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RESEARCH UPDATE

U 1999-9

**PERFORMANCE OF COLD RECYCLED BITUMINOUS PAVEMENT
CHESTER-SPRINGFIELD, VT ROUTE 11**

REFERENCES:

Report WP 92-R-7, Research Report 94-1, U96-8, U97-8

INTRODUCTION:

This report describes the performance of cold recycled bituminous pavement (CRBP) which was placed on VT Route 11 in the towns of Chester and Springfield. The study was initiated by the Vermont Agency of Transportation as part of an ongoing research effort into the performance of CRBP. The focus of the study is whether the CRBP process can cost effectively increase the service life of bituminous wearing courses. An analysis of pavement performance based on collected data is presented herein.

PROJECT DESCRIPTION:

The project was completed in the summer of 1993 and covers 10.7 km of Vermont Route 11 from MM 5.116 in the Town of Chester to MM 3.528 in the Town of Springfield. The CRBP process that was used was modified from the usual in-place method. Rather than process the reclaimed material on-site with the recycle train, the reclaimed asphalt pavement was hauled off site, ground and mixed for gradation, treated with asphalt emulsion, then returned to the site for placement. Four test sites were established for evaluation. A detailed description of the process is available in Research Report 94-1.

For comparison, two control sections were incorporated into the project, a cold planed pavement and, a standard bituminous overlay. Each has two test sites, 30 m in length, which are examined yearly for cracking, rutting and ride roughness.



All units in metric. Exceptions: mile markers/mileage reference for project location and supplier's costs.

PAVEMENT DESIGN	
Cold Recycled Bituminous Pavement Chester ... MM 7.2 Springfield ... MM 1.0, MM 2.2, MM 3.4	Recycle depth of 90 mm and surface with 40 mm wearing course of VT Type III (12.5 mm maximum) bituminous concrete
Cold Planing Chester ... MM 5.9, MM 6.0	Cold planed to a depth of 90 mm, replaced with 50 mm binder course of VT Type III (12.5 mm maximum) bituminous concrete and 40 mm wearing course of VT Type III (12.5 mm maximum) bituminous concrete
Standard Overlay Chester ... MM 6.1, MM 6.2	VT Type III (12.5 mm maximum) bituminous concrete leveling course and 40 mm wearing course

Prior to construction, VAOT Research and Development personnel established test sites within each of the project's three sections. Cracking and rutting measurements are taken at these sites each summer in order to evaluate rates of deterioration. In addition, yearly ride roughness (IRI) values are collected. Due to the unavailability of equipment, however, IRI values were not gathered for 1999. Through the collection of data, comparisons in performance can be made between the various treatments.

PERFORMANCE;

The following table compares six years of performance evaluation among cold planing, standard overlay and CRBP.

PAVEMENT PERFORMANCE EVALUATION (1994 - 1999)											
	MM 5.9 Cold Planed	MM 6.0 Cold Planed	Average Cold Planed	MM 6.1 Standard Overlay	MM 6.2 Standard Overlay	Average Standard Overlay	MM 7.2 CRBP	MM 1.0 CRBP	MM 2.2 CRBP	MM 3.4 CRBP	Average CRBP
1994											
Cracking	4	0	2	153	203	178	13	11	51	51	32
Rutting	*	*	0	*	*	0	*	*	*	*	0
IRI	1.8	1.8	1.8	2.0	2.0	2.0	1.9	2.0	1.8	2.5	2.1
1995											
Cracking	4	0	2	190	219	205	17	25	65	72	45
Rutting	*	*	0	*	*	0	*	*	*	*	0
IRI	1.8	2.0	1.9	1.8	2.0	1.9	2.1	1.8	2.4	2.5	2.2
1996											
Cracking	137	31	84	238	253	246	57	34	74	128	73
Rutting	*	*	0	*	*	0.2	*	*	*	*	0
IRI	1.4	1.4	1.4	1.5	1.5	1.5	1.7	1.7	1.7	1.7	1.7
1997											
Cracking	205	85	145	260	290	275	134	50	173	213	143
Rutting	*	*	0.1	*	*	0.6	*	*	*	*	0.8
IRI	1.5	1.4	1.5	1.6	1.4	1.5	1.6	1.6	1.8	2.0	1.8
1998											
Cracking	205	85	145	260	290	275	204	52	173	298	182
Rutting	*	*	0.1	*	*	0.8	*	*	*	*	0.8
IRI	1.6	1.4	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.7	1.6
1999											
Cracking	205	85	145	260	290	275	216	56	198	298	192
Rutting	*	*	0.2	*	*	0.8	*	*	*	*	0.8
IRI	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

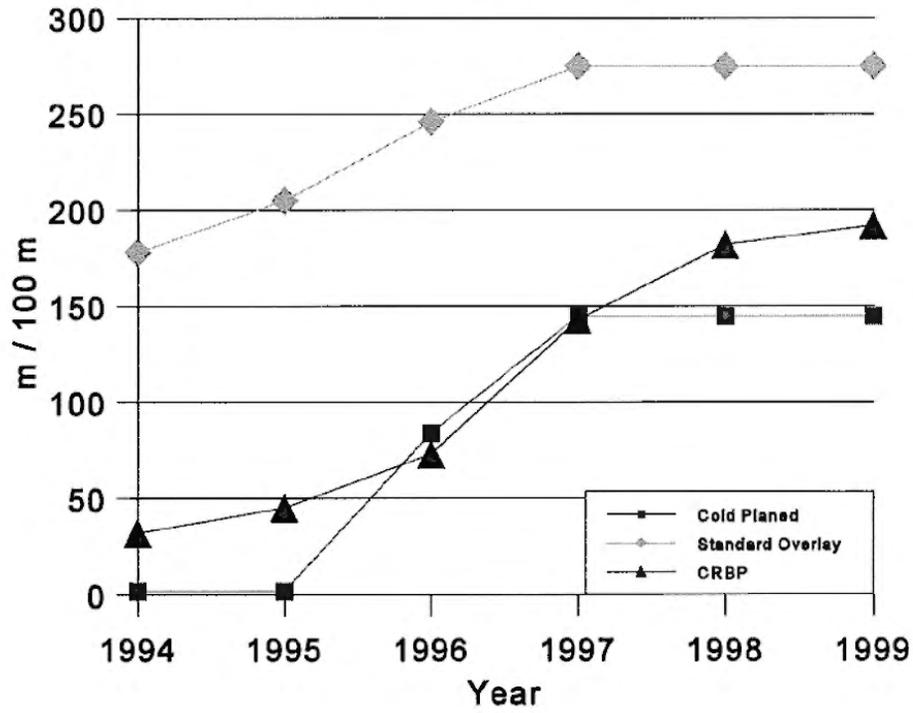
* minimal values (averages provided)

Units: Cracking m/100m (average of longitudinal and transverse cracks, excluding center line cracks)

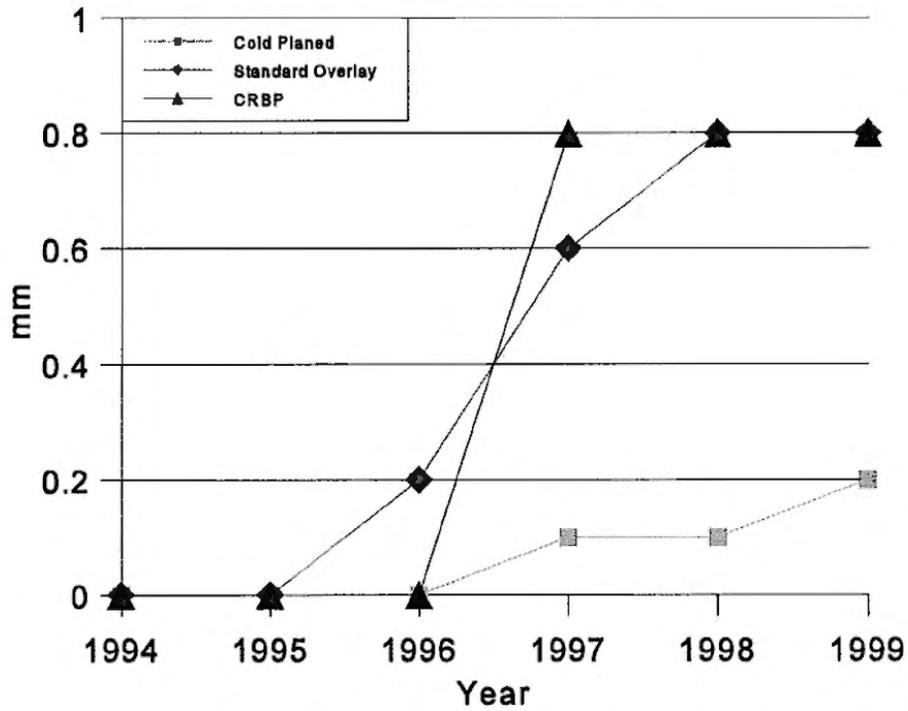
Rutting mm (average of both lanes, inner and outer wheel paths)

Roughness (IRI) m/km (average of both lanes)

AVERAGE CRACKING



AVERAGE RUTTING



COST:

Conducting a cost comparison on the Chester-Springfield rehabilitation is not possible with the available data. Pay items for the CRBP process were bid extremely low, resulting in pay items that are not typical of the market. Since no consistent data are available, cost comparison of the project treatments has not been attempted. Actual cost data is presented in Research Report 94-1.

SUMMARY:

After six years of service, both the cold planed and CRBP treatments are superior in performance to the standard overlay. The standard overlay control section, averaging 275m/100m in cracking (53% transverse cracks), has developed transverse reflective cracks and shows signs of distress in the same areas as those found during the pre-construction pavement survey. The poor condition of the standard overlay after relatively short service provides strong evidence that this section of Vermont Route 11 has an inherently weak substructure and that rehabilitative efforts to address reflective cracking are warranted.

In 1997, crack sealant was applied on Vermont Route 11, sealing the cracks in the two control sections and a portion of the CRBP section. As seen in the data, crack sealant has helped to delay the onset of additional cracks. No additional cracking has occurred in either the cold planed or standard overlay test sections since the application. The CRBP section has developed additional cracking, mainly in areas which were not sealed.

The performance of all three treatment methods appears equal in rutting and ride roughness. Rutting has been minimal throughout the life of the project, and virtually no rutting appeared until the fourth year. Each year the ride quality has been equivalent among all three treatments. It is important to note that because the Mays meter, a device that measures the road roughness, is calibrated each year, data may not be consistent from year to year, but are nonetheless relative within a given year.

The CRBP and cold planed treatments appear to be performing nearly equal. The predominant cracking at these test sites is longitudinal, with prominent patches of "alligator" cracking in some of the wheel paths of the CRBP sections. It is also noteworthy, that transverse cracking is virtually nonexistent in the cold planed sections. Yet, in the CRBP test sites, it is in the formative stages with 11% of the cracking being transverse. The CRBP on the Chester-Springfield project has yet to show superior performance over the cold planed treatment.

FOLLOW UP:

Pavement surveys will continue on an annual basis until firm conclusions can be drawn on the anticipated service life of the modified CRBP process. Special attention will be given to load related cracking in the wheel paths of the CRBP sections.



**Figure 1 Standard
Overlay Treatment**



Figure 2 Cold Planed Treatment



**Figure 3 Cold Recycled
Bituminous Pavement (CRBP)**