RECLAIMED BASE STABILIZATION
BELVIDERE VT 109

INITIAL REPORT 94-7
OCTOBER 1994

REPORTING ON WORK PLAN 91-R-7

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

PATRICK J. GARAHAN, SECRETARY OF TRANSPORTATION
ROBERT L. MERCHANT, DIRECTOR OF CONSTRUCTION AND MAINTENANCE
ROBERT F. CAULEY, MATERIALS AND RESEARCH ENGINEER
RONALD I. FRASCOIA, RESEARCH AND DEVELOPMENT SUPERVISOR

Prepared By:

Robert E. Brunelle, Technician IV
Research and Development Subdivision

Reviewed By:

Robert F. Cauley

R.F.Cauley,
Materials and Research Engineer

Date: 18 Oct 94

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle	5. Report Date
Reclaimed Base Stabilization Belvidere VT 109	October 1994
	6. Performing Organization Code
	8. Performing Organization Report No.
7. Author(s) Robert E. Brunelle	94-7
9. Performing Organization Name and Address Vermont Agency of Transportation Materials & Research Division 133 State Street Montpelier, VT 05602	10. Work Unit No. (TRAIS)
	11. Contract or Grant No. HPR
	13. Type of Report and Period Covered Initial
12. Sponsoring Agency Name and Address Federal Highway Administration Division Office Federal Building Monpelier, VT 05602	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This initial report documents construction data as well as controls and criteria for the evaluation of the cost effectiveness of the full depth reclamation process for Project RS0282(6) on VT 109 in Belvidere.

This report includes initial data for a performance evaluation of rutting, International Roughness Index (IRI) and Falling Weight Deflectometer (FWD) Values.

17. Key Words	18. Distribution Statement
Pavement Asphalt Recycling In Place	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	8	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

* U. S. GOVERNMENT PRINTING OFFICE : 1973 725-504/328

RECLAIMED BASE STABILIZATION
VT ROUTE 109 BELVIDERE

INTRODUCTION:

Vermont's standard pavement maintenance/rehabilitation approach includes a thin "shim" course and a wearing course of 38 mm (1.5 in.) of bituminous concrete pavement. The cost effectiveness of this strategy remains to be proven since it has never been firmly established that the extension of service life resulting with this treatment is commensurate with cost. Further, experience has shown that the effective service life of thin overlays is limited by reflective cracking which occurs very soon after the thin wearing course is placed.

One alternative to the standard overlay for pavement rehabilitation is reclaimed base stabilization. This technique consists of pulverizing the existing pavement full depth and blending the crushed material with the subbase. Optionally, the reconstituted base is then stabilized by the addition of an asphalt emulsion or calcium chloride. Experience with reclaimed base stabilization has been quite successful, since it eliminates the possibility of reflective cracking due to underlying pavement layers. The principal limitations upon the selection of this rehabilitation technique are the inability of state-of-the-art equipment to work effectively in pavements which are greater than 203 mm (8 in.) in depth, poor performance which results when subbase materials are substandard, and the necessity for resurfacing the reconstituted base with a substantial thickness of new pavement, usually 76.2 mm (3 in).

There is an ongoing debate relative to one aspect of the reclaimed base stabilization technique and that is the cost effectiveness of the addition of a stabilizing agent, most commonly emulsified asphalt. The primary objective of this evaluation is to determine if the addition of an asphalt stabilizer (a high float asphalt emulsion) enhances the long term performance of the pavement. The second and more encompassing objective is the evaluation of the overall effectiveness of the full depth reclamation of a section of Vt. Route 109 in Belvidere, from an economic as well as a performance standpoint.

PROJECT DESCRIPTION AND ROADWAY CONDITION:

Project RS 0282(6) began at a point on Vt. Route 109, approximately 4.683 km (2.910 mi) east of the Waterville-Belvidere town line and extending easterly for approximately 6.279 km (3.902 mi) to the junction of Vt. Route 109 with Vt. Route 118 at km 10.963 (MM 6.812) in Belvidere. Project work included pavement rehabilitation with reclaimed base stabilization and a 3 inch overlay of bituminous concrete pavement. This section of Vt. Route 109 was incorporated into the State system on June 1, 1949 and first paved when improved in 1982 under project number RS 0282(2). That improvement included reconstruction to provide a pavement that was 6.7 m (22 ft) wide and a roadbed width which varied from 7.9 m (26 ft) to 9.1 m (30 ft). The project also provided a 51 mm (2 in) thick pavement and a 457 mm (18 in) gravel subbase. Average daily traffic on this section of Vt. Route 109 was 250 in 1988.

Pre-construction information was gathered in the spring of 1991 when four test pits were dug. Falling weight deflectometer (FWD) testing was done, Mays meter measurements of rideability were made and tests of the materials sampled from the test pits were conducted. Representative crack counts were taken in one foot wide sections across the roadway after four 152 m (500 ft) test sections had been identified. All data collected indicated a severely distressed pavement.

PRECONSTRUCTION CONDITION DATA

TEST SITE NO.	1	2	3	4
Location km	6.84	7.60	8.32	10.25
Belvidere (MM)	(4.25)	(4.72)	(5.17)	(6.37)
Ave.Init. Pav't. mm	71	71	51	86
Thickness (in)	(2.8)	(2.8)	(2.0)	(2.7)
IRI mm/km	3283	3425	3030	3504
(in/mi)	(208)	(217)	(192)	(222)
FWD (Struct. No.) NB	3.26	3.10	3.20	3.25
SB	3.24	3.50	3.20	3.40
Rutting mm	13	16	19	11
(1/16 in)	(8) n	(10)	(12)	(7)
Cracks m/100m	3500	3500	8500	1400
(ft/100 ft)	(3500)	(3500)	(8500)	(1400)

Sample materials from the test pits showed existing pavement depths that varied from a 38.1 mm (1.5 in) minimum to a maximum thickness of 83 mm (3.25 in). Subbase material was a good gravel, with only one sample (from TS#1) slightly out of specification for the percent passing the #200 sieve. Subgrade soils were also good, ranging in classification from gravelly sand to sandy gravel. The severely distressed condition of the pavement and the good quality of the subbase and subgrade materials provided strong support for the decision to utilize a stabilized base for this project.

TEST SECTIONS:

Four test sites were established prior to construction. Each five hundred feet in length, they were designed to provide evaluation controls as described below:

Test Site #1 @km 6.840 (MM 4.25) was constructed with a 50.8 mm (2 in) overlay in lieu of the project typical overlay of 76.2 mm (3 in). Asphalt emulsion (AE) was added to the pulverized base at an application rate of 4.455 l/m^2 (0.984 gal/SY) in the southbound lane while no AE was added in the northbound lane. The experiment controls were intended to provide a direct comparison between the performance of the stabilized base vs. unstabilized base. Also, the thickness requirement for the project overlay was originally estimated (based on pavement design) at 63.5 mm (2.5 in). The 50.8 mm (2 in) overlay was included to provide a comparison of a slightly under-designed section with the 76.2 mm (3 in) project overlay representing a slight

overdesign.

Test Site #2 @ km 7.600 (mm 4.72) was constructed with a 76.2 mm (3 in) overlay. AE addition rate was 4.296 l/m^2 (0.949 gal/SY) in the northbound lane and no AE was added to the southbound lane.

Test Site #3 @ km 8.320 (MM 5.17) was constructed with a 76.2 mm (3 in) overlay. Two AE addition rates were used on this test site, to investigate the possible improvement in performance when application rates were increased. 8.51 l/m^2 (1.88 gal/SY) of AE was applied on the NB lane and 3.246 l/m^2 (0.717) gal/SY was applied on the SB.

Test Site #4 @ km 10.251 (MM 6.37) was constructed with the 76.2 mm (3 in) overlay. The SB lane was treated with a 4.255 l/m^2 (0.94 gal/SY) application of emulsified asphalt while the NB lane was untreated.

SUMMARY OF TEST SITES:

TEST SITE NO.	1	2	3	4
TEST SITE KM	6.84	7.60	8.32	10.25
(MM)	4.25	4.72	5.17	6.37
RECLAIM DEPTH mm	134.6	124.5	129.5	134.6
(in)	(5.3)	(4.9)	(5.1)	(5.3)
ASPH EMULS l/m^2 (NB)	0	4.296	8.511	0
(gal/SY)	(0)	(0.95)	(1.88)	(0)
ASPH EMULS l/m^2 (SB)	4.455	0	3.246	4.255
(gal/SY)	(0.984)	(0)	(0.717)	(0.94)

PROJECT CONSTRUCTION:

Project work began on 6/12/91 and the base stabilization work was completed in 10 days on 6/26/91 indicating an average daily production rate of 7635 m^2 (6,384 SY) or 0.63 km (0.39 mi). Based on the final project quantities and assuming the weight of the emulsified asphalt to be 8.33 lb/gal, the average application rate of the emulsion was 3.62 l/m^2 (0.80 gal/SY). In place density and moisture content values were taken on the pulverized, stabilized and compacted material on 06/21/94, with nuclear gauge equipment, between km 4.7 (MM 2.9)+/- and km 6.0 (MM 3.7). Dry densities varied from 133.7 to 125.8 (avg. 127.9) and moisture content ranged from 5.4% to 6.6% (avg. 5.9%).

Subsequent to completion of paving operations, cores taken at each of the test sections showed pavement thicknesses that varied as follows: Test Section #1-56.4mm (2.22 in), Test Section #2-78.2 mm (3.08 in), Test Section #3-73.4 mm (2.89 in) and Test Section #4-80.8 mm (3.18 in). Structural number values of the roadbed after compaction of the stabilized base and prior to resurfacing averaged 3.0 (range was 2.9-3.1).

COST:

Based on the average (project wide) application rate for emulsified asphalt of 3.62 l/m^2 (0.80 gal/SY), an assumed unit weight of 8.33 lb/ gal for

that material and its low bid price of $462.97/tn ($21.00/CWT), the cost for the applied emulsified asphalt, Item 404.65 (mod.) was $2.09/m^2 ($1.75/SY). Combined with the $1.20/m^2 ($1.00/SY) cost for Bituminous Base Stabilization, Item 310.15, the total cost to reclaim the pavement on this project was $3.29/m^2 ($2.75/SY). The cost/SY for bituminous concrete for this project was $6.08/m^2 ($5.08/SY) and the entire cost to rehabilitate the pavement was therefore $9.36/m^2 ($7.83/sy). For the sake of comparison, the cost to apply a standard overlay of 38.1 mm (1.5 in) of bituminous concrete pavement at the contract bid price of $33.63/tn ($30.50/t) would be $3.04/m^2 ($2.54/SY).

POST CONSTRUCTION ROADWAY CONDITIONS:

1992 SITE

TEST SITE NO.	1	2	3	4
TEST SITE MM	4.25	4.72	5.17	6.37
IRI mm/km NB	994	1073*	1215*	1073
(in/mi) NB	(63)	(68*)	(77*)	(68)
IRI mm/km SB	947*	947	837*	1136*
(in/mi) SB	(60*)	(60)	(53*)	(72*)
Cracking m/100 m	0	0	0	0
(ft/100 ft)	(0)	(0)	(0)	(0)
Wheelpath ruts mm	0	0	0	0
(in/16)	(0)	(0)	(0)	(0)
Str. No. (FWD) NB	3.0	2.9*	3.1*	2.9
Stab. Base SB	2.8*	2.9	2.9*	2.8*
Str. No. (FWD) NB	4.0	3.9*	4.1*	3.9
Post Pave SB	3.6*	3.8	4.0*	3.8*

1993

IRI mm/km NB	1073	1420*	900*	1278
(in/mi)	(68)	(90*)	(57*)	(81)
IRI mm/km SB	977*	1626	1010*	1515*
(in/mi)	(65*)	(103)	(64*)	(96*)
Cracking m/100 m	0	0	0	0
(ft/100 ft)	(0)	(0)	(0)	(0)
Wheelpath Ruts mm	0	0	0	0
(in/16)	(0)	(0)	(0)	(0)

1994

Cracks m/100 m(NB)	11	23*	27	16
(ft/100 ft)	(11)	(23*)	(27)	(16)
m/100 m (SB)	24	22	13	26*
(ft/100ft)	(24)	(22)	(13)	(26*)

1994 (cont'd.)				
WP Ruts mm (NB)	0	1	0	0
(in/16)	(0)	(0)	(0)	(0)
mm (SB)	1	0	1	1
in/16	(1)	(0)	(0)	(1)

(IRI values not taken yet)

* Indicates AE was utilized

CONCLUSIONS:

The structural numbers achieved, based on FWD testing on existing (pre-construction) pavements and on recycled pavements with and without the emulsified asphalt additive, strongly suggest that no additional strength is gained through use of the additive. Rutting and cracking have been minimal on sections both with and without the emulsified asphalt additive. Thus, these indicators cannot be used for the cost/benefit analysis until clear differences are discernible. Available evidence at this point, however, seems to indicate that the required additional expense for use of the additive is not justified.

After three winters, rutting and cracking and IRI values taken on the four test sections indicate a very encouraging trend for the performance of this project. The excellent performance thus far is probably at least partly attributable to the low traffic volume and the relatively generous application of bituminous concrete pavement.

FOLLOW UP:

Performance monitoring for the Belvidere project will continue on an annual basis until the effectiveness of the treatment has been established.

RECLAIMED STAB. BASE
BELVIDERE VT 109
Construction 1991