Illinois Tollway

Open Roads for a Faster Future

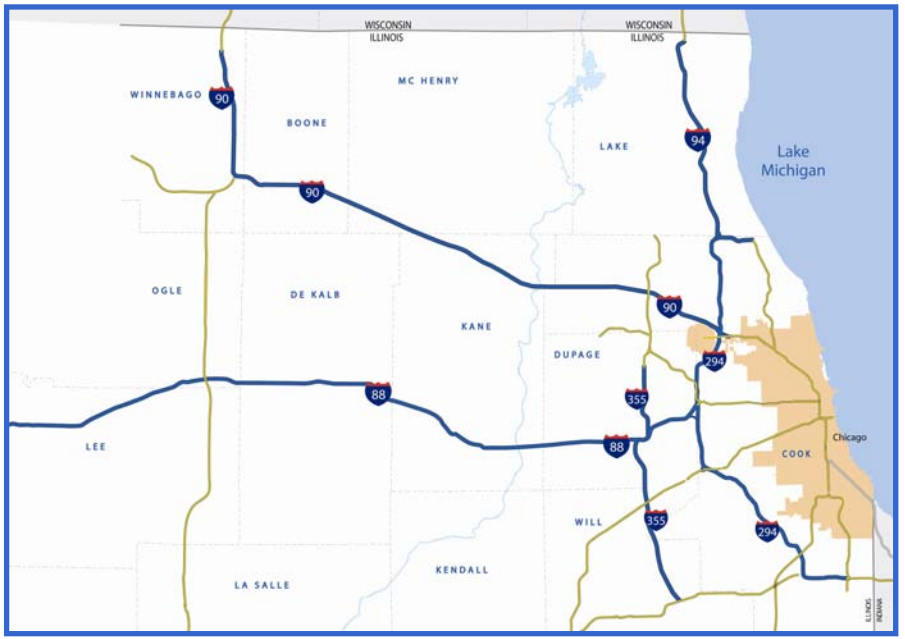
High RAP Research and Applications

RAP ETG

April 22, 2009

Illinois Tollway – Key Statistics

- **286-mile system comprised of four tollways**
  - Tri-State (I-94/I-294/I-80)
  - Jane Addams Memorial (I-90)
  - Reagan Memorial (I-88)
  - Veterans Memorial (I-355)
- **Opened in 1958 as a bypass around Chicago to connect Indiana and Wisconsin**
- **Carries more than 1.4 M vehicles per day**
- **User-fee system – no state or federal gas tax dollars used for maintenance and operations**



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Congestion-Relief Program–Phase One

$6.3 Billion Congestion-Relief Program (CRP) to reduce travel times by:

- ❑ **Rebuilding/Restoring** nearly the entire 286-mile system – 50% Complete
- ❑ **Widening** many miles of major roads – 50% Complete
- ☑ Converting 20 barrier toll plazas to **Open Road Tolling**
- ☑ Building the 12.5-mile **extension of I-355** to serve fast-growing Will County

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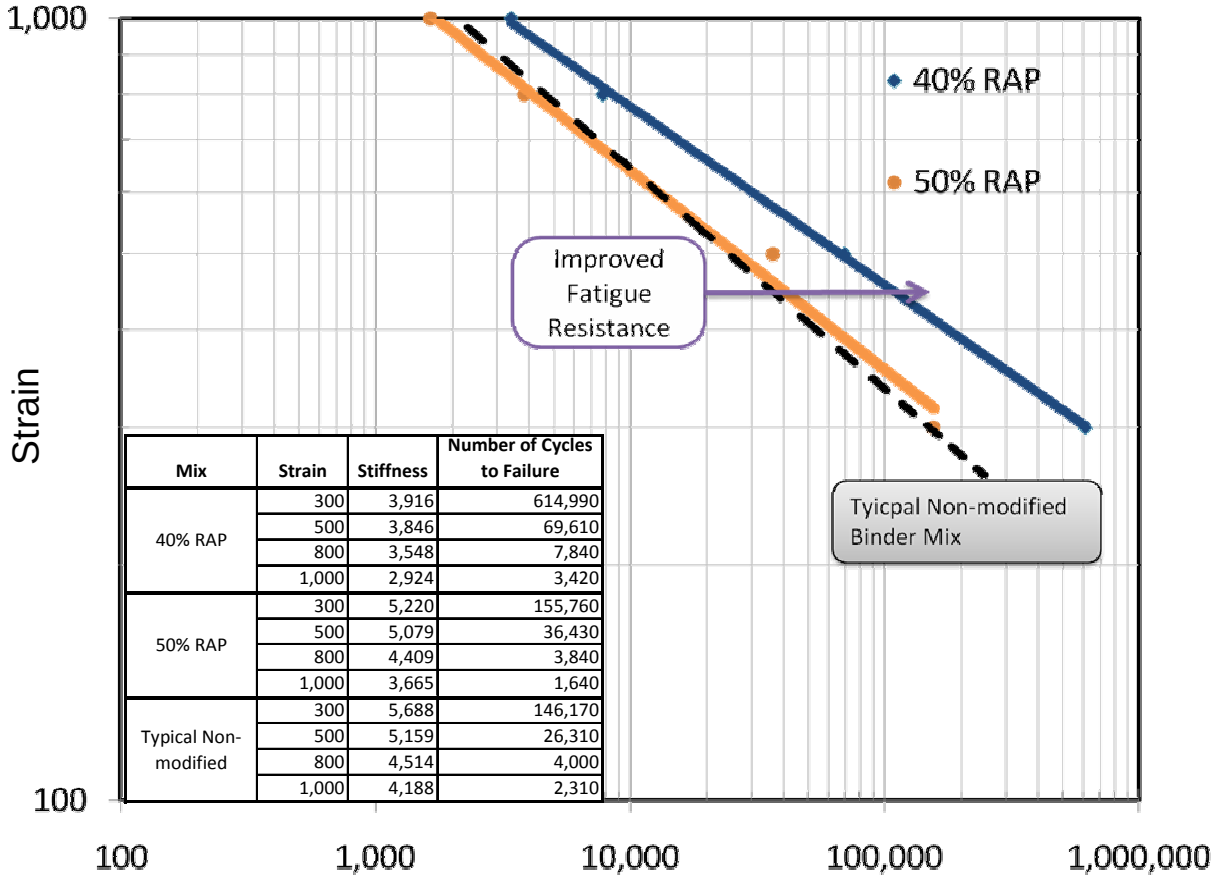
Early 2007 Fatigue Testing



Mix	Strain	Stiffness	Number of Cycles to Failure
40% RAP	300	3,916	614,990
	500	3,846	69,610
	800	3,548	7,840
	1,000	2,924	3,420
50% RAP	300	5,220	155,760
	500	5,079	36,430
	800	4,409	3,840
	1,000	3,665	1,640
Typical Non-modified	300	5,688	146,170
	500	5,159	26,310
	800	4,514	4,000
	1,000	4,188	2,310

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Jane Addams Memorial Tollway (I-90) Reconstruction & Widen Project

- 2007 – FRAP test mixtures on widening and crossovers
- 2008 – EB reconstruction
- 2009 – WB reconstruction
- Contractor willingness to participate - vital

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Collaborative Effort

- Illinois Tollway
- IDOT
- Rock Road Companies
- Rockford Blacktop
- Seneca Petroleum
- Heritage/Levy Slag
- Rib Mountain Aggregate
- ARA & STATE Testing
- University of Illinois Center for Transportation

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FRAP Research Goals

- Mixture Quality Control can be maintained
- Retain long-term performance at lower costs
- Fatigue and Strength analysis
  - Are mix properties compromised with higher RAP?
  - How soft for the PG with the increased RAP? (64-22 vs. 58-22 vs. 58-28)

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Tollway FRAP Specifications

- 2 splits: minus ½ inch/plus #4, and minus #4

- Category 1 FRAP
  - From Tollway Mainline
  - Crushed Aggregates only
  - Required in SMA (fine portion only)

- Category 2 FRAP
  - From other Tollway or State projects
  - Allowable in all dense graded mixtures

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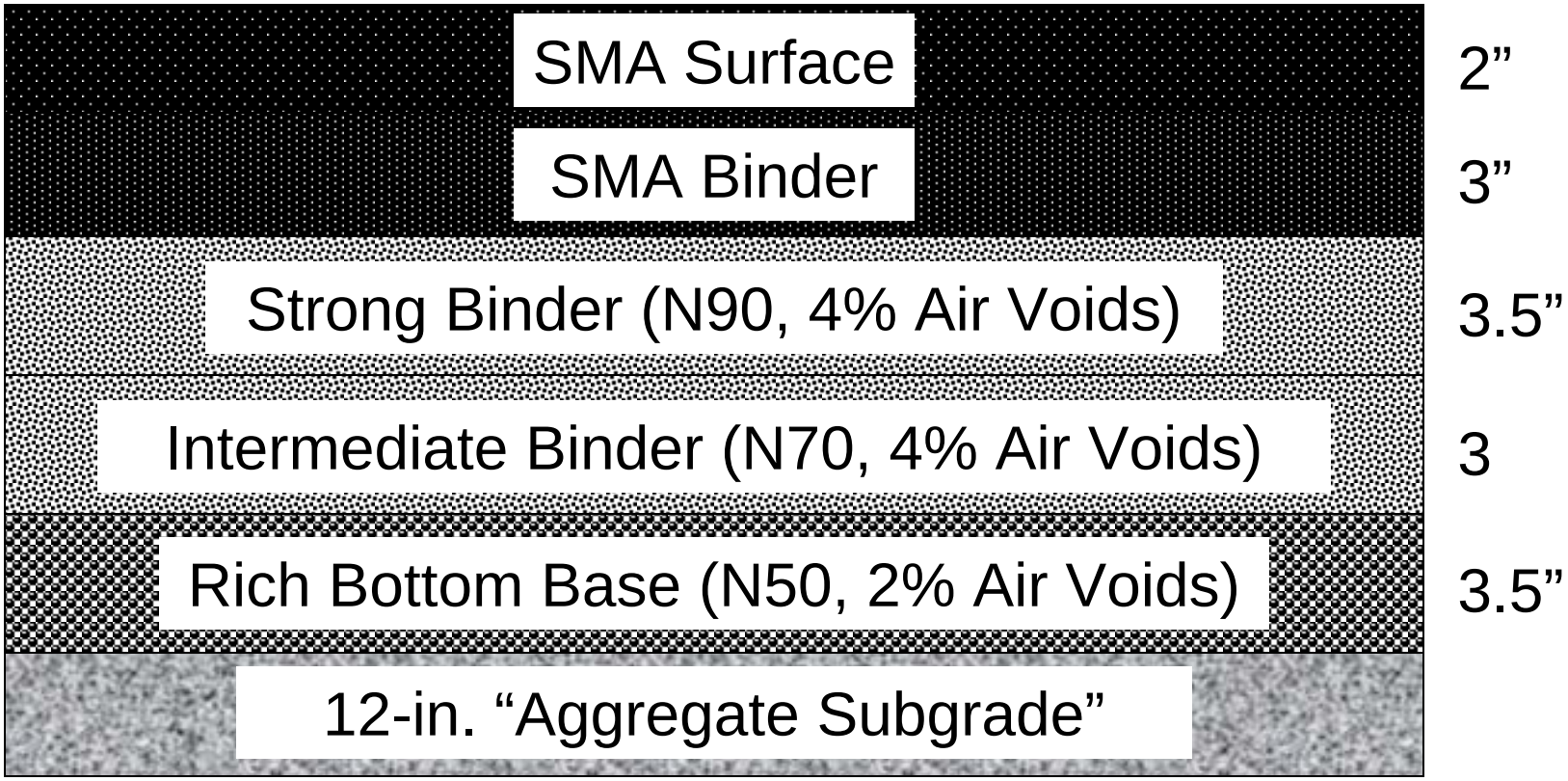
Tollway Mainline



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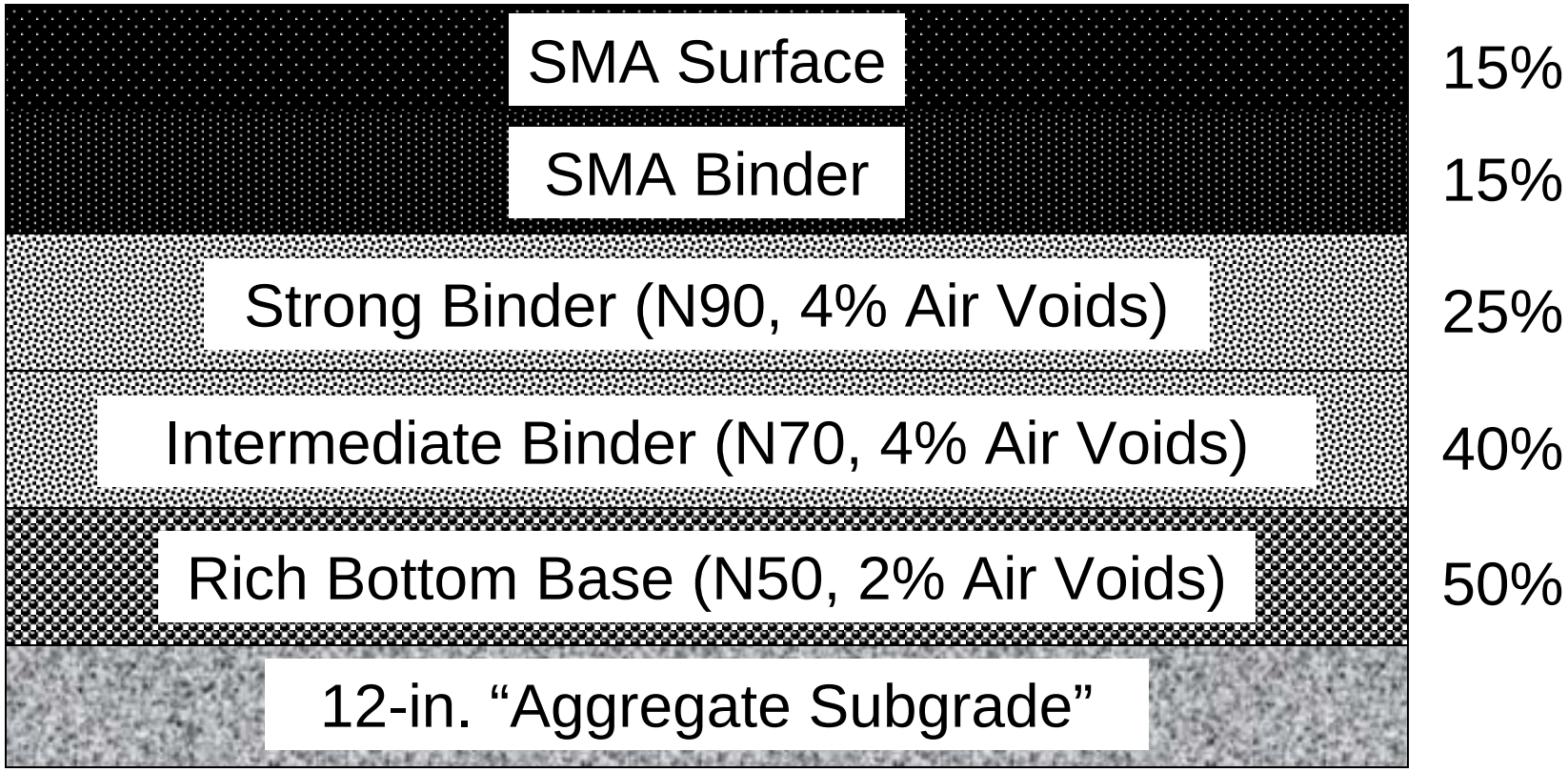
Tollway Mainline FRAP Allowances



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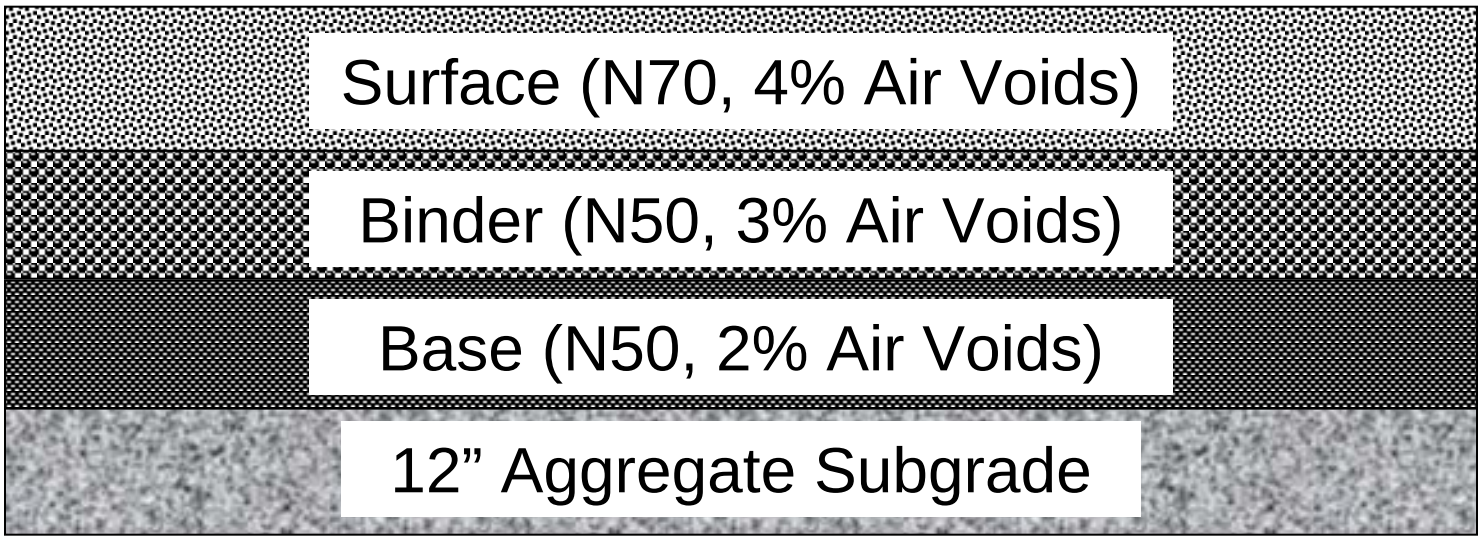
Tollway Shoulders



- Thicker Shoulder Pavement for Temporary Construction Traffic
- “Standard” shoulders are 6 inches thick

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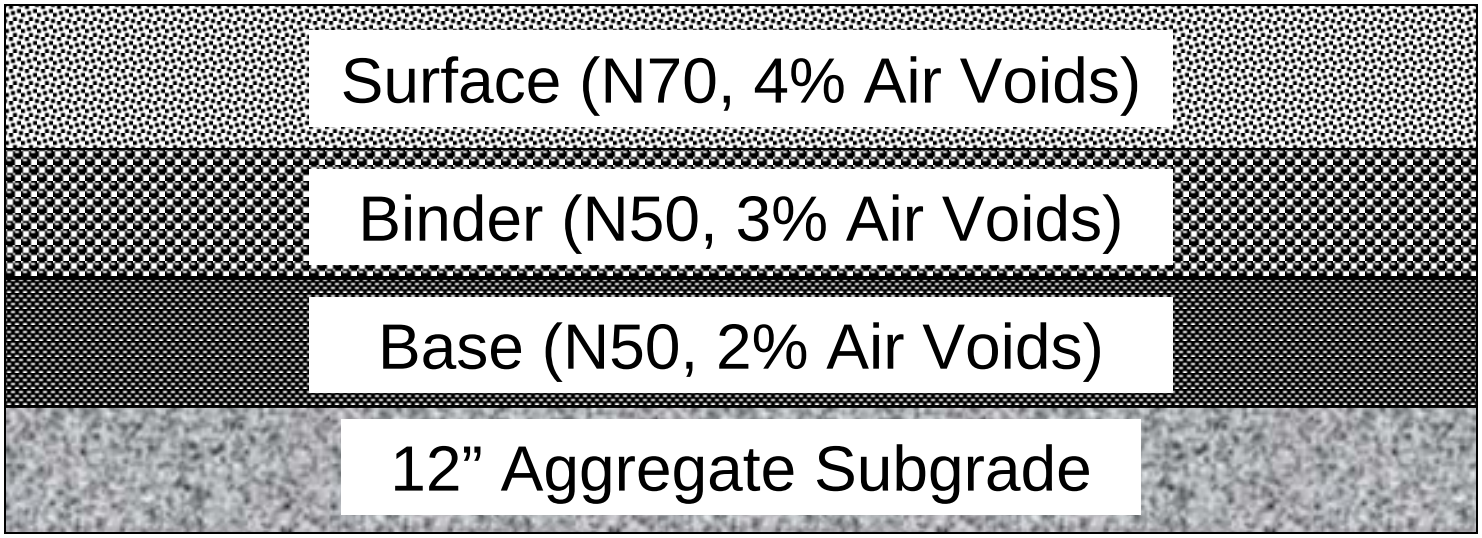
Tollway Shoulder FRAP Allowances



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Nine FRAP Research Mixtures (2007)

- 3 SMA mixtures (Steel slag, trap rock, and crushed gravel coarse aggregates).
  - Used GTR modified PG 76-22 liquid.
- N70 binder – 40% FRAP
- N70 Surface – 25% FRAP
- N50 Binder – 40% FRAP, PG 58-28 & PG 58-22
- N50 Base – 40% FRAP, PG 58-28 & PG 58-22

The FRAP Process

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The FRAP Process

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2007 FRAP Research Goals & Results

- Quality Control maintained e
- Retain long-term performance at lower costs
- Fatigue and Dynamic Modulus analysis
  - Are mix properties compromised with higher RAP? (No.)
  - How soft for the PG? (64-22? vs. 58-22 vs. ~~58-28~~)

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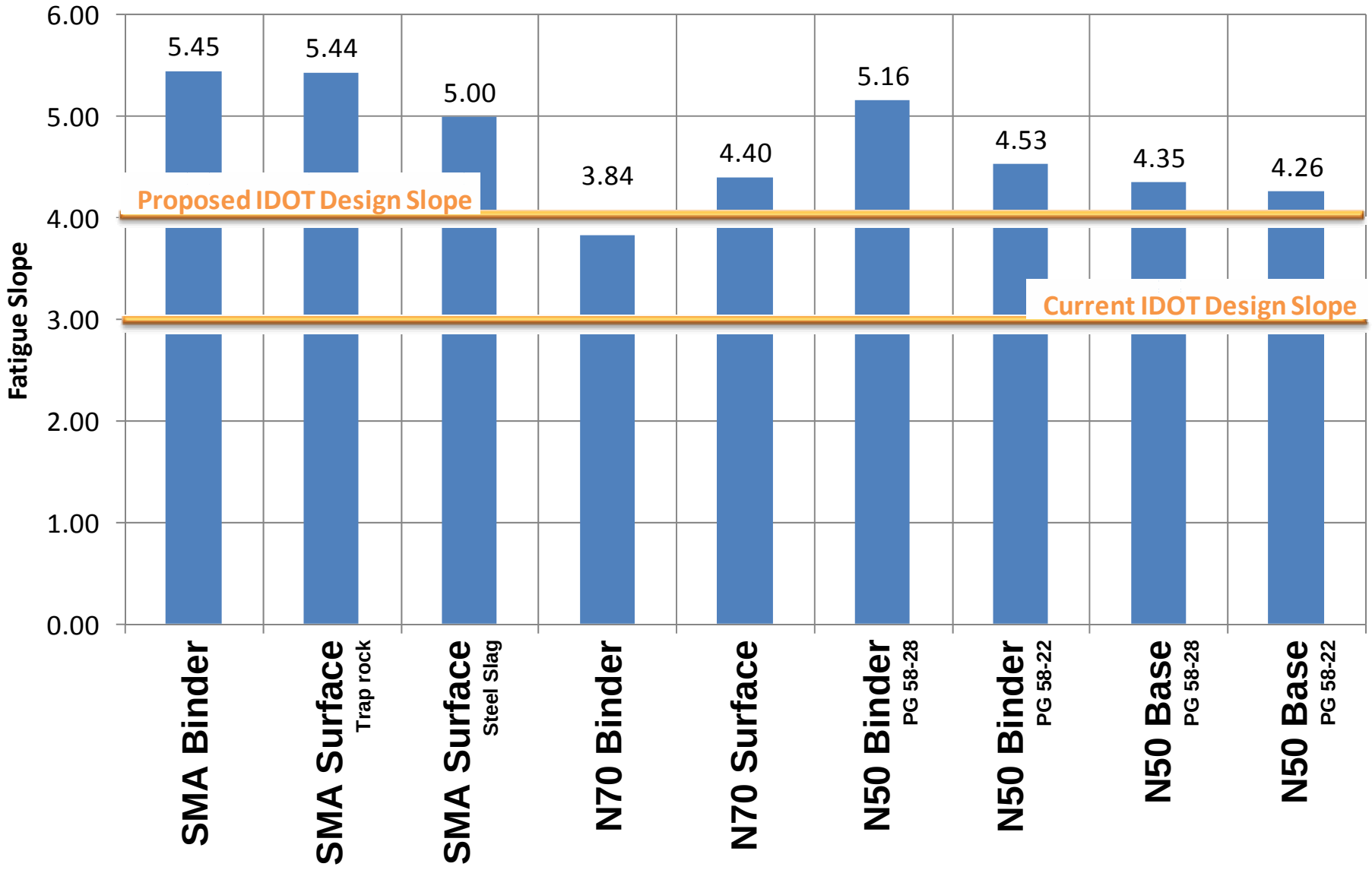
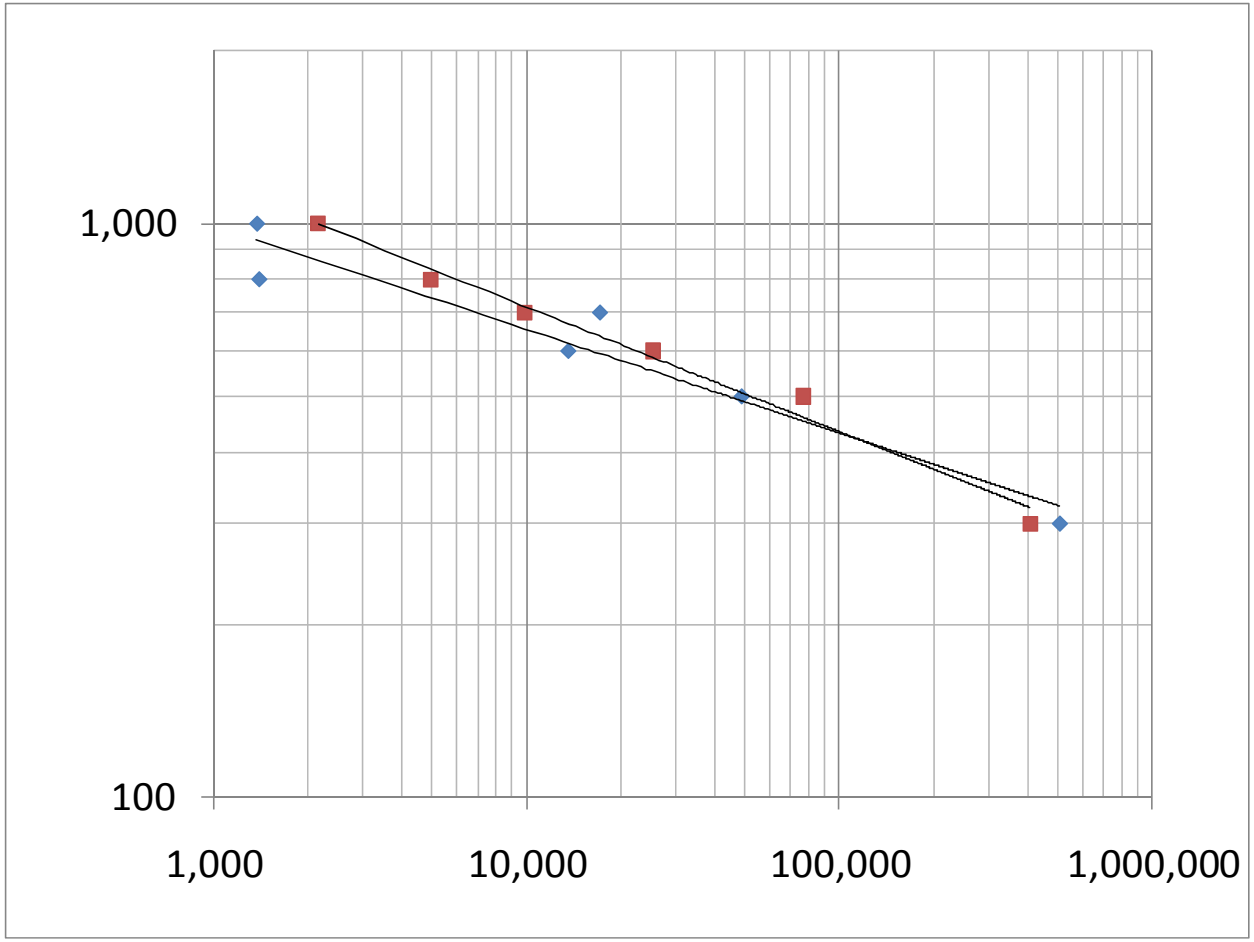
Fatigue Analysis



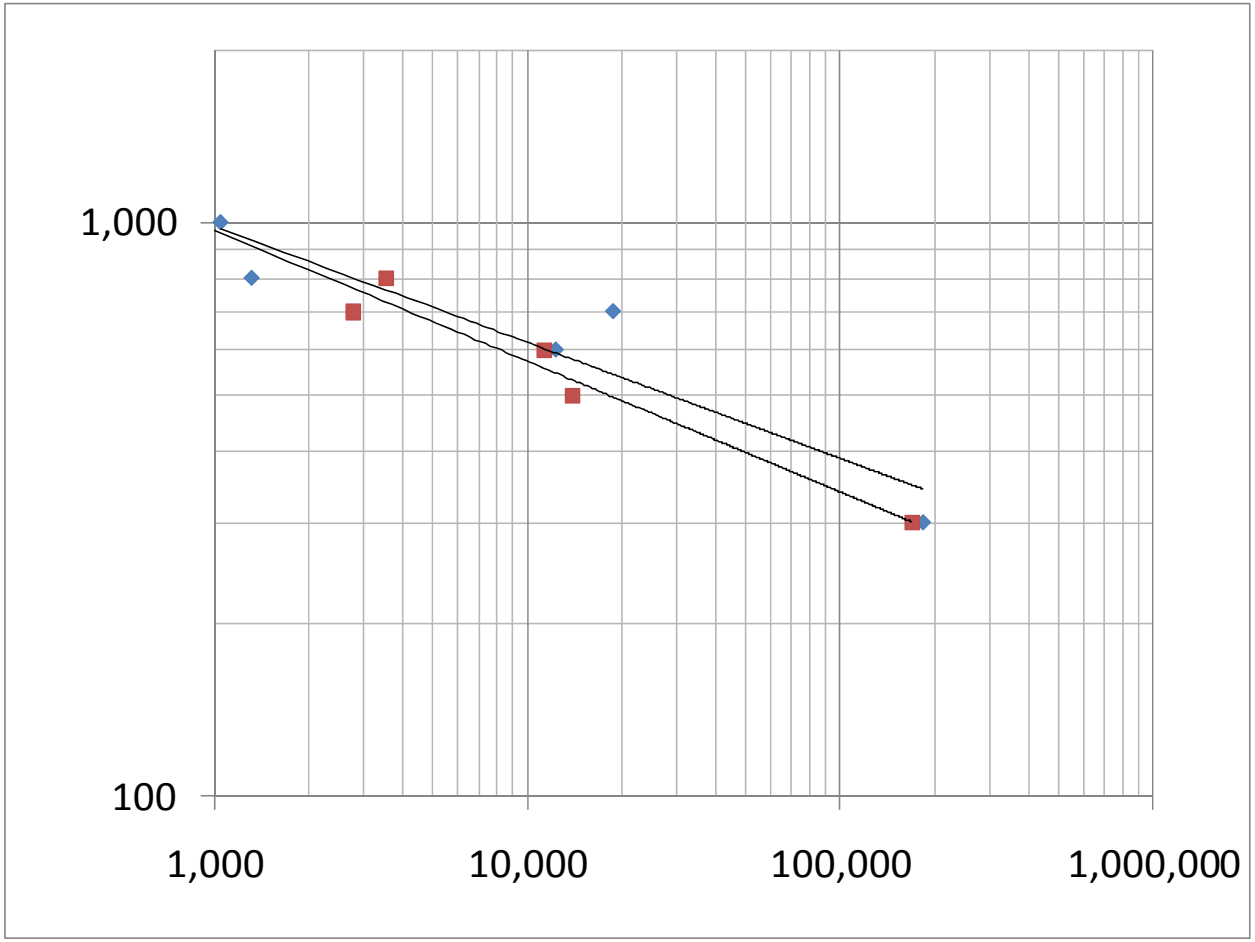
Binder Mix Double Bump

- The performance of the 2 mixes is nearly identical

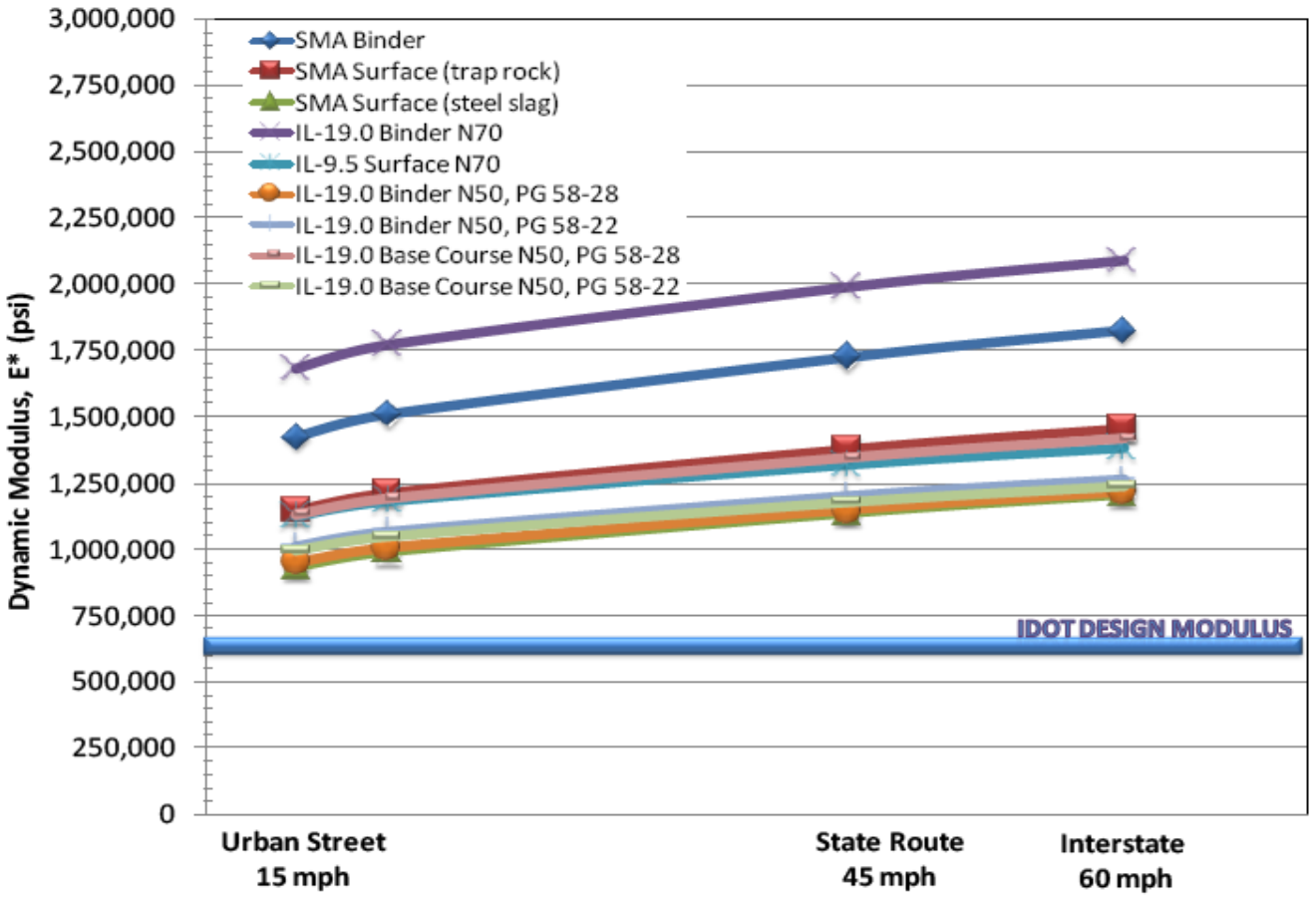


Base Mix Double Bump

- The performance of the 2 mixes is nearly identical



Dynamic Modulus Results



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Modulus Test Interpretation

- The results are typical of all-virgin-aggregate IDOT mixtures.
- The magnitude of the modulus values are typical of IDOT mixtures,
- No extra hardening of these mixes with the high RAP content.
- Compaction to lower voids increases the modulus slightly, as expected.
- Performance should be the same as a typical IDOT mix with all new materials.

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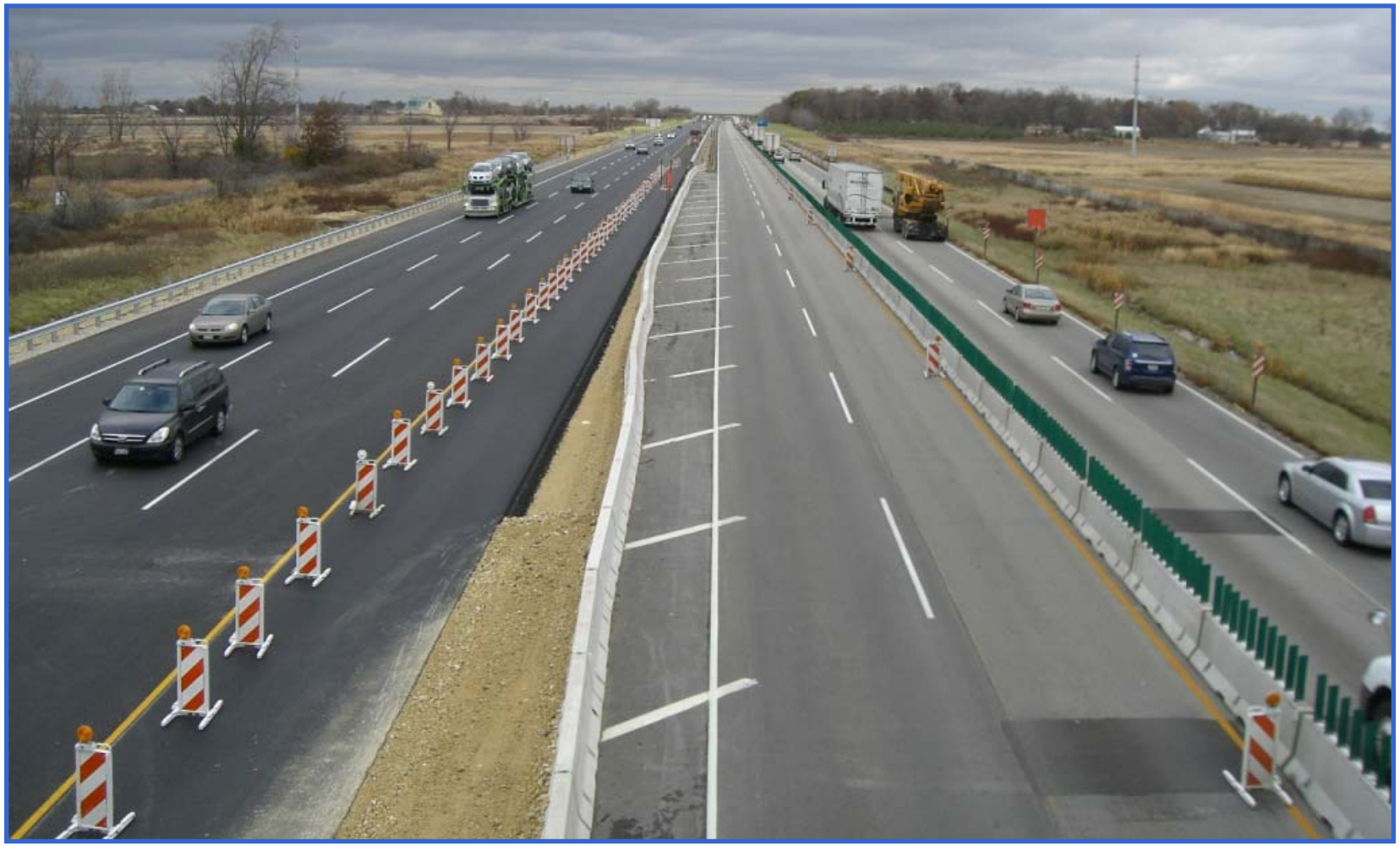
Reconstruction Stage 1 - Complete



2008 FRAP and Mix Research

- N70 Binder, 4% Air Voids
- 3 asphalt grades (PG 64-22, PG 58-22, & PG 58-28)
- 3 percentages of FRAP (10%, 27.5%, & 45%)
- Lab-produced samples; production samples
- Fatigue and Dynamic Modulus Analysis

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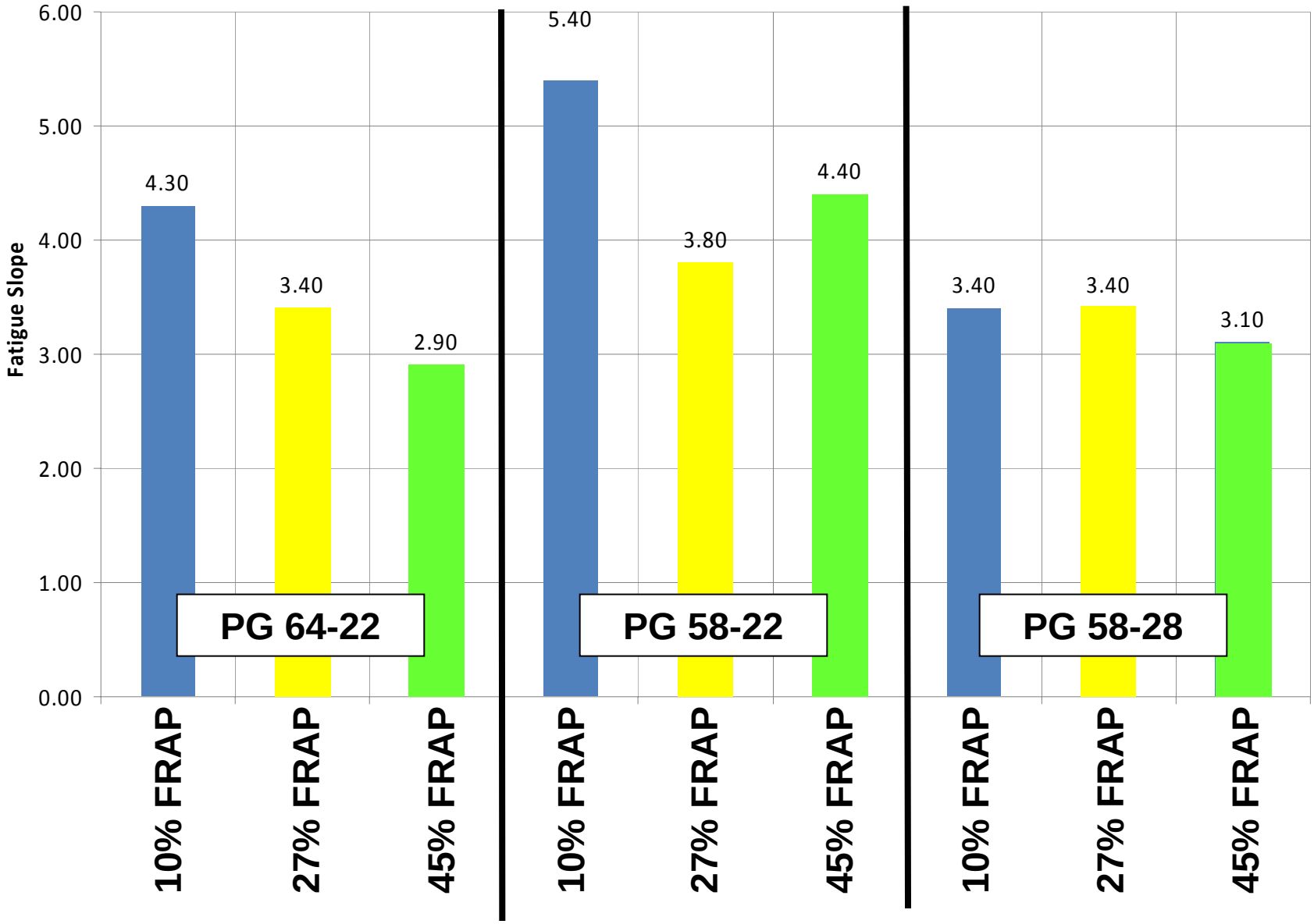
2008 FRAP Research - Lab Mixes



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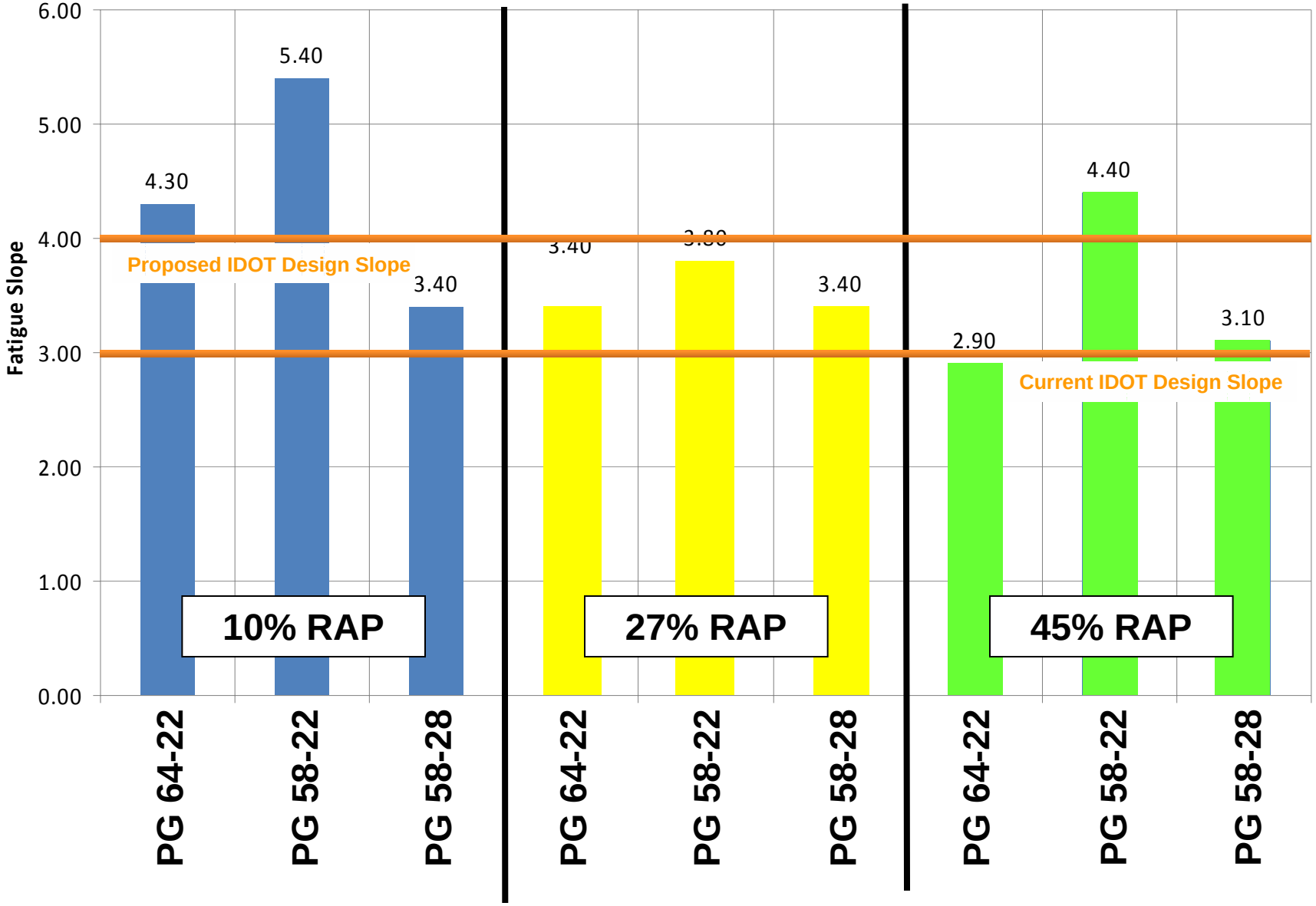

2008 FRAP Research - Lab Mixes

	Percent FRAP		
PG Grade	**10**	**27**	**45**
PG 64-22	113	99	80
PG 58-22	161	131	138
PG 58-28	92	106	76

Predicted Fatigue Endurance Limit from fatigue curve (Carpenter 2008 AAPT)

- FEL generally decreases with more FRAP
- Single bump helps the FEL
- Double bump is the same or worse (confirms NCHRP 9-38)
- All mixes have FEL above 70 (current Tollway full-depth design criteria)

Cost Savings and Moving Forward

- Estimated $10 million+ HMA savings – I-90
- GTR modified binder – avoided SBS “shortage”
- Tollway specs give FRAP option (with increased RAP allowance) on all contracts
- Results of 2008 research to be shared with industry.

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The FRAP Process

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The FRAP Process

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Resource Conservation

Additional research and applications

- Recycling of asphalt shingles
  - Recycled Tear-offs into high FRAP mixes
- Sand Mix with fine-graded FRAP
- Warm Mix GTR modified SMA

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Sand Mix Leveling Course

Sand Mix Leveling Course

GTR modified SMA – Warm Mix

GTR modified SMA – Warm Mix

- GTR SMA -
  - 310ºF typical mixing temperature
  - Compactable to 240ºF
- Evotherm modifier
- Warm Mix
  - Started mixing at 310ºF
  - Mixed down to 250ºF
  - Compactable to 190ºF

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THANK YOU