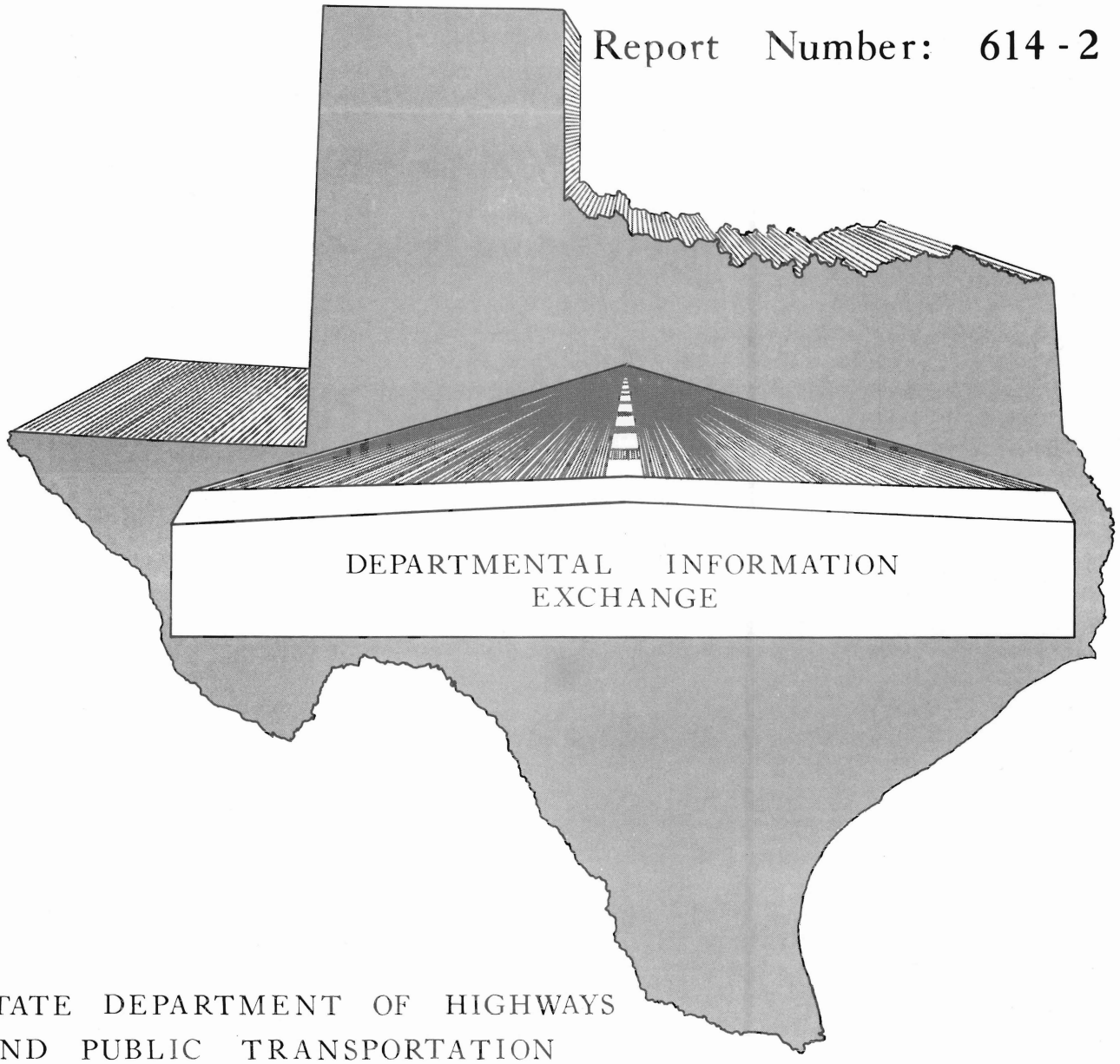
EXPERIMENTAL PROJECTS

POLYMER CONCRETE DECK REPAIR

Report Number: 614-2



STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

POLYMER CONCRETE PAVEMENT REPAIR

Report No. 614-2

A Narrative Report

by

Donald R. Mosier
Resident Engineer
District 16

Texas State Department of Highways and Public Transportation

April, 1976

POLYMER CONCRETE DECK REPAIR

On February 13, 1976, District 16 with the assistance of David W. Fowler from the Center for Highway Research, The University of Texas at Austin, set out to make some test repairs on the Corpus Christi Harbor Bridge. This structure was completed in 1959, spans the ship channel, and is a major route into the City carrying approximately 25,000 vehicles per day.

The deck consists of light weight concrete over steel girders and truss sections, and regular concrete over the prestressed beam sections. The light weight sections have deteriorated badly in the last four years. The progression of cracking started in the outside lanes with slight transverse cracking turning into severe transverse cracking with alligator cracking breaking into spalled areas and delaminations.

The purpose of this research was to determine the possibility of using polymerization to seal and bond the concrete to return some integrity to the deck.

Starting at 9:30 a.m. the outside northbound lane was coned off by maintenance forces. After the lane was safely coned off and the flagmen in place, the areas to be repaired were selected. Five cracked areas and one spalled area located between wheel paths were selected and marked for identification.

At 10:30 a.m. an infrared butane heater was placed over the area marked #1 to facilitate drying. The wind, temperature, and humidity had produced a slight dampness on the deck and especially in the cracks and spalled areas. The drying of area #1 was continued for 20 minutes and while drying proceeded, the ingredients of mix #1 were weighted out. Mix #1 consisted of Methyl Methacrylate, Butyl Acrylate, Lauroyl Peroxide, and N-N-Dimethyl-Para-Toluidine in the percentages by weight as shown in the attached table. The Lauroyl Peroxide was dissolved in the MMA, and the DMT in the BA. The two were then

combined for the final mixture.

After completing the drying time for area #1, the heater was moved to area #2. Fine sand was then spread over area #1 and brushed into the cracks. Mix #1 was applied to the area by hand and involved pouring small amounts of monomer over the area and working the sand and monomer into the cracks with a trowel. The cracks were kept moist by application of more monomer as the monomer already applied soaked into the cracks or was evaporated at the surface. After 15 minutes, a total of 600 grams of monomer had been applied to the area. The area was then covered with polyethylene to minimize evaporation at the surface. After 10 minutes, the film was removed and an additional 200 grams of monomer was applied, especially where cracks were noticeably dry.

Immediately after area #1 was completed, treatment of area #2 was begun. The infrared heater had been used to dry the area for 10 minutes and then the area was left to cool. A new mix identified as mix #2 was made up as shown in the attached table. This mix was similar to that used on area #1 except that it contained a smaller percentage of Butyl Acrylate. The Butyl Acrylate forms a more rubbery polymer than the MMA which produces a harder polymer at normal temperature. Thus mix #2 with less BA, produced a somewhat less ductile filler than mix #1. Mix #2 was applied after sand had been placed in the cracks. Approximately 500 grams were spread over the area and then covered for 10 minutes with polyethylene film. Then the film was removed and another 200 grams was spread into the dry areas.

Areas #3 and #4 were treated without prior drying with mix #1 and #2 respectively. Sand was brushed over these areas prior to monomer application. Then 400 grams of mix #1 was applied to area #3 and 300 grams of mix #2 was applied to area #4. After 5 or 6 minutes, additional monomer was applied to each as required to keep the sand moist.

A new mix identified as mix #3 on the attached table was made up.

This mix was designed to cure more quickly than the other two mixes, but still incorporated the use of Butyl Acrylate to provide some ductility. The mixing process involved first dissolving the Benzoyl Peroxide Catalyst in the MMA and then the remaining ingredients added.

Area #5 was dried with the heater for 10 minutes. A small pile of sand was wetted with the monomer and brushed over the area with a stiff floor broom until the cracks were thoroughly filled. Additional monomer was applied to the sand which dried rapidly. The monomer became fairly hard in 35 minutes.

Area #6 was a spalled area at the north end of the test area. The spalled area, which was about 6 inches long by 3 inches wide and 1/2 to 3/4 inches deep, was dried for 20 minutes and allowed to cool. Then it was filled with sand and saturated with monomer mix #3. As the sand dired out, more monomer was applied until polymerization occurred.

The test repairs were all completed by 2:00 p.m. and the lane was opened to traffic 40 minutes later.

Three weeks later an observation trip was made to the bridge to determine the results of the repairs.

Areas #1 and #3, which were repaired with mix #1, showed very little retention of the patch material. What little material was left was in the lower portion of the cracks. Mix #1 definitely was not an acceptable mix.

Areas #2 and #4, which were repaired with mix #2, showed signs of stability with about 70 percent of the cracks sealed and 30 percent open. The open cracks still contained some material in the bottom.

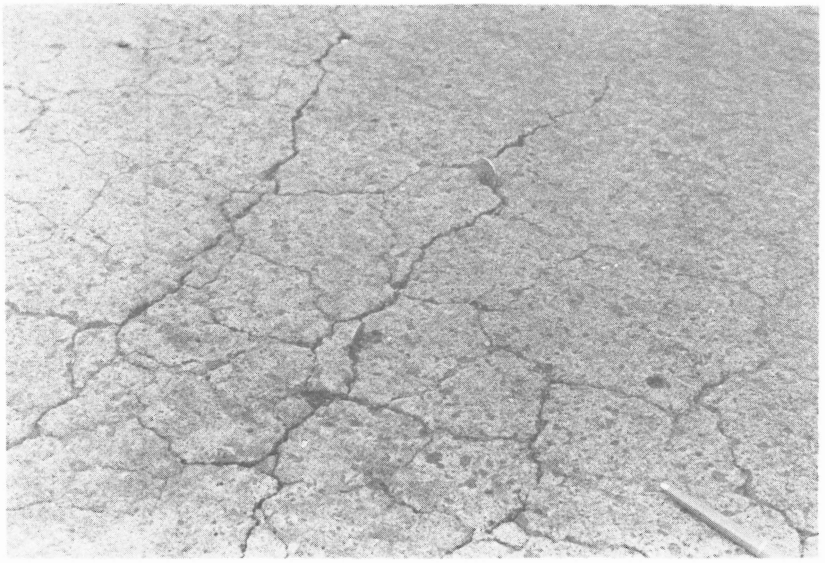
Area #5 repaired with mix #3 showed practically no patching material remaining. Also, the spalled area #6, patched with the same mix, failed.

Conclusion from these test repairs are that only one mix produced some positive results. Possibly by picking a more suitable day for application and by holding the traffic off of the repairs longer to insure the mix had completely hardened, a more acceptable repair could be achieved.

Table 1. Monomer Mixture Formulations

Mix Number	Components of Mix % (wt)						
	MMA(g)	BA(g)	TMPTMA(g)	LP(g)	BzP(g)	DMA(g)	DMT(g)
1	70%	30%		2.7%			2%
2	80%	20%		2.7%			2%
3	66.5%	28.5%	5%		2%	2%	

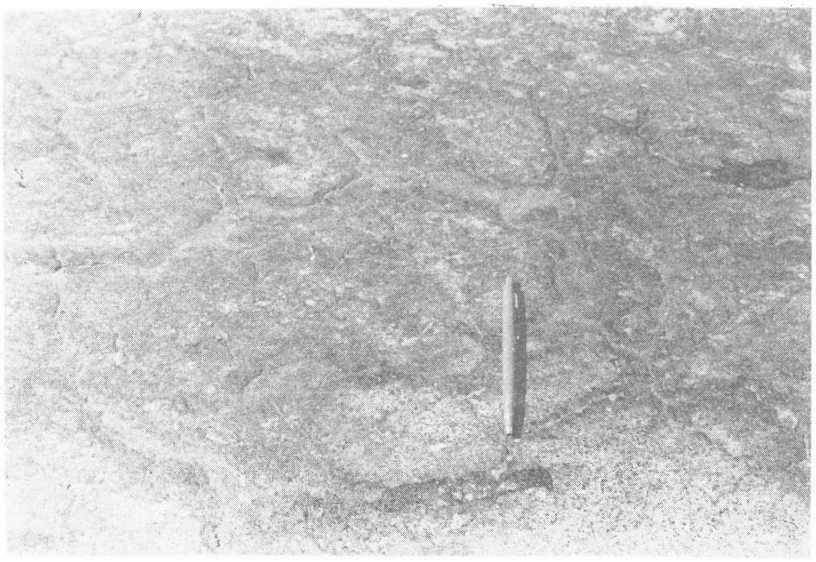
MMA - Methyl Methacrylate
BA - Butyl Acrylate
TMPTMA - Trimethylol Propane Trimethacrylate
LP - Lauroyl Peroxide
BzP - Benzoyl Peroxide
DMA - Dimethyl Aniline
DMT - N, N-Dimethyl-Para-Toluidine



a) Prior to Treatment

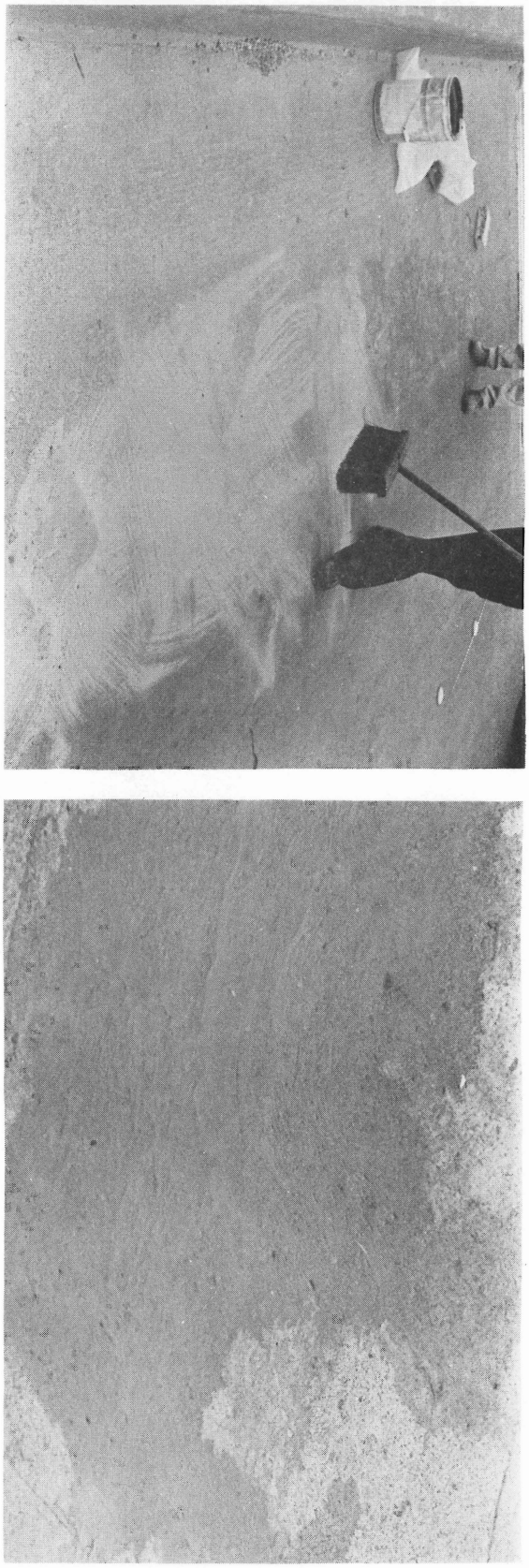
b) Applying Sand

c) Applying Monomer



d) Repaired Cracks

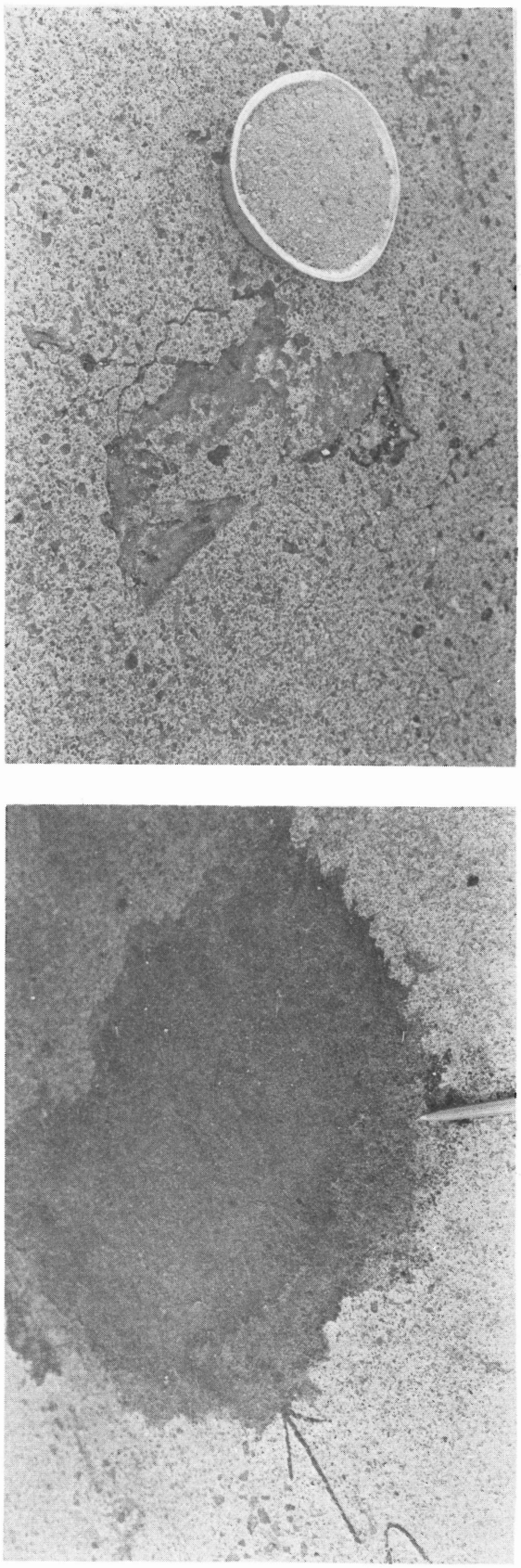
Figure 1 - Cracks Being Repaired Individually (Area No. 1)



a) Broomming on Monomer-Wetted Sand

b) After Application of Monomer

Figure 2 - Cracks Repaired by Brooming (Area No. 5)



a) Before Patching

b) After Repair

Figure 3 - Repair of 0.5 to 0.75 in. Deep Spalled Area