

OFFICE MEMORANDUM

May 19, 1969



MICHIGAN
DEPARTMENT OF STATE HIGHWAYS

To: F. Copple, Supervisor
Pavement Performance

From: R. L. Felter

Subject: Survey of Substructures on Edsel Ford Freeway. Research Project 63 B-69(4). Research Report No. R-702.

This project was initiated at the request of W. W. McLaughlin, Testing and Research Engineer [ret], to determine the cause of deterioration on several bridge structures on the Edsel Ford Freeway.

Research Report R-510, with attachments, describes the location and extent of deterioration in detail as well as the conclusions drawn as to the causes of deterioration. These causes were stated in a letter from Warren F. Cox, Maintenance Division, to J. F. Oravec, Maintenance Operations Engineer, dated December 14, 1964, and are summarized below:

- "1. Areas of porous concrete (honeycomb) located along the corners of the columns.
2. Reinforcing steel with less than two inches of concrete cover.
3. The extreme exposure to which the pier columns on the Detroit Freeways are subjected."

This report summarizes additional data obtained subsequent to the publication of Research Report R-510.

Pachometer readings were taken on several structures to determine the depths of the reinforcing steel. Depths of steel reinforcement as found in these tests ranged from 1-1/2 to 3-1/4 in. for horizontal steel and 1-3/4 to 4-1/2 in. for vertical steel. Although these tests did indicate some steel with less than 2 in. of cover, there was no correlation between steel depth and degree of deterioration on these structures.

Compressive strengths of the concrete pier column, measured with a swiss hammer, ranged from 7300 to 10,000+ psi with an average of 9,200+ psi. Twenty-eight day compressive strength required by specification was 3500 psi. There was no correlation between compressive strength and degree of deterioration.

Samples of concrete were taken from the pier columns of five representative structures with varying degrees of deterioration and returned to the Laboratory for an analysis of air content. Fourteen samples, tested by using the linear traverse method in accordance with ASTM C 457-60 T, gave air contents ranging from 1.0 to 5.9 percent and averaging 2.6 percent. There was

no correlation shown between air content and degree of deterioration; however, eight of the fourteen samples tested were below specification air content of 3 to 6 percent. Present specifications call for 5 to 8 percent entrained air.

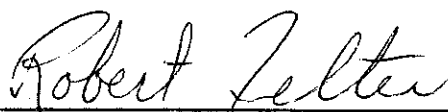
Of the 30 structures surveyed, 10 were cured during periods in which the temperatures dropped below 40 F and heaters and tarpaulins were used to protect the concrete. There was no correlation shown between curing temperatures and percent deterioration.

In 1963, specifications were changed, reducing the maximum size aggregate allowed in concrete structures from 1-1/2 to 1 in. This change was to allow more efficient flow of concrete into the area between the reinforcing steel and forms, thereby reducing the possibility of honeycombing.

In summary, additional data appear to support conclusions listed in Research Report No. R-510, with the major cause being porous concrete or honeycomb, which would allow water and de-icing chemicals to infiltrate the concrete, rust the steel, and cause expansion and subsequent cracking. The water would also be subject to freezing, causing expansion and subsequent cracking.

All structures considered in this study have been repaired.

TESTING AND RESEARCH DIVISION



Supervisor-Pavement Serviceability Studies

RLF:sjt