December 18, 2000

Mr. Rodney A. Boyd
Trinity Industries, Inc.
2525 Stemmons Freeway
Post Office Box 568887
Dallas, Texas 75356-8887

Refer to : HSA-1/CC72

Dear Mr. Boyd:

In his November 21 letter to Mr. Richard Powers of my staff, your consultant, Mr. James Albritton, requested the Federal Highway Administration's (FHWA) acceptance of a modified Slotted Rail Terminal (SRT) as an National Cooperative Highway Research Program (NCHRP) Report 350 test level 3 (TL-3) terminal for w-beam guardrail. To support this request, he also sent the Texas Transportation Institute (TTI) final report entitled " Testing and Evaluation of the Linear SRT with Steel HBA Posts," dated November 2000, and copies of the test video tapes.

The tested design consisted of an 11.4-m (37.5-foot) straight flare with the first post offset 1.2 m (4 feet) from the downstream guardrail. The two anchor posts were steel Hinged Breakaway (HBA) posts while the remaining posts were standard 1830-mm (6-foot) long CRT posts. The HBA posts were modified slightly from the design accepted for use with the ET-2000 terminal. These modifications included the use of 102 x 152 x 5 mm (4 x 6 x 3/16 in) soil tubes in lieu of W150 x 13 (W6 x 8.5) steel stub posts, and two parallel ground struts between post no. 1 and post no. 2. To prevent premature failure of the end post in a downstream hit, the rail to post attachment hole at post no. 1 was slotted to the end of the beam element. Enclosure 1 shows these and other design details.

You conducted three tests on your proposed design. These were NCHRP Report 350 tests 3-30, 3-31, and 3-35. Test 3-32, an 820-kg car impacting the terminal nose at 100 km/h and at a 15 degree angle, was conducted when the HBA posts were developed and tested with the tangent ET-2000. Satisfactory performance with these similar posts on the flared SRT can be safely assumed. Test 3-33, the test with a 2000-kg pickup truck under the same impact conditions as test 3-32, can also be waived. Test 3-34, a 20 degree impact at post no. 2 with the small car, was conducted under earlier tests of the original SRT design which has a more critical parabolic flare, rather than the straight flare of the linear SRT.

The design that you actually tested used four CRT posts. In reviewing the tests, all of which met Report 350 evaluation criteria, it was noted that the use of a standard line post at post no. 7 contributed to a relatively high roll angle in test 3-31 and to a higher than expected pitch angle in test 3-35. These results can be directly related to the vehicle striking post no 7 in both tests. After discussions between Mr. Richard Powers of my staff and Mr. Albritten, you agreed to specify a fifth CRT post at post position no. 7. This change from the tested design is reflected in drawing no. SS 351 dated December 12, 2000 (Enclosure 1). The summary results of the three tests you conducted are enclosed (Enclosure

2). Based on the results of test 3-35, the beginning length-of-need of the linear SRT is at post no. 3, approximately 3.8 m (12.5 feet) from the end.

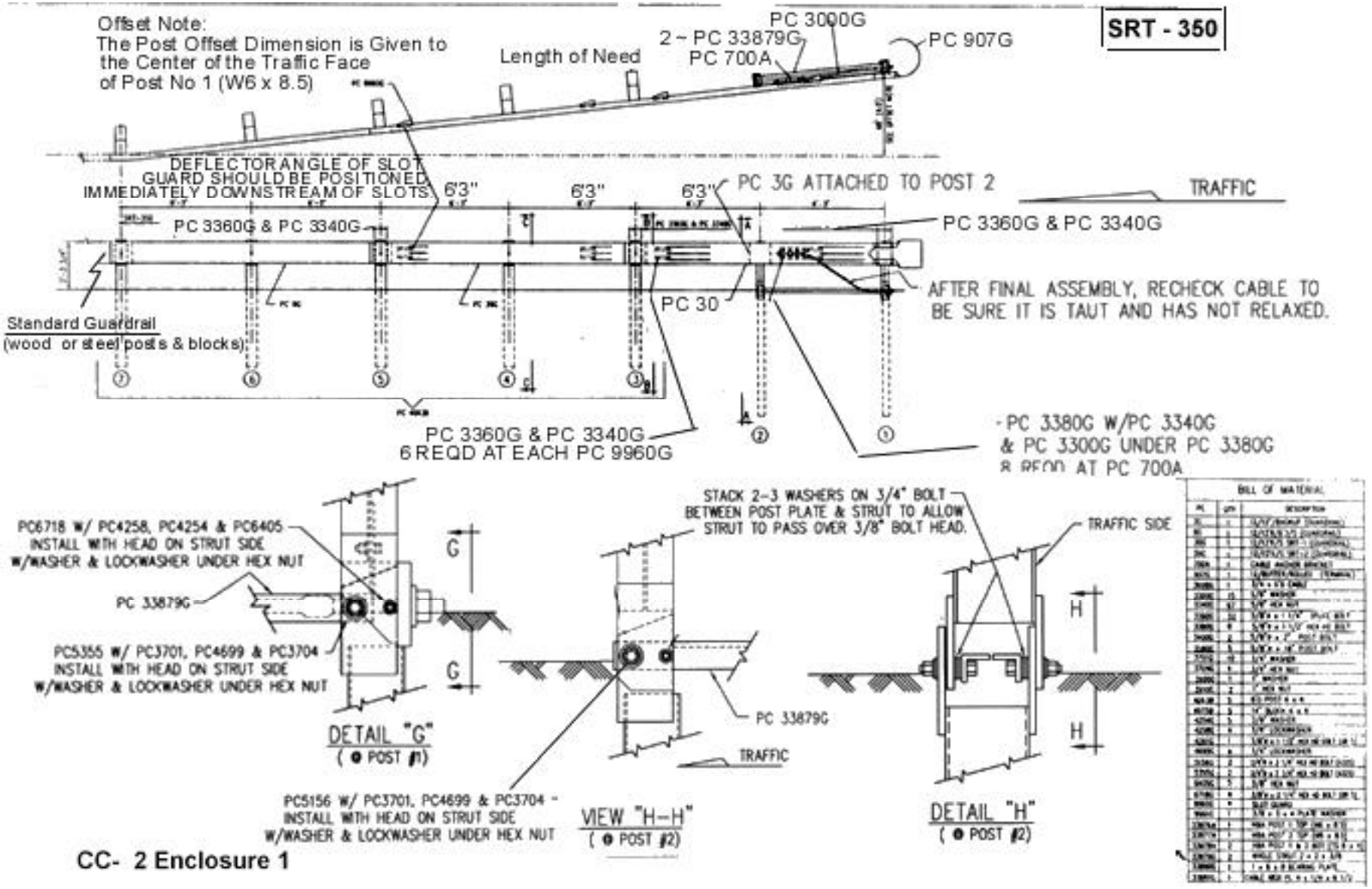
Considering the above, the modified linear SRT terminal with an offset of 1.2 m (4 feet), two steel HBA posts, and five CRT posts may be considered acceptable for use on the National Highway System as a TL-3 w-beam terminal when such use is requested by a State or local transportation agency. As with all gating, non-energy absorbing terminals, it should not be used in locations where there is inadequate run out distance immediately behind and parallel to the railing itself. Based on the final position of the pickup truck in test 3-31, approximately 53 m (175 feet) of barrier proper should be used in advance of a fixed object hazard when a non-energy absorbing design like the SRT is used to terminate the barrier.

Sincerely yours,

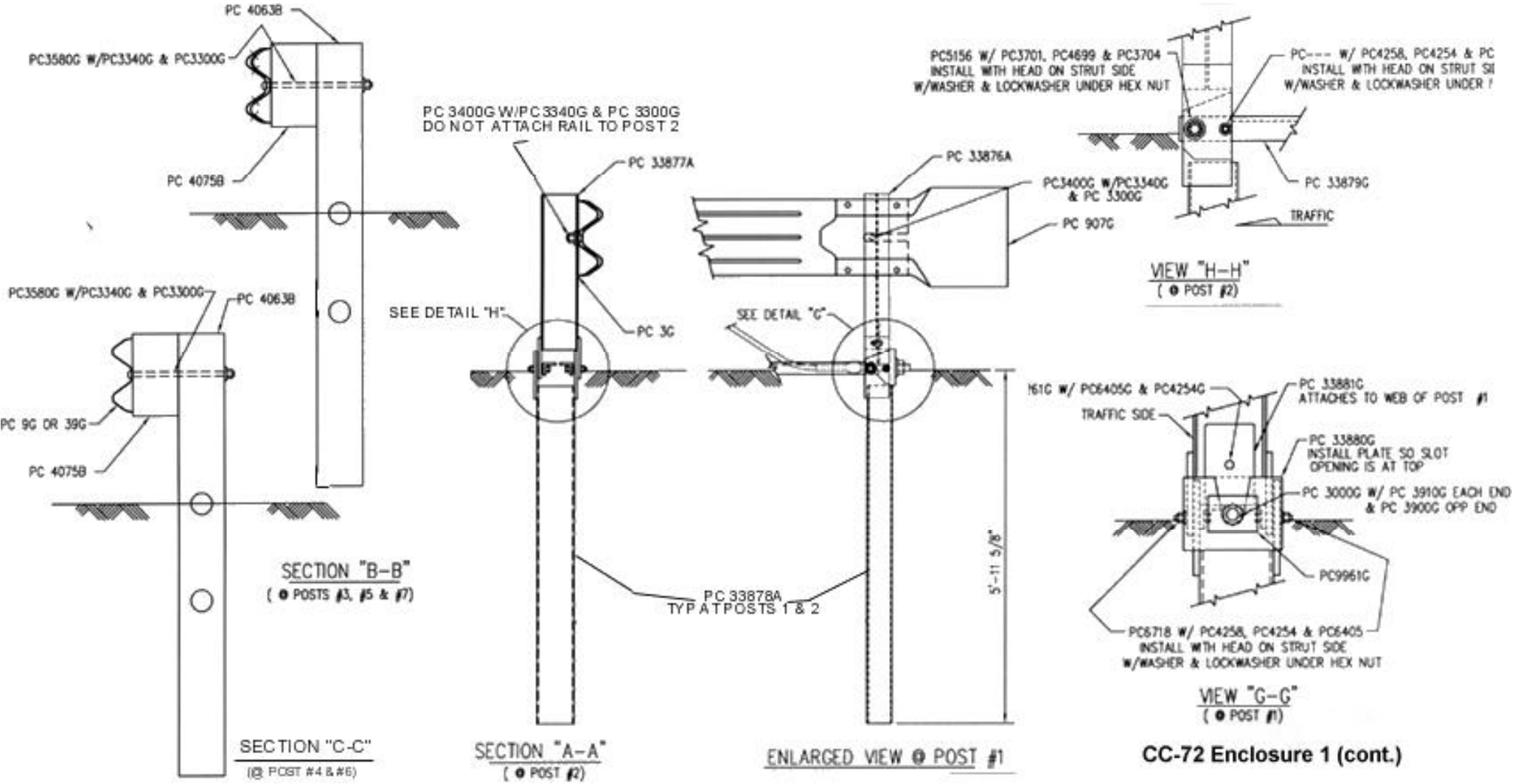
(original signed by Rudolph M. Umbs)
for
Frederick G. Wright, Jr.
Program Manager, Safety

2 Enclosures

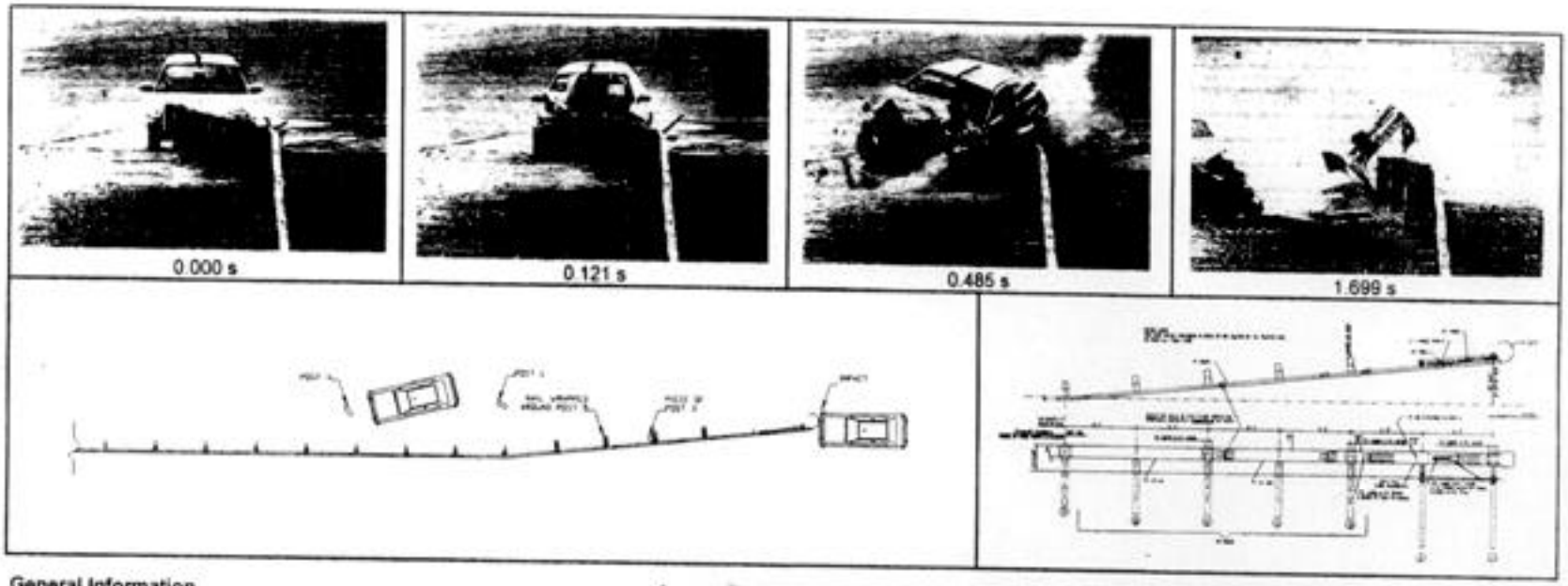
SRT - 350



CC- 2 Enclosure 1



CC-72 Enclosure 1 (cont.)



General Information
- Test Agency ..... Texas Transportation Institute
- Test No. 400001-SRT5
- Date 10/06/00

Test Article
- Type ..... Terminal
- Name ..... Linear SRT w/ith Steel HBA Posts
- Installation Length (m) 53.3
- Material or Key Elements ... Slotted Rail Panels with 1220 mm Linear Flare and Steel HBA Posts

Soil Type and Condition .... Standard Soil, Dry

Test Vehicle
- Type ..... Production
- Designation 820C
- Model ..... 1995 Geo Metro
- Mass (kg)
  - Curb 868
  - Test Inertial 820
  - Dummy 76
  - Gross Static 896

Impact Conditions
- Speed (km/h) 102.0
- Angle (deg) 0.4

Exit Conditions
- Speed (km/h) 25.4
- Angle (deg) 26.4

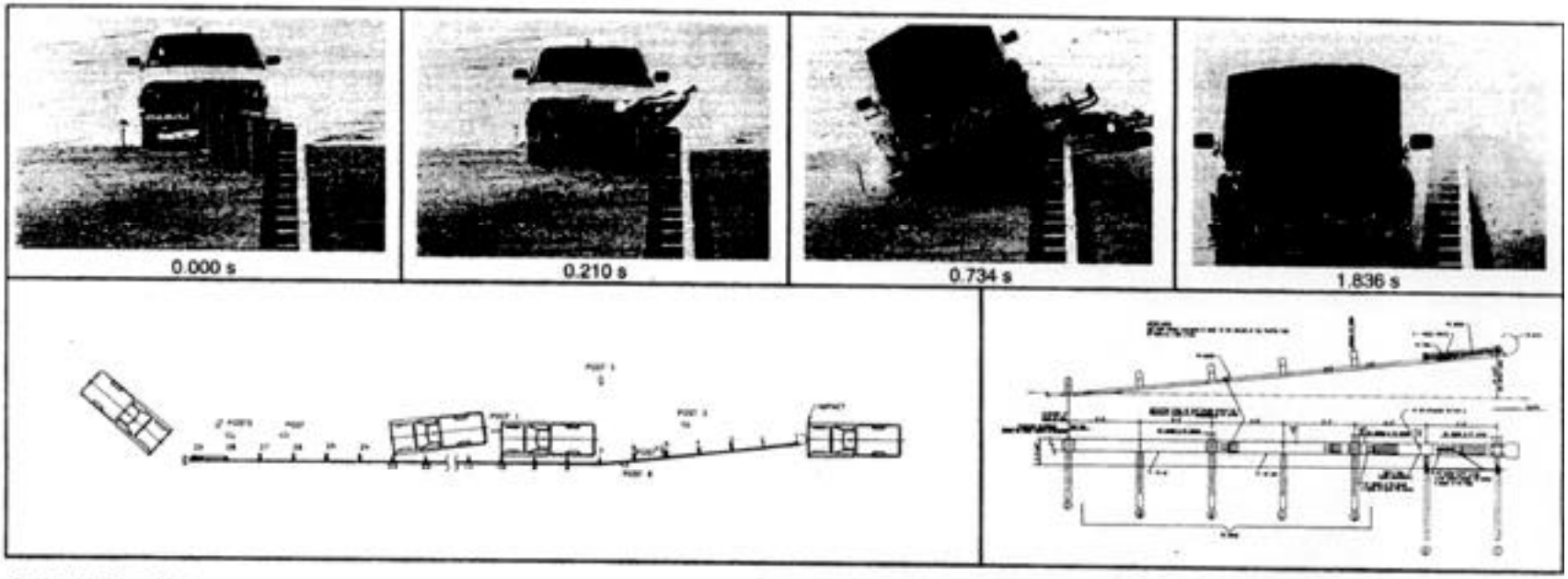
Occupant Risk Values
- Impact Velocity (m/s)
  - x-direction 7.3
  - y-direction ..... -0.2
- THIV (km/h) 26.6
- Ridedown Accelerations (g's)
  - x-direction ..... -12.1
  - y-direction 7.4
- PHD (g's) 13.0
- ASI 0.70
- Max. 0.050-s Average (g's)
  - x-direction ..... -8.2
  - y-direction 2.8
  - z-direction ..... -4.1

Test Article Deflections (m)
- Dynamic 7.60
- Permanent 7.60

Vehicle Damage
- Exterior
  - VDS 12FD7
  - CDC 12FDEW7
- Maximum Exterior
  - Vehicle Crush (mm) 320
- Interior
  - OCDI FS0010000
- Max. Occ. Compart. Deformation (mm) 43I

Post-Impact Behavior (during 1.0 s after impact)
- Max. Yaw Angle (deg) 25
- Max. Pitch Angle (deg) ..... -12
- Max. Roll Angle (deg) ..... -19

Figure 30. Summary of results for test 400001-SRT5, *NCHRP Report 350* test 3-30.



General Information
- Test Agency ..... Texas Transportation Institute
- Test No. 220546-19
- Date 01/14/00

Test Article
- Type ..... Terminal
- Name ..... Linear SRT with Steel HBA Posts
- Installation Length (m) 53.3
- Material or Key Elements ... Slotted Rail Panels with 1220 mm Linear Flare and Steel HBA Posts

Soil Type and Condition .... Standard Soil, Dry

Test Vehicle
- Type ..... Production
- Designation 2000P
- Model ..... 1994 Chevrolet 2500 Pickup Truck
- Mass (kg)
  - Curb 1969
  - Test Inertial 2000
  - Dummy ..... No dummy
  - Gross Static 2000

Impact Conditions
- Speed (km/h) 102.2
- Angle (deg) 0

Exit Conditions
- Speed (km/h) ..... N/A
- Angle (deg) 0

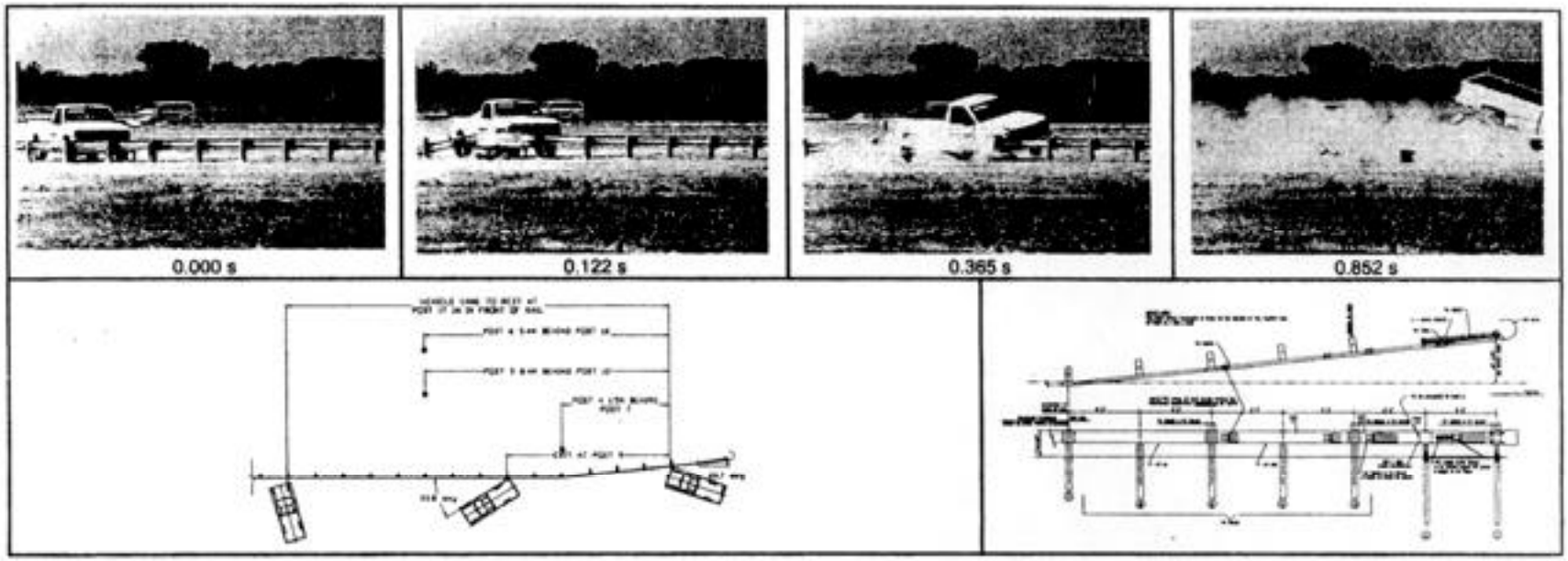
Occupant Risk Values
- Impact Velocity (m/s)
  - x-direction 5.7
  - y-direction ..... No contact
- THIV (km/h) 20.6
- Ridedown Accelerations (g's)
  - x-direction ..... -4.7
  - y-direction 3.0
- PHD (g's) 6.6
- ASI 0.46
- Max. 0.050-s Average (g's)
  - x-direction ..... -5.6
  - y-direction ..... -1.3
  - z-direction 2.8

Test Article Deflections (m)
- Dynamic 11.4
- Permanent 11.4

Vehicle Damage
- Exterior
  - VDS 12FD2
  - CDC 12FDEW2
- Maximum Exterior Vehicle Crush (mm) 490
- Interior
  - OCDI FS0000000
- Max. Occ. Compart. Deformation (mm) ..... nil

Post-Impact Behavior (during 1.0 s after impact)
- Max. Yaw Angle (deg) ..... -6
- Max. Pitch Angle (deg) 6
- Max. Roll Angle (deg) 26

Figure 16. Summary of results for test 220546-19, *NCHRP Report 350* test 3-31.



General Information

Test Agency	Texas Transportation Institute
Test No.	400001-SRT2
Date	07/11/00

Test Article

Type	Terminal
Name	Linear SRT with Steel HBA Posts
Installation Length (m)	53.3
Material or Key Elements	Slotted Rail Panels with 1220 mm Linear Flare and Steel HBA Posts
Soil Type and Condition	Standard Soil, Dry

Test Vehicle

Type	Production
Designation	2000P
Model	1995 Chevrolet 2500 Pickup Truck
Mass (kg)	
Curb	2153
Test Inertial	2000
Dummy	No dummy
Gross Static	2000

Impact Conditions

Speed (km/h)	100.2
Angle (deg)	20.7

Exit Conditions

Speed (km/h)	50.7
Angle (deg)	33.8

Occupant Risk Values

Impact Velocity (m/s)	
x-direction	4.7
y-direction	3.8
THIV (km/h)	21.1
Ridedown Accelerations (g's)	
x-direction	-6.9
y-direction	-7.4
PHD (g's)	9.7
ASI	0.60
Max. 0.050-s Average (g's)	
x-direction	-4.6
y-direction	-4.5
z-direction	4.7

Test Article Deflections (m)

Dynamic	1.28
Permanent	0.70

Vehicle Damage

Exterior	
VDS	01RFQ3
CDC	01FREK3 & 01RYEW3
Maximum Exterior	
Vehicle Crush (mm)	360
Interior	
OCDI	FS0000000
Max. Occ. Compart.	
Deformation (mm)	5

Post-Impact Behavior

(during 1.0 s after impact)

Max. Yaw Angle (deg)	-50
Max. Pitch Angle (deg)	-24
Max. Roll Angle (deg)	17

Figure 23. Summary of results for test 400001-SRT2, *NCHRP Report 350* test 3-35.