Interlayers

- Primary purpose: to delay or prevent distress from reflecting from underlying pavement/material
- Types:
  - Fabric/geotextiles
    - Woven, non-woven
    - Typically placed over a leveling course
  - Chip seal-type applications
    - Asphalt rubber membrane interlayer
    - Underseal
  - Hot mix asphalt
    - Strata®
    - Rich intermediate/rich bottom layer

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Potential Interlayer Concerns

- Multiple operations to mobilize for
  - Added complexity, cost, time
- Specialized work (geotextile placement, asphalt-rubber SAMI application)
- Traffic control during construction
- Cost
- Effectiveness
  - Mixed experience
  - Make sure that the conditions are appropriate
    - Stable underlying structure (minimal vertical movement under loading at cracks)
    - Underlying material resistant to moisture damage
    - Correct any problem with subsurface drainage.

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Strata®

- Introduced by Koch Materials in 1990's
  - Now ArrMaz Road Science
    - https://www.arrmaz.com/wp-content/uploads/2020/05/Road_Science_Strata_Benefit_Sheet.pdf
  - Thin (1 inch) hot mix asphalt (HMA) application
  - Fine aggregate mixture
  - Highly elastic polymer modified asphalt
  - High asphalt content
- Primary Purposes: To seal the underlying pavement and resist reflection cracking

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"Rich Intermediate Layer" (RIL)

- Generic ODOT Specification, Section 411(J)
- Characteristics: Flexible, impermeable, provides structural benefit
- Small nominal maximum aggregate size, high binder content, low air voids mixture using highly modified asphalt (HiMA) binder
  - PG76E-28
- Purpose: to resist reflection of underlying cracks through the surface while providing additional pavement structure and a leveling/profiling opportunity
- First used at the NCAT Test Track in Section N8

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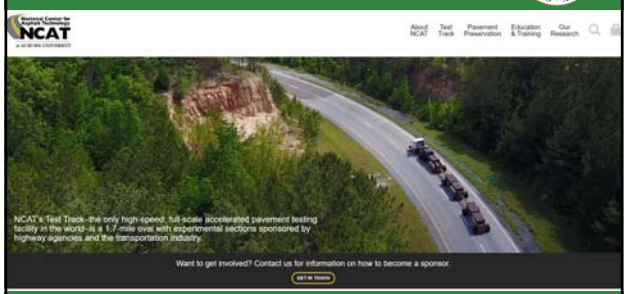

https://www.eng.auburn.edu/research/centers/ncat/testtrack/index.html

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NCAT 2006 Construction, Sections N8 & N9, Oklahoma DOT

- ODOT tested the perpetual pavement concept in anticipation of building SH 152 southwest of OKC
  - Reconstructed the embankment for N8 and N9 to approximate central Oklahoma conditions
  - Both test sections included a "Rich Bottom Layer," and SMA surface
- Sections N8 (10 in., total) and N9 (14 in., total), Section N9 – no distress, as expected. N8 was severely distressed and required rehabilitation for safety and operational purposes
  - First rehabilitation attempt included milling 5 in., replacing with similar materials as before (as per typical ODOT rehab strategy), placing a geotextile on top of the dense-graded leveling course
  - Cracking observed after 2.7 million ESAL, then deteriorated rapidly requiring additional rehabilitation

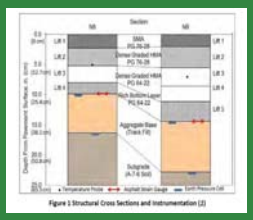

Figure 1 Structural Cross Sections and Instrumentation (2)

Timm, D. H., D. Gierhart, and J. R. Willis. Strain Regimes Measured in Two Full Scale Perpetual Pavements. Proc., International Conference on Perpetual Pavement, Columbus, OH., 2009.

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NCAT Section N8 – June 29, 2010

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NCAT Section N8, Oklahoma DOT

- Excellent performance observed on the adjacent test section (N7), which was a thin (5¾-inch) pavement using "highly-modified" asphalt (HiMA) binder
- Milled 6 inches, replaced with a like thickness of mixtures using HiMA binder
  - This approach could be done very quickly and easily
  - Included a 1-inch "rich HPM" (RIL) lift to retard reflection cracking- designed to similar volumetric requirements as rich bottom layer mixture.

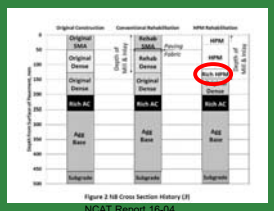

Figure 2 N8 Cross Section History (3)

NCAT Report 16-04

https://www.eng.auburn.edu/research/centers/ncat/files/technical-reports/rep16-04.pdf

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NCAT Section N8 Rehabilitation-Results

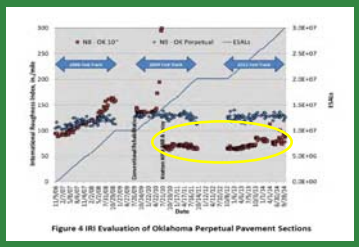

Figure 4 IRI Evaluation of Oklahoma Perpetual Pavement Sections

NCAT Report 16-04
https://www.eng.auburn.edu/research/centers/ncat/files/technical-reports/rep16-04.pdf

- Roughness, rutting stabilized after HiMA rehabilitation
- No cracks observed until more than 15 million ESAL
- A viable option for rapid rehabilitation of Interstates or other pavements subjected to heavy vehicle traffic

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I-40, Caddo County(approx. MP 102.2-104.2)

- Feb-April 2012
- Milled 5 inches, replaced with:
  - 1½ in RIL, PG76-28E (HiMA)
  - 5 in S3, PG76-28E, in two lifts
  - 1½ in S5, PG76-28E
  - ¾" OGFC (PG76-28, not HiMA)

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I-40, Caddo County

- Avg. 2020 IRI: 49.97 in/mi (EB), 47.81 in/mi (WB)*
- 2021 AADT = 29,600 with 36% trucks (7% single-unit, 29% combination)

* https://spotlight-ok.dot.hub.arcgis.com/apps/master-roadway-bridge-data-viewer/explore

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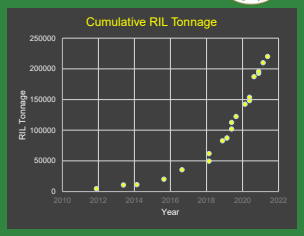
ODOT History of RIL Use: 2012-2022

- Steady increase since 2018
- Used in all ODOT Districts
  - Most in District 1
- Projects ranging from county roads to Interstate highways



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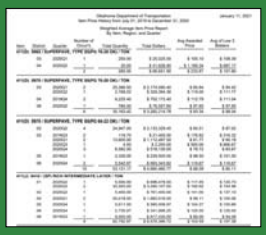
Oklahoma DOT Historical Cost Data

- Oklahoma Department of Transportation publishes "Average Price History," available online
- Compare RIL with Fabric Interlayer + S5 leveling

https://www.odot.org/contracts/avgprices/index.php



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Cost Comparison: RIL vs. Fabric + Leveling

Item	Low bid	Avg. 3 low bids
S411(J), RIL (1.25")	$114.10/ton	$120.35/ton
S407(D), Tack Coat (NT), (0.10 gal/sy)	$3.28/gal	$3.32/gal
S409, Fabric	$2.33/sy	$2.28/sy
S409, Bit. Binder	$3.99/gal	$4.54/gal
S411 (D), Type S5 (PG64-22), 1.25"	$80.29/ton	$85.63/ton
S411 (D), Type S5 (PG76-28)	$95.20/ton	$102.40/ton

Source: Oklahoma DOT (https://www.odot.org/contracts/avgprices/index.php), March 14, 2022 Price History

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Comparison: RIL vs. Fabric + Leveling*

- RIL Cost = RIL (1.25 in) + Tack (trackless tack @ 0.10 gal/sy)
- Fabric = Fabric + Bituminous Binder (@ 0 .225 gal/sy) + S5 (1.25 in)

Alternative	Low Bid	Avg. 3 lowest
1.25 in Rich Intermediate Layer (RIL)	$8.17/sy	$8.60/sy
Fabric, 1.25 in. S5 (PG64-22)	$8.75/sy	$9.19/sy
Fabric, 1.25 in. S5 (PG76-28)	$9.77/sy	$10.34/sy

*Note that this does not account for differences in mobilization, traffic control or other items

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ODOT RIL Specification

- Section 411/708, 2019 Standard Specifications
- Laboratory Mix Design Properties:
  - S5 gradation (9.5 mm NMS), min. 5.5% binder content
  - N_{des} = 50 gyrations, 97% G_{mm}, VMA ≥ 15.5%, VFA: 73-79%
  - Hamburg Wheel Tracking: max 12.5 mm deformation after 20,000 cycles
- PG76E-28 binder grade (HiMA)

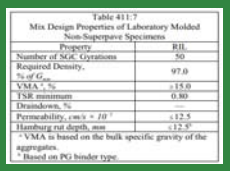

Table 411:7
Mix Design Properties of Laboratory Molded Non-Superpave Specimens

Property	RIL
Number of SGC Gyrations	50
Required Density, % of G_{mm}	97.0
VMA [1], %	≥15.0
TSR minimum	0.80
Draindown, %	---
Permeability, cm/s × 10^{-5}	≤12.5
Hamburg rut depth, mm	≤12.5[2]

[1] VMA is based on the bulk specific gravity of the aggregates.
[2] Based on PG binder type.

Special Provision 411-015

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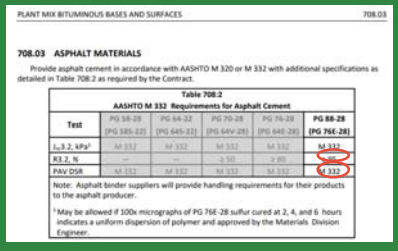
Oklahoma DOT HiMA Specification, PG76E-28



PLANT MIX BITUMINOUS BASES AND SURFACES 708.03

708.03 ASPHALT MATERIALS

Provide asphalt cement in accordance with AASHTO M 320 or M 332 with additional specifications as detailed in Table 708.2 as required by the Contract.

Table 708.2
AASHTO M 332 Requirements for Asphalt Cement

Test	PG 58-28 (PG 58S-22)	PG 64-22 (PG 64S-22)	PG 70-28 (PG 64V-28)	PG 76-28 (PG 64E-28)	PG 88-28 (PG 76E-28)
J_{nr} 3.2, kPa[1]	M 332	M 332	M 332	M 332	M 332
R3.2, %	--	--	≥ 50	≥ 80	≥ 80
PAV DSR	M 332	M 332	M 332	M 332	M 332

Note: Asphalt binder suppliers will provide handling requirements for their products to the asphalt producer.

[1] May be allowed if 100x micrographs of PG 76E-28 sulfur cured at 2, 4, and 6 hours indicates a uniform dispersion of polymer and approved by the Materials Division Engineer.

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Iowa DOT Hot Mix Asphalt Interlayer Specification

- PG 58-34E binder
- No RAP
- AASHTO T-321 Min 100,000 cycles to failure at 2000 microstrain
- In use since 2014, mostly for overlaying jointed concrete pavement

https://intrans.iastate.edu/app/uploads/2018/03/asphalt_interlayer_on_jointed_concrete_t2.pdf

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Iowa DOT SS-15010

≈ ODOT RIL/S5 Gradation

- N_{des} = 50 gyrations, 98% G_{mm}
- Film Thickness > 8.0 µm

https://iowadot.gov/erl/current/IMcontent/510aa.htm

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Alabama DOT Projects

1) I-59/I-20, Tuscaloosa Co., 2016-7
2) I-459, Jefferson Co., 2018
3) I-85, Macon Co., 2021
4) I-59, Etowah & Dekalb Co.'s, 2022

- 9.5 mm NMS Superpave, designed at 2% air voids requiring HiMA (PG76-22E per ALDOT specs)
- Used to delay/prevent reflection cracking

Thanks to John Jennings, P.E. State Materials Engineer and Scott George, P.E., State Materials and Tests Engineer, ALDOT!

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Alabama I-59/I-20

- Opened in 1970, rehabilitated in 1983, 1990 and 2001
- Extensive longitudinal cracking
  - About 1/3 of cracks extended beyond top 4 inches of pavement
  - Deflection (FWD) analysis suggested the need for additional pavement thickness
- 17 bridges within project limits complicated things
  - Very costly to raise the surface profile to allow for additional structure
  - Estimated to cost almost $8.7 million just to raise bridge surfaces
- Drew from NCAT experience in Section N8

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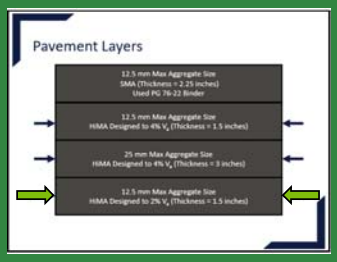
Alabama I-59/I-20 Rehabilitation



From Braden Smith (Hunt Refining) at 2018 SEAUPG Meeting, Raleigh, NC

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Alabama I-59/I-20 Conditions

- Opened in 2016, no distress reported by ALDOT in 2020
- Roughness difficult to assess due to bridges, but no change evident
- So far, so good!

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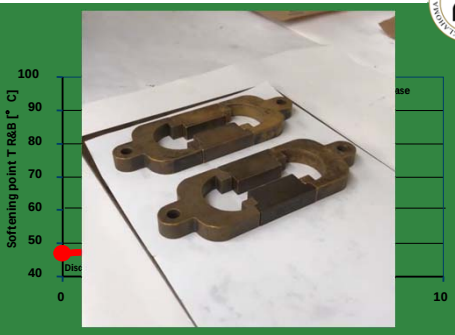
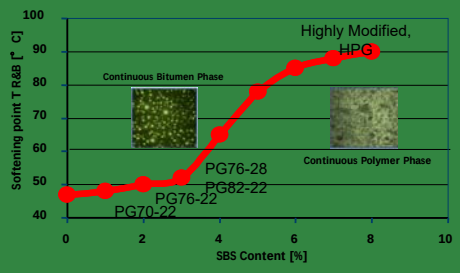
HiMA (Highly-Modified Asphalt) Binder

- Not a product, but a binder grade
  - Examples include PG76E-28 (Oklahoma), PG76-28E (HP)(Virginia), High Polymer (Florida), HPG (Texas)
  - Distinguished by high MSCR recovery/low compliance at elevated temperature
- Results in higher SB polymer content (2X-3X) that of conventional polymer-modified binder grades
- Enables the use of high binder content without instability

"S-Curve" – Effect of increasing SBS content

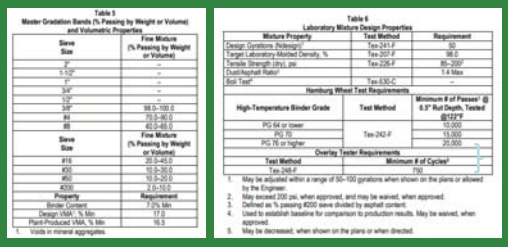


"S-Curve" – Effect of increasing SBS content



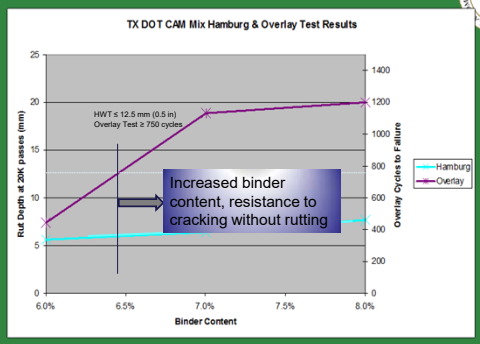
HiMA Impact-TxDOT "Crack Attenuating Mixture" (CAM)

- TxDOT Special Specification (2014) Item 3000



Unlike OK & AL, no general requirement for a particular binder grade

TxDOT Item 3000, Crack Attenuating Mixture (CAM)



FHWA "Every Day Counts" Initiative, EDC-6

- Targeted Overlay Pavement Solutions (TOPS)
- Solutions for integrating innovative overlay procedures into practices that can improve performance, lessen traffic impacts, and reduce the cost of pavement ownership.
- Approximately half of all infrastructure dollars are invested in pavements, and more than half of that investment is in overlays. By enhancing overlay performance, State and local highway agencies can maximize this investment and help ensure safer, longer-lasting roadways for the traveling public.

State of the Practice

Recent improvements to design methods, interlayer technology, slab geometry, and concrete mixtures have broadened concrete overlay surface treatment applicability, reliability, sustainability, and cost-effectiveness. A joint effort by Georgia, Iowa, Kansas, Michigan, Minnesota, Missouri, North Carolina, and Oklahoma resulted in the development of an improved design procedure for jointed unbonded concrete overlays on either concrete or composite pavements.

For asphalt overlays, several State departments of transportation (DOTs) have adopted SMA due to increased service life and performance. The Maryland, Alabama, and Utah DOTs each used over 1 million tons of SMA during a 5-year period. DOTs in Florida, Georgia, New Jersey, New York City, Tennessee, and Virginia found highly modified asphalt in thin overlays is more resistant to reflective cracking. It has increased pavement life by two to four times for DOTs in Alabama and Oklahoma.

https://www.fhwa.dot.gov/innovation/everydaycounts/edc_6/


Questions?
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