FAILURE OF I 94 JOINT SEALANTS
Mt. Clemens to Marysville

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Research Laboratory Division
Office of Testing and Research
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Joint sealant performance on I 94 projects between Mt. Clemens and Marysville was surveyed on November 20, 1963, as a result of a request that a Research Laboratory representative accompany James Dykstra of the Office of Construction for an inspection to determine. if possible, the cause or causes of poor sealant performance on recently opened projects throughout this entire 30-mile section of I 94. D. F. Simmons of the Research Laboratory and Mr. Dykstra were accompanied by G. D. Krotchko and B. W. Steffarud of the Bureau of Public Roads, who had surveyed the projects previously and were dissatisfied with the quality of the work. L. R. Parr of the Graphic Presentation Section accompanied the survey party to obtain a photographic record.

Typical joints in each of the four joint sealing contractors' working areas were thoroughly inspected and photographs were taken. Available paving and sealing data for these projects are given in Table 1. Sealing operations were still under way in some areas of the two northernmost projects on the day of the inspection trip. Frequent instances of sealant cohesion and adhesion failure were found in joints sealed previously, as shown in Figs. 1 through 6. Although these failures varied in type and

extent among the projects, at least 80 percent of all joints exhibited some form of failure. A considerable amount of dirt also was found in many of the sealed joints, and it should be noted that shouldering operations on nearly 25 miles of this portion of I 94 took place after joints had been sealed.

P. J. Serafin of the Testing Laboratory Division made a cursory inspection of these projects on January 2, 1964, and summarized his findings (with related laboratory test data on the sealants) in a memorandum to E. A. Finney dated January 6. His inspection indicated that northbound roadway joints sealed by Davidson (BI 50111I, C12) and Hertel-Deyo (BI 50111J, C13) were in fairly good condition except for some spalling along joint edges. This differs from conditions observed November 20 on the corresponding southbound roadway joints (Figs. 1 and 2). A sealer sample taken by Serafin from a northbound roadway joint indicated no evidence of overheating.

In joints sealed by Denton (BI 50111K, C22, and BI 50111A, C1), Mr. Serafin found adhesion and cohesion failures, dirt infiltration, and some evidence of overheating in a sample taken from a northbound roadway joint. This agrees with conditions observed by Simmons and Dykstra on November 20 (Figs. 3 and 4).

Joints in one of the three projects sealed by Sargent (BI 77111A, C2) were reported by Serafin as exhibiting many instances of cohesion and

adhesion failures and considerable sand and gravel in the joints. This agrees with conditions shown in Fig. 5. Serafin's sealer sample from BI 77111A, C2, also showed some evidence of overheating.

Examination of those joints in Sargent's Project BI 77111B, C3, which had already been sealed at the time of the November survey revealed considerable adhesion and cohesion failures as shown in Fig. 6. When observed by Serafin in January, the joints in this and in Sargent's last project (BI 77111D, C4) appeared to be in generally satisfactory condition.

The laboratory tests summarized in the table indicate that all sealants, from three different producers, met specification requirements. Some material may have been borderline in quality, as evidenced by failure of one out of three samples in bond tests of three different lot numbers. Serafin mentions that increasing competition among joint seal producers has resulted in many hot-pour sealants being "of just barely passable quality." Some joint seal lots required melting temperatures of 370 to 380 F, but most lots required 420 F. Overheating of sealants has been mentioned as a factor in the failures, but this was probably not the primary problem, considering the number of sealing days, the quantity and variety of sealers used, and the different contractors and equipment involved.

Since the I 94 contracts in question were sealed under varying weather conditions from summer through late fall of 1963, by four different contractors using sealants from three different producers, it is difficult to explain why such a high proportion of the sealing was of generally poor quality. The fact that most shouldering operations were conducted after completion of sealing would not in itself explain the generally poor condition of the sealants. There is also no information on where the sealers represented by tested samples were actually used in the field, and indeed information on activities of the sealing contractors is generally incomplete, since sealing is a "non-pay" contract item for which detailed records are not required. Thus, even identification of the failed sealant in a specific joint is necessarily tentative.

Due to the poor quality of joint sealing prevailing on these projects, Messrs. Dykstra and Simmons recommend that all substandard joints be properly cleaned and resealed under close inspection.

TABLE 1

SUMMARY OF AVAILABLE CONSTRUCTION DATA FOR I 94 PROJECTS FROM MT. CLEMENS TO MARYSVILLE

Listed from South (POB) to North (POE)

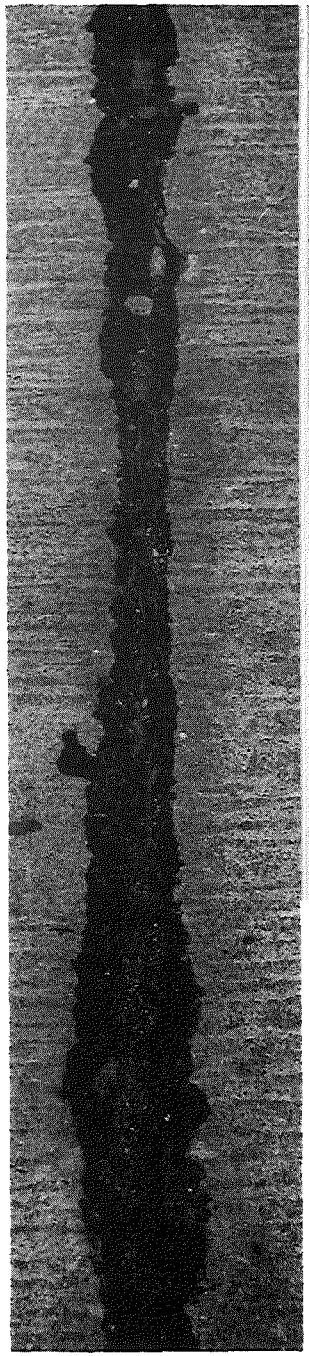
Project	Stations	Location	Length, miles	Paving Contractor	Pour Dates	Sealing Contractor	Sealing Location and Dates	Sealer Used[a]	Batch or Lot No. (a)	Test Results[b]				
										Pour Point, deg F	Melting Time, min	Penetration	Flow	Bond
BI 50111, C12	63+42.7 to 204+00	Clinton River	2.428	L. A. Davidson	6-20-63 to 8-29-63	Davidson	Northbound and Southbound: 8-3-63 to 8-8-63 (Sta 63+42.7 to 204+00)	Allied	158	420	50	0.62	0.10	2P (1F-5th)
								Allied	481	420	50	0.62	0.10	3P
								Servicised	3068	430	55	0.77	0.20	3P
								Servicised	3100	370	35	0.85	0.30	3P
								Servicised	8010	430	50	0.82	0.10	3P
BI 50111J, C13	204+00 to 430+00	Joy Road to Cotton Road	4.225	Hertel-Deyo Co. and Blue Water Excavating Co.	7-22-63 to 10-30-63	Hertel-Deyo	Northbound and Southbound: 8-25-63 to 9-7-63 (Sta 230+00 to 430+00) 11-1-63 to 11-7-63 (Sta 204+00 to 230+00)	Allied	210	420	50	0.59	0.10	2P (1F-4th)
BI 50111K, C22	430+00 to 473+24.42	Cotton Road to 23 Mile Road	0.819	Canonie Construction Co.	6-20-63 to 8-14-63	Denton Construction Co.	Northbound and Southbound: 8-25-63 to 9-7-63 (Sta 430+00 to 809+00)	Servicised	8013	370	35	0.77	0.10	3P
								Servicised	8015	370	35	0.87	0.20	3P
BI 50112A, C1	473+24.42 to 809+00	23 Mile Road to Macomb-St. Clair County Line	6.359											
BI 77111A, C2	809+00 to 1120+00	Macomb-St. Clair County Line to St. Clair Highway	5.890	Sargent Construction Co.	6-18-63 to 9-16-63	Sargent	Northbound: 8-9-63 to 8-15-63 (Sta 809+00 to 919+00 and Sta 1041+00 to 1120+00) Southbound: 8-6-63 to 8-7-63 (Sta 844+00 to 1026+00) 8-14-63 (Sta 1041+00 to 1120+00)	Allied	210	420	50	0.59	0.10	2P (1F-4th)
								Allied	211	420	50	0.62	0.10	3P
BI 77111B, C3	1120+00 to 1362+00	St. Clair Highway to Big Hand Road	4.583	Sargent Construction Co.	7-24-63 to 9-21-63	Sargent	Northbound: 8-15-63 (Sta 1120+00 to 1150+00) 11-23-63 (Sta 1150+94 to 1201+00 and Sta 1243+00 to 1245+00) Southbound: 8-14-63 (Sta 1120+00 to 1150+00) 11-20-63 to 11-23-63 (Sta 1181+00 to 1251+00)	Allied	214	430	55	0.57	0.10	3P
BI 77111D, C4	1362+00 to 1699+00	Big Hand Road to US 25 Jct.	6.322	Holloway Construction Co.	9-20-63 to 11-13-63	Sargent	Northbound and Southbound: 11-20-63 to 12-1-63 (Sta 1362+00 to 1699+00)*	Servicised	3151	380	35	0.82	0.10	3P
								Permiteco	8311A	400	35	0.67	0.30	2P (1 B. F.)
								Permiteco	8311C	400	40	0.68	0.30	3P
								Permiteco	8311D**	400	40	0.68	0.30	3P

* Only project where sealing occurred after construction of shoulders.

** Part of this batch also used for resealing some joints on other Sargent projects (BI 77111A, C2, and BI 77111B, C3), where dirt had been embedded in sealants during shouldering operations.

(a) Data obtained directly from Road Construction Division project engineers.

(b) Data obtained from Testing Laboratory Division. Pour point and melting time not specified, but safe heating temperature must be at least 20 deg higher than pouring temperature recommended by manufacturer. Other specification requirements: "Penetration," 0.90 cm max; "Flow," 0.5 cm max; "Bond," at least two out of three specimens must pass five cycles.



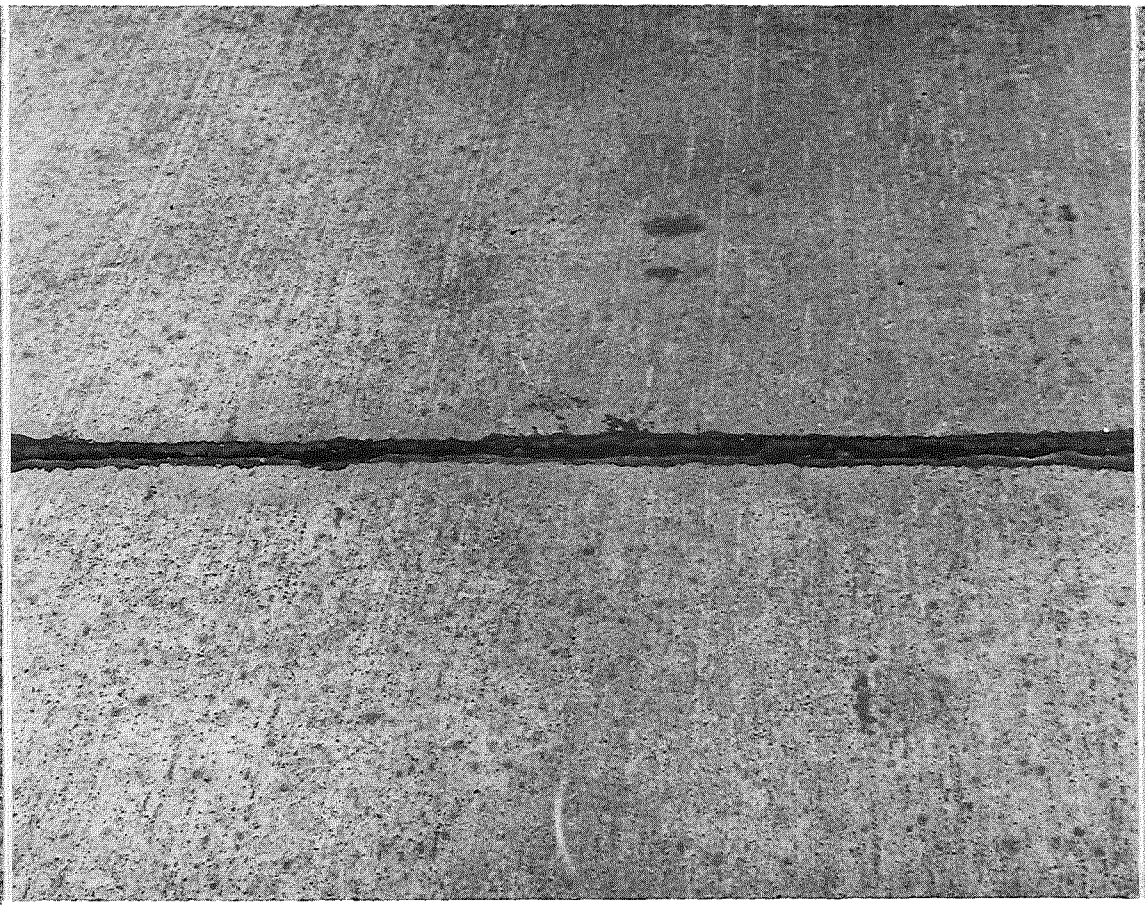


Figure 1 (left). Typical adhesion failure with sand and gravel embedded in joint seal (Project BI 50111 I, C12, Sta. 87+70 SB).

Figure 2 (above). Typical cohesion failure, with much infiltration of dirt and sand into joint (Project BI 50111J, C13, Sta. 343+80 SB).

Figure 3 (right). Typical intermittent adhesion failure with embedded dirt (Project BI 50112A, C1, Sta. 538+60 NB).

Figure 4. Typical severe adhesion failure with embedded dirt (Project BI 50112A, C1, Sta. 798+02 NB).

Figure 5. Cohesion failure typical of this area (Project BI 77111A, C2, Sta. 908+02 NB).

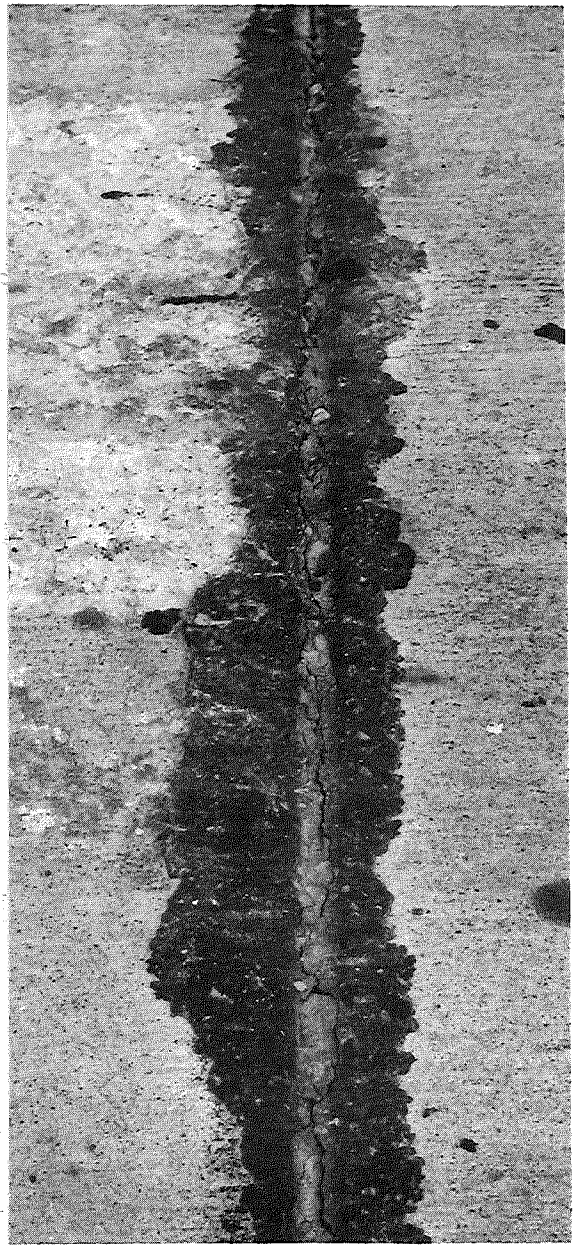


Figure 6. Overfilled joint with typical cohesion - adhesion failure (Project BI 77111B, C3, Sta. 1203+50 NB).

THIRD INSPECTION OF FAILED JOINT SEALANTS
I 94: Mt. Clemens to Marysville
(Supplement to Research Report R-456)

A. J. Permoda

Research Laboratory Division
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Michigan State Highway Department
John C. Mackie, Commissioner
Lansing, July 1964

THIRD INSPECTION OF FAILED JOINT SEALANTS
I 94: Mt. Clemens to Marysville
(Supplement to Research Report R-456)

In accord with a telephone request by R. L. Greenman, a third inspection has been completed of joint sealants installed in 1963 on I 94 projects between Mt. Clemens and Marysville. Two earlier inspections of these joints by Testing and Research personnel were summarized in Research Report R-456, dated April 1964. The third inspection was completed on June 10, 1964, by Ed Rohacz, Pontiac District Special Assignment Engineer; B. W. Steffarud of the Bureau of Public Roads; and A. J. Permoda, D. F. Simmons, and E. A. Finney for the Research Laboratory Division.

The inspection was made at an air temperature of about 70 F, after several days of maximum temperatures over 90 F. Because of this recent heat, the concrete roadway was warmer than the air, producing narrowed joint spaces that measured about 5/8 in. in width. The general external appearance of most of the joint sealants was good, as could be expected since closing of the joint spaces had healed the previously observed adhesion and cohesion failures, exuded sealer out of the joint spaces, and caused it to fold over and overlap adjoining pavement surfaces by varying amounts. This is shown in Fig. 1, which compares current appearance of one sealed joint with its appearance during the first inspection almost seven months earlier.

Probing of joint spaces that had exhibited adhesion and cohesion failures during the previous first inspection showed dirt and aggregate to have infiltrated the sealer. In the case of 1963 adhesion failures, poor bonding of the sealer to the joint face again was apparent (Fig. 2). Although most joint sealants gave a normal external appearance in the June 1964 inspection, showing good resiliency, joints sealed by Denton (BI 50111K, C22, and BI 50111A, C1) were given a poorer rating by the observers because of generally lower resiliency and less overlapping at the joint edges. This is shown in Fig. 3 which compares current appearance of a Denton-sealed joint with its appearance last year.

Summary

Inspection of I 94 joints in June 1964 (seven to ten months after sealant installation) showed most sealers to have about average or normal resiliency and appearance under prevailing warm temperatures. Joints sealed by one contractor presented

a poorer appearance and the sealer was less resilient. Appearance of the joint sealing in the current inspection does not alter the fact that an abnormal amount of adhesion and cohesion failures was observed during previous inspections in November 1963 and January 1964, as described in Research Report No. R-456. These failures have now healed over under warm temperatures that have narrowed the joint space. Road dirt and aggregate infiltrated the sealer in the past through these adhesion and cohesion failures, and this material was readily detected by probing of the joint spaces. It is believed that this infiltrated material (plus loss of sealer that has exuded when joint space narrowed in warm weather) will contribute to poorer-than-average performance of joint sealants to be expected under cooling temperatures during Fall and Winter of 1964.

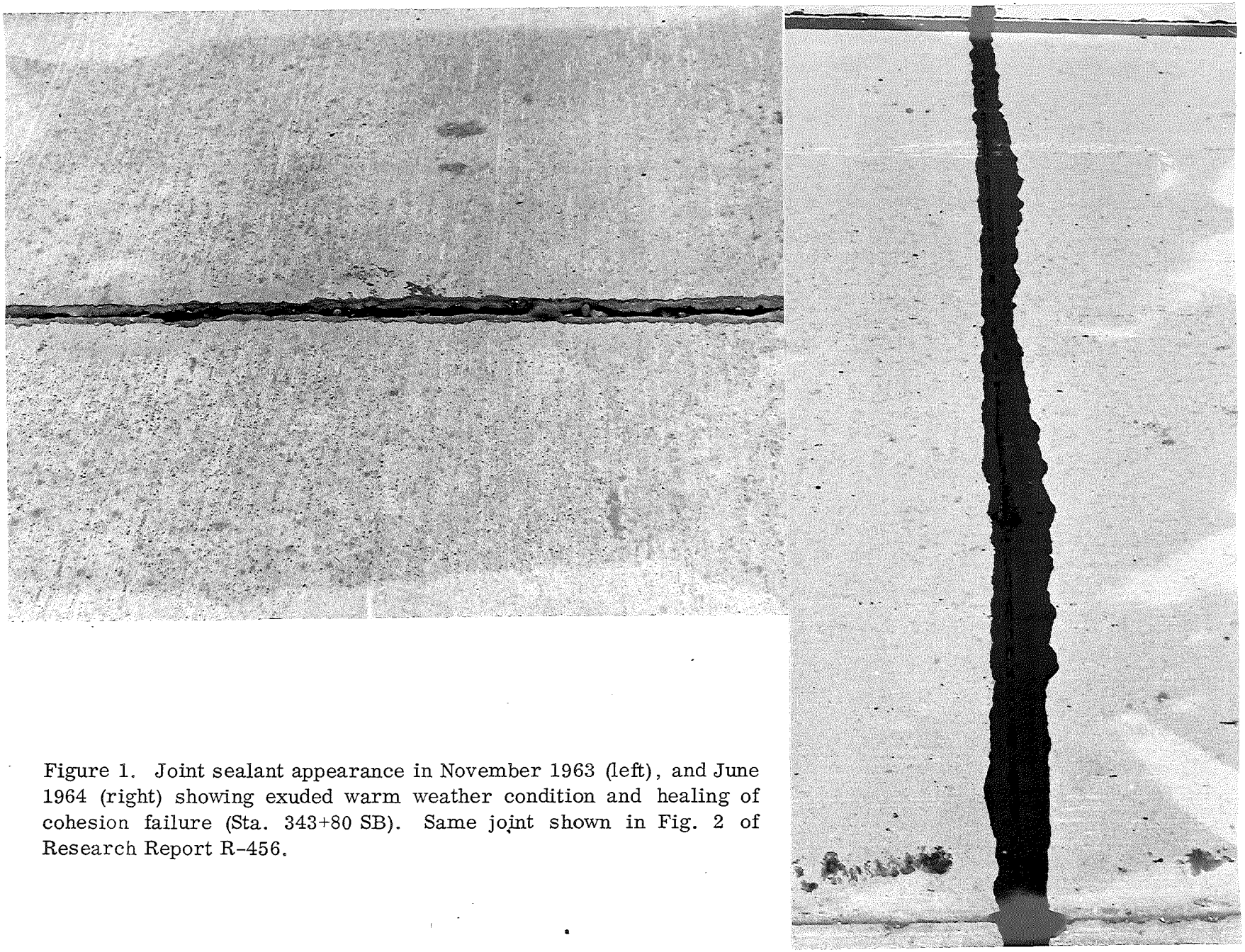

Figure 1. Joint sealant appearance in November 1963 (left), and June 1964 (right) showing exuded warm weather condition and healing of cohesion failure (Sta. 343+80 SB). Same joint shown in Fig. 2 of Research Report R-456.

Figure 2. Adhesion failure with dirt infiltration, preventing good bond of sealant to joint face when joint narrows in warm weather (Sta. 537+30 SB, June 1964).

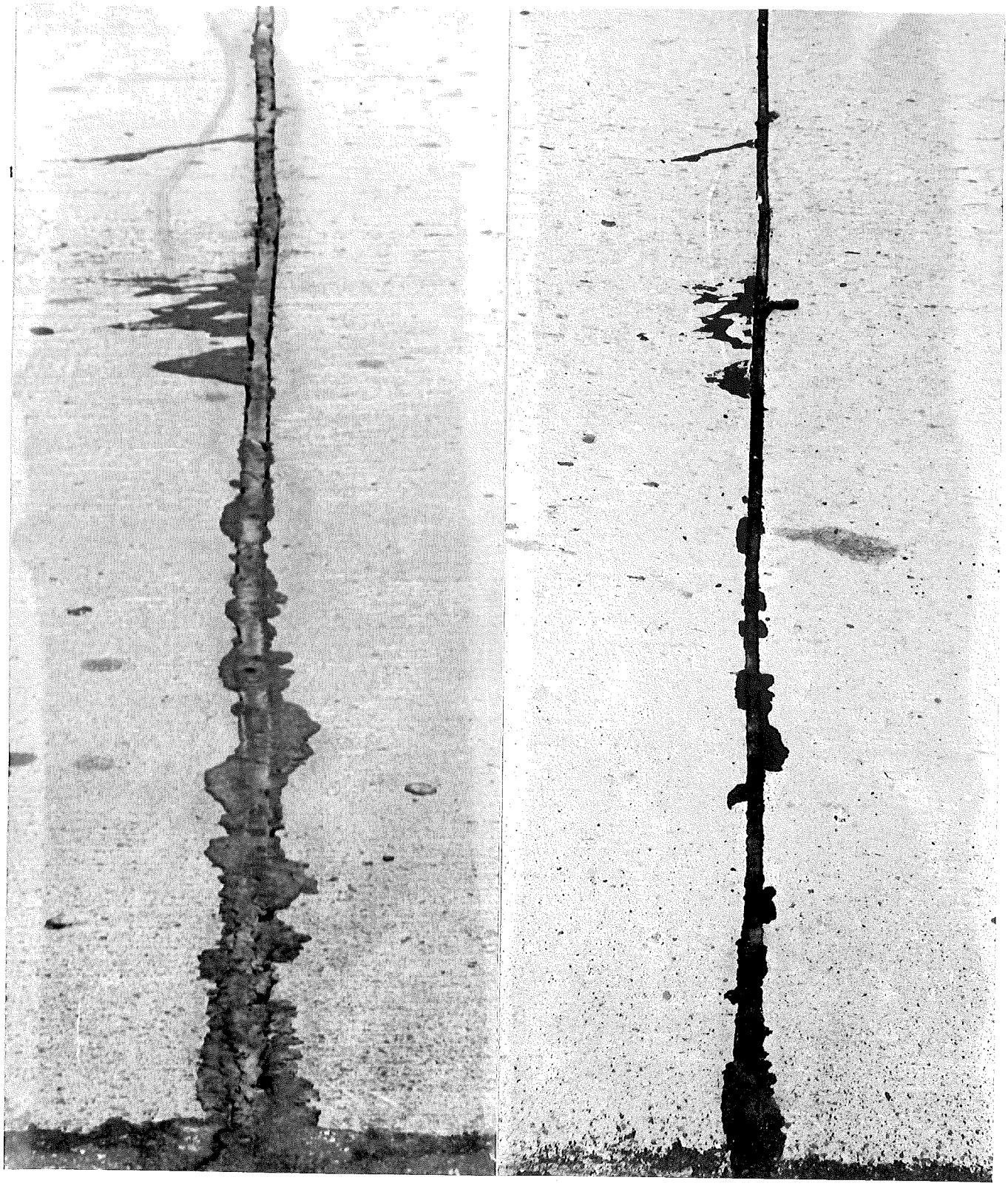

Figure 3. Joint sealant appearance in November 1963 (left) and June 1964 (right) showing little warm weather overlapping of joint edges and poor healing of adhesion failure (Sta. 798+02 NB). Same joint shown in Fig. 4 of Research Report R-456.