

DECK OVERLAY  
FIRESTONE RUB-R-ROAD

Experimental Feature  
Final Report

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## RUB-R-ROAD

### INTRODUCTION and BACKGROUND

During the fall of 1979, the Interstate Bridge, which spans the Columbia River carrying Interstate Highway 5 between Oregon and Washington, was overlaid with Rub-R-Road, a rubberized (latex-reinforced) asphalt concrete. Rub-R-Road, developed by Rub-R-Road, Inc. of Akron, Ohio, uses an asphalt cement which is 5 percent latex by weight. Specifications for the Rub-R-Road asphalt concrete used in this project are included in the appendix.

A 1977 Report entitled, "Membrane Waterproofing for Bridge Decks", prepared by William Quinn, Oregon State Highway Division, Research Section, reported that Rub-R-Road failed the testing for use as a waterproofing membrane for bridge decks. However, it was noted in the report that because the membranes were beneath an asphalt concrete wearing course, the electrical resistivity test used as the pass-fail criterion was unreliable, the reason being once the asphalt concrete overlay becomes saturated with water, the resistance test can be short circuited around the edge of the membrane resulting in erroneous measurements. The performance of Rub-R-Road as a waterproofing membrane was, therefore, not reliably established.

Prior to this study, Multnomah County, Oregon, reported good results using Rub-R-Road as a combination membrane and wearing course. Without the problems caused by the asphalt concrete wearing course, the resistivity tests showed that Rub-R-Road was satisfactory as a waterproofing membrane. Consequently, it was then decided to document the performance of Rub-R-Road as a wearing course and waterproofing membrane by evaluating it on the Interstate Bridge overlay project.

The Interstate Bridge is comprised of two three lane structures. These structures, each with seventeen spans, are over 3,500 feet in length. To allow passage of the main Columbia River shipping channel, the third span of each structure is a drawbridge. The northbound structure, built in 1917, had an asphalt concrete overlay, while the southbound structure, built in 1958, had a Portland cement concrete surface. The average daily traffic for both structures is approximately 100,000 vehicles.

## CONSTRUCTION

Prior to placement of the Rub-R-Road on the Northbound Structure, removal of the old asphalt concrete pavement was required. This was complicated by the presence of three sets of trolley tracks which were imbedded in the concrete deck. Consequently, some old AC pavement was left in place since full removal was prevented by the tracks.

The thickness of the Rub-R-Road wearing course originally was to be 2 1/2 inches. Only one inch was placed on the northbound structure because full removal of the existing asphaltic concrete was not possible.

The tack coat, which contained liquid rubber, was applied immediately before placement of the Rub-R-Road. The new wearing course was then placed using a self-powered paver.

The Rub-R-Road asphalt concrete was very difficult to work with, and smooth raking was sometimes impossible. This caused particular problems in the hand placed areas such as at expansion joints. Some of these areas were too rough after placement and had to be repaired with a standard Oregon "C" mix.

## TESTING AND EVALUATION

Electrical resistivity tests were conducted in order to determine the permeability of the membrane. A sponge wetted with a detergent solution was placed between the Rub-R-Road surface and a one foot square copper plate. Insulated wire connected the copper plate and the reinforcing steel in the bridge deck. The measurements were made using a battery operated volt-ohm meter. The test area chosen was located on the outside lane, eighth span, of the northbound structure. A matrix was marked out so that 20 test points in a 2 x 10 pattern on six foot centers could be monitored. These points were soaked for thirty minutes with the detergent wetting solution and then the resistance readings were taken.

The evaluation of the electrical resistivity test used the following criteria:

The membrane was considered "satisfactory" if 80% of all readings were greater than 500,000 ohms and 100% of all readings were greater than 100,000 ohms.

The membrane rated "unsatisfactory" if more than 50% of all readings were below 100,000 ohms.

The membrane was rated "doubtful" if the reading fell between those two extremes.

Testing was done on two dates, just after construction in September 1979 and again in July 1981. The Rub-R-Road surface proved to be satisfactorily impermeable, with only one measurement less than 500,000 ohms. All the other measurements were above 1.9 million ohms, with 93 % of the readings above 5 million ohms.

In July 1981 and again in April 1982, rutting in the wheel tracks was measured. On both dates, the ruts were generally 3/8 inch deep, although some ruts 1/2 inch to 5/8 inch deep were found. There are two possible explanations for this excessive rutting. First, since a fine aggregate gradation was specified for the Rub-R-Road system, a 2 1/2 inch thick overlay may have been excessive. A lift of 1 1/2 inches would have given greater resistance to deformation while maintaining adequate waterproofing and wearing course properties. Second, the contractor achieved the specified 95% relative compaction in only 15% of the tests. The average relative compaction was only 91.6%.

In May 1982 the skid numbers of the Rub-R-Road surface were determined using a skid trailer. All lanes in both directions were tested with several tests on each lane. The results of the skid tests are tabulated below. Skid numbers lower than 38 are considered undesirable.

SKID TABLE

Direction	Lane	Average SN	Maximum SN	Minimum SN	No. of Tests	Standard Deviation
NB	RT	44.8	47.9	38.6	8	3.2
NB	CTR	34.2	39.0	28.4	7	4.7
NB	LT	43.5	45.8	41.0	8	1.9
SB	RT	39.6	41.4	38.3	7	1.2
SB	CTR	39.8	48.4	35.7	8	4.1
SB	LT	45.7	48.9	43.6	8	2.0

During the 1981 testing, cores were taken to determine the percent voids after recompaction. It was found that the voids were close to zero in several samples, and in all samples tested it was below the design value. These low values could indicate a tendency to bleed, and therefore, may be the cause of the low skid numbers.

#### CONCLUSIONS

In spite of the high traffic volumes, the Rub-R-Road membrane and wearing surface has performed well. As a membrane, it is impermeable and should provide good protection against the intrusion of chlorides into the deck. As a wearing surface, there have been some deficiencies, namely rutting and poor skid resistance. More attention to the design and specifications should help to alleviate these problems. As a result of this project, Rub-R-Road is currently in the Oregon State Highway Division specifications as one of seven approved bridge deck waterproofing membrane systems.

APPENDIX

RUB-R-ROAD ASPHALT CONCRETE SPECIFICATIONS

COLUMBIA RIVER (INTERSTATE) BRIDGE DECK OVERLAY

The contractor shall furnish, install and remove temporary steel cover plates as called for on Drawing No. 34581 of the plans.

PAINTING - All new exposed steel shall be painted after installation as follows:

Formula	No. of Coats	Thickness (mils)
10-74	1	2
310-74	2	3

MEASUREMENT - The quantities to be paid for shall be the number of joints removed and replaced as specified.

PAYMENT - Payment will be made at the contract unit price per each for the item "Deck Joint Replacement, Pier.....", which payment shall be full compensation for removing and disposing of the existing joint materials, furnishing and installing new joint materials, including all labor, tools, equipment and incidentals necessary to complete the work as specified.

The applicable pier number will be inserted in the above pay item.

RUBBERIZED ASPHALT CONCRETE PAVEMENT

The asphalt concrete pavement to be placed on all spans of each bridge shall consist of "Rub-R-Road" rubberized asphalt concrete.

WEATHER LIMITATIONS - Pavement shall be constructed only when the existing pavement is dry and when the weather is not rainy. Unless otherwise directed, pavement shall be constructed only when the atmospheric temperature is at least 50 F.

RUBBERIZED ASPHALT CONCRETE:

MATERIAL - Paving Material approved for use on this project is rubberized (latex-reinforced) asphaltic concrete. The latex material shall be "Rub-R-Road", as manufactured by Rub-R-Road, Inc., of Akron, Ohio.

AGGREGATE - Aggregate shall conform to subsection 703.08 of the Standard Specifications.

Fine aggregate as produced shall be supplemented with fine sand of a suitable gradation to correct any deficiencies which may occur in the separate sizes of fine materials as required in the mix.

MINERAL FILLER - Mineral filler shall conform to subsection 703.15 of the Standard Specifications.

BITUMINOUS MATERIALS - Emulsified asphalt for tack coat shall be SS-1 (Anionic) asphalt conforming to Section 702 of the Standard Specifications.

Asphalt in mixture shall be AR-4000 asphalt conforming to Section 702 of the Standard Specifications.

DECK PREPARATION - The existing asphalt concrete wearing surface on the deck of the northbound structure shall be removed to bare concrete as far as is practical. Small areas of asphalt and asphalt stain need not be removed if smooth and tightly bonded to the deck and not over 1/16 inch thick. All asphalt concrete removed shall become the property of the contractor to be disposed of in a manner satisfactory to the engineer.

The existing asphalt is on Bridge No. 1377A spans 1 through 4 and 9 through 13.

The use of flame-type heater-planers will not be permitted. The existing concrete deck surfaces shall be patched or ground as required to provide a generally smooth surface. Spalled or loose concrete shall be removed to sound concrete. Holes or rough areas greater than 1/2 inch in depth shall be brought to the elevation of the surrounding areas before paving by hand application and tamping of the mixture taken from the truck. Holes or rough areas greater than 1/2 inch in depth shall be repaired by grouting or as otherwise directed by the engineer. Projections greater than 1/2 inch in height shall be ground down to a maximum height of 1/2 inch as measured by using a 36-inch straight edge.

All deck surfaces and the lower 1-1/2 inches of the curb faces shall be thoroughly cleaned of all dust, dirt, laitance, loose concrete and other foreign material. High pressure air shall be used for cleaning, supplemented by brooming or scraping as required. Grease, oil or similar substances may require solvent or light sandblasting for removal.

Immediately before application of the tack coat, the deck surface shall be clean and dry and approved for application by the engineer.

The tack coat shall be placed at rates as hereinafter specified. The coating shall be uniform and continuous. Application of the tack coat shall be by mechanical distributor.

The tack coat shall be applied just ahead of the application of the wearing course so that the trucks and pavers will travel on the tack coat before the emulsion "breaks".

WEARING COURSE MIXTURE - This material shall consist of a mixture of aggregates, mineral filler, bituminous material and rubber compound as specified above. It shall be capable of application in a compacted thickness of 2-1/2 inches.

Storage and handling of the rubber compound shall be in accordance with the manufacturer's recommendations.

The gradation of the aggregate shall be such that, when combined with any mineral filler used, the composite aggregate will meet the following grading requirements when tested by means of square-mesh Tyler sieves:

Tyler Sieve Size	Total Percent Retained
No. 3/8	0
No. 4	6-15
No. 8	10-20
No. 14	12-25
No. 28	12-25
No. 48	10-20
No. 100	8-16
No. 200	3-11
Passing 200	2-8

The composite aggregate, asphalt cement and rubber compound shall be combined in such proportions that the composition by weight of the finished mixture shall be as approved by the engineer, but within the following range limits:

Composite Aggregate: 90.0 to 93.0%

Rubber - Bitumen: 7.0 to 10.0%

The ratio of rubber compound to asphalt cement shall be not less than 5% rubber solids by weight +/- .3%.

HOT-MIX PLANT AND PREPARATION - The plant used for the manufacture of the asphalt concrete shall be of the batch-type and shall be capable of producing completely coated uniform mixtures within the tolerance set forth and at a uniform workable temperature as specified by the engineer, but not to exceed 360 F., for the mixture when leaving the plant. A separate dry storage shall be provided for any mineral filler used.

The exact proportions, within the limits specified, shall be regulated so as to produce a satisfactory mixture with all particles coated with asphalt cement and rubber. The sand and any mineral used shall be mixed dry for not less than 15 seconds. The asphalt cement shall then be added in an evenly spread sheet over the full length of the mixer box. The mixing shall be continued for a period of not less than 10 seconds and at least until the aggregate is completely coated with bitumen. The rubber compound shall then be added to the coated aggregate. The mixing shall be continued for a period of not less than 50 seconds. The length of the dry mixing and wet mixing periods may vary, but under no circumstances shall the total mixing time and the opening of the mixer gate be less than 80 seconds. The finished mix shall contain no materials other than the approved aggregate, asphalt cement and residual rubber solids. The temperature of the mixture when discharged from the mixer shall be 300 F TO 360 F.

WEARING COURSE APPLICATION - The wearing course mixture shall not be mixed or placed when the ground or atmospheric temperature is below 50 F. The wearing course mixture shall be laid so far as practical, with a mechanical, self-powered paver. Initial rolling shall be performed with a steel-wheeled roller of the three-wheel type.

Temperature of the mix when deposited on the bridge deck shall be not less than 275 F.

COMPACTION - Immediately after the mixture has been spread, struck off and surface irregularities and other defects remedied, it shall be thoroughly and uniformly compacted by rolling until compacted to 95% relative maximum density.

PAVEMENT TESTING - At least one week prior to starting paving the contractor shall furnish a trial batch of the rubberized pavement placed on a suitably prepared concrete surface. The engineer will test pavement for quality, texture, adhesion and cohesion.

MEASUREMENT - Measurement of all work required under these provisions will be by the ton in conformance with Section 403 of the Standard Specifications.

PAYMENT - Payment for furnishing and placing the rubberized asphalt concrete pavement will be made at the contract unit price per ton for the item "Rubberized Pavement", which payment shall be full compensation for furnishing all labor, equipment and materials required to construct the pavement as specified including removal of existing pavement, deck preparation and asphalt tack coat.