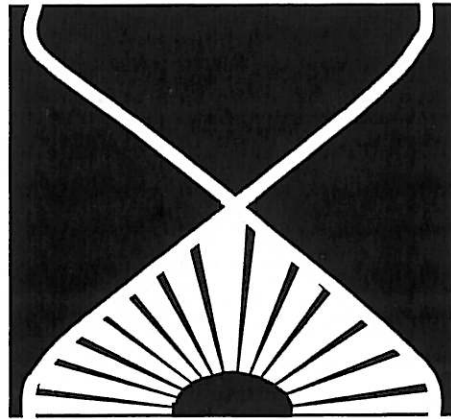


**AASHTO'S**



**National  
Transportation  
Product  
Evaluation  
Program**

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**REPORT OF  
WINTER 1996/SUMMER 1996  
FLEXIBLE DELINEATOR  
IMPACT TESTING**

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**REPORT 96**

**NTPEP 124**

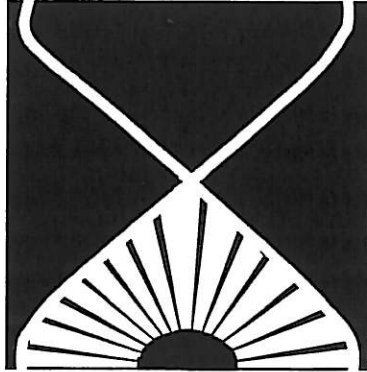
**October 1996**



REPORT OF WINTER 1996/SUMMER 1996

FLEXIBLE DELINEATOR IMPACT TESTING

**AASHTO'S**



**National  
Transportation  
Product  
Evaluation  
Program**

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Prepared by

**TENNESSEE DEPARTMENT OF TRANSPORTATION**

**MATERIALS AND TESTS DIVISION**

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## SECTION I - FLEXIBLE DELINEATOR POST TESTING

The Winter 1996/Summer 1996 test series was conducted on 9 different flexible delineator systems. Each system was pre-approved by the NTPEP coordinator before testing commenced. Manufacturers submitted a set of ten posts with reflective sheeting attached for each delineator model or series that was tested. Eight of the ten posts were subjected to impact testing. The remaining two posts of each set were retained for ultraviolet exposure testing. Impact testing was conducted at both high and low ambient temperatures as specified in the test procedure. Cold weather testing required impact tests be conducted between 27 and 37 degrees Fahrenheit. Hot weather testing specified that posts be impacted between 80 and 90 degrees Fahrenheit. Actual temperatures were measured between 32 and 35 degrees Fahrenheit for the cold weather testing and 80 to 84 degrees Fahrenheit for the hot weather testing. At each of the two temperature ranges the eight posts were impacted five times with the bumper and wheel of a standard automobile complying with bumper height requirements as outlined in the testing procedure. The automobile was traveling at a speed of 55 miles per hour during each of the impact tests. Manufacturer's representatives were present for the cold and hot weather testing. A series of photographs were taken initially, and following each impact of the posts as shown in the appendix.

The test site was located in Davidson County along a section of Briley Parkway north of County Hospital Road. The surface mounted posts were placed along the paved shoulder of the roadway. Ground mount posts were placed in the compacted shoulder which consisted of crushed limestone.

Manufacturer's representatives installed their own systems while TDOT officials observed. This took place on February 6, 1996. Cold weather testing was performed on February 7, 1996. Ground mounted posts were left in place after impact so that they could be subjected to warm weather testing at a later date. Surface mounted posts were removed from their bases following winter testing and taken to a protected outside site. They were re-installed in the bases for summer testing.

Warm weather testing was performed on July 16, 1996. The impact vehicle used in the testing was a 1991 Dodge Dynasty automobile. No alterations were made to the vehicle.

Control numbers were assigned to identify samples as to manufacturer, model/series and the type of product being evaluated. Included for each sample is a brief description of the

product derived from information supplied by manufacturers. Specific test data generated by each impact are contained in tabular form.

### Ultraviolet Resistance Test Observations

Six bow tie specimens were cut from delineator post samples submitted for the purpose of ultraviolet (UV) exposure testing. Three of each type were used for control purposes. The remaining three were subjected to 1000 hours of UV exposure in the Q.U.V. weatherometer. Specimen dimensions conformed to those outlined in ASTM standard D412. Control specimens were #1, #2, #3, while weathered specimens were #4, #5 and #6 respectively.

Table 1 summarizes the tensile strengths of each, and the average tensile strength for both control and weathered samples. Table 2 summarizes the tensile elongation of each, and the average tensile elongation for both control and weathered samples.

The average values from Table 2 are listed in Table 3, with the percent change in tensile strength and tensile elongation calculated.

Table 4 shows average tensile stresses of the control and weathered samples.



## SAMPLE IDENTIFICATION

<u>Sample No.</u>	<u>Manufacturer</u>	<u>Model-Series</u>
TTC-96W-1	Impact Recovery Systems	201-S

The Impact Recovery Systems 201-S is a surface mounted delineator post consisting of a high density polyethelene composition. The post has a spring assembly that consists of a stainless steel cable, custom spring, and a pivoting hinge near the bottom of the post. The post is mounted to a high density polyethelene base via four screws. The base is held down by a "Super Bundy" heavy duty adhesive pad comprised of thermoplastic and heated in place by a portable propane torch. All posts were supplied with 3M high intensity reflective sheeting at the top. Installation time averaged 1 minute per post.

<u>Sample No.</u>	<u>Manufacturer</u>	<u>Model-Series</u>
TTC-96W-2	Kennco	Polycarbonate Extension

The Kennco Polycarbonate Extension is a two component ground mounted delineator post. The lower portion of the post is comprised of two strips of recycled steel belted passenger tires laminated together. This rubber base is attached to the extruded polycarbonate extension with bolts. A steel spike was attached to the base of the post and driven with a sledgehammer. All posts were supplied with 3M high intensity reflective sheeting at the top. Installation time averaged 1 minute per post.

<u>Sample No.</u>	<u>Manufacturer</u>	<u>Model-Series</u>
TTC-96W-3	Kennco	HDPE Extrusion

The Kennco High Density Polyethelene Extrusion is a two component ground mounted delineator post. The lower portion of the post is comprised of two strips of recycled steel belted passenger tires laminated together. This rubber base is attached to the extruded high density polyethelene extension with bolts. A six inch galvanized nail was driven through the bottom of the post to act as an anchor pin. An auger was used to dig the post holes. All posts were supplied with 3M high intensity reflective sheeting at the top. Installation time averaged 3-1/2 minutes per post.

<u>Sample No.</u>	<u>Manufacturer</u>	<u>Model-Series</u>
TTC-96W-4	Line Connection	Dura-Post

The Dura-Post is a surface mounted delineator post. The post consists of a flexible urethane material. The base connects to the post via one aluminum pin that is driven through the post. The base is held down by a "Super Bundy" heavy duty adhesive pad comprised of thermoplastic and heated in place by a portable propane torch. All posts were supplied with 3M high intensity reflective sheeting at the top. Installation time averaged 2 minutes per post.

<u>Sample No.</u>	<u>Manufacturer</u>	<u>Model-Series</u>
TTC-96W-5	Davidson Plastics	FG-300

The Davidson Plastics Flexi-Guide 300 is a surface mounted delineator post with a low density polyethelene composition. The post is connected to a thermoplastic base via two plastic pins. The base is anchored to the road surface with a two part epoxy, which has a set time of approximately 20 minutes. All posts were supplied with 3M high intensity reflective sheeting at the top. Installation time averaged 4 minutes per post.

<u>Sample No.</u>	<u>Manufacturer</u>	<u>Model-Series</u>
TTC-96W-6	Davidson Plastics	FG-400 (FG-95 anchor)

The Davidson Plastics Flexi-Guide 400 with FG-95 anchor is a ground mounted delineator post with a recycled engineered thermoplastic composition. A manual slide hammer was used in conjunction with an auger to dig the post holes. A V-shaped plastic barb was inserted at the base of the post to reduce pull-out upon impact. All posts were supplied with 3M high intensity reflective sheeting at the top. Installation time averaged 5 minutes per post.

<u>Sample No.</u>	<u>Manufacturer</u>	<u>Model-Series</u>
TTC-96W-7	Davidson Plastics	FG-400 (FG-96 anchor)

The Davidson Plastics Flexi-Guide 400 with FG-96 anchor is a ground mounted delineator post with a recycled engineered thermoplastic composition. A manual slide hammer was used in conjunction with an auger to dig the post holes. An 18 inch steel U-channel was bolted to the base of the post. The steel channel was driven into the ground by a mechanical air hammer with a special attachment that fits over the top of the steel U-channel. All posts were supplied with 3M high intensity reflective sheeting at the

top. Installation time averaged 1 minute per post.

<u>Sample No.</u>	<u>Manufacturer</u>	<u>Model-Series</u>
TTC-96W-8	Davidson Plastics	FG-500 (FG-95 anchor)

The Davidson Plastics Flexi-Guide 500 with FG-95 anchor is a ground mounted delineator post with a recycled engineered thermoplastic composition. A manual slide hammer was used in conjunction with an auger to dig the post holes. A V-shaped plastic barb was inserted at the base of the post to reduce pull-out upon impact. All posts were supplied with 3M high intensity reflective sheeting at the top. Installation time averaged 5 minutes per post.

<u>Sample No.</u>	<u>Manufacturer</u>	<u>Model-Series</u>
TTC-96W-9	Davidson Plastics	FG-500 (FG-96 anchor)

The Davidson Plastics Flexi-Guide 500 with FG-96 anchor is a ground mounted delineator post with a recycled engineered thermoplastic composition. A manual slide hammer was used in conjunction with an auger to dig the post holes. An 18 inch steel U-channel was bolted to the base of the post. The steel channel was driven into the ground by a mechanical air hammer with a special attachment that fits over the top of the steel U-channel. All posts were supplied with 3M high intensity reflective sheeting at the top. Installation time averaged 1 minute per post.

Laboratory Test Data

NTPEP I.D. #	<u>Control Specimen</u>				<u>Weathered Specimen</u>			
	#1	#2	#3	AVG.	#4	#5	#6	AVG.
TTC-96W-1	250	251	271	257	281	285	254	273
TTC-96W-5	94	75	80	83	90	84	84	86
TTC-96W-6	547	544	504	532	574	536	501	537
TTC-96W-7	526	521	541	529	506	498	485	496
TTC-96W-8	568	597	582	582	609	600	593	601
TTC-96W-9	610	604	561	592	610	585	581	592

**Table 1 - Tensile Strengths of Specimens Tested in Lbs**

*Note: A break in sequence denotes withdrawal from testing by the manufacturer.*

NTPEP I.D. #	<u>Control Specimen</u>				<u>Weathered Specimen</u>			
	#1	#2	#3	AVG.	#4	#5	#6	AVG.
TTC-96W-1	6.000	4.131	5.807	5.073	6.000	2.084	2.788	3.624
TTC-96W-5	6.000	2.599	3.786	4.128	6.000	6.000	6.000	6.000
TTC-96W-6	2.380	2.300	1.865	2.182	2.355	1.834	0.590	1.593
TTC-96W-7	2.429	1.981	1.944	2.118	1.666	1.682	0.938	1.429
TTC-96W-8	2.092	1.790	1.731	1.871	1.654	1.778	1.739	1.724
TTC-96W-9	1.864	1.875	2.002	1.914	1.076	1.534	2.032	1.547

**Tensile Elongations of Specimens Tested in Inches**

**Table 2**

*Note: A break in sequence denotes withdrawal from testing by the manufacturer.*

NTPEP I.D. #	<u>AVG Strengths</u>			<u>AVG Elongations</u>		
	Control	Weath.	Change	Control	Weath.	%Change
TTC-96W-1	257	273	+6.226	5.073	3.624	-28.57
TTC-96W-5	83	86	+3.614	4.128	6.000	+45.35
TTC-96W-6	532	537	+0.940	2.182	1.593	-26.99
TTC-96W-7	529	496	-6.238	2.118	1.429	-32.53
TTC-96W-8	582	601	+3.265	1.871	1.724	-7.857
TTC-96W-9	592	592	0.0	1.914	1.547	-19.17

Percent Change in Ultimate  
Tensile Strength and Elongation after  
1000 Hrs of U.V. Exposure

Table 3

*Note: A break in sequence denotes withdrawal from testing by the manufacturer.*

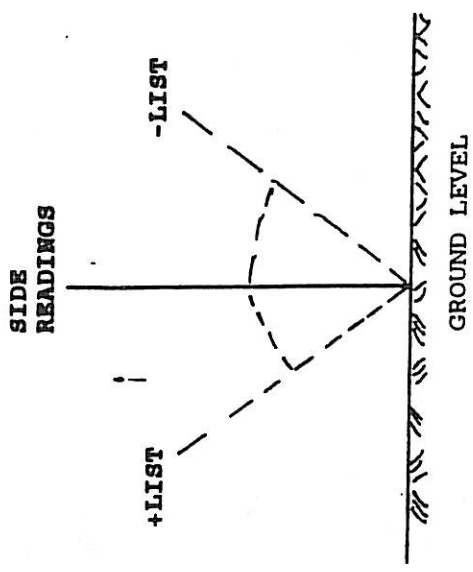
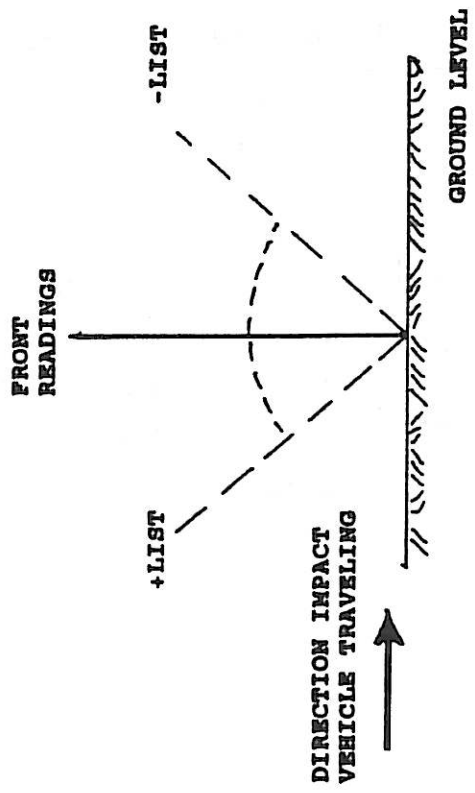
NTPEP I.D. #	<u>Cross-Sectional Area (in<sup>2</sup>)</u>		<u>AVG Tensile Stresses</u>	
	Control	Weathered	Control	Weathered
TTC-96W-1	0.0982	0.0964	2617	2832
TTC-96W-5	0.0485	0.0504	1711	1706
TTC-96W-6	0.0717	0.0706	7420	7606
TTC-96W-7	0.0704	0.0681	7514	7283
TTC-96W-8	0.0806	0.0814	7221	7383
TTC-96W-9	0.0811	0.0803	7330	7372

Average Tensile Stressess in P.S.I.  
of Specimens Test

Table 4

*Note: A break in sequence denotes withdrawal from testing by the manufacturer.*

# LEGEND FOR IMPACT READINGS



TTC No:		96W-1		Test Area				1				Installed Date: February 6, 1996		
Product:		Impact Recovery Systems, Inc.		201-S				Test Date: February 7, 1996			Temperature: 32° F			
Impact Number:				1		2		3		4		5		
	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List		
		Side	Front									Side	Front	% List
Wheel Impacts	1	3L	0	-4	4.4	-4	4.4	-6	6.7	-3	3.3	8L	-4	4.4
	2	3L	0	0	0.0	1	1.1	1	1.1	1	1.1	1R	2	2.2
	3	3L	0	0	0.0	0	0.0	1	1.1	0	0.0	2L	1	1.1
	4	3L	0	3	3.3	8	8.9	1	1.1	-1	1.1	6L	4	4.4
Bumper Impacts	5	3L	1	0	1.1	1	0.0	0	1.1	0	1.1	3L	1	0.0
	6	3L	1	0	1.1	0	1.1	0	1.1	0	1.1	3L	3	2.2
	7	3L	0	0	0.0	0	0.0	0	0.0	0	0.0	3L	0	0.0
	8	3L	0	0	0.0	0	0.0	-1	1.1	0	0.0	2L	0	0.0

- #1 Impact: Sheeting adhesive on post #4, 5 and 6 began stripping off. Post #4, 6, 7 and 8 had 10% sheeting damage. Post #5 had 15% sheeting damage.
- #2 Impact: Post #1 and 2 had 5% sheeting damage. Post #3, 7 and 8 had 15% sheeting damage. Post #4 had 40% sheeting damage. Post #5 had 50% sheeting damage. Post #6 had 30% sheeting damage.
- #3 Impact: Post #2 had 15% sheeting damage. Post #4 and 5 had 80% sheeting damage. Post #3 had 25% sheeting damage. Post #6 and 8 had 45% sheeting damage. Post #7 had 30% sheeting damage.
- #4 Impact: Post #3 and 6 had 60% sheeting damage. Post #2 had 30% sheeting damage. Post #5 had 85% sheeting damage. Post #7 and 8 had 40% sheeting damage.
- #5 Impact: Post #2 and 7 had 40% sheeting damage. Post #4, 5 and 8 had 85% sheeting damage. Post #6 had 100% sheeting damage. Post #3 had 75% sheeting damage.

TTC No:		96W-1		Test Area				1				Installed Date: February 6 1996		
Product:		Impact Recovery Systems, Inc.		201-S				Test Date: July 16 1996			Temperature: 80° F			
Impact Number:				1		2		3		4		5		
	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List		
		Side	Front									Side	Front	% List
Wheel Impacts	1	7L	-3	1	4.4	-4	1.1	5	8.9	-3	0.0	3L	-14	12.2
	2	2L	1	1	0.0	3	2.2	-4	5.6	6	5.6	1R	5	4.4
	3	4L	0	3	3.3	-13	14.4	5	5.6	-6	6.7	1R	10	11.1
	4	3L	-2	7	10.0	-9	7.8	5	7.8	-30	31.1	10L	0	2.2
Bumper Impacts	5	5L	3	3	0.0	5	2.2	5	2.2	-4	7.8	1L	6	3.3
	6	3L	0	1	1.1	1	1.1	3	3.3	6	6.7	1L	2	2.2
	7	5L	-2	-1	1.1	0	2.2	1	3.3	3	5.6	3L	2	4.4
	8	4L	-3	-1	2.2	0	3.3	0	3.3	-1	2.2	3L	-1	2.2

- #1 Impact: No further damage noted.
- #2 Impact: Post #4 had 90% sheeting damage.
- #3 Impact: Post #1 had 80% sheeting damage. Post #3 had 100% sheeting damage.
- #4 Impact: No further damage noted.
- #5 Impact: No further damage noted.

TTC No: 96W-2		Test Area					Installed Date: February 6, 1996							
Product: Kennco, Inc.		4					Test Date: February 7, 1996							
Polycarbonate Extension							Temperature: 32° F							
Impact Number:			1		2		3		4		5			
Wheel Impacts	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List		
		Side	Front									Side	Front	% List
	1	1L	-2	-3	1.1	-6	4.4	-9	7.8	-14	13.3	2L	-15	14.4
	2	0	-1	-1	0.0	-2	1.1	-5	4.4	-5	4.4	1L	-4	3.3
	3	1L	-2	-2	0.0	-5	3.3	-6	4.4	-7	5.6	2L	-5	3.3
4	2R	0	-2	2.2	-2	2.2	-3	3.3	-5	5.6	3R	-5	5.6	
Bumper Impacts	5	1L	2	-2	4.4	-3	5.6	-6	8.9	-6	8.9	2R	-7	10.0
	6	3L	0	-2	2.2	-6	6.7	-5	5.6	-17	18.9	2R	-20	22.2
	7	4L	6	3	3.3	1	5.6	---	---	---	---	---	---	---
	8	1L	2	-1	3.3	-5	7.8	-9	12.2	-8	11.1	4R	-10	13.3

#1 Impact: Post #6 had 5% sheeting damage.

#2 Impact: Post #1 had 60% sheeting damage. Post #2 had 10% sheeting damage.

#3 Impact: Post #2 had 20% sheeting damage. Post #3 had 60% sheeting damage. The entire upper plastic section of post #7 was torn off. Post #5, 6, 7 and 8 pulled up 1 inch.

#4 Impact: No further damage noted.

#5 Impact: The top 14 inches of post #2 fractured and tore off the right side of the post.

Note: Warm weather testing was not performed on this sample due to manufacturer removing post from testing following winter test.



TTC No: 96W-3			Test Area				Installed Date: February 6, 1996							
Product: Kennco, Inc.			5				Test Date: February 7, 1996							
HDPE Extrusion							Temperature: 32° F							
Impact Number:			1		2		3		4		5			
	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List		
		Side	Front									Side	Front	% List
Wheel Impacts	1	1L	-2	-5	3.3	-5	3.3	-5	3.3	-6	4.4	1L	-7	5.6
	2	1L	2	-2	4.4	-4	6.7	-5	7.8	-7	10.0	1L	-7	10.0
	3	1L	2	-1	3.3	-2	4.4	-2	4.4	-3	5.6	1L	-4	6.7
	4	2L	-1	-4	3.3	-5	4.4	-6	5.6	-9	8.9	2L	-8	7.8
Bumper Impacts	5	1L	4	2	2.2	0	4.4	-1	5.6	-2	6.7	0	-2	6.7
	6	0	3	-2	5.6	-2	5.6	-5	8.9	-4	7.8	---	---	---
	7	4L	-1	-5	4.4	-8	7.8	-12	12.2	-10	10.0	2L	-14	14.4
	8	0	1	-3	4.4	-6	7.8	-8	10.0	-10	12.2	2L	-11	13.3

- #1 Impact: No sheeting damage was noted. Post #2, 4, 6, 7 and 8 developed splits along the sides of the plastic casing.
- #2 Impact: Post #6 and 8 had 100% sheeting damage. Post #5 had 50% sheeting damage. The front part of the plastic casing on post #6 tore off. Post #2, 3, 4, 7 and 8 further developed splits along the sides of the plastic casing.
- #3 Impact: Post #2, 4 and 5 had 100% sheeting damage. Post #3 had 60% sheeting damage.
- #4 Impact: The remaining upper portion of post #6 tore off.
- #5 Impact: Post #7 had 40% sheeting damage.

Note: Warm weather testing was not performed on this sample due to manufacturer removing post from testing following winter test.

TTC No: 96W-4			Test Area				Installed Date: February 6, 1996							
Product: Flint Trading, Inc.			2				Test Date: February 7, 1996							
Dura-Post							Temperature: 32° F							
Impact Number:			1		2		3		4		5			
Wheel Impacts	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List		
		Side	Front							Side	Front	% List		
	1	4L	-1	-1	0.0	-1	0.0	-2	1.1	-3	2.2	6L	-2	1.1
	2	3L	0	-1	1.1	-1	1.1	-1	1.1	-2	2.2	6L	-1	1.1
	3	4L	0	-1	1.1	-1	1.1	-1	1.1	-1	1.1	5L	-2	2.2
4	4L	0	0	0.0	0	0.0	-1	1.1	-1	1.1	6L	-1	1.1	
Bumper Impacts	5	4L	0	-4	4.4	-8	8.9	-10	11.1	-12	13.3	4L	-11	12.2
	6	4L	0	-11	12.2	-10	11.1	-9	10.0	-9	10.0	4L	-8	8.9
	7	4L	0	-6	6.7	-7	7.8	-8	8.9	-10	11.1	3L	-12	13.3
	8	4L	0	-2	2.2	-3	3.3	-6	6.7	-10	11.1	3L	-7	7.8

#1 Impact: Post #7 had 10% sheeting damage. Post #6, 7 and 8 developed a 6 inch crack at the top.

#2 Impact: No further damage noted.

#3 Impact: No further damage noted.

#4 Impact: Post #5 had 15% sheeting damage. Post #6 and 7 had 20% sheeting damage.

#5 Impact: Post #5 had 25% sheeting damage. Post #7 had 40% sheeting damage. Post #8 had 15% sheeting damage.

Note: Warm weather testing was not performed on this sample due to manufacturer removing post from testing following winter test.

TTC No:		96W-5		Test Area				3				Installed Date:		February 6, 1996	
Product:		Davidson Plastics, Inc.										Test Date:		February 7, 1996	
		FG-300										Temperature:		32° F	
Impact Number:				1		2		3		4		5			
Wheel Impacts	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List			
		Side	Front									Side	Front	% List	
	1	3L	0	-20	22.2	-25	27.8	-33	36.7	-45	50.0	---	63	70.0	
	2	3L	0	-22	24.4	-29	32.2	-36	40.0	-45	50.0	---	50	55.6	
	3	3L	-1	-16	16.7	-29	31.1	-41	44.4	-51	55.6	---	---	---	
	4	3L	0	-22	24.4	---	---	---	---	---	---	---	---	---	
Bumper Impacts	5	3L	0	-7	7.8	-11	12.2	-12	13.3	-12	13.3	3L	-10	11.1	
	6	3L	0	-7	7.8	-11	12.2	-12	13.3	-13	14.4	2L	-14	15.6	
	7	3L	0	-10	11.1	-11	12.2	-14	15.6	-13	14.4	1L	-13	14.4	
	8	3L	0	-8	8.9	-8	8.9	-12	13.3	-13	14.4	3L	-13	14.4	

- #1 Impact: Post #5 had 100% sheeting damage. Post #6 had 60% sheeting damage.  
 Post #7 and 8 had 40% sheeting damage. A crack started to develop at the bottom of post #1, 2, 3 and 4
- #2 Impact: Post #2, 3, 6, 7 and 8 had 100% sheeting damage. Post #4 tore out at the base.
- #3 Impact: No further damage was noted.
- #4 Impact: No further damage was noted.
- #5 Impact: No side readings could be obtained on post #1 and 2. Post #3 bent down flat on the ground. The tear at the bottom of Post #1, 2 and 3 became more severe.

TTC No:		96W-5		Test Area				3				Installed Date		February 6 1996	
Product:		Davidson Plastics, Inc.										Test Date:		July 16 1996	
		FG-300										Temperature		80° F	
Impact Number:				1		2		3		4		5			
Wheel Impacts	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List			
		Side	Front									Side	Front	% List	
	1	---	---	---	---	---	---	---	---	---	---	---	---	---	
	2	---	---	---	---	---	---	---	---	---	---	---	---	---	
	3	---	---	---	---	---	---	---	---	---	---	---	---	---	
	4	---	---	---	---	---	---	---	---	---	---	---	---	---	
Bumper Impacts	5	1R	-1	-4	3.3	6	7.8	-7	6.7	-8	7.8	1L	-9	8.9	
	6	2L	-1	---	---	---	---	---	---	---	---	---	---	---	
	7	1L	-1	-4	3.3	6	7.8	-8	7.8	-8	7.8	---	---	---	
	8	1L	-3	-6	3.3	8	12.2	---	---	---	---	---	---	---	

- #1 Impact: Post #1 and 2 could not be re-installed in the bases due to the severe tear at the bottom of the post.  
 Post #6 tore up at the bottom of the post.
- #2 Impact: No further damage noted.
- #3 Impact: Post #8 tore up at the bottom of the post.
- #4 Impact: No further damage noted.
- #5 Impact: No further damage noted.

TTC No: 96W-6			Test Area 6				Installed Date: February 6, 1996							
Product: Davidson Plastics, Inc. FG-400 (FG-95 anchor)							Test Date: February 7, 1996							
							Temperature: 35° F							
Impact Number:			1		2		3		4		5			
Wheel Impacts	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List		
		Side	Front									Side	Front	% List
	1	1L	3	0	3.3	0	3.3	0	3.3	0	3.3	1L	-1	4.4
	2	3L	4	2	2.2	0	4.4	-1	5.6	-1	5.6	2R	1	3.3
	3	2L	5	0	5.6	-1	6.7	-2	7.8	-2	7.8	1L	-3	8.9
	4	1L	-2	-6	4.4	-5	3.3	-7	5.6	-6	4.4	---	---	---
Bumper Impacts	5	1L	0	-2	2.2	-3	3.3	-4	4.4	-4	4.4	1L	-5	5.6
	6	2L	2	0	2.2	-1	3.3	-2	4.4	-3	5.6	2L	-2	4.4
	7	0	2	0	2.2	-1	3.3	-2	4.4	-2	4.4	1R	-3	5.6
	8	0	2	1	1.1	0	2.2	-1	3.3	-2	4.4	1R	-1	3.3

#1 Impact: Post #5 had 5% sheeting damage.

#2 Impact: Post #2 had 5% sheeting damage.

#3 Impact: Post #1, 2, 3, 4, 6, 7 and 8 had 2% sheeting damage.

#4 Impact: Post #2, 3, 6, 7 and 8 had 5% sheeting damage. Post #5 had 8% sheeting damage.

#5 Impact: Post #4 tore in half.

TTC No: 96W-6			Test Area 6				Installed Date: February 6, 1996							
Product: Davidson Plastics, Inc. FG-400 (FG-95 anchor)							Test Date: July 16, 1996							
							Temperature: 84° F							
Impact Number:			1		2		3		4		5			
Wheel Impacts	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List		
		Side	Front									Side	Front	% List
	1	2R	4	2	2.2	---	---	---	---	---	---	---	---	---
	2	3R	3	-1	4.4	-3	6.7	3	0.0	-4	7.8	3L	-4	7.8
	3	1R	5	1	4.4	1	4.4	1	4.4	-2	7.8	0	-4	10.0
	4	---	---	---	---	---	---	---	---	---	---	---	---	---
Bumper Impacts	5	1R	6	0	6.7	-2	8.9	4	2.2	-4	11.1	1L	-8	15.6
	6	1R	9	3	6.7	-2	12.2	60	56.7	-65	82.2	2R	-65	82.2
	7	0	12	0	13.3	-12	26.7	70	64.4	-75	96.7	1R	-75	96.7
	8	1L	9	3	6.7	1	8.9	2	7.8	-3	13.3	1R	-4	14.4

#1 Impact: Post #1 developed a 1 inch crack in the middle of the post.

#2 Impact: The top 12 inches of post #1 tore off. Post #5 had 10% sheeting damage.

#3 Impact: The bottom of post #6 and 7 developed a 1-1/2 inch crack.

#4 Impact: Post #7 had 10% sheeting damage.

#5 Impact: Post #2 developed two 1 inch cracks in the middle of the post.

TTC No:		96W-7		Test Area				7				Installed Date:		February 6, 1996	
Product:		Davidson Plastics, Inc.		7				Test Date:		February 7, 1996		Temperature:		32° F	
TTC No:		96W-7		Test Area				7				Installed Date:		February 6, 1996	
Product:		Davidson Plastics, Inc.		7				Test Date:		February 7, 1996		Temperature:		32° F	
FG-400 (FG-96 anchor)		Impact Number:				1		2		3		4		5	
Wheel Impacts	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List			
		Side	Front									Side	Front	% List	
	1	2R	-1	-2	1.1	-2	1.1	-5	4.4	-2	-1.1	---	---	---	
	2	1L	-1	-1	0.0	-2	1.1	-2	1.1	-2	1.1	1L	-3	2.2	
	3	1L	-3	2	5.6	1	4.4	1	4.4	0	3.3	2L	-1	2.2	
	4	2L	1	-1	2.2	-1	2.2	-2	3.3	-2	3.3	2L	-2	3.3	
Bumper Impacts	5	1L	3	2	1.1	1	2.2	1	2.2	0	3.3	1L	0	3.3	
	6	2L	2	0	2.2	-2	4.4	-2	4.4	-2	4.4	2L	-2	4.4	
	7	2R	7	6	1.1	6	1.1	5	2.2	4	3.3	1R	4	3.3	
	8	3L	2	0	2.2	-1	3.3	-1	3.3	-1	3.3	2L	-2	4.4	

#1 Impact: No damage noted.

#2 Impact: Post #5 and 8 had 2% sheeting damage. Post #6 had 5% sheeting damage.

#3 Impact: Post #6 had 10% sheeting damage. Post #2 had 5% sheeting damage.

#4 Impact: Post #1, 2 and 7 had 8% sheeting damage.

#5 Impact: Post #1 cracked in the middle of the post and bent forward at an 80 degree angle.

TTC No:		96W-7		Test Area				7				Installed Date:		February 6, 1996	
Product:		Davidson Plastics, Inc.		7				Test Date:		July 16, 1996		Temperature:		80° F	
TTC No:		96W-7		Test Area				7				Installed Date:		February 6, 1996	
Product:		Davidson Plastics, Inc.		7				Test Date:		July 16, 1996		Temperature:		80° F	
FG-400 (FG-96 anchor)		Impact Number:				1		2		3		4		5	
Wheel Impacts	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List			
		Side	Front									Side	Front	% List	
	1	---	---	---	---	---	---	---	---	---	---	---	---	---	
	2	2R	4	---	---	---	---	---	---	---	---	---	---	---	
	3	1R	7	1	6.7	-2	10.0	-25	35.6	---	---	---	---	---	
	4	1R	1	-2	3.3	-3	4.4	-5	6.7	-3	4.4	3L	-6	7.8	
Bumper Impacts	5	---	---	---	---	---	---	---	---	---	---	---	---	---	
	6	1R	9	9	0.0	-2	12.2	0	10.0	0	10.0	2L	-1	11.1	
	7	1L	10	6	4.4	4	6.7	2	8.9	1	10.0	2R	1	10.0	
	8	1R	9	-10	21.1	-50	65.6	-65	82.2	-65	82.2	2R	-65	82.2	

#1 Impact: Post #5 had been removed prior to summer testing. Post #2 tore off near the bottom of the post.

#2 Impact: Post #4 and 8 had 10% sheeting damage. Post #3 had 5% sheeting damage. Post #6 and 7 had 15% sheeting damage.

#3 Impact: Post #8 developed a 2 inch crack near the bottom of the post and bent forward.

#4 Impact: Post #3 tore in half.

#5 Impact: Post #8 had 15% sheeting damage.

TTC No: 96W-8			Test Area 8				Installed Date: February 6, 1996							
Product: Davidson Plastics, Inc.							Test Date: February 7, 1996							
FG-500 (FG-95 anchor)							Temperature: 32° F							
Impact Number:			1		2		3		4		5			
Wheel Impacts	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List		
		Side	Front									Side	Front	% List
	1	4L	4	2	2.2	2	2.2	2	2.2	0	4.4	4L	1	3.3
	2	4L	0	-1	1.1	-1	1.1	-2	2.2	-2	2.2	4L	-2	2.2
	3	1R	0	-1	1.1	-1	1.1	-1	1.1	0	0.0	5L	-1	1.1
	4	5L	3	1	2.2	1	2.2	1	2.2	0	3.3	---	---	---
Bumper Impacts	5	1L	-5	3	8.9	4	10.0	3	8.9	3	8.9	1L	3	8.9
	6	0	1	-2	3.3	-1	2.2	-2	3.3	-2	3.3	1R	-2	3.3
	7	4L	-1	-2	1.1	-2	1.1	-2	1.1	-2	1.1	3L	-2	1.1
	8	2L	1	1	0.0	1	0.0	1	0.0	0	1.1	2L	-1	2.2

#1 Impact: Post #6 had 5% sheeting damage.

#2 Impact: Post #3 had 15% sheeting damage. Post #4 had 20% sheeting damage. Post #8 had 5% sheeting damage.

#3 Impact: Post #4 had 30% sheeting damage.

#4 Impact: Post #3 had 20% sheeting damage.

#5 Impact: The top 12 inches of post #4 tore off.

TTC No: 96W-8			Test Area 8				Installed Date: February 6, 1996							
Product: Davidson Plastics, Inc.							Test Date: July 16, 1996							
FG-500 (FG-95 anchor)							Temperature: 80° F							
Impact Number:			1		2		3		4		5			
Wheel Impacts	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List		
		Side	Front									Side	Front	% List
	1	5L	3	4	1.1	2	1.1	2	1.1	3	0.0	5L	1	2.2
	2	5L	0	-1	1.1	0	0.0	-2	2.2	-2	2.2	5L	-2	2.2
	3	4L	1	0	1.1	-1	2.2	-1	2.2	-1	2.2	4L	-1	2.2
	4	---	---	---	---	---	---	---	---	---	---	---	---	---
Bumper Impacts	5	2L	6	5	1.1	4	2.2	3	3.3	3	3.3	3L	3	3.3
	6	0	3	3	0.0	2	1.1	2	1.1	1	2.2	2R	0	3.3
	7	2L	2	2	0.0	0	2.2	0	2.2	-1	3.3	2L	-1	3.3
	8	2L	4	3	1.1	2	2.2	2	2.2	2	2.2	3L	2	2.2

#1 Impact: Post #2 had 5% sheeting damage.

#2 Impact: No further sheeting damage.

#3 Impact: No further sheeting damage.

#4 Impact: No further sheeting damage.

#5 Impact: No further sheeting damage.

TTC No: 96W-9			Test Area 9				Installed Date: February 6, 1996							
Product: Davidson Plastics, Inc. FG-500 (FG-96 anchor)							Test Date: February 7, 1996							
							Temperature: 32° F							
Impact Number:			1		2		3		4		5			
Wheel Impacts	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List		
		Side	Front									Side	Front	% List
	1	1L	1	2	1.1	0	1.1	0	1.1	0	-1.1	1L	1	0.0
	2	2L	4	4	0.0	4	0.0	4	0.0	4	0.0	1L	3	1.1
	3	1L	2	2	0.0	1	1.1	0	2.2	0	2.2	0	-1	3.3
	4	1L	3	2	1.1	1	2.2	0	3.3	0	3.3	1L	1	2.2
Bumper Impacts	5	1L	3	1	2.2	6	3.3	0	3.3	0	3.3	0	0	3.3
	6	1L	7	6	1.1	6	1.1	4	3.3	5	2.2	1R	4	3.3
	7	5R	4	3	1.1	3	1.1	3	1.1	2	2.2	5R	2	0.0
	8	0	2	2	0.0	2	0.0	1	1.1	2	0.0	0	1	1.1

#1 Impact: No damage noted.

#2 Impact: Post #2 and 3 had 20% sheeting damage.

#3 Impact: Post #1 had 50% sheeting damage. Post #2 and 3 had 30% sheeting damage. Post #4 had 40% sheeting damage. Post #6 had 5% sheeting damage.

#4 Impact: Post #8 had 10% sheeting damage.

#5 Impact: Post #1 had 60% sheeting damage. Post #4 had 45% sheeting damage. Post #8 had 20% sheeting damage.

TTC No: 96W-9			Test Area 9				Installed Date: February 6, 1996							
Product: Davidson Plastics, Inc. FG-500 (FG-96 anchor)							Test Date: July 16, 1996							
							Temperature: 80° F							
Impact Number:			1		2		3		4		5			
Wheel Impacts	Post No.	Initial List		Deg. List	% List	Deg. List	% List	Deg. List	% List	Deg. List	% List	Final List		
		Side	Front									Side	Front	% List
	1	1L	3	0	3.3	-6	10.0	-80	92.2	-85	97.8	3L	-85	97.8
	2	1L	6	3	3.3	4	2.2	3	3.3	3	3.3	1L	3	3.3
	3	1L	3	1	2.2	0	3.3	1	2.2	-1	4.4	1L	-2	5.6
	4	0	2	3	1.1	1	1.1	0	2.2	0	2.2	0	0	2.2
Bumper Impacts	5	0	4	3	1.1	2	2.2	2	2.2	1	3.3	0	0	4.4
	6	1L	8	8	0.0	8	0.0	8	0.0	7	1.1	1L	6	2.2
	7	4R	5	5	0.0	3	2.2	3	2.2	3	2.2	4R	3	2.2
	8	0	4	3	1.1	2	2.2	2	2.2	2	2.2	1R	0	4.4

#1 Impact: Post #5 had 15% sheeting damage.

#2 Impact: Post #3 had 35% sheeting damage.

#3 Impact: Post #1 had 80% sheeting damage.

#4 Impact: Post #1 had 85% sheeting damage.

#5 Impact: Post #3 had 40% sheeting damage.





SECTION II

REPORT OF WINTER 1996/SUMMER 1996  
APPENDIX

NATIONAL TRANSPORTATION PRODUCT EVALUATION PROGRAM.

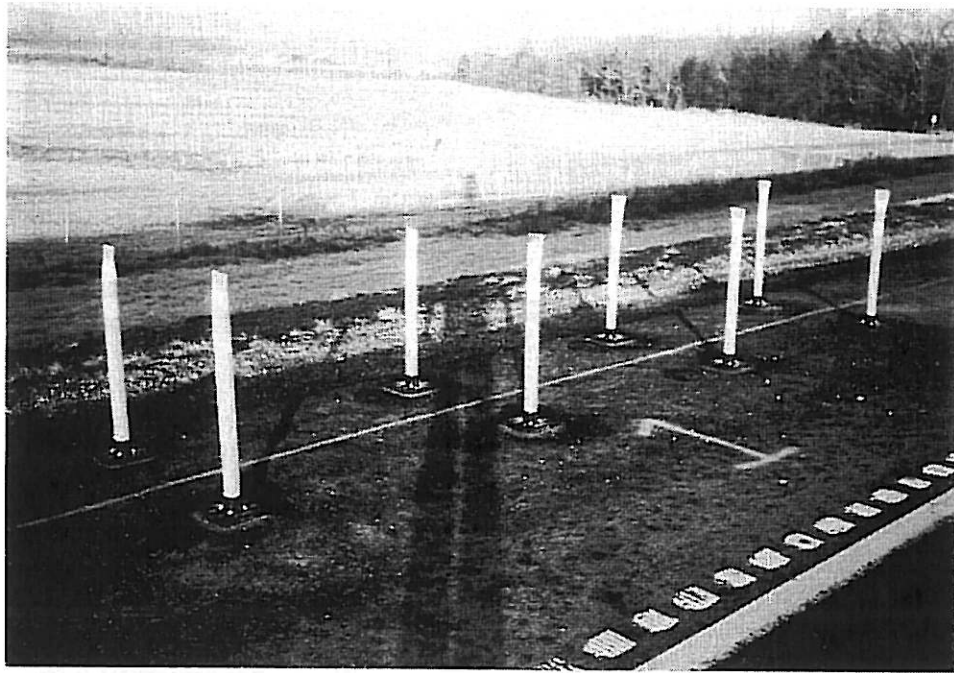
Prepared by

TENNESSEE DEPARTMENT OF TRANSPORTATION

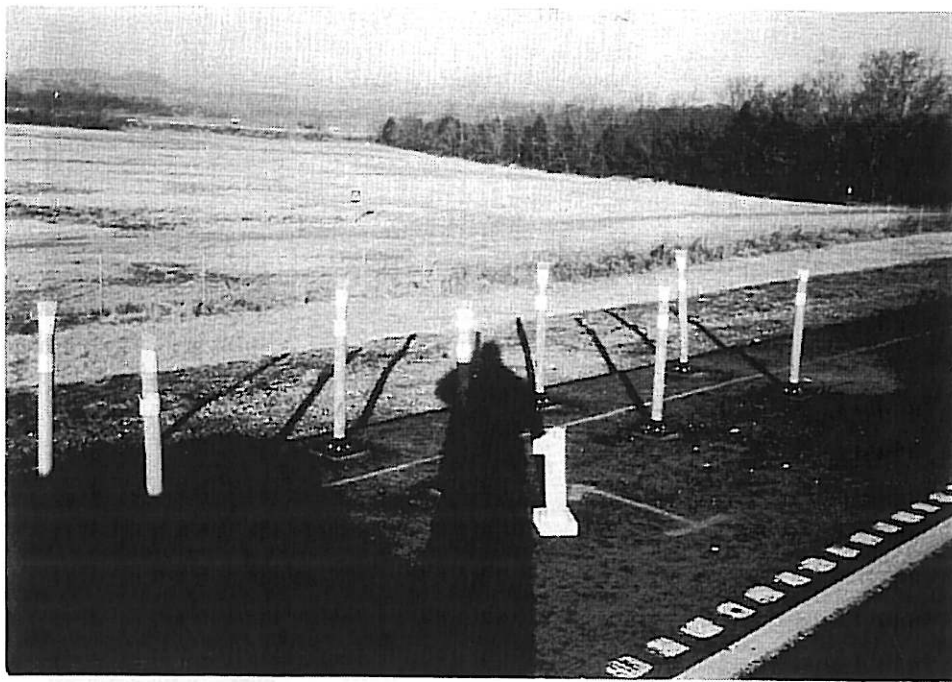
MATERIALS AND TEST DIVISION



IMPACT RECOVERY SYSTEMS 201-S

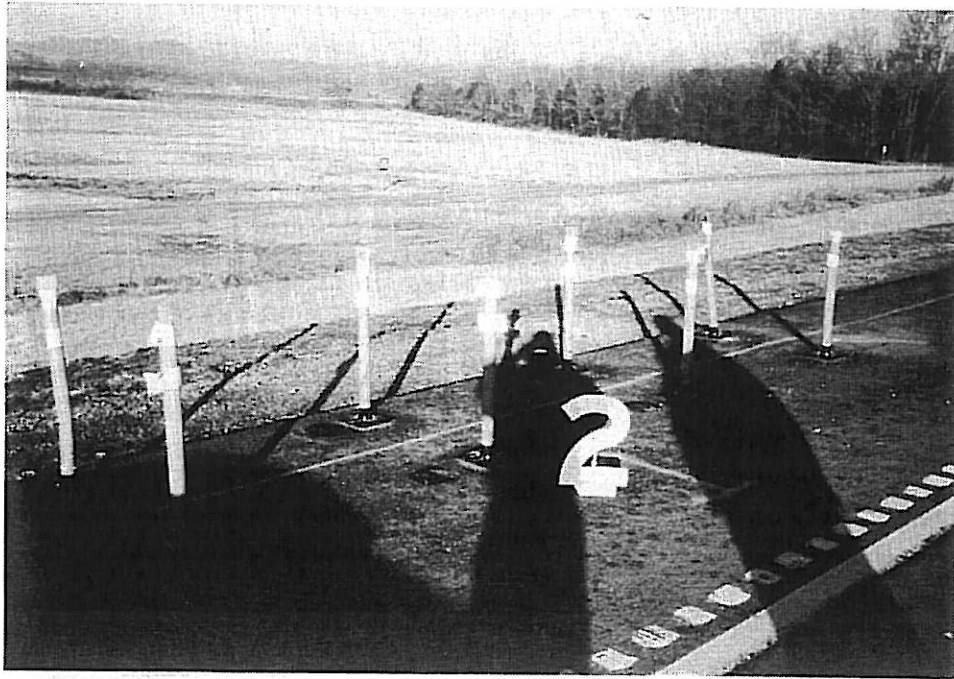


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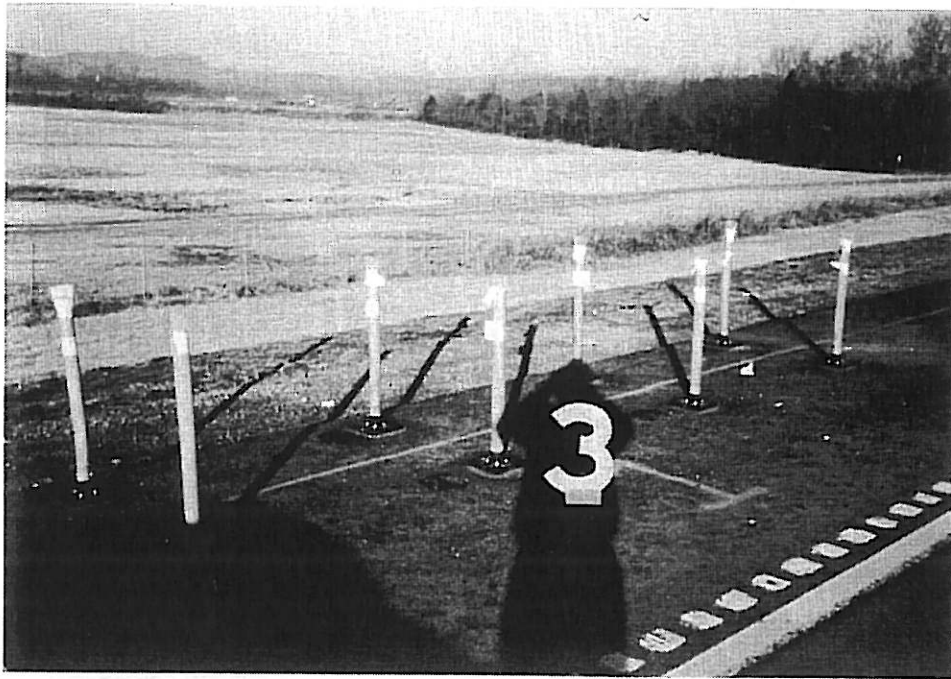


ONE WINTER IMPACT COMPLETED

IMPACT RECOVERY SYSTEMS 201-S

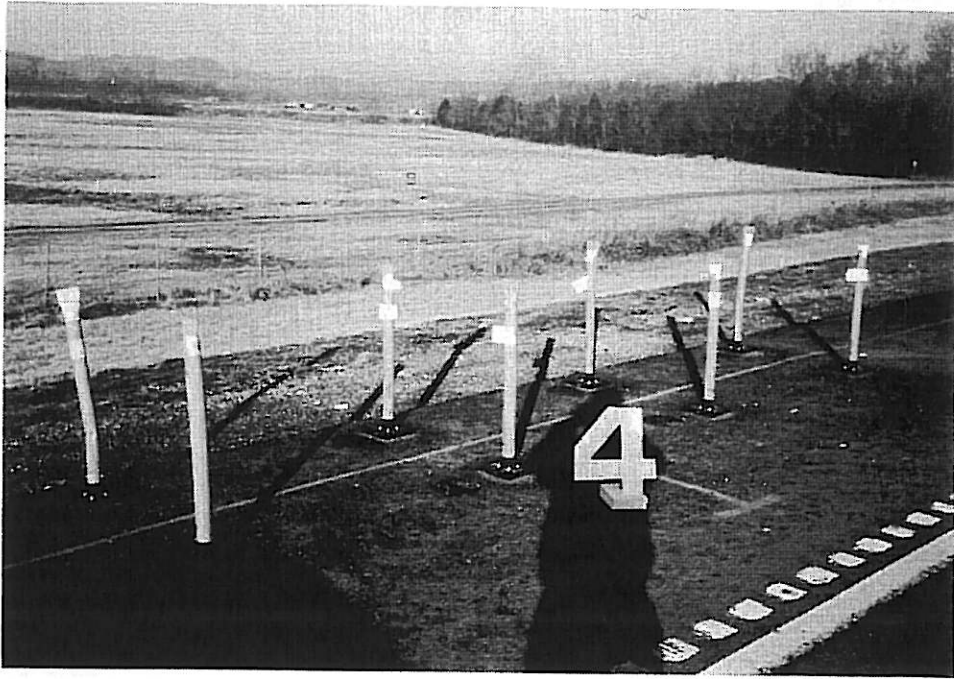


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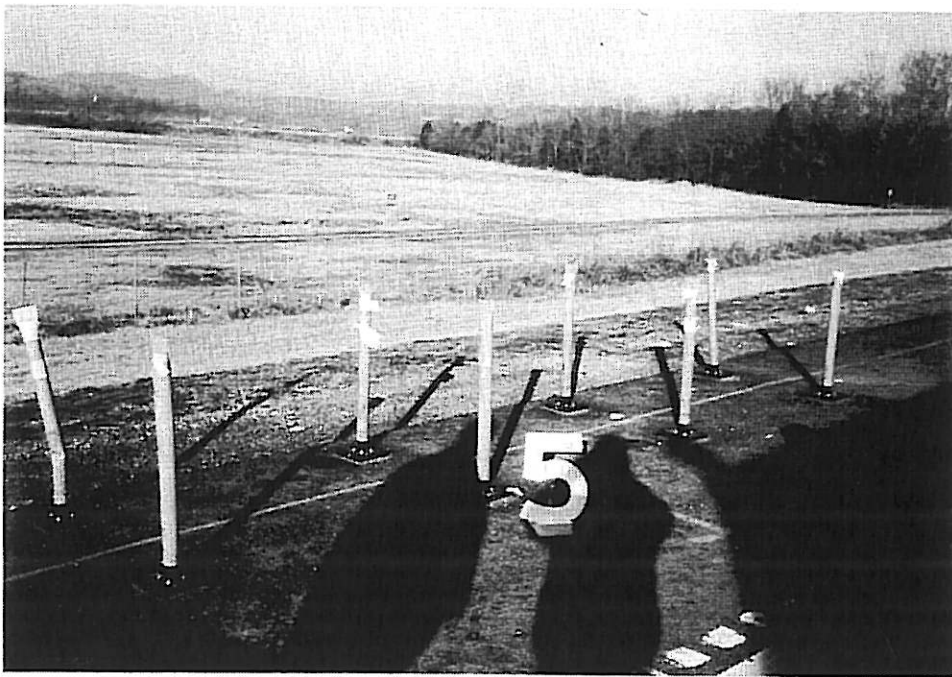


THREE WINTER IMPACTS COMPLETED

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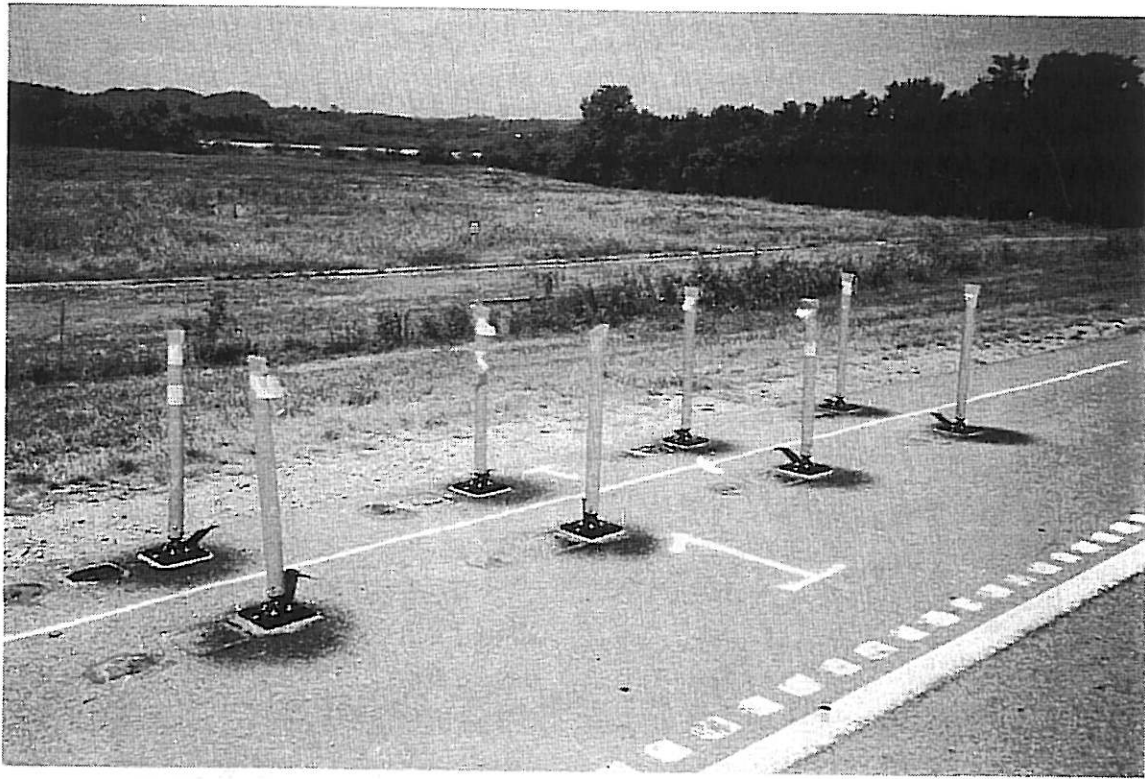


FOUR WINTER IMPACTS COMPLETED



FIVE WINTER IMPACTS COMPLETED

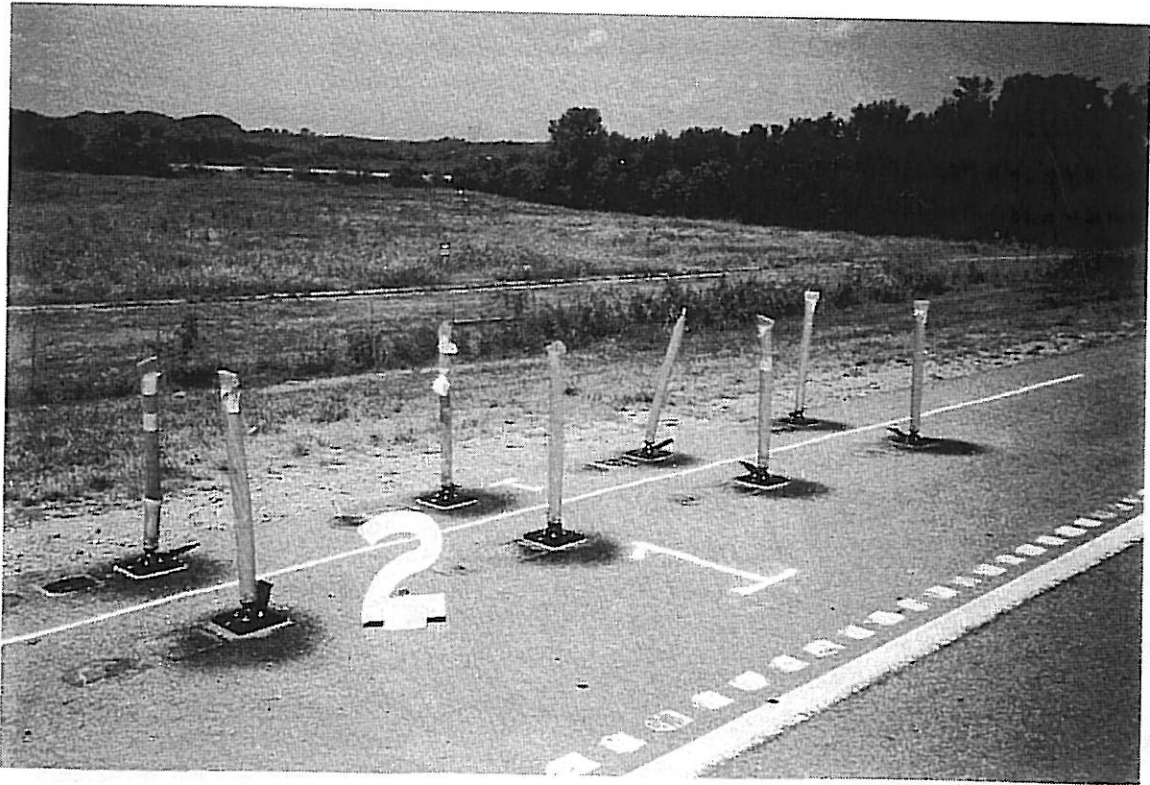
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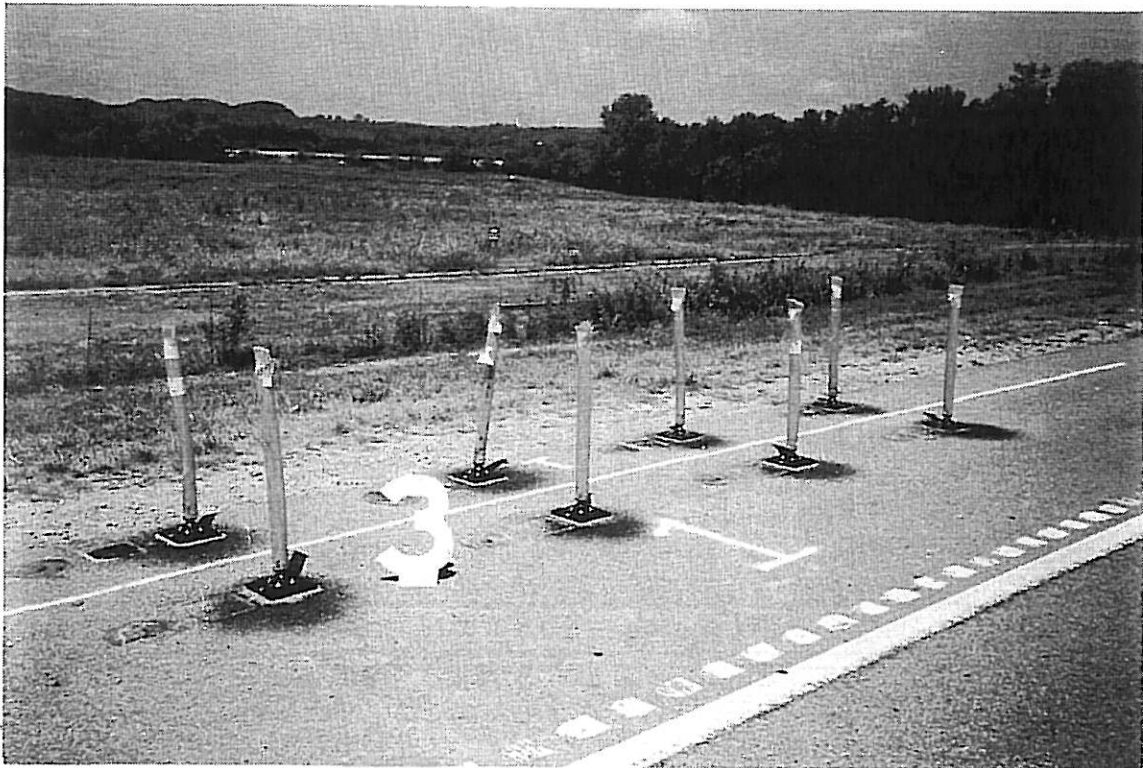
FIVE WINTER IMPACTS COMPLETED  
SUMMER IMPACTS BEGIN

FIRST SUMMER IMPACT  
(PHOTO NOT AVAILABLE)

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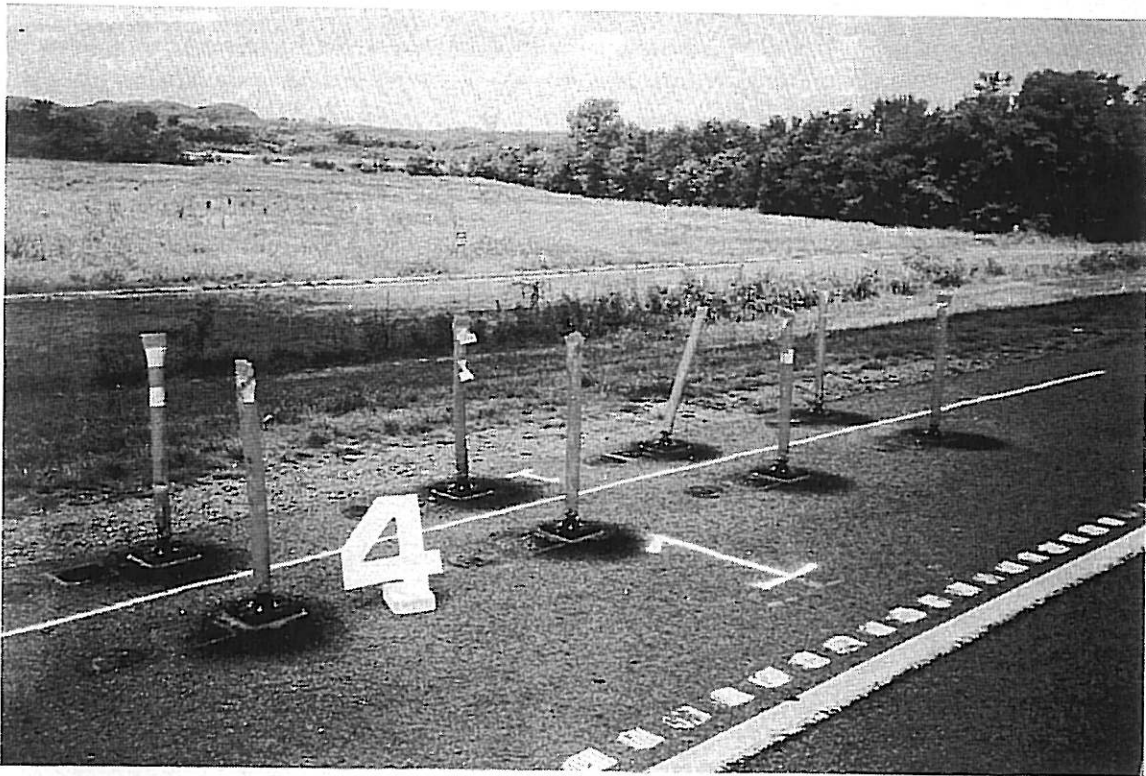


FIVE WINTER IMPACTS COMPLETED  
TWO SUMMER IMPACTS COMPLETED

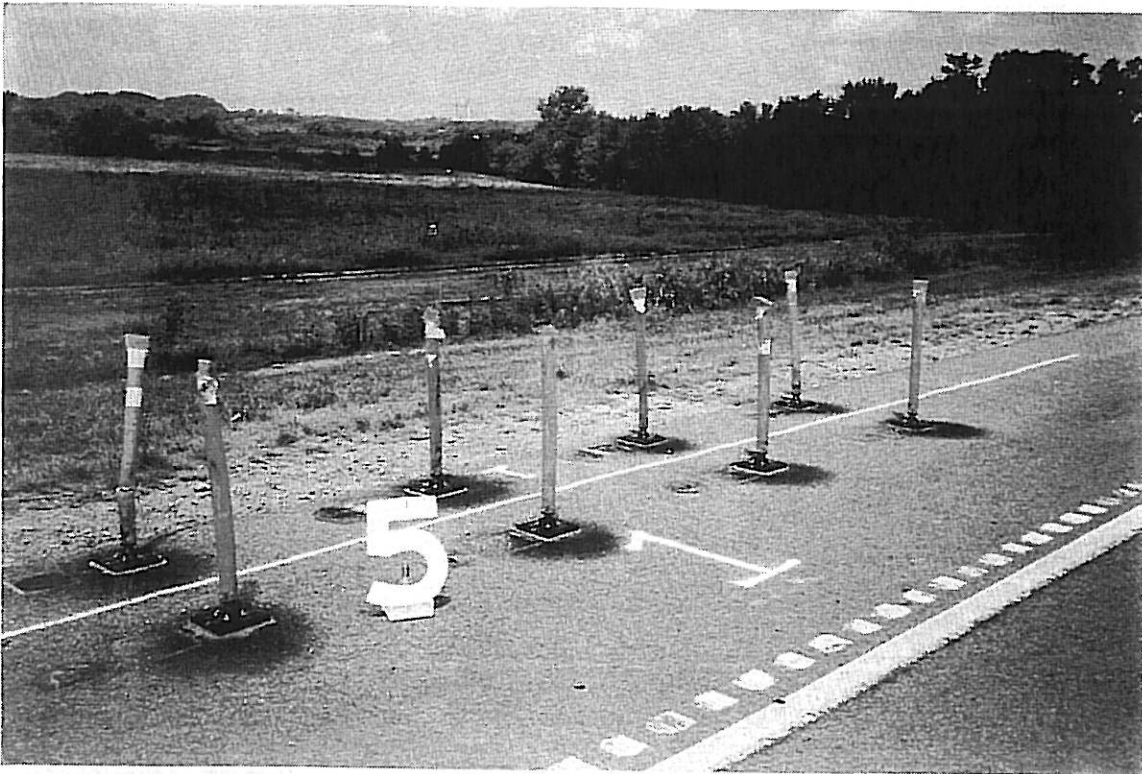


FIVE WINTER IMPACTS COMPLETED  
THREE SUMMER IMPACTS COMPLETED

IMPACT RECOVERY SYSTEMS 201-S



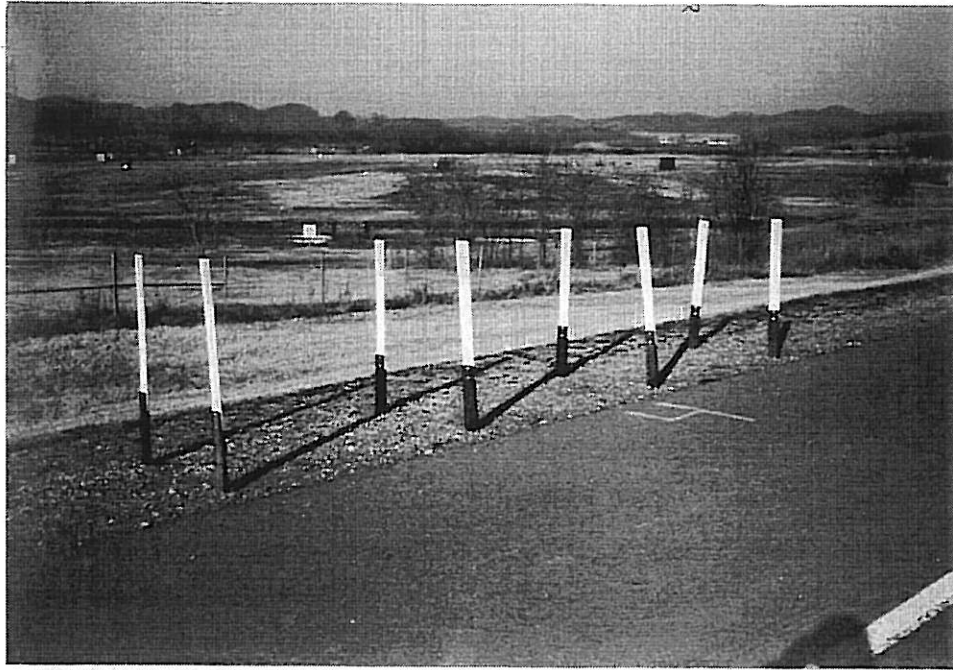
FIVE WINTER IMPACTS COMPLETED  
FOUR SUMMER IMPACTS COMPLETED



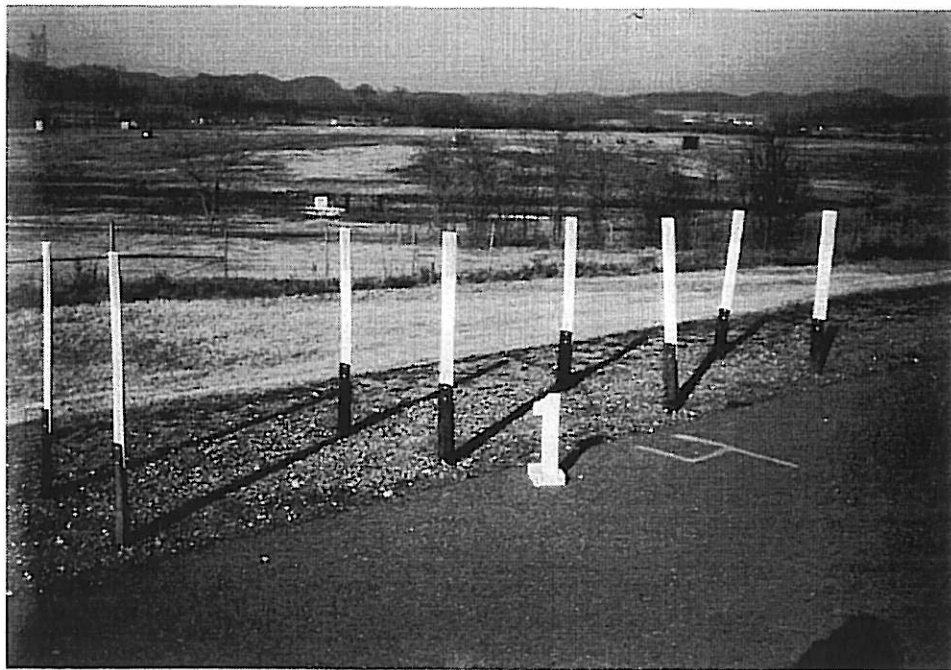
FIVE WINTER IMPACTS COMPLETED  
FIVE SUMMER IMPACTS COMPLETED



KENNCO POLYCARBONITE EXTENSION

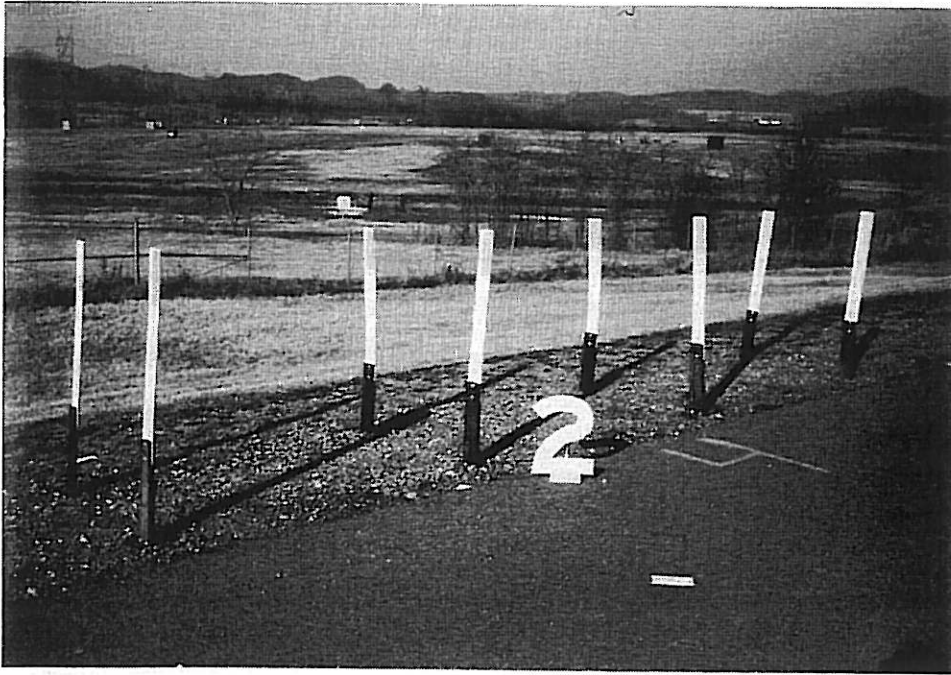


INSTALLED NO IMPACTS IN 05/17

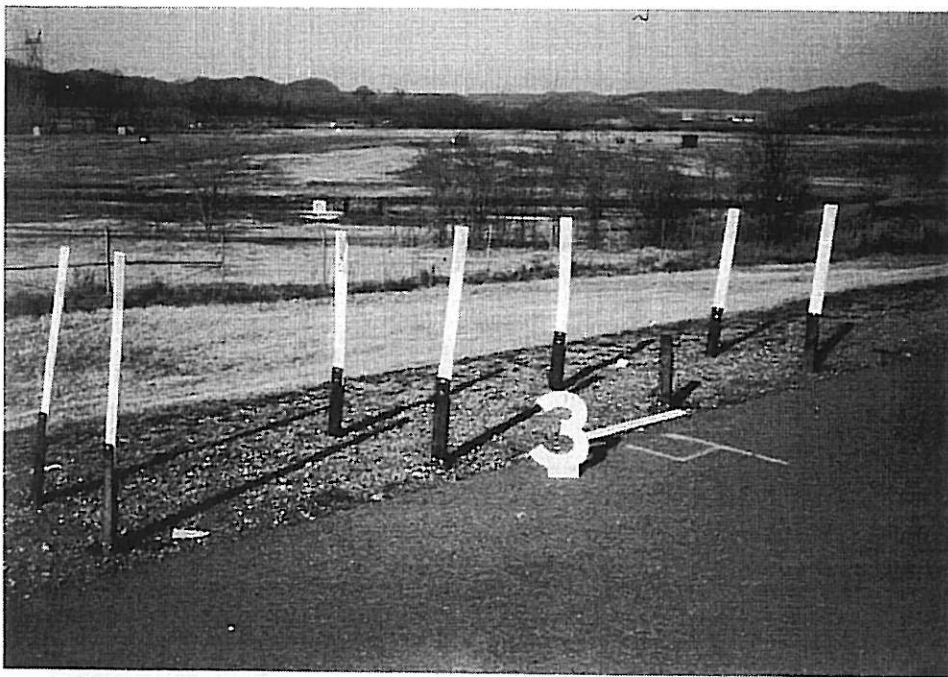


ONE WINTER IMPACT COMPLETED

KENNCO POLYCARBONITE EXTENSION

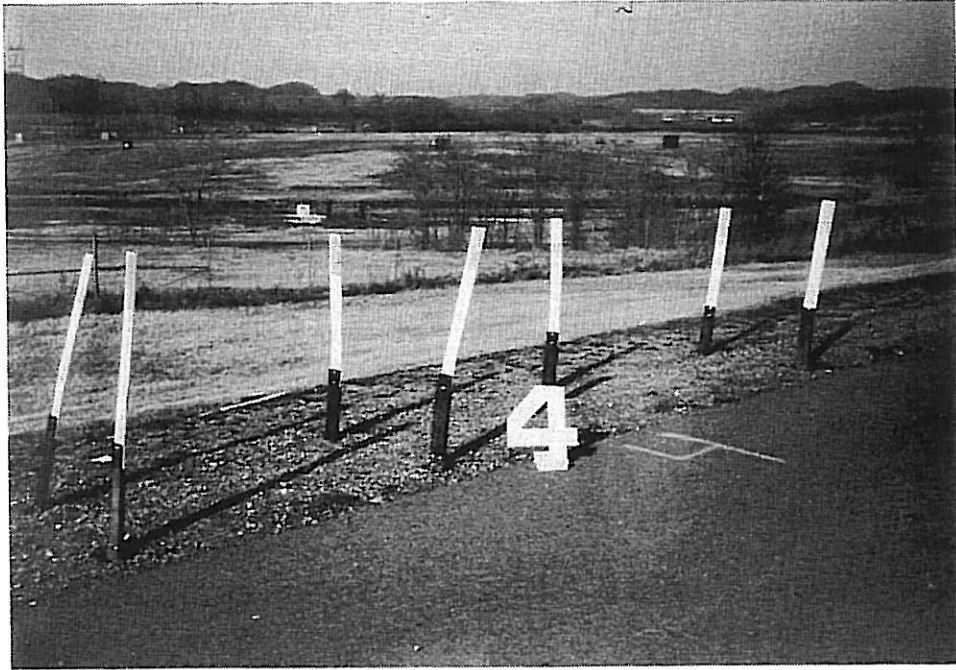


TWO WINTER IMPACTS COMPLETED

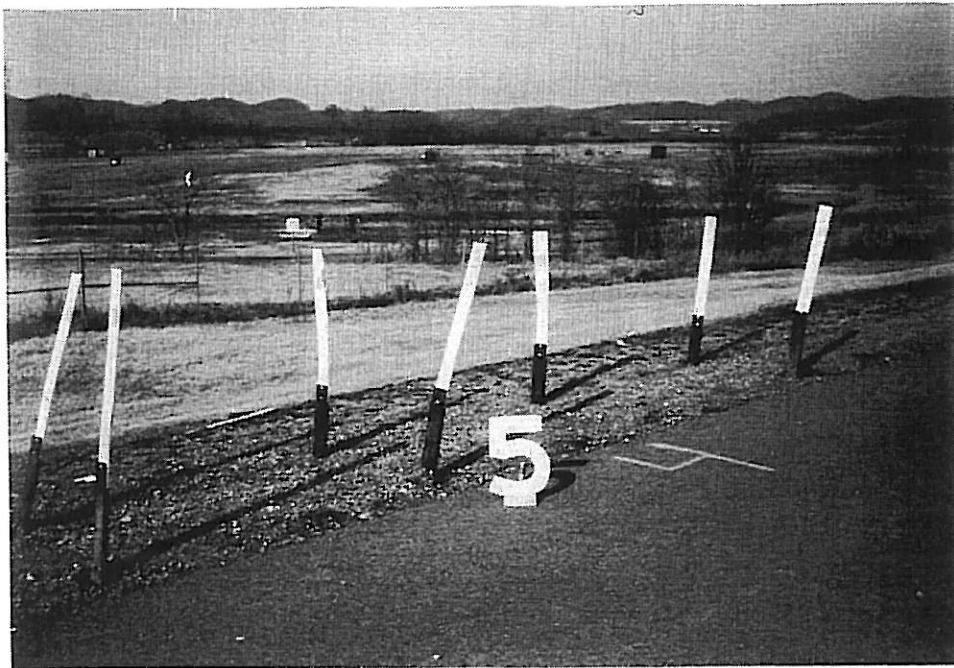


THREE WINTER IMPACTS COMPLETED

KENCO POLYCARBONITE EXTENSION



FOUR WINTER IMPACTS COMPLETED



FIVE WINTER IMPACTS COMPLETED

KENNCO HDPE EXTRUSION



INSTALLED NO IMPACTS

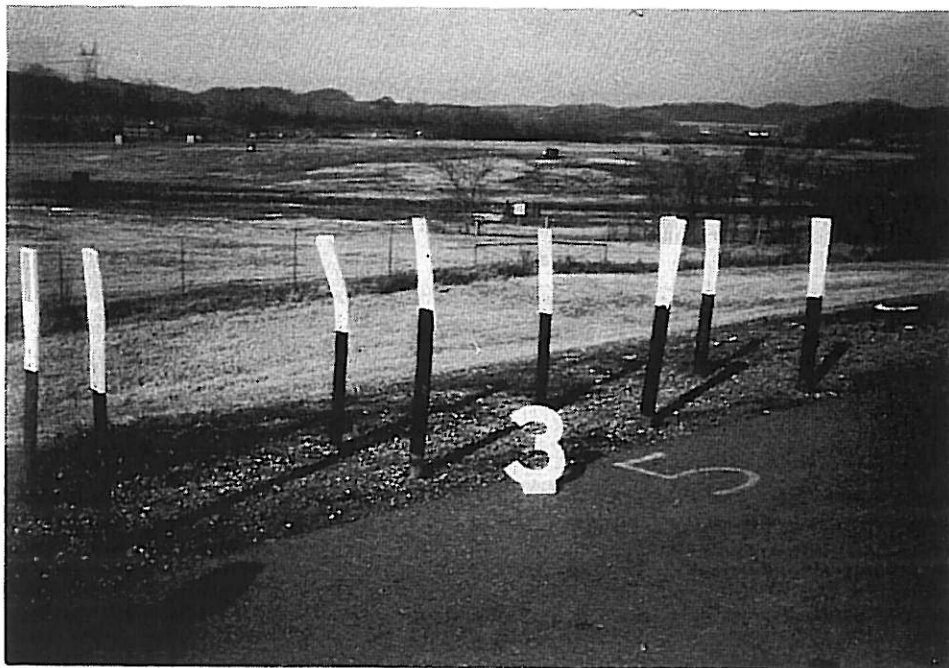


ONE WINTER IMPACT COMPLETED

KENNCO HDPE EXTRUSION



TWO WINTER IMPACTS COMPLETED

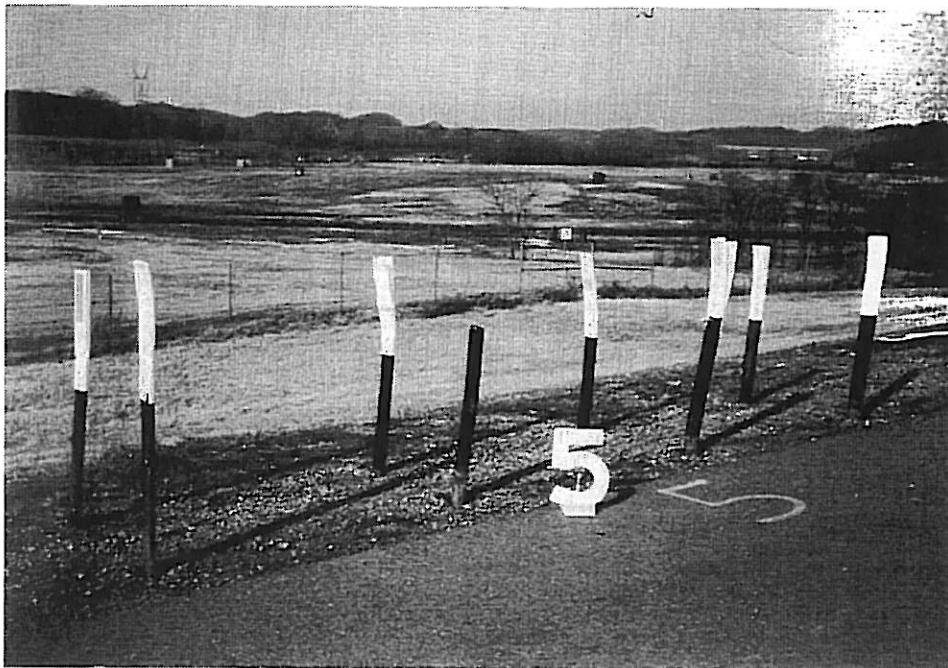


THREE WINTER IMPACTS COMPLETED

KENNCO HDPE EXTRUSION

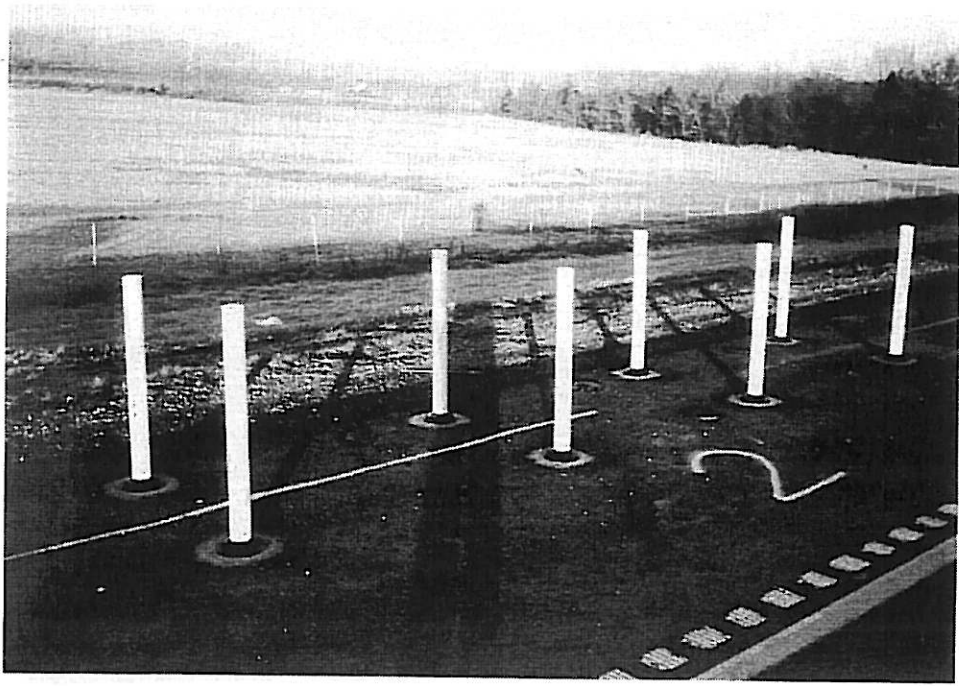


FOUR WINTER IMPACTS COMPLETED



FIVE WINTER IMPACTS COMPLETED

LINE CONNECTION DURA-POST

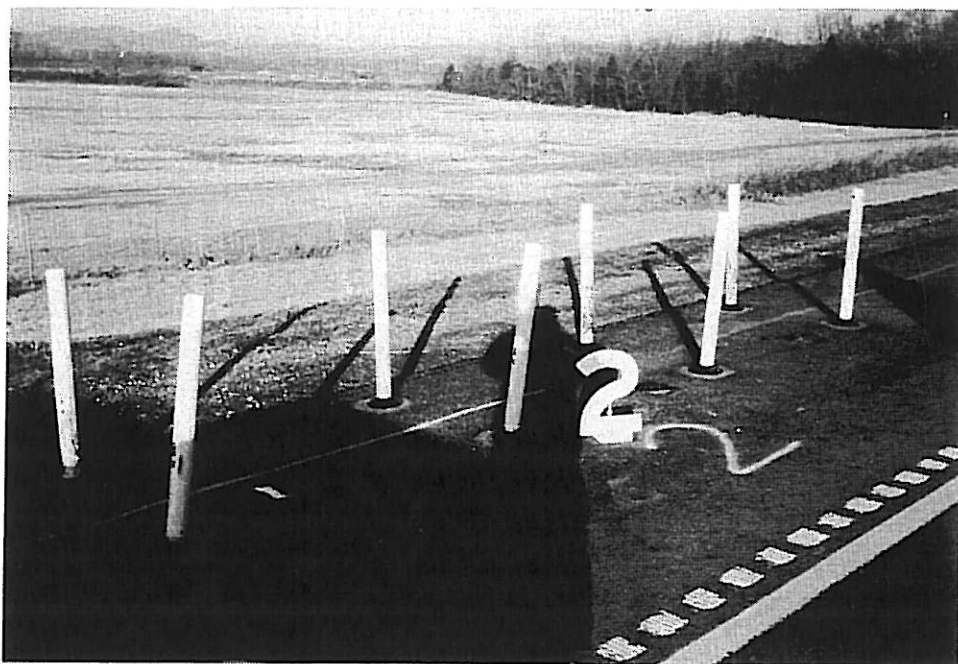


INSTALLED NO IMPACTS

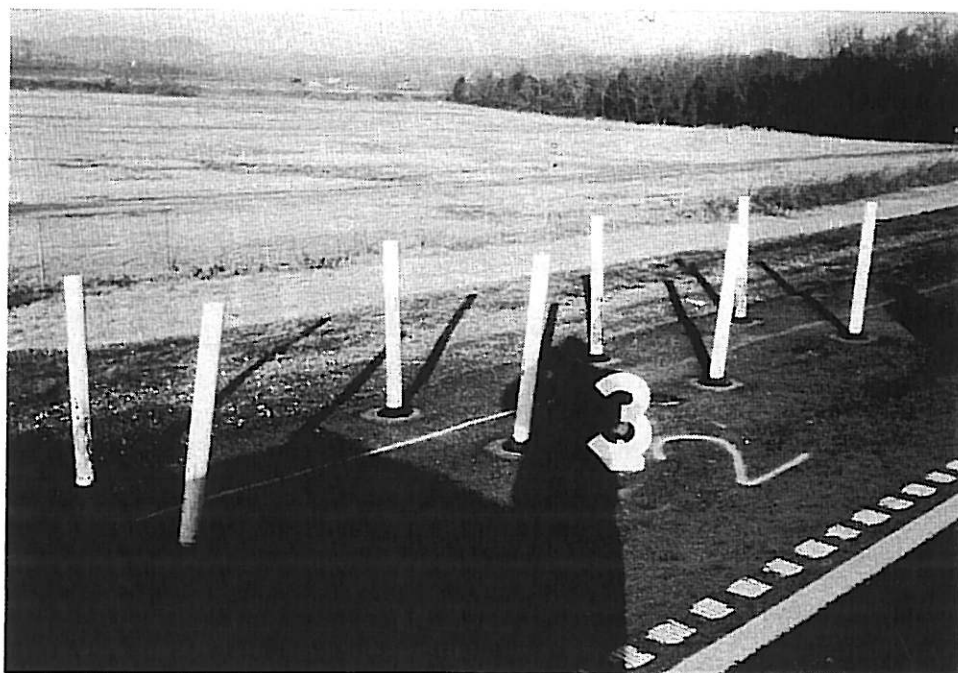


ONE WINTER IMPACT COMPLETED

LINE CONNECTION DURA-POST



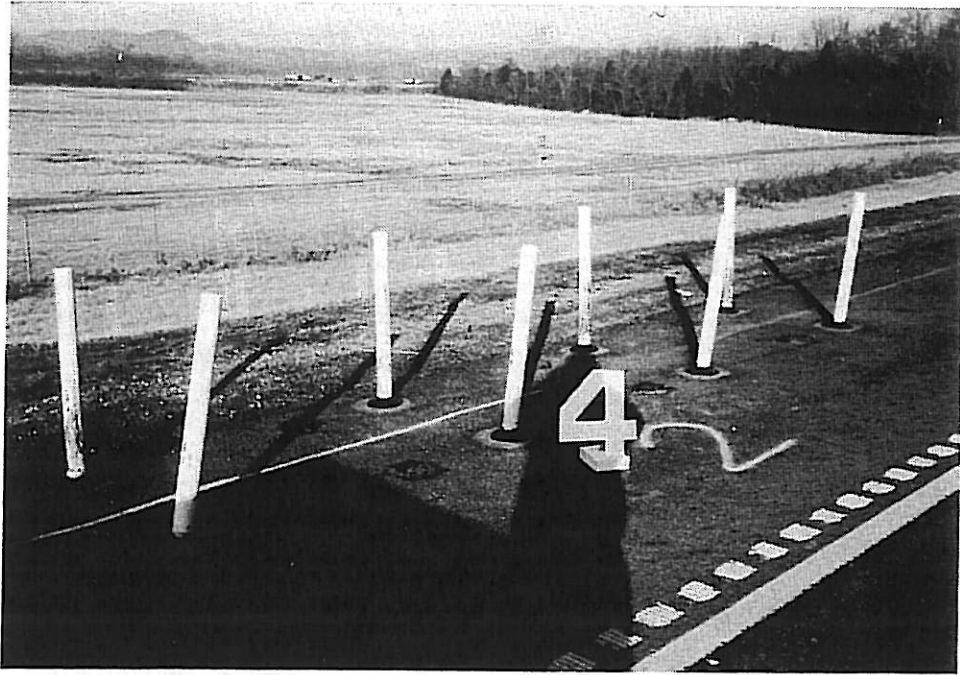
TWO WINTER IMPACTS COMPLETED



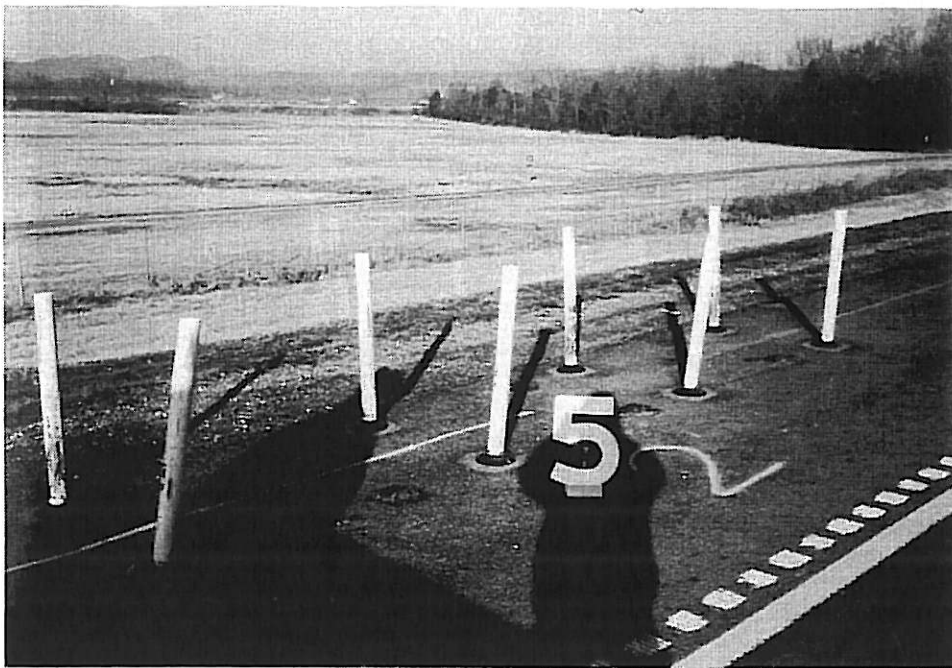
THREE WINTER IMPACTS COMPLETED



LINE CONNECTION DURA-POST

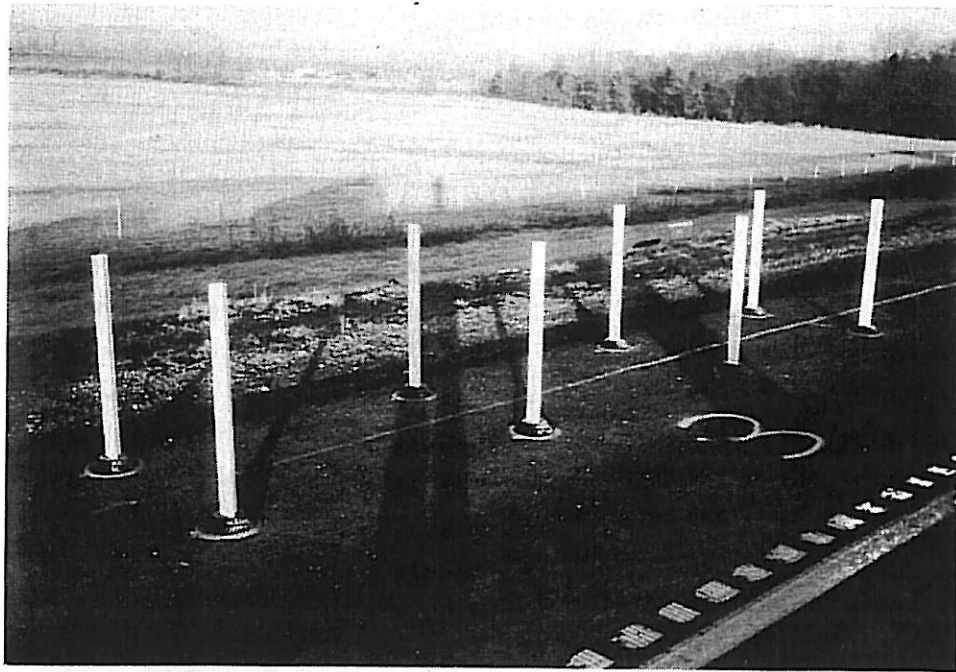


FOUR WINTER IMPACTS COMPLETED

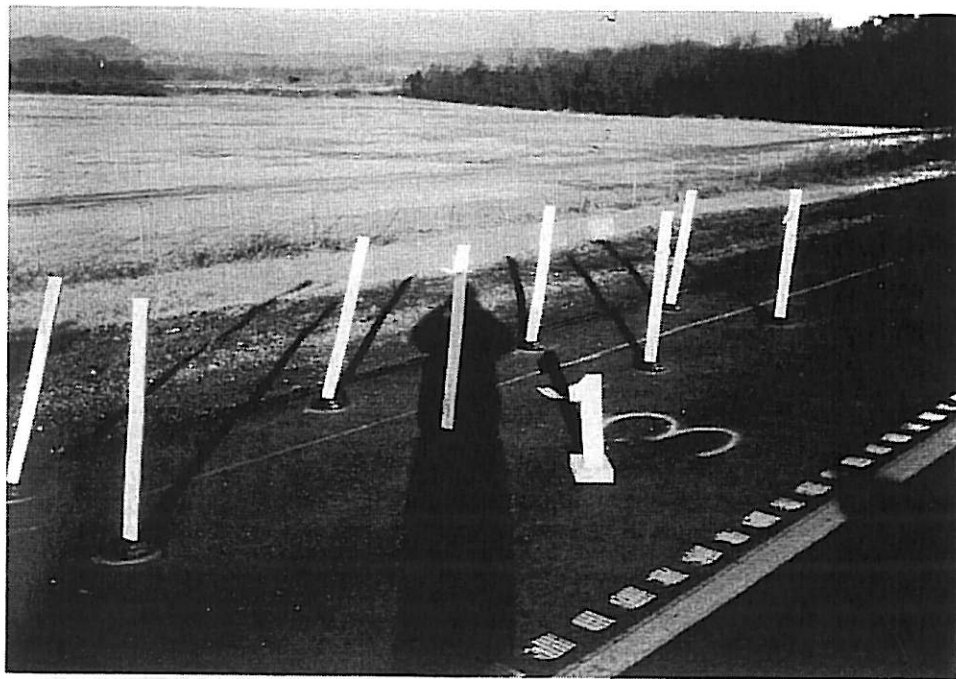


FIVE WINTER IMPACTS COMPLETED

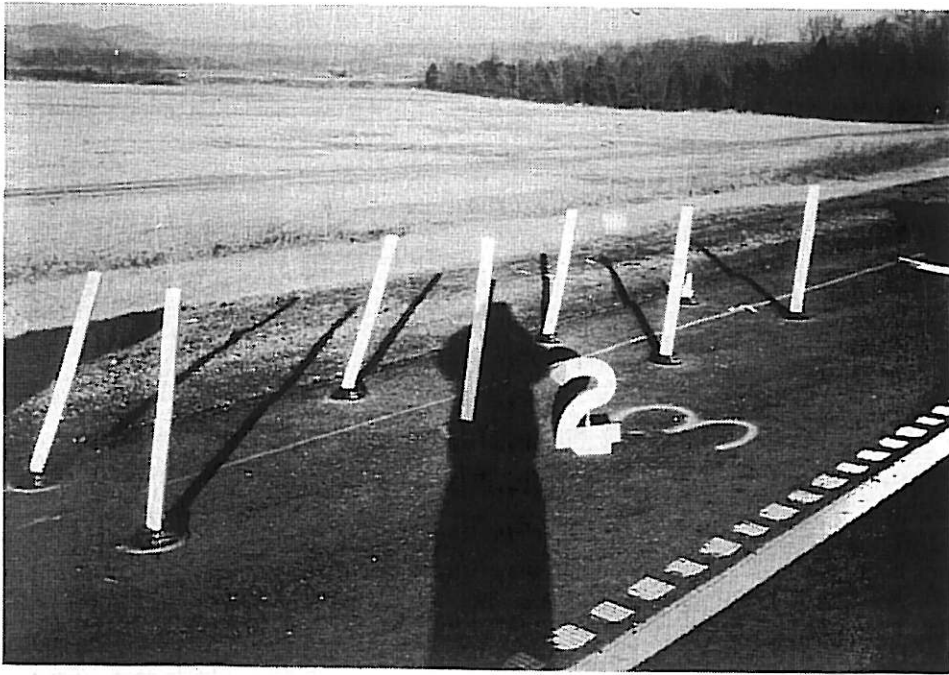
DAVIDSON PLASTICS FG-300



INSTALLED NO IMPACTS



ONE WINTER IMPACT COMPLETED



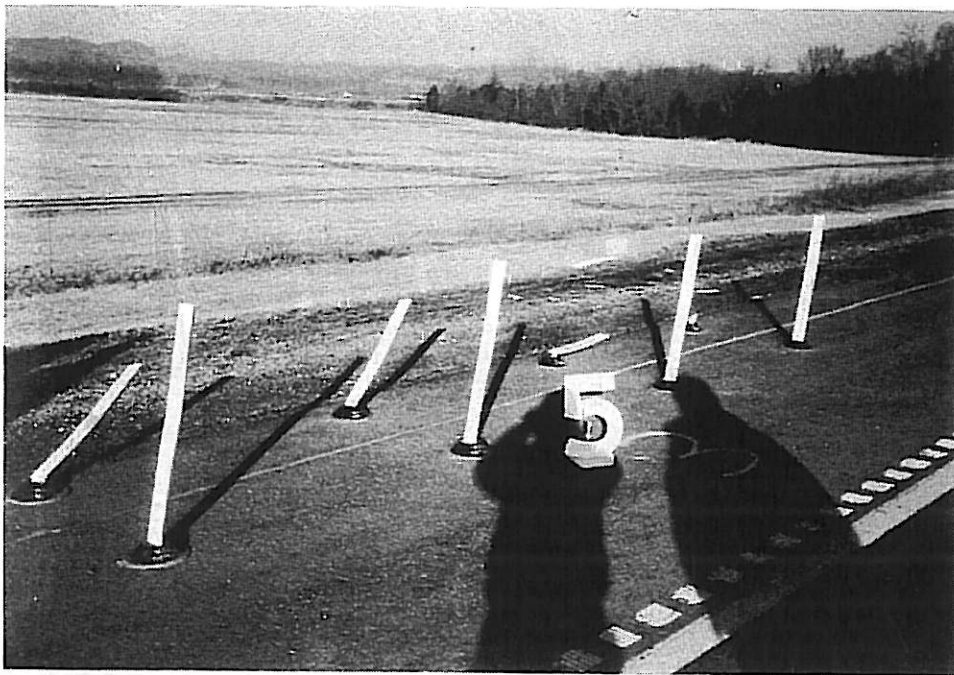
TWO WINTER IMPACTS COMPLETED



THREE WINTER IMPACTS COMPLETED

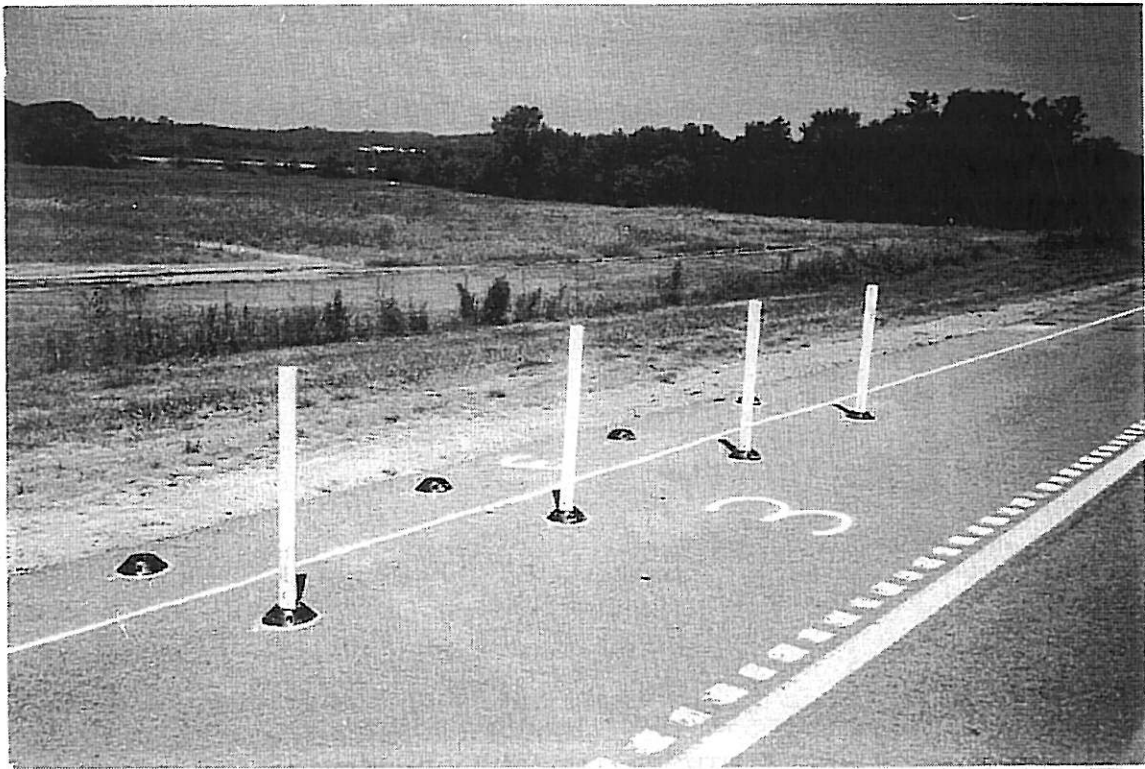


FOUR WINTER IMPACTS COMPLETED

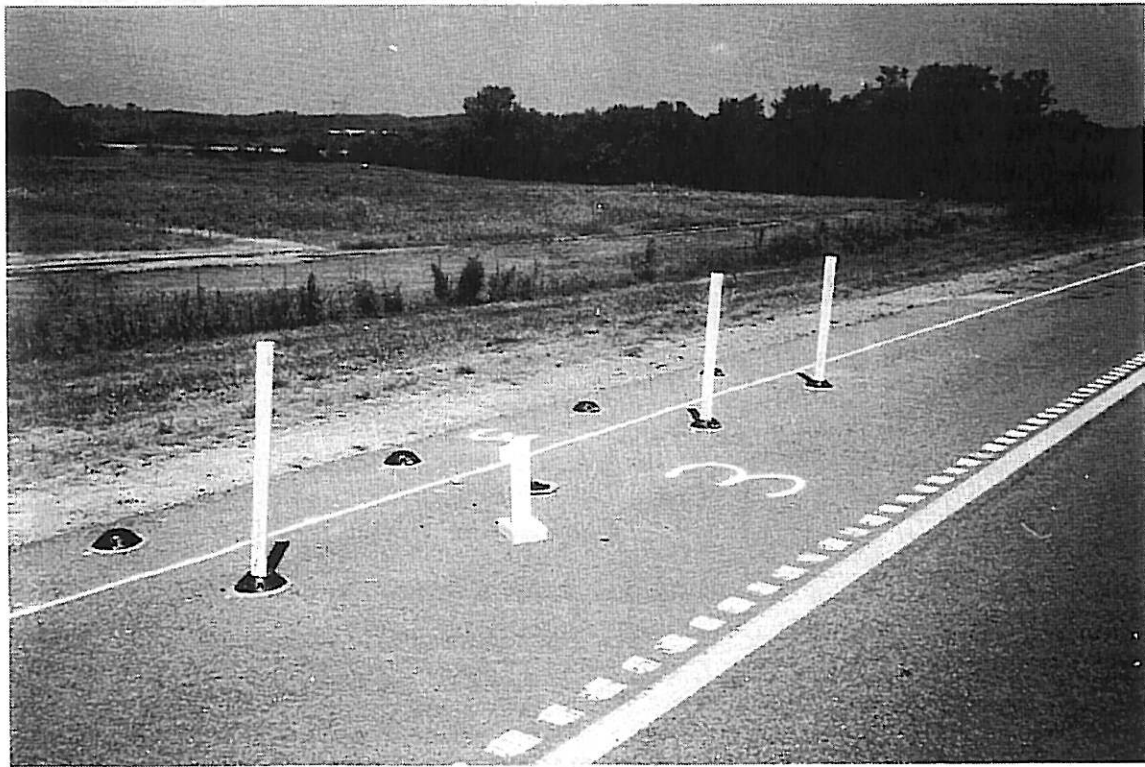


FIVE WINTER IMPACTS COMPLETED

DAVIDSON PLASTICS FG-300



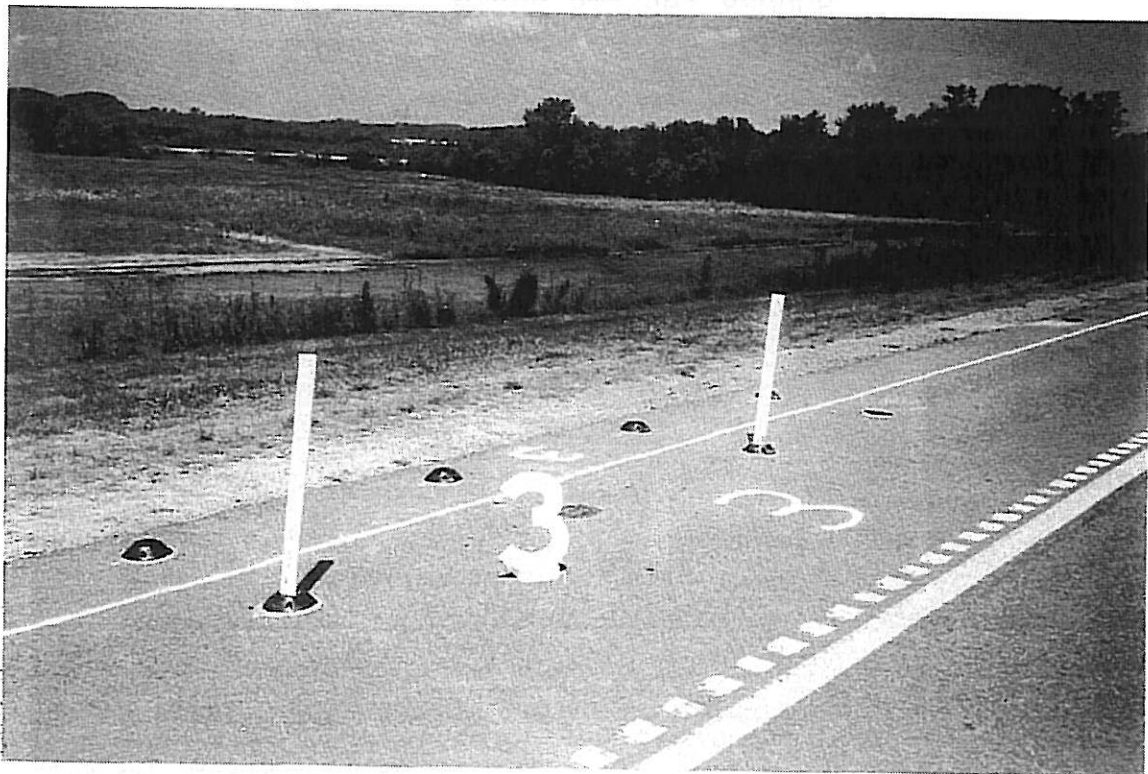
FIVE WINTER IMPACTS COMPLETED  
SUMMER IMPACTS BEGIN



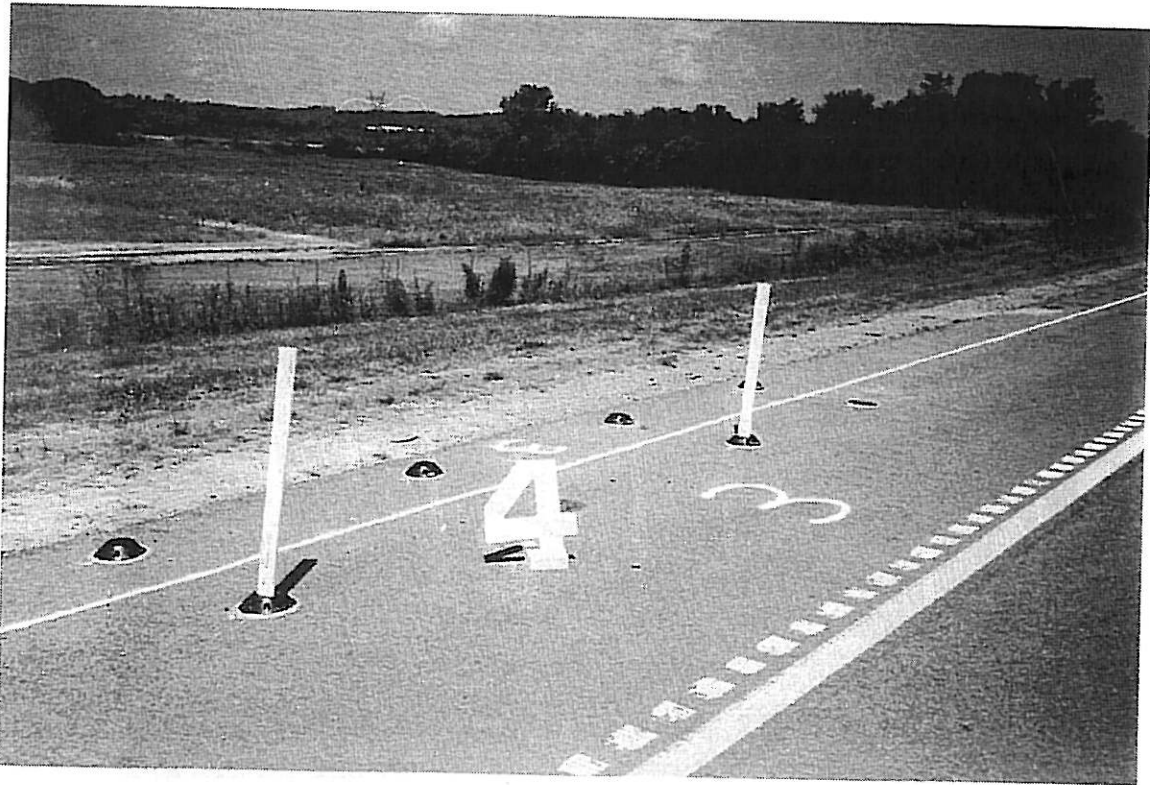
FIVE WINTER IMPACTS COMPLETED  
ONE SUMMER IMPACT COMPLETED



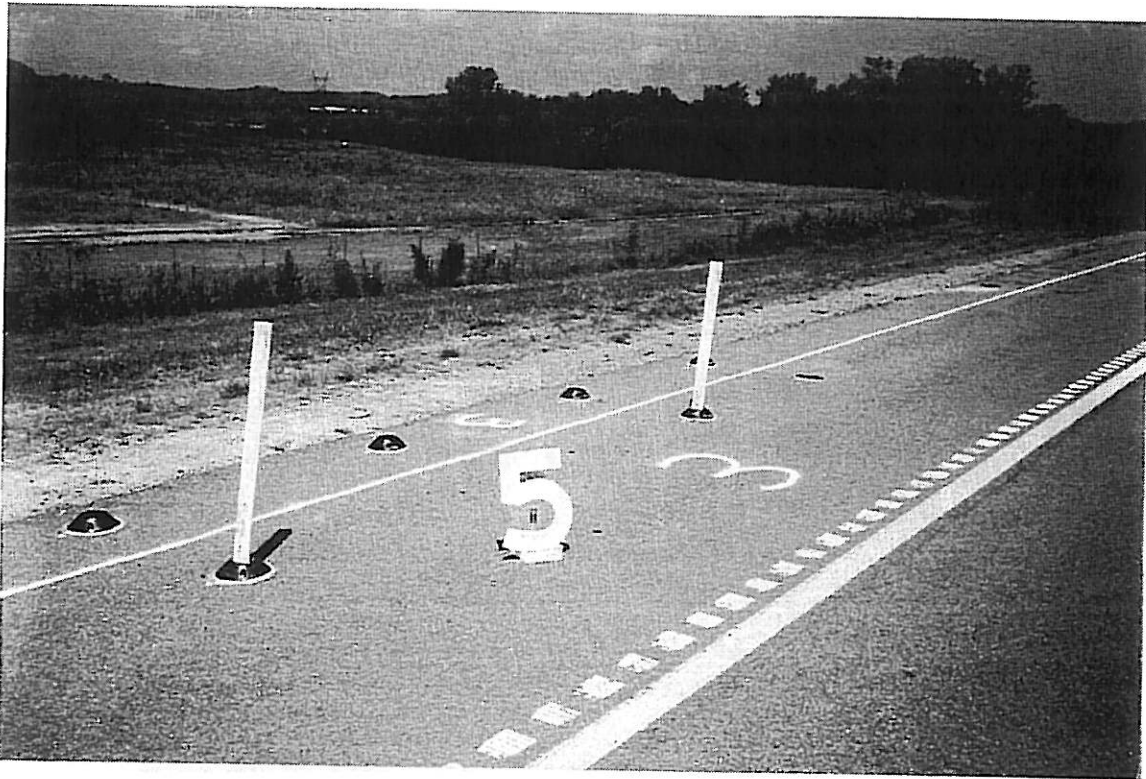
FIVE WINTER IMPACTS COMPLETED  
TWO SUMMER IMPACTS COMPLETED



FIVE WINTER IMPACTS COMPLETED  
THREE SUMMER IMPACTS COMPLETED

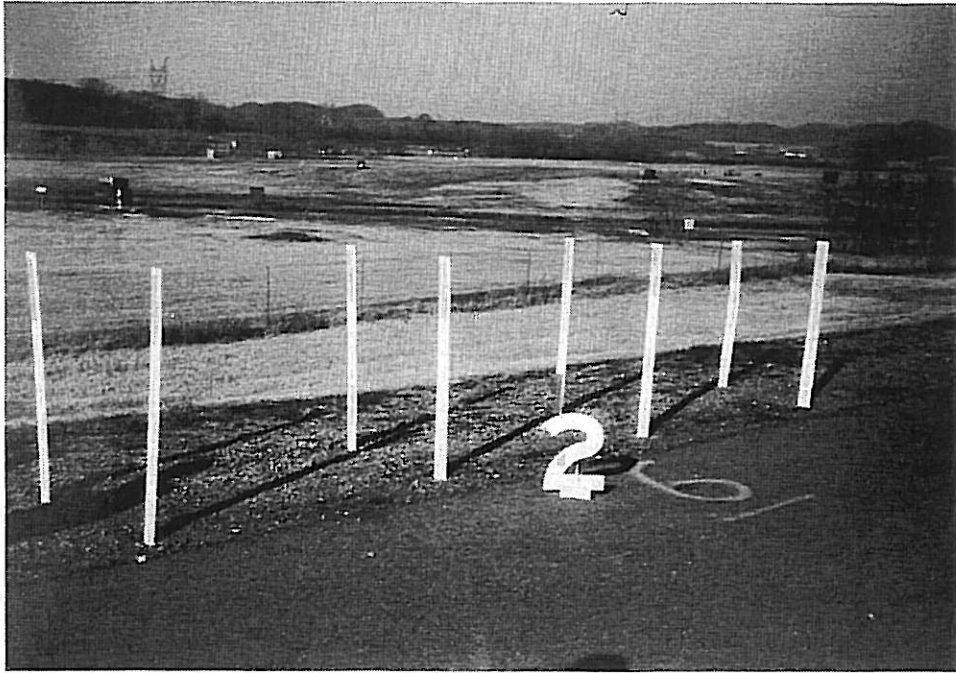


FIVE WINTER IMPACTS COMPLETED  
FOUR SUMMER IMPACTS COMPLETED

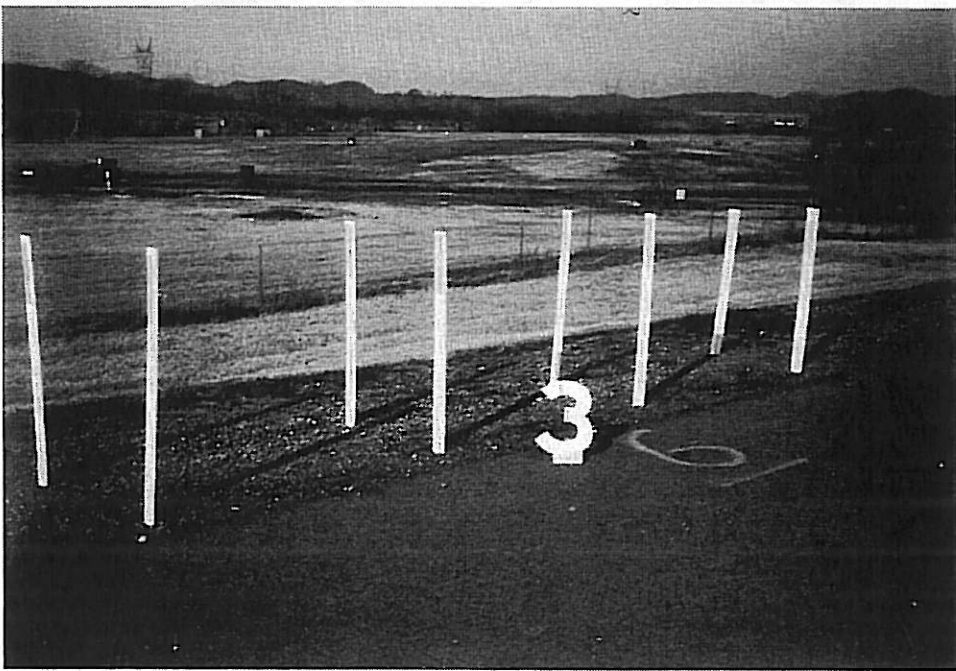


FIVE WINTER IMPACTS COMPLETED  
FIVE SUMMER IMPACTS COMPLETED

DAVIDSON PLASTICS FG-400 (FG-95)



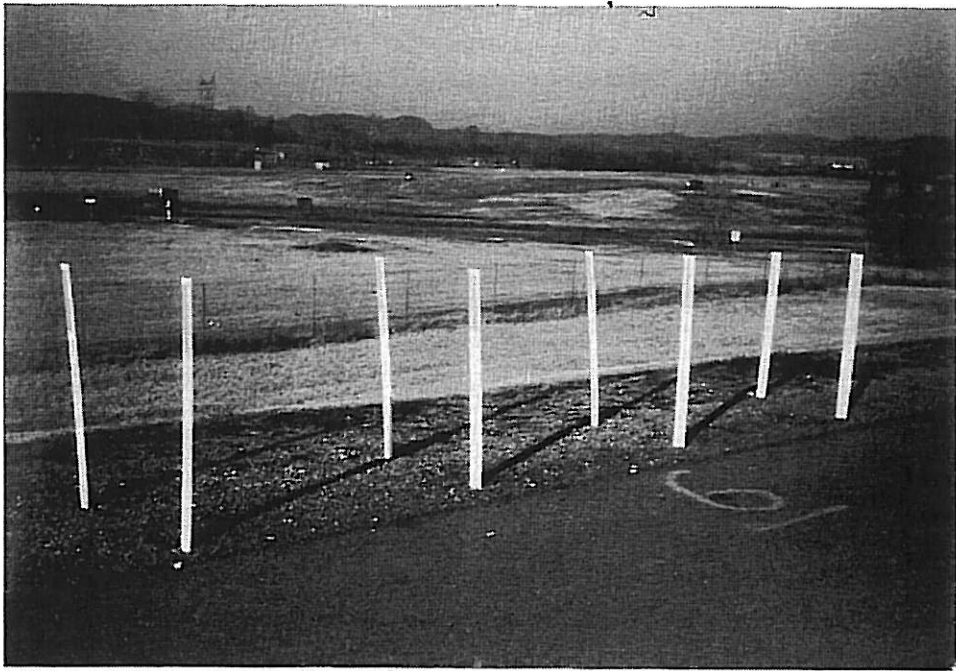
TWO WINTER IMPACTS COMPLETED



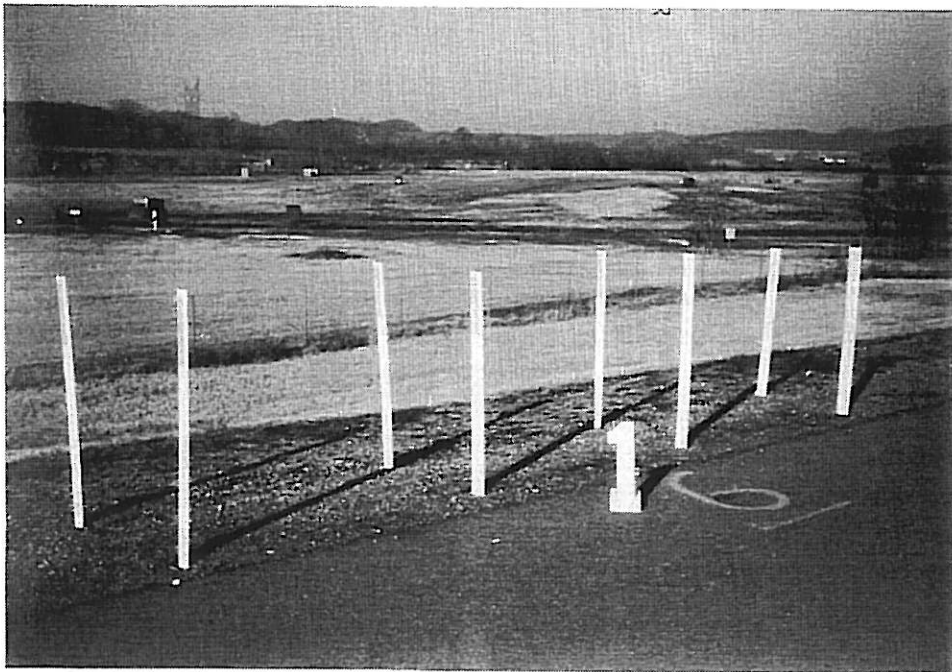
THREE WINTER IMPACTS COMPLETED



DAVIDSON PLASTICS FG-400 (FG-95)

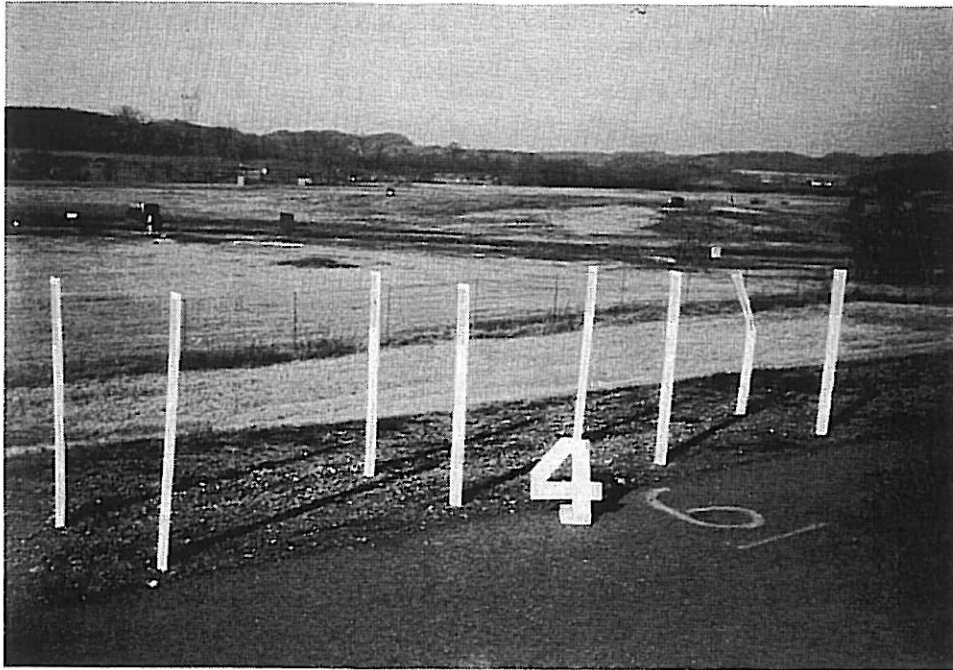


INSTALLED NO IMPACTS

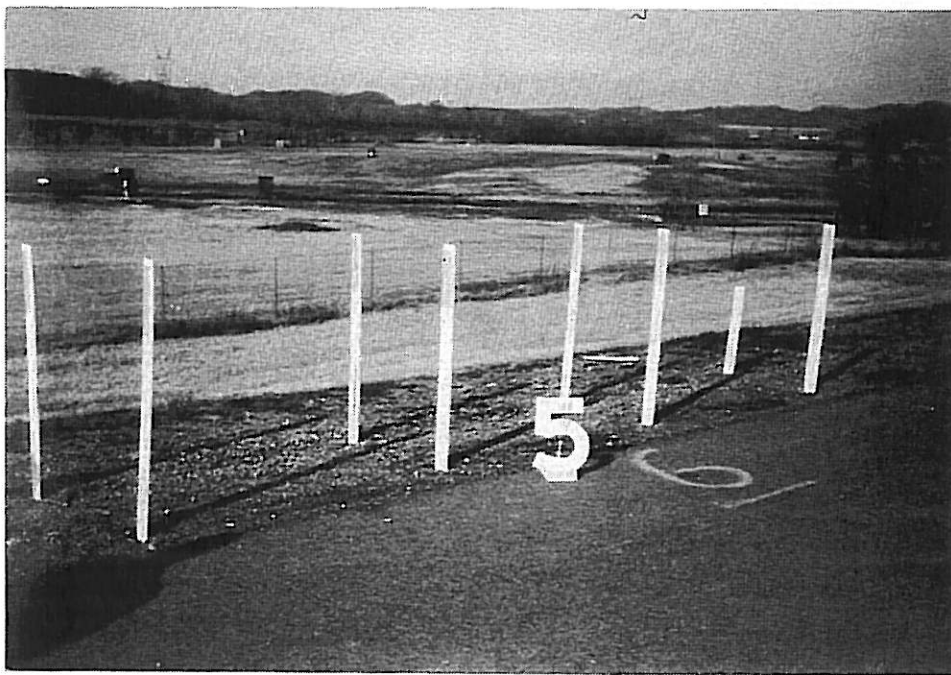


ONE WINTER IMPACT COMPLETED

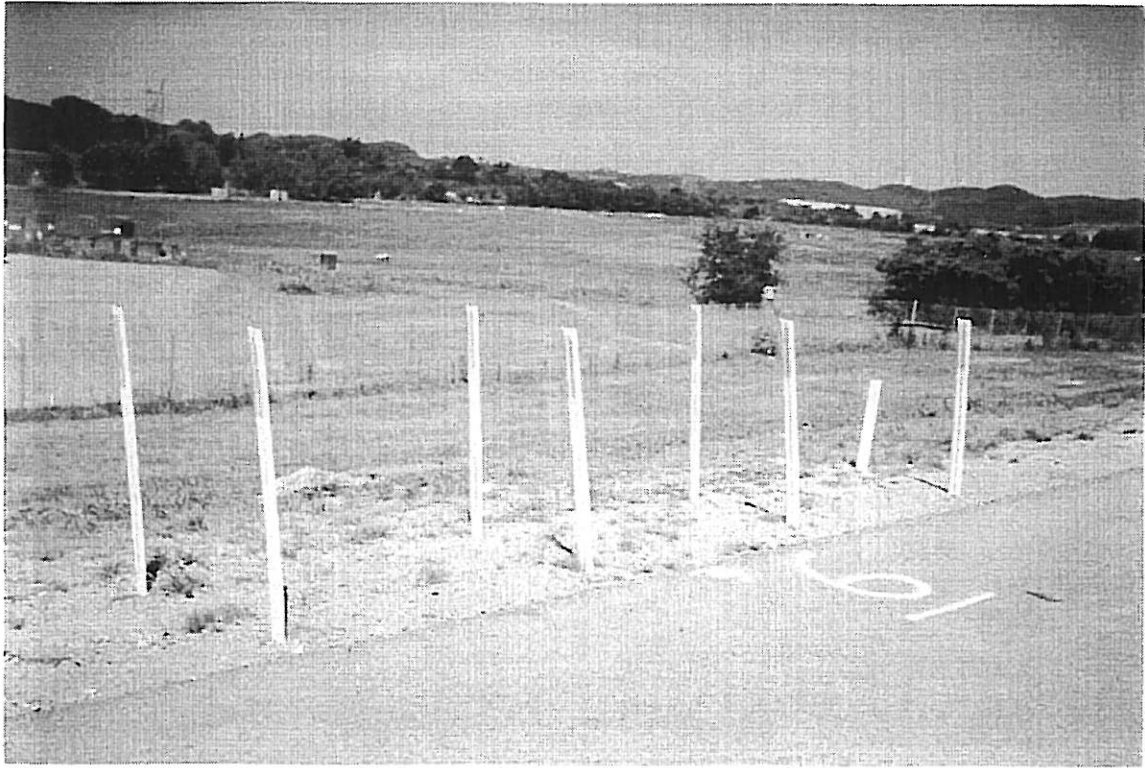
DAVIDSON PLASTICS FG-400 (FG-95)



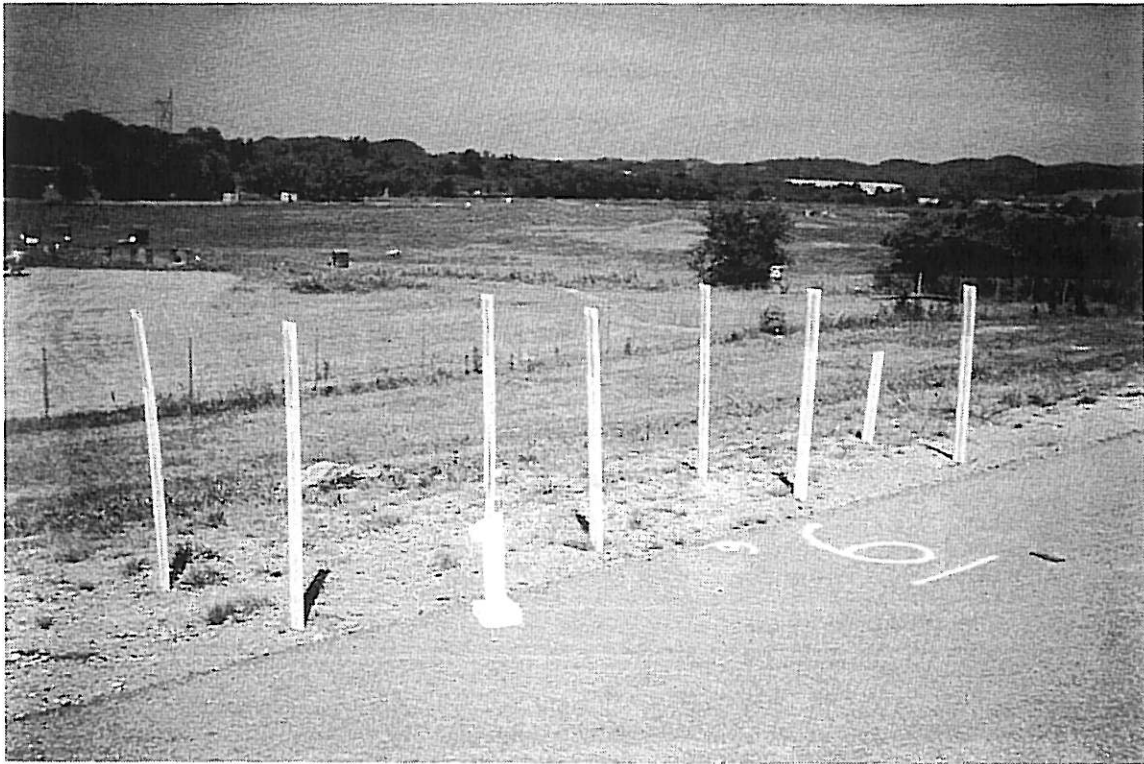
FOUR WINTER IMPACTS COMPLETED



FIVE WINTER IMPACTS COMPLETED



FIVE WINTER IMPACTS COMPLETED  
SUMMER IMPACTS BEGIN

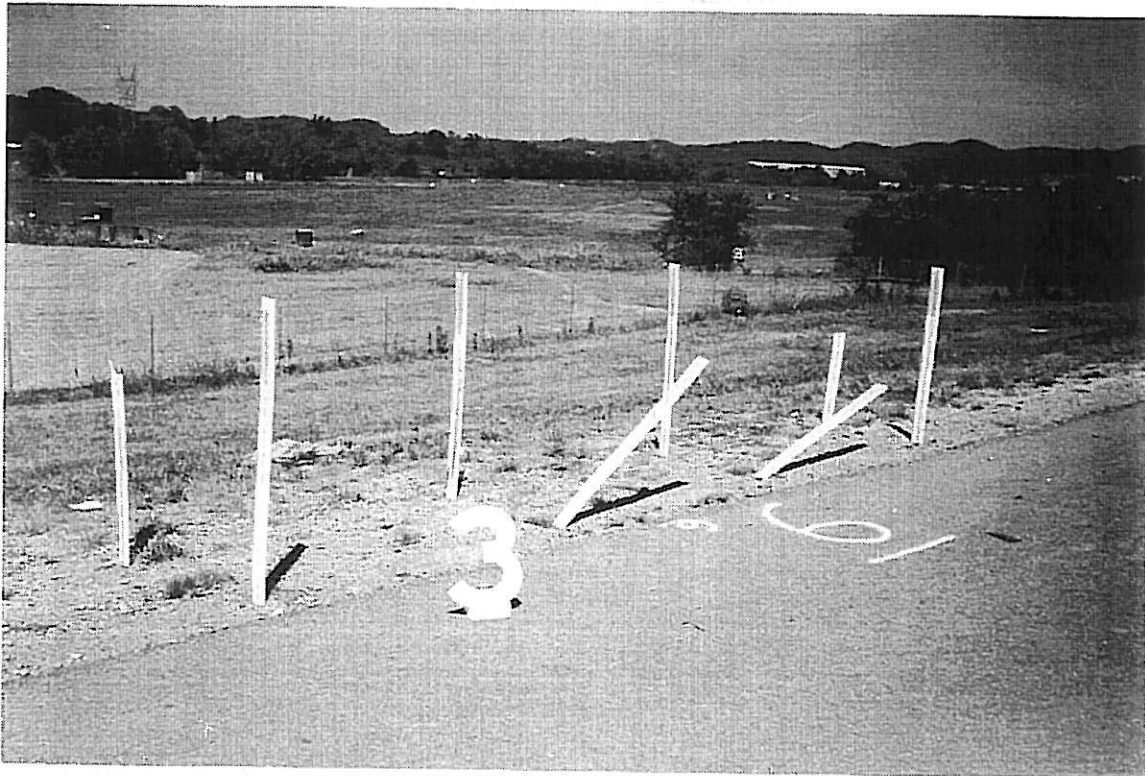


FIVE WINTER IMPACTS COMPLETED  
ONE SUMMER IMPACT COMPLETED

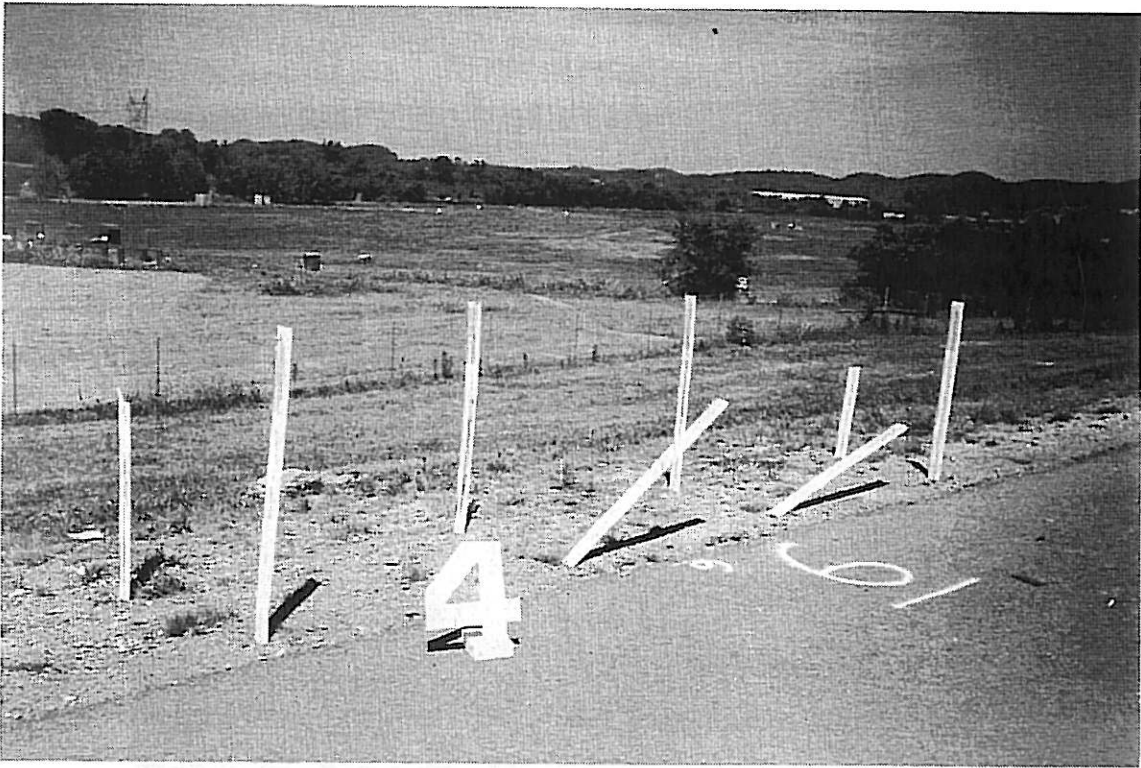
DAVIDSON PLASTICS FG-400 (FG-95)



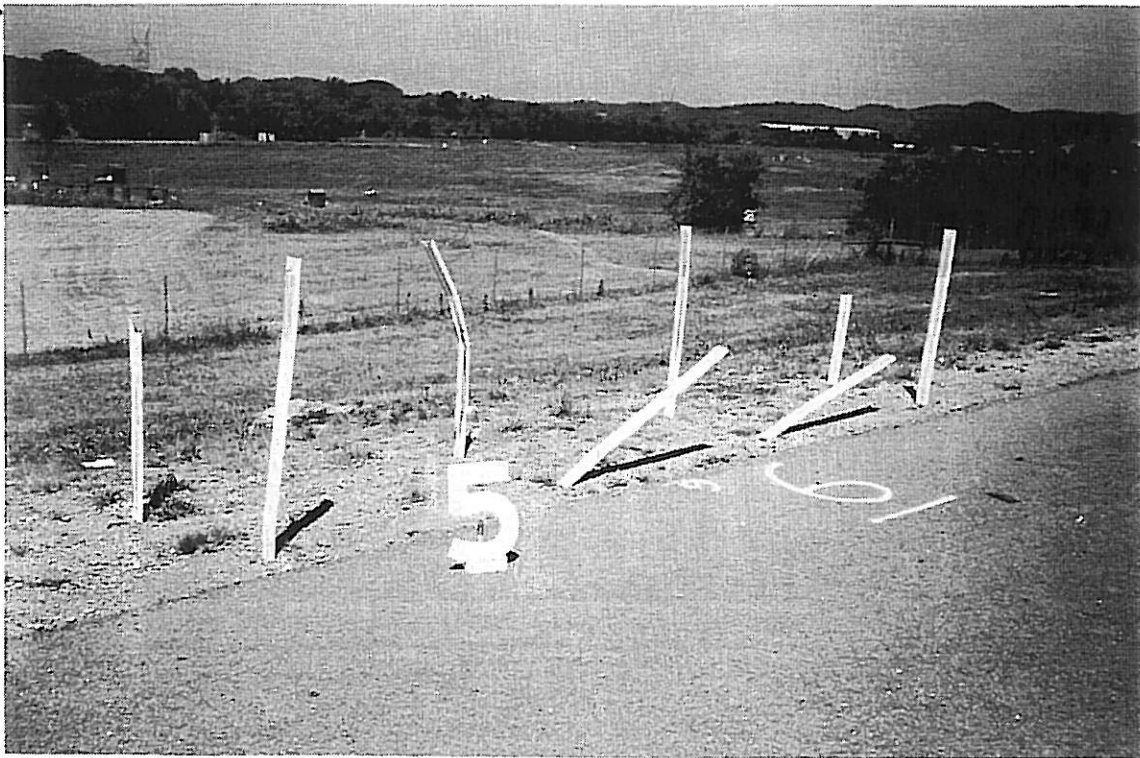
FIVE WINTER IMPACTS COMPLETED  
TWO SUMMER IMPACTS COMPLETED



FIVE WINTER IMPACTS COMPLETED  
THREE SUMMER IMPACTS COMPLETED

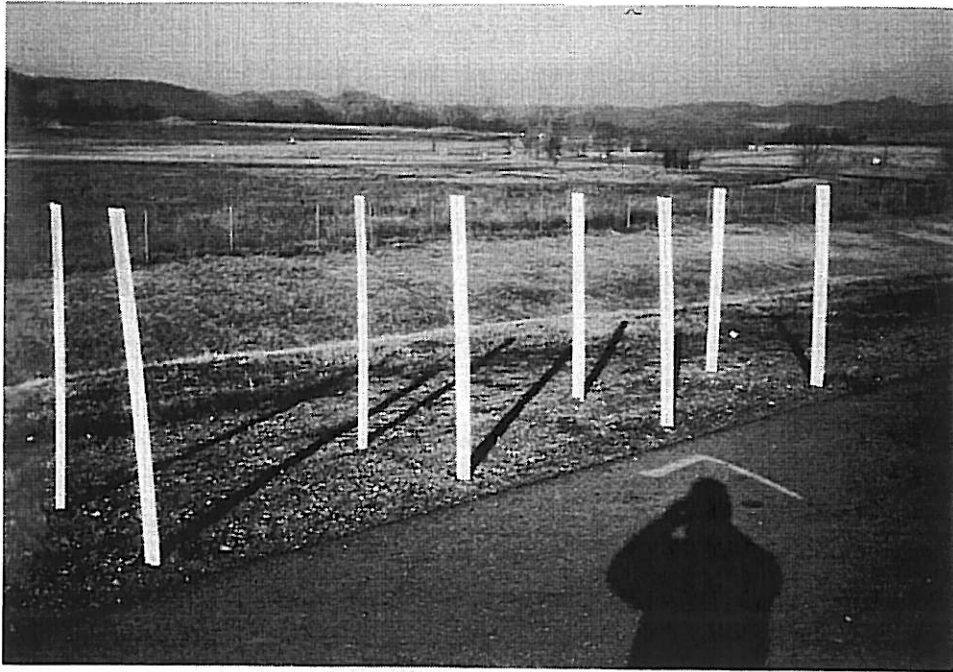


FIVE WINTER IMPACTS COMPLETED  
FOUR SUMMER IMPACTS COMPLETED

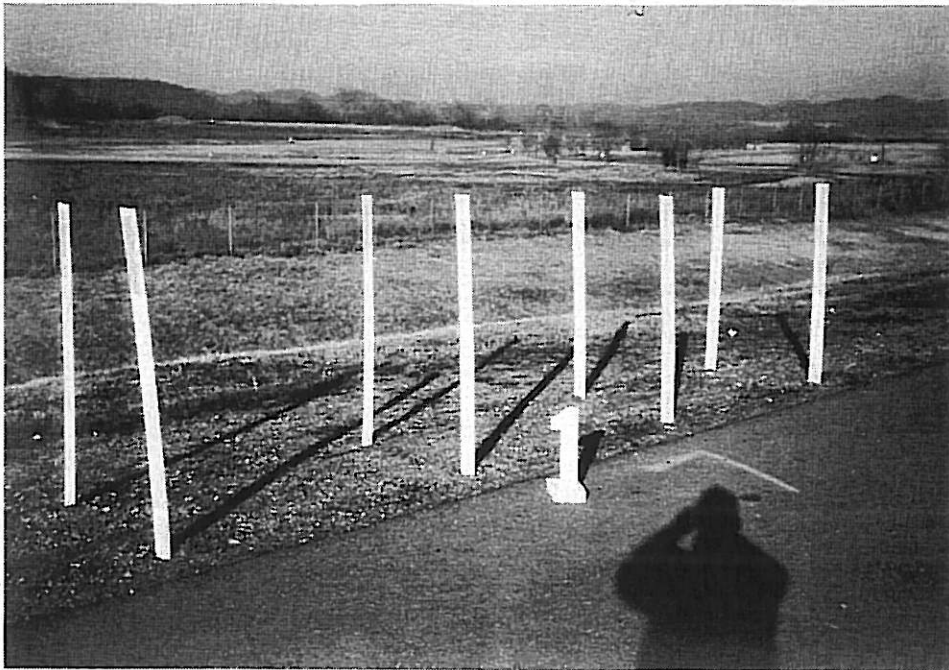


FIVE WINTER IMPACTS COMPLETED  
FIVE SUMMER IMPACTS COMPLETED

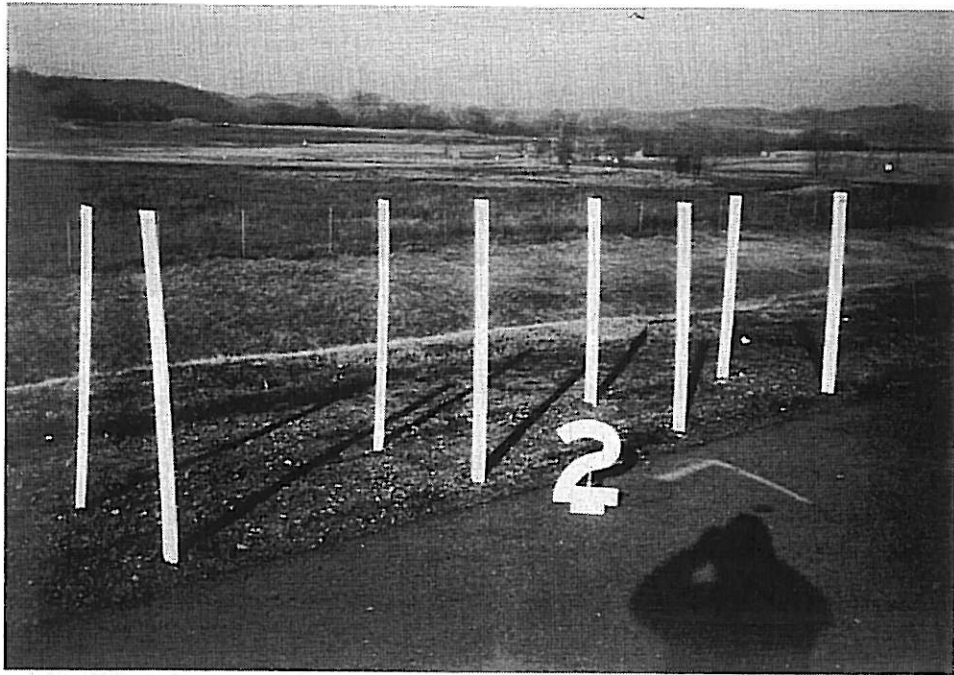
DAVIDSON PLASTICS FG-400 (FG-96)



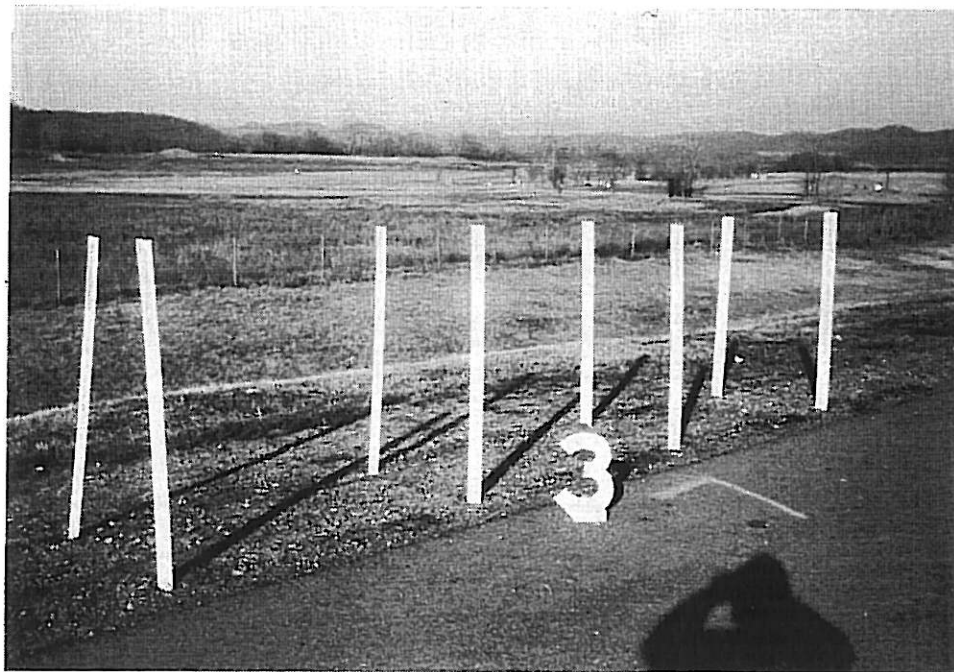
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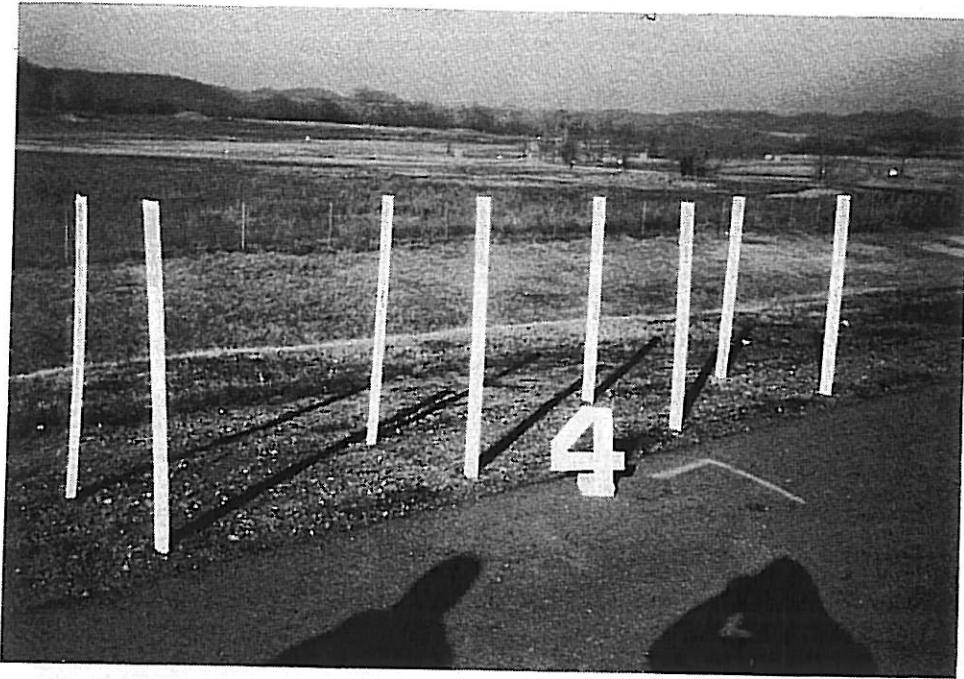
ONE WINTER IMPACT COMPLETED



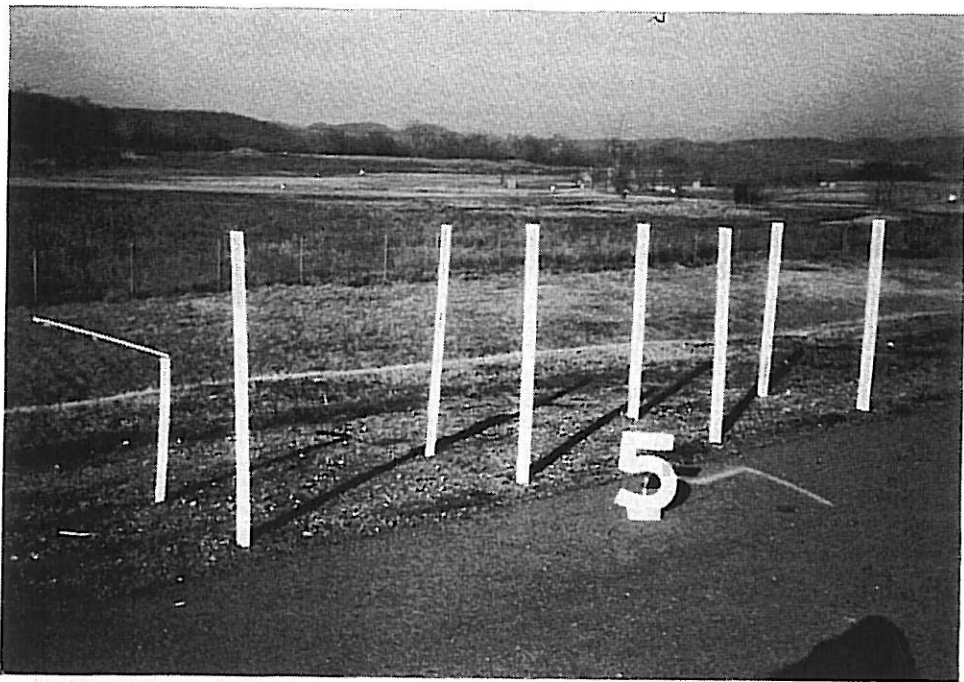
TWO WINTER IMPACTS COMPLETED



THREE WINTER IMPACTS COMPLETED

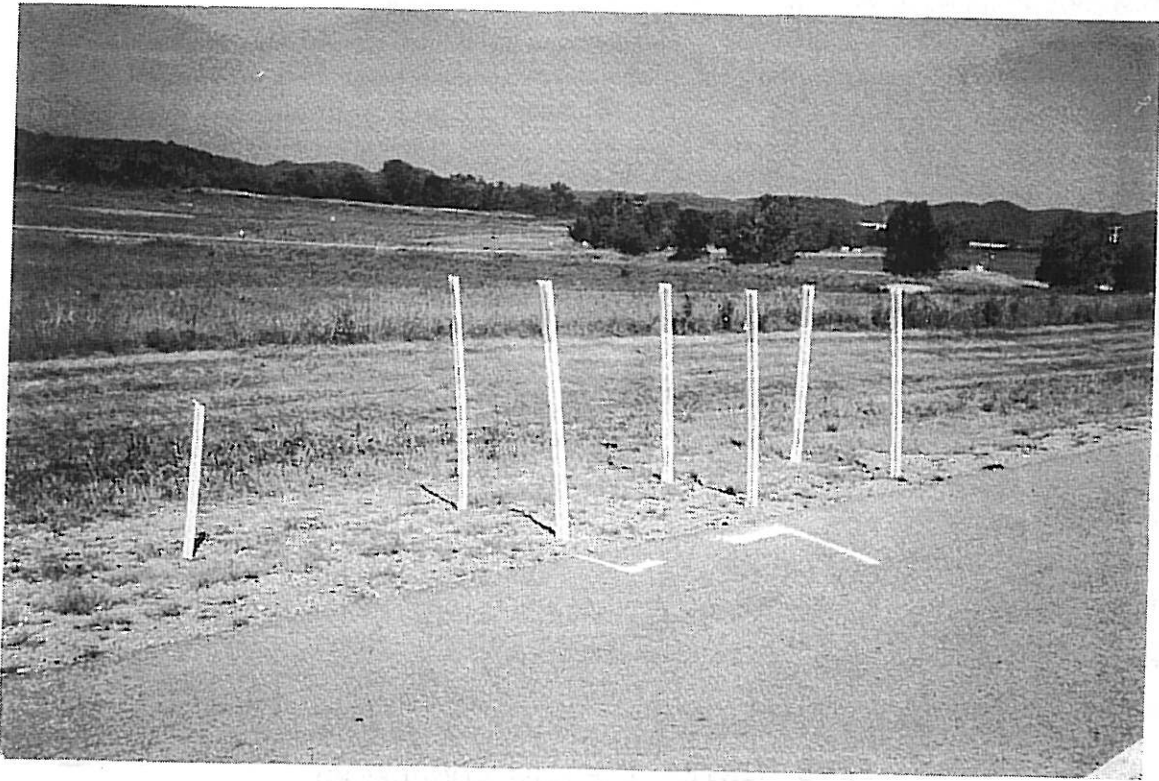


FOUR WINTER IMPACTS COMPLETED

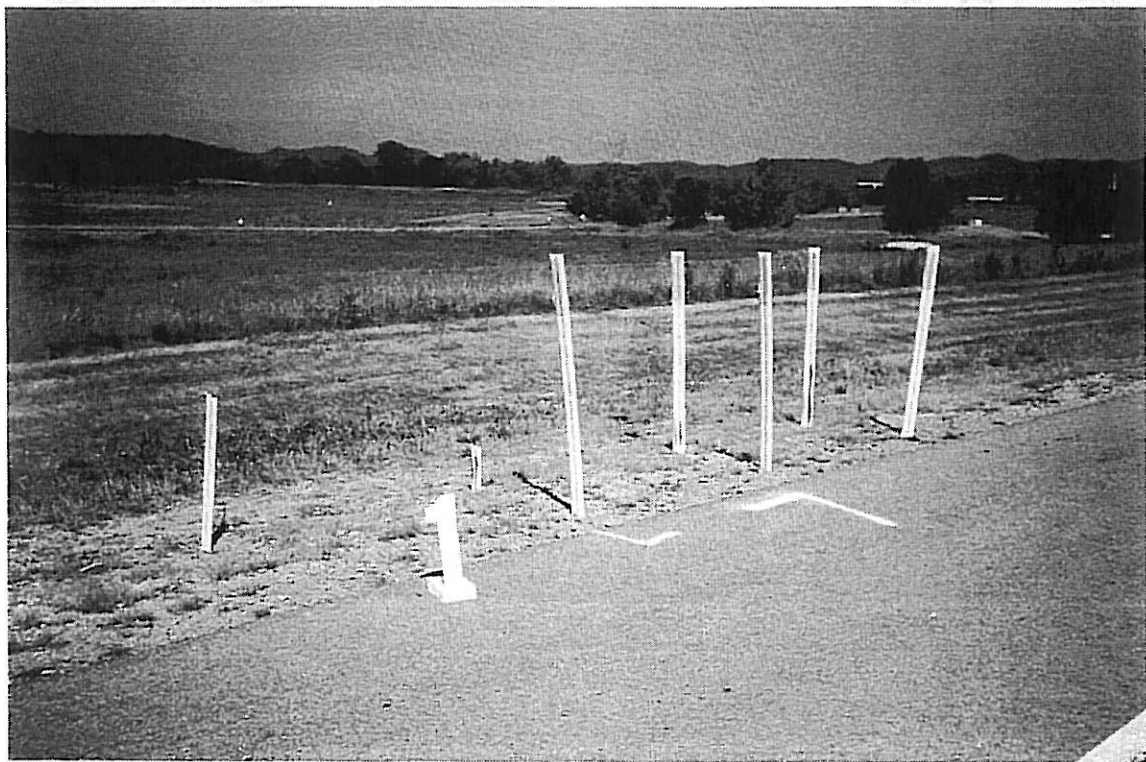


FIVE WINTER IMPACTS COMPLETED

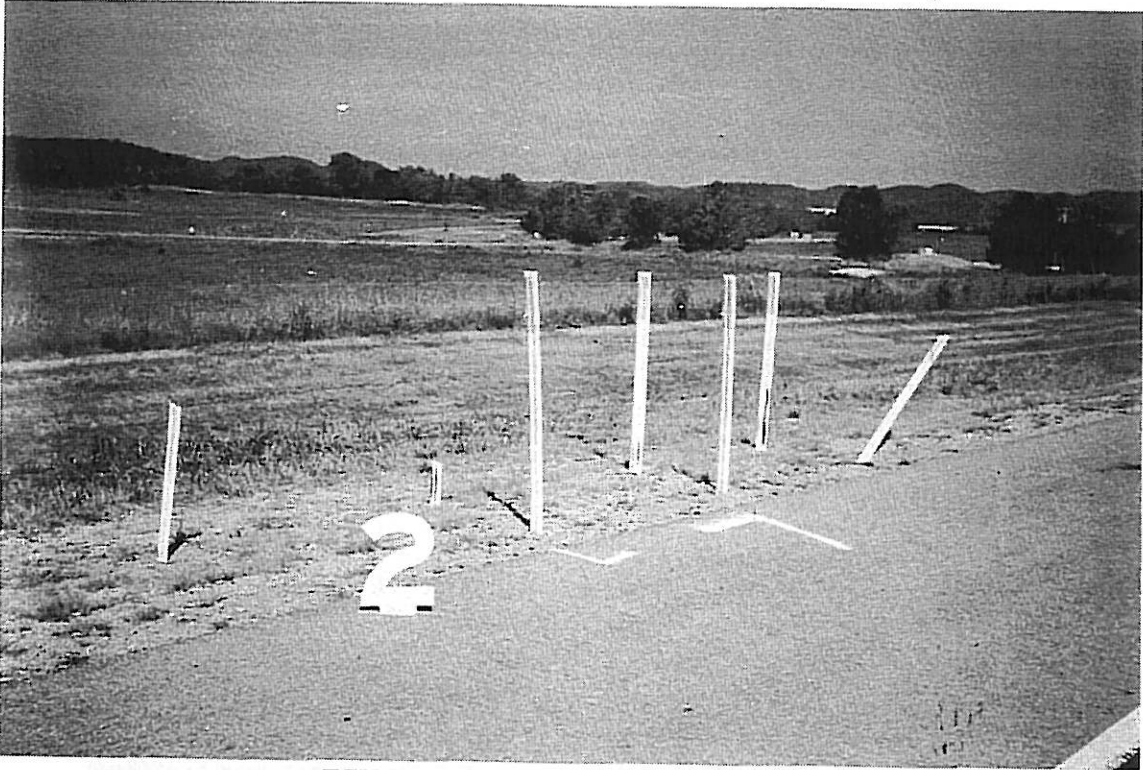




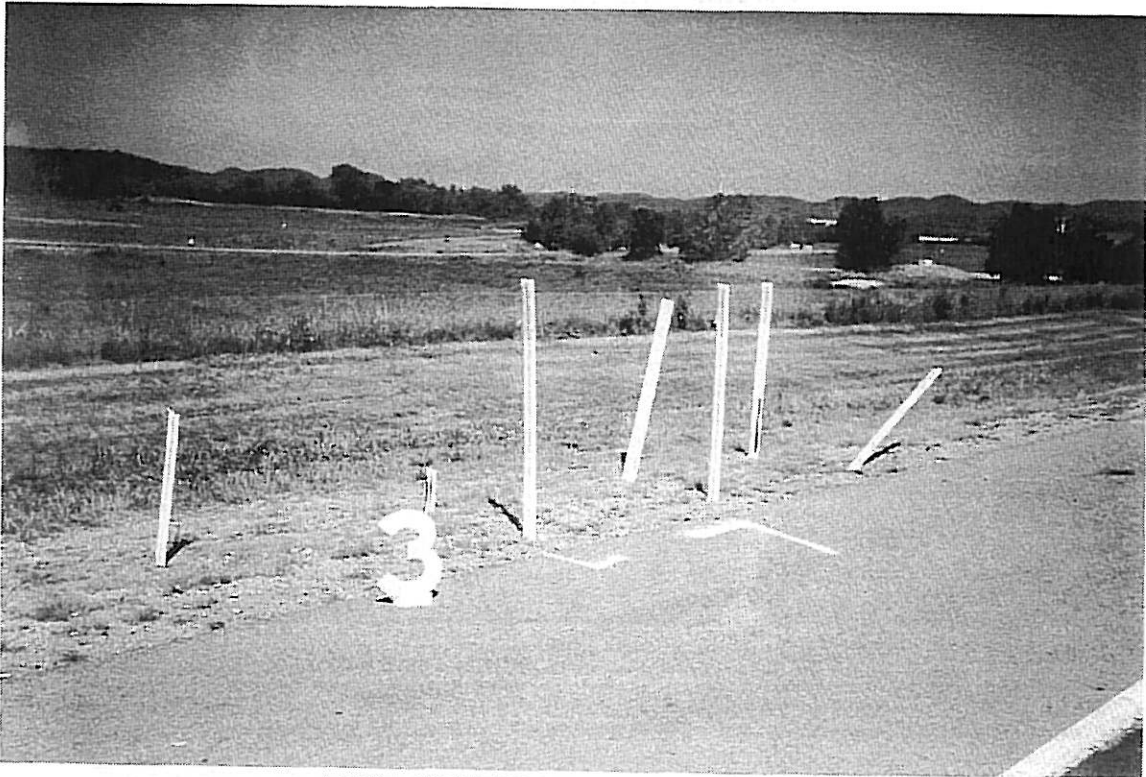
FIVE WINTER IMPACTS COMPLETED  
SUMMER IMPACTS BEGIN



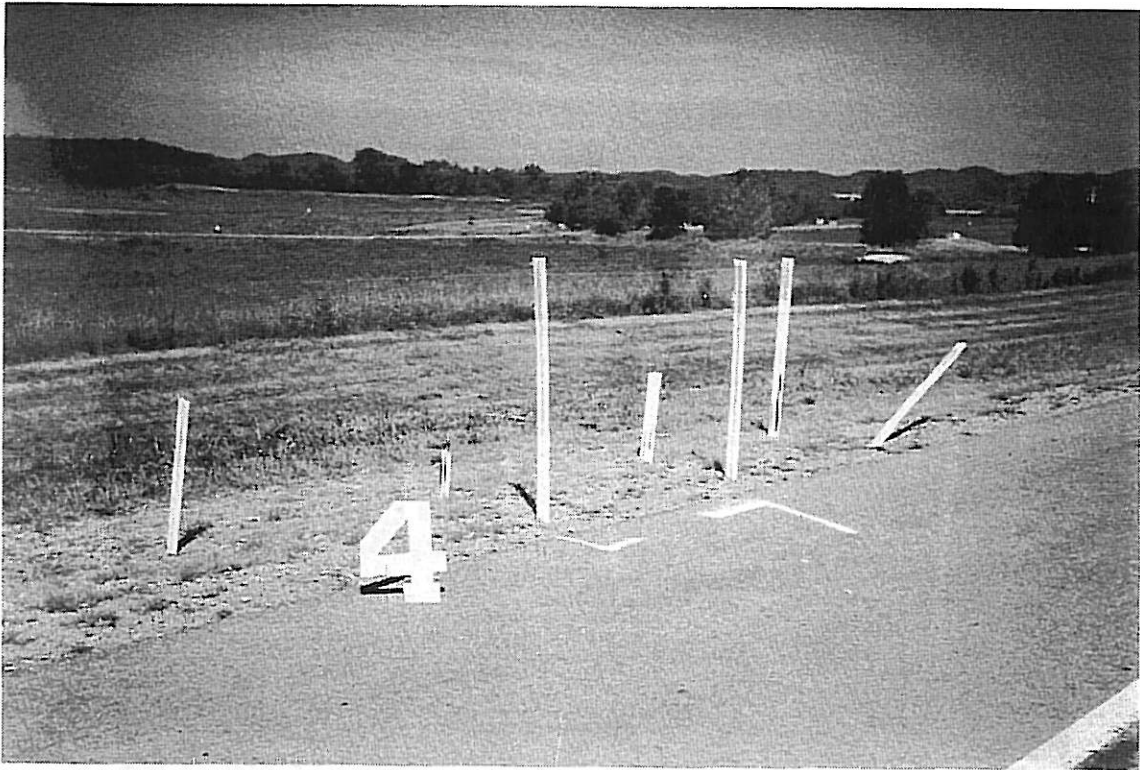
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ONE SUMMER IMPACT COMPLETED



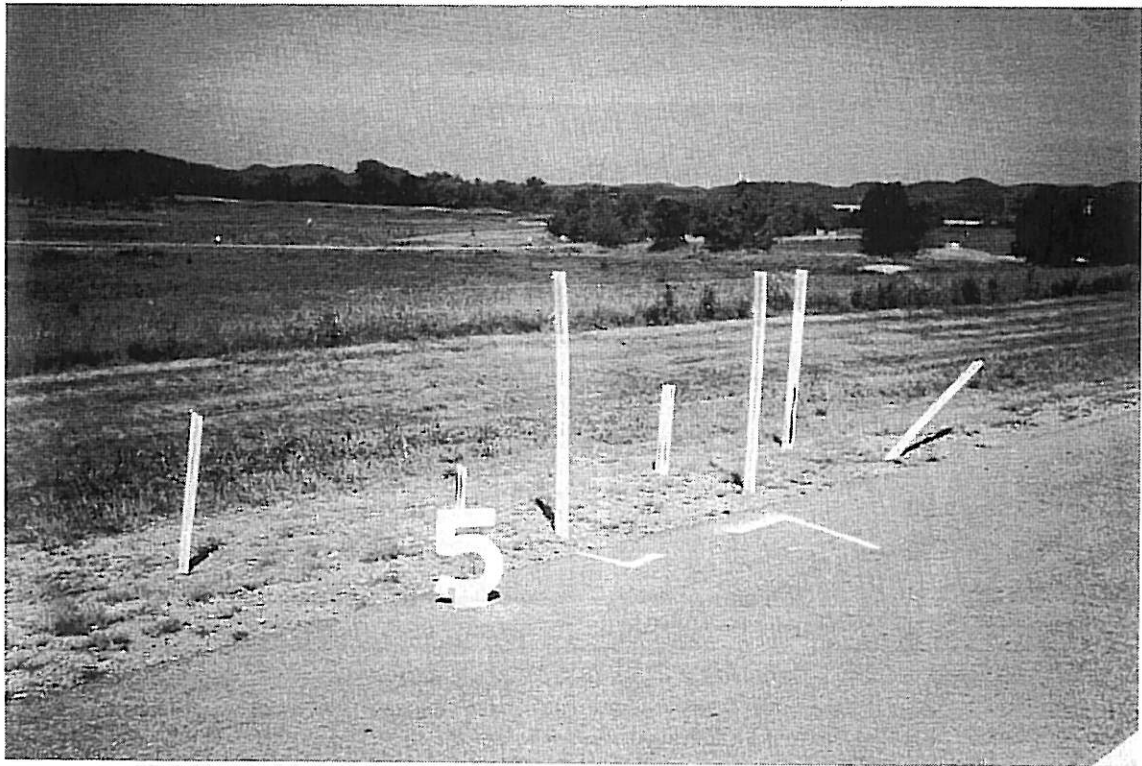
FIVE WINTER IMPACTS COMPLETED  
TWO SUMMER IMPACTS COMPLETED



FIVE WINTER IMPACTS COMPLETED  
THREE SUMMER IMPACTS COMPLETED

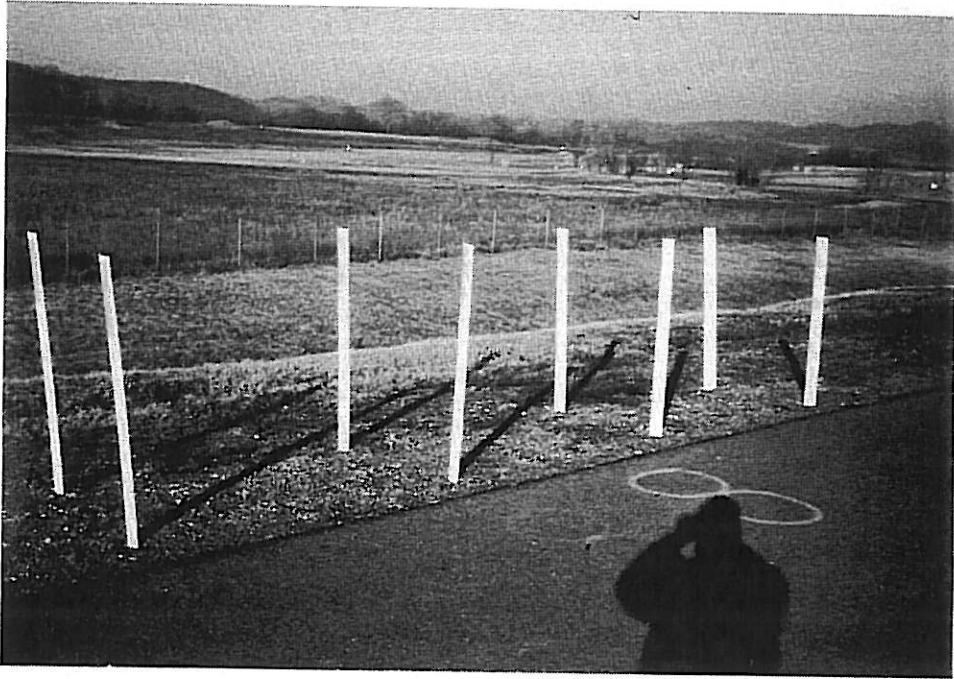


FIVE WINTER IMPACTS COMPLETED  
FOUR SUMMER IMPACTS COMPLETED

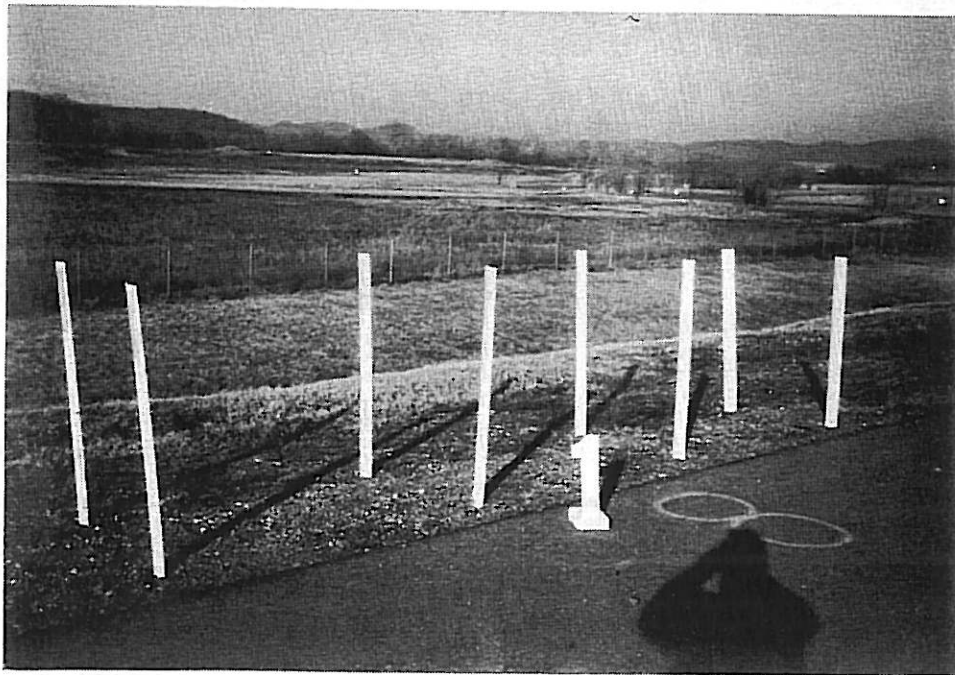


FIVE WINTER IMPACTS COMPLETED  
FIVE SUMMER IMPACTS COMPLETED

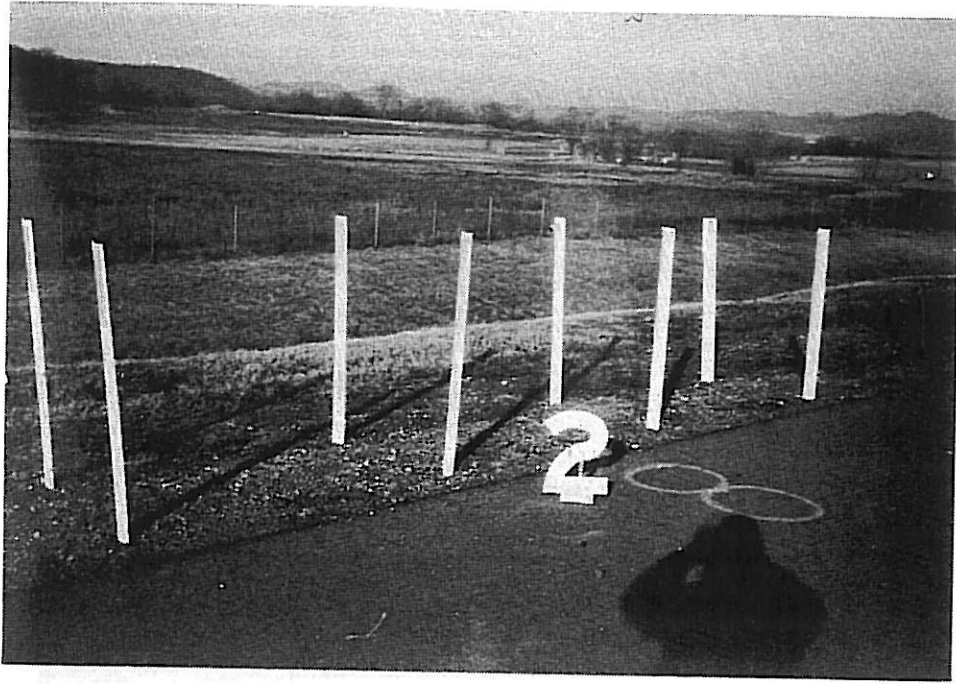
DAVIDSON PLASTICS FG-500 (FG-95)



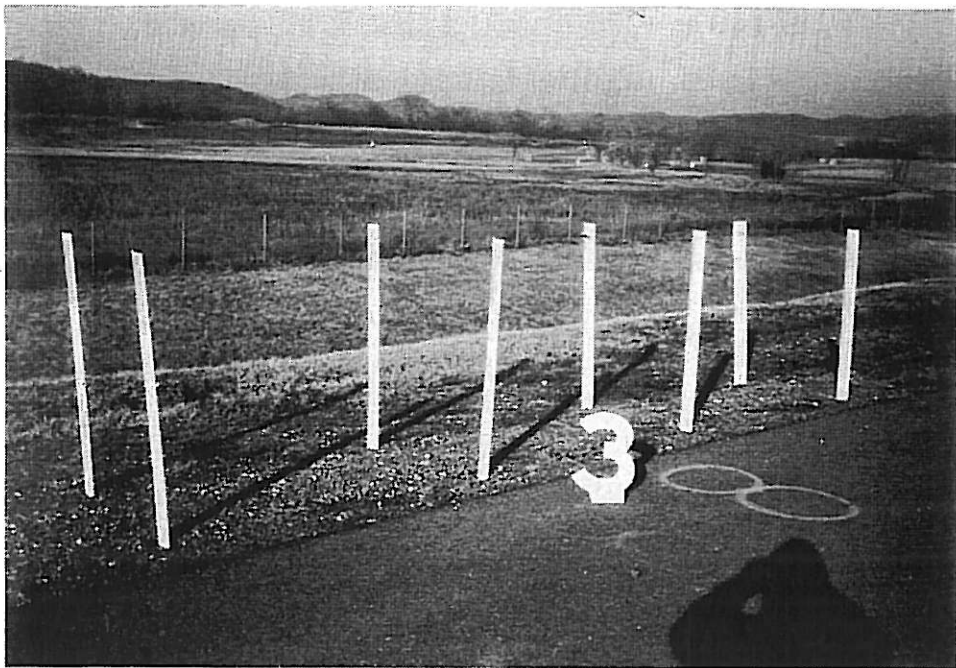
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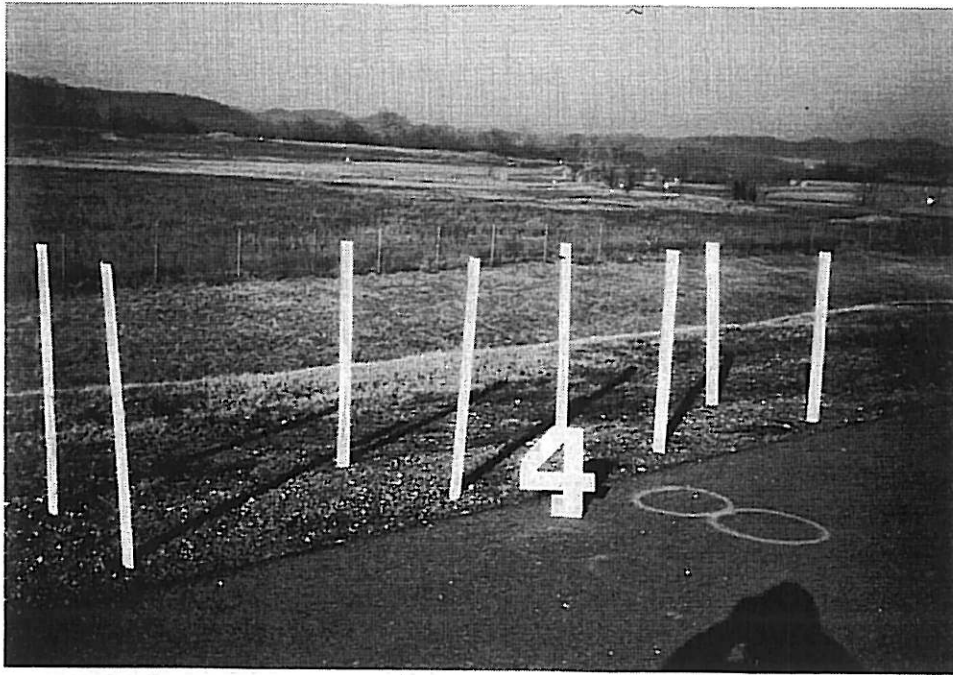
ONE WINTER IMPACT COMPLETED



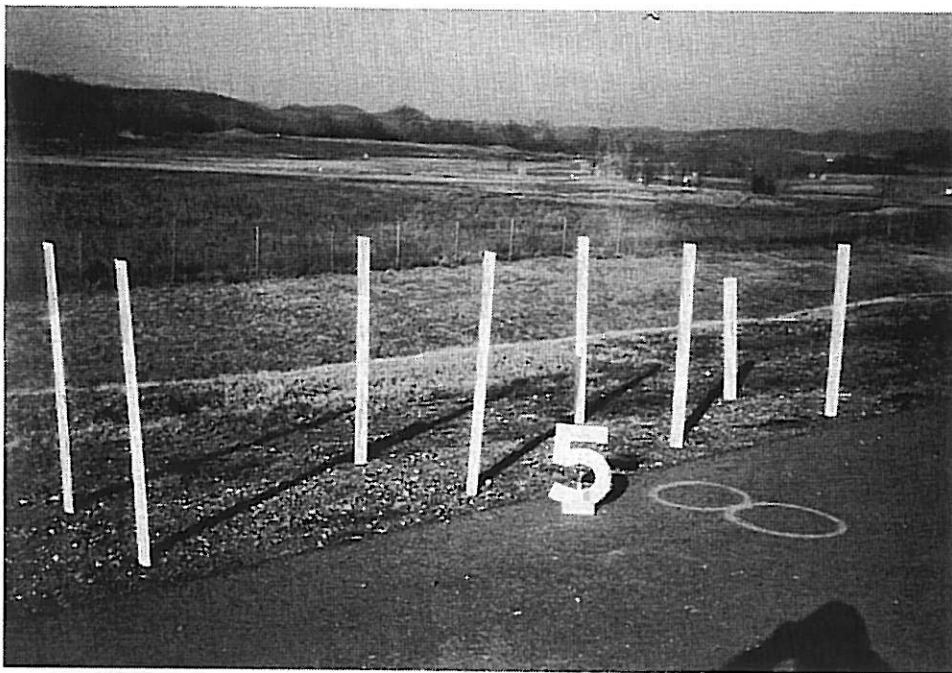
TWO WINTER IMPACTS COMPLETED



THREE WINTER IMPACTS COMPLETED

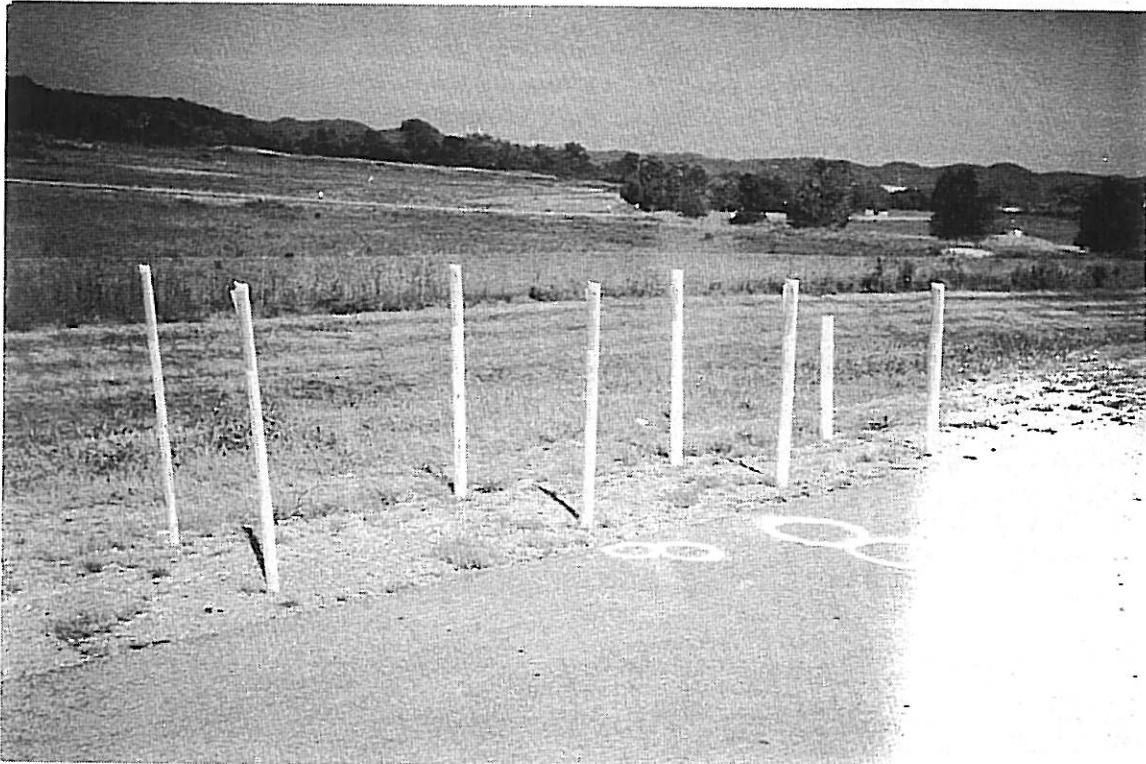


FOUR WINTER IMPACTS COMPLETED

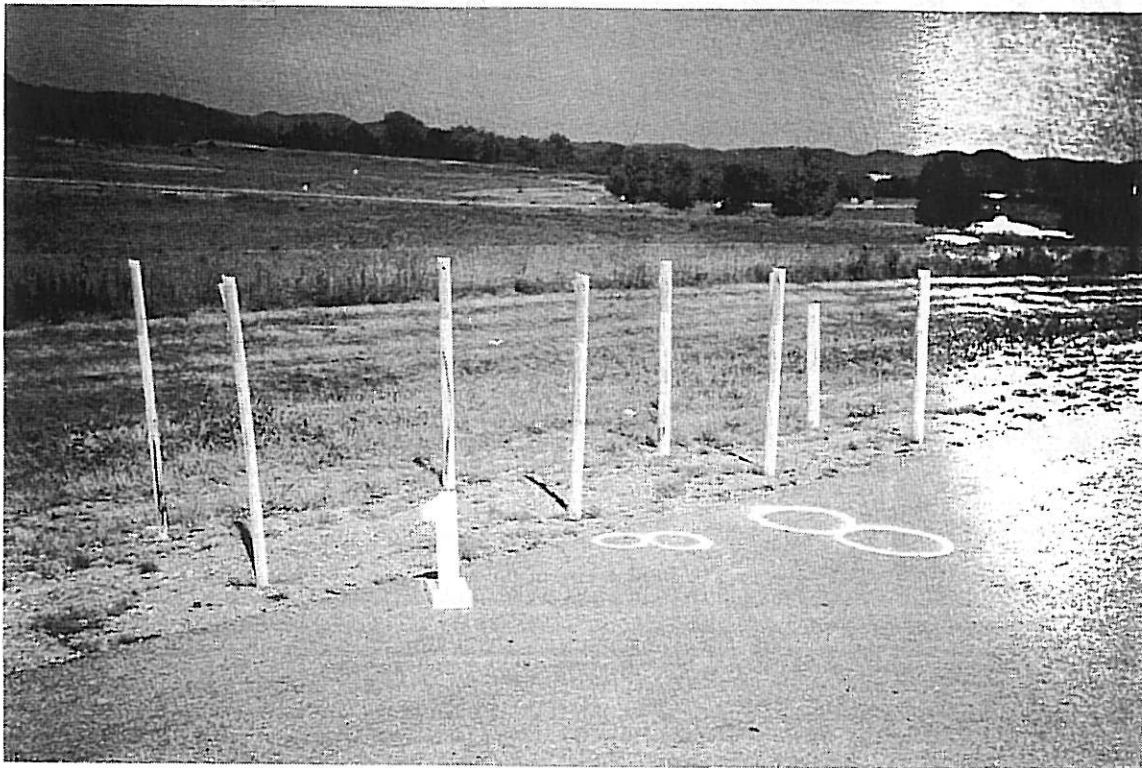


FIVE WINTER IMPACTS COMPLETED

DAVIDSON PLASTICS FG-500 (FG-95)



FIVE WINTER IMPACTS COMPLETED  
SUMMER IMPACTS BEGIN

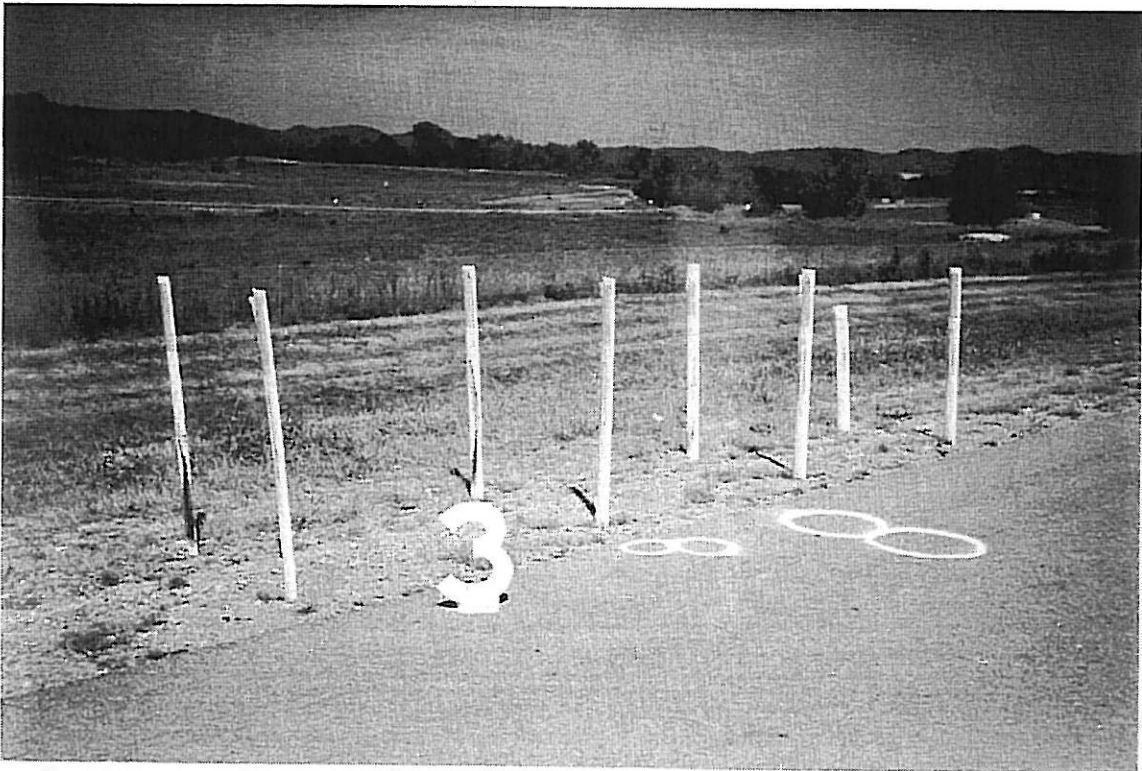


FIVE WINTER IMPACTS COMPLETED  
ONE SUMMER IMPACT COMPLETED

DAVIDSON PLASTICS FG-500 (FG-95)

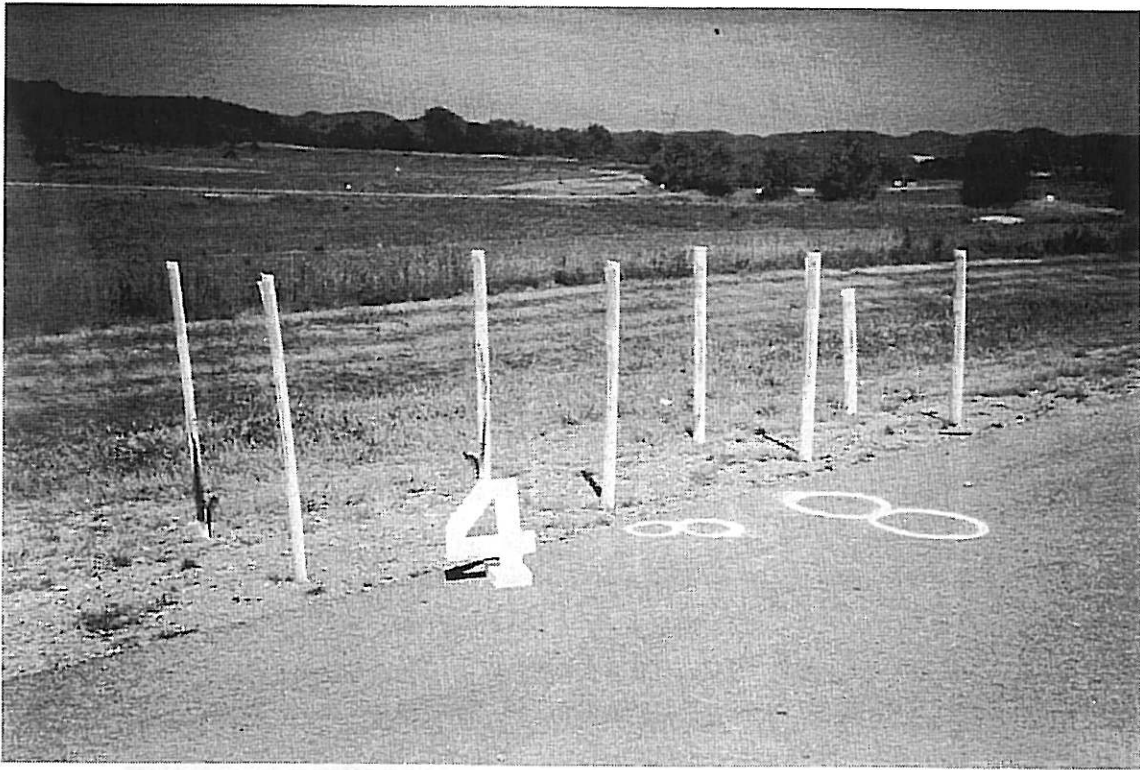


FIVE WINTER IMPACTS COMPLETED  
TWO SUMMER IMPACTS COMPLETED

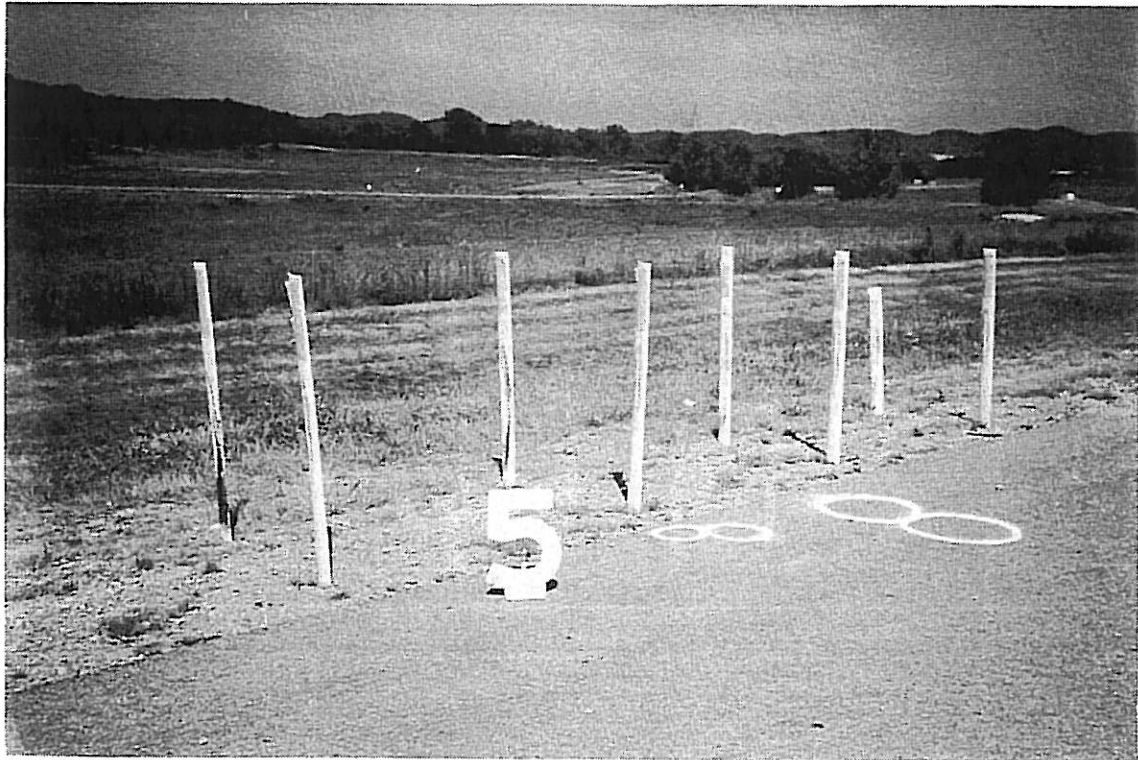


FIVE WINTER IMPACTS COMPLETED  
THREE SUMMER IMPACTS COMPLETED



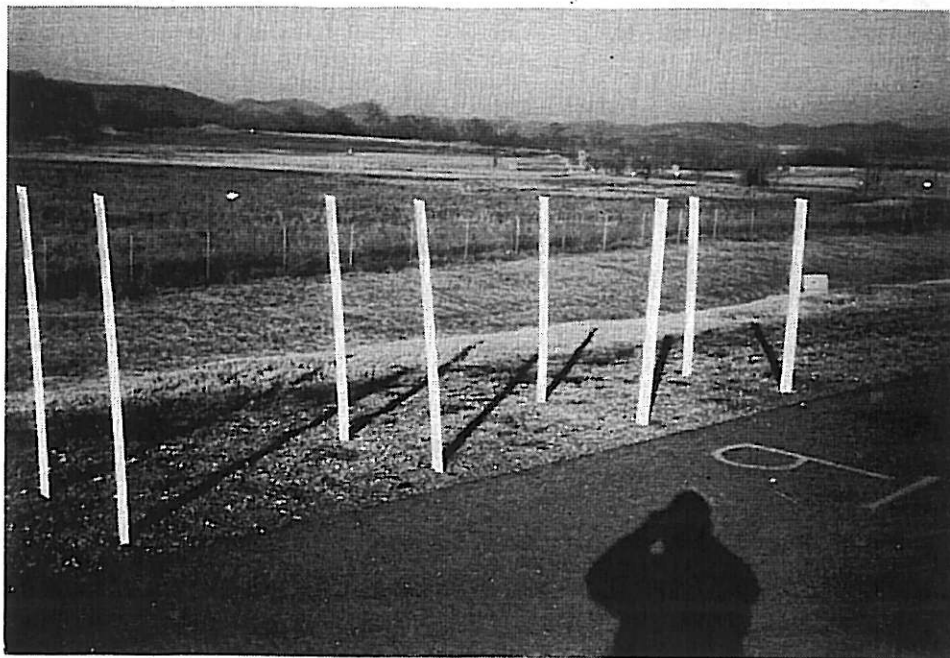


FIVE WINTER IMPACTS COMPLETED  
FOUR SUMMER IMPACTS COMPLETED

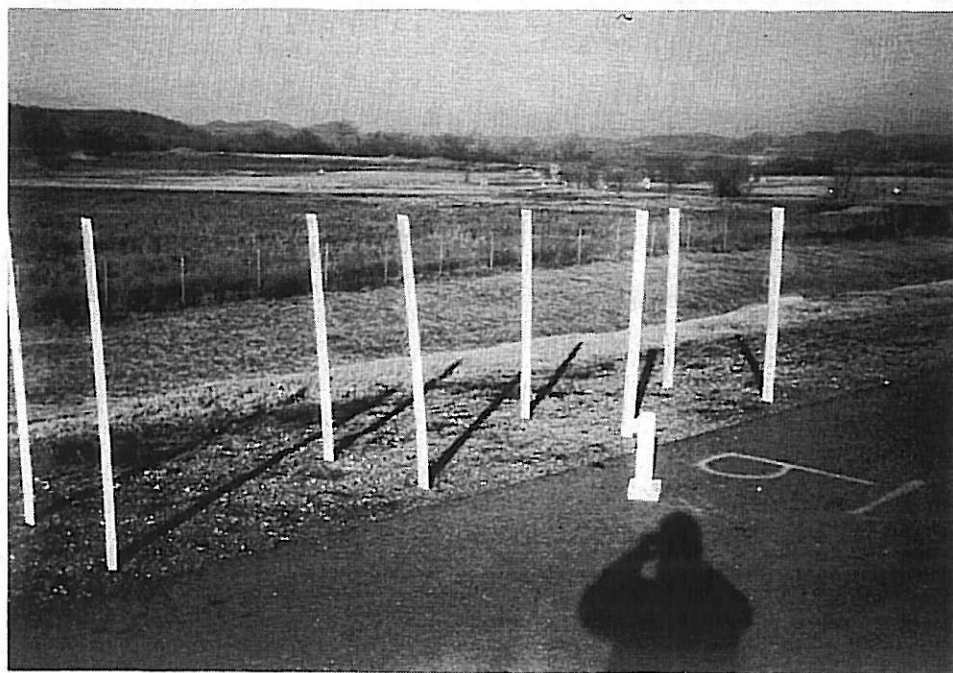


FIVE WINTER IMPACTS COMPLETED  
FIVE SUMMER IMPACTS COMPLETED

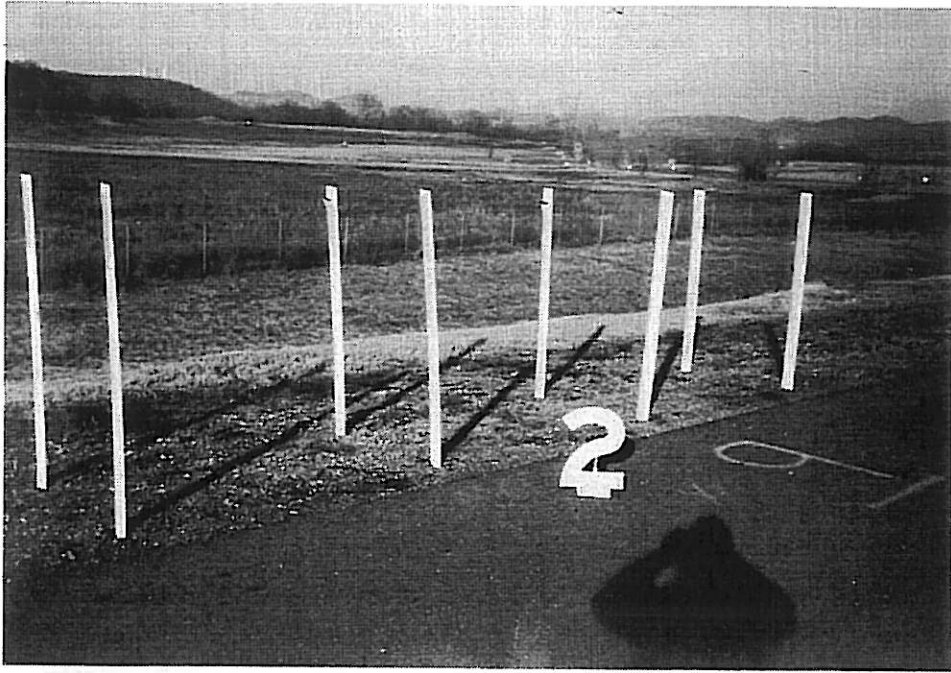
DAVIDSON PLASTICS FG-500 (FG-96)



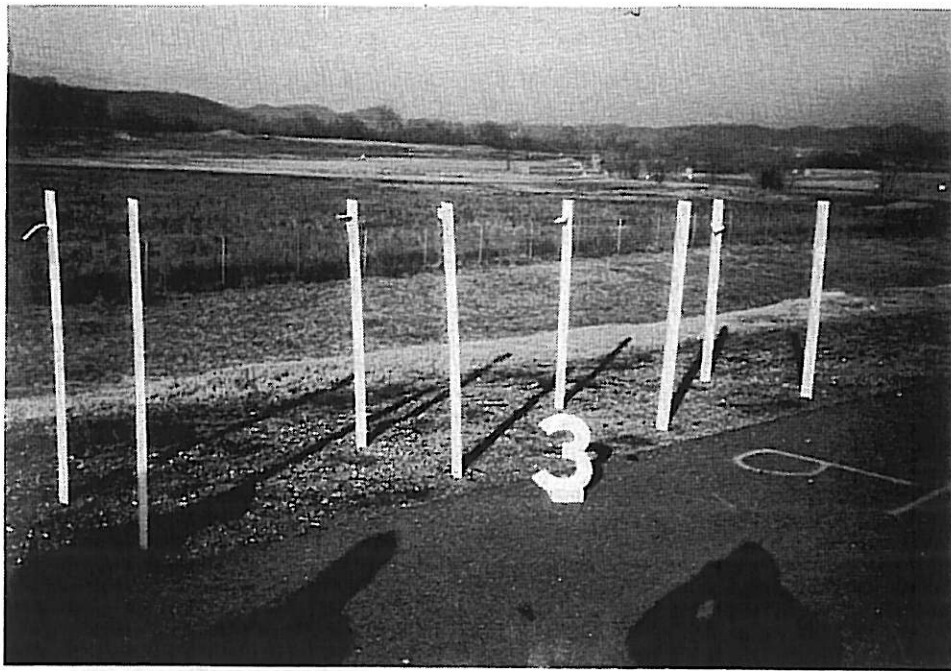
INSTALLED NO IMPACTS



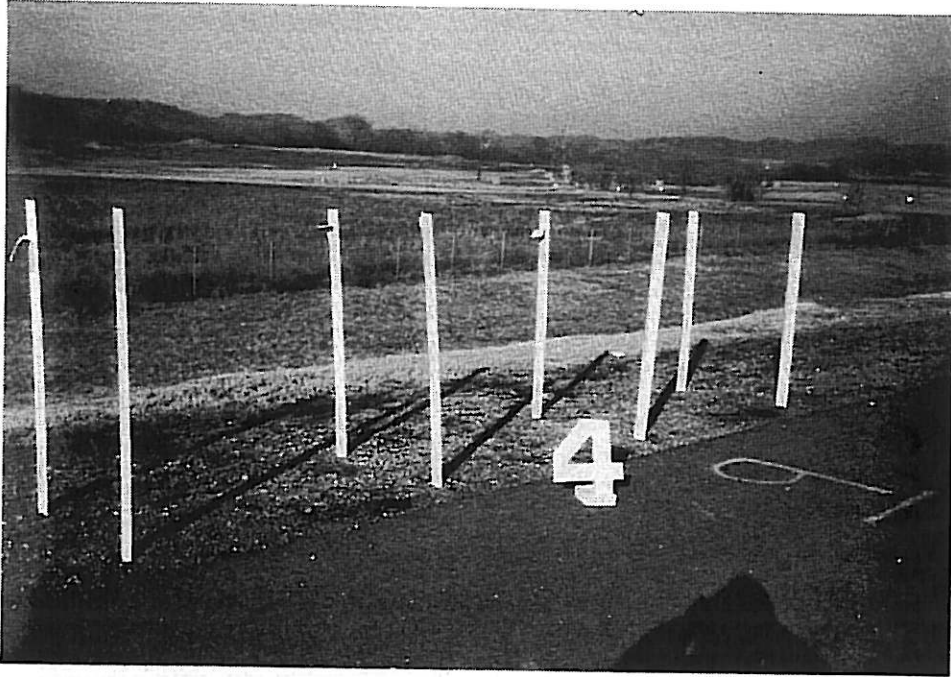
ONE WINTER IMPACT COMPLETED



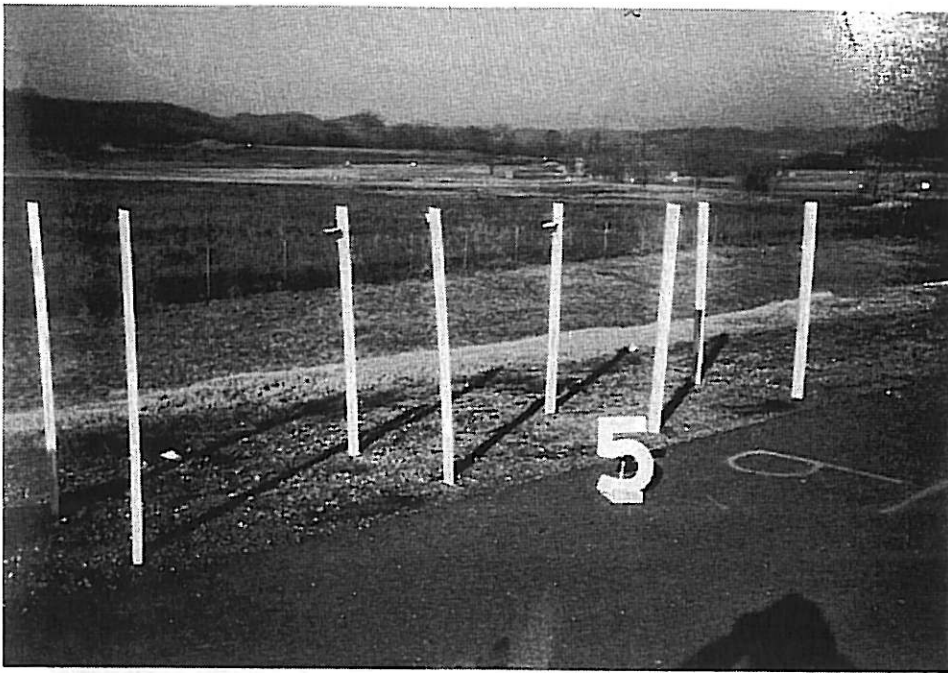
TWO WINTER IMPACTS COMPLETED



THREE WINTER IMPACTS COMPLETED

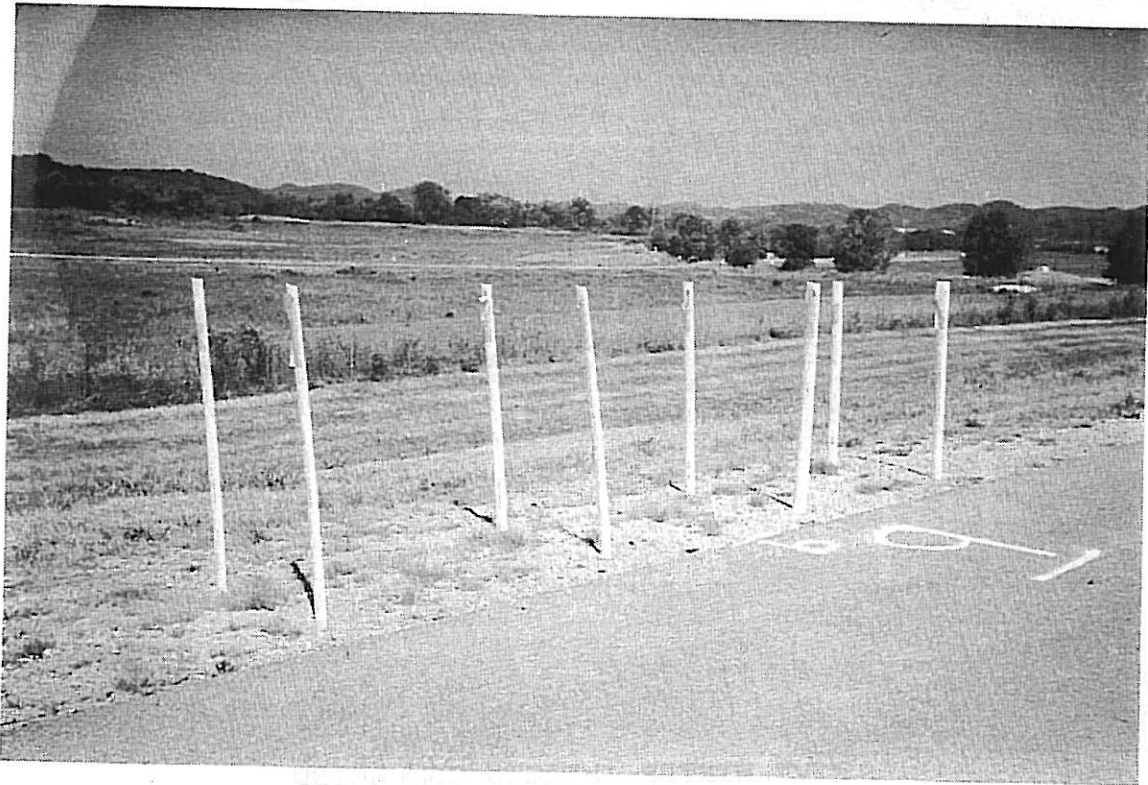


FOUR WINTER IMPACTS COMPLETED

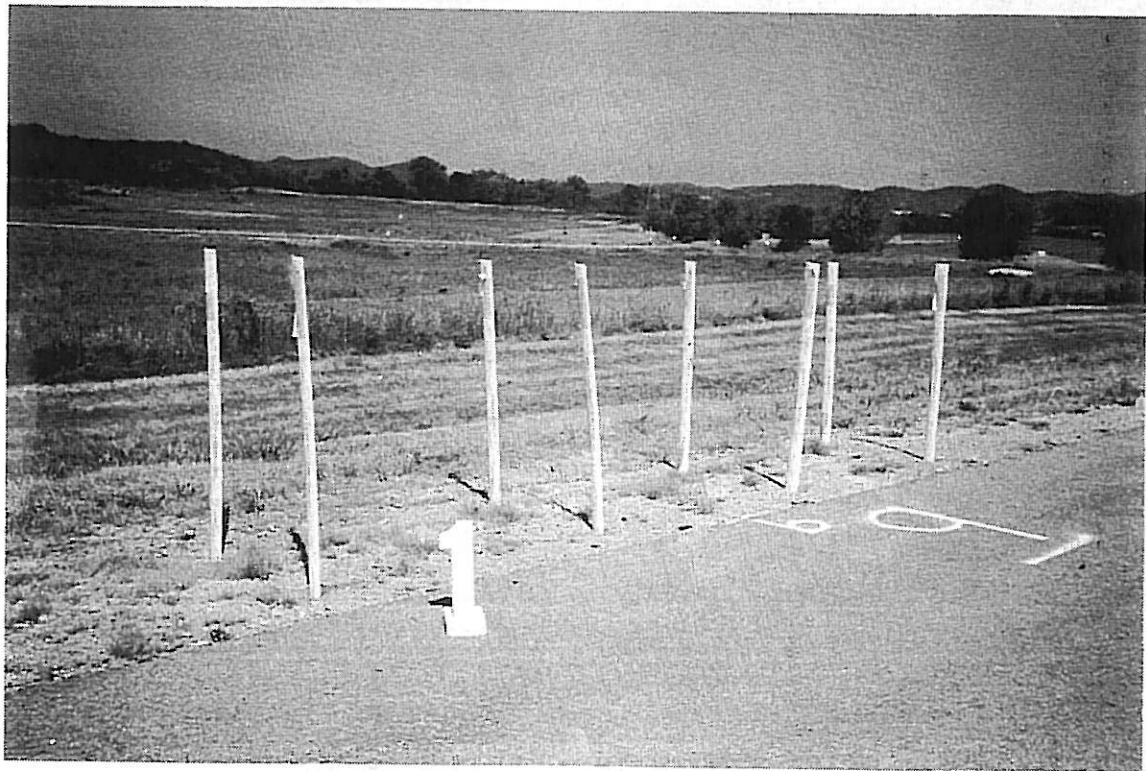


FIVE WINTER IMPACTS COMPLETED

DAVIDSON PLASTICS FG-500 (FG-96)



FIVE WINTER IMPACTS COMPLETED  
SUMMER IMPACTS BEGIN

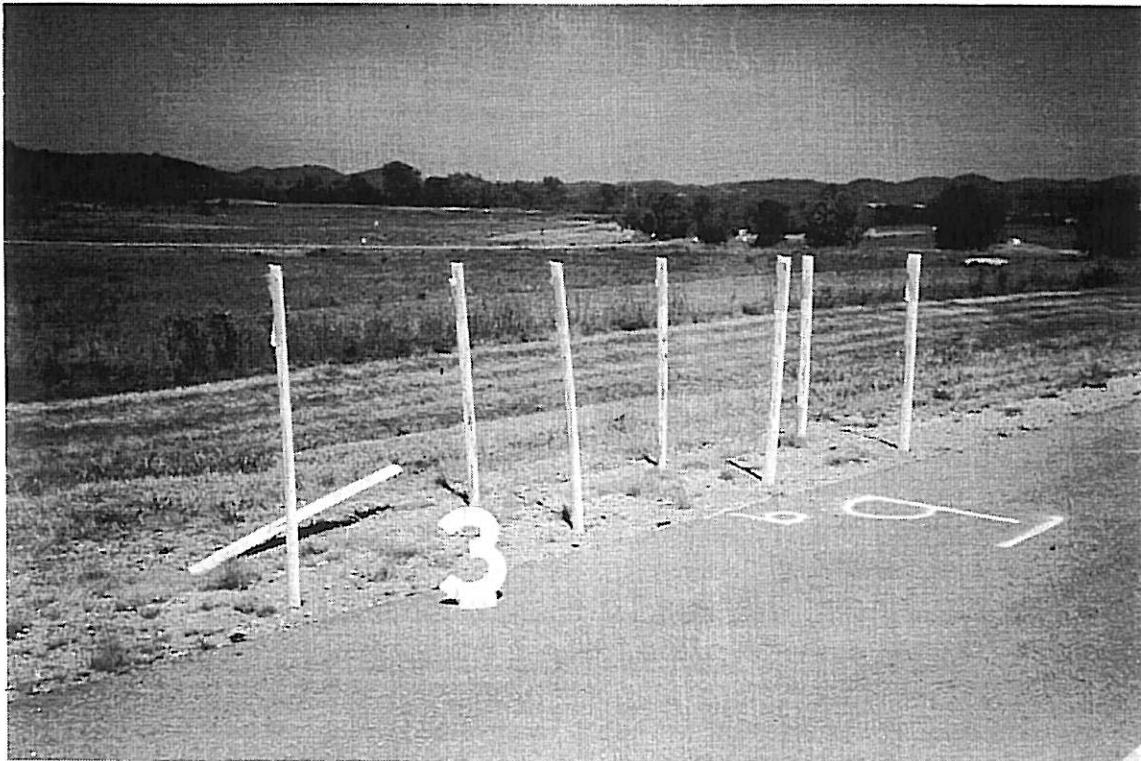


FIVE WINTER IMPACTS COMPLETED  
ONE SUMMER IMPACT COMPLETED

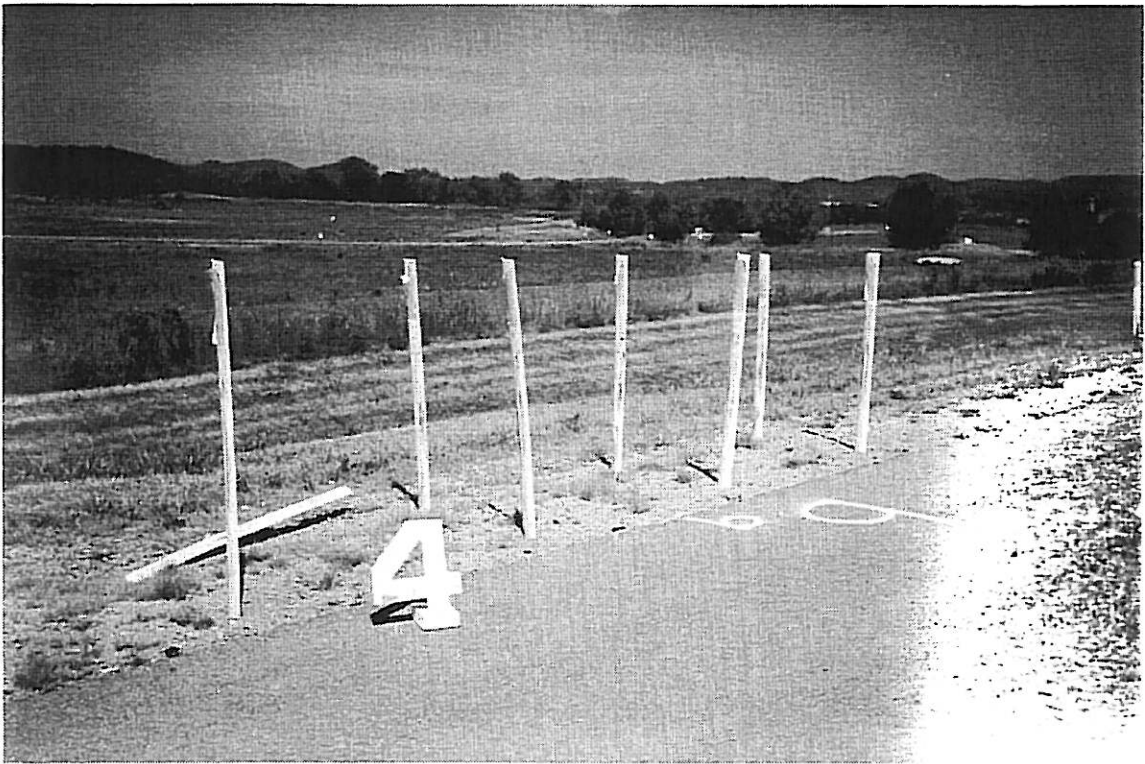
DAVIDSON PLASTICS FG-500 (FG-96)



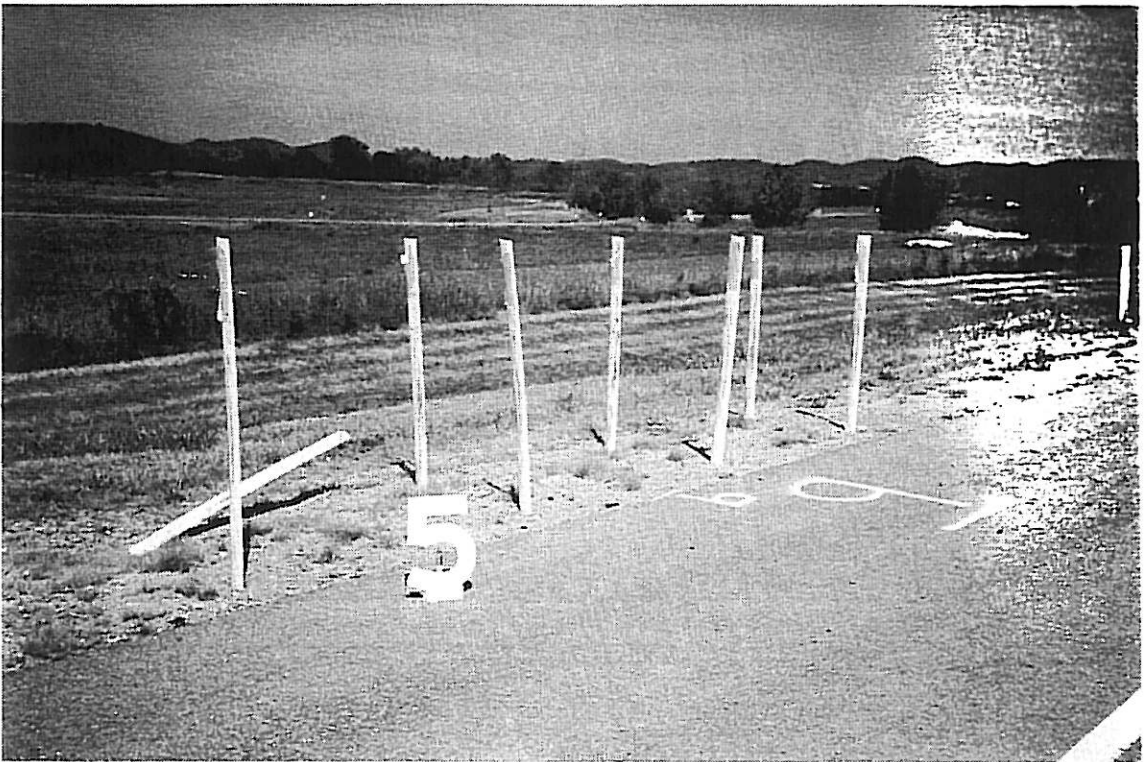
FIVE WINTER IMPACTS COMPLETED  
TWO SUMMER IMPACTS COMPLETED



FIVE WINTER IMPACTS COMPLETED  
THREE SUMMER IMPACTS COMPLETED



FIVE WINTER IMPACTS COMPLETED  
FOUR SUMMER IMPACTS COMPLETED



FIVE WINTER IMPACTS COMPLETED  
FIVE SUMMER IMPACTS COMPLETED

