June 18, 1999

Refer to: HMHS-B56

Mr. David Hubbell
Structures of Ironwood
P.O. Box 600
Saranac Lake, New York 12983

Dear Mr. Hubbell:

In your June 7 letter to Mr. Richard Powers of my staff, you formally requested Federal Highway Administration acceptance of your composite wood/steel IRONWOOD guardrail system at National Cooperative Highway Research Program (NCHRP) Report 350 test level 3 (TL-3). To support this request you had earlier provided Mr. Powers with a May 1999 report prepared by E-TECH Testing Services, Inc.,entitled "NCHRP Report 350 Crash Test Results for the IRONWOOD Guardrail," and a videotape of the crash tests that were run.

The IRONWOOD Guardrail consists of a composite rail element consisting of a 203-mm diameter round timber rail with a 6-mm thick steel channel embedded into and bolted to the timber rail. This composite rail is attached to 1600-mm long S3x5.7 steel posts set 965 mm into the soil and spaced 2000 mm on centers. Each post includes a 203 mm by 610 mm soil bearing plate. The above-ground section of each post is covered by a routed, 171-mm diameter timber post which functions like a standard guardrail block while providing an all-wood appearance to the barrier from the road side of the installation. Nominal rail height is 660 mm above ground surface. Enclosure 1 shows the design details, including all connection hardware and timber specifications. We understand that any wood species matching or exceeding the physical properties of the tested posts and rails, as noted on drawing number 1 of Enclosure 1, may be used for the IRONWOOD Guardrail. NCHRP Report 350 tests 3-10 and 3-11 were conducted and the summary results of each test are shown in Enclosure 2. Maximum dynamic deflection of the IRONWOOD guardrail was reported as 1640 mm when the 128 m test installation was impacted near mid-point with the 2000-kg pickup truck.

Based on our review of the information you provided, we concur that the IRONWOOD Guardrail, as tested, may be considered a test level 3 (TL-3) traffic barrier and used on the National Highway System when such use is requested by an appropriate transportation agency. However, there are two concerns that we need to mention. First, the tested design was reportedly installed at a height of 660 mm to the top of the rail but an allowable construction tolerance of +/- 25 mm is noted in the test report. We will accept a rail height of 685 mm, but will not accept a height lower than the tested 660 mm without a test at the lower height. Because the rail is rounded, its effective height is already reduced from a vertical-face rail and this increases the likelihood that the bumper of a pickup truck could override the rail and result in penetration by an impacting vehicle.

Our second concern is the lack of a tested end-anchor (terminal) for the IRONWOOD Guardrail. As with other aesthetic barriers that have been accepted for use, the preferred end treatment is to terminate the barrier at full height into an existing back slope wherever possible. However, flaring the barrier until the terminal is beyond the appropriate clear zone remains an acceptable treatment. Unlike other approved aesthetic barrier designs, yours is a weak post system which depends primarily on tensile continuity to function properly. Since the impact point in test 3-11 was near the mid-point of the 128 m installation, impact forces transmitted to the terminal were minimized. Until you determine the beginning length of need point, or test the guardrail closer to the terminal, we will assume that, for a TL-3 installation, the beginning length of need will be a minimum of 60 m downstream from the terminal. We note that your present terminal has a single-bolt connection to two steel posts driven directly into the ground and appears significantly less substantial than weak post terminals currently in use.

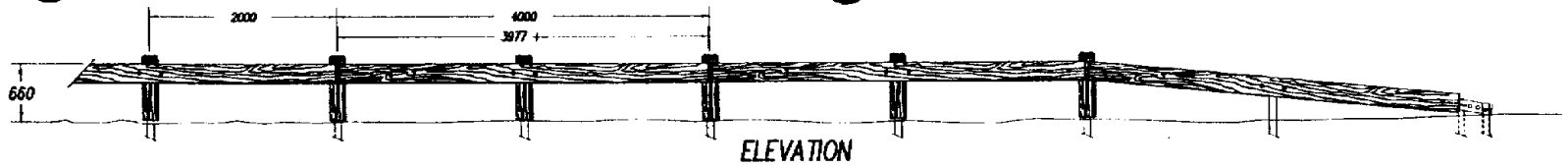
We believe that your IRONWOOD Guardrail will be well-received by agencies seeking an aesthetic TL-3 traffic barrier and encourage you to develop and test an effective terminal to maximize the potential use of this design. Should you have any questions, please call Mr. Richard Powers at (202) 366-1320.

Sincerely yours,

(original signed by Rudolph M. Umbs)

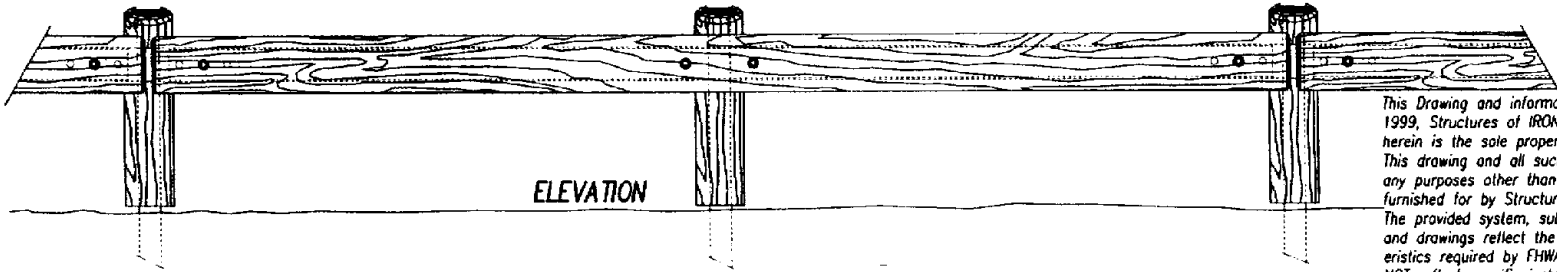
for Dwight A. Horne
Director, Office of Highway Safety Infrastructure

2 Enclosures



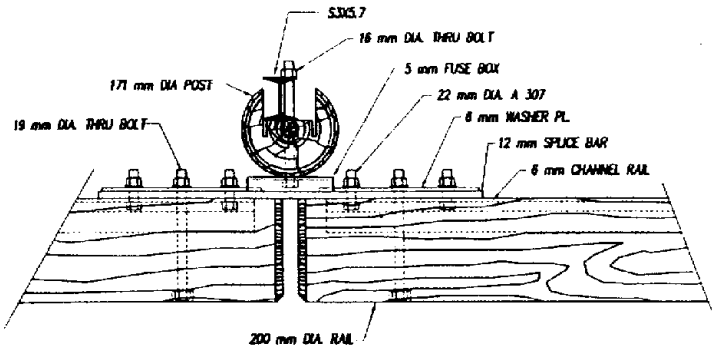
ELEVATION

PLAN

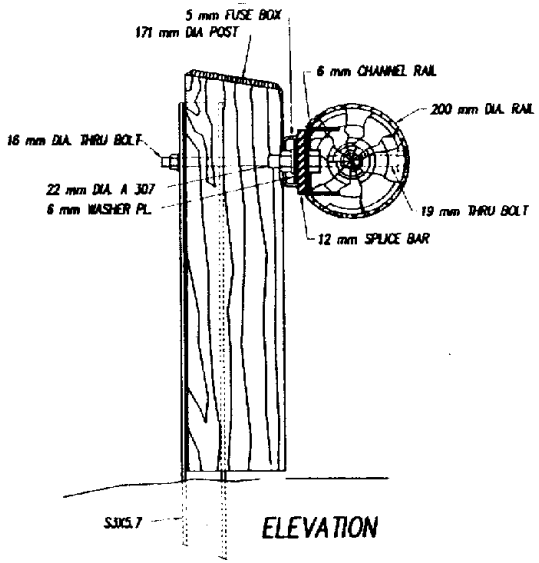


ELEVATION

N1



PLAN



ELEVATION

ALL WOOD POSTS ARE PESSURE TREATED RED PINE No. 2
E=1,100 Ksi & Fb=675 Psi or BETTER

ALL WOOD RAILS ARE PRESSURE TREATED DOUGLAS-FIR
E=1,000 Ksi & MODULUS OF RUPTURE=7,100 Psi or BETTER

ALL STEEL ASTM A36 & HOT DIP GALVANIZED PER ASTM A123

ALL HARDWARE TO BE ASTM A 307 & GALVANIZED PER ASTM A153

IRONWOOD GUIDERAIL

TITLE	IRONWOOD GUIDERAIL
P. I. N.	
COUNTY :	
CONTRACT :	
GEN. CONTRACTOR :	
SUB CONTRACTOR :	
ITEM :	
DRAWN BY : J. RUSSO	DATE : 1/99
CHECKED BY : M. SHERIDAN	DATE :

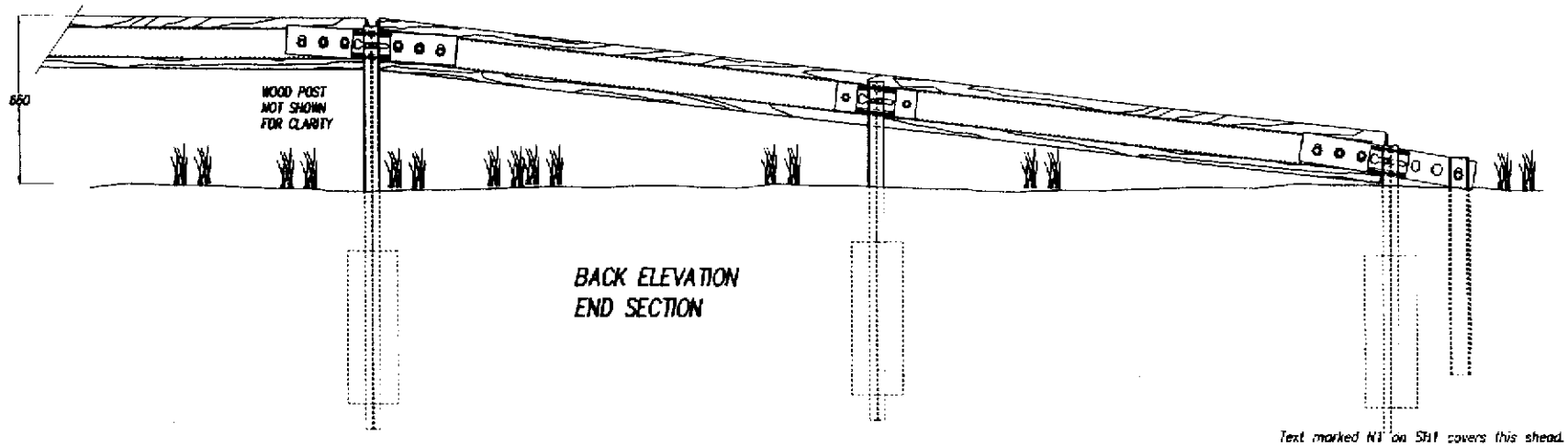
STRUCTURES OF IRONWOOD LLC
P.O. BOX 600
SARANAC LAKE
NEW YORK, U.S.A.
12983
PHONE (518) 891-1669 FAX 891-4322

DWG. NO. 1

DRAWING : ALL DIMENSIONS ARE IN MILLIMETERS

Enclosure 1 (1 of 7)

PLAN END SECTION



BACK ELEVATION
END SECTION

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E=1,100 Ksi & Fb=675 Psi or BETTER

ALL WOOD RAILS ARE PRESSURE TREATED DOUGLAS-FIR
E=1,000 Ksi & MODULUS OF RUPTURE=7,100 Psi or BETTER

ALL STEEL ASTM A36 & HOT DIP GALVANIZED PER ASTM A123

ALL HARDWARE TO BE ASTM A 307 & GALVANIZED PER ASTM A153

Text marked N1 on Sh1 covers this sheet.

IRONWOOD GUIDERAIL

TITLE

P. I. N.

COUNTY :

CONTRACT :

GEN. CONTRACTOR :

SUB CONTRACTOR :

ITEM :

DRAWN BY : J. RUSSO DATE : 1/99

CHECKED BY : M. SHERIDAN DATE :

PO BOX 816
SARANAC LAKE
NEW YORK, U.S.A.
12983

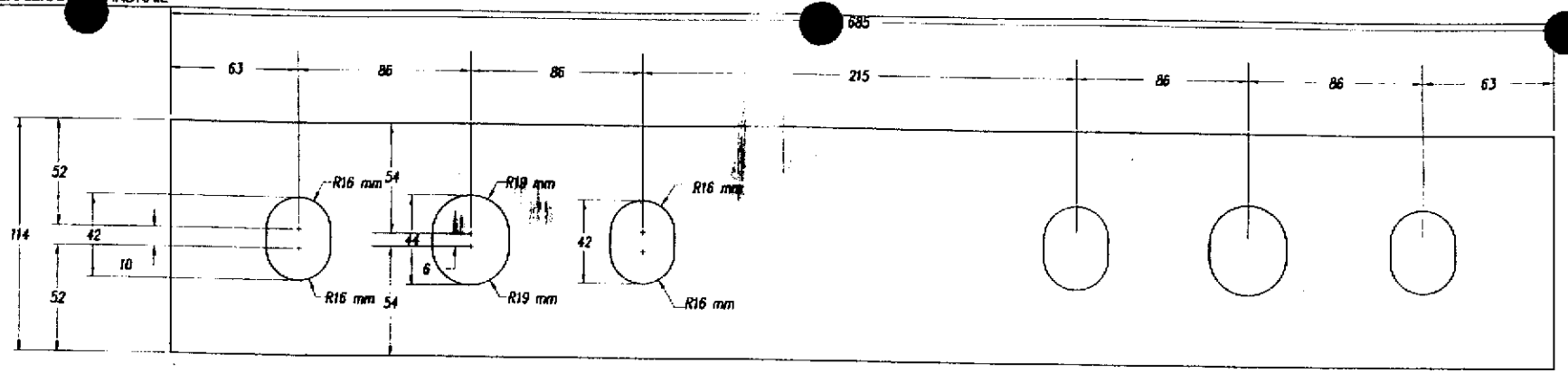
STRUCTURES OF IRONWOOD LLC

PHONE (518) 891-1669 FAX 891-4922

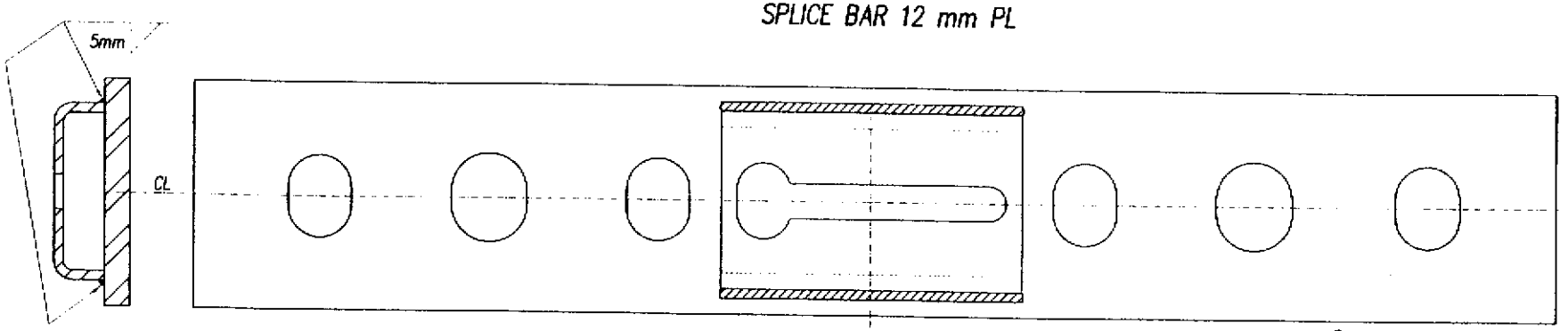
DWG. NO. 2

DRAWING :

ALL DIMENSIONS ARE IN MILLIMETERS

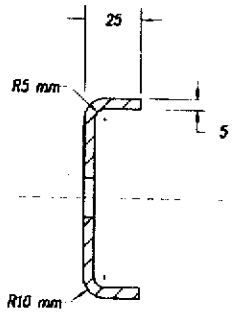


SPLICE BAR 12 mm PL



SPLICE BAR & FUSE BOX WELDED

SECTION



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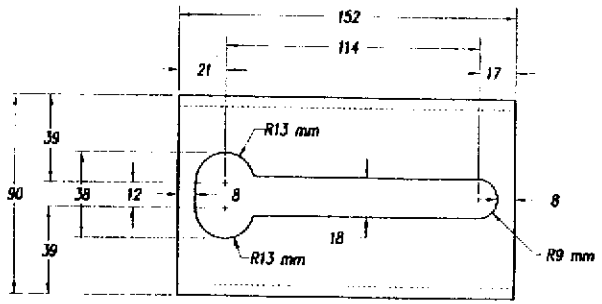

FUSE BOX 5 mm BENT PL

Text marked N1 on SH1 covers this sheet.

IRONWOOD GUIDERAIL

TITLE SPLICE PL & FUSE BOX

P. I. N.

COUNTY :

CONTRACT :

GEN. CONTRACTOR :

SUB CONTRACTOR :

ITEM :

DRAWN BY : J. RUSSO DATE : 1/99

CHECKED BY : M. SHERIDAN DATE :

STRUCTURES OF IRONWOOD LLC
PO BOX 600
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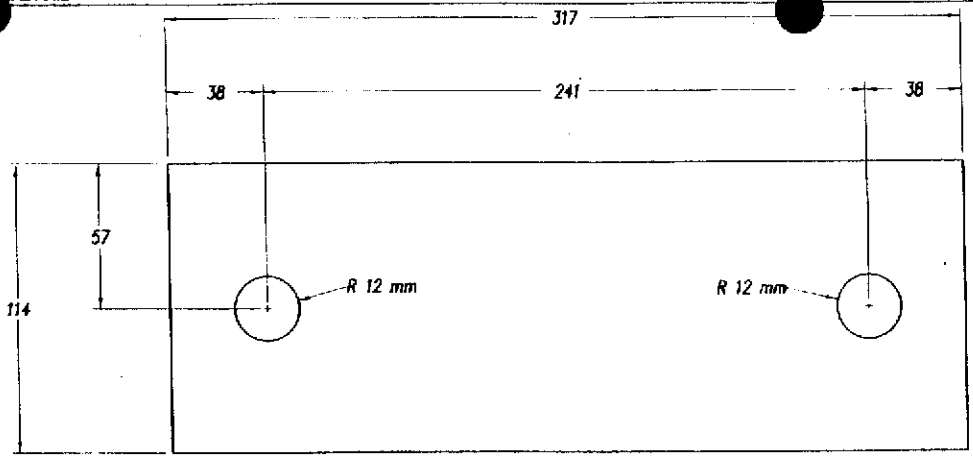
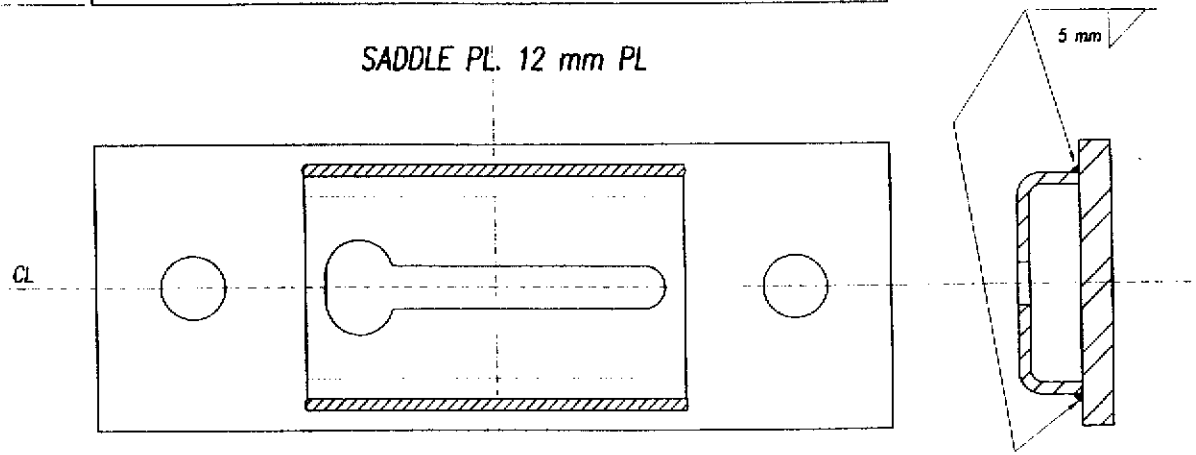
12983
PHONE (518) 891-1660 FAX 891-4322

DRAWING : ALL DIMENSIONS ARE IN MILLIMETERS

DWG. NO. 3

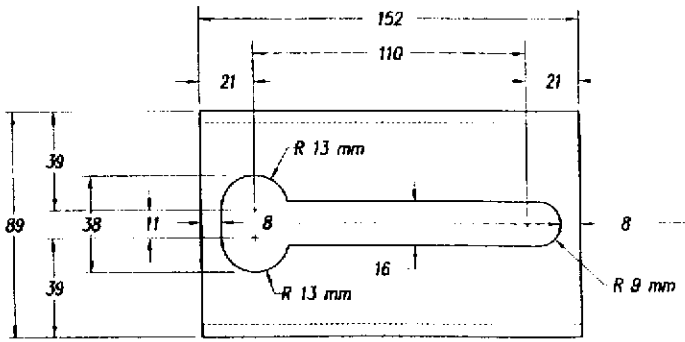


SADDLE PL. 12 mm PL



SADDLE PL & FUSE BOX WELDED

SECTION



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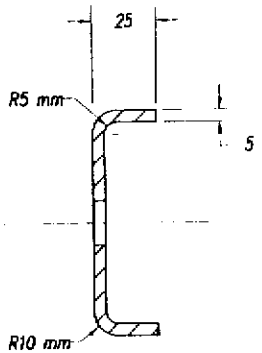

SECTION

IRONWOOD GUIDERAIL

TITLE: SADDLE PL & FUSE BOX

P. I. N.:

COUNTY:

CONTRACT:

GEN. CONTRACTOR:

SUB CONTRACTOR:

ITEM:

DRAWN BY: J. RUSSO DATE: 1/99

CHECKED BY: M. SHERIDAN DATE:

STRUCTURES OF IRONWOOD LLC
PO BOX 60
SARANAC LAKE
NEW YORK U.S.A
12983
PHONE 518-891-1669 FAX 891-4322

DWG. NO. 4

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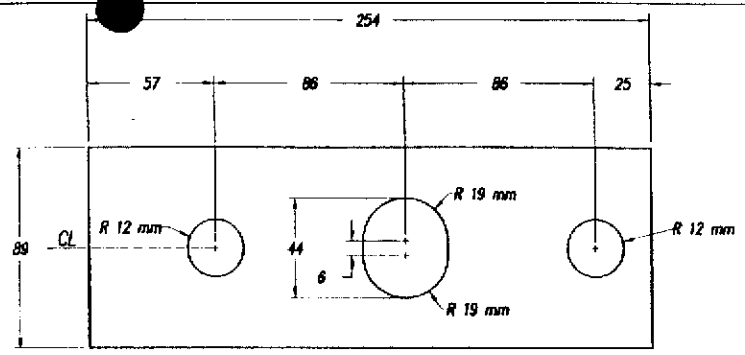
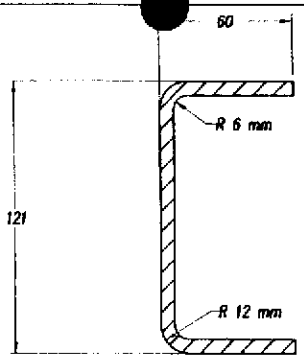
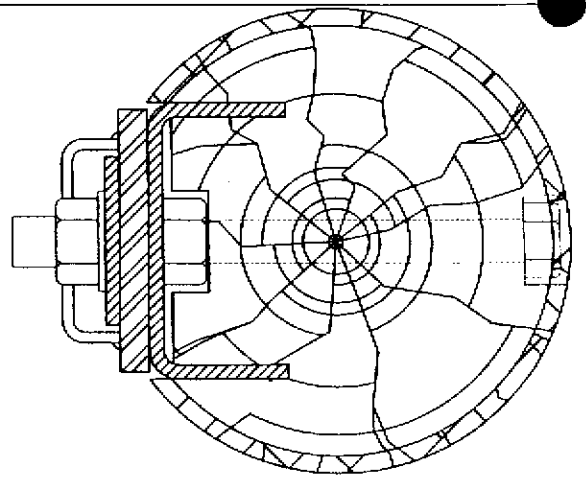


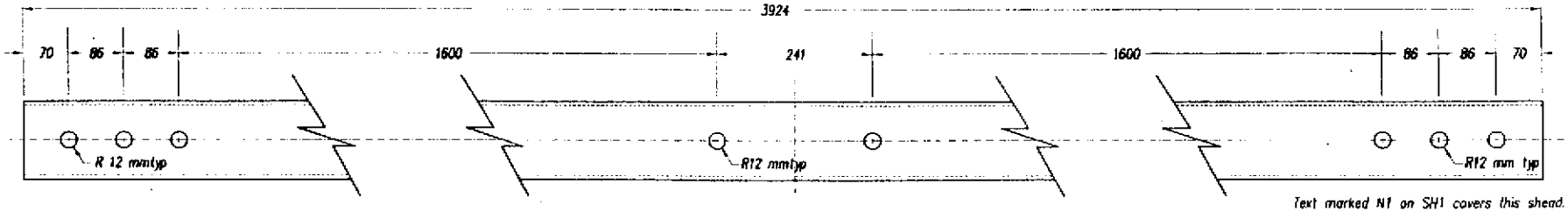
PLATE WASHER
6 mm GALV. PL.



CHANNEL RAIL
BENT 6 mm PL.



RAIL END VIEW



CHANNEL RAIL ELEVATION

Text marked N1 on SH1 covers this sheet.

This Product, its subassemblies, and individual components may be covered by one or more US and foreign patents, including but not limited to US Patent No. 5402987

IRONWOOD GUIDERAIL

TITLE PLATE WASHER & RAIL

P. I. N.

COUNTY :

CONTRACT :

GEN. CONTRACTOR :

SUB CONTRACTOR :

ITEM :

DRAWN BY : J. RUSSO DATE : 1/99

CHECKED BY : M. SHERIDAN DATE :

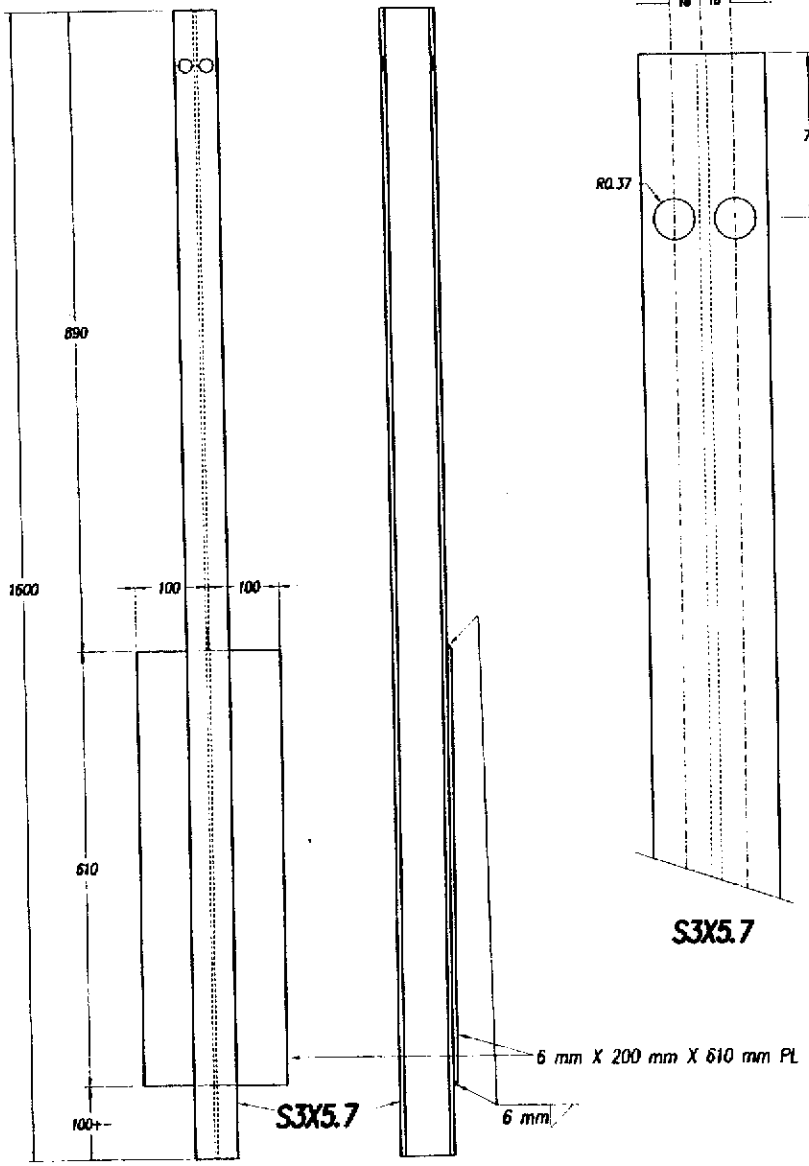
STRUCTURES OF IRONWOOD LLC
PO BOX 501
SARANAC LAKE
NEW YORK, USA
12983
PHONE (518) 891-1669 FAX 891-4322

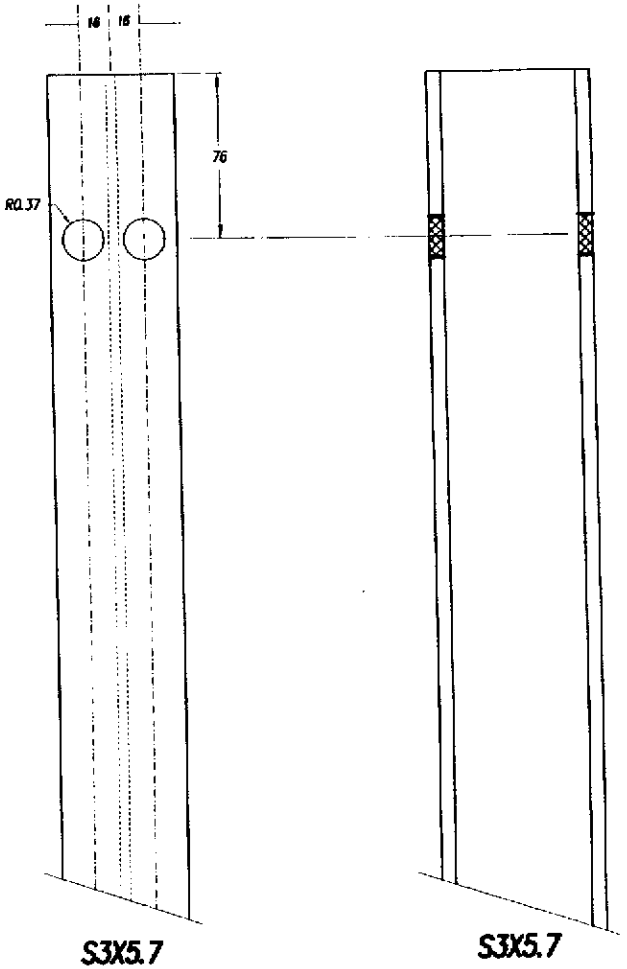
DWG. NO. 5

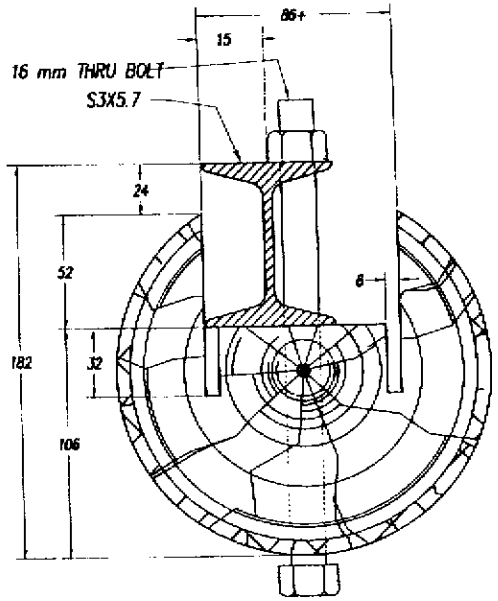
DRAWING :

ALL DIMENSIONS ARE IN MILLIMETERS

Enclosure 1 (5 of 7)







POST PLAN

Text marked NI on Sht1 covers this sheet.

This Product, its subassemblies, and individual components may be covered by one or more US and foreign patents, including but not limited to US Patent No. 5402987

IRONWOOD GUIDERAIL

TITLE STEEL POST

P. I. N.

COUNTY :

CONTRACT :

GEN. CONTRACTOR :

SUB CONTRACTOR :

ITEM :

DRAWN BY : J. RUSSO DATE : 1/99

CHECKED BY : M. SHERIDAN DATE :

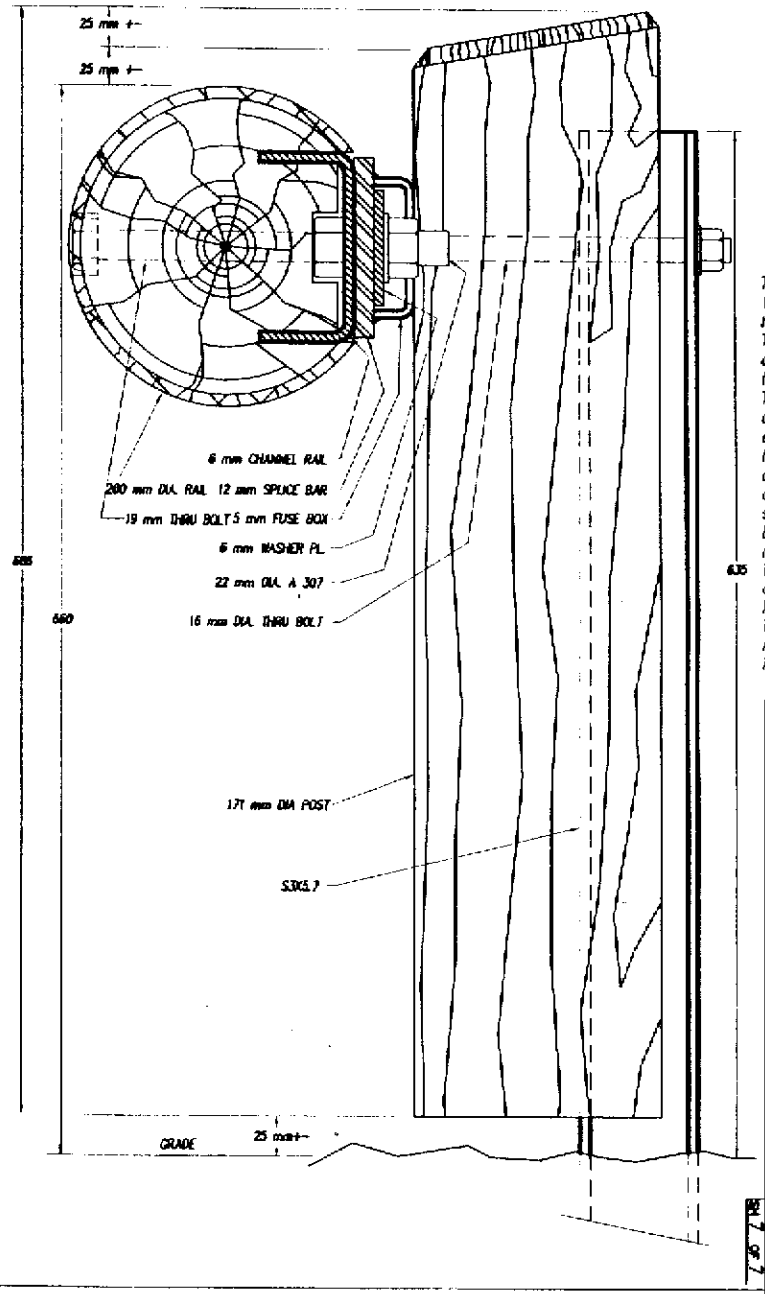
PO BOX 606
SARANAC LAKE
NEW YORK U.S.A.
12983

STRUCTURES OF IRONWOOD LLC

PHONE (518) 891-1669 FAX 891-4332

DWG. NO. 6

DRAWING : ALL DIMENSIONS ARE IN MILLIMETERS



IRONWOOD GUIDERAIL

TITLE STEEL POST & WOOD POST

P. I. N.

COUNTY :

CONTRACT :

GEN. CONTRACTOR :

SUB CONTRACTOR :

ITEM :

DRAWN BY : J. RUSSO DATE : 1/99

CHECKED BY : M. SHERIDAN DATE :

P.O BOX 800
SARANAC LAKE
NEW YORK, U.S.A.
12983

STRUCTURES OF IRONWOOD LLC

PHONE (518) 891-1669 FAX 891-4322

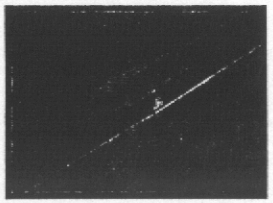
NOTE: THIS DRAWING HAS BEEN SCALED TO FIT ON THIS PAPERSIZE. SCALED FROM 1:1 TO 1:5

DWG. NO. 7

DRAWING : IRWD-7

ALL DIMENSIONS ARE IN MILLIMETERS

Enclosure 1 (7 of 7)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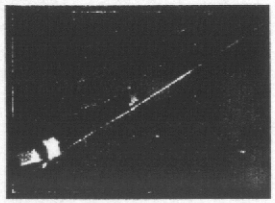
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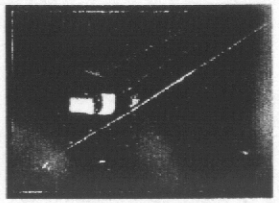
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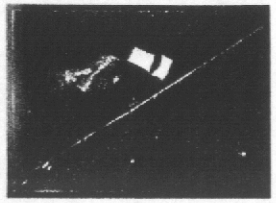
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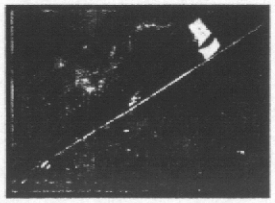
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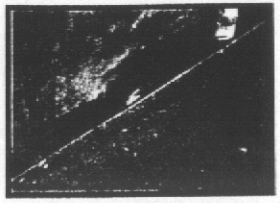
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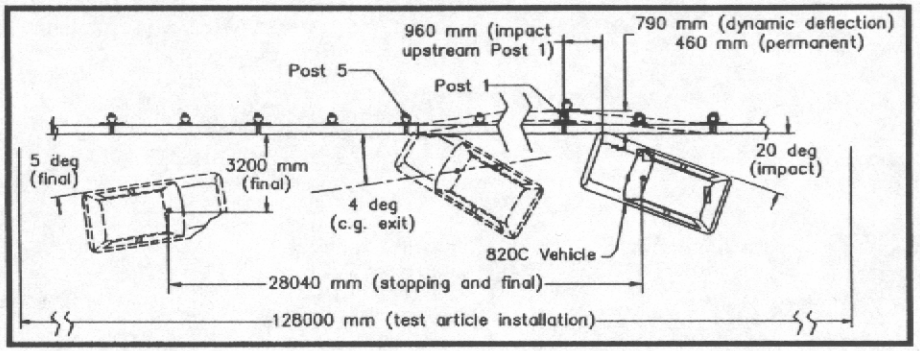
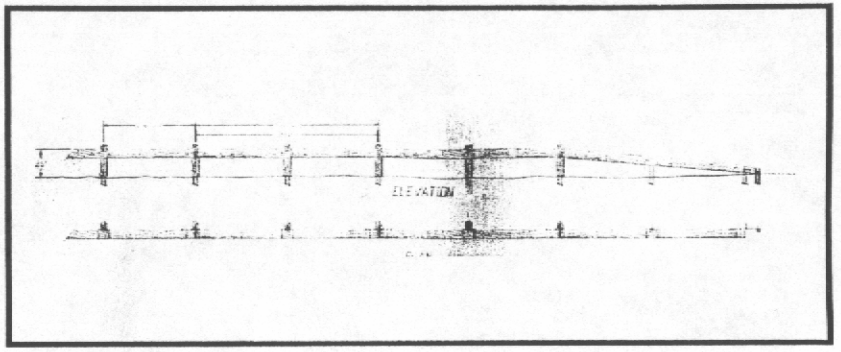




General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-10
Test No.	12-0102-002
Date	2/4/99

Test Article

Type	Structures of Ironwood, LLC
	IRONWOOD Guiderail
Installation Length, (m)	128 (length of need)
Size and/or dimension and material of key elements	660 mm Rail height, 2000 mm Post spacing
Foundation Type and Condition	NCHRP 350 Weak soil, well drained and compacted

Test Vehicle

Type	Production Model
Designation	820C
Model	1988 Ford Festiva
	Hatchback
Mass (kg)	
Curb	838.6
Test inertial	825.0
Dummy	75.0
Gross Static	900.0

Impact Conditions

Speed (km/h)	102.5
Angle (deg)	20
Impact Severity (kJ)	39.1

Exit conditions

Speed (km/h)	41.8
Angle (deg)	4

Occupant Risk Values

Impact Velocity (m/s)	
x-direction	5.0
y-direction	-4.9
Ridedown Acceleration (g's)	
x-direction	-14.2
y-direction	10.0
THIV (m/s)	10.0
PHD (g's)	5.9
ASI	0.8

Test Article Deflections (mm)

Dynamic	790
Permanent	460

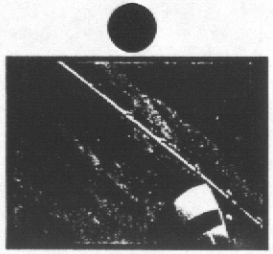
Vehicle Damage

Exterior	
VDS	RFQ-5
CDC	01RYEW2
Interior	
OCDI	AS0010000

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle	10.9
Maximum Pitch Angle	7.9
Maximum Yaw Angle	155.9

Figure 1. Summary of Results - IRONWOOD Guiderail Test 12-0102-002



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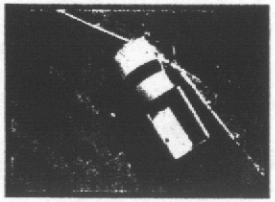

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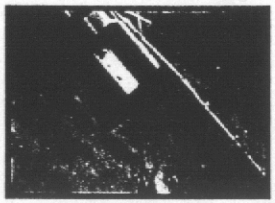

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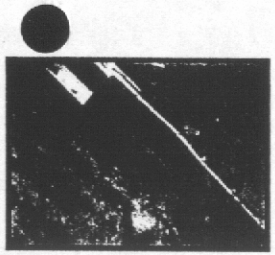

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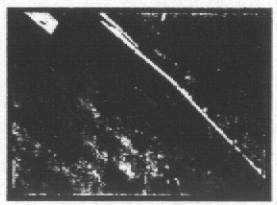

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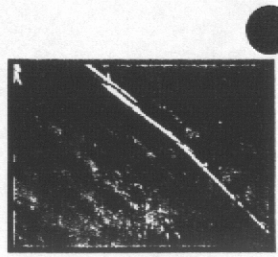

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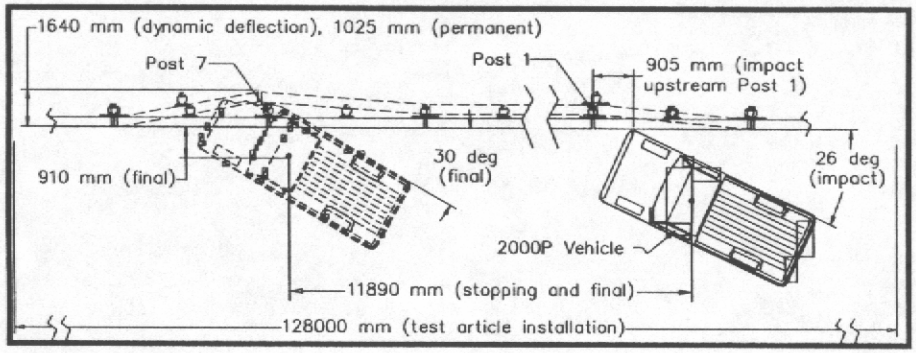

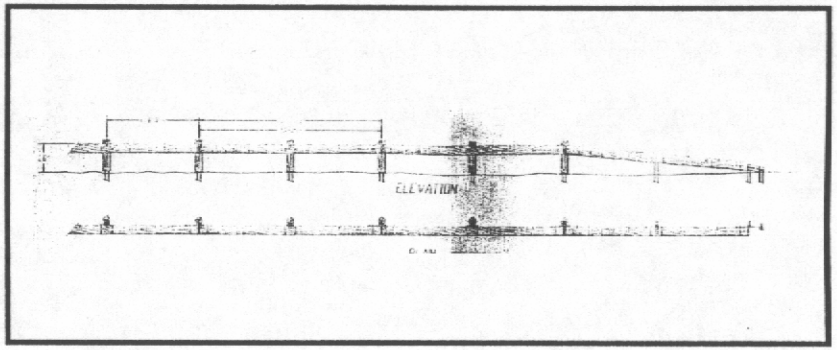

General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-11
Test No.	12-0102-001
Date	2/3/99

Test Article

Type	Structures of IronWood, LLC
	IRONWOOD Guiderail
Installation Length, (m)	128 (length of need)
Size and/or dimension and material of key elements	660 mm Rail height,
	2000 mm Post spacing
Foundation Type and Condition	NCHRP 350 Weak soil,
	well drained and compacted

Test Vehicle

Type	Production Model
Designation	2000P
Model	1988 Chevrolet C2500
	3/4 Ton Pickup
Mass (kg)	
Curb	1937.2
Test inertial	2009.8
Dummy	N/A
Gross Static	2009.8

Impact Conditions

Speed (km/h)	98.3
Angle (deg)	26
Impact Severity (kJ)	144.0

Exit conditions

Speed (km/h)	N/A
Angle (deg)	N/A

Occupant Risk Values

Impact Velocity (m/s)	
x-direction	5.7
y-direction	-4.0
Ridedown Acceleration (g's)	
x-direction	-13.0
y-direction	-11.9
THIV (m/s)	8.6
PHD (g's)	6.4
ASI	0.8

Test Article Deflections (mm)

Dynamic	1640
Permanent	1025

Vehicle Damage

Exterior	
VDS	RFQ-5
CDC	01RYEW2
Interior	
OCDI	AS1010000

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle	-8.5
Maximum Pitch Angle	-1.9
Maximum Yaw Angle	-24.2

Figure 6. Summary of Results - IRONWOOD Guiderail Test 12-0102-001