Measured Effects of Joint and Crack Sealing

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Moisture in Pavement Systems

Moisture entering the pavement system through joints and cracks contributes to loss of load carrying capacity due to a reduction in base and subgrade strength and stiffness. The result is premature pavement failure. Therefore, reducing infiltration and removing excess moisture rapidly is critical with respect to pavement life.

Joints and Cracks

Longitudinal shoulder joints in concrete pavement systems, constructed with bituminous shoulders, are known to be a one of the weakest parts of the pavement-shoulder system. Additionally, this joint if not sealed, provides direct access for moisture infiltration into the pavement system. The infiltrated moisture causes settling of the adjacent shoulder, joint deterioration, as well as other distresses such as cracking, spalling, faulting, and corner breaks. The structural integrity of both the pavement and shoulder are compromised as a result of the infiltrated moisture.

Cracking in Hot Mix Asphalt (HMA) pavements also leads to increased infiltration into the pavement as well as the base and subgrade. Pavement surfaces can have hundreds of lineal feet of cracks that essentially serve as conduits into the pavement base material.

Pavement rehabilitation or reconstruction is costly. Employing preventive measures that consist of relatively inexpensive treatments, that reduce moisture infiltration into the pavement system, is important.

Preventive Maintenance

Preventive maintenance treatments, such as crack sealing, are currently being studied at the Mn/ROAD test facility and other sites on the highway system. In this issue preventive maintenance treatments are evaluated in the context of pavement drainage and moisture infiltration.

Preventive Maintenance:

The right treatment, to the right road,

at the right time.

Sealing Concrete Shoulder-Joints

The joint sealing study, conducted on drained concrete test sections at the Mn/ROAD site, involves looking at pavement drainage in response to single rain events; both before and after the shoulder joint is sealed. Precipitation data is collected from an on-site weather station while drainage data is collected using tipping buckets installed at the headwall of the edge drain outlets. Data collected before and after the joint sealing is presented in the graph below. Additionally, two precipitation events similar in volume and intensity are compared (Table 1). Initial results indicate that sealing the edge joint on concrete pavements reduces the volume of water drained through the edge drains by as much as 85%. These findings suggest that one of the primary sources of infiltration into the pavement system is through the edge joint. Therefore, it may be cost effective to seal joints to prevent infiltration, and thus reduce the potential for shoulder settlement, pavement deterioration and distress. ◄

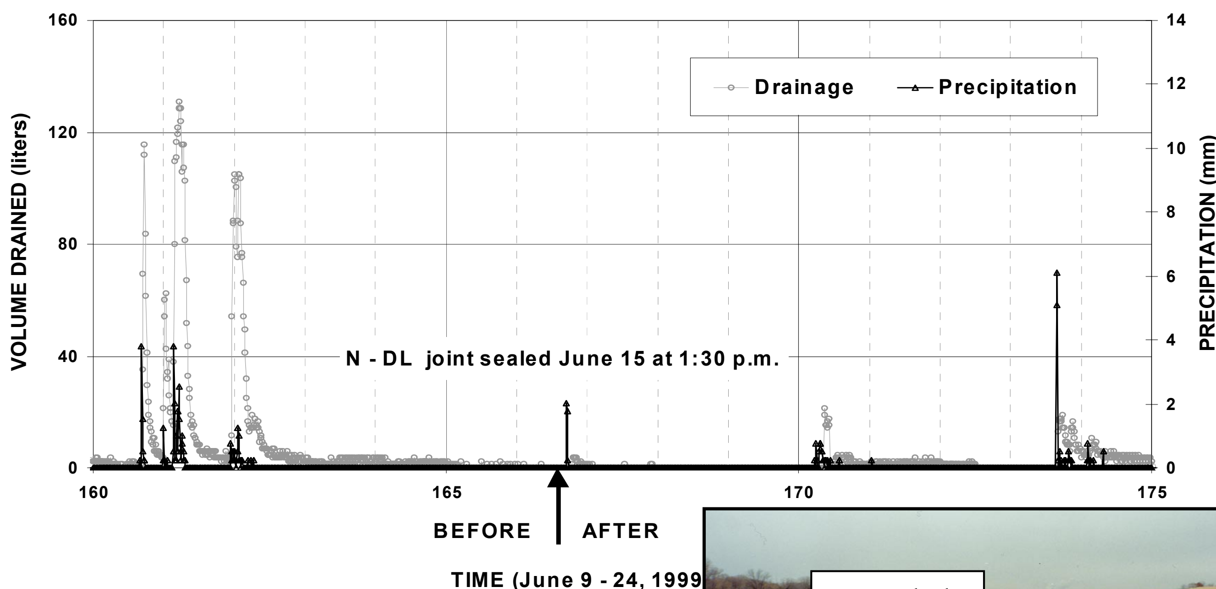
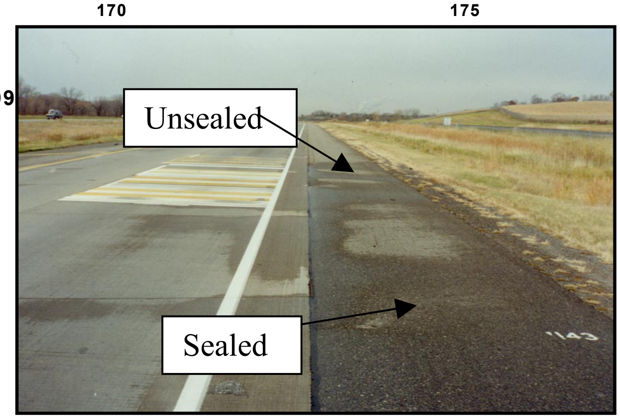


Table 1. Before and After Joint Seal

Date	Event Volume (mm)	Event Intensity (mm/hr)	Volume Drained (liters)
June 10	7.78	1.03	2553
June 15	***Edge Joint Sealed***		
June 19	6.35	0.92	423



Crack Sealing Hot Mix Asphalt

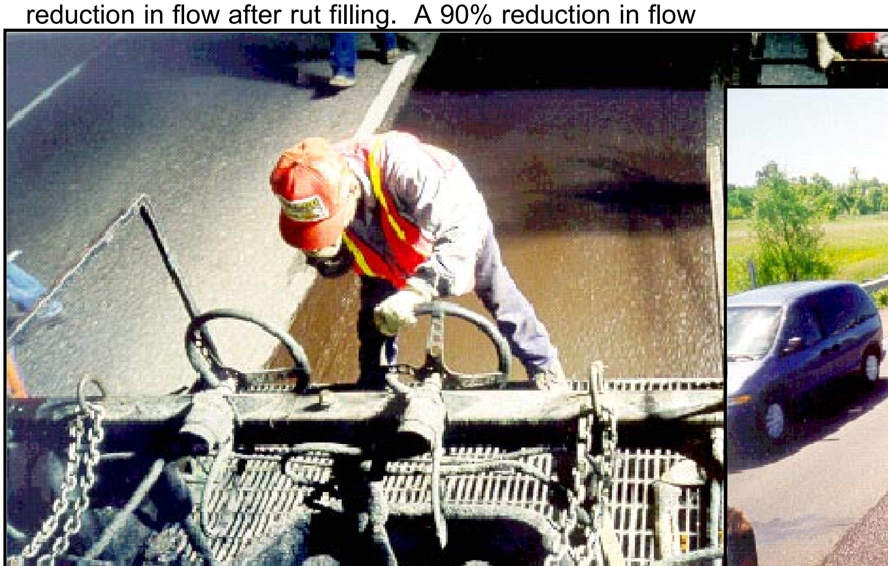
Microsurfacing

Two Mn/ROAD test cells (cells 20 and 23) were included, primarily to correct a rutting problem, in a statewide contract to evaluate microsurfacing. Although the data presented is from the microsurfacing test sections, this experiment is considered to be an experiment to verify the benefits of crack sealing. Even though microsurfacing is not intended as a means of sealing cracks, this treatment did produce a surface that is completely sealed for a period of time. That is, until cracks reflect through the treatment. MN/DOT normally uses crack sealing or crack filling procedures, on asphalt pavements, to minimize moisture infiltration into the base and subgrade.

Cell 23, which consists of 8.75 inches of HMA over 4 inches of Permeable Asphalt Stabilized Base (drainable base) has tipping buckets in place to measure the outflow of moisture from the pavement system. Tipping buckets record the number of tips within a 15 minute interval. With the application of the microsurfacing treatment, there was the opportunity to determine the reduction of moisture infiltration into the pavement system. The results from single rain events of similar intensity, both before and after the microsurfacing treatment, are presented (Table 2). There was an 83% reduction in flow after rut filling. A 90% reduction in flow

Table 2. *Before and After Microsurfacing*

Date	Event Volume (mm)	Event Intensity (mm/hr)	Volume Drained (liters)
July 3	25.9	9.4	531
July 7	***Rut Filling***		
July 25	31.8	14.0	90
August 13	***Surface Course***		
August 22	58.4	11.1	119



Maintenance Procedures

Edge Joint Sealing Procedure

Sealing the edge joint on the test section consisted of routing a 3/4" x 3/4" reservoir on the asphalt shoulder adjacent to the PCC edge. After clearing the reservoir of any debris it was filled with a MN/DOT specification 3725 sealant. In this case Crafco 522.

Microsurfacing

Microsurfacing consisted of placing a rut fill and surface course as a pavement preservation treatment. In this case, to correct rutting. The microsurfacing treatment in this study is viewed as a crack sealing experiment.

Crack Sealing

Mn/DOT normally uses crack sealing or crack filling procedures on asphalt pavements to minimize infiltration of moisture in the base and subgrade. Preferably, within 5 years of construction. The normal procedure consists of routing the crack to a 3/4" x 3/4" reservoir, and sealing with MN/DOT specification 3725 sealant (ASTM D3405 modified material).

Summary

The Mn/ROAD test facility offers some unique opportunities to conduct special experiments. One area of research where the data collected has been of great benefit to MN/DOT and other researchers, is the area of pavement drainage.

From the research presented here we know that if the edge joint is sealed, moisture infiltration is reduced. As well, if cracks are sealed there is a reduction in infiltration into the pavement system. There remains the need for continued research on the long-term performance of sealants. Continued monitoring of these sections is planned.

References

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2. Hagen, M. G. and G.R. Cochran. Comparison of Pavement Drainage Systems. Minnesota Department of Transportation Report, 1995.

3. Ahmed *et al*., Comparative Field Performance of Subdrainage Systems. Journal of Irrigation and Drainage Engineering, May/June 1997.

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