

BULKHEAD JOINTS FOR CONCRETE BASE SHOULDERS

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MICHIGAN DEPARTMENT OF STATE HIGHWAYS

BULKHEAD JOINTS FOR CONCRETE BASE SHOULDERS

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Progress Report on a "Category 2" Experimental Construction Project

**Research Laboratory Section
Testing and Research Division
Research Project 70 F-117
Research Report No. R-857
(Work Plan No. 11)**

**Michigan State Highway Commission
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Vice-Chairman, Claude J. Tobin, Peter B. Fletcher
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Introduction

This progress report covers the findings to date from the evaluation of lane ties used in bulkhead joints for concrete base shoulders. The project was initiated as a result of the Pavement Selection Committee meeting of April, 1970. The work is being done by the Michigan Department of State Highways as a "Category 2" experiment, in cooperation with the Federal Highway Administration.

The Department's Construction Division selected the location for the experiment, prepared the authorizations, and supervised the construction of the project. The Research Laboratory established reference points for measurements, and is responsible for evaluating and reporting results.

Thermal expansion and frost action have, on occasion, resulted in horizontal and vertical displacement of concrete base shoulders. This displacement interferes with the lateral drainage of the roadway, allows increased amounts of water to penetrate into the base, and is troublesome with regard to snow removal operations. The raised shoulders interfere with scraper blades, and damage to both blades and shoulders can occur.

It is the objective of this study to determine if the addition of lane ties has a beneficial effect in deterring differential movement between the roadway and concrete base shoulders.

General Information

Hookbolt lane ties were installed in the concrete base course widening for the rest area and ramps C and E of the LaPorte Rd interchange on State Project BI 11014-010 (Fed. No. I 94 - 1 (26) 0) I 94 near the Indiana State Line. The lane ties were placed by authorization on the original contract. Ramps A, B and F of the same interchange, which were added under State Project BI 11014-012, have no lane ties, and are being used as control sections. Figure 1 shows the location and lay-out of the experimental and control ramps.

Instrumentation

All of the subject ramps were instrumented with flat-head stainless steel rivets which have a conical recess machined in the top to accept mating cones on the ends of the reading devices. The rivets were placed 4 in. each side of the bulkhead joint and at 50-ft intervals along the length of the ramps. In order to obtain stable reference points, the rivets were recessed approximately 1 to 1-1/2 in. into the bituminous wearing course and

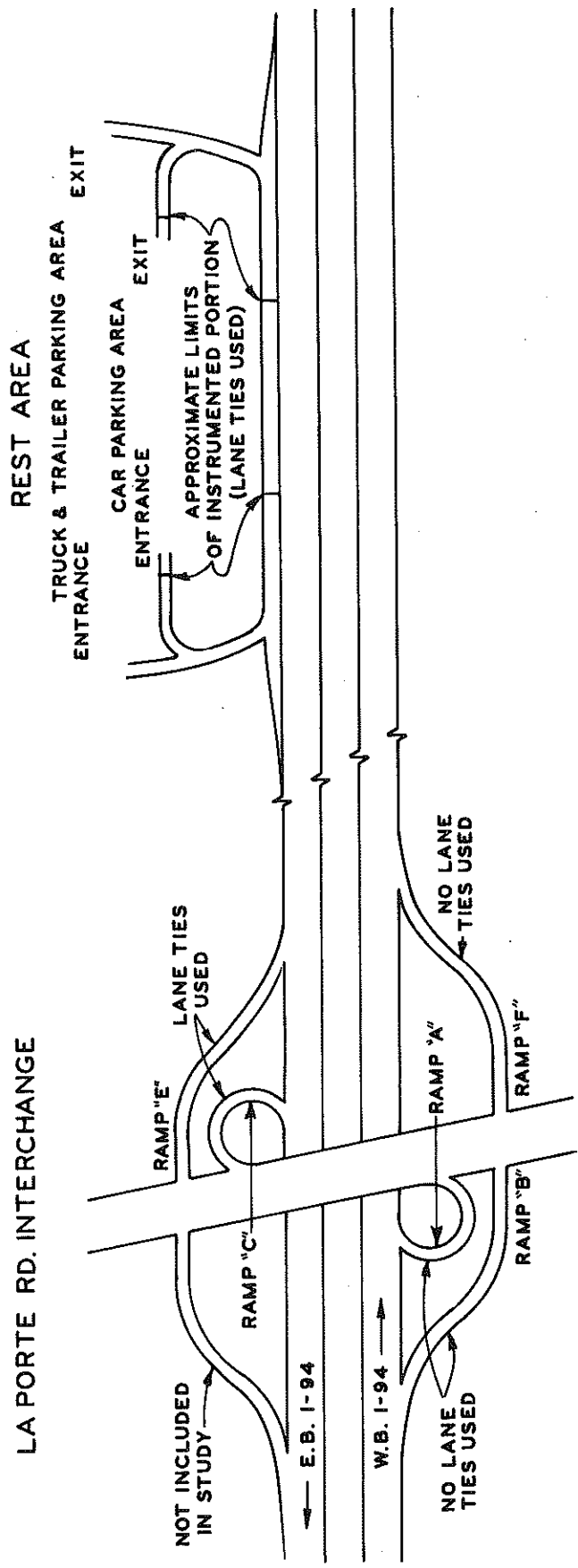


Figure 1. LaPorte Rd interchange and rest area showing location of instrumented ramps.

grouted in the concrete base course with non-shrinking mortar. Recessing the rivets should also eliminate their loss due to scraper blade damage during snow removal operations. Rivets in the roadway were similarly recessed.

The ramps were instrumented shortly after construction. Ramp B was completed in the fall of 1970, the remaining ramps were finished in the fall of 1971.

Measurements

Measurements for joint opening and faulting are made across the longitudinal bulkhead joint. Joint opening measurements are made with a vernier caliper, and fault measurements with the special fixture shown in Figure 2. The two forward legs of the instrument are set in the rivets, the rear leg is adjustable and is used to level the device. A reading is then taken from the scale on the right side of the fixture. Changes in reading from one time to another indicate a relative vertical displacement of positions of the roadway and shoulder.

Readings have been taken in the spring and fall of each year since the ramps were instrumented.

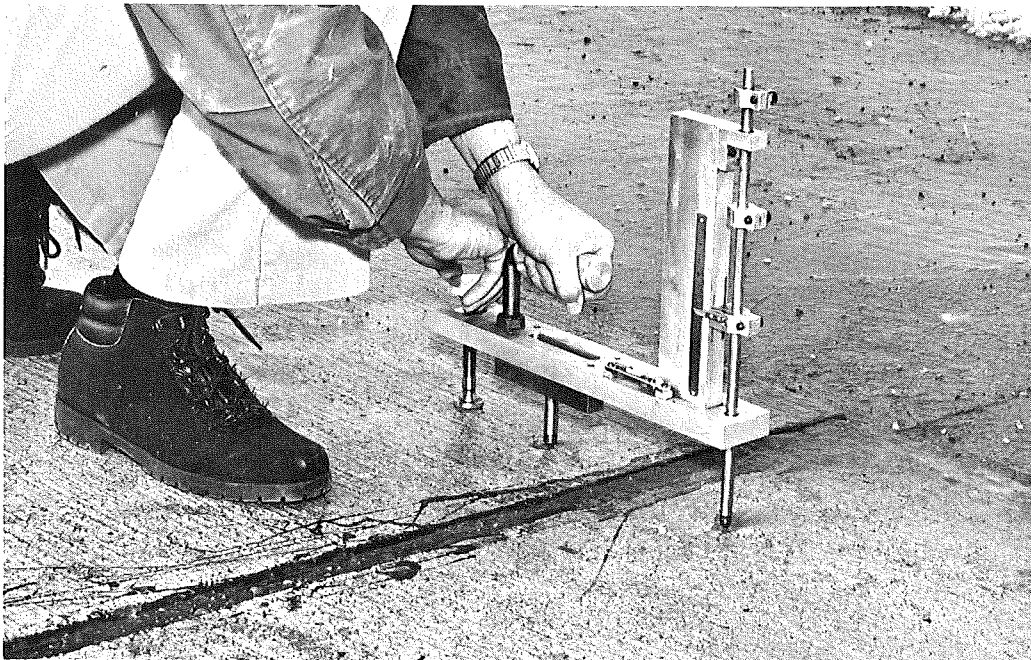


Figure 2. Special fixture for measuring faulting of joint.

Observations

Table 1 shows the average horizontal and vertical displacement for each ramp, along with related information.

The amount of joint opening shown is the average of the total number of readings taken on each ramp in March 1973. Previous readings are quite similar except for ramp B. Average joint openings for this ramp were 0.01 in 1971, 0.05 in 1972 and 0.08 in 1973. Maximum openings were 0.05, 0.17, and 0.27 for 1971, 1972, and 1973, respectively. From data obtained, it appears that once an opening is established, penetration of water into the base along with freeze-thaw cycles contribute to further opening of the joint.

TABLE 1
SUMMARY OF RAMP DATA

Ramp Designation	Project Number	Hook Bolts	Instrumented Section	Length, ft	Number of Readings	Average Joint Openings As Of March 1973, in.	Vertical Displacement
A	BI 11014-012	No	Sta. 31+50 to Sta. 19+84	1166	25	0.00+	None
B	BI 11014-012	No	Sta. 33+95 to Sta. 21+50	1245	26	0.08	None
C	BI 11014-010	Yes	Sta. 12+56 to Sta. 22+50	994	21	0.01	None
E	BI 11014-010	Yes	Sta. 10+81 to Sta. 19+74	893	20	0.00+	None
F	BI 11014-012	No	Sta. 28+96 to Sta. 16+02	1294	27	0.01	None
Rest Area "On" Ramp	BI 11014-010	Yes	Sta. 7+00 to Sta. 16+48	948	20	0.03*	Sta. 7+00 1/4 in.
Rest Area "Off" Ramp	BI 11014-010	Yes	Sta. 30+69 to Sta. 40+95	1026	22	0.01	None

*By deleting the initial three reference points, average drops to 0.01 in.

The average joint opening of the rest area "on" ramp is somewhat misleading due to the fact that the first three reference points contribute greatly to the average shown (0.03 in.). By deleting these initial three readings, the average drops to 0.01 in. which is close to the average movement shown by the other ramps. The possibility exists that these unusually high readings at the beginning of the ramp are caused by omission of the lane ties or perhaps different base conditions at the transition from standard to concrete base shoulder. This particular location was the only one exhibiting any vertical displacement at the time of the recent survey. However, the past winter was not typical for the area, and future developments could vary considerably.

Performance data will continue to be collected and maintained by the Research Laboratory until such time that further reporting is warranted by additional information gathered.