WHEN AND WHERE TO USE POLYMAC MICROSURFACING

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for Presentation at a Seminar for Clients of Vestal Asphalt Co.
March 13, 1991

Years ago, "Smitty" was one of our best district maintenance engineers. Tall and trim and a bit awkward, Smitty was a hands-on engineer who was caught only once in his career wearing a suit and tie. The occasion was the annual Ohio State University Transportation Engineering Conference where he had been "invited" in spite of his protests to participate in a 3-man panel discussion on Hot Mix overlays. After the speakers had completed their presentations, questions were taken from the audience.

"How often should you overlay a pavement?" After a pause, almost as if he were reading the answer from the floor, he responded: "Sometime between 4 and 8 years you'd better be doing something or the pavement will become irreparably damaged."

"How long does it last?" " Sometimes after 12 years they look like the day they were laid. Other times they blow to kingdom come in 2 years."

"How thick should the overlay be?"
"The thinner it is the quicker it cracks."

"What do you do about cracks?"---"I've got my share of cracks and you should have yours."

This then was the informed attitude 30 years ago towards the maintenance of hot mixed pavements.

Since then, a great deal of study and field applications of new techniques from all quarters has been accomplished and continues today at an increasing pace with the various SHRP programs and local programs as well as innovations from contractor laboratories. One approach has been to view a pavement system as consisting of a structural element which supports the load and a surface element which protects the structure. Following this logic, there are then 2 types of pavement distress. Structural or load-base associated distress and surface distress.

Figure 1.

PAVEMENT SYSTEM COMPONENTS:

1. STRUCTURE - Supports the load
2. SURFACE - Protects the structure

TYPES OF PAVEMENT DISTRESS

1. STRUCTURAL - Load/Base associated
2. SURFACE - Surface Associated

Here we are concerned only with maintenance of the surface element of a pavement; i.e., the visible part of the pavement where the tire meets the road.

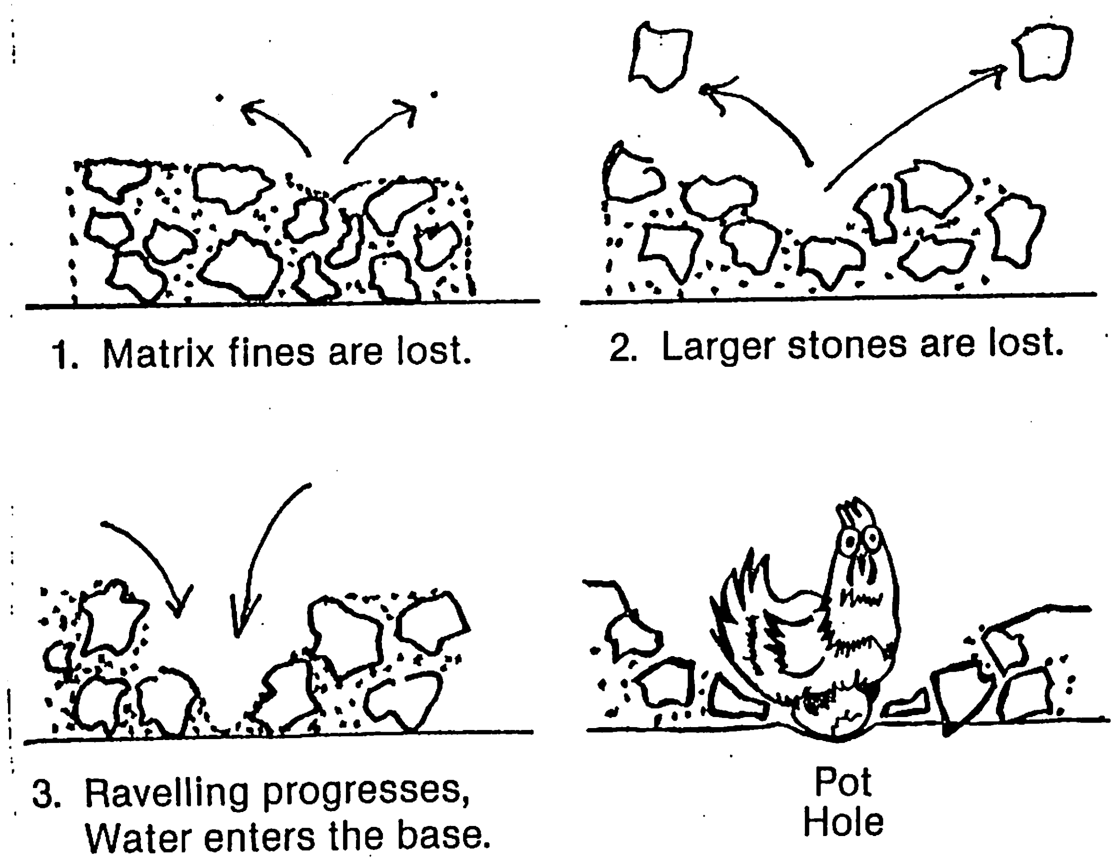


Figure 2.

The casual observer will note the stages of surface deterioration where sanding or loss of matrix allows pop-outs progressive ravelling and cracking until the infamous pot-hole or "chicken nest" renders the pavement unserviceable.

The Kandhal Curve, explains these stages of deterioration by relating the pavement condition to the present properties of bituminous binder, specifically the low temperature ductility.

Figure 3.

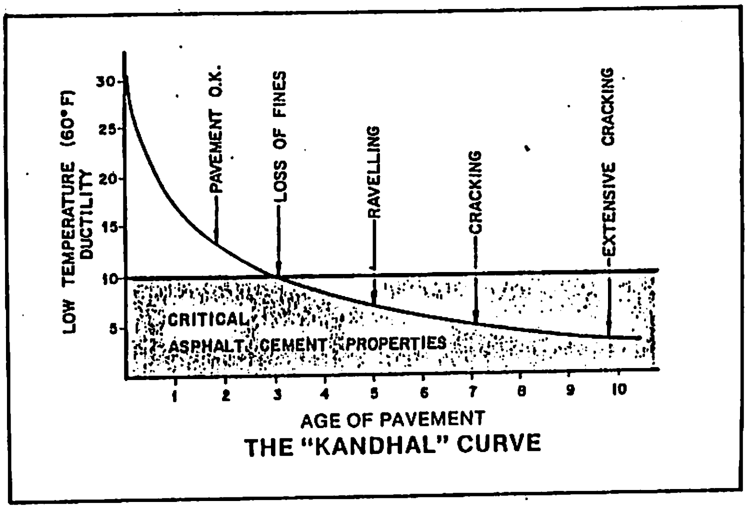
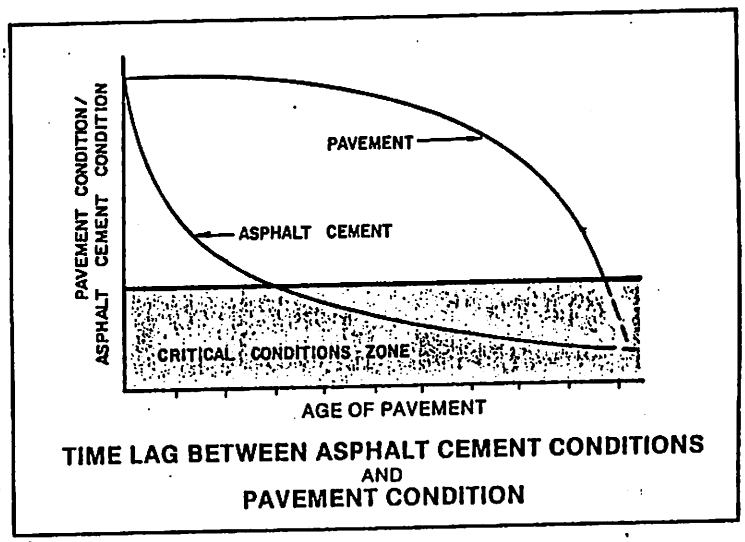


Figure 4.



Note that about half of the original ductility ("stretch") is lost or burned up during hot mixing and lay down operations. The quality of the bitumen and it's interaction with aggregate and the degree of initial compaction will control the rate of ductility loss and thus the life of a pavement surface.

The cause of loss of ductility or embrittlement is the presence of water, air and sunlight---the "brittlizers". Anything that will slow the rate of exposure to the brittlizers will increase the life of a pavement. In fact, if one were to place a pavement in an air tight container, (a weatherless environment), there would be no change in pavement properties for even 100 years!

The answer to the question "When should a pavement receive a surface treatment" is: BEFORE SURFACE DISTRESS BECOMES APPARENT----BEFORE RIGOR MORTIS SETS IN---WHILE AT LEAST SOME LIFE REMAINS. Obviously, the sooner the better.

The many kinds of surface treatments were classified in 1976 as follows: Here we are concerned with asphalt emulsion-dense graded aggregate mixes: i.e., conventional slurry and polymer modified microsurfacing.

KINDS OF SURFACE TREATMENTS
How shall we preserve and protect our pavements?

A. Non-penetrating liquids
   1. Fog seal - dilute emulsion
   2. Natural asphalt cut-back
   3. Coal tar pitch - clay emulsion

B. Penetrating Liquids
   1. Cut-back asphalt primers
   2. Cut-back asphalt emulsions
   3. Tar primers
   4. Cut-back tar
   5. Rejuvenators:
      a. Resin-oil plasticizers
      b. Emulsion plasticizers
      c. Solvent plasticizers

C. Aggregate Seals
   1. Spray bar and box seals
      a. Sand cover seals
      b. Chip cover seals
   2. Mix seals
      a. Tar emulsion
      b. Asphalt emulsion slurry seals (travel plant)
      c. Asphalt emulsion mix seal (travel plant)
      d. Asphalt cold mix (central plant)
      e. Asphalt/tar hot mix (central plant)

D. Surface Reworking
   1. Heater Planer and slurry seal
   2. Heater Scarify - rejuvenate - slurry seal
   3. Recycle (remove, remix, relay, seal)

E. Special Membranes
   Fiber (woven and meshed), rubber mat, wire, rubber chip seals, latex slurries, combination tread rubber-aggregate slurries, epoxy-calcined bauxite chip seals.

KINDS OF SURFACE TREATMENTS

1. Non-Penetrating Liquids
2. Penetrating Liquids
3. Aggregate Seals - Bar or Mix
4. Surface Reworking/Reclaiming
5. Special Membrane Treatments

Figure 5.

The primary uses for these emulsified asphalt mix-seals are:

1. Preventive.... To prevent surface distress from occurring in newly laid pavements such as the effects of weathering (oxidation, loss of oils, loss of matrix and embrittlement of the structural mix) and to provide special durability and texture not available in the underlying mix.

2. Corrective......To correct surface distresses that have already occurred in older pavements such as surface cracking, ravelling, loss of matrix, increased air and water permeability and slipperiness from flushing or aggregate polishing.

Another way of classifying a particular surface treatment is by the OBJECTIVES to be accomplished:

Objectives for surface treatments:

Monolayer applications

1. Weather proofing/sealing
2. Mass crack sealing
3. Preparation for overlay or subsequent treatment
4. Sight delineation/contrast
5. Noise reduction
6. Macrotexture, improved friction

Multilayer applications

1. Rut filling
2. "Sanitizing"; scratch course and cover
3. Wedges and crowns
4. Cross slope drainage improvement

The primary difference between Slurry Seal and Polymer Modified Micro Asphalt Concrete (Cold MAC) is found in their **DIFFERENCES IN RESPONSE TO COMPACTION BY TRAFFIC.**

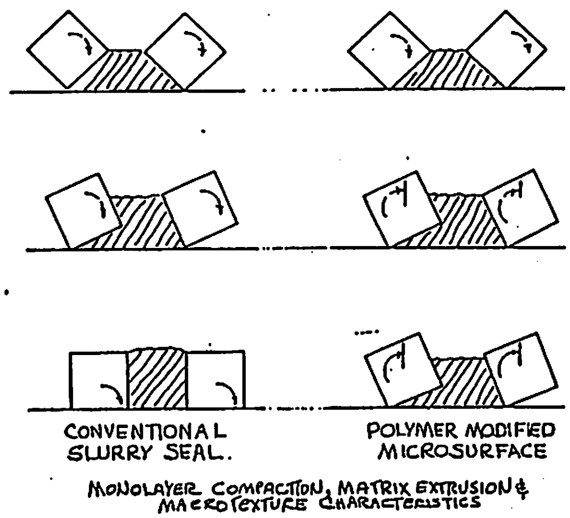


Figure 6. Monolayered slurry systems will typically lose macrotexture due to soft matrix extrusion as traffic compcats the mix; i.e., the larger aggregates assume their "most comfortable position". On the other hand, Polymod cold MACs resist compaction because of a matrix stiff enough to prevent complete compaction; more like mix consolidation rather than compaction.

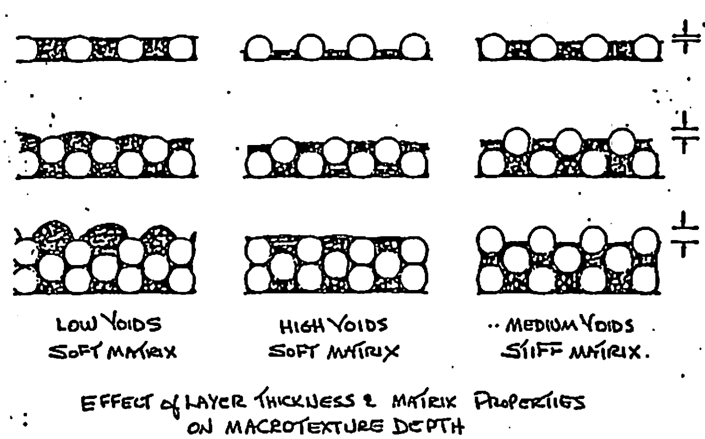


Figure 7. Multilayered soft matrix slurries lose macrotexture as layer thickness increases, while the stiff matrix cold MAC's macrotexture actually increases with layer thickness.

Figure 9 Compares 75 lb. applied load at ambient compaction or displacement characteristics of 3 different polymer systems with an unmodified plain system.

Figure 8.

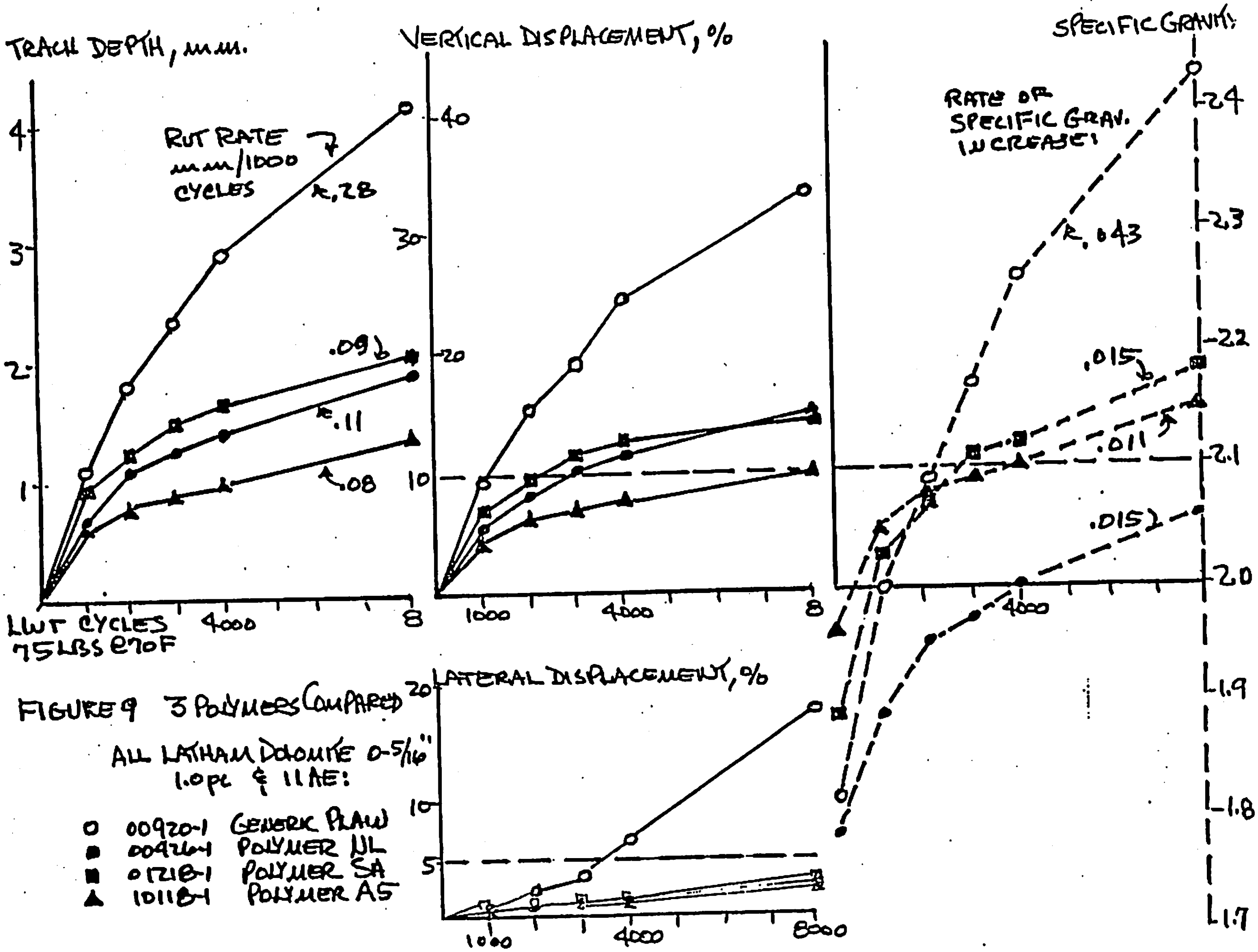
The tabular results are:

	PLAIN	SBR	NATURAL	A 5
1. Vertical Displacement, %	34	14	15	9
2. Lateral Displacement, %	18	3	2.5	2
3. Cycles to Steady Rate of Specific Gravity Increase	8000+	3000	2000	2000
4. Initial Specific Gravity	1.82	1.92	1.79	1.96
5. Specific Gravity at Beginning of Steady Rate Increase *	2.43+	2.11	1.92	2.09
6. Specific Gravity @ 8000 Cycles	2.43	2.18	2.06	2.15
7. Specific Gravity Rise at 8000	.61	.21	.27	.19
8. Steady Rate of Specific Gravity Increase /K cycles	.043	.015	.015	.011
9. Cycles to Steady Rut Rate or Track Depth	8000+	2000	2000	2000
10. Steady Rut/Track Rate, mm/k	.28	.09	.11	.08
11. Elastic Recovery, 7 Days (?) mm	.22	.17	.33	.16

* ASG = 2.77

Resistance to compaction is measured in the laboratory by traffic simulating devices, the Loaded Wheel Tester and the high temperature Wheel Tracking test. Both tests are rather severe and are intended to give accelerated answers.

Figure 9 clearly distinguishes between polymer modified microsurfacing materials and plain, unmodified materials. The rate of compaction in the unmodified system is .28mm/1000 cycles while the accelerated rate of compaction of the polymer modified materials are .08,.09,.13. At real world loads, the compaction rates become nearly "zero" while the unmodified materials continues compaction until all voids are closed and severe plastic deformation takes place and the pavement is destroyed. Note the high initial rate of compaction and the level of compaction constancy (=polymer effectiveness).



The answer to WHERE SHOULD Polymac Microsurfacing be used is:

1. Where multilayers are required (ruts, wedges, scratch and "sanitizing" or minor leveling)

2. Where long term macrotexture is required especially under heavy traffic.

3. Where additional "low temperature stretch" is desirable.

4. Where extended life is desirable.

We indicate the recently published ISSA Technical Bulletin #151 "Specification for Quick Traffic Polymer Modified Microasphalt Systems", which provides a list of laboratory test responses of successful applications.

Summary

The questions of when and where to use Polymer Modified Microasphalt surfaces are discussed. The author's conclusions are that these systems should be used on structurally sound pavements in need of surface maintenance where multilayer applications, especially under heavy traffic, are required.

INTERNATIONAL SLURRY SURFACING ASSOCIATION

TECHNICAL BULLETIN

1101 CONNECTICUT AVE., N.W., WASHINGTON D.C. 20036

No. 151
Proposed
January 1991

Specifications for Quick Traffic Polymer Modified Microasphalt Systems

Polymer Modified Microasphalt Systems should be: (1) capable of being spread in variably thick cross sections (wedges, ruts, scratch courses) which, (2) after initial traffic consolidation, resists further consolidation throughout the entire design bitumen and additive tolerance range and variable thicknesses encountered and (3) maintains good macrotexture in variably thick cross sections throughout the service life of the microasphalt surface.
It is the intent of this specification to consider only the laboratory performance of the ***total mix system.***

APPLICABLE REFERENCES

ISSA A-143	Recommended Performance Guidelines for Microsurfacing, January 1991
ISSA	Design Technical Bulletins - 1991
Gordillo, Gomez & Bada	"Proposal of Specifications for Polymer Modified Emulsions for Microsurfacing" Presented 27th ISSA Conv.-Kona, Hawaii Feb 1989

TESTS ON EMULSION RESIDUE

These tests and test parameters are presented for information only. The values presented have been found to fairly represent successful polymer modified binder properties but do not account for the important effects of the aggregate on the total mix system. See: Gordillo, et.al.

Penetration Index (P.I.) (Ring & Ball Softening Point vs. Penetration) ASTM D-36/2398, ASTM 3-5, NLT 124, NLT 125	>+1.50
Plasticity Interval (Fraas Brittle Point vs. R&B Softening Point) NLT 124, ASTM D-36/2398	>125°F
Elastic (Torsional) Recovery Caltrans Test No. 322	>30%
Tenacity Test (/Toughness-Tenacity)	20 kg. cm.

TESTS ON MICROASPHALT JOB MIX FORMULA

The design tests at optimum binder and additive contents should meet or exceed the following values:

Mix Time	ISSA TB 113	controllable to 120"
Wet Cohesion at 30'	ISSA TB 139	>12 kg. cm.
Wet Cohesion at 60'	ISSA TB 139	>20 kg. cm.
60°C Cured Cohesion	ISSA TB 139	>24 kg. cm.
Compatibility Classification Schulze-Breuer-Ruck	ISSA TB 145	>11 grade points, (AAA,BAA)
Wet Track Abrasion, C-100 Equivalent, (min. binder)	ISSA TB 100 ASTM D 3910	16.4g. loss 1-hour soak 24.5g. loss 6-day soak
Monolayer Loaded Wheel Test Sand Adhesion (max. binder)	ISSA TB 109	538g/m² max. (50g/ft² max.)
Multilayer Unconfined Loaded Wheel Displacement Tests at Ambient:	ISSA TB 147A	<10% vertical < 5% lateral
Rate of Specific Gravity Increase after Initial Consolidation	ISSA TB 147A	<.02 max/1000, 125-lb cycles
Compacted Density/Specific Gravity, Corrected to 2.65 ASG: 1000, 125 lb. cycles	ISSA TB 147A	<2.10
Voids in Total Mix, compacted		8-18%
Multilayer Unconfined Wheel Tracking Test Rutting Rate at 45°C (115°F) after Consolidation	ISSA TB 147B	<.15mm/1000 cycles
4°C Low Temperature Flexural Tension Test, 12.7 mm, 450-gram Sample	ISSA TB 144	>8.mm
Macrotexture, compacted		>1.00 mm