OFFICE MEMORANDUM

MICHIGAN
STATE HIGHWAY DEPARTMENT
JOHN C. MACKIE, COMMISSIONER

July 30, 1962

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

From: C. C. Rhodes, Assistant Director
Research Laboratory Division

Subject: Aluminum Chain Link Fencing. Research Project 57 G-85.
Report No. R-393.

At a meeting of the Committee for Investigation of New Materials on June 20, 1962, R. L. Greenman read a memorandum from N. C. Jones to W. W. McLaughlin, dated June 12, calling attention to certain observations by F. Skebensky on the performance of aluminum alloy chain link fence installed at structures on the Walter P. Chrysler freeway in Detroit. Mr. Skebensky was said to have stated that he considered aluminum fencing considerably less durable than steel, that it is easily damaged by cars as well as by children, and that the aluminum becomes brittle in time so that pieces can be easily broken off by hand. After some discussion, the Committee named William J. MacCreery, C. C. Rhodes, and James Lindemuth to investigate the condition of present installations and report back to the Committee.

After several unsuccessful attempts to make arrangements with Mr. MacCreery for the trip, it was decided that the Research Laboratory Division should go ahead and make the inspection with its own personnel without further delay. Accordingly, arrangements were made with Mr. Skebensky for C. C. Rhodes and G. R. Cudney to inspect the Chrysler installations with Donald Wickham on July 20. Following is our report on that trip with a discussion of pertinent factors and suggestions for further action.

The first fencing inspected was of galvanized steel and had been hit by a car (Fig. 1). According to Mr. Wickham, this fence was probably installed sometime in 1960. There was no noticeable rust and the fabric had not been broken, but the fence was damaged enough to require replacement. In another area we were shown a section of aluminum fence (Fig. 2) which had also been damaged by a vehicle a short time previously. The damage here was considerably greater than at the galvanized steel location.

Continuing our inspection of aluminum fencing in the area, Mr. Wickham called our attention to several significant factors in performance: 1) it is possible to break off lengths of the aluminum wire where exposed without reinforcement at the ends, such as at the ends of fabric ties and the knuckled selvage above the top rail, but very little of this type of damage was observed; 2) the expansion sleeves connecting successive segments of top rail were loose-fitting and insufficient longitudinal expansion space had been provided, so that the rail was buckled at almost every joint and considerable lateral movement was possible (Fig. 4); 3) in most cases fabric ties were not completely wound and their ends were projecting an inch or more after only a turn or two around the retained fabric wire (Fig. 3). Other evidence of poor erection may be seen in Fig. 5 which shows a gate too short for its opening, where the gap had been closed by rotating the offset hinges out of normal position. Corner fittings and braces on the gate are satisfactory but welded construction is preferable.

Discussion

1. Damage by Vehicles. According to the Office of Design, the sole purpose of chain link fence is to keep pedestrians and animals from entering or crossing the roadway. Neither steel nor aluminum chain link fence gives effective protection against vehicle encroachment and both must be replaced when hit. In accident-susceptible areas, it may be advisable to extend the use of short sections of guard rail as is done now in some cases at dead ends of intersecting streets.

2. Damage by Pedestrians. The installations examined were located in a slum area of Detroit where considerable willful damage by residents may be expected. The looseness of the expansion sleeves and long projecting ends of fabric ties are open invitations to "racking" the top rail and breaking the ties. However, there was little evidence of damage caused either by attempts to scale the fence or by deliberately tampering with it. It is true that the aluminum alloys used for chain link fence are quite brittle. About three years ago, the alloy recommended for the fabric was changed from 5052-H38 or Alclad 5056-H38 to 6061-T94, apparently to increase strength and achieve uniformity throughout the industry. This change increased tensile strength to 55,000 psi and probably resulted in a slight loss of ductility. The apparent brittleness noted by Mr. Skebensky is not the result of aging but an inherent property of the alloy. Wire fabric ties are of Alloy 1100-H18. This is a highly corrosion-resistant pure aluminum, fully strain-hardened and has been required ever since our specifications were first written. It should be ductile enough and strong enough for its purpose when the ties are properly wrapped or wound on the fabric wires. As a matter of fact, aluminum ties of this kind are also used for fastening steel fabric.

3. Erection Deficiencies. There were two deficiencies in erection that should be corrected both on this installation and any future installations of aluminum chain link fence. The first and more serious one was the type of expansion sleeve used to join sections of top rail. The sleeves on this job (Fig. 6) do not meet our specifications which require that "Expansion sleeves for the top rail shall be 1-1/2-in. Schedule No. 40 pipe, expanded or bored to 1.690-in. inside diameter or from drawn tube with 1/8-inch wall thickness and 1.690-in. inside diameter." This inside diameter is critical since the sleeve must accommodate a rail of 1.660 in. outside diameter without

excessive play. The sleeves used on this job were unmachined castings with an average inside diameter of 1.743 in. at the end and 1.798 in. within the pipe.

The second deficiency was the manner of fastening the fabric ties, which left an inch or more of wire unwound on the end of the tie. If these ties were wrapped completely with, say, less than 1/2 in. of loose ends there would be no chance to break them off.

Conclusions

On the basis of the inspection described and discussed above, our comments are summarized as follows:

1. Aluminum is not as strong as steel but not necessarily less "durable". It is more easily damaged by vehicles than galvanized steel but is considerably more resistant to corrosion. Chain link fence is not intended to act as a guard rail and other means should be used to protect both vehicles and fence in accident-susceptible areas. These facts were known and weighed when aluminum alloy chain link fence was first specified for use on urban expressways. In spite of its higher initial cost (about 25 percent), aluminum was considered preferable to steel in view of the Department's newly assumed obligation to maintain these fences. According to information available at the time, the costs of steel and aluminum would equalize in a little less than 10 years.

2. In all of the places inspected, there was very little evidence of destruction by area residents, either children or adults.

3. The only wires we were able to break off with our unaided hands were the ends of ties left projecting an inch or more. The possibility of such breakage can be entirely eliminated by wrapping the ends of the tie completely around the fabric wire.

4. Aluminum alloys for chain link fence are quite brittle, ductility having been sacrificed somewhat for increased strength. Alloys of the -T9 series are heat treated, artificially aged and then strain hardened, so there is little likelihood of increasing brittleness of the fence fabric through natural aging.

5. In view of these facts, we see no reason for discontinuing the use of aluminum alloy chain link fence at this time.

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Figure 1. Galvanized steel fence damaged by vehicle (east service drive between Madison and Clinton Avenues. Walter P. Chrysler Expressway, Detroit).

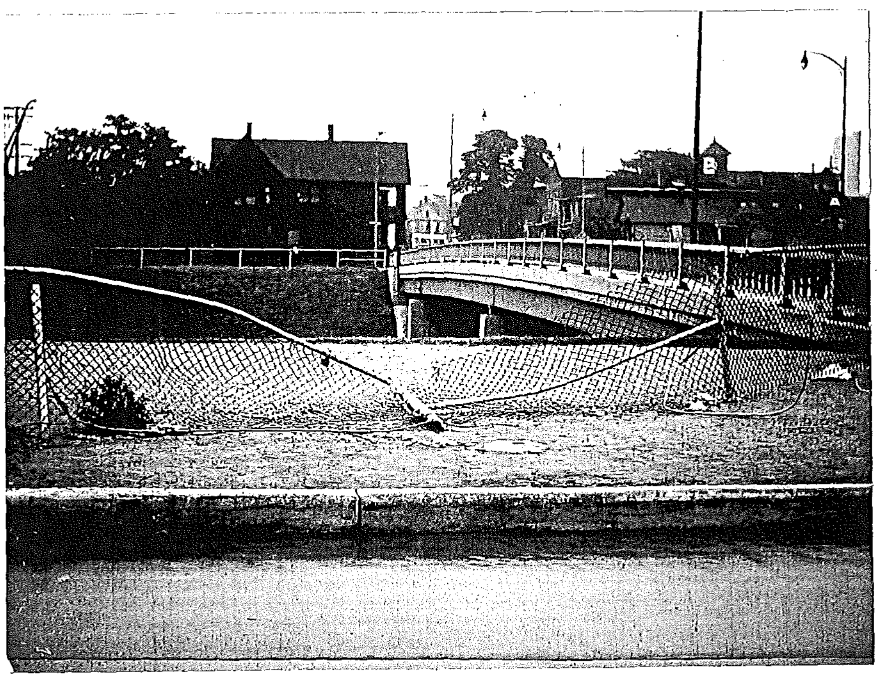

Figure 2. Aluminum fence damaged by vehicle (west service drive at Wilkins St. Chrysler Expressway, Detroit).

Figure 3. Aluminum fence; note incomplete wrapping of fabric tie at center of post.

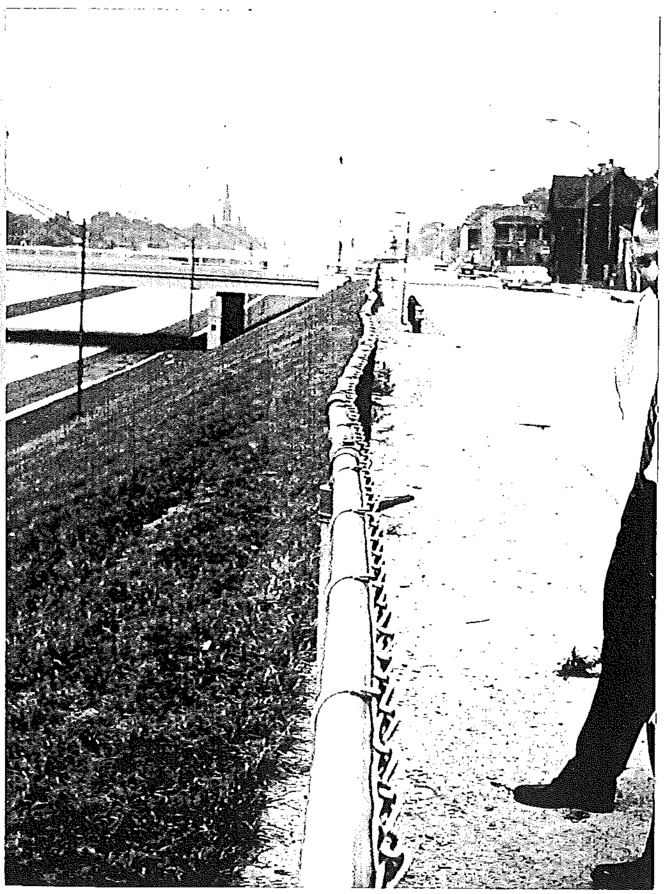

Figure 4. Poor rigidity and alignment of top rail on aluminum fence, due to loose expansion sleeves.

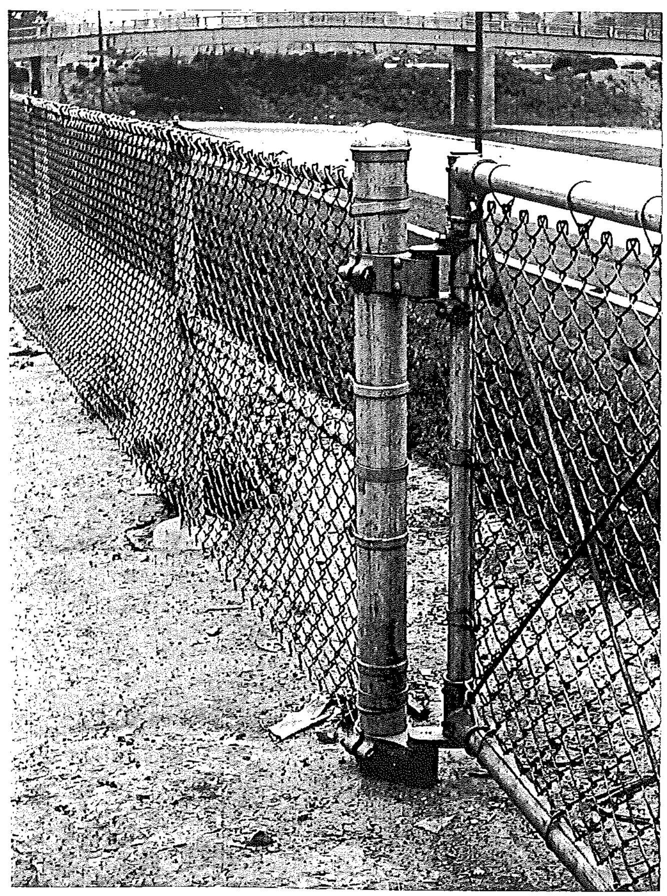

Figure 5. Expedient used to install gate which was too short for the opening between posts; note corner fittings and braces.

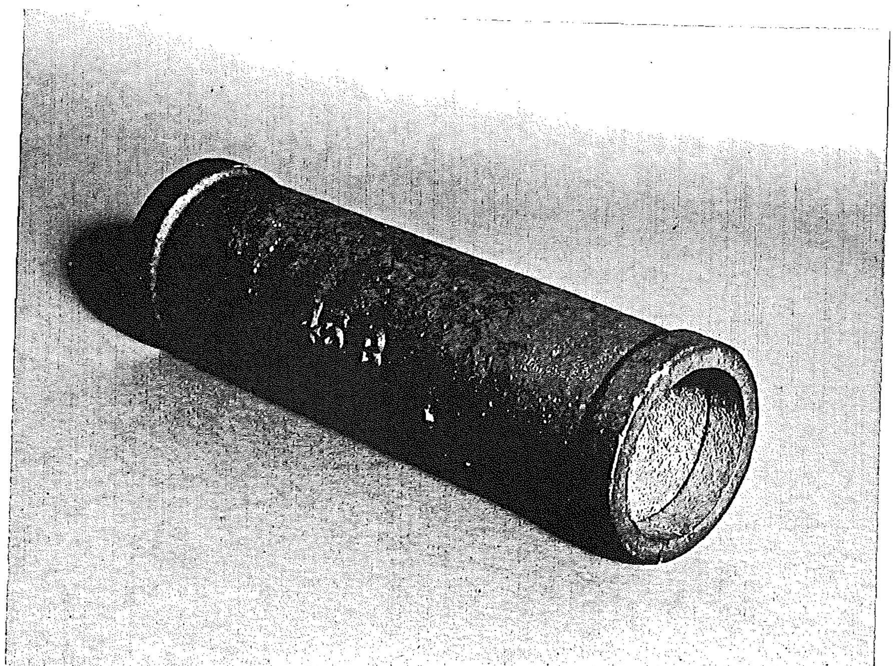

Figure 6. Cast aluminum expansion sleeve used on top rail of aluminum chain link fence.