

PERFORMANCE OF JOINT SEALANTS
USED IN 1964 THROUGH 1967 MICHIGAN CONSTRUCTION
(THIRD ANNUAL REPORT)

LAST COPY
DO NOT REMOVE FROM LIBRARY



MICHIGAN DEPARTMENT OF STATE HIGHWAYS

PERFORMANCE OF JOINT SEALANTS
USED IN 1964 THROUGH 1967 MICHIGAN CONSTRUCTION
(THIRD ANNUAL REPORT)

F. J. Bashore

Research Laboratory Section
Testing and Research Division
Research Project 62 G-116
Research Report No. R-670

State of Michigan
Department of State Highways
Lansing, April 1968

INFORMATION RETRIEVAL DATA

REFERENCE: Bashore, F. J. Performance of Joint Sealants Used in 1964 through 1967 Michigan Construction (Third Annual Report). Michigan Department of State Highways Research Report No. R-670. April 1968. Research Project 62 G-116.

ABSTRACT: Joint sealants were inspected on representative projects constructed from 1964 through 1967. Preformed neoprene sealers continue to perform well in contraction joints, while the liquid sealers show some failure for the first season with continuing progressive failure. Neoprene is performing satisfactorily in expansion joints, while cold-applied two-component sealer—with few exceptions—has not. Hot-poured rubber-asphalt is performing satisfactorily, but this was used on summer-paved projects and only at structures, etc. A decrease in joint groove spalling is apparent where grooves were sawed, compared with those formed with temporary filler.

KEY WORDS: contraction joints, elastomer modified asphalts, elastomers, expansion joints, grooves, hot joint sealants, joint fillers, joint sealing methods, joint sealers neoprene, sawed joint, sealants, sealing experiments.

PERFORMANCE OF JOINT SEALANTS
USED IN 1964 THROUGH 1967 MICHIGAN CONSTRUCTION
(THIRD ANNUAL REPORT)

This report is one in a series describing the performance of transverse pavement joint sealers. The previous report in this series (R-625) was issued in March 1967.

This report has been prepared specifically in response to a request from N. E. MacDougall of the Bureau of Public Roads to H. E. Stafseth dated October 6, 1967 in which he requested further review of the performance of neoprene seals in Michigan. John E. Meyer, in his letter to Mr. MacDougall dated November 1, 1967, reviewed the department's experience with joint sealers and stated, "We will again survey joint seal performance this coming winter and intend to report on this during March 1968."

SCOPE OF THE 1968 FIELD SURVEYS

January 1968 field surveys of 1964 construction included five projects: two with neoprene joint seals, one with cold-applied contraction joint seals and hot-poured expansion joint seals, and two with hot-poured joint seals. All transverse joint grooves were formed with manually placed temporary fillers.

Field surveys of 1965 construction included three projects: two neoprene and one cold-applied. The neoprene projects have only a few expansion joints which were hot-poured. All transverse joints for these projects were formed with temporary filler.

Seven 1966 construction projects were field surveyed. Six had neoprene seals while the seventh had a few hot-poured expansion joints. Joint grooves of five projects were formed by sawing and two were formed with temporary filler.

Eight 1967 construction projects were surveyed. All had neoprene seals and all joint grooves were formed by sawing.

Sealing Procedure

For neoprene seals, a vertical joint groove was formed down each slab edge to extend the seal to the bottom of the slab. These vertical grooves were omitted where curbs, curbs and gutters, or additional lanes were to be added. Placement of neoprene sealants was preceded by compressed air cleaning of the grooves, and placement of liquid sealants was preceded by sandblasting and compressed air cleaning. Joint groove spalls were repaired with epoxy mortar before sealant installation.

Standard widths for neoprene seals were 1-1/4 in. for contraction and 1-5/8 in. for expansion joints. Experimental project sealants were exceptions to these widths and are discussed later in this report. None of the 1964 and 1965 projects were exclusively sealed with installation machines. All 1966 contraction sealant surveyed was machine installed while much of the sealant on the 1967 projects surveyed was installed with a manually operated roller. Liquid-type sealants were installed by specified procedures including use of a nozzle-mix machine for the cold-applied sealant.

Inspection Procedure

A representative number of joints was selected from each project, as widely distributed throughout its length as possible. Areas where traffic control during inspection might be difficult or impossible were excluded, such as curves or beyond the crests of hills.

Briefly, the inspections consisted of the following:

1. Recording joint location so that the same joints could be studied in subsequent inspections.
2. Measuring length and depth of adhesion and cohesion failures of liquid sealants.
3. Measuring depth below pavement surface for neoprene sealants.
4. Describing general sealant condition, including dirt infiltration for liquid sealants, and tears and breaks for neoprene sealants.
5. Measuring joint groove widths
6. Measuring lengths of repaired spalls and spalls occurring after sealing.

7. Photographing typical joints, as well as unusual conditions noticed during inspections.

The criterion used in 1968 for identifying joint groove spalls is slightly different from that used in previous inspections. Previously, any spall which increased the joint groove width more than 1/4 in., and approximately 1/4 in. or greater in depth, was recorded. This method was used so that comparisons could be made between neoprene sealed joints and liquid sealed joints where the depth was difficult to measure. For the 1968 field surveys, only those spalls which increased the joint groove width more than 1/4 in. and were at least 1/2-in. deep were recorded. In other words, only those spalls which might adversely affect the seal were measured so that a more realistic comparison could be made between sawed joint grooves and those formed with temporary fillers, both sealed with neoprene.

As a result of this change in inspection procedure, the quantities of existing joint groove spalls shown in Tables 1, 2, and 3 show a decrease for some projects in 1968 compared to 1967.

SURVEY OBSERVATIONS OF CONTRACTION JOINT SEALANTS

Survey data for contraction joints are summarized in Table 1. Conditions encountered are illustrated for 1964 joints in Figure 1, for 1965 joints in Figure 2, for 1966 joints in Figure 3, and for 1967 joints in Figure 4.

Joints Sealed in 1964

Preformed neoprene sealants with over 3 years of service are performing excellently. They appear to be satisfactorily tight, and no significant vertical movement is indicated by comparing latest seal depth with earlier measurements.

Performance data on cold-applied, two-component elastomeric sealers obtained during four successive winters show progressive adhesion failure. Some degree of adhesion failure exists on 87 percent of the joint faces.

Data for hot-poured, rubber-asphalt sealer from one of two projects surveyed in 1965 (I 196, Grand Rapids) showed extensive cohesion failure of contraction joints. Less cohesion failure was apparent in 1967, but deep folds had developed in the upper surfaces of many seals, which were expected to collect debris that would be folded into the seal during the following summer. No cohesion failure was apparent again in 1968 but there

TABLE 1
SUMMARY OF CONTRACTION JOINT SEAL PERFORMANCE

| Sealer Type | Project Number | | Location | Survey Date | Air Temp, F | Joint Groove Width, in. | | | Joint Forming Method | Joint Groove Spalls, % of Total Length | | Seal Depth Below Surface, in. | | | Computed Seal Compression, % | | | Sealer Failure | | Cohesion |
|--------------------------------------|--------------------|---------------|--------------------------|------------------|-------------|-------------------------|------|------|----------------------|--|----------|--------------------------------------|----------------|----------------|------------------------------|----------------|-----|--|--------------------------------------|----------|
| | Michigan | Federal | | | | Max | Min | Avg | | Repaired | Existing | Max | Min | Avg | Max | Min | Avg | % of Total Joint Length | Estimated Depth Range, in. | |
| Preformed Neoprene | I 41027A, C24 | I 96-1(47)72 | Grand Rapids | 3-15-65 | 42 | 0.83 | 0.61 | 0.73 | Temporary Filler | 1.2 | 5.9 | 0.59 | 0.00 | 0.23 | 51 | 34 | 43 | Not Applicable For This Sealant Type | 0.0 | |
| | | | | 12- 5-65 | 33 | 0.90 | 0.68 | 0.79 | | 6.9 | 0.50 | 0.00 | 0.23 | 46 | 28 | 37 | | | | |
| | | | | 2-14-67 | 40 | 0.92 | 0.87 | 0.79 | | --- | 12.2 | 0.56 | 0.03 | 0.23 | 43 | 22 | 35 | | | |
| | F 50092A, C1 | F 256(11) | M 19, New Haven | 1-23-68 | 20 | 0.93 | 0.74 | 0.83 | Temporary Filler | 0.6 | 1.0 | 0.88 | 0.06 | 0.20 | 49 | 34 | 44 | Not Applicable For This Sealant Type | 0.0 | |
| | | | | 3- 9-65 | 35 | 0.82 | 0.64 | 0.70 | | 2.2 | 0.38 | 0.03 | 0.21 | 49 | 38 | 43 | | | | |
| | | | | 12- 9-65 | 43 | 0.77 | 0.64 | 0.71 | | 3.8 | 0.41 | 0.03 | 0.21 | 54 | 45 | 50 | | | | |
| Cold-Applied Two-Component Elastomer | F 81102B, C7 | F 82(10) | M 14, Ypsilanti | 1-18-68 | 26 | 0.73 | 0.62 | 0.69 | Temporary Filler | 0.0 | 3.4 | 0.34 | 0.00 | 0.17 | 50 | 42 | 45 | 2.7 Center to bottom 24.6 Center to bottom 36.2 Center to bottom 87.0 0 to bottom | 0.0 0.0 0.0 | |
| | | | | 2-23-65 | 18 | 0.52 | 0.50 | 0.57 | | 0.0 | 1.6 | Not Applicable For This Sealant Type | Not Applicable | Not Applicable | Not Applicable | Not Applicable | | | | |
| | | | | 12- 8-65 | 38 | 0.72 | 0.54 | 0.64 | | 3.2 | 0.73 | 0.48 | 0.58 | 3.8 | --- | --- | --- | | | --- |
| Hot-Poured Rubber-Asphalt | I 41028E, C3 | I 96-1(45)70 | Grand Rapids | 1-11-68 | 20 | 0.78 | 0.48 | 0.68 | Temporary Filler | 0.0 | 3.2 | --- | --- | --- | --- | --- | --- | 0.0 1.1 1 in. to bottom 5.7 3/4 in. to bottom 0.0 | 53.9 All to bottom 0.0 0.0 | |
| | | | | 12-16-65 | 30 | 0.97 | 0.81 | 0.88 | | 2.5 | 0.0 | 0.97 | 0.81 | 0.84 | 2.4 | --- | --- | | | --- |
| | | | | 2-14-67 | 47 | 0.89 | 0.81 | 0.84 | | 2.2 | 0.94 | 0.86 | 0.89 | --- | --- | --- | --- | | | |
| | Preformed Neoprene | E 81104A, C18 | I 94-5(55)178 | M 14, Ann Arbor | 1-12-67 | 40 | 0.92 | 0.76 | 0.83 | Temporary Filler | 0.8 | 0.7 | 0.56 | 0.00 | 0.26 | 46 | 36 | 42 | Not Applicable For This Sealant Type | 0.0 |
| | | | | | 1-11-68 | 24 | 0.95 | 0.81 | 0.89 | | 4.0 | 0.85 | 0.00 | 0.20 | 35 | 24 | 29 | | | |
| | | | | | 12-15-65 | 35 | 0.83 | 0.66 | 0.77 | | 9.0 | 4.8 | 0.56 | 0.09 | 0.27 | 47 | 34 | 38 | | |
| Cold-Applied Two-Component Elastomer | F 50013A, C1 | F 212(35) | M 53, Utica | 1-23-67 | 59 | 0.76 | 0.67 | 0.71 | Temporary Filler | 0.0 | 0.0 | 0.75 | 0.03 | 0.32 | 46 | 39 | 43 | 1.1 Top to bottom 100.0 Top to bottom 100.0 Top to bottom | 0.2 Top to bottom 0.0 0.0 | |
| | | | | 1-18-68 | 40 | 0.86 | 0.77 | 0.81 | | 16.4 | 1.05 | 0.06 | 0.28 | 38 | 31 | 35 | | | | |
| | | | | 12-13-65 | 42 | 0.80 | 0.68 | 0.73 | | 0.8 | 0.7 | 0.56 | 0.00 | 0.26 | 46 | 36 | 42 | | | |
| Preformed Neoprene | U 63052A, C18 | U 238(21) | Square Lake Rd., Pontiac | 1-20-67 | 27 | 0.81 | 0.62 | 0.68 | Sawing | 1.7 | 1.3 | 0.81 | 0.16 | 0.51 | 50 | 35 | 46 | Not Applicable For This Sealant Type | 0.0 | |
| | | | | 1-31-68 | 24 | 0.94 | 0.50 | 0.69 | | --- | 1.6 | 1.08 | 0.17 | 0.47 | 52 | 25 | 45 | | | |
| | | | | 1-26-67 | 23 | 0.82 | 0.62 | 0.75 | | 0.0 | 2.3 | 0.94 | 0.16 | 0.41 | 50 | 34 | 40 | | | |
| | Preformed Neoprene | F 67015A, C1 | F 133(22) | US 131, Cadillac | 1-16-68 | 17 | 0.92 | 0.71 | 0.82 | Temporary Filler | 0.1 | 8.9 | 0.53 | 0.00 | 0.25 | 50 | 37 | 42 | Not Applicable For This Sealant Type | 0.0 |
| | | | | | 1-18-67 | 14 | 0.79 | 0.63 | 0.72 | | 0.1 | 8.2 | 0.35 | 0.00 | 0.22 | 47 | 34 | 42 | | |
| | | | | | 1-25-68 | 16 | 0.92 | 0.66 | 0.73 | | --- | --- | --- | --- | --- | --- | --- | --- | | |
| Preformed Neoprene | F 79012A, C3 | F 260(21) | M 46, Kingston | 1-24-67 | 36 | 0.74 | 0.55 | 0.61 | Sawing | 0.4 | 1.3 | 0.66 | 0.03 | 0.25 | 56 | 41 | 51 | Not Applicable For This Sealant Type | 0.0 | |
| | | | | 1-24-68 | 9 | 0.78 | 0.62 | 0.70 | | --- | --- | --- | --- | --- | --- | --- | | | | |
| | | | | 1-25-67 | 35 | 0.88 | 0.55 | 0.64 | | 2.4 | 0.9 | 0.91 | 0.13 | 0.47 | 56 | 30 | 49 | | | |
| Preformed Neoprene | F 73073D, C6 | F 141(12) | M 81, Saginaw | 1-10-68 | 15 | 0.64 | 0.65 | 0.73 | Sawing | 1.3 | 0.8 | 0.84 | 0.06 | 0.45 | 48 | 33 | 42 | Not Applicable For This Sealant Type | 0.0 | |
| | | | | 1-19-67 | 4 | 0.97 | 0.72 | 0.84 | | 1.3 | 9.8 | 0.41 | 0.05 | 0.25 | 42 | 22 | 33 | | | |
| | | | | 1-27-68 | 30 | 0.94 | 0.69 | 0.80 | | --- | 14.8 | 0.36 | 0.07 | 0.23 | 45 | 25 | 36 | | | |

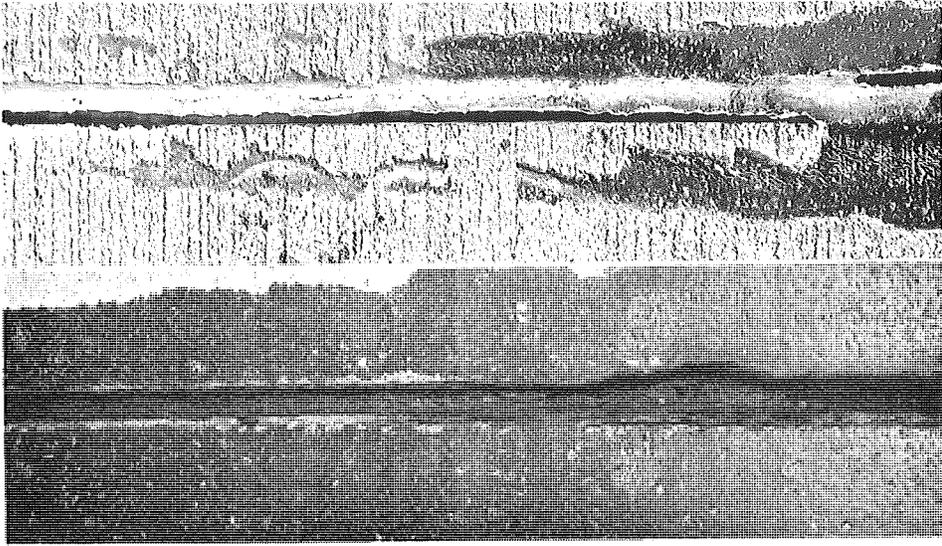
(1) All neoprene sealer width measurements are based upon the stated nominal width of the seal, even though actual width variation is allowed within the Standard Specifications.

TABLE 1 (Cont.)
SUMMARY OF CONTRACTION JOINT SEAL PERFORMANCE

| Sealer Type | Project Number | | Location | Survey Date | Air Temp, F | Joint Groove Width, in. | | | Joint Forming Method | Joint Groove Spalls, % of Total Length | | Seal Depth Below Surface, in. | | | Computed Seal Compression, ⁽¹⁾ % | | | Adhesion | | Sealer Failure Cohesion | |
|--------------------|-------------------|--------------|--------------------------------------|-------------|-------------|-------------------------|------|------|----------------------|--|----------|-------------------------------|------|------|---|-----|-----|-------------------------|-------------------------------------|-------------------------|------------------|
| | Michigan | Federal | | | | Max | Min | Avg | | Repaired | Existing | Max | Min | Avg | Max | Min | Avg | % of Total Joint Length | Estimated Depth Range, in. | % of Total Joint Length | Depth Range, in. |
| | | | | | | | | | | | | | | | | | | | | | |
| | I 13073D, C8 | I 69-1(17)29 | I 69, Marshall | 12-20-67 | 43 | 0.84 | 0.69 | 0.75 | Sawing | 0.5 | 0.9 | 0.80 | 0.12 | 0.36 | 45 | 33 | 40 | | | | |
| | I 13073A-007 | I 69-1(16)25 | I 69, North of Tekonsha | 12-20-67 | 45 | 0.78 | 0.54 | 0.63 | Sawing | 0.4 | 0.4 | 0.97 | 0.24 | 0.58 | 57 | 38 | 50 | | | | |
| | I 13073A, 65-1718 | I 69-1(15)22 | I 69, North of Branch Co. Line | 12-20-67 | 52 | 0.79 | 0.63 | 0.72 | Sawing | 0.2 | 1.7 | 0.49 | 0.02 | 0.22 | 50 | 37 | 43 | | | | |
| | I 12034E, C1 | I 69-1(13)15 | I 69, South of North Branch Co. Line | 1- 4-68 | 9 | 0.93 | 0.60 | 0.82 | Sawing | 0.4 | 4.4 | 0.68 | 0.07 | 0.31 | 52 | 26 | 34 | | | | |
| Preformed Neoprene | I 12034A, C4 | I 69-1(12)12 | I 69, North of US 12 | 1- 4-68 | 9 | 0.69 | 0.64 | 0.67 | Sawing | 0.0 | 1.7 | 0.49 | 0.12 | 0.31 | 49 | 45 | 46 | | Not Applicable For This Sealer Type | | |
| | I 12033D, C5 | I 69-1(11)10 | I 69, South of US 12 | 1- 4-68 | 9 | 0.69 | 0.67 | 0.79 | Sawing | 0.0 | 1.8 | 0.62 | 0.25 | 0.44 | 46 | 29 | 37 | | | | |
| | I 12033B, C7 | I 69-1(10)6 | I 69, South of Coldwater | 1- 4-68 | 9 | 0.97 | 0.76 | 0.85 | Sawing | 0.0 | 0.9 | 0.58 | 0.23 | 0.40 | 39 | 22 | 32 | | | | |
| | I 12033A, C10 | I 69-1(19)0 | I 69, North of Indiana Line | 1- 4-68 | 9 | 0.94 | 0.79 | 0.84 | Sawing | 0.1 | 0.3 | 0.92 | 0.11 | 0.57 | 37 | 24 | 33 | | | | |

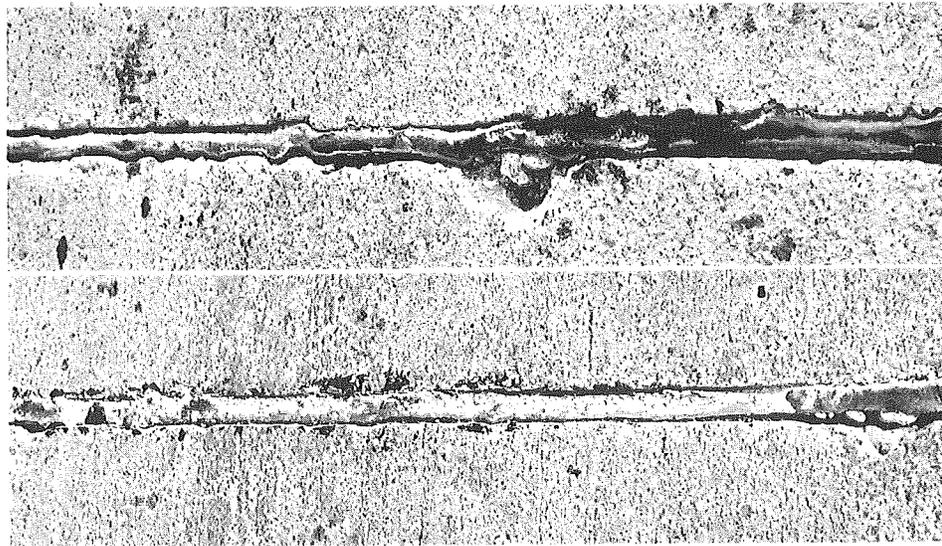
⁽¹⁾ All neoprene sealer width measurements are based upon the stated nominal width of the seal, even though actual width variation is allowed within the Standard Specifications.

HOT - Poured
RUBBER - ASPHALT



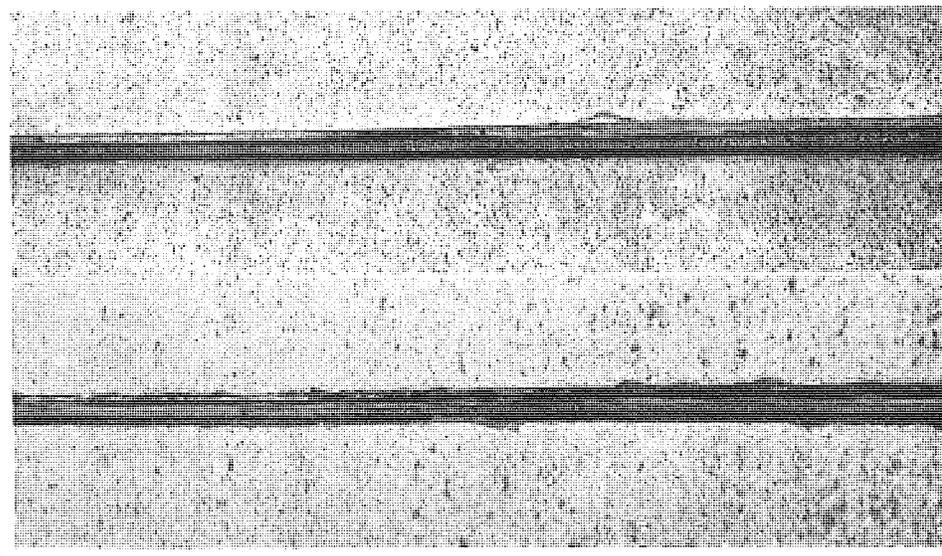
Sta. 563+12 (WB)
M 14, Ypsilanti
(Photo: 1-11-68)

COLD - Applied
TWO - COMPONENT ELASTOMER



Sta. 589+85 (EB)
M 153, Ypsilanti
(Photo: 1-11-68)

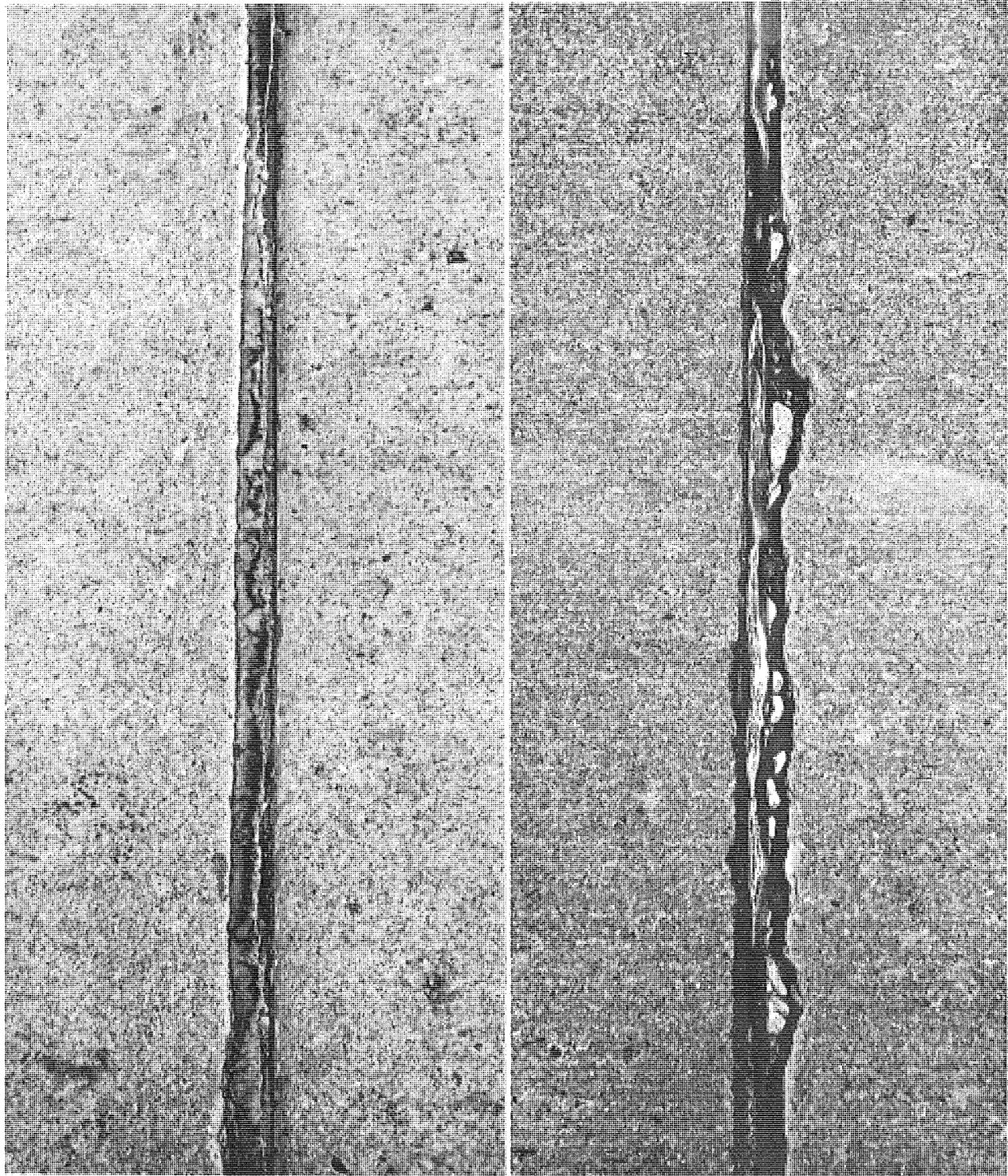
PREFORMED NEOPRENE



Sta. 83+54 (EB)
M 19, New Haven
(Photo: 1-18-68)

Sta. 444+30 (EB)
I 196, Grand Rapids
(Photo: 1-27-68)

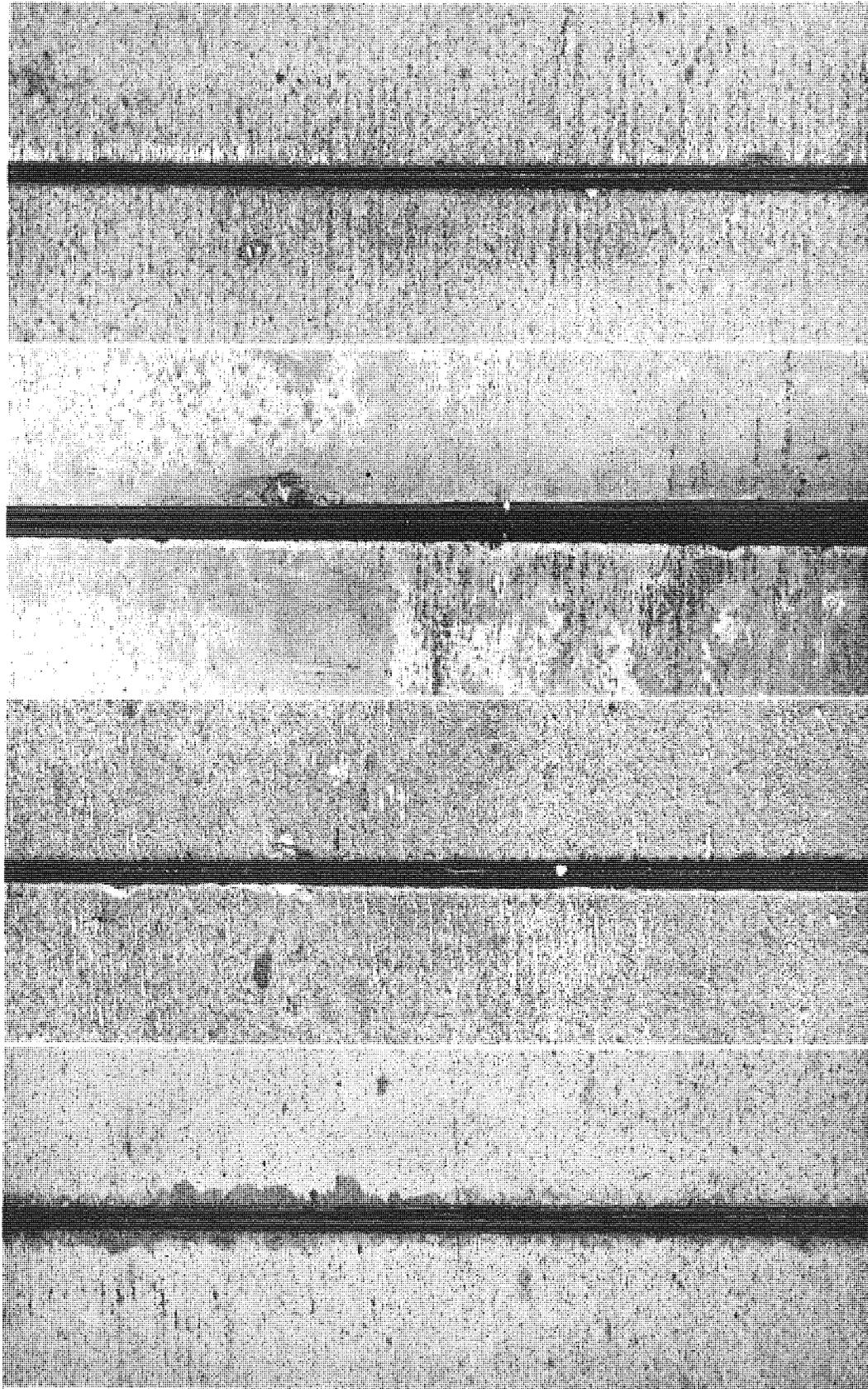
Figure 1. Appearance of typical contraction joints sealed in 1964, after more than 3 years of service. Good performance of neoprene (left) contrasts with adhesion failure of cold-applied elastomer (center), and adhesion failure of hot-poured rubber-asphalt (right).



Sta. 860+79 (NB)
M 53, Utica
(Photo: 1-18-68)

Sta. 757+90 (NB)
M 53, Utica
(Photo: 1-18-68)

Figure 2. Typical two-component elastomeric sealer in contraction joints after 2 years of service, showing failure in adhesion.



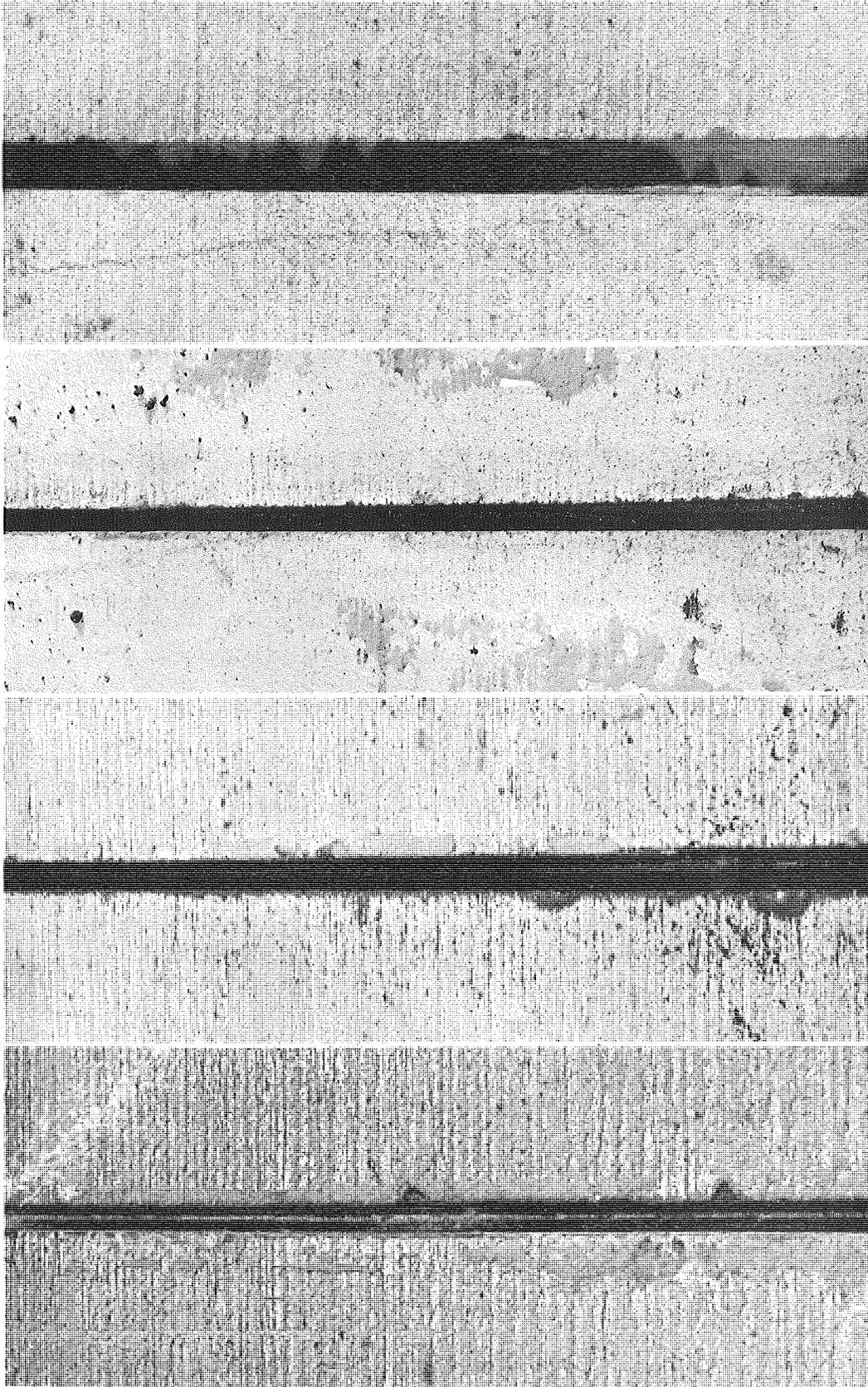
Sta. 103+06 (WB)
M 46, Kingston
(Photo: 1-24-68)

Sta. 351+50 (EB)
M 47, Saginaw
(Photo: 1-10-68)

Sta. 930+61 (NB)
US 131, Cadillac
(Photo: 1-16-68)

Sta. 635+56
US 127, Holt
(Photo: 1-5-68)

Figure 3. Typical neat appearing neoprene contraction joints sealed in 1966.



Sta. 735+27 (SB)
I 69, Coldwater
(Photo: 1-4-68)

Sta. 409+23 (SB)
I 69, Coldwater
(Photo: 1-4-68)

Sta. 1424+03 (SB)
I 69, Tekonsha
(Photo: 12-19-67)

Sta. 1514+33 (SB)
I 69, Tekonsha
(Photo: 12-19-67)

Figure 4. Appearance of typical joints sealed in 1967. The three at the left are contraction joints and the one at the right is an expansion joint.

was some increase in adhesion failure. The other project (M 14, Ypsilanti) showed 8.3 percent partial adhesion failure in 1965, which increased in quantity and depth in the 1967 survey. In 1968 there was a considerable increase in adhesion failure; 75.5 percent compared to 17.3 percent in 1967.

Joints Sealed in 1965

The two projects surveyed showed excellent performance of preformed neoprene seals with satisfactory tightness and only one short tear in the top surface of a single seal where it is flush with the pavement surface.

Small adhesion failures were found for cold-applied, two-component elastomeric sealer in the 1965 survey. The 1967 survey indicated progressive adhesion failures ranging in depth from minimal to total along virtually 100 percent of the joint faces. The 1968 survey showed that approximately 20 percent of the seals had been replaced with hot-pour.

Joints Sealed in 1966

Nine construction projects sealed with preformed neoprene representing a total length of 50 miles, were surveyed. Standard 1-1/4-in. neoprene contraction seal was used on eight, and a 13/16-in. seal on one which will be discussed later. Six of the eight neoprene-sealed projects had joint grooves formed by sawing, and the remaining two by manual placement of temporary fillers.

The 1968 field surveys showed excellent performance on eight projects. The condition of the neoprene seals on the ninth project appeared to be excellent except for two seals which showed less compressive force or tightness than expected. Both seals had small pebbles lodged between the joint face and the seal indicating that when the joint opened at low temperature, recovery of the seal was not immediate thus permitting intrusion of debris. Since all seals were covered with sand and ice at the time of the survey, it was decided that a more comprehensive study would be made later when a minimum of cleaning of joint grooves would be necessary.

Joints Sealed in 1967

Eight construction projects sealed with preformed neoprene were field surveyed. Other projects were also selected but not surveyed since they were not open to traffic and therefore snow-covered at the time scheduled for survey. All joint grooves were sawed and standard 1-1/4-in. contraction seal was used.

Field surveys continued to show significantly less joint groove spalling for sawed joint grooves when compared to older projects where temporary filler was used to form the joint grooves.

Seals were generally installed with little twisting but there was significant variation in the depth at which the seals were placed below the surface of the pavement. There is a need for improved technique and quality control in seal placement.

SURVEY OBSERVATIONS OF EXPANSION JOINT SEALANTS

Survey data for expansion joints are summarized in Table 2. Conditions encountered are illustrated for 1964 joints in Figure 5, for 1965 joints in Figure 6, for 1966 joints in Figure 7, and for 1967 joints in Figure 4.

Joints Sealed in 1964

Joint grooves for the preformed neoprene sealant were formed to 1-in. widths, and in some cases closed to 3/8 in. during hot weather. All expansion seals on the Grand Rapids project which were inspected had split longitudinally expelling the top portion. In all cases, the lower portion was still in place and apparently keeping dirt and debris out of the joint below. The expansion seals on the New Haven project which had been selected for annual survey are now missing and replaced, so no data are shown from that project in Table 2. One joint had been sawed-out and the concrete repoured, presumably because of a joint failure. The others are now missing and replaced, probably because of high original placement in the joint groove and subsequent damage by traffic and snow plows.

Hot-poured, rubber-asphalt seals showed generally good performance. There were minor adhesion failures on all three projects and minor cohesion failures for one.

Joints Sealed in 1965

Two 1965 projects surveyed had neoprene contraction joints and hot-poured rubber-asphalt expansion joints. They were poured during the summer when only a few expansion joints were required, such as at structures, etc. Expansion joint grooves were formed with temporary fillers and were 1-in. wide. Surveys in December 1965, January 1967, and January 1968 showed good to excellent performance.

TABLE 2
SUMMARY OF EXPANSION JOINT SEAL PERFORMANCE

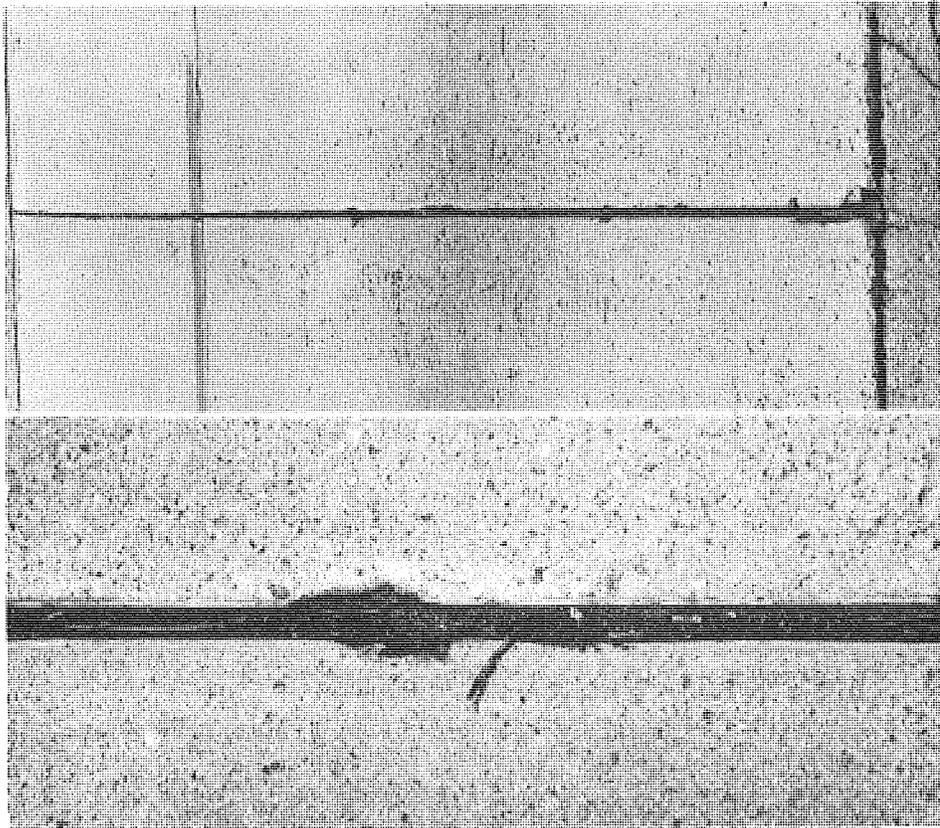
| Sealer Type | Project Number | | Location | Survey Date | Air Temp. F | Joint Groove Width, in. | | | Joint Groove Spalls, % of Total Length | Seal Depth Below Surface, in. | | | Computed Seal Compression ⁽¹⁾ , % | | | Adhesion | | Cohesion | | | | |
|--------------------------------------|----------------|--------------|----------------------------------|--------------|-------------|-------------------------|--------|------|--|-------------------------------|---------------------|---------------------|--|------|------|--------------------------------------|--------------------------------------|-------------------------|----------------------------|-------------------------|------------------|---------------|
| | Michigan | Federal | | | | Max | Min | Avg | | Repaired | Existing | Max | Min | Avg | Max | Min | Avg | % of Total Joint Length | Estimated Depth Range, in. | % of Total Joint Length | Depth Range, in. | |
| Preformed Neoprene | I 41027A, C24 | I 96-1(47)72 | I 196, Grand Rapids | 3-15-65 | 42 | 1.39 | 1.00 | 1.13 | 0.5 | 3.6 | 1.09 | 0.16 | 0.41 | 39 | 14 | 30 | Not Applicable For This Sealant Type | 1.2 | Center to bottom | | | |
| | | | | 12-6-65 | 33 | 1.10 | 0.83 | 1.03 | Temporary | 4.4 | 0.72 | 0.00 | 0.16 | 49 | 32 | 36 | | | | 2.2 | Top to bottom | |
| | | | | 2-14-67 | 40 | 0.97 | 0.71 | 0.81 | Filler | 4.7 | 1.25 ⁽²⁾ | 0.38 ⁽²⁾ | 0.79 ⁽²⁾ | 56 | 40 | 50 | | | | | | 10.0 |
| | | 1-28-68 | 20 | 0.99 | 0.74 | 0.84 | | 5.6 | | | | 54 | 39 | 46 | | | | | | | | |
| Hot-Poured Rubber-Asphalt | F 81103B, C7 | F 82(10) | M 14, Ypsilanti | 12-8-65 | 38 | 1.40 | 0.98 | 1.25 | 0.0 | 1.0 | | | | | | Not Applicable For This Sealant Type | 3.7 | Center to bottom | | | | |
| | | | | 1-12-67 | 33 | 1.15 | 0.78 | 0.93 | Filler | 2.6 | | | | | | | | | 2.6 | Top to bottom | | |
| | | | | 1-11-68 | 20 | 1.36 | 0.71 | 0.97 | | 4.1 | | | | | | | | | | | 10.0 | Top to bottom |
| | | 1-28-68 | 20 | 1.68 | 1.28 | 1.52 | | 0.4 | | | | | | | | | | | | | | |
| Cold-Applied Two-Component Elastomer | F 50013A, C1 | F 212(35) | M 53, Utica | 12-15-65 | 36 | 1.58 | 1.30 | 1.38 | 0.0 | 5.3 | | | | | | Not Applicable For This Sealant Type | 0.0 | 0 | | | | |
| | | | | 1-23-67 | 59 | 1.23 | 1.15 | 1.18 | Filler | 5.7 | | | | | | | | | 0.1 | 1/2 | | |
| | | | | 1-18-68 | 40 | 1.18 | 1.08 | 1.14 | | 3.9 | | | | | | | | | | | 21.3 | 0 to full |
| | | 1-18-68 | 40 | 1.18 | 1.08 | 1.14 | | 0.0 | | | | | | | | | | | | | | |
| Hot-Poured Rubber-Asphalt | F 60013A, C2 | F 212(36) | M 53, Utica | 12-13-65 | 42 | 1.49 | 1.16 | 1.36 | 0.0 | 0.1 | | | | | | Not Applicable For This Sealant Type | 0.0 | 0 | | | | |
| | | | | 1-12-67 | 40 | 1.30 | 1.22 | 1.26 | Filler | 0.0 | | | | | | | | | 0.4 | 1/4 | | |
| | | | | 1-11-68 | 24 | 1.48 | 1.01 | 1.47 | | 0.6 | | | | | | | | | | | 0.0 | 0 |
| | | 1-18-68 | 40 | 1.38 | 1.16 | 1.28 | | 0.9 | | | | | | | | | | | | | | |
| Preformed Neoprene | F 67015A, C1 | F 133(22) | US 131, Cadillac | 1-28-67 | 23 | (3) | (3) | 1.23 | 0.0 | 4.2 | 0.75 | 0.41 | 0.55 | (3) | 24 | Not Applicable For This Sealant Type | 2.6 | Center to bottom | | | | |
| | | | | 1-18-68 | 17 | (3) | (3) | 1.15 | 0.0 | 4.0 | 0.58 | 0.31 | (3) | 30 | 10.0 | | | | Top to bottom | | | |
| | | | | 1-24-67 | 36 | 1.29 | 1.24 | 1.27 | Sawing | 0.8 | 1.4 | 0.88 | 0.06 | 0.30 | | | | | | 24 | 21 | 22 |
| | | 1-24-68 | 14 | 1.15 | 1.05 | 1.10 | | 3.6 | 0.94 | 0.06 | 0.37 | 35 | 30 | 33 | | | | | | | | |
| Hot-Poured Rubber-Asphalt | F 33035A, C6 | F 146(21) | US 127, Holt Rd. to Columbia Rd. | 1-25-67 | 35 | 1.34 | 1.15 | 1.25 | 4.4 | 0.7 | 1.22 | 0.22 | 0.67 | 29 | 18 | 23 | Not Applicable For This Sealant Type | 25.8 | 1/8 to 1/4 | | | |
| | | | | 1-10-68 | 15 | 1.22 | 1.00 | 1.10 | 0.0 | 0.4 | | | | | | | | | | 0.1 | .8 | |
| | | | | 2-28-67 | 27 | 1.82 | 1.30 | 1.54 | Temporary | 0.0 | 0.4 | | | | | | | | | | | |
| | | 1-17-68 | 30 | 1.53 | 1.10 | 1.35 | Filler | 0.3 | | | | | | | | | | | | | | |
| | | 12-20-67 | 43 | (3) | (3) | 1.24 | Sawing | 0.4 | 0.4 | 0.60 | 0.35 | 0.47 | (3) | (3) | 24 | | | | | | | |
| Preformed Neoprene | I 13073D, C8 | I 69-1(17)29 | I 69, Marshall | 12-20-67 | 45 | 1.38 | 1.27 | 1.32 | 1.7 | 0.6 | 0.75 | 0.51 | 0.61 | 22 | 15 | 19 | Not Applicable For This Sealant Type | 1.0 | Center to bottom | | | |
| | | | | 1-69-1(16)25 | 45 | 1.38 | 1.27 | 1.32 | Sawing | 1.7 | 0.6 | 0.75 | 0.51 | 0.61 | 22 | 15 | | | | 19 | 10.0 | Top to bottom |
| | | | | 1-69-1(15)22 | 52 | 1.44 | 1.30 | 1.36 | Sawing | 16.3 | 1.8 | 0.46 | 0.15 | 0.29 | 20 | 11 | | | | 16 | | |
| | | 1718 | | | | | | | | | | | | | | | | | | | | |

(1) All neoprene sealer width measurements are based upon the stated nominal width of the seal, even though actual width variation is allowed within the Standard Specifications.

(2) Top portion of seal missing.

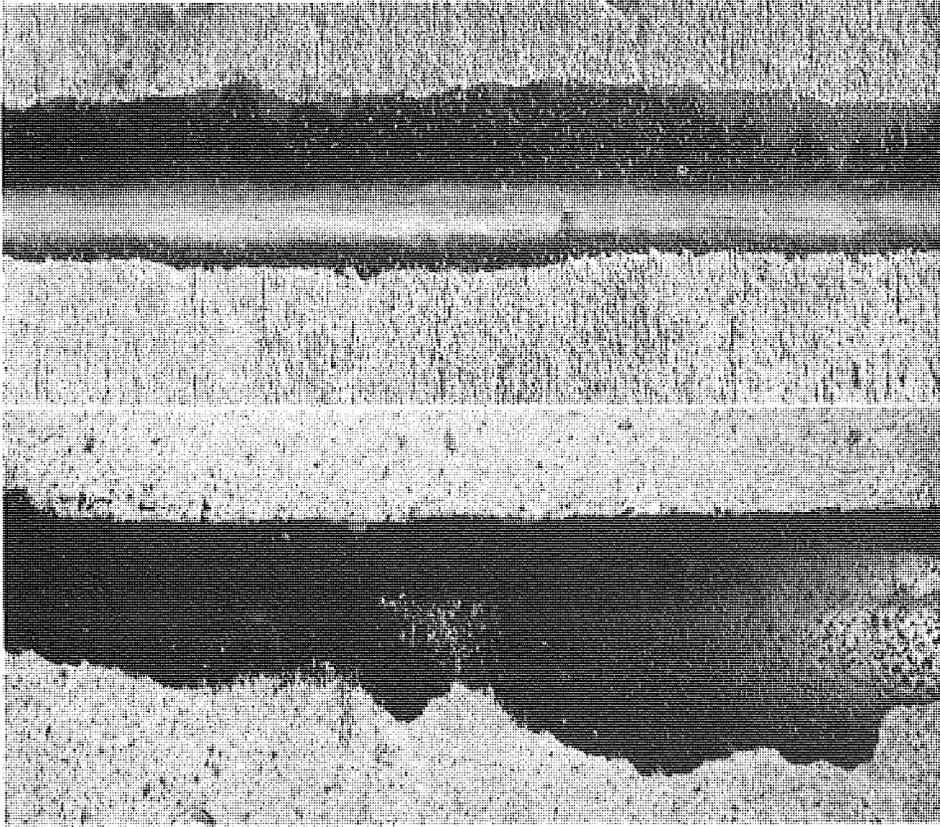
(3) Only one expansion joint surveyed.

PREFORMED NEOPRENE



Sta. 445+47 (EB)
I 196, Grand Rapids
(Photo: 1-23-68)

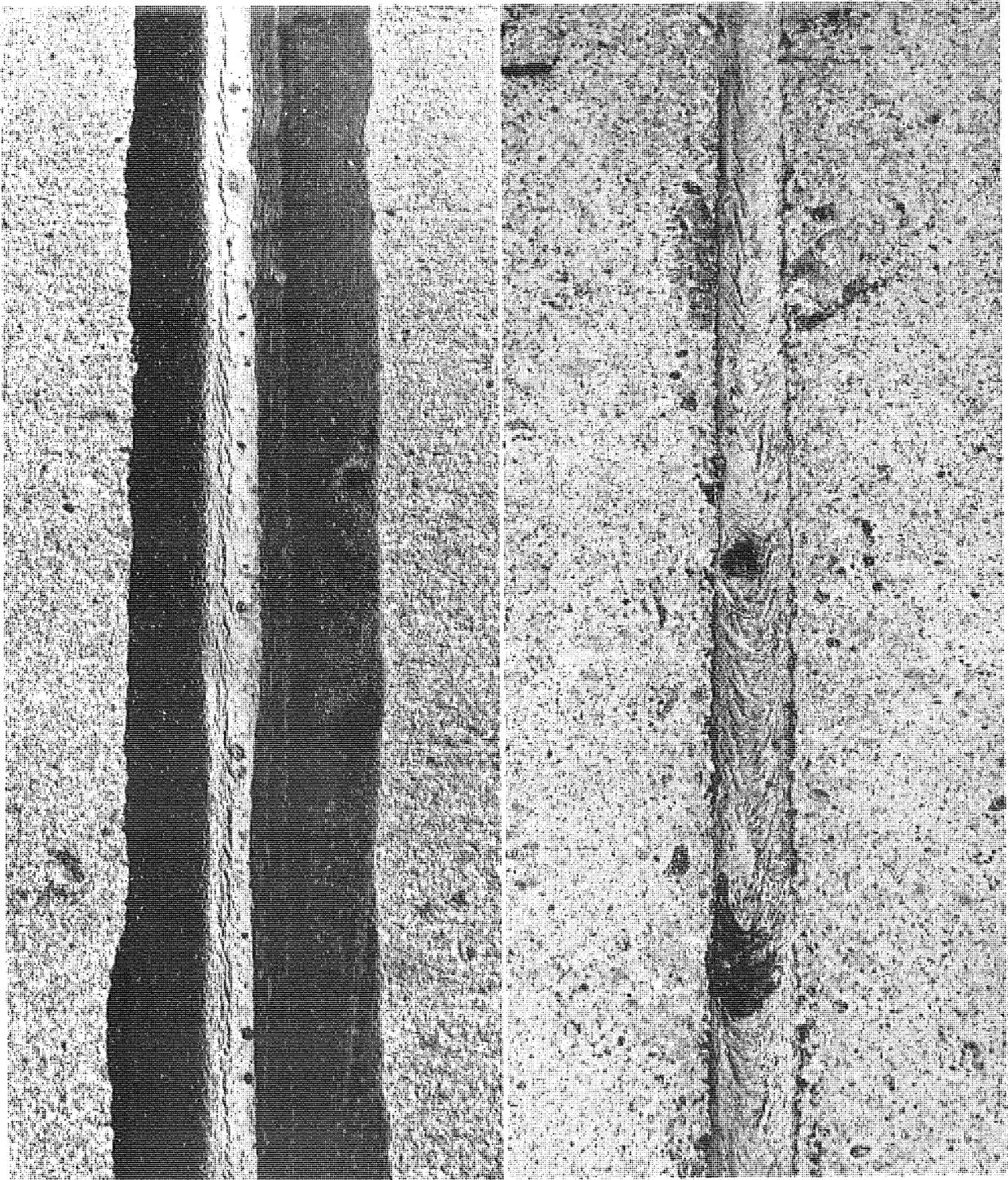
HOT - Poured RUBBER - ASPHALT



Sta. 339+73
I 196, Grand Rapids
(Photo: 1-23-68)

Sta. 565+88
M 14, Ypsilanti
(Photo: 1-11-68)

Figure 5. Appearance of expansion joints sealed in 1964, after more than 3 years of service. Top portion of neoprene sealant (left) has split away and is missing, but remaining portion maintains effective seal. Hot-poured rubber-asphalt seals (right) are in good condition.



Sta. 61+96
M 14, Ann Arbor
(Photo: 1-11-68)

Sta. 939+54
M 53, Utica
(Photo: 1-18-68)

Figure 6. Hot-poured expansion joints sealed in 1965 and performing well.

PREFORMED NEOPRENE

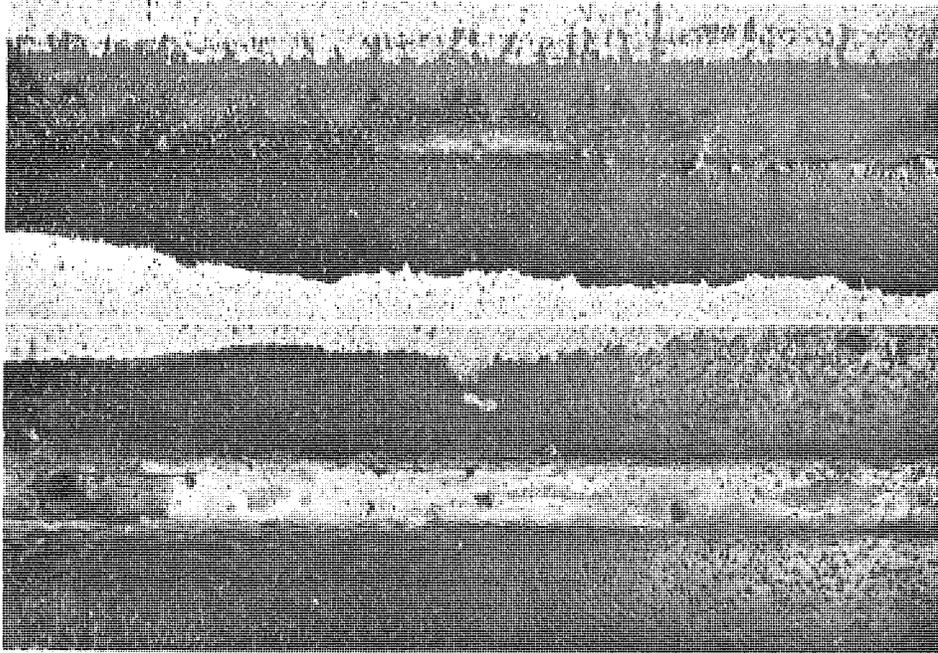


Sta. 178+60
Square Lake Rd., Pontiac
(Photo: 1-31-68)

Sta. 455+38
M 46, Kingston
(Photo: 1-24-68)

Sta. 367+39
M 47, Saginaw
(Photo: 1-10-68)

HOT - Poured RUBBER-ASPHALT



Sta. 432+05 (SB)
US 127, Holt
(Photo: 1-17-68)

Sta. 533+66 (NB)
US 127, Holt
(Photo: 1-17-68)

Figure 7. Appearance of expansion joints sealed in 1966, during their second winter of service. Typical neatly installed neoprene sealants are shown at left. Performance of hot-poured rubber-asphalt sealer shown at right is good.

One 1965 project sealed with cold-applied two-component elastomer had only a few expansion joints similar to those above. The December 1965 and January 1967 surveys showed excellent performance but by January 1968 there was 21.3 percent failure in adhesion.

Joints Sealed in 1966

The 1966 projects using preformed neoprene sealants, had expansion joint grooves sawed to 1-1/4 in. January inspection in 1967 showed the sealers to have an average compression of 14 to 24 percent. Inspection in January 1968 showed an average compression of 25 to 33 percent.⁽¹⁾ This shows a progressive closing although the air temperature range at the time of the 1968 inspection was lower than in 1967.

Expansion joints on one project were sealed with "up-graded" hot-poured rubber asphalt. This material's principal difference from Federal specification requirements is that it must pass a more severe bond extension test at 0 F. Performance in 1968 appears to be excellent.

Joints Sealed in 1967

Almost all of the pavement covered by the survey was poured during the summer when few expansion joints are used. Those inspected were therefore located near structures, etc. Installations were generally more uniform in depth of placement than in older projects. Compression was quite low as would be expected for the first winter. Compression ranged from 11 to 24 percent. The amount of compression is expected to increase somewhat from year to year based on prior studies.

EXPERIMENTAL NEOPRENE-SEALED JOINTS

Because of the previously mentioned difficulty with neoprene expansion joint sealers installed in 1964, experimental installations were authorized on three construction projects. Variables studied were initial joint width, sealer width, and sealer wall thicknesses. Two of these projects were sealed in 1965 and the third early in 1966.

⁽¹⁾ All neoprene sealer width measurements are based upon the stated nominal width of the seal, even though actual width variation is allowed within the Standard Specifications.

Expansion Joints

Two projects formerly surveyed, at Holland and at Holt, were omitted from this study. Holt Road over US 127 paving was done during the summer when expansion joints are not placed except at structures and road intersections. On both projects there were numerous expansion joints; because of side streets at Holland and two structures on the Holt project. Movement of these joints is not expected to be severe and therefore little could be learned by continued annual survey.

The third project, US 127 from I 96 to Holt Road, was paved in the fall of 1965 and sealed in early 1966. Every fifth joint was an expansion joint formed by sawing 1- by 2-1/4-in. grooves. They were sealed with 1-5/8-in. thin-wall neoprene. The first field survey in January 1967 showed that the seals were well placed and neat in appearance. During the summer of 1967 considerable extrusion of seals occurred. A detailed inspection was made by Research Laboratory personnel and is covered in Research Report No. R-654. It was found that approximately 50 percent of the joint grooves had closed to less than 0.50 in. Consequently, there was longitudinal splitting of the seals and some loss of the top sections as was experienced earlier on the Grand Rapids project using the previously specified heavier cross-section. Survey data are given in Table 3.

Contraction Joints

On the US 127 project (I 96 to Holt Road) contraction joints were formed by sawing 3/8- by 2-in. grooves before uncontrolled cracking occurred. Grooves were sealed with 13/16-in. preformed contraction joint sealer. These sealers and groove sizes were used to study their feasibility as compared to the standard 1-1/4-in. sealer and 1/2-in. joint groove, in both cases using the 71-ft 2-in. slab length.

The 13/16-in. neoprene-sealed joints on US 127 were initially inspected in January 1967. These were excellent in appearance and had compression of 35 percent, with few repaired or existing spalls along joint groove edges. When inspected in January 1968, compression was found to range from 4 to 36 percent and averaged 20 percent. The minimum compression for design purposes is 20 percent. Joint grooves were formed at low temperatures on this project resulting in less movement than would be expected from joints formed at higher, more normal, temperatures. Therefore the 13/16-in. sealer which is marginal in available compression on this project would be inadequate for most construction using the present standard joint spacings.

TABLE 3
 EXPERIMENTAL NEOPRENE SEAL PERFORMANCE - US 127, Holt Rd to I 96
 (Michigan Project No. F33035B, C1: Federal Project No. F146(17))

3/8- by 2-in. Sawn Groove, Sealed 1966

| Joint Type | Specified Seal Width, in. | Survey Date | Air Temp, F. | Joint Groove Width, in. | | | Joint Groove Spalls, % of Total Length | | Seal Depth Below Surface, in. | | | Computed Seal Compression, % (1) | | |
|-------------|---------------------------|-------------|--------------|-------------------------|------|------|--|----------|-------------------------------|------|------|----------------------------------|-----|-----|
| | | | | Max | Min | Avg | Repaired | Existing | Max | Min | Avg | Max | Min | Avg |
| Contraction | 13/16 | 1-11-67 | 25 | 0.67 | 0.42 | 0.53 | 0.5 | 1.5 | 0.72 | 0.19 | 0.26 | 48 | 18 | 35 |
| | | 1-5-68 | 10 | 0.78 | 0.52 | 0.65 | ----- | 1.0 | 0.47 | 0.07 | 0.26 | 36 | 4 | 20 |
| Expansion | Thin wall 1-5/8 | 1-11-67 | 25 | 1.10 | 0.69 | 0.88 | 4.0 | 4.3 | 0.63 | 0.06 | 0.38 | 58 | 32 | 46 |
| | | 1-5-68 | 10 | 0.94 | 0.64 | 0.82 | ----- | 4.0 | 0.50 | 0.00 | 0.23 | 61 | 43 | 49 |

(1) All neoprene sealer width measurements are based upon the stated nominal width of the seal, even though actual width variation is allowed within the Standard Specifications.

SUMMARY

Inspections have been conducted on construction projects covering over 100 miles of roadway built from 1964 through 1967.

Preformed neoprene sealers are performing well in contraction joints with no indication of failure except for two seals on one project which showed less compressive force than expected. The liquid sealers have shown some degree of failure the first season with continuing progressive failure.

For expansion joints, neoprene seals installed in the currently specified 1-1/4-in. wide groove are performing satisfactorily, except for a very few cases where the grooves were sawed to 1-1/4 in. at abnormally low temperatures and then closed much more during hot weather than would be considered normal. These unusual conditions were not found on any of the surveyed projects. Cold-applied two-component sealers have not performed well in expansion joints other than those at structures in some cases and then for only one or two seasons. Hot-poured rubber-asphalt is performing satisfactorily in the surveyed projects but it should be noted that all of these projects were paved during the summer when expansion joints are used only at structures, curves, etc.

Inspections continue to show a decrease in joint groove spalling on projects where transverse joint grooves were sawed compared to those formed with temporary fillers. There was not as much improvement in placement of neoprene seals on 1967 projects as was expected. This may be a result of the hand roller installation of many of the seals on the 1967 surveyed projects. The 1966 projects surveyed were all machine installed.