NCHRP Project 9-40 Update Optimization of Tack coat for HMA Placement

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Research Team

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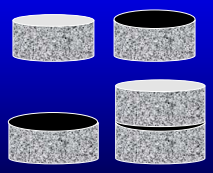
Outline

- Project Objectives
- Methodology
- Conduct Laboratory Experiment.
  - Tack Coat Quality
    - » Equipment Development
  - Interface Bond Strength
    - » Equipment Development
  - Calibration
    - » Computerized Tack Coat Distributor
  - Field/Laboratory Experiment
    - » Spray Of Emulsion
    - » Overlay Construction
- Preliminary Results



Project Objectives

- Determine for the various uses of tack coats
  - optimum application methods,
  - equipment type and calibration procedures,
  - application rates, and
  - asphalt binder materials
- Recommend revisions to relevant AASHTO methods and practices related to tack coats

Methodology

PHASE I

- Task 1: Literature Review
- Task 2: Design A Comprehensive Experiment To Study Tack Coat Variables
  - Identify Laboratory And Field Test Devices
  - Develop Laboratory Experiment To Evaluate Tack Coats
  - Develop Field Experiment To Evaluate Tack Coats
- Task 3: Prepare And Submit Interim Report

PHASE 2

- Task 4: Conduct Experiment Approved In Task 3
- Task 5: Recommend Test Methods, Criteria, And Construction Guidelines
- Task 6: Demonstrate The Use Of Recommended Test Methods And Construction Guidelines
- Task 7: Prepare Instructional Materials For A Training Course
- Task 8: Prepare And Submit Final Report

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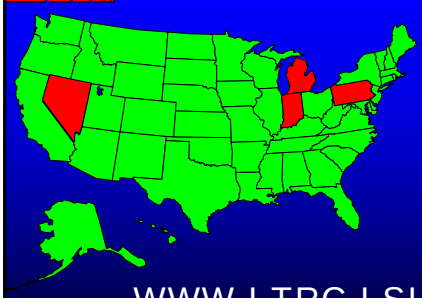
Task 1: Literature Review

- A worldwide survey was conducted to determine various tack coat practices
- Survey Objective
  - Collect information on the state of the practice related to:
    - » types of materials used for tack coats;
    - » dilution rates of tack coat materials;
    - » residual application rates;
    - » determination of rate for different types of surfaces;
    - » methods used for tack coat distribution; and
    - » pavement failures related to tack coat application
- Survey sections:
  - Tack Coat Materials
  - Tack Coat Application Methods
  - Characterization of Tack Coat Application
- 27 Questions

Literature Review - States Responded



- 46 state DOTs, Washington D.C.
- 5 Provinces in Canada.
- Other countries
  - Denmark
  - Finland
  - South Africa
  - Netherlands

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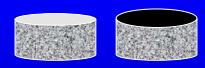
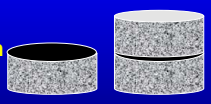
Development of Test Equipment

- Tack Coat Quality
  - » Equipment Development

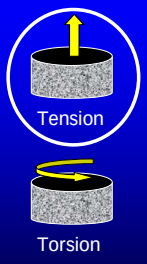


- Interface Bond Strength
  - » Equipment Development



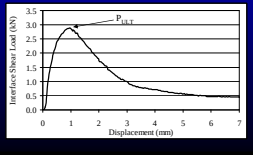
Measurement of Tack Coat Quality

- Force Application
  - Tension
  - Torsion
- Response
  - measured



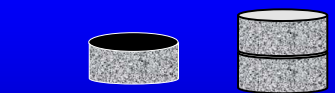
Measurement of Tack Coat Quality
Louisiana Tack Coat Quality Tester -- LTCQT

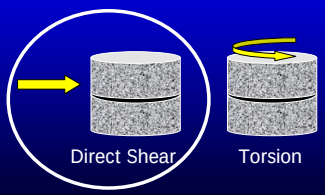
- Developed equipment
  - Updated ATacker
  - Tack coat quality
    - residual
  - Tension
- User friendly
- Easy to use
- Adopted
  - Laboratory and field
- Draft test method in AASHTO format is developed
- Tensile load
  - Displacement
  - Tensile Force
  - Time



Measurement of Interface Bond Strength

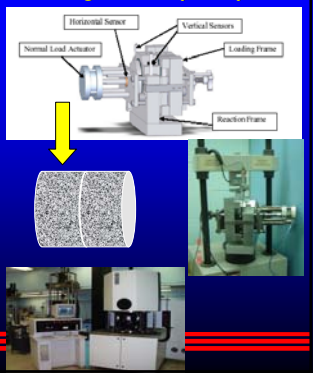
- Force Application
  - Direct shear
  - Torsion
- Response
  - Measured





Measurement of Interface Bond Strength Test Louisiana Interlayer Shear Strength Tester (LISST)

- Developed equipment
  - Interface Bond Strength Shear
- Easy to use
- Portable
- Adoptable to exiting load frames
- Reasonable cost
- Accommodate both 100 and 150-mm sample diameter
- Accommodate confinement
- Draft test method in AASHTO format



Experimental Test Factorial

- Variables and their ranges were carefully selected
  - through a worldwide survey
  - on the state of the practice
  - on the use of tack coats

Experimental Test Factorial

- Pavement surface types:
  - existing HMA, milled HMA, New HMA, and PCC
- Construction surface condition:
  - clean and dirty/dusty (before)
  - Wet and Dry (after)
- Tack coat material types
  - Hot AC
    - PG 64-22
  - Emulsion
    - CRS-1, Trackless, SS-1h, SS-1
- Application rates (residual):
  - high, medium, and low
- Surface coverages by tack coat:
  - 100% and 50%

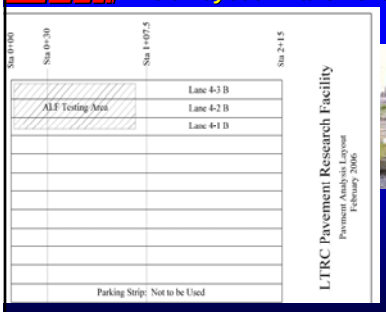
Experimental Test Factorial

Surface Type:	HMA					PCC			Milled	
Tack Coat Type	1	1	1	1	1	1	1	1	1	1
	PG 64-22	SS-1h	CRS-1	Trackless	No Tack	PG 64-22	SS-1h	SS-1	SS-1h	SS-1
Coverage Rate	2	2	1	1	1	1	1	1	1	1
	50 & 100%	50 & 100%	100%	100%		100%	100%	100%	100%	100%
Residual Rate (gal/yd²)	3	3	3	3	1	3	3	3	3	3
	0.031 0.062 0.155	0.031 0.062 0.155	0.031 0.062 0.155	0.031 0.062 0.155		0.031 0.062 0.155	0.031 0.062 0.155	0.031 0.062 0.155	0.031 0.062 0.155	0.031 0.062 0.155
Surface Condition	2	2	1	1	1	2	2	1	2	1
	Wet & Dry	Wet & Dry	Dry	Dry	Dry	Wet & Dry	Wet & Dry	Dry	Wet & Dry	Dry
Cleanliness	2	2	1	1	1	1	1	1	1	1
	High & Low	High & Low	High	High	High	High	High	High	High	High
Temperature	1	1	1	1	1	1	1	1	1	1
	77 °F	77 °F	77 °F	77 °F	77 °F	77 °F	77 °F	77 °F	77 °F	77 °F
Normal Load	2	2	2	2	2	2	2	2	2	2
	0 & 20 psi	0 & 20 psi	0 & 20 psi	0 & 20 psi	0 & 20 psi	0 & 20 psi	0 & 20 psi	0 & 20 psi	0 & 20 psi	0 & 20 psi
Replicates	3	3	3	3	3	3	3	3	3	3
Subtotal	144	144	18	18	6	36	36	18	36	18
Total	330					90			54	
Grand Total	474									

Specimen Preparation

- Bond Strength Test
- Full-scale test site was designed and constructed
  - LTRC Pavement Research Facility
- Selected tack coat materials were applied
  - computerized distributor truck on an existing HMA pavement surface
- Followed by the placement of a 75-mm HMA overlay.
- Cores were extracted

Field Layout – Pavement Research Facility

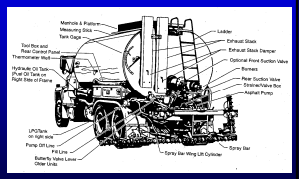


Survey of Test Lanes at the PRF

- Survey of the condition of the surface of the test lanes at the LTRC pavement research facility
  - identify and document surface irregularities
  - avoid them during the coring processes
- Surface texture measurement

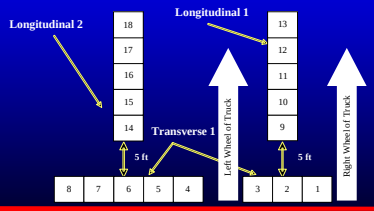
Distributor Truck Calibration

- Equipments
  - Asphalt Products Unlimited, Inc
  - Computerized tack coat distributor truck
  - Etnyre, Model 2000



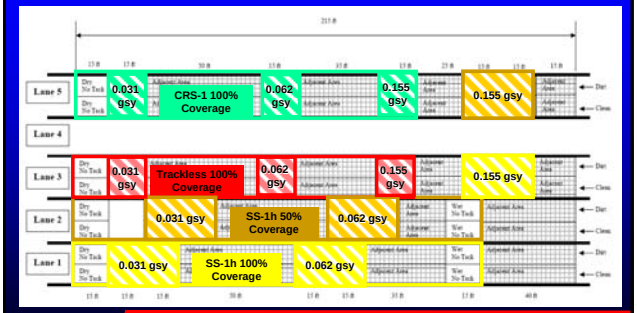
Distributor Truck Calibration

- Geotextile Pad layout
  - ASTM 2995
  - One transverse direction and two longitudinal directions



Distributor Truck Calibration

Lane Layout – Existing HMA Surface PRF



Spray of Emulsion

100% Coverage

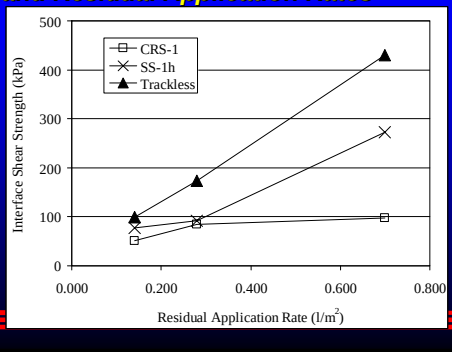
50% Coverage

Overlay Construction

Paved Lanes

Preliminary Results

Effect of Emulsified Tack Coat Types and Residual Application Rates



Summary

- Conducted a worldwide survey
  - determine various tack coat practices
- A direct shear device was developed
  - Louisiana Interlayer Shear Strength Tester (LISST)
  - Characterize the interface shear strength of cylindrical specimens
- Developed a method to measure the bonding characteristics of tack coat in the field
  - Louisiana Tack coat Quality Tester (LTCQT)
  - Field quality control
- Research is on-going
  - Determine for the use of various types of tack coats
  - optimum application rates for the various surfaces,
  - calibration procedures,
  - Prepare Instructional Materials For A Training Course

Acknowledgement

TRB TRANSPORTATION RESEARCH BOARD OF THE NATIONAL ACADEMIES

LOUISIANA DEPARTMENT of Transportation & Development DOTD

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  - Distributor Truck
  - SS-1h, CRS-1
- Costal
  - HMA Overlay
- Blacklidge
  - Trackless


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