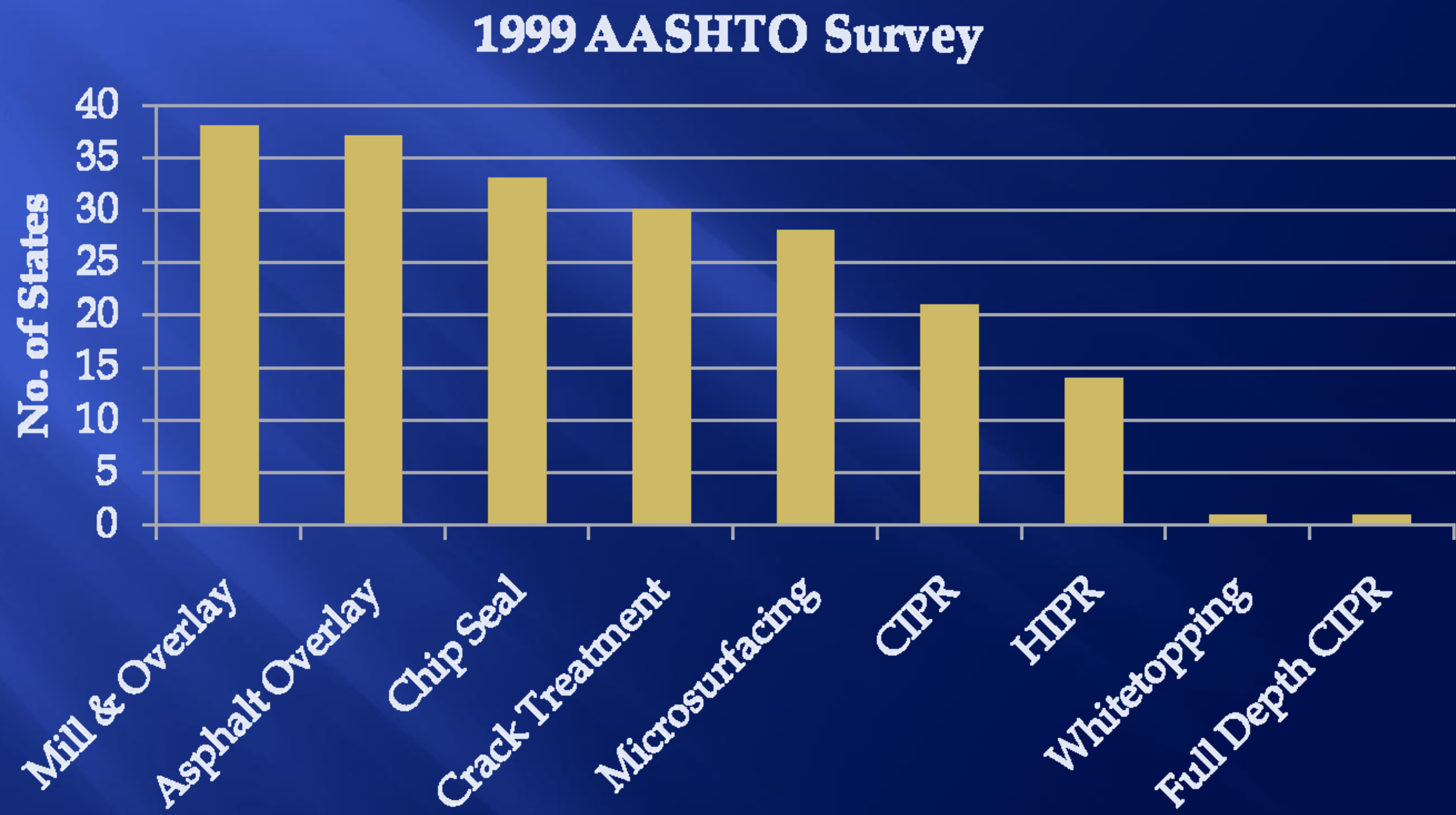
THIN ASPHALT OVERLAYS FOR PAVEMENT PRESERVATION

NAPA
NATIONAL ASPHALT PAVEMENT ASSOCIATION

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 and Dense-Graded
  - Superpave mix design
  - Warm Mix
  - Reclaimed Asphalt Pavement (RAP)
  - Roofing Shingles

Thin Asphalt Overlays are Popular



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

Topics

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

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

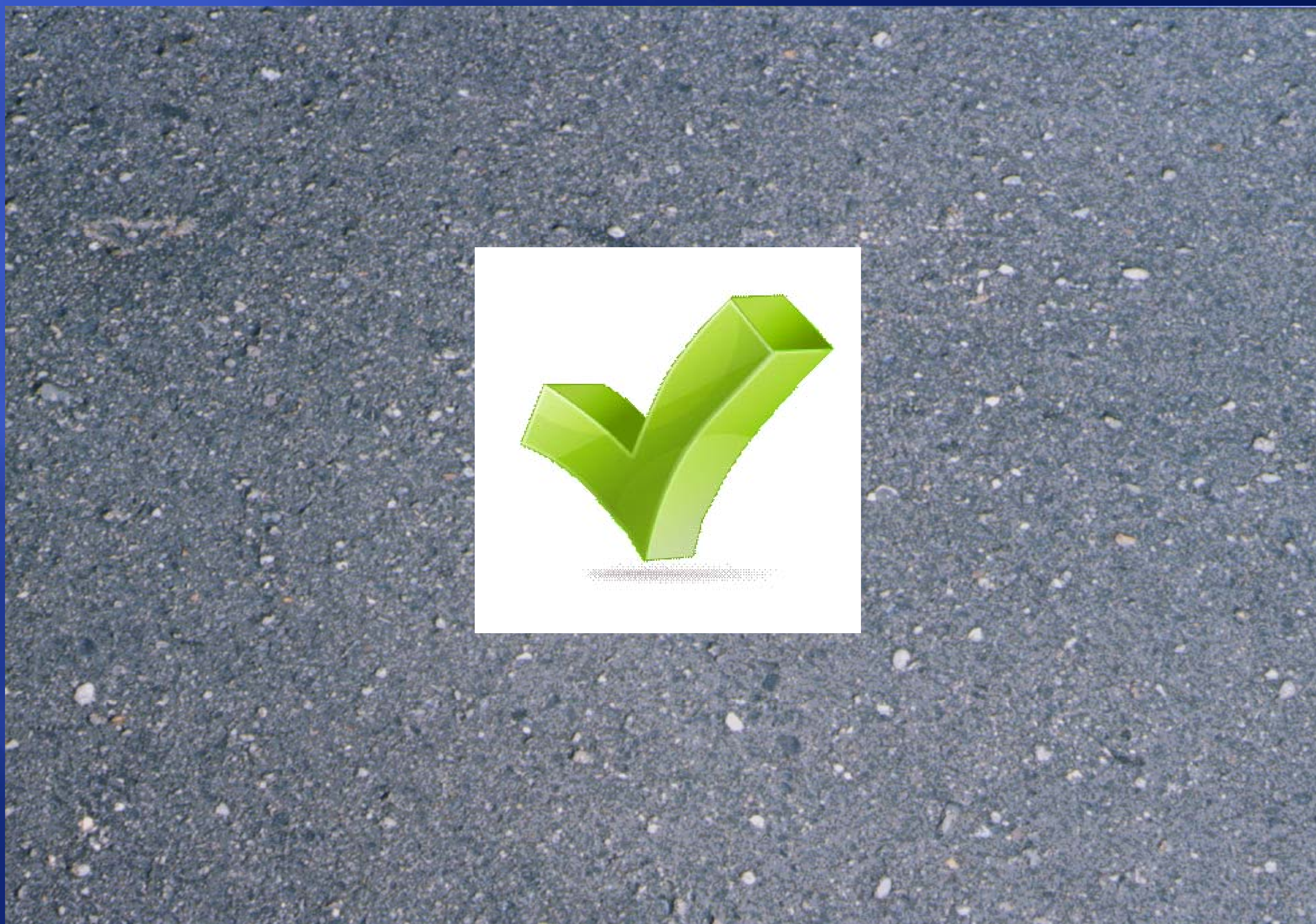
Visual Survey

- 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.

Types of Distress

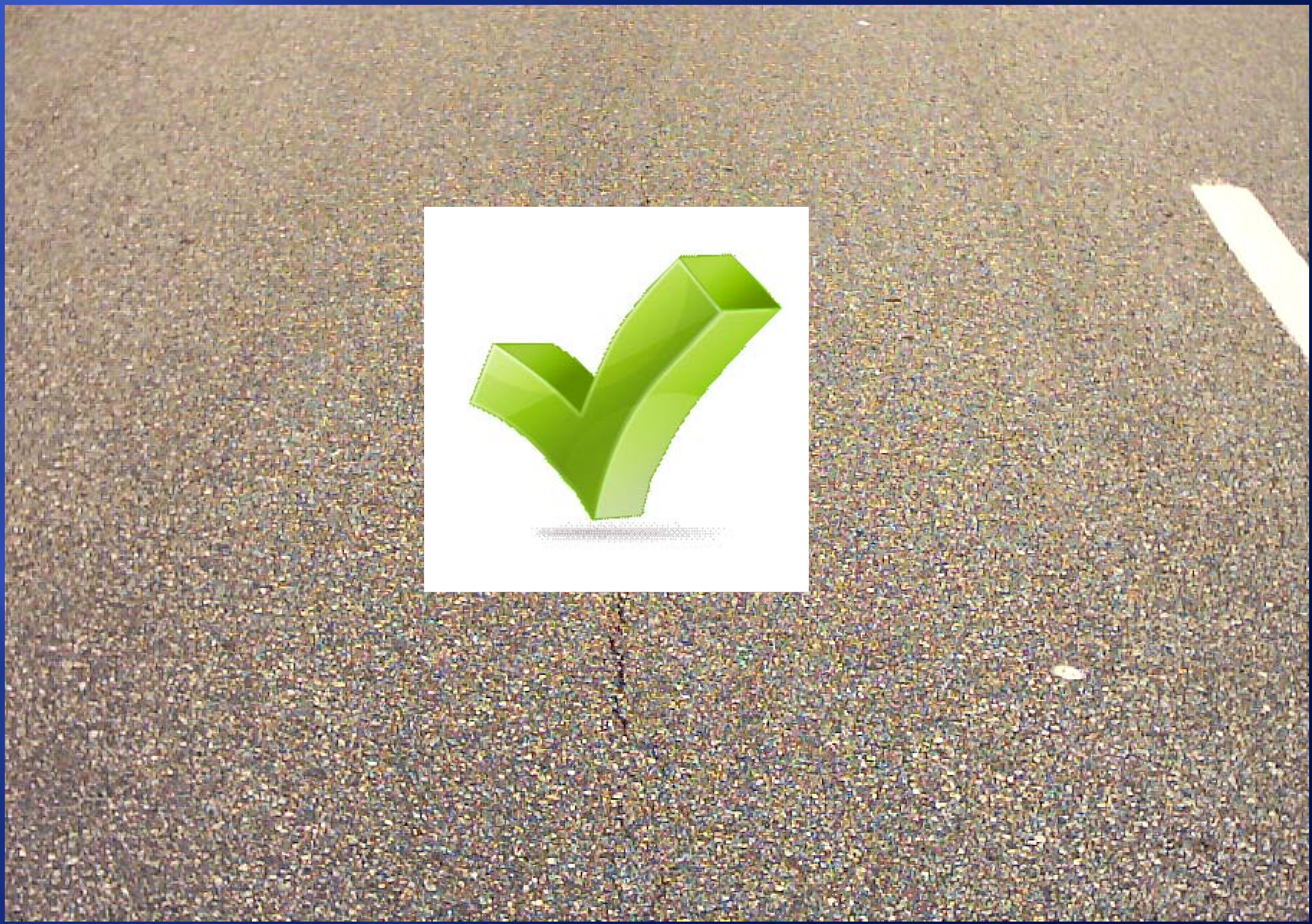
- Raveling
- Longitudinal Cracking (not in wheelpath)
- Longitudinal Cracking (in wheelpath)
- Transverse Cracking
- Alligator Cracking
- Rutting

Raveling



Longitudinal Cracking (not in wheelpath)

Longitudinal Cracking (wheelpath)



Temporary Fix for Minor Distress

Transverse Cracking

Alligator (Fatigue) Cracking

Temporary Fix for Minor Distress

Rutting or Shoving

Severe Structural Failure

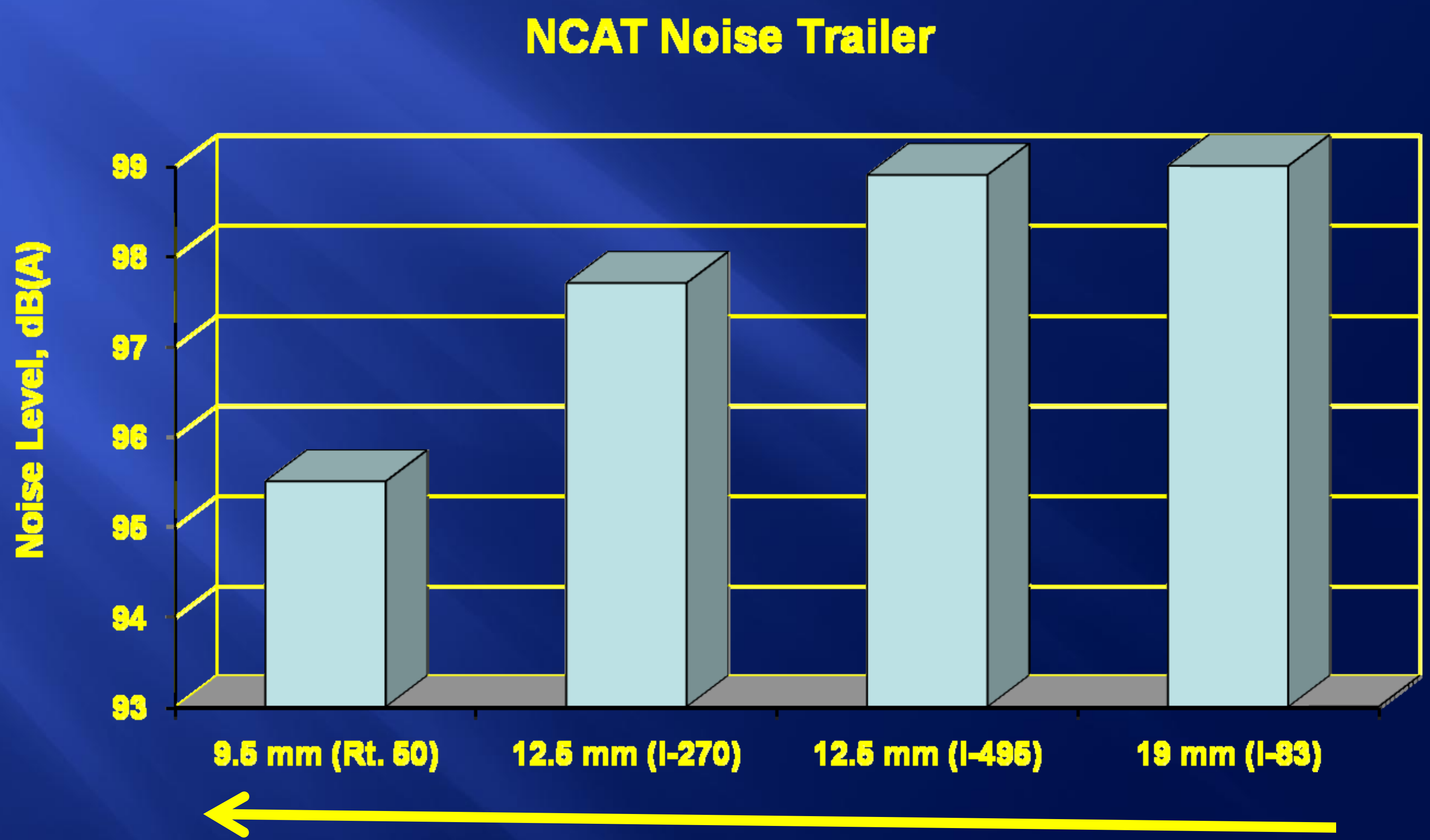
Surface Failure – Milling Required

Ride Quality and Skid Resistance

Rough Surfaces Should be Milled

Skid Problems can be Milled, but not Required

Noise can be Reduced



Smaller Aggregate = Less Noise

Drainage Evaluation

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	✓		✓

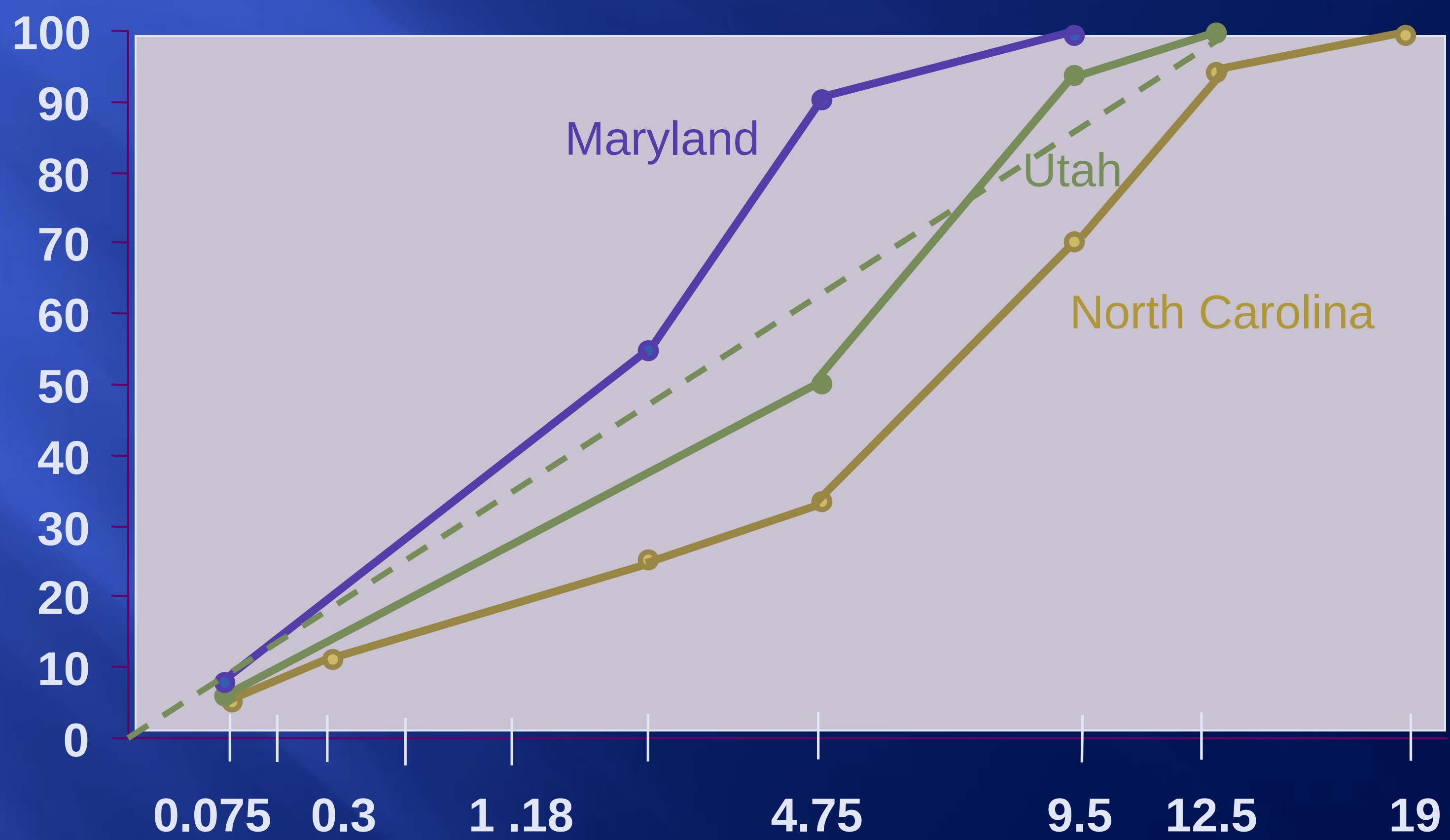
Materials & Mix Design

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

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 (Uncompacted Voids): 40-45

Example Gradations



Materials Selection - Binder

- Most specifications use PG system for climate and traffic
  - Minnesota – Unmodified binder
  - Ohio – Polymer modified PG 64-22 or PG 76-22
  - New York – same as Ohio
  - New Jersey – PG 76-22 for high performance mix
  - North Carolina – depends upon traffic level

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

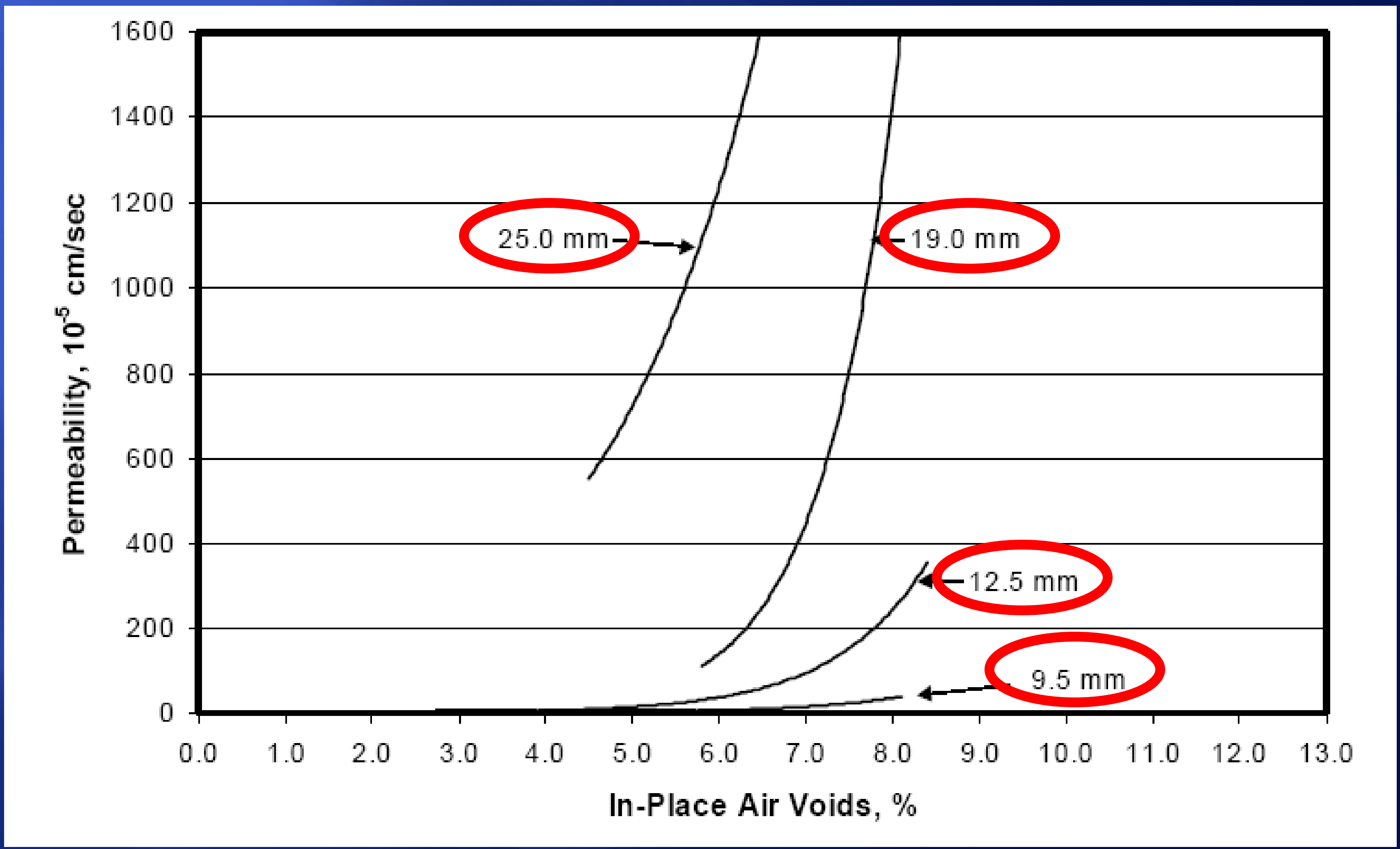
Mix Design

- 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

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



Construction & Quality Control

- Construction
    - Production
    - Paving
- Quality Control

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 $\leq$ 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

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)

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"

Quality Control - Plant

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

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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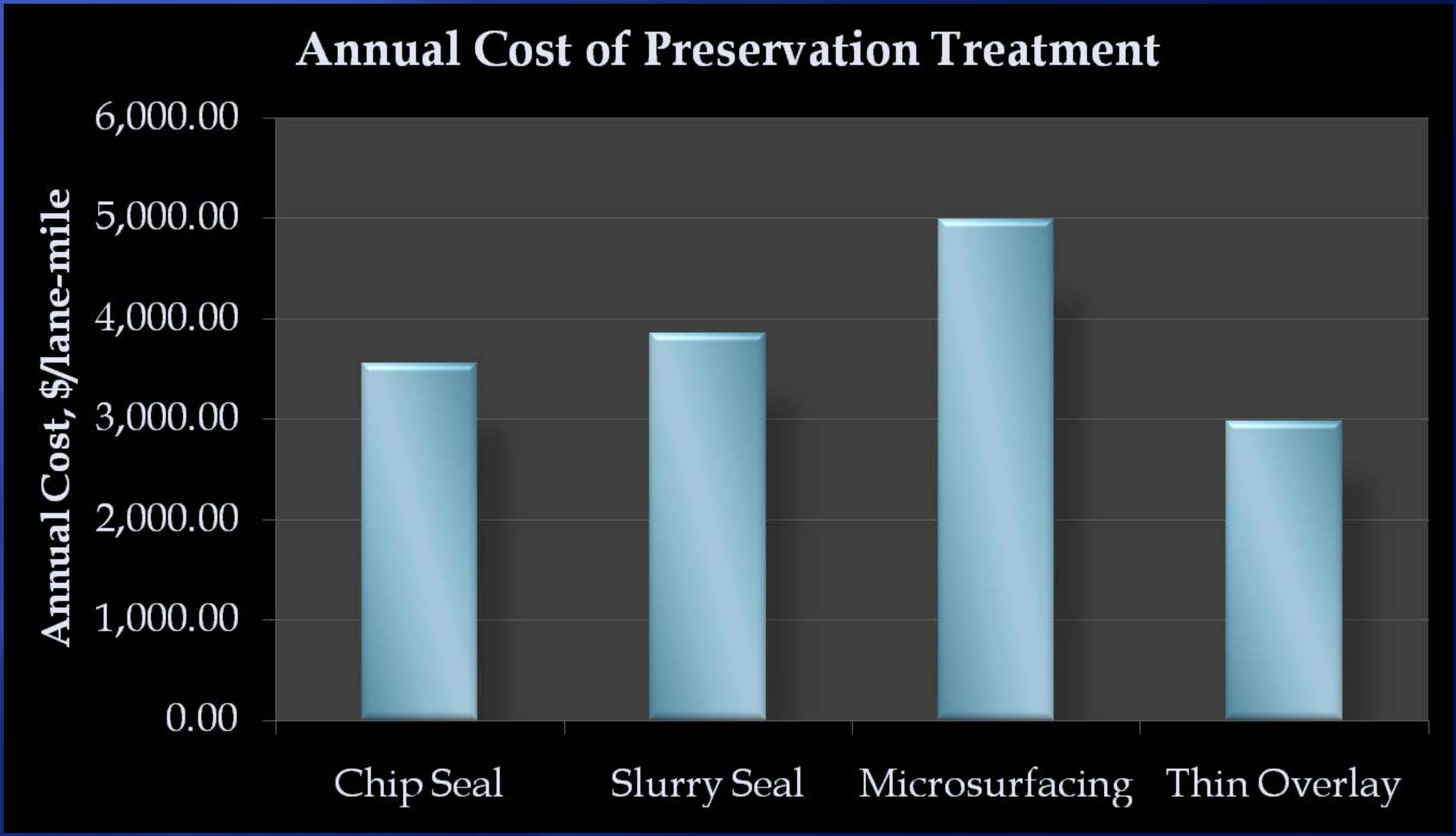
Economics

- Chou et al. (2008):
  - Thin overlays on asphalt – almost always most cost effective
  - Thin overlays on PCC – not as cost effective, but greater deterioration prior to overlay
- 2008 NAPA Survey of State Asphalt Associations

Treatment	Expected Life, yrs	Range	Cost, $/SY	Range	Annual Cost, $/lane-mile
Chip Seal	4.08	2.5 - 5	2.06	0.50 – 4.25	3,554.51
Slurry Seal	3.25	2 - 4	1.78	1.00 – 2.20	3,855.75
Micro-surfacing	4.67	4 - 6	3.31	2.30 – 6.75	4,989.81
Thin Surfacing	10.69	7 - 14	4.52	2.40 – 6.75	2,976.69

Economics


Annual Cost of Preservation Treatment
Annual Cost, $/lane-mile
6,000.00
5,000.00
4,000.00
3,000.00
2,000.00
1,000.00
0.00
Chip Seal
Slurry Seal
Microsurfacing
Thin Overlay

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.