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MICHIGAN
STATE HIGHWAY DEPARTMENT
Charles M. Ziegler
State Highway Commissioner

PROGRESS REPORT
NEOPRENE PREMOLDED JOINT SEAL STUDY
Construction Project F 54-15, C4

Research Project 36 G-4 (3H)

Progress Report No. 2

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Research Laboratory
Testing and Research Division
Report No. 161
June 20, 1951

NEOPRENE PREMOLDED JOINT SEAL STUDY

This is the first progress report covering the experimental Neoprene Premolded Joint Seal Installation made on construction project F 34-15, C4, Route M-66 in October 1949. Complete details of the installation have been covered in Research Laboratory Report No. 139, dated November 15, 1949 and will not be repeated here. A reference map is given in Figure 1.

Since installation of the joints, two field inspections have been made by Messrs. B. W. Pocock and W. Martin of the Research Laboratory, the first on August 11, 1950 and the latest on June 7, 1951. The results of these two surveys are included in this report.

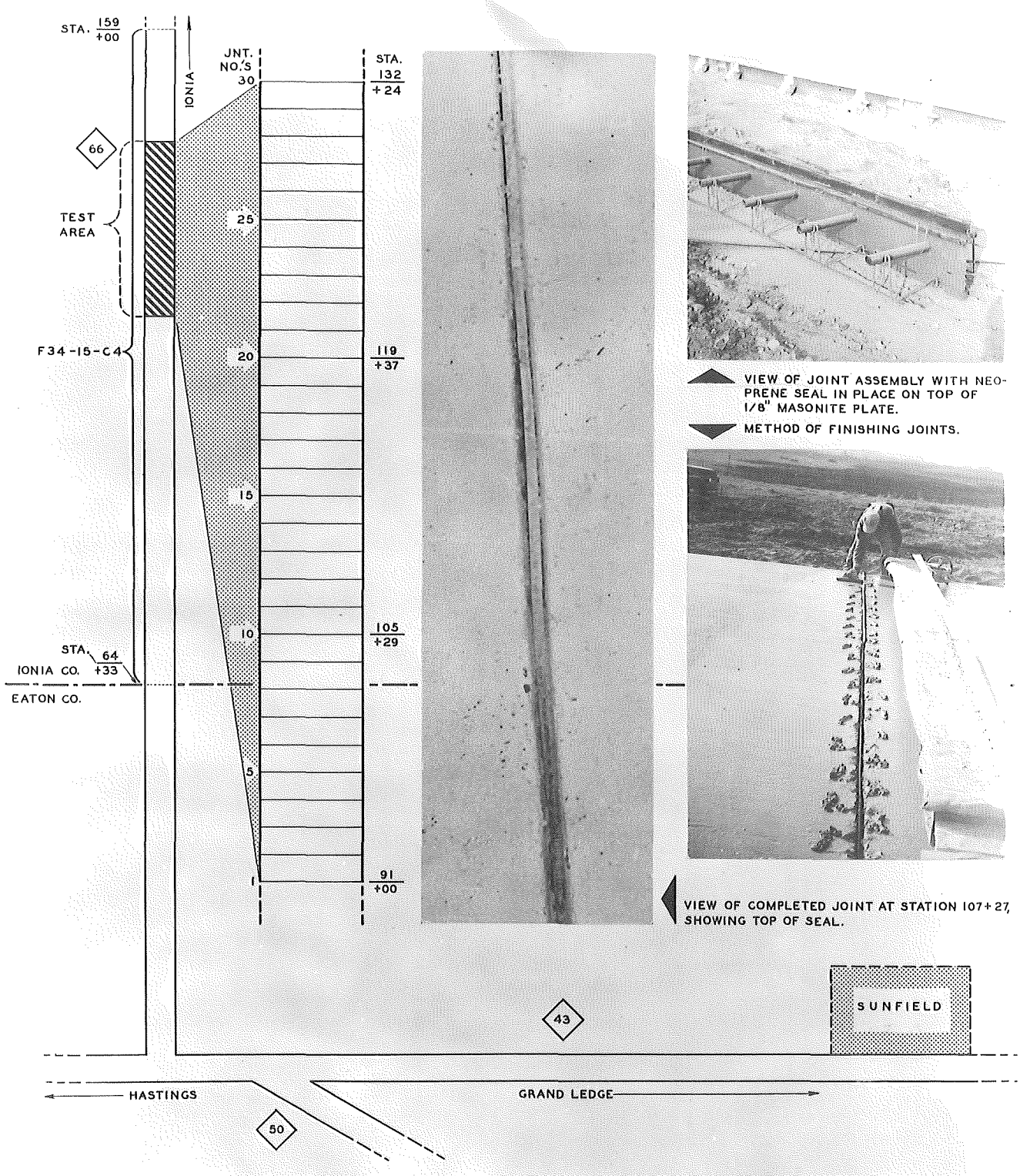
CONDITION OF JOINTS ON AUGUST 11, 1950

Inspection on August 11, 1950 at the age of 10 months disclosed that although many of the joints were in excellent condition, considerable spalling of the concrete surface at certain joints had occurred, principally at the contraction joints located in the south half of the test area. The accompanying photographs in Figure 2 illustrate the nature of the most severe cases of spalling. Complete data on joint spalling are presented in Table I.

All joints were tightly closed with the exception of one (Station 117+39), which was open 1/16 inch at the top. This joint marked the end of a day's pour.

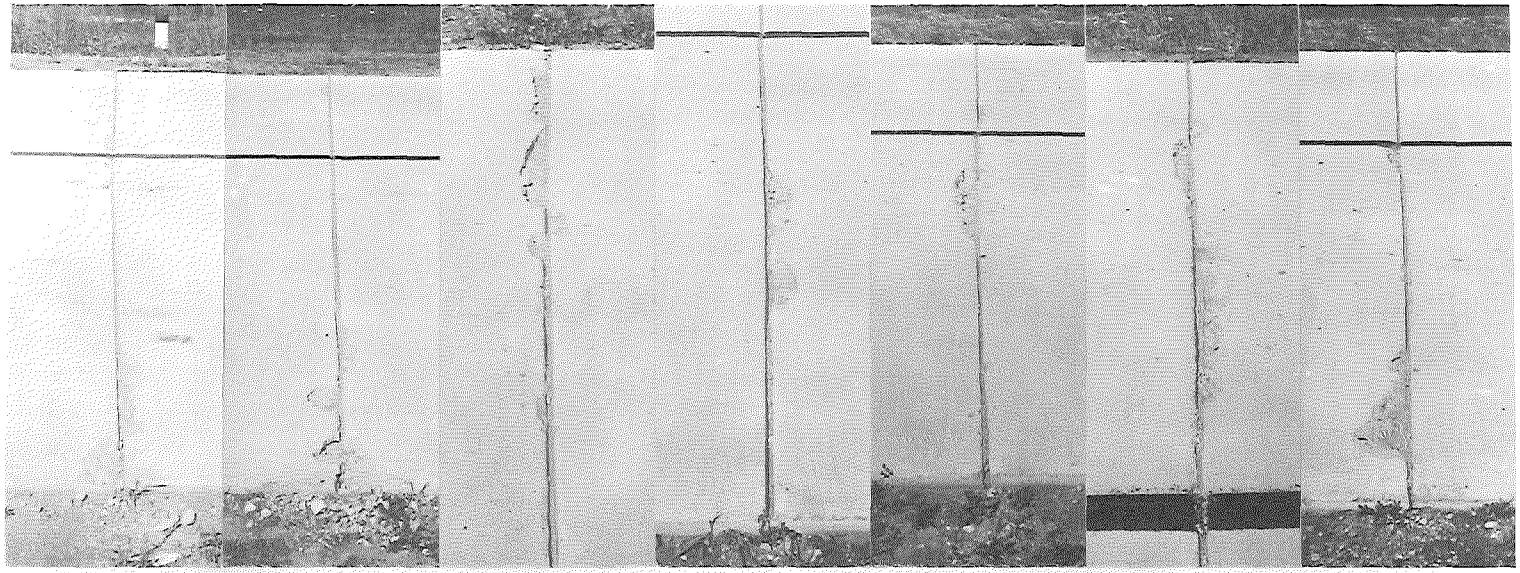
In general, the following observations were made:

1. The joints where the neoprene sealing strips were more than 1/4 inch below the pavement surface were filled with sand, dirt, stones and miscellaneous debris, otherwise the joints were clean.



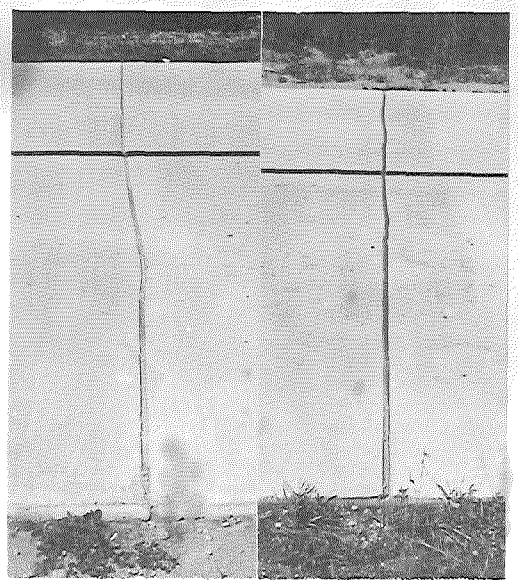
NEOPRENE PREMOLDED JOINT SEAL INVESTIGATION

FIGURE 1



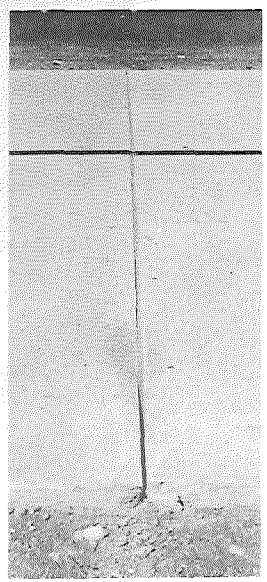
STATION: 91+00 | 95+95 | 101+33 | 103+31 | 104+30 | 109+25 | 113+21
JOINT NO. 1 | 5 | 7 | 8 | 9 | 13 | 16

TYPICAL SPALLING AT JOINTS



TYPICAL CONDITION OF NEOPRENE SEALED JOINTS WITH SPALLING.
NOTE WAVINESS OF JOINTS.

WHEN SEAL WAS INSTALLED LOW
JOINTS FILLED WITH SOIL MATERIALS



STATION: 116+18 | 127+29
JOINT NO. 8 | 26

94+96
4

EXAMPLES OF JOINT CONDITION
AGE: 10 MONTHS

FIGURE 2

TABLE I

SUMMARY OF JOINT CONDITION DATA, AUGUST 1950, AGE 10 MONTHS

Joint No.	Station	Condition in Respect to Spalling
1	91+00	Spalling about 50% of joint
2	91+99	Moderate spalling; east half.
3	92+98	Moderate spalling; west half.
4	94+96	Small area of spalling, west half.
5	95+95	Spalling: both ends.
6	96+94	Spalling east end only.
7	101+33	Bad spalling, west half.
8	103+31	Spalling, east half.
9	104+30	Bad spalling both sides.
10	105+29	Spalling, center.
11	107+27	No spalling.
12	108+26	No spalling.
13	109+25	Bad spalling; west half.
14	111+23	No spalling.
15	112+22	No spalling
16	113+21	Spalling, east half and center.
17	115+19	Slight edge spalling, east half.
18	116+18	No spalling.
19	117+39	No spalling
20	119+37	Slight edge spalling, west lane.
21	120+36	No spalling
22	121+35	No spalling
23	123+33	No spalling
24	124+32	No spalling
25	125+31	No spalling
26	127+29	No spalling
27	128+28	No spalling
28	129+27	No spalling
29	131+25	No spalling
30	132+24	Slight spalling center

2. Fifteen of the thirty joints installed were in excellent condition after 10 months, the other fifteen joints displayed spalling in varying degrees.

3. Spalling of the pavement surface at contraction joints was distributed irrespective of lane or direction of traffic.

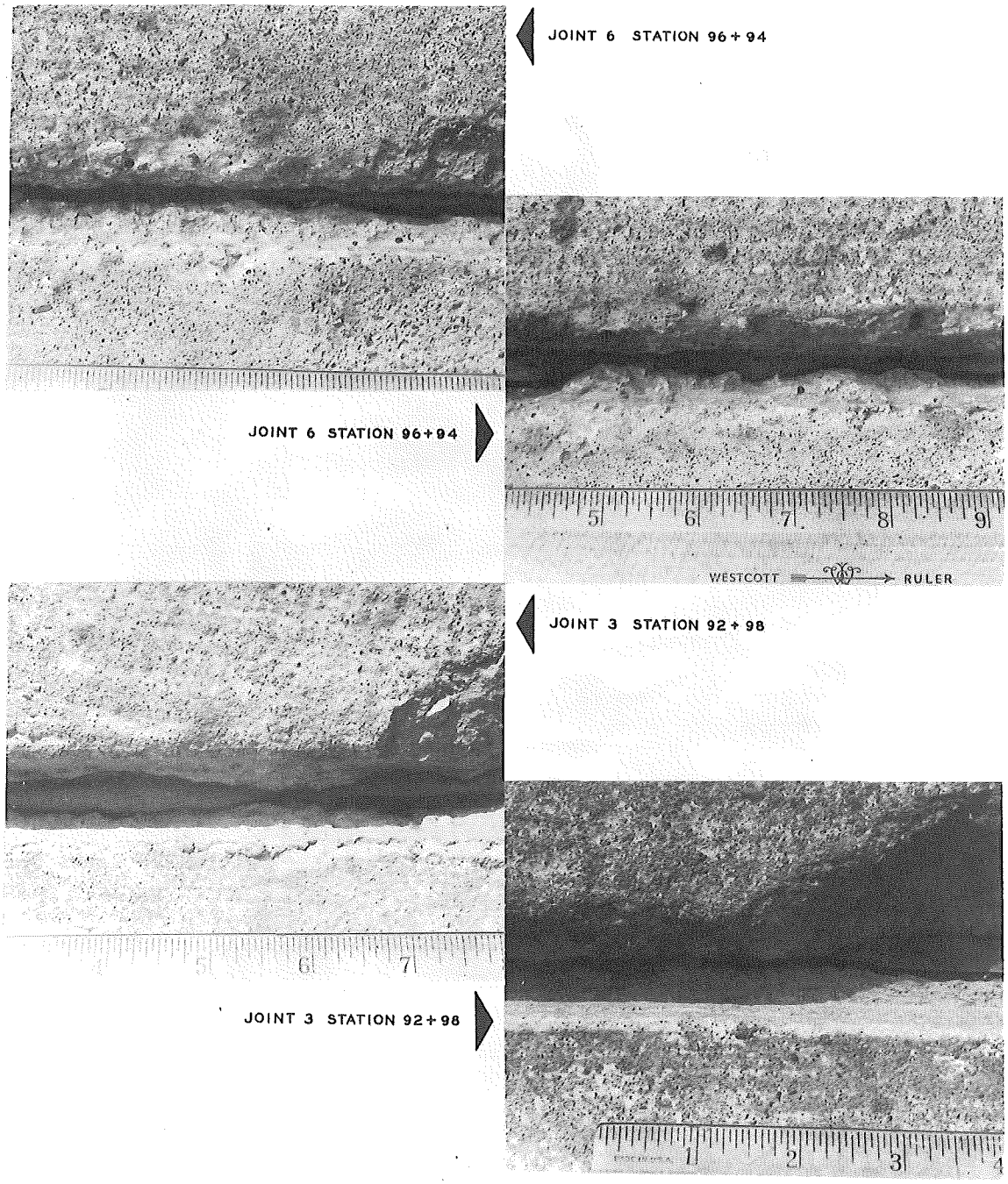
4. In general, spalling was confined to contraction joints in which the neoprene seal had been installed particularly low, although not all such joints showed spalling.

5. The following summary expresses conditions after 10 months:

Condition of Joint	Number of Joints Involved
Excellent	15
Spalling, both lanes	3
Spalling, east lane	4
Spalling, west lane	5
Spalling, center	3

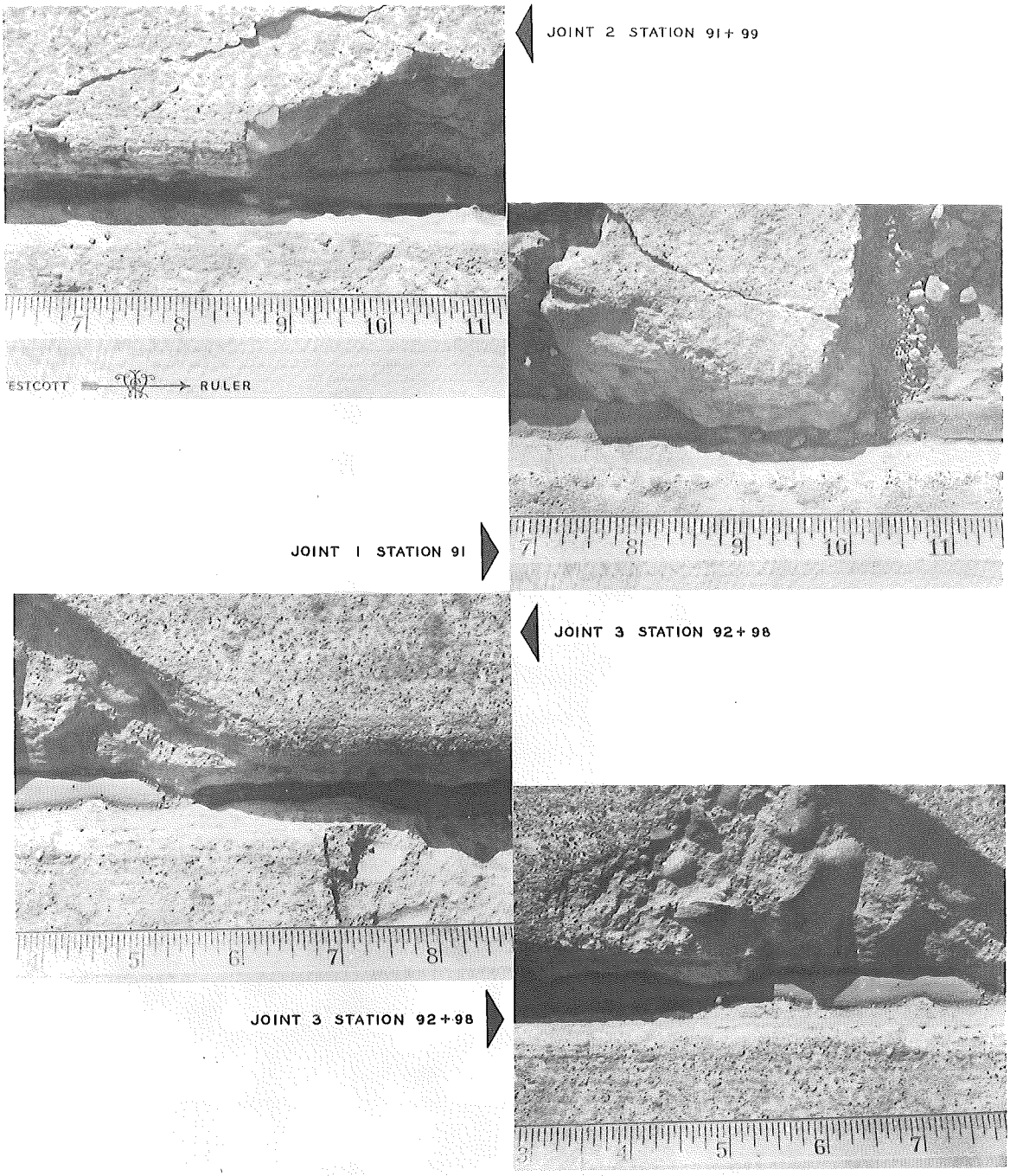
Conditions Incident to Spalling:

The photographs in Figures 3, 4, and 5 show typical joint conditions contributory to spalling. In many instances where the neoprene seal was installed below the surface of the pavement the concrete above the seal was not entirely removed by the concrete finishers, as may be seen in Figure 3, thus allowing a complete or partial bridge of concrete to harden over the seal. In the case of a partial bridge, such as shown in Figure 3, there is still ample clearance between joint faces to permit horizontal and vertical movement of slab ends without causing spalling, but in spite of this, spalling has occurred evidently due to high tensile stresses imparted to the concrete lip at the joint edge by passing wheel loads. Typical cases of this type of joint spalling are shown in Figure 4 where it is evident that the overhanging lip of concrete at the joint edge breaks off and is eventually displaced by traffic.



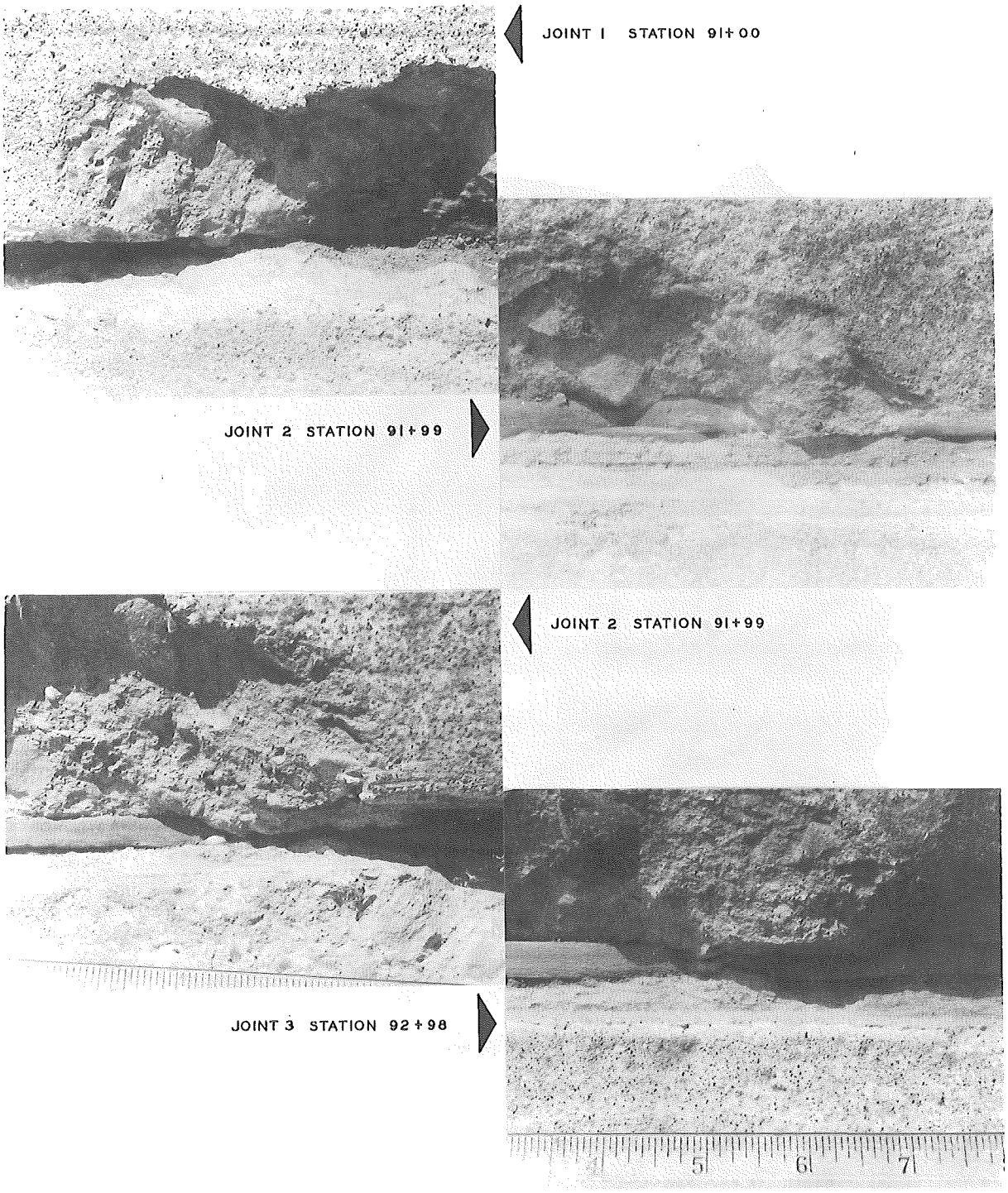
EXAMPLES OF JOINT EDGE CONDITION WHERE NEOPRENE SEAL WAS PLACED BELOW SURFACE OF CONCRETE

FIGURE 3



CHARACTERISTIC SPALLING OF JOINT EDGES WHEN NEOPRENE SEAL IS PARTIALLY BRIDGED BY CONCRETE

FIGURE 4



CHARACTERISTIC SPALLING AT JOINT EDGES WHERE CONCRETE COMPLETELY COVERS NEOPRENE SEAL

FIGURE 5

In those cases where the concrete completely bridges the neoprene seal, spalling invariably occurs when the joint is under high compression, as illustrated in Figure 5.

CONDITION OF JOINTS ON JUNE 7, 1951

A more recent inspection was made on June 7, 1951, 20 months after installation. Data pertaining to depth of seal, linear extent of spalling, and prevalence of resonance on percussion of the concrete surface adjacent to the joints are given in Table II. In addition, photographs presented in Figure 6 illustrate two bad conditions of spalling encountered on the June 1951 survey.

From a close examination of the two spalled areas shown in Figure 6, it was evident that the cause of spalling in each of the two cases was different. In the case of Joint 26 at Station 127+29 the Neoprene seal was found to be tipped uniformly throughout the entire lane width as much as 1/2 inch from the vertical. This was caused probably by the finishing machine during construction. We know from experience that spalling at joint edges will inevitably result wherever premolded joint materials are not installed vertically in the joint. See insert in Figure 6A.

It is indicated that the spalling at Joint 19 Station 117+39 was caused by a localized pressure condition due to impacted dirt within the joint, as illustrated by insert in Figure 6B. There was evidence that considerable fine sand and inert material has become lodged in the joint between the concrete joint face and the Neoprene seal material. This infiltration of inert material probably started when the slabs were fully contracted during the winter time and gradually built-up and solidified

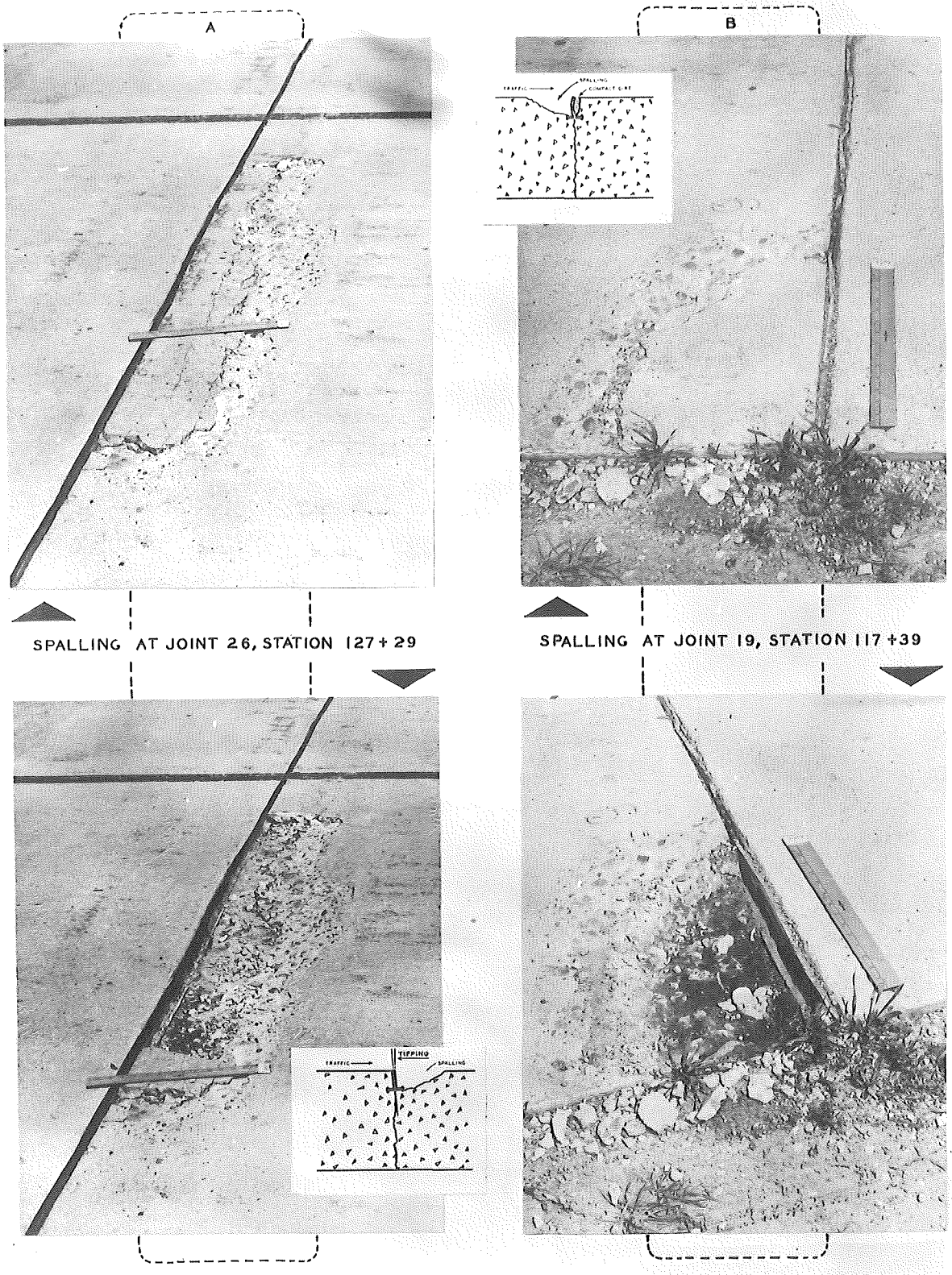
TABLE II

SUMMARY OF JOINT CONDITION DATA, JUNE 1951, AGE 20 MONTHS

Joint No.	Station	Depth of Seal below Surface of Pavement, in. East Edge	Center	West Edge	Linear feet of Spalling**
1	91+00	1-1/4	3/4	1-1/8	9.0
2	91+99	1-1/16	9/16	1-5/16	4.0
3	92+98	2	3/8	1	4.0 W
4	94+96	1-3/16	1	15/16	0.5
5	95+95	5/8	3/8	9/16	5.0
6	96+94	1/16	3/8	5/16	0.0
7	101+33	3/8	1/16	9/16	4.5 W
8	103+31	13/16	7/16	5/8	3.0 E
9	104+30	7/8	9/16	3/4	5.0
10	105+29	15/16	7/8	3/8	3.0
11	107+27	3/4	1/2	1/2	0.0
12	108+26	1-1/8	3/4	3/8	0.0
13	109+25	1	5/8	5/8	6.0 W
14	111+23	1	1	7/8	1.0 W
15	112+22	9/16	13/16	13/16	1.0
16	113+21	7/8	1 (R)*	13/16	4.0 E
17	115+19	9/16	7/16	3/4	0.0
18	116+18	3/8	3/16	9/16	0.0
19	117+39	3/8	3/8	Flush	1.0 W
20	119+37	3/8	3/16	5/8	1.5 W
21	120+36	7/8	3/8	7/16	0.5 E
22	121+35	7/16	3/8 (R)	9/16	0.5 E
23	123+33	5/8	1/16	3/8	0.0
24	124+32	9/16	1/32 above	3/16	0.2 E (R)
25	125+31	3/8	3/16	7/16	0.0
26	127+29	1/4	1/16 above	1/16 above	8.0 W (R)
27	128+28	7/8	1/16 above	3/8	0.0
28	129+27	3/16	Flush	3/8	0.0
29	131+25	3/8	7/16	3/4	0.0
30	132+24	11/16	3/4	9/16	2.0
				Total	63.7

* W = west slab
E = east slab

** (R) = tympany (resonance on percussion) which would indicate future spalling.



EXAMPLES OF MOST SEVERE SPALLING ENCOUNTERED IN JUNE 1951 SURVEY

FIGURE 6

until it was able to offer sufficient resistance to the slab movement to cause shear of the concrete at the joint face. It is easy to visualize that similar infiltration conditions may develop at other Neoprene sealed joints.

With reference to Table II, the total linear feet of spalling encountered in this survey is 63.7 feet or approximately 10% of total length of the 30 22-ft. neoprene sealed joints. Resonance of the concrete on percussion at certain spots along the joint edges indicates the possibility of future spalling in those areas.

Physical Condition of Adjacent Groove-type Joints:

In conjunction with the June 7, 1951 survey an inspection was made of an equal number of M.S.H.D. standard groove-type joints located immediately south of the Neoprene joint seal installation for comparative purposes. The area included in the survey starts at Station 59+90 and extends to Station 91+00.

In the case of the thirty joints inspected, three joints were found each having 6-in. spalled areas and one joint with a 12-in. spall, a total of 2.5 ft. of spalling for the groove joints as compared to 63.7 feet for the Neoprene sealed joints. In all cases spalling occurred at the ends of the joints evidently due to compressive forces which developed either by the presence of compacted foreign material in the end of the joint or the end of the joints were not thoroughly cleared of concrete during their construction.