REPORT OF COMMITTEE ON RIGID PAVEMENT DESIGN

R D. BRADBURY, *Chairman*

SYNOPSIS

At the 1940 Annual Meeting of the Highway Research Board the Committee presented descriptions of three investigational concrete pavement projects built by the States of Kentucky, Michigan and Minnesota in cooperation with the Public Roads Administration

During the past year Oregon and Missouri completed construction of their projects and descriptions of them are presented in this report

These projects comprise a comprehensive investigational program sponsored by the Public Roads Administration in cooperation with the various State Highway Departments undertaken primarily for study of the problem of joints in concrete pavements Each project has been built in conformity with a master design pattern, although additional features of design and construction which are of special interest to them have been included in their respective projects by most of the States.

None of the projects has been in service long enough for significant data to be recorded The Committee will continue to keep in close touch with all of these projects and will attempt to maintain a cumulative record of results by encouraging the presentation of progress reports from time to time as indicative data become available

INVESTIGATIONAL CONCRETE PAVEMENT IN OREGON

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A section of the Northeast Portland Secondary Highway, known as the Lombard Street-Killingsworth Street Section, was selected for the Oregon project and the experimental sections were built during the 1941 construction season. This road is partly within the City of Portland and partly outside, but immediately adjacent to the city boundary. The completed highway serves as a bypass route around the congested city center and carries a large volume of traffic which is predominately of heavy trucks.

The length available, after eliminating a few sections which were complicated by traffic interchange structures, was not enough for the entire test schedule proposed by the Public Roads Administration, and permission was obtained to eliminate its Sections No 2 The Oregon installation, therefore, consists of Sections No. 1, 3, 4, 5, 6, and 7 as shown in Table 1, in which the section numbers correspond to the descriptions given in Mr. Kelley's report at the 1940 annual meeting of the Highway Research Board.[1] All sections except No. 1 were installed in duplicate and are designated as E (east) and W (west).

The project is nicely situated for the purposes of the experiment. The soil characteristics are practically constant throughout its length. Except for two short sections in Section No. 1, the embankment is less than 5 ft in depth on center line, and the cuts do not exceed 4 ft. In the two sections referred to above, the fill depth is a maximum of 22 ft

The soil over the entire project is classed as A-4. Soil samples were taken in each test section and showed a range of liquid limit between 23 and 27 In all sections except 3E and 4E, the plasticity

[1] E F Kelley, "History and Scope of Cooperative Studies of Joint Spacing in Concrete Pavements," *Proceedings*, Highway Research Board, Vol. 20, p 333

index was zero. In these two sections, the plasticity index was 3. The soil analysis shown in Table 2 is typical of the subgrade material over the entire project, except for an increasing amount of gravel (larger than 2 mm) in the easterly sections of the project.

Those portions of the project which are used as test sections are on new alignment and are not complicated by the unequal compaction of old road-beds, except at a few points where the new alignment crosses existing streets. The major portion of the grading was done in 1939. All embankments were placed in 6-in. layers and compacted by the hauling equipment. Grade adjustment, the placing of a rock base course, and an extension of the project easterly over Test Sections 6E and 7E were included in the paving contract.

The paving of the test sections was begun on June 10, 1941, and completed on July 7, 1941. Sand and gravel aggregates were obtained from a commercial pit immediately adjacent to the project. Batching was done at the pit and hauled to the paver in trucks carrying three or four batches. A 27-cubic-foot paver was used in mixing and placing The spreading and compacting were done with a strike-off machine traveling on the side forms, which was equipped with a vibrator tube across the entire width. Finishing was done with a power-driven finishing machine traveling on the side forms. The concrete was cured under cotton mats placed as soon as the surface finish was completed. These mats were kept wet for a minimum of 72 hr.

The concrete mix was controlled by weight so that a constant proportion of

TABLE 1

ARRANGEMENT OF EXPERIMENTAL SECTIONS

Section No	Length	Thickness	Metal reinforcement	Expansion joints		Contraction joints	
				Spacing	Load transfer	Spacing	Load transfer
	ft	in		ft		ft	
1	5,280	9–7–9	None	At ends	Dowels	15	None
3W	2,430	9–7–9	None	405	Dowels	15	None
3E	2,430	9–7–9	None	405	Dowels	15	None
4W	1,200	9–7–9	None	120	Dowels	15	None
4E	1,200	9–7–9	None	120	Dowels	15	None
5W	1,200	9–7–9	None	120	Dowels	15	Dowels
5E	1,200	9–7–9	None	120	Dowels	15	Dowels
6W	1,200	9–7–9	Mesh	120	Dowels	60	Dowels
6E	1,200	9–7–9	Mesh	120	Dowels	60	Dowels
7W	1,200	8 uniform	None	120	None	15	None
7E	1,260	8 uniform	None	120	None	15	None

TABLE 2

SOIL ANALYSIS

F.M E	20%	Larger than 2 0 mm	0 0%
C M E	9%	Coarse sand, 2 0 to 0 25 mm	9 8%
L L	24%	Fine sand, 0 25 to 0 05 mm	36 7%
P L	0%	Silt, 0 05 to 0 005 mm	37 4%
P I	0%	Clay, smaller than 0 005 mm.	6 1%
S L	0%	Colloids, smaller than 0 001 mm	5 3%
L S	0%		
S G	2 63	Group A-4	

1 part cement to 1.75 parts sand to 3.56 parts coarse aggregate, when measured as dry rodded volume, was obtained. The conversion from dry rodded volume to weight depended upon the specific gravity of the material and the amount of moisture in the aggregate as received, and the actual weights were corrected from time to time as the material varied. The coarse aggregate was divided into two sizes, which were weighed separately so as to accurately control the grading. The proportions given above resulted in a cement content of 1.46 barrels per cubic yard Triplicate test beams, cast from each day's run, were broken when 28 days old The average strength was 580 pounds per square inch.

The test procedure is following closely the recommendations of the Public Roads Administration. Brass plugs have been set at each side of all expansion joints and at a selected number of contraction joints to measure individual joint movement. Movements are measured with a micrometer caliper. The brass plugs were set in holes drilled in the hardened concrete. These plugs were supplemented by large-headed roofing nails set in the fresh concrete. Measurements of joint movements during the curing period were made between holes drilled in the heads of the nails Permanent monuments were placed on each side of the pavement to measure total movement of the sections. These monuments were placed opposite each end, the center, and the quarter points of Section No. 1; at each end and the center of Section No. 3; and at each end and each intermediate expansion joint of Sections 4, 5, 6, and 7. Round-headed carriage bolts were set in the pavement surface on each side of each joint at which movement is to be observed and also at the ends and centers of other selected panels. Accurate initial elevations have been established, and changes in elevation will be watched for several seasons A temperature well has been placed in each section, and the temperature of the concrete will be determined when joint movements or elevations are measured A close inspection to record any cracking of the pavement slabs was made immediately after the curing was completed. This inspection will be repeated twice each year. A survey of the general condition of the pavement will be made each year. In this survey, special attention will be given to the conditions of the joints.

In addition to the foregoing data requested by the Public Roads Administration, an attempt is being made to measure the temperature and moisture content at 1-in. intervals in depth in the slab and at two points in the subgrade. Temperature measurements are made with thermocouples and moisture measurements by Bouyoucos resistance cells. The principal objects of these observations are to study the temperature gradient through the slab, the relationship of the slab temperature to the air temperature at different seasons and at different hours of the day, the moisture content of the slab at different seasons of the year, and the effect of temperature and moisture on the curl of the slab. Preparations are also being made to measure the differential vertical movement across expansion and contraction joints of both the doweled and undoweled types

The project is still in its initial stage, and no conclusion can as yet be drawn as to the relative merits of the several sections.