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


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# Outline

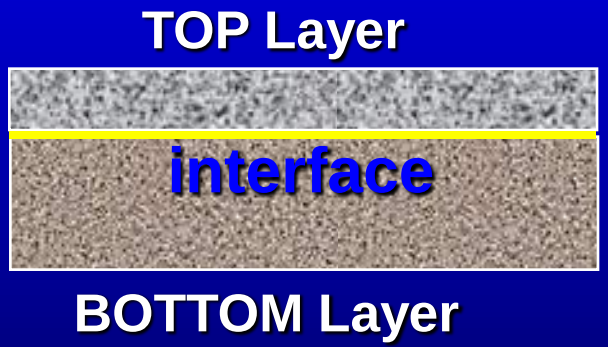
- Laboratory Controlled Study
  - Background
  - Objective
  - Scope
  - Methodology
  - Results
  - Conclusions
- NCHRP Project 9-40
  - Update

# *Acknowledgement*


- Louisiana DOTD
- FHWA
- NCHRP

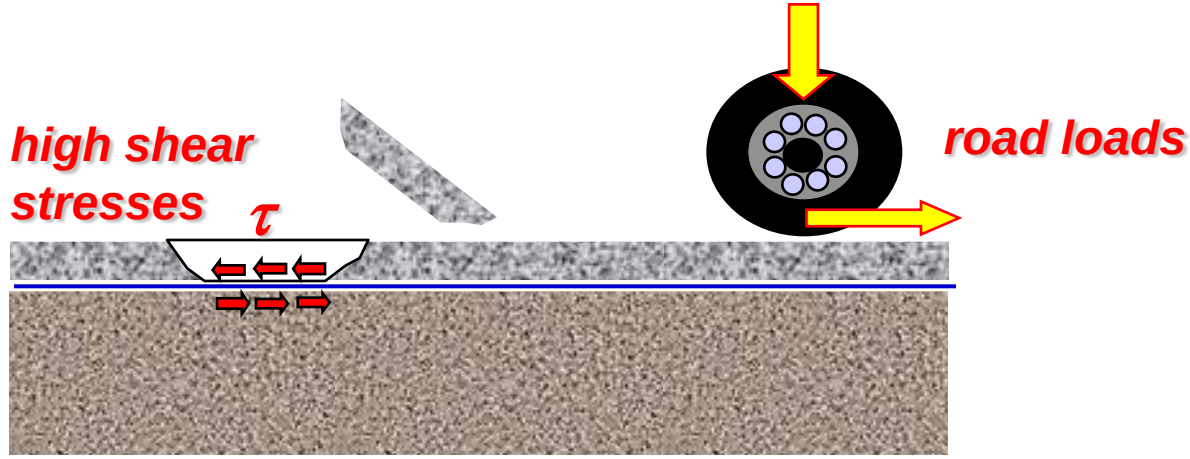
# What is a Tack Coat?

- 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:**

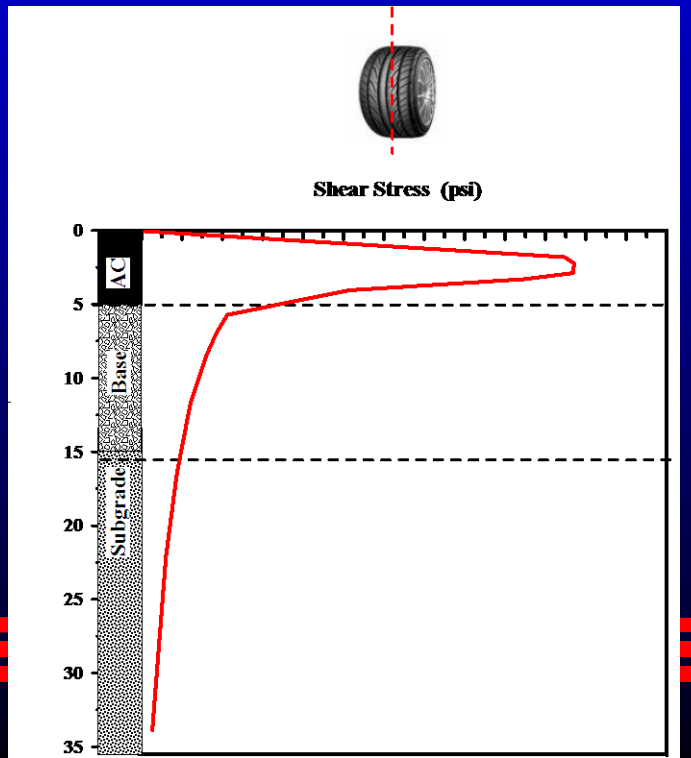

**Long term pavement performance and durability can be affected by Debonding as well as Rutting and Cracking.**

# 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 |

- 

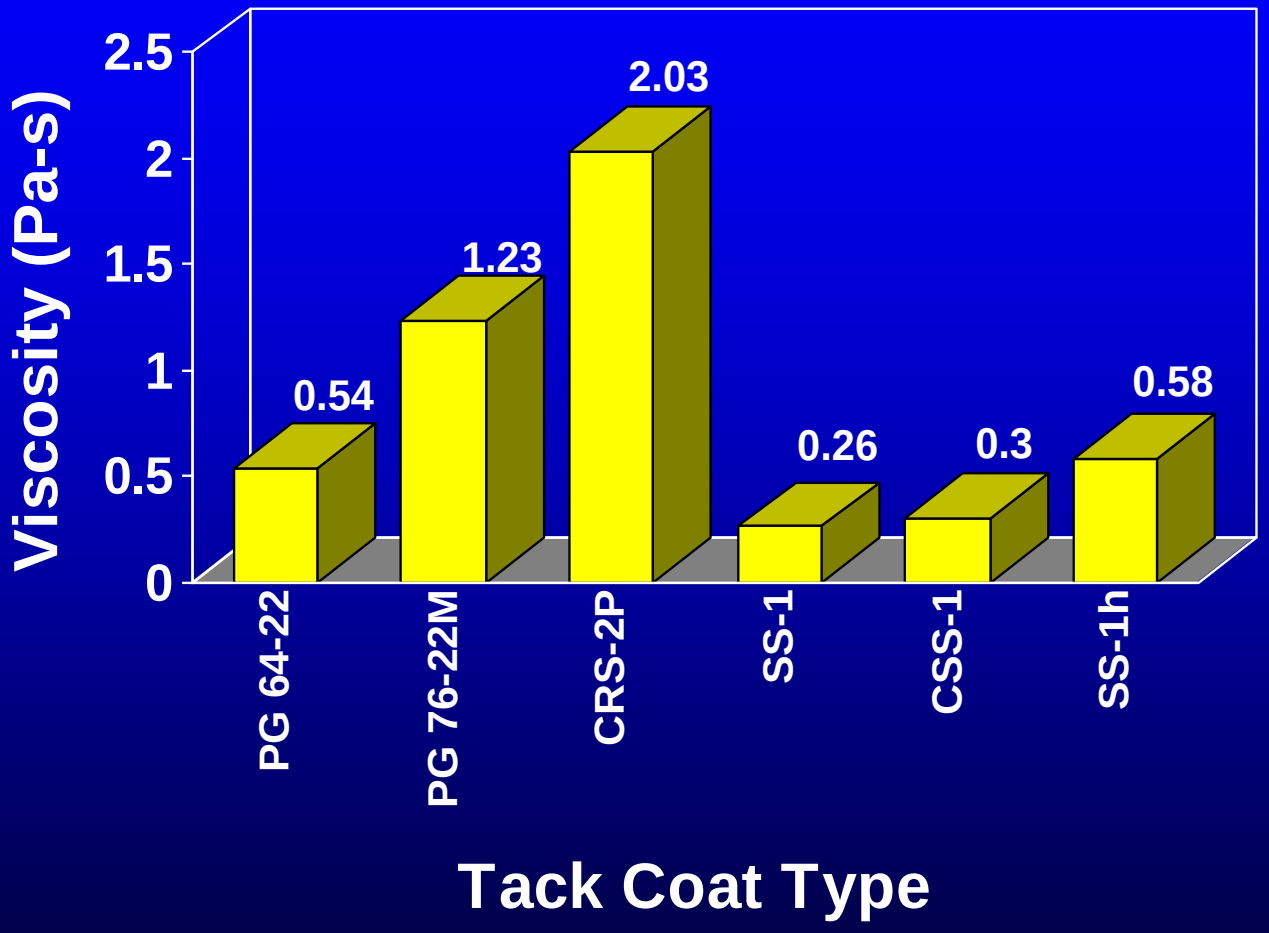
| Application Rates | |
|---|---|
| l/m² | gal/yd² |
| 0.00 | 0.00 |
| 0.09 | 0.02 |
| 0.23 | 0.05 |
| 0.45 | 0.10 |
| 0.90 | 0.20 |

- 

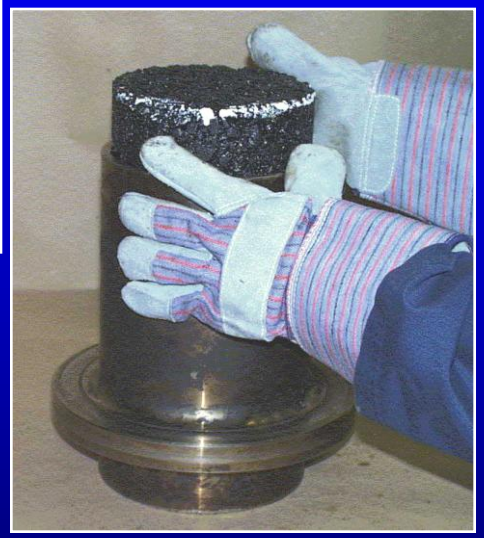
| Test Temperatures | |
|---|---|
| °C | °F |
| 25 | 77 |
| 55 | 131 |

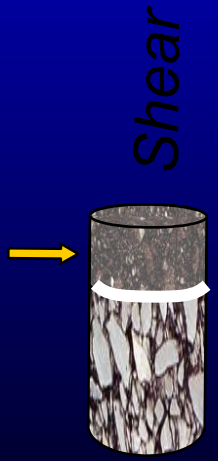
- Triplicate samples
- 156 samples

# Viscosities of Tack Coats at 135°C

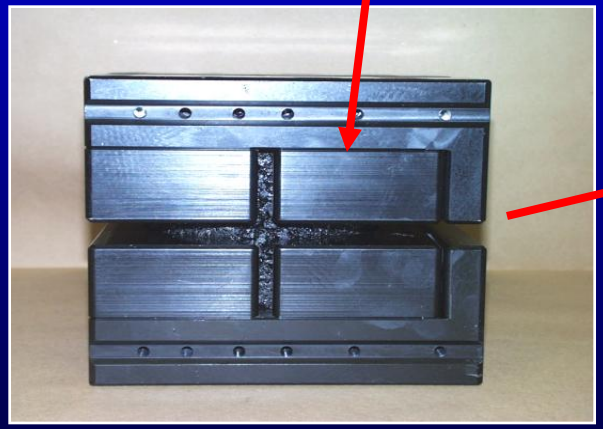


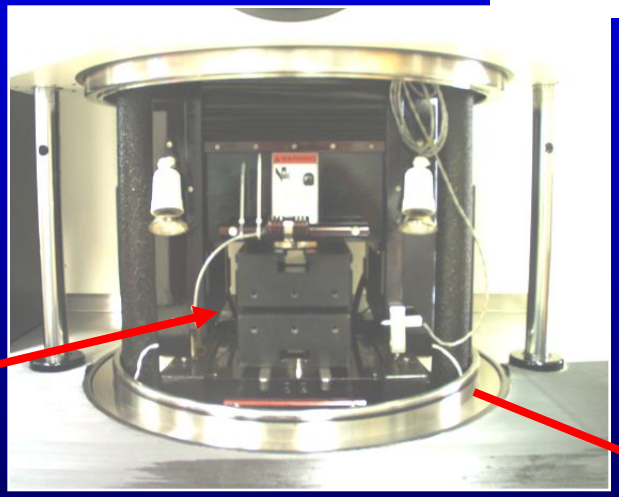
# Sample Preparation

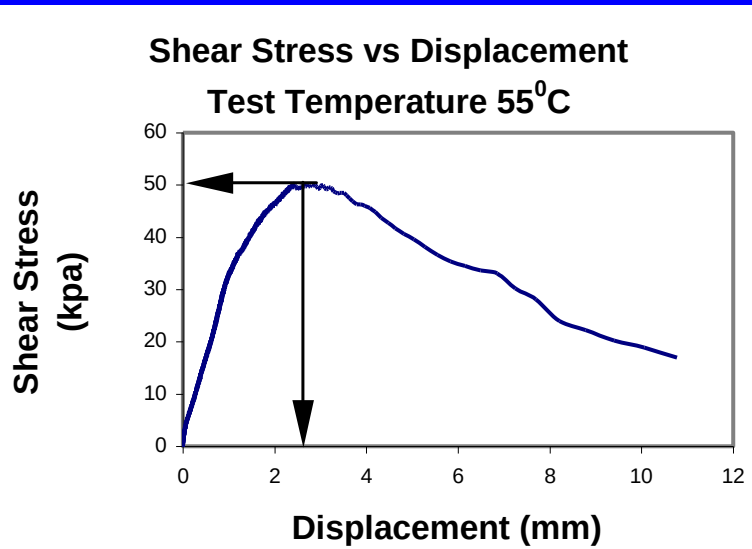




# Test Procedure





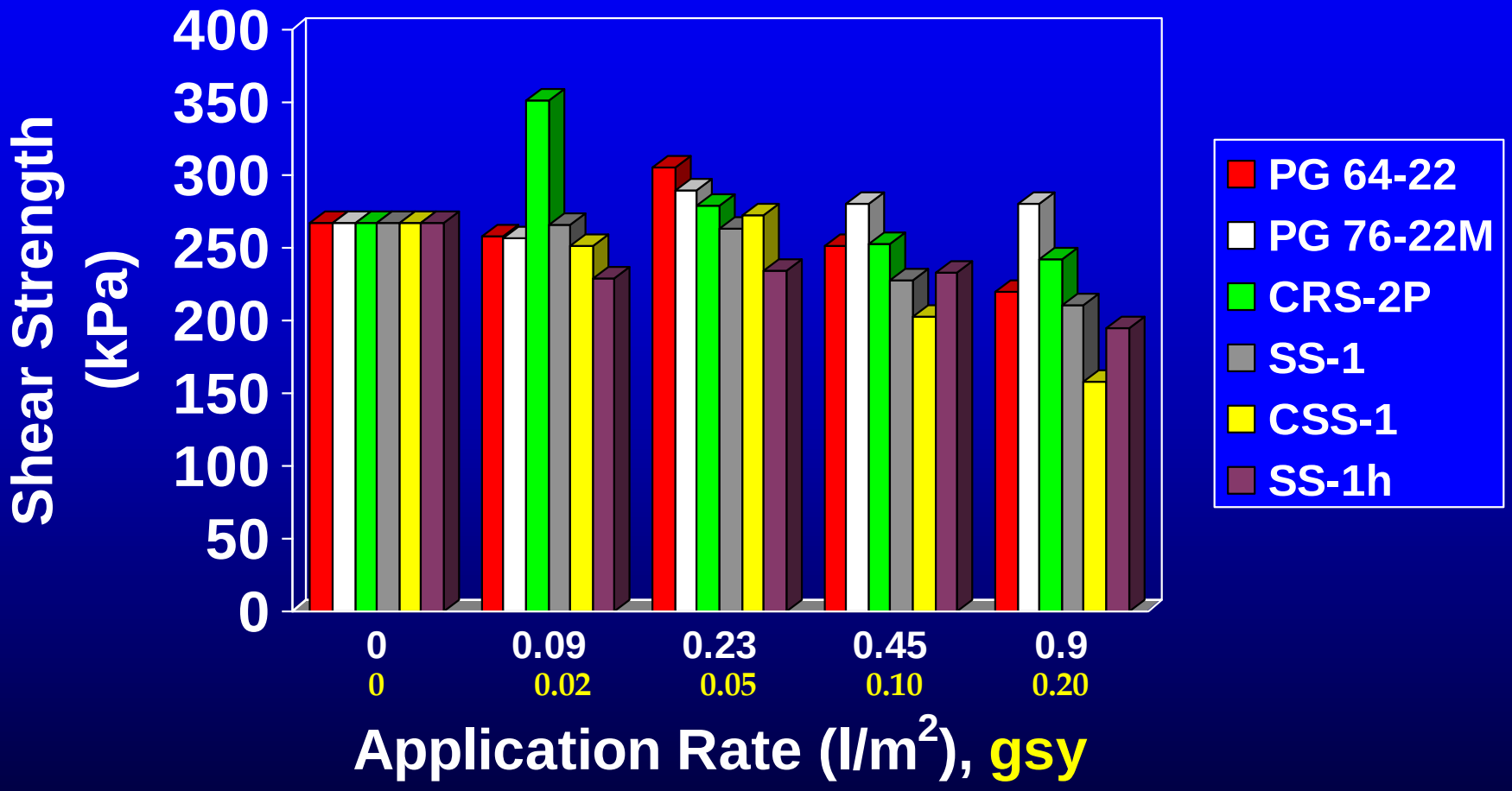



*50 lb/min until failure*

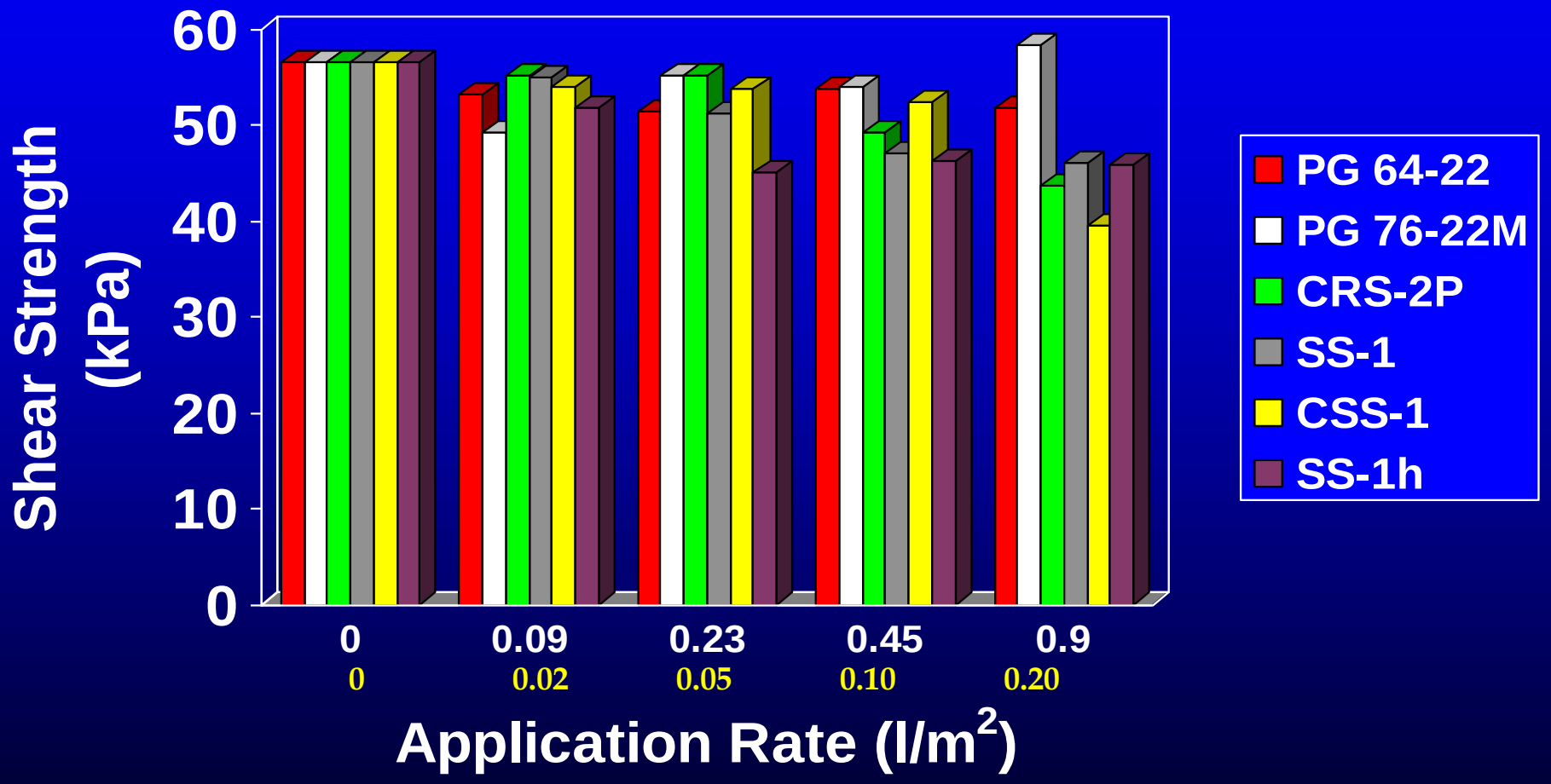
# Data Analysis

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

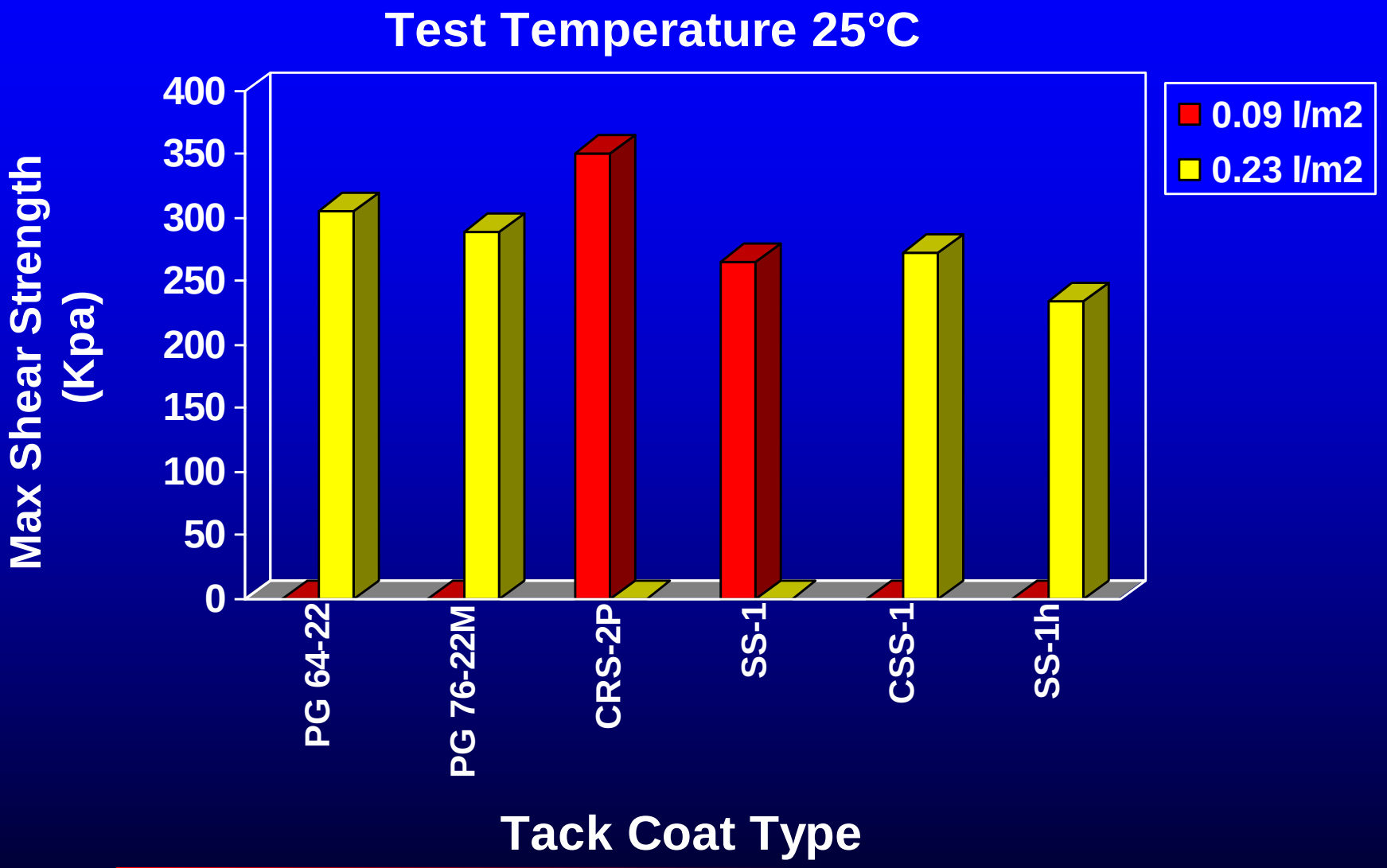
# Variation of Shear Strength Versus Application Rate at 25°C



# Variation of Shear Strength Versus Application Rate at 55°C



# Maximum Interface Shear Strength



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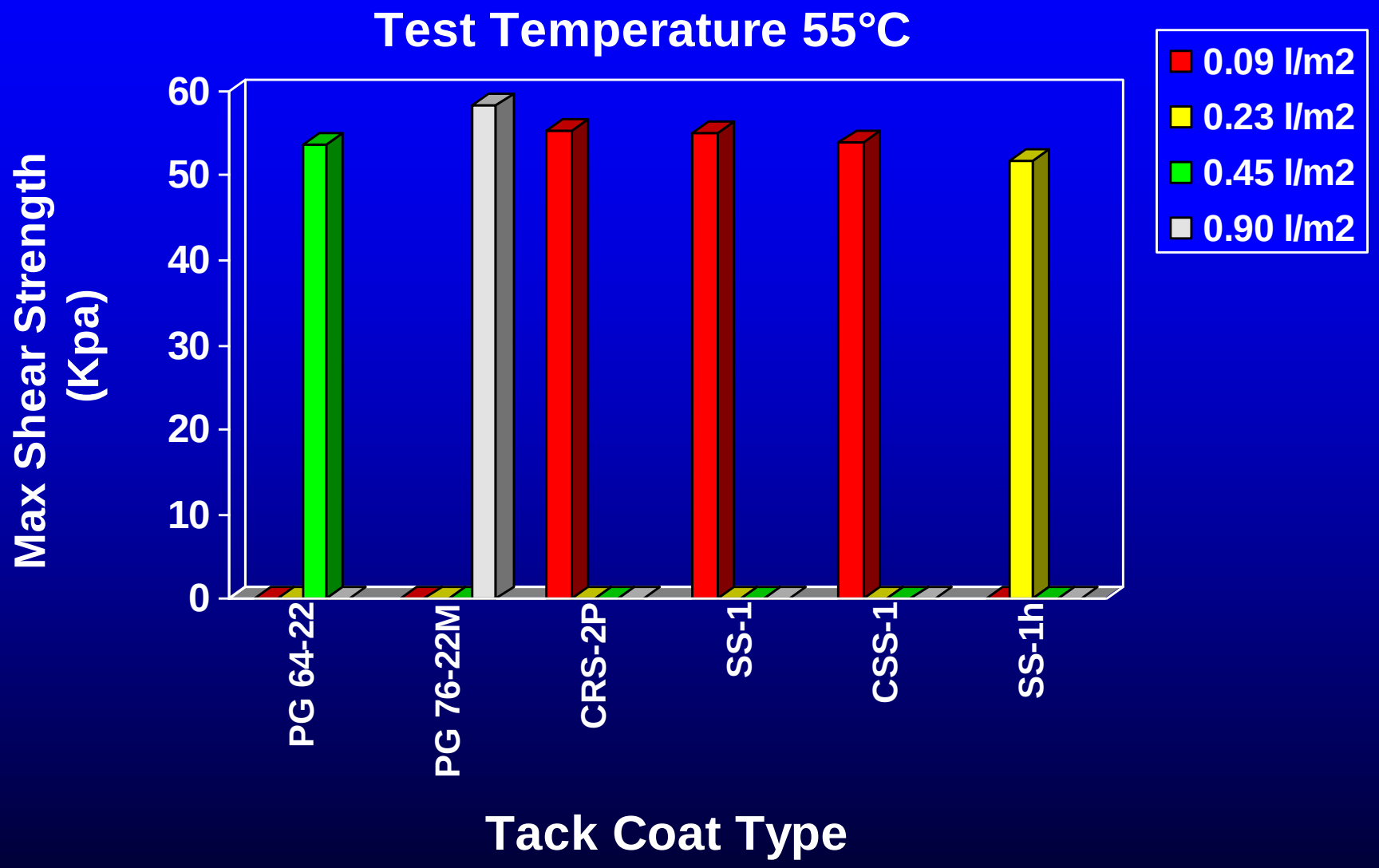

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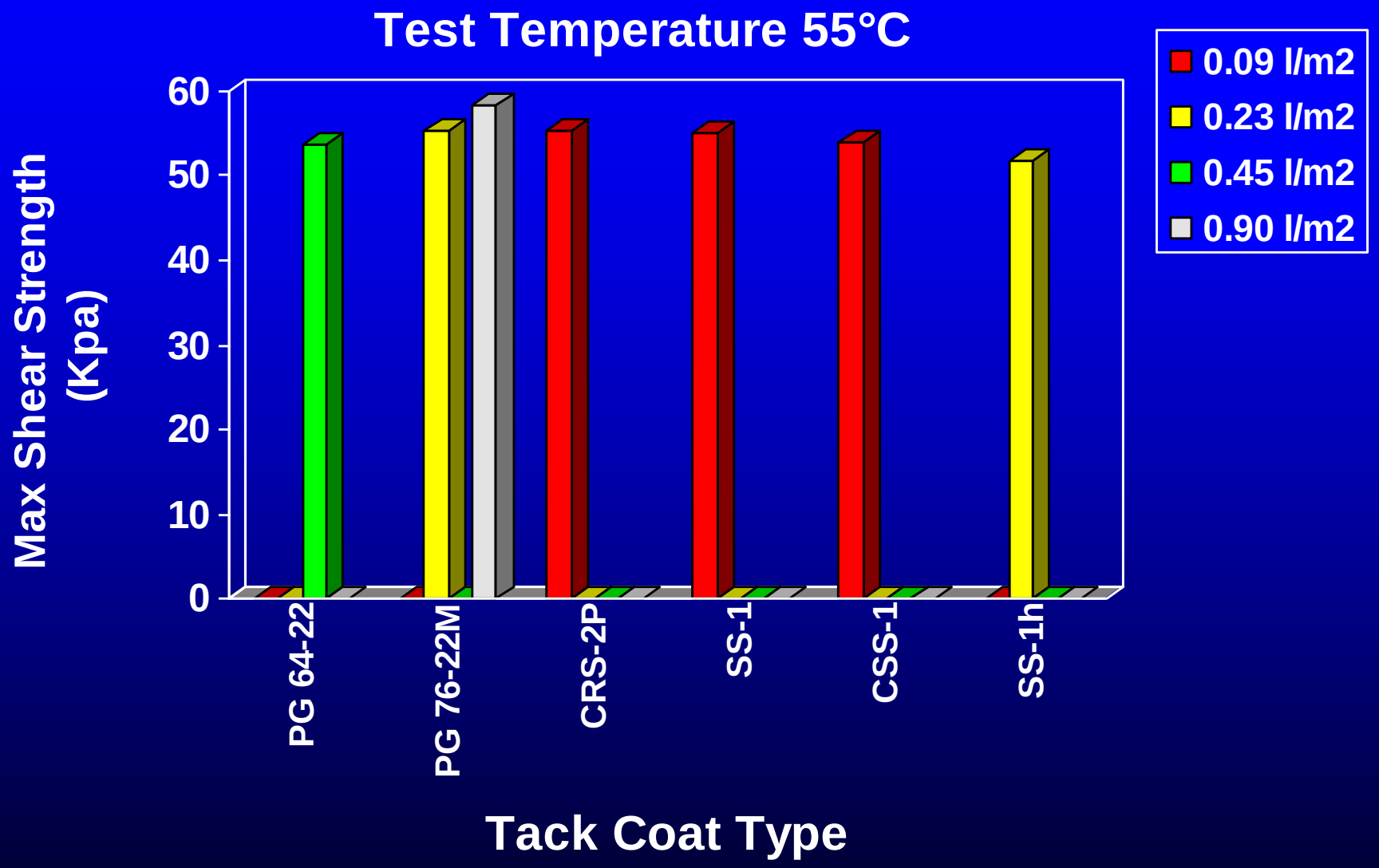


# Summary and Conclusions

- 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**

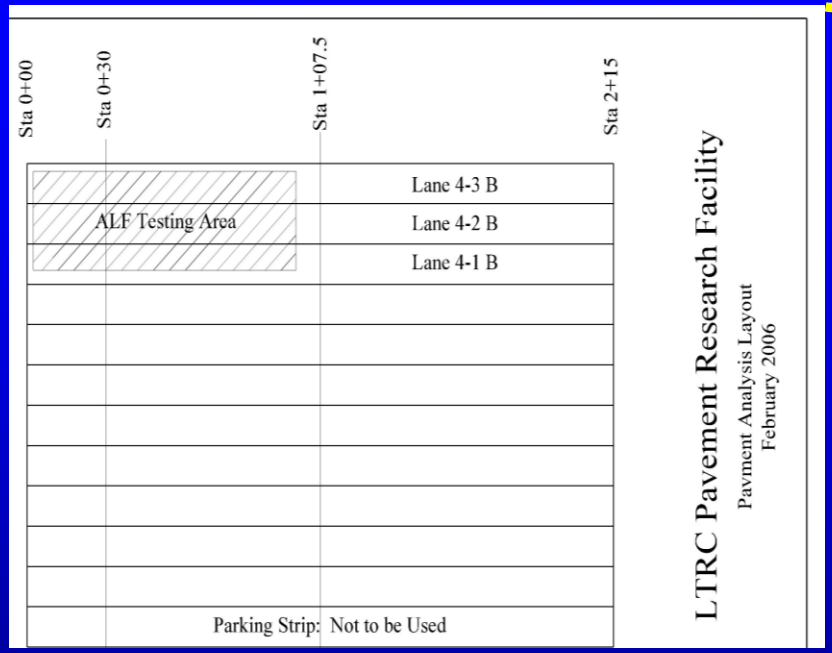
**PHASE II**

- **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**

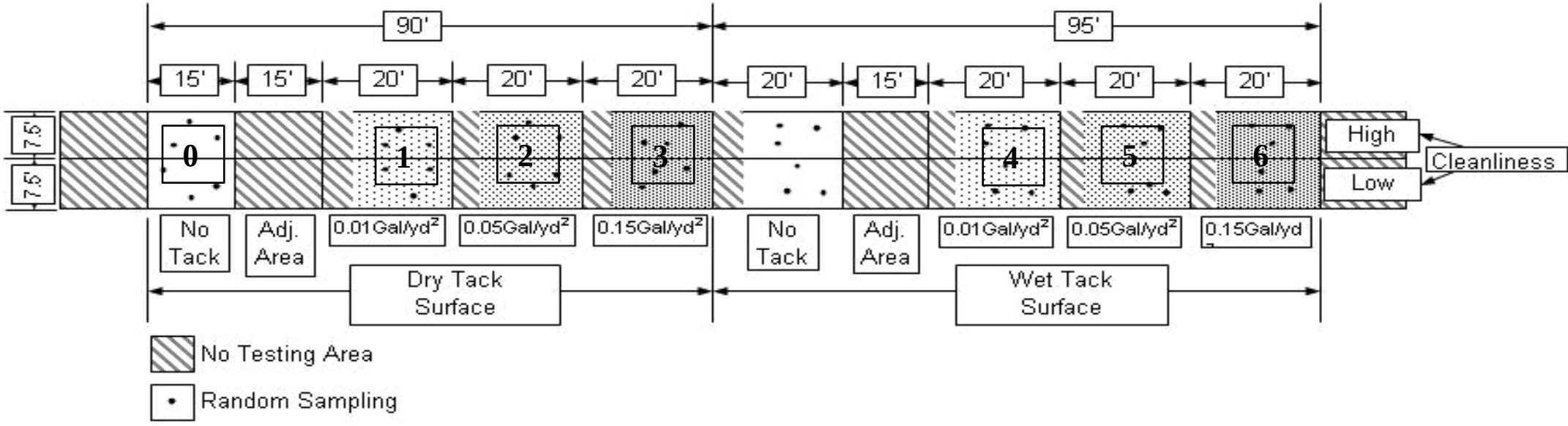
# NCHRP Project 9-40 Factors

- 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

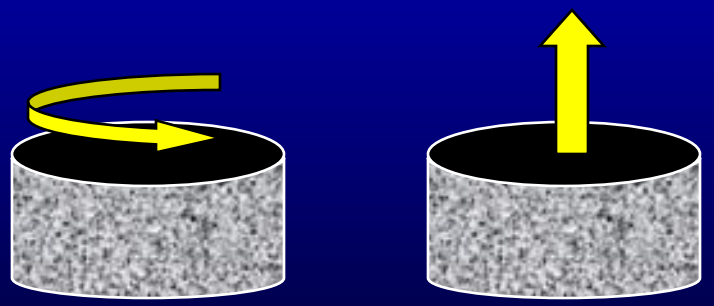






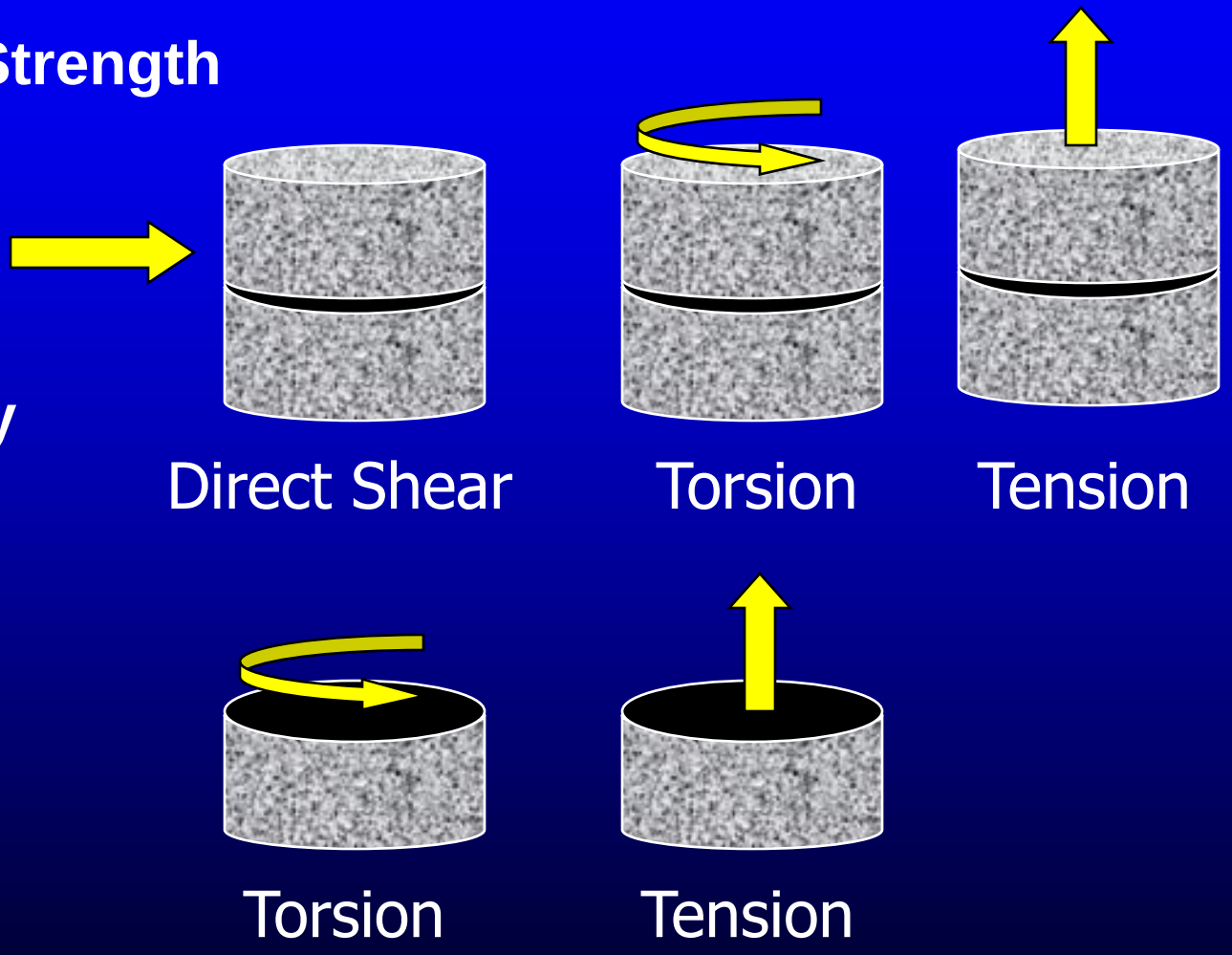
# *Characterization*
# *Tack Coat Quality*

- **Tack Coat Quality**



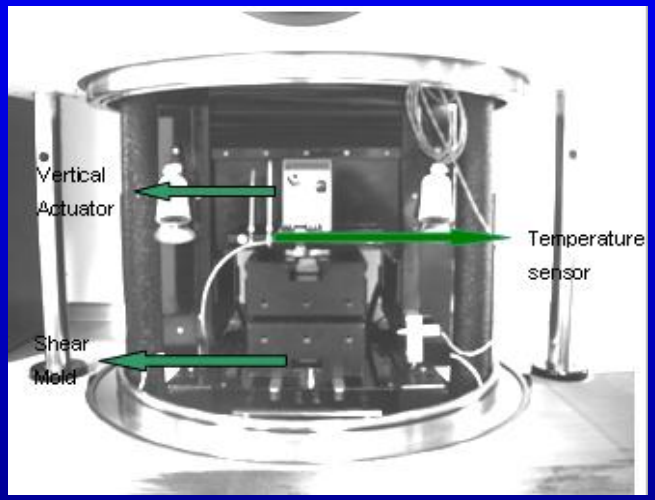
# *Characterization*
# *Interlayer & Tack Coat Quality*

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



# Characterization of Tack Coat Interface Bond Strength Tests

- Candidates
- Direct Shear

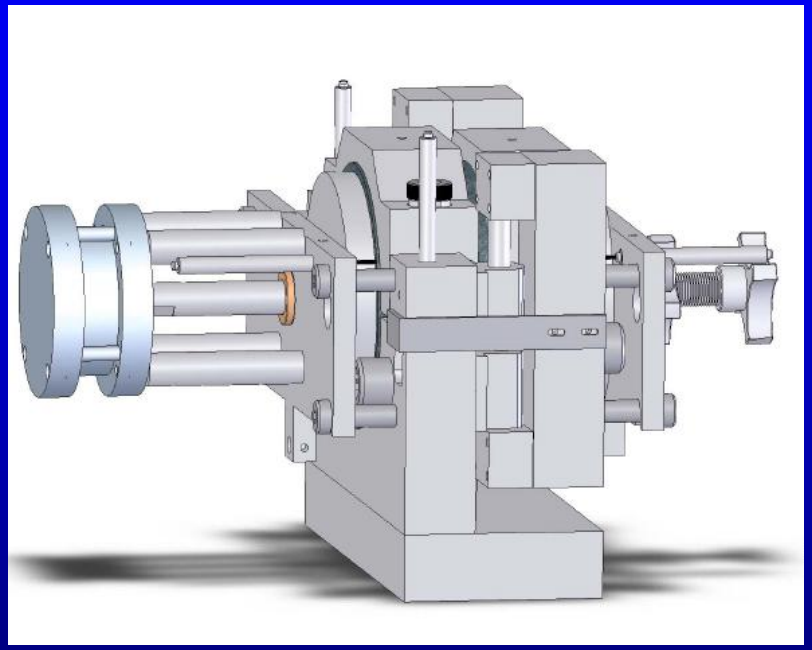


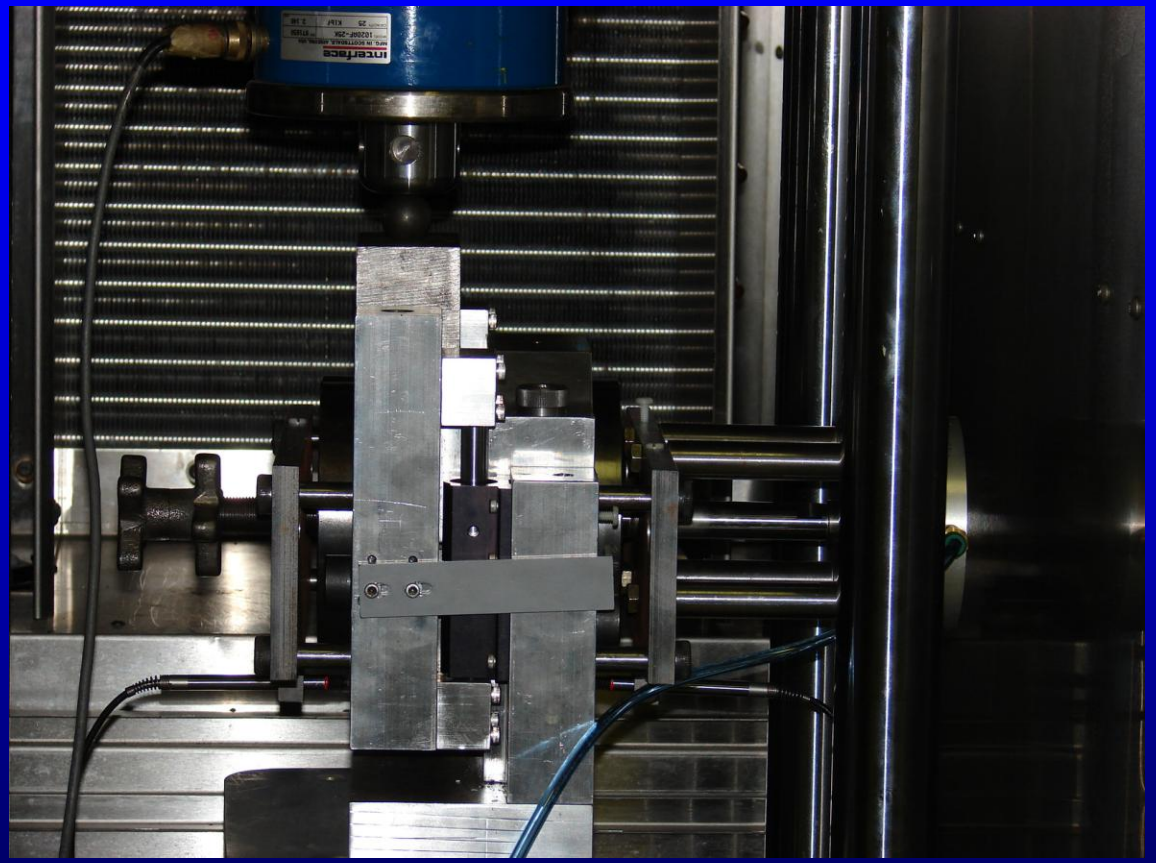

LTRC Shear Test

Overlay Bond Strength Tester

NCAT Direct Shear Test

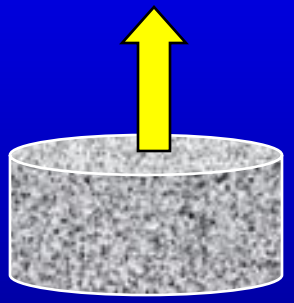
# Characterization of Interface Bond Strength
# Louisiana Interlayer Shear Strength Tester





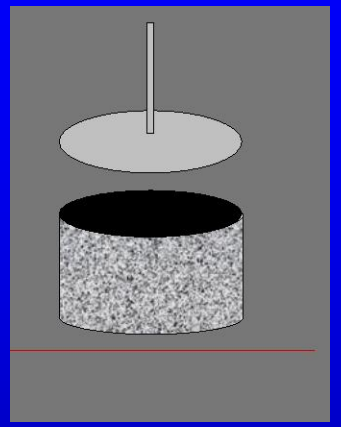
# *Characterization of Tack Coat Film Quality Tests*

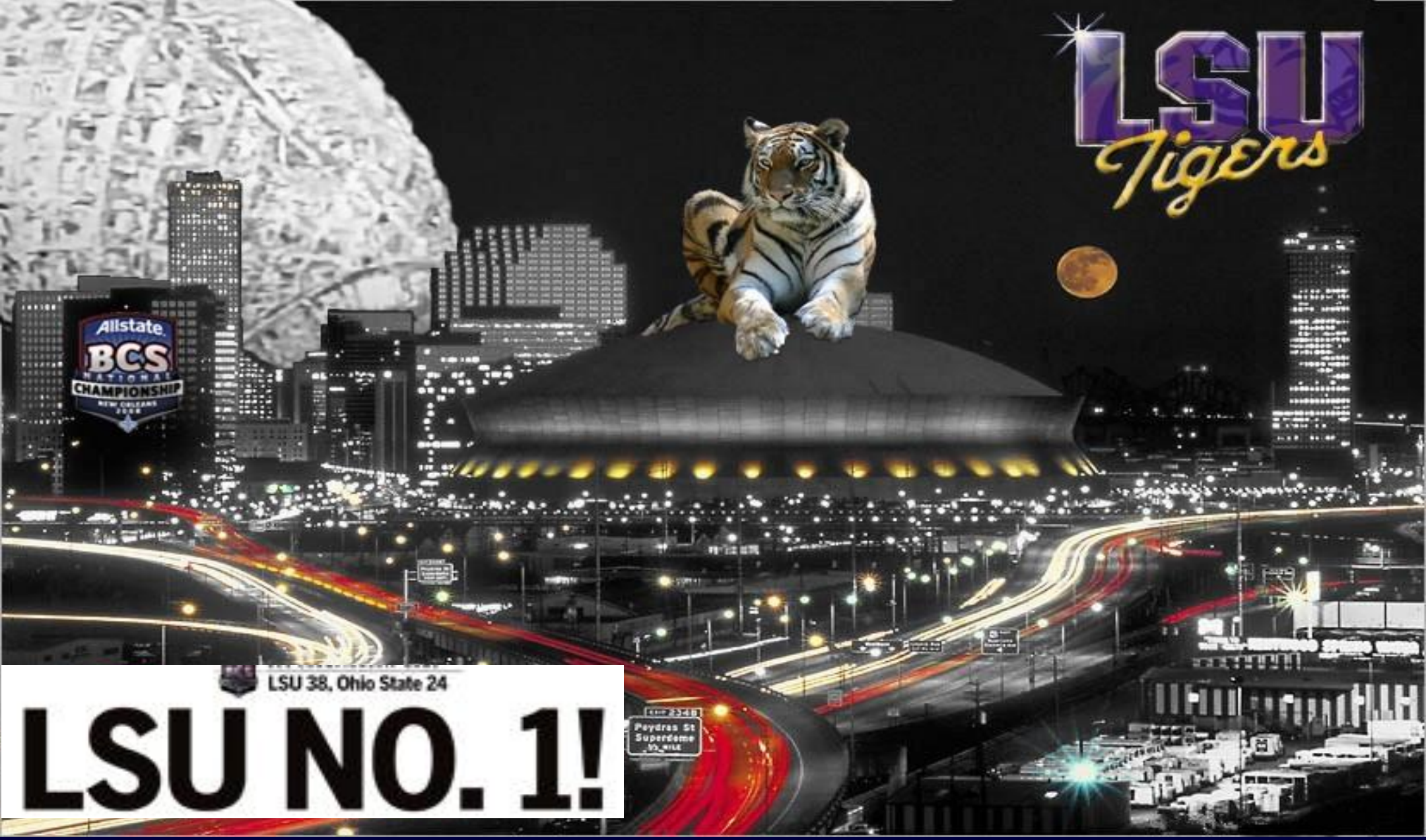
- Candidate
- Modified ATacker



Atacker Tensile/Torsion Test

# Characterization of Tack Coat Quality ATacker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LSU 38, Ohio State 24
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