OFFICE MEMORANDUM

MICHIGAN
DEPARTMENT OF STATE HIGHWAYS

August 2, 1971

To: L. T. Oehler
Engineer of Research

From: H. L. Patterson

Subject: Determination of Extent of Fire Damage to Span 7 of X03 of 25042. (Ramp B over GT&W RR and I 75 at the I 75 - M 78 Interchange, southwest of Flint.) Research Project 71 TI-28. Research Report No. R-774.

Spans 5 and 6 of the subject bridge were destroyed by a gasoline tanker truck fire on January 14, 1971. In a letter of March 30, 1971 to Max N. Clyde, M. Rothstein requested that cores be drilled from the east end of span 7 to determine the extent of fire damage to the concrete. On April 5 and 6, seven cores were cut at the locations shown in Figure 1, and delivered to the Research Laboratory for examination and testing.

The cores were examined and the usual data (core depth, steel position, and general concrete appearance) were recorded (Table 1). It was noted at this time that the bottom surface of the cores was blackened with smoke, but the usual evidence of fire damage was absent.[1]

After initial resonant vibration frequencies of the cores were measured, rapid freeze-thaw testing (ASTM C 291-67) was begun and additional measurements were taken at regular intervals throughout the test interim. The general sound condition of all seven cores noted early in the testing prompted the Design Division to decide to remove only the end two feet of span 7 which was damaged upon removal of span 6. At the completion of testing, the cores were again examined and all visible evidence of freeze-thaw deterioration was noted (Table 1). Considerable delay was experienced in obtaining these data since a transformer malfunction rendered the equipment inoperable. It was found that there was no visible freeze-thaw deterioration to the fire-exposed end of the cores or to the remainder of the cores, other than some fine cracking associated with the coarse aggregate.

For each of the resonant frequency measurements that were taken throughout the freeze-thaw testing interval, the dynamic modulus of elasticity was calculated and the average values are shown in graphical form in Figure 2. The figure shows a rate of decrease which is slightly greater than that which is considered normal for good air-entrained structural

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(1) Characteristic features of concrete exposed to a sustained high temperature fire are surface spalls, thermal expansion cracking, and discoloration caused by thermal dehydration of the mortar, i.e., the mortar color changes from gray to pinkish-yellow.

concrete. However, since the freeze-thaw deterioration was apparently uniform throughout the cores, there is no visual evidence to suggest that fire-weakened concrete significantly contributed to the decrease in the dynamic modulus.

In conclusion, it would be safe to state that any fire damage sustained by the concrete in span 7 is of a minor nature and would not jeopardize the function of the slab for its continued use under traffic.

TESTING AND RESEARCH DIVISION

H L Patterson

Physical Research Engineer
Research Laboratory Section

TABLE 1

CORE INSPECTION DATA

Laboratory No.	Core No.	Length, in.	Steel depth (in. to bar ℄)	Visual Inspection	
				Before freeze-thaw testing	After 294 freeze-thaw cycles
71CC-19	1	8.4	No. 6 @ 2.8, 5.8, & 6.8; No. 4 @ 3.8	Several 1/16 to 1/4-in. TAV[1] throughout core. Full-depth crack; no fire damage.	Numerous short cracks throughout the depth of core. Several fractured coarse aggregate stones.
71CC-20	2	8.5	No. 6 @ 2.9 & 6.5	Several 1/16 to 3/8-in. TAV over full depth of core. No apparent fire damage.	A few short cracks throughout the depth of core. Several fractured coarse aggregate stones.
71CC-21	3	8.5	No. 6 @ 2.8 & 6.5	Same as 71CC-20.	Same as 71CC-20.
71CC-22	4	8.4	No. 6 @ 2.3 & 6.1	Same as 71CC-20.	Same short cracks and fractured aggregate as 71CC-20 plus two vertical cracks running half the depth of core.
71CC-23	5	8.6	No. 6 @ 6.8	Same as 71CC-20.	Same as 71CC-19.
71CC-24	6	8.8	No. 6 @ 7.0	Several 1/16 to 3/8-in. TAV over full depth of core. Full-depth crack; no fire damage.	Same as 71CC-19.
71CC-25	7	8.5	No. 6 @ 6.5	Same as 71CC-20.	Same as 71CC-20.

(1) Trapped air voids.

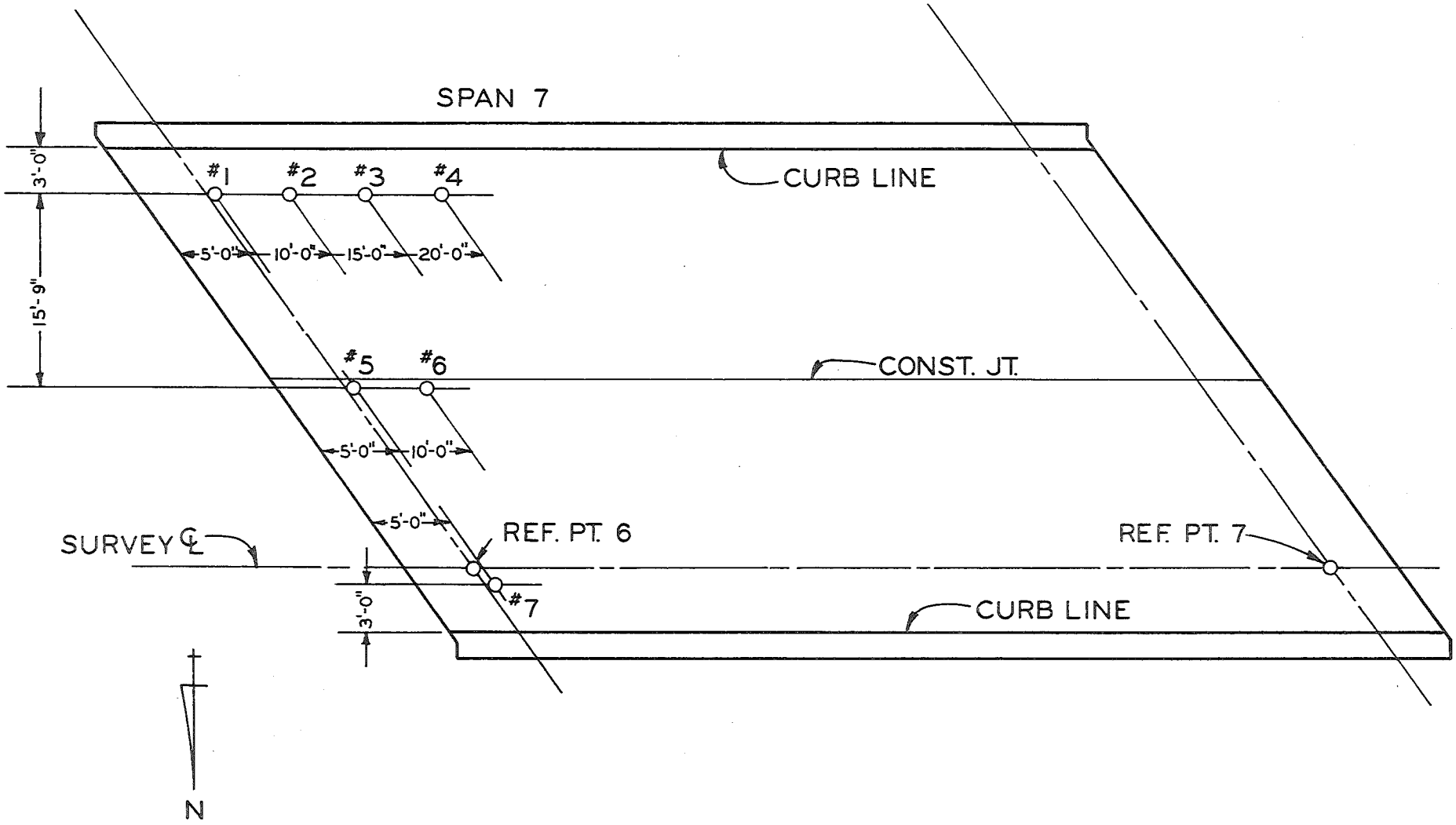

Figure 1. Core location plan X03 of 25042D (Ramp B over GTWRR and I 75).

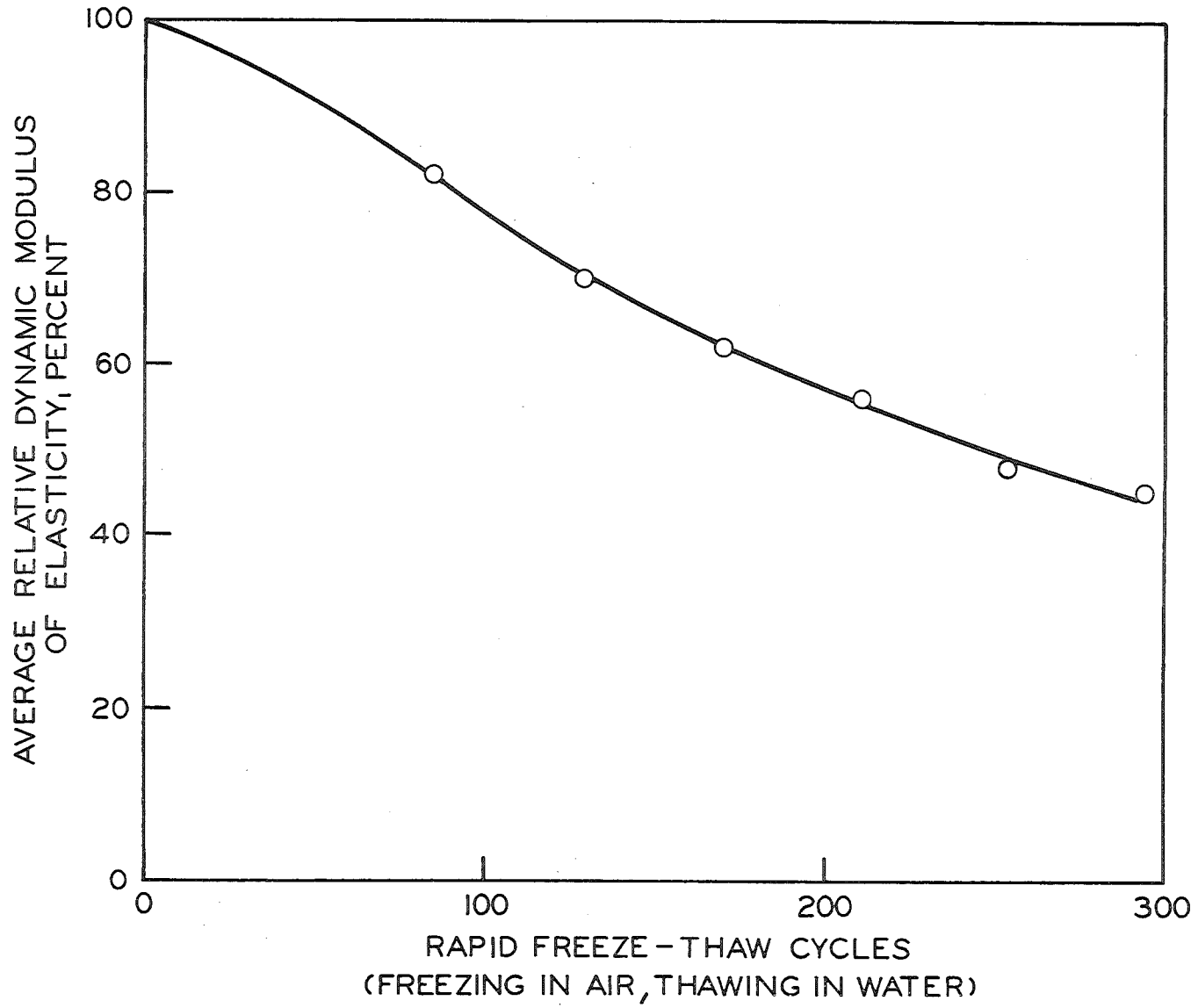

Figure 2. Average dynamic modulus of elasticity vs. freeze-thaw cycles. (Does not include Cores No. 1 and 6 which were cut over full-depth cracks).