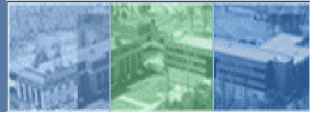

Full Scale Accelerated Pavement Test
Cracking Performance of High RAP + WMA
Experimental Design and Timeline

RAP Expert Task Group

July 24, 2012

Nelson Gibson

FHWA Office of Infrastructure R&D

What is requested from the ETG?

- Some questions related to production and construction may not be answered until the pre-bid meeting or until the contractor is selected
- Thus far,…. Does the experimental design look sound enough to write specifications up to the pre-bid stage?

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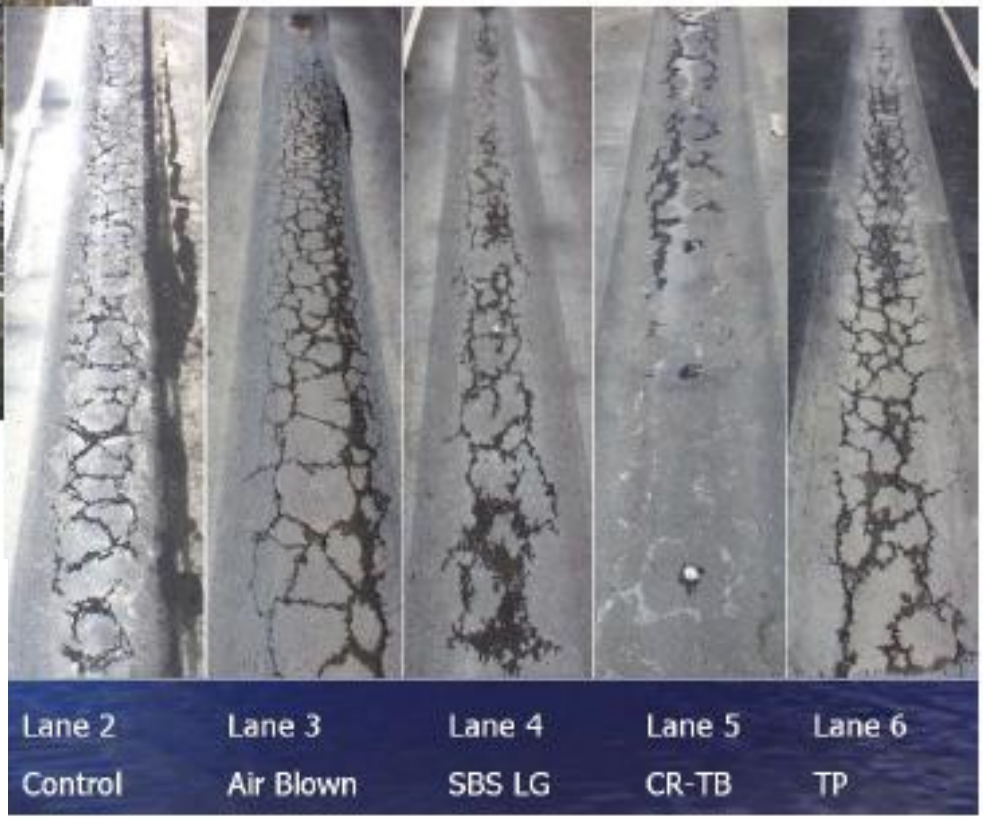

Stakeholder Input on Next ALF Exp. Combined Polling Results

1. ***Fatigue performance of High RAP HMA & Overlays***
2. Cracking & durability of ultrathin HMA overlays as pavement preservation
3. Thinner & cheaper perpetual pavements with premium HMA
4. Cost effectiveness of high-modulus high binder HMA base
5. More structure oriented experiments and less binder-oriented experiments
6. Shorter turn around time

Convergence of Two Initiatives

High RAP Content

- Less virgin binder
- Degree of mixing?
- Cracking/durability performance one of highest concerns

Warm Mix Asphalt

- Sometimes less asphalt content than HMA
- Cracking less concern
- Affect blending of RAP for the better?

- **OBJECTIVE: Establish realistic boundaries for high-RAP mixtures employing WMA technologies based on percent binder replacement and binder grade changes when using high RAP with WMA**

Key Features of Experiment

- Focus on fatigue cracking, temp. controlled at 20°C no high temperature rutting*
- Three year completion
  - 2 years of loading
  - 2 ALF units allow simultaneous loading
- Unmodified PG64-22 binder for all lanes
- WMA Technology which does not change PG grade
- 10 kip single wheel = 20 kip equivalent axle
- 4-inch total asphalt thickness

Experimental Design

WMA / HMA Production Temperature	Lower 250°C			Higher 300°C		
Warm Mix Technology	None	Foam	Chem.	None	Foam	Chem.
RAP Content						
15%	?			✔		
25%		✔	✔		✔	✔
40%		✔	✔		✔	✔

Experimental Design

WMA / HMA Production Temperature	Lower 250°C			Higher 300°C		
Warm Mix Technology	None	Foam	Chem.	None	Foam	Chem.
RAP Content						
15%	?			✔		
25%		✔	✔		✔	✔
40%		✔	✔		✔	✔

Added Binder Content?

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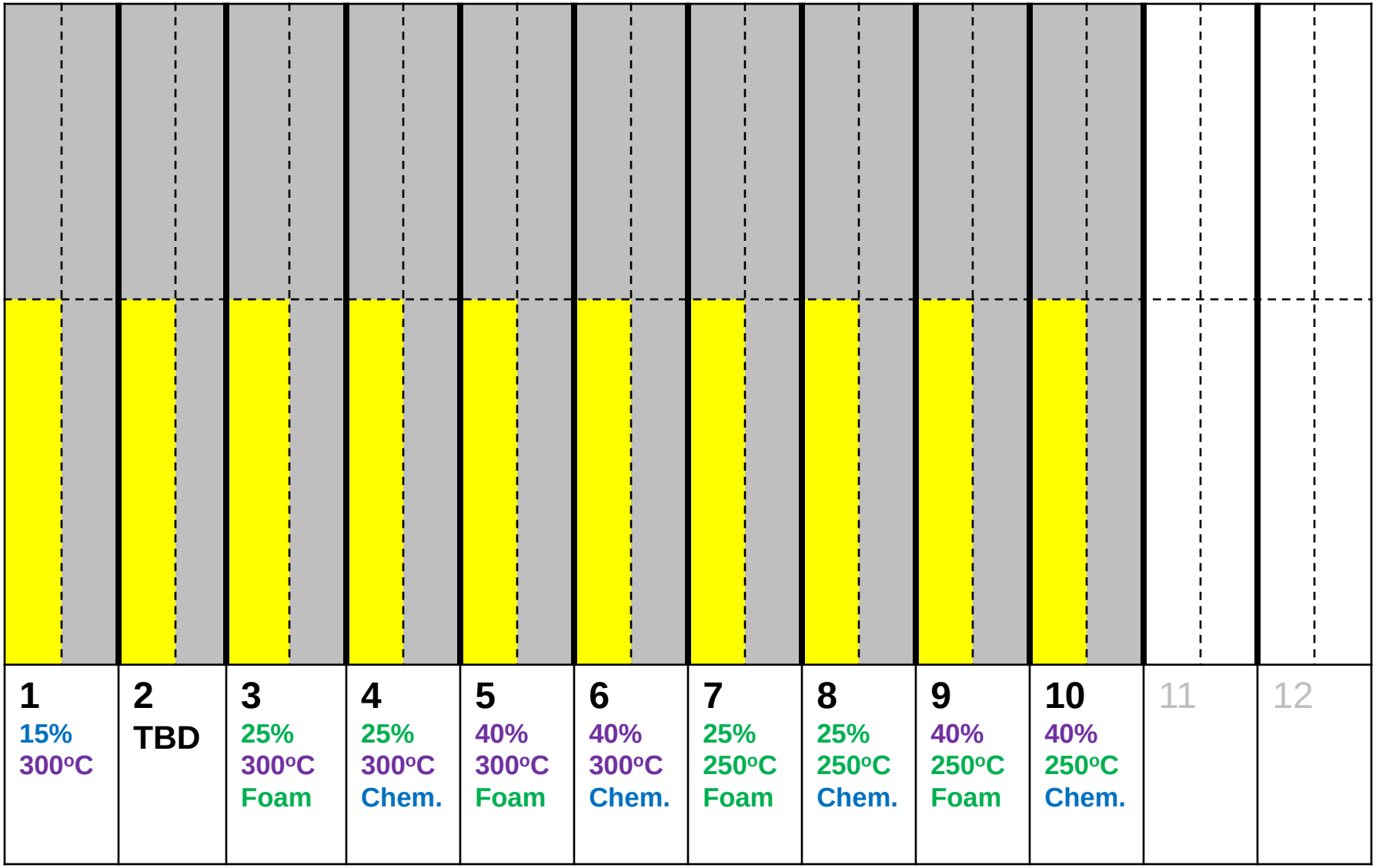
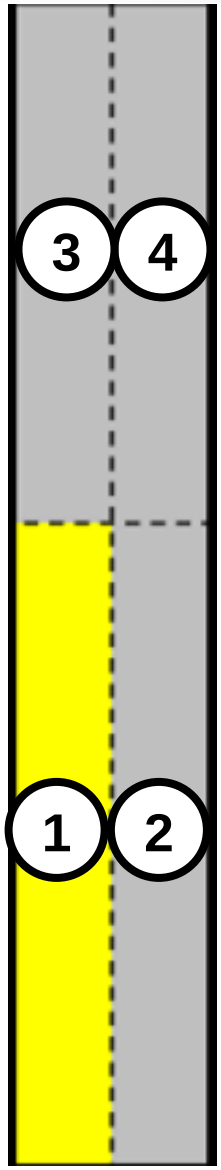




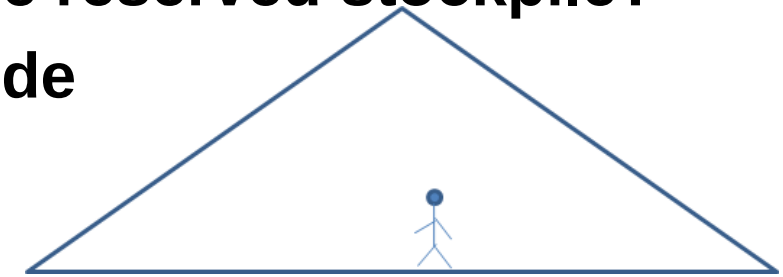
- In each Lane there are 4 Test Sites
- Current planning is to use only 1 of 4 for the “core of the experiment”
- Leave 3 other sites to explore the following at a later date
  - Long term aging (natural or accelerated)
  - Extension of life from pavement preservation treatments

Tonnage

- **Each Constructed Lane will Require**

Waste	30 Tons
Actual Test Lane	50 Tons
Test Strip (Parking Lot)	109 Tons
– Total Production:	189 Tons

- **Total Mix** 1890 Tons
- **Total RAP Required + extra** 631 Tons
  - **Have contractor set aside reserved stockpile?**
  - **About 19 ft tall & 54 ft wide**



Proposed Loading Sequence

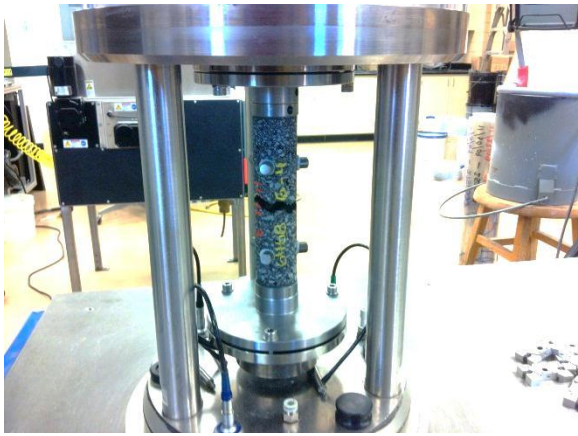
	ALF #1	ALF #2
1st	15% - 350F – (none)	TBD
2nd	25% - 350F - Foam	25% - 250F – Chem
3rd	25% - 350F - Chem	25% – 250F- Foam
4th	40% - 300F - Foam	40% - 250F – Chem
5th	40% - 300F – Chem	40% - 250F - Foam

2 Years

2 Years

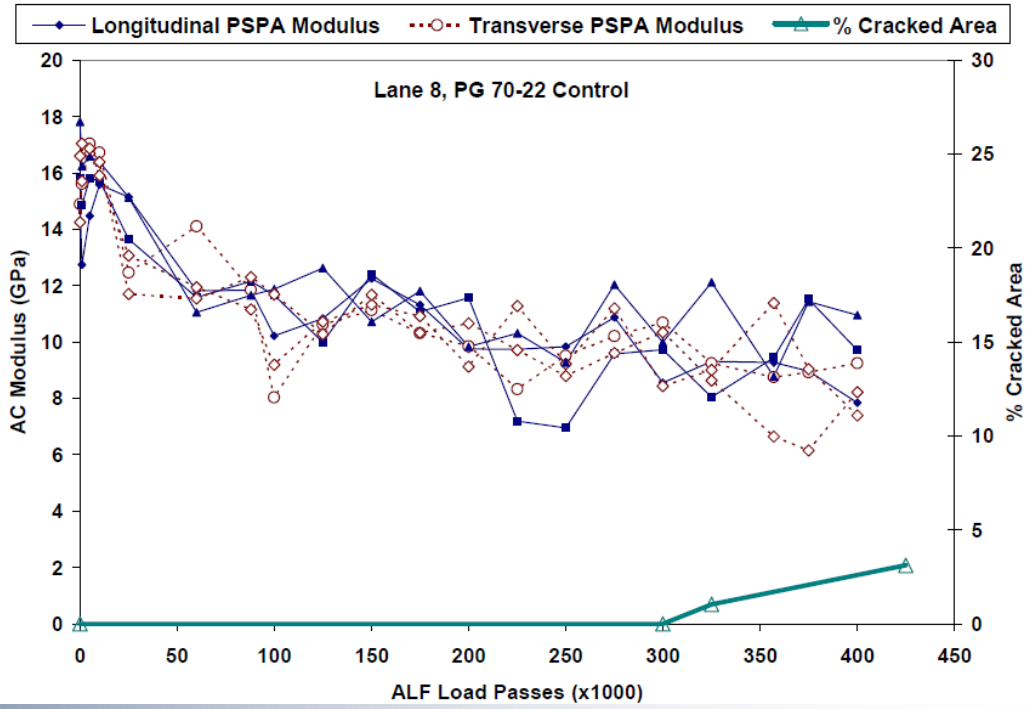
Lab Characterization to Address Field Sequencing

- **Plant Produced – Lab Compacted**
  - Immediate
  - Long Term Oven Aged
  - AMPT
- **Plant Produced – Field Compacted**
  - Post Construction
  - After Completion of each ALF site loading
  - AMPT
  - Bending Beam Fatigue



In-Situ Characterization to Address Field Sequencing

- **Portable Seismic Pavement Analyzer (PSPA)**
  - **Monthly, background aging**
  - **During ALF loading**
- **Seasonal FWD**
  - **Unbound Layers**



Exploratory RAP Mix Designs

Made with Milled ALF + Virgin ALF

As-Milled

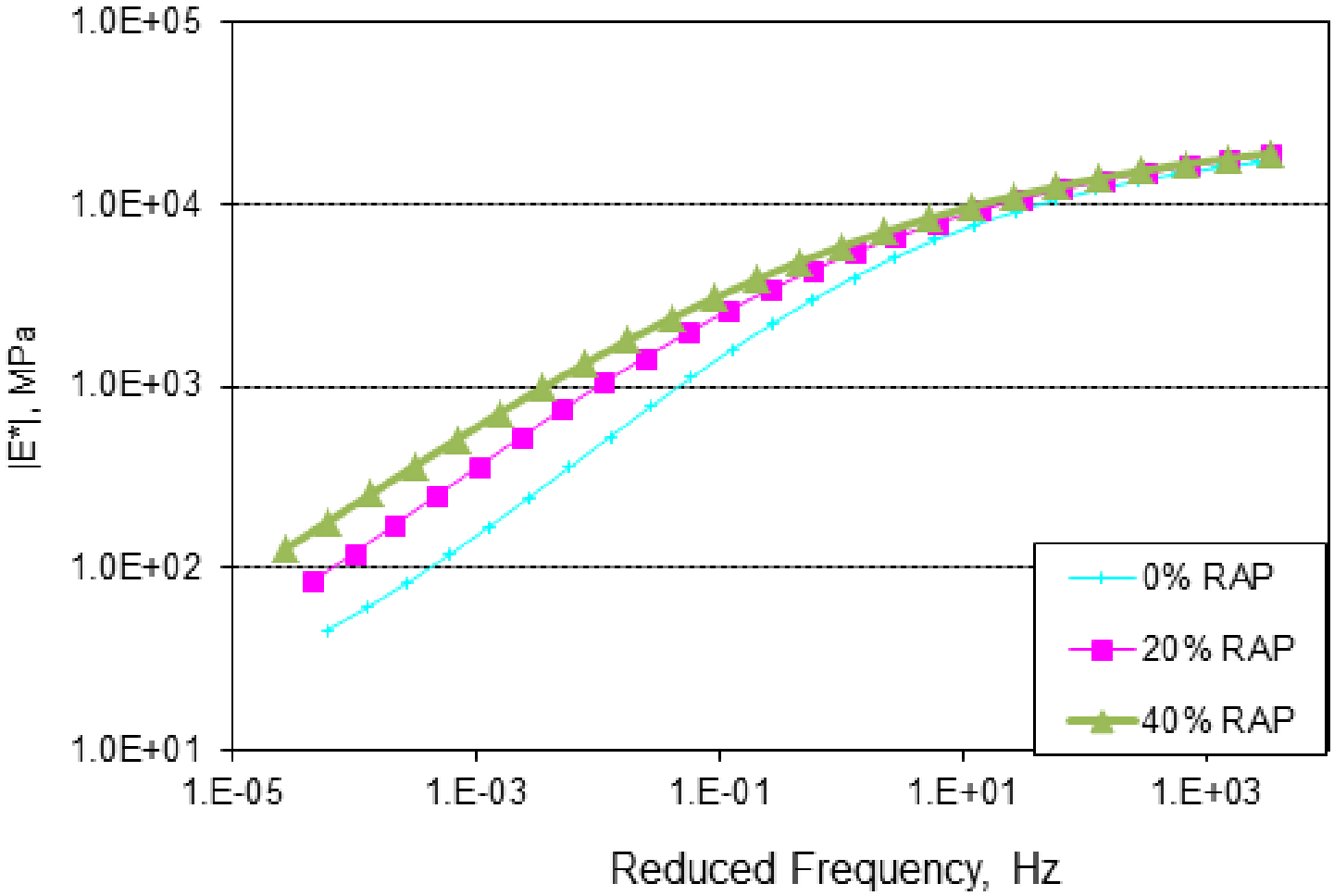
After Heating

Original PG Grade
PG72-23
Extracted PG Grade
High 94 to 88
Low -10 to -4

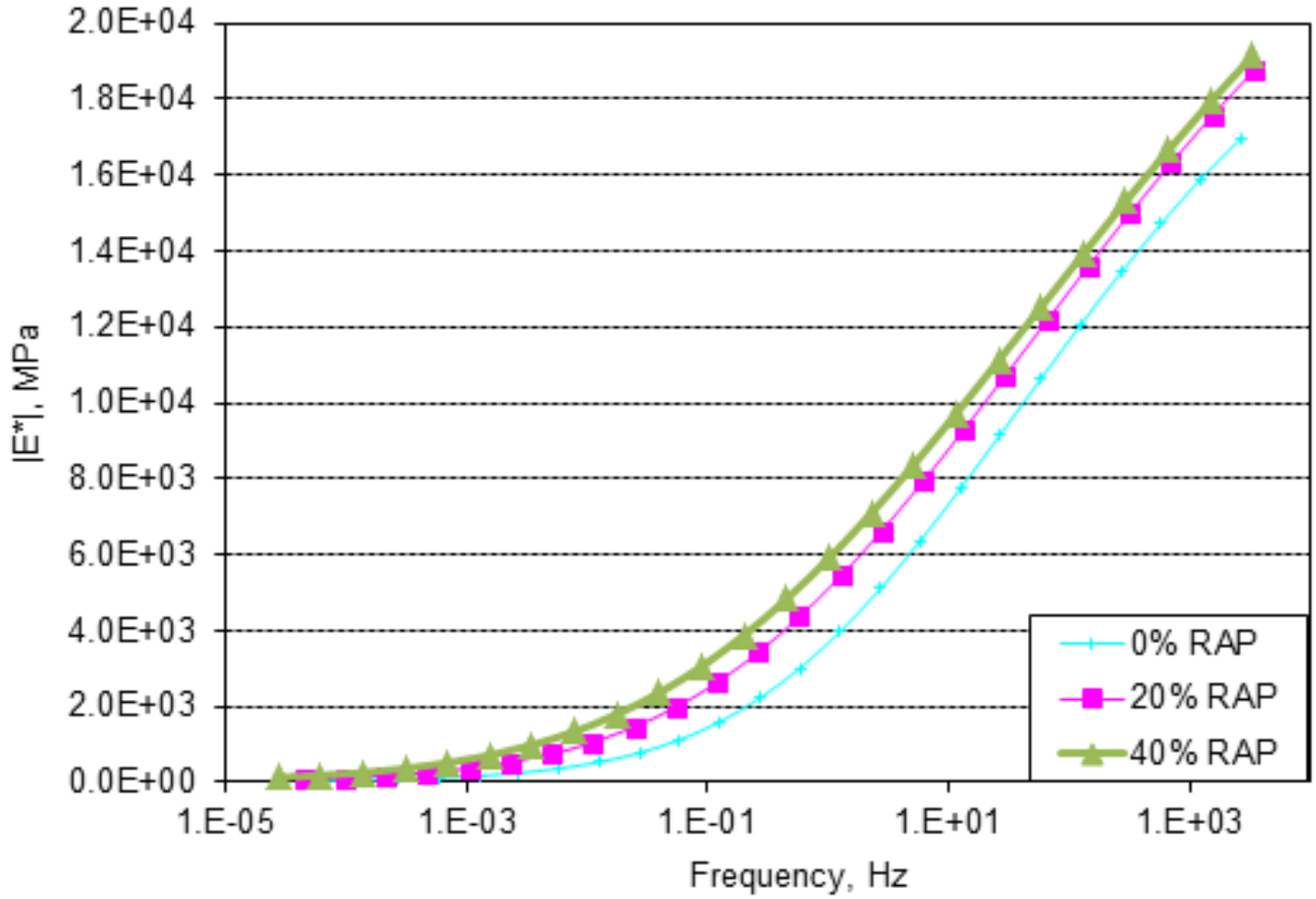
Volumetrics (No WMA Used)

	0% RAP	20% RAP	40% RAP
N_{DESIGN}* *Last ALF mix was 65GYR	75	75	75
Air Voids	2.32	2.89	2.33
VMA	15.0	15.1	14.4
VFA	84.5	81.0	83.8
Total Binder	5.34	5.24	5.35
Virgin Binder	5.34	4.29	3.29
Dust : Binder	5.0	4.7	4.7
Passing #200	1.25	1.41	1.32

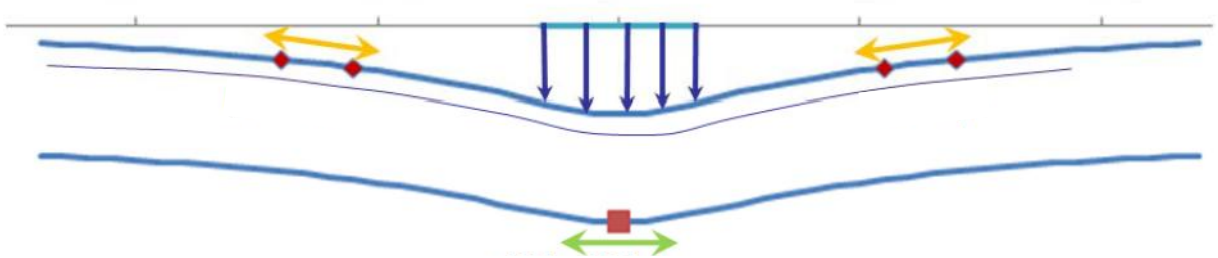
Dynamic Modulus (No WMA Used)



Dynamic Modulus (No WMA Used)

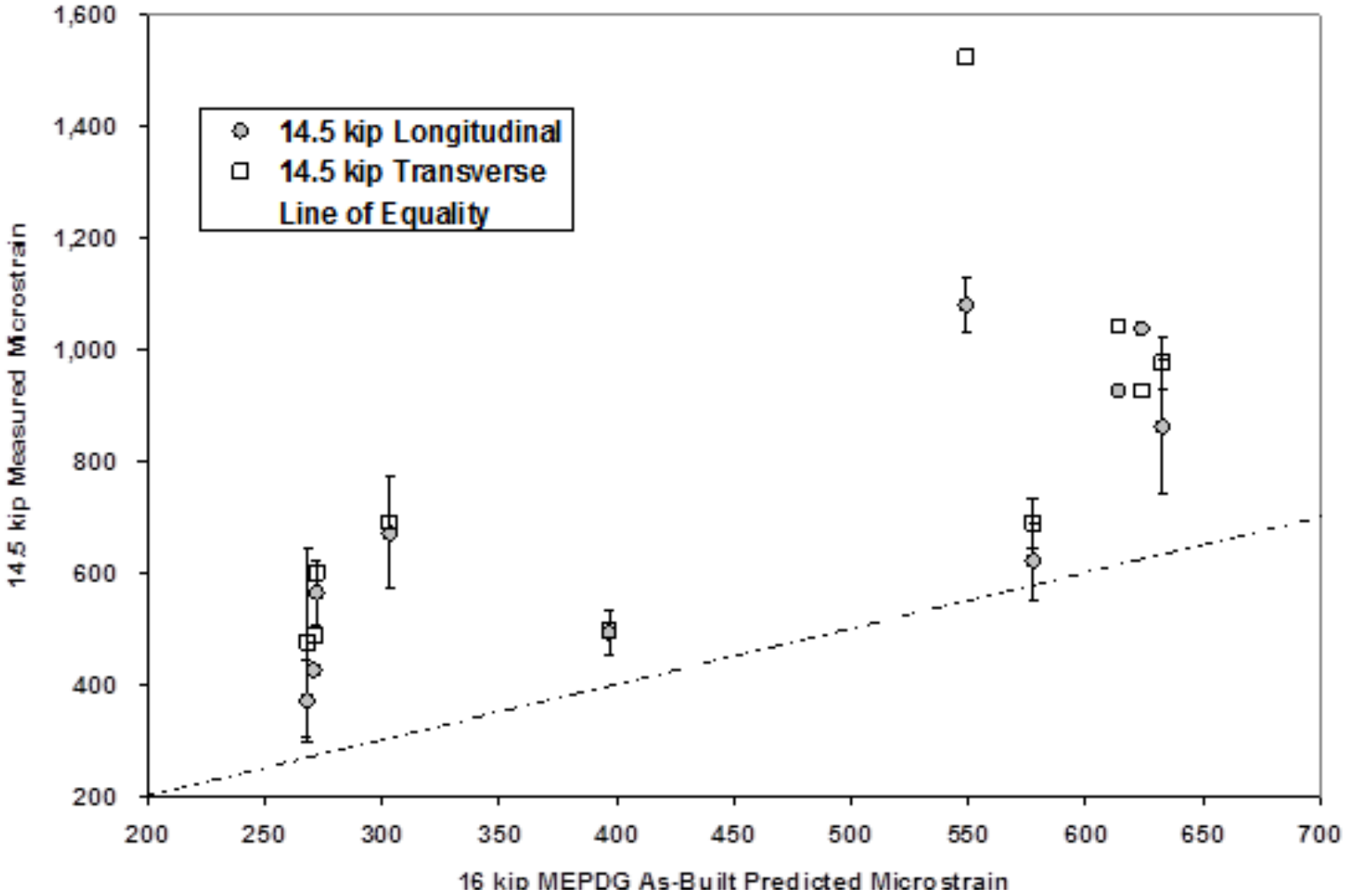


Scoping Potential ALF Structural Response



		RAP Content		
		0%	20%	40%
|E*| 10Hz 21°C [MPa]		6,985 (100%)	8,509 (122%)	9,363 (134%)
Tensile Micro Strain [με]	10 kip / 100psi Proposed Next ALF	298 (100%)	259 (87%)	242 (81%)
	16.6 kip / 120 psi Last ALF Experiment	427 (100%)	375 (88%)	351 (82%)

Structural Response – Last ALF

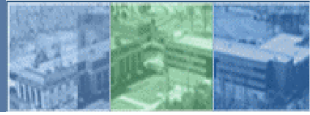


Laboratory Fatigue Response

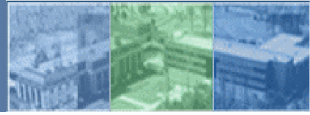
[…ongoing…]

Next Steps

- ~~Construction coordination meeting July 18th~~
- Gather RAP/WMA ETG input on July 24th
- Out for Bid/Award in Fall/Winter 2012
- Construction Starts Spring 2013
- Finish Paving End of July 2013
- Accelerated loading beginning in Fall 2013

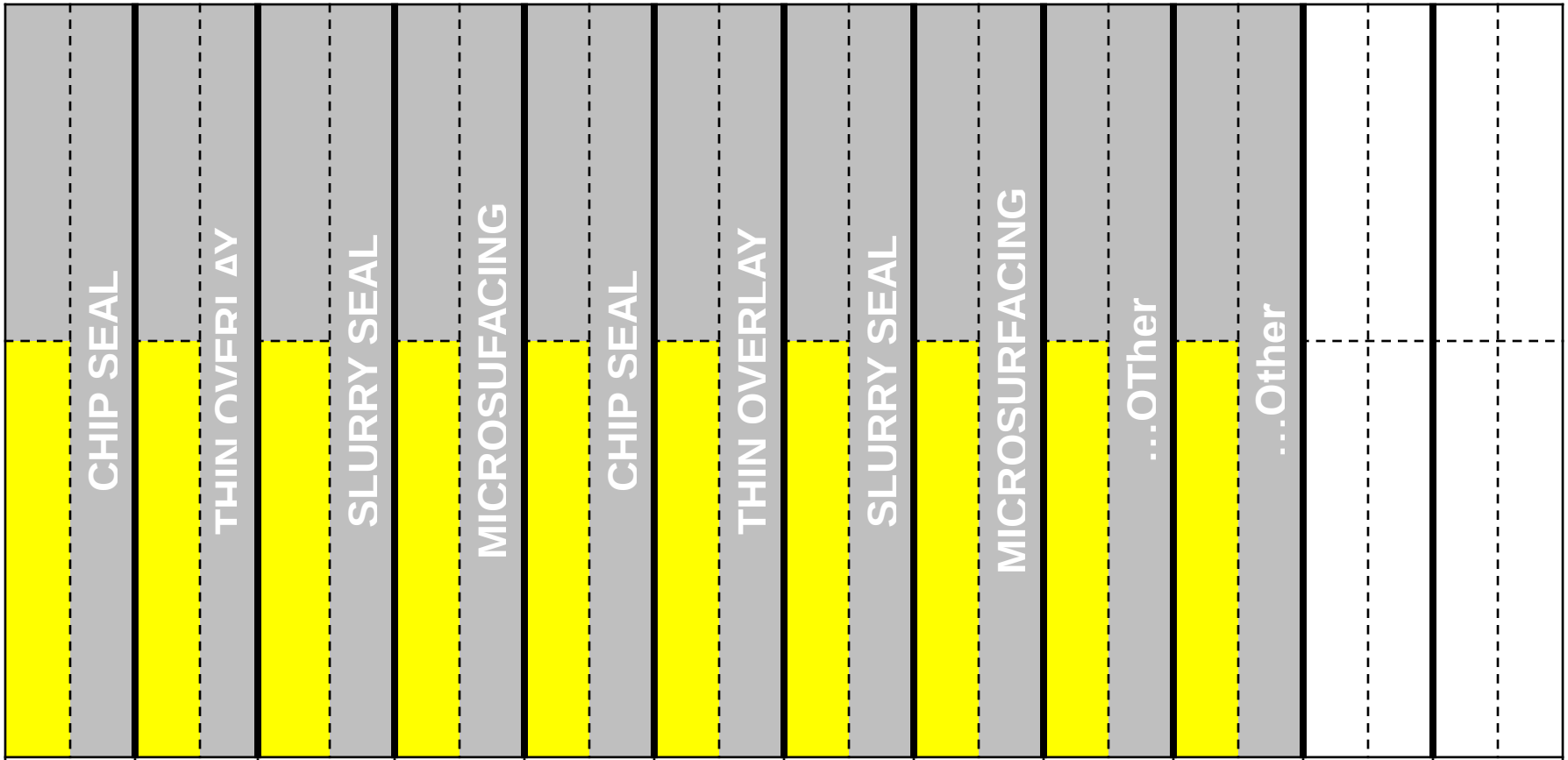


Thank you for your time



Name & Affiliation
(if you care to provide)
_____

- **Feedback**
  - **RAP Contents?**
  - **Temperature Production Range?**
  - **WMA Technology?**
  - **Other Comments?**



1	2	3	4	5	6	7	8	9	10	11	12
15% 300°C	? TBD	25% 300°C Foam	25% 300°C Chem.	40% 300°C Foam	40% 300°C Chem.	25% 250°C Foam	25% 250°C Chem.	40% 250°C Foam	40% 250°C Chem.		