2022 OAPC ASPHALT TECHNICAL SYMPOSIUM

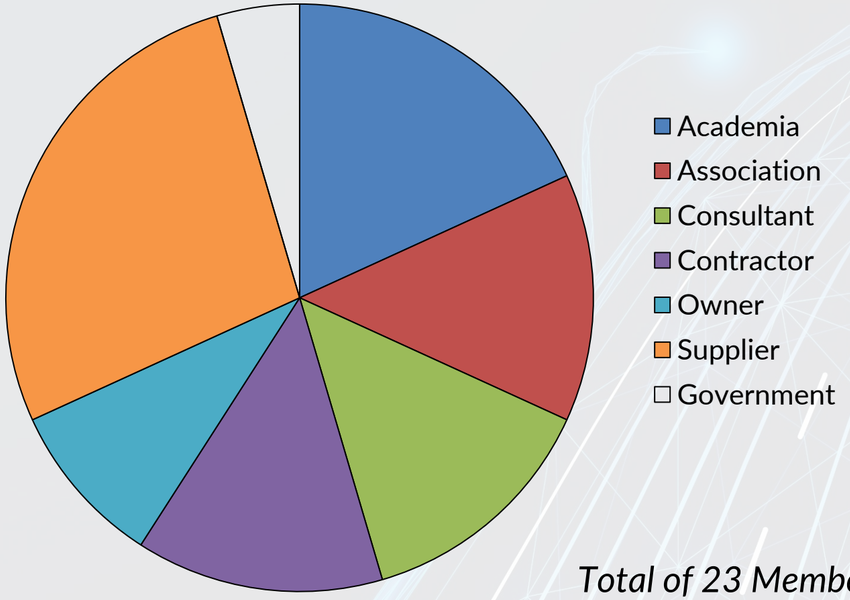
Asphalt. ONTARIO RIDES ON US

ORBA

apc ONTARIO ASPHALT PAVEMENT COUNCIL

Ontario Asphalt Expert Task Group (OAETG)

Well-balanced group providing an open forum to all industry stakeholders



Total of 23 Members

Chair: **Sina Varamini,** Ph.D., P.Eng., MCSCE
Director, Pavements and Materials Group
Engtec Consulting Inc.

Vice-Chair: **Pejoohan Tavassoti**, Ph.D.,
Assistant Professor
University of Waterloo

Secretary: **Amma Wakefield,** Ph.D., P.Eng.,
Canadian Regional and Research Engineer
Asphalt Institute

Ontario Asphalt Expert Task Group (OAETG)

OUR MANDATE

I-ABC

Identify improvements to binder and mixture specification and testing methods
Ontario-specific climate and traffic conditions

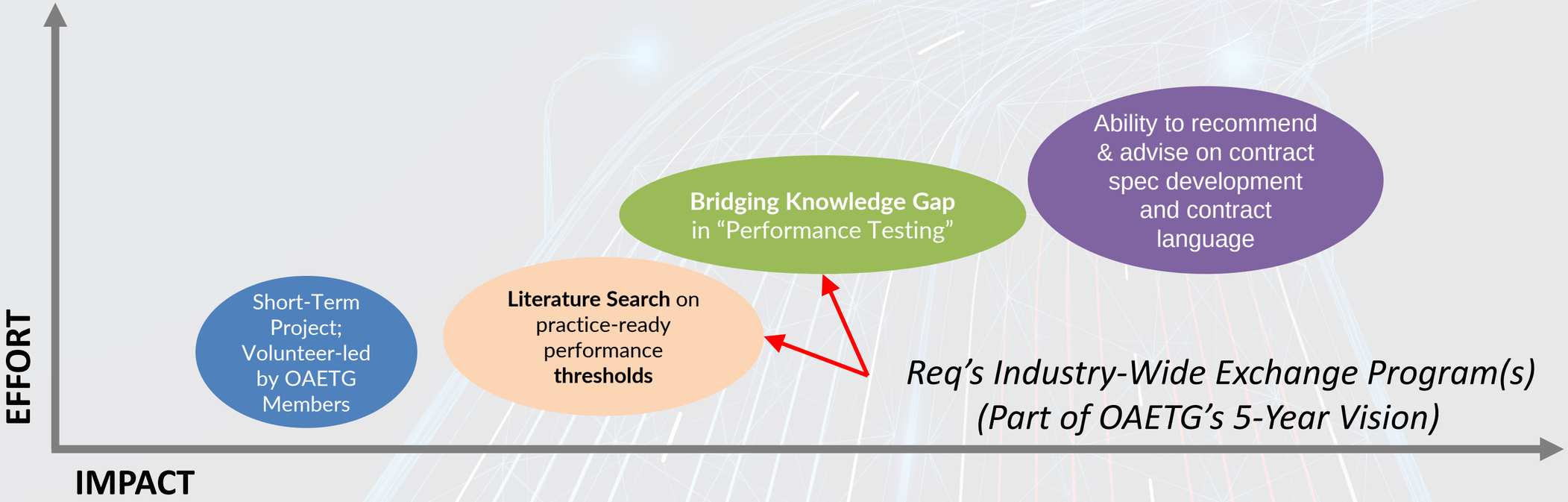
Act as an **advisory group**
Recommending and/or perform asphalt research interests and needs

Brainstorm asphalt-related and emerging issues
Particularly on subjects of RAC and Mix Performance acceptance

Contribute to content development and organization of the Asphalt Technical Symposium (ATS)

Ontario Asphalt Expert Task Group (OAETG)

OAETG's approach to I-ABC | ACTIONS



Ontario Asphalt Expert Task Group (OAETG)

MIX ASPHALT PROGRAM (MAP) ROUND-1

OBJECTIVES (WHAT)

Understanding **Variability**

- Inherent variability within test method – test variability
- Variability due to mix properties – volumetrics variability
- Interlaboratory variability – equipment(s) and technician(s)

Bridge the knowledge gap in “Performance Testing Methods and Acceptance”

Ontario Asphalt Expert Task Group (OAETG)

MIX ASPHALT PROGRAM (MAP) ROUND-1

OBJECTIVES (WHAT)

RESOURCES (HOW)

Plant-Produced Loose-Mix Donated by **Two (2)** contractors

- Sampled Summer 2021 – Limited Study
- Representative of SP12.5 “CAT-E” – Zone 3 (PGAC 70-28 XJ)

Test Methods

- Hamburg Wheel Tracking Test (**HWT**)
- Semi-Circular Bend Test – Flexibility Index (**FI**)
- Disk-Shaped Compact Tension Test (**DCT**)
- **PGAC** on tank samples and **RAC**

Four (4) Testing Labs with full to partial capabilities

Ontario Asphalt Expert Task Group (OAETG)

MIX ASPHALT PROGRAM (MAP) ROUND-1

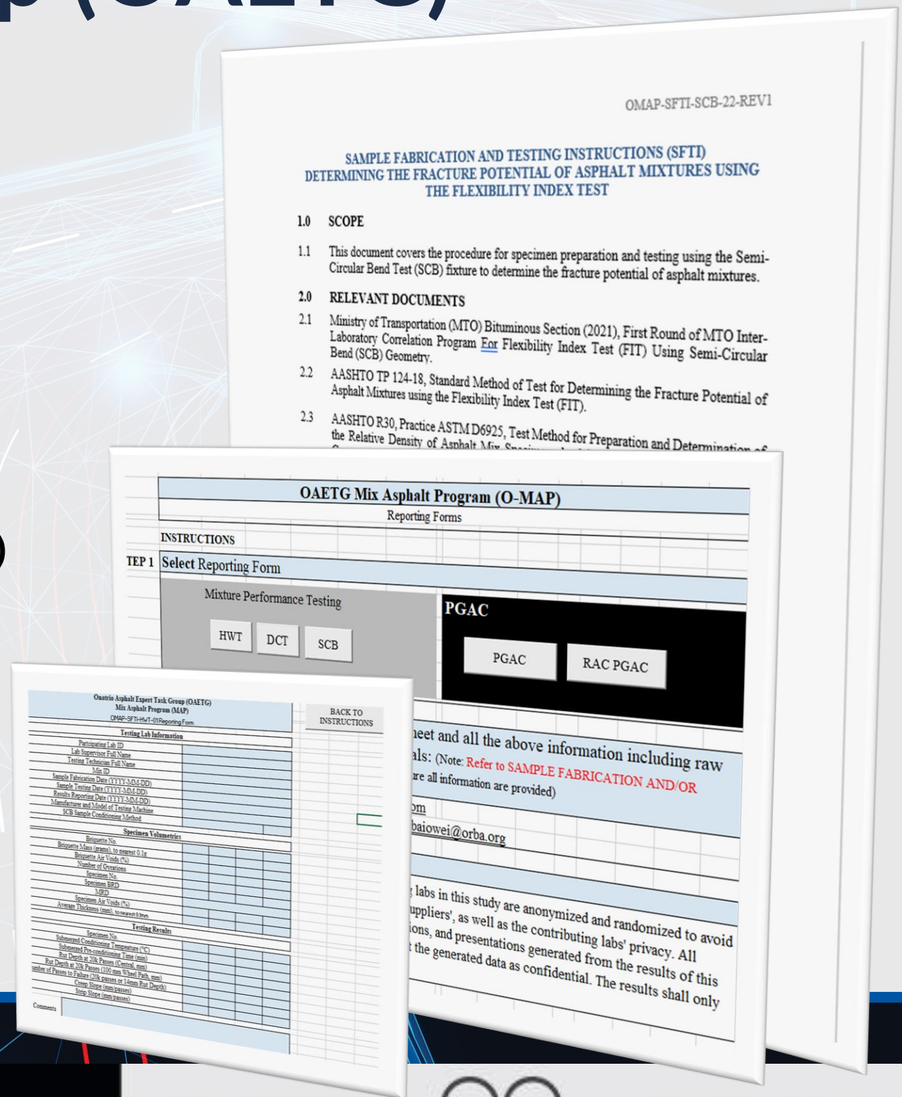
OBJECTIVES (WHAT)

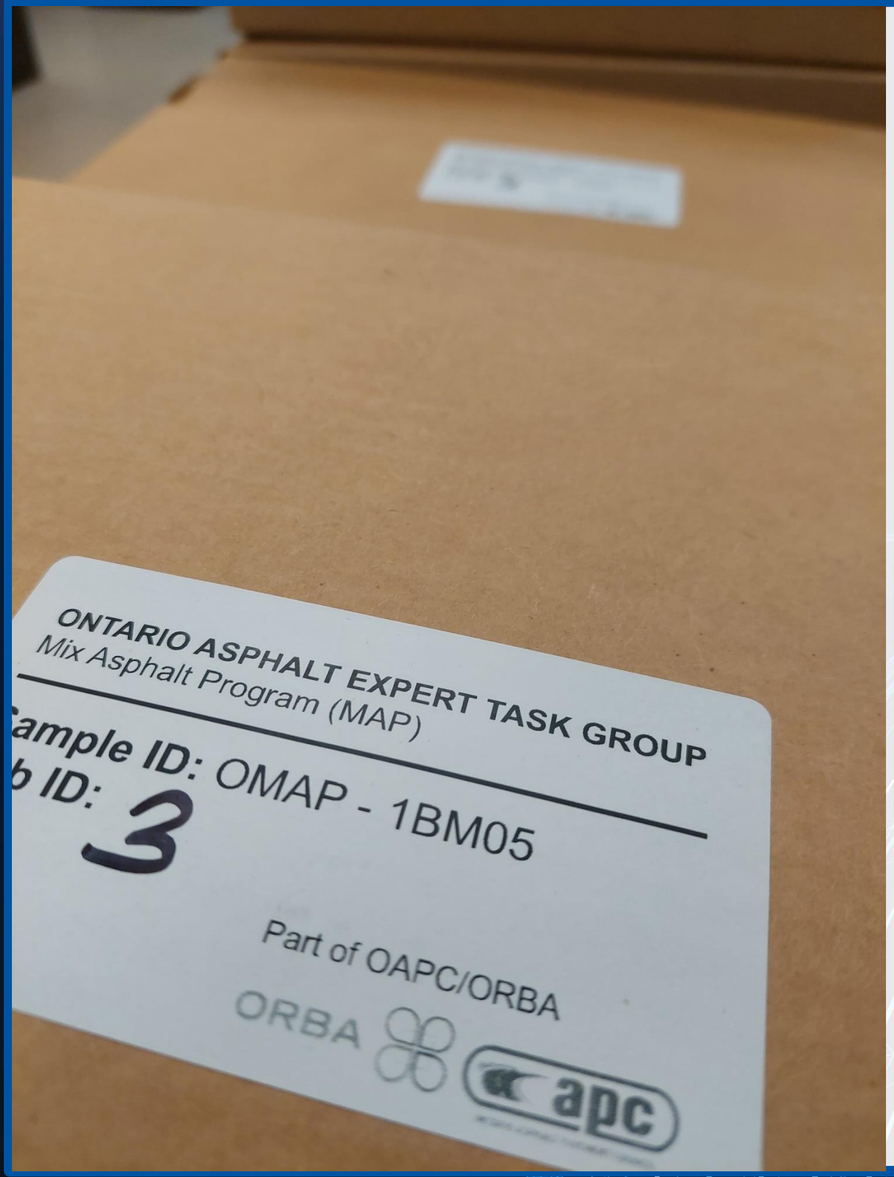
RESOURCES (HOW)

Procedures and Instructions Developed

Controlling consistency

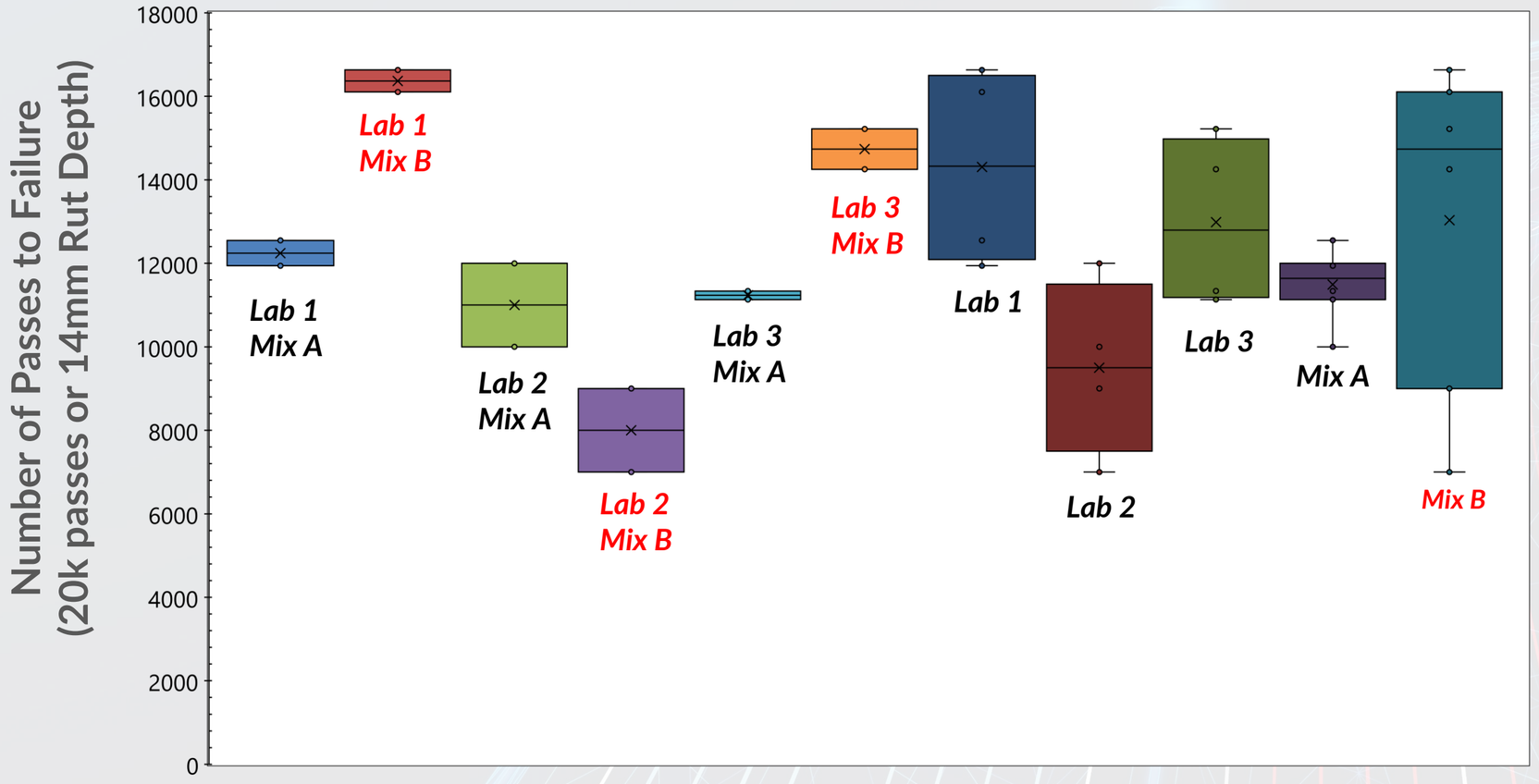
- Sample Fabrication and Testing Instructions **(SFTIs)**
- Interactive Reporting Forms **(IRFs)**
- Large Input from MTO's round of correlations





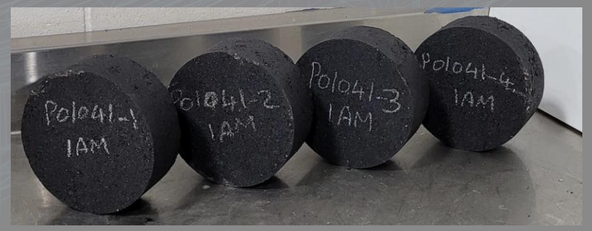
OAETG
MIX ASPHALT PROGRAM (MAP)
ROUND-1
RESULTS

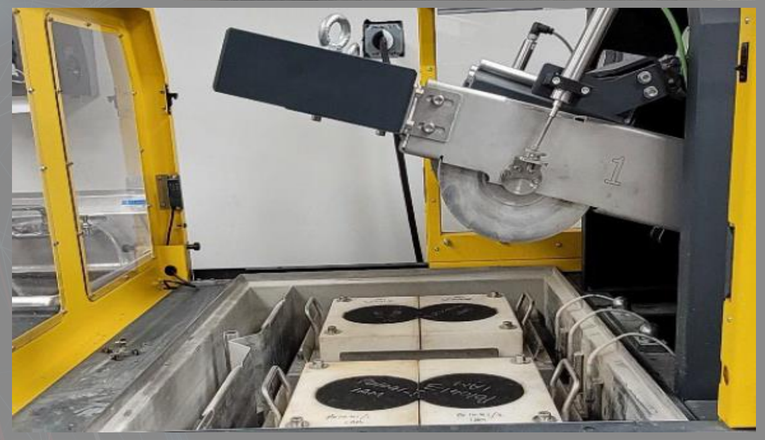
O-MAP Round 1
Hamburg Wheel Tracking Test



TEST INFO

SG compacted
***60-mm** thickness*
*Tested at **50°C***
MTO preliminary spec Max. 6 mm after 20k passes for PG 70-YY

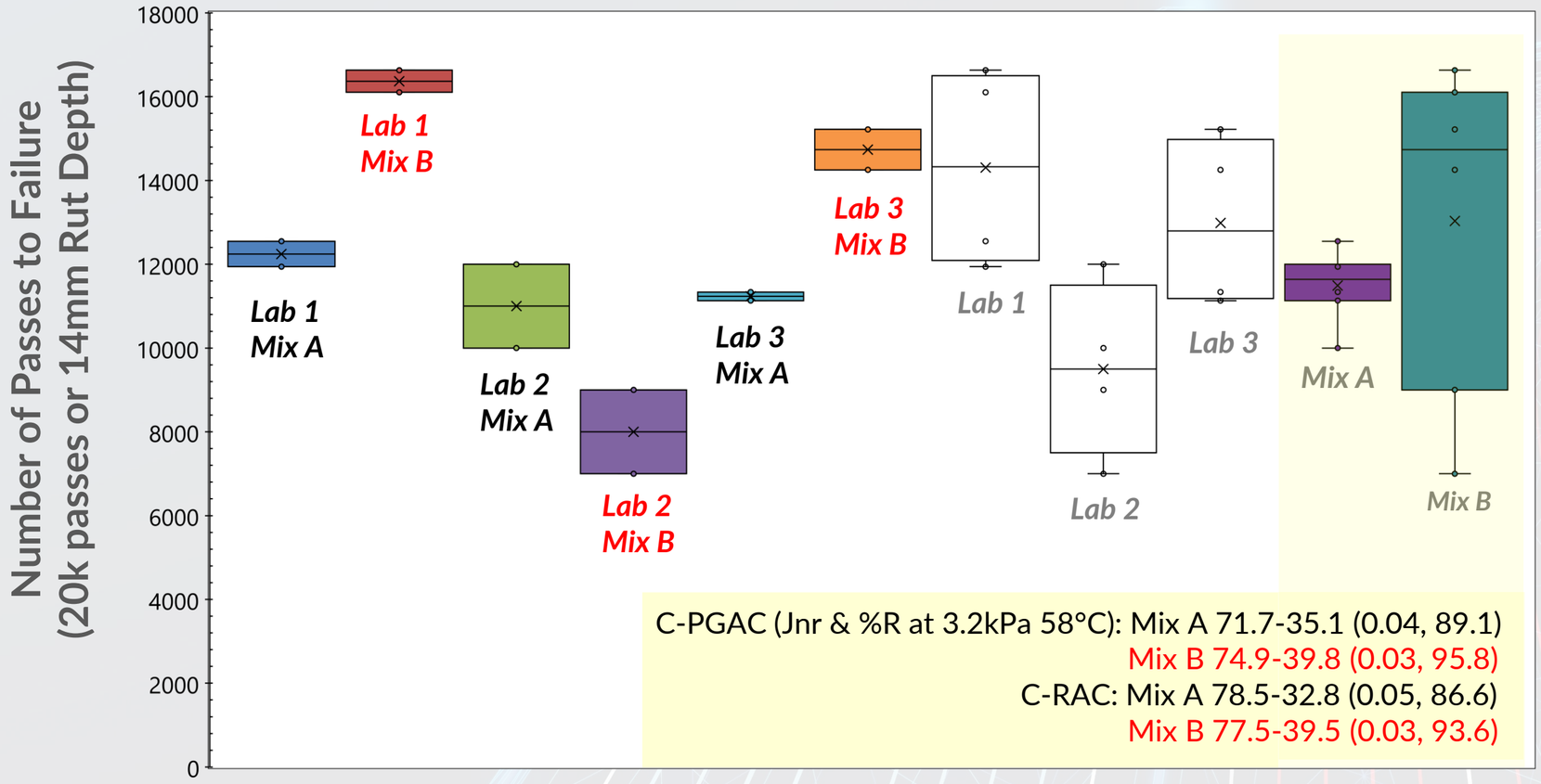




BEFORE

AFTER

O-MAP Round 1
Hamburg Wheel Tracking Test



C-PGAC (Jnr & %R at 3.2kPa 58°C): Mix A 71.7-35.1 (0.04, 89.1)
Mix B 74.9-39.8 (0.03, 95.8)
C-RAC: Mix A 78.5-32.8 (0.05, 86.6)
Mix B 77.5-39.5 (0.03, 93.6)

FINDINGS

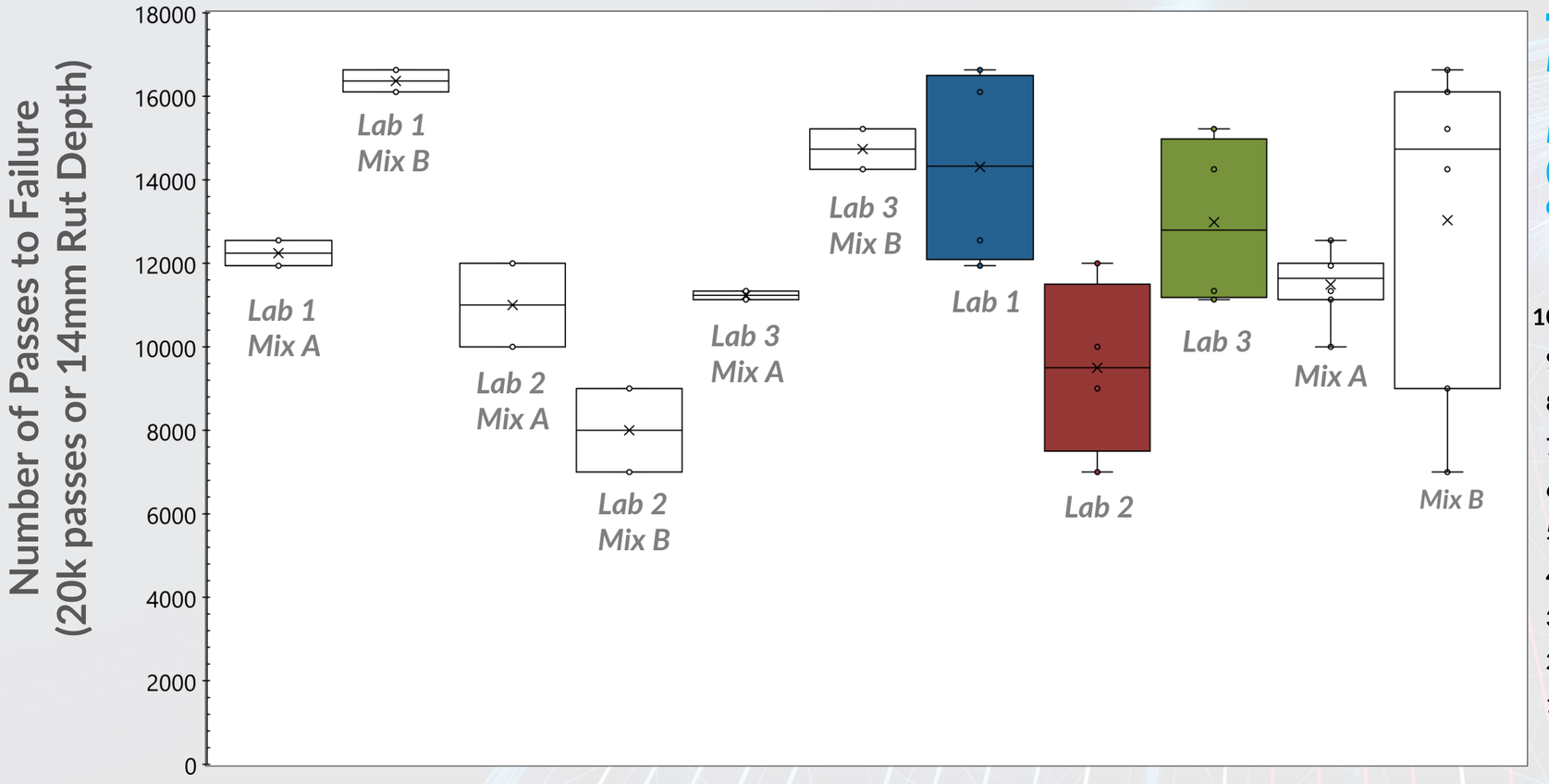
Both mixes A & B failed rutting criteria – Good Field Rutting Reported by the Contractors

Mix B exhibited higher variability – gradation or PGAC? Relatively lower AC content (around 0.25% difference)?

Property		Mix A	Mix B
Gradation (% passing)	Sieve Size (mm)		
	9.5	89.5	81.7
	4.75	65.0	54.4
	2.36	46.3	39.8
	0.075	5.10	3.30
VMA (%)		14.4	15.8
VFA (%)		72	74.7
Dust Proportion, DP		1.2	0.69
Asphalt Content (%)		5.25	5.0
TSR (%)		90.4	95.2
Extracted AC content (%)		5.30	5.06

O-MAP Round 1

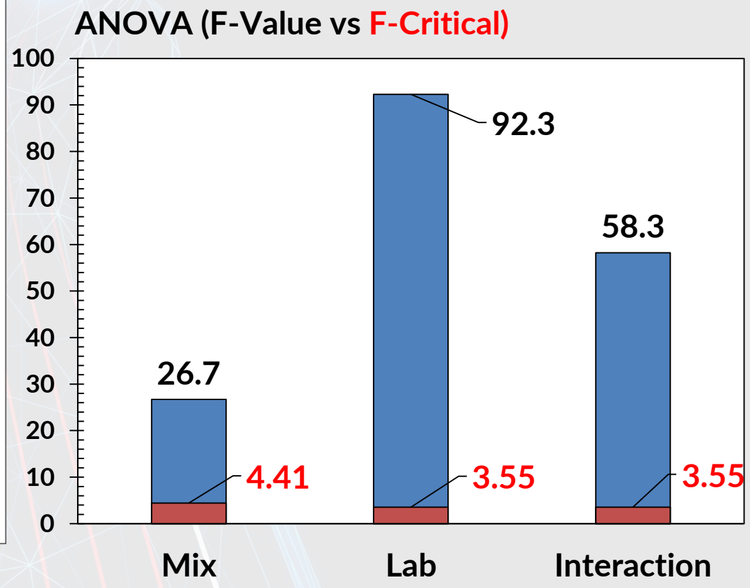
Hamburg Wheel Tracking Test



FINDINGS

Inter-laboratory effect is still more significant

Might be due to fabrication inconsistencies (sample splitting, heating, different type of compactors, lowered height)



SIDE NOTE

LAB COMPACTION – SAMPLE FABRICATION

Barber Asphalt Paving Company
Manual Mixing
Feel of Workability & Ratio of AC with Sand and Pulverized carbonite Lime

Francis Hveem (Caltrans)
Introduction of mechanical kneading compactor
Slightly angled

Superpave – SHRP program
Introduction of gyratory compactor, 150-mm Dia. and 115-mm Height

Level 1 (volumetric-based approach) using 4% air voids

Level 2 & 3 (performance-based/Pavement Design approach) – Never implemented

First trial in Ontario placed in 1996

Not all SGCs the same!
Thickness changes = Higher variability

1890 → 1920s → 1927 → 1943 → 1993 - Now

Charles Hubbard and Frederick Field (Hubbard-Field Method)
First 30 hand-tamper "heavy blows" were applied with a 50 mm diameter hand tamp followed by 30 blows with a 145 mm diameter hand tamp.
Sample Turnover req'd.

Bruce Marshall (Mississippi DOT)
Refined Hubbard Field Method – standardization of compaction energy with drop hammer

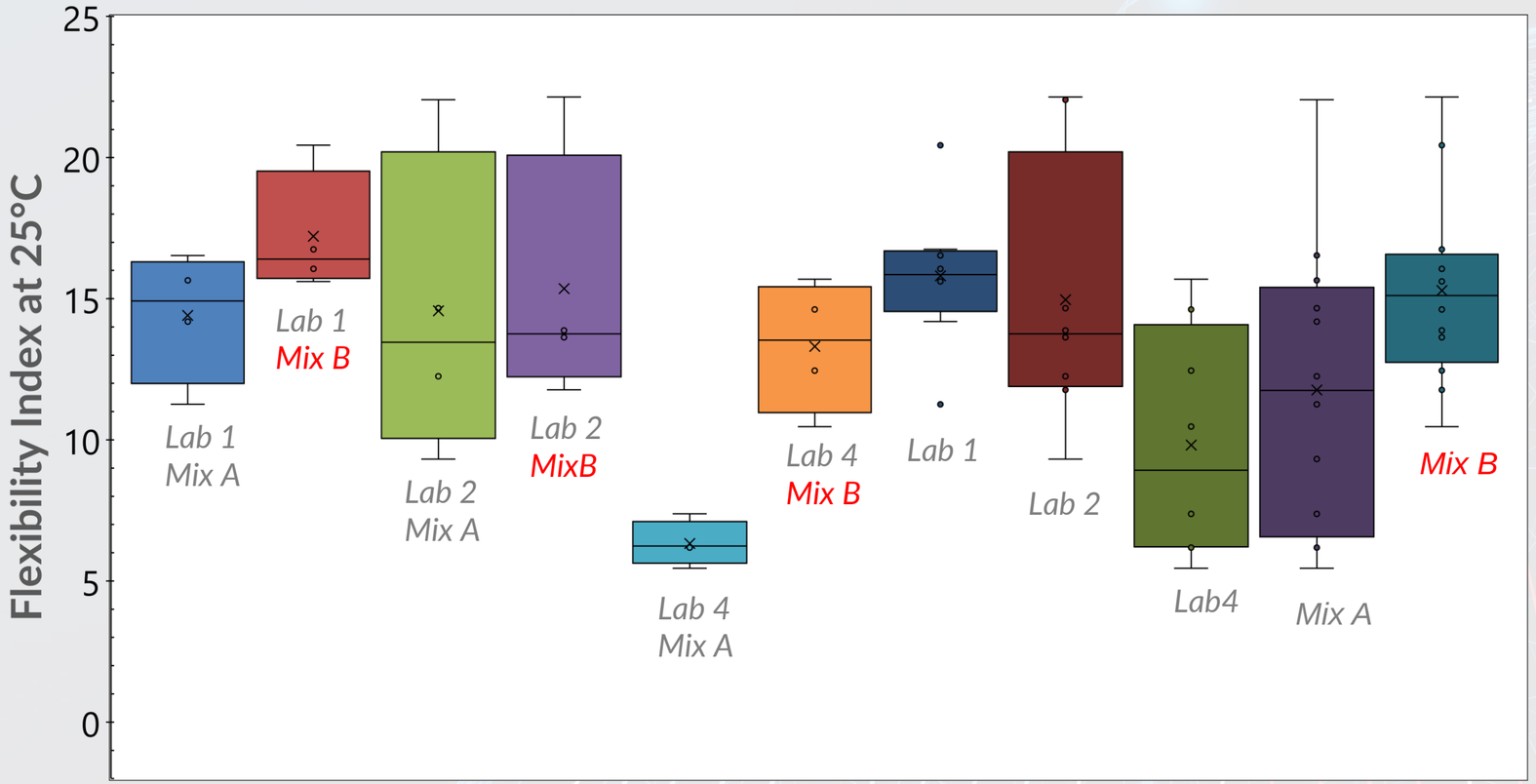
Testing Agency	Frame Stiffness (Deg / N-m) – Superpave Gyratory Compactor (SGC) Model					
	Pine AFG125x	Pine AFG1	Pine AFGB1 (Brovold)	Troxler 4140	Troxler 4141	ServoPac
Univ. of Arkansas *(Stiffness Study)*	0.00031	0.00034	0.00036	0.00109	0.00063	
Univ. of Arkansas *(RAM ILS)*	0.00046		0.00025	0.00139	0.00053	
Univ. of Arkansas *(RAM-DAV/HMS Study)*	0.00037	0.00047	0.00031	0.00127	0.00054	
Florida DOT *(used by permission)*	0.00033		0.00041	0.00172		0.00041
InstroTek *(used by permission)*	0.00047	0.00050	0.00055	0.00176	0.00180	
				0.00136	0.00122	
				0.00132		
Mean Value	0.00039	0.00044	0.00038	0.00142	0.00095	0.00041
Standard Deviation	0.000074	0.000085	0.000114	0.000242	0.000548	N/A
Coefficient of Variation (%)	19.0	19.5	30.3	17.1	57.5	N/A

D'Angelo J. "Everything You Ever Wanted to Know About HMA in 30 Minutes", North East Asphalt User/ Produced Group, Meeting Presentation, (2004).

Timeline prepared by Sina.V after reviewing "History of asphalt mix design in North America" published by Asphalt Magazine
Link: http://asphaltmagazine.com/history-of-asphalt-mix-design-in-north-america-part-1/

O-MAP Round 1

SCB Intermediate Cracking Index - FI

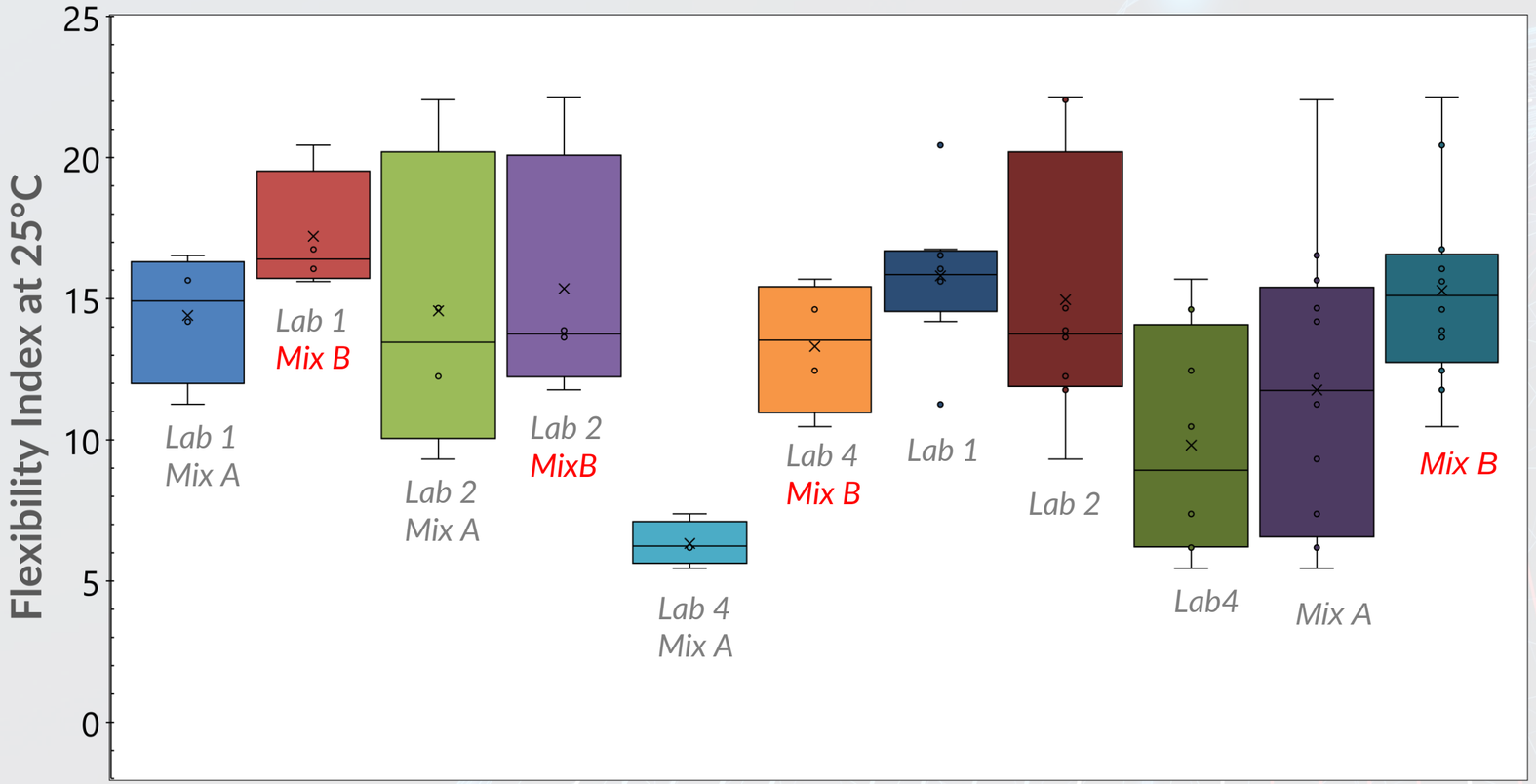


TEST INFO

SG compacted
160-mm+ thickness and then cut into 50-mm disks
Flexibility Index (FI) ***Min. 10***
Tested at ***25°C***

O-MAP Round 1

SCB Intermediate Cracking Index - FI



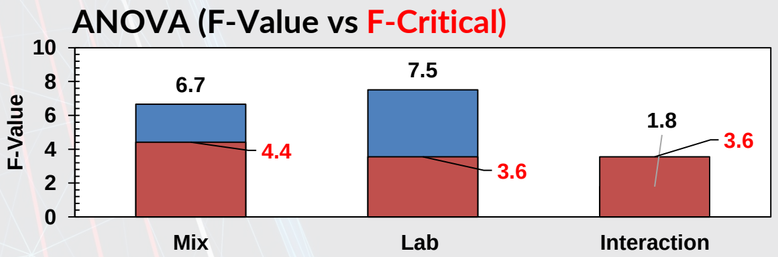
FINDINGS

All mixes passed Min. FI of 10; except mix B when tested by "Lab 3"

Mix A & B are statistically expected to behave similar; Mix B still higher variability in behaviour

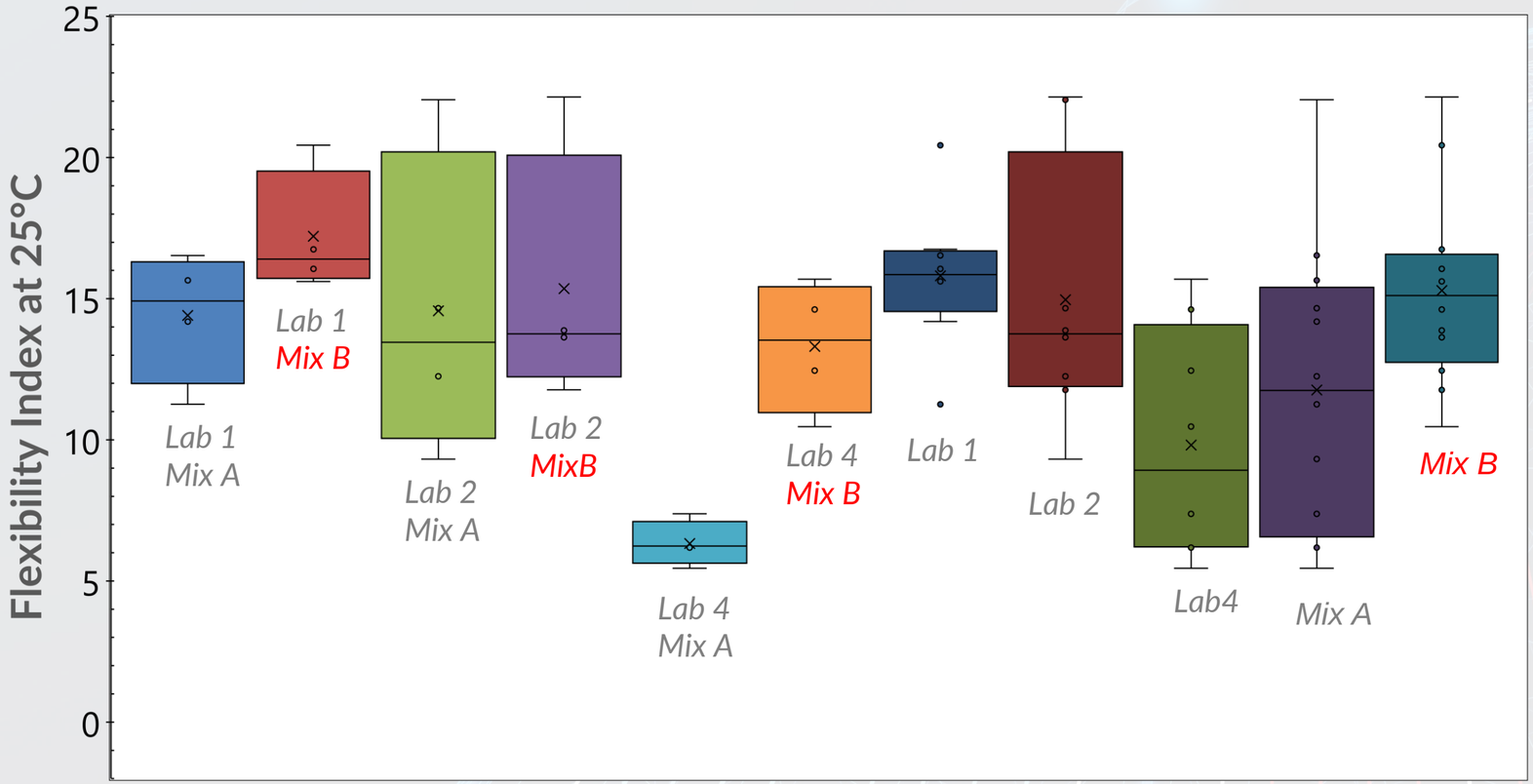
Mix A has tendency to exhibit lower FI – contrary to higher AC content

Variabilities could be due to fabrication inconsistencies (sample splitting, heating, different type of compactors), as well as PGAC formulations/sources



O-MAP Round 1

SCB Intermediate Cracking Index - FI

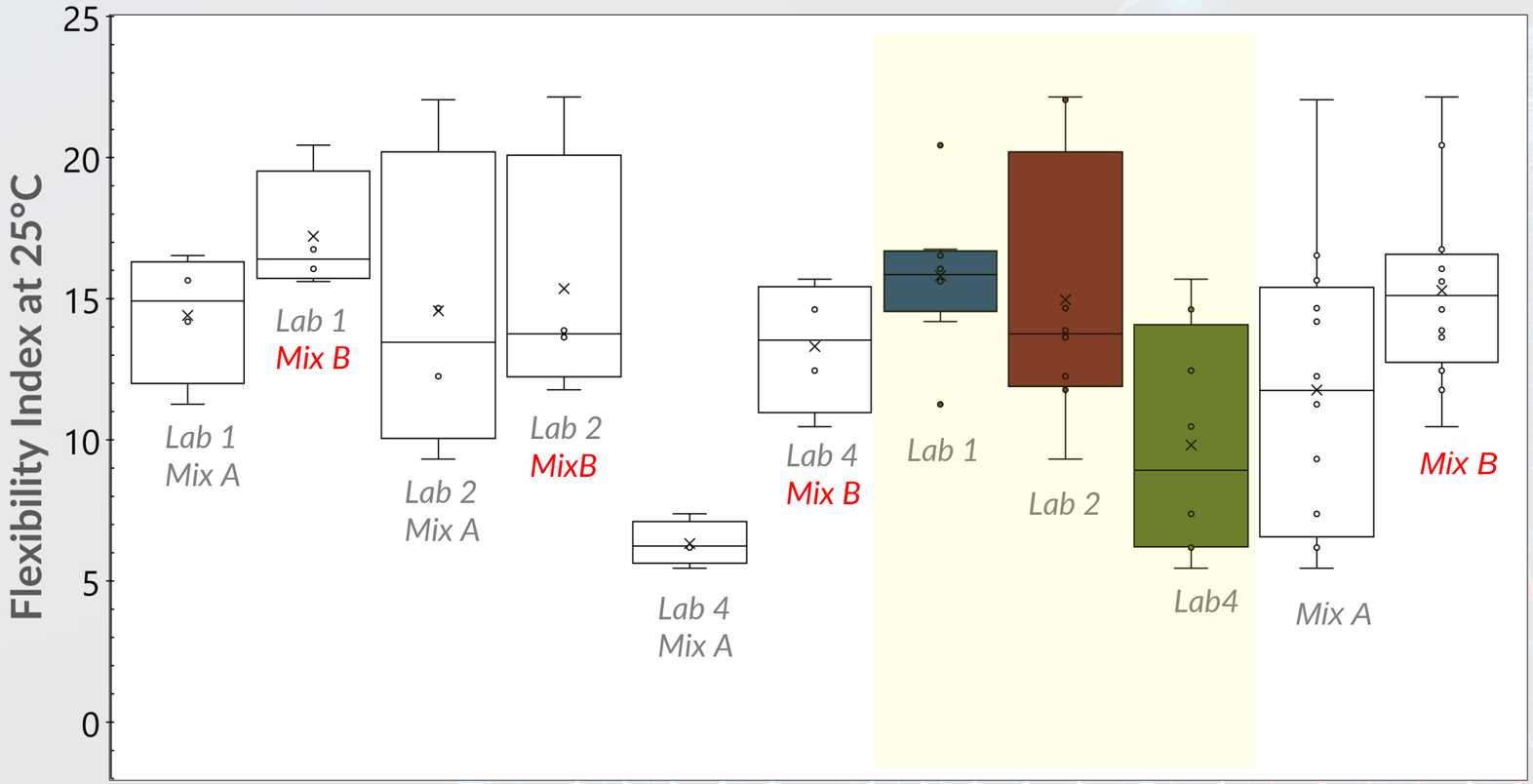


Binder Properties

Tank Sample OR RAC	Mix ID	PAV Method	CTOD (m)	X-Over Temp at δ = 45°
Tank Sample	A	20	25.2	12.6
		40	9.70	21.8
RAC	A	20	9.00	21.6
		40	4.90	31.0
Tank Sample	B	20	25.10	26.1
		40	15.20	15.9
RAC	B	20	11.0	10.6
		40	9.50	25

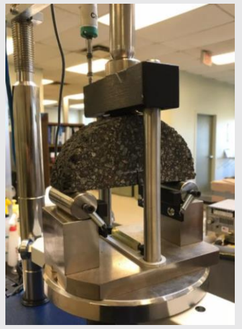
O-MAP Round 1

SCB Intermediate Cracking Index - FI



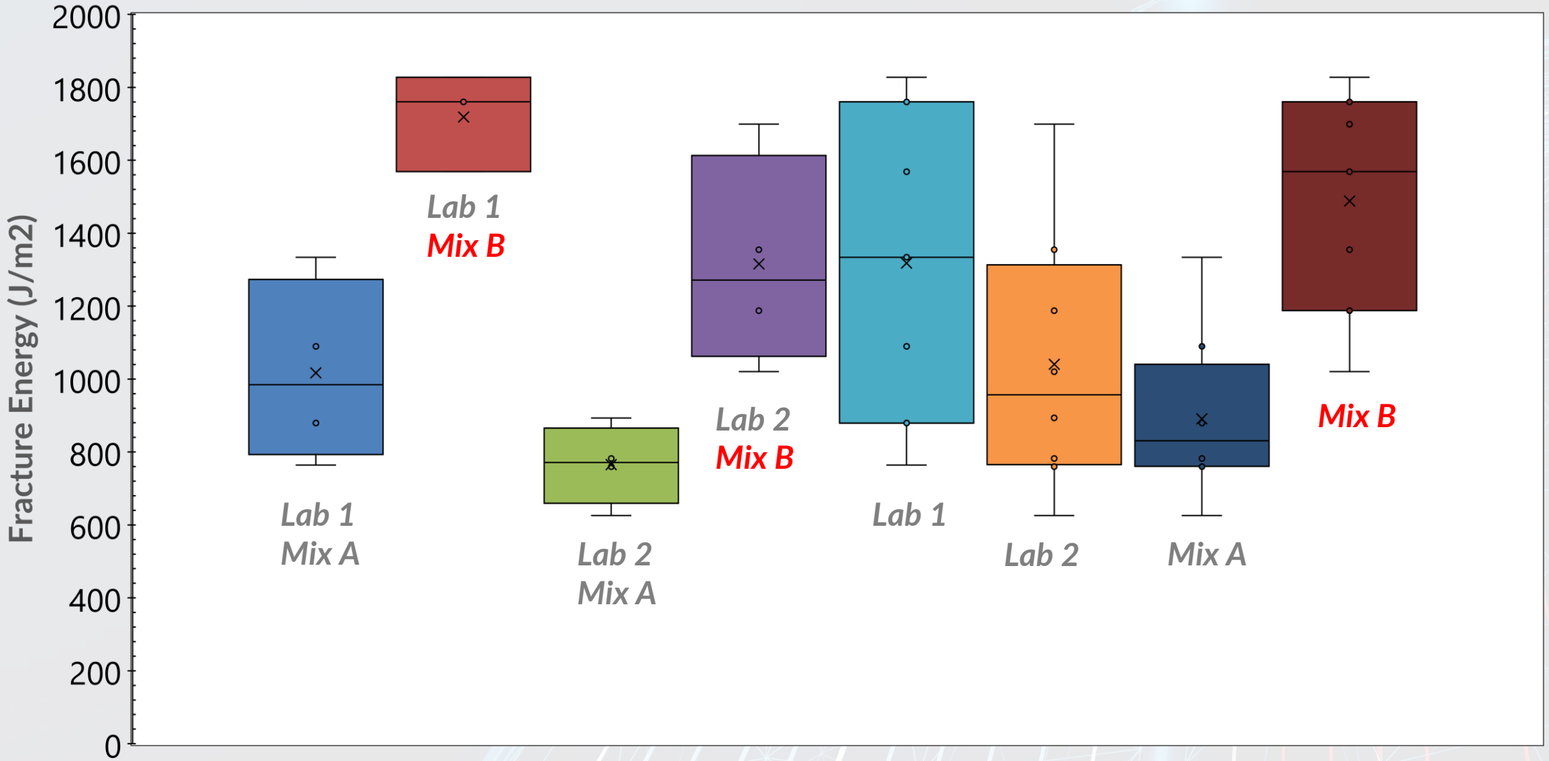
Sources of Variation

Screw Driven Frame vs Hydraulic Frame
Internal & External Chamber Conditioning vs Water Bath
Free rollers – screw or springs



O-MAP Round 1

DCT Low Temp Cracking Index

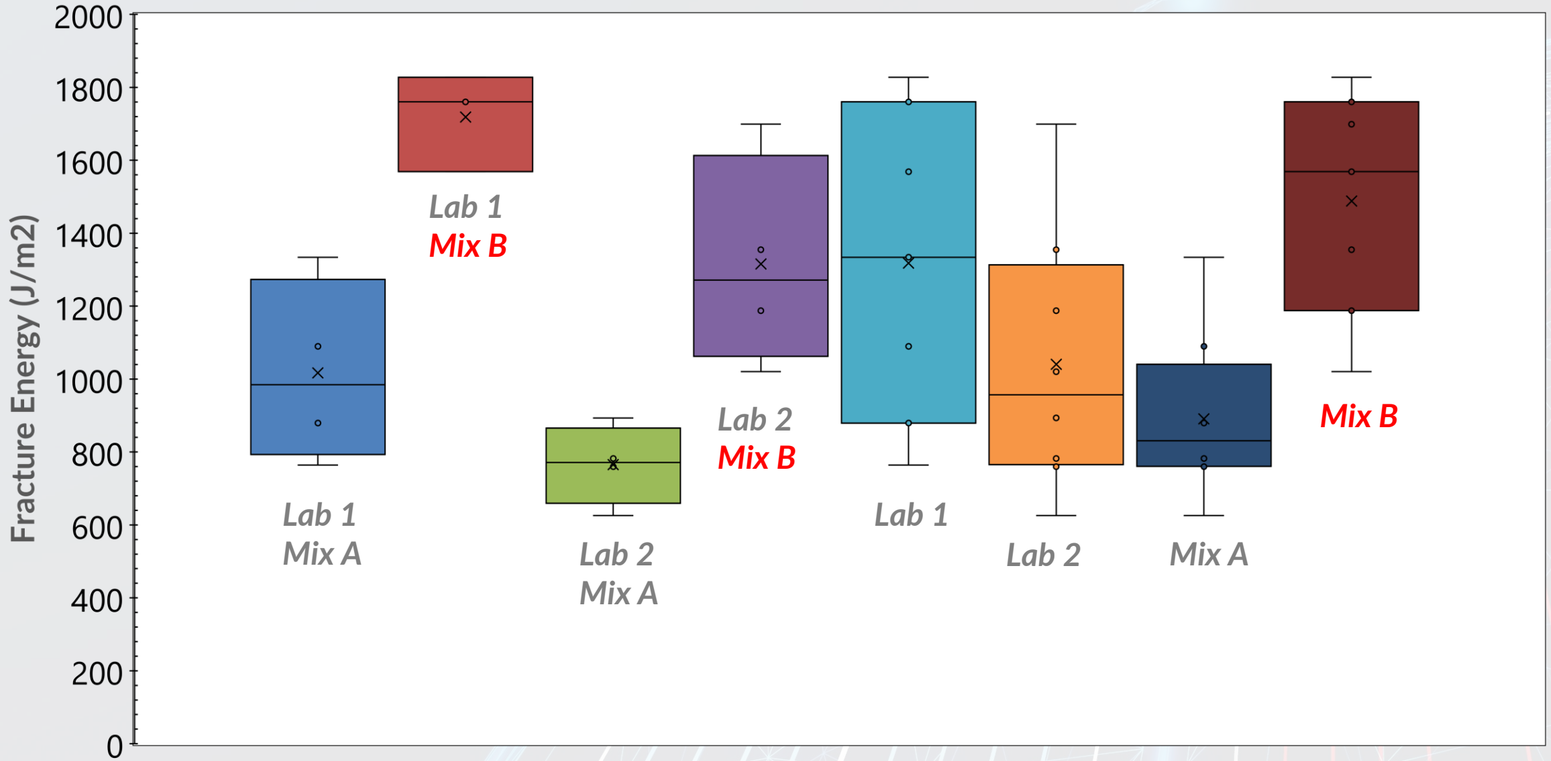


TEST INFO

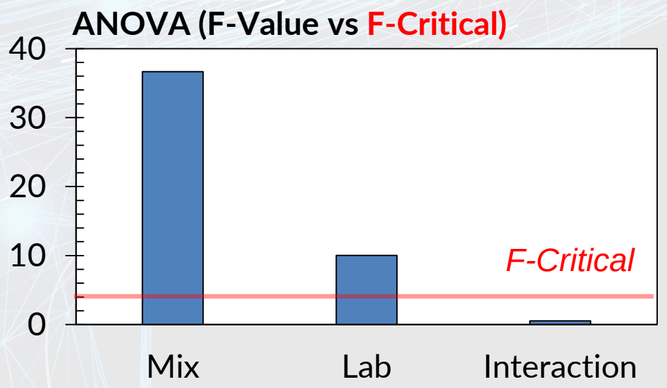
SG compacted
160-mm+ thickness and then cut into 50-mm disks
DCT Min. 600 Fracture Energy
Tested at 10°C above PG -YY

O-MAP Round 1

DCT Low Temp Cracking Index



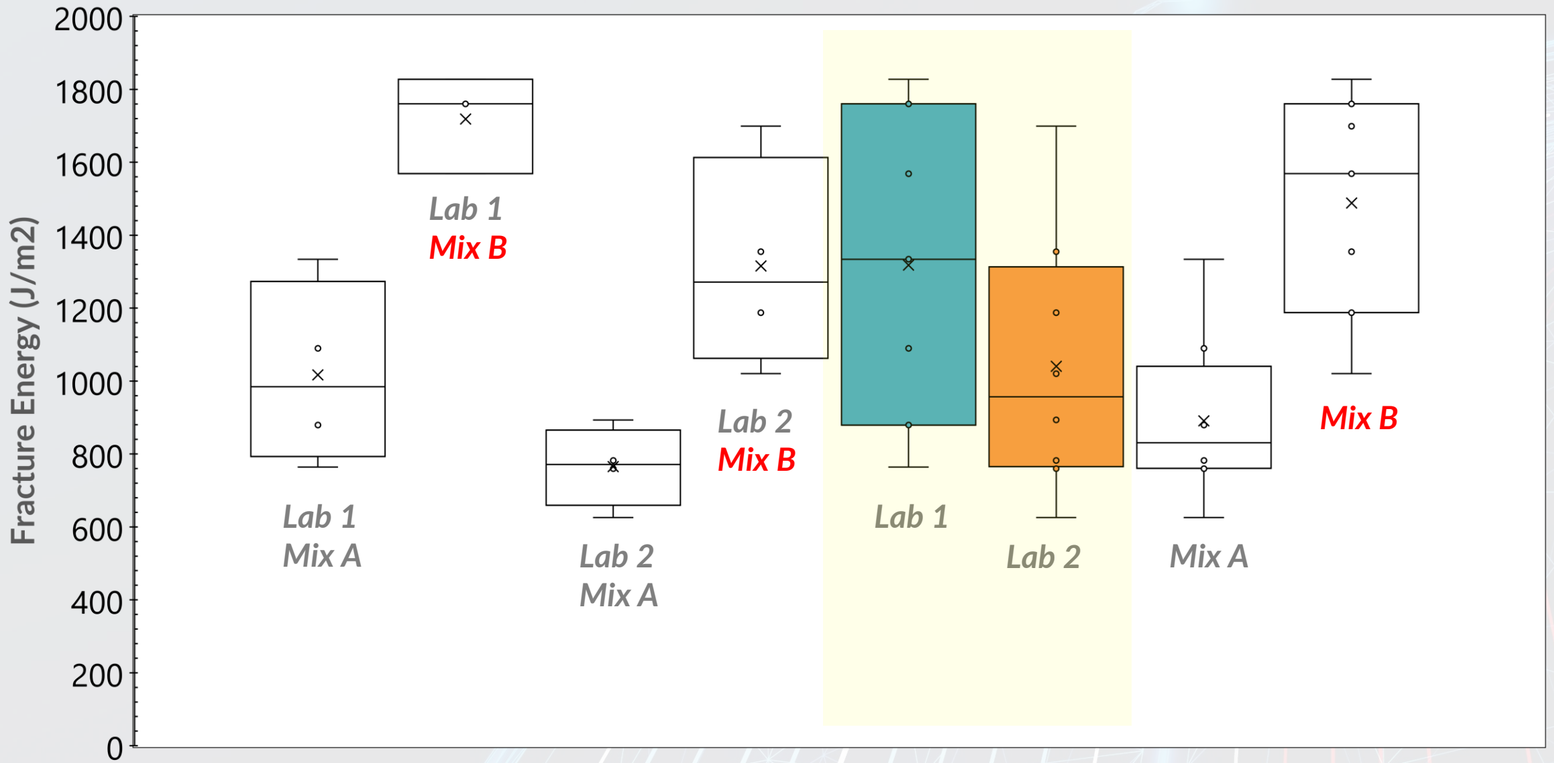
FINDINGS



	Mix	PAV Method	C-LT (°C)	Δ Tc	EXBBR	
					LTLG	Grade Loss
Tank	A	20	-35.1	-0.9	-30.9	3.9
		40	-32.0	-5.4	-27.0	3.3
RAC	A	20	-32.28	-4.9	-26.0	4.6
		40	-28.51	-6.8	-20.3	7.5
Tank	B	20	-39.8	2.0	-37.1	1.2
		40	-36.2	1.0	-32.9	3.5
RAC	B	20	-39.54	0.1	-34.1	2.9
		40	-35.07	-2.9	-28.4	6.3

O-MAP Round 1

DCT Low Temp Cracking Index



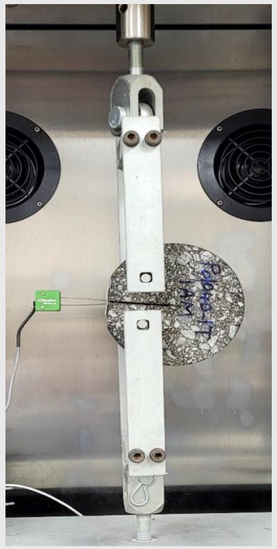
Fixture Differences

Potential source of variability and may need further investigation

Fixed Ends
Lab 1

VS

Flex Ends – Self Aligned
Lab 2



The same manufacturer of testing frame and chamber (same loading capacity)

Ontario Asphalt Expert Task Group (OAETG)

MIX ASPHALT PROGRAM (MAP) ROUND-1

FINDINGS

Mix Properties

Both binder and mix properties do play a role in performance – inclusion of mix performance check part of design & production

Procedures and Instructions Developed

Controlling consistency

Sample Fabrication and Testing Instructions **(SFTIs)** requires refinement on sample heating, splitting, compaction and cutting

Collaboration

Work Closely with MTO and other agencies considering performance-verified or based designs on coarse and fine tunning sample fabrication, as well as testing parameters (including temperature)

Ontario Asphalt Expert Task Group (OAETG)

MIX ASPHALT PROGRAM (MAP) ROUND-1

FINDINGS

FUTURE STEPS

Research work on effect of cuts, gyratory frame stiffness; especially for HWT test

Testing temperature combined with mix properties on variability of HWT, SCB & DCT

Evaluating IDEAL type of tests such as Cracking and Rutting test (CT & RT), or any other test methods

Placing greater emphasis on laboratory produced mixes to be tested part of mix design stage;

Establishing a performance test correction factor between laboratory and plant produced mixes;

Simplifying the binder testing and placing more emphasises on mix testing and performance;

Evaluating mixes containing RAP

Understanding the role of traffic in test method and/or temperature selection.

ACKNOWLEDGEMENTS

OAETG members for their contributions to the success of the group

Contractors donating materials and local testing labs

Special thank to Oversite Study Team (OST) for help with data analysis and reporting:

Mike Aurilio, Yellowline Asphalt

Yashar Azimi Alamdary, Coco Group

Amin Mneina, Good Roads

Mehran Farashah, York Region

Ali Al-Abbasi, Aecom

Saeid Salehi Ashani, University of Waterloo

Trevor Tinney, Town of Innisfil

Questions and Discussions

Sina Varamini, Ph.D., P.Eng., MCSCE

Chair, Ontario Asphalt Expert Task Group (OAETG)
Director, Pavements and Materials Group (Engtec Consulting Inc.)
Adjunct Assistant Professor (University of Waterloo)

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Thank You

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