AHD25 Recorded Webinar Series Part-2: Asphalt Crack Sealing Basics

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About the AHD 25 webinar series…

- The webinar series is designed to serve as a best practices and technology transfer tool
- This is second of two recorded webinars for 2015
- Previous webinar: Concrete Joint and Crack Sealing Basics (Scott Eilken and Dan Zollinger)
- We are always looking for other webinar ideas and speakers
    - Committee Chair: Jim McGraw (jim.mcgraw@state.mn.us)
    - CCC: eshan.dave@unh.edu

Webinar Objectives

The **focus** of this webinar is to present the proper techniques for preparation of cracks and joints in concrete pavements and installation of sealants

- Summarize why cracks should be sealed
- List the types of equipment used for sealing in asphalt pavement
- Understand how to choose the appropriate sealant configuration
- Recognize how to select the proper sealant material
- Understand how to properly clean and prepare cracks
- Gain knowledge on how to properly install sealants
- List typical failure types and their causes

Presenters

Larry Galehouse
NCPP, MSU

Jim Chehovits
Crafco Inc.

Kevin Kruckow
Fahrner Asphalt

Crack Treatments

Larry Galehouse, P.E., P.S.
Director, National Center for Pavement Preservation

What is a Crack Treatment?

Crack Treatments are methods in which cracks are directly treated through sealing or filling operations.

- **Crack Sealing**
- **Crack Filling**

Crack Treatments are cost-effective pavement preservation methods that:

- **Extend pavement life**
- **Protect an agency's investments**
- **Maintains pavement structure**
- **Limits future deterioration, prevents potholes**

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What is Crack Sealing and Crack Filling?

Crack Sealing:

Placement of <u>specialized treatment materials (sealant)</u> above or into cracks using unique configurations to <u>prevent</u> the intrusion of water and incompressible materials into the crack.

Crack Filling:

Placement of <u>ordinary treatment materials</u> into low-moving cracks to <u>reduce</u> infiltration of water and to reinforce the adjacent pavement.

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Crack Sealing	Crack Filling
Seals the crack to prevent the intrusion of water and incompressible materials	Fills some of the void in the crack to reduce intrusion of water and incompressible materials
Specialized treatment materials	Ordinary treatment materials
Highly-elastic and flexible material	Rigid material or semi rigid
Endures vertical & horizontal movement	Can not endure vertical & horizontal movement
Crack preparation to assure long service life of sealant	Cursory crack preparation
Sealant placement configuration	Fill crack void, then dust with sand

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Crack Sealing	Crack Filling
Considered semi-permanent	Considered temporary
Seals routed/working crack (Life average of 5 years. Up to 10 years on new pavements)	Filling not recommended for moving cracks, unable to accommodate movement
Seals overbanded/non-working crack (Life approximately 2 to 5 years)	Fills non-working crack (Life approximately a few months up to 1 year)
Modification to perform in a wide variety of climatic temperatures	More susceptible to environmental conditions

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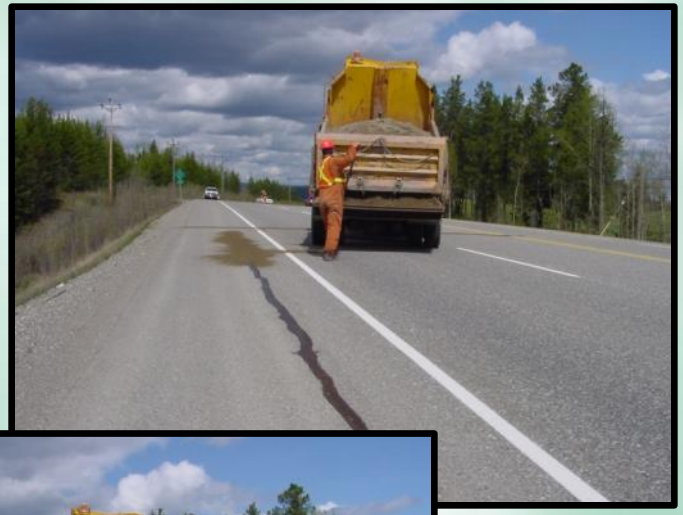
What is Crack Sealing and Crack Filling?

Crack Sealing

Crack Filling



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Why Use Crack Treatments?

- Reduces water penetration into underlying pavement layers, thus maintaining base strength near the crack.
- Reduces incompressibles, thus reducing crack growth and raveling.

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Benefits of Crack Treatment

- Slows pavement deterioration
- Prevents future roughness increase
- Reduces potholes
- Slows crack spalling
- Extends pavement life from 1 to 4 years

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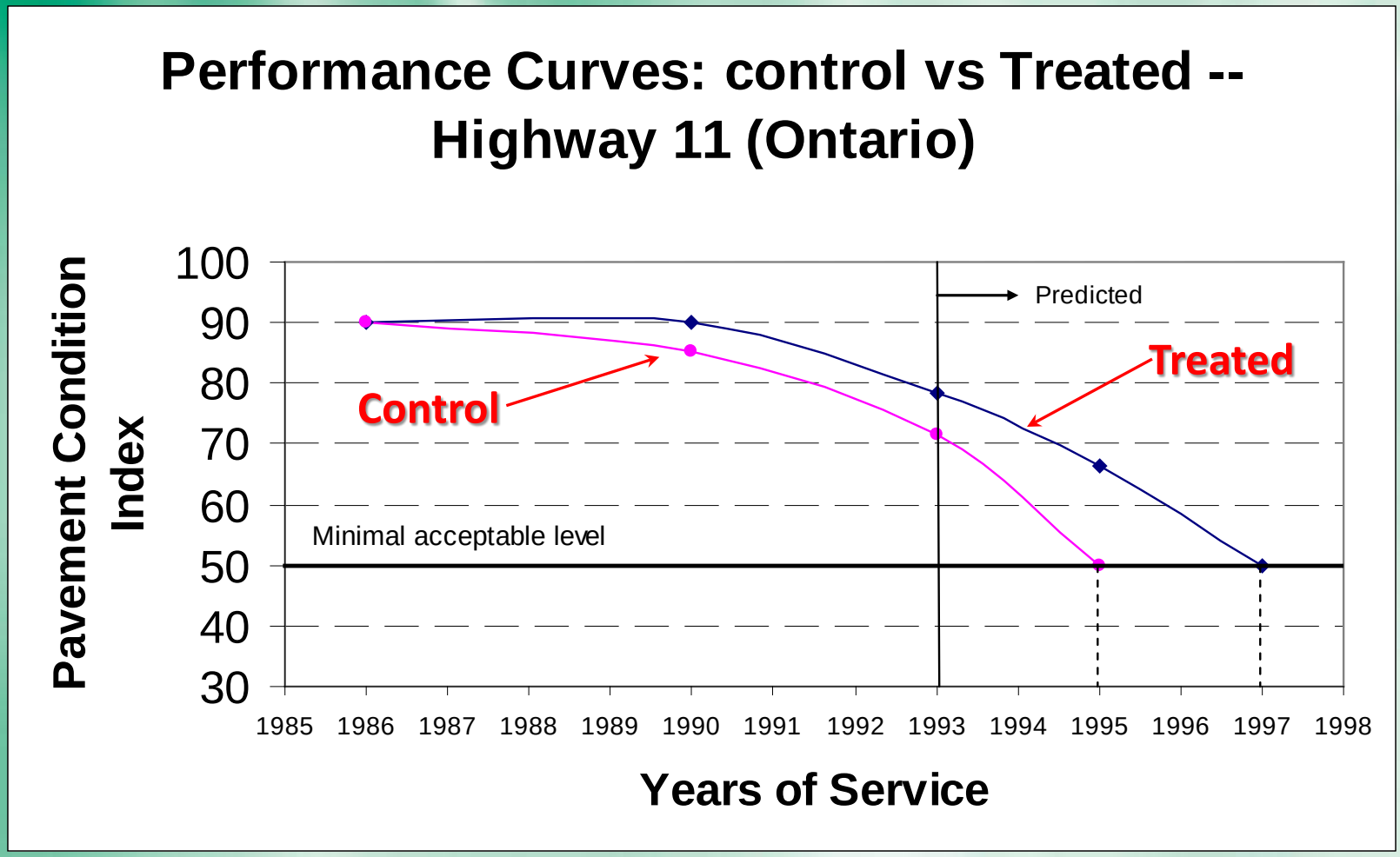
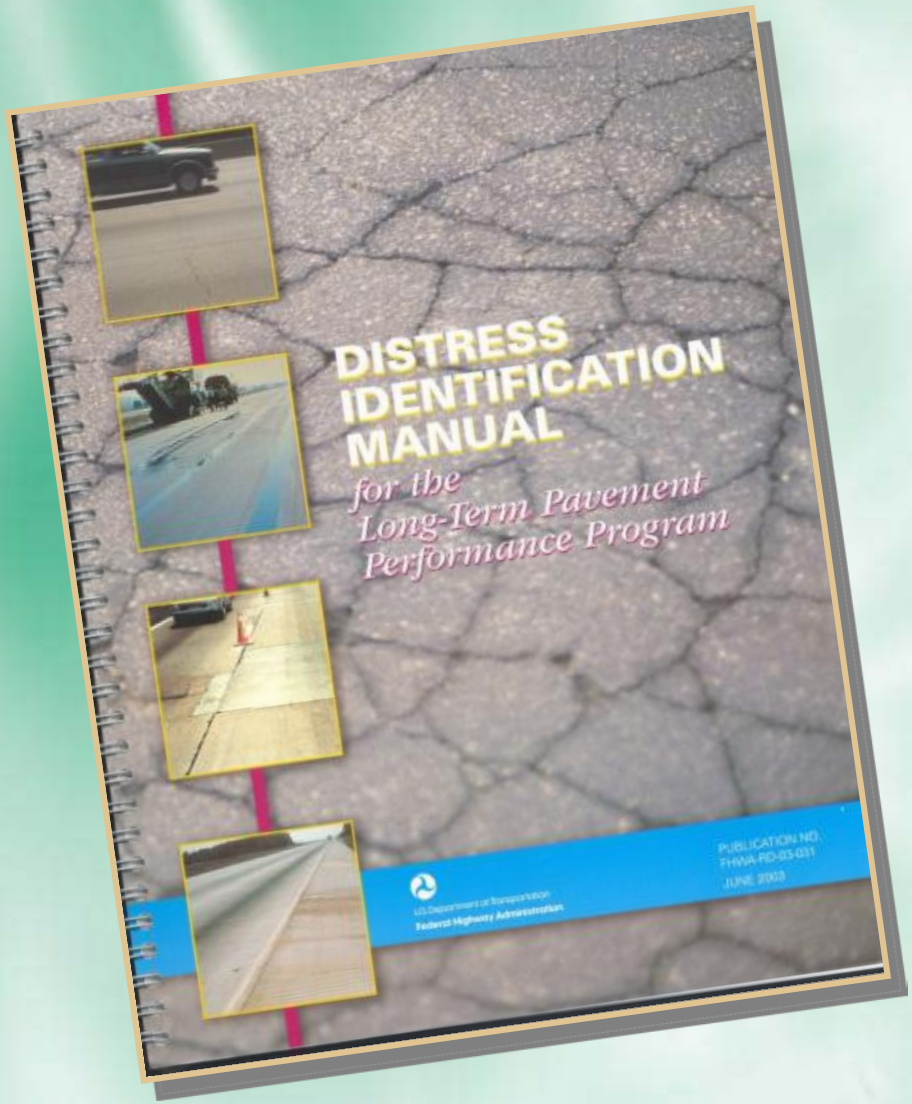
Benefits of Crack Treatment



Project Selection



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Project Selection

Cracks = Distresses

- Type of Crack(s)
- Severity of Crack(s)
- Amount of Cracks

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Type of Distresses (includes Cracks)

Flexible Pavements

1. Alligator (fatigue) Cracking
2. Bleeding
3. Block Cracking
4. Corrugation
5. Depression
6. Joint Reflective Cracking
7. Lane/Shoulder Drop Off or Heave
8. Lane/Shoulder Separation
9. Longitudinal & Transverse Cracking
10. Patch Deterioration
11. Polished Aggregate
12. Potholes
13. Pumping & Water Bleeding
14. Raveling, Weathering, Stripping
15. Rutting
16. Slippage Cracking
17. Swelling

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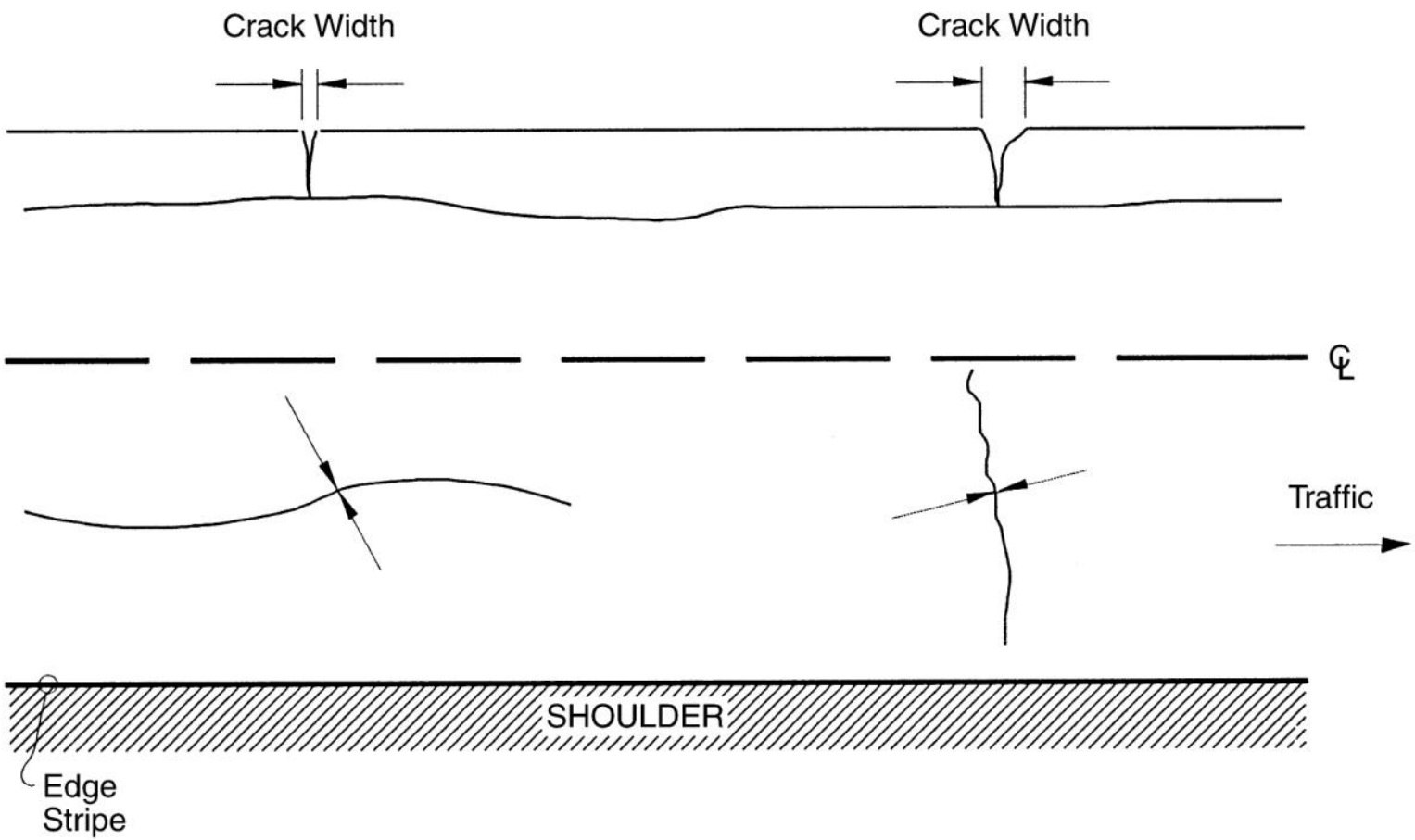
Type of Distresses (includes Cracks)

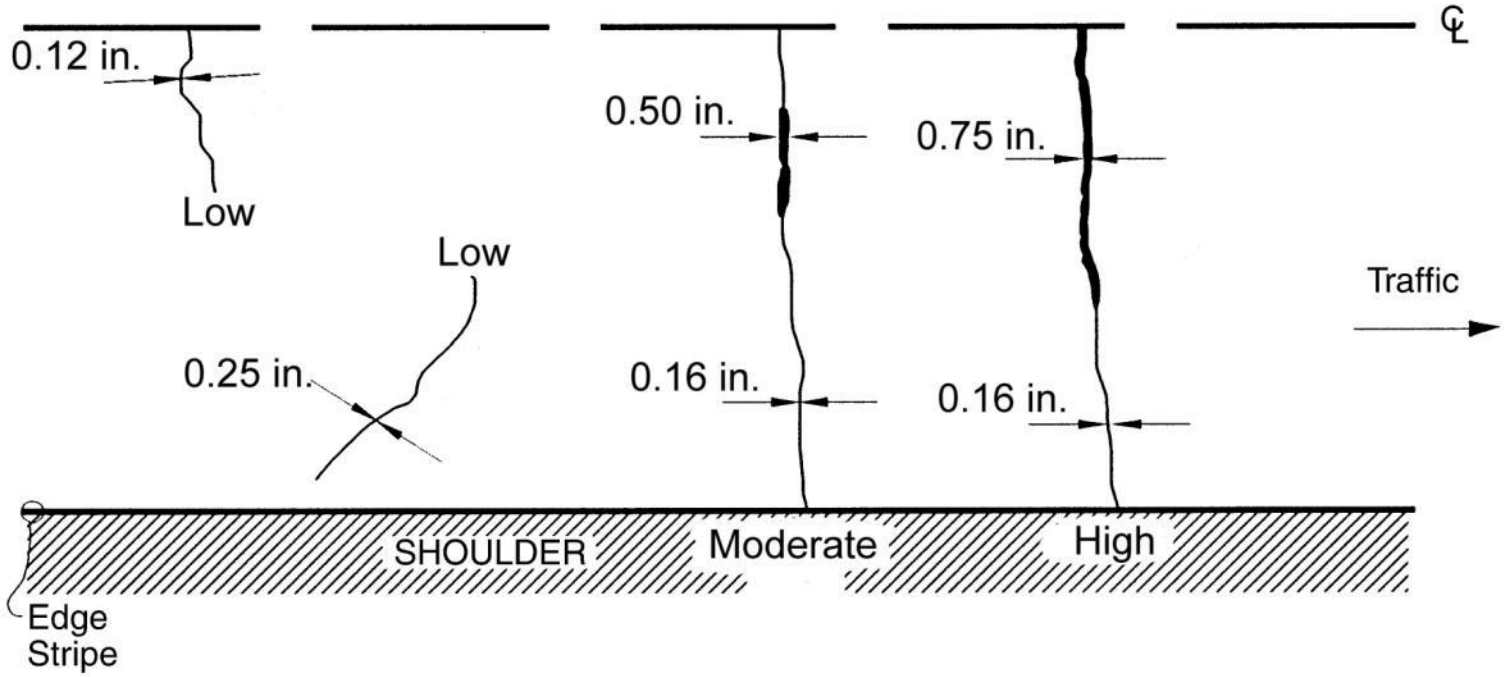
Rigid Pavements

1. Blowup
2. Corner Break
3. Depression
4. Durability ("D") Cracking
5. Faulting of Transverse Joints & Cracks
6. Load Transfer Associated Deterioration
7. Joint Seal Damage
8. Lane/Shoulder Drop Off or Heave
9. Lane/Shoulder Joint Separation
10. Longitudinal Cracks
11. Longitudinal Joint Faulting
12. Patch Deterioration
13. Popout
14. Pumping & Water Bleeding
15. Reactive Aggregate
16. Scaling, Map Cracking
17. Spalling
18. Swell
19. Transverse and Diagonal Cracks

Severity of Crack

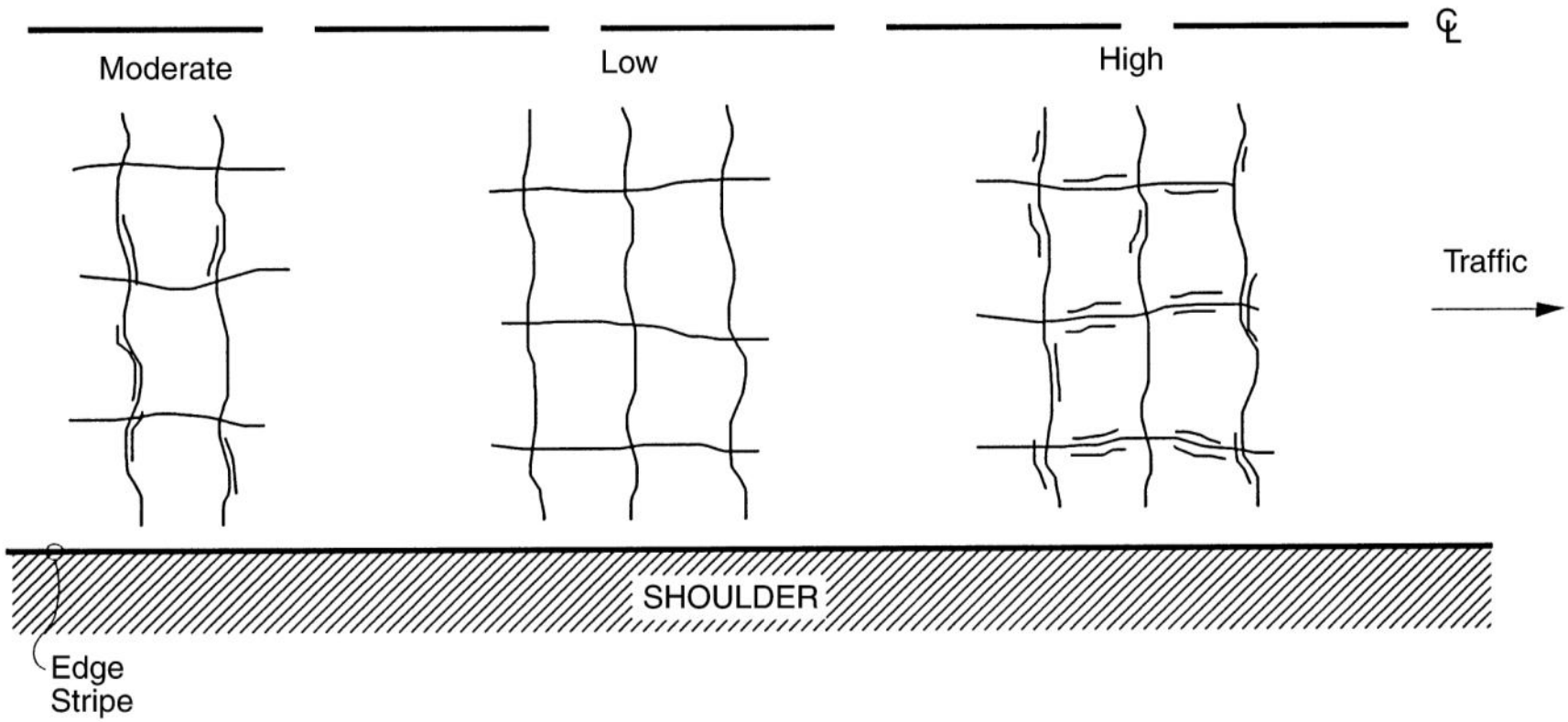


Severity of Crack



Note: Rate entire crack at highest level present for 10% or more of total crack length

Severity of Crack



Moderate - Adjacent Low Severity Cracking
High - Adjacent Moderate Severity Cracking

Amount of Cracks

Acceptable

Too Much

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Flexible Pavement Cracks

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Crack Formation

- Cracks occur when the asphalt is no longer flexible enough to resist movement due to:
  - Traffic loadings
  - Seasonal temperature changes
- Asphalt is most flexible and resistant to cracking at construction.

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Transverse Cracks

- Transverse cracks form perpendicular to the pavement lane
  - Thermal
  - Reflective
- Typically caused by environmental factors and by reflection of underlying joints
- Often experience concentrated and extreme movement
- Crack Sealing (and routing when appropriate) is recommended to accommodate the expected crack movement.

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Longitudinal Cracks

- Longitudinal cracks run parallel to the pavement lane
  - Construction Joint
  - Thermal/Reflective
  - Wheel path
- Typically caused by construction of pavement joint, thermal conditions, and traffic loading
- Crack Sealing (and routing when appropriate) is recommended to prevent intrusion of moisture and debris.

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Block Cracks

- Block cracks typically form in older pavement.
  - Hardening of asphalt
  - Thermal effects/shrinkage of asphalt during cold weather
  - Form in traffic and non-traffic areas
- Effectively treated by crack sealing.

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Edge Cracks

- Edge cracks typically form due to:
  - Lack of lateral support
  - Settlement of underlying material
  - Weak Base
  - Heavy traffic along edge
- Prevent intrusion of run off water and debris by crack sealing.

Fatigue Cracks

Also known as Alligator Cracks

- **Fatigue cracks are also known as "alligator" cracks.**
- **Indication of structural failure.**
- **Typically occurs later in a pavement's life due to high traffic loads.**
- **Crack seal or fill cracks larger than 1/8" as a pre-treatment to other surface treatments.**

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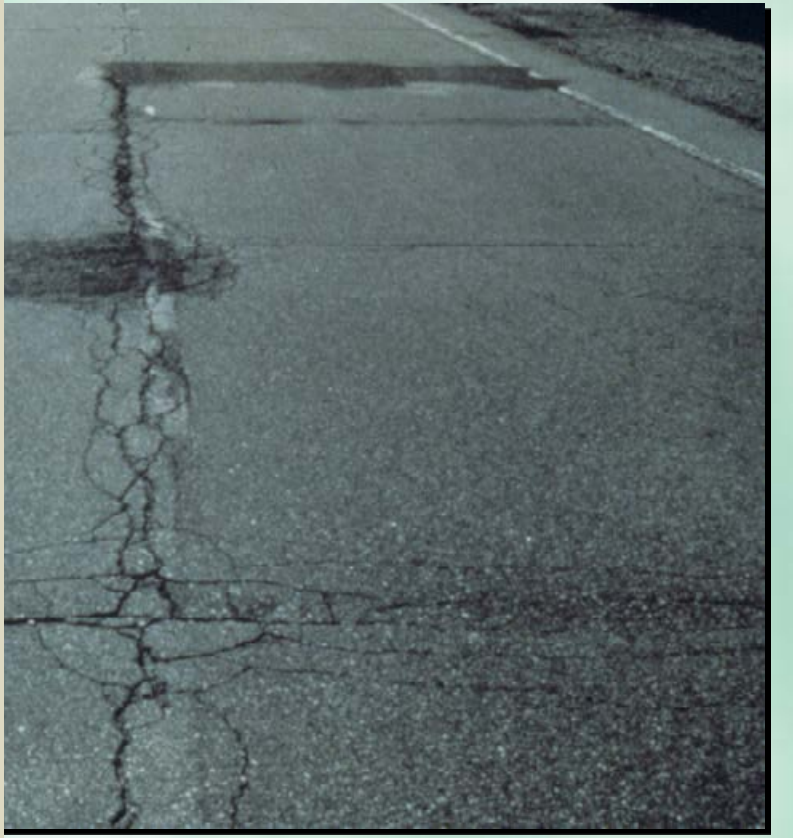
Reflective Cracks

- Unique to asphalt surfaced PCC pavements
- Includes all longitudinal and transverse cracks that appear on top of the PCC joints
- Caused by movements in the PCC slab beneath the asphalt because of thermal and / or moisture changes
- Reflective cracks start at the bottom of the AC surface and eventually propagate toward the pavement surface



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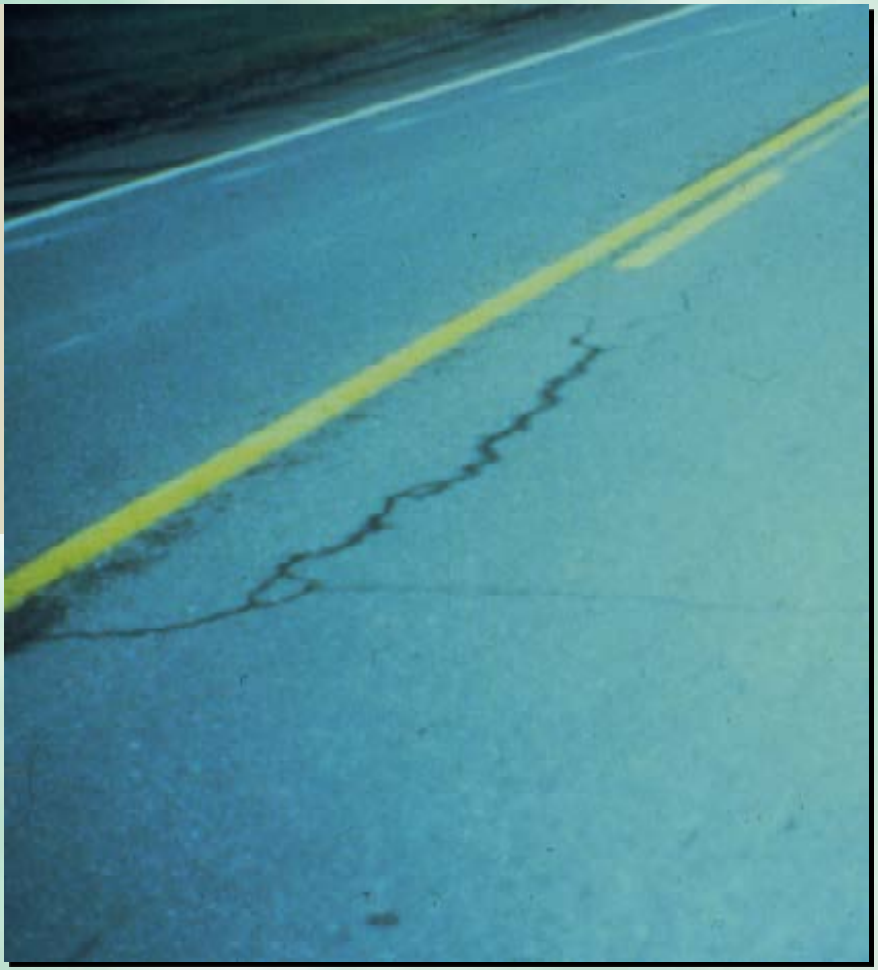
Longitudinal Cracks

- Longitudinal cracks occur generally parallel to the centerline of the pavement.
- Often caused by improper construction practices.
- Consider crack sealing at low severity levels.



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Commonly Missed Opportunities for Crack Treatments

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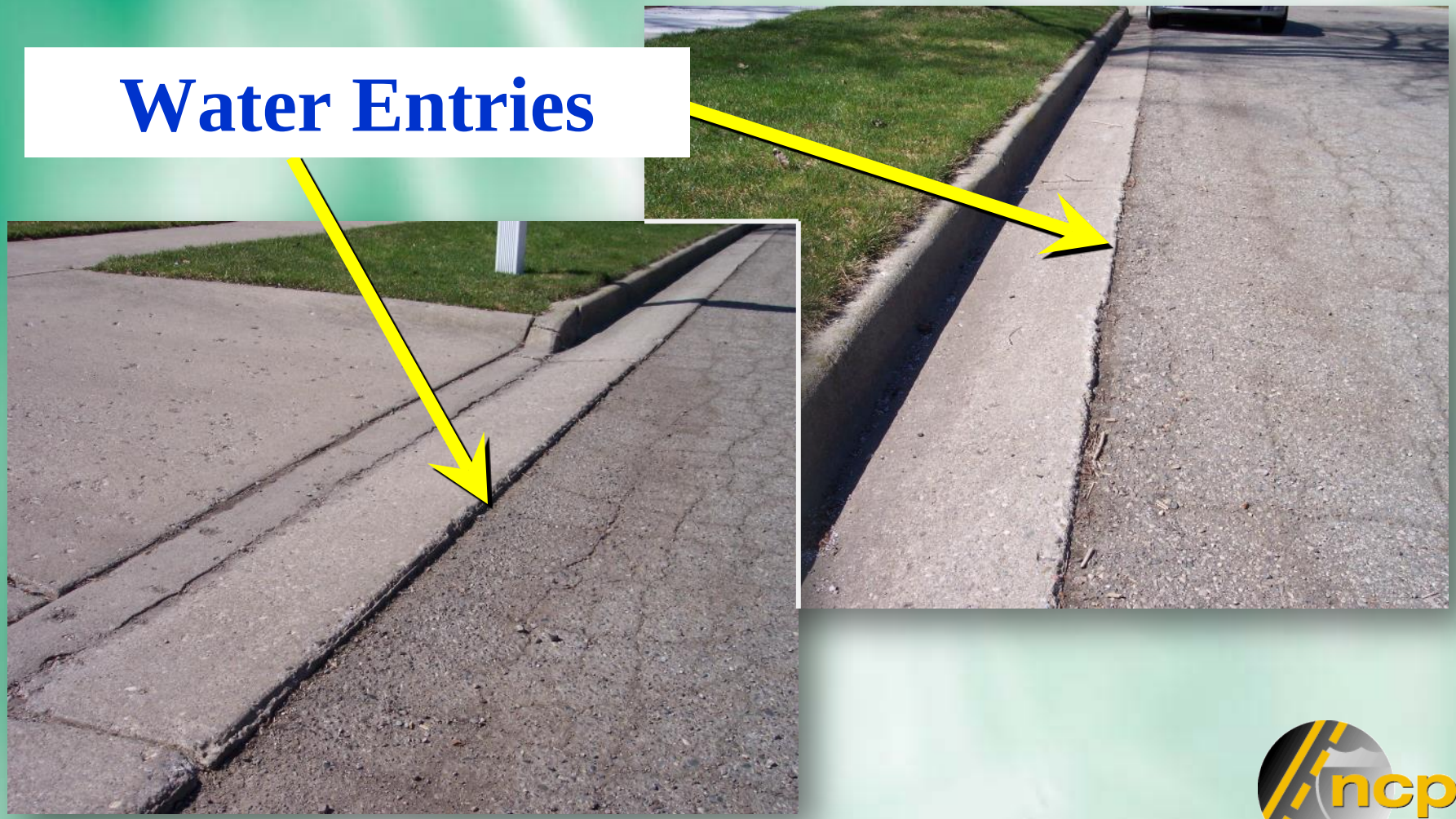
Commonly Missed Opportunities for Crack Treatments

Water Entries



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Crack Treatment Best Practice

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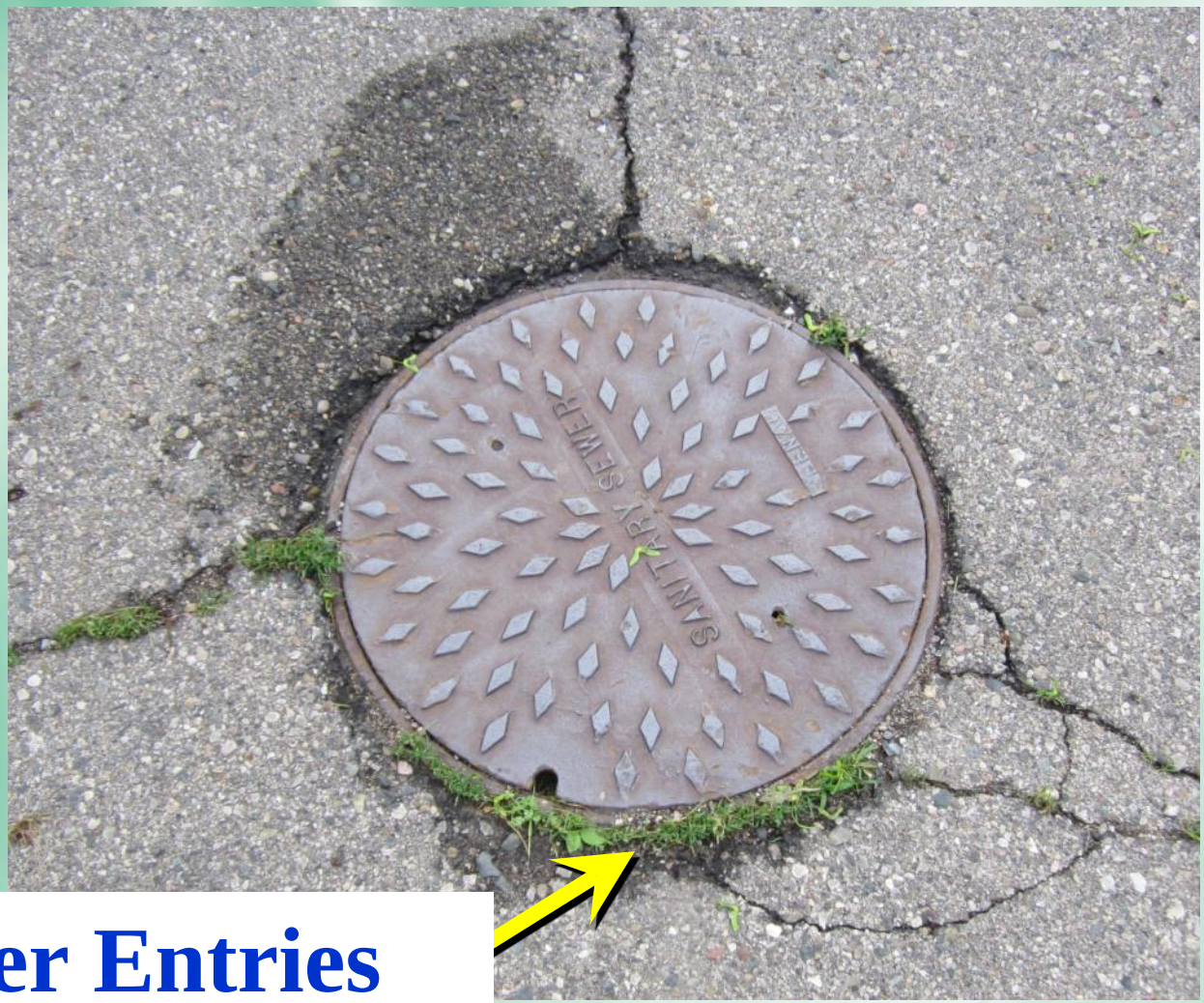
Commonly Missed Opportunities for Crack Treatments



Water Entries

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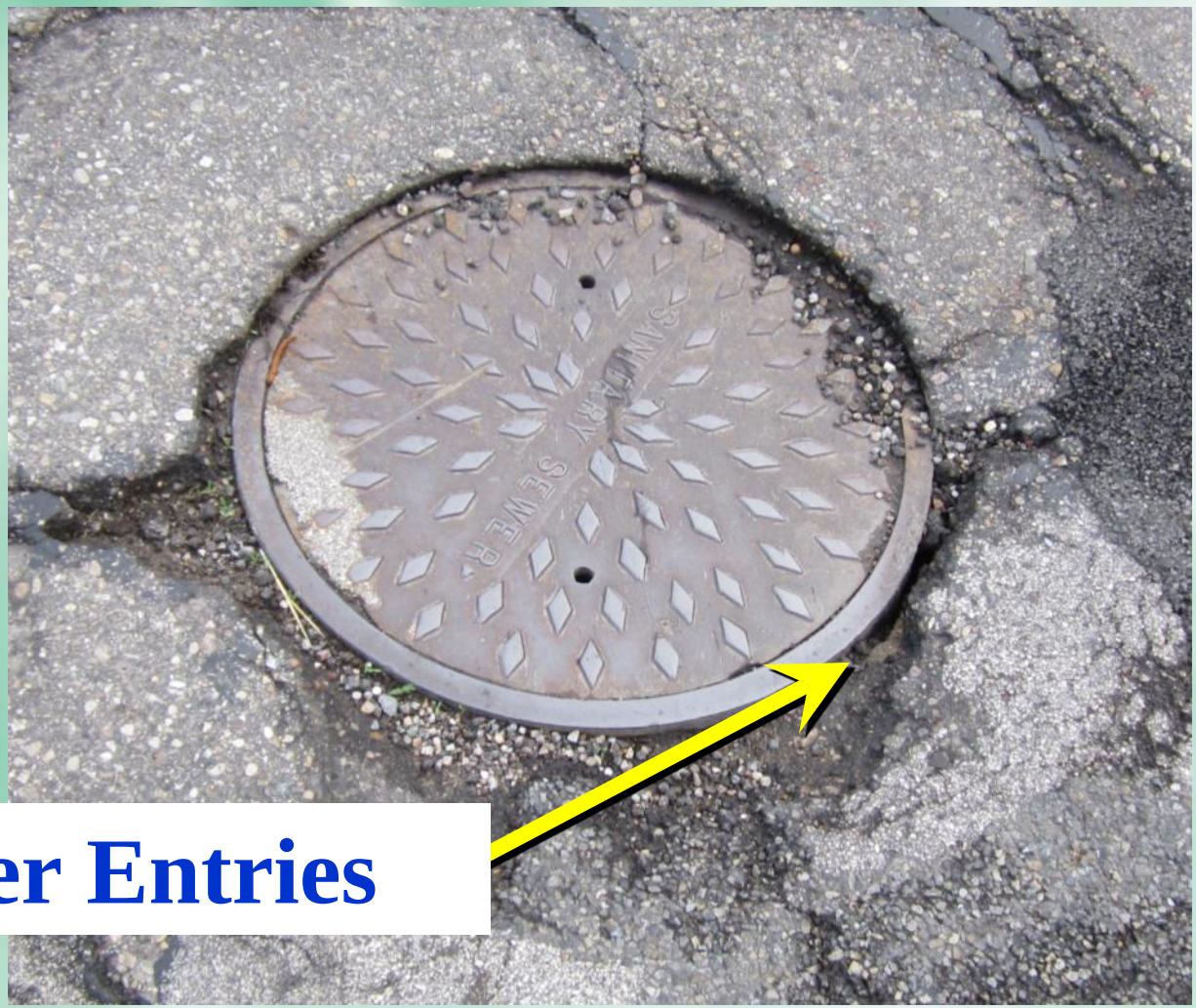
Commonly Missed Opportunities for Crack Treatments



Water Entries

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Commonly Missed Opportunities for Crack Treatments

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Crack Treatment Best Practice

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Crack Treatment Best Practice

Seal Joints at Patches

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Questions

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Sealant Selection for Crack Treatments in Asphalt Concrete Pavements

Jim Chehovits
Vice President Operations
Crafco, Inc

Presentation Topics

- Factors Influencing Sealant Selection
- Needed properties of sealing materials
- Determining temperature exposures
- Pavement condition / crack movements
- Properties/specifications of material types
- Sealant Selection

Project Specifications

- The Sealant material specification is the major factor influencing material selection
- Current Specifications are provided by
  - ASTM
  - AASHTO
  - Federal Government
  - European Union
  - State/Government Agencies
  - Local Requirements

Project Factors

- Climate at the Location
- Crack Types, Spacing, Condition
- Traffic Conditions
  - Volume, Speed,
  - Parking Lot
- Slopes/ super elevation

ASTM D6690 General Requirements

- Resilient and adhesive compound
- Effectively seals joints and cracks from moisture and foreign material throughout repeated cycles of expansion and contraction with temperature changes
- Will not flow or be picked up by tires
- Completely fill joints
- Relatively unchanged for 6 hour heating

Desired Performance

Crack sealing materials need to remain functional without tracking, loosing adhesion or cracking throughout:

The entire temperature range experienced

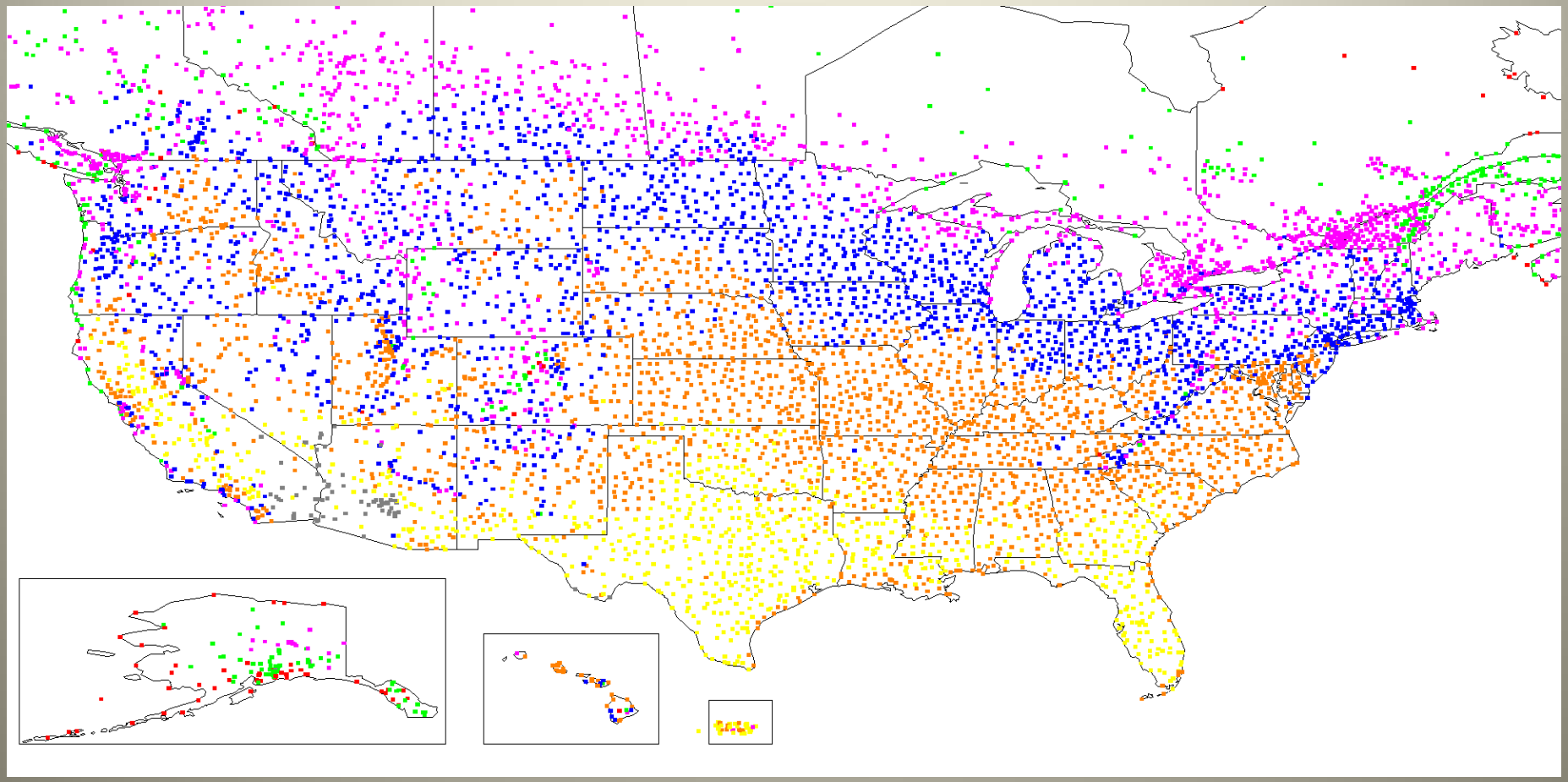
and

The range of movements experienced

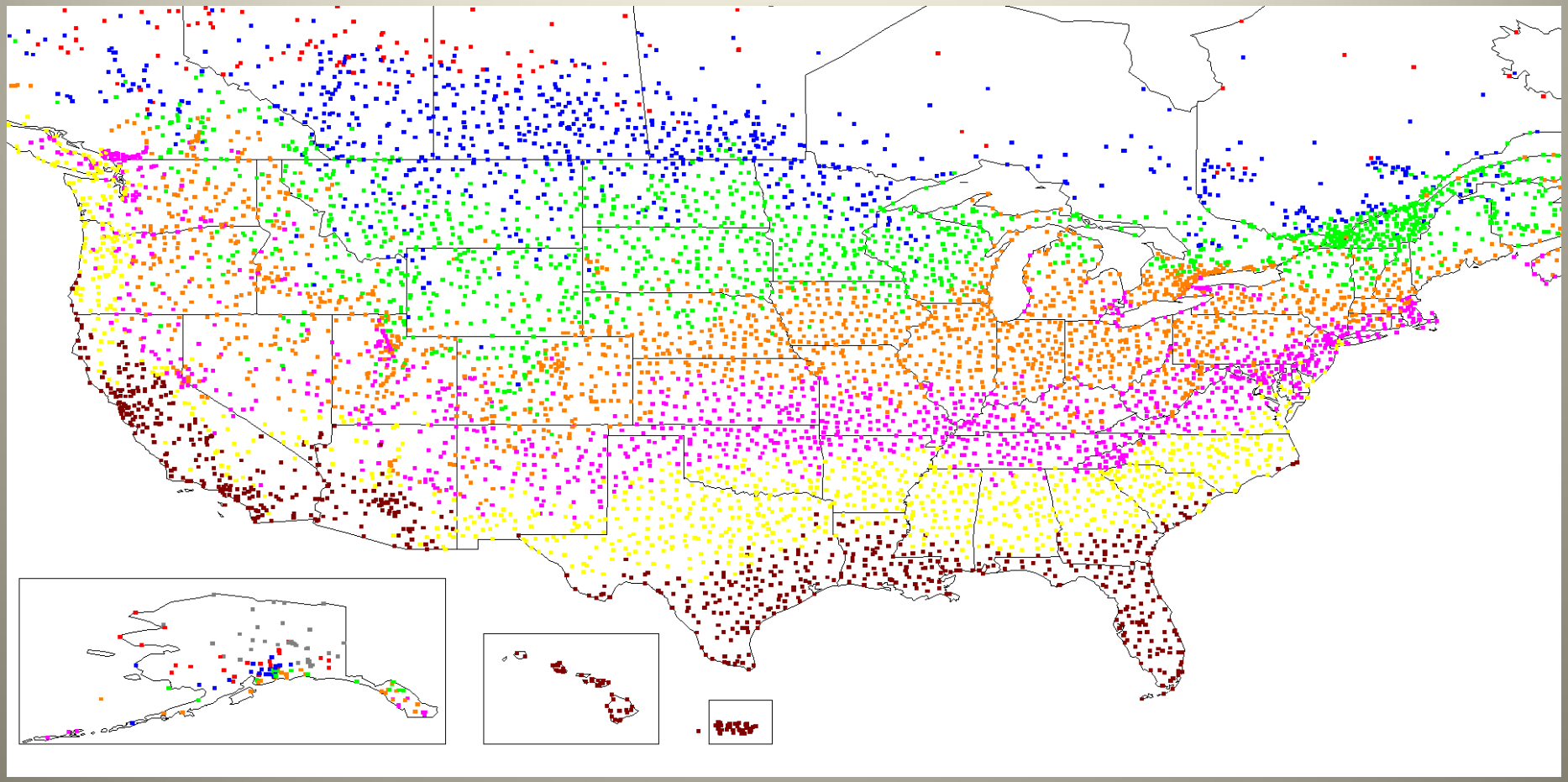
Temperature Range

- How Hot??? How Cold???
- FHWA LTPPBind, at surface level

LTPPBind V 3.1 98% High



LTPPBind V 3.1 98% Low



FHWA RD-03-080

Using LTPPBind V 2.1
To Improve Crack Sealing
in Asphalt Concrete Pavements

APPLICATIONNOTES

Using LTPPBind to Improve Crack Sealing in Asphalt Concrete Pavements

FHWA Contact: Antonio Nieves, 202–493–3074,
antonio.nieves@fhwa.dot.gov

The Challenge

Repairing cracks in asphalt concrete pavements is essential to insuring pavement performance and reducing life-cycle maintenance and replacement costs. One of the ways to extend pavement life is to include crack-sealing treatments as part of pavement preventive maintenance practice. The effectiveness of these treatments depends on many factors, including the properties of sealant materials, installation methods, temperature extremes, pavement conditions, traffic levels, and crack movements.

Sealants with different properties are needed in different climates. Warm climates require stiff sealants to resist hot summer temperatures. If the sealant is too soft, it may flow or be pulled from the crack by vehicle tires. Softer, more flexible sealants are more appropriate for cold climates in which pavements are prone to large crack movements, especially during the winter. In any given climate, sealant materials must function over the range of temperatures from summer to winter.

Installation methods also vary by climate. Correct installation ensures that the sealant can conform to crack movements in the pavement. The tendency of pavement cracks to widen or move in the winter increases as the distances between existing cracks and variations in winter and summer temperatures increase. If the installation is not correct, cracking or debonding may develop as cracks widen in the winter.

Pavements in good condition that demonstrate transverse thermal cracking, but otherwise have minimal cracking, are best treated with rout and seal procedures. These procedures use very flexible and extensible sealants in widened reservoirs with working cracks that move more than 3 millimeters (mm) throughout the year. For pavements with more extensive cracking, such as longitudinal, block, fatigue, and closely spaced transverse cracks in which crack movement is minimal (less than 3 mm a year), techniques such as crack filling, clean and seal, and overband are appropriate. These techniques use stiffer, more traffic-resistant sealant materials in cracks that generally are not widened.

In the past, highway agencies from across the United States have developed area-specific crack-sealing treatment procedures through a series of test sections, evaluating and investigating sealant types and installation methods by trial and error. Selecting sealant materials for specific climates has been based on approximate descriptions of temperature ranges in hot, moderate, or cold climates, and with some general air temperature highs and lows.

U.S. Department of Transportation
Federal Highway Administration

Crack Movements

- Horizontal – slow, yearly, daily
  - Thermal expansion and contraction as temperature changes from hot to cold
  - Measured from the highest and lowest temperatures experienced during the year
  - Movements proportional to crack spacing
  - Movements up to 1 inch can occur in severe climates with 100 ft crack spacings
  - Typical maximum movement of 0.1” per 10 ft crack spacing in severe climates

Crack Movements

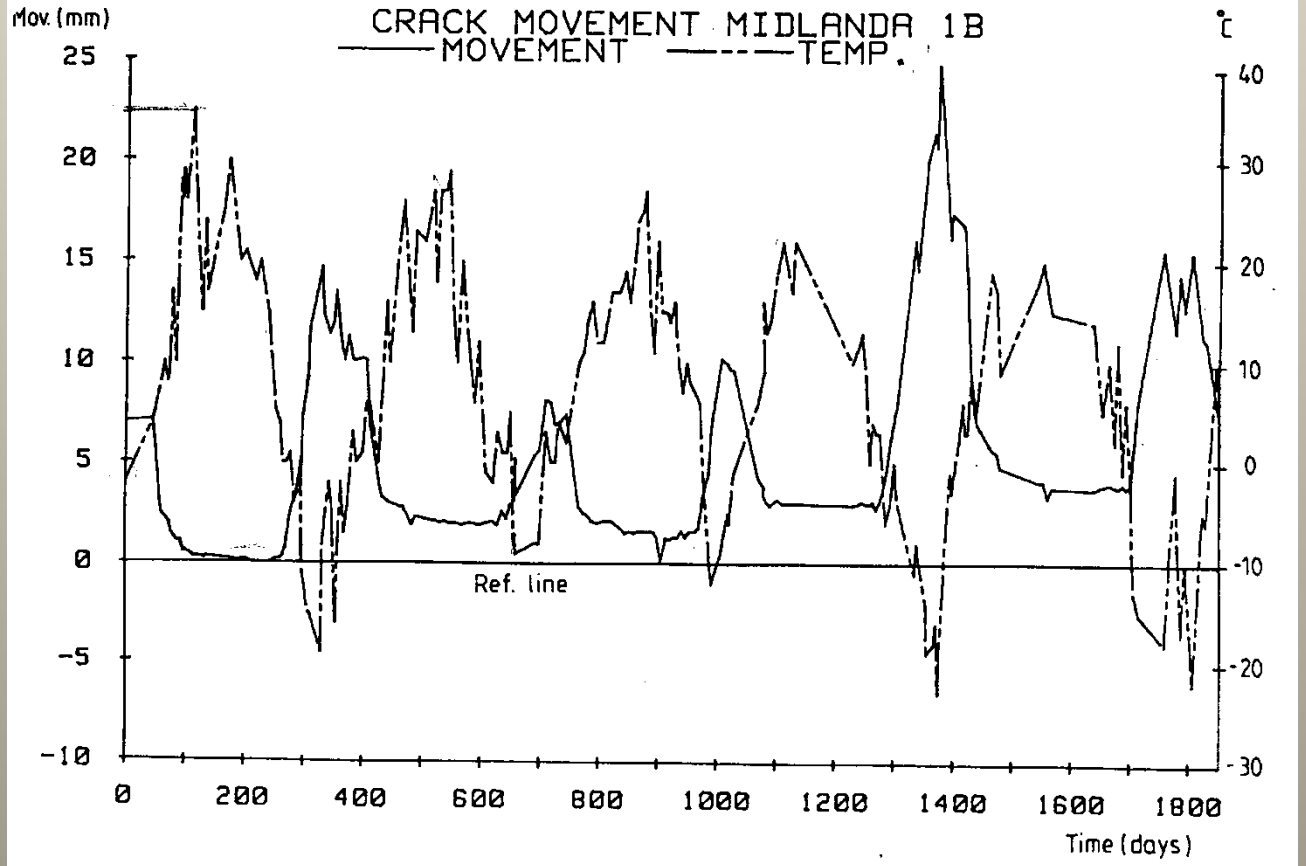


Figure 12 c Crack movement, crack No. 1. pos. 1 B

Movement Percentage

- Movement % 0 to > 100%
- Example - ½ inch wide in summer when sealant installed, opens to 1 inch in winter equals 100% crack movement
- Sealant would be subjected to 100% elongation from summer to winter
- If crack widened to 1 inch reservoir when installed, elongation reduces to 50%

Pavement Condition

- Type of Cracks
- Extent of cracking
- Crack Spacing
- All Influence Crack Movements

FHWA RD 99-147 (SHRP H-106)

- **Working** - >1/8 inch movement,
  - Typically transverse at over 15- 20 ft.
  - **Use Crack Seal Process**
- **Non-Working** - < 1/8 inch movement,
  - Typically longitudinal, transverse or other at less than 15- 20 ft.
  - **Use Crack Fill Process**

Milwaukee, Wisconsin

Transverse Thermal Working Cracks

Spacing 50 to 75 ft

High Movement

est ½ inch +

58-28 98%
LTPPBind Area

Silverton Colorado

Transverse Thermal Working Cracks

Spacing 15 to 30 ft

High Movement
est ¼ inch

46-34C 98%
LTPPBind Area

Prescott Arizona

Random, Aging, Thermal Non-Working Cracks

Spacing 1 to 10 Ft

Low Movement

est <1/8 inch

64-16C 98% LTPPBind Area

Sealant Properties Influencing Selection

- Application Temp - Viscosity
- High Temperature- Softening point, flow, 122 or 140F penetration
- Low Temperature-Bond, flexibility, 0F penetration
- Adhesion- Bond, tensile adhesion
- Elasticity - resilience

Proposed SG Specification

Table B.1. Crack Sealant Performance Grade

Crack Sealant Performance Grade	SG 46	SG 52	SG 58	SG 64	SG 70	SG 76	SG 82
	-46 -40 -34 -28 -22 -16 -10	-46 -40 -34 -28 -22 -16 -10	-46 -40 -34 -28 -22 -16 -10	-46 -40 -34 -28 -22 -16 -10	-46 -40 -34 -28 -22 -16 -10	-46 -40 -34 -28 -22 -16 -10	-46 -40 -34 -28 -22 -16 -10
Apparent Viscosity, SC-2	Installation Temperature						
Maximum Viscosity (Pa.s)	3.5						
Minimum Viscosity (Pa.s)	1						
Vacuum Oven Residue (SC-3)							
Dynamic Shear, SC-4	46	52	58	64	70	76	82
Minimum Flow Coeff. (kPa.s)	4						
Minimum Shear Thinning	0.7						
Crack Sealant BBR, SC-5	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-34 -40 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4
Maximum Stiffness (MPa)	25						
Minimum Avg. Creep Rate	0.31						
Crack Sealant DTT, SC-6	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-34 -40 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4
Minimum Extendibility (%)	85 85 70 55 40 25 10	85 85 70 55 40 25 10	85 85 70 55 40 25 10	85 85 70 55 40 25 10	85 85 70 55 40 25 10	85 85 70 55 40 25 10	85 85 70 55 40 25 10
Crack Sealant AT, SC-7	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-34 -40 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4	-40 -34 -28 -22 -16 -10 -4
Minimum Load (N)	50						

Note: Crack sealant surface energy is provided by manufacturer.

Material Types

- Unmodified asphalt cements, emulsions, cutbacks ASTM D6373, D977
- Fiber Modified
- Ground Tire Modified ASTM D5078
- Polymer Modified /Rubberized

  ASTM D6690 Type I-IV, Agency specs
- Combinations

Unmodified Asphalts

- Crack at approx 0 to -5 C (20-30F)
- Excessive softening above 40- 50 C (104 - 120F)
- Fill Use
- Typical effective range of 0 C to 50C (30-120F)
- Typically < 1 year life

Fiber Modified

- Provides Tensile Reinforcement
- Improves High temperature stiffness
- Improves low temperature cracking resistance
- Overband Fill applications

Ground Tire Rubber Modified

- Swells in the asphalt
- Increases high temperature stiffness
- Improved low temperature flexibility and fracture resistance
- Increases elasticity
- Generally Fill use

Polymer Modified / Rubberized

- Can provide high levels of modification
- Improves low and high temperature properties
- Can provide high levels of low temperature extensibility
- Can be Fill or Seal Use
- Effective ranges from -46 C to 82 C
  (-50 to 180F)

Sealant Selection

- Low Temperature
  - **Crack Seal**- Pass bond test at the determined low temperature 50-200%
  - **Crack Fill** - Pass a mandrel bend test at the determined low temperature - 10% elongation

Sealant Selection

- **High Temperature**
  - **Crack Seal** - Meet D6690 Softening Point requirements of 80 C (176 F) minimum and be at least 16 C (29 F) above the high pavement temperature
  - **Crack Fill** - Minimum D36 Softening Point of 22 C (40 F) above high pavement temperature, and lower penetration results for higher pavement temperature areas

General Specification Applicability Seal and Fill Use

Type	High Temp(C)	Low Temp(C)
Type IV	52,58	-28,-34,-40,-46
Type II, III	52,58,64	-10,-16,-22,-28
Type I	52,58,64	-10,-16,-22
State/Local	70,76	-10,-16

Usage may vary depending on specific product characteristics that exceed specifications

General Fill Use Applicability

Type	High Temp(C)	Low Temp(C)
D5078	52,58,64	-22,-16,-10
Fiber Mod	52,58,64	-22,-16,-10
Polymer/GTR	52,58, 64,70,76	-28,-22,-16,-10

Usage my vary depending on specific product characteristics that exceed specifications

Additional Considerations

- Sloped Areas-higher viscosity to resist flow
- Winter Installation-may use softer material due to lesser concern on pick up
- Hot Summer- Greater high temp stiffness
- Parking lots- Greater high temp stiffness
- Wide Cracks-Higher viscosity to resist sag

Summary

- Sealant needs to withstand temperature extremes and crack movements
- Temperature extremes can be determined using LTPPBind
- Movements can be estimated from crack types and spacing
- Sealant properties can be matched to temperature extremes and expected movements

.

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Installation Procedures & Techniques of Crack Treatments in Asphalt Concrete Pavements

Kevin Kruckow, Regional Vice President
Fahrner Asphalt Sealers, LLC

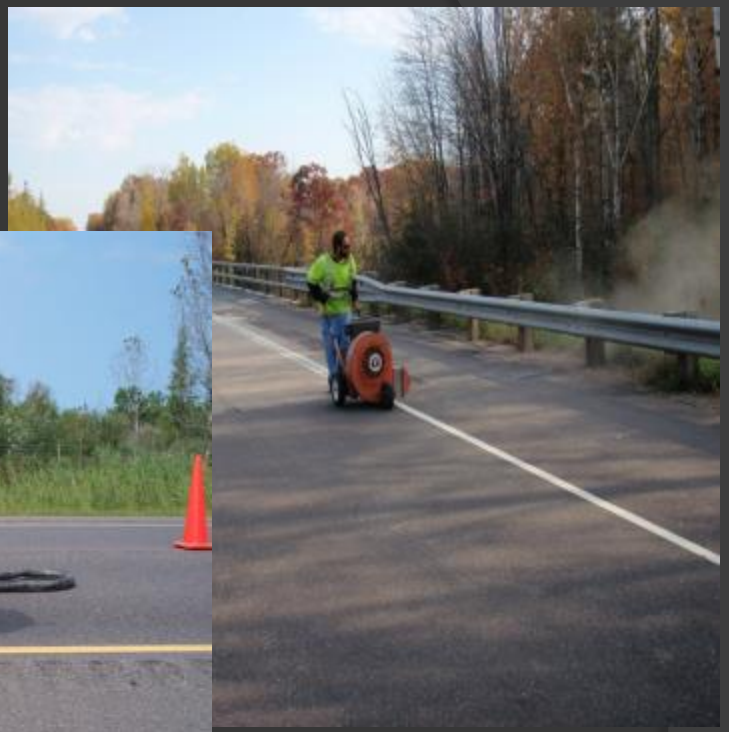
FAHRNER asphalt sealers llc
Pavement Maintenance Contractors
EEO/AA Employer

* *ALWAYS FOLLOW THE EQUIPMENT & PRODUCT MANUFACTURERS RECOMMENDATIONS*

SAFETY FIRST

- PROPER TRAFFIC CONTROL HELPS PROTECT THE WORKERS AND THE TRAVELING PUBLIC

CRACK PREPARATION



Proper Equipment - Routing
PAVEMENT CUTTER

Proper equipment - Routing

Worn Cutters will not provide a good reservoir.

New Cutter

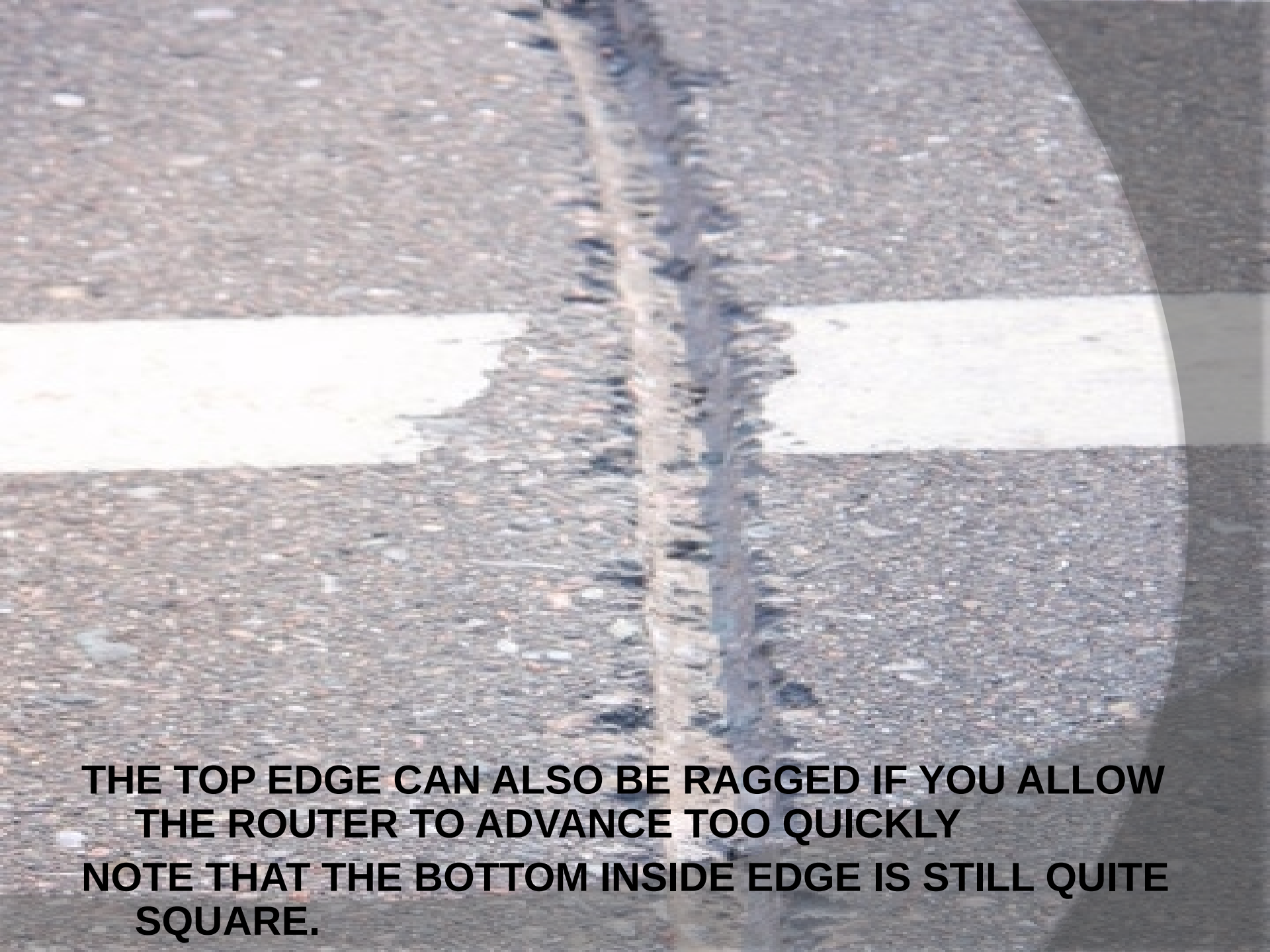
Worn Cutter

- FOLLOW THE CRACK AS BEST AS YOU CAN

- SOMETIMES PART OF THE CRACKS ARE MISSED
- WHILE THE ROUT MIGHT NOT COVER IT, THE OVERBAND FILLER SHOULD

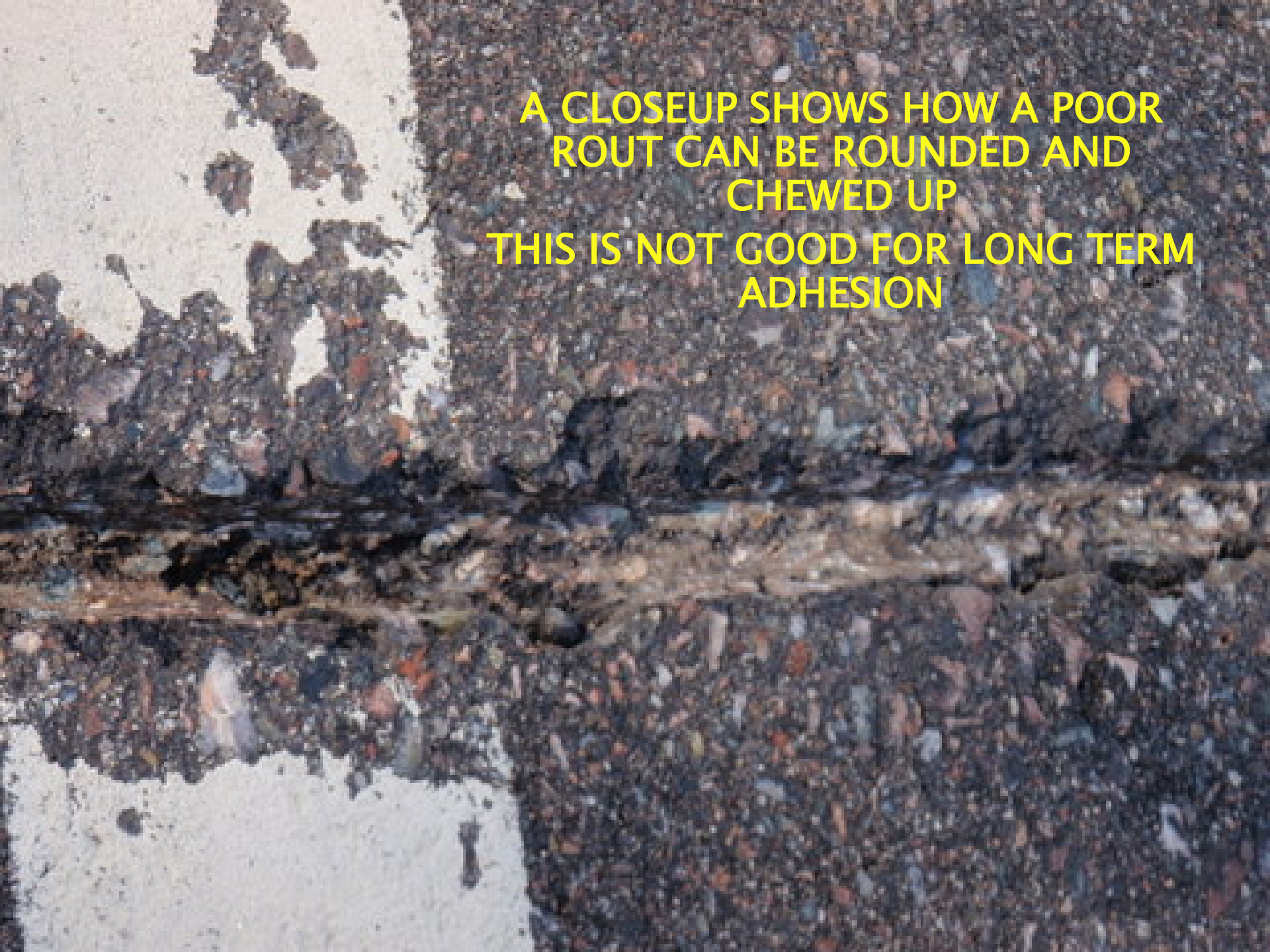
- WHAT DO YOU DO WITH WEEDS?

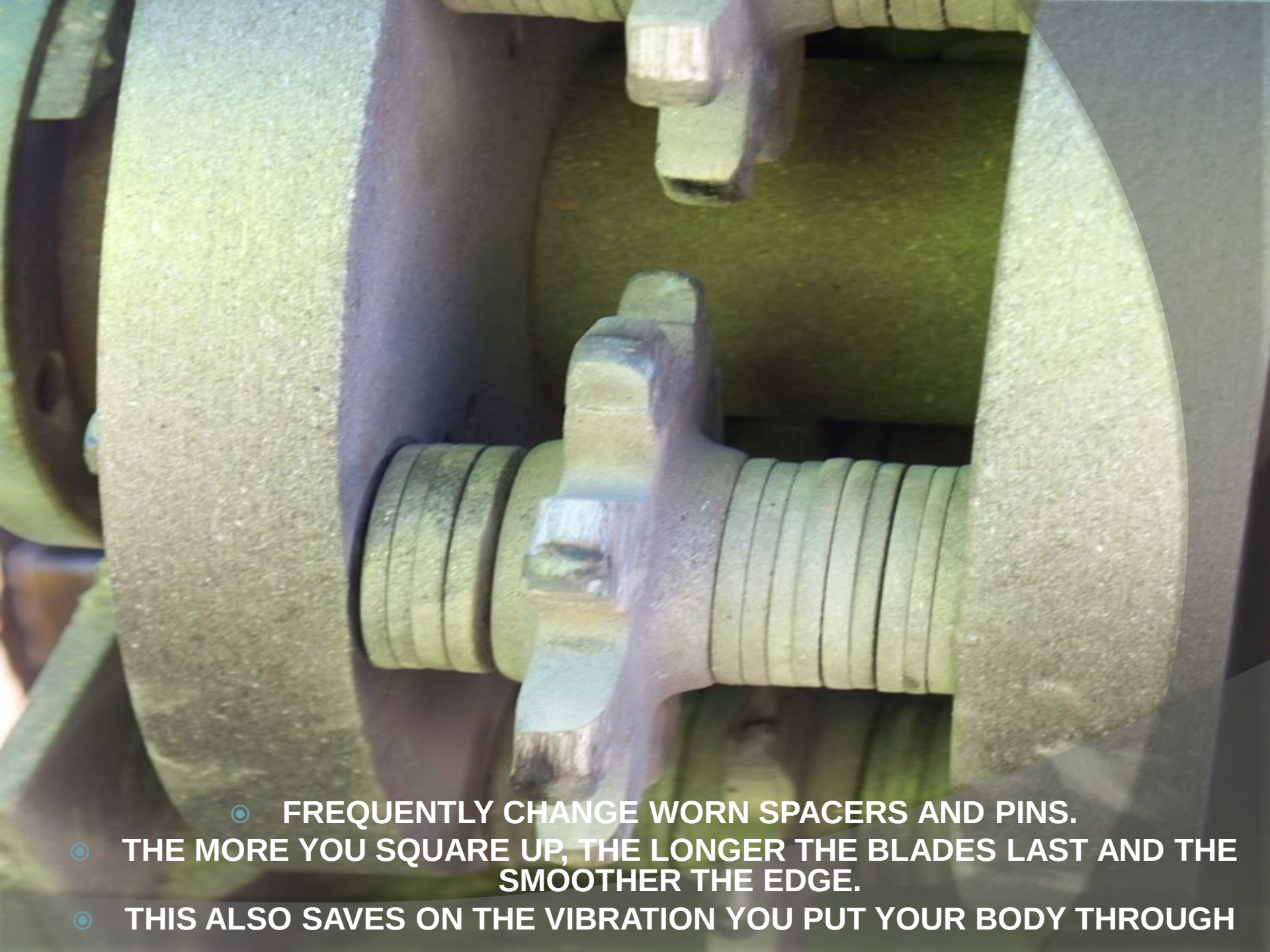
- SOME WEEDS CAN BE LEFT BEHIND
- THEY SHOULD BE REMOVED BY
  - THE HIGH PRESSURE AIR
  - OR THE HEAT LANCE



THE TOP EDGE CAN ALSO BE RAGGED IF YOU ALLOW THE ROUTER TO ADVANCE TOO QUICKLY

NOTE THAT THE BOTTOM INSIDE EDGE IS STILL QUITE SQUARE.


A CLOSEUP SHOWS HOW A POOR ROUT CAN BE ROUNDED AND CHEWED UP
THIS IS NOT GOOD FOR LONG TERM ADHESION



- FREQUENTLY CHANGE WORN SPACERS AND PINS.
- THE MORE YOU SQUARE UP, THE LONGER THE BLADES LAST AND THE SMOOTHER THE EDGE.
- THIS ALSO SAVES ON THE VIBRATION YOU PUT YOUR BODY THROUGH

Proper equipment -Cleaning

Cleaning Methods

Unclean Crack

- Compressed air - sufficient pressure and velocity
- Vacuum - in combination with compressed air
- Heat lance - used to warm pavement when needed

Clean Crack

- BLOWERS HELP TO REMOVE THE BULK OF THE DEBRIS FROM THE ROADWAY
- TRY TO KEEP IT IN THE PROTECTED WORK ZONE

- THE CRACK NEEDS TO BE CLEAN AND DRY
- SOMETIMES TWO PASSES ARE NEEDED TO CLEAN BOTH SIDES OF THE JOINT

- THE GOAL IS TO KEEP THE DEBRIS FROM THE TRAVELING PUBLIC

Cleaning Methods

HOT-AIR LANCE

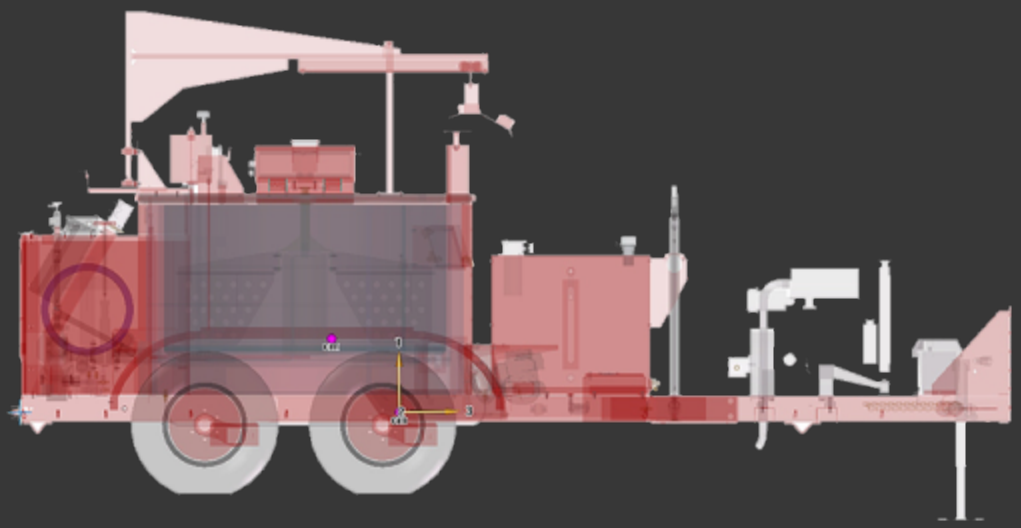
Hot Air Lances should be used to dry slightly moist pavement or heat pavement up to 40°F.

THIS PAVEMENT IS TOO WET. HOT-AIR LANCE WILL NOT BE EFFECTIVE. MOISTURE WILL RE-ENTER CRACK BEFORE SEALANT IS APPLIED.


ONE PASS IS USUALLY SUFFICIENT – GO SLOW ENOUGH TO HEAT THE JOINTS – WITHOUT BURNING THE ASPHALT

Proper Equipment - Melters

Melter Applicator



- ***Oil-jacketed***
- ***Thermostatic heat controls***
- ***Continuous agitation***
- ***Over-heating safety controls***
- ***Right size for operation***
- ***Many commercial versions…***

** ALWAYS FOLLOW THE EQUIPMENT MANUFACTURERS RECOMMENDATIONS*

Proper Equipment - Melters

- Applicator Tips:

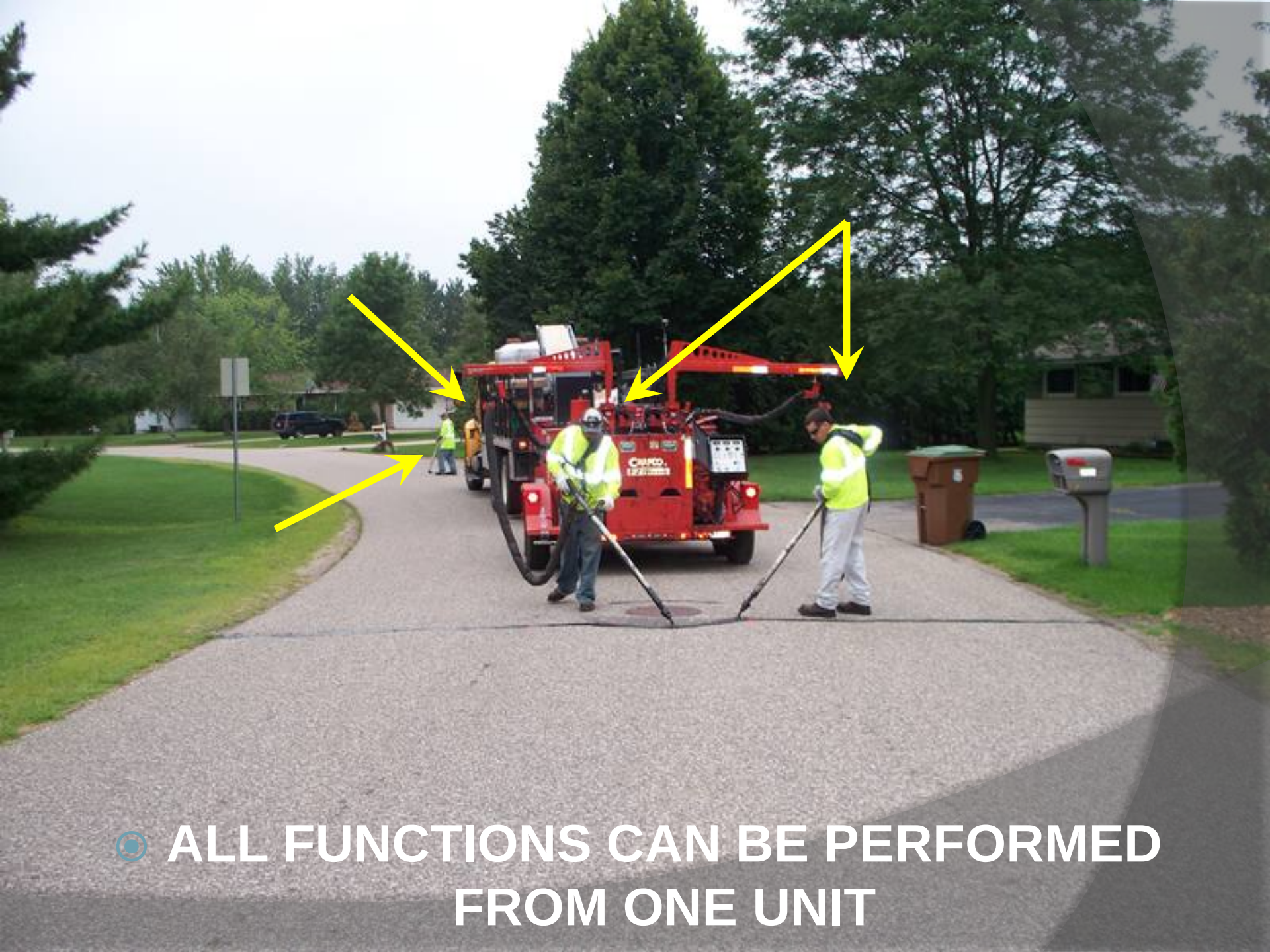
Flush Fill

Proper Equipment - Melters

Applicator Tips:

Overband

- APPLICATION TIPS COME IN ALL SHAPES AND SIZES, DEPENDING ON THE AMOUNT OF FLOW YOU NEED TO CARRY, THE WIDTH OF THE TOP BAND, OR IF IT NEEDS TO BE FLUSH FILLED



- ALL FUNCTIONS CAN BE PERFORMED FROM ONE UNIT

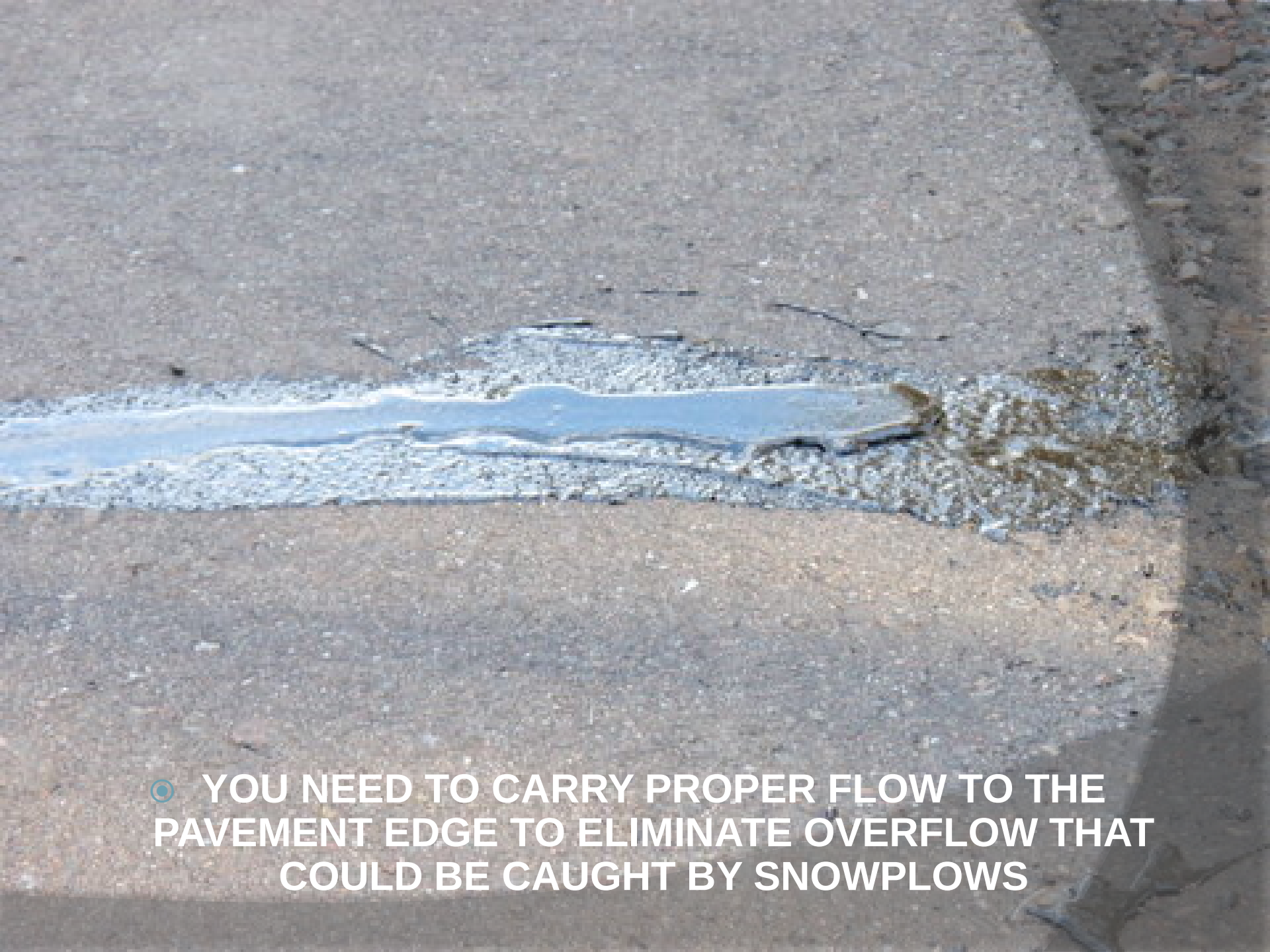
- TOUCHING UP OLD CRACKS IS COMMON WHILE FILLING NEW CRACKS AS YOU GO

- DO NOT OVER FILL THE BOTTOM OF THE RUMBLE

- THIS OVERBAND DOESN’T APPEAR TO BE WIDE ENOUGH

- SOMETIMES YOU RUN INTO “SINKERS” THAT MAY NEED MULTIPLE PASSES

- OBVIOUSLY, MOST ROADWAYS ARE MAINTAINED ONE LANE AT A TIME



- YOU NEED TO CARRY PROPER FLOW TO THE PAVEMENT EDGE TO ELIMINATE OVERFLOW THAT COULD BE CAUGHT BY SNOWPLOWS

- THIS LOOKS MUCH BETTER
- NOTE THE GREAT ADHESION TO THE ROUGH SURFACE


IN TRAFFIC AREAS AND
INTERSECTIONS, USE DE-TACK
TO KEEP THE FRESH SEALER
FROM ADHERING TO CAR TIRES

OR USE TOILET PAPER

- PREPERATION IS KEY TO SUCCESS

- LEAVING AN EFFECTIVE PAVEMENT REPAIR

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