June 4, 1999 Refer to: HMHS-CC51A

Mr. King K. Mak
Research Engineer
Safety & Structural Systems Division
Texas Transportation Institute
College Station, TX 77843-3135

Dear Mr. Mak:

In your April 26 letter to me you requested the Federal Highway Administration's acceptance at the National Cooperative Highway Research Program (NCHRP) Report 350 test level 3 (TL-3) of an Improved Slotted Rail Terminal having a 1.22-m end offset. I have previously accepted a similar design with a 0.9-m end offset (initially called the Improved Slotted Rail Terminal or ISRT and subsequently marketed as the ROSS - Reduced Offset Slotted System) in my June 18, 1998 letter to you. The primary difference in the new 1.22-m offset design from the original Slotted Rail Terminal (SRT) design is an increase in the post spacing, which reduced the number of CRT posts from eight to six, as was done with the ROSS, and the addition of a steel strap below the post bolt holes on the first two posts.

To support your request, you sent me copies of two reports prepared at the Texas Transportation Institute by K. K. Mak, H. E. Ross, Jr., R. P. Bligh, and W. C. Menges: "Improved W-Beam Slotted Rail Terminal With 1.22-M End Offset," dated December 1998, and "Improved W-Beam Slotted Rail Terminal with 1.22-m End Offset and Steel Line Posts," dated April 1999. You also sent video tapes showing the tests that you ran on each design. A summary of each test is enclosed as Enclosure 1. Enclosure 2 shows the design details of the Improved Slotted Rail Terminal with a 1.22-m offset. A 19-mm wide, 0.38-mm thick steel strap was added approximately 25 mm below the post bolt hole in posts 1 and 2 to lessen the likelihood of these posts splitting under tensile loading.

Based on staff review of the material you submitted, the Improved Slotted Rail Terminal with a 1.22-m offset is acceptable for use on the National Highway System when installed with either steel or wood line posts. Since I have previously accepted this terminal with a 0.9-m offset, an intermediate offset design of 1.07 m can also be considered acceptable, as you requested. The appropriate post offsets for each of the three variations are shown in Table 1 (Enclosure 3). The 19 mm steel strap must be used on posts 1 and 2 when the 1.07-m offset layout is used.

Finally, you also asked to standardize the slot pattern in the second w-beam panel with two sets of 305-mm long slots and stated that such standardization would have no adverse effect on system performance. Since our review of tests previously conducted with the three-slot panel showed that the middle set of slots did not activate in either end-on test, you may also consider

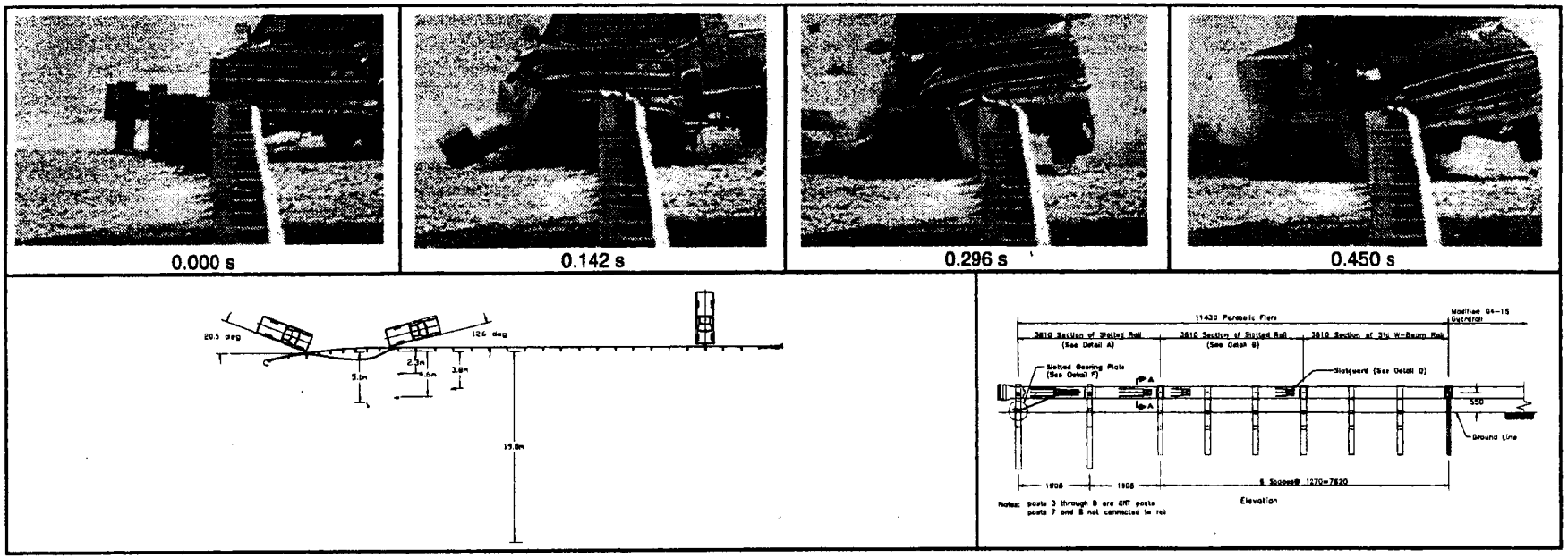
this change acceptable. The standard panel, which can be used with all previous and current slotted Rail terminals, is as shown on page 2 of Enclosure 2. The steel-tube, soil plate alternatives listed in my June 18, 1998 letter for the first two posts of the ISRT/ROSS remain acceptable for use with the 1.07-m offset and the 1.22-m offset ISRT.

Sincerely yours,

(original signed by Dwight A. Horne)

Dwight A. Horne
Director, Office of Highway Safety Infrastructure

3 Enclosures



General Information
- Test Agency ..... Texas Transportation Institute
- Test No. 220546-14
- Date 03/09/99

Test Article
- Type ..... Terminal
- Name or Manufacturer ..... Improved SRT w/ 1.2 m flare
- Installation Length (m) 53.3
- Material or Key Elements ... Slotted W-beam guardrail

Soil Type and Condition .... Standard soil, dry

Test Vehicle
- Type ..... Production
- Designation 2000P
- Model ..... 1993 Chevrolet 2500 pickup truck
- Mass (kg)
  - Curb 2083
  - Test Inertial 2000
  - Dummy ..... No dummy
  - Gross Static 2000

Impact Conditions
- Speed (km/h) 100.6
- Angle (deg) 20.5

Exit Conditions
- Speed (km/h) 48.5
- Angle (deg) 12.6

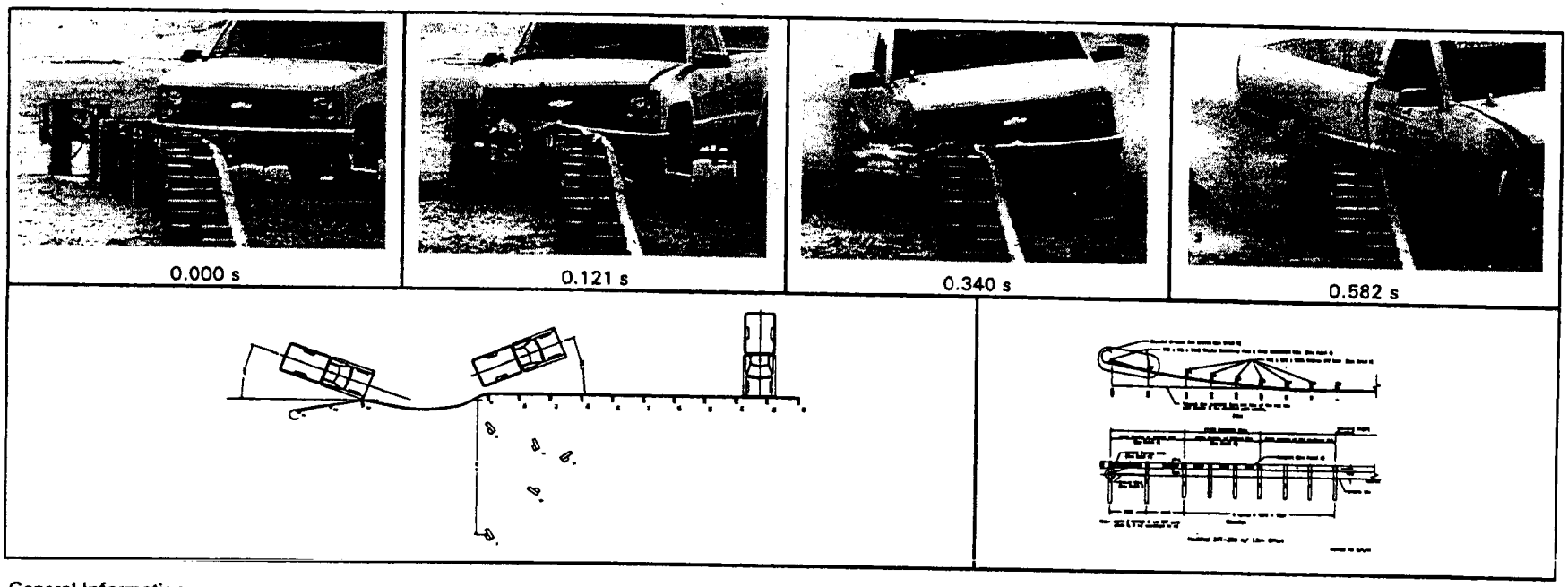
Occupant Risk Values
- Impact Velocity (m/s)
  - x-direction 4.6
  - y-direction 4.3
- THIV (km/h) 20.4
- Ridedown Accelerations (g's)
  - x-direction ..... -8.0
  - y-direction ..... -10.8
- PHD (g's) 12.6
- ASI 0.68
- Max. 0.050-s Average (g's)
  - x-direction ..... -5.6
  - y-direction ..... -4.8
  - z-direction 3.9

Test Article Deflections (m)
- Dynamic 1.37
- Permanent 1.05

Vehicle Damage
- Exterior
  - VDS 01FL3
  - CDC 01FREW3
- Maximum Exterior
  - Vehicle Crush (mm) 400
- Interior
  - OCDI FS0002000
- Max. Occ. Compart. Deformation (mm) 15

Post-Impact Behavior (during 1.0 s after impact)
- Max. Yaw Angle (deg) ..... -29
- Max. Pitch Angle (deg) ..... -6
- Max. Roll Angle (deg) 20

Figure 13. Summary of Results for test 220546-14, *NCHRP Report 350* test 3-35.



General Information

Test Agency	Texas Transportation Institute
Test No.	220546-10
Date	11/24/98

Test Article

Type	Terminal
Name or Manufacturer	Improved SRT with 1.2 m offset
Installation Length (m)	53.3
Material or Key Elements	Slotted W-beam guardrail
Soil Type and Condition	Standard soil, dry

Test Vehicle

Type	Production
Designation	2000P
Model	1995 Chevrolet 2500 pickup truck
Mass (kg)	
Curb	2145
Test Inertial	2000
Dummy	No dummy
Gross Static	2000

Impact Conditions

Speed (km/h)	100.5
Angle (deg)	20.4

Exit Conditions

Speed (km/h)	39.9
Angle (deg)	22.7

Occupant Risk Values

Impact Velocity (m/s)	
x-direction	7.2
y-direction	4.4
THIV (km/h)	25.0
Ridedown Accelerations (g's)	
x-direction	- 8.2
y-direction	- 8.2
PHD (g's)	10.9
ASI	0.70
Max. 0.050-s Average (g's)	
x-direction	-6.5
y-direction	-5.1
z-direction	3.3

Test Article Deflections (m)

Dynamic	1.03
Permanent	0.18

Vehicle Damage

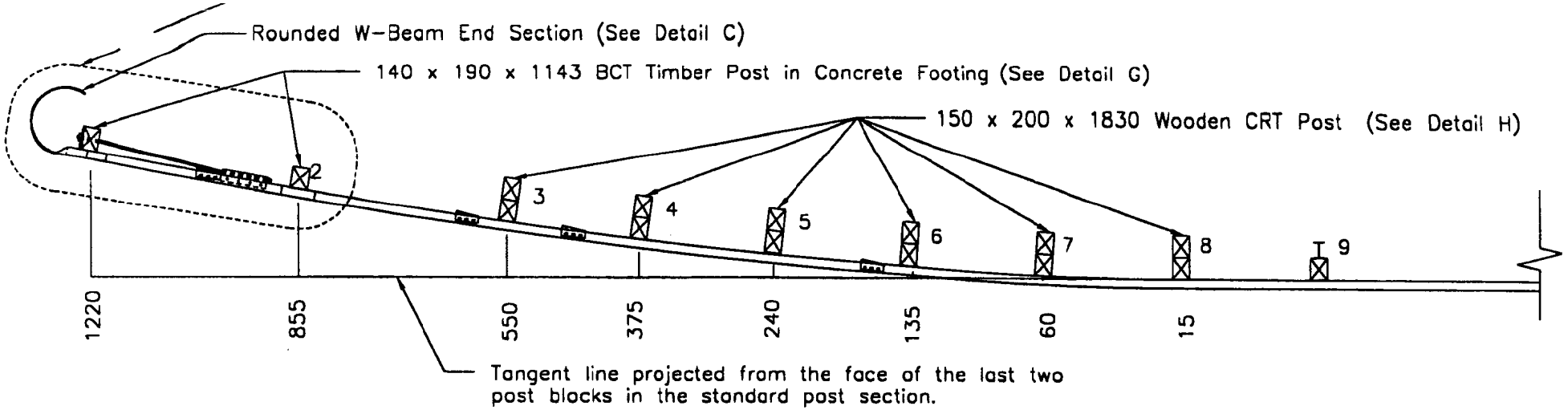
Exterior	
VDS	01FL3
CDC	01FREW3
Maximum Exterior	
Vehicle Crush (mm)	290
Interior	
OCDI	RS0000000
Max. Occ. Compart.	
Deformation (mm)	nil

Post-Impact Behavior

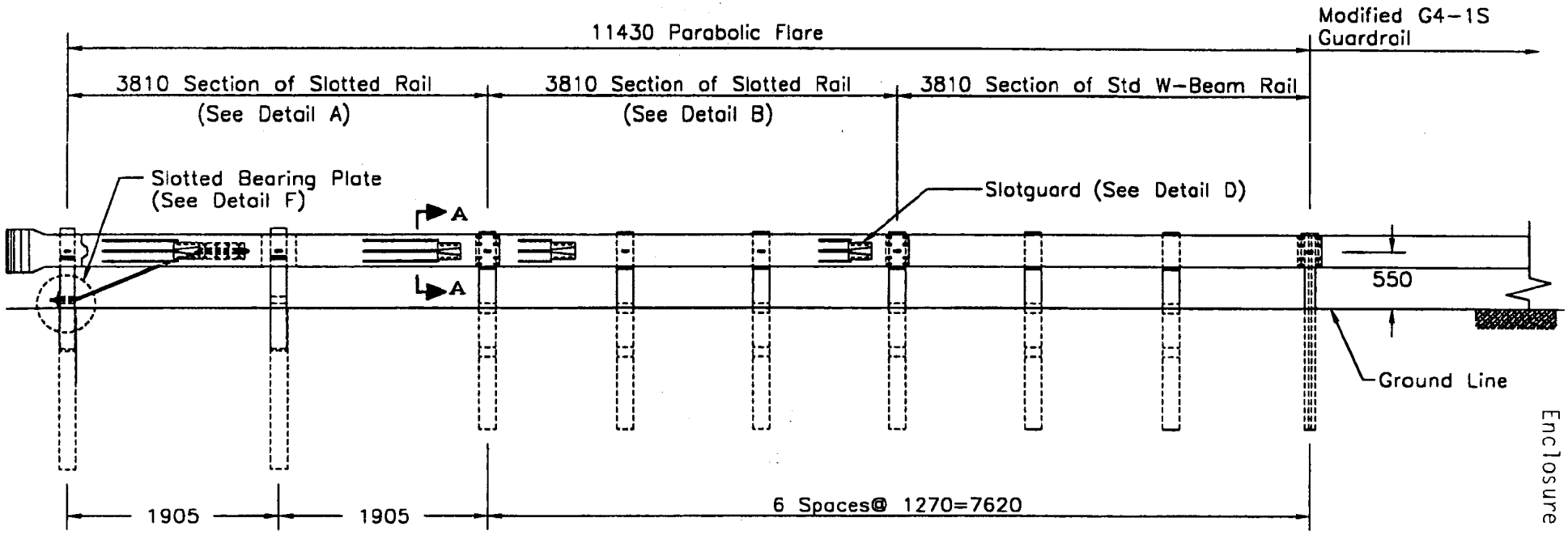
(during 1.0 s after impact)

Max. Yaw Angle (deg)	-45
Max. Pitch Angle (deg)	-8
Max. Roll Angle (deg)	18

Figure 15. Summary of results for test 220546-10, NCHRP Report 350 test 3-35.



Plan

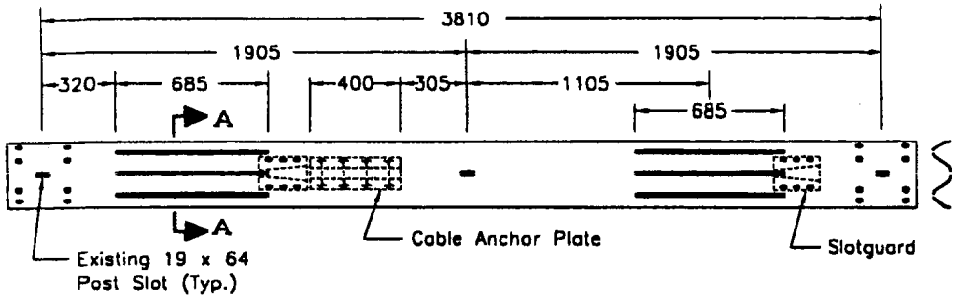


Elevation

Notes: posts 3 through 8 are CRT posts
posts 7 and 8 not connected to rail

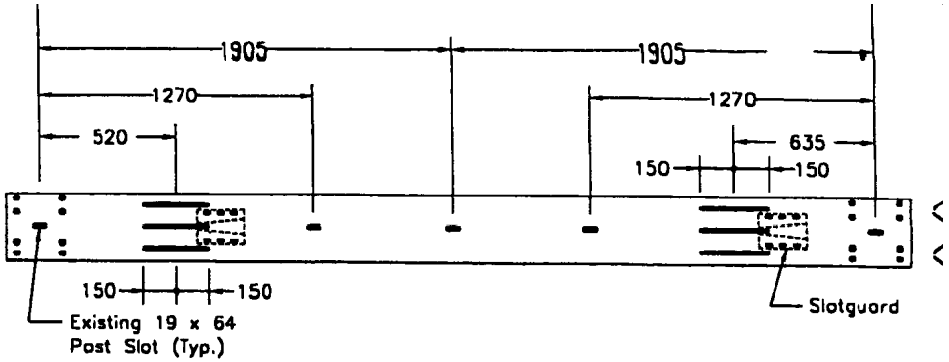
MODIFIED SRT-350

REVISED ON 1/15/99



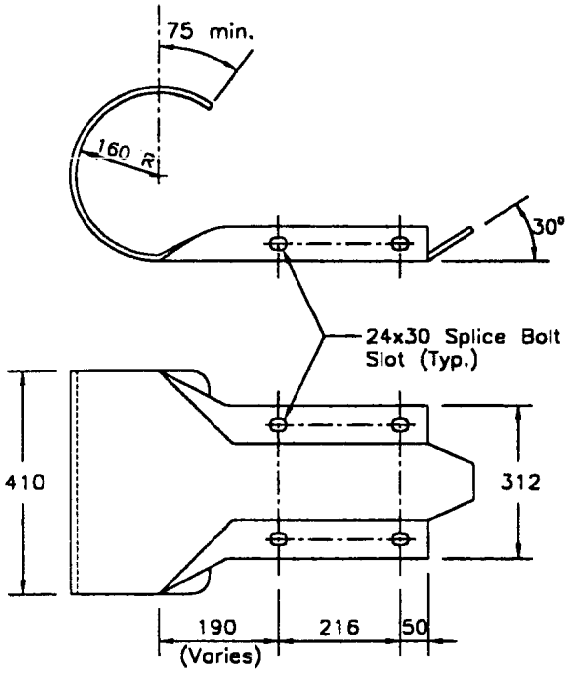
Note: At Location shown, cut three 13 mm slots. One on each peak and one in the valley of the W-beam.

DETAIL A
3810 SLOTTED RAIL ELEMENT

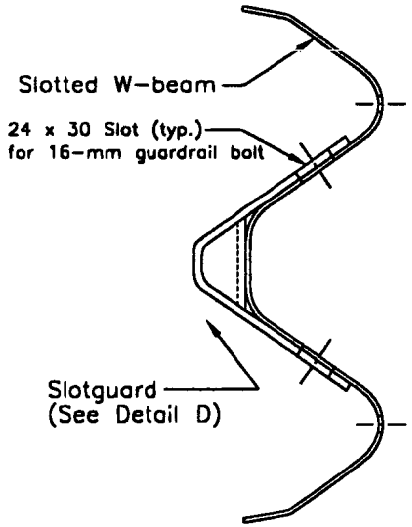


Note: At Location shown, cut three 13 mm slots. One on each peak and one in the valley of the W-beam.

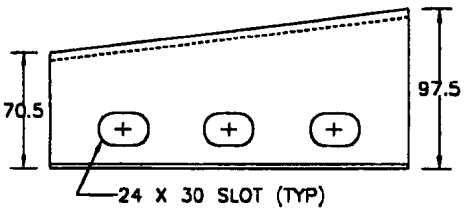
DETAIL B
3810 SLOTTED RAIL ELEMENT

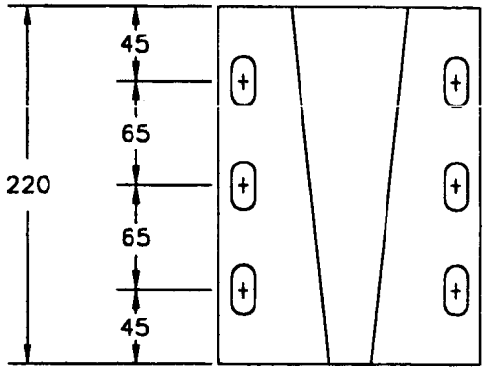


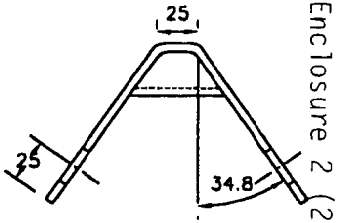
DETAIL C
ROUNDED W-BEAM END SECTION



SECTION A-A

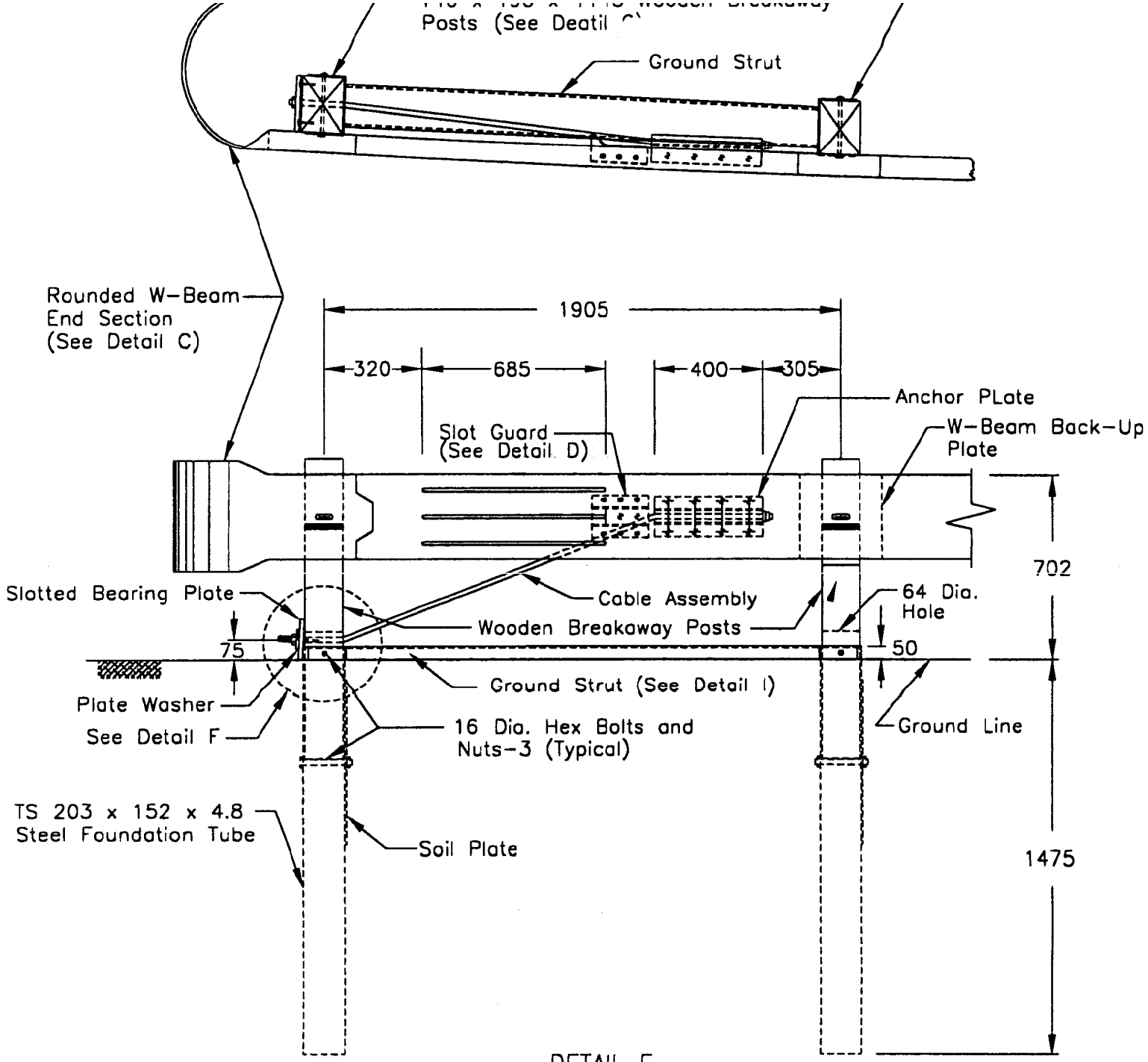






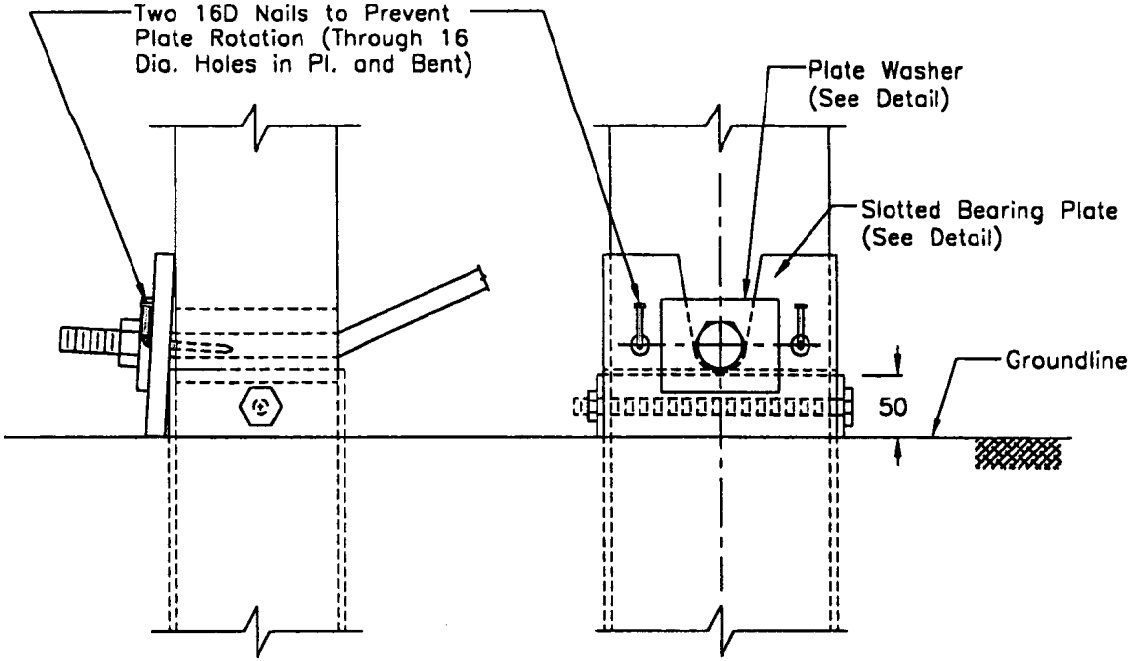
DETAIL D
SLOTGUARD

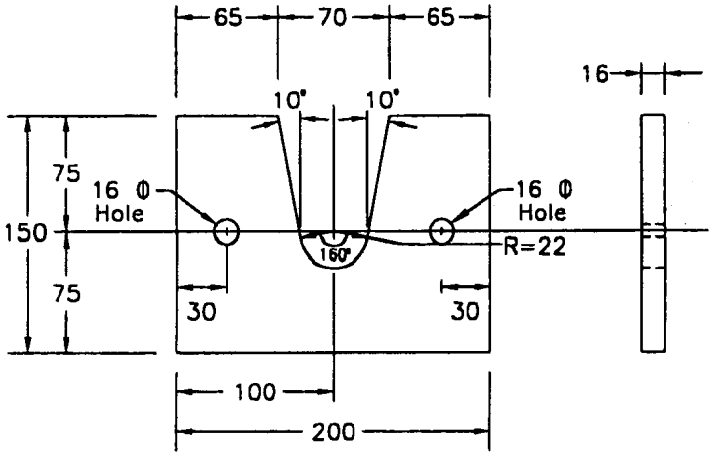
Revised on 1/15/99



DETAIL E
END ANCHORAGE ASSEMBLY

REVISED ON 1/15/99





Slotted Bearing Plate

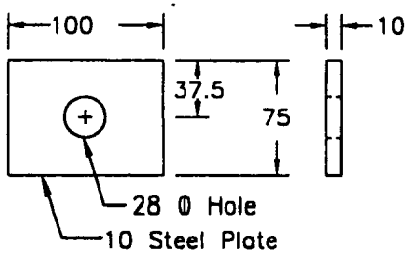
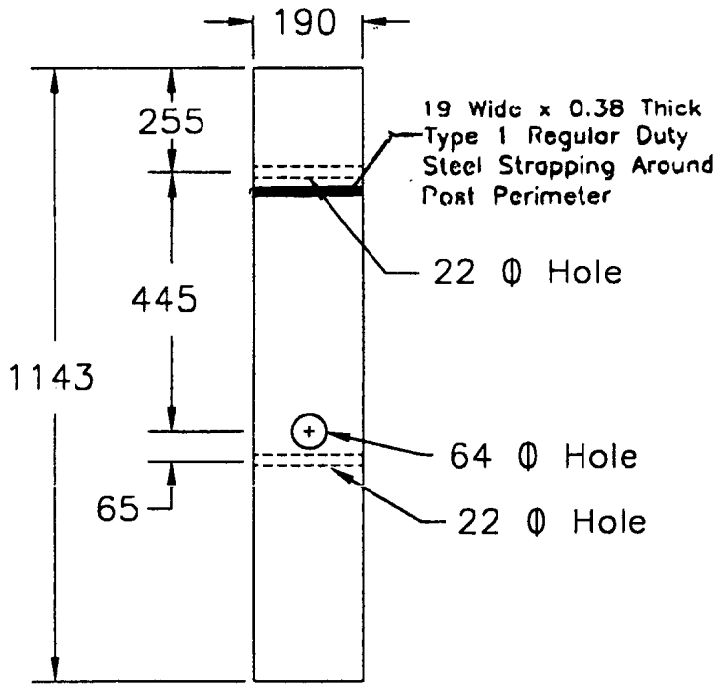
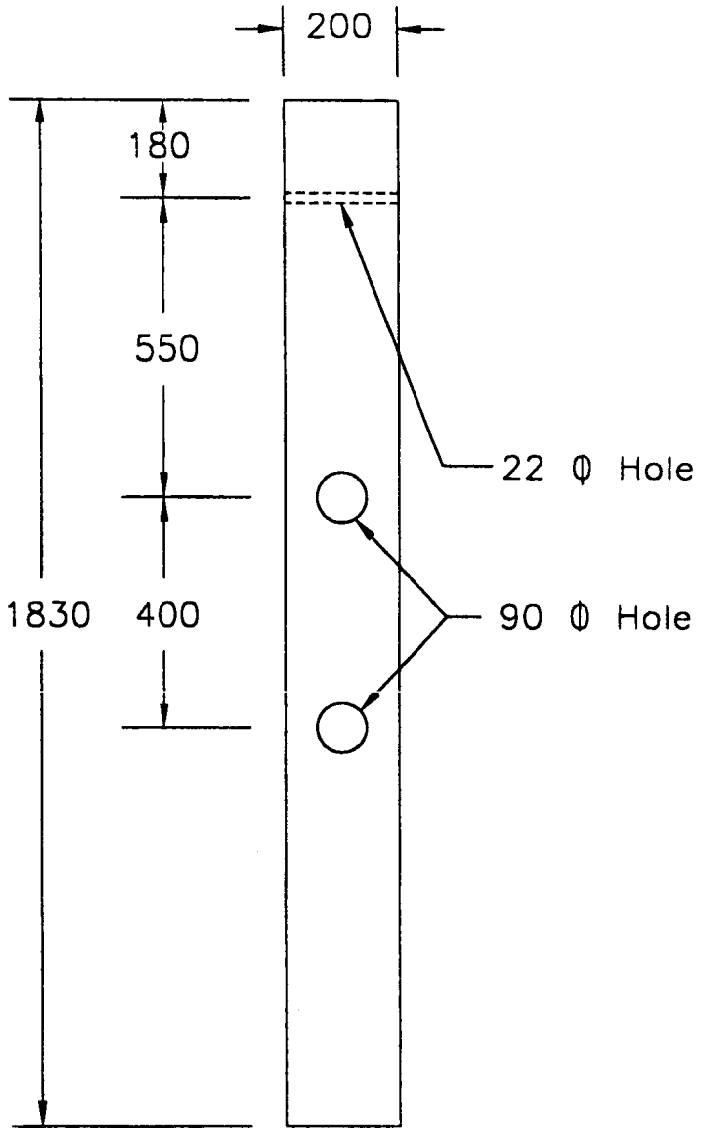


Plate Washer



DETAIL G
SHORT BREAKAWAY WOODEN POST



DETAIL H
WOODEN CRT POST

Table 1. Lateral Post Offset for End Offsets of 915, 1070 and 1220 mm

Post No.	Long. Distance (mm)	End Offset		
		915 mm	1070 mm	1220 mm
1	0	915	1070	1220
2	1905	565	705	850
3	3810	300	420	540
4	5080	170	270	375
5	6350	75	150	240
6	7620	20	70	135
7	8890	0	20	60
8	10160		0	15
9	11430			0