



OFFICE MEMORANDUM

DATE: April 23, 1979

TO: K. A. Allemeier
Engineer of Testing and Research

FROM: L. T. Oehler

SUBJECT: Performance Evaluation of Non-Reinforced Ramps
Research Project 78 TI-528, Research Report No. R-1115

At its August 2, 1978 meeting, the Engineering Operations Committee reviewed the results of a condition survey of ramp pavement cracking on eight interchanges on I 275. The Committee requested the Research Laboratory to inspect all non-reinforced ramp pavements to obtain information on their performance. The field work has been completed and this report transmits the results. In addition to conducting the pavement condition survey, surface roughness was also measured.

A total of 16 interchanges consisting of 63 non-reinforced ramps and 5,813 individual slabs were surveyed. The ramps were constructed from 1972 through 1978. The two interchanges built in 1978 (M 14 at Beck Rd and M 14 at Godfredson Rd) are not yet in service. The data presented on the I 275 interchanges were gathered in May 1978; whereas, the remaining interchanges were inspected during the fall and winter of that year.

The performance of the ramps at each interchange with respect to the percentage of slabs cracked is shown in Figure 1. As can be seen, only three interchanges have unusually large percentages of cracked slabs. They are: I 275 at Will Carlton Rd, I 275 at Sibley Rd, and US 31 at Polk Rd. It appears the cracks on the two I 275 interchange pavements have occurred as a result of loss of base support or from non-uniform frost heaving. The cracking at the US 31 and Polk Rd is mainly on the northbound US 31 'off' ramp and the southbound US 31 'on' ramp; these two ramps were used as connector routes until late 1978 when the freeway was extended further north. It is, therefore, concluded that cracks on these two ramps were primarily caused by traffic loadings.

Four different types of crack, defined as follows, were noted:

- 1) Transverse - a crack extending across the width of the slab.
- 2) Longitudinal - a crack running parallel to the slab edge for the length of the slab.
- 3) Angular - a crack extending from a joint to a slab edge.
- 4) Multiple - a combination of any two or more of the above types of crack in a slab.

Of the total number of non-reinforced slabs, 6 percent, or 348 slabs were noted to have cracked. The crack distribution with respect to crack type is shown in Figure 2.

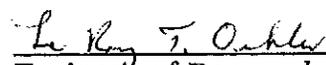
As can be seen, 60 slabs (1 percent) were found to have multiple cracks, 65 slabs (1.1 percent) exhibited angular cracks, 102 slabs (1.8 percent) had cracked longitudinally, and 121 slabs (2.1 percent) contained transverse cracks.

The frequency of slab cracking of each ramp at the 16 interchanges is shown in Table 1. Also included in the table is the Riding Quality Index for each ramp. Twenty-three (37 percent) of the 63 ramps were found to be without cracks. As previously mentioned, the interchanges with the most cracked slabs are I 275 at Will Carlton Rd, I 275 at Sibley Rd, and US 31 at Polk Rd. In addition, at the US 31 and Shelby Rd interchange, the Shelby Rd to southbound US 31 ramp had cracks in 22 percent or 24 of its slabs. Eighteen slabs were found to have cracked longitudinally. Since this ramp is on a high fill, the rather severe cracking is believed to have resulted primarily from base settlement.

Comparing the RQI (Riding Quality Index) numbers measured on the ramps to the latest bonus-penalty specification requirements for pavement riding quality, used on main line pavements, none of the ramps had a RQI number less than 44, which means that they would not have been entitled to incentive payment. Eleven ramps had RQI numbers ranging between 45 and 55 which is the range where the pavement would be accepted without any pay adjustment. The remaining 52 ramps had RQI numbers over 55 and would have been subject to reduced payment. In addition, 33 of the ramps had RQI numbers over 60 and could have been subject to corrective action if the Engineer had determined that such work was necessary. It should be noted that except for the two M 14 interchanges, the ramps have been opened to traffic, which, in addition to the cracking, could have increased the RQI numbers. However, on the M 14 interchanges, seven of the 10 ramps have RQI numbers of 60 or over, which in this case is not caused by slab cracking or traffic.

As indicated in the Engineering Operations Committee meeting minutes of August 2, 1978, the Department is now reinforcing all ramp pavements. On the basis of the visual inspection of the non-reinforced ramps, it appears that base problems and/or heavy or frequent traffic have caused the cracks to develop. Therefore, unless better ways are found to ensure that the base is compatible with a non-reinforced slab, it is suggested that the use of reinforcement be continued. The reinforcement will not prevent cracking, but will keep the cracks tight for a number of years; whereas, cracks in the non-reinforced pavement can open and fault more readily which could require early maintenance.

TESTING AND RESEARCH DIVISION



Engineer of Research

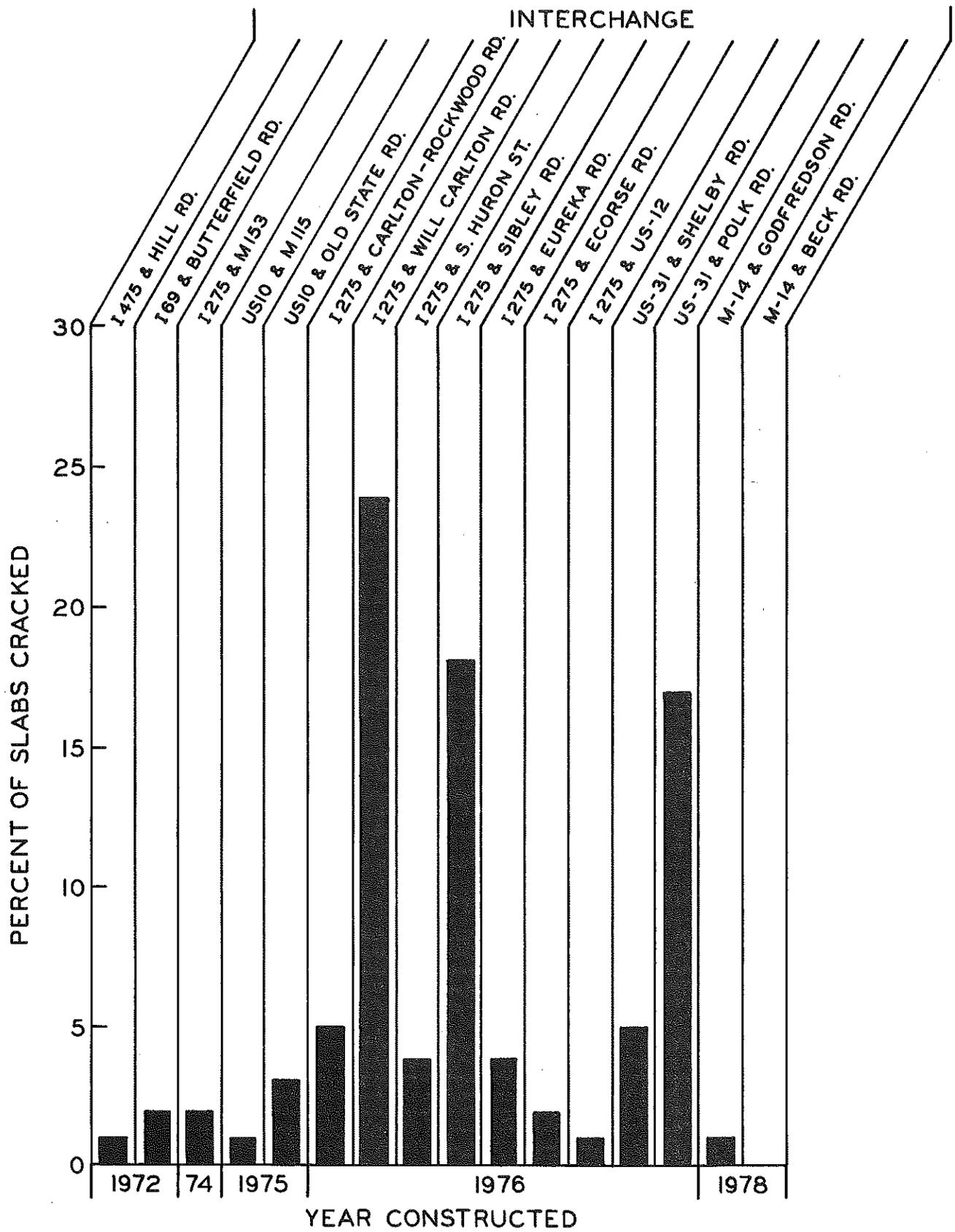


Figure 1. Overall performance of interchanges having non-reinforced ramps.

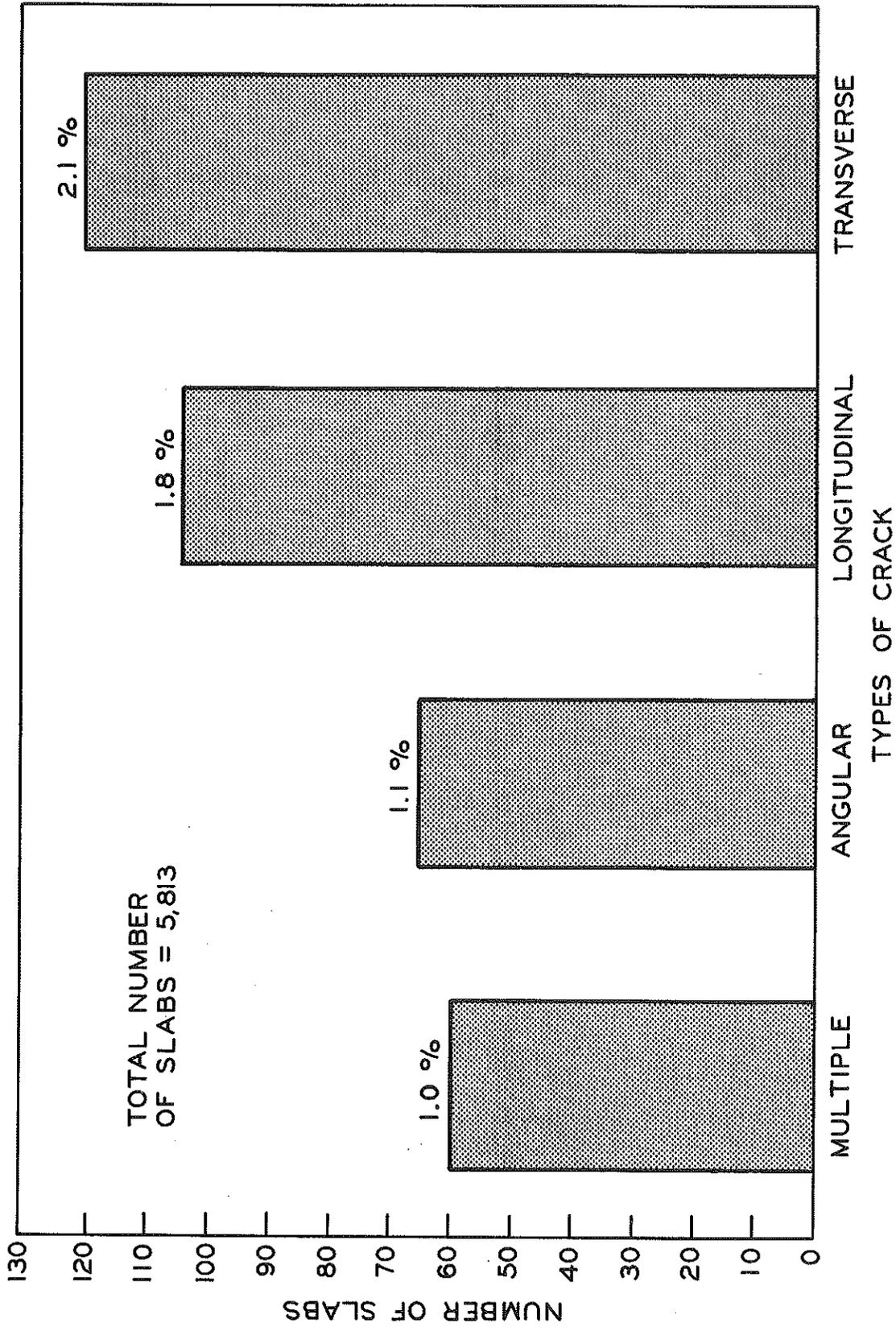


Figure 2. Distribution of crack types in non-reinforced ramps.

TABLE 1
PERFORMANCE OF NON-REINFORCED RAMPS

	Interchange	Ramp	No. of Slabs	Percentage of Slabs Cracked	Riding Quality Index	
1972	I 475 and Hill Rd	SB I 475 to Hill Rd	83	0	62	
		WB Hill Rd to NB I 475	76	0	66	
		WB Hill Rd to SB I 475 (loop ramp)	63	0	60	
		EB Hill Rd to NB I 475 (loop ramp)	58	3	70	
	I 69 and Butterfield Rd	SB I 69 to Butterfield Rd	110	0	59	
		Butterfield Rd to SB I 69	81	2	57	
NB I 69 to Butterfield Rd		105	0	63		
		Butterfield Rd to NB I 69	75	5	55	
1974	I 275 and M 153	EB M 153 to SB I 275	88	0	59	
		EB M 153 to NB I 275 (loop ramp)	64	6	65	
1975	US 10 and M 115	WB US 10 to M 115	125	1	60	
		SB M 115 to WB US 10	68	6	59	
		EB US 10 to M 115	114	1	58	
		NB M 115 to EB US 10	74	0	58	
		SB M 115 to EB US 10 (loop ramp)	70	0	67	
	US 10 and Old State Rd	EB US 10 to Old State Rd	100	6	56	
		Old State Rd to EB US 10	88	7	64	
		WB US 10 to Old State Rd	108	0	55	
		Old State Rd to WB US 10	79	1	60	
1976	I 275 and Carlton-Rockwood Rd	SB I 275 to Carlton-Rockwood Rd	94	9	60	
		Carlton-Rockwood Rd to SB I 275	99	2	67	
		NB I 275 to Carlton-Rockwood Rd	101	4	62	
		Carlton-Rockwood Rd to NB I 275	98	4	66	
	I 275 and Will Carlton Rd	NB I 275 to Will Carlton Rd	102	17	64	
		Will Carlton Rd to NB I 275	86	24	61	
		SB I 275 to Will Carlton Rd	113	36	64	
		Will Carlton Rd to SB I 275	89	17	59	
	I 275 and South Huron Rd	NB I 275 to South Huron Rd	110	3	63	
		South Huron Rd to NB I 275	118	2	68	
		SB I 275 to WB South Huron Rd	102	4	56	
		South Huron Rd to SB I 275	91	5	63	
			SB I 275 to EB South Huron Rd (loop ramp)	86	5	63
	I 275 and Sibley Rd	NB I 275 to Sibley Rd	117	5	58	
		Sibley Rd to NB I 275	100	32	67	
		SB I 275 to Sibley Rd	111	15	54	
		Sibley Rd to SB I 275	94	22	63	
	I 275 and Ecourse Rd	SB I 275 to Ecourse Rd	106	0	59	
		Ecourse Rd to NB I 275	87	3	63	
		NB I 275 to Ecourse Rd	106	3	65	
		Ecourse Rd to SB I 275	86	0	58	
	I 275 and US 12	EB US 12 to SB I 275	63	0	58	
		WB US 12 to SB I 275 (loop ramp)	60	0	59	
		EB US 12 to NB I 275 (loop ramp)	55	1	68	
I 275 and Eureka Rd	WB Eureka Rd to NB I 275	110	9	60		
	EB Eureka Rd to SB I 275	96	2	52		
	WB Eureka Rd to SB I 275 (loop ramp)	76	0	50		
US 31 and Shelby Rd	NB US 31 to Shelby Rd	115	0	55		
	Shelby Rd to NB US 31	116	1	48		
	SB US 31 to Shelby Rd	124	0	50		
	Shelby Rd to SB US 31	104	22	58		
US 31 and Polk Rd	NB US 31 to Polk Rd	104	48	53		
	Polk Rd to NB US 31	118	7	56		
	SB US 31 to Polk Rd	126	2	60		
	Polk Rd to SB US 31	103	16	47		
1978	M 14 and Beck Rd	EB M 14 to Beck Rd	55	0	62	
		NB Beck Rd to EB M 14	104	0	58	
		SB Beck Rd to WB M 14	43	0	60	
		SB Beck Rd to EB M 14 (loop ramp)	68	0	63	
		NB Beck Rd to WB M 14 (loop ramp)	67	0	73	
	M 14 and Godfredson Rd	EB M 14 to Godfredson Rd	98	0	51	
		Godfredson Rd to EB M 14	97	1	65	
		WB M 14 to Godfredson Rd	91	2	57	
		Godfredson Rd to WB M 14	95	0	61	