Performance-Based Testing Specifications for Asphalt Pavement Constructions in North Dakota

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Introduction

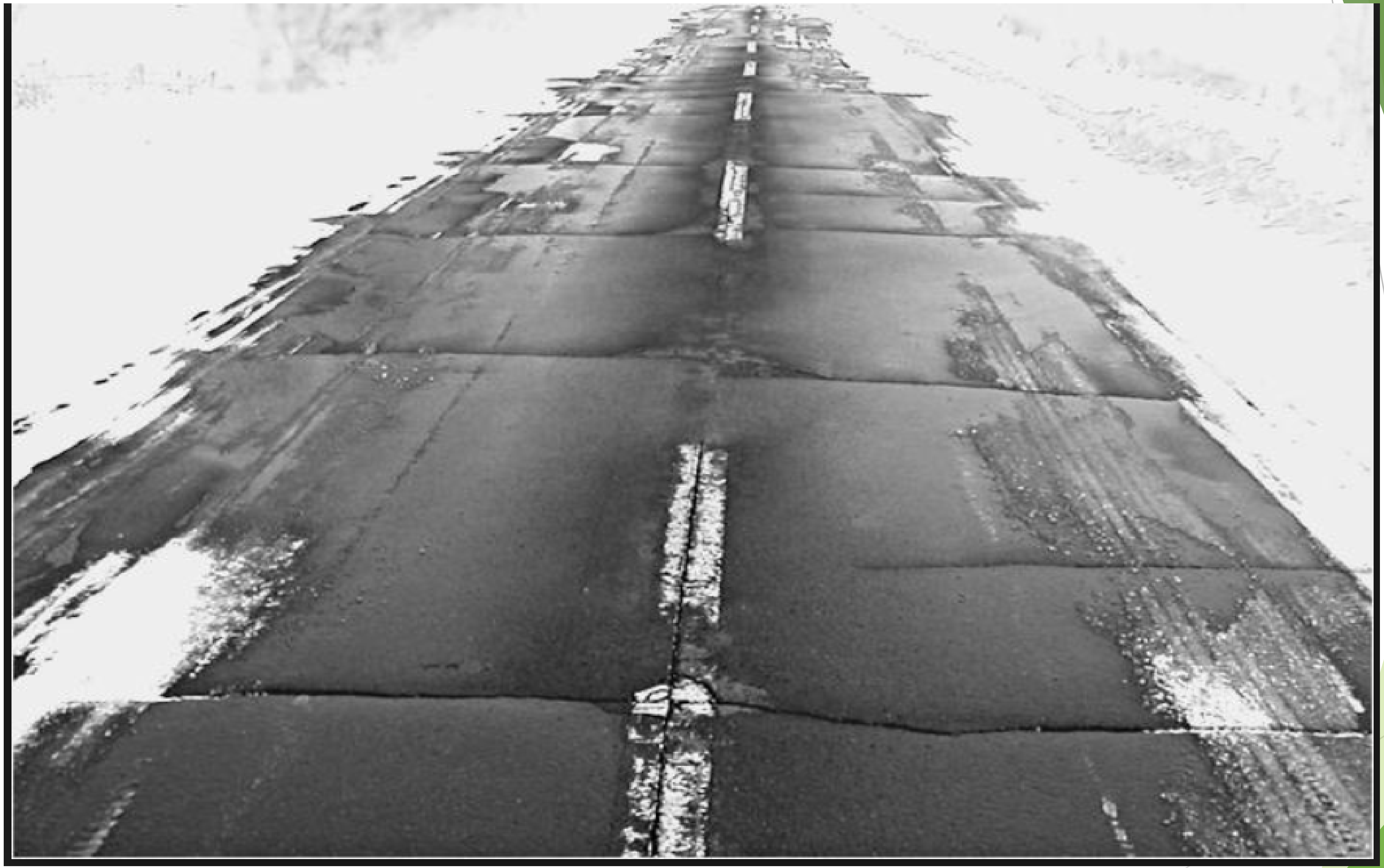
- PBSs:
  - describe the desired levels of fundamental engineering properties
  - acceptance quality characteristics tied to performance through prediction models

- PBS emphasizes the mix and pavement structure characteristics that most affect performance

- Critical asphalt pavement distresses include:
  - fatigue cracking
  - low-temperature cracking
  - rutting

Fatigue/Alligator Cracking

Low-temperature/Thermal/Transverse Cracking



Rutting

Performance Based on Literature Review

Test	Property	Parameter	Unit	Fail	Pass
DCT	Low-temp.	Fracture Energy	J/m^2	<400	400-460 LT
					460-690 MT
					>690 HT
SCB	Fatigue	Flexibility Index	FI Index	<2	2 - 4 Fair
					>4 Good
APA	Rutting	Rut depth	mm	>7	<7

Objectives

- Determine low-temperature, fatigue, and rutting performance of mixes commonly used in NDDOT Districts
- Compare field and laboratory mix performance
- Develop performance specifications for NDDOT

Test Matrix

Test Type or Material Type	Project 1	Project 2	Project 3		Total Per District	Total for 8 Districts
	Field Mix	Field Mix	Field Mix	Lab Mix		
Low-temperature	3	3	3	3	12	96
Fatigue	3	3	3	3	12	96
Rutting	4	4	4	4	16	128
Moisture Sensitivity	0	0	6	6	12	96
Total specimens	10	10	16	16	52	416
Loose Mix Needed (lb)	150	150	200		500	4,000
Raw Mat. Needed (lb)				200	200	1,600

Selected Projects

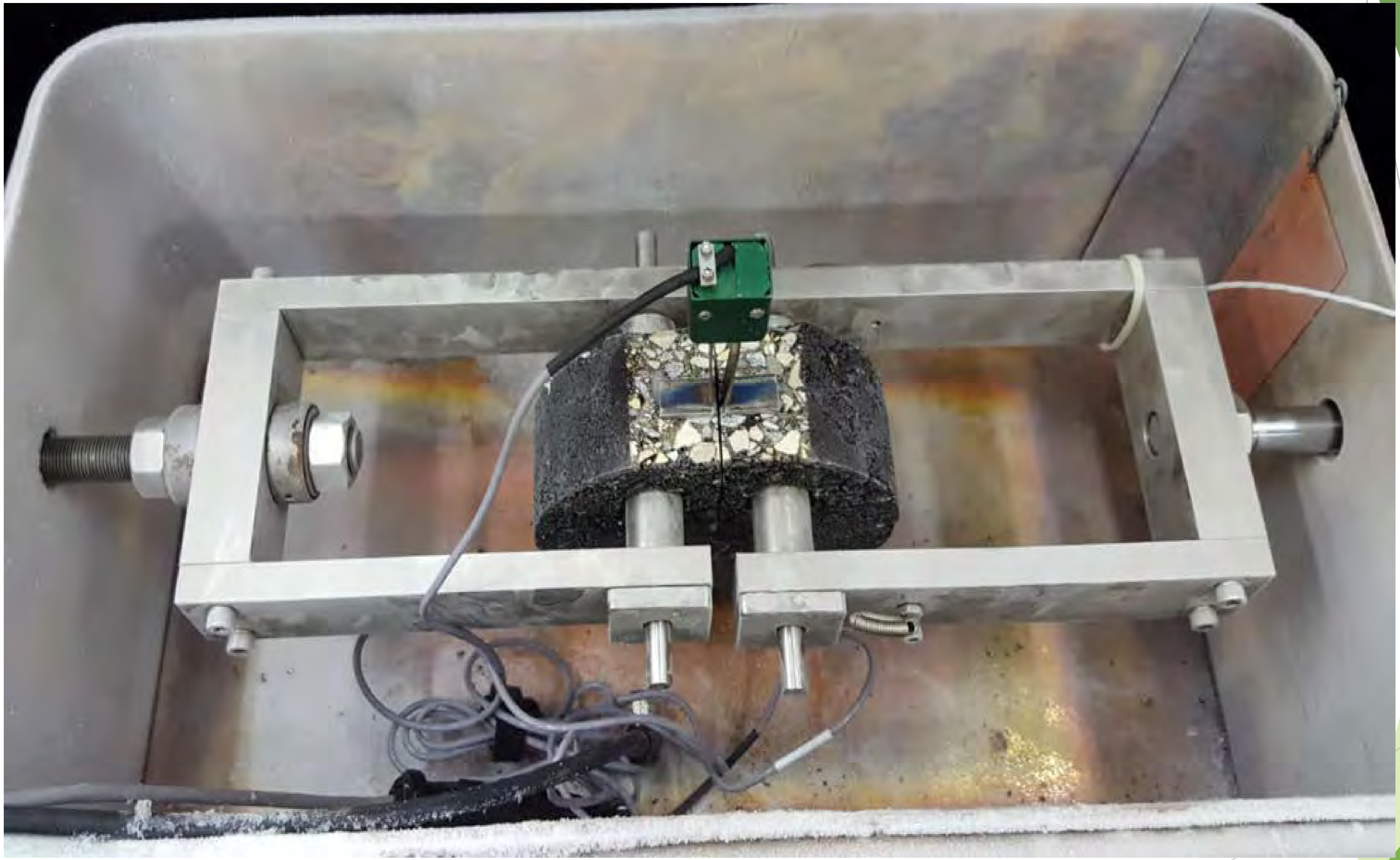
District	Project Number	HMA Thickness	HMA Grade	Oil Type	RAP %	Status
Grand Forks	SS-2-020(017)027	2"	FAA43	PG 58S-28	20	Completed
	SS-6-017(047)082	2"	FAA43	PG 58S-28	25	Completed
	SS-6-066(027)124	2"	FAA45	PG 58H-28	15	Completed
Bismarck	NH-1-200(074)213	3"	FAA 42	PG58S-28	20	Completed
	NH-1-006(017)042	2"	FAA 45	PG58S-34	18	Completed
	NH-1-003(049)093	3"	FAA 43	PG58S-34	0	Completed
Valley City	SS-2-046(047)060	3"	FAA 42	58S-28	25	Completed
	SS-2-032(029)049	3"	FAA 42	28S-28	25	Completed
	IM-2-094(156)221	2.7-2"	FAA 45	58H-28	0	Completed
		2"	SMA	58H-34	0	Incomplete
Minot	NH-4-052(083)059	2"	FAA 45	64-28	0	Completed
	NH-4-003(015)136	2"	FAA 43	58S-28	0	Completed
	SNH-4-052(073)112	2"	FAA 45	58H-28	0	Completed
	SOIB-CPU-TRP-4-083(130)920	2" Top	FAA 45	64-28	0	Completed
		4" Bott	FAA 45	58-28	0	Completed
Williston	NH-NHU-7-002(156)022	7"	FAA45	PG58V-28	13	Completed
	SS-7-008(032)203	2"	FAA45	PG 58S-28	0	Completed
	SOIB-7-804(060)267	6"	FAA45	PG 58H-28	0	Completed
Dickinson	SS-5-008(048)081	3	FAA 43	58S-28	25	Completed
	SS-5-016(027)076	2	FAA 45	58S-28	25	Completed
Devils Lake	NH-3-003(027)177	3"	FAA 42	58S-28	0	Completed
	NH-3-057(056)000	2"	FAA 43	58H-34	15	Completed

Properties, Test Temperature, and Equipment

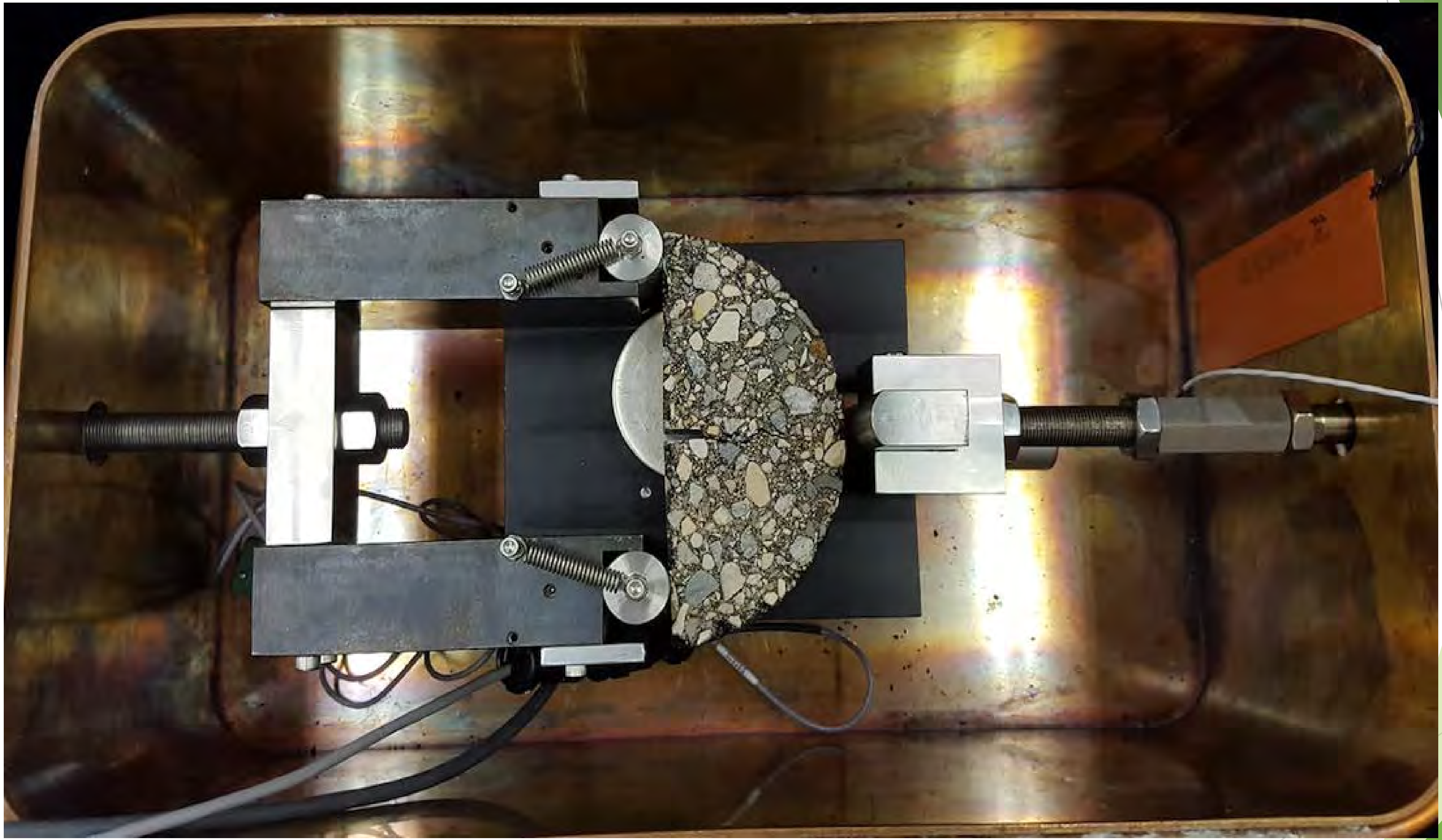
Properties		Test Temperature	Equipment
Mechanical properties of the mixes	Low-temperature cracking	Low	DCT
	Fatigue cracking	Medium	SCB
	Rutting	High	APA
Moisture damage of the mixes	Durability	Medium	Universal Testing Machine

SGC

DCT Test



SCB Test

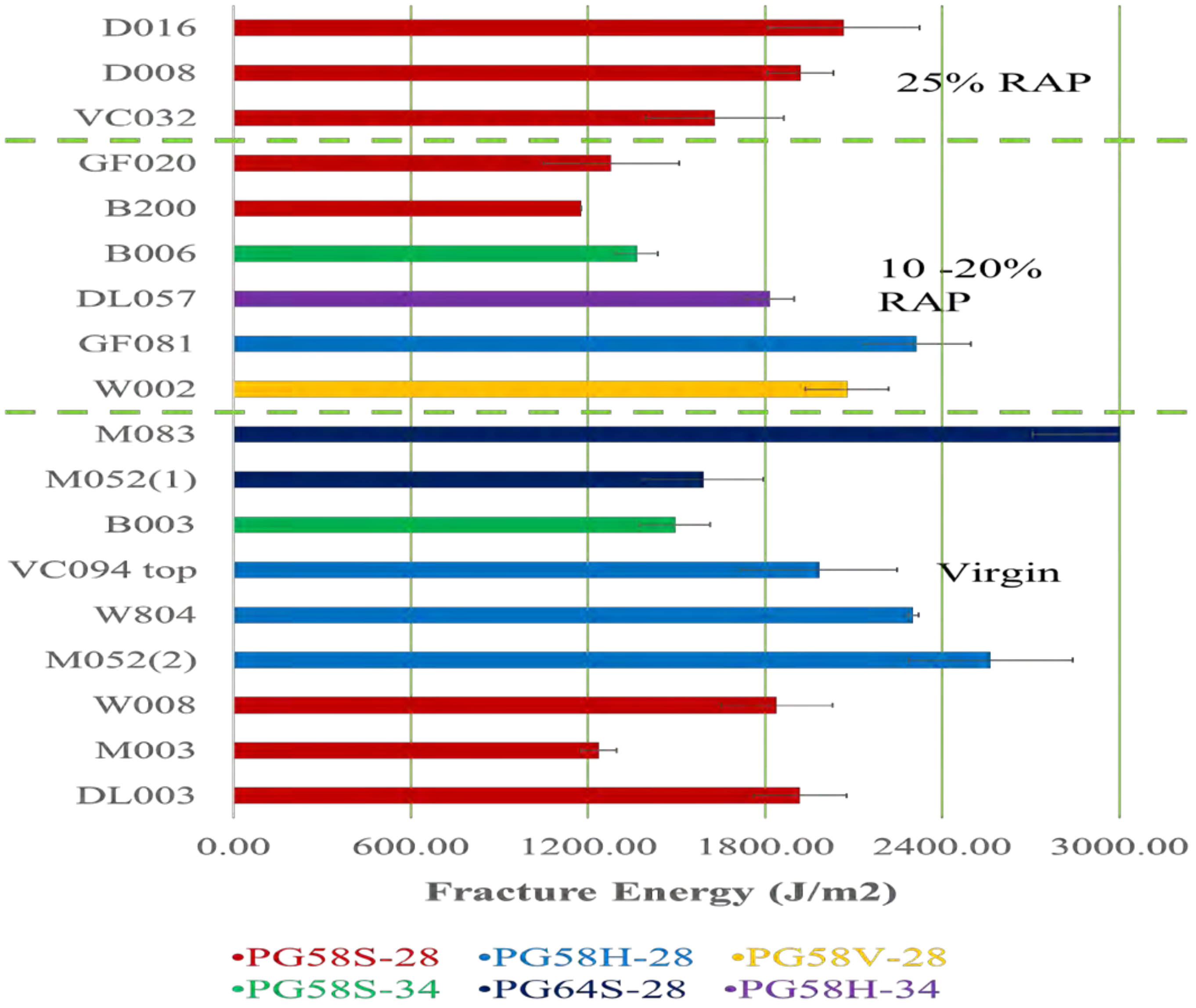


APA

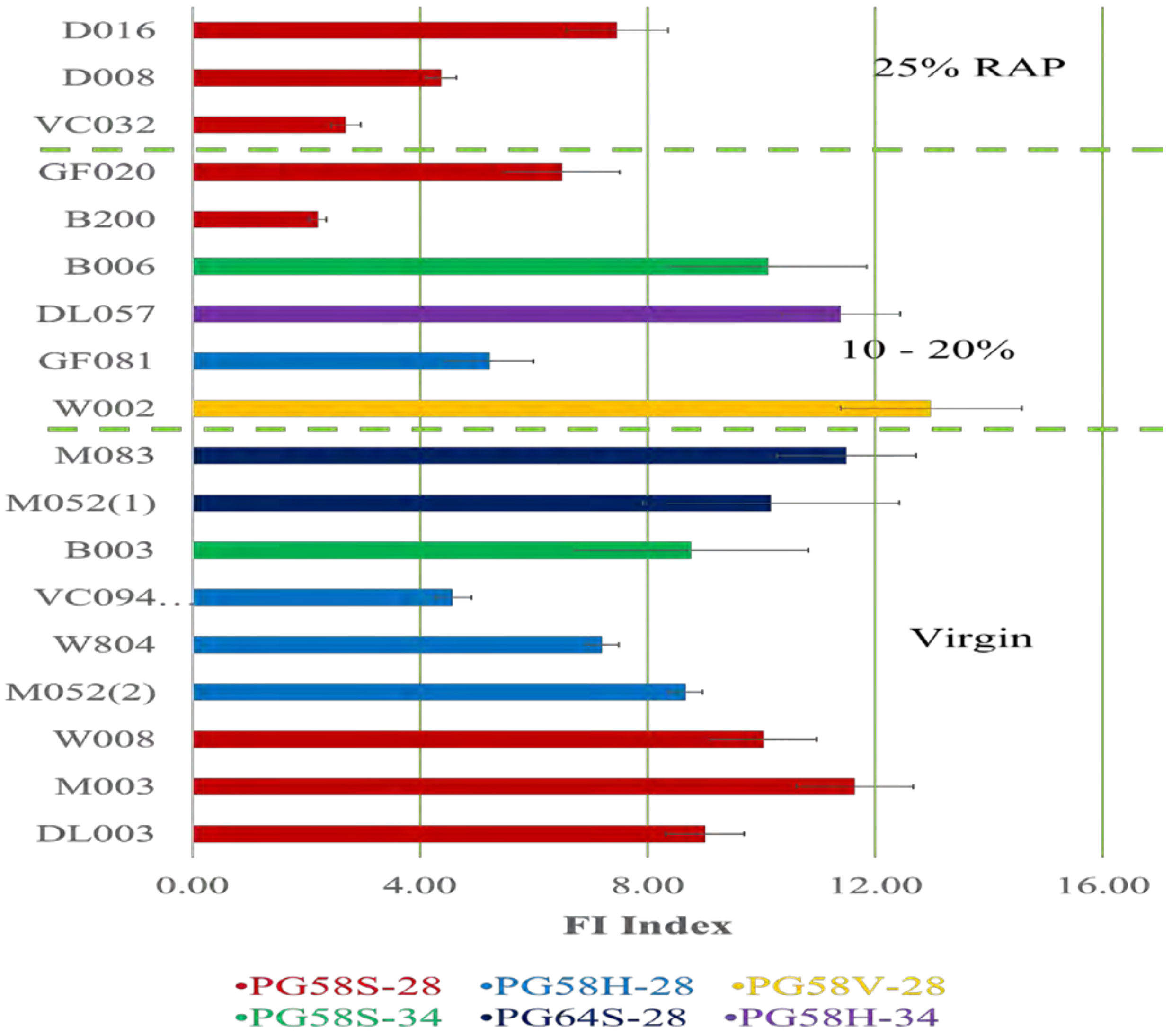
RESULTS AND DISCUSSIONS

Field Mix Performance

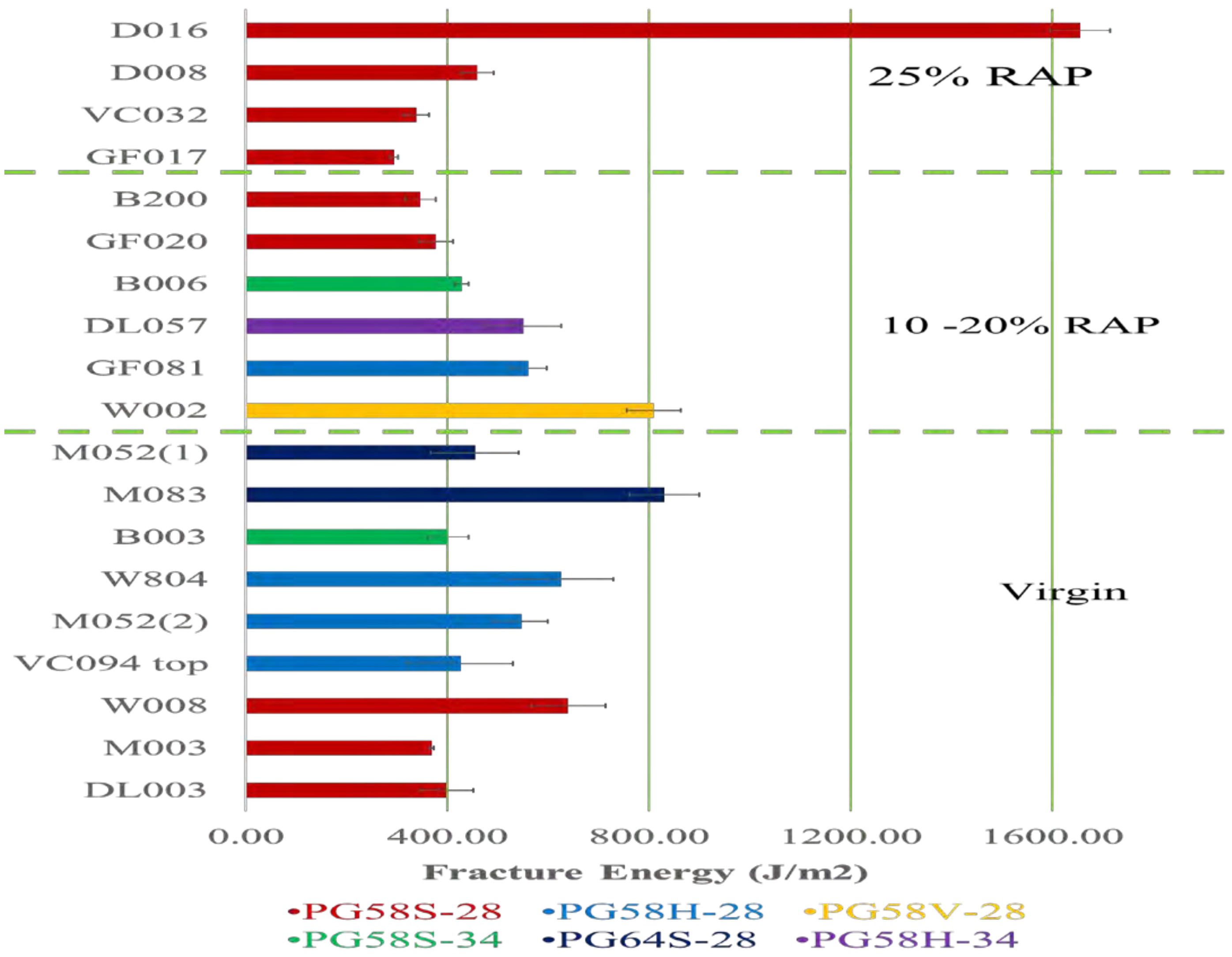
Fracture Energy at 25ºC



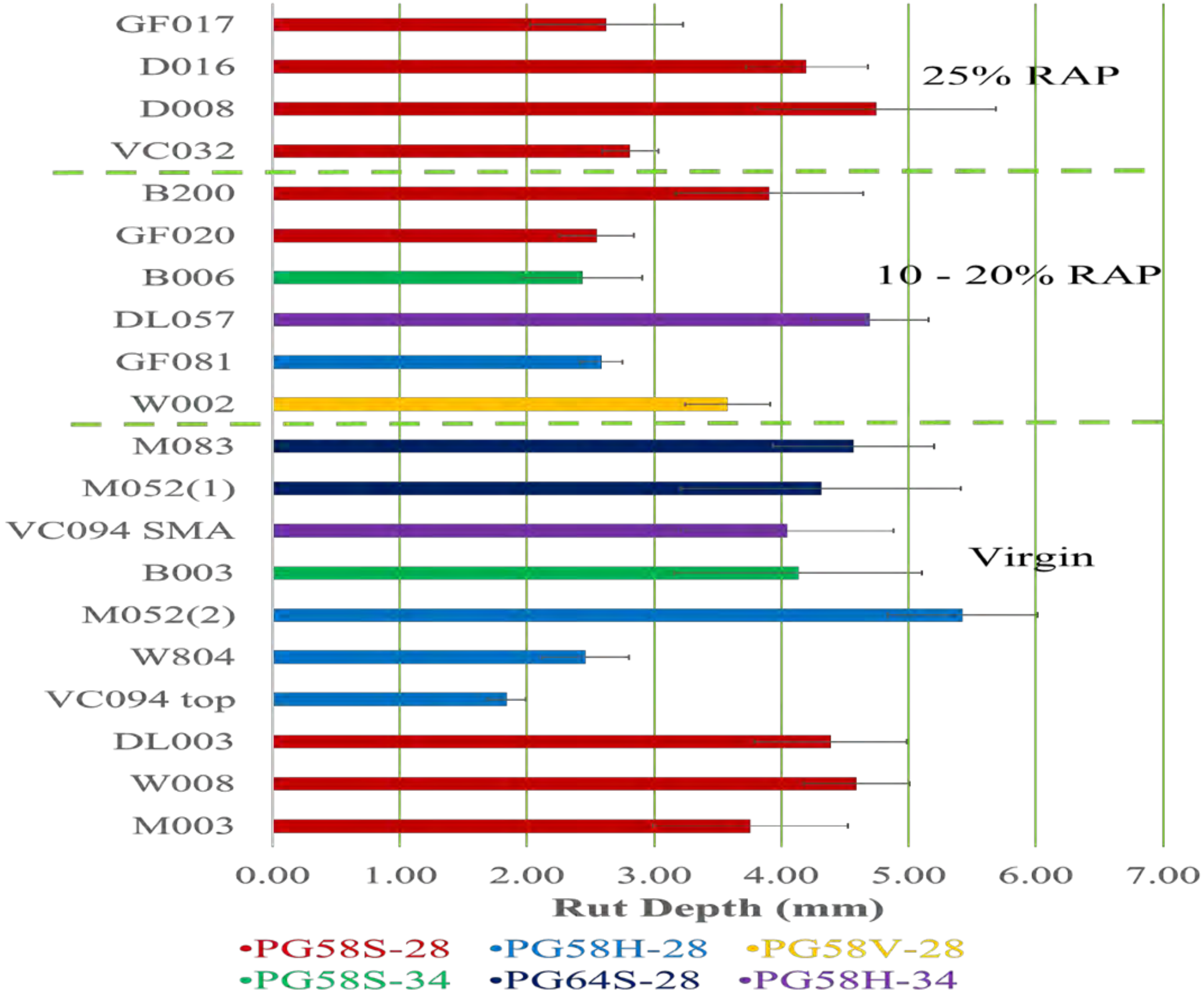
Flexibility Index (FI)



Low-temperature Cracking

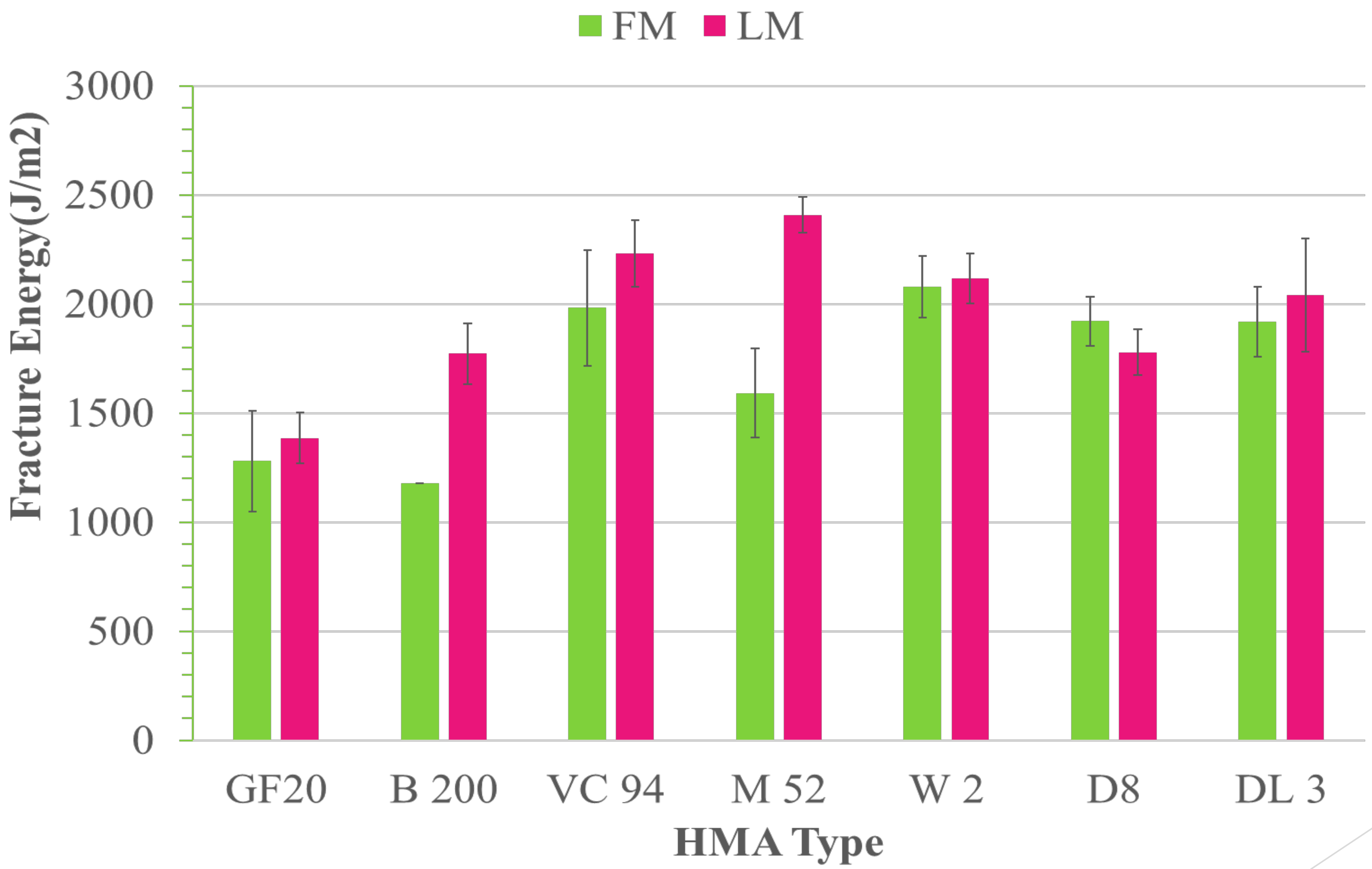


Average Rut Depth at 8000 Cycles

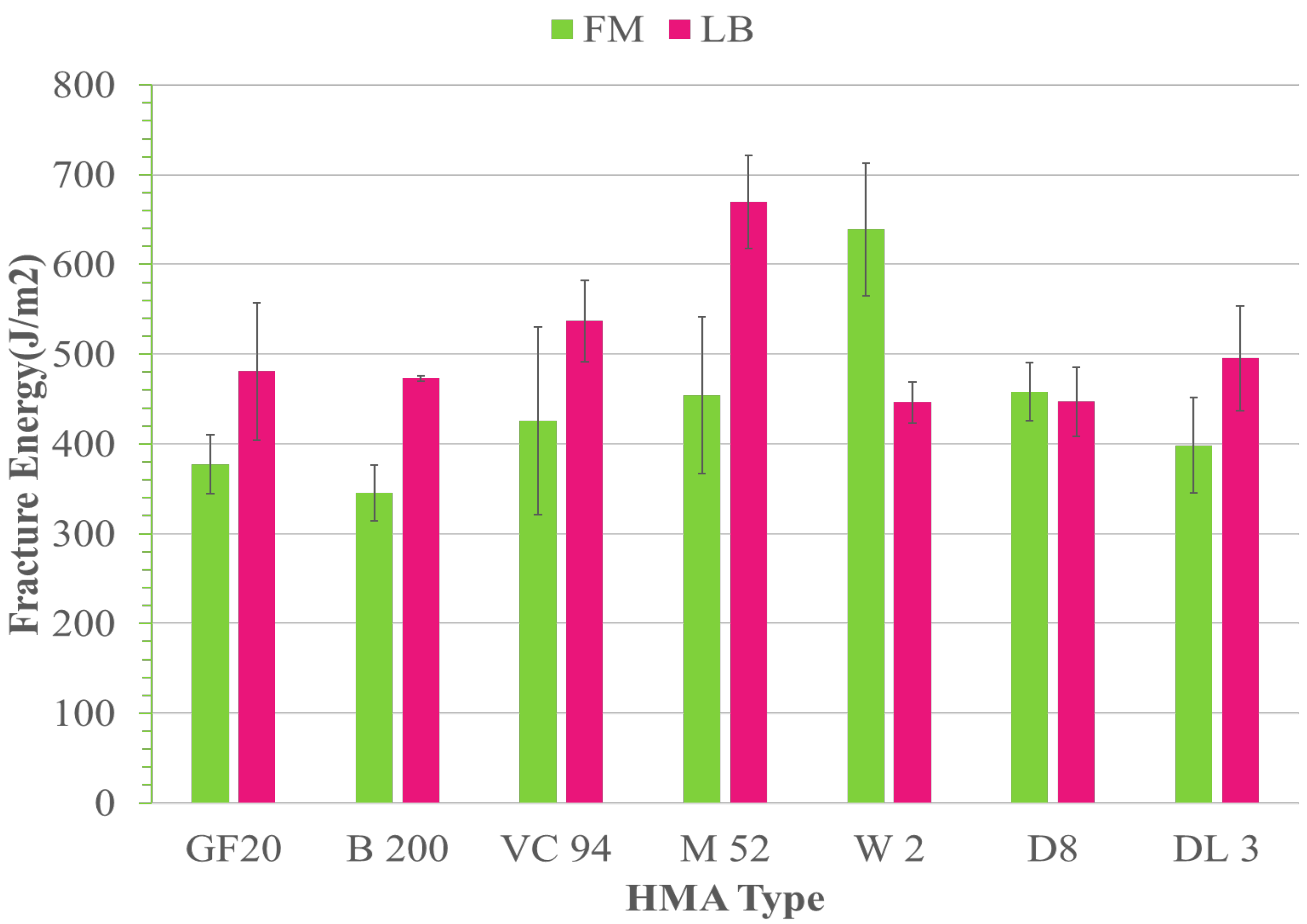


Comparison of Field and Lab Mixes

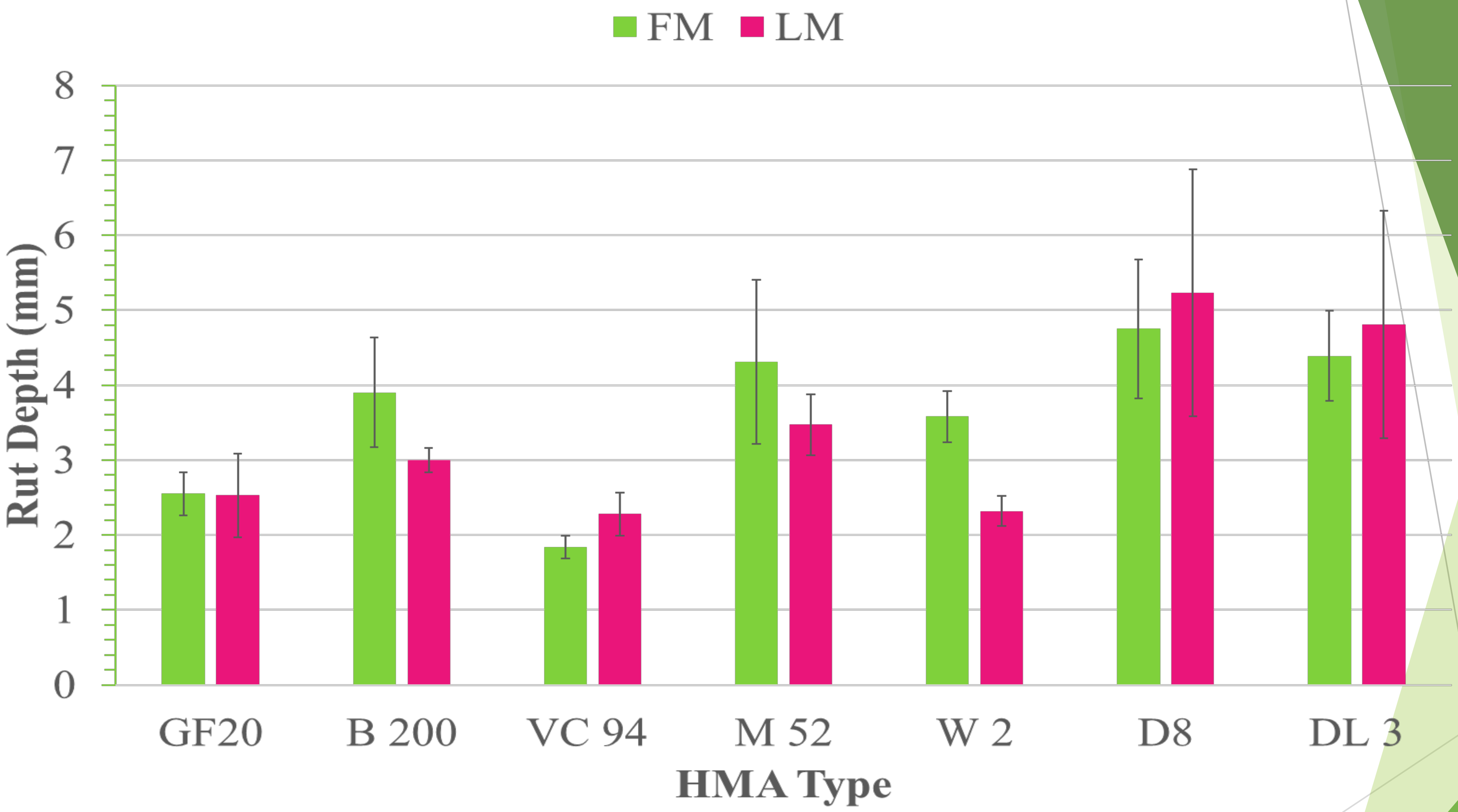
Fracture Energy at 25ºC



Low-temperature Cracking



Average Rut Depth at 8000 Cycles



Conclusions

- For virgin mixes:
  - PG 58H-28 is the most rut resistant.
  - PG 64S-28 and PG 58-28 showed similar fatigue cracking performance.
  - PG 58H-28 and PG 64S-28 had better low- temperature performance.

- For 10-20% RAP mixes:
  - PG 58S-34 was the most rut resistant
  - PG 58V-28 was the most low-temperature and fatigue cracking resistant.

Conclusions *(Continued)*

- For 25% RAP mixes, PG 58S-28 has similar rutting and low-temperature cracking performance, and higher fatigue cracking performance than virgin mix.
- Lab mixes had better fatigue cracking resistance whereas field mixes had higher flexibility indices.
- Lab mixes had better low-temperature performance than field mixes.
- The fracture energy reduces with the increase in RAP percentages in general.

Future Work

- Complete testing
- Develop PBSs
- Write a report

Acknowledgement

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  - District material coordinators for sampling
- Curt Dunn from Grand Forks District for his help
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Thank you!
Questions?