Draft

Aggregate Base Properties

Aggregate Base Classifications

Mn/DOT Aggregate Base Classification	Field Identification	Possible Equivalent Classes		
		Mn/DOT Granular Equivalent	AASHTO	ASTM Unified
Class 7 (Mn/DOT Spec. 3138)	10 - 100 Percent Recycled	1.0	A-1	
Class 6 (Mn/DOT Spec. 3138)	> 15 Percent Crushed < 7 Percent Shale	1.0	A-1	
Class 5 (Mn/DOT Spec. 3138)	> 10 Percent Crushed < 10 Percent Shale	1.0	A-1	

Index Tests

Sieve Analysis				Atterberg Limits				Standard Proctor		
Passing #200		Silt Content		Plastic Limit		Liquid Limit		Density	Optimum Moisture	Saturation
Estimated		Estimated								
Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev			
%	%	%	%	%	%	%	%	$lb/_{ft^3}$	%	%
7	3	5	2	NA	NA	NA	NA	NA	NA	NA
5	2	4	2	NA	NA	NA	NA	NA	NA	NA
7	3	5	2	NA	NA	NA	NA	NA	NA	NA

Strength and Stiffness Tests

Laboratory Optimum Moisture Condition																				
R-Value (240 psi Exudation Pressure)							Plate Load	E_{RIMN}						CBR	DCP					
Estimated From			Measured		Estimated From		Estimated From							Estimated From						
-#200	Silt Content	Plastic Limit	Mean	Std Dev	R-Value		Silt Content		R-Value		Silt Content			CBR	E_{RIMN}	Clay Content	Plastic Limit	Pore Suction Resistance Factor		Susceptibility Resistance Factor
%	%	%	%	%	MPa	ksi	MPa	ksi	MPa	ksi	%			mm/blow	mm/blow	%	%			NA
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			NA	NA					
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			NA	NA					
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			NA	NA					

Moisture Condition

Lab Optimum	In Situ Equilibrium (water depth greater than 5 feet)				
Saturation					
Estimated From		Pore Suction Resistance Factor		Susceptibility Resistance Factor	
Clay Content	Plastic Limit				
%	%			NA	
80	70	1.15		1	
80	70	1.15		1	
80	70	1.15		1	

MnPAVE Design Moduli

Early Spring	Late Spring		Summer		Fall		Winter	
2 weeks	Various Lengths Based on Location							
Seasonal Moisture Resistance Factor								
0.3	0.7		0.85		1.0		Frozen	
MPa	MPa	ksi	MPa	ksi	MPa	ksi	MPa	ksi
43	101	15	123	18	144	21	350	50
49	114	17	139	20	164	24	350	50
43	101	15	123	18	144	21	350	50

Granular Subbase Properties

Subbase Classifications

Mn/DOT Subbase Classification	Field Identification	Possible Equivalent Classes		
		Mn/DOT Granular Equivalent	AASHTO	ASTM Unified
Class 4 (Mn/DOT Spec. 3138)		0.75		
Class 3 (Mn/DOT Spec. 3138)		0.75		
Select Granular (Mn/DOT Spec. 3149.2B2)		0.5		
Granular (Mn/DOT Spec. 3149.2B1)		NA		

Index Tests

Sieve Analysis				Atterberg Limits				Standard Proctor		
Passing #200		Silt Content		Plastic Limit		Liquid Limit		Density	Optimum Moisture	Saturation
Estimated		Estimated								
Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev			
%	%	%	%	%	%	%	%	$lb/_{ft^3}$	%	%
7	3	5	2	NA	NA	NA	NA	NA	NA	NA
7	3	5	2	NA	NA	NA	NA	NA	NA	NA
8	4	5	2	NA	NA	NA	NA	NA	NA	NA
16	4	12	3	NA	NA	NA	NA	NA	NA	NA

Strength and Stiffness Tests

Laboratory Optimum Moisture Condition																				
R-Value (240 psi Exudation Pressure)							Plate Load	E_{RIMN}						CBR	DCP					
Estimated From			Measured		Estimated From		Estimated From							Estimated From						
-#200	Silt Content	Plastic Limit	Mean	Std Dev	R-Value		Silt Content		R-Value		Silt Content			CBR	E_{RIMN}	Clay Content	Plastic Limit	Pore Suction Resistance Factor		Susceptibility Resistance Factor
%	%	%	%	%	MPa	ksi	MPa	ksi	MPa	ksi	%			mm/blow	mm/blow	%	%			NA
NA	NA	NA	NA	NA	NA	NA	70	10.2	NA	NA	NA			NA	14					
NA	NA	NA	NA	NA	NA	NA	70	10.2	NA	NA	NA			NA	14					
NA	NA	NA	NA	NA	NA	NA	70	10.2	NA	NA	NA			NA	14					
NA	NA	NA	NA	NA	NA	NA	65	9.4	NA	NA	NA			NA	15					

Moisture Condition

Lab Optimum	In Situ Equilibrium (water depth greater than 5 feet)				
Saturation					
Estimated From		Pore Suction Resistance Factor		Susceptibility Resistance Factor	
Clay Content	Plastic Limit				
%	%			NA	
80	70	1.15		1.59	
80	70	1.15		1.59	
81	70	1.15		1.59	
81	75	1.08		1.46	

MnPAVE Design Moduli

Early Spring	Late Spring		Summer		Fall		Winter	
2 weeks	Various Lengths Based on Location							
Seasonal Moisture Resistance Factor								
0.3	0.7		0.85		1.0		Frozen	
MPa	MPa	ksi	MPa	ksi	MPa	ksi	MPa	ksi
24	56	8.2	68	9.9	80	11.7	350	50
24	56	8.2	68	9.9	80	11.7	350	50
24	56	8.2	69	9.9	81	11.7	350	50
21	49	7.1	59	8.6	69	10.1	350	50

Soil Properties

Soil Classifications

Mn/DOT Standard Textural Classification	Field Identification	Ribbon Length	Rating	Possible Equivalent Classes		
				Mn/DOT Soil Factor	AASHTO	ASTM Unified
		inches				
Gravel (G)	Stones pass 75 mm sieve, retained on 2 mm	0	Excellent	50-75	A-1	GP-GM
Sand (Sa)	Will form a cast when wet. Crumbles easily. 100% passes 2 mm sieve.	0	Good to Excellent	50-75	A-1, A-3	SP-SM
Loamy Sand (LSa)	Grains clearly seen. Will form a cast. Will stand light jarring.	0	Good to Excellent	50-75	A-2	SM, SC
Sandy Loam (SaL) slightly plastic (< 10 % clay)	Slightly plastic. Sand grains seen and felt. Gritty.	0 - 0.75	Fair to Good	100-130	A-2	SM, SC
Sandy Loam (SaL) plastic (10 to 20 % clay)	Slightly plastic to plastic. Sand grains seen and felt. Gritty.	0.75 - 1.5	Fair	100-130	A-4	SM, SC
Loam (L)	Somewhat gritty, but smoother than SaL.	0.25 - 1.5	Fair	100-130	A-4	ML, MH
Silt Loam (SiL)	Smooth, slippery or velvety. Cloddy when dry. Easily pulverized.	0 - 1.5	Poor	120-130	A-4	ML, MH
Sandy Clay Loam (SaCL)	Somewhat gritty. Considerable resistance to ribboning.	1.5 - 2.5	Fair to Good	100	A-6	SC, SM
Clay Loam (CL)	Smooth, shiny, moderate resistance to ribboning.	1.5 - 2.5	Fair to Good	100	A-6	CL
Silty Clay Loam (SiCL)	Dull appearance, slippery. Less resistance to ribboning than CL.	1.5 - 2.5	Poor	120-130	A-6	ML/CL, MH/CH
Sandy Clay (SaC)	Very plastic but gritty. Long, thin ribbon. 50 to 70 percent sand.	2.5<	Fair	120-130	A-7	SC
Silty Clay (SiC)	Buttery, smooth, slippery. Less resistance to ribboning than CL.	2.5<	Poor	120-130	A-7	ML/CL, MH/CH
Clay (C)	Smooth, shiny when smeared, long thin ribbon or thread.	2.5<	Fair	120-130	A-7	CL, CH

Index Tests

Sieve Analysis				Atterberg Limits				Standard Proctor		
Passing #200		Silt Content		Plastic Limit		Liquid Limit		Density	Optimum Moisture	Saturation
Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev			
%	%	%	%	%	%	%	%	$lb/_{ft^3}$	%	%
ND	ND	ND	ND	NA	NA	NA	NA	ND	ND	ND
7	3	5	2	NA	NA	NA	NA	112 - 134	7 - 12	60 - 86
17	3	21	5	118 - 134	8 - 12	76 - 90				
42	5	28	5	17	3	27	6	113 - 125	10 - 14	79 - 89
56	4	40	4	19	3	31	5	108 - 120	12 - 17	80 - 92
79	12	65	11	22	3	29	5	106 - 117	13 - 17	77 - 88
45	6	23	6	16	2	29	5	ND	ND	78 - 86
62	6	38	6	19	3	37	5	103 - 115	14 - 20	81 - 91
85	7	62	7	23	9	37	6	99 - 112	15 - 21	80 - 86
ND	ND	ND	ND	17	5	ND	ND	ND	ND	ND
88	5	55	5	27	5	ND	ND	ND	ND	ND
77	10	36	8	21	4	49	10	94 - 111	16 - 24	81 - 93

Strength and Stiffness Tests

Laboratory Optimum Moisture Condition																				
R-Value (240 psi Exudation Pressure)							Plate Load	E_{RIMN}						CBR	DCP					
Estimated From			Measured		Estimated From		Estimated From							Estimated From						
-#200	Silt Content	Plastic Limit	Mean	Std Dev	R-Value		Silt Content		R-Value		Silt Content			CBR	E_{RIMN}	Clay Content	Plastic Limit	Pore Suction Resistance Factor		Susceptibility Resistance Factor
%	%	%	%	%	MPa	ksi	MPa	ksi	MPa	ksi	%			mm/blow	mm/blow	%	%			NA
######	#VALUE!	NA	ND	ND	#####	######	#####	######	######	######	#VALUE!			#VALUE!	#VALUE!	#VALUE!	70	#VALUE!		#VALUE!
61	51	NA	ND	ND	50	7.2	70	10.2	83	12.0	14.1			15	14	80	70	1.15		1.59
39	30	NA	60	14	41	6.0	65	9.4	68	9.9	7.2			22	15	81	75	1.07		1.46
21	18	NA	40	16	33	4.7	53	7.6	55	7.9	4.3			28	18	81	80	1.02		1.19
18	17	16	22	6	29	4.2	52	7.5	54	7.8	3.9			30	18	83	85	0.98		1.17
15	14	14	20	6	27	4.0	44	6.4	46	6.7	3.6			31	21	83	85	0.98		1.00
11	10	12	25	15	25	3.7	22	3.2	32	4.6	3.1			33	41	83	90	0.92		0.49
17	19	18	21	6	30	4.4	55	7.9	57	8.3	3.8			30	17	85	85	1.00		1.24
14	14	14	17	4	27	4.0	44	6.4	46	6.7	3.4			32	21	85	85	1.00		1.00
11	10	8	16	5	22	3.1	27	3.9	34	5.0	3.1			33	34	85	90	0.94		0.60
######	#VALUE!	14	ND	ND	27	4.0	#####	#####	######	######	#VALUE!			#VALUE!	#VALUE!	#VALUE!	85	#VALUE!		#VALUE!
11	11	8	ND	ND	22	3.1	33	4.8	38	5.5	3.1			33	28	87	90	0.97		0.75
11	14	12	14	3	25	3.7	44	6.4	46	6.7	3.2			33	21	89	90	0.98		1.00

Moisture Condition

Lab Optimum	In Situ Equilibrium (water depth greater than 5 feet)				
Saturation					
Estimated From		Pore Suction Resistance Factor		Susceptibility Resistance Factor	
Clay Content	Plastic Limit				
%	%			NA	
#VALUE!	70	#VALUE!		#VALUE!	
80	70	1.15		1.59	
80	70	1.15		1.59	
80	70	1.15		1.59	
81	70	1.15		1.59	
81	75	1.08		1.46	
85	85	1.00		1.24	
85	85	1.00		1.00	
85	90	0.94		0.60	
#VALUE!	85	#VALUE!		#VALUE!	
87	90	0.97		0.75	
89	90	0.98		1.00	

MnPAVE Design Moduli

Early Spring	Late Spring		Summer		Fall		Winter	
2 weeks	Various Lengths Based on Location							
Seasonal Moisture Resistance Factor								
Frozen	0.7		0.85		1.0		Frozen	
MPa	MPa	ksi	MPa	ksi	MPa	ksi	MPa	ksi
350	#####	#####	#####	#####	#####	#####	350	50
350	56	8.2	68	9.9	80	11.7	350	50
350	49	7.0	59	8.5	69	10.0	350	50
350	37	5.4	45	6.6	53	7.7	350	50
350	35	5.1	43	6.2	51	7.3	350	50
350	30	4.4	37	5.3	43	6.3	350	50
350	14	2.0	17	2.5	20	2.9	350	50
350	38	5.5	46	6.7	54	7.9	350	50
350	31	4.5	38	5.4	44	6.4	350	50
350	18	2.6	21	3.1	25	3.6	350	50
350	#####	#####	#####	#####	#####	#####	350	50
350	22	3.2	27	3.9	32	4.6	350	50
350	30	4.4	37	5.4	43	6.3	350	50

NA = Not Applicable

ND = No Data

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