



Post-Production Mix Performance Testing MTO's Experience

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Mix Expert Task Group
May 2018

Outline

- ❖ Background
- ❖ HMA Performance Tests and Results
 - Semi-Circular Bend
 - Disk-Shaped Compact Tension
 - Hamburg Wheel Tracking
- ❖ Results & Findings
- ❖ Next Steps

Background

- ❖ Superpave mix design covers material properties and mix volumetrics, but does not test for performance
- ❖ MTO is committed to evaluate suitable performance tests and develop acceptance criteria for post-production asphalt mix that provide a balance between both resistance to cracking and rutting and correlate with pavement performance
- ❖ Work in this area started in 2017 and is on going

HMA Performance Tests

MTO reviewed various performance tests available to predict cracking and rutting.



The following tests are believed to have the highest potential for post-production acceptance criteria:

Semi-Circular Bend (SCB) test
(intermediate temperature crack resistance)

Disk-shaped Compact Tension (DCT) test
(low-temperature crack resistance)

Hamburg Wheel Tracking test
(rutting and moisture damage)

Cyclic Fatigue test
(fatigue crack resistance)

Texas Overlay-Future Testing
(reflective crack resistance)

Materials Tested

- ❖ We received loose mix for 13 of 16 contracts selected in 2017
- ❖ Tested both:
 - lab prepared Superpave gyratory specimens and
 - pavement cores obtained during construction
- ❖ For SCB test, four specimens tested to determine the average flexibility index
- ❖ For DCT test, three specimens tested to determine the average fracture energy
- ❖ For Hamburg Wheel Track test, four specimens in two separate moulds were tested

Semi-Circular Bend (SCB) Test



SCB Test Setup

According
to
AASHTO
TP124

Test
Temperature:
25°C

Specimen
Thickness:
50 mm

Notch
Depth:
15 mm

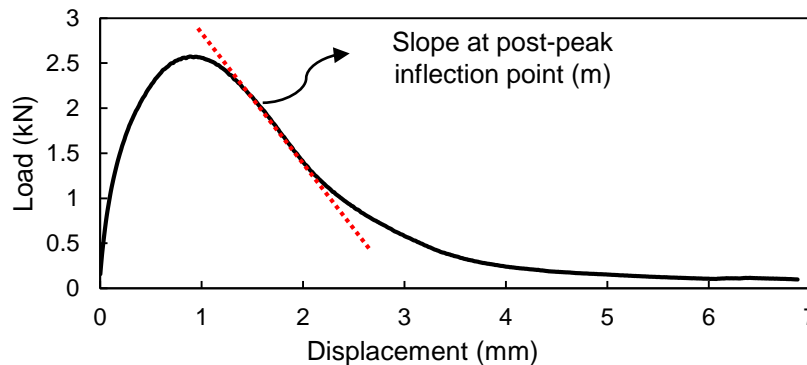
Monotonic
load of:
50 mm/min

Outcome:

Flexibility
Index (FI)

Fracture
Energy
(J/m²)

Load-Displacement curve of SCB



SCB Test Specimen Preparation



1. Cutting into discs



2. Cutting discs in half

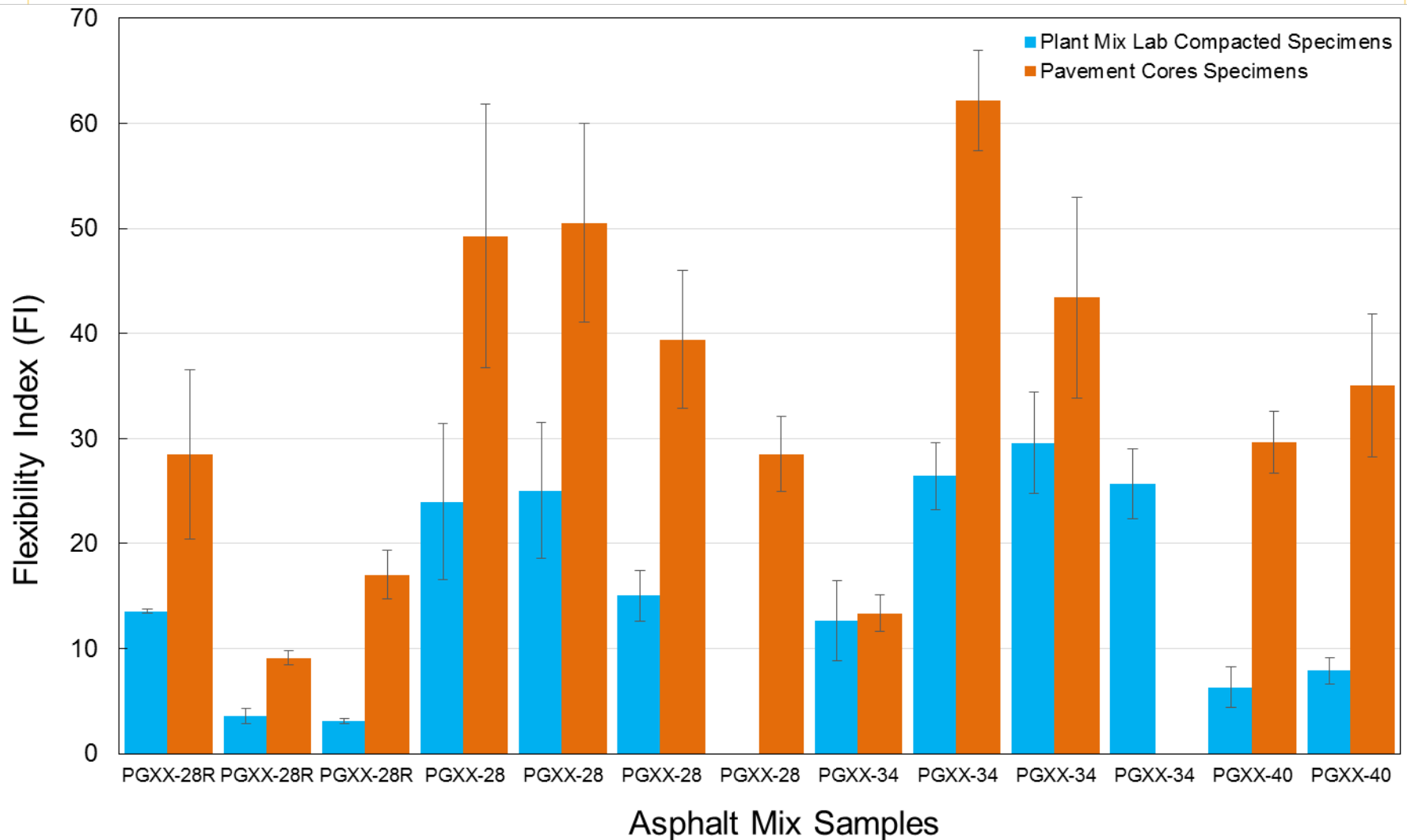
- Requires tile saw for precision cutting to 1.0 mm precision

SCB Test Specimen Preparation



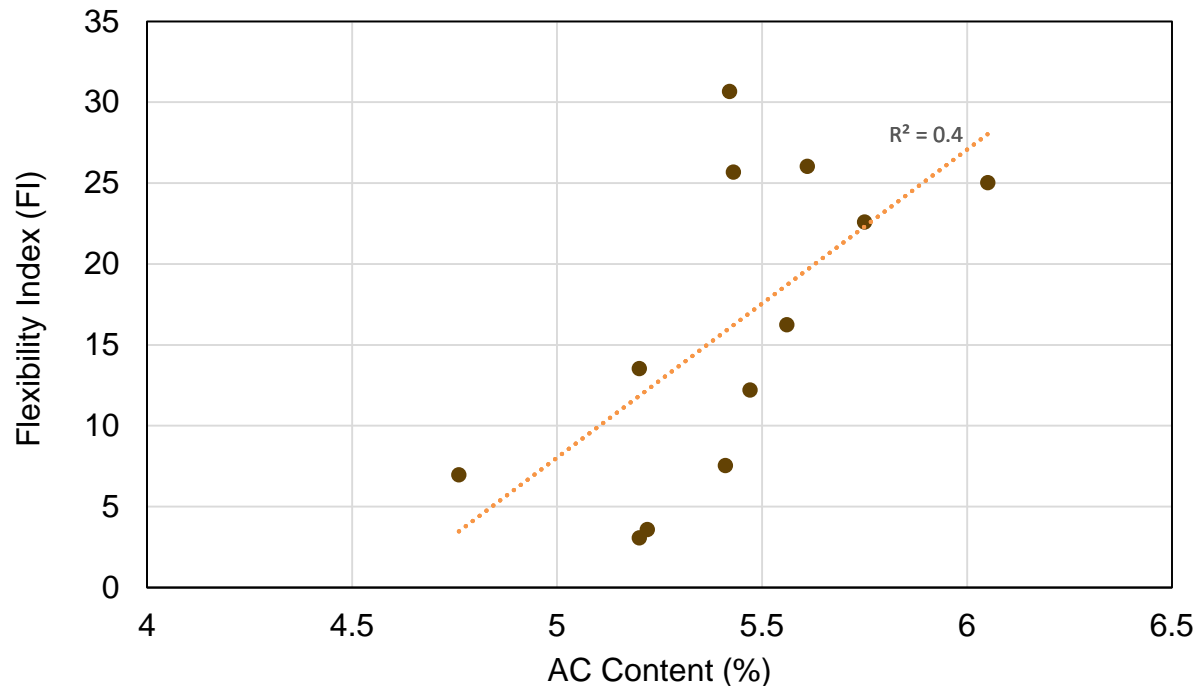
When the pavement's core diameter $< 150\text{mm}$, the technician must adjust specimen's position so the notch is correctly centered

SCB Test Results



SCB Test Results

- ❖ Results for gyratory lab compacted specimens vs recovered AC content for each mix

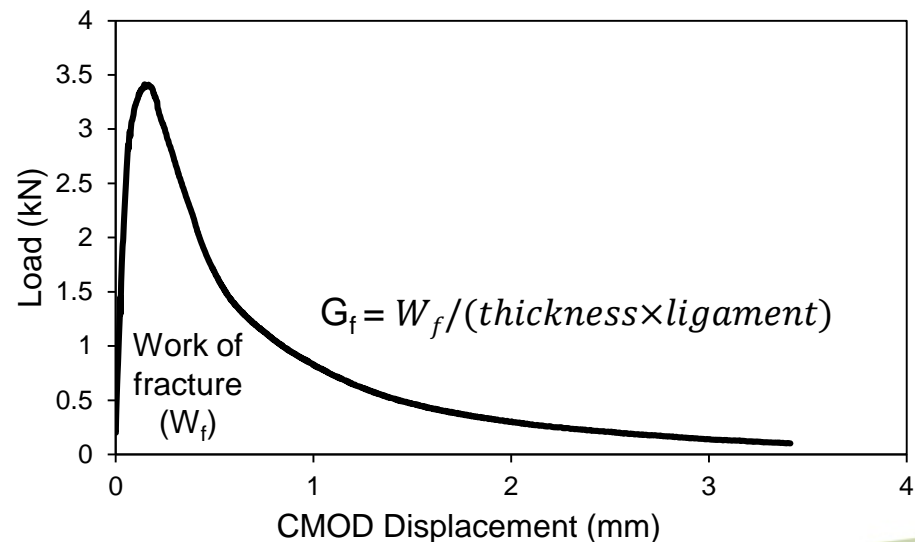
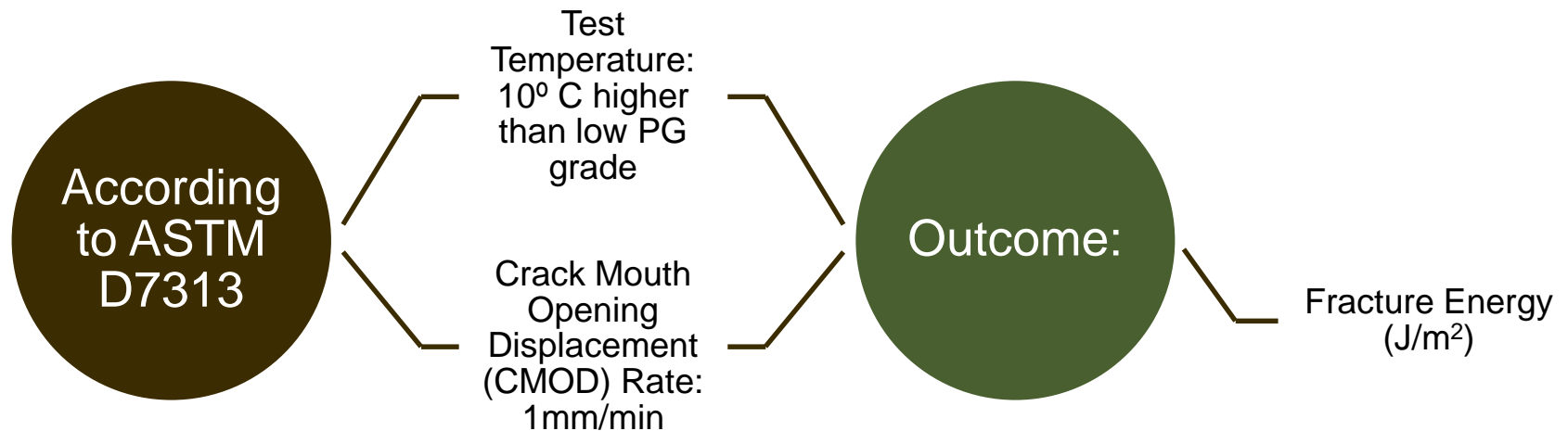


SCB Observations

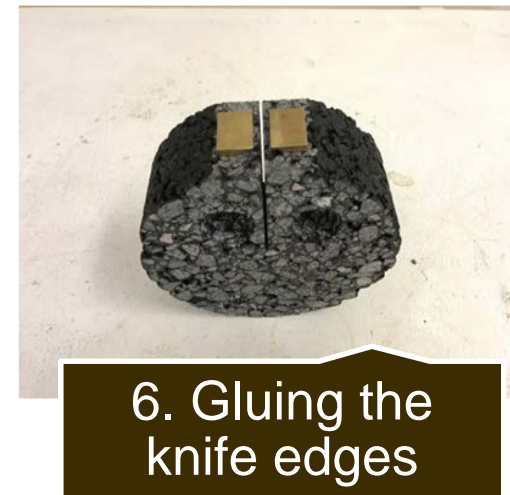
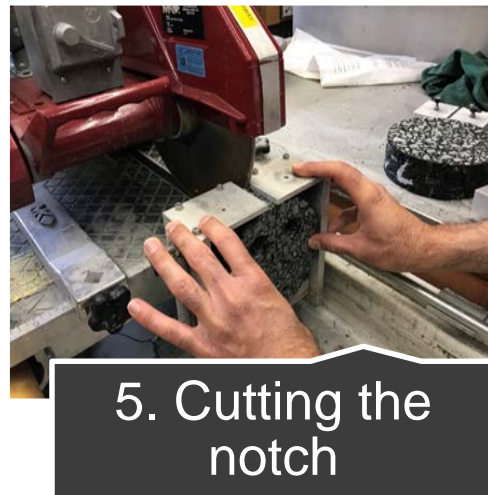
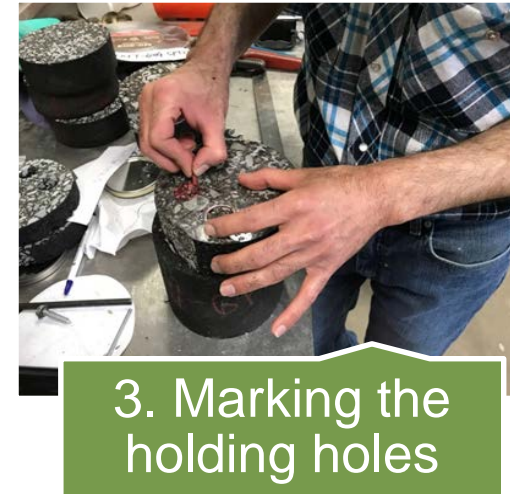
- ❖ Appears AC content may impact FI
- ❖ Has anyone seen a correlation with effective AC or with film thickness?
- ❖ Is SCB a RAP Test?



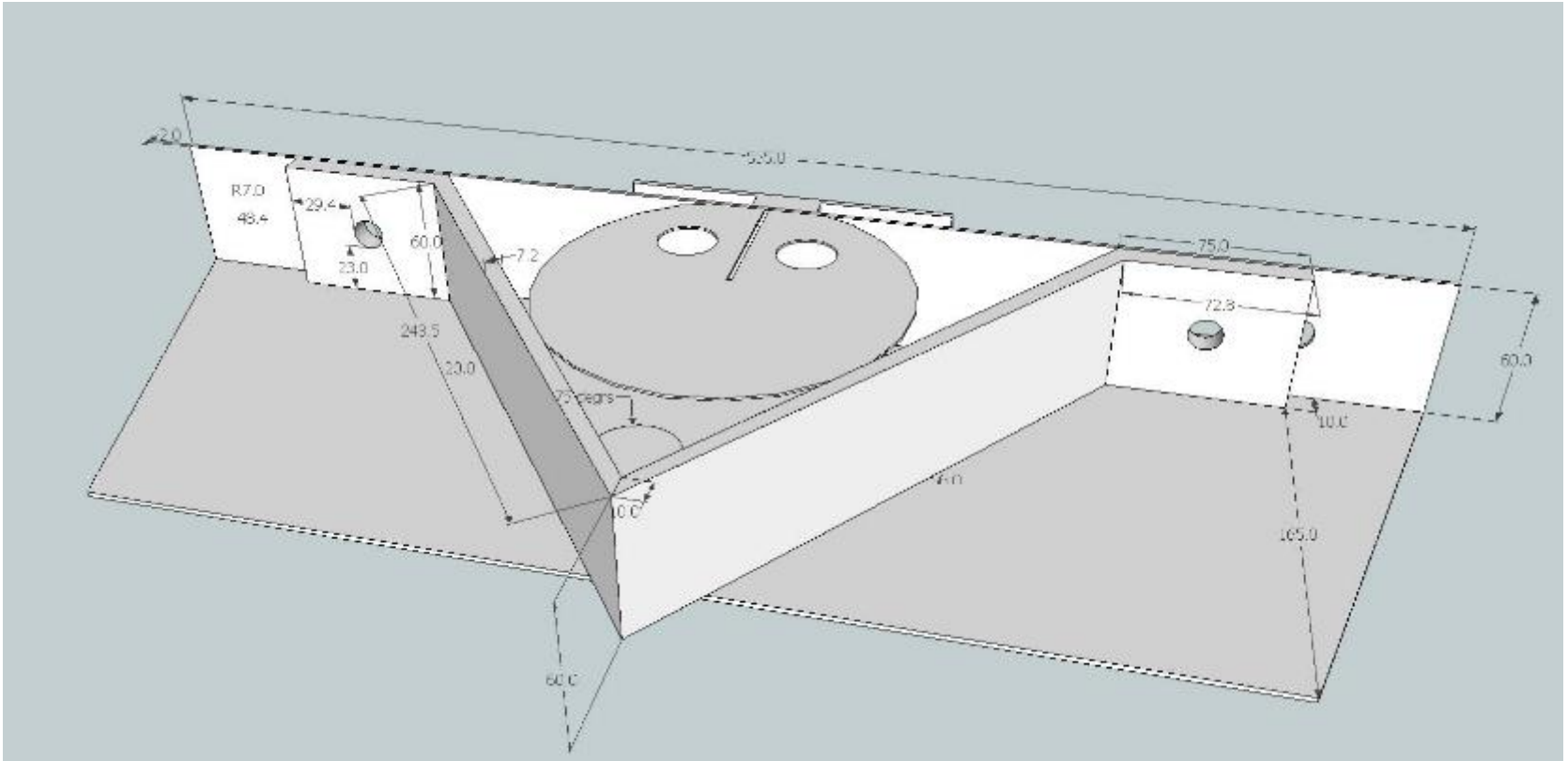
Disk-Shaped Compact Tension (DCT) Test



DCT Test Specimen Preparation



MTO's V-Shape Jig Attachment for DCT



V-Shape Jig Attachment for DCT



DCT Test Specimen Preparation

- ❖ For pavement cores check diameter: $\pm 150\text{mm}$
 - Adjust specimen in the saw to ensure precision of flat edges and notch



$\approx 150\text{ mm}$ diameter core:
When reclined on frame's
right wall, the notch in the
middle

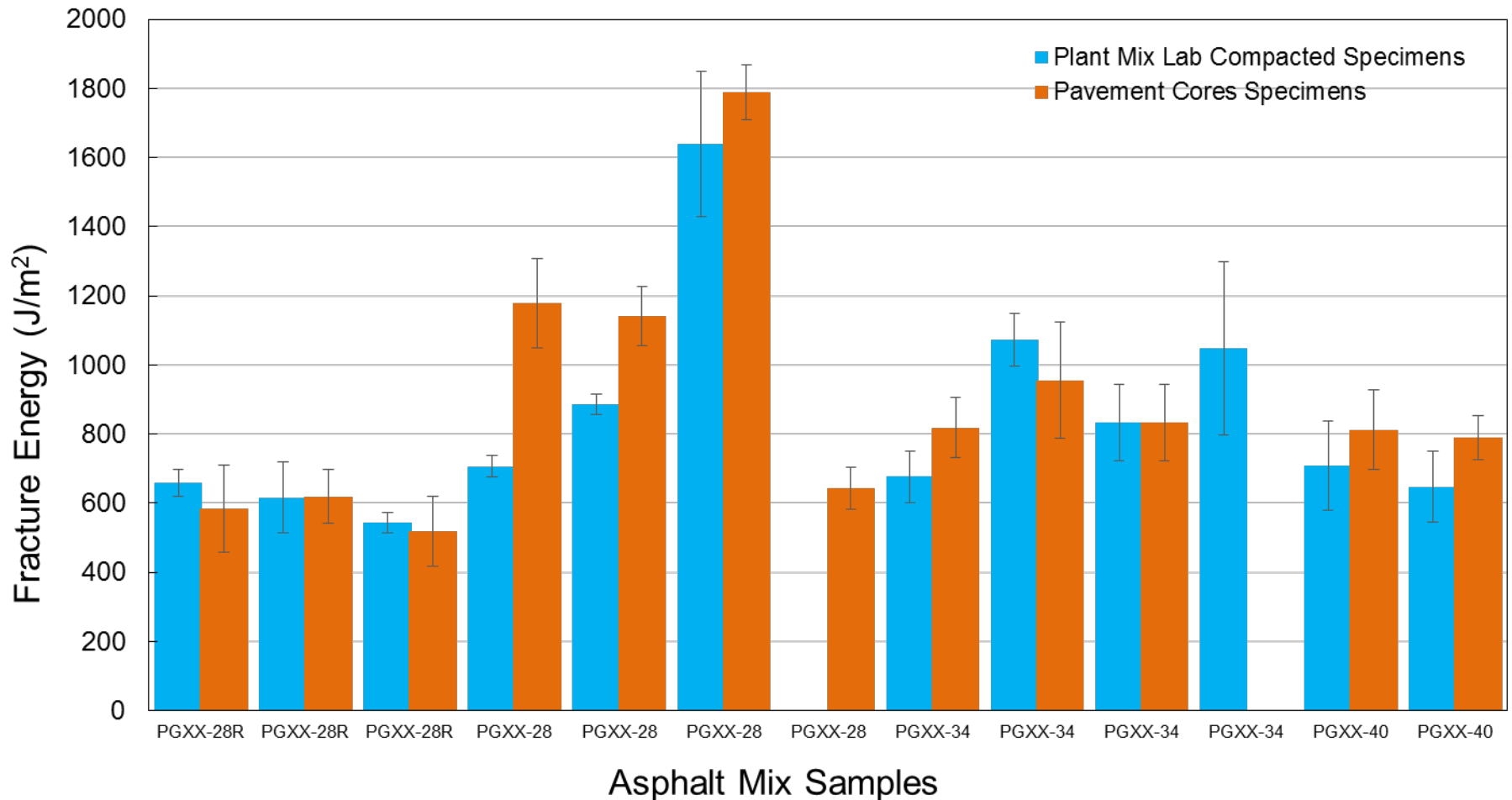


$< 150\text{ mm}$ diameter core:
Notch is misaligned when
core is placed against the
right wall of the frame -
care required

DCT Test Specimen Conditioning & Testing Challenges

- ❖ Long preconditioning time
 - According to ASTM D7313: 8 to 16 hour preconditioning time required at test temperature
- ❖ Testing at -24°C and -30°C test temperature
 - As soon as you open the chamber to mount the specimen, testing is delayed ~ 30 to 45 minutes, to get the temperature of chamber and dummy specimen back to testing temperature

DCT Test Results



DCT and SCB Observations

- ❖ Sometimes crack propagation in some specimens deviates from notch alignment
- ❖ Should we be concerned?



Hamburg Wheel Tracking Test

According
to
AASHTO
T324

Samples
submerged in
water

Test
Temperature:
50° C

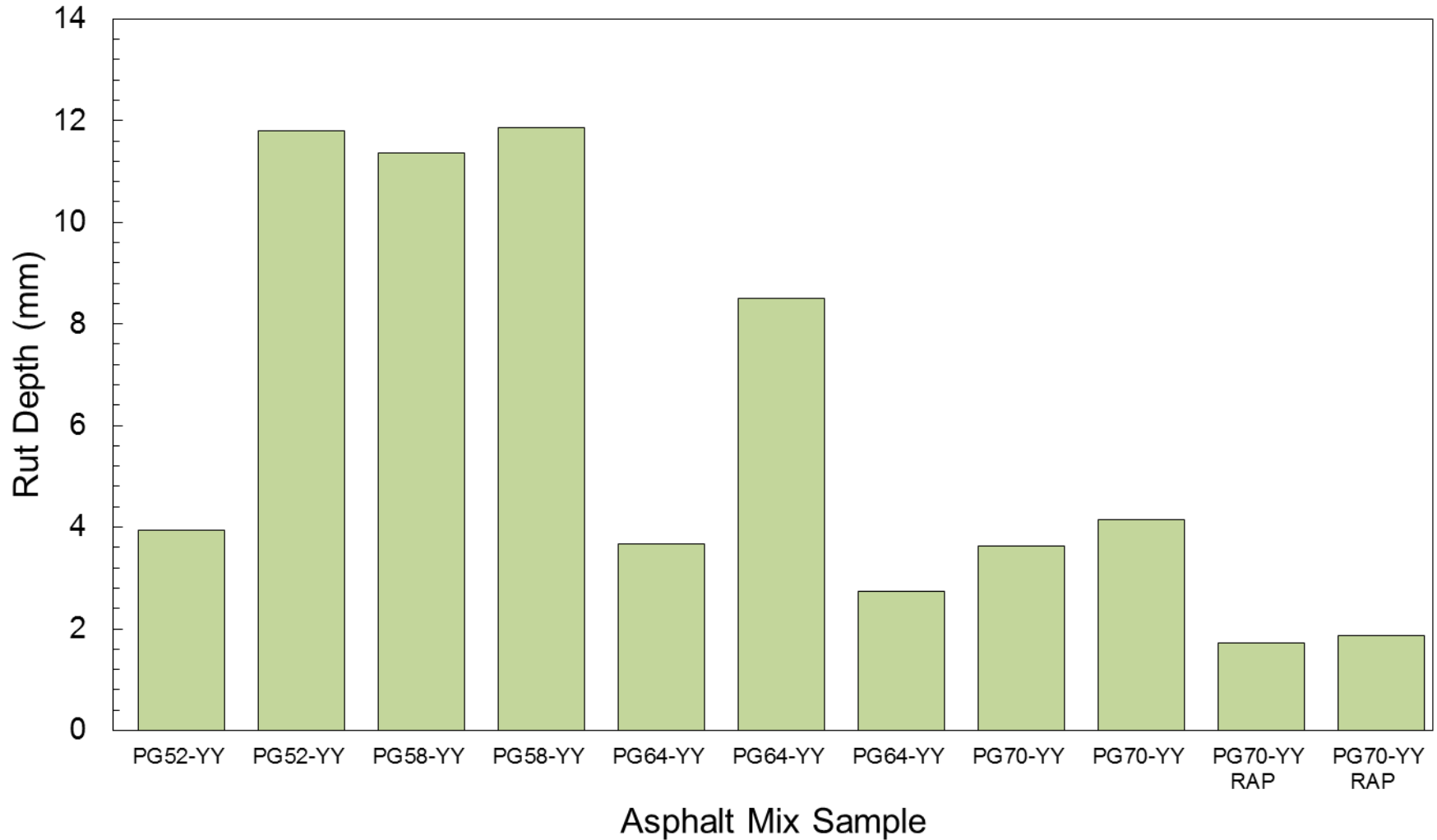
Number of
cycles:
10000 cycles

Outcome:

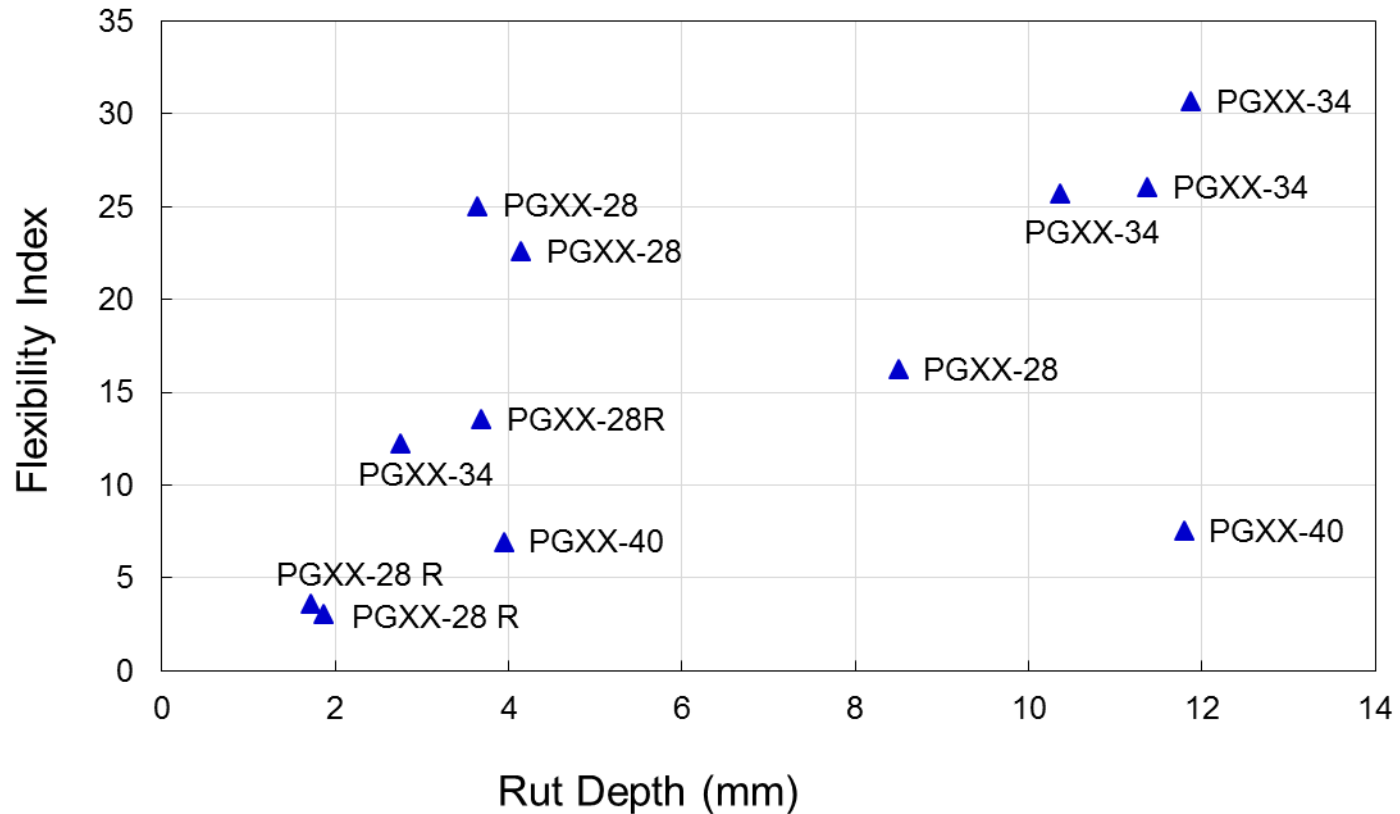
Rut depth vs.
of load
cycles



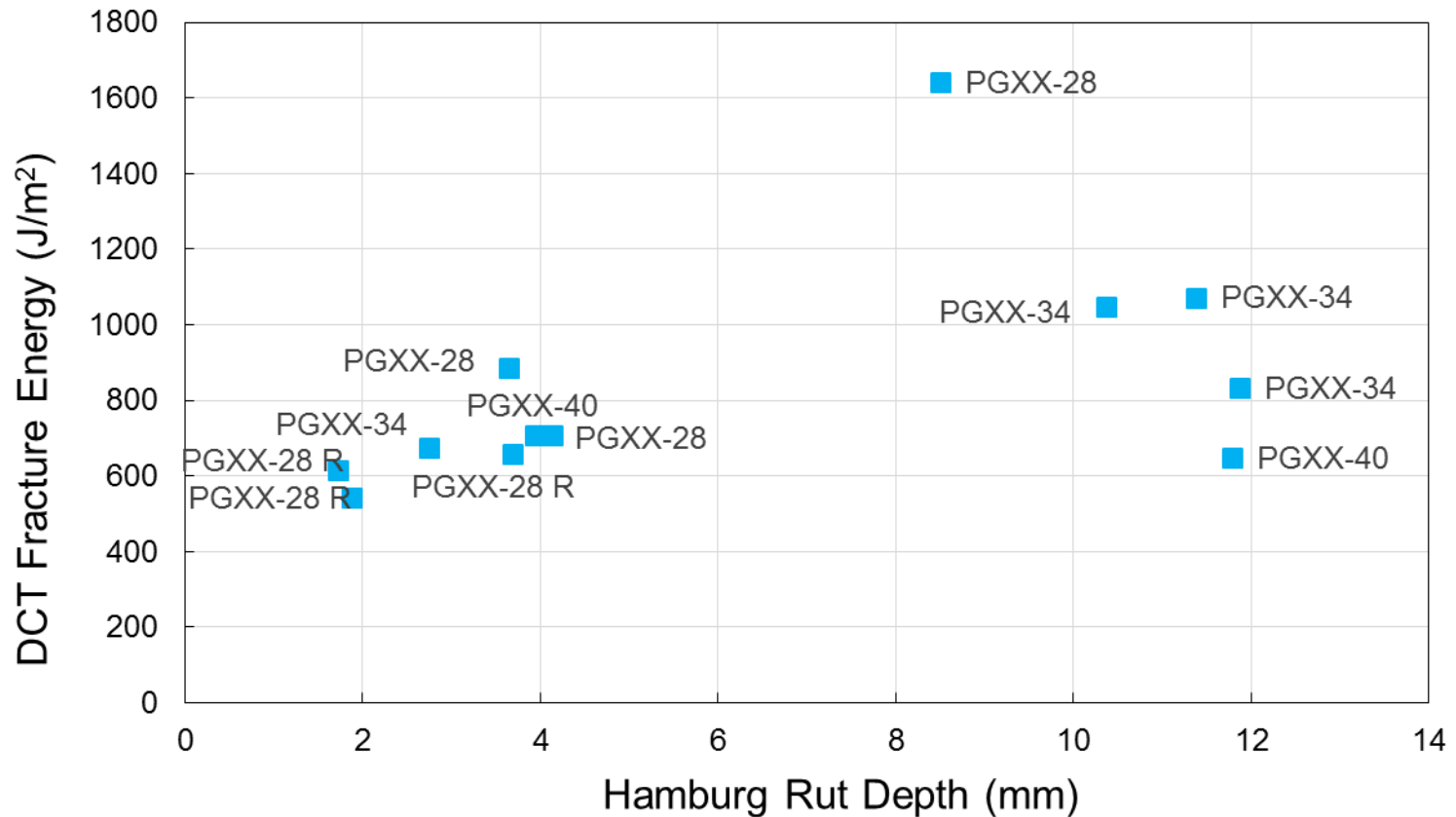
Hamburg Wheel Tracking Test Results



Results: SCB & HWT

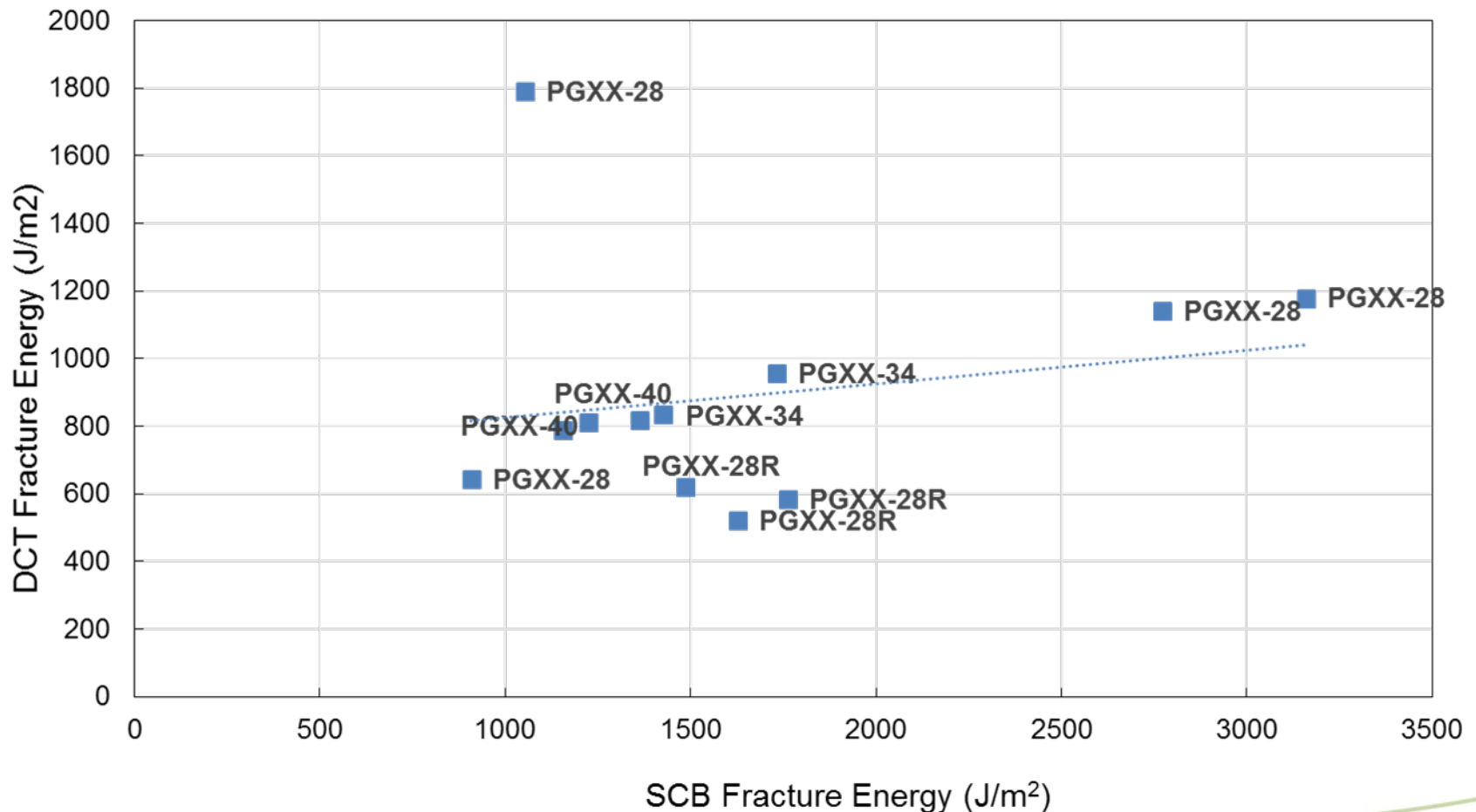


Results: DCT & HWT



Results: Fracture Energy DCT & SCB

SCB-DCT Fracture Energy (Field Cores)



Findings to-Date

- ❖ FI (SCB) was more variable for SMA mix (lab and pavement cores)
- ❖ DCT lab and pavement core test values were closer, than the SCB lab and pavement cores test values for the same production mix
- ❖ Appears there is a trend for between FI and AC content
- ❖ RAP mixes have lower FI (SCB) and Fracture Energy (DCT) results

Next Steps

- ❖ Run remaining mixture tests
- ❖ Drop test temperature for SCB test to environmental intermediate test temperature for softer grades
- ❖ Carry out Hamburg Wheel Track Testing at 44°C for PG 52-XX instead of 50°C
- ❖ Investigate impact of changing SCB test with the SCB jig for QA/QC lab using:
 - TSR loading frame
 - Alternate conditioning methods

Questions



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Appendix

❖ Additional Slides

Big Saw for Cutting Slices



Tile Saw by MK Diamond Products



Findings: SCB, DCT and HWT

