

IMPACT TESTS OF BREAKAWAY LIGHT POLES

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Prepared in Cooperation with the Traffic Division

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ABSTRACT: Impact tests of a late model auto with steel light poles having both conventional and special breakaway anchorage designs are described. Under these test conditions, it appeared that less damage would occur to the vehicle and less injury to its occupants in a collision with a pole having the breakaway anchorage.

KEY WORDS: lights, poles, posts, anchorages, collision tests, highway lighting.

IMPACT TESTS OF BREAKAWAY LIGHT POLES

In a memorandum dated September 6, 1966, H. H. Cooper, Director, Traffic Division, requested that the Office of Testing and Research cooperate in preparing a report on comparative impact testing of light poles, conducted by personnel of the General Motors Proving Ground, Milford, Michigan. On August 21, a General Motors film of this testing had been shown to Messrs. Hill, Meyer, Laird, McCarthy, McLaughlin, O'Toole, and Doyle. In cooperation with the Traffic Division, the following report has been prepared, based on General Motors notes and film taken during the tests and later transmitted to the Department for information. Photographs included in this report also were furnished by General Motors.

Specifically to be described are two impact tests involving collision of a late model Chevrolet sedan with an MDSH conventionally anchored steel light pole and with a pole having a breakaway base joint connection designed by General Motors.

Design

The conventional anchorage design for steel street light poles is shown in Figure 1. As can be seen, the pole is fastened to a concrete base with four 1-in. diam bolts through a steel base plate. The base telescopes over the butt of the pole and is connected to the pole with two continuous fillet welds--one on the inside at the bottom of the base and one on the outside at the top of the base.

The breakaway base joint connection (Fig. 2) consists of a 3/4-in. steel plate fastened to the concrete base with four 1-in. diam bolts and

a 3/4-in. thick "slip" plate attached to the pole base with four 7/8-in. diam countersunk head bolts. A 1-3/4 in. thick spacer plate is welded to the steel-to-concrete base plate at the bottom and to a 3/4-in. slip plate at the top. The pole is anchored by clamping the two slip plates together with four 3/4-in. diam bolts, one at each plate corner. The slip plates are notched so that the clamping bolts will slip out when a vehicle strikes the pole.

Poles with conventional and breakaway anchorages are shown before testing in Figure 3, with test vehicles illustrating the anticipated points of impact. The pole assemblies were shop-painted only. In the conventional anchorage, the bolts, nuts, and washers were hot-dip galvanized. The top slip plate, clamping bolts, and washers used in the breakaway joint base also were hot-dip galvanized. The bottom slip plate assembly and anchor bolts did not appear to have received any surface treatment. In both tests the top of the concrete footing was flush with the ground surface.

Test Procedure

The erected pole assemblies consisted of the shaft, bracket arm, and a weight attached to the luminaire end of the arm to simulate a standard luminaire. Each pole assembly contained electric wiring. The conventional anchorage bolts were tightened normally, whereas the clamping bolts in the breakaway joint anchorage were torqued to 50 ft-lb. No lubricant was used on these clamp bolts.

The remote-controlled car, containing a lap-belted dummy in the right front passenger seat was driven into each of the two pole assemblies at a speed of 40 mph. The line of impact was perpendicular to the bracket arm.

Results

Breakaway Base Joint. At impact, the breakaway joint anchorage detached as intended in its design. The pole assembly was thrown into the air and as it descended the base struck the trunk lid of the car. The pole shaft was dented at the point of impact and the bracket arm deformed as it hit the ground. The pole assembly came to rest in line with the pre-collision vehicle path. The wiring was severed at the pole base. The anchorage, pole, and site are shown after test in Figures 4 and 5. The lap-belted dummy passenger remained in position without striking the instrument panel. The car was crushed approximately 3 in. in the front at the impact point and the trunk lid was slightly deformed and torn (Fig. 6).

Conventional Anchorage. The pole shaft fractured above the shaft-to-base fillet weld at the top of the base during impact, but all four of the anchor bolts remained intact (Fig. 7). The wiring was severed at the base. There was evidence that this fillet weld was cracked before the test. The pole assembly was thrown into the air and descended to the ground without striking the car. The shaft was severely damaged at the point of impact and the bracket arm connection broke as the pole hit the ground (Fig. 8). The pole assembly came to rest in line with the pre-collision vehicle path (Fig. 9). The lap-belted dummy passenger struck its right knee on the instrument panel. The car was crushed approximately 24 in. before the pole shaft fractured (Fig. 10).

Conclusions

Based on the results of these tests, and under the test conditions described, it appears that in a collision of a vehicle with a steel street light pole assembly having a breakaway joint base, less damage occurs to the vehicle as well as less serious injury to its occupants than in a collision with a conventionally anchored pole assembly.

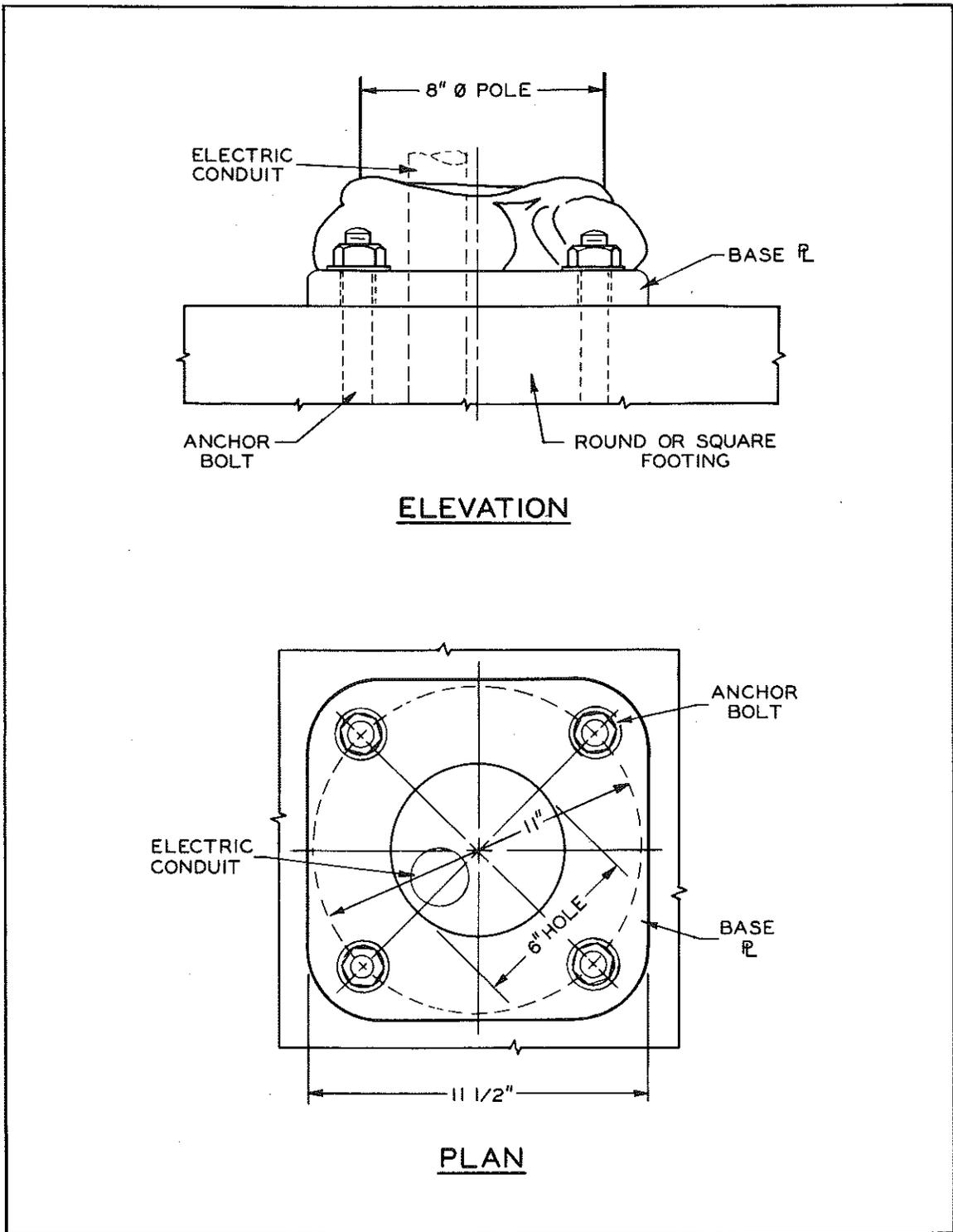


Figure 1. Michigan Department of State Highways conventional steel light pole anchorage design.

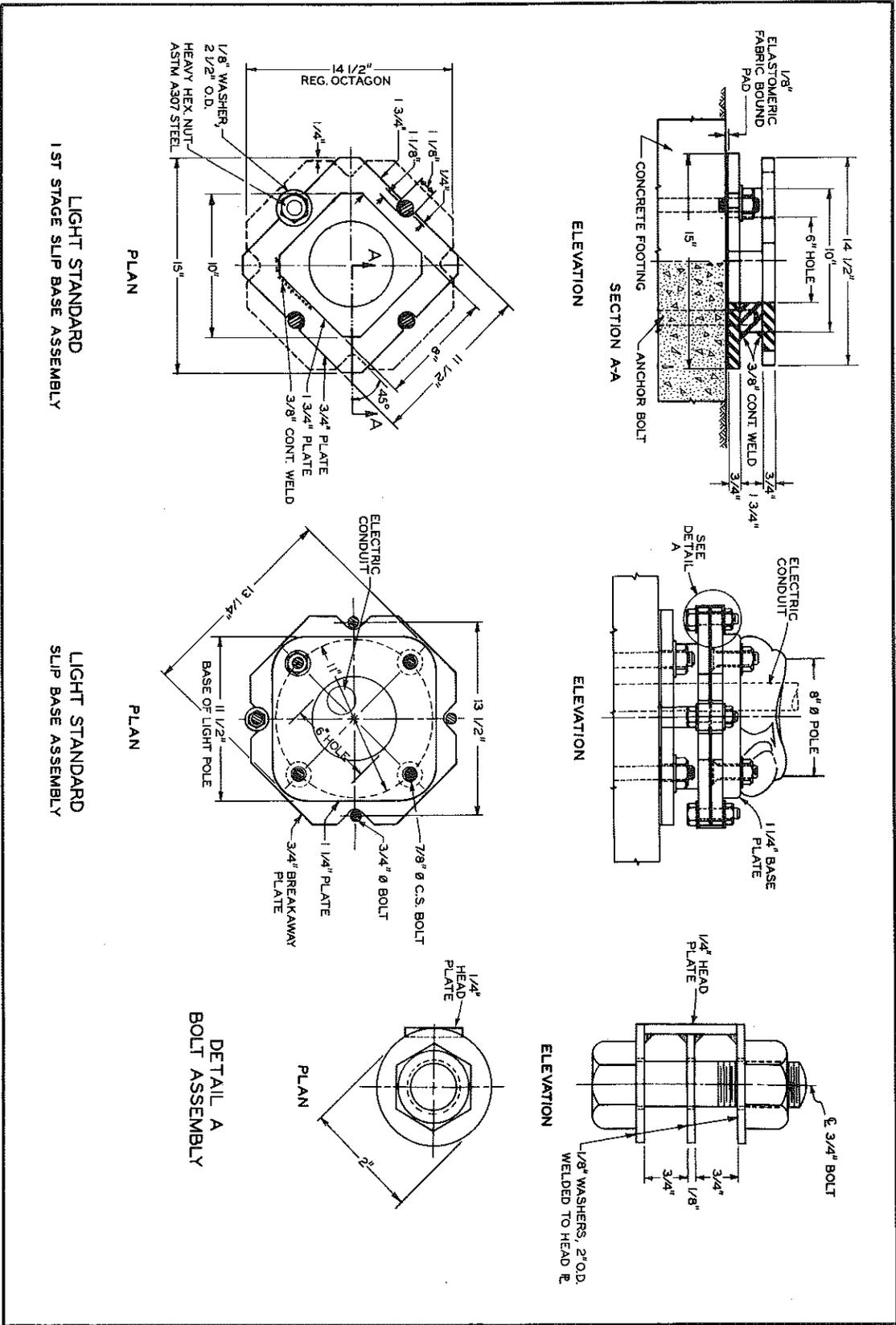


Figure 2. General Motors steel light pole with breakaway joint anchorage design.

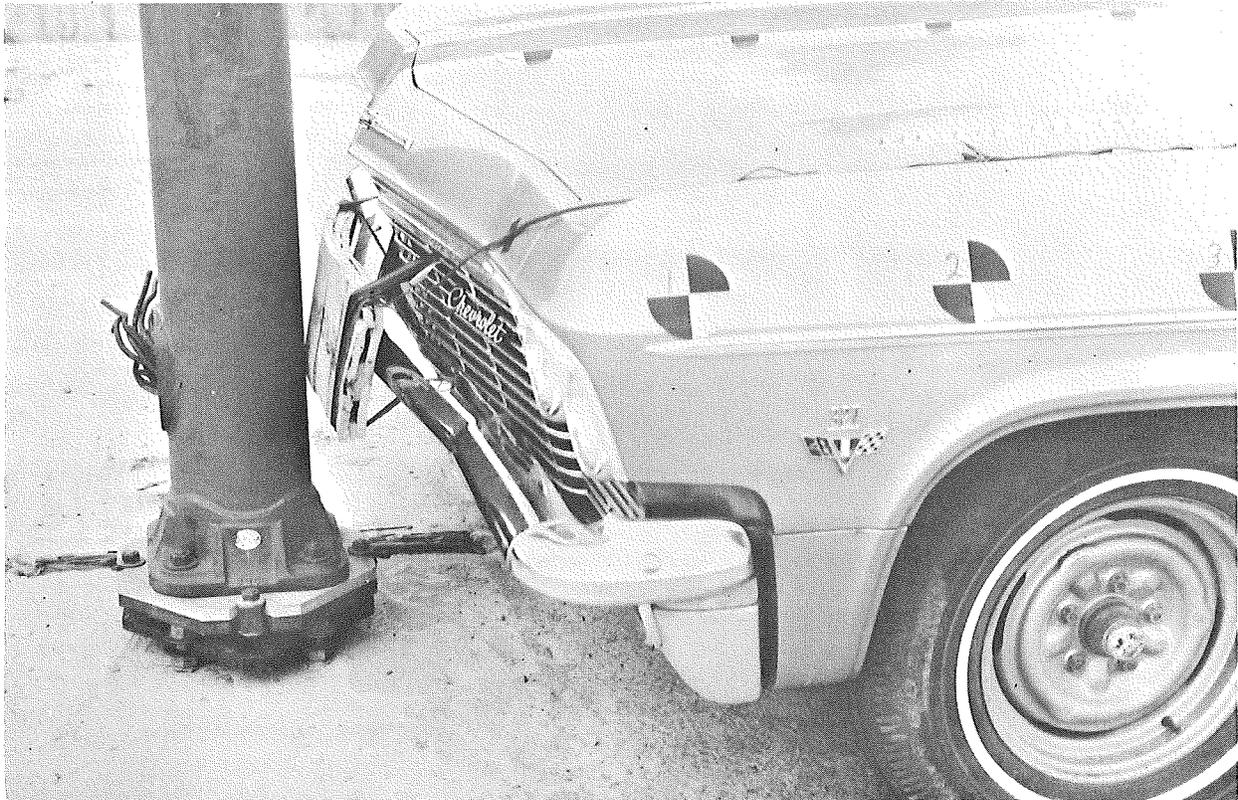


Figure 3. Poles with conventional and breakaway anchorages (above and below) showing approximate points of impact.

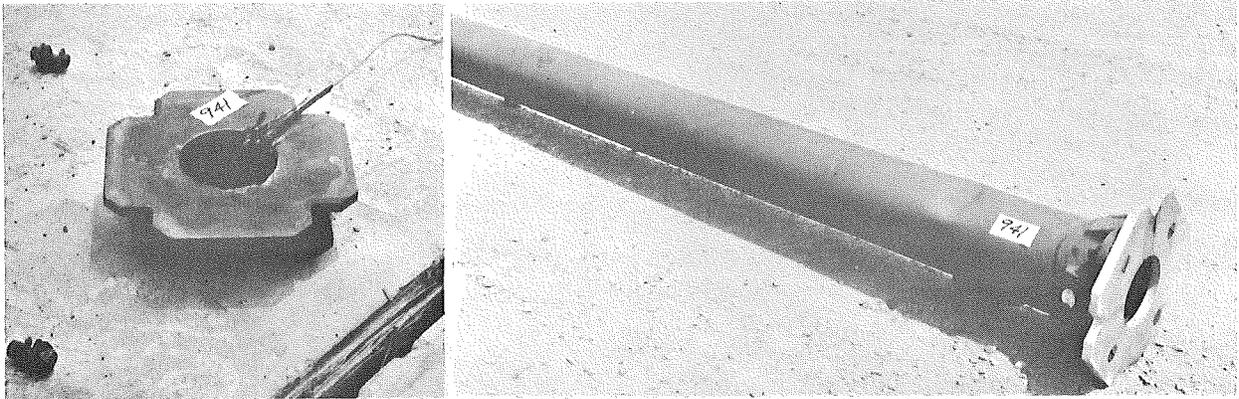


Figure 4. Bottom slip plate and severed wiring of breakaway anchorage after test impact (left), and damaged pole with top slip plate attached (right).

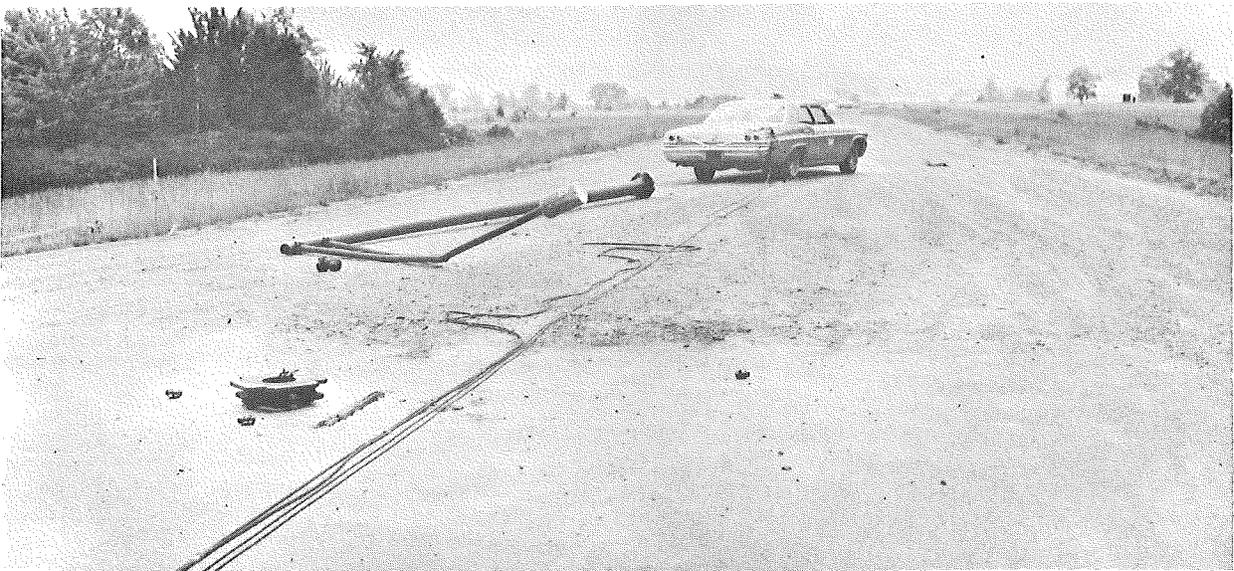


Figure 5. Test area after impact, showing breakaway anchorage, deformed bracket arm on pole, and test vehicle with remote control cables attached.

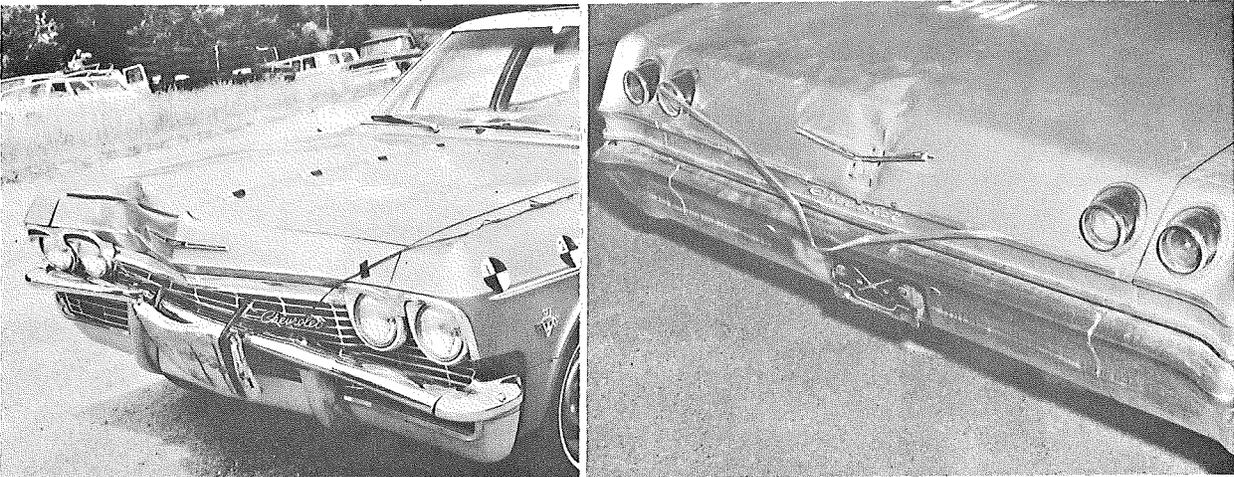


Figure 6. Damage from test impact with breakaway joint anchorage light pole.

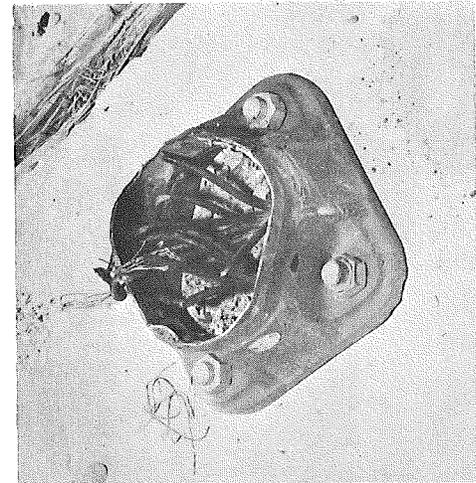


Figure 7. Conventional anchorage and severed wiring after impact.

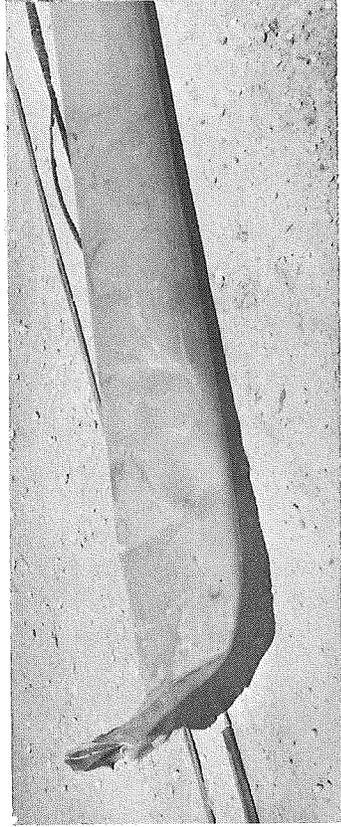


Figure 8. Damaged pole shaft and broken bracket arm connection after impact with conventional light pole.

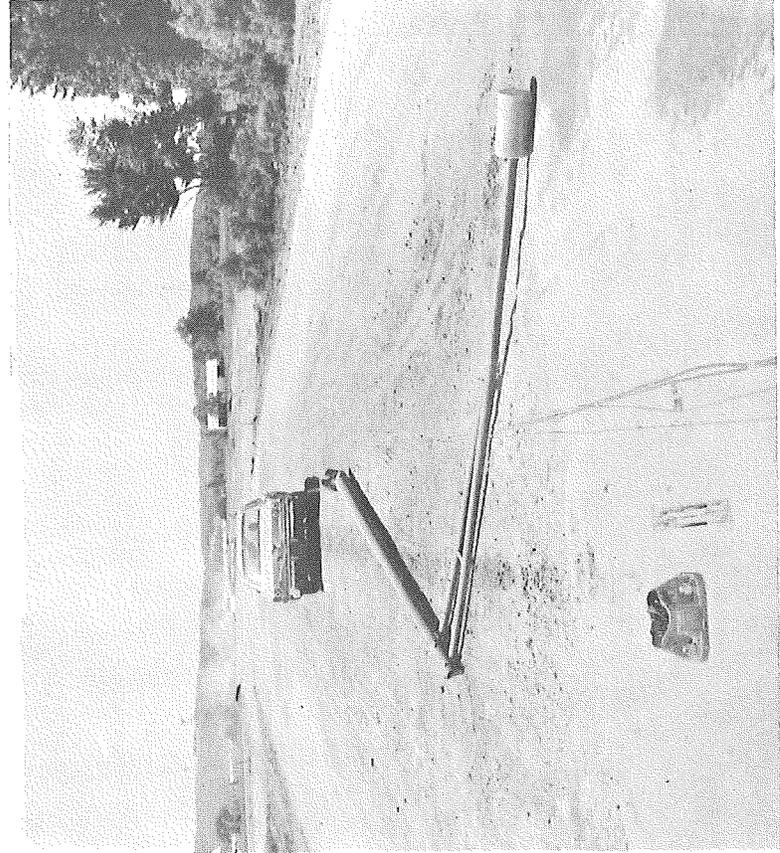


Figure 9. Test area after impact, showing conventional anchorage, damaged pole and bracket arm, and test vehicle with remote control cables attached.

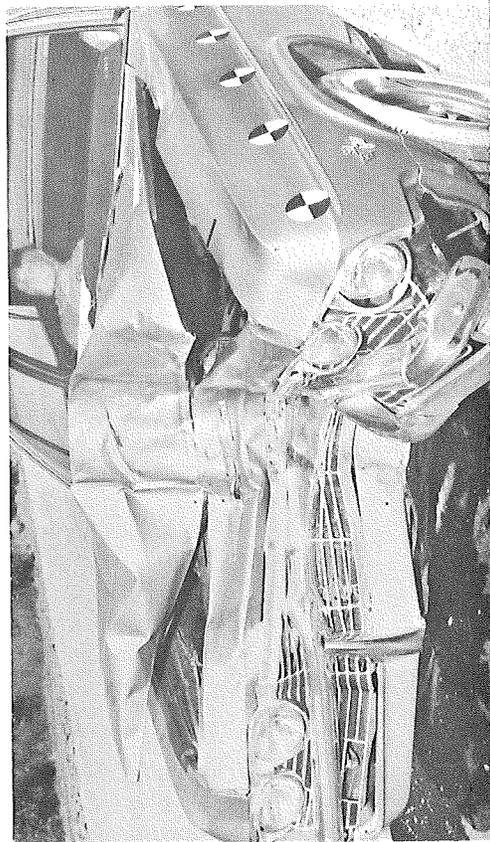


Figure 10. Damage from test impact with conventionally anchored pole.