



U.S. Department
of Transportation
**Federal Highway
Administration**

June 3, 2020

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

In Reply Refer To:
HSST-1/B-341

Mr. Alex Lim
Oregon Department of Transportation
4040 Fairview Industrial Drive SE, MS 4
Salem, OR 97302
USA

Dear Mr. Lim:

This letter is in response to your March 16, 2020 request for the Federal Highway Administration (FHWA) to review a roadside safety device, hardware, or system for eligibility for reimbursement under the Federal-aid highway program. This FHWA letter of eligibility is assigned FHWA control number B-341 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

The following device is eligible within the length-of-need, with details provided in the form which is attached as an integral part of this letter:

- Oregon 3-Tube Curb Mount Bridge Rail

Scope of this Letter

To be found eligible for Federal-aid funding, new roadside safety devices should meet the crash test and evaluation criteria contained in the American Association of State Highway and Transportation Officials' (AASHTO) Manual for Assessing Safety Hardware (MASH). However, the FHWA, the Department of Transportation, and the United States Government do not regulate the manufacture of roadside safety devices. Eligibility for reimbursement under the Federal-aid highway program does not establish approval, certification or endorsement of the device for any particular purpose or use.

This letter is not a determination by the FHWA, the Department of Transportation, or the United States Government that a vehicle crash involving the device will result in any particular outcome, nor is it a guarantee of the in-service performance of this device. Proper manufacturing, installation, and maintenance are required in order for this device to function as tested.

This finding of eligibility is limited to the crashworthiness of the system and does not cover other structural features, nor conformity with the Manual on Uniform Traffic Control Devices.

Eligibility for Reimbursement

Based solely on a review of crash test results and certifications submitted by the manufacturer, and the crash test laboratory, FHWA agrees that the device described herein meets the crash test and evaluation criteria of the AASHTO's MASH. Therefore, the device is eligible for reimbursement under the Federal-aid highway program if installed under the range of tested conditions.

Name of system: Oregon 3-Tube Curb Mount Bridge Rail
Type of system: Longitudinal Bridge Barrier
Test Level: MASH Test Level 4 (TL4)
Testing conducted by: Texas A&M Transportation Institute
Date of request: March 16, 2020

FHWA concurs with the recommendation of the accredited crash testing laboratory on the attached form.

Full Description of the Eligible Device

The device and supporting documentation, including reports of the crash tests or other testing done, videos of any crash testing, and/or drawings of the device, are described in the attached form.

Notice

This eligibility letter is issued for the subject device as tested. Modifications made to the device are not covered by this letter. Any modifications to this device should be submitted to the user (i.e., state DOT) as per their requirements.

You are expected to supply potential users with sufficient information on design, installation and maintenance requirements to ensure proper performance.

You are expected to certify to potential users that the hardware furnished has the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the test and evaluation criteria of AASHTO's MASH.

Issuance of this letter does not convey property rights of any sort or any exclusive privilege. This letter is based on the premise that information and reports submitted by you are accurate and correct. We reserve the right to modify or revoke this letter if: (1) there are any inaccuracies in the information submitted in support of your request for this letter, (2) the qualification testing was flawed, (3) in-service performance or other information reveals safety problems, (4) the system is significantly different from the version that was crash tested, or (5) any other information indicates that the letter was issued in error or otherwise does not reflect full and complete information about the crashworthiness of the system.

Standard Provisions

- To prevent misunderstanding by others, this letter of eligibility designated as FHWA control number B-341 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 upon request.
- This letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder.
- This FHWA eligibility letter is not an expression of any Agency view, position, or determination of validity, scope, or ownership of any intellectual property rights to a specific device or design. Further, this letter does not impute any distribution or licensing rights to the requester. This FHWA eligibility letter determination is made based solely on the crash-testing information submitted by the requester. The FHWA reserves the right to review and revoke an earlier eligibility determination after receipt of subsequent information related to crash testing.

Sincerely,



Michael S. Griffith
Director, Office of Safety Technologies
Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	March 16, 2020	<input checked="" type="radio"/> New <input type="radio"/> Resubmission
	Name:	AlexLim	
	Company:	Oregon Department of Transportation	
	Address:	4040 Fairview Industrial Drive SE, MS4, Salem, OR97302	
	Country:	U.S.A	
	To:	Michael S. Griffith, Director FHWA, Office of Safety Technologies	

I request the following devices be considered eligible for reimbursement under the Federal-aid highway program.

Device & Testing Criterion - Enter from right to left starting with Test Level

System Type	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'B': Rigid/Semi-Rigid Barriers (Roadside, Median, Bridge Railings)	<input checked="" type="radio"/> Physical Crash Testing <input type="radio"/> Engineering Analysis	Oregon 3-Tube Curb Mount Bridge Rail	AASHTOMASH	TL4

By submitting this request for review and evaluation by the Federal Highway Administration, I certify that the product(s) was (were) tested in conformity with the AASHTO Manual for Assessing Safety Hardware and that the evaluation results meet the appropriate evaluation criteria in the MASH.

Individual or Organization responsible for the product:

Contact Name:	AlexLim	Same as Submitter <input checked="" type="checkbox"/>
Company Name:	Oregon Department of Transportation	Same as Submitter <input checked="" type="checkbox"/>
Address:	4040 Fairview Industrial Drive SE, MS4, Salem, OR97302	Same as Submitter <input checked="" type="checkbox"/>
Country:	U.S.A	Same as Submitter <input checked="" type="checkbox"/>

Enter below all disclosures of financial interests as required by the FHWA 'Federal-Aid Reimbursement Eligibility Process for Safety Hardware Devices' document.

Texas A&M Transportation Institute (TTI) was contracted by the Oregon Department of Transportation to perform full-scale crash testing of the Oregon 3-Tube Curb Mount Bridge Rail. There are no shared financial interests in the Oregon 3-Tube Curb Mount Bridge Rail by TTI, or between the Oregon Department of Transportation and TTI, other than the costs involved in the actual crash tests and reports for this submission to FHWA.

PRODUCT DESCRIPTION

Help	
<input checked="" type="radio"/> New Hardware or Significant Modification	<input type="radio"/> Modification to Existing Hardware
<p>The installation for the Oregon 3-Tube Curb Mount Bridge Rail consisted of an 8-inch thick reinforced concrete cantilevered deck and a 9 inch tall curb, with a 2-inch thick lift of asphalt on the deck. The deck and curb were 158 ft 11½ inches long, with three 1-inch open joints. Steel posts, which supported three rectangular steel rails, were mounted on the curb. There was a post mounted at 28¼ inches from each end. The second post from each end was located 7 ft from the first, and the remaining posts were spaced at 10 ft. The top of the curb was at 7 inches above grade, and the tops of the rails were at 19½ inches, 32¼ inches, and 42 inches above grade.</p>	
<h3>CRASH TESTING</h3>	
<p>By signature below, the Engineer affiliated with the testing laboratory, agrees in support of this submission that all of the critical and relevant crash tests for this device listed above were conducted to meet the MASH test criteria. The Engineer has determined that no other crash tests are necessary to determine the device meets the MASH criteria.</p>	
Engineer Name:	Nathan D. Schulz
Engineer Signature:	<div style="display: flex; align-items: center;"> <div style="font-size: 24pt; font-weight: bold; margin-right: 10px;">Nathan D. Schulz</div> <div style="font-size: 10pt;"> Digitally signed by Nathan D. Schulz Date: 2020.02.21 09:56:34 -06'00' </div> </div>
Address:	<div style="display: flex; justify-content: space-between;"> <div style="font-size: 10pt;">TTI, Texas A&M REILIS Campus, 3100 State Hwy 47, Bldg. 7091, Bryan TX 77807</div> <div style="font-size: 10pt;">Same as Submitter <input type="checkbox"/></div> </div>
Country:	<div style="display: flex; justify-content: space-between;"> <div style="font-size: 10pt;">U.S.A</div> <div style="font-size: 10pt;">Same as Submitter <input type="checkbox"/></div> </div>
<p>A brief description of each crash test and its result: Help</p>	

Required Test Number	Narrative Description	Evaluation Results
4-10(1100C)	<p>TTI Crash Test Report No. 612711-01 contains the results of this 4-10 Test that was conducted on December 13, 2019. The target CIP was 3.6 ft upstream of the center of the joint between posts 13 and 14.</p> <p>The impact speed and angle were 63.5 mi/h and 26.4°. The actual impact point was 4.3 ft upstream of the center of the joint between posts 13 and 14.</p> <p>The Oregon 3-Tube Curb Mount Bridge Rail contained and redirected the 1100C vehicle. The vehicle did not penetrate, underide, or override the installation. Maximum dynamic deflection during the test was 1.6 inches.</p> <p>No detached elements, fragments, or other debris were present to penetrate or show potential for penetrating the occupant compartment or present hazard to others in the area.</p> <p>Maximum occupant compartment deformation was 3.0 inches in the left front floor pan.</p> <p>The 1100C vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 13° and 17°, respectively.</p> <p>Occupant risk factors were within the limits specified in MASH. Longitudinal OIV was 23.6 ft/s, and lateral OIV was 37.4 ft/s.</p> <p>Longitudinal occupant ridedown acceleration was 5.9g, and lateral occupant ridedown acceleration was 10.7g.</p> <p>The Oregon 3-Tube Curb Mount Bridge Rail performed acceptably for MASH test 4-10.</p>	PASS

Required Test Number	Narrative Description	Evaluation Results
4-11 (2270P)	<p>TTI Crash Test Report No. 612711-01 contains the results of this 4-11 Test that was conducted on December 12, 2019. The target CIP was 4.3 ft upstream of the joint between posts 9 and 10.</p> <p>The impact speed and angle were 61.9 mi/h and 23.9°. The actual impact point was 4.4 ft upstream of the joint between posts 9 and 10.</p> <p>The Oregon 3-Tube Curb Mount Bridge Rail contained and redirected the 2270P vehicle. The vehicle did not penetrate, underide, or override the installation. Maximum dynamic deflection during the test was 6.25 inches. Some small pieces of concrete spalled off the field side of the bridge rail, however, there were no other fragments or debris on the traffic side of the bridge rail. These pieces did not penetrate or show potential for penetrating the occupant compartment. Maximum occupant compartment deformation was 1.0 inch in the left front floorpan/firewall area.</p> <p>The 2270P vehicle remained upright during and after the collision period. Maximum roll and pitch angles were 36° and 10°, respectively.</p> <p>Occupant risk factors were within the preferred limits of MASH. Longitudinal OIV was 14.1 ft/s, and lateral OIV was 25.9 ft/s. Longitudinal occupant ridedown acceleration was 5.4 g, and lateral occupant ridedown acceleration was 12.9 g.</p> <p>The Oregon 3-Tube Curb Mount Bridge Rail performed acceptably for MASH test 4-11.</p>	PASS

4-12 (10000S)	<p>TTI Crash Test Report No. 612711-01 contains the results of this 4-12 Test that was conducted on December 11, 2019. The target CIP was 5.0 ft upstream of the joint between posts 5 and 6.</p> <p>The impact speed and angle were 56.9 mi/h and 14.2°. The actual impact point was 5.3 ft upstream of the joint between posts 5 and 6.</p> <p>The Oregon 3-Tube Curb Mount Bridge Rail contained and redirected the 10000S vehicle. The vehicle did not penetrate, underide, or override the installation. Maximum dynamic deflection during the test was 7.1 inches.</p> <p>No detached elements, fragments, or other debris were present to penetrate or show potential for penetrating the occupant compartment, or to present hazard to others in the area.</p> <p>Maximum occupant compartment deformation was 2.0 inches in the left front floor pan.</p> <p>The 10000S vehicle remained upright during and after the collision event.</p> <p>The Oregon 3-Tube Curb Mount Bridge Rail performed acceptably for MASH test 4-12.</p>	PASS
4-20 (1100C)	Test for transition is not applicable for this bridge barrier system.	Non-Relevant Test, not conducted
4-21 (2270P)	Test for transition is not applicable for this bridge barrier system.	Non-Relevant Test, not conducted
4-22 (10000S)	Test for transition is not applicable for this bridge barrier system.	Non-Relevant Test, not conducted

Full Scale Crash Testing was done in compliance with MASH by the following accredited crash test laboratory (cite the laboratory's accreditation status as noted in the crash test reports.):

Laboratory Name:	Texas A&M Transportation Institute	
Laboratory Signature:	Digitally signed by Darrell L. Kuhl 'Date: 2020.02.17 14:55:12-01	
Address:	TTI, Texas A&M RELLIS Campus, 3100 State Hwy 47, Bldg. 7091, Bryan TX 77807	Same as Submitter <input type="checkbox"/>
Country:	U.S.A	Same as Submitter <input type="checkbox"/>
Accreditation Certificate Number and Dates of current Accreditation period :	ISO 17025 Laboratory Certificate Number: 2821.01 Valid to: April 30, 2021	

SubmitterSignature*: **AlexLim** Digitally signed by AlexLim
 Date: 2020.03.17 13:05:09
 -07'00'

Submit Form

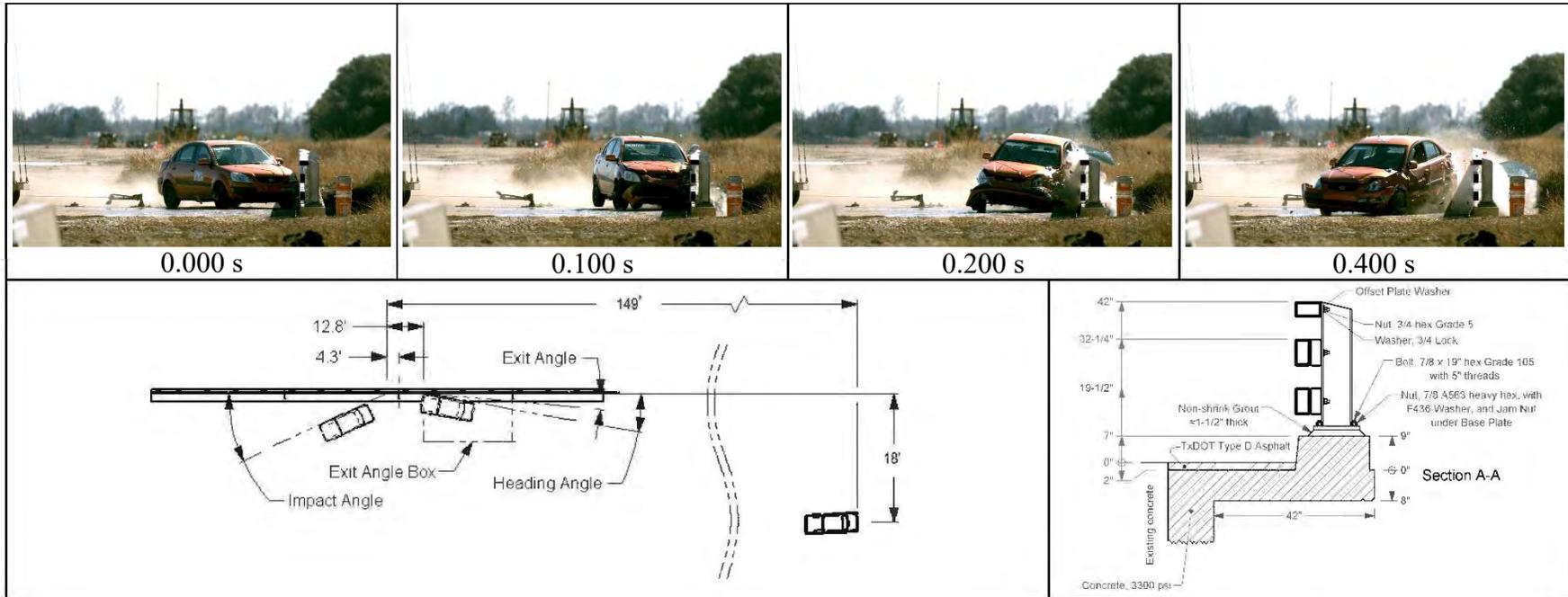
ATTACHMENTS

Attach to this form:

- 1) Additional disclosures of related financial interest as indicated above.
- 2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
- 3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications [[Hardware Guide Drawing Standards](#)]. For proprietary products, a single isometric line drawing is usually acceptable to illustrate the product, with detailed specifications, intended use, and contact information provided on the reverse. Additional drawings (not in TF-13 format) showing details that are relevant to understanding the dimensions and performance of the device should also be submitted to facilitate our review.

FHWA Official Business Only:

Eligibility Letter		
Number	Date	Key Words



General Information

Test Agency..... Texas A&M Transportation Institute (TTI)
 Test Standard Test No. MASH Test 4-10
 TTI Test No. 612711-01-2
 Test Date 2019-12-13

Test Article

Type Longitudinal Barrier – Bridge Rail
 Name Oregon 3-Tube Curb Mount Bridge Rail
 Installation Length..... 158 ft-11½ inches
 Material or Key Elements ... Three rectangular steel rails supported by steel posts on reinforced concrete cantilevered 8-inch thick deck, 9-inch tall curb, with 2-inch thick asphalt on the deck

Soil Type and Condition

Concrete bridge deck, Damp

Test Vehicle

Type/Designation..... 1100C
 Make and Model 2009 Kia Rio
 Curb..... 2482 lb
 Test Inertial..... 2430 lb
 Dummy 165 lb
 Gross Static 2595 lb

Impact Conditions

Speed 63.5 mi/h
 Angle 26.4°
 Location/Orientation 4.3 ft upstream of joint 13 and 14

Impact Severity

Exit Conditions

Speed 51.4 mi/h
 Trajectory/Heading Angle... 8.8° / 12.8°

Occupant Risk Values

Longitudinal OIV 23.6 ft/s
 Lateral OIV 37.4 ft/s
 Longitudinal Ridedown 5.9 g
 Lateral Ridedown 10.7 g
 THIV 13.3 m/s
 ASI..... 2.95

Max. 0.050-s Average

Longitudinal -13.4 g
 Lateral..... 22.1 g
 Vertical..... -2.6 g

Post-Impact Trajectory

Stopping Distance..... 149 ft downstream
 18 ft twd traffic lanes

Vehicle Stability

Maximum Yaw Angle 53°
 Maximum Pitch Angle 17°
 Maximum Roll Angle 13°
 Vehicle Snagging No
 Vehicle Pocketing No

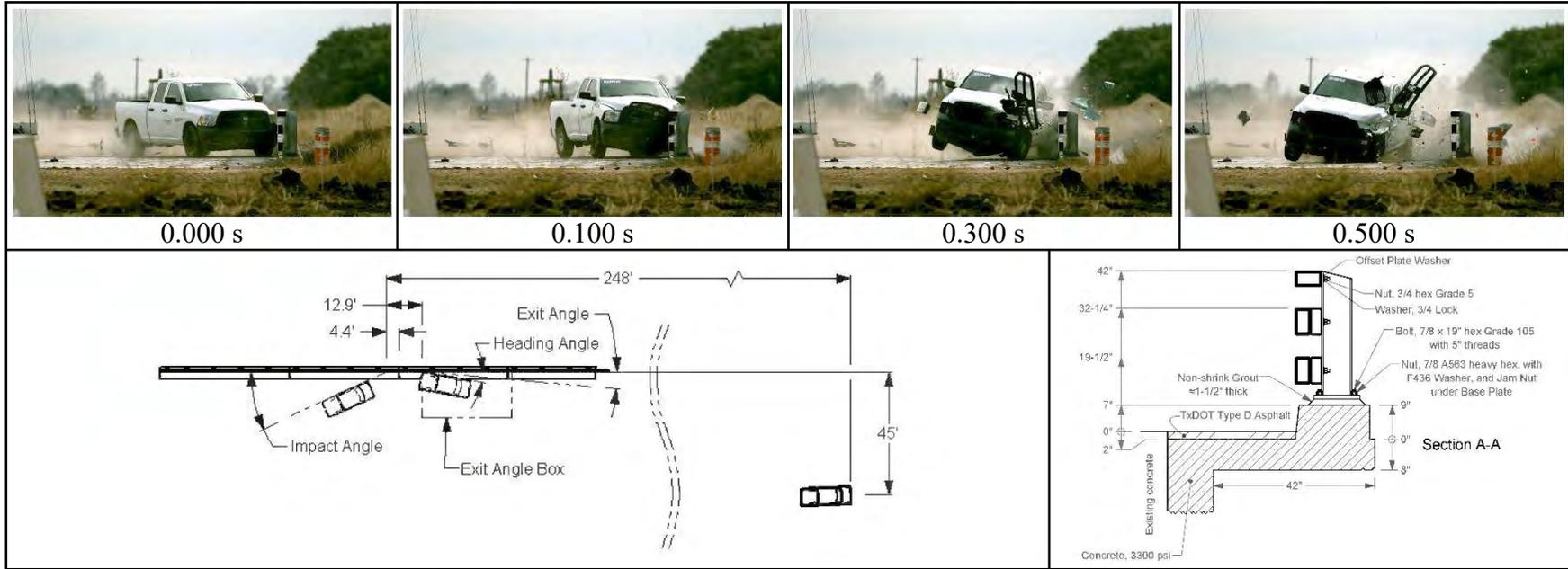
Test Article Deflections

Dynamic..... 1.6 inches
 Permanent 0.6 inch
 Working Width..... 19.5 inches
 Height of Working Width 7.0 inches

Vehicle Damage

VDS 11LFQ5
 CDC..... 11FLEW4
 Max. Exterior Deformation..... 9.0 inches
 OCDI..... LF0101000
 Max. Occupant Compartment Deformation 3.0 inches

Figure 5.7. Summary of Results for MASH Test 4-10 on Oregon 3-Tube Curb Mount Bridge Rail.



General Information

Test Agency..... Texas A&M Transportation Institute (TTI)
 Test Standard Test No. MASH Test 4-11
 TTI Test No. 612711-01-3
 Test Date 2019-12-12

Test Article

Type Longitudinal Barrier – Bridge Rail
 Name Oregon 3-Tube Curb Mount Bridge Rail
 Installation Length..... 158 ft-11½ inches
 Material or Key Elements ... Three rectangular steel rails supported by steel posts on reinforced concrete cantilevered 8-inch thick deck, 9-inch tall curb, with 2-inch thick asphalt on the deck
 Soil Type and Condition Concrete bridge deck, Damp

Test Vehicle

Type/Designation 2270P
 Make and Model 2013 RAM 1500 Pickup
 Curb 4936 lb
 Test Inertial 5050 lb
 Dummy 165 lb
 Gross Static 5215 lb

Impact Conditions

Speed 61.9 mi/h
 Angle 23.9°
 Location/Orientation 4.4 ft upstream of joint 9-10

Impact Severity

..... 106 kip-ft
Exit Conditions
 Speed 51.3 mi/h
 Trajectory/Heading Angle... 6.7° / 6.4°

Occupant Risk Values

Longitudinal OIV 14.1 ft/s
 Lateral OIV 25.9 ft/s
 Longitudinal Ridedown 5.4 g
 Lateral Ridedown 12.9 g
 THIV 8.47 m/s
 ASI 1.77
 Max. 0.050-s Average
 Longitudinal -6.5 g
 Lateral 13.6 g
 Vertical 3.8 g

Post-Impact Trajectory

Stopping Distance 248 ft downstream
 45 ft twd traffic lanes

Vehicle Stability

Maximum Yaw Angle 38°
 Maximum Pitch Angle 10°
 Maximum Roll Angle 36°
 Vehicle Snagging No
 Vehicle Pocketing No

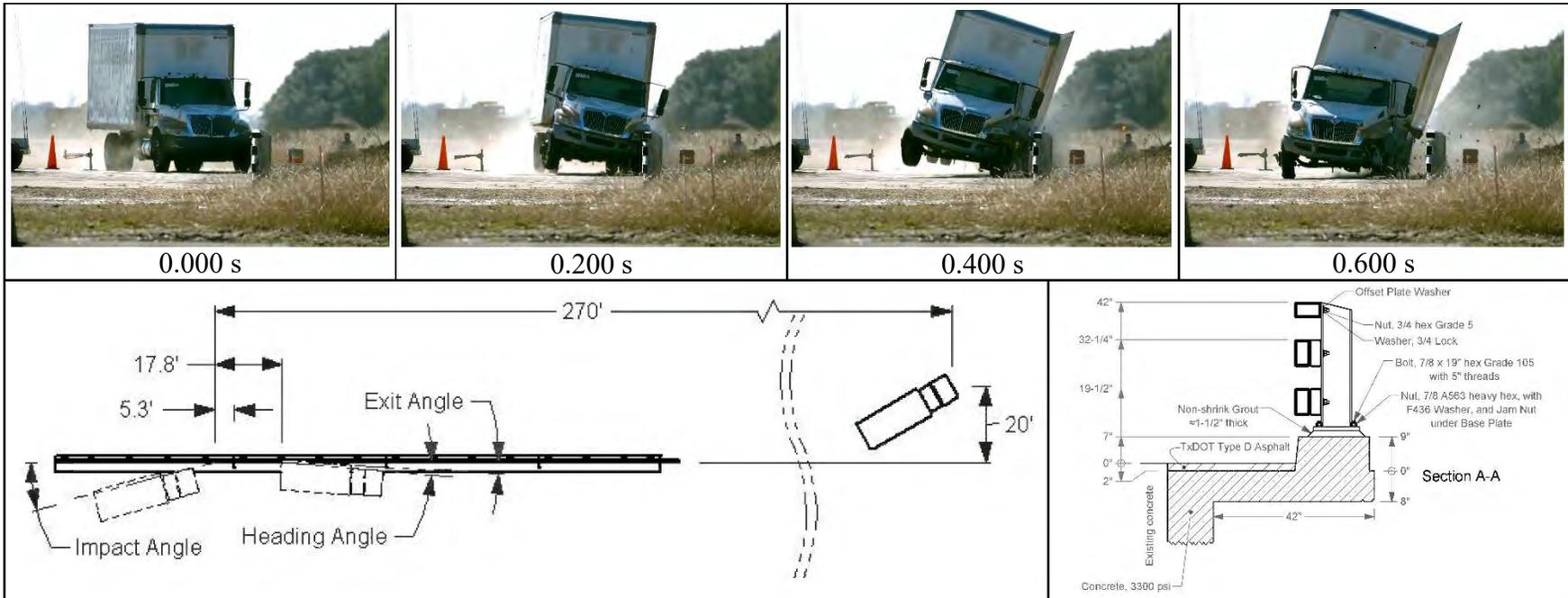
Test Article Deflections

Dynamic 6.25 inches
 Permanent 1.1 inches
 Working Width 19.5 inches
 Height of Working Width 42.0 inches

Vehicle Damage

VDS 11LFQ4
 CDC 11FLEW4
 Max. Exterior Deformation 13.0 inches
 OCDI LF0010000
 Max. Occupant Compartment Deformation 1.0 inch

Figure 6.7. Summary of Results for MASH Test 4-11 on Oregon 3-Tube Curb Mount Bridge Rail.



General Information

Test Agency..... Texas A&M Transportation Institute (TTI)
 Test Standard Test No. MASH Test 4-12
 TTI Test No. 612711-01-1
 Test Date 2019-12-11

Test Article

Type Longitudinal Barrier – Bridge Rail
 Name Oregon 3-Tube Curb Mount Bridge Rail
 Installation Length..... 158 ft-11½ inches
 Material or Key Elements ... Three rectangular steel rails supported by steel posts on reinforced concrete cantilevered 8-inch thick deck, 9-inch tall curb, with 2-inch thick asphalt on the deck

Soil Type and Condition

Concrete bridge deck, Damp

Test Vehicle

Type/Designation..... 10000S
 Make and Model 2012 International 4300
 Curb..... 13,880 lb
 Test Inertial..... 22,110 lb
 Dummy No dummy
 Gross Static 22,110 lb

Impact Conditions

Speed 56.9 mi/h
 Angle 14.2°
 Location/Orientation 5.3 ft upstream of joint 5-6

Impact Severity.....

144 ft-kips

Exit Conditions

Speed 49.9 mi/h
 Trajectory/Heading Angle... 1.7° / 1.7°

Occupant Risk Values

Longitudinal OIV 7.5 ft/s
 Lateral OIV 14.8 ft/s
 Longitudinal Ridedown 2.3 g
 Lateral Ridedown 8.0 g
 THIV 5.1 m/s
 ASI..... 0.8

Max. 0.050-s Average

Longitudinal -2.2 g
 Lateral..... 6.3 g
 Vertical..... 2.2 g

Post-Impact Trajectory

Stopping Distance..... 270 ft downstream
 20 ft twd field side

Vehicle Stability

Maximum Yaw Angle 20°
 Maximum Pitch Angle 3°
 Maximum Roll Angle 20°
 Vehicle Snagging No
 Vehicle Pocketing No

Test Article Deflections

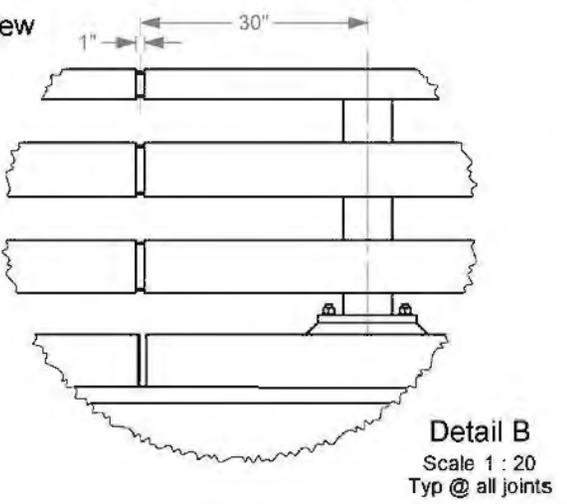
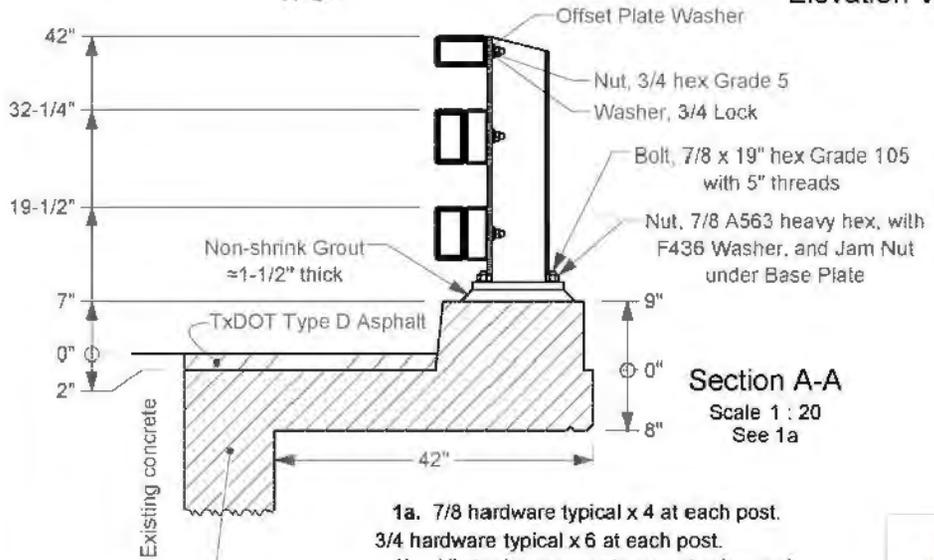
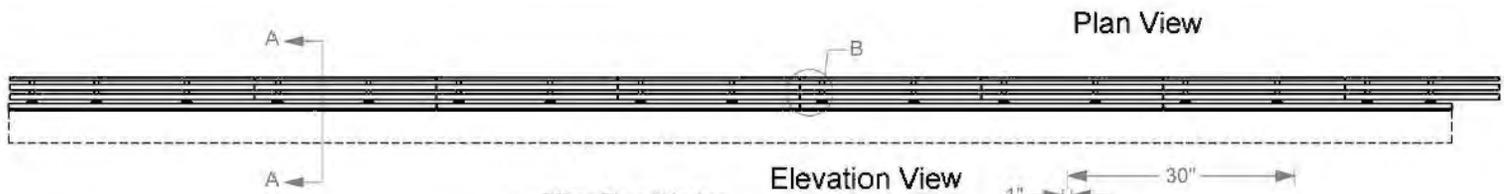
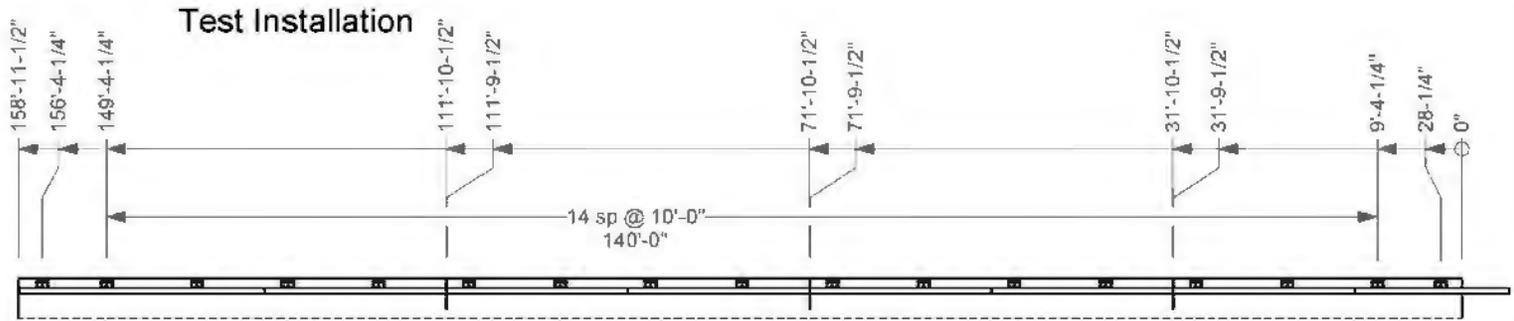
Dynamic..... 7.1 inches
 Permanent 4.25 inches
 Working Width..... 45.7 inches
 Height of Working Width 147.1 inches

Vehicle Damage

VDS NA
 CDC 11FLEW4
 Max. Exterior Deformation..... 14.0 inches
 OCDI..... NA
 Max. Occupant Compartment Deformation 2.0 inches

Figure 7.8. Summary of Results for MASH Test 4-12 on Oregon 3-Tube Curb Mount Bridge Rail.

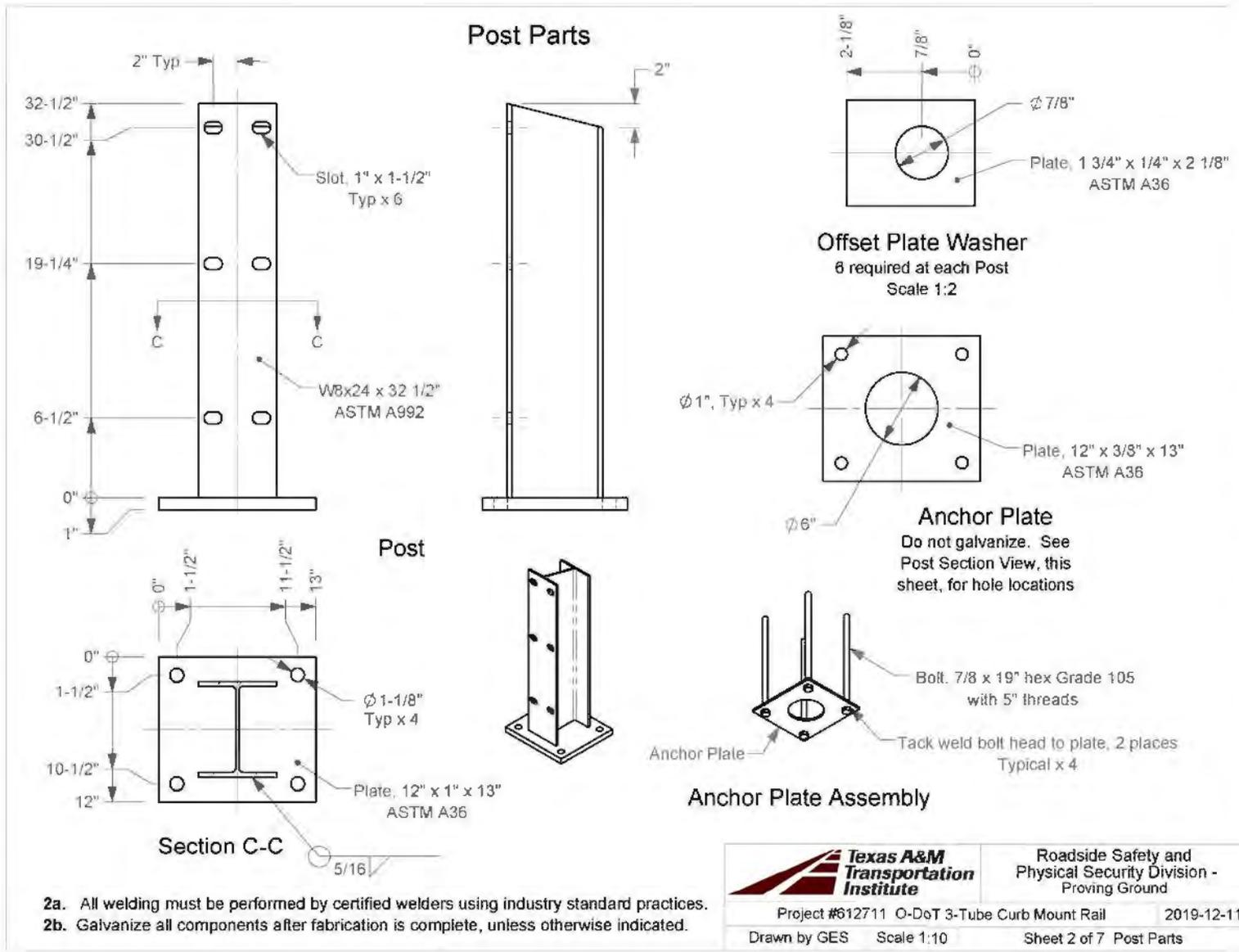
APPENDIX A. DETAILS OF THE OREGON 3-TUBE CURB MOUNT BRIDGE RAIL



- 1a. 7/8 hardware typical x 4 at each post.
3/4 hardware typical x 6 at each post.
- 1b. All steel components except rebar and Anchor Plates (see next sheet), but including hardware, shall be galvanized.

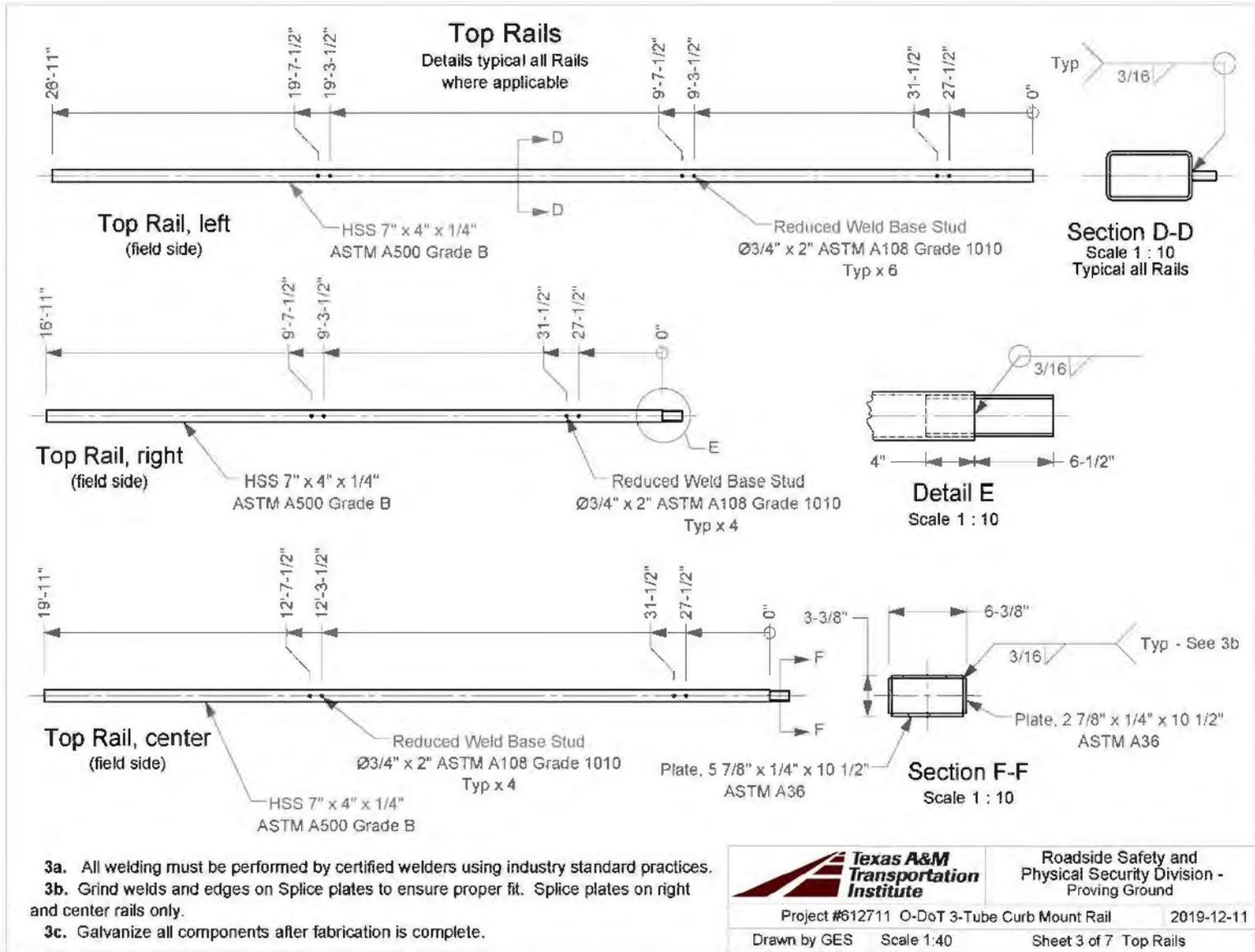
	Roadside Safety and Physical Security Division - Proving Ground	
	Project #612711 O-DoT 3-Tube Curb Mount Rail	2019-12-11
Drawn by GES	Scale 1:200	Sheet 1 of 7 Test Installation

O:\Accreditation\17025-2017\EIR-000 Project Files\612711 - Oregon Bridge Rail - Schulz\Drafting_612711\612711 Drawing

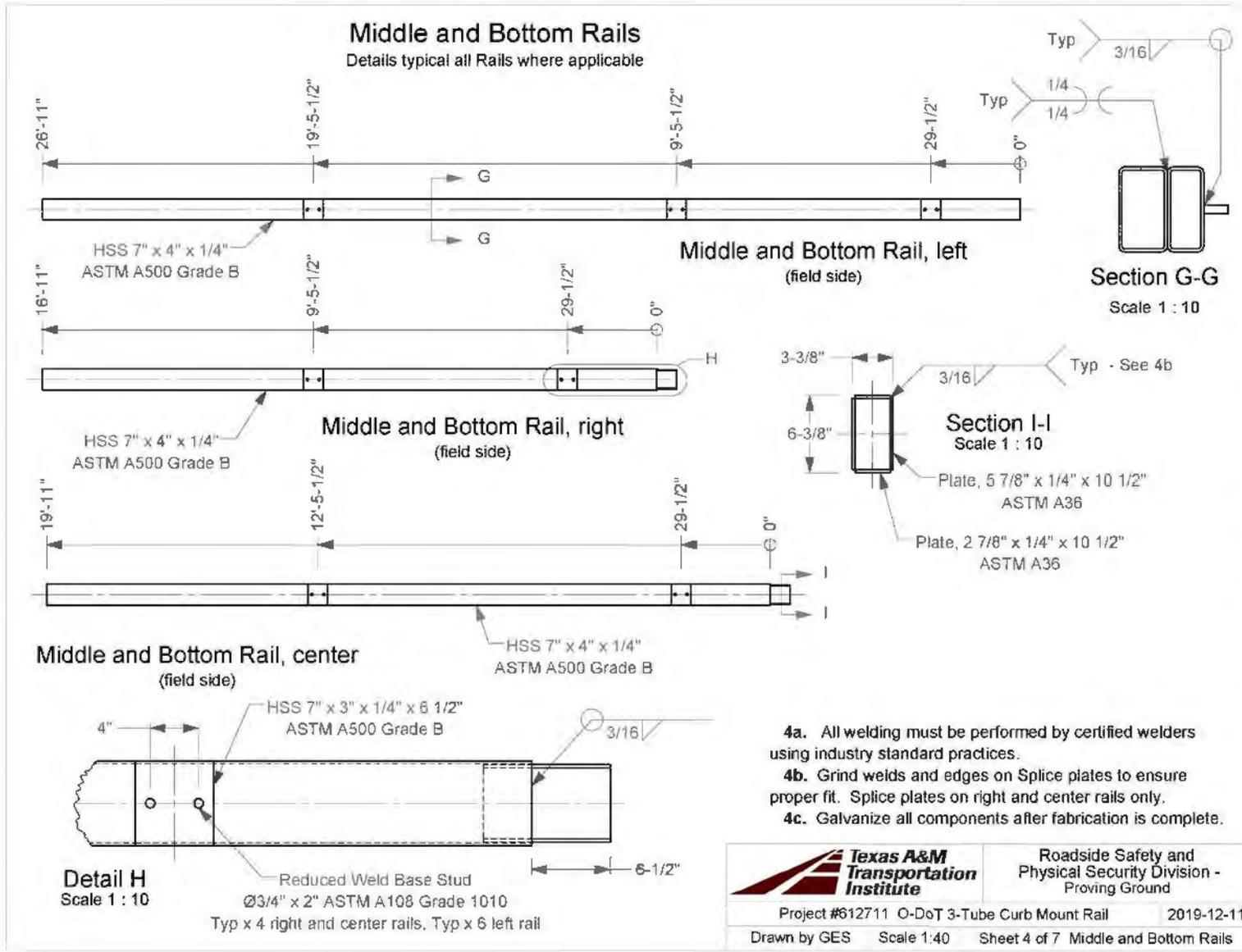


Q:\Accreditation-17025-2017-ElR-000 Project Files\612711 - Oregon Bridge Rail - Schulz\Drawing, 612711\612711 Drawing

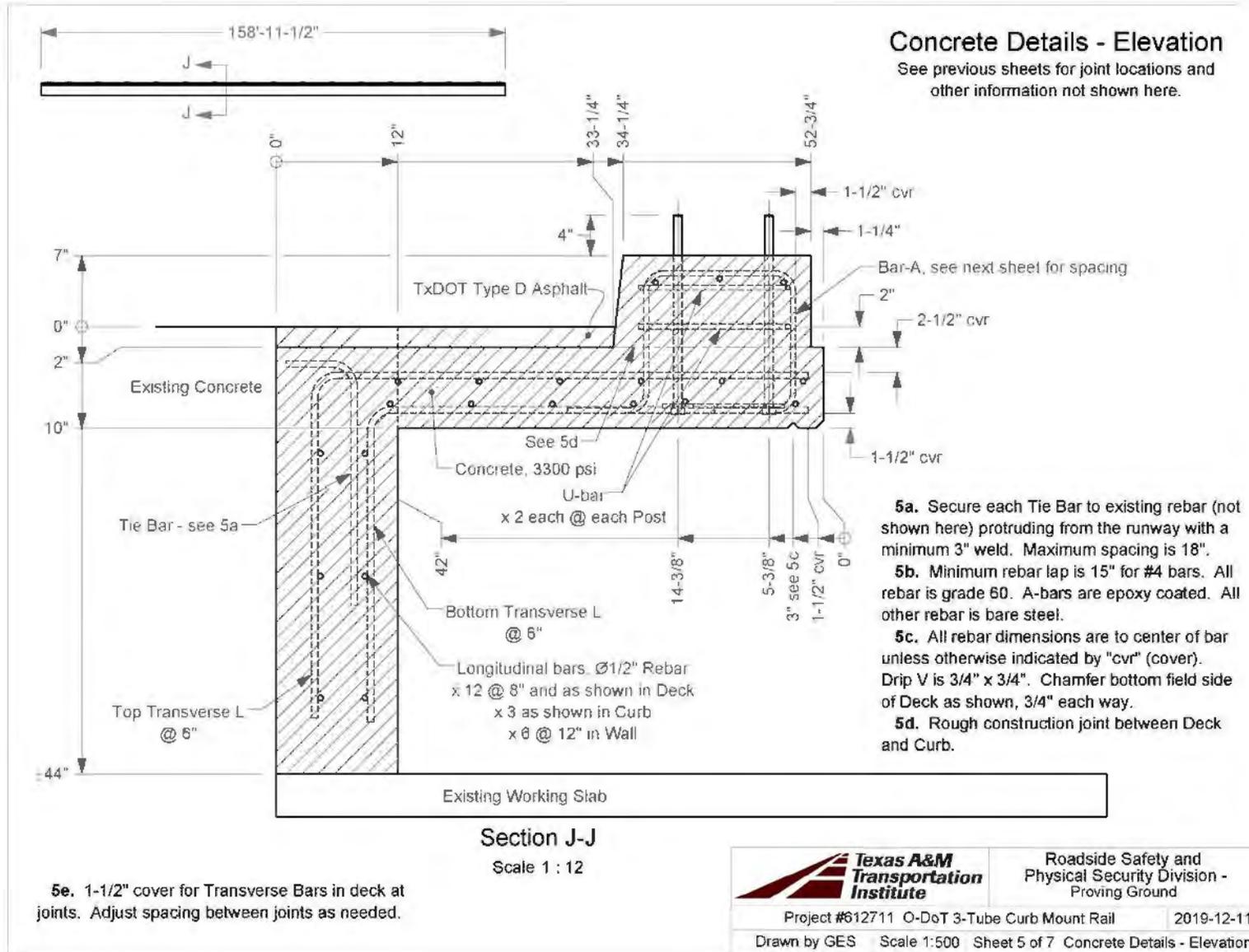
	Roadside Safety and Physical Security Division - Proving Ground	
	Project #612711 O-DoT 3-Tube Curb Mount Rail	2019-12-11
Drawn by GES	Scale 1:10	Sheet 2 of 7 Post Parts



Q:\Accreditation-17025-2017-EIR-000 Project Files\612711 - Oregon Bridge Rail - Schulz Drafting, 612711\612711 Drawing

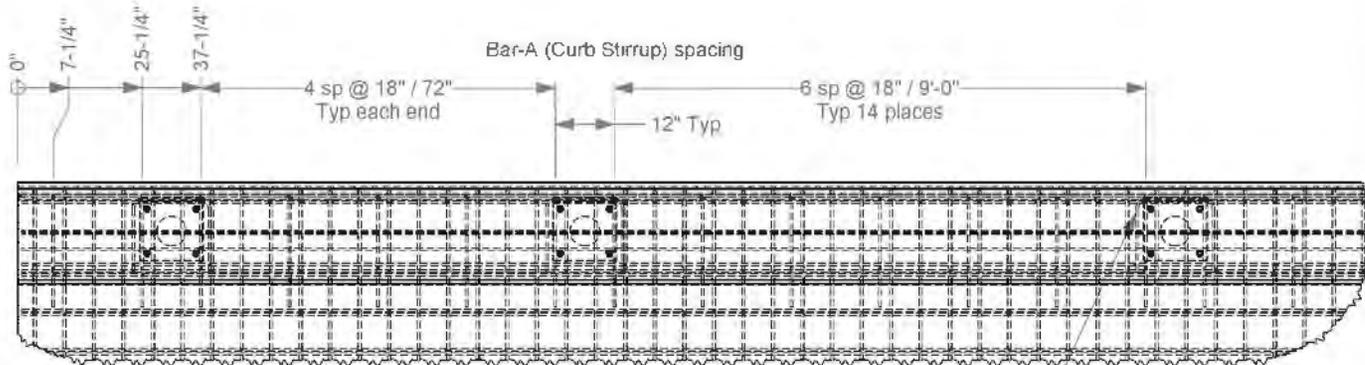
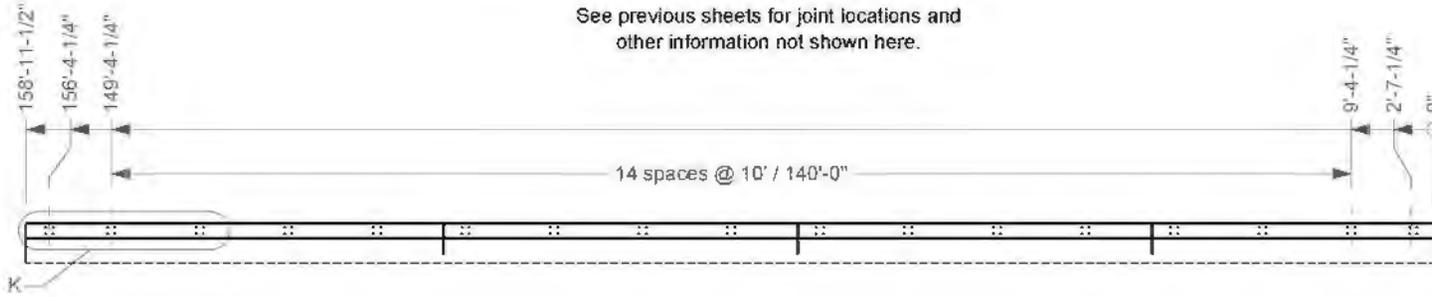


Q:\Accreditation-17025-2017\EIR-000 Project Files\612711 - Oregon Bridge Rail - Schulz\Drawing, 612711\612711 Drawing



Concrete Details - Plan

See previous sheets for joint locations and other information not shown here.



Detail K

Scale 1 : 30

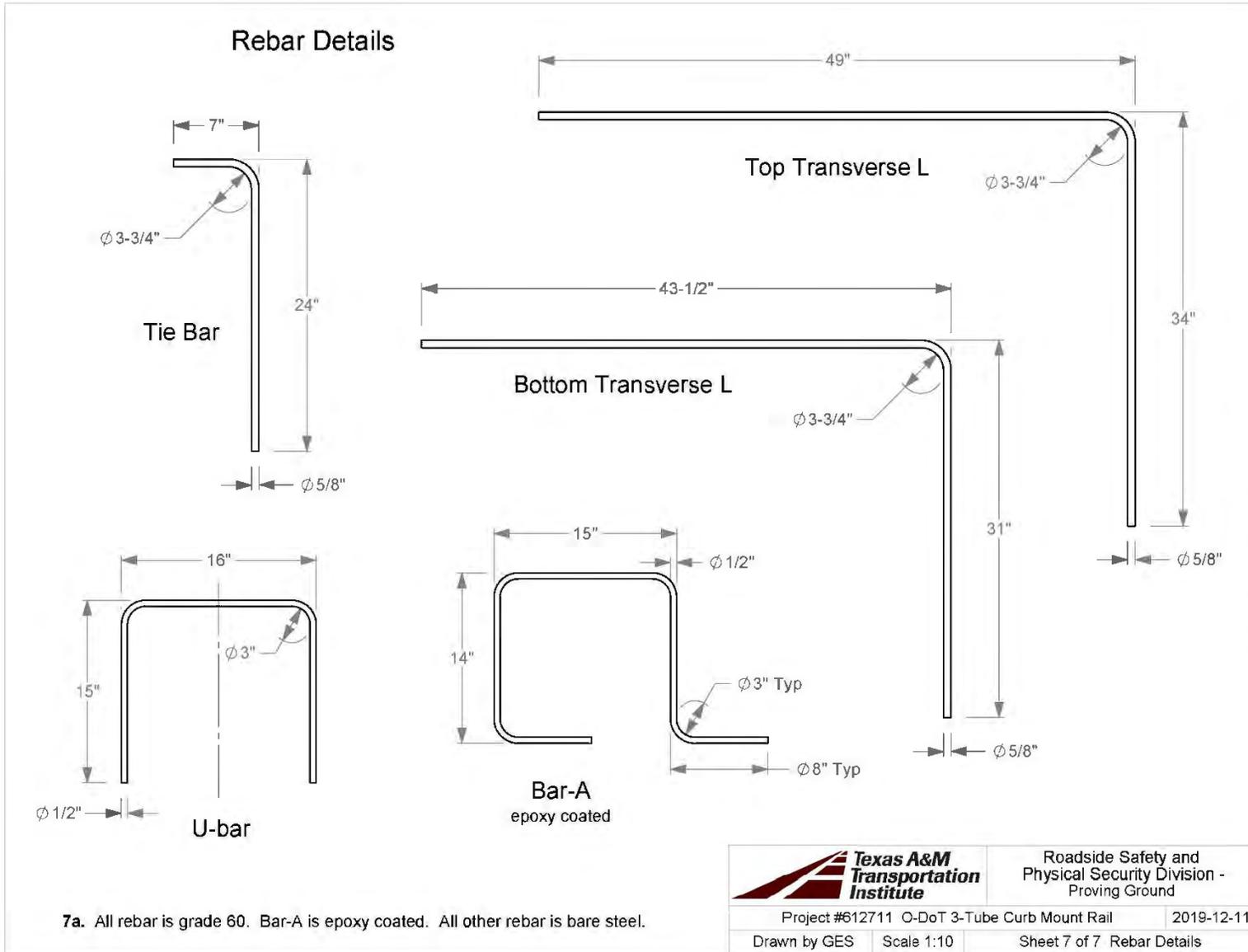
6a. 1-1/2" cover for Transverse Bars in deck at joints. Adjust spacing between joints as needed.



Roadside Safety and Physical Security Division - Proving Ground

Project #612711 O-DoT 3-Tube Curb Mount Rail 2019-12-11

Drawn by GES Scale 1:200 Sheet 6 of 7 Concrete Details - Plan



Q:\Accreditation-17025-2017\EIR-000 Project Files\612711 - Oregon Bridge Rail - Schulz\Drafting, 612711\612711 Drawing