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INVESTIGATIVE REPORT

U2014-01

Assessment of Extendo-Pave, a Polymer Crumb Rubber Crack Fill vs Standard Type II and Type IV Crack Fill

INTRODUCTION:

The purpose of this study is to examine and evaluate the constructability, overall performance, and cost effectiveness of Extendo-Pave, a polymer and crumb rubber modified asphalt compound with reinforcing fibers crack fill material versus ASTM D6690-12 Type II and Type IV Crack Fillers. It is reported that Extendo-Pave will not deteriorate from age and/or weather, is designed to maintain a strong resistance to softening, flow and cracking, prevents future water infiltration due to increased bond strength, and includes ambient-ground recycled tire rubber that gives it elasticity and flexibility in any climate (*1*).

As requested by the VTrans Pavement Management Section, the objective of this evaluation was to assess each product's durability at each location in specific test site locations, which were determined during preconstruction. All cracks were filled or sealed according to the project plans. For the purpose of this study, working cracks were defined as those experiencing 1/8 inch or more vertical or horizontal movement due to temperature changes and vehicular loading. All non-working cracks were defined as having less than 1/8 inch vertical or horizontal movement. Efforts were made to provide a comparative analysis with regard to performance and cost of all material types.

PRODUCT DESCRIPTION:

Extendo-Pave is produced by Tri Products, LLC of Watertown, Massachusetts. According to product literature, the material is composed of a modified asphalt-fiber compound designed especially for improving strength and performance of the parent asphalt sealant. The material consists of a blend of 1) Asphalt binder that meets PG 64-28E and grade requirements of AASHTO M320-10 and AASHTO T350-14/M 332-14; 2) Chemically modified crumb rubber consists of a minimum of 7% crumb rubber, and the maximum particle size for recycled tire rubber is 80 mesh (#80 sieve or 0.007 inch); and 3) Fiber reinforcing polymer package that are short-length polyester fibers (0.25 in +/- 0.02 in) (*2*).

The Type II and Type IV crackfill that were used on the project were both common materials used statewide. The Type II product was Road Saver 221 and Type IV was Road Saver 231. Both materials are manufactured by Crafco.

PROJECT LOCATION

An approximately 8.5 mile section along VT Route 25 in the towns of Bradford, Corinth, and Topsham was selected for the evaluation as it was already scheduled for crack filling during the summer of 2013 as part of the Statewide Crackfilling project, STP CRAK (31).

A total of 12 test sites to monitor distresses over time were selected prior to construction. Distresses include adhesion, spalling, cohesion, and overall crack width spreading. Longitudinal cracking was noted to be minimal throughout the length of the roadway segment. Because of this 1-2 sites were chosen per material type that incorporated at least 1 longitudinal crack for monitoring. Four transverse cracks were chosen for evaluation in each test site except in test site 3 which focused on longitudinal cracking. All transverse cracks extend across both lanes of road when possible. The test site locations are shown in Table 1 below.

Table 1: Test site locations.

Crackfill Type	TS #	Town	MM
Extendo-Pave	1	Bradford	6.753
	2	Bradford	7.026
	3	Corinth	0.300
	4	Corinth	0.943
Type II	5	Corinth	1.850
	6	Corinth	2.053
	7	Corinth	2.500
	8	Corinth	2.600
	9	Corinth	3.173
	10	Corinth	3.300
Type IV	11	Topsham	2.400
	12	Topsham	2.905

CONSTRUCTION:

Sealcoating Inc. of Braintree, Massachusetts installed the Extendo-Pave for approximately 2 miles from MM 6.376 in Bradford to MM 1.345 in Corinth on April 30th, 2013. Nicom Coatings Corporation of Berlin, Vermont installed both the Type II and IV crackfill. The Type II crackfill was installed on August 27th and August 28th, 2013 from MM 1.345 in Corinth to MM 1.9 in Topsham for an approximate distance of 4.5 miles. The Type IV crackfill was installed August 29th from MM 1.9 to MM 3.9 in Topsham for a total distance of 2 miles.

Both the Extendo-Pave and the Type II crackfill were installed utilizing the "blow and go" application method. With the blow and go method, the cracks were cleaned using a hot air lance prior to placing the crackfill (see Figures 1 and 2.) The blown hot air is used to remove any dirt and debris and to ensure the cracks were dry as well as hot enough to improve the bonding of the material and pavement.

The Type IV crackfill material was installed utilizing the "route and seal" method. With this method, a pavement cutter or router is used to cut reservoirs approximately ¾" wide by ¾" deep (see Figure 3.) All cut areas were then cleaned using a hot air lance before the cracks were filled. All operations were completed without incident.


Figure 1: Hot air lance.


Figure 2: Blow and go crackfilling.


Figure 3: Typical routing operation.

PERFORMANCE:

Initial Visit

The sites were visited after crackfill installation on May 20th, 2013 for test sites 1-4 in the Extendo-Pave section and on September 6th and 11th, 2013 in test sites 5-12 in the Type II and Type IV sections.

At these visits nails were placed perpendicularly on either side of each crack selected for monitoring. The distance between each set of nails was measured. The distances will be measured during each site visit to determine the amount of movement of each crack. Cracks that move more could be expected to develop more crack fill distresses in the future. The nail distances were measured with the use of a set of calibrated calipers with a 1/1000th of an inch resolution. There was no adhesion, spalling, or cohesion distresses noted in any test site at this visit. Figures 4-7 below depict the filled cracks in each section. Figures 4, 8, and 12 shows the same crack during the three visits over 2013-2014. Figures 5, 9, and 13 the same. As well as Figures 6 and 10.

Figure 4: Transverse crack in test site 2 in the Extendo-Pave section.

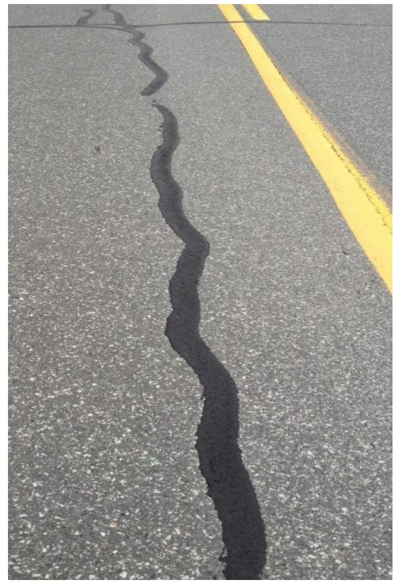

Figure 5: Longitudinal crack in test site 3 in the Extendo-Pave section.

Figure 6: Tranvserse crack in test site 7 in the Type II section.

Figure 7: Transverse crack in test site 12 in the Type IV section.

<u>First Year - Winter</u>

The first year winter visit was conducted on January 17th, 2014. The weather was noted to be sunny during this visit. The high temperature for the day was 32°F and the low was 27°. At this visit it was noted that no cohesion distresses (splitting or cracking of the sealant material) were noted. There was minimal spalling (weakening of the pavement around joints and cracks), averaging 1% and it was isolated to test sites 11 and 12 where the cracks were routed.

Adhesion distress (sealant peeling away from crack wall) within the transverse cracks was 9% in the Extendo-Pave section and the 8% in the Type II section. The Type IV product exhibited a much lower percentage, averaging 2%. For longitudinal cracks, the adhesion distress average was much higher for the Extendo-Pave product, averaging 34%, where the Type II averaged 2% and Type IV averaged 0%.

Nail movement for transverse cracks was noted to be the largest in the Type II section, averaging a 0.129 inch increase. Extendo-Pave averaged 0.053 inches and Type IV averaged 0.083 inches. For longitudinal cracks, the nail movement increase was largest in the Extendo-Pave section, averaging 0.192. Followed by Type II at 0.140 inches and Type IV, 0.064 inches. Figures 8-11 depict typical distress seen during this site visit.

Figure 8: Adhesion loss in transverse crack in test site 2 in Extendo-Pave section.

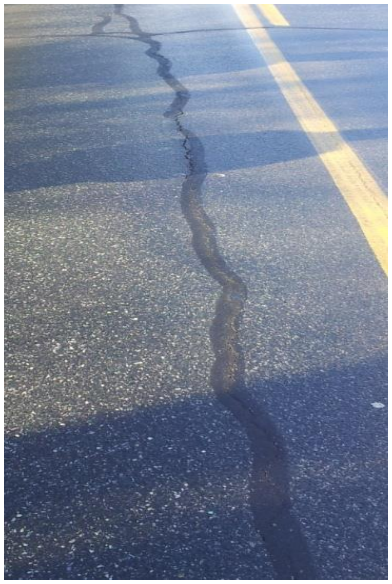

Figure 9: Longitudinal crack in test site 3 in Extendo-Pave section.

Figure 10: Adhesion loss in transverse crack in test site 7 in the Type II section.

Figure 11: Spalling distress in test site 12 in Type IV section.

First Year – Summer

The first year summer visits were completed on July 30th and August 1st, 2014. The weather was noted to be sunny during both days of this visit. The high temperature for the July 30th was 64°F and the low was 46°F. On August 1st the high was 66°F and the low was 48.9°F. Similar to the winter visit, there was no cohesion distress noted in any of the test sites and spalling was again isolated to test sites 11 and 12 and was noted to be minimal, averaging 4%.

Adhesion distress significantly increased, presumably due to the below average temperatures and numerous freeze-thaw cycles in the months following the winter site visit. Within the transverse cracks, Extendo-Pave averaged 43% failure, Type II averaged 25%, and Type IV averaging 4%. For longitudinal cracking, Type II and IV fared better, averaging respectively 12% and 0%. The Extendo-Pave averaged 78% failure rate. There were four longitudinal cracks monitored in this section. Of the four, one crack was 25%, one crack was 85%, and the other two were 100% failed where the crackfill was not intact. As a note, the two transverse measurements taken in this test site had higher failure percentages than the rest of the transverse measurements. The two measurements were 96% and 90% failed.

Nail movement increase for transverse cracks was noted to be the largest in the Extendo-Pave section, averaging an increase of 0.066 inches from original. Type II averaged 0.033 inches and Type IV averaged 0.022 inches. For longitudinal cracks, the nail movement increase was largest in the Type II section, averaging 0.042 inches. Based on the average nail movement increase, all cracks were non-working cracks. Followed by Extendo-Pave at 0.039 inches and Type IV, 0.024 inches.

All first year average distress data which is displayed both in inches and percentage of each original crack length and average nail movement increase are shown in Table 3-5. Cohesion distress was excluded from the table because there was no distress of this type noted in any of the test sites. Figures 12-15 depict typical distress seen during this site visit.

Table 2: Average 1st year adhesion failure.

Material Type	Crack Type	Fill Method	Adhesion			
			Winter 1	% Winter 1	Summer 1	% Summer 1
Extendo-Pave	Transverse	Blow and Go	12	9%	55	43%
Type II	Transverse	Blow and Go	9	8%	32	25%
Type IV	Transverse	Route and Seal	2	2%	5	4%
Extendo-Pave	Longitudinal	Blow and Go	82	34%	186	78%
Type II	Longitudinal	Blow and Go	3	2%	23.	12%
Type IV	Longitudinal	Route and Seal	0	0%	0	0%

Table 3: Average 1st year spalling failure.

Material Type	Crack Type	Fill Method	Spalling			
			Winter 1	% Winter 1	Summer 1	% Summer 1
Extendo-Pave	Transverse	Blow and Go	0	0%	0	0%
Type II	Transverse	Blow and Go	0	0%	0	0%
Type IV	Transverse	Route and Seal	1	1%	5	4%
Extendo-Pave	Longitudinal	Blow and Go	0	0%	0	0%
Type II	Longitudinal	Blow and Go	0	0%	0	0%
Type IV	Longitudinal	Route and Seal	1	1%	0	0%

Table 4: Average 1st year nail width increase.

Material Type	Crack Type	Fill Method	Average Nail Width Increase (Inches)	
			Winter 1	Summer 1
Extendo-Pave	Transverse	Blow and Go	0.053	0.066
Type II	Transverse	Blow and Go	0.129	0.033
Type IV	Transverse	Route and Seal	0.083	0.022
Extendo-Pave	Longitudinal	Blow and Go	0.192	0.039
Type II	Longitudinal	Blow and Go	0.140	0.042
Type IV	Longitudinal	Route and Seal	0.064	0.024

Figure 12: Adhesion distress in longitudinal crack in test site 3 in Extendo-Pave section.

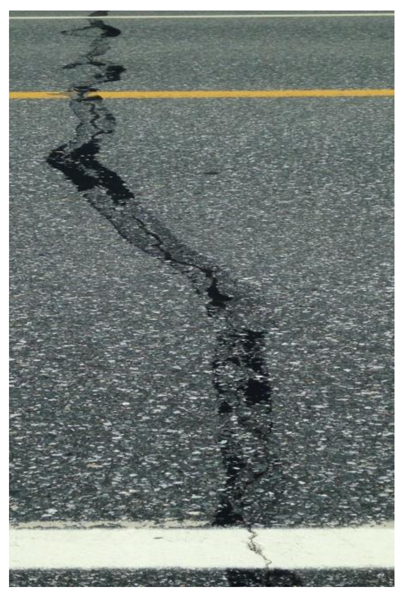

Figure 13: Adhesion distress and wearing in transverse crack in test site 4 in Extendo-Pave section.

Figure 14: Adhesion distress in longitudinal crack in test site 5 in Type II section.

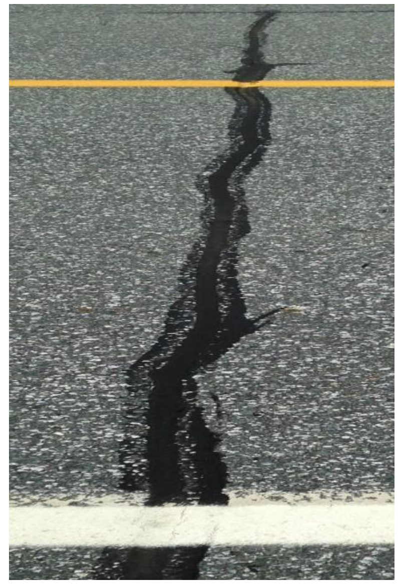

Figure 15: Transverse crack in test site 12 in Type IV section.

FOLLOW-UP:

Measurement results reveal that the average amount of Extendo-Pave crack fill material that allows water infiltration after one year is 43% for transverse cracks and 78% for longitudinal. These values are considerably higher than the control sections consisting of typical Vermont Agency of Transportation prescribed materials and installation methods. Due to the distresses measured over the 12-15 month evaluation period it has been concluded that the experimental Extendo-Pave crackfill product does not meet the Agency's needs. No further evaluation will continue on any products at this location.

REFERENCES:

1. "Extendo-Pave Crack Sealant." Tri-Products Product Advertisement.
2. "Extendo-Pave Crack Sealant Specification No. 1E." Sealcoating Inc. http://www.sealcoatinginc.com/specs/2014-Random-Crack-Sealing-Specification.pdf.

APPENDIX A

Table A1 Original nail distances and crack lengths.

Material Type	Test Site	Crack #	Lane	Crack Type	Crack Length (inches)	Year 1 Winter Change (inches)	Year 1 Summer Change (inches)
Extendo-Pave	1	1A	NB	Transverse	144.0	0.030	0.017
		1B	SB	Transverse	134.4	0.049	0.005
		2A	NB	Transverse	98.4	0.075	0.071
		2B	SB	Transverse	139.2	0.053	0.239
		3A	NB	Transverse	139.2	0.025	0.000
		3B	SB	Transverse	141.6	0.063	0.182
		4A	NB	Transverse	139.2	0.066	-0.118
		4B	SB	Transverse	122.4	0.027	-0.022
	2	1A	NB	Transverse	139.2	0.131	0.133
		1B	SB	Transverse	136.8	-0.093	-0.201
		2A	NB	Transverse	139.2	0.046	-0.045
		2B	SB	Transverse	129.6	0.135	0.233
		3A	NB	Transverse	136.8	0.078	0.200
		3B	SB	Transverse	132.0	0.066	0.086
		4A	NB	Transverse	134.4	0.120	0.051
		4B	SB	Transverse	136.8	0.084	0.032
	3	1A	NB	Longitudinal	240.0	-0.030	-0.024
		2A	NB	Transverse	93.6	-0.023	0.004
		2B	SB	Transverse	98.4	0.011	0.112
		3	SB	Longitudinal	240.0	0.197	0.112
		4	SB	Longitudinal	240.0	0.343	0.029
		5	SB	Longitudinal	240.0	0.256	Cancelled
	4	1A	NB	Transverse	136.8	0.045	0.111
		1B	SB	Transverse	134.4	0.016	0.236
		2A	NB	Transverse	132.0	0.037	0.118
		2B	SB	Transverse	132.0	0.023	-0.014
		3A	NB	Transverse	134.4	0.060	0.035
		3B	SB	Transverse	132.0	0.141	0.167
		4A	NB	Transverse	134.4	0.066	0.098
		4B	SB	Transverse	127.2	0.055	-0.011
Type II	5	1A	NB	Transverse	136.8	0.129	0.003
		1B	SB	Transverse	55.2	0.014	0.020
		2A	NB	Transverse	132.0	0.061	0.218
		2B	SB	Transverse	74.4	0.154	0.039
		3A	NB	Longitudinal	242.4	0.065	-0.023
		3B	NB	Longitudinal	242.4	0.099	0.013

Material Type	Test Site	Crack #	Lane	Crack Type	Crack Length (inches)	Year 1 Winter Change (inches)	Year 1 Summer Change (inches)
		4A	NB	Transverse	136.8	0.158	-0.001
		4B	SB	Transverse	74.4	0.056	0.013
		5A	NB	Transverse	136.8	0.068	0.048
		5B	SB	Transverse	134.4	0.144	0.010
	6	1A	NB	Transverse	136.8	0.121	0.013
		1B	SB	Transverse	112.8	0.103	0.028
		2A	NB	Transverse	136.8	0.169	Cancelled
		2B	SB	Transverse	98.4	0.154	Cancelled
		3A	NB	Transverse	136.8	0.159	0.042
		3B	SB	Transverse	134.4	0.151	0.048
		4A	NB	Transverse	139.2	0.085	0.008
		4B	SB	Transverse	132.0	0.200	0.026
	7	1A	NB	Transverse	115.2	0.120	0.222
		1B	SB	Transverse	134.4	0.236	0.074
		2A	NB	Transverse	136.8	0.082	0.008
		2B	SB	Transverse	81.6	0.027	0.009
		3A	NB	Transverse	136.8	0.051	0.052
		3B	SB	Transverse	132.0	0.126	0.025
		4A	NB	Transverse	172.8	0.062	0.007
		4B	SB	Transverse	120.0	0.114	0.043
	8	1A	NB	Transverse	136.8	0.196	0.058
		1B	SB	Transverse	136.8	0.229	0.047
		2A	NB	Transverse	134.4	0.040	0.065
		2B	SB	Transverse	115.2	0.225	0.111
		3A	NB	Transverse	134.4	-0.026	-0.233
		3B	SB	Transverse	136.8	0.262	0.070
		4A	NB	Transverse	132.0	0.059	0.026
		4B	SB	Transverse	136.8	0.133	0.050
	9	1A	NB	Transverse	103.2	0.020	0.075
		1B	SB	Transverse	112.8	0.102	-0.029
		2A	NB	Transverse	156.0	0.137	0.037
		2B	SB	Transverse	132.0	0.093	-0.008
		3A	NB	Transverse	134.4	0.286	-0.050
		3B	SB	Transverse	134.4	0.130	0.002
		4A	NB	Transverse	136.8	0.376	0.118
		4B	SB	Transverse	136.8	0.077	0.079
		5A	SB	Longitudinal	180.0	0.164	0.036
		5B	SB	Longitudinal	180.0	0.233	0.142
	10	1A	NB	Transverse	57.6	-0.019	0.015
		1B	SB	Transverse	139.2	0.197	0.010

Material Type	Test Site	Crack #	Lane	Crack Type	Crack Length (inches)	Year 1 Winter Change (inches)	Year 1 Summer Change (inches)
		2A	NB	Transverse	134.4	0.208	0.015
		2B	SB	Transverse	134.4	0.111	-0.023
		3A	NB	Transverse	136.8	0.223	0.022
		3B	SB	Transverse	120.0	0.083	-0.008
		4A	NB	Transverse	100.8	0.228	0.120
		4B	SB	Transverse	129.6	0.075	0.009
Type IV	**11**	1A	NB	Transverse	105.6	0.050	0.006
		1B	SB	Transverse	132.0	0.082	0.055
		2A	NB	Transverse	64.8	0.097	0.003
		2B	SB	Transverse	88.8	0.108	0.062
		2A-L	SB	Longitudinal	136.8	0.037	0.012
		2B-L	SB	Longitudinal	136.8	0.092	0.037
		3A	NB	Transverse	72.0	-0.001	-0.041
		3B	SB	Transverse	141.6	0.108	0.037
		4A	NB	Transverse	139.2	0.126	0.058
		4B	SB	Transverse	103.2	0.093	0.023
	12	1A	NB	Transverse	100.8	-0.007	-0.021
		1B	SB	Transverse	132.0	0.117	0.039
		2A	NB	Transverse	134.4	0.113	0.042
		2B	SB	Transverse	136.8	0.037	0.005
		3A	NB	Transverse	134.4	0.274	0.051
		3B	SB	Transverse	84.0	0.025	0.028
		4A	NB	Transverse	117.6	0.033	-0.008
		4B	SB	Transverse	139.2	0.079	0.006