FINAL REPORT ON JOINT LOAD TRANSFER TEST ROAD TO EVALUATE ACME LOAD TRANSFER ASSEMBLIES, PLASTIC COATED DOWELS AND END-OF-POUR CONSTRUCTION JOINT ASSEMBLIES

MICHIGAN DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

TESTING AND RESEARCH DIVISION
RESEARCH LABORATORY SECTION

FINAL REPORT ON JOINT LOAD TRANSFER TEST ROAD TO EVALUATE ACME LOAD TRANSFER ASSEMBLIES, PLASTIC COATED DOWELS AND END-OF-POUR CONSTRUCTION JOINT ASSEMBLIES

J. E. Simonsen

Research Laboratory Section
Testing and Research Division

Research Projects 67 F-95
and 68 F-104
Research Report No. R-1137

Lansing, March 1980

SUMMARY

This project was conducted to determine the performance of plastic coated dowels and Acme load transfer assemblies (two-piece malleable iron castings) used to transfer load across the joint, as in comparison to standard steel dowels, and to evaluate the feasibility of using a two-part dowel in end-of-pour construction joints.

The pavement containing these assemblies was constructed in 1969 and is located on M 52 between Bennington Rd and Morrice Rd in Shiawassee County. It is 24 ft wide and consists of a 9-in. reinforced concrete slab with joints spaced at 71 ft 2 in. The joint grooves are sawed and sealed with neoprene seals.

Evaluation of the use of the two-part dowel assembly in end-of-pour joints was reported in 1970 and on the basis of recommendations included in the report the assembly was approved for use. In 1976, its use was discontinued in favor of a tied end-of-pour construction joint.

The results of this evaluation of the standard steel dowels, Acme assemblies, and plastic coated dowels, in terms of six performance factors, are tabulated below.

Factor	Performance		
	Standard	Acme	Plastic Coated
Uniformity of joint movement (Figs. 4, 5, and 6)	Poor	Good	Excellent
Initial pull-out resistance (Avg. lb/dowel)	6,500	0	700
Joint groove spalling (lin in./joint)	40	11	6
Slabs with fractured steel (percent of lane slabs)	34	9	10
Load transfer effectiveness (percent)	92	85	89
Corrosion (in. of penetration)	1/8	Minor	0

The tabulated values for pull-out resistance, corrosion, and load transfer effectiveness are from data collected after four years' service, except for the corrosion of the plastic coated dowels which was checked again after

10 years' service and found to be zero. The remaining values are based on 10-year service data.

On the basis of the listed performance factors, it is concluded that both the Acme and plastic coated dowels performed better than the standard steel dowels. Although not included as a performance factor, faulting of the Acme joints has developed and for this reason Acme assemblies are not acceptable. The plastic coated dowels were included in a laboratory evaluation in 1973 and approved for use along with other types of coated dowels. Because of their excellent performance on this pavement, their use in future new construction is encouraged.

It is evident that the experimental pavement is deteriorating and it is suggested that maintenance in the form of spall repairs and crack routing and sealing be undertaken.

Introduction

In 1969, the Michigan Department of State Highways and Transportation, in cooperation with the Federal Highway Administration, constructed a test road for the evaluation of load transfer assemblies. The test pavement is a part of Michigan Project S 262(10), State Project 76011-009 and is located on M 52 between Bennington Rd and Morrice Rd in Shiawassee County (Fig. 1).

The test pavement consists of 3.25 miles of 24-ft reinforced concrete 9-in. uniform thickness placed on a 14-in. granular subbase. The assemblies being evaluated consist of 67 Acme load transfer assemblies, 10 assemblies containing plastic coated dowels, and 8 assemblies for use in construction joints. A control section with standard load transfer assemblies and approximately one mile long was established during the construction. The control and test section locations and joint layout are shown in Figure 2. The transverse joint spacing is 71 ft - 2 in. and the joint grooves are sawed and sealed with neoprene seals. The longitudinal center joint is also sawed but is sealed with a cold-applied liquid sealant.

Construction of the pavement began July 23, 1969, was completed August 12, 1969, and opened to traffic November 10, 1969. Full-width construction was employed, whereby the entire 24-ft width of pavement was placed at one time. The concrete was placed in two layers; the first layer was struck-off 3 in. below the pavement surface and the reinforcement placed at that depth. A second layer was then placed and the surface finished with mechanical equipment. The final surface treatment consisted of hand floating followed by burlap dragging. The pavement was protected during the curing period by applying a white membrane curing compound.

Earlier research reports have dealt with the evaluation of end-of-pour construction joints (Report No. R-718), the construction of the concrete pavement (Report No. R-737), and the performance of the load transfer assemblies after four years' service (Report No. R-910). Pertinent portions or summaries from these reports are included in this report which discusses the 10-year performance of the test sections as compared to the control pavement.

Objectives

The objectives set forth in the project Work Plan are:

1) To evaluate the Acme assembly, and assemblies containing plastic coated dowel bars, by comparing them with the performance of standard

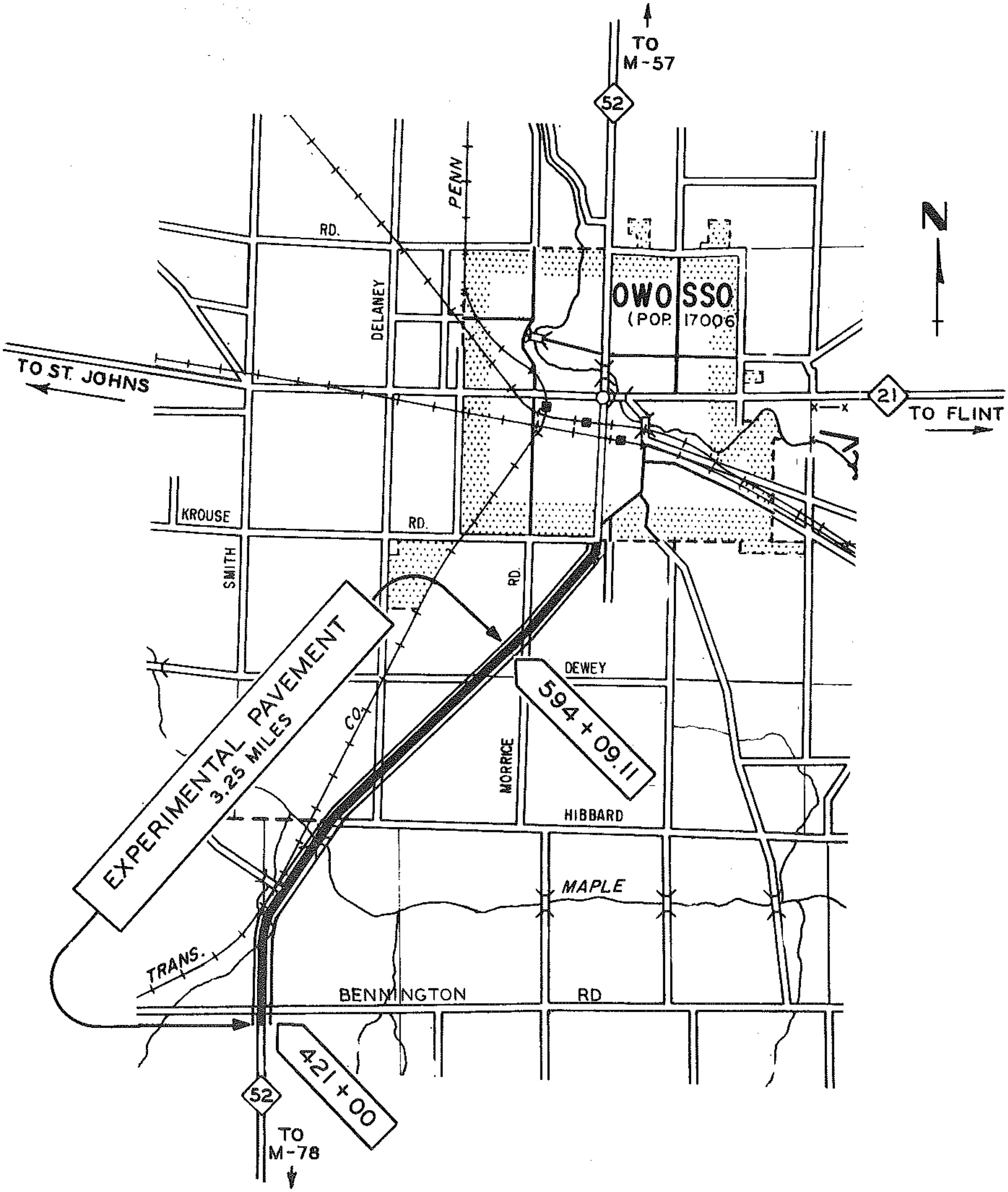


Figure 1. Location of experimental pavement.

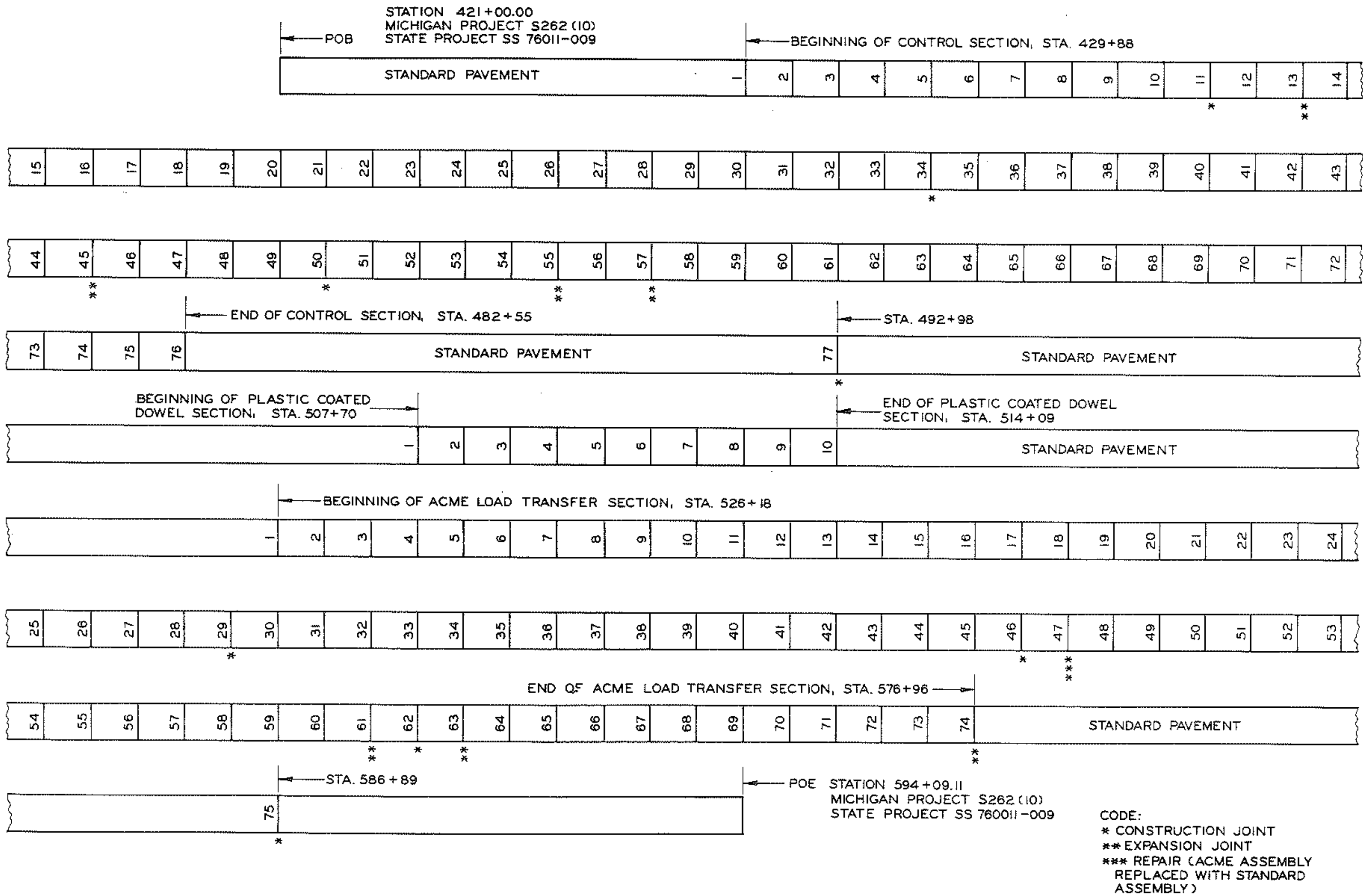


Figure 2. Test section locations and joint layout.

assemblies in light of the following criteria:

a. load transfer capability,
b. joint movement restraint,
c. joint and slab deterioration,
d. corrosion of load transfer unit.

2) To determine the feasibility of using a two-piece type of dowel assembly at end-of-pour joints.

Description of Load Transfer Assemblies

1) Michigan's Standard Assembly - Load transfer is accomplished using 1-1/4-in. diameter steel dowels 18 in. long. The dowels are held in a wire frame on 12-in. centers and at mid-depth of the slab. Alternate ends of the dowels are welded to the frame. The free dowel ends are sawed to maintain their roundness and thereby reduce restraint of movement. To prevent bonding of the concrete to the free dowel end, a coating of liquid asphalt RC-250 is applied for not less than 2/3 of the length of each dowel.

2) Assembly with Plastic Coated Dowels - This assembly is identical to the standard assembly except the dowels are coated with a plastic material. The coating consists of a 4-mil thick adhesive material overlaid by a 17-mil thick high density polyethylene material. The coating system is applied by an extrusion process before the dowels are sawed and welded into the wire frame. The plastic coating prevents bonding of the concrete to the dowels, thus eliminating application of a bond-breaker in the field. In addition to acting as a bond-breaker, the plastic coating also minimizes corrosion of the steel bar.

3) Acme Assembly - This assembly utilizes malleable iron castings to accomplish load transfer. Each individual transfer unit within a 12-ft assembly consists of a female and male casting which engage for a distance of 1-1/2 in. at the center of the assembly. The castings are straight in the engagement area but then curve down and outward and are fastened to sheet metal angles designed to support the assembly on the subbase. Spacing of the individual units at the center of the assembly is maintained by fastening to a metal plate. Assemblies are designed for load transfer at the mid-depth point of the slab. The assembly is held together during handling and installation by crimping the female casting, which is open on one side, onto the male casting. Because the sliding portion of the units is enclosed on three sides and is only 1-1/2 in. long, no bond breaker needs to be applied in the field before installation.

4) End-of-Pour Assembly - This assembly differs from a standard contraction joint assembly in two ways: first, the dowels consist of a 7-1/2-in. length of bar threaded into one end of a 3-in. long sleeve, and a 10-1/2-in. bar threaded into the other sleeve end, and; secondly, the plain ends of the shorter dowel pieces are welded to one assembly side frame; whereas, the other side frame is clipped onto the longer dowel pieces. This design permits the dowels to be supported independently of the bulkhead and allows removal and replacement of the half assembly extending into the second pour area.

Figure 3 illustrates an assembly of each type. Since the construction was performed in accordance with Standard Specifications the test sections contain expansion joints at intersections of other structures and at the PC's and PT's of curves.

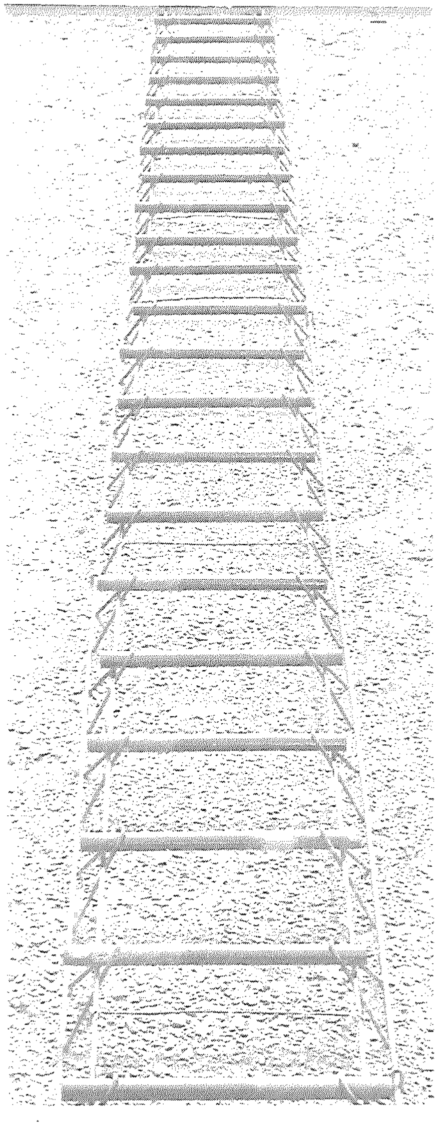
Evaluation

The performance of the Acme assembly and the plastic coated dowels was determined on the basis of a comparison of the following factors with the same performance factors for standard dowels:

1) uniformity of joint movement,
2) pull-out resistance of load transfer unit,
3) formation of transverse slab cracks,
4) amount of joint groove spalling,
5) load-deflection at joints,
6) corrosion resistance of the load transfer unit.

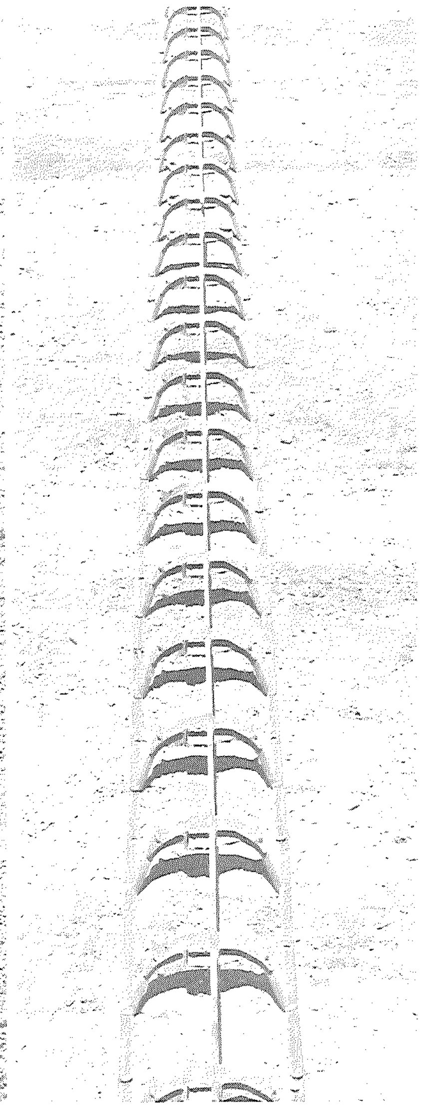
The feasibility of using the end-of-pour assembly as a standard load transfer device in construction joints was determined on the basis of observing installation procedures during construction of the pavement slab.

Construction Joints - The end-of-pour load transfer assembly is used only when the second pour is placed more than seven days after the first pour. However, on this project the contractor was required to use the assembly at each day's end-of-pour joint to obtain as much information as possible on the installation of the assembly. A total of eight joints were constructed using the assembly, and on the basis of observation of constructing these joints, it was concluded that the assembly was satisfactory for use. On the basis of recommendations contained in Research Report No. R-718, the Department approved the assembly for use in all end-of-pour joints. The assembly was in use until June 1976 when a change to tied end-of-pour joints was made. The tied joints are constructed using either



Standard dowel bar assembly.

Assembly with plastic coated dowel bars.



Acme assembly.

End-of-pour assembly.

Figure 3. Standard MDOT and experimental load transfer assemblies.

hook bolts or straight deformed steel bars. The location of tied construction joints is required to be at least 15 ft away from a regular dowelled joint.

Joint Movements - In order for a pavement to perform satisfactorily for its design life it is necessary that the joints continue to open and close freely and to move a nearly uniform amount. However, under normal service conditions this is seldom the case, but rather joint movements vary considerably in amount especially with time, when some joints cease to move at all. To demonstrate the nonuniformity of joint movements (openings) over a 10-year period, semiannual movements of each joint for various temperature drops are shown in Figures 4, 5, and 6 for standard steel dowels, Acme dowels, and plastic coated dowels, respectively.

The amount of movement resulting from cooling the pavement depends on the magnitude of the temperature drop involved. This can be seen on the graphs by comparing the movements to the temperature change. For example, the amount of movements shown in 1970 for a 65 F change for the three joint types are much larger than those recorded in 1978 for a 30 F change.

On a given section of pavement there are several factors, such as dowel restraint, uniformity of concrete mix, curing conditions, pour temperature, and subgrade friction that influence the uniformity of joint movements. For the three sections involved on this project it appears that, in general, joints with 'small' movements the first year will continue to have small movement and similarly, joints with 'large' openings the first year show the same pattern of movement. This initial as well as subsequent nonuniformity from joint to joint can be noted on the graphs by observing the peaks and valleys of the bars representing the joint movements. Basically, the variation in movements stayed nearly the same through 1976 but by 1978 the movements are much more erratic, especially in the section containing standard steel dowels. By comparing the graphed movements, it is evident that the joints with plastic coated dowels moved more uniformly than the Acme or standard dowelled joints throughout the 10-year period.

The reason for the dramatic change in joint movement in the standard dowelled section in 1978 and even more noticeable in 1980 is that numerous imminent or complete steel fractures have occurred. Once the steel fractures or yields all or some of the movement occurs at the crack. The location of steel fractures and their effect on the 1980 joint movements are shown in Figure 7. As can be seen, the movements are affected more in the standard section than in the sections with Acme and plastic coated dowels. The reason for this is that the dowel restraint of Acme and plastic

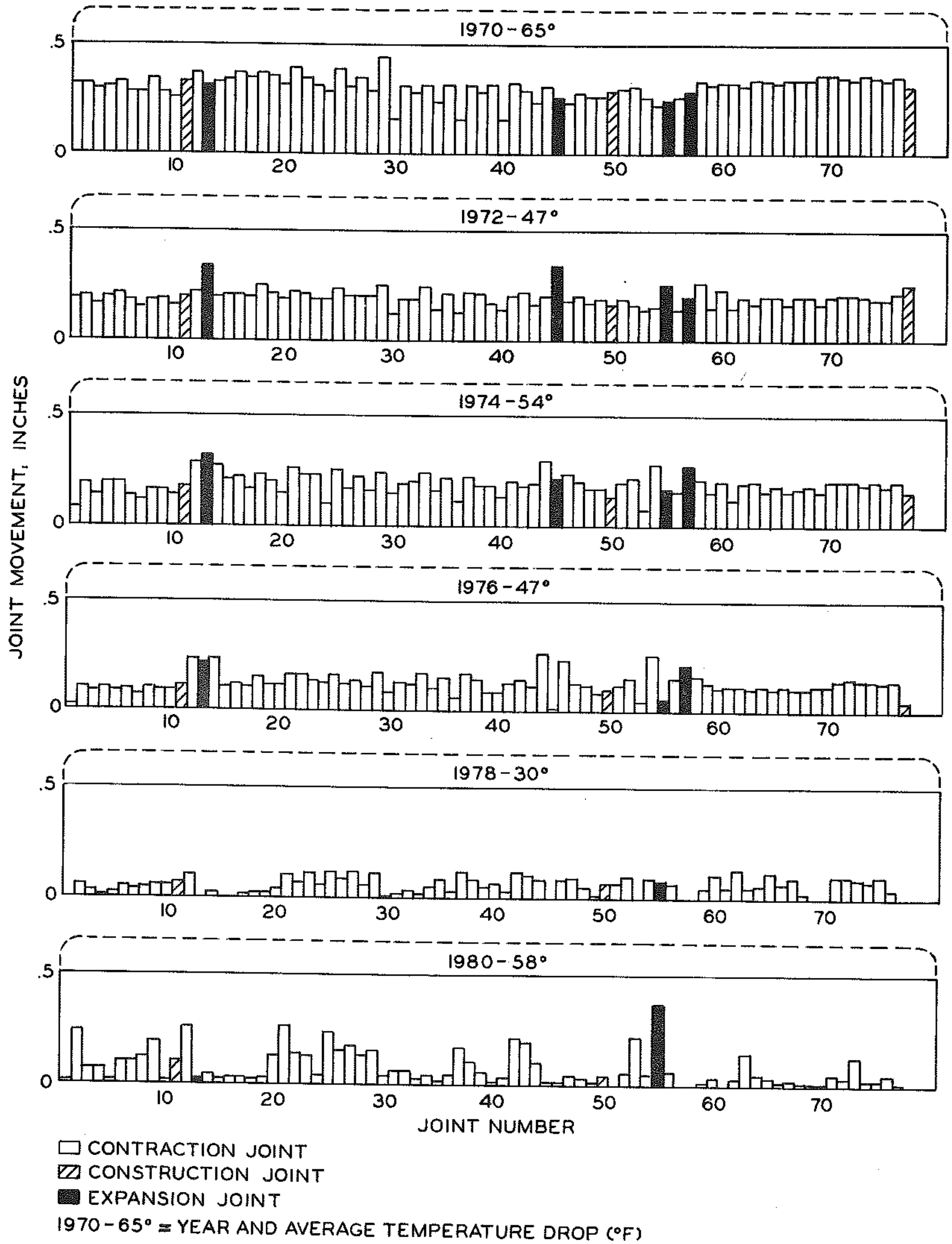


Figure 4. Ten-year period of semiannual joint movements (openings) for each joint caused by the temperature drops shown (standard steel dowels).

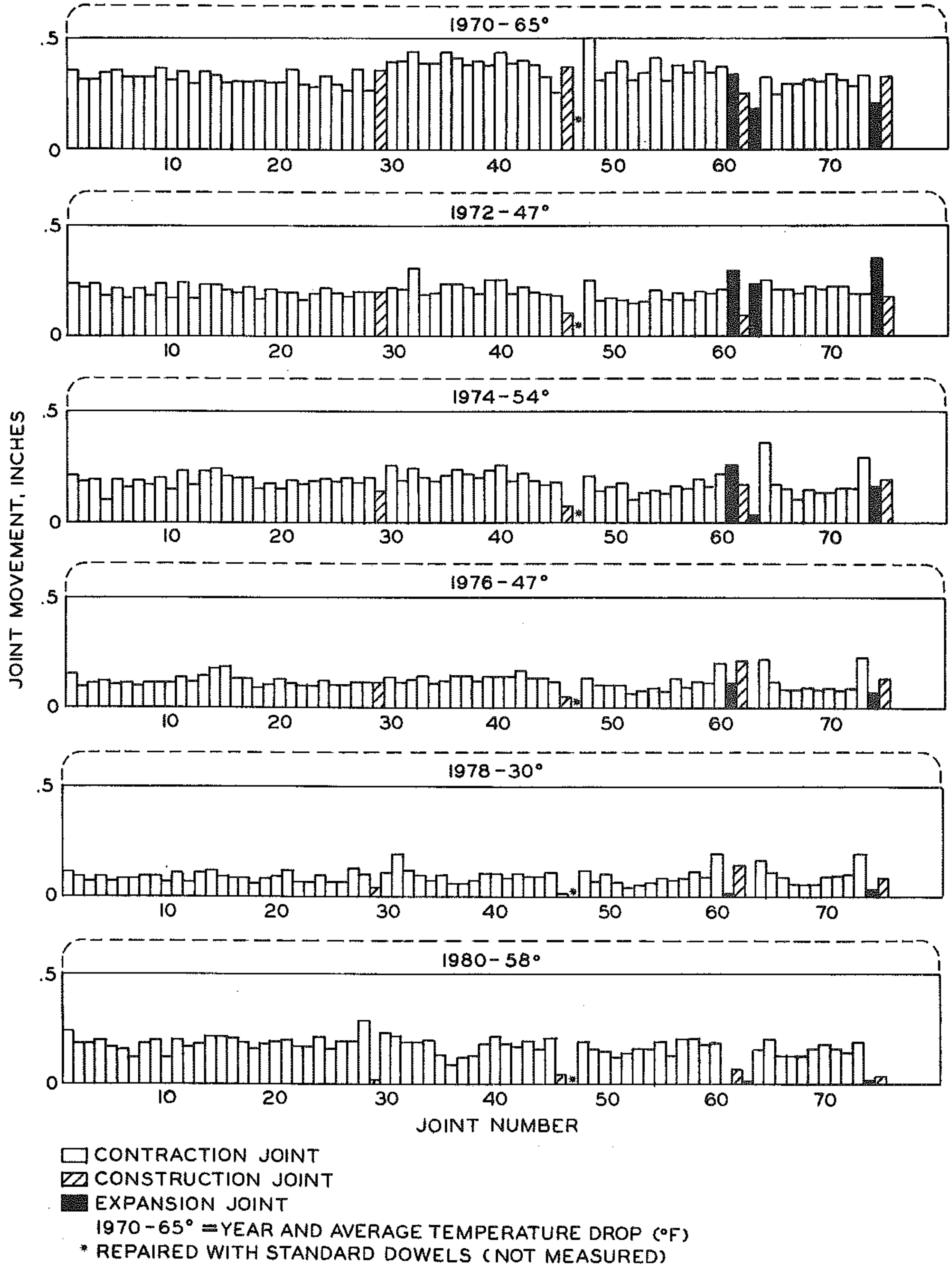


Figure 5. Ten-year period of semiannual joint movements (openings) for each joint caused by the temperature drops shown (Acme dowels).

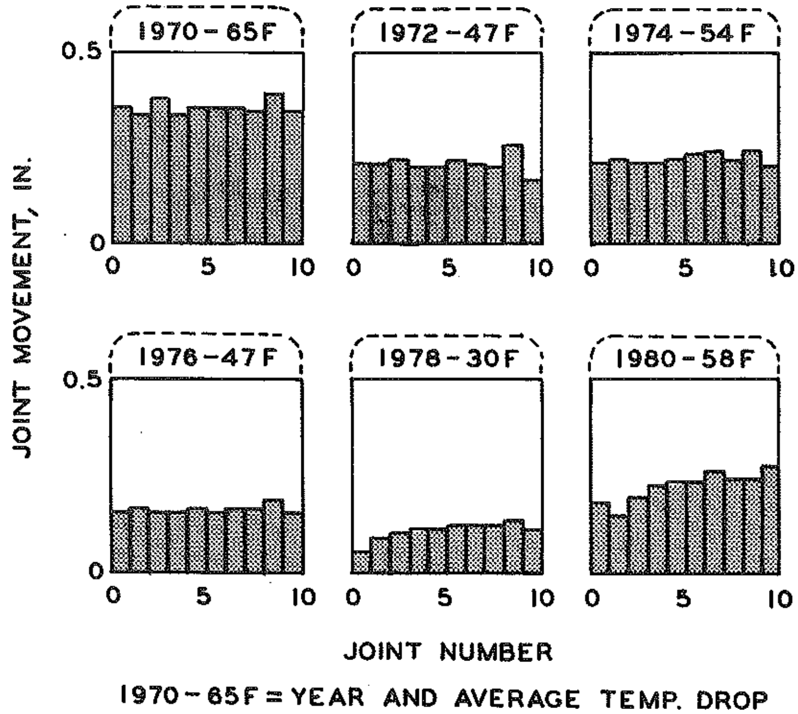


Figure 6. Ten-year period of semiannual joint movements (openings) for each joint caused by the temperature drops shown (plastic coated dowels).

coated dowels is low and the joints adjacent to the untied cracks continue to open an amount proportional to the new slab length; whereas, the restraint of the standard dowels is so great that nearly all the movement is transferred to the crack.

Pull-Out Resistance

From each of the three test sections, three individual dowels were removed after four years' service to check the amount of load required to open the joints. All dowels removed were adjacent to the northbound shoulder edge. At each location a 12-in. wide, by 24-in. long, full-depth piece of concrete was removed by sawing the slab full-depth. The blocks were removed carefully, placed on pallets and transported to the Laboratory for testing.

The results of the pull-out tests are given in Table 1. The load, as noted, was recorded at 0.01 in. of movement, and at 0.50 in. of movement, the maximum distance the joint was opened. In addition, the maximum load and the movement at which it occurred are included in the table.

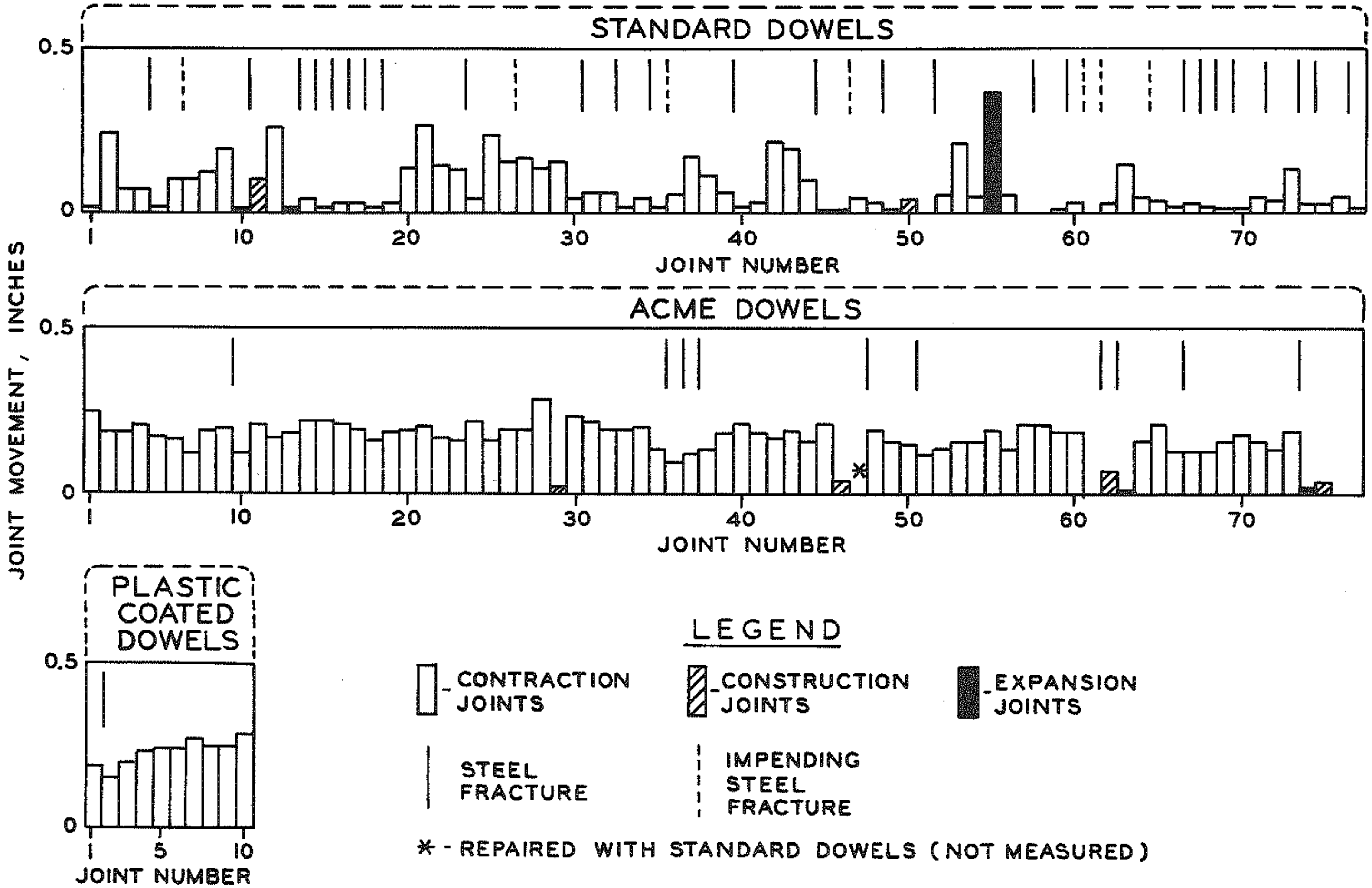


Figure 7. Effects of fractured steel on joint movements after 10 years of service.

TABLE 1
PULL-OUT TESTS

Joint No.	Dowel Type	Lubricant	Load (lb) at Movement (in.)					
			Load	Movement	Load[1]	Movement[1]	Load	Movement
22	Standard	Asphalt[2]	6,200	0.010	7,400	0.018	2,200	0.50
26	Standard	Asphalt	7,400	0.010	8,200	0.021	1,800	0.50
30	Standard	Asphalt	6,000	0.010	8,500	0.023	3,400	0.50
2	Plastic coated	None	800	0.010	2,000	0.250	2,000	0.50
6[3]	Plastic coated	None	6,200	0.010	9,000	0.100	1,800	0.50
9	Plastic coated	None	600	0.010	1,400	0.200	1,400	0.50
18	Acme	None	No tests because load-transfer unit separated during handling.					
21	Acme	None						
24	Acme	None						

1 Maximum Load (occurred at movement shown).
2 RC-70 or RC-250
3 Dowel coating damaged.

Except for the load on the plastic coated dowel from joint No. 6, the maximum load recorded for these dowels were about one-quarter of that measured for the standard dowels. The maximum load on the standard dowels occurred at only about 0.02 in. movement. However, once this load was reached, the load decreased rapidly until the load recorded at 0.50 in. opening was attained. This suggests that the dowels 'bond' to the concrete and once this resistance to movement has been overcome the load required to further open the joint decreases sharply.

The plastic coated dowel from joint No. 6 behaved almost like a standard dowel during testing. Later, when the block was opened it was discovered that the plastic coating had split and was open about 3/8 in. for the length of the bar. It was also noted that the movement had occurred between the bar and plastic coating rather than between the plastic and the concrete. The cause of the damage to the plastic coating is not known, but it was evident from the concrete removed from the dowel that the split had occurred prior to concrete pouring.

For the undamaged plastic coated dowels, the maximum load occurred at about 0.25 in. movement, and then remained at that value until the test was discontinued at 0.50 in. movement. Unlike the standard dowels, the plastic coated dowels do not appear to require a high initial load to induce movement. Examination of the exposed dowels showed that the movement in both cases had occurred partially between concrete and coating and between coating and bar.

As noted in Table 1, the Acme dowels could not be tested because the units came apart during handling. From the design of this type of load transfer device it is clear that the restraint of movement would be very little since the maximum engagement of the unit is only 1-1/2 in.

Transverse Slab Cracking

Transverse cracks in slabs longer than about 10 ft are expected to occur. In reinforced concrete slabs, the steel prevents the cracks from opening more than a few hundredths of an inch. As long as the steel is intact the cracks present no problem. However, when the steel fractures, the cracks open and are infiltrated by incompressible material which results in additional compressive forces in the pavement during expansion and contributes to joint failures.

Figure 8 shows the frequency distributions of the number of cracks per lane slab in each of the three pavement sections being evaluated. The distributions are given at yearly intervals through 1973 and then every other year through 1979. Basically, the formation of cracks has followed the same pattern in each test section as can be seen on the graph by noting that the lines are only separated by a few percentage points. After four years of service the crack pattern was rather well established and by the end of 10 years nearly all slabs had cracked. Also, after 10 years, 90 percent or more of the slabs in each section had two or more cracks per slab.

As previously mentioned, the Acme dowels offer very little, if any, resistance to slab contraction, and plastic coated dowel restraint after four years embedment is only about one-fourth of that for standard steel dowels lubricated with asphalt. Apparently, for this pavement, dowel restraint has a minor effect on crack formation, but appears to have a significant relationship to steel fracture. For example, after 10 years' service the standard dowelled section contained 52 lane slabs with fractured steel, the Acme section had 20 lane slabs with steel fractures and 2 lane slabs in the plastic section had fractured steel (Fig. 7). It should be noted that eight of the fractures in the Acme section are in slabs joined by either a construction or expansion joint containing steel dowels. Eliminating these fractures, the percent of slabs fractured in the standard, plastic coated, and Acme dowelled sections are 34, 10, and 9, respectively. Table 2 lists the number of lane slabs with zero to six transverse cracks per slab and the number of these slabs with cracks containing fractured steel. As can be seen, steel fractures have occurred mostly in slabs with three or more transverse cracks. Also, the relatively large number of slabs with fractured steel in the section containing standard dowels would indicate that increased dowel

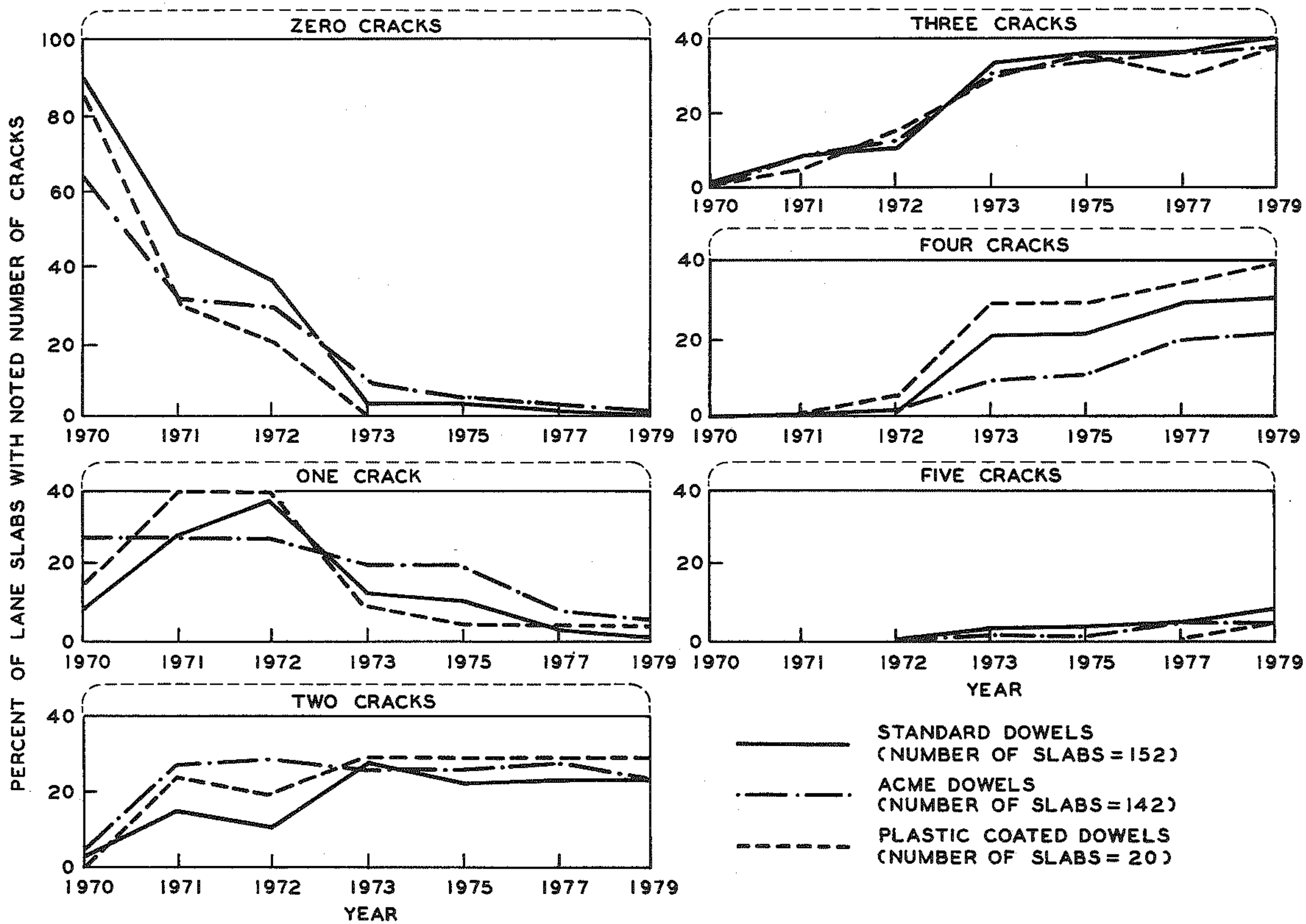


Figure 8. Percent of slabs in standard, Acme, and plastic coated dowel sections with zero to five cracks per slab at yearly intervals, 1970 through 1973, and then semiannually through 1979.

TABLE 2
SUMMARY OF THE TRANSVERSE CRACK DATA
FOR THE THREE DOWEL TYPES

	Number of Lane Slabs with Cracks / Number of Lane Slabs with Fractured Steel						
No. of Cracks per Lane Slab	0	1	2	3	4	5	6
Standard Dowels	1 /	3 / 1	24 / 6	61 / 22	49 / 16	14 / 7	/
Acme Dowels	3 /	10 /	32 / 3	53 / 8	33 / 1	8 /	1 /
Plastic Coated Dowels	/	1 /	6 /	4 /	8 / 1	1 / 1	/

restraint induces more steel fractures. However, other factors are involved in the process leading to steel fractures, because the Acme dowels do not restrain slab contraction, yet six slabs have cracks with fractured steel. Nevertheless, the four to five time reduction in steel fractures experienced on the experimental sections certainly is significant and the use of load transfer devices that will function for years with little or no resistance to movement is of utmost importance.

Joint Groove Spalling

The effect of joint groove spalling on the performance of load transfer devices is difficult to ascertain. Small shallow spalls that do not release the compression in the neoprene seals have little effect on the amount of moisture entering the joint. However, when spalls relieve the compression in the seal, moisture would have free access to the joint at the spall location and would probably accelerate corrosion of the dowels. Thus, severe spalling could contribute to earlier 'freezing' of the joints and the accumulation of rust on the dowels could possibly cause tensile failure spalls over the bars.

The length of groove edge spall on each contraction joint was estimated at yearly intervals. Spalls less than 1 in. wide were not included in the estimate. Figure 9 shows the distribution of the percent of joints with different amounts of spalls in each of the three pavement sections after 1, 5, and 10 years' service. After one year's service, 59, 67, and 100 percent

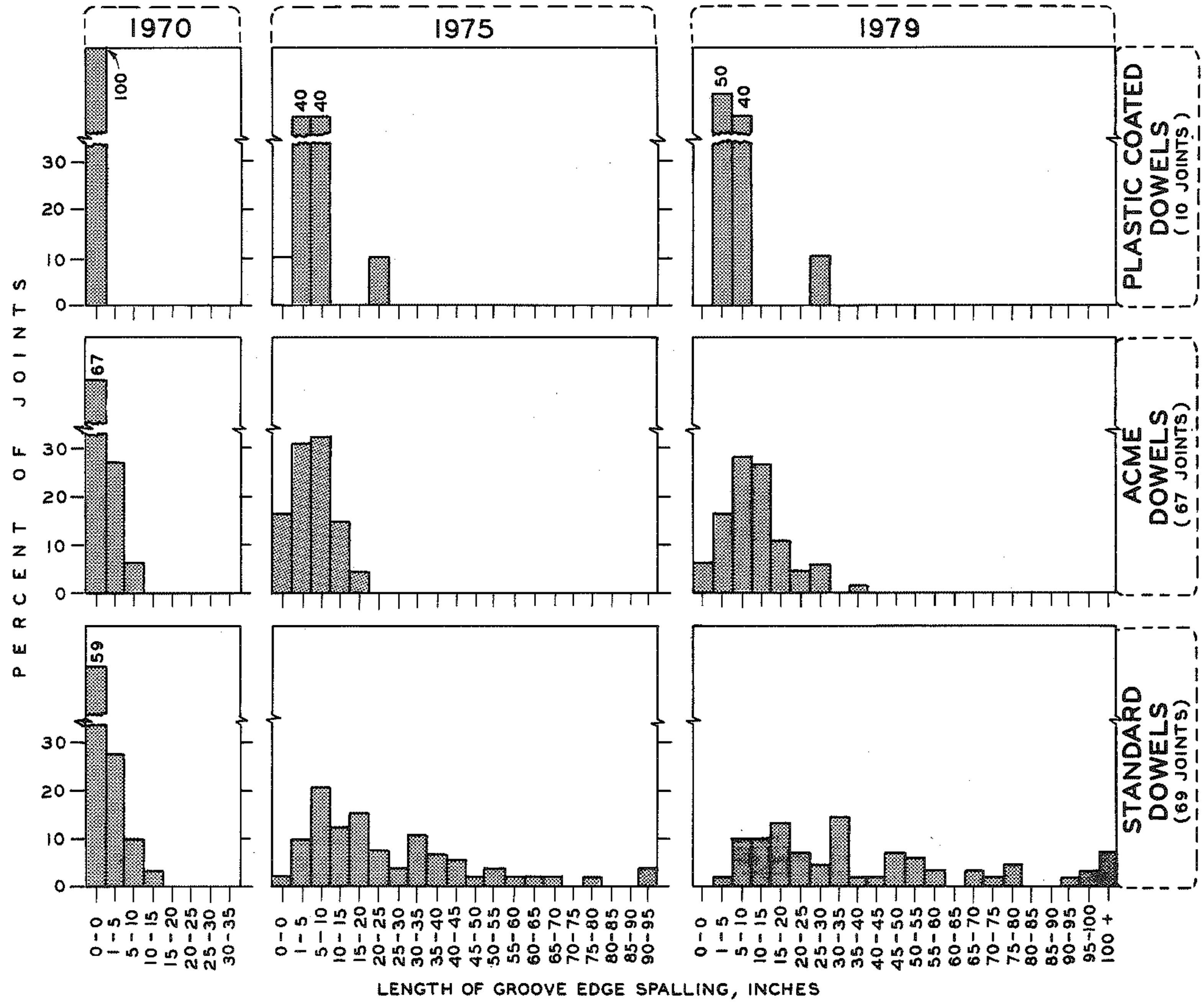


Figure 9. Histogram of contraction joint groove edge spalling in sections with the three different dowel types after 1, 5, and 10 years' service.

of the joints in the standard, Acme, and plastic coated dowelled sections, respectively, were without any spalls. After five years nearly all of the joints had spalled to some degree in the standard section. Thirty-six percent were spalled more than 25 in.; whereas, in the Acme and plastic coated dowelled sections all joints had spalled less than that amount. The 1979 graph shows that spalling in the standard section is still more severe than in the other two sections. In the plastic coated dowelled pavement, 90 percent of the joints had 10 in. or less of spall, while in the Acme dowelled section, 51 percent were spalled 10 in. or less. In the standard dowelled section, however, only 12 percent of the joints had spalls 10 in. or less in length. In all sections, most spalls were between 1 and 2 in. wide. The typical appearance of the spalls is shown in Figure 10.

Figure 10. Condition of typical spall in neoprene sealed contraction joints; 10 years' service.

Load Transfer

Nighttime load-deflection tests were conducted at three contraction joints in each of the three sections on December 4, 1969. The same three joints in each section were subjected to daytime tests on December 21, 1973. The change to daytime tests was made to eliminate the traffic hazards created by nighttime lane closures.

A single axle load of 18,000 lb was moved across the joint at creep speed with the outside tire being 12 in. from the pavement edge. Deflection measurements were made 2 in. each side of the joint centerline, 1 in. from the pavement edge, and three trials were made at each joint. The 1969

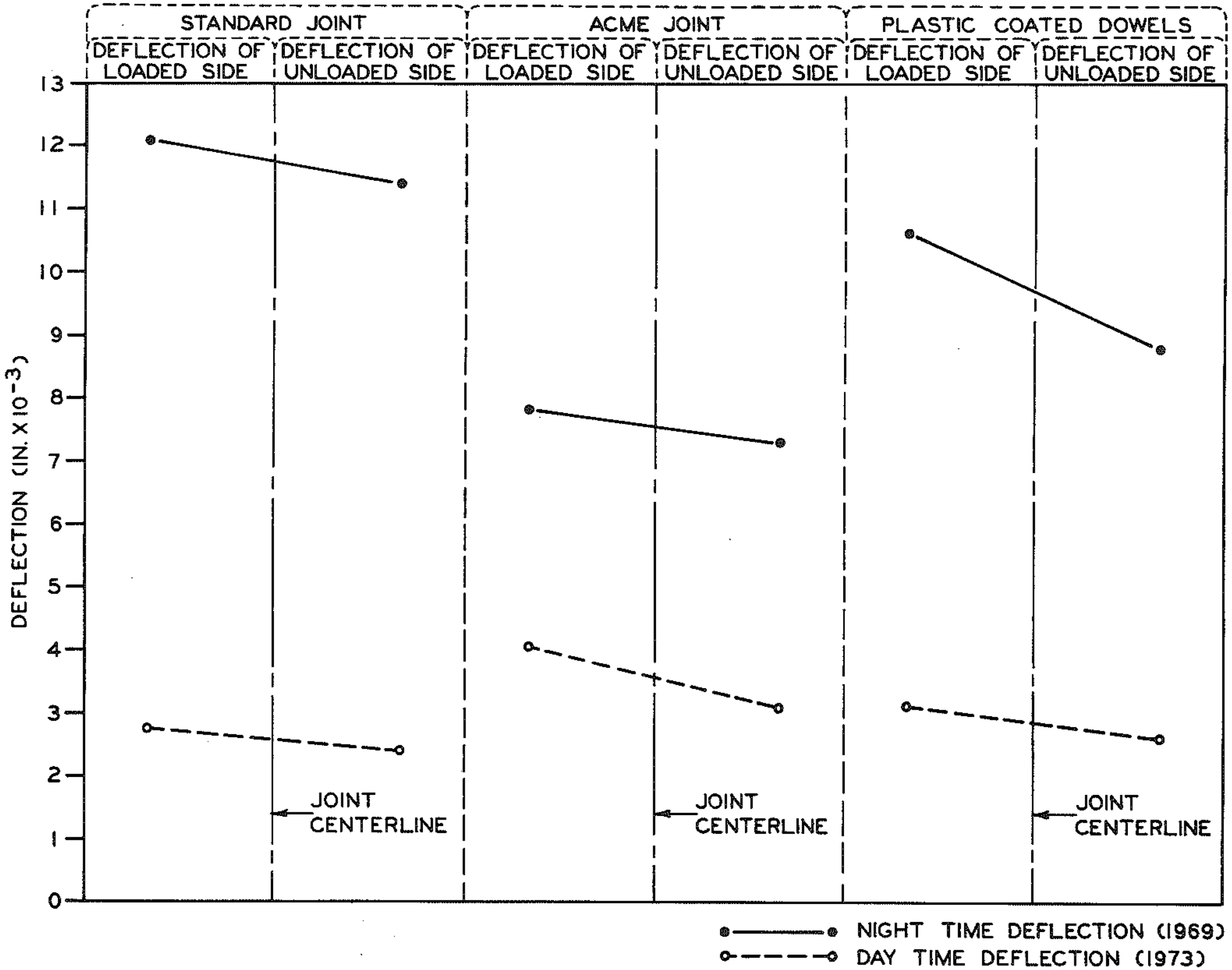


Figure 11. Deflection at joints in each test section.

measurements were made with linear variable differential transformers and recorded on a Sanborn Oscillograph. In 1973, direct current differential transformers and a direct writing Brush recorder were used to measure the deflection.

The deflection measurements of the loaded and unloaded side obtained in each test section were averaged to obtain one value for each type of load transfer device. Figure 11 shows the average deflection across a joint of each type. The low values recorded for the daytime tests reflect the difference in warping condition of the pavement at the time the two tests were conducted.

The load-transfer effectiveness is defined as the ratio of the deflections of the unloaded side of the joint to the loaded side. As expected, and as can be seen in Figure 11, the unloaded side of the joints always deflected less than the loaded side which indicate none of the devices are 100 percent effective in transferring load. On the basis of the recorded deflections, the load transfer effectiveness of the standard assemblies was 94 percent in 1969 and 89 percent in 1973. The effectiveness of the Acme assemblies changed from 94 percent to 77 percent, whereas, for the plastic coated dowels there was no change from the 83 percent obtained in 1969. The results indicate that the standard and plastic coated dowels are performing better with respect to load transfer than the Acme units.

Corrosion of Dowels

The dowels contained in the concrete blocks removed after four years' service were examined for corrosion. Figure 12 shows the condition of the standard dowels; as can be seen, rusting has commenced. The affected portion of the bars was at the joint centerline and is about 1 in. long. The deepest penetration, 1/8 in., was measured on bar No. 30. A depth of 1/16 in. was measured on both bar Nos. 22 and 26.

The plastic coated dowels removed from joint Nos. 2 and 9 did not exhibit any signs of corrosion (Fig. 13). The plastic coating was stained in the joint crack area but was without creases or cracks. Figure 14 shows the bar removed from joint No. 6, where as previously mentioned, the plastic coating had split prior to concrete pouring. As a result the bar had corroded in the joint crack area to a depth of 1/8 in.

The three Acme units are shown in Figure 15. Although each unit showed signs of corrosion in the engagement area, the loss of metal by rusting was very small.

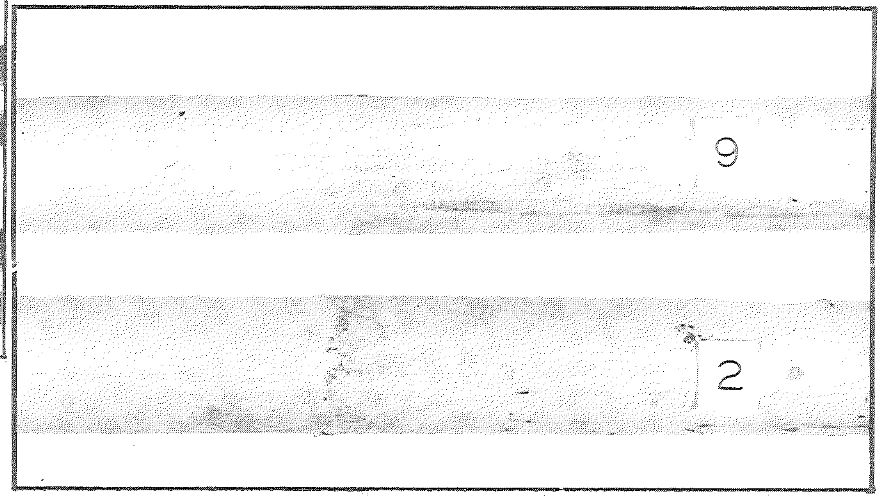


Figure 12. Corrosion of standard dowels after four years of service.

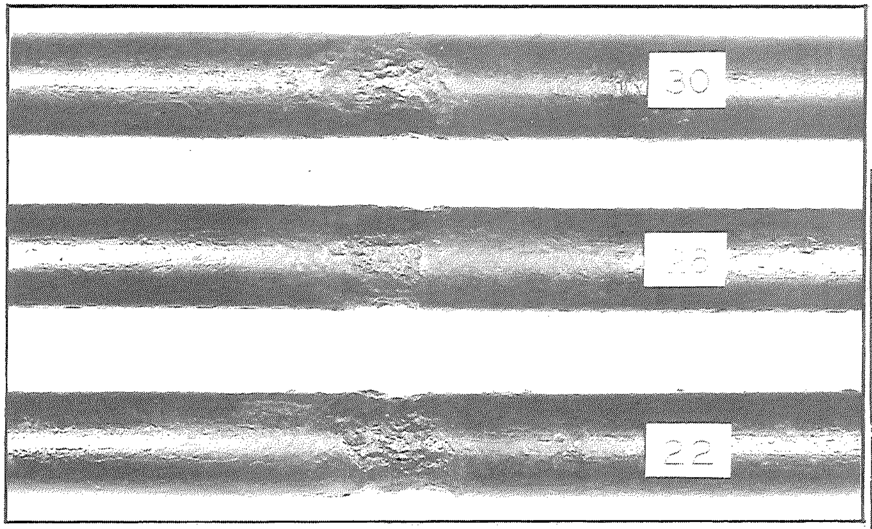


Figure 13. Plastic coated dowels after four years' service show no corrosion.

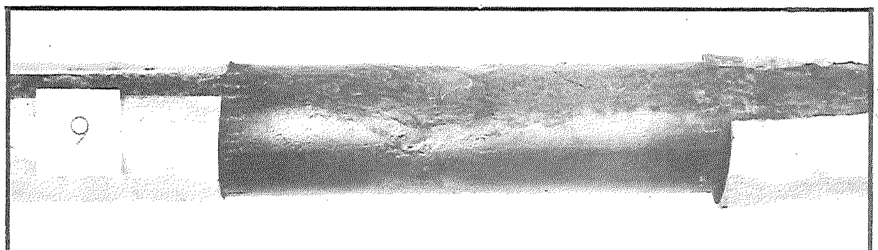


Figure 14. Plastic coated dowel with damaged coating shows corrosion in joint crack area.

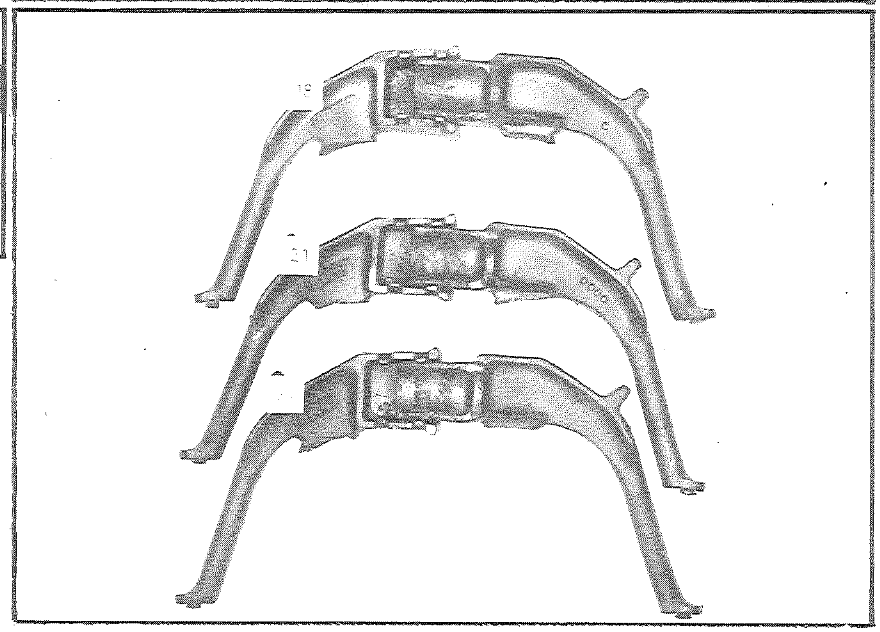


Figure 15. Acme dowel units show very little corrosion compared to standard dowels after equal length of service.

In 1979, after 10 years' service, three plastic coated dowel samples were removed by taking 6-in. diameter cores through the joints. These samples are shown in Figure 16. As can be noted, the dowels are free of any corrosion whatsoever. There are a few shallow indentations in the coating, but no breaks were found.

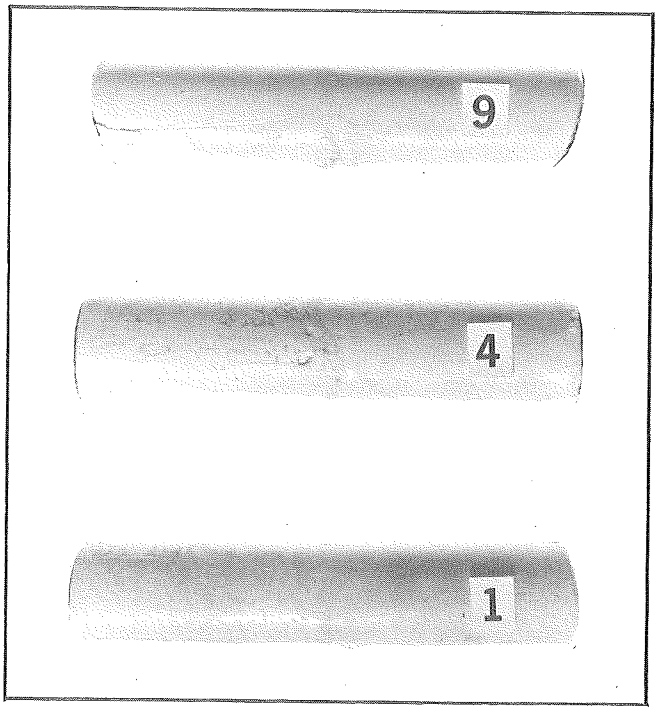


Figure 16. Corrosion-free plastic coated dowels; 10 years' service.

Although no samples of Acme dowels were removed in 1979, it is suspected that they are corroding or wearing a good deal because faulting of the joints are developing. Recent measurements of 20 consecutive joints showed that the joints were faulted an average of 1/8 in.

On the basis of the limited corrosion study, it is evident that plastic coated dowels are superior in resisting corrosion in comparison to the standard and Acme dowels.

Conclusions

On the basis of 10 years' performance of the plastic coated dowels, it is concluded that these dowels are greatly superior to both Acme and standard steel dowels. The section with these dowels has outperformed the other two sections with respect to uniformity of joint movements, the formation of open cracks, the amount of groove edge spalling, and the dowel's resistance to corrosion. Their pull-out resistance is only one-fourth of that for steel dowels, but their load transfer effectiveness is a few percentage points less than that for the standard steel dowels.

The Acme dowelled section has performed better than the standard section, but faulting of the joints has developed. For this reason, Acme dowels are not acceptable for use in load transfer devices.

Recommendations

Since this project was initiated in 1968 much work has been done to develop coatings for dowels that would eliminate the corrosion problem. Five coating systems, including the plastic coated dowels, were tested in 1973 by the Department's Research Laboratory. The results led to the adoption of specifications requiring all dowels to be coated for corrosion protection. The plastic coated dowels evaluated on this project meet the specification requirements and since they performed excellently in the field it is recommended that their use in new construction be encouraged.

It is evident from the evaluation of the load transfer assemblies that the pavement itself is deteriorating and is in need of maintenance. The spalls should be repaired to prevent contamination of the joints and the cracks with fractured steel should be repaired also to prevent solids from entering them. The spalls can be repaired with fast-set mortars but the repair of cracks is more expensive and complicated. The only way to repair an open crack so as to ensure that faulting will not develop, is to install a dowelled joint at the crack location. This is a costly remedy but for heavily travelled routes and for pavements in good condition, it is justifiable.

On this pavement, with an ADT volume of 6,800 (1975), it may be feasible to rout a groove along the top of the crack and then seal it with a liquid sealant. This would be less costly than installing dowels and should be quite successful in preventing contamination of the open cracks. It is suggested that consideration be given to repairing the spalls and determining the feasibility of routing and sealing the open cracks. This type of work could be done under contract or by our maintenance forces, but should be designated as an experimental project.