



COMMONWEALTH OF KENTUCKY
DEPARTMENT OF HIGHWAYS
FRANKFORT

February 19, 1962

HENRY WARD
COMMISSIONER OF HIGHWAYS

ADDRESS REPLY TO
DEPARTMENT OF HIGHWAYS
MATERIALS RESEARCH LABORATORY
132 GRAHAM AVENUE
LEXINGTON 29, KENTUCKY

D. 1. 7.
B. 2. 2. 1.

MEMORANDUM

TO: A. O. Neiser
Assistant State Highway Engineer

SUBJECT: Seal-Coat Application to
Clark Memorial Bridge

The concrete in the deck of the Clark Memorial Bridge between Louisville, Kentucky, and Jeffersonville, Indiana, is in a badly deteriorated condition. This concrete is over 33 years old and is showing severe freeze- and thaw-damage. The approach ramps are in particularly poor condition.

In an effort to provide a non-skid surface until such time as traffic could be re-routed over the new bridges in the area, a sand asphalt surface was placed in the fall of 1958. Early in 1960, a considerable percentage of the area of the concrete deck popped off and in doing so removed the thin surface course with it. Patching of the failed areas became rather critical in the later winter and early spring.

It appears that a combination of freezing and thawing and vibrational effects from traffic has produced the popping-off of the concrete deck. With this in mind, it was proposed that a light-weight bituminous concrete mix developed in the laboratory be used as a two-inch thick insulating course and covered with a sand-asphalt surface. The objective in this proposal was to seal out surface moisture and to absorb some of the impact and vibrational loading of the heavy axles using the bridge. After receiving bids for this proposal, the Maintenance Division decided that the bids were too high, inasmuch as the surfacing contemplated

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was to be used only until replacement of the deck could be scheduled. Alternatively, the Maintenance Division decided to seal the deck with an RS-2 emulsified asphalt containing approximately 2-1/2 percent neoprene rubber latex. The cover stone used was a black, wet-bottom boiler slag. Mr. Robert C. Deen has discussed the construction of the seal coat in the attached memorandum.

Although excessive cover aggregate was applied, there have been some losses of aggregate by traffic action. The seal coat appears to have lessened the penetration of water into the concrete deck. Surface failures have not been as extensive thus far this winter as they were previously; although, major repairs have been made on areas where the concrete deck material itself has popped off.

Respectfully submitted,



W. B. Drake
Director of Research

WBD:dl

Enc.

cc: Research Committee Members
Bureau of Public Roads (3)

Commonwealth of Kentucky
Department of Highways

Report

on

SEAL COAT APPLICATION TO
CLARK MEMORIAL BRIDGE

by

Robert C. Deen
Research Engineer Senior

Highway Materials Research Laboratory
Lexington, Kentucky
January, 1962

January 26, 1962

B.2.2.1.

MEMORANDUM

TO: W. B. Drake
Director of Research

FROM: Robert C. Deen
Research Engineer Senior

SUBJECT: Seal Coat Application to
Clark Memorial Bridge

The maintenance of the surface of the approach ramps and bridge deck of the Clark Memorial Bridge in Louisville has presented certain problems over the past few years. The ramps at each end of the bridge are rather steep, and on the Louisville side the ramp intersects Main Street where traffic movements are controlled by traffic signals. Thus, the northbound traffic accelerating upgrade from a stop and the southbound traffic braking to a stop on the downgrade present two very severe conditions that the surface must withstand. The increased use of salt for snow and ice removal has also contributed to deterioration of the surface.

In the summer of 1958, it was found necessary to resurface Clark Memorial Bridge. The Research Division recommended the use of a silica sand-asphalt surface on the basis of promising results from laboratory testing and the success of similar resurfacing in New York. The laboratory work done in designing the sand-asphalt mixture and the record of construction have been reported previously.*

* Florence, R. L., "The Design of Thin, Silica Sand-Asphalt Wearing Surfaces for Highways and Bridges," Reports of the Highway Materials Research Laboratory, Vol. XIV, 1959, pp.253-310.

Strunk, L. H., "Bridge Resurfacing with Silica Sand-Asphalt Mixture," *ibid.*, Vol. XIII, 1958, pp. 334-367.

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In March, 1961, a performance report* was made indicating the condition of the ramps and bridge deck at various times since resurfacing in 1958. The condition of the bridge deck at the time of the last performance survey (March, 1960) was such that some repair work and patching was required in the spring of 1960. It was also noted that portions of the concrete deck would eventually have to be removed and replaced, but it was hoped that this type of work could be deferred through maintenance until construction has been completed on the new bridge across the Ohio.

Accordingly, the feasibility of using light weight bituminous concrete for resurfacing was investigated in the laboratory by the Research Division. A light weight resurfacing was deemed necessary because of dead weight considerations in the bridge design. After some study the Research Division submitted a recommended "Special Provision for Light Weight Bituminous Concrete" and a "Proposal for Resurfacing Clark Memorial Bridge" (transmitted to the Director of Maintenance, April 20, 1961) making use of a mixture of expanded shale aggregate and PAC-3. After the Maintenance Division had received and reviewed bids submitted by contractors for this resurfacing, it was decided not to resurface the approaches and the bridge during 1961. Instead, the Maintenance Division proposed to seal the approach ramps and bridge deck with its own forces.

The materials suggested for this sealing were an emulsified asphalt and a ceramic aggregate. Since the Department had no experience with this particular aggregate, it was decided to seal a test section on one of the Louisville streets before applying the seal to the approach ramps and deck of Clark Memorial Bridge. The Research Division was asked to observe the performance of the test section. The remainder of this memorandum contains remarks concerning the construction and materials used.

A section approximately 1000 feet long in the southbound lane of Poplar Level Road, Louisville, Kentucky, was selected to receive a test application of the seal coat. This test section was just north of the intersection of Poplar Level Road with Trevilian Way. The northern portion of the test section was nearly level while the southern portion was on an approximately 5% grade. Traffic at the intersection was controlled by a signal, and thus the southbound traffic was accelerating upgrade from a stop.

* Florence, R. L., "Bridge Resurfacing with Silica Sand-Asphalt Mixture," Department Report, March, 1961.

The aggregate used on the test section was a black, wet-bottom boiler slag obtained from the Clifty Creek Power Plant at Madison, Indiana. The aggregate is a hard, black, angular substance of fused silica, iron, and aluminum oxides. In this area the aggregate is distributed by Black Beauty of Ohio, Inc., Cincinnati, Ohio. The gradation of this aggregate as used on the test strip is shown in Fig. 1. In order to obtain an indication of the wear of the Black Beauty aggregate, an abrasion test was performed using Charge D of ASTM Designation C-131-47. A test was run on a sample of the slag aggregate and another was run on a limestone aggregate from Central Rock Quarry in Lexington. The results are shown in Fig. 2.

The binder used was a RS-2 emulsion obtained from the American Bitumuls and Asphalt Company of Louisville. On a portion of the test strip, RS-2 with neoprene rubber latex added at the rate of 1 gallon of latex to 40 gallons of emulsion was used. On the remainder of the section of the binder was the RS-2 with no additive. Results of the laboratory tests on the emulsion are given in Table 1. Difficulty was encountered in running the viscosity test and it was thought that the emulsion may have broken somewhat prior to testing.

The application of emulsion to the roadway was started at about 9:00 a. m. on October 6, 1961, when the temperature and the relative humidity at Standiford Field were reported to be 55°F and 80 percent. The aggregate was spread by a Flaherty Spreadmaster and a 4-ton pneumatic roller was available for rolling purposes. The seal coat was completed at approximately 11:30 a. m. and traffic was kept off the section until about 2:00 p. m. when the temperature and relative humidity were 74°F and 44 percent. A photograph of the seal coat on the latex section soon after rolling is shown in Fig. 3. A layout of the test section shows the rates of application and the materials used (See Fig. 4).

A visual inspection of the test site was made on October 10. It appeared that the aggregate was being retained satisfactorily; this was particularly so in the case of the binder containing the latex. The aggregate did not appear to be polished to any significant degree.

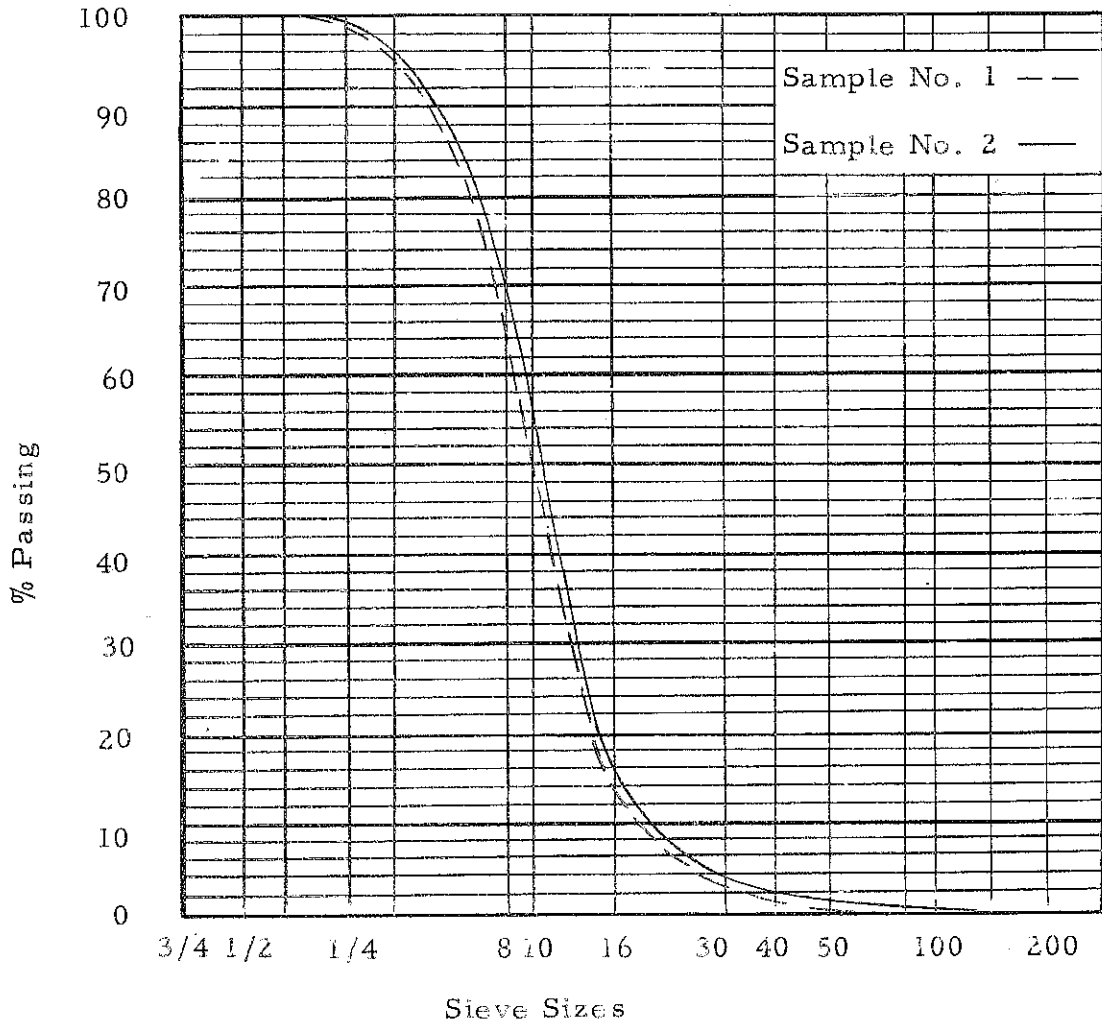


Fig. 1. Gradation Curves of Black Beauty Aggregate.

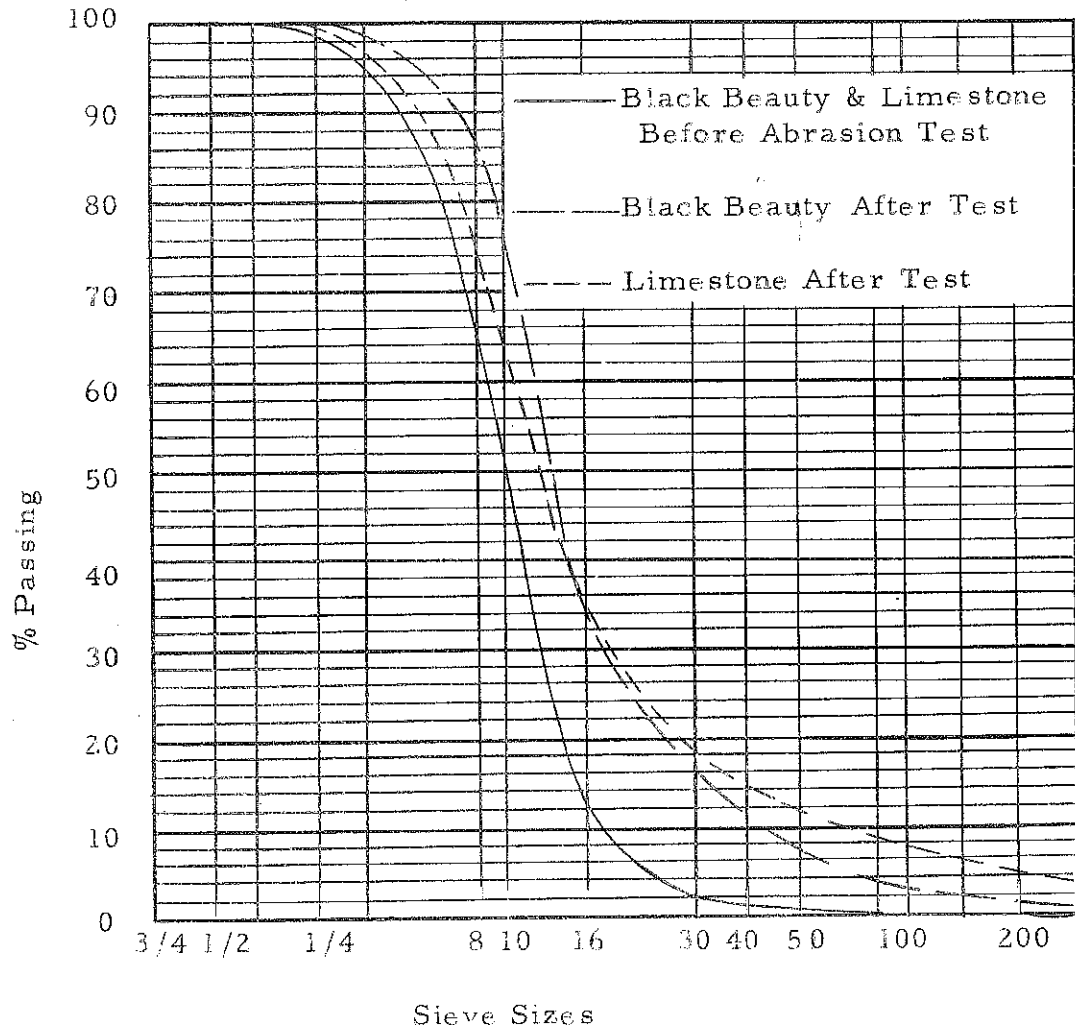


Fig. 2. Results of Wear Tests.



Fig. 3. Photograph Showing Surface Texture Soon After Rolling on Section using the Latex Additive.

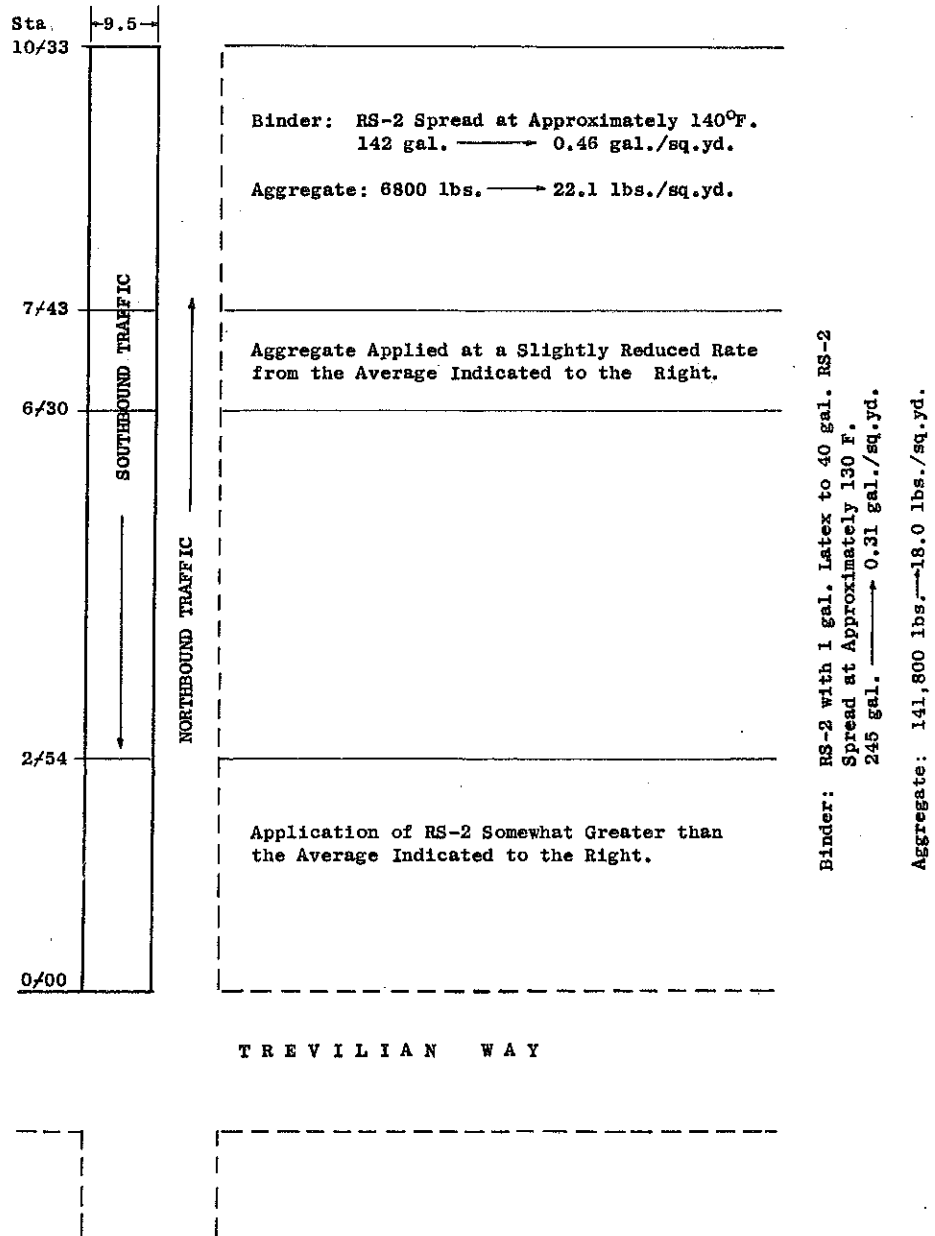


Fig. 4. Layout of Test Section.

Table I. Laboratory Tests on Emulsified Asphalts
 Sampled from Poplar Level Road Seal-Coating

Test	RS-2 W/Latex	RS-2
Viscosity, Saybolt-Furel 60 ml. at 122°F, Sec.	271	669
Water Content (Percent)	32.6	31.4
Penetration on Residue by Evaporation, 77°F, 100 g, 5 sec.	150	165
Stripping Test AASHO T-182-27	None	None
Stripping After Agitation for 7-1/2 hrs.	None	None
Ductility of Residue by Evaporation (cm) 5 cm/mm. at 77°F.	150+	110; 150+

Table 2. Summary of Weather Data, Standiford Field,
Kentucky

Date (1961)	Time	Temp. (°F)	Rel. Hum. (%)	Remark
Oct. 6	7:00 a. m.	46	89	Min. Temp.
	8:00 a. m.	48	93	Sky
	9:00 a. m.	55	80	Condition -
	10:00 a. m.	61	70	Clear
	11:00 a. m.	71	41	
	12:00 noon	72	38	
	1:00 p. m.	73	84	
	2:00 p. m.	74	44	Max. Temp.
Oct. 11	7:00 a. m.	54	90	Min. Temp.
	8:00 a. m.	59	83	Sky
	9:00 a. m.	61	85	Condition -
	10:00 a. m.	70	64	Broken
	11:00 a. m.	74	56	to
	12:00 noon	74	60	Overcast
	1:00 p. m.	75	56	
	2:00 p. m.	77	52	
	3:00 p. m.	81	48	
4:00 p. m.	81	49	Max. Temp.	
Oct. 12	7:00 a. m.	57	100	Min. Temp.
	8:00 a. m.	60	93	Sky
	9:00 a. m.	64	90	Condition -
	10:00 a. m.	70	79	Clear
	11:00 a. m.	75	74	
	12:00 noon	78	71	
	1:00 p. m.	80	67	
	2:00 p. m.	82	53	
3:00 p. m.	84	40	Max. Temp.	

On the basis of the performance of the test section over a period of approximately a week, the Maintenance Division decided to seal the approaches and deck of the Clark Memorial Bridge with the Black Beauty aggregate and the RS-2 emulsion with the latex additive. The equipment available for use was the same as that used on Poplar Level Road. The sealing was started on October 11, and completed on October 12. The aggregate was applied at a rate of 24 lbs. per square yard and the emulsion at a rate of 0.3 gallon per square yard. A total of 25,000 square yards was sealed at a cost of \$0.165 per square yard.

On January 25, 1962, a visual inspection was made of the seal coat on the bridge as well as on the Poplar Level Road test site. It was noted that much of the aggregate had been lost, but there still remained sufficient aggregate that it could be very definitely felt by the hand when rubbed over the surface. More aggregate appeared to have been retained at the Poplar Level Road site than at Clark Memorial Bridge. This may be attributed to the difference in traffic carried by the two roads. Potholes and scaling had already started to develop on the approaches and deck of the Clark Memorial Bridge. Some of the distress appeared to be a scaling of the sand-asphalt resurfacing that was placed in 1958. The material has been thrown out of these areas to depths of only 1/2 inch or so. It has been reported, however, that in many of the areas which had been patched, the concrete deck itself had deteriorated and popped out, and in some instances the reinforcing steel was exposed. Extensive maintenance patchwork has already been required to maintain the approaches in a reasonable condition.

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