Effect of Tack Coat Material type and Application Rate on the Bond Strength

Louay N. Mohammad, Ph.D.

Louisiana Transportation Research Center

Department of Civil and Environmental Engineering

Louisiana State University

9th Annual Meeting of the Association of Modified Asphalt Producers

February 11 - 13, 2008

Austin, Texas

Outline

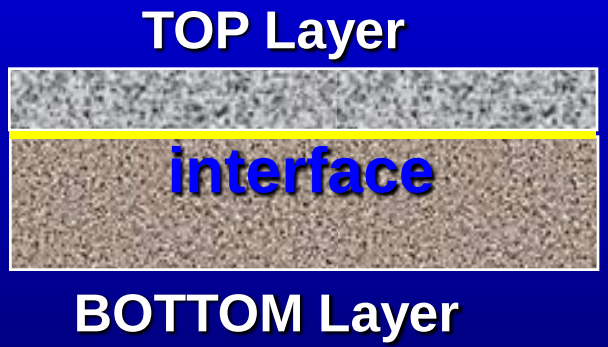
- Laboratory Controlled Study
  - Background
  - Objective
  - Scope
  - Methodology
  - Results
  - Conclusions
- NCHRP Project 9-40
  - Update

Acknowledgement

- Louisiana DOTD
- FHWA
- NCHRP

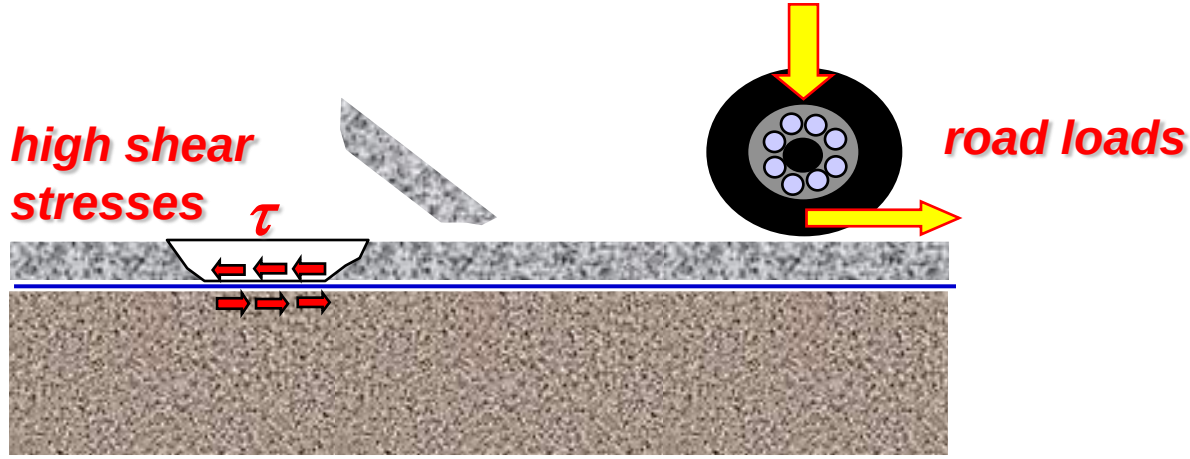
What is a Tack Coat?

- A light application of asphalt, usually asphalt diluted with water. It is used to ensure a *bond* between the surface being paved and the overlying course



What is NOT A BOND?

Loss of ADHESION and/or INTERLOCK at the interface:



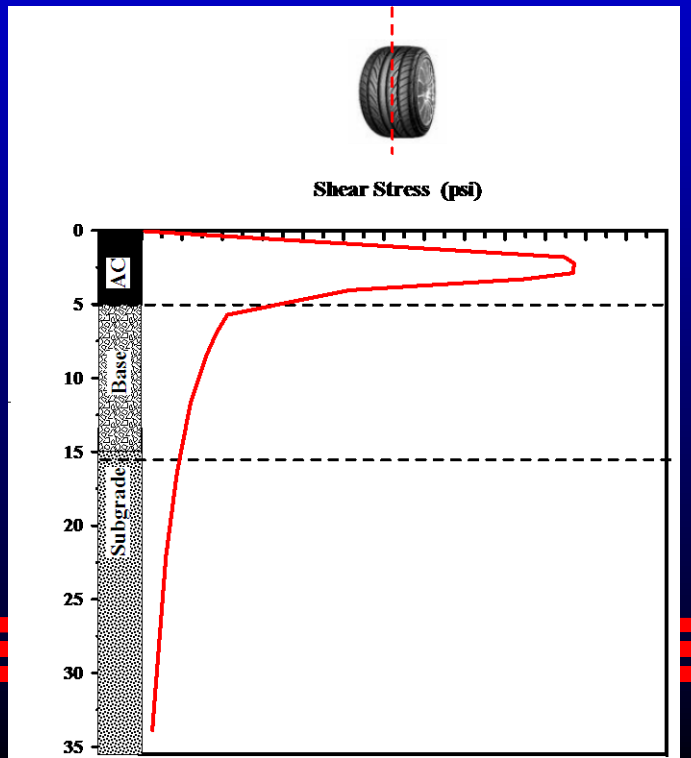
Long term pavement performance and durability can be affected by Debonding as well as Rutting and Cracking.

Common Tack Coat Materials

- Hot AC (AC-20, AC-30, …)
- Emulsified Asphalts (SS-1, SS-1h, CRS-2, CSS-1h, …)
- Cutback Asphalts (RC-70, RC-250, …)

Why is it Used?

- Tack coat is used to bind two pavement layers
- Monolithic structure to withstand/transfer shear stresses from traffic loading
- A strong tack coat binding between the layers is critical to transfer shear stresses into the entire pavement structure
- Lack of bond
  - slippage
  - activate distress mechanisms and rapidly lead to total failure



The Question Is?

1. **What Material Should Be Used?**
2. **What should be the optimum residual application rates?**

Objective

- Evaluate the current practice of using tack coats through controlled laboratory shear tests
- Examine the influence of tack coat types, application rates, and test temperatures on interface shear strength

Scope

- 19 mm Mix
-

Tack Coat Materials	
Emulsions	CRS-2P
	SS-1
	CSS-1
	SS-1h
Asphalt Cements	PG 64-22
	PG 76-22M

-

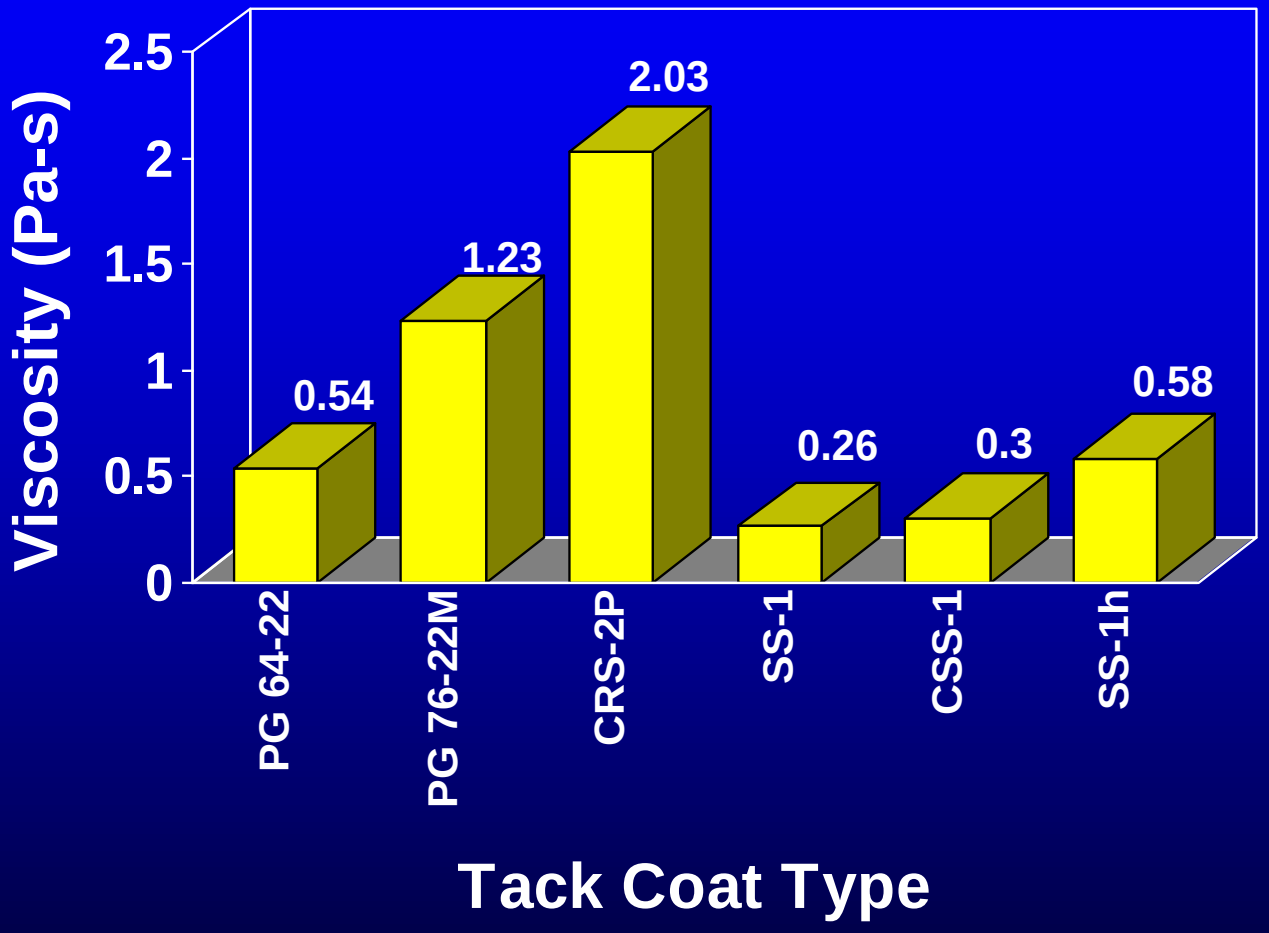
Application Rates	
l/m²	gal/yd²
0.00	0.00
0.09	0.02
0.23	0.05
0.45	0.10
0.90	0.20

-

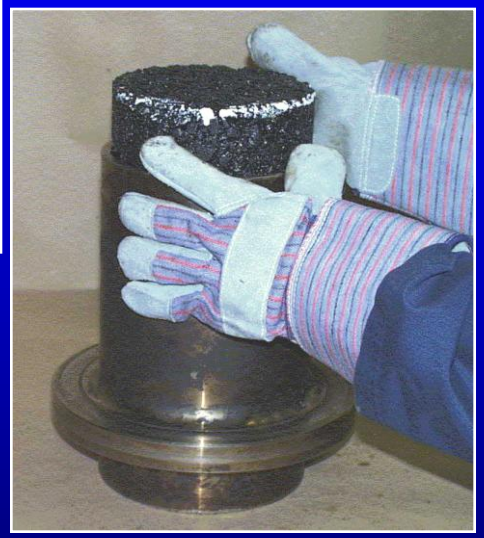
Test Temperatures	
°C	°F
25	77
55	131

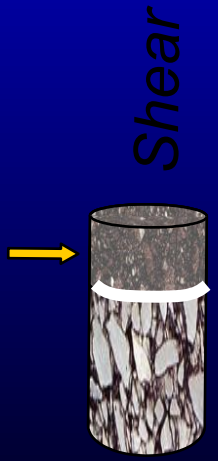
- Triplicate samples
- 156 samples

Viscosities of Tack Coats at 135°C

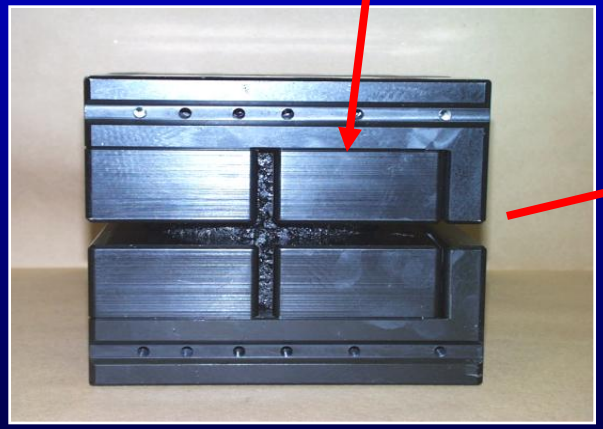


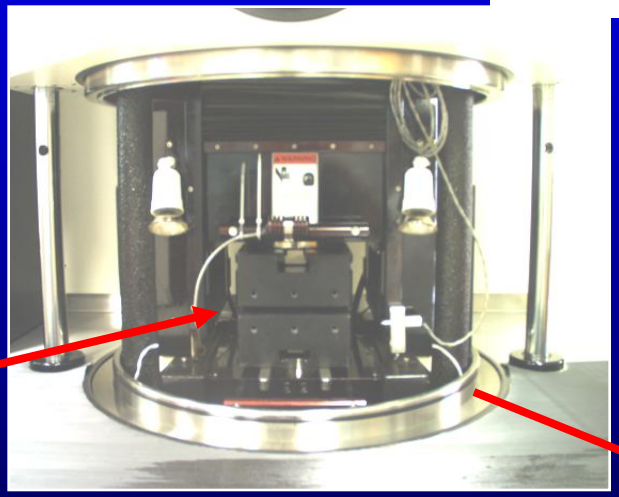
Sample Preparation

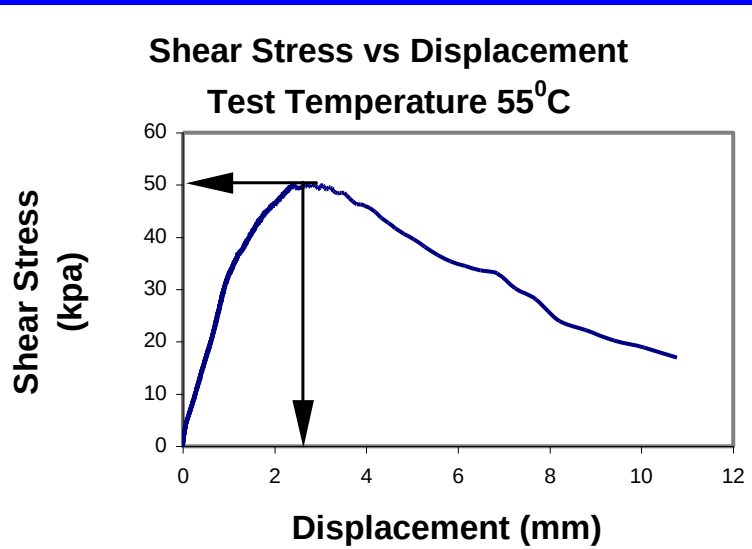




Test Procedure





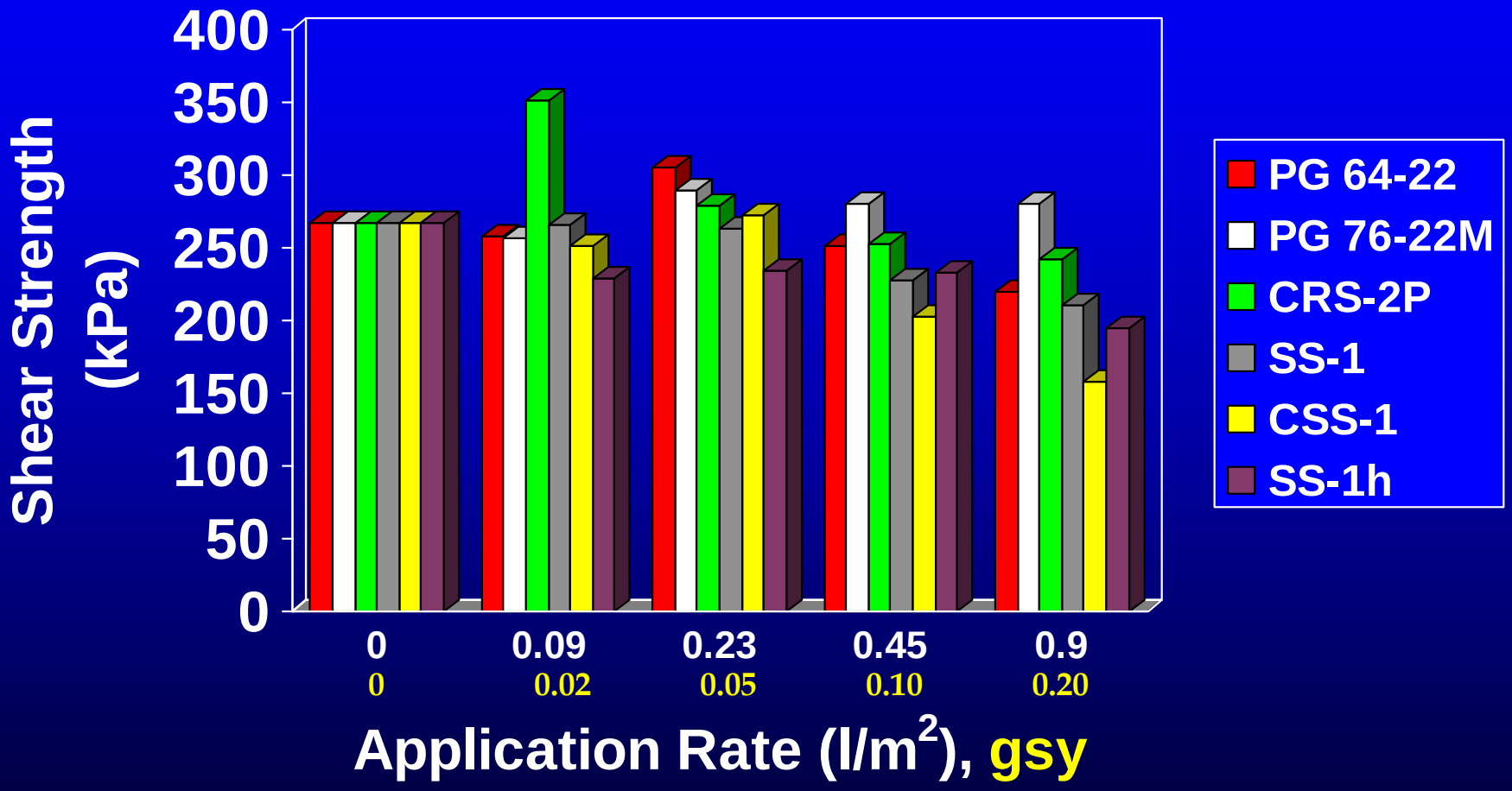


50 lb/min until failure

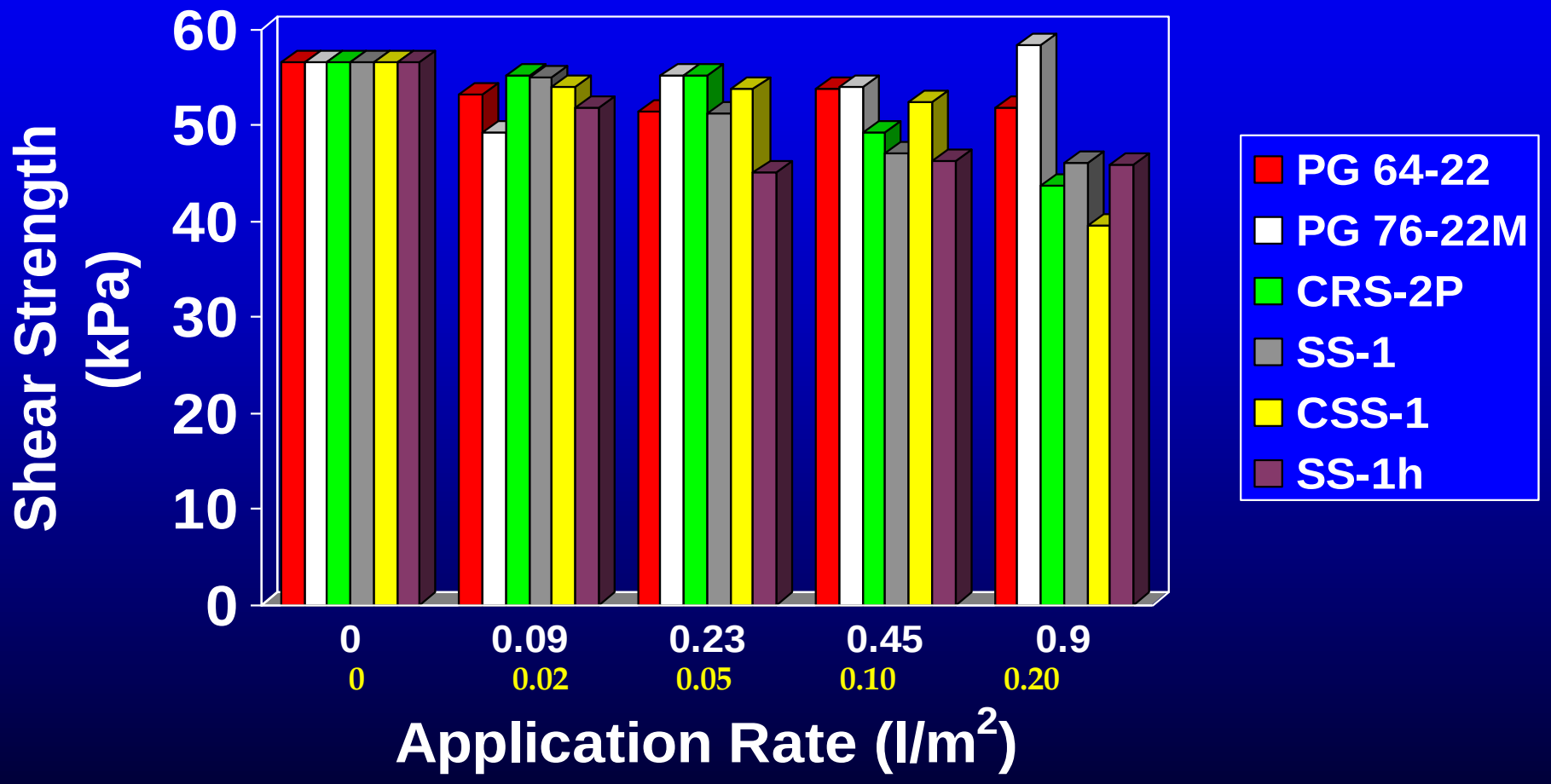
Data Analysis

- A multiple comparison procedure
  - Fisher's Least Significant Difference
  - 95% confidence interval
  - Ranking

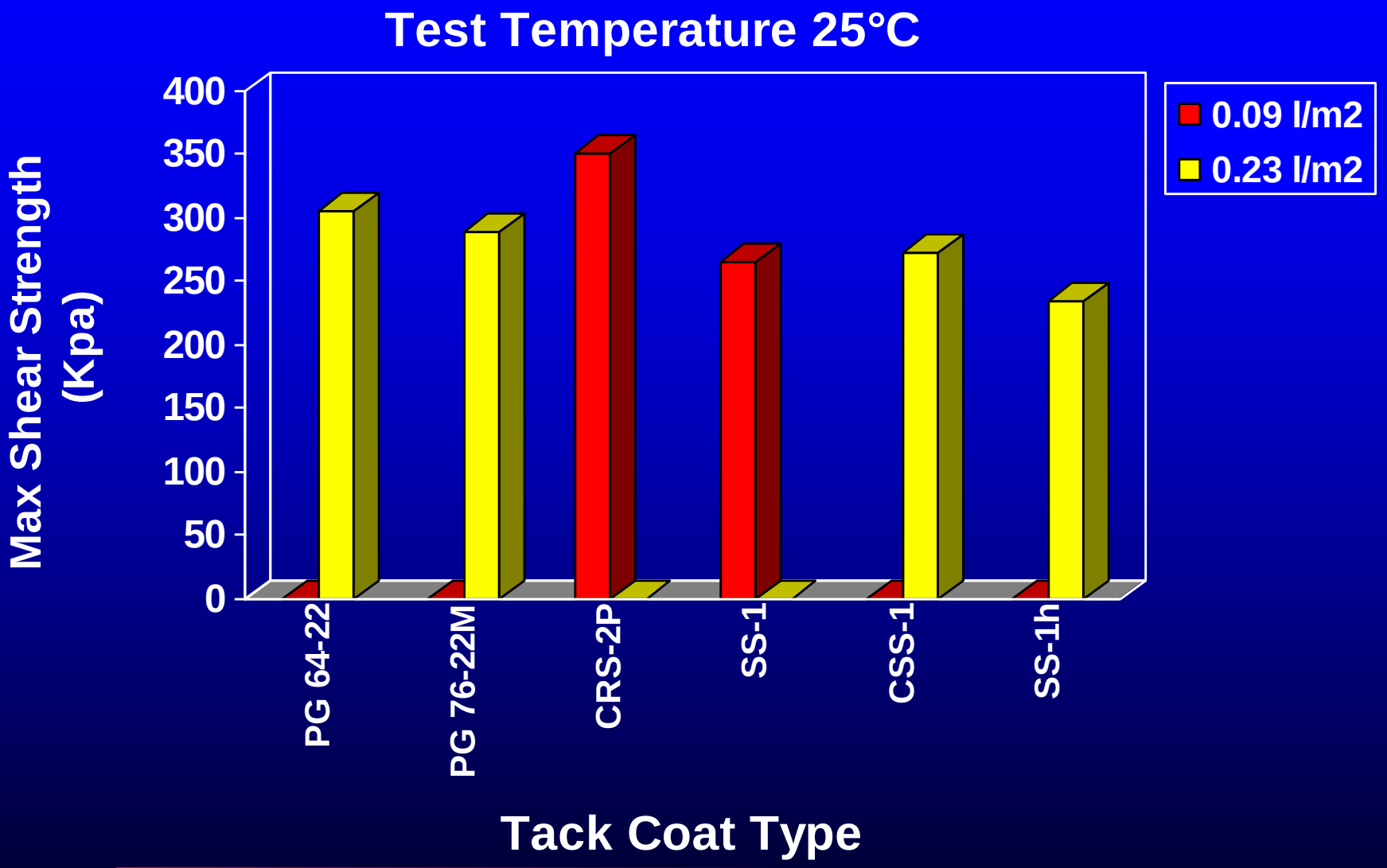
Variation of Shear Strength Versus Application Rate at 25°C



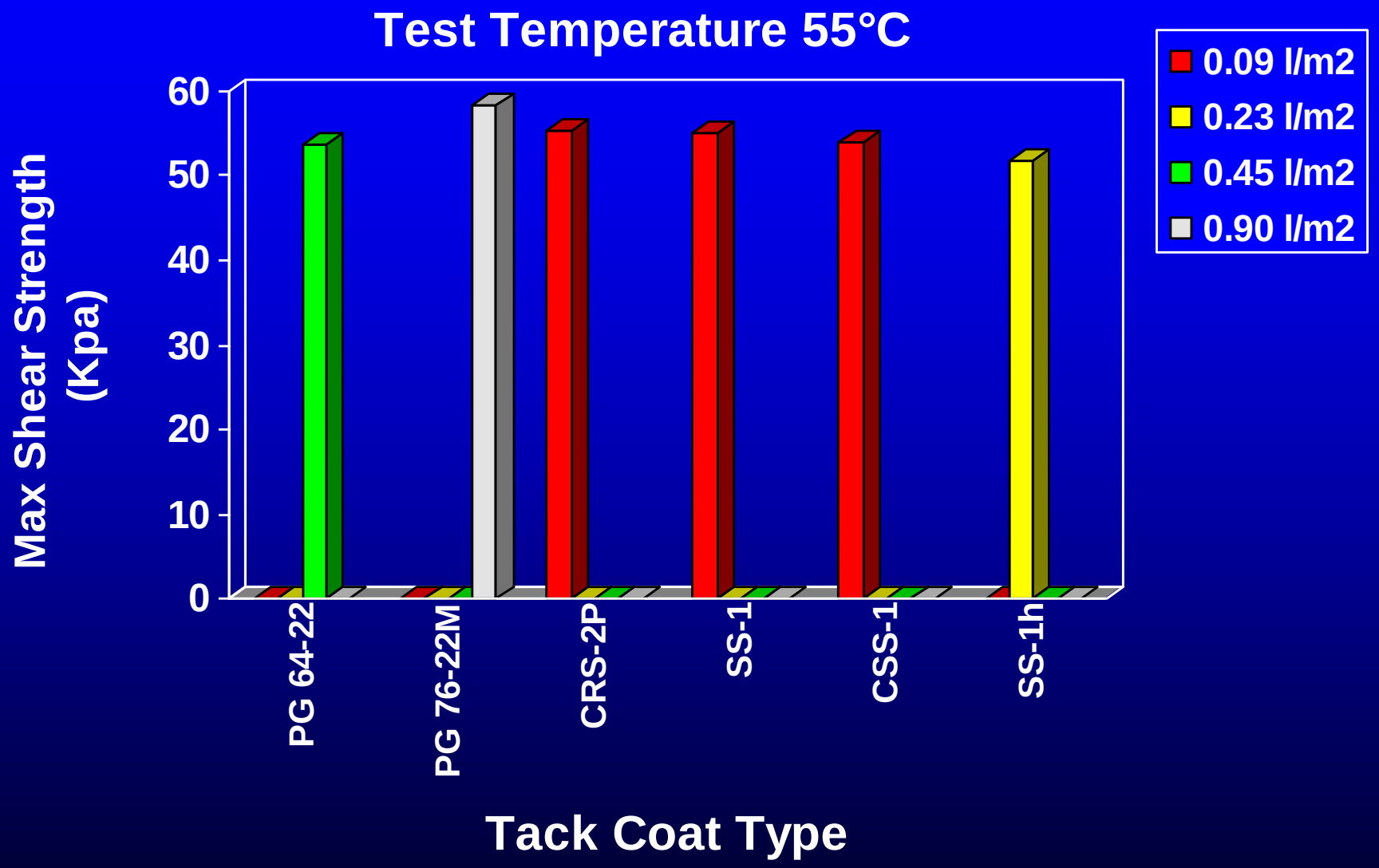
Variation of Shear Strength Versus Application Rate at 55°C



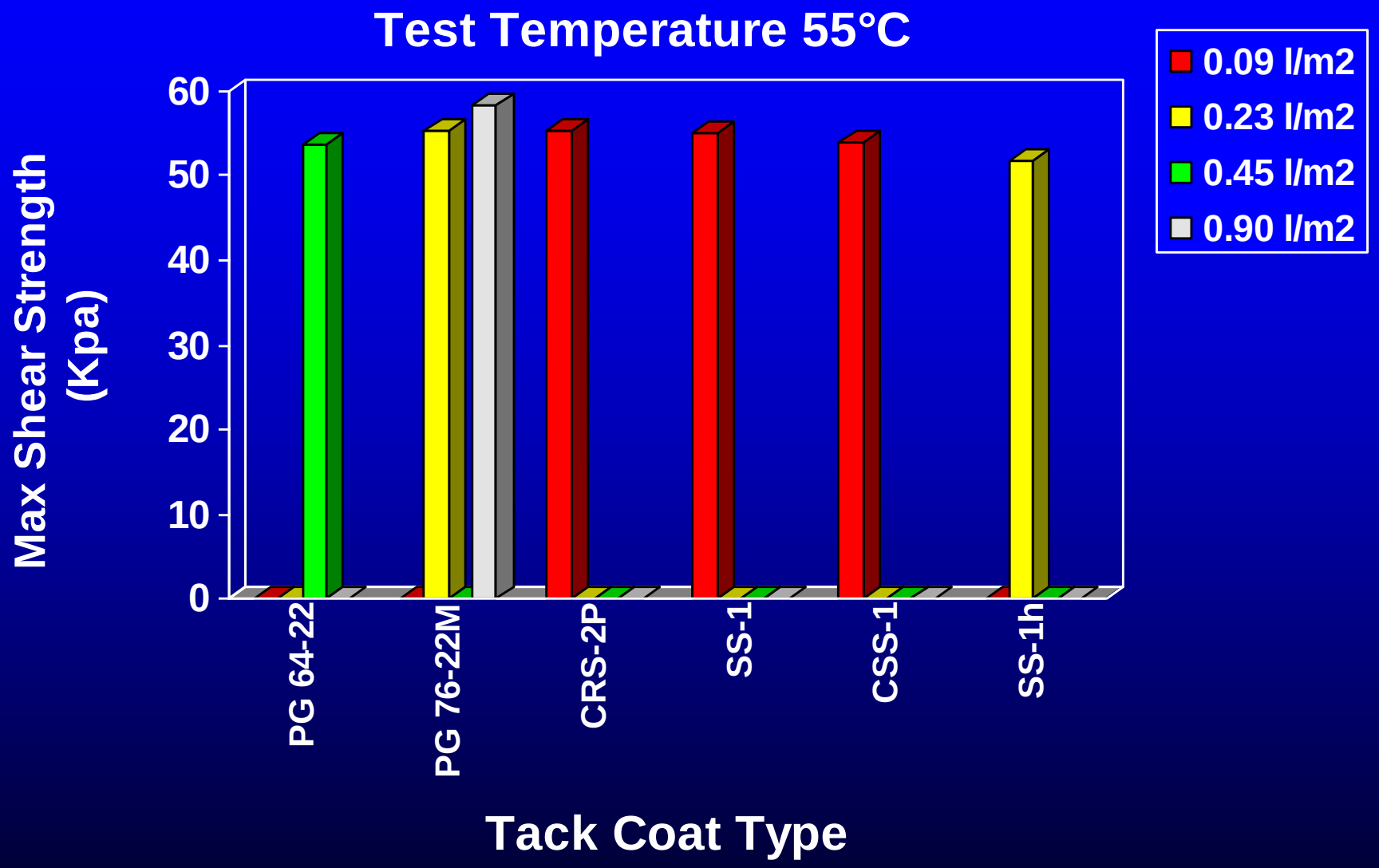
Maximum Interface Shear Strength



Maximum Interface Shear Strength



Maximum Interface Shear Strength



Summary and Conclusions

- Controlled laboratory simple shear tests
  - optimum application rate
- The influence of tack coat types, application rates, and test temperatures on the interface shear strength
- Among the six different tack coat materials used, CRS 2P emulsion was identified as the best performer
- Optimum application rate for CRS 2P emulsion was 0.09 l/m^2 (0.02 gal/yd^2)
- At 25C, increasing the tack coats application rates generally resulted in a decrease in interface shear strength
- At 55C, the interface shear strength was not sensitive to the application rate
- CRS 2P at the optimum application rate provided only 83 percent of the monolithic mixture shear strength
- Suggests that the construction of flexible pavements in multiple layers introduces weak zones at these interfaces

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

- **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**

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

PHASE I

- **Task 1 - Conduct a review of the worldwide state of practice**
- **Task 2 - Design a comprehensive experiment**
- **Task 3 - Interim Report**

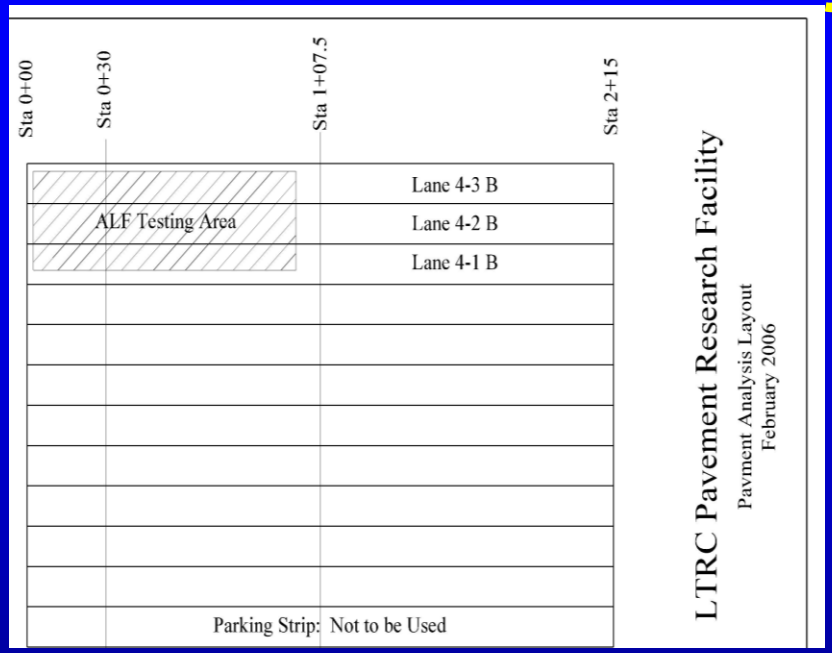
PHASE II

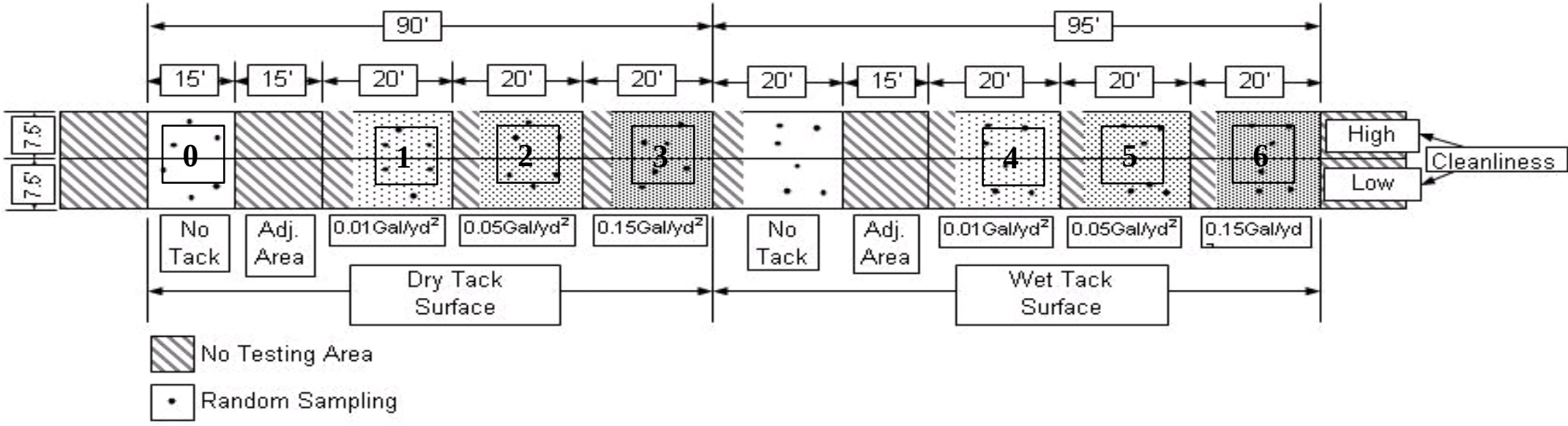
- **Task 4 - Conduct Experiment Approved In Task 3**
- **Task 5 - Recommend Test Methods, Criteria, and Construction Guidelines**
- **Task 6 - Demonstrate the Use of Recommended Test Methods and Construction Guidelines**
- **Task 7- Prepare Instructional Materials for a Training Course**
- **Task 8 - Prepare And Submit Final Report**

NCHRP Project 9-40 Factors

- Pavement surface types
  - existing HMA, milled HMA, PCC
- Two tack coat material types:
  - hot AC and emulsion
- Pavement surface coverages by tack coat:
  - 100% and 50%
- Three application rates
  - high, medium, low
- Two surface textures:
  - high and low
- Two permeability levels:
  - high and low
- Two surface cleanliness:
  - clean and dirty/dusty

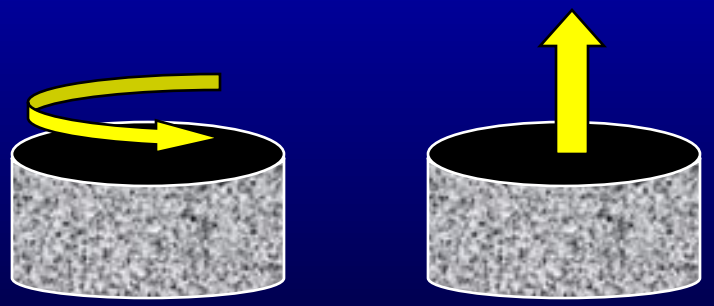
NCHRP Project 9-40
Field-Laboratory Experiment





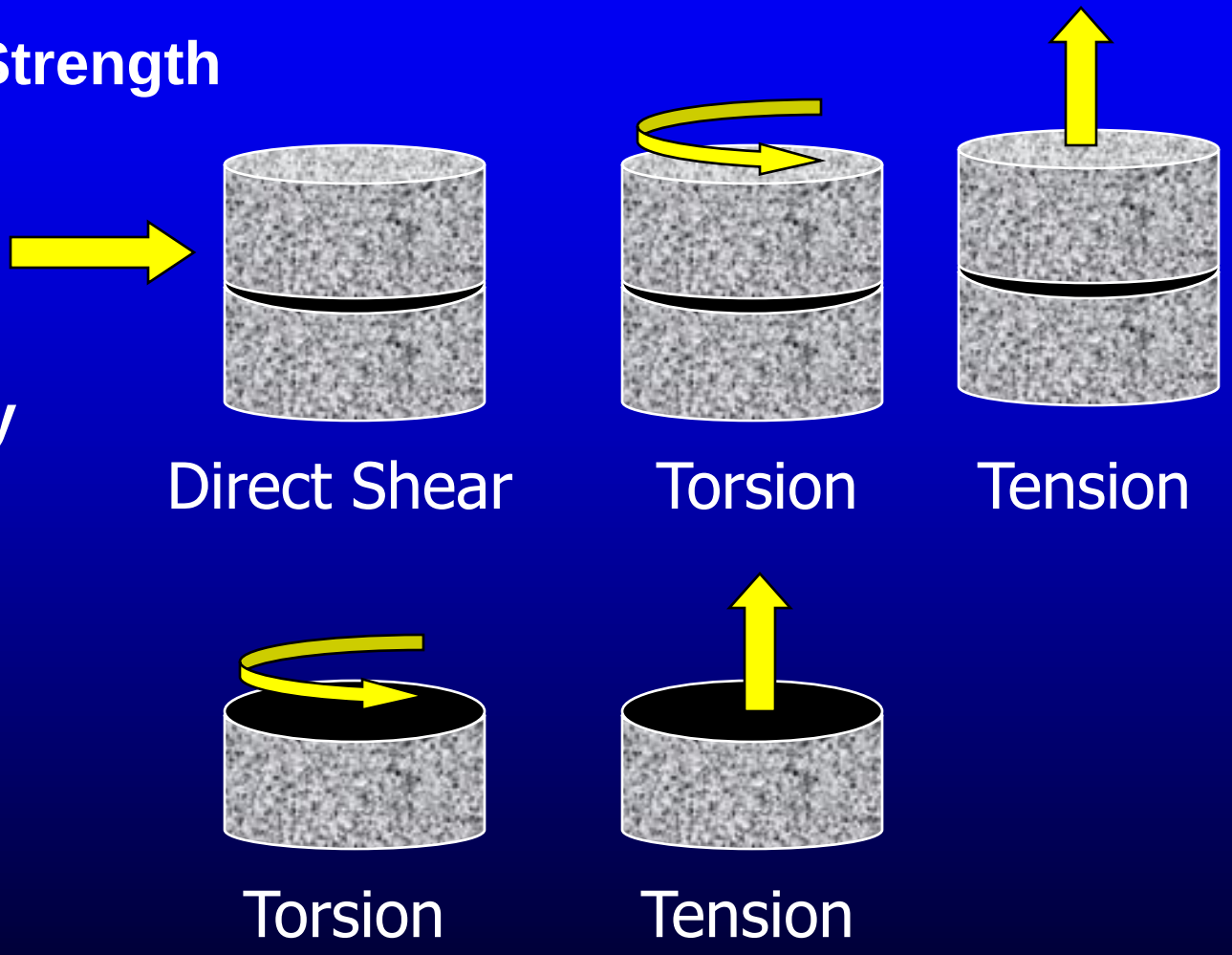
Characterization
Tack Coat Quality

- **Tack Coat Quality**



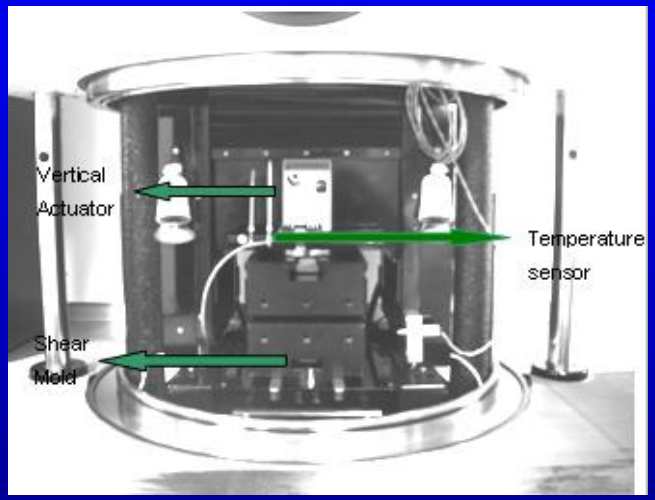
Characterization
Interlayer & Tack Coat Quality

- **Interlayer Bond Strength**
- **Tack Coat Quality**



Characterization of Tack Coat Interface Bond Strength Tests

- Candidates
- Direct Shear

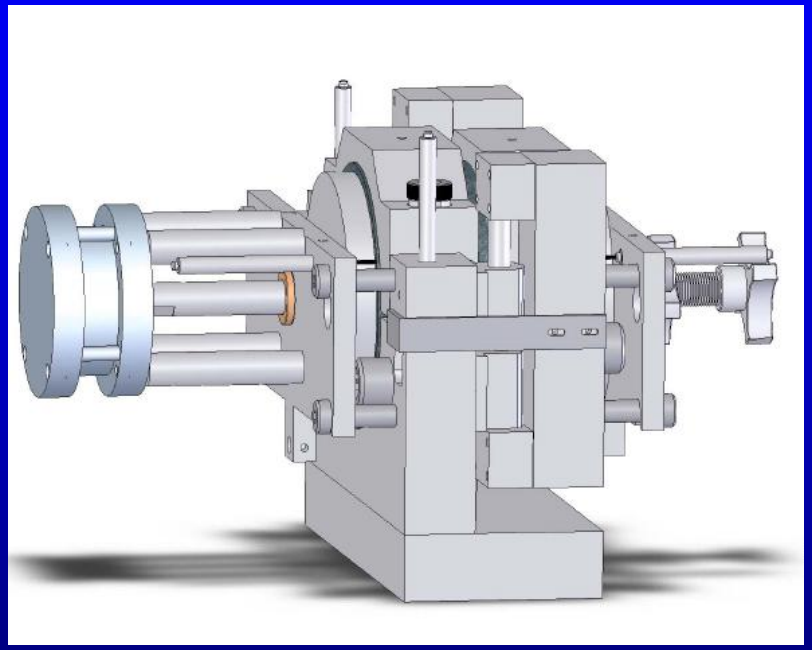


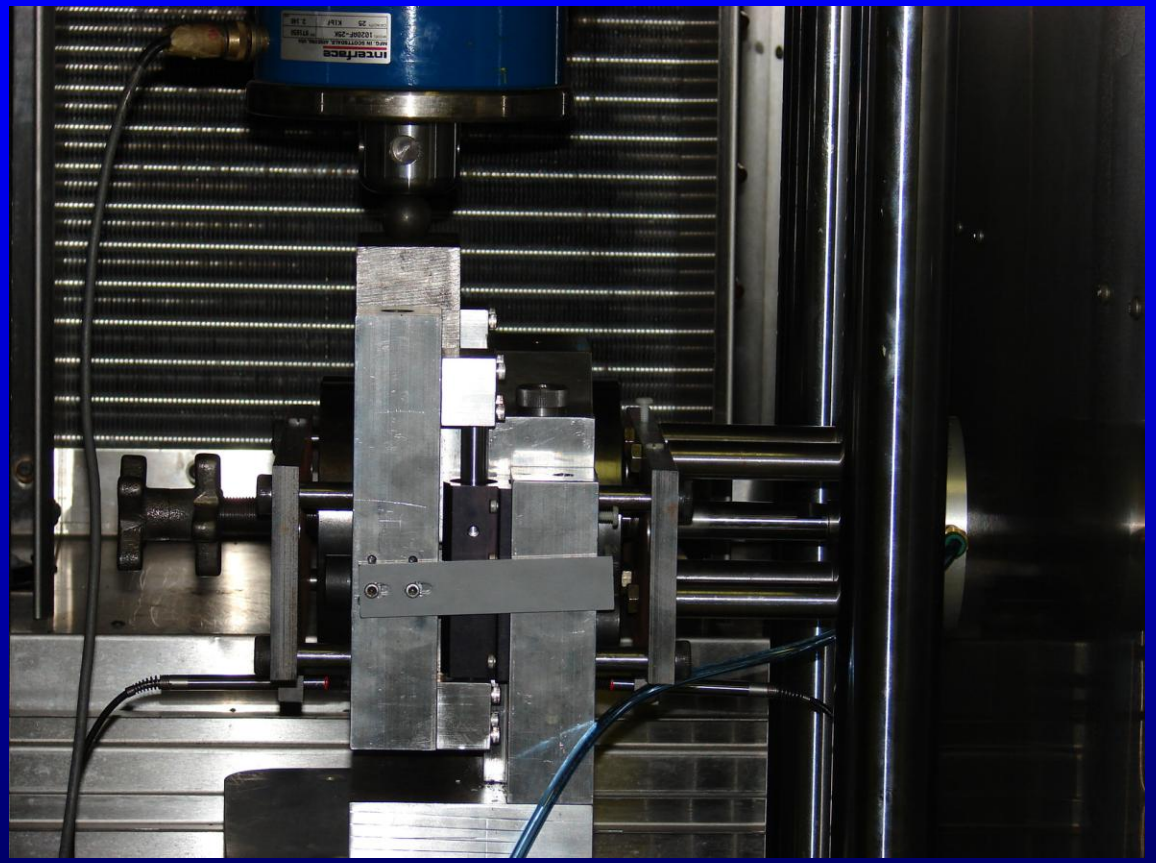
LTRC Shear Test

Overlay Bond Strength Tester

NCAT Direct Shear Test

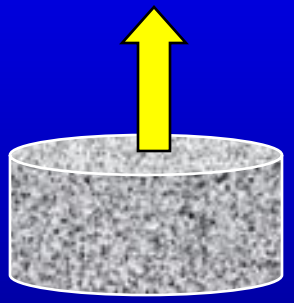
Characterization of Interface Bond Strength
Louisiana Interlayer Shear Strength Tester





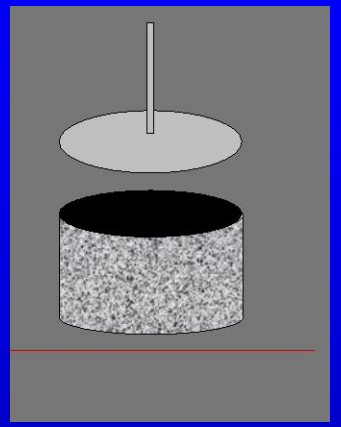
Characterization of Tack Coat Film Quality Tests

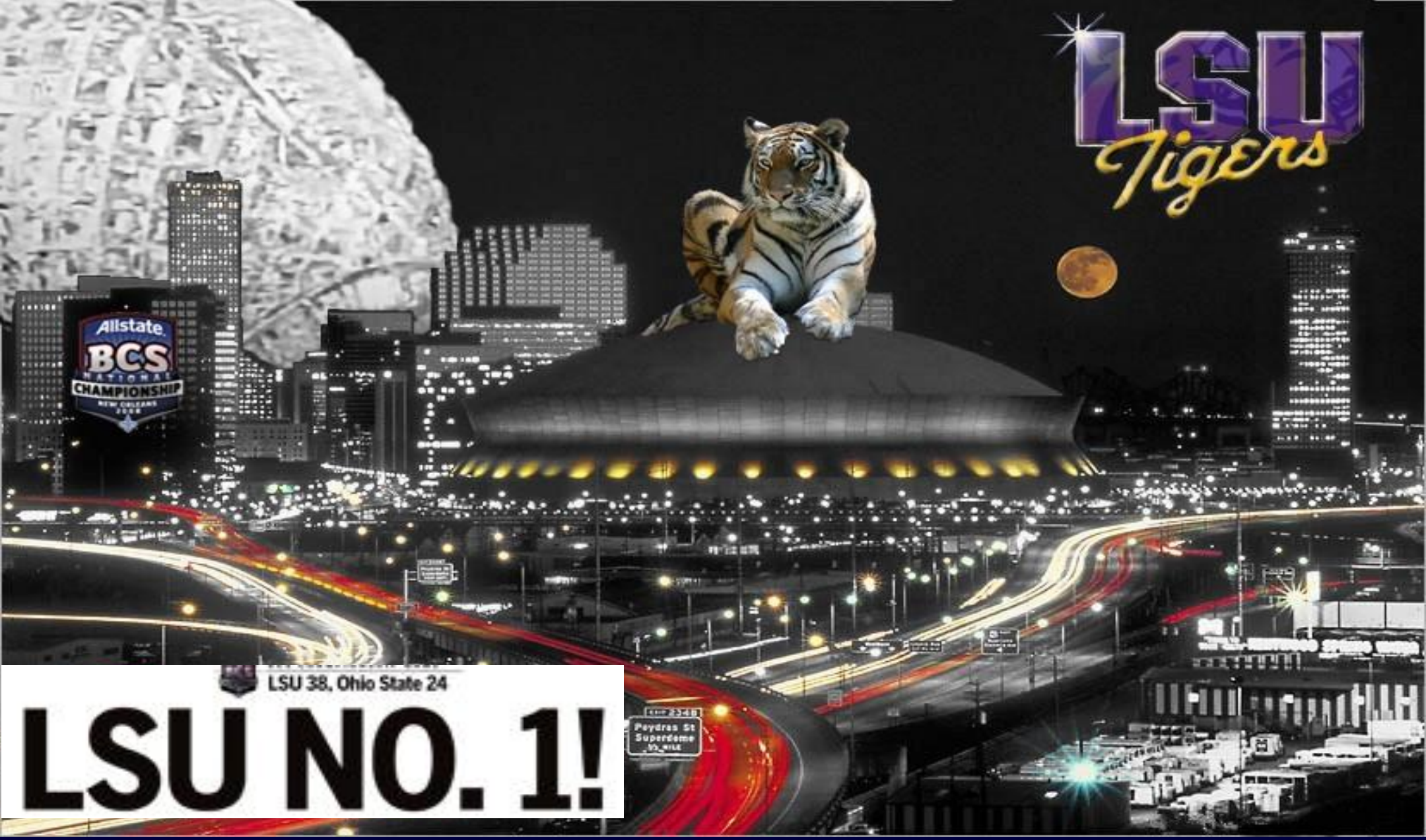
- Candidate
- Modified ATacker



Atacker Tensile/Torsion Test

Characterization of Tack Coat Quality ATacker

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