

Performance Testing on Asphalt Mixtures

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2023 Asphalt Technical Symposium

Presentation Outline

Testing Methods

Preliminary Acceptance Criteria

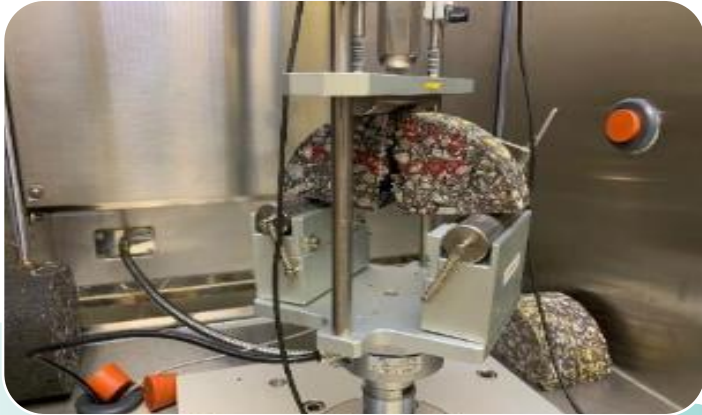
Mix Performance Testing – Laboratories

Results on Regression Contracts

Next Steps

Closing Remarks

Performance of Asphalt Mixtures-Testing Methods



Flexibility Index Test (FIT)
(fatigue cracking)



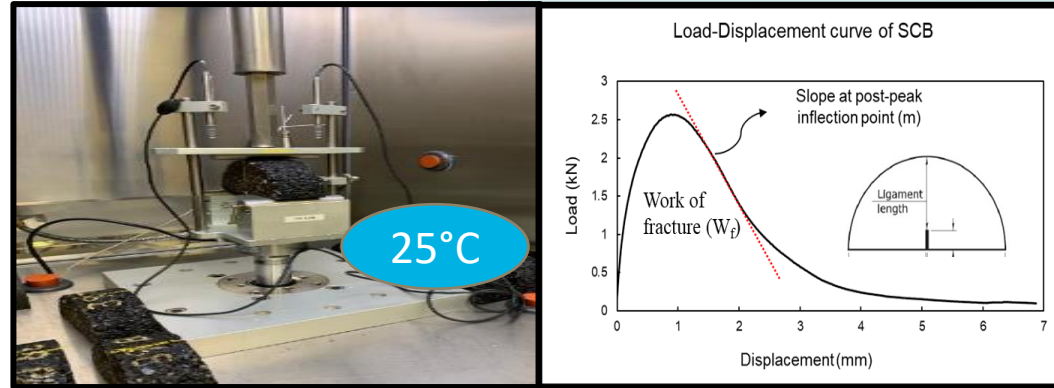
Disk-Shaped Compact Tension (DCT)
(low temperature cracking)



Hamburg Wheel-Track Test (HWT)
(rutting)

Flexibility Index Test: Semi-Circular Bend (SCB) Geometry AASHTO T 393

Laboratory
Compacted
Specimens



Field Core
Specimens



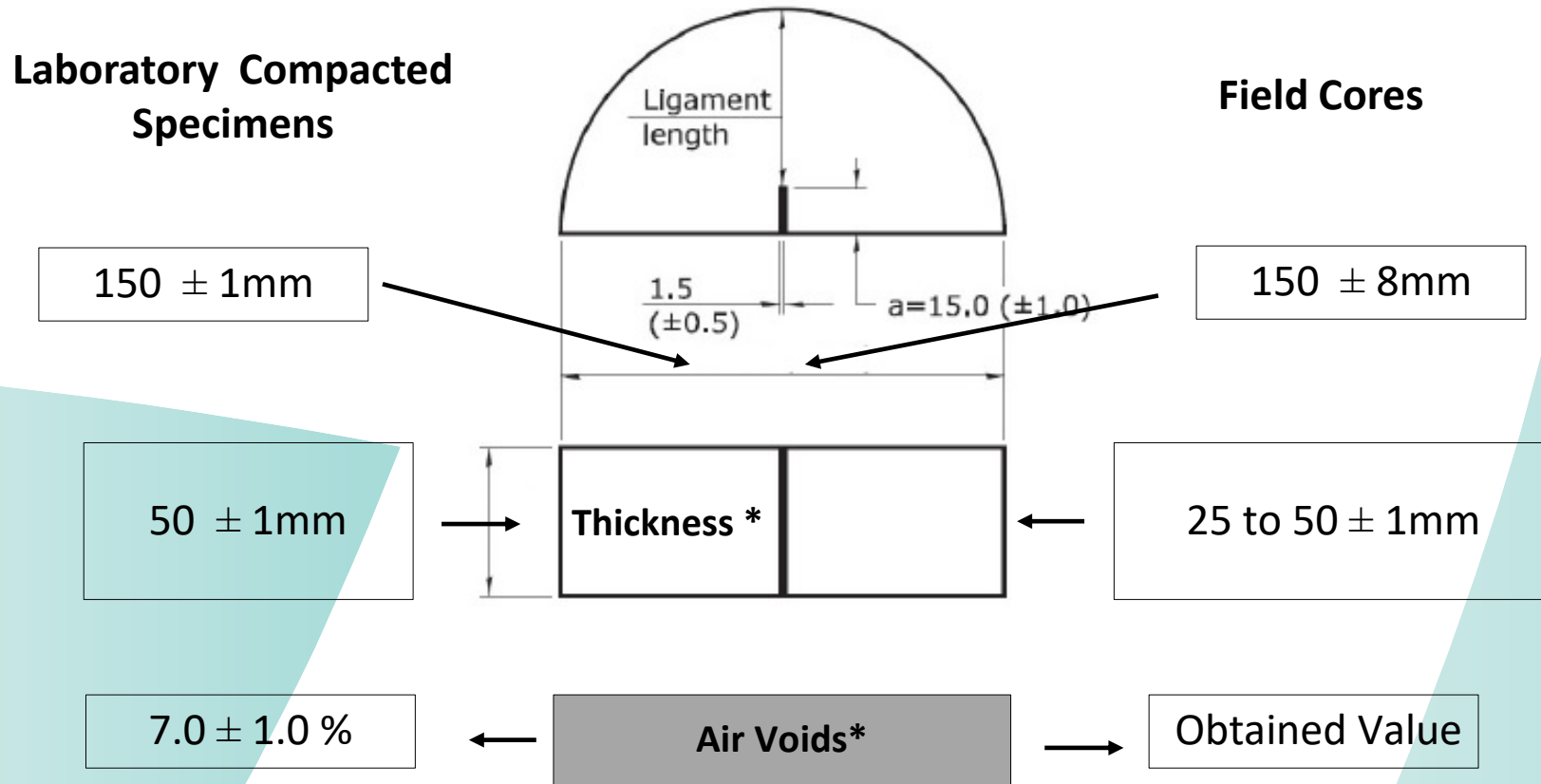
Fracture Energy, G_f (J/m^2)
 $G_f = W_f / (\text{Thickness} \times \text{Ligament Length})$

Post-peak load slope, m



Flexibility Index (FI) = G_f / m

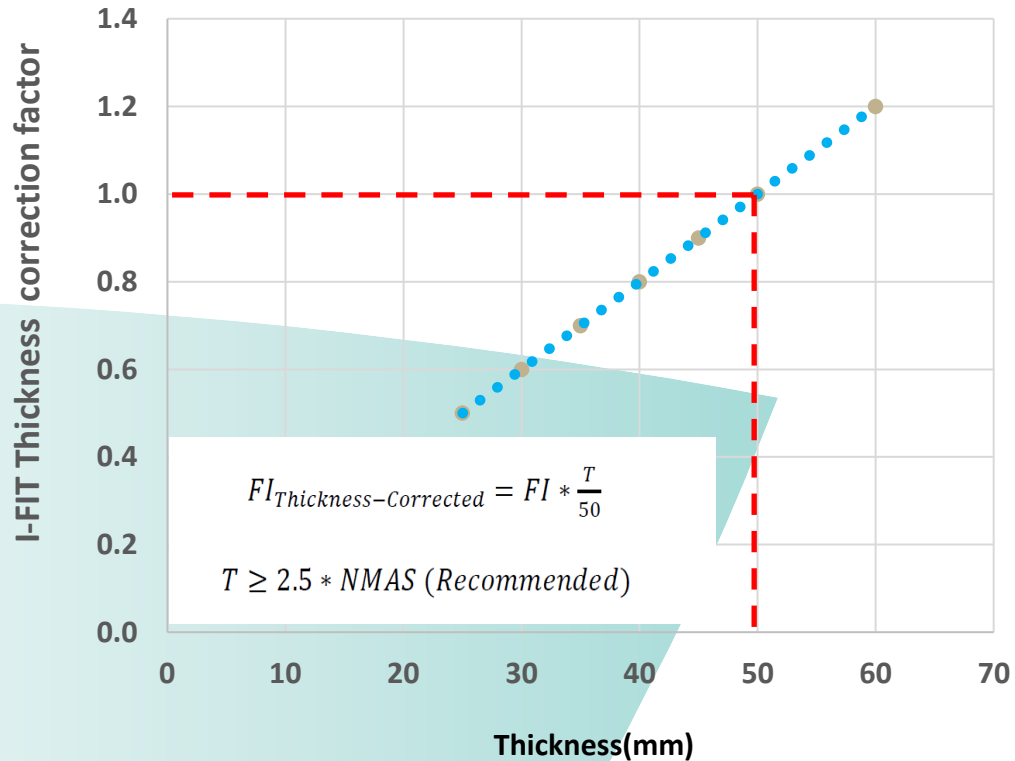
Flexibility Index Test: Semi-Circular Bend (SCB) Geometry AASHTO T 393



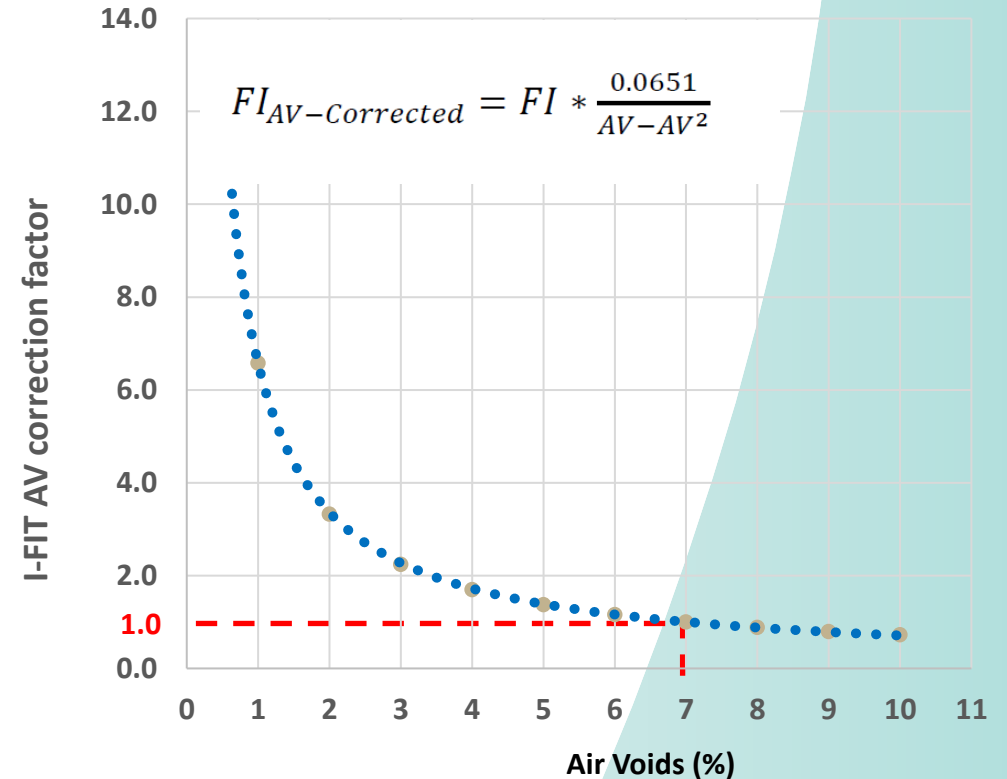
* Correction factors are used in calculations

Flexibility Index Test: Correction Factors

Thickness Correction:



Air Voids Correction:



based on M.K Barry 2016 Thesis“ An analysis of impact factors on I-FIT”

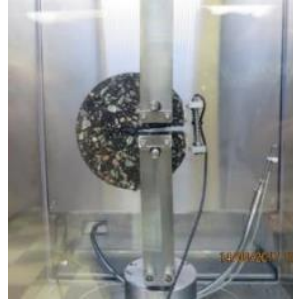
T-Thickness

NMAS-nominal maximum aggregate size

AV-Air Voids

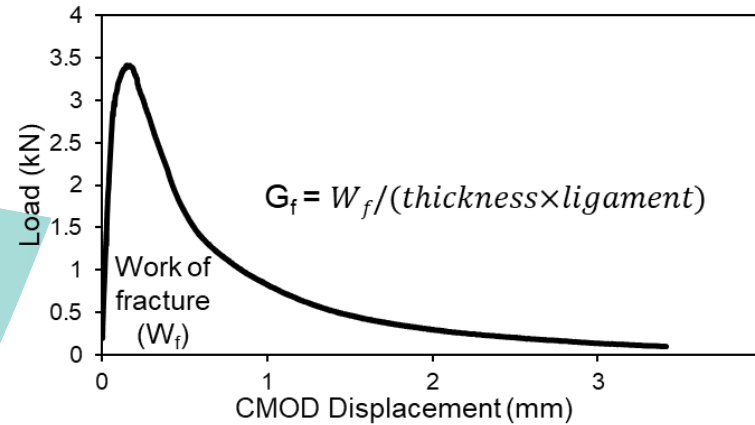
Disk-Shaped Compact Tension (DCT) Test ASTM D7313

Laboratory
Compacted
Specimens



Field Core
Specimens

Test
Temperature:
10° C higher
than low PG
grade

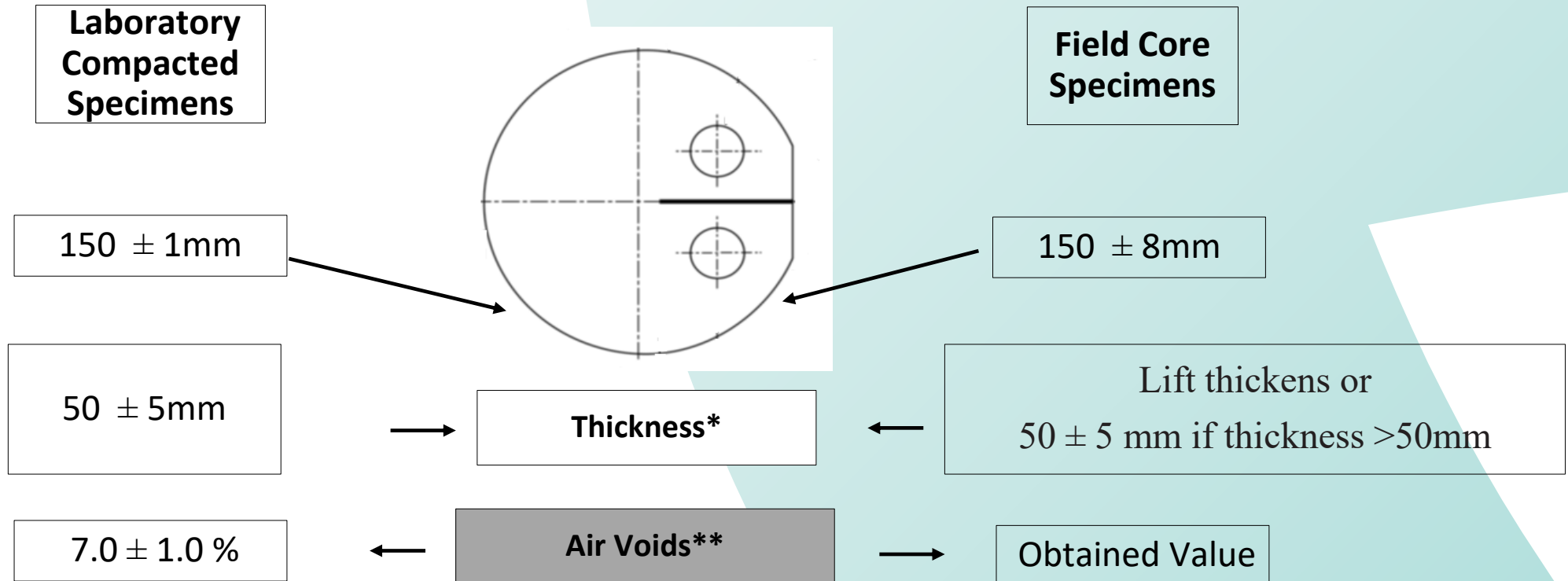


Crack Mouth
Opening
Displacement
(CMOD) Rate:
1mm/min



Fracture Energy G_f , (J/m^2)

Disk-Shaped Compact Tension (DCT) Test ASTM D7313

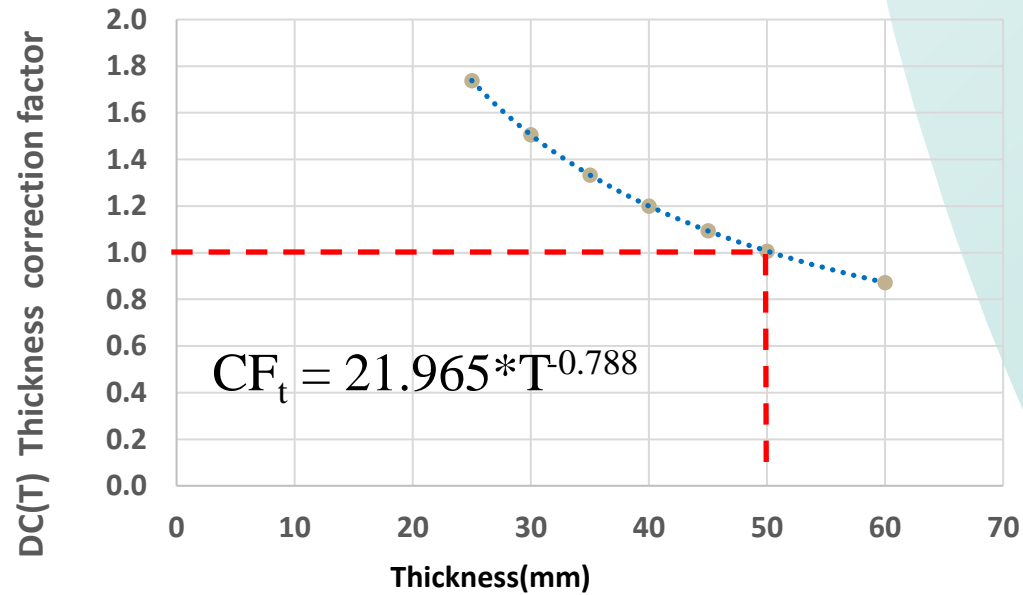


* Correction factors are used in calculations

** Not significant impact as per Braham et al, 2007, Effect of Binder Type, Aggregate, and Mixture Composition on Fracture Energy of Hot-Mix Asphalt in Cold Climates

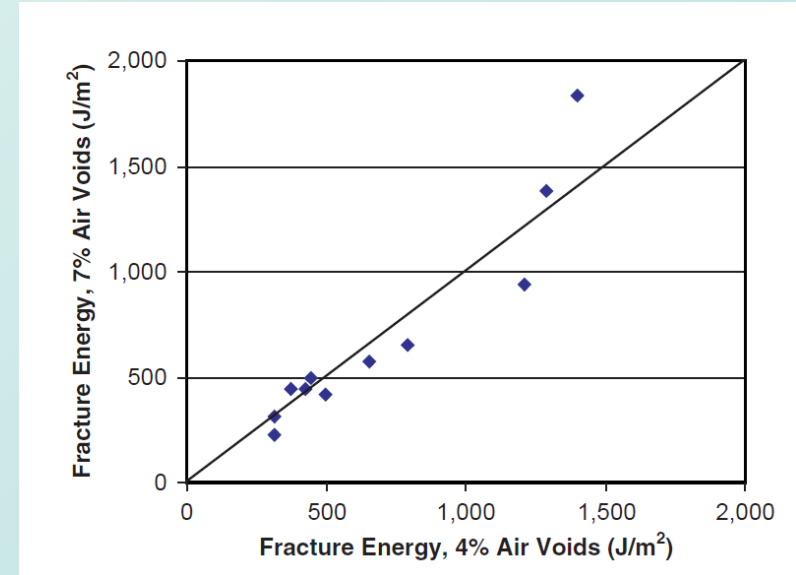
DC(T) Correction Factors

Thickness Correction:



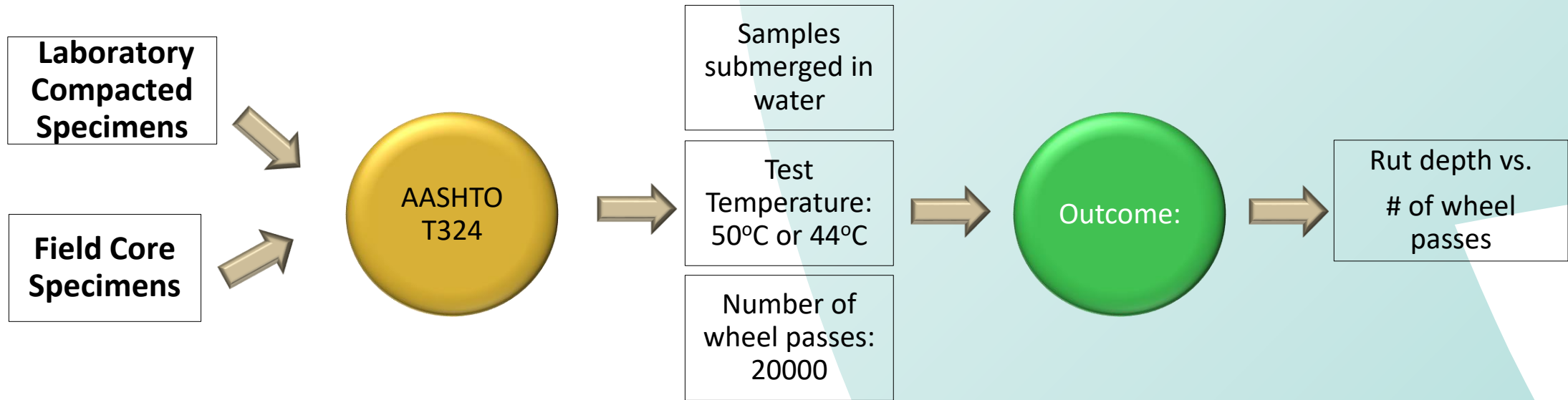
Al-Qadi et al ,2015, FHWA-ICT-15-017

Air Voids Correction: ** Not significant impact



Braham et al, 2007, Effect of Binder Type, Aggregate, and Mixture Composition on Fracture Energy of Hot-Mix Asphalt in Cold Climates

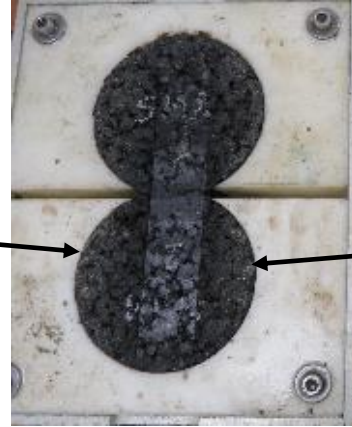
Hamburg Wheel-Tracking (HWT) Test



Hamburg Wheel-Tracking (HWT) Test

Laboratory Compacted Specimens

$150 \pm 1\text{mm}$



Field Cores

$150 \pm 8\text{mm}$

$60 \pm 1\text{mm}$

Thickness*



$38 \text{ to } 60 \pm 1\text{mm}$


$7.0 \pm 1.0\%$

Air Voids

Obtained Value

Preliminary Acceptance Criteria

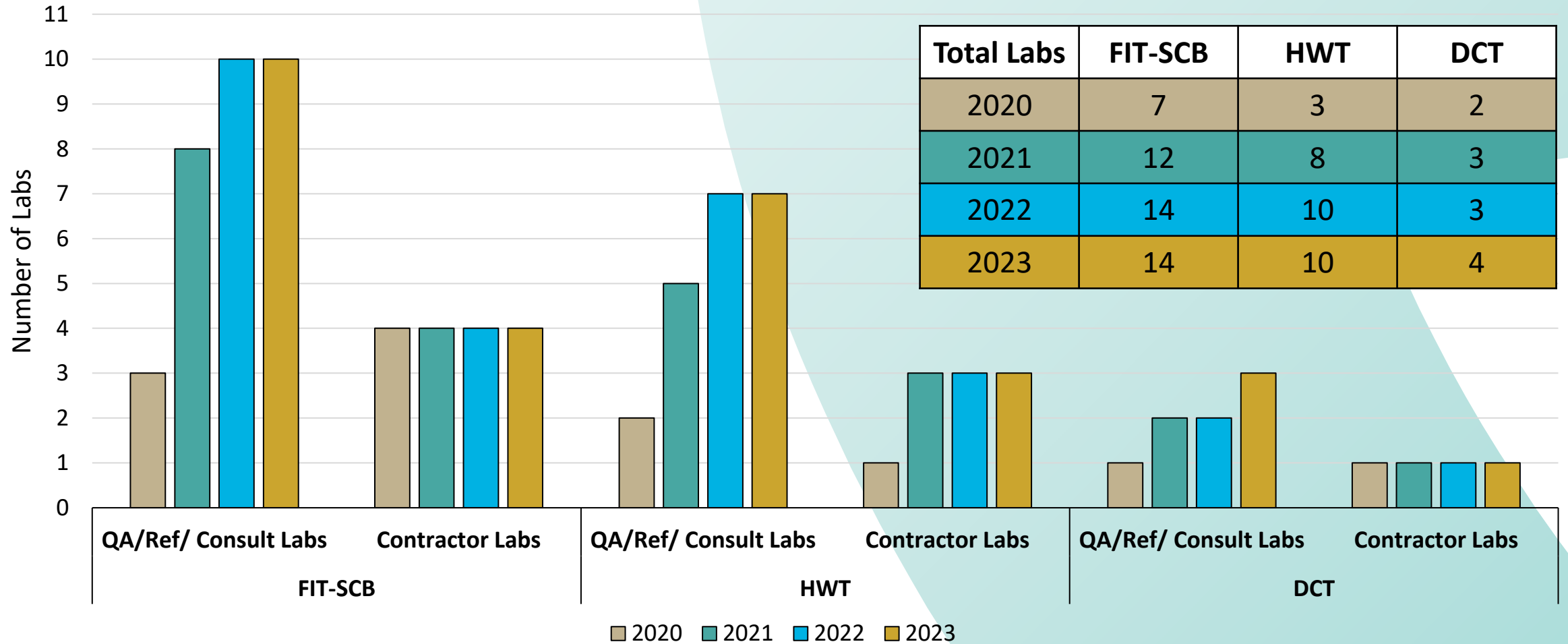
 Flexibility Index Test (FIT) using Semi-Circular Bend (SCB) Geometry			 Disk-Shaped Compact Tension (DCT) test		
Mix Type	Temperature (°C)	Flexibility Index (FI)	Mix Type	Test Temperature (°C)	Preliminary Minimum Average DC(T) Fracture Energy Threshold (J/m ²)
All Surface Course Mixes for all Traffic Categories	25	10.0	SMA and Surface Course Mixes for Traffic Category E (>30 million ESALS)	Low PG Temperature+10°C	700
SMA Surface Course Mixes	25	15.0	All other Surface Course Mixes and Traffic Categories (B, C, and D)	Low PG Temperature+10°C	600

 Hamburg Wheel Tracking (HWT) test	PGAC Grade	Test Temperature (°C)	Thresholds
	70-YY	50	Max. 6.0 mm Rut Depth @20000 Passes (For Traffic Category E only)
	64-YY	50	Max. 12.5 mm Rut Depth @20000 Passes
	58-YY and 52-YY	44	Max. 12.5 mm Rut Depth @20000 Passes

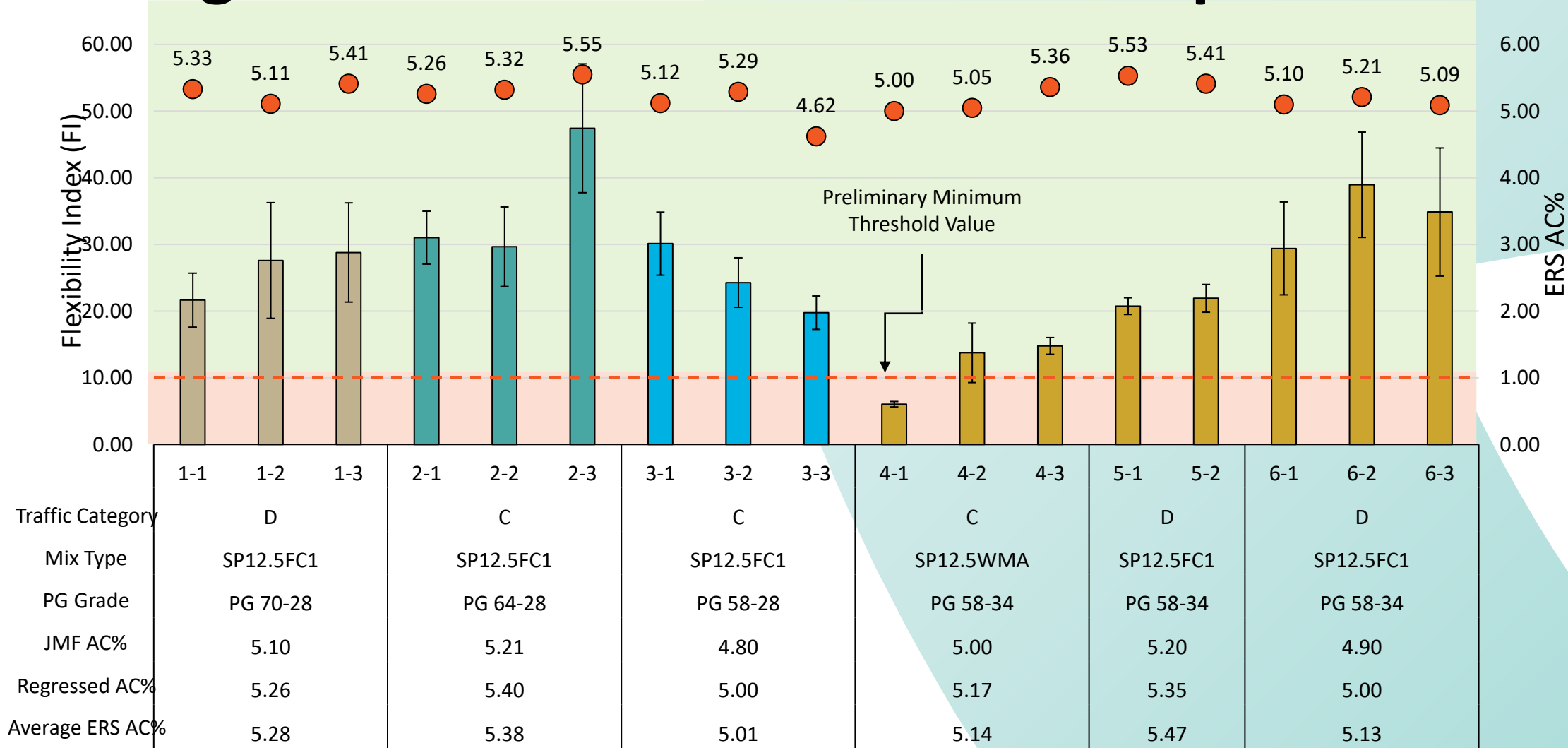
Bashir et al., CTAA Virtual Conference, Nov. 2020

Loose mix and pavement cores collected from contracts

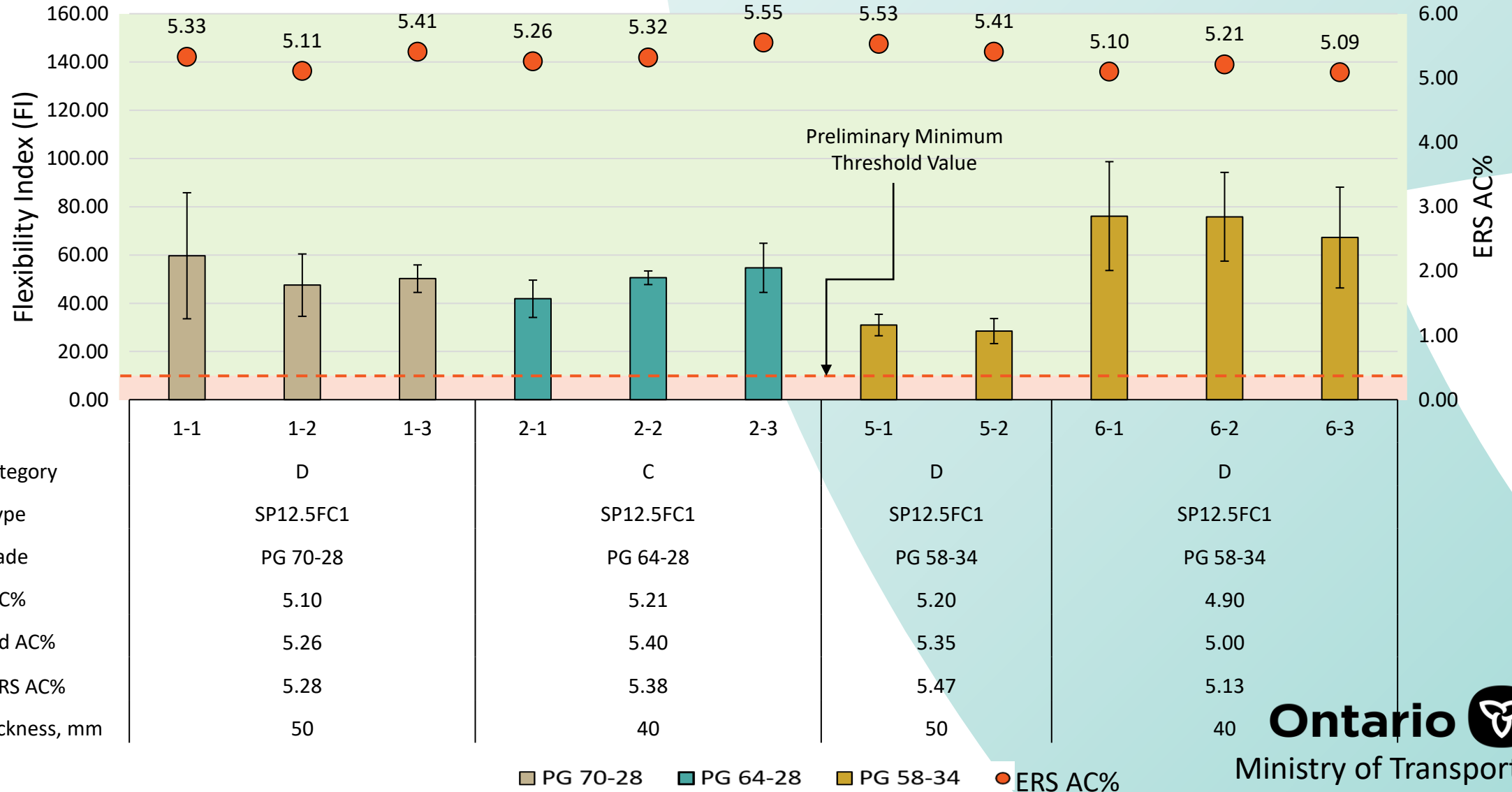
Mix Performance Testing – Laboratories



Regression FIT-SCB Results: PPLC Specimens

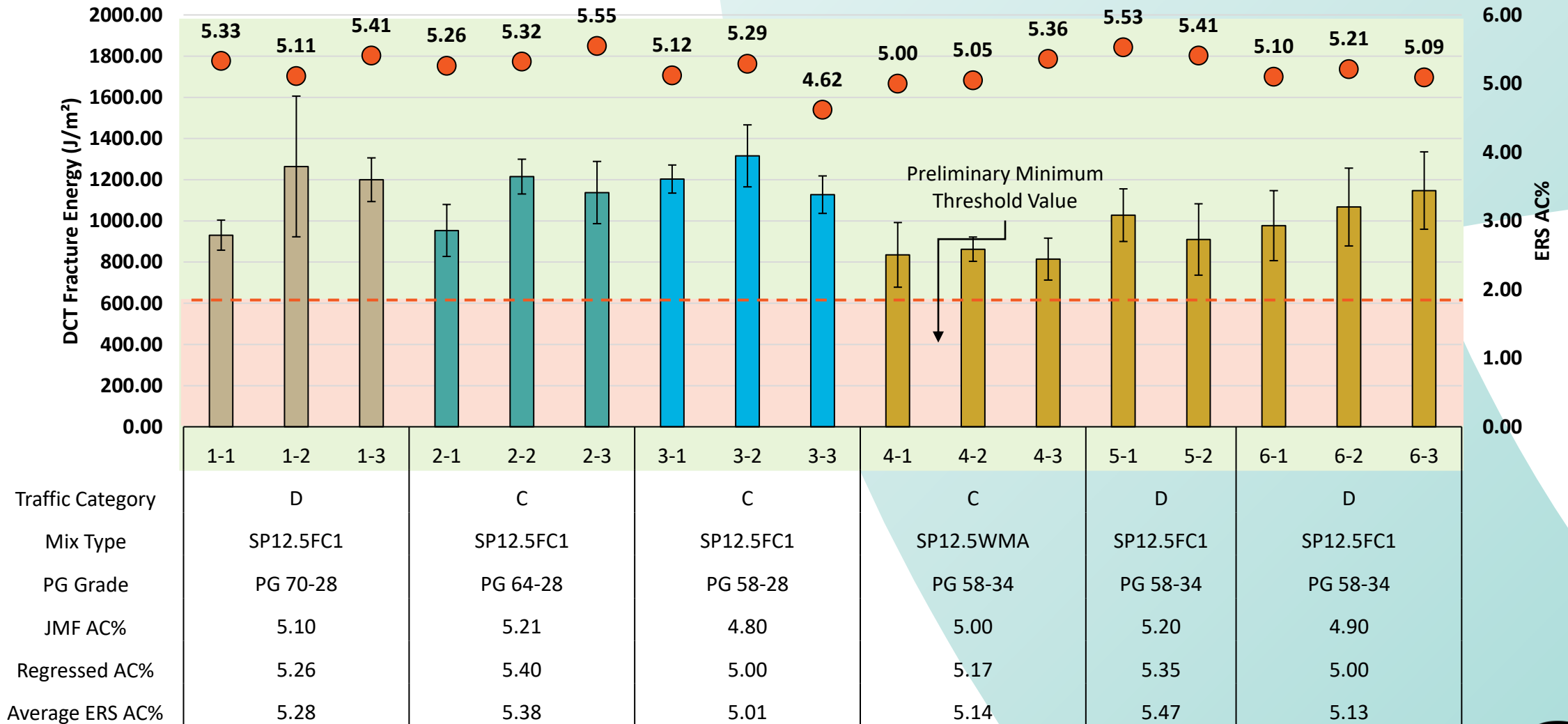


Regression FIT-SCB Results: Core Specimens



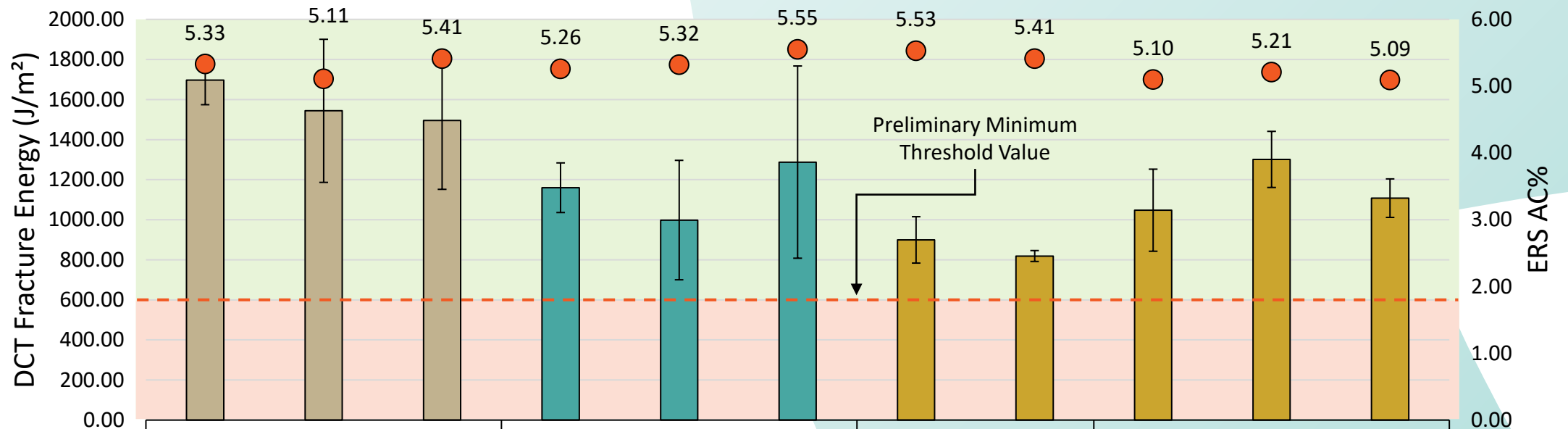
Ontario Ministry of Transportation

Regression DCT Results: PPLC Specimens



PPLC: Plant Produced Lab Compacted ■ PG 70-28 ■ PG 64-28 ■ PG 58-34 ● ERS AC%

Regression DCT Results: Core Specimens



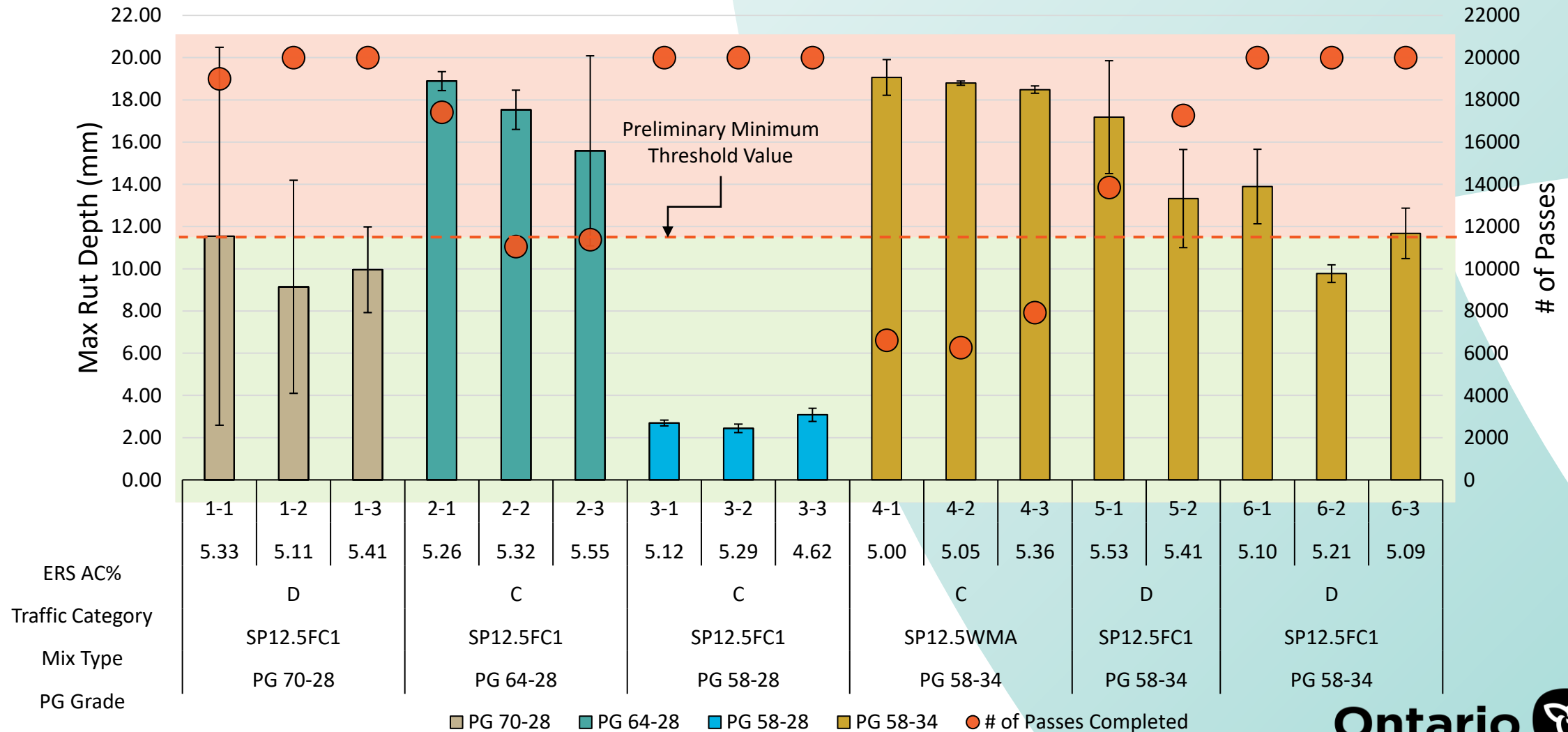
	1-1	1-2	1-3	2-1	2-2	2-3	5-1	5-2	6-1	6-2	6-3
Traffic Category		D								D	
Mix Type		SP12.5FC1			SP12.5FC1			SP12.5FC1		SP12.5FC1	
PG Grade		PG 70-28			PG 64-28			PG 58-34		PG 58-34	
JMF AC%		5.10			5.21			5.20		4.90	
Regressed AC%		5.26			5.40			5.35		5.00	
Average ERS AC%		5.28			5.38			5.47		5.13	
Design Lift Thickness, mm		50			40			50		40	

■ PG 70-28 ■ PG 64-28 ■ PG 58-34 ● ERS AC%



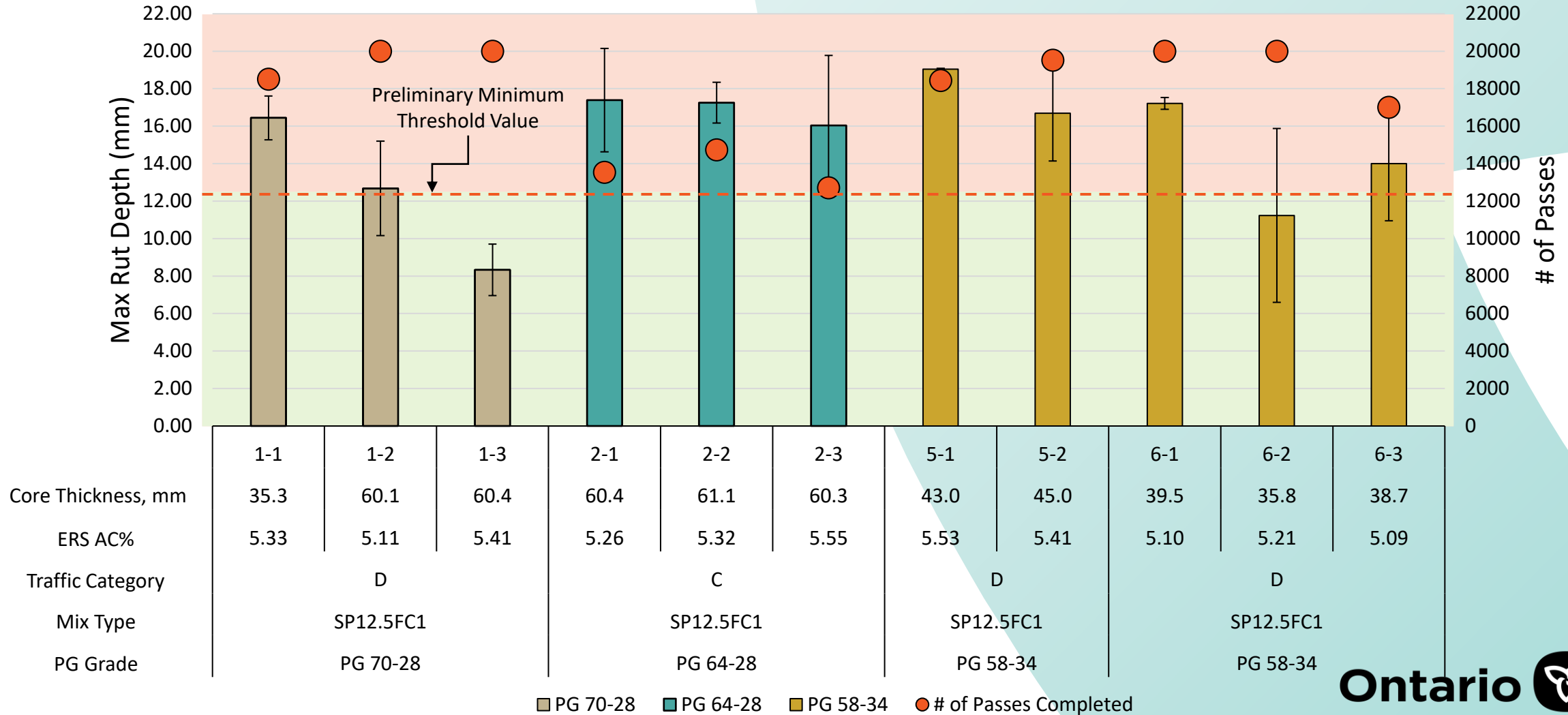
Ontario Ministry of Transportation

Regression HWT Results: PPLC Specimens



PPLC: Plant Produced Lab Compacted

Regression HWT Results: Core Specimens



Mix Performance Testing – Next Steps

Collecting post-production mixes as well as pavement cores from select contracts

Testing for information performed by QA Labs

Knowledge transfer and assistance provided by MTO staff through presentations, webinars, virtual platforms etc.

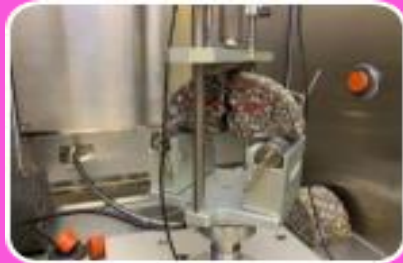
Mix performance testing needs to be done in conjunction with tank AC and recovered AC testing while monitoring pavement performance to refine mix performance acceptance criteria

Next Steps-Industry

Balanced mix design to be adopted by asphalt industry

Testing needs to be done by trained laboratory technicians to run performance testing

Participate in MTO's Correlation Program



Flexibility Index Test
(FIT)

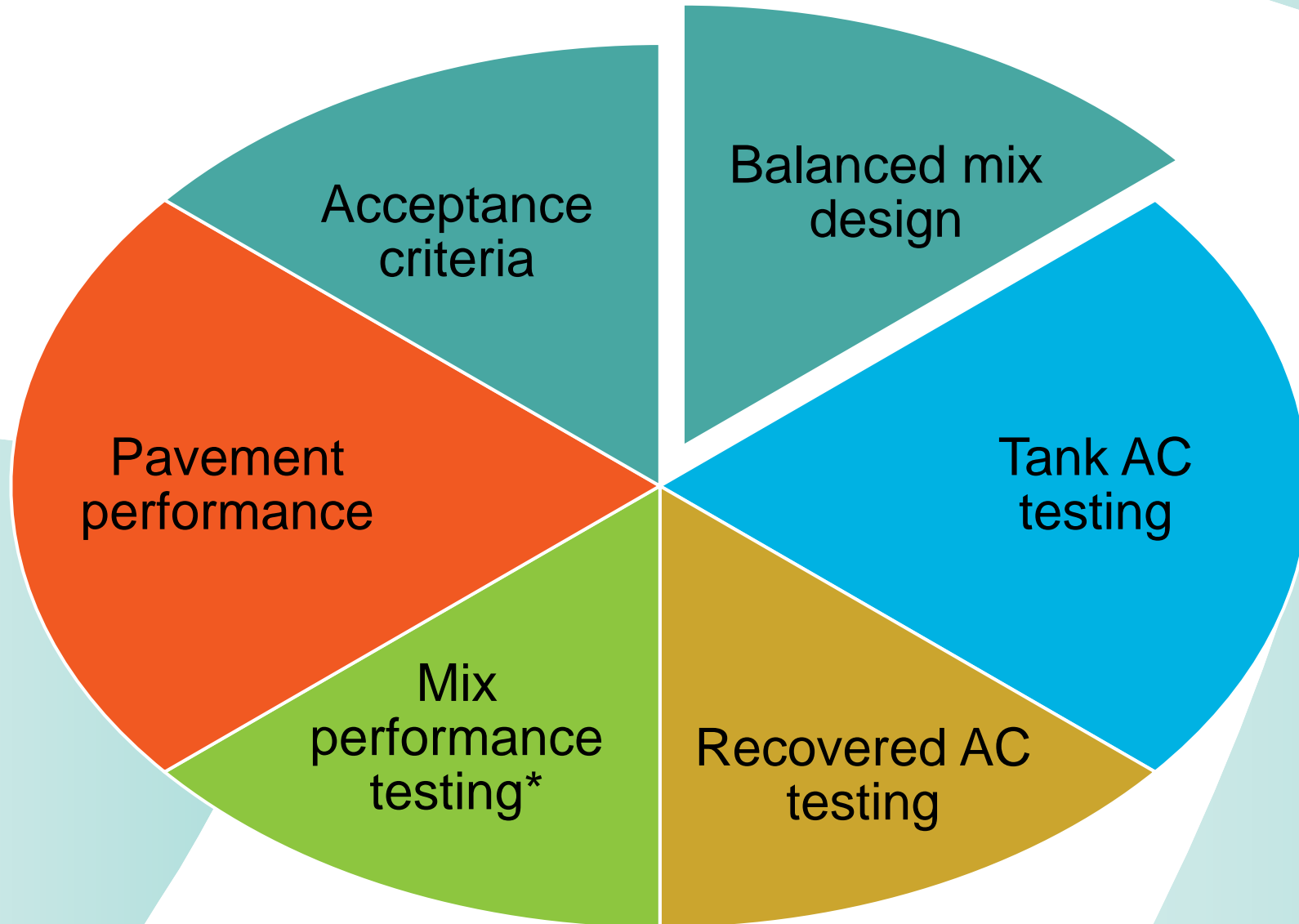


Hamburg Wheel Tracking
(HWT)



Disk-Shaped Compact
Tension
(DCT)

Closing Remarks



*on post-production asphalt mixes and pavement cores

Questions?



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