

# Innovations in Thin Asphalt Overlays

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# Thin Asphalt Overlays for Pavement Preservation



*Beyond the  
basics ...*

Free at: NAPA's Booth or at  
[www.asphaltpavement.org](http://www.asphaltpavement.org)



# Thin Asphalt Overlays

## An Essential Pavement Preservation Tool

- Lower life-cycle costs
- Applied to all roadway types, various conditions
- Most common used preservation treatment after crack filling & sealing for high volume roadways
- The most effective preservation treatment
- Long-life (Perpetual) pavement

Washington Street in the Village of Canal Winchester, OH with Smoothseal™.

# Thin Overlays for Preservation: From Drawbacks to *Innovative Solutions*

- May have higher initial cost than other preservation strategies.
  - *Provide longer life*
  - *Thinner lifts*
  - *Use low-cost screenings and recycled materials (RAP, RAS, rubber)*
- Construction & application in cooler temperatures
  - *Warm Mix Asphalt*
- Durability versus permanent deformation
  - *Higher asphalt contents*
  - *Engineered binders (e.g. polymer, rubber, etc.)*



# Innovations In Thin Overlays for Pavement Preservation

- Fine Grade Polymer Thin Overlays
  - Warm Mix Asphalt
- Smaller NMAS Mixes (i.e. 4.75 mm mixes)
  - RAP and RAS
- Perpetual through Preservation



Innovations in Thin Asphalt Overlays

# FINE GRADE POLYMER MIXES



# The Smoothseal™ Timeline

1950/60s – Developed in Rockville, MD

1991 – Ohio Industry Initiative

- Economical, thin life to save \$

- Preserve and provide some structure

- Non-proprietary

- Good durability (latex)

2005 – Ohio DOT Specification Item 424 as pavement preservation treatment

2010 – Over 500,000 CY placed by Ohio DOT

2012 – Experimental project as wearing course in new construction



# Material Characterization

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## Item 424, Mix Types

### ▣ Type A

- Mix Design – Recipe mix (all traffic types – light, medium, heavy applications)

### ▣ Type B (*Smoothseal*)

- Mix Design – Volumetric mix design using Marshall Method (light, medium or heavy traffic pavements)





# Material Characterization

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## Item 424, Mix Types

- ▣ Type “A” Composition
  - Blend of sands w/ 8.5% polymer modified asphalt binder (76-22 SBS or 64-22 w/5% SBR)
  - Silicon dioxide requirement on the fine agg. ensures good skid resistance
  - Highest polymer dosage used in Ohio’s market enhances mix toughness, stability, and longevity



# Material Characterization

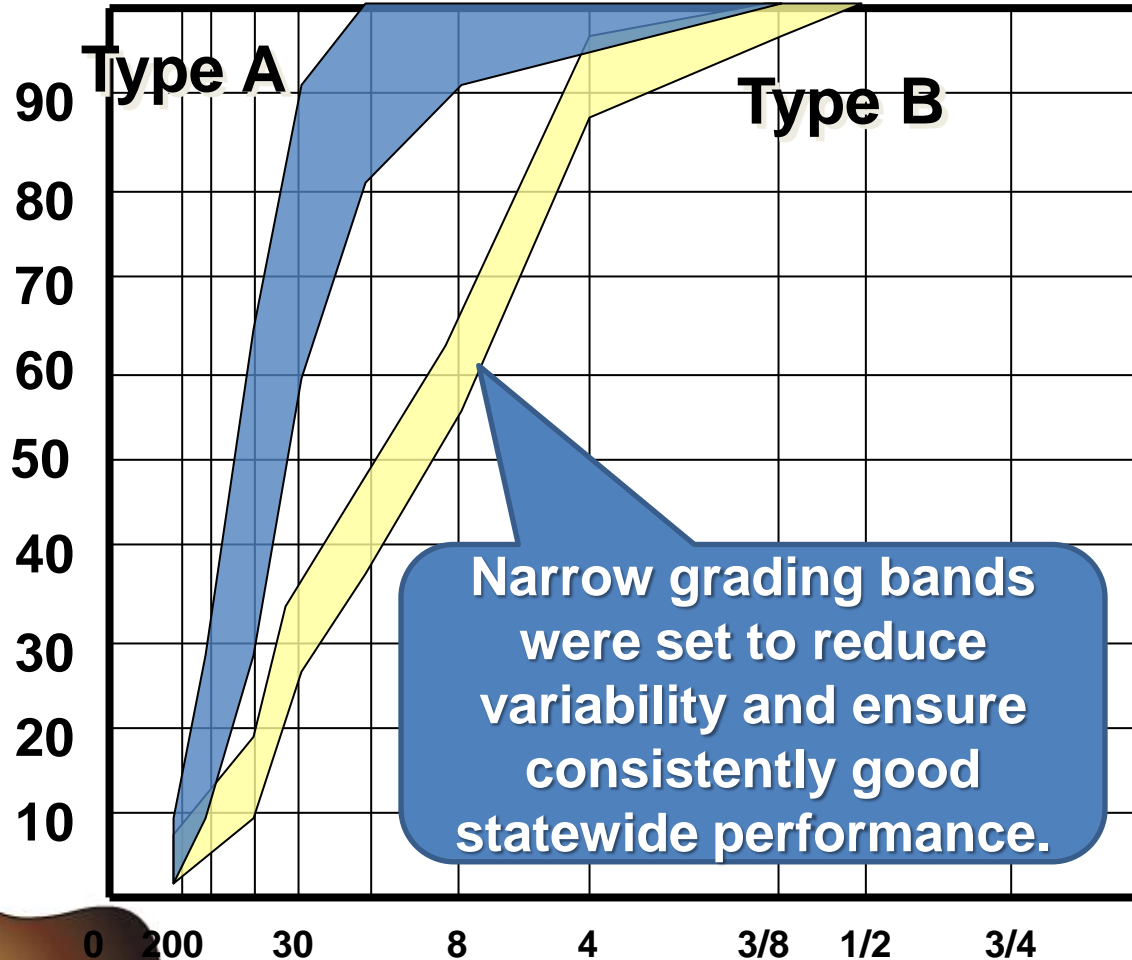
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## Item 424, Mix Types

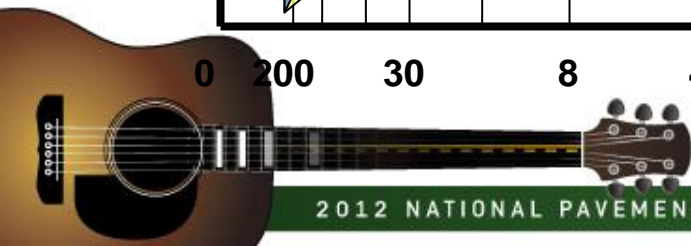
- ▣ Type “B” (*Smoothseal*) Composition
  - ½-inch max. sized coarse agg. and sand particles w/ min. polymer binder content of 6.4% (76-22 SBS or 64-22 w/5% SBR)
  - 100% two-faced crushed coarse agg. for heavy traffic mixes to provide stability
  - Silicon dioxide requirement on the fine agg. ensures good skid resistance
  - Polymer modification used to enhance mix toughness, stability and longevity
  - **10% RAP permitted**



# Material Characterization



Item 424, Type B	
1/2 inch	100
3/8 inch	95-100
No. 4	85-95
No. 8	53-63
No. 16	37-47
No. 30	25-35
No. 50	9-19
No. 100	
No. 200	3-8



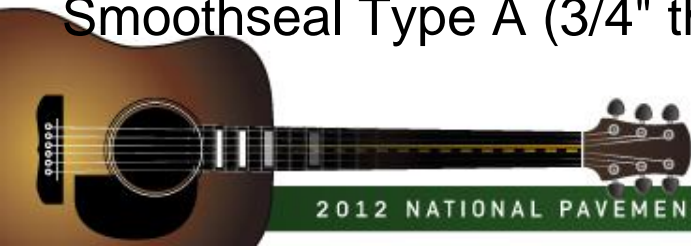
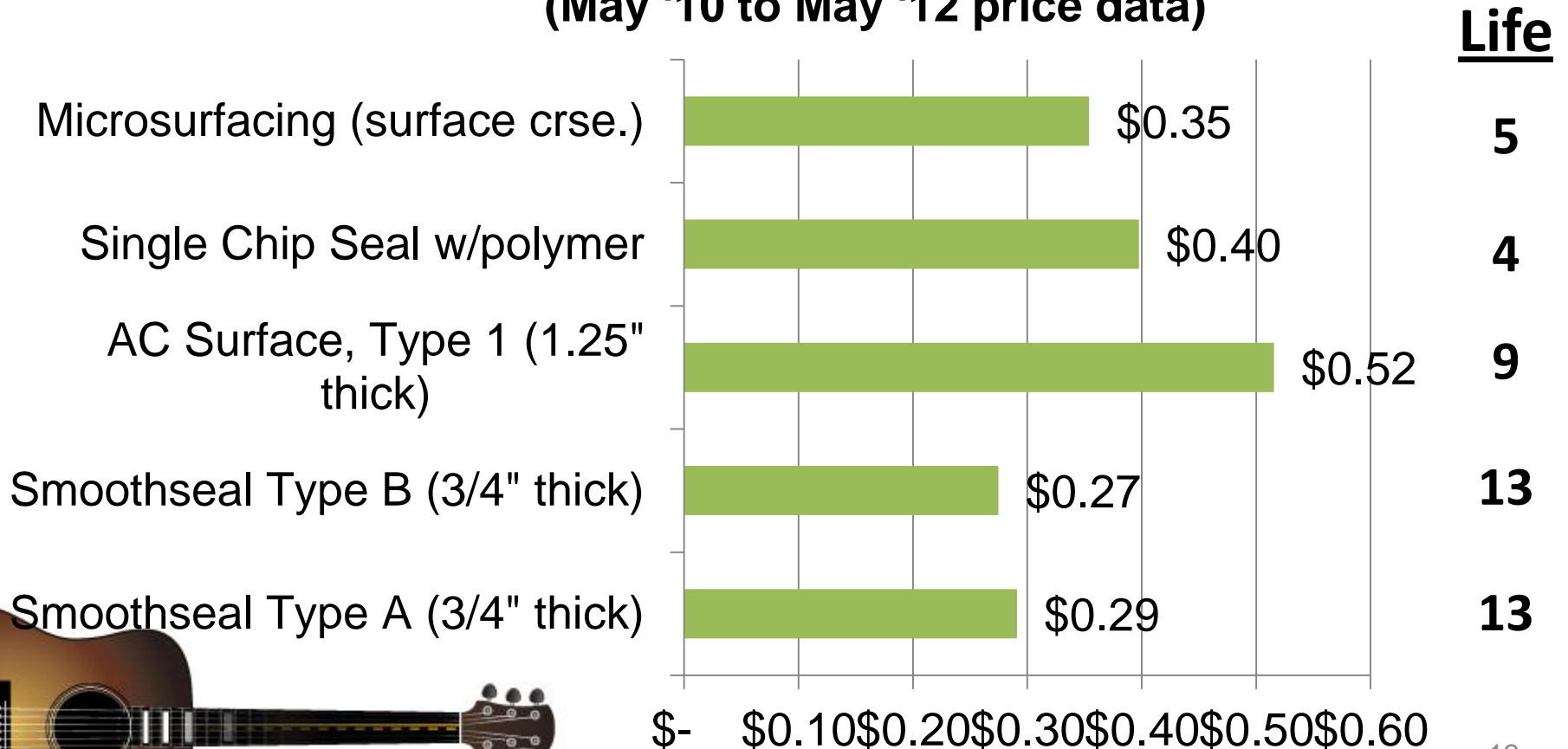
# Economics

## Annualized Cost per SY (OHIO)

- no discount -

(Based on Ave. Years Between Treatment)

(May '10 to May '12 price data)

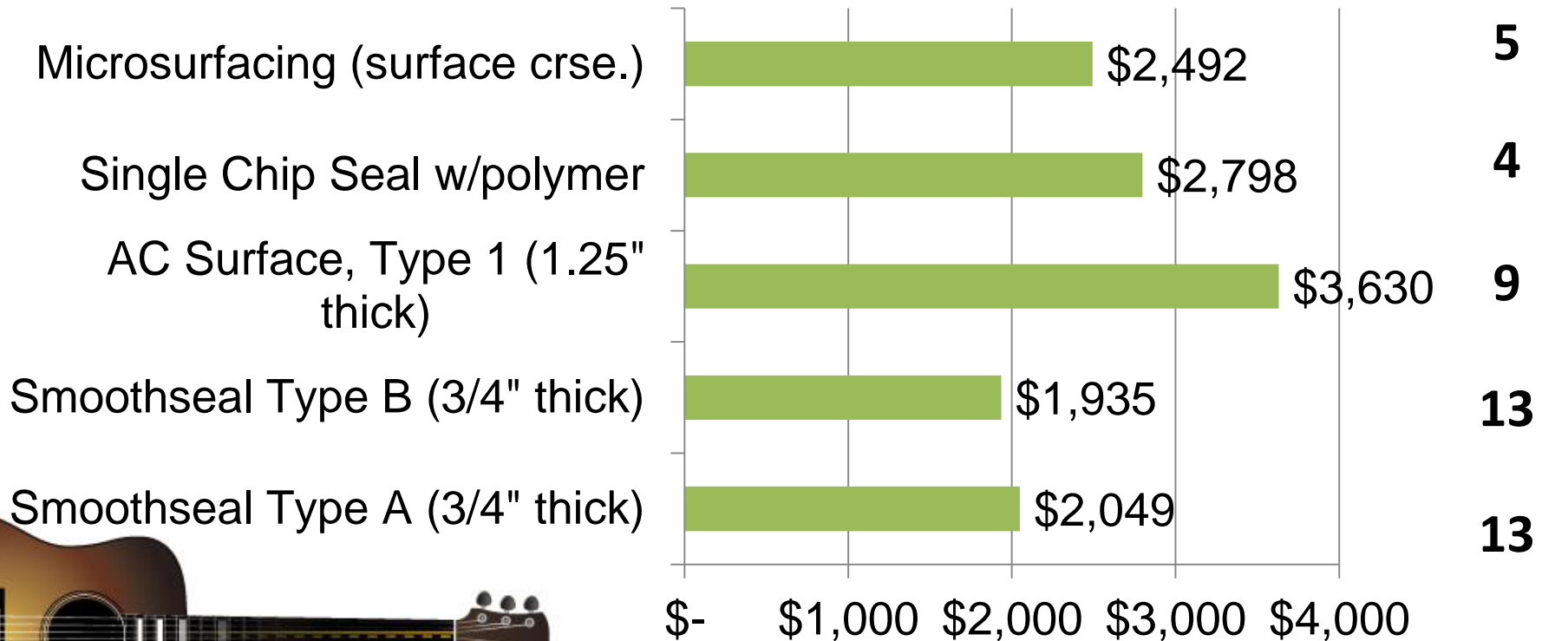


# Economics

## Annualized Cost per Lane Mile (OHIO)

- no discount -

(Based on Ave. Years Between Treatment)  
(May '10 to May '12 price data)





Smoothseal™ with Warm Mix Asphalt  
SR 146 in Muskingum County, Ohio

# What Distinguishes Smoothseal™ from Other Treatments?

- No loose aggregate
- Corrects minor rutting ( $< 1/4''$ )
- Improves Ride Quality & Driver Safety
- Increases Structural Strength
- Improves Pavement Drainage

Smoothseal™ with Warm Mix Asphalt  
SR 146 in Muskingum County, Ohio

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# 4.75 MM MIXES





# Refining 4.75 mm Mixtures: *Performance and Cost Savings*

- Mississippi Test Section at NCAT Test Track in 2003
  - Limestone screenings, crushed gravel, natural sand
  - SBS modified PG76-22 binder
  - 0.8 inches thick
  - 8 years of extreme trafficking = 30 million ESALs
  - Only ¼” rutting, no cracking



# Refining 4.75 mm Mixtures: *Performance and Cost Savings*

- Pooled Fund Study among 9 States
- Refine Superpave mix design
- New Superpave revisions for AASHTO 2012 Standards

<http://www.ncat.us/files/research-synopses/475mm-mixes.pdf>



# Revised 4.75 mm Mix Design Criteria

Design ESAL Range (Millions)	$N_{des}$	Minimum FAA	Minimum Sand Equivalent	Minimum $V_{be}$	Maximum $V_{be}$	$\%G_{mm}@N_{ini}$	Dust-to-Binder Ratio
<0.3	50	40	40	12.0	15.0	$\leq 91.5$	1.0 to 2.0
0.3 to $\leq 3.0$	75	45	40	11.5	13.5	$\leq 90.5$	1.0 to 2.0
3.0 to $\leq 30$	100	45	45	11.5	13.5	$\leq 89.0$	1.0 to 2.0

Gradation Limits		
Sieve Size	Maximum	Minimum
12.5 mm	—	100
9.5 mm	100	95
4.75 mm	100	90
1.18 mm	30	55
0.075 mm	13	6

**Design Air Void Range = 4.0 to 6.0 percent**



# The Solution for High Asphalt Contents



- Fine RAP with high asphalt content and high dust is well suited for use in 4.75 mm mixes
- Stiff RAP binder and dust help make mixes more resistant to tenderness and rutting



# NCAT's Group Pavement Preservation Study

- 4.75 mm mixes
  - 50% RAP (fractionated, fine)
  - RAP and RAS

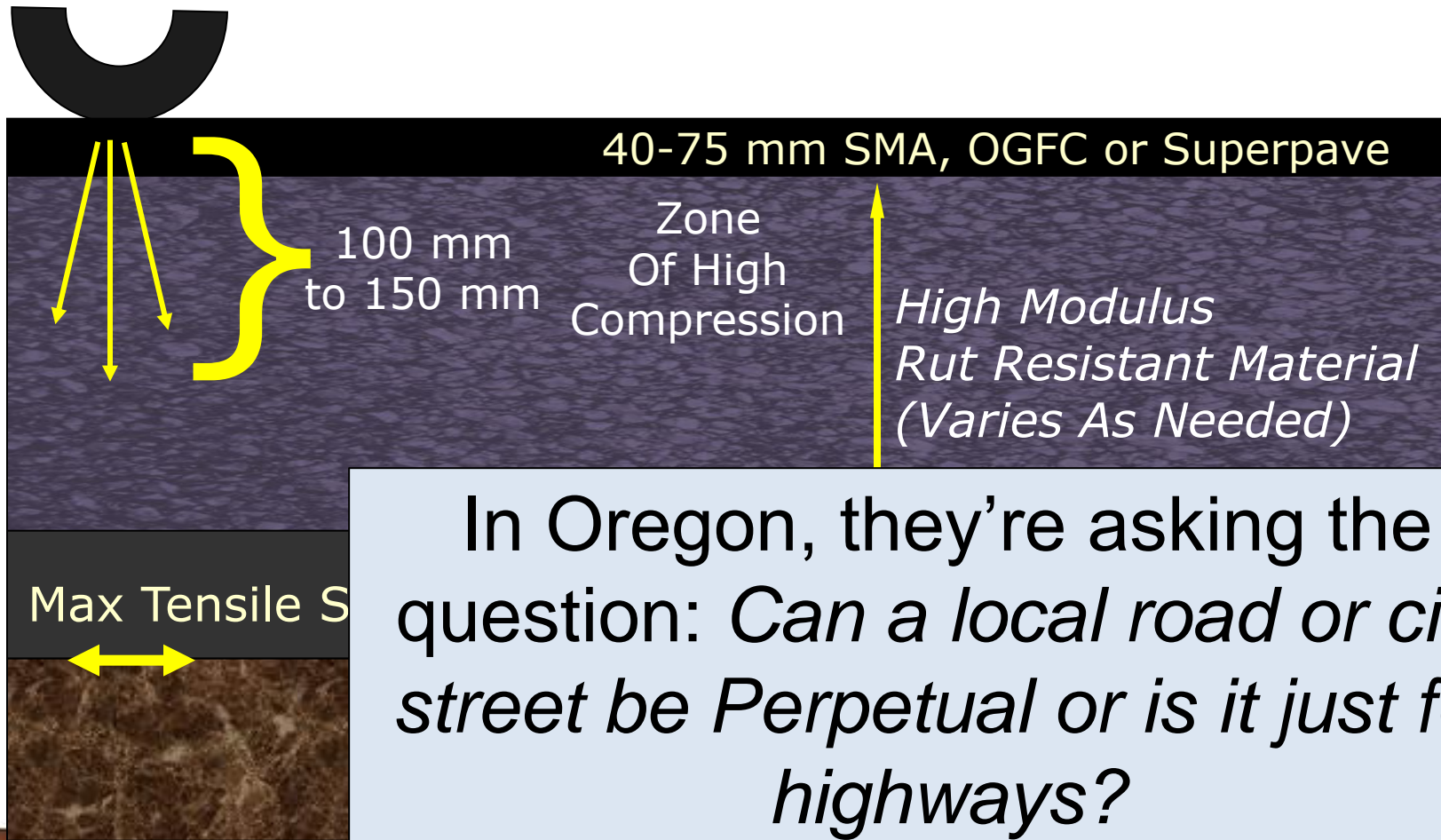


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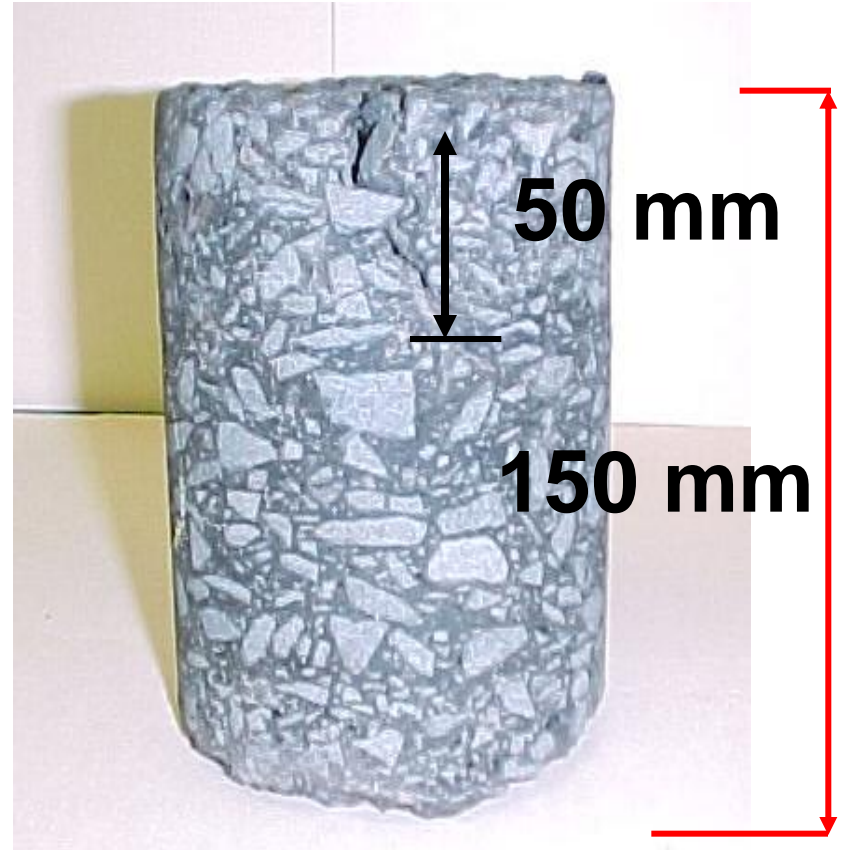
# PERPETUAL THROUGH PRESERVATION



# Perpetual Pavements



*Preserve the Structure and Preserve the Surface*  
Design Pavements to fail “top down” not bottom up





# Perpetual through Preservation

- May not have to build Interstate thicknesses on a county road or city street to become a Perpetual Pavement
- Preventive seals on pavements less than 4-5 inches will only mask structural distresses and eventually may lead to full depth failures
- A 1 inch overlay of an existing 4 inch pavement can double the fatigue life
- Once you achieve a perpetual design thickness you can focus on preserving the surface for functional attributes



# Asphalt Thickness vs. Fatigue life

Thickness	Micro strain	Reps to failure
2	-652	30,234
3	-495	71,537
4	-383	160,693
5	-302	340,507
6	-242	682,133



# Getting to Perpetual

- Pavement inventory should include accurate thicknesses and condition of lower layers
- Don't assume cracks are bottom up, if you have existing pavements > 5" thick it is probable that the cracks are top down
- Core through cracks to confirm



# Key Elements for Existing Pavements

- Pavement Management Strategy: Include goal to get to a Perpetual Structure
- Determine the ultimate thickness needed
- Schedule overlay(s) to get to appropriate thickness before the pavement has full depth structural distresses



# Check the toolbox...there's an improved multi-tool in there.

- ✓ Longer life from a preservation treatment
- ✓ Lower life cycle costs
- ✓ Versatile, effective
- ✓ Sustainable
  - ✓ Milling and thin asphalt overlays
  - ✓ Local materials
  - ✓ Recycled materials
  - ✓ Warm Mix Asphalt



# For more detailed information...

Smoothseal™ - Cliff Ursich at Flexible Pavements of Ohio at [www.flexiblepavements.org](http://www.flexiblepavements.org)

4.75 mm mixtures - Randy West at the National Center for Asphalt Technology at [www.ncat.us](http://www.ncat.us)

Perpetual, 1" at a time - Jim Huddleston at Asphalt Pavement Association of Oregon at <http://www.apao.org/index.shtml>





**THANK YOU!**

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