THIN ASPHALT OVERLAYS FOR PAVEMENT PRESERVATION

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Acknowledgement

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Federal Highway Administration

Why Thin Asphalt Overlays?

- Shift from new construction to renewal and preservation
- Functional improvements for safety and smoothness needed more than structural improvements – Perpetual Pavements
- Material improvements
  - Binders – Superpave and Polymers
  - SMA, OGFC, Ultra-Thin Bonded and Dense-Graded
  - Superpave mix design
  - Warm Mix
  - Reclaimed Asphalt Pavement (RAP)
  - Roofing Shingles

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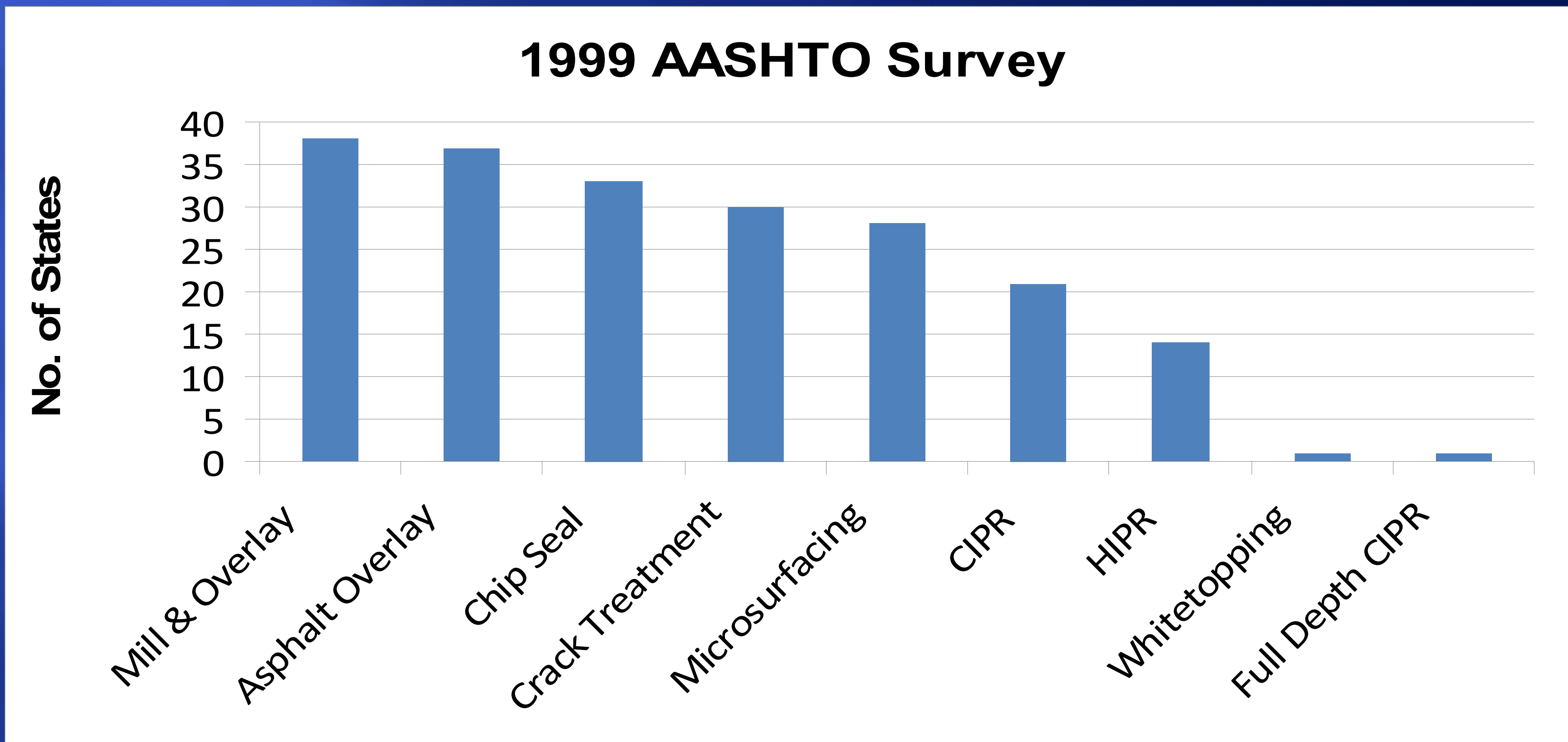
Thin Asphalt Overlays are Popular



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Benefits of Thin Asphalt Overlays

- Long service, low life-cycle cost
- Maintain grade and slope
- Handles heavy traffic
- Smooth surface
- Seal the surface
- No loose stones
- Minimize dust
- Minimize traffic delays
- No curing time
- Low noise generation
- No binder runoff
- Can be recycled
- Can use in stage construction
- Easy to maintain
- Restore skid resistance

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Topics

- Project Selection
- Materials Selection and Mix Design
- Construction and Quality Control
- Performance
- Conclusions

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Project Selection

Avoid Projects Needing Structural Rehabilitation!!

Basic Evaluation

- Visual Survey
- Structural Assessment
  - No structural improvement required
- Drainage Evaluation
  - What changes are needed
- Functional Evaluation
  - Ride quality
  - Skid resistance
- Discussion with Maintenance Personnel

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Visual Survey

- Part of a good Pavement Management System.
- Get good, current project-specific data
- Need to know:
  - Type of distress
  - Extent
  - Severity
- Visit the site and validate data.

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Types of Distress

- Raveling
- Longitudinal Cracking (not in wheelpath)
- Longitudinal Cracking (in wheelpath)
- Transverse Cracking
- Alligator Cracking
- Rutting

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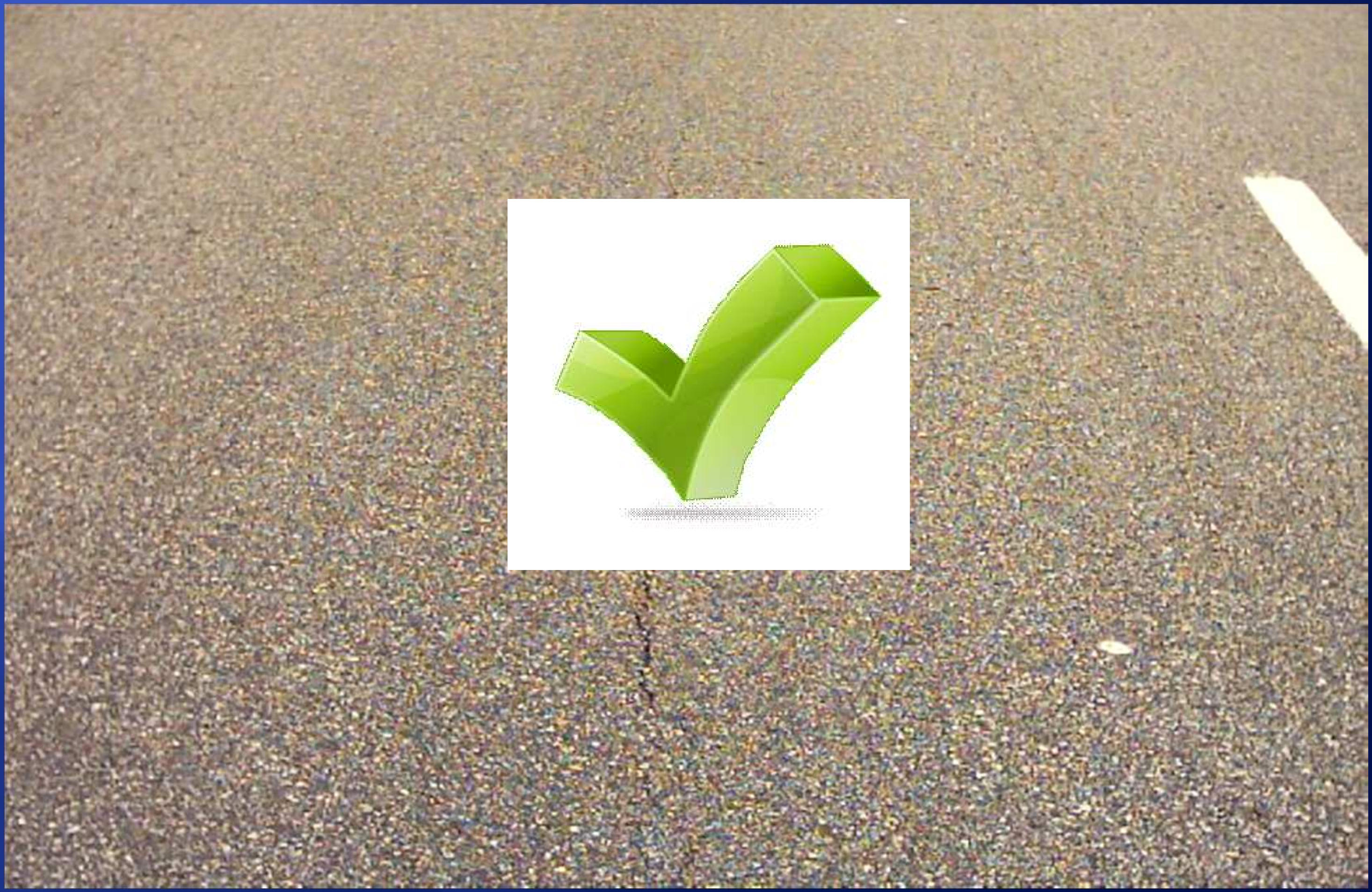
Raveling

Longitudinal Cracking (not in wheelpath)

Longitudinal Cracking (wheelpath)



Temporary Fix for Minor Distress

Transverse Cracking

Alligator (Fatigue) Cracking

Temporary Fix for Minor Distress

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Rutting or Shoving

Severe Structural Failure

Surface Failure – Milling Required

Ride Quality and Skid Resistance

Rough Surfaces Should be Milled

Skid Problems can be Milled, but not Required

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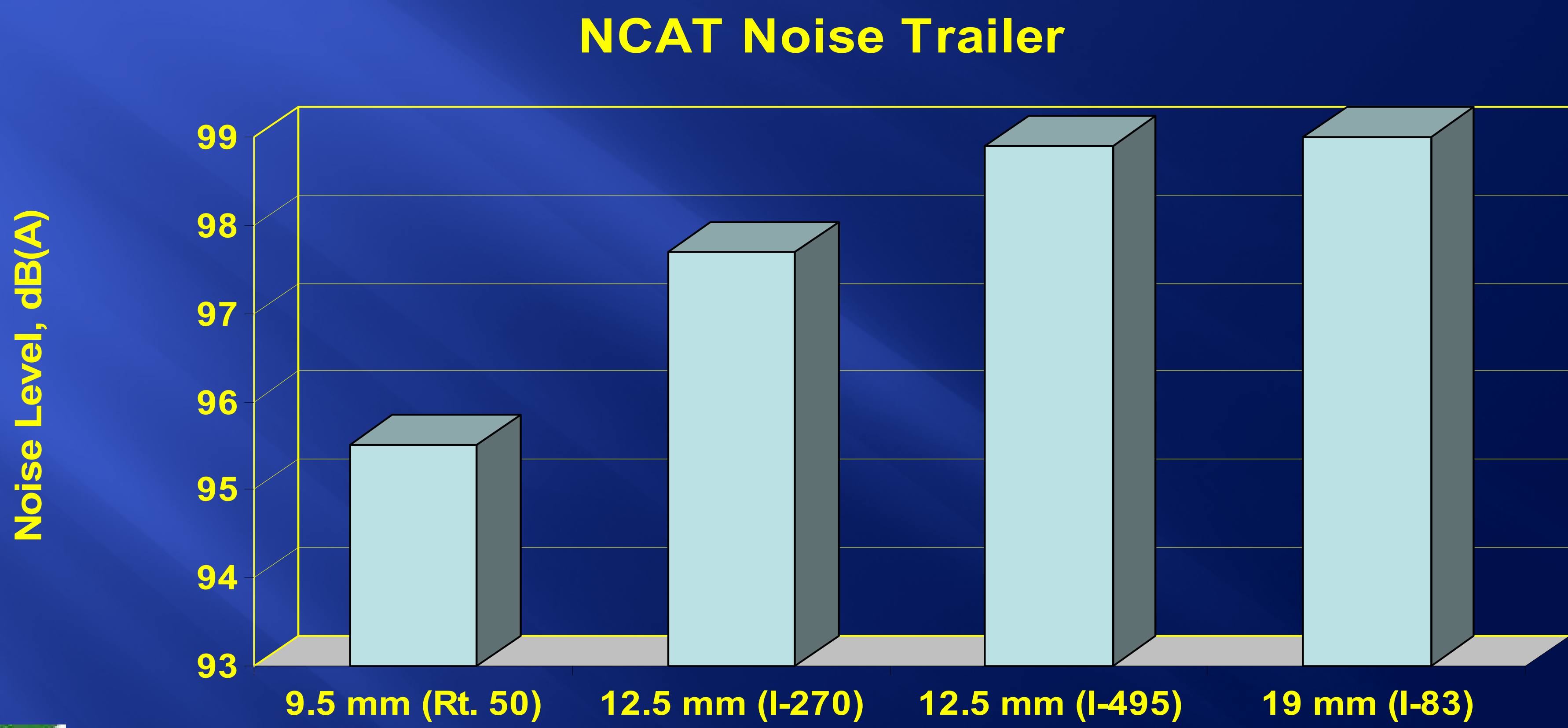
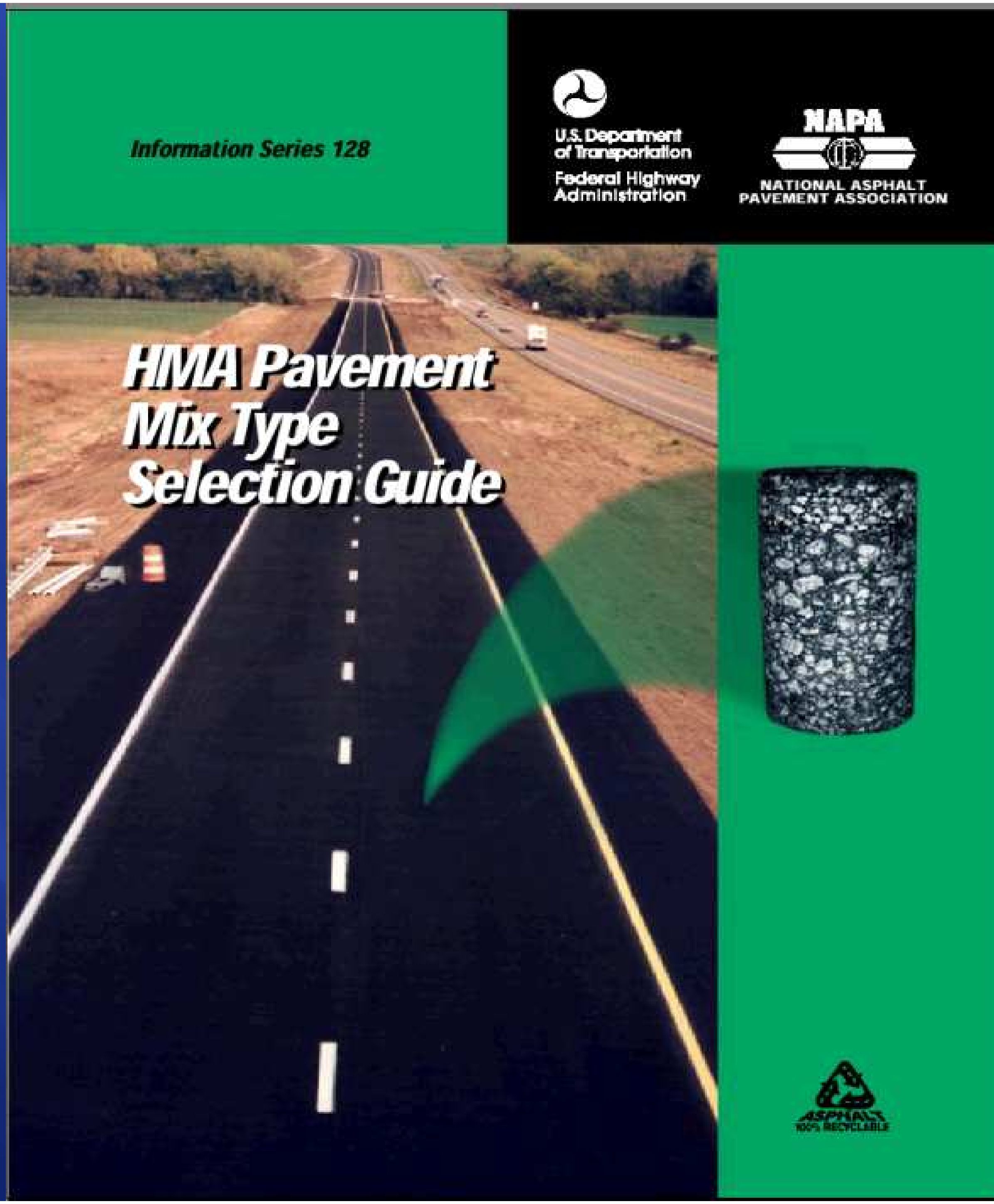
Noise can be Reduced



Smaller Aggregate = Less Noise

Drainage Evaluation



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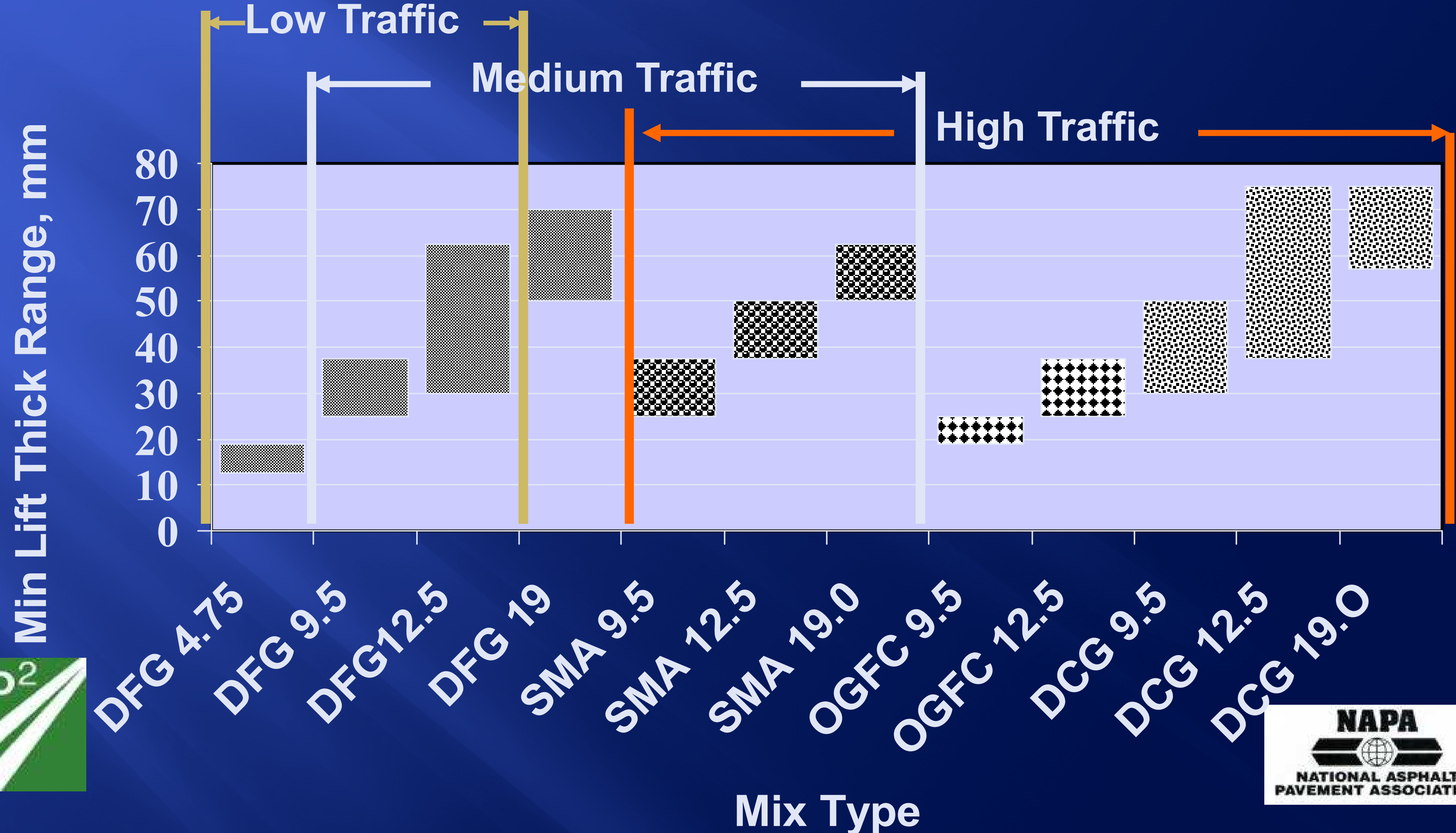
Recommended Mix Types
Surface Courses



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If a Thin Overlay is the Answer. . .

- Select
  - Surface Preparation
    - Distresses
    - Roughness
    - Considerations for Curb Reveal and Drainage
  - Materials
    - Traffic
    - Availability
    - Climate
  - Thickness
    - NMAS
    - Geometrics

Surface Preparation

	Mill	Fill Cracks with Mix	Clean and Tack
Raveling			✓
Long. Crack – not in w.p.	✓	✓	✓
Long. Crack – w.p.	✓	✓	✓
Transverse Crack	✓	✓	✓
Alligator Crack	✓		✓
Rutting	✓		✓

Materials & Mi

- Materials Selection
- Mix Design for Dense-Graded Mixes
- Other Mix Types

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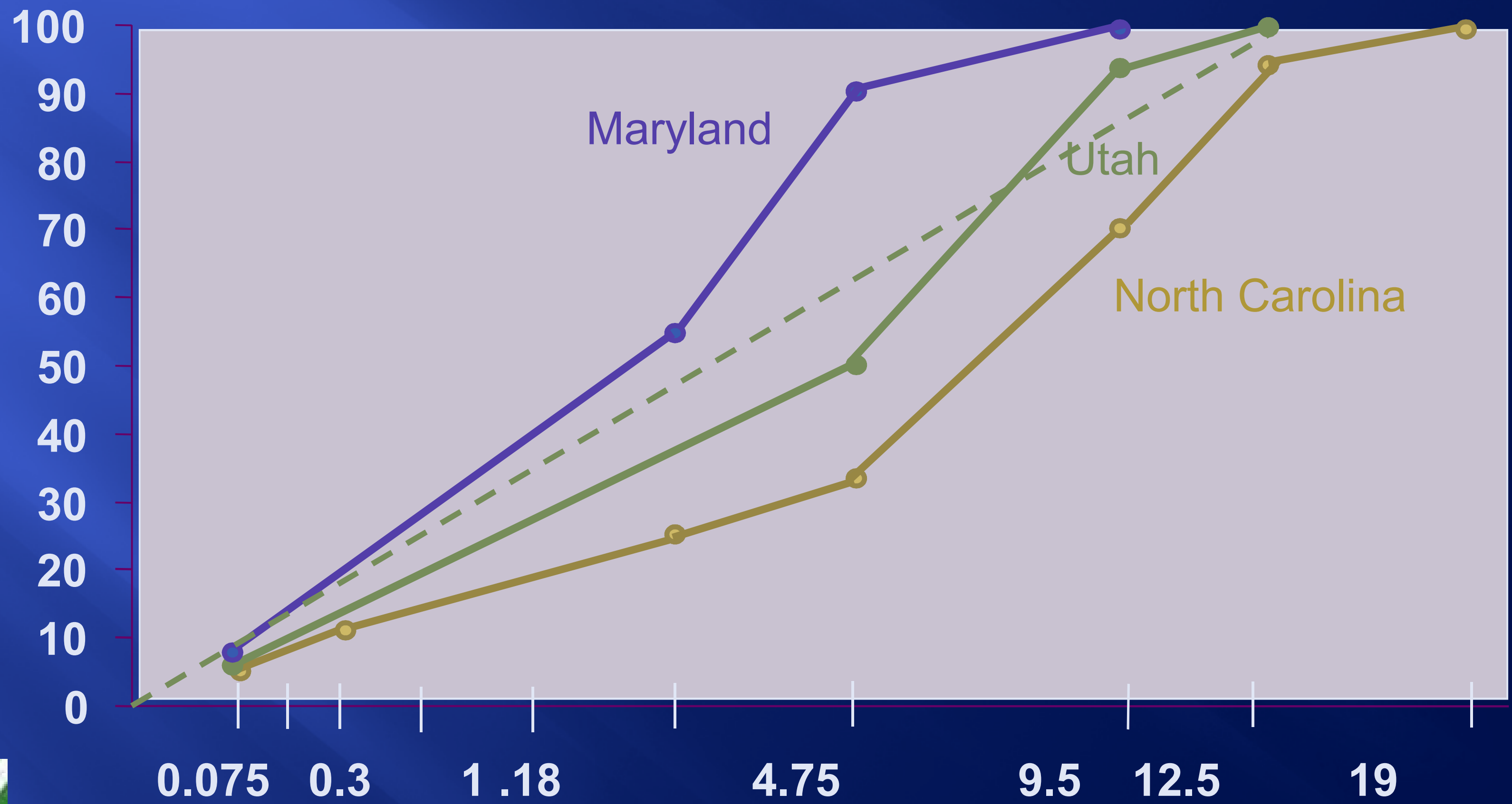
Materials Selection – Aggregate

- Thin overlays need small NMAS
  - Thin overlays ≤ 1.5 inches thick
  - Aggregate size between 4.75 and 12.5 mm NMAS
  - Ratio of lift thickness to NMAS range 3:1 to 5:1
- Quality
  - LA Abrasion: 35-48 maximum
  - Sodium Sulfate: 10-16 maximum
  - CA Fractured Faces (does not apply to 4.75 mm)
    - 2 or More: 80-90
    - 1: 10-100
  - Sand Equivalent: 28-60
  - FA Angularity (Un-compacted Voids): 40-45

Example Gradations



Materials Selection – Binder

- Most specifications use PG system for climate and traffic
  - Minnesota – Unmodified binder
  - Ohio – Polymer modified PG 76-22
  - New Jersey – PG 76-22 for high performance mix, AR used
  - North Carolina – depends upon traffic level

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Materials Selection – RAP

- Small NMAS mixes should contain fine RAP
- RAP or shingles will help
  - Stabilize cost by reducing added asphalt and added aggregate
  - Prevent rutting
  - Prevent scuffing
- Use maximum allowable while maintaining gradation and volumetrics

Mix Design

- Laboratory Compaction
  - Low Volume – 50 gyrations in MD and GA
  - Medium Volume – 60 to 75 in MD, NY, AL
  - High Volume – 60 (AL) to 125 (UT)
  - Needs to be enough for interlock without fracturing aggregate
- Volumetrics
  - Void Requirements – Mixes are relatively impermeable
  - VMA – Should increase as NMAS decreases
  - Asphalt Content – Should depend on Voids and VMA

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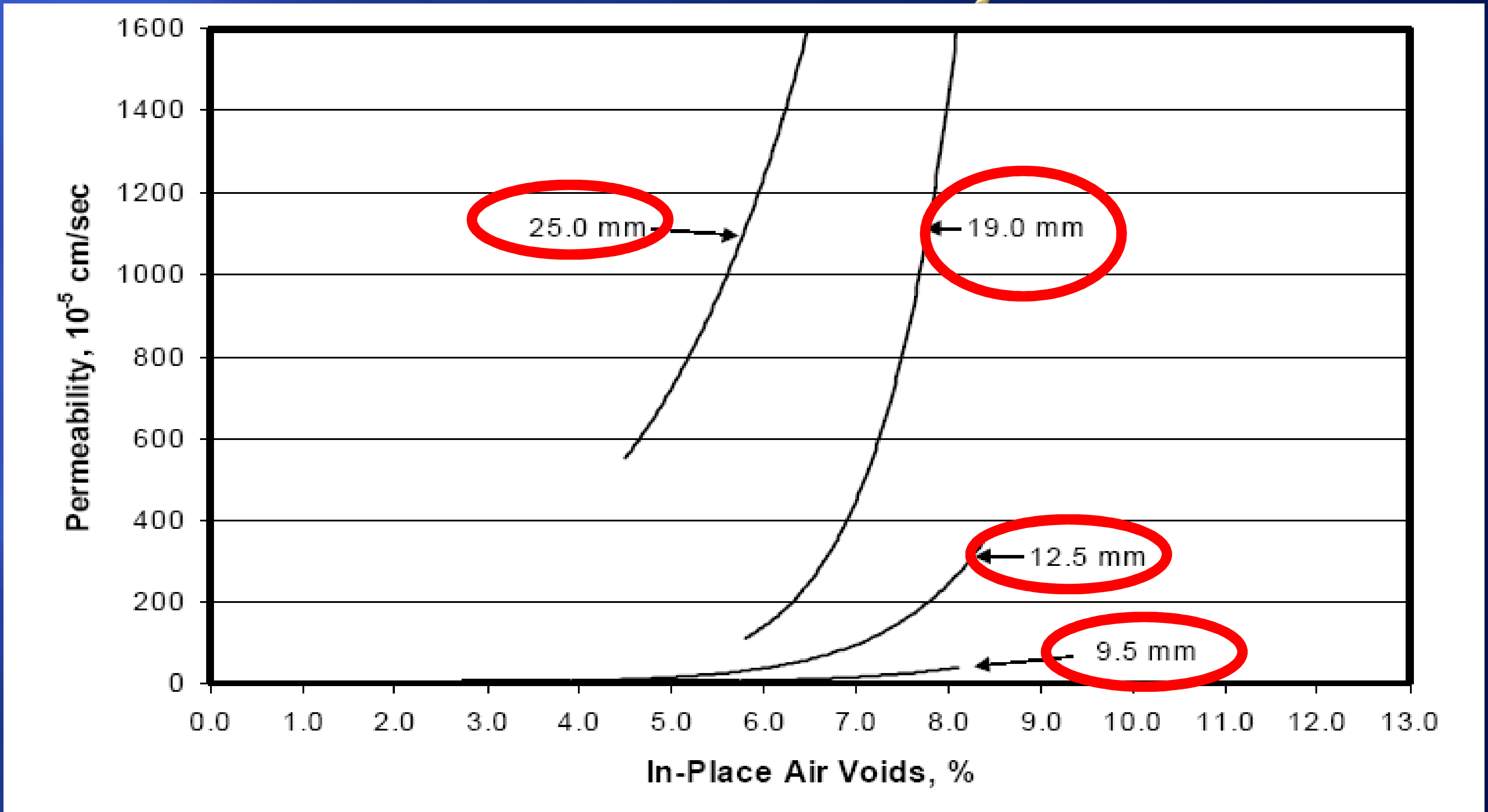
Mix Design Requirements

NMAS	12.5 mm		9.5 mm		6.3 mm	4.75 mm		
State	AL	NC	NV	UT	NY	MD	GA	OH
Comp. Level	60			50-125	75	50/65	50	50/75
Design Voids			3-6	3.5	4.0	4.0	4.0-7.0	3.5
% VMA	15.5 min		12-22		16 min			15 min
% VFA				70-80	70-78		50-80	
% AC	5.5 min	4.6-5.6				5.0-8.0	6.0-7.5	6.4 min

Permeability



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Construction & Quality Control

- Construction
  - Production
  - Paving
- Quality Control

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Construction – Production

- Aggregate
  - Proper stockpiles
    - Slope and Pave
    - Cover, if needed
  - Moisture content
- Plant operations
  - Slower because
    - More time to coat
    - Higher moisture content
    - Thicker aggregate veil
  - Aggregate moisture management
  - Warm mix can help

Construction – Production

- RAP – Process for size and consistency
  - Max size ≤ NMAS
- Storage and Loading
  - Follow normal best practices
- Warm Mix
  - Increase haul distance
  - Pave at cooler temperatures
  - Achieve density at lower temperatures
  - Extend paving season
  - Pave over crack sealer

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Construction – Production

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Warm Mix

Construction – Production

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Construction – Paving Surface Preparation

- Milling
  - Remove defects
  - Roughen surface
  - Improve smoothness
  - Provide RAP
  - May eliminate need for tack
  - Size machinery properly
- Tack
  - Emulsion or hot asphalt
  - Polymer emulsion or unmodified
  - Rate: 0.10 to 0.15 gal/sy (undiluted emulsion)

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Construction – Paving Surface Preparation

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Construction – Paving Placement and Compaction

- Paving
  - Best to move continuously
  - MTV or windrow can help
  - Cooling can be an issue
    - 1” cools 2X faster than 1.5”
  - Warm mix
- Compaction
  - Seal voids & increase stability
  - Low permeability
  - No vibratory on < 1”

Construction – Paving Placement and Compaction

- **Ultra-Thin Bonded Overlay**

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Quality Control – Plant

- Aggregate
  - Gradation
  - Moisture Content
- Mix Volumetrics
  - Air Voids
  - VMA
  - Asphalt Content
  - Gradation

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Quality Control – Field

- Field Density
  - Thin-lift NDT gauges OK for > 1” mat
  - Cores may not be representative
  - Permeability not as big an issue
- Ride Quality
  - Depends on
    - Condition of existing pavement
    - Surface preparation
    - Overlay thickness
  - Specification should be based on existing condition

Performance

- Immediate Benefits
- Pavement Life
- Economics

Immediate Benefits

- Labi et al. (2005)
  - 18 to 36% decrease in roughness
  - 5 to 55% decrease in rut depth
  - 1 to 10% improvement in condition rating
- Noise
  - Corley-Lay and Mastin (2007): 6.7 dB reduction on overlaid PCC
  - FHWA (2005): 5 dB reduction on overlaid PCC in Phoenix
- 3dB reduction = ½ traffic volume

Pavement Life

Location	Traffic	Underlying Pavement	Performance, yrs.
Ohio	High/Low	Asphalt	16
	Low	Composite	11
	High	Composite	7
North Carolina	----	Concrete	6 – 10
Ontario	High	Asphalt	8
Illinois	Low	Asphalt	7 – 10
New York	----	Asphalt	5 – 8
Indiana	Low	Asphalt	9 – 11
Austria	High/Low	Asphalt	$\geq$10
	High	Concrete	$\geq$8
Georgia	Low	Asphalt	10

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Georgia	Low	Asphalt	10

Conclusions

- Thin Overlays for Pavement Preservation
  - Improve Ride Quality
  - Reduce Distresses
  - Maintain Road Geometrics
  - Reduce Noise
  - Reduce Life Cycle Costs
  - Provide Long Lasting Service
- Place before extensive rehab required
- Expected performance
  - 10 years or more on asphalt
  - 6 to 10 years on PCC

Thin Asphalt Overlays

Thin asphalt overlays are a popular solution to pavement preservation. They are economical, long-lasting, and effective in treating a wide variety of surface distresses to restore ride quality, skid resistance, and overall performance.

Resources

- NCAT website: www.ncat.us
- New NAPA Publication:
  - IS-135, "Thin Asphalt Overlays for Pavement Preservation"
- Transportation Research Record:
  - Labi, et al. 2005.
- Ohio DOT:
  - Chou, et al. April 2008.

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