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ASPHALT RUBBER HOT MIX
BOLTON-WATERBURY, U.S. ROUTE 2

REFERENCES:

WP 95-R-21, Research Report 95-6

INTRODUCTION:

Bolton-Waterbury RS 0284(13) was constructed in the summer of 1993 as a demonstration project for asphalt rubber hot mix (ARHM), a pavement design which incorporates recycled waste tire rubber. The Intermodal Surface Transportation Efficiency Act (ISTEA) stipulated that by 1994 all federally funded asphalt tonnage must contain at least 5% waste tire rubber. Consequently, the Vermont Agency of Transportation found it prudent to initiate a research effort to evaluate the performance and cost effectiveness of ARHM prior to its mandated use.

Bolton-Waterbury was selected as the test project for ARHM. In order to evaluate the performance of ARHM, control sections of standard asphalt cement (AC) and varying depths of reclaimed base were included in the project design for comparison.

PROJECT DESCRIPTION:

The Bolton-Waterbury project begins on U.S. Route 2 in the Town of Bolton approximately 2.706 miles east of the Richmond-Bolton town line and extends easterly 4.346 miles to MM 1.337 in Waterbury. The ADT is approximately 3000, of which 12% constitutes truck traffic.

The paving contractor, Frank W. Whitcomb, Inc., incorporated an asphalt rubber mix design which was developed by Western Technologies, Inc. Because no facility was available in Vermont which could produce properly graded waste tire material, tires from Palmer Shredding in North Ferrisburg, Vermont were shipped to Baker Shredding in Chambersburg, Pennsylvania for additional processing and then returned. This effort was made to ensure that waste rubber from Vermont was used in the process.

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

Metric

The pavement's performance was evaluated through yearly measurements of cracking, rutting, and Mays ride roughness at 18 test sites established on the project. The following table displays average values for each of the project treatments.

ANNUAL PAVEMENT PERFORMANCE VALUES

Treatment	Survey Year	Avg. Cracking m/100m	Avg. Wheel Path Ruts mm	Roughness (Mays) mm/km
90 mm AC 100 mm Recl. Base	1993 1994 1995 1996	0 0 0 21	0 0 0 2	1594 1841 1673 1973
90 mm ARHM 90 mm Recl. Base	1993 1994 1995 1996	0 0 7 22	0 0 0 0	1736 1989 1815 1562
40 mm AC Standard Overlay	1993 1994 1995 1996	0 8 25 187	0 0 0 0	1720 2020 1649 1468
40 mm ARHM Standard Overlay	1993 1994 1995 1996	0 44 99 204	0 0 0 0	1494 1747 1636 1389
90 mm ARHM 100 mm Recl. Base	1993 1994 1995 1996	0 0 4 193	0 0 0 2	1647 1935 1670 1768
90 mm ARHM 50 mm Cold Planed	1993 1994 1995 1996	0 0 7 201	0 0 0 0	2099 2320 1705 2336
65 mm ARHM 100 mm Recl. Base	1993 1994 1995 1996	0 0 27 138	0 0 0 2	1657 2289 1926 1310

OBSERVATIONS:

CRACKING

Cracking was the most prominent distress observed. Within the first year of service cracking had developed in the 40 mm standard overlay sections. Between 1995 and 1996 the rate of cracking had increased sharply in all but two of the treatments. Deep longitudinal cracks along the edge line were observed from MM 4.4 in Bolton and ran fairly regularly to the north end of the project. Transverse cracking was found in Bolton from MM 3.4 to MM 4.4. The transverse cracking was typically shoulder-to-shoulder and occurred at regular intervals. Interspersed throughout the project were patches of fine map-pattern cracking as well as incidences of joint separation at the centerline.

RUTTING

Wheel path rutting was minimal throughout the project, averaging 2 mm.

MAYS RIDE ROUGHNESS

Mays ride roughness values are inexplicably disproportionate with the level of cracking. For instance, test sites with 40 mm of ARHM have the largest percentage of cracking, yet have the lowest Mays values. It is possible that the fine cracking did not cause enough ride disturbance to register on the meter. Future Mays readings should fall in line once the fine cracking worsens.

It some instances the Mays values have decreased over time- an improbable scenario given the steady increase in cracking. This could be caused by the annual calibration of the Mays meter, which unavoidably gives somewhat different values from year to year. Because of this fluctuation, more data will be needed before a measurable trend develops. At present, there are insufficient data to reflect a deterioration rate for the pavement; although the values do reflect ride quality during a given year.

EVALUATION:

Most areas of the Bolton-Waterbury project have developed a high rate of cracking after three years of service. With the exception of a 1/2+/- mile section in Bolton, nearly all of the treatments are distressed. Given the high rate of early cracking, the overall condition of the pavement after three years of service is considered to be poor.

Inconsistent substructure is thought to be causing similar treatments to wear differently. The previously mentioned 1/2+/- mile section in Bolton is showing good crack resistance with a treatment of 90 mm of ARHM over 90 mm of reclaimed base. A section in Waterbury paved with 90 mm of ARHM over an even thicker reclaimed base of 100 mm is heavily cracked, even though a thicker base should have better crack resistance. It is possible that there were problems in the paving process, but it is more likely that poor substructure was the cause.

The test data show that ARHM has performed on par with AC over most of the project. The data further show that both AC and ARHM perform better when placed over 90 to 100 mm of reclaimed base, which experience has shown, reduces reflective cracking. Reflective cracking was observed in boh ARHM and AC in 40 mm standard overlay.

The control section with 50 mm cold planing showed the same rate of cracking as the standard overlay section. Cold planing did not add any measurable crack resistance to the ARHM.

COST ANALYSIS:

Although the data indicate that ARHM is roughly equal in performance to standard AC, it does so at a considerable increase in cost, as demonstrated by the following unit costs:

40 mm ARHM	**$4.25/SY**	vs.	40 mm AC	**$2.34/SY**

(see Initial Report for more detailed cost analysis)

In a standard overlay thickness of 40 mm, the ARHM was 55% more expensive than AC. Much of this cost increase was due to special equipment, material, and expertise not readily available to the contractor, but required to produce the ARHM.

SUMMARY AND CONCLUSIONS:

Based on data collected at project test sites, it has been concluded that ARHM has similar performance characteristics as AC. Although some areas of ARHM are severely cracked, they are intermittent and probably due to poor substructure rather than poor material. The level of cracking on the Bolton-Waterbury project is unusually high for only three years of service, consequently this rehabilitation is expected to have a disappointingly short service life. Even though ARHM is a creative means of recycling waste tires, it has not performed commensurate with its cost.

FOLLOW UP:

The Vermont Agency of Transportation Research and Development Unit will continue yearly performance studies of the Bolton-Waterbury project. Hopefully, additional data will reconcile inconsistencies in the Mays values and provide valuable information about the long term performance of ARHM.

PHOTO ADDENDUM

Bolton-Waterbury RS 0284(13)
U.S. Route 2

Test Site MM 3.18
90 mm AC/ 100 Recl. Base
Best condition on project

Test Site MM 4.4
40 mm ARHM Std. Overlay
Note regular tranverse crackiing

Test Site 4.8
65 mm ARHM/ 100 mm Recl. Base
Longitudinal cracking along edge line