

at AUBURN UNIVERSITY

Research Update Michael Heitzman, PE, PhD







2015 NCAT Pavement Test Track

ONSITE LAB AND TRUCK MAINTENANCE

E 8

E 7

Eff

E 6

E10

W1 N13 N12 N11 N10 N9 H8 N7 H6 N5 N4 N3 N2 N1 🚽

- N1 N11, S5 S6, and S8 S13 are structural sections
- All other sections have deep perpetual foundations
- Research cycle of surface placement shown by color
- Black=00, Blue=03, Red=06, Yellow=09, Green=12, Purple=15
- Off-Tracktest sections on Lee Road 159 & US-280 shown below

1 51 52 53 54 55 56 57 58 59 510 511 512 513 E



W

W-4

W5

WE

W7

W8

W9

W10



Performance Data

Parameter	Track	Lee Road 159	US-280
Roughness	Weekly	Weekly	Weekly
Rutting	Weekly	Weekly	Weekly
Macrotexture	Weekly	Weekly	Weekly
Crack Mapping	Weekly	Monthly+	Monthly+
FWD	Weekly	Monthly	Quarterly
Surface Friction	Monthly	Monthly	Monthly
Permeability	Quarterly	-	Quarterly
Noise	Quarterly	Quarterly	Quarterly





Cracking Group (CG) Experiment



BBF



SCB-LA



I-FIT



OT-TX



OT-NCAT



SVECD



DCT

Energy Ratio



Nflex Factor



Cantabro





Southern Cracking Group (CG)

• N1 - 20% RAP Ctrl N2 - High Dens Ctrl N5 - Low AC & Dens Ctrl • N8 – Ctrl + 5% RAS S5 – 35% RAP w/ 58-28 S6 – Ctrl w/ HiMA S13 - 15% RAP AZ GTR.





Northern Cracking Group (CG)

			RECYC	cled Rial				
CELL NO	MIX DESIGNATION	MAX AGG SIZE (mm)	ABR %	RAS	Air voids at N _{design}	N _{design}	MSCR BINDER GRADE	COMMENTS
16	SPWEB540L	12.5	30-40	Var	4.0	80	PG 645-22	
17	SPWEB540L	12.5	20-30	res	4,0	80	PG 645-22	
18	SPWEA540L	12.5	15-25		4.0	80	PG 645-22	
19	SPWEB530L	12.5	15-25		3.0	100	PG 645-22	
20	SPWEB540A	12.5	25-35		4.0	80	PG 525-34	
21	SPWEB540C	12.5	15-25	No	4.0	80	PG 58H-34	
22	SPWEB540C	12.5	15-25		4.0	80	PG 58H-34	3139 modified for limestone
23	SPWEB5401	12.5	10-20		4.0	80	PG 64E-34	Highly modified asphalt binder



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National Center for



NCAT





6/5/2017 Buzz's best guess as of this date at what 2018 partnership funding may look like based on spor

Re

	Sponsorship Options for the 2018 NCAT+MnROAD Research Cycle						
	50	80	100	150	180	210	
2015 Options	PG	Surf Cont	Struc Cont	Surf Inlay	Struc Inlay	<u>Struc</u>	1
CG(S13), PG15	1		1				
PG	1	1					
CG+		1	1				
E9, E10, CG, PG	1	2	1			1	
E7, E8, CG	1	2	1			1	
N12, N13, PG	1			2			
PG15, S7	1	1	1				
S3, PG(S2)	1	1				1	
PG	1		1	1			
CG	1	1				1	
N9, PG, CG	1		1		1	1	
PG15	1		1				
new S4, PG	1	2	1				
NA				1		1	
S12, N3, N4			3				•
W8, N8(soft), W3		2					•
PG15	1						
PG15, CG	1		1	1			
PG15	1			1			
PG15, CG	1		1				
PG15, CG	1		1				
PG15,CG	1		1				
PG15, CG	1		1				
NA	10						
	2015 Options CG(S13), PG15 PG CG+ E9, E10, CG, PG E7, E8, CG N12, N13, PG PG15, S7 S3, PG(S2) PG15, S7 S3, PG(S2) PG15 CG N9, PG, CG PG15 NA S12, N3, N4 W8, N8(soft), W3 S12, N3, N4 W8, N8(soft), W3 PG15 CG PG15, CG PG15, CG PG15, CG PG15, CG PG15, CG	Sponsor 2015 Options PG CG(S13), PG15 1 PG 1 CG 1 CG+ 1 E9, E10, CG, PG 1 E7, E8, CG 1 N12, N13, PG 1 PG15, S7 1 S3, PG(S2) 1 PG15 1 PG15 1 N9, PG, CG 1 PG15 1 NS12, N3, N4	Sponsor-hip Options 2015 Options PG Surf Cont CG(S13), PG15 1 PG 1 1 CG(S13), PG15 1 1 PG 1 1 CG+ 1 1 E9, E10, CG, PG 1 2 E7, E8, CG 1 2 N12, N13, PG 1 1 PG15, S7 1 1 S3, PG(S2) 1 1 PG 1 1 N9, PG, CG 1 1 N9, PG, CG 1 2 NA 1 2 NA 1 2 NA 1 2 NA 1 2 PG15, CG 1 2	Sponsor-Higher 20182015 OptionsPGSurf ContStruc ContCG(S13), PG1511PG11PG11CG+11E9, E10, CG, PG12N12, N13, PG11PG15, S711PG11S3, PG(S2)11PG11PG511PG1511N9, PG, CG11N421N512, N3, N423W8, N8(soft), W323PG15, CG11PG15, CG11<	Sponsortip Options to the 2015 OptionsSolution of the 2015 OptionsOptionsSurf contSurf contSurf contSurf contSurf inlayCG(S13), PG1511111PG111111CG+1111111CG+12111111E9, E10, CG, PG12112111<	Sponsorship Options for the 2015 NCAT+MOR DERSearch2015 OptionsPGSurf ContStruc ContSurf InlayCG(\$13), PG1511Struc InlayPG111PG111CG+111E7, E8, CG1121PG15, S71111PG15, S711111PG15, S7111111PG15111111PG15111111PG15111111PG15111111PG15111111PG15111111PG15111111PG15111111PG15111111PG15111111PG15, CG111111PG15, CG11 <t< td=""><td>Sponsor-bit poptions for the 2018 NCAT+MINE-DA Research Cycle2015 OptionsPGSurf ContStruc ContSurf InlayStruc InlayStrucCG(S13), PG1511Struc ContSurf InlayStrucStrucPG111InlayStruc InlayStrucCG(S13), PG15111InlayStruc InlayStrucPG111InlayInlayInlayCG+111InlayInlayInlayCG+121InlayInlayInlayE9, E10, CG, PG121InlayInlayInlayF8, CG121InlayInlayInlayPG15, S7111InlayInlayInlayPG15, S711InlayInlayInlayInlayPG15, S711InlayInlayInlayInlayPG15, S711InlayInlayInlayInlayPG1511InlayInlayInlayInlayPG1512InlayInlayInlayInlayPG1512InlayInlayInlayInlayPG15, CG1InlayInlayInlayInlayPG15, CG1InlayInlayInlayInlayPG15, CG1InlayInlayInlayInlayPG15, CG1Inla</td></t<>	Sponsor-bit poptions for the 2018 NCAT+MINE-DA Research Cycle2015 OptionsPGSurf ContStruc ContSurf InlayStruc InlayStrucCG(S13), PG1511Struc ContSurf InlayStrucStrucPG111InlayStruc InlayStrucCG(S13), PG15111InlayStruc InlayStrucPG111InlayInlayInlayCG+111InlayInlayInlayCG+121InlayInlayInlayE9, E10, CG, PG121InlayInlayInlayF8, CG121InlayInlayInlayPG15, S7111InlayInlayInlayPG15, S711InlayInlayInlayInlayPG15, S711InlayInlayInlayInlayPG15, S711InlayInlayInlayInlayPG1511InlayInlayInlayInlayPG1512InlayInlayInlayInlayPG1512InlayInlayInlayInlayPG15, CG1InlayInlayInlayInlayPG15, CG1InlayInlayInlayInlayPG15, CG1InlayInlayInlayInlayPG15, CG1Inla



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Performance Curves for Pavement Preservation



Preservation Group Study

• GOAL:

Develop *independent* life-extending benefit curves for a range of pavement preservation treatments, under varying traffic levels and climates



Treatments

- Control Sections
- Surface Treatments
 - Crack Sealing
 - Fog Seal
 - Chip Seals
 - Scrub Seals
 - Microsurfacing
 - Combinations (Cape Seals)

- Cold Recycling + 1" overlay
 - Cold-in-place (CIR)
 - Cold Central Plant Recycle (CCPR)
- Thin Overlays (3/4")
 - Dense Graded (4.75 mm)
 - OGFC
 - UTBWC
 - Combinations



Life Extending Benefit



Time / Traffic









Good: < 5% Fair: 5 - 20% Poor: > 20%



Performance Models

- S-shaped curves make the most sense
- Logistic growth models looks reasonable









Example

		Yr 4.8			
Section	CATEGORY	% Crack	CAT @ Yr 4.8	Yrs in Good	Yrs to Poor
Control (Untreated)	GOOD	31.3	POOR	1.2	2.3
	FAIR	44.5	POOR	NA	1.0
	POOR	94.3	POOR	NA	

Section	CATEGORY	Yr 4.8 % Crack	CAT @ Yr 4.8	Yrs in Good	Yrs to Poor
Single Chip Seal	GOOD	10.3	FAIR	2.7	4.8+
	FAIR	5.6	FAIR	4.5	4.8+
	POOR	34.6	POOR	2.7	3.4
Single Chip Seal + Crack Seal	GOOD	3.4	GOOD	4.8+	4.8+
	FAIR	15.6	FAIR	3.0	4.8+
	POOR	17.3	FAIR	3.0	4.8+

Challenges

Most important...

How do we define life-extending benefit?





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Asphalt Alternatives to High Friction Surface Treatments on the 2015 Track











Research Test Sections

N9 OK DOT "higher" friction OGFC
W3 FHWA "higher" friction SMA
W7 FHWA "higher" friction micro-surfacing



N9 OK DOT OGFC Friction & Bond Strength Study

- Compared high friction aggregate sources with accelerated lab friction testing
- Compare Test Track friction performance with previous OK DOT Test Track Sections
- Compare tack coat performance



N9 OK DOT OGFCFeb 2016July 2016April 2017



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N9 OK DOT OGFC

Macro-texture CTM MPD 1.80 mm, rolling MTD 1.15 mm



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N9 OK DOT OGFC 2015 N9 Sandstone vs 2012 E9 granite







N9 OK DOT OGFC Past OK mixes friction performance

OK DOT Sections Comparison



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W7 FHWA Micro-surfacing High Friction Alternative Study

- Compare friction performance of two micro-surfacing treatments using different friction aggregates Compare friction performance to HFST
- sections



W7 FHWA Micro-surfacing

Mix Design by Paragon Technical Services
India calcined bauxite source
50% bauxite, 49% LMS sand, 1% cement filler, 12% CSS-1HP (HiMA eFlex)
All aggregate passes #4
ASTM/ISSA mix design method



W7 FHWA Micro-surfacing



W7 FHWA Micro-surfacingFeb 2016July 2016Apr 2017







W3 FHWA SMA High Friction Alternative Study

- Measure friction performance of SMA with calcined bauxite as the predominant coarse aggregate
- Compare friction performance with HFST sections and previous W3 SMA
- Surface placed April 4, 2017



W3 FHWA SMA

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Final JMF Mar 2017, 4.75 mm NMAS, 50-blow Marshall, 40% India bauxite, 59% LMS M-10, 1% filler, 8.3% PG 76 -22, 5% voids CA 50% = +No 16 (2:1 bauxite:LMS)











End-of-Cycle Track Conference



High RAP/RAS balanced mix designs
Nationwide pavement preservation
Preventing reflective distresses
Optimized structural design
Implementation



Pavement Test Track Conference March 27-29, 2018

The Hotel at Auburn University and Dixon Conference Center



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