

# Update on TPF-5(019)

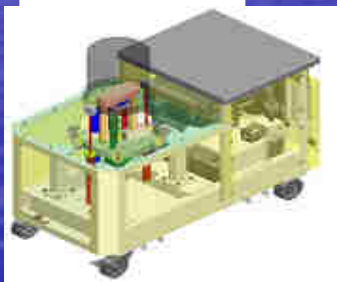
## Full-Scale Accelerated Performance Testing for Superpave and Structural Validation

**Tom Harman**

Materials & Construction Team Leader

**Federal Highway Administration**

**[www.TFHRC.gov](http://www.TFHRC.gov)**

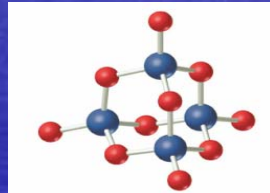


**MATERIALS & CONSTRUCTION**

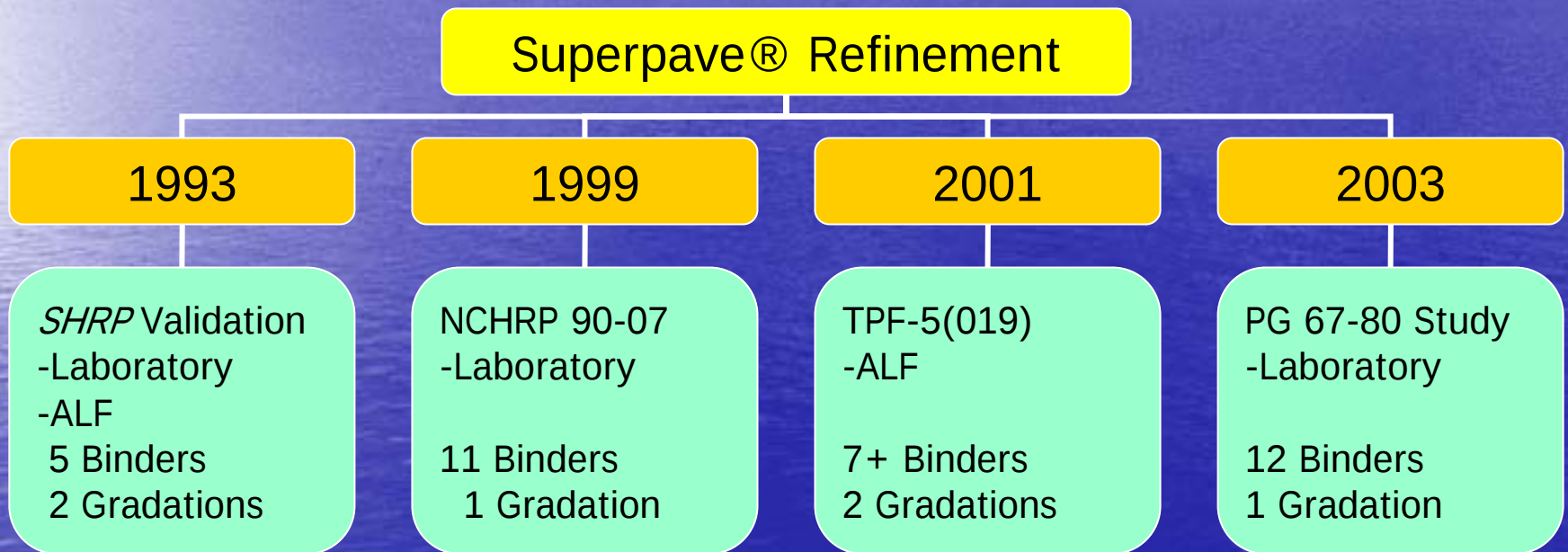
**TEAM, R&D**

# What's Go'in On

- Modified Binder Research Program
  - ALF '93, 90-07, ALF '01, PG 67-80 Study
- Phosphoric Modification of Asphalt Binders
  - AASHTO SOM, Binder ETG
- Evaluation of Moisture Damage
  - 3D Flow Models, Fundamental Chemistry
- Warm Mix Asphalt
  - WHO? – IARC, EPA, NAPA, NCAT, HIPT

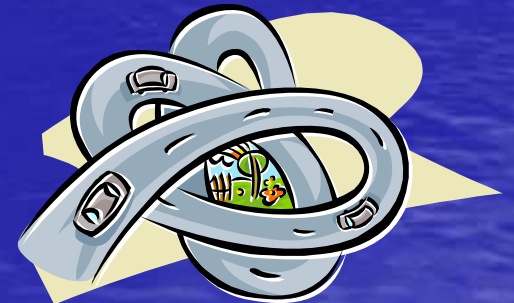


# Total Research Organization



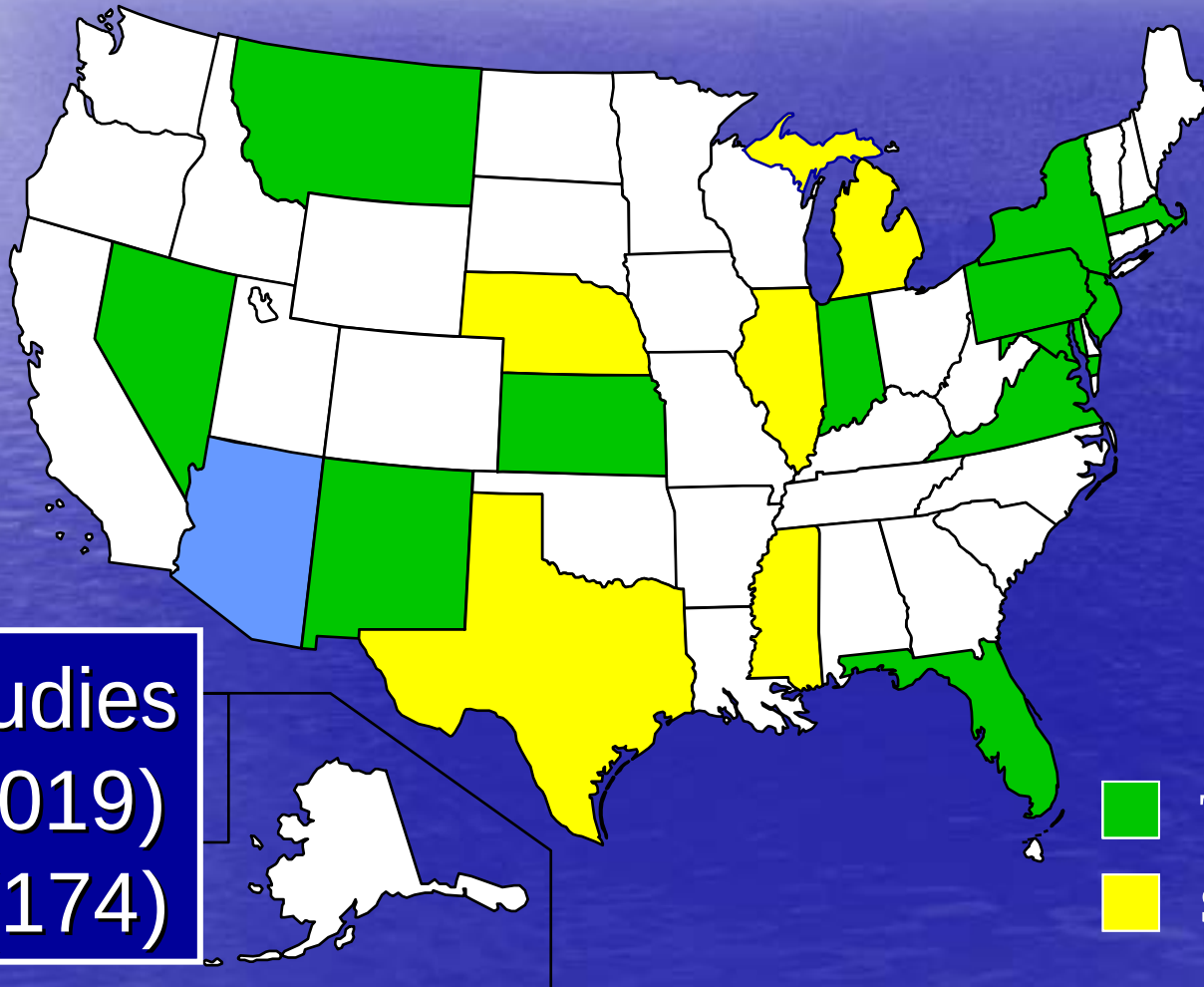
# ALF 2001 - Outline

- Pooled Fund Stakeholders
- Experiment Objectives
- FHWA Accelerated Loading Facility
- ALF Testing Status
- Rutting Testing Results
- Fatigue Testing Results
- Future Plans



# TPF 5(019) / SPR 2(174)

## State Pooled Fund Participants



ALF Studies  
TPF 5(019)  
SPR 2(174)

TPF 5(019)  
SPR 2(174)

# Industry Partners

- Citgo
- Dow
- Dupont
- Koch
- Paramount
- TexPar
- Trifinery, GCA
- Trumbull
- Wright Asphalt
- Martin Color Fi
- Bit Mat
- Mathy Construction
- Hot Mix Industries
- FNF Construction
- Consulpav
- Rubber Producers Assoc.
- ISS
- RTG
- NAPA
- Friends

# Collaborative Research Partners

- Asphalt Institute
- National Center for Asphalt Technology
- Western Research Institute
- University of Arkansas
- Ohio University
- Queens University
- Arizona State University
- FWD Users Group

# Experiment Objectives

- Primary
  - Refine Superpave for Modified Binders
- Secondary, Evaluate...
  - M-E Pavement Design Guide
  - Crumb Rubber-Modified Asphalts
    - Arizona and Terminal Blend Processes
  - Simple Performance Test

Two ALF's with  
12 Pavement Lanes Constructed in  
the Summer and Fall of 2002



# Final Test Matrix...



|                                                                                 |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
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|  |  |  |  |  |  |  |  |  |  |  |  |
| <b>AZ<br/>CRM<br/>----<br/>70-22</b>                                            | <b>PG<br/>70-22<br/>Control</b>                                                   | <b>Air<br/>Blown</b>                                                              | <b>SBS</b>                                                                        | <b>TX<br/>TBCR</b>                                                                | <b>T-P</b>                                                                        | <b>PG<br/>70-22<br/>+<br/>Fibers</b>                                               | <b>PG<br/>70-2264-40</b>                                                            | <b>SBS</b>                                                                          | <b>Air<br/>Blown</b>                                                                | <b>SBS</b>                                                                          | <b>T-P</b>                                                                          |
| <b>1</b>                                                                        | <b>2</b>                                                                          | <b>3</b>                                                                          | <b>4</b>                                                                          | <b>5</b>                                                                          | <b>6</b>                                                                          | <b>7</b>                                                                           | <b>8</b>                                                                            | <b>9</b>                                                                            | <b>10</b>                                                                           | <b>11</b>                                                                           | <b>12</b>                                                                           |

# ALF Testing

Rutting  
 $T_{\text{high}} = 64^{\circ}\text{C}$

1 2

Replicate

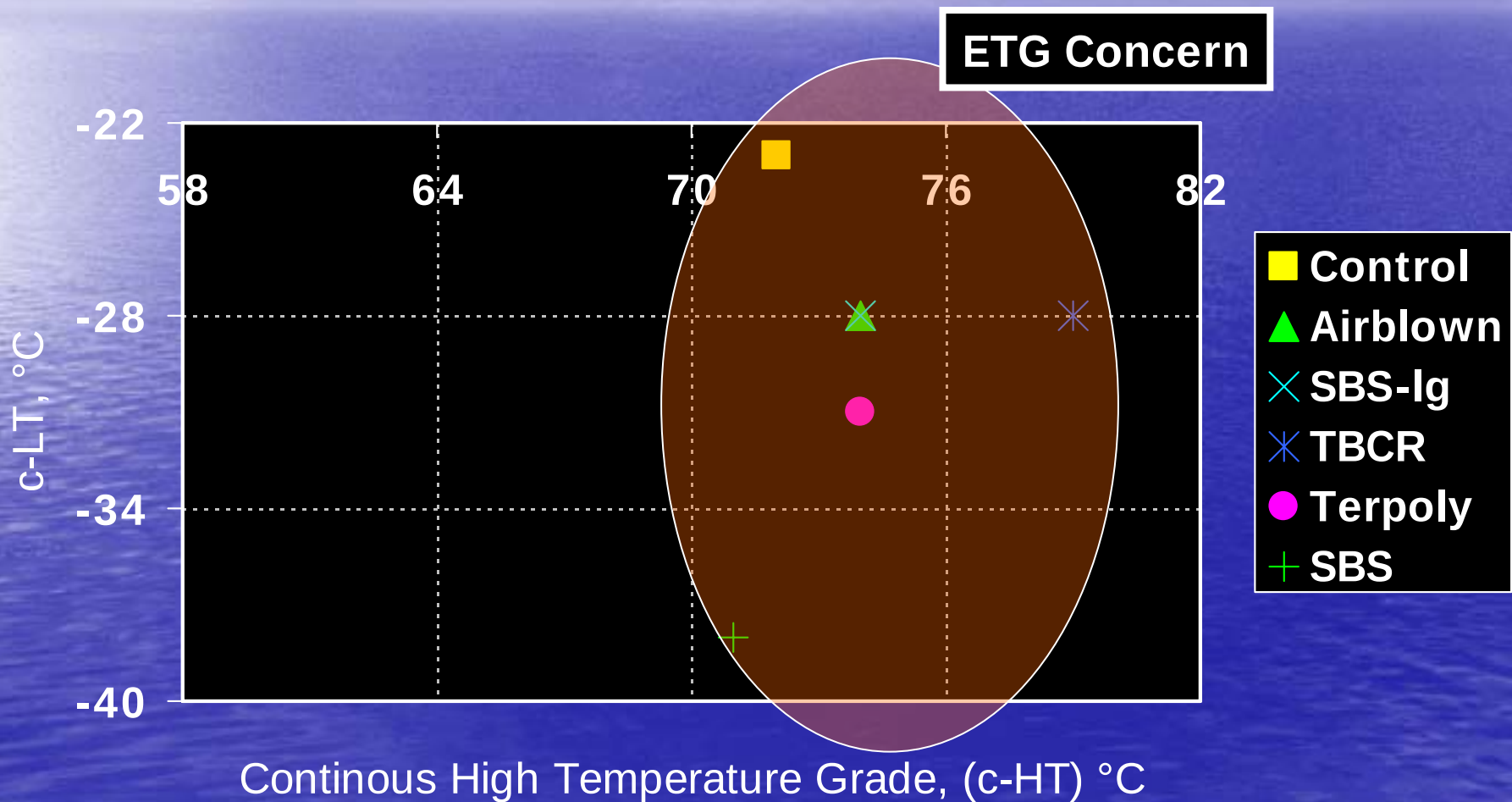
Fatigue  
 $T_{\text{int}} = 19^{\circ}\text{C}$

3 4

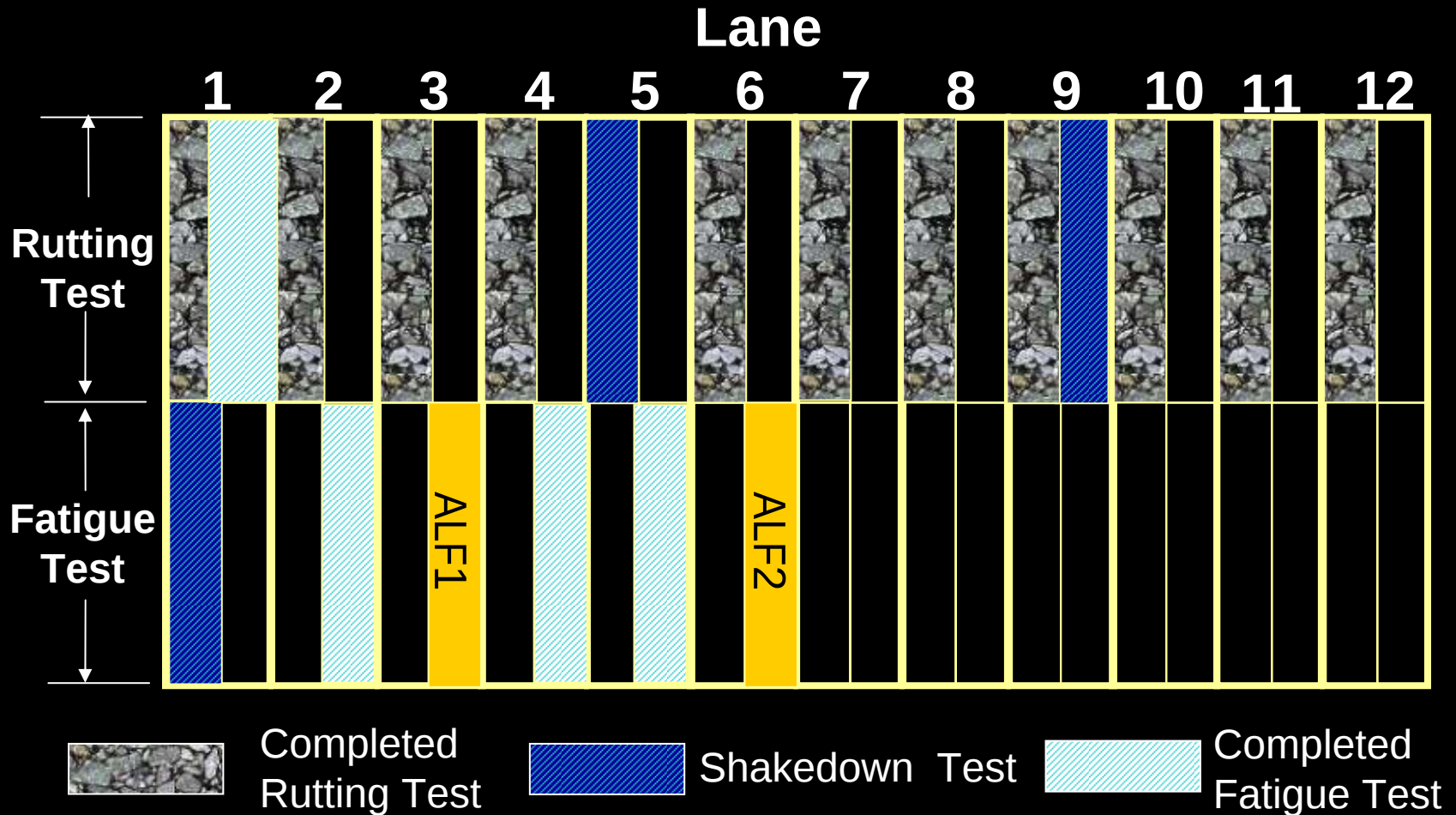
Fatigue  
 $T_{\text{int}} = 28^{\circ}\text{C}$



# In situ ALF Binders



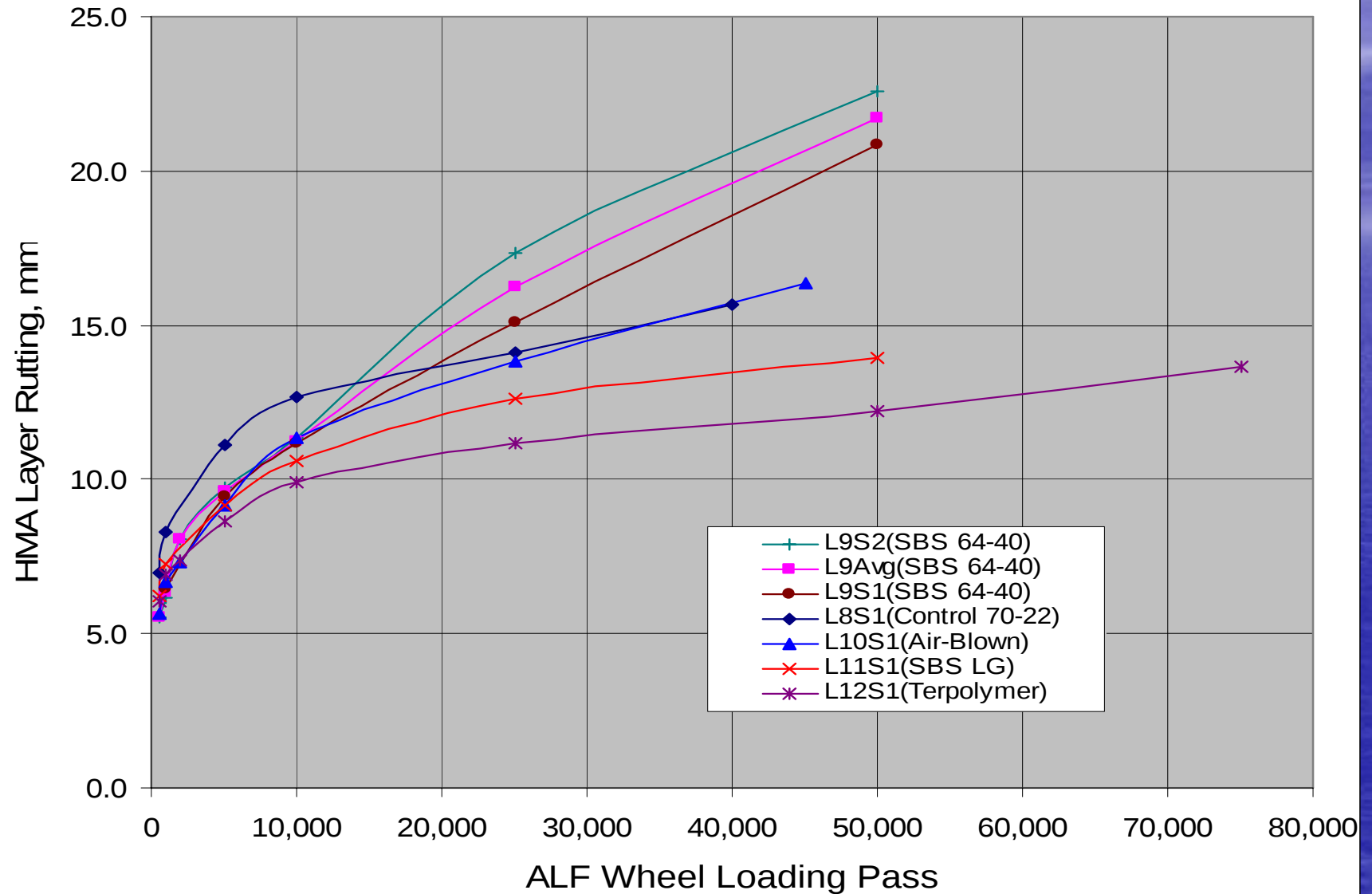
# ALF Testing Status (Jan. 05)



- Initial Strain Measurements: Complete
- Rutting Tests: All 12 Lanes Complete
- Fatigue Tests: Lanes 1, 2, 4, and 5 Complete
- Current Fatigue Tests: Lanes 3 and 6

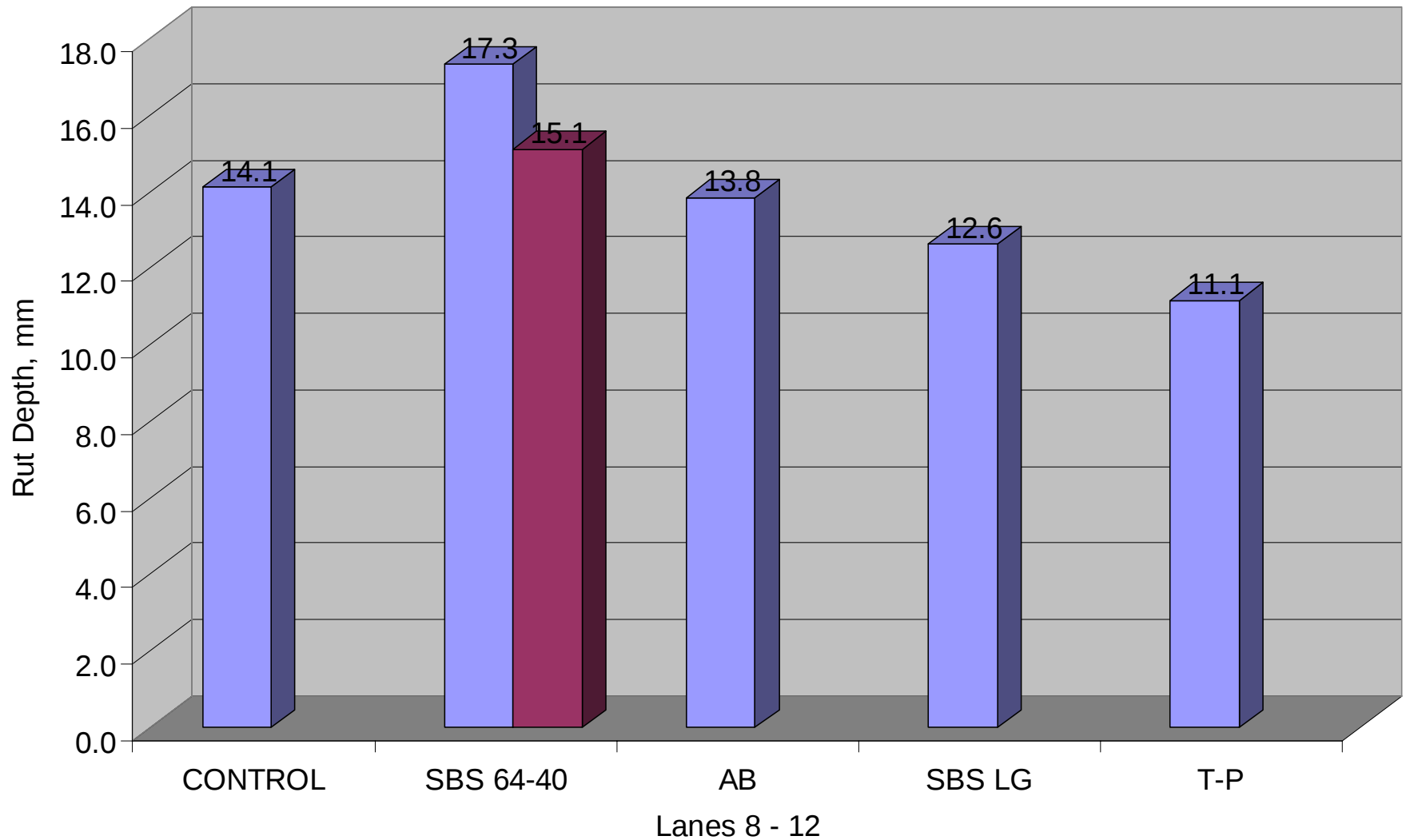
A photograph of a road surface, likely asphalt, showing a diagonal white line and a horizontal black line. The text "Rutting Testing Results" is overlaid in yellow. The background is a dark, textured surface, possibly a road or pavement, with a white diagonal line and a black horizontal line. The text is in a bold, yellow, sans-serif font.

# Rutting Testing Results

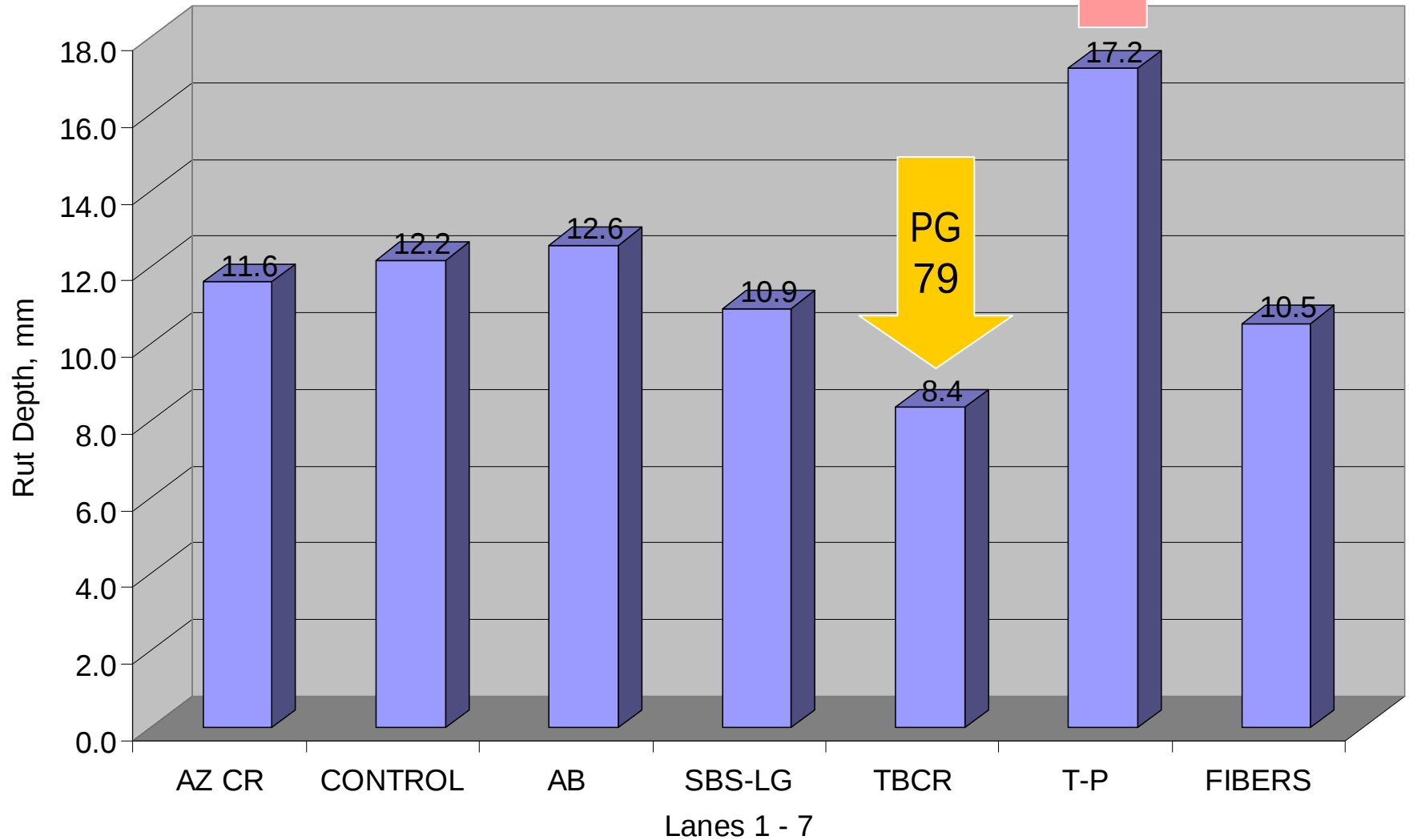


**HMA Layer Rutting among 150-mm HMA Pavements**

Rutting within 150mm AC Layer at 25,000 Passes



Rutting within 100mm AC Layers at 25,000 Passes



# Comparison to Lab Mixture Tests

- French Pavement Rutting Tester
- Hamburg Wheel Testing Device
- Superpave Shear Tester
  - Repeated Shear at Constant Height (RSCH)
  - Frequency Sweep (FS)
- Simple Performance Tests (under way)

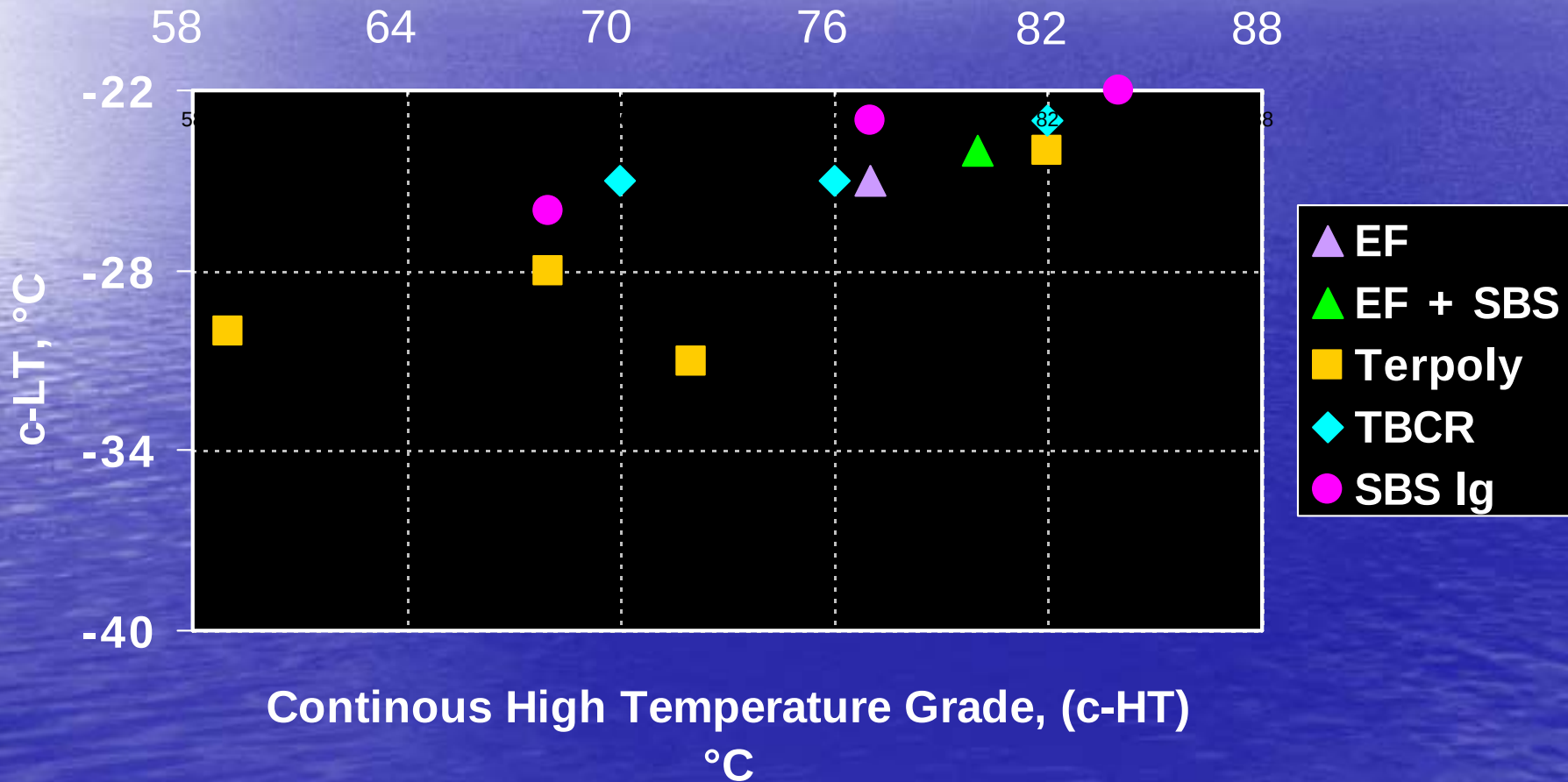
# Preliminary Conclusions

- Limited Correlation between ALF and mixture lab tests, so far...

Best:

- 100 mm: French PRT vs. ALF
  - 150 mm: RSCH vs. ALF
- PG 67-80 Study...

# 67-80 Binders



# Papers Presented at 2<sup>nd</sup> Int. APT Conference in Sept. 2004

- “ALF Testing for Development of Improved Superpave Binder Specification,” can be found at:  
[http://mnroad.dot.state.mn.us/research/index\\_files/pdfs/Mitchell\\_T.pdf](http://mnroad.dot.state.mn.us/research/index_files/pdfs/Mitchell_T.pdf)
- “Strain Responses in ALF Modified-Binder Pavement Study,” can be found at:  
[http://mnroad.dot.state.mn.us/research/index\\_files/pdfs/Qi\\_X.pdf](http://mnroad.dot.state.mn.us/research/index_files/pdfs/Qi_X.pdf)

A micrograph of a metal surface showing a network of fatigue cracks. The cracks are dark, irregular lines forming a complex, interconnected pattern across the entire field of view. The background is a light, grainy texture. The text "Fatigue Testing Results" is overlaid in the center in a yellow, serif font.

# Fatigue Testing Results

# JACKPOT:

# 0 PASSES

LANE 1  
AZ CR

90

LANE 2  
CONTROL

60

60

NO  
CRACKING !

LANE 4  
SBS LG

25

90

LANE 5  
TBCR

NO  
CRACKING !

25

# JACKPOT: 100,000 PASSES

LANE 1  
AZ CR

NO  
CRACKING !

NO  
CRACKING !

LANE 2  
CONTROL

90

90

LANE 4  
SBS LG

NO  
CRACKING !

NO  
CRACKING !

LANE 5  
TBCR

25

25

# JACKPOT: 300,000 PASSES

LANE 1  
AZ CR

LANE 2  
CONTROL

LANE 4  
SBS LG

LANE 5  
TBCR

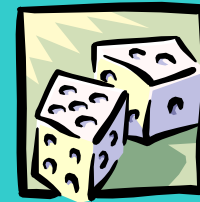
NO  
CRACKING !



60



NO  
CRACKING !



60





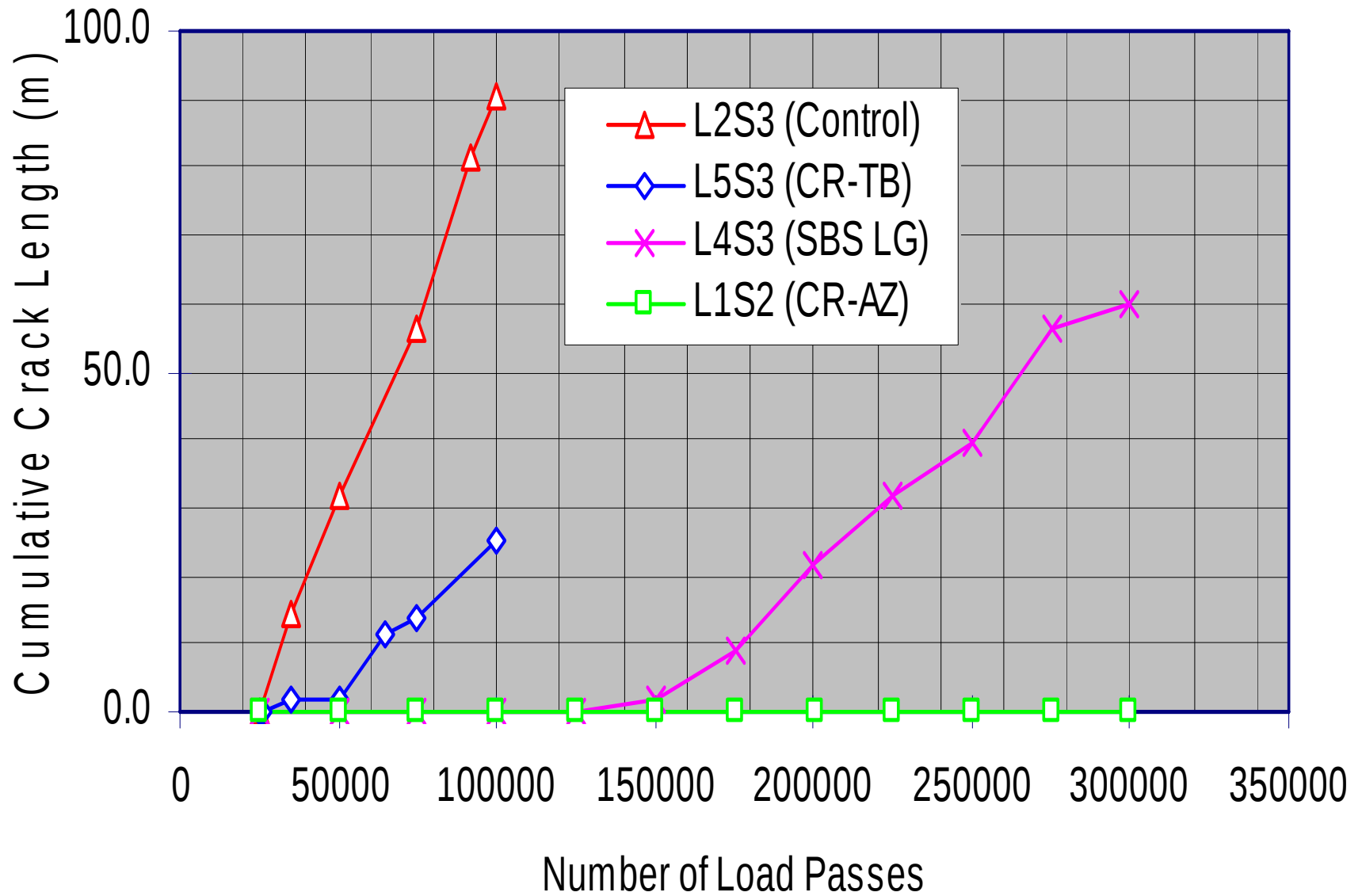
Lane 2 (Control)  
After 100,000 Loads



Lane 4 (SBS LG)  
After 300,000 Loads



Lane 5 (CR-TB)  
After 100,000 Loads



**Fatigue Cracking Length vs. ALF Wheel Load Passes**

# Modified Binders Affect Performance

- Same aggregate gradation different binders

PG 63-22 mod. no rutting



PG 67-22 un-mod 15mm rutting



# What do we need?

- **Refinement to the Superpave binder purchase specification** to better capture the unique benefits of modified systems (Step 2)
- Better laboratory accelerated performance prediction tools to evaluate and characterize modified systems (Step 1)

# Purchase Specification

- Performance Criteria
  - Test Procedures, must be...
    - Easy to set up
    - Easy to run
    - Easy to analyze
  - Test Procedures must be...
    - Repeatable
    - Reproducible

# Research Tools

- Performance Measure
  - Test Procedures, can be...
    - Very difficult to set up
    - Laborious to run
    - Subject to interpretation
  - Test Procedures should be...
    - Repeatable
    - But not necessarily reproducible

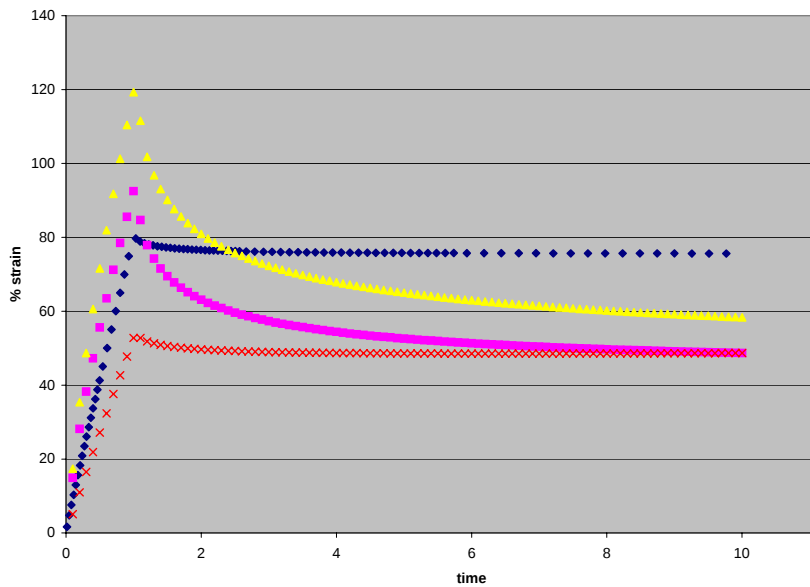
# Asphalt Binder Systems are...

- Visco-Elasto-Plastic
- Effected by:
  - Temperature, Time, & Aging
  - Rate of loading
  - Stress and Strain level
- Stress path dependent
- Quite simple, really?

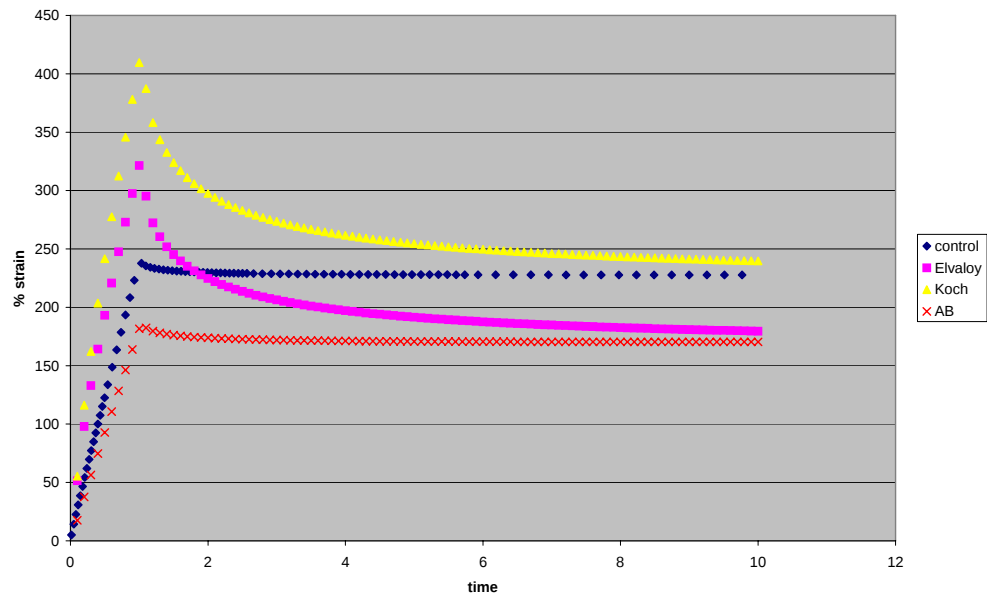
# Repeated Load, Creep Testing Holds the Greatest Promise, currently...

- Compliance – that which is not recovered.

Creep 1st cycle 70C 300 Pa



creep 1st cycle 70C 1000 Pa



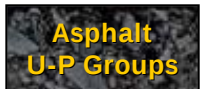
# Future Plan

- Complete ALF Fatigue Loading
- Conduct Lab Beam Fatigue Tests & SPT
- Compare ALF Results to Lab Tests
- TWG Meeting in May/June 2005
- Future of APT – with TWG meeting
- Continued reporting to the ETG's

SHRP



ASPHALT INSTITUTE



# ONGOING Refinement

- Understanding modifiers
- *Understanding acid*
- Improved moisture test
- Construction quality
- Link to pavement design
- Communication!



# CHALLENGES

# Paul Mack

*New York State - Retired*

*Imperfection should never  
stall implementation.*

*You can still drink from a  
chipped cup.*



And then there were three...

