R-726

# OFFICE MEMORANDUM

MICHIGAN
DEPARTMENT OF STATE HIGHWAYS

January 15, 1970



To: R. L. Greenman
Testing and Research Engineer

From: L. T. Oehler

Subject: Performance of Latex-Modified Mortar on Concrete Bridge Decks. Research Project 57 B-39. Research Report No. R-726.

The following brief summary of the performance of thin latex-modified overlays applied to concrete bridge deck repair projects was prepared by M. G. Brown per your recent request.

The first field application of latex-modified mortar in Michigan was made in the late summer of 1957 and 1958 on a three-span bascule bridge carrying US 23 over the Cheboygan River in Cheboygan. The preparation and application details, as well as early performance characteristics on this structure (B03 of 16081), were described in Research Report R-321 (December 1959). This report also appeared in HRB Bulletin 260.

This early test structure has been inspected a number of times; most recently in the summer of 1967 and 1968. Figures 1 through 4 show the current condition of the 5/8- to 3/4-in. latex mortar surfacing which was originally applied in 1957 or replaced in 1958. In general, the latex mortar has maintained its bond to the old substrate for over 11 or 12 years. The end spans, Figures 1 and 4, appear in sound condition as they did in the inspection of 1959. However, Figures 2 and 3 show several areas in the counterweight pours which have lost bond and developed cracks. These areas can be attributed to partial opening of the bascule span and vibration effects during the initial placements in 1957 and 1958.

More recently, in 1968 and 1969, about four bridge deck repair projects were done using SM-100 latex-modified mortar or concrete mixed and applied with mobile equipment owned by the Dow Chemical Co. This equipment is shown in Figure 8 and consists of a vehicle which can batch and mix up to 6 cu yds of mortar or concrete and is used in conjunction with a Maginniss self-propelled vibratory screed. The SM-100 liquid latex admixture, as now designated, is essentially the same as the Dow 560 used at Cheboygan, with the addition of a defoamer so the SM-100 can now be used with air-entrained cement.

Figure 5 shows a completed 13- by 30-ft patch placed August 14, 1968, in the north lane of span 8 on S34 of 82112 which carries westbound M 102 over I696 in Detroit. This patch repaired a badly spalled area and was saw-cut at the perimeter and chipped out about 2 in. deep by Wayne County personnel. A latex-modified concrete was used containing 1/2-in. gravel, 7 sacks per cu yd of

Wyandotte type 3 cement, 3.5 gal of SM-100 per sack of cement, and 6 to 7 percent entrained air. Thus far, this patch looks very good although some other spalled areas are developing in spans 6 and 8. Figure 6 shows one of these areas in span 8 which has been progressively getting larger. These spalls appear to be developing from shrinkage cracks which were observed to have formed during the initial deck placement on October 11, 1964.

Figure 7 shows three patched areas in the west half of B04 of 38111 which carries southbound US 127 over the Grand River on the east side of Jackson. These areas were prepared by District 8 Maintenance personnel and finished with latex-modified concrete of the same design as used on the M 102 structure. The large patches in spans 1 and 3 were placed on August 23, 1968, and the remainder on August 26, with the deck being opened to traffic on August 30. The patches are currently in sound condition as they are being exposed to their second winter.

The most recent latex-modified placements which we have followed, were applied in the summer of 1969 on John R and Brush Streets over I 75 in Detroit. These two structures S 26 and S 27 of 82195, were scarified 1/4 in. deep with a Tennant model G-12 machine, sandblasted, and then surfaced with 1 in. of an SM-100 latex mortar using the Dow mixing-finishing equipment previously described. An MDSH Supplemental Specification, dated 3-28-69, was prepared and used for these two projects. The latex mortar was applied to these structures to add about 3/4 in. of cover to the top steel which was too shallow in some areas. Figure 8 shows the Dow batching and mixing truck ahead of the self-propelled vibratory screed placing the first 11-ft wide pass along the west curb of the Brush Street structure on July 16, 1969. The rest of the surfacing was placed on July 17, August 7, 8, 19, and 21. The John R Structure was similarly surfaced on July 25, 30, and August 13, 14, and 21. About 15.8 square yards of the latex mortar had to be re-done on the two structures where loss of bond was discovered. These small areas were primarily at the ends of the structures where the latex mortar was carried 2 feet beyond the end joints without providing for early movement under the new mortar.

The primary advantage in using SM-100 latex-modified mortar or concrete is the increase in tensile and bonding strengths which are obtained at relatively high degrees of fluidity. This increase in fluidity is obtained at lower water-cement ratios which also produces a mortar with lower expansion-shrinkage tendencies under wetting and drying conditions. These benefits were indicated in the earlier referenced Research Report R-321 and more recently, in Research Report R-715 (October, 1969). This latter report showed the higher bond strengths of SM-100 mortar through 200 cycles of freezing and thawing in air and water.

In general, latex-modified mortar and concrete applications appear to be performing quite well in the field. However the success of these applications depends on the close control of all operations from the old concrete deck pre-

paration to the final curing. It has been found that latex-modified surfaces must be covered very quickly (within 1/2 to 1 hour) with wet burlap and polyethylene sheeting to prevent a dry skin formation with possible shrinkage cracks. With the advent of the new batching-mixing truck an accurate preliminary check should be made on each project to assure proper mixing, yield, and air entrainment under jobsite conditions.

TESTING AND RESEARCH DIVISION

L. T. Oehlerox

Engineer of Research
Research Laboratory Section

LTO/MGB:sjt

Figure 1. Latex mortar surfacing on west end span, looking east on US 23.

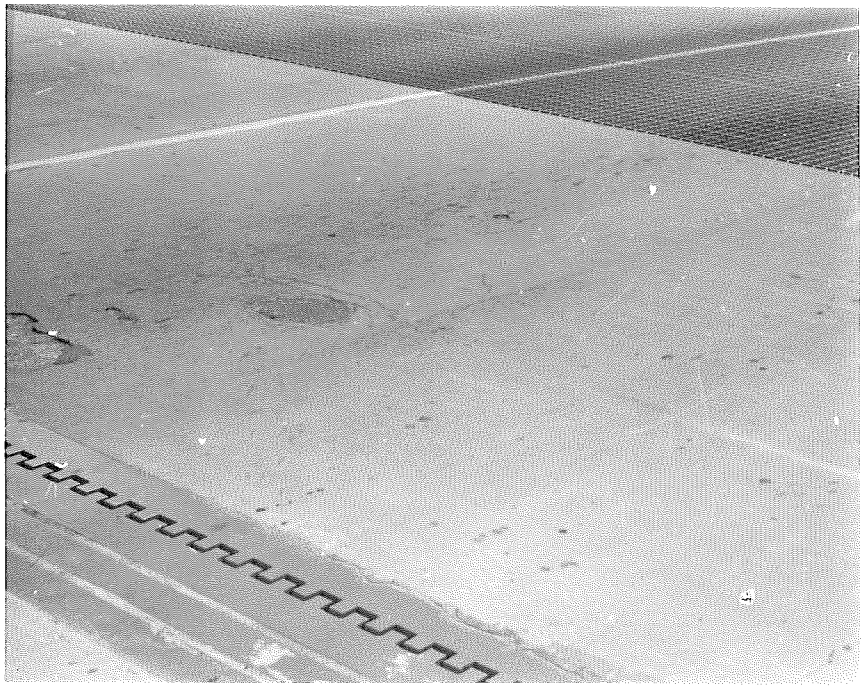

Figure 2. Area in west counterweight span with some loss of bond and cracking of latex mortar surface.

Figure 3. Small area in east counterweight surface with bond loss of latex mortar.


Figure 4. View of east end span and counterweight pour looking west on US 23.

Figure 5. Curing of latex concrete patch in north lane of westbound M 102 (span 8).

Figure 6. Typical spall development in westbound lane along median adjacent to latex concrete patch (5-1-69).

Figure 7. Latex concrete patches placed 8-23-68 in southbound US 127 over the Grand River (11-13-68).

Figure 8. Latex mortar surfacing being placed with vibratory screed and batching and mixing truck. West lane of Brush Street over I 75 (7-16-69).