

OFFICE MEMORANDUM

R-555R



MICHIGAN
DEPARTMENT OF STATE HIGHWAYS

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To: E. A. Finney, Director
Research Laboratory Division

From: F. Copple

Subject: Inspection of Pavement Joints on US 127: Hudson to Ohio State Line.
Project 39 F-7(14). Research Report No. R-555R.

On September 22, 1965, Construction Projects 30-04, C3 and 30-04, C5 located on US 127 from Hudson south to the Ohio border, were inspected by G. R. Cudney, J. E. Simonsen, and F. Copple.

Construction Project 30-04, C3

Almost every joint in this project, which extends about 5 miles south from Hudson, was distressed to some degree, with about 50 percent of the joints in very bad condition. Figure 1 shows a badly distressed joint typical of this project with its profile revealed through a hole dug in the shoulder.

The concrete at the joint had disintegrated in a wedge shape, tapering up to the dowel bars from the plastic base plate. The concrete above the dowels was fractured into small pieces, as though subjected to severe compression. The surface of this project had numerous popouts (Figs. 1 and 2).

Characteristics of this construction project are as follows:

Date of concrete pour -- September-October 1947
Project length -- 5 mi.
Pavement width -- 22 ft
Slab depth -- 8 in.
Reinforcement -- standard wire mesh
Slab length -- 100 ft
Load transfer -- 1 by 15 in. dowel bars at 12-in. centers
Curing -- clear membrane
Cement -- Huron Vinsol Resin
Fine aggregate -- Elliot Pit, Hudson (Harry Pickett)
Coarse aggregate -- Oxford Pit (American Aggregate)
Green Oak Pit (American Aggregate)

Construction Project 30-04, C5

Joints in the northern portion (Sta. 105+27 to 266+00) of this project were in excellent condition with almost no distress evident. Figure 3 shows a typical joint in this area. However, from Sta. 105+27 south to the Ohio border, numerous joints had serious spalls where maintenance was required.

By digging through the shoulder, the profile of an apparently sound joint in the northern portion was revealed as shown in Figure 4. In this area, the concrete had disintegrated in a typical wedge, with its wider end across the plastic base plate, tapering to an apex near the dowel bars. This suggests that a series of joint failures may be imminent in the currently satisfactory northern portion of this project.

Pavement characteristics of this project are as follows:

Date of concrete pour -- September-October 1949

Project length -- 4.8 mi.

Pavement width -- 22 ft

Slab depth -- 8 in.

Reinforcement -- standard wire mesh

Slab length -- 99 ft

Load transfer -- 1 by 15 in. dowel bars at 12-in. centers

Curing -- clear membrane

Cement -- Huron Vinsol Resin

Fine aggregate -- Vernier Pit, Ransome Twp. (Harry Pickett)

Coarse aggregate -- Sta. 22+11.5 to 105+27: from Vernier Pit, Ransome Twp.
(Harry Pickett)

Sta. 105+27 to 136+39: from Silica Pit (Sylvania, Ohio)

Sta. 136+39 to 266+00: 4A from the Silica Pit and 10A from
the Vernier Pit.

Subbase Testing

At the request of W. W. McLaughlin, samples from the subbase of both projects were obtained and tested in the Research Laboratory's soils laboratory. Eleven areas, selected at random throughout the lengths of the projects were sampled on November 4, 1965 at the general locations shown in Figure 5.

These subbases were placed before the introduction of current specifications which require gradation control for this type of material. Granular materials selected by the Soils Engineer for these jobs were probably of the Coloma or Bellefontaine series, with which possibly were mixer other granular materials salvaged from older roadways in the area.

Average results obtained from testing the eleven subbase samples were as follows:

Sieve Size	Percent Passing	
	30-04, C3	30-04, C5
3/4-inch	98.7	99.7
3/8-inch	95.2	99.3
No. 4	90.7	98.1
No. 8	85.8	96.7
No. 30	67.3	92.3
No. 200	12.4	15.6
Average Field Moisture Content, percent	8.0	9.1

Both materials can be grouped under AASHO classifications as A-2-4 soils, a designation indicating a good subgrade rating. These tests show no indication that subgrade composition has contributed to the condition of the concrete surfaces. In fact, due to the lower fines content, the subgrade beneath Project 30-04, C3, with the poorer joints, should be somewhat more satisfactory than that under Project 30-04, C5.

Discussion

The 1964 ADT for the length of US 127 under study varied from about 3500 just south of Hudson to 2600 just north of the Ohio border. About 12 percent of the vehicles were commercial.

Performance of the two projects may be summarized as follows:

<u>Construction Project</u>	<u>Joint Performance</u>	<u>Popouts</u>	<u>Transverse Cracks</u>
30-04, C3	Very Poor	Numerous	Numerous
30-04, C5			
Sta. 22+11.5 to 105+27	Poor	Numerous	Numerous
Sta. 105+27 to 136+39	Excellent	Almost None	Numerous
Sta. 136+39 to 266+00	Excellent	Almost None	Numerous

Comparison of these three data tabulations shows that the only apparent difference in the construction factors of pavements with excellent and poor joints is the coarse aggregate used in the concrete. The pavement constructed using coarse aggregate from the Silica Pit (limestone) had joints that performed excellently. Figure 5 shows the distribution of the various sources of concrete coarse aggregate used in the projects.

Samples of the crumbly concrete material were taken from the rotted wedges of joints in both construction projects. Analysis of this material indicated 0.34 lb of free sodium chloride per ton of concrete in Project C3 and 0.62 lb per ton in Project C5. These results support the theory that concrete deterioration in the lower section of joints is aggravated by the penetration of salt solutions (from ice control chemicals) into the pavement joints, and their subsequent impoundment by joint base plates.

It is proposed to make an annual condition survey of sample lengths of Project 30-04, C5 to determine if and when the joints begin to fail.

OFFICE OF TESTING AND RESEARCH



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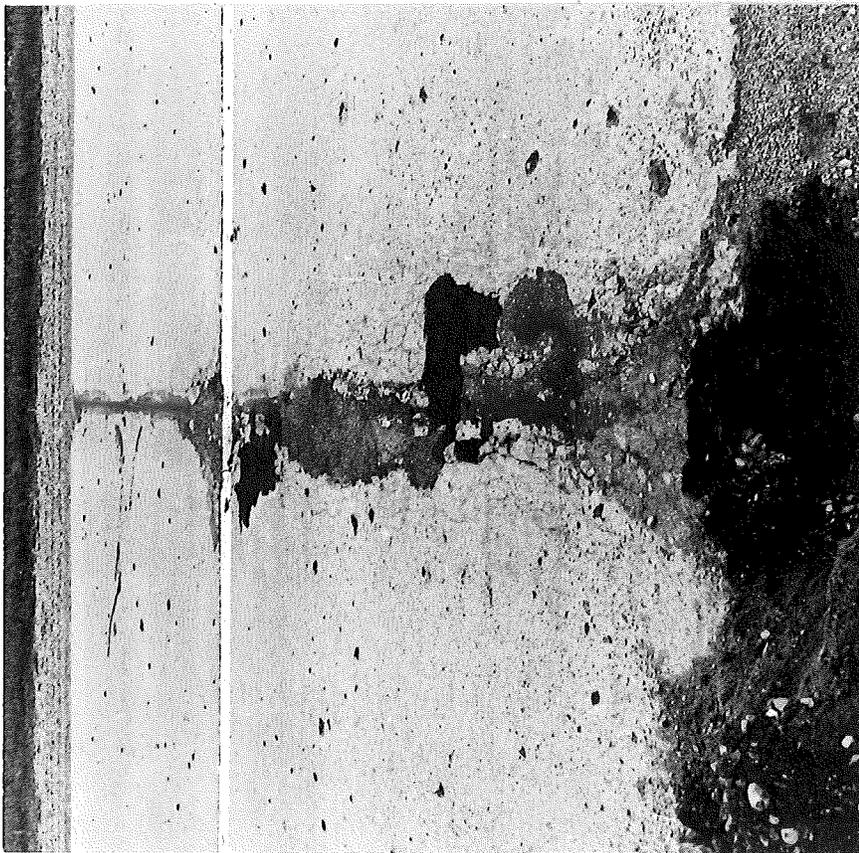


Figure 1. Distressed joint with end exposed: Construction Project 30-04, C3.

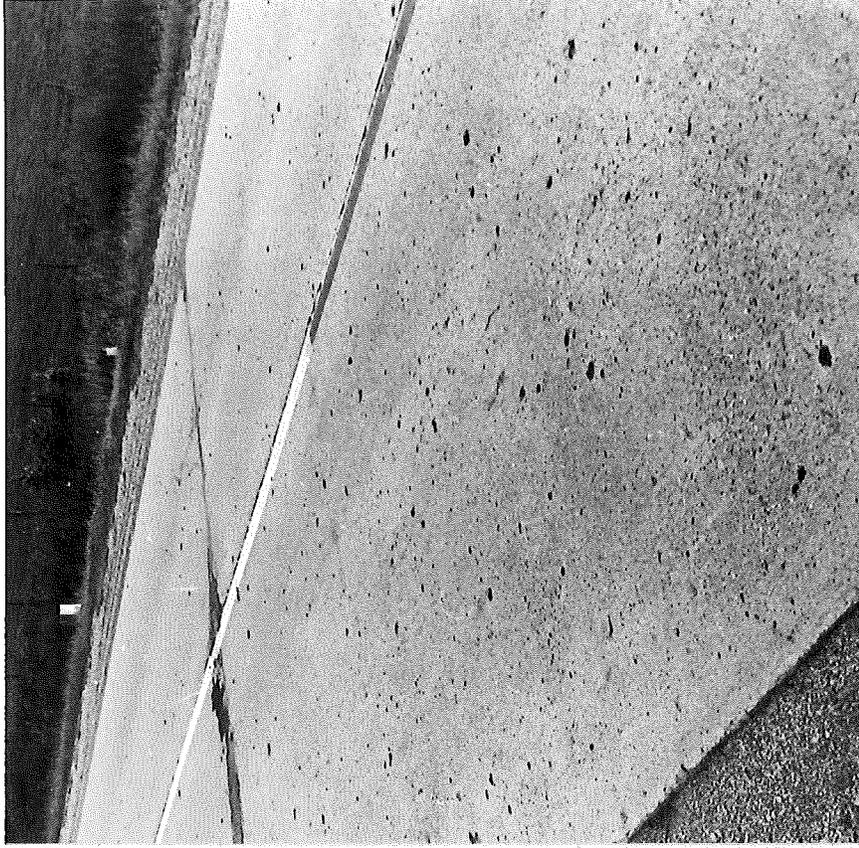


Figure 2. Numerous popouts in pavement surface: Construction Project 30-04, C3.

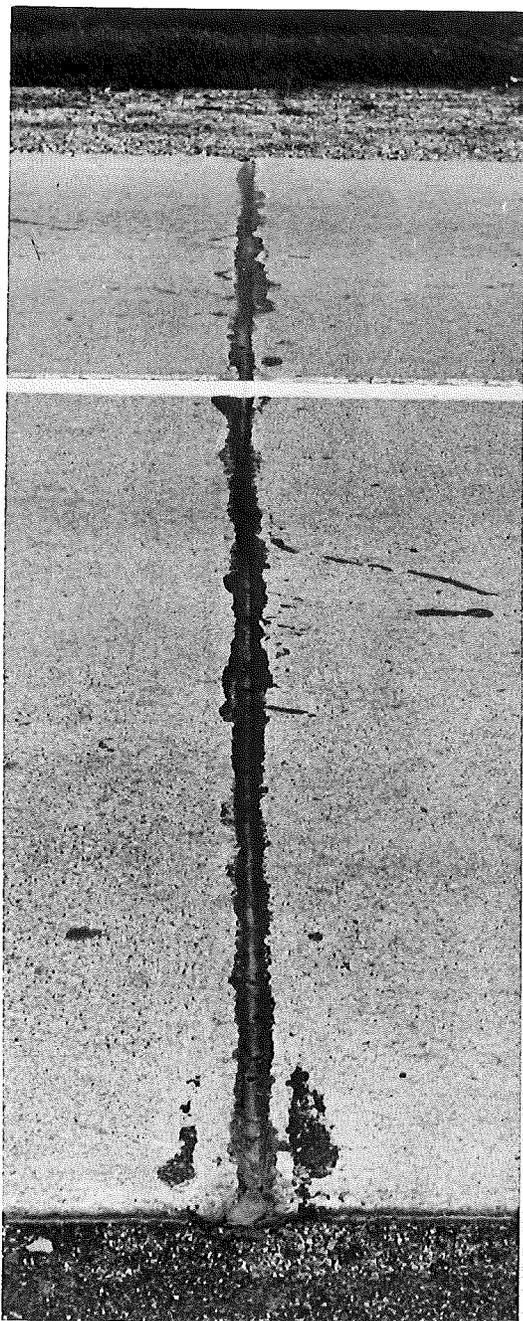


Figure 3. Typical joint in Construction Project 30-04, C5, between Stations 105+27 and 266+00.



Figure 4 (right). End view of sound joint in Construction Project 30-04, C5, before removal of end plate (top), and after removal of end plate (bottom). Note disintegration of concrete above base plate.

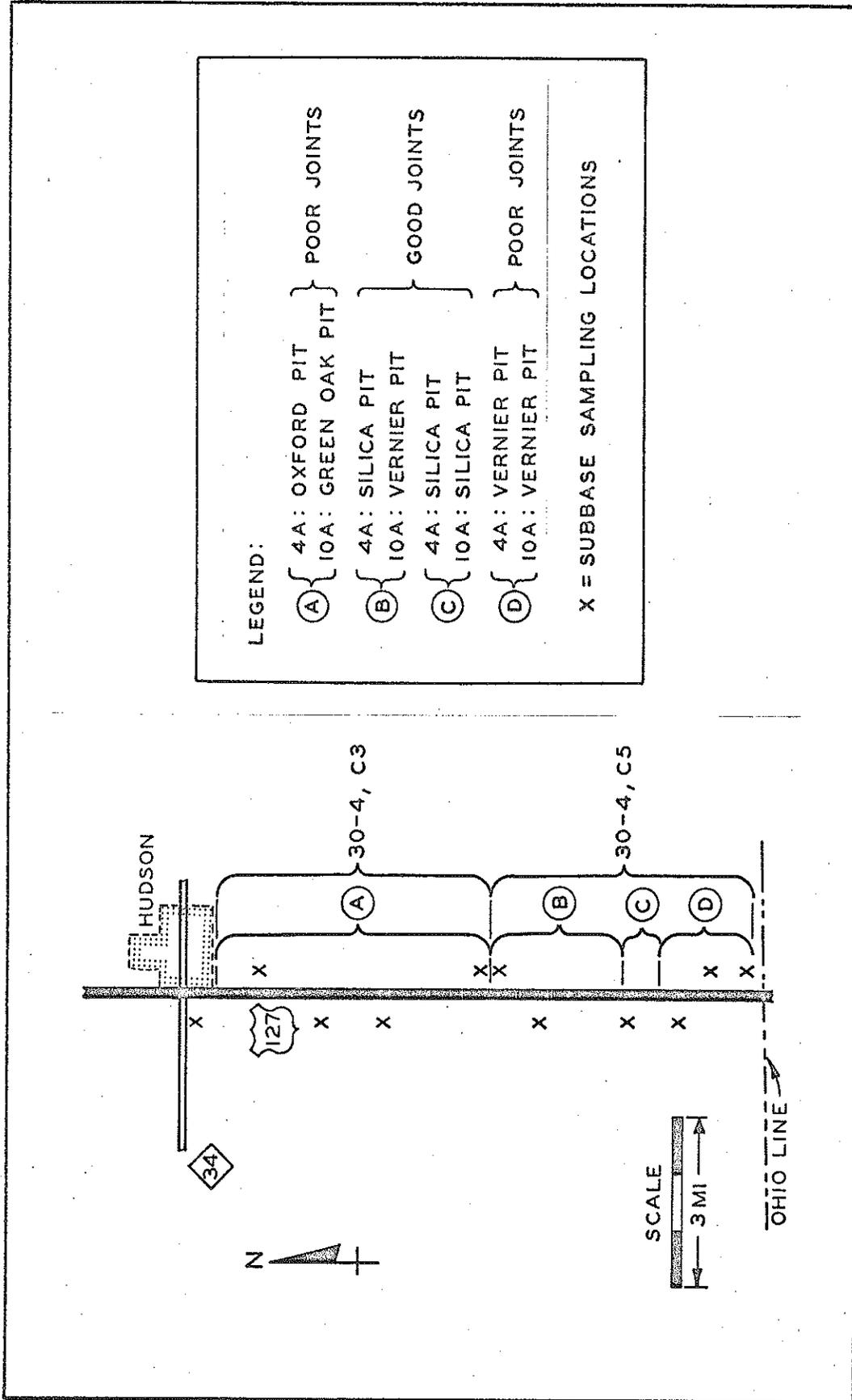


Figure 5. Distribution of coarse aggregates used in concrete on US 127 projects from Hudson to Ohio State Line.