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CONSTRUCTION AND IMPACT TESTING OF A SHORT SECTION OF EXPERIMENTAL CONCRETE GLARE SCREEN

MICHIGAN HIGHWAY RESEARCH LABORATORY SECTION

MICHIGAN DEPARTMENT OF STATE HIGHWAYS

CONSTRUCTION AND IMPACT TESTING OF A SHORT SECTION OF EXPERIMENTAL CONCRETE GLARE SCREEN

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Background Information

Roadway alignment at some locations requires the installation of glare screen for prevention of visibility problems during night driving. Traditional metal mesh type screens have proven to be quite expensive to install, and subject to damage from plow-thrown snow, wind-blast vibrations, and vehicle impact. The results have been poor appearance, impaired functioning, and considerable maintenance expense. Recent requirements for installation of glare screen on concrete median barrier led to the proposition of the use of concrete for the glare screen as well as the barrier, with the screen to be slip-formed on top of the completed barrier. Champagne-Weber Corporation of Fraser, Michigan, contractors for slip-form median barrier construction, proposed the concept and agreed to build and test a section in their yard, if the Department would pay for labor and materials.

A meeting was held on June 13, 1973, in which representatives of the FHWA and the MDSH Divisions of Construction, Design, Testing and Research, and Traffic and Safety, discussed the proposal. The discussion resulted in a tentative plan for the glare screen as shown in Figure 1.

The vertical tiebars secure the screen to the barrier, and the longitudinal reinforcement was included to prevent flying pieces of concrete in case of vehicle impact into the screen.

The experiment was set up in two phases, with the first phase to consist of construction, curing, and destructive testing of a short section of glare screen at the contractor's yard. Satisfactory completion of phase one was to result in an experimental installation of approximately 1,000 ft of screen on C. S. I 630103A, Michigan Project No. I 696 - 8(37)225, Job No. 00895A, (I 696 at Couzens St in Madison Heights). This section of glare screen was to be added to the contract by authorization.

PHASE I

Construction

The experimental glare screen was cast on June 15, 1973, at the contractor's yard. It was placed by the slip-form method, on top of an existing concrete median barrier that was approximately 60 ft long. Initially there was some problem with the operation, but once the mix was properly adjusted to about 2-in. slump, the screen was formed quite readily. Figure 2 shows the barrier, ready for placement of the screen. Note that the por-

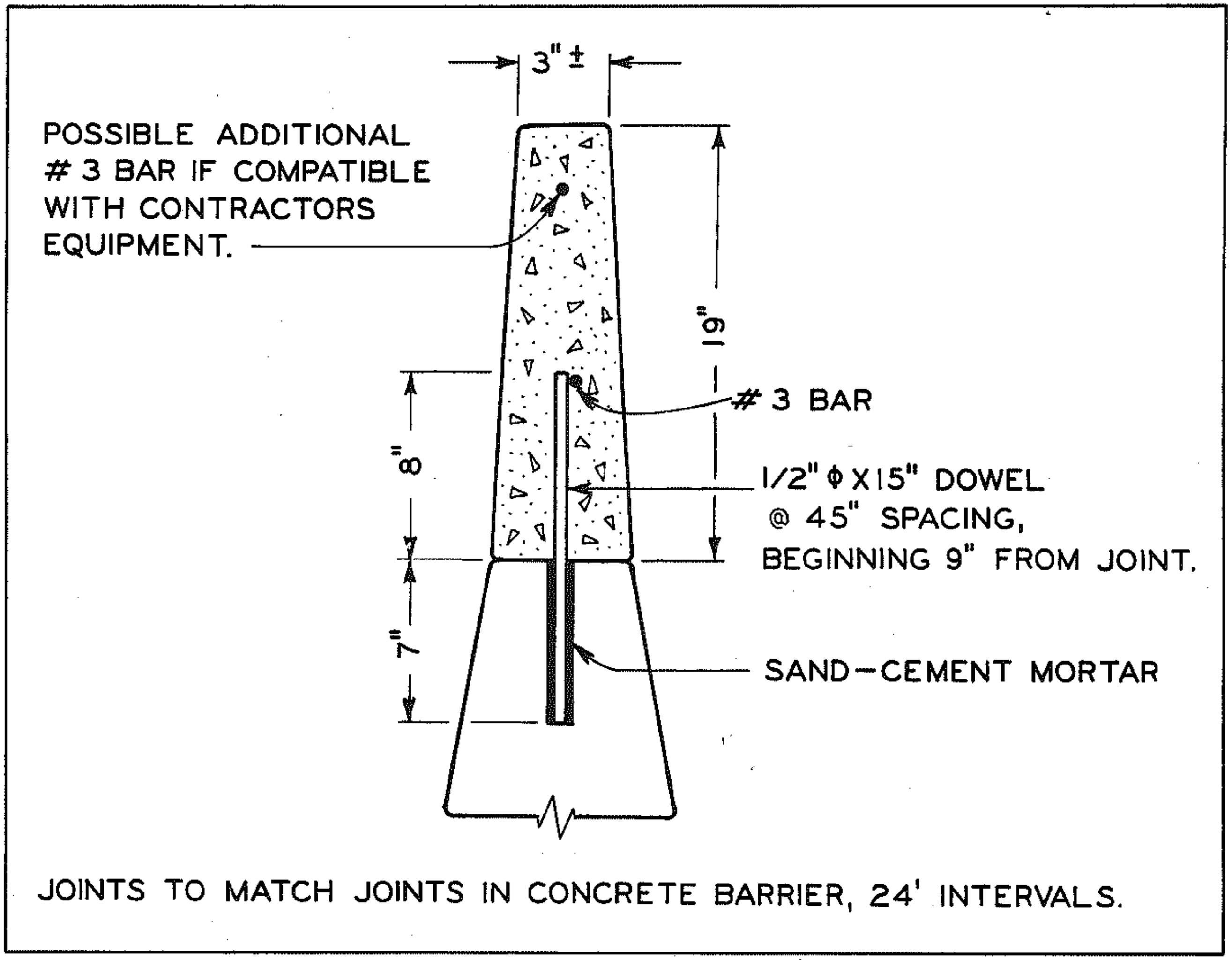


Figure 1. Proposed concrete glare screen to be placed on previously constructed concrete median barrier.

tion in the foreground has been set up with no longitudinal steel, for comparative performance. Figure 3 shows the screen under construction, and after hand finishing. The mix used for the glare screen contained 17A aggregate, and water reducer-retarder. High-early-strength concrete was used, so that testing could be done more quickly.

It was found during construction that the second No. 3 longitudinal rebar proposed for addition near the top of the barrier (Fig. 1) could not be placed effectively. The bar tended to travel with the machine, causing tearing of the top portion of the screen. Also, due to the small cross-sectional area near the top, it was very difficult to maintain correct alignment of the bar. Therefore, the final section that was placed for testing had only one longitudinal bar, approximately 8 in. above the top of the barrier.

Evaluation

The glare screen was cured for two weeks and on June 29, 1973, impact tests were run to determine the mode of failure. No precisely controllable device was available for impacting the screen, so the observations are subjective and would not be expected to be accurately reproducible.

The following is a description of the testing that was done and of the results obtained. It is intended mainly for informational purposes, and is not presented as a comprehensive evaluation.

It was generally agreed that most impacts from traffic probably would be on the lower portion of the screen. Figure 4 shows a concrete truck positioned against the barrier to show probable point of contact of the front of such a vehicle. The rack portion of flat-bed trucks could be expected to be slightly higher. It was decided to attempt to hit the screen near the top, to subject it to the most severe condition. A wrecking ball, estimated to weigh 2,000 lb, was used to break the barrier. It was swung by a crane, and not controllable to hit a precise location. Greater impact was provided by swinging the ball through a greater arc. Figure 5, shows the ball at contact with the screen. Results were as follows:

1. First section, with longitudinal reinforcement. Swing approximately 10 ft, hit 6 in. from bottom of screen, no damage. Swing of about 15 ft, developed a crack. After about six 15-ft swings, a large piece was broken from the end. The screen stayed together, and no large loose pieces flew more than 3 or 4 ft. A hit near the top with about a 25-ft swing knocked 6 to 8-in. pieces about 10 ft, while the same impact down lower caused only a crack.

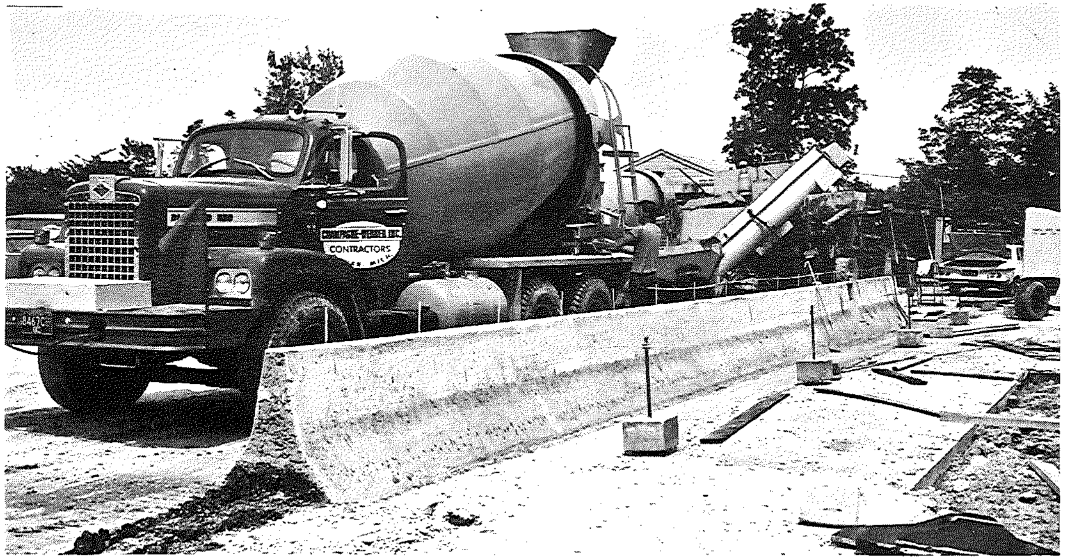


Figure 2. Median barrier ready for placement of concrete glare screen. Note that longitudinal reinforcement has been left out of the section in the foreground.

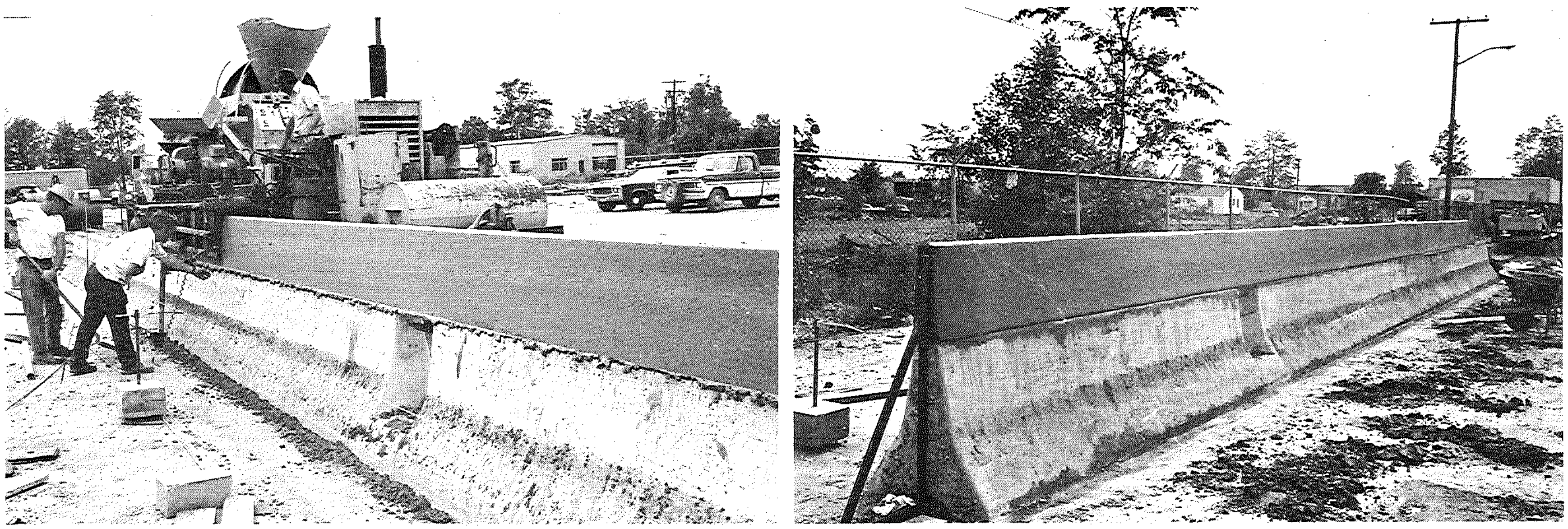
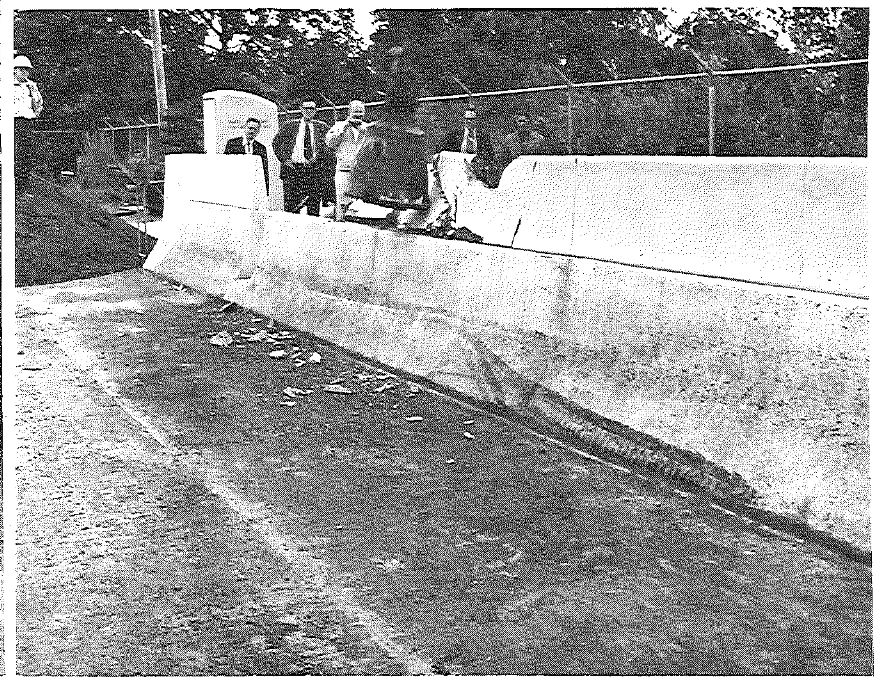


Figure 3. Construction of the glare screen (left) and finished product (right).

Figure 4. Concrete truck positioned against barrier to show probable height of contact for such a vehicle.

Figure 5. Wrecking ball estimated to weigh about 2,000 lb, used to break glare screen.



2. Second section, with only vertical tiebars. A hit approximately half way down the screen, with a 20-ft swing caused only cracking. The third swing broke the screen off the wall, in pieces approximately 2 ft long.

Figure 6 shows the pieces of the two types of screen, and indicates the effectiveness of the rebar in holding larger fragments of concrete together.

3. A small remaining section of reinforced screen was rammed by an end loader, as shown in Figure 7, and fractured in a manner similar to the other longitudinally reinforced portion.

Representatives of the Department and FHWA observed the demonstration. They agreed that the concrete glare screen appeared to be a reasonable alternate to presently specified screen, and that one longitudinal rebar should be included in any future construction. Based on this limited evaluation of the feasibility of the construction method, and the behaviour of the concrete under impact, it was agreed that the second phase of the experiment should proceed.

A movie was made of the impact testing of the screen, and is available upon request.

PHASE II

Construction of the glare screen on I 696, was started on July 18, 1973 and finished the next day. There were some early problems with a stiff mix, but once the proper mix was obtained, the operation proceeded quite well. The rail was formed approximately as per Figure 1, with the exception that a No. 4 rebar was used longitudinally instead of the No. 3 bar noted on the plan. Joints in the glare screen were matched in kind, with joints in the median barrier, but the longitudinal steel was carried through the dummy contraction joints.

This installation will be observed periodically by Research personnel to document any damage that occurs in service and to evaluate repair techniques.

Cost

The concrete glare screen placed on I 696 was added to the contract by authorization, at a negotiated price of $10.25 per lineal ft. This compares with recent bid prices of $10.35 and $10.65 per ft for conventional mesh-type glare screen on other jobs that had considerably larger quantities. Past prices for mesh-type glare screen have ranged up to $25.00 per foot.

Figure 6. Fragments of screen after repeated impacts. Pieces in foreground had only vertical tiebars, while those in rear were held together by the longitudinal reinforcement.

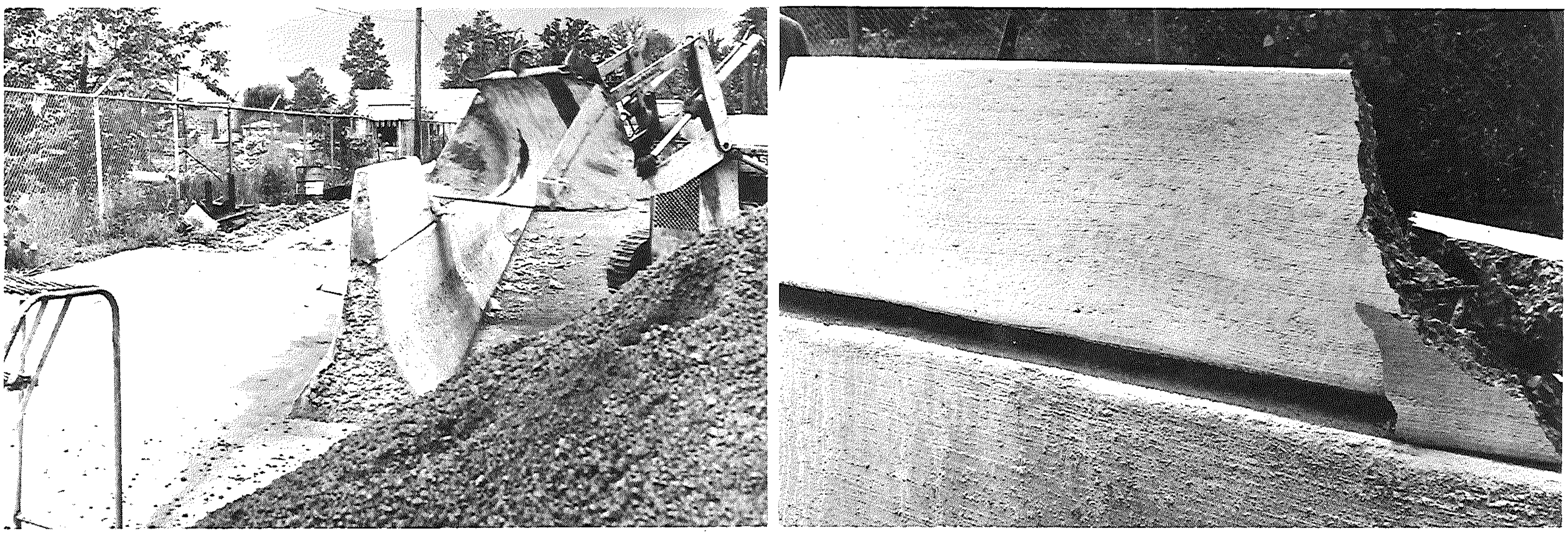


Figure 7. Results of end-loader impact on longitudinally reinforced screen.

Conclusions

The limited experiment reported here has shown that slip-form construction of concrete glare screen is feasible, and that the completed product has considerable structural strength. Therefore it seems that such installations should provide long life and low maintenance usually associated with structural concrete. Also, in the unusual case of an automobile tending to ride over the median barrier, the additional height and strength of the glare screen should provide an extra measure of safety, in helping to keep the errant vehicle out of the opposing lanes of traffic.