INFORMATION: Buried-in-backslope Guardrail Anchor — July 10, 1998

Chief, Federal-Aid and Design Division — HNG-14

Regional Administrators
Federal Lands Highway Program Administrator

The attached sketches (Attachment 1) show the design and layout concepts for three variations of the subject end anchor which were successfully tested at test level 3 (TL-3) with the 2000-kg pickup truck under a Federal Highway Administration contract. The first two tests were run on installations with a 1:10 foreslope (with and without a flat-bottomed ditch), the third on an installation with a 1:6 foreslope forming a V-ditch with a 1:4 backslope. The 1:6 variation allows the use of the buried-in-backslope system at many existing locations without requiring significant site modifications. Each test met the appropriate evaluation criteria for NCHRP Report 350 test 3-35 and is summarized in Attachment 2. The tests are described in detail in the Texas Transportation Institute reports titled "Testing and Evaluation of W-Beam Guardrails Buried-in-Backslope," dated November 1996, and "Crash Test of the G-4 W-Beam Guardrail with Terminal Buried-in-Backslope," dated March 1998.

At present, this type of end anchor is the only non-proprietary terminal design that will be acceptable for use with w-beam guardrail on the National Highway System after October 1 of this year. It should be the terminal of choice at locations where a natural backslope is reasonably close to the point where the barrier is introduced and its use at such locations should be encouraged. When properly designed and located, this type of anchor provides full shielding for the identified hazard, eliminates the possibility of an end-on impact with the barrier terminal, and minimizes the likelihood of access behind the rail.

Key design considerations include keeping the height of the w-beam rail constant relative to the roadway grade until the barrier crosses the ditch flow line, using a flare rate that is appropriate for the design speed until the flow line is reached (Note: a 22 m minimum distance upstream from the area of concern is recommended if the backslope is flat enough to allow an impacting vehicle to climb over the anchor), adding a rubrail, and using an anchor (concrete block or steel post) that is capable of developing the full tensile strength of the w-beam rail.

Detailed drawings of the above designs are available from the Office of Highway Safety and are expected to be distributed shortly.

(original signed by Dwight A. Horne)

Dwight A. Horne

2 Attachments
Acceptance Letter CC-53

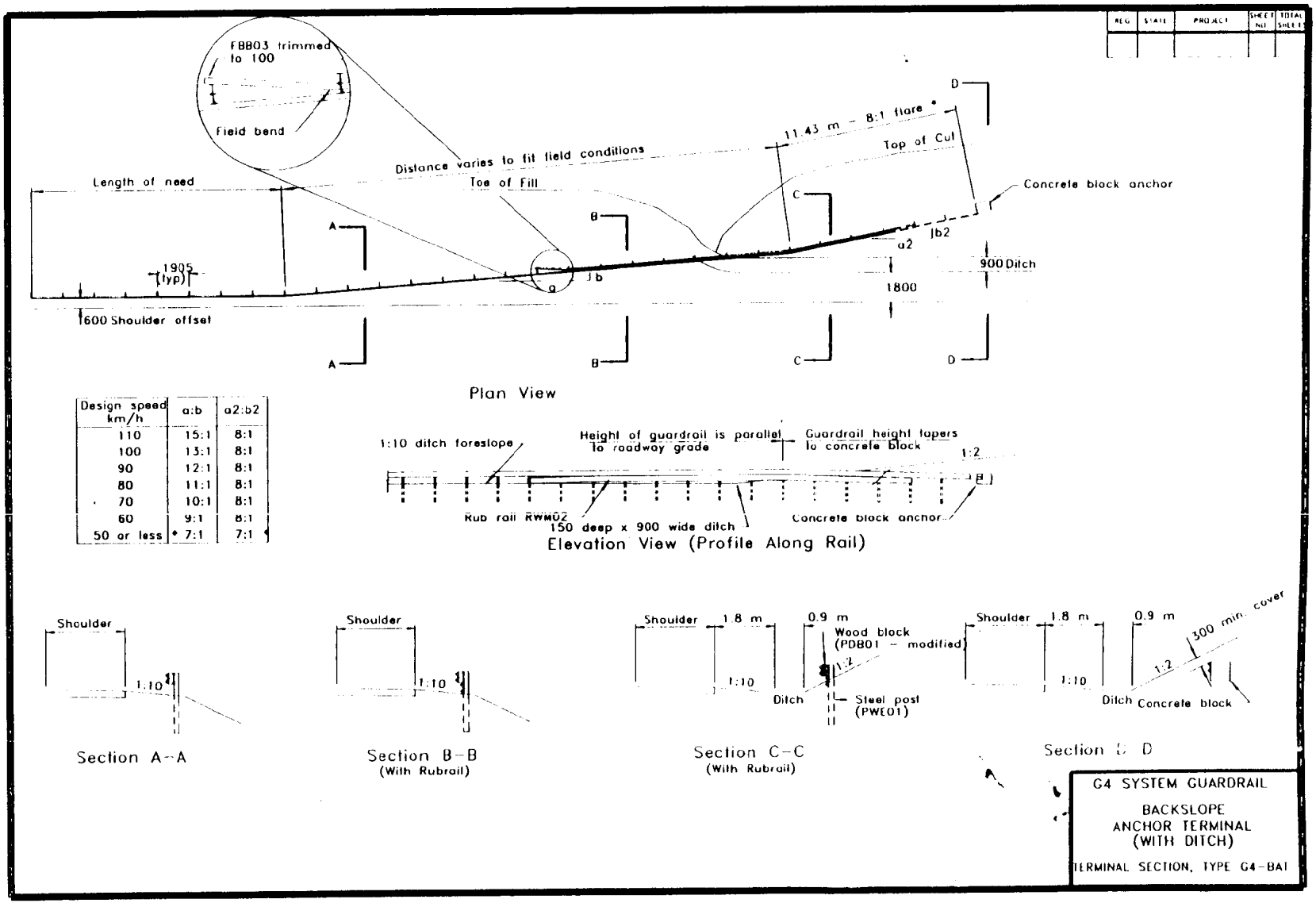


Figure 1. Details of the W-beam guardrail buried-in-backslope (with ditch) installation.

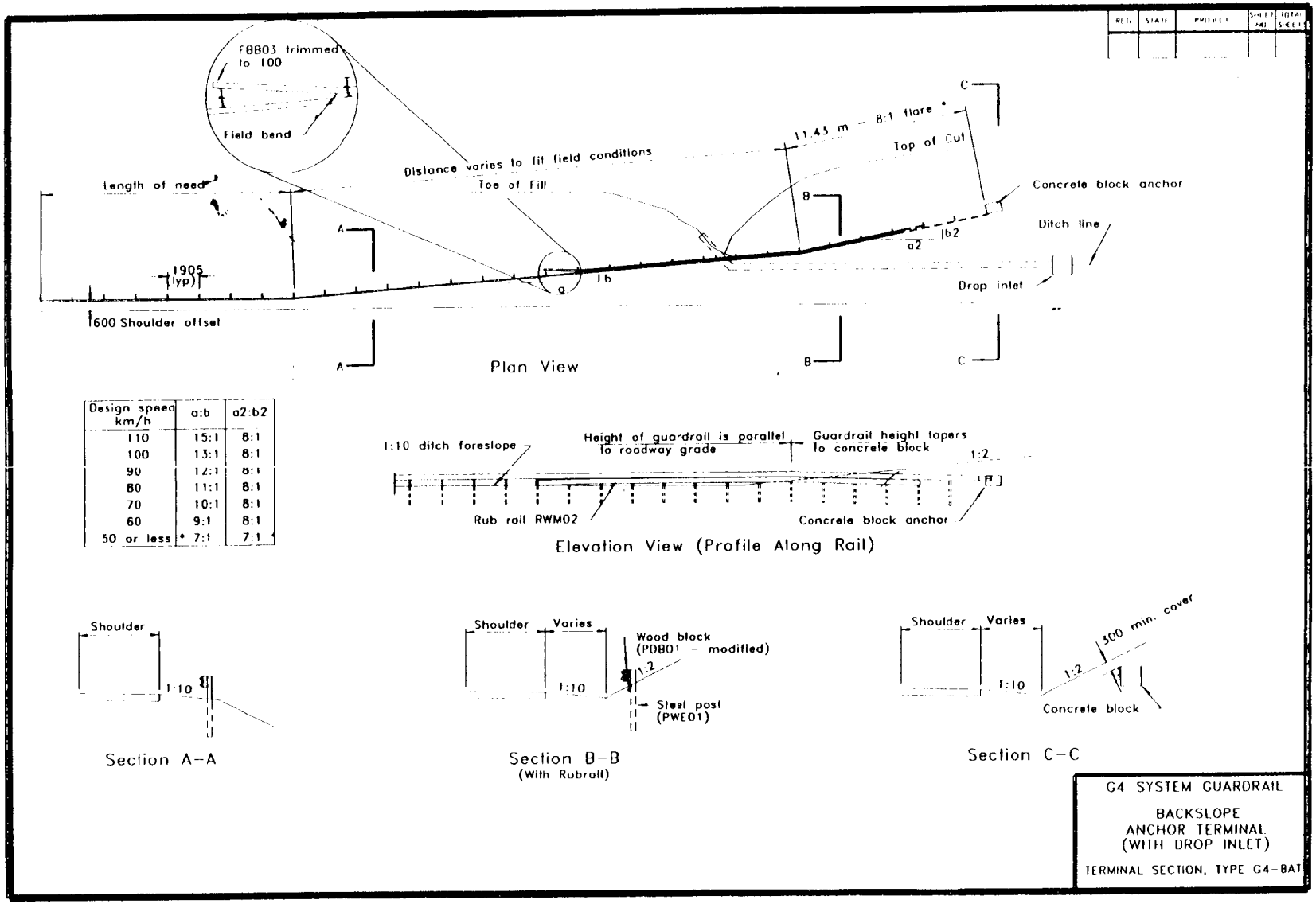


Figure 2. Details of the W-beam guardrail buried-in-backslope (with drop inlet) installation.

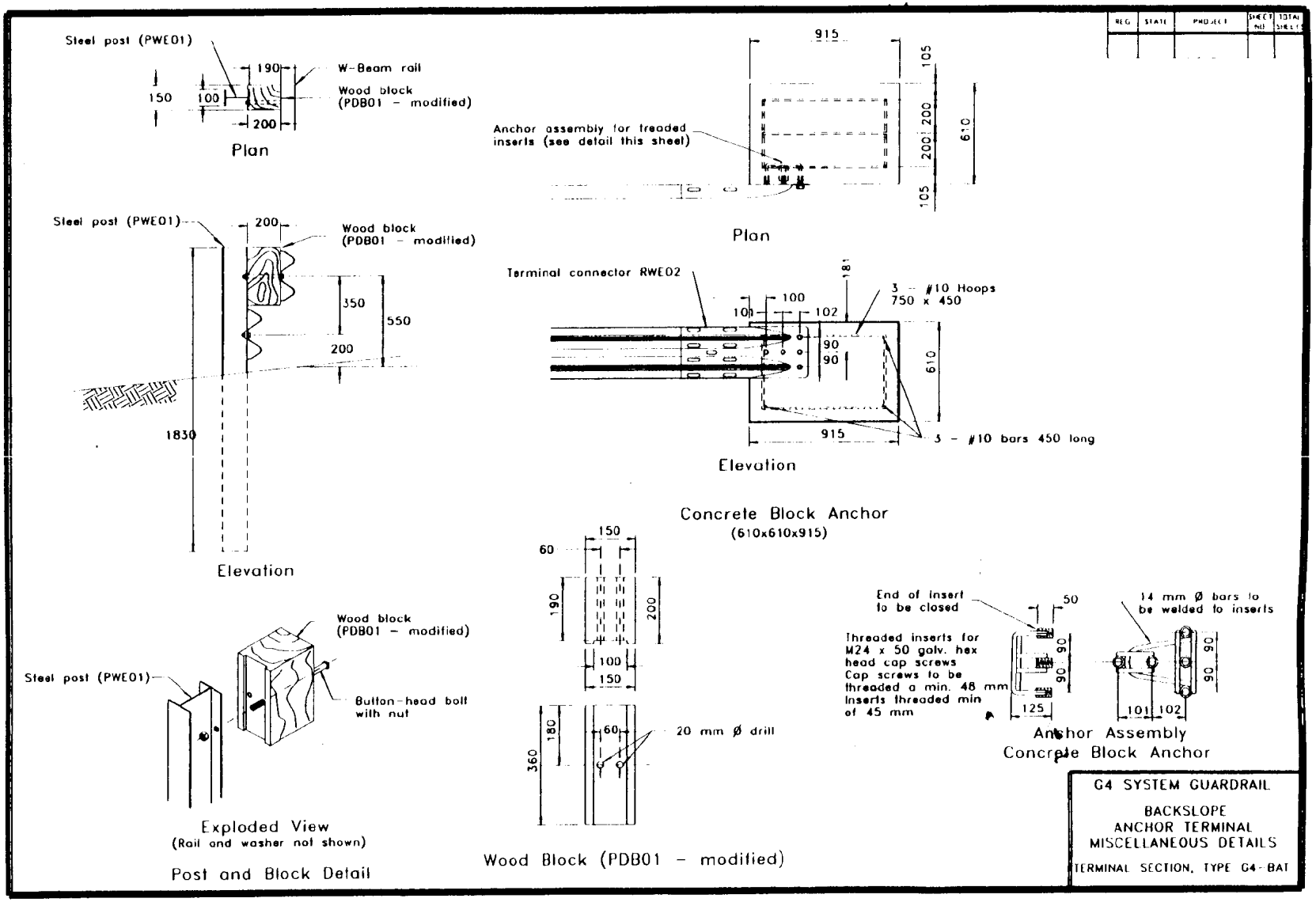


Figure 3. Miscellaneous backslope anchor terminal details.

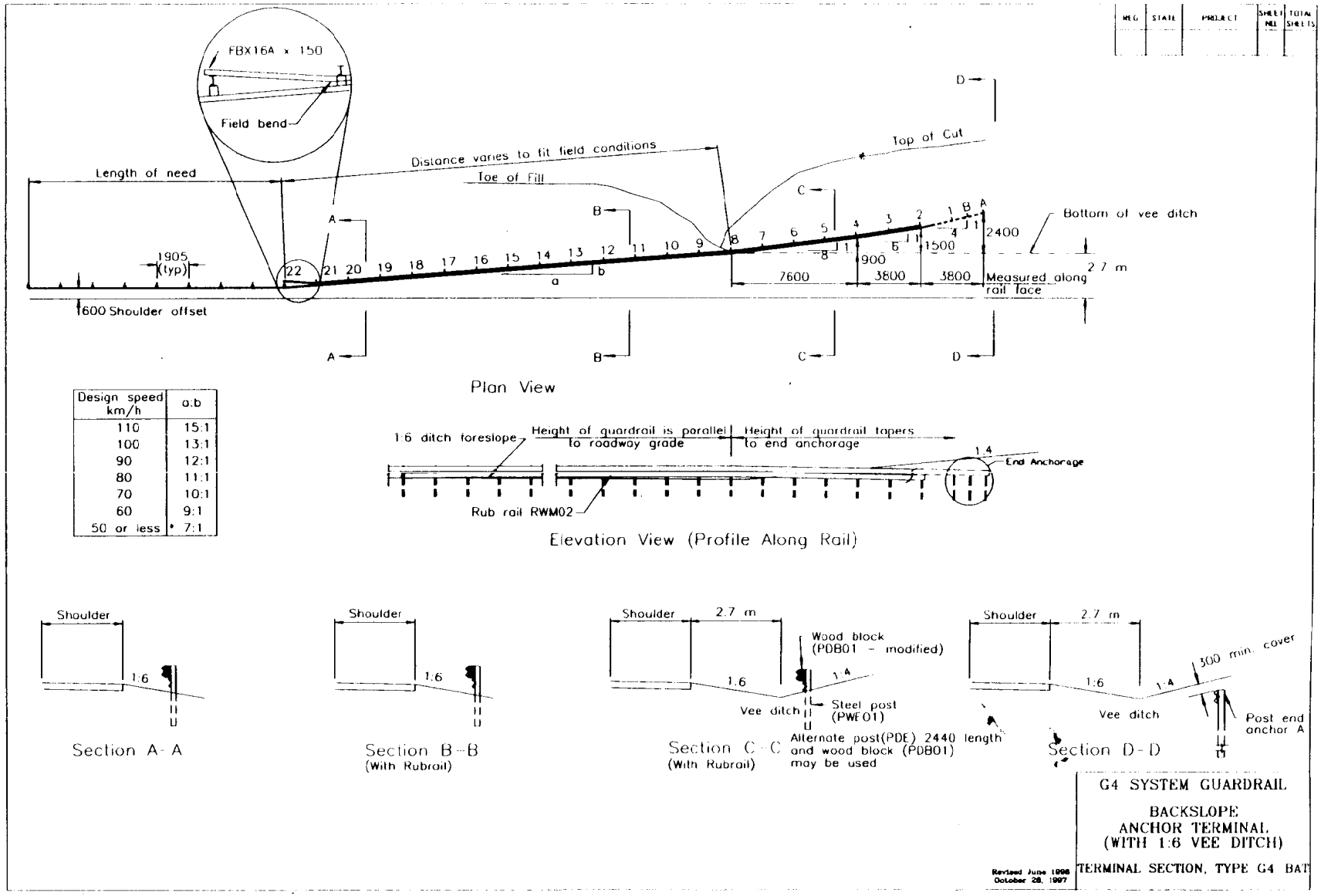


Figure 1. Details of the G4 W-beam guardrail buried-in-backslope anchor terminal installation.

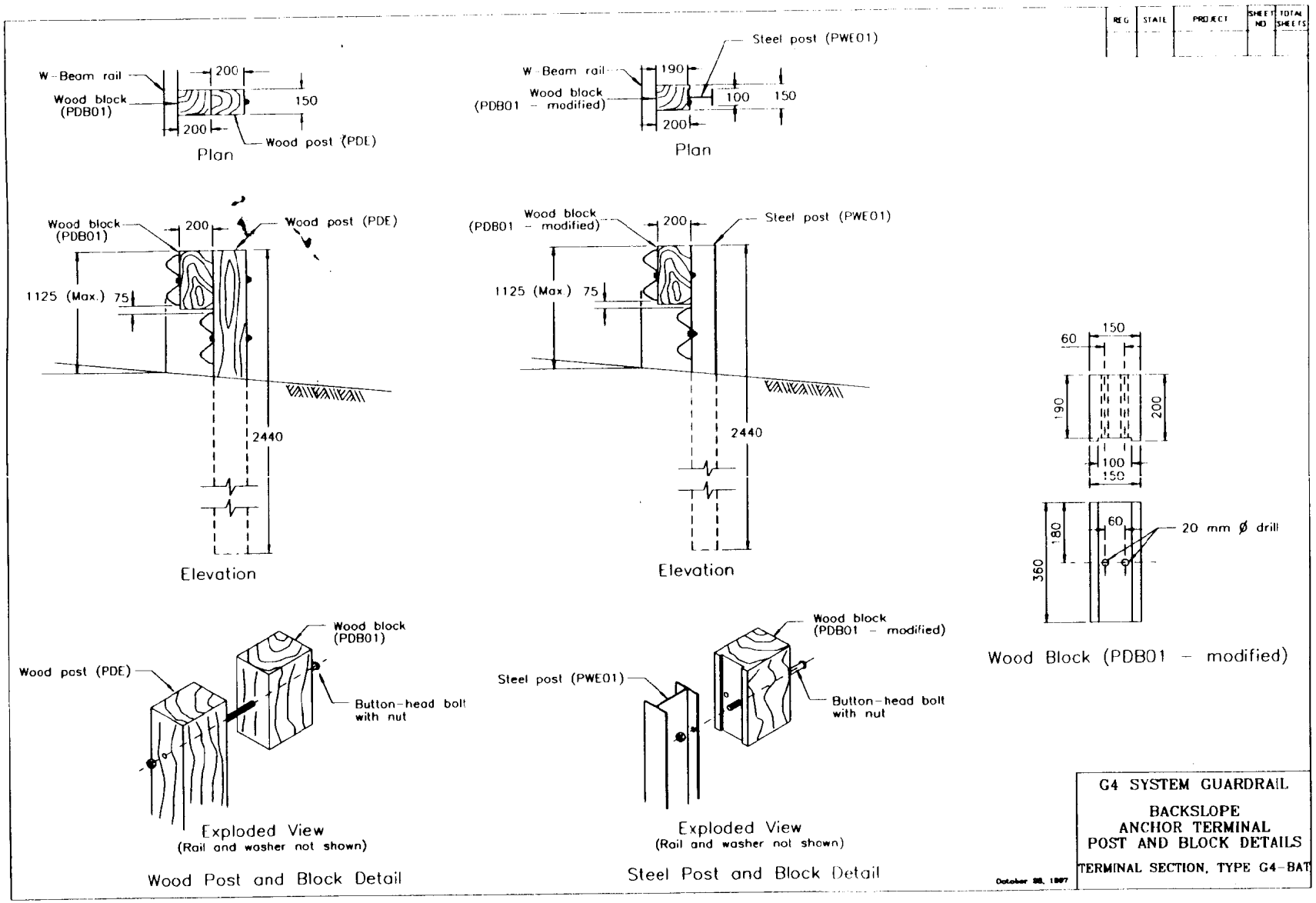


Figure 2. Post and block details for the G4 W-beam guardrail buried-in-backslope anchor terminal.

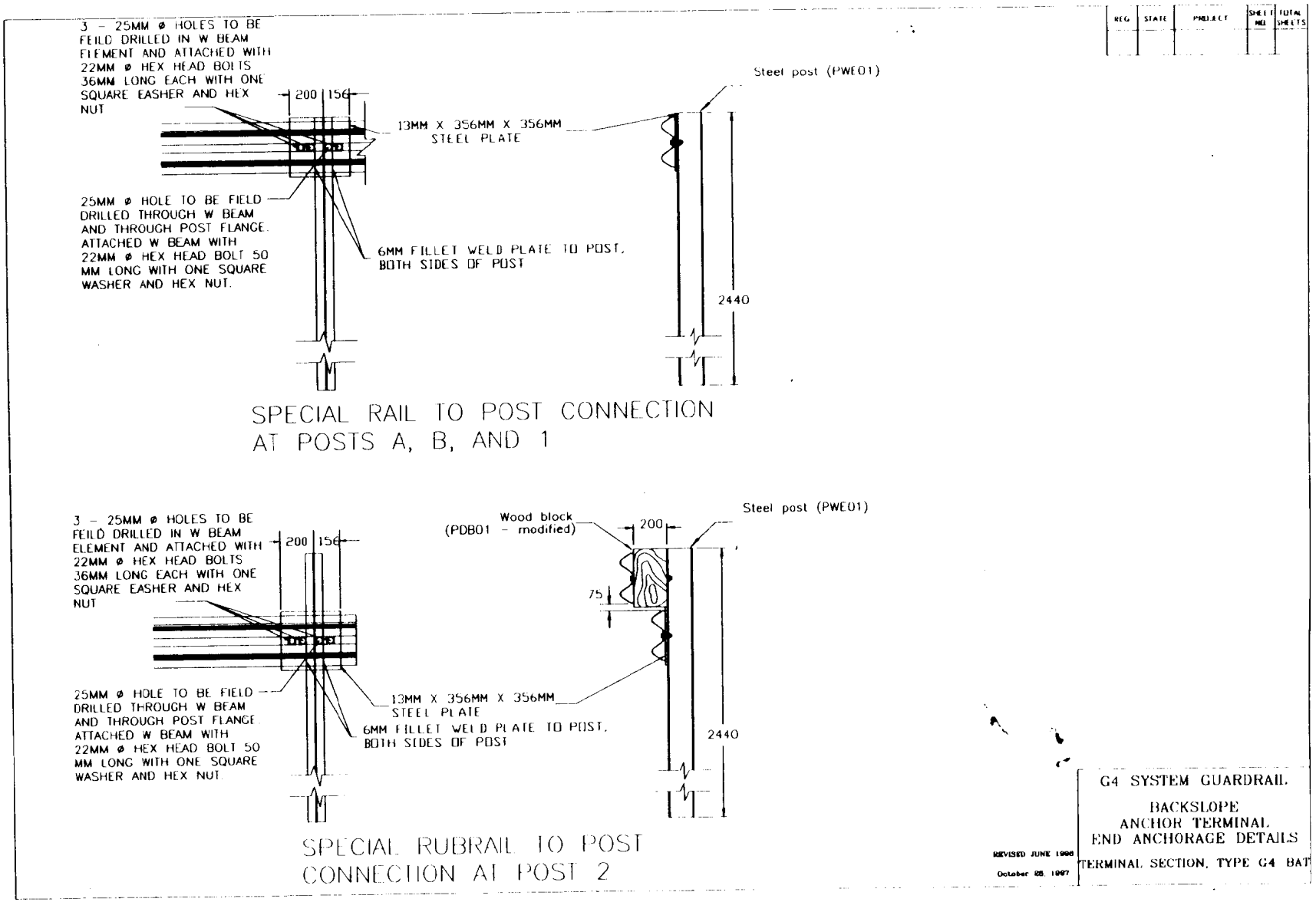
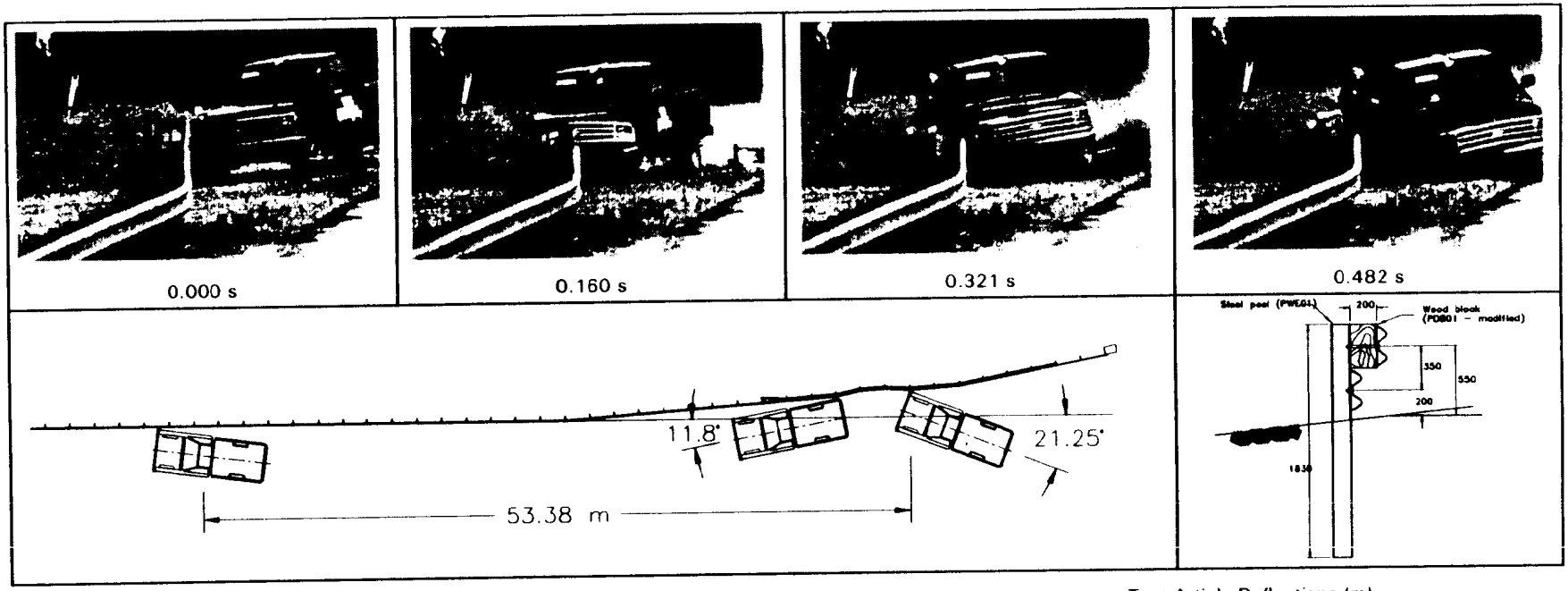


Figure 3. End anchorage details for the G4 W-beam guardrail backslope anchor terminal.



General Information
- Test Agency . . . . . Texas Transportation Institute
- Test No. 405521-1
- Date 10/03/96

Test Article
- Type . . . . . Terminal
- Name . . . . . W-beam Buried-in-backslope
- Installation Length (m) 114.3
- Size and/or dimension and material of key elements . . . . . W-beam guardrail on steel posts w/wood blockouts, rubrail, ditch
- Soil Type and Condition . . . . . Standard soil, dry

Test Vehicle
- Type . . . . . Production
- Designation 2000P
- Model . . . . . 1991 Chevrolet 2500 pickup
- Mass (kg) Curb 1947
  - Test Inertial 2000
  - Dummy 76
  - Gross Static 2076

Impact Conditions
- Speed (km/h) 98.12
- Angle (deg) 21.25

Exit Conditions
- Speed (km/h) 72.31
- Angle (deg) 11.80

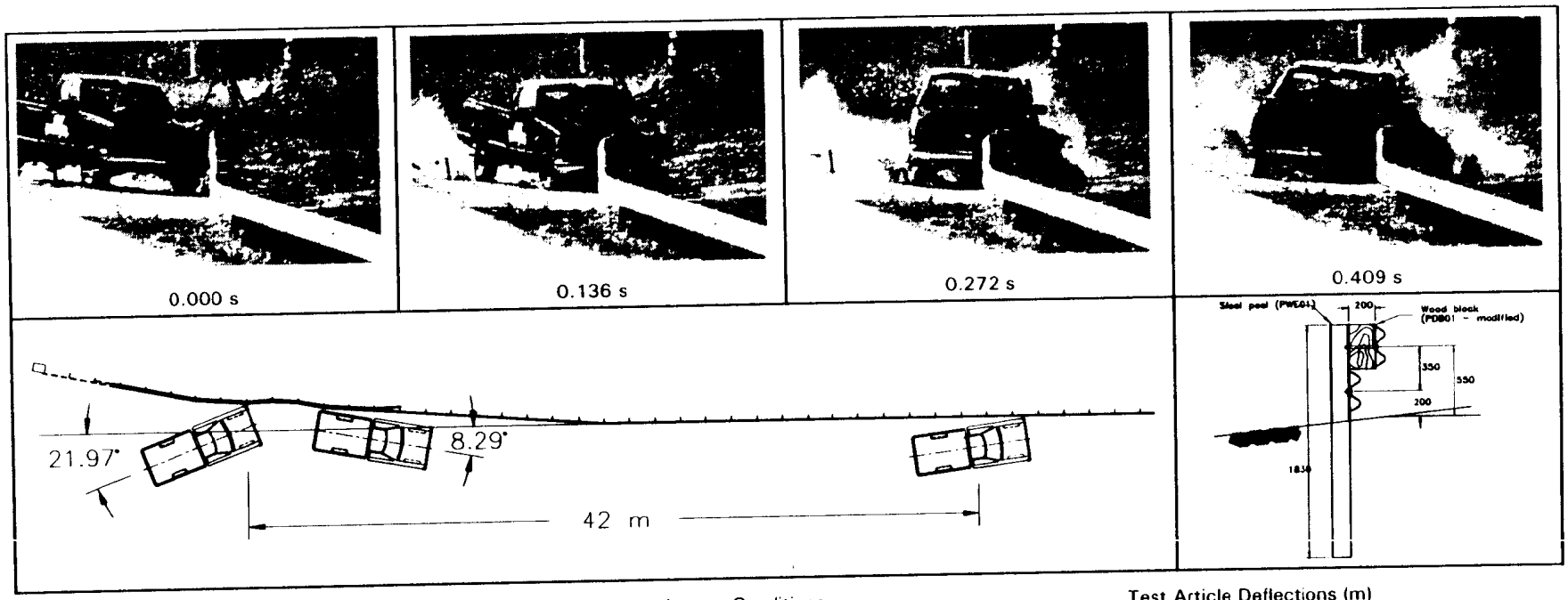
Occupant Risk Values
- Impact Velocity (m/s)
  - x-direction 7.41
  - y-direction 5.85
- Ridedown Accelerations (g's)
  - x-direction . . . . . -5.59
  - y-direction . . . . . -8.92
- Max. 0.050-s Average (g's)
  - x-direction . . . . . -6.08
  - y-direction . . . . . -7.54
  - z-direction . . . . . -3.12

Test Article Deflections (m)
- Dynamic 0.75
- Permanent 0.24

Vehicle Damage
- Exterior
  - VDS 01RFQ5
  - CDC 01FREW3
- Maximum Exterior Vehicle Crush (mm) 500
- Interior
  - OCDI RF0103000
- Max. Occ. Compart. Deformation (mm) 66

Post-Impact Behavior (during 1.0 s after impact)
- Max. Roll Angle (deg) . . . . -29.44
- Max. Pitch Angle (deg) . . . . -5.94
- Max. Yaw Angle (deg) . . . . -35.11

Figure 14. Summary of results for test 405521-1.



General Information
- Test Agency . . . . . Texas Transportation Institute
- Test No. 405521-2
- Date 10/03/96

Test Article
- Type . . . . . Terminal
- Name . . . . . W-beam Buried in backslope
- Installation Length (m) 114.3
- Size and/or dimension and material of key elements . . . . . W-beam guardrail on steel posts w/wood blockouts, rubrail, drop inlet

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

Test Vehicle
- Type . . . . . Production
- Designation 2000P
- Model . . . . . 1990 Chevrolet 2500 pickup
- Mass (kg) Curb 1955
- Test Inertial 2000
- Dummy 76
- Gross Static 2076

Impact Conditions
- Speed (km/h) 97.00
- Angle (deg) 21.97

Exit Conditions
- Speed (km/h) 61.71
- Angle (deg) 8.29

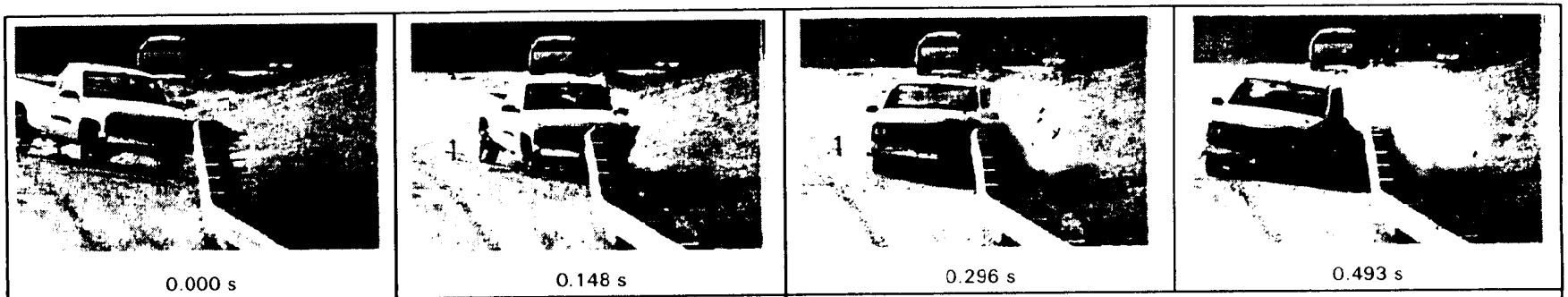
Occupant Risk Values
- Impact Velocity (m/s)
  - x-direction 7.73
  - y-direction 5.53
- Ridedown Accelerations (g's)
  - x-direction . . . . . -7.56
  - y-direction 7.27
- Max. 0.050-s Average (g's)
  - x-direction 5.97
  - y-direction 6.17
  - z-direction 5.21

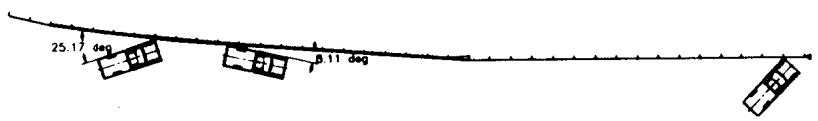
Test Article Deflections (m)
- Dynamic 0.80
- Permanent 0.50

Vehicle Damage
- Exterior
  - VDS 01LFQ5
  - CDC 01FLEW3
- Maximum Exterior Vehicle Crush (mm) 600
- Interior
  - OCDI LF0100000
- Max. Occ. Compart. Deformation (mm) 33

Post-Impact Behavior (during 1.0 s after impact)
- Max. Roll Angle (deg) 41.30
- Max. Pitch Angle (deg) . . . . -4.68
- Max. Yaw Angle (deg) 36.74

Figure 20. Summary of results for test 405521-2.





Drawings being prepared by FHWA 3/3/98

General Information
- Test Agency . . . . . Texas Transportation Institute
- Test No. 404211-1
- Date 01/29/98

Test Article
- Type . . . . . Terminal
- Name . . . . . W-beam Buried in Backslope
- Installation Length (m) 76.2
- Material or Key Elements . . W-beam Guardrail on Steel Posts w/WoodBlockouts, Rubrail, 1:6 Ditch

Soil Type and Condition . . . . . Standard Soil, Damp

Test Vehicle
- Type . . . . . Production
- Designation 2000P
- Model . . . . . 1995 GMC 2500 pickup truck
- Mass (kg) Curb 1933
  - Test Inertial 2000
  - Dummy 76
  - Gross Static 2076

Impact Conditions
- Speed (km/h) 97.23
- Angle (deg) 25.17

Exit Conditions
- Speed (km/h) 70.58
- Angle (deg) 8.11

Occupant Risk Values
- Impact Velocity (m/s)
  - x-direction 7.20
  - y-direction 7.23
- Ridedown Accelerations (g's)
  - x-direction . . . . . -9.42
  - y-direction 8.65
- Max. 0.050-s Average (g's)
  - x-direction . . . . . -6.00
  - y-direction 8.78
  - z-direction . . . . . -9.34

Test Article Deflections (m)
- Dynamic 0.67
- Permanent 0.41

Vehicle Damage
- Exterior
  - VDS 11LFQ4
  - CDC . . . . . 11FLEK2 &11LYEW3
- Maximum Exterior Vehicle Crush (mm) 520
- Interior
  - OCDI FS0100002
- Max. Occ. Compart. Deformation (mm) 205

Post-Impact Behavior (during 1.0 s after impact)
- Max. Yaw Angle (deg) 32.5
- Max. Pitch Angle (deg) 11.0
- Max. Roll Angle (deg) 38.5

Figure 14. Summary of results for test 404211-1, NCHRP Report 350 test 3-35.