HOT MIX ASPHALT (HMA) THIN LIFT OVERLAY RESEARCH UPDATE

NEPPP Annual Meeting Enfield, Connecticut

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Presented By:

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OBJECTIVES

1. Development of Thin-Lift HMA Utilizing High Percentages of Recycled Asphalt Pavement (RAP) and Warm Mix Asphalt (WMA) Technology

2. Determining the Effect of Polymer Modified Asphalts on the Performance of Thin-Lift HMA



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THIN-LIFT WITH HIGH % RAP

Project Emphasis:

- 1. Mixture Stiffness in Terms of Dynamic Modulus |E*|
- 2. Mixture Workability



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THIN-LIFT WITH HIGH % RAP

Fractionated 4.75 mm NMAS RAP based on extracted dry aggregate gradation.





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THIN-LIFT WITH HIGH % RAP

Wax Additive WMA Technology (Sasobit®)

Added to Virgin Binder at Dosage Rate of 1.5% of Total Binder in Mix (RAP +Virgin)





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<u>Virgin Binders:</u> PG 64-28 PG 52-33 PG52-33 (w/ 1.5 %latex)

Note: 1.5% latex added by weight of total binder in selected PG52-33 mixes only.



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DYNAMIC MODULUS |E*| TESTING

Temperature	Frequency		
4°C	10 Hz, 1Hz, 0.1Hz		
20°C	10 Hz, 1Hz, 0.1Hz		
40°C	10 Hz, 1Hz, 0.1Hz, 0.01Hz		





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DYNAMIC MODULUS |E*| RESULTS -SUPERPAVE PG52-33



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DYNAMIC MODULUS |E*| RESULTS -SUPERPAVE PG64-28



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DYNAMIC MODULUS |E*| RESULTS -DISCUSSION

- 1. Data indicated that addition of RAP increased mixture stiffness at low, intermediate and high frequencies.
- 2. Error bars show standard error of the data. Significant difference occurs when error bars between specimens do not overlap.
- 3. Control and 15% RAP using the PG64-28 showed no-significant changes in mixture stiffness.



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MIX MASTER CURVE DEVELOPMENT

Dynamic Modulus |E*| data measured in the Asphalt Mixture Performance Tester (AMPT) device utilized to develop mix Master Curve.

Master Curve provides and indication of the performance of each mix at different temperatures and loading frequencies.

Comparison of mix Master Curves provides a measure to evaluate the performance of one mix versus another.



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MASTER CURVE COMPARISON SUPERPAVE - PG52-33



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MASTER CURVE COMPARISON SUPERPAVE - PG64-28







MASTER CURVE COMPARISON SUPERPAVE - 0% RAP



MASTER CURVE COMPARISON SUPERPAVE - 15% RAP



MASTER CURVE COMPARISON SUPERPAVE - 30% RAP



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MASTER CURVE COMPARISON SUPERPAVE - 50% RAP



WORKABILITY

Workability is significant to these mixes due to the high stiffness of the binder in the RAP and the amount of RAP being used in each mix.

Workability evaluation of each mix was conducted using the Asphalt Workability Device (AWD) designed and built by UMass Dartmouth.



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UMass Dartmouth PRISM – Asphalt Workability Device (AWD)

Patent Pending



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WORKABILITY - SUPERPAVE PG64-28



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CONCLUSIONS

1. Based on dynamic modulus data and master curves, the mixture stiffness increased as the amount of RAP increased. This potentially indicates that a degree of blending occurs between the virgin and RAP binder.

2. Mixtures prepared with the PG64-28 and PG52-33 incorporating 30% and 50% RAP had similar stiffness. This potentially indicates that the use of a softer PG52-33 grade for these mixtures had little effect on mixture stiffness.



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CONCLUSIONS (CONT'D)

3. Workability testing showed that the addition of WMA technology did not improve the workability of the mixtures with RAP. This indicates that a larger dose of WMA additive or the use of other WMA additives may be more appropriate for these types of mixes.



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POLYMER MODIFIED THIN-LIFT HMA

Project Emphasis:

- Development of 9.5mm and 4.75mm
 Superpave Mix Designs Using a Crushed
 Stone and Gravel Source
- Binder Testing (MSCRT, Elastic Recovery, PG Grade)



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POLYMER MODIFIED THIN-LIFT HMA

- 1. PG 64-28 without modification (Control)
- 2. PG 64-28 Poly-Phosphoric Acid (PPA) Modified
- 3. PG 64-28 SBR (Styrene-Butadiene Rubber) 2.0% Latex Modified
- 4. PG 76-22 SBS (Styrene-Butadiene-Styrene) Modified
- 5. PG 64-22 with 12% GTR
- 6. PG 64-34 SBS (Styrene-Butadiene-Styrene) Modified



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POLYMER MODIFIED THIN-LIFT HMA -9.5MM GRADATIONS



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POLYMER MODIFIED THIN-LIFT HMA -9.5MM GRADATIONS

Sieve Size	Crushed Stone "Fine"	Gravel "Fine"	Crushed Stone "Coarse"	Gravel "Coarse"	Superpave Specification
12.5 mm	100.0	100.0	100.0	100.0	100 min.
9.5 mm	99.0	100.0	98.4	99.0	90-100
4.75 mm	80.5	81.2	68.4	80.5	90 max.
2.36 mm	58.1	57.9	42.6	58.1	32-67
1.18 mm	39.9	42.6	29.1	39.9	a de la compañía de l
0.60 mm	27.2	30.7	20.0	27.2	
0.30 mm	17.5	19.9	13.0	17.5	
0.15 mm	10.5	10.9	8.0	10.5	
0.075 mm	6.6	6.3	5.2	6.6	2-10

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POLYMER MODIFIED THIN-LIFT HMA – 4.75MM GRADATIONS





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POLYMER MODIFIED THIN-LIFT HMA – 4.75MM GRADATIONS

Sieve Size	Crushed Stone	Gravel	Superpave Specification
12.5 mm	100.0	100.0	100 min
9.5 mm	99.6	100.0	95-100
4.75 mm	90.6	90.6	90-100
2.36 mm	73.5	69.2	and the second
1.18 mm	55.2	51.3	30-60
0.60 mm	39.1	37.0	
0.30 mm	22.2	23.8	
0.15 mm	11.0	12.9	
0.075 mm	6.8	7.4	6-12

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Tuesday October 21st, 2008





BINDER TESTING

Verification of Performance Grade (PG) of each binder in accordance with AASHTO and Superpave specifications.

Elastic recovery testing of each binder per AASHTO T301 (original & RTFO aged) & ASTM D6084 Method A (RTFO only).

Perform Multi-Stress Creep Recovery Test (MSCRT) on each binder.



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