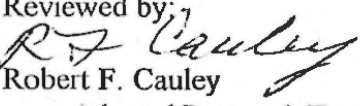



MATERIALS & RESEARCH DIVISION

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RESEARCH UPDATE

Update U97-9

VALUE OF PAVEMENT CRACK FILLING**REFERENCE:**

WP 94-R-14

HISTORY:

In 1994, a study was initiated to determine if maintenance crack filling is effective in extending pavement life. Despite failures associated with cold temperatures, and resultant crack widening, it is reasonable to assume that the filler material reduces water intrusion in the winter months and might also minimize intrusion in the warm months when the crack width is reduced. Because visual inspection alone cannot confirm the value of crack filling, performance is also evaluated by monitoring the roughness of treated and untreated road segments. If crack filling is effective, untreated segments should become rougher over the service life of the pavement.

OBJECTS:

The specific locations and types of treatment include the following:

Town	Route	Year Paved	Begin MM/Lane	End MM/Lane	Treatment
Ryegate	302	1992	1.40/Eastbound	2.40/Eastbound	Rout and Seal
Ryegate	302	1992	2.40/Eastbound	3.20/Eastbound	Heat and Seal
Ryegate	302	1992	1.40/Westbound	3.20/Westbound	None
Waterford	93	1982	2.0/Northbound	4.2/Northbound	Heat and Seal*
Waterford	93	1982	4.2/Northbound	5.4/Northbound	Rout and Seal*
Waterford	93	1982	4.0/Southbound	2.0/Southbound	Heat and Seal*
Brighton	105	1992	0.0/Eastbound	6.40/Eastbound	Heat and Seal
Windsor	105	1992	0.0/Westbound	2.29/Westbound	Heat and Seal

*These treatments alternated with no treatment at 0.2 mile intervals over the project length.

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The design of the 1992 Ryegate project included a 910 ton per mile leveling course and a 1 1/2 " overlay. Transverse reflective cracking occurred after the first winter. Because they were still quite narrow, when the cracks were filled as a part of the study in October 1994, a router was used to widen the crack, creating a 3/4" wide by 3" deep reservoir on a one mile segment of the eastbound lane.

The crack filling on I 93 in Waterford was also completed in October 1994. At the time of inspection the pavement was 12 years old and cracking was extensive.

VT 105 in Brighton and Ferdinand was overlaid with a leveling course and a 1 1/4" overlay in 1992. A preconstruction crack survey was accomplished before the commencement of this project. During an inspection in the summer of 1993, it was determined that 30% of the cracks observed during the initial survey had reflected up through the new overlay. The width of the transverse cracks remained quite narrow, and the crack filling operation was not completed until early May of 1995, alternating between the east and west bound lanes.

OBSERVATIONS:

The projects were inspected during March 1996. Results were as follows:

Route	Location (MM)	Town	Total inches	Cracked in.	Percent	Width	Type
302	0.33	Ryegate	132	35	26	<1/8"	R/S
302	0.83	Ryegate	132	41	31	<1/8"	R/S
302	2.40 EB	Ryegate	120	68.5	57	<1/8"	B/S
93	3.8(#2) SB	Waterford	144	134	94	1/8"	B/S
93	3.8-20 SB	Waterford	144	62	43	1/8"	B/S
93	2.05+50 SB	Waterford	144	19	13	1/8"	B/S
93	4.2+0 SB	Waterford	144	20	14	1/8"	R/S
93	4.2+50 SB	Waterford	144	1 1/2"	1	1/8"	R/S
105	#2 EB	Brighton	132	54	41	1/8	B/S
105	7.8-15 EB	Brighton	132	31	23	1/8	B/S
105	7.8+15 EB	Brighton	132	1	0.7	<1/8"	B/S
105	1.00 WB	Ferdinand	132	48	36	<1/8"	B/S
105	#6 WB	Ferdinand	120	7	6	<1/8"	B/S

1996 INSPECTION

Ryegate US 302: At the time of the inspection on March 15, 1996, the air temperature was about 20°F and crack filler did not appear to be in tension. Although there were almost no visible open cracks in the filler itself, either the routed or heated segments, areas which probably opened up during previous cold weather were visible in the form of numerous, short, tight cracking of the crack filler material. In the routed section, each treated transverse crack contained some cracks in the filler material, but even where up to 10 inches of such cracking was noted per

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Not of crack-filled sections, numerous short, non-distressed areas were also noted. Simply stated, continuous cracking more than several inches in length was almost non-existent. The total percent of cracking of the sealant material over the lane width ranged from 26% to 62% on the five routed cracks inspected.

The area treated with the burn and seal (hot air lance) treatment looked good but had from 57% to 86% cracking over the lane width. The increase in sealer failure is reasonable considering the fact that the pavement cracks were narrow (1/8" to 3/16") when filled compared to the 3/4" wide by 3/8" deep reservoir created on the routed section. As had been noted on the routed cracks, some water intrusion could occur but nothing like the volume of water which could enter the untreated cracks on the eastbound lane.

The untreated cracks in the eastbound lane averaged about 3/8" in width. Raveling of the edges was limited but where it had occurred, crack widths up to 3/4" were noted. Although the untreated cracks have certainly allowed more moisture to penetrate to the subbase, no difference in eastbound vs westbound ride was detectable.

Waterford I 93: An inspection of the project on March 15, 1996 revealed overall success with between 1% and 20% crack filler failure on the routed NB test section. The heated and sealed section on the SB lane was also considered successful, although the crack failure rate was much higher, ranging between 13 and 94%. This is because even where the sealant had failed, crack width in the sealant material was minimal and any intrusion of water would also have been minimal under such conditions.

Brighton VT 105: During the survey of March 1996, it was observed that the width of the filled cracks averaged about 3 mm. The amount of sealant failure ranged from 1% to 41% with an average of 21%. The visible cracks in the sealant were not open a measurable amount at the time of inspection.

1997 INSPECTION

The above areas were inspected in May 1997 during an extended period of warm weather. All of the crack sealed areas on US 302 and VT 105 exhibited better internal adhesion than in March 1996. This is to be expected given the warmer temperatures in May. However, almost all of the inspected cracks on Interstate 93 were separated more at this time than during the previous inspection. It is unclear why this is the case as these failure areas occur where different sealing methods were used, and were in both the NB and SB lanes. The age of the pavement (15 years vs. 5 years for the other two projects) may have been a contributing factor in this case. The following table illustrates these results:

Route	Location	Total Cracks (in)	1996 Observed Cracks (in)	1996 %	1997 Observed Cracks (in)	1997 %	% Change
US 302	MM 2.40 EB, Ryegate	120	68.5	26	6	5	-21
I 93	MM 3.8 #2, Waterford	144	134	94	107	74	-20
I 93	MM 2.05 +50 SB, Waterford	144	19	13	80	55	+42
I 93	MM 4.2 +50 SB, Waterford	144	1.5	1	3.5	2.4	+1.4
VT 105	7.8 - 15 EB, Brighton	132	31	23	10	7.5	-15.5
VT 105	MM 1.00 WB, Ferdinand	132	48	36	42	32	-4

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TRAFFIC DATA AND IRI

Overall, US 302 in Ryegate has a higher percentage of truck traffic as compared with the other two areas. IRI in this area is also the lowest of the three projects. The area in Brighton and Ferdinand also showed no appreciable difference due to the supposed high truck traffic in the east bound vs the west bound lanes. The worst IRI results are on I 93, where it is possible that no measurable difference in roughness occurred due to the fact that the 13 year old pavement (i.e., 13 years old at the time of the crack filling) was already rough before the cracks were filled. This area also has the highest AADT, as well as the higher DHV. Traffic data and IRI for the three areas are as follows (No crack filling was done on US 302 WB in Ryegate):

Town	AADT	DHV	%Trucks (DHV)	IRI (Treated) (1997)	IRI (Untreated) (1997)
Ryegate, US 302	2825	385	60%	78 (East) -----	91 (East) 88 (West)
Waterford, I 93	3160	485	45%	128 (North) 160 (South)	124 (North) 164 (South)
Brighton, VT 105	790	170	47%	101 (East) 86 (West)	97 (East) 99 (West)
Ferdinand, VT 105	660	140	47%	see above	see above

COST DATA

Data from the 1995 maintenance season indicate that overall the cost for crack filling was \$1.16/lb. This number is not constant and can change quite a bit from season to season. As an example, the costs were \$1.68, \$1.96, \$1.10, and \$1.16/lb from 1992 to 1995 inclusive. In 1995, 2508 lbs/mi were placed making the total cost per mile \$2,919.

CONCLUSION

The significant difference encountered on I 93 may be the result of the age and the roughness of the pavement. Taking this into account, after three winters of exposure, observations suggest the crack filling procedure is worthwhile and routing appears preferable to the hot lance treatment. It should be noted that routing may not be needed or preferred where the cracks have opened up significantly prior to the beginning of a sealing operation.

FOLLOW UP

These projects will continued to be surveyed and evaluated, and future reports will be issued as significant data are collected.