Maximizing the Use of Local Aggregates in Asphalt Surfaces

Transportation Research Board

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Outline

- Background and Objectives
- Approach
- Findings
- Implementation

Background

- Local materials predominantly carbonates
- Limestones are susceptible to polishing
- Available high friction aggregates are steel and blast furnace slags and sandstone
  - Limited sources
  - Long haul distances
  - Premium prices
- Current limits based on historical performance

Objective

- Objective – explore opportunities to allow the use of more local materials in HMA in place of “imported” fine and coarse aggregates
- Aligned with INDOT goal of reducing construction costs while maintaining level of performance.

How much local aggregate can replace high quality friction aggregate in HMA surfaces?

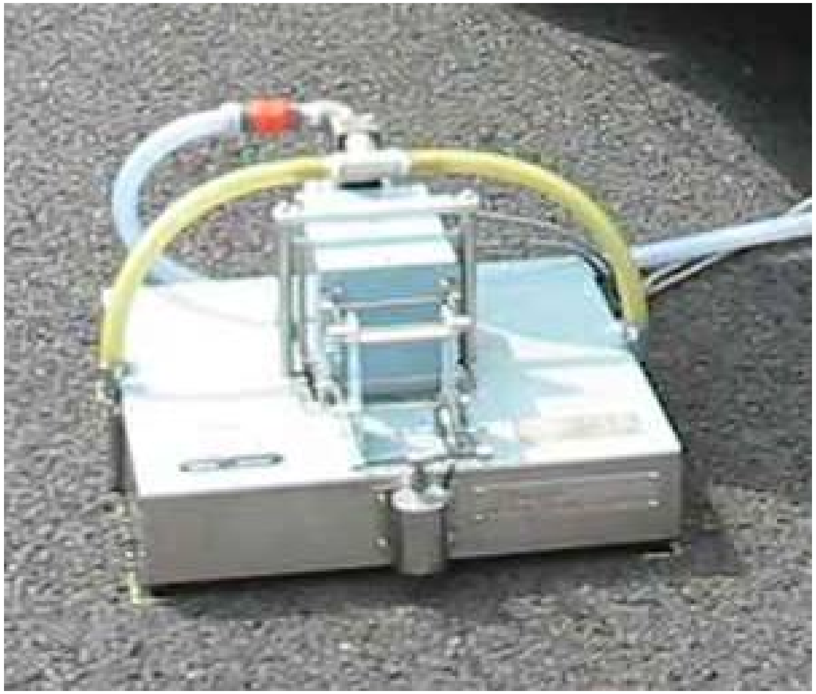
Experimental Approach

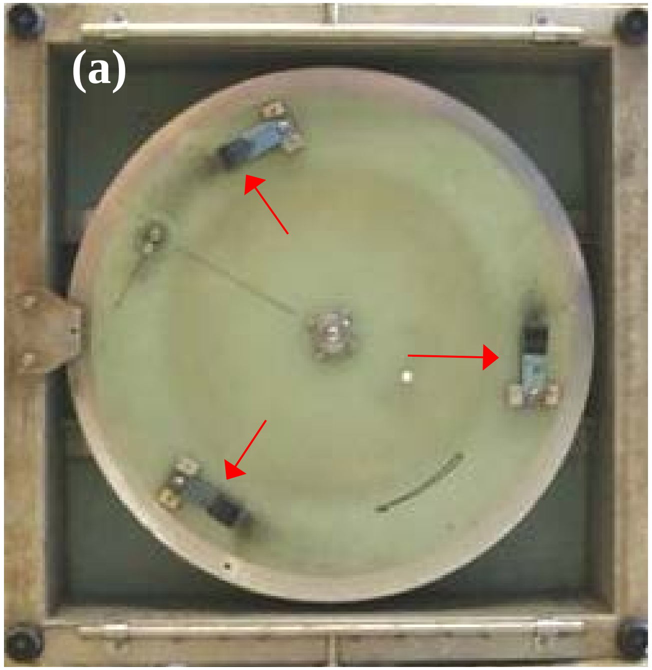
- Build on testing procedure developed in earlier study
- Fabricate, polish and test slabs of various compositions
  - Local coarse aggregate up to 40% blended with steel slag, ACBF and sandstone
  - Local fine aggregate up to 20%
  - Both local fine and coarse at 20%
  - 9.5 mm DGA and SMA mixes

Goals for Required Lab Method

- Test friction and texture
- Accelerate polishing
- Test asphalt mixtures, not aggregates only
- Ideal to be able to test in lab and field
- Led to identification of Dynamic Friction Tester and Circular Track Meter
- Needed a polisher to match
- Idea from NCAT, refined by NCSC

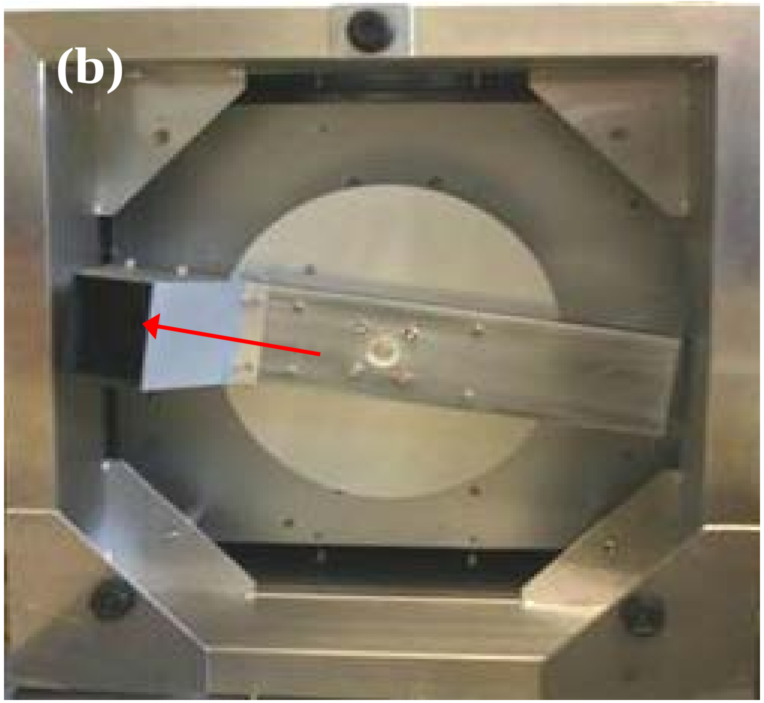
Dynamic Friction Tester (DFT)





DFT – dynamic friction at 20 km/h (DF20)

Circular Track Meter (CTM)

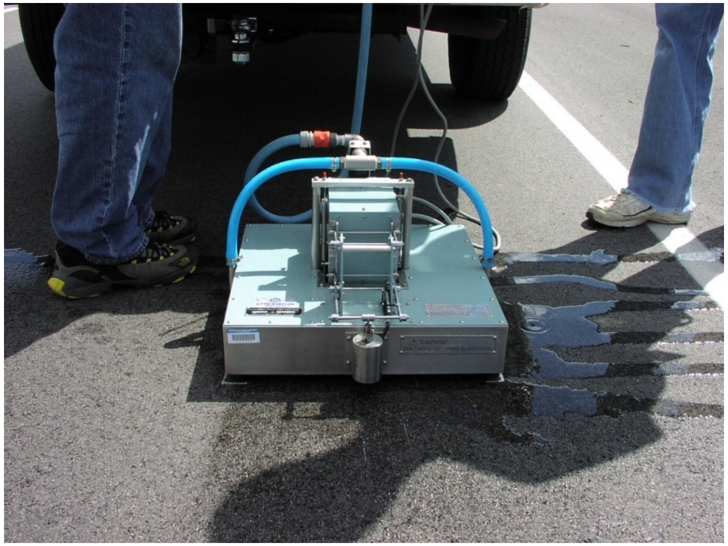


CTM – Mean Profile Depth, mm

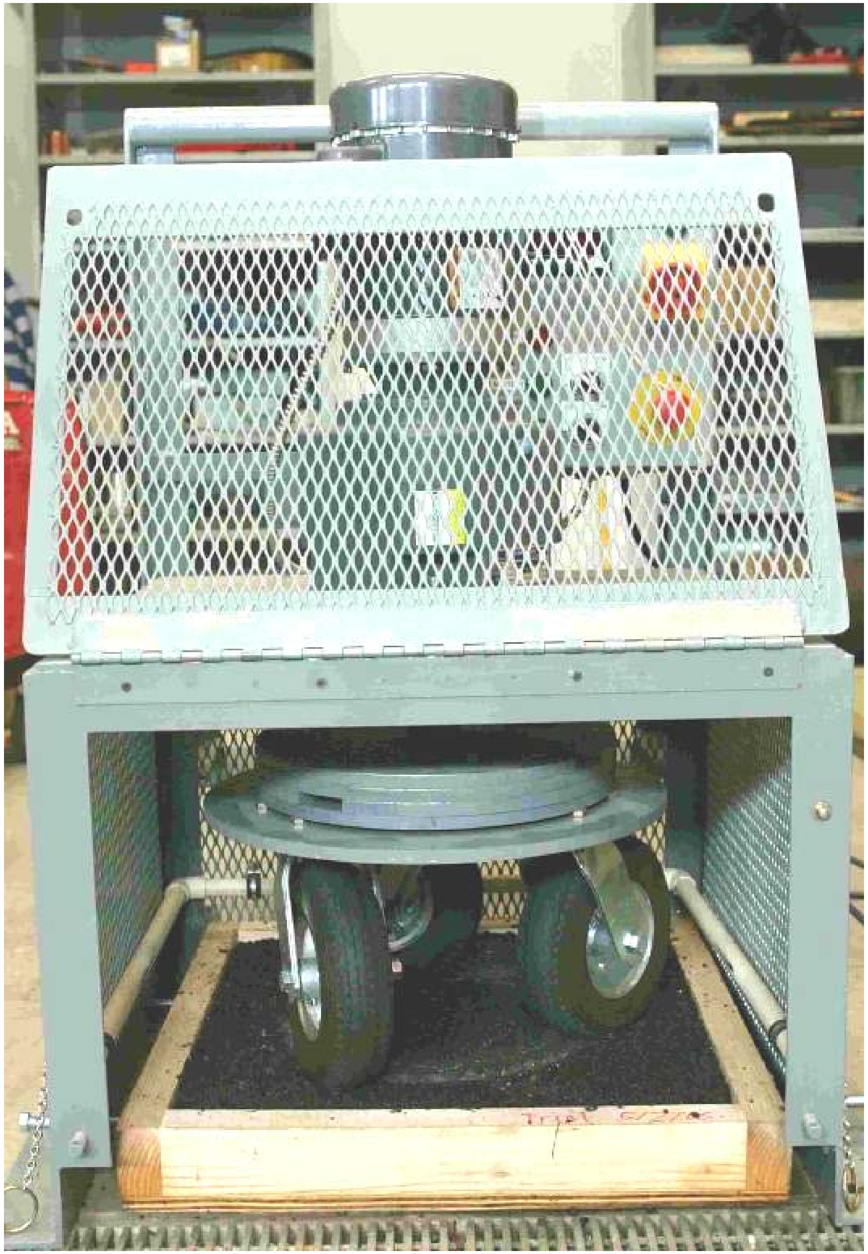
International Friction Index

IFI ($F60$, S_p)

$$\begin{cases} F60 = 0.081 + 0.732 DF_{20} e^{\frac{-40}{Sp}} \\ S_p = 14.2 + 89.7 MPD \end{cases}$$

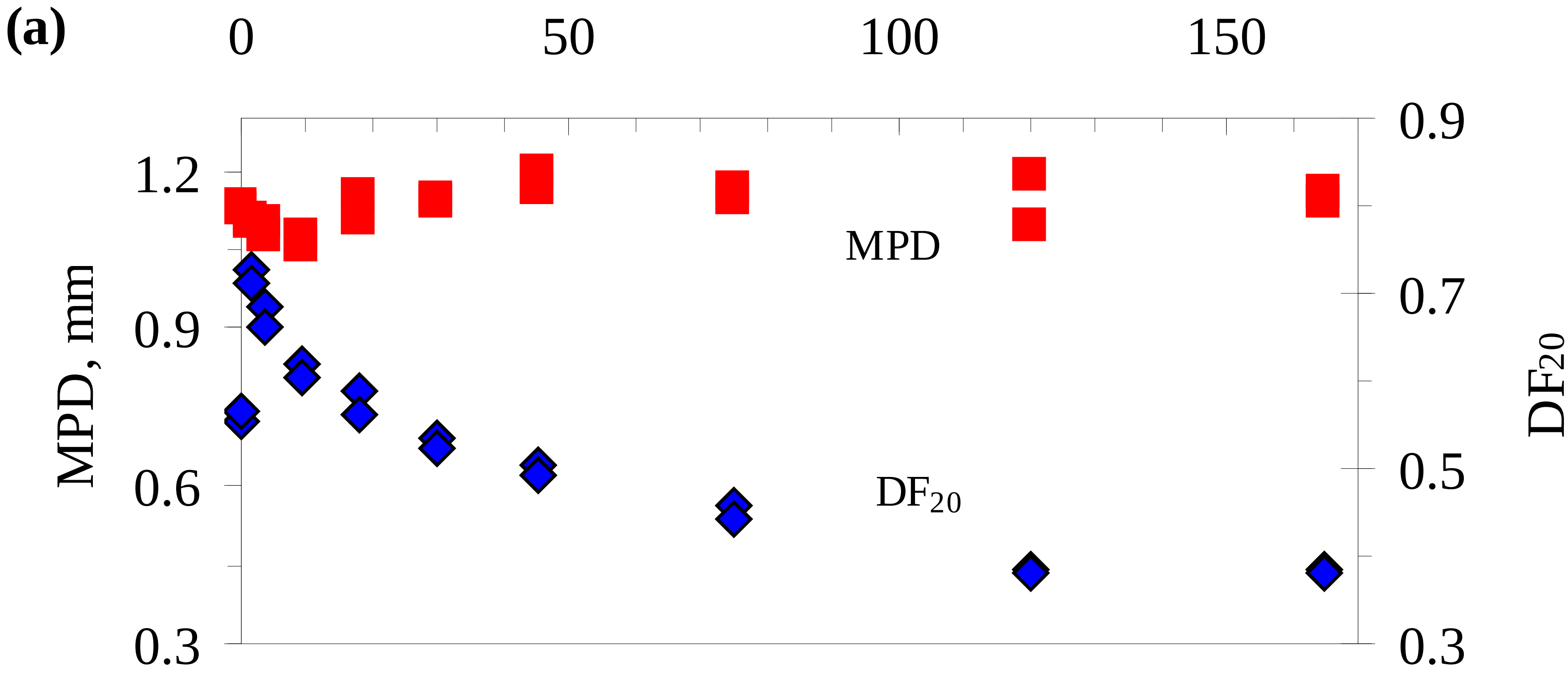


Circular Track Polishing Machine



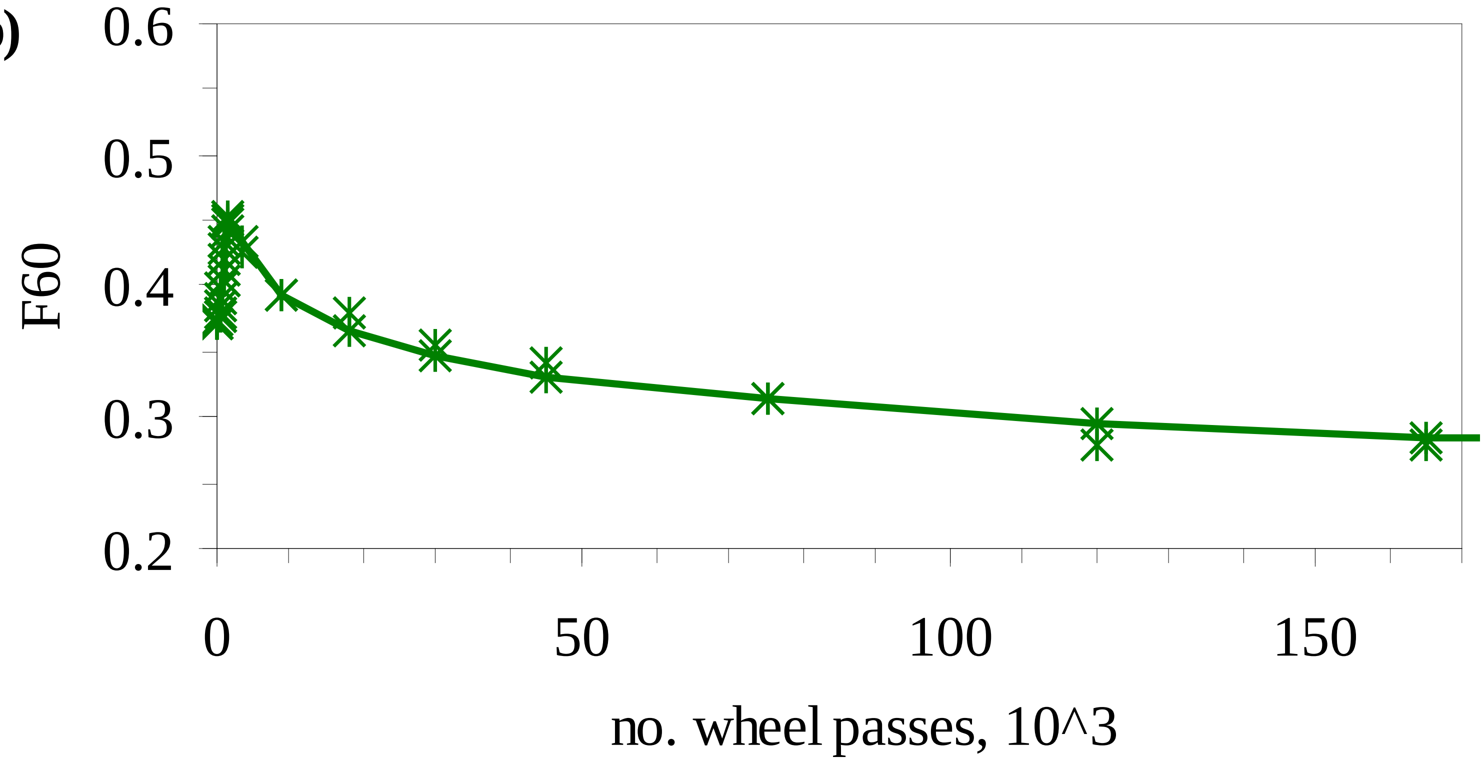

(a)
(b)
(c)
(d)

Texture and Friction (DF20)

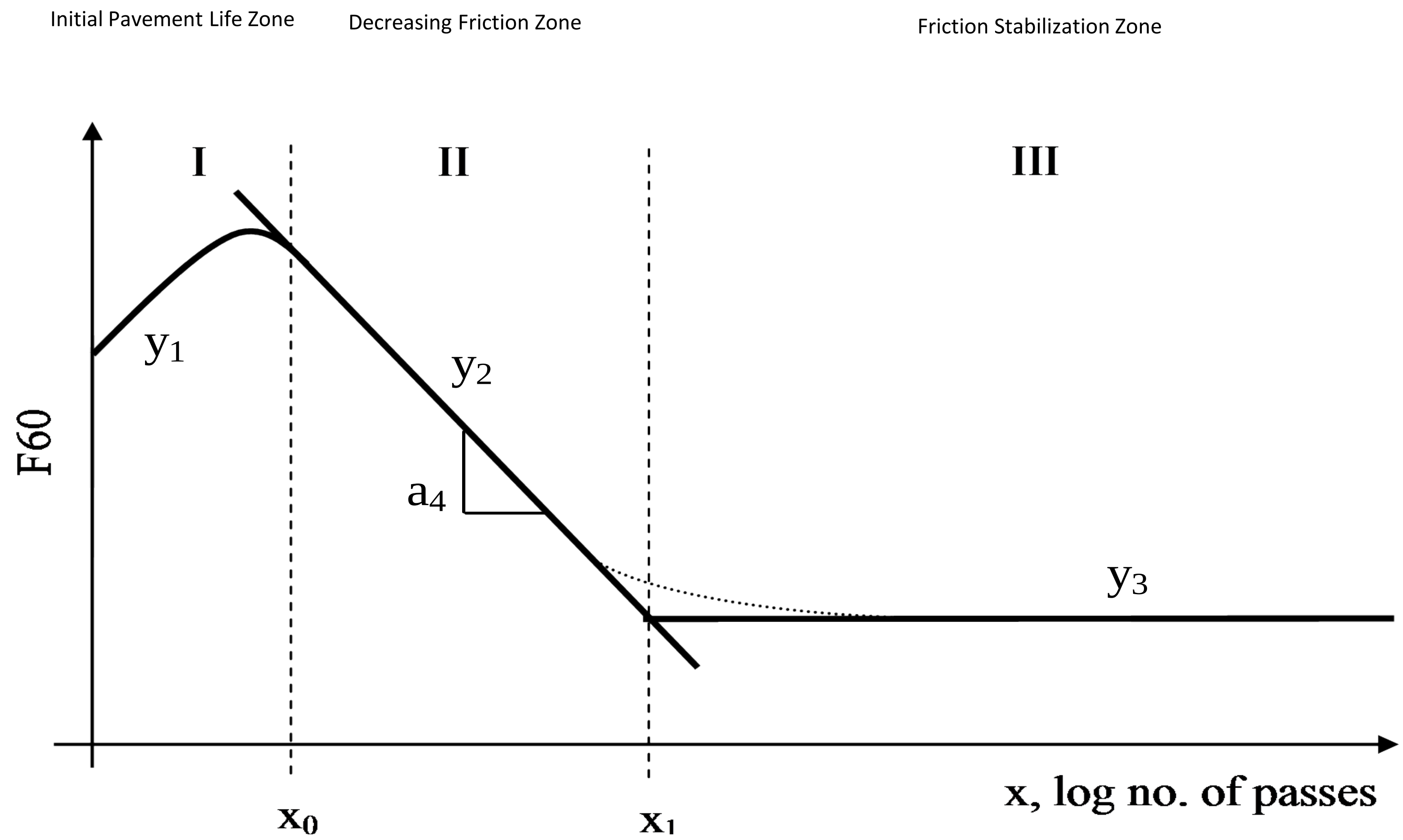


IFI (F60)

(b)



Polishing Model



Calculate F60 (IFI Value) per E1960. See AAPT 2009, Kowalski et al.

Aggregates Selected for Testing

- Polish Resistant
  - Steel slag
  - Blast furnace slag
  - Sandstone
- Polish Susceptible (St. Genevieve formation)
  - 3 sources
- Polish Resistant Aggregate - Carbonate (PRA)
  - 1 source

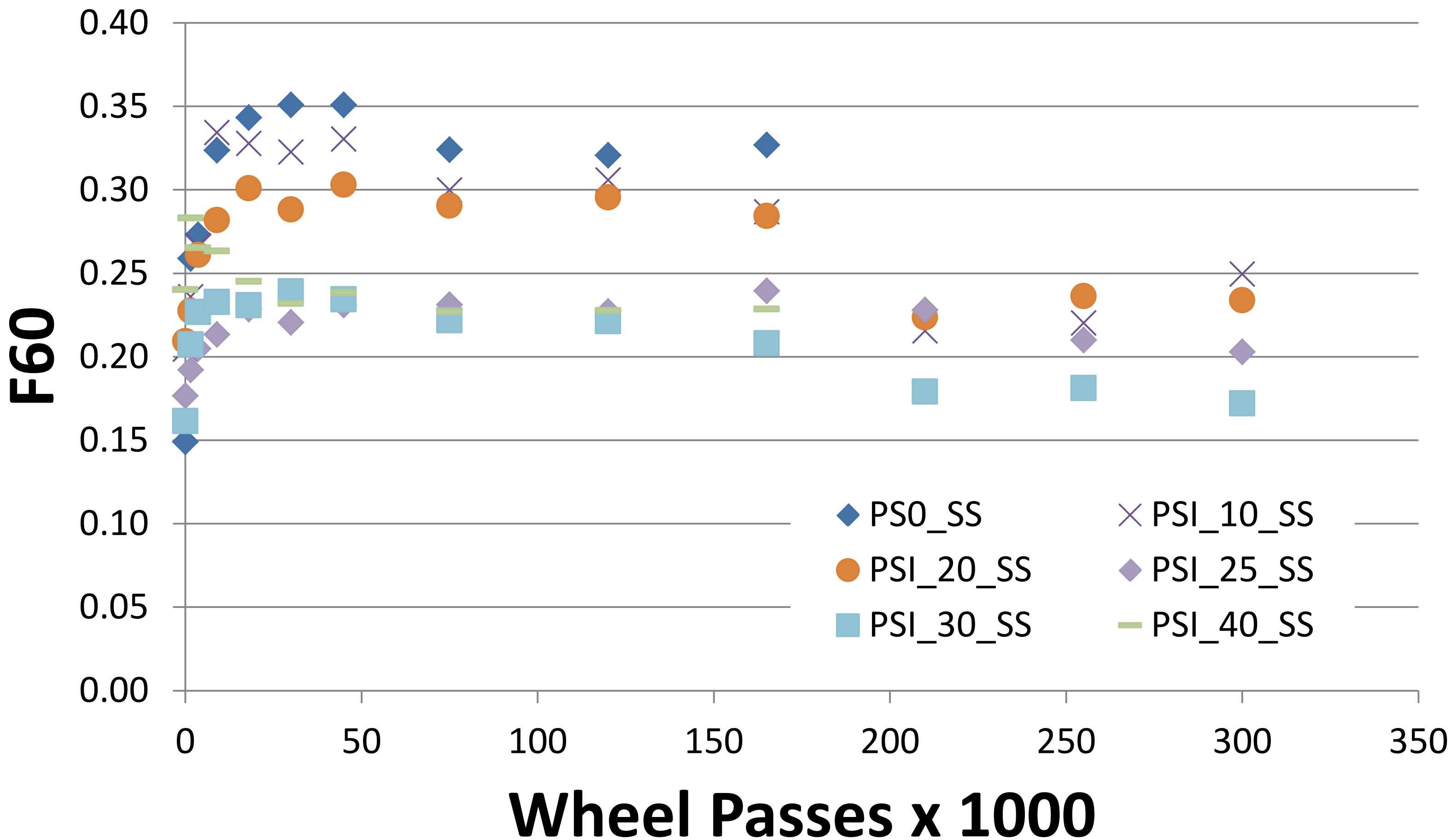
Coarse Agg in DGA – F60

Resistant/Susceptible	0%	10%	20%	40%
Steel Slag/PSI	0.33	0.29	0.28	0.23
Steel Slag/ PSII	0.33	--	0.31	--
Sandstone/PSI	0.30	--	0.27	--
ACBF/PSI	0.34	--	0.26	--

All at 165,000 wheelpasses.

40% is too high.

Coarse Agg in DGA with Steel Slag

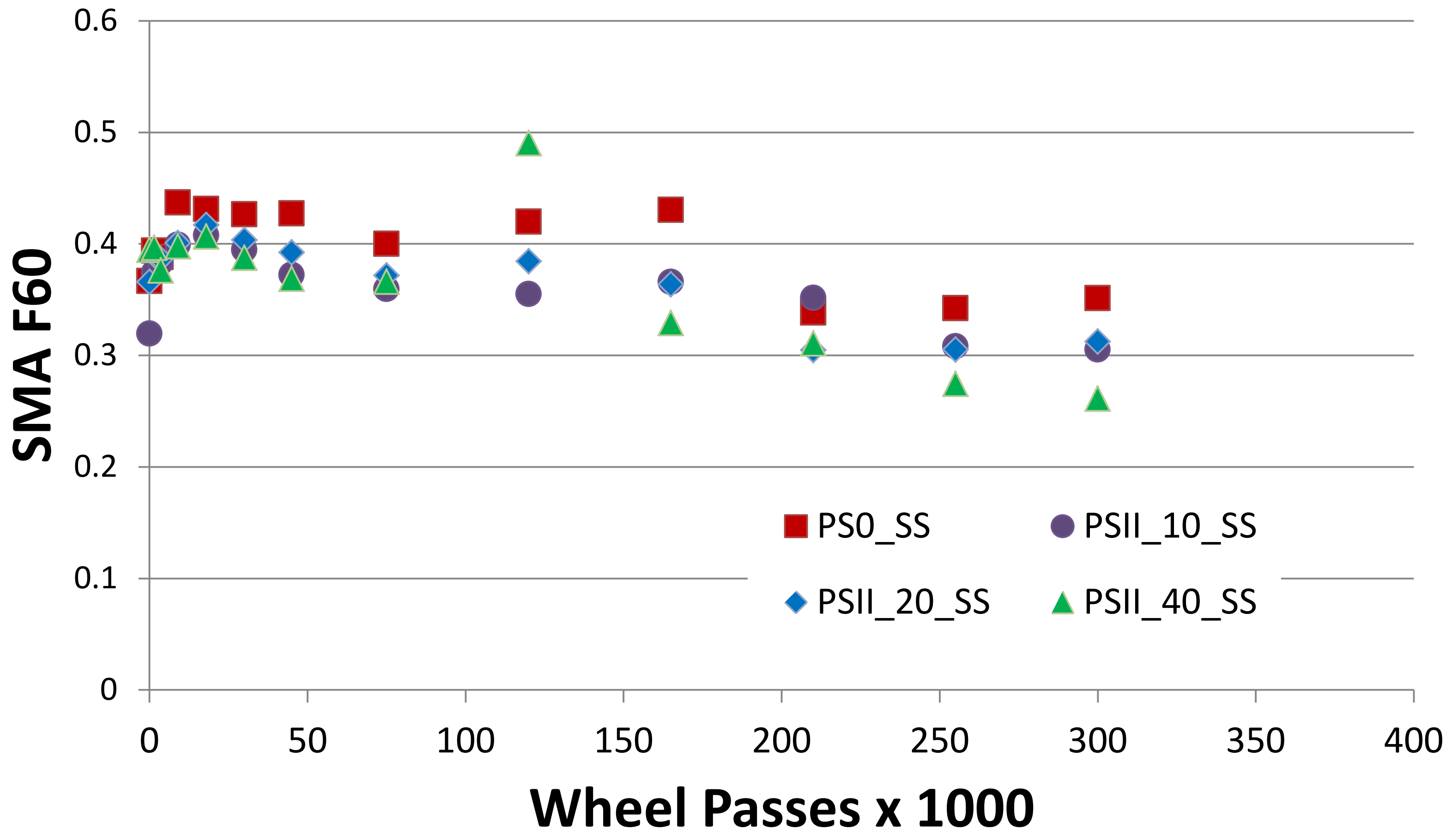


Coarse Agg in SMA– F60

Resistant/Susceptible	0%	10%	20%	40%
Steel Slag/PSI	0.43	0.37	0.37	--
Steel Slag/PSII	0.43	0.37	0.36	0.33
Sandstone/PSII	0.42		0.34	--
ACBF/PSII	0.41	0.29	0.32	--

All at 165,000 wheelpasses.

Coarse Agg in SMA with Steel Slag



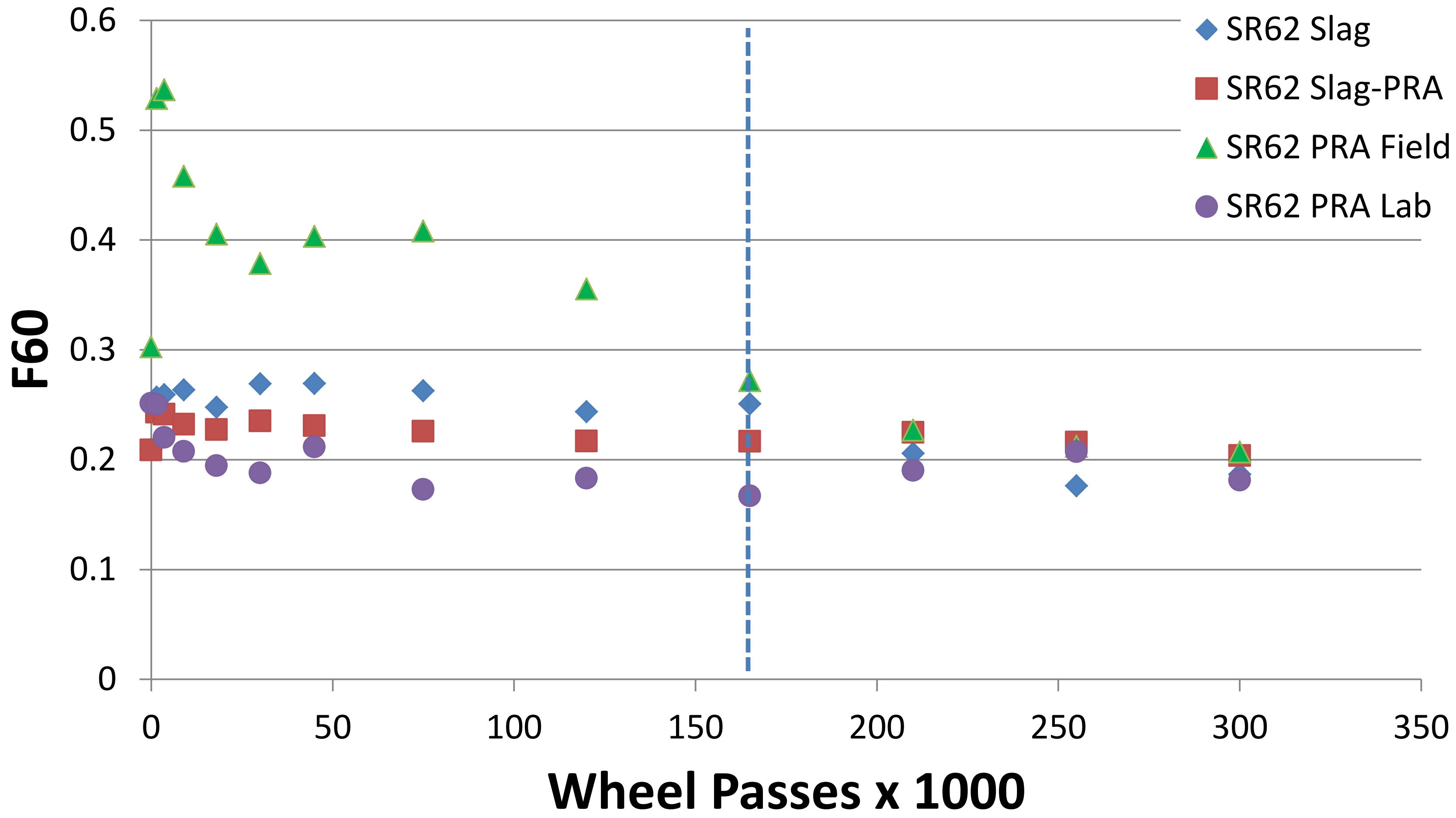
Findings

- Adding polish susceptible agg caused decrease in surface friction in DGA and SMA.
- Friction was still acceptable at up to ~20% local agg.
- Fine aggregate data was somewhat erratic.
- Fine agg up to 20% had small negative effect.
- There are other considerations besides friction (shape, strength, gradation).

Other Testing

- SR62 test strip, June 2010
- Coarse Aggregates
  - Steel Slag alone
  - PRA alone
  - PRA and steel slag blend
- Samples of three mixes and aggregates provided
- Slabs prepared, compacted and tested

Mixes from Field Trial



Ultimate Product

- Laboratory screening test method for qualifying aggregates
- Set baseline for steel slag, ACBF slag, sandstone
- Aggregate producers can choose to have aggregates screened
- If they pass, go to field test
- Comparison is made to known aggregate, not a particular F60 value (at this time)
- Implemented as screening test for ESALs ≥10,000,000 (ITM 221)

Potential Cost Savings

Substituting local agg for steel slag could save:

- $1.50 to 2 per ton of hot mix (fine aggregate)
- $3 to 4 per ton of hot mix (coarse agg)
- $4.50 to 6 per ton of hot mix (both)
- Up to 10% of cost of mix
- $3000 to 4000 per lane mile of surface mix

Acknowledgement

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- The contents of this presentation reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein, and do not necessarily reflect the official views or policies of the sponsoring organizations. These contents do not constitute a standard, specification, or regulation.

Questions?

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