I-710 Freeway Rehabilitation – Design, Construction, Performance Evaluations and Lessons Learned

Rita B Leahy, PhD, PE
Technical Director
Asphalt Pavement Association of California

Acknowledgments

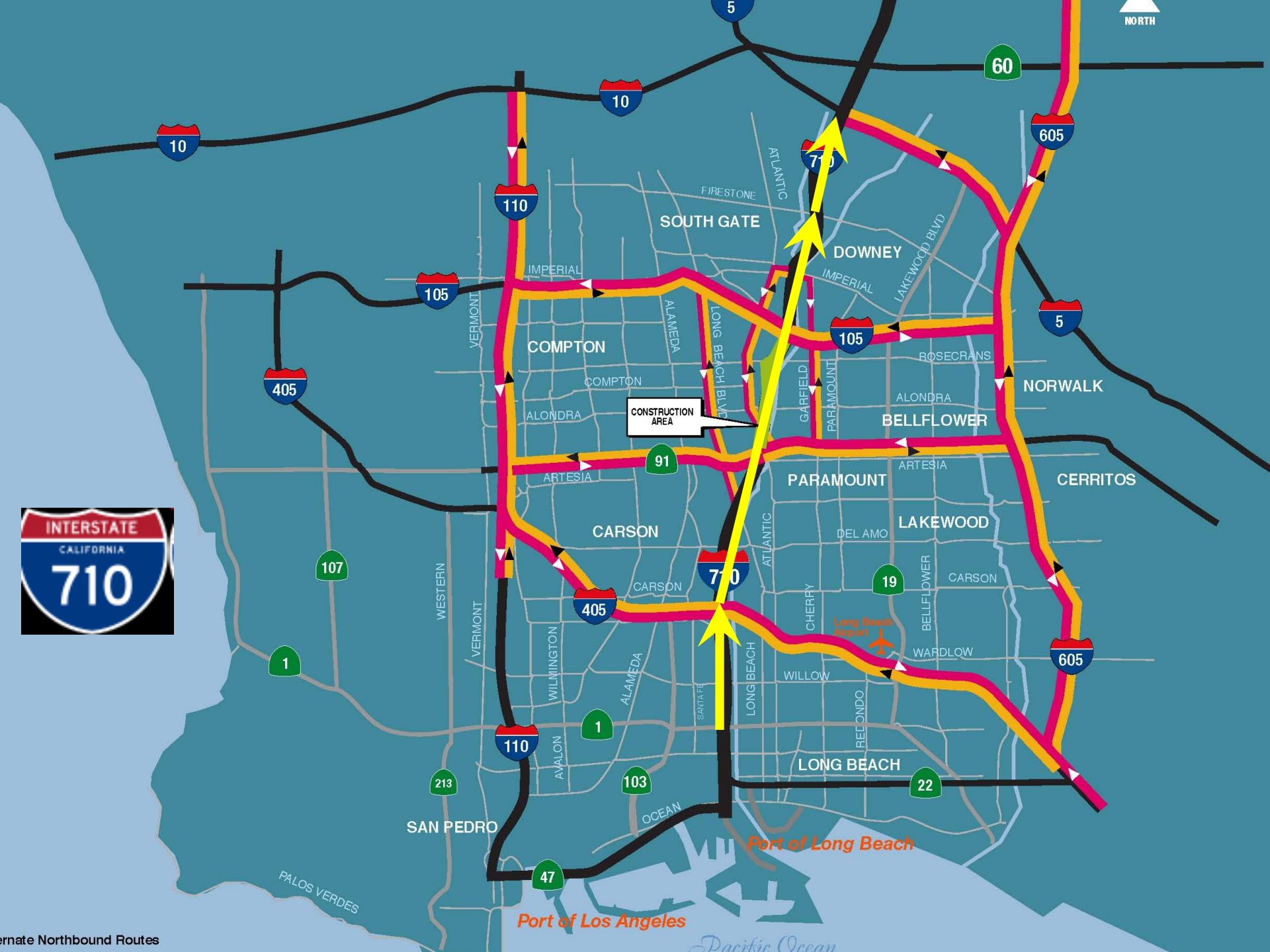
- Carl Monismith (UC-Berkeley, Pavement Research Center)
- Jim St Martin (Asphalt Pavement Assn of California)

Presentation Overview

- Background – Long Life Asphalt Pavement Rehab Task Group
- Design Considerations – Materials, Structural Section & Specs
- Construction
- Lessons Learned
- Pavement Performance
- Phase II

Asphalt Pavement Association Of California

UCPRC



ernate Northbound Routes

Background

- **Partnered Effort**
  - Caltrans
  - Industry
  - University of California PRC
- **Existing Pavement**
- **Long Life Pavement Concepts**
  - Recently Developed Technology for Mix & Structural Design

Asphalt Pavement Association Of California

UCPRC


I-710
March 2003

Design Considerations

- 30-year Design: ~200 Million ESALs
- QC/QA Specifications
- Polymer Modified Binders
- Aggregate Requirements
- Modified Mix Design
- HMA Compaction Requirement
- Construction Constraints: 55-hour Weekend Closure

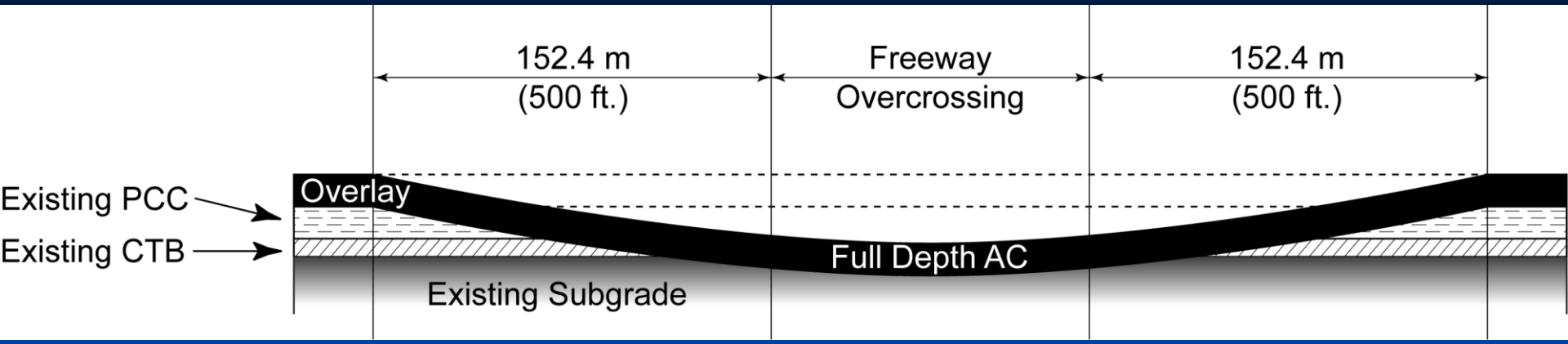
Asphalt Pavement Association Of California

UCPRC

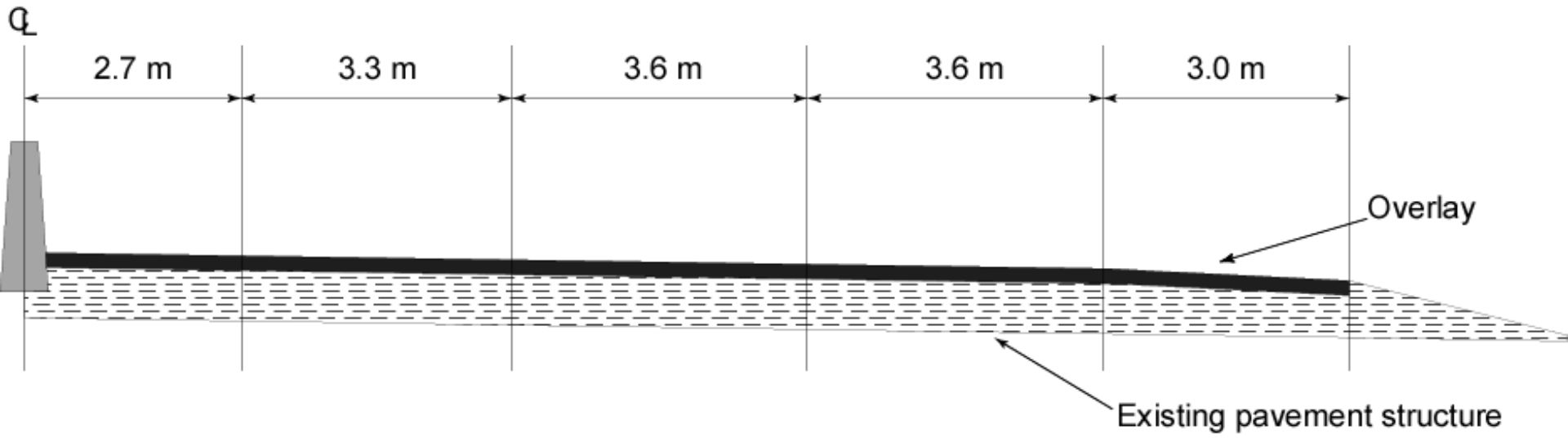
Structural Sections

- **Full-Depth Asphalt Concrete**
  - replacement under overpasses
- **Overlay of PCC**
  - (cracked & seated)

Full Depth Replacement Section



Cracked & Seated Section



Materials & Mix Design

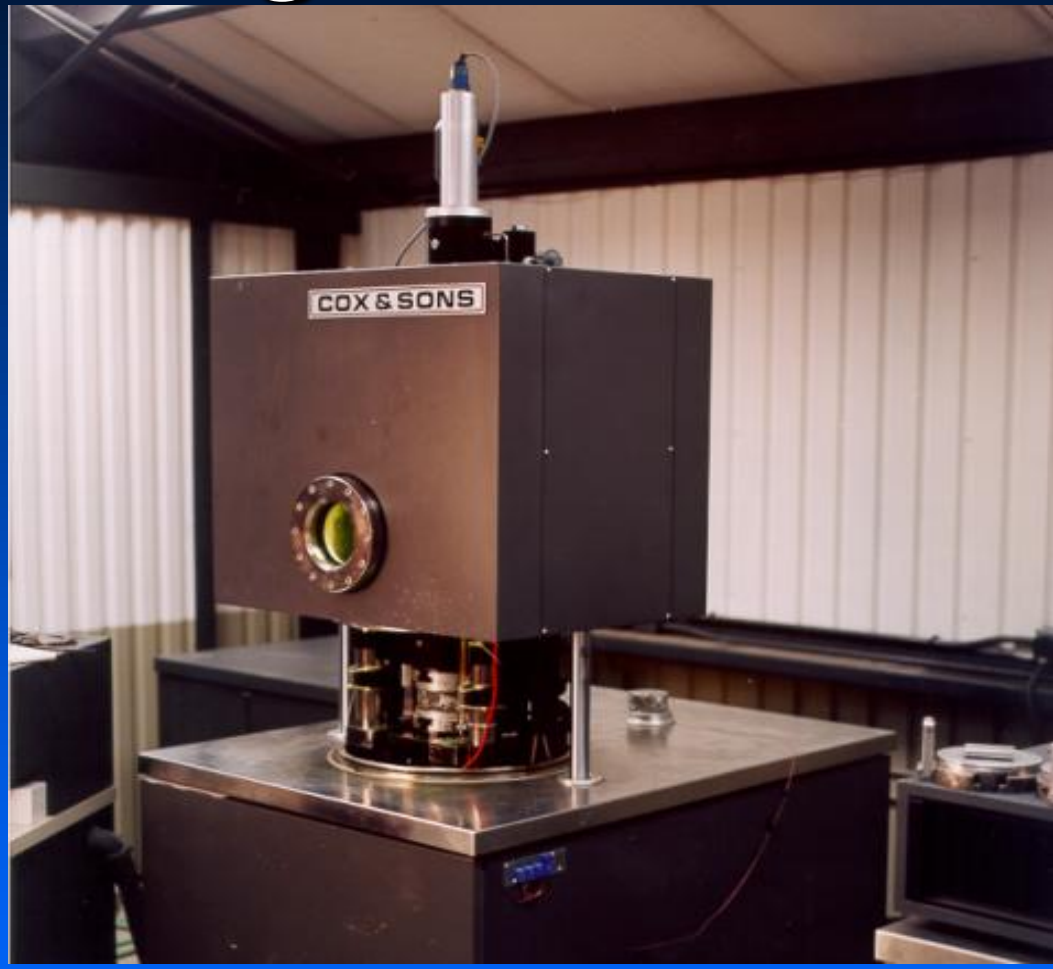
- **San Gabriel Aggregate (all crushed)**
- **Binders**
  - Conventional AR-8000
  - Polymer modified PBA-6a*
- **Binder Content**
  - Hveem – preliminary
  - Performance Testing – final

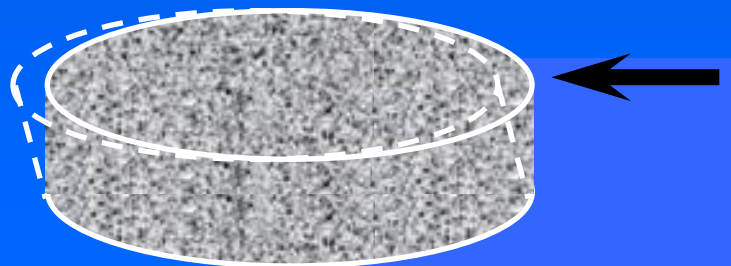
Asphalt Pavement Association Of California

UCPRC

Performance Testing

Shear –
Binder Content

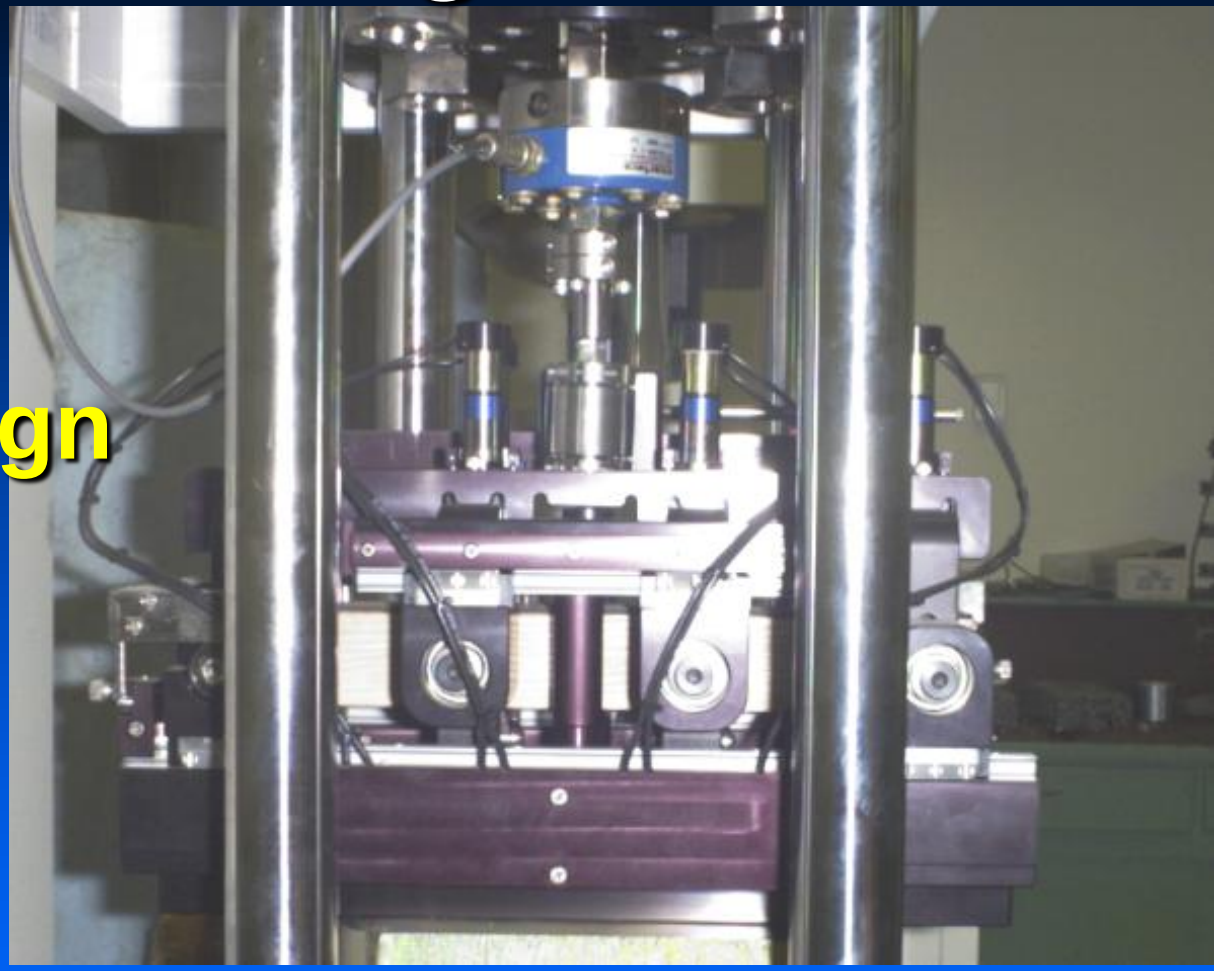


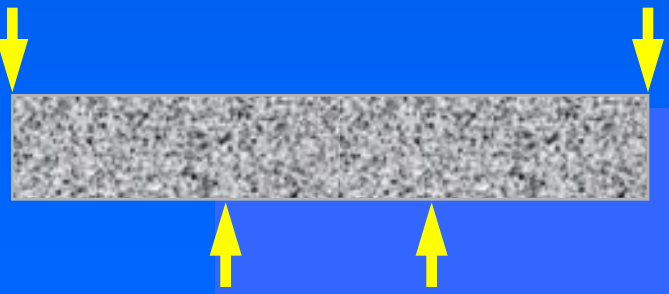


Asphalt Pavement Association Of California

Performance Testing

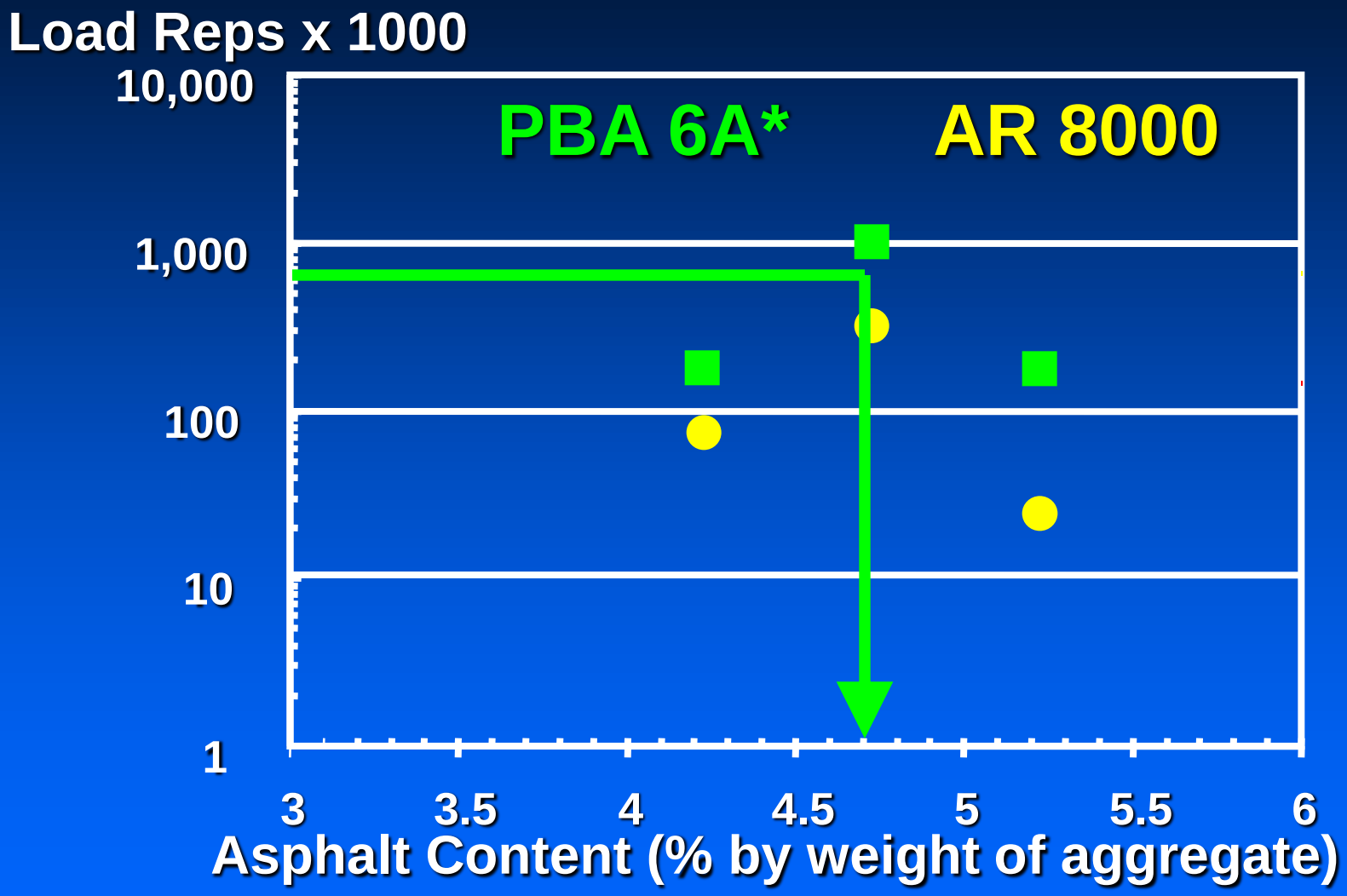
Fatigue –
Structural Design





Asphalt Pavement Association Of California

Shear Test Results (50 °C)



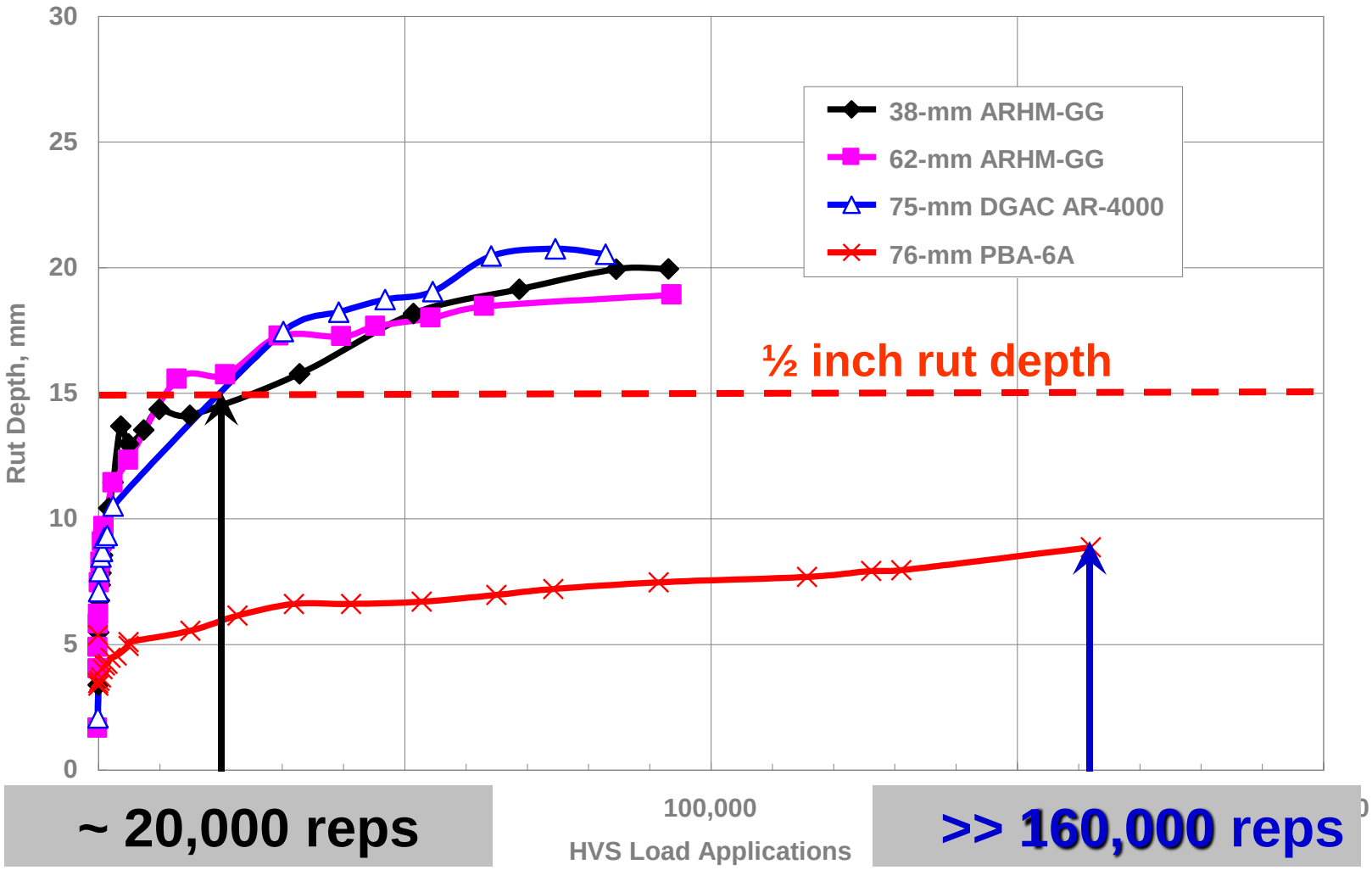
Asphalt Pavement Association Of California

UCPRC

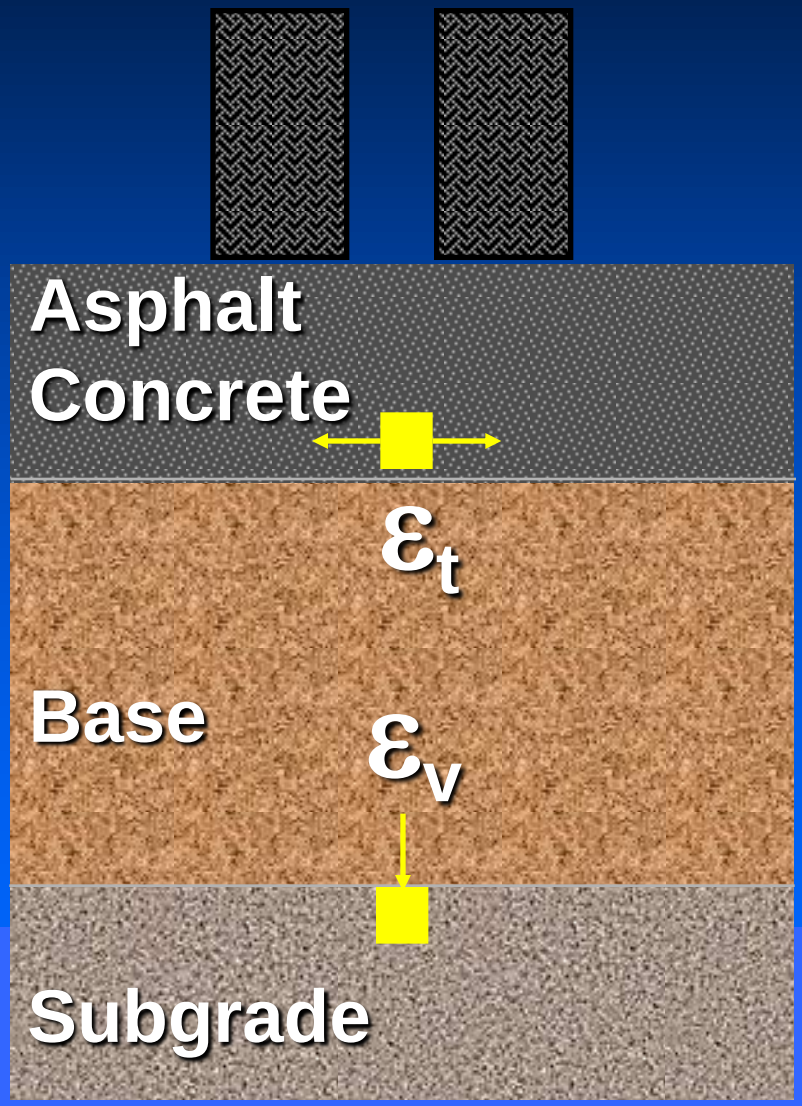
HVS Rutting Study

Asphalt Pavement Association Of California

Mix Performance Evaluation



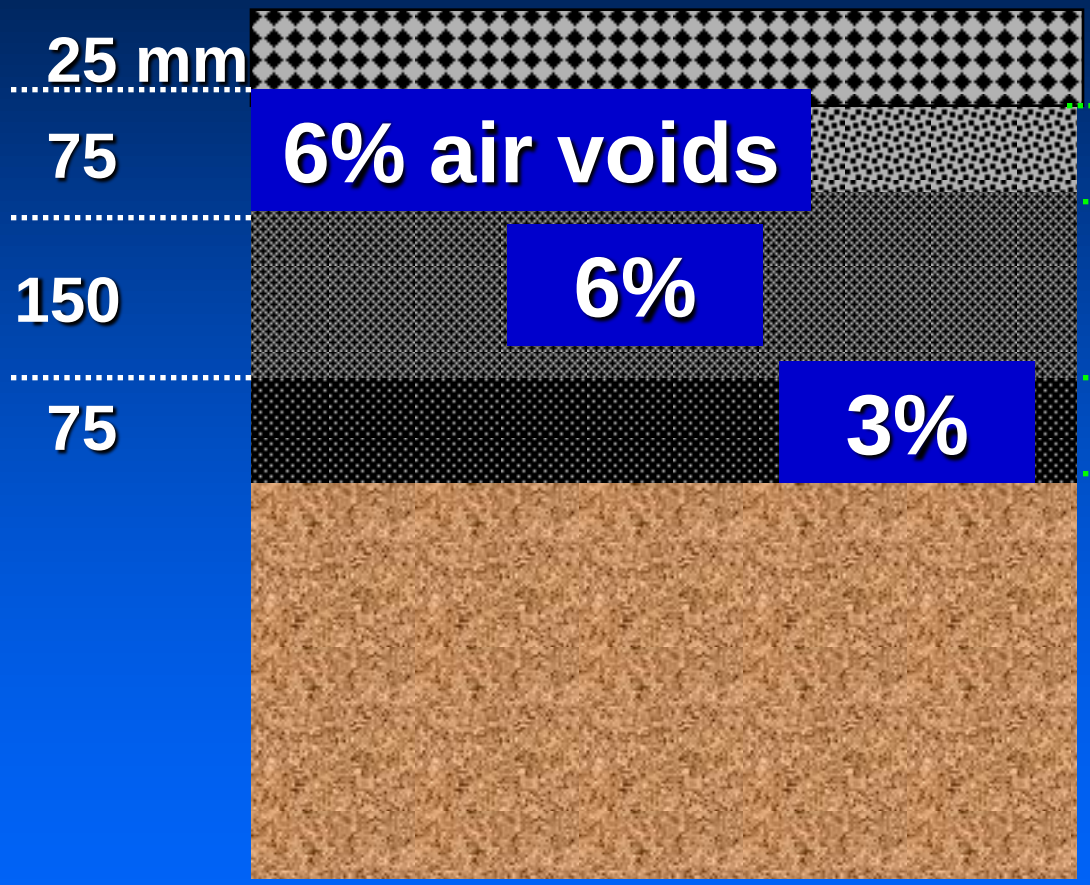
Design Considerations



Fatigue Cracking

Deformation

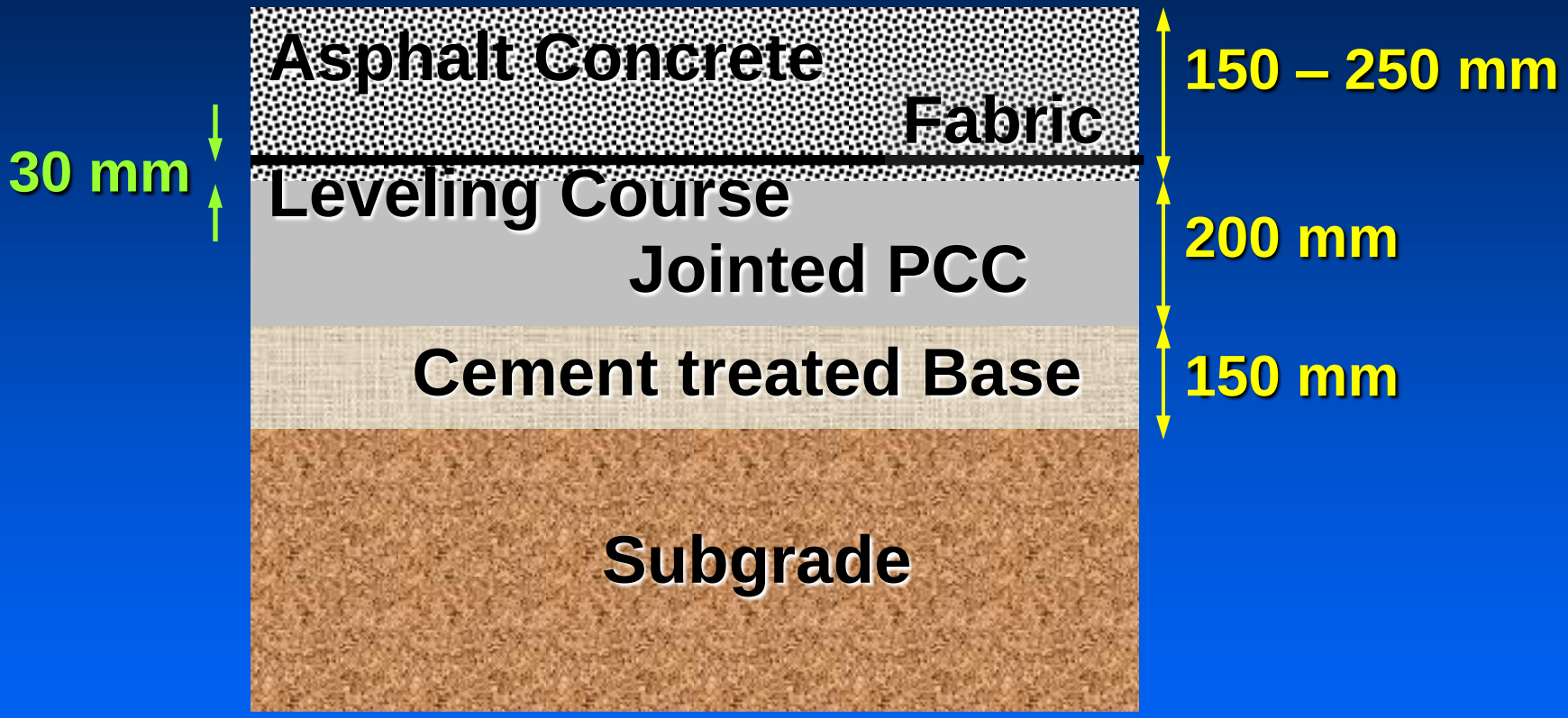
Final Design – Full Depth HMA



Asphalt Pavement Association Of California

UCPRC

Overlays

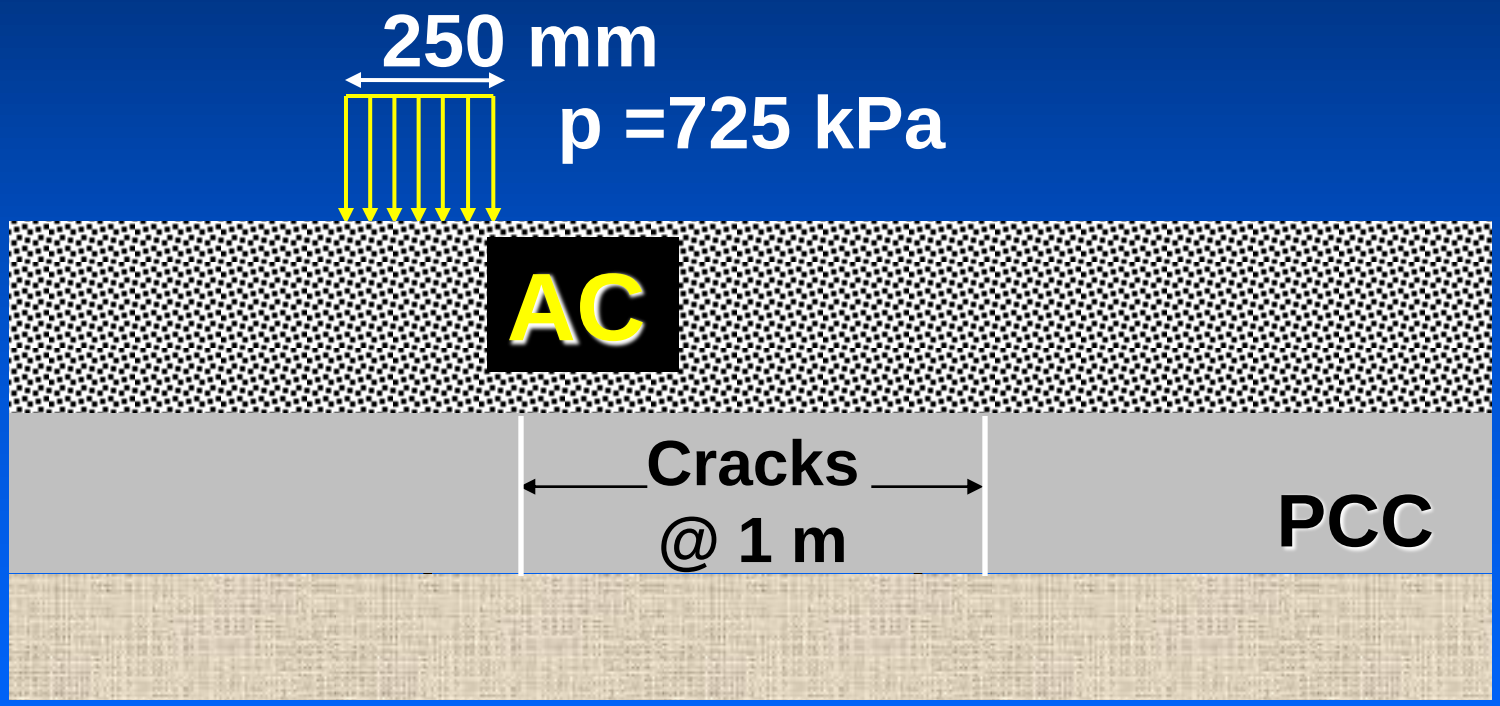


Asphalt Pavement Association Of California

UCPRC

Calculated Configuration

Traffic loads applied statically; symmetrical boundaries.

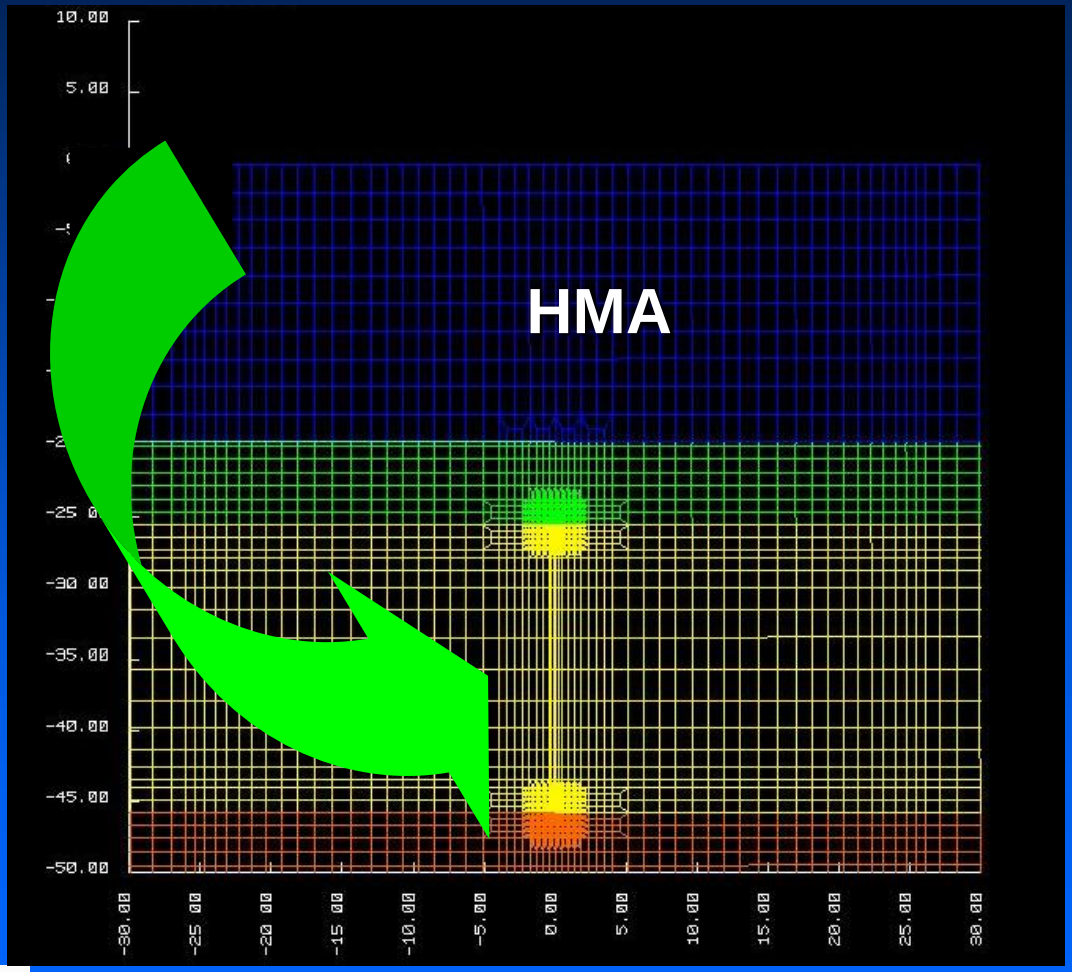


Asphalt Pavement Association Of California

UCPRC

Finite Element Mesh

~ 12,000 elements, NIKE2D

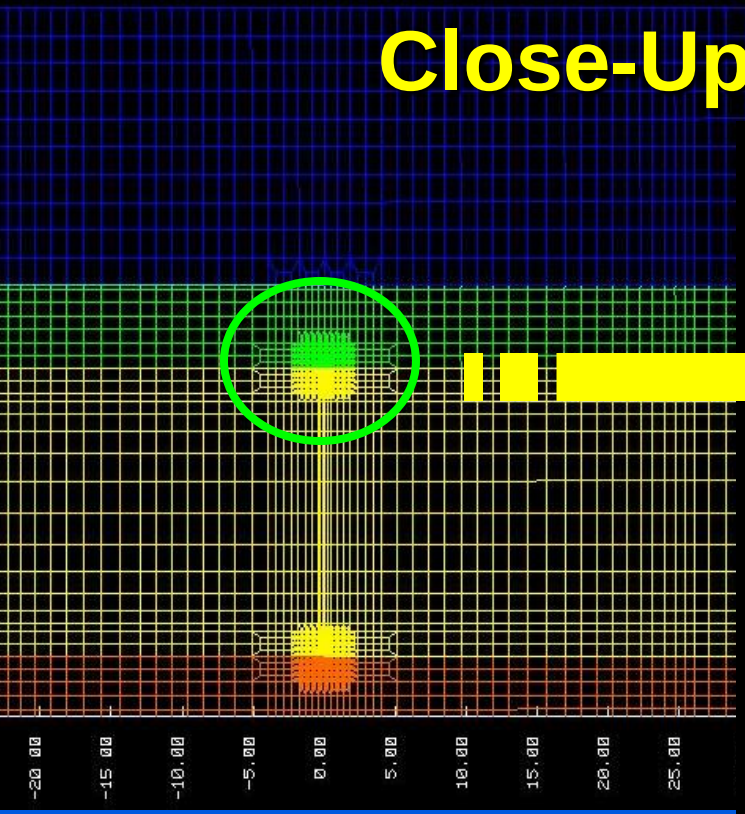


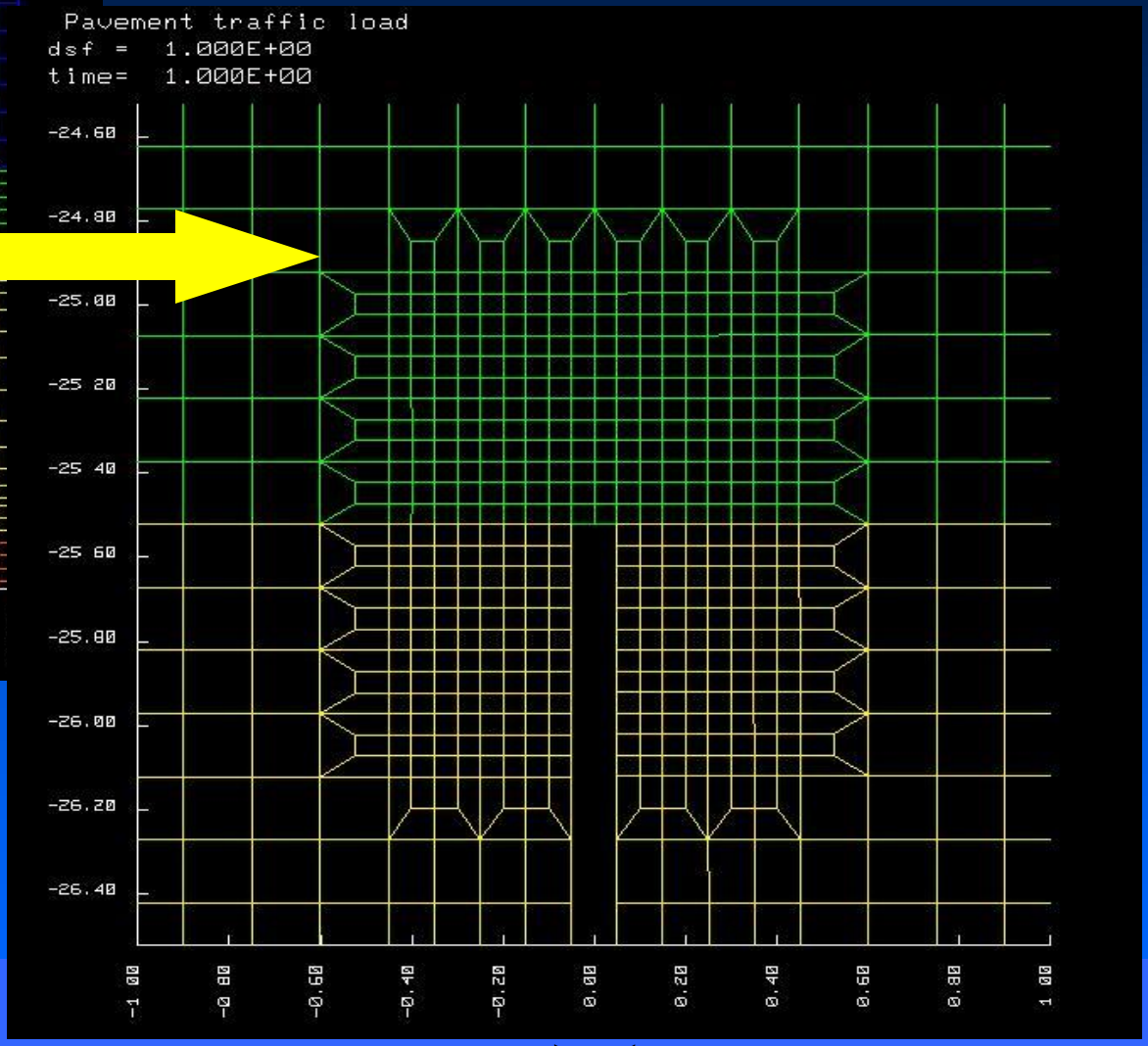
Asphalt Pavement Association Of California

UCPRC

Finite Element Mesh

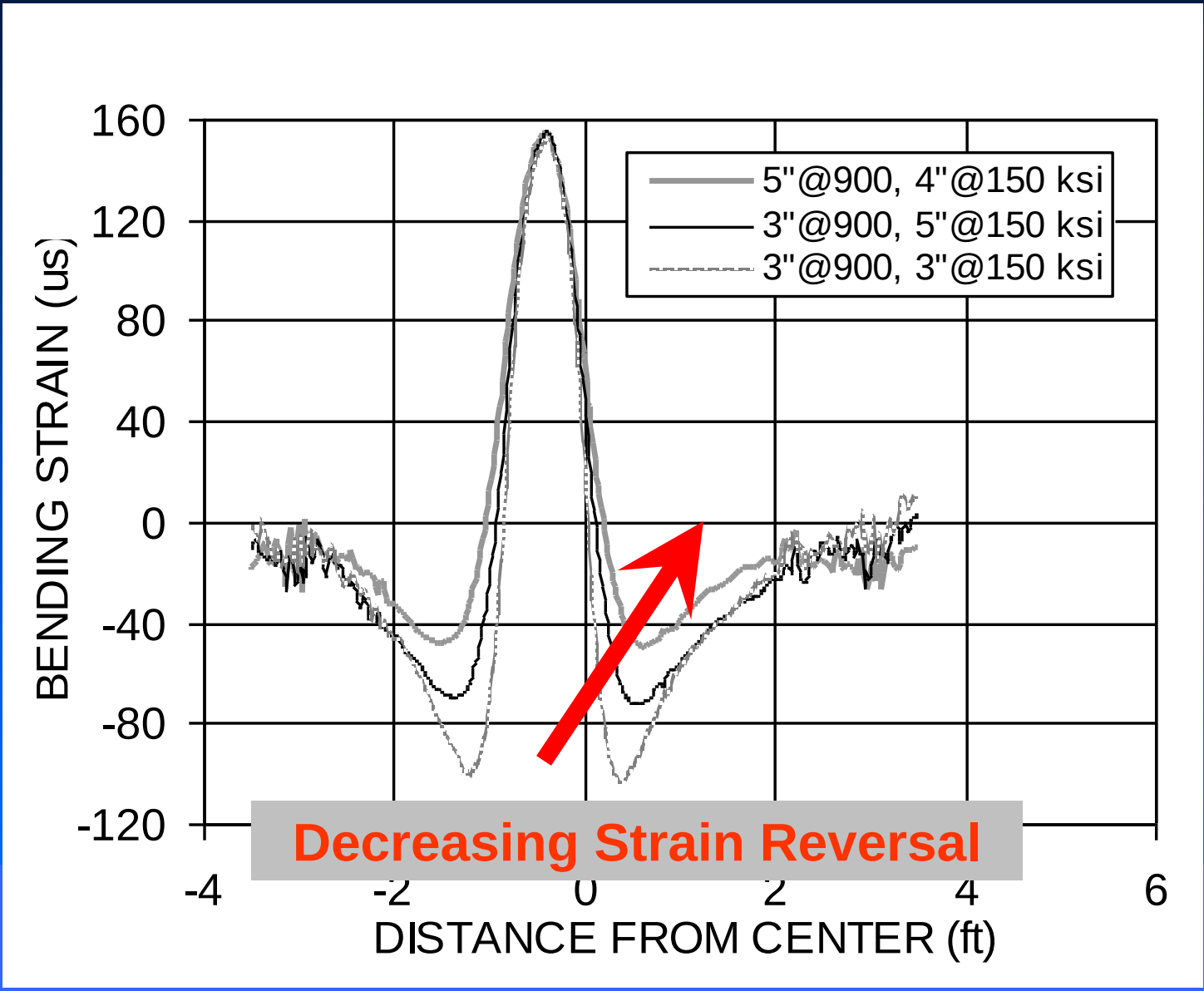
Close-Up in Vicinity of Crack



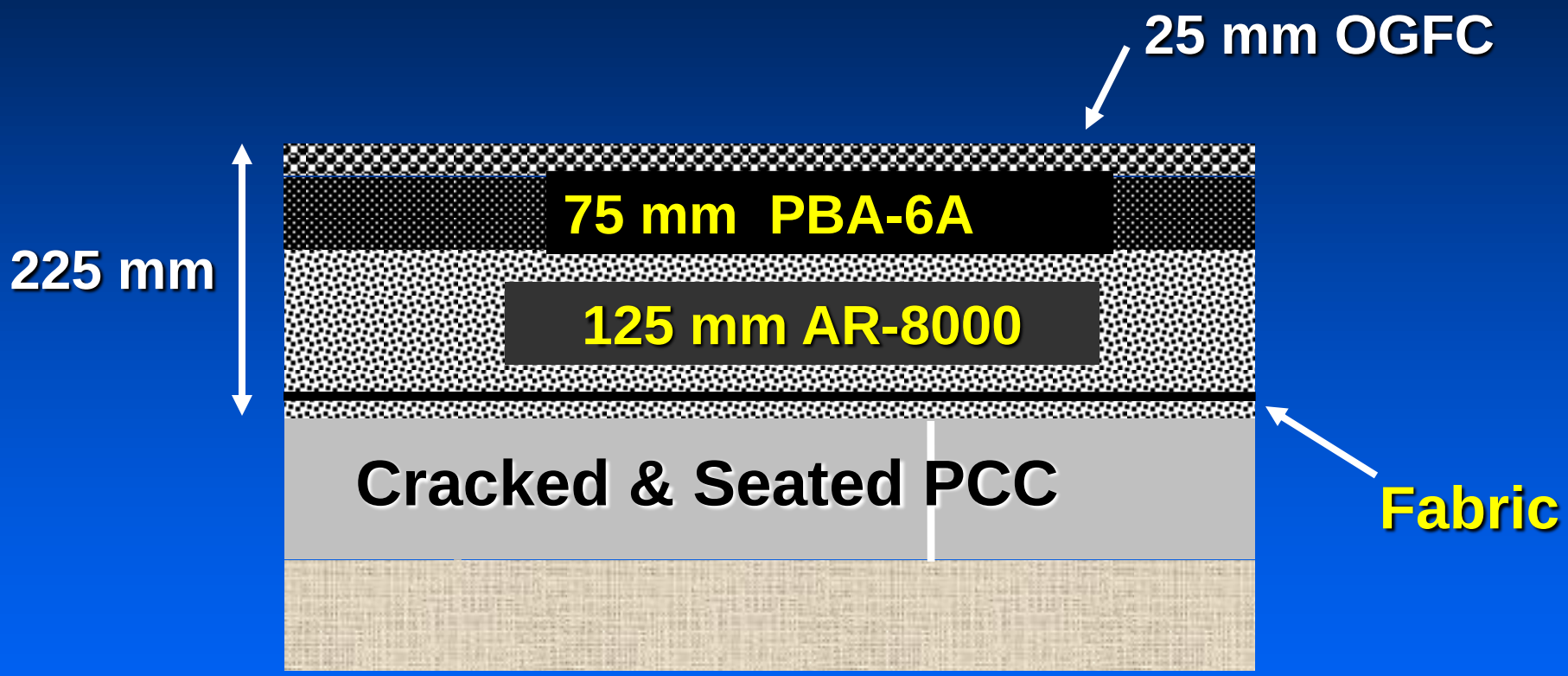


0.1 inches

Bending Strains in Mix Just above Fabric



Final Design – Overlay



Asphalt Pavement Association Of California

UCPRC

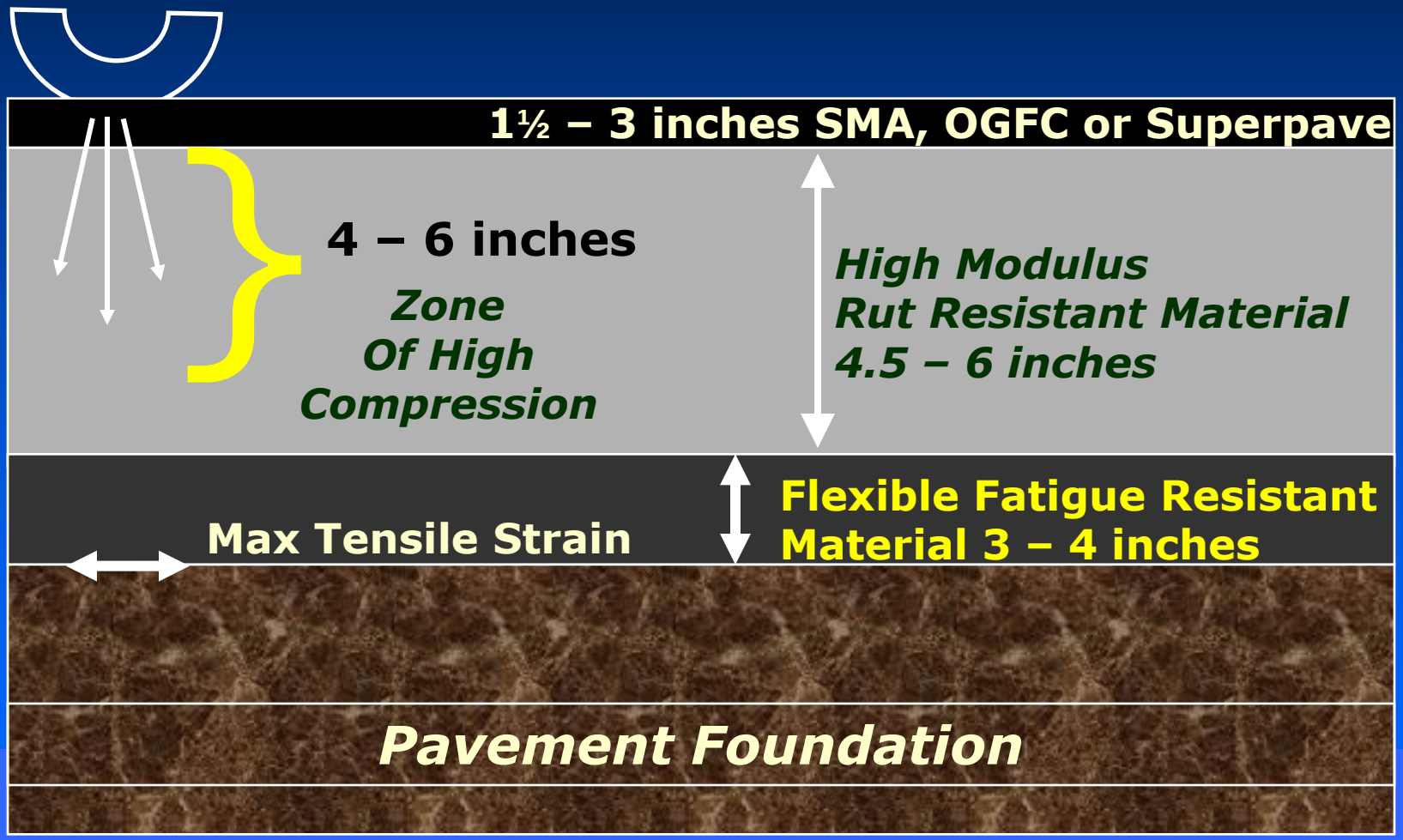
Full-Depth Design Comparisons

- The Asphalt Institute
- United Kingdom
- Australia
- Asphalt Pavement Alliance-U.S.

Asphalt Pavement Association Of California

UCPRC

Perpetual Pavement Design Concepts



Construction Specs

- Performance requirements based on shear and fatigue testing
- More stringent compaction requirements
- Tack coat between layers
  - Asphalt cement (AR- 4000)

Asphalt Pavement Association Of California

UCPRC

Construction – Weekend Closures (55- hour)

- 10 originally planned
- Use of CA4PRS – eliminated 2 weekend closures!
- Crack & seat, and overlay
- Full depth construction
  - ~ 15,000 tons of HMA per weekend

Asphalt Pavement Association Of California

UCPRC

Lessons Learned

- Pre-bid conference mandatory for all potential bidders
- Partnering meeting mandatory – Construction CRITICAL to Success!
- Contingency Planning

Asphalt Pavement Association Of California

UCPRC

Lessons Learned

Materials Testing

- **Equipment Calibration**
- **Adherence to Test Procedures**
- **Analysis of Test Data**

Lessons Learned

Specs

- Modified to account for test variability; ie, statistical considerations
- QC & QA activities
  - Staffing to accommodate large quantities of materials
  - Timely QA results

Lessons Learned

- Human resources – 3 to 5 weekend closures in a row maximum; if more required, allow 1 to 2 weekend interval

Lessons Learned

- **In digout areas**
  - Exploratory testing imperative
  - Exact location of underground utilities

Lessons Learned

- **Contingency plan important**
  - **Digout areas - working platform; materials easily accessible**
  - **Standby HMA plant(s)**
- **Meteorologist for contractor (construction in digout areas)**

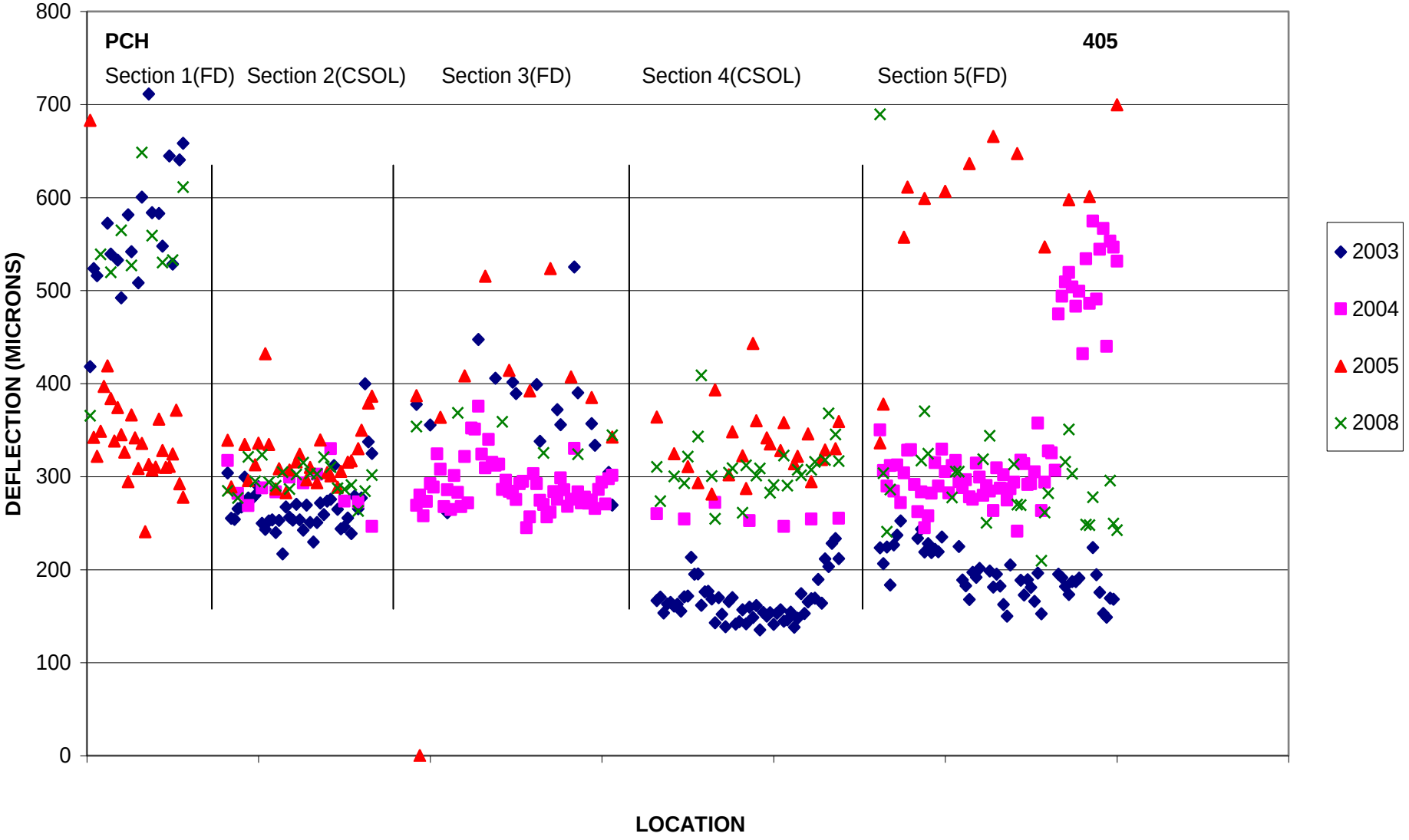
Performance Evaluation

- Deflection testing using the HWD (2003 through 2008)
- Back calculations of layer moduli and strains in HMA layers using MLEA*
- Condition surveys
- Longitudinal and transverse profile measurements
- Noise measurements
- Laboratory testing of cores and slabs

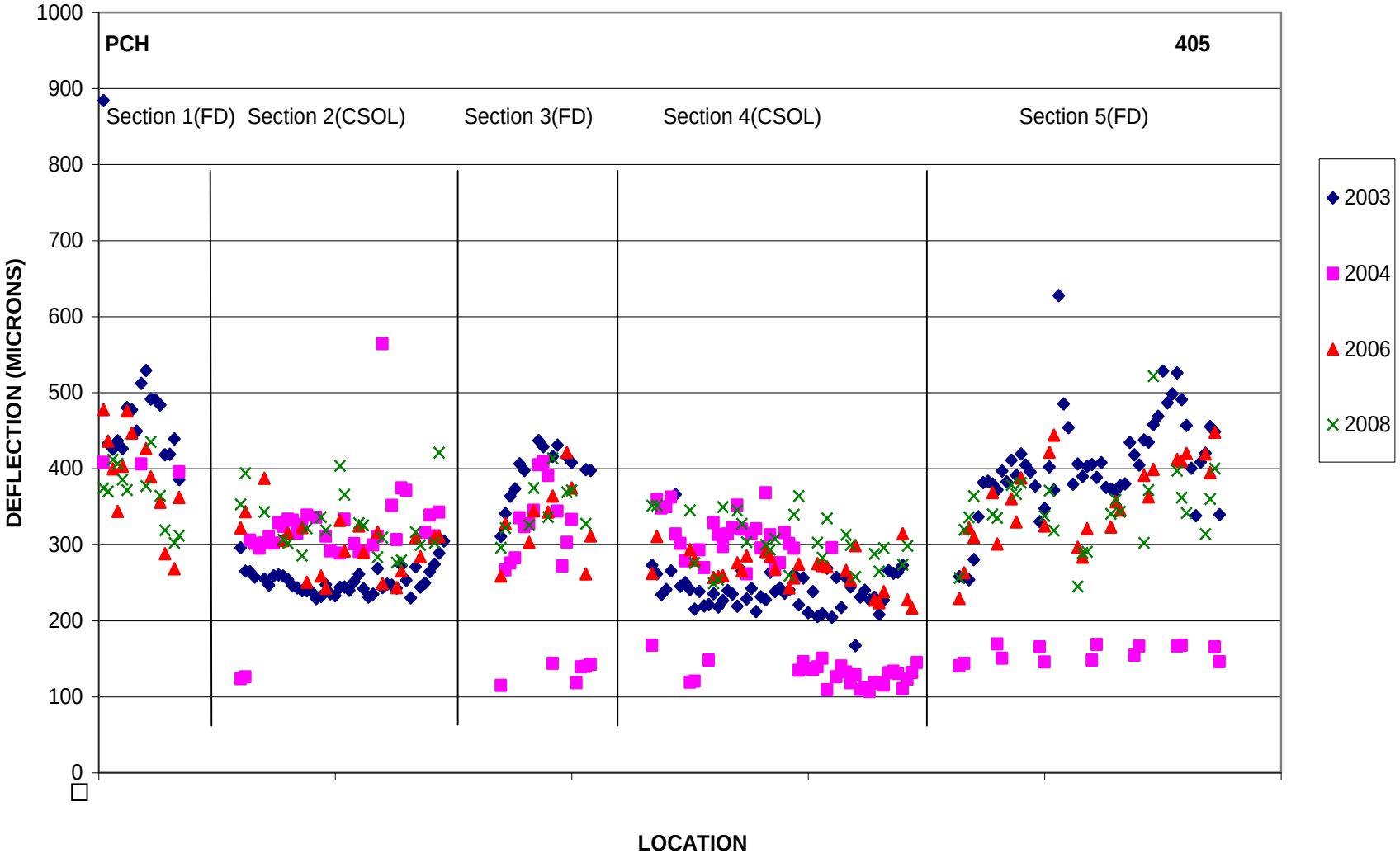
Asphalt Pavement Association Of California

UCPRC

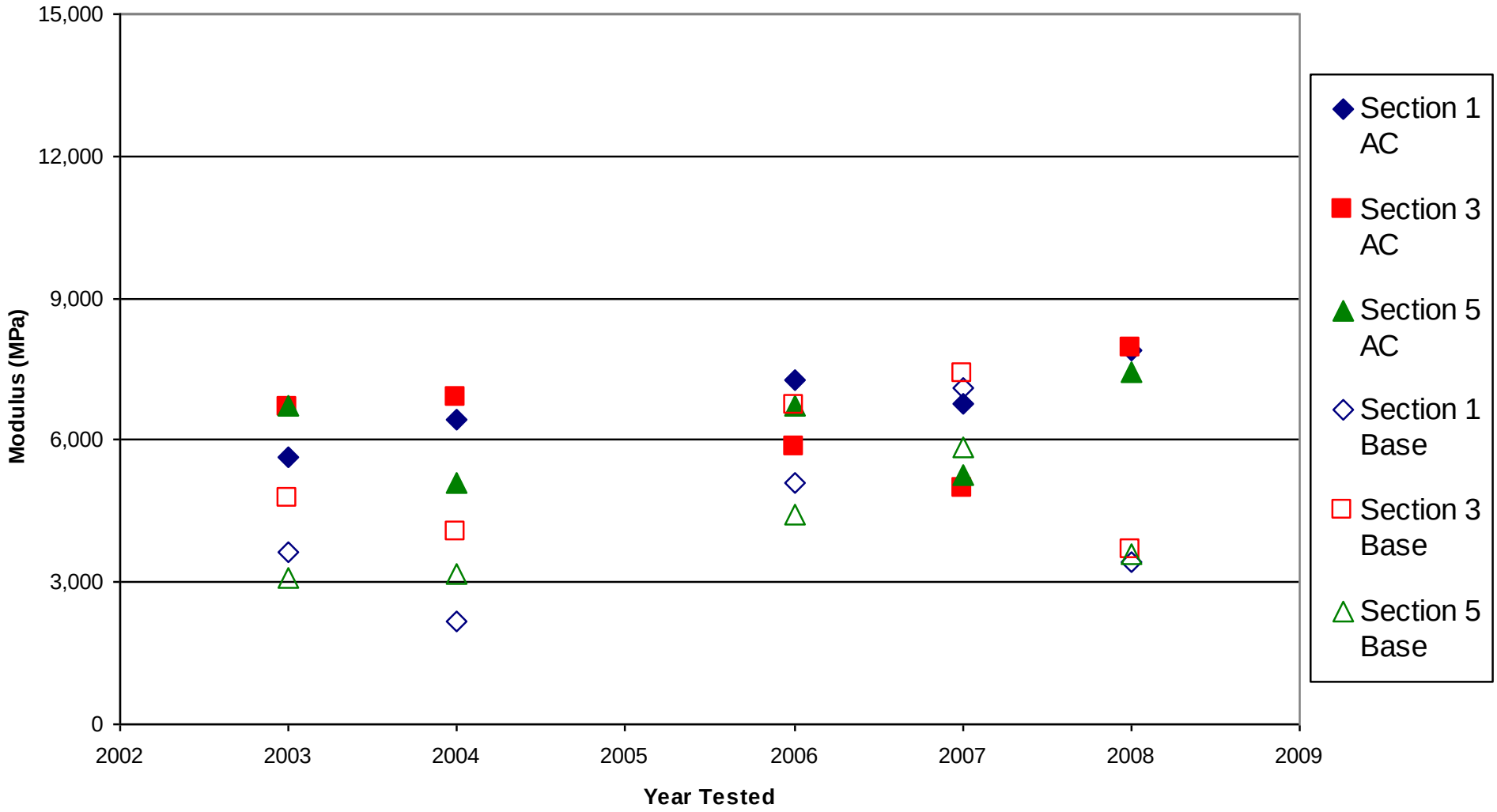
Deflections – SB Lane 3



Deflections – NB Lane 3



NB Lane 3 – Layer Moduli



Tensile Strain, Underside HMA Layer, in/in x 10^{-6}

Section	NB	SB
1	18	49
3	17	18
5	16	8.5

Asphalt Pavement Association Of California

UCPRC

Phase II

- **Modifications**
  - Design traffic: 40-year Design, 330 Million ESALs
  - Thickness of HMA base layer [PG 70-10 (AR-8000)] increased
  - Surface course: RAC-G instead of RAC-O

Asphalt Pavement Association Of California

UCPRC

Concluding Thoughts

- Implementation of New Technology for Mix & Structural Design
- Strict Attention To Pavement Construction
- Constructability Considerations - Use of CA4PRS

Asphalt Pavement Association Of California

UCPRC

Questions? Comments?

Asphalt Pavement Association Of California

UCPRC