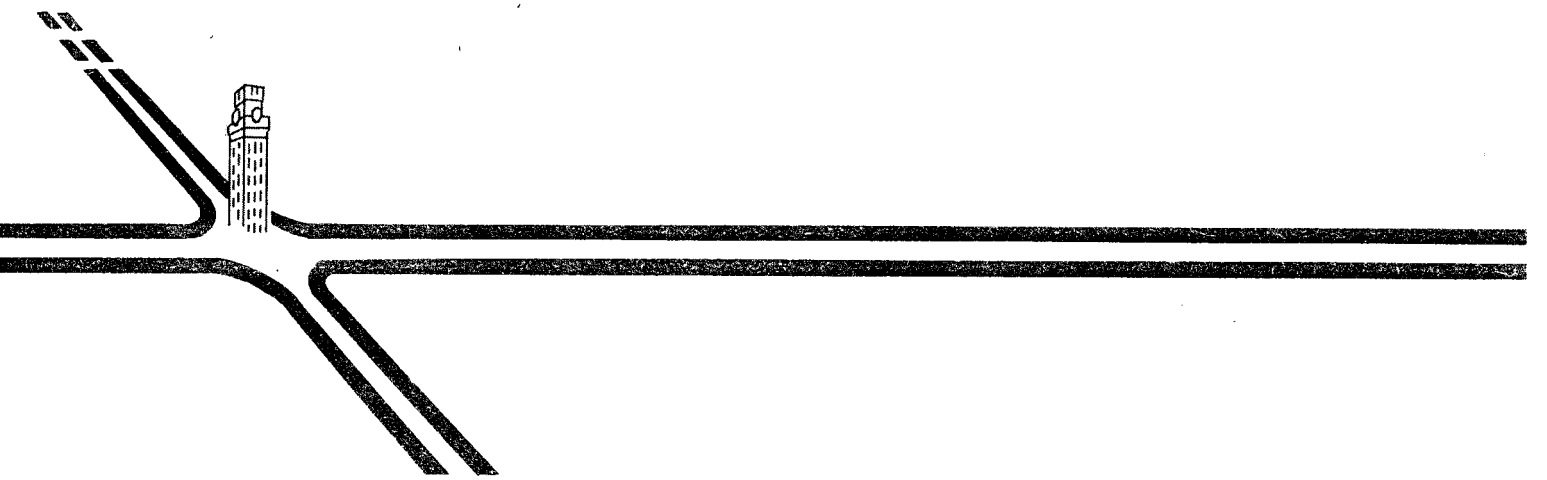
POLYMER CONCRETE REPAIR OF BRIDGE DECKS

By

David W. Fowler and Donald R. Paul



SUMMARY REPORT 114-8(S)

SUMMARY OF

RESEARCH REPORT 114-8

PROJECT 3-9-71-114

COOPERATIVE HIGHWAY RESEARCH PROGRAM
WITH TEXAS
STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION
AND
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

CENTER FOR HIGHWAY RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN
MARCH 1979

SUMMARY REPORT 114-8(S)

Polymer Concrete Repair of Bridge Decks

Polymer concrete (PC) consists of aggregate and liquid monomer which is subsequently cured, or polymerized, to produce a strong, durable material which bonds well to portland cement concrete. The polymer (plastic) serves as the aggregate binder, and no portland cement is required.

The primary monomer used in this study was methyl methacrylate (MMA), which has a viscosity slightly less than water. The polymer made from MMA, known commercially as Plexiglas® or Lucite®, has very good mechanical and durability properties.

Other monomers used in relatively small quantities include butyl acrylate (BA), used to improve ductility, and trimethylolpropane trimethacrylate (TMPTMA), used to increase the curing rate and to minimize surface blistering on the PC during curing. An initiator and an accelerator are added to cure the monomer.

The aggregate should be well-graded to require a minimum of monomer to fill the voids. Well-graded concrete sand is satisfactory for thin repairs (¾ in. or less); a combination of concrete sand and Grade 3 or 4 coarse aggregate in approximately equal weight proportions is typically used for deeper repairs. The aggregate should be dry, with a maximum moisture content of one percent, and free of dirt, asphalt, and other contaminants.

The PC is usually cured in 30 to 60 minutes after the monomer is added. The PC develops compressive strengths in the range of 4500 to 10,000 psi (31,000 to 69,000 kN/m^2). The moduli of rupture range from 1100 to 2000 psi (7600 to 13,800 kN/m^2). The moduli of elasticity vary from 1×10^6 to 3×10^6 psi (6.9×10^6 to 20.7×10^6 kN/m^2).

Some of the chemicals to make PC are moderately toxic and are flammable. Experience has shown that these materials can be used safely even on large-scale projects if sound safety procedures are followed. Methods of handling, mixing and storage are described in Report 114-8.

Preparation of the repair area is similar to repairs using conventional or fast-setting concretes. All unsound concrete should be removed, and corrosion scab or asphalt should be removed. To insure adequate bond, the existing concrete surface should be dry.

Due to the low viscosity of the monomer, formwork, if required, should be watertight. Wooden forms should be treated with a release agent to facilitate removal.

Two methods of mixing and placing PC have been used. In the first method, premixed aggregate is placed in the repair area and saturated with the monomer system. Vibration or tamping is used to consolidate the material, and the surface is screeded and troweled. In the second method, aggregate and monomer are premixed in a mixer or wheelbarrow and the PC is then placed in the repair and finished in the same manner as for the first method.

A large number of PC repairs have been made throughout the state. These overlay repairs have been made using sand saturated with monomer. The surface was first dried, sand was screeded over the surface to a depth of about ⅜ to ½ in. (10 to 13 mm), monomer was poured over the sand, and the surface was finished (Fig 1). Shallow repairs were made by filling the voids with a combination of fine and coarse aggregate and saturating it with monomer (Fig 2). The finished repairs were typically ready for traffic within an hour (Fig 3). Repairs of joints in bridges are also

Fig 1. Finishing MoPac Boulevard repair.

Fig 2. Monomer application.

Fig 3. Completed repair.

described in Report 114-8. PC repairs have proven to be durable and permanent in nearly all cases.

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

The full text of Research Report 114-8 can be obtained from Mr. Phillip L. Wilson, State Planning Engineer, Transportation; Transportation Planning Division; File D-10R; State Department of Highways and Public Transportation; P.O. Box 5051; Austin, Texas 78763.