U.S. Department
of Transportation
Federal Highway Administration

June 25, 2019

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

In Reply Refer To:
HSST-1/B-324

Mr. Tekeste Amare
Maryland Transportation Authority
300 Authority Drive
Baltimore, MD 21222

Dear Mr. Amare:

This letter is in response to your April 15, 2019 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-324 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:

- MDTA Chesapeake Bay Bridge Concrete Rail System

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: MDTA Chesapeake Bay Bridge Concrete Rail System
Type of system: Longitudinal Bridge Barrier
Test Level: MASH Test Level 4 (TL4)
Testing conducted by: Texas A&M Transportation Institute
Date of request: April 15, 2019

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-324 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.

- If the subject device is a patented product it may be considered to be proprietary. If proprietary systems are specified by a highway agency for use on Federal-aid projects: (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

Sincerely,

Michael S. Griffith

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:	April 15, 2019	◉ New ○ Resubmission
	Name:	Tekeste Amare	
	Company:	Maryland Transportation Authority	
	Address:	300 Authority Drive, Baltimore, MD 21222	
	Country:	United States of America	
	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)	◉ Physical Crash Testing ○ Engineering Analysis	MDTA Chesapeake Bay Bridge Concrete Rail System	AASHTO MASH	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:	Tekeste Amare	Same as Submitter ☒
Company Name:	Maryland Transportation Authority	Same as Submitter ☒
Address:	300 Authority Drive, Baltimore, MD 21222	Same as Submitter ☒
Country:	United States of America	Same as Submitter ☒
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 Modjeski and Masters, Inc. (M&M) vis-a'-vis the Maryland Transportation Authority (MDTA) to perform full-scale crash testing of the MDTA Chesapeake Bay Bridge Concrete Rail System. There are no shared financial interests in the MDTA Chesapeake Bay Bridge Concrete Rail System by TTI, or between/among M&M / MDTA and TTI, other than costs involved in the actual crash tests and reports for this submission to FHWA.		

PRODUCT DESCRIPTION

(•) New Hardware or Significant Modification ( ) Modification to Existing Hardware

The MDTA Chesapeake Bay Bridge Concrete Rail System consists of a single sectionalized elliptical steel rail and posts anchored to a 32-inch tall steel reinforced concrete parapet with a New Jersey barrier profile on the traffic side. The parapet itself is anchored to the bridge deck using two types of threaded anchor rods; the anchor rods extend through the entire thickness of the deck and are secured at the top and bottom of the deck using nuts. The bridge rail has an overall height of 50 inches (measured at the top of the rail) above the bridge deck. The steel rail is comprised of a series of 29 ft-11 inch long sections, and 14 ft-10.5 inch long end sections, with 2-inch gaps at spliced expansion joints in the steel bridge rail between each section. The parapet has a 0.5 inch wide joint between each 15-ft segment along the length of the installation.

CRASH TESTING

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.

Engineer Name:	William F. Williams	
Engineer Signature:	William Williams Digitally signed by William Williams Date: 2019.05.20 10:19:50 -05'00'	
Address:	TTI, TAMU 3135 College Station, TX 77843-3135	Same as Submitter ☐
Country:	United States of America	Same as Submitter ☐

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
4-10 (1100C)	Test 4-10 involves an 1100C vehicle impacting the test article at a target impact speed of 62 mi/h and target angle of 25°. The target CIP for the left corner of the front bumper was 3.6 ft upstream of the centerline of the fifth joint in the concrete parapet (between posts 10 & 11). The results of the test conducted on December 1, 2017, are found in TTI Test Report No. 607841-3. The test vehicle was traveling at an impact speed of 62.0 mi/h as it made contact with the MDTA Chesapeake Bay Bridge Concrete Rail System 3.6 ft upstream of the fifth parapet joint and at an impact angle of 25.6°. After loss of contact with the barrier, the vehicle came to rest 260 ft downstream of the impact point and 44 ft toward the traffic lanes. The MDTA Chesapeake Bay Bridge Concrete Rail System contained and redirected the 1100C vehicle. The vehicle did not penetrate, underride, or override the installation. The vehicle exited within the exit box criteria defined in MASH. Maximum dynamic deflection during the test was less than 1 inch. Maximum permanent deformation was 0.4 inch. Working width was 20.0 inches. No detached elements, fragments, or other debris were present to penetrate, or to show potential for penetrating, the occupant compartment, or to present undue hazard for others in the area. The 1100C vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 21° and 7°, respectively. Longitudinal OIV was 24.0 ft/s and lateral OIV was 29.5 ft/s. Maximum longitudinal occupant ridedown acceleration was 6.0 g, and maximum lateral occupant ridedown acceleration was 4.2 g. Occupant risk factors were within the preferred limits specified in MASH. Maximum exterior crush to the vehicle was 7.0 inches in the side plane in the front plane at the left front corner at bumper height. Maximum occupant compartment deformation was 2.5 inches in the left floor pan area. The MDTA Chesapeake Bay Bridge Concrete Rail System performed acceptably for MASH	PASS

Required Test Number	Narrative Description	Evaluation Results
4-11 (2270P)	Test 4-11 involves a 2270P vehicle impacting the test article at a target impact speed of 62 mi/h and target angle of 25°. The target CIP for the left corner of the front bumper was 4.3 ft upstream of the centerline of the seventh joint in the concrete parapet (between posts 14 & 15). The results of the test conducted on November 30, 2017, are found in TTI Test Report No. 607841-2. The test vehicle was traveling at an impact speed of 62.8 mi/h as it made contact with the MDTA Chesapeake Bay Bridge Concrete Rail System 3.9 ft upstream of the seventh parapet joint and at an impact angle of 24.9°. After loss of contact with the barrier, the vehicle came to rest 180 ft downstream of the impact point and 45 ft toward the field side. The MDTA Chesapeake Bay Bridge Concrete Rail System contained and redirected the 2270P vehicle. The vehicle did not penetrate, underride, or override the installation. The vehicle exited within the exit box criteria defined in MASH. Maximum dynamic deflection during the test was 1.0 inch. Maximum permanent deformation was 0.9 inch. Working width was 44.2 inches. No detached elements, fragments, or other debris were present to penetrate, or to show potential for penetrating, the occupant compartment, or to present undue hazard for others in the area. The 2270P vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 9° and 5°, respectively. Longitudinal OIV was 24.6 ft/s and lateral OIV was 25.9 ft/s. Maximum longitudinal occupant ridedown acceleration was 8.6 g and maximum lateral occupant ridedown acceleration was 5.7 g. Occupant risk factors were within the preferred limits specified in MASH. Maximum exterior crush to the vehicle was 16.0 inches in the front plane at the left front corner at bumper height. Maximum occupant compartment deformation was 7.5 inches in the left floor pan area. The MDTA Chesapeake Bay Bridge Concrete Rail System performed acceptably for MASH	PASS

4-12 (10000S)	Test 4-12 involves a 10000S vehicle impacting the test article at a target impact speed of 56 mi/h and target angle of 15°. The target CIP for the left corner of the front bumper was 5.0 ft upstream of centerline of the third joint in the concrete parapet (between posts 6 & 7). The results of the test conducted on November 29, 2017, are found in TTI Test Report No. 607841-1. The test vehicle was traveling at an impact speed of 56.3 mi/h as it made contact with the MDTA Chesapeake Bay Bridge Concrete Rail System 4.6 ft upstream of the third parapet joint and at an impact angle of 15.4°. After loss of contact with the barrier, the vehicle came to rest 235 ft downstream of the impact point and 8 ft toward the field side. The MDTA Chesapeake Bay Bridge Concrete Rail System contained and redirected the 10000S vehicle. The vehicle did not penetrate, underride, or override the installation. The vehicle exited within the exit box criteria defined in MASH. Maximum dynamic deflection during the test was 2.0 inches. Maximum permanent deformation was 2.0 inches. Working width was 28.3 inches. No detached elements, fragments, or other debris were present to penetrate or to show potential for penetrating the occupant compartment, or to present undue hazard for others in the area. The 10000S vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 12° and 4°, respectively. Longitudinal OIV was 8.5 ft/s, and lateral OIV was 14.1 ft/s. Maximum longitudinal occupant ridedown acceleration was 1.3 g, and maximum lateral occupant ridedown acceleration was 10.5 g. Maximum exterior crush to the vehicle was 16.0 inches in the side plane at the left front corner at bumper height. No occupant compartment deformation or intrusion was observed. The MDTA Chesapeake Bay Bridge Concrete Rail System performed acceptably for MASH test 4-12.	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 Proving Ground	
Laboratory Signature:	Digitally signed by Darrell L. Kuhn 'Date: 2019.05.08 08:53:16 -05'00	
Address:	TTI, TAMU 3135, College Station, TX 77843-3135	Same as Submitter ☐
Country:	United States of America	Same as Submitter ☐
Accreditation Certificate Number and Dates of current Accreditation period :	ISO 17025 Laboratory Certificate Number: 2821.01 Valid To: April 30, 2019	

Submitter Signature*: Tekeste Amare Digitally signed by Tekeste Amare Date: 2019.05.20 13:30:49 -04'00'

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

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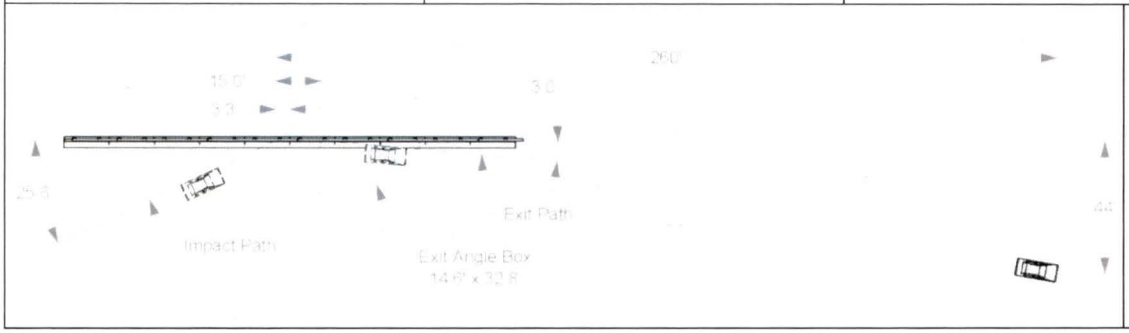
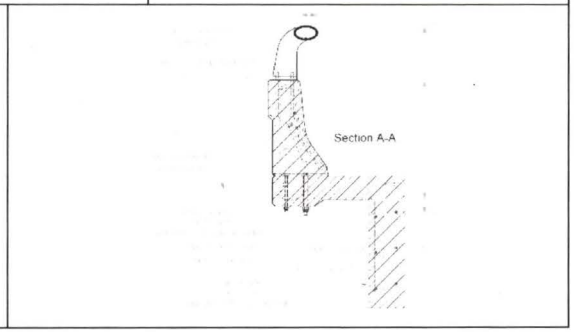
0.200 s

0.400 s

0.600 s





General Information

Test Agency	Texas A&M Transportation Institute (TTI)
Test Standard Test No.	MASH Test 4-10
TTI Test No.	607841-3
Test Date	2017-12-01

Test Article

Type	Bridge Rail
Name	William P. Lane, Jr. Bridge
Installation Length	150 ft 4½ inches
Material or Key Elements	Four 29-ft 11-inch long steel rail sections, and two 14-ft 10½-inch long end sections set atop 32-inch tall steel reinforced concrete sectionalized parapet; 50 inches in overall height
Soil Type and Condition	Concrete Bridge Deck, Damp

Test Vehicle

Type/Designation	1100C
Make and Model	2009 Kia Rio
Curb	2466 lb
Test Inertial	2440 lb
Dummy	165 lb
Gross Static	2605 lb

Impact Conditions

Speed	62.0 mi/h
Angle	25.6°
Location/Orientation	3.6 ft upstream of 5th parapet joint
Impact Severity	59 kip-ft

Exit Conditions

Speed	46.2 mi/h
Angle	3.0°

Occupant Risk Values

Longitudinal OIV	24.0 ft/s
Lateral OIV	29.5 ft/s
Longitudinal Ridedown	6.0 g
Lateral Ridedown	4.2 g
THIV	41.6 km/h
PHD	6.0 g
ASI	2.56
Max. 0.050-s Average	
Longitudinal	-12.8 g
Lateral	17.3 g
Vertical	-7.1 g

Post-Impact Trajectory

Stopping Distance	260 ft downstream 44 ft twd traffic

Vehicle Stability

Maximum Yaw Angle	43°
Maximum Pitch Angle	7°
Maximum Roll Angle	21°
Vehicle Snagging	No
Vehicle Pocketing	No

Test Article Deflections

Dynamic	<1.0 inch
Permanent	0.38 inch
Working Width	20.0 inches
Height of Working Width	32.0 inches

Vehicle Damage

VDS	11LFQ5
CDC	11FLEW4
Max. Exterior Deformation	7.0 inches
OCDI	
Max. Occupant Compartment Deformation	2.5 inches

Summary of Results for *MASH* Test 4-10 on New *MASH* TL-4 Bridge Rail for William P. Lane, Jr. Bridge.

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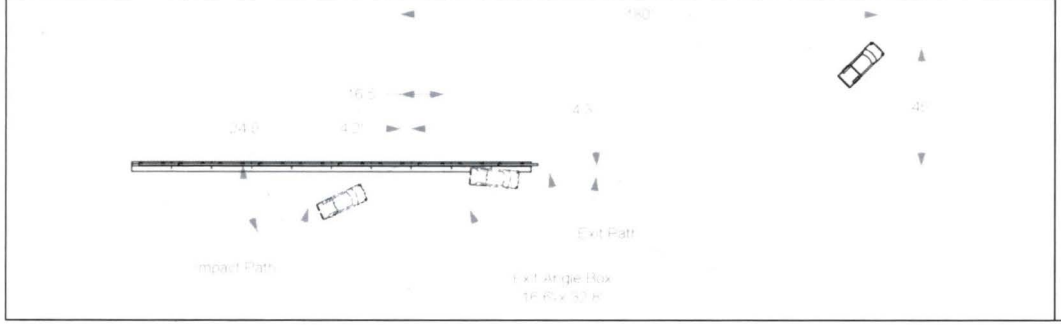

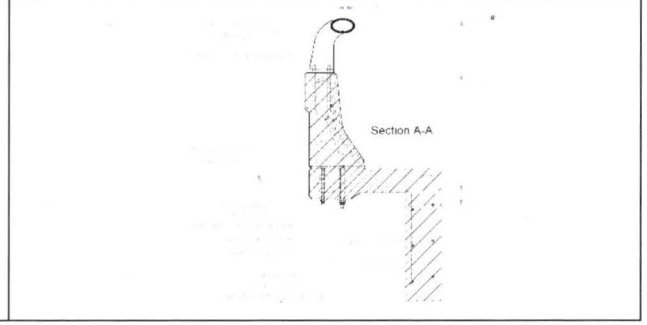

General Information

Test Agency	Texas A&M Transportation Institute (TTI)
Test Standard Test No.	MASH Test 4-11
TTI Test No.	607841-2
Test Date	2017-11-30

Test Article

Type	Bridge Rail
Name	William P. Lane, Jr. Bridge
Installation Length	150 ft 4½ inches
Material or Key Elements	Four 29-ft 11-inch long steel rail sections, and two 14-ft 10½-inch long end sections set atop 32-inch tall steel reinforced concrete sectionalized parapet; 50 inches in overall height
Soil Type and Condition	Concrete Bridge Deck, Damp

Test Vehicle

Type/Designation	2270P
Make and Model	2011 Dodge RAM 1500 Pickup
Curb	4978 lb
Test Inertial	5012 lb
Dummy	165 lb
Gross Static	5177 lb

Impact Conditions

Speed	62.8 mi/h
Angle	24.9°
Location/Orientation	3.9 ft upstream of 7th parapet joint
Impact Severity	117 kip-ft

Exit Conditions

Speed	43.9 mi/h
Angle	4.3°

Occupant Risk Values

Longitudinal OIV	24.6 ft/s
Lateral OIV	25.9 ft/s
Longitudinal Ridedown	8.6 g
Lateral Ridedown	5.7 g
THIV	38.5 km/h
PHD	8.7 g
ASI	1.94
Max. 0.050-s Average	
Longitudinal	-11.1 g
Lateral	14.2 g
Vertical	2.5 g

Post-Impact Trajectory

Stopping Distance	180 ft downstream 45 ft twd field side

Vehicle Stability

Maximum Yaw Angle	32°
Maximum Pitch Angle	5°
Maximum Roll Angle	9°
Vehicle Snagging	Yes
Vehicle Pocketing	No

Test Article Deflections

Dynamic	1.0 inch
Permanent	0.9 inch
Working Width	44.2 inches
Vehicle Intrusion	52.2 inches

Vehicle Damage

VDS	11LFQ6
CDC	11FLEW5
Max. Exterior Deformation	16.0 inches
OCDI	LF0200000
Max. Occupant Compartment Deformation	7.5 inches

Summary of Results for *MASH* Test 4-11 on New *MASH* TL-4 Bridge Rail for William P. Lane, Jr. Bridge.

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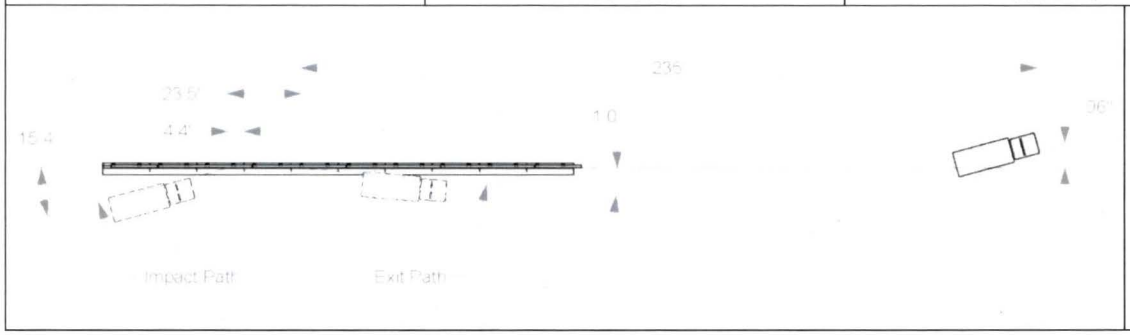
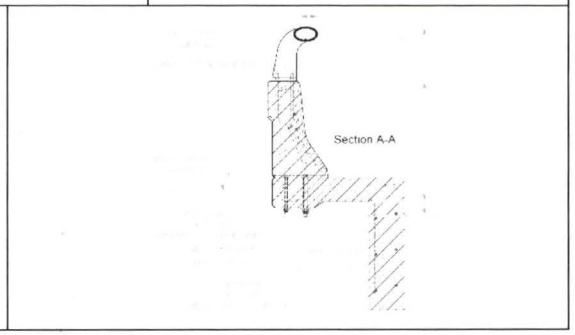




General Information

Test Agency	Texas A&M Transportation Institute (TTI)
Test Standard Test No.	MASH Test 4-12
TTI Test No.	607841-1
Test Date	2017-11-19

Test Article

Type	Bridge Rail
Name	William P. Lane, Jr. Bridge
Installation Length	150 ft 4½ inches
Material or Key Elements	Four 29-ft 11-inch long steel rail sections, and two 14-ft 10½-inch long end sections set atop 32-inch tall steel reinforced concrete sectionalized parapet; 50 inches in overall height
Soil Type and Condition	Concrete Bridge Deck, Damp

Test Vehicle

Type/Designation	10000S
Make and Model	2004 GMC C7500 Single Unit Truck
Curb	15,270 lb
Test Inertial	22,640 lb
Dummy	No dummy
Gross Static	22,640 lb

Impact Conditions

Speed	56.3 mi/h
Angle	15.4°
Location/Orientation	4.6 ft upstream of the 3rd parapet joint

Impact Severity 169 kip-ft

Exit Conditions

Speed	50.2 mi/h
Angle	1.0°

Occupant Risk Values

Longitudinal OIV	8.5 ft/s
Lateral OIV	14.1 ft/s
Longitudinal Ridedown	1.3 g
Lateral Ridedown	18.9 km/h
THIV	10.5 g
PHD	0.91
ASI	

Max. 0.050-s Average

Longitudinal	-2.8 g
Lateral	7.2 g
Vertical	3.8 g

Post-Impact Trajectory

Stopping Distance	235 ft downstream 8 ft twd field side

Vehicle Stability

Maximum Yaw Angle	24°
Maximum Pitch Angle	4°
Maximum Roll Angle	12°
Vehicle Snagging	No
Vehicle Pocketing	No

Test Article Deflections

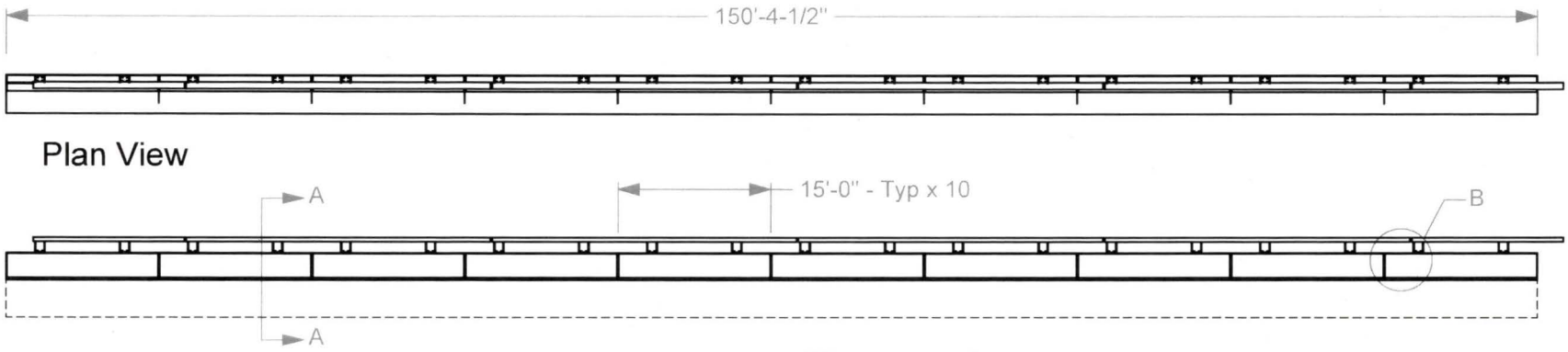
Dynamic	2.0 inches
Permanent	2.0 inches
Working Width	28.3 inches
Height of Working Width	96.4 inches

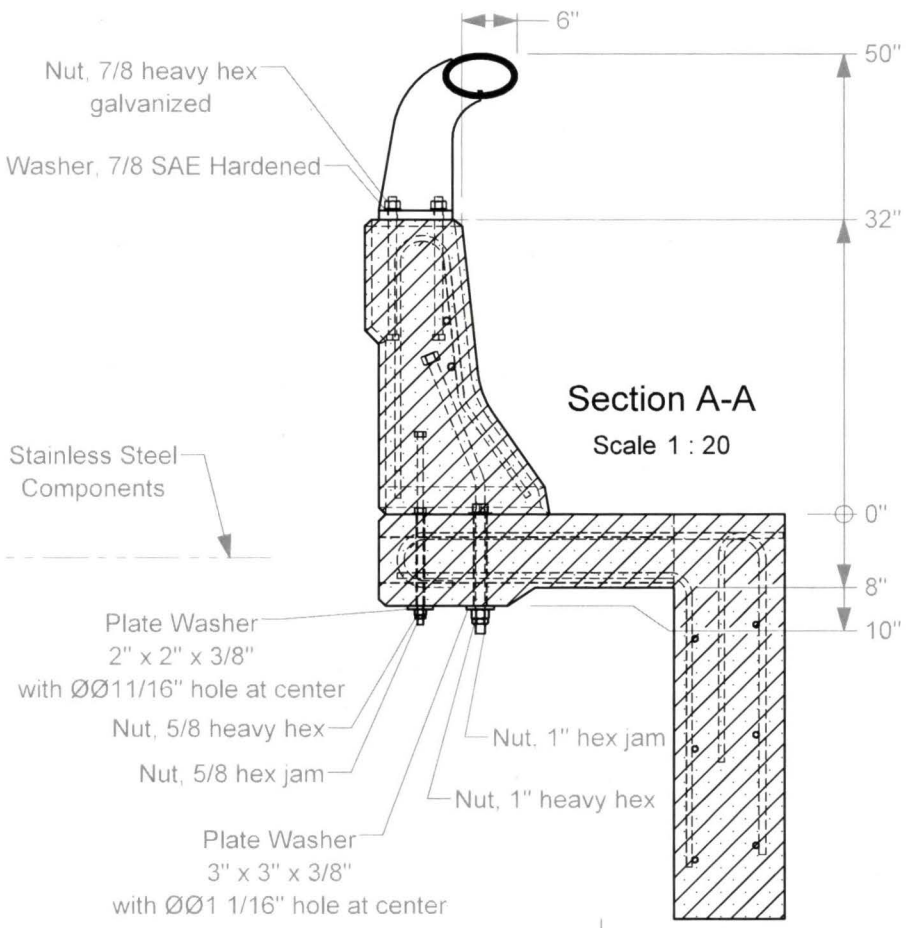
Vehicle Damage

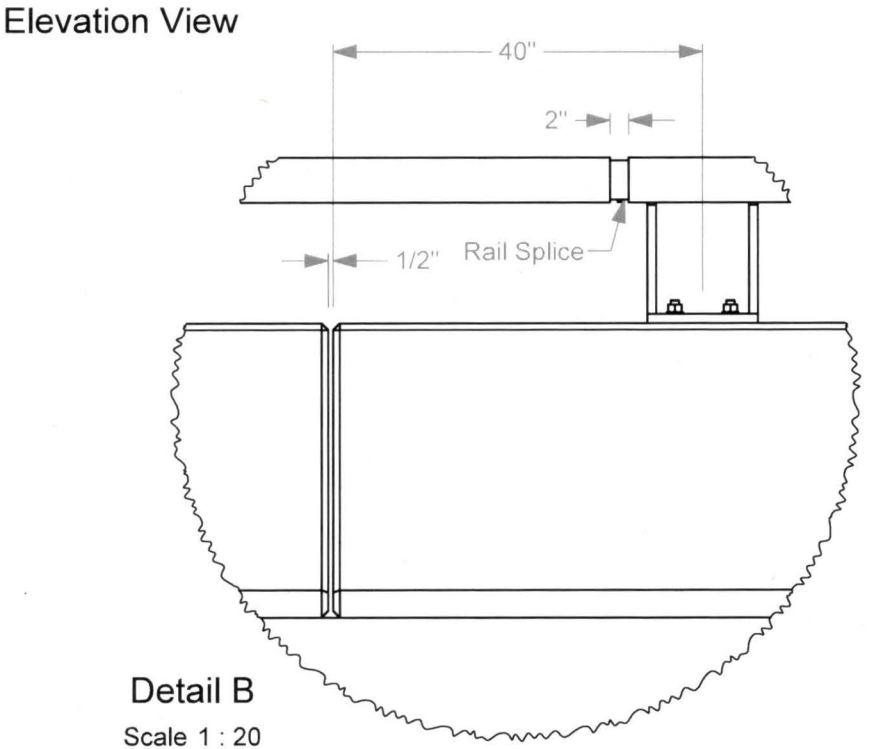
VDS	NA
CDC	11FLEW4
Max. Exterior Deformation	16.0 inches
OCDI	None
Max. Occupant Compartment Deformation	FS0000000

Summary of Results for *MASH* Test 4-12 on New *MASH* TL-4 Bridge Rail for William P. Lane, Jr. Bridge.

Test Installation







Texas A&M Transportation Institute

Roadside Safety and Physical Security Division - Proving Ground

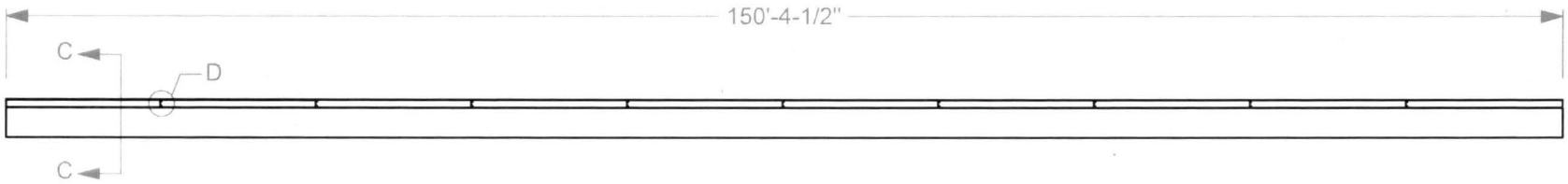
Project #607841 WP Lane Bridge Rail 2017-09-13

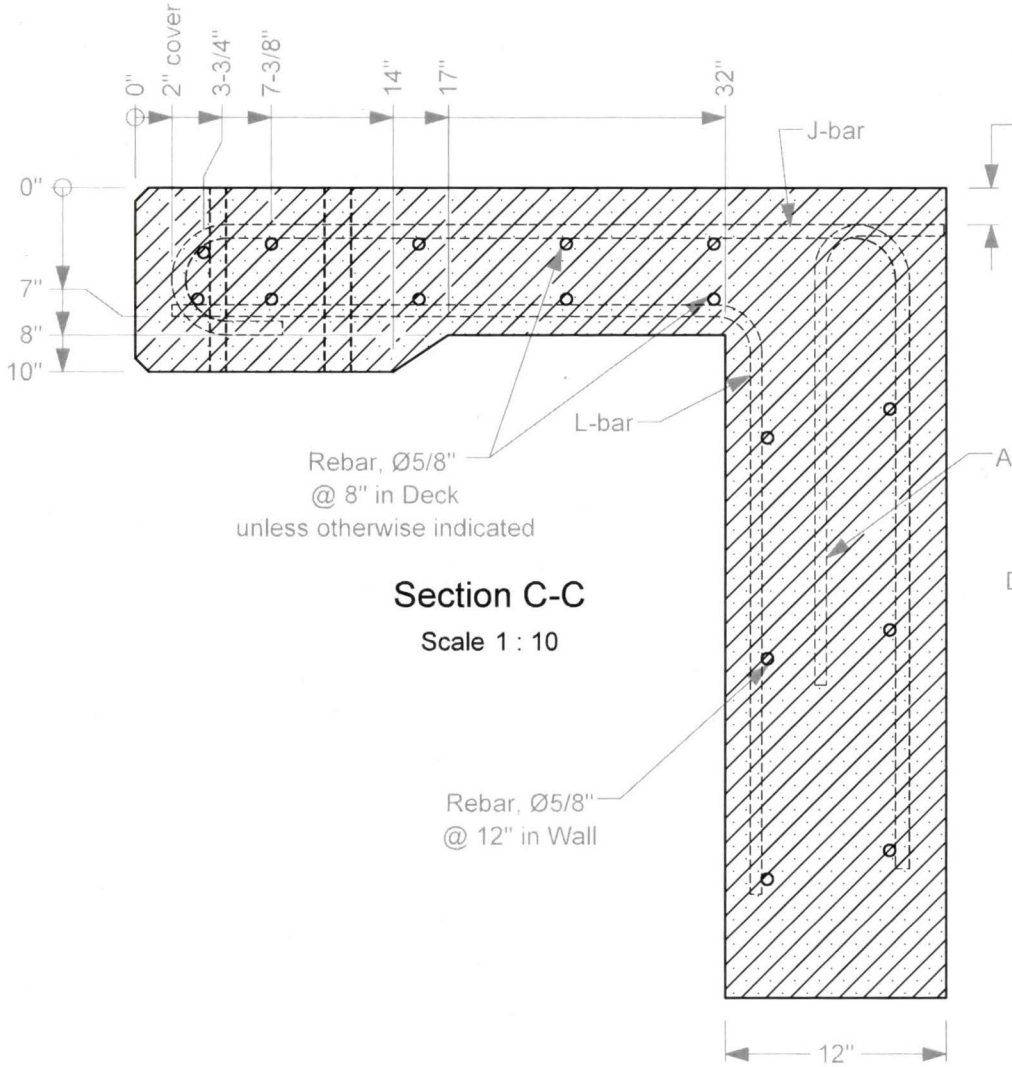
Drawn by GES Scale 1:200 Sheet 1 of 9 Test Installation

T:\1-ProjectFiles\607841 - WP Lane Jr. Bridge - Williams\Drafting, 607841\607841 Drawing

Deck Details - Elevation

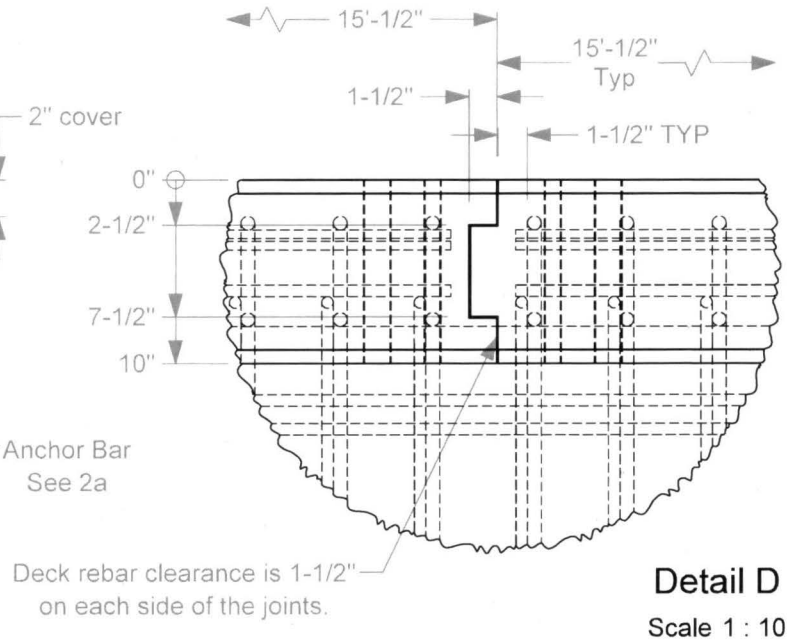
(from Field Side)





Section C-C

Scale 1 : 10



Detail D

Scale 1 : 10

2a. Weld Anchor Bars to existing rebar (not shown here) protruding from Apron at 18" spacing.

2b. All rebar is grade 60. Minimum lap length for #5 bars is 18-3/4".

2c. 3/4" Chamfer at back edges of the deck as shown.

2d. Concrete strength is 5000 psi.

Texas A&M Transportation Institute

Roadside Safety and Physical Security Division - Proving Ground

Project 607841	WP Lane Bridge Rail			2017-09-13
Drawn By GES	Scale1:200	Sheet 2 of 9		Deck Details - Elevation

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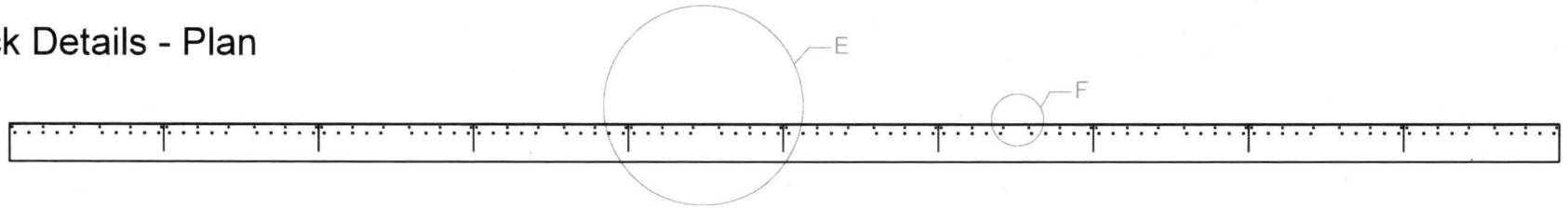
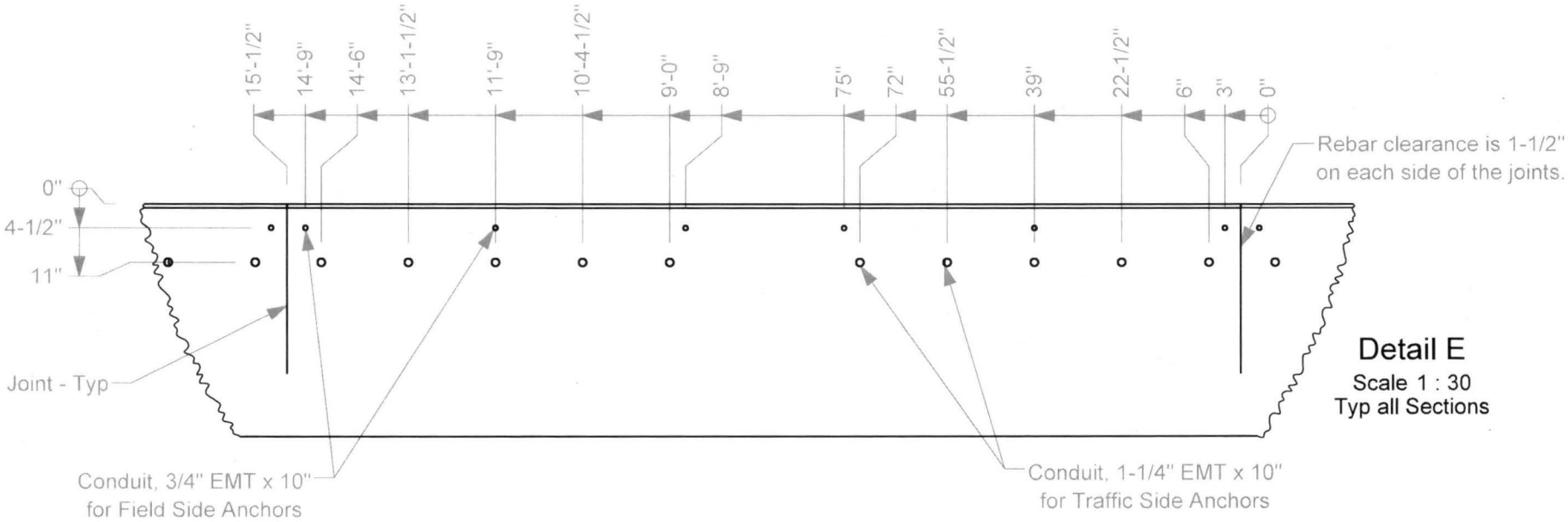
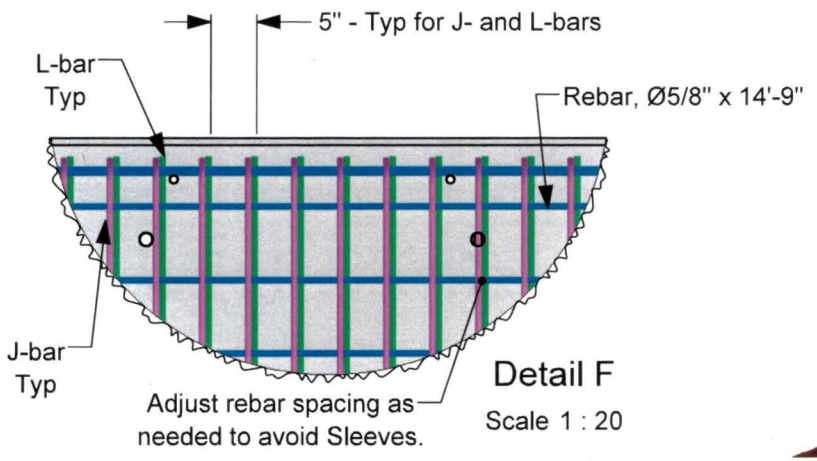
Deck Details - Plan





Detail E
Scale 1 : 30
Typ all Sections



Detail F
Scale 1 : 20

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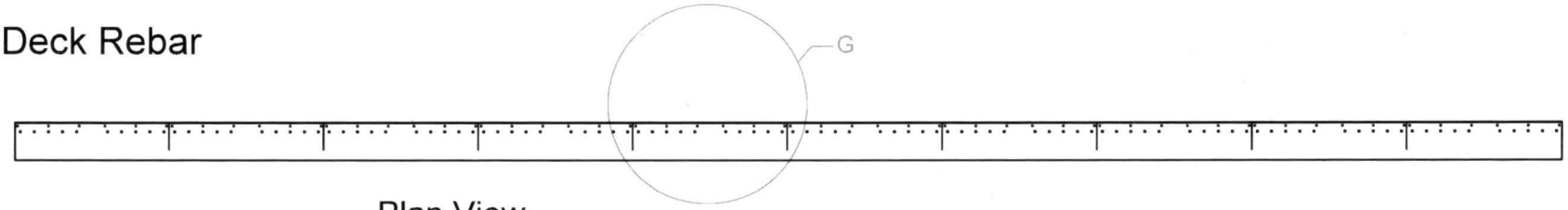
Roadside Safety and Physical Security Division - Proving Ground

Project #607841 WP Lane Bridge Rail 2017-09-13

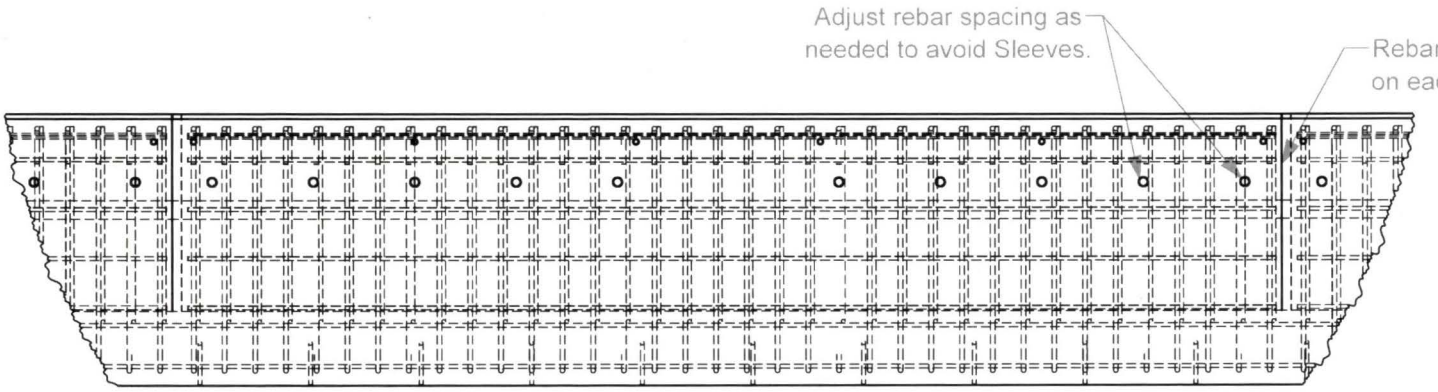
Drawn by GES Scale 1:200 Sheet 3 of 9 Deck Details - Plan

T:\1-ProjectFiles\607841 - WP Lane Jr. Bridge - Williams\Drafting, 607841\607841 Drawing

Deck Rebar

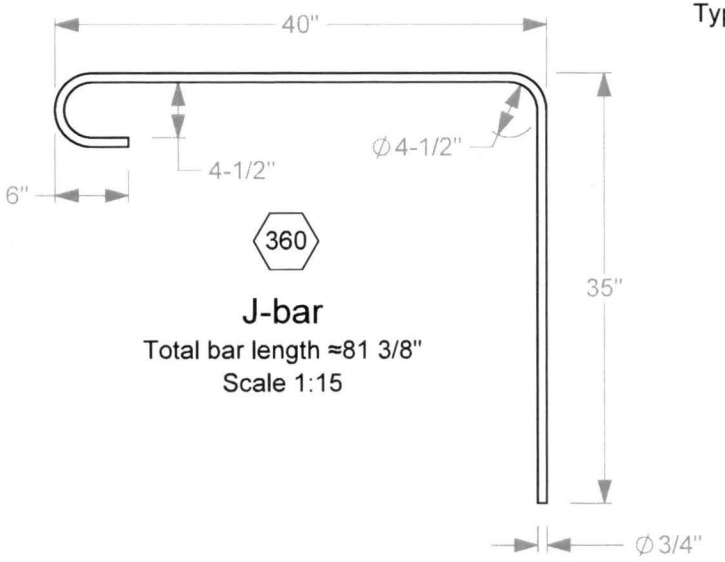


Plan View



Detail G

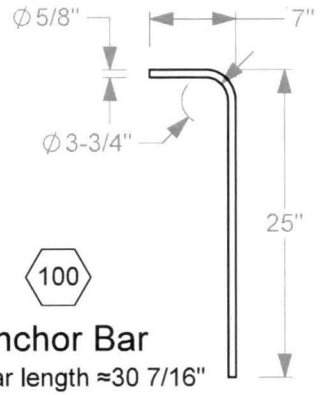
Scale 1 : 30
Typ all Sections



360

J-bar

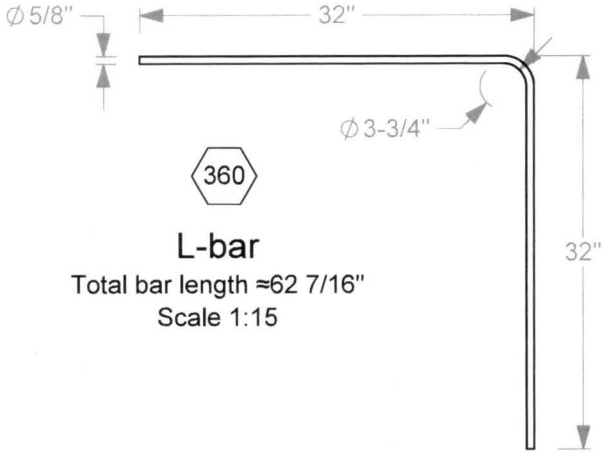
Total bar length ≈81 3/8"
Scale 1:15



100

Anchor Bar

Total bar length ≈30 7/16"
Scale 1:15



360

L-bar

Total bar length ≈62 7/16"
Scale 1:15

4a. The numerals in hexagons indicate the quantity needed for each Bar.

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Drawn by GES Scale 1:200 Sheet 4 of 9 Deck Rebar

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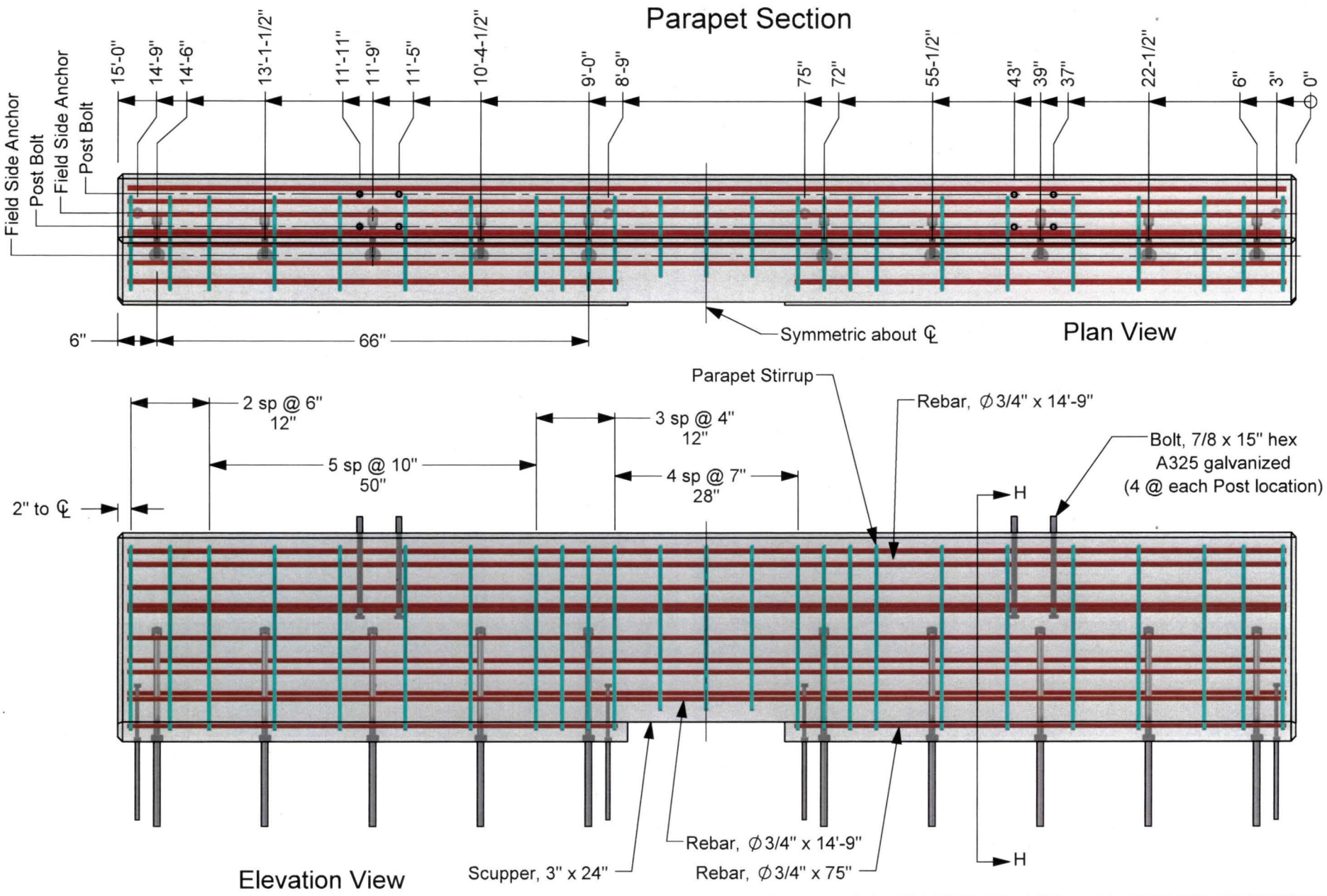

5a. Concrete strength is 5000 psi.

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Drawn by GES Scale 1:20 Sheet 5 of 9 Parapet Section

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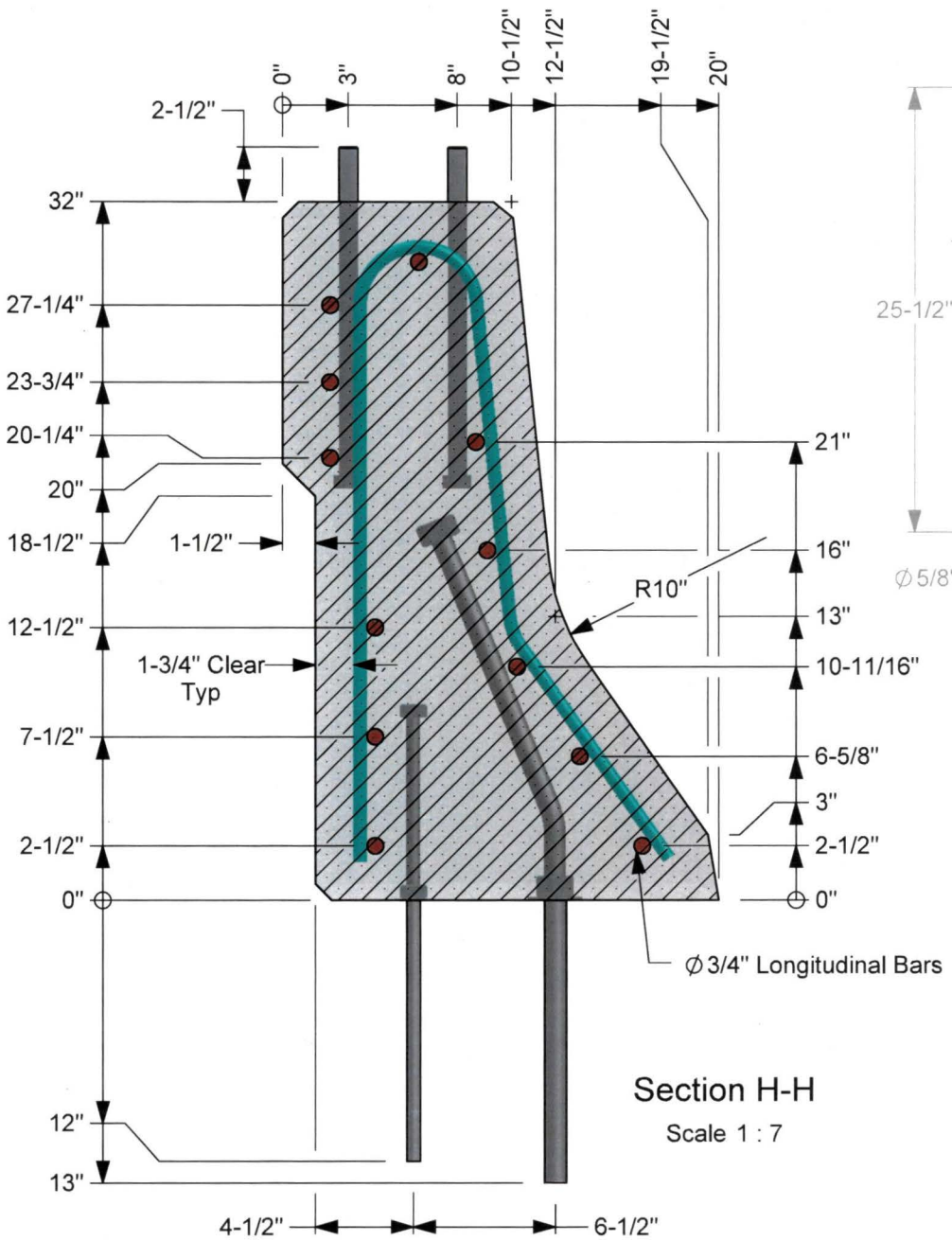
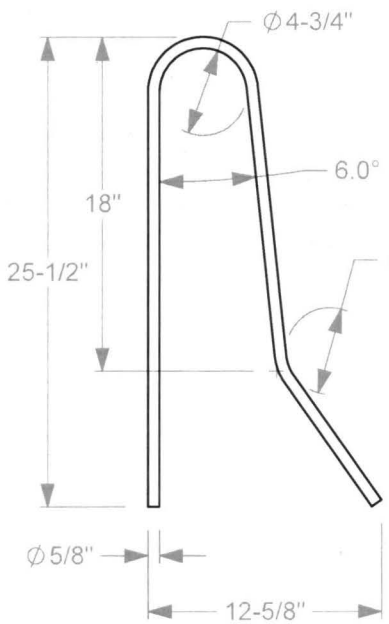


Section H-H

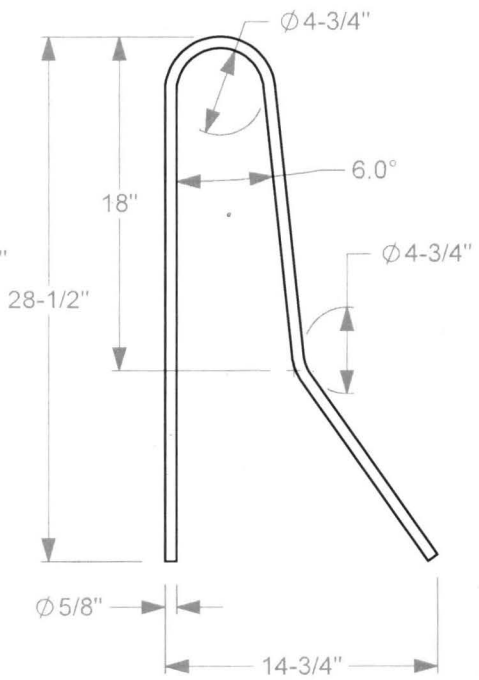
Scale 1 : 7



3

Scupper Stirrup

Total rebar length ≈54 15/16"



22

Parapet Stirrup

Total rebar length ≈61 9/16"

6a. The numerals in hexagons indicate the quantity needed for each Parapet segment. The length dimensions are given as a reference only. The individual dimensions take precedence in the event of a conflict.

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Drawn by GES Scale 1:8 Sheet 6 of 9 Section View

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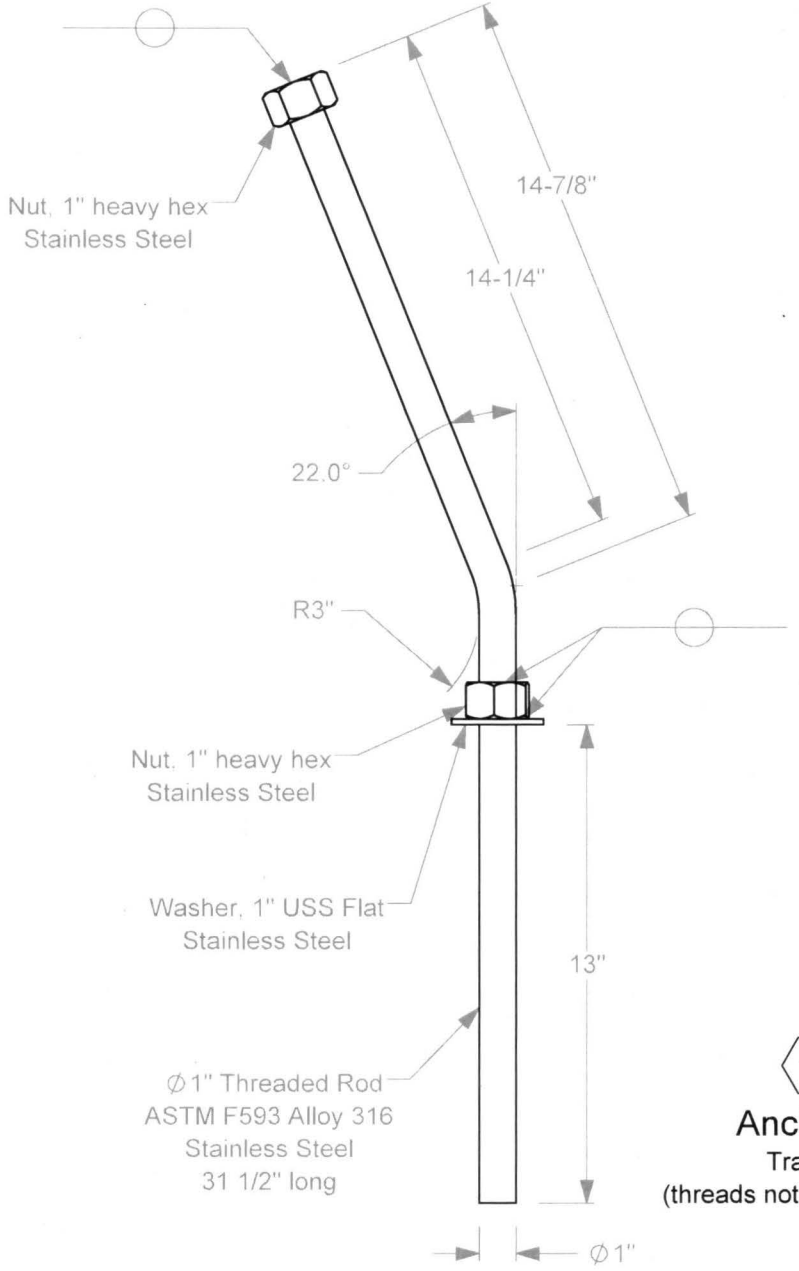
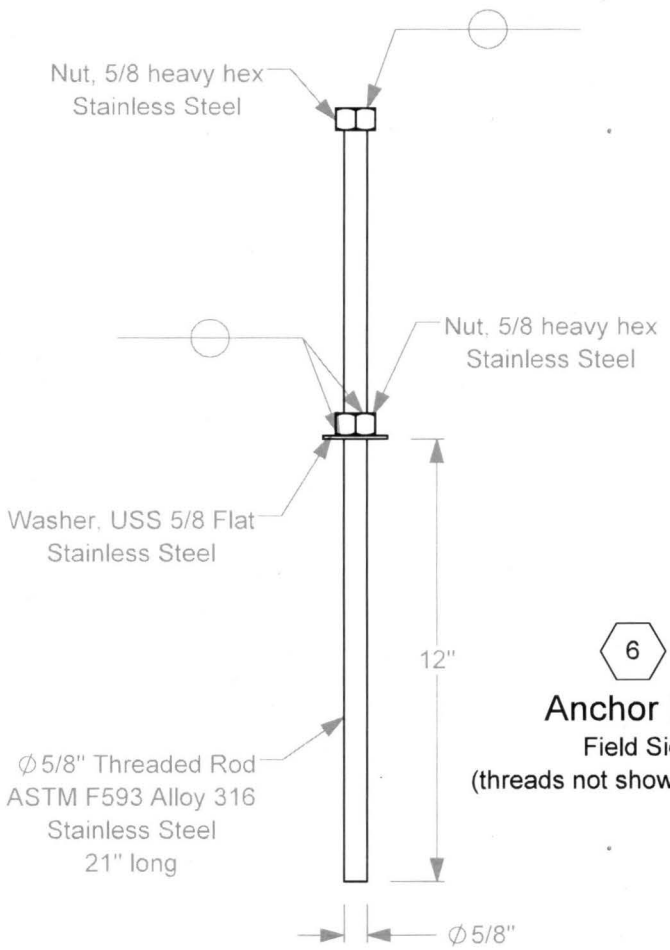


10

Anchor Rod

Traffic Side

(threads not shown for clarity)



6

Anchor Rod

Field Side

(threads not shown for clarity)

7a. The numerals in hexagons indicate the quantity needed for each Parapet segment.

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Project #607841 WP Lane Bridge Rail 2017-09-13

Drawn by GES Scale 1:5 Sheet 7 of 9 Anchor Rods

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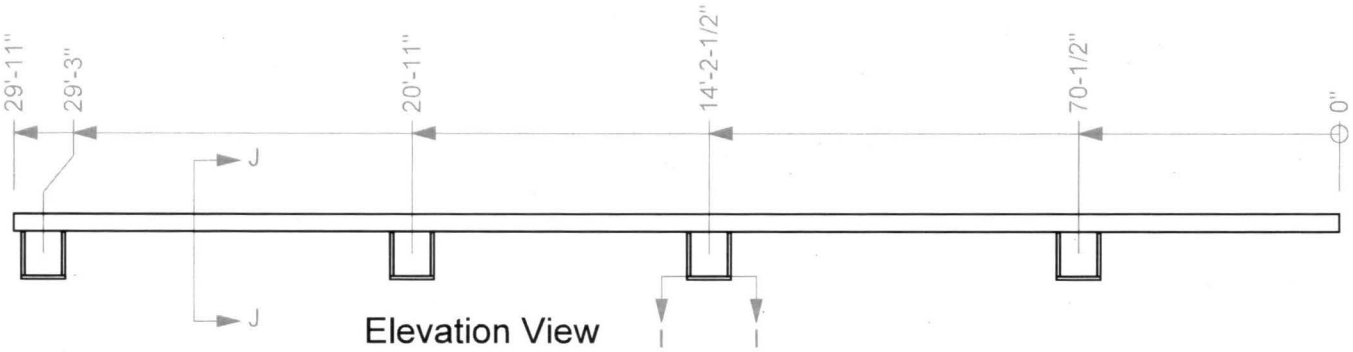
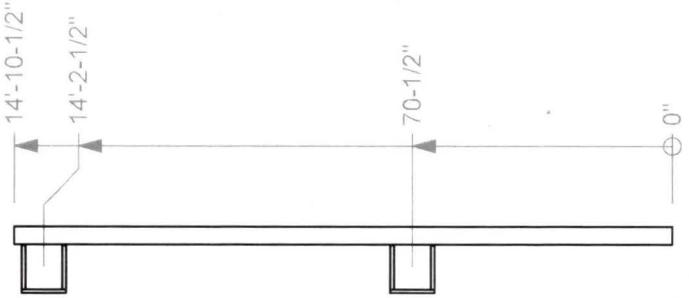
Rail Details

Sections I-I and H-H are typical for each Rail type



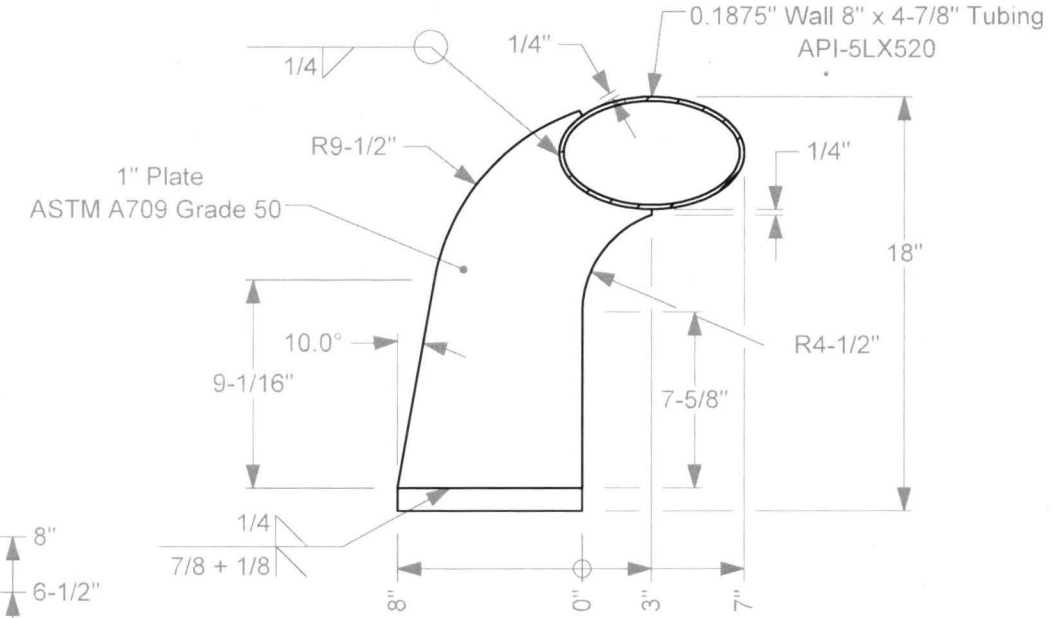
Elevation View

Center Section



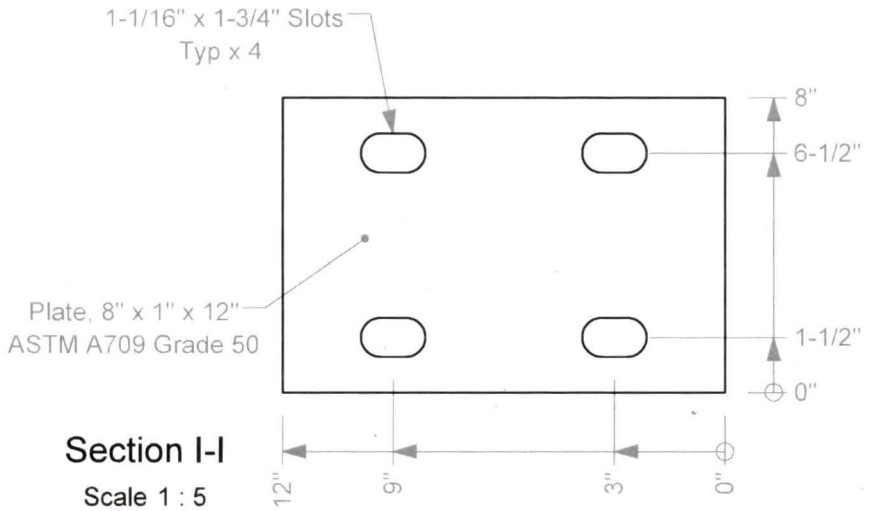
Elevation View

End Section



Section J-J

Scale 1 : 8



Section I-I

Scale 1 : 5

8a. Galvanize Rail and Splice Sections after all fabrication is complete.

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Project #607841 WP Lane Bridge Rail 2017-09-13

Drawn by GES Scale 1:50 Sheet 8 of 9 Rail Details

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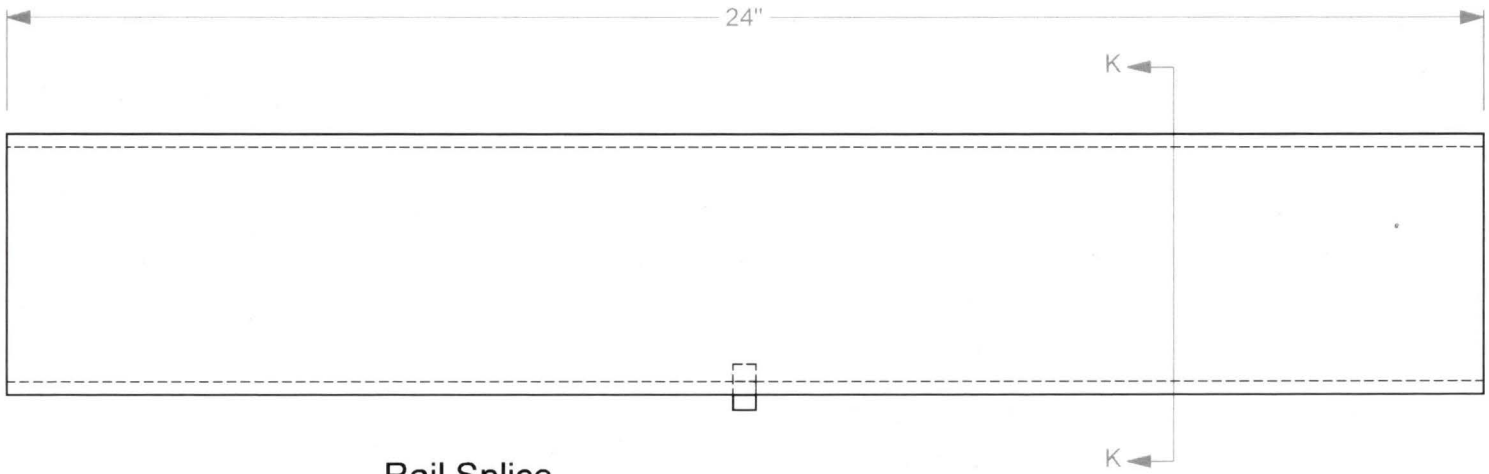
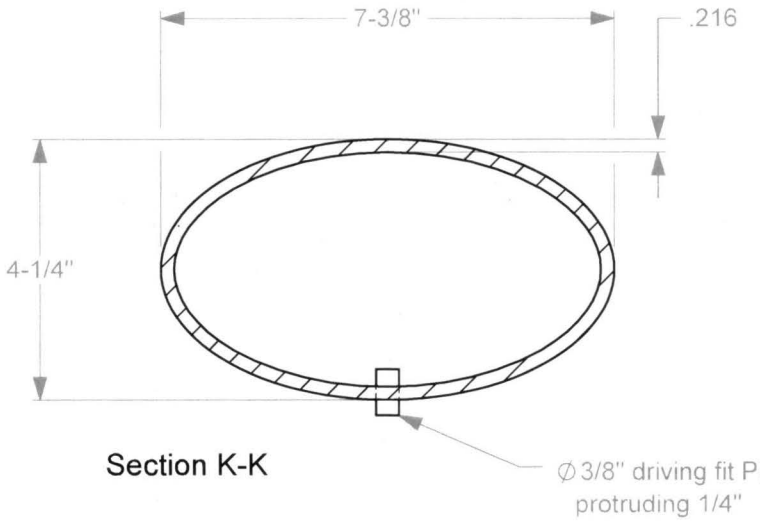


Rail Splice
API-5LX52



Section K-K

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Project #607841 WP Lane Bridge Rail 2017-09-13

Drawn by GES Scale 1:3 Sheet 9 of 9 / Rail Splice

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