UNH T² Center Technical Note

Cracksealing Practices and Benefits

By Chris Bourque, UNH T² Project Assistant & UNH Civil Engineering Student

Nearly all pavement damage can be attributed to water. Water infiltrates pavement through pavement cracks. This creates the freeze-thaw cycle of water, which damages the road subbase. Crack sealing is a cost-effective technique to prevent this damage to pavement.

When to Crack Seal

Crack sealing is a preventive maintenance procedure. It must be done before the road is severely damaged. Perform cracksealing routinely as part of the road maintenance plan. Inspect roads at least biannually and keep good records on road condition to determine how best to maintain it. Consider crack density and road edge deterioration when deciding on an appropriate action to take for cracks (*see Table 1*). Crack density is a general measure of the number of cracks in an area. Crack density can be low, medium, or high.

Longitudinal, transverse, and block cracks are typical occurences on the roadway. Longitudinal cracks run parallel to the length of the roadway while transverse cracks run perpedicular to the length of the roadway. Block cracks divide the pavement surface into rectangular pieces, typically 1 square foot or more in size. Use crack sealing on longitudinal, transverse, and distantly spaced block cracks.

Crack sealing strategies include partial depth patching, spot patching, microsurfacing and fog sealing. Use partial depth patching for repairs within the upper one-third of the pavement depth. Use spot patching to correct localized problems, such as potholes. Use microsurfacing and fog sealing to treat the entire road surface. Microsurfacing is a mixture of asphalt emulsion, aggregate, water, and other additives. It is properly proportioned, mixed, then spread on a paved surface. A fog seal is a light application of diluted asphalt without any aggregate applied to the pavement surface.

Crack Characteristics	Crack Treatment Activity	
	Crack Sealing (Treatment)	Crack Filling (Repair)
Width, mm	5 to 19	5 to 25
Edge Deterioration (i.e., spalls, secondary cracks)	Minimal to None (< 25 percent of crack length)	Moderate to None (< 50 percent of crack length)
Annual Horizontal Movement, mm	> 3	< 3
Type of Crack	Transverse Thermal Cracks	Longitudinal Reflective Cracks
	Transverse Reflective Cracks	Longitudinal Cold-Joint Cracks
	Longitudinal Reflective Cracks	Longitudinal Edge Cracks
	Longitudinal Cold-Joint Cracks	Distantly Spaced Block Cracks

Table 1: Corrective Action Guidelines.--Adapted from SHRP H-106

Follow these steps for a crack treatment program:

1. Review construction and maintenance records, including pavement age, design, and prior maintenance, including any recent work.
2. Inspect the pavement and record distresses.
3. Determine the appropriate type of maintenance for the pavement (*see Table 1 above*).
4. Determine whether cracks should be sealed or routed (*see Table 2 on next page*).
5. Select materials and procedures for the crack treatment operation based on climate, traffic, crack characteristics, available equipment and

Crack Characteristics	Crack Treatment Activity	
	Crack Sealing	Routing
Width, inches	1/5 (0.2) to 3/4 (0.75)	1/5 (0.2) to 1.0
Edge Deterioration (i.e., spalls, secondary cracks)	Minimal to None (< 25 percent of crack length)	Moderate to None (< 50 percent of crack length)
Annual Horizontal Movement, inches	> 1/10	< 1/10
Type of Crack	Transverse Thermal Cracks Transverse Reflective Cracks Longitudinal Reflective Cracks Longitudinal Cold-Joint Cracks	Longitudinal Reflective Cracks Longitudinal Cold-Joint Cracks Longitudinal Edge Cracks Distantly Spaced Block Cracks

Table 2: Criteria for Selecting Sealing or Routing Procedure. --Adapted from FHWA Report No. FHWA-RD-99-147 Materials and Procedures for Sealing and Filling Cracks in Asphalt-Surfaced Pavements Manual of Practice.

manpower, cost, and performance.

6. Acquire material and equipment.
7. Conduct and inspect the crack treatment operation.
8. Periodically evaluate treatment performance.

When NOT to Crack Seal

Crack sealing will not be effective on a road with significant damage. It will be difficult to fully seal the road and water infiltration is then likely. Also cracksealing is sometimes aesthetically displeasing (*see Figure 1*).

High density cracks, such as alligator and block cracking, are not good candidates for cracksealing (*see Table 1*). Alligator cracking is a grouping of cracks that form a pattern which resembles an alligator's back, and is usually a higher density than block cracks.

Do not use cracksealing to fill potholes. Instead, consider a complete surface treatment, rehabilitation, or reconstruction of the road.

Crack Sealing Materials

The three primary sealant materials used for crack sealing are cold-applied, hot-applied, and chemically-cured thermosetting materials. Variations of each material can be created. The most common variations are:

1. Cold-applied thermoplastic bituminous materials:
    a. Liquid asphalt (emulsion)
    b. Polymer-modified liquid asphalt
2. Hot-applied thermoplastic bituminous materials:
    a. Asphalt cement
    b. Fiberized asphalt
    c. Asphalt rubber
    d. Rubberized asphalt
    e. Low-modulus rubberized asphalt
3. Chemically cured thermosetting materials:
    a. Self-leveling silicone

The most commonly used materials for crack sealing are hot applied sealants. Hot applied sealants are usually asphalt cements (sometimes modified

Figure 1: Crack sealing performed on alligator cracking. An alternate solution should have been used on this road.

with rubber), which are heated to around 350 to 375 degrees F. When the sealant is applied, the material cools and the thermoplastics harden. Hot applied sealants typically last three to five years.

Cold applied sealants are also commonly used. Cold applied sealants are usually emulsified asphalt. When the sealant is applied, water evaporates from the material causing the emulsifying agent to harden. Cold applied sealants typically last one to two years.

Two advantages to using cold applied sealants are:

1. They do not require heating for application. This makes application easier and safer.
2. They may be applied in times of high humidity.

Consider performance, characteristics, and cost when choosing material. Select a sealant with high durability and flexibility for roads with high traffic volumes. Use a highly elastic material for roads with wide cracks.

Specify hot-applied sealants that meet ASTM D5078 (*Crack Filler, Hot-Applied, for Asphalt Concrete and Portland Cement Concrete Pavements*), ASTM D6690 (*Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements*), Federal Specification SS-S-1401, or specifications required by the NHDOT.

Specify sealants to meet ASTM D5893 (*silicone-based sealants*), or ASTM D7116 (*jet fuel resistant sealants*) for concrete pavements when appropriate. *Visit the ASTM website for more information: www.ASTM.org.*

Asphalt cutback materials and mineral-filled asphalts are not typically used. Asphalt cutbacks are harmful to the environment and are banned in many areas and mineral fillers (stone, lime, fly ash) are expensive.

Crack Sealing Procedure

Seal cracks in moderately cool temperatures to minimize movement in the sealant material. Thermal expansion of asphalt causes cracks to be tightest in hot temperatures and widest in cold temperatures. Spring and fall are usually ideal times to crackseal with temperatures between 45 and 65 degrees F.

Seal cracks in three steps:

1. Clean and dry the crack using a hot-air lance or a high pressure air hose. Ensure the crack surface is free of dirt and water or the sealant will not stick to the surface. Be careful not to burn the pavement when using a hot-air lance.
2. Fill cracks immediately with sealant after they are clean and dry to stop condensation or debris from entering the crack. Follow the manufacturer's and agency's guidelines on sealant installation.
3. Use a squeegee to remove excess sealant and to create an overband around the crack. An overband is a strip of sealant material centered over the surface of a crack. This protects the pavement surrounding the crack from damage. Do not form a wide overband, especially on longitudinal cracks. Sealant overbands form a surface that is much more slick than pavement and it creates a slipping hazard, especially to motorcycles.
4. Reroute traffic around the treated area until the sealant is completely dry. Protect the material with a light cover of sand, toilet paper, or sawdust if traffic must be allowed to pass over the treated area.

Crack Routing

Crack routing is an effective way to improve the quality of crack seals. Routing is cutting a rectangular section at the crack surface to provide a reservoir to place the sealant in.

To rout a crack, cut a block into the pavement centered over the crack using a pavement saw or router. Use a sharp blade to minimize spalling (cracking, breaking, chipping, or fraying of the pavement surface within 2 feet of a joint or crack). Fill the reservoir and crack with sealant by following the same procedure as regular crack sealing.

Routing will protect the crackseal since the reservoir is below the paved surface and not easily

damaged by traffic or plows. Routing also helps the sealant adhere to the pavement. The Strategic Highway Research Program (SHRP) identified standard routing as one of the most effective crack sealing methods.

Safety When Crack Sealing

Crack sealing poses a safety hazard to workers and drivers/riders. Follow all safety precautions for material handling and equipment operation provided by the manufacturer. Hot applied sealants are used at 350 degrees F or higher and require strict safety precautions.

Ensure that workers wear proper safety apparel including long sleeved shirts, long pants, safety glasses, gloves, steel-toed boots, and hard hats.

Do not allow pedestrians or vehicles near the crack sealing operation if possible.

Benefits to Crack Sealing

The major benefit of crack sealing is limiting water infiltration. Preventing water infiltration will reduce freeze-thaw damage and protect the roads' subbase. Studies by the Ministry of Transportation in Ontario support that a properly performed crack sealing treatment can extend asphalt pavement life by at least two years. The useful life of asphalt pavement is typically around eight to twelve years. Therefore, crack sealing can extend the road life by over 20%.

Figure 2 shows the difference in pavement life of a road with no maintenance versus a road that is periodically crack sealed. The road life is increased and the pavement condition improves each time the road is crack sealed. However, the road does continue to deteriorate even with crack treatment. Road deterioration is inevitable, but it can be delayed with proper maintenance.

Crack sealing also:

- prevents cracks from worsening,
- stops sand and debris from getting into cracks and damaging surrounding pavement,
- prevents potholes from forming,
- reduces tire and suspension wear for drivers, and
- assures residents that their road is considered in the municipal road maintenance plan.

Crack sealing is inexpensive compared to most other repair procedures, including road rehabilitation. Cracksealing is a valuable maintenance operation since the benefit-cost ratio is high. However, eventually crack sealing will no longer be effective and other alternatives must be used.

References

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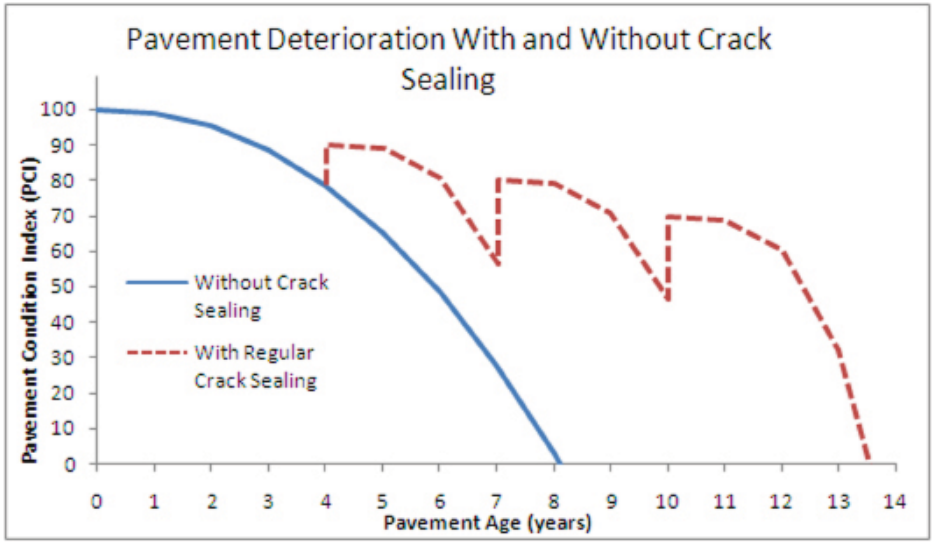

Figure 2: Pavement Deterioration With and Without Crack Sealing