WMA with RAP

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Sites

- Daytona
  - 45% RAP WMA and HMA with PG 52-16
  - 45% RAP WMA with PG 64-22
- Milwaukee
  - 20% RAP WMA with PG 64-22
- Rock Hill
  - 30% and 50% RAP WMA with PG 64-22

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Mixes

Mix ID	Mix Type	Lift	NMAS	Fractionated	RAP Percentage	Virgin PG
FL1	WMA	Binder	12.5	Yes	45/55	64-22
FL2	WMA	Binder	12.5	Yes	45/52	RA 800
FL3	HMA	Binder	12.5	Yes	45/58	RA 800
SC1	WMA	Intermediate	12.5	Yes	50/47	64-22
SC2	WMA	Surface	9.5	Yes	50/38	64-22
SC3	WMA	Surface	9.5	Yes	50/35	64-22
WI1	WMA	Surface	12.5	Yes	25/16	64-22

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Asphalt Performance Grade

	FL1	FL2	FL3	Coarse RAP	Fine RAP
True Grade	84.4-20.7	71.8-24.0	75.5-22.7	82.7-16.6	85.6-14.6
PG Grade	82-16	70-22	70-22	82-16	82-10

	SC1	SC2	SC3	Coarse RAP	Fine RAP
True Grade	85.7-21.8	81.0-24.6	82.5-21.5	88.7-17.8	97.5-9.6
PG Grade	82-16	76-22	82-16	88-16	94-4

	WI1	RAP
True Grade	73.2-21.5	77.7-19.5
PG Grade	70-16	76-16

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APA

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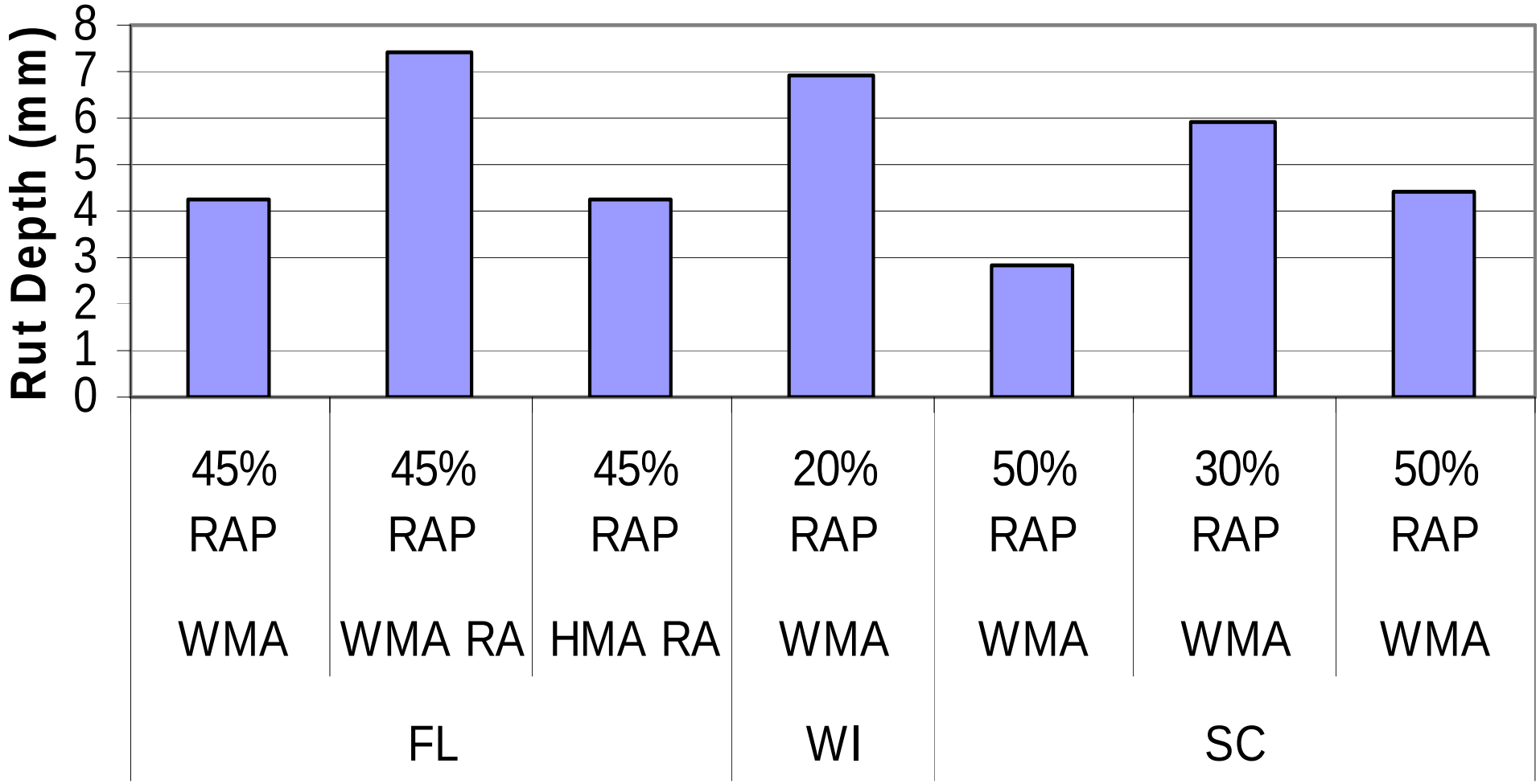

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TSR

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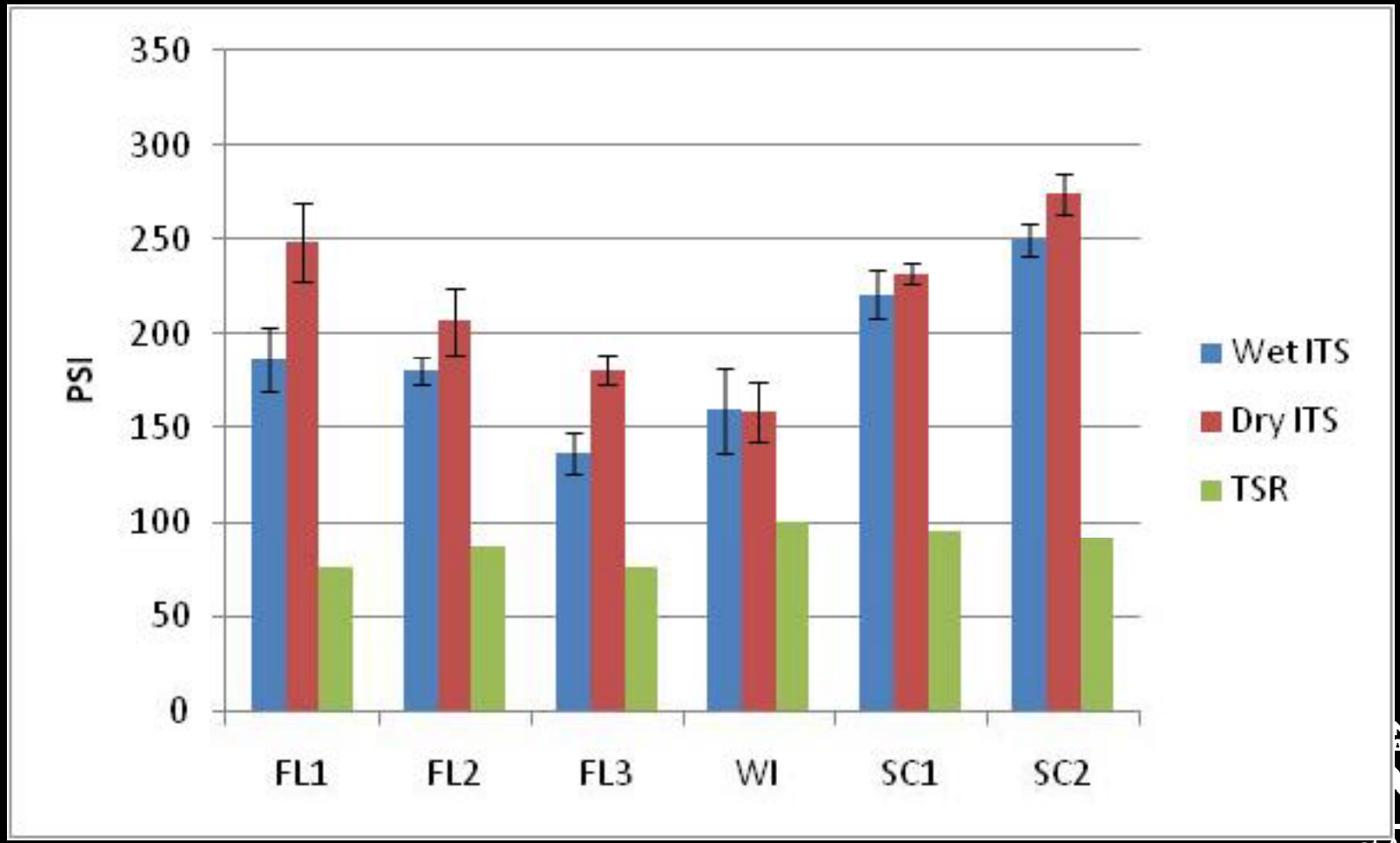
TSR Results



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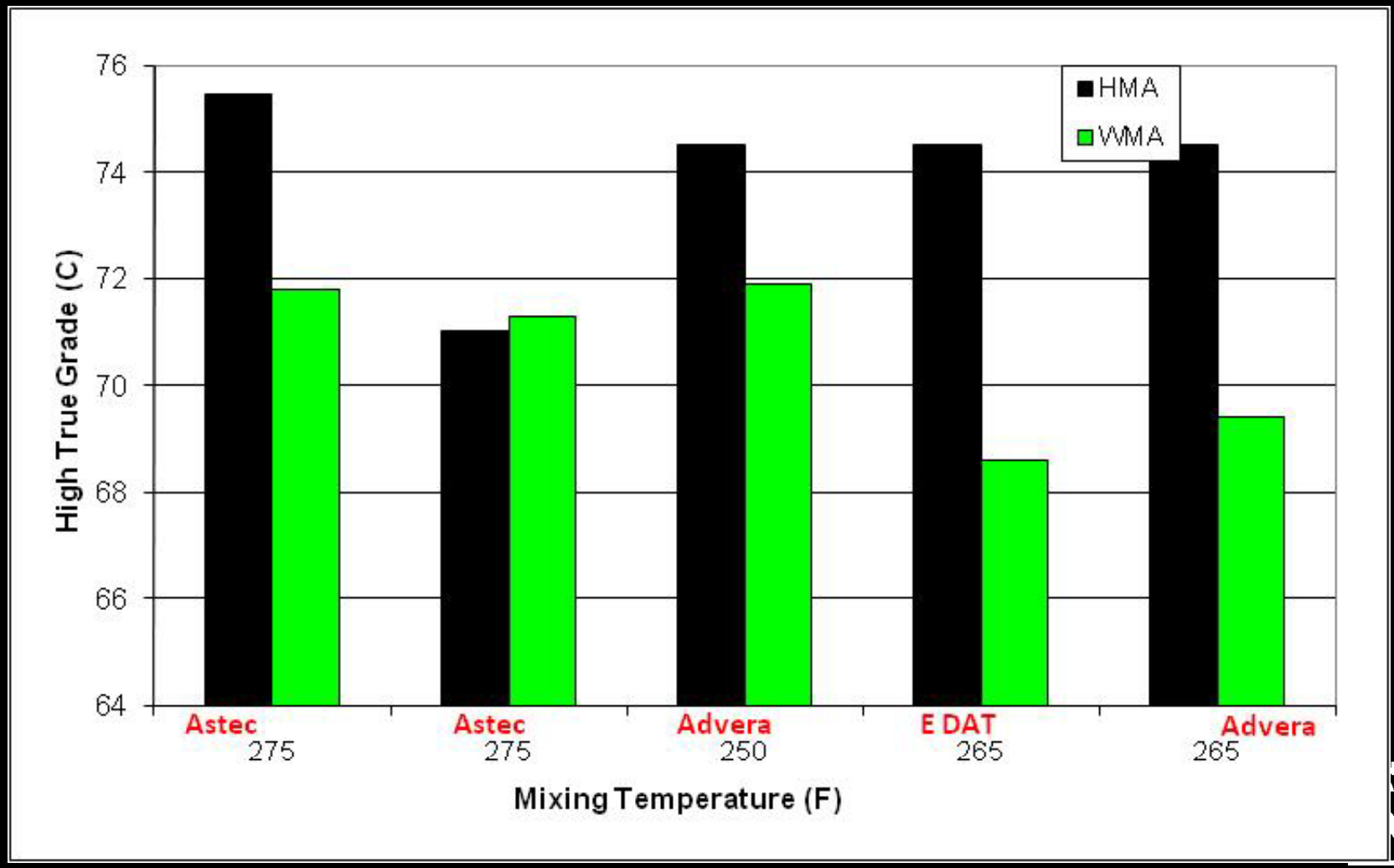
High True Grade



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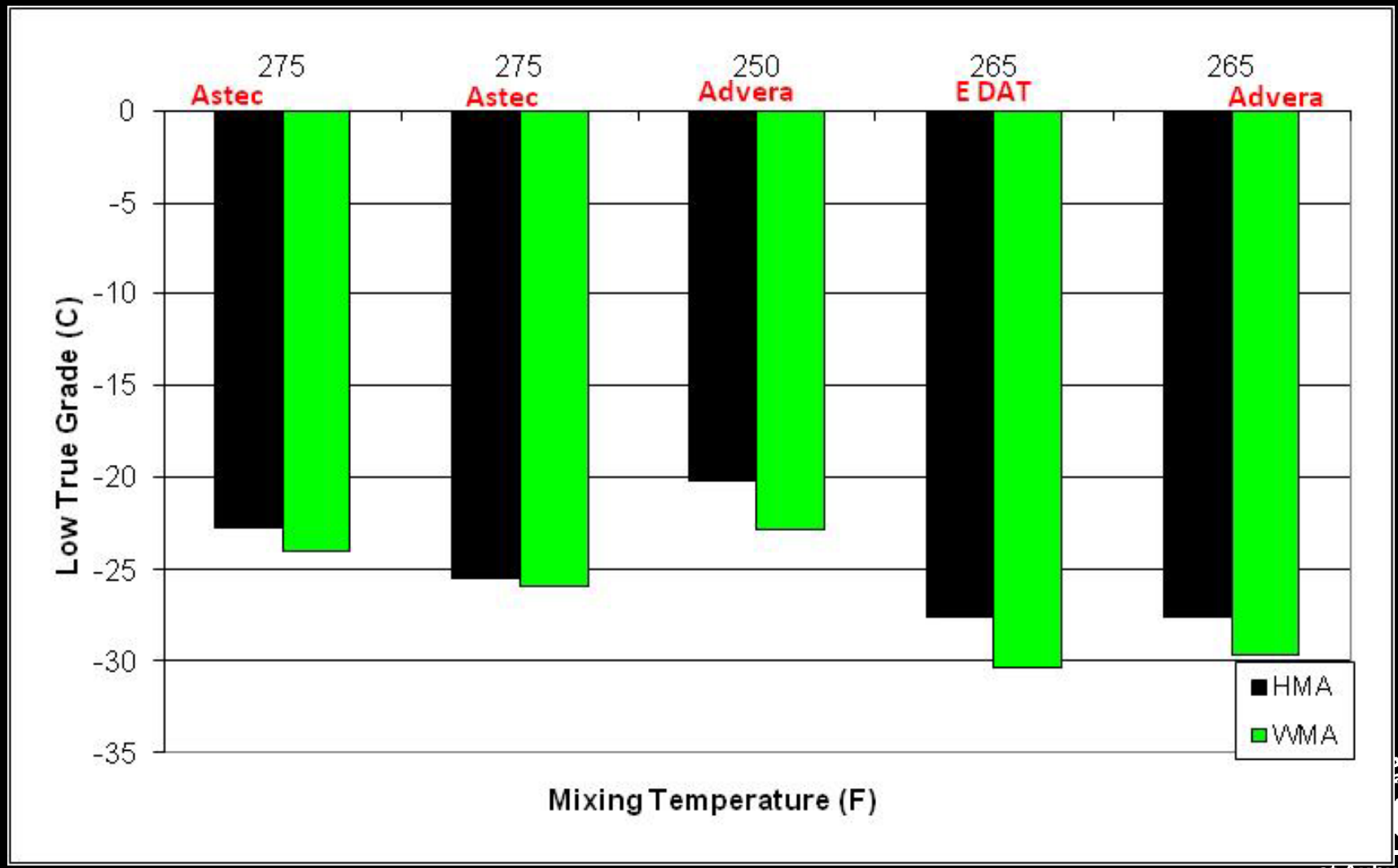
Low Temperature Grade



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LTPP data showed that fatigue may be a concern

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Beam Fatigue

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Beam Fatigue Testing

- 400 microstrain
- 10 Hz frequency
- 20°C test temperature
- AV 7±0.5%
- 3+ beams per mix
  - Some of the earlier mixes have 6 specimens per set because too many were made and they all hit AV so they ran them all

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Mix	Type	Fract.	Virgin Grade		Mix Grade			AC, %	NMAS, mm	RAP,%	Rap Binder/ Total Binder,%
			High	*Low*	*High*	*Low*	*Int.*				
FL1	WMA	Y	64	-22	82	-16	27	5	12.5	45	55
FL2	HMA	Y	52	-16	70	-22	23	5.4	12.5	45	52
FL3	WMA	Y	52	-16	70	-22	23	4.7	12.5	45	58
WI	WMA	Y	64	-22	70	-16	26	5	12.5	25	16
SC1	WMA	Y	64	-22	76	-22	32	5.1	9.5	30	35
SC2	WMA	Y	64	-22	82	-16	25	4.7	9.5	50	38
GA	HMA	N	64	-22	76	-16	27	5.4	9.5	15	12
MN1	WMA	N	58	-34	64	-22	14	5.6	12.5	0	0
MN2	HMA	N	58	-28	88	-10	23	5.6	12.5	30	32
MN3	HMA	Y	58	-28	70	-22	21	5.7	12.5	30	32
MN4	HMA	Y	58	-34	88	-16	23	5.5	12.5	30	32
N1	HMA	N	67	-28	68.4	-31	20	4.9	19	0	0
N2	HMA	N	64	-22	69.1	-28	18	7	12.5	0	0
N3	HMA	N	64	-22	68.6	-26	20	5.2	19	0	0
N4	HMA	N	70	-22	71.3	-25	24	7.7	9.5	0	0
G1	WMA	N	67	-22	--	--	--	5.1	12.5	30	28
G2	HMA	N	67	-22	--	--	--	5.1	12.5	30	28

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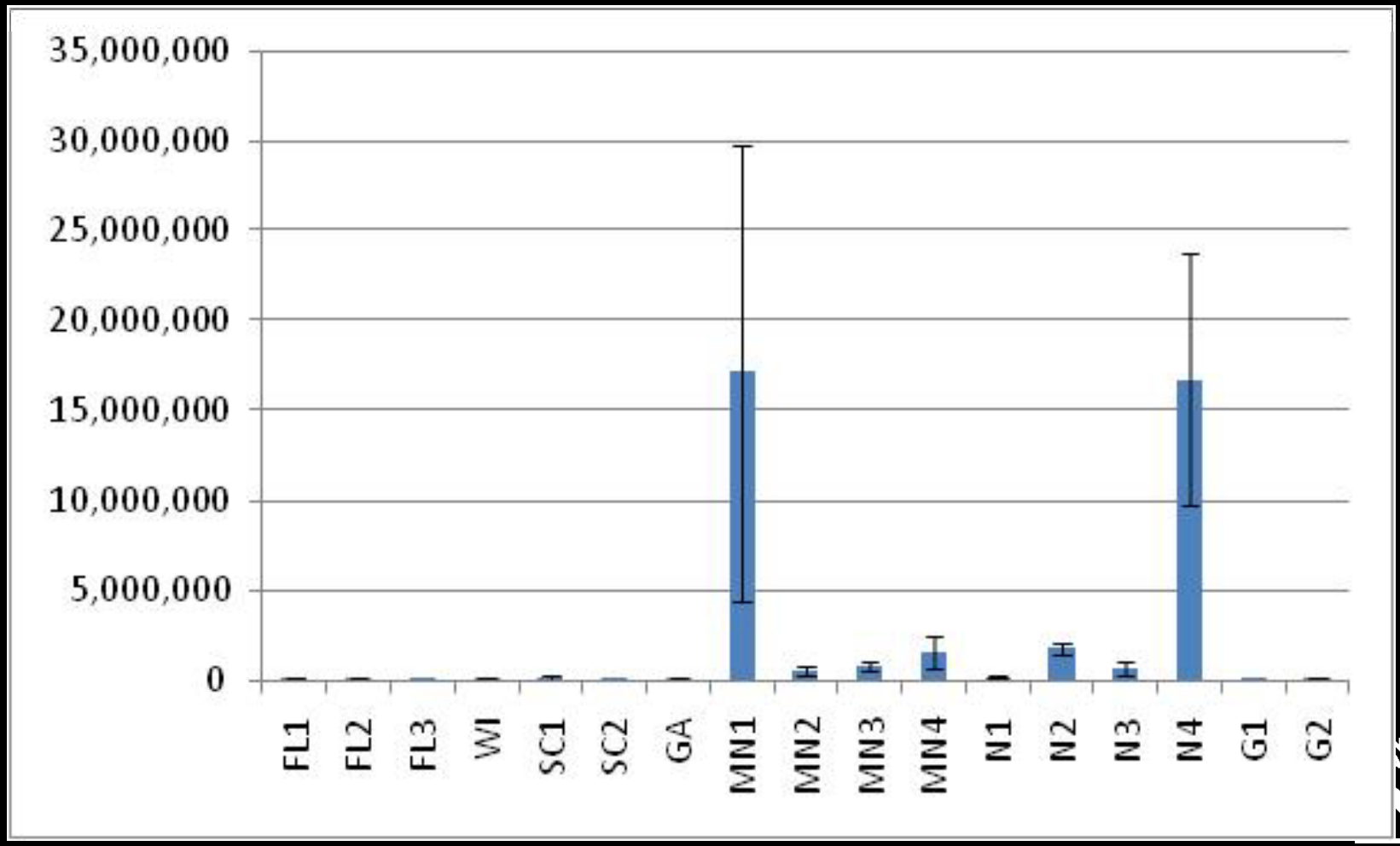
Results



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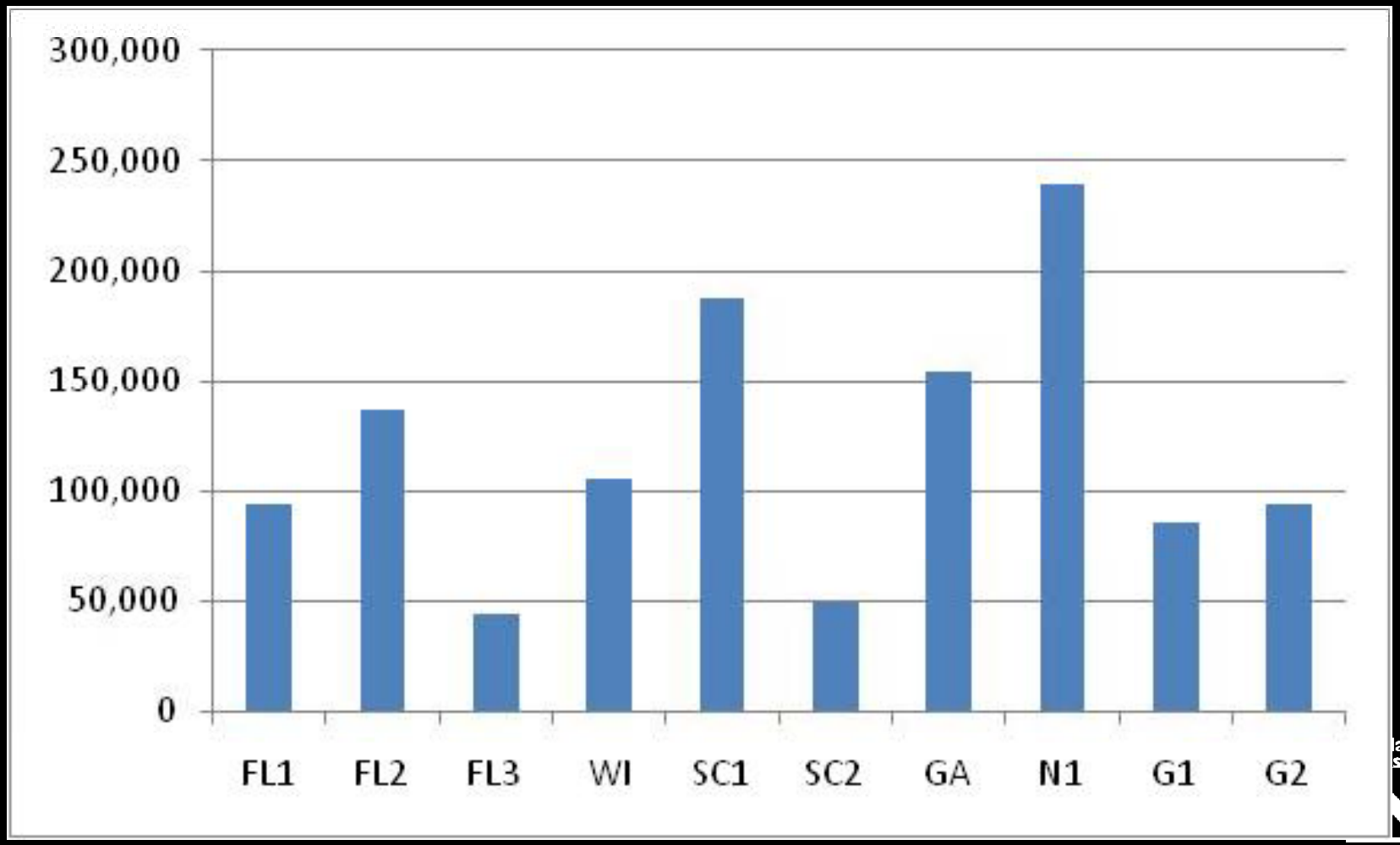
Lower Cycles to Failure



Statistics

- ANOVA used to evaluate factors that contributed to variability
  - Intermediate temperature
  - RAP % (by weight of mix)
- WMA did significantly improve or decrease fatigue life

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Tensile Strength Ratio

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