A View From The Bureau of Materials & Physical Research

IAPA March 2015
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BMPR
Illinois Dept of Transportation

HMA Issues

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HMA Issues – a Technical Opinion

Cautious

HMA Issues – a Technical Opinion

Perspective of an Owner

- A Desirable Paving Material Will:
  - Provide a Safe Surface for Motorists
  - Have a Long Life
  - Have a Low Life Cycle Cost
  - Have a Low First Cost
  - Use Readily Available Local Materials
  - Be Safe for the Environment

Perspective of an Owner

- Challenges to Success Have Been From:
  - Rutting
  - Pot Holing
  - Inconsistent Performance
  - Increased Binder Costs
  - Friction Requirements

Perspective of an Owner

Challenges to Success

- Rutting:
  - Implementation of Hamburg Wheel Mix Performance Test

Challenges to Success

- Pot Holing:
  - Ongoing Implementation of New Tack Coat Specification
  - Adoption of a Bond Test for Acceptance

Challenges to Success

- Inconsistent Performance:
  - Adoption of Finer Graded Mixes
  - Specifying a Material Transfer Device
  - Enforcement of Paver Segregation Kits
  - Longitudinal Joint Density – Draft Spec
  - Adoption of New Acceptance Methods
    - PFP
    - QCP
    - QMP for Locals * Proposed


Illinois
Interstat


MAIL CONTRACTORS
WATERLOO, WI

50 Shades of

50 Shades of Grey

Challenges to Success

- Increased Binder Costs:
  - Use of Higher Amounts of Recycled Materials
    - RAP, FRAP
    - RAS
  - Addition of Non-Asphalt Modifiers

Challenges to Success

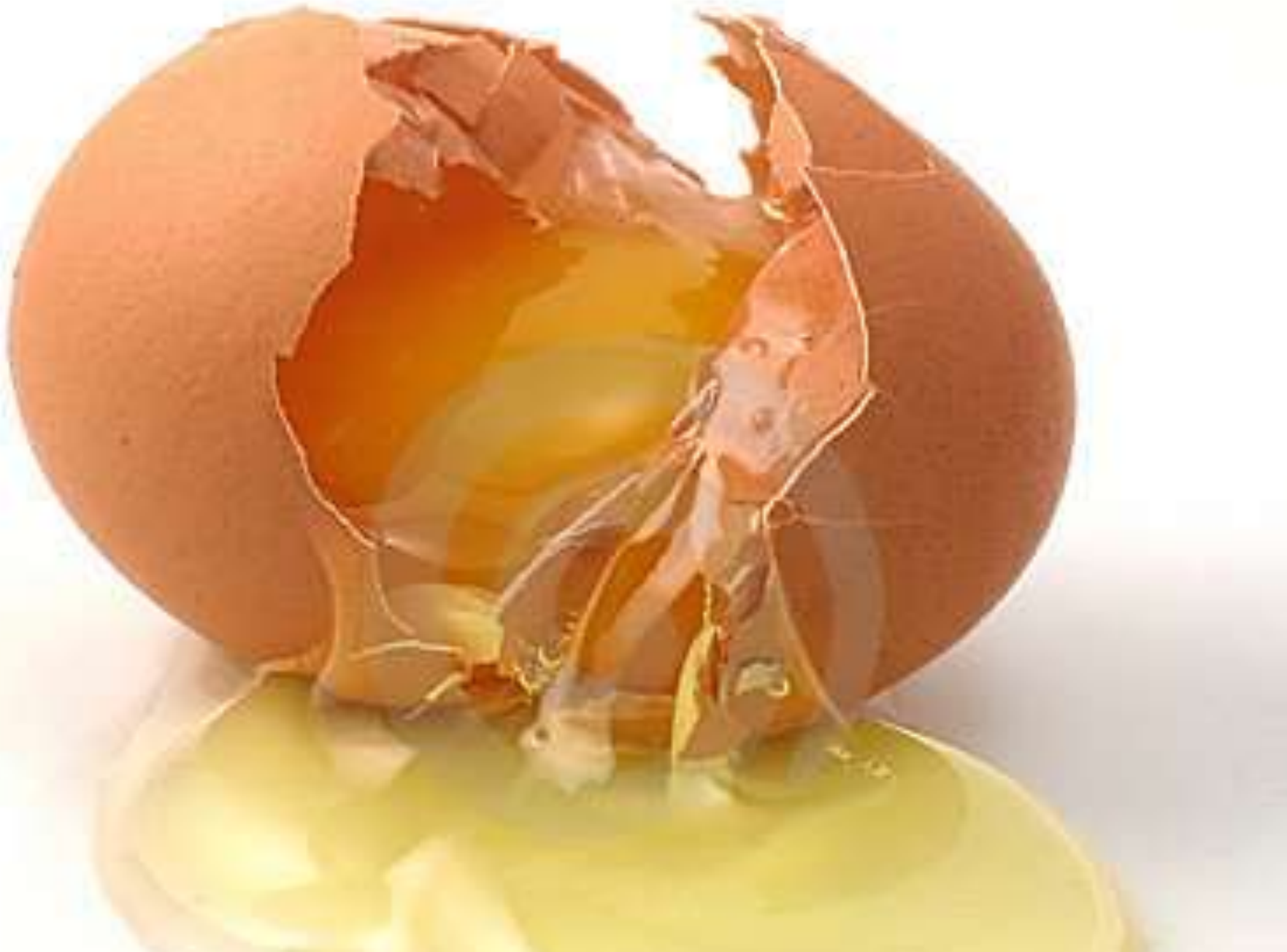
- Friction Requirements:
  - Allowing Blends of Coarse Aggregates
  - Finer "Coarse" Aggregates

On-going ICT Research Efforts

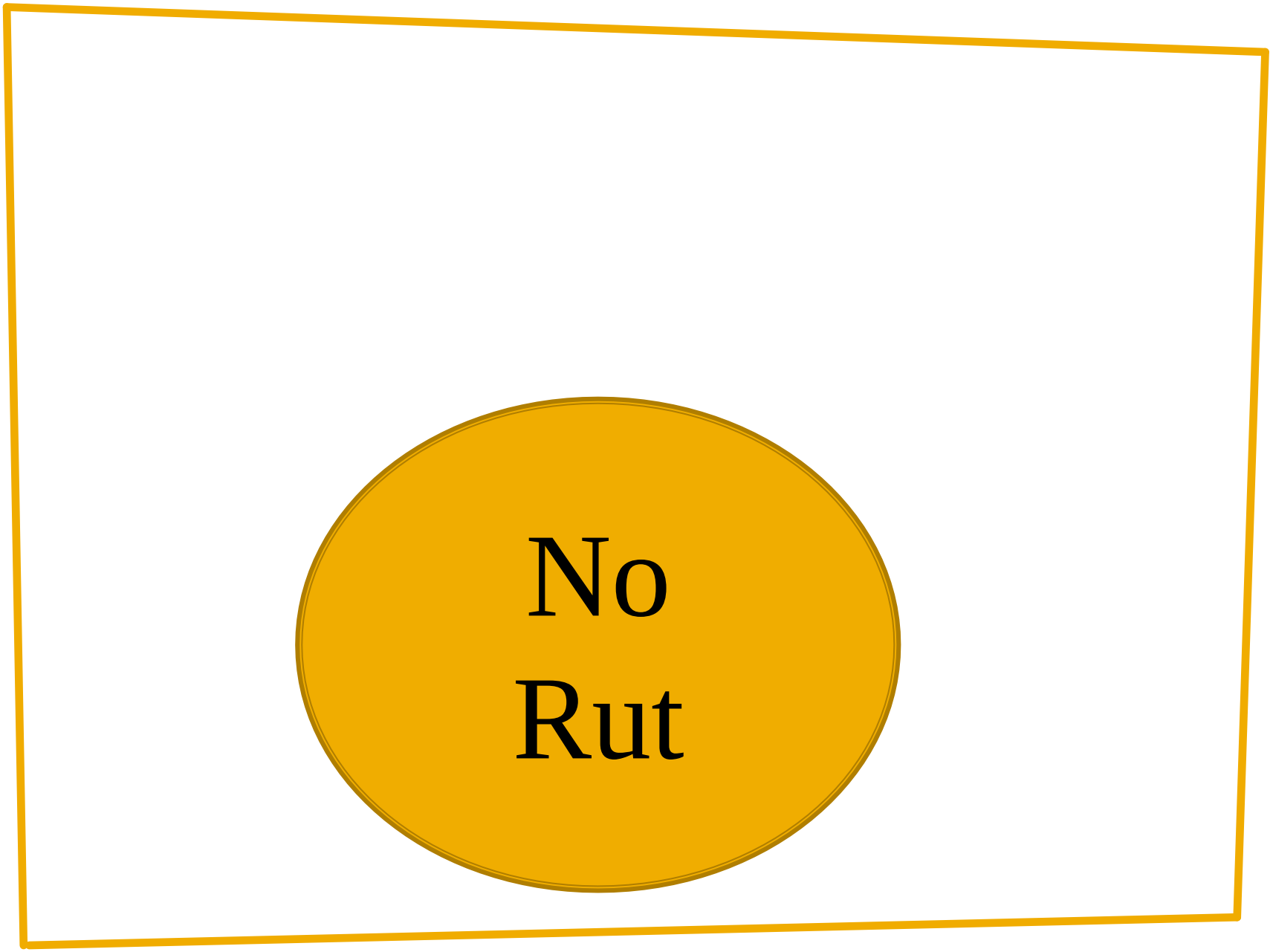
- Development of Improved Overlay Thickness Design for Locals
- Implementation of AIMS in Measuring Aggregate Resistance to Polishing
- Test Protocols to Ensure Performance of High Asphalt Binder Replacement Mixtures – Development of a Mix Cracking Test
- Mechanistic-Empirical (M-E) Design Implementation

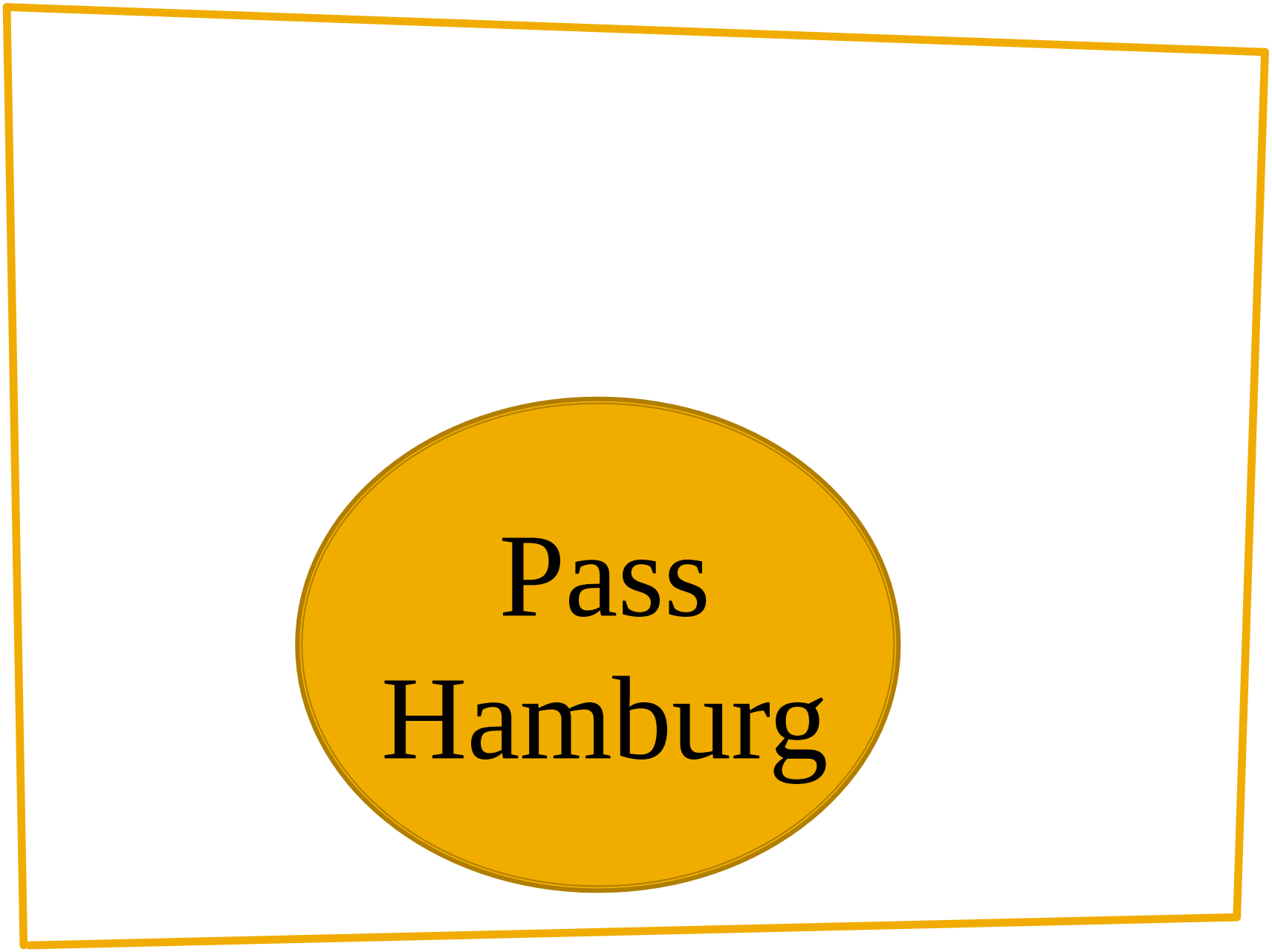
On-going ICT Research Efforts

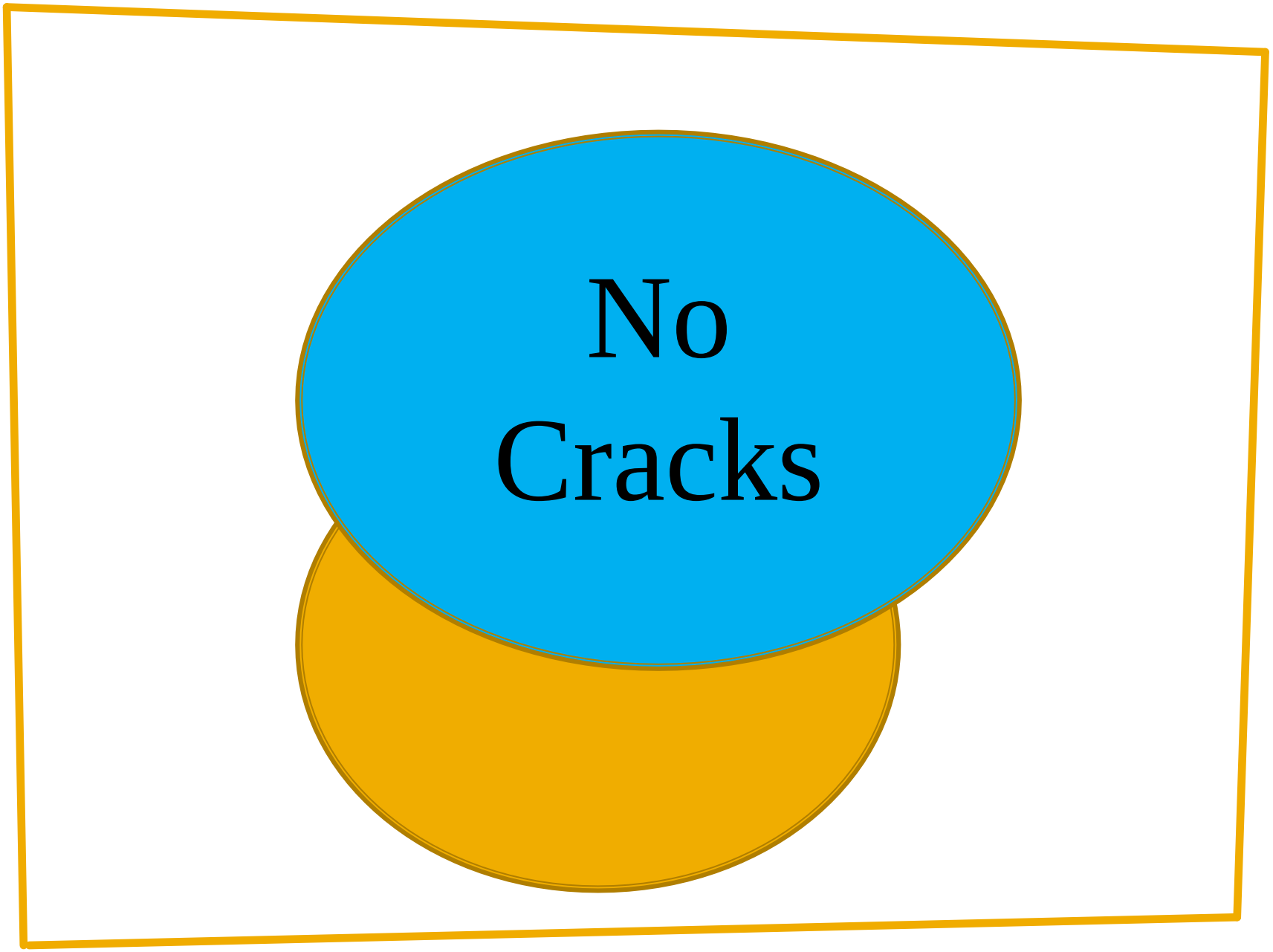
- The Thermodynamics of Production of High RAP/RAS Mixes
- Chemical and Compositional Characterization of Recycled Binders
- Construction and Performance Monitoring of Various Asphalt Mixes
- Evaluation of PG Graded Asphalts with a Low Level of ReOB

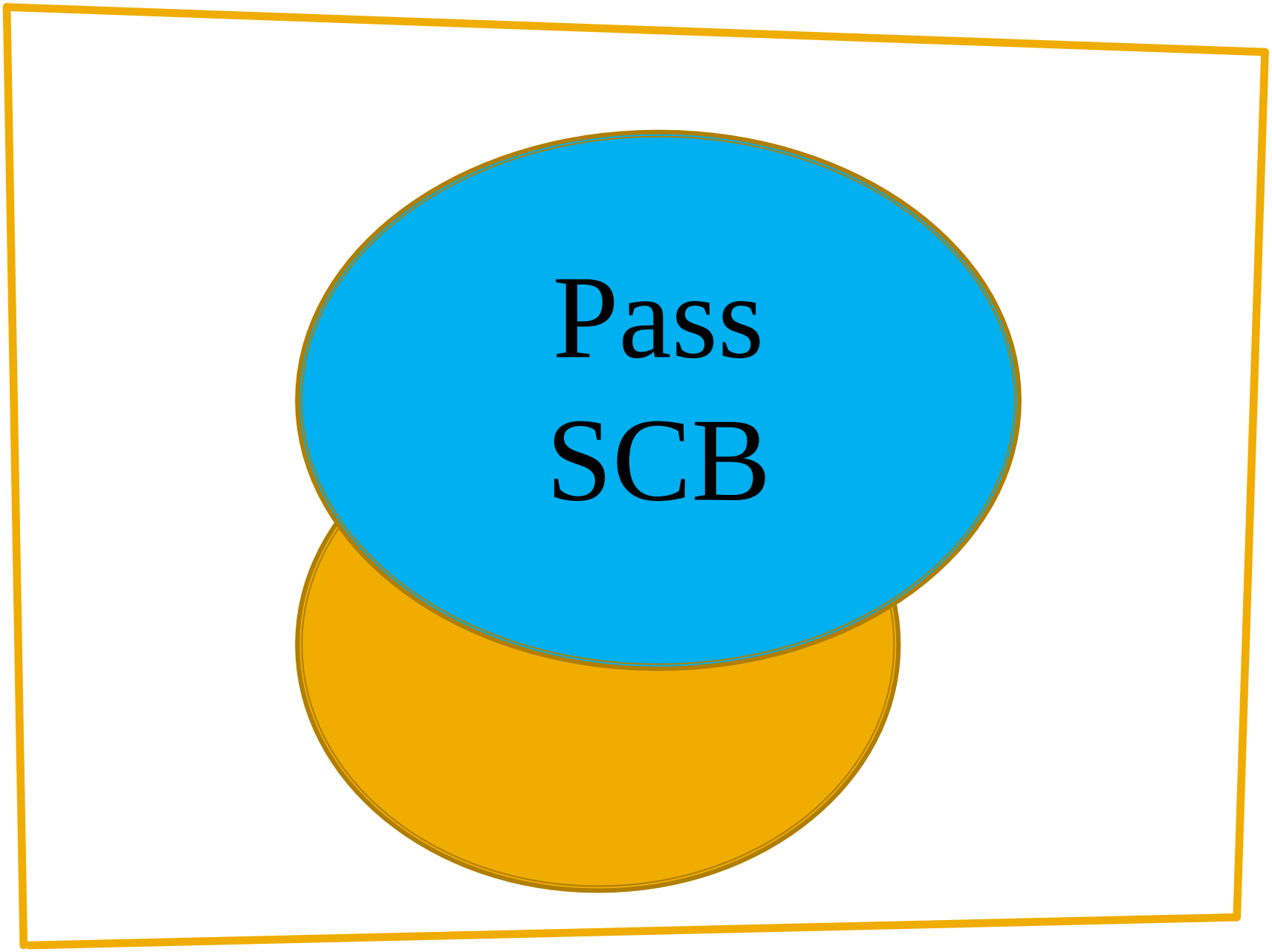


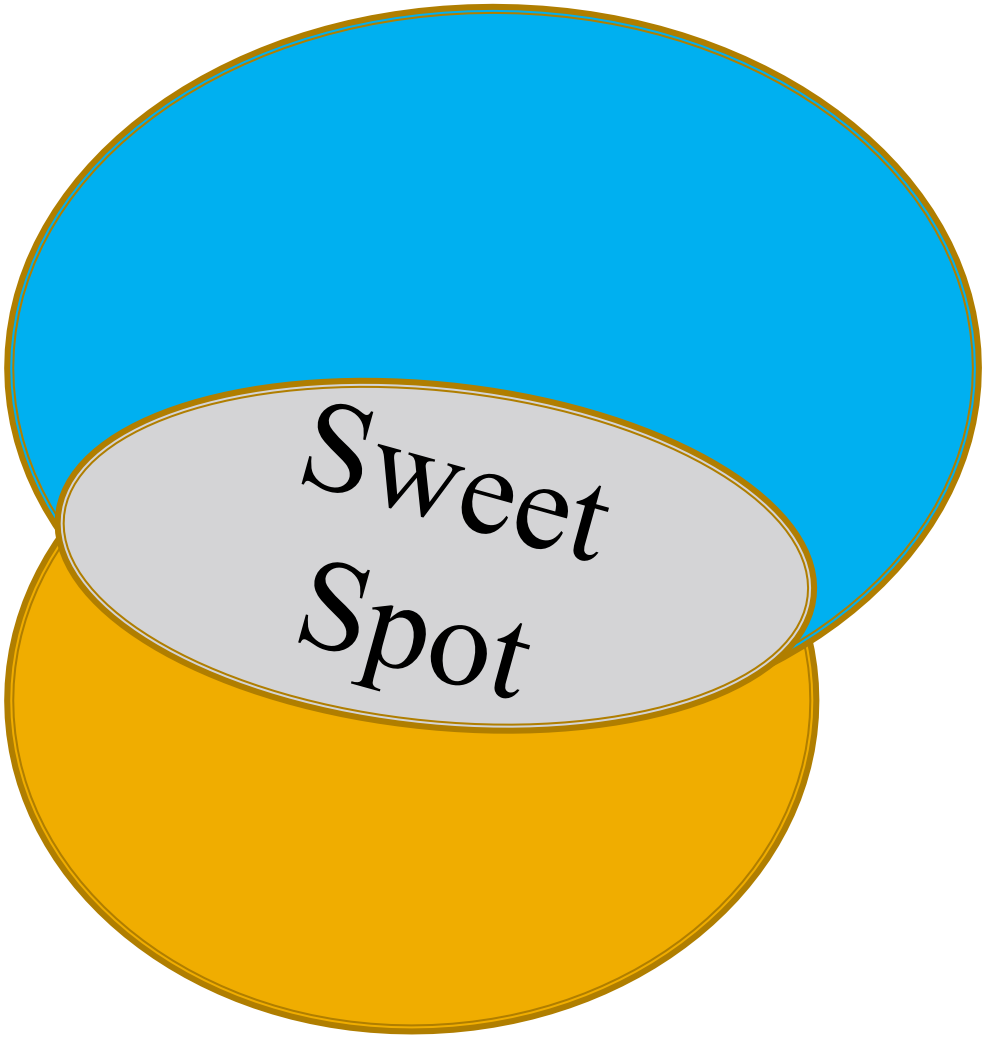
All HMA Mixes

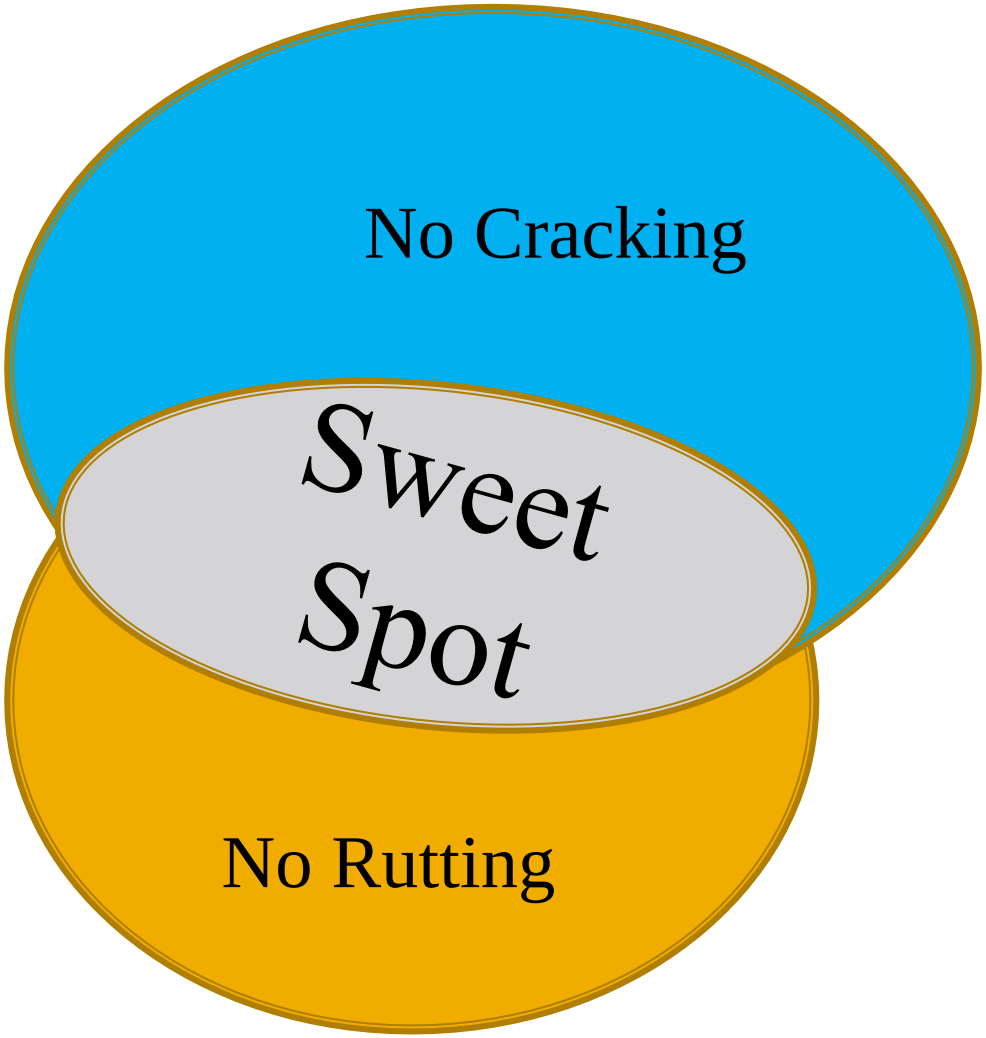

No
Rut


Pass
Hamburg


No
Cracks


Pass
SCB


Sweet
Spot


No Cracking
Sweet Spot
No Rutting

4 Month Old Research Pavement

Rejuvenators

Rejuvenators - No Reproducible Research They Can Reduce Cracking of High Recycle Mix


PEPE

HMA Pavement Failures

- Rutting

Solution – a Performance Test

HMA Pavement Failures

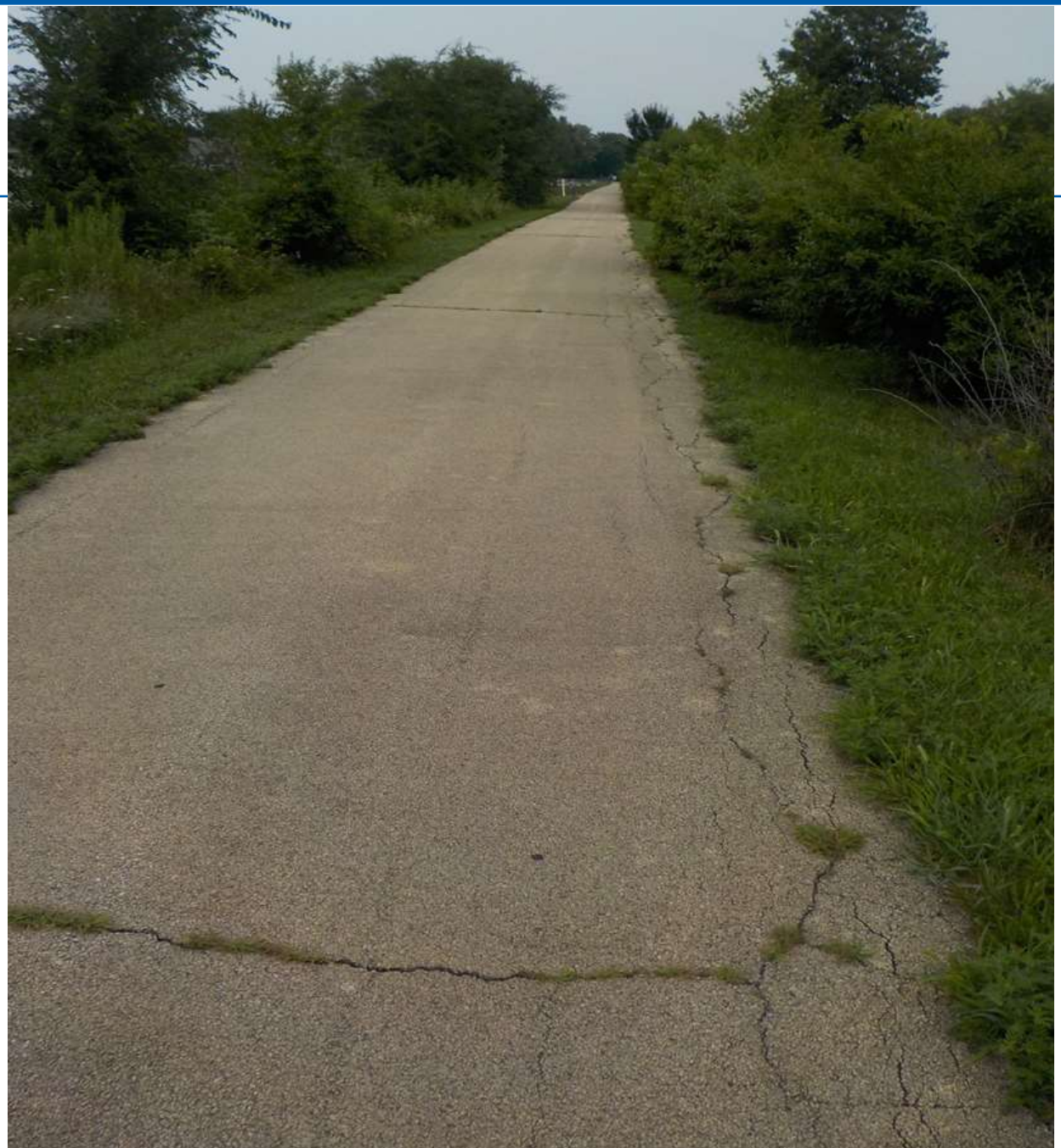
- Rutting
- Cracking

HMA Pavement Failures

- Rutting
- Cracking
  - Reflective

HMA Pavement Failures

- Rutting
- Cracking
  - Reflective
  - Thermal (Cold Weather)



HMA Pavement Failures

- Rutting
- Cracking
  - Reflective
  - Thermal (Cold Weather)
  - Fatigue

Could There be a Single Solution?

Challenges

- SuperPave was developed for neat materials
- More recycled materials are being used in HMA – less virgin components – especially PG asphalts in the final mix
- Currently, some recycled materials are allowed by method specifications intended to limit the risk of cracking by ABR limits and grade bumping, not actual mix performance
- Fatigue cracking issue: stiffer mixes with high ABR may exhibit early fatigue cracking
- Thermal/Block cracking issue: stiffer mixes have reduced relaxation potential

Challenges (RAP/RAS)

- RAP AC can be hard or soft – depends on project(s) milled
- RAP aggregates may be siliceous or carbonate
- Shingle asphalt (***PG 112+02***) is much harder than paving grades
- Counteracting various hard recycled binders with virgin PG binder becomes **arbitrary**
- Neat asphalt **blending** with RAP and RAS for final mix is not understood

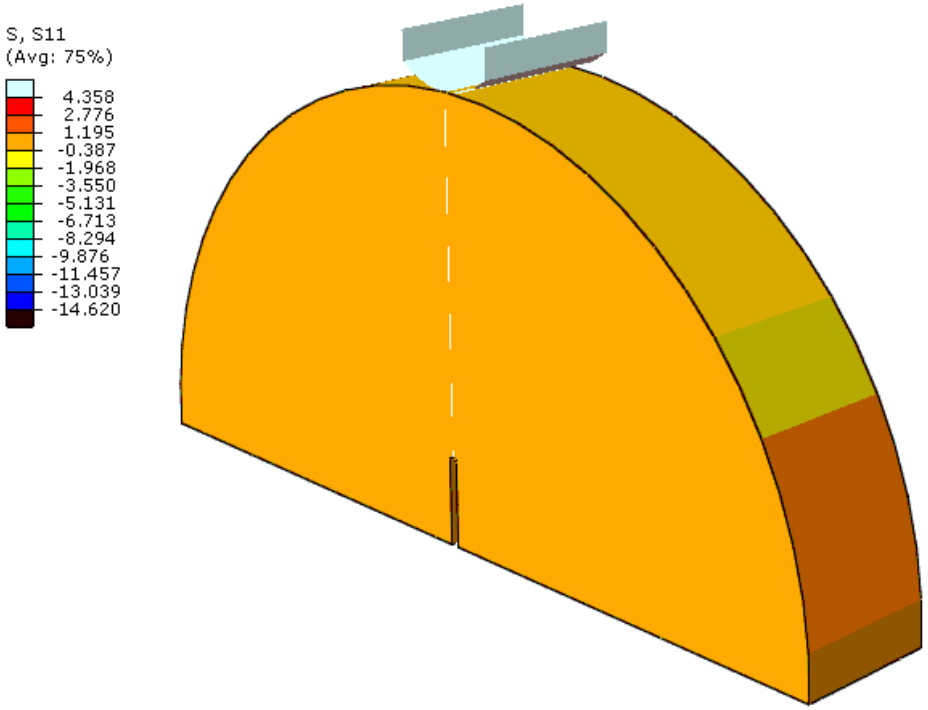
And Now a Solution

Test Method Selection Criteria

- Practical $$
- Quick turnaround
- Correlation to independent tests and engineering intuition
- Significant and meaningful spread in test output
- Correlation to field performance

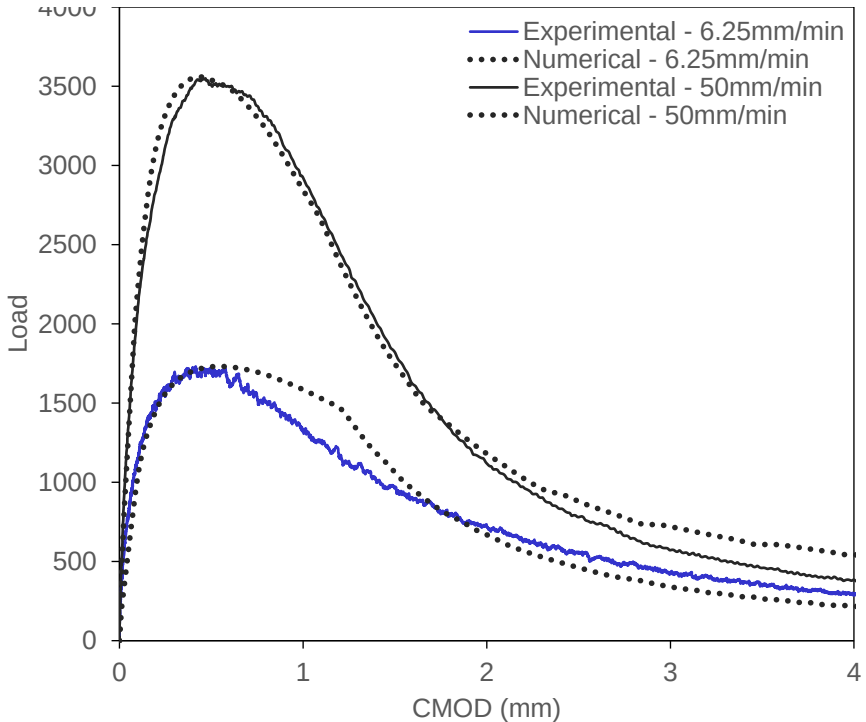
Semi-Circular Bending Test

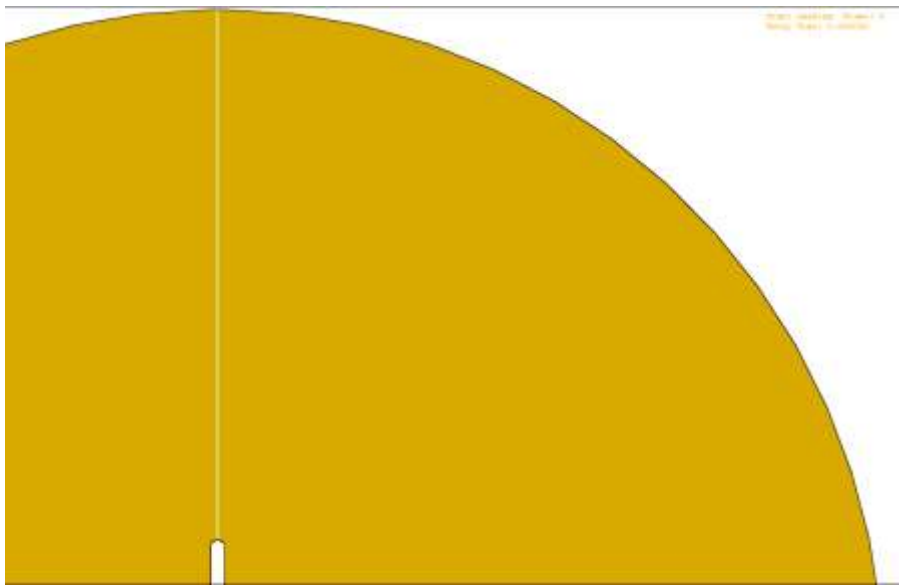
- Relies on simple three point bending
- Easy specimen preparation
- Can use AASHTO T283 equipment *
- Repeatable



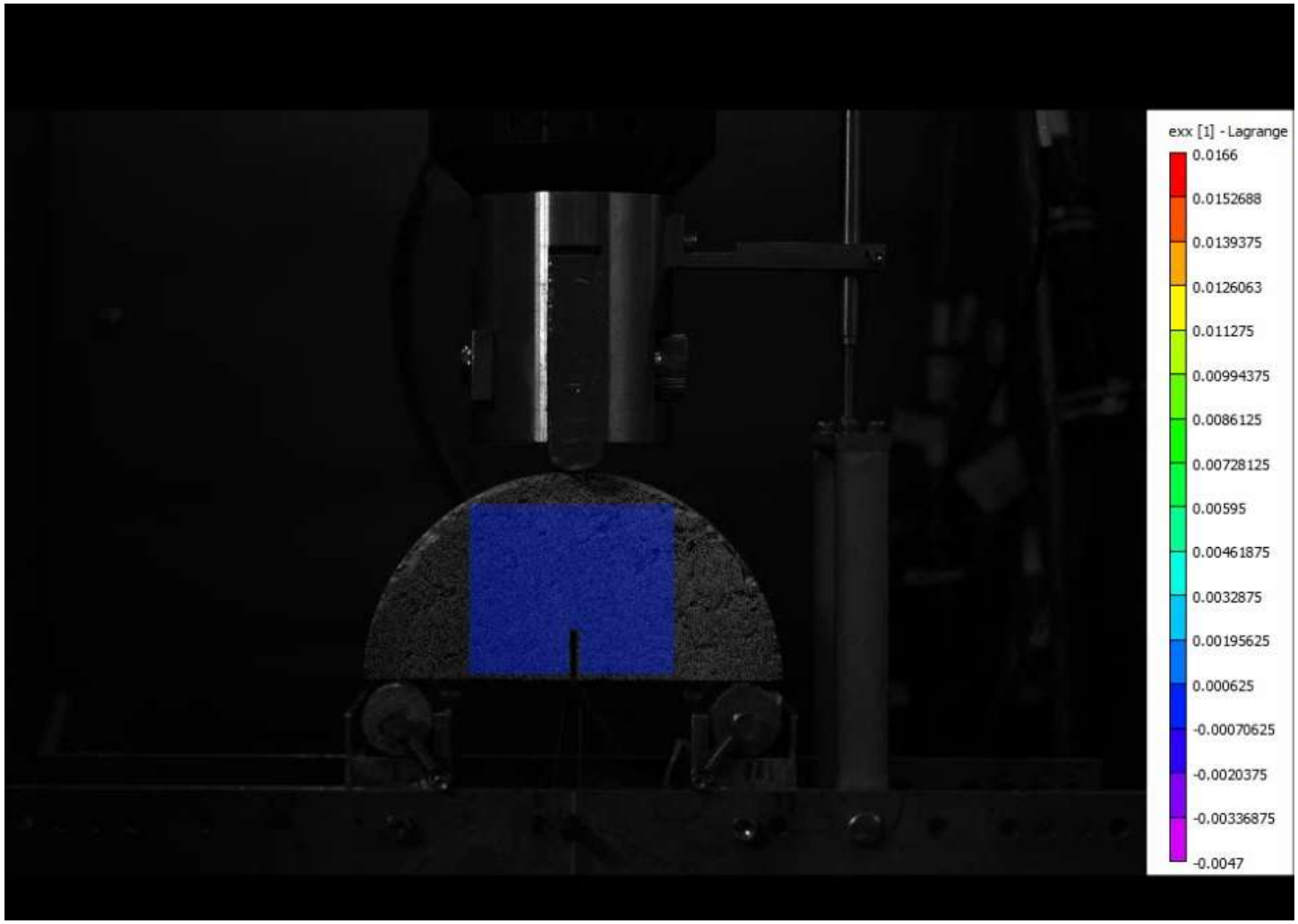
FEM Results

- FEM simulations of N80-25 mix



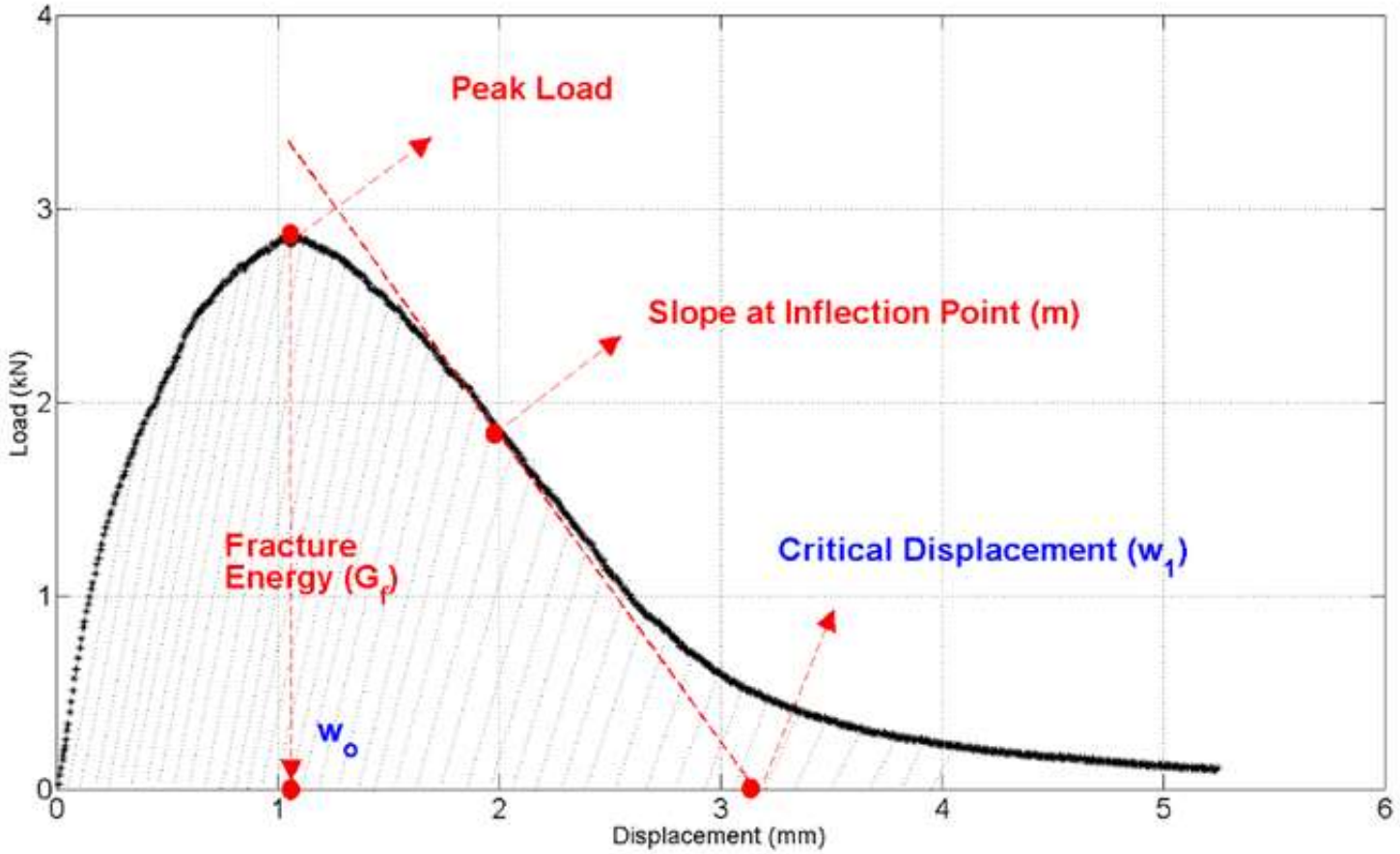


Fracture Process Zone



SCB Fracture Results

Flexibility Index (FI) = A∗G_F /m



SCB Tensile Strength T 283 Hamburg Wheel



Low Temperature Cracking

Fatigue Cracking/ Service Temperature

Permanent Deformation

-40°C **-20°C** **20°C** **40°C**

Low in-service temperatures

Intermediate in-service temperatures

High Temperatures

Owner Concerns

- We don’t know where asphalts originate
- We don’t know what is added to asphalts
- We don’t know what is in recycled materials
- We don’t know what happens when sources of asphalt and aggregate change
- We don’t know what damage occurs during production in various plants
- We need a mix cracking performance test

The Other HMA *Performance* Test

- With the Hamburg Wheel to minimize rutting probability ….
- The SCB reduces risk to the owner of premature pavement cracking
  - It is simple and scientifically sound
  - Can test gyratory specimens or field cores
  - The Flexibility Index can discriminate between good and poor performing mix
  - More validation is underway*

Questions ?