TECHNOLOGY COMPARISON
Bituminous Pavements

TECHNISOIL IND.   2016

OVERVIEW

Road systems in relative proximity to asphalt plants are economical to build, however, this scenario only fits a small percentage of the need. Specific aggregate needs for modern asphalt designs are costly to produce and transport large distances to rural projects.

Our current asphalt pavement technology was first introduced to the market in 1870. Changes to bitumen chemistry and aggregate preparation have improved performance, however core characteristics of asphalt pavement remain unchanged. Short life cycles are often observed especially in regions of the world with limited infrastructure.

Asphalt is a flexible paving material. It is primarily dependent on the integrity of the underlying materials. Sub base requirements can be costly due to the volume of crushed stone needed.

Technisoil Industrial has created Technisoil G5, a composite paving system that boasts superior durability and strength values when compared to hot mix asphalt. We continuously work in conjunction with Federal and State Laboratories, University researchers, and leading hot mix asphalt quality control labs in California to test G5 alongside hot mix asphalt with aggregates currently used in highway mix designs. The following document gives brief description and provide comparison of individual tests used to determine quality properties of asphalt pavements.

HAMBURG WHEEL TRACKER

ASPHALT PAVEMENT ANALYZER

RUTTING RESISTANCE : FLOW NUMBER

TENSILE STRENGTH

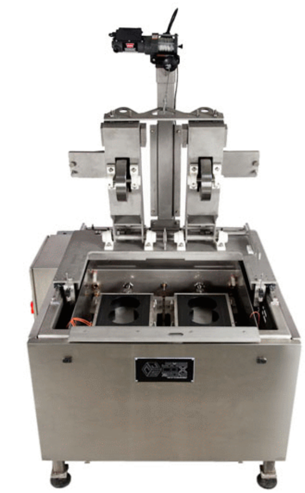
FATIGUE LIFE : FLEXURAL STIFFNESS

HVEEM STABILITY

COMPRESSIVE STRENGTH

HAMBURG WHEEL TRACK DEVICE

The Hamburg Wheel Tracking Device (HWTD), developed in Germany, can be used to evaluate rutting and stripping potential. The HWTD tracks a loaded steel wheel back and forth directly on a HMA sample. Tests are typically conducted on 10.2 x 12.6 x 1.6 inch slabs (although the test can be modified to use SuperPave gyratory compacted samples) compacted to 7 percent air voids. Most commonly, the 1.85 inch (47 mm) wide wheel is tracked across a submerged sample for 25,000 cycles using a 158 lb (705 N) load. Rut depth is measured continuously with a series of LVDTs on the sample. The HWTD has been found to have excellent correlation with field performance (especially in moisture damage evaluation). [1]



Hamburg Wheel Track Device
James Cox and Sons

Asphalt Pavement (25,000 passes, 10 mm rut depth

G5 / ¼" mixture (25,000 passes, 0.3 mm rut depth)

Results

TechniSoil Industrial G5 blended with ¼" minus crusher fines was tested in an accredited hot mix asphalt laboratory.[2] The results of the HWTD test show the outstanding resistance to rutting and moisture induced damage mixtures with G5 exhibit.

(1) "Laboratory Wheel Tracking Devices" 1 July 2011. http://www.pavementinteractive.org <http://www.pavementinteractive.org/article/laboratory-wheel-tracking-devices/> 21 December 2015

(2) Testing performed at CGI Technical Services, Inc. Redding, CA.

ASPHALT PAVEMENT ANALYZER

The Asphalt Pavement Analyzer tracks a loaded aluminum wheel back and forth across a pressurized linear hose over a sample. Although the APA can be used for a number of tests, it is typically used to measure and predict rutting. Most commonly, the wheel is tracked across the sample for 8,000 cycles using a 100 lb (445 N) load and a 100 psi (690 kPa) hose pressure. Test samples can be in the form of beams or cylinders. Beams are typically compacted with the asphalt vibratory compactor, while cylinder samples are typically compacted with the SuperPave Gyratory Compactor.(1)

Asphalt Pavement (8,000 passes, 9 mm rut depth)

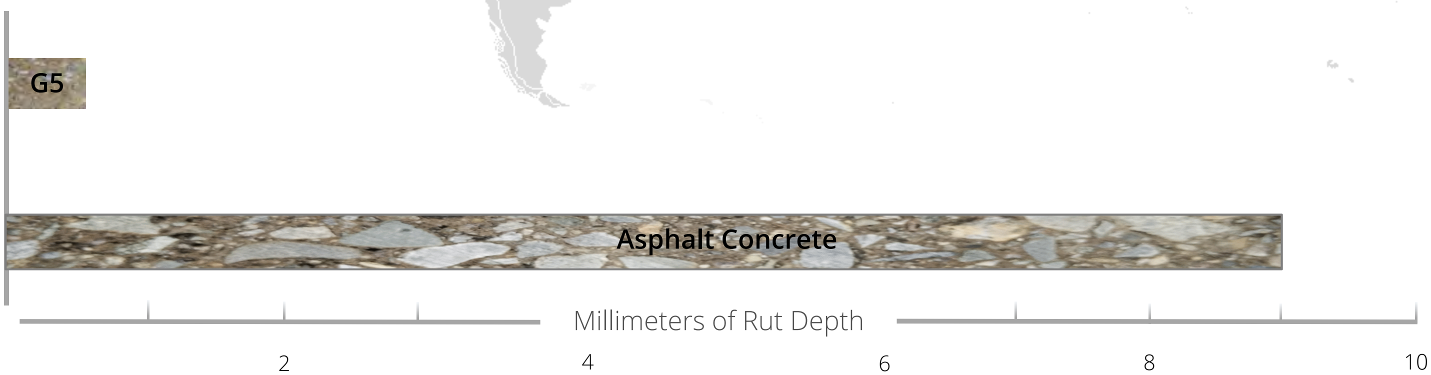
G5 / Recycled Asphalt Pavement (8,000 passes, 0.5 mm rut depth)

G5 / Recycled Asphalt Pavement (8,000 passes, 0.5 mm rut depth)

ASPHALT PAVEMENT ANALYZER
Pavement Technology, Inc.

Results

TechniSoil Industrial G5 and 100% recycled asphalt pavement was tested in a federal hot mix asphalt laboratory.(2) The results of the APA test show the outstanding resistance to rutting mixtures with G5 exhibit.



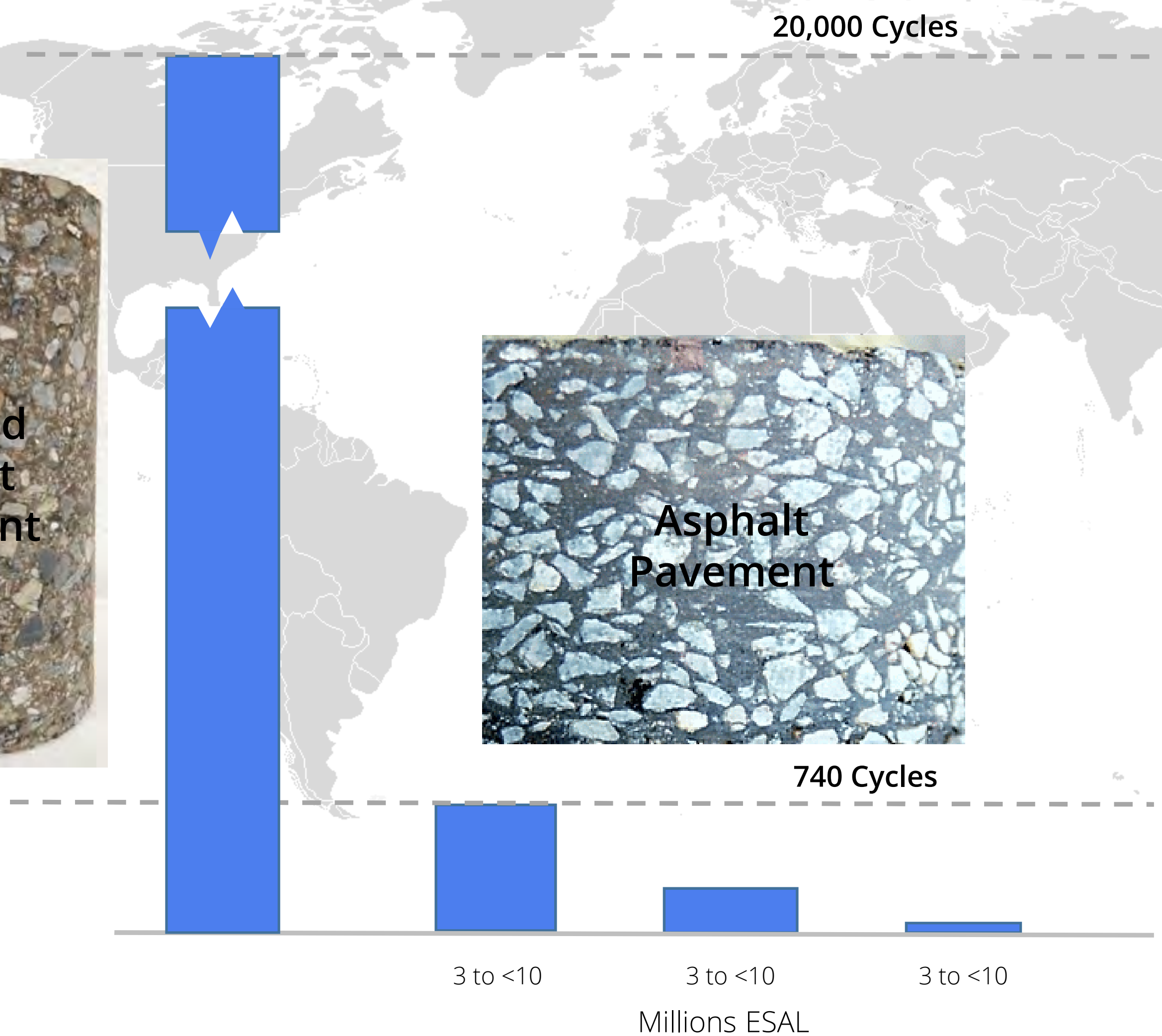
(1) "Laboratory Wheel Tracking Devices" 1 July 2011. http://www.pavementinteractive.org <http://www.pavementinteractive.org/article/laboratory-wheel-tracking-devices/> 21 December 2015

(2) Testing performed at CGI Technical Services, Inc. Redding, CA.

RUTTING RESISTANCE : FLOW NUMBER

Evaluating the rutting resistance of a mixture using the flow number is straightforward. During flow number testing, a specimen is subjected to a repeated compressive load pulse at a specific test temperature. The resulting permanent axial strains are measured for each load pulse and used to calculate the flow number, or point where the specimen exhibits uncontrolled tertiary flow. The current requirement for highways constructed in the interstate system is a minimum of 740 cycles before flow occurs. The flow number requirement is based on the design Equivalent Single Axle Load (ESAL).

ASPHALT STANDARDS TESTER
IPC global



Results

TechniSoil Industrial G5 and 100% recycled asphalt pavement was tested for flow at University of Nevada Reno. G5 exhibits the highest cycles for flexible pavements. Testing was aborted at 20,000 cycles when no tertiary flow had been observed.

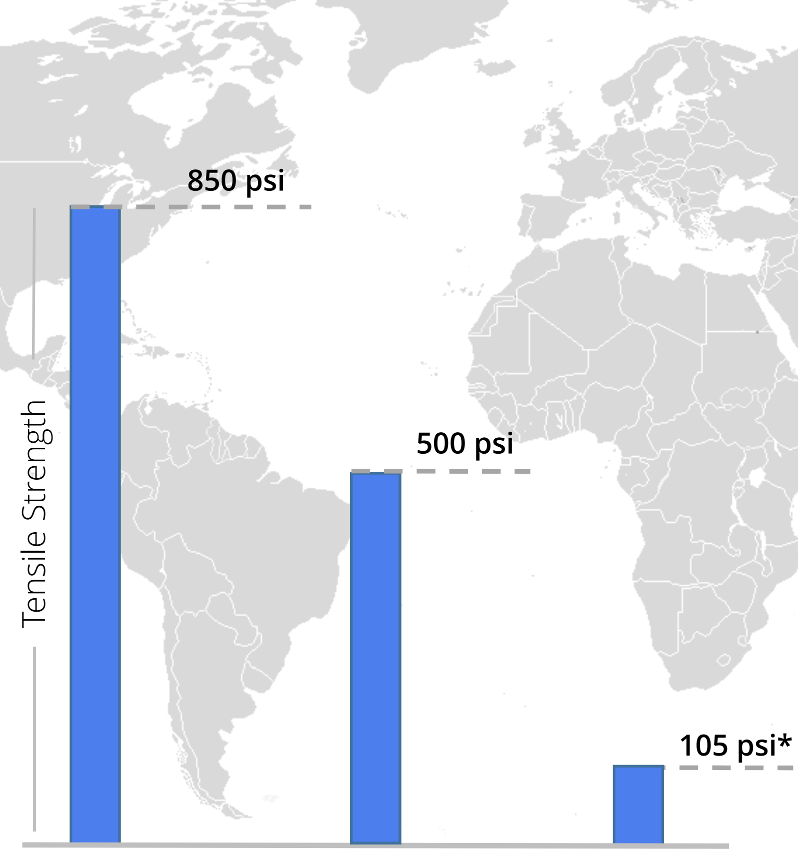
(1) www.fhwa.dot.gov/pavement/pubs/hif13060.pdf

(2) Testing performed at the Western Regional Superpave CVenter

TENSILE STRENGTH

In HMA pavements, The tensile strength is primarily a function of the binder properties. The amount of binder in a mixture and its stiffness influence the tensile strength. Tensile strength also depends on the absorption capacity of the aggregates used. At given asphalt content, the film thickness of asphalt on the surface of aggregates and particle-to-particle contact influences the adhesion or tensile strength of a mixture. [1] G5 mixtures are similar to asphalt mixtures in regards to film thickness and air voids. The superior adhesion properties allow for higher tensile strengths even in 100% recycled asphalt mix designs.

DIGITAL MASTER LOADER
Humboldt mfg.



G5, 3/8" Dense Graded Aggregate Design

Asphalt Pavement

Results

G5 mixtures when engineered to serve as roadway wearing courses exhibit tensile strength results higher than any dry strength requirements. Additionally G5 mixtures with recycled asphalt can achive higher tensile strengths than original asphalt designs

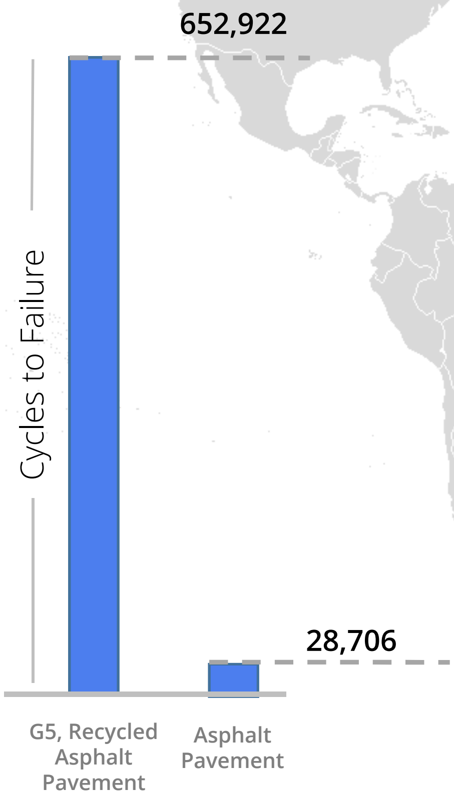
*Current California Department of Transportation minimum dry strength requirements

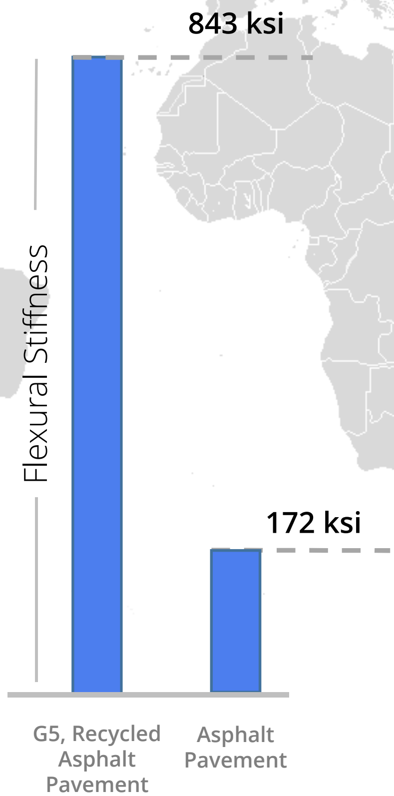
(1) "TENSILE STRENGTH – A DESIGN AND EVALUATION TOOL FOR SUPERPAVE MIXTURES by N. Paul Khosla and K.I. Harikrishnan HWY-2005-14 FHWA/NC/2006-24 FINAL REPORT
(2) Testing performed at TechniSoil Laboratory Redding, CA

FATIGUE LIFE : FLEXURAL STIFFNESS

In HMA pavements, fatigue cracking occurs when repeated traffic loads ultimately cause sufficient damage in a flexible pavement to result in fatigue cracking. A number of factors can influence a pavement's ability to withstand fatigue, including pavement structure (thin pavements or those that do not have strong underlying layers are more likely to show fatigue cracking than thicker pavements or those with a strong support structure), age of the pavement, and the materials used in construction. The flexural fatigue test is used to investigate fatigue as it relates to construction materials. [1]

FLEXURAL ASPHALT APPARATUS
IPC global





Results

The G5 mixture (100% RAP) exhibited an excellent resistance to fatigue cracking at 21C (70F) while maintaining a high flexural stiffness. The increase over standard dense graded HMA is 5 times in average flexural stiffenss (ksi) and 22.7 times in cycles.

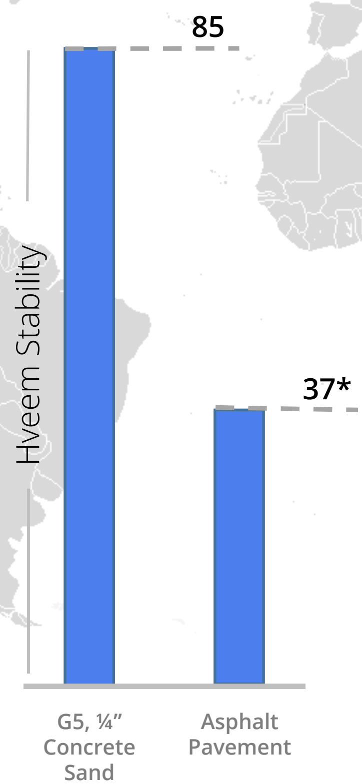
(1) "Flexural Fatigue" 1 July 2011. http://www.pavementinteractive.org <http://www.pavementinteractive.org/article/flexural-fatigue/>

(2) Testing performed at the Western Regional Superpave CVenter

HVEEM STABILITY

The Hveem stabilometer (Figure 3) provides the key performance prediction measure for the Hveem mix design method (TRB, 2000[1]). The stabilometer measures the resistance to deformation of a compacted HMA sample by measuring the lateral pressure developed from applying a vertical load (AASHTO, 2000[1]). The cohesiometer then measures the cohesion of the same compacted HMA sample by measuring the forces required to break or bend the sample as a cantilevered beam (AASHTO, 2000). (1)

California Kneading Compactor
James Cox & Sons



Results

The G5 mixture with ASTM C33 concrete sand exhibits an excellent resistance deformation. Concrete sands are typically screened and used 100% round with no mechanical crushing.

*California Department of Transportation minimum requirements for hot mix asphalt Type A

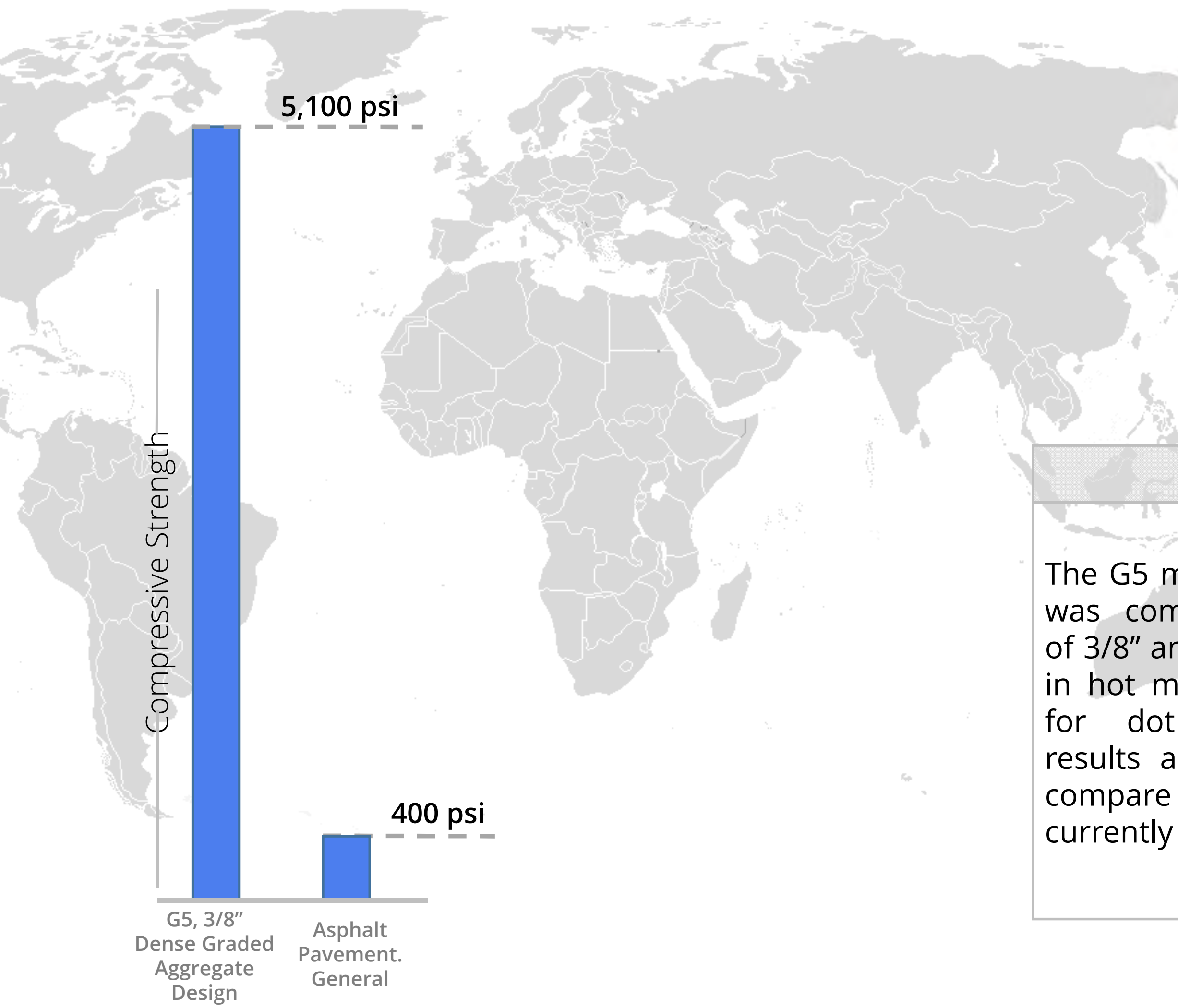
(1) ""Hveem Mix Design" 15 August 2007. http://www.pavementinteractive.org <http://www.pavementinteractive.org/article/hveem-mix-design/> 29 December 2015

(2) Testing performed at Materials Testing, Inc. Redding, CA

COMPRESSIVE STRENGTH

In HMA pavements, compressive strength is key in determining the layers ability to carry the loads of traffic over the life cycle. While it is not the most important factor in mix designs it is critical for heavy point loading as seen on airports and military installations. [1]

Concrete Compression Test Mark



Results

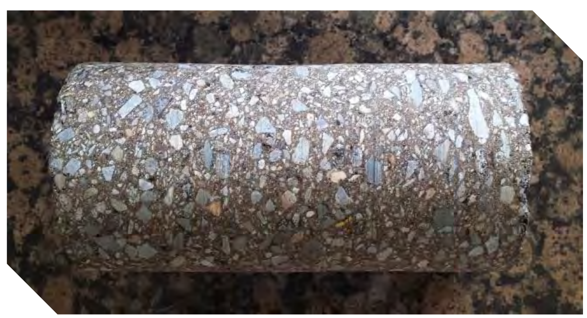
The G5 mixture in this slide was combined aggregates of 3/8" and 1/4" minus used in hot mix asphalt designs for dot contracts. The results are staggering and compare to highway PCC currently used.

(1) "Flexural Fatigue" 1 July 2011. http://www.pavementinteractive.org <http://www.pavementinteractive.org/article/flexural-fatigue/>

(2) Testing performed at Materials Testing Inc. Redding, CA

Laboratory Evaluation of 100% RAP (Recycled Asphalt Pavement) with TechniSoil G5® Binder

Western Regional Superpave Center (WRSC)
Pavements/Materials Engineering Program
Dept. of Civil & Env. Engineering
University of Nevada, Reno



Experimental Plan

(1) Dynamic Modulus (AASHTO TP79 and PP61)

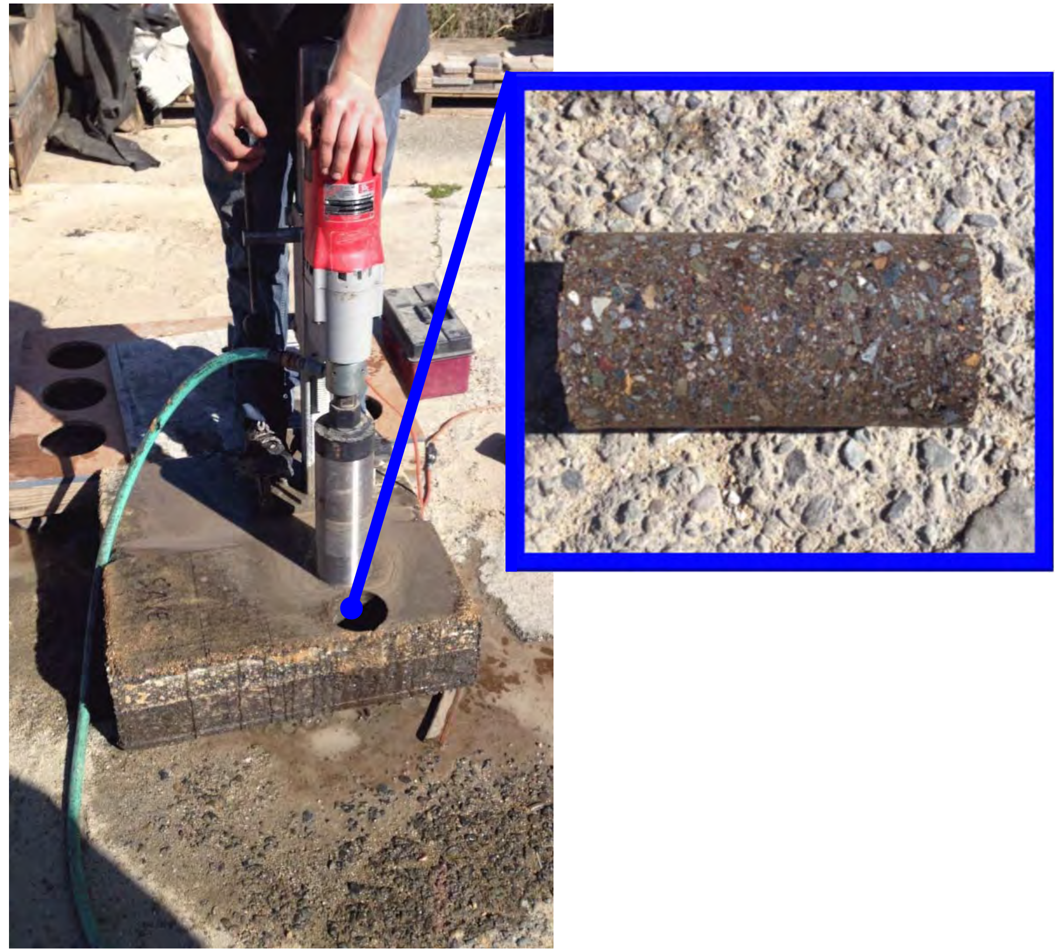
(2) Rutting Resistance (AASHTO TP79)

(3) Fatigue Cracking Resistance (AASHTO T321)

(4) Thermal Cracking Resistance (Draft AASHTO)

(5) Mechanistic-Empirical Analysis of Pavement Structure

Slab Preparation / Coring
100% Recycled Asphalt Pavement (RAP) + G5 Binder



Experimental Plan

(1) DYNAMIC MODULUS

(1) Dynamic Modulus Master Curve (AASHTO TP79 and PP61)

- Determine the modulus of the mixture as a function of temperature and loading rate/frequency.
- Using *time-temperature superposition* principle, master curve is constructed at a reference temperature (generally 20°C).

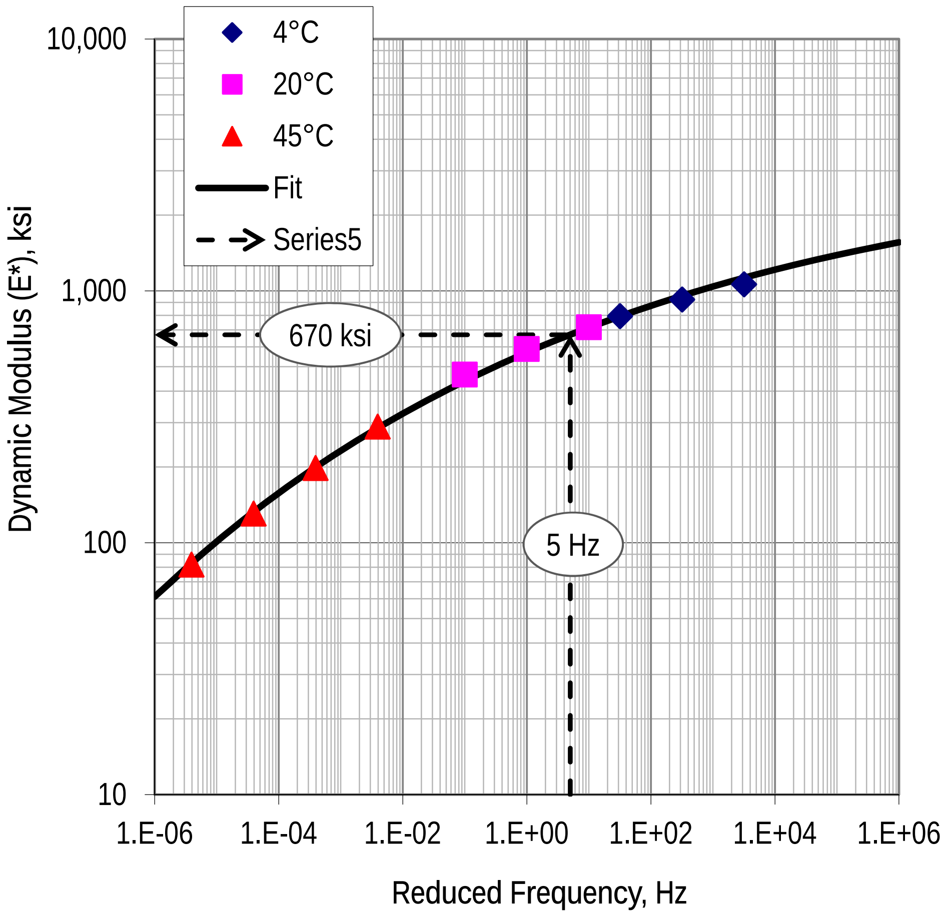
(1) Dynamic Modulus Master Curve (Cont'd)
Specific Gravities and Air Voids

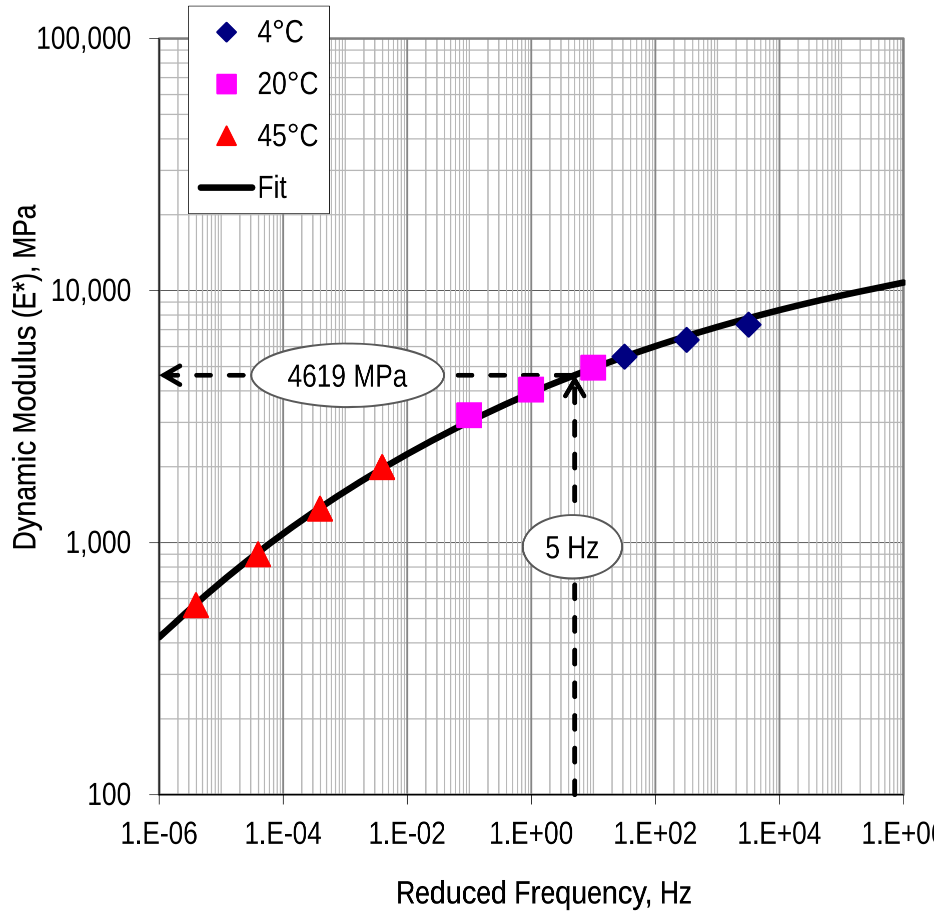
Sample	Tests	Dry weight	Sub Water	SSD Water	Gmb	Air Voids (Va), %
D	Dyn. Modulus	2,605.9	1,370.8	2,620.1	2.086	11.7%
E	Dyn. Modulus	2,564.8	1,348.1	2,580.4	2.081	11.9%
F	Dyn. Modulus	2,584.3	1,358.6	2,597.4	2.086	11.7%

(1) Dynamic Modulus Master Curve (Cont'd)

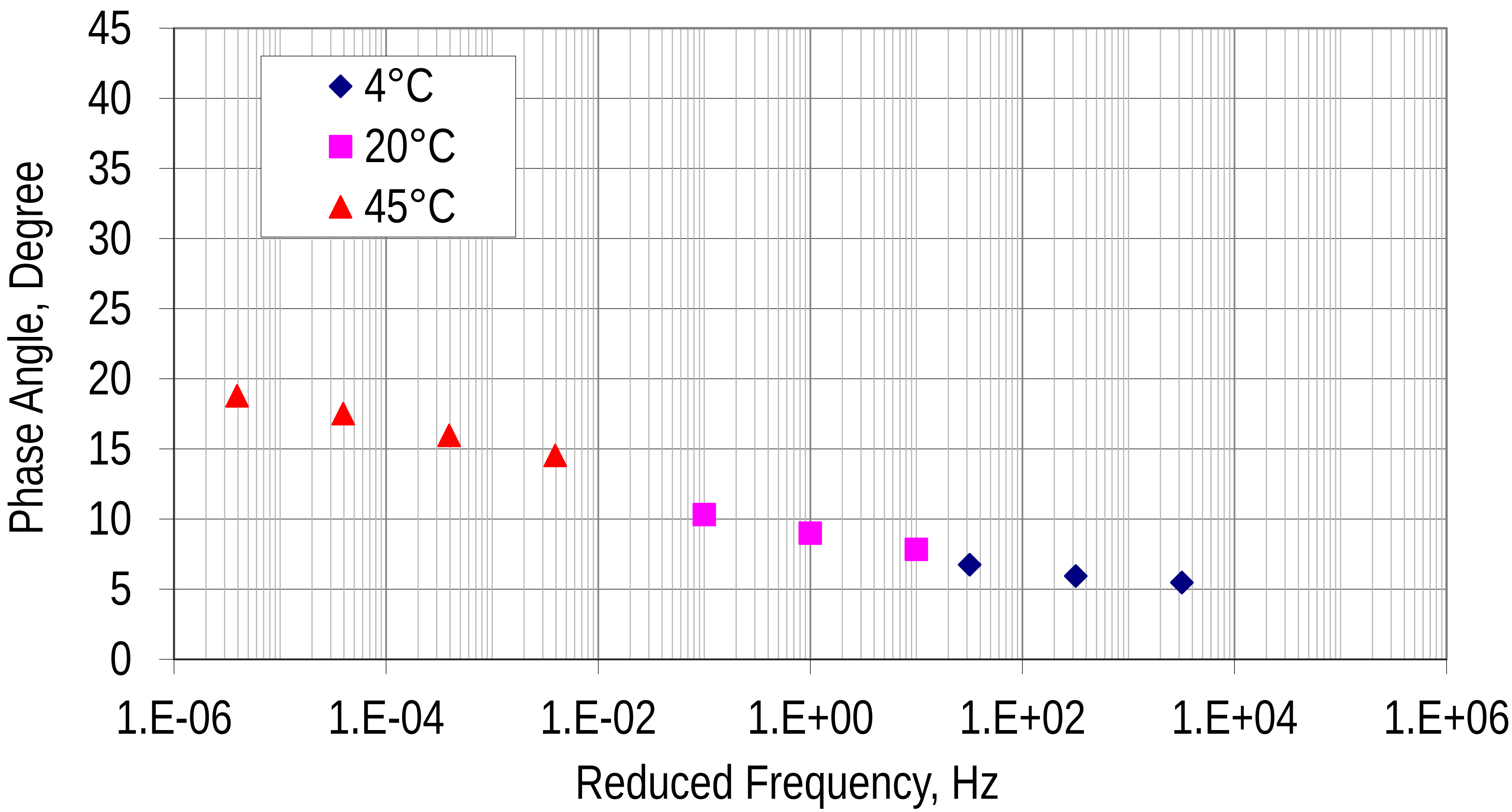
Conditions		Specimen 1		Specimen 2		Specimen 3		Modulus		Phase Angle	
Temp	Frequency	Modulus	Phase Angle	Modulus	Phase Angle	Modulus	Phase Angle	Average	COV	Average	Std Dev
C	Hz	Ksi	Degree	Ksi	Degree	Ksi	Degree	Ksi	%	Deg	Deg
4	0.1	748.4	7.1	773.7	6.8	861.0	6.4	794.4	7.4	6.8	0.4
4	1	875.6	6.2	902.3	6.0	998.4	5.6	925.4	7.0	5.9	0.3
4	10	1011.0	5.7	1037.0	5.6	1141.0	5.1	1063.0	6.5	5.5	0.3
20	0.1	449.4	10.6	442.1	10.7	503.6	9.7	465.0	7.2	10.3	0.6
20	1	568.6	8.9	564.7	9.7	630.6	8.3	588.0	6.3	9.0	0.7
20	10	701.6	8.0	686.0	8.1	765.5	7.4	717.7	5.9	7.8	0.3
45	0.01	79.2	18.8	79.4	18.8	87.4	18.8	82.0	5.7	18.8	0.0
45	0.1	124.8	17.6	124.5	17.8	142.4	17.2	130.6	7.8	17.5	0.3
45	1	189.5	16.3	189.4	16.3	215.1	15.4	198.0	7.5	16.0	0.5
45	10	276.8	14.7	277.4	14.6	314.2	14.4	289.5	7.4	14.5	0.2

(1) Dynamic Modulus Master Curve at 20°C





(1) Dynamic Modulus Master Curve at 20°C



(1) Conclusions – Dynamic Modulus

- The G5 mixture (100% RAP) is stable and exhibited a stiffness similar to that of asphalt mixtures.
- The stiffness of the G5 mixtures (100% RAP) varied with temperature and loading frequency.

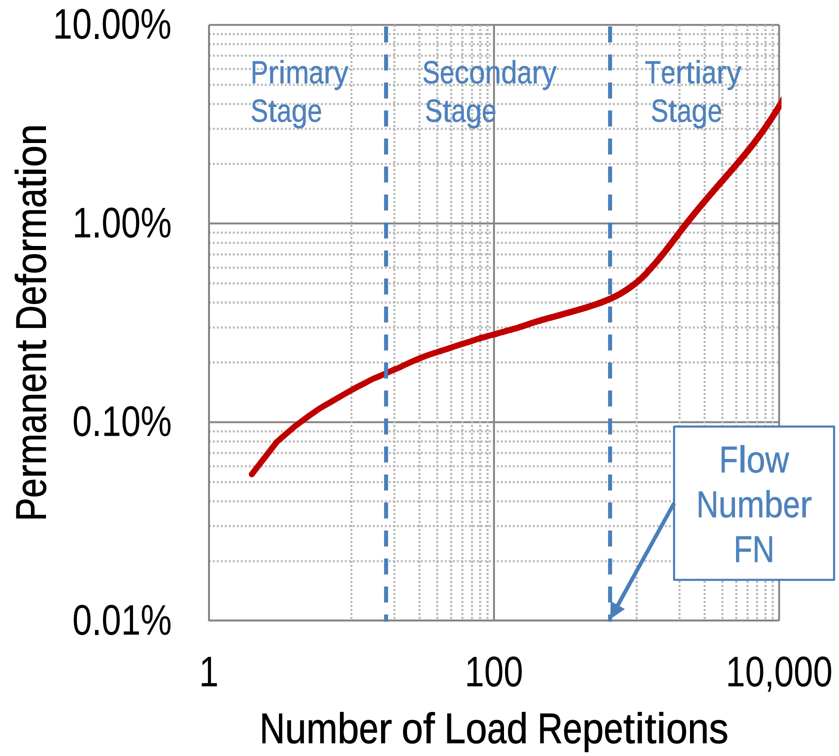
Experimental Plan

(2) RUTTING RESISTANCE

(2) Rutting Resistance: Flow Number (AASHTO TP79)

- Subject specimen to repeated compressive loads at a specific test temperature.
- Flow number (FN) is determined by the point at which the specimen exhibits tertiary flow.
- The higher the FN the better the rutting resistance of the mixture.

(2) Rutting Resistance: Flow Number (Cont'd)

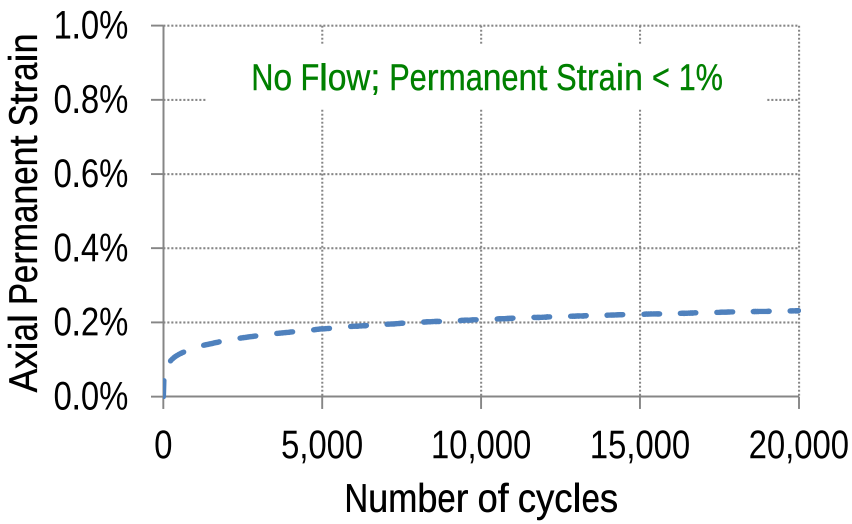


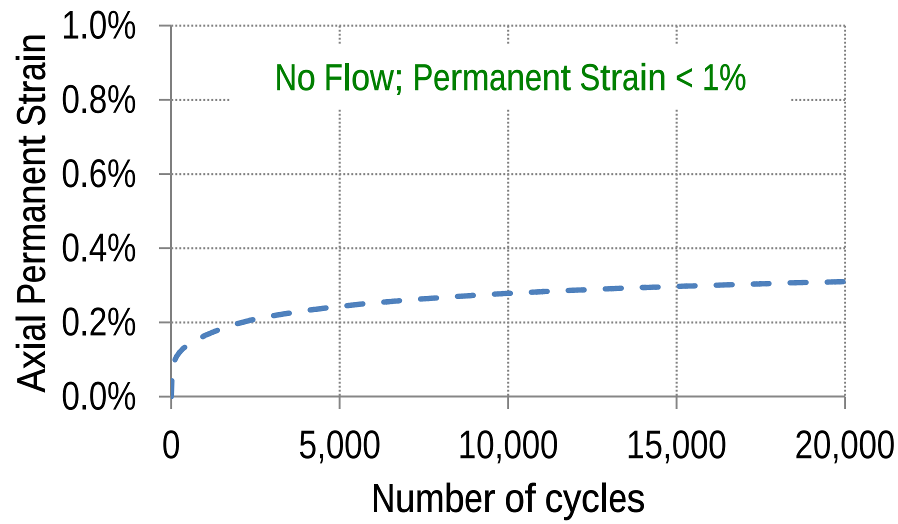
(2) Rutting Resistance: Flow Number (Cont'd) Specific Gravities and Air Voids

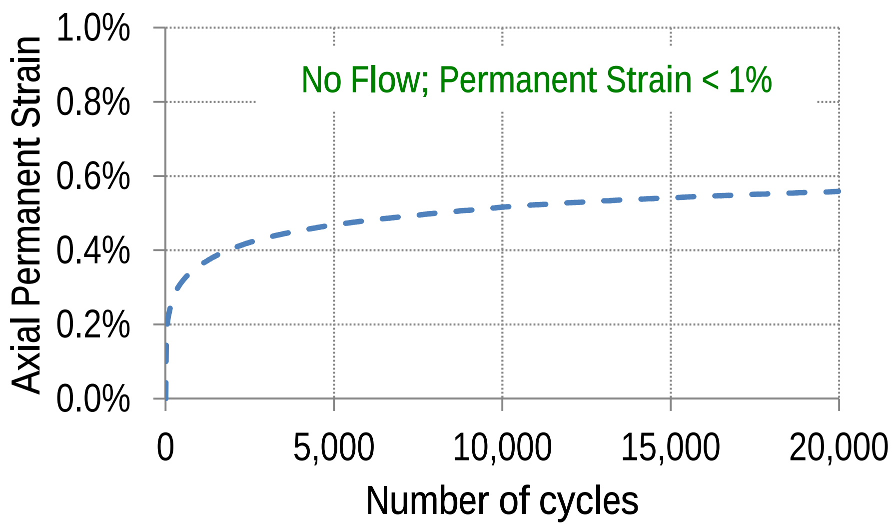
Sample	Tests	Dry weight	Sub Water	SSD Water	Gmb	Air Voids (Va), %
A	Unconfined FN	2,640.0	1,395.4	2,653.4	2.099	11.2%
G	Unconfined FN	2,563.2	1,343.6	2,568.3	2.093	11.4%
H	Unconfined FN	2,567.3	1,351.2	2,573.2	2.101	11.1%

(2) Rutting Resistance

Unconfined Flow Number at 60°C (600 kPa Repeated Axial Stress)







(2) Rutting Resistance
Minimum Average FN Requirements

AASHTO TP 79 – FN Requirements for Hot-Mix Asphalt (HMA)					Results
Traffic Level (Million ESALs)	< 3	3 to < 10	10 to < 30	≥ 30	100% RAP + G5
Minimum Flow Number (Cycles)[1]	Testing Not Needed	53	190	740	*No Flow after 20,000 Cycles*

[1] FN test conditions: (1) unconfined; (2) 600 kPa (87 psi) deviator stress; (3) and at 7-day maximum pavement temperature 20 mm below the pavement surface, at 50% reliability.

(2) Conclusions – Rutting Resistance

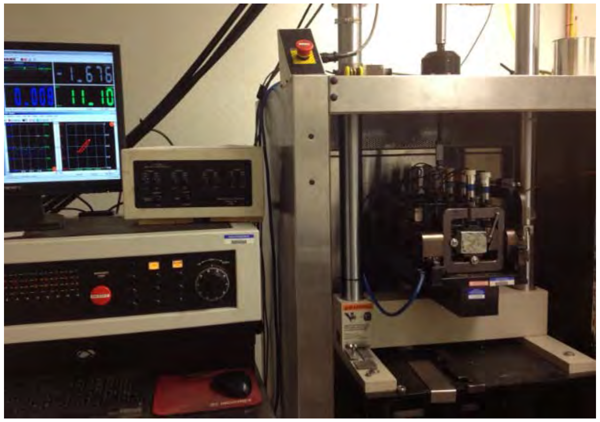
- The G5 mixture (100% RAP) exhibited an excellent resistance to rutting at 60°C (140°F).
  - G5 Mixture at 11.2% air voids *did not exhibit any flow after 20,000* loading cycles
  - Permanent strain remained *under 1%* after 20,000 loading cycles.

Experimental Plan

(3) FATIGUE CRACKING RESISTANCE

(3) Fatigue Resistance: AASHTO T321

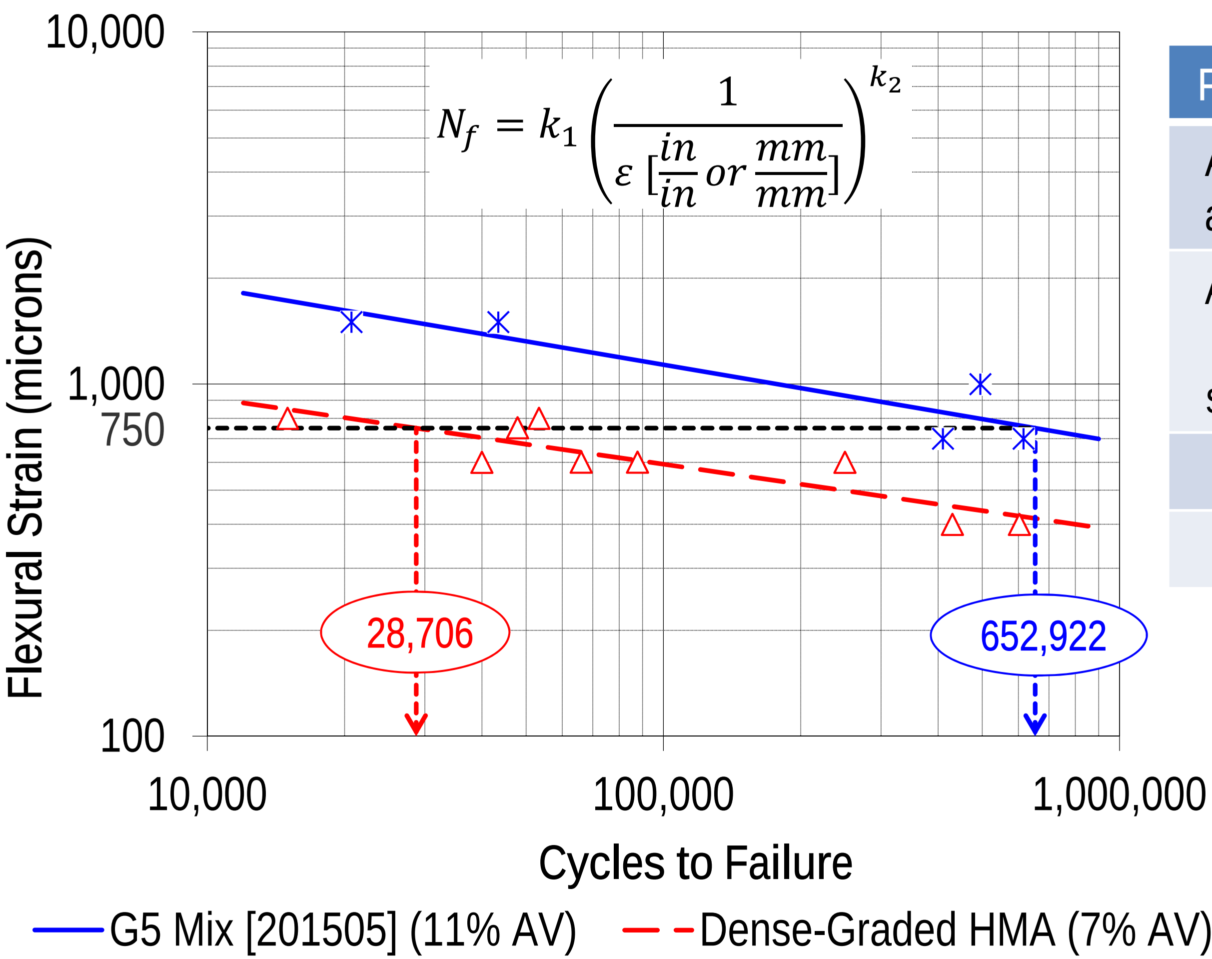
- Constant strain mode of testing
- 2.5 × 2.0 × 1.5 inch beam specimen.
- Loading frequency = 10 Hz
- Test temperature = 21°C (70°F)
- Failure at a given strain level is defined as the point of 50% reduction in initial stiffness = Fatigue life



(3) Fatigue Resistance: AASHTO T321

- General expected trends in a ***constant strain*** mode of testing:
  - Fatigue life decreases with:
    - increase in applied strain.
    - decrease in testing temperature (i.e., colder temperatures).
    - increase in specimen air voids.
    - Increase in stiffness.

(3) Fatigue Resistance: Test Results at 21°C



Property	G5 Mix	DG-HMA
Average air voids	11.2%	6.7%
Average flexural stiffness	5,812 MPa (843 ksi)	1,186 Mpa (172 ksi)
K_1	4.524E-09	8.293E-13
K_2	4.531	5.293

(3) Conclusions – Fatigue Resistance

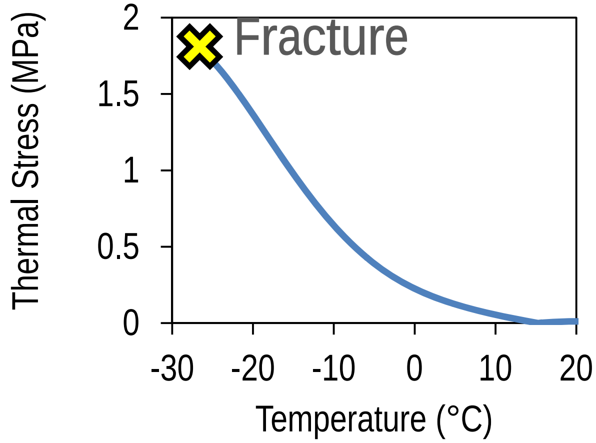
- The G5 mixture (100% RAP) exhibited an excellent resistance to fatigue cracking at 21°C (70°F) while maintaining a high flexural stiffness.

Experimental Plan

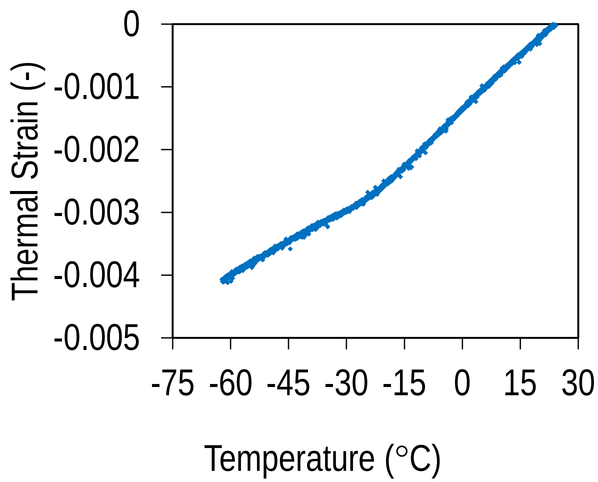
(4) THERMAL CRACKING RESISTANCE

(4) Resistance to Thermal Cracking: UTSST (Draft AASHTO)

- Measure thermal stress build-up in restrained specimen (cooling at 10°C/hr).
  - Fracture temperature
  - Fracture stress

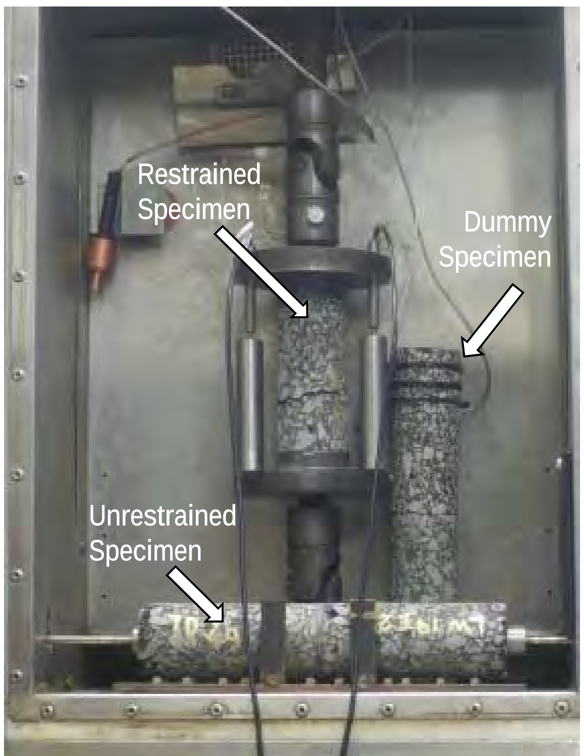


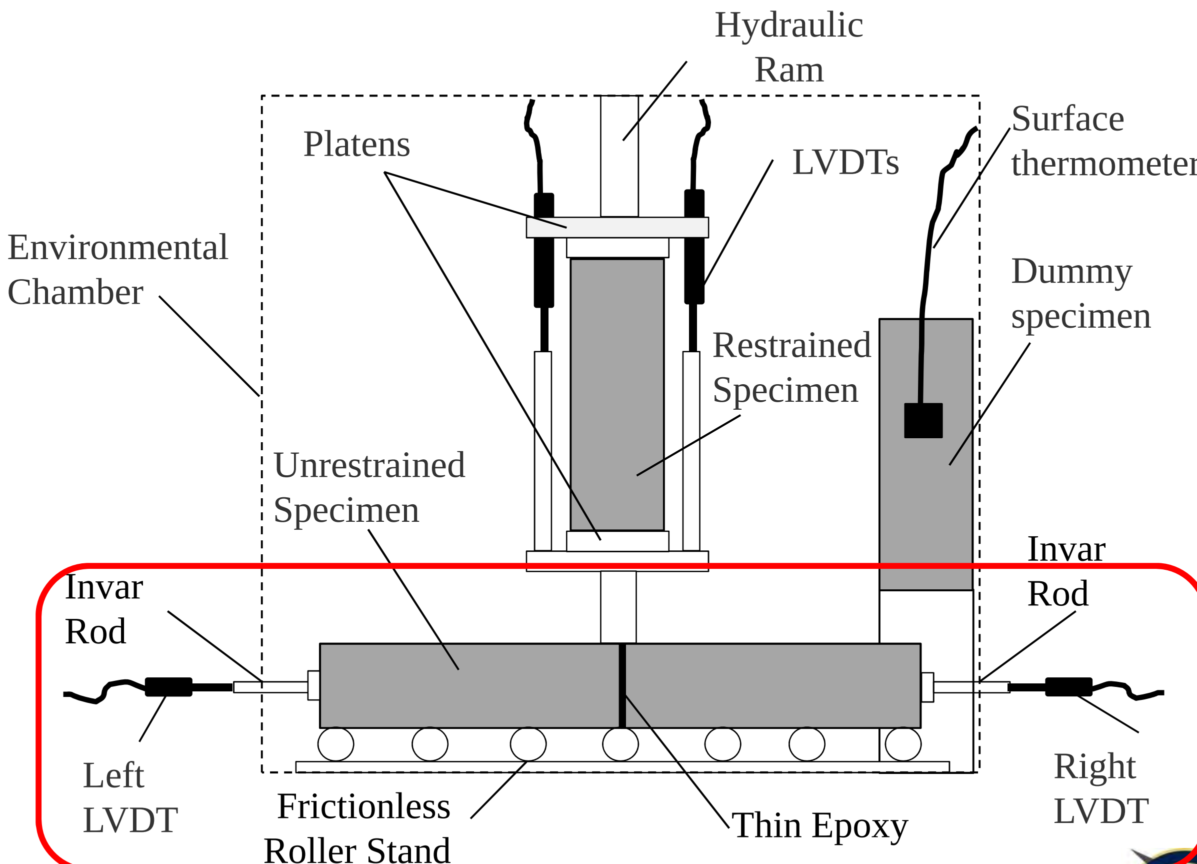
- Measure thermal strain in unrestrained specimen (cooling at 10°C/hr).
  - Linear coefficient of thermal contraction



(4) Resistance to Thermal Cracking: Uniaxial Thermal Stress and Strain Test (UTSST, Draft AASHTO)

Draft AASHTO @ http://marcomdocs.unr.edu/draft-aashto-cracking.pdf





(4) Resistance to Thermal Cracking: UTSST

Specimens Preparation

- Four 57mm (2 ¼ in.) diam. × 134mm (5 ¼ in.) height specimens
  - Cored 90° from the axis of compaction of a SGC sample or a field core sample.

(4) Resistance to Thermal Cracking: UTSST

Specimens Gluing

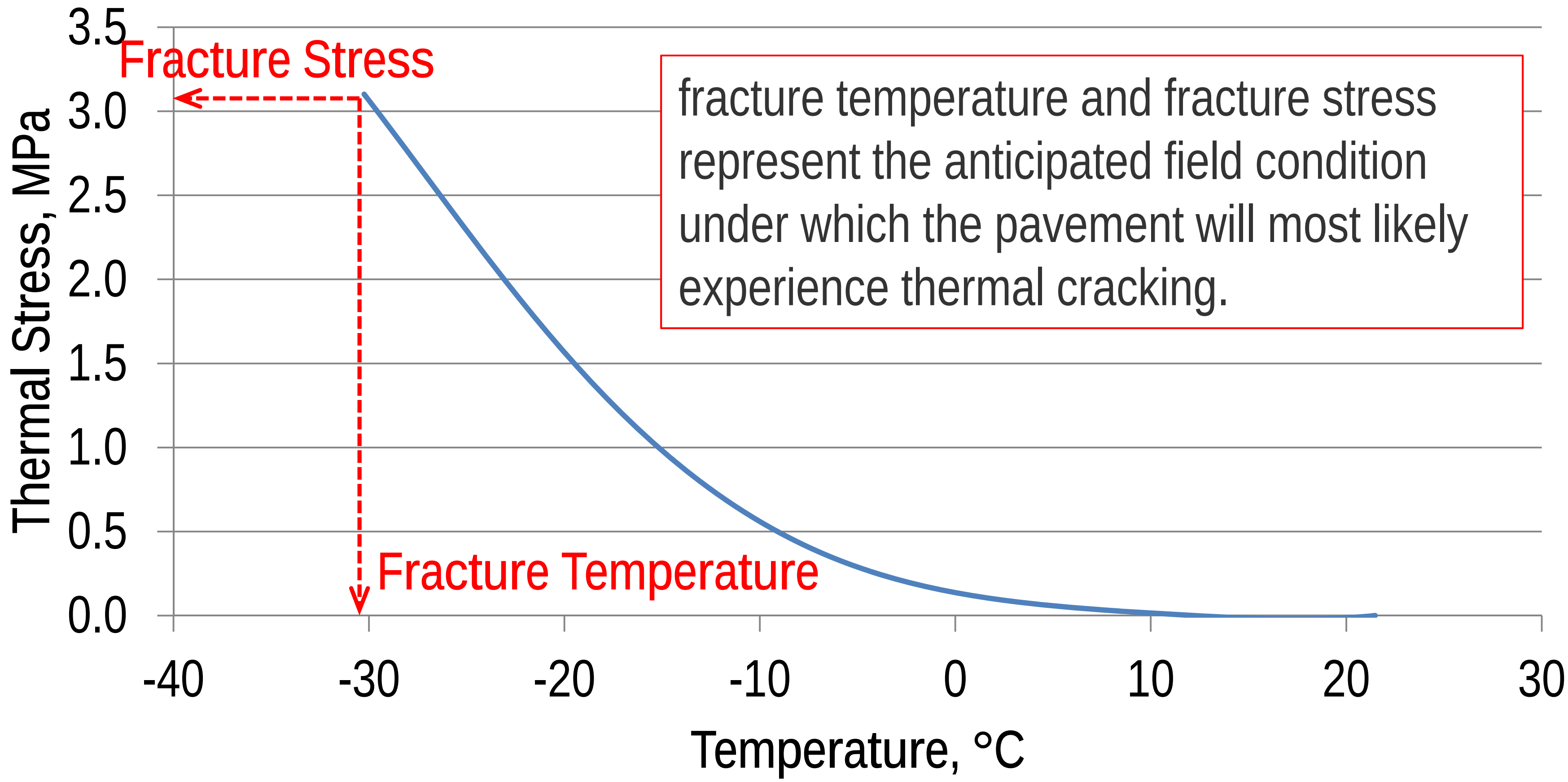
- Cleaning of end platens.
- Gluing restrained test specimen (2 replicates) to end platens.
- Gluing two specimens to form a single unrestrained test specimen.


(4) Resistance to Thermal Cracking: UTSST
Loading Specimens into Testing Chamber

(4) Resistance to Thermal Cracking: UTSST
Running the Test

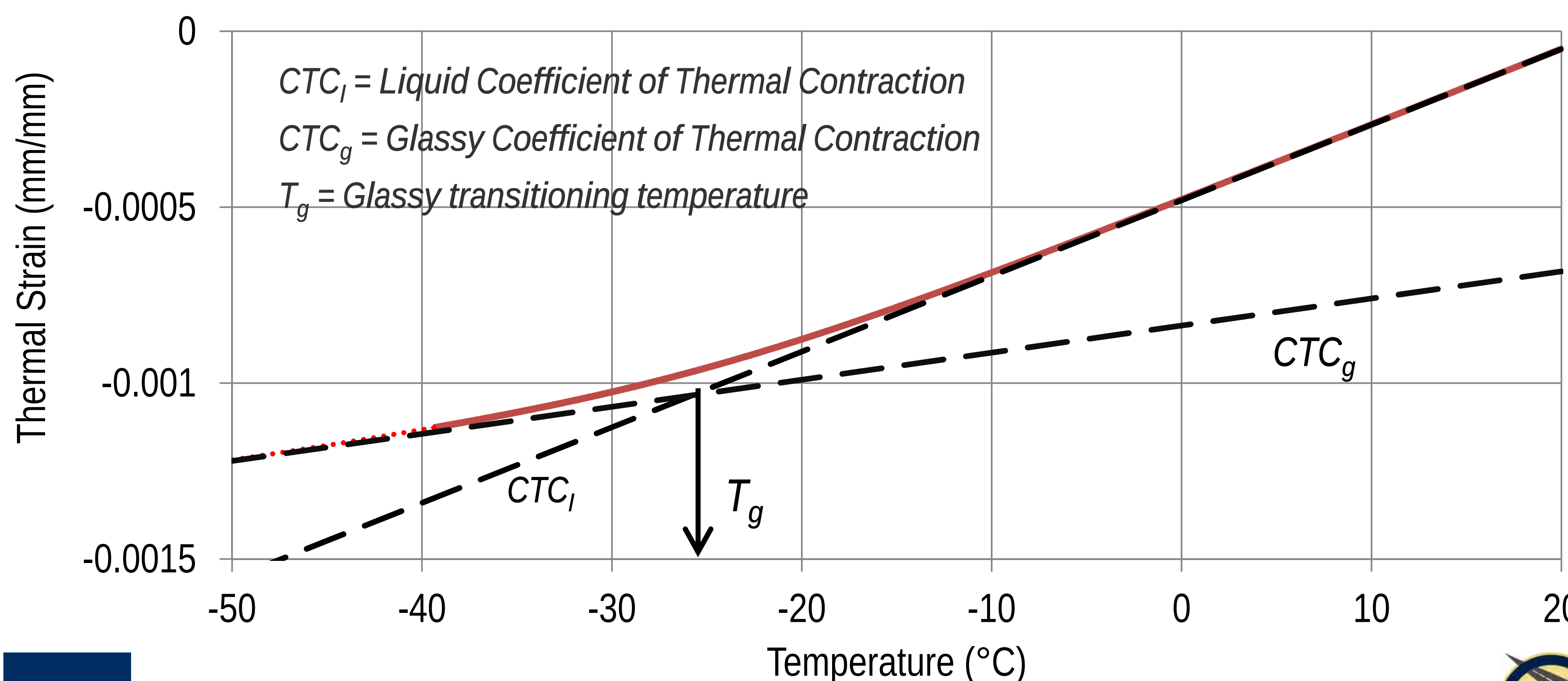
- Start test at room temperature (typically 20°C)
- Apply thermal loading at 10°C/hour through -40°C.

(4) Resistance to Thermal Cracking: UTSST Typical Thermal Stress Build-up Plot



(4) Resistance to Thermal Cracking: UTSST Typical Thermal Strain Plot

$$\varepsilon_{th} = \frac{\Delta l}{l_0} = C + CTC_g(T - T_g) + ln\left\{\left[1 + e^{\frac{(T-T_g)}{R}}\right]^{R(CTC_l - CTC_g)}\right\};\ CTC(T) = CTC_g + \frac{(CTC_L - CTC_g) \times e^{(\frac{T-T_g}{R})}}{(1 + e^{\frac{T-T_g}{R}})}$$



(4) Resistance to Thermal Cracking: UTSST (Cont'd)

- The G5 Mix Specimens were ***long-term aged*** for 5 days at 85°C (185°F) in accordance with AASHTO R30
  - Simulate the long-term aging properties of the mixture in the field when thermal cracking becomes critical.
- Restrained specimens average air voids = 12.3%

(4) Resistance to Thermal Cracking: UTSST Test Results

Property	Value
Fracture	
Fracture Temperature	-34.1°C
Fracture Stress	4,227 kPa (613 psi)
Linear Coefficient of Thermal Contraction (CTC)	
CTC_{liquid}	2.42×10^{-5} /°C

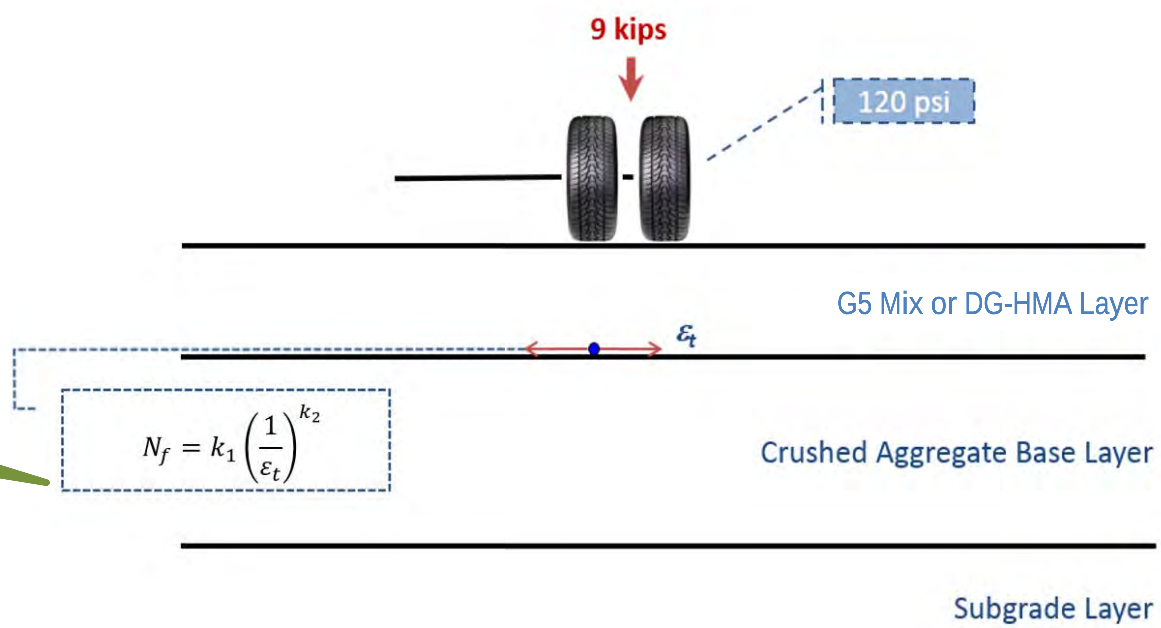
Experimental Plan

(5) MECHANISTIC ANALYSIS

(5) Mechanistic-Empirical Analysis of Pavement Structure

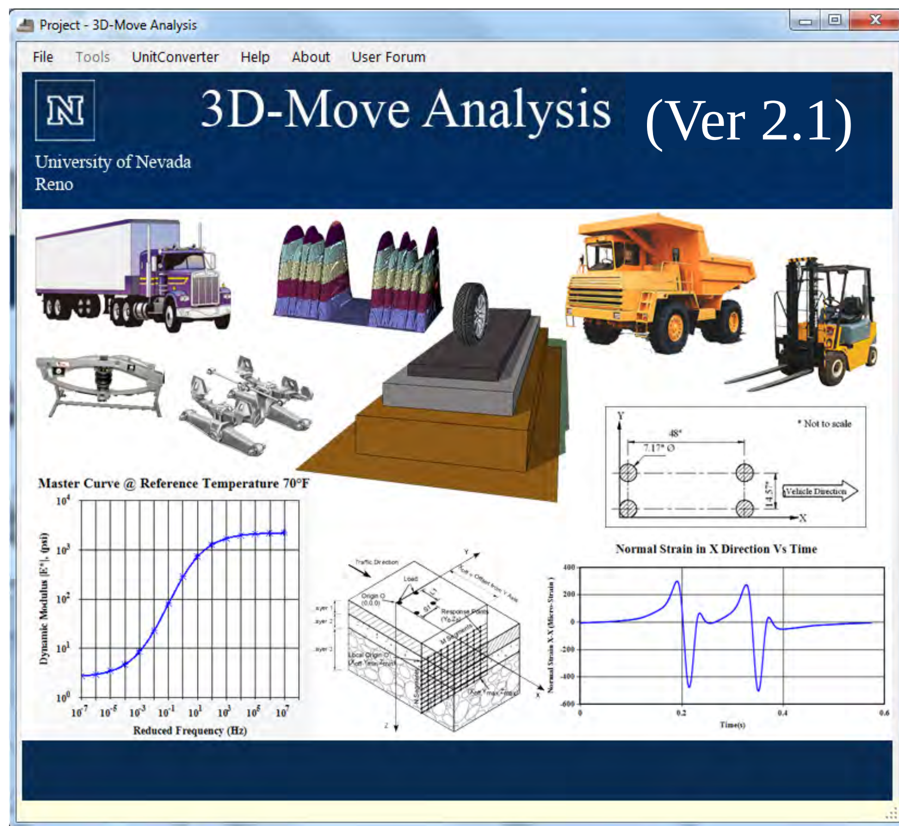
- Mechanistic analysis covers the determination of the responses of the flexible pavement structure to the loads imparted by heavy vehicles and their impact on pavement life.

Property	G5 Mix	DG-HMA
Average air voids	11.2%	6.7%
K_1	4.524E-09	8.293E-13
K_2	4.531	5.293



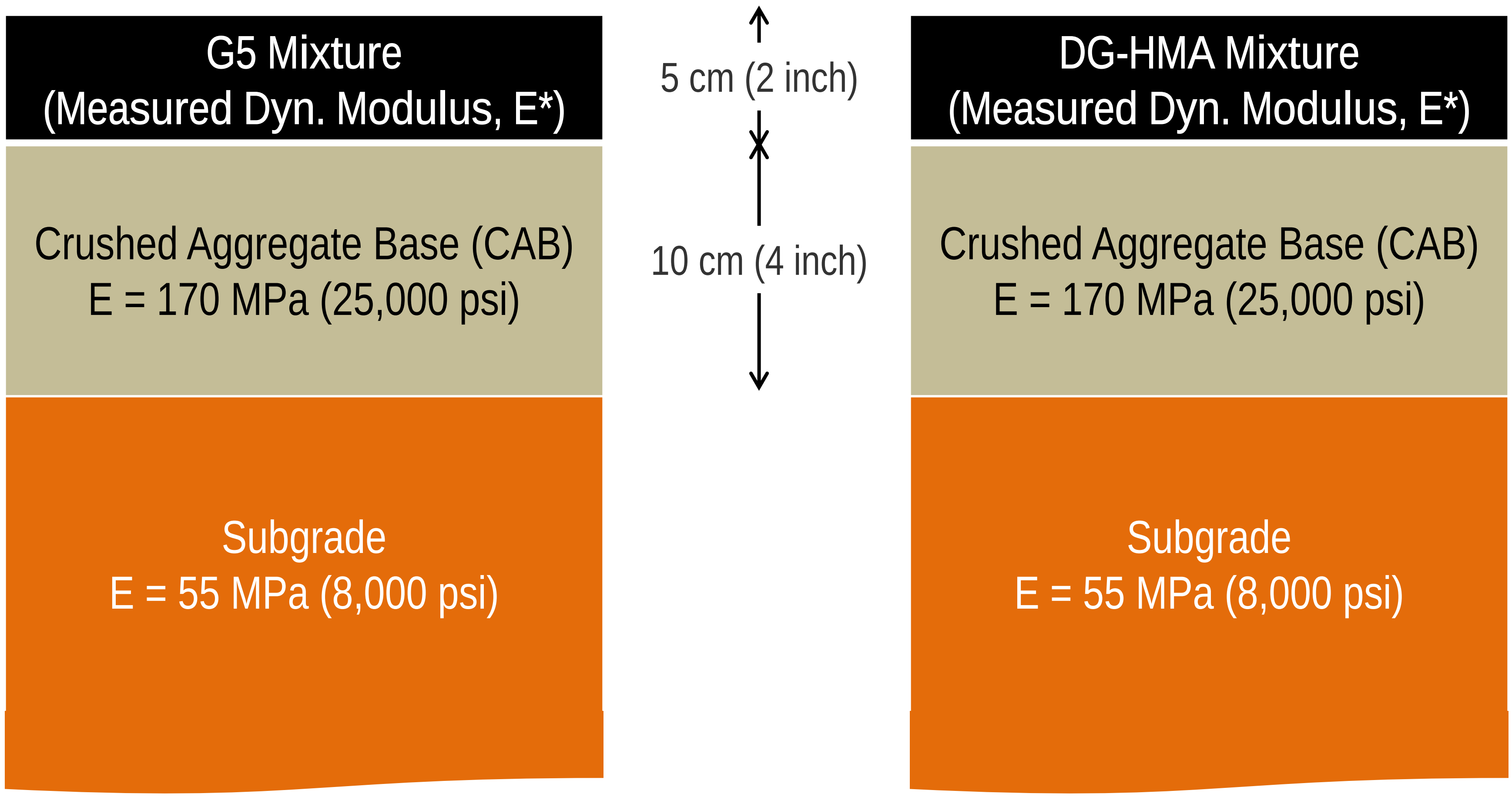
(5) Mechanistic-Empirical Analysis
3D-Move Analysis Software

Download for free @ http://www.arc.unr.edu/Software.html



(5) Mechanistic-Empirical Analysis

Pavement Structure 1

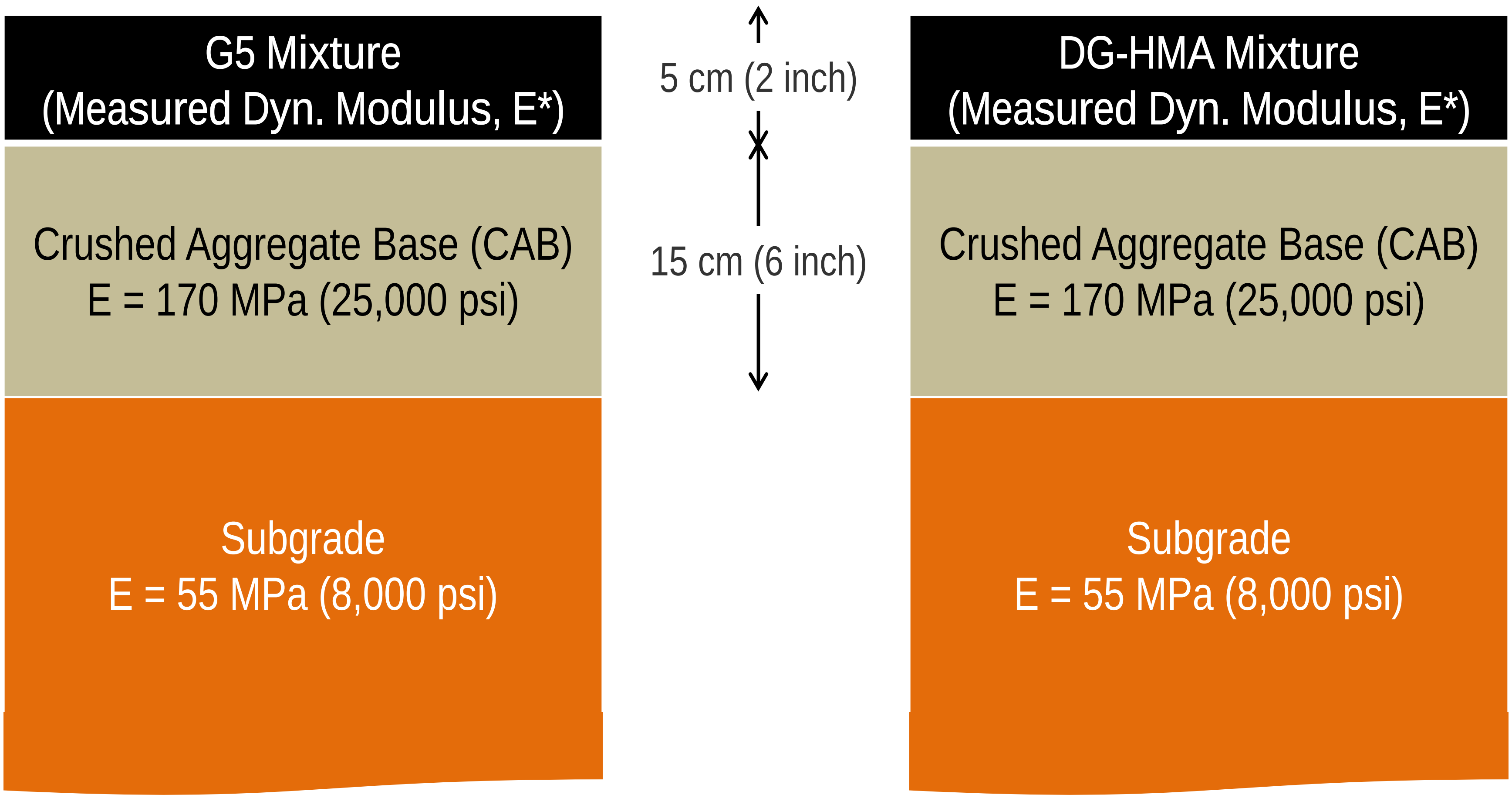


(5) Mechanistic-Empirical Analysis

Comparative Results – Pavement Structure 1

Pavement Structure	Vehicle Speed	Surface Mixture	Fatigue Analysis at 21°C (70°F)		
			Tensile strain, ε_t, mm/mm (in/in)	Number of repetitions to failure, N_f (million)	Fatigue life ratio
5 cm (2 inch) of Surface Mixture on top of 10 cm (4 inch) of CAB	72 kph (45 mph)	G5-100%RAP	494×10^{-6}	4.3	10.8
		DG-HMA	454×10^{-6}	0.4	
	16 kph (10 mph)	G5-100%RAP	519×10^{-6}	3.4	17.0
		DG-HMA	525×10^{-6}	0.2	

(5) Mechanistic-Empirical Analysis
Pavement Structure 2



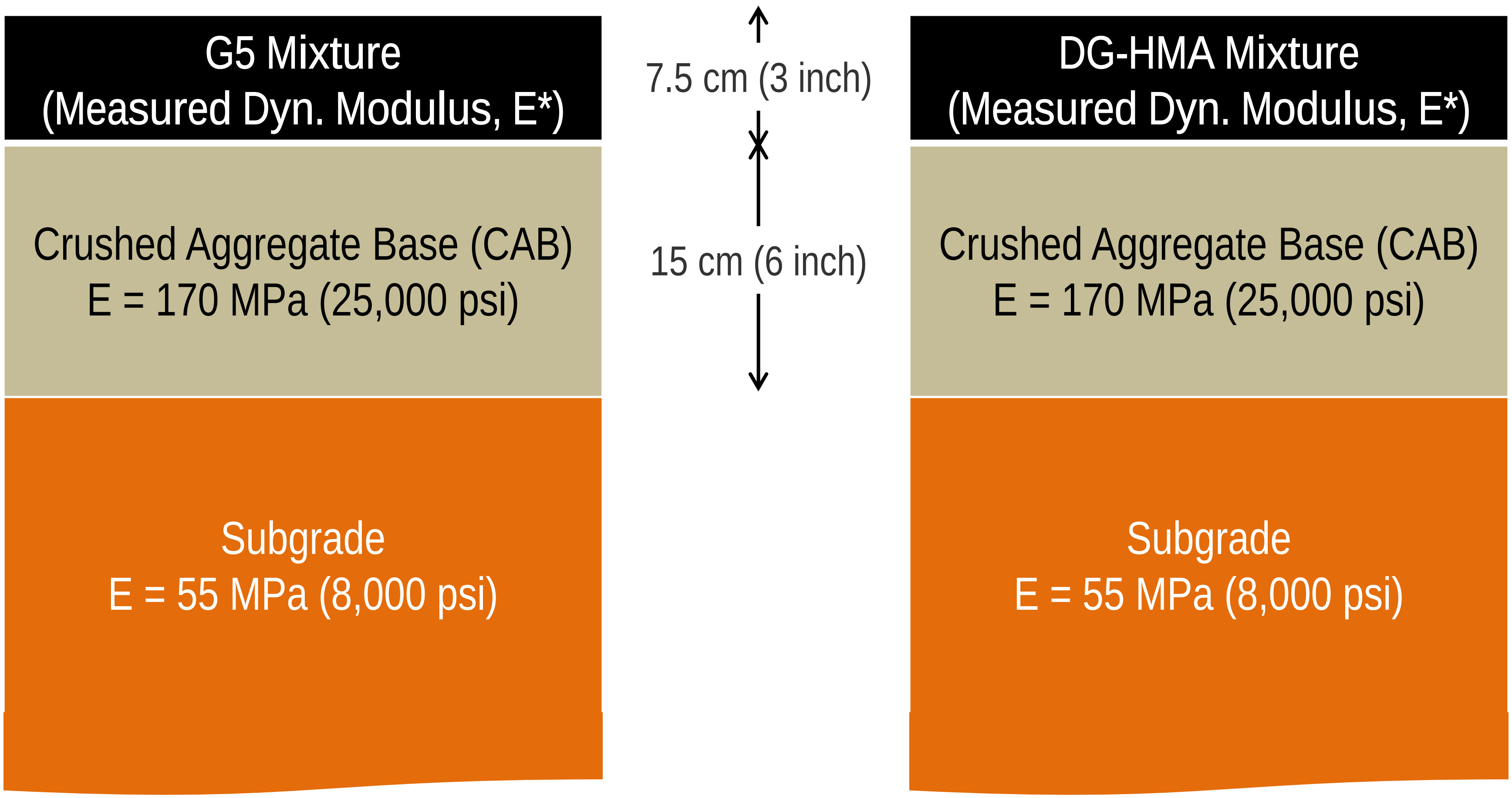
(5) Mechanistic-Empirical Analysis

Comparative Results – Pavement Structure 2

Pavement Structure	Vehicle Speed	Surface Mixture	Fatigue Analysis at 21°C (70°F)		
			Tensile strain, ε_t, mm/mm (in/in)	Number of repetitions to failure, N_f (million)	Fatigue life ratio
5 cm (2 inch) of Surface Mixture on top of 15 cm (6 inch) of CAB	72 kph (45 mph)	G5-100%RAP	454×10^{-6}	6.3	9.0
		DG-HMA	415×10^{-6}	0.7	
	16 kph (10 mph)	G5-100%RAP	477×10^{-6}	5.0	16.7
		DG-HMA	478×10^{-6}	0.3	

(5) Mechanistic-Empirical Analysis

Pavement Structure 3

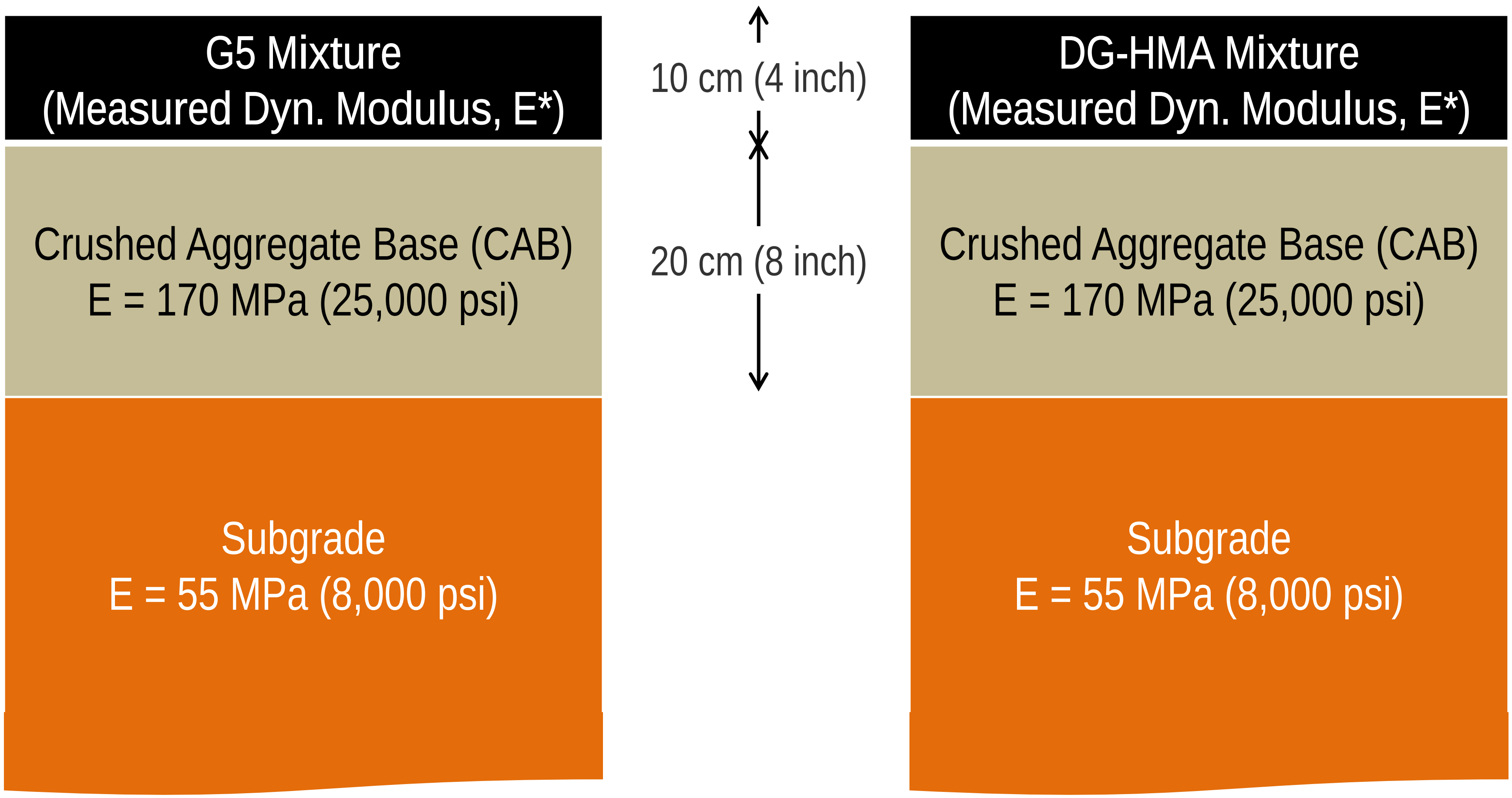


(5) Mechanistic-Empirical Analysis

Comparative Results – Pavement Structure 3

Pavement Structure	Vehicle Speed	Surface Mixture	Fatigue Analysis at 21°C (70°F)		
			Tensile strain, ε_t, mm/mm (in/in)	Number of repetitions to failure, N_f (million)	Fatigue life ratio
7.5 cm (3 inch) of Surface Mixture on top of 15 cm (6 inch) of CAB	72 kph (45 mph)	G5-100%RAP	341×10^{-6}	23.2	8.0
		DG-HMA	313×10^{-6}	2.9	
	16 kph (10 mph)	G5-100%RAP	363×10^{-6}	17.6	14.7
		DG-HMA	373×10^{-6}	1.2	

(5) Mechanistic-Empirical Analysis
Pavement Structure 4



(5) Mechanistic-Empirical Analysis

Comparative Results – Pavement Structure 4

Pavement Structure	Vehicle Speed	Surface Mixture	Fatigue Analysis at 21°C (70°F)		
			Tensile strain, ε_t, mm/mm (in/in)	Number of repetitions to failure, N_f (million)	Fatigue life ratio
10 cm (4 inch) of Surface Mixture on top of 20 cm (8 inch) of CAB	72 kph (45 mph)	G5-100%RAP	251×10^{-6}	93.4	6.6
		DG-HMA	232×10^{-6}	14.2	
	16 kph (10 mph)	G5-100%RAP	269×10^{-6}	68.2	13.1
		DG-HMA	281×10^{-6}	5.2	

Experimental Plan

OVERALL SUMMARY

Overall Summary

- The G5 (100% RAP) mixture is stable and exhibited a stiffness similar to that of asphalt mixtures.
- The G5 (100% RAP) mixture exhibited an excellent resistance to rutting at 60°C (140°F); hence, offering significantly more resistance to rutting at the elevated pavement temperature.
- The G5 (100% RAP) mixture exhibited an excellent resistance to fatigue cracking at 21°C (70°F) while maintaining a high flexural stiffness.
- The G5 (100% RAP) mixture exhibited a fracture temperature of -34°C indicating that the mixture will perform well in designated cold environment.
- The G5 (100% RAP) mixture significantly improved the fatigue life of thin pavements.

Materials Testing, Inc.

8798 Airport Road
Redding, California 96002
(530) 222-1116, fax 222-1611

865 Cotting Lane, Suite A
Vacaville, California 95688
(707) 447-4025, fax 447-4143

Client: Technisoil Industrial, LLC
5680 Westside Road
Redding, CA 96001

Client No: 3053-014
Report No: 0100-001
Revised: 12/28/15

Project: 2015 Mix Design Development
Aggregate Suppler: Greenhorn Pit

Admixture: 7% G5
Mix Number: 3/8" Agg Mix

CORE COMPRESSIVE STRENGTH DATA

Identification	Core 1
Date Cast:	12/09/15
Date Tested:	12/24/15
Age in Days:	14
Average Diameter, in.	3.89
Length, in.	7.8
X-Sect. Area, in^2	11.88
L/D Factor	2.0
Max. Load, lbs.	60,100
Compr. Strength, psi	5,060
Corr. Compr. Stgth. psi	---
Fracture Pattern, Type:	Shear & Columnar

Notes:
Reference test method ASTM C42.
Core specimen delivered 12/23/15 dry.

Respectfully Submitted,
MATERIALS TESTING, INC.

Andrew L. King, P.E.
Principal Engineer

Asphalt Pavement Association of Oregon
www.apao.org
5240 Gaffin Road, S.E. ▲ Salem, Oregon 97317
Phone (503) 363-3858 ▲ FAX (503) 363-5571

Staff:
Ira J. (Jim) Huddleston, Executive Director
Gary Thompson, Training Director
Dawn Lindeman, Administration

Date: May 2, 2013

To: Sam Manley

From: Jim Huddleston, PE
Executive Director

Re: Asphalt Pavement Analyzer Rut Testing Results

Please find enclosed the results of the rut testing performed on compacted samples submitted for the referenced project. Testing was performed per AASHTO T 340 – 10.

Project Name:	Kodiak Pacific
Contract No.:	N/A
Level and Mix Class:	Cores from slab.
Mix ID No.:	N/A
Laboratory Batching Aggregates:	Kodiak Pacific
Asphalt Cement Supplier and Grade:	N/A
JMF Max Sp Gr, G_{mm}:	N/A
Rut Test Technician:	Kevin Berklund
Measured Max Sp Gr, G_{mm}:	N/A
Measured Avg Air Void Content:	N/A
Test Temperature, °C:	64
Average Rut Depth (8000 cycles), mm:	0.6

This material ☒**meets** / ☐**does not meet** the minimum requirements specified per the ODOT Contractor Mix Design Guidelines.

If you have questions, please contact me at (503) 363-3858.

cc: Michael Stennett, Asst. Pavement Materials Engineer, ODOT

APAO: Project Number OT-13-001

ASPHALT PAVEMENT ASSOCIATION OF OREGON

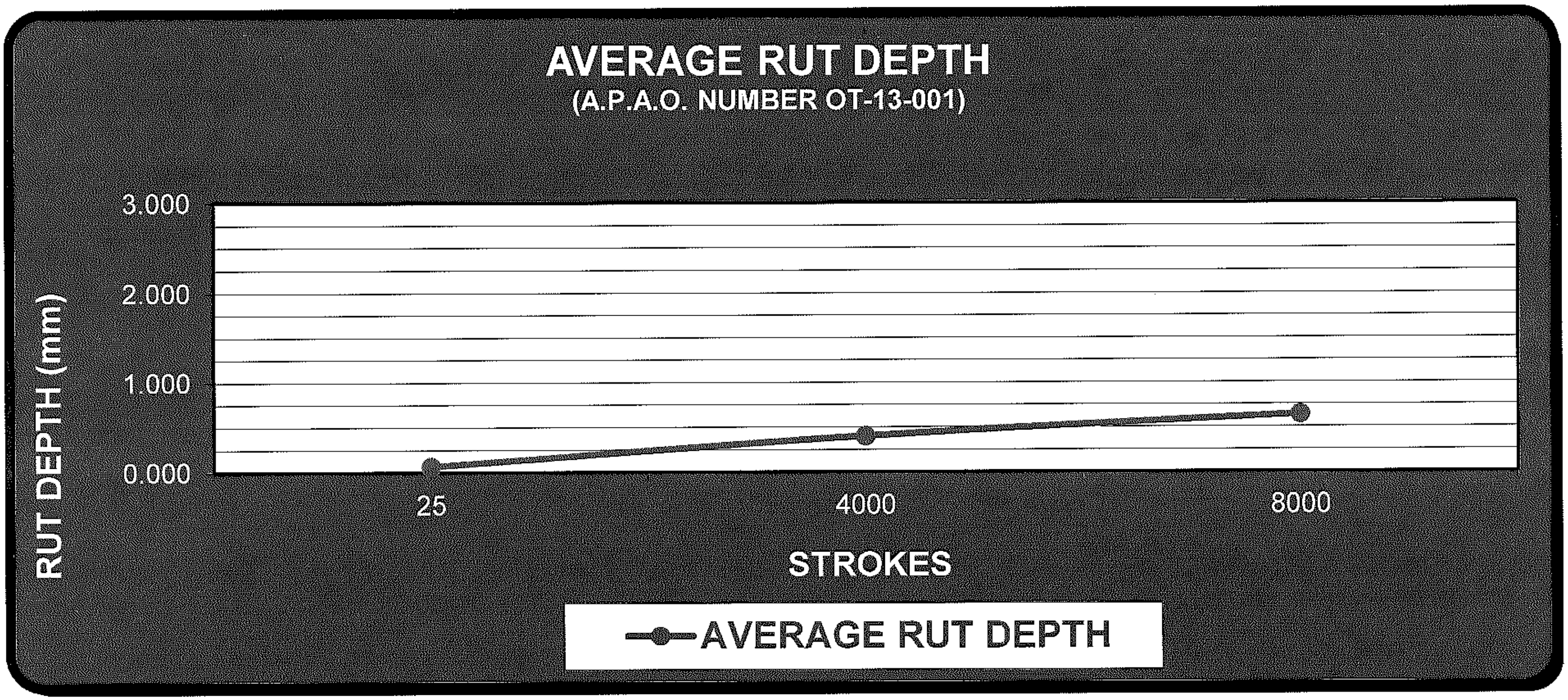
ASPHALT PAVEMENT ANALYZER RESULTS
Kodiak Pacific
APAO PROJECT NUMBER: OT-13-001

STROKES	LEFT DEPTHS OT-13-0011,2	MIDDLE DEPTHS OT-13-0013,4	RIGHT DEPTHS OT-13-0015,6	FIRST AVERAGE
25	0.080	0.064	0.043	0.062
4000	0.369	0.474	0.348	0.397
8000	0.502	0.746	0.651	0.633

STANDARD DEVIATION	LEFT OUTLIER ANALYSES	MIDDLE OUTLIER ANALYSES	RIGHT OUTLIER ANALYSES	FINAL AVERAGE
0.018	0.989	0.094	1.056	**0.062**
0.068	0.415	1.134	0.721	**0.397**
0.123	1.067	0.922	0.147	**0.633**

If the outlier analyses results are greater than 1.153 then the specimen is not included in the final average.

Date Analyses Performed: 05/02/13



AVERAGE RUT DEPTH
(A.P.A.O. NUMBER OT-13-001)
RUT DEPTH (mm)
3.000
2.000
1.000
0.000
25
4000
8000
STROKES
AVERAGE RUT DEPTH

Materials Testing, Inc.

8798 Airport Road
Redding, California 96002
(530) 222-1116, fax 222-1611

865 Cotting Lane, Suite A
Vacaville, California 95688
(707) 447-4025, fax 447-4143

Client: TechniSoil Global, Inc.
5680 Westside Road
Redding, CA 96001

Client No.: 3053-009
Report No.: 1000-001
Date: 09/23/14

Project: Aggregate Quality Testing
Sample No: 1
Material: Base Sand @ 5.5%
Location: ---
Source: J.F. Shea Fine Aggregate

Submitted Date: 09/22/14
Sample Date: ---
Temperature: ---
Time: ---
Tons: ---

Bulk Specific Gravity & Stability of Compacted Bituminous Mixtures of Cored Sample (CTM 308 & CTM 366)

Sample Height (Ave of 3)	Absorption	Bulk Specific Gravity (Ave of 3)	Density, pcf (Ave of 3)	Stability Value (Ave of 3)
2.41	2.0%	2.081	129.5	85

Notes:
1) Sample compacted and delivered by Client (40-day cure).

Technisoil Industrial G5
G5 Testing Data

Prepared by: StroiPromspytania

In connection to: VNIISTROM-NV

Accreditation # ROSS RU.00001.21CA07

"APPROVED"

General Director

000 "VNIISTROM-NV"

The Russian Federation

Testing Laboratory "StroiPromIspytania"
In connection to "VNIISTROM-NV
Accreditation # ROSS RU.0001.21CA07
Valid till 25 of June, 2017

"APPROVED"
General Director
OOO "VNIISTROM-NV"
[Signature] Sapelin N.A.
[Stamp] 23 of April, 2013

RECORD OF INSPECTIONS
#47-I from 23 of April, 2013

Product Name: Sample cubes of concrete mix TechniSoil G5
Reason for Inspections: Request from OOO "Investment Capital Consulting"
Purpose of Inspections: Defining the strength during compression in dry state and water-saturated state, water absorption, swelling/expansion, cold weather test
Evidence of Testing Samples: Samples-beams 16x4x4 – 9 pieces
Registration data of the testing center (laboratory): 13.45 I
Testing methods: GOST 12730.3-78, GOST 10180-90, GOST 18105-2010, GOST 10060.2-95
Testing dates: March-April 2013

TESTING RESULTS:

1. Strength during compression in dry state –
   17.38; 17.25; 18.36 – average number – 17.88 MPa
2. Water absorption –
   3.36; 3.47; 3.49 – average number -3.44%
3. Strength during compression in water-saturated state –
   8.25; 8.32; 7.39 – average number – 7.99 MPa
4. Swelling / Expansion –
   0.13; 0.13; 0.06; 0.13 – average number – 0.11%
5. Coefficient of Linear Expansion

5.1 Coefficient of Linear Expansion in +50C degree temperature –
0, 0, 0, 0 – average number – 0%

5.2 Coefficient of Linear Expansion in -50C degree temperature –
0.13; 0.06; 0.00; 0.06 – average number – 0.06%

6. Cold weather test

After 20 cycles of alternate freezing-thawing in salts in -50C degree temperature, the mass loss was 1.2%, loss of durability was 1.5%

CONCLUSION:

Sample-cubes of concrete mix TechniSoil G5 meet the standards of GOST 26633-91 "Heavy-weight and sand concretes. Specifications" for concrete strength type B12.5 (concrete grade M150), cold weather grade for road concrete and airfields F200.

Supervisor of the testing laboratory [Signature] N.P. Kordyukov

INVESTMENT (ICC)

Mix components: crushed rock, sand, clay, humus, water, G5
Mass of hard components.
Mh= Ms + Mm + Mhum+ Mcl
Where:

Ms – Mass os sand
Mm – Mass of crushed rock
Mhum – Mass of humus
Mcl – Mass of clay

Because in all the soils SiO2 exceeds 60% , we take sand as the base
Consider the following independent factors:

1. X1 – ratio of dry mass of crushed rock to dry mass of sand. Crushed rock / Sand = 0 / 0.3
(0; 0.075; 0.15; 0.225; 0.3)
2. X2 – ratio of dry mass of humus to dry mass of sand. Humus / Sand = 0 / 0.3
(0; 0.075; 015; 0.225; 0.3)
3. X3 – ratio of dry mass of clay to dry mass of sand. Clay / Sand = 0 / 0.3
(0; 0.075; 0.15; 0.225; 0.3)
4. X4 – ratio of mass of water to dry mass of hard components. Water / Hard Components = 0 / 0.16 (0; 0.04; 0.08; 0.12; 0.16)

G5 in all cases is added by mass of 6% of hard components

Coding factors when seeking an optimum with "rototabelny method of second degree":

Level of factors and variation interval	Xi	Factor X1	Factor X2	Factor X3	Factor X4
Bottom Star Point	-2	0	0	0	0
Bottom level	-1	0.075	0.075	0.075	0.04
Zero level	0	0.15	0.15	0.15	0.18
Top level	1	0.225	0.225	0.225	0.12
Top star point	2	0.3	0.3	0.3	0.16
Variation interval	1	0.075	0.075	0.075	0.04

After making the mixes and holding it for 21 days we can identify the following characteristics:

Y1 – Density
Y2 – Strength during compression
Y3 – Strength during bending
Y4 – Abrasion
Y5- Cold weather resistance of 200 cvcles in salts

Testing Laboratory "StroiPromIspytania"
In connection to "VNIISTROM-NV

Accreditation # ROSS RU.0001.21CA07
Valid till 25 of June, 2017

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General Director
OOO "VNIISTROM-NV"
[Signature] Sapelin N.A.
[Stamp] 6 of March, 2013

RECORD OF INSPECTIONS
#29-I / 1 from 6 of March, 2013

Product Name: Sample cubes of concrete mix TechniSoil G5
Reason for Inspections: Request from OOO "Investment Capital Consulting"
Purpose of Inspections: Strength during compression in natural state, water absorption, strength during bending in natural state, strength during compression of samples heated at 60C degrees

Evidence of Testing Samples: 8 cube-bars
Samples-beams 16x4x4 – 2 pieces
Registration data of the testing center (laboratory): 13.26-I
Testing methods: GOST 12730.3-78, GOST 10180-90, GOST 18105-10
Testing dates: March 2013

TESTING RESULTS:

1. Strength during compression in natural state –
   9.6; 10.3; 11.3 – average number – 10.4 MPa
2. Water absorption –
   1.5; 1.5; 1.8– average number -1.6%
3. Strength during bending in natural state
   2.77; 2.66 – average number – 2.7 MPa
4. Strength during compression of samples heated at 60C degrees
   12.3; 12.0; 12.8; 12.5 – average number – 12.4 MPa

CONCLUSION:

Sample-cubes of concrete mix TechniSoil G5 meet the standards of GOST 23558-94 "Crushed stone-gravel-sandy mixtures, and soils treated by inorganic binders for road and airfield construction" for strength grade M100

Supervisor of the testing laboratory [Signature] N.P. Kordyukov

Testing Laboratory "StroiPromIspytania"
In connection to "VNIISTROM-NV
Accreditation # ROSS RU.0001.21CA07
Valid till 25 of June, 2017

"APPROVED"
General Director
OOO "VNIISTROM-NV"
[Signature] Sapelin N.A.
[Stamp] 25 of March, 2013

RECORD OF INSPECTIONS
#38-I from 25 of March, 2013

Product Name: Sample cubes of concrete mix TechniSoil G5
Reason for Inspections: Request from OOO "Investment Capital Consulting"
129344, Moscow, Iskry street, dom 31, korpus 1, pom. II, kom. 7B
Purpose of Inspections: Abrasion tests
Evidence of Testing Samples: Sample-cubes polymer-concrete, 3 pieces
Registration data of the testing center (laboratory): 13.39 / 1-I
Testing methods: GOST 13087-81 "Concretes. Methods of abrasion tests"
Testing dates: 03.22.13 – 03.25.13

Testing results are enclosed in the attachments: #1 on 1 page

CONCLUSION:

Abrasion of the tested cubes of concrete mix TechniSoil G5 meets the standards of GOST 13015-2003 "Concrete and reinforced concrete products for construction. General technical requirements. Rules for acceptance, marking, transportation and storage" for product designs intended to work in high intensity traffic.

Supervisor of the testing laboratory [Signature] N.P. Kordyukov

IL “NV-Stroyispitania”
Attachment #1 to Record of Inspections #38-I from 25 of March, 2013

TESTING RESULTS
Sample-cubes polymer-concrete

Testing date: 03.22.13 – 03.25.13
Samples marking: IL: 13.39/1-I

#	Measure of the tested sample	Units of Measure	Requirements for tested products: Name and abbreviation of the document (division, paragraph)	Requirements for tested products: Standard Index	Name and abbreviation of standards for testing (division, paragraph)	Testing results (measured number)	Meets (doesn’t meet) the required standards for this test
1	Abrasion	Gr / cm2	GOST 13015-2003, paragraph 5.3.11	Not higher than 0.7 – for product designs, intended to work in high intensity traffic (slabs for roads and airfields, slabs for walking paths along highways, etc)	GOST 13087-81, paragraph 2	0.29; 0.30; 0.28 average number – 0.29	Meets requirements for product designs, intended to work in high intensity traffic

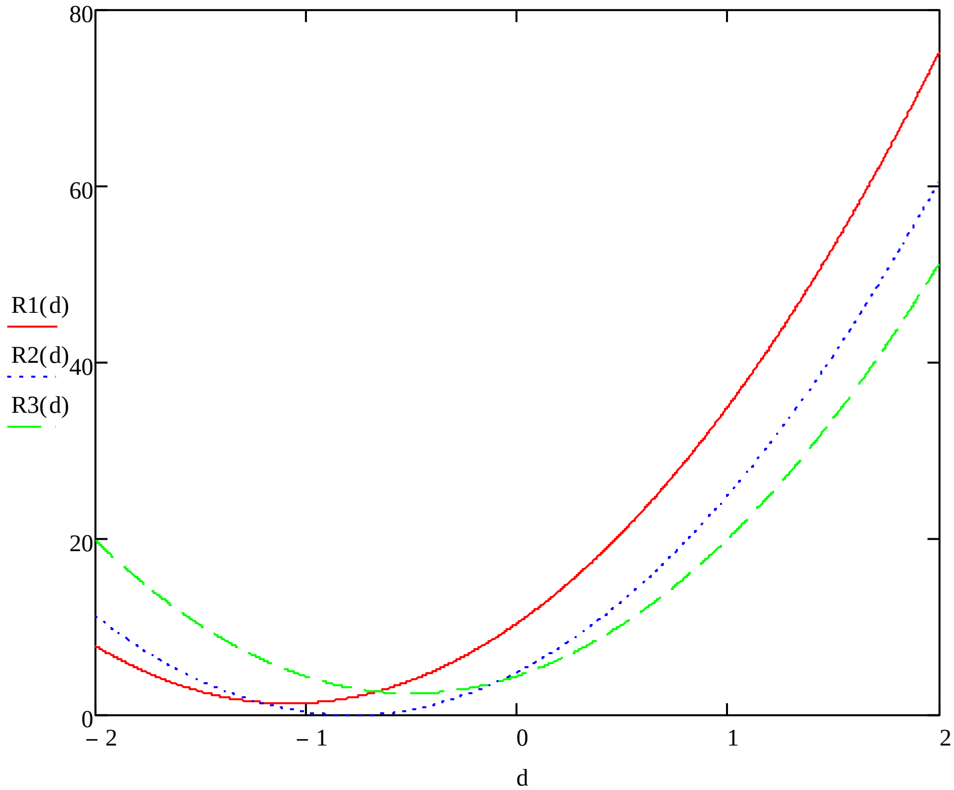
Testing was conducted by: Engineer [Signature] E.A. Mitrakov

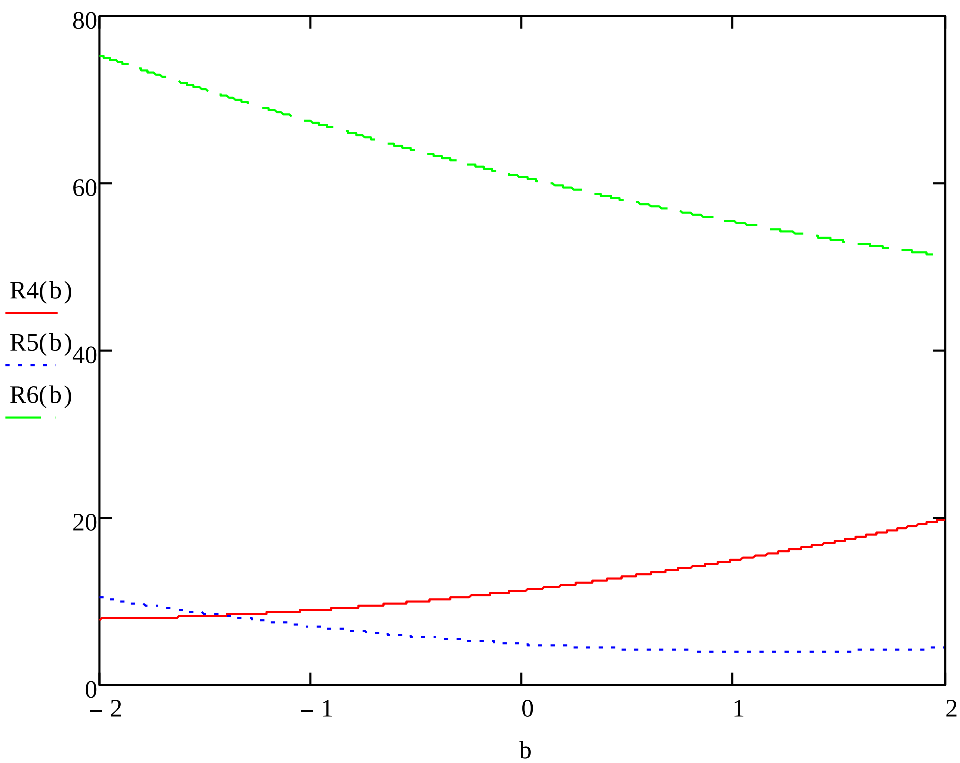
Conditions and Testing results

FACTORS								RESULTS				
X1		X2		X3		X4		Y1	Y2	Y3	Y4	Y5
-	0,075	-	0,075	-	0,075	-	0,04					
+	0,225	-	0,075	-	0,075	-	0,04					
-	0,075	+	0,225	-	0,075	-	0,04					
+	0,225	+	0,225	-	0,075	-	0,04					
-	0,075	-	0,075	+	0,225	-	0,04					
+	0,225	-	0,075	+	0,225	-	0,04					
-	0,075	+	0,225	+	0,225	-	0,04					
+	0,225	+	0,225	+	0,225	-	0,04					
-	0,075	-	0,075	-	0,075	+	0,12					
+	0,225	-	0,075	-	0,075	+	0,12					
-	0,075	+	0,225	-	0,075	+	0,12					
+	0,225	+	0,225	-	0,075	+	0,12					
-	0,075	-	0,075	+	0,225	+	0,12					
+	0,225	-	0,075	+	0,225	+	0,12					
-	0,075	+	0,225	+	0,225	+	0,12					
+	0,225	+	0,225	+	0,225	+	0,12					
-2	0	0	0,15	0	0,15	0	0,08					
+2	0,3	0	0,15	0	0,15	0	0,08					
0	0,15	-2	0	0	0,15	0	0,08					
0	0,15	+2	0,3	0	0,15	0	0,08					
0	0,15	0	0,15	-2	0	0	0,08					
0	0,15	0	0,15	+2	0,3	0	0,08					
0	0,15	0	0,15	0	0,15	-2	0					
0	0,15	0	0,15	0	0,15	+2	0,16					
0	0,15	0	0,15	0	0,15	0	0,08					
0	0,15	0	0,15	0	0,15	0	0,08					
0	0,15	0	0,15	0	0,15	0	0,08					
0	0,15	0	0,15	0	0,15	0	0,08					
0	0,15	0	0,15	0	0,15	0	0,08					
0	0,15	0	0,15	0	0,15	0	0,08					
0	0,15	0	0,15	0	0,15	0	0,08					

COMPONENTS WITH 10KG OF SAND

TEST #	FACTORS								COMPONENTS				
	X_1		X_2		X_3		X_4		Macadam kg	Humus Kg	Clay Kg	Water Kg	G5 kg
1	-	0,075	-	0,075	-	0,075	-	0,04	0,75	0,75	0,75	0,49	0,735
2	+	0,225	-	0,075	-	0,075	-	0,04	2,25	0,75	0,75	0,55	0,825
3	-	0,075	+	0,225	-	0,075	-	0,04	0,75	2,25	0,75	0,55	0,825
4	+	0,225	+	0,225	-	0,075	-	0,04	2,25	2,25	0,75	0,61	0,915
5	-	0,075	-	0,075	+	0,225	-	0,04	0,75	0,75	2,25	0,55	0,825
6	+	0,225	-	0,075	+	0,225	-	0,04	2,25	0,75	2,25	0,61	0,915
7	-	0,075	+	0,225	+	0,225	-	0,04	0,75	2,25	2,25	0,61	0,915
8	+	0,225	+	0,225	+	0,225	-	0,04	2,25	2,25	2,25	0,67	1,005
9	-	0,075	-	0,075	-	0,075	+	0,12	0,75	0,75	0,75	1,47	0,735
10	+	0,225	-	0,075	-	0,075	+	0,12	2,25	0,75	0,75	1,65	0,825
11	-	0,075	+	0,225	-	0,075	+	0,12	0,75	2,25	0,75	1,65	0,825
12	+	0,225	+	0,225	-	0,075	+	0,12	2,25	2,25	0,75	1,83	0,915
13	-	0,075	-	0,075	+	0,225	+	0,12	0,75	0,75	2,25	1,65	0,825
14	+	0,225	-	0,075	+	0,225	+	0,12	2,25	0,75	2,25	1,83	0,915
15	-	0,075	+	0,225	+	0,225	+	0,12	0,75	2,25	2,25	1,83	0,915
16	+	0,225	+	0,225	+	0,225	+	0,12	2,25	2,25	2,25	2,01	1,005
17	-2	0	0	0,15	0	0,15	0	0,08	0	1,5	1,5	1,04	0,78
18	+2	0,3	0	0,15	0	0,15	0	0,08	3	1,5	1,5	1,28	0,96
19	0	0,15	-2	0	0	0,15	0	0,08	1,5	0	1,5	1,04	0,78
20	0	0,15	+2	0,3	0	0,15	0	0,08	1,5	3	1,5	1,28	0,96
21	0	0,15	0	0,15	-2	0	0	0,08	1,5	1,5	0	1,04	0,78
22	0	0,15	0	0,15	+2	0,3	0	0,08	1,5	1,5	3	1,28	0,96
23	0	0,15	0	0,15	0	0,15	-2	0	1,5	1,5	1,5	0	0,87
24	0	0,15	0	0,15	0	0,15	+2	0,16	1,5	1,5	1,5	2,32	0,87
25	0	0,15	0	0,15	0	0,15	0	0,08	1,5	1,5	1,5	1,16	0,87
26	0	0,15	0	0,15	0	0,15	0	0,08	1,5	1,5	1,5	1,16	0,87
27	0	0,15	0	0,15	0	0,15	0	0,08	1,5	1,5	1,5	1,16	0,87
28	0	0,15	0	0,15	0	0,15	0	0,08	1,5	1,5	1,5	1,16	0,87
29	0	0,15	0	0,15	0	0,15	0	0,08	1,5	1,5	1,5	1,16	0,87
30	0	0,15	0	0,15	0	0,15	0	0,08	1,5	1,5	1,5	1,16	0,87
31	0	0,15	0	0,15	0	0,15	0	0,08	1,5	1,5	1,5	1,16	0,87


80
60
40
20
0
R1(d)
R2(d)
R3(d)
– 2
– 1
0
1
2
d


80
60
40
20
0
R4(b)
R5(b)
R6(b)
– 2
– 1
0
1
2
b

Technisoil Industrial G5
G5 Testing Data

Prepared by: StroiPromspytania

In connection to: VNIISTROM-NV

Accreditation # ROSS RU.00001.21CA07

“APPROVED”

General Director

000 “VNIISTROM-NV”

The Russian Federation

Испытательная лаборатория ИЛ "НВ-Стройиспытания"

в составе ООО "ВНИИСТРОМ-НВ"

Аттестат аккредитации № РОСС RU.0001.21СА07

Действителен до « 25 » июня 2017 г.

«УТВЕРЖДАЮ:»
Генеральный директор
ООО «ВНИИСТРОМ-НВ»
Сапелин Н.А.
23 апреля 2013 г.

М.П.

ПРОТОКОЛ ИСПЫТАНИЙ
№ 47И от 23 апреля 2013 года

Наименование продукции	Образцы-кубы из бетонной смеси TechniSoil G5
Основание для проведения испытаний	Запрос ООО «ИНВЕСТМЕНТ КАПИТАЛ КОНСАЛТИНГ»
Цель испытаний	Определение прочности на сжатие в сухом и водонасыщенном состоянии, водопоглощение, набухания, морозостойкости
Сведения об испытанных образцах	Образцы-балочки 16х4х4 – 9 штук
Регистрационные данные испытательного центра (лаборатории)	13.45И
Методика испытания	ГОСТ 12730.3-78, ГОСТ 10180-90, ГОСТ 18105-2010, ГОСТ 10060.2-95
Дата испытания	Март-апрель 2013г.
Результаты испытаний	1. Прочность на сжатие в сухом состоянии – 17.38; 17,25; 18,36 - среднее значение – 17,66 МПа 2. Водопоглощение – 3,36; 3,47; 3,49 - среднее значение – 3,44 % 3. Прочность на на сжатие в водонасыщенном состоянии – 8,25; 8,32;7,39 - среднее значение – 7,99 МПа 4. Набухание – 0,13; 0,13; 0,06; 0,13, среднее значение – 0,11% 5.Коэффициент линейного расширения 5.1 Коэффициент линейного расширения при температуре +50 ^{0}C – 0, 0, 0, 0 - среднее значение – 0% 5.2 Коэффициент линейного расширения при температуре -50 ^{0}C – 0,13; 0,06; 0,00; 0,06 - среднее значение – 0,06% 6. Морозостойкость- после 20 циклов попеременного замораживания-оттаивания в солях при температуре -50^{0}C потеря массы составила 1,2 %, потеря прочности 1,5%.
ЗАКЛЮЧЕНИЕ:	Испытанные образцы-кубы из бетонной смеси TechniSoil G5 соответствуют требованиям ГОСТ 26633-91 «Бетоны тяжелые и мелкозернистые. Технические условия» для класса бетона по прочности B12,5 (марки бетона по прочности M150), марки по морозостойкости для бетонов дорожных и аэродромных покрытий F200 .

Руководитель испытательной лаборатории Н. П. Кордюков

ИНВЕСТМЕНТ (ICC)

Состав смеси: щебень, песок, глина, гумус, вода, состав G5
Выделим твердые. Масса твердых
$М_Т = М_п + М_щ + М_{гум} + М_{гл}$
Где: $М_п$ – масса песка
$М_щ$ – масса щебня
$М_{гум}$ – масса гумуса
$М_{гл}$ – масса глины
Так как во всех почвах содержание SiO_2 превышает 60 %, то за основу примем песок
Принимаем следующие независимые факторы:

1. X_1 - Отношение сухой массы щебня к сухой массе песка Щ/П = 0÷0,3 (0; 0,075; 0,15; 0,225; 0,3)
2. X_2 - Отношение сухой массы гумуса к сухой массе песка Гум/П = 0÷0,3 (0; 0,075; 0,15; 0,225; 0,3)
3. X_3 - Отношение сухой массы глины к сухой массе песка Гл/П = 0÷0,3 (0; 0,075; 0,15; 0,225; 0,3)
4. X_4 - Отношение массы воды к сухой массе твердых составляющих В/Т = 0÷0,16 (0; 0,04; 0,08; 0,12; 0,16)

Состав G5 во всех случаях добавляется по массе 6% от твердых составляющих

Кодирование факторов при исследовании оптимума с помощью рототабельного плана второго порядка

Уровень факторов и интервал варьирования	x_i	Факторы			
		X_1	**X_2**	**X_3**	**X_4**
Нижняя звездная точка	**-2**	0	0	0	0
Нижний уровень	**-1**	0,075	0,075	0,075	0,04
Нулевой уровень	**0**	0,15	0,15	0,15	0,08
Верхний уровень	**1**	0,225	0,225	0,225	0,12
Верхняя звездная точка	**2**	0,3	0,3	0,3	0,16
Интервал варьирования	1	0,075	0,075	0,075	0,04

После приготовления составов и выдержки в течении 21 суток можно определить следующие характеристики:
Y_1 – плотность
Y_2 – прочность при сжатии
Y_3 – прочность при изгибе
Y_4 – истираемость
Y_5 – морозостойкость 200 циклов в солях

Испытательный центр ИЛ "НВ-Стройиспытания"

наименование испытательного центра (лаборатории)

в составе ООО "ВНИИСТРОМ-НВ"

наименование юридического лица

Аттестат аккредитации № РОСС RU.0001.21CA07

Действителен до « 25 » июня 2017 г.

«УТВЕРЖДАЮ:»

Генеральный директор

ООО «ВНИИСТРОМ-НВ»

__________ Сапелин Н.А.

06 марта 2013 г.

М.П.

ПРОТОКОЛ ИСПЫТАНИЙ

№ 29И/1 от 06 марта 2013 года

Наименование продукции	Образцы-кубы из бетонной смеси TechniSoil G5
Основание для проведения испытаний	Запрос ООО «ИНВЕСТМЕНТ КАПИТАЛ КОНСАЛТИНГ»
Цель испытаний	Прочность на сжатие в естественном состоянии, водопоглощение, прочность на изгиб в естественном состоянии, прочность на сжатие образцов, нагретых до 60 градусов
Сведения об испытанных образцах	8 кубов-пластин Образцы-балочки 16х4х4 – 2 штуки
Регистрационные данные испытательного центра (лаборатории)	13.26И
Методика испытания	ГОСТ 12730.3-78, ГОСТ 10180-90; ГОСТ 18105-10
Дата испытания	март 2013г.
Результаты испытаний	1. Прочность на сжатие в естественном состоянии - 9,6; 10,3; 11,3 - среднее значение - 10,4 МПа 2. Водопоглощение - 1,5; 1,5; 1,8 - среднее значение - 1,6 % 3. Прочность на изгиб в естественном состоянии - 2,77; 2,66; среднее значение – 2,7 МПа 4. Прочность на сжатие образцов, нагретых до 60 градусов - 12,3; 12,0; 12,8; 12,5 среднее значение - 12,4 МПа
ЗАКЛЮЧЕНИЕ:	**Образцы-кубы из бетонной смеси TechniSoil G5 соответствуют требованиям ГОСТ 23558-94 «СМЕСИ ЩЕБЕНОЧНО-ГРАВИЙНО-ПЕСЧАНЫЕ И ГРУНТЫ, ОБРАБОТАННЫЕ НЕОРГАНИЧЕСКИМИ ВЯЖУЩИМИ МАТЕРИАЛАМИ, ДЛЯ ДОРОЖНОГО И АЭРОДРОМНОГО СТРОИТЕЛЬСТВА» для марки по прочности М100**

Руководитель испытательного центра (лаборатории) __________ Н. П. Кордюков

Испытательная лаборатория ИЛ "НВ-Стройиспытания"

наименование испытательного центра (лаборатории)

в составе ООО "ВНИИСТРОМ-НВ"

наименование юридического лица

Аттестат аккредитации № РОСС RU.0001.21СА07

Действителен до « 25 » июня 2017 г.

«УТВЕРЖДАЮ:»
Генеральный директор
ООО «ВНИИСТРОМ-НВ»

Сапелин Н.А.

25 марта 2013 г

М.П.

ПРОТОКОЛ ИСПЫТАНИЙ

№ 38И от 25 марта 2013 г.

Наименование продукции: Образцы-кубы из бетонной смеси TechniSoil G5

Заявитель: ООО «ИНВЕСТМЕНТ КАПИТАЛ КОНСАЛТИНГ»
129344, г. Москва, ул, Искры, д. 31, корпус 1, пом. II, ком.7Б

Цель испытаний: Определение истираемости

Сведения об испытанных образцах: Образцы-кубы полимербетонные, 3 штуки

Регистрационные данные испытательного центра (лаборатории): 13.39/1И

Методика испытания: ГОСТ 13087-81 «Бетоны. Методы определения истираемости»

Дата испытания: 22.03.13-25.03.13 г.

Результаты испытаний приведены в прилагаемых приложениях №1 на 1 листе

ЗАКЛЮЧЕНИЕ: Истираемость испытанных кубов из бетонной смеси TechniSoil G5 соответствует требованиям ГОСТ 13015-2003 «Изделия железобетонные и бетонные для строительства. Общие технические требования. Правила приемки, маркировки, транспортирования и хранения» для изделий конструкций, работающих в условиях повышенной интенсивности движения.

Руководитель испытательной лаборатории Н.П. Кордюков

Conditions and Testing results

FACTORS				RESULTS				
X1	X2	X3	X4	Y1	Y2	Y3	Y4	Y5

Условия и результаты опытов

Факторы								Результаты				
X_1		**X_2**		**X_3**		**X_4**		Y_1	Y_2	Y_3	Y_4	Y_5
-	0,075	-	0,075	-	0,075	-	0,04					
+	0,225	-	0,075	-	0,075	-	0,04					
-	0,075	+	0,225	-	0,075	-	0,04					
+	0,225	+	0,225	-	0,075	-	0,04					
-	0,075	-	0,075	+	0,225	-	0,04					
+	0,225	-	0,075	+	0,225	-	0,04					
-	0,075	+	0,225	+	0,225	-	0,04					
+	0,225	+	0,225	+	0,225	-	0,04					
-	0,075	-	0,075	-	0,075	+	0,12					
+	0,225	-	0,075	-	0,075	+	0,12					
-	0,075	+	0,225	-	0,075	+	0,12					
+	0,225	+	0,225	-	0,075	+	0,12					
-	0,075	-	0,075	+	0,225	+	0,12					
+	0,225	-	0,075	+	0,225	+	0,12					
-	0,075	+	0,225	+	0,225	+	0,12					
+	0,225	+	0,225	+	0,225	+	0,12					
-2	0	0	0,15	0	0,15	0	0,08					
+2	0,3	0	0,15	0	0,15	0	0,08					
0	0,15	-2	0	0	0,15	0	0,08					
0	0,15	+2	0,3	0	0,15	0	0,08					
0	0,15	0	0,15	-2	0	0	0,08					
0	0,15	0	0,15	+2	0,3	0	0,08					
0	0,15	0	0,15	0	0,15	-2	0					
0	0,15	0	0,15	0	0,15	+2	0,16					
0	0,15	0	0,15	0	0,15	0	0,08					
0	0,15	0	0,15	0	0,15	0	0,08					
0	0,15	0	0,15	0	0,15	0	0,08					
0	0,15	0	0,15	0	0,15	0	0,08					
0	0,15	0	0,15	0	0,15	0	0,08					
0	0,15	0	0,15	0	0,15	0	0,08					
0	0,15	0	0,15	0	0,15	0	0,08					

COMPONENTS WITH 10KG OF SAND

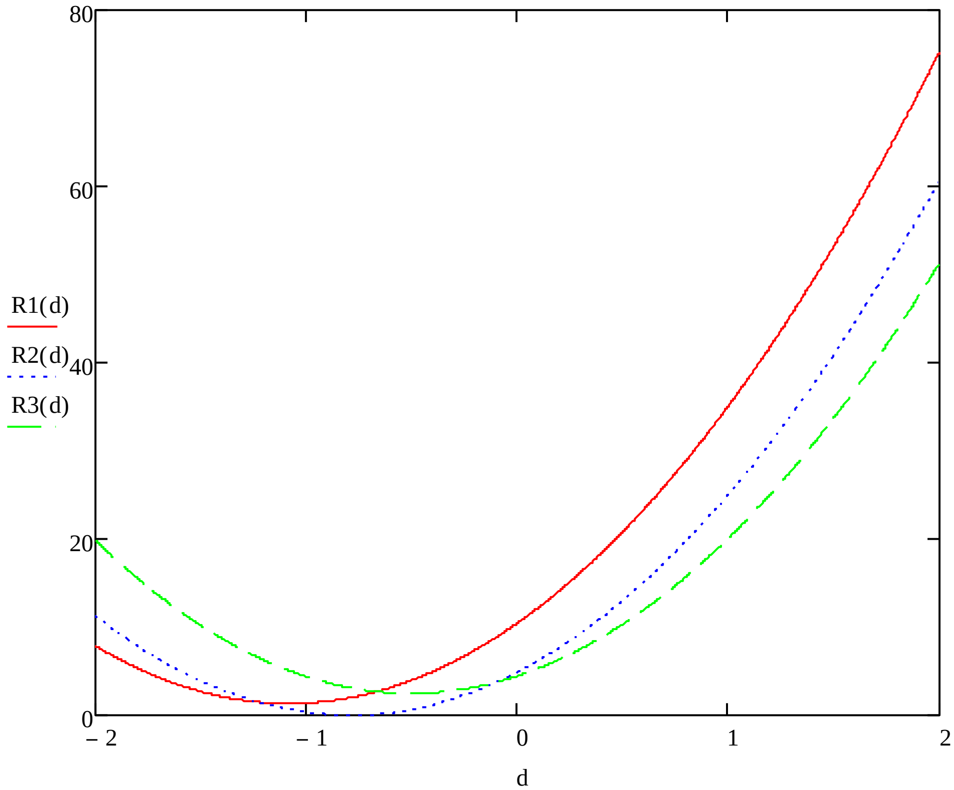
Test #	FACTORS				COMPONENTS				
	X1	X2	X3	X4	Macadam kg	Humus Kg	Clay Kg	Water Kg	G5 kg

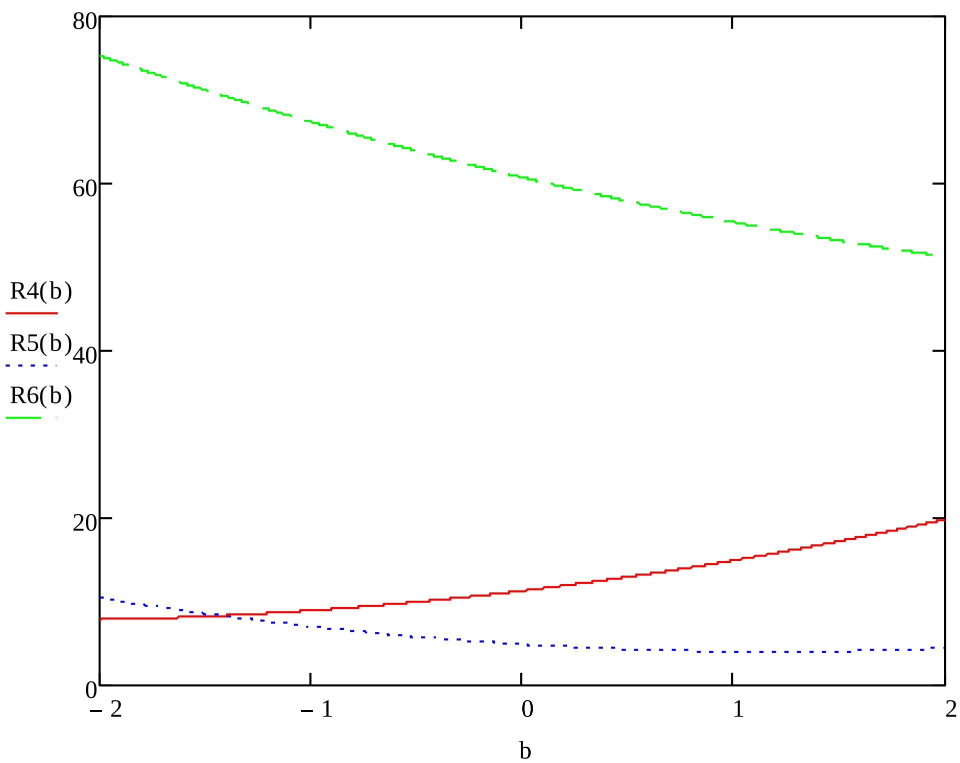
Состав на 10 кг песка

№ опыта	Факторы								Состав				
	X_1		X_2		X_3		X_4		Щебень, кг	Гумус, кг	Глина, кг	Вода, кг	Соста G5, к
1	-	0,075	-	0,075	-	0,075	-	0,04	0,75	0,75	0,75	0,49	0,735
2	+	0,225	-	0,075	-	0,075	-	0,04	2,25	0,75	0,75	0,55	0,825
3	-	0,075	+	0,225	-	0,075	-	0,04	0,75	2,25	0,75	0,55	0,825
4	+	0,225	+	0,225	-	0,075	-	0,04	2,25	2,25	0,75	0,61	0,915
5	-	0,075	-	0,075	+	0,225	-	0,04	0,75	0,75	2,25	0,55	0,825
6	+	0,225	-	0,075	+	0,225	-	0,04	2,25	0,75	2,25	0,61	0,915
7	-	0,075	+	0,225	+	0,225	-	0,04	0,75	2,25	2,25	0,61	0,915
8	+	0,225	+	0,225	+	0,225	-	0,04	2,25	2,25	2,25	0,67	1,005
9	-	0,075	-	0,075	-	0,075	+	0,12	0,75	0,75	0,75	1,47	0,735
10	+	0,225	-	0,075	-	0,075	+	0,12	2,25	0,75	0,75	1,65	0,825
11	-	0,075	+	0,225	-	0,075	+	0,12	0,75	2,25	0,75	1,65	0,825
12	+	0,225	+	0,225	-	0,075	+	0,12	2,25	2,25	0,75	1,83	0,915
13	-	0,075	-	0,075	+	0,225	+	0,12	0,75	0,75	2,25	1,65	0,825
14	+	0,225	-	0,075	+	0,225	+	0,12	2,25	0,75	2,25	1,83	0,915
15	-	0,075	+	0,225	+	0,225	+	0,12	0,75	2,25	2,25	1,83	0,915
16	+	0,225	+	0,225	+	0,225	+	0,12	2,25	2,25	2,25	2,01	1,005
17	-2	0	0	0,15	0	0,15	0	0,08	0	1,5	1,5	1,04	0,78
18	+2	0,3	0	0,15	0	0,15	0	0,08	3	1,5	1,5	1,28	0,96
19	0	0,15	-2	0	0	0,15	0	0,08	1,5	0	1,5	1,04	0,78
20	0	0,15	+2	0,3	0	0,15	0	0,08	1,5	3	1,5	1,28	0,96
21	0	0,15	0	0,15	-2	0	0	0,08	1,5	1,5	0	1,04	0,78
22	0	0,15	0	0,15	+2	0,3	0	0,08	1,5	1,5	3	1,28	0,96
23	0	0,15	0	0,15	0	0,15	-2	0	1,5	1,5	1,5	0	0,87
24	0	0,15	0	0,15	0	0,15	+2	0,16	1,5	1,5	1,5	2,32	0,87
25	0	0,15	0	0,15	0	0,15	0	0,08	1,5	1,5	1,5	1,16	0,87
26	0	0,15	0	0,15	0	0,15	0	0,08	1,5	1,5	1,5	1,16	0,87
27	0	0,15	0	0,15	0	0,15	0	0,08	1,5	1,5	1,5	1,16	0,87
28	0	0,15	0	0,15	0	0,15	0	0,08	1,5	1,5	1,5	1,16	0,87
29	0	0,15	0	0,15	0	0,15	0	0,08	1,5	1,5	1,5	1,16	0,87
30	0	0,15	0	0,15	0	0,15	0	0,08	1,5	1,5	1,5	1,16	0,87
31	0	0,15	0	0,15	0	0,15	0	0,08	1,5	1,5	1,5	1,16	0,87

После изготовления 31 образца получим зависимости свойств изделия от состава

(см.пример)





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SMITH-EMERY SAN FRANCISCO
An Independent Commercial Testing Laboratory

May 21, 2010

Project:

Eco Research
5680 Westside Rd.
Redding, Ca. 96001

SECo Job No.: 66274
SECo Lab No.: 10L0120
Lab Technician: WILL LARRAMA
Test Date: May 21, 2010

Attn: Sean Weaver

STATIC COEFFICIENT OF FRICTION TEST (ASTM C 1028)

Sample Description :Decomposed Granite Stabilized w/ Technisoil Polymer
Specification : ASTM C 1028 (Modified)-Hillyards renovator(cleaner) not used
Source :Eco Research

Procedure :
A block of wood with a 3" x 3" x 1/8" section of standard neolite cement liner attached was placed on the surface to be tested. A 50 pound (22kg) weight was placed on the block of wood. Using a dynamometer, the force in pounds required to cause the test assembly to slip parallel to the test surface was measured. Four measurements were taken using the neolite test surface, each measurement perpendicular to the previous one. The twelve measurements thus obtained were averaged to obtain the static coefficient of friction for each test condition.

Dry Calibration Factor 0.13
Wet Calibration Factor -0.14

TEST CONDITIONS	Trial No.	N	E	S	W	AVG.	INDIVIDUAL COEFFICIENT OF FRICTION (fc)
Dry Neolite	1	37	37	38	38		
	2	44	46	46	45	42.4	**0.96**
	3	46	44	43	44		
Wet Neolite	1	39	37	34	40		
	2	41	41	40	39	38.4	**0.61**
	3	38	39	36	38		

Per Ceramic Tile Institute
Coefficient of Friction values greater than 0.60 will be considered slip resistant
Coefficient of Friction values between 0.50 to 0.60 will be conditionally slip resistant
Coefficient of friction values less than 0.50 are questionable.

Respectfully Submitted,
Smith-Emery Company

Wylie Stevenson
LABORATORY MANAGER
Wylie Stevenson
Lab Manager