U.S. Department
of Transportation
Federal Highway
Administration

400 Seventh St., S.W.
Washington, D.C. 20590

November 1, 2000

Refer to: HSA-1/HSA-B64A

Gary L. Hoffman, P.E.
Chief Engineer, Highway Administration
Pennsylvania Department of Transportation
P.O. Box 2951
Harrisburg, PA 17105-2951

Dear Mr. Hoffman:

In your September 22 letter to Mr. Dwight Horne, the former Director of the Federal Highway Administration's (FHWA) Office of Highway Safety, you requested formal acceptance of a modified weak-post w-beam guiderail. To support your request, you included copies of two reports prepared by the Texas Transportation Institute, "NCHRP Report 350 Test 3-11 on the Modified PennDOT Type 2 Guide Rail – Test 3," dated June 2000, and "NCHRP Report 350 Test 3-10 on the Modified PennDOT Type 2 Guide Rail – Test 4," dated July 2000. You also sent videotapes, CD-ROMS, and photographs of the tests that were conducted to qualify the new design as a test level 3 (TL-3) barrier.

The original weak-post w-beam was successfully tested at 70 km/h to NCHRP Report 350 test level 2 (TL-2), but failed to contain the pickup truck at the TL-3 speed of 100 km/h. Based on finite element analysis coupled with additional full-scale testing, a modified design was successfully tested, the results of which are detailed in the reports listed above. The significant changes in the design include:

- The top rail height was increased by two inches (50 mm) to 32.3 inches (820 mm)
- Rail splices were located mid-span between posts rather than at a post
- A 12-inch (300-mm) w-beam backup plate (12 Gage) was added at each post location
- Minor changes included the use of two square washers on the traffic side of the post connection bolts and a single round washer and double nut connection on the opposite side of these bolts

These details are shown in Enclosure 1 and summary results of the two full-scale tests are shown in Enclosure 2.

You noted in your letter that several posts pulled out of the ground in each test and that the gas tank of the small car was torn in the test with that vehicle. The test installation used standard length posts that had two inches less embedment than usual as a result of the increased rail height. Consequently, you plan to increase the post lengths to 65 inches and to lengthen the soil plate by

2 inches (to within 2 inches of the bottom of the posts) to increase the soil friction. Although the ruptured gas tank is a cause for concern, we agree with your analysis that found such an event to be rare and not likely repeatable in a crash test. Using longer posts should further minimize the likelihood of a recurrence of this event.

The weak-post w-beam traffic barrier, as described above, may be considered an NCHRP Report 350 barrier at TL-3 and used on the National Highway System (NHS) when such use is requested by the appropriate transportation agency. The guardrail terminals located on the approach end of the weak-post w-beam guiderail on a high-speed, high-volume NHS route must likewise be a crashworthy design if they are located within the minimum clear zone distance for that particular roadway. As noted in the American Association of State Highway and Transportation Officials (AASHTO)-FHWA Agreement on NCHRP Report 350 Implementation, the turned-down terminal normally used to anchor this system is not considered crashworthy. However, any of the accepted Report 350 w-beam terminals can be transitioned to and used with the weak-post design. You may call Mr. Richard Powers of my staff directly at (202) 366-1320 if you have any questions regarding this letter.

Sincerely yours,

Frederick G. Wright, Jr.
Program Manager, Safety

2 Enclosures

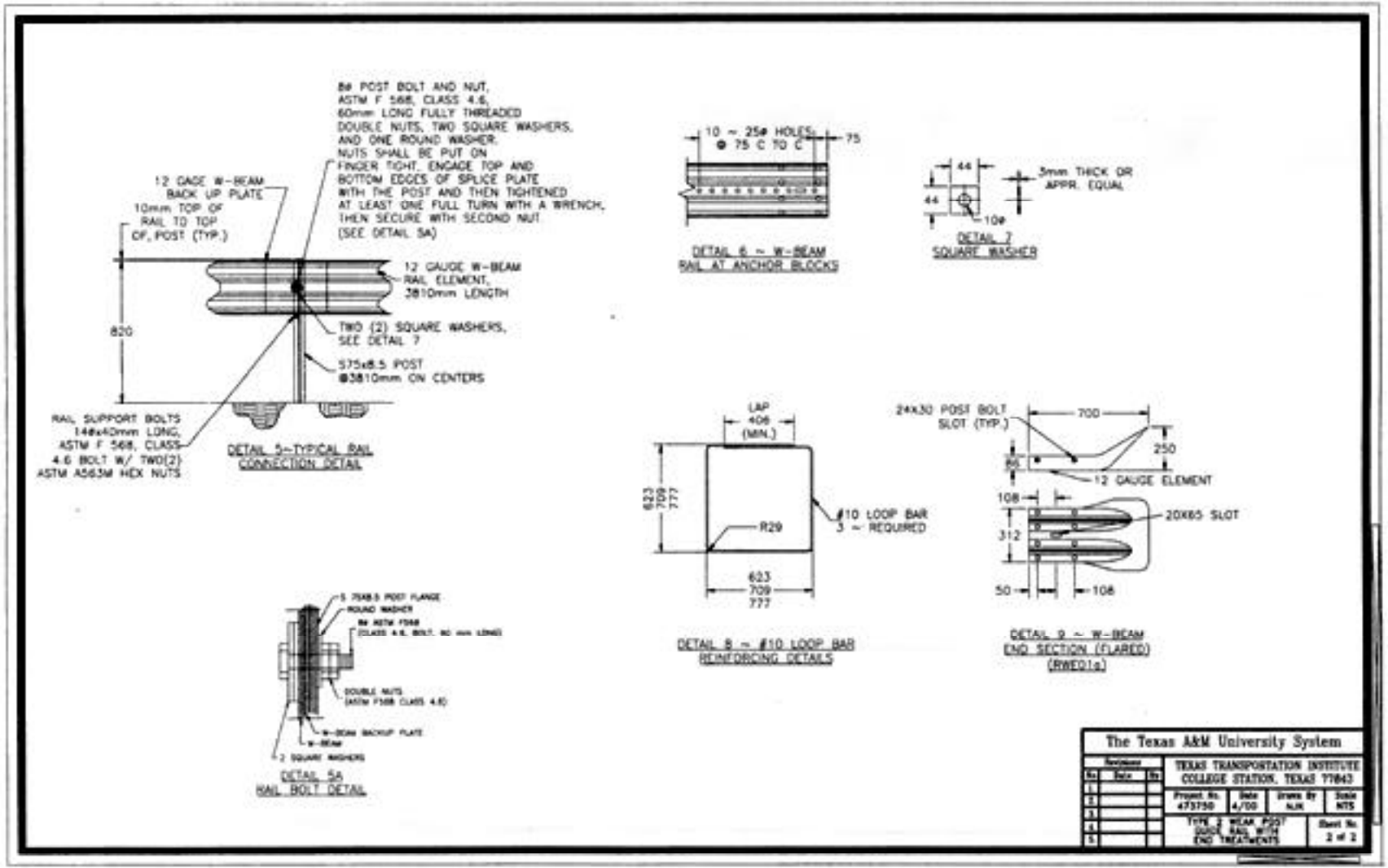
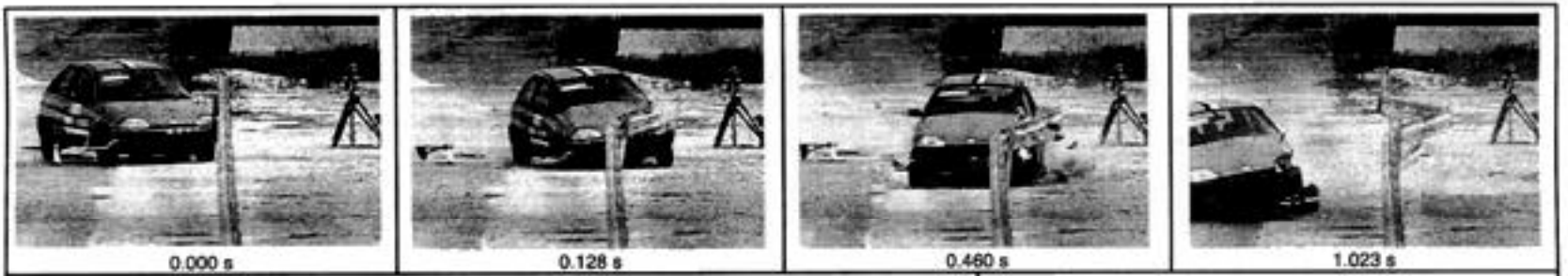
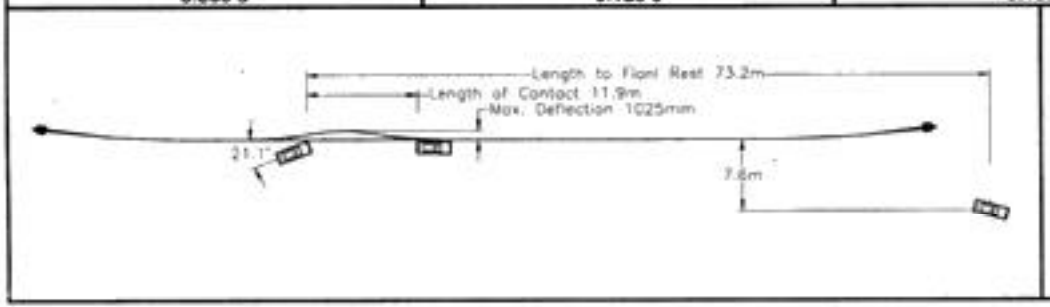
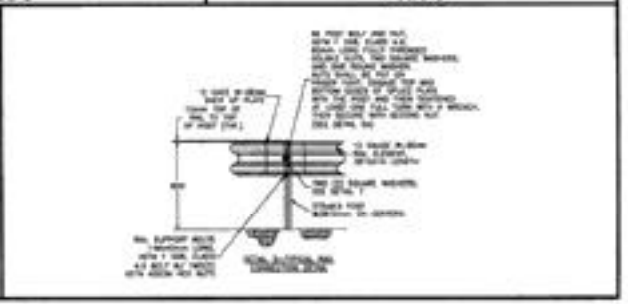


Figure 1. Details of the PennDOT Type 2 guide rail for test 473750-4 (continued).







General Information

Test Agency	Texas Transportation Institute
Test No.	473750-4
Date	06/22/00

Test Article

Type	Guide Rail
Name or Manufacturer	Modified Penn DOT Type 2 Guide Rail
Installation Length (m)	99.0
Material or Key Elements	W-beam Guide Rail w S3x5.7 Posts & Backup Plates
Soil Type and Condition	Standard Soil, Dry

Test Vehicle

Type	Production
Designation	820C
Model	1997 Geo Metro
Mass (kg)	
Curb	827
Test Inertial	820 (1806 lb)
Dummy	76 (168 lb)
Gross Static	896 (1974 lb)

Impact Conditions

Speed (km/h)	100.5 (62.4 mi/h)
Angle (deg)	21.1

Exit Conditions

Speed (km/h)	78.4 (48.7 mi/h)
Angle (deg)	1.0

Occupant Risk Values

Impact Velocity (m/s)	
x-direction	3.3 (10.8 ft/s)
y-direction	4.5 (14.8 ft/s
THIV (km/h)	18.3 (1.1 mi/h)
Ridedown Accelerations (g's)	
x-direction	-6.0
y-direction	5.0
PHD (g's)	12.3
ASI	0.56
Max. 0.050-s Average (g's)	
x-direction	-2.8
y-direction	4.6
z-direction	-2.5

Test Article Deflections (m)

Dynamic	1.025 (3.4 ft)
Permanent	0.940 (3.0 ft)

Vehicle Damage

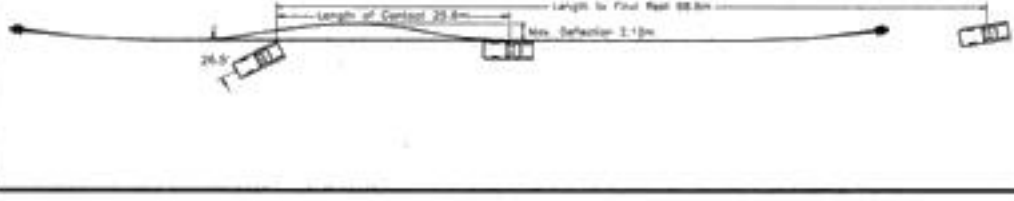
Exterior	
VDS	11LFQ2
CDC	11FLEK2 & 11IDEW2
Maximum Exterior Vehicle Crush (mm)	200 (7.9 in)
Interior	
OCDI	FS0000000
Max. Occ. Compart. Deformation (mm)	6 (0.25 in)

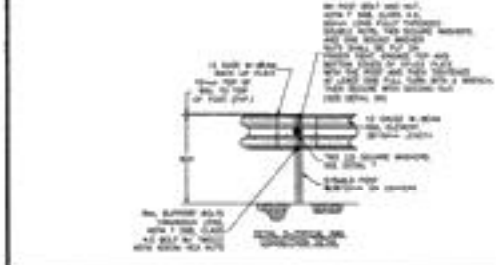
Post-Impact Behavior

(during 1.0 s after impact)

Max. Yaw Angle (deg)	43
Max. Pitch Angle (deg)	4
Max. Roll Angle (deg)	-11

Figure 10. Summary of Results for test 473750-4, *NCHRP Report 350* test 3-10.





General Information
- Test Agency ..... Texas Transportation Institute
- Test No. 473750-3
- Date 05/09/00

Test Article
- Type ..... Guide Rail
- Name or Manufacturer ..... Modified Penn DOT Type 2 Guide Rail
- Installation Length (m) 99.0
- Material or Key Elements ... W-beam Guide Rail w S3x5.7 Posts & Backup Plates

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

Test Vehicle
- Type ..... Production
- Designation 2000P
- Model ..... 1995 Chevrolet 2500 Pickup Truck
- Mass (kg)
  - Curb 2104
  - Test Inertial 2000
  - Dummy ..... No Dummy
  - Gross Static 2000

Impact Conditions
- Speed (km/h) 102.4
- Angle (deg) 26.5

Exit Conditions
- Speed (km/h) 59.3
- Angle (deg) ..... -2

Occupant Risk Values
- Impact Velocity (m/s)
  - x-direction 3.9
  - y-direction 4.2
- THIV (km/h) 18.5
- Ridedown Accelerations (g's)
  - x-direction ..... -5.9
  - y-direction 6.4
- PHD (g's) 8.8
- ASI 0.53
- Max. 0.050-s Average (g's)
  - x-direction ..... -3.4
  - y-direction 4.0
  - z-direction ..... -1.9

Test Article Deflections (m)
- Dynamic 2.12
- Permanent 1.64

Vehicle Damage
- Exterior
  - VDS 11LFQ2
  - CDC ..... 11FLEK2 & 11IDEW2
- Maximum Exterior Vehicle Crush (mm) 230
- Interior
  - OCDI FS0000000
- Max. Occ. Compart. Deformation (mm) ..... nil

Post-Impact Behavior (during 1.0 s after impact)
- Max. Yaw Angle (deg) 36
- Max. Pitch Angle (deg) ..... -5
- Max. Roll Angle (deg) ..... -12

Figure 11. Summary of results for test 473750-3, *NCHRP Report 350* test 3-11.