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RESEARCH UPDATE

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

REFERENCES:

WP 95-R-21, Research Report 95-6, Update 96-29

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. In order to evaluate the performance of ARHM, control sections of standard asphalt cement (AC), varying depths of reclaimed base, and cold planed pavement 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 4.34 km east of the Richmond-Bolton town line and extends easterly 6.99 km to MM 1.337 in Waterbury. The average annual daily traffic count is approximately 3,000, of which 12% constitutes truck traffic.

The project incuded the following sections:

- 90 mm asphalt cement over 100 mm reclaimed base
- 90 mm asphalt rubber hot mix over 90 mm reclaimed base
- 40 mm asphalt cement standard overlay
- 40 mm asphalt rubber hot mix
- 90 mm asphalt rubber hot mix over 100 mm reclaimed base
- 90 mm asphalt rubber hot mix over 50 mm cold planed
- 65 mm asphalt rubber hot mix over 100 mm reclaimed base

All units in metric except mile markers and supplier's costs.

Metric

The performance of the various sections has been 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 Location	Survey Year	Avg. Cracking m/100m	Avg. Wheel Path Ruts mm	Rougluess (Mays) mm/km
90 mm AC	1993	0	0	1594
100 mm Recl. Base	1994	0	0	1841
	1995	0	0	1673
Bolton	1996	21	2	1973
MM 2.94 - 3.20	1997	29	2	1862
90 mm ARHM	1993	0	0	1736
90 mm Recl. Base	1994	0	0	1989
	1995	7	0	1815
Bolton	1996	22	0	1562
MM 3.2 - 3.5	1997	28	0	1768
40 mm AC	1993	0	0	1720
Standard Overlay	1994	8	0	2020
	1995	25	0	1649
Bolton	1996	187	0	1468
MM 3.5 - 3.7	1997	224	0	1626
40 mm ARHM	1993	0	0	1494
Standard Overlay	1994	44	0	1747
	1995	99	0	1636
Bolton	1996	204	0	1389
MM 3.7 - 4.63	1997	220	0	1610
65 mm ARHM	1993	0	0	1657
100 mm Recl. Base	1994	0	0	2289
	1995	27	0	1926
Bolton	1996	138	2	1310
MM 4.63 - 5.71	1997	168	3	1831
90 mm ARHM	1993	0	0	1647
100 mm Recl. Base	1994	0	0	1935
	1995	4	0	1670
Waterbury	1996	193	2	1768
MM 0.00 - 1.10	1997	236	5	1799
90 mm ARHM	1993	0	0	2099
50 mm Cold Planed	1994	0	0	2320
	1995	7	0	1705
Waterbury	1996	201	0	2336
MM 1.10 - 1.20	1997	266	0	2241

OBSERVATIONS:

CRACKING

The pavement condition survey conducted in July 1997 showed a 21% increase in cracking since 1996. By comparison, from 1995 to 1996 cracking increased 475%. From MM 2.94 to MM 3.5 in Bolton the pavement still shows only minimal cracking. In this area the reclaimed base appears to have been effective in controlling cracking, in both AC and ARHM surface courses. Elsewhere on the project reclaimed base was less effective. Reclaimed base failed to prevent extensive cracking between MM 4.63 in Bolton and MM 1.10 in Waterbury, where longitudinal and map pattern cracking in the wheel paths is moderate to severe.

The 40 mm standard overlay test sections, in both AC and ARHM wearing courses, are exhibiting both transverse and longitudinal cracking. As is typical with standard overlays, much of the cracking is reflective.

Test sites in the 50 mm cold planed section had the highest rate of cracking, 266 m/100 m, and the crack density was uncharacteristically higher than in the standard overlay sections where no subbase remediation was performed.

Crack data collected from the test sites do not point to clearly superior performance from any particular treatment. For example, the 90 mm AC with 100 mm reclaimed base section averages 29 m/100m of cracking compared with 28 m/100 m of cracking in the adjoining section treated with 90 mm ARHM and 90 mm reclaimed base, indicating that both AC and ARHM are performing well in this area of the project. Two miles away, a section of 90 mm ARHM and 100 mm reclaimed base has developed 236 m/100 m of cracking. The discrepancy in performance between these similar treatments is most likely due to inconsistency in substructure integrity over the length of the project.

Comparisons between test sections of AC and ARHM wearing courses in both reclaimed base and standard overlay applications show only minimal difference in cracking. This demonstrates that AC and ARHM are exhibiting similar susceptibility to cracking.

RUTTING

Wheel path rutting is becoming more pronounced, but is still considered minimal through the majority of the project. The highest average depression measured was in the 90 mm ARHM/100 mm reclaimed base section, where values reached 5 mm. This section also developed prominent fatigue cracking in the wheel paths. As a point of reference, end-of-service life due to rutting is generally considered to be when wheel path ruts reach 13 mm in depth.

MAYS RIDE ROUGHNESS

Mays ride roughness values collected in 1997 demonstrate that average ride roughness rose 18% from 1996 (1,687 mm/km to 1,820 mm/km). As IRI (International Roughness Index) values reach 4,000 mm/km, ride quality is considered to be so poor that rehabilitation is needed.

Note: Instances where Mays values appear to decrease over time are due to the yearly calibration of the Mays meter and do not point to an improvement in ride quality.

COST ANALYSIS:

Comparison of the relative prices of AC and ARHM is demonstrated through the following unit costs:

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

(see Initial Report 95-6, February 1996, for more detailed cost analysis)

The premium paid for ARHM is attributed to special equipment, material, and consultant fees.

SUMMARY AND CONCLUSIONS:

Cracking has stabilized this year, with an increase of 21%, versus a 475% increase between 1995 and 1996. Rutting is minimal project-wide. Mays values indicate a only a slightly worsening ride quality, with an average increase in IRI of 8% since 1996. Given the current pavement condition, the project pavement is considered to be approximately 50% deteriorated after four years of service.

Because of the severity of the wheel path fatigue cracking, district maintenance forces have started crack sealing in the worst effected sections in the Town of Waterbury in an effort to extend the service life of the pavement. Areas at the terminus of the project (Town of Bolton) are in better condition and do not require immediate attention.

Data collected at project test sites in 1997 further supports conclusions reached in 1996 (see Update 96-29), which demonstrated that asphalt rubber hot mix is performing similarly to conventional asphalt cement on the Bolton-Waterbury project. In conclusion, this investigation has shown that the wet blend method of introducing recycled waste tire rubber into hot mix delivers a product which shows no appreciable difference in performance to asphalt cement. As a pavement rehabilitation treatment, asphalt rubber hot mix was not a cost effective method on the Bolton-Waterbury project because it failed to extend pavement life commensurate with its cost.

FOLLOW UP:

Because crack sealing will compromise any further study of deterioration in these areas, it is considered prudent to close this investigation. Therefore, this will be the last report on this work plan.