Image source: NAPA

Image source: ACPA

U.S. Department of Transportation
Federal Highway Administration

TOPS

Targeted Overlay Pavement Solutions

A solution for extending the life of an existing pavement investment.

Except for any statutes or regulations cited, the contents of this webinar do not have the force and effect of law and are not meant to bind the public in any way. This webinar is intended only to provide information to the public regarding existing requirements under the law or agency policies.

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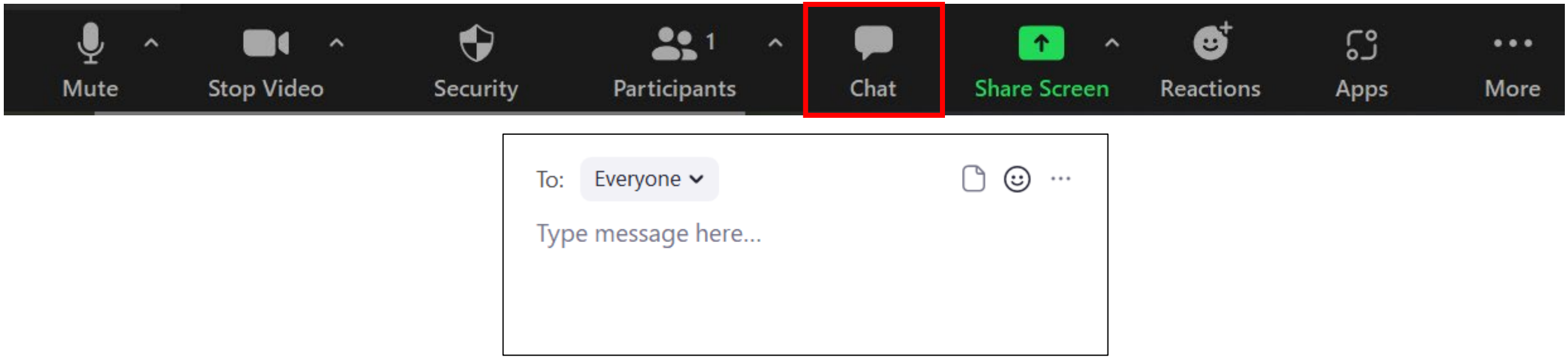
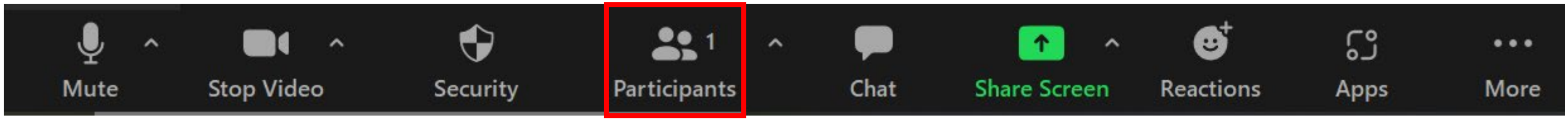
Submitting Questions

- To ask a question, send a message using the chat function.
- All questions from participants will be answered during the Q&A session at the end of the webinar.



Zoom Features

- To view a list of meeting participants, click the Participants button in the bottom panel.



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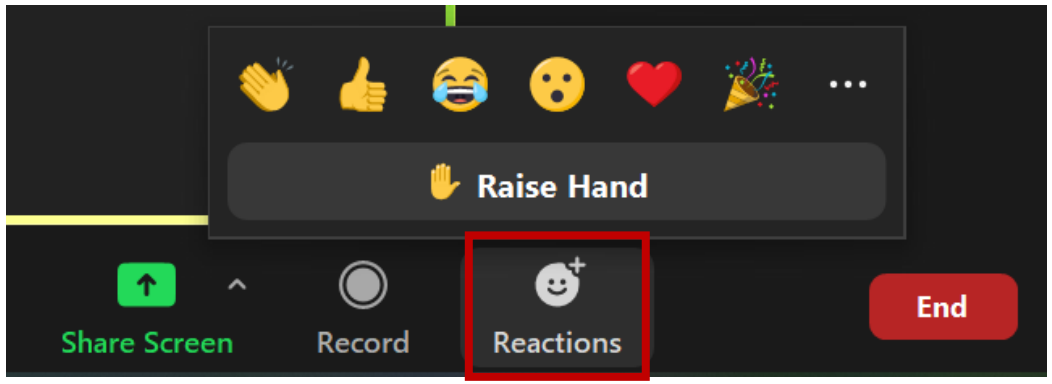
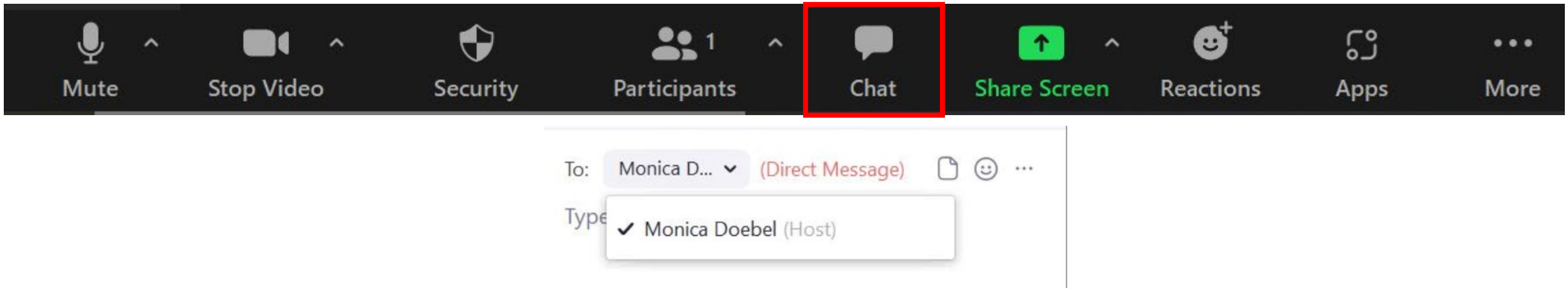


Technical Difficulties?

- If you experience any technical issues, please reach out using one of the following methods:
  - Send a direct message to the meeting hosts.



  - Email Monica Doebel and Eric Schulman.

Webinar Overview

- Introduction to EDC-6 TOPS: Tim Aschenbrener, FHWA
- HPTO Overview
- HPTO Agency Experience: Robert Blight, NJDOT
- CAM Overview
- CAM Agency Experience: Ashwaq Mohammed, TxDOT (Houston District)
- CAM/HPTO Q & A

FHWA TOPS EDC-6 Team

Tim Aschenbrener
FHWA Headquarters

Sam Tyson
FHWA Headquarters

Derek Nener-Plante
FHWA Resource Center

Bob Conway
FHWA Resource Center

Background

- Over 25% of all State DOT infrastructure funds go to pavements overlays.
- State DOT manage 2.8 million miles of pavements.

- *Information source: FHWA*

Image source: Iowa State University

How is this different than typical overlays?

TOPS matches treatments to high-priority, high-need locations.

Image source: Georgia DOT

TOPS EDC Mission

Image source: iStock

Extend pavement life, increase load-carrying capacity, and improve safety, mobility, and user satisfaction in a cost-effective and sustainable manner by delivering targeted pavement overlay solutions to Federal, State, and local transportation agencies.

EDC-6 Goals

- Increase the number of participating agencies that demonstrate, assess, or institutionalize an additional TOPS technology not previously institutionalized.
- Build awareness and expand TOPS usage
  - Identify a champion at each State agency
  - Share information at conferences/workshops
  - Train people (webinars/peer exchanges)

What's in the TOPS asphalt toolbox?

Asphalt overlay products:

- High-Performance Thin Overlay (HPTO)
- Crack Attenuating Mixture (CAM)
- Highly Modified Asphalt (HiMA)
- Enhanced friction overlay
- Stone matrix asphalt (SMA)
- Asphalt Rubber Gap-Graded (ARGG)
- Open-Graded Friction Course (OGFC)
- Ultra-thin bonded wearing course (UTBWC)

What's in the TOPS concrete toolbox?

Concrete overlay products:

- Concrete on Asphalt – Bonded (COA-B)
- Concrete on Asphalt – Unbonded (COA-U)
- Concrete on Concrete – Bonded (COC-B)
- Concrete on Concrete – Unbonded (COC-U)

TOPS Potential Benefits

- Improved Safety
- Improved Performance
- Retained Investments
- Cost Savings
- Environmentally Sound

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TOPS
Targeted Overlay Pavement Solutions

High Performance Thin Overlays (HPTO)

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HPTO Characteristics

- New Jersey DOT (NJDOT) defines HPTO as a fine-graded polymer-modified asphalt mixture that uses aggregate with a nominal maximum aggregate size (NMAS) of ⅜-inch.
- Texas DOT's (TxDOT's) version is called Thin Overlay Mixture (TOM).
- Performance testing requirements during design and production differentiate HPTO as 'high-performance' compared to other thin overlays.

High Performance Thin Overlay

Source: NCAT 2020

HPTO Background

- In the late 1990s, a New Jersey contractor needed a heavy-duty thin lift overlay to put down in an auto dealership's parking lot.
- In Texas, thin surface mixtures were first developed in-house in the TxDOT Austin District in early 2000s.

Placement of first generation HPTO in NJ

Source: Tom Bennert 2016

Placement of first TOM in Georgetown TX

Source: TxDOT 2014

Potential Benefits of HPTO

- May be appropriate for state highway systems with high traffic volumes.
- Renews the road surface, provides a good surface treatment and extends pavement life.
- Minimizes impact on traffic with shorter lane closures.
- Adds service life to the pavement without a significant change in profile grade.
- Ride quality may be improved.
- TxDOT and NJDOT have reported a reduction in noise and improvement in long-term skid resistance on some projects.

Design and Planning

- Project selection criteria.
- Pavement and asset evaluation.
- Pavement design, thickness criteria, and repair strategies.
- Cost and benefit-cost ratio.
- Other considerations.

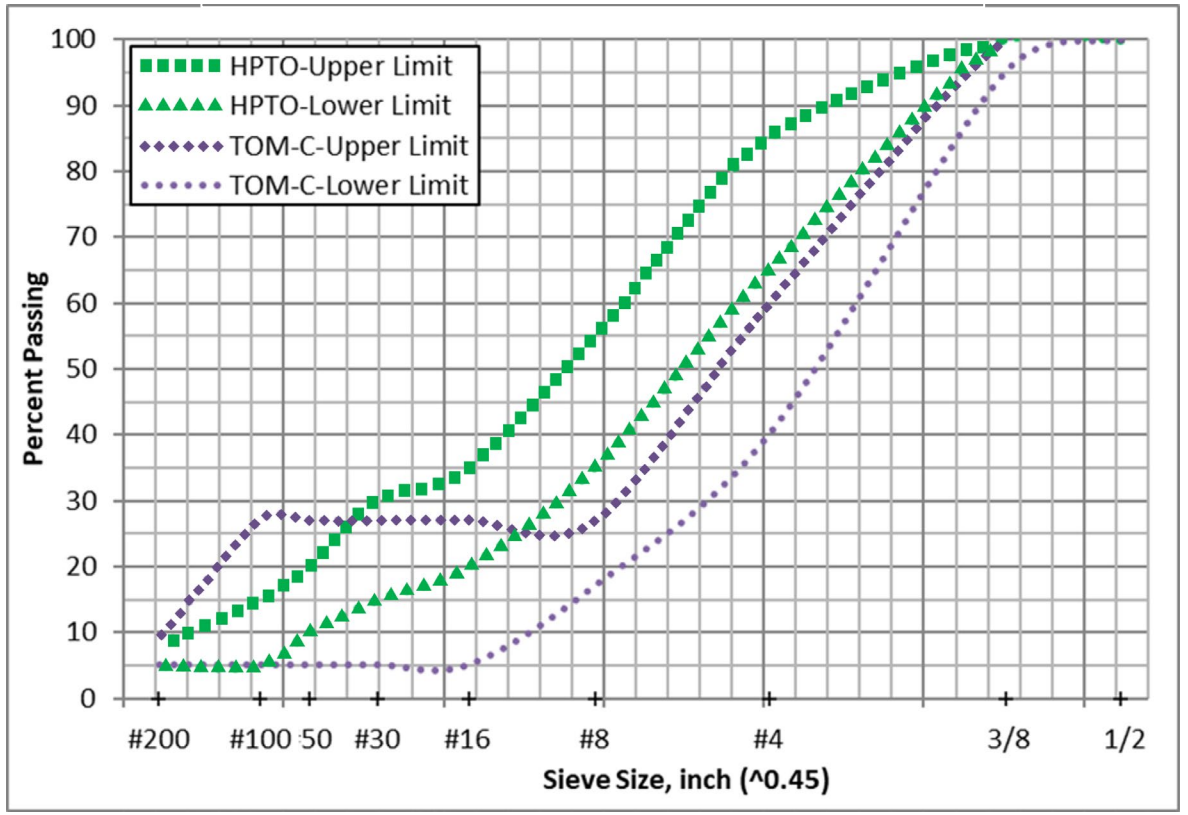
Poor candidates for HPTO

Source: TXDOT 2014

Materials/Mixture Properties

- Aggregates.
- Asphalt binder.
- Recycled materials and additives.
- Mixture design.
- Performance requirements.
- Specifications.

Typical Gradations - HPTO and TOM-C



Source: FHWA 2021

Materials and Mixture Properties

Mix Property	HPTO (NJDOT Section 902)	TOM-F (TxDOT 347)
Binder Content (total weight of mix), min. %	7.4	6.0
Design VMA, %	≥18.0	16.0 Min.
Design Gyrations	50	50
Lab-molded density, %	96.5	97.5 (Texas Gyratory compactor)
Tensile strength ratio, %	85	No requirement specified
Dry Tensile strength, PSI	No requirement specified	85-200
Dust to Asphalt Ratio	0.6-1.2	No requirement specified
Draindown, %	≤1.0	0.20 max.
Hamburg Wheel Test, 12.5 mm rut depth	Not Applicable	PG 76: 20,000 passes (min.)
Overlay Tester, min. cycles	600	300
Asphalt Pavement Analyzer (APA), 8,000 cycles (min.)	4 mm (max.)	Not Applicable

Source: FHWA 2021

Production and Construction Practices

- Materials.
- Production, storage, and transportation.
- Surface preparation.
- Placement and compaction.
- State QC requirements.
- Successful practices.

Material Transfer Vehicle (MTV)

Source: NJDOT 2020

NJDOT Case Study

About the Presenter

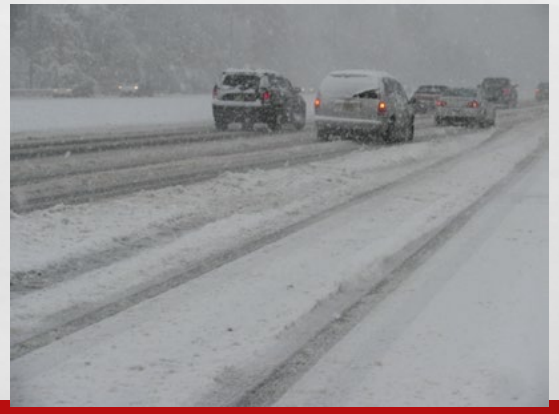
- **Robert Blight** is the Executive Manager of the Pavement & Drainage Management & Technology unit at NJDOT.
- He received his B.S. in Civil Engineering from Rutgers University in NJ.
- Over the past 25 years, Robert has worked in the fields of pavement engineering, pavement management, materials, geotechnical engineering, and construction.

NEW JERSEY DOT – HPTO CASE STUDY

EDC-6 TOPS

WHY HPTO?

- WHY HIGH PERFORMANCE THIN OVERLAY (HPTO)?
  - VERY HEAVY TRAFFIC
  - EXTREME CLIMATIC CONDITIONS
  - OLD CRUMBLING INFRASTRUCTURE
- NEED HIGH PERFORMING ASPHALT OVERLAY FOR PRESERVATION
- PAVEMENT LIFE EXTENSION

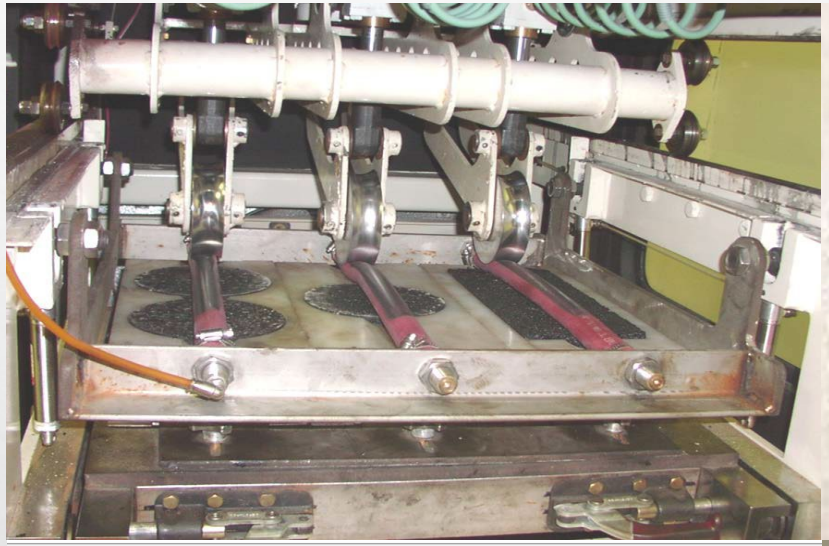


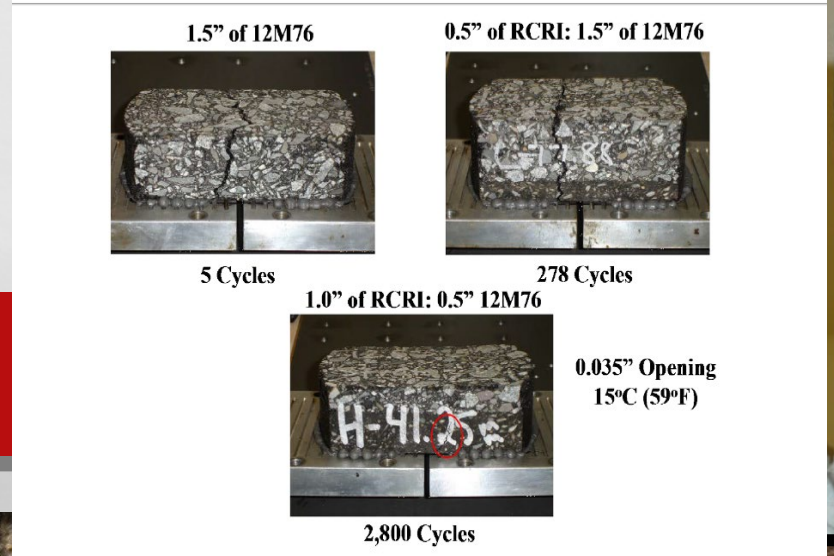
HIGH PERFORMANCE THIN OVERLAY (HPTO)

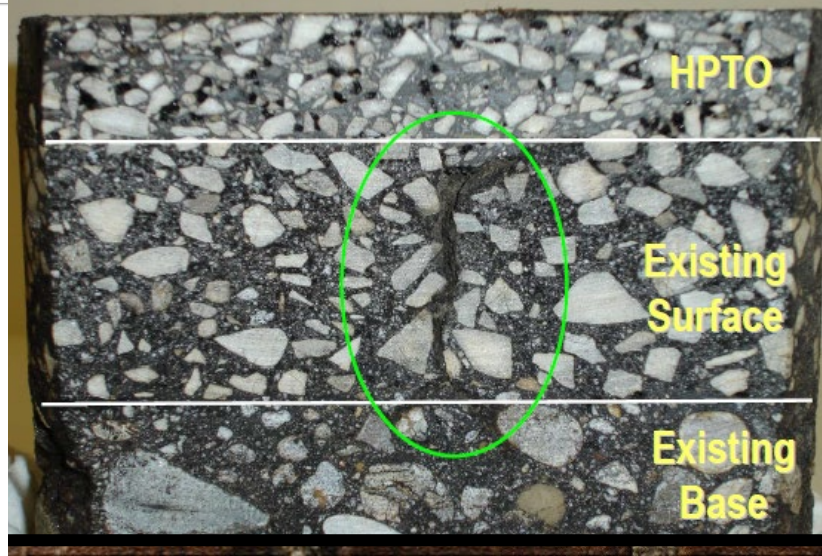
- HPTO = 1” THICK PAVEMENT PRESERVATION THIN OVERLAY
- 3/8” NMA SIZE WITH PMA (PG64E-22)
  - MODIFIED SUPERPAVE VOLUMETRIC DESIGN
  - APA RUT PERFORMANCE TESTING
  - TEXAS OVERLAY CRACK PERFORMANCE TESTING

HPTO

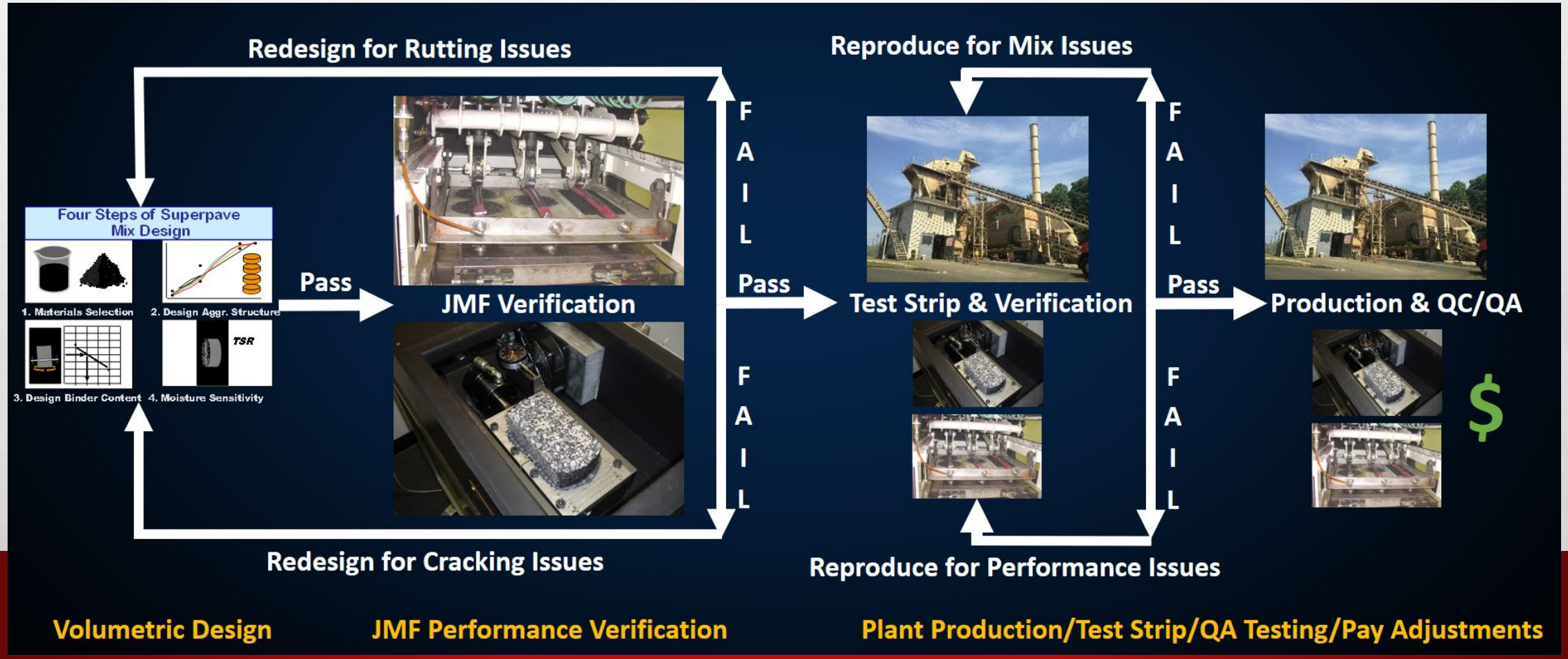
- HPTO MUST MEET MIXTURE PERFORMANCE REQUIREMENTS
  - TEXAS OVERLAY CRACK TESTER
    - CYCLES > 600 IN OT
  - ASPHALT PAVEMENT ANALYZER RUT TESTER
    - RUT < 4MM IN APA







NJDOT PRS METHODOLOGY



HPTO PAY ADJUSTMENT

Table 902.08.03-1 Performance Testing Pay Adjustments for HPTO

Test	Requirement	Test Result	PPA
APA @ 8,000 loading cycles, mm (AASHTO T 340)	5.0 maximum	$t \leq 5.0$ $5.0 < t \leq 12.0$ $t > 12.0$	0 -50(t-5)/7 -100 or Remove & Replace
Overlay Tester, cycles (NJDOT B-10)	600 minimum	$t \geq 600$ $600 > t \geq 400$ $t < 400$	0 -(600-t)/4 -100 or Remove & Replace

1ST HPTO PRESERVATION PROJECT – 2008 I-295 NB IN SALEM & GLOUCESTER COUNTIES

- AADT = 60,000 VPD
  - 20 YEAR ESAL'S = 76 MILLION
- EXISTING 4" SUPERPAVE HMA PAVED IN 2000 OVER 10" THICK JRCP
- 2007 PMS DATA
  - SDI = 3.4, IRI = 90 IN/MI

1ST HPTO PRESERVATION PROJECT – 2008 I-295 NB IN SALEM & GLOUCESTER COUNTIES (CONTINUED)

- 2008 1” HPTO
  - SDI = 5.0, IRI = 90 IN/MI
  - NO IRI REQUIREMENT INCLUDED
- 2019 REVIEW OF PMS DATA (PRIOR TO 2ND PRESERVATION)
  - SDI = 4.0, IRI = 89 IN/MI
- 11 YEARS STILL GOOD CONDITION
- 2ND PRESERVATION TREATMENT APPLIED IN 2019 - UTFC

I-287 MIDDLESEX COUNTY

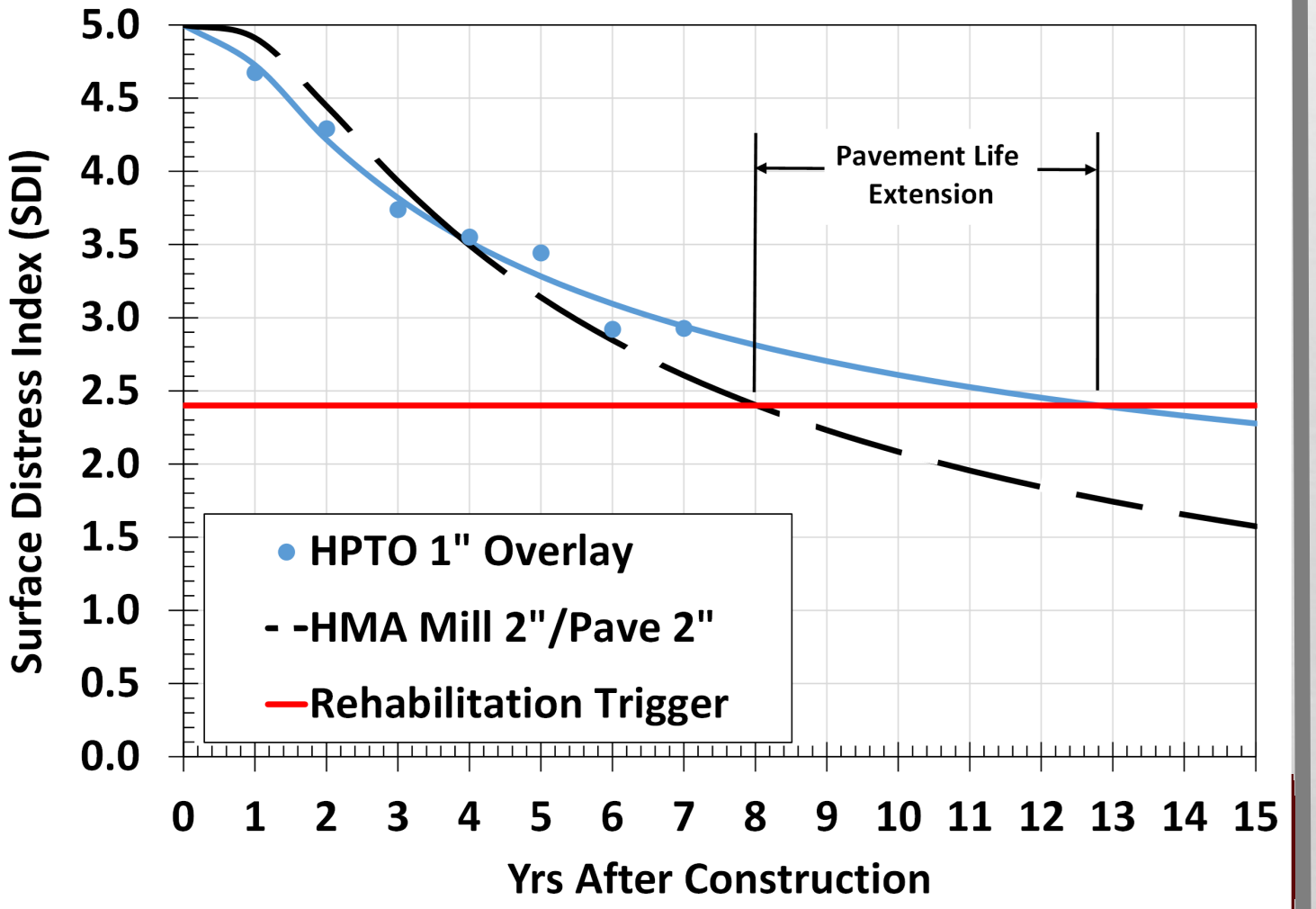
- AADT = 150,000 VPD
  - 20 YEAR ESAL'S = 50+ MILLION
- EXISTING 5" SUPERPAVE HMA PAVED IN 2008 OVER 10" THICK JRCP (CIRCA 1973) ~ 78'2" JOINT SPACING
- 2015 PMS DATA BEFORE HPTO
  - SDI = 3.4, IRI = 124 IN/MI

I-287 MIDDLESEX COUNTY (CONTINUED)

- 2015 1” HPTO OVER TYPE 2 MICROSURFACING
  - SDI = 5.0, IRI = 76 IN/MI (39% IMPROVEMENT!)
- 2021 REVIEW OF PMS DATA
  - SDI = 4.3, IRI = 79 IN/MI
- 6 YEARS STILL GOOD CONDITION

HIGH PERFORMANCE THIN OVERLAY (HPTO)

- APPLICABLE TO ALL TYPES OF ROADWAYS
  - NJDOT USES PREDOMINANTLY ON HIGH TRAFFIC FREEWAYS & INTERSTATES
- SIGNIFICANT USE IN NJDOT PAVEMENT PRESERVATION PROGRAM
  - 30+ PROJECTS
  - OVER 1,500 LANE MILES
- EXCELLENT LIFE EXTENSION (12+ YEARS) & DURABILITY
  - MILL 2" PAVE 2" W/ HMA = 8 YEARS AVERAGE LIFE



LESSONS LEARNED/CHALLENGES

- PRE-OVERLAY REPAIRS
- QUALITY MICRO-MILLING WHERE REQUIRED
- HPTO MIX DESIGN & PRODUCTION QC IS CRITICAL
- TEST STRIP
  - SIMULATE CONDITIONS OF PRODUCTION
  - ESTABLISH ROLLER PATTERN
  - CORRELATE THIN LIFT NUCLEAR DENSITY GAUGE WITH FIELD CORES

MORE LESSONS LEARNED/CHALLENGES

- WEATHER LIMITATIONS
  - BASE TEMPERATURE 50° F MINIMUM
  - DRY PAVEMENT, NO PRECIPITATION FORECASTED
  - SOME BLISTERING HAS OCCURRED WHEN MOISTURE IS PRESENT BELOW HPTO
- SURFACE CLEAN & DRY
  - VACUUM SWEEPER IS SPECIFIED – MUST BE ENFORCED

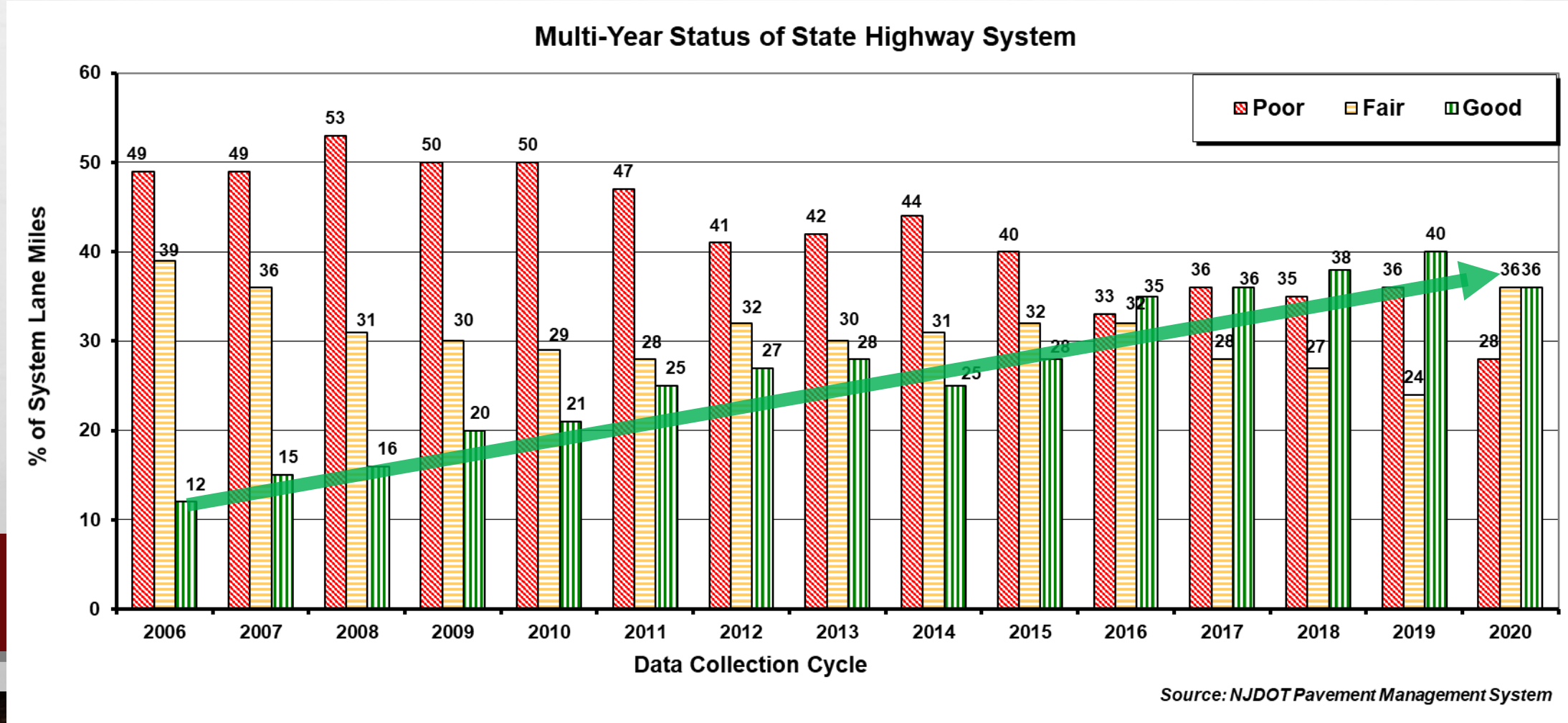
MORE LESSONS LEARNED/CHALLENGES (CONTINUED)

- PROPER QC DURING PAVING
  - THIN LIFT NUCLEAR DENSITY GAUGE
  - FOLLOW ROLLER PATTERN ESTABLISHED DURING TEST STRIP
  - NEW TEST STRIP IF CONDITIONS/MATERIAL CHANGES
  - ELIMINATE USE OF DIESEL FOR CLEANING PAVING EQUIPMENT/TRUCKS/ROLLERS/MTV/HAND TOOLS
  - CONTINUOUS PAVING OPERATION - # TRUCKS, PAVER, MTV, ROLLERS

WHAT COULD GO WRONG?

I-287 NB HPTO PROJECT WON THE 2020 NJ ASPHALT PAVING ASSOCIATION AWARD! (47% IMPROVEMENT IN IRI)

HPTO WORKS FOR NJDOT!



THANK YOU!

ROBERT BLIGHT

EMAIL: ROBERT.BLIGHT@DOT.NJ.GOV

Further Reading

- FHWA TOPS – “High Performance Thin Overlays – New Jersey Department of Transportation Case Study 2-pg Report”
- FHWA TOPS – “High-Performance Thin Overlays – How-To Document”

U.S. Department of Transportation
Federal Highway Administration

TOPS
Targeted Overlay Pavement Solutions

Crack Attenuating Mixture (CAM)

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CAM Characteristics

- CAM is used as an interlayer paired with surface mix.
- CAM has a fine gradation with NMAS of No. 4 to 3/8 inches and a high asphalt content (typically around 7.0%).
- CAM products are performance tested for crack mitigation resistance and rut resistance.
- Uses polymer-modified asphalt and high-quality aggregates.

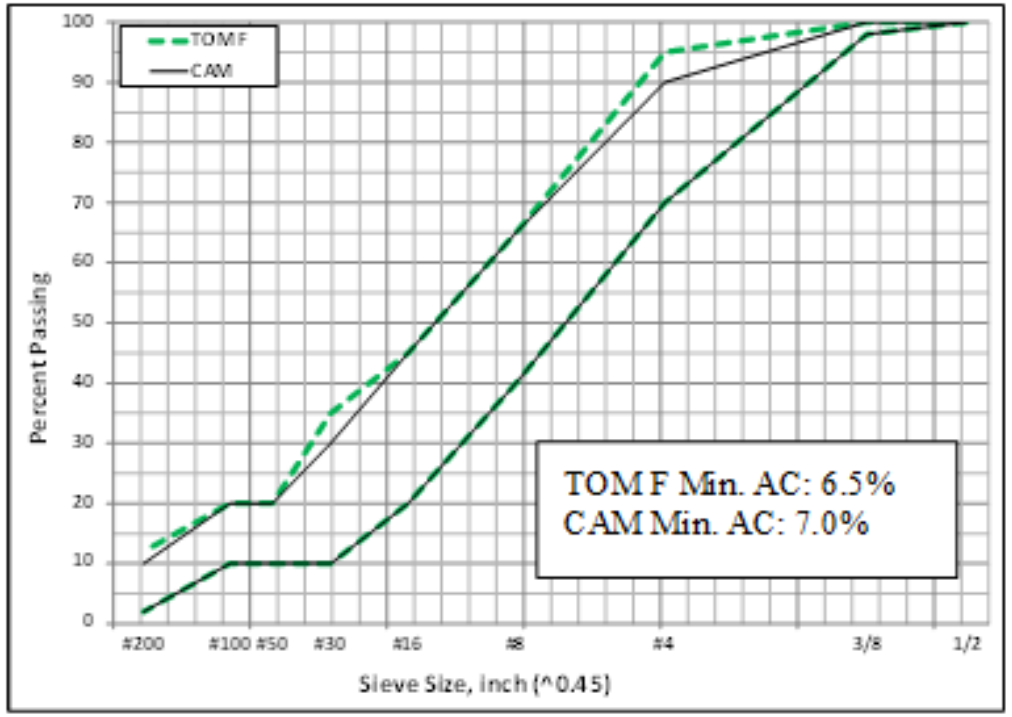
CAM Terminology

- Binder/bituminous-rich intermediate course (BRIC) – New Jersey DOT
- Engineered stress relief course (ESRC) – Nevada DOT
- Crack relief interlayer, stress relief course, fracture-tolerant shear-resistant interlayer

Background

- CAM Background
  - Inspired by a proprietary crack relief interlayer marketed in the 1990s.
  - The proprietary product was crack resistant but not rut resistant.
  - TxDOT desired product that used local materials and was crack and rut resistant.
- TOM Background
  - Developed to find a use for a surplus of high-quality fine aggregate piles leftover from coarse aggregate production.

Broadband gradations for CAM and TOM-F



Source: FHWA 2021

Potential Benefits of CAM

Properly designed CAM interlayers can reduce the number of reflective cracks and slow the rate of reflective cracking.

Lab samples of CAM interlayer (bottom) and TOM-C surface course (TOP)

Source: Tom Scullion, TTI, 2014

Design and Planning

- Project selection criteria considerations.
- Repair of existing significant or structural distresses.
- Surface mixture selection.
  - Some crack attenuating properties in the surface mix to mitigate crack jumping.
- Mechanism to encourage bonding and sealing (as needed) between lifts.

Crack jumping observed in core sample

Source: Bennert, 2018

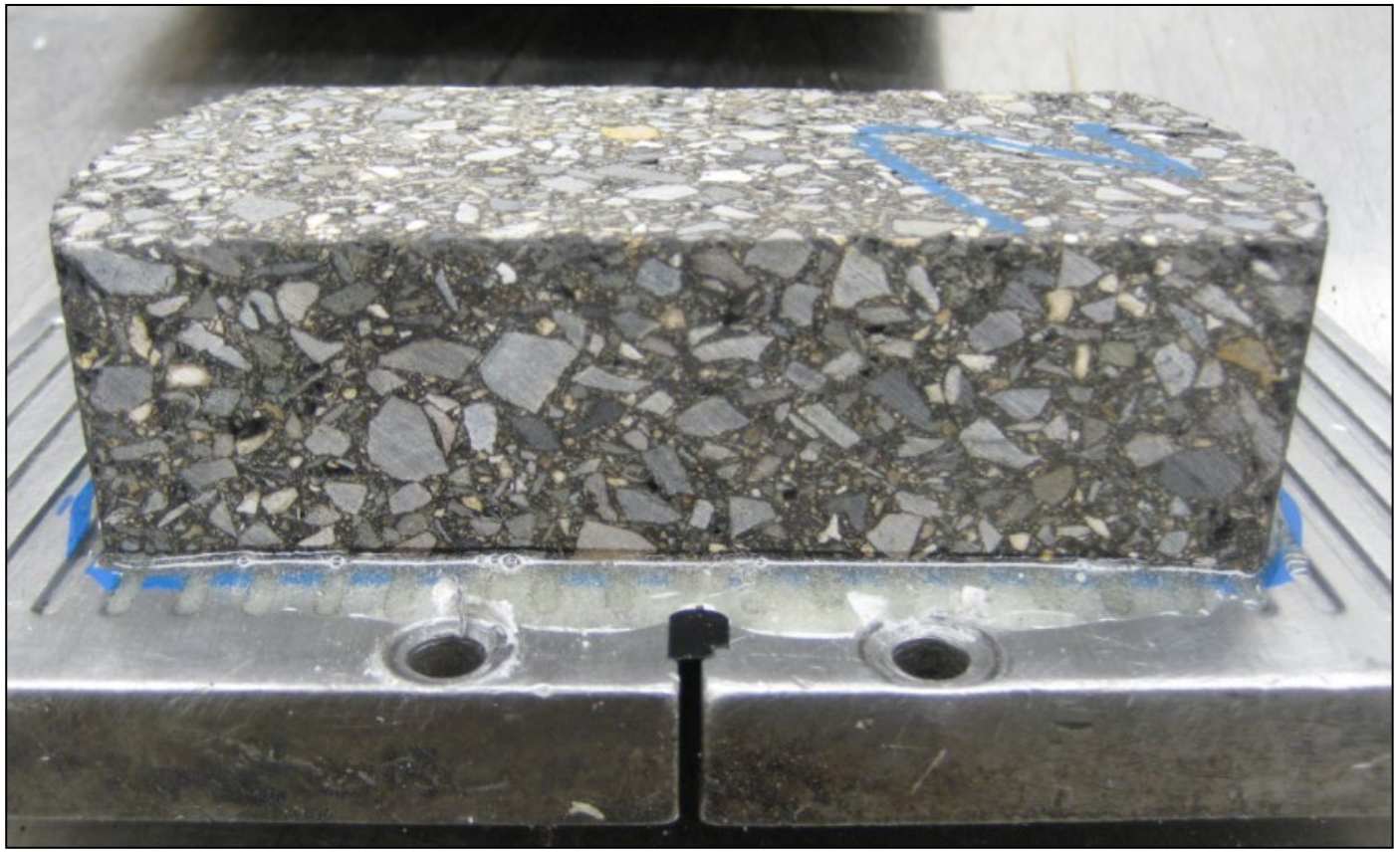
Materials and Mixture Properties

Test Property	Test Method	CAM Requirement	TOM-F Requirement
Minimum Binder Content, %	N/A	7.0	6.5
Design VMA, %	N/A	17.0	16.5
Plant Produced VMA, %	N/A	16.5	16.0
Design Gyrations	Tex-241-F	50	50
Target Laboratory Molded Density, %	Tex-207-F	98.0	97.5
Tensile Strength (dry), psi	Tex-226-F	85-200	85-200
Dust/Asphalt Ratio	N/A	1.4 Max	N/A
Boil Test	Tex-530-C	N/A	N/A
Drain-down, %	Tex-235-F	N/A	0.20 Max
HWTT (minimum passes at 0.5" (12.5-mm) rut depth tested at 122˚F)	Tex-242-F	PG 64 or lower: 10,000 PG 70: 15,000 PG 76 and higher: 20,000	PG 70: 15,000 PG 76: 20,000
Overlay Tester (minimum cycles to failure)	Tex-248-F	750	300 or more (500 for Houston District CAM)

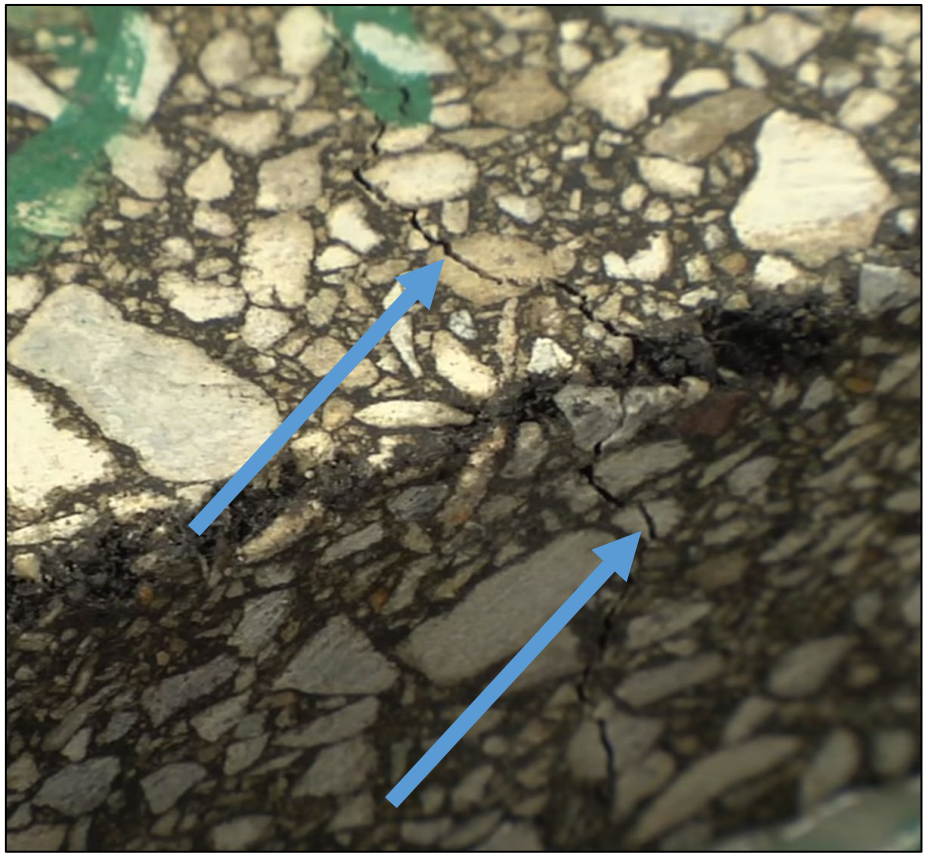
Source: FHWA 2021

Performance Testing – Crack Resistance Overlay Test Tex-248-F

OT specimens before (left) and after (right) testing



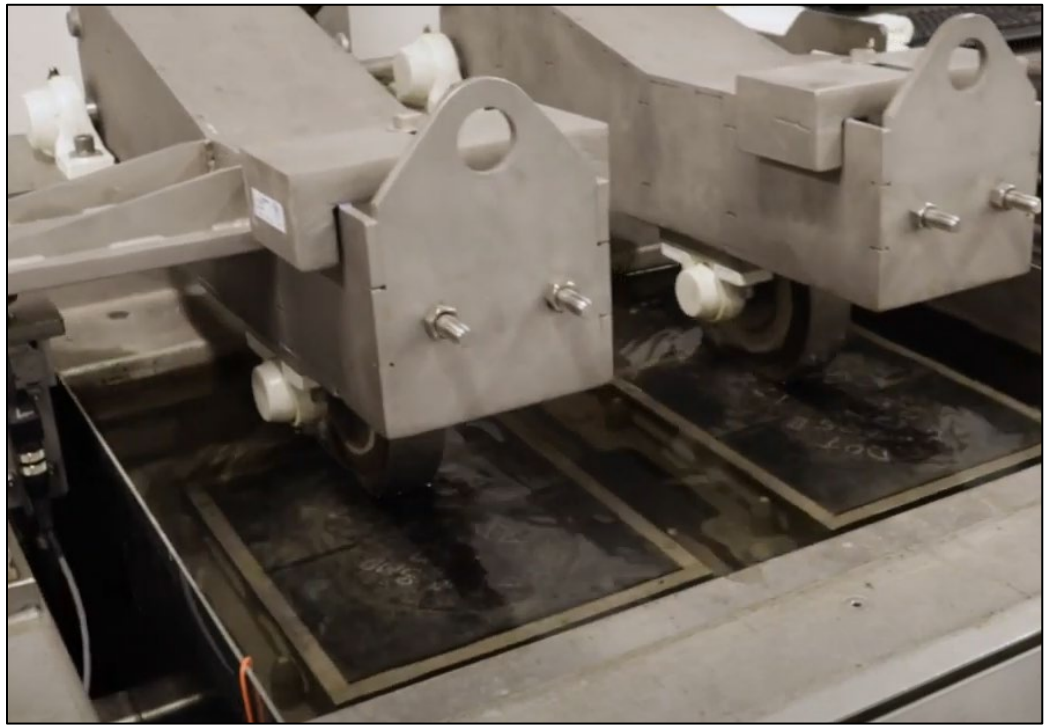
Source: Tom Scullion, TTI, 2014



Source: TTI 2015

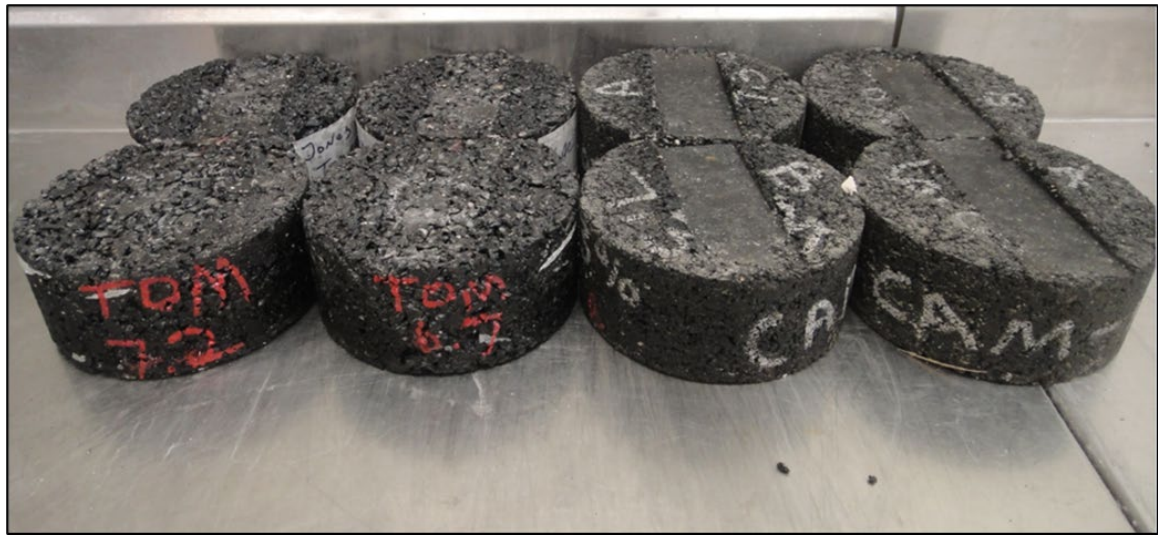
Performance Testing – Rut Resistance Hamburg Wheel Tracking Test: Tex-242-F

HWTT test equipment



Source: NCAT, 2021

HWTT test specimens after testing



Source: Tom Scullion, TTI, 2014

TxDOT Case Study

About the Presenter

- **Ashwaq Mohammed, Civil Engineer**
- TxDOT – Houston District
- 16 Years of field construction Experience (including 4 years with TXDOT)
- Construction & Maintenance Projects
- Experience with Thin Overlay Mixture (TOM) Projects

Outline

- Background – Thin Overlay Mixtures (TOMs)
- Why Houston?
- Do's and Don'ts - Design & Construction
- Summary

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Houston District

OUTLINE

Thin Overlay Mixture (TOM)

- First developed in TxDOT Austin District
  - TOM-C, TOM-F
- Became standard specification in 2014 (item 347)
- Since used on a variety of pavement projects in TxDOT – Houston District (and other districts)

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Houston District

BACKGROUND

Why Houston?

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Houston District - TOMs

- First used in 2014 on US 59 (IH 69) M/L concrete overlay project --> 7 Mile stretch from IH-610 to BW-8
  - *US 59 (IH 69) is one of busiest US highways (300,000 ADT)
- Needed durable, crack-resistant mix for restoration of old CRCP concrete pavement (originally built in 1987)
  - Reconstruction not an option
  - Conventional asphalt overlay (TY-D or TY-C) not optimal choice

Texas Department of Transportation

Houston District

TOMs - HOUSTON DISTRICT

US 59 (Interstate Highway 69) Project

- Tom Scullion (Texas A&M TTI Research Institute) introduced us to TOMs and helped develop all detail requirements for testing & construction execution
- End result: Seal Coat-Asphalt Rubber, 1" CAM (TOM-F) level up, 1" TOM-C surface with trackless coat
- Project successfully constructed, currently lasting 7+ years with surface in good condition

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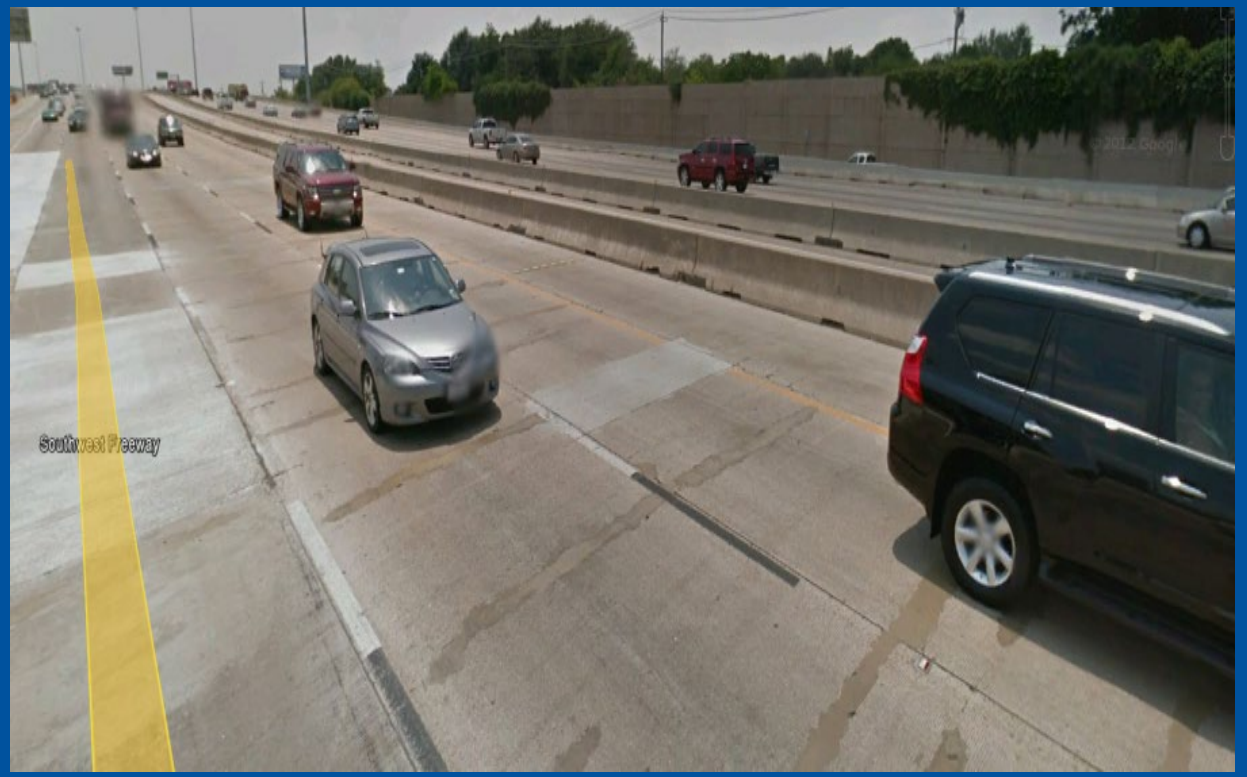
TOMs - HOUSTON DISTRICT

US 59 (Interstate Highway 69) Project

- BEFORE OVERLAY (2014)



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TOMs - HOUSTON DISTRICT

US 59 (Interstate Highway 69) Project (continued)

- AFTER (2021)

Texas Department of Transportation

Houston District

TOMs - HOUSTON DISTRICT

Conventional Dense Graded HMA Overlay

Several issues discovered over time:

1) Specification for regular asphalt (Items 340 & 341) allowed for use of recycled materials – RAP & RAS
2) Low asphalt content
   - After a few years (approx. 3-4 yrs), stiff and premature cracking
   - Overall expensive to keep replacing the asphalt

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Houston District

TOMs - HOUSTON DISTRICT

TOMs – Pavement Preservation

Several benefits of using TOMs in Houston District:

1) Equal or better performance
2) Long term resistance to rutting and cracking
3) Sound reduction
4) Restores and improves ride quality
5) Restores and improves skid resistance
6) In the end: cost-effective!

Texas Department of Transportation

Houston District

TOMs - HOUSTON DISTRICT

Houston District - TOMs

- Since 2014, constructed several TOM projects on existing surfaces – both concrete and asphalt
- Houston – high volume traffic highways (more than 80,000 ADT with over 10% trucks) as well as stop-and-go traffic condition roads
- TOMs offer a new alternative to minimize future maintenance costs and improve longevity

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Houston District

TOMs - HOUSTON DISTRICT

Do's and Don'ts: Design & Construction

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Pavement Considerations

*FIRST: Important to evaluate pavement condition as candidate for TOM projects – thin surface application is not ideal for pavements requiring extensive rehabilitation or structural improvement

1. Perform crack sealing, spot base repair in highly distressed areas (on concrete, full depth repair, joint repair) prior to placing TOMs
   - ➢ We use Seal Coat and TOMs in overlaying pavement where surface cracks are not wider than 3/8 inch and areas of rutting less than 0.5 inch

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Houston District

DO'S & DON'TS

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DO'S & DON'TS

More Pavement Considerations

2. Surface must be very clean and dry before placement
   - ➢ Dirt or dust causes bonding issue
   - ➢ Don't place TOM after rain when surface is saturated with moisture

3. TOM should always be produced with temperature > 300° F and placed air temperature > 70° F

4. Seal and bond is very important for thin overlays to prevent moisture infiltration and failure
   - ➢ We use seal coat (A-R or TR) before placing 1" of TOM-F interlayer with 1" TOM-C as surface
     --> bonding, waterproof, and seals small cracks

Texas Department of Transportation

Houston District

DO'S & DON'TS

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Houston District

DO'S & DON'TS

Jet & Heat Bar

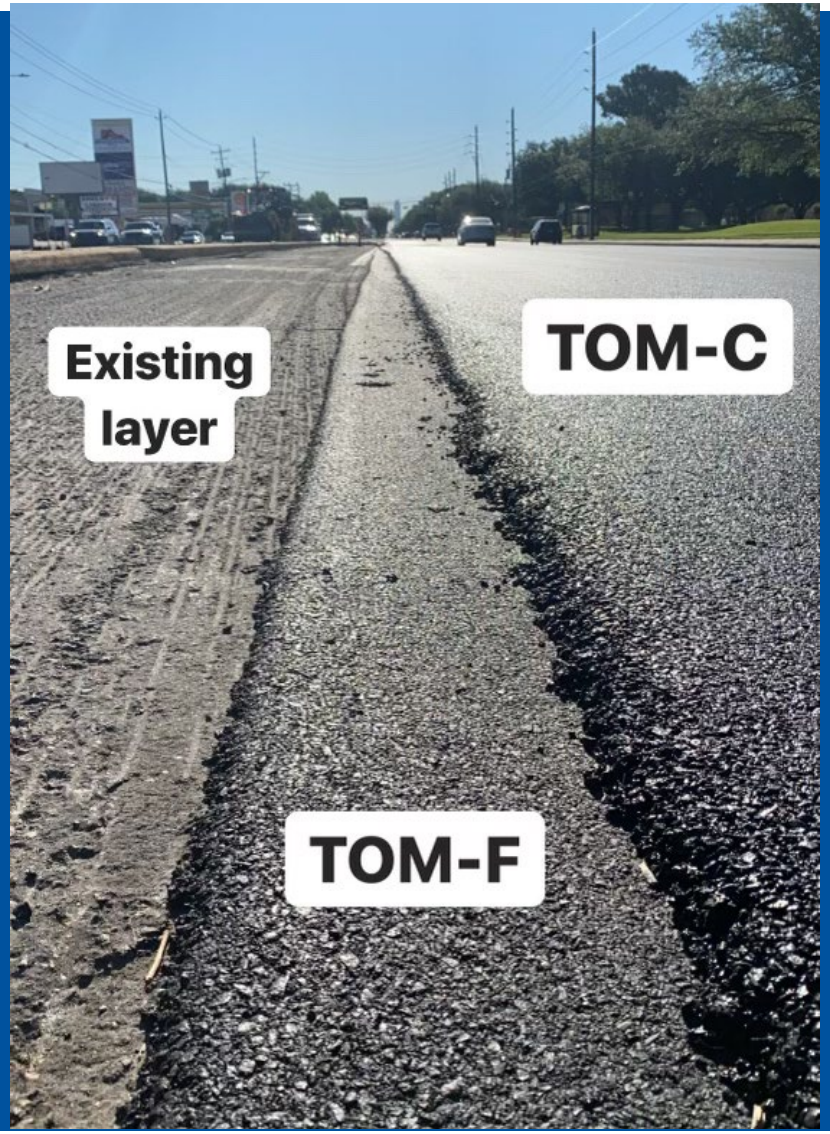
More Pavement Considerations (continued)

5. Compaction
   - Use of dual steel wheel rollers working in tandem is recommended (Pneumatic-tired rollers have excessive asphalt pick-up)
   - TOM cools quickly and is difficult to compact once temperature loss occurs
   - TxDOT water flow test recommended to ensure density and impermeability
   - *Use regular asphalt in areas where roller is unable to work (man-operated machine didn't work with TOM)
6. Train field inspectors on execution of TOMs and provide construction guidelines to ensure quality

Texas Department of Transportation

Houston District

DO'S & DON'TS



Texas Department of Transportation

Houston District

DO'S & DON'TS

AFTER (2021)

Texas Department of Transportation

Houston District

DO'S & DON'TS

Summary

- Thin Overlay Mixture (TOM) has been used on a variety of pavement projects in TxDOT districts
- Cost effective – less expensive than conventional mixes
- Longer life-span – more durable, crack resistance
- Better overall performance

- Questions? Comments?

Texas Department of Transportation

Houston District

DO'S & DON'TS

Further Reading

- FHWA TOPS – “Crack Attenuating Mixtures – How-To Document”

Crack Attenuating Mixture (CAM)

High Performance Thin Overlays (HPTO)

Q & A

Please Register for Upcoming Webinars

Webinar 1: HPTO/CAM

Webinar 2: Concrete Overlays

Webinar 3: SMA/HiMA

Webinar 4: Concrete over Concrete Unbonded (COC-U)

Webinar 5: UTBWC/OGFC

Webinar 6: Concrete over Asphalt Unbonded (COA-U)

Webinar 7: ARGG/EFO

Webinar 8: Concrete over Asphalt Bonded (COA-B)

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