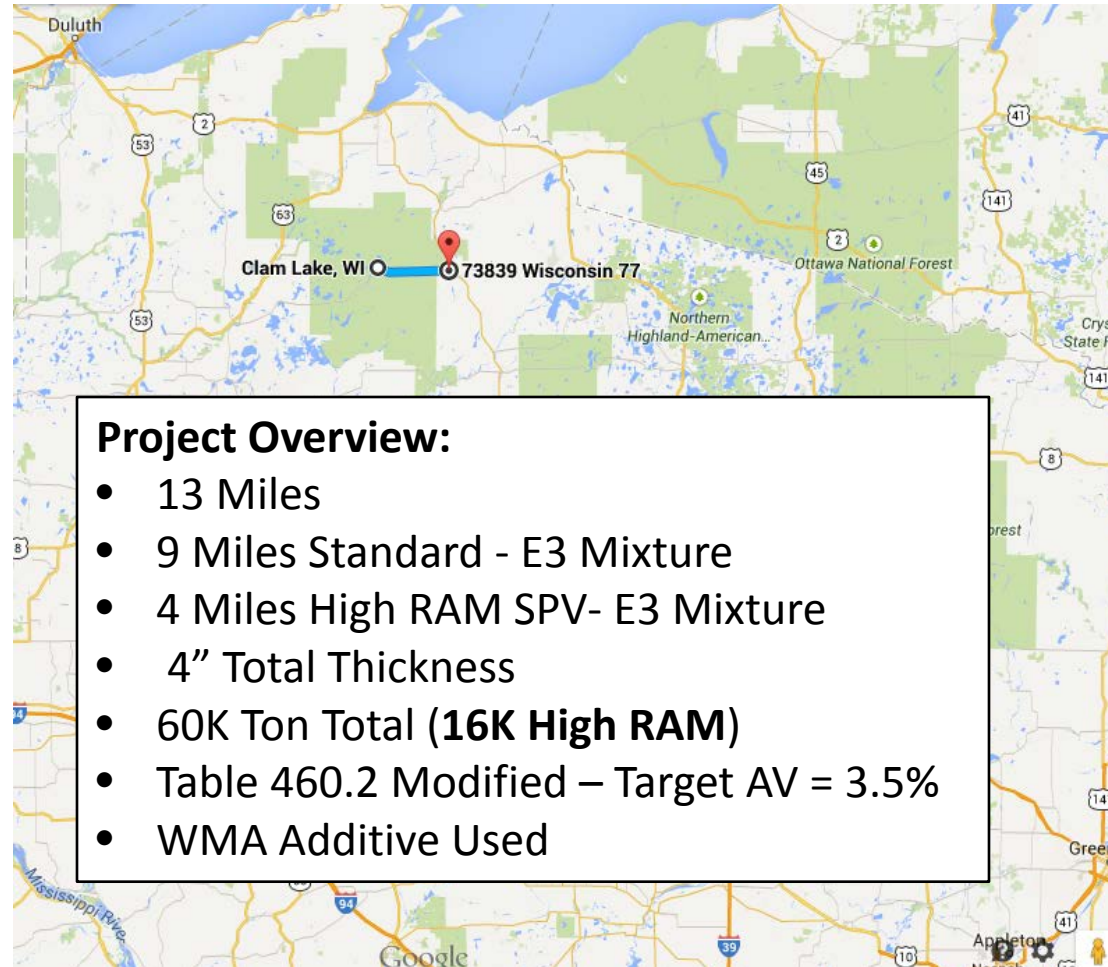


STH 77 Project Objectives



- **Design High PBR Mixes Using RAP**
 - Meet project specifications
- **Primum non nocere**
 - First, do no harm.
- **Meet performance objectives**
 - No rutting
 - No cracking
 - (minimize) thermal and
 - fatigue



Project Overview:

- 13 Miles
- 9 Miles Standard - E3 Mixture
- 4 Miles High RAM SPV- E3 Mixture
- 4" Total Thickness
- 60K Ton Total (**16K High RAM**)
- Table 460.2 Modified – Target AV = 3.5%
- WMA Additive Used

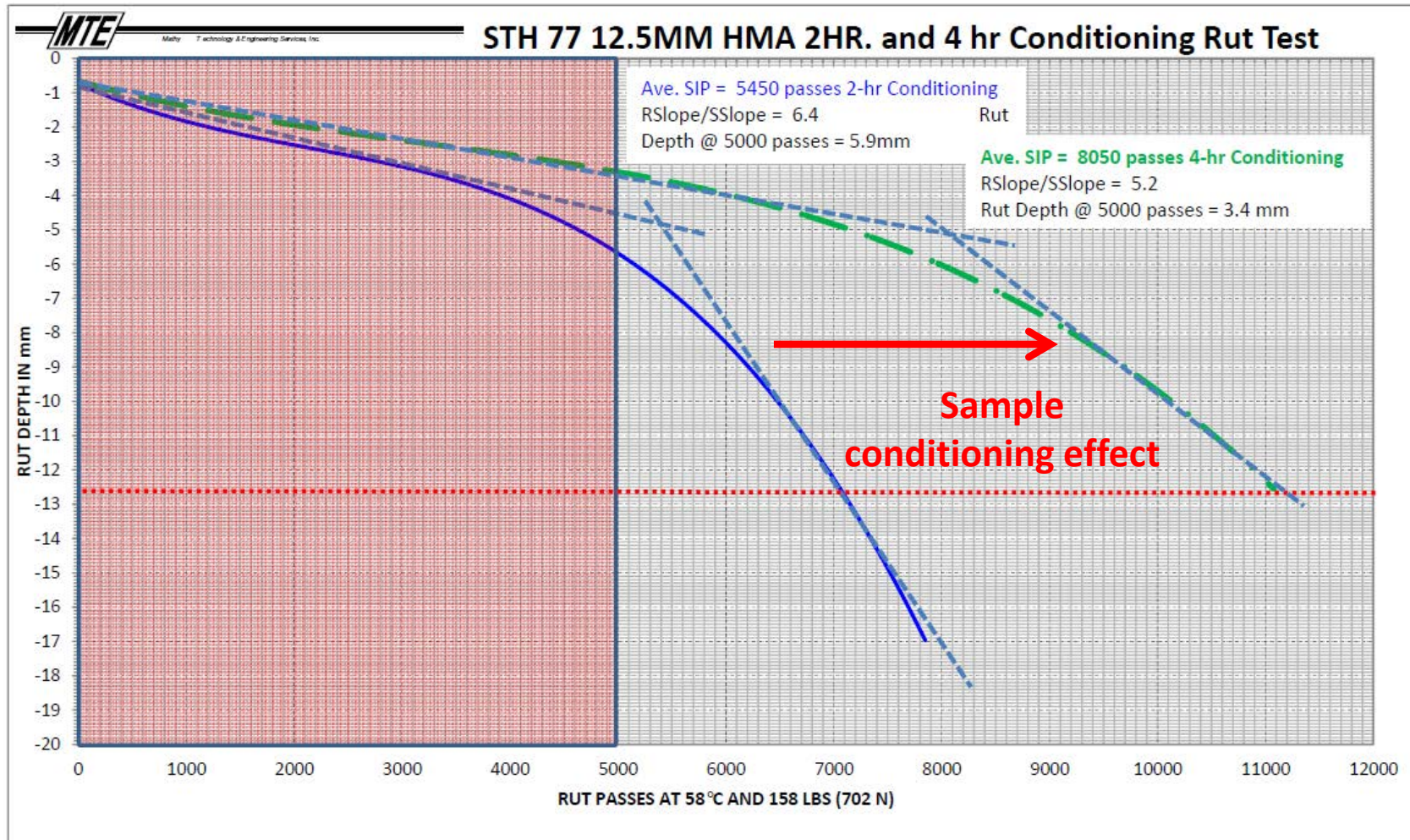
Pilot Projects – Sth 77



Location: Clam Lake to Sth 13

- Total Project Length – 13.69 miles
 - 3" pavement depth
 - 1.25" Leveling Layer 12.5mm E3 PG 58-34P
 - 1.75" Upper Layer 12.5mm E3 PG 58-34P
- High Recycle Length – 4.08 miles (West End)
 - 4" total pavement depth
 - 2.25" Lower Layer 19mm E3 High Recycle
 - 1.75" Upper Layer 12.5mm E3 High Recycle

Hamburg Results - Stripping Inflection Point (SIP) Effects of Sample Conditioning

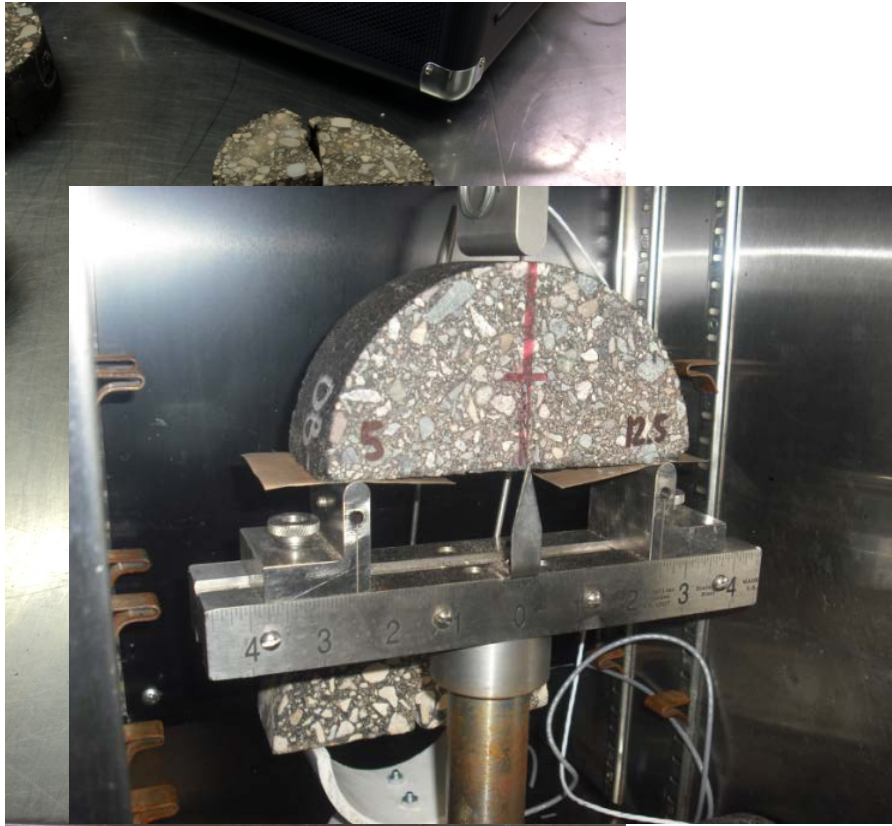


DCT - Disc Shaped Compact test



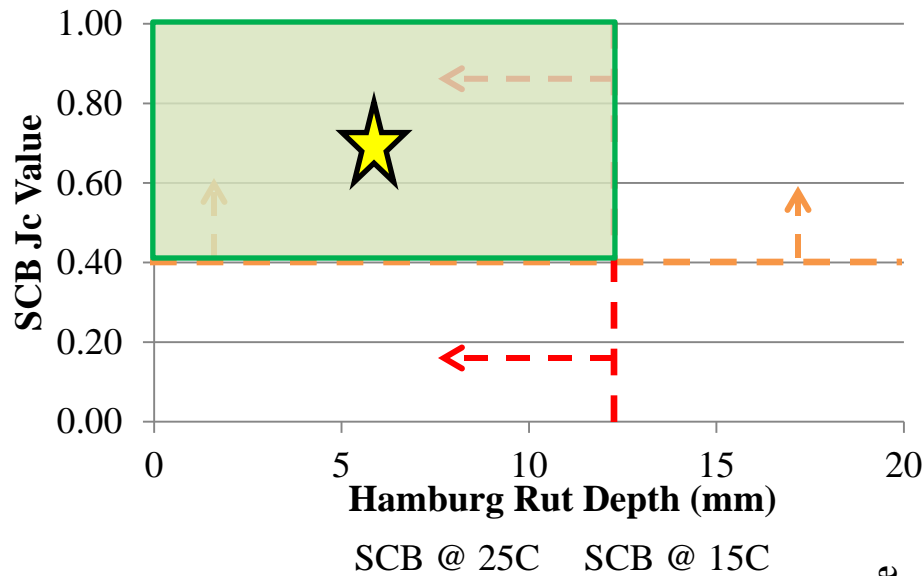
- ▶ Low temperature cracking
- ▶ 400 J/m² the desired minimum
- ▶ Run at 10C above the design required minimum
 - Dsn PG: -34 C
 - Test Temp: -24 C

SCB – Semi-Circular Bend Test at intermediate temperature



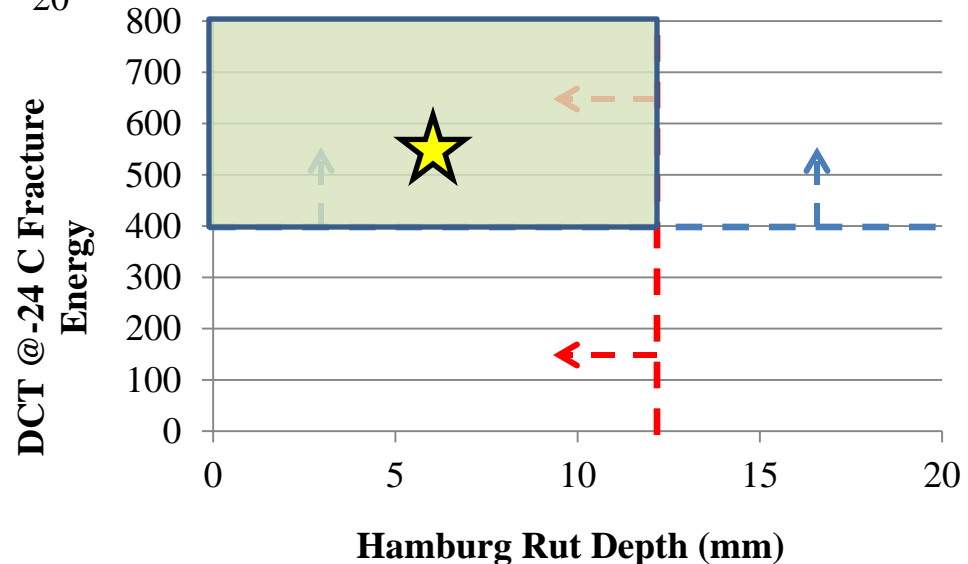
- ▶ Wheel path fatigue cracking
- ▶ Following the Louisiana Procedure
- ▶ 3 different notch depths
 - 25.4, 31.8 and 38.1 mm
- ▶ No set limit, collecting information for specification development

Extending the Balanced Mix Design Concept

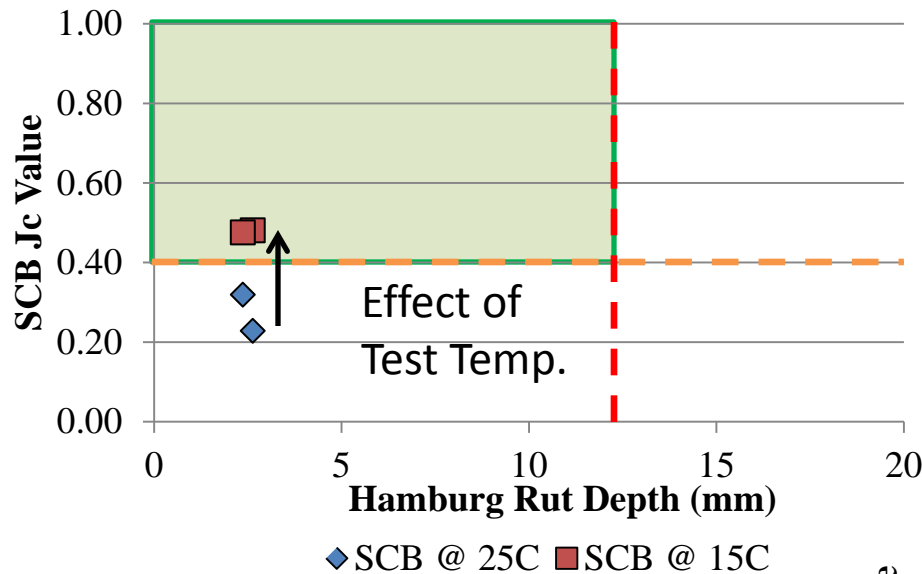


Northern Climate requires that we balance rutting resistance with cracking performance at both intermediate and low temperatures.

- Rut depth < 12.5mm
- Minimum Cracking Resistance
 - Inter. Temp - SCB: $J_c > 0.4 \text{ kJ/m}^2$
 - Low Temp - DCT: $FE > 400 \text{ J/m}^2$
- Target is upper left quadrant.



STH 77 Results

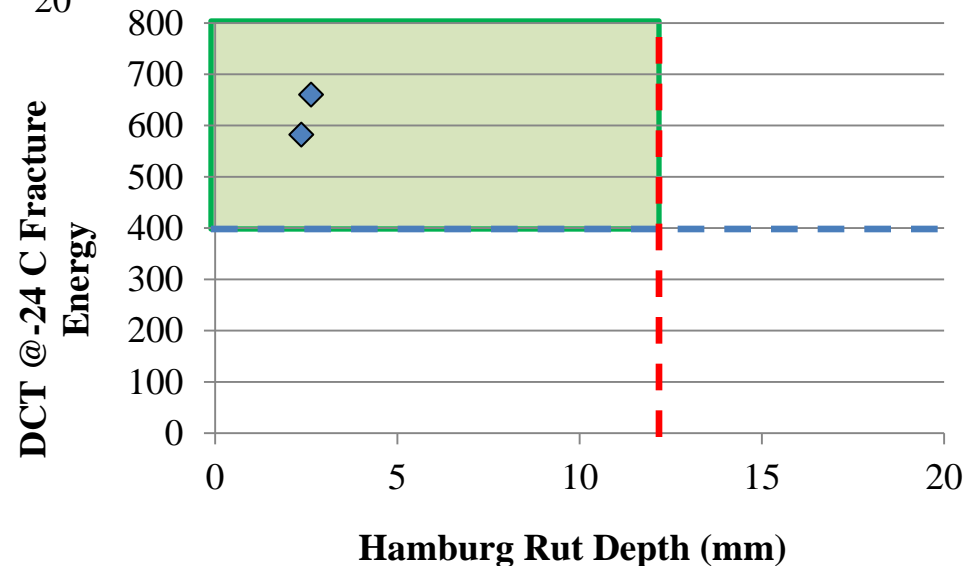


Intermediate Temperature (SCB)

- SCB conditions greatly affect comparison to national threshold value.
- Important to consider climate in temp. selection.

Low Temperature (DCT)

- At -24C fracture energy exceeds specification minimum.
- Mix performance is indicator that a thermal cracking resistant mix can be designed using the current SPV.

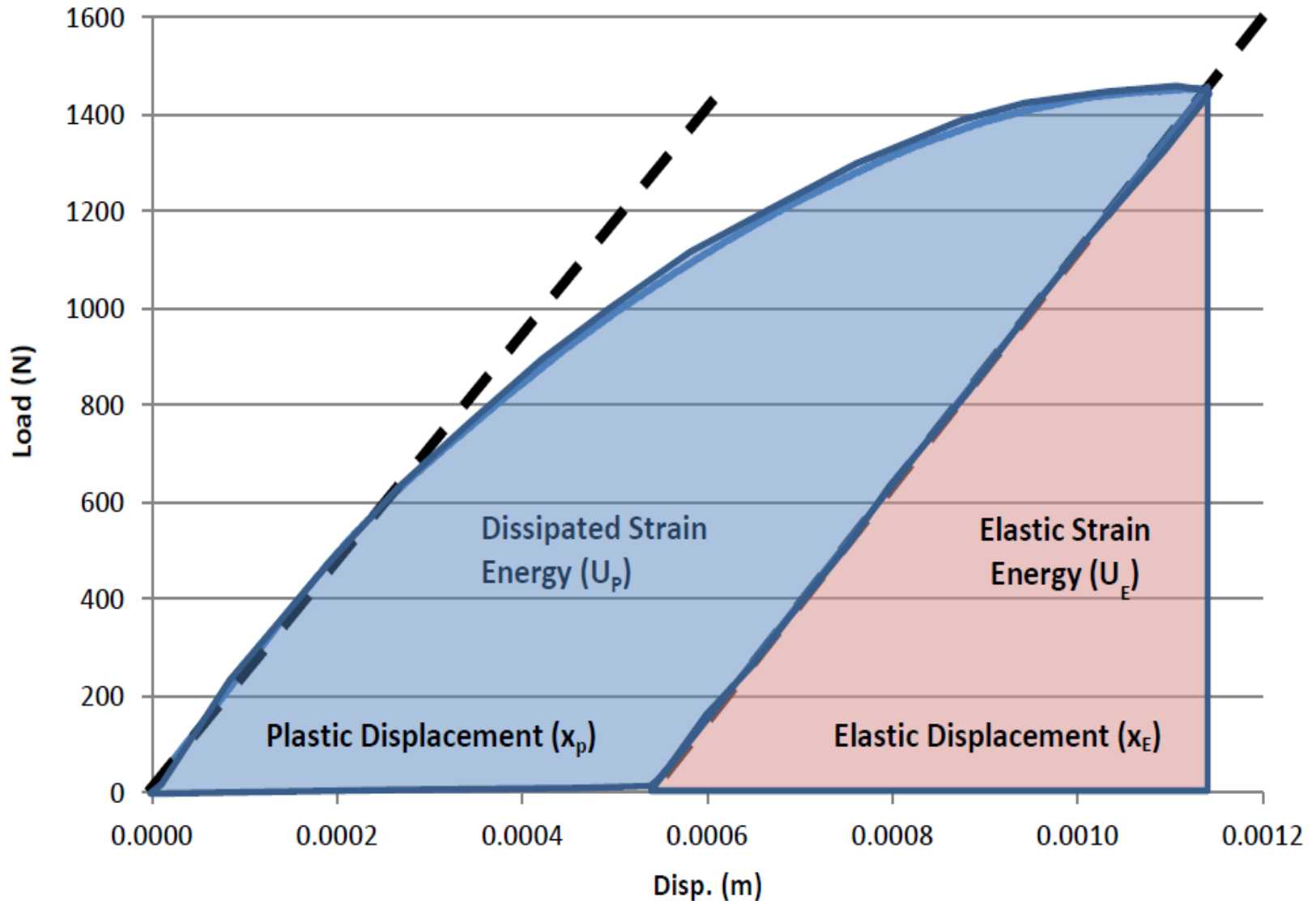


More Results – Sth 77

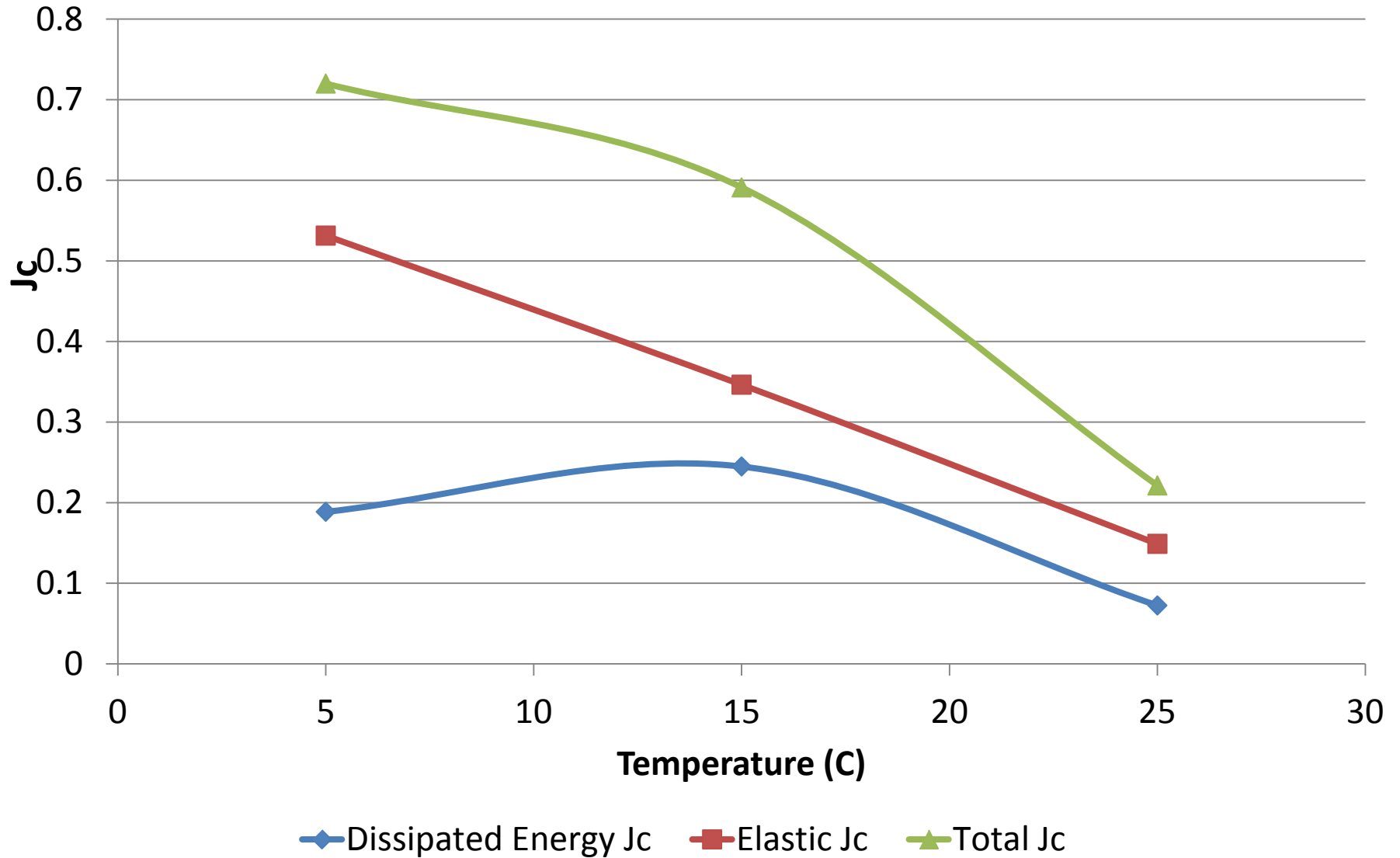


Lab	Sample	Notch (mm)	Max Load (kN)	Disp. @ max load (mm)	Fracture Energy	Friction Reducer
MTE	1	26.93	1.45	0.96	0.75	Teflon
Brovold	2	25.35	1.25	1.11	0.79	Teflon
Brovold	1	25.40	1.95	1.09	1.23	No Teflon

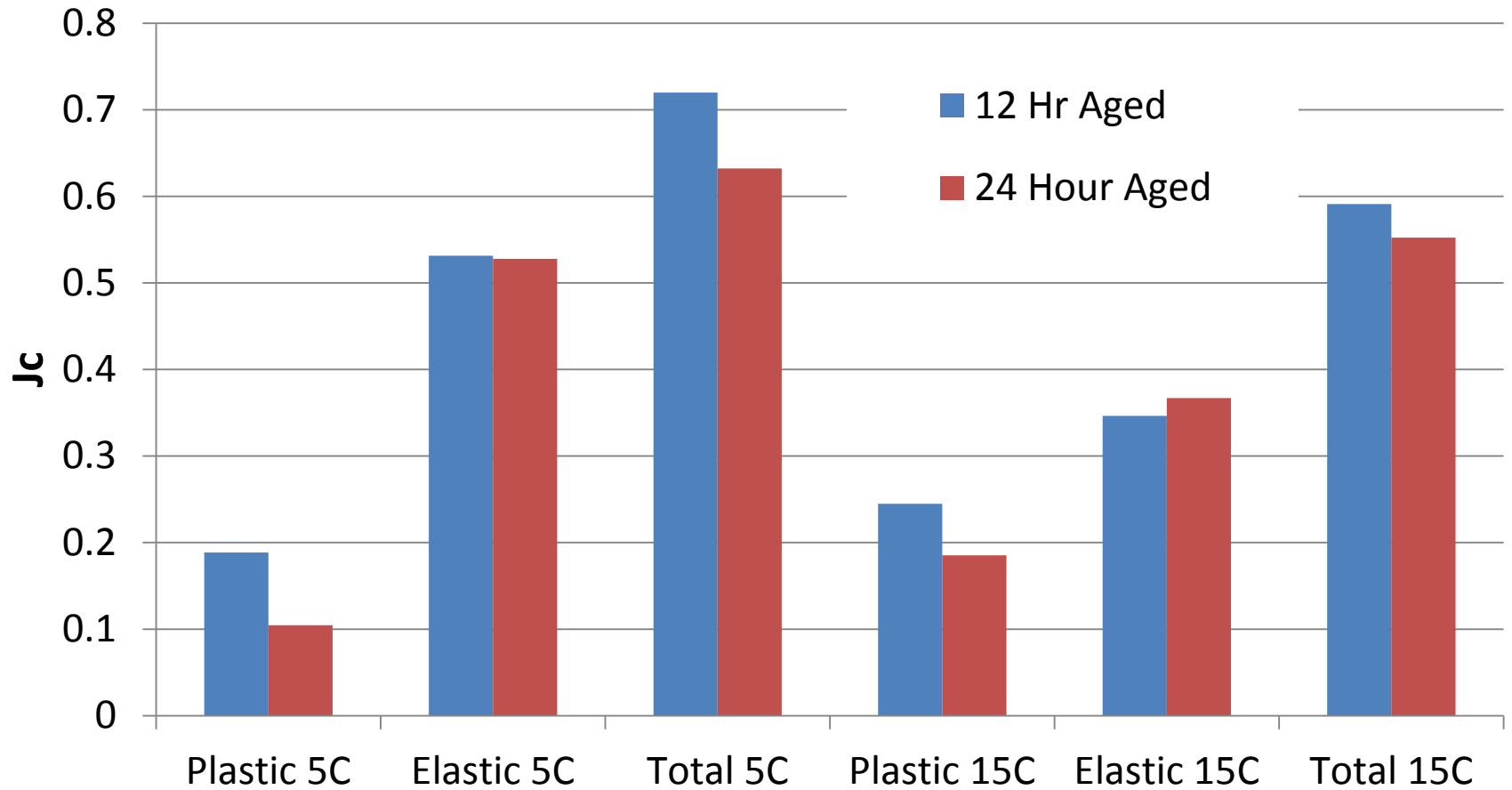
Further Analysis



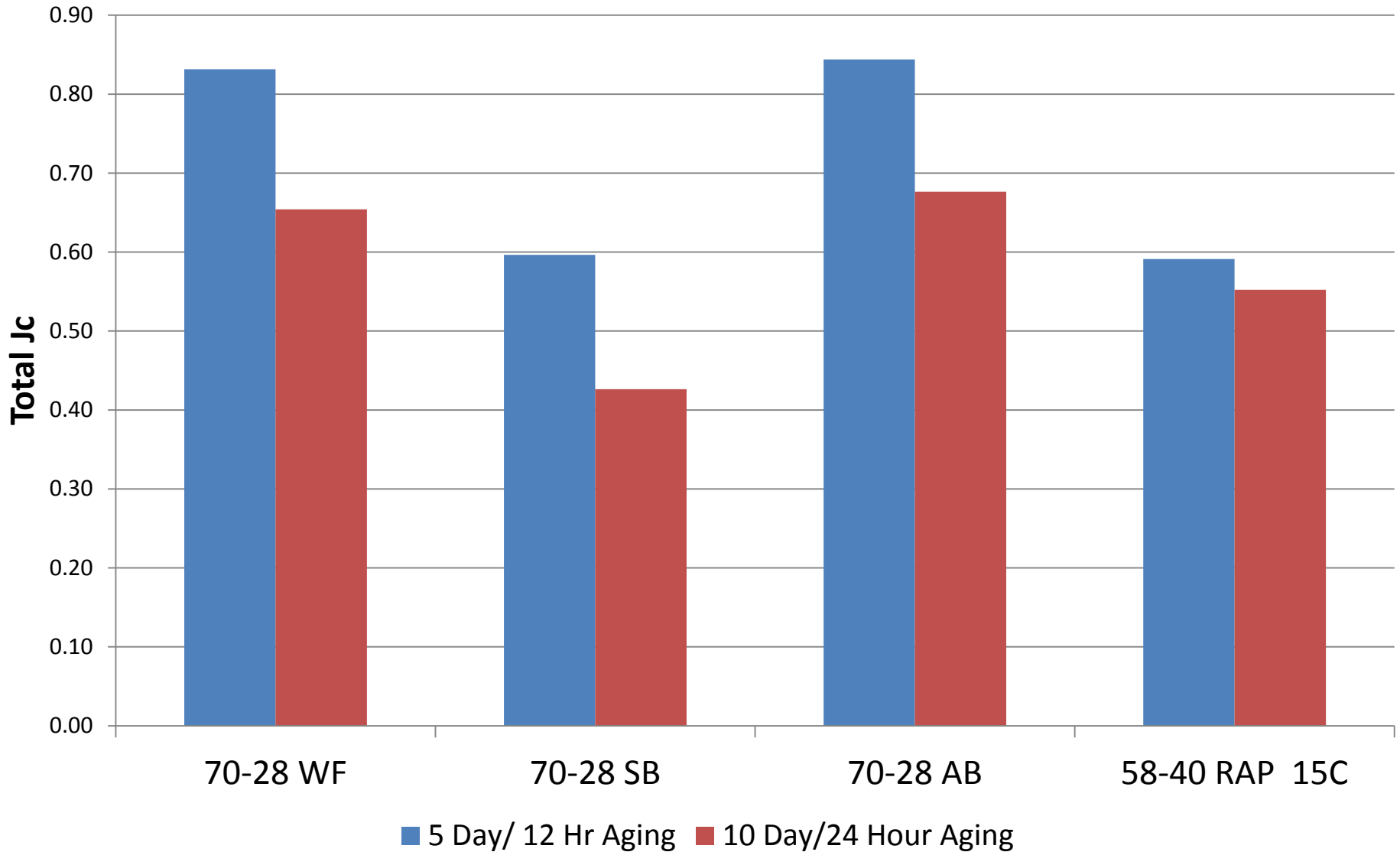
STH 77 Results



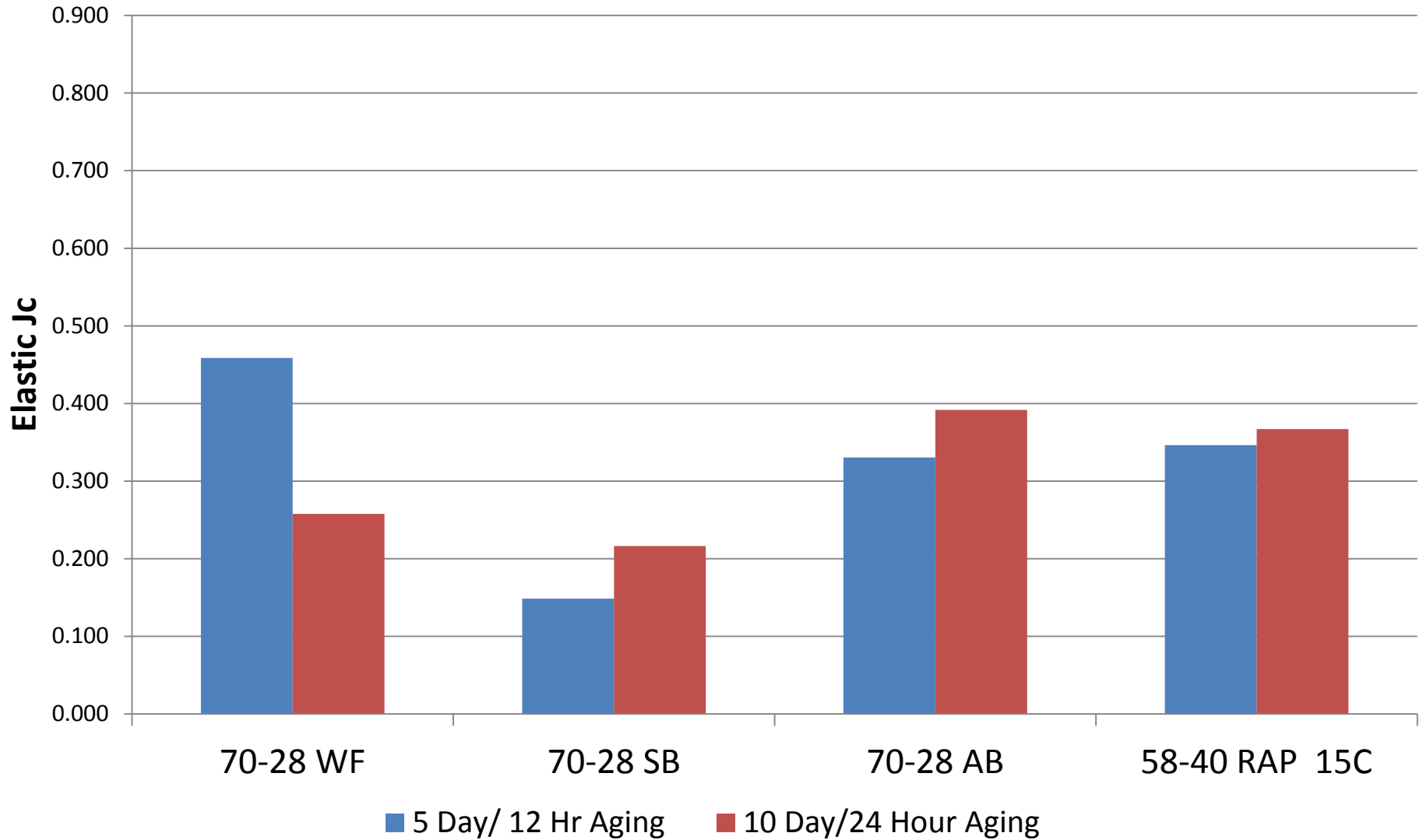
STH 77 Results



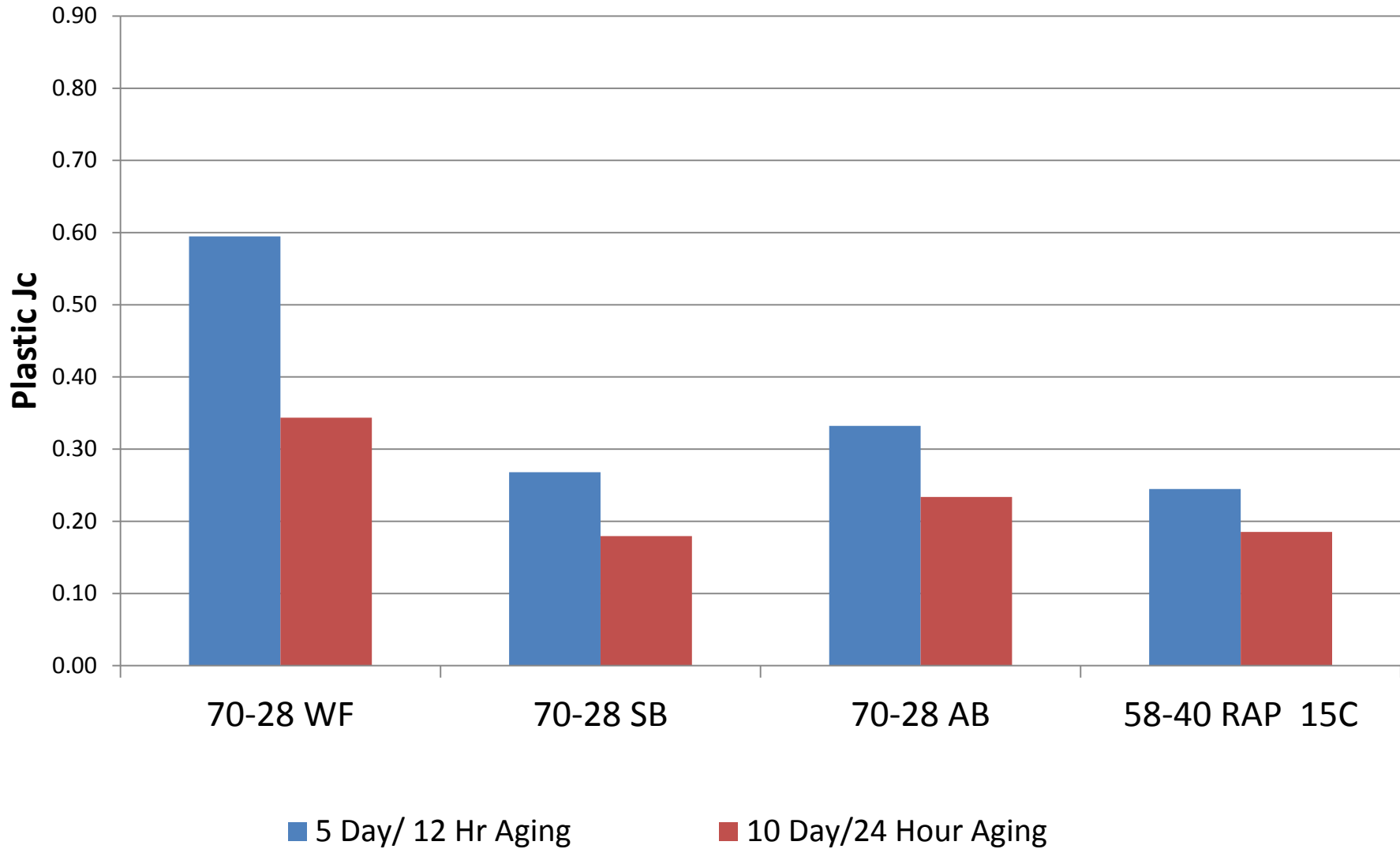
More Results



More Results



More Results



Planned Activities



- ASTM Collaboration Site: [WK48574](#) - New Standard Evaluation of Asphalt Mixture Crack Propagation using the Semi-Circular Bend Test (SCB) at Intermediate Temperature
- Continued Ruggedness Testing – round 4
- ASTM ILS Study – 10labs
- ASTM/AASHTO Specification



- Black Space beginning considered