SUMMARY REPORT 12—2F(S)

DEBRIS REMOVAL FROM CONCRETE BRIDGE DECK JOINTS

SUMMARY REPORT
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A commercially available high-pressure water-jet apparatus consisting of a trailer mounted pump and a hand operated jet-gun can be used to effectively clean joints in concrete bridge decks.

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Debris Removal From Concrete Bridge Deck Joints

by

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This report describes the research efforts to develop improved methods for cleaning joints in concrete bridge decks. This research was initiated because of the need of highway maintenance personnel for a practical and effective technique for removing debris from joints of in-service bridges. At the beginning of this study the technique being used was to loosen the debris by hand with picks and chisels and then to blow out the loosened material with an air hose. Although the technique was effective for joints wide and shallow enough to accommodate hand tools, it was difficult and time consuming.

At the outset of the study there was no known effective technique for removing debris in the deep and narrow joints of pan-formed bridges. It was recognized that these joints which are less than one-inch wide and about two to three-feet deep did not provide much access for debris removal. To loosen and remove debris when the only access was a very narrow slot posed a difficult problem. Thus, early in the study primary emphasis was placed on cleaning pan-formed bridge joints. It was concluded that a satisfactory cleaning technique for these joints would also be suitable for other joints which are generally shallower and more accessible.

Preliminary Investigation

At the outset of this study no technical references could be found that were specifically directed toward the problem of cleaning joints. Contacts were made with various highway agencies and numerous manufacturers of tools and equipment to find methods or equipment which might be applied to the problem. It was learned that the maintenance staff of the Louisiana Department of Highways had conducted demonstration tests of two different devices applicable to the problem. One was a high-pressure water-jet apparatus which had been used to successfully remove debris from bridge deck joints and the other was a tractor-mounted cutting wheel which had been used for widening joints in pavements and bridge approach slabs.

Based upon these initial contracts many ideas for possible solutions to the problem were ruled out due to their lack of technical feasibility; however, several possible approaches were found.

Observations made on in-service bridges indicated that some joints in need of cleaning would require widening. Specifically it was found that most joint distress on pan-formed bridges occurs at joints of the fixed-type. These joints are typically two to three feet deep, open about one-quarter of an inch at the top, and completely closed at the bottom. It was believed impossible to remove the debris lodged in these deep and narrow wedge-shaped cavities without widening them.

The research staff made arrangements for a demonstration of the high-pressure water-jet apparatus. From this test it was concluded that an effective cleaning technique could be devised using this equipment to clean pan-formed bridge expansion joints which are typically about three-quarters of an inch wide and contain an asphalt impregnated fiber board beneath a shallow asphaltic seal.

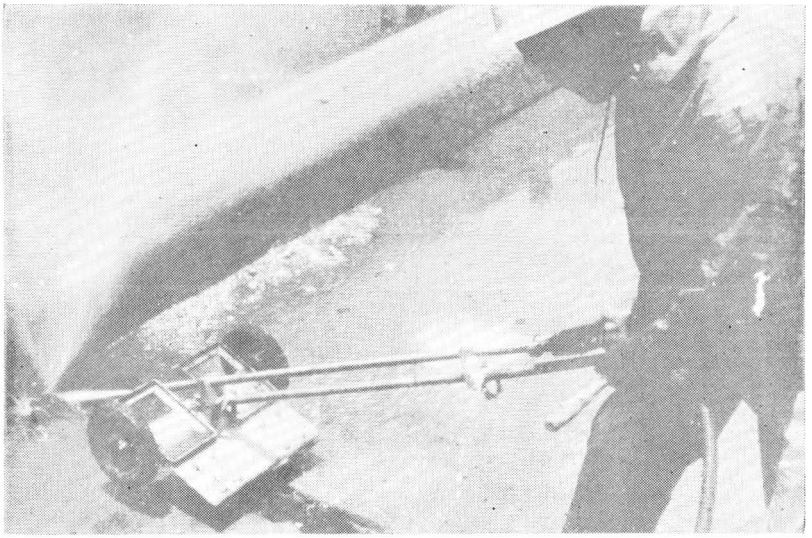
As a result of this investigative period, two approaches to joint cleaning were established. One involved a widening technique for very narrow or completely closed joints. The other involved the high-pressure water-jet apparatus which appeared capable of removing debris from joints which were at least one-half inch wide. These two approaches were pursued concurrently in the study.

Joint Widening Investigation

Although an extensive search was made, no readily implementable, industrial equipment could be found that would widen the deep narrow joints like those on pan-formed bridges. However, two of several cutting methods found are believed to be technically feasible. One is the use of a diamond impregnated wire which is used in the stone quarrying industry. It would involve the design of a complex band-type saw apparatus for guiding the wire. The other feasible method is the use of a large diameter diamond saw which would involve the design of a complex driving and positioning device. The development of either of these methods would require an extensive and costly effort.

Developmental Water-Jet Testing

Initial developmental testing with the water-jet apparatus was done in the Bryan district by research personnel. During this period it was learned that a single circular orifice designed to produce a narrow jet stream provided better cutting action than orifices designed for other shaped streams. More effective debris removal was achieved when the apparatus was operated at its maximum design flow and pressure, i.e. 10 gpm at 10,000 psi. The back thrust of the stream from the hand-held jet-gun quickly tired the operator; thus, to provide relief, a small cart was built to hold the jet-gun. More effective operations resulted when cleaning was begun at the sides of a bridge and progressed toward the center so that a drainage channel was provided. After



Cleaning operations are more effective if work begins at the sides and progresses toward the center so that drainage is provided.

the initial developmental testing it was concluded that the apparatus was ready for pilot implementation by highway maintenance personnel.

Pilot field tests were conducted in the Fort Worth and Beaumont districts. Basically the maintenance personnel in these districts undertook separate two-week experimental joint cleaning programs. The results were quite successful. The personnel in both districts felt that the cleaning technique was far superior to any other that they had tried. It was found that all debris could be removed from pan-formed bridge expansion joints.

Similar brief joint cleaning programs were undertaken by the Pharr, Wichita Falls, Dallas and Waco districts. In each of these districts some attempts to clean the fixed-type joints on pan-formed bridges were included in the tests. The results of these tests were also successful. The technique was found to be far superior to any other that had been tried previously in these districts. It not only cleaned the expansion joints but it also satisfactorily cleaned the narrow fixed joints. All detectable debris except a few tightly wedged pebbles was removed from the fixed joints. It was concluded that such debris removal would reduce and probably eliminate future distress at these joints.

Conclusions and Recommendations

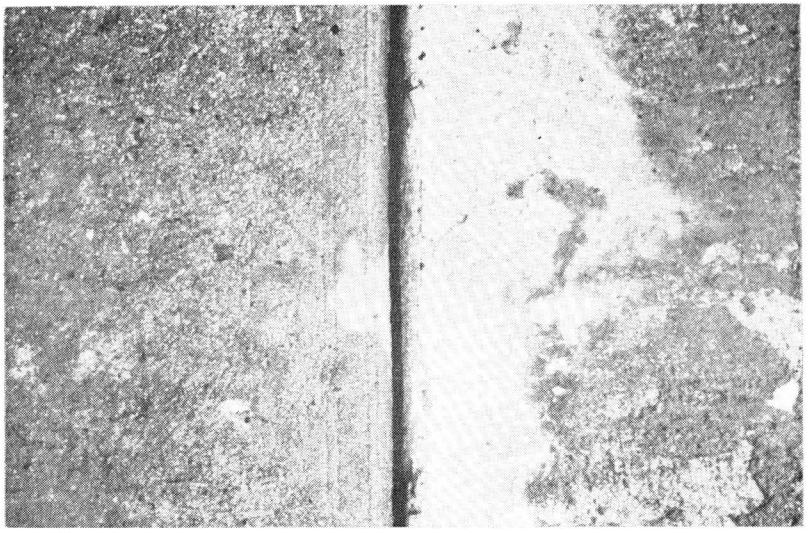
A commercially available high-pressure water-jet apparatus is a practical and effective means for cleaning joints in concrete bridge decks. For effective operations the apparatus should supply a narrow jet stream of at least ten gallons per minute using a

line pressure of at least 10,000 psi. A small cart facilitates operator control and steadies the jet stream for more effective debris removal.

It is apparent that the high-pressure water-jet apparatus can be used to remove debris from joints in concrete pavements. However, caution in such use is recommended because of the possibility of introducing water into the pavement subgrade. This is not a factor on bridges and was not investigated in the research.

Although an extensive search was made, no readily implementable equipment appears to be available for widening the deep narrow joints like those on pan-formed bridges. However, two different stone sawing techniques could be applied to the problem. Either of them will require extensive apparatus development which is not believed to be warranted at this time.

Almost all of the pier-cap distress on pan-formed bridges is apparently caused by debris in the fixed joints. Therefore, it is recommended that these joints be cleaned and sealed on a routine basis to prevent additional pier-cap fractures. If after a few years of implementation this does not substantially eliminate



Almost all detectable debris can be removed from fixed joints in pan-formed bridges. A routine cleaning and sealing program for these joints is the most promising approach to eliminate pier-cap fractures.

further joint distress, it is recommended that the joint widening research begun in this study be continued.

If a pan-formed deck span is fixed at both ends and one of the ends has cracked its pier-cap—a typical type of distress—it is recommended that the dowels between the deck and the cap be cut with a welding torch prior to the cap repair.

Implementation

Field tests indicate that the joint-cleaning technique developed in this study for use on bridge decks is practical and effective for immediate implementation by highway maintenance personnel. The initiation of a routine cleaning and sealing program for the fixed-type joints on pan-formed bridges appears warranted as priorities permit.

Caution in the use of the technique on concrete pavement joints is recommended because of the possibility of introducing water into the pavements' subgrade.

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