

Automated Plate Load Testing Summary

Highway 63, Alberta, Canada

Research Organization

Ingios Geotechnics, Inc.

Section Tested

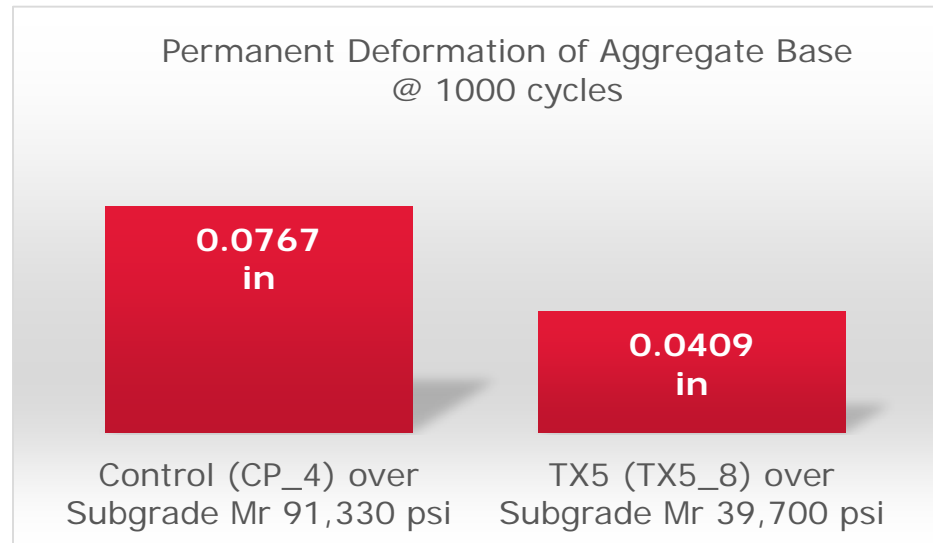
- 7.9-inches (200 mm) of base (control)
- 7.9-inches (200 mm) of base over TX5
- 15.8-inches (400 mm) of base over TX5

Testing Conducted

- Mr of the mechanically stabilized base course
- Mr of the subgrade
- Mr composite modulus
- Permanent deformation @ 1,000 cycles



In-situ testing of 10 locations	
Average Mr for 7.9" (200 mm) TX5 stabilized base from 950-1000 cycles	495,474 psi (a2 = 0.44)
Average Mr for 15.9" (400 mm) TX5 stabilized base from 950-1000 cycles	143,033 psi (a2 = 0.30)
Average subgrade Mr for the TX5 stabilized sections	47,385 psi



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Project Location:
Highway 63
Bet. Sta. 19+200 and 20+600
Near Crow Lake Provincial Park
Alberta, Canada

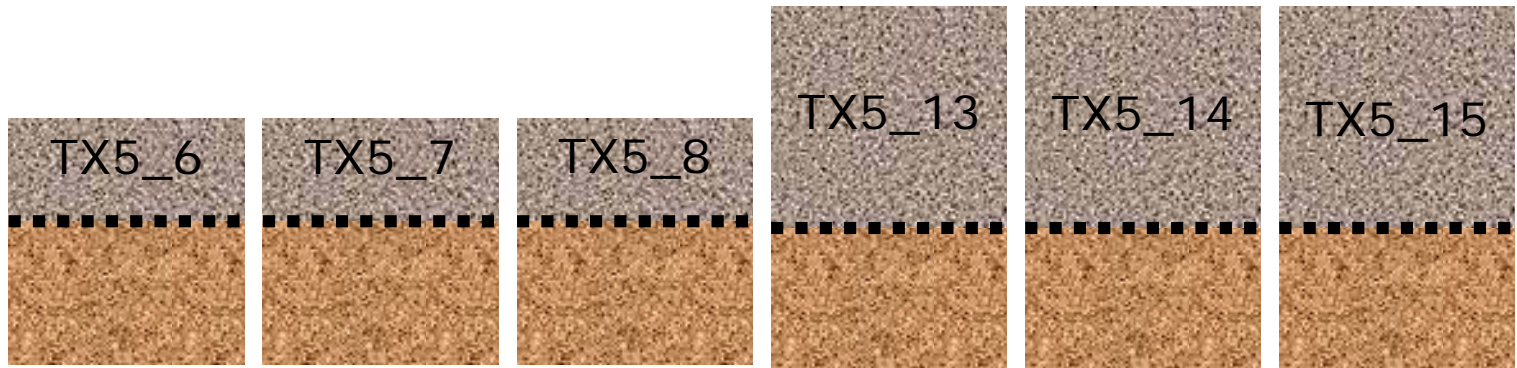
CP_4_DH
CP_4_10k
CP_3
CP_2
CP_1
TX5_15@7
TX5_7@10k
TX5_6
TX5_5
TX5_14@6
TX5_13@5
TX5_8
TX5_2
TX5_8_DH
TX5_4
TX5_3
TX5_1



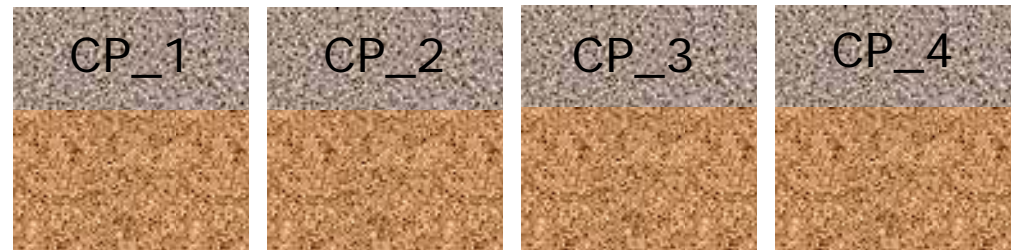
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TX5 = TX5 stabilized sections. Nominal aggregate base section thicknesses were 7.9 & 15.8 inches (200 & 400mm) thick.



CP= Control Sections. Nominal aggregate base section thickness was 7.9 inches (200 mm). Deformation tested.



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Subgrade consisted of a medium plasticity clay.

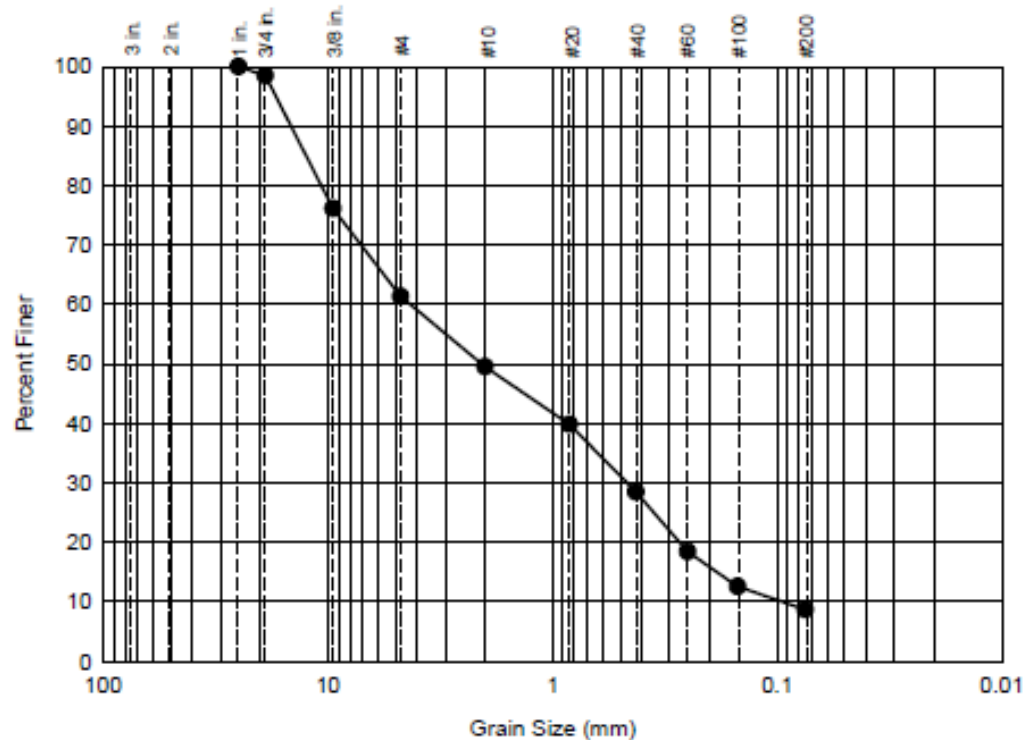


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Base course consisted of a poorly graded sand with silt and gravel



% Gravel		% Sand			% Fines
Coarse	Fine	Coarse	Medium	Fine	Silt + Clay
1.5	37.1	11.8	21.0	19.8	8.7

Gradation Parameters						
$D_{10} = 0.100$	$D_{30} = 0.480$	$D_{50} = 2.107$	$D_{60} = 4.430$	$D_{85} = 13.263$	$c_u = 44.117$	$c_c = 0.518$

Atterberg Limits			Classification	
PL = NP	LL = NP	PI = NP	USCS = SP-SM Poorly graded sand with silt and gravel	AASHTO = A-1-a

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Full-Gradation sample of aggregate base



Aggregate base course retained on No. 4 sieve after washing and oven drying.



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Table 4. Comparison of test results for in-situ composite M_r and permanent deformation (arrows indicate direct subgrade layer test at the same locations as aggregate base layer test).

Test Point	M_r (psi)	
	(cycles 950-1000)	δ_p (in.) at 1,000 cycles
TX5_1*	252,545	0.0342
TX5_2	92,975	0.0488
TX5_3**	21,107	0.2175
TX5_4**	32,759	0.1252
TX5_5	94,364	0.0412
TX5_6	80,922	0.0466
TX5_7	68,057	0.0657
TX5_8	76,780	0.0409
TX5_13‡	126,700	0.0686
TX5_14‡	112,838	0.0261
TX5_15‡	92,323	0.0949
Min.	21,107	0.0261
Max.	252,545	0.2175
Avg.	95,579	0.0736
CP_1	194,469	0.0315
CP_2	98,871	0.0377
CP_3	95,103	0.0390
CP_4‡	158,585	0.0767
Min.	95,103	0.0315
Max.	194,469	0.0767
Avg.	136,757	0.0462
TX5_8 (SG)	39,700	N/A
CP_4 (SG)	91,330	N/A

Notes: * Adjacent to highly trafficked section at transition from paved to unpaved; ** Uncompacted/loose; ‡ Immediately after placement and compaction of 2nd lift; † adjacent to highly trafficked section near cross road.



At two test locations, the base course was removed to allow for APLT testing directly on the subgrade. **Subgrade strength of TX5 section was much softer than the control section.**

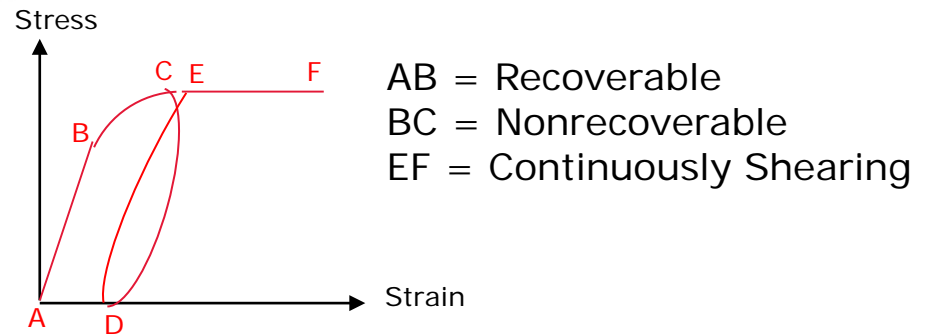
“The ratio of composite to subgrade M_r in the TX5 and control section were 1.9 and 1.7, respectively. The ratio of base layer to subgrade M_r in the TX5 and control sections were 4.3 and 3.3, respectively, **representing a 30% increase in the stabilized section.**”

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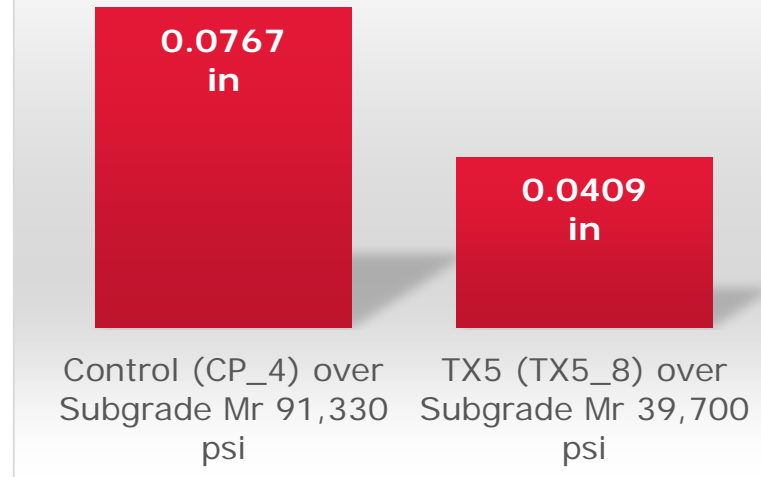
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“The recoverable deformation (ability of a soil to maintain the modulus characteristics under repeated loading conditions) was about three times greater at the completion of 10,000 cycles in the TX5 section compared to the control section for the 7.9 in. (200 mm) aggregate base layer thickness. This response demonstrates a stabilization mechanism of the geogrid stabilized aggregate base layer.”

- Ingios report pg. 32



Permanent Deformation of Aggregate Base @ 1000 cycles



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Table 5. Comparison of test results for in-situ M_r and permanent deformation.

Test Point	M_r (psi) (cycles 950-1000)	M_r (Base) (psi) (cycles 950-1000)	M_r (sg) (psi) (cycles 950-1000)	M_r (Base) / M_r (sg) at 1,000 cycles	δ_p (in.) at 1,000 cycles	h_e/r
TX5_1	252,545	2,287,206	57,273	39.9	0.0342	4.5
TX5_2	92,975	493,087	28,216	17.5	0.0488	3.4
TX5_3	21,107	NA*	NA	NA	0.2175	<1
TX5_4	32,759	35,244	30,316	1.2	0.1252	1.4
TX5_5	94,364	185,856	52,706	3.5	0.0412	2.0
TX5_6	80,922	143,273	48,814	2.9	0.0466	1.9
TX5_7	68,057	154,572	34,462	4.5	0.0657	2.2
TX5_8	76,780	156,129	41,935	3.7	0.0409	2.0
		169,083	39,700†	4.3		NA
TX5_13	126,700	167,529	66,480	2.5	0.0686	3.6
TX5_14	112,838	148,495	59,734	2.5	0.0261	3.6
TX5_15	92,323	113,076	56,156	2.0	0.0949	3.3
Min.	21,107	35,244	28,216	1.2	0.0261	0.7
Max.	252,545	2,287,206	66,480	39.9	0.2175	4.5
Avg.	95,579	354,174	48,933	8.0	0.0736	2.6

Average M_r of 7.9" (200 mm) thick stabilized base correlates to a layer coefficient (a2) of 0.44.

Average M_r of 15.8" (400 mm) thick stabilized base correlates to a layer coefficient (a2) of 0.30.

Next to highly trafficked area

Uncompacted/ loose

More trafficking allows the aggregate to lock into the geogrid.

Summary of Testing

- The 7.9" (200 mm) TX5 stabilized layer demonstrated an average resilient Modulus (M_r) of 495 ksi ($a_2 = 0.44$). The 15.8" (400 mm) TX5 stabilized layer demonstrated an average resilient Modulus (M_r) of 143 ksi ($a_2 = 0.30$). Average subgrade resilient modulus was 47 ksi.
- The recoverable deformation (ability of a soil to maintain the modulus characteristics under repeated loading conditions) was about 3 times greater at the completion of 10,000 cycles in the TX5 section compared to the control section.