Thinlay Asphalt for Pavement Preservation

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Eagle, Colorado

Wisdom from a California Boy

R-E-L-A-X

The Need

- Pavement Management Professionals are tasked with implementing strategies to provide highest level of service at least cost over life cycle

Keeping Good Roads Good!

The Olde Days

Persevere!

Preservation Treatments:
Correct minor surface distresses

- Cracking
- Rutting
- Raveling

Preservation Treatments

- Should seal existing pavement to prevent intrusion of water and air

Preservation Treatments should also improve serviceability

- Smoothness
- Surface friction
- Drainage

Preservation Treatments

Long Life = {

- low life cycle cost
- minimal user impacts
- optimization of network performance

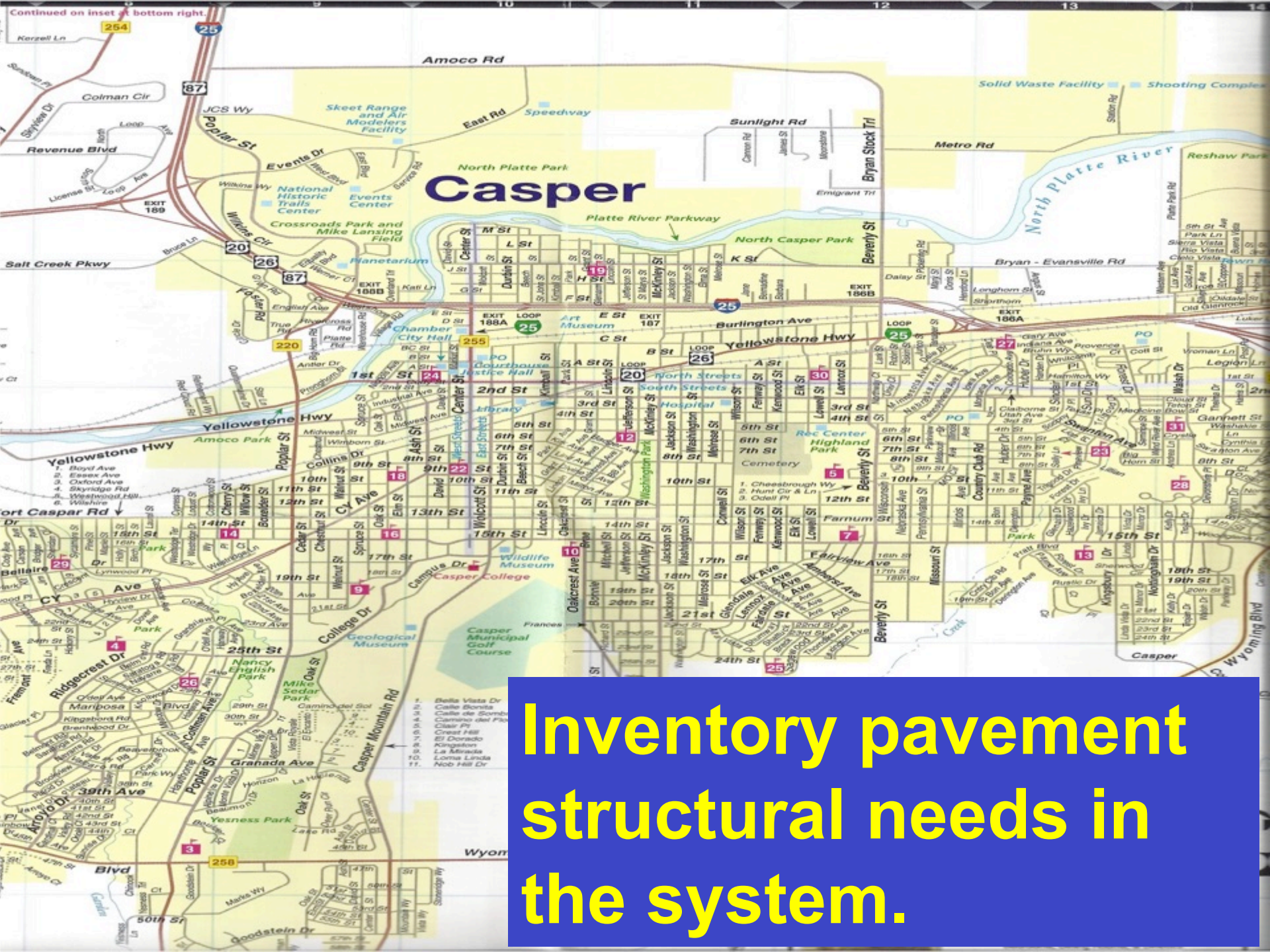
Have a Plan!

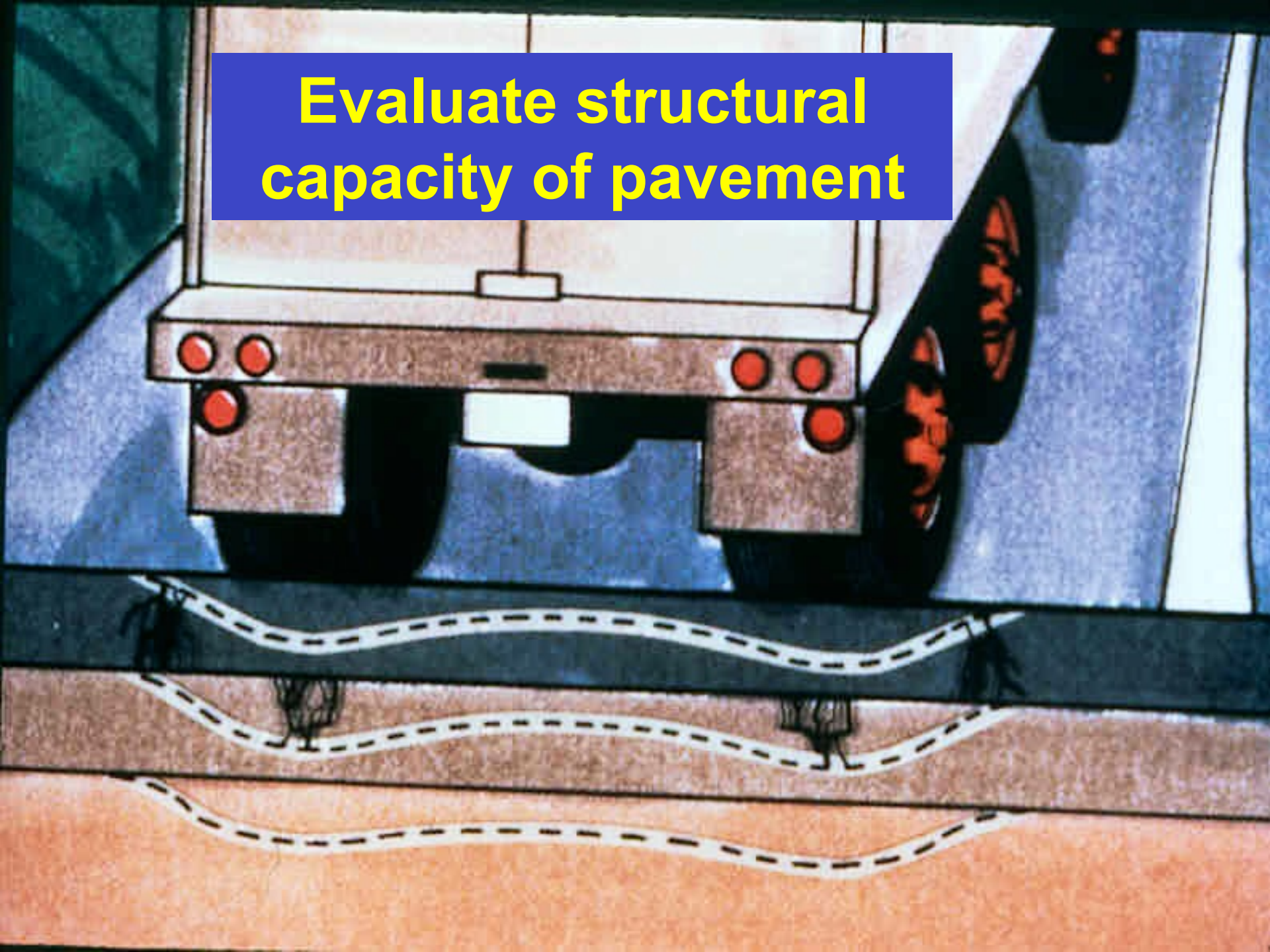
Know what to expect!

Preservation Strategies

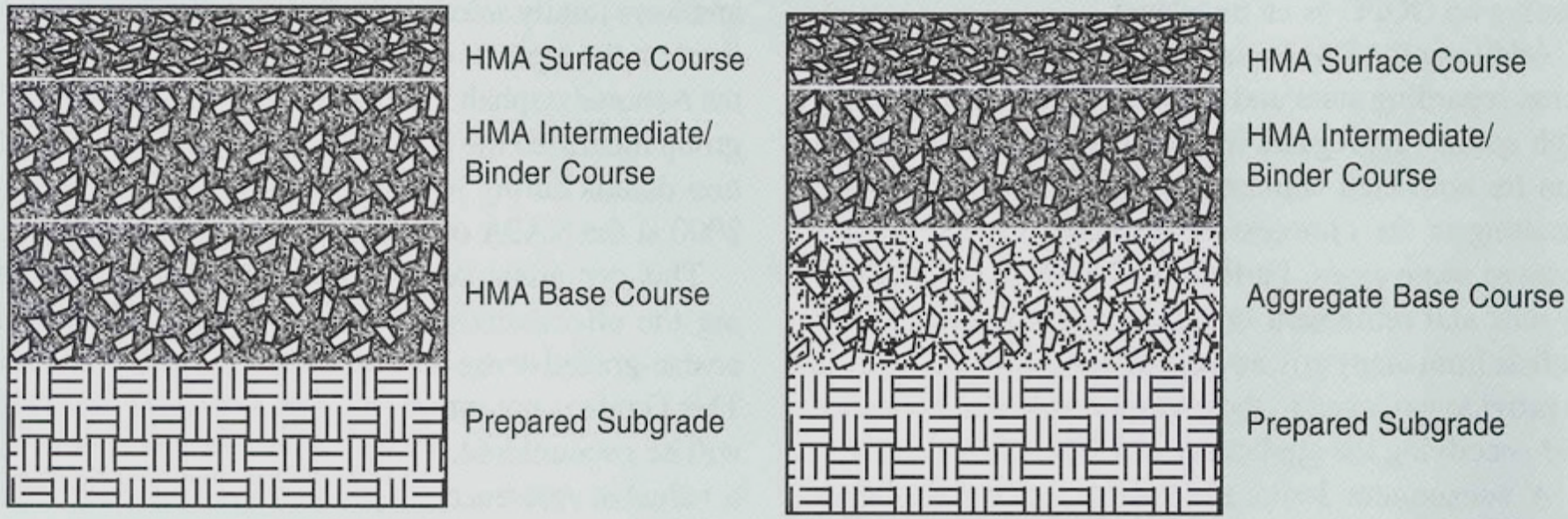
- Include inventory of structural needs
- Evaluate structural capacity of pavement
- Understand existing structure and materials
- What is impact of fatigue failure?
- Choose proper treatment for condition

Preservation Strategies


Casper
Amoco Rd
Yellowstone Hwy
Platte River Parkway
North Platte River
Burlington Ave
Bryan - Evansville Rd
Metro Rd
Sunlight Rd
Beverly St
College Dr
CY Ave
Wyoming Blvd
Inventory pavement structural needs in the system.


Evaluate structural capacity of pavement

Understand existing pavement structure and materials



Understand Problem before Developing a Solution

Impact of Fatigue Failure

Choose proper treatment

What effect does treatment have on pavement life?

Thinlay Asphalt Treatments

- Are designed to address key Preservation needs
  - ✓ Correct Surface distress
  - ✓ Seal the existing surface
  - ✓ Improve Serviceability
  - ✓ Provide long life
  - ✓ Extend structural life

Ohio Decision Tree

- Determines candidates for Thinlay
- Uses Pavement Condition Rating
- Separates primary and general system routes
- Describes cost effectiveness

- NHI Course describes how to choose treatments

Why Thinlay?

- Low life cycle cost
- Fast construction
- Smooth surface >>> Happy drivers
- Improve friction
- Low noise >>> Happy Neighbors
- Recyclable
- Structural improvement

What is a Thinlay?

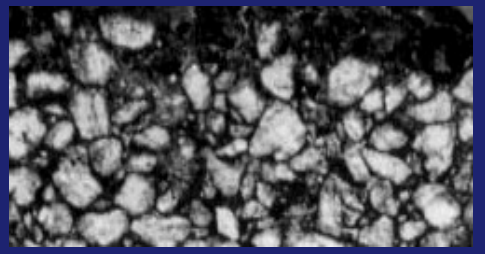
- Asphalt mixes engineered specifically for pavement preservation
- Designed with aggregate gradations allowing placement as thin as ¾”
- Binders and gradations selected to optimize flexibility, durability and rut resistance

Thinlay Suite of Treatments

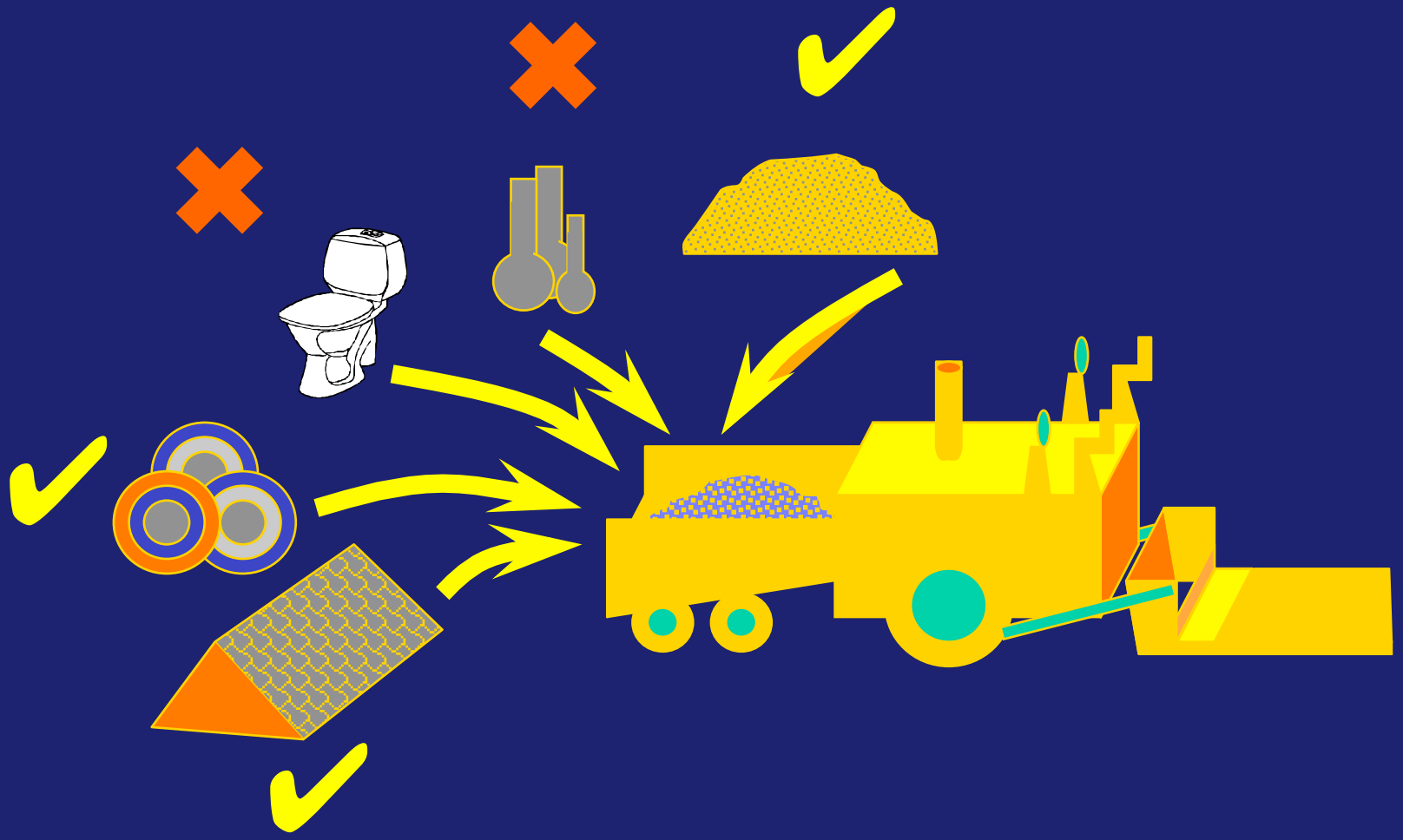
Dense-Graded

Stone Matrix Asphalt (SMA)

Open-Graded



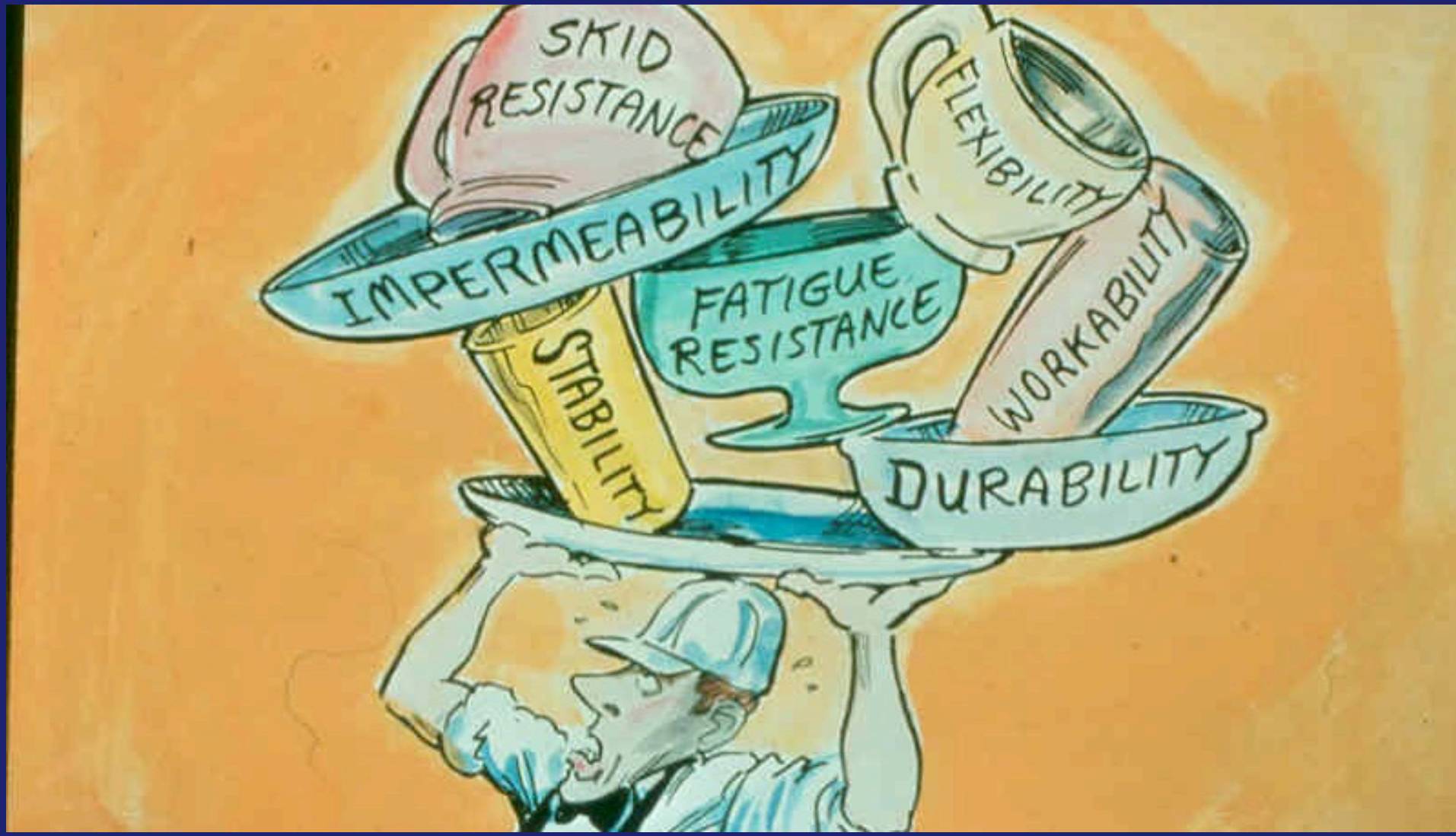
Waste Materials in Mixtures



Thinlay Asphalt Treatments

- Can include recycled materials
  - RAP, RAS, GTR
  - Enhance performance, reduce costs, reduce demand for new raw materials
  - Improve sustainability
- Using WMA technology is excellent approach

Thinlay Mix Design



Thinlay Mix Design

- Mix design criteria to optimize preservation needs
  - ✓ Nominal Max ≤ 1/3 lift thickness (for ¾" lift use 6.3 mm or smaller mix)
  - ✓ binder selected to optimize crack and rut resistance
    - ✓polymers for highest demand areas
  - ✓RAP and RAS combined with softer base binders to provide optimum value

Thinlay Mix Design

- Mix design Criteria:
  - ✓ Gyration level to match traffic and local practice (generally 65-80)
  - ✓ Va (4 ± 1%)
  - ✓ VMA (15-17)
  - ✓VFA (70-80), avoid low VMA high dust mixes
  - ✓ Minimum binder contents normally 6%, typically higher due to fine grading

Wisonsin DOT Special Provision

WisDOT Thin Layer Overlay Special Prov.

Binder: PG 58-34 for all except E-10
PG 64-34 for E-10

Maximum Allowable Percent Binder Replacement: 20

VMA: 15.0 for 9.5 except E-10 (15.5)
16.0 for 4.75 except E-10 (16.5)

WI Thin Layer Overlay SP

Size (Thk)	9.5 mm (1-1.5”) For all traffic		4.75mm (0.75-1.0”) For all traffic	
Traffic	E-0.3	E-1	E-3	E-10
FF (2)	65	70	75	98
FAA	40	43	45	45
LA	50	45	42	40
Gyrations (Ndes)	40	40	40	75


Thinlay in Texas
¾” thick
TXDOT: No RAP
40% in this mix


RTS
MATERIALS


Constructability

Thinlay Construction

- Generally same as conventional
- Adjust production to account for high % fines
- Account for high moisture in fines
  - Paving
  - Sloping
  - Remove from dry side
  - Cover stockpiles

Sound Familiar??

Thinlay Construction

- Plant runs slower
  - Coating fines
  - Drying aggregate
  - Thicker aggregate veil
- Use proper RAP management
- 1% increase in moisture increases drying costs 10%

Thinlay Construction

- Proper tack coat application
  - Wide range – 0.02 to 0.2 gsy
  - Typical – 0.10 to 0.15 gsy
  - To break or not to break?
- Best Practices for Tack Application

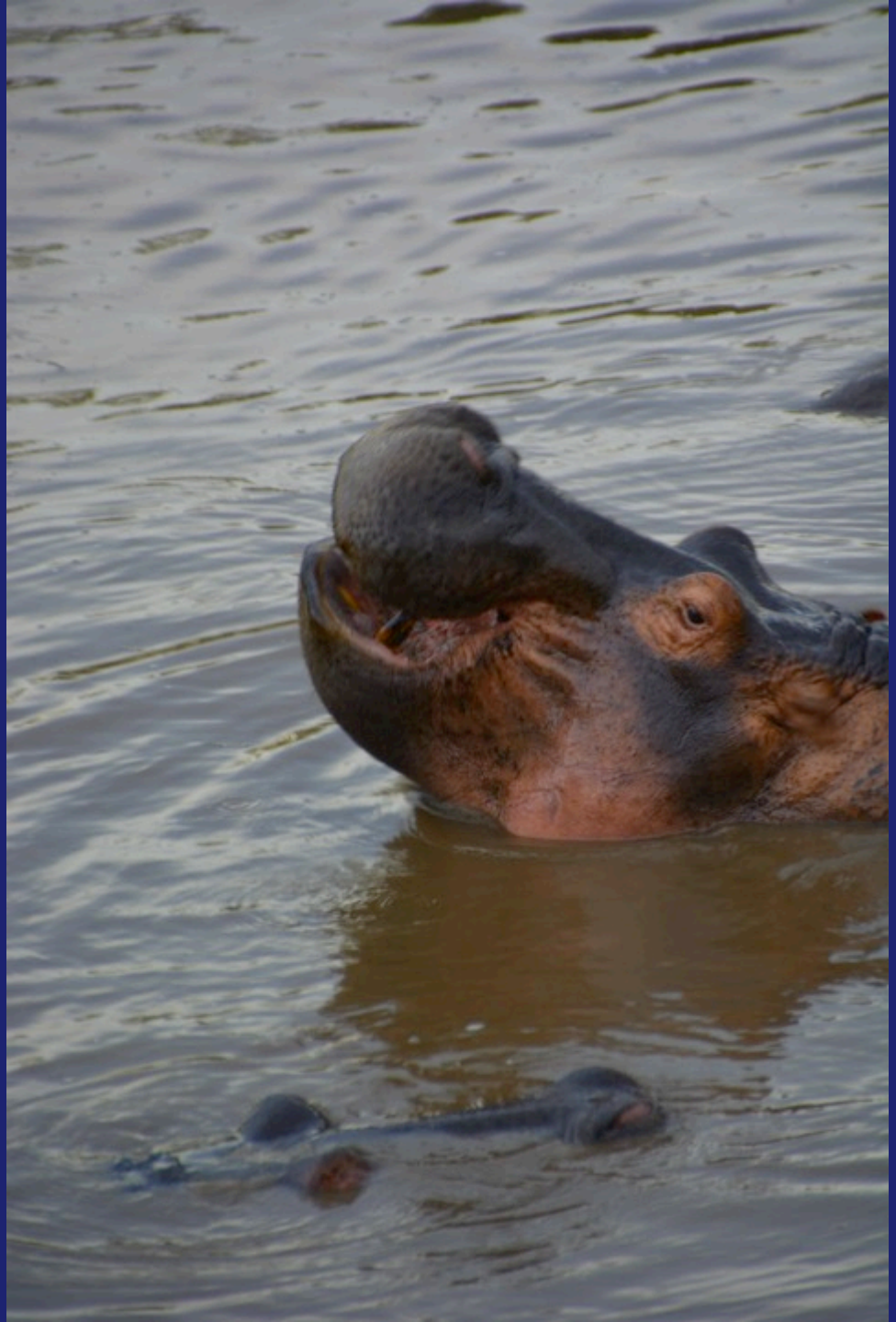

Lack of Bonding is a Problem!

Thinlay Construction

- Paving Best Practices!
  - Including preparation
- Mix cools quickly
  - 1” mat cools from 300 to 175F twice as fast as 1.5” mat
- Conventional density testing may not be appropriate for <1” mat
  - Some states use a method spec

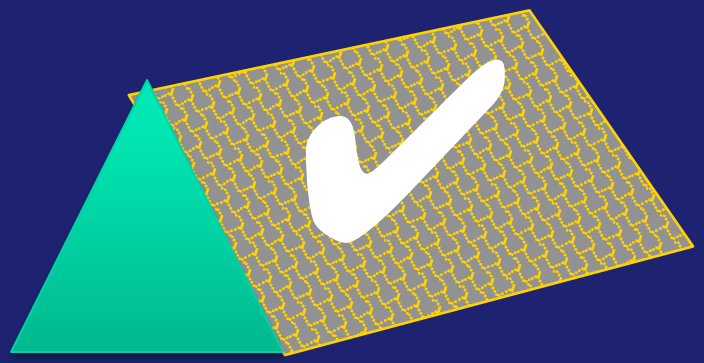
Thinlay Asphalt Benefits

- Seals existing pavement
- Corrects surface distresses
- Improves structure
- Restore cross-slope and profile
- Reduce cost of maintenance
- Improves skid resistance
- Reduces noise



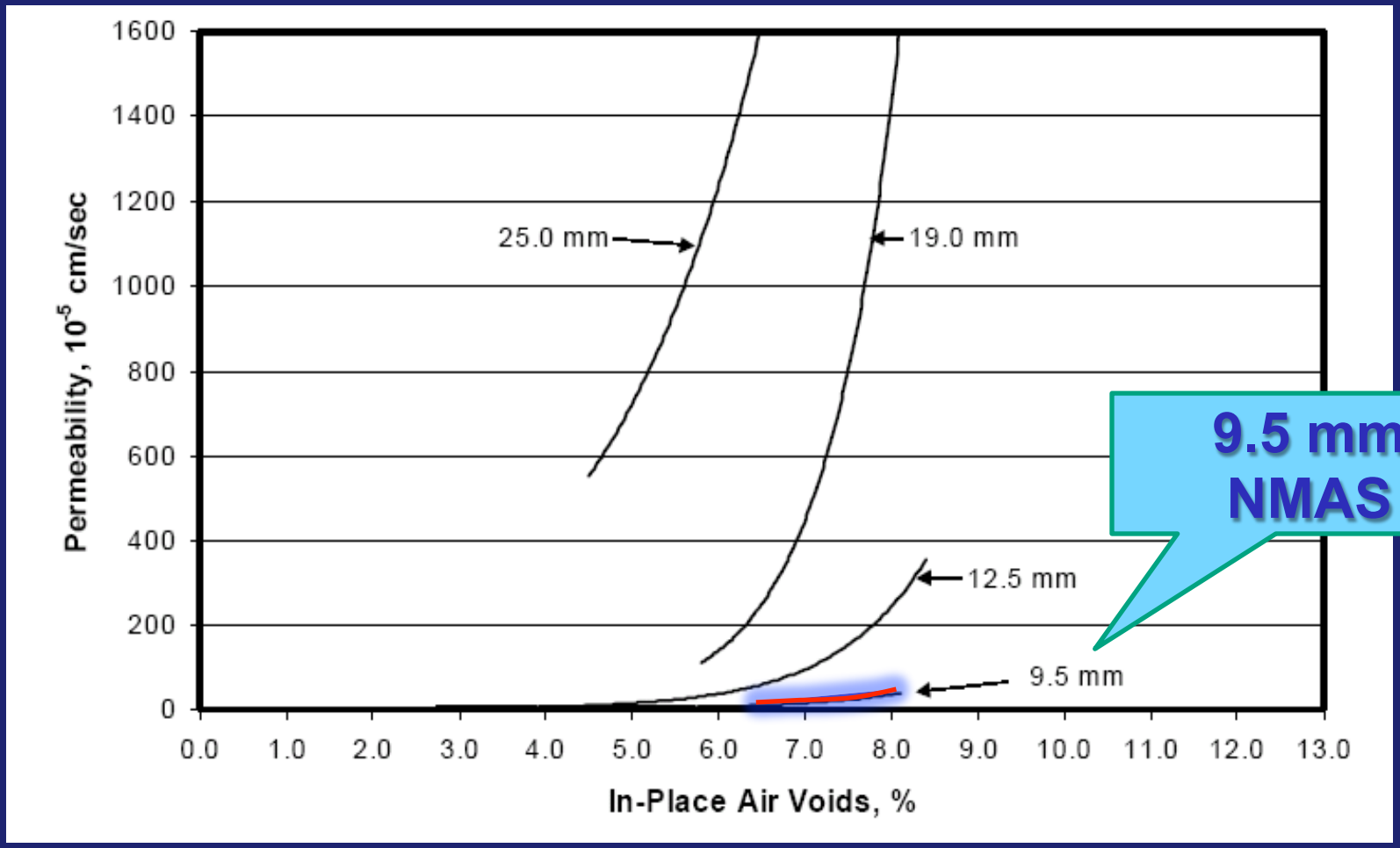
Thinlay Asphalt Benefits

Reduced permeability improves pavement longevity by protecting the pavement from the damaging effects of air and moisture intrusion



Thinlay Asphalt Benefits

PAVEMENT PERMEABILITY



Source: NCAT

SHRP SPS-3 STUDY

- Thin overlays significantly improved pavement smoothness after treatment
- Chip seals and slurry seals showed little or no pavement smoothness improvement after treatment

Thinlay Asphalt Benefits

- Improve ride and correct cross slope deficiencies
- MAP21 requires reporting pavement condition
- Primary condition measure will be IRI

Thinlay Asphalt Benefits

- Reduce cost of pavement maintenance
  - Properly designed thinlay asphalt requires very little maintenance and can improve pavement life

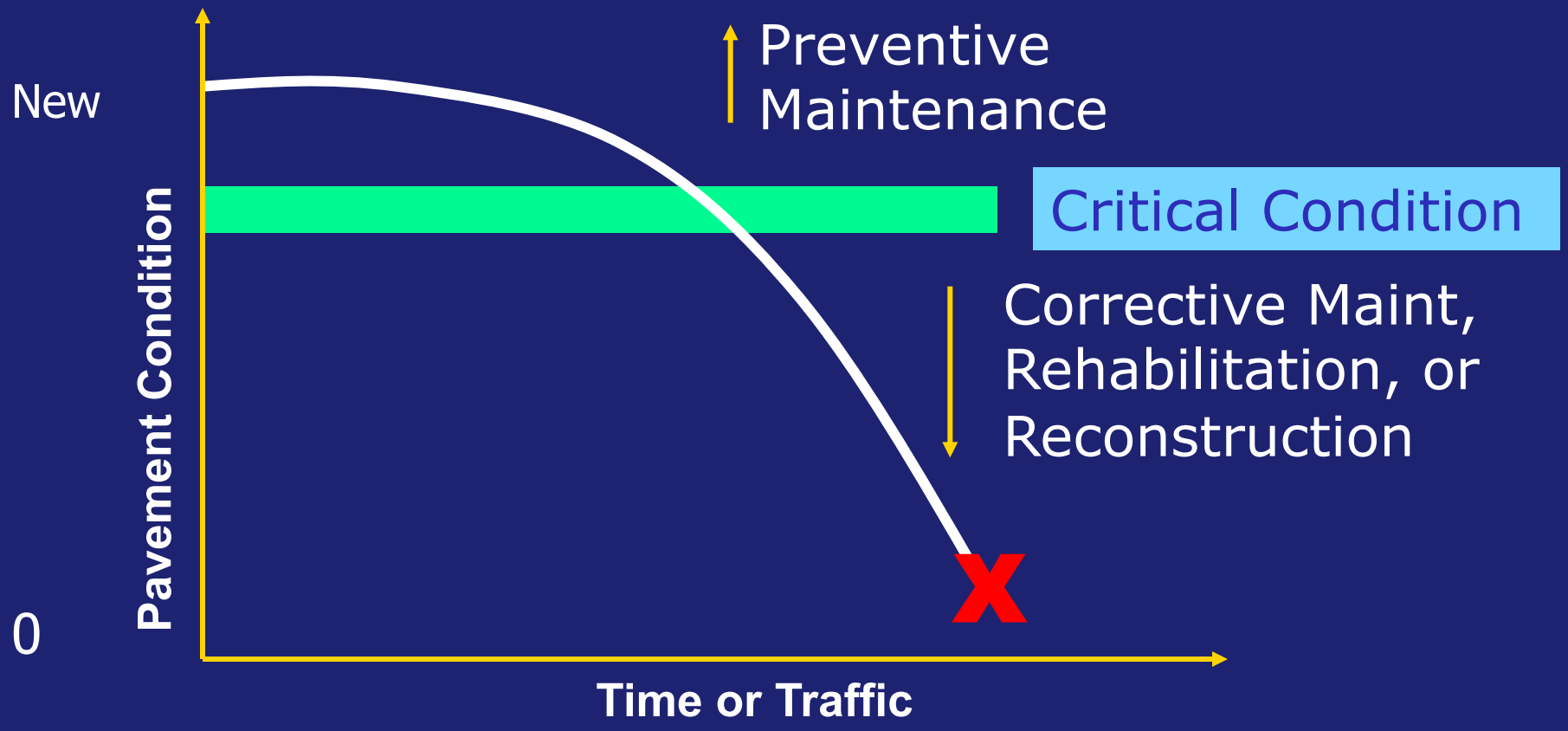
Thinlay Asphalt Benefits

- No need to program seals on a thinlay due to low permeability
- Seal reflective cracks as for any pavement

Thinlay Asphalt Benefits

- Rapid construction and immediately open to traffic
- Public views road as “like new” following thinlay paving
- No cure time or sweeping, or broken windshields
- Limited performance risk
- Preferred by cyclists and other non auto traffic

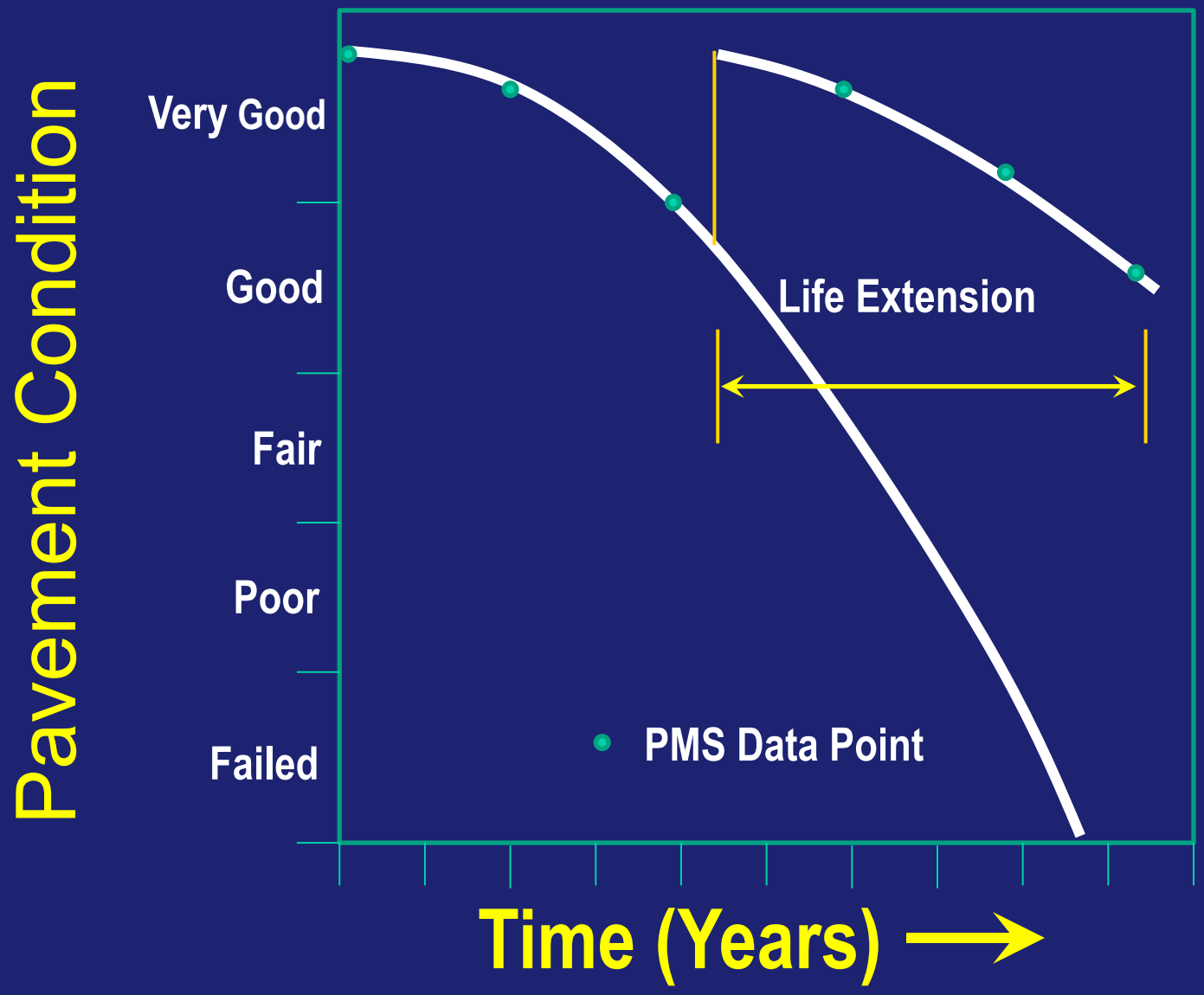
Preservation Treatment Effects on Pavement Condition and Serviceability



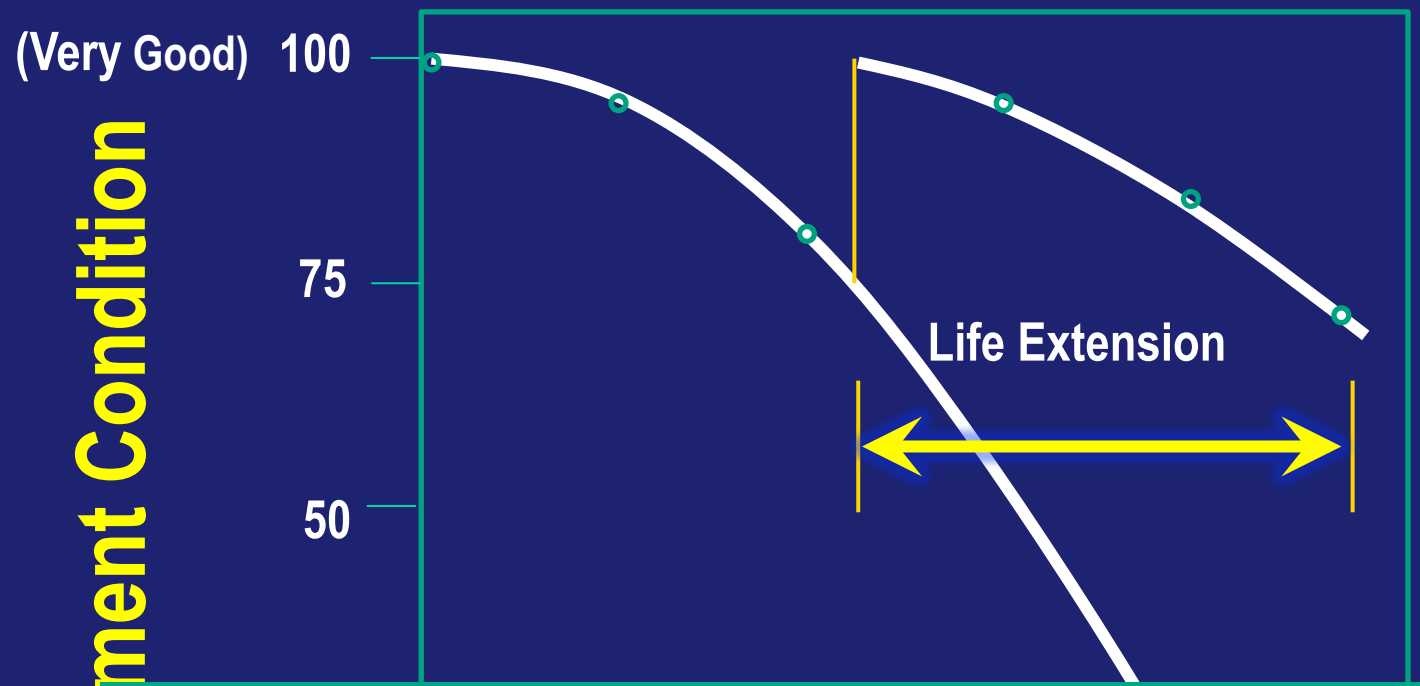
Pavement Condition Rating System

Flexible pavement distress types

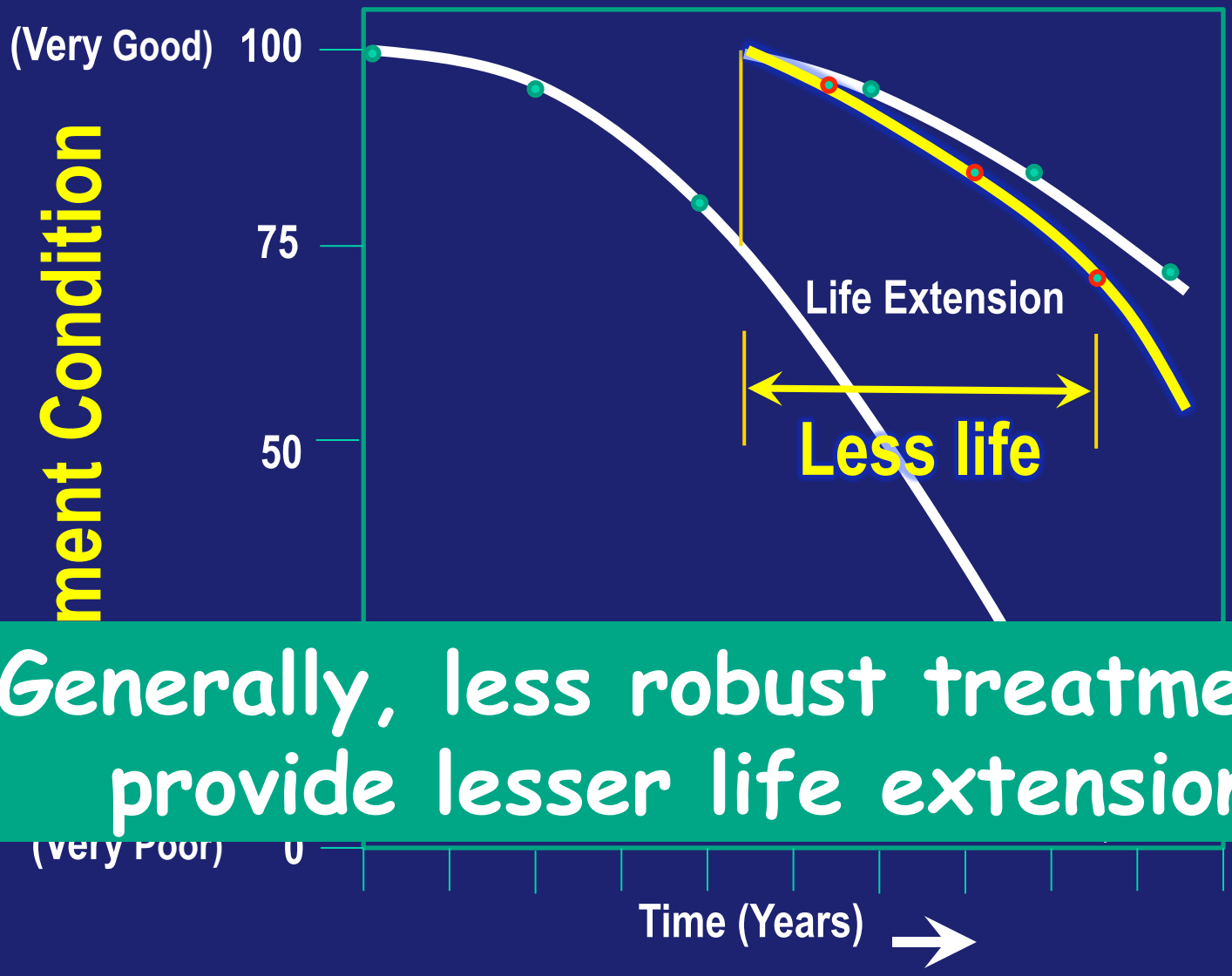
- Raveling
- Bleeding
- Patching
- Potholes/debonding
- Crack sealing deficiency
- Rutting
- Settlements
- Corrugations
- Wheel track cracking
- Block & Transverse cracking
- Longitudinal joint cracking
- Edge cracking
- Random cracking



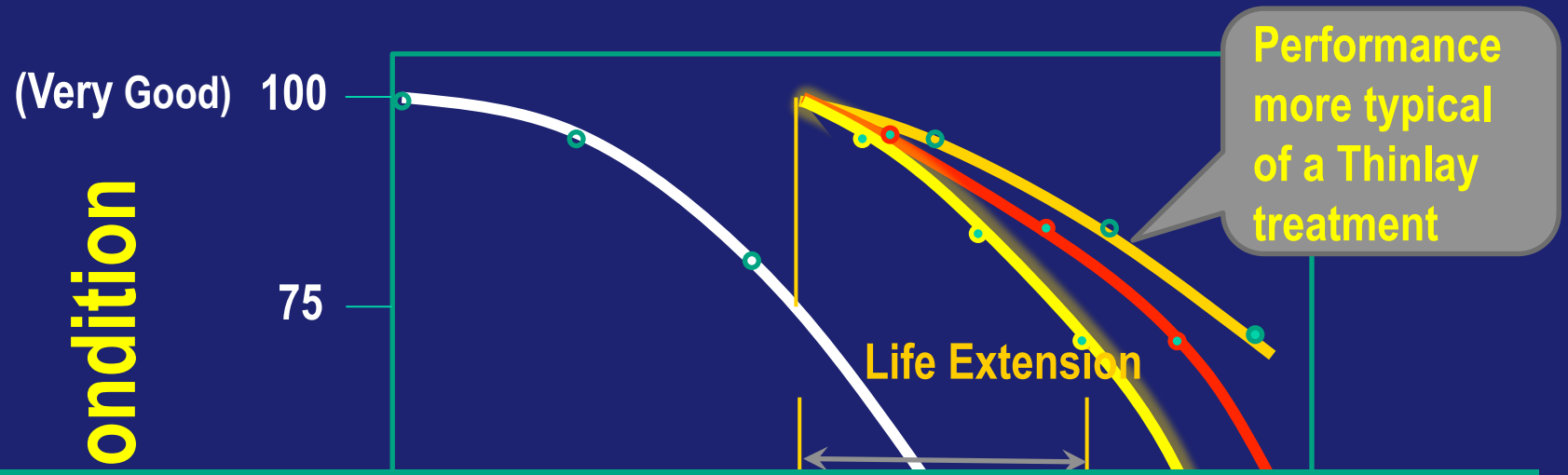
Source: FHWA Pavement Preservation Compendium



Life Extension depends on
(1) structural soundness of pavement upon which treatment is to be applied
(2) robustness of treatment



Generally, less robust treatments provide lesser life extension



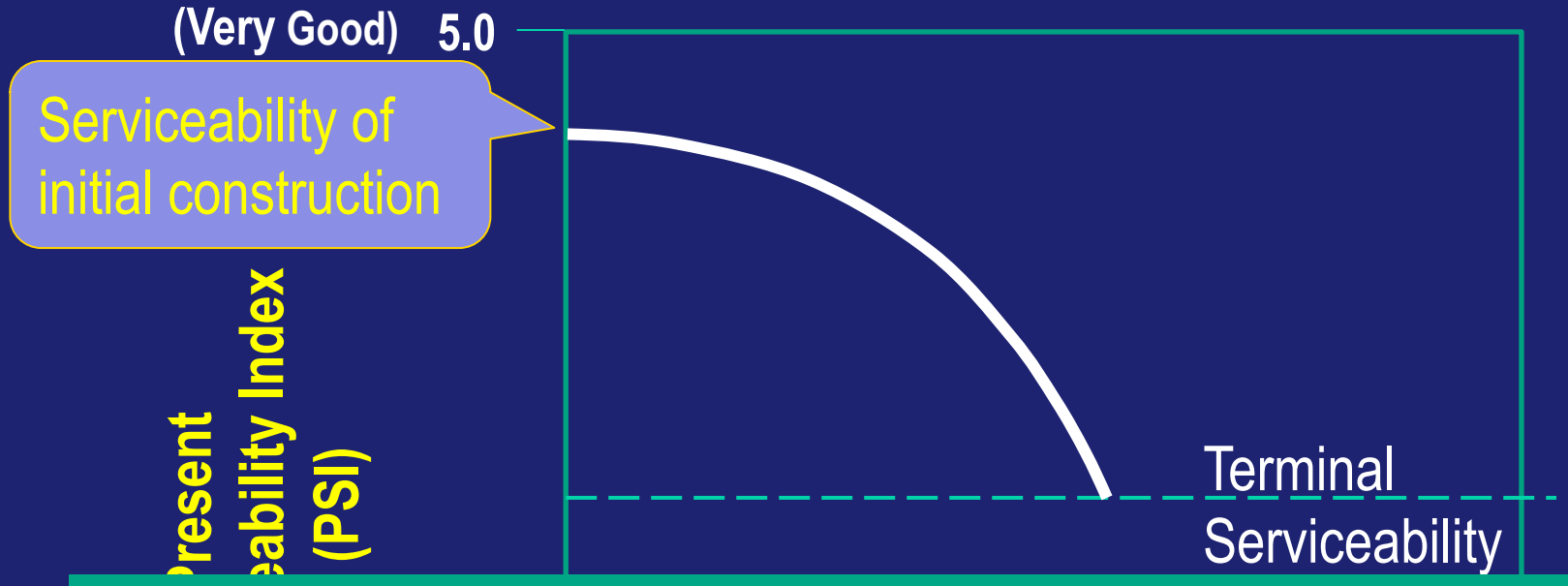
Life extension varies based on robustness of the preventive maintenance treatment. Generally ThinLay asphalt Treatments afford greater Life Extension.

Condition ratings provide only part of the answer.

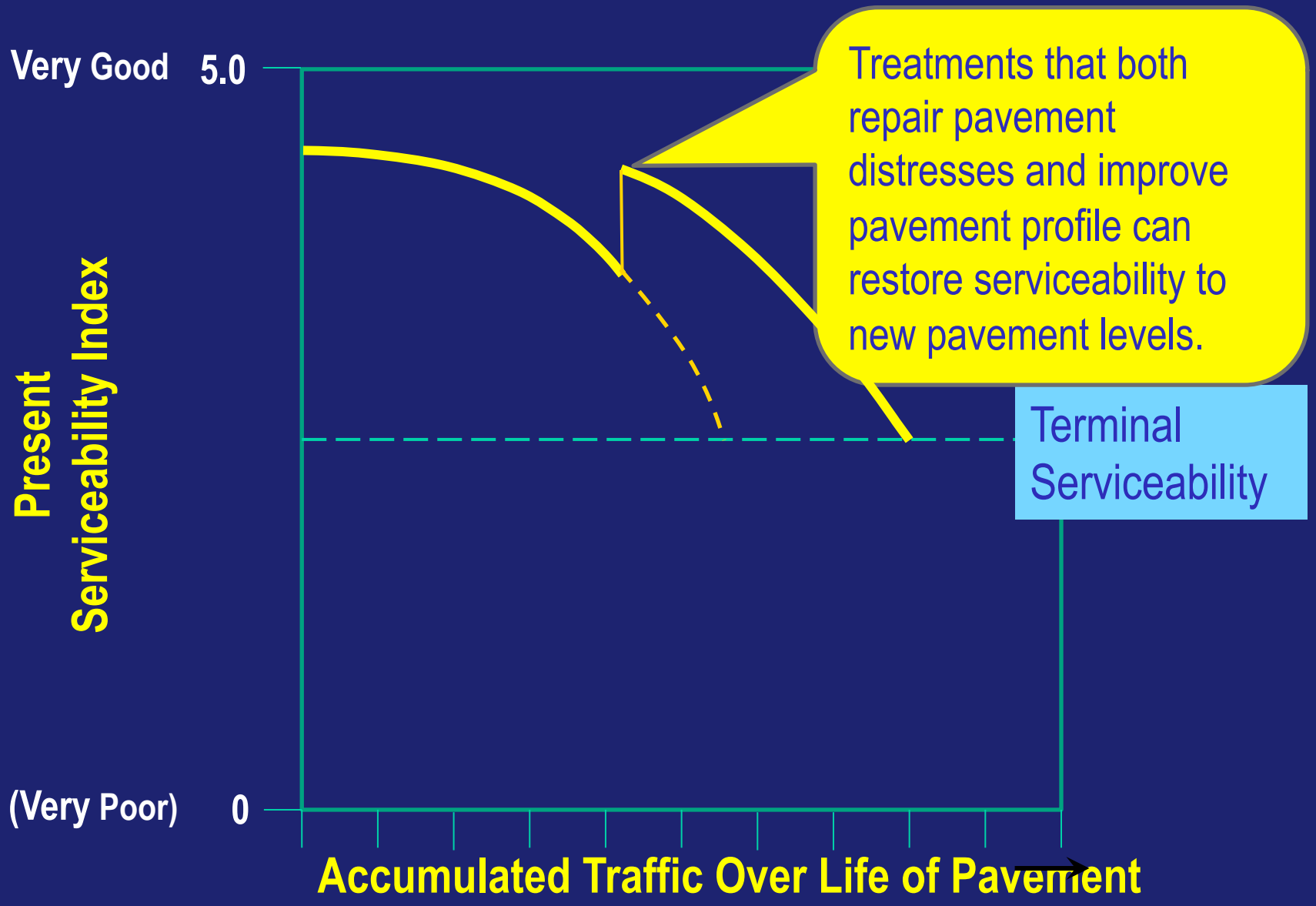
“Serviceability” also needs to be considered.

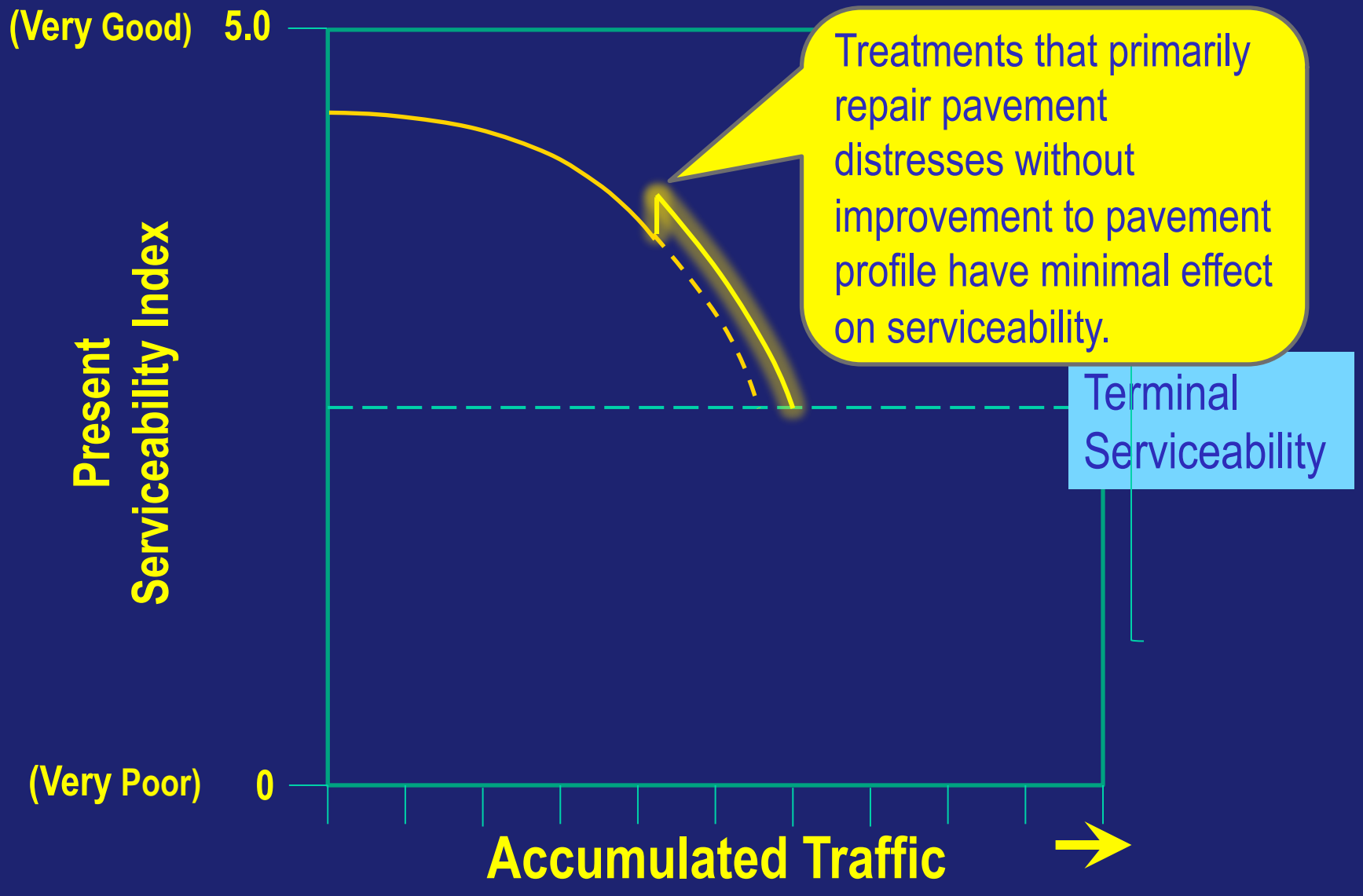
Serviceability is…

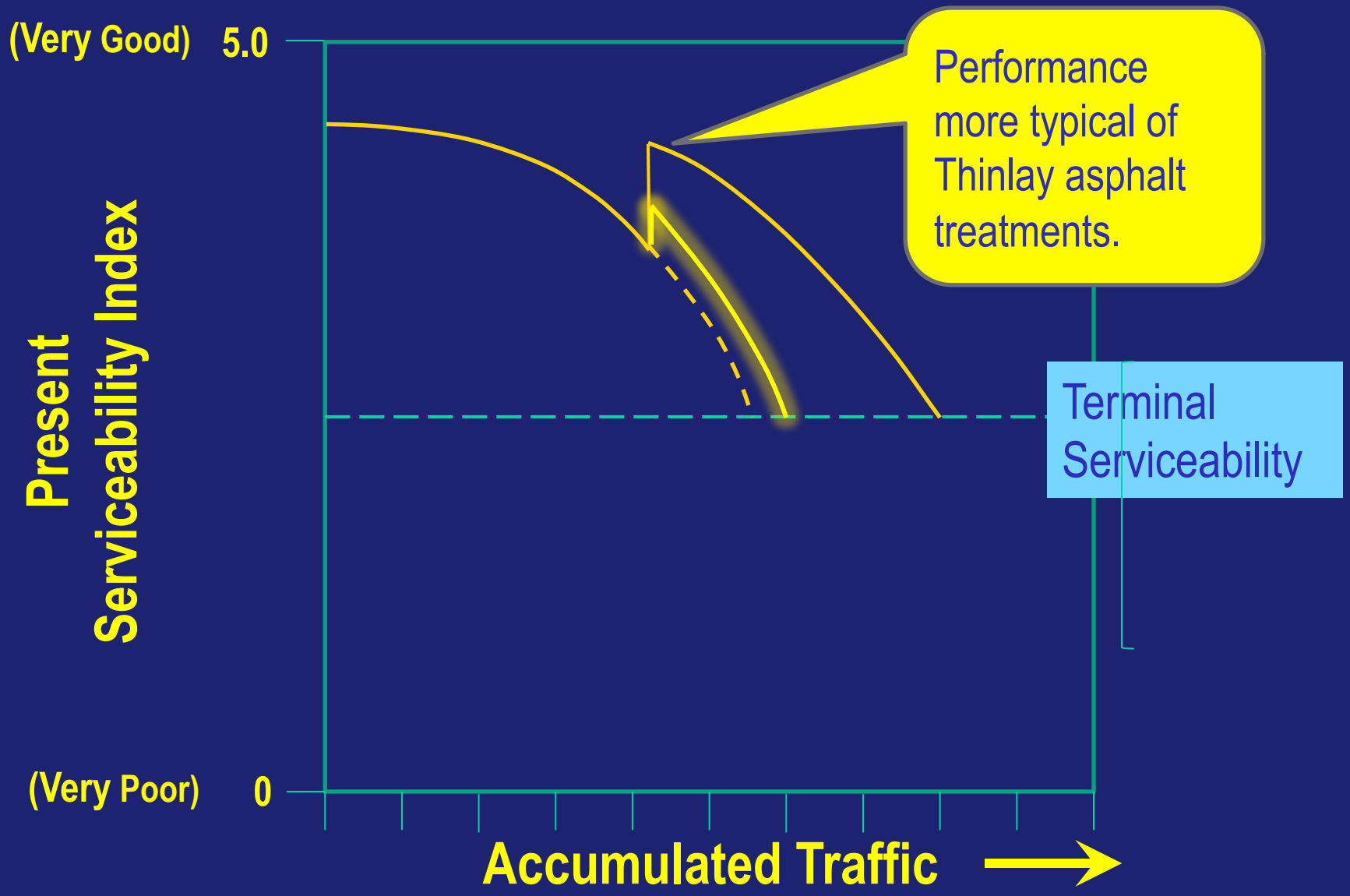
- A pavement performance measure developed as part of AASHO Road Test
- A measure of pavement's ability to serve type of traffic which use facility
- A measurement of users' perceptions regarding **acceptability of a pavement**
- Largely impacted by user's perception of ride quality.



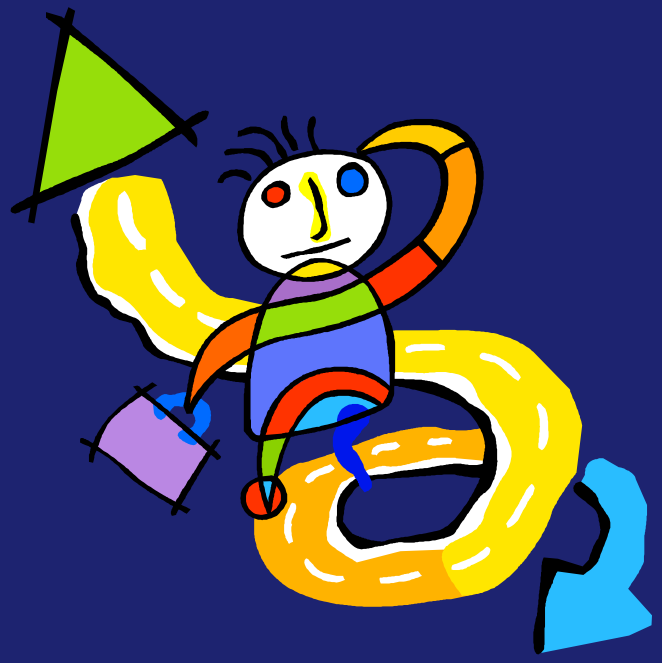
- Serviceability declines as pavement deteriorates under traffic
- Lowest tolerable level of serviceability is called "Terminal Serviceability"


Very Good 5.0
Present Serviceability Index
(Very Poor) 0
Treatments that both repair pavement distresses and improve pavement profile can restore serviceability to new pavement levels.
Terminal Serviceability
Accumulated Traffic Over Life of Pavement


(Very Good) 5.0
Present Serviceability Index
(Very Poor) 0
Accumulated Traffic
Treatments that primarily repair pavement distresses without improvement to pavement profile have minimal effect on serviceability.
Terminal Serviceability


(Very Good) 5.0
Present Serviceability Index
(Very Poor) 0
Performance more typical of Thinlay asphalt treatments.
Terminal Serviceability
Accumulated Traffic

Preventive maintenance treatments differ widely in their ability to improve serviceability



Structural Benefits

- Preventive Maintenance treatments are typically non-structural
- Preventive Maintenance treatments should be applied to structurally sound pavements
- Slurry seals, Chips Seals, micro surfacing add no structure
- A 1 inch thinlay asphalt treatment provides structural benefits

Structural Benefits

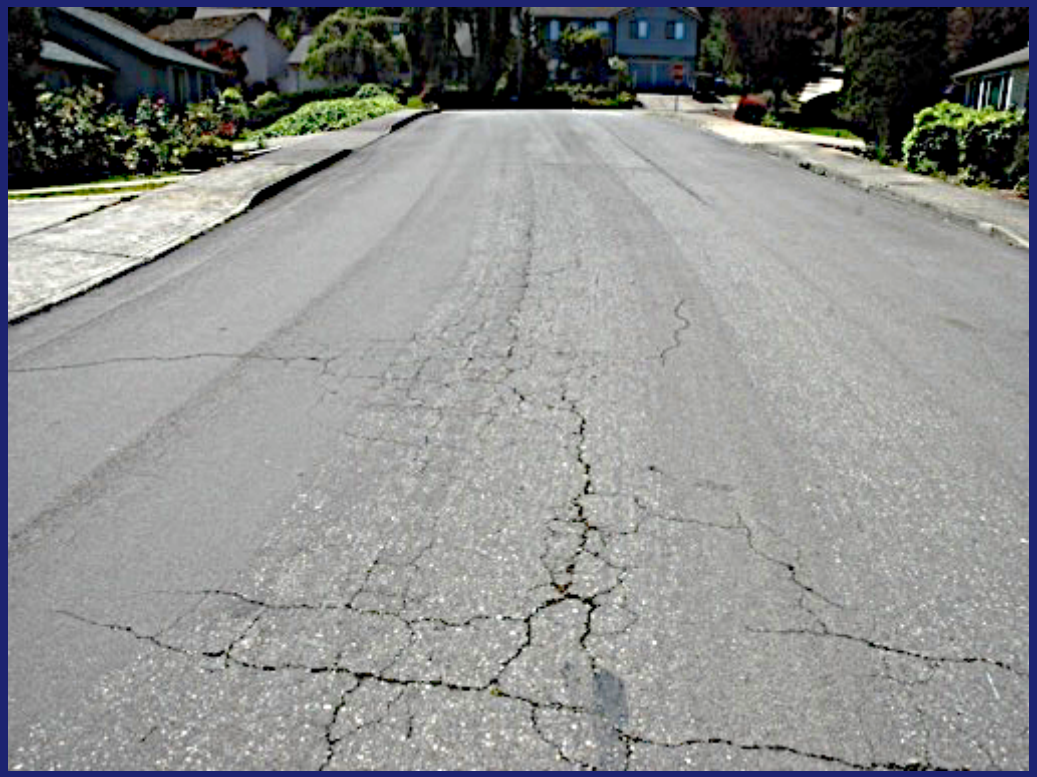
- Most pavements designed for 20 years with AASHTO design
- They have finite bottom up fatigue life
  - if thickness is not increased, pavement will eventually fail from bottom up cracking

Structural Benefits

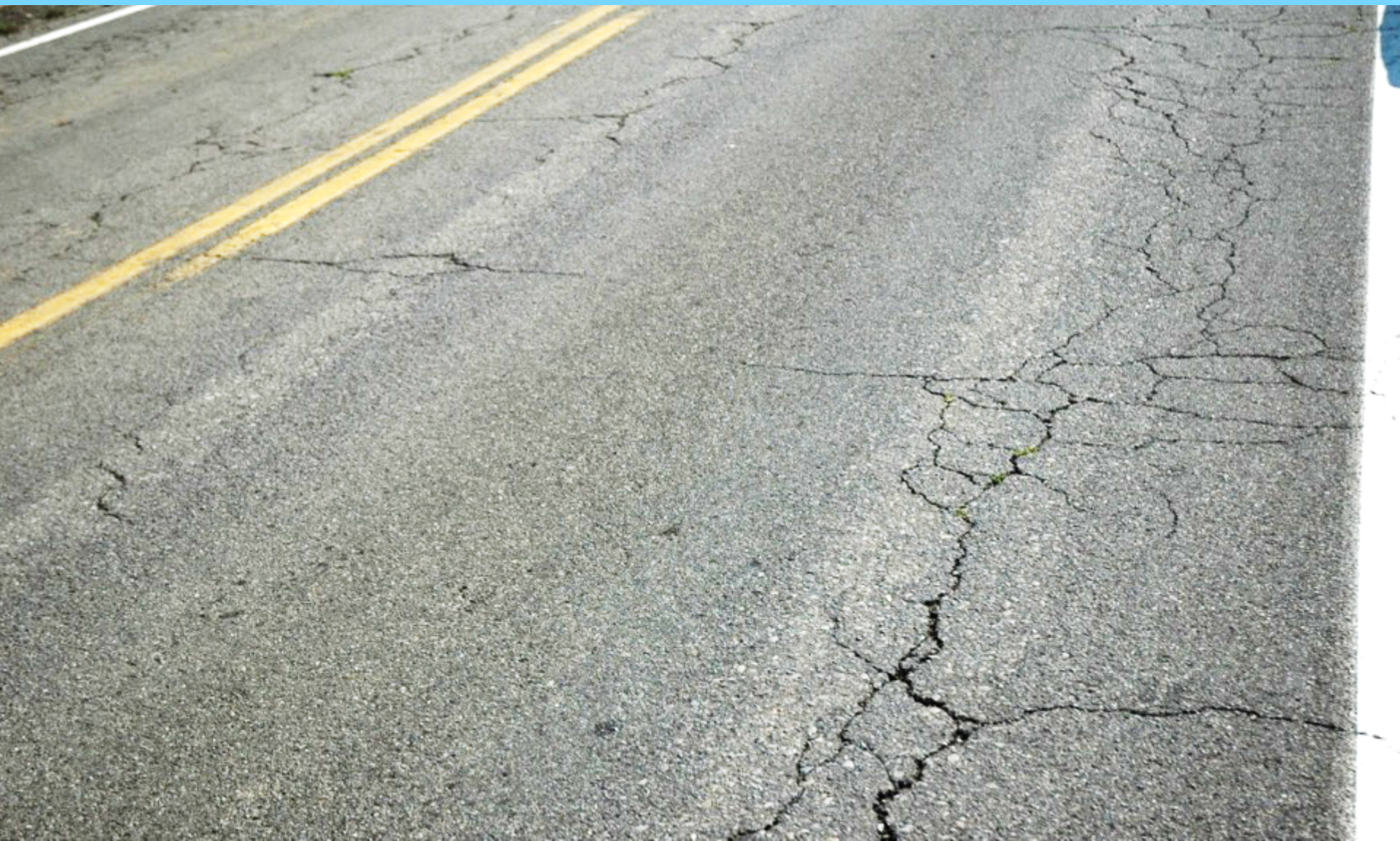
- A seal type treatment applied on those pavements will have no impact on tensile strain
- Therefore no impact on structural life

Structural Benefits

- Preventive seals on these pavements mask structural distress and lead to full depth failures



Pavement Maintenance Treatments do not fix structural failures



Timely Thinlay treatments can save your structure

Thinlay Structure?

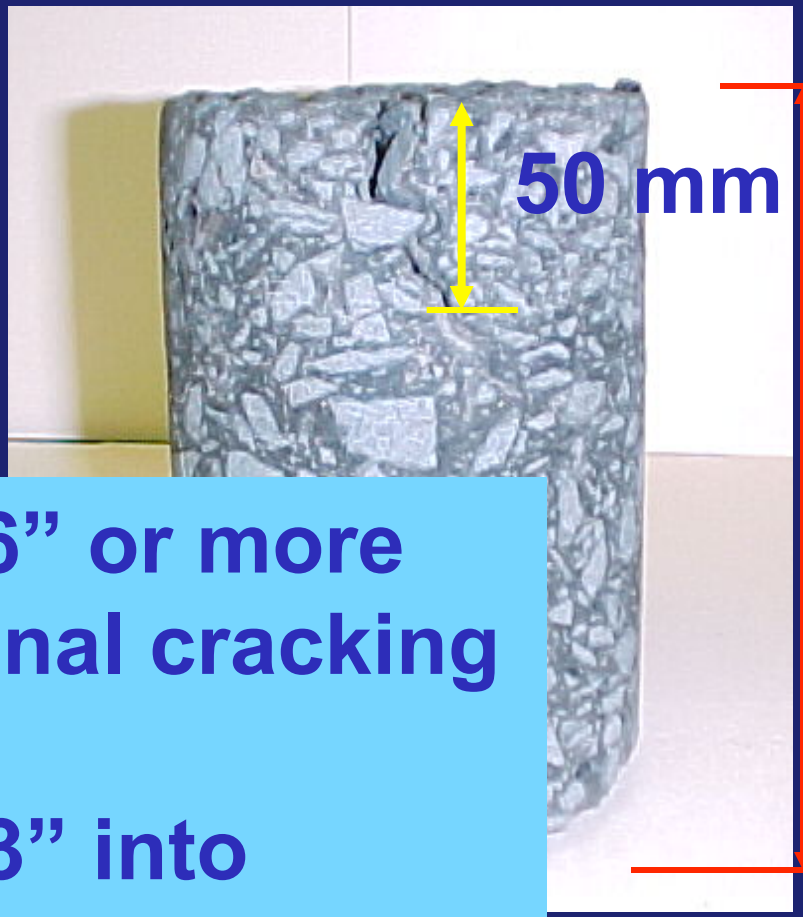
What's an inch?
Asphalt Thickness vs. Fatigue Life

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

Perpetual Pavements

- Goal of a perpetual pavement is to achieve a thickness that will confine future distresses to surface
- Full depth failures are prevented
- Pavement can then be managed at surface indefinitely

Washington State Longitudinal Cracking



- In pavements with 6” or more thickness, longitudinal cracking started at surface
- Propagated only 2-3” into structure

Structural contribution of 1”

- 1 inch overlay of existing 4 inch pavement will double fatigue life
- Second 1 inch overlay can extend the structural life beyond 50 years
- Once you achieve a perpetual thickness you can focus on managing at surface for functional attributes
  - Structural worries are over


Successful applications in many states

Thinlay Experience in Oregon

- 15 years of good performance history with thin lift paving
- Oregon DOT recently has added Thinlay to their preservation tool chest
- Several local agencies with on-going success

Thinlay at ODOT

- ODOT to date has let 3 contracts
- One experimental test section with high polymer binder on I-5 near Medford
- Two larger projects this year, one on the Tillamook highway near Forest Grove and one on highway 101 North of Lincoln City
- They also have a short section on I-5 North of Eugene that is going on 5 years old

Thinlay at ODOT

Micro Mill

- Micro milling removed surface distress and provides very smooth and uniform surface to place 1” lift

Normal tack shot rates and materials


CB-534D
CATERPILLAR

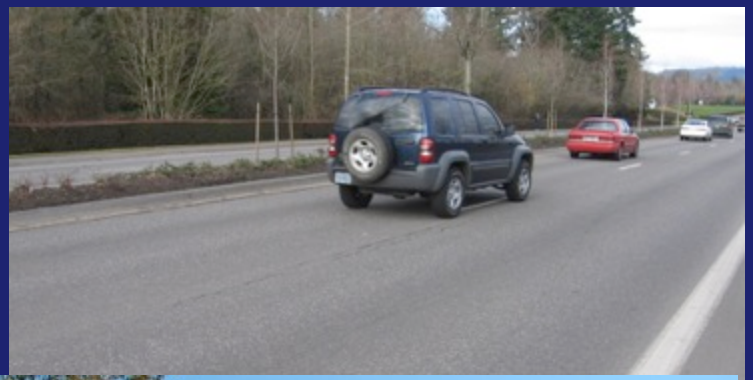

CATERPILLAR
BOMAG

Micro mill and Thinlay

Urban and Residential

Rural

Good Performance



The Circle of Life

Economics of Preventive Maintenance Treatments

A Case Study Rehabilitation Using Thinlay Overlays

Washington County, OR

Summer, 2001

Murray Blvd.

- ADT = 30,000 vehicles per day

Why Thinlay Overlays? (1” fine graded mix)

- Minimize Lane Closures
- Appearance and Ride Quality
- Added Structural Life
- Limited Contractor Availability for Slurry Seals/Micro-Seals
- Reduced Risk
- Lower Life-Cycle Cost???

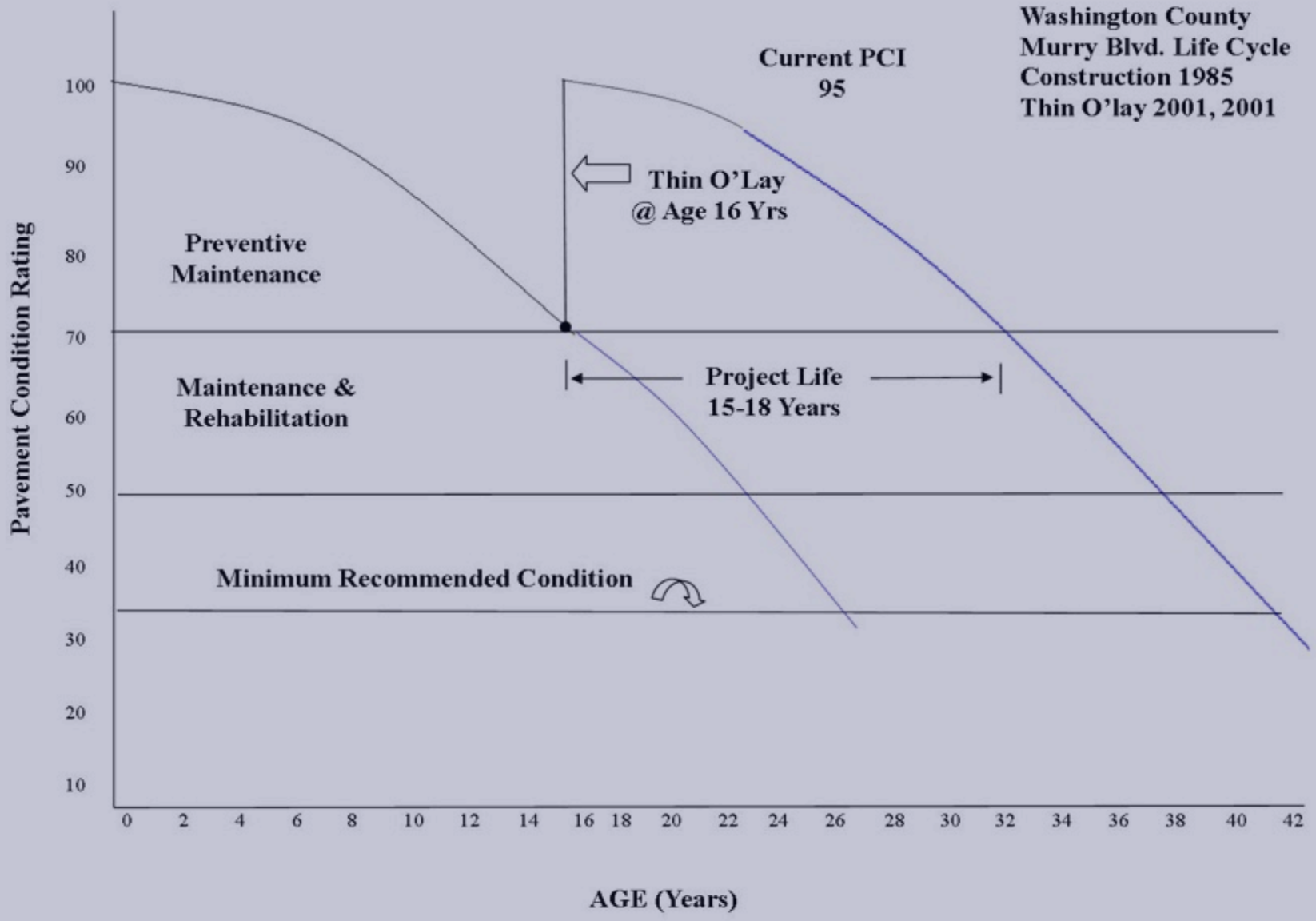
Cost

- Thinlay Treatment = $2.53 per square yard
- Micro-Surfacing = $1.92 per square yard
- 32% cost increase

Life Cycle Costs
Estimated in 2001

- 20 Years, I=4%
- Thinlay = $4.24 (based on estimated 10 year life)
- Micro Surface = $6.74 (based on experience of 5 year life)

Thinlay Saves $2.50/$yd^2$ in 20 Years and Adds Structure


Washington County
Murry Blvd. Life Cycle
Construction 1985
Thin O'lay 2001, 2001
Current PCI
95
Thin O'Lay
@ Age 16 Yrs
Preventive
Maintenance
Maintenance &
Rehabilitation
Project Life
15-18 Years
Minimum Recommended Condition
Pavement Condition Rating
100
90
80
70
60
50
40
30
20
10
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
AGE (Years)

Actual Life Cycle Costs

- 15 Years, I=4%, Thinlay life = 15 year life
- Average micro surfacing life = 5 years
- Thinlay = $2.53
- Micro Surface = $4.79

Thinlay Saves $2.26/yd^2 in 15 Years, adds structure, and provides high serviceability, far less user impact

Cost Comparison on Murray Blvd. (no discount)

- Thin Lift Overlay = $2.53 per square yard
  - $0.18 per square yard per year of service
- Micro-Surfacing = $1.92 per square yard
  - $0.38 per square yard per year of service

New Developments

- APAO in conjunction with NCAT and NAPA conducting research to develop high performance high recycle content thinlay mixes for preservation
- Mixes designed to be placed as thin as ¾”
- Mixes designed to be flexible and provide excellent crack resistance
- Mixes that maximize recycle content to provide value

Approach

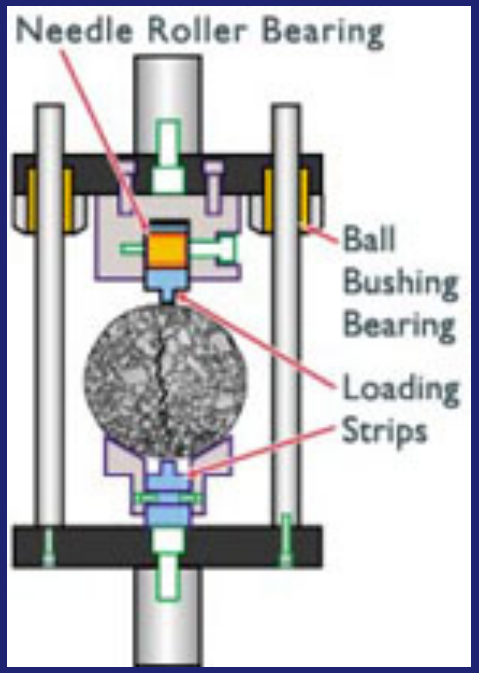
- Softer base binders are being used to improve crack resistance and to offset the stiffening effects of the RAP/RAS
- Mix tests for cracking are being used rather than blended binder properties because they better predict mix performance and model actual binder blending

Testing

- All mixes meet Superpave criteria and ODOT criteria for rutting, TSR and voids
- All mixes are being tested first in the Overlay Crack Tester

Testing

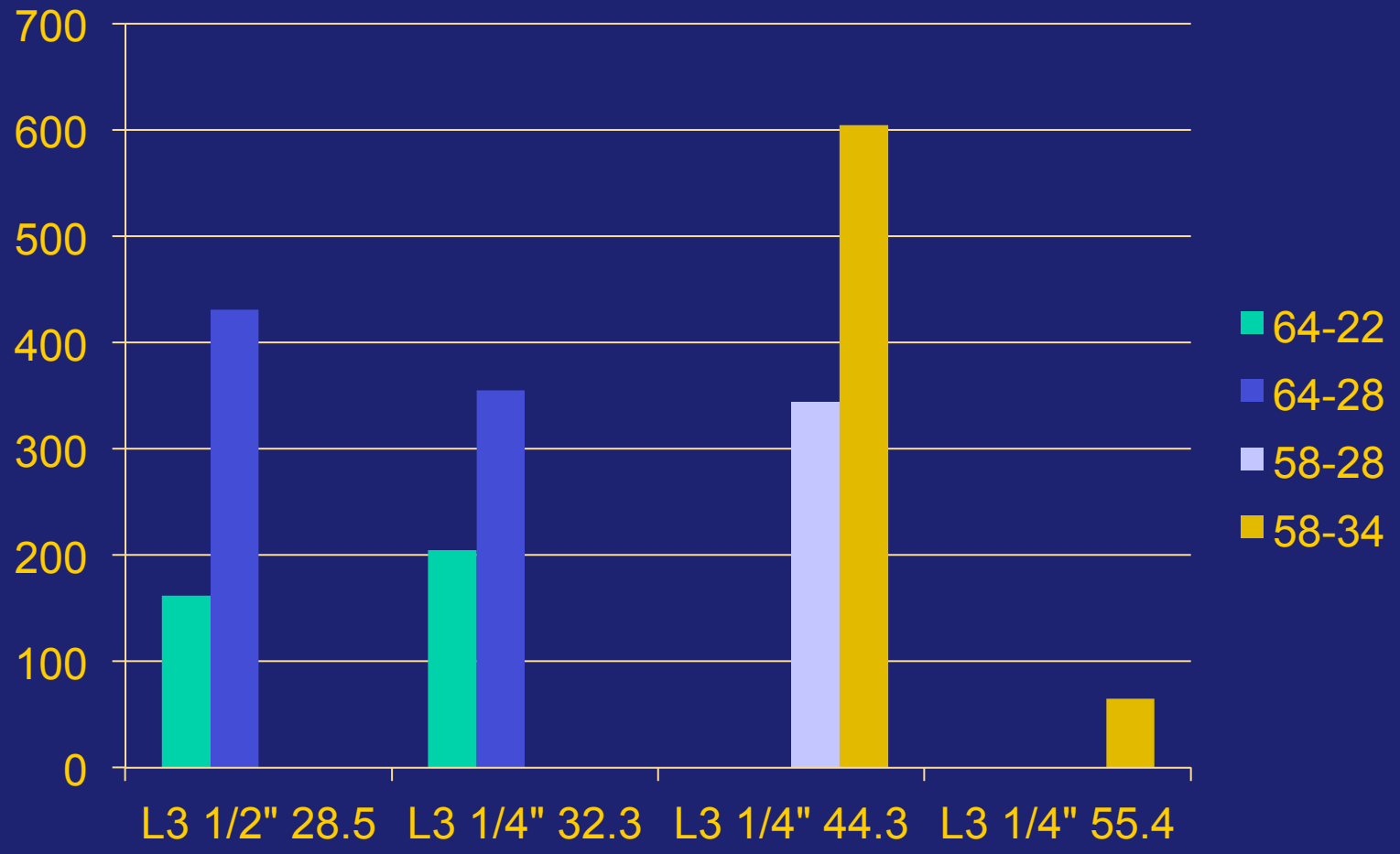
- Some use the overlay crack test to “screen” the mixes for further testing
- Further testing includes IDT for fatigue and cold temperature properties



Mixes and Preliminary Results for Oregon

	L3 ½" 30% RAP	L3 ¼" 30% RAP	L3 ¼" 40% RAP	L3 ¼" 50% RAP	L3 ¼" 20% RAP 3% RAS	L3 ¼" 20% RAP 5% RAS
Pb	6.2	7.2	7.0	7.0	7.7	7.5
Pbr	5.9	7.75	7.75	7.75	14.44	11.8
Binder Grade	64-22 64-28	64-22 64-28	58-28 58-34	58-28 58-34	58-28 58-34	58-28 58-34
Binder Replaced	28.5%	32.3%	44.3%	55.4%	33%	39.3%
Overlay test results	160/430	205/365	350/605	-/65	N/A	N/A

Preliminary Overlay Crack Test Results



Findings from O'lay testing

- Low temperature grade has greatest influence on the overlay crack test results
- High temp grade has some influence
- Using softer binders can more than offset the stiffening effects of increased RAP binder up to a point

Findings from O'lay testing

- Results appear to be independent of NMAS
- These results relate to reflective type cracking (strain control) and not necessarily to fatigue

Next Testing Phase

- Phase 2 testing with IDT for fracture energy (fatigue) is underway
- L3 ½” control, the L3 ¼” 64-28, the L3 ¼” 40% RAP with both binders for Phase 2 testing
- Test one or both of the RAP/RAS samples

Expected outcomes

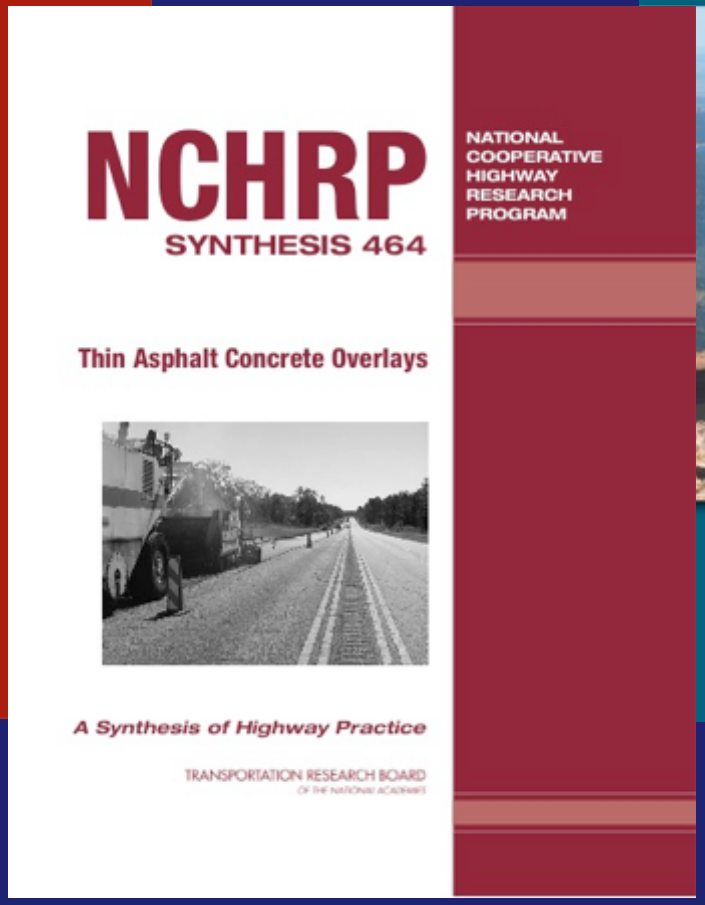
- Completed research by mid 2014
- Guide specification for material selection and mix design
- Will include ¼” and 3/8” NMAS mixes
- A polymer modified binder used in test array to evaluate potential benefits

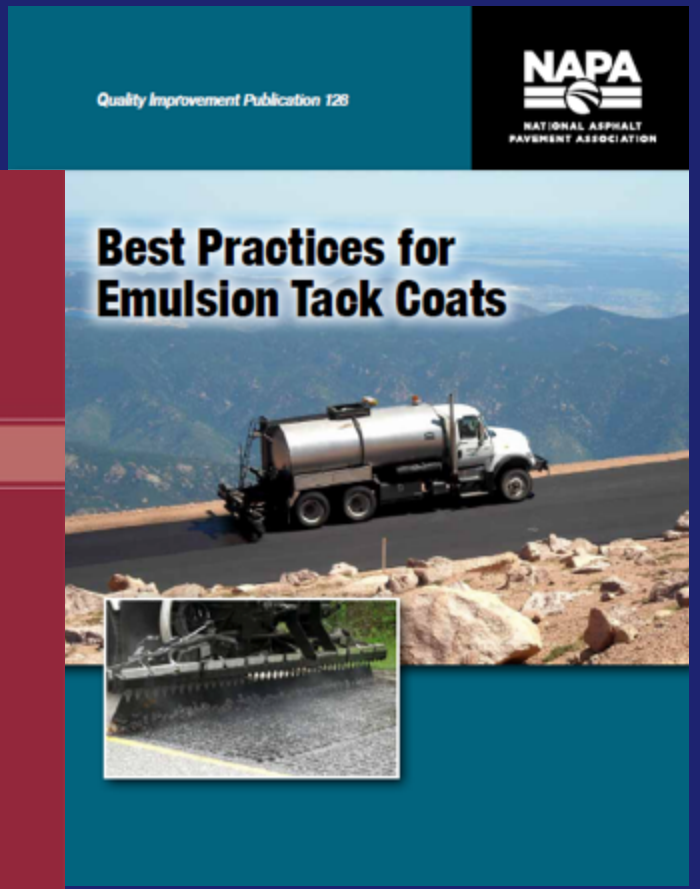
Thinlay Asphalt

- Longest Life of all treatments
- Lowest life cycle cost
- Superior Smoothness
- Preferred by road users
- Maintains Structural integrity

Resources


Information Series 135
NAPA
NATIONAL ASPHALT PAVEMENT ASSOCIATION
Thin Asphalt Overlays for Pavement Preservation


NCHRP
SYNTHESIS 464
NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
Thin Asphalt Concrete Overlays
A Synthesis of Highway Practice
TRANSPORTATION RESEARCH BOARD


Quality Improvement Publication 128
NAPA
NATIONAL ASPHALT PAVEMENT ASSOCIATION
Best Practices for Emulsion Tack Coats


MOUNT KILIMANJARO
CONGRATULATIONS
YOU ARE NOW AT
UHURU PEAK, TANZANIA 5895M/19341Ft AMSL
•AFRICA'S HIGHEST POINT
•WORLD'S HIGHEST FREE STANDING MOUNTAIN
•ONE OF WORLD'S LARGEST VOLCON
•WORLD HERITAGE AND WONDER OF
WILDCATS.

Thank You!

Dale Decker

Eagle, Colorado

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