R-625

PERFORMANCE OF JOINT SEALANTS USED IN 1964, 1965, AND 1966 MICHIGAN CONSTRUCTION

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ABSTRACT: Joint sealants were inspected on representative projects built from 1964 through 1966. Preformed neoprene sealers are performing satisfactorily and generally better than either hot-poured or cold-applied sealers. Improvements in neoprene performance are expected to result from sawing of joint grooves (rather than formation by temporary filler), and from machine installation of sealant. Observations also continued on experimental neoprene-sealed joints with various groove and seal dimensions, and various sealant wall thicknesses.

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, 1965, AND 1966 MICHIGAN CONSTRUCTION

This report has been prepared in response to a request from N. E. MacDougall of the Bureau of Public Roads to H. E. Hill in a letter dated February 3, 1966. It was requested of the Bureau that this report be delayed until after December 1966, so that survey data could be obtained at more suitable winter temperatures. This request was granted by Mr. MacDougall in his letter to Mr. Hill dated November 1, 1966, in which he stated "...we agree with your suggestion that the submission of the report be delayed until about March 1, 1967 in order that your field survey may be carried out during the most favorable season."

Previous surveys of 1964 and 1965 construction projects discussed in Research Report No. R-563 included hot-poured and cold-applied sealed joints in addition to preformed neoprene-sealed joints. While the 1967 surveys of these projects include all three types, it was necessary to discontinue the survey of some projects to keep the study to a manageable size. Approximately 50 construction projects were sealed with preformed neoprene in 1966. Projects selected for field survey were generally more than 20 miles long and located close enough to Lansing to eliminate excessive travel time. No 1966 projects on metropolitan expressways were selected for reasons of safety for the inspection team.

SCOPE OF THE 1967 FIELD SURVEYS

January-February 1967 field surveys of 1964 construction included five projects: two neoprene, one with cold-applied contraction joints and hot-poured expansion joints, and two hot-poured. All transverse joint grooves for these projects were formed with manually placed temporary fillers.

Field surveys of 1965 construction also included five projects: four neoprene and one cold-applied. Joint grooves of two neoprene and the cold-applied were formed with temporary filler. These two neoprene projects have only a small number of expansion joints, which were hot-poured. The other two neoprene projects are experimental; all seals are neoprene and have joint grooves formed by sawing, with a few exceptions on one project where joints were formed with temporary filler.

Nine 1966 construction projects were field surveyed. Eight had neoprene seals while the ninth had a few hot-poured expansion joints. Joint grooves of seven projects were formed by sawing and two were formed with temporary filler.

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. Liquid-type sealants were installed by specified procedures including use of a nozzle-mix machine for the cold-applied sealant.

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.

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, and for 1966 joints in Figure 3.

Joints Sealed in 1964

Preformed neoprene sealants with over 2 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 three successive winters show progressive adhesion failure. Typical joints have some adhesion failure extending to the bottom of the sealant, permitting intrusion of water and debris.

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 have developed in the upper surfaces of many seals, which are expected to collect debris that will be folded into the seal during the coming summer. 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.

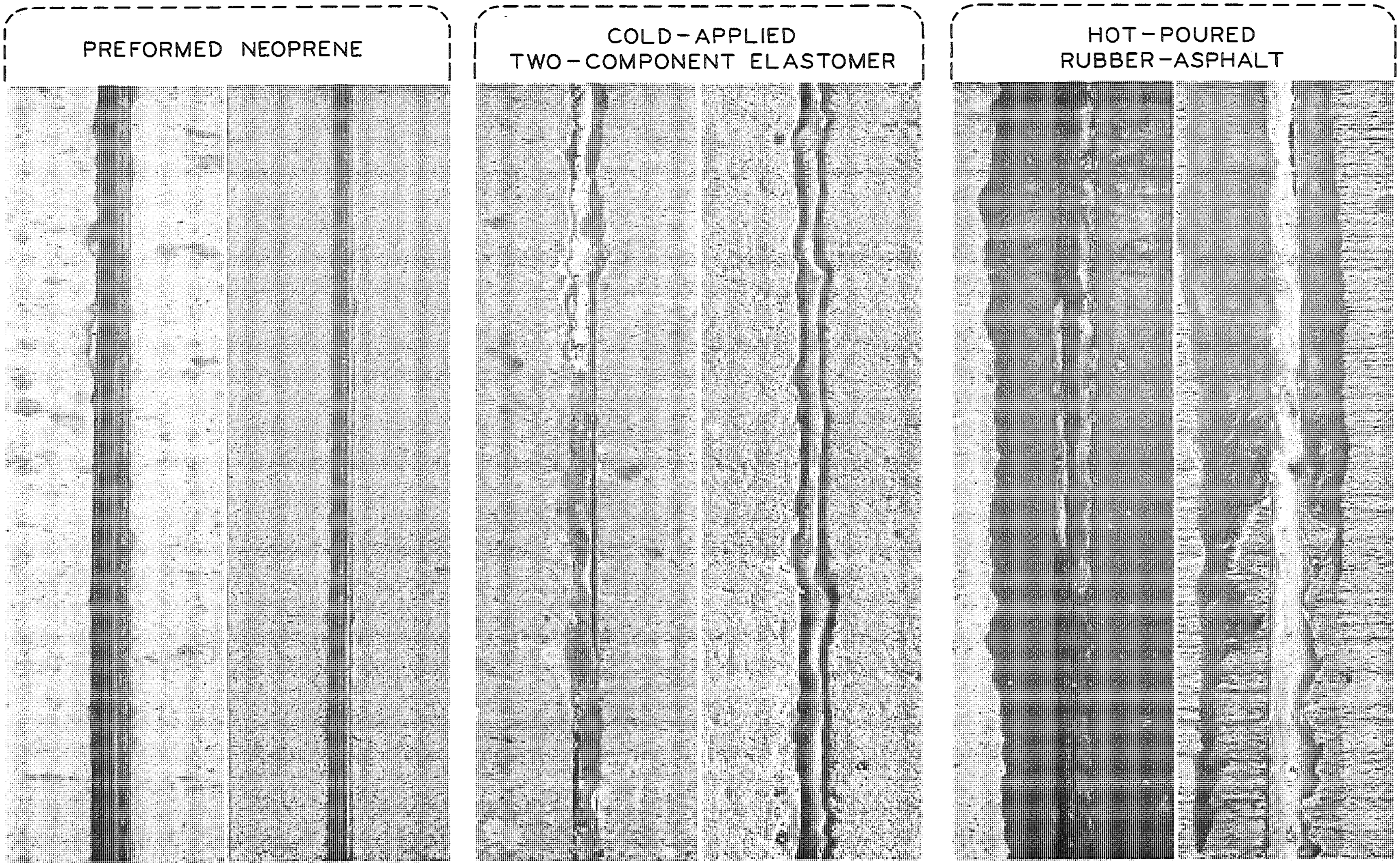
Joints Sealed in 1965

The two projects surveyed show excellent performance of preformed neoprene sealant with satisfactory tightness and no tears or breaks. Seal depth data show slight downward movement for both projects (Table 1). This possibility was anticipated, since slab lengths for both projects are 99 ft rather than the currently specified 71 ft 2 in., thus providing a greater maximum joint opening.

Small adhesion failures were found for cold-applied, two-component elastomeric sealer in the 1965 survey. The 1967 survey indicated adhesion failures ranging in depth from minimal to total along virtually 100 percent of the joint faces. Adhesion failure is expected to progress with time, as has occurred in older installations.

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			
																			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.
SEALED 1964	Preformed Neoprene	I 41027A, C24	I 96-1(47)72	I 196, 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			
					12-6-65	33	0.90	0.68	0.79		--	6.9	0.50	0.00	0.23	46	28	37				
					2-14-67	40	0.92	0.67	0.79		--	13.4	0.56	0.03	0.23	43	22	35				
		F 50092A, C1	F 256(11)	M 19, New Haven	3-9-65	35	0.82	0.64	0.70	Temporary Filler	0.6	1.0	0.38	0.06	0.20	49	34	44				
					12-9-65	43	0.77	0.64	0.71		--	2.2	0.38	0.03	0.21	49	38	43				
					1-23-67	54	0.69	0.58	0.63		--	3.8	0.41	0.03	0.21	54	45	50				
	Cold-Applied Two-Component Elastomer	F 81121A, C2	F 250(15)	M 153, Ypsilanti	2-23-65	18	0.62	0.50	0.57	Temporary Filler	0.0	1.6	Not Applicable For This Sealant Type						2.7	Center to bottom	0.0	0
					12-8-65	38	0.72	0.54	0.64		--	3.2							24.6	Center to bottom	0.0	0
					1-12-67	33	0.73	0.48	0.58		--	3.8							36.2	Center to bottom	0.7	Top to 1/2 in.
	Hot-Poured Rubber-Asphalt	I 41029E, C3	I 96-1(45)70	I 196, Grand Rapids	12-16-65	30	0.97	0.81	0.88	Temporary Filler	0.0	2.5	Not Applicable For This Sealant Type						0.0	0	53.9	All to bottom
					2-14-67	47	0.89	0.81	0.84		--	2.4							1.1	1 in. to bottom	0.0	0
		F 81103B, C7	F 82(10)	M 14, Ypsilanti	12-8-65	38	0.96	0.82	0.88	Temporary Filler	0.0	0.0							8.3	Top to center	0.3	Top to center
					1-12-67	40	0.95	0.77	0.87		--	0.8							17.3	1/2 in. to bottom	0.5	1/8 in. to bottom
SEALED 1965	Preformed Neoprene	BI 81104A, C18	I 94-5(55)178	M 14, Ann Arbor	12-13-65	42	0.80	0.68	0.73	Temporary Filler	0.8	0.7	0.56	0.00	0.26	46	36	42	Not Applicable For This Sealant Type			
					1-12-67	40	0.92	0.76	0.83		--	4.8	0.97	0.00	0.31	39	26	34				
		F 50013A, C2	F 212(36)	M 53, Utica	12-15-65	35	0.83	0.66	0.77	Temporary Filler	9.0	4.8	0.56	0.09	0.27	47	34	38				
					1-23-67	59	0.76	0.67	0.71		--	9.7	0.75	0.03	0.32	46	39	43				
	Cold-Applied Two-Component Elastomer	F 50013A, C1	F 212(35)	M 53, Utica	12-15-65	36	0.94	0.72	0.79	Temporary Filler	0.1	5.6	Not Applicable For This Sealant Type						1.1	Top to bottom	0.2	Top to bottom
					1-23-67	59	0.78	0.62	0.70		--	6.3							100.0	Top to bottom	0.0	0
SEALED 1966	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			
		F 67015A, C1 F 67015A, C2	F 133(22) F 133(21)	US 131, Cadillac	1-26-67	23	0.82	0.62	0.75	Sawing	0.0	2.3	0.94	0.16	0.41	50	34	40				
		SS 73021C, C11	S 211(11)	M 57, Chesaning	1-18-67	14	0.79	0.63	0.72	Temporary Filler	0.1	8.9	0.53	0.00	0.25	50	37	42				
		F 79042A, C3 F 79042A, C4	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				
		F 73073D, C6	F 141(12)	M 81, Saginaw	1-25-67	35	0.88	0.55	0.64	Sawing	2.4	0.9	0.91	0.13	0.47	56	30	49				
		F 33035A, C6	F 146(21)	US 127, Holt Rd. to Columbia Rd.	1-18-67	4	0.97	0.72	0.84	Temporary Filler	1.3	9.8	0.41	0.06	0.25	42	22	33				



Sta. 444+30 (EB) I 196, Grand Rapids (Photo: 2-14-67)

Sta. 83+54 (EB) M 19, New Haven (Photo: 1-23-67)

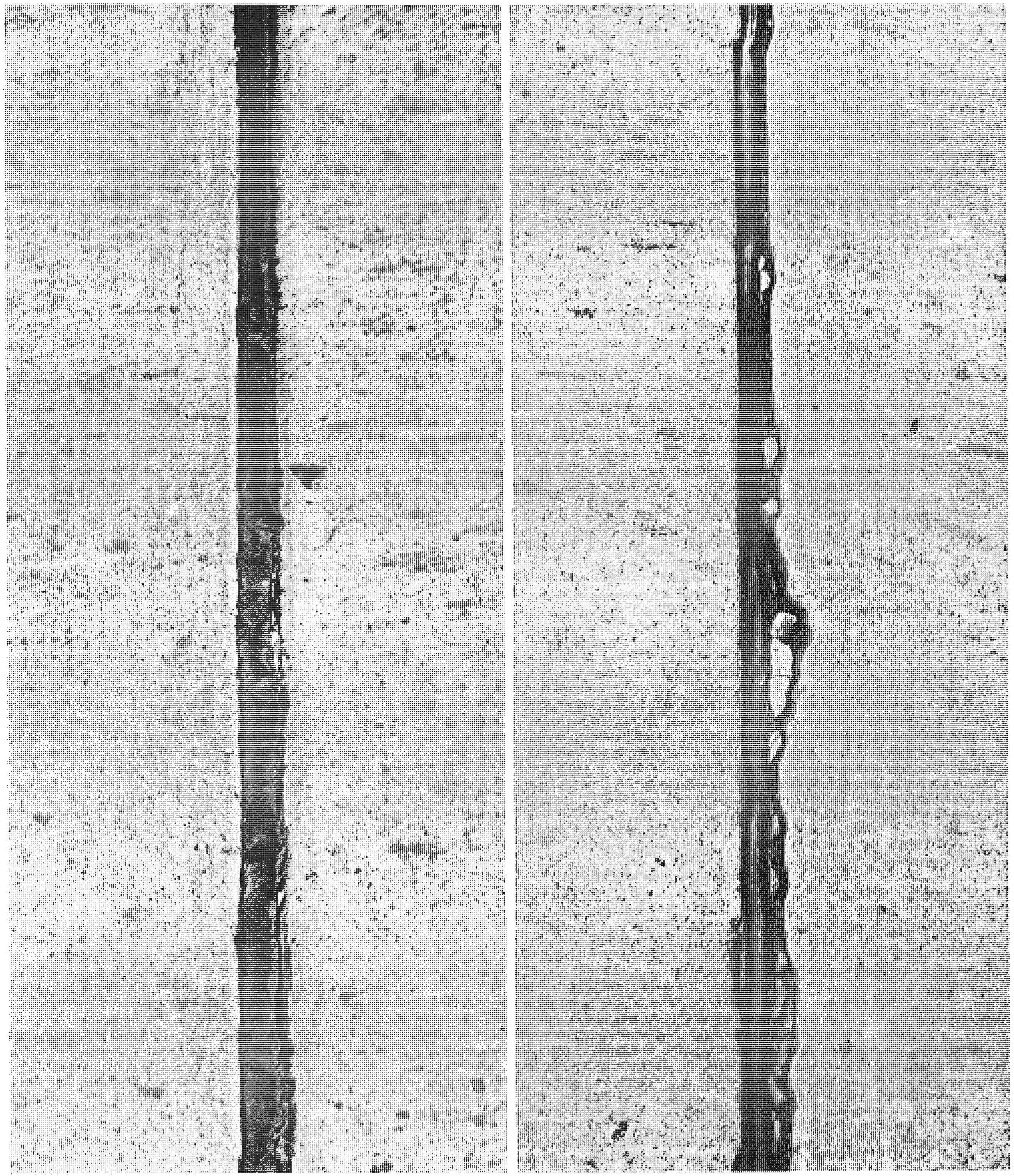
Sta. 575+40 (WB) M 153, Ypsilanti (Photo: 1-12-67)

Sta. 589+85 (EB) M 153, Ypsilanti (Photo: 1-12-67)

Sta. 368+45 (WB) I 196, Grand Rapids (Photo: 2-14-67)

Sta. 563+12 (WB) M-14, Ypsilanti (Photo: 1-12-67)

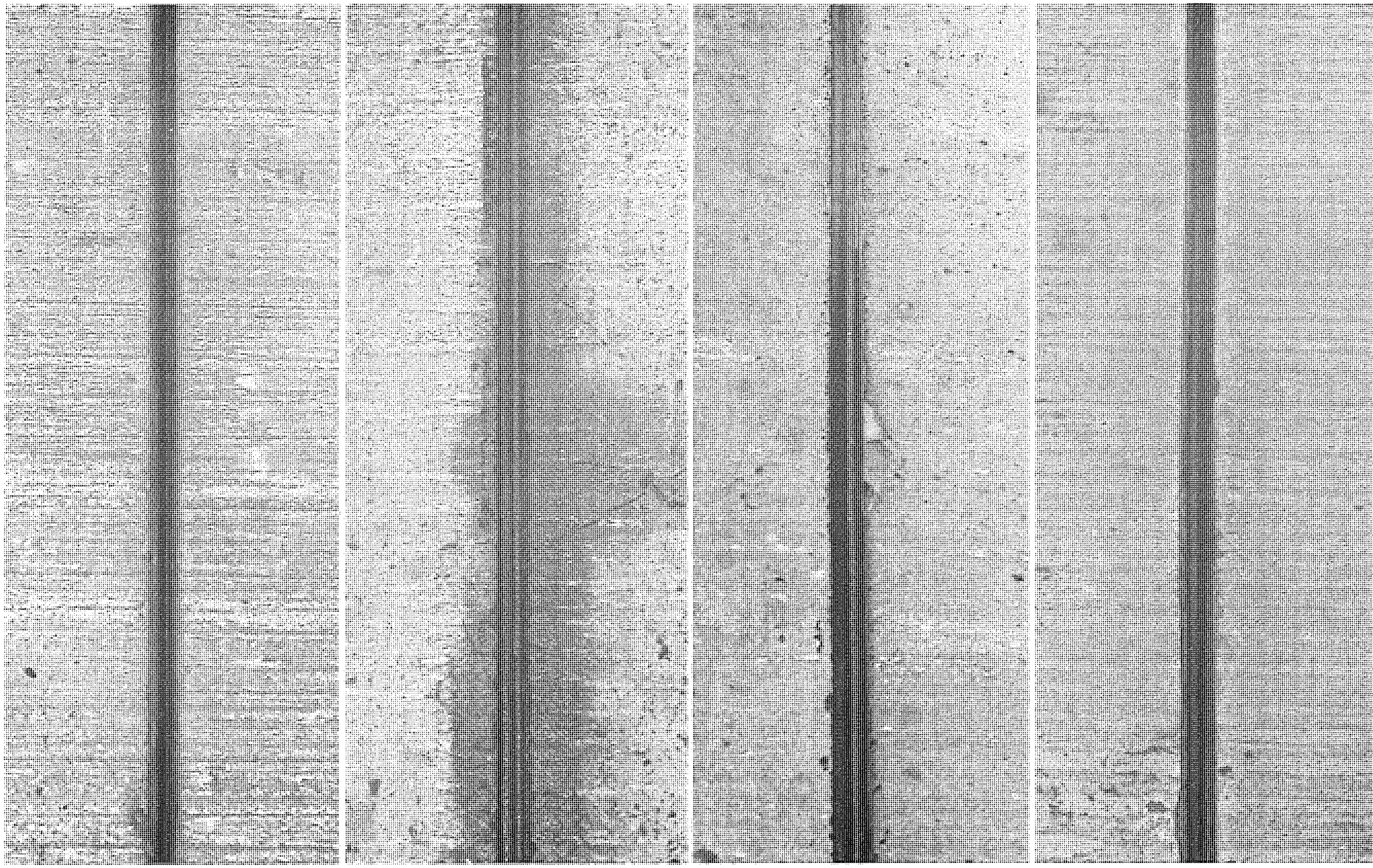
Figure 1. Appearance of typical contraction joints sealed in 1964, after more than 2 years of service. Good performance of neoprene (left) contrasts with adhesion failure of cold-applied elastomer (center), and deep fold and adhesion failure of hot-poured rubber-asphalt (right).



Sta. 860+79 (NB)
M 53, Utica
(Photo: 1-23-67)

Sta. 757+90 (NB)
M 53, Utica
(Photo: 1-23-67)

Figure 2. Typical two-component elastomeric sealer in contraction joints after 1 year of service, showing failure in adhesion.



Sta. 121+28 (WB) M 46, Kingston (Photo: 1-24-67)	Sta. 351+50 (EB) M 47, Saginaw (Photo: 1-25-67)	Sta. 930+61 (NB) US 131, Cadillac (Photo: 1-26-67)	Sta. 555+20 US 127, Holt (Photo: 1-18-67)

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

Joints Sealed in 1966

Nine construction projects sealed with preformed neoprene, representing a total length of 50 miles, were selected for field survey. 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 with other experimental installations. Six of the eight neoprene-sealed projects had joint grooves formed by sawing, and the remaining two by manual placement of temporary fillers. The neoprene sealer was exclusively installed with either the D. S. Brown Co. or Barton Co. machines.

Field surveys show two apparent qualitative improvements for the 1966 projects as compared to earlier ones. There is much less twisting or tilting of sealer and its depth below the pavement surface appears more uniform. Quantitative measurements of sealer depth still show significant variation, however, and thus a need for further improvement in placement.

For 1966 projects, sawing of joint grooves resulted in much less spalling of joint faces than did the temporary filler method. It should be pointed out, however, that the two 1966 projects that did have joint grooves formed by temporary filler exhibited considerably more spalling than similarly formed grooves examined on other projects in earlier surveys.

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 4, for 1965 joints in Figure 5, and for 1966 joints in Figure 6.

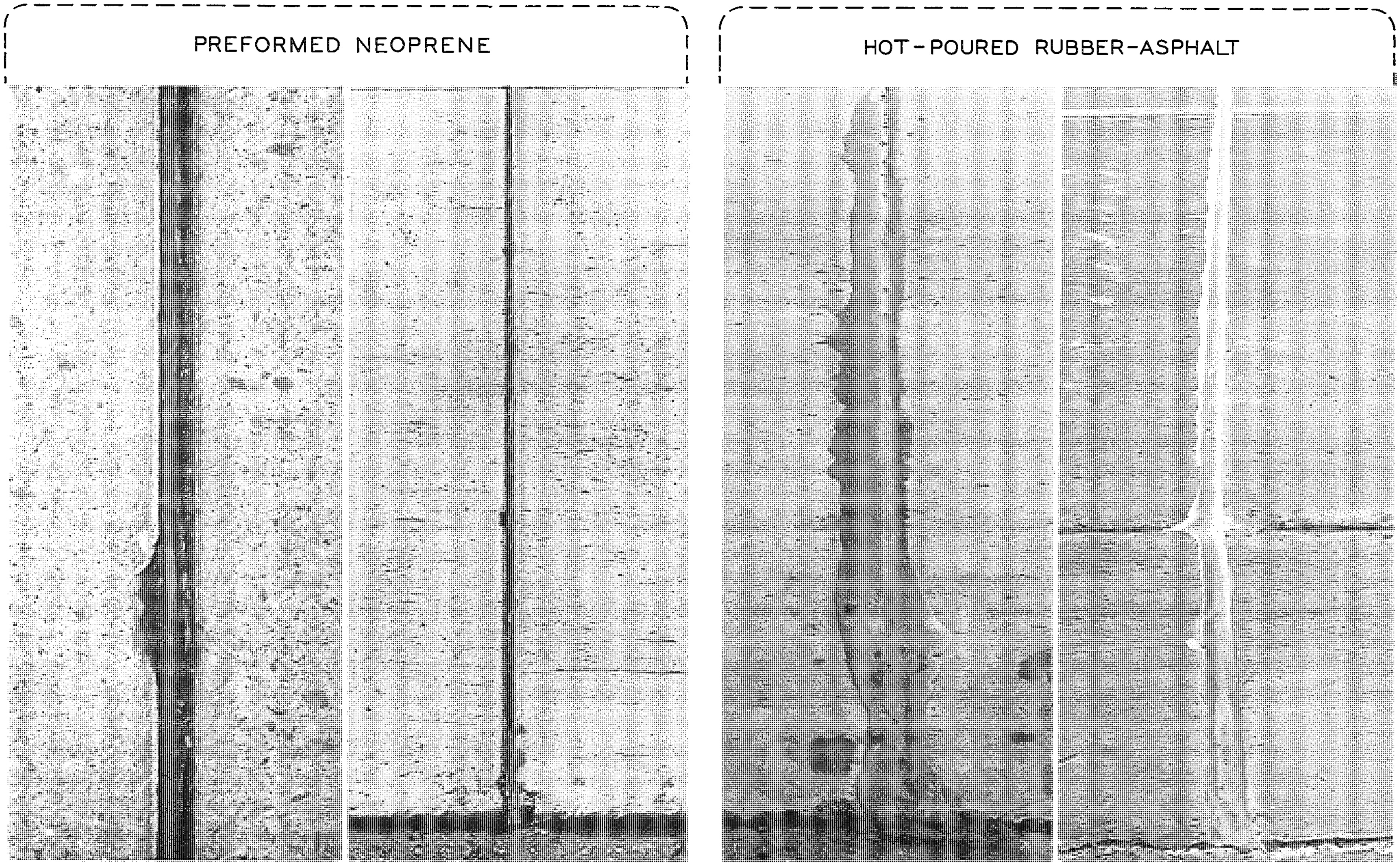
Joints Sealed in 1964

Joint grooves for the preformed neoprene sealant were formed to 1-in. widths, and in some cases close to 3/8-in. during hot weather. This condition prevails on the Grand Rapids project where most expansion seals, except at structures, have split longitudinally with the top portion expelled. These joints have not been repaired, since the remaining portion of the seal appears to be keeping out dirt and debris (Fig. 4). Expansion seals on the New Haven project are generally in good condition, although closer to the pavement surface than is now specified. For unknown reasons, one seal is entirely missing.

TABLE 2
SUMMARY OF EXPANSION JOINT SEAL PERFORMANCE

Sealed	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: 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.
1964	Preformed Neoprene	I 41027A, C24	I 96-1(47)72	I 196, Grand Rapids	3-15-65	42	1.39	1.00	1.13	Temporary Filler	0.5	3.6	1.09	0.16	0.41	39	14	30	Not Applicable For This Sealant Type			
					12-6-65	33	1.10	0.83	1.03		--	4.4	0.72	0.00	0.16	49	32	36				
					2-14-67	40	0.97	0.71	0.81		--	4.7	1.25*	0.38*	0.79*	56	40	50				
		F 50092A, C1	F 256(11)	M 19, New Haven	3-9-65	35	1.40	1.30	1.35	Temporary Filler	0.0	7.3	0.19	0.06	0.15	20	14	17				
					12-9-65	43	1.26	1.14	1.20		--	11.4	0.31	0.12	0.23	30	22	26				
					1-23-67	54	1.05	1.04	1.05		--	16.0	0.28	0.13	0.21	36	35	36				
	Hot-Poured Rubber-Asphalt	F 81121A, C2	F 250(15)	M 153, Ypsilanti	12-8-65	38	1.40	0.98	1.25	Temporary Filler	0.0	1.0	Not Applicable For This Sealant Type						3.7	Center to bottom	1.2	Center to Bottom
					1-12-67	33	1.15	0.78	0.93		--	2.6							2.6	Top to bottom	2.2	Top to bottom
		I 41029E, C3	I 96-1(45)70	I 196, Grand Rapids	12-16-65	30	0.97	0.81	0.88	Temporary Filler	0.0	2.5							0.0	0	0.0	0
					2-14-67	47	1.60	1.30	1.47		--	0.0							1.0	1/4	0.0	0
		F 81103B, C7	F 82(10)	M 14, Ypsilanti	12-8-65	38	1.57	1.38	1.50	Temporary Filler	0.0	0.0							0.0	0	0.0	0
					1-12-67	40	1.30	1.25	1.28		--	0.3							10.2	3/4 to full	0.1	1/2
1965	Cold-Applied Two-Component Elastomer	F 50013A, C1	F 212(35)	M 53, Utica	12-15-65	36	1.58	1.30	1.38	Temporary Filler	0.0	5.3	Not Applicable For This Sealant Type						0.0	0	0.0	0
					1-23-67	59	1.23	1.15	1.18		--	5.7							0.0	0	0.1	1/2
	Hot-Poured Rubber-Asphalt	BI 81104A, C18	I 94-5(55)178	M 14, Ann Arbor	12-13-65	42	1.49	1.16	1.36	Temporary Filler	0.0	0.1	Not Applicable For This Sealant Type						0.0	0	0.0	0
					1-12-67	40	1.30	1.22	1.26		--	0.0							0.4	1/4	0.8	1/4
		F 50013A, C2	F 212(36)	M 53, Utica	12-15-65	35	1.58	1.27	1.46	Temporary Filler	1.0	0.0							0.0	0.0	0.0	0.0
					1-23-67	59	1.42	1.19	1.31		--	0.9							0.0	0.0	0.0	0.0
1966	Preformed Neoprene	U 63052A, C18	U 238(21)	Square Lake Rd., Pontiac	1-20-67	27	1.42	1.37	1.40	Sawing	1.3	3.0	1.47	0.41	0.67	16	13	14	Not Applicable For This Sealant Type			
		F 67015A, C1	F 133(22)	US 131, Cadillac	1-26-67	23	**	**	1.23	Sawing	0.0	4.2	0.75	0.41	0.55	**	**	24				
		F 79042A, C3 F 79042A, C4	F 260(21)	M 46, Kingston	1-24-67	36	1.29	1.24	1.27	Sawing	0.8	1.4	0.88	0.06	0.30	24	21	22				
		F 73063D, C6	F 141(12)	M 81, Saginaw	1-25-67	35	1.34	1.15	1.25	Sawing	4.4	0.7	1.22	0.22	0.67	29	18	23				
	Hot-Poured Rubber-Asphalt	F 33035A, C6	F 146(21)	US 127, Holt Rd. to Columbia Rd.	2-28-67	27	1.82	1.30	1.54	Temporary Filler	0.0	0.4	Not Applicable For This Sealant Type						25.8	1/8 to 1/4	0.0	0.0

*Top portion of seal missing.
**Only one expansion joint surveyed.

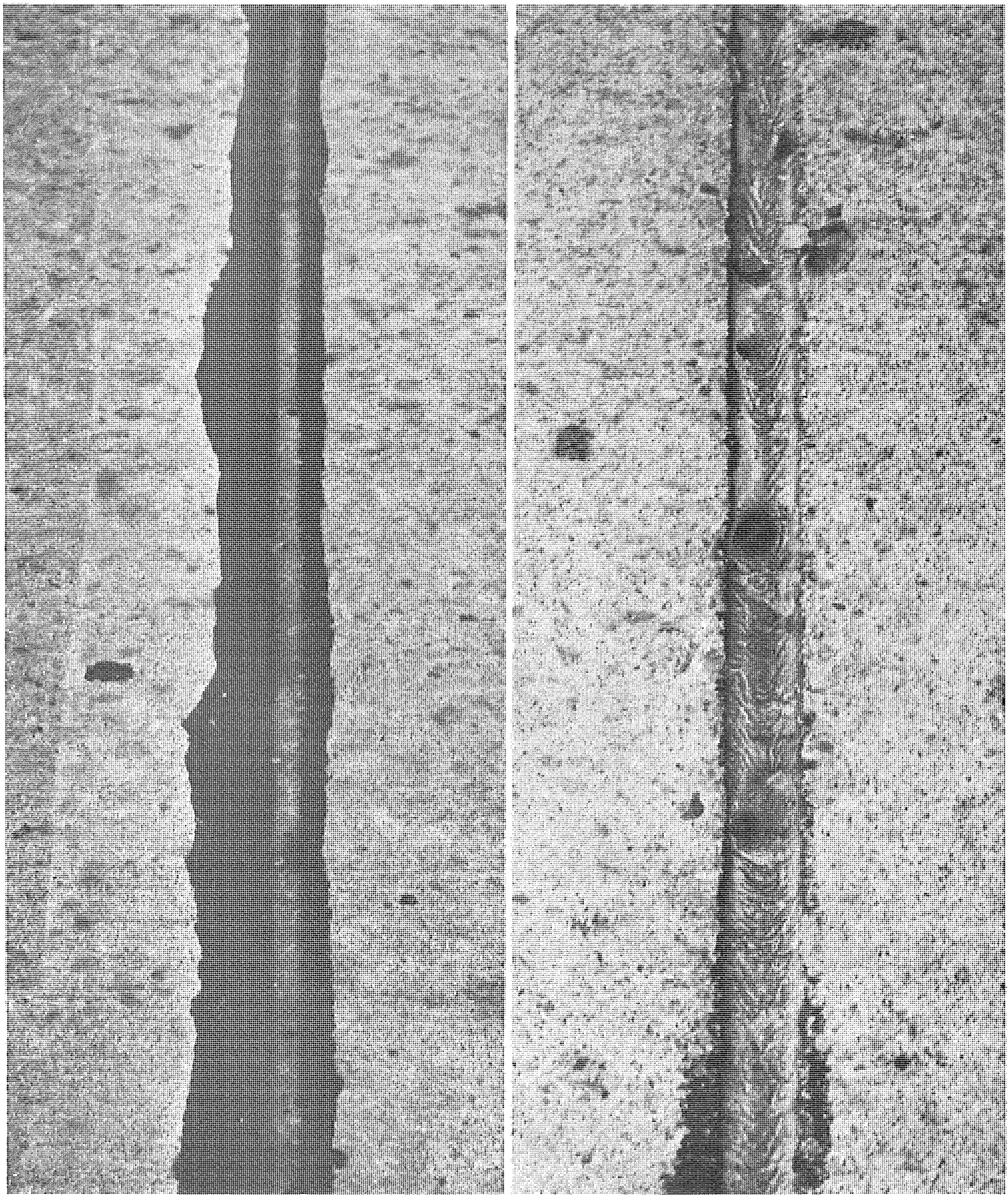


Sta. 445+47 (EB)
I 196, Grand Rapids
(Photo: 2-14-67)

Sta. 339+89
I 196, Grand Rapids
(Photo: 2-14-67)

Sta. 565+88
M 14, Ypsilanti
(Photo: 1-12-67)

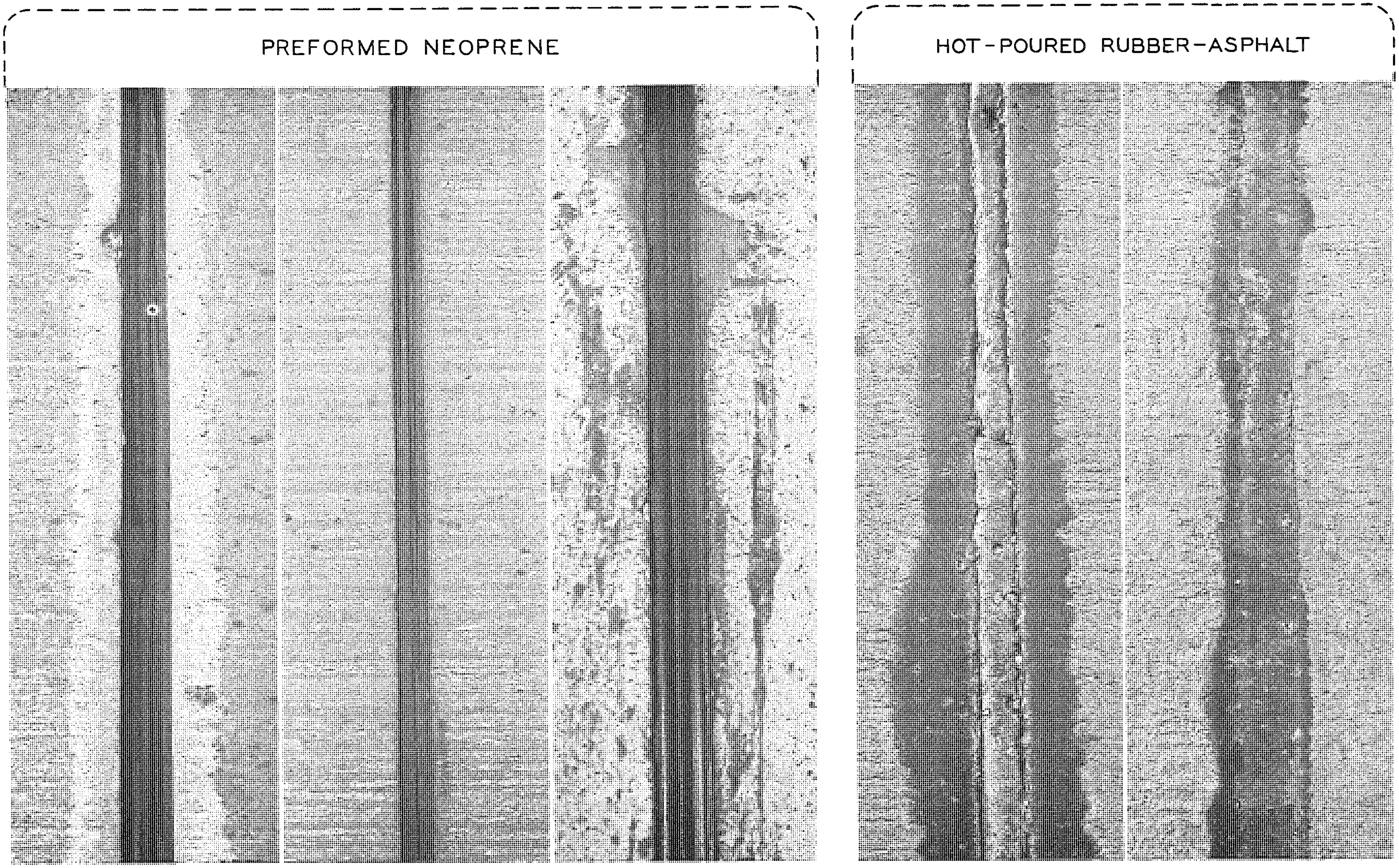
Figure 4. Appearance of expansion joints sealed in 1964, after more than 2 years of service. Top portion of neoprene sealant (left) has split away and is missing, but remaining portion maintains effective seal. Hot-poured rubber-asphalt seals (right) are in good condition.



Sta. 61+96
M 14, Ann Arbor
(Photo: 1-12-67)

Sta. 939+54
M 53, Utica
(Photo: 1-23-67)

Figure 5. Hot-poured expansion joints sealed in 1965 and performing well.



Sta. 178+60
Square Lake Rd., Pontiac
(Photo: 1-20-67)

Sta. 455+38
M 46, Kingston
(Photo: 1-24-67)

Sta. 367+39
M 47, Saginaw
(Photo: 1-25-67)

Sta. 432+05 (SB)
US 127, Holt
(Photo: 2-28-67)

Sta. 533+66 (NB)
US 127, Holt
(Photo: 2-28-67)

Figure 6. Appearance of expansion joints sealed in 1966, during their first winter of service. Typical neatly installed neoprene sealants are shown at left. Performance of hot-poured rubber-asphalt sealer was variable within the same project (right), with joint showing shallow adhesion failure adjacent to joint in good condition.

No two-component, cold-applied elastomeric seals in 1964 projects were selected for continuing survey.

Generally good performance of hot-poured, rubber-asphalt seals was observed on two projects, although minor adhesion and cohesion failures were found.

Joints Sealed in 1965

The two 1965 projects surveyed had neoprene contraction joints and hot-poured rubber-asphalt expansion joints. They were paved during 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 1965 and early 1967 show excellent performance.

Joints Sealed in 1966

For preformed neoprene sealants, 1966 projects had expansion joint grooves sawed to 1-1/4 in. Sealers had theoretical compressions of 14 to 24 percent at the time of inspection. Prior studies show that expansion joints close progressively with years of service, so that the 1966-67 winter joint widths are maximums. Some measurements of sealer depth below pavement surface were greater than specified, although average depths are not considered excessive.

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. The February 1967 inspection shows varying behavior. Seven consecutive joints have considerable shallow adhesion failure along both joint faces with an unusual amount of embedded stone in the surface. The next four consecutive joints are excellent in appearance and have no adhesion failure. Laboratory examination of materials from these two groups of joints showed that the materials are identical in appearance, but that material from the poorer joints has a lower melting temperature. Flow tests show that both materials still meet specification requirements.

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. Contraction joint grooves were sawed so that quality of installation and frequency of spalling could be compared with other projects where joint grooves were formed with temporary fillers.

Expansion Joints

At Holland, expansion joint grooves were all initially formed using 1-in. temporary fillers. Various joints were then sealed with preformed neoprene expansion joint sealers in three categories:

Group 1. Standard 1-in. grooves were sealed with 1-3/8-in. thin-wall neoprene, with the exception of one groove in which 1-1/2-in. thin-wall neoprene was used. This latter material had been submitted as 1-3/8-in. sealer, but was oversize and was designated as 1-1/2-in. nominal size.

Group 2. Standard 1-in. grooves were sawed to 1-1/4-in. and sealed with 1-5/8-in. thin-wall neoprene.

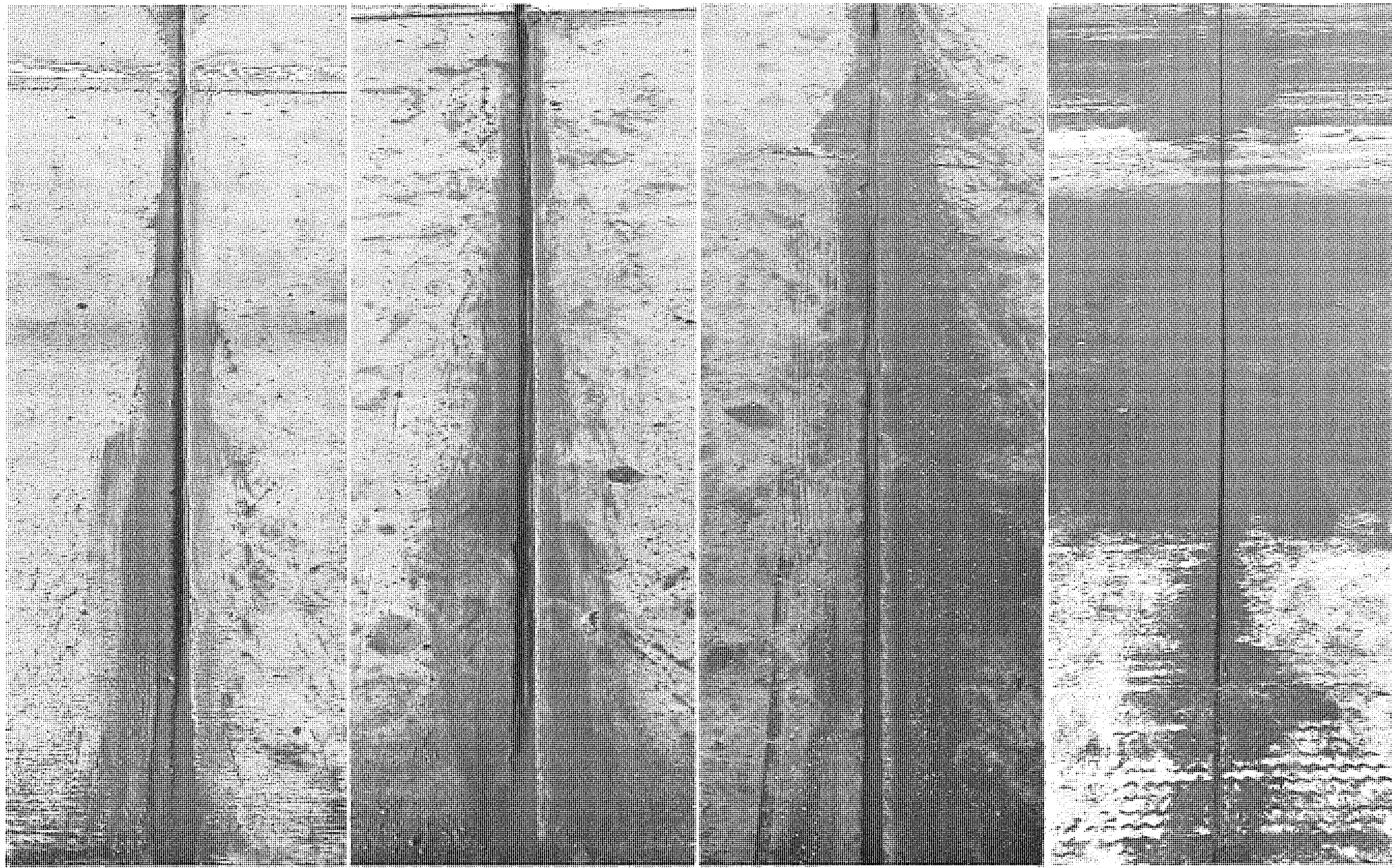
Group 3. Standard 1-in. grooves were sawed to 1-1/4-in. and sealed with 1-5/8-in. regular weight neoprene.

At Holt (Holt Road over US 127 and US 127 South of Holt Road to I 96), expansion joints were formed by sawing 1- by 2-1/4-in. grooves before uncontrolled cracking occurred. These were then sealed with 1-5/8-in. thin-wall neoprene. Upon inspection in early December 1965, shortly after completion of sealer installation, all expansion joints were neat in appearance, but all five different types of installation had isolated spots where sealer was low in the groove. The second winter inspection in January-February 1967 showed that the only group that had not moved downward significantly in the joint groove was Group 3 at Holland (Table 3). Typical installations of the different types are shown in Figure 7. The US 127 project was sealed in early 1966 and initial inspection in January 1967 showed that the seals were well placed and neat in appearance. The joints inspected in detail had no exceptionally low spots (Table 3), but a cursory inspection of other joints showed a few isolated spots where sealer depth was uneven. Inspection in the 1967-68 winter will be necessary to show whether the sealer will be pushed down, as was the case for the same type of installation on Holt Road over US 127.

TABLE 3
SUMMARY OF EXPERIMENTAL NEOPRENE SEAL PERFORMANCE

Sealed	Joint Type	Project Number		Location	Specified Sawed Joint Groove Dimensions, in.		Specified Seal Width, in.	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, %		
		Michigan	Federal		Width	Depth				Max.	Min.	Avg.		Repaired	Existing	Max.	Min.	Avg.	Max.	Min.	Avg.
1965	Contraction	BI 33035B, C1	F 146(17)	Holt Rd. over US 127	3/8	2	13/16	12-17-65	30	0.50	0.43	0.46	Sawing	1.0	0.3	0.50	0.06	0.28	47	38	43
								1-10-67	28	0.80	0.48	0.58		--	2.7	0.50	0.09	0.31	41	15	29
		U 70012B, C2	U 210(20)	US 31BR, Holland	1/2	2	1-1/4	12-16-65	30	0.85	0.64	0.72	Temporary Filler and Sawing	2.9	1.4	0.53	0.06	0.25	49	32	42
								2-9-67	28	1.10	0.65	0.81		--	10.7	0.91	0.00	0.50	48	12	35
	Expansion	BI 33035B, C1	F 146(17)	Holt Rd. over US 127	1	2-1/4	Thin Wall 1-5/8	12-17-65	30	1.28	1.09	1.18	Sawing	9.6	1.1	0.66	0.12	0.33	33	21	27
								1-10-67	28	1.13	0.87	1.00		--	7.8	1.59	0.00	0.88	47	31	39
		U 70012B, C2	U 210(20)	US 31BR, Holland	1-1/4	2-1/4	Regular 1-5/8	12-16-65	30	1.46	1.12	1.37	Temporary Filler and Sawing	0.8	1.1	0.88	0.12	0.40	31	10	15
								2-9-67	28	1.27	1.14	1.23		--	0.8	0.91	0.22	0.48	30	22	24
					1-1/4	2-1/4	Thin Wall 1-5/8	12-16-65	30	1.53	1.41	1.47	Temporary Filler and Sawing	0.9	1.8	0.53	0.16	0.35	13	6	9
								2-9-67	28	1.62	1.20	1.31		--	3.2	1.44	0.16	0.69	26	0	19
					1	2-1/4	Thin Wall 1-3/8	12-16-65	30	1.58	1.32	1.44	Temporary Filler	2.1	2.0	0.88	0.12	0.32	4	0	0
								2-9-67	28	1.33	0.95	1.17		--	4.3	1.31	0.19	0.65	30	3	15
					1	2-1/4	Thin Wall 1-1/2*	12-16-65	30	--	--	1.48	Temporary Filler	0.0	0.0	0.47	0.19	0.34	--	--	1.3
								2-9-67	28	--	--	1.15		--	0.5	1.12	0.66	0.87	--	--	23
1966	Contraction	F 33035B, C1	F 146(17)	US 127, Holt Rd. to I 96	3/8	2	13/16	1-11-67	25	0.67	0.42	0.53	Sawing	0.5	1.5	0.72	0.19	0.26	48	18	35
	Expansion	F 33035B, C1	F 146(17)	US 127, Holt Rd. to I 96	3/8	2	Thin Wall 1-5/8	1-11-67	25	1.10	0.69	0.88	Sawing	4.0	4.3	0.63	0.06	0.38	58	32	46

*Only one joint sealed with material of this size.



Sta. 323+65 US 31BR, Holland (Photo: 2-9-67)	Sta. 314+60 US 31BR, Holland (Photo: 2-9-67)	Sta. 301+08 US 31BR, Holland (Photo: 2-9-67)	Sta. 97+43 Holt Rd., Holt (Photo: 1-10-67)

Figure 7. Experimental neoprene expansion joint installation after 1 year of service: 1-5/8-in. regular weight in 1-1/4-in. groove (left), 1-5/8-in. thin wall in 1-1/4-in. groove (left center), 1-3/8-in. thin wall in 1-in. groove, and 1-5/8-in. thin wall in 1-in. groove.

Contraction Joints

At Holland, contraction joint grooves were constructed using 1/4- by 2-in. temporary fillers and subsequently sawing over the filler to form 1/2- by 2-in. grooves after the concrete had cured. These joints were sealed with standard 1-1/4-in. preformed neoprene contraction joint sealer.

At Holt (Holt Road over US 127 and US 127 south of Holt Road to I 96), 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 contraction joint installations were first inspected at the same time as the expansion joints, in early December 1965. At both locations, the contraction joints were excellent in appearance, tight, and had very few patched or unpatched spalls. The most significant observation was considerably less twisting of the seal and greater uniformity of depth below the pavement surface than in installations where joint grooves were not sawed.

The thin temporary filler used at Holland was difficult to place and keep straight, as reported by construction personnel. In some cases, it was impossible to saw exactly over the filler where it was out of alignment, resulting in a variable joint groove width (Table 3). The February 1967 inspection showed that the sealer moved down from an average of 0.25 to 0.50 in. below the pavement surface during the year between inspections. There was no noticeable change in appearance of the 13/16-in. neoprene-sealed joint on Holt Road.

The 13/16-in. neoprene-sealed joints on US 127 were initially inspected in January 1967. These were excellent in appearance and had a theoretical compression of 35 percent, with few repaired or existing spalls along joint groove edges.

It should be pointed out that paving where the 3/8-in. joint grooves were sawed and 13/16-in. neoprene sealer was installed, was done late in the season at moderate temperatures. The joint grooves, therefore, would not be expected to open as much during the winter as would grooves made during hot weather paving.

SUMMARY

Periodic inspections have been conducted on construction projects covering more than 70 miles of roadway built from 1964 through 1966. Preformed neoprene sealers are performing satisfactorily and better than either hot-poured or cold-applied sealers, with some exceptions where hot-poured rubber-asphalt sealed expansion joints are performing well.

Inspections confirm that significant improvements were accomplished in installation of preformed neoprene joint seals in 1966, due to sawing of joint grooves and use of machine installation. Further improvements are expected with more experience in sawing and further refinement of installation equipment. Uniformity of sealer dimensions has also improved considerably, which no doubt has been another contributing factor.