EXPERIMENTAL CONCRETE PAVEMENT RAMPS
CONSTRUCTION REPORT
(Experimental Work Plan No. 7)

MICHIGAN
RESEARCH LABORATORY SECTION

MICHIGAN DEPARTMENT OF
STATE HIGHWAYS AND TRANSPORTATION

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Introduction

This report covers the construction of experimental ramps on two Michigan construction projects, to evaluate non-reinforced concrete pavements without load transfer devices, subjected to different traffic conditions. The work is being carried out by the Michigan Department of State Highways as a "Category 2" experiment, in cooperation with the Federal Highway Administration.

Ramp paving with large modern equipment leads to problems due to the lack of room for the paving train and associated equipment for delivery of materials. Slipform pavers have difficulty on the sharply curved superelevated grade due to lateral drift and interference with load transfer devices and reinforcement. Such problems have made the cost of ramp pavement quite high.

Since many ramps receive only a small percentage of the mainline traffic, lower cost pavements may be suitable.

Once a decision was made to build the experimental ramps, the experiment was inserted, as soon as possible, into the planned highway program. Therefore, the final selection of sites was limited by the availability of planned interchanges in the proper stage of preparation. Although the number and location of variables and controls are not as extensive as would be desirable from the point of view of experimental design, it appears that some useful information will be generated at an earlier time than otherwise would have been possible.

Objectives

The objectives of this study are to determine the relative cost and performance of the experimental non-reinforced ramps.

Scope

Experimental unreinforced pavements were placed by two different contractors on a total of eight ramps in two interchanges having considerable differences in projected traffic volume. Six additional ramps are used as control sections.

Experimental Details

Pavement thickness is 9 in., with sawed joint grooves 1/2 in. wide and 3/4 in. deep spaced at 20-ft intervals, sealed with hot-poured rubber asphalt sealant. Plane-of-weakness joints 1/8 by 2-1/2 in. were sawed initially to control cracking at each joint location. Joint skew of 1 ft in 6 ft was used on one experimental ramp of each interchange. Six in. of aggregate base, compacted to 100 percent density, over 8 in. of sand compacted to 95 percent on clay grade, were used on six of the experimental ramps. The other two had 4-in. bituminous stabilized base, over 4-in. aggregate base and 6 in. of sand, both compacted to 95 percent density on the clay grade. Six additional ramps with standard 9-in. reinforced concrete pavement, are being used as control sections. These ramps have 71 ft 2-in. slabs with load transfer, on 4-in. aggregate base over 10 in. of sand.

Acceleration and deceleration lanes were not included in the experiment, so that the slab lengths in those lanes would be compatible with the main line pavement.

The first experimental ramps were built during June of 1972, on project I 25132H, I 475 from I 75 to Maple Rd (Hill Rd Interchange, Flint). Figure 1 shows the interchange with the various ramp types designated. Bituminous-stabilized base was placed on ramps B and E.

The original work plan for the experiment called for a subbase of 6 in. of select material compacted to 100 percent density over 8 in. of sand at 95 percent density, for all experimental ramps. A later request from the FHWA asked for inclusion of bituminous-stabilized base in both projects. It was agreed to use black base on the I 475 project only, due to lack of a local source at the other project site. Since plans for the I 475 project already had been completed, changes were required in details to incorporate the black base, reduce the thickness of select material from 6 in. to 4 in., and reduce the sand thickness from 8 in. to 6 in. Evidently there was some misunderstanding of the density requirements for the aggregate base material under the black base on ramps B and E. During the construction of Ramp B, the contractor's attempts to obtain 100 percent density on the thinner aggregate base course resulted in stability problems in the various layers of base. Some rutting occurred during placement of the black base, and again during placement of the concrete pavement. Ramp E was placed with much less difficulty, and only relatively minor base disruptions.

A series of ten cores and base borings was made on ramp B to determine the existing cross-section at various locations. Results are shown in Table 1. It is obvious that there is a great amount of variability in the cross-section of Ramp B. However, it does not appear that there should be structural problems with the ramp as constructed. The locations of the

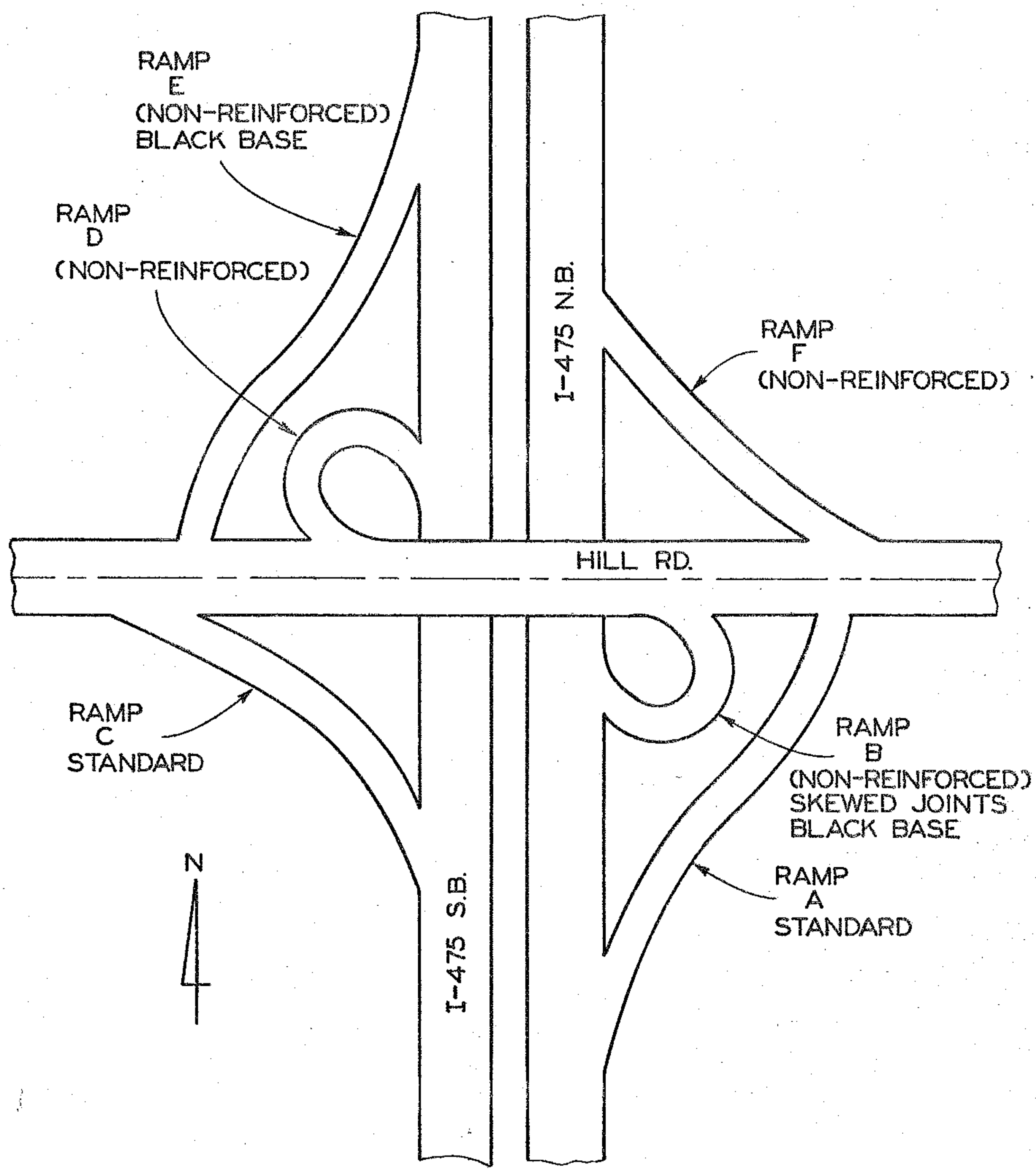

Figure 1. Hill Rd interchange on I 475 showing location of various experimental ramps and control sections.

TABLE 1
LOG OF BORINGS THROUGH RAMP "B" OF HILL ROAD INTERCHANGE ON I-475 (I 25132 - 00372A), FROM I-75 TO MAPLE ROAD

Sta. 3+01 - 6 ft Left of Baseline

8-in.	Concrete
3-in.	Second course of bituminous base
2-in.	First course of bituminous base
3.7-in.	Aggregate base for bituminous surface
5.4-in.	Sand subbase
to 2.8 ft+	Stiff sandy clay

Sta. 4+14 - 7.5 ft Left of Baseline

10.1-in.	Concrete
1.7-in.	Second course of bituminous base
1.8-in.	First course of bituminous base
2.4-in.	Aggregate base for bituminous surface
8.0-in.	Sand subbase
to 2.7 ft+	Stiff sandy clay

Sta. 5+01 - 7.5 ft Left of Baseline

11.4-in.	Concrete
1.6-in.	Second course of bituminous base
1.9-in.	First course of bituminous base
2.5-in.	Aggregate base for bituminous surface
6.6-in.	Sand subbase
2.4-in.	Firm clay
to 3.0 ft+	Stiff sandy clay

Sta. 6+00 - 0.9 ft Left of Baseline

10.0-in.	Concrete
1.9-in.	Second course of bituminous base
2.3-in.	First course of bituminous base
9.8-in.	Aggregate base for bituminous surface
0.0-in.	Sand
3.6-in.	Firm clay
to 3.0 ft+	Stiff clay

Sta. 7+00 - 14.6 ft Left of Baseline

10.0-in.	Concrete
2.0-in.	Second course of bituminous base
2.4-in.	First course of bituminous base
4.6-in.	Aggregate base course
8.0-in.	Sand subbase
to 3.0 ft+	Stiff clay

Sta. 7+98 - 5.8 ft Left of Baseline

13.7-in.	Concrete
0.0-in.	Bituminous base
9.1-in.	Aggregate base course
0.0-in.	Sand
2.4-in.	Firm clay
4.8-in.	Stiff clay
to 3.0 ft+	Firm sandy clay

Sta. 9+01 - 11.5 ft Left of Baseline

10.7-in.	Concrete
1.9-in.	Second course of bituminous base
2.2-in.	First course of bituminous base
5.6-in.	Aggregate base course
3.0-in.	Sand subbase
2.4-in.	Firm clay
7.8-in.	Stiff clay
to 3.0 ft+	Firm silty clay

Sta. 10+00 - 3.5 ft Left of Baseline

10.4-in.	Concrete
1.9-in.	Second course of bituminous base
1.9-in.	First course of bituminous base
5.5-in.	Aggregate base course
4.2-in.	Sand subbase
1.2-in.	Firm clay
to 3.0 ft+	Stiff clay

Sta. 11+00 - 13.2 ft Left of Baseline

10.2-in.	Concrete
1.7-in.	Second course of bituminous base
1.8-in.	First course of bituminous base
5.3-in.	Aggregate base course
5.0-in.	Sand subbase
4.8-in.	Firm clay
to 3.0 ft+	Stiff clay

Sta. 12+00 - 7.5 ft Left of Baseline

8.2-in.	Concrete
2.5-in.	Second course of bituminous base
2.3-in.	First course of bituminous base
3.2-in.	Aggregate base course
7.3-in.	Sand subbase
10.1-in.	Firm clay
to 3.0 ft+	Stiff clay

areas where construction was most difficult, have been noted for future reference. Performance of ramp B will be followed along with the others, keeping in mind the variable cross-section that exists.

A second interchange with experimental ramps was built during October and November of 1972, on project I 23061, I 69 from southern Eaton County line to McDonald Rd (Butterfield Rd west of Olivet). Details of cross-section and slab length for the non-reinforced ramps were the same as the I 475 job, except that no black base was used. Figure 2 shows the location and lay-out of the experimental ramps, along with the nearby Ainger Rd interchange that is used as a control section for comparison.

Construction Method

All of the ramps were constructed by the slipform method, using central mixed concrete, transported in agitator or side-dump trucks. The paving train used on the I 475 project is shown in action in Figure 3. Equipment used on I 69 was similar.

Construction of tightly curved ramps is greatly simplified by elimination of reinforcement and load transfer. This is especially true when slipform equipment is used, but would apply also to form-type paving.

Costs

Comparative project costs probably are not very significant for the relatively small quantities involved in this experiment, but they are included here for information. Quantities for the two projects are similar. Bid items have been broken down to an approximate sq yd cost, for ease of comparison, as shown in Table 2. Total costs indicated include granular base, concrete pavement, contraction joints, and stabilized base or reinforcement, where applicable.

TABLE 2
APPROXIMATE COSTS PER SQUARE YARD FOR EXPERIMENTAL AND STANDARD SECTIONS

Location	Exp Ramp, Bituminous-Stabilized Base	Exp Ramp, Granular Base	Standard Ramp	Standard Mainline
I 475	$11.30	$8.30	$8.70	$7.90
I 69	not used	$7.20	$8.00	$6.60

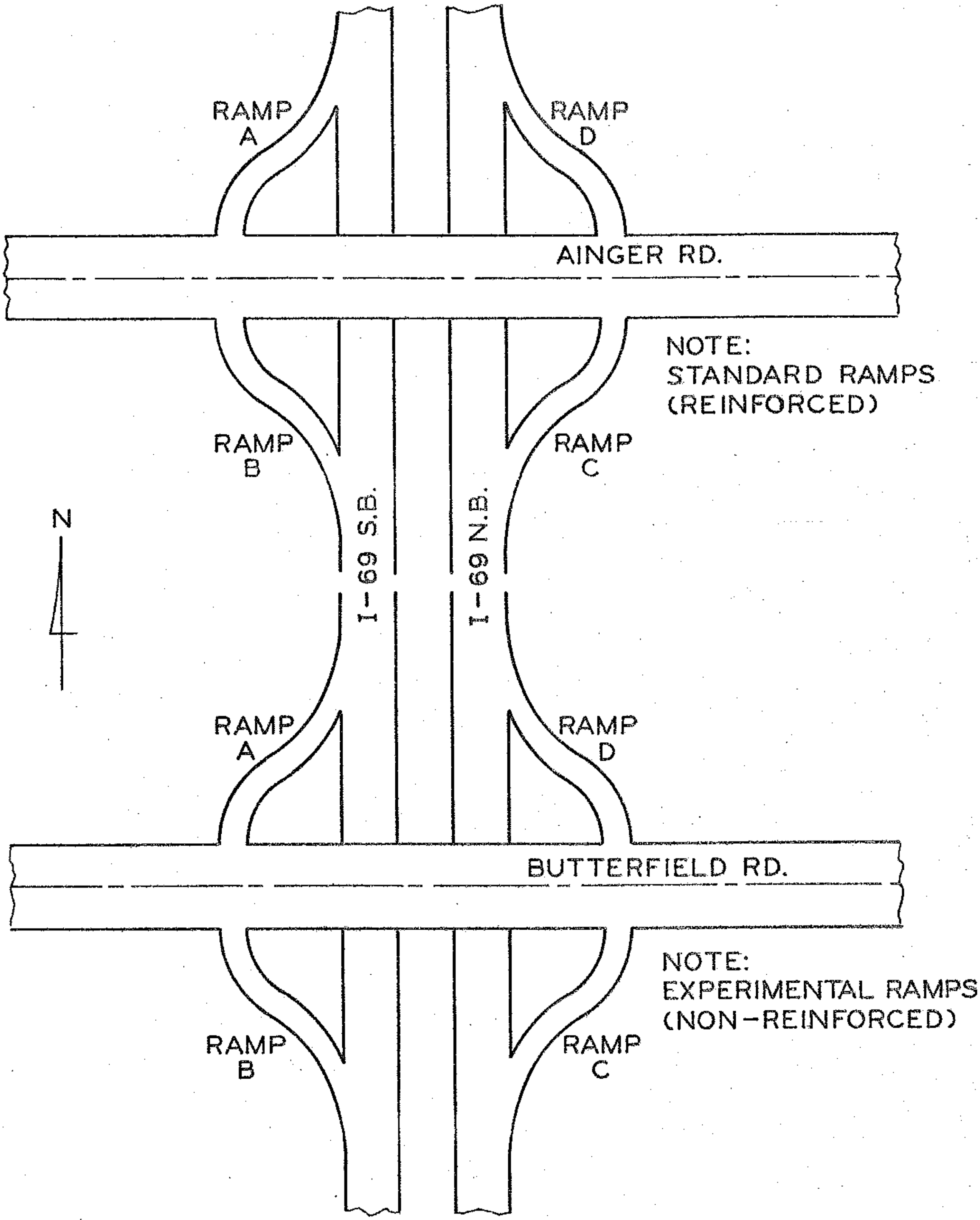

Figure 2. Butterfield and Ainger Rd interchanges - I 69, experimental and control sections.

Figure 3. Slip-form paving train placing ramp on Hill Rd Interchange, I 475.

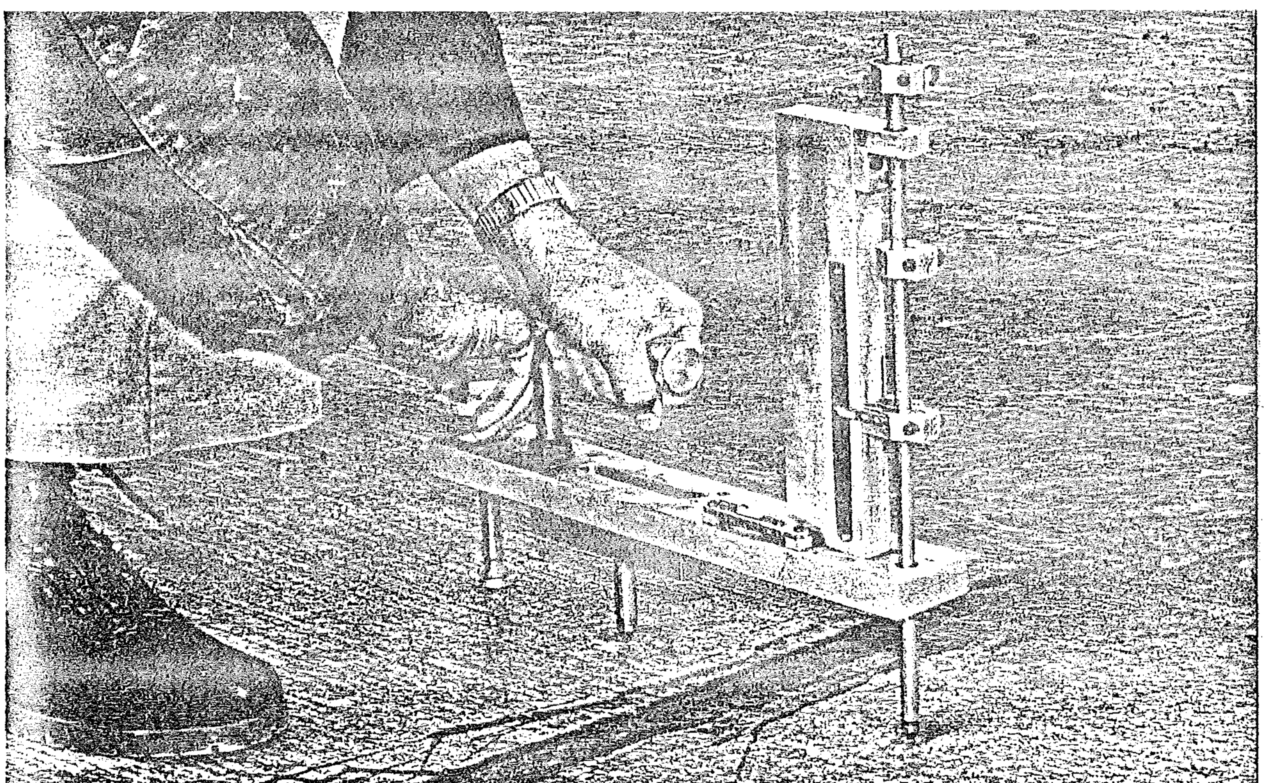

Figure 4. Device for measurement of joint faulting.

Instrumentation

Stainless steel rivets were placed at all joints in both the experimental and control sections. These rivets will be used as reference points for both joint opening and faulting measurements. The device used for fault measurements is shown in Figure 4. The centrally located pointer is placed in the rivet on the approach slab, the front pointer set in the other rivet in the leave slab and the instrument is leveled. A reading from the graduated scale is then recorded. Comparison of readings taken at various times indicates the relative vertical position of the two points as compared to the initial position.

Rivets have been set and initial readings recorded on all joints. Subsequent readings will be made at least once each year. Slab cracking and spalling also will be noted. Initial profile and roughness will be recorded by the Laboratory's GM Rapid Travel Profilometer, and additional runs will be made each year to document changes in rideability.

A recently published California report documented the horizontal pumping of fine base and shoulder material as the cause of faulting in short-slab no-load-transfer pavements. After review of the report, a request was made to the Laboratory's Soils Unit to collect samples of aggregate base course from the I 69 project, and to make a sieve analysis of the samples to determine the amount of fine particles present and the variation of fines content from place to place. Samples were collected at approximately 200-ft intervals, and returned to the laboratory for analysis, which has not yet been completed.

Experimental data will be compiled and maintained in the Research Laboratory, and further reports will be issued whenever sufficient information is available to warrant publication. In the interim period, information concerning this project may be obtained by inquiry if desired.