Results of NCHRP Project 9-40: Tacking Your Way to Performance

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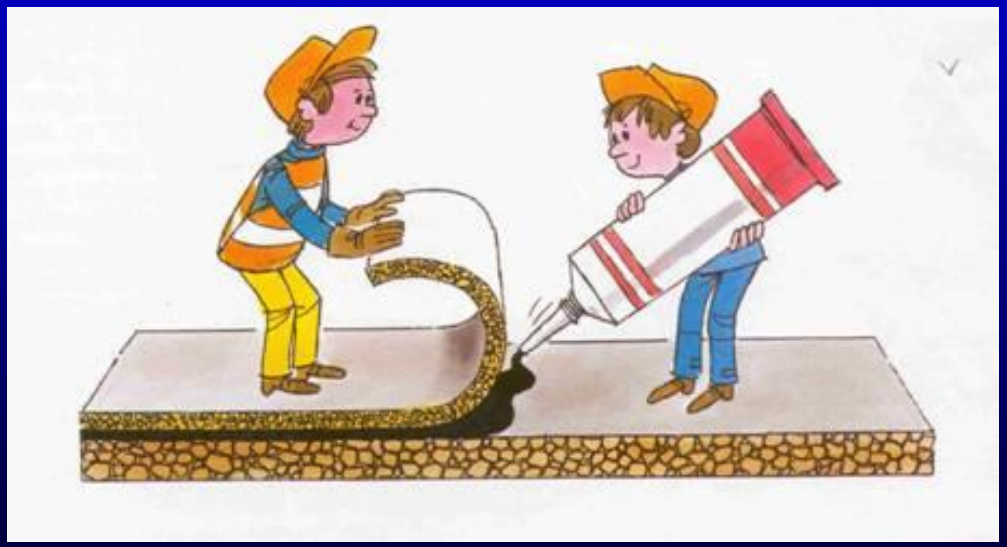
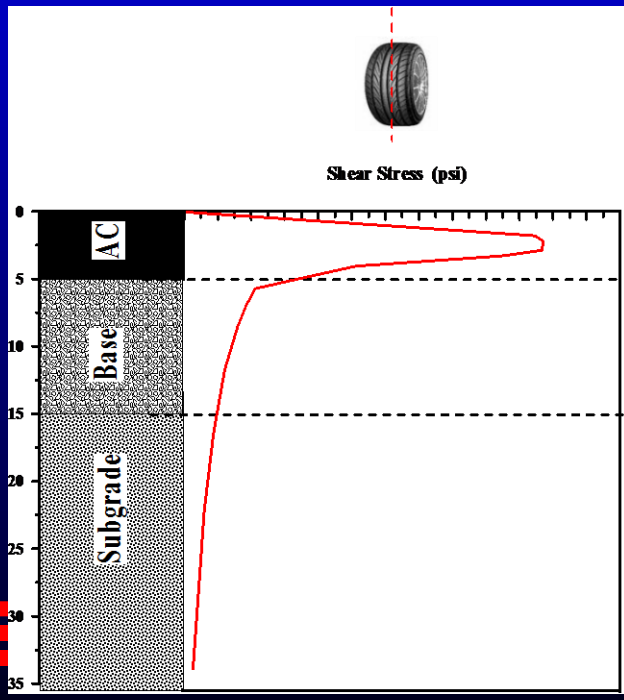
What is a Tack Coat?

- An application of asphalt onto a pavement surface
  - HMA, PCC
  - Emulsion
  - Hot AC
- Used to ensure a *bond* between the surface being paved and the underlying course





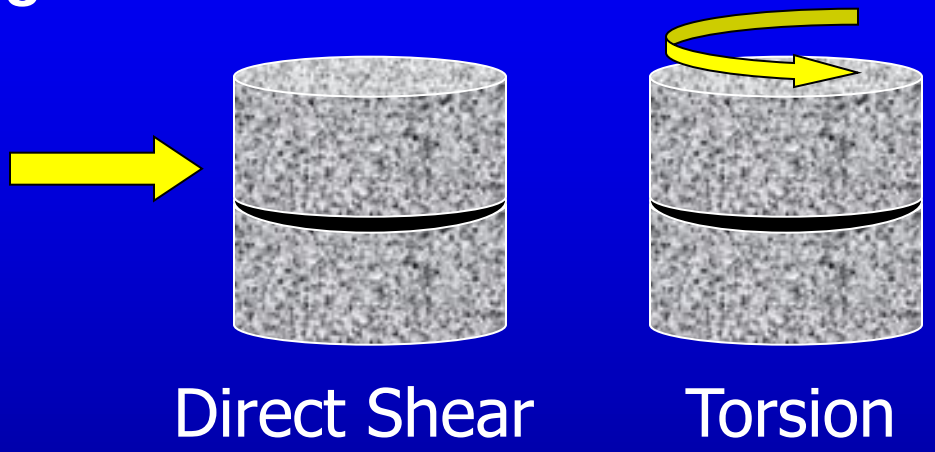
Background

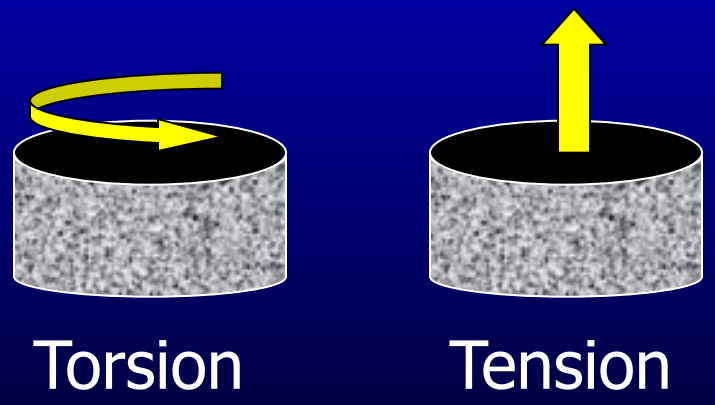
- Experience and empirical judgment
  - Selection of tack coat material type, application rate, and placement
- Quality control and quality assurance testing
  - rarely conducted
  - resulting in the possibility of unacceptable performance at the interface,
  - premature failure.

- NCHRP Project 9-40
  - Optimization of Tack Coat for HMA Placement
  - develop a procedure to evaluate the tack coat quality in the field
  - bonding characteristics testing

Tack Coat Material Approaches to Test Strength

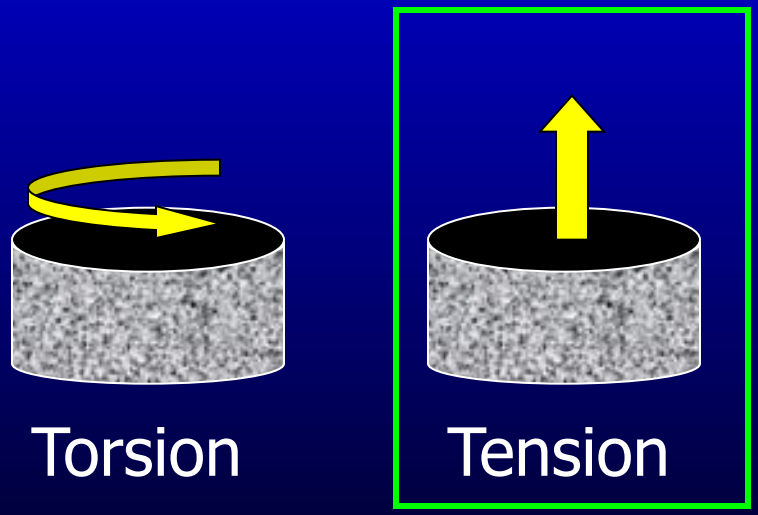
- **Interlayer Bond Strength**
- **Tack Coat Quality**



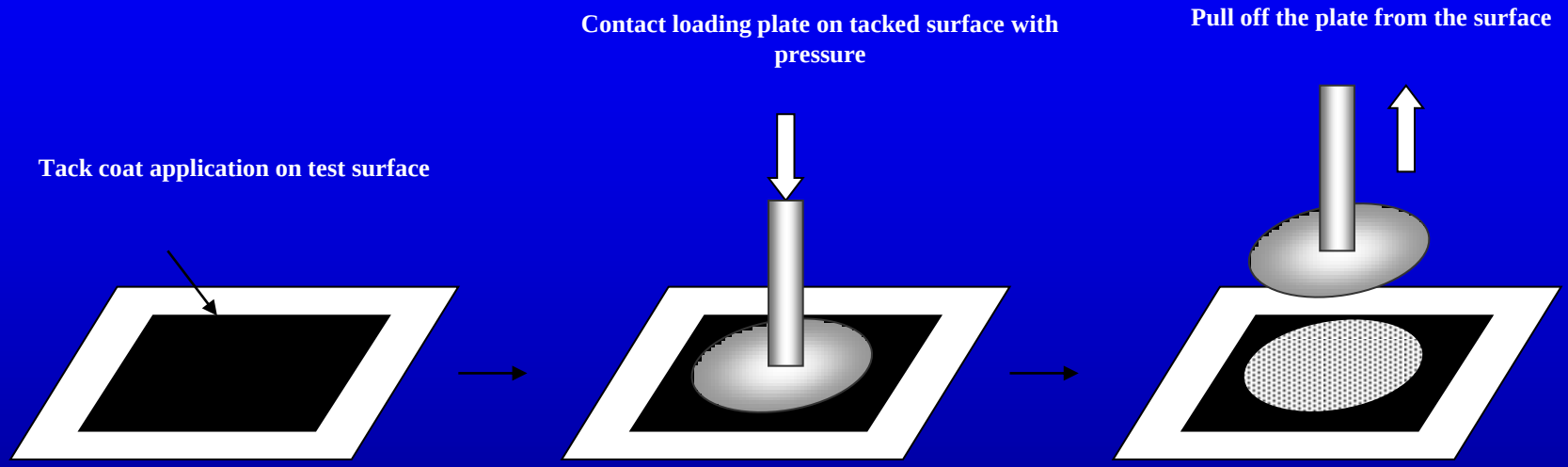


Tack Coat Material Approaches to Test Strength

- **Tack Coat Quality**



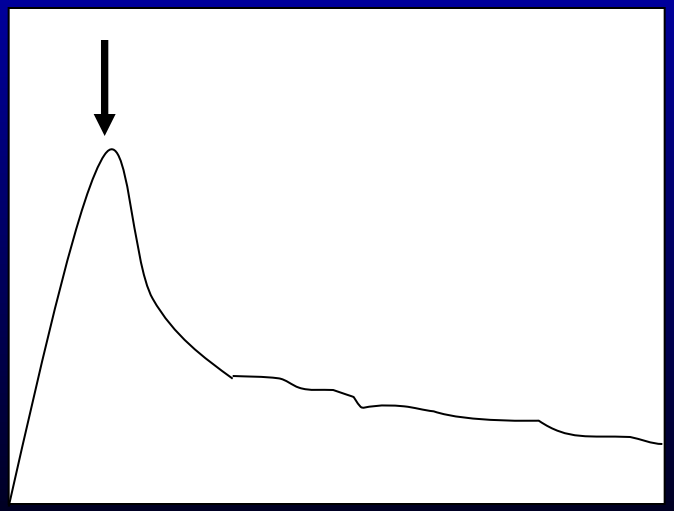
Field Pull-off Test for Tack Coat Evaluation

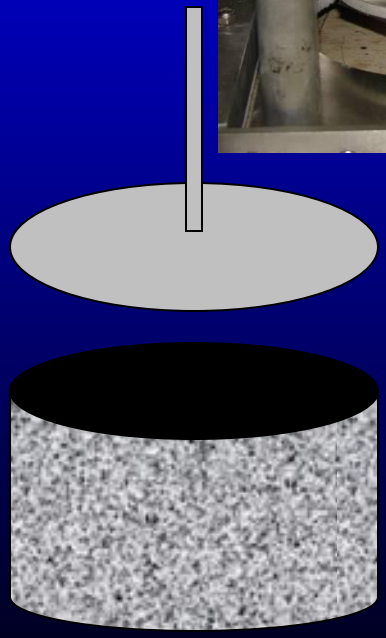


- Apply adhesive material on the pavement surface
- Contact plate is pushed into the pavement surface with a specific pressure
- The plate is then pulled off
- tensile strength between the plate and tack coat surface is measured

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

- **Developed equipment**
  - **Tack coat quality -- residual**
  - **Tension**
- **User friendly, Easy to use**
- **Laboratory and field**
- **Draft test method in AASHTO format**
- **Tensile load**
  - **Displacement**
  - **Tensile Force**
  - **Time**





Summary

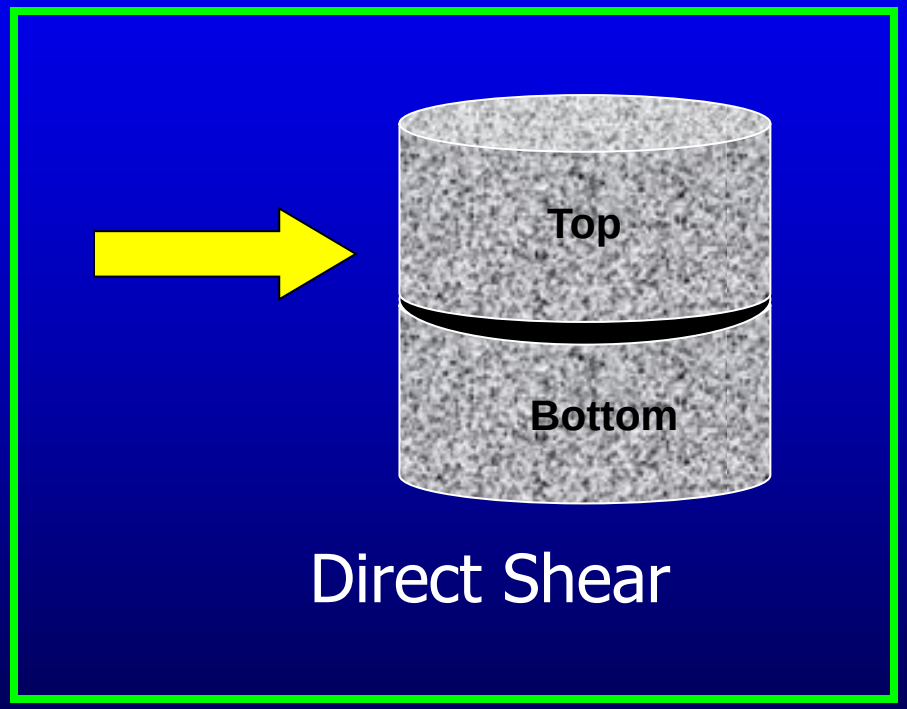
- LTCQT could serve as a valuable tool for highway agencies to perform comparative evaluations of various tack coat materials and application rates in the field.
- Repeatability of measurements
  - average coefficient of variation of less than 14%

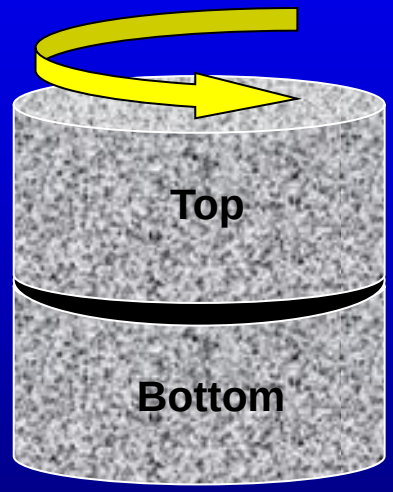
Reference

- "Development Of Pull-Off Test Device And Methodology To Evaluate The Bond Strength Of Tack Coat Materials In The Field." Journal of the Transportation Research Board, TRR No. 2126, 2009, pp.1-11.

Evaluate the Effectiveness of Tack Coat Materials

- **Interface Bond Strength**





Objective

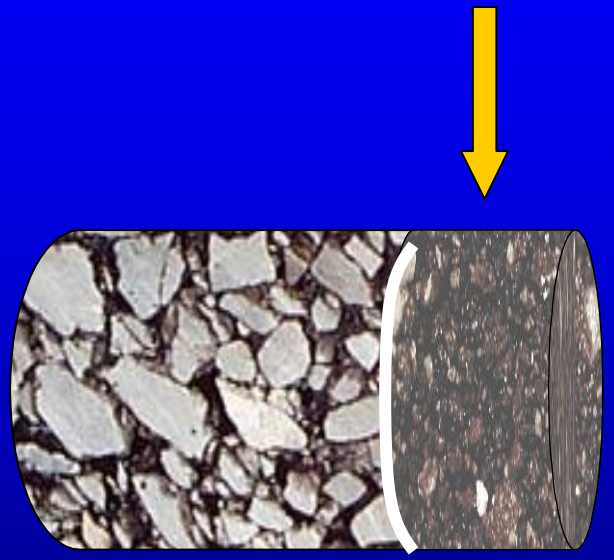
- Evaluate the interface shear strength of tack coat materials under a wide range of testing conditions commonly encountered in field applications
  - effect of tacked surface type;
  - effect of tack coat materials type;
  - effect of application rate;
  - Construction condition;
    - » effect of wetness (rain).

Testing Factorial

Variable	Content	Number of Levels
Tack Coat Material	CRS-1, SS-1h, SS-1, Trackless, PG 64-22	5
Residual Application Rate (l/m^2, gsy)	0.00-, 0.14-, 0.28-, 0.70- (0.00-, 0.031-, 0.062, 0.155)	4
Pavement Surface	HMA: Existing, Milled, New PCC: Existing	4
Wet (Rain) Condition	Wet, Dry	2
Testing Temperature	25°C	1
Testing Replicates	3	3
Total Number of Tested Specimens		375

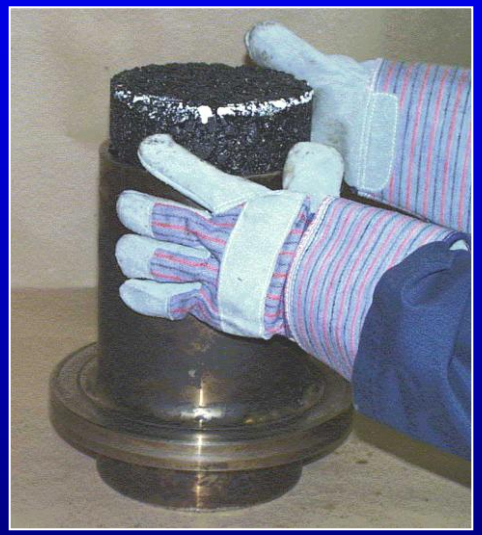
Specimen Type

- Laboratory mixed/compacted
- Field mixed/compacted



Sample Preparation

- Laboratory mixed/compacted



Sample Preparation

- Laboratory mixed/compacted
- Field mixed/compacted
  - Field test sections
  - LTRC Pavement Research Facility
  - computerized tack coat distributor truck
  - conventional paving equipment

Surface Texture

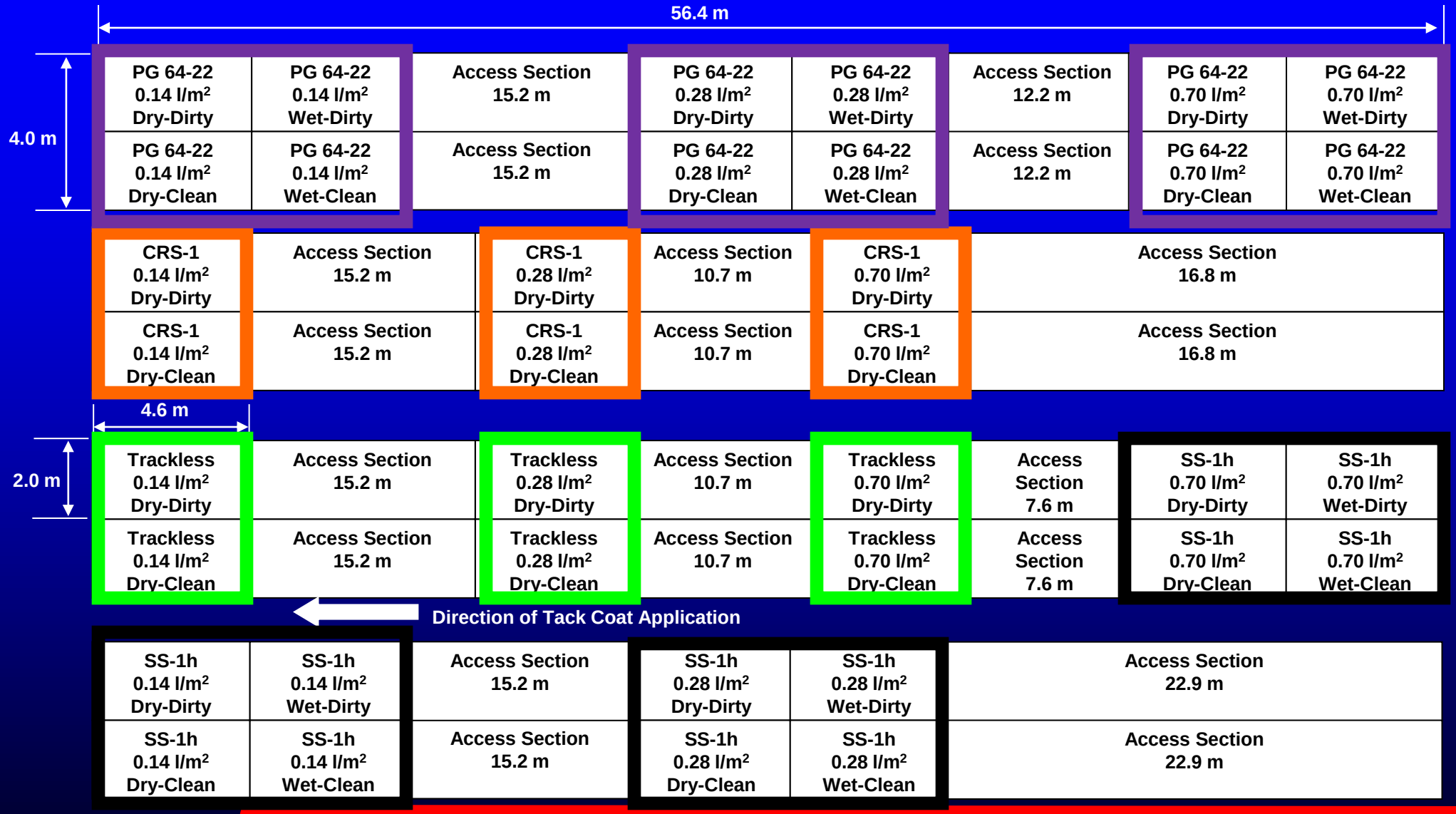
- LTRC Pavement Research Facility
- Surface texture measurement
  - ASTM E1845
  - HMA New : 0.63 mm
  - HMA Existing: 1.05 mm
  - HMA Milled : 1.25 mm
  - PCC : 1.19 mm


Sand Patch Method,


Road Surface Profiler


Circular Texture (CT) Meter

Lane Layout – Existing HMA Surface



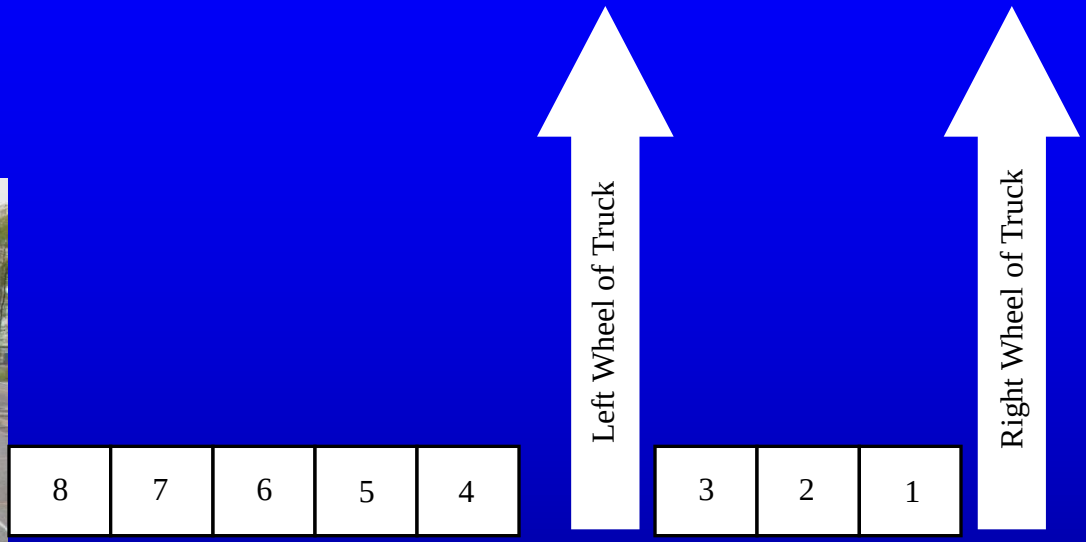
Layout of Test Sections

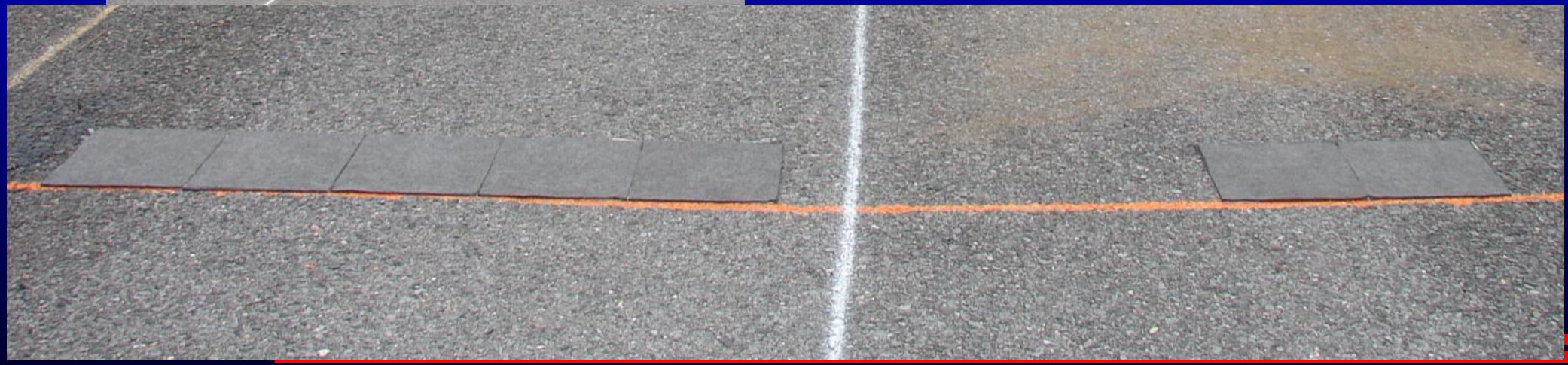
Spray Application of Tack Coat

- **Equipments**
  - Etnyre, Model 2000
  - Computerized tack coat distributor truck

Verification of Spray Rates

- **Geotextile Pad layout**
  - **ASTM 2995**
  - **One transverse direction**





Spray Application of Tack Coat
Existing HMA Surface Type
100% Coverage

0.14 l/m²

Low

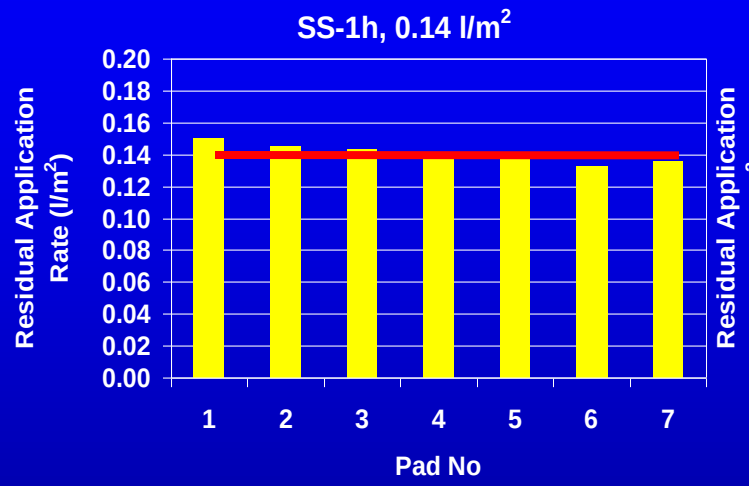
0.28 l/m²

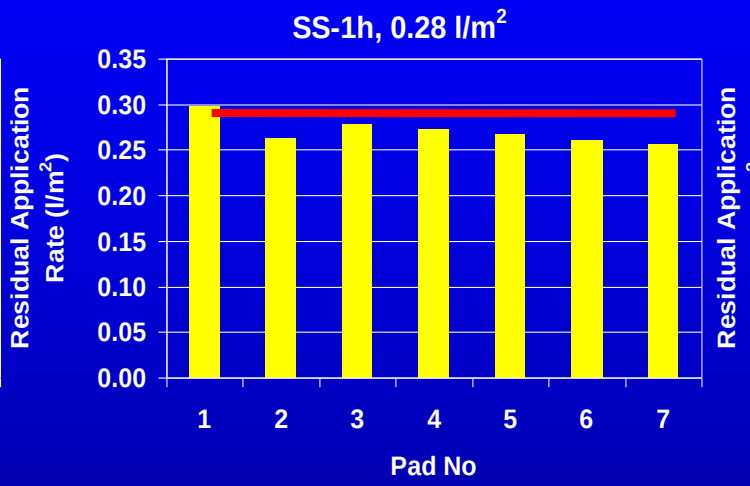
Medium

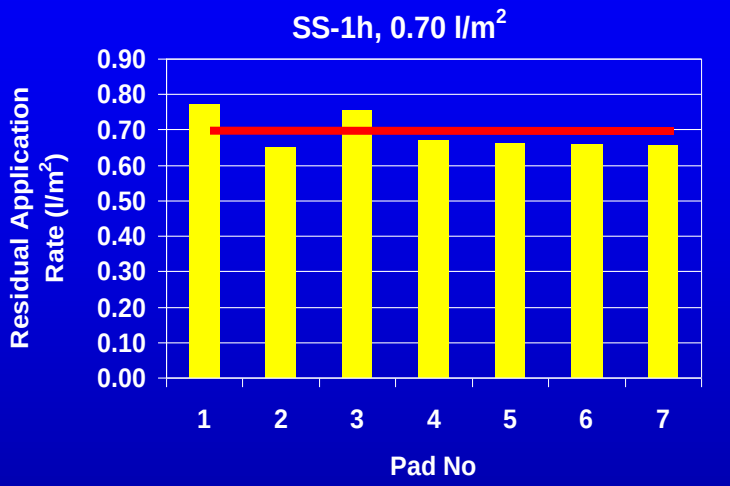
0.70 l/m²

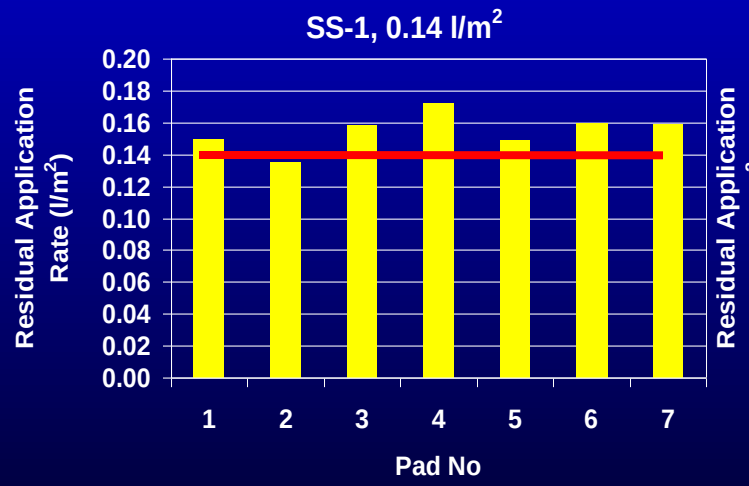
High

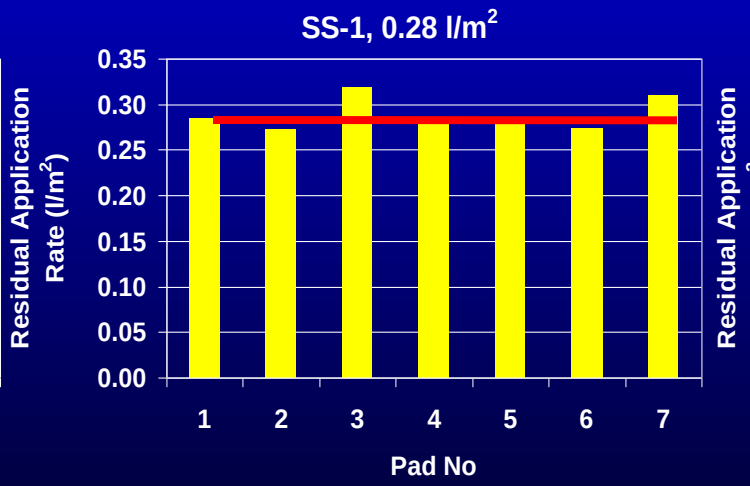
Typical Calibration Results
Milled Surface: SS-1h, SS-1

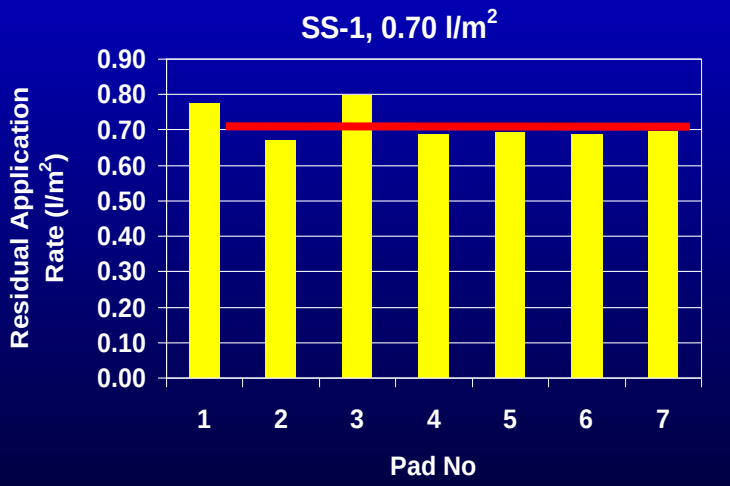












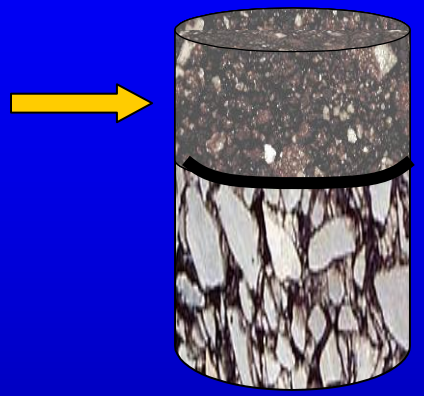
Construction Condition -- Wet

Rate = 0.27 L/m²

Overlay Construction

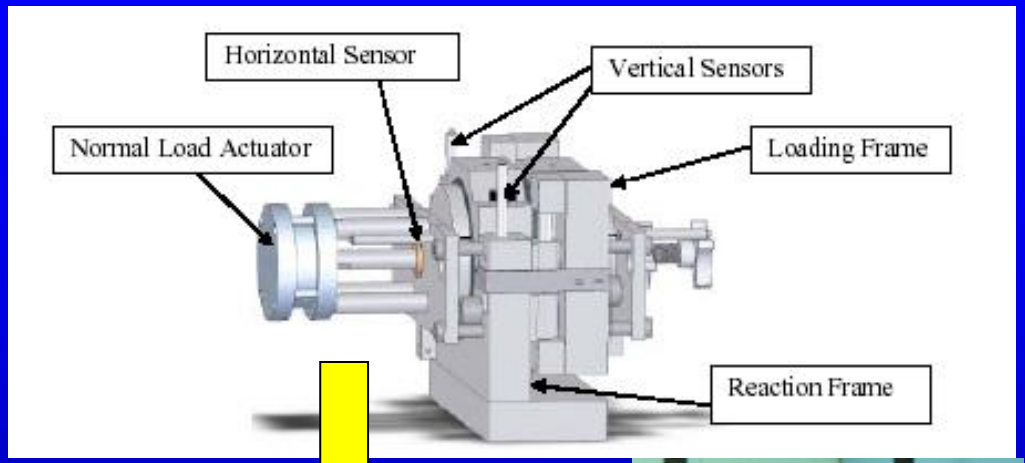
Completion Test Sections

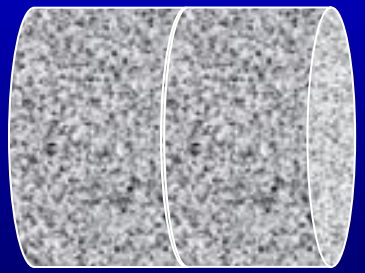
Coring Process



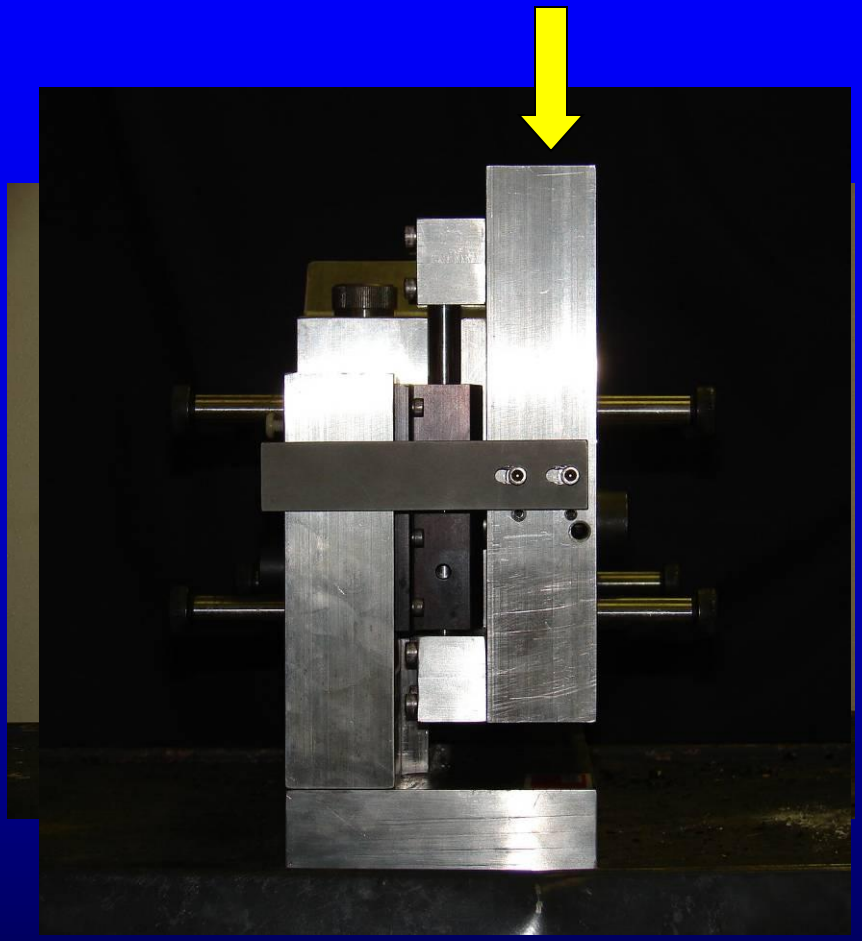
Direct Shear Test Device
Louisiana Interlayer Shear Strength Tester (LISST)

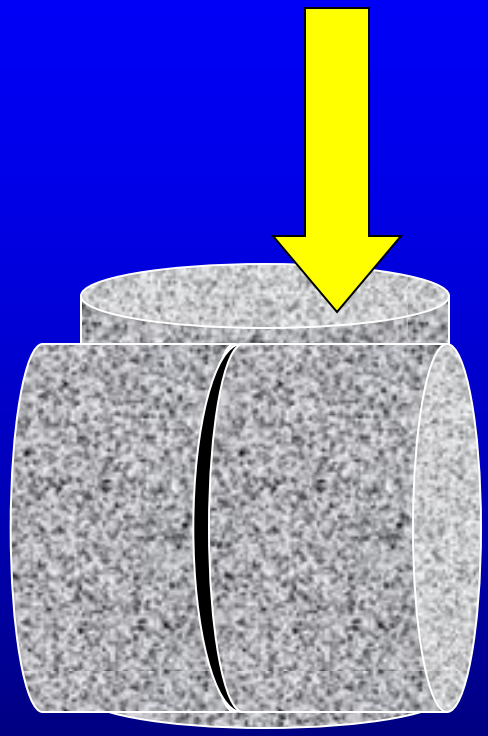
- **Two Main Parts**
  - **Shearing frame,**
  - **Reaction frame**
  - **Frictionless linear bearing**
    - **Maintain vertical travel**
- **Easy to use**
- **Portable**
- **Adoptable to exiting load frames**
- **Reasonable cost**
- **accommodate both 100 and 150-mm sample diameter**
- **Comparison**
  - **Superpave Shear Tester**



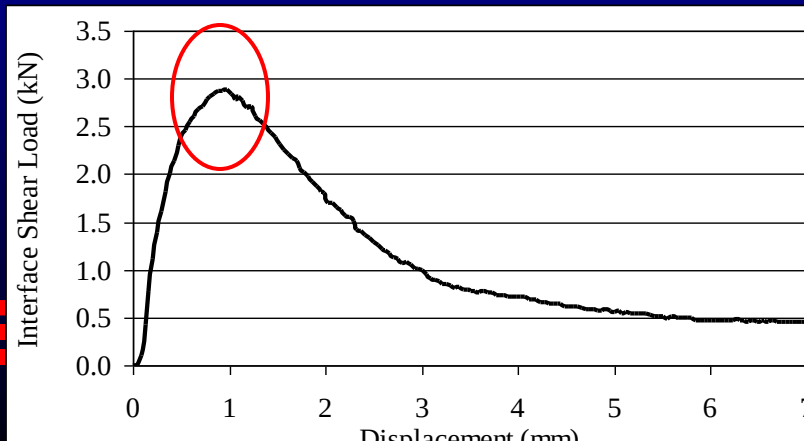


Interface Shear Strength (ISS) Test Results



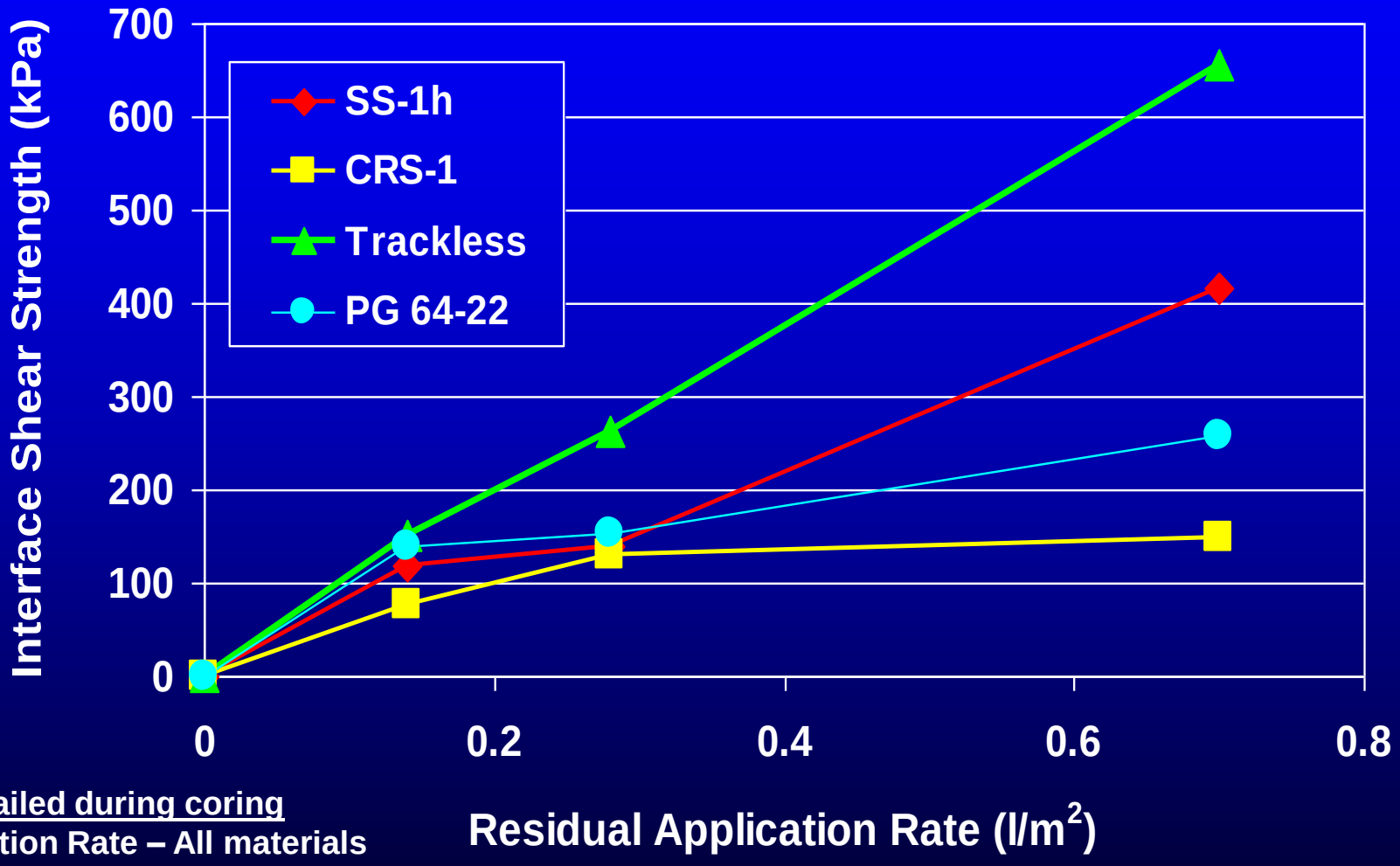


- **Interface Shear Strength**
  - **ISS**
  - **% CV < 15%**



Effect of Residual Application Rates on ISS: Pavement Surface: Existing HMA

Clean and Dry Condition, No Confinement

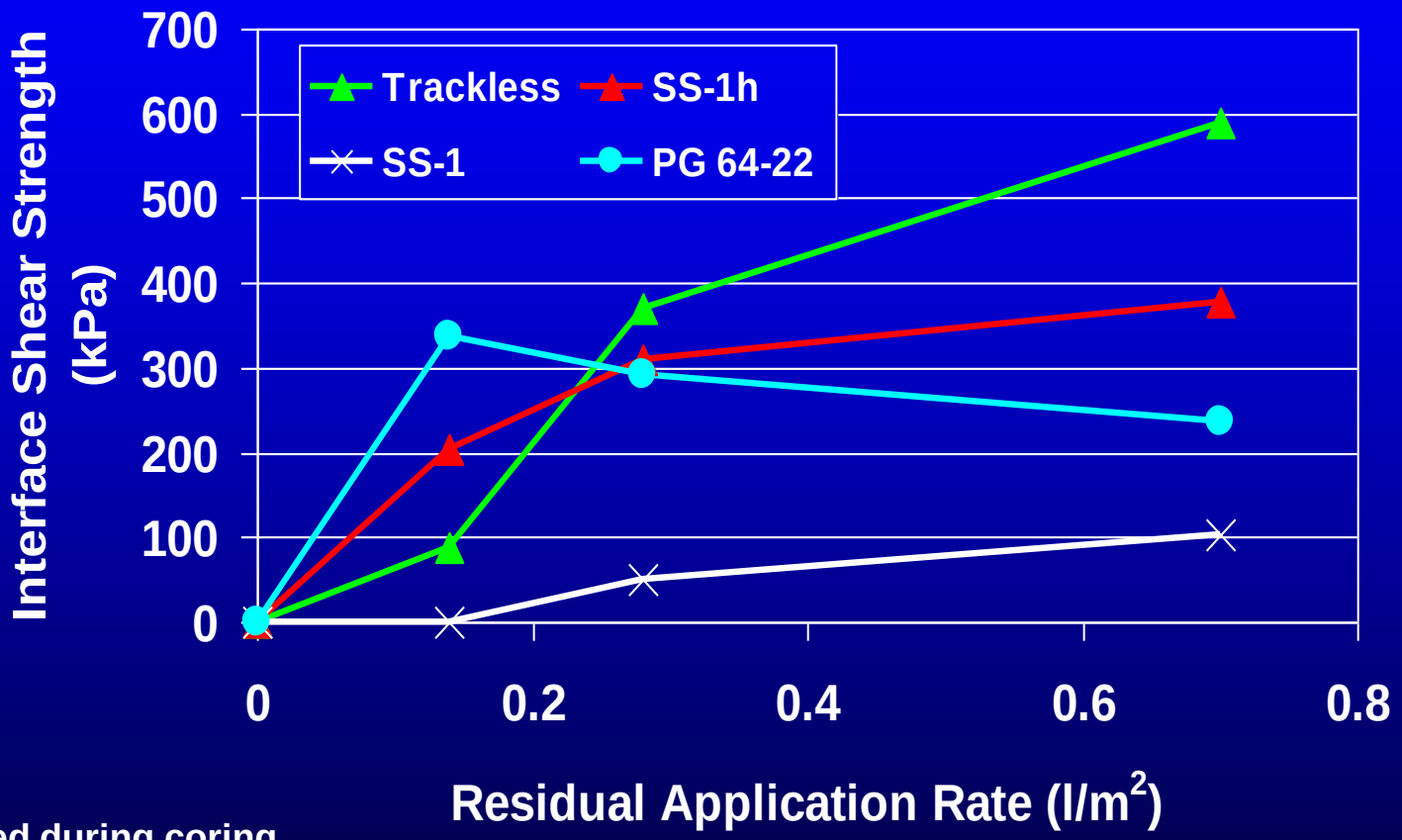


Sample failed during coring

0 Application Rate – All materials

Effect of Residual Application Rates on ISS : Pavement Surface: Existing PCC

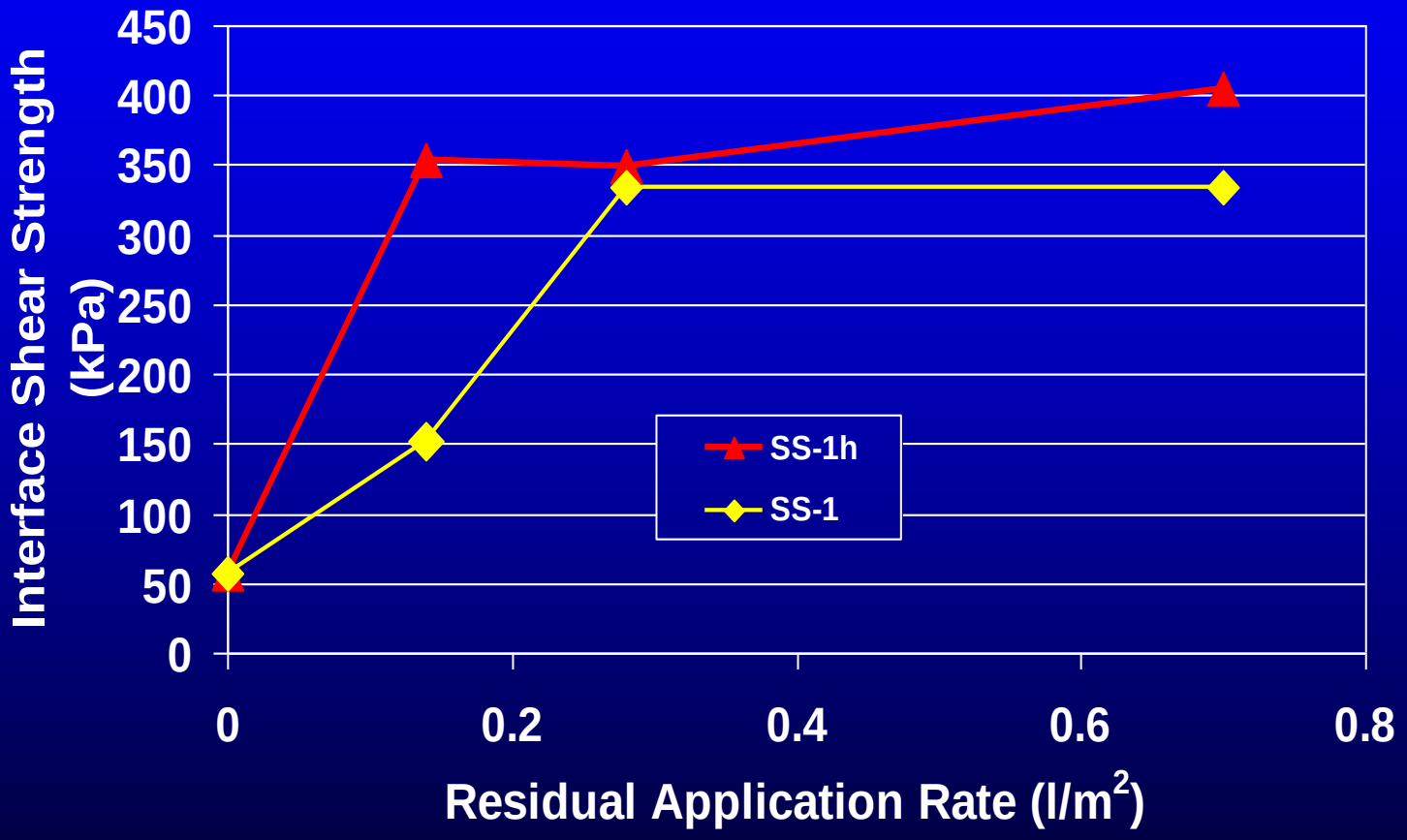
Clean and Dry Condition, No Confinement



Sample failed during coring
0.14 l/m² SS-1

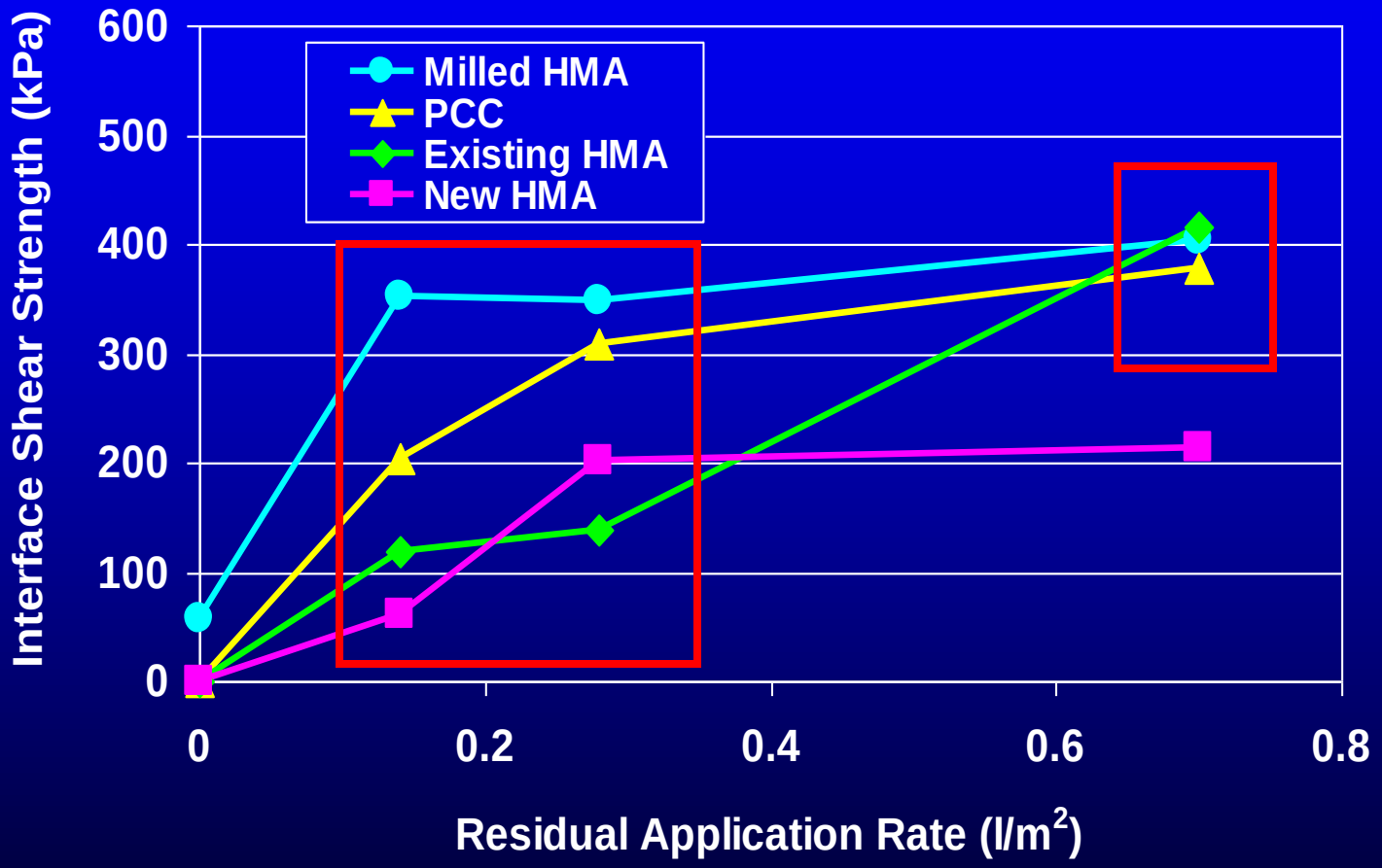
Effect of Residual Application Rates on ISS : Pavement Surface: Milled HMA

Clean and Dry Condition, No Confinement



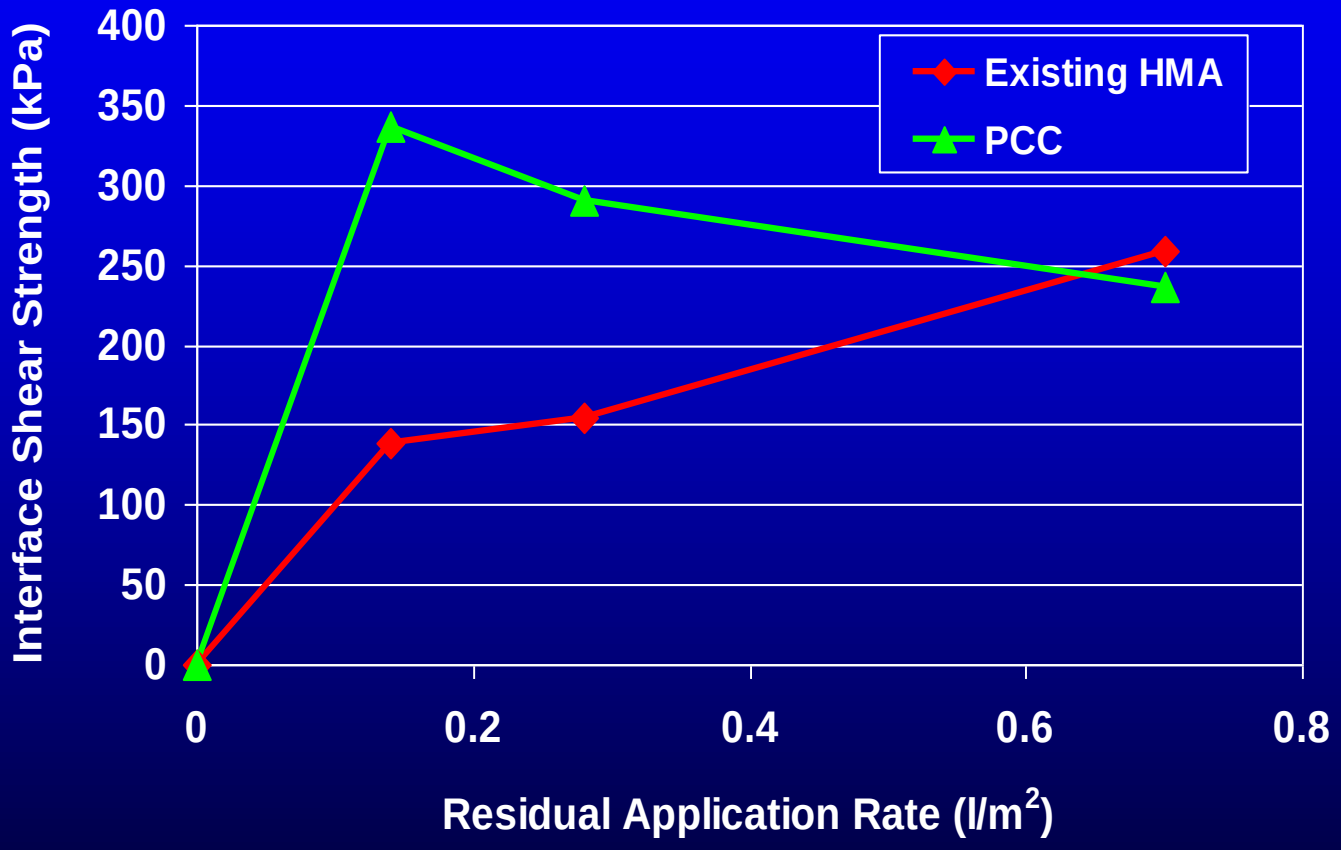
Effect of Pavement Surface Type on ISS Tack Coat Materials: SS-1h

Clean and Dry Condition, No Confinement



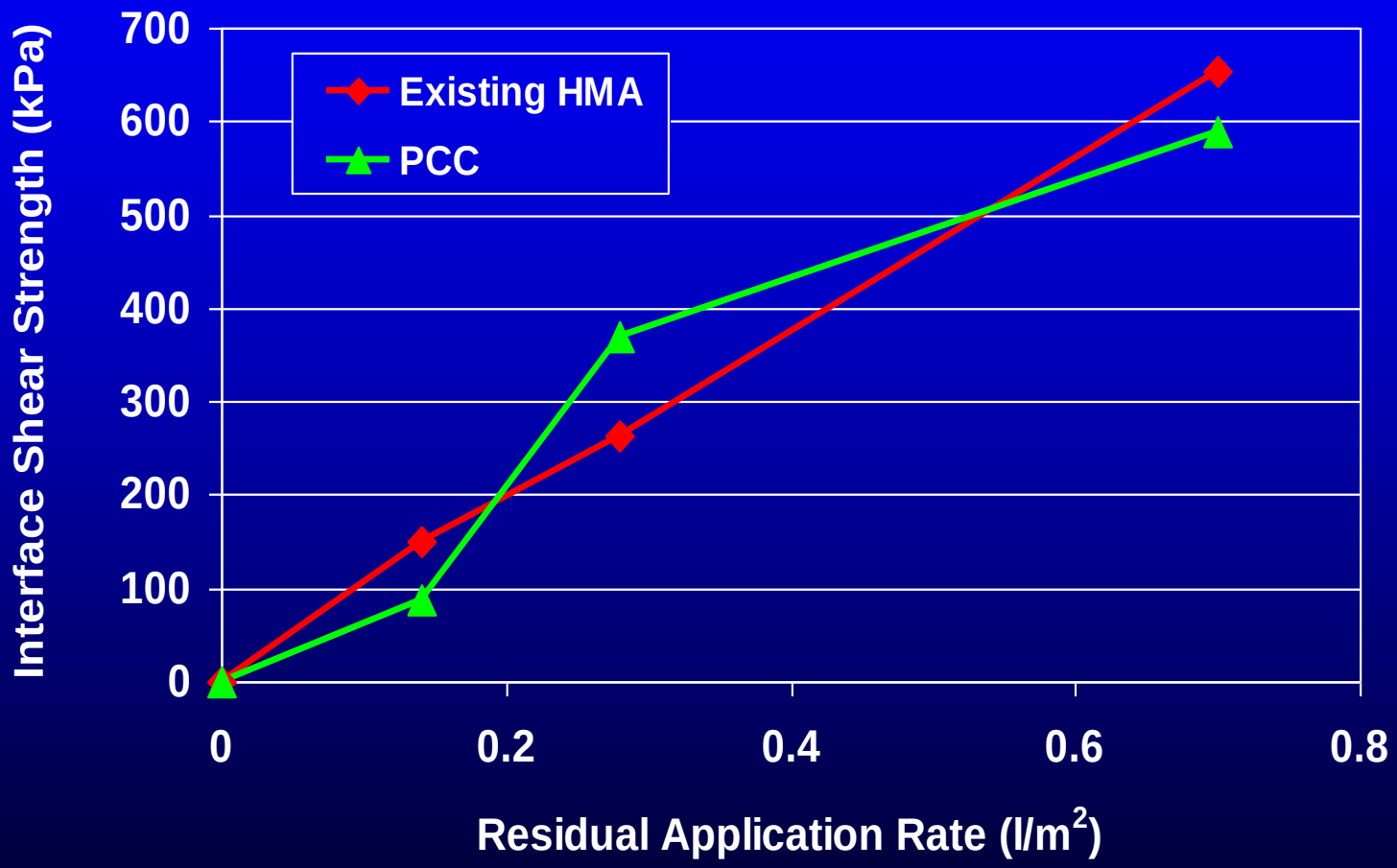
Effect of Pavement Surface Type on ISS Tack Coat Materials: PG 64-22

Clean and Dry Condition, No Confinement

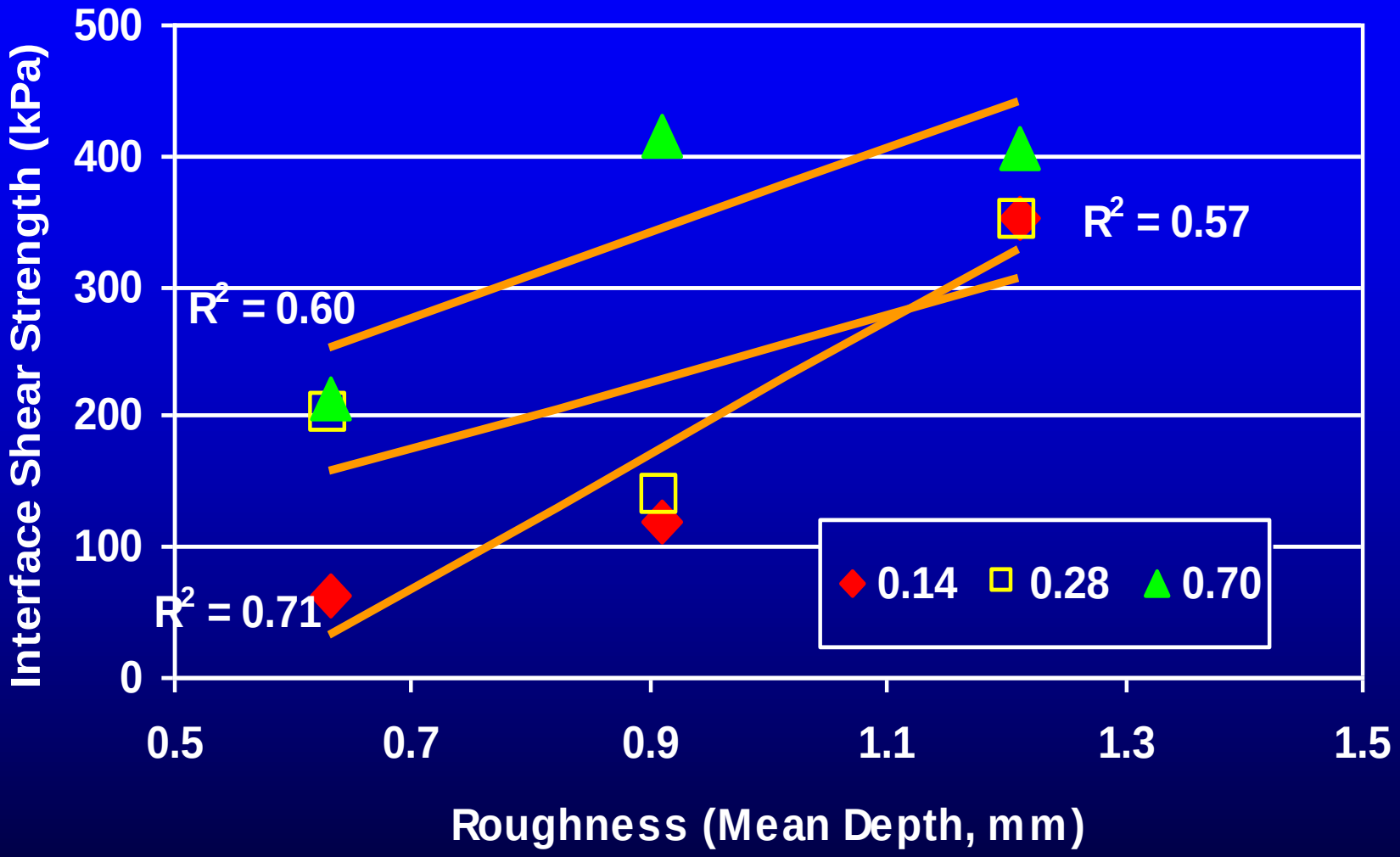


Effect of Pavement Surface Type on ISS Tack Coat Materials: Trackless

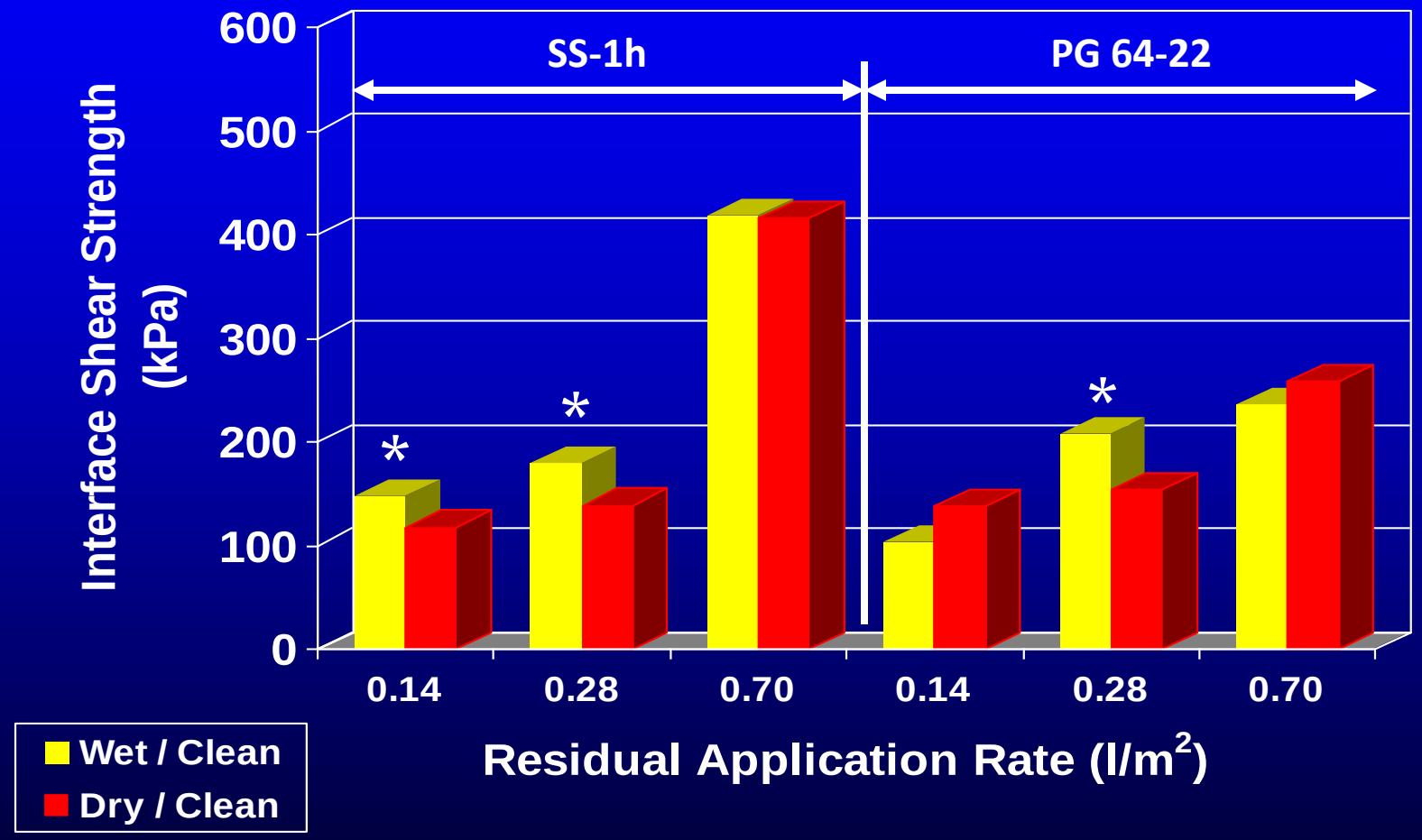
Clean and Dry Condition, No Confinement



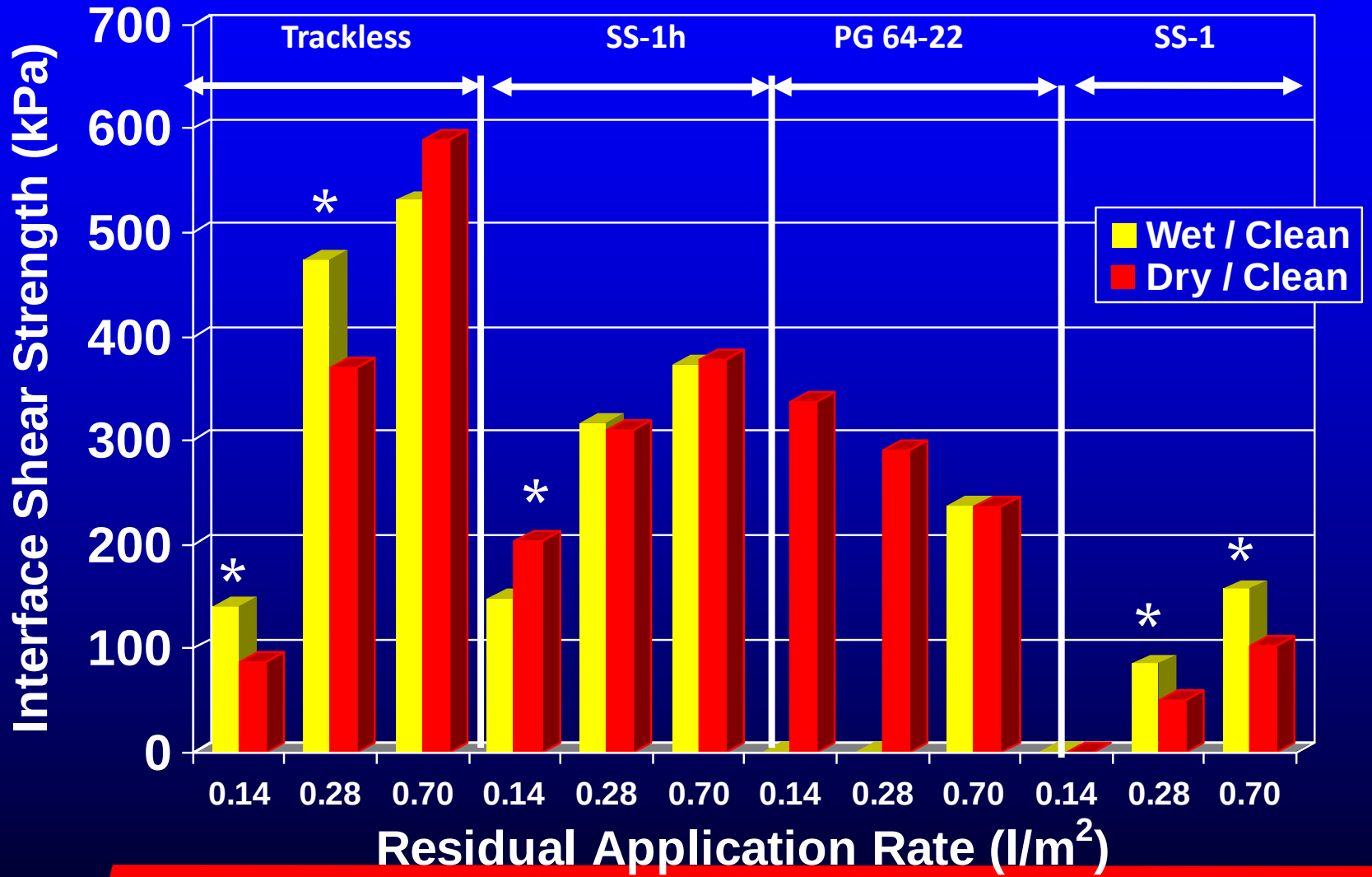
Roughness Effect: SS-1h



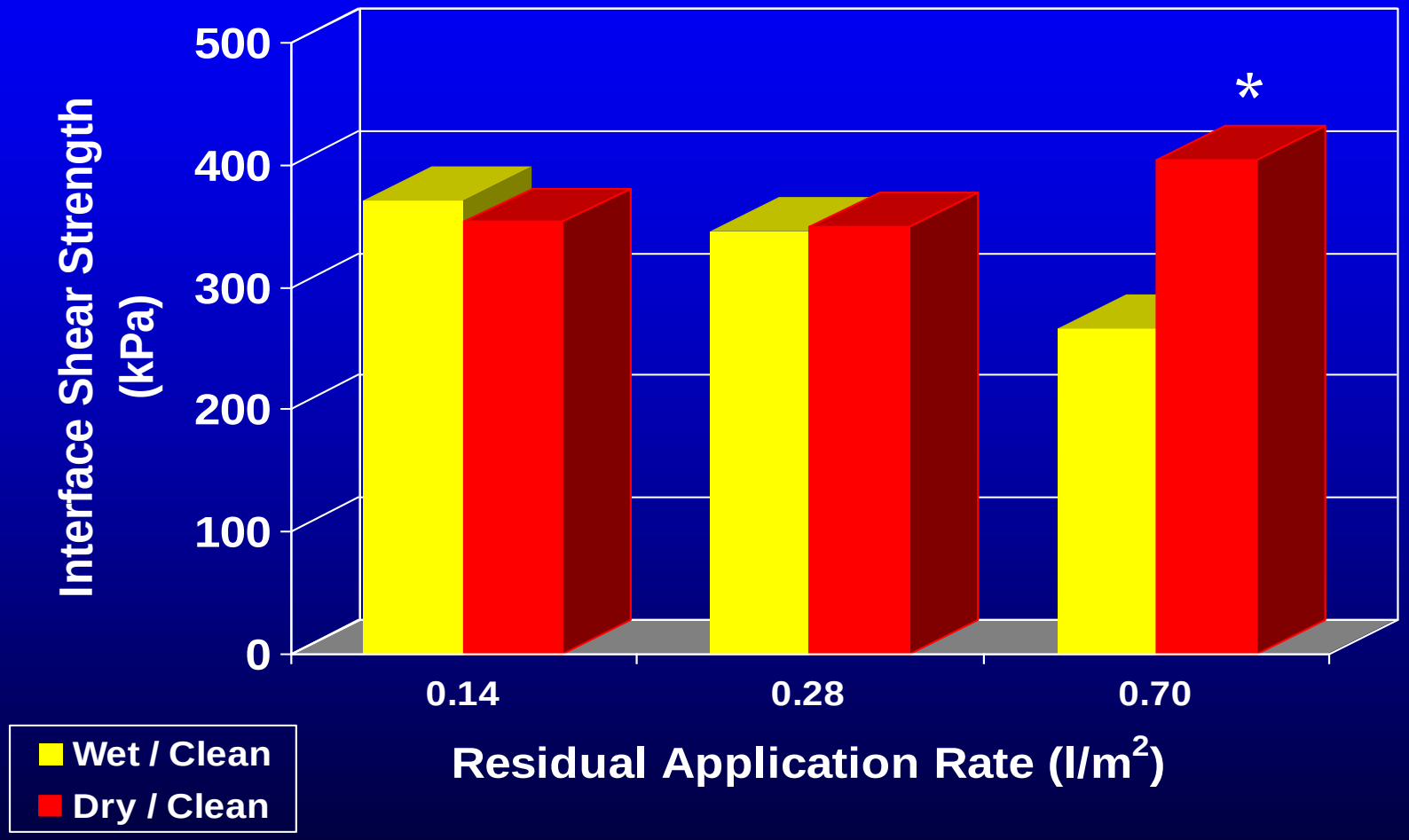
Effect of Wet Condition of Existing HMA Surface on ISS -- Clean



Effect of Wet Condition of PCC Surface on ISS -- Clean Condition

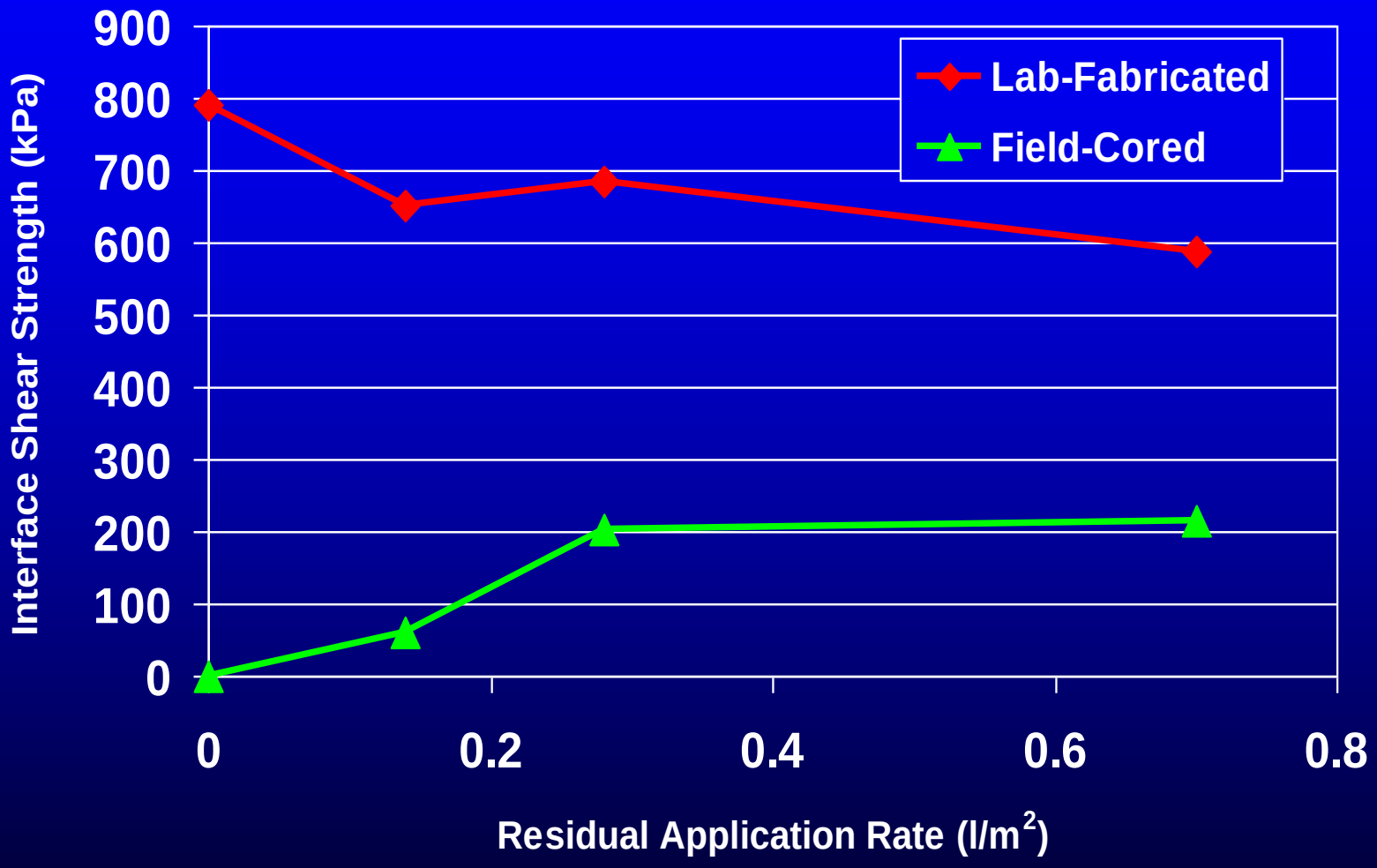


Effect of Wet Condition of Milled HMA Surface on ISS -- SS-1h, Clean



Effect of Sample Preparation Method on ISS Tack Coat Materials: SS-1h

Clean and Dry Condition, No Confinement, New on New



Conclusions

- Effect of tack coat materials type
  - trackless exhibited the highest ISS at all application rates
    - » Existing HMA, PCC
  - CRS-1 resulted in the lowest ISS
    - » Existing HMA
  - SS-1 presented lowest ISS
    - » PCC
- Effect of application rate
  - In general, ISS increased with an increase in the application rate
  - Existing HMA
    - » Rate of increase: Trackless, SS-1h, PG 64-22, and CRS-1
  - PCC
    - » Rate of increase: Trackless, SS-1h, SS-1
      - Except PG 64-22: Decrease
  - Milled HMA
    - » ISS is not sensitive to increase in application rate
    - » Texture is more dominant

Conclusions

- **Effect of wetness condition**
  - Majority of the cases: no statistically significant difference b/w dry and wet conditions.
  - Small amount of water can be flashed away by the hot HMA mat
    - » inconsequential effects on the quality of the tack coat.

- **Preparation method**
  - Laboratory-prepared samples grossly overestimated the interface shear strength when compared to pavement cores.
  - While a decreasing trend was observed in the laboratory, an increasing trend in the measured interface shear strength was observed in the field.

Acknowledgement

- **NCHRP**
  - Project 9-40
    - » Optimization of Tack Coat for HMA Placement
  - Technical Review Panel

TRB TRANSPORTATION RESEARCH BOARD OF THE NATIONAL ACADEMIES

- **LDOTD**

LOUISIANA DEPARTMENT of Transportation & Development — DOTD — Agency of: Louisiana.gov

- **Asphalt Products Unlimited**
  - Distributor Truck
  - SS-1h, CRS-1

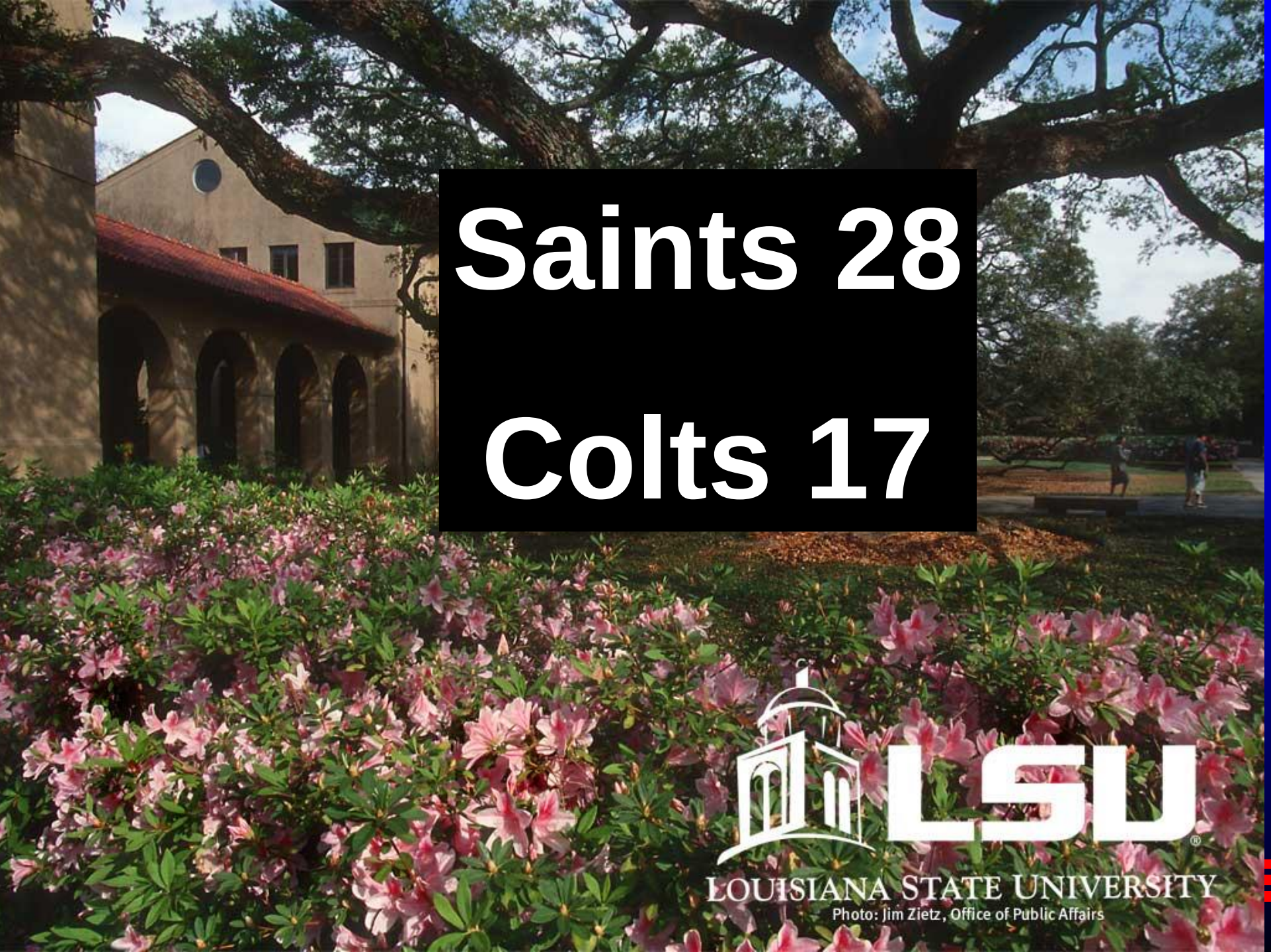
ASPHALT PRODUCTS UNLIMITED inc. — PRODUCTS FOR THE PLANT • PRODUCTS FOR THE ROAD

- **Coastal Bridge**
  - HMA
  - Construction

CB COASTAL BRIDGE COMPANY LLC. 3371 LA HWY. 1 NORTH, PORT ALLEN, LA 70767 — ASPHALT SALES 225-223-0226

- **Blacklidge**
  - Trackless

Blacklidge Emulsions, Inc.


Saints 28
Colts 17
LSU
LOUISIANA STATE UNIVERSITY
Photo: Jim Zietz, Office of Public Affairs

THANK YOU