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Testing of Small and Large Sign Support Systems FOIL Test Number: 92F014

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15. Supplementary Notes

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16. Abstract

This test report contains the results of a crash test performed at the Federal Outdoor Impact Laboratory (FOIL) in McLean, Virginia. The test was performed on a small sign support system at 20 mi/h (8.9 m/s), test 92F014. The vehicle used for these test was a 1985 Honda Civic. The purpose of this test was to evaluate the low-speed safety performance of a dual post sign support with concrete foundations in weak soil. The posts were made from 4-in by 6-in (102-mm by 152-mm) pressure treated wood and were spaced 3.5 ft (1.1 m) apart. The performance evaluation was based on the latest requirements for breakaway supports as specified in Volume 54, Number 3 of the Federal Register dated January 5, 1989. These criteria specify, in part, that the occupant change in velocity must be 16 ft/s (4.9 m/s) or less, that the significant test article stub height remaining after impact be no more than 4 in (102 mm), and that there can be no occupant compartment intrusion. The test results indicate that the dual wood post sign support with concrete foundations in weak soil does not meet all of the applicable performance criteria for roadside safety appurtenances specified by the FHWA.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
	AREA			
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
	VOLUME			
fl oz	fluid ounces	29.57	milliliters	ml
gal	gallons	3.785	liters	l
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE	Volumes greater than 1000 l shall be shown in m^3			
	MASS			
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celcius temperature	°C
	ILLUMINATION			
fc	foot-candles	10.76	lux	l
fl	foot Lamberts	3.426	candela/m^2	cd/m^2
	FORCE and PRESSURE or STRESS			
lbf	poundforce	4.45	newtons	N
psi	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
	AREA			
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	ac
ha	hectares	2.47	acres	mi^2
km^2	square kilometers	0.386	square miles	
	VOLUME			
ml	milliliters	0.034	fluid ounces	fl oz
l	liters	0.264	gallons	gal
m^3	cubic meters	35.71	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
	MASS			
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg	megagrams	1.103	short tons (2000 lb)	T
	TEMPERATURE (exact)			
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
	ILLUMINATION			
lx	lux	0.0929	foot candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
	FORCE and PRESSURE or STRESS			
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	psi

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

(Revised August 1997)

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1. SCOPE

This test report contains the results of a crash test performed at the Federal Outdoor Impact Laboratory (FOIL) in McLean, Virginia. The test was performed on a small sign support system at 20 mi/h (8.9 m/s), test 92F014. The vehicle used for this test was a 1986 Honda Civic. The purpose of this test was to evaluate the low speed safety performance of a dual legged wooden 4x6 sign support. The performance evaluation was based on the latest requirements for breakaway supports as specified in Volume 54, Number 3 of the Federal Register dated January 5, 1989. These criteria specify, in part, that the occupant change in velocity must be 16 ft/s (4.9 m/s) or less, that the significant test article stub height remaining after impact be no more than 4 inches (102 mm), and that there can be no occupant compartment intrusion.

2. TEST MATRIX

The test was performed on a small sign support system. The test speed was 20 mi/h (8.9 m/s). The sign was buried in NCHRP Report Number 230, S-2 weak soil[1]. A summary of the test conditions is presented in table 1.

Table 1. Test matrix.

Test Number	Test Vehicle	Test Weight (lb)	Test Speed (mi/h)	Test Article Description	Impact Location
92F014	'86 Honda Civic	1860	20	2 leg wood 4x6	center

3. VEHICLE

The test vehicle was a 1986 Honda Civic two door hatchback with a manual transmission. Prior to the test, the vehicles' fluids were drained and its inertial properties measured. The vehicle was stripped of certain components which made space for the installation of test equipment. The vehicle was ballasted with a data acquisitions system, transducers, a brake system and weight plates (if necessary) to bring its inertial weight to approximately 1850 pounds (839 kg). The actual weight of the test vehicle was 1860 pounds (844 kg). After ballasting, the vehicles' inertial properties were remeasured.

4. SIGN SUPPORT

The sign support system consisted of two 4-in by 6-in (102-mm by 152-mm) wooden legs 13 ft (4.0 m) long. The actual dimensions of the sign legs were 3.5 in by 5.5 in (89mm by 140 mm). The wooden legs were made from pressure treated southern yellow pine. Two feet (0.9 m) of each leg was inserted inside a steel sleeve which was cast inside an 18-in (0.457-m) diameter concrete footer. The footers were 2.5 ft (0.8 m) deep and were buried in NCHRP Report 230 S-2 weak soil (sand). Attached to the 2 legs was a 4-ft high by 10-ft (1.2-m by 3.0-m) wide aluminum sign panel. The final panel was assembled from four 1-ft by 10-ft (0.3-m by 3.0-m) extruded aluminum panels and was installed 7 ft (2.1 m) above ground. The two legs were installed 3.5 ft (1.1 m) apart. The whole sign support system was assembled and the

concrete footers cast. The concrete footers were inserted in a hole in the weak soil. The hole was backfilled in 6-in (0.152-m) lifts and compacted until the final grade was reached. The sign support was then inserted inside the footers. Figure 1 and figure 2 are drawings of the sign support system.

5. TEST RESULTS - 20 MI/H (8.9 M/S), TEST 92F014

The test vehicle was accelerated to 20.9 mi/h (30.6 ft/s (9.3 m/s)) prior to impacting the sign support. The centerline of the test vehicle was aligned with the mid point between the two sign legs.

The bumper made contact with both sign legs and began to collapse. The brunt of the impact occurs to outside edge of the bumper supports on either side of the test vehicle. The bumper had collapsed to the headlight socket 0.020 s into the event. During the collapse of the bumper, the wooden legs were bowed outward away from the vehicle. At 0.022 s the wooden legs began to fracture. The right leg fractured approximately 3 ft (1.2 m) above ground. The left leg began to fracture 4 ft (0.9 m) above ground. Thirty milliseconds into the event, the right leg had broken completely at 3 ft (0.9 m) and had begun fracture down at the steel sleeve insert. The left had not broken completely at 4 ft (1.2 m). The right leg had completely fractured in two places 0.050 s after initial contact. The left leg continued to resist fracture but had begun to split vertically. At 0.114 s the left leg continued to split vertically and the vehicle continued to push on the lower segment of the wooden leg. The moment exerted on the left leg by the vehicle pushing 19 in (0.483 m) above ground did not fracture the wood at the ground line, instead the soil collapsed in front of the foundation and the concrete foundation rotated up towards the surface. Because the left leg never completely fractured and the left foundation rotated well after the right leg failed, the vehicle yawed counter-clockwise approximately 20 degrees. No secondary impact occurred between the vehicle and the sign support. The remainder of the wood legs with the panel attached fell backwards away from the vehicle.

Damage to the vehicle consisted of minor damage to the bumper. The damage was to plastic bumper parts and not to any structural members. The maximum crush measured after the test was recorded to be 4 in (0.102 m). None of the sign components impaled the occupant compartment.

Damage to the sign consisted of two fractured wooden legs. The upper sections of the legs remained attached to the sign panel. A 4-ft (1.2-m) section of the left leg remain inside the concrete footer which had rotated up and become partially unburied. The right leg fractured in two places, at ground level and 3 ft (0.9 m) above ground level. Two feet (0.6 m) of the right leg remain inside the concrete footer. The sign panel was in good condition after the test.

The occupant impact velocity using the 2-ft (0.6-m) flail space model outlined in NCHRP Report Number 230, was determined to be 19.8 ft/s (6.0 m/s). The occupant impact velocity was reached 0.153 s into the crash event. The 10 ms ridedown acceleration was determined to be 1.5 g's. The peak force (300 Hz data) for the impact event was 14.8 g's (27.5 kips (122 kN)). Because the sign stopped the vehicle, the vehicle change in velocity was equal to the impact velocity. The actual vehicle change in velocity was calculated to be 29.5 ft/s (9.0 m/s).

Photographs during the impact event are presented in figure 3. A summary of the impact conditions and the test results is presented in figure 4. Figures 5 through 8 are plots of data collected during the test. Pre- and

post-test photographs of the vehicle and sign support system are presented in figures 9 through 12. Figure 13 is sketch of the vehicle static crush recorded after the test.

6. CONCLUSION

The test results indicate that the small sign support system does not meet all of the applicable criteria for the low-speed test in weak soil. There was no occupant compartment intrusion and no significant stub remaining after the test, however the occupant impact velocity was 19.8 ft/s (6.0 m/s) which is not less than or equal to the 16 ft/s (4.9 m/s) limit specified by the FHWA.

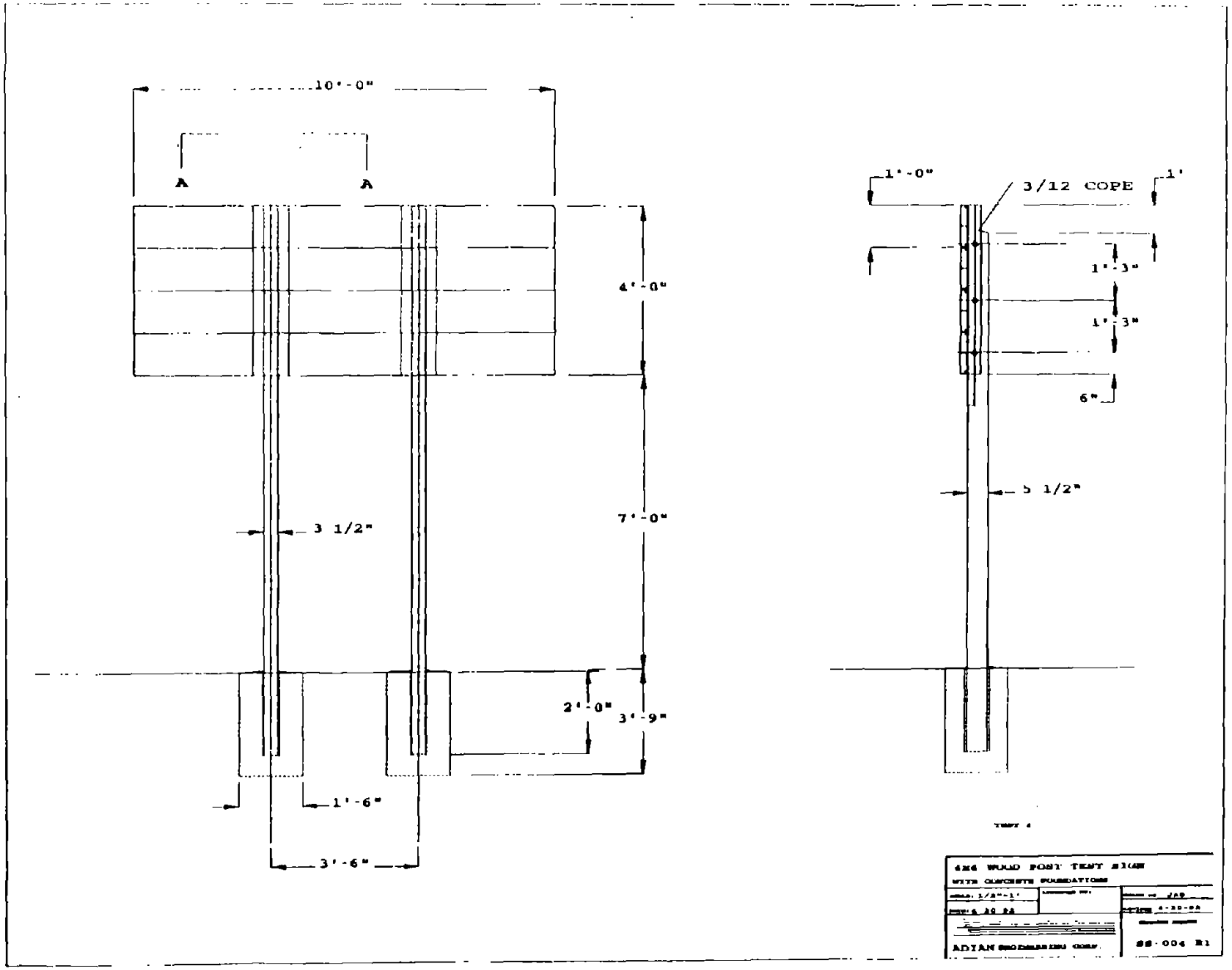


Figure 1. Sketch of small sign support.

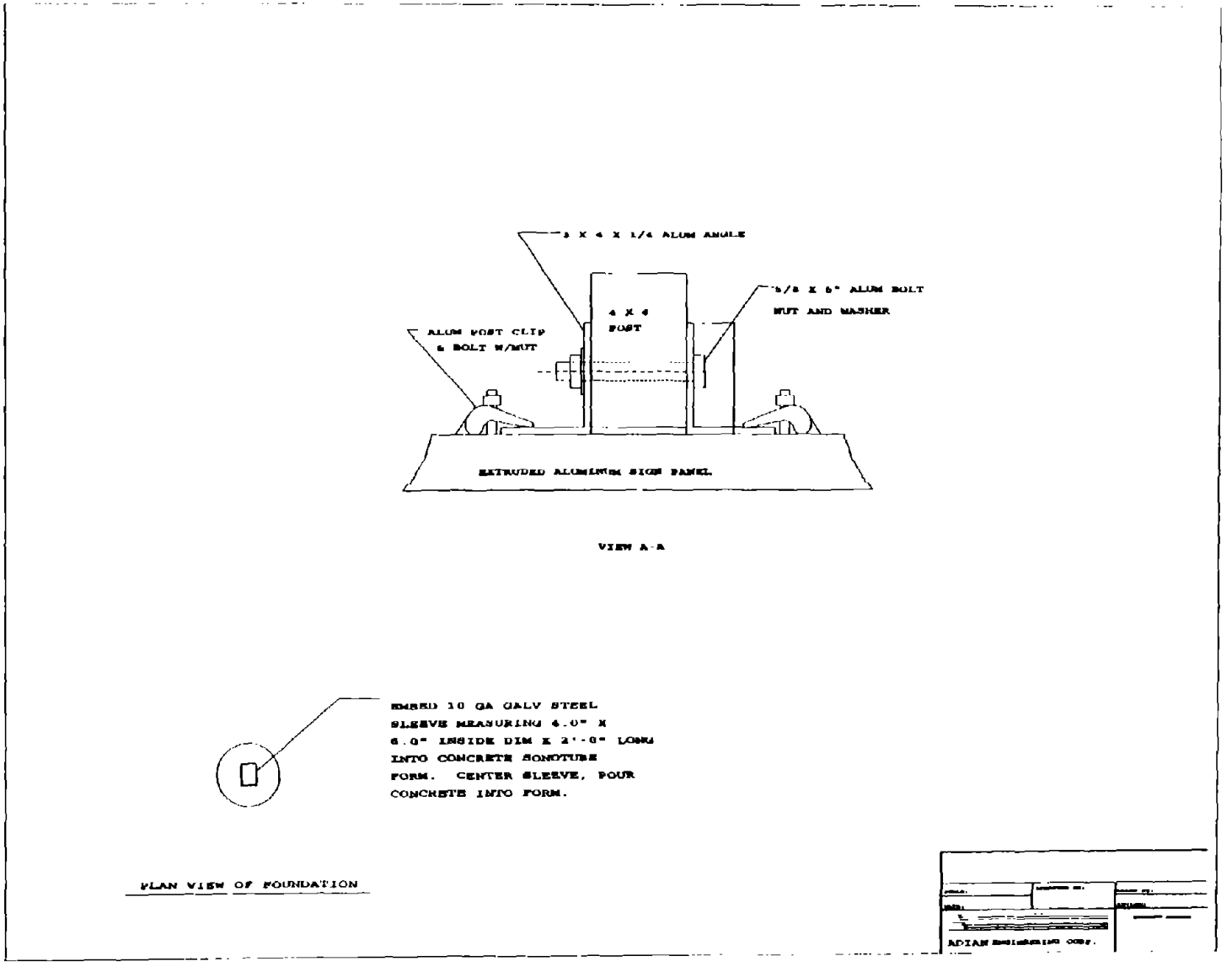
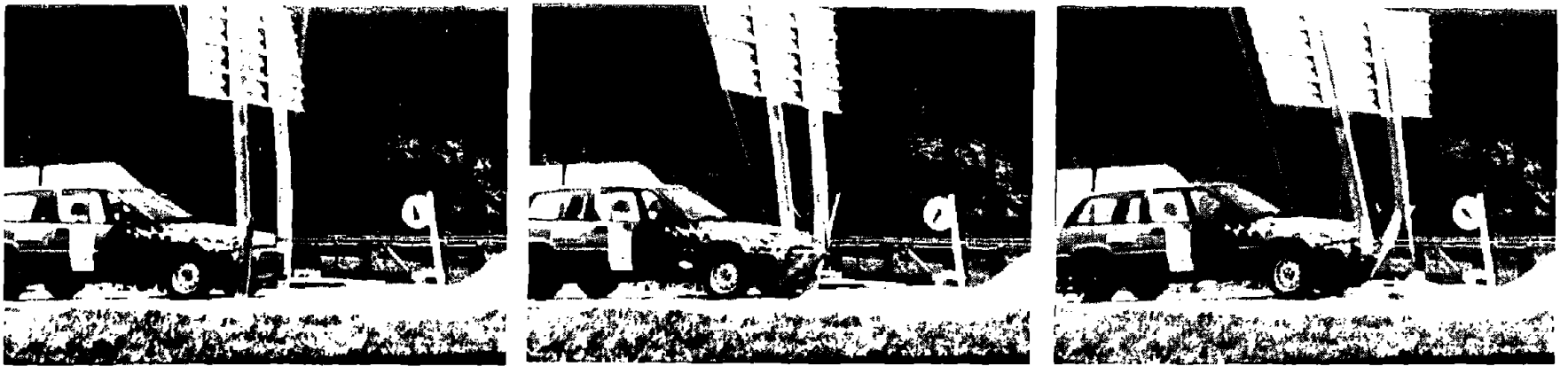


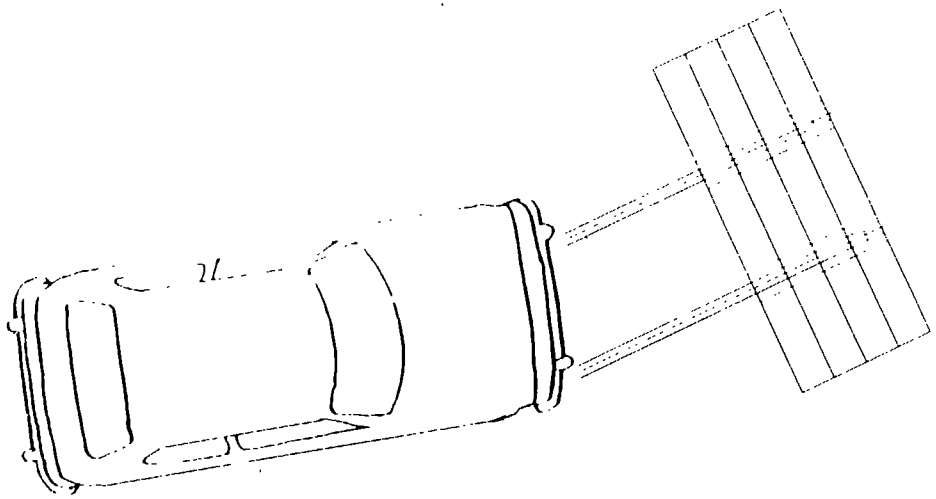
Figure 2. Sketch of small sign support, attachment detail.



0.028 s 0.060 s 0.150 s

0.200 s 0.282 s 0.704 s

Figure 3. Test photographs during impact, test 92F014.



Test number..... 92F014

Date..... June 12, 1992

Test vehicle.....1986 Honda Civic

Vehicle weight.....1860 lb (844 kg)

Test article.....Small Sign Support

Material.....4 inch by 6 inch wood
2-Leg, 2-Hit

Embedment depth.....2.5 feet

Panel type.....4 foot by 10 foot extruded aluminum

Height.....11 feet

Foundation.....18 inch dia. concrete footers in S-2 Weak Soil

Impact speed.....30.6 ft/s (9.3 m/s)

Impact angle.....0 degrees

Impact location.....Head-on, centerline

Vehicle analysis:	Observed	Design/Limit
Longitudinal:		
Occupant Delta V at 2 ft	19.8 ft/s	≤16 ft/s
Ridedown Acceleration	1.5 g's	15/20 g's
Lateral:		
Occupant Delta V at 1 ft	no contact	no spec
Ridedown Acceleration	no contact	no spec
Peak 50 msec acceleration		
Longitudinal	7.5 g's	
Lateral	NA	
Vehicle Damage (TAD)	12-FC-2	
(VDI)	12FDEN1	
Vehicle crush	4 inches	
Vehicle velocity change	29.5 ft/s	
Exit angle	no exit	

Figure 4. Summary of test 92F014.

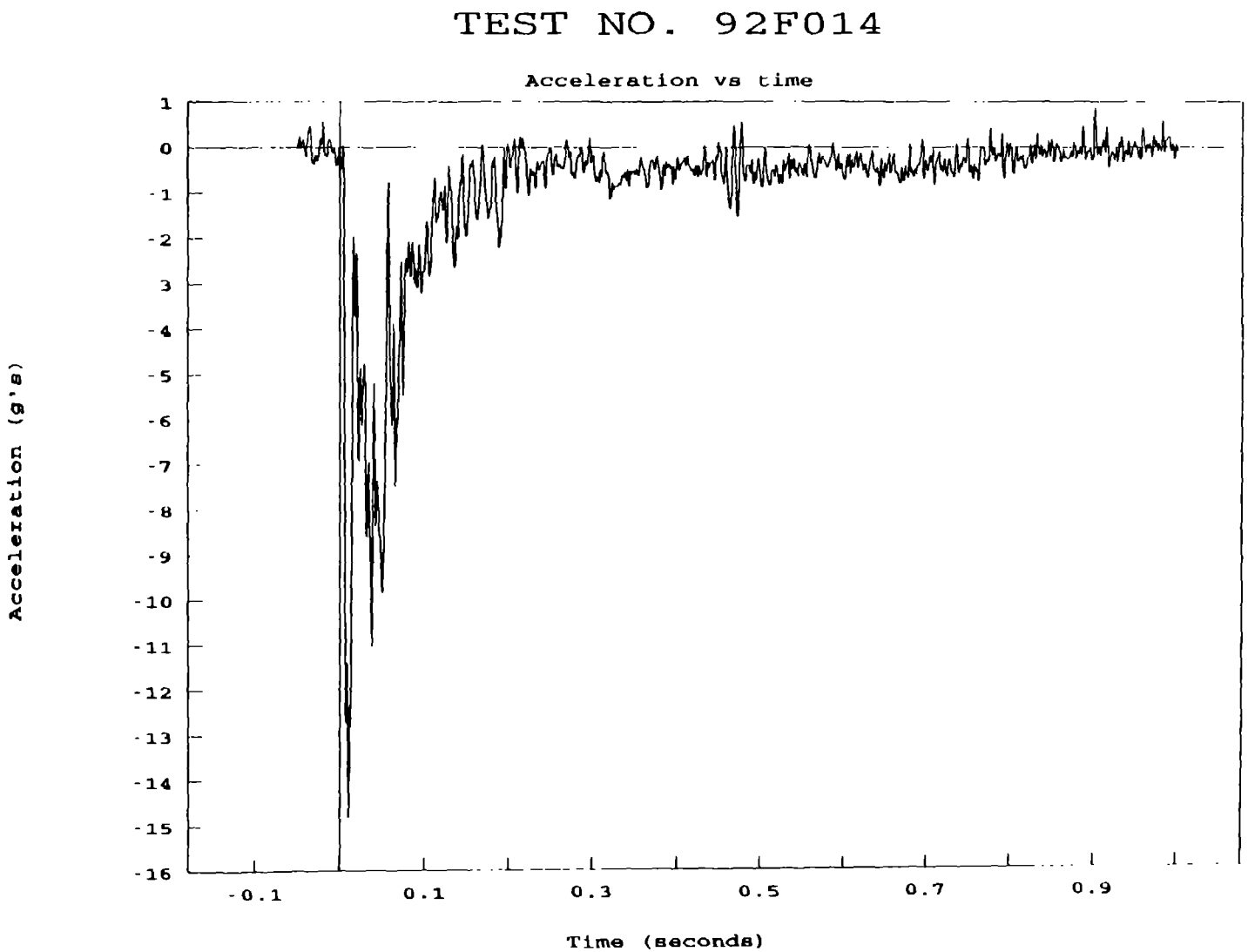


Figure 5. Acceleration versus time, X-axis, test 92F014.

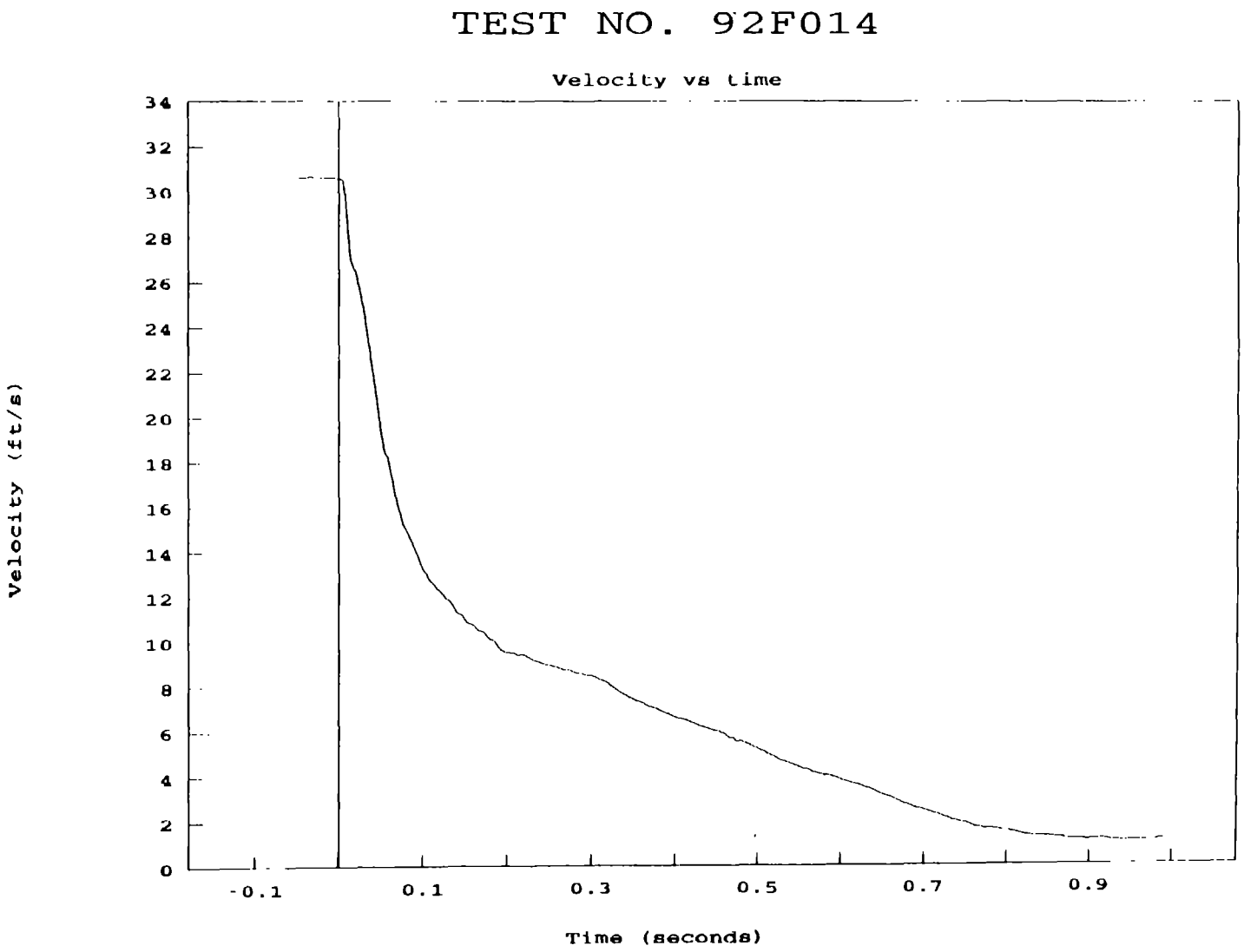


Figure 6. Velocity versus time, X-axis, test 92F014.

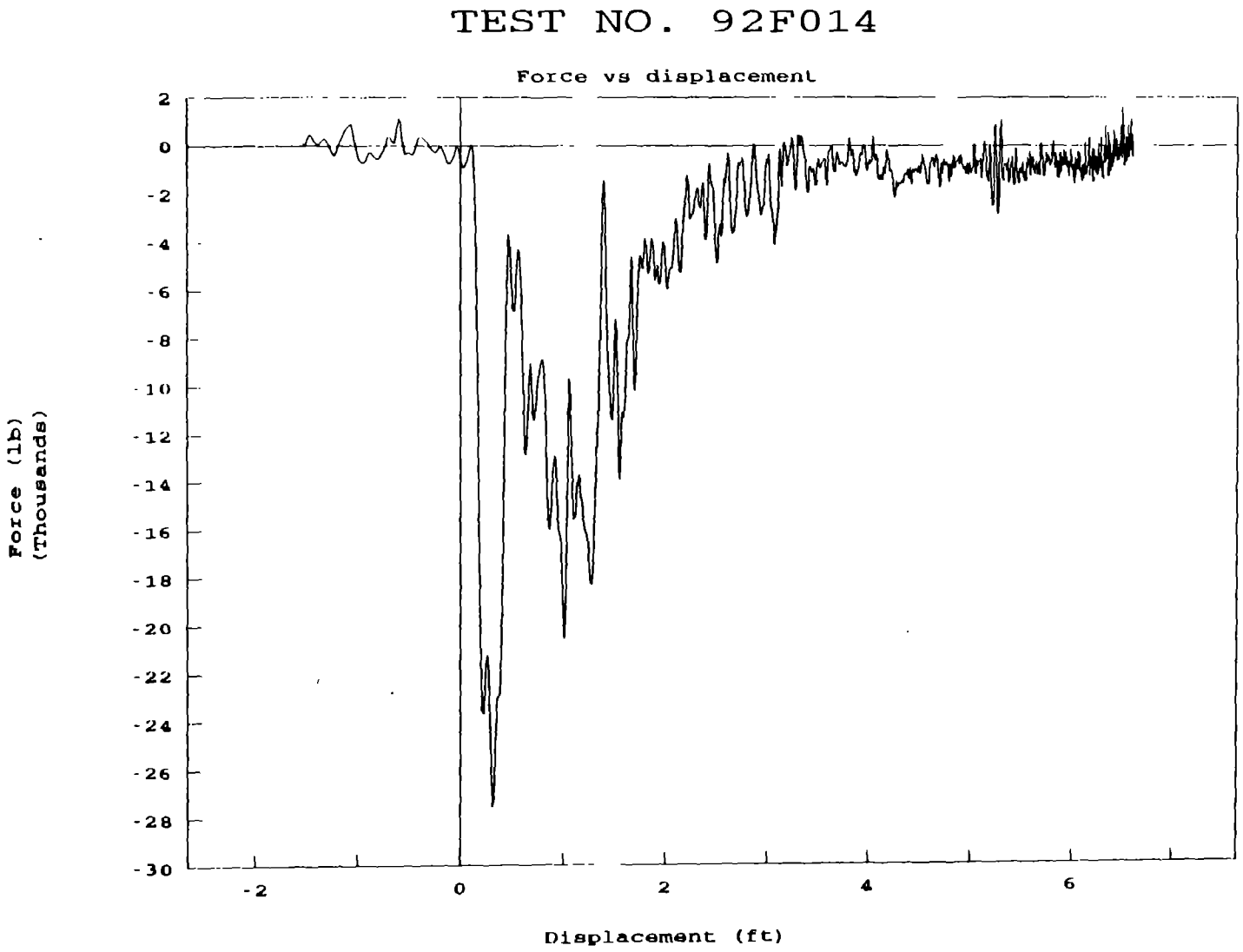


Figure 7. Force versus displacement, X-axis, test 92F014.

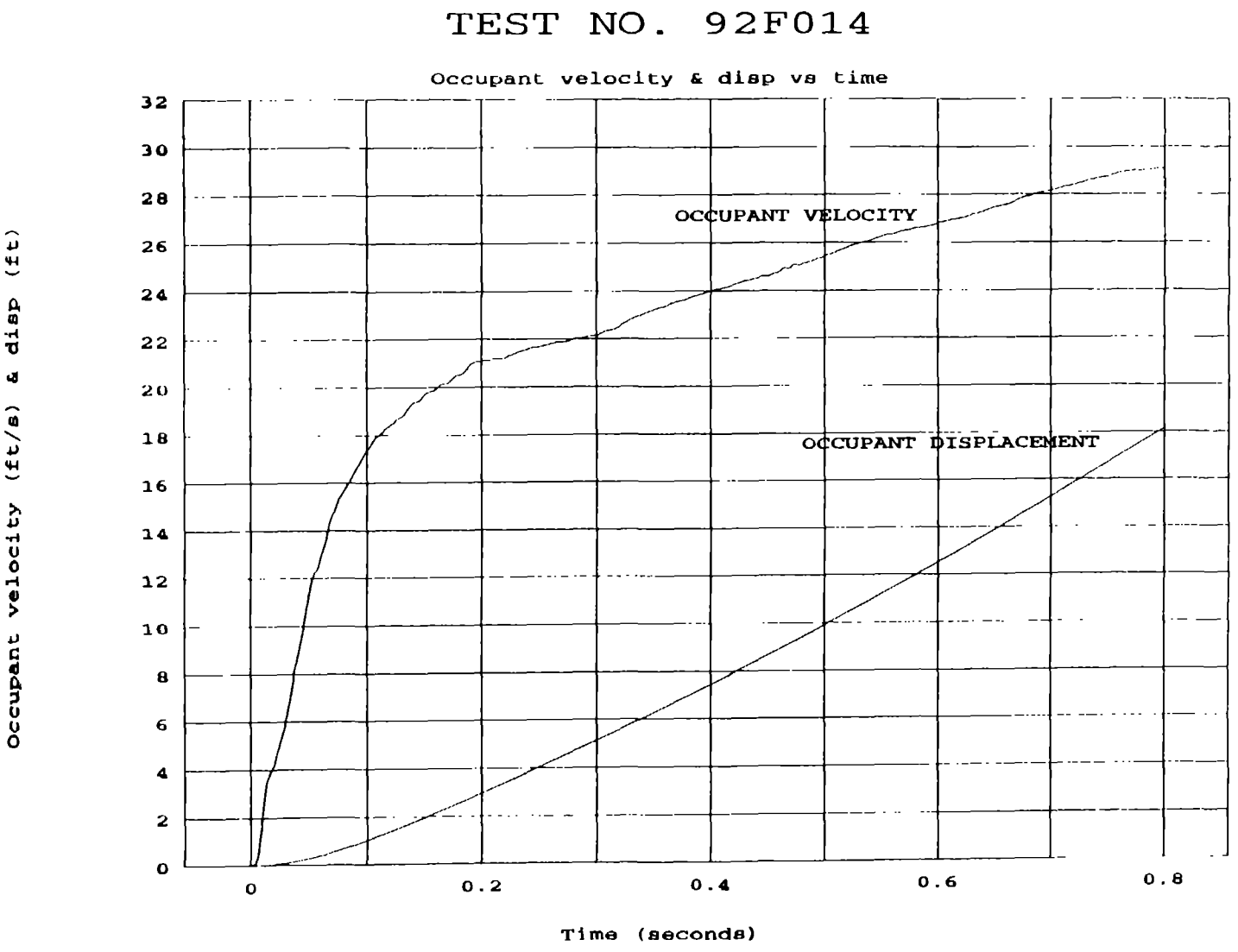


Figure 8. Occupant velocity and relative displacement versus time, X-axis, test 92F014.

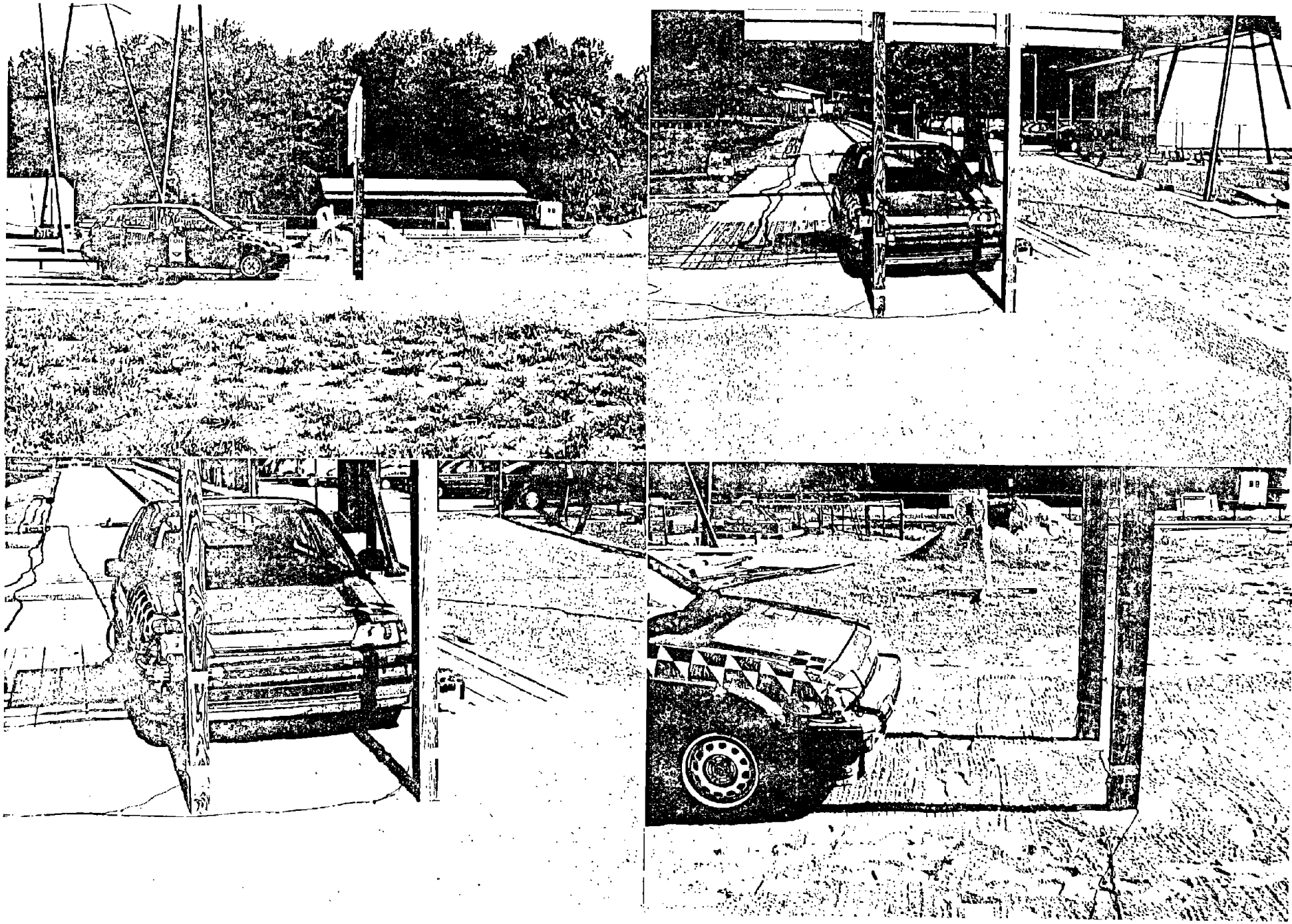


Figure 9. Pretest photographs of test 92F014.

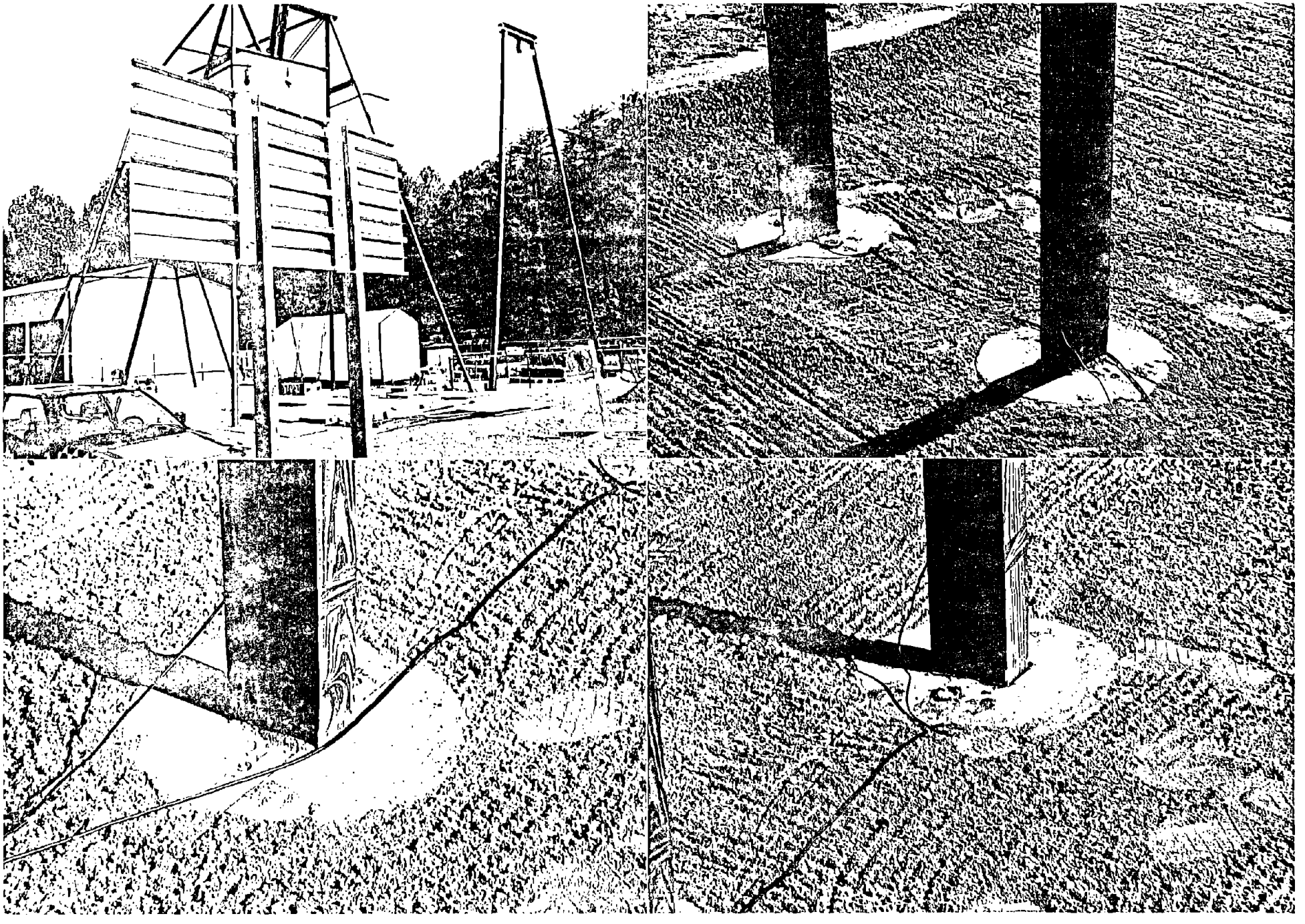


Figure 10. Additional pretest photographs of test 92F014.

Figure 11. Post-test photographs of test 92F014.

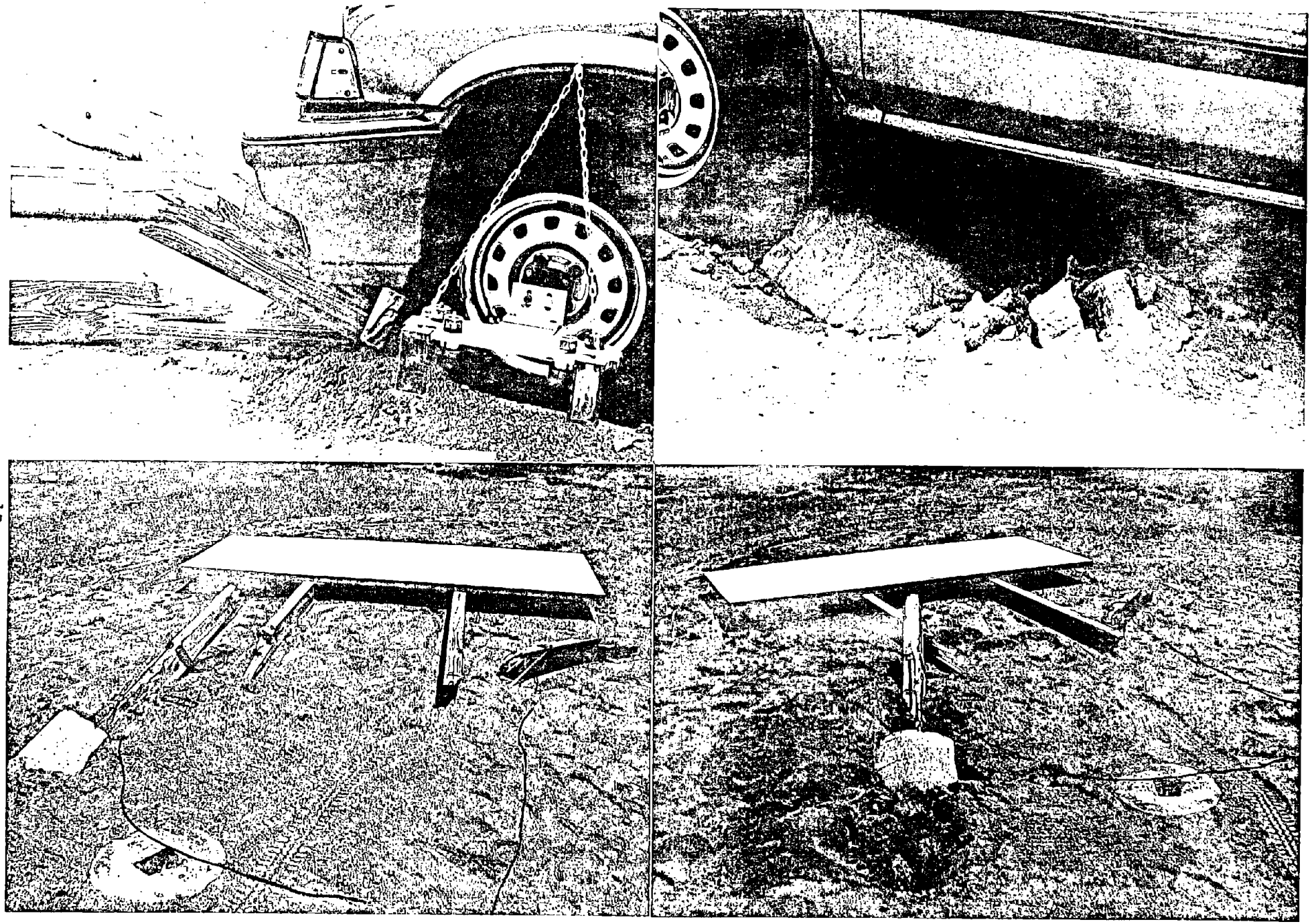
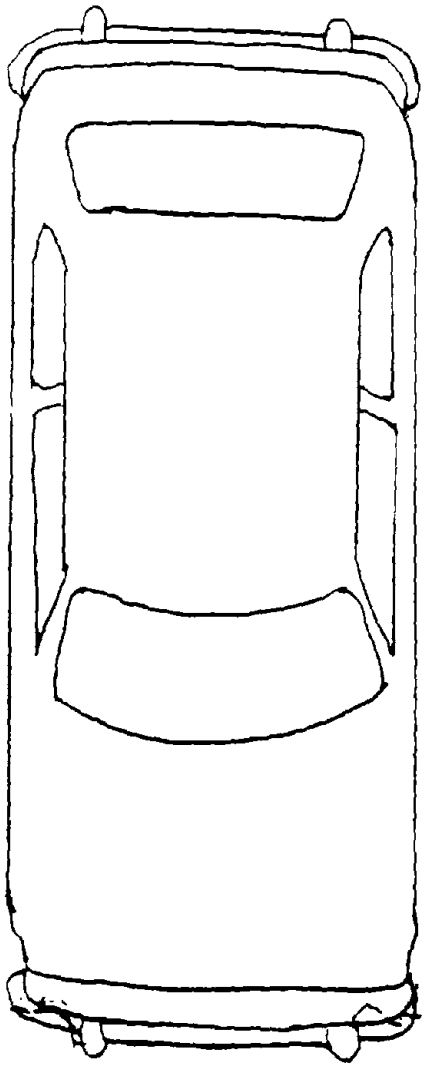


Figure 12. Additional post-test photographs of test 92F014.



------- Post test

1 in = 2.54 cm

Figure 13. Sketch of vehicle crush, test 92F014.

8. REFERENCES

(1) Michie, Jarvis D., "Recommended Procedures for the Safety Performance Evaluation of Highway Appurtenances," National Cooperative Highway Research Program Report Number 230, March 1981.