

DISCUSSION OF REPORT AND SUPPLEMENTARY STUDIES

H J Kirk Mr Hogentogler has done a great mass of work and his report is in great detail. I don't think there are many here who appreciate the amount of work embodied in it. He has asked a number of us to make investigations for him, and he called upon us for an investigation of 15 miles of road built in 1915 along Lake Erie, some plain and some reinforced with bars laid transversely 6 inches apart in fills and 18 inches in cuts. He noticed conditions on this particular piece of road that he thought might bear closer investigation than he was able to give. We made the investigation and I am going to outline a few conclusions.

INVESTIGATION OF PLAIN AND REINFORCED CONCRETE SECTIONS INTER-COUNTY HIGHWAY NO 3, ERIE COUNTY, OHIO

SUMMARY OF REPORT

BY H J KIRK

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The road, located along Lake Erie, between Sandusky and Cleveland, consists of four sections, L-1, L-2, H and K, and was constructed in 1914, 1915, and 1916. All sections were 16 feet wide, 6-8-6 inches thick, and were constructed with crushed stone aggregate (some slag in Section H) and a 1 1/2 3 mix. Section H was not reinforced, while sections L-1, L-2, and K contained 1/2" twisted bars spaced about 6 inches apart on fills and 18 inches apart in cuts. Cores taken from the slabs indicated that the bars in Section K were placed more uniformly than in Section L, where they ranged from within two inches of the top to (in some instances) the subgrade. Tar or felt expansion joints, 3/8 of an inch wide, were placed every 30 feet. The concrete was to be cured under 2 inches of earth kept moist for ten days. The pavements were opened for traffic at the end of 15 days.

Section L-2 was constructed between April and October, 1915, on a location which required very little grading, but, because of rainy weather, on a subgrade which was very wet.

Part of Section L-1 (Sta 107+23 to Sta 51+67) was laid between October and December, 1915. Wet clay subgrade was again encountered. Also a lack of cement for this mile of road was indicated by the inspectors' reports.

The remainder of Section L-1 (Sta 51+67 to 0+00) was laid between May and October, 1916, and during the pouring of concrete but one rainy day was reported.

Part of Section H (about one mile to Old Woman's Creek Bridge) was laid after October 1, 1914. The remainder was laid between May and November, 1915. The grading and wet subgrade were similar to those of Section L-2. The 1914 and 1915 work was laid with different inspectors.

Part of Section K was constructed in 1915 and part in 1916, and was controlled by three different inspectors. Cores indicated that the thickness of the surface was less than that specified.

Comparative conditions of various parts of the sections are shown in Table 8.

From a study of this road it was noted that

- 1 The portion of Section L-1 laid on new location (Sta 0 to 79+20—swampy soil, difficult of drainage) contained three times as many transverse cracks, slightly less longitudinal cracking, five times as many broken corners, and three times as much replacement as the remaining part (Sta 79+20 to Sta 187+73) laid on old road bed.

- 2 The number of broken corners seemed to increase as the length of longitudinal crack decreased.

- 3 More longitudinal cracks were found on curves than on tangents.

- 4 It was indicated that longitudinal cracking was decreased and transverse and corner cracking was increased when the number of transverse bars was increased.

- 5 Defects, including scaling, in Section K seemed to be dependent upon the inspectors.

- 6 Relatively, the plain concrete section (H) contained twice as many transverse cracks, four times the length of longitudinal crack, about four times as much replacement, and but one-half as many corner breaks as the reinforced sections (L-1, L-2, and K).

General conclusions are as follows:

- 1 Pavement condition was dependent on subsoil, drainage, and inspection.

- 2 Reinforcement reduced cracking, breakage, and replacement. Also, it reduced the width of the crack. Otherwise, it did not influence the surface condition of the concrete.

- 3 Observations on these sections would warrant the recommendation of a reinforced pavement constructed with center joint and laid under the best of inspection.

TABLE 9—RELATIVE CONDITIONS OF SECTIONS L-1, L-2, H and K—I C H NO 3, ERIE COUNTY, OHIO

Sect No	Location		Length ft	Width ft	Cross Sect	Type	Year laid	Sub-grade	Inspect- or	Condition per mile				
	Sta to Sta	Exp Jts No								Trans Crs No	Long Crs ft	Broken Cors No	Repl Sq Yds	
L-1	0	79+20	7,920	16	6-8-6	R	1915	New	Andres	184	86	1,383	142	142
L-1	79+20	187+73	10,853	16	6-8-6	R ●	1916	Old	Huntley	184	28	1,510	28	49
L-2	0	53+27	5,327	16	6-8-6	R	1915	-	Huntley	188	45	445	10	243
K	191+71	218+11	2,640	16	6-8-6	R	1915	-	Huntley	194	14	1,916	10	12
K	218+11	284+11	6,600	16	6-8-6	R	1916	-	Moore	194	77	165	118	383
K	284+11	402+47	11,831	16	6-8-6	R	1915	-	Carley	188	21	1,480	19	60
K	422+36	437+95	1,559	16	6-8-6	R	1916	-	Moore	183	7	88	70	53
H	57+05	133+05	7,600	16	6-8-6	P	1914	-	Sarr	191	112	4,550	28	696
H	133+65	191+71	5,806	16	6-8-6	P	1915	-	Huntley	191	45	3,340	20	153
L-1	0	187+73	18,773	16	6-8-6	R	15-16	-		184	52	1,458	76	89
L-2	0	53+27	5,327	16	6-8-6	R	1915	-		188	45	445	10	243
K	191+71	437+95	22,630	16	6-8-6	R	15-16	-		189	35	1,055	50	148
H	57+05	191+71	13,406	16	6-8-6	P	14-15	-		191	83	3,800	25	462
L-1, L-2 and K			46,730	16	6-8-6	R	15-16			187	44	986	45	120
H			13,406	16	6-8-6	P	14-15			191	83	3,800	25	462

P. M. Tebbs I want to make one comment before I go into the information as indicated by our studies in Pennsylvania. Mr. Kirk has just remarked that he had more corner breaks on sections where there were no longitudinal cracks. It seems to me that this is explained by the phenomenon of curling of the edges and that it justifies the placing of a center joint to check the curling. Where you have a longitudinal crack or construction joint, the edge is allowed to rest more uniformly on the subgrade, and there should be less corner breaking.

EFFECT OF REINFORCEMENT IN PENNSYLVANIA STATE HIGHWAYS

SUMMARY OF REPORT

By P. M. TEBBS

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This information was furnished by condition surveys covering about 1,500 miles of concrete road.

The relative effect of various weights of reinforcement are given by average slab length and cracking in Table 8, and the variation of crack (in 5-7-5 by 16 feet, No 25 mesh) with age, in Figure 89.

From these surveys the following conclusions are offered:

1. Transverse cracking occurred mainly in the first and second years, with no considerable increase after the third year.
2. Average spacing of transverse cracks in short slabs was less than in long sections.
3. Total number of cracks increased with age of road.
4. Cracking was considerably reduced by increasing the weight of mesh reinforcement from 25 to 56 and 65 pounds per 100 sq. ft.
5. A four-year-old 6-8-6 by 18-foot plain concrete surface laid on gravel subgrade showed exceptionally few cracks, having an average slab length of 70 feet. The same design on other subgrades had average slab length of 28 feet.

W. L. Blaum I will confine myself to a few comments on Mr. Hogentogler's paper, following which Mr. Acheson will give a report on the Syracuse Resurfacing Experiment built under his direction.

In connection with this report and with the conclusions drawn, I believe that most of our highway engineers in New York will be in accord. The following conclusions of Mr. Hogentogler seem to be especially well established:

Plain concrete surface in widths greater than 10 feet have developed longitudinal cracks. This condition is now very largely eliminated by the use of the longitudinal construction joint.