CONDITION OF THE STOCKBRIDGE SOIL-CEMENT PROJECT AFTER 21 YEARS OF SERVICE

Construction Project M 33-50, C1

R. C. Mainfort

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In June 1941, a field experiment was begun to determine the durability and suitability of a soil-cement roadway mixture for use on Michigan's highway system. The installation was located on M 92, beginning approximately 1-1/2 miles north of Stockbridge, and extending north approximately 3 miles to the junction with M 36 (Fig. 1). The treated roadway was 22 ft wide and 6 in. deep. The soil used was a Fox sandy loam, about 80 percent of which was obtained from a pit near the job site. Additional, similar soil was used as found in place on the roadway. The average properties of the natural soils used are shown in Table 1. The only significant difference between the borrow and in-place soils was in the minus-200 portion where the in-place soil (about 20 percent of the job) was higher in fines.

Eight percent cement, by volume, was added to the soil and the resulting mixture compacted to design density. The properties of the soil-cement mixture were as follows:

Cement content: 8 percent by volume
Design density: 127.5 pcf
Design moisture: 9 to 10 percent
In-place density: 127.5 $\pm$ 6.6 pcf

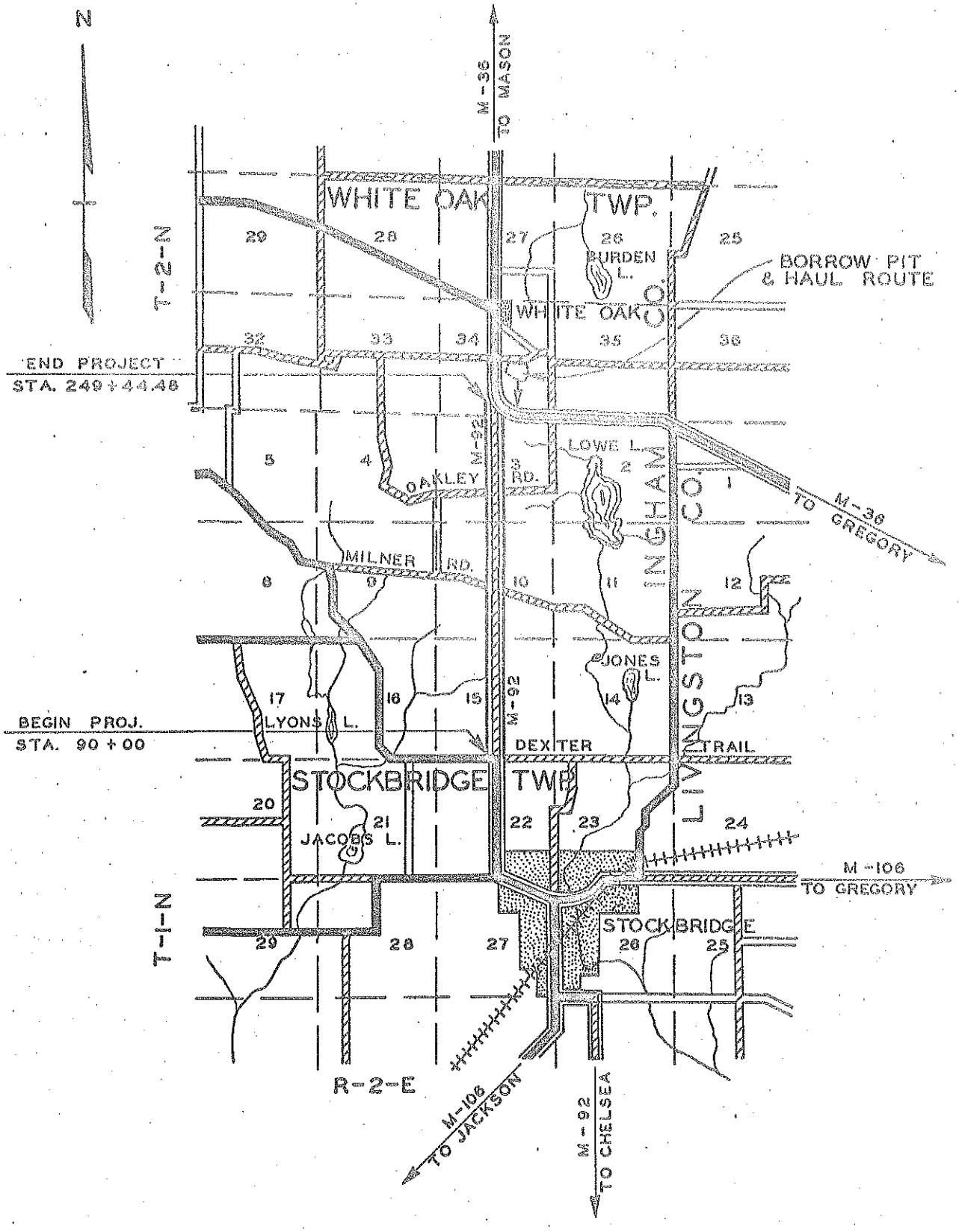


Figure 1. Location of project.

The base stabilization portion of the job was completed in October 1941, and left as an open-surface road until the following summer. During this time the development of surface ravelling, rutting, and chuckholes indicated that a wearing course for the soil-cement was necessary. In June 1942, the surface was sealed with an oil-aggregate mixture at the rate of 130 lb per sq yd. The traffic count at this time was 403 vehicles per day.

TABLE 1
CHARACTERISTICS OF THE NATURAL SOIL

Sieve Size	Percent Passing	Atterberg Limits
1-1/2 in.	100	Liquid Limit: 11 to 20
1 in.	98	Plasticity Index: Non-Plastic
3/4 in.	97	Shrinkage Limit: 20
3/8 in.	95	
No. 4	87	
No. 10	76	
No. 40	52	
No. 200	7 to 13	

By 1946, the surface had begun to ravel along the edges, had become hard and brittle, and in some areas pitting had developed which exposed the soil-cement base. The base itself was in good condition, but had developed longitudinal and transverse cracks at approximately 5- to 10-ft intervals in both directions. These cracks continued through the bituminous surfacing. The pavement was resurfaced in August 1946, using 0.25 gal of T-9 tar with 25 lb of 31-B aggregate per sq yd.

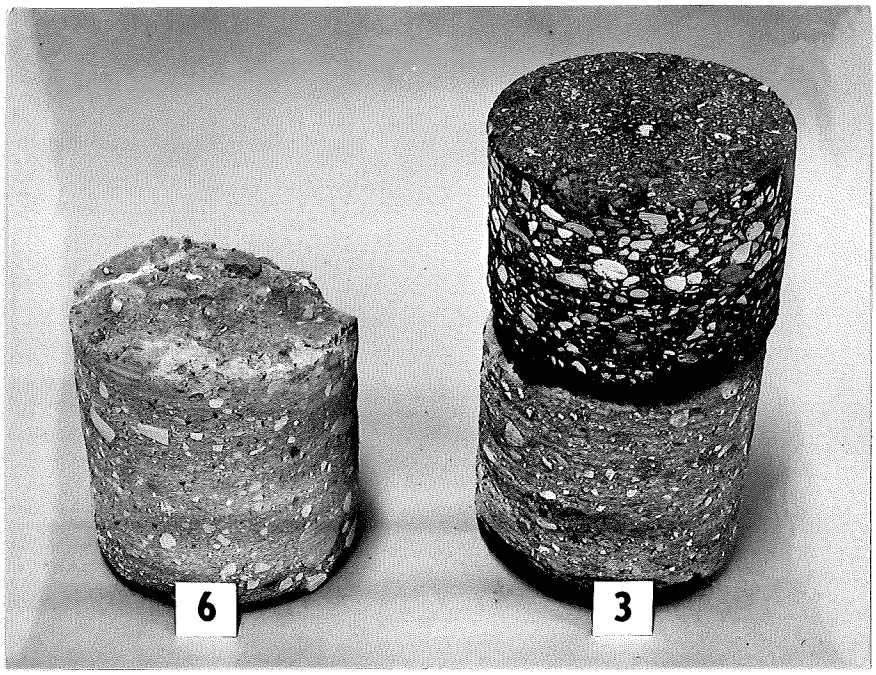
A condition survey of this pavement in 1947, showed it to be in excellent condition. The surfacing thickness then measured 3/4 to 1-1/4 in.

In 1950, an additional surface treatment similar to that applied in 1946, was added. The present bituminous aggregate surface was applied in 1959, at a rate of 160 lb per sq yd.

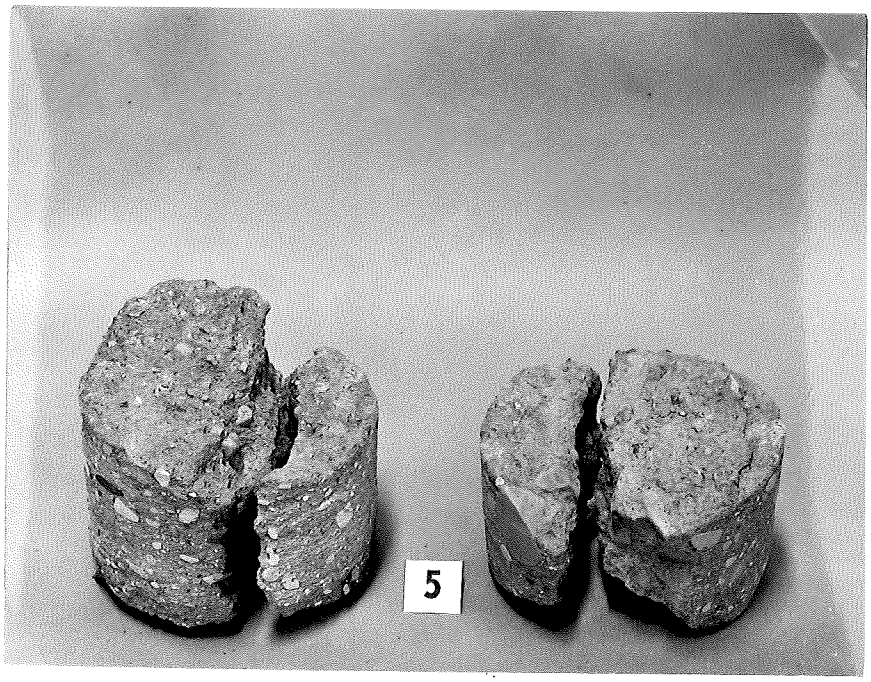
In October 1962, the project was inspected and nine samples were cored from the surfacing and base. In all cases, the samples were quite firm and offered no problems during the coring operations. Fig. 2 shows representative cores as obtained throughout the length of the project. Fig. 2-A shows typical full length cores obtained and includes a section of the present 3-1/2 to 4-in. thick surfacing course. Fig. 2-B shows cores obtained from an area where a longitudinal crack was encountered, resulting in broken cores. All the portions were very firm, however.

The depth of the soil-cement portion of the cores varied from 4-1/2 to 6-1/4 in. The diameter was 6 in. The average compressive strength of four selected cores, corrected to a 2 to 1 height-to-diameter ratio, was 1310 psi. These compressive strengths were slightly higher than those obtained by similar operations in 1945. Average dry density of the cores was approximately 135 pcf, somewhat higher than obtained during construction.

The inspection, sampling, and testing of this project in October 1962, indicate that the soil-cement base course has withstood the detrimental



A. Cores obtained from soil-cement base; No. 3 includes sample of 4-in. thick surface course.



B. Split cores obtained at longitudinal crack; individual sections were very hard.

Figure 2. Typical 6-in. diam cores obtained from the Stockbridge soil-cement project (cored October 19, 1962).

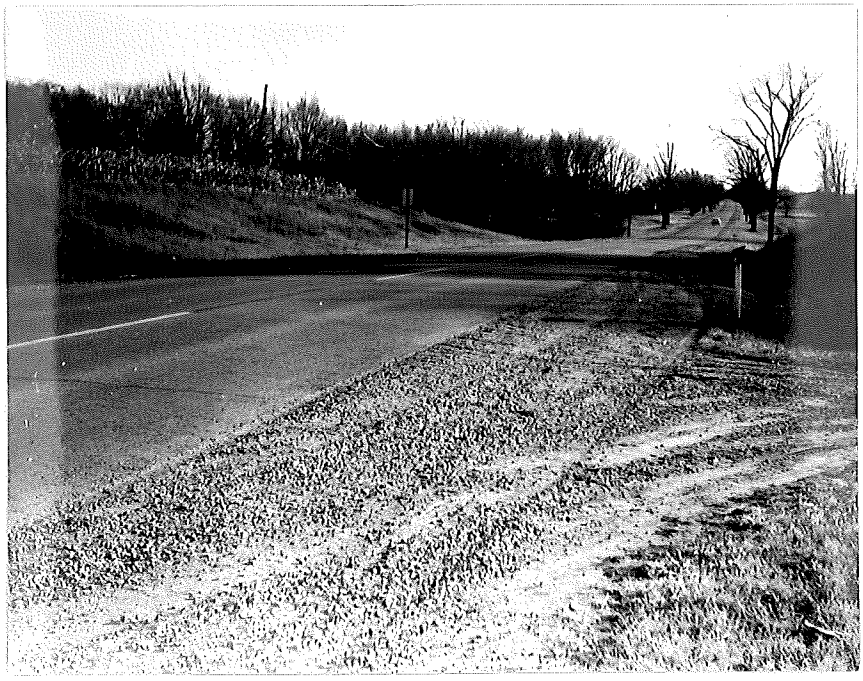
effects of traffic and weather well during the past 21 years, and that the roadway as a whole is in excellent condition. Typical surface condition throughout the length of the project is shown in Fig. 3.

Average daily traffic over the project has increased from 400 vehicles daily at the time of construction to 1200 in 1961. Based on equivalence factors obtained from the AASHO Road Test pavement research report (HRB Special Report No. 61E), this represents total traffic loading equivalent to 469,200 18-kip single axle load repetitions for this 20-year period.

It should be noted that the soils over which this soil-cement project was built belong primarily to the Fox series, a soil formed over well drained sandy-gravelly glacial outwash deposits, and providing excellent foundation conditions for flexible pavement. One exception to this condition is a small outcrop of glacial till clay (Miami soil series) in the cut section (Fig. 3B). In this area, the soil was undercut to provide a 3- to 4-ft overall thickness of subbase, soil-cement, and bituminous surface.

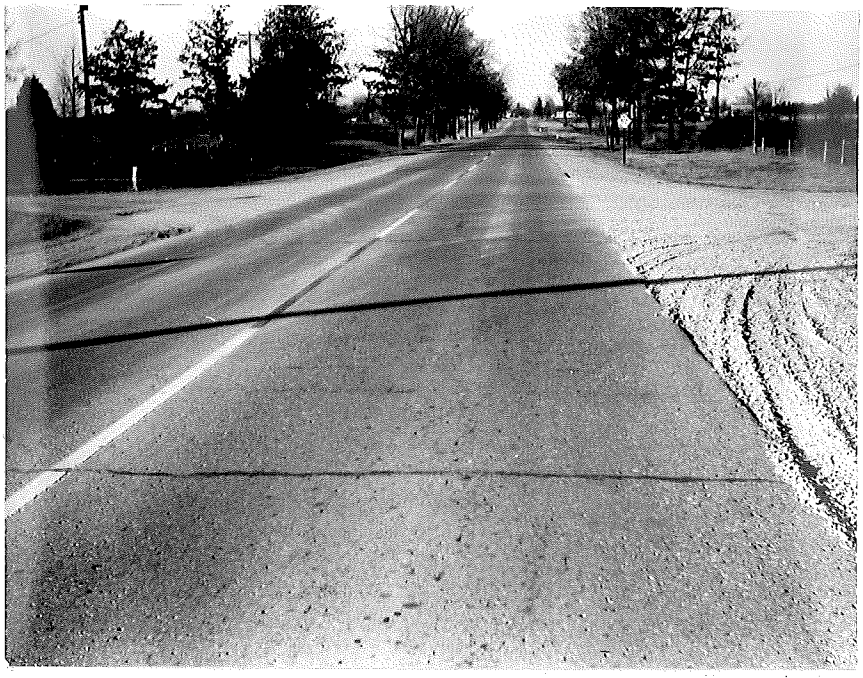
It has been pointed out by O. L. Stokstad, Design Development Engineer, that under such foundation conditions as were provided in this project, both soil-cement and well crushed gravel serve successfully as base course materials for flexible pavement construction. Under Michigan conditions, not only has a crushed gravel base been considerably cheaper to build than soil-cement, but it is also less sensitive to weather conditions during construction. For these reasons, soil-cement has never developed into a popular base course construction technique in this area.

A. North from POB (near Dexter Trail).

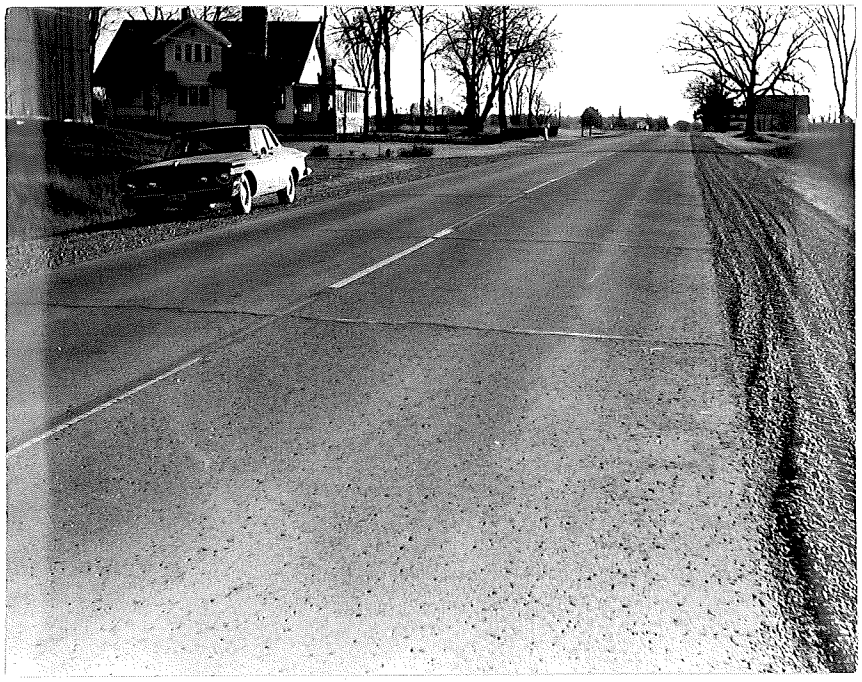


B. South through cut section.

Figure 3. Project surface condition (November 1962).



C. North at intersection with Milner Road.



D. South from end of project (near M 36 junction).

Figure 3 (continued). Project surface condition (November 1962).