327

TRANSVERSE JOINT PROBLEMS

Prepared for Review of the Design Division
At the Request of the Committee on Investigation of New Materials

Report No. 327
Research Laboratory Division
Office of Testing and Research
Research Project 39 F-7(14)

Michigan State Highway Department
John C. Mackie, Commissioner
Lansing, April 1960

TRANSVERSE JOINT PROBLEMS

At a meeting on June 30, 1959, the Committee for Investigation of New Materials reviewed a proposal by the Expansion Joint Institute for the construction of a pavement joint experiment. The experiment would consist of installing a 1/2-in. thick compressible board material at 99-ft intervals to form transverse joints, as an alternate method to the current practice of installing a styrofoam strip at the surface to create a weakened-plane section. Their purpose in proposing this study was to determine if this method would serve to overcome some of the present joint weaknesses, the most common being manifested by joint spalling, longitudinal cracking at transverse joints, concrete shattering, and blow-ups.

It was the consensus that before action could be taken on this proposal, the Research Laboratory Division should summarize the joint problems which have developed over the past several years and discuss them with the Design Division. If the Design Division feels that such an experimental project is desirable, then the Committee in turn will act on the project.

The following report, for the most part pictorial, has been prepared for review by both the Design Division and the Committee on Investigation of New Materials. It includes photographic evidence of different types of transverse joint problems common to postwar concrete pavements. The subjects covered include: 1) longitudinal cracking, 2) spalling, 3) concrete "blow-up" failure, 4) dowel bar assemblies, 5) dowel bar corrosion, 6) construction joints, 7) compression cracking, 8) transverse joint construction, and 9) joint sealing.

LONGITUDINAL CRACKING

A study of 143 projects constructed between 1946 and 1955, on which survey data were available, revealed longitudinal cracking at transverse joints. This phenomenon is not common to Michigan alone. Other States report similar experiences. Mr. Harry Cashell, Bureau of Public Roads, reports that all States but New Jersey are experiencing longitudinal cracking at transverse joints. New Jersey uses a 3/4-in. expansion joint at 78-ft intervals.

Of the 143 projects studied, 58 or approximately 40 percent evidenced longitudinal cracking at transverse joints in varying degrees, whereas in the remaining 85 projects or 60 percent, no transverse cracking was detected. The percent of joints with longitudinal cracking among the projects studied varied from a low of 0.2 percent of the joints per lane mile of pavement to a maximum of 46 percent (Table 1).

The causes of longitudinal cracking are not definitely known. Age apparently is not a major factor in the incidence of longitudinal cracking. This phenomenon has been discovered on new pavements not yet subjected to normal traffic, as well as on older projects. The following significant construction and design factors, either individually or in concert, may contribute to longitudinal cracking:

1. Heavy loads during early life of structure, such as earthmoving equipment or other heavy contractors' equipment.

2. Infiltration of inert soil particles from shoulder materials, causing unusual transverse facial pressure.

3. Misalignment of dowel bars.

4. Frozen dowel bars caused by rusting and lack of proper lubrication.

5. Localized pressure on ends of dowels in transverse joints.

6. Localized pressure at slab edges caused by unequal volume changes due to moisture conditions.

7. Unequal slab movement at joints.

8. Character of subbase support.

TABLE 1
SUMMARY OF PROJECTS WITH LONGITUDINAL CRACKING AT TRANSVERSE JOINTS

Project	Construction Dates		Last Survey	Lane Miles	Joints		Cracks		Joints Cracked			24-Hr Average Daily Traffic				Thickness*	
	From	To			Total	per lane mi	Total	per lane mi	Total	per lane mi	% per lane mi	Total	Year	1955 Total	1955 Commercial	Edge, in.	Center, in.
58-28-C1	6-23-49	7-25-49	1954	4.2	213	50.7	148	35.2	98	23.3	46.0	2700	49	5000	1100	W10	C5
61-26-C4	5-25-48	no date	1952	3.9	228	58.5	97	24.8	74	19.0	32.5	2660	49	8000	710	W9	C5
35-3-C9	5-24-48	6-2-48	1954	1.0	53	53.0	17	17.0	13	13.0	24.5	0500	49	2500	380	W10	C5
30-4-C5	9-8-49	9-30-49	1955	4.8	249	52.0	69	14.4	58	12.1	23.3	1450	49	2000	450	8	8
39-40-C4	6-8-53	7-14-53	1954	7.5	398	53.1	102	13.6	86	11.5	21.7	---	--	6150	1625	9	9
73-6-C6	8-9-49	9-15-49	1953	8.8	477	54.2	103	11.7	90	10.2	18.8	1600	49	2200	318	8	8
63-46-C3	5-15-50	6-3-50	1955	2.8	207	74.0	28	10.0	20	7.1	9.6	6800	50	13500	1100	W13	C5
19-36-C1	9-7-51	9-17-51	1956	2.5	143	57.2	12	4.8	12	4.8	8.4	5620	51	6500	1050	9	9
56-27-C4	6-4-47	7-2-47	1952	4.9	267	54.5	25	5.1	22	4.5	8.3	0572	43	2500	360	8	8
47-26-C6	6-20-49	7-22-49	1954	3.6	203	56.4	18	5.0	16	4.4	7.8	0990	49	2500	240	8	8
64-7-C10	6-5-50	7-24-50	1955	7.1	413	58.2	35	4.9	32	4.5	7.7	3060	50	4200	710	W14	C5
52-2-C6	6-4-49	6-27-49	1954	2.6	128	49.2	11	4.2	9	3.5	7.1	2790	49	4000	350	8	8
58-54-C1	7-26-49	7-27-49	1954	0.7	42	56.0	3	3.8	3	3.8	6.8	2700	49	4000	1100	W10	C5
33-54-C1	6-5-48	7-9-48	1952	3.5	192	54.9	13	3.7	13	3.7	6.7	6440	49	7400	1530	9	9
74-38-C2	8-16-48	9-29-48	1954	4.9	265	54.0	23	4.7	17	3.5	6.5	1390	49	1400	220	8	8
33-26-C7	5-29-53	7-30-54	1954	11.3	482	42.6	32	2.9	30	2.7	6.3	8200	53	8700	2000	9	9
70-51-C4	10-14-49	10-26-49	1955	0.8	47	58.7	4	5.0	3	3.7	6.3	1990	49	7500	1430	9	9
52-2-C7	6-6-49	6-11-49	1954	1.5	80	53.3	5	3.3	5	3.3	6.2	2790	49	1700	280	8	8
61-41-C4	5-12-49	6-4-49	1954	3.3	197	59.6	15	4.5	12	3.6	6.0	3980	49	9000	1190	9	9
33-54-C4	10-6-52	6-29-53	1955	7.4	476	64.3	36	4.9	26	3.5	5.4	4900	53	7400	1530	W10	C6
11-42-C3	9-28-47	10-17-47	1947	1.8	94	52.2	7	3.9	5	2.8	5.4	4966	42	5800	900	9	9
44-32-C1	10-21-46	11-4-46	1954	4.2	229	54.5	17	4.1	12	2.9	5.3	4788	47	3300	640	W8	C5
63-39-C3	9-9-50	10-9-50	1955	5.0	291	58.2	15	3.0	15	3.0	5.2	9020	50	9650	1880	9	9
56-8-C2	10-5-49	10-29-49	1950	2.4	128	53.4	6	2.5	6	2.5	4.7	4140	49	10000	800 ±	8	8
6-27-C1	9-19-47	10-16-47	1955	4.4	237	53.9	15	3.4	11	2.5	4.6	0423	42	1400	245	8	8
7-21-C2	8-31-49	10-13-50	1954	11.1	609	54.7	29	2.6	28	2.5	4.6	1450	49	1000	170	8	8
28-38-C2	6-25-48	8-2-48	1956	4.2	228	54.3	12	2.9	10	2.4	4.4	2590	49	3800	430	8	8
2-32-C1	10-25-49	11-2-49	1954	1.2	122	101.6	7	5.8	5	4.2	4.1	1060	49	1800	95	8	8
72-7-C4	7-21-47	8-21-47	1949	4.8	269	56.0	12	2.5	11	2.3	4.1	1038	42	3800	310	8	8
9-12-C8	6-25-51	8-14-51	1956	7.8	536	68.7	21	2.7	21	2.7	3.9	7560	51	9000	1250	9	9
41-75-C3	6-22-49	7-26-49	1954	6.0	324	54.0	13	2.2	12	2.0	3.7	1000	49	3400	450	8	8
43-16-C2	7-1-47	7-26-47	1956	4.2	221	52.5	8	1.9	8	1.9	3.6	3696	47	1200	250	8	8
49-29-C2	6-5-48	7-3-48	1954	4.2	251	59.8	9	2.1	9	2.1	3.5	1580	49	1800	170	8	8
36-5-C3	9-9-48	10-4-48	1954	5.1	268	52.5	9	1.8	9	1.8	3.4	1710	49	2800	370	8	8
38-48-C2	8-1-49	10-12-49	1955	5.4	541	60.1	12	2.2	11	2.0	3.3	7520	49	5700	1890	9	9
78-27-C1R	7-24-53	9-29-53	1955	6.6	293	45.1	10	1.5	10	1.5	3.3	4800	53	5850	500	W8	C6
19-41-C1	8-20-47	11-6-47	1952	9.8	518	52.9	17	1.7	17	1.7	3.2	4444	42	6800	925	9	9
50-46-C2	6-16-52	7-1-52	1953	2.2	124	56.4	7	3.2	4	1.8	3.2	3000	52	4000	350	8	8
52-33-C6, 7	7-22-50	8-8-50	1955	3.8	211	54.1	6	1.6	6	1.6	3.0	3000	53	3850	407	8	8
32-43-C3	9-23-51	10-17-51	1956	2.9	139	48.0	4	1.4	4	1.4	2.9	1270	51	2000	360	8	8
73-57-C1	6-6-51	10-19-51	1956	3.2	192	60.0	5	1.5	5	1.5	2.5	8300	50	8800	850	10	10
79-60-C2 } 44-27-C5 }	5-21-49	6-9-49	1954	4.1	228	55.6	5	1.2	5	1.2	2.2	690	49	1200	278	8	8
39-45-C2, 3	8-10-49	9-8-49	1954	4.6	238	51.7	4	1.1	4	1.1	2.1	1830	49	2400	345	8	8
50-50-C2	No Date	No Date	1952	4.2	246	58.5	5	1.2	4	0.9	1.5	9859	44	2500	500	9	9
7-20-C6	6-2-48	8-2-48	1955	8.8	479	54.4	7	0.8	7	0.8	1.5	1160	49	700	57	8	8
14-24-C6	6-9-49	6-22-49	1953	1.2	60	50.0	1	0.8	1	0.8	1.3	2360	49	2800	420	8	8
19-41-C3, 4, 5	8-7-51	8-30-51	1956	8.9	400	45.0	5	0.6	5	0.6	1.3	5110	49	6900	1050	9	9
41-76-C1	9-8-50	9-29-50	1952	3.3	184	55.8	2	0.6	2	0.6	1.1	5490	51	6000	800	9	8
73-62-C1	8-2-51	8-17-51	1956	1.8	101	56.0	1	0.6	1	0.6	1.1	1400	51	1300	150	8	8
20-4-C3	5-14-49	6-15-49	1954	6.0	312	52.0	4	0.6	3	0.5	1.0	2400	49	3600	190	8	8
63-48-C2	5-13-50	6-8-50	1955	3.8	231	60.7	2	0.5	2	0.5	0.8	6920	50	12000 ±	1100	9	9
47-26-C8	10-18-51	3-17-52	1952	5.3	285	53.7	2	0.4	2	0.4	0.7	1230	52	1800	240	8	8
80-35-C2	7-22-50	9-29-50	1952	6.8	379	55.6	3	0.4	3	0.4	0.7	650	50	2400	350	C5	C5
31-18-C8	7-8-49	7-22-49	1954	3.1	170	54.8	1	0.3	1	0.3	0.5	2800	49	2150	240	8	8
38-48-C5	9-12-51	9-14-51	1956	2.6	120	46.2	4	0.2	4	0.2	0.4	7900	53	9000	1000	9	9
45-21-C2	7-12-49	8-16-49	1955	9.0	495	55.1	3	0.3	2	0.2	0.4	910	49	1300	170	8	8
50-51-C2U	9-24-54	5-13-55	1956	6.6	407	61.7	1	0.2	1	0.2	0.3	10500	52	5000	500	10	10
72-7-C5 } 20-4-C2 }	7-19-48	8-27-48	1954	7.9	425	53.9	1	0.1	1	0.1	0.2	1700	49	3400	310	8	8

9. Climatic conditions at time of construction, including temperature and moisture.

10. Amount of time between completion of pavement construction and opening to traffic.

11. Construction factors, such as shoulder operations, in relation to joint sealing.

Longitudinal cracks appear at various distances from the pavement edge and not necessarily over dowels. They usually develop and remain parallel to the pavement edge, extending from the joint face for only a few feet. The cracks are held tight by reinforcement. Typical examples of longitudinal cracking are shown in Figure 1.

SPALLING

Four major types of spalling at transverse joints are in evidence, which may be classified by location at the transverse joint groove, at longitudinal joints, at the pavement edge, or at the slab bottom.

At the Joint Groove

At transverse contraction joint grooves, spalling may occur whether a joint was formed by inserting a mandrel as was formerly the standard practice, or formed with styrofoam as is now customary (Fig. 2).

At Longitudinal Joints

Figure 3 illustrates typical spalling at the intersection of transverse and center longitudinal joints. This type of spalling is more prevalent than transverse joint groove spalling, and can become a serious maintenance problem.

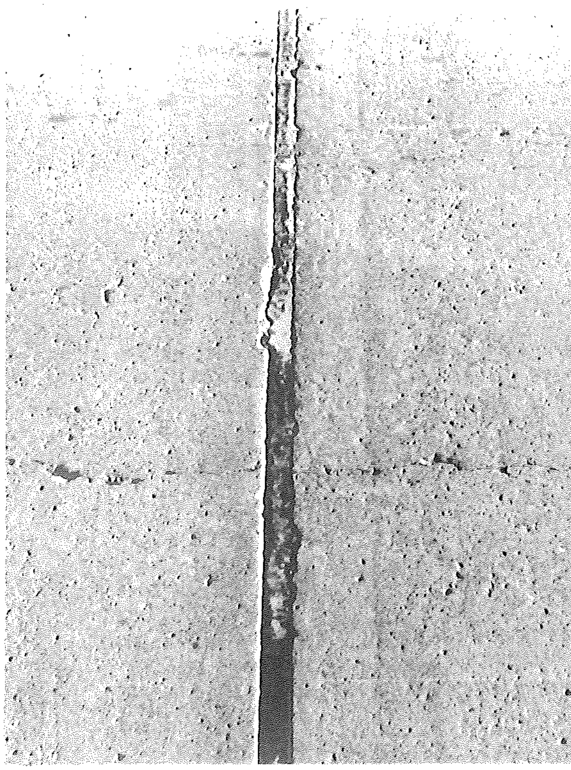
At the Pavement Edge

This common spalling type may appear to be superficial, but further examination may show a serious impairment of the structural soundness of the pavement slab, as in Figure 4. Other examples are shown in Figure 5.

Sta 201+16, Proj 47-26, C6; constr 1949 (Nov '56)

Sta 184+85, Proj 47-26, C6; constr 1948 (Nov '56)

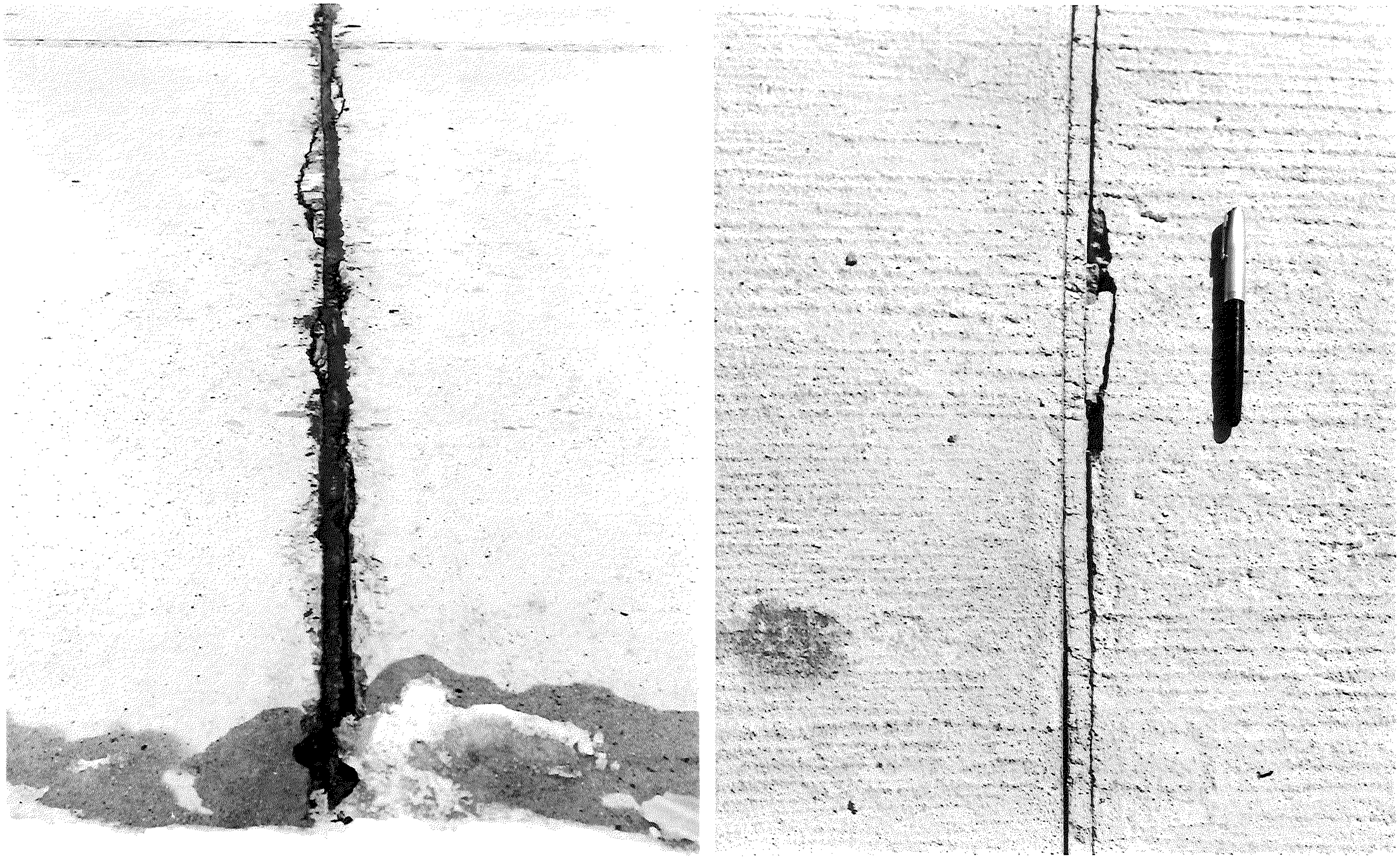
US 52 in Indiana, with 40-ft joint spacing (May '51)



Sta 16+00, Capping Proj 58-28, C1, constr 1949 (Apr '57)

Sta 298+76, Proj M 23-17, C14XI, constr 1957 (July '57) Corner cracking before opening to traffic, possibly caused by construction equipment.

Figure 1. Typical longitudinal cracking.



Sta 1611+15, Proj 32-48, C2; constr 1953 (Feb '59)

Sta 551+40, Proj 38-7, C5; constr 1955 (Aug '55)

Figure 2. Spalling at groove edges of transverse contraction joints formed by inserting a mandrel (left) or styrofoam strips (right).

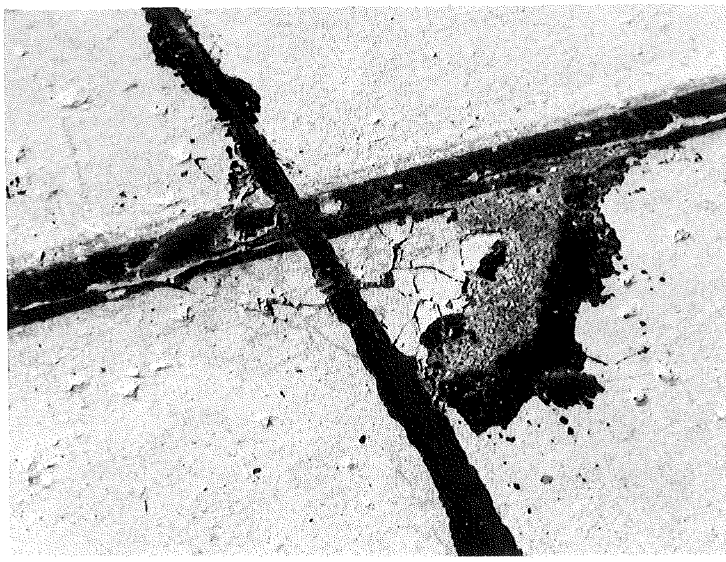


Figure 3. Typical spalling at intersecting transverse and longitudinal joints. Sta 76+13; Proj 28-38, C2; constr 1948 (July '56)

Figure 4. Surface appearance of a pavement edge spall (top), with view of same joint after removal of spalled concrete (bottom). Sta 1016+83, Proj 39-40, C4; constr 1954 (Nov '54)

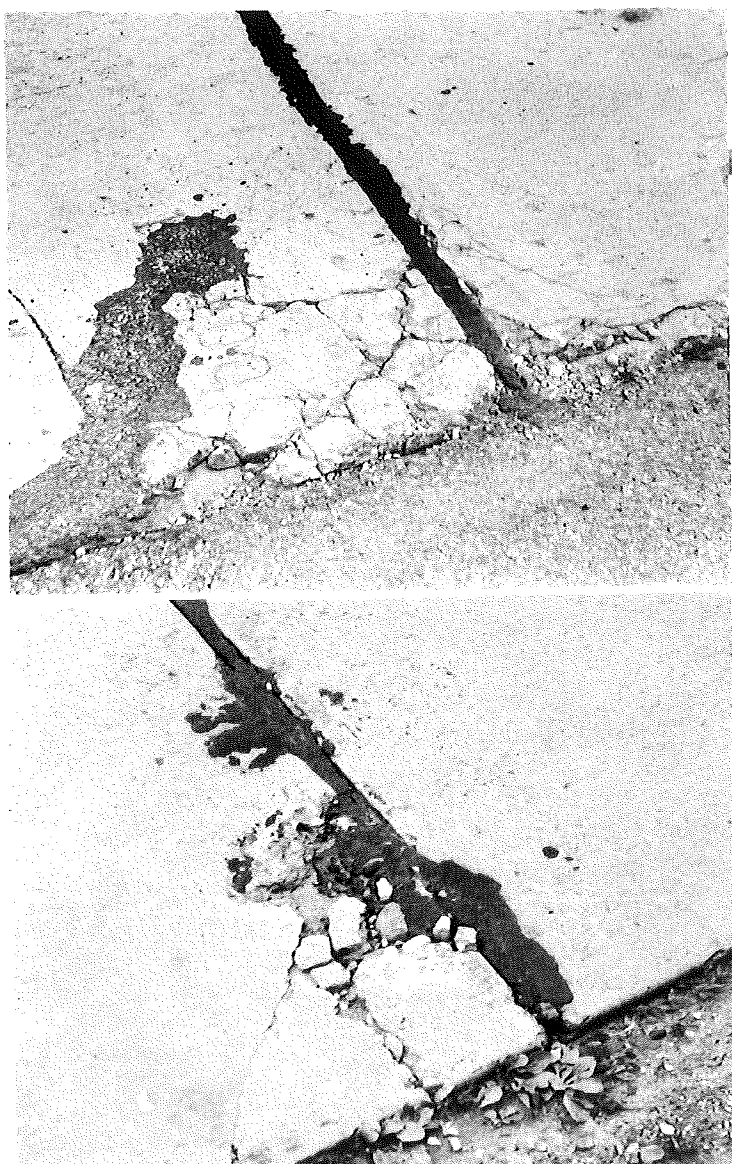


Figure 5. Surface appearance of two pavement edge spalls on a 10-year-old project. Proj. 17-7, C6; constr 1947 (Sept '57)

At the Slab Bottom

Examination of several projects has revealed serious spalling at the bottom edges of slabs at transverse contraction joints. This spalling condition has several aspects, a few of which are illustrated in Figure 6. In most cases, this condition may exist for some time without affecting the normal appearance of the slab surface, and thus escape detection.

CONCRETE "BLOW-UP" FAILURE

Typical failures of the pavement slab at transverse joints, notably at construction joints, may be classed in two major categories: 1) general and gradual crushing or deterioration of the concrete at one side or both sides of the joint, and 2) spalling along the joint followed by sudden shattering of the concrete usually accompanied by slipping of one slab over the adjacent slab or by vertical lifting of the two abutting slab ends.

Experience indicates that blow-ups generally occur in postwar pavements at the age of about 8 years, as compared to 15 years for prewar pavements. This notable difference in blow-up experience for the pavements constructed in the two periods may be attributed to the purposeful omission of expansion joints since 1945.

Examination of many blow-up cases clearly indicates that in most, some construction factor triggered the incident, such as misalignment of dowels, faulty dowel baskets, inferior concrete at construction joints, faulty placement of steel reinforcement, frozen dowels, or the strength factor of the concrete itself being insufficient to resist normal compressive pressures. Figure 7 illustrates four typical stages in the development of this type of joint failure, at four locations on a 10-year-old project. Briefly, the first manifestation of weakness is the occurrence of a major spall somewhere along the joint, followed by more general spalling, then by complete spalling along the joint, and eventually by removal of the completely shattered concrete for traffic safety and local patching.

Ten-year surveys of selected projects constructed in 1946 and 1947 have indicated the relative frequency with which blow-ups have occurred (Table 2).

Sta 1067+81, Proj 39-40, C4; constr 1953 (Oct '56)

Sta 876+00, Proj 39-40, C4; constr 1953 (Apr '57)

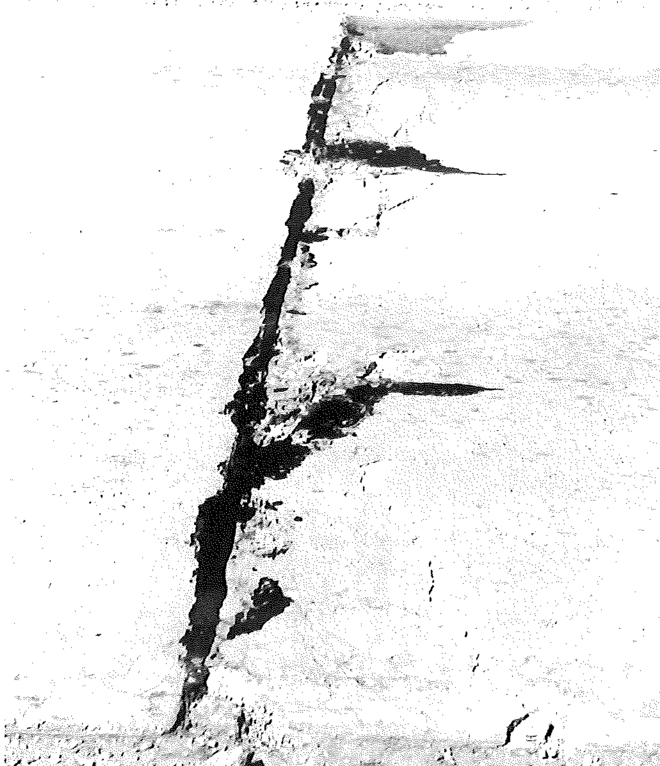
Sta 262+25, Proj 72-7, C5; constr 1947 (Nov '54)

Sta 207+09, Proj 47-26, C6; constr 1948 (Nov '56)

Figure 6. Slab bottom spalling at four joints, exposed by excavating; pavement ages of 3, 4, 7, and 8 years.

1. Sta 499+25

2. Sta 517+42



3. Sta 498+25

4. Sta 496+25

Figure 7. Typical steps in concrete "blow-up" failure: 1) initial spall, 2) progressive spalling, 3) concrete breakdown along the transverse joint, and 4) removal of crushed concrete for local patching. Note typical failure along only one edge of the joints in this 10-year-old pavement. Project 72-7, C5; constr 1947 (May '57).

TABLE 2
BLOW-UP FREQUENCIES ON 10-YEAR-OLD PAVEMENTS

1946 Projects		1947 Projects	
Number of Blowups	Number of Projects	Number of Blowups	Number of Projects
0	4	0	20
1	2	1	4
4	1	2	5
Total	7	4	3
		5	1
		7	1
		12	1
		Total	35

DOWEL BAR ASSEMBLIES

The use of inferior or imperfect dowel assembly devices in the past has complicated the joint failure picture. Assembly devices which do not hold the dowels securely in place permit the entire assembly of dowels to push upward, splitting the slab at the plane line of the dowels as shown in Figure 8; note how the entire assembly of dowels has moved vertically out of the dowel holding clips. Further, dowel assemblies incapable of holding the dowels firmly in place during placing of concrete can also cause trouble (Fig. 9). Finally, misplacement of dowel assemblies can cause joint failures (Fig. 10).

DOWEL BAR CORROSION

The extent to which dowel corrosion may influence joint failures has been difficult to determine; however, evidence gained from examining joint failures indicates that this factor may have had considerable effect in certain cases (Figs. 11 and 12).

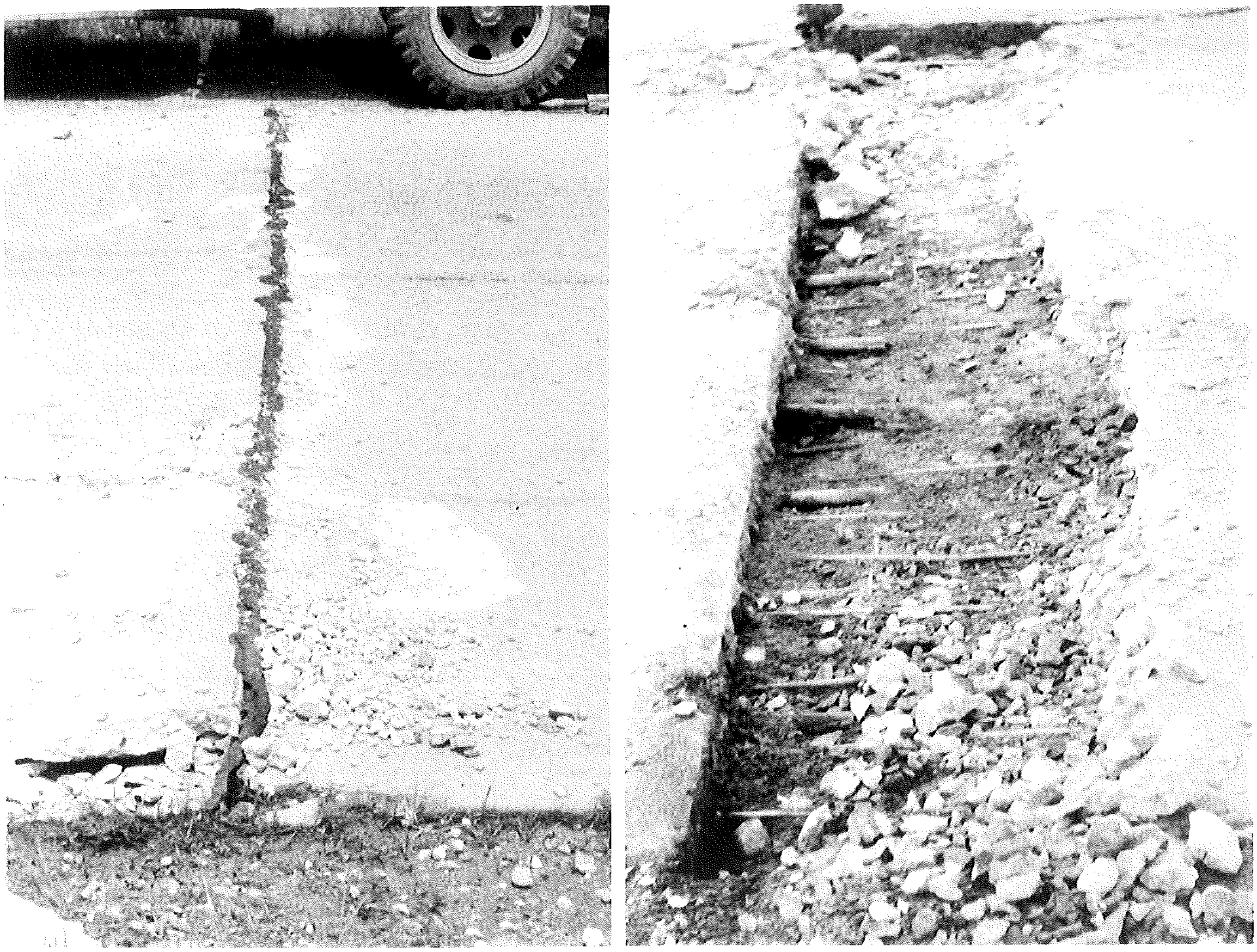


Figure 8. Joint failure in which dowel assembly device pushed upward, splitting the slab (left), with view after removal of overlying concrete (right). Proj 38-48, C5; constr 1952 (June '57).

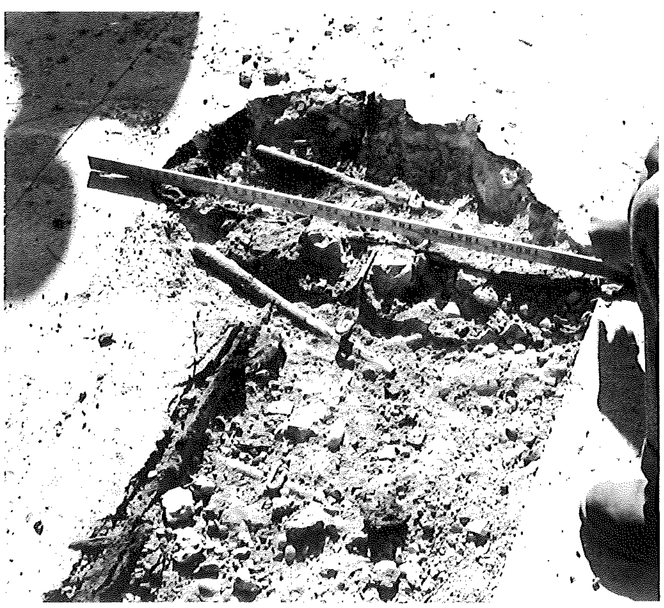


Figure 9. Dowel misalignment during concrete placement, due to inability of assembly to hold dowels in place. Sta 56+27, Proj 63-67, C4; constr 1947 (Oct '52)

Figure 10. Blow-up at joint with dowels and bar assembly too close to surface. Sta 297+22, Proj 72-7, C5; constr 1947 (Nov '54)

Figure 11. Corroded dowel bar taken from joint shown in Fig. 8, recovered after about 5 years in pavement.

Figure 12. Corroded dowel in place in 9-year-old pavement. Sta 496+25, Proj 72-7, C5; constr 1948 (May '57).

CONSTRUCTION JOINTS

Numerous failures occur at night construction joints. Two primary factors are involved, variation in the quality of separate concrete pours and dowel misalignment.

First, invariably it seems that the concrete placed at the end of a day's run is inferior to that placed at the beginning of the next day's pour. This weakness is not so easily discernible in the case of air-entrained concrete, but eventually when a failure does occur at a construction joint, concrete in the slab at the end of the previous day's pour almost always fails first.

The visible difference in concrete quality for separate pours is demonstrated in Figure 13, which shows both air-entrained and non-air-entrained pavements. On concrete without air entrainment, the difference in concrete quality is usually more pronounced.

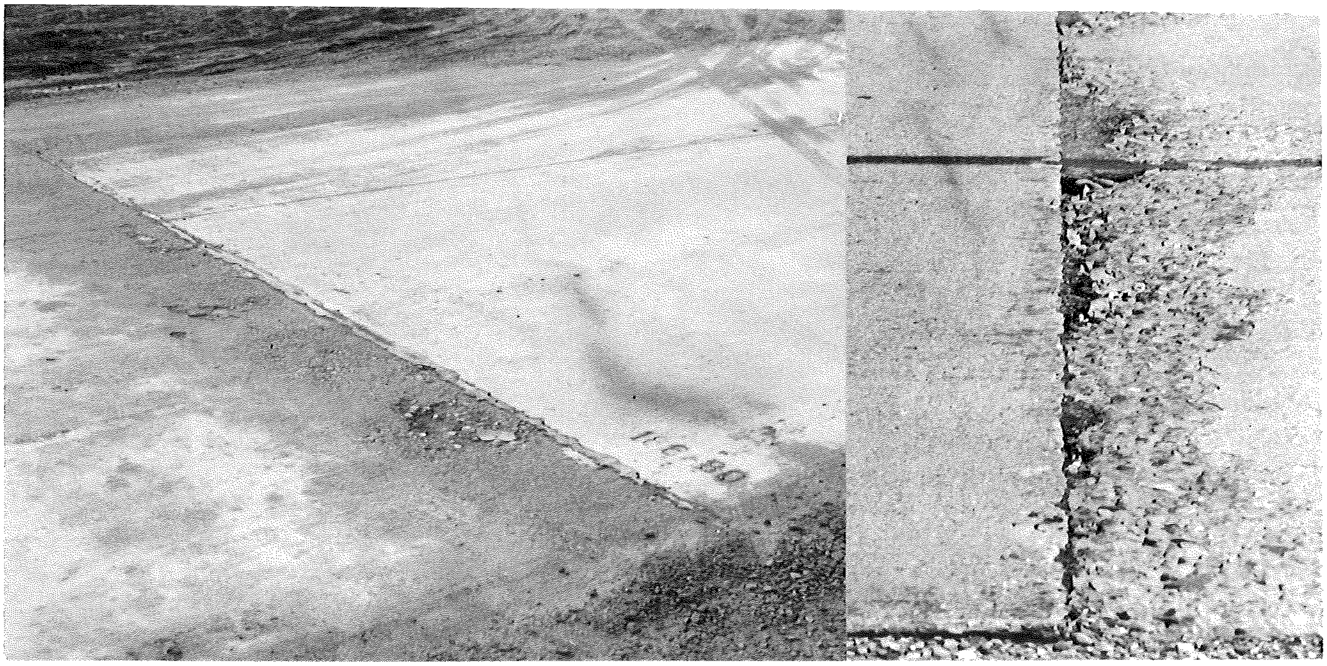
Second, the misalignment of dowels at a construction joint often triggers a joint failure. Examples of poor dowel installations at construction joints are illustrated in Figure 14.

COMPRESSION CRACKING

The causes of compression cracking are unknown, but this phenomenon may be associated with the physical properties of the concrete in relation to faulty joint construction and high-concentration compressive stresses. Figure 15 shows compression cracking parallel to two transverse joints, at early and advanced stages of development.

TRANSVERSE JOINT CONSTRUCTION

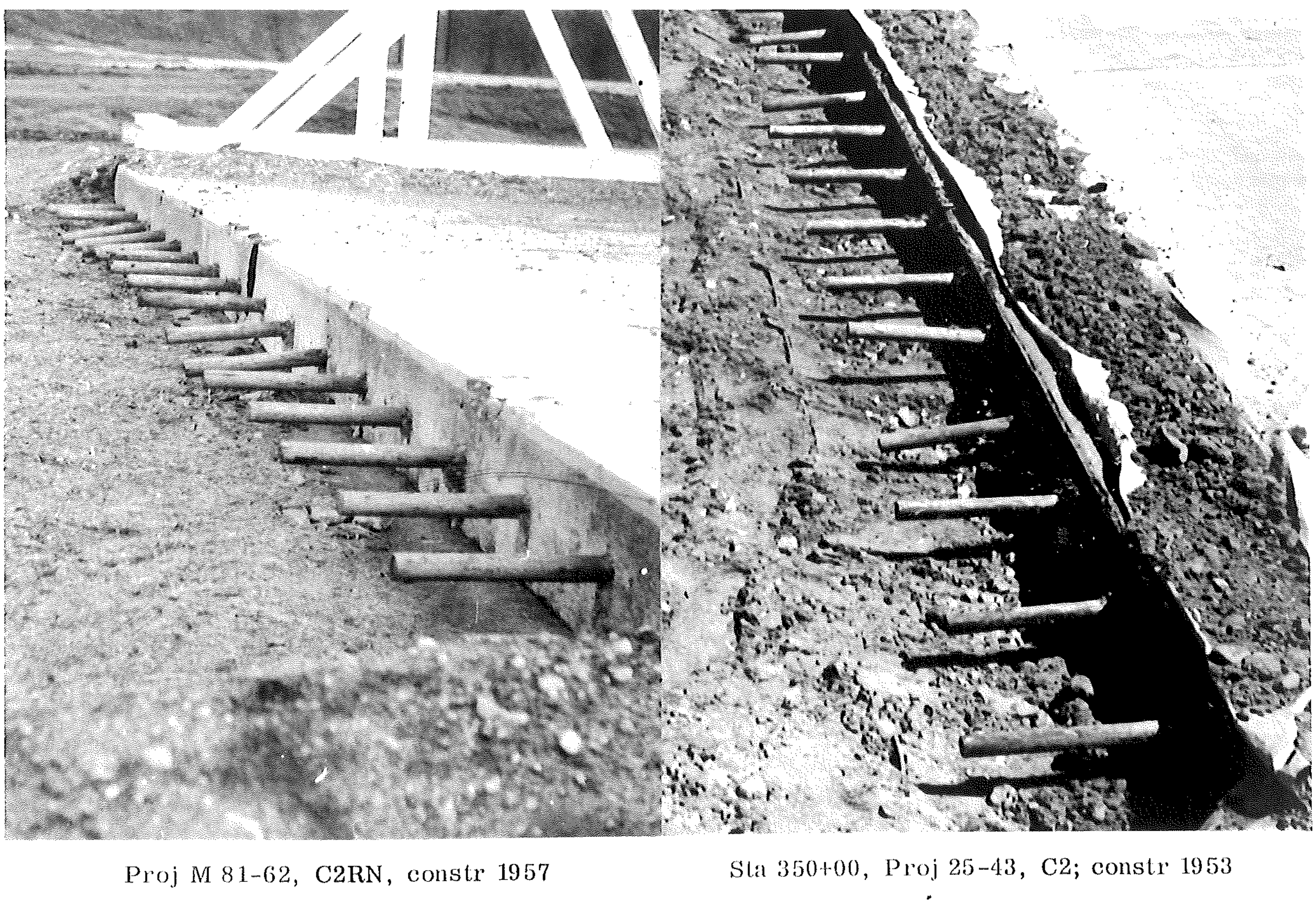
With the advent of styrofoam strips to form weakened planes for transverse joints, it is now the practice not to seal joints until all the shoulder work has been completed. Formerly, joints were sealed before any traffic or grading started. The new practice may have certain undesirable features which should be considered.



Sta 186+80, Proj I 9-15, C7N & C8R; constr 1955 (Dec '55)

Sta 789+42, Section 1C Mich. Test Road (M 115) constr 1940.

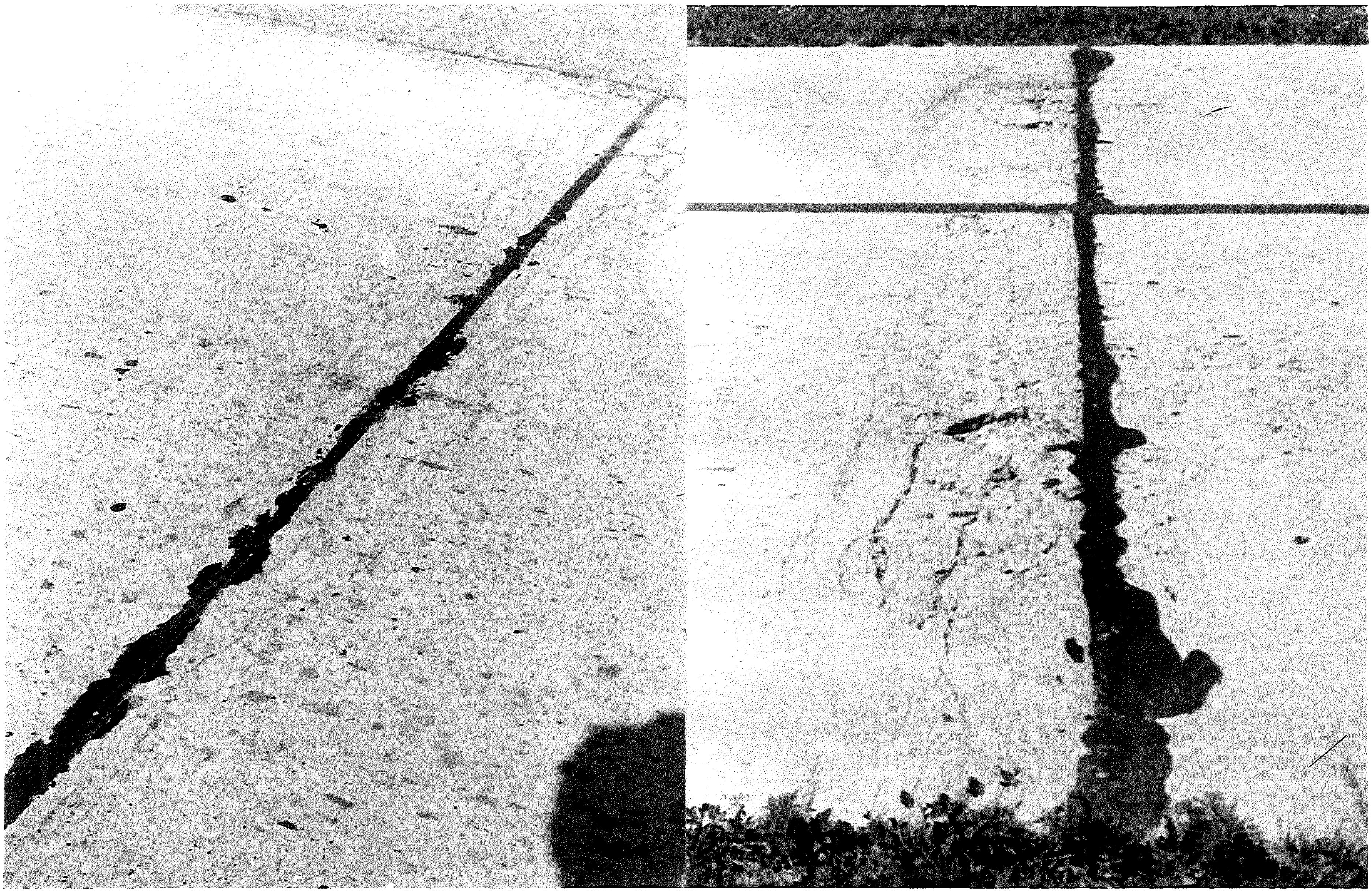
Figure 13. Views of construction joints, showing different concrete qualities of two day's pours, in air-entrained pavement (left) and non-air-entrained pavement (right).



Proj M 81-62, C2RN, constr 1957

Sta 350+00, Proj 25-43, C2; constr 1953

Figure 14. Typical dowel misalignment at construction joints on two projects.



Proj 28-38, C2; constr 1948 (July '56) Sta 214+94

Project 73-30, C4; constr 1947

Figure 15. Compression cracking at two joints, at early (left) and advanced (right) stages of development.

An example of what can take place is shown in Figure 16. Soil material filtering in between the slab and base plate, or compacting within the joint crack, or collecting in the joint groove, under proper circumstances could induce early joint spalling at the pavement edge and so-called longitudinal restraint cracking.

JOINT SEALING

The performance of specification rubber-asphalt joint sealers is not up to expectations. Typical failures for three types of joint sealers are illustrated in Figure 17.

Theoretical considerations, backed by recent field and laboratory studies by outside agencies, definitely indicate that in order to seal a joint at all adequately with specification materials, the joint groove width should be established on the basis of slab length, and the depth of sealer should be approximately equal to the joint width.

The graph in Figure 18 shows the effect of slab length on contraction joint opening, based on Michigan data. This graph clearly shows that present contraction joints can be expected to open as much as 0.50 in. under extreme temperature conditions.

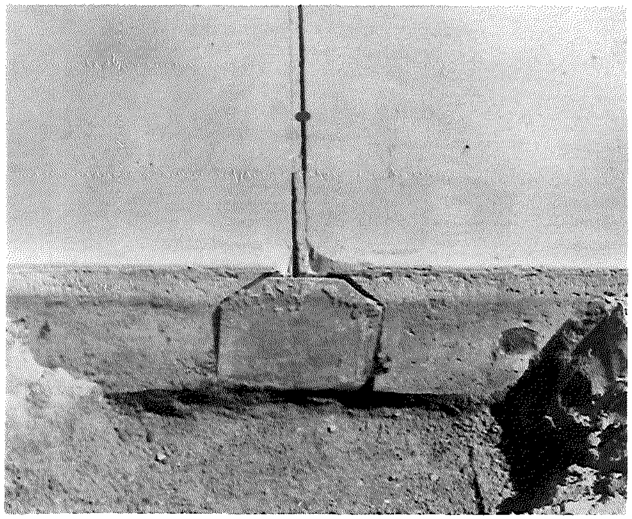
Tons[1] reports that the maximum strain, S_{max}, of hot-poured rubber-asphalt sealers is 120 percent. S_{max} is the increase in length of a line in the surface of the sealer in a plane normal to the joint edge when the sealer is extruded. S_{max} for different joint widths and joint depths, based on a contraction joint opening of 0.5 in. is given in Table 3.

Measurements of joint width openings on several experimental pavements in Michigan indicate that under normal conditions, joint width movements of around 0.2 to 0.3 in. may be expected. Considering this fact in conjunction with the data above, it is indicated that the formed joint opening should be 3/4-in., instead of 1/2-in. as now constructed.

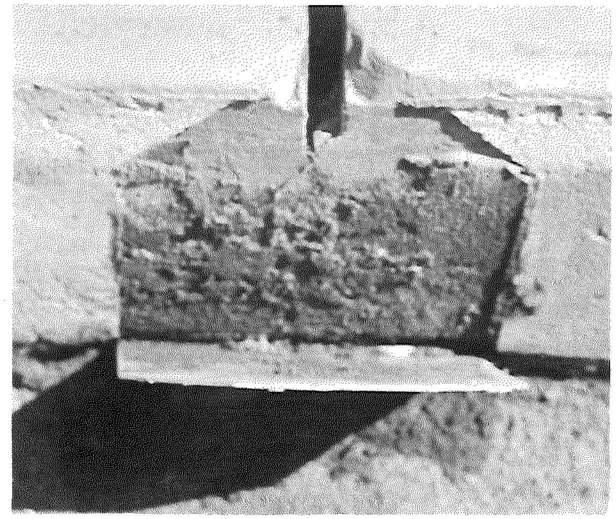
The data in Table 4, based on a New York State experimental project and reported by HRB Committee D-3, shows that better performance was obtained when the depth of sealer was approximately half the formed joint width.

---

1 Tons, Egon, "A Theoretical Approach to Design of a Road Joint Seal." HRB Bull. 229, pp. 20-53 (1959).



The shoulder face of a transverse joint was excavated.

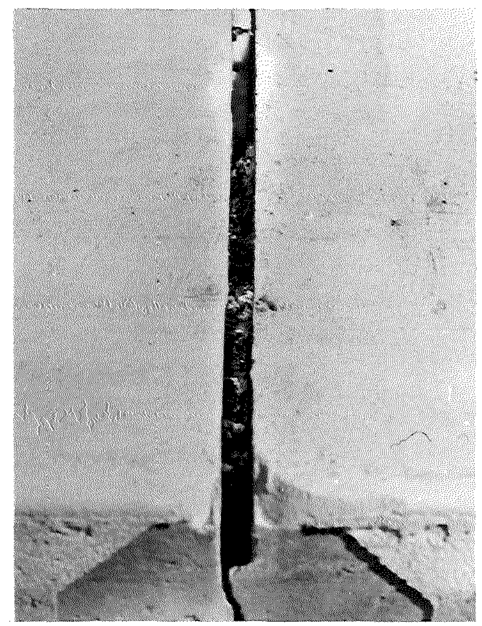


The steel end plate was turned down, revealing a deposit of packed fine sandy soil.

When this excess soil was removed, additional compacted soil was found in the joint crack.

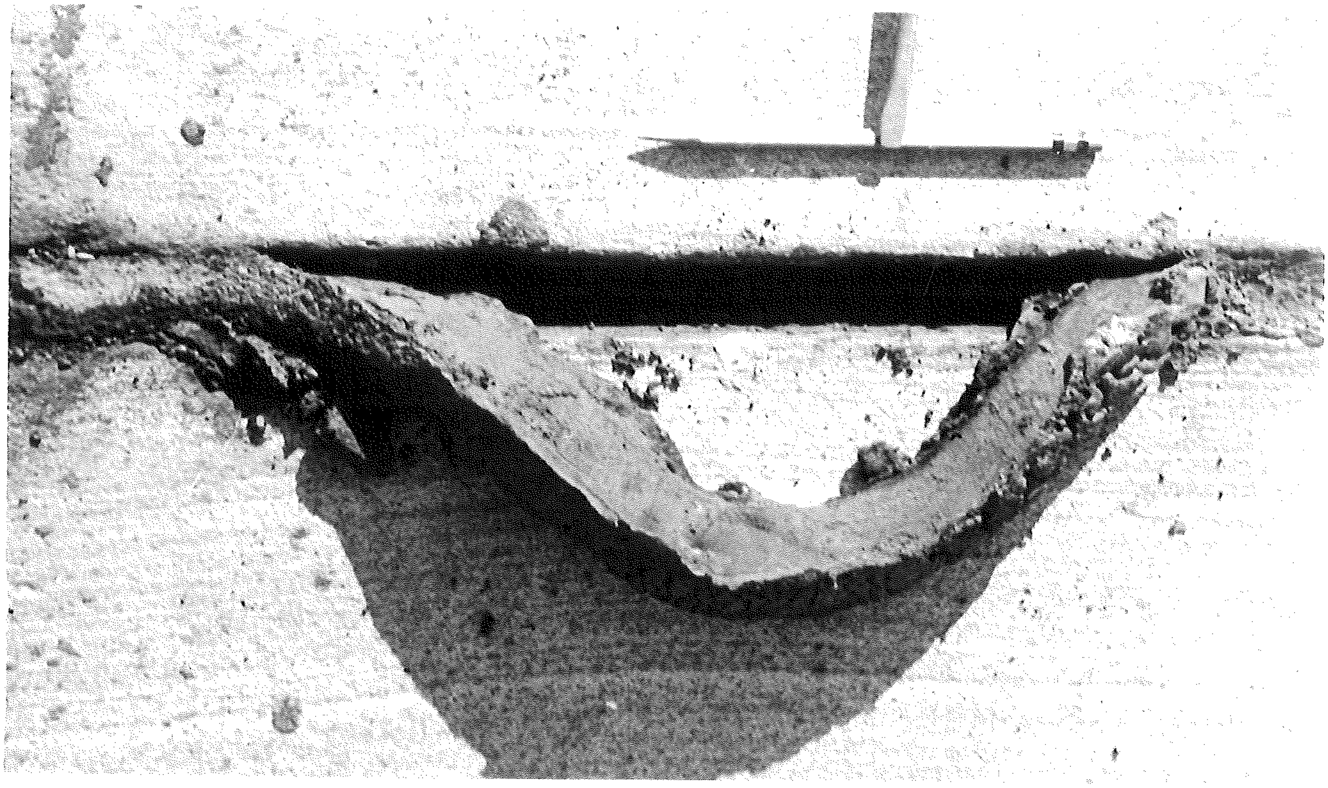
The base plate was found to be depressed, and the space between the plate and slab filled with fine soil.

The joint crack after removal of soil material near the slab edge.

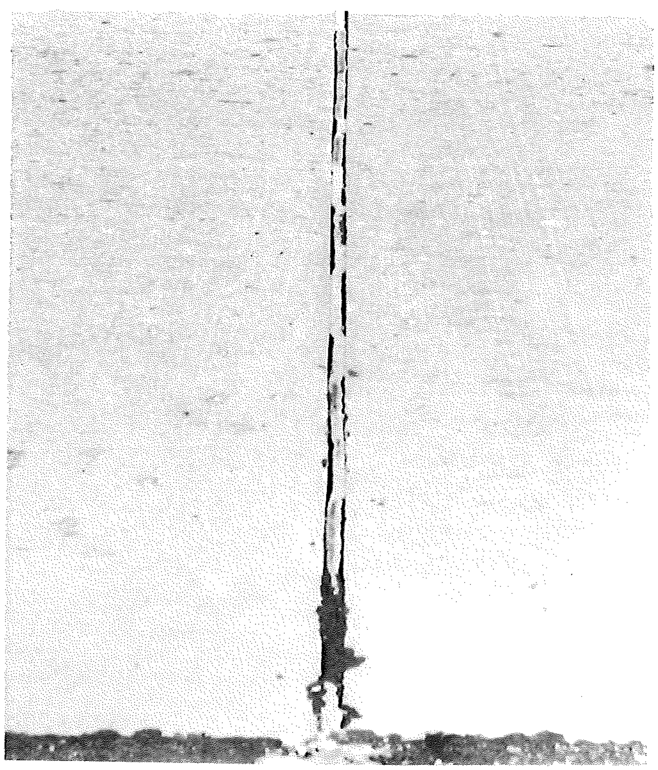


Additional material was found to have filtered in around the styrofoam material in the joint groove.

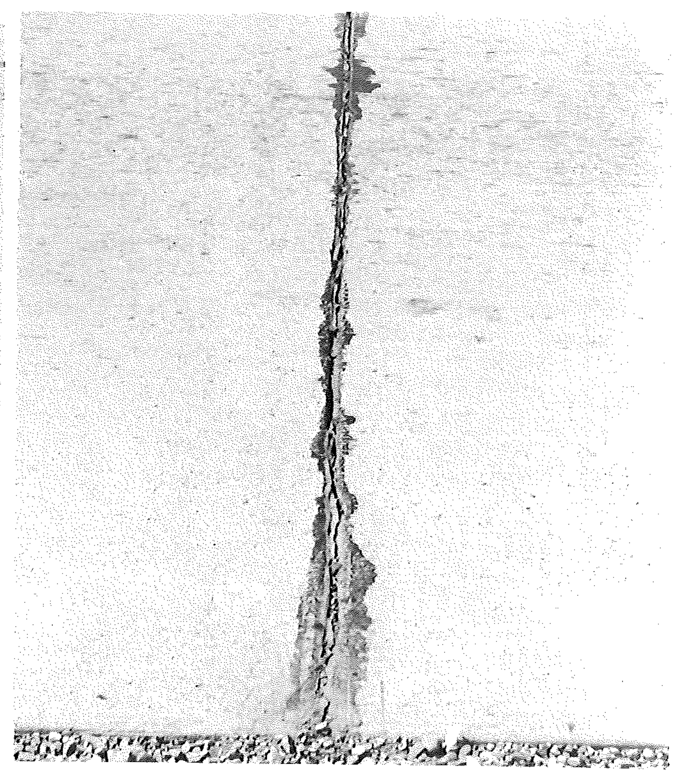
Figure 16. Examination of a joint ready for sealing on a new project.
Sta 298+76, Proj 23-17, C14RN; constr 1956.



Sta 328+10, Proj 38-7, C5; constr 1955 (Feb '56)



Sta 436+73, Proj 23-17, C14; constr 1956 (Mar '58)



Sta 421+57, Proj 23-17, C14; constr 1956 (July '58)

Figure 17. Typical failures of a two-component cold-pour sealer, PRC (left), of a normal hot-pour rubber asphalt sealer (above) and a single component cold-pour sealer (right).

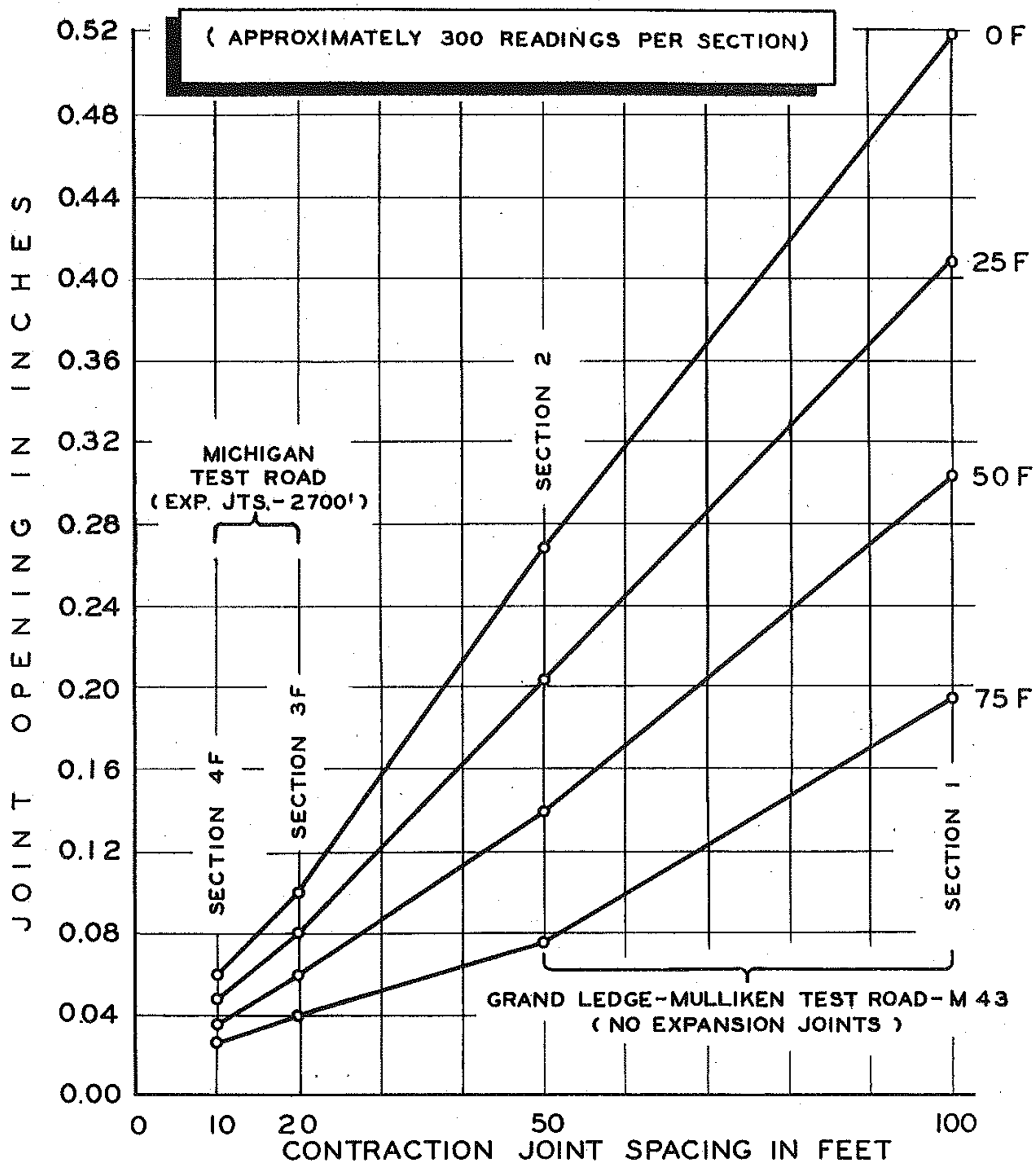


Figure 18. Effect of Slab Length on Contraction Joint Opening

TABLE 3
MAXIMUM STRAIN VALUES

Joint Width inches	Joint Depth inches	H* inches	S_{max} percent
1/2	2.00	0.75	275
3/4	2.00	0.60	140
3/4	1.65	0.50	120
3/4	1.00	0.30	80

H = depth of "necking" or curve-in line of surface

TABLE 4
EFFECT OF DEPTH OF SEALER ON PERFORMANCE
New York Experimental Project
HRB Committee D-3

		40-ft slabs
1/2 by 1/2-in.	joint about	4% failed in adhesion
1/2 by 1 in.	"	25% "
1/2 by 2 in.	"	76% "
3/8 by 1/2 in.	"	15% "
3/8 by 1 in.	"	30% "
3/8 by 2 in.	"	67% "
1/4 by 1/4 in.	"	Uncertain (not enough material in joint)
1/4 by 1/2 in.	"	37% failed in adhesion
1/4 by 1 in.	"	50% "
1/4 by 2 in.	"	74% "
		80-ft slabs
1/2 by 1/2 in.	"	60% failure
1/2 by 1 in.	"	75% "
1/2 by 2 in.	"	95% "