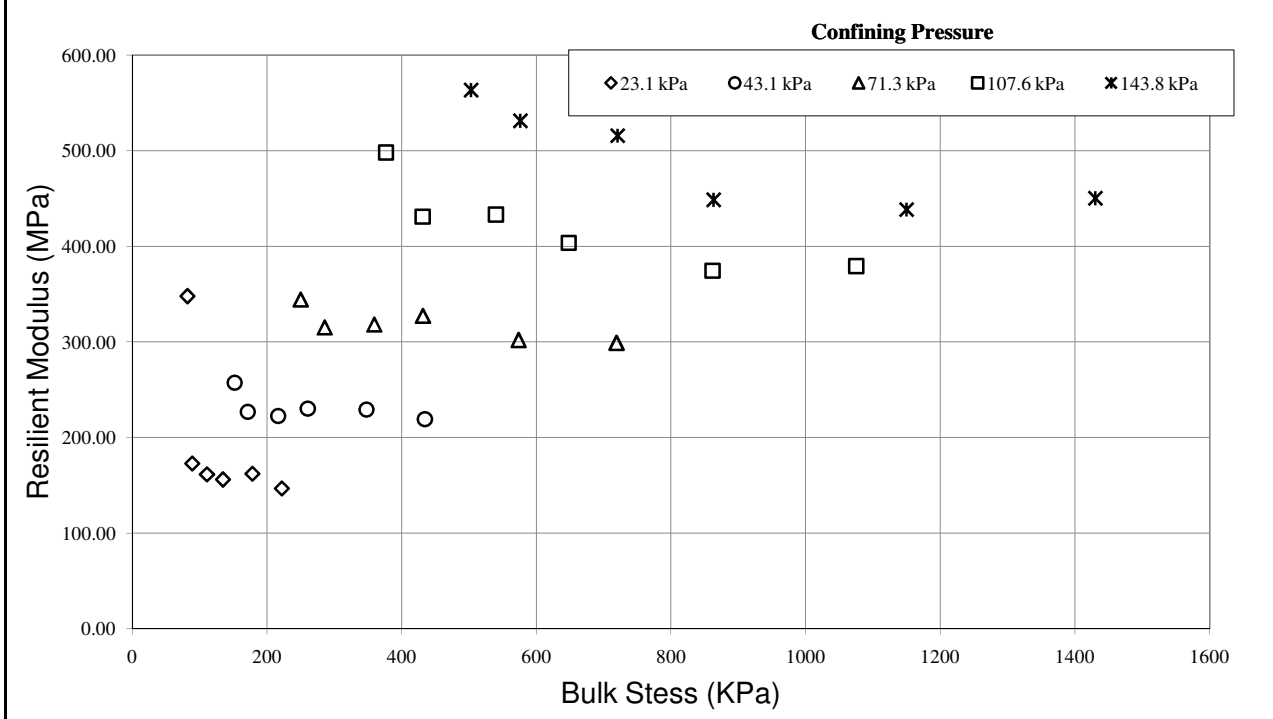
Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.17	217.28	324.36	431.52	108.97	217.55	360.70	538.71
Confining Pressure (kPa)	42.93	70.39	107.29	144.18	22.90	42.89	71.20	107.57
Resilient Modulus (MPa)	216.42	299.79	400.83	466.54	150.27	223.70	304.71	384.96

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	715.79	152.02	303.85	503.41	751.96	998.45		
Confining Pressure (kPa)	143.93	23.32	43.01	71.22	107.55	143.87		
Resilient Modulus (MPa)	453.75	145.02	220.00	302.38	378.30	445.13		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-L-12-3	Client Lab #:
Date Tested: Nov 27, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2260.20	Soil Type: A-Base Limestone with 10.5% fines
Sample Moisture (%): 4.74%	Max. Dry Density (kg/m³): 2277
Replicate #: 1	Optimum Moisture (%): 7.00%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.66	21.57	35.87	54.05	72.30	20.98	43.28	72.53
Confining Pressure (kPa)	23.69	43.32	71.44	107.47	143.50	22.66	42.64	70.99
Resilient Modulus (MPa)	347.84	257.68	344.33	498.10	563.39	173.00	227.06	315.18

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.50	145.48	43.09	87.89	145.96	217.71	288.83	65.36
Confining Pressure (kPa)	107.25	143.50	22.66	42.77	71.10	107.47	143.85	23.03
Resilient Modulus (MPa)	431.32	531.30	161.56	222.79	318.19	433.15	516.09	155.99

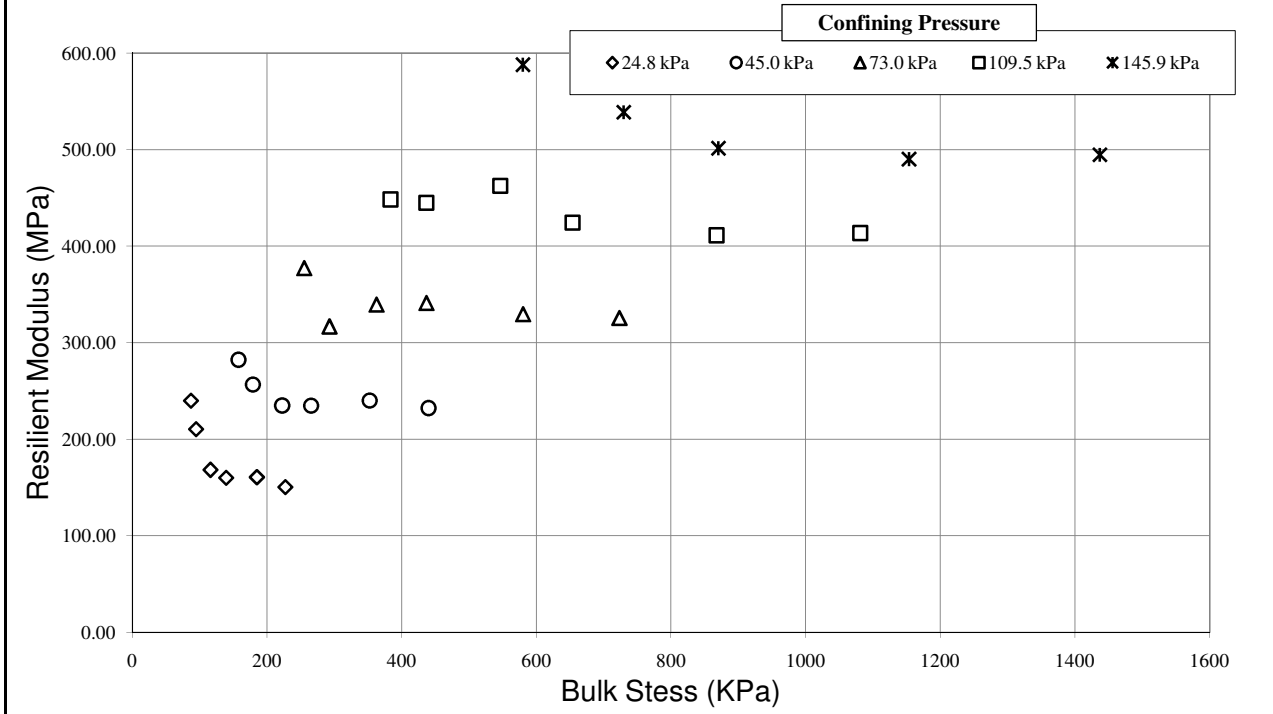
Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.49	217.66	324.84	431.19	108.80	217.91	360.69	538.77
Confining Pressure (kPa)	43.07	71.39	107.69	143.99	23.19	43.18	70.95	107.71
Resilient Modulus (MPa)	230.51	327.21	403.92	448.59	162.14	229.44	301.93	374.71

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	716.14	152.30	304.34	503.72	751.81	998.63		
Confining Pressure (kPa)	144.46	23.23	43.46	71.88	107.81	143.74		
Resilient Modulus (MPa)	438.80	146.82	219.39	298.88	379.25	450.20		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-L-5-2	Client Lab #:
Date Tested: Nov 13, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2179.32	Soil Type: A-Base Limestone with 4.5% fines
Sample Moisture (%): 7.48%	Max. Dry Density (kg/m³): 2202
Replicate #: 2	Optimum Moisture (%): 7.50%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.70	21.58	35.85	54.19	72.58	21.00	43.14	72.85
Confining Pressure (kPa)	25.44	45.22	73.13	109.59	146.04	24.51	45.19	73.30
Resilient Modulus (MPa)	239.97	282.24	377.11	448.26	679.79	210.49	256.99	316.77

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.11	145.51	42.86	87.91	145.70	217.46	289.19	65.44
Confining Pressure (kPa)	109.03	144.76	24.37	44.92	72.31	109.56	146.81	24.60
Resilient Modulus (MPa)	445.19	587.89	168.27	234.92	339.41	462.64	538.92	160.05

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.50	217.57	324.91	431.80	109.54	217.85	360.93	538.88
Confining Pressure (kPa)	44.59	73.07	109.57	146.07	25.22	44.79	73.11	109.43
Resilient Modulus (MPa)	234.93	341.00	424.67	501.30	160.62	240.36	329.39	411.24

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	716.43	152.64	303.96	503.66	751.90	998.82		
Confining Pressure (kPa)	145.74	24.87	45.26	73.31	109.63	145.95		
Resilient Modulus (MPa)	490.06	150.45	232.23	325.61	413.46	494.82		

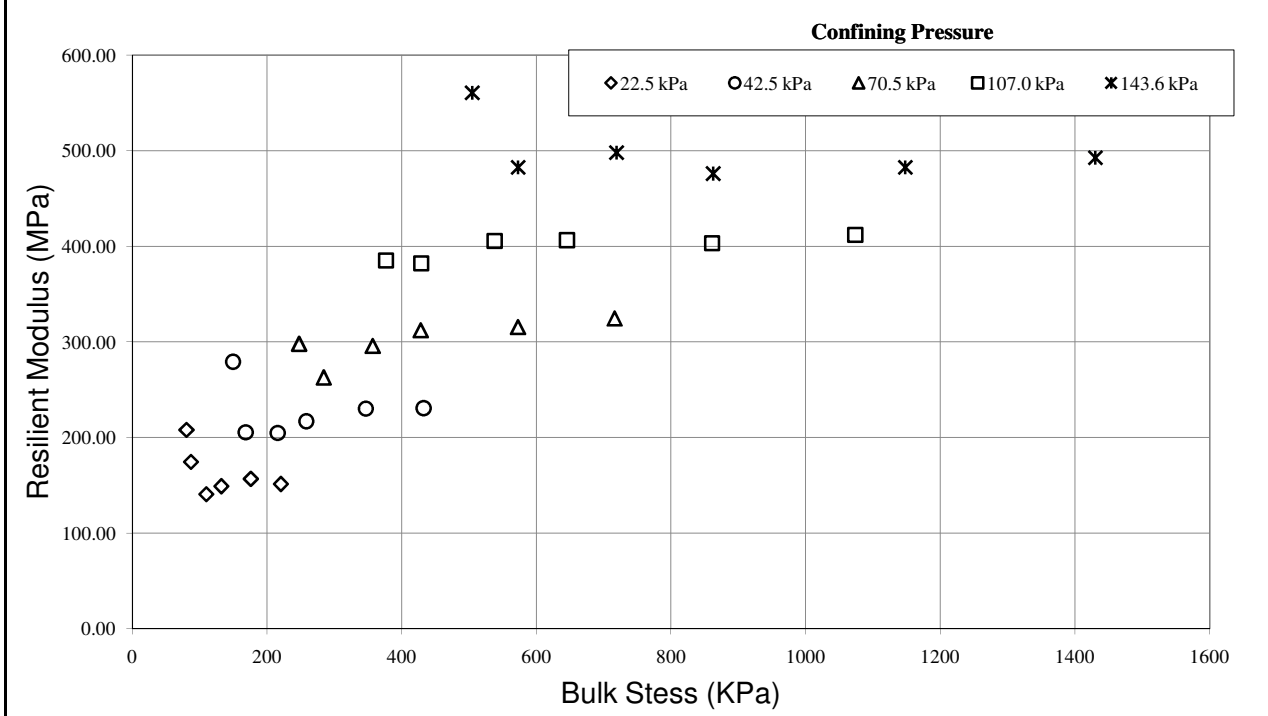
Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	



Pavements Research Laboratory

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-L-5-1	Client Lab #:
Date Tested: Nov 08, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2198.80	Soil Type: A-Base Limestone with 4.5% fines
Sample Moisture (%): 7.67%	Max. Dry Density (kg/m³): 2202
Replicate #: 1	Optimum Moisture (%): 7.50%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.70	21.41	35.70	54.32	72.92	21.07	42.67	73.14
Confining Pressure (kPa)	23.31	42.63	70.72	107.36	144.01	21.98	41.94	70.39
Resilient Modulus (MPa)	207.97	279.16	297.98	385.38	560.80	174.66	205.64	262.82

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.38	145.35	42.42	88.07	145.98	217.57	289.12	65.45
Confining Pressure (kPa)	106.42	142.45	22.46	42.68	70.42	106.91	143.40	22.20
Resilient Modulus (MPa)	382.36	482.80	140.81	205.12	295.64	405.79	498.18	148.95

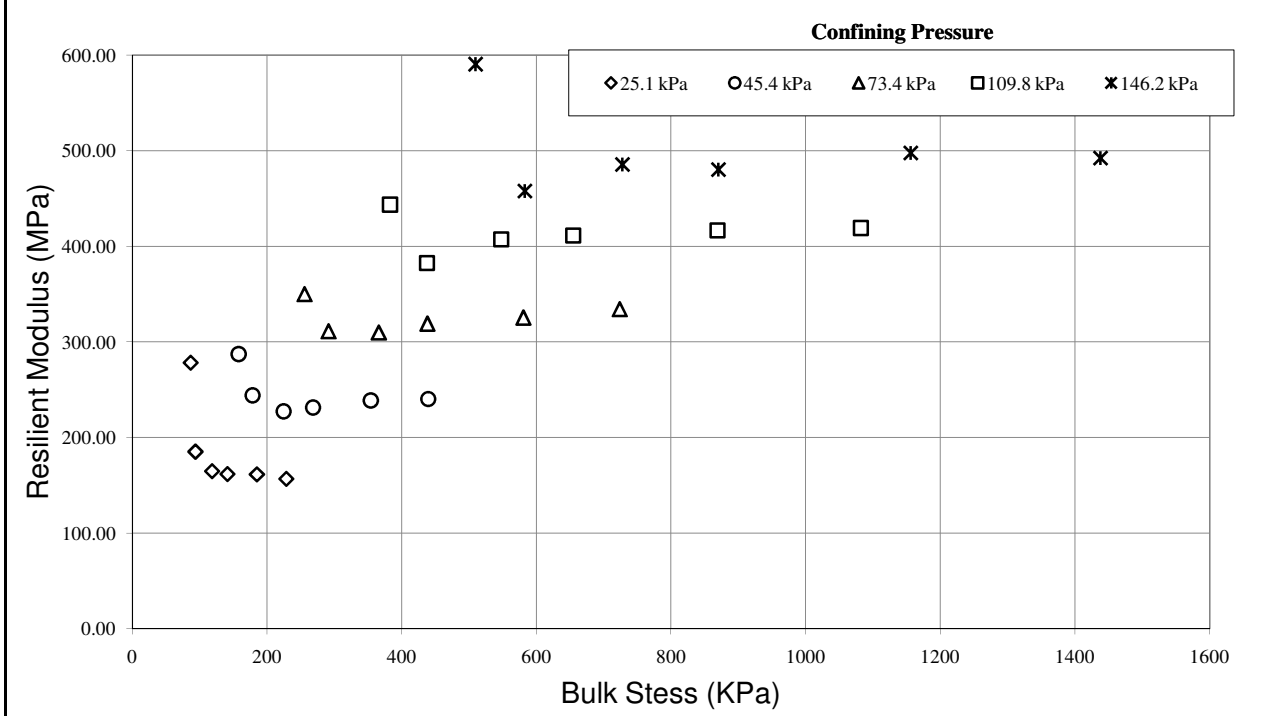
Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.66	217.76	324.78	431.72	109.58	218.19	361.15	538.79
Confining Pressure (kPa)	42.19	70.25	106.96	143.67	22.19	42.73	70.60	107.26
Resilient Modulus (MPa)	216.86	312.23	406.36	475.98	156.70	230.46	315.40	403.55

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	715.92	152.71	304.41	503.81	751.87	998.41		
Confining Pressure (kPa)	143.92	22.58	42.78	70.78	107.32	143.86		
Resilient Modulus (MPa)	482.93	151.28	230.64	324.53	412.17	493.01		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-L-5-4	Client Lab #:
Date Tested: Nov 26, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2182.24	Soil Type: A-Base Limestone with 4.5% fines
Sample Moisture (%): 5.25%	Max. Dry Density (kg/m³): 2202
Replicate #: 2	Optimum Moisture (%): 7.50%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.52	21.60	35.65	54.25	72.28	21.04	43.34	72.61
Confining Pressure (kPa)	25.34	45.51	73.33	109.53	145.74	24.29	44.97	72.95
Resilient Modulus (MPa)	278.39	287.17	349.95	443.56	590.55	185.07	244.08	311.16

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	108.89	145.09	42.94	87.61	145.37	217.30	288.34	65.47
Confining Pressure (kPa)	109.43	145.91	25.10	45.53	73.61	110.04	146.47	25.23
Resilient Modulus (MPa)	382.72	458.09	164.76	227.26	309.79	407.53	485.94	161.87

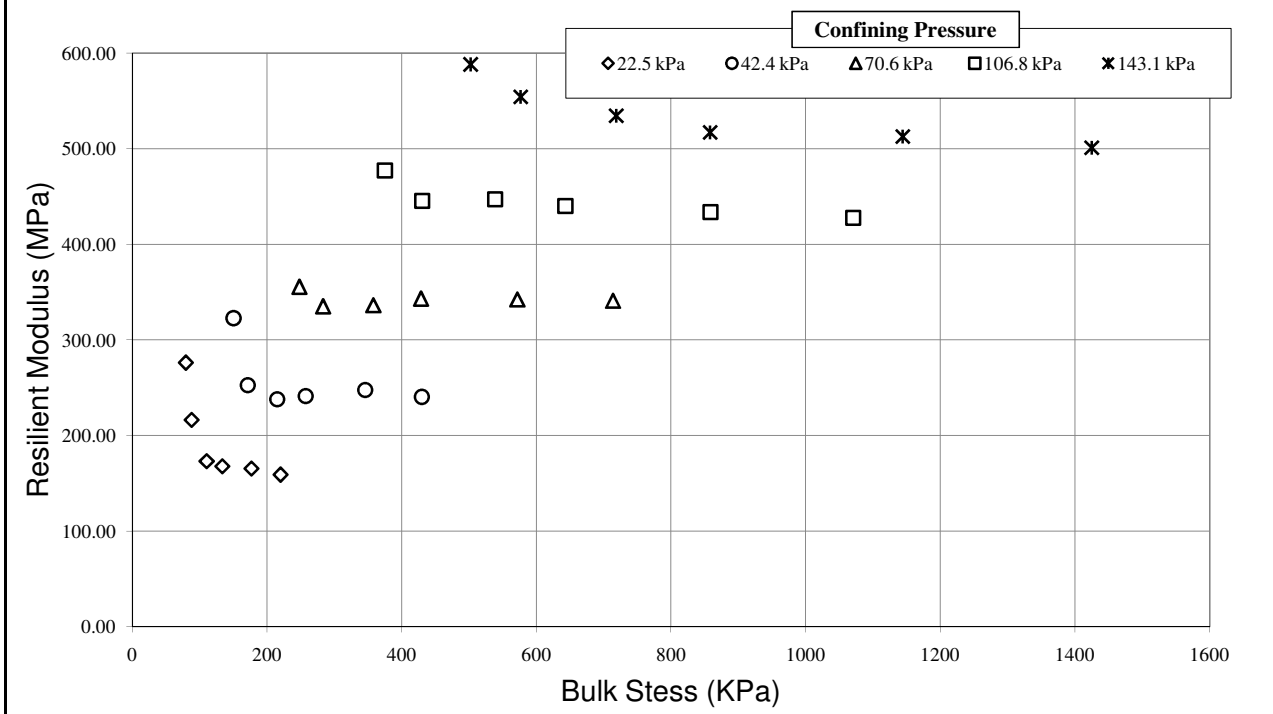
Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.10	217.26	324.36	430.82	109.19	217.68	360.18	538.31
Confining Pressure (kPa)	45.62	73.61	110.04	146.47	25.31	45.56	73.54	110.11
Resilient Modulus (MPa)	231.29	318.98	411.59	480.61	161.52	238.69	325.35	417.03

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	715.55	152.10	303.68	503.41	752.17	998.89		
Confining Pressure (kPa)	146.68	25.46	45.11	73.47	109.85	146.23		
Resilient Modulus (MPa)	497.84	156.72	240.56	334.29	419.14	492.50		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-L-5-3	Client Lab #:
Date Tested: Nov 22, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2181.63	Soil Type: A-Base Limestone with 4.5% fines
Sample Moisture (%): 5.30%	Max. Dry Density (kg/m³): 2202
Replicate #: 1	Optimum Moisture (%): 7.50%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.51	21.55	35.99	53.99	72.20	21.02	43.13	72.49
Confining Pressure (kPa)	22.97	42.96	70.73	107.09	143.46	22.30	42.67	70.25
Resilient Modulus (MPa)	276.22	322.73	355.50	477.59	588.12	216.42	252.93	335.06

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.07	144.97	43.04	88.02	145.23	216.87	288.15	65.84
Confining Pressure (kPa)	107.07	143.89	22.49	42.29	70.97	107.25	143.53	22.61
Resilient Modulus (MPa)	445.81	554.42	173.23	238.14	336.32	447.40	534.82	167.80

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.23	217.02	324.01	430.82	109.60	217.49	360.12	537.74
Confining Pressure (kPa)	41.93	70.59	106.43	142.28	22.44	42.65	70.62	106.79
Resilient Modulus (MPa)	241.43	343.14	440.47	517.37	165.60	247.77	342.22	433.94

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	714.86	152.48	303.69	503.03	751.18	997.78		
Confining Pressure (kPa)	142.97	22.49	41.99	70.27	106.33	142.38		
Resilient Modulus (MPa)	512.92	159.02	240.36	341.04	427.96	501.41		

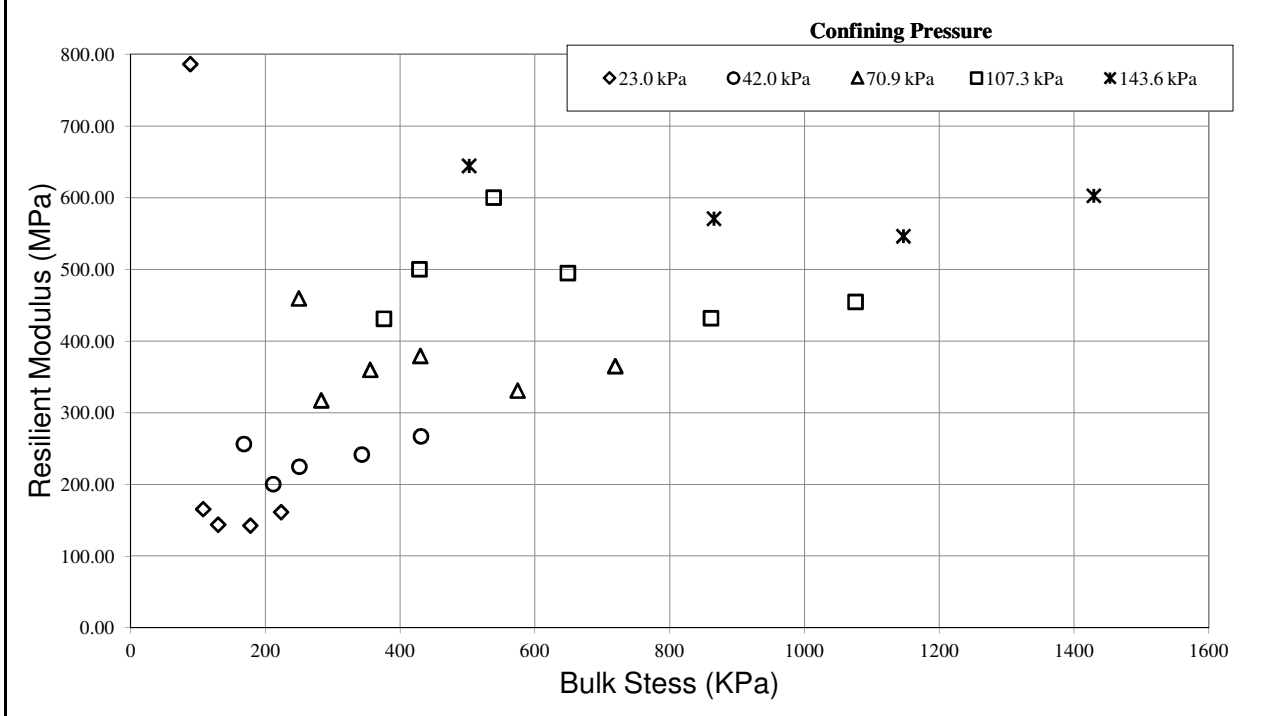
Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	



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Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Base Materials Testing	Contract #:
PRL Lab #: MR-GR-9-2	Client Lab #:
Date Tested: Aug 15, 2014	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2288.36	Soil Type: A-Base Granite with 9.0% fines
Sample Moisture (%): 7.37%	Max. Dry Density (kg/m³): 2308
Replicate #: 2	Optimum Moisture (%): 6.30%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.70	21.60	34.30	52.43	70.72	21.52	40.51	69.67
Confining Pressure (kPa)	23.81	43.45	71.70	107.75	143.79	22.28	42.45	71.01
Resilient Modulus (MPa)	3931.86	1405.61	459.50	431.22	644.39	786.46	256.43	317.40

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	107.20	144.66	39.85	84.24	144.53	217.38	290.12	61.61
Confining Pressure (kPa)	107.04	143.06	22.52	42.37	70.29	107.02	143.74	22.70
Resilient Modulus (MPa)	500.30	850.96	165.62	200.44	359.90	600.20	777.54	143.93

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	129.89	217.93	326.51	433.42	107.53	218.15	361.94	540.33
Confining Pressure (kPa)	40.08	70.60	107.33	144.07	23.32	41.56	70.72	106.95
Resilient Modulus (MPa)	224.77	379.35	494.91	570.72	142.61	241.74	330.95	431.92

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	717.00	153.04	305.18	505.05	753.16	998.61		
Confining Pressure (kPa)	143.19	23.34	41.82	71.32	107.44	143.56		
Resilient Modulus (MPa)	546.29	161.32	267.12	365.11	454.74	602.63		

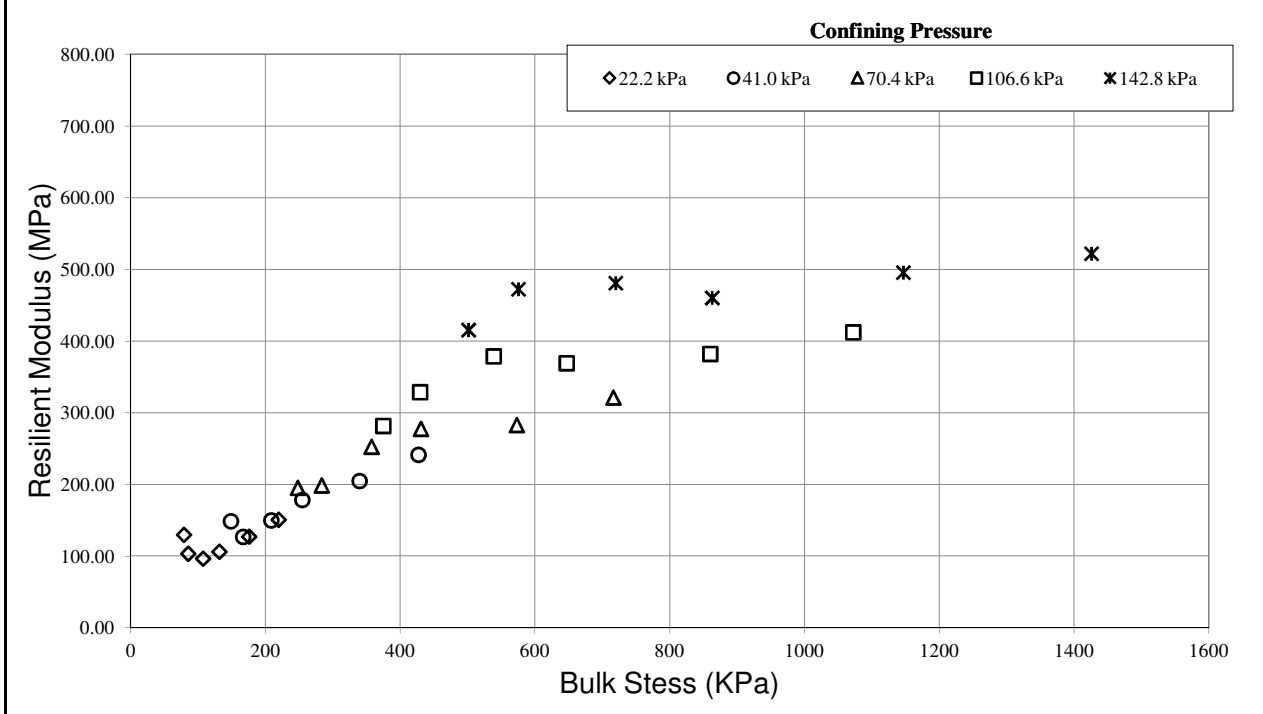
Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	



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Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Base Materials Testing	Contract #:
PRL Lab #: MR-GR-9-1	Client Lab #:
Date Tested: Jul 05, 2014	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2289.52	Soil Type: A-Base Granite with 9.0% fines
Sample Moisture (%): 7.04%	Max. Dry Density (kg/m³): 2308
Replicate #: 1	Optimum Moisture (%): 6.30%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.09	20.63	35.45	54.16	72.60	20.10	42.25	72.81
Confining Pressure (kPa)	22.98	42.68	70.84	106.89	142.94	21.72	41.49	70.21
Resilient Modulus (MPa)	129.70	148.63	195.21	281.60	415.35	103.40	126.84	198.52

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.62	146.24	41.73	87.70	146.58	218.88	290.98	64.65
Confining Pressure (kPa)	106.62	143.03	21.87	40.31	70.26	106.61	142.96	22.29
Resilient Modulus (MPa)	328.61	472.28	96.45	149.83	252.58	378.61	480.92	106.11

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.85	219.01	326.64	433.89	109.61	219.00	362.90	540.91
Confining Pressure (kPa)	40.90	70.55	106.79	143.03	22.02	40.20	70.01	106.39
Resilient Modulus (MPa)	178.37	277.55	369.15	460.15	127.21	204.75	282.87	382.05

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	718.45	153.35	305.11	505.53	753.60	999.39		
Confining Pressure (kPa)	142.77	22.04	40.64	70.26	106.21	142.15		
Resilient Modulus (MPa)	495.52	150.78	241.32	321.15	412.20	521.98		

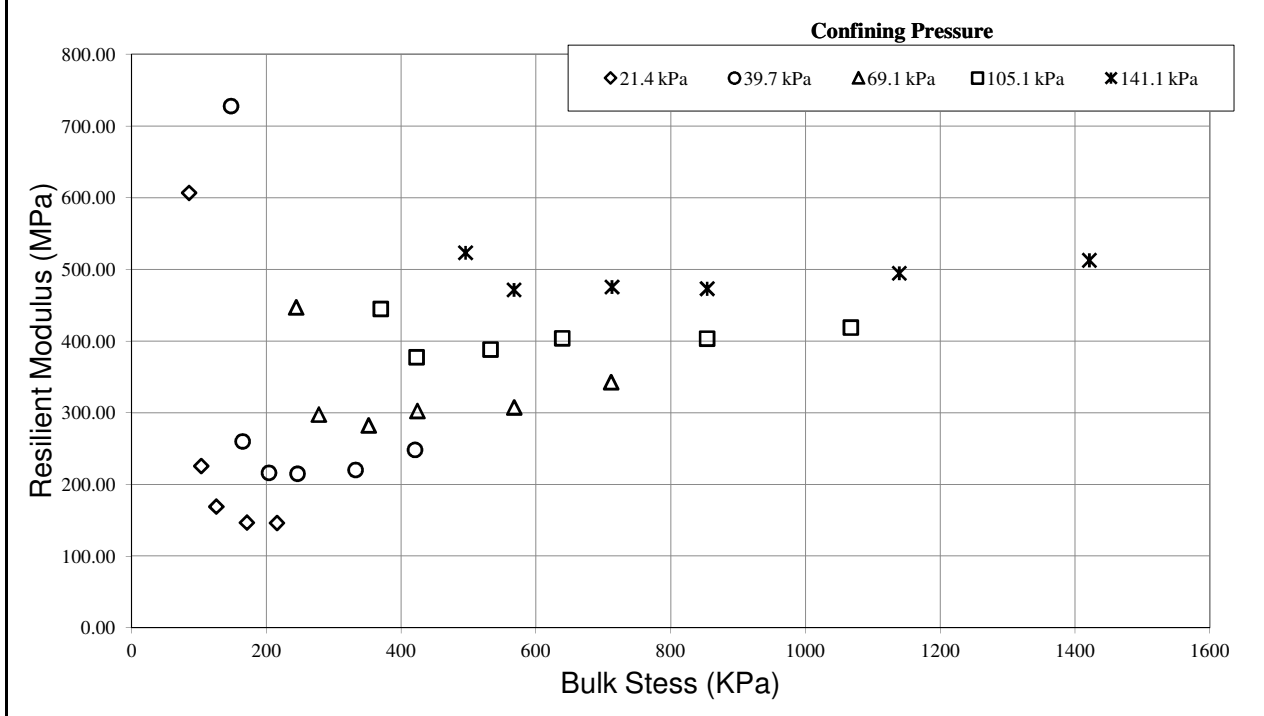
Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	



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Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Base Materials Testing	Contract #:
PRL Lab #: MR-GR-9-4	Client Lab #:
Date Tested: Aug 22, 2014	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2283.53	Soil Type: A-Base Granite with 9.0% fines
Sample Moisture (%): 4.72%	Max. Dry Density (kg/m³): 2308
Replicate #: 2	Optimum Moisture (%): 6.30%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.77	21.64	34.69	52.68	71.07	21.34	40.98	70.41
Confining Pressure (kPa)	22.58	41.87	69.76	105.59	141.43	21.22	41.17	69.07
Resilient Modulus (MPa)	1061.28	727.84	447.12	444.80	523.17	606.80	260.06	297.47

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	107.29	143.93	40.45	84.64	144.54	216.95	288.82	61.95
Confining Pressure (kPa)	105.08	141.09	20.87	39.64	69.02	105.16	141.30	21.18
Resilient Modulus (MPa)	377.47	471.45	225.71	216.25	282.39	388.26	475.45	169.15

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	129.91	217.13	324.12	431.22	107.55	217.40	361.13	539.12
Confining Pressure (kPa)	38.68	68.92	104.91	140.91	21.11	38.24	68.82	104.85
Resilient Modulus (MPa)	215.01	302.53	403.91	473.05	146.80	220.24	307.57	403.51

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	716.47	151.81	303.81	503.74	751.99	998.51		
Confining Pressure (kPa)	140.87	21.21	38.83	69.22	105.05	140.88		
Resilient Modulus (MPa)	494.55	146.25	248.29	342.61	418.82	512.72		

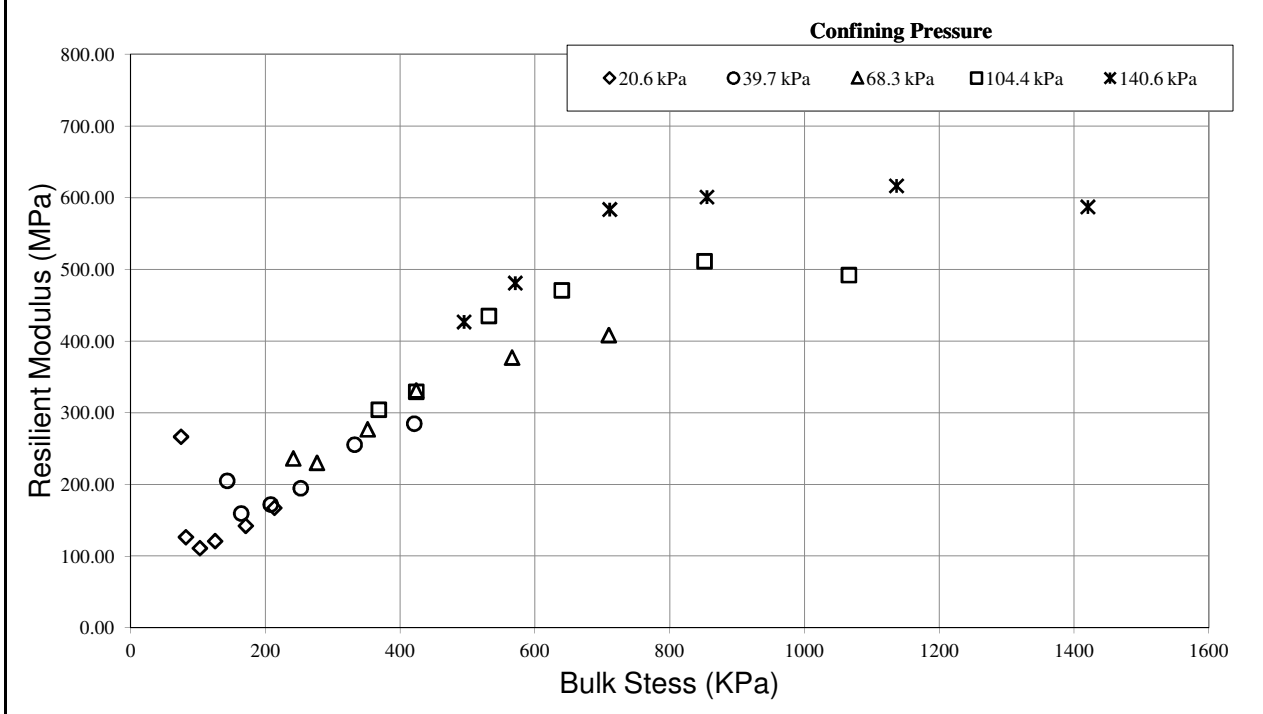
Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	



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Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Base Materials Testing	Contract #:
PRL Lab #: MR-GR-9-3	Client Lab #:
Date Tested: Aug 19, 2014	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2284.38	Soil Type: A-Base Granite with 9.0% fines
Sample Moisture (%): 4.50%	Max. Dry Density (kg/m³): 2308
Replicate #: 1	Optimum Moisture (%): 6.30%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.28	20.64	35.35	54.14	72.69	19.88	42.36	72.37
Confining Pressure (kPa)	21.44	40.82	68.61	104.64	140.68	20.63	40.50	67.98
Resilient Modulus (MPa)	266.52	205.09	236.27	304.31	426.67	126.43	159.55	230.20

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.60	146.29	41.63	87.46	146.84	218.79	290.48	64.42
Confining Pressure (kPa)	104.73	141.47	20.30	40.07	68.24	104.18	140.12	20.25
Resilient Modulus (MPa)	329.24	480.93	111.15	172.01	276.85	435.03	583.61	120.91

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	132.35	218.82	326.14	432.82	109.24	218.25	361.00	539.03
Confining Pressure (kPa)	39.95	68.25	104.48	140.72	20.49	37.96	68.28	104.14
Resilient Modulus (MPa)	194.72	331.03	470.83	601.01	142.29	255.51	377.05	511.42

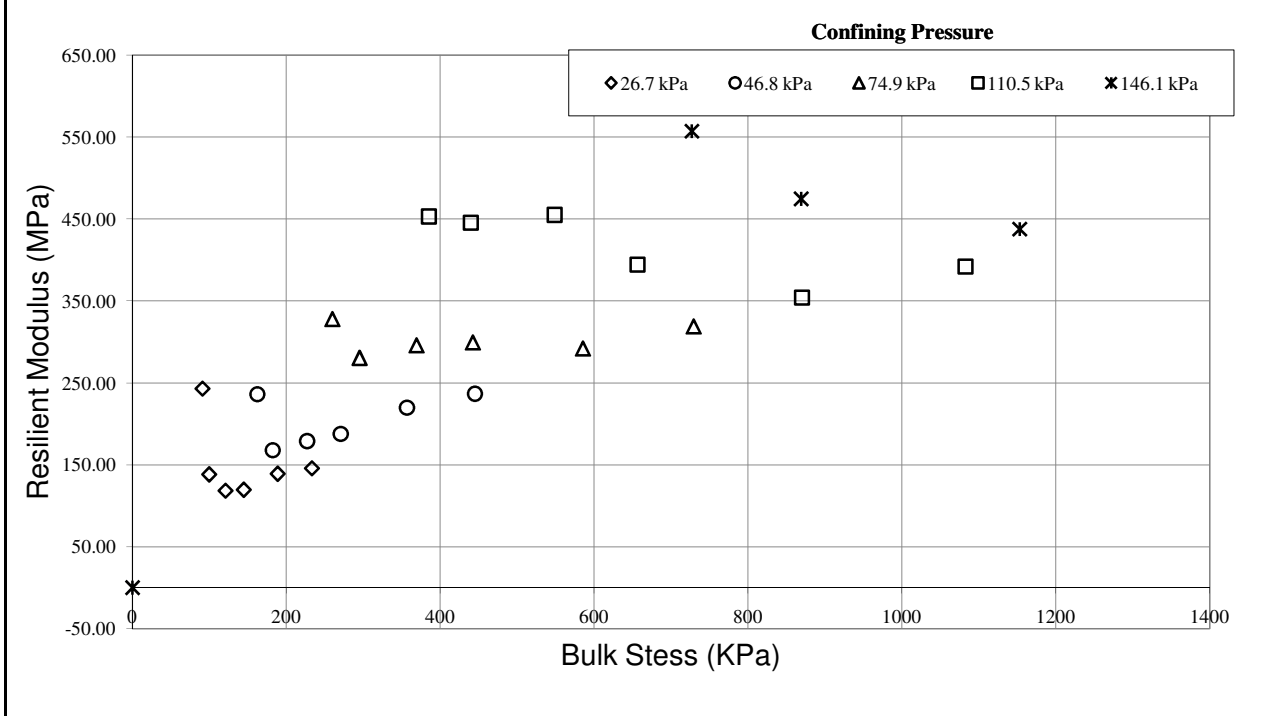
Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	716.44	151.99	304.22	504.08	752.56	999.09		
Confining Pressure (kPa)	140.00	20.35	38.82	68.45	104.44	140.43		
Resilient Modulus (MPa)	616.54	167.40	284.81	408.40	491.99	587.19		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	



Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-GA-12-11	Client Lab #:
Date Tested: Apr 14, 2014	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2198.97	Soil Type: A-Base Gravel with 14.5% fines
Sample Moisture (%): 7.94%	Max. Dry Density (kg/m³): 2203
Replicate #: 2-pd	Optimum Moisture (%): 8.30%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.66	20.87	35.25	53.66	71.45	20.49	42.34	71.72
Confining Pressure (kPa)	26.80	47.11	74.91	110.45	146.00	26.42	46.59	74.55
Resilient Modulus (MPa)	243.05	236.35	327.74	453.06	661.79	138.25	168.19	280.36

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	108.23	144.32	41.98	86.51	144.76	217.07	288.59	64.31
Confining Pressure (kPa)	110.40	146.25	26.37	46.92	74.86	110.50	146.14	26.81
Resilient Modulus (MPa)	445.92	604.84	118.44	178.87	295.77	454.91	557.45	119.54

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	130.53	217.34	324.58	431.07	108.63	217.77	360.79	538.26
Confining Pressure (kPa)	46.79	75.05	110.56	146.08	26.75	46.41	74.94	110.56
Resilient Modulus (MPa)	188.16	299.23	394.56	474.49	139.03	220.07	291.84	354.31

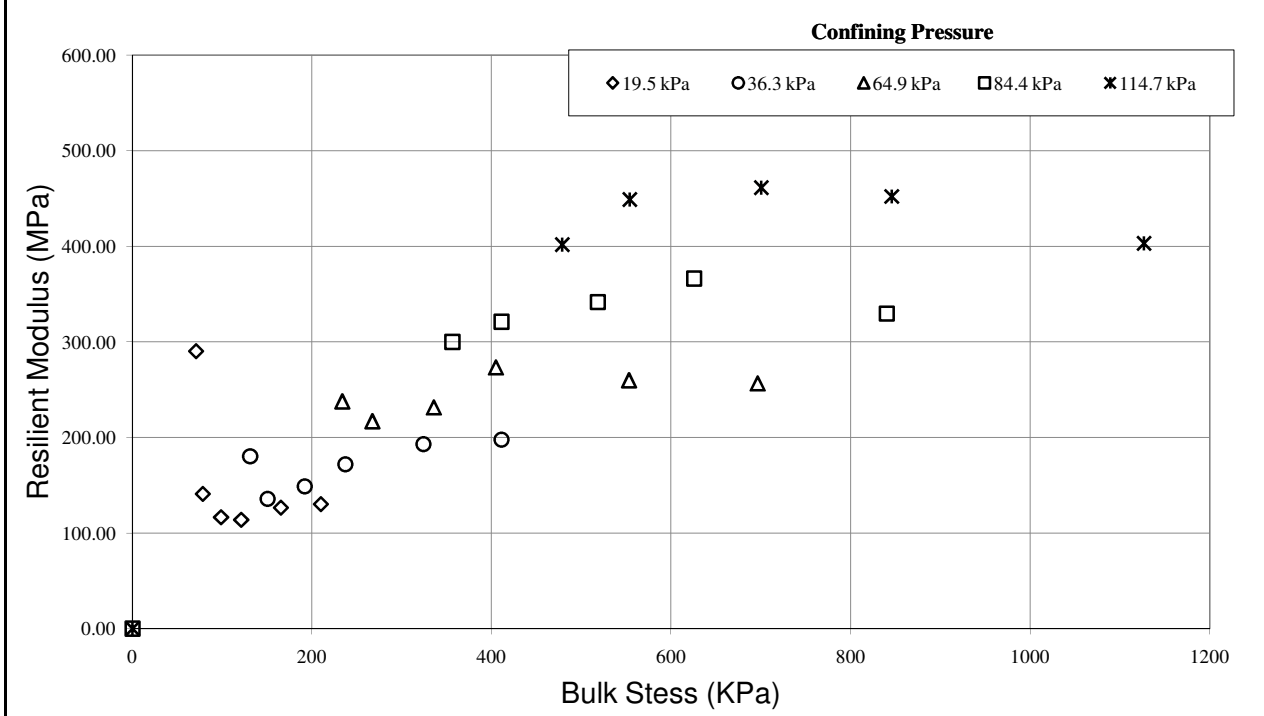
Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	714.73	152.36	304.36	503.65	750.42			
Confining Pressure (kPa)	146.18	26.99	46.92	75.23	110.61			
Resilient Modulus (MPa)	438.03	145.86	236.59	318.85	392.31			

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	



Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-GA-12-2	Client Lab #:
Date Tested: Sep 18, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2185.90	Soil Type: A-Base Gravel with 14.5% fines
Sample Moisture (%): 8.22%	Max. Dry Density (kg/m³): 2203
Replicate #: 2	Optimum Moisture (%): 8.30%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.87	20.22	34.52	53.11	71.10	20.19	41.19	70.91
Confining Pressure (kPa)	20.07	37.07	66.43	101.16	135.88	19.42	36.46	65.51
Resilient Modulus (MPa)	290.39	180.67	237.68	299.93	401.74	141.09	136.05	216.87

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	107.21	143.13	41.04	85.24	143.45	214.91	286.05	63.44
Confining Pressure (kPa)	101.24	136.96	19.30	35.48	64.14	101.12	138.11	19.32
Resilient Modulus (MPa)	320.98	448.90	116.67	149.08	231.43	341.86	461.30	114.01

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	128.66	214.63	321.47	428.09	107.30	215.33	358.33	536.10
Confining Pressure (kPa)	36.11	63.44	101.37	139.30	19.36	36.22	64.92	101.36
Resilient Modulus (MPa)	172.32	273.36	366.25	452.36	126.75	193.32	259.77	329.86

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	713.17	151.44	302.26	501.46				
Confining Pressure (kPa)	137.80	19.50	36.27	65.03				
Resilient Modulus (MPa)	403.01	130.35	198.03	256.62				

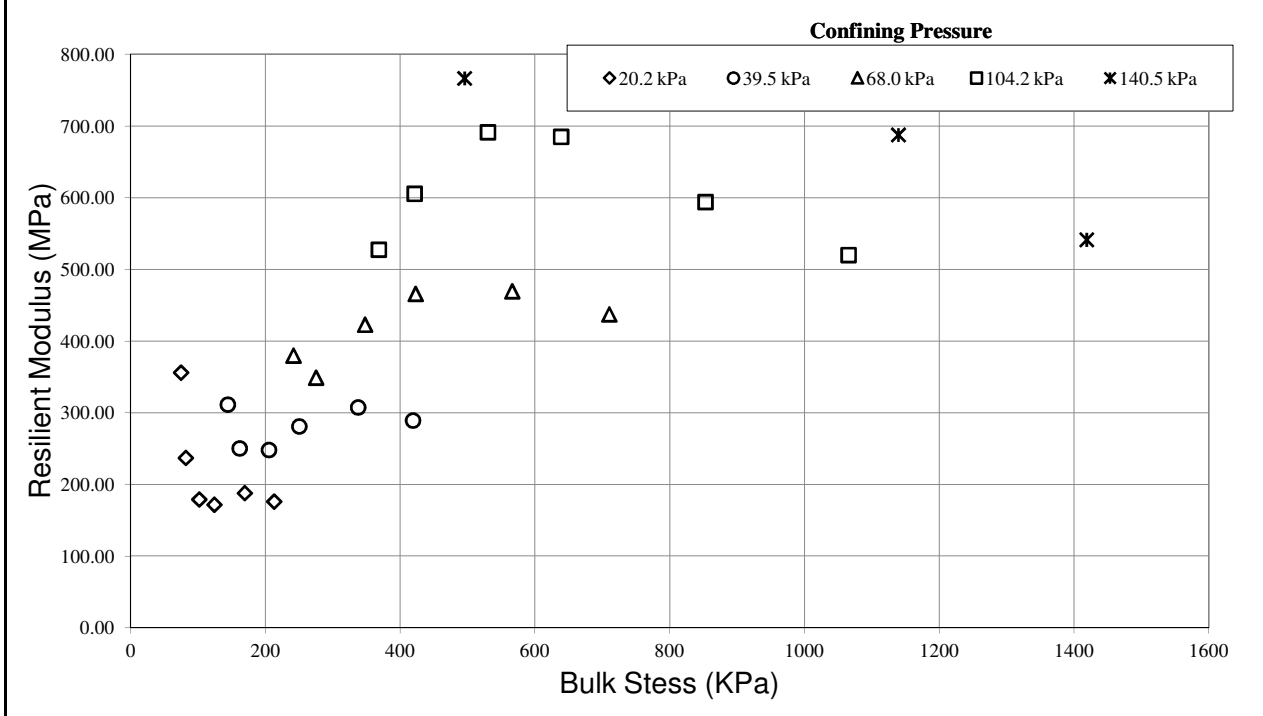
Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	



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Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Base Materials Testing	Contract #:
PRL Lab #: MR-GA-12-14	Client Lab #:
Date Tested: Jun 30, 2014	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2180.90	Soil Type: A-Base Gravel with 14.5% fines
Sample Moisture (%): 6.34%	Max. Dry Density (kg/m³): 2203
Replicate #: 2	Optimum Moisture (%): 8.30%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.96	21.42	35.88	53.84	72.12	21.20	42.64	72.16
Confining Pressure (kPa)	21.22	40.86	68.52	104.81	141.10	20.17	39.64	67.62
Resilient Modulus (MPa)	355.94	311.37	379.80	527.38	766.47	236.97	250.29	349.02

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	108.83	145.54	42.44	86.87	146.15	218.26	290.07	64.64
Confining Pressure (kPa)	104.13	140.64	19.74	39.41	67.18	103.96	140.75	19.84
Resilient Modulus (MPa)	605.47	965.27	179.02	248.09	422.84	691.23	906.65	171.74

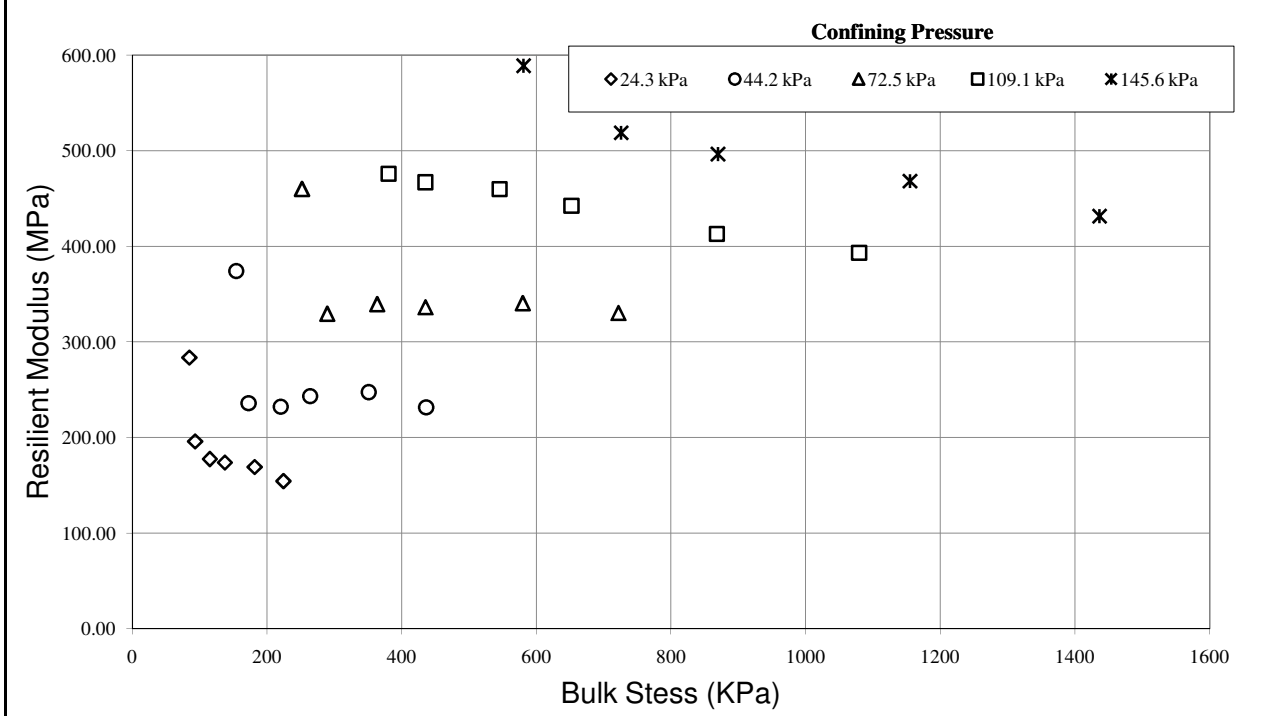
Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	130.97	218.54	326.14	433.22	109.11	218.95	362.17	540.26
Confining Pressure (kPa)	39.71	68.10	104.15	140.20	20.05	39.49	67.99	104.21
Resilient Modulus (MPa)	280.96	465.83	684.85	863.60	187.91	307.47	469.43	594.01

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	717.95	152.09	305.01	505.28	753.34	999.69		
Confining Pressure (kPa)	140.43	20.26	37.94	68.31	103.99	139.66		
Resilient Modulus (MPa)	687.64	176.09	289.16	437.22	520.01	541.31		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Base Materials Testing	Contract #:
PRL Lab #: MR-GA-12-3	Client Lab #:
Date Tested: Oct 18, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2202.73	Soil Type: A-Base Gravel with 14.5% fines
Sample Moisture (%): 6.52%	Max. Dry Density (kg/m³): 2203
Replicate #: 1	Optimum Moisture (%): 8.30%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.94	21.15	35.85	53.92	71.97	21.17	42.69	72.34
Confining Pressure (kPa)	24.67	44.33	72.09	108.72	144.97	24.09	43.39	72.38
Resilient Modulus (MPa)	283.66	374.32	459.98	476.28	688.09	196.01	236.20	329.35

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	108.72	145.38	42.35	86.49	145.59	217.44	288.73	64.40
Confining Pressure (kPa)	108.75	145.12	24.20	44.55	72.71	109.20	145.69	24.37
Resilient Modulus (MPa)	467.04	588.80	177.43	232.45	339.41	460.16	519.01	173.90

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	130.70	217.71	324.45	431.85	108.66	217.64	361.15	539.17
Confining Pressure (kPa)	44.41	72.51	109.25	146.00	24.41	44.37	72.84	109.50
Resilient Modulus (MPa)	243.48	336.34	442.70	496.41	169.17	247.42	340.45	413.22

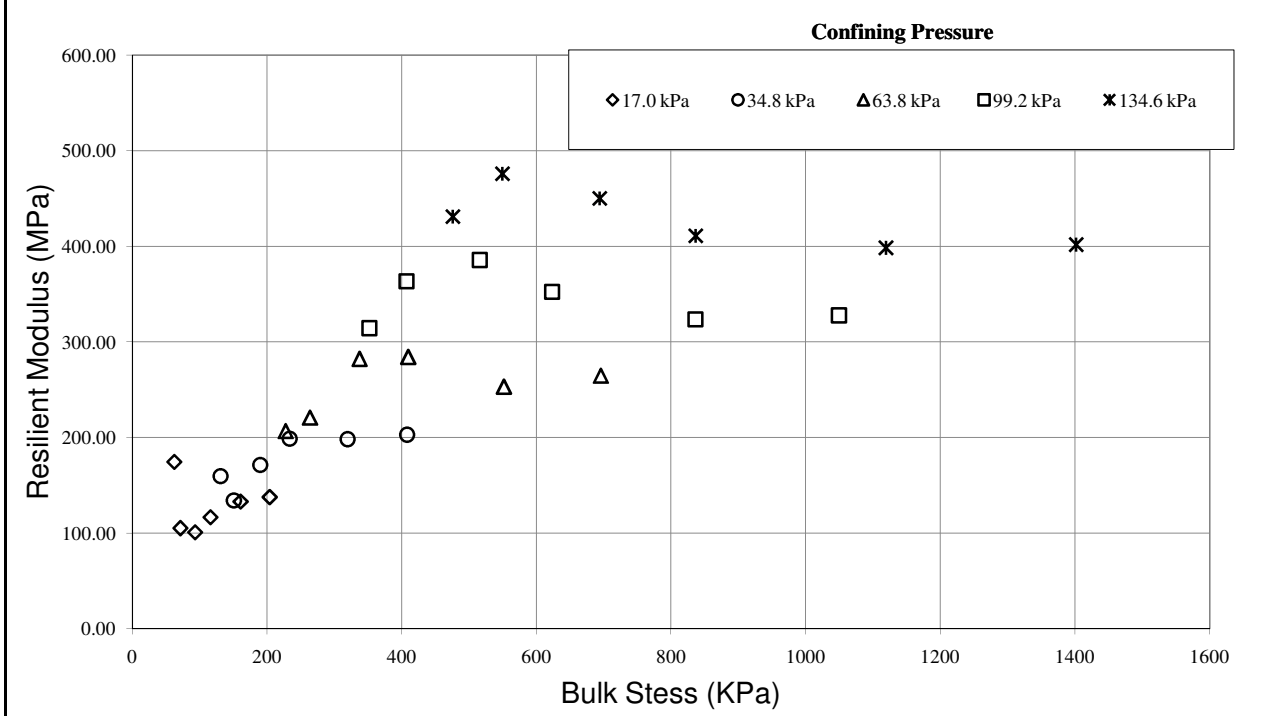
Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	716.50	151.91	303.75	503.93	752.08	999.19		
Confining Pressure (kPa)	146.15	24.21	44.25	72.67	109.13	145.59		
Resilient Modulus (MPa)	468.59	154.33	231.79	330.26	393.49	431.45		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	



Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-GA-5-2	Client Lab #:
Date Tested: Sep 27, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2202.60	Soil Type: A-Base Gravel with 9% fines
Sample Moisture (%): 6.89%	Max. Dry Density (kg/m³): 2223
Replicate #: 1	Optimum Moisture (%): 7.00%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.52	20.80	35.90	54.17	72.35	20.49	42.54	72.89
Confining Pressure (kPa)	17.27	36.66	63.90	99.19	134.49	16.98	36.13	63.73
Resilient Modulus (MPa)	174.66	159.85	206.62	314.35	431.42	105.08	134.33	220.65

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.46	145.79	42.61	87.76	146.20	217.92	289.38	65.41
Confining Pressure (kPa)	99.16	134.58	16.83	33.99	63.72	99.28	134.83	16.86
Resilient Modulus (MPa)	363.64	476.15	101.01	171.48	282.15	385.62	450.36	116.71

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.63	218.36	325.37	432.41	109.88	218.38	361.50	539.07
Confining Pressure (kPa)	33.95	63.86	99.25	134.65	17.01	33.71	63.51	98.98
Resilient Modulus (MPa)	198.91	284.23	352.74	411.14	133.16	198.19	253.03	323.97

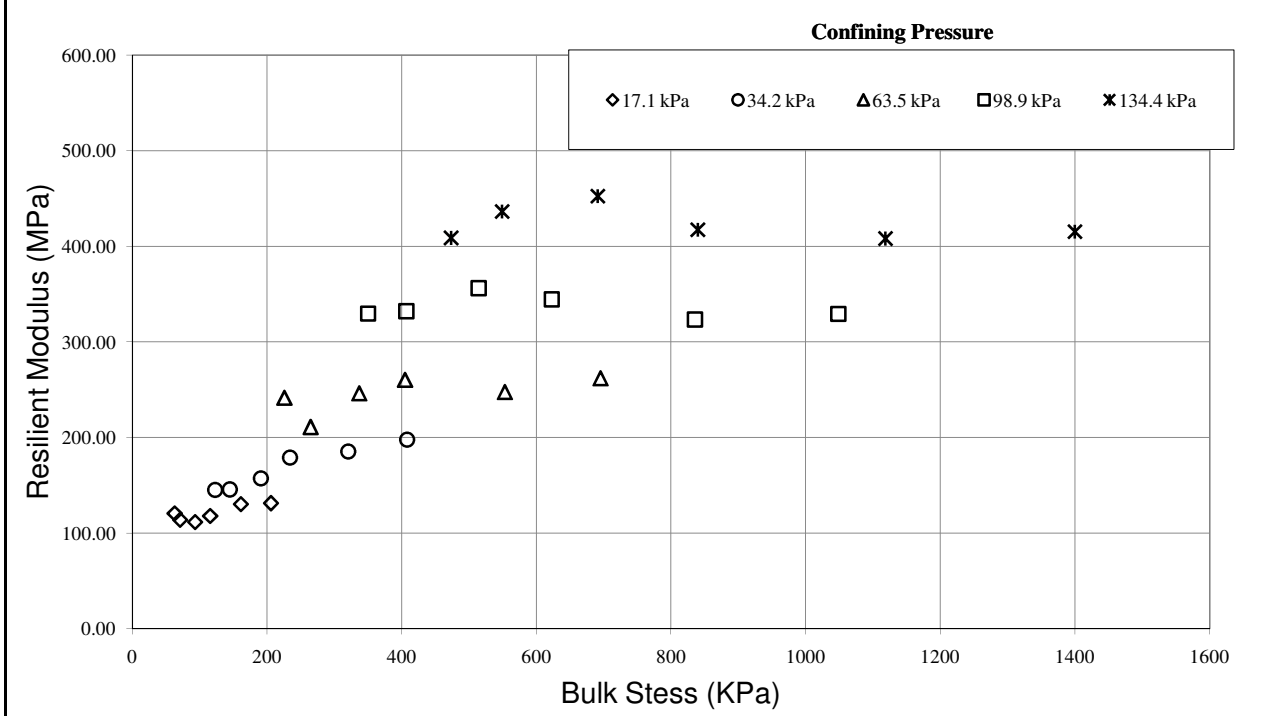
Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	716.05	153.40	304.45	503.94	751.67	997.47		
Confining Pressure (kPa)	134.44	16.95	34.43	63.91	99.27	134.64		
Resilient Modulus (MPa)	398.37	137.56	202.91	264.69	327.73	401.67		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	



Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-GA-5-1	Client Lab #:
Date Tested: Sep 20, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2222.92	Soil Type: A-Base Gravel with 9% fines
Sample Moisture (%): 7.26%	Max. Dry Density (kg/m³): 2223
Replicate #: 1	Optimum Moisture (%): 7.00%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.32	20.55	35.60	54.14	72.38	20.22	42.34	72.86
Confining Pressure (kPa)	17.56	34.03	63.46	98.61	133.75	16.86	34.07	63.94
Resilient Modulus (MPa)	120.66	145.37	241.46	329.95	408.72	114.01	145.56	210.85

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.69	145.78	42.27	87.96	146.30	218.07	288.99	65.52
Confining Pressure (kPa)	99.14	134.35	17.02	34.27	63.60	98.80	134.01	16.75
Resilient Modulus (MPa)	332.07	436.59	111.65	157.42	246.21	356.19	452.81	118.06

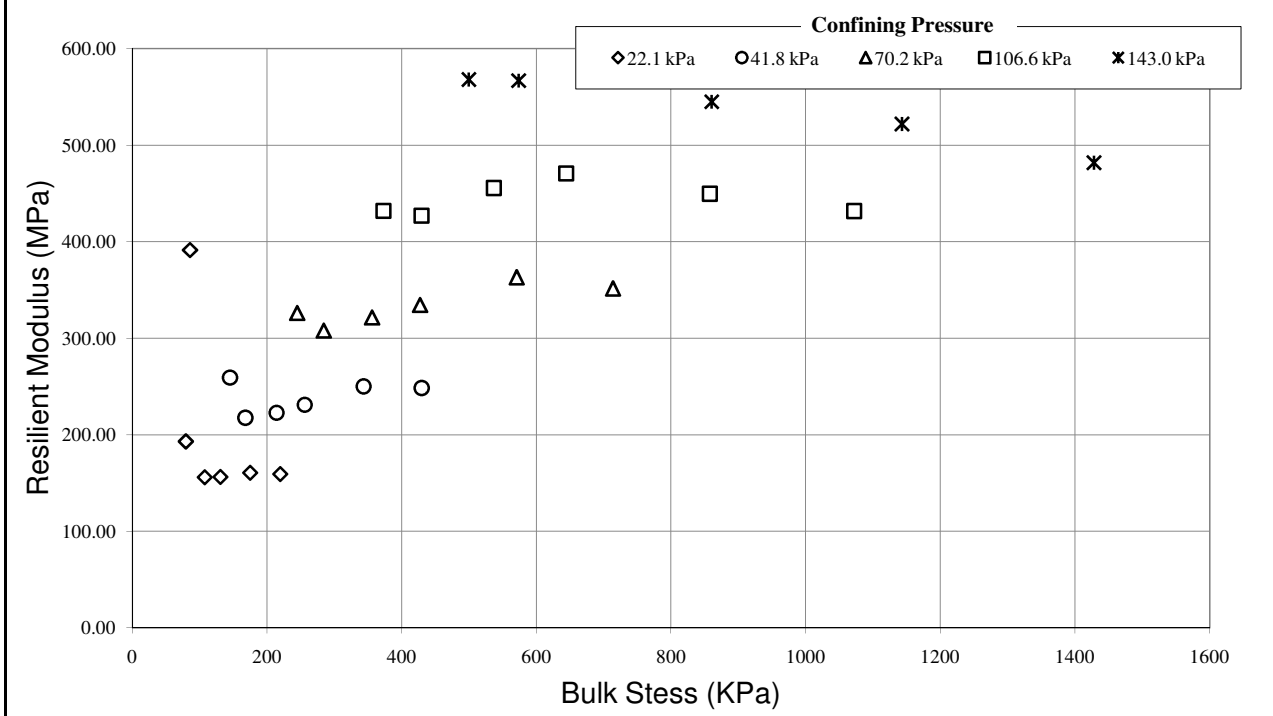
Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.68	218.01	325.01	432.00	109.81	218.35	361.17	538.70
Confining Pressure (kPa)	34.09	62.36	99.18	135.99	17.09	33.98	63.98	98.99
Resilient Modulus (MPa)	179.32	260.26	344.43	417.59	130.48	185.52	247.55	323.36

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	716.14	153.19	304.19	503.75	751.75	997.34		
Confining Pressure (kPa)	134.01	17.51	34.50	63.83	98.97	134.10		
Resilient Modulus (MPa)	408.04	131.19	197.94	261.92	329.53	415.64		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-GA-5-4	Client Lab #:
Date Tested: Oct 28, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2203.26	Soil Type: A-Base Gravel with 9% fines
Sample Moisture (%): 5.44%	Max. Dry Density (kg/m³): 2223
Replicate #: 2	Optimum Moisture (%): 7.00%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.61	21.33	35.41	54.14	72.48	21.00	42.54	72.86
Confining Pressure (kPa)	23.03	41.33	69.88	106.12	142.36	21.61	41.85	70.52
Resilient Modulus (MPa)	193.01	259.44	325.98	432.24	567.89	391.34	217.50	307.85

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	108.92	145.07	42.44	87.78	145.52	216.61	287.92	64.94
Confining Pressure (kPa)	106.72	142.92	21.71	42.05	70.23	106.69	143.14	21.99
Resilient Modulus (MPa)	427.18	567.05	155.97	223.00	321.48	455.50	574.22	156.39

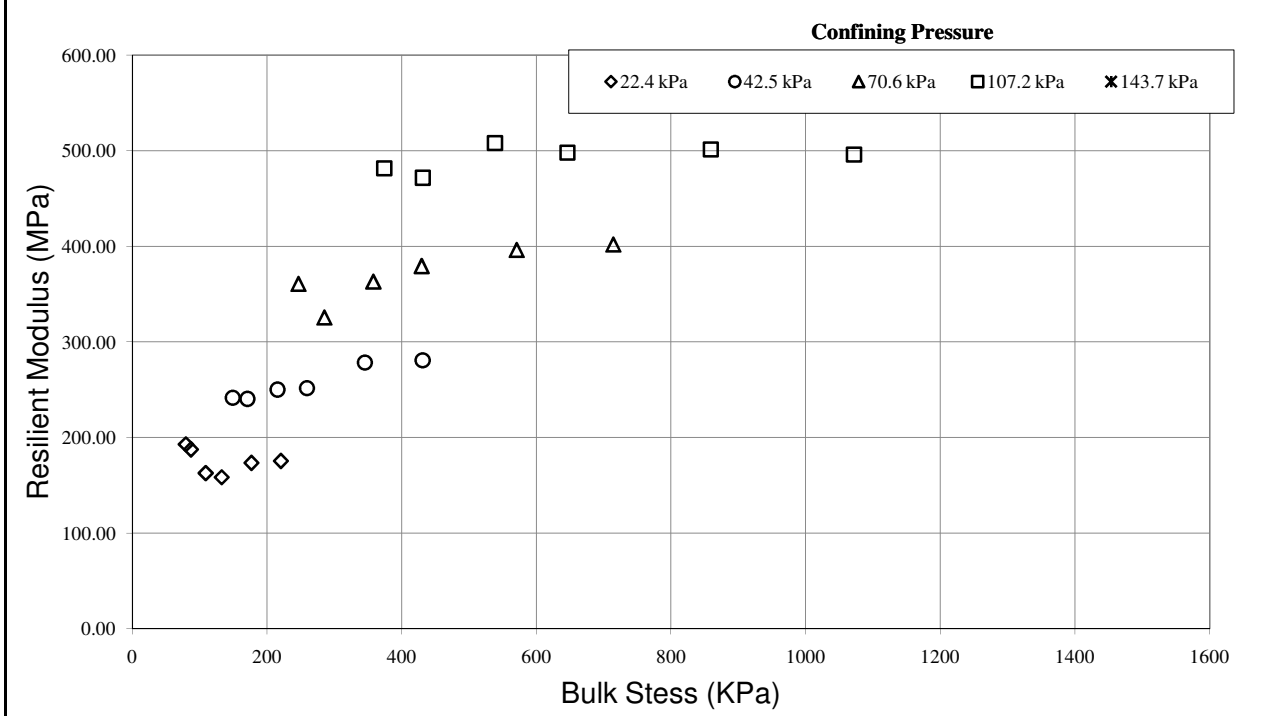
Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.24	217.00	323.78	430.47	109.23	217.46	360.28	537.92
Confining Pressure (kPa)	41.51	70.18	106.69	143.20	21.94	41.91	70.21	106.44
Resilient Modulus (MPa)	231.24	334.44	471.03	545.20	160.60	250.02	363.03	449.58

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	715.12	152.63	303.74	503.21	751.30	998.02		
Confining Pressure (kPa)	142.67	22.30	42.06	70.22	106.82	143.43		
Resilient Modulus (MPa)	521.78	159.26	248.40	351.44	431.60	481.71		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-GA-5-3	Client Lab #:
Date Tested: Oct 25, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2201.20	Soil Type: A-Base Gravel with 9% fines
Sample Moisture (%): 5.17%	Max. Dry Density (kg/m³): 2223
Replicate #: 1	Optimum Moisture (%): 7.00%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.61	21.37	36.18	54.19	72.40	20.99	43.19	72.71
Confining Pressure (kPa)	23.03	42.44	70.22	106.71	143.22	22.03	42.51	70.86
Resilient Modulus (MPa)	193.01	241.85	360.76	481.84	681.76	187.44	240.30	325.48

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.00	145.26	43.08	88.22	145.88	217.02	288.12	65.77
Confining Pressure (kPa)	107.31	143.76	22.03	42.38	70.77	107.25	143.73	22.30
Resilient Modulus (MPa)	471.64	650.66	162.67	250.08	363.01	508.25	631.97	158.60

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.47	217.30	323.81	430.52	109.64	217.64	359.92	537.21
Confining Pressure (kPa)	42.58	70.74	107.32	143.91	22.39	42.50	70.28	107.18
Resilient Modulus (MPa)	251.98	379.30	498.36	590.27	173.43	278.63	396.16	501.64

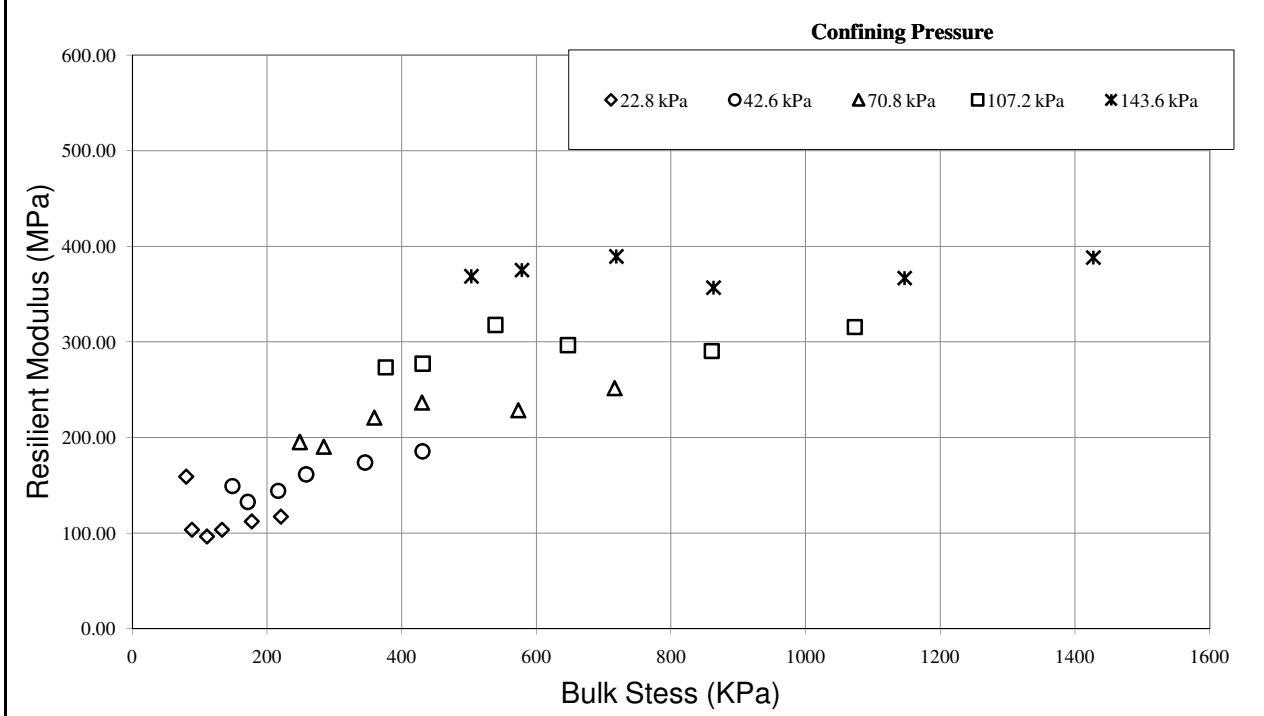
Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	714.56	152.56	303.59	502.36	750.23	996.83		
Confining Pressure (kPa)	144.08	22.65	42.56	70.62	107.20	143.78		
Resilient Modulus (MPa)	583.70	175.38	281.07	401.83	496.36	551.69		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Pavements Research Laboratory

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-GA-0-2	Client Lab #:
Date Tested: Oct 03, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2164.71	Soil Type: A-Base Gravel with 4% fines
Sample Moisture (%): 8.69%	Max. Dry Density (kg/m³): 2170
Replicate #: 2	Optimum Moisture (%): 7.90%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.43	20.86	35.96	54.19	72.50	20.67	42.73	72.97
Confining Pressure (kPa)	23.12	42.49	70.93	107.25	143.57	22.57	42.78	70.40
Resilient Modulus (MPa)	159.21	149.43	195.14	273.72	368.59	103.48	132.61	190.24

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.52	145.90	42.86	87.55	146.19	217.96	289.73	65.23
Confining Pressure (kPa)	107.26	144.12	22.62	42.95	71.03	106.98	142.92	22.62
Resilient Modulus (MPa)	277.16	375.32	96.50	144.47	220.84	317.70	389.27	103.55

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.21	217.76	325.20	431.87	108.75	217.40	360.62	538.36
Confining Pressure (kPa)	42.36	70.75	107.26	143.78	22.84	42.78	70.81	107.24
Resilient Modulus (MPa)	161.35	236.59	296.55	356.96	112.28	173.78	228.47	290.78

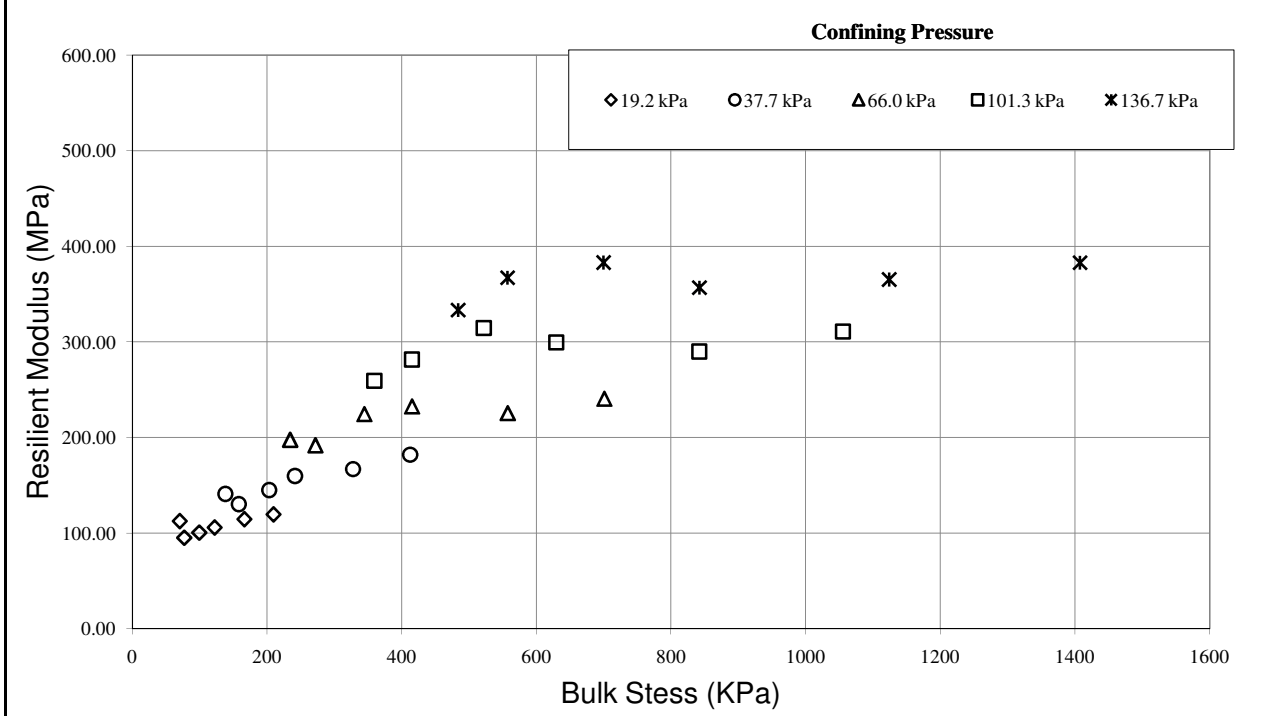
Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	715.59	152.07	303.40	503.42	751.35	997.54		
Confining Pressure (kPa)	143.66	22.82	42.35	70.88	107.06	143.25		
Resilient Modulus (MPa)	366.97	117.38	185.48	251.46	315.80	388.49		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Pavements Research Laboratory

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-GA-0-1	Client Lab #:
Date Tested: Oct 03, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2165.18	Soil Type: A-Base Gravel with 4% fines
Sample Moisture (%): 8.74%	Max. Dry Density (kg/m³): 2170
Replicate #: 1	Optimum Moisture (%): 7.90%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.16	20.66	35.25	54.24	72.76	20.33	41.85	73.00
Confining Pressure (kPa)	20.04	39.06	66.43	101.77	137.11	19.01	38.71	66.30
Resilient Modulus (MPa)	112.46	140.90	197.52	259.60	333.56	95.08	130.22	191.76

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.73	145.82	42.07	87.46	146.09	217.91	289.85	65.24
Confining Pressure (kPa)	101.70	137.11	19.18	38.47	66.21	101.37	136.53	19.03
Resilient Modulus (MPa)	281.57	367.42	100.41	144.97	224.50	314.92	382.97	105.75

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.37	218.06	325.51	432.12	109.26	217.75	361.13	539.15
Confining Pressure (kPa)	36.76	65.79	101.28	136.76	19.05	36.62	65.51	100.80
Resilient Modulus (MPa)	159.67	232.39	299.74	357.04	114.52	167.20	225.35	289.90

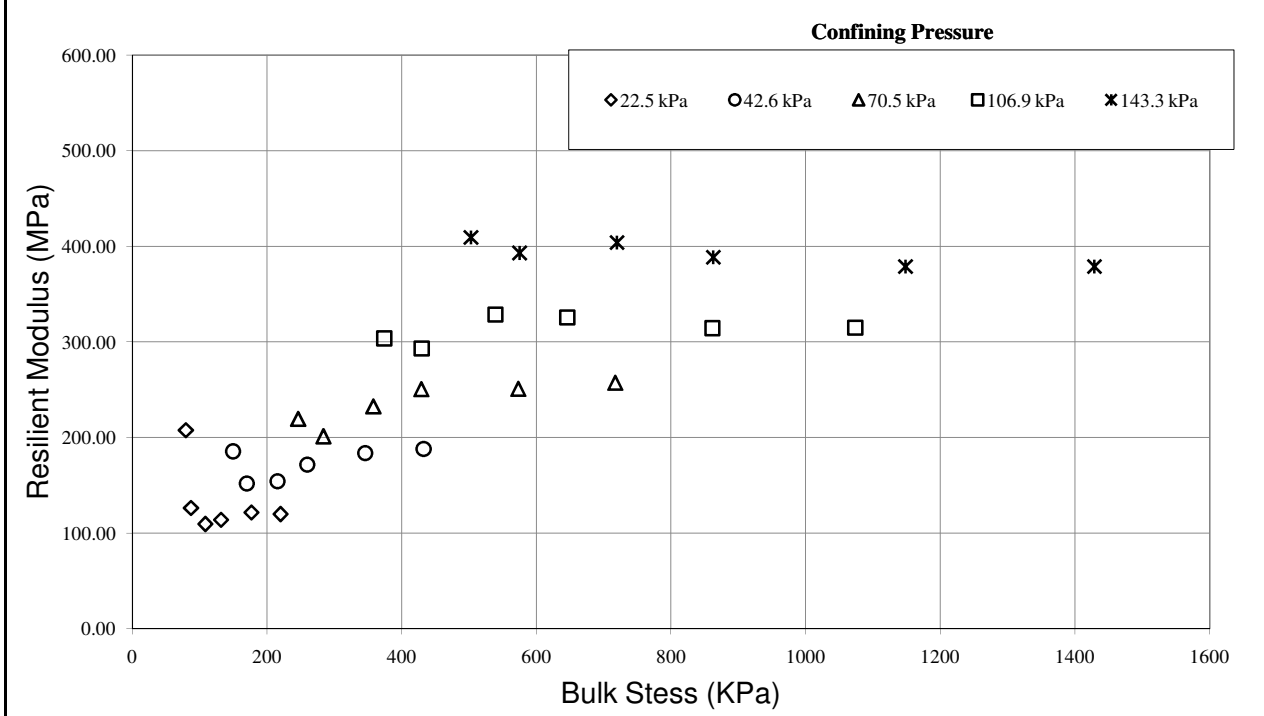
Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	715.87	152.55	303.83	503.73	751.50	997.43		
Confining Pressure (kPa)	136.09	18.99	36.31	65.76	101.17	136.59		
Resilient Modulus (MPa)	365.19	119.48	182.19	240.55	311.05	383.08		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Pavements Research Laboratory

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-GA-0-4	Client Lab #:
Date Tested: Oct 30, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2161.05	Soil Type: A-Base Gravel with 4% fines
Sample Moisture (%): 5.83%	Max. Dry Density (kg/m³): 2170
Replicate #: 2	Optimum Moisture (%): 7.90%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.35	21.06	35.46	53.66	72.66	20.63	42.26	72.83
Confining Pressure (kPa)	23.10	42.75	70.31	106.88	143.45	22.22	42.50	70.36
Resilient Modulus (MPa)	207.65	185.42	219.39	303.60	409.63	126.35	152.10	201.20

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.58	145.75	42.23	87.67	145.90	217.67	289.33	64.41
Confining Pressure (kPa)	106.76	143.16	22.08	42.53	70.74	107.06	143.37	22.47
Resilient Modulus (MPa)	293.49	392.99	109.47	154.48	232.40	329.00	404.27	113.99

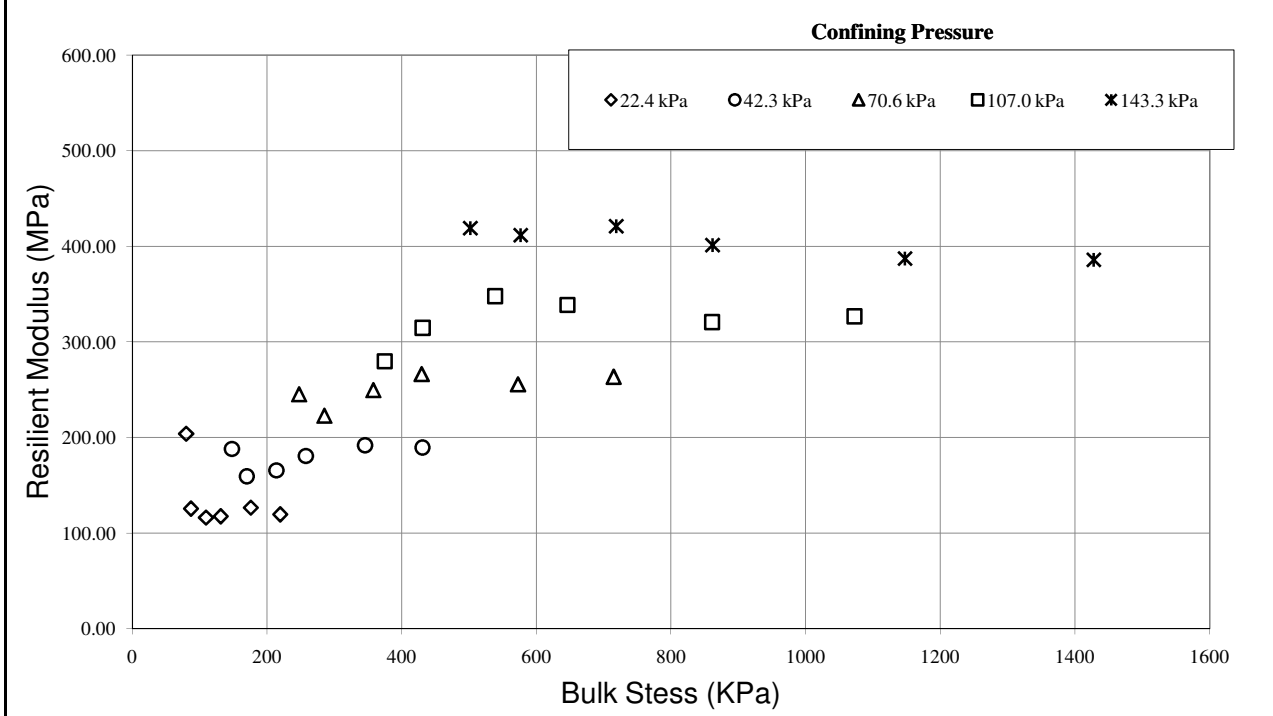
Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.56	218.02	325.33	432.51	109.56	218.38	361.77	540.13
Confining Pressure (kPa)	42.70	70.41	106.90	143.40	22.46	42.40	70.47	107.05
Resilient Modulus (MPa)	171.97	250.64	325.90	388.77	121.69	183.88	250.83	314.29

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	717.52	152.65	304.77	504.72	753.23	999.49		
Confining Pressure (kPa)	143.62	22.45	42.67	70.78	106.86	142.95		
Resilient Modulus (MPa)	379.18	119.80	188.37	257.18	315.11	379.09		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	

Base/Soil Resilient Modulus - Test Summary

Client: Manitoba Infrastructure and Transportaion	Report To:
Project: Resilient Modulus for Base Materials	Contract #:
PRL Lab #: MR-GA-0-3	Client Lab #:
Date Tested: Oct 29, 2013	Location:
Tested By: M.A.	Date Sampled:
Sample Prepared By: M.A.	Sampled By: MIT
Sample Dry Density (kg/m³): 2146.57	Soil Type: A-Base Gravel with 4% fines
Sample Moisture (%): 5.57%	Max. Dry Density (kg/m³): 2170
Replicate #: 1	Optimum Moisture (%): 7.90%



Sequence No.	1	2	3	4	5	6	7	8
Cyclic Stress (kPa)	10.34	21.29	35.60	53.88	72.84	20.87	42.52	72.85
Confining Pressure (kPa)	23.29	42.26	70.67	106.88	143.09	22.01	42.42	70.83
Resilient Modulus (MPa)	203.92	188.35	245.30	279.95	419.35	125.48	159.28	222.81

Sequence No.	9	10	11	12	13	14	15	16
Cyclic Stress (kPa)	109.70	145.95	42.37	87.95	146.00	217.87	289.35	64.88
Confining Pressure (kPa)	107.18	143.53	22.39	42.06	70.68	106.91	143.14	22.14
Resilient Modulus (MPa)	314.64	411.84	116.38	165.93	249.45	347.83	421.31	117.47

Sequence No.	17	18	19	20	21	22	23	24
Cyclic Stress (kPa)	131.29	217.71	324.92	432.14	109.01	217.70	361.13	539.16
Confining Pressure (kPa)	42.18	70.73	106.98	143.22	22.25	42.69	70.62	107.13
Resilient Modulus (MPa)	181.02	266.39	338.89	401.60	126.68	191.84	255.57	320.65

Sequence No.	25	26	27	28	29	30		
Cyclic Stress (kPa)	716.41	152.47	303.96	503.94	752.10	998.70		
Confining Pressure (kPa)	143.63	22.40	42.17	70.32	106.64	142.96		
Resilient Modulus (MPa)	387.55	119.47	189.49	263.47	326.72	386.19		

Tested By: Haithem Soliman, Mohammed Ahmeduzman	Date:
Reviewed By: Dr. Ahmed Shalaby	