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Testing of Small and Large Sign Support Systems FOIL Test Number: 92F015

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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 92F015. 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 4-in (102-mm by 102-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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Acceleration, occupant impact velocity, weak soil, vehicle, FOIL.	No restrictions. This document is available to the public through the National Technical Information Service Springfield, Virginia 22161

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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 1992)

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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 92F015. The vehicle used for this test was a 1985 Honda Civic. The purpose of this test was to evaluate the low speed safety performance of a dual legged wooden 4x4 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
92F015	'85 Honda Civic	1860	20	2 leg wood 4x4	center

3. VEHICLE

The test vehicle was a 1985 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 4-in (102-mm by 102-mm) wooden legs 13 feet (4.0 m) long. The actual dimensions of the sign legs were 3.5-in by-3.5 in (89-mm by 89-mm). The wooden legs were made from pressure treated southern yellow pine. Two ft (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 5-ft 8-in (1.2-m by 1.7-m) wide aluminum sheet sign panel 1/8 in (3 mm) thick. The sign panel 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 92F015

The test vehicle was accelerated to 21.6 mi/h (31.7 ft/s (9.7 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 0.034 s into the event. During the collapse of the bumper, the wooden legs were bowed outward away from the vehicle. At 0.036 s the wooden legs began to fracture. The right leg fractured approximately 3 ft (0.9 m) above ground. The left leg began to fracture 6 in (0.152 m) above ground. Neither leg broke completely. Each leg split vertically in the center. Seventy four milliseconds into the event, the right leg had split vertically approximately 4 ft (1.2 m) above ground. Wood fibers held together throughout the event never completely tearing apart. The same action occurred on the left leg. The leg split vertically for approximately 5 ft (1.5 m). The wood never yielded completely. The vehicle continued to push the remaining wood fibers of the left leg and eventually bent the leg backwards to the ground. The left leg took longer to bend backward thus causing the vehicle to yaw 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 damage to the bumper and headlights. The damage was to plastic bumper parts and not to any structural members. The sign legs did penetrate the bumper into the headlight sockets which is where the maximum crush occurred. The maximum crush measured after the test was recorded to be 10.5 in (0.267 m). None of the sign components impaled the occupant compartment.

Damage to the sign consisted of two fractured wooden legs. The legs were split vertically with wood fiber holding the wood inside the footers to the upper sections of the legs. The upper sections of the legs remained attached to the sign panel. Two feet (0.6 m) of each leg remained inside the concrete footers. 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 17.4 ft/s (5.3 m/s). The occupant impact velocity was reached 0.185 s into the crash event. The 10 ms ridedown acceleration was determined to be 2.3 g's. The peak force (300 Hz data) for the impact event was 11.6 g's (21.5 kips (95 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 29.0 ft/s (8.8 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 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 17.4 ft/s (5.3 m/s) which is not less than or equal to the 16 ft/s (4.9 m/s) limit specified by the FHWA.

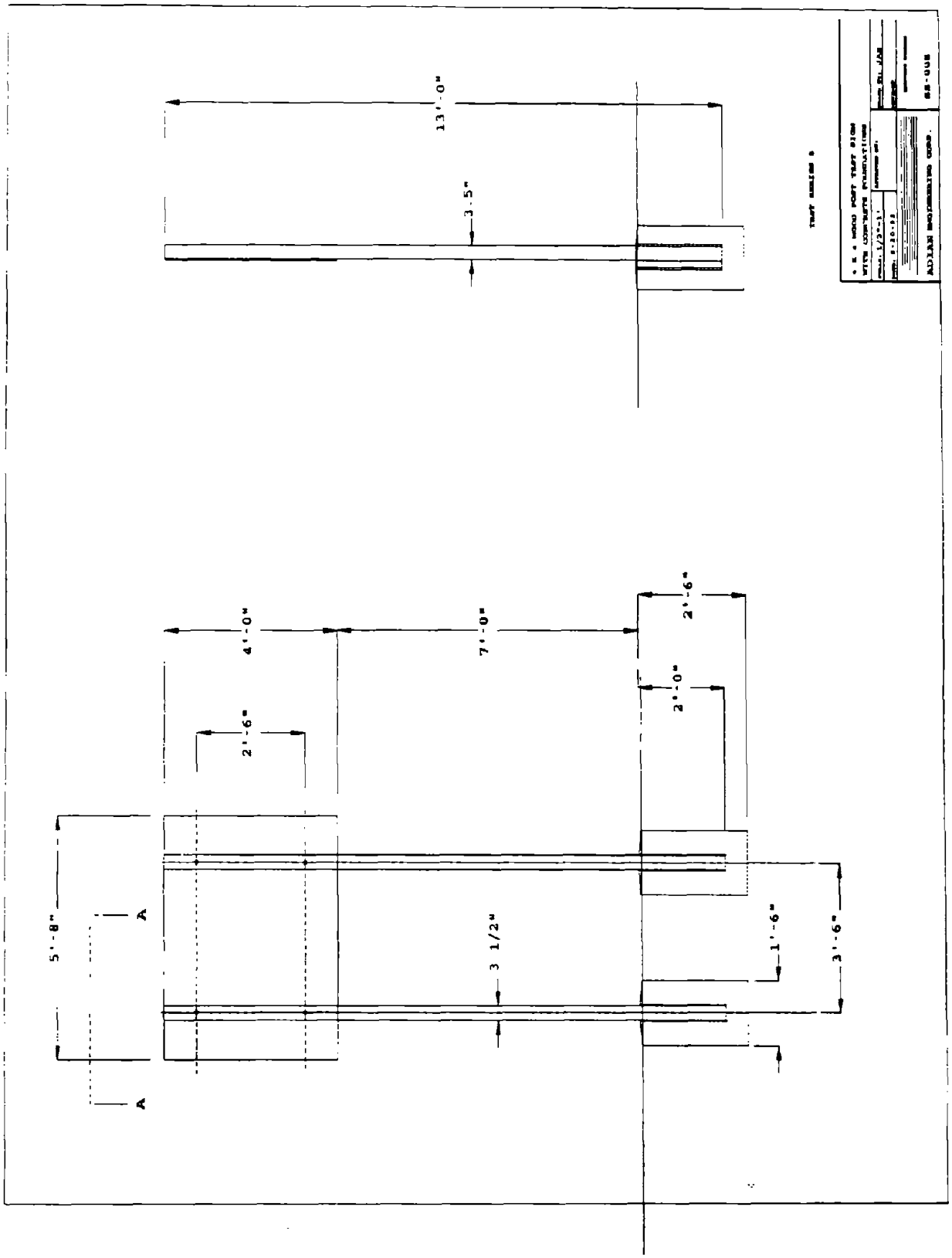


Figure 1. Sketch of small sign support.

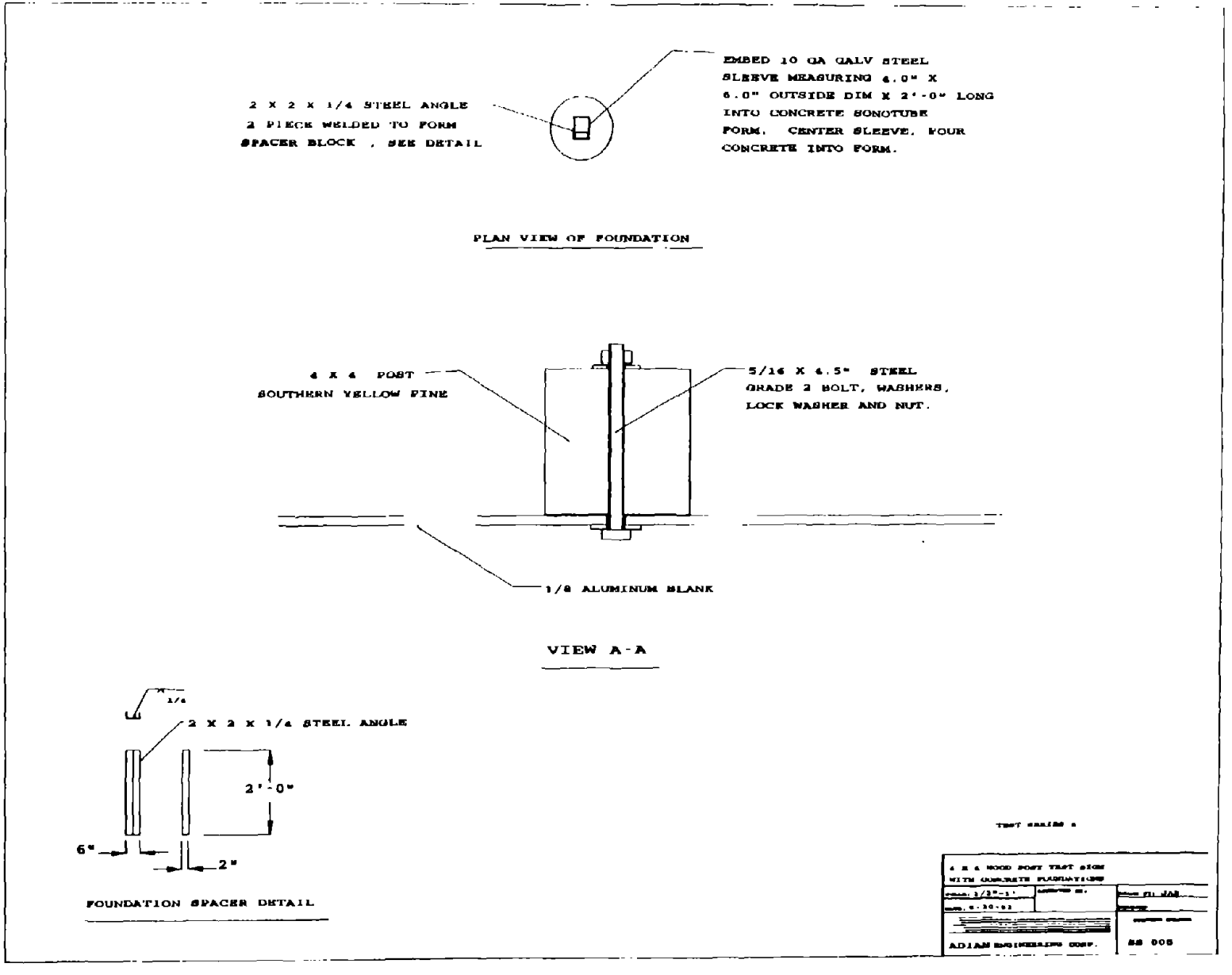


Figure 2. Sketch of small sign support, attachment detail.

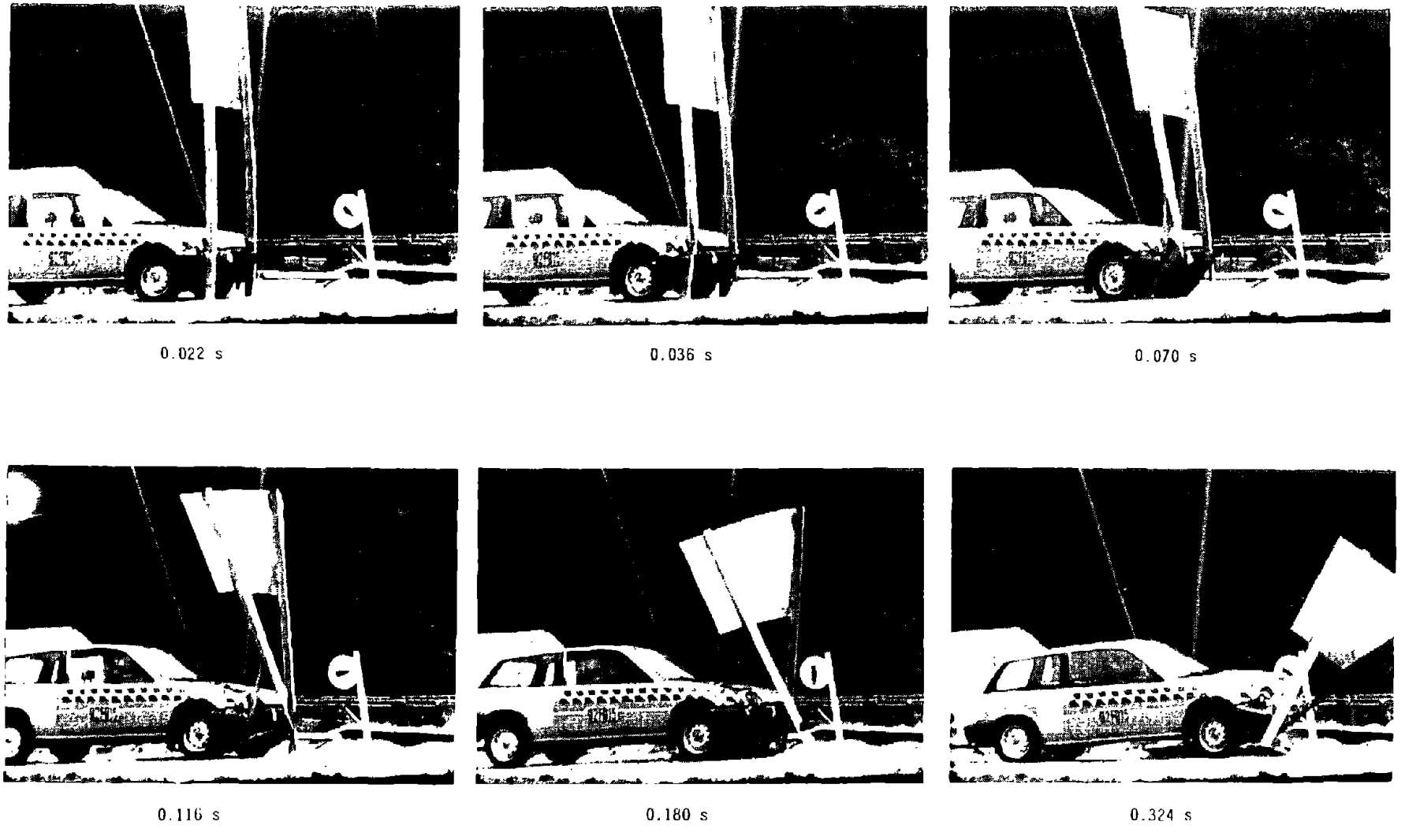
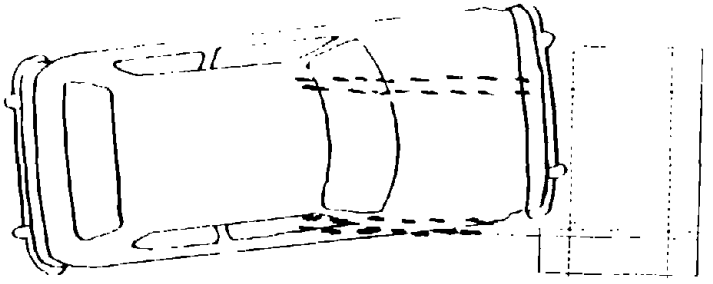


Figure 3. Test photographs during impact, test 92F015.



Test number..... 92F015

Date..... June 17, 1992

Test vehicle.....1985 Honda Civic

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

Test article.....Small Sign Support

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

Embedment depth.....2.5 feet

Panel type.....4 foot by 5 foot 8 inch alum. sheet

Height.....11 feet

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

Impact speed.....31.7 ft/s (9.7 m/s)

Impact angle.....0 degrees

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

Vehicle analysis:	Observed	Design/Limit
Longitudinal:		
Occupant Delta V at 2 ft	17.4 ft/s	≤16 ft/s
Ridedown Acceleration	2.3 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.....5.8 g's
Lateral.....NA

Vehicle Damage (TAD).....12-FC-2
(VDI).....12FDEN2

Vehicle crush.....10.5 inches

Vehicle velocity change.....29.0 ft/s

Exit angle.....no exit

Figure 4. Summary of test 92F015.

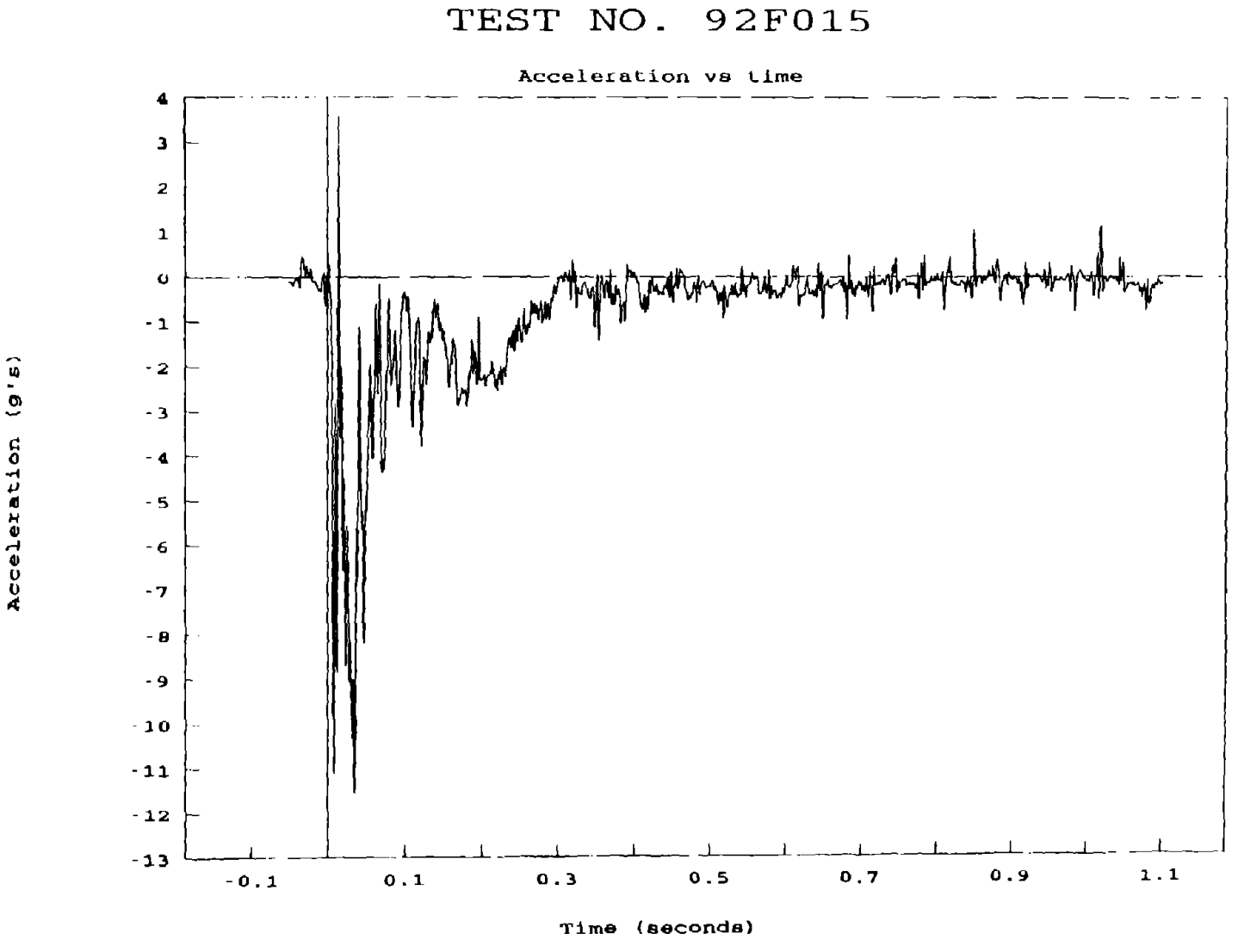


Figure 5. Acceleration versus time, X-axis, test 92F015.

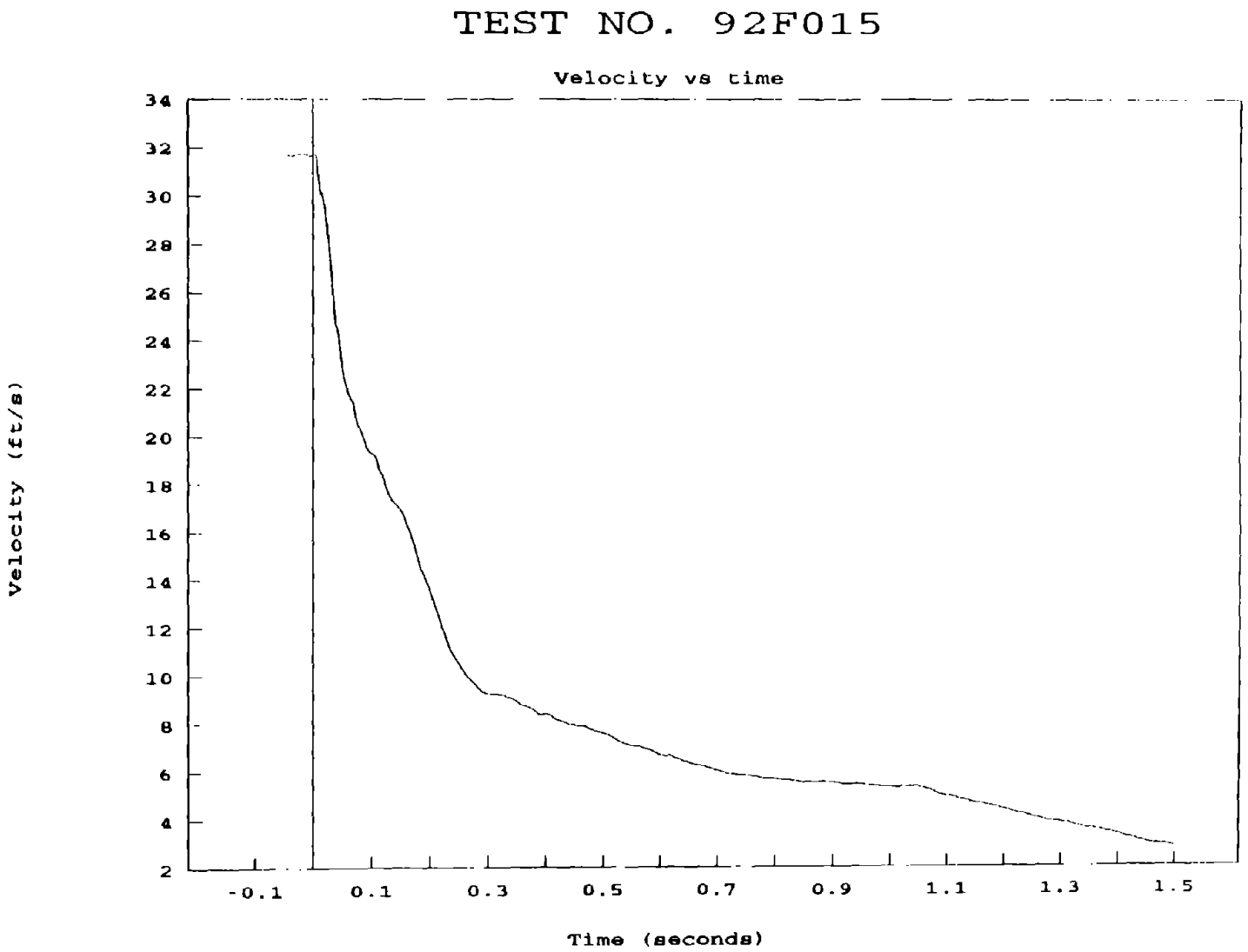


Figure 6. Velocity versus time, X-axis, test 92F015.

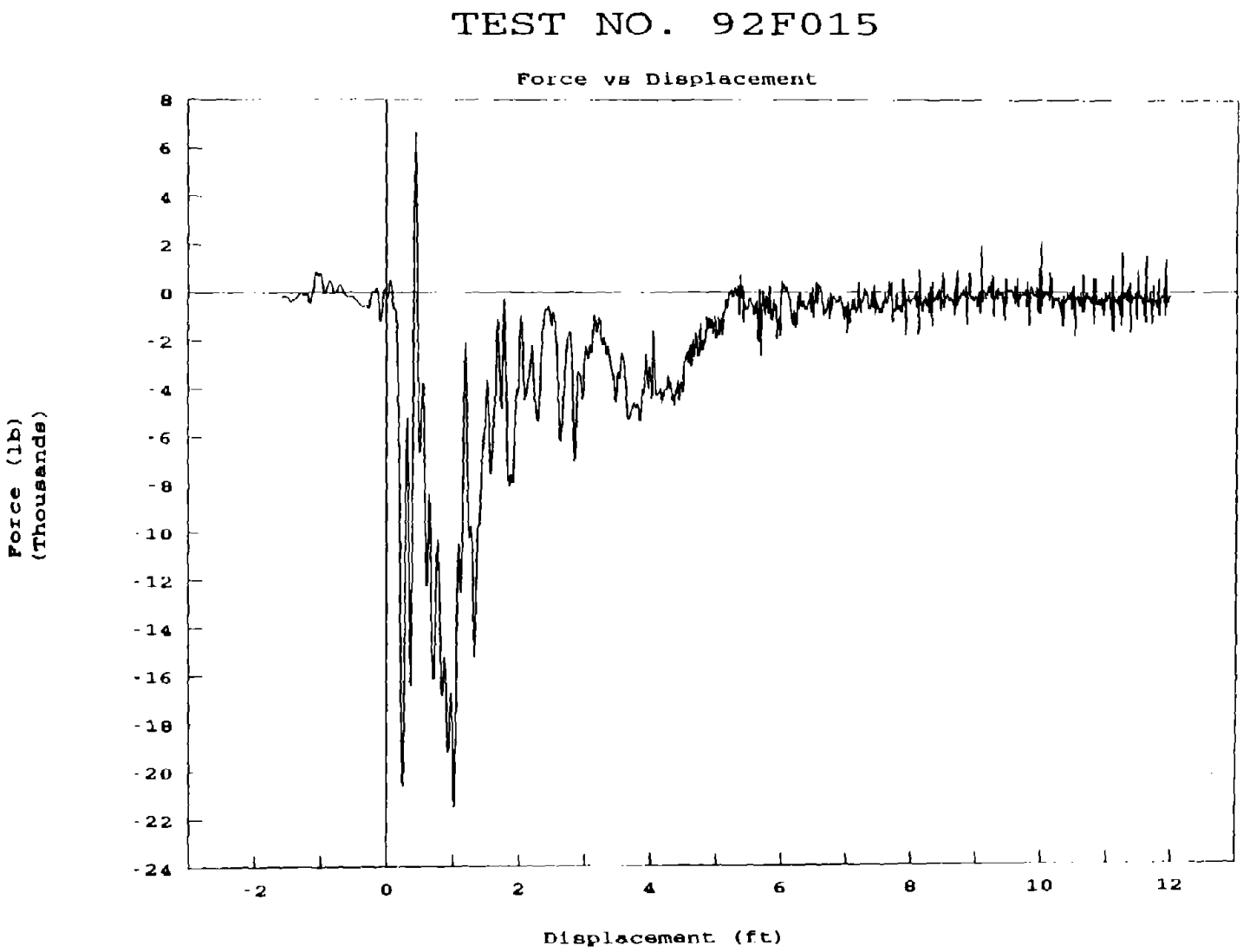


Figure 7. Force versus displacement, X-axis, test 92F015.

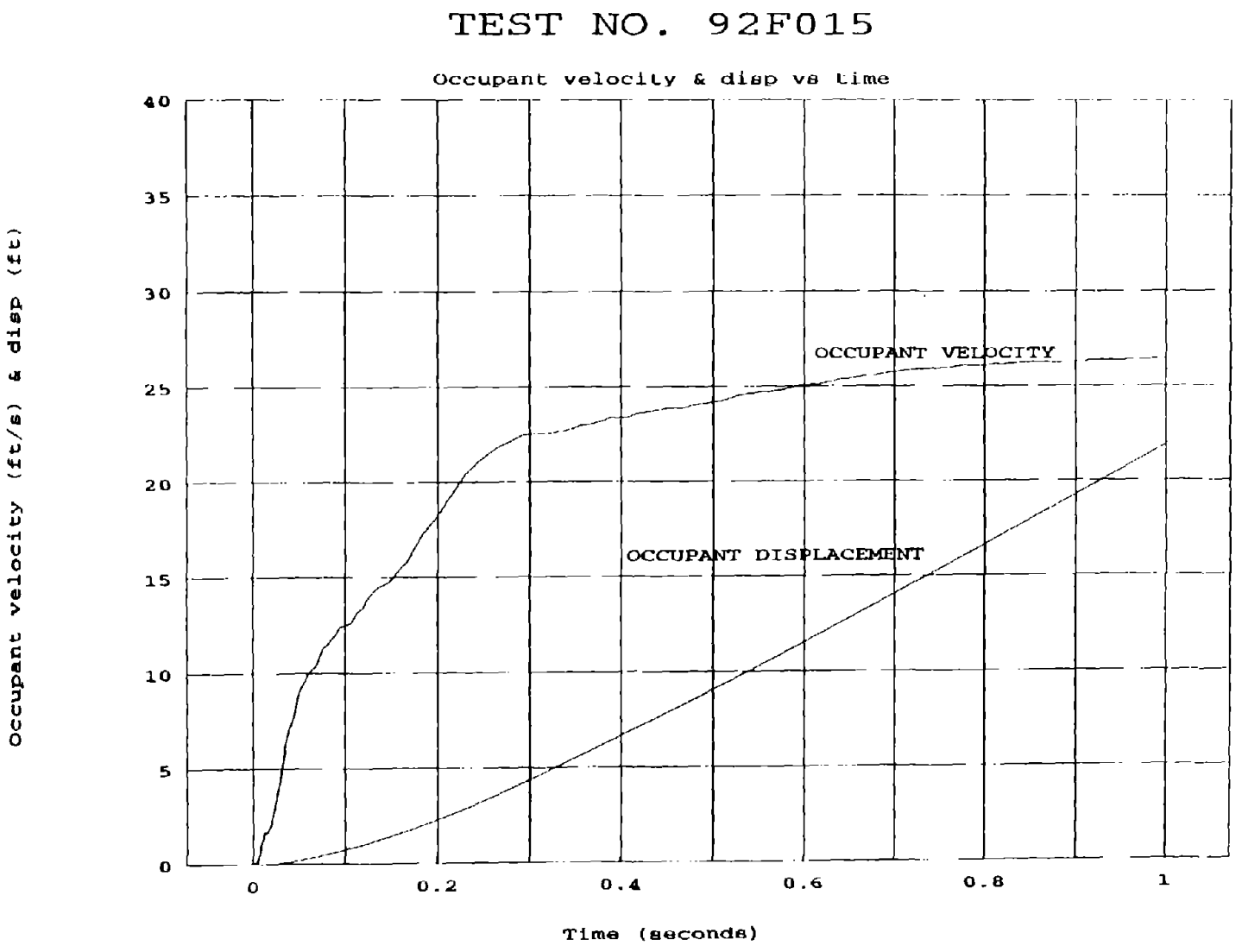


Figure 8. Occupant velocity and relative displacement versus time, X-axis, test 92F015.

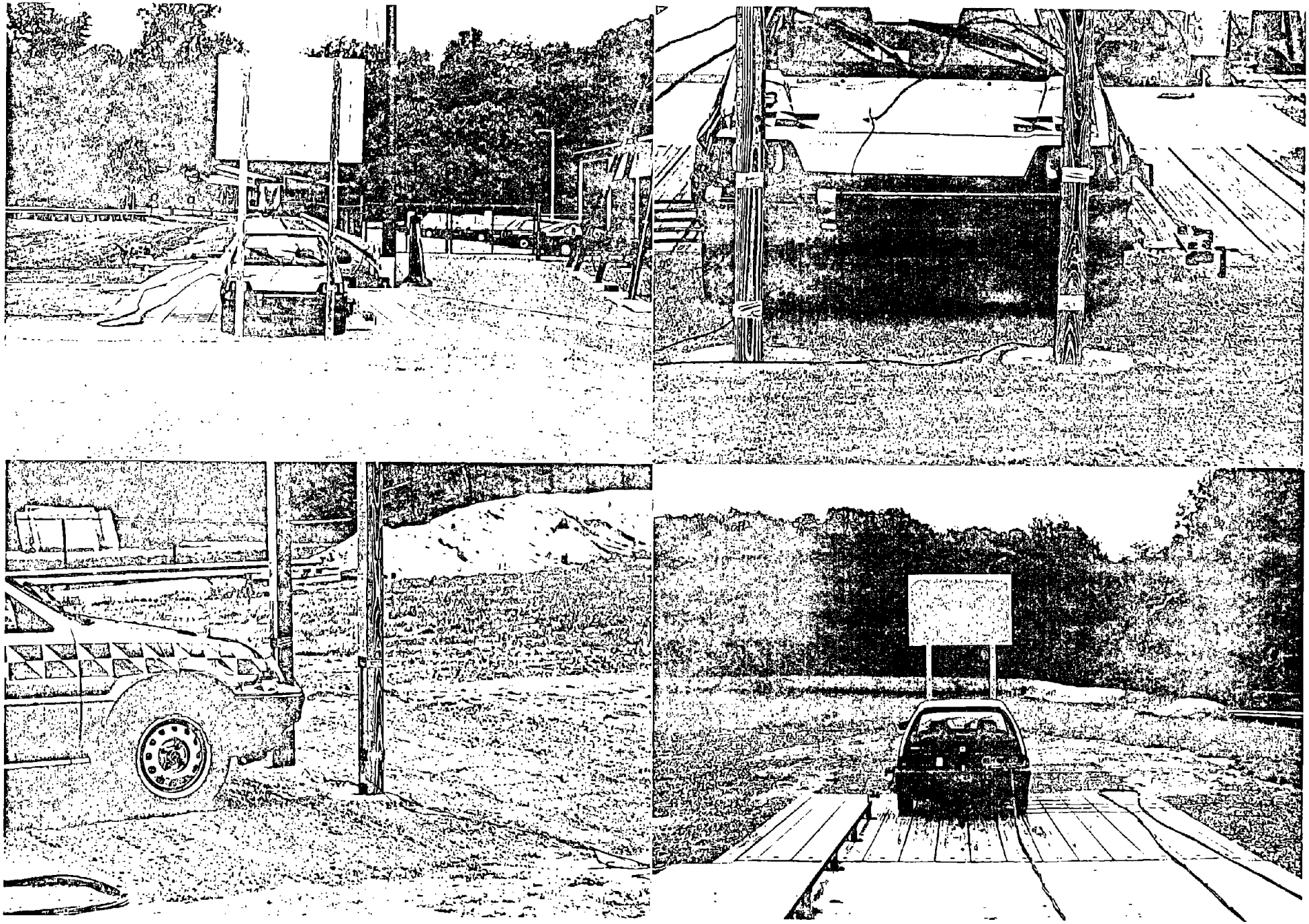


Figure 9. Pretest photographs of test 92F015.

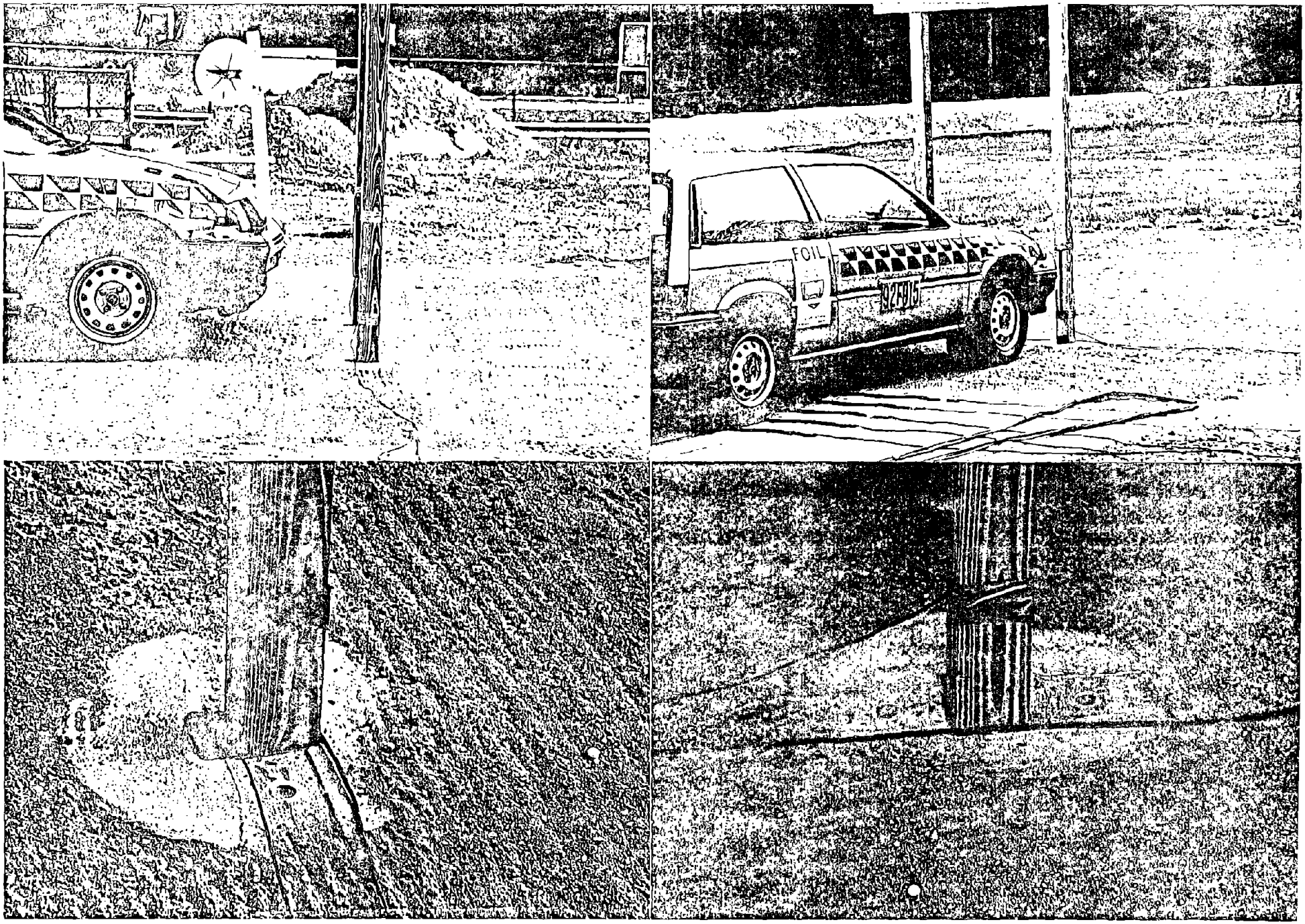


Figure 10. Additional pretest photographs of test 92F015.

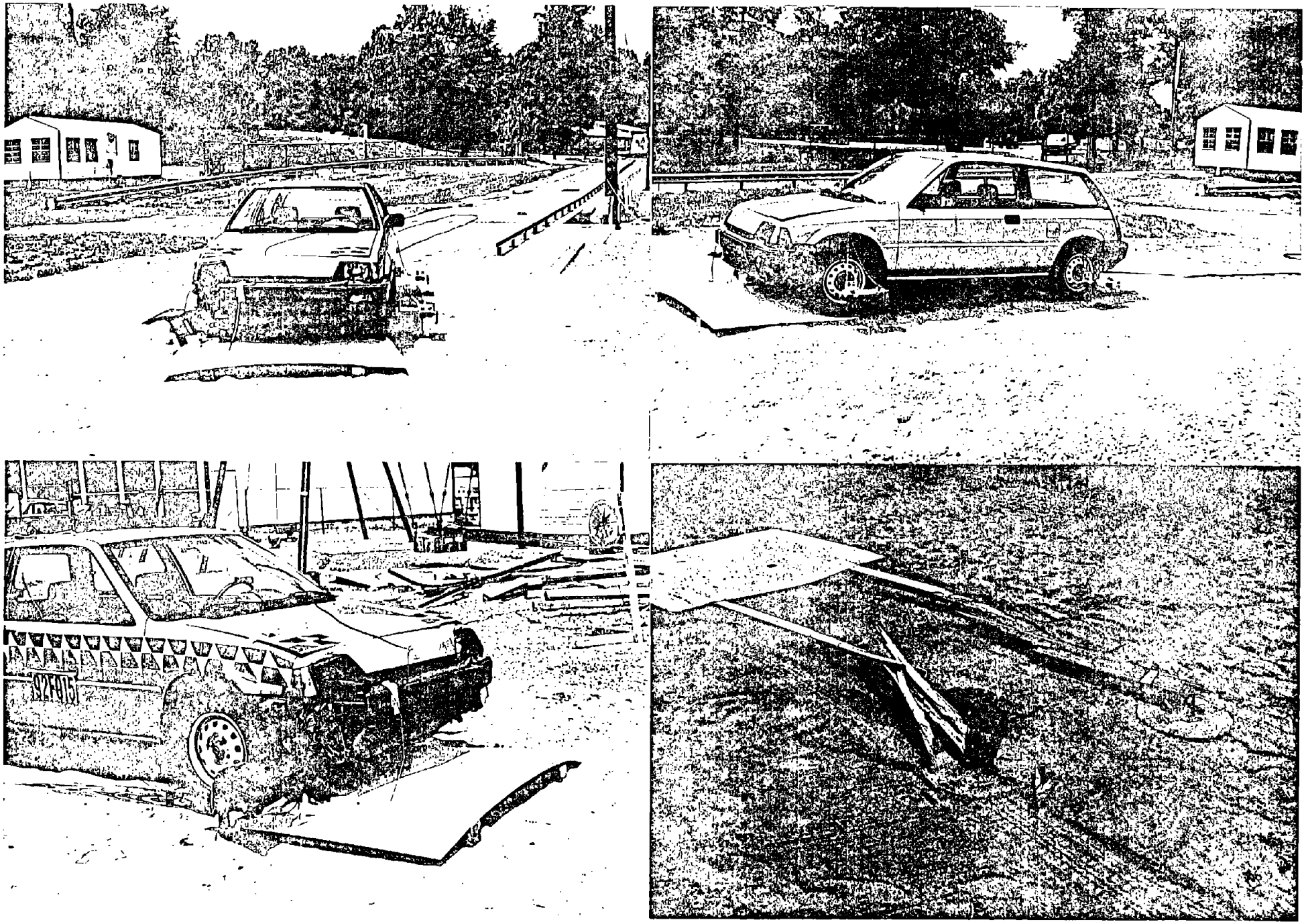


Figure 11. Post-test photographs of test 92F015.

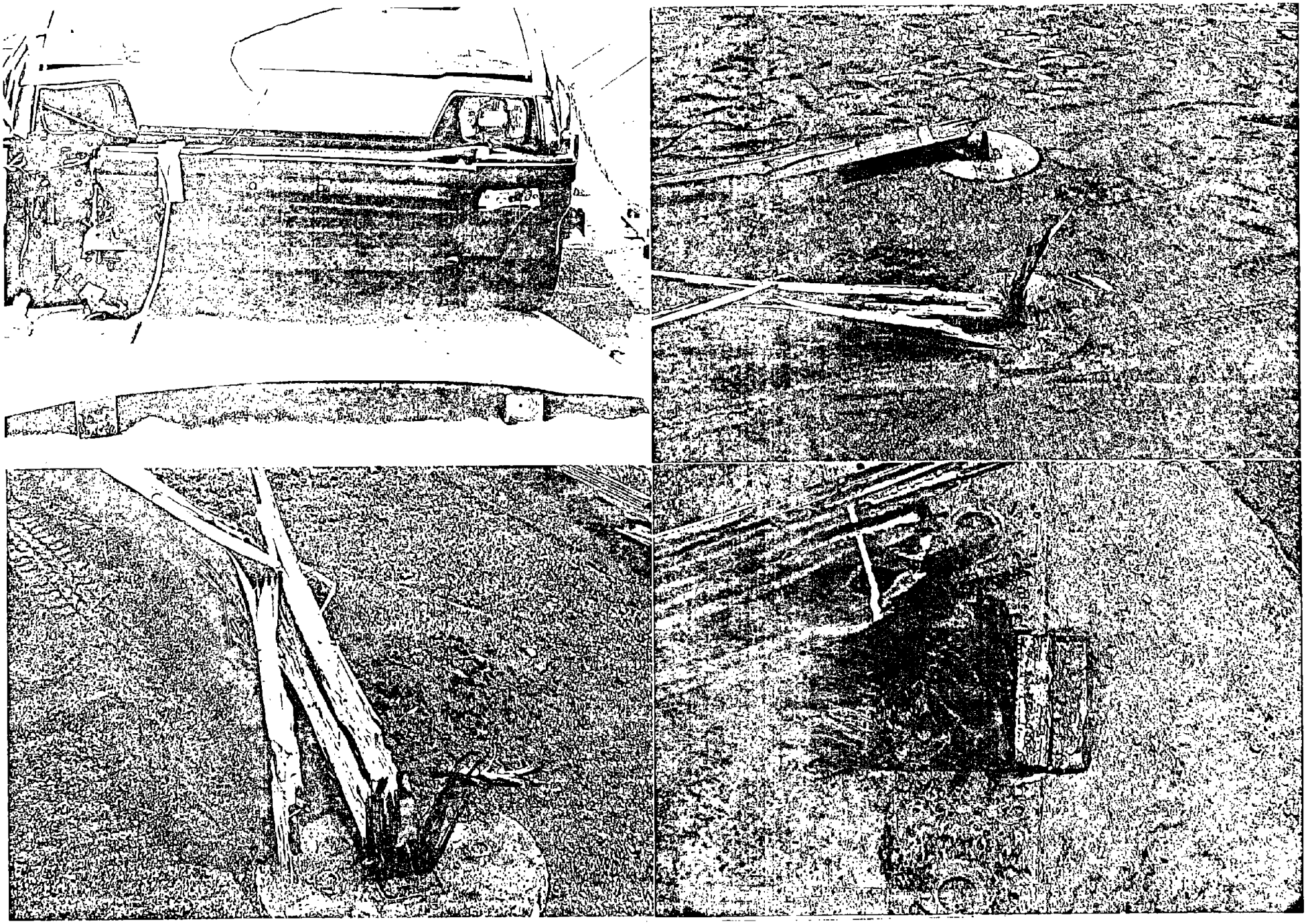
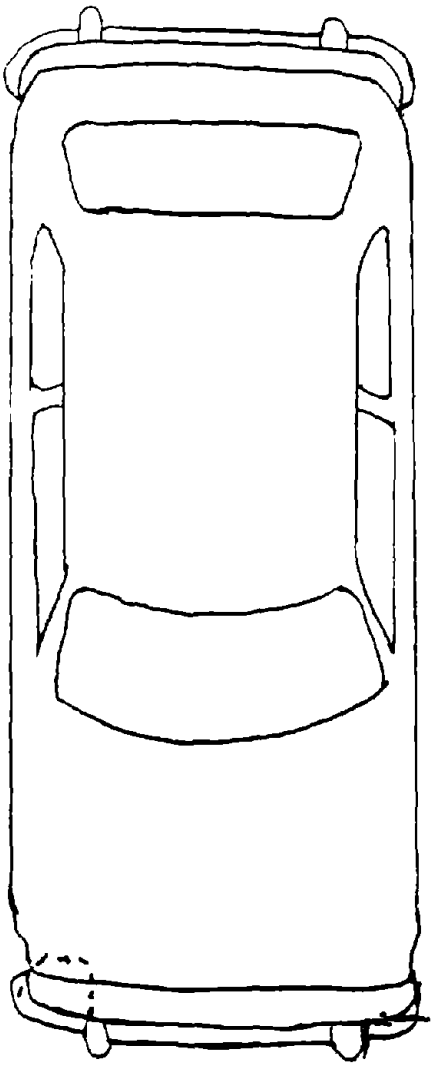


Figure 12. Additional post-test photographs of test 92F015.



------- Post test

1 in = 2.54 cm

Figure 13. Sketch of vehicle crush, test 92F015.

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.