

OFFICE MEMORANDUM



MICHIGAN
STATE HIGHWAY DEPARTMENT

JOHN C. MACKIE, COMMISSIONER

April 26, 1962

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

From: A. J. Permoda

Subject: Analysis of Test Cores from S04 of 82062, Scotten Ave. over
US 12 (Michigan Ave.), Detroit. Research Project 61 B-59.
Report No. 383.

The following report, prepared by M. G. Brown, covers salt content and compressive strength tests of ten cores taken from the Scotten Ave. structure, which was built in 1940 with a 7-in. uniform, reinforced, non-air-entrained deck, and later resurfaced with bituminous concrete and sheet asphalt. In a letter to W. W. McLaughlin dated November 13, 1961, J. F. Oravec reported that the deck showed extensive deterioration and requested analysis for "strength and possibly brine infiltration." In accord with Mr. McLaughlin's approval of November 14, the cores, which had been extracted by the Wayne County Road Commission, were sent to the Research Laboratory Division from the Redford District office. Transmitted with the cores, whose appearance is shown in Fig. 1, were tabulated descriptions as included in Table 1, from A. Radzibon, Wayne County Road Commission, addressed to C. H. Brown, Senior District Engineer, District 10, and dated September 28, 1961.

Test results for compressive strength and salt content are listed in Table 1. Sections of four cores tested in compression produced strengths of 4350 to 5340 psi, which are lower than are expected of 20-year-old concrete. The other cores were in such an advanced state of disintegration that they could not be tested. The salt contents of the ten cores also showed considerable variation, with the two cores of lowest salt content (Cores 4 and 8) also having the two highest compressive strengths.

Salt contents of the cores were determined by titrating an aliquot portion of a water extraction of the pulverized concrete with a standard silver nitrate solution and converting the determined chloride content to the reported sodium chloride value. The bituminous caps were removed from all cores before crushing the entire concrete portion, excluding any steel, down to a 100-mesh size for the water extraction. All broken fragments of disintegrated cores were included for analysis.

No attempt was made to determine salt variation with depth since the only cores intact and suitable for this purpose were broken for compression strength tests. Previous laboratory data have shown that hardened concrete saturated with a concentrated salt solution would contain at least 0.70-percent sodium chloride by weight.

Therefore, some idea of depth of salt penetration in these cores may be gained by multiplying their nominal height of 7 in. by the ratio of salt content to the 0.70 figure. For example, Core 5 with 0.36 percent salt would have approximately the top half (3.5 in.) saturated. This example does not allow for a salt dilution gradient with depth, including the possibility of precipitated salt crystals existing in the top portion of the core, factors which would alter values for depth of penetration correspondingly.

Comparison of salt content and core location in Table 1 does not seem to indicate any definite relationship between salt concentration and core position with respect to the centerline of the 42-ft roadway. It could be expected that, in areas adjacent to the curbs, the salt content would be even higher than the 0.36-percent figure for Core 5.

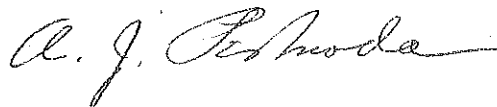
Conclusions

Wayne County authorities reported that deck concrete on the Scotten Ave. structure, 22 years old and non-air-entrained, had undergone extensive deterioration.

The appearance of cores from the deck substantiated this, the majority being too crumbled for laboratory compression tests. Deterioration diminished with depth. Of the ten representative cores submitted for analysis only four could be tested for compression. These four gave values from 4350 to 5340 psi, even the latter figure being at least 20 percent lower than would be expected from sound concrete of such an age.

Analysis of chloride content of entire cores gave values ranging from 0.05 to 0.36 percent salt. The four lowest values were obtained on the only cores sound enough for compression testing. Of these four, the strongest concrete tended to have the least chloride.

OFFICE OF TESTING AND RESEARCH



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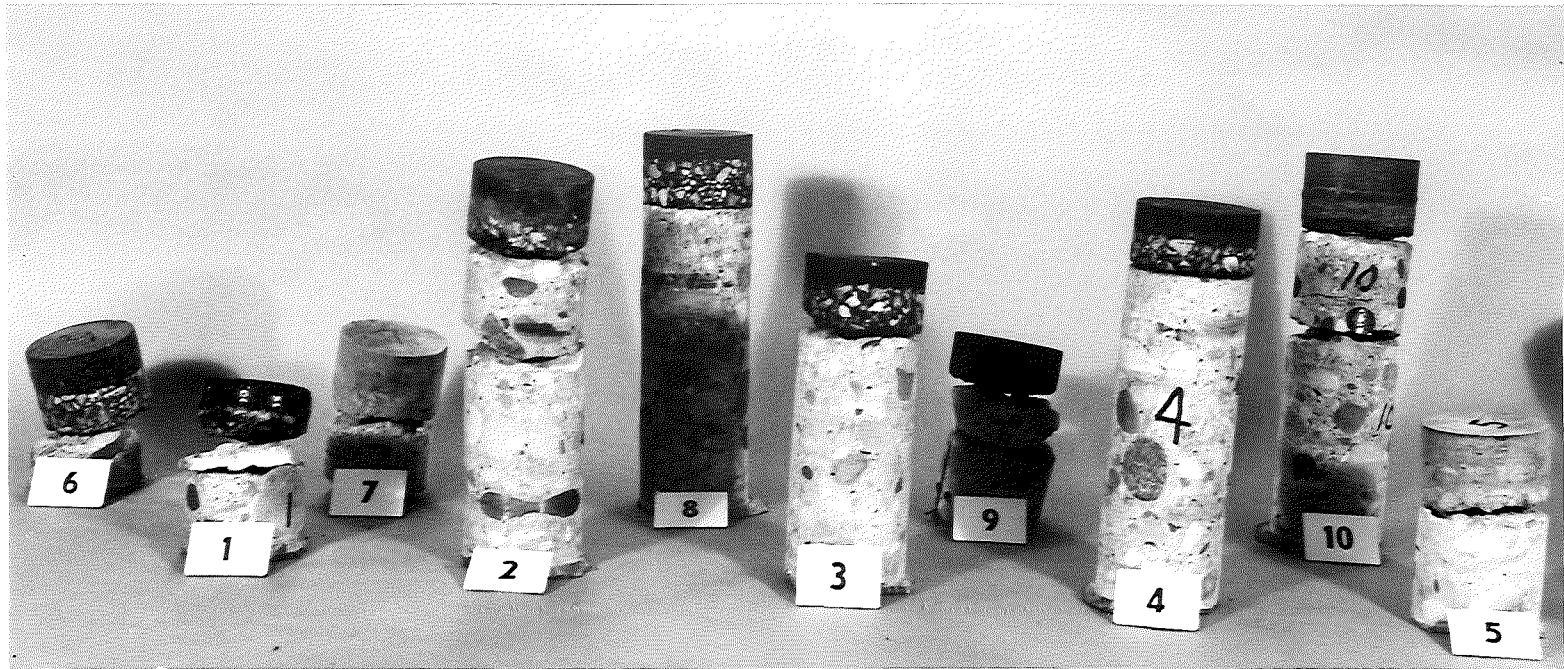


Figure 1. Ten deck cores as received at the laboratory. Fragments between bituminous cap and intact core base of five disintegrated cores are not shown.

TABLE 1
CORE DESCRIPTIONS AND TEST RESULTS
Structure S04 of 82062, Scotten Ave. over US 12 (Mich. Ave.), Detroit

Core	Core Location ⁽¹⁾⁽²⁾	Deck Condition at Core Location ⁽¹⁾	Core Condition Upon Removal ⁽¹⁾⁽³⁾	Laboratory Identification	Laboratory Test Results	
					Compressive Strength, psi ⁽⁴⁾	Salt Content, percent NaCl ⁽⁵⁾
1	8.5 ft west of east curb, 55.8 ft north of centerline	Heavy leaching and crazing	Disintegrated except for 2-in. piece	61 CR-28	----	0.19
2	8.5 ft east of west curb, 48.1 ft north of centerline	Light leaching and crazing	Broke near top re-steel bars into 5-1/4 and 2 in. lengths	61 CR-29	----	0.12
3	18.5 ft east of west curb, 31.8 ft north of centerline	Moderate leaching and crazing	Top disintegrated, recovered 5-3/4 in. length	61 CR-30	4660	0.14
4	18.5 ft west of east curb, 9.5 ft north of centerline	No sign of deterioration	Recovered full core; 7.5-in. long	61 CR-31	5340	0.07
5	13.5 ft west of east curb, on centerline	Heavy leaching and crazing	Disintegrated except for two 2-3/4 in. pieces	61 CR-32	----	0.36
6	8.5 ft east of west curb, 14.5 ft south of centerline	Heavy leaching and crazing	Disintegrated except for 2-in. piece	61 CR-33	----	0.24
7	13.5 ft west of east curb, 29.3 ft south of centerline	Heavy leaching and crazing	Disintegrated except for 2-in. piece, entire core saturated with moisture	61 CR-34	----	0.10
8	13.5 ft east of west curb, 39.5 ft south of centerline	No sign of deterioration	Recovered full core, 7-3/4 in. long	61 CR-35	5110	0.05
9	8.5 ft west of east curb, 52.4 ft south of centerline	Heavy leaching and crazing	Disintegrated except for 2-in. piece	61 CR-36	----	0.17
10	8.5 ft east of west curb, 55.8 ft south of centerline	Moderate leaching and crazing	Broke near top re-steel bars into 5 and 2.5 in. lengths	61 CR-37	4350	0.17

(1) As described by A. Radzibon, Wayne County Road Commission.

(2) Deck width is 42 ft, with longitudinal distances measured from the east-west or transverse centerline.

(3) Core diameter is 2-3/4 in., and average thickness of bituminous wearing surface covering the deck is 1 3/4 in. Two to four bars of reinforcing steel were cut in each core.

(4) Corrected to height-to-diameter ratio of 2:1.

(5) Determined on concrete portion only, with bituminous cap removed, percent based on dry weight of entire core excluding steel.