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PAVEMENT EVALUATION OF I 94 CONTROL SECTIONS 81041, 81062, AND 81063 Detroit Industrial Expressway from Carpenter Rd. to Rawsonville Rd. (Washtenaw-Wayne County Line)

F. Copple

Research Laboratory Division
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On June 21, 1965, E. A. Finney received a request from G. J. McCarthy for a pavement survey of I 94 between Carpenter Rd. and the Washtenaw-Wayne County Line (Rawsonville Rd.). This request was incorporated into the Research Laboratory Division's current program of pavement evaluation. As a result of previous requests from Mr. McCarthy, similar pavement evaluations have been conducted on adjoining I 94-Detroit Industrial Expressway Control Sections 82021 (Rawsonville Rd. to Hannan Rd.) and 82022 (Ozga Rd. to US 24-Telegraph Rd.). These earlier evaluations were analyzed in Research Reports R-465 (July 1964) and R-523 (June 1965).

General Description of Projects

Pavement inspection was completed on June 25, 1965, by F. Copple and P. M. Schafer. Updating of condition survey maps for these projects was completed on July 8, and pavement roughness measurements were made on July 12. These evaluations included the seven construction projects described in Table 1, which cover an overall distance of about 7-1/2 miles of dual roadway pavement. Project locations are shown in Fig. 1.

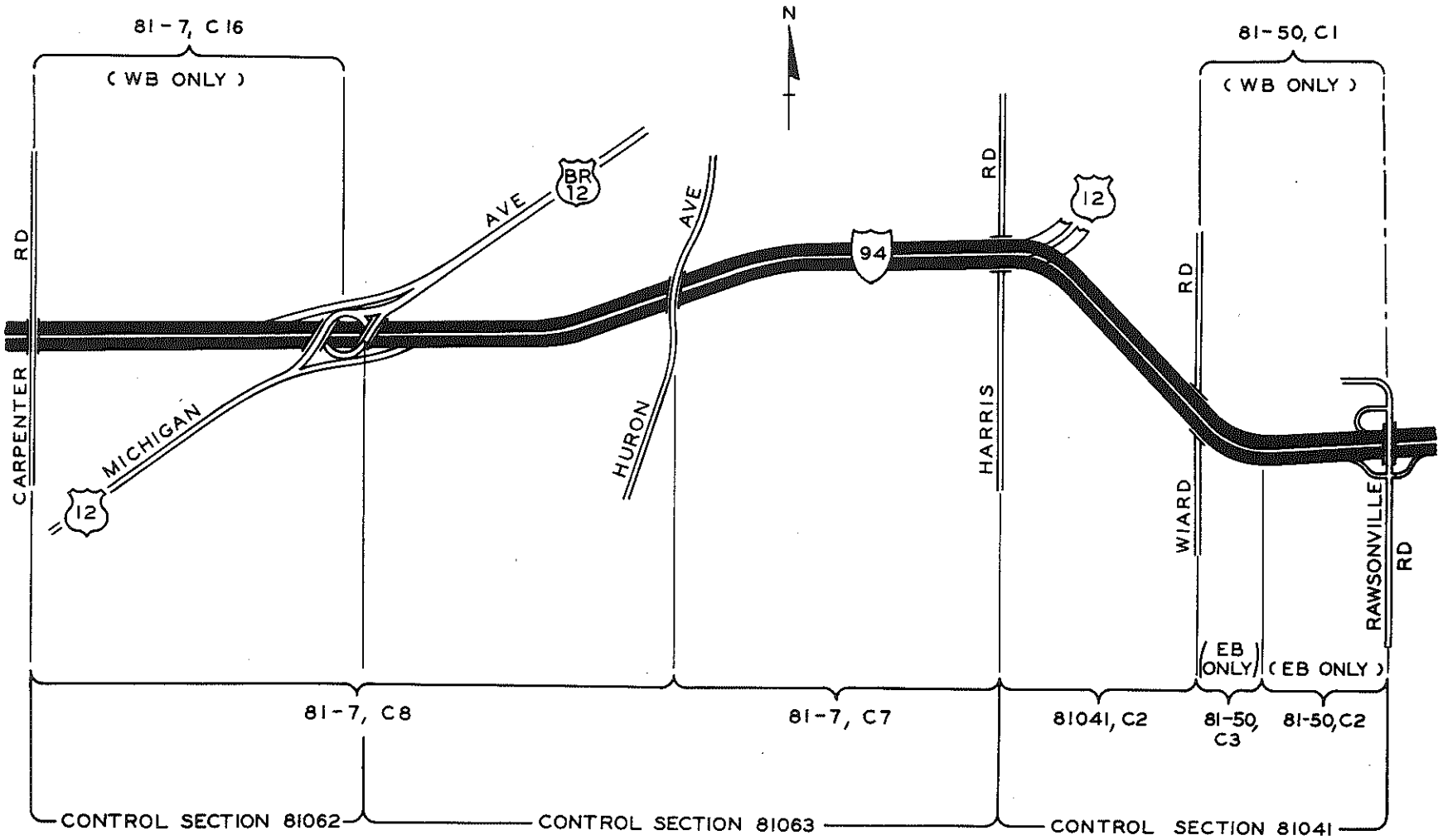

Figure 1. Schematic drawing showing relative locations of I 94 projects from Carpenter Rd. east to Washtenaw-Wayne County Line.

These projects involve the following four different pavement types, for which survey data are listed separately in this report:

a. Rigid pavement constructed during World War II, which was widened and resurfaced in 1955-57.

b. A shorter length of rigid pavement constructed during World War II, which was widened and resurfaced twice--once in 1955 and again in 1962.

TABLE 1
SUMMARY OF CONSTRUCTION PROJECT DATA
Control Sections 81041, 81062, and 81063

Project	Location	Roadway	Length, mi.	Pavement Thickness, in.	Year Constructed	Year Resurfaced
81-7, C8	Carpenter Rd. to Huron Rd.	EB	3.29	9	1943	1955-57*
81-7, C16	Carpenter Rd. to Mich. Ave.	WB	1.28	9	1956	--
81-7, C8	Mich. Ave. to Huron Rd.	WB	2.01	9	1943	1956
81-7, C7	Huron Rd. to Harris Rd.	EB-WB	1.70	9	1944	1956
81041, C2	Harris Rd. to Wiard Rd.	EB-WB	1.32	9	1957	--
81-50, C1	Wiard Rd. to Rawsonville Rd.	WB	1.00	10	1942	1957
81-50, C2, C3	Wiard Rd. to Rawsonville Rd.	EB	C2: 0.68 C3: 0.41	10 9	1942	1957

* Partially resurfaced in 1962 (from Carpenter Rd. to Sta. 16+00).

c. Rigid pavement constructed during World War II, which was widened and resurfaced in 1955 in an experimental project using steel-reinforced bituminous concrete.

d. Rigid pavement constructed in 1956-57, without subsequent bituminous surfacing or resurfacing.

Projects constructed in 1942, 1943, and 1944 shared the following characteristics:

Pavement type--portland cement concrete (including slag coarse aggregate in Project 81-7, C8)
Pavement width--22 ft
Reinforcement--none
Expansion joints--120-ft spacing, 1-in. width
Contraction joints--20-ft spacing
Load transfer--none.

In 1955-57, these 1942-44 pavements were widened to 24 ft and resurfaced with bituminous concrete, which is the present wearing surface.

During the 1955 resurfacing of Project 81-7, C8, two test sections of welded wire mesh continuous reinforcement, of 3299- and 4505-ft lengths, were placed beneath the bituminous concrete mat. Performance of this reinforced resurfacing was reported in 1962.[1] Additional roughness measurements and condition survey data for the reinforced resurfacing were obtained in 1965 and are listed in this report.

Project 81-7, C16 was constructed in 1956 and Project 81041, C2 in 1957, with the following characteristics:

Pavement type--portland cement concrete
Pavement width--24 ft
Reinforcement--wire mesh
Expansion joints--none
Contraction joints--99-ft spacing
Load transfer--1-1/4-in. diam bars at 12-in. centers.

Traffic Division data show a 1964 traffic count for the area under study of about 30,000 to 35,000 vehicles per day, about 20 percent of which were commercial.

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[1] Lindy, O. L. "Continuously Reinforced Bituminous Resurfacing: Detroit Industrial Expressway (I 94), West of Ypsilanti." MSHD Research Report No. R-365 (Jan. 1962).

Results of Inspection and Field Survey

Condition surveys were made on each project, using sample 500-ft lengths of pavement which were selected at random. A minimum of one such sample per pavement mile was surveyed in both the eastbound and westbound roadways. These surveys indicated that almost all transverse joints and longitudinal widening strip joints had reflected through the bituminous surface. Fig. 2 shows a typical reflection crack pattern. Table 2 lists transverse cracking data for each construction project. Excepting the reinforced bituminous areas, all projects exhibited more transverse cracking in traffic lanes than in passing lanes. The passing lane transverse crack intensity in the reinforced bituminous surface was about 60-percent higher than in any other area. However, the occurrence of transverse cracks in the traffic lane of this experimental pavement was no greater than in nonreinforced bituminous surfaces.

The frequency of transverse cracking varied considerably among construction projects of similar design and age. Of bituminous-surfaced projects, Project 81-7, C8 averaged about 70-percent more transverse cracks than 81-50, C2 or C3. For rigid pavements, Project 81041, C2 averaged more than twice as many transverse cracks as 81-7, C6. Further, many of the transverse cracks in Project 81041, C1 were open about 1/4-in., suggesting broken reinforcing steel (Fig. 3).

Longitudinal cracking (Table 3) was negligible in the rigid pavement. The reinforced bituminous pavement did not differ significantly in this regard from the nonreinforced bituminous surface. Except for the short stretch of 1962 bituminous resurfacing, the entire length of the widening

Figure 2 (left). Typical reflection cracking over the longitudinal widening strip joint.

Figure 3 (below). Transverse cracking in Project 81041, C|2; note open cracks at center and right.

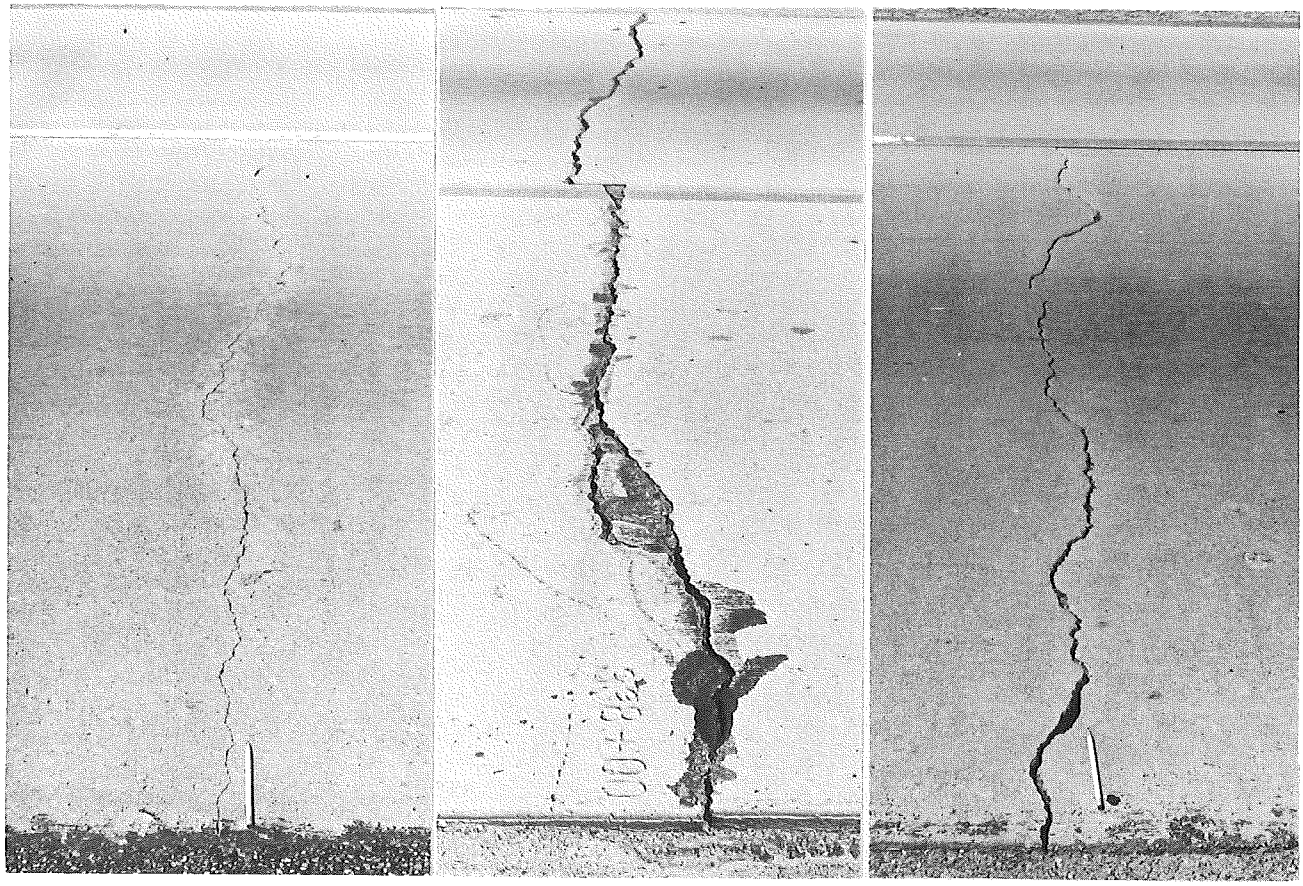


TABLE 2
SUMMARY OF TRANSVERSE CRACKING

Project, Surface Type, and Year	Roadway	Cracks per 500-ft Sample Length		
		Traffic Lane	Passing Lane	Total
BITUMINOUS RESURFACING				
Project 81-7, C8				
Reinforced (1955)	EB	41.5*	84.0*	125.5
Nonreinforced (1955)	EB	50.0*	46.0*	96.0
Nonreinforced (1962)	EB	10.0*	20.0*	30.0
Nonreinforced (1955)	WB	51.0*	35.5*	86.5
Project 81-7, C7 (1956)	EB	38.5*	32.0*	70.5
	WB	42.5*	32.5*	75.0
Project 81-50, C2, C3 (1957)	EB	30.0	31.0	61.0
	WB	31.0	32.0	63.0
CONCRETE				
Project 81-7, C16 (1956)	WB	19.0*	13.0*	32.0
Project 81041, C2 (1957)	EB	38.5*	29.0*	67.5
	WB	46.0*	30.0*	76.0

* Average of measurement of two 500-ft sample sections.

TABLE 3
SUMMARY OF LONGITUDINAL REFLECTION CRACKING IN BITUMINOUS RESURFACING

Project and Year	Roadway	Total Length, ft per 500-ft Sample Length		
		Widening Joint	Centerline Joint	Other
Project 81-7, C8				
Reinforced (1955)	EB	500*	500*	74
Nonreinforced (1955)	EB	500*	415*	76
Nonreinforced (1962)	EB	26	27	0
Nonreinforced (1955)	WB	500*	172*	95
Project 81-7, C7	EB	500*	105*	284*
	WB	363*	10*	206*
Project 81-50, C2, C3	EB	500	500	85
	WB	500	500	176

* Average of measurements of two 500-ft sample sections.

strip joint had reflected through the bituminous mat. Surface deterioration (Fig. 4) appeared frequently in one portion of the reinforced bituminous section (Stas. 16+00 to 46+06), and occasionally for short 200- to 300-ft lengths in other areas. However, most of the bituminous surface appeared as shown in Fig. 5 and exhibited no notable deterioration.

Several joint repairs were found in the resurfaced pavement (Fig. 6); it is assumed that these were required because of joint blowups in the portland cement concrete base. Defining "joint repair" as pavement replacement for the full width of one lane, these totaled 37 in the eastbound roadway (6.1 per mile of resurfaced pavement) and 28 in the westbound (5.9 per mile of resurfaced pavement).

The Michigan roughometer was used to measure roughness in the traffic lane of each roadway over the entire length of every project (Table 4). Using Michigan's rating scale for riding quality (in which 0 to 130 accumulated inches per mile of roughness = "good"; 130 to 175 in. = "average"; and over 175 in. = "poor"), Project 81041, C2 was surprisingly good (128 in. per mi) in view of the relatively high intensity of open transverse cracks. On the other hand, Project 81-7, C8 (both the nonreinforced and reinforced bituminous concrete sections), and 81-7, C7 must both be considered to have poor riding qualities.

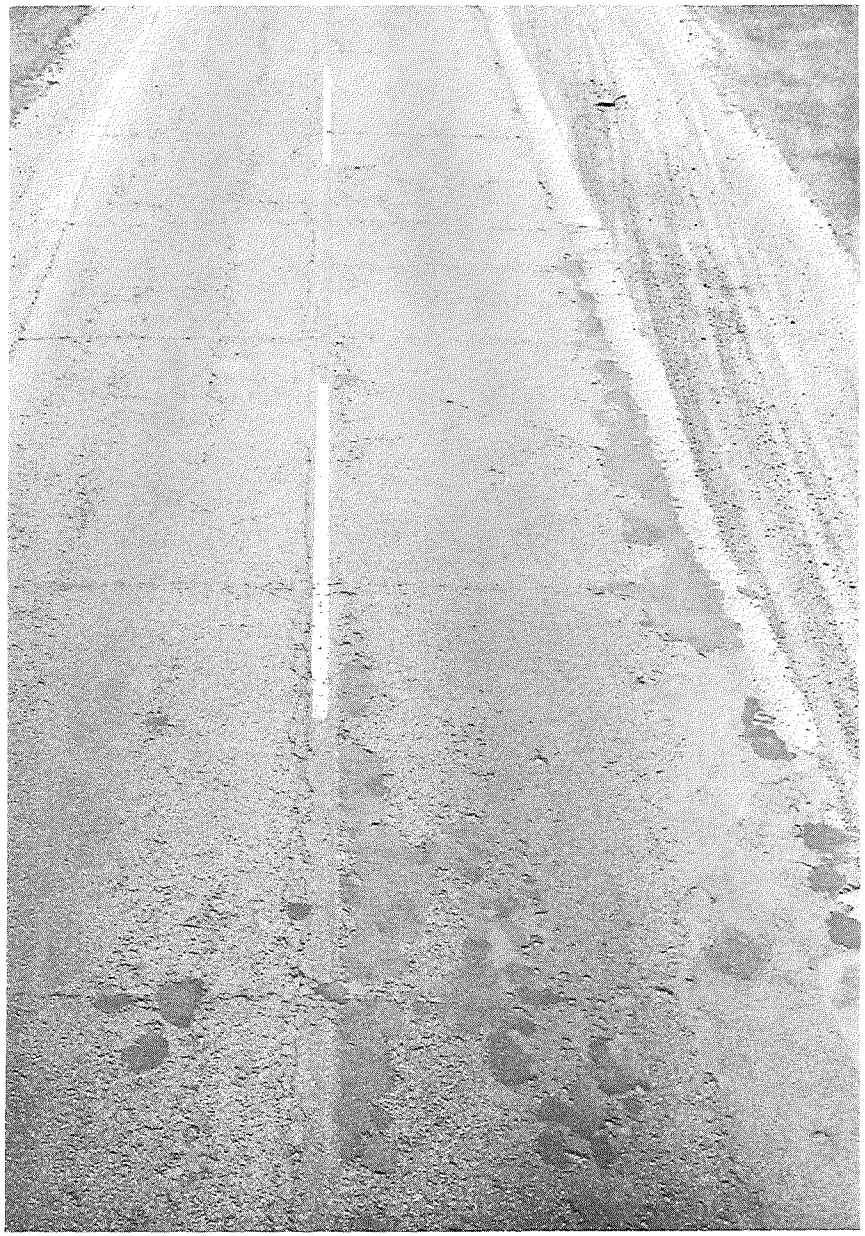


Figure 4. Advanced deterioration in evidence over a large portion of reinforced bituminous surface.

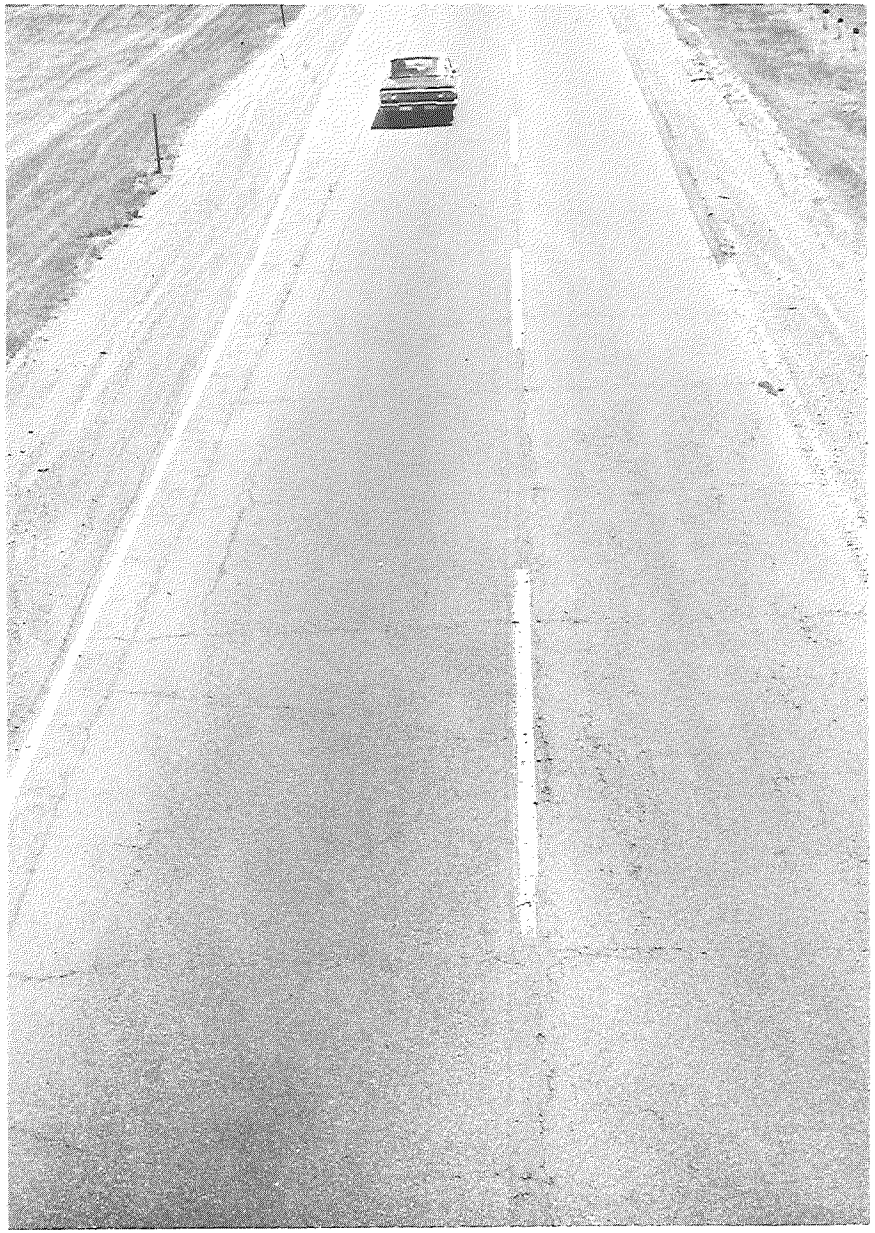
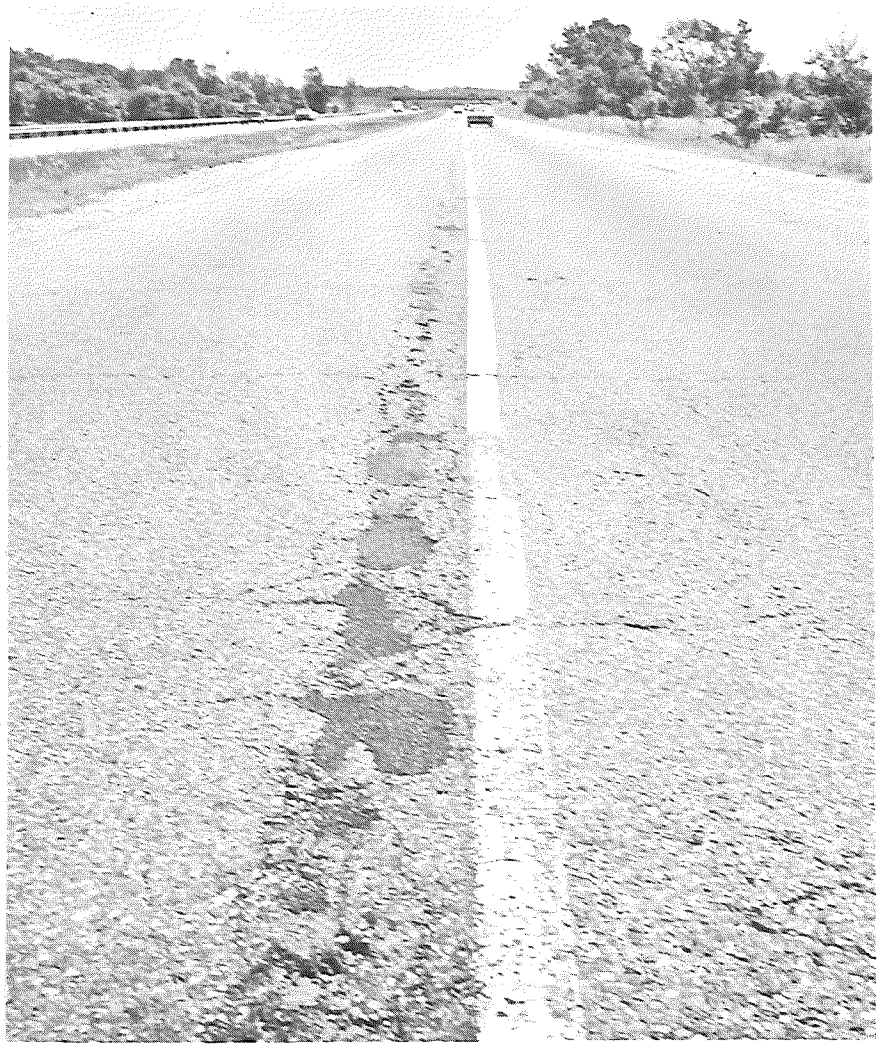


Figure 5. Typical deterioration over most of the bituminous surface.

Figure 6 (left). Typical joint repairs in resurfaced pavement.

Figure 7 (below). Deterioration along reflection crack, on eastbound roadway.



Discussion of Results

Because I 94 pavement between Carpenter and Rawsonville Rds. is generally elevated higher than the surrounding terrain, surface drainage appeared to be good.

The existing rigid pavement with its good riding quality and absence of widespread deterioration should continue to carry traffic without requiring major repairs. Thus, the rigid pavement could be widened without resurfacing. However, transverse cracks in the concrete should be sealed before water penetration causes structural damage.

TABLE 4
SUMMARY OF PAVEMENT RIDING QUALITY

Bituminous Resurfacing			Concrete		
Project	Years of Service	Inches per Mile*	Project	Years of Service	Inches per Mile*
81-7, C8			81-7, C16	9	155
Reinforced	10	242**			
Nonreinforced	10	249**	81041, C2	8	128
81-7, C7	9	214			
81-50, C2, C3	8	139			

* Riding Quality Scale: "Good" -- 0 to 130 in.
"Average" -- 130 to 175 in.
"Poor" -- over 175 in.

** Average of two measurements

The projects surfaced with bituminous concrete should provide a firm foundation if resurfaced. Experience elsewhere, however, has shown that unless some preventive measures are taken, approximately 50 percent of the old pavement cracks reflect through a new bituminous surface

after about 2 years of service.[2] Deterioration usually occurs in a narrow band parallel to reflection cracks (Fig. 7), and riding quality degenerates. It has been found that a soil aggregate cushion about 4-in. deep can reduce reflection cracking to less than 10 percent. Further, a soil-aggregate cushion could provide an insulating layer effective in reducing joint blowups in the resurfaced rigid pavement.

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[2] Copple, F. "Soil-Aggregate Cushions for Prevention of Reflection Cracking of Resurfaced Pavements: Second Progress Report." MSHD Research Report No. R-470 (Sept. 1964).