

OFFICE MEMORANDUM

R-573



MICHIGAN DEPARTMENT OF STATE HIGHWAYS

March 28, 1966

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

From: J. E. Simonsen

Subject: Accident Damage to Aluminum and Steel Guard Rails.
Research Project 54 F-36. Research Report No. R-573.

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As requested, an inspection of accident-damaged aluminum guard rails was made on March 14, 1966. The damaged rails had been removed from the portion of I-296 north from I-196 to Richmond Street in Grand Rapids (Construction Projects EBACI 41027A, C23, and BI 41131, C89).

Because damaged rails are disposed of shortly after repair, only two 12-ft sections of aluminum and one 12-ft section of galvanized steel from a recent accident were available for inspection. According to T. Morgan, District Foreman, Kent County Road Commission, these three rail sections were removed from the site of an accident which occurred on March 2, 1966. The galvanized steel rail had been used to repair previous accident damage at the same site at a time when the County was out of aluminum rail stock.

The accident site was on southbound I-296 just past the exit ramp to westbound I-196 (Fig. 1). The car involved went through the guard rail, rolled down the embankment, and stopped along the entrance ramp to northbound I-296. Details of the accident were not available, because the police report had not yet been received.

The damaged rails are shown in Figure 2, the buckled rail being steel. During the impact, the aluminum rail was completely fractured at both ends at the splice connections and the loose section was found at the toe of the embankment. Details of the fractures are illustrated in Figures 3 and 4.

Based on Mr. Morgan's experience with aluminum guard rail, this type fractures easier than the galvanized steel rail, but in most cases the failure occurs as a shear-out fracture at the bolt holes. Since no two accidents involving guard rails have exactly the same characteristics, it would be impossible to determine the performance of the two rail types using the amount of damage as a criterion. It is well known that of the two types of materials in question, the steel rail has a considerably greater resistance to fracture under impact loading.

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As stated on previous occasions with regard to guard rail design, the three essential requirements for an effective barrier are as follows: 1) to prevent the vehicle from going through, under, or over the barrier, 2) to prevent the vehicle from rebounding back into the traffic lane, and 3) to bring the vehicle to a safe stop within tolerable deceleration limits. Full-scale tests on guard rail barriers, reported by J. L. Beaton and R. N. Field in HRB Bulletin 266 (1960) demonstrated that the steel single beam type guard rail mounted on posts spaced at 12 ft 6 in. is ineffective, as the rail pockets the vehicle, or the vehicle snags a post resulting in pitching or rolling, extremely high decelerations, and total loss of the vehicle after impact. For the case of an aluminum alloy single beam type rail of the same shape and post spacing, since the material is essentially brittle, and the toughness or energy absorbed to fracture is quite small, the probability of a fracture of the beam rail under impact would be high, allowing the vehicle to go through the barrier as was the case here.

OFFICE OF TESTING AND RESEARCH

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Attachment

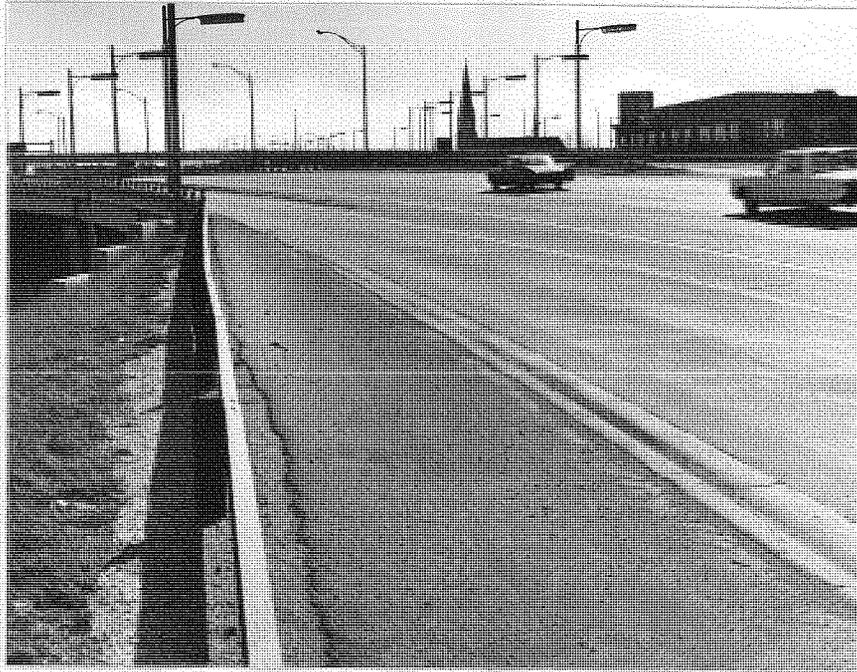


Figure 1. Site of accident on southbound I-296, Grand Rapids. The guard rail involved is at center, partially hidden by the first car.

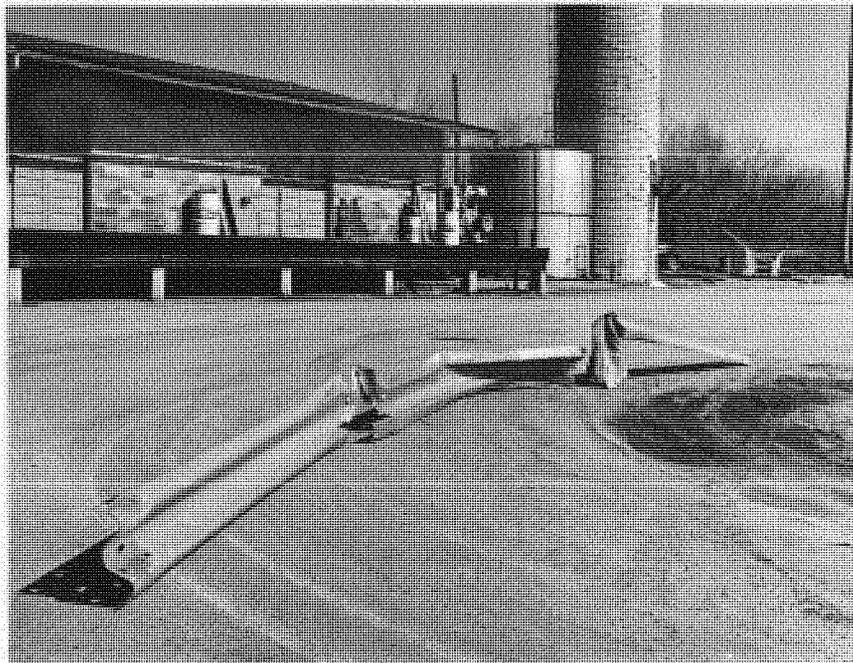


Figure 2. Damaged rails. Rail at right is galvanized steel.

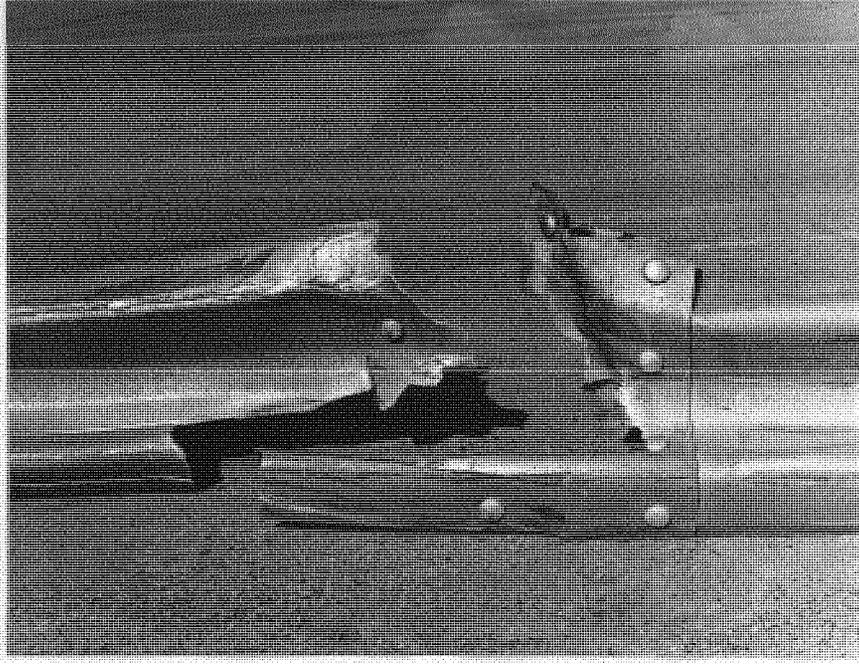


Figure 3. Fractured aluminum guard rail.

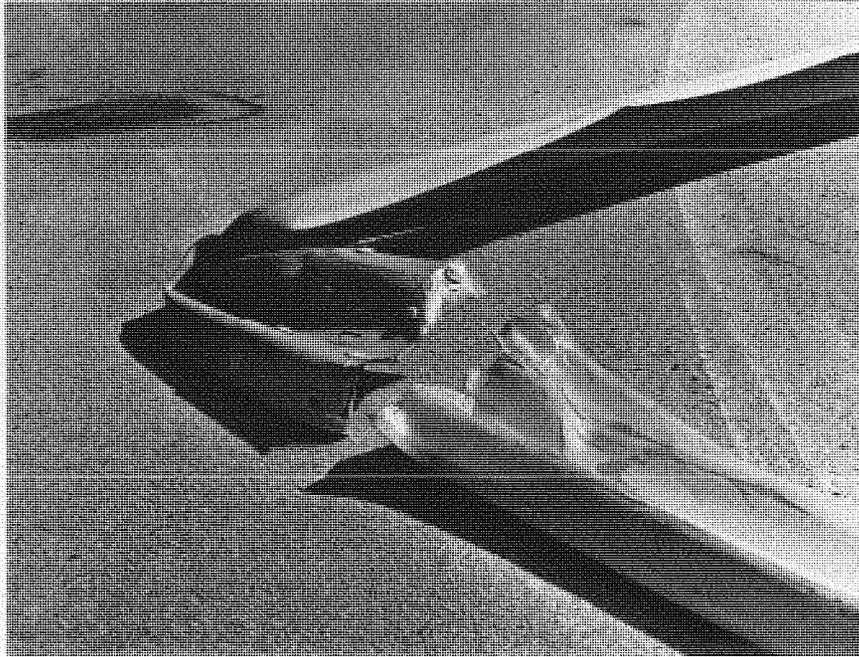


Figure 4. Buckled steel rail and fractured aluminum rail.