OFFICE MEMORANDUM

MICHIGAN
STATE HIGHWAY DEPARTMENT
JOHN C. MACKIE, COMMISSIONER

June 22, 1962

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

From: M. G. Brown, Chemical Engineer
Materials Research Section

Subject: Effect of Erroneous Admixture in Bridge Deck Concrete. S06 of 23152B, (I 96 at Millett Road). Research Project R62 B-63. Report No. R-388.

The following is a summary of tests performed on field and laboratory samples from the subject structure according to R. L. Greenman's letter request to you dated May 18, 1962.

Circumstances relating to the first deck pour of May 15, 1962, on the west end of this structure were described in R. S. Fulton's memorandum to J. C. Brehler of May 17, 1962. As stated by R. S. Fulton, the admixture mistakenly used for Plastiment retarder was suspected of being creosote. A sample of this dark brown liquid was sent to the Testing Laboratory Division and their test results of May 29, 1962, (sample 62 B-B11), identified the material as a creosote oil such as described in AASHO specification M133-60.

The creosote oil was used at the rate of 4 ounces per sack of cement, or 23.6 ounces per cubic yard of concrete. A total of 31.5 cubic yards of concrete containing creosote was placed in the morning of May 15, 1962, before work was halted at a bulkhead over the west pier. This is an area 31 feet wide and approximately 35 feet long. Two field beams were made at the end of the pour but the concrete was settling so fast the bottom portions of both beams were honey combed. One beam was broken at 7 days on May 22 and the pieces brought into the Research Laboratory for sawing and air determination by the linear traverse method. The modulus of rupture averaged 667 psi for breaks of 617 and 717 psi. Air contents determined on vertical slices at each end of the center beam section were 2.0 and 2.1 percent respectively.

A visual examination was made of the completed deck pours in the afternoon of May 22. Although the creosote portion of May 15 was placed and finished with difficulty due to the rapid set, the surface compared favorably with the remainder of the deck poured May 16 using the required Plastiment retarder. However, evidence was found of placement problems by the presence of a large void in the west end of the deck. This void was in the vertical face of the end joint and extended at least 8 inches horizontally into the deck. The hole at the joint face was about 6 inches wide and 3 inches high. A larger void was uncovered on May 23 on the bottom of the deck when forms were pulled. This was approximately one foot in diameter and showed some of the lower reinforcing steel. This void was filled in later, although Jesse Curtiss, Project Engineer, had instructed the contractor's men not to do so.

To check further the air content and soundness of the concrete deck, three cores each were drilled May 25 half way through the deck near the north and south edges in areas to be covered later by the sidewalk pours. Results of air determinations on the top inch and freeze-thaw durability on 2-1/2 inch segments of each core are given in the attached Table 1. Five of the six cores averaged 2.6 percent air and one was slightly higher at 3.6 percent. After 102 cycles of rapid freeze-thaw in water, ASTM method C290, the mortar portion of these core sections is showing considerable breakdown as indicated by the percent weight loss.

At about the same time the cores were being taken in the field, two laboratory mixes were made using the same materials and proportions as used on May 15. The effect of the creosote on the air content of these laboratory mixes and 7-day strengths can be seen in the attached Table 2. The air content of the creosote mix was only half that of the control mix, 2.1 as compared to 4.0 percent. The compressive and flexural strengths of the creosote mix are higher by an amount consistent with this difference in air. Two cylinders of each mix were also started in the Freeze-thaw test after 14 days of curing and the weight change after 42 cycles is also given in Table 2. These will be tested to at least 100 cycles to compare with the six deck cores.

The 31.5 cubic yards of concrete placed on May 15 with creosote instead of Plastiment admixture is deficient in entrained air as mentioned earlier. Freeze-thaw tests would indicate a questionable durability, and resistance to deicing salts. Two large voids are known to exist in the deck and others may be hidden. In general, the concrete is not of specification quality in air content and of doubtful continuity within the deck. To assure a lasting structure of minimum maintenance it is recommended the concrete be removed and replaced with that of the same quality as the rest of the deck poured May 16, 1962.

MGB:cgc

attachment

Table 1.
Summary of Tests on Deck Cores,
S06 of 23152B, Span on West End.

Core Number	Laboratory Number	Air Content Percent *	Weight Loss, Percent ** 59 cycles	71 cycles	102 cycles
1N	62 CR-15	2.6	0.74	0.74	2.55
2N	62 CR-16	2.8	1.06	2.50	5.67
3N	62 CR-17	2.8	0.33	0.90	1.80
1S	62 CR-18	2.4	2.16	2.24	10.80
2S	62 CR-19	2.5	1.40	1.40	1.20
3S	62 CR-20	3.6	0.16	0.48	1.40

* Linear traverse method on top one inch of core.
** Rapid freeze-thaw in water, (ASTM C290), on 2-1/2 inch section of 4 inch diameter core. Cores 16 days old at start of test.

Table 2.
Summary of Laboratory Mixes.
Materials and Mix Design of May 15, 1962

Test	With Creosote	Without Creosote
Air content, percent	2.1	4.0
Slump, inches	1/2*	3-1/4
Compressive Strength, 7 day, psi	4650	4160
	4760	4200
	Average 4705	Average 4180
Flexural Strength, 7 day, psi (third point loading)	758	725
	839	683
	Average 799	Average 704
Freeze-thaw Durability, Weight Loss, percent at 42 cycles.	0	0.2
	-0	0.0
	Average 0	Average 0.1

* Appeared to have same consitency as control mix but lost workability fast.