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AGENCY OF TRANSPORTATION

ASSESSMENT OF THE 40" WIDE PAVING SKID BOX FOR PREVENTATIVE MAINTENANCE

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16. Abstract

VTrans has typically employed common preventative maintenance treatments (PMTs) such as bituminous crack fill sealant, chip seal, micro-surfacing, slurry seal, cape seal, fog seal, paver placed surface seal, ultra-thin bituminous overlay, cold milling and bituminous overlays, and hot-in-place bituminous overlays. These treatments have proven to be effective. Their costs however can be fairly expensive depending on the treatment and roadway type. The average winning bid price was approximately $1.6 million to treat an approximate average of 12 miles of state maintained highways from 2009 to 2011. Many state maintenance departments are investigating ways to repair deteriorated roadways at lower costs. VTrans Operations division has contracted with ST Paving located in Waterbury, VT through a Category II Maintenance Rental Agreement (CAT II MRA) to address several distresses along four sections of roadway in central Vermont in a cost-effective manner. The project repaved a 40 inch wide area around the right wheel paths in each direction, rather than repave the entire roadway surface.

The goal of the project is to eliminate water penetration, stop further failures, repairing and improving the ride, and extend the service life of the existing pavement. These goals will further improve safety in these areas by: 1) eliminating water retention and hydroplaning; 2) reducing roughness for cars and bicyclists; and 3) eliminating snow retention thus reducing the amount of salt needed for winter maintenance to clear the roadways. This report outlines the effectiveness of the process used as well as the 40" skid box on the sections of US Route 2.

Sites visits with observation of rutting and cracking show an improvement in performance over the period of this study, and allow for an extended service life of this roadway segment.

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1. Introduction

Bituminous concrete pavements deteriorate over time due to several distress factors including water infiltration, temperature extremes, inadequate structural layers, construction quality, temperature susceptibility including freeze thaw cycles, aging characteristics of the asphalt cement, and vehicular loading [1]. Research has shown that water infiltration is one of the most common factors leading to accelerated deterioration. This can cause cracking, raveling, oxidation, stripping, and softening or weakening of the base and/or subbase. This damage leads to a loss of structural support and subsequently a shorter life span in asphalt pavements. Studies have shown that an increase in moisture from 16 to 18 percent in silty clay can cause a 75 to 100 percent reduction in strength, as measured by the California bearing ratio [2]. Free water in granular base courses can reduce their strength by 25 percent or more under dynamic load [2].

Ever increasing construction costs combined with a rapidly deteriorating highway infrastructure has prompted State Transportation Agencies to seek cost effective methods for increasing the service life of pavements. Pavement preservation, according to the American Association of State Highway and Transportation Officials (AASHTO), is a planned strategy of cost-effective treatments to an existing roadway system that preserves the system, retards future deterioration and maintains or improves the functional condition of the system without significantly increasing structural capacity. The application of a preventative maintenance treatment at the proper time provides a cost effective alternative that typically extends the serviceability of the pavement until the time when a corrective (or rehabilitative) treatment is needed. Studies have shown that any delay in preventative maintenance directly increases the quantity and severity of pavement defects, consequently resulting in higher costs over time [3].

VTrans has typically employed common preventative maintenance treatments (PMTs) such as bituminous crack fill sealant, chip seal, micro-surfacing, slurry seal, cape seal, fog seal, paver placed surface seal, ultra-thin bituminous overlay, cold milling and bituminous overlays, and hot-in-place bituminous overlays. These treatments have proven to be effective. Their costs however can be fairly expensive depending on the treatment and roadway type. The average winning bid price in Vermont for these treatments was approximately $1.6 million to treat an approximate average of 12 miles of state maintained highways from 2009 to 2011. Many state maintenance departments are investigating ways to repair deteriorated roadways at lower costs. In 2012, the VTrans Operations Division contracted with ST Paving located in Waterbury, VT through a Category II Maintenance Rental Agreement (CAT II MRA) to address several distresses along four sections of roadway in central Vermont in a cost-effective manner.

The goal of the project is to eliminate water penetration, stop further failures, repairing and improving the ride, and extend the service life of the existing pavement. These goals will further improve safety in these areas by: 1) eliminating water retention and hydroplaning; 2) reducing roughness for cars and bicyclists; and 3) eliminating snow retention thus reducing the amount of salt needed for winter maintenance to clear the roadways. This report outlines the effectiveness of the process used including the 40” skid box on the sections of US Route 2.

2. Project Location and Summary

This project was set in two different locations along US Route 2 in central Vermont. The first section began at the Middlesex Maintenance Garage at MM 0.0 and extended eastward 3.2 miles. The FHWA Approved Work Plan (2012) states that along the first section, there were an observed 114,580 linear feet of ruts and cracks. The second section began at the intersection of VT Route 100 and extended eastward 2.8 miles. Along the second section, there were 14,113 linear feet of cracks and ruts.

The four test sites were located along the first section. Mile markers for the beginning of each test site were recorded. Cracking and rutting were analyzed in 200’ sections. Table 1 shows the mile markers of the test site locations. Test site visits were conducted pre construction, during construction, post construction, and twice annually thereafter. The results of each survey where analyzed in the office and the subsequent data recorded. There were only two cracking surveys administered: once before construction and once after construction. Rutting readings were taken every 50’ starting with the beginning mile marker for each test section. Readings were taken on the eastbound left and right wheel path and identical readings were taken for the westbound lane.

Table 1: Project Mile Marker Test Site Locations

Test Section ID	Beginning MM	Ending MM
TS 1	2.78	2.82
TS 2	2.2	2.34
TS 3	2.35	2.39
TS 4	2.96	3

3. Material Description

The pavement used in this study was Type IV 50 Blow Marshall Bituminous Concrete Pavement. The binder used was PG 52-34. Construction can be seen in Figure 1. The pavement was applied through a five-step process. The first; cold planning at variable depths at a width of 40", second; sweeping before the application of the emulsion tack coat. The third step; applying the emulsion tack coat, which was a rapid setting (RS-1(h)). The fourth step; paving at variable depths using the 40" skid box. Lastly, the pavement was then rolled for compaction.

Figure 1: Construction

4. Performance and Observations

4.1. Initial Conditions

Initial conditions before construction began were taken in spring 2012, then twice during construction once after the milling of the westbound lane (5/14/12) and once after the milling of the eastbound lane (5/21/12). Although, at TS1 the post milling readings were missed due to the paving operations being earlier than expected. Additionally, at TS4 there was no repair to the eastbound lane. Table 2 shows the average rutting for each lane in each test site throughout the pre and post construction process. The cracking summary pre and post construction are shown in Table 3. It is important to note that the cracking results are only for the repaved area in each lane.

Table 2: Average Rutting (inches)

	Pre-Treatment				After Milling -Westbound Lane 5/14/12				After Milling -Eastbound Lane 5/21/12			
Test Site	EB R WP	EB L WP	WB L WP	WB R WP	EB R WP	EB L WP	WB L WP	WB R WP	EB R WP	EB L WP	WB L WP	WB R WP
TS 1	0.6	0.5	0.35	0.55					1.6	0.4875	0.2875	0.4875
TS 2	1.025	0.1625	0.1125	0.7875	0.275	0.225	0.175	1.75	1.925	0.225	0.1643	0.825
TS 3	1.05	0.3125	0.175	0.7625	0.1375	0.35	0.1625	1.675	1.7375	0.3125	0.1875	1.1125
TS 4	0.1125	0.225	0.2	2.1375	0.2	0.8125	0.175	1.8875				
	After Paving 6/1/12				3/1/2013				7/18/2013			
Test Site	EB R WP	EB L WP	WB L WP	WB R WP	EB R WP	EB L WP	WB L WP	WB R WP	EB R WP	EB L WP	WB L WP	WB R WP
TS 1	0.375	0.5	0.4125	0.3	0.425	0.6	0.35	0.275	0.35	0.2	0.15	0.275
TS 2	0.375	0.1625	0.1	0.0125	0.175	0.175	0.125	0.275	0.65	0.2	0.15	0.2
TS 3	0.2875	0.3375	0.2	0.0625	0.4	0.3	0.125	0.2	0.375	0.375	0.2	0.2
TS 4	0.1875	0.2625	0.25	0.0125	0.2	0.25	0.2	0.275	0.25	0.275	0.3	0.325
	4/2/2014				8/11/2014				3/18/2015			
Test Site	EB R WP	EB L WP	WB L WP	WB R WP	EB R WP	EB L WP	WB L WP	WB R WP	EB R WP	EB L WP	WB L WP	WB R WP
TS 1	0.25	0.55	0.45	0.275	0.25	0.75	0.35	0.275	0.45	0.625	0.425	0.35
TS 2	0.575	0.25	0.175	0.225	0.95	0.2	0.125	0.4	0.525	0.35	0.225	0.4
TS 3	0.625	0.525	0.2	0.275	0.725	0.35	0.2	0.275	0.375	0.425	0.35	0.4
TS 4	0.325	0.3	0.275	0.2	0.25	0.275	0.3	0.2	0.35	0.275	0.3	0.375

Table 3: Average Cracking (feet)

	Preconstruction			Year 1			
Test Site ID	Fatigue	Transverse	Total	Fatigue	Transverse	Reflective	Total
TS1	765	254	1398	116	40	n/a	156
TS2	133	224	626	241	31		272
TS3	467	362	1314	280	12		292
TS4	720	469	2140	287	0		287

4.2. Observations

The site was visited in March 2013 and July 2013 to evaluate the repair and measure rutting in each test site. Photographs and general observations were made at each visit. Figure 2 shows each test site during the April 2014 visit. Because the only sections milled and paved were around the right wheel paths for both lanes the only way to measure the effectiveness of the 40” pave box is by comparing the milled sections pre and post construction. Figure 3 shows the rutting values for the for the eastbound right wheel path over the test period. Of note, the high value on 5/21/12 shows the depth of milling, prior to repaving. As the data suggest, the repaved section is preforming well and maintained rutting values less than the preconstruction over the test period. The westbound lane also has similar results for overall rutting, as shown in figure 4, with the milled depth being registered on 5/21/12. Paving for both directions was completed on 6/1/2012. The cracking summary for the two surveys is shown below in Figure 5, with 2012 representing preconstruction and 2013 showing results of one year of use. The percent reductions of all cracks are shown in Table 4. Test site 2 showed an increase in fatigue cracking post construction, likely related to the westbound lane fill being underflush with adjacent pavement and the eastbound lane fill being overflush with adjacent pavement.

Test Site 1

Test Site 2--Westbound

Test Site 3

Test Site 4

Figure 2: April 2014 Site Visits

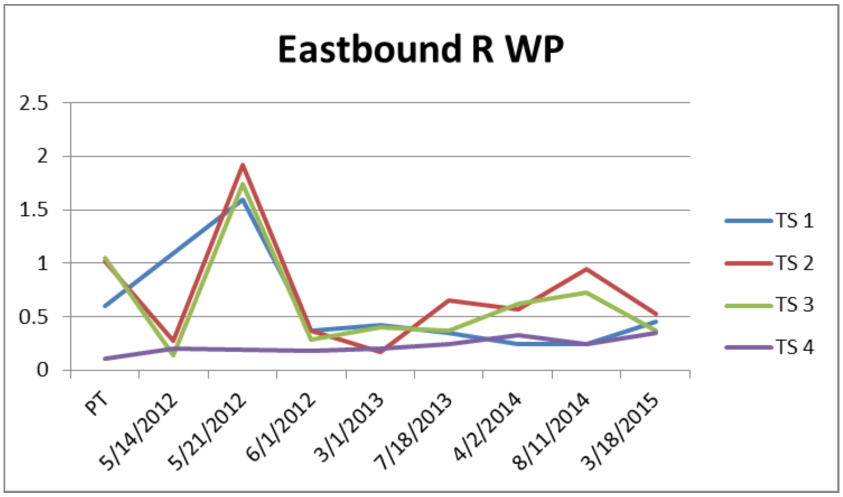

Figure 3: Eastbound right wheel path rutting

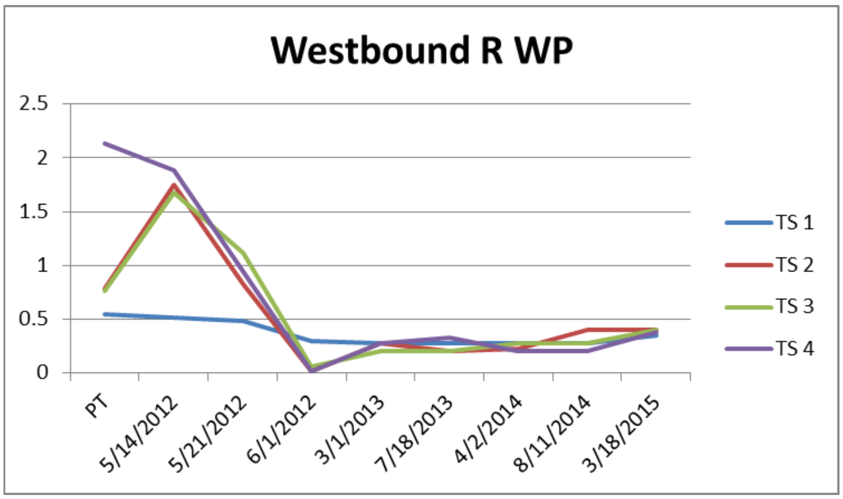

Figure 4: Westbound right wheel path rutting

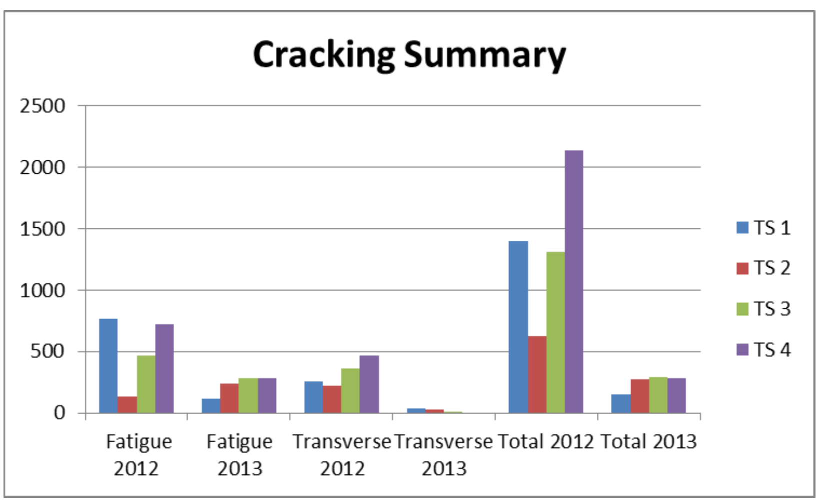

Figure 5: Cracking Summary

Table 4: Cracking Percent Reduction

	Percent Reduction		
Test Site ID	Fatigue	Transverse	Total
TS1	85%	84%	57%
TS2	81%	86%	57%
TS3	40%	97%	78%
TS4	60%	100%	87%

5. Summary and Recommendations

The purpose of this study was to examine and evaluate the constructability, overall performance and cost effectiveness of using this repair method. Research personnel assessed the existing pavement condition prior to construction to document all distresses, construction practices, and visited the sites annually to document any failures. Overall, the performance of the skid box (repaving only under the right wheel path) was effective in reducing cracking as well as repairing rutting. The data from this project suggest that using the 40" skid box to repair distressed sections is a viable alternative to repairing and repaving an entire section of road. Rutting was significantly reduced and remained so for the entirety of the project, as well the total cracking within the repaved project sections was reduced as well for the period of this study.

6. References

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