Preventive Maintenance, Techniques and Timing

North Dakota Asphalt Conference

March 31, 2015

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Director, National Center for Pavement Preservation

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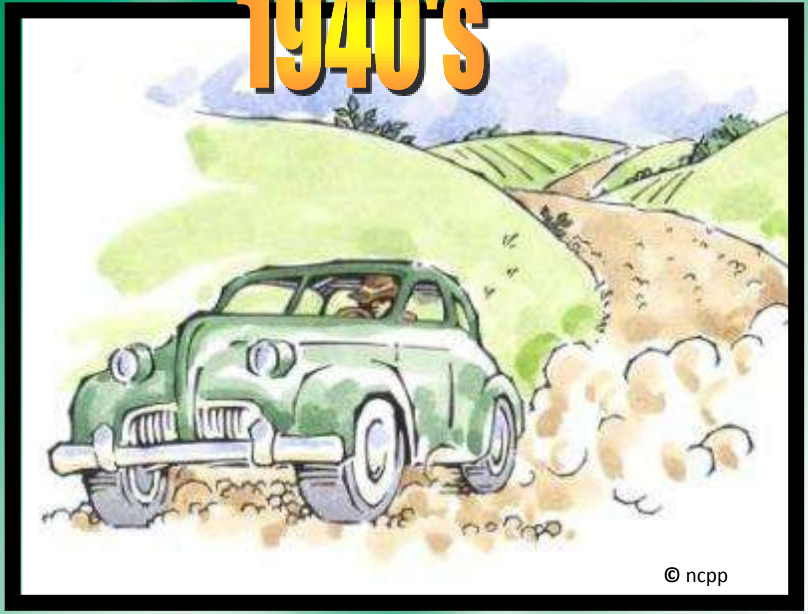
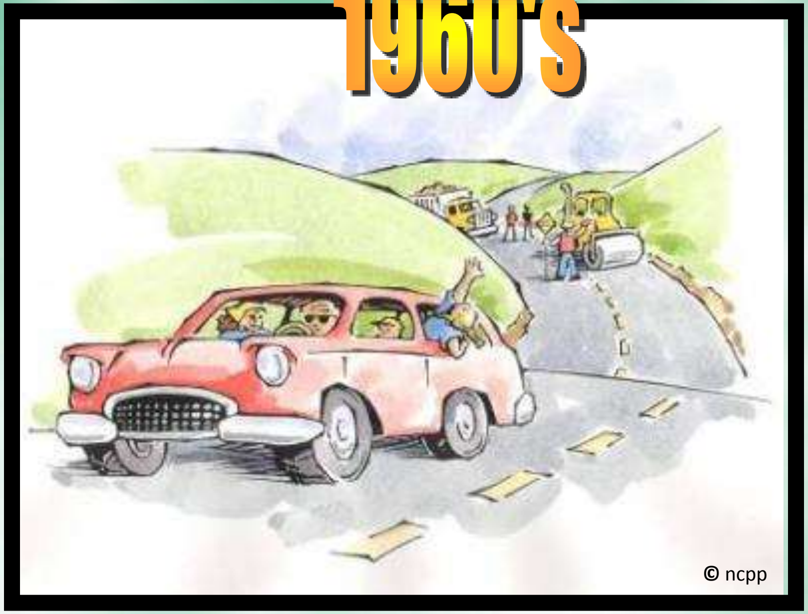
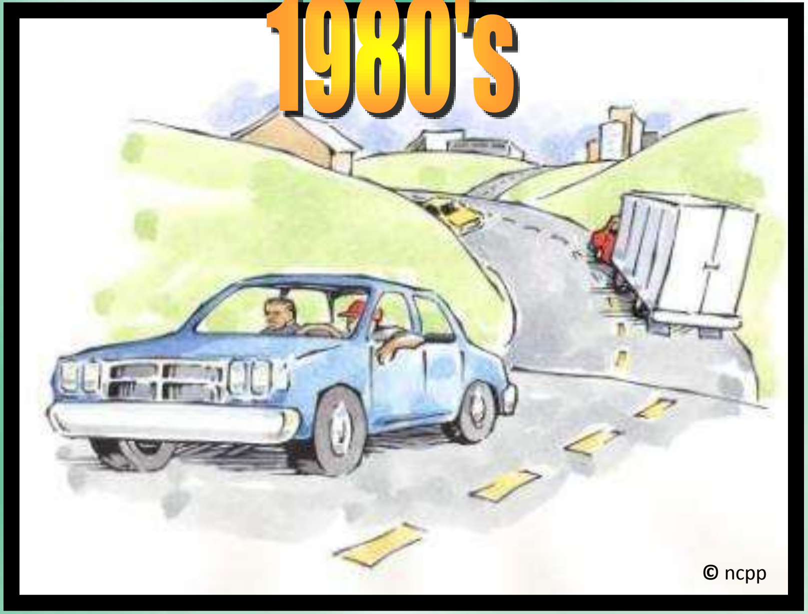
1940's



1960's



1980's



Today

The Elected Official

Protecting Our Investment Cost Effectively

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Highway Pavement & Bridge Preservation

Expenditures

Needed = $200 billion annually

Economy

Lack of Funding

- Last Federal Gas tax – 1993
- Of the 18.4 cents about 2.6 goes to Mass Transit
- CPI up 3.36% since 1993
- Meaning $1 today buys less than $0.30 worth of 1993 products

Cost of Driving

- Driving 20,000 miles per year at 20 miles per gallon will equal 1,000 gallons of fuel per year
- 1,000 X $.184 / gal = $184.00 per year ***(50 ¢ per day)***
- *Roads are one of the lowest cost things in our Society!!*

Cost of a Gallon…

1 Gallon
$3.89*
($3.89 / gal)

6ct, 16.9oz
$3.99*
($5.04 / gal)

6ct, 16.9oz
$2.69*
($3.40 / gal)

59oz
$2.99*
($6.49 / gal)

1 Gallon
$2.98*
($2.98 / gal)

* Average Costs November 2014

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Where We Spend Our Money

Consumer Purchase	Average Monthly Bill
Cable Television	$ 123
Cell Phone	$ 71
Internet	$ 50
Road Taxes	**less than $ 35**

Road Taxes: (Federal $15.30 + North Dakota $ 19.17)

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Preventive Maintenance Applied to HMA Pavements

Treatment	Treatment Life (yr.)	Life Extension (yr.)
Rejuvenator*	NA	3 - 6
Surface Sealer	0 - 1	2 - 4
Crack Sealing	3 - 8	2 - 4
Crack Filling	2 - 4	1 - 3
Slurry Seal	4 - 5	3 - 5
Micro Surfacing - Single	3 – 6	3 - 5
Micro Surfacing - Double	4 - 7	4 - 6
Chip Seal - Single	3 – 7	5 - 6
Chip Seal - Double	5 – 10	8 - 10
Ultra-thin Bonded Wearing	7 – 12	NA
Dense Graded Thin HMA	5 - 12	NA
Open Graded Thin HMA	6 - 12	NA
Hot In-place Recycling	6 - 10	NA
Cold In-place Recycling	6 - 10	NA

* Only certain rejuvenators were considered

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Typical Life Extensions
(Years)

Treatment	Good Condition (PCI=80)	Fair Condition (PCI=60)	Poor Condition (PCI=40)
Crack Fill	1 - 3	0 - 2	0
Crack Seal	2 - 4	1 - 3	0
Fog Seal	2 - 4	0 - 1	0
Chip Seal	5 - 6	3 - 5	0 - 3
Micro-Surfacing	4 – 6	3 - 5	1 - 4
Thin HMA	4 - 10	3 - 7	2 - 4

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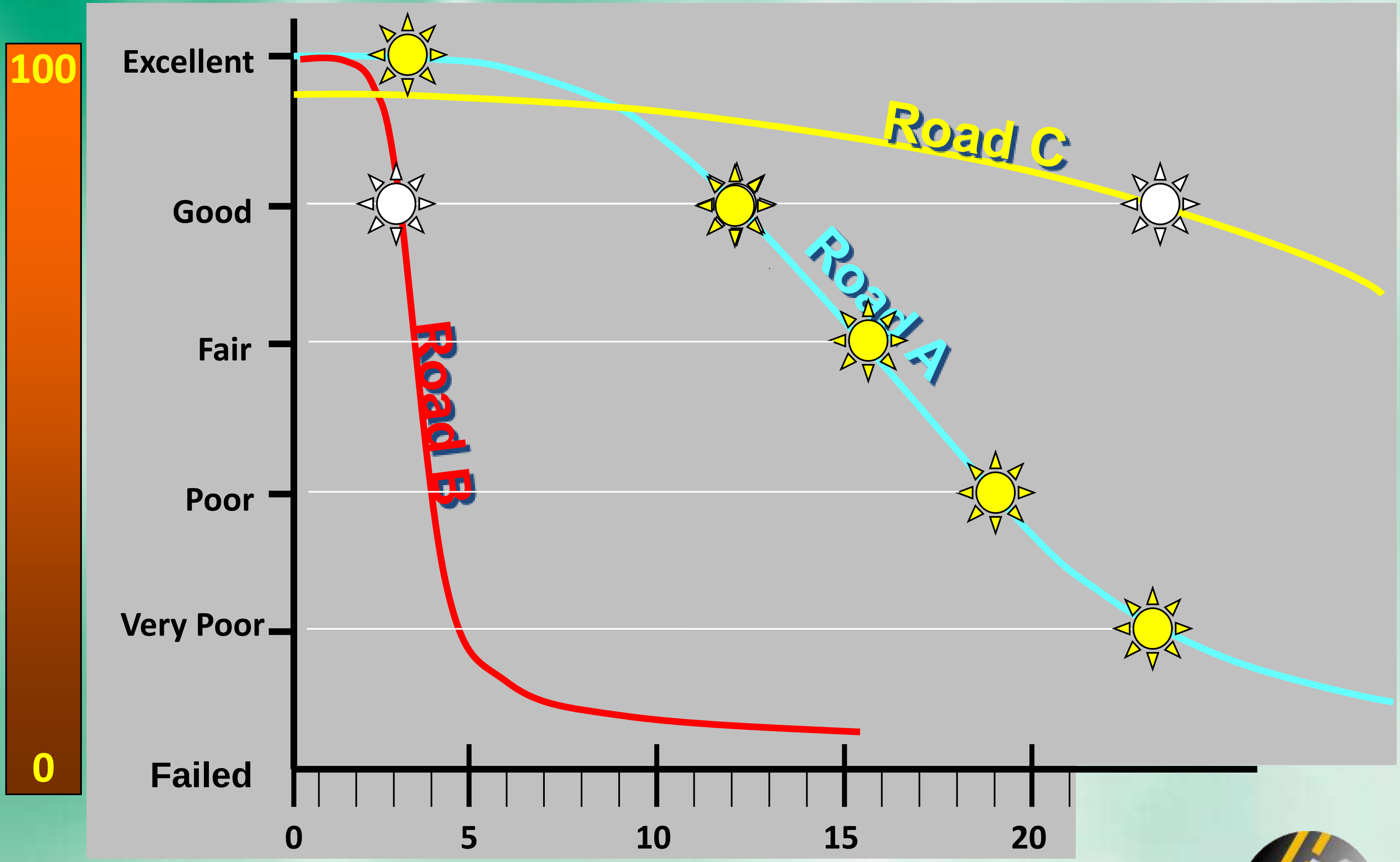
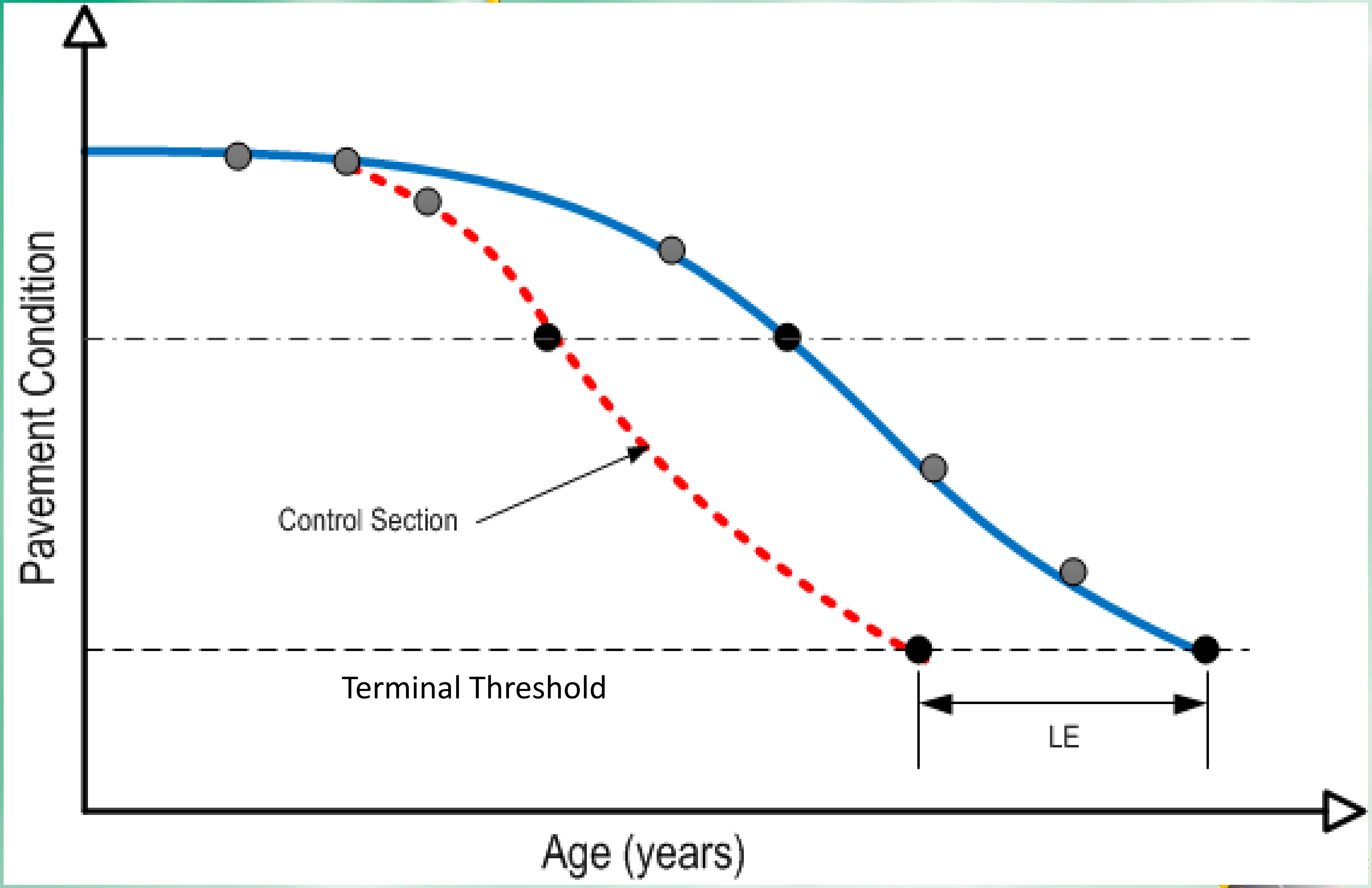
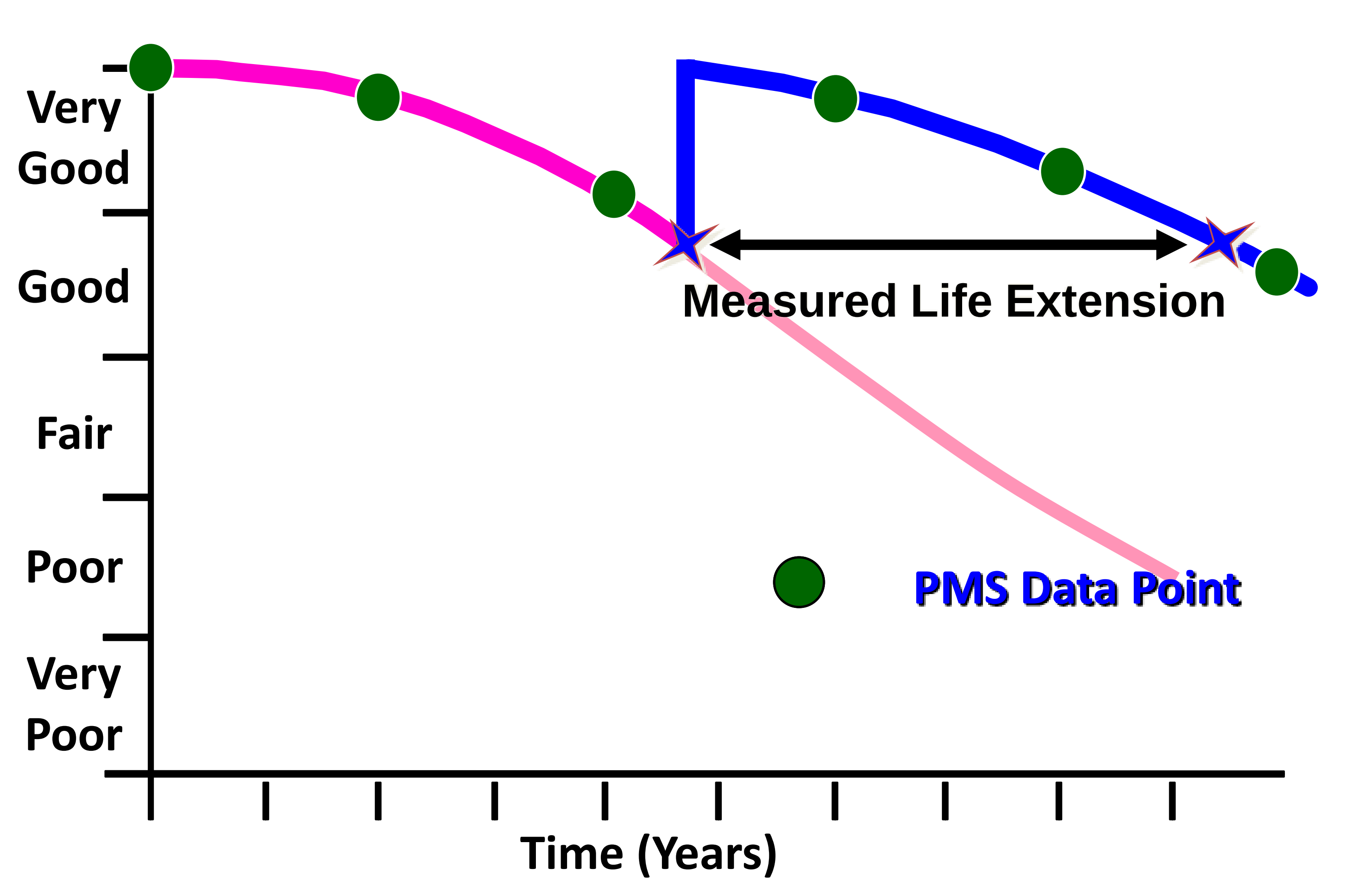
Pavement Condition Index (PCI)



Life Extension of Rejuvenators & Asphalt Sealers



Life Extension



Pavement Selection

Pavement Selection

Pavement Selection

Framework for Treatment Selection

- Other potential criteria
  - Availability of qualified contractors
  - Availability of materials
  - Time (of year) of construction
  - Pavement noise
  - Facility downtime
  - Surface friction

Asphalt Treatments

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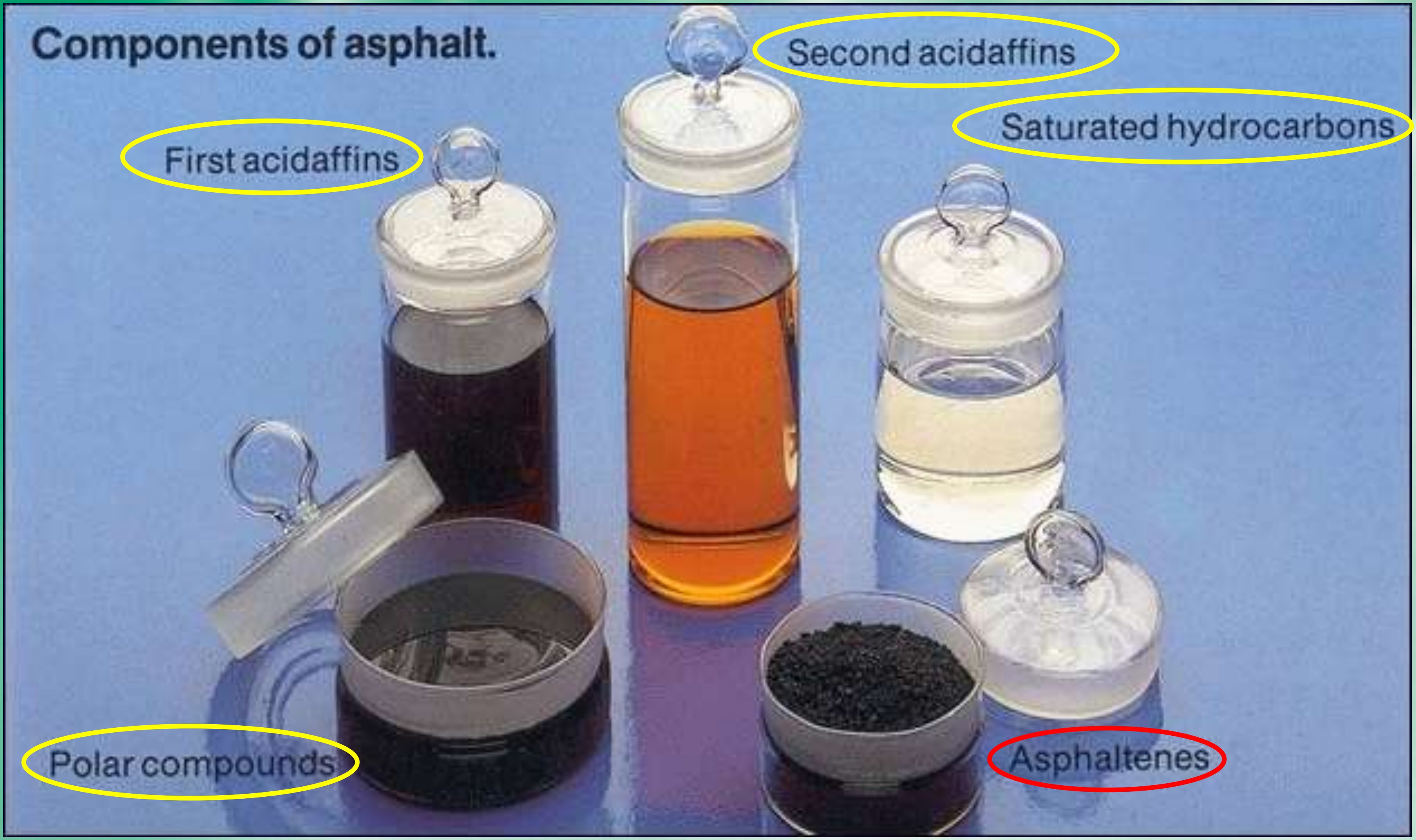
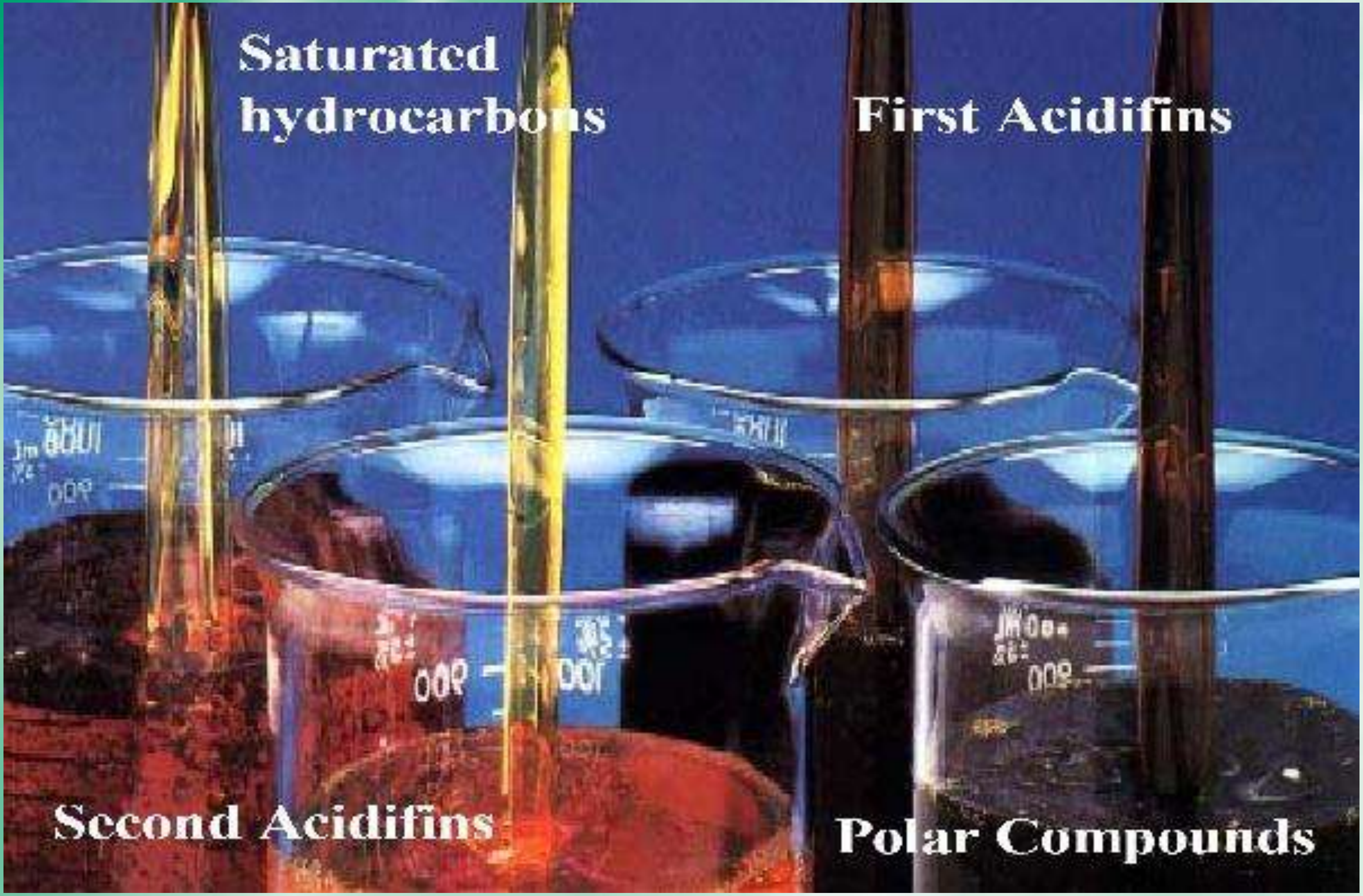
Chemical Properties

- The causes for aging and deterioration of asphalt binders
- Petroleum Asphalt is comprised of two fractional components

  Asphaltenes & Maltenes


Components of asphalt.
Second acidaffins
Saturated hydrocarbons
First acidaffins
Polar compounds
Asphaltenes

Maltene Fractions of Asphalt



- Aging and breakdown of asphalt binders and loss of maltenes begins at the hot-mix plant due to the extreme heating necessary to blend asphalt with aggregate and to get it to the job site in a pliable state.

Asphalt binder deterioration continues once the mixture is placed on a roadway due to :

- Constant exposure to the Sun's UV rays
- Environmental temperatures
- Oxidation
- Stripping action of storm water and melting snow
- Traffic wear

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- Ultraviolet light exposure and the sun's heating effect cause the maltene fractions to be oxidized from the asphalt binder.

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Pavement Aged 3-5 Years

Pavement Aged 13-17 Years

Rejuvenator Selection

- Pure maltene based rejuvenators are translucent and leave pavement markings visible with no need for restriping.

- The long term effectiveness of a maltene based rejuvenator.

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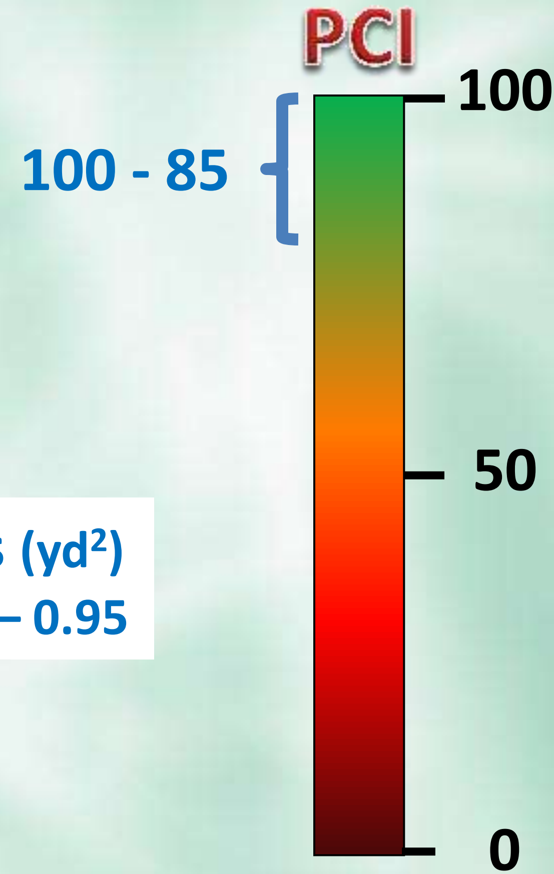
Rejuvenator Selection

Conditions Addressed

- Oxidation
- Maltine Replenishment
- Moisture Infiltration

Limitations

- Initial Low Skid



Costs (yd^2)
\$0.80 – 0.95

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Asphalt Sealer Selection

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- Emulsion seals the pavement from moisture, prevent oxidation and provides a temporary blackening of the pavement surface.

Cautions

- If used on tight, impermeable pavements, the oil may remain on the surface, leaving a surface with poor skid resistance. This is corrected if sand or slag is applied over the treated surface at 1 to 2 lbs/SY.
- The lower skid numbers typically return to normal or acceptable levels within 3-4 days.

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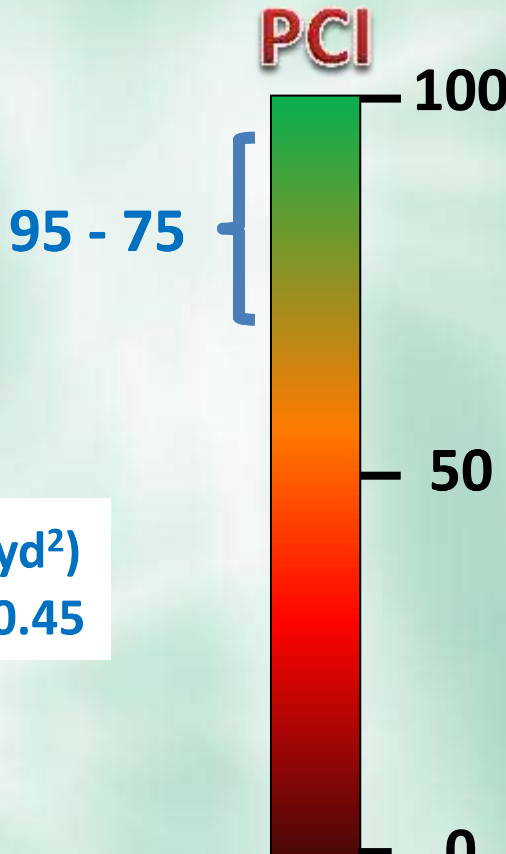
Asphalt Sealer Selection

Conditions Addressed

- Oxidation
- Asphalt Film Thickness
- Initial Raveling
- Moisture Infiltration

Limitations

- Initial Low Skid

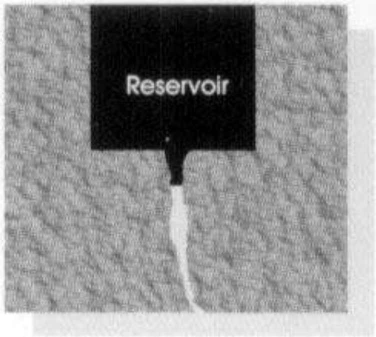


Costs (yd^2)
\$0.25 – 0.45

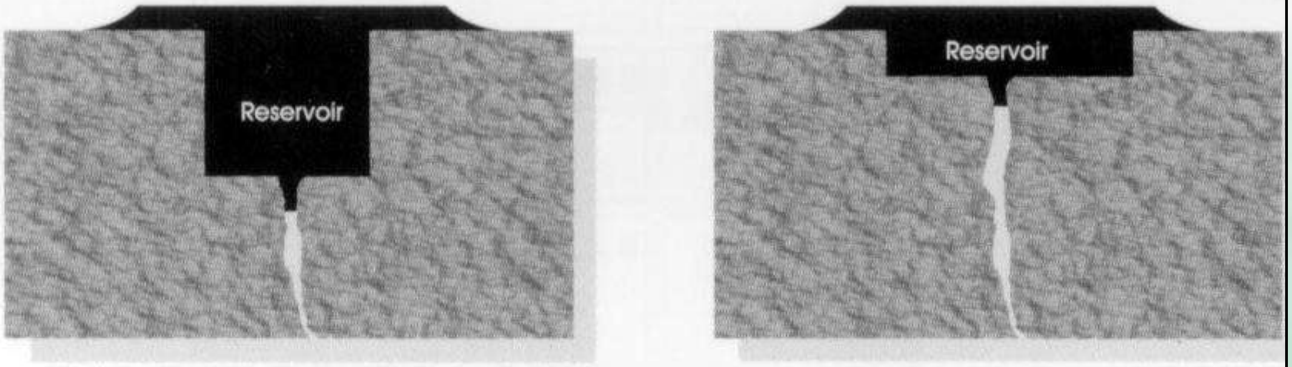
IRI <95

Crack Sealing Selection

Reservoir Types



Configuration A
Standard Reservoir-and-Flush



Configuration B
Standard Recessed Band-Aid

Configuration C
Shallow Recessed Band-Aid

Router

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Cutting Drums & Cutter Bits

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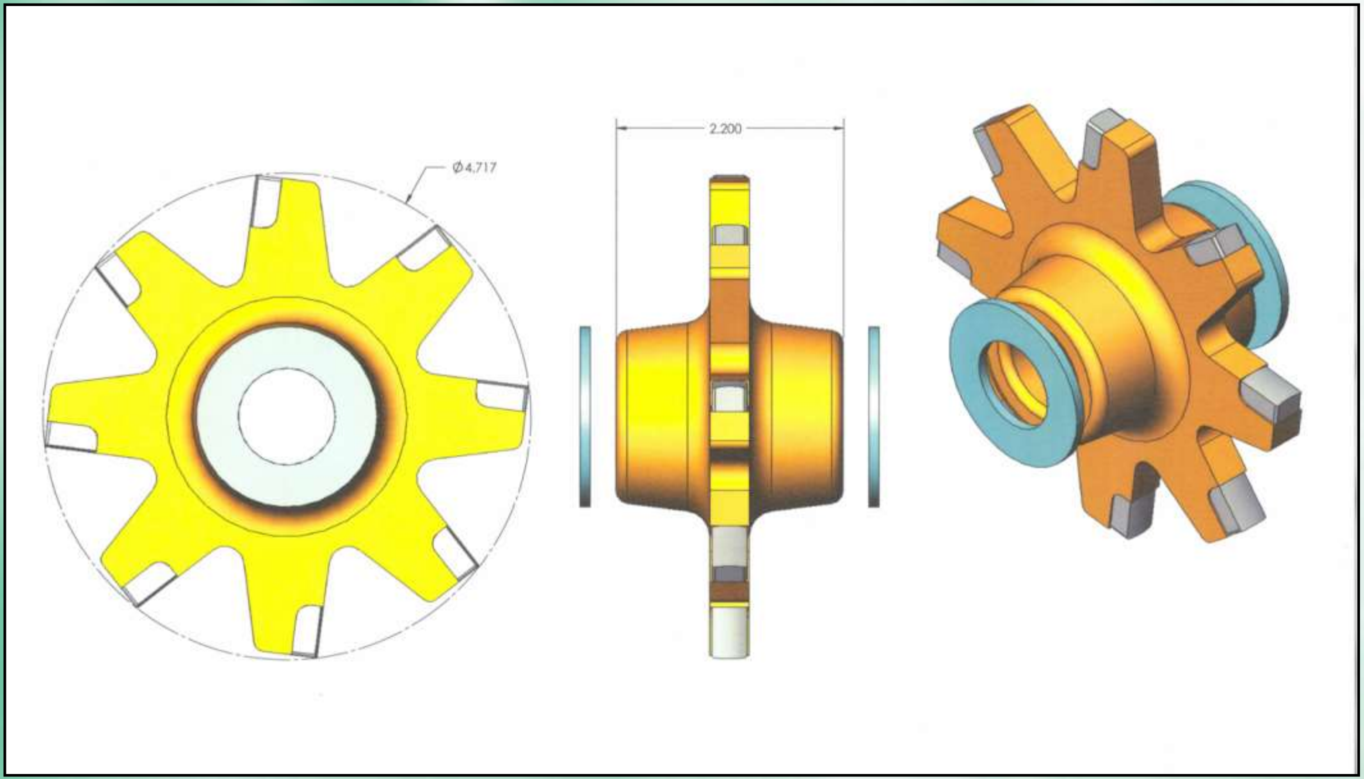
Carbide Cutter - 4 ¾" Wide Hub



Random Crack Saw

Crack Sealing Selection

Conditions Addressed

- Water Infiltration
- Incompressibles

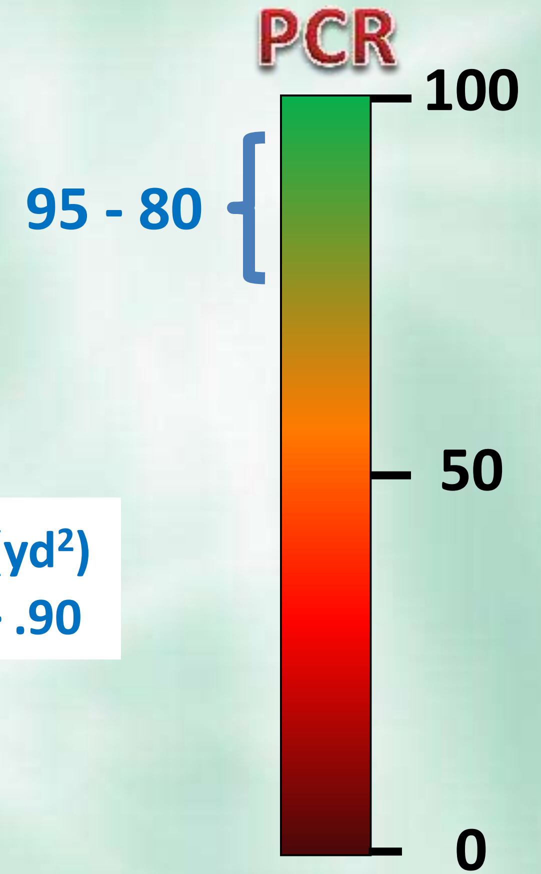
Primary Working Cracks

- Transverse cracking
- Reflective cracking

Limitations

- Must have Clean & Dry Reservoir

Costs (yd^2)
\$0.55 – .90



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Crack Filling Selection

Melter and Applicator

- Oil-jacketed
- Thermostatic heat controls
- Continuous agitation
- Over-heating safety controls
- Heated hose and wand
- Right size tank capacity for operation

Melter and Applicator

Tank Agitation

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Swivel Applicator

Overband Configuration

Treating Edge Joints

Edge Drops

Water Entry

Crack Filling Selection

Conditions Addressed

- Water Infiltration
- Incompressibles

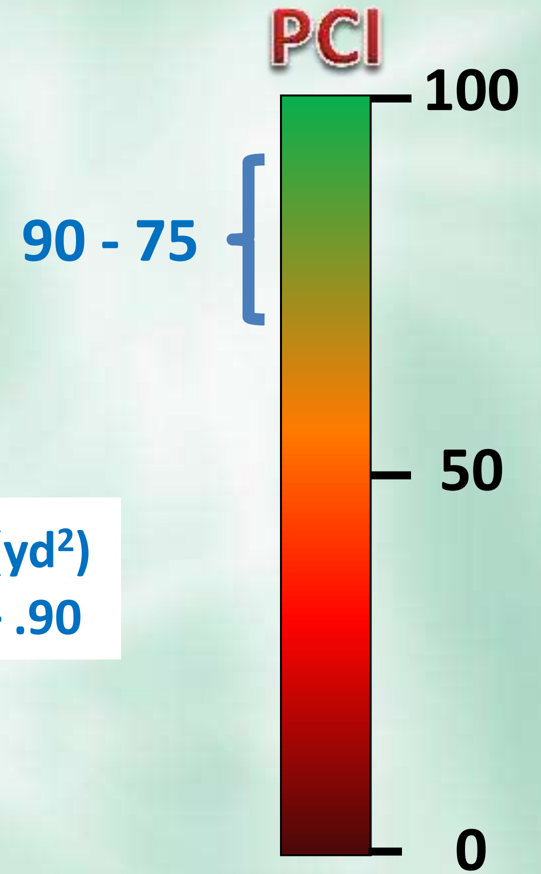
Non-Working Cracks

Secondary Cracks

- Longitudinal cracking
- Minor block cracking

Limitations

- Potential Hot Weather Tracking



Costs (yd^2)
\$0.55 – .90

IRI <95

Slurry Seal Selection

Small Cracks & Minor Raveling

Low Volume Roads & Streets

Slurry Seal

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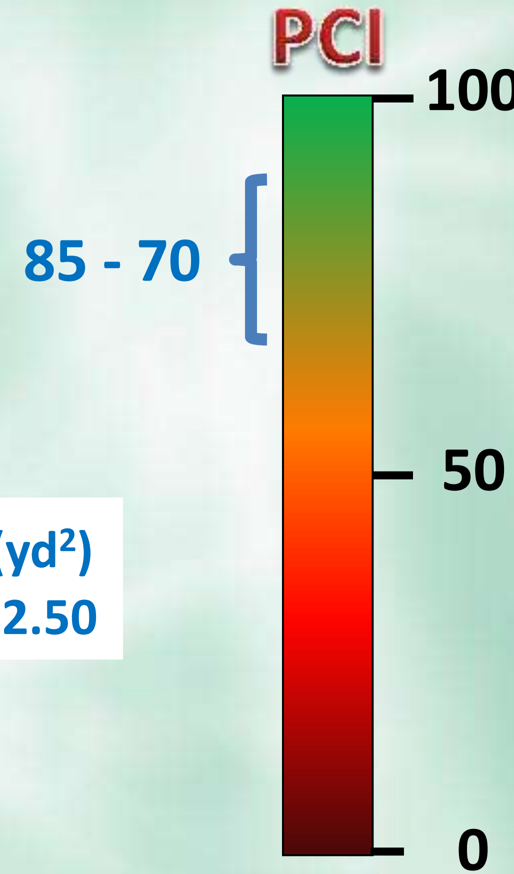
Slurry Seal Selection

Conditions Addressed

- Moisture Infiltration
- Longitudinal cracking
- Transverse cracking
- Raveling
- Friction Loss

Limitations

- Opening to Traffic Dependent on Set-Time



Costs (yd^2)
\$1.75 – 2.50

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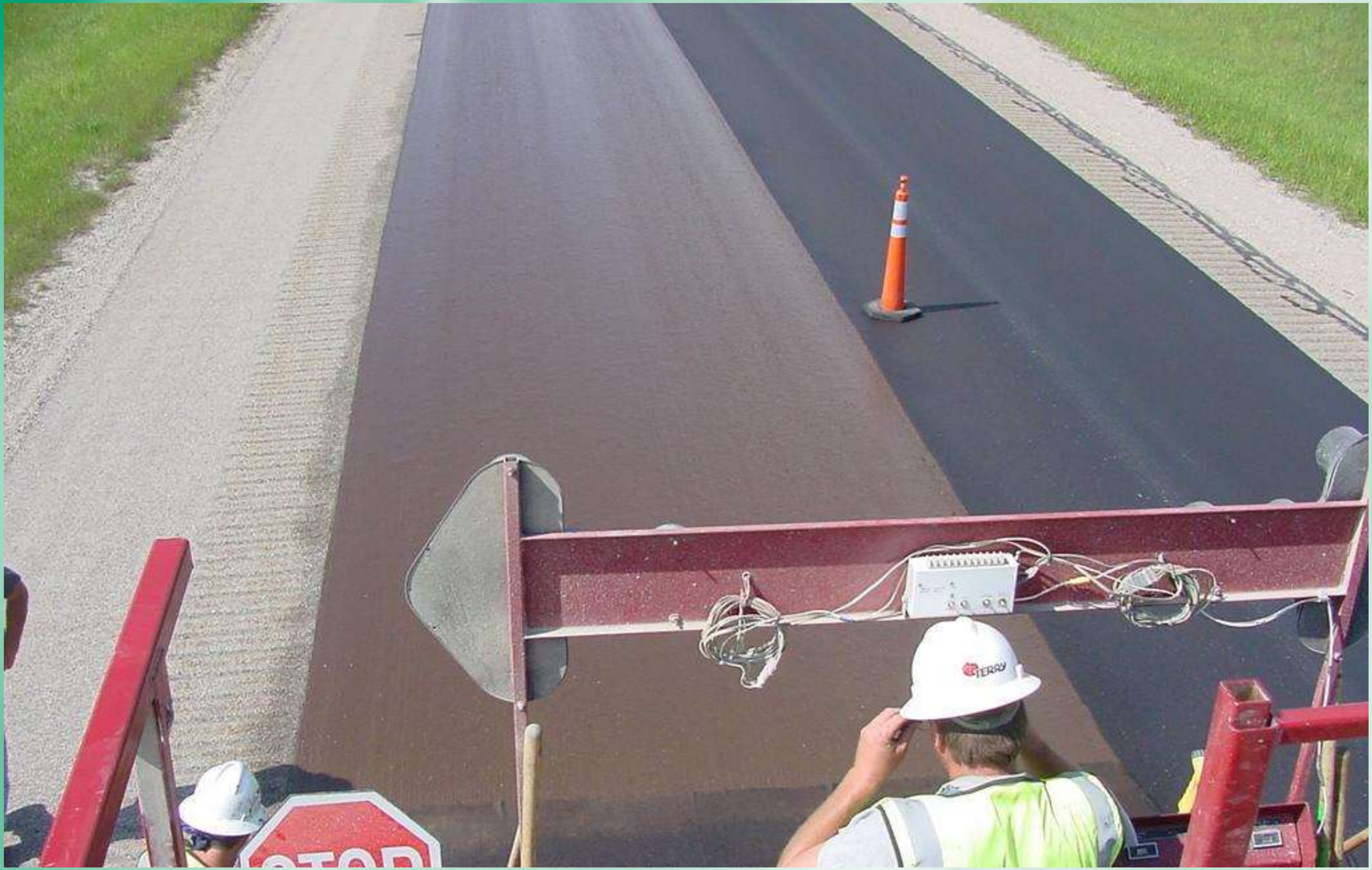
Micro Surface Selection



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Corrects
Rutting, Raveling, & Friction

Micro Surfacing Mix Design

Company Letterhead

Date: April 1, 20XX

RE: Type III CQS-1HP Microsurfacing Mix Design

Dear ____________________,

As requested, *Testing Company Name* prepared a job mix formula according to ISSA accepted testing procedures using Type III aggregate from *Company Name*, *Quarry Name*, and the following emulsion CQS-1HP from *Company Name*, *Terminal Name*.

The job mix formula based on the data from the laboratory tests is reported as follows. All values are based on dry aggregate weight.

CQS-1HP:	12.0 ± 1.0 %
Water:	5.0 - 9.0%
Cement:	0.5 - 1.0%
Residual Content of Emulsion:	62.4%
Residual AC Content:	7.4 ± 0.6 %

Test results summarized in this report represent laboratory conditions only. The laboratory tests were performed on materials submitted to this laboratory using accepted procedures. As always, laboratory and field conditions vary significantly due to fluctuations such as temperature and moisture. Care should be taken to adjust material percentages to compensate for any changes.

Sincerely,

John Smith, Chief Chemist

Micro Surfacing Mix Design

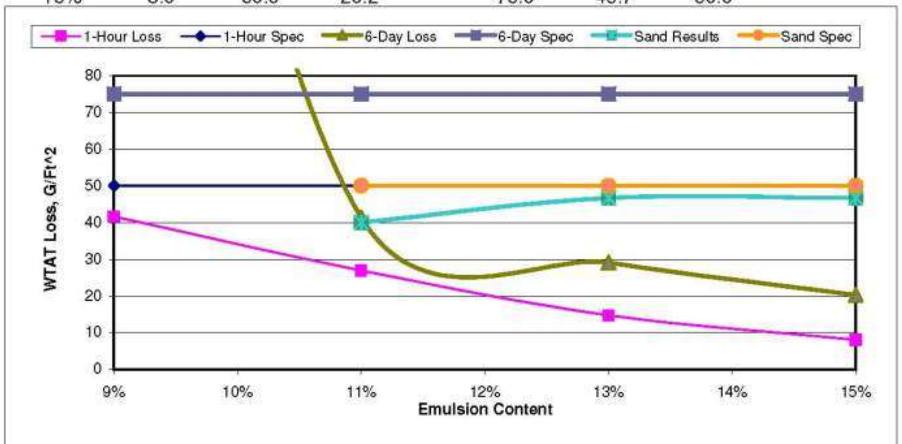
Date: April 1, 20XX
Agg. Source: *Company Name, Quarry Site*
Agg. Type: Type III
Emulsion: CQS-1HP
Emuls. Source: *Company Name, Terminal Name*

Properties for Microsurfacing Mix Design
Tests were run with 12% emulsion by dry weight of aggregate

Test Method	Lab Results	Min	Max
ISSA TB 113 Mixing Time @ 77 °F, sec	180+	120	
ISSA TB 144 Classification Compatibility	12	11	
ISSA TB 139 Wet Cohesion, 30 min, kg-cm	12	12	
ISSA TB 139 Wet Cohesion, 60 min, kg-cm	20	20	
ISSA TB 114 Wet Stripping, %	>95	90	

Asphalt Content Optimization Results
ISSA TB 100 Wet Track Analysis, ISSA TB 109 Sand Adhesion

Emulsion Content	1-Hour Loss, g/ft^2	1-Hour Spec, g/ft^2	6-Day Loss, g/ft^2	6-Day Spec, g/ft^2	Sand Ad., g/ft^2	Sand Spec, g/ft^2
9%	41.6	50.0	251	75.0		50.0
11%	26.9	50.0	41.3	75.0	40.0	50.0
13%	14.7	50.0	29.1	75.0	46.7	50.0
15%	8.0	50.0	20.2	75.0	46.7	50.0



ISSA TB 147 Loaded Wheel Test Lateral Displacement and Specific Gravity

Emulsion Content	Lateral Displace. %	Spec	Specific Gravity	Spec
11%	2.3	5.0	1.85	2.10
13%	2.2	5.0	1.88	2.10
15%	2.8	5.0	1.89	2.10

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Micro Surfacing Mix Design

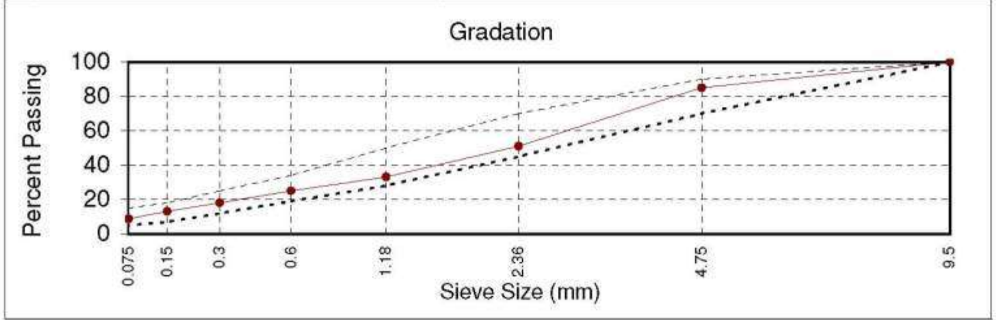
Date: April 1, 20XX
Agg. Source: *Company Name, Quarry Site*
Agg. Type: Type III
Emulsion: CQS-1HP
Emuls. Source: *Company Name, Terminal Name*

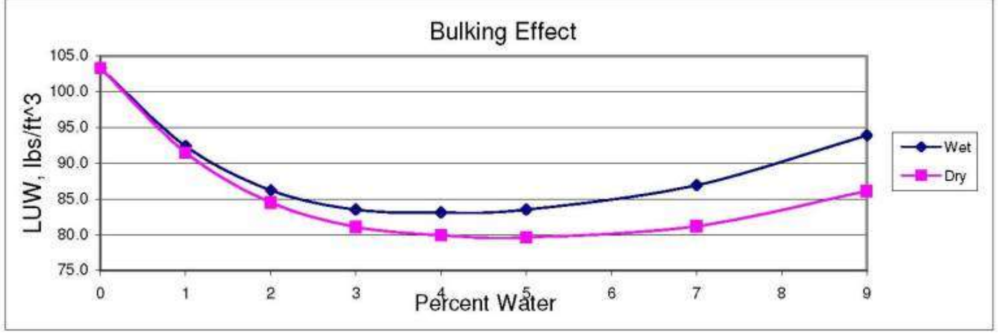
Aggregate Analysis Results

Sieve Analysis AASHTO T 11 and T 27			
Sieve Size	% Passing	Minimum	Maximum
3/8"	100	100	100
#4	85	70	90
#8	51	45	70
#16	33	28	50
#30	25	19	34
#50	18	12	25
#100	13	7	18
#200	8.7	5.0	15.0

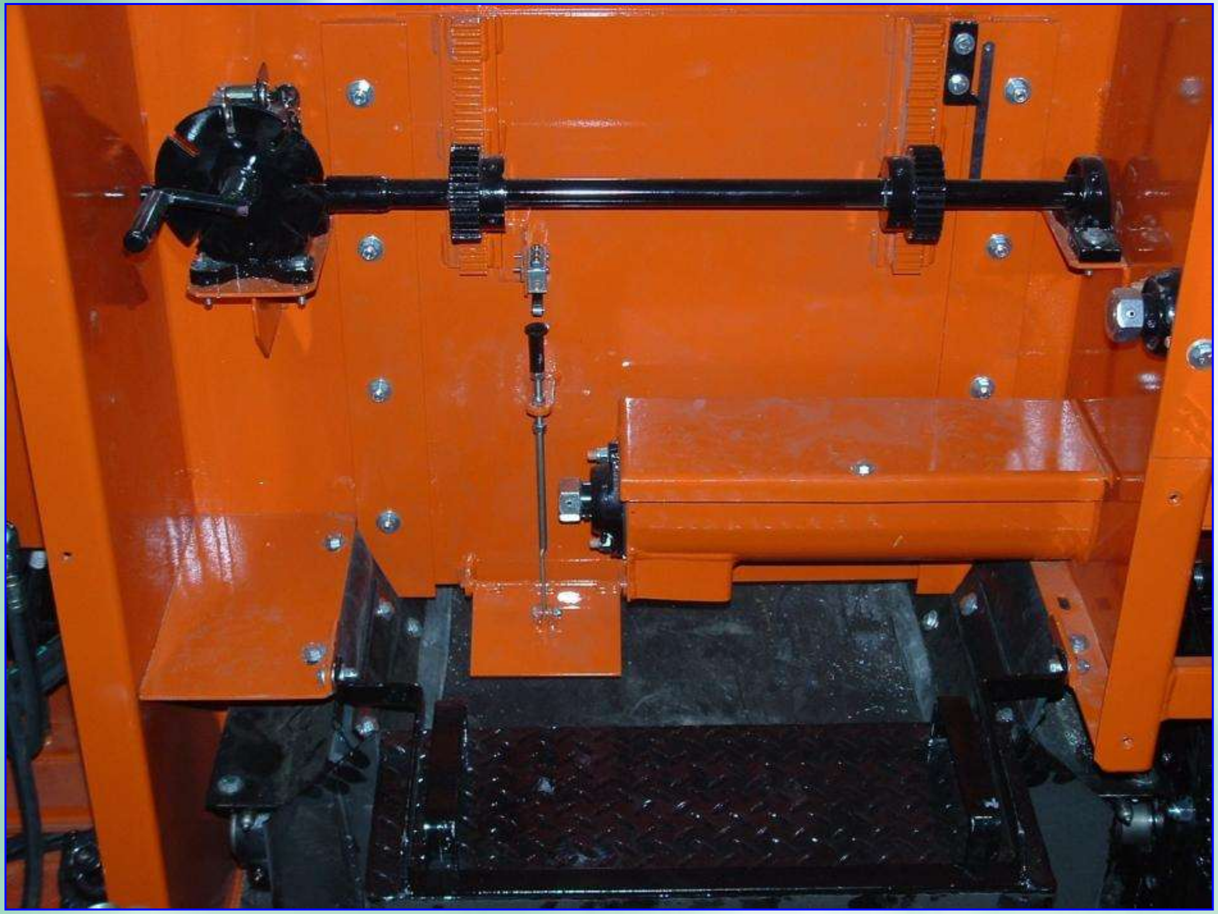
Bulking Effect Loose Unit Weight, lbs/ft^3		
% Water	Wet	Dry
0	103.3	103.3
1	92.4	91.5
2	86.2	84.5
3	83.5	81.1
4	83.1	79.9
5	83.5	79.6
7	86.9	81.2
9	93.9	86.1

Sand Equivalent, AASHTO T 176		
Result	Minimum	Maximum
69	65	





Equipment Calibration to Match Mix Design



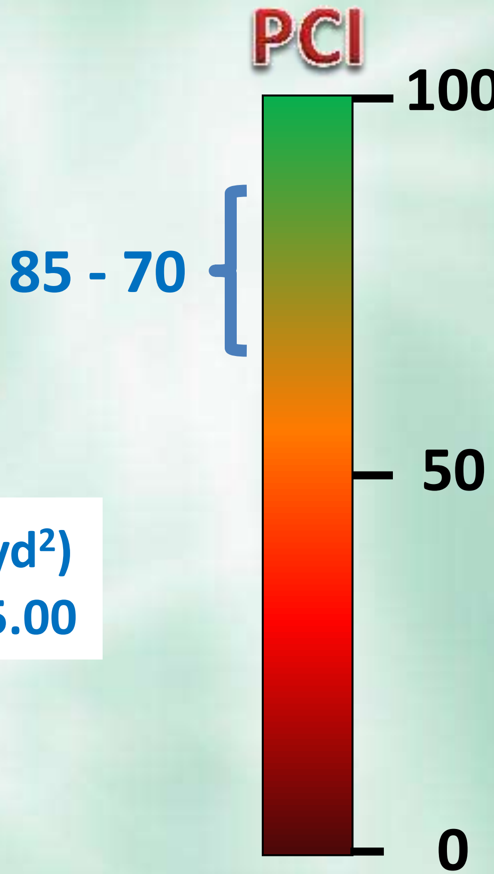
Micro Surface Selection

Conditions Addressed

- Moisture Infiltration
- Longitudinal cracking
- Transverse cracking
- Raveling
- Friction Loss
- Bleeding
- Rutting

Limitations

- Mixture subject to reflective cracking



Costs (yd²)
$2.00 – 5.00

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Chip Seal Selection

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Chip Seal

5 Months Old

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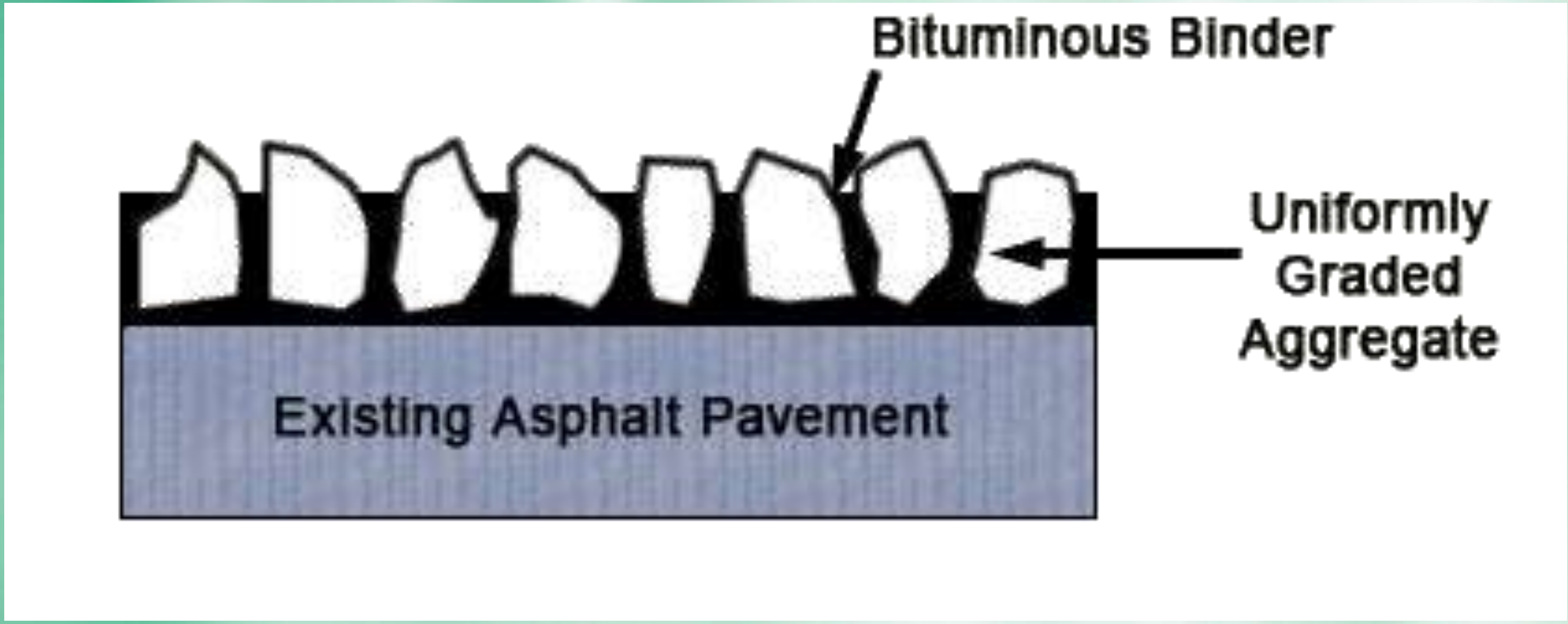
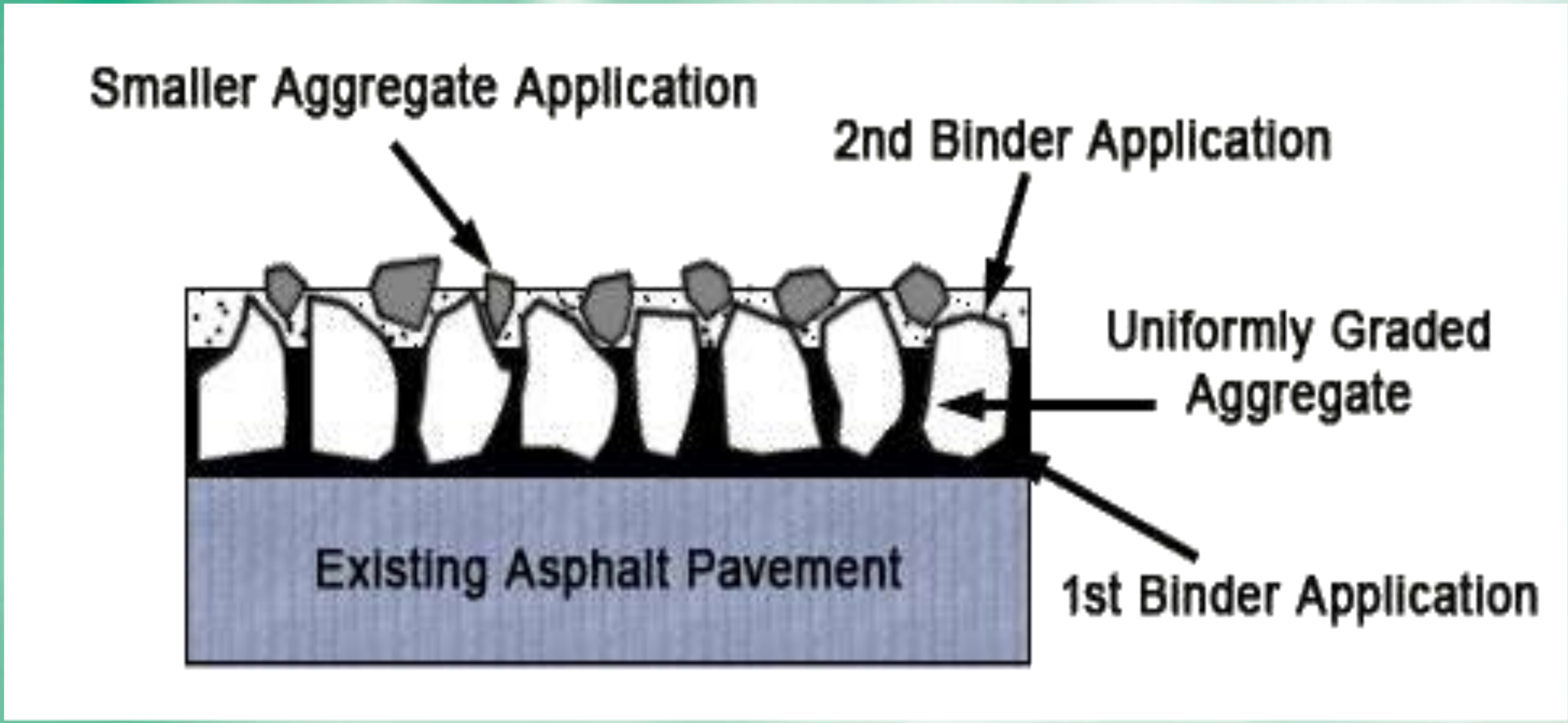
Single Chip Seal



Double Chip Seal



Pneumatic Rollers

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Sweeper

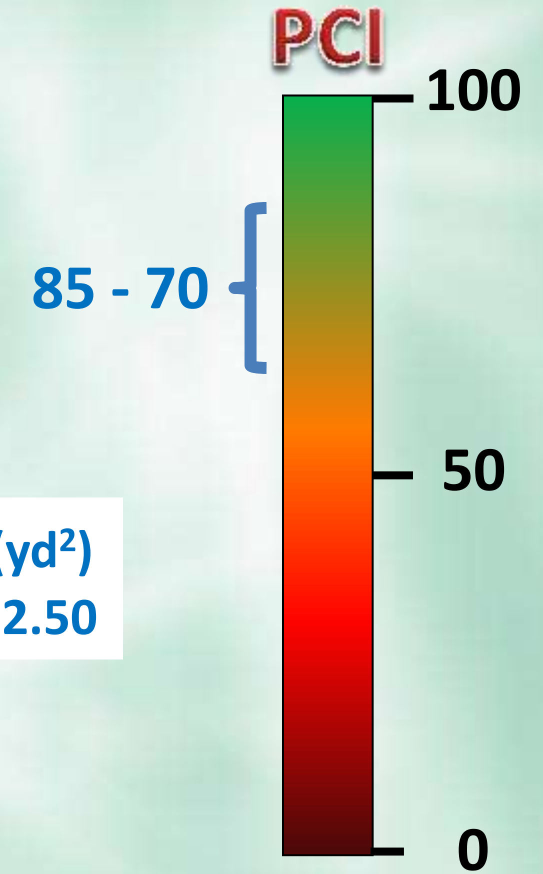
Chip Seal Selection

Conditions Addressed

- Moisture Infiltration
- Longitudinal cracking
- Transverse cracking
- Block cracking
- Friction Loss
- Bleeding

Limitations

- Longer set time



Costs (yd^2)
$1.50 – 2.50

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Framework for Success

It is the:

"right" treatment on the
"right" road at the
"right" time by the
"right" people

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Questions ?

MICHIGAN STATE UNIVERSITY

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