U.S.Department of Transportation
Federal Highway Administration

1200 New Jersey Avenue, SE
Washington, D.C. 20590

January 12, 2010

In Reply Refer To:
HSSD/B-198

Mr. Ronald K. Faller, Ph.D
Research Assistant Professor
Midwest Roadside Safety Facility
University of Nebraska-Lincoln
527 Nebraska Hall
Lincoln, NE 68588-0529

Dear Dr. Faller:

You requested that we formally find this device acceptable for use on the National Highway System (NHS) under the provisions of American Association of State Highway and Transportation Officials, Manual for Assessing Safety Hardware (MASH). This letter is a response to your request for the Federal Highway Administration (FHWA) acceptance of a roadside safety device for use on the NHS.

Name of device: West Virginia TL-1 Timber Curb-Type Bridge Barrier
Type of device: Permanent Timber Barrier Bridge Railing
Test Level: AASHTO Manual for Assessing Safety Hardware (MASH) TL-1
Testing conducted by: Midwest Roadside Safety Facility (MwRSF)
Date of request: September 13, 2009
Date of completed package: September 13, 2009
Task Force 13 Designator: SBD05a

Requirements
Roadside safety devices should meet the guidelines contained in the MASH.

Description
For this project, the research objective was to adapt an existing, crashworthy, Test Level 1 (TL-1) curb-type bridge barrier for use on transverse, timber, nail-laminated bridge decks supported by steel wide-flange beams. The barrier system was redesigned to meet the TL-1 impact safety standards set forth by MASH. The existing MwRSF curb-type timber bridge barrier system was successfully crash tested to the TL-1 safety performance criteria as per

NCHRP Report 350. This timber bridge barrier system served as the basis for the new West Virginia TL-1 Timber Curb-Type Bridge Barrier design. However, the railing for this project was required to meet the TL-1 safety performance criteria provided in MASH. Therefore, modifications were made to the previous system in order to accommodate the increased impact severity and increased vehicle height resulting from the 2270P vehicle as per current MASH guidelines. These changes are described as follows.

The test installation consisted of three major sub-systems: (1) a 120-ft (36.6-m) long, nail-laminated, timber bridge deck placed on wide-flange, steel girders; (2) a curb-type, timber bridge railing system; and (3) a 35-ft (10.7-m) long, sloped, safety treatment located on the upstream end of the bridge barrier. The total length of the test installation was 155 ft (47.2 m).

The bridge barrier system consisted of three major structural components: (1) a longitudinal, glulam timber rail; (2) steel H-splice plates; and (3) post assemblies consisting of sawn lumber scupper blocks.

The glulam timber rail consisted of 19.9-ft (6.08-m) long, glulam rail segments with a 6-3/4 in. x 12 3/8 in. (171 mm x 314 mm) cross section, as shown in Figure 36. The glulam rails were manufactured from Combination No. 48 Southern Yellow Pine and were treated with pentachlorophenol in heavy oil to a minimum net retention of 0.60 lbs/ft^3 (9.61 kg/m^3) conforming to the American Wood Preserver's Association (AWPA) use category UC4A [8]. The ends of each rail segment were narrowed to a width of 11 5/8 in. (295 mm) in order to accept the steel H-splice plates and allow the outer plate surface to be flush with the gross rail section.

The steel H-Splice plates were fabricated from ASTM A656 Grade 50 Type 7 material. The two side plates were 34 3/4 in. long by 6 3/4 in. wide by 3/8 in. thick (883 mm x 171 mm x 9.5 mm) with twelve 1 1/8-in. (29-mm) diameter holes. For the H-splice, the center connecting plate was installed orthogonal to the outer two plates and measured 11 5/8 in. long by 6 3/4 in. wide by 3/8 in. thick (295 mm x 171 mm x 9.5 mm). The H-splice plates connected adjacent glulam rail segments end to end using six 1-in. (25.4-mm) diameter by 14-in. (356-mm) long, ASTM A307 galvanized dome-head bolts in each rail end.

The bridge rail post assemblies consisted of two timber scupper blocks stacked on top of each other. Each scupper block was fabricated from Grade No. 1 Southern Yellow Pine sawn lumber and measured 23 in. long by 9 1/2 in. wide, and 7 1/2 in. tall (584 mm x 241 mm x 191mm). Four 13/16-in. (21-mm) diameter bolt holes were drilled in the scuppers at 5-in. (127-mm) spacing intervals.

The West Virginia TL-1 Timber Curb-Type Bridge Barrier drawings for the construction of the test installation are included with this correspondence.

Findings

We concur with your request that the West Virginia TL-1 Timber Curb-Type Bridge Barrier that has been successfully crash tested to AASHTO MASH TL-1 conditions will be considered

acceptable for use on the NHS, assuming all other factors such as timber specifications and component details are identical to the tested version. For further information on the crash test, the Test Data Summary Sheet is included with this correspondence.

Please note the following standard provisions that apply to the FHWA letters of acceptance:

- This acceptance is limited to the crashworthiness characteristics of the devices and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the device will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of the FHWA and the MASH.
- To prevent misunderstanding by others, this letter of acceptance is designated as number B-198 and shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed at our office upon request.
- The Timber Curb-Type Bridge Barrier system is a generic system and not considered proprietary.
- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

David A. Nicol, P.E.
Director, Office of Safety Design
Office of Safety

Enclosures

FHWA:HSSD:WLongstreet:tb:x60087:12/16/09
File: s://directory folder/WLongstreet/B198-FDOT Low Profile Barrier – Space Restricitive Applications.doc
cc: HSSD (Reader, HSA; Chron File, HSSD; W.Longstreet, HSSD; NArtimovich, HSSD; MMcDonough, HSSD)

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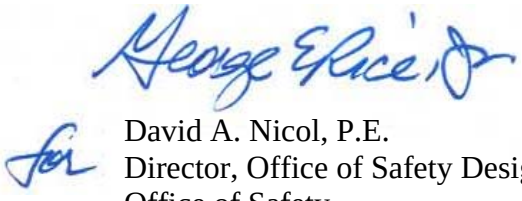
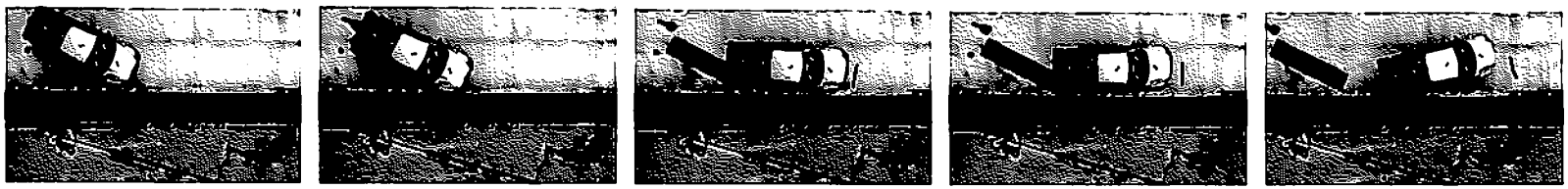
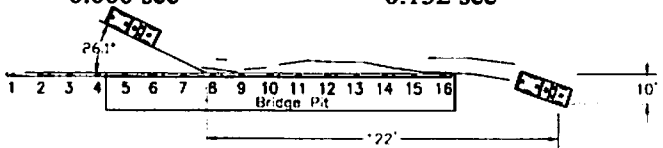


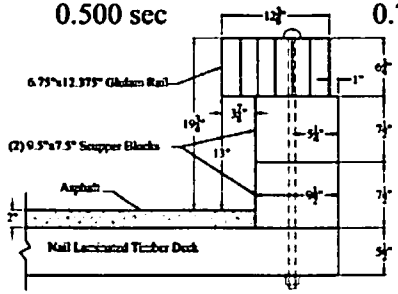
David A. Nicol, P.E.
Director, Office of Safety Design
Office of Safety

Enclosures





- Test Agency ..... MwRSF
- Test Number WVBR-1
- Date 7/18/08
- MASH-08 Test Designation 1-11
- Test Article ..... Low-Profile, Curb-Type, Timber Bridge Rail
- Total Length ..... 155 ft
- Scupper Block or Post Spacing ..... 10 ft
- Key Component - Glulam Bridge Rail Segment
  - Length ..... 20 ft
  - Width ..... 6 ¾ in.
  - Depth ..... 12 ⅜ in.
- Key Component - Scupper Block
  - Length ..... 23 in.
  - Width ..... 7 ½ in.
  - Depth ..... 9 ½ in.
- Vehicle Model ..... 2002 Dodge Ram 1500 Quad Cab
  - Curb ..... 5,119 lbs
  - Test Inertial ..... 5,007 lbs
  - Gross Static ..... 5,179 lbs
- Impact Conditions
  - Speed ..... 30.8 mph
  - Angle ..... 26.1 deg
  - Impact Location ..... 30 ½ in. Upstream from Post No. 4
- Exit Conditions
  - Speed ..... 19.1 mph
  - Angle ..... 12.6 deg
- Vehicle Stability ..... Satisfactory
- Vehicle Stopping Distance ..... 120 ft Downstream from Impact



- Occupant Ridedown Acceleration (DTS)
  - Longitudinal ..... -4.74 g's < 20.49 g's
  - Lateral ..... -3.23 g's < 20.49 g's
- Occupant Impact Velocity (DTS)
  - Longitudinal ..... -10.95 ft/s < 40.0 ft/s
  - Lateral ..... -13.00 ft/s < 40.0 ft/s
- Occupant Ridedown Acceleration (EDR-3)
  - Longitudinal ..... -5.33 g's < 20.49 g's
  - Lateral ..... -2.69 g's < 20.49 g's
- Occupant Impact Velocity (EDR-3)
  - Longitudinal ..... -11.81 ft/s < 40.0 ft/s
  - Lateral ..... -12.61 ft/s < 40.0 ft/s
- Maximum Roll Angle ..... 8.7 degrees
- THIV ..... 15.72 ft/s < 39.4 ft/s
- PHD ..... 5.25 g's < 20 g's
- Vehicle Damage ..... Minimal
  - TAD[11] 1-RFQ-3
  - SAE[12] 01-RFLW1
  - Maximum Deformation ..... 1 ¼ in. Near Front Floor Pan
- Test Article Damage ..... Minimal
- Maximum Rail Deflections
  - Permanent Set ..... 2.4 in.
  - Dynamic ..... 6.1 in.
- Working Width ..... 12.4 in.

Figure 65. Summary of Test Results and Sequential Photographs, Test No. WVBR-1

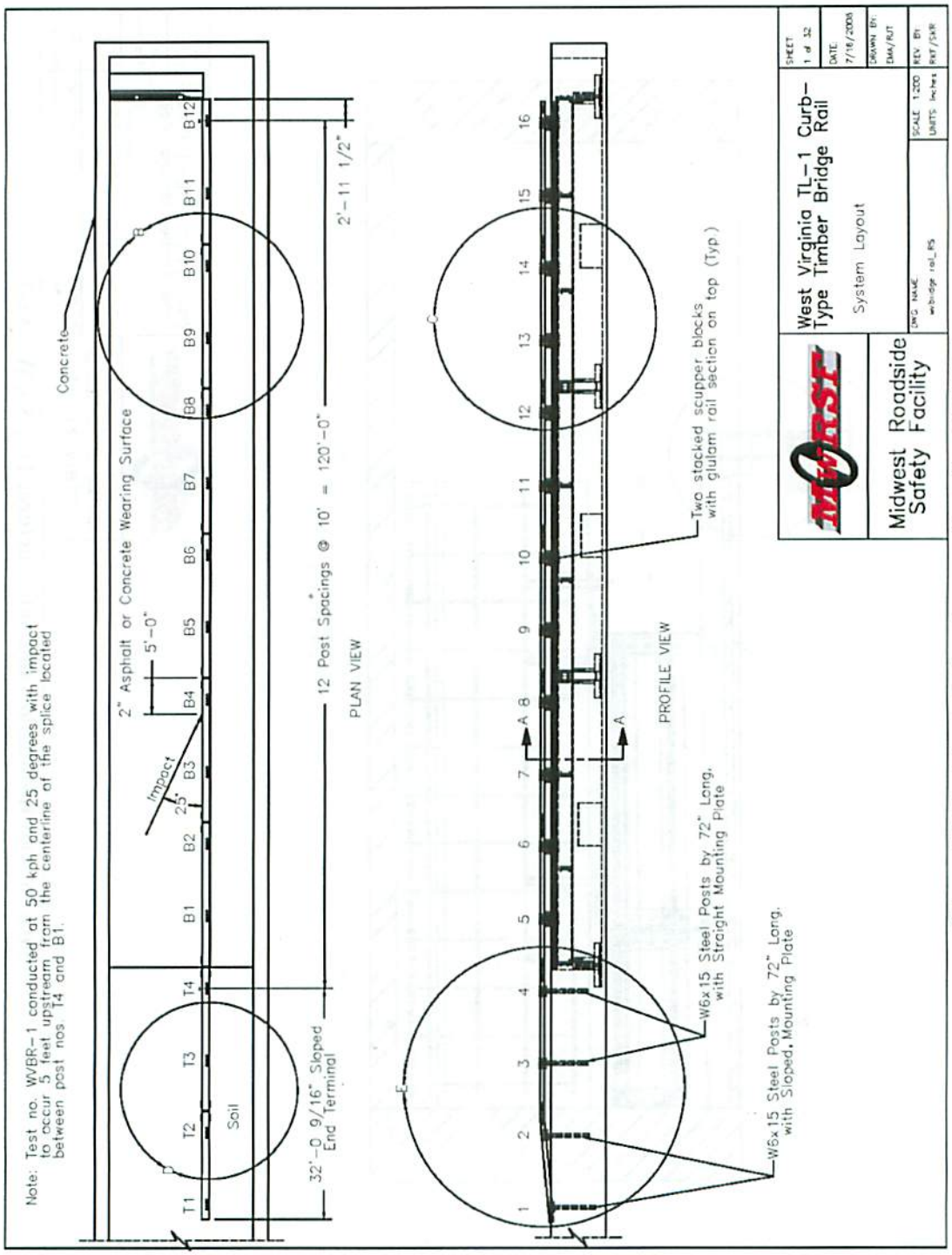


Figure 25. Test Installation Layout, Test No. WVBR-1

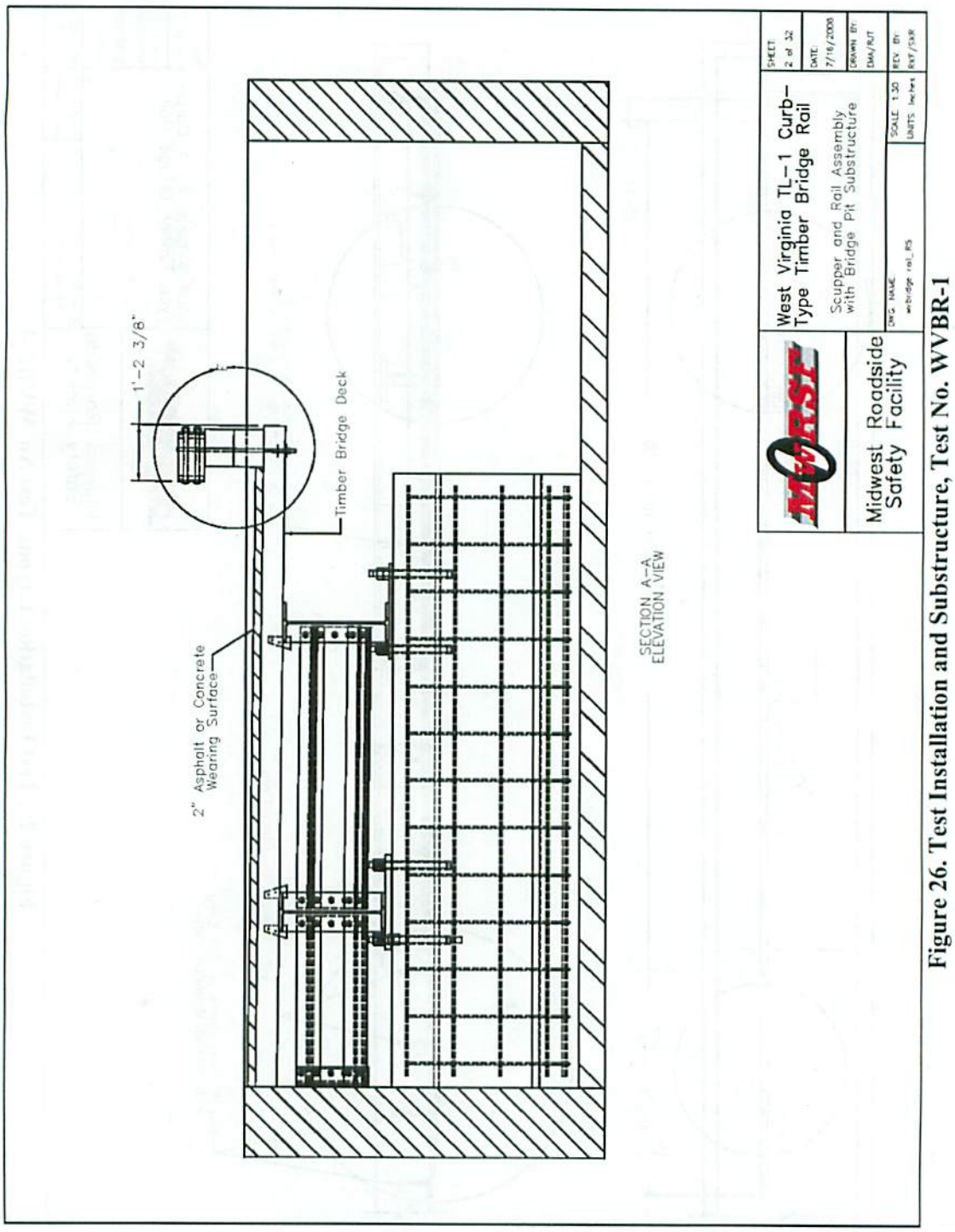


Figure 26. Test Installation and Substructure, Test No. WVBR-1

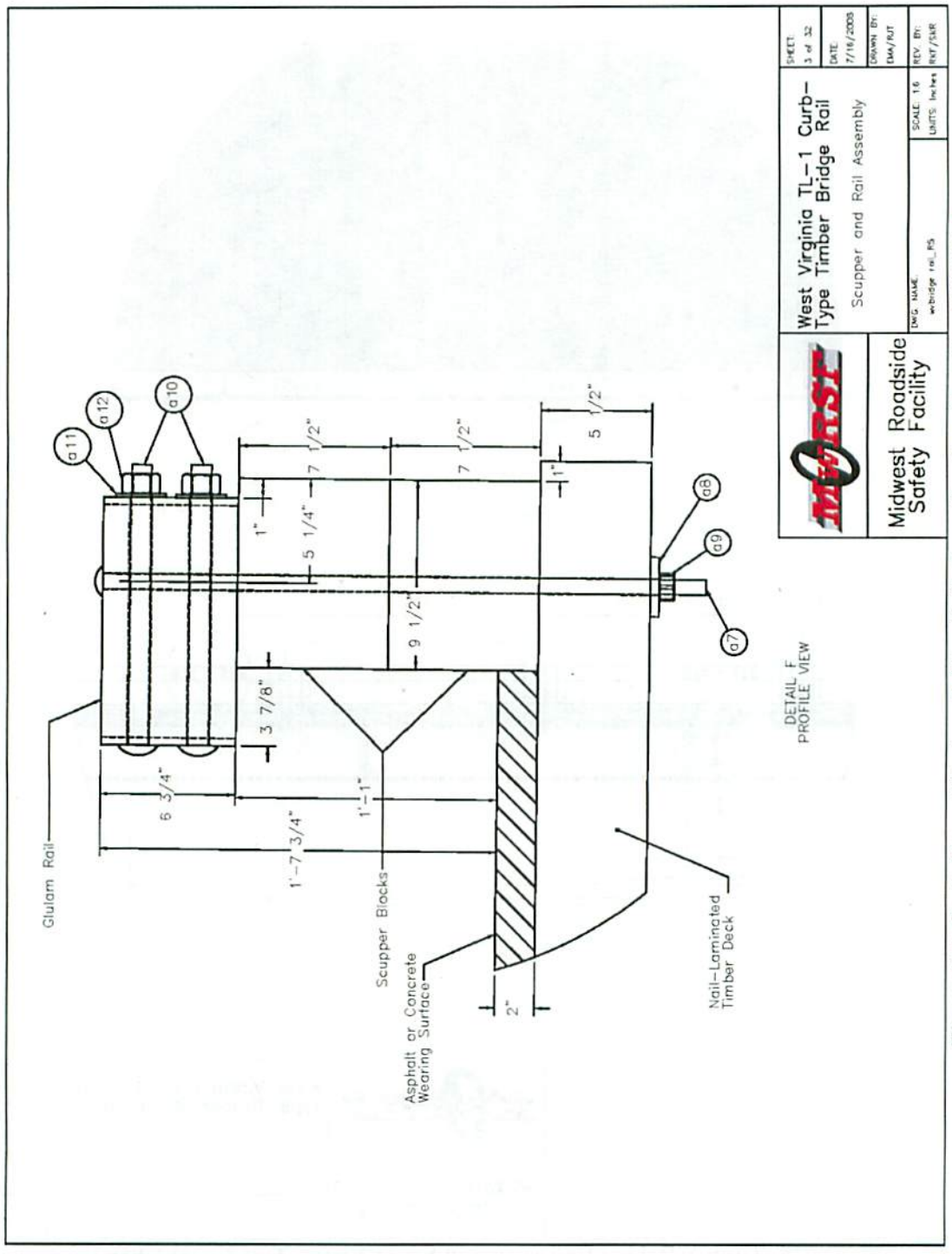


Figure 27. Curb-Type, Timber Bridge Rail Cross Section, Test No. WVBR-1

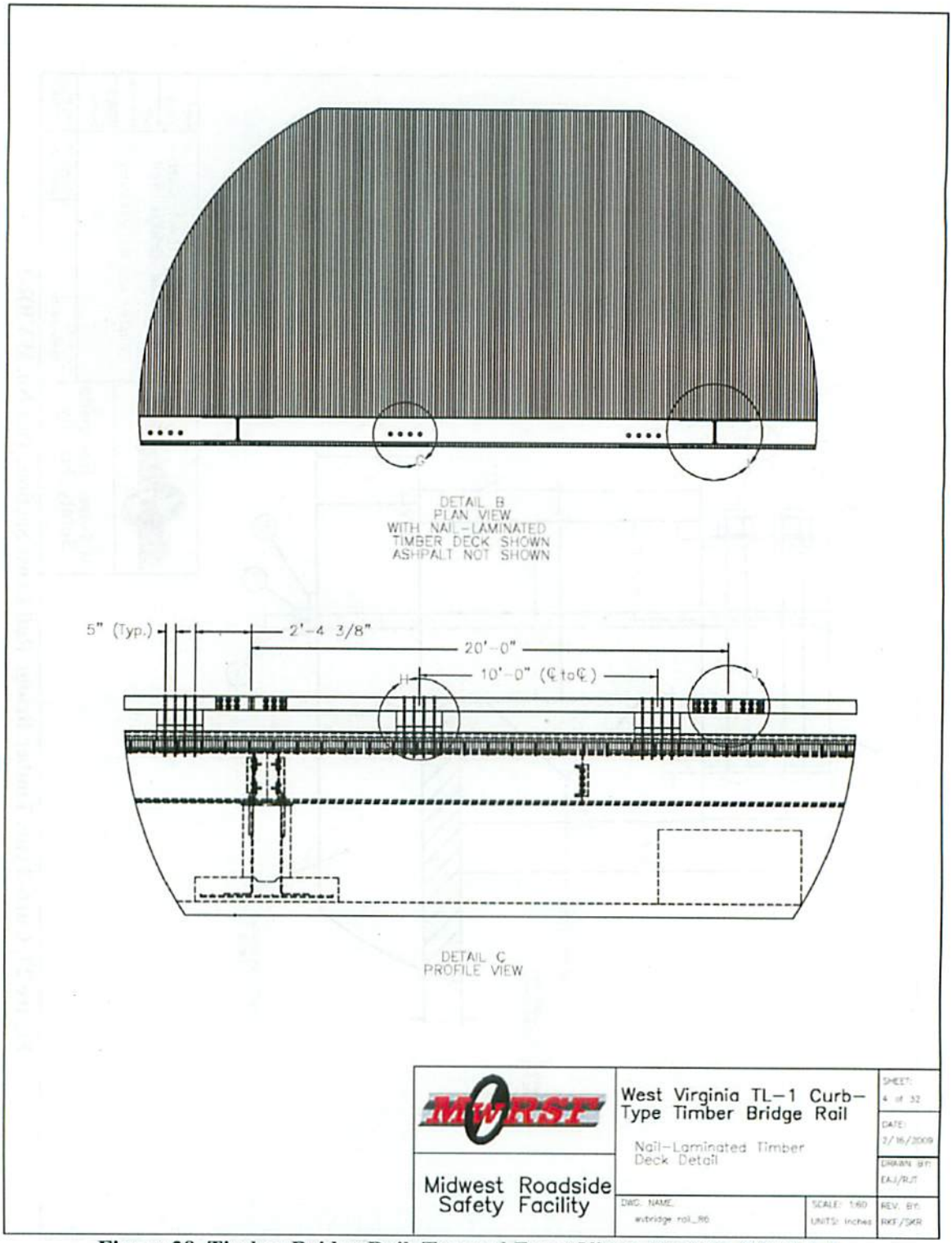


Figure 28. Timber Bridge Rail, Top and Front Views, Test No. WVBR-1

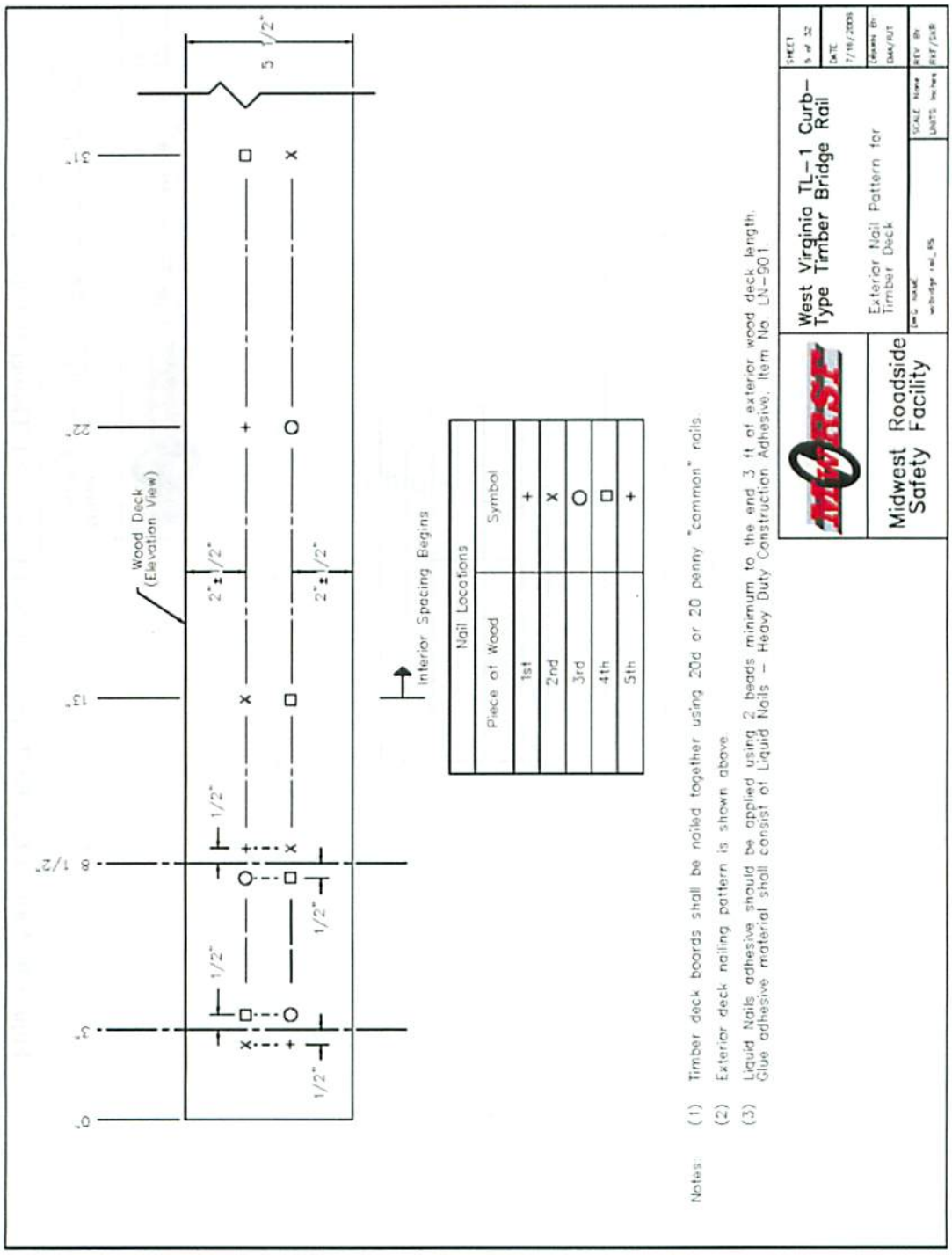


Figure 29. Exterior Nail Pattern for Transverse, Nail-Laminated, Timber Bridge Deck

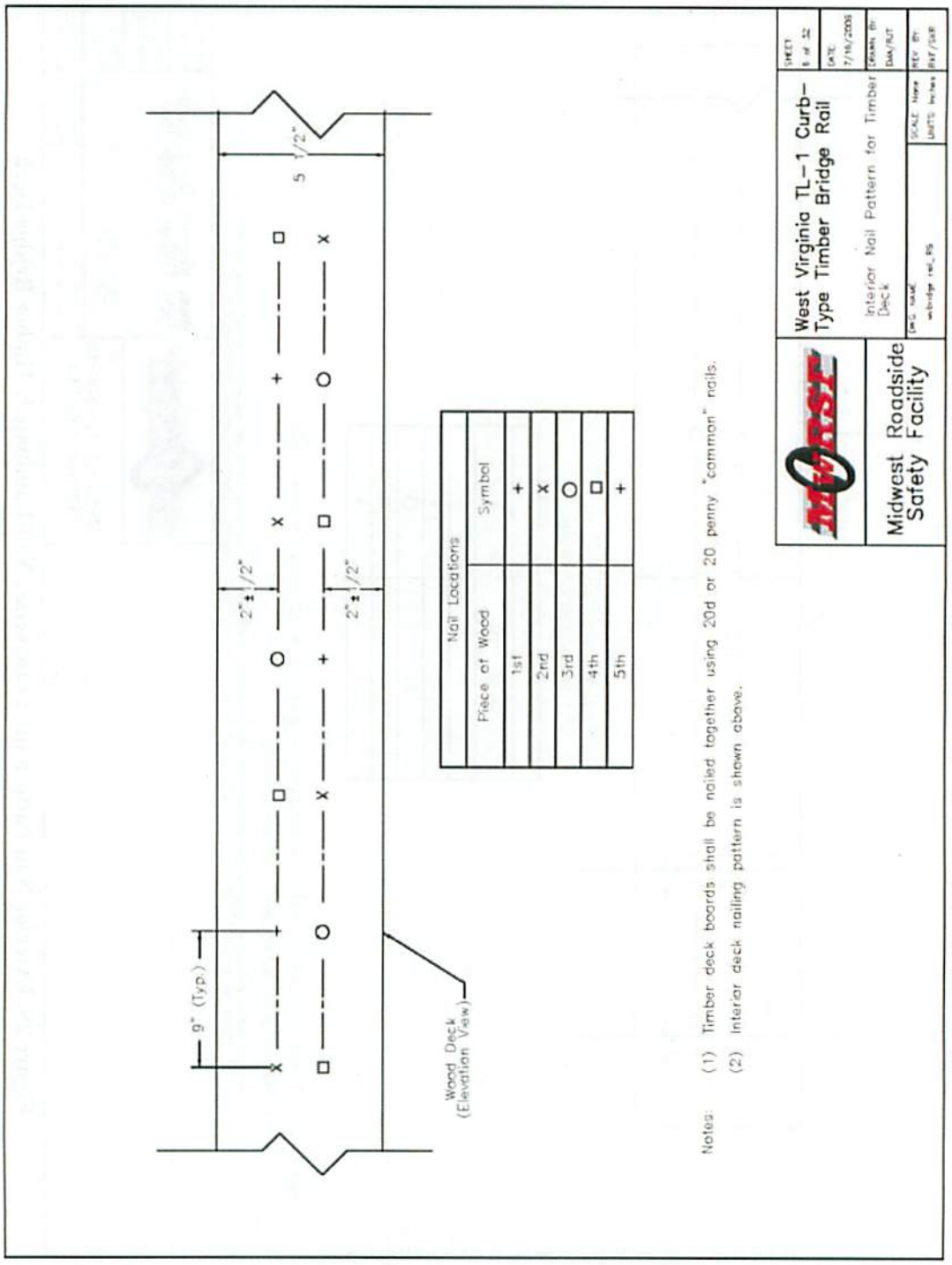


Figure 30. Nail Pattern for Transverse, Nail-Laminated, Timber Bridge Deck

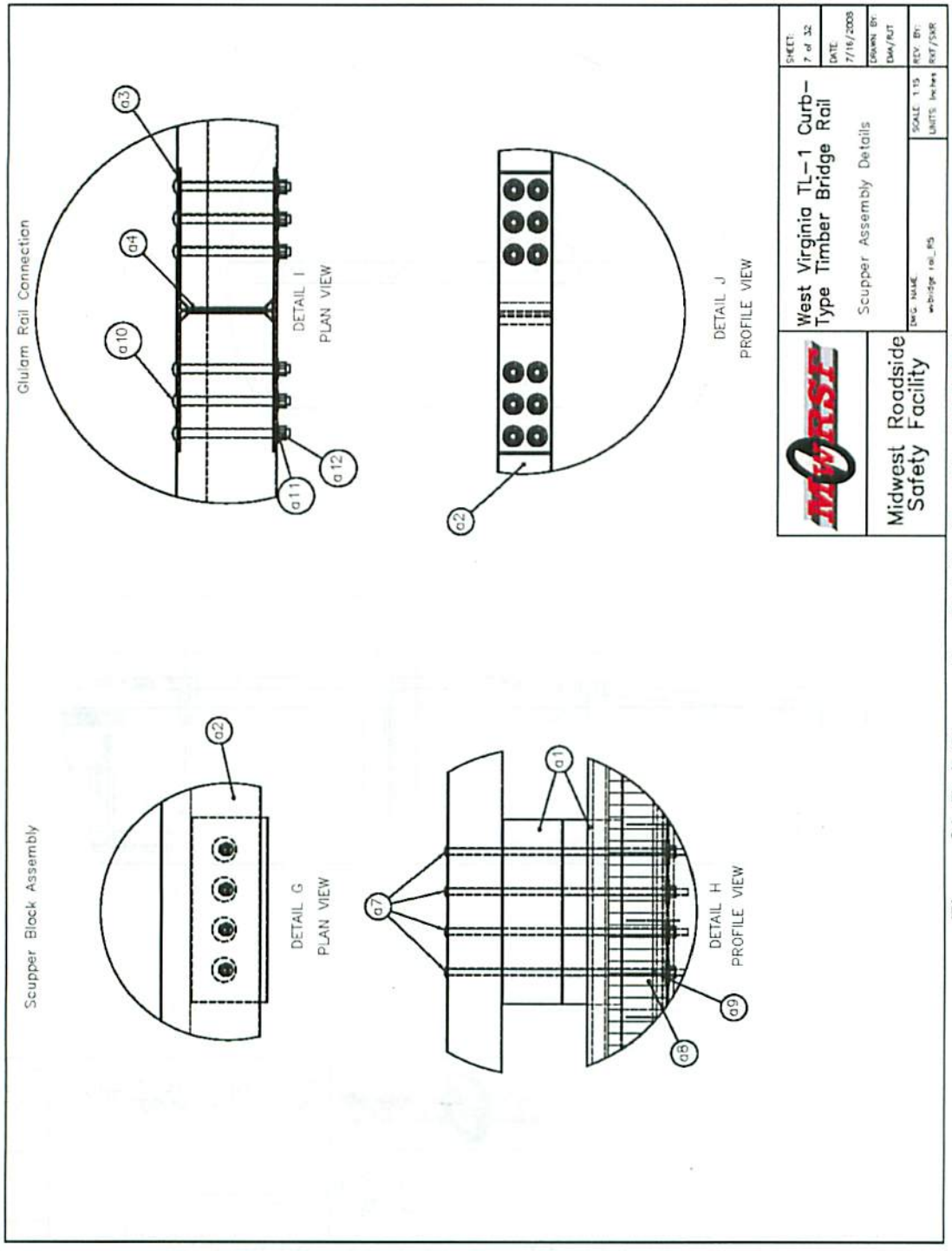
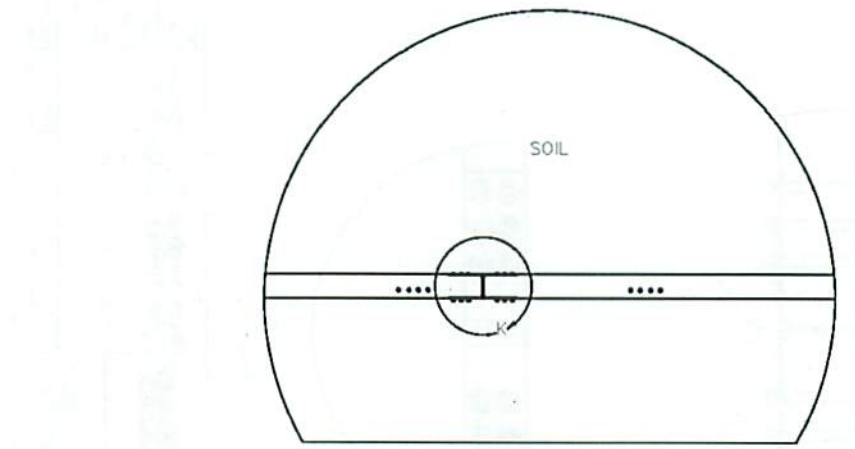
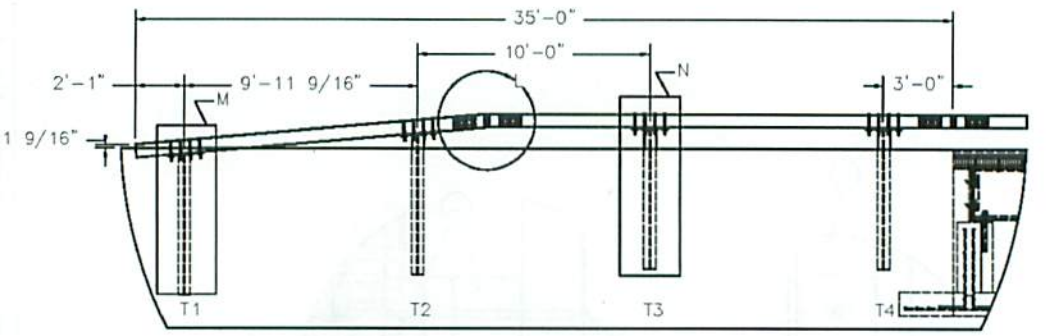


Figure 31. Rail Connection Details, Test No. WVBR-1



DETAIL D
PLAN VIEW



DETAIL E
PROFILE VIEW

Note: (1) The end of the sloped end terminal is partially buried under ground. The maximum height above ground is 4".

MwRSF	West Virginia TL-1 Curb-Type Timber Bridge Rail	SHEET: 8 of 32
	Sloped End Rail Terminal	DATE: 7/16/2008
		DRAWN BY: EMA/RJT
Midwest Roadside Safety Facility	DWG. NAME: wvbridge rail_RS / SCALE: 1:75 / UNITS: Inches	REV. BY: RKT/SKR

Figure 32. Rail End Treatment, Test No. WVBR-1

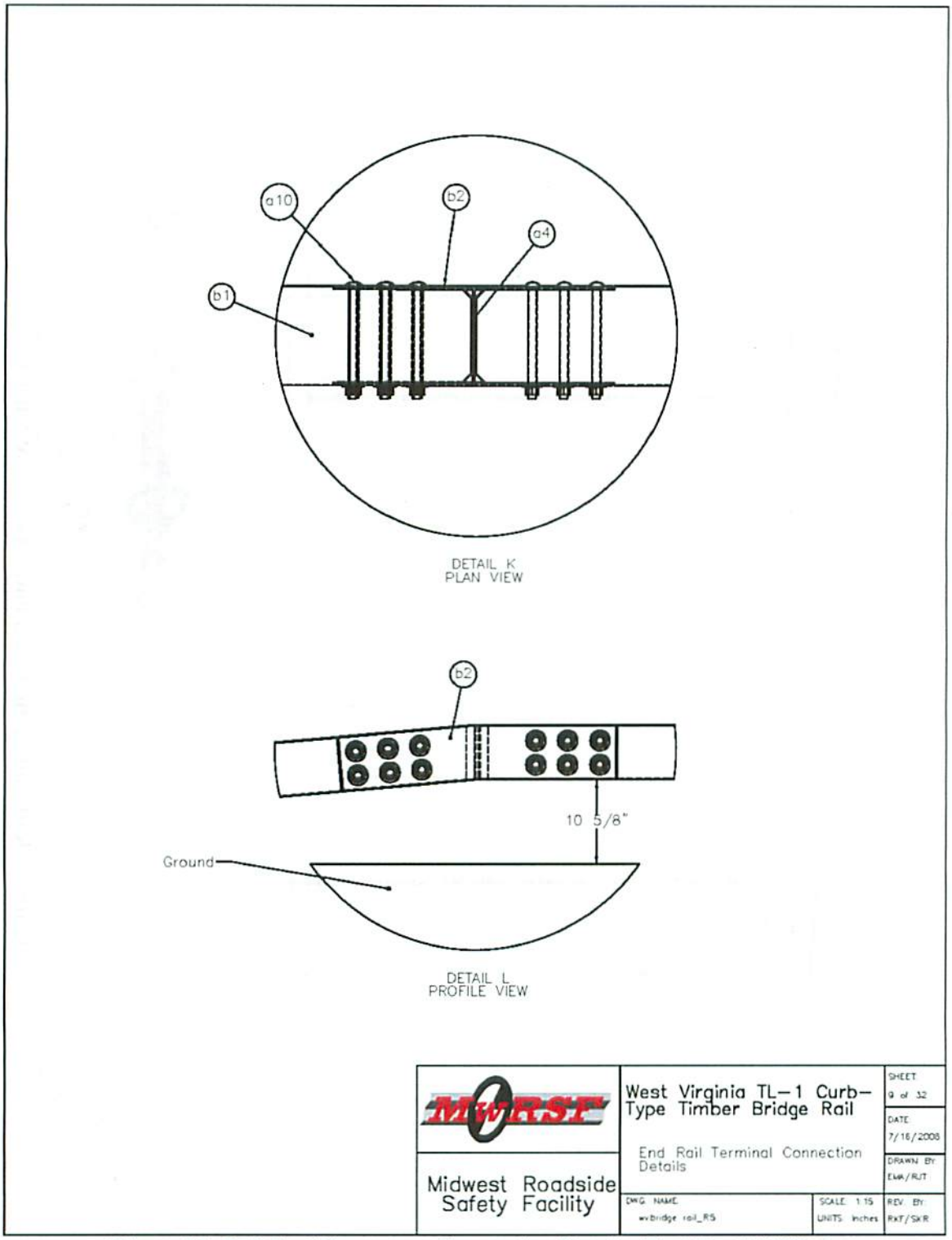


Figure 33. Rail End Treatment Connection Details, Test No. WVBR-1

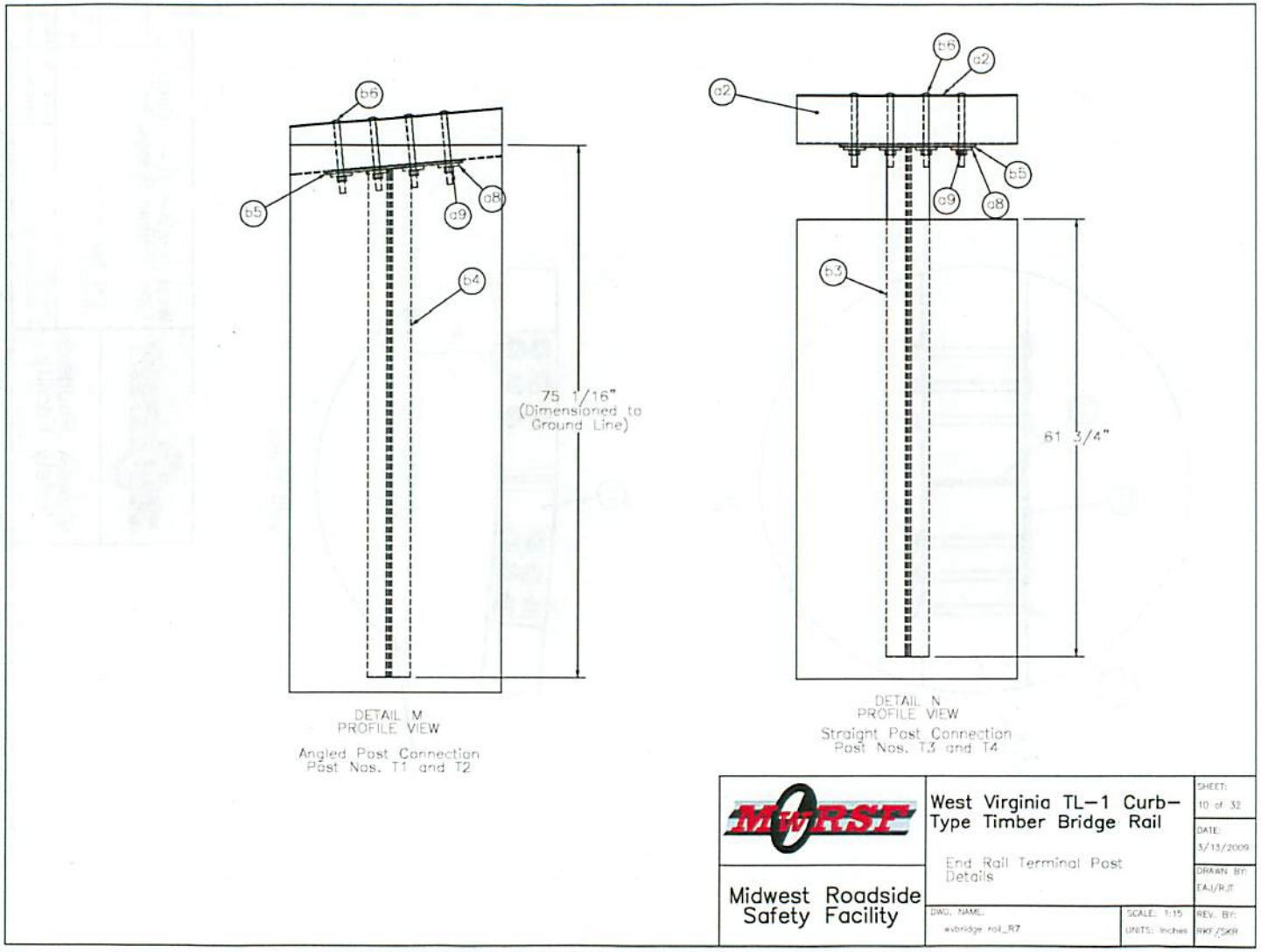


Figure 34. Rail End Section Steel Posts, Test No. WVBR-1

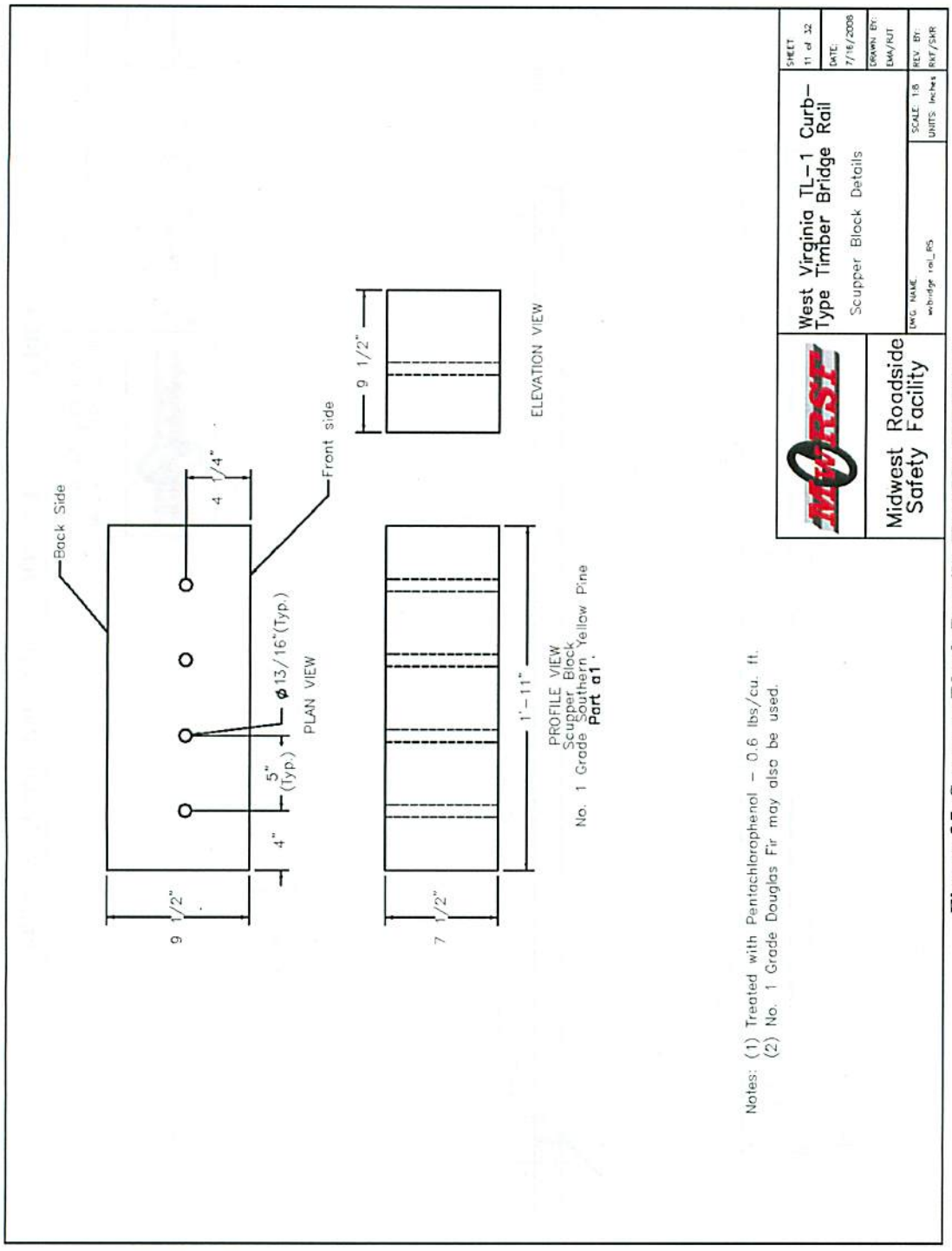


Figure 35. Scupper Block Details, Test No. WVBR-1

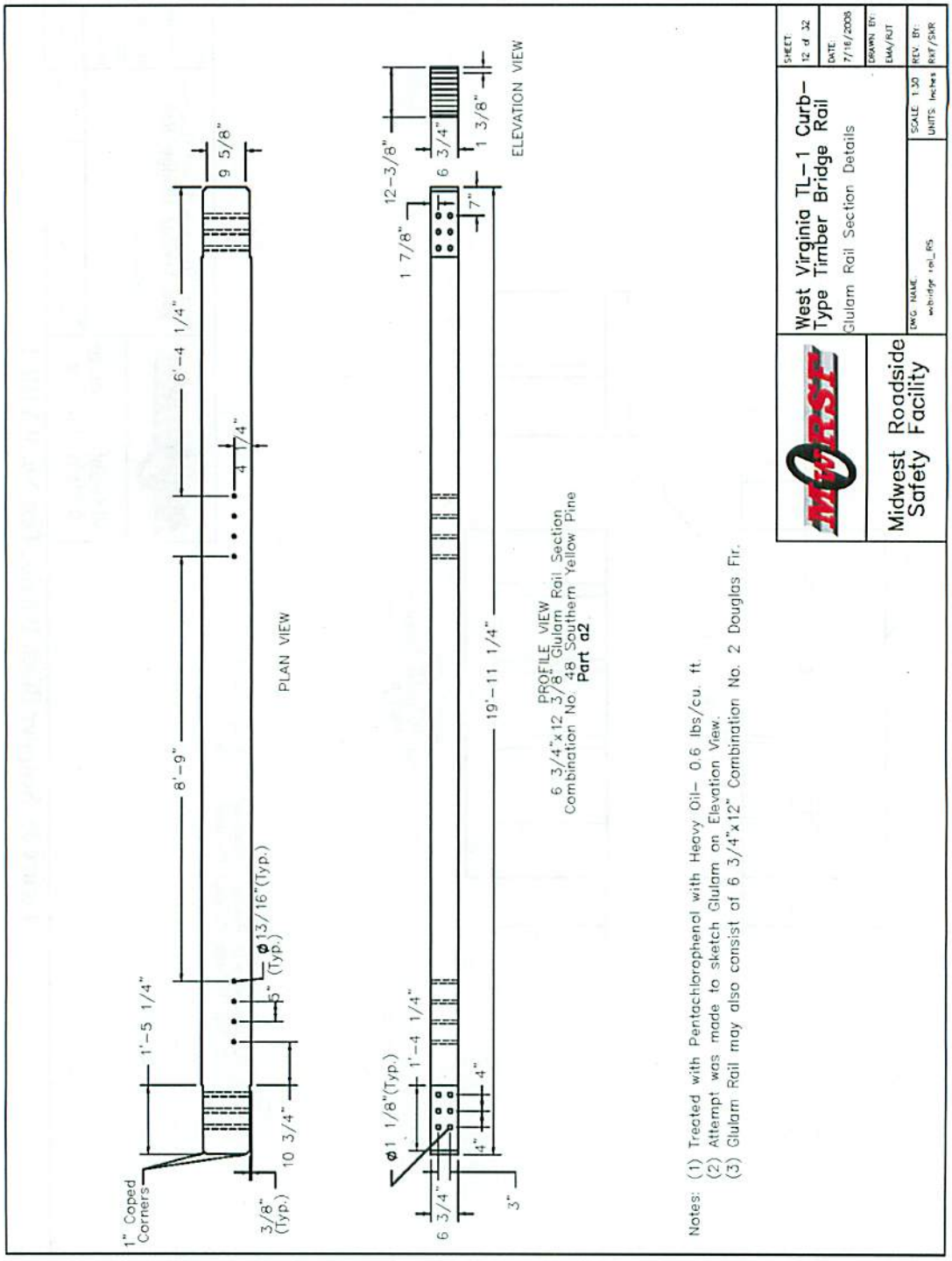


Figure 36. Glulam Rail Segment Details, Test No. WVBR-1

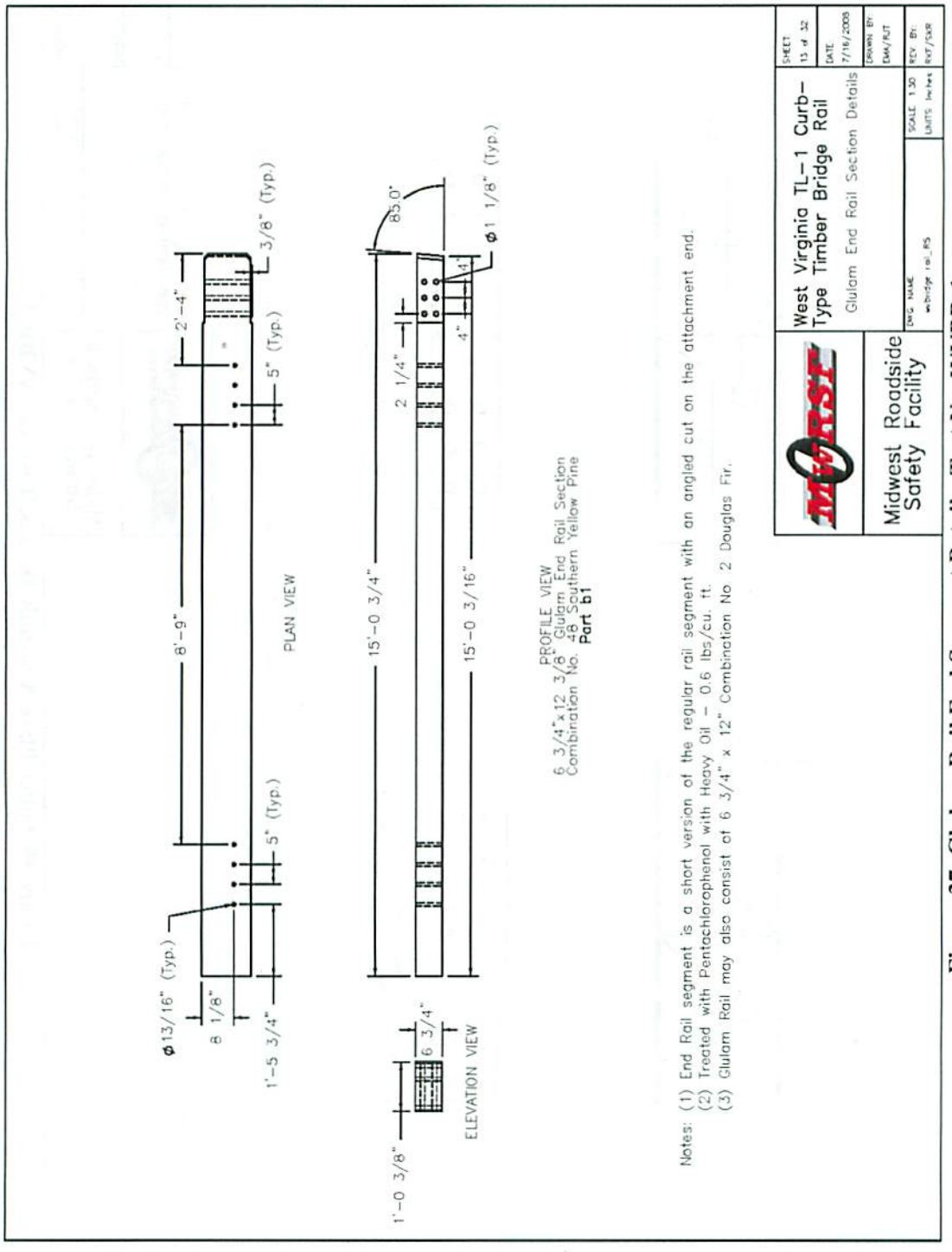


Figure 37. Glulam Rail End Segment Details, Test No. WVBR-1

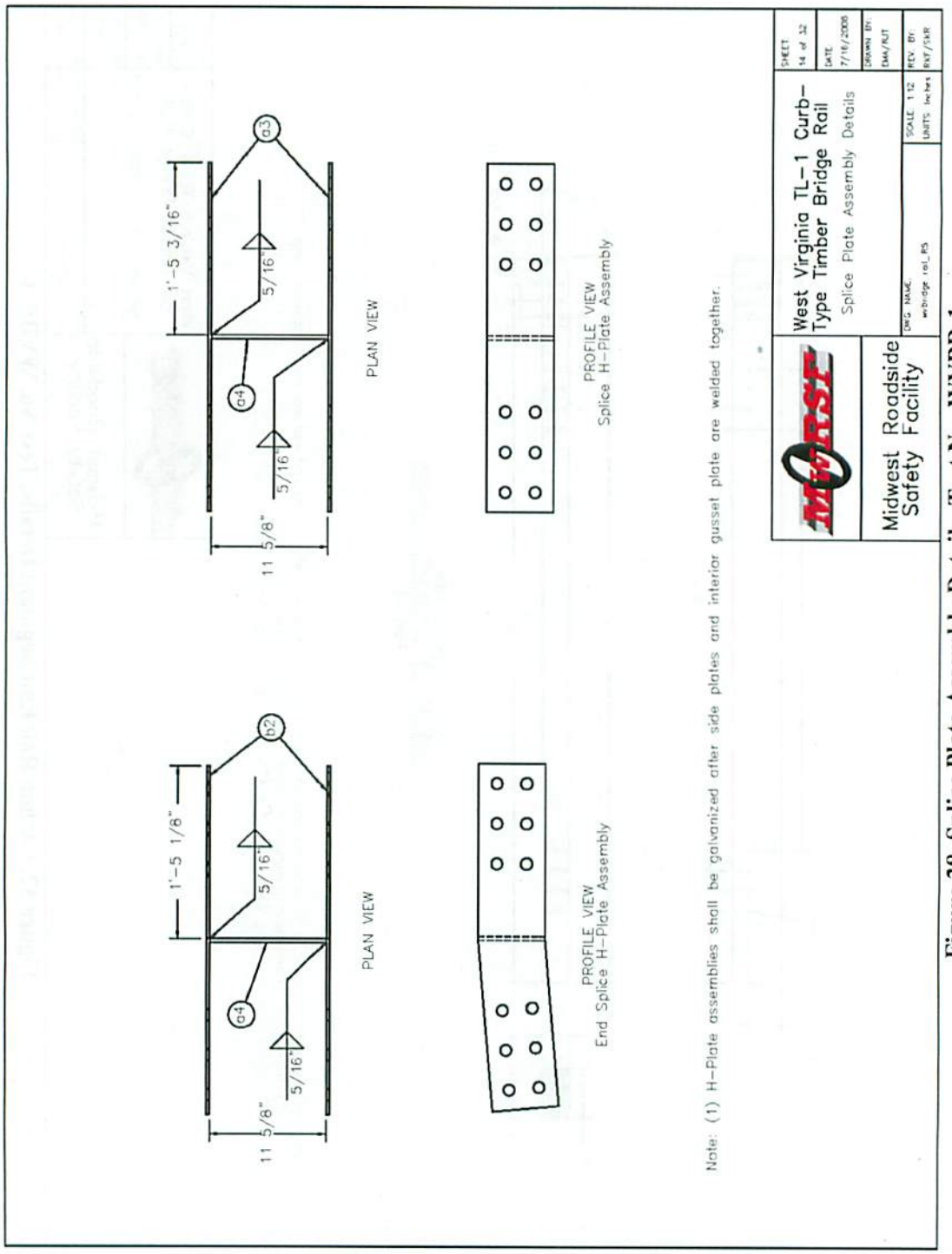


Figure 38. Splice Plate Assembly Details, Test No. WVBR-1

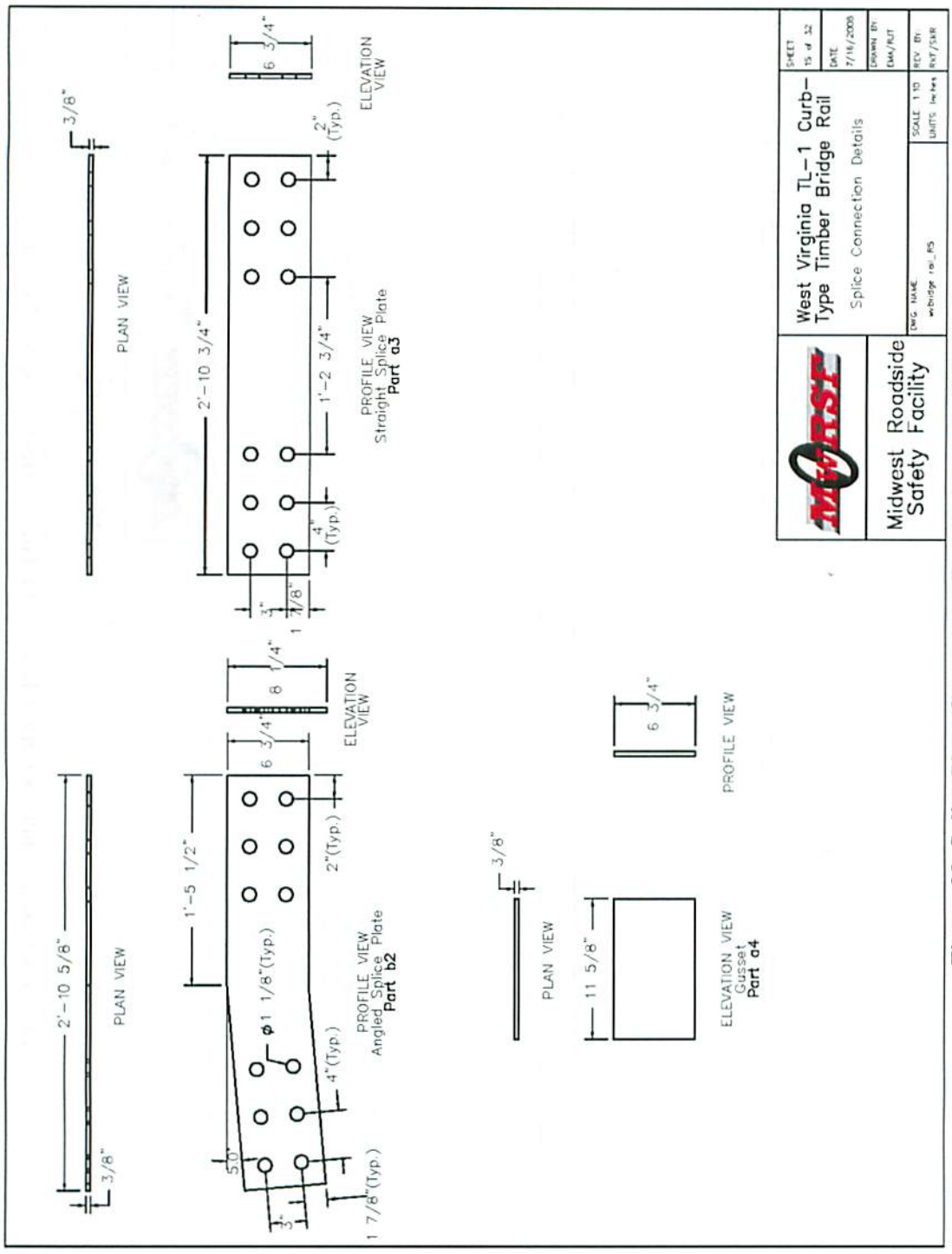


Figure 39. Splice Plate Component Details, Test No. WVBR-1

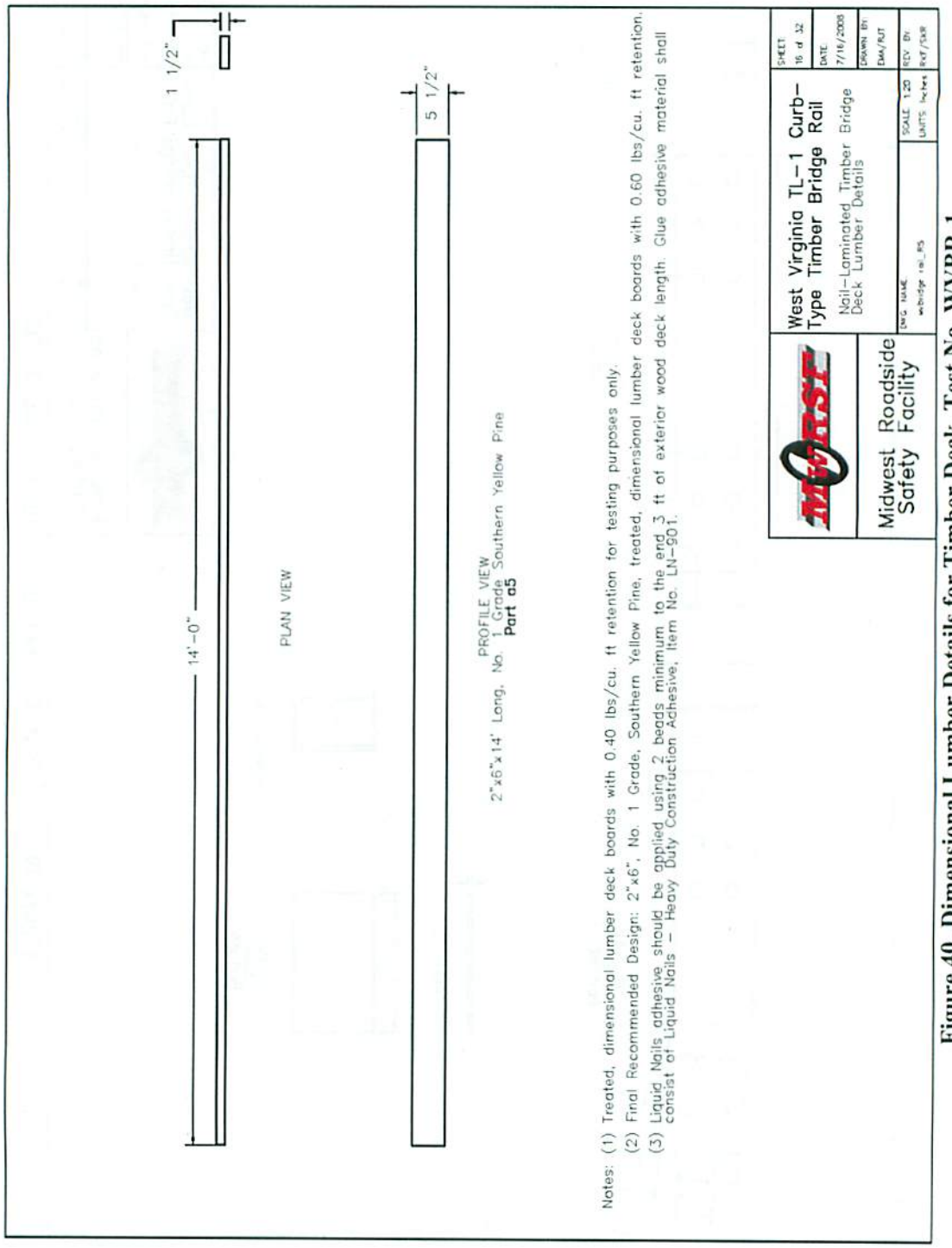


Figure 40. Dimensional Lumber Details for Timber Deck, Test No. WVBR-1

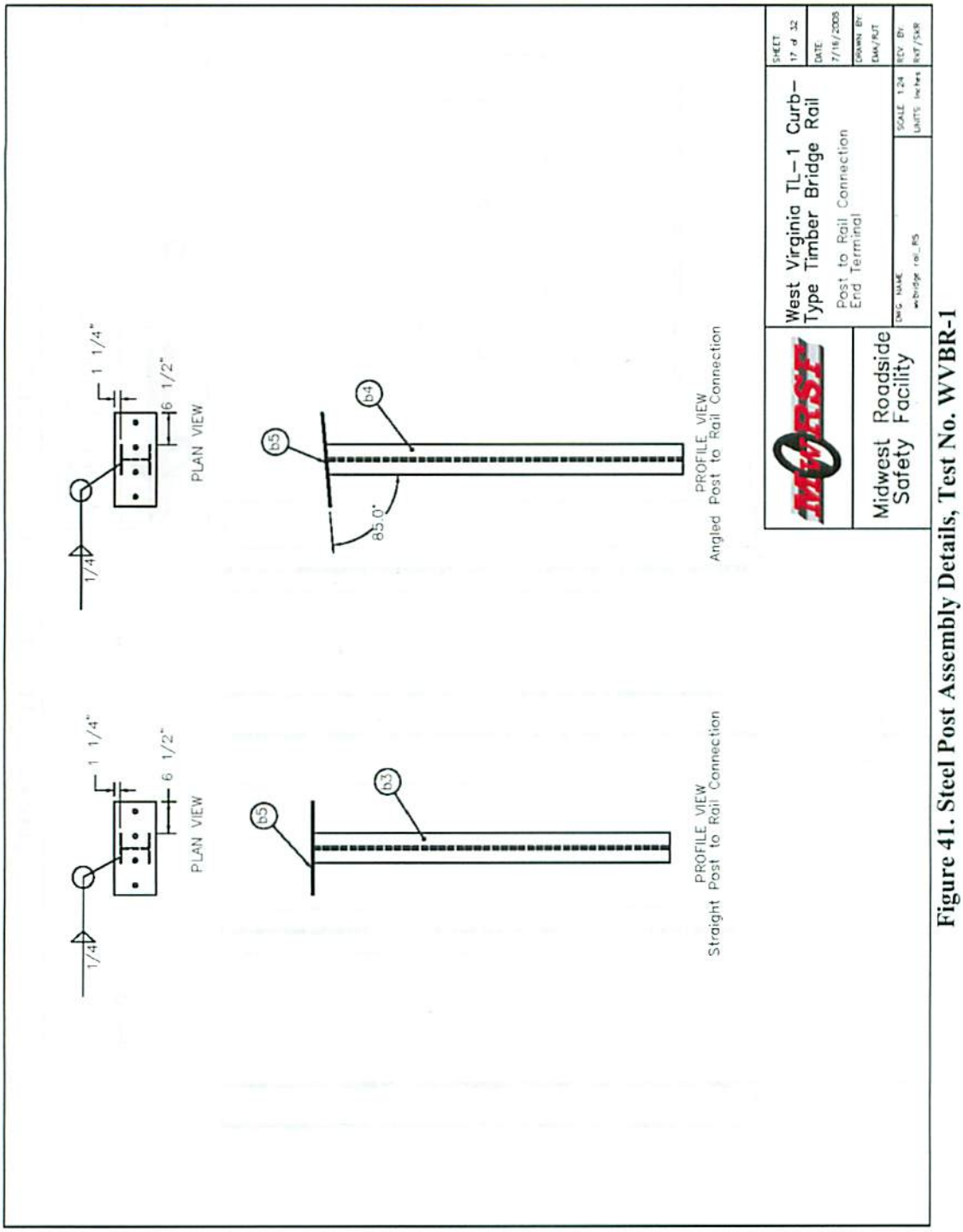


Figure 41. Steel Post Assembly Details, Test No. WVBR-1

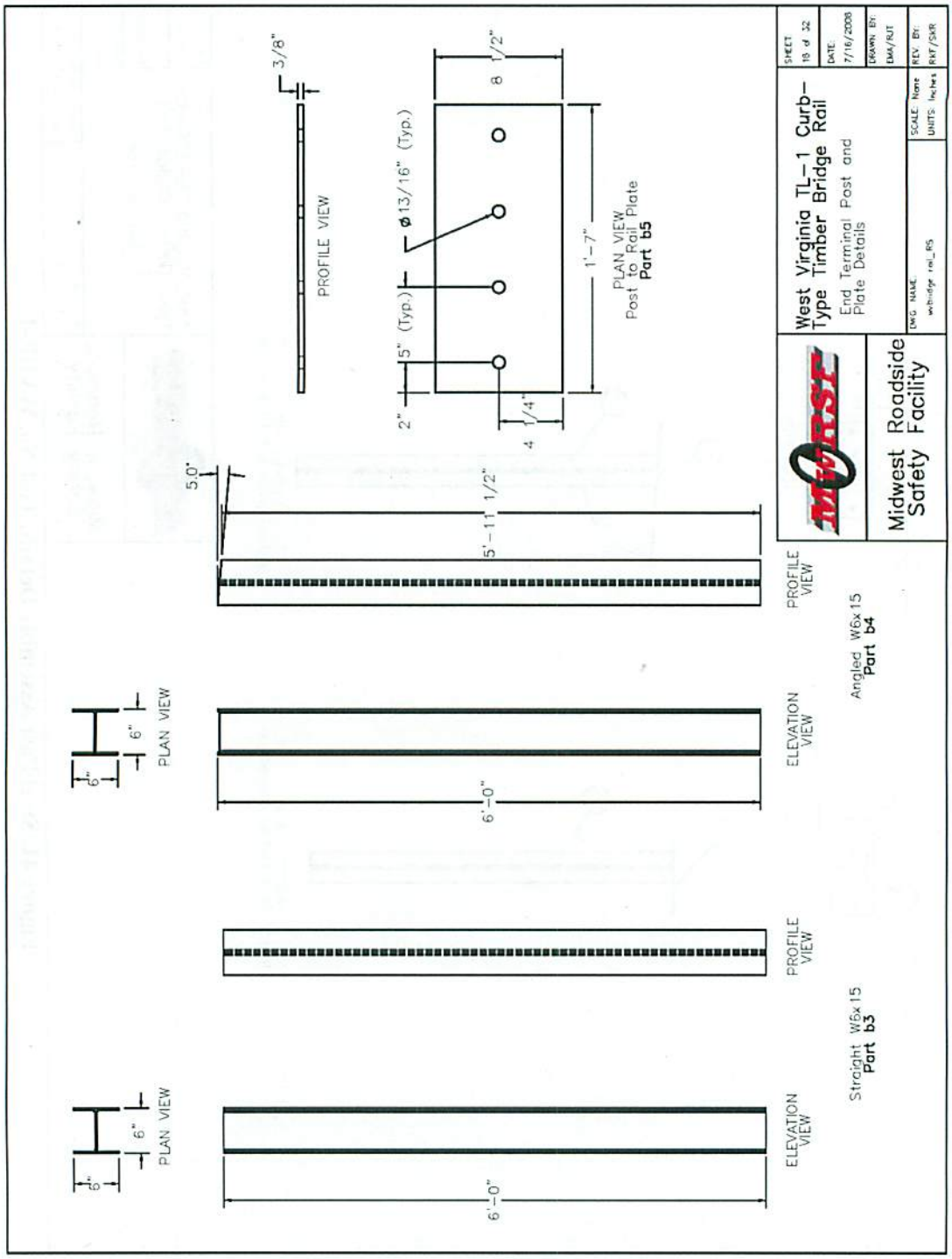
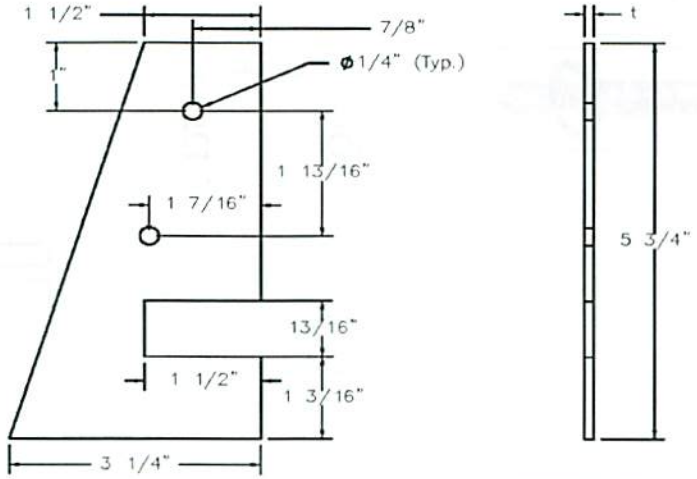


Figure 42. Steel Post Details, Test No. WVBR-1



Galvanized Deck Anchor Bracket
Part a6

Steel Specification	Galvanizing	Thickness, t
ASTM A1011 Gr. 36 Hot Rolled Sheet (U.S. Steel Designator – HR36SK53) [Fy(min) = 36 ksi, Fu(min) = 53 ksi]	ASTM A653 G90	11 Gauge
ASTM A1011 Gr. 36 Type 1 SS Hot Rolled Structural Steel Sheet [Fy(min) = 36 ksi, Fu(min) = 53 ksi]	ASTM A653 G90	11 Gauge
ASTM A1011 Gr. 36 Type 2 SS Hot Rolled Structural Steel Sheet [Fy(min) = 36 ksi, Fu(min) = 58–80 ksi]	ASTM A653 G90	11 Gauge
ASTM A36 Steel Plate [Fy(min) = 36 ksi, Fu(min) = 58–80 ksi]	Hot Dipped Galvanized ASTM ??? (0.90 oz/sq. ft)	1/8"

Notes: (1) Use 11–gauge option for crash–tested system.
(2) Deck anchor brackets shall be installed using 20d or 20 penny "common" nails.

Midwest Roadside Safety Facility

West Virginia TL–1 Curb–Type Timber Bridge Rail

Deck Anchor Bracket Details

SHEET: 19 of 32
DATE: 7/16/2008
DRAWN BY: EMA/RJT
DWG. NAME: wvbridge rail_RS
SCALE: 1:2
UNITS: Inches
REV. BY: RKF/SKR

Figure 43. Deck Anchor Bracket Details, Test No. WVBR-1

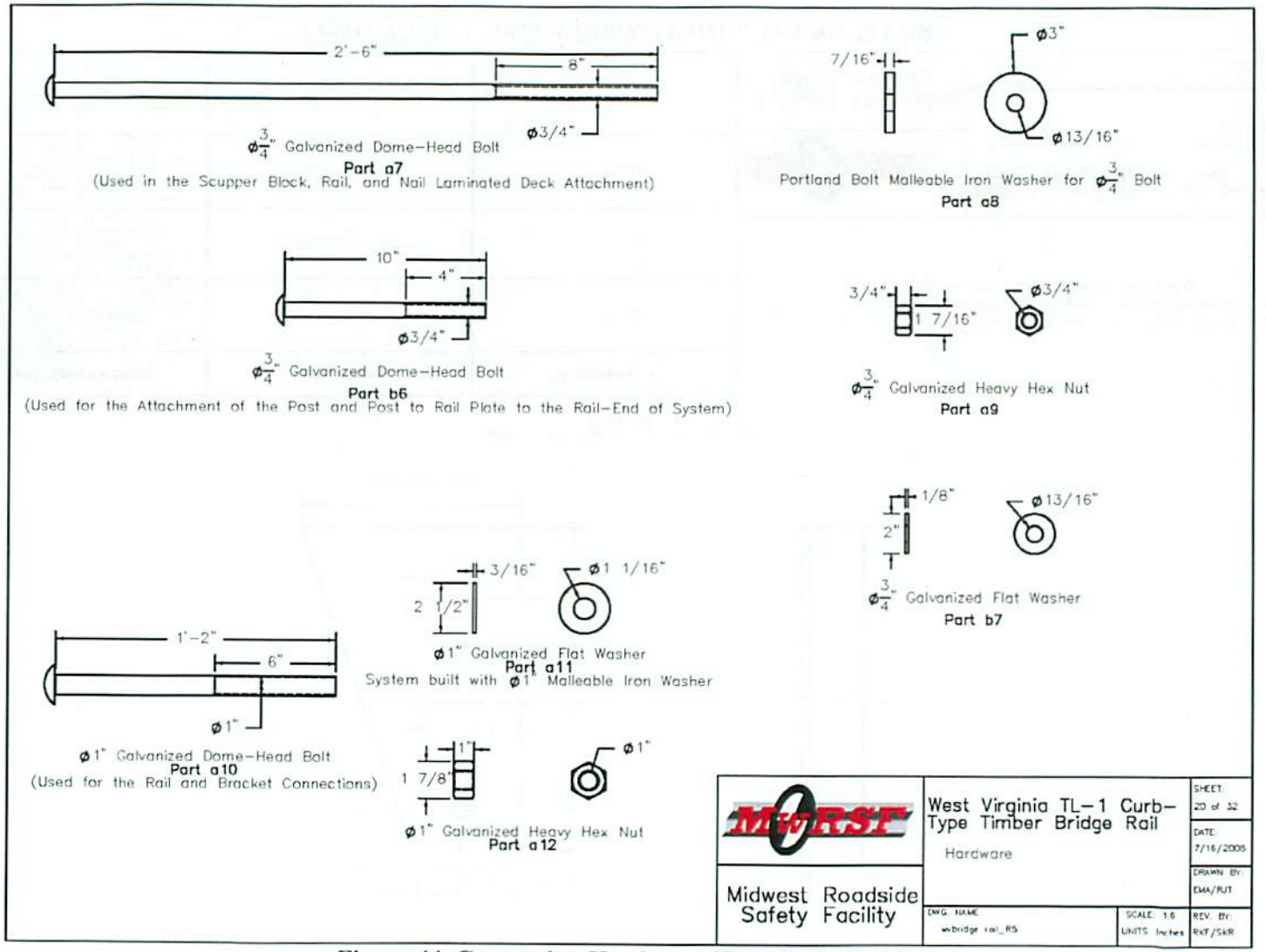


Figure 44. Connection Hardware, Test No. WVBR-1

West Virginia TL-1 Curb-Type Timber Bridge Rail			
Item No.	QTY.	Description	Material Specifications
a1	24	Scupper Block	Southern Yellow Pine No. 1
a2	7	Glulam Rail Section	Southern Yellow Pine Combination No. 48
a3	12	Straight Splice Plate	Design-A572 Gr. 42; Used-A656 Gr. 50 Ty. 7
a4	7	Splice Gusset	Design-A572 Gr. 42; Used-A656 Gr. 50 Ty. 7
a5	960	2"x6"x14' Long Treated, Dimensional Lumber (0.60 lbs retention)	Southern Yellow Pine No. 1
a6	240	Deck Anchor Plate	See Page 18 of 31
a7	48	3/4" Dome Head Bolt 30" Long	Galvanized A307
a8	64	3/4" Malleable Iron Washer	-
a9	64	3/4" Heavy Hex Nut	Galvanized A307
a10	84	1" Dome Head Bolt 14" Long	Galvanized A307
a11	84	1" Flat Washer (as built-Malleable Iron)	Galvanized A307
a12	84	1" Heavy Hex Nut	Galvanized A307
b1	1	Glulam End Rail Section	Southern Yellow Pine Combination No. 48
b2	2	Angled End Splice Plate	Design-A572 Gr. 42; Used-A656 Gr. 50 Ty. 7
b3	2	Straight W6x15	Galvanized A36
b4	2	Angled W6x15	Galvanized A36
b5	4	Post to Rail Plate	Galvanized A36
b6	16	3/4" Dome Head Bolt 10" Long	Galvanized A307
b7	16	3/4" Flat Washer	Galvanized A307
c11	18	0.625x4.75x25.375 Plate	A36
c12	18	0.375x4.75x25.375 Plate	A36*
c14	12	WT3x10x66.5" Long	A36
c16	6	C15x33.9x66.5" Long	A36
c17	6	Sole Plate 1 1/2" Thick	A36
c18	6	Sole Plate 3/4" Thick	-
c19	6	W27x94	-

Midwest Roadside Safety Facility

West Virginia TL-1 Curb-Type Timber Bridge Rail

Bill of Materials for Bridge Rail

SHEET: 21 of 32
DATE: 3/13/2009
DRAWN BY: EAI/NJT
DWG. NAME: wvbridge rail_R7
SCALE: None
UNITS: inches
REV. BY: RKF/SKR

Figure 45. Bill of Materials, Test No. WVBR-1