

OFFICE MEMORANDUM

262



MICHIGAN

STATE HIGHWAY DEPARTMENT

JOHN C. MACKIE, COMMISSIONER

May 18, 1962

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

From: M. G. Brown

Subject: Investigation of Low Test Strength on Concrete from
Project EBI 17034, C1UN. Research Project 61 B-60.
Report No. 385.

The following is a summary of tests performed on sections of field beams and cores from the subject project. Four center sections of field beams, from series 19, cast at Sta. 16+25 on Easterday Avenue, November 11, 1961, were transmitted to the Research Laboratory for a cement content determination. This was by letter request of J. Herbst through C. J. Olsen dated December 12, 1961.

Abnormally low beam breaks indicated the possibility of low cement contents or dirty aggregates. Further, almost half of the 215 feet of 24-foot pavement poured on November 11 was done with untested bagged cement (Huron, Alpena, Type 1) from the Locks Concrete Products Co. This was necessitated when the supply of Penn-Dixie, Petoskey, type 1A, cement ran out about 11:00 AM. Based on the 319 sacks of Huron purchased, and total of 821.5 sacks used, the change in cement probably occurred somewhere in the vicinity of Sta. 15+64. This would be prior to casting of the four test beams of series 19.

Visual examination of the beam sections indicated an unusual amount of air entrainment, therefore, vertical slices were made of each section and linear traverse measurements were run on the polished surfaces. Results of these high air contents along with the low modulus of rupture tests from the field are given in the attached Table 1.

It was decided to take a series of cores throughout the 215 feet (Sta. 14+33 to 16+48) to obtain a more concise evaluation of concrete strength and cement variation. Six cores were drilled on January 3, 1962, and tested in compression on January 9 at the Testing Laboratory prior to being received on January 15 at the Research Laboratory for cement content determinations. The cores were two months old at time of test. Samples of the Huron, type 1, cement and aggregates were also received to fabricate standard cylinders and determine corrections necessary for the cement content tests as given in ASTM Method C85-54, and Research Laboratory Report 300 of November 1958. Results of these various tests are given in the attached Table 2. It may be noted that air measurements were made on intact top portions of three of the cores and one bottom portion broken in

E. A. Finney

- 2 -

May 18, 1962

compression prior to crushing them down to the 140-200 mesh size for cement determinations. The air content of Cores S-1 and S-3 proved to be quite high but not of the 10.1 to 11.6 percent range obtained on the field beam sections.

The cement content of the six cores as determined by this method ranged from 4.5 to 5.1 sacks per cubic yard. Although determinations for the two standard cylinders checked the design value of 5.5 sacks very closely, we cannot assume an accuracy greater than ± 0.5 sack for this method. Cores S-1, 2, and 3 were the most deficient in cement, which probably is due to their higher air content. These first three would definitely be in the Huron cement area. Cores S-5 and 6 are of adequate strength for 2-month old concrete and normal air content practically ruling out any curing deficiencies, since all of the 215 feet poured on November 11 were cured in the same manner with straw and paper cover. These last two cores were made with Penn-Dixie cement at the beginning of the November 11 pour. Core S-4 failed mainly in the top portion indicating the bottom and top pours may be from the two brands of cement involved, or in the area where mixes were changed.

Later tests at the Testing Laboratory indicate the purchased Huron, type 1, cement passed on air entrainment and strength properties. Their laboratory sample 62 C-39 of this cement entrained 9.9 percent air on standard mortar and developed cube strengths at 7 and 28 days of 3390 and 4420 psi, respectively. This would eliminate the possibility of old cement producing the low beam and core strengths.

A later conversation with J. Herbst indicated that when the change from Penn-Dixie, type 1A, to Huron, type 1, cement was made, too much Darex may have been added to obtain air entrainment. The paving report of November 11 does not mention the quantity of Darex added to the Huron batches. Erratic air entrainment may be part of the problem from approximately Sta. 15+40 to 16+48. There also appears to be some deficiency in cement but not enough in itself to reduce compressive strengths to the 2200-2500 range. It is improbable that additional cores within the last 110 feet of pavement would now produce adequate concrete strengths even after 6 months. Possibly a few more cores around Sta. 15+48 would be needed to define the point at which both top and bottom pours would be of the original Penn-Dixie mix.

OFFICE OF TESTING AND RESEARCH

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TABLE 1
TEST DATA ON FIELD BEAMS
Cast November 11, 1961 at Sta. 16+25
Series 19

Beam Number	Ann Arbor Lab. No.	Modulus of Rupture, psi*	Age, Days	Air Content, percent**
19A	61A-11486	625	9	11.4
19B	61A-11487	316	10	11.6
19C	61A-11488	391	10	10.7
19D	61A-11489	491	16	10.1

Note: *From Modulus of Rupture report dated 11-27-61.
**Linear traverse method on a vertical 6 in. x 6 in. slice.

TABLE 2
SUMMARY OF TEST DATA ON CORES
Drilled on January 3, 1962

Core No.	Ann Arbor Lab. No.	Research Lab. No.	Station Location	Compressive Strength, psi(1)	Air Content, percent(2)	Cement Content sacks/cyd(3)
S-1	62 A-103	62 CR- 7	16+35, 6.1L	2580	7.5	4.5
S-2	62 A-104	62 CR- 8	16+45, 2.9L	2480	---	4.7
S-3	62 A-105	62 CR- 9	16+15, 6.7R	3490	8.7	4.7
S-4	62 A-106	62 CR-10	15+48, 7.1R	2230	3.9	5.0
S-5	62 A-107	62 CR-11	15+00, 3.4R	5380	---	5.0
S-6	62 A-108	62 CR-12	14+53, 5.5R	4640	5.1	5.1
Standard A(4)						5.5
Standard B						5.5

- Note: (1) From Ann Arbor report of January 12, 1962.
 (2) Linear traverse method on top 3/4 inch of intact portion of broken core, except S-4, which was run on bottom portion of core.
 (3) Calculated from bone dry unit weights of 136 lb/cu ft on first 3 cores and 143 lb/cu ft on last 3 cores because of difference in air content.
 (4) Standard cylinders made in laboratory using mix of November 11 and materials from project.

D. 386

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