Commonwealth of Kentucky
Department of Highways

Progress Report

on

EXPERIMENTAL JOINTING INSTALLATIONS FOR CONCRETE PAVEMENTS

by

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Combined in this report are descriptions of the progress of three individual experimental joint installations. Each of these includes a series of two or more experimental joints of special design, installed in concrete pavement in lieu of the conventional types employed in their respective construction projects.

These experimental joints included at one location a prefabricated neoprene seal; and, at two locations, aluminum load transfer devices. All installations were contraction joints only. Periodic inspections of these have been made and will be continued on two of the projects until adequate performance records are established. The condition of concrete about the joints with neoprene seals has reached the stage where there would be little value in additional observations.

Project F 367 (10) - U.S. 27 Campbell County
Prefabricated Neoprene Seal

A report on the installation in Campbell County was made previously (January 16, 1950) by A. C. Peed, Jr., Assistant Research Engineer. Part of that information is repeated here, together with data from observations made since that date.

The neoprene joint sealer is a product of the Lastite Joint Company, 105 W. Madison Street, Chicago 2, Illinois. The installation was made on November 30, 1948, under the supervision of a company representative, during construction of Project F 367 (10), a section of U.S. 27 in Campbell County. These joints are located at stations given in Fig. 1 (approximately 3.9 miles north of the junction with Ky. 154).

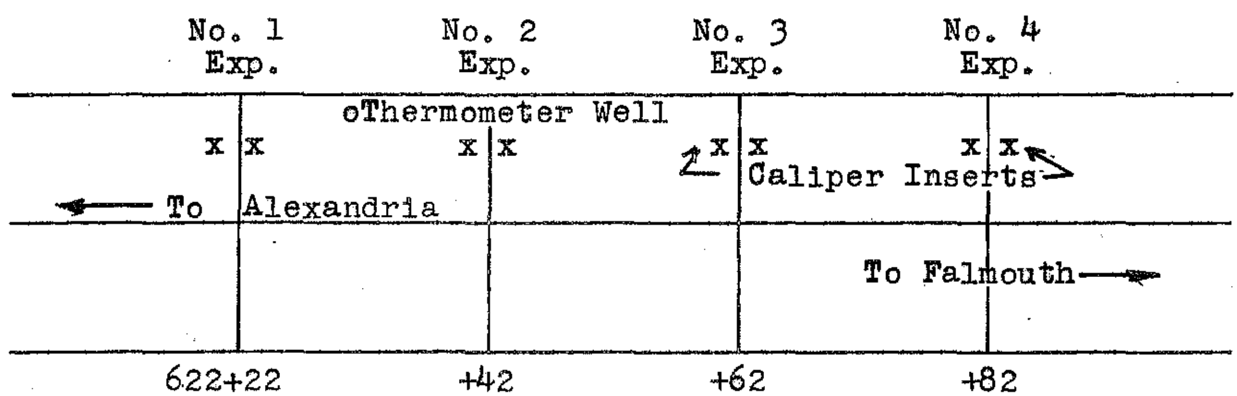


Fig. 1 - Layout of Campbell County installation showing location and identification of the joints investigated and positions of Caliper Inserts.

The conventional or standard-type joints installed throughout the project, were the weakened-plane-type without load transfer. All standard joints were sealed with "hot-poured" rubber-asphalt sealer. The three experimental joints consisted of a dowel-bar joint-assembly, of a conventional type but included a rigid pressed board "divider-strip" which separated the slabs through their full depths. The neoprene seal was fitted as a cap to the top and outside vertical edges of the pressed board prior to installation of the joint assembly. (See Fig. 2)

Due to the lack of experience of the crew and inept handling, the placement of the experimental joints was not at all satisfactory. Two of these joints were knocked out of position by the finishing machine, as illustrated in Figs. 3 and 5.

Brass caliper inserts were set in the north bound lane on each side of the three experimental joints and one standard joint for the purpose of observing joint measurements as influenced by time and temperature variations (See Fig. 1). A thermometer well was also provided for measuring the internal temperature of the concrete at the same time. The results of these measurements are listed in Table I and plotted in Fig. 10. No great amount of closure was observed in the three special joints even with an appreciable temperature increase, while in the standard reference joint there was a slight amount of opening despite the temperature increase. Measurements made in December, 1949, and February, 1951, when temperatures were comparable with that at time of the original measurements, indicate a progressive opening of all joints. This condition was more pronounced in the standard reference joint than in the special joints with neoprene sealers.

Spalling at the experimental joints was first observed on

Fig. 2. Installing dowel-bar load transfer joint assembly with neoprene sealers. November, 1948.

Fig. 3. Closeup of Joint at Sta-622+42 in February, 1949. At the center of the pavement the neoprene sealer did not form a continuous seal.

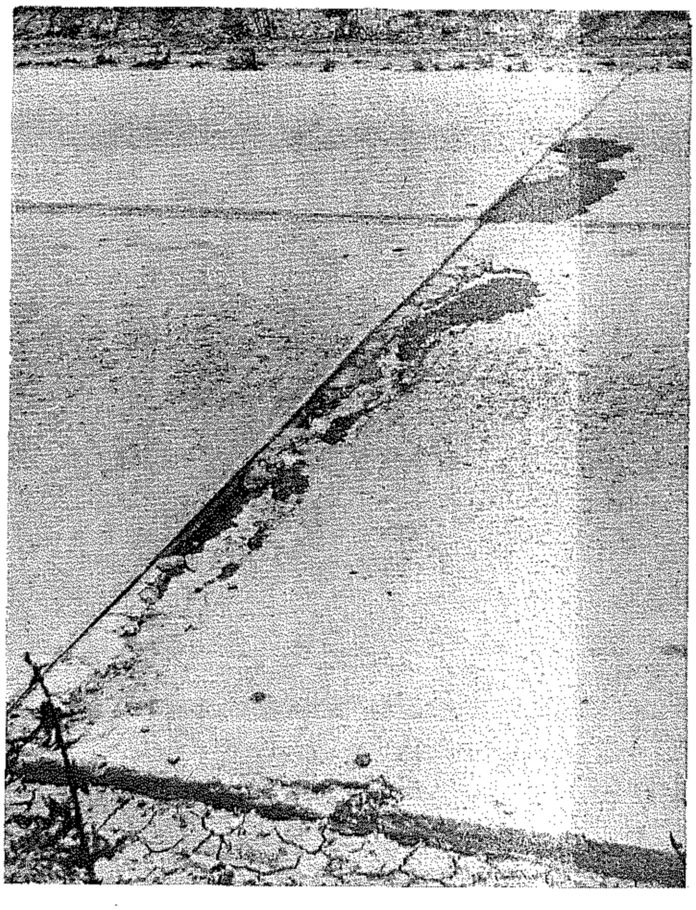
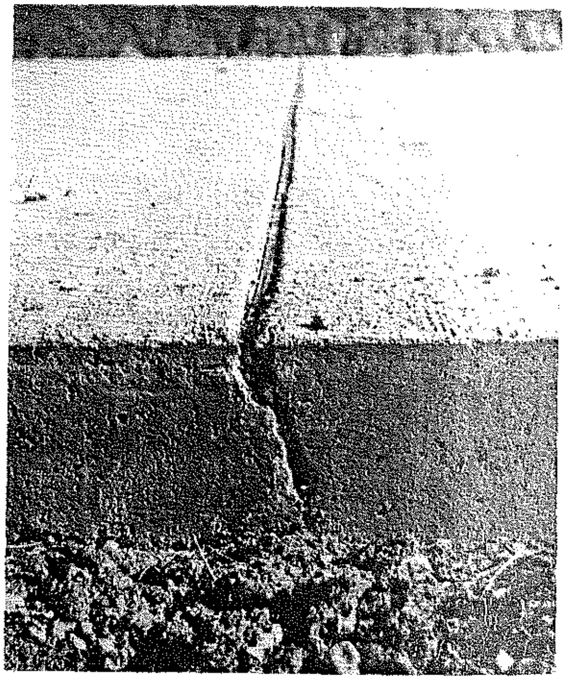
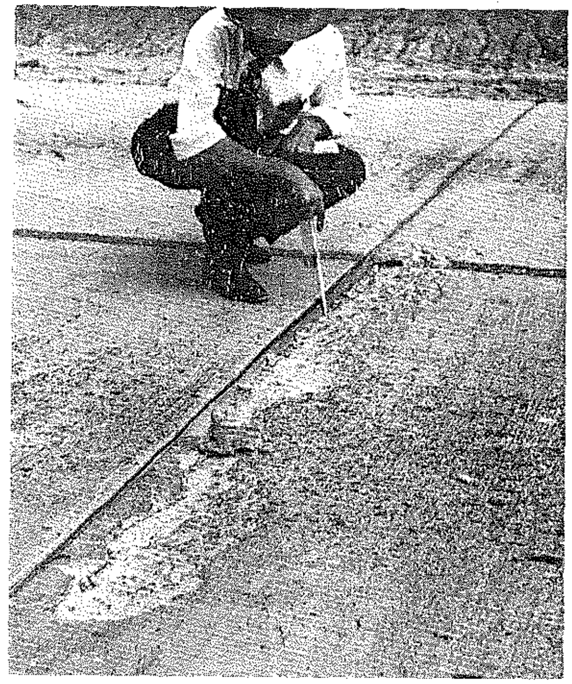


Fig. 4. Joint at Station 622+42 in June, 1951. Slight spalling at this joint was noted as early as September, 1949, and this condition extended rapidly from the near edge toward the center. Deterioration in the near lane had almost reached the center line before the far lane was affected.

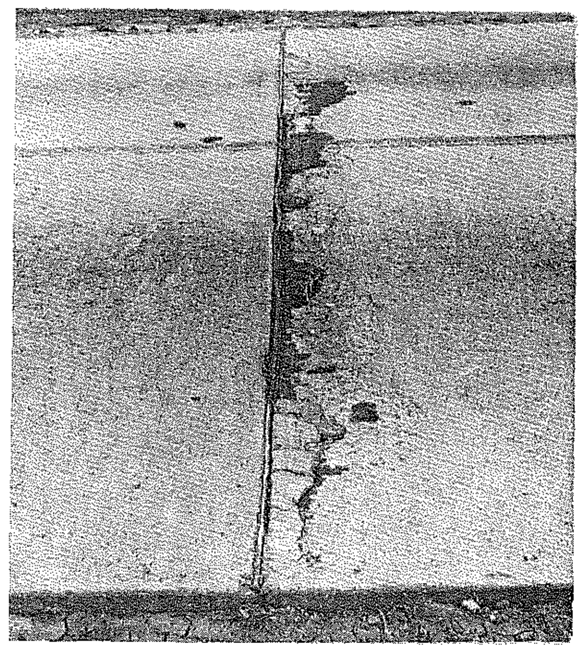


February, 1949. In the finishing operations this joint was tilted considerably.



September, 1949. Severe spalling developed within the first few months that the pavement was in use.

December, 1949. Patching restored the riding qualities of the pavement, but did not prevent further failure about the joint.



June, 1951. Spalling about the joint extended with time and the bituminous patch material was removed by passing traffic.

Fig. 5. View of joint at Station 622+22 on Project F 367(10), U. S. 27, Campbell County, showing the condition at various stages since installation.

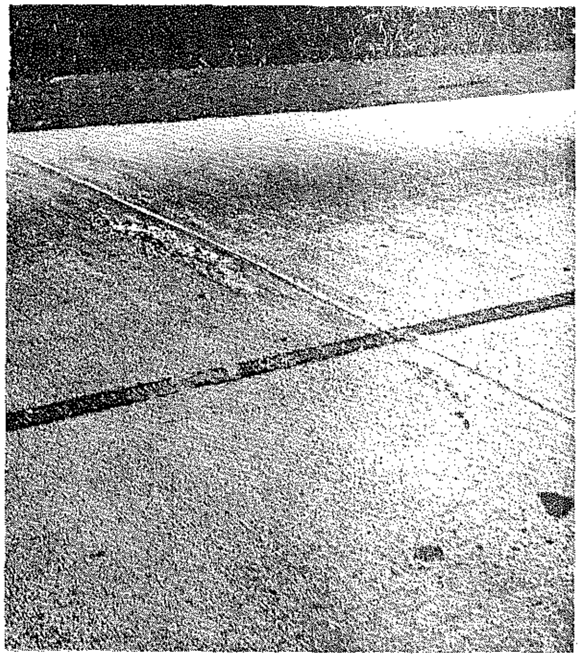
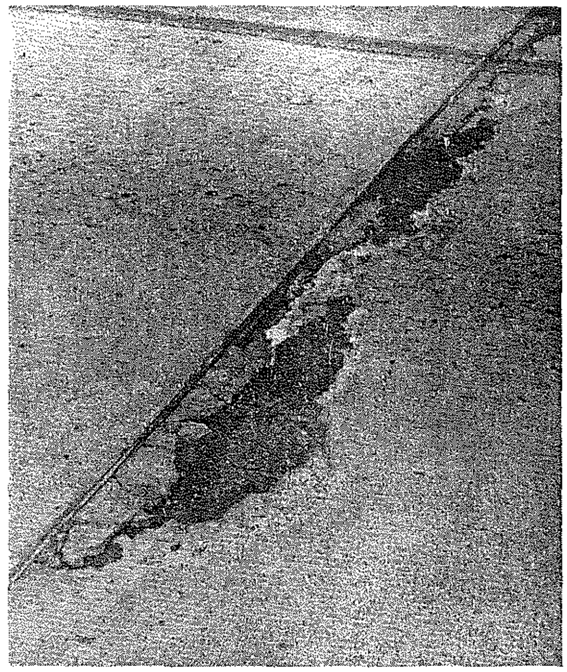


Fig. 6. Joint at Station 622/62 in December, 1949. The first evidence of spalling at this joint was recorded three months prior to this time.



Fig, 7, Joint at Station 622/62 in June, 1951. This condition, as shown in Fig. 9, extends almost throughout the full width of the pavement.

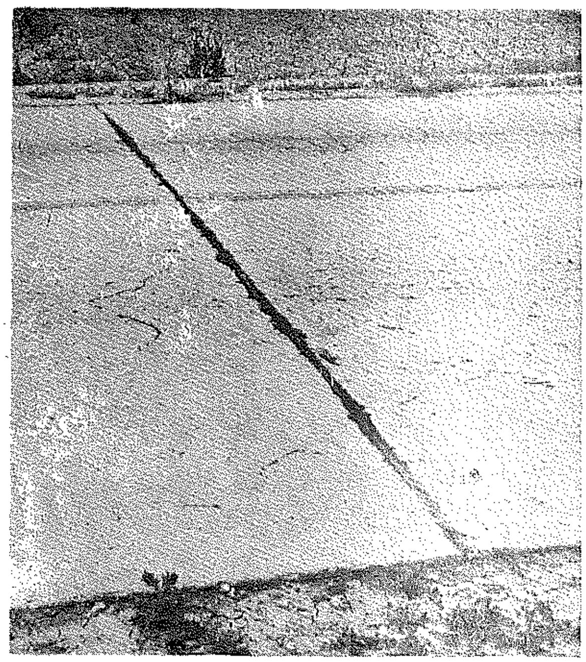


Fig. 8. Comparison joint of standard design at Station 622/82, in June, 1951. The sealer here, as in all other standard joints on the project, was hot-poured rubber asphalt compound.

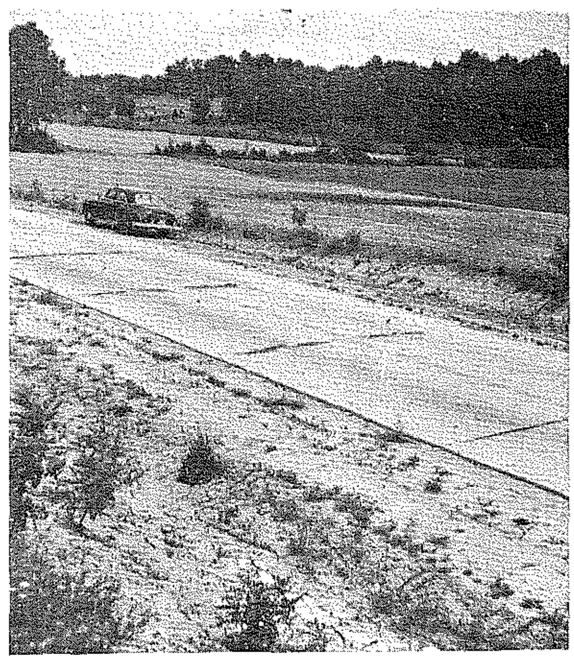


Fig. 9. General view of the three experimental joints with neoprene seals and the comparison joint of standard design. The order of stationing is from 622/22 on the left to 622/82 (standard joint) on the right.

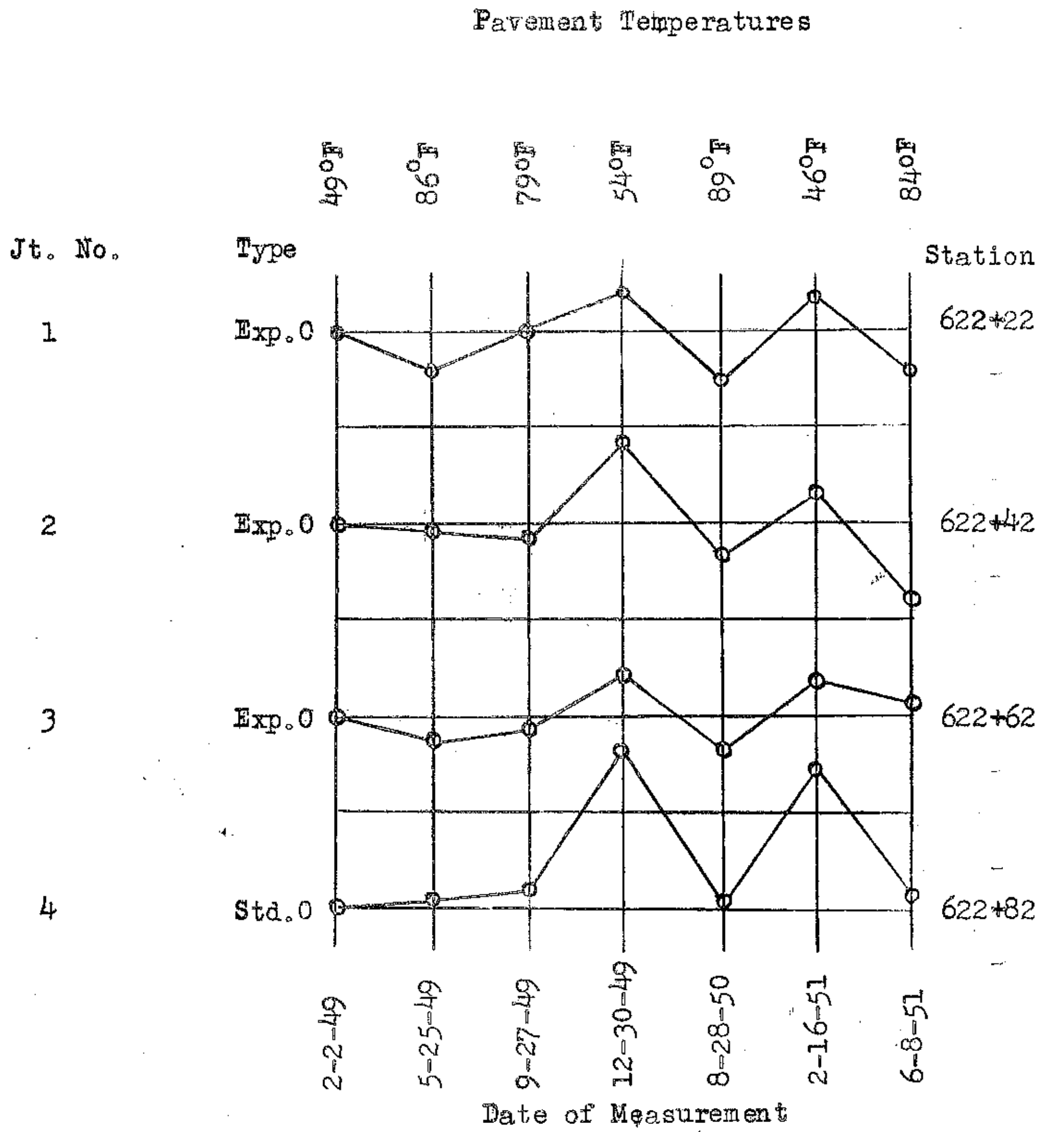
September 27, 1949. (See Figs. 5 and 6). This condition was the most serious at Joint No. 1 where one entire face of the seal was exposed for as much as 7 or 8 feet in the south-bound lane. Spalling was slightly in evidence at Joint No. 2; and, at Joint No. 3, spalling had begun in an area approximately 3 feet long by 8 inches wide paralleling the joint on the south side. All areas of spalling first occurred in the south-bound lane and were confined to the south side (or forward side) of the joints. The condition became more aggravated with the passage of time - Joint No. 1 requiring a bituminous patch prior to December 30, 1949. On July 28, 1950, the spalling at Joint No. 1 had progressed to the center of the north-bound lane and the spalled areas at both Joints No. 2 and 3, had increased in width and had crossed over into the north-bound lane. This condition was not found at any of the standard joints on the project.

At the time of the last inspection, June 8, 1951, the spalled area at Joint No. 1 had progressed to the full width of the pavement; and at Joints No. 2 and 3, the spalled areas had increased proportionately, extending past the center of the north-bound lane. (See Figs. 4, 5, and 7).

In view of the conditions of these particular joints, which are definitely failures, further observations of this project can be considered of little or no value. However, in view of difficulties that arose during placement it is doubtful that the neoprene sealers themselves were at fault. To the extent that they complicated finishing operation they were at fault, but at least a considerable portion of the damage may be attributed to the joint assembly and its poor installation. If further investigations are desired on this type of design, it is recommended that additional installations be made only if control of the placement and finishing is worked out in advance.

Table I - Results of Joint Width Measurements

Date		2-2-49	5-25-49	9-27-49	12-30-49	7-28-50	2-16-51	6-8-51
Temp. of Air Temp. of Conc. Time		48°F 49°F 11:30	78°F 86°F 1:40	78°F 79°F 11:45	51°F 54°F 11:00	85°F 89°F 10:30	50°F 46°F 12:00	76°F 83°F 11:15
Joint No. & Sta.	Type	Gauge Lengths and Width Variations in Inches						
1 622+22	Exp.	5.036 - -	5.015 -0.021	5.035 -0.001	5.056 +0.020	5.008 -0.028	5.052 +0.016	5.015 -0.021
2 622+42	Exp.	4.931 --	3.928 -0.003	4.924 -0.007	4.975 +0.044	4.915 -0.016	4.944 +0.13	4.891 -0.040
3 622+82	Exp.	4.953 --	4.940 -0.013	4.948 -0.005	4.976 +0.023	4.936 -0.017	4.969 +0.016	4.962 +0.009
4 622+82	Std.	5.045 --	5.050 +0.005	5.053 +0.008	5.128 +0.083	5.047 +0.002	5.116 +0.071	5.050 +0.005
Averages			-0.008	-0.001	+0.042	-0.015	+0.029	-0.012



Note: - Original measurements taken as zero. Points above the zero line indicate ~~the amount of opening and points~~ below indicate the amount of closure, with relation to the joint widths at the time of the first measurement.

Vertical Scale - 1.0 inch = 0.10 inches

Fig. 10 - Joint Width Variations

Project U - 586 - Paducah Belt Line
Aluminum Load Transfer

This project was reported initially February, 1950, by Harvey J. Field, Jr., Assistant Research Engineer, who was observer on the project at the time of the installation.

Two joints, using the aluminum load transfer device, were installed, for experimental purposes in September of 1949, during the construction of concrete pavement on Project U-586 of the Paducah Belt Line (Joe Clifton Drive) in Paducah (See Fig. 10A). The first aluminum joint was placed at Station 70+00 on September 9, and a few days later the second joint was installed at Station 60+98.5.

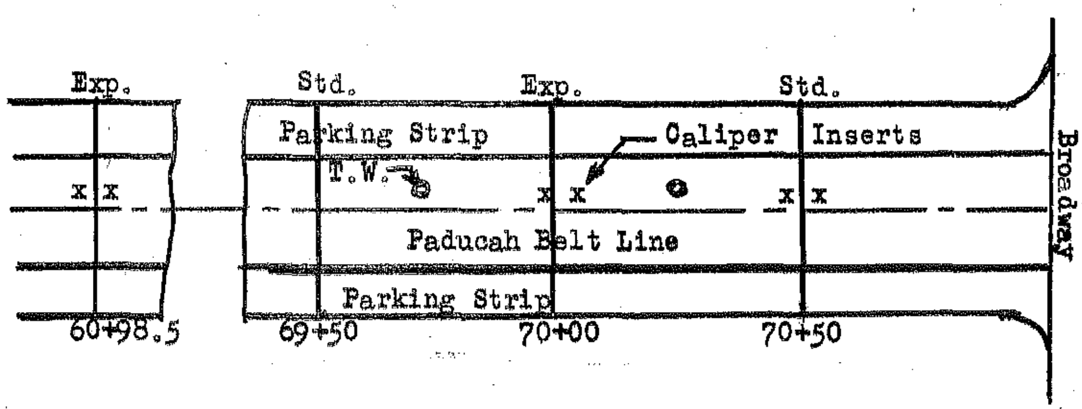


Fig. 10A - Layout sketch of pavement section showing locations of joints under investigation and the positions of Caliper Inserts and Thermometer Wells (T.W.).

The load transfer device under investigation was developed by the Oxford Manufacturing Comany of Oxford, Indiana, and fabricated by the Reynolds Metal Company. It is designed as a weakened-plane contraction joint, and is manufactured of aluminum by extrusion process in the shape of an inverted cross (See Fig. 11). The vertical member, forming the weakened plane, is 1/16-inch thick and 4-inches high (3 inches extending above the intersection with the horizontal member); and the horizontal member, providing the load-bearing plane is 3/16-inch thick and extending 1 inch on each side of the vertical member.

These jointing devices were supported at the desired height by means of "chairs" (ferrous metal) pinned to the subgrade (See Figs. 12 and 13). There was one difference between the two installations in the design of the chairs. The chairs in the joint at 70+00 were the type as pictured in Fig. 14. The base plate was 5-inches long with the vertical member welded flush with the heel. The chairs used at Station 60+98.5 were much the same, except that the base plate was 7-inches long, two inches of which extended beyond the heel. This revision was an effort to add greater stability to the assembly. The standard joints on the rest of the project were a conventional weakened-plane type with dowel bar load transfer assembly (See Fig. 15).

Brass caliper inserts were grouted on each side of the two special joints and one standard joint at Station 70+50 (Fig. 10), for the purpose of measuring the amount of movement as effected by time and temperature changes. Thermometer wells were also provided for measuring the internal temperature of the concrete.

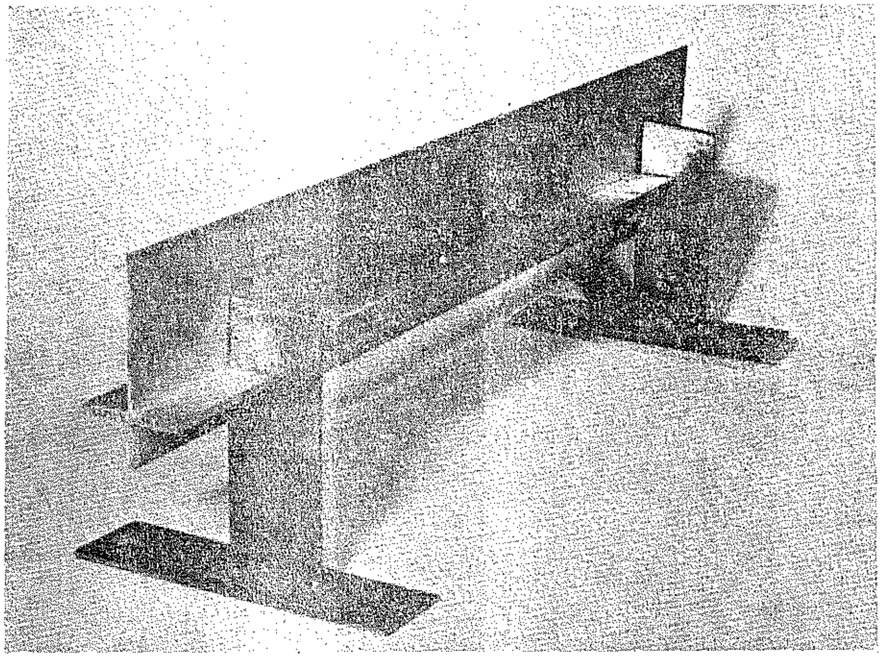


Fig. 11. Closeup view of a section of the aluminum load transfer device. The chairs shown are the type used at Station 60/98.5 .

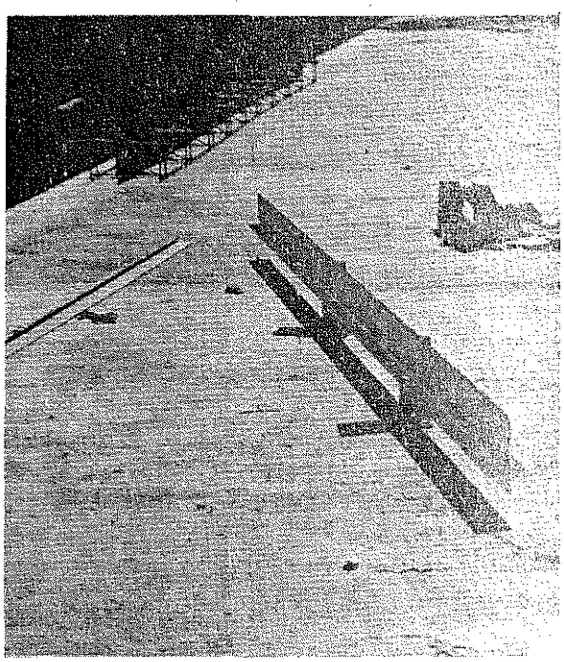


Fig. 12. View of the experimental aluminum joint installation at Station 70/00. The standard type of joint used in the project appears in the background.

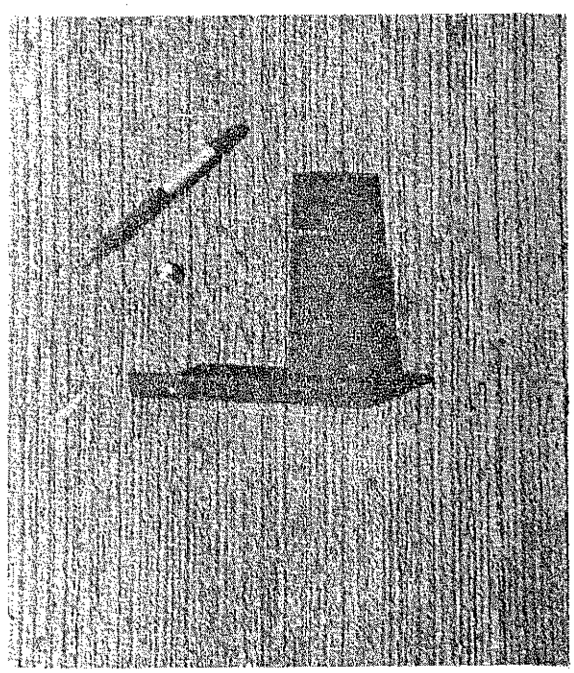


Fig. 13. Closeup view of chair used at Station 70/00.

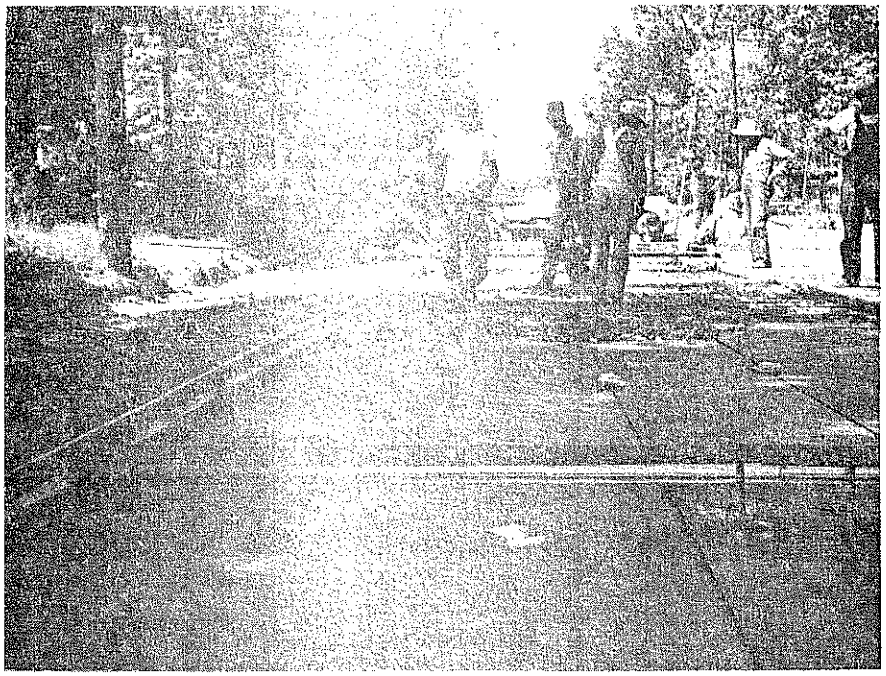


Fig. 14. Experimental aluminum joint in place at Station 70+00. Removable cap is in place.

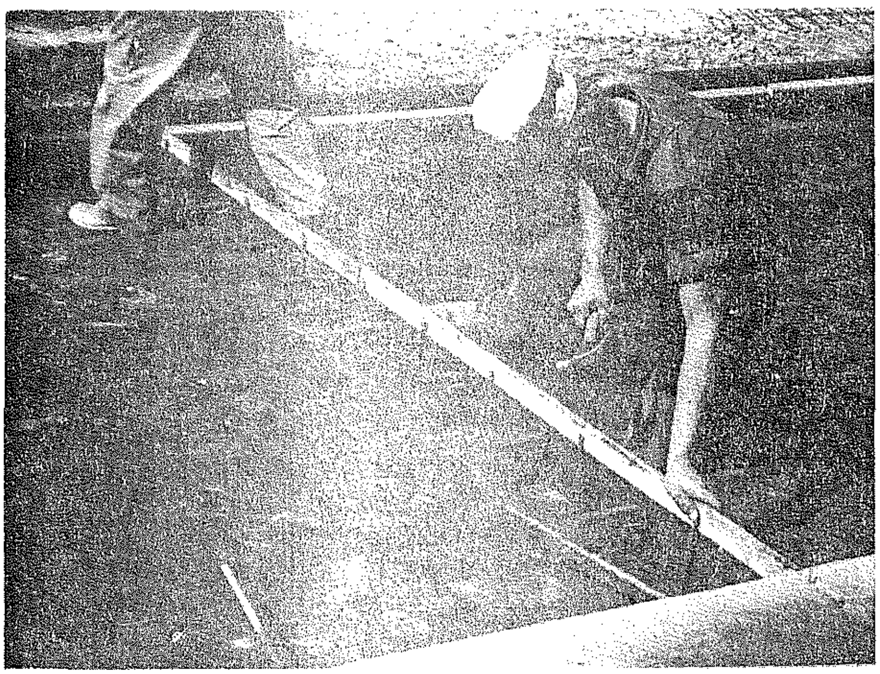


Fig. 15. Installing a standard joint assembly used in the project.

The results of these measurements are given in the following table:

Table II - Results of Joint Width Measurements

Date		1-31-50	12-26-50
Temp. Air Temp. Conc. Time		-- 64°F --	30°F 38°F 2:00
Type of Joint	Station	Gauge Lengths and Width Variations in Inches	
Standard	70+50	4.998 --	5.048 +0.050
Experimental	70+00	4.994 --	5.050 +0.056
Experimental	60+98.5	5.024 - -	5.076 +0.052
Averages			+0.053

No signs of deterioration or other unusual conditions were observed at the date of the last inspection, December, 1950.

Advantages claimed by the producer for the aluminum jointing device over dowel bar types are its greater load-bearing surface areas, its light weight, its simplicity of installation, and its permanence.

The two first mentioned features are true; however, there is a definite lack of stability in the assembled device and it is easily dislocated during placement of concrete about the joint. There are, also, some doubts as to the permanence of aluminum when exposed to concrete; that is, the corrosive reaction of concrete on aluminum may be equally as serious or more so, than rusting of ferrous metals.

Project FI - 117 (22)
Truck Lanes - U.S. 60, Shelby County
Aluminum Load Transfer

The aluminum devices installed in this project as special joints for experimental purposes, were also the product of the Oxford Manufacturing Company. However, the investigation was on a much larger scale than was the Paducah Project. Service conditions of greater severity are expected to lead to a more conclusive evaluation.

These special joints were installed in the Fall of 1950 during the construction of the truck lanes, Project FI-117 (22), on U.S. 60 between Shelbyville and Louisville. Their location and identification are given in Fig. 16.

The aluminum device was revised to an equal-armed cross, 2 by 2-inches but the web thicknesses of 1/16-inch for the vertical members and 3/16-inch for the horizontal members were retained (See Fig. 17). The supporting chairs were in the shape of an inverted "T" and were fitted to the lower part of the vertical web, instead of the horizontal web as before. Additional apparatus was designed to hold the joint assembly more firmly in position while the concrete was being placed around it. This apparatus does not remain a permanent part of the assembly, but can be moved by hand from one joint to another. Included in its makeup are four tong-like extensions which grip the aluminum strip. It must be removed before the finishing machines can pass over the joint (See Figs. 18 through 23).

Lanes on this project (Fig. 16), are designated in this report as one, two, three and four from west to east in the order

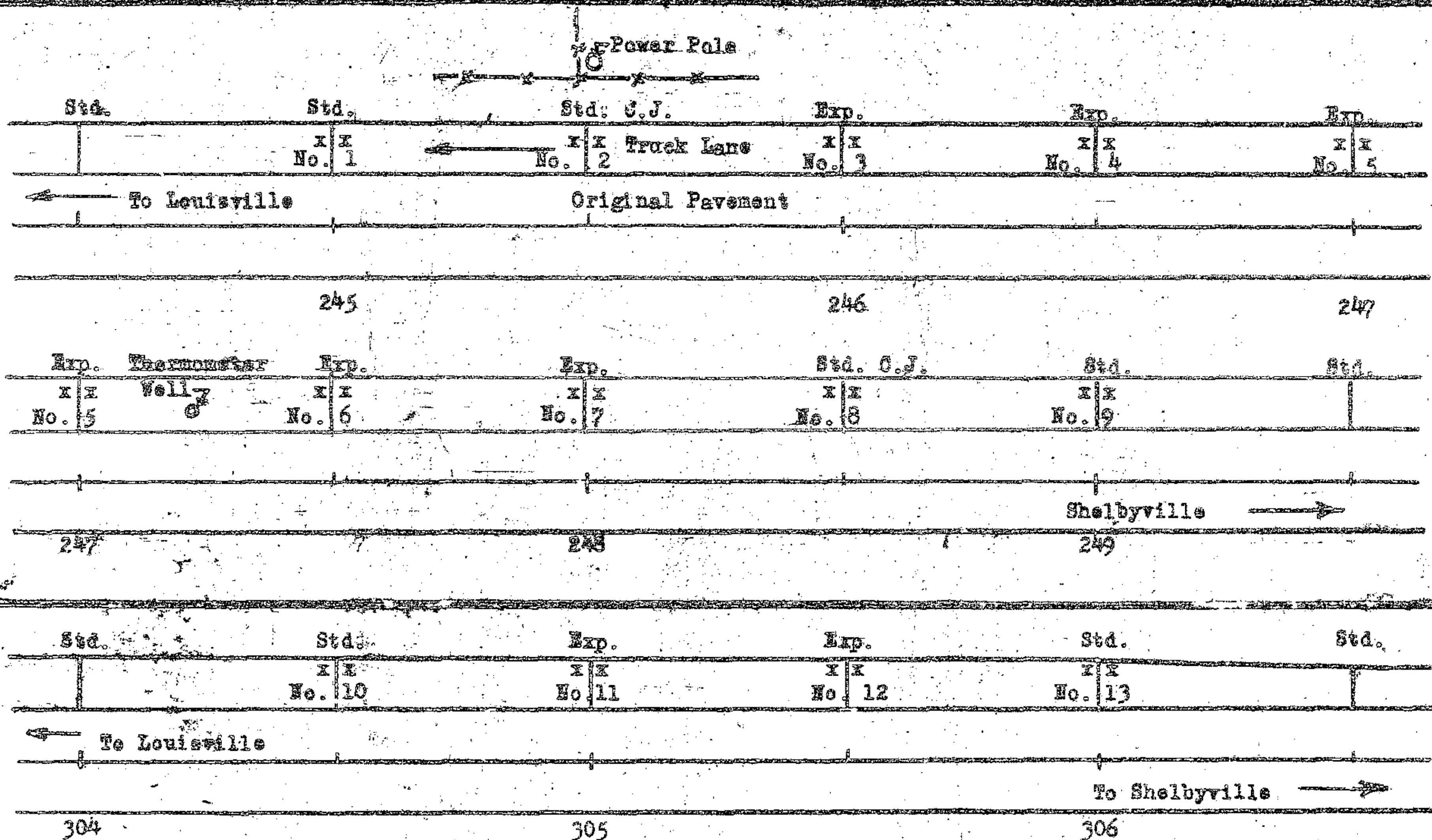


Fig. 16. Layout showing locations and identifications of experimental joints in the truck lanes on U. S. 60, Shelby County.

of the stationing. Paving began on Lane Four and continued westward through Lane One. All of the regular joints in this construction were weakened-plane contraction joints with load-transfer dowels set at 50-foot intervals. Those referred to as standard are conventional-type dowel bar assemblies (Fig. 24).

The first aluminum joints (identified as experimental Joints No. 11 and 12) were placed September 30 in Lane Four, at the second and third full-width (11 feet) joints nearest the Shelbyville end (Fig. 16). Joint No. 12 was tilted to the rear (See Fig. 25), and was tilted slightly ahead with respect to the direction of paving. Due to these unsatisfactory results, further installations were postponed until adjustment could be made in the "joint-holding" apparatus.

A third joint was installed October 10, at Station 294+08.5, but paving operations were suspended immediately thereafter on account of rain. No identification number is given to this joint.

To further improve the stability of the joint assembly, the company representative decided to prepare devices to hook over the cap and to be secured with a pin driven into the subgrade - similar to those employed with the dowel bar assembly (See sketch in Fig. 26). These hook and pin devices were used in conjunction with the "tong" apparatus and were removed prior to the final finishing of the joints. Five special joints Nos. 7 through 3, (Station 248+00 to Station 246+00) were installed in Lane Three on October 10, employing this combination of securing devices with satisfactory results.

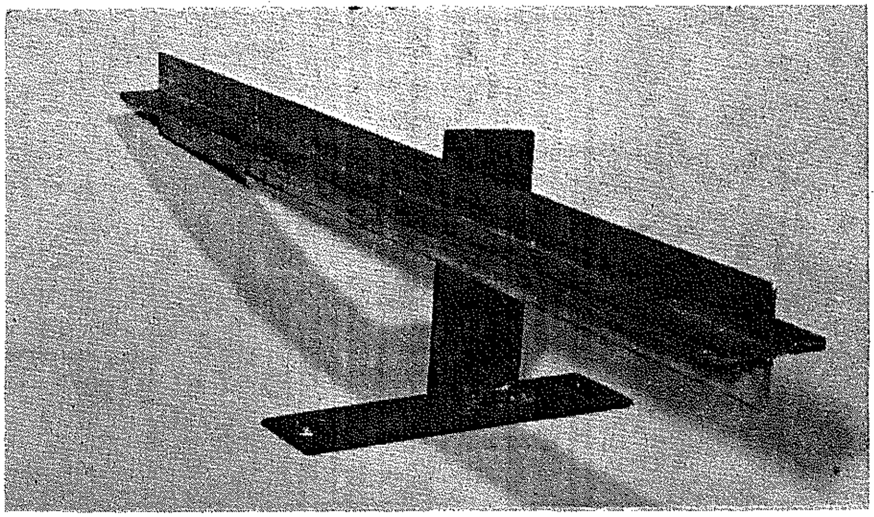


Fig. 17. A closeup view of the revised aluminum load transfer device used in the experimental joints installed in the truck lanes on U. S. 60 in Shelby County. The chair pictured was not the type used in the joint assembly on this project.

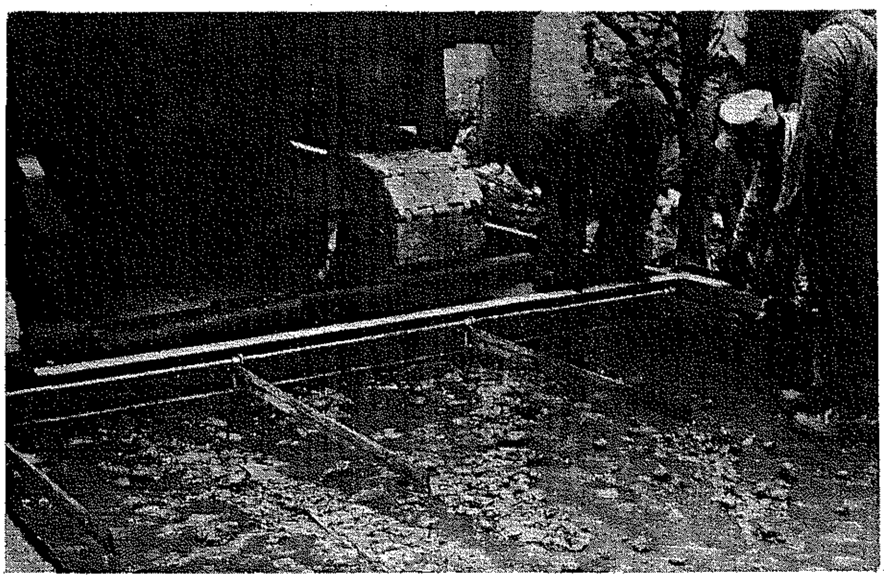


Fig. 18. The apparatus designed to secure the aluminum load transfer device firmly in position during the placement of concrete around the joint. The four members extending parallel to the centerline of the roadway are tong-like devices that grip the horizontal section of the aluminum strip. One arm of each tong is fixed rigidly to the transverse member which spans the forms, and the other arm is pivoted on the first near the free end (a detailed sketch is shown in Fig. 27) and is opened and closed by means of a spring and eccentric mechanism arranged on a rotating circular bar. The circular bar is rotated by a lever and it manipulates the four tongs simultaneously. This apparatus was developed by the company that furnished the joint.

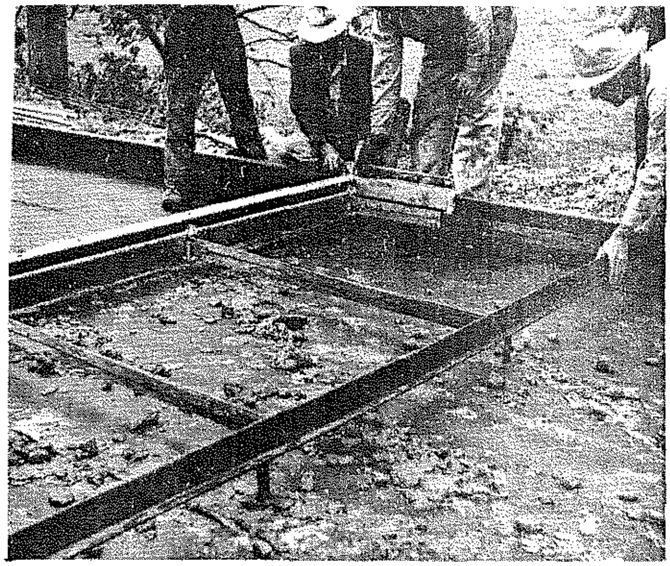


Fig. 19. A view of the aluminum load transfer device, with the removable cap in place, secured in position by the tong apparatus. The circular bar, with the spring and eccentric attachment, which operates the tongs, may be seen in the upper portion of the photo.

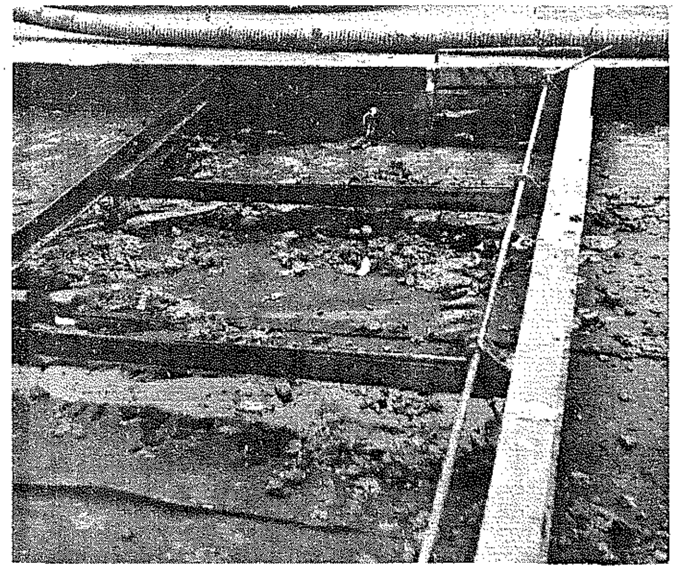


Fig. 20. Another view of the joint and tong apparatus, showing the lever, at the upper right, that rotates the circular bar which, in turn, applies the gripping force to the tongs.

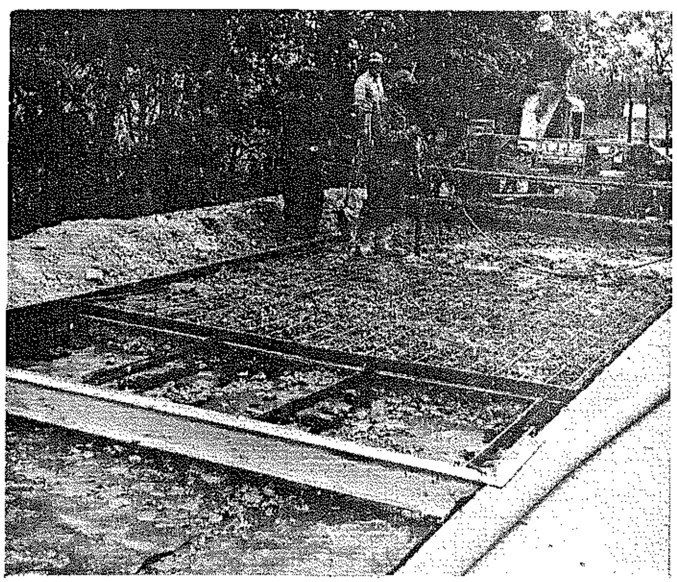


Fig. 21. First course of concrete with the joint and wire mesh in place.

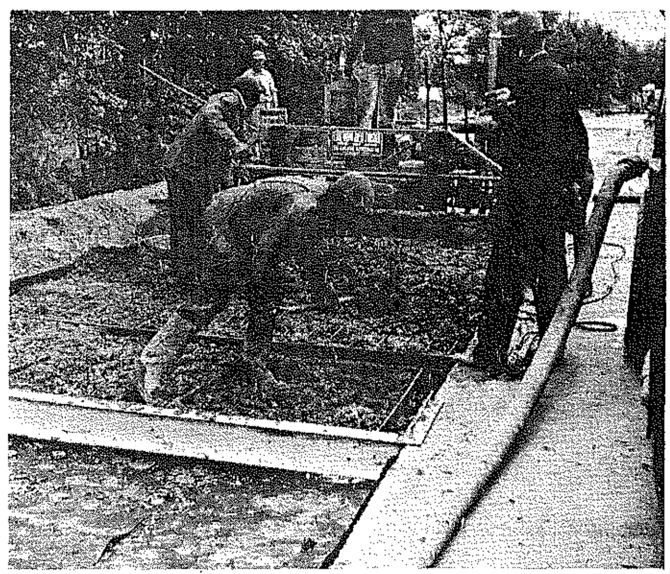


Fig. 22. Final placement of concrete around the joint.

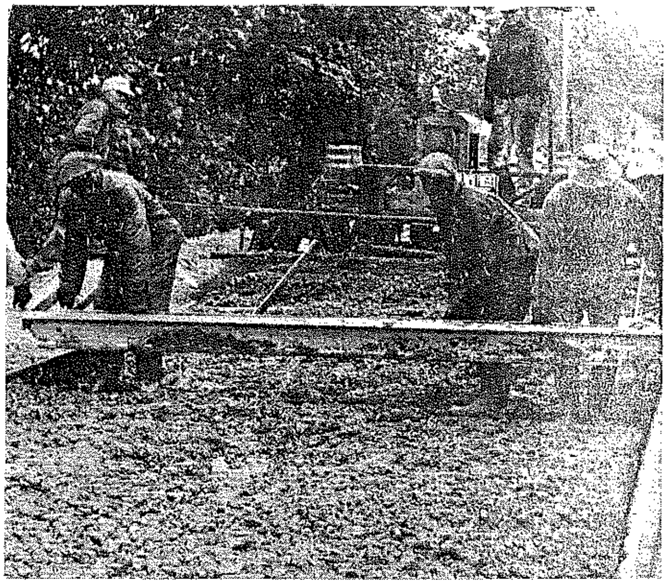


Fig. 23. Removing the joint "holding" apparatus prior to the first pass of the finishing machine over the joint.

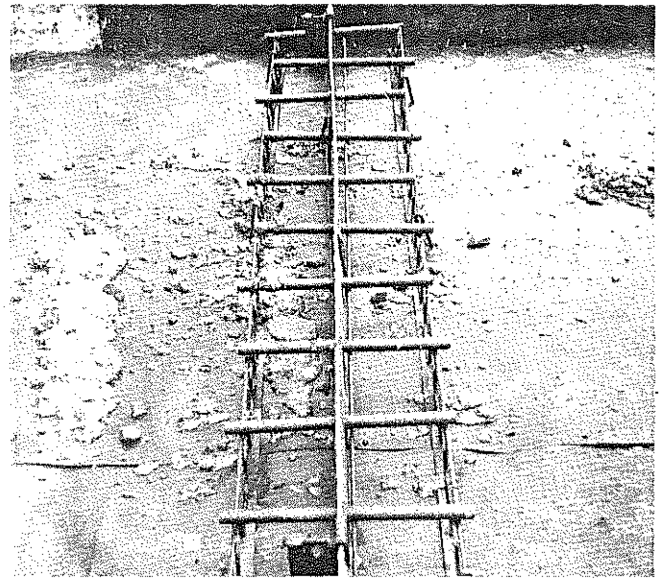


Fig. 24. A view of the conventional or standard contraction joint, with dowel bar load transfer assembly, that was used in the normal joint construction.

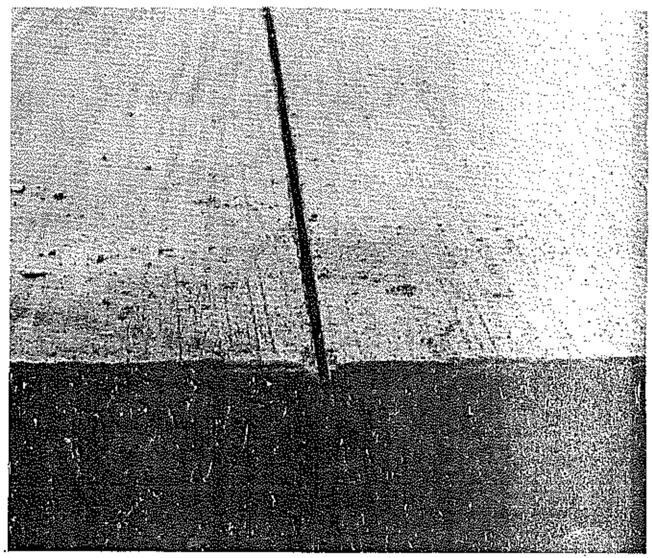


Fig. 25. An inclined joint at Station 305+00. The direction of paving was from left to right.

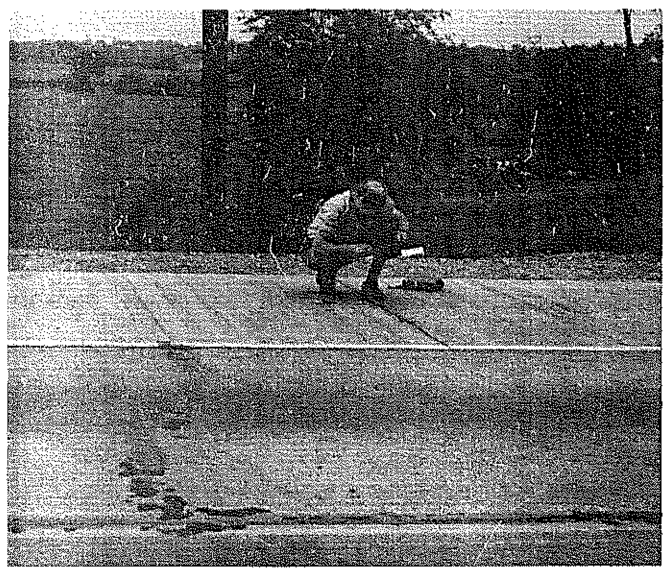
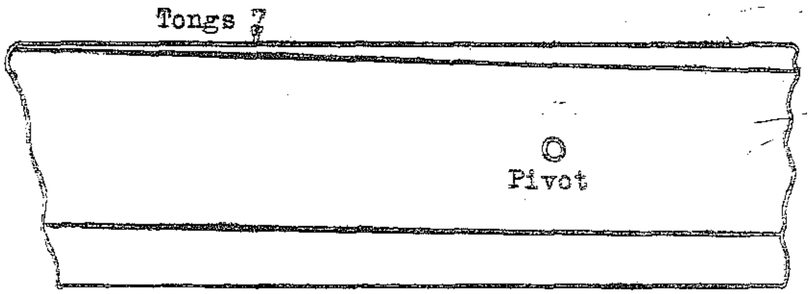


Fig. 26. Making width measurements over Joint No. 2 at Station 245+50 in June, 1951. At this time the truck lanes had been in service about 8 months, and there was no apparent difference in the condition of the standard and the aluminum joints, nor any difference in the condition of the concrete about the two types of joints.



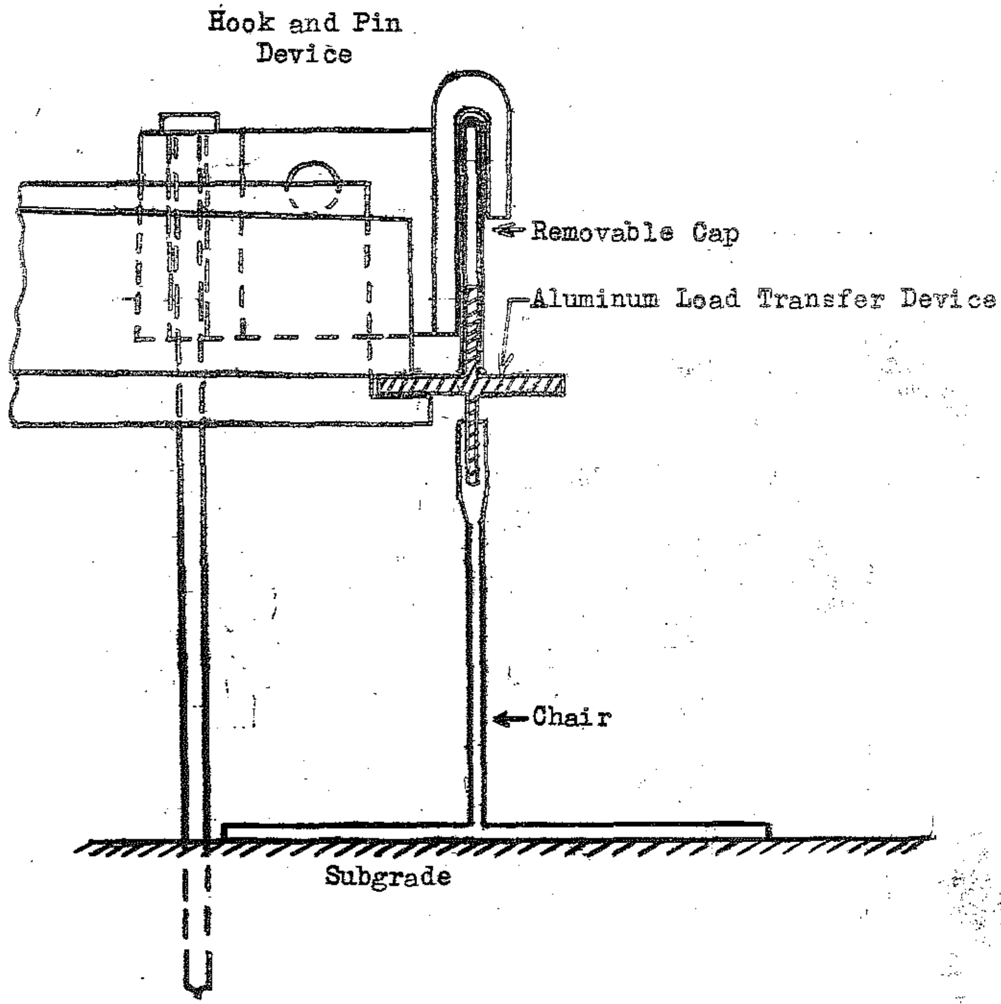


Fig. 27. Sketch showing the experimental joint assembly with the securing devices finally employed. The tongs were removed before the first pass of the finishing machine over the joint. The "hook and pin" and cap were removed before the final finishing the joint.

Caliper inserts were set at 13 joints identified as standard joints No. 1, 2, 8 and 9; experimental joints No. 3, 4, 5, 6 and 7 in Lane Three; and standard joints No. 10 and 13, and experimental joints No. 11 and 12 in Lane Four. No inserts were set for the joint at Station 294+08.5.

Measurements for joint widths were made February 19, and June 7, 1951. These values are given in Table III together with the computed variations. The joint movements were in accord with the temperature changes with the exception of Joints No. 10 and 12, the measurements of which show a slight amount of opening despite temperature increases.

At the time of the last inspection, June 7, 1951, no change in the condition of the joints was observed.

Table III - Joint Width Measurements

Date			2-19-51	6-7-51
Temperature of Air Temperature of Concrete Time			66°F 62°F 12:00	80°F 84°F 10:30
Type of Joint	Joint No.	Station	Gauge Lengths and Width Variations in Inches	
Standard	1	245+00	5.215	5.123 -0.092
Standard	2	245+50	5.286	5.243 -0.043
Experimental	3	246+00	4.404	4.375 -0.029
Experimental	4	246+50	4.523	4.500 -0.023
Experimental	5	247+00	4.670	4.623 -0.047
Experimental	6	247+50	4.880	4.867 -0.013
Experimental	7	248+00	5.213	5.200 -0.013
Standard	8	248+50	4.819	4.804 -0.015
Standard	9	249+00	5.328	5.308 -0.020
Standard	10	304+50	4.939	4.949 +0.010
Experimental	11	305+00	4.684	4.654 -0.030
Experimental	12	305+50	4.817	4.825 +0.008
Standard	13	306+00	4.807	4.796 -0.011