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RESEARCH UPDATE

U96-20

COLD RECYCLED BITUMINOUS PAVEMENT GROTON-PEACHAM, VT 232

REFERENCE: U 94-9

INTRODUCTION:

Groton-Peacham PMA 9224 was the first Vermont Agency of Transportation (VAOT) project to use the Gorman Brothers, Inc. process for cold recycled bituminous pavement (CRBP). The CRBP process uses the pavement recycling train, a multi-equipment procedure which mills, sizes, treats and replaces existing pavement in one continuous operation. The "in-place" feature minimizes interference with traffic flow and reduces construction time. Advocates of CRBP state that the process reduces reflective cracking and prolongs service life. Reflective cracking is a recognized shortcoming of standard overlays, the mainstay of the VAOT's pavement rehabilitation effort. The Agency has been monitoring the performance of CRBP to determine if it is a cost effective rehabilitative method, particularly when compared with standard overlay.

PROJECT DESCRIPTION:

Groton-Peacham was rehabilitated in 1991. The project began at the intersection of VT 232 and US 302 in the Town of Groton and proceeded northerly on VT 232 for 14.2 km, ending at MM 1.646 in the Town of Peacham. With the exception of four standard overlay sections, the existing pavement was recycled to a depth of 100 mm using the CRBP process and then surfaced with a 50 mm course of Type III bituminous concrete. Four control sections of standard overlay were placed throughout the project. The standard overlay control sections were paved with a 50 mm Type III course, but did not include recycling. For further comparison, a thin overlay section containing a 20 mm Type IV course was placed between MM 1.251 and MM 1.743 in the Town of Groton.

The project contained nine test sites, four of these were located in the standard overlay sections, four were in the CRBP sections, and one was in the thin overlay section. These sites are inspected annually to determine the relative performance of the treatments.

All units in metric except mile markers/mileage references for project location and supplier's costs.

Metric

OBSERVATIONS:

Pavement surveys conducted for the first three years after construction indicated the average crack rate was 18 m/100 m in the recycled sections compared with 31 m/100 m in the resurfaced control sections. Rutting values averaged 2 mm for the recycled section and 1 mm for the control. Overall, these 1994 values were quite acceptable for a three year old pavement.

When tested in 1995, the Mays values had worsened considerably. The Mays values had doubled, from 1.3 m/km in 1993 to 2.6 m/km. Even though the ride quality had dropped, cracking had not yet become a problem.

The pavement survey conducted during the summer of 1996 revealed a sharp increase in cracking, as was forecast by the previous year's Mays values. As shown on the table below, cracking in the both CRBP and standard overlay test sites increased rapidly over the past year. Careful inspection of the entire project revealed that the cracking and rutting measurements made within the eight, relatively short, test sections did not adequately represent the serious pavement deterioration.

Many of the centerline joint cracks ran almost continuously for the first 2.5 km from the US Route 302 intersection, with many as wide as 35 mm+/-. Longitudinal cracking at Groton MM 1.169 and MM 4.592 had developed into large areas of map pattern cracking. Transverse cracking was discovered throughout the project, the worst area being at MM 1.3 in Groton, where cracks appeared at intervals of 3 meters. Shoving and rutting were also prevalent project-wide. At MM 5.2 in Groton one extreme example of rutting measured 30 mm. Based on the 1996 values, the pavement is considered to be at the end of its service life.

The results of the 1995 and 1996 surveys are shown in the table below.

GROTON-PEACHAM AVERAGE PAVEMENT PERFORMANCE VALUES						
	Ave. Cracks CRBP	Ave. Cracks Std. Overlay	Ave. Ruts CRBP	Ave. Ruts Std. Overlay	Ave. MAYS CRBP	Ave . MAYS Std. Overlay
1995	27 m/100 m	61 m/100 m	2 mm	2 mm	2.6 m/km	2.6 m/km
1996	34 m/100 m	65 m/100 m	2 mm	2 mm	3.6 m/km	3.6 m/km

1996 Summary of Pavement Cracking (mm/km)					
Cold Recycled Bituminous Pavement		**Standard Overlay**		**Thin Overlay**	
MM 1.048	**66**	MM 1.148	**68**	MM 1.169	**149**
MM 3.225	**0**	MM 3.325	**20**		
MM 4.472	**25**	MM 4.572	**136**		
MM 1.426	**44**	MM 1.526	**31**		

A summary of the cracking per test site is presented above. Cracking was fairly consistent between the paired sections, with the exception of an unusually high rate at MM 4.572. As expected, the thin overlay suffered the highest level of cracking, and was mostly reflective. The paired test sites would indicate that CRBP and standard overlay have performed comparably over the past five years.

COST ANALYSIS:

The total cost of the CRBP was $7.11/SY , which included recycling, emulsified asphalt, and a 50 mm Type III wearing course. The 50 mm standard overlay cost, without recycled pavement, was $3.44/SY.

SUMMARY AND CONCLUSIONS:

THIN OVERLAY

The 20 mm thin overlay was the worst performing treatment. Pre-construction pavement surveys compared with 1996 data confirm that most of the cracking found in test site MM 1.169 was reflective.

CRBP and STANDARD OVERLAY

Compared with the thin overlay section, CRBP with a 50 mm overlay appears to resist reflective cracking, as does a 50 mm overlay *without* recycled pavement. Based on a cost per square yard that is 52% greater than the standard overlay, the CRBP process did not perform cost effectively on VT 232.

The extensive fatigue cracking has been attributed to inadequate substructure. This deficiency was not improved with the 100 mm course of recycled pavement. The depth of the cracks and the washboard shoving point to fatigue as the major contributor. Early failure of the pavement is probably a result of overloading of the structure.

VT 232 has an ADT in the range of 370 to 570 and is primarily an access road to recreational areas. Low ESAL loading would be expected given these data. But, logging operations in the Groton State Forest have most likely subjected the pavement to higher ESAL loading than anticipated. Areas of severe shoving, rutting, and cracking provide sound evidence of overloading, much as would be expected from heavily laden log carriers. This situation was made even more serious by an inadequate subbase, in some areas as thin as 95 mm. Given the load demands, it is not surprising that both the cold recycled pavement and standard overlay have developed severe distress.

Investigation of the long term durability of CRBP on the Groton-Peacham project has been compromised due to early failure of the pavement. Future projects using CRBP should be selected based on suitable substructure; otherwise, fatigue cracking will eliminate any anticipated return on investment.

FOLLOW UP:

As Groton-Peacham PMA 9224 has reached the end of its service life, this is the final report.