National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

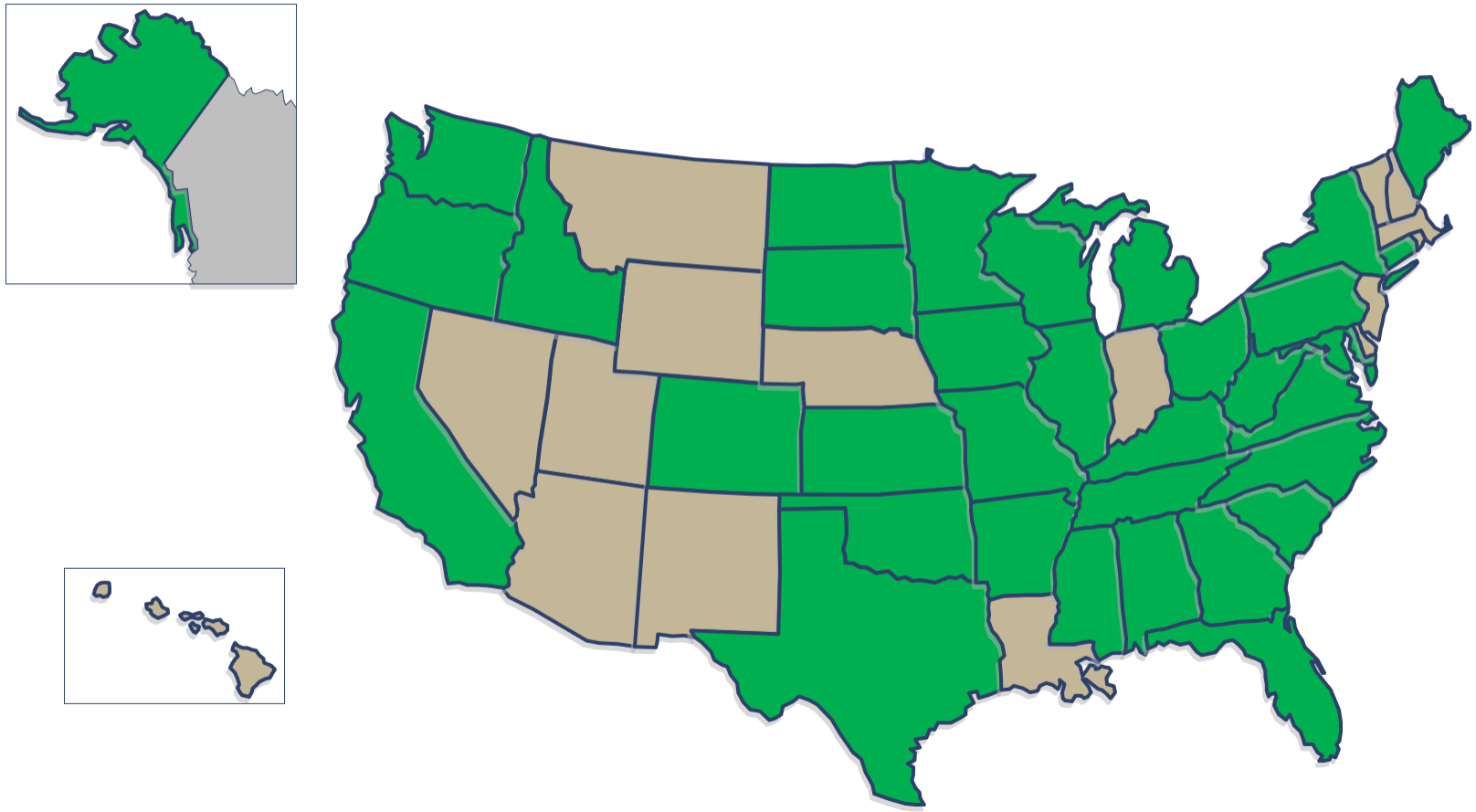
Construction and Performance Impacts of Asphalt Mix Additives

2021 (Eighth) Research Cycle

NCAT Pavement Test Track

NCAT Pavement Test Track

- National Center for Asphalt Technology @ Auburn since 1986
- Innovative, relevant, and implementable research projects
- Advancement of safe and sustainable asphalt pavements
- Mix/materials$_{86}$, structural pavement design$_{03}$, and preservation$_{12}$
- 1.7-mile nonprofit Track since 2000 with rebuild/rezero every 3-years.



2021 (Eighth) Research Cycle

NCAT Pavement Test Track

2021 NCAT Pavement Test Track

- 32 sponsored sections
  - 16 traffic continuations
  - 7 mill/inlay sections
  - 9 structural sections
- 16 repaved/rebuilt sections
  - ~1/3 of the Track (typical).

Traffic Continuations$_{16}$

- Higher RAP with recycling agents – CA_{N3}
- Foamed cold central plant recycle (CCPR) base – VA_{N4}
- High performance thinlays (DGA, SMA) – $AL_{N10,N11}$
- Crack prevention interlayer strategies – $GA_{N12,N13}$
- Soybean based polymer modified asphalt – SB_{W10}
- BMD via recycling agents, gradation, etc. – OK_{S1}, $TX_{S10,S11}$
- Impact of base stabilization, subgrade modification – MS_{S2}
- Long term benefit of surface rejuvenators – MS_{S3}
- Full depth rapid rebuilds (grinding vs thinlays, HiMA) – SC_{S9}
- Open graded friction surface rejuvenation – SR_{E1}
- Impact of density on performance – $FL_{E5,E6}$

New Mill/Inlay Sections$_7$

- BMD via additives, gradation, etc. – $OK_{N8,N9}$, TX_{N6}
- BMD with SGC for design and Marshall for QC – TN_{S4}
- Bond strength with different tack products and/or rates – NC_{W4}
- Friction performance mix optimization – KY_{S7}
- High performance open graded friction course surface – AL_{E9}

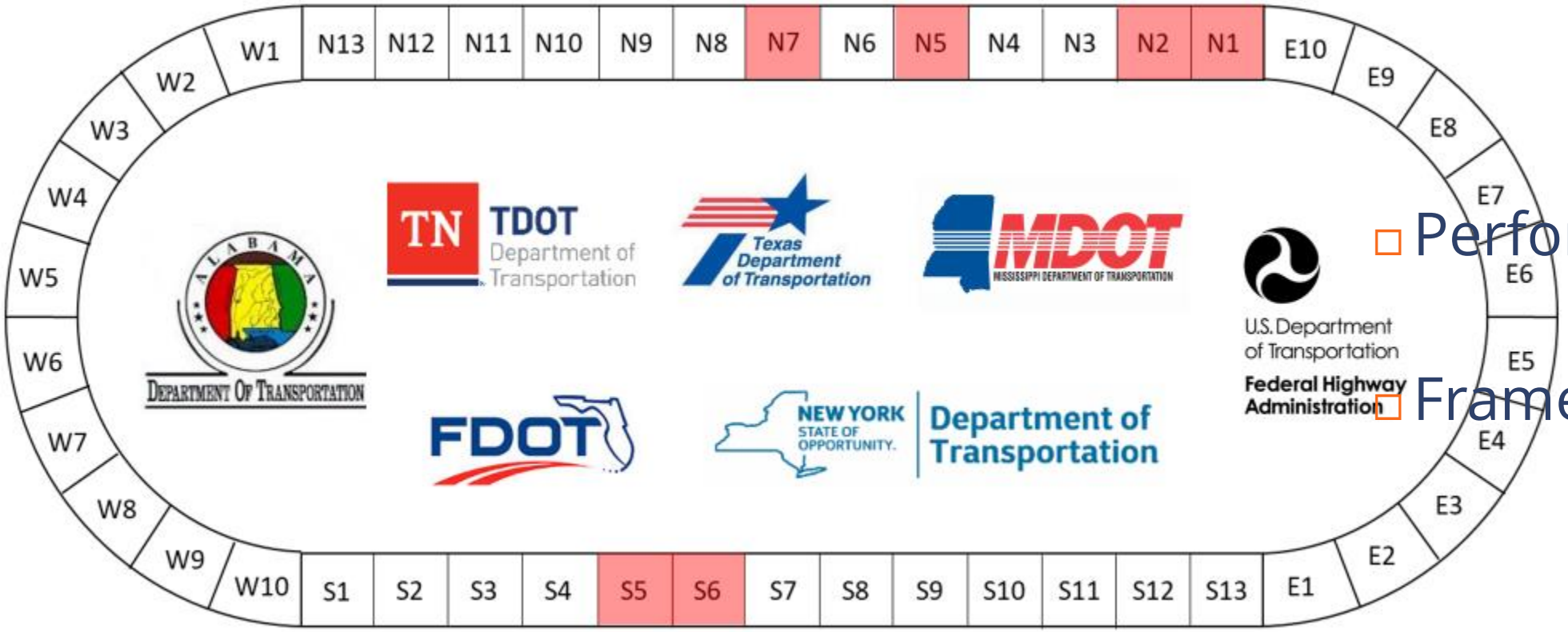
New Structural Sections$_9$

- Minimum HMA thickness over cold (re)recycling – VA$_{S12}$
- Additive Group (AG) study for impact on pavement life
- "AG+" New polymer from old recycled tire rubber – Sigmabond HP$_{S8}$
- "AG+" High polymer performance with reduced viscosity – BASF$_{S13}$

Polyco
ENGINEERED TO PERFORM

BASF
We create chemistry

2021 Additive Group (AG) Study



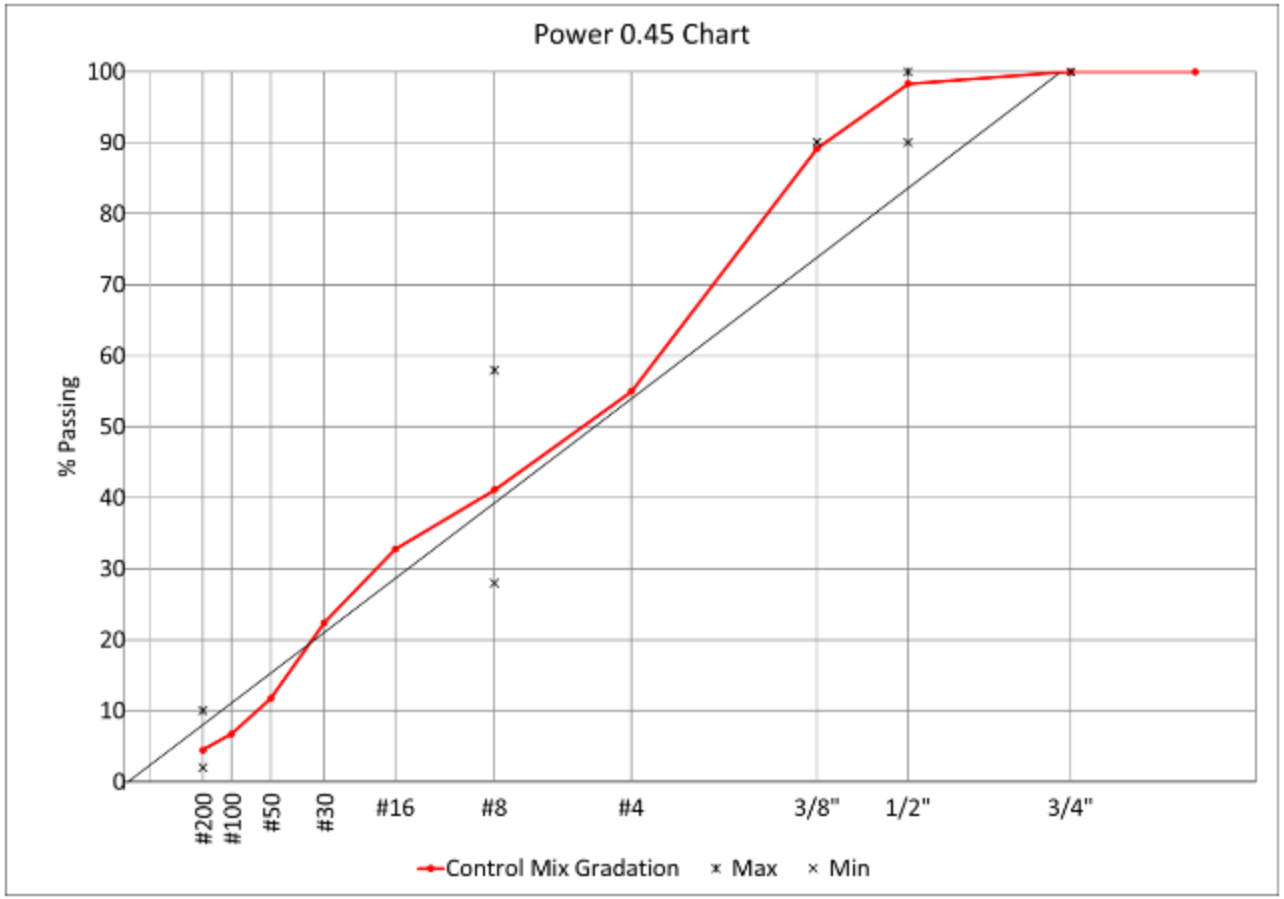
- Performance
- Framework

Phase 1 Studies (BMD+Fatigue)

Category	Mix ID	Company
Control	PG 76-22	
	PG 67-22 (reference only)	
Recycled Rubber	Rheopave™	Lehigh
	SmartMIX™	Liberty
	TB Rubber Binder	Entech
	TOR Coated Rubber	Evonik-Entech
Recycled Plastics	CERANOVUS® A115	GreenMantra
	LLDPE+ELVALOY™ RET	Dow
	NecoPlastic	NecoTech
	NecoFibers	NecoTech
Aramid Fibers	Ctrl for FORTA FI®	
	FORTA FI®	FORTA
	Ctrl for ACE XP®	
	ACE XP®	SurfaceTech
Reactive Polymer	B2Last®	BASF

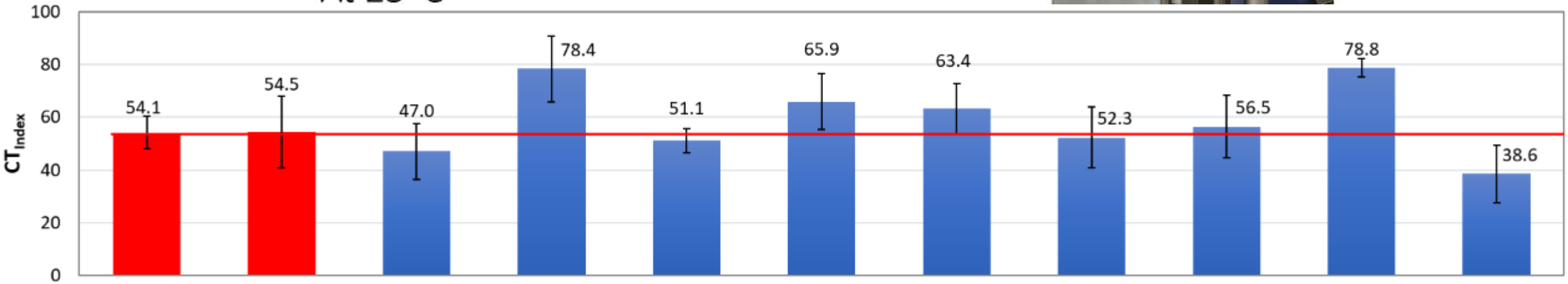
AG+ Control Mix (Lab and Track)

- 12.5 mm NMAS
- 20% RAP
- N_{des} = 60 gyrations
- 76-22 Binder
- Aggregates:
  - Granite 78 – 26%
  - Granite 89 – 25%
  - Sand – 28%
  - BHF – 1%
  - RAP – 20%



Balanced Mix Design for AG+ Study

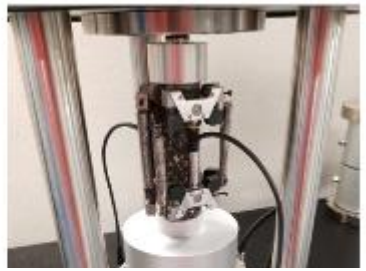
- IDEAL-CT (CT_{Index})
  - LMLC-STOA at 4hrs & 135°C
  - At 25°C

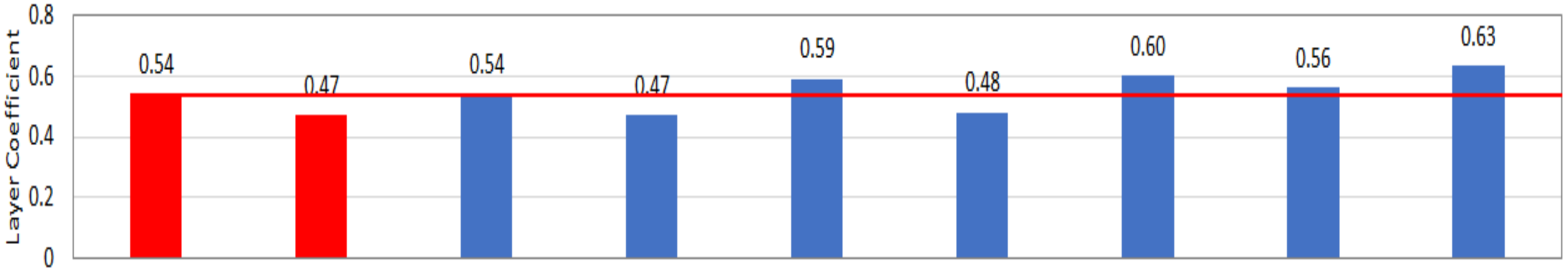


- Control mix criterion:
  - Max. rut = 12.5 mm at 20,000 passes

Fatigue Testing and Modeling

- Dynamic Modulus (E*)
  - Small Specimen – AASHTO TP 132-19
  - Generate E* master curves



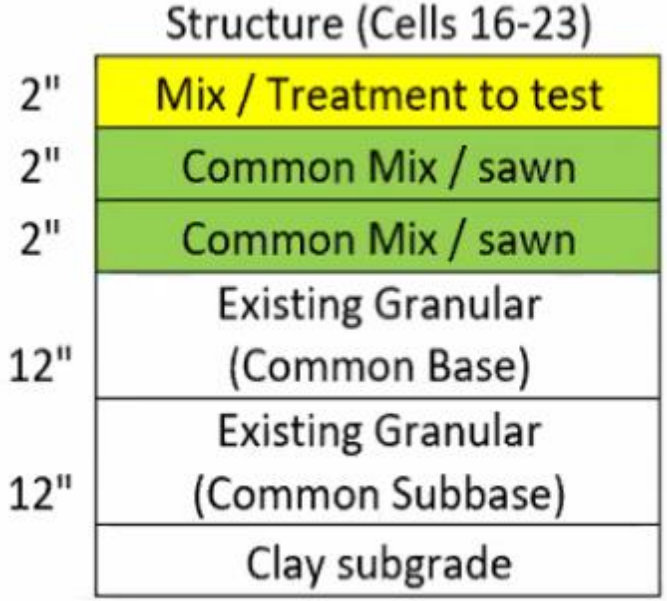


- 21°C and 10 Hz
- Generate S_{app} and FlexPAVE Inputs

Agency Selected AG Treatments

- Recycled tire rubber
  - "Wet" Entech PG76-22$_{N2}$
  - "Dry" Smart Mix in PG67-22$_{N1}$
- Recycled low density plastic
  - "Wet" Dow with Elvaloy PG76-22$_{S6}$
  - "Dry" *pellets* with PG76-22$_{S5}$
- High strength aramid fibers
  - Surface Tech ACE XP with PG76-22$_{N5}$
- Control with PG76-22$_{N7}$

- MnROAD in 2022



Hi-Tech Asphalt Solutions Feed System

← Smart Mix$_{12}$

Dry Plastic$_{8½}$→

← Asphalt Plus$_{12}$

Thick Lift Paving

Asphalt Mix Additive Takeaways

- Regional investigation/adoption of BMD requirements
- BMD compliance is easier than volumetrics, but no “Easy Button”
- Additive utilization is nothing to fear by industry/agencies
- Agency “wet” additive preference, contractor preference for “dry”
- Importance of production BMD testing (especially for “dry” option)
- No difficulty in meeting density requirement with healthier mixes
- Track “ground truth” for included additives, validated lab process (others)
- ~3½ million ESALs on 5½” AG+ sections (2003 ~2M for 5”, ~4M for 7”)
- BMD_{2021} mixes with 20% RAP outperforming $virgin_{2003}$ volumetric mixes!

Questions and Answers

- www.pavetrack.com
- asphaltresearch
- 2018Track

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