I-5: Vancouver Vicinity

Asphalt-Rubber Open-Graded Friction Course

Post Construction Report
WA-RD 131.1

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Washington State Department of Transportation
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This report describes the construction of experimental asphalt-rubber and polymer-asphalt open-graded friction course overlays on Interstate 5 in Vancouver, Washington. A 1200 foot section of conventional open-graded pavement was included as a control section. Evaluations will be conducted over a period of three years to measure the performance of the rubber and polymer sections against the control section of conventional open-graded pavement.

Initial observations and tests show no significant differences between the control and the asphalt-rubber and polymer sections.

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ASPHALT-RUBBER OPEN-GRADED FRICTION COURSE

I-5, Vancouver Vicinity

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Post Construction Report
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Prepared for
Washington State Department of Transportation
and in cooperation with
U.S. Department of Transportation
Federal Highway Administration

September, 1987

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ABSTRACT

This report describes the construction of experimental asphalt-rubber and polymer-asphalt open-graded friction course overlays on Interstate 5 in Vancouver, Washington. A 1200 foot section of conventional open-graded pavement was included as a control section. Evaluations will be conducted over a period of three years to measure the performance of the rubber and polymer sections against the control section of conventional open-graded pavement.

Initial observations and tests show no significant differences between the control and the asphalt-rubber and polymer sections.

INTRODUCTION

This report describes the construction of an experimental asphalt-rubber open-graded friction course overlay on I-5 in Vancouver, Washington. The asphalt-rubber overlay was chosen to replace, via a change order, a conventional open-graded overlay. The change was prompted by the desire of the District construction personnel for a pavement with greater resistance to ravelling. A 1200 foot section of conventional open-graded pavement was included as a control section. A 3000 foot section of polymer-asphalt open-graded pavement was added during construction by the District. Evaluations will be conducted to measure the performance of both the asphalt-rubber and polymer-asphalt pavements against the control section of conventional open-graded pavement.

STUDY SITE

The project begins just north of the Columbia River Bridge which connects Portland, Oregon with Vancouver, Washington and ends at the junction of SR-500 as shown on the vicinity map. The pertinent facts concerning the contract are tabulated below.

Contract Number: 3044

Contract Name: Columbia River to 39th Street

Route Number: Interstate 5

Milepost Limits: 0.28 to 2.42

Number of Lanes: 6 plus on-off collectors & ramps

Overlay Thickness: 0.06 feet (3/4 inch)

Project Engineer: Bill Pierce

Contractor: Cascade Construction Co., Portland, OR

Start of Paving: June 28, 1986

End of Paving: July 25, 1986

A schematic drawing of the location of the various pavement types is shown in Figure 1. It should be noted that an added variable was introduced into the experiment with the addition of a fog seal on certain portions of the project.

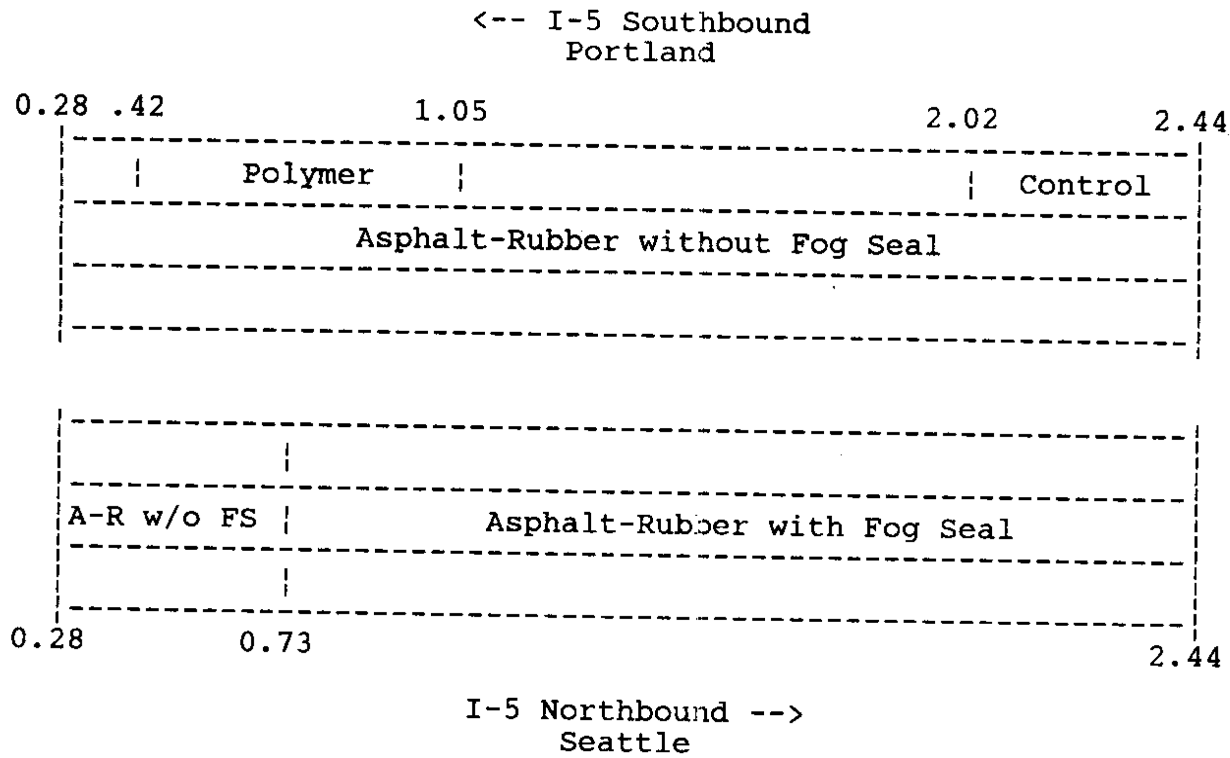


Figure 1. Locations of pavement sections.

CONSTRUCTION SUMMARY

The high traffic volumes of the Vancouver-Portland corridor of I-5 necessitated that the paving operations be conducted at night or on weekends. Cascade Construction Company began paving of the asphalt-rubber mix on June 28, 1986 and completed the final paving on July 25, 1986. Air temperatures during this period ranged from 55 to 82 degrees F and there were only two weather related shutdowns, one for rain and one for low temperature. Photographs of the paving operations are included in Appendix A.

The asphalt mix was produced out of a 15,000 lb. batch plant and hauled to the project site by conventional dump trucks. The paving train normally consisted of a Blaw Knox PF 180 paver followed by three 8-10 ton Hyster tandem steel wheel vibratory rollers. An additional vibratory roller and Barber Greene 260 paver were added to the paving train when the paving schedule included more than a single lane. A tack coat of CRS-2 was applied by distributor at a rate of 0.06 to 0.09 gallons per square yard on newly placed Class G preleveling and at a rate of 0.10 to 0.12 gallons per square yard on the areas which received no preleveling. Fog seals were generally applied at the conclusion of each nights paving and consisted of CSS-1 applied at a rate of 0.05 to 0.10 (0.03 to 0.05 residual) gallons per square yard.

A total of 7012 tons of asphalt-rubber mix, 383 tons of polymer-asphalt mix, and 117 tons of conventional mix were placed on the project. The asphalt-rubber binder consisted of 20% recycled vulcanized rubber and 80% AR4000W asphalt cement plus enough extender oil to make the rubber compatible with the cement. The job mix design called for 7% asphalt-rubber cement content in the final mix. The asphalt-rubber was purchased from Arizona Refining Company of Phoenix, Arizona which markets the product under the trade name ARM-R-SHIELD.

The polymer-asphalt was furnished to the contractor by Asphalt Service & Supply of Denver, Colorado. This binder consisted of AC-20 paving grade asphalt rubberized with 1.2 to 2.0 percent by weight of virgin synthetic styrene-butadiene rubber. A AC-20 asphalt is roughly equivalent to a AR8000W asphalt. The polymer-asphalt cement was also added at the same job mix design binder content of 7%.

A summary of the plant and street mix temperatures and the ambient air temperatures for each days paving is shown in Table 1.

Table 1. Summary of plant, street, and air temperatures.

DATE	ASPHALT TYPE	AIR TEMP. DEG. F	ASPHALT MIX TEMP. STREET DEG. F	PLANT DEG. F
6/28/86	RUBBER	60 to 65	295, 300, 310	325
7/02/86	RUBBER	60 to 72	270, 285, 250, 275	315
7/07/86	RUBBER	62 to 70	320, 330	340
7/08/86	RUBBER	63 to 74	300, 300	315
7/09/86	RUBBER	58 to 67	290, 335	305
7/12/86	RUBBER	55 to 72	305, 305	330
7/22/86	RUBBER	60 to 73	300, 315, 320, 285	330
7/23/86	CONVENTIONAL	56 to 70	258	280
7/23/86	RUBBER	56 to 70	285, 325	315
7/24/86	RUBBER	58 to 82	295, 320	320
7/24/86	POLYMER	58 to 82	270, 275	300
7/25/86	RUBBER	62 to 79	285, 295	320

PROBLEMS

The biggest difficulty on this project and for that matter on any project where rubber is added to the asphalt mix is determining the amount of binder in the final mix. The rubber in the binder, whether it is recycled or synthetic, clogs the filter on the extraction test apparatus used to determine the asphalt content of the mix sample. On this project quality control of the binder content was based on the computer readouts at the batch plant. Gradation specifications were controlled by periodically sampling a batch of conventional mix run through the plant specifically for this purpose. The contractor placed this special sampling batch in his recycle pile for future use.

The only other problem encountered was with aggregate gradation on the first few days of production. The problem was traced to a stockpile which was out of specification. The situation was remedied by using the screens and bins on the plant as opposed to the cold feed out of the stockpile. Additional aggregates in the sizes missing from the original stockpile were brought in to help remedy the situation.

ECONOMICS

The original bid price for the conventional open-graded mix was $36.80 per ton. The change order price for the asphalt-rubber mix was $55.56 per ton. The difference in price, $18.76 per ton, represents an increase of 51% over the conventional mix. Translating this into cost-effectiveness terms it means that the rubberized mix must perform 51% better than the conventional mix. For example, if 8 years is the normal service life of a conventional open-graded pavement, then the asphalt-rubber and polymer-asphalt pavements must last about 12 years to be cost-effective.

TEST RESULTS

The work plan for the experimental feature calls for periodic measurements of pavement rutting/wear, pavement condition, and friction resistance.

Rutting/Wear

Post construction measurements of rutting/wear are shown in Table 2. All measurements are made in the outside (driving) lane.

Table 2. Pavement rutting/wear measurements.

LOCATION	SECTION	RUTTING/WEAR
M.P. 2.29 SB	CONTROL	NONE
M.P. 1.05 SB	POLYMER-ASPHALT	NONE
M.P. 1.00 NB	ASPHALT-RUBBER	1/16 inch
M.P. 2.20 NB	ASPHALT-RUBBER	1/16 inch

Pavement Condition

A visual inspection of the project three months after its completion revealed an absence of any defects which would lower the initial pavement condition survey rating below the 100 or zero defect level. In fact, the four pavement sections; (1) control, (2) polymer-asphalt, (3) asphalt-rubber with fog seal, and (4) asphalt-rubber without fog seal could not be differentiated from each other by visual inspection.

Friction Resistance

Friction resistance measurements were conducted on September 3, 1986 following construction and again on June 17, 1987. Results from both series of tests are shown in Table 3.

Table 3. Friction resistance measurements.

SEPTEMBER 3, 1986

SECTION	RANGE (FN)	AVERAGE (FN)
CONTROL	43.2 to 44.6	44.1
POLYMER-ASPHALT	35.6 to 44.6	41.4
ASPHALT-RUBBER w/Fog Seal	36.2 to 44.6	39.9
ASPHALT-RUBBER w/o Fog Seal	35.3 to 45.9	41.5

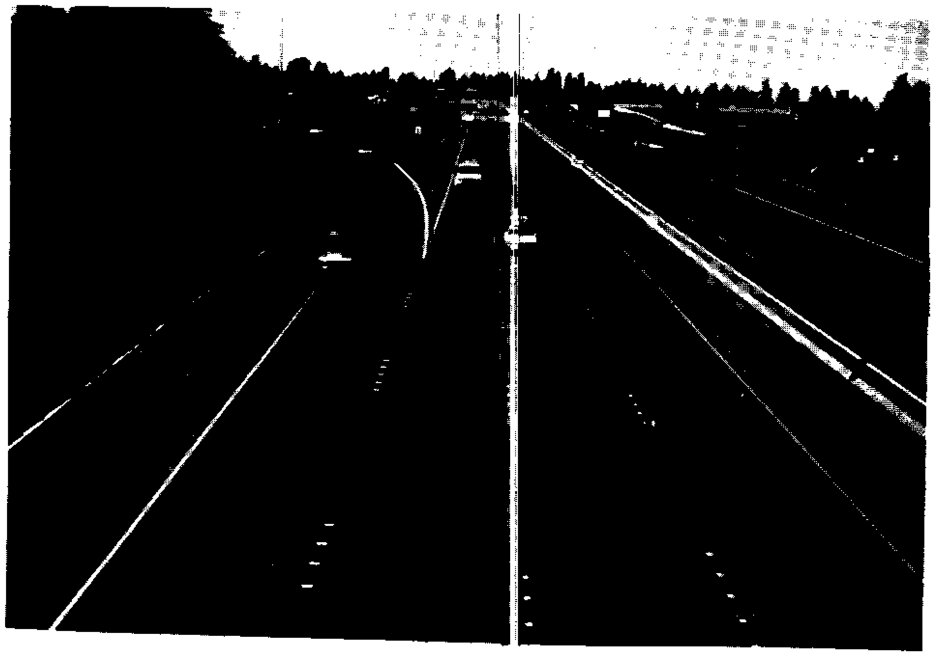
JUNE 25, 1987

SECTION	RANGE (FN)	AVERAGE (FN)
CONTROL	46.4 to 48.2	46.8
POLYMER-ASPHALT	46.1 to 49.5	47.7
ASPHALT-RUBBER w/Fog Seal	45.0 to 52.1	47.8
ASPHALT-RUBBER w/o Fog Seal	39.9 to 50.5	46.6

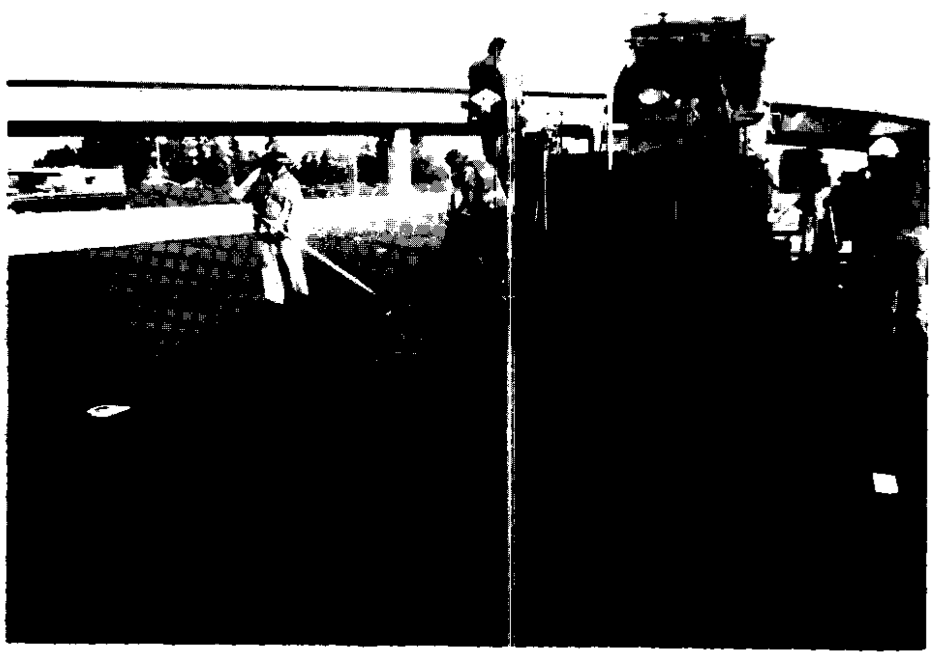
The post-construction friction resistance results are somewhat lower than generally experienced on new asphalt pavements, but are well within the normal range for open-graded pavements. The open-graded pavements are designed to have slightly higher asphalt contents than dense graded pavements to provide thicker film thicknesses on the aggregate particles for added resistance to ravelling. The fog seals, which are applied as a standard practice to the open-graded pavements, also decrease the initial friction resistance of the pavements until traffic has a opportunity to wear off the asphalt films on the aggregate. This change is illustrated by the second series of tests performed on June 17, 1987.

LONG TERM MONITORING PLAN

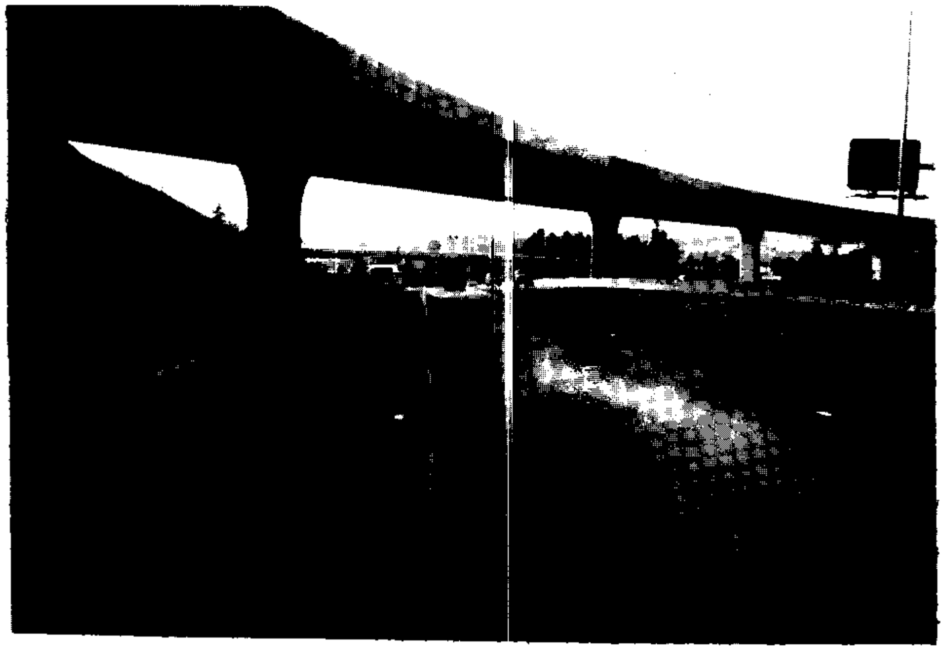
The work plan for this experimental feature calls for rutting/wear, pavement condition, and friction resistance measurements for a period of three years which would be 1989. The monitoring will be extended if at the end of this period the pavement sections are still performing in an equivalent fashion. It would not be unreasonable to expect that a monitoring period of 8 to 12 years might be needed to draw the final conclusions on this comparison.



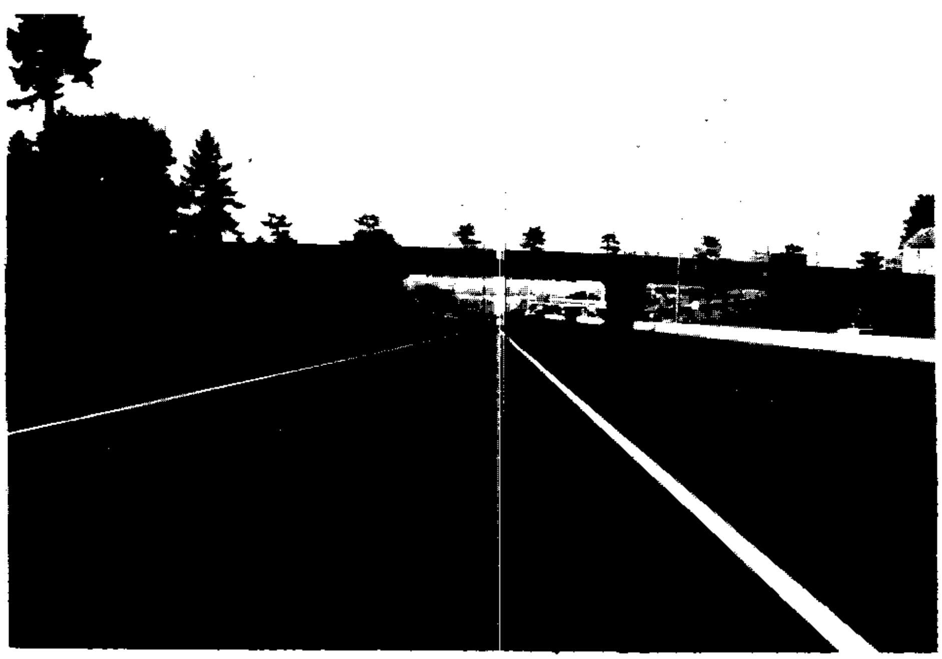
Condition of roadway before overlay. View is looking north at the southbound lanes from the Evergreen Blvd. structure at M.P. 0.85.



Placement of conventional open-graded Class D asphalt pavement. Location is the southbound outside lane at M.P. 2.30.



Conventional open-graded Class D pavement in the background and asphalt-rubber open-graded Class D pavement in the foreground. Person on shoulder marks dividing line. Location is the southbound lane at M.P. 2.20.



Completed asphalt-rubber Class D pavement. View is looking north at the southbound lanes at M.P. 0.70. The structure is Evergreen Blvd.