

AFH60

January 11, 2010



***Investigation of Low and High  
Temperature Properties  
of Plant-Produced RAP Mixtures***



# Approach

- Evaluated plant-produced mixes with up to 40% RAP and two virgin binder grades
- Originally proposed to focus on effects of RAP on low temperature properties
  - Not strictly confined to low temps though



# What We Did

- Five contractors (IN and MI) produced six plant mixes.
- Heritage and NCSC tested RAP, virgin and mixture properties
  - Binder properties – extraction/recovery and PG binder tests
  - Mix properties – Indirect Tensile Strength, Dynamic Modulus
  - Blending analysis – a la Bonaquist
  - Fatigue – pending at TFHRC



# Experimental Design

	Reclaimed Asphalt Pavement			
Binder Grade	0%	15%	25%	40%
PG 58-28			X	X
PG 64-22	X	X	X	X

# 1<sup>st</sup> Contractor - Critical Cracking Temperatures

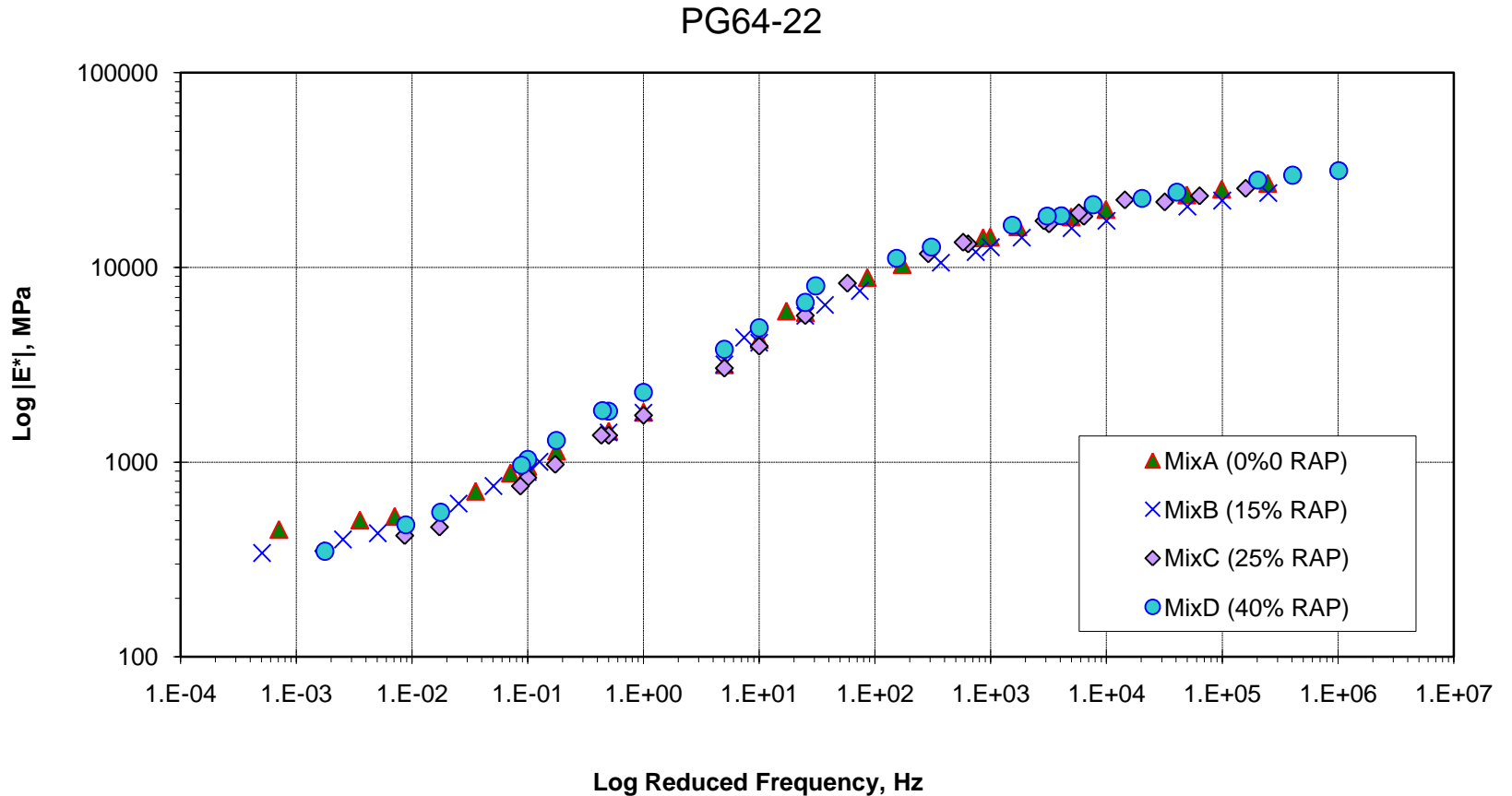
Mix	RAP Content	T <sub>c</sub> (°C)
A – PG64-22	0	-28.9
B – PG64-22	15	-23.3
C – PG64-22	25	-25.6
D – PG64-22	40	-22.8
E – PG58-28	25	-27.2
F – PG58-28	40	-23.9



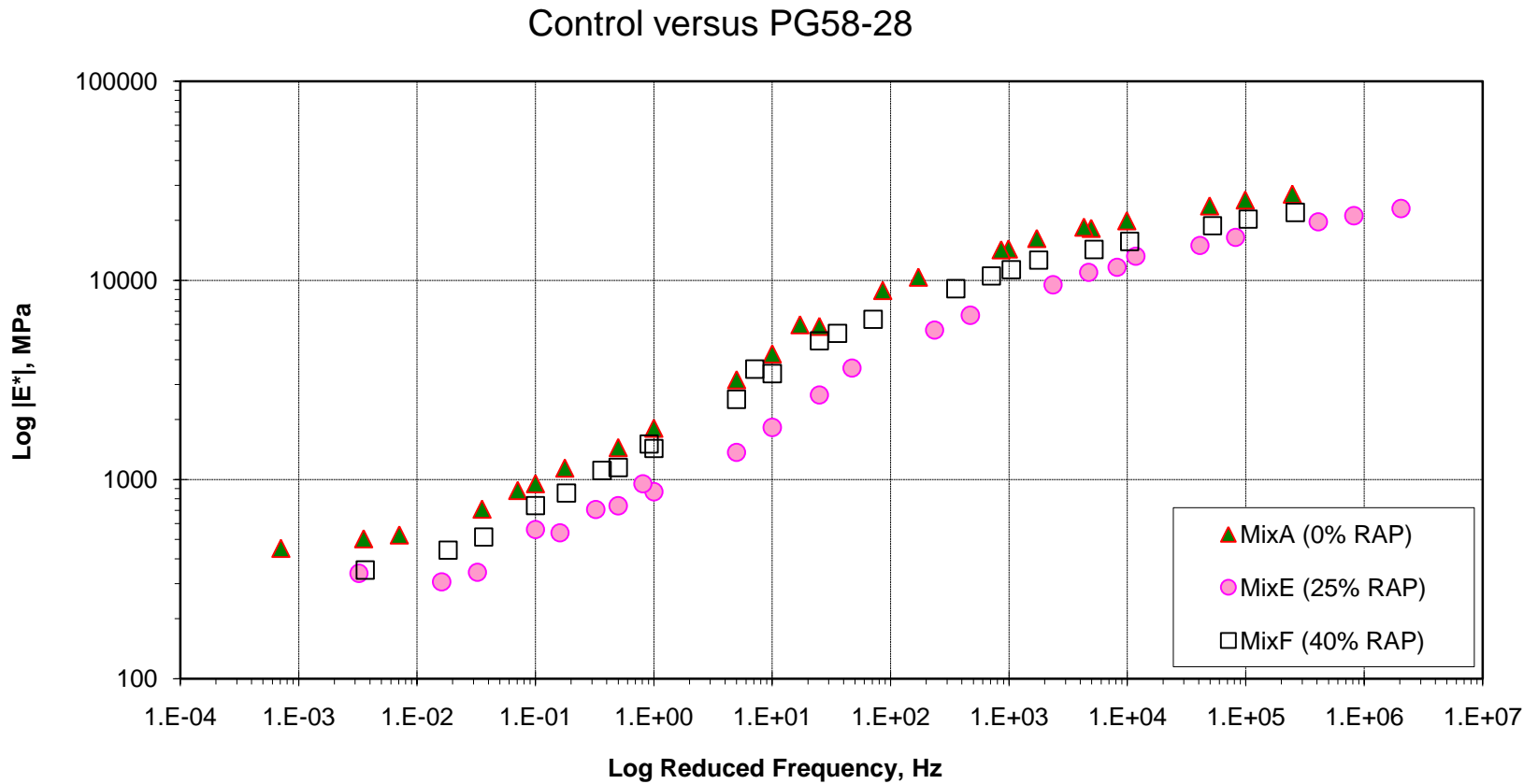
# 2006 Results

- One contractor, one plant, one set of materials
- For these materials and this plant, the RAP mixes were not as stiff as expected.
- The binder did not stiffen linearly with increasing RAP content.
- In this case, dropping the virgin grade to PG58-28 for 25% RAP was not necessary.

# One Example - Mix $|E^*|$

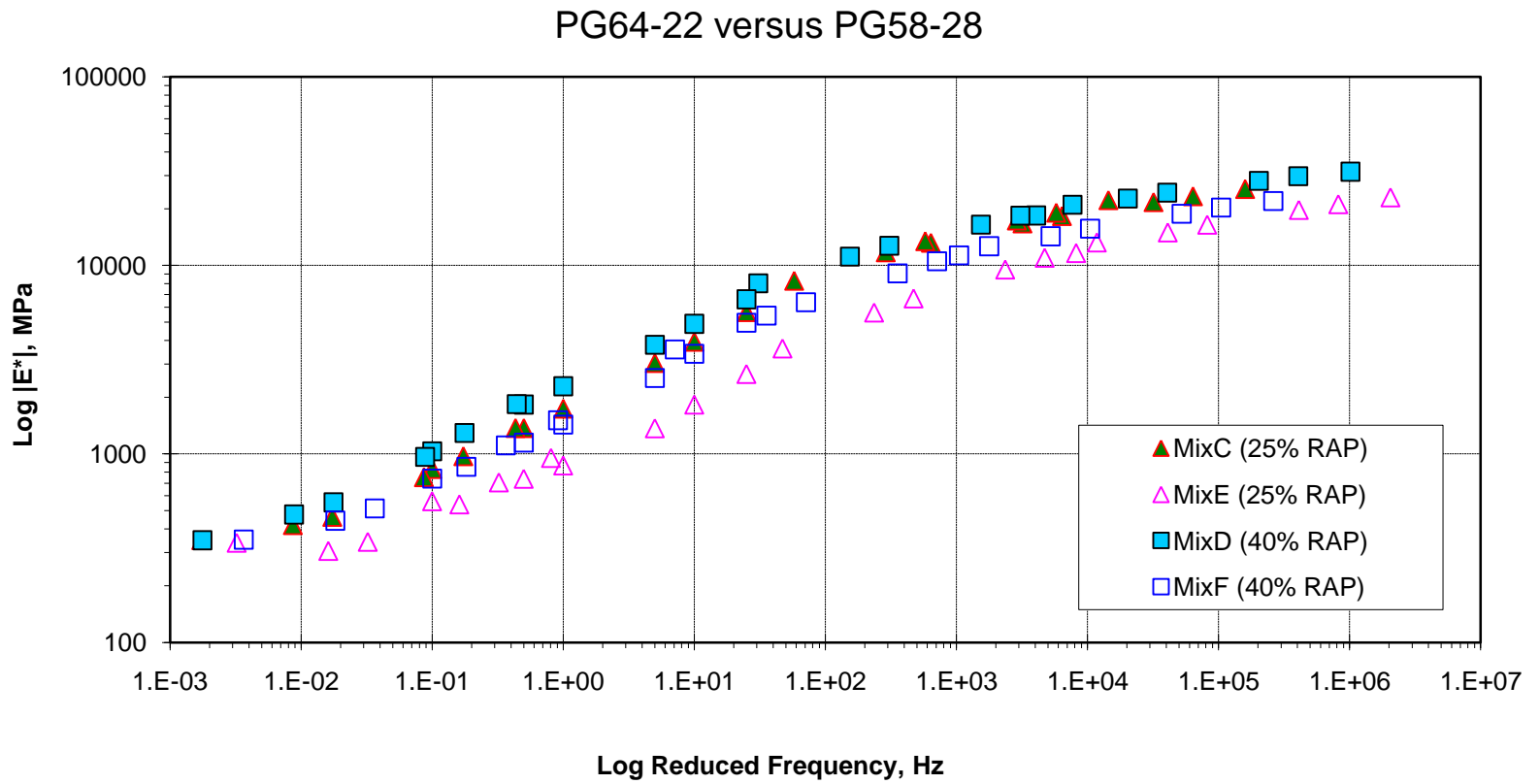


# One Example - Mix |E\*|

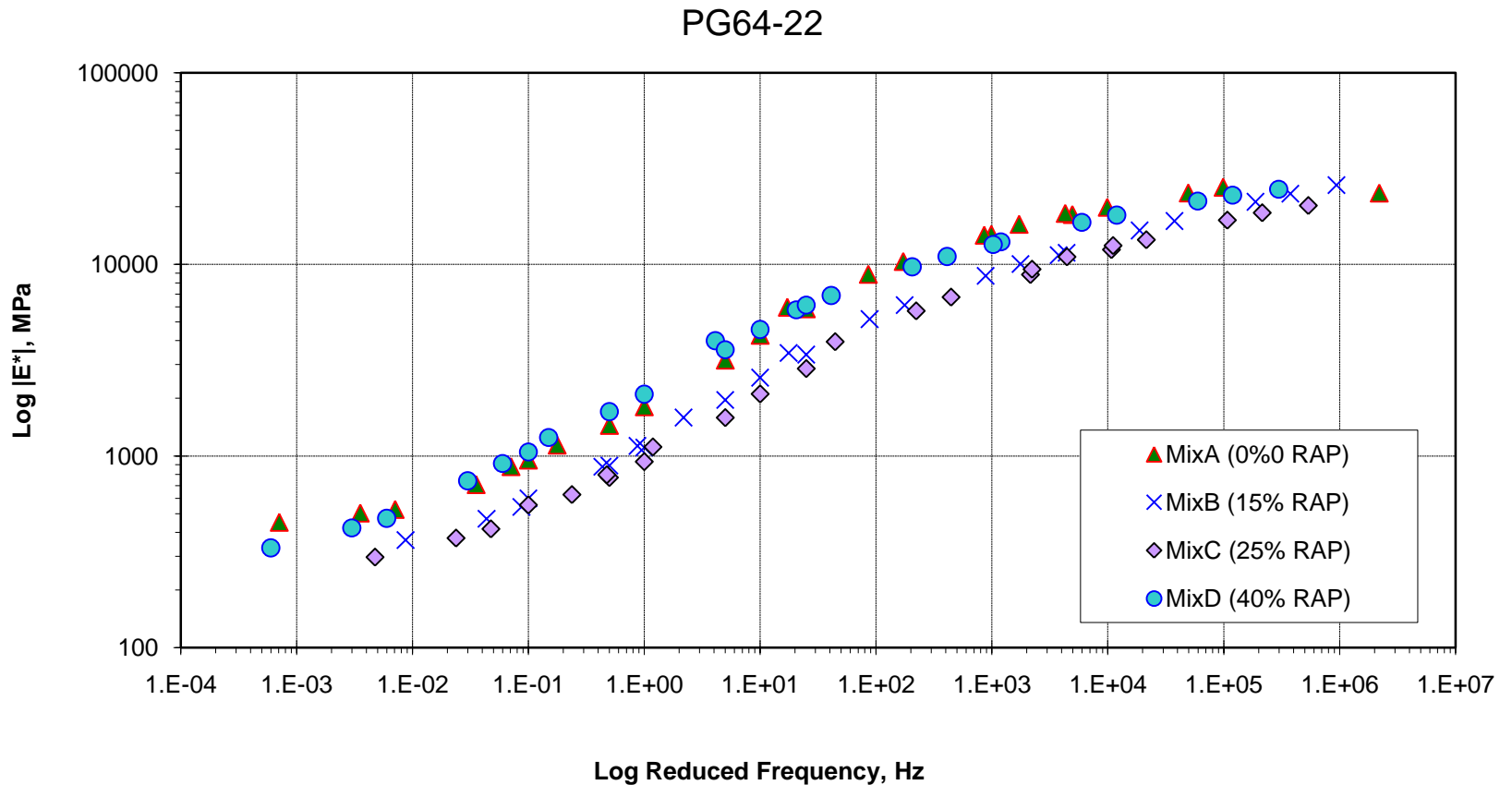




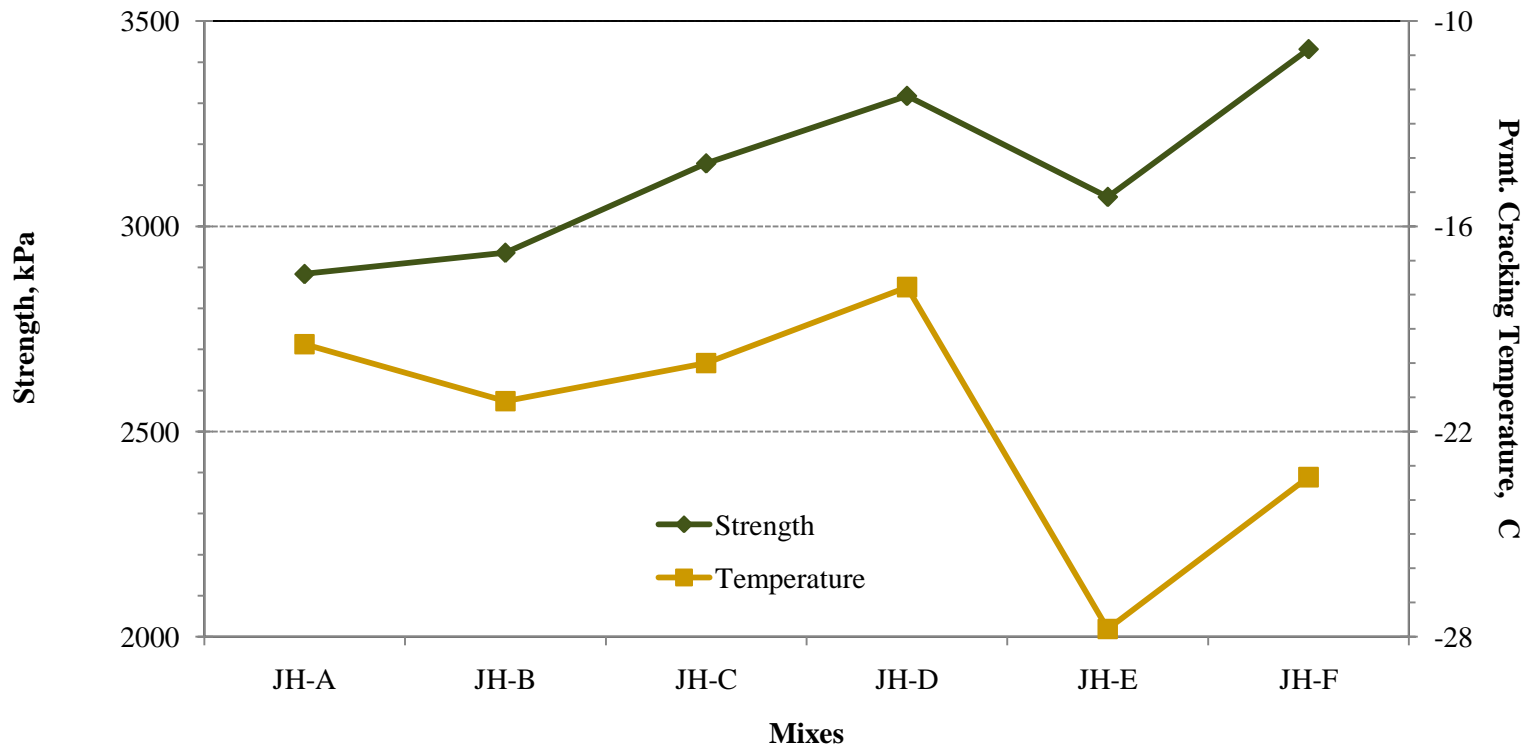
# One Example - Mix |E\*|



# Second Example - Mix $|E^*|$



# IDT Strength Example 2





# Blending Analysis

- Two cases indicated pretty good blending, two showed less
- Relates to other comparisons
  - IDT indicated little effect of binder grade in the cases with questionable blending
- Results were not totally consistent



# INDOT RAP Binder Testing

- INDOT OMM tested 33 RAP sources
  - extracted, recovered and graded RAP binder
- Statewide average – PG90.1–11.1
- All fell within a fairly narrow range



# Risks of False Assumptions

- Assuming there is blending may be more conservative.
  - Shouldn't rely on binder to control rutting
  - Increased cracking can have performance and economic impacts



# Status

- Presented to INDOT and industry
- INDOT OMM explored PG grading of RAP sources across the state
- Based on all these results, spec change has been approved
  - 25% with no grade change, 40% max
- Report is 90-95% complete



**QUESTIONS?**