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A SURVEY OF DISTRESS AND DEBRIS IN THE JOINTS OF PAN-FORMED CONCRETE BRIDGES

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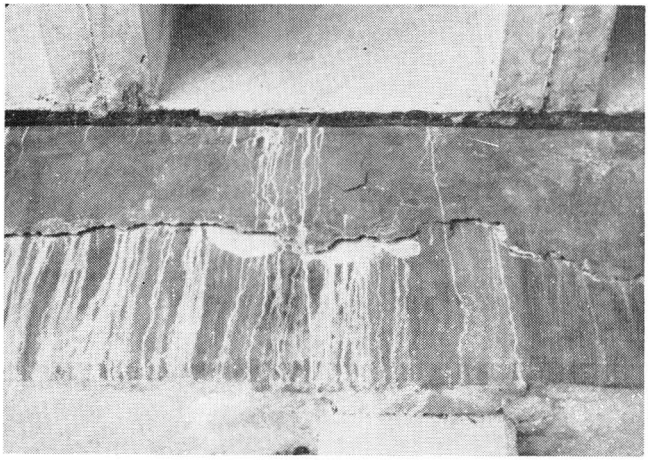

Pier cap distress is frequently found in pan-formed bridges. Such distress results from damaging expansion pressure at debris filled joints.

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A Survey of Distress and Debris in the Joints of Pan-Formed Concrete Bridges

by

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Deterioration of concrete at expansion joints in pavement and bridge decks frequently occurs when damaging pressure is developed in the adjacent concrete by expansion of the slabs in excess of the compressibility of the material in the joint. In cold weather, when slab contractions open joints, absent or inadequate seals allow entry of incompressible debris into the joints. With repeated expansion and contraction, these joints accumulate so much debris that damaging pressures finally develop.

This study, "Improved Methods for Cleaning Joints in Concrete Bridge Decks," was initiated because of the need for a practical and effective technique for removing accumulated debris from existing joints. Such an improved technique was thought to be particularly needed for the maintenance of pan-formed bridges which have very deep and narrow joints.

An interim research report is summarized which describes the results from a survey of seventy-three pan-formed bridges made to locate bridge expansion joints in need of cleaning. Such joints were sought in order to apply the techniques being developed in the course of this study. At the time it was made, this survey was not considered to be a major portion of the research effort; it was merely an effort to locate, for experimentation, suitable bridges convenient to the research headquarters. However, the findings of the survey are believed to be significant enough to justify the interim research report. In fact, the authors believe that the findings point out a major problem facing the Texas Highway Department in the maintenance of pan-formed bridges.

Survey Results

Seventy-three multiple-span, pan-formed bridges principally located within Texas Highway Department District 17, were examined to locate expansion joints suitable for cleaning experimentation. In addition to noting the amount of debris in joints, associated distress was noted for evaluating priority in the need for cleaning. Also, other facts pertinent to joint cleaning were recorded, such as the depth from the deck surface as well as at the pier cap.

Of the 382 joints between adjacent spans which were investigated, 79% were found to have accumulated appreciable amounts of debris due to the absence of any joint seal or because of deterioration of the sealing material. Table I shows the distribution of the debris with respect to the type of joint.

TABLE I. DEBRIS VERSUS TYPE OF JOINT

	Number Without Debris	Number With Debris	Total Number	% With Debris
Fixed Joints	12	147	159	98.8
Expansion Joints	68	155	223	69.5
Total	80	302	382	79.0

It appears that the absence of seals at the fixed joints favors accumulation of debris there. Typically, the fixed joints are open about 1/4 inch wide at the top and closed at the bottom. The wedge shaped cavity thus formed provides a space for the debris to accumulate.

The expansion joints were found, typically, to be about 3/4 inch wide and to contain a fiberboard filler beneath an asphaltic seal. However, in most cases, these seals had failed to prevent entry of debris. The high-pressure water-jet technique, which is under investigation in this study, appears well adapted to removal of debris, filler, and deteriorated seal material from these expansion joints. For the narrower, tapered fixed joints, however, it appears that only the near-surface debris can be removed by this technique.

Indications of serious distress, such as cracked diaphrams or cracked pier caps, were seen in 26 of the 73 structures. Table II shows the distribution of the damage with respect to the type of joint at which it was observed to occur.

TABLE II. DISTRESS VERSUS TYPE OF JOINT

	Without Distress	With Distress	Total	% Distressed
Fixed Joints	106	53	159	33.3
Expansion Joints	217	6	223	2.7
Total	323	59	382	15.4

From this table, it is seen that the frequency of damage at fixed joints is more than ten times that at expansion joints.

In view of the finding that most damage occurs at fixed joints, it is apparent that measures are needed to relieve or prevent distress at these joints. Since typical fixed joints are open only about 1/4 of an inch wide at the top and completely closed at the bottom (24-26 inches deep), removal of the debris is difficult. There appear to be three possible remedial measures: (a) removing as much debris as possible from the accessible portion of the joint and providing a seal which will prevent further

entry of debris, (b) cutting one set of dowel pins so that each span is pinned only at one end, and (c) widening the fixed joints by cutting a slot in the concrete to the bottom of the joint between adjacent slabs.

Conclusions

Widespread deterioration of seal materials at expansion joints in pan-formed bridges is permitting most of these joints to become filled with debris. The high pressure water-jet joint cleaning method currently being investigated in this study may prove to be ample for cleaning such joints.

The absence of seals at the fixed joints, in combination with the tendency of these joints to open about 1/4 inch at the deck surface, makes them particularly prone to accumulate debris. Damage was observed in the surveyed bridges more than ten times as frequently at these joints than at expansion joints. It does not appear likely that cleaning only the expansion joints would appreciably diminish the distress at the fixed joints.

Although Texas Highway Department design changes have substantially eliminated fixed joints in new pan-formed bridge construction, the findings of this limited survey indicate that approximately 42% of the joints in existing pan-formed bridges are of the fixed type. A very high incidence of distress (about 33%) was found in this type of joint. Without some type of treatment like the remedial measures currently under investigation in this study, the incidence of distress in these joints can be expected to increase and cause severe future maintenance problems.

Implementation Statement

The survey conducted in this study has revealed that damage and distress in multi-span, pan-formed bridges occur predominantly at the support where relative longitudinal movement between the beam and the pier cap is prevented, i.e, where two spans are doweled to one pier cap, thus forming a "fixed joint." Remedial measures for minimizing further distress which are applicable to these joints are currently being investigated and have yet to be developed to the stage of full implementation.

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