Brief Introduction to the

Illinois Center for Transportation

Imad L. Al-Qadi

ILLINOIS CENTER FOR TRANSPORTATION

ICT Vision,

Since its inception in 2005

- **Serve the transportation needs of IDOT, the State of Illinois, and the nation through *research, education, and outreach***
  - **Rapid response to future scientific challenges in transportation**
  - **Adapt to changing needs**
- **Develop and implement innovative and cost-effective technologies**
- **Optimize the limited resources of IDOT**

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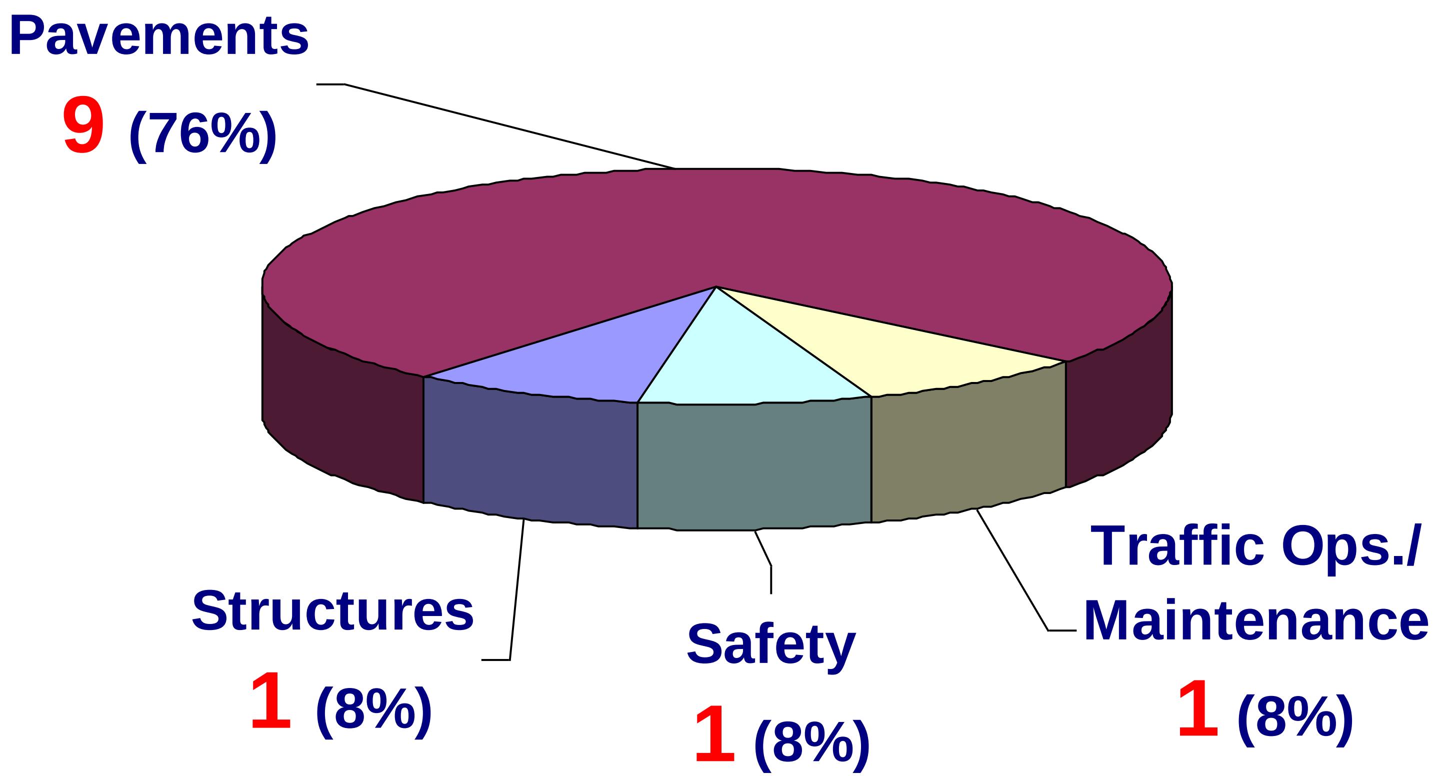
Initial Projects, 2005



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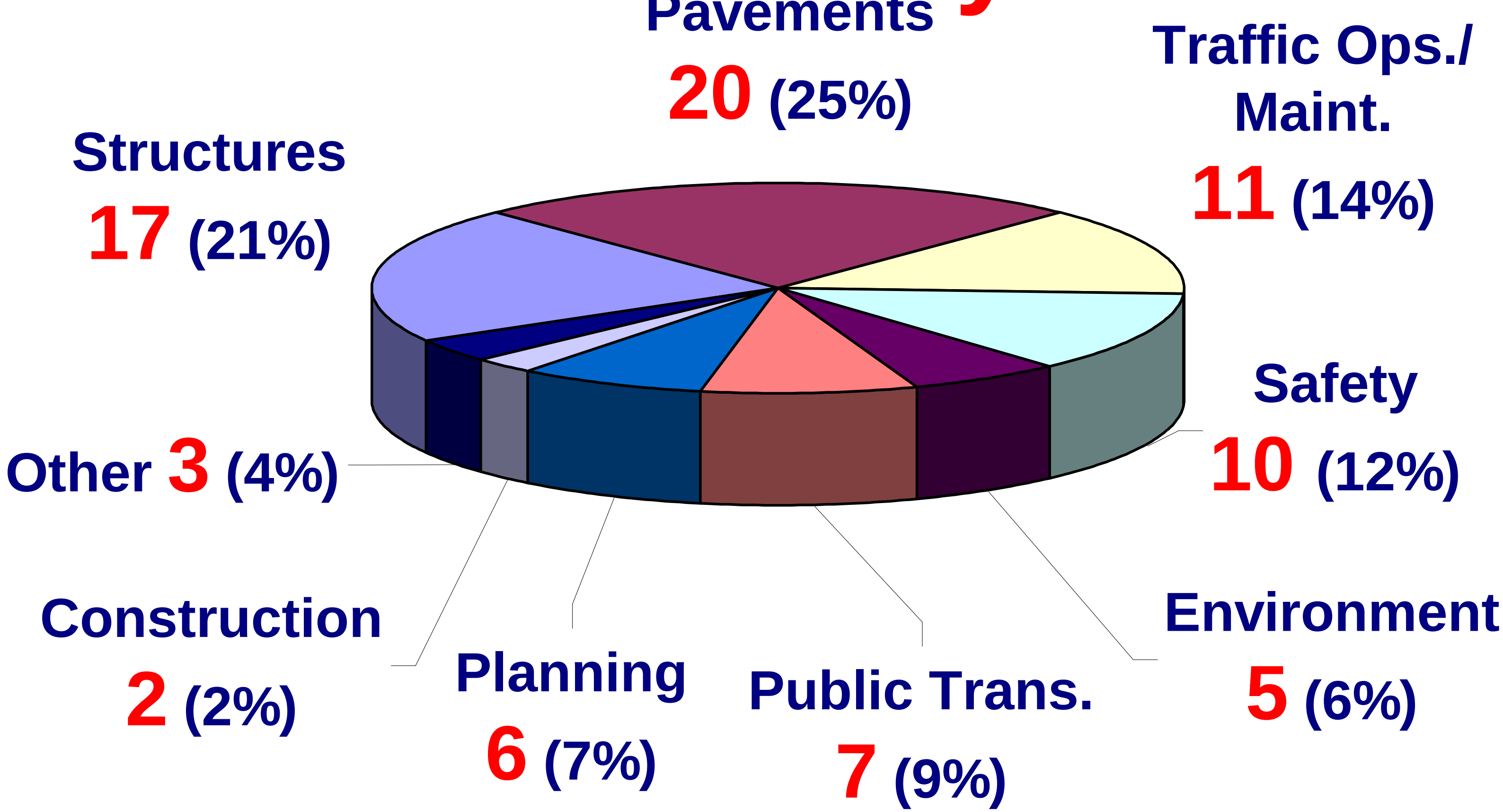
Now - Transportation Diversity!



Research Progress/ Status

- Total Projects Approved to Date = 93
  - 81 Regular Projects – Selected by Exec. Committee
  - 12 Special (Short-Term) Projects
- 29 Projects Are Completed
  - 19 Regular Projects
  - 10 Special (Short-Term) Projects
- 26 ICT Reports Published on Website
- 64 Active ICT Projects

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Who’s Participating in ICT?

- 40 Academic Researchers (PI’s/ Co-PI’s)
- 50 Graduate Students
- 9 Universities
- 4 Private Consulting Firms
- 2 Federal/ Local Gov’t. Agencies
- Consultants

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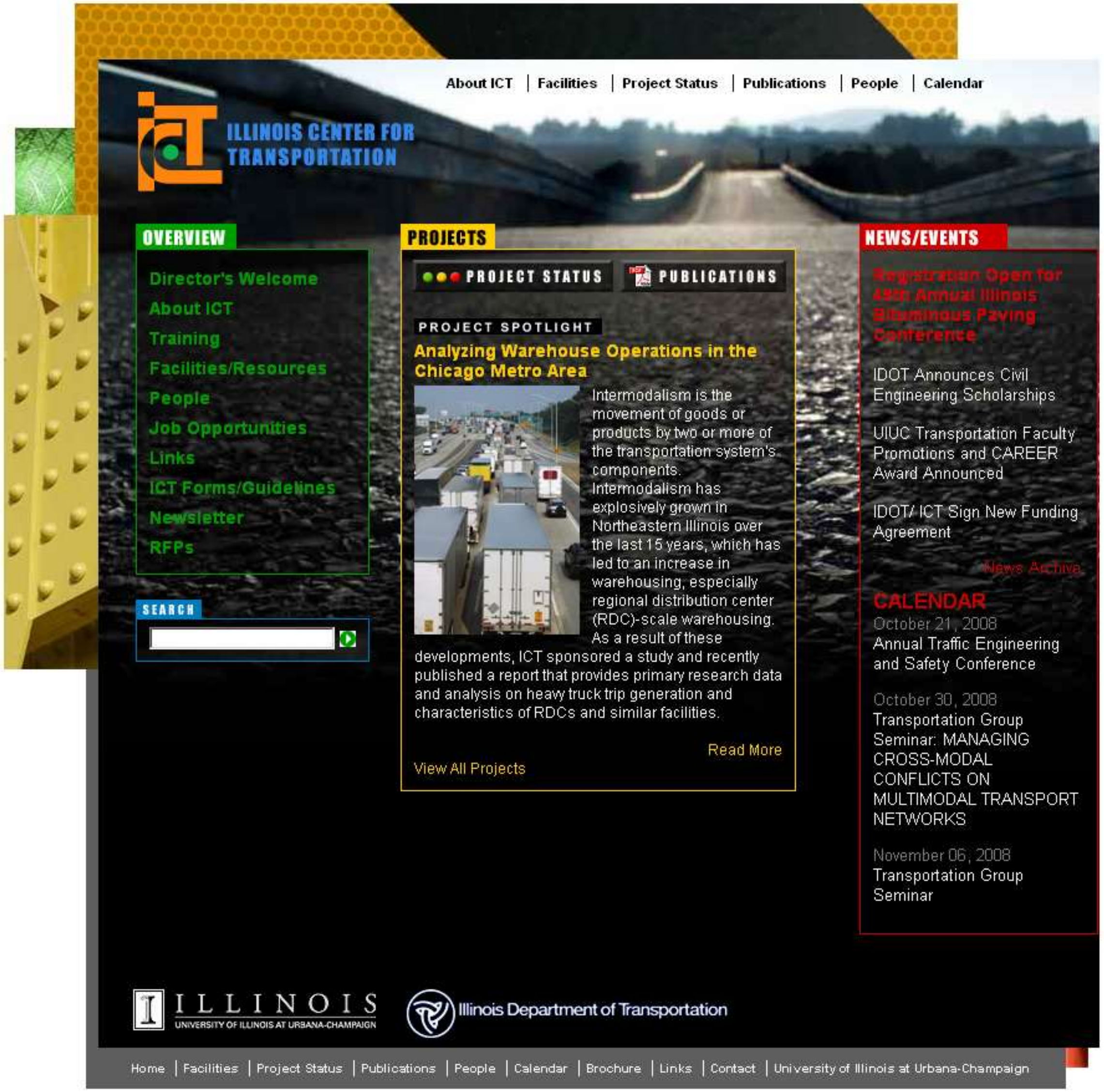
Served by a Top Facility - ATREL







www.ict.uiuc.edu

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About ICT | Facilities | Project Status | Publications | People | Calendar

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PROJECTS

- Project Spotlight
- Project Status
- Publications
- Search Publications

PUBLICATIONS

Pub. No.	Proj. No.	Title	Authors	Date
ICT-08-025	ICT R27-15	REGIONAL WAREHOUSE TRIP PRODUCTION ANALYSIS,Chicago Metro Area, September, 2008	Jon B. DeVries and Sofia V. Dermisi	Oct-08
FHWA-ICT-08-021	ICT-R27-23	Evaluation of HMA Overlays in Illinois	Angela S. Wolters, Todd E. Hoerner, and Kurt D. Smith	Sep-08
FHWA-ICT-08-022	ICT R39-2	Nondestructive Pavement Analysis Using ILLI-PAVE Artificial Neural Network Models	Onur Pekcan, Erol Tutumluer, Marshall Thompson	Sep-08
FHWA-ICT-08-023	ICT R55	Tack Coat Optimization for HMA Overlays: Laboratory Testing	Imad L. Al-Qadi, Samuel H. Carpenter, Zhen Leng, Hasan Ozer, James S. Trepanier	Sep-08
ICT-08-024	ICT R43	Evaluation of Video Detection Systems, Volume 1 - Effects of Configuration Changes in the Performance of Video Detection Systems	Juan C. Medina, Rahim F. Benekohal, Madhav Chitturi	Sep-08
FHWA-ICT-08-017	ICT-R39	EXTENDED LIFE HOT MIX ASPHALT PAVEMENT (ELHMAP) TEST SECTIONS AT ATREL	S.H. Carpenter	Jul-08
FHWA-ICT-08-018	ICT-R27-16	Truckers' Park/Rest Facility Study	Peter Beltemacchi, Laurence Rohter, Jac Selinsky, Terry Manning	Jul-08
FHWA-ICT-08-[illegible]	ICT-R27-7	Carbon Monoxide Screen for Signalized Intersections COSIM, [illegible]	Scott Peters	Jul-08

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Bonding HMA to PCC
the Key to Overlay Performance

Imad L. Al-Qadi

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Outline

- Introduction
- Objective
- Experimental Program and Lab Test Results
- HMA Overlay Construction
- Accelerated Pavement Testing (APT) Results
- Conclusions and Recommendations

Introduction

- Interface bonding between HMA overlays and PCC pavements is critical to overlay performance.
- Various pavement distresses can be caused by poor interface bonding.
- Most of the previous research studies have focused on the interface between HMA layers, and few field validated studies have been conducted.

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Objective

- To quantify the effectiveness of tack coat application between existing PCC pavement and HMA overlay.
  - Laboratory Testing
  - Accelerated Pavement Testing

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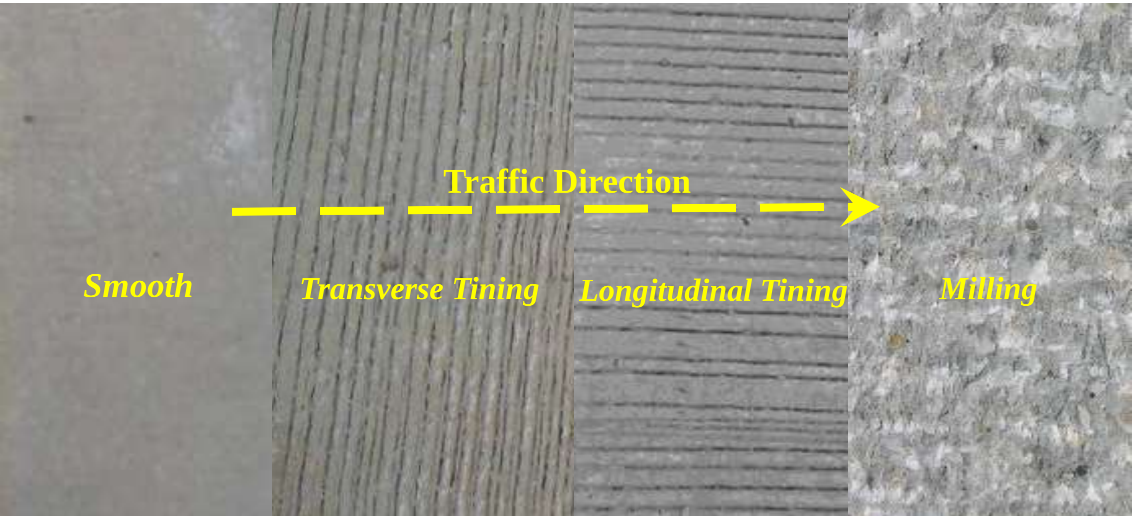
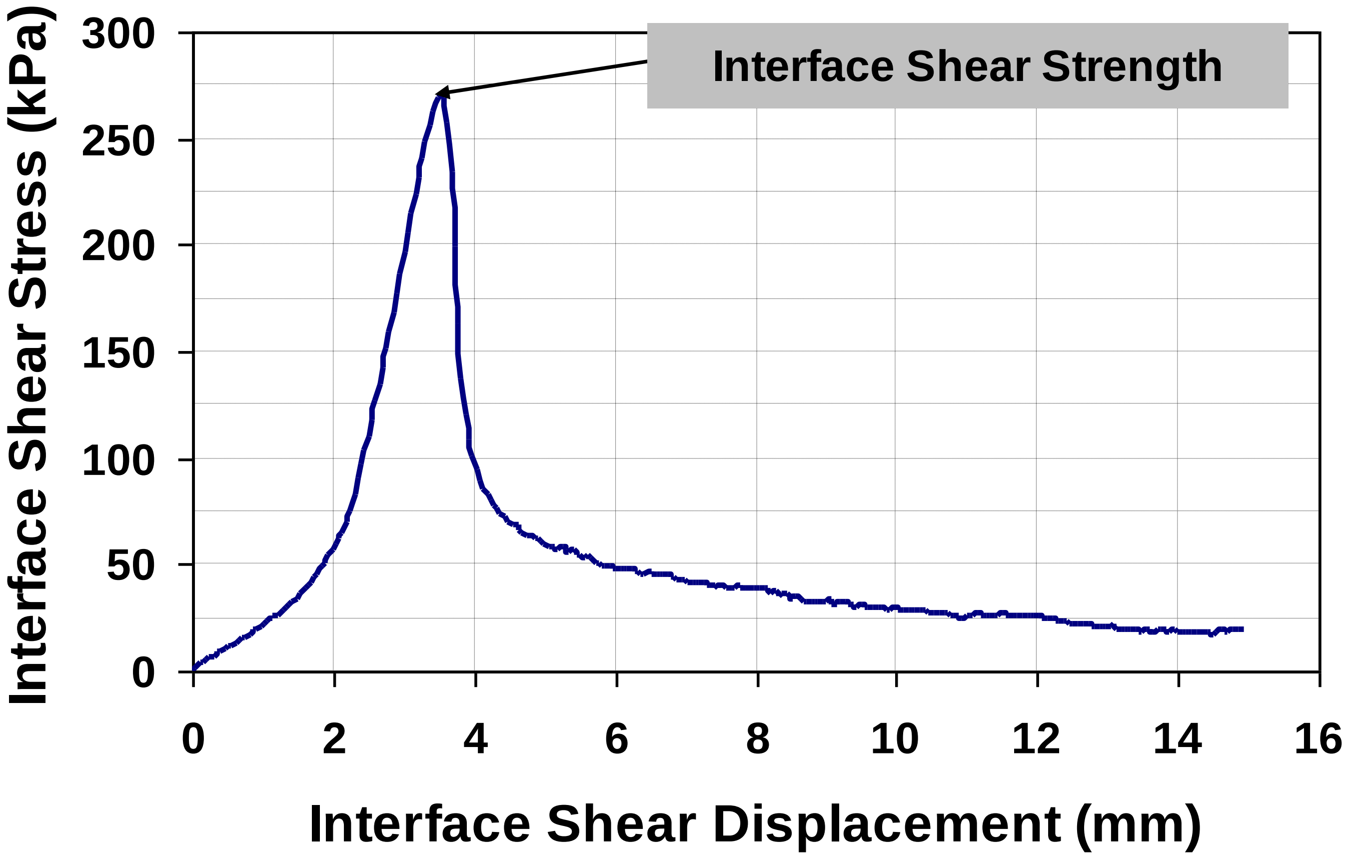
Laboratory Testing

- A specially designed direct shear testing fixture was used
- Experimental variables include tack coat type, tack coat application rate, HMA type, temperature, and moisture.



Typical Interface Shear Stress-Displacement Curve



Experimental Variables

Variables	Levels (No. of Levels)
HMA Type	Surface, Standard Binder, Moisture-Sensitive Binder (3)
Tack Coat Type	SS-1hP, SS-1h, RC-70 (3)
Residual Tack Coat Application Rate	0, 0.02, 0.05, 0.09 gal/yd^2 (4)
Concrete Surface Texture	Smooth, Transverse-Tined, Longitudinal-Tined, Milled (4)
Temperature	50, 68, 86 ^{o}F (3)
Moisture Condition	Dry, Saturated (2)

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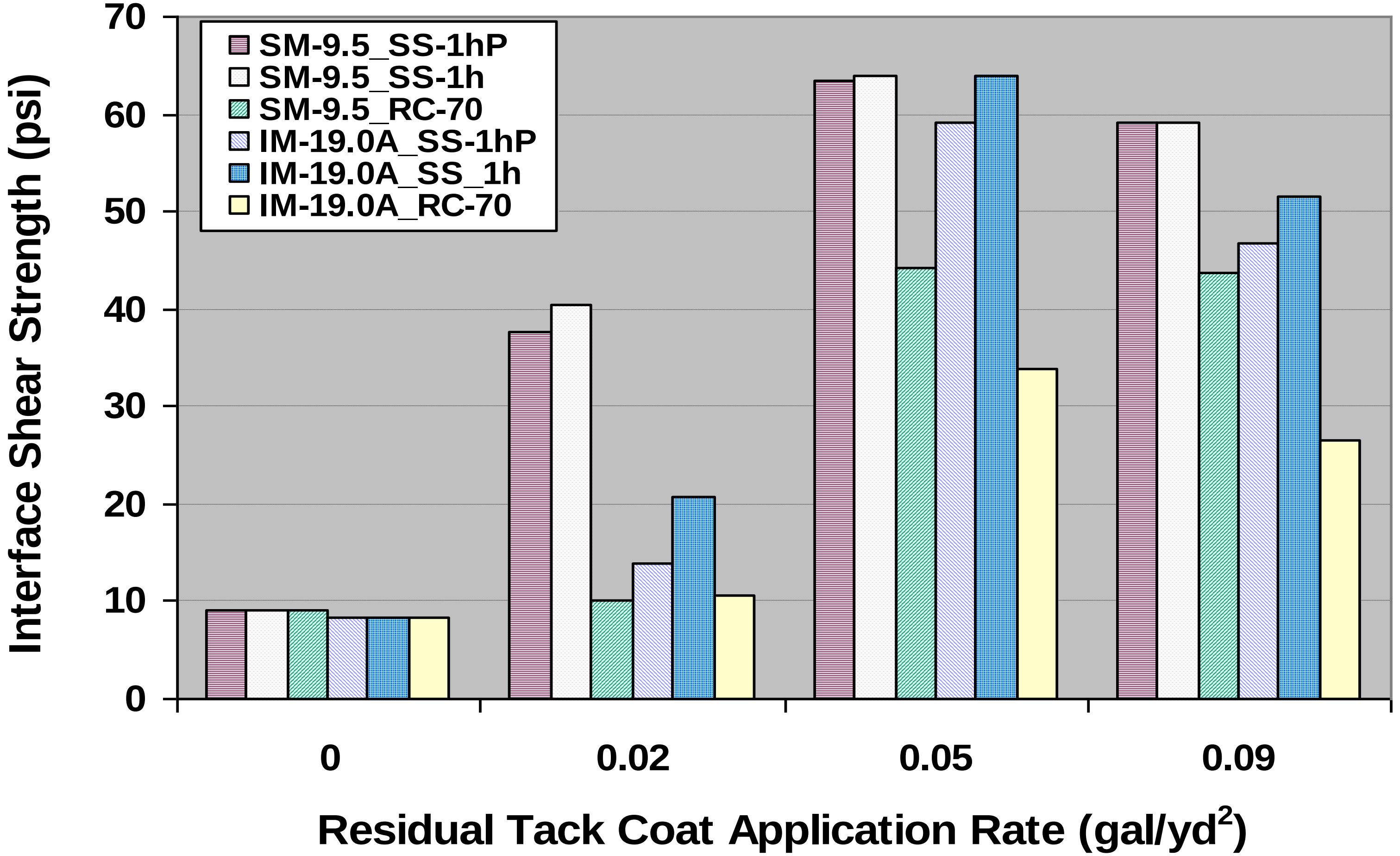
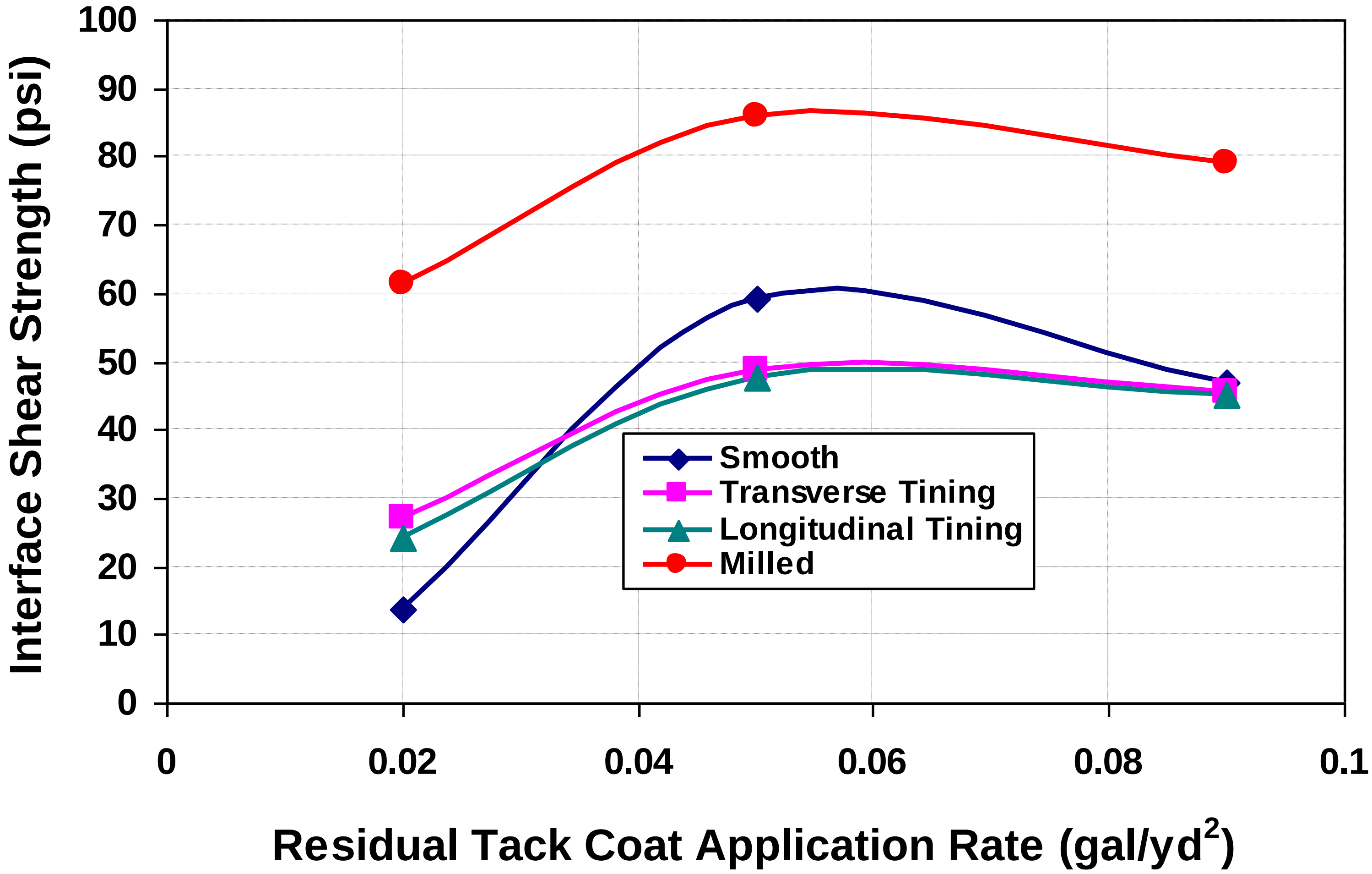
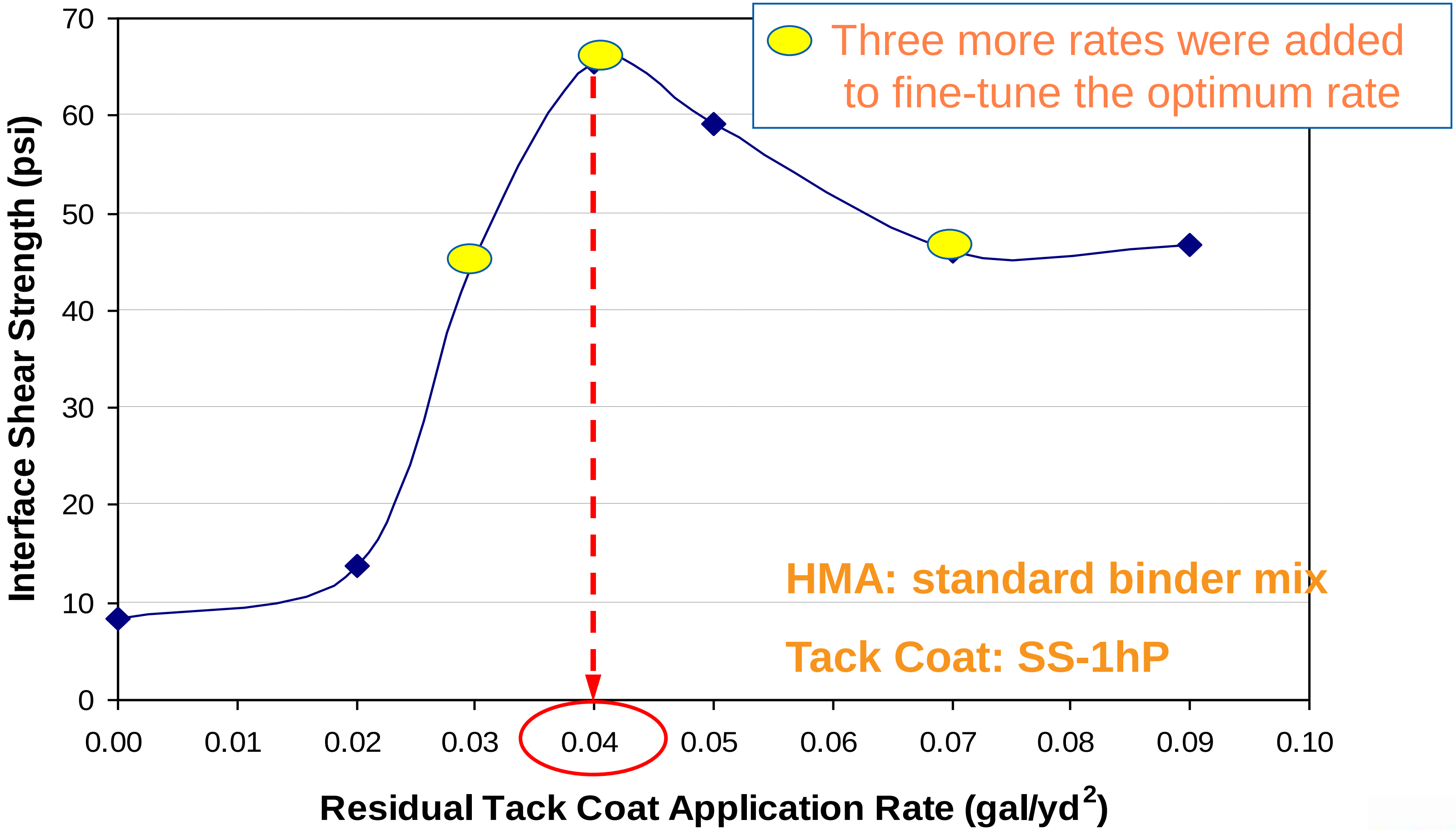
Effects of HMA Type and Tack Coat Type and Application Rate



Concrete Surface Texture Effect



Optimum Tack Coat Application Rate Determination



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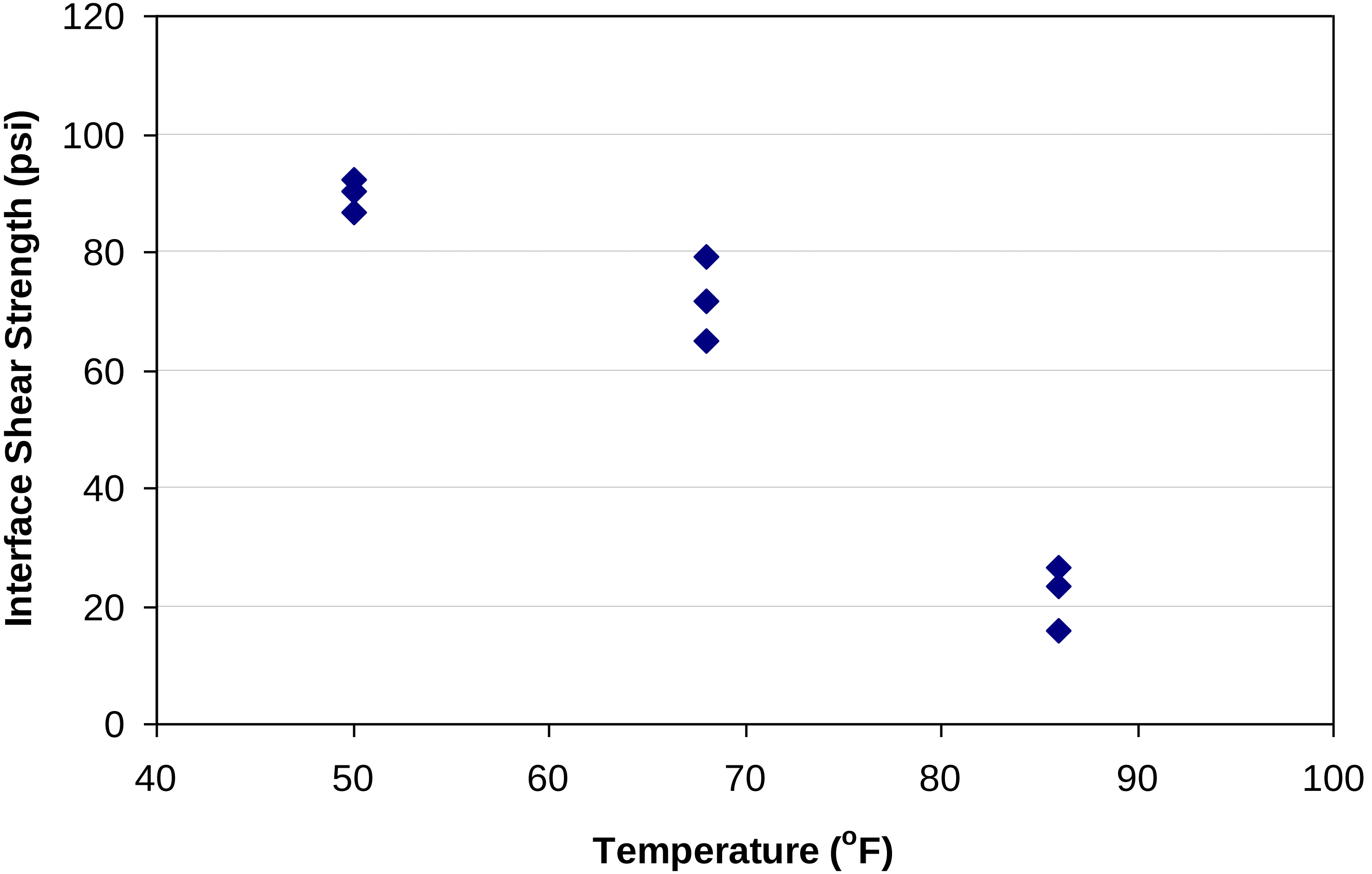
Temperature Effect



Moisture Conditioning

- AASHTO Designation T283-02 was modified to condition the HMA-PCC specimens
- Saturation degree: 70-80%
- Water bath at 140^{o}F (60^{o}C) for 24hrs
- Water bath at 68^{o}F (20^{o}C) for 2hrs
- Shear test at 68^{o}F (20^{o}C)
- Calculate interface shear strength ratio between dry and moisture conditioned specimens

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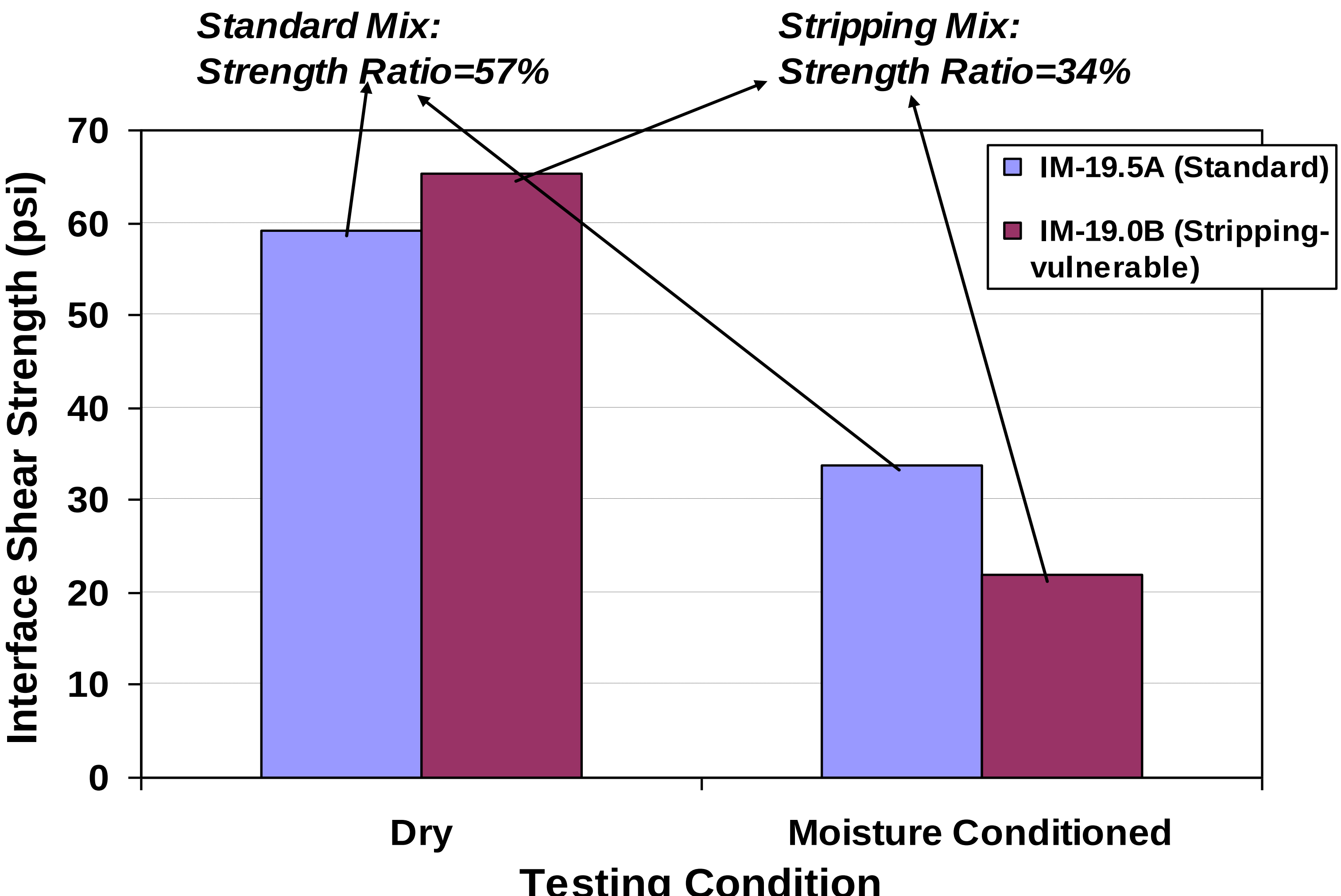
Moisture Effect



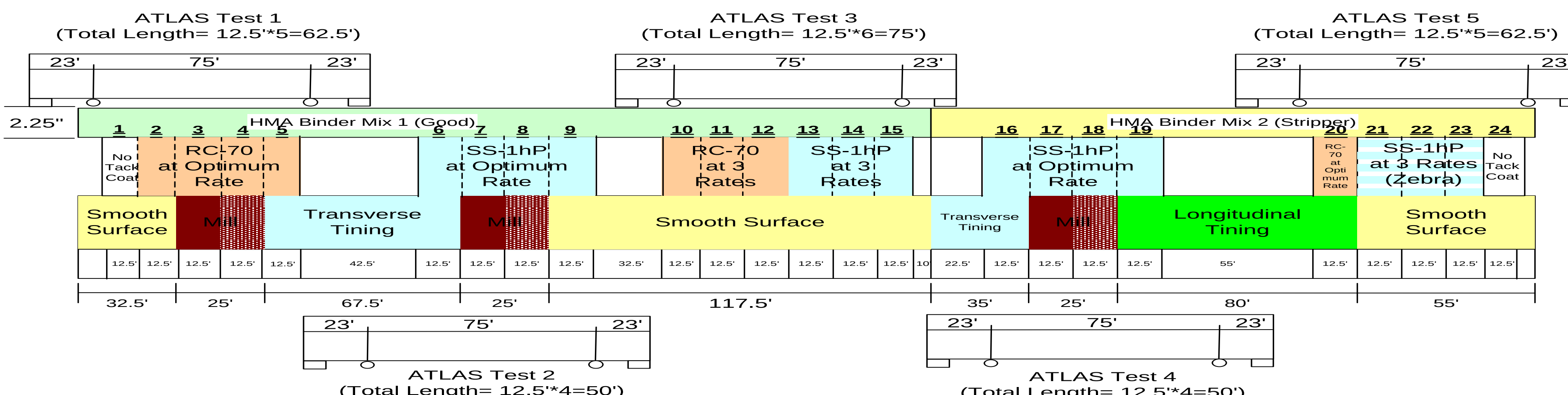
Lab Testing Findings

- Surface mix provides **better interface shear strength** than binder mixes.
- **SS-1hP and SS-1h** provide better interface shear strength than RC-70; no significant difference between SS-1hP and SS-1h.
- The optimum residual tack coat rate for SS-1hP using standard binder mix is **0.04gal/yd^2** (0.18L/m^2).

Lab Testing Findings (Cont'd)

- Milled PCC surface provides the highest interface shear strength.
- Lower temperature produces better bonding at intermediate to high temperatures.
- Moisture conditioning significantly reduces interface strength. The reduction is more pronounced when a stripping-vulnerable mix is used.

APT Validation & Construction Layout



* ATLAS Test 3 compares the tack coat application rates.
* ATLAS Tests 1, 2, & 4 compare various surface textures with one tack coat application rate.
* ATLAS Test 5 compares the zebra distribution effect at various application rates.

A broom-cleaned milled surface

An air-blast-cleaned milled surface

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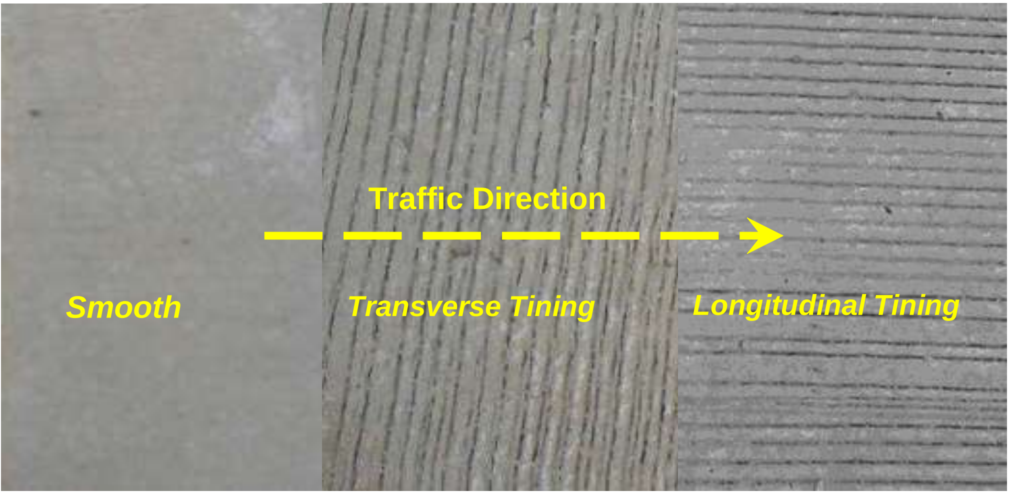
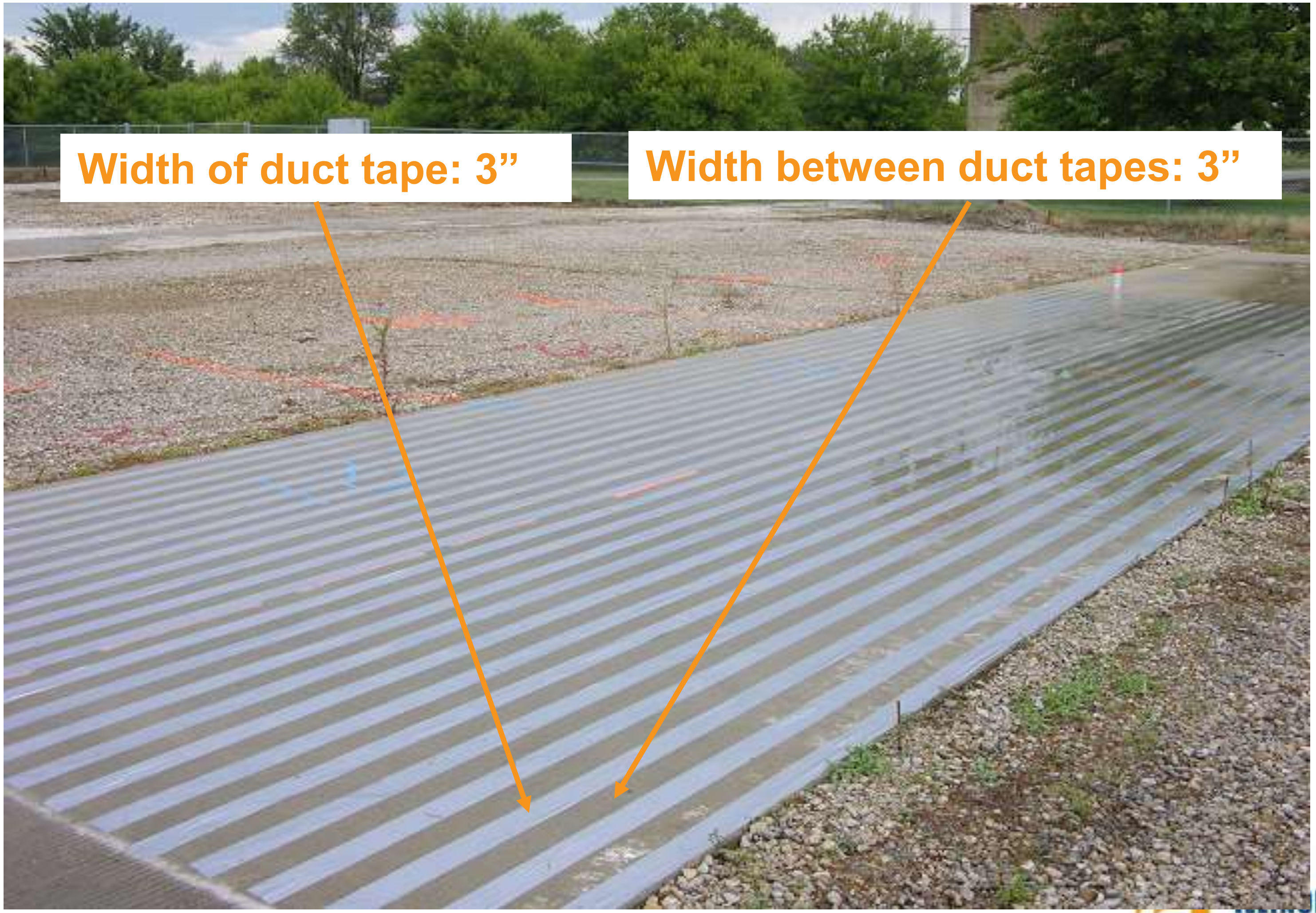
PCC Surface Preparation



Zebra/Striped Sections



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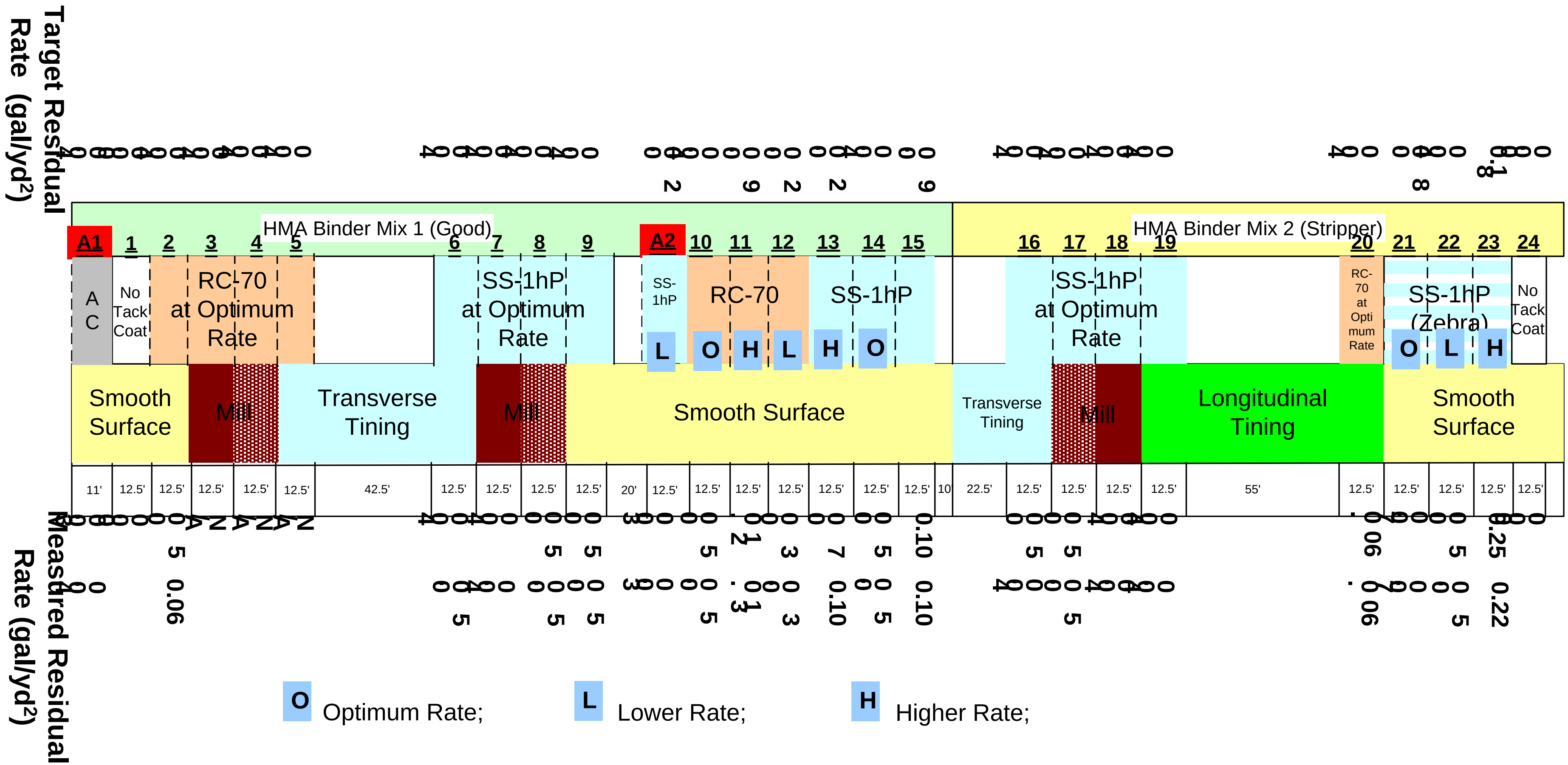
Field Tack Coat Application

Centennial variable-bar liquid distributor

Geotextile Pad for Tack Coat Application Rate Measurement

Tack Coat Application Rate Check



Strain Gauge Instrumentation


H-type strain gauge


Level strain gauge

Strain gauge installation

Placement of HMA Overlay

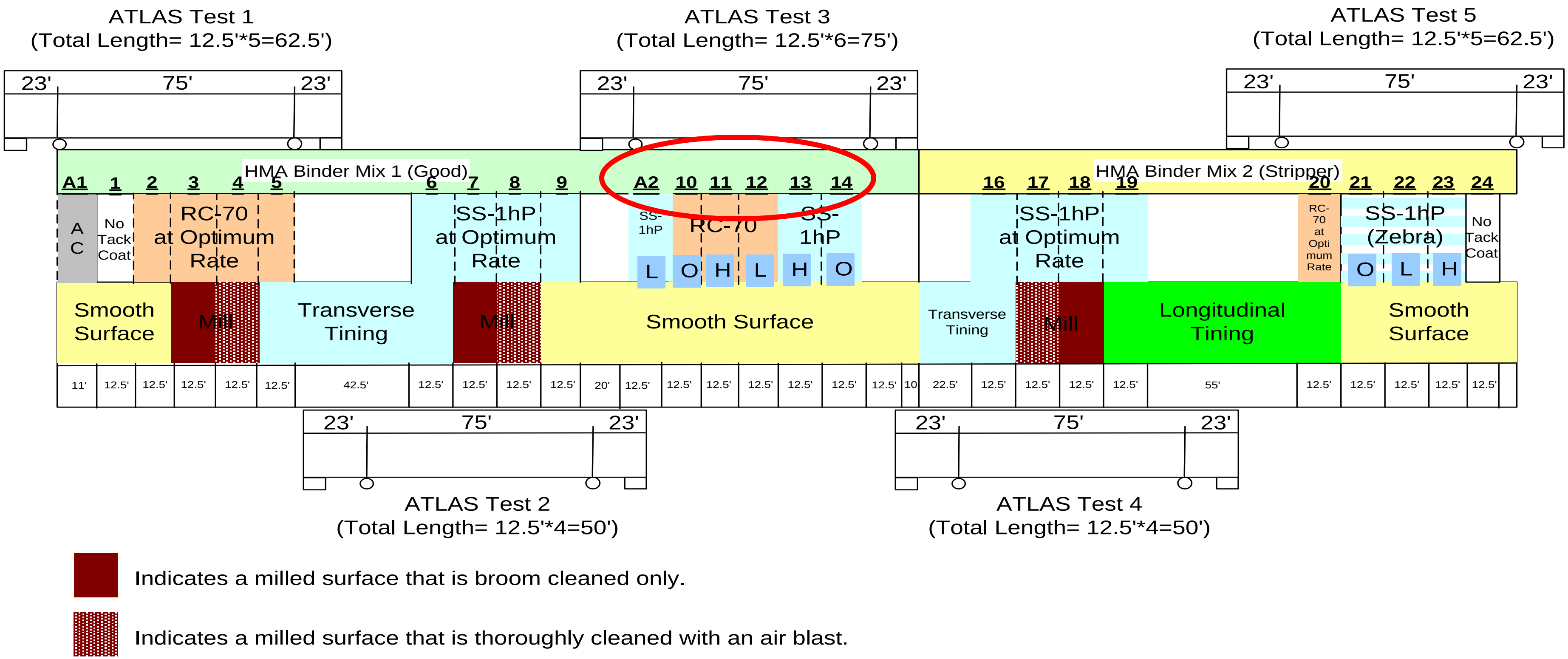
ROADTEC Material Transfer Device

HMA Overlay Material: standard binder mix and moisture-sensitive mix

Density check with nuclear density gauge

Accelerated Pavement Testing

ATLAS Test 3: Sections A2 - 14



- To compare different tack coat and tack coat application rates.
- Two tack coats: RC-70 and SS-1hP and each at three residual application rates: 0.02, 0.04 and 0.09 gal/yd^2.

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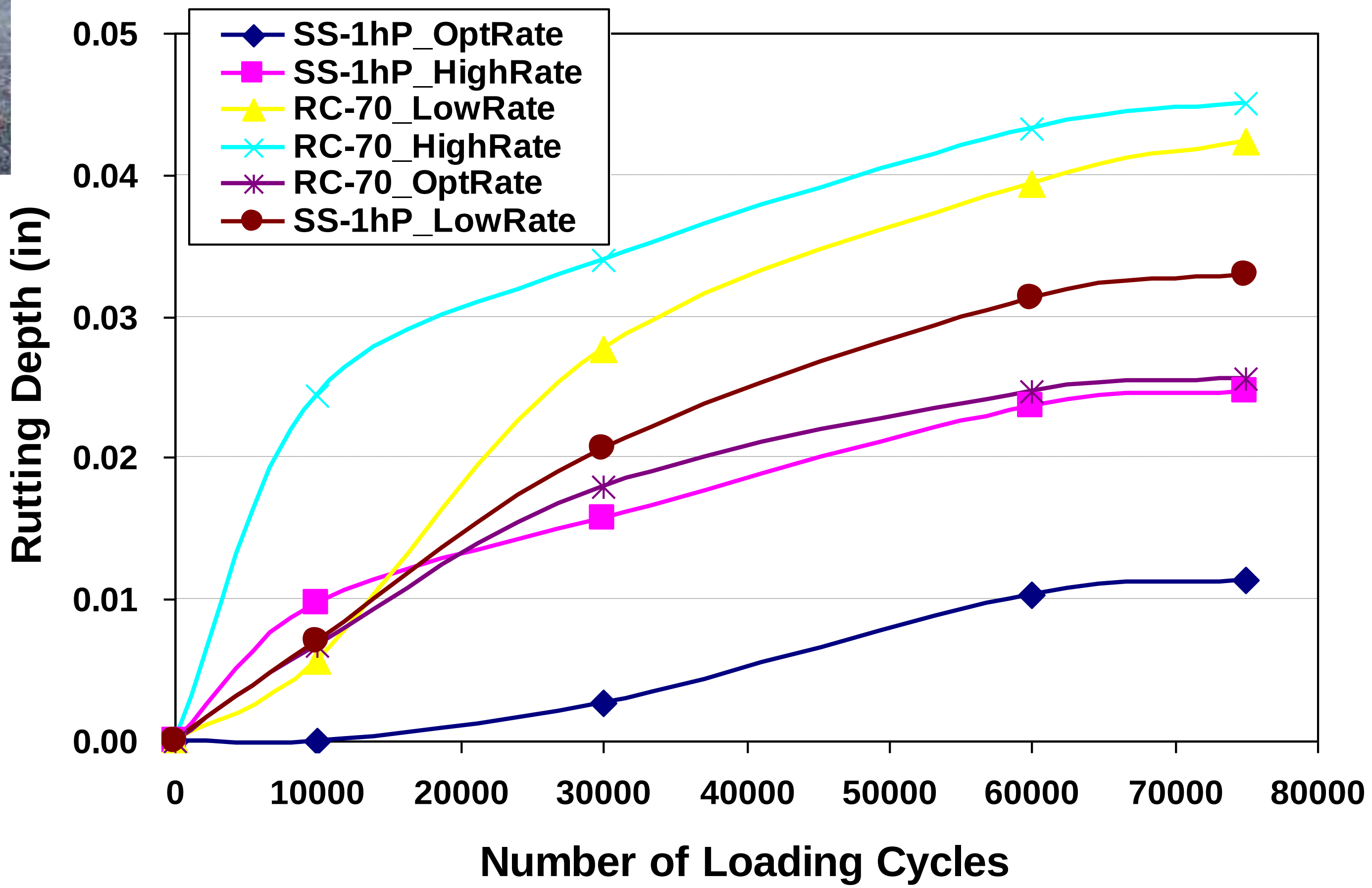
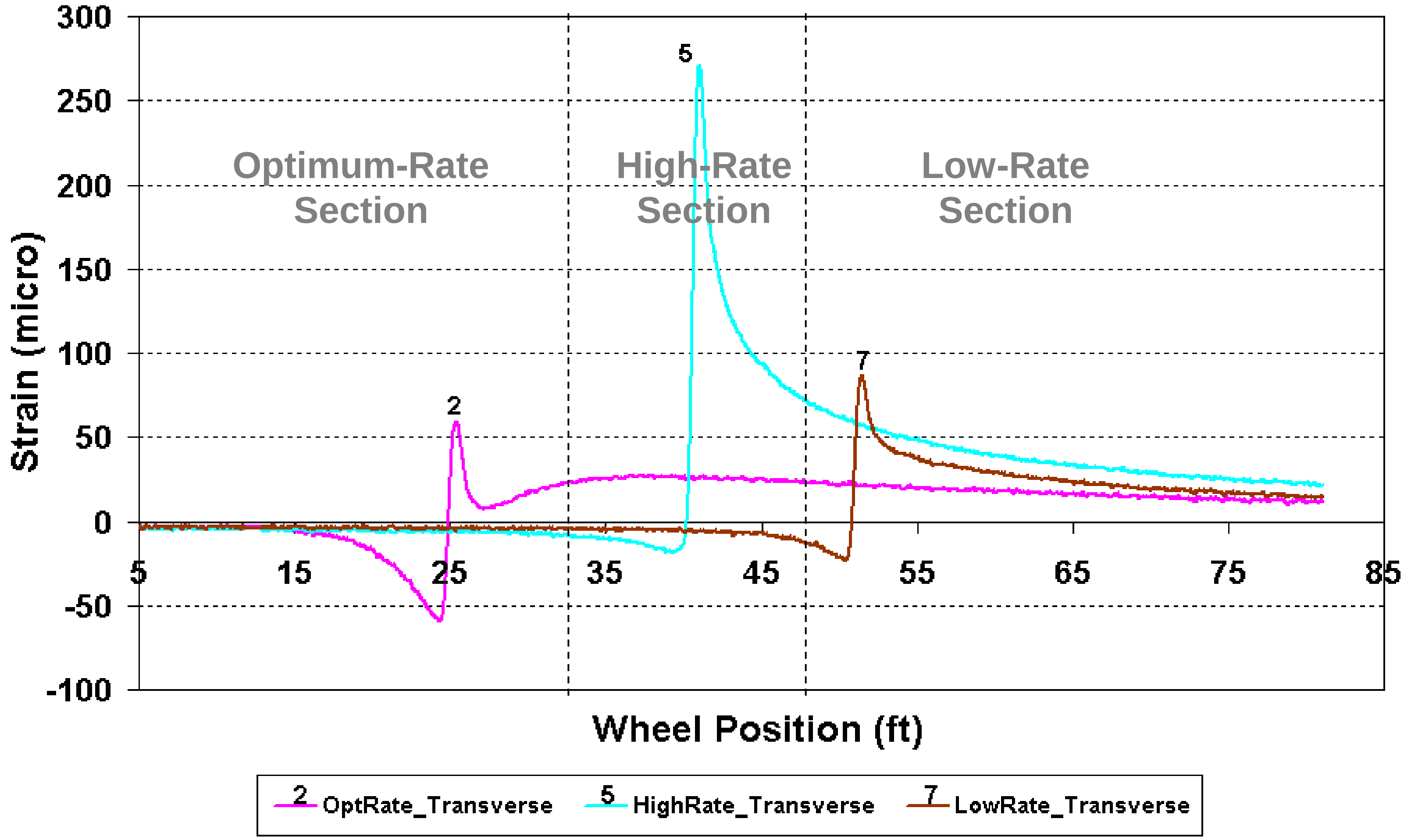
Test 3 – Rutting Depth Progress



Test 3 - Transverse Strain Response



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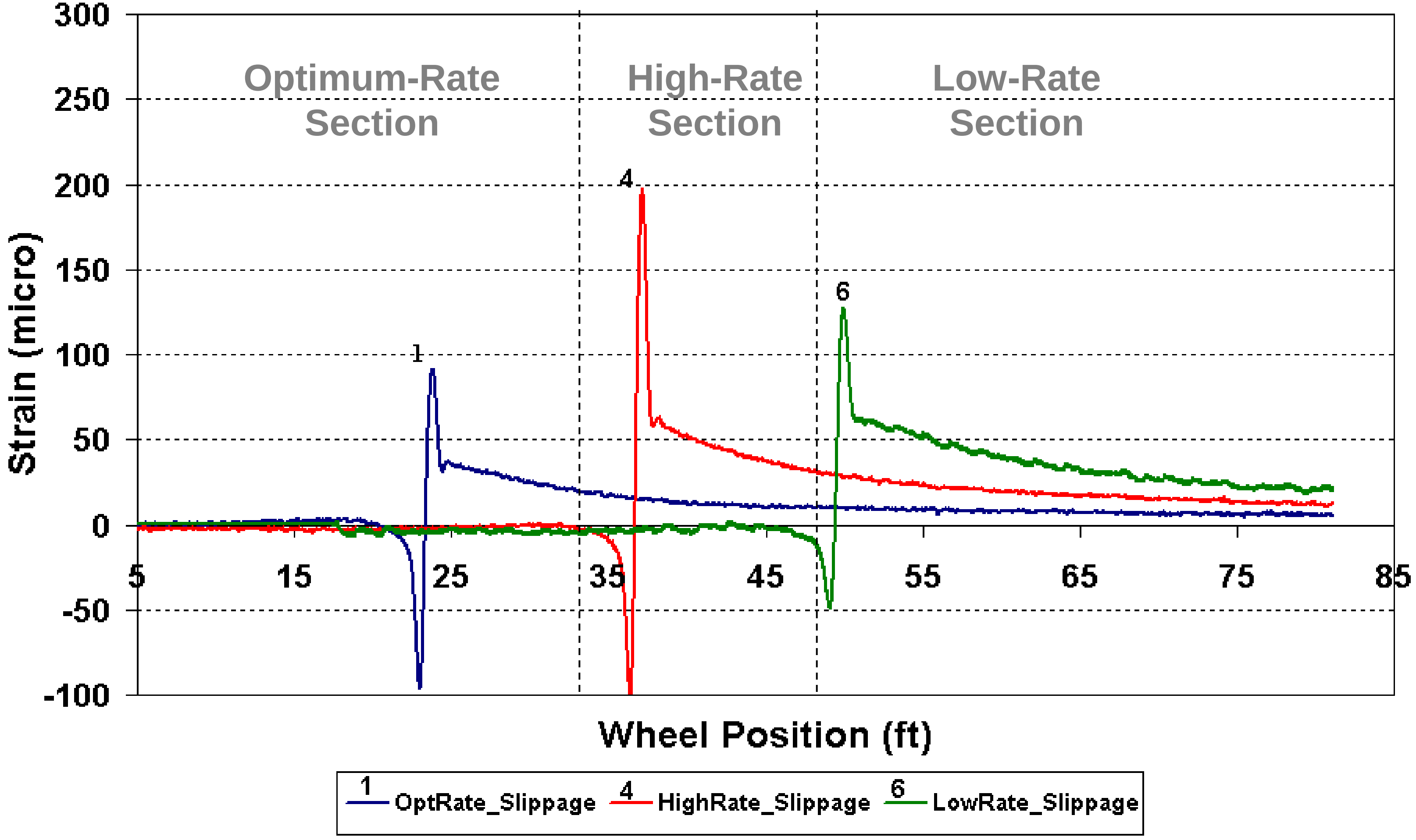
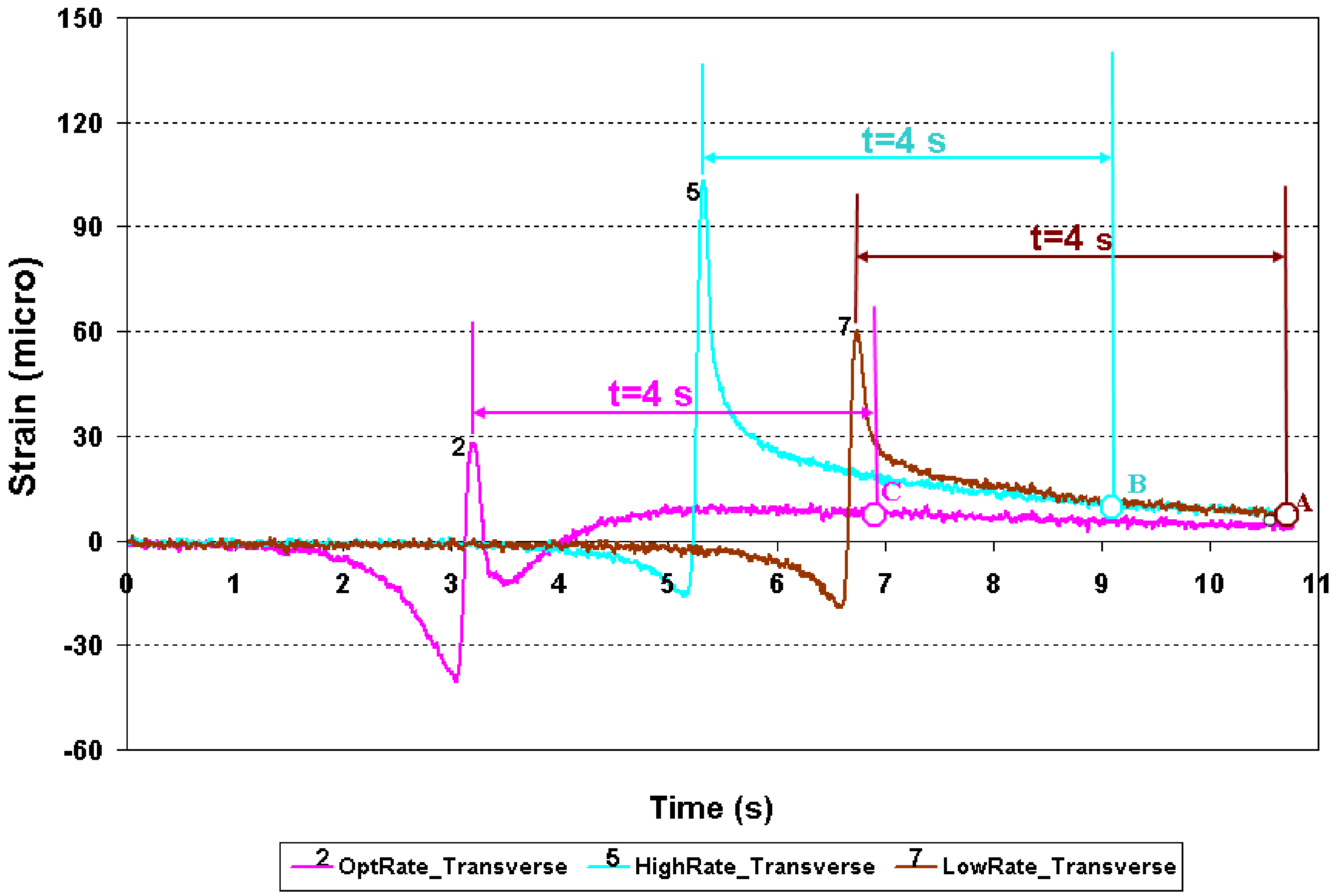
Test 3 - Slippage Strain Response



Residual Strain Calculation



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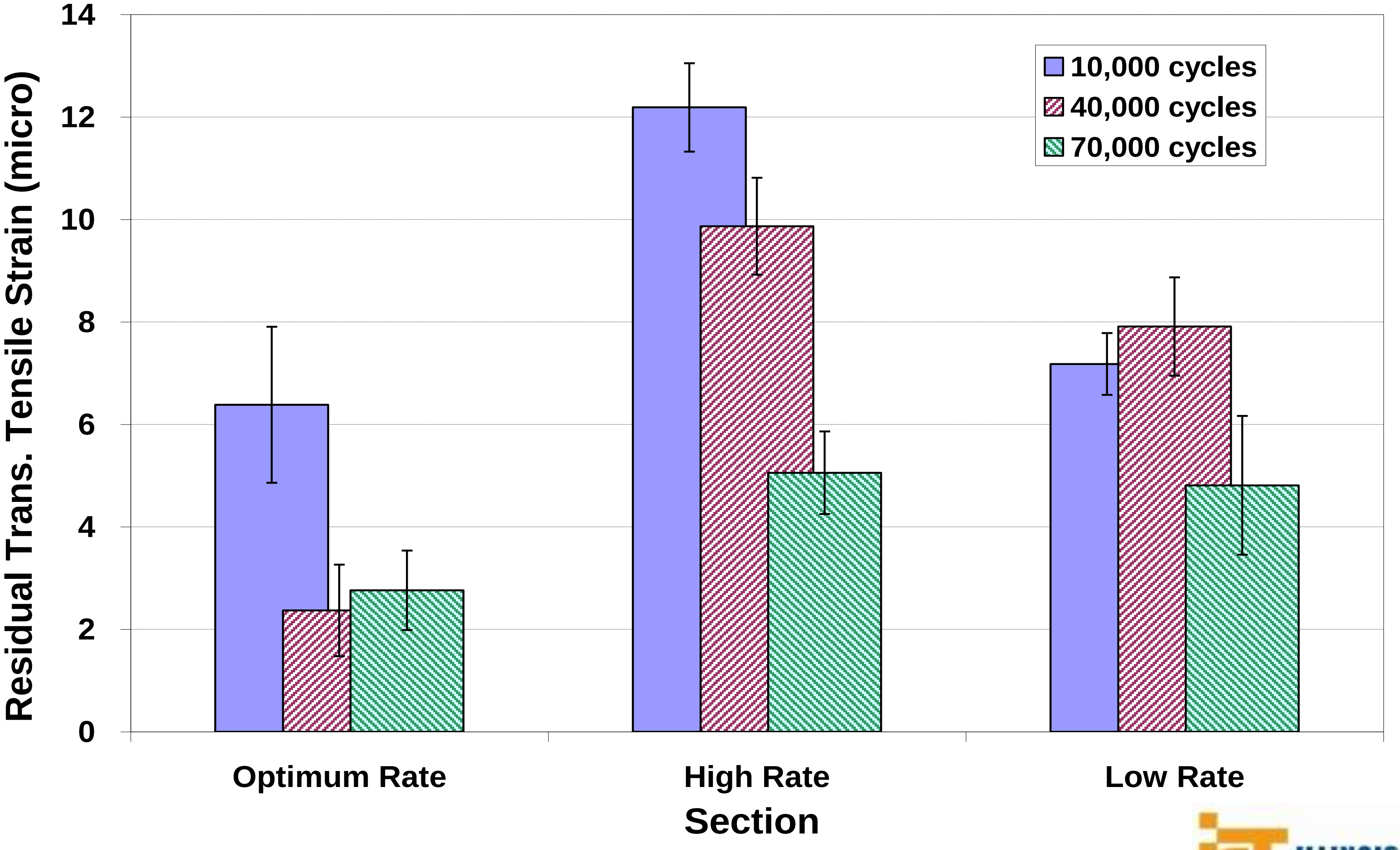
Residual Transverse Tensile Strain



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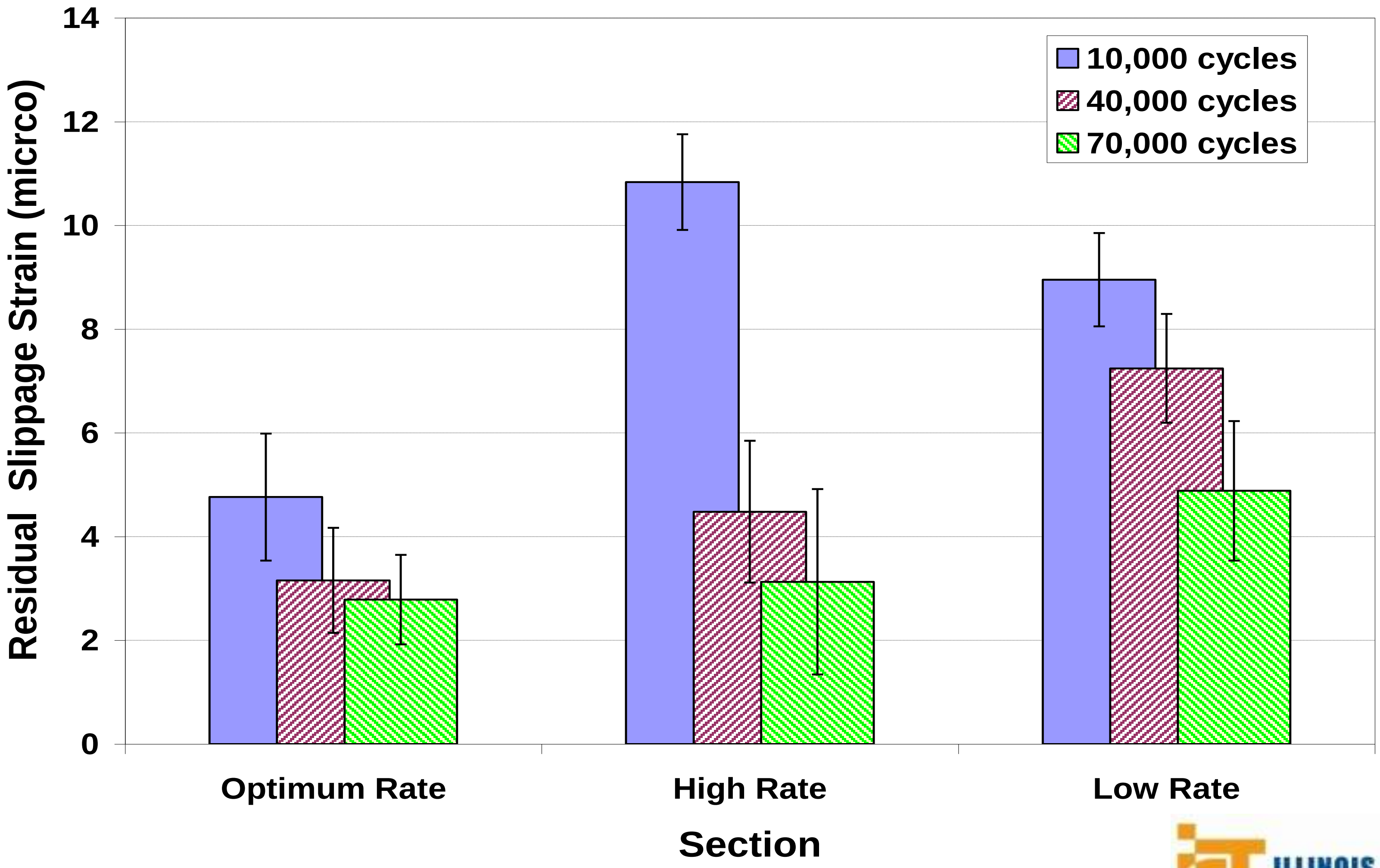
Residual Slippage Strain



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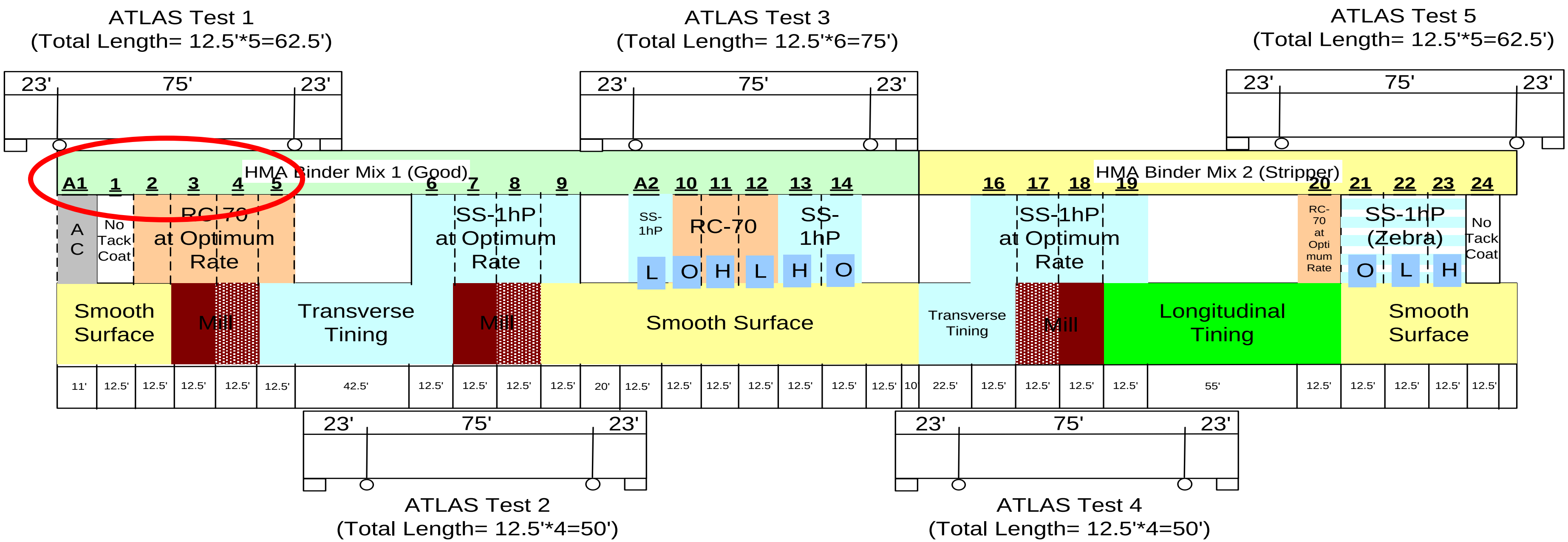
ATLAS Test 1: Sections A1 - 5



Indicates a milled surface that is broom cleaned only.

Indicates a milled surface that is thoroughly cleaned with an air blast.

O Optimum Rate; L Low Rate; H High Rate;

- To compare different PCC surface textures.
- Four PCC surface textures: smooth, broom cleaned milling, air blast cleaned milling, and transverse tinting

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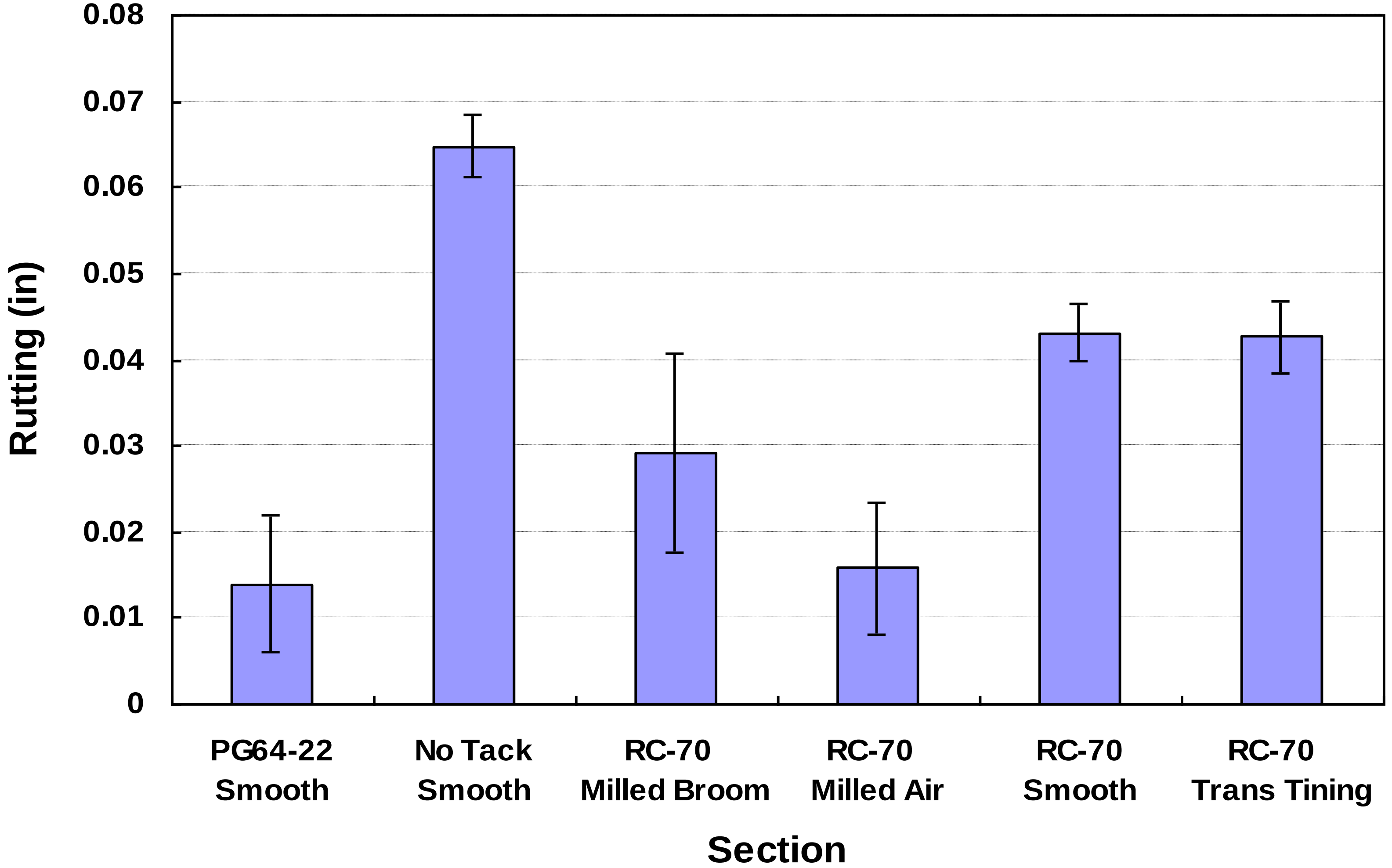
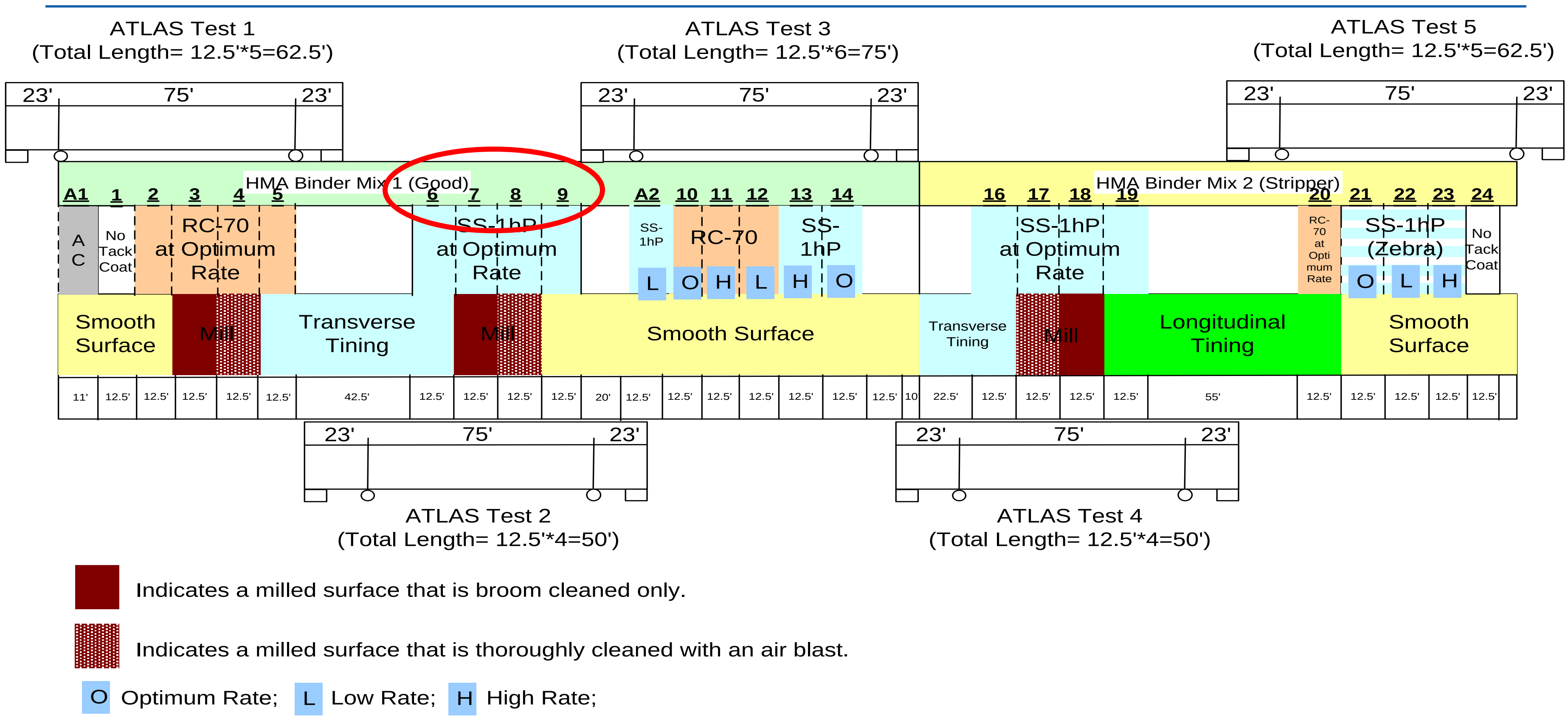
ATLAS Test 1 - Final Rutting Depth



ATLAS Test 2: Sections 6 - 9



- To compare various PCC surface textures.
- Four PCC surface textures: transverse tining, broom cleaned milling, air blast cleaned milling, and smooth.

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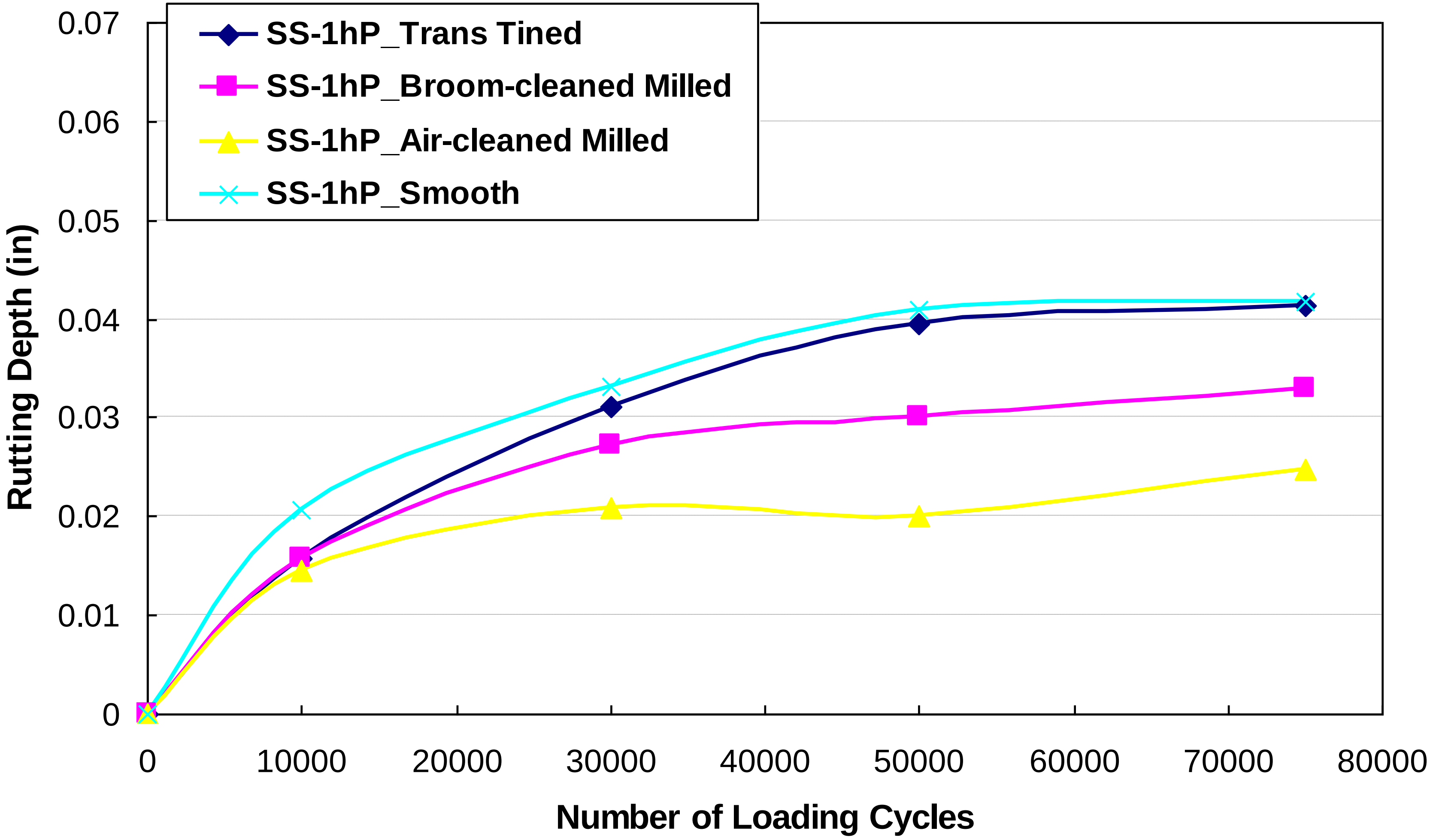
Test 2 – Rutting Depth Progress



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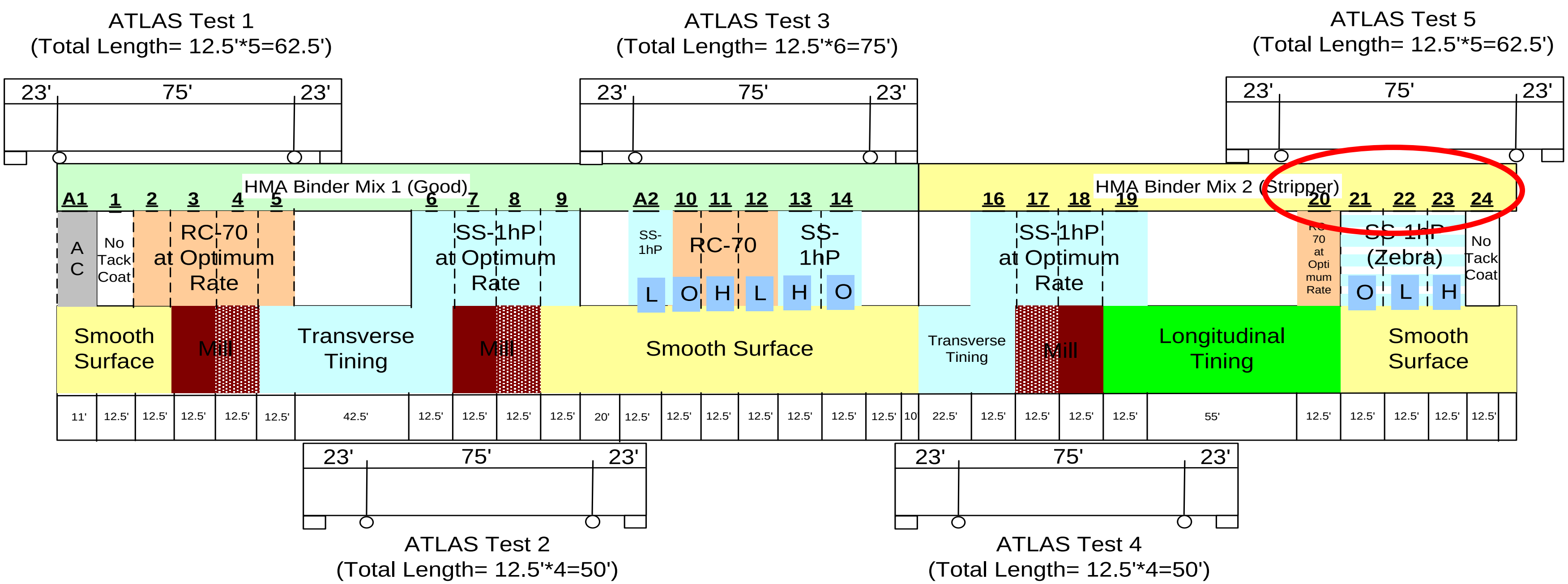
ATLAS Test 5: Sections 20-24



Indicates a milled surface that is broom cleaned only.

Indicates a milled surface that is thoroughly cleaned with an air blast.

O Optimum Rate; L Low Rate; H High Rate;

- To compare zebra effects, i.e., effects of non-uniform tack coat distribution

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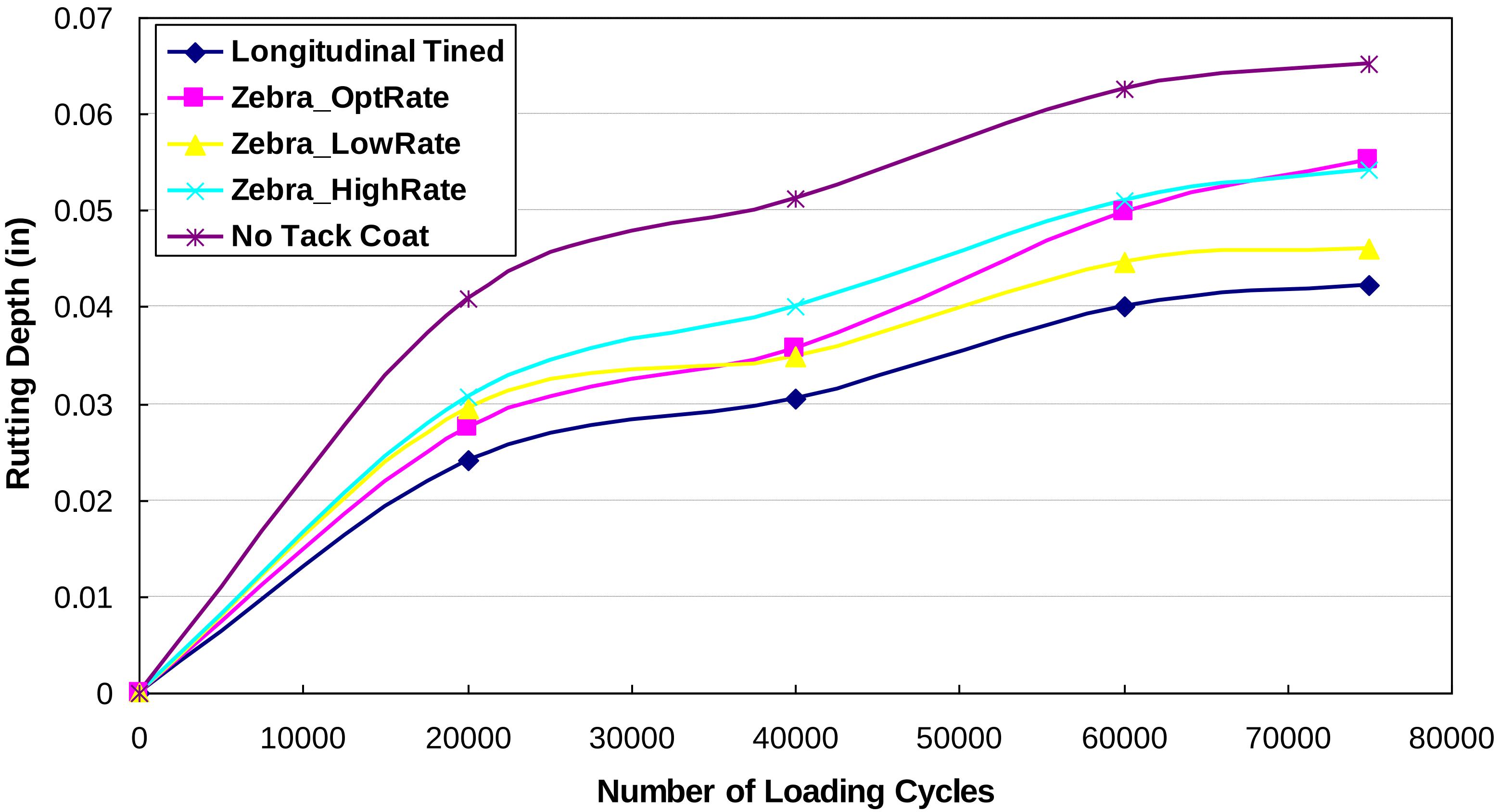
Test 5 - Rutting Depth Progress



Conclusions (1)

- Lab and field testing results suggest that asphalt emulsion provides better interface bonding than RC-70.
- Lab testing results didn’t show significant difference between SS-1hP and SS-1h.
- From lab testing, optimum SS-1hP tack coat residual application rate is 0.04 gal/yd^2. This value was validated in the field testing. Similar conclusion applied to RC-70.

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Conclusions (2)

- Lab testing results showed that temperature and moisture affected interface shear strength.
  - At intermediate to high temperature range, the higher the temperature, the lower the interface shear strength
  - Moisture reduces interface shear strength. It is more pronounced when stripping-vulnerable mixture is used.
- Milled PCC surface provides better interface shear strength than tined and smooth PCC surfaces.
- PCC surface cleanliness level affects rutting depth; air-cleaned surfaces performed better than broom-cleaned surfaces.
- Non-uniform tack coat distribution would cause higher HMA surface rutting.

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Recommendations

- SS-1hP (or SS-1h from lab) is recommended for use as tack coat at the HMA-PCC interface
- The recommended optimum residual tack coat application rate is 0.04 gal/yd^2
- Milling PCC surface should be applied when possible.
- Thoroughly cleaning is recommended (air blast)
- Tack coat should be applied uniformly; zebra application should not be allowed.
- PCC surface tining may not add to the HMA-PCC interface bonding.

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Acknowledgement

- This project was supported by IDOT and FHWA through ICT
- Technical Review Panel of ICT-R55 project: James Trepanier (Chair), Amy Schutzbach, Charles Weinrank, Patty Broers, Terry Hoekstra, Derek Parish, and Tom Winkelman.
- David Lippert

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Thank you!

Comments/ Questions?