



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

March 7, 2023

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

In Reply Refer To:  
HSST-1/B-369

Michael Hyzak  
Bridge Design Section Director, Bridge Division  
Texas Department of Transportation  
125 East 11<sup>th</sup> Street, Austin, Texas 78701  
USA

Dear Mr. Hyzak:

We received your correspondence of March 23, 2022 requesting issuance of a reimbursement eligibility letter under the Federal-aid highway program for the roadside safety system, device, design, product, or hardware (collectively “device”) described below. This letter is assigned Federal Highway Administration (FHWA) control number B-369.

#### **ELIGIBILITY LETTERS**

The FHWA issues Federal-aid reimbursement eligibility letters for new roadside safety devices that are crash tested in accordance with the industry standard of the American Association of State Highway and Transportation Officials (AASHTO) Manual for Assessing Safety Hardware (MASH).

FHWA, the Department of Transportation, and the United States (government) do not regulate roadside safety devices, crash test facilities, or the manufacturing industry. Issuance of eligibility letters is discretionary and provided only as a service to the states. FHWA may, at its discretion, decline to issue, revise, or rescind an eligibility letter. Eligibility letters are only issued by the FHWA headquarters Office of Safety.

Eligibility letters are issued only as notice to the states that a device is eligible for reimbursement under the Federal-aid highway program. They do not establish approval or certification for any other purpose. Issuance of an eligibility letter is not a prerequisite or requirement for state transportation agencies seeking to use Federal-aid funds for roadside safety devices. State agencies may use a device for which an eligibility letter has not been issued and seek Federal-aid reimbursement.

#### **FEDERAL-AID REIMBURSEMENT**

The request for issuance of this letter certified the device was crash tested in accordance with the industry standard of AASHTO’s MASH. This eligibility letter is based on that certification and the material offered in support of its issuance. The device described below is eligible for reimbursement under the Federal-aid highway program.

Name of system: TxDOT C2P Bridge Rail  
Type of system: Longitudinal Bridge Barrier  
Test Level: Test Level 4  
Testing conducted by: Texas A&M Transportation Institute  
Date of request: March 23, 2022

Information about the device, including material such as the eligibility request, crash test reports, drawings, or images are included in one or more attachment(s) to this letter.

Eligibility letter B-369 is inapplicable to devices, optional equipment, alternate materials, or other features that were not crash tested in accordance with AASHTO's MASH.

This letter is issued only for the subject device as crash tested under AASHTO's MASH. Later modification(s) of the device are not eligible for Federal-aid reimbursement under this letter. Notice of later modification(s) should be given to transportation agencies, facility owners, and operators (collectively "agencies").

Agencies should be provided appropriate information about the device's design, installation, maintenance, materials, and mechanical properties.

Issuance of this letter is discretionary, and it may be revised or rescinded at FHWA's discretion. This letter is not a determination of compliance with the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) or ownership of any intellectual property rights.

This eligibility letter is not a determination by the government that a crash involving the subject device will result in any particular outcome. It is limited to only the device's eligibility for Federal-aid reimbursement.

### **INTELLECTUAL PROPERTY**

Issuance of this eligibility letter does not convey property rights of any sort nor any exclusive privilege. This letter is not authorization or consent by the government for the use, manufacture, or sale of any patented or proprietary system, device, design, product, or hardware for which the requester is not the patent owner. Eligibility letters are not an expression of any view, position, or determination by the government as to the validity, scope, or ownership of any intellectual property rights to a specific device. These letters do not grant, impute, suggest, or otherwise establish any ownership, distribution, or licensing rights to the requester. The government expresses no opinion about the intellectual property rights relating to any device for which this or any other eligibility letter is issued.

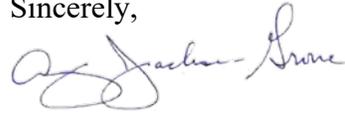
### **PUBLIC DISCLOSURE**

To prevent any misunderstanding, and as discussed above, this eligibility letter is assigned FHWA control number B-369. It should only be reproduced in full with its attachment(s). This letter and the material offered by the requester supporting its issuance is public information. All eligibility letters and supporting material are subject to public disclosure under the Freedom of

Information Act (FOIA). Eligibility letters are available to the public at [https://safety.fhwa.dot.gov/roadway\\_dept/countermeasures/reduce\\_crash\\_severity/](https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/).

If you have any questions please contact Aimee Zhang at [Aimee.Zhang@dot.gov](mailto:Aimee.Zhang@dot.gov).

Sincerely,

A handwritten signature in blue ink that reads "Amy Jackson-Grove". The signature is cursive and stylized, with the first letters of each name being capitalized and prominent.

Amy Jackson-Grove  
Acting Director, Office of Safety  
Technologies  
Office of Safety

Enclosures

## Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

<b>Submitter</b>	Date of Request:	March 23, 2022	<input checked="" type="radio"/> New <input type="radio"/> Resubmission
	Name:	Michael Hyzak, P.E., Bridge Design Section Director, Bridge Division	
	Company:	Texas Department of Transportation	
	Address:	125 East 11th Street, Austin, Texas 78701	
	Country:	USA	
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	TxDOT C2P Bridge Rail	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:	Michael Hyzak, P.E., Bridge Design Section Director, Bridge Division	Same as Submitter <input checked="" type="checkbox"/>
Company Name:	Texas Department of Transportation	Same as Submitter <input checked="" type="checkbox"/>
Address:	125 East 11th Street, Austin, Texas 78701	Same as Submitter <input checked="" type="checkbox"/>
Country:	USA	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 Texas Department of Transportation (TxDOT) to perform full-scale crash testing of the C2P Bridge Rail. There are no shared financial interests in the C2P Bridge Rail by TTI, or between TxDOT and TTI, other than costs involved in the actual crash tests and reports for this submission to FHWA.

\*\*490026-4-1, 2, 3\*\*

## PRODUCT DESCRIPTION

<input checked="" type="radio"/> New Hardware or Significant Modification	<input type="radio"/> Modification to Existing Hardware
<p>The overall height of the bridge rail system was 42 inches above the bridge deck. The horizontal centerlines of the three longitudinal rail elements were 39¾, 27, and 17 inches above the bridge deck. The upper rail was comprised of a 4½-inch outside diameter (OD) × 3/16-inch wall thickness steel round hollow structural section (HSS4.500×0.1875), and the middle and lower rails were each 6-inch × 2-inch × ¼-inch wall thickness rectangular steel hollow structural sections (HSS6.00×2.00×0.250). The rail elements were attached to 32-inch tall posts were fabricated from 3/4-inch steel plate that were equally spaced at 8 ft. The posts were anchored to the top of a 9-inch tall steel reinforced concrete curb using four 7/8-inch diameter anchor rods. Picket panels fabricated from steel angle and plate were attached to the field side of the middle and lower longitudinal rails between posts.</p>	

### 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:	Roger P. Bligh, P.E.	
Engineer Signature:	Roger Bligh	Digitally signed by Roger Bligh Date: 2022.03.23 16:43:56 -05'00'
Address:	1254 Avenue A, Bldg 7091, Bryan, Texas 77807	Same as Submitter <input checked="" type="checkbox"/>
Country:	USA	Same as Submitter <input checked="" type="checkbox"/>

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
4-10 (1100C)	<p>Test 4-10 involves an 1100C vehicle weighing 2420 lb <math>\pm</math>55 lb impacting the test article at a target impact speed of 62 mi/h <math>\pm</math>2.5 mi/h and a target impact angle of 25° <math>\pm</math>1.5°. The target CIP was for the left corner of the front bumper to impact at 3.6 ft upstream of the centerline of post 11.</p> <p>The results of TTI Test 490026-4-1, conducted on July 20, 2016, are found in TxDOT Report TR No. 9-1002-15-2. The test vehicle was traveling at an impact speed of 63.0 mi/h as it made contact with the C2P Rail 3.75 ft upstream of the centerline of post 11 at an angle of 25.7°. After loss of contact with the test installation, the vehicle came to rest 174 ft downstream of the impact point and 2 ft towards the field side.</p> <p>The bridge rail contained and redirected the 1100C vehicle. The vehicle did not penetrate, underride, or override the installation. The 1100C vehicle exited within the exit box criteria.</p> <p>Working width was 14.0 inches. Maximum dynamic deflection was 0.8 inches during the test. No permanent deformation was observed afterwards.</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 exterior crush to the vehicle was 13.0 inches in the side plane at the left front corner at bumper height. Maximum occupant compartment deformation was 4.0 inches in the left front firewall/toe pan area.</p> <p>The 1100C vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 6° and 5°, respectively. Longitudinal OIV was 26.2 ft/s, and lateral OIV was 33.1 ft/s. Longitudinal occupant ridedown acceleration was 2.8 g, and lateral occupant ridedown acceleration was 8.2 g. The occupant risk factors were within the MASH allowable limits.</p> <p>The C2P Bridge Rail performed acceptably for MASH Test 4-10.</p>	PASS

Required Test Number	Narrative Description	Evaluation Results
4-11 (2270P)	<p>Test 4-11 involves a 2270P vehicle weighing 5000 lb <math>\pm</math> 110 lb impacting the test article at a target impact speed of 62 mi/h <math>\pm</math> 2.5 mi/h and a target impact angle of 25° <math>\pm</math> 1.5°. The target CIP was for the left corner of the front bumper to impact at 4.3 ft upstream of the centerline of post 6.</p> <p>The results of TTI Test 490026-4-2, conducted on July 13, 2016, are found in TxDOT Report TR No. 9-1002-15-2. The test vehicle was traveling at an impact speed of 62.9 mi/h as it made contact with the C2P Rail 4.0 ft upstream of the centerline of post 6 at an angle of 24.5°. After loss of contact with the test installation, the vehicle came to rest 220 ft downstream of the impact point and 1 ft towards the traffic side. The bridge rail contained and redirected the 2270P vehicle. The vehicle did not penetrate, underride, or override the installation. The 2270P vehicle exited within the exit box criteria.</p> <p>Working width was 14.0 inches. Maximum dynamic deflection during the test was 2.5 inches. Permanent deformation was 1.4 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 exterior crush to the vehicle was 13.0 inches in the side plane at the left front corner at bumper height. Maximum occupant compartment deformation 2.25 inches in the instrument panel area.</p> <p>The 2270P vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 5° and 4°, respectively. Longitudinal OIV was 18.4 ft/s, and lateral OIV was 29.5 ft/s. Longitudinal occupant ridedown acceleration was 3.0 g, and lateral occupant ridedown acceleration was 9.5 g. The occupant risk factors were within the MASH preferred limits.</p> <p>The C2P Bridge Rail performed acceptably for MASH Test 4-11.</p>	PASS

4-12 (10000S)	<p>Test 4-12 involves a 10000S vehicle weighing 22,000 lb <math>\pm</math>660 lb impacting the test article at a target impact speed of 56 mi/h <math>\pm</math>2.5 mi/h and a target impact angle of 15° <math>\pm</math>1.5°. The target CIP was for the left corner of the front bumper to impact at 5.0 ft upstream of the centerline of post 6.</p> <p>The results of TTI Test 490026-4-3, conducted on June 27, 2016, are found in TxDOT Report TR No. 9-1002-15-2. The test vehicle was traveling at an impact speed of 58.4 mi/h as it made contact with the C2P Rail 5.3 ft upstream of the centerline of post 6 at an angle of 15.3°. After loss of contact with the test installation, the vehicle came to rest 240 ft downstream of the impact point and 6 ft towards the traffic side. The bridge rail contained and redirected the 10000S vehicle. The vehicle did not penetrate, underide, or override the installation. The 10000S vehicle exited within the exit box criteria. Working width was 62.3 inches. Maximum dynamic deflection of the rail during the test was 11.4 inches. Permanent deformation was 7.25 inches. 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. Maximum exterior crush to the vehicle was 14.0 inches in the side plane at the left front corner at bumper height. No occupant compartment deformation was observed. The 10000S vehicle remained upright during and immediately after the collision event, but rolled onto its left side after losing contact with the bridge rail. Maximum roll and pitch angles were 89° and 10°, respectively. Longitudinal OIV was 6.2 ft/s, and lateral OIV was 15.1 ft/s. Longitudinal occupant ridedown acceleration was 3.6 g, and lateral occupant ridedown acceleration was 8.0 g.</p> <p>The C2P Bridge Rail performed acceptably for MASH Test 4-12.</p>	PASS
4-20 (1100C)	This bridge rail is not a transition system	Non-Relevant Test, not conducted
4-21 (2270P)	This bridge rail is not a transition system	Non-Relevant Test, not conducted
4-22 (10000S)	This bridge rail is not a transition 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. Kuhn 'Date: 2022.03.23 16:11:52 -05'00 	
Address:	1254 Avenue A, Bldg 7091, Bryan, Texas 77807	Same as Submitter <input checked="" type="checkbox"/>
Country:	USA	Same as Submitter <input checked="" type="checkbox"/>
Accreditation Certificate Number and Dates of current Accreditation period :	ISO 17025-2017 Laboratory A2LA Certificate Number: 2821.01 Valid To: April 30, 2023	

Submitter Signature\*:

DocuSigned by:



F12C956DA92B49E...

Submit Form

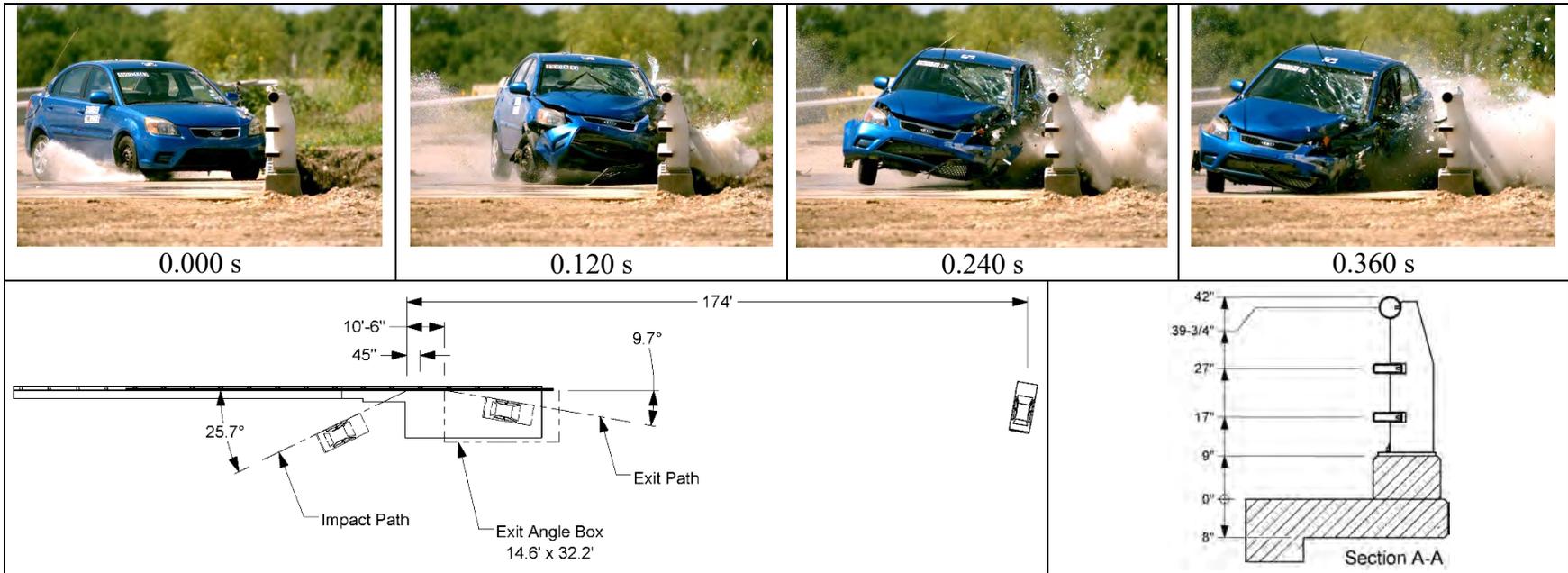
## ATTACHMENTS

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		Key Words
Number	Date	



**General Information**

Test Agency..... Texas A&M Transportation Institute (TTI)  
 Test Standard Test No..... MASH Test 4-10  
 TTI Test No. .... 490026-4-1  
 Test Date..... 2016-07-20

**Test Article**

Type ..... Bridge Rail  
 Name..... TxDOT Type C2P Bridge Rail  
 Installation Length..... 112 ft Rail Post-to-Post  
 Material or Key Elements .... Three steel rails supported on fabricated steel posts mounted on concrete curb and deck

**Soil Type and Condition** ..... Concrete Bridge Deck, Dry

**Test Vehicle**

Type/Designation..... 1100C  
 Make and Model ..... 2010 Kia Rio  
 Curb..... 2493 lb  
 Test Inertial..... 2433 lb  
 Dummy..... 165 lb  
 Gross Static..... 2598 lb

**Impact Conditions**

Speed .....63.0 mi/h  
 Angle .....25.7 degrees  
 Location/Orientation .....45 inches upstream of post 11

**Impact Severity**.....60 kip-ft

**Exit Conditions**

Speed .....49.5 mi/h  
 Angle .....9.7 degrees

**Occupant Risk Values**

Longitudinal OIV .....26.2 ft/s  
 Lateral OIV.....33.1 ft/s  
 Longitudinal Ridedown.....2.8 g  
 Lateral Ridedown.....8.2 g  
 THIV .....46.0 km/h  
 PHD.....8.5 g  
 ASI.....2.81

**Max. 0.050-s Average**

Longitudinal .....-14.9 g  
 Lateral.....-19.7 g  
 Vertical.....-3.8 g

**Post-Impact Trajectory**

Stopping Distance..... 174 ft downstream  
 2 ft twd field side

**Vehicle Stability**

Maximum Yaw Angle .....52 degrees  
 Maximum Pitch Angle .....5 degrees  
 Maximum Roll Angle .....6 degrees  
 Vehicle Snagging .....No  
 Vehicle Pocketing .....No

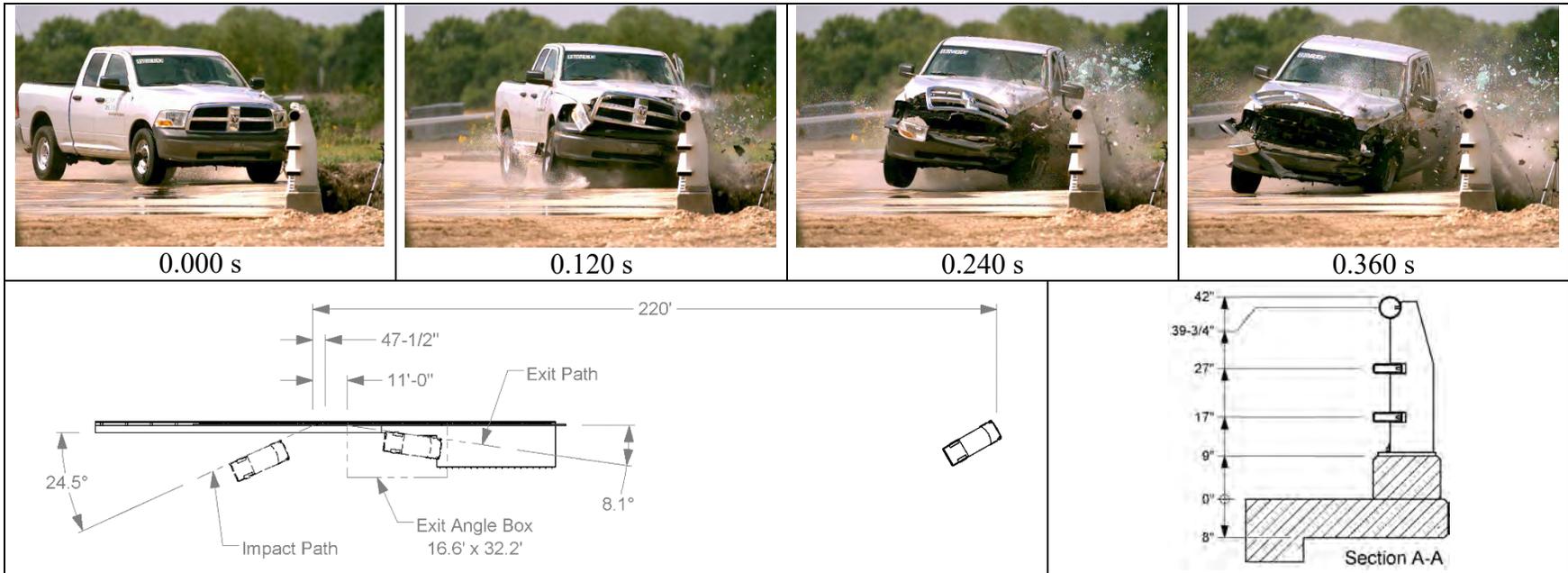
**Test Article Deflections**

Dynamic.....0.8 inch  
 Permanent .....None noted  
 Working Width.....14.0 inches

**Vehicle Damage**

VDS.....11LFQ5  
 CDC.....11FLEW4  
 Max. Exterior Deformation.....13.0 inches  
 OCDI.....LF0033000  
 Max. Occupant Compartment Deformation.....4.0 inches Driver's side toe pan

**Figure 5-1. Summary of Results for MASH Test 4-10 on TxDOT Type C2P Bridge Rail.**



**General Information**

Test Agency..... Texas A&M Transportation Institute (TTI)  
 Test Standard Test No..... MASH Test 4-11  
 TTI Test No. .... 490026-4-2  
 Test Date ..... 2016-07-13

**Test Article**

Type ..... Bridge Rail  
 Name ..... TxDOT Type C2P Bridge Rail  
 Installation Length..... 112 ft Rail Post-to-Post  
 Material or Key Elements .... Three steel rails supported on fabricated steel posts mounted on concrete curb and deck

**Soil Type and Condition** ..... Concrete Bridge Deck, Dry

**Test Vehicle**

Type/Designation ..... 2270P  
 Make and Model ..... 2011 Dodge RAM 1500  
 Curb..... 4911 lb  
 Test Inertial ..... 5048 lb  
 Dummy ..... 165 lb  
 Gross Static ..... 5213 lb

**Impact Conditions**

Speed .....62.9 mi/h  
 Angle .....24.5 degrees  
 Location/Orientation .....47½ inches upstream of post 6

**Impact Severity**.....115 kip-ft

**Exit Conditions**

Speed .....50.5 mi/h  
 Angle .....8.1 degrees

**Occupant Risk Values**

Longitudinal OIV .....18.4 ft/s  
 Lateral OIV.....29.5 ft/s  
 Longitudinal Ridedown .....3.0 g  
 Lateral Ridedown .....9.5 g  
 THIV .....38.7 km/h  
 PHD .....9.9 g  
 ASI .....2.03  
 Max. 0.050-s Average  
 Longitudinal .....-9.9 g  
 Lateral.....15.3 g  
 Vertical.....-2.5 g

**Post-Impact Trajectory**

Stopping Distance .....220 ft downstream  
 1 ft twd traffic lanes

**Vehicle Stability**

Maximum Yaw Angle .....37 degrees  
 Maximum Pitch Angle .....4 degrees  
 Maximum Roll Angle .....5 degrees  
 Vehicle Snagging .....No  
 Vehicle Pocketing .....No

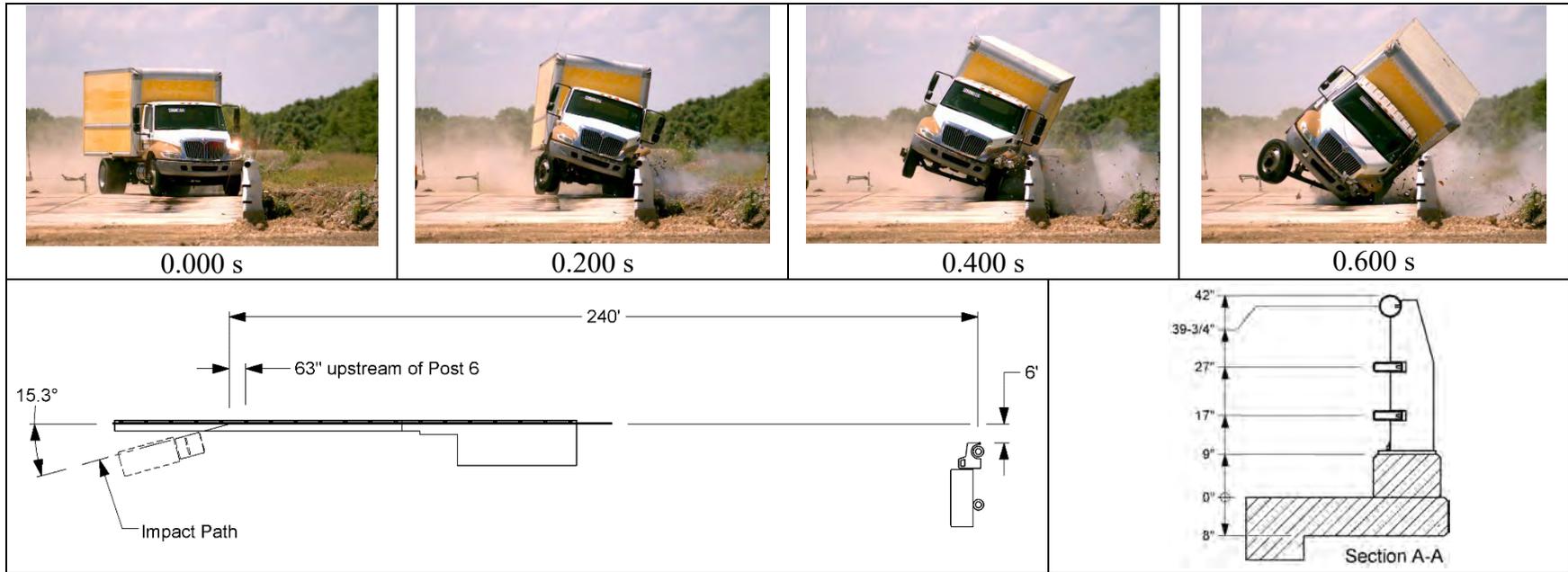
**Test Article Deflections**

Dynamic.....2.5 inches  
 Permanent .....1.4 inches  
 Working Width.....14.0 inches

**Vehicle Damage**

VDS .....11LFQ4  
 CDC .....11FLEW3  
 Max. Exterior Deformation.....13.0 inches  
 OCDI.....LF0000000  
 Max. Occupant Compartment  
 Deformation .....2.25 inches driver side dash.

**Figure 6-2. Summary of Results for MASH Test 4-11 on TxDOT Type C2P Bridge Rail.**



**General Information**

Test Agency..... Texas A&M Transportation Institute (TTI)  
 Test Standard Test No..... MASH Test 4-12  
 TTI Test No. .... 490026-4-3  
 Test Date ..... 2016-06-27

**Test Article**

Type ..... Bridge Rail  
 Name ..... TxDOT Type C2P Bridge Rail  
 Installation Length..... 144 ft Rail Post-to-Post  
 Material or Key Elements .... Three steel rails supported on fabricated steel posts mounted on concrete curb and deck

**Soil Type and Condition**

..... Concrete Bridge Deck, Dry

**Test Vehicle**

Type/Designation ..... 10000S  
 Make and Model ..... 2004 International 4200 single-unit box van truck  
 Curb..... 12,360 lb  
 Ballast..... 10,287  
 Test Inertial ..... 22,220 lb  
 Gross Static ..... 23,385 lb

**Impact Conditions**

Speed .....58.4 mi/h  
 Angle .....15.3 degrees  
 Location/Orientation .....63 inches upstream of post 6

**Impact Severity**

.....176 kip-ft

**Exit Conditions**

Speed .....54.1 mi/h  
 Angle .....Not obtainable

**Occupant Risk Values**

Longitudinal OIV .....6.2 ft/s  
 Lateral OIV.....15.1 ft/s  
 Longitudinal Ridedown.....3.6 g  
 Lateral Ridedown .....8.0 g  
 THIV .....17.8 km/h  
 PHD.....8.0 g  
 ASI.....0.61  
 Max. 0.050-s Average  
 Longitudinal .....-1.8 g  
 Lateral.....-5.4 g  
 Vertical.....-2.5 g

**Post-Impact Trajectory**

Stopping Distance.....240 ft dwnstrm  
 6 ft twd traffic

**Vehicle Stability**

Maximum Yaw Angle .....29 degrees  
 Maximum Pitch Angle ..... 10 degrees  
 Maximum Roll Angle .....89 degrees  
 Vehicle Snagging .....No  
 Vehicle Pocketing .....No

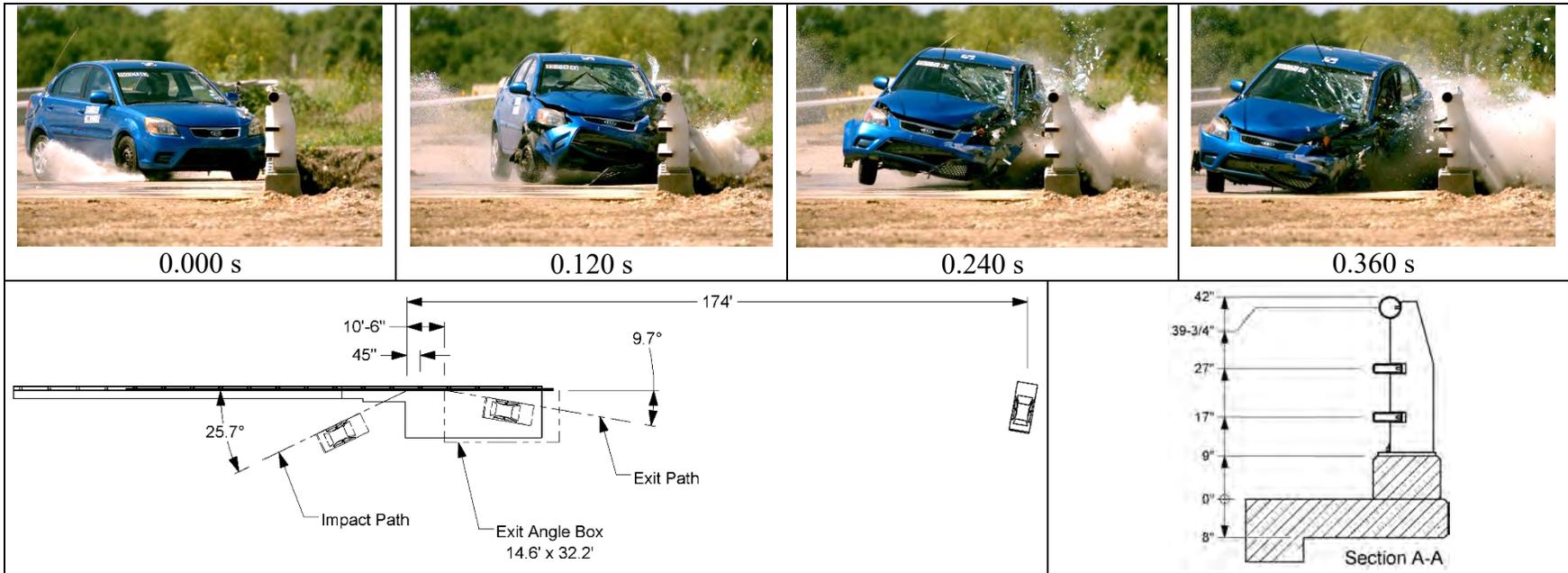
**Test Article Deflections**

Dynamic..... 11.4 inches  
 Permanent ..... 7.25 inches  
 Working Width.....62.3 inches

**Vehicle Damage**

VDS ..... NA  
 CDC..... 11FLEW5  
 Max. Exterior Deformation..... 14.0 inches  
 OCDI.....LF0000000  
 Max. Occupant Compartment Deformation .....None

**Figure 7-3. Summary of Results for MASH Test 4-12 on TxDOT Type C2P Bridge Rail.**



**General Information**

Test Agency..... Texas A&M Transportation Institute (TTI)  
 Test Standard Test No..... MASH Test 4-10  
 TTI Test No. .... 490026-4-1  
 Test Date..... 2016-07-20

**Test Article**

Type ..... Bridge Rail  
 Name..... TxDOT Type C2P Bridge Rail  
 Installation Length..... 112 ft Rail Post-to-Post  
 Material or Key Elements .... Three steel rails supported on fabricated steel posts mounted on concrete curb and deck

**Soil Type and Condition** ..... Concrete Bridge Deck, Dry

**Test Vehicle**

Type/Designation..... 1100C  
 Make and Model ..... 2010 Kia Rio  
 Curb..... 2493 lb  
 Test Inertial..... 2433 lb  
 Dummy ..... 165 lb  
 Gross Static..... 2598 lb

**Impact Conditions**

Speed .....63.0 mi/h  
 Angle .....25.7 degrees  
 Location/Orientation .....45 inches upstream of post 11

**Impact Severity**.....60 kip-ft

**Exit Conditions**

Speed .....49.5 mi/h  
 Angle .....9.7 degrees

**Occupant Risk Values**

Longitudinal OIV .....26.2 ft/s  
 Lateral OIV.....33.1 ft/s  
 Longitudinal Ridedown.....2.8 g  
 Lateral Ridedown.....8.2 g  
 THIV .....46.0 km/h  
 PHD.....8.5 g  
 ASI.....2.81

**Max. 0.050-s Average**

Longitudinal .....-14.9 g  
 Lateral.....19.7 g  
 Vertical.....-3.8 g

**Post-Impact Trajectory**

Stopping Distance..... 174 ft downstream  
 2 ft twd field side

**Vehicle Stability**

Maximum Yaw Angle .....52 degrees  
 Maximum Pitch Angle .....5 degrees  
 Maximum Roll Angle .....6 degrees  
 Vehicle Snagging .....No  
 Vehicle Pocketing .....No

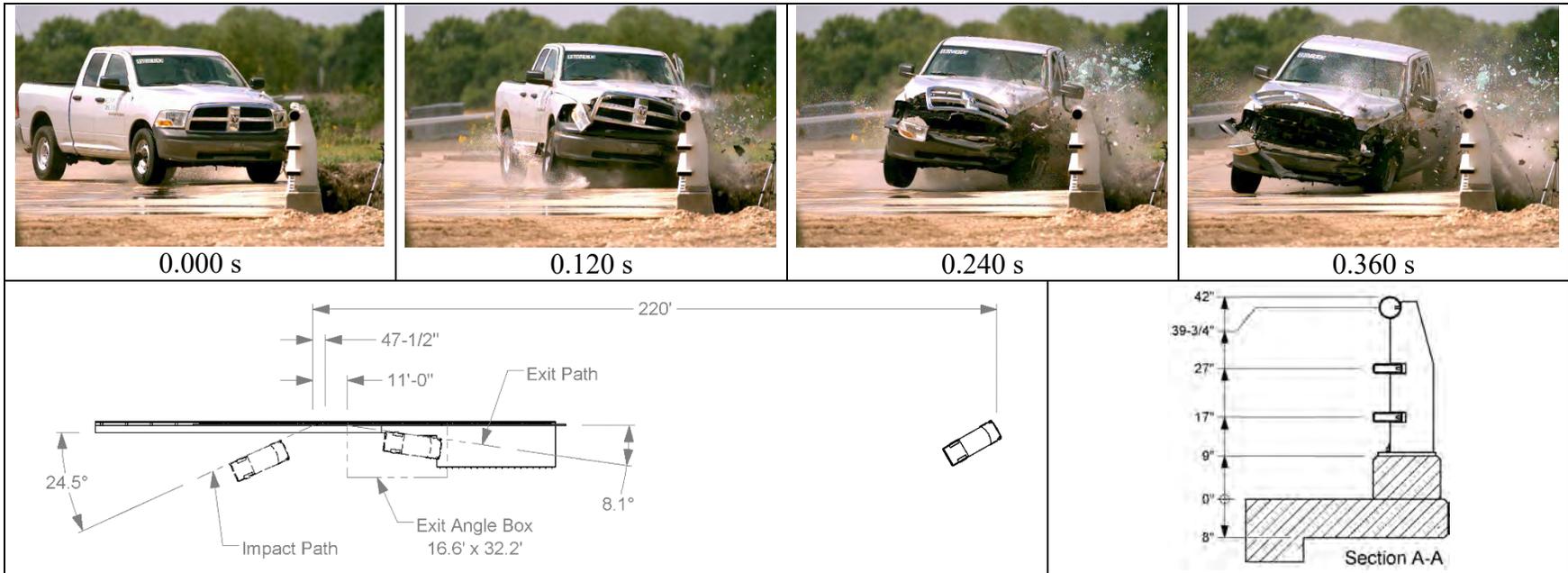
**Test Article Deflections**

Dynamic.....0.8 inch  
 Permanent .....None noted  
 Working Width.....14.0 inches

**Vehicle Damage**

VDS .....11LFQ5  
 CDC.....11FLEW4  
 Max. Exterior Deformation.....13.0 inches  
 OCDI.....LF0033000  
 Max. Occupant Compartment Deformation.....4.0 inches Driver's side toe pan

**Figure 5-1. Summary of Results for MASH Test 4-10 on TxDOT Type C2P Bridge Rail.**



**General Information**

Test Agency..... Texas A&M Transportation Institute (TTI)  
 Test Standard Test No..... MASH Test 4-11  
 TTI Test No. .... 490026-4-2  
 Test Date..... 2016-07-13

**Test Article**

Type ..... Bridge Rail  
 Name..... TxDOT Type C2P Bridge Rail  
 Installation Length..... 112 ft Rail Post-to-Post  
 Material or Key Elements .... Three steel rails supported on fabricated steel posts mounted on concrete curb and deck

**Soil Type and Condition** ..... Concrete Bridge Deck, Dry

**Test Vehicle**

Type/Designation..... 2270P  
 Make and Model ..... 2011 Dodge RAM 1500  
 Curb..... 4911 lb  
 Test Inertial..... 5048 lb  
 Dummy ..... 165 lb  
 Gross Static..... 5213 lb

**Impact Conditions**

Speed .....62.9 mi/h  
 Angle .....24.5 degrees  
 Location/Orientation .....47½ inches upstream of post 6

**Impact Severity**.....115 kip-ft

**Exit Conditions**

Speed .....50.5 mi/h  
 Angle .....8.1 degrees

**Occupant Risk Values**

Longitudinal OIV .....18.4 ft/s  
 Lateral OIV.....29.5 ft/s  
 Longitudinal Ridedown.....3.0 g  
 Lateral Ridedown.....9.5 g  
 THIV .....38.7 km/h  
 PHD.....9.9 g  
 ASI.....2.03  
 Max. 0.050-s Average  
 Longitudinal .....-9.9 g  
 Lateral.....15.3 g  
 Vertical.....-2.5 g

**Post-Impact Trajectory**

Stopping Distance.....220 ft downstream  
 1 ft twd traffic lanes

**Vehicle Stability**

Maximum Yaw Angle .....37 degrees  
 Maximum Pitch Angle .....4 degrees  
 Maximum Roll Angle .....5 degrees  
 Vehicle Snagging .....No  
 Vehicle Pocketing .....No

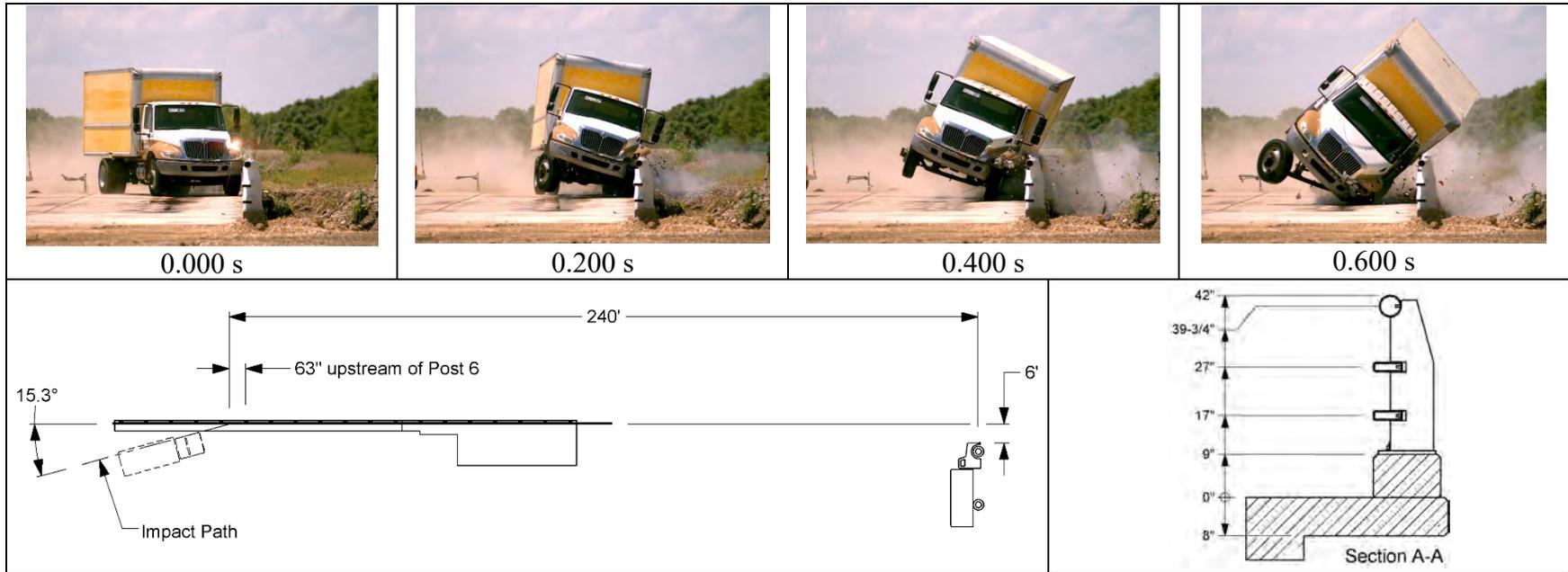
**Test Article Deflections**

Dynamic.....2.5 inches  
 Permanent .....1.4 inches  
 Working Width.....14.0 inches

**Vehicle Damage**

VDS .....11LFQ4  
 CDC.....11FLEW3  
 Max. Exterior Deformation.....13.0 inches  
 OCDI.....LF0000000  
 Max. Occupant Compartment Deformation.....2.25 inches driver side dash.

**Figure 6-2. Summary of Results for MASH Test 4-11 on TxDOT Type C2P Bridge Rail.**



**General Information**

Test Agency..... Texas A&M Transportation Institute (TTI)  
 Test Standard Test No..... MASH Test 4-12  
 TTI Test No. .... 490026-4-3  
 Test Date ..... 2016-06-27

**Test Article**

Type ..... Bridge Rail  
 Name ..... TxDOT Type C2P Bridge Rail  
 Installation Length..... 144 ft Rail Post-to-Post  
 Material or Key Elements .... Three steel rails supported on fabricated steel posts mounted on concrete curb and deck

**Soil Type and Condition**

..... Concrete Bridge Deck, Dry

**Test Vehicle**

Type/Designation ..... 10000S  
 Make and Model ..... 2004 International 4200 single-unit box van truck  
 Curb..... 12,360 lb  
 Ballast..... 10,287  
 Test Inertial ..... 22,220 lb  
 Gross Static ..... 23,385 lb

**Impact Conditions**

Speed .....58.4 mi/h  
 Angle .....15.3 degrees  
 Location/Orientation .....63 inches upstream of post 6

**Impact Severity**

.....176 kip-ft

**Exit Conditions**

Speed .....54.1 mi/h  
 Angle .....Not obtainable

**Occupant Risk Values**

Longitudinal OIV .....6.2 ft/s  
 Lateral OIV.....15.1 ft/s  
 Longitudinal Ridedown .....3.6 g  
 Lateral Ridedown .....8.0 g  
 THIV .....17.8 km/h  
 PHD .....8.0 g  
 ASI .....0.61  
 Max. 0.050-s Average  
 Longitudinal .....-1.8 g  
 Lateral.....-5.4 g  
 Vertical.....-2.5 g

**Post-Impact Trajectory**

Stopping Distance.....240 ft dwnstrm  
 6 ft twd traffic

**Vehicle Stability**

Maximum Yaw Angle .....29 degrees  
 Maximum Pitch Angle ..... 10 degrees  
 Maximum Roll Angle .....89 degrees  
 Vehicle Snagging .....No  
 Vehicle Pocketing .....No

**Test Article Deflections**

Dynamic..... 11.4 inches  
 Permanent ..... 7.25 inches  
 Working Width.....62.3 inches

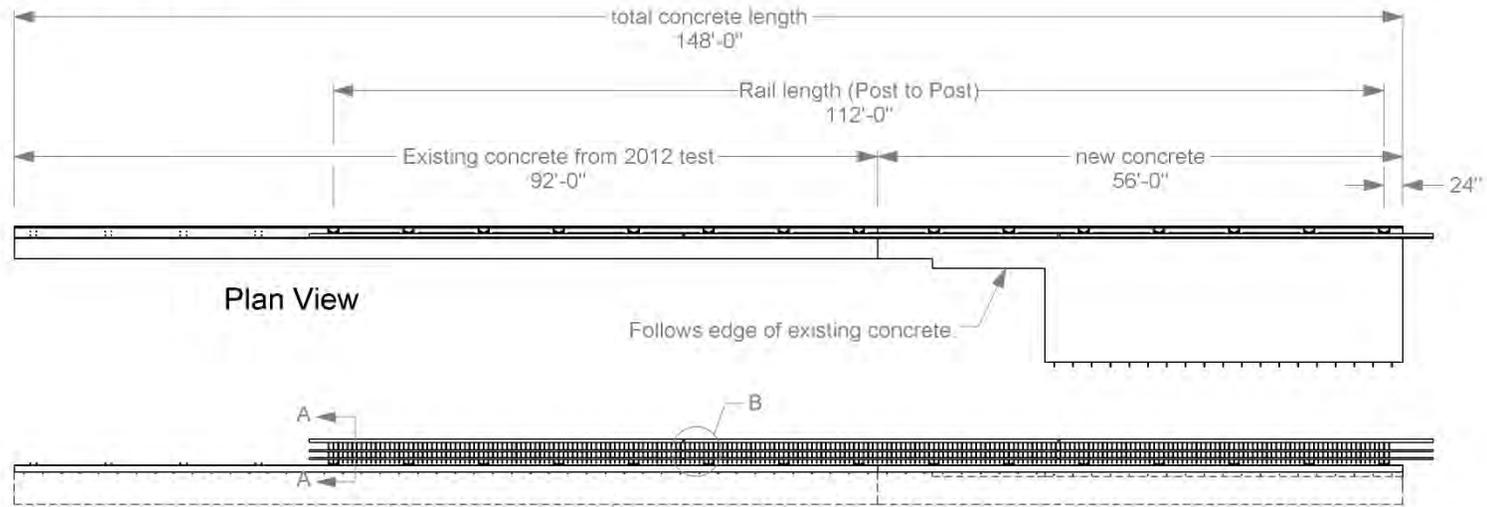
**Vehicle Damage**

VDS ..... NA  
 CDC ..... 11FLEW5  
 Max. Exterior Deformation..... 14.0 inches  
 OCDI.....LF0000000  
 Max. Occupant Compartment Deformation .....None

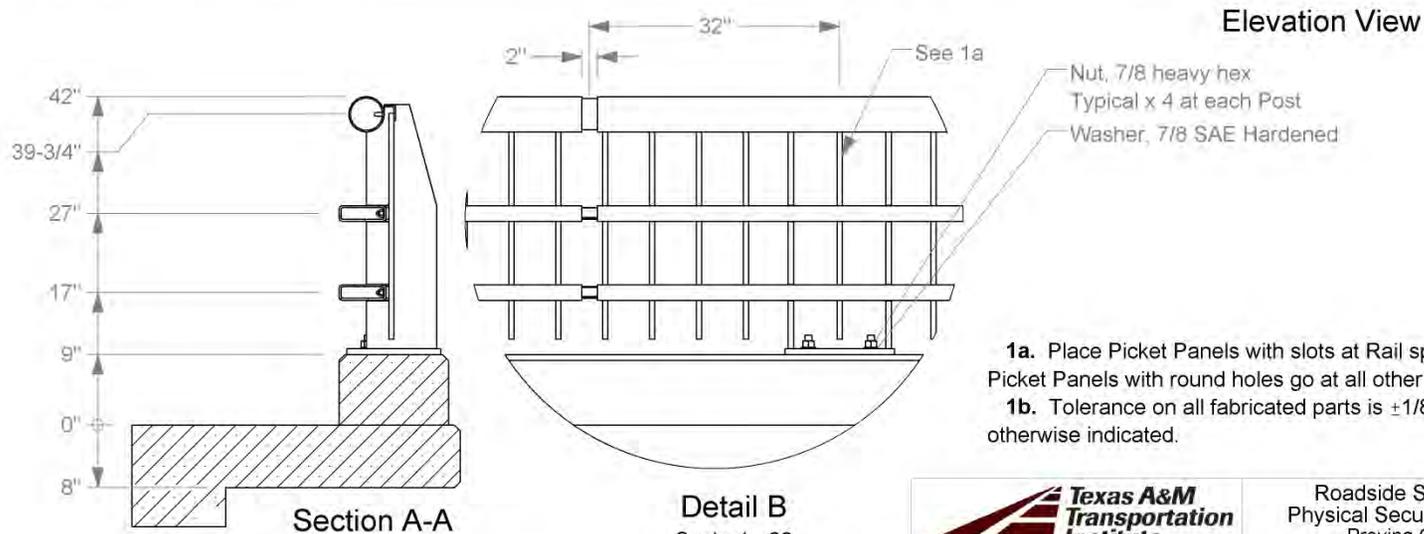
**Figure 7-3. Summary of Results for MASH Test 4-12 on TxDOT Type C2P Bridge Rail.**



# Test Installation



Plan View



- 1a. Place Picket Panels with slots at Rail splice locations. Picket Panels with round holes go at all other locations.
- 1b. Tolerance on all fabricated parts is  $\pm 1/8"$  unless otherwise indicated.

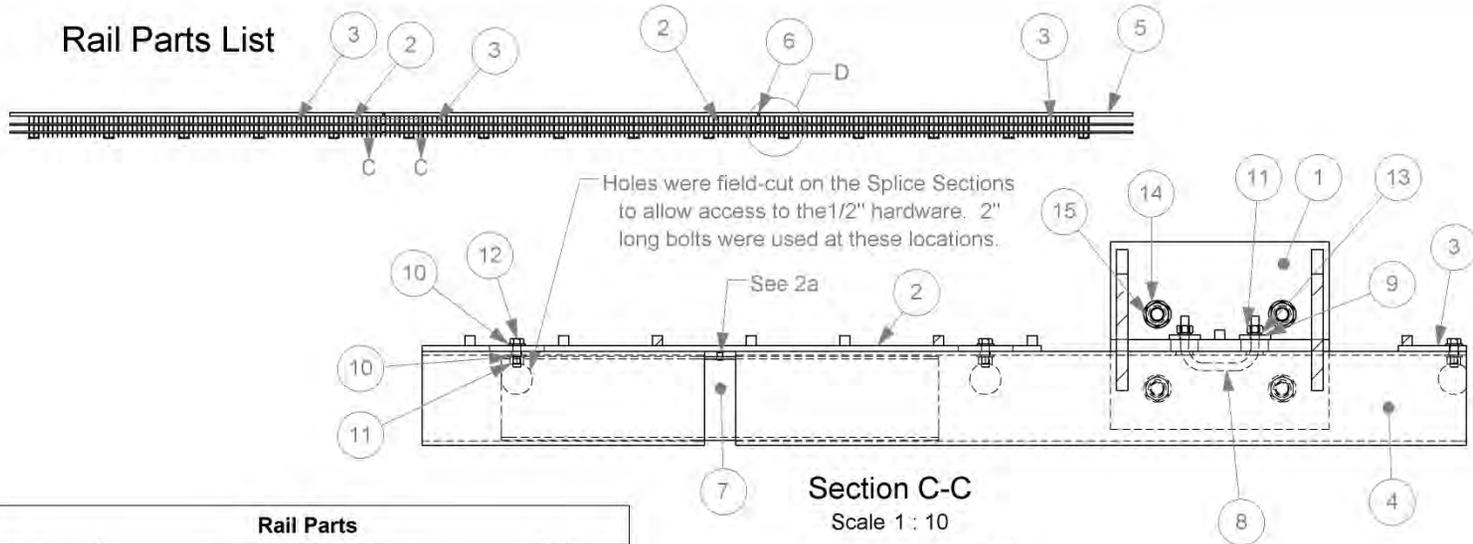
Detail B  
Scale 1 : 20  
Typical each joint



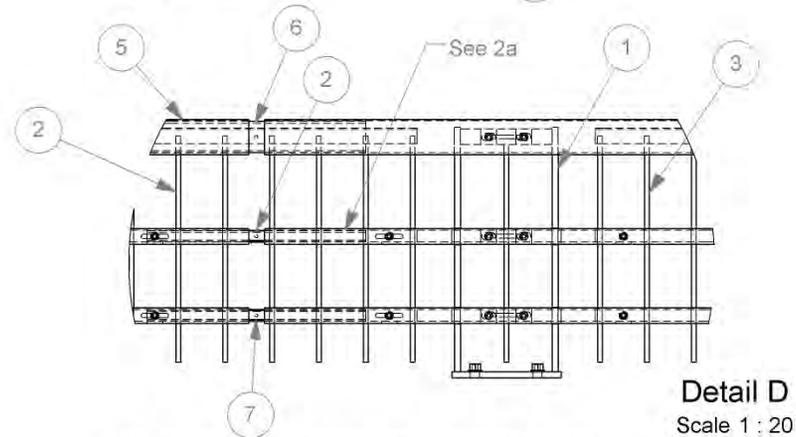
Roadside Safety and  
Physical Security Division -  
Proving Ground

T:\1-ProjectFiles\490026-TxDOT\1-4 - 42 inch Picket Rail - Williams\4-2\Drafting\490026-4-2 Drawing

## Rail Parts List



Rail Parts		
#	Part Name	Qty.
1	Post for 42" Picket Rail	15
2	Picket Rail Panel, with slots	2
3	Picket Rail Panel, with holes	12
4	Rectangular Rail	6
5	Round Rail	3
6	Splice Section for Round Rail	2
7	Splice Section for Rectangular Rail	4
8	U-bolt for Picket Rail	45
9	Plate Washer for U-bolt	90
10	Washer, 1/2 SAE Hardened	168
11	Nut, 1/2 heavy hex	174
12	Bolt, 1/2" x 1 1/2" hex	84
13	Washer, 1/2 Lock	90
14	Washer, 7/8 SAE Hardened	60
15	Nut, 7/8 heavy hex	60



2a. Place Splice Sections with Pins on Field Side.

2b. Ø1/2" Bolts are ASTM A325. Ø7/8" Bolts are ASTM A449.



Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4 / 1-2 42" Picket Rail

2016-07-18

Drawn By GES

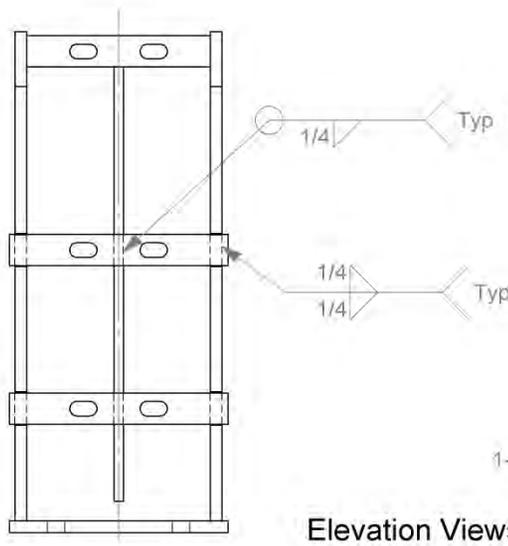
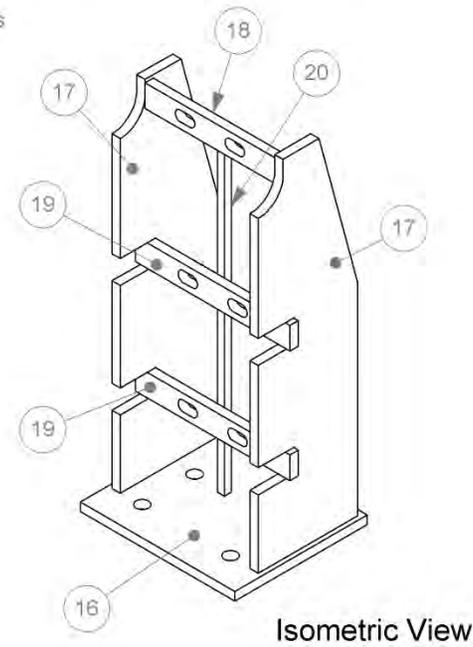
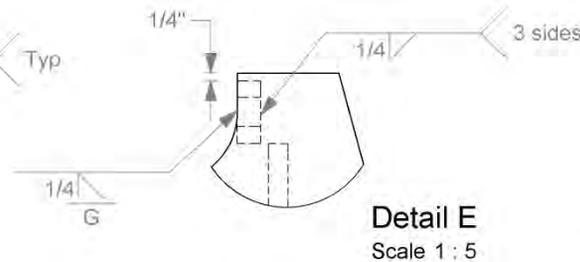
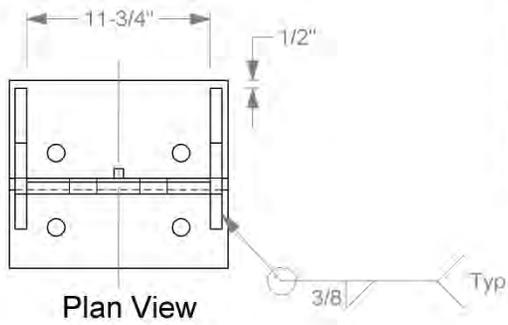
Scale: 1:200

Sheet 2 of 14

Rail Parts List

# Post

Post Parts					
#	Body Name	Description	Length	MATERIAL	Qty
16	Base Plate	Plate, 12" x 3/4"	14"	ASTM A572 Grade 50	1
17	Side Plate	Plate, 9" x 3/4"	31 1/4"	ASTM A572 Grade 50	2
18	Rail Plate, Top	Plate, 2" x 3/4"	11 3/4"	ASTM A36 Steel	1
19	Rail Plate, Bot and Mid	Plate, 2" x 3/4"	14"	ASTM A36 Steel	2
20	Picket	Plate, 5/8" x 5/8"	27 3/4"	ASTM A36 Steel	1

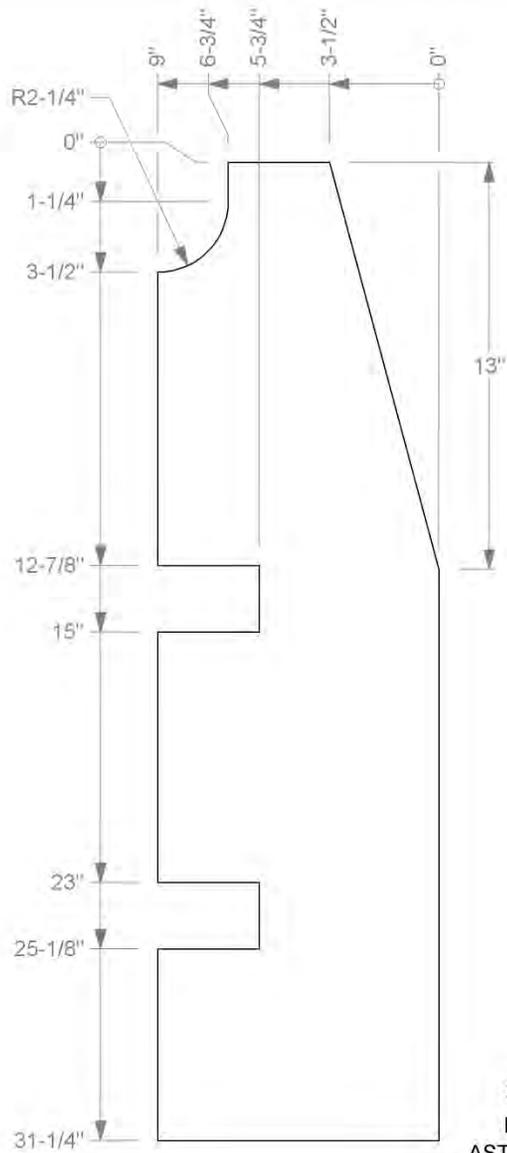


Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4 / 1-2 42" Picket Rail

2016-07-18

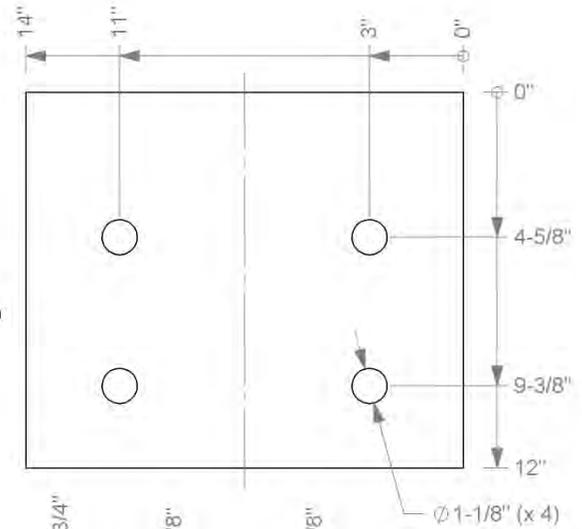
Drawn By GES Scale:1:500 Sheet 3 of 14 Post



### Post Parts

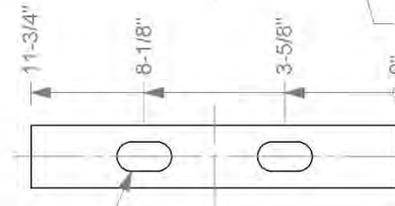
(See Table, previous sheet, for Picket details)

**Base Plate**  
Plate, 12" x 3/4"  
ASTM A572 Grade 50

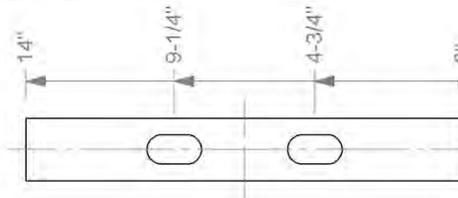


**Rail Plate, Top**  
Plate, 2" x 3/4"  
ASTM A36 Steel

Slots, 15/16" x 1-3/4"  
Typical both Rail Plates



**Rail Plate, Bot and Mid**  
Plate, 2" x 3/4"  
ASTM A36 Steel



**Side Plate**  
Plate, 9" x 3/4"  
ASTM A572 Grade 50

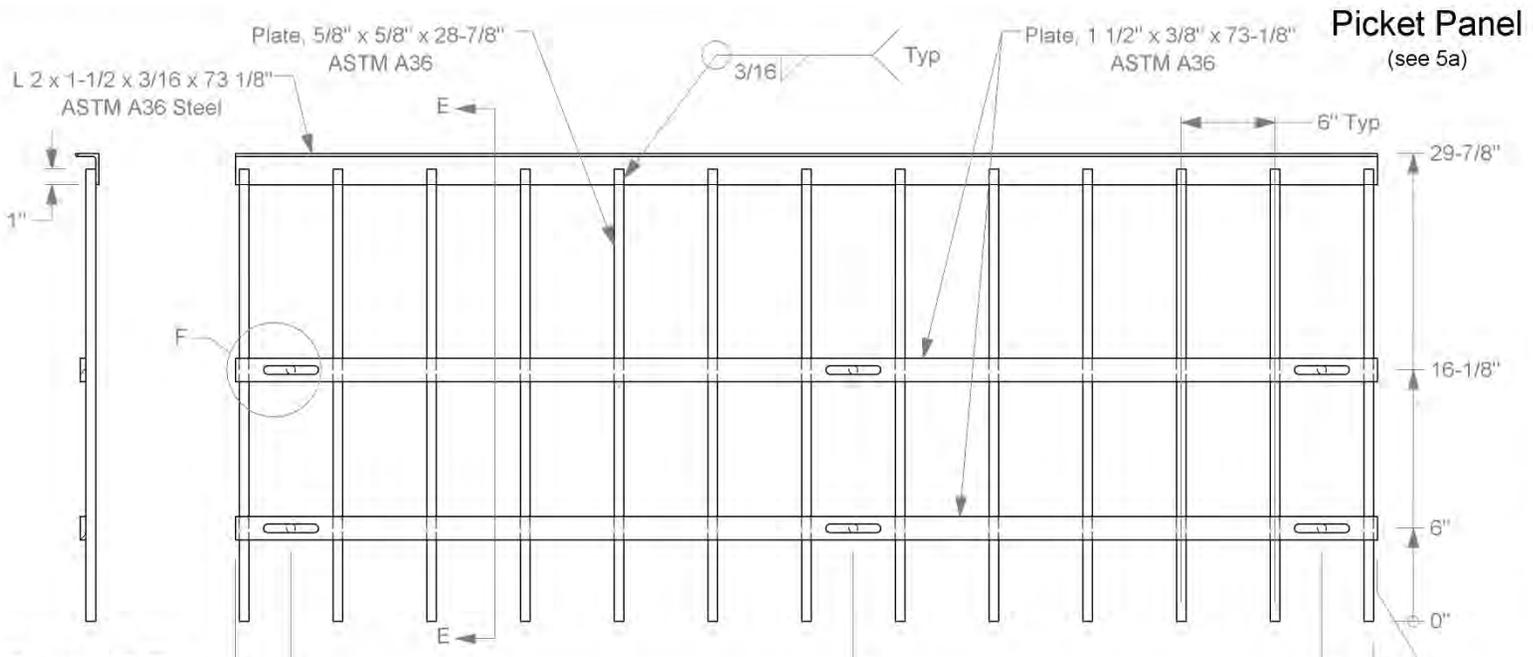


Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4 / 1-2 42" Picket Rail

2016-07-18

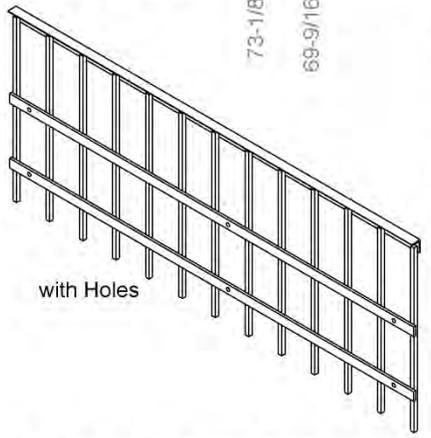
Drawn By GES Scale 1:5 Sheet 4 of 14 Post Parts



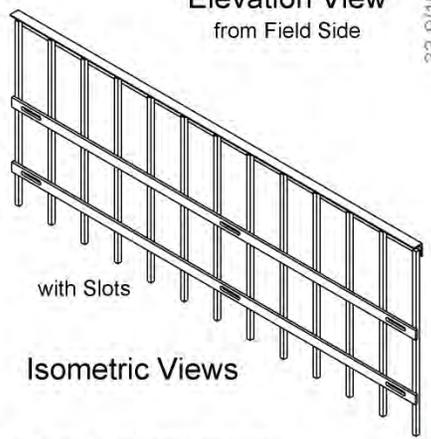
**Picket Panel**  
(see 5a)

**Section E-E**

**Elevation View**  
from Field Side

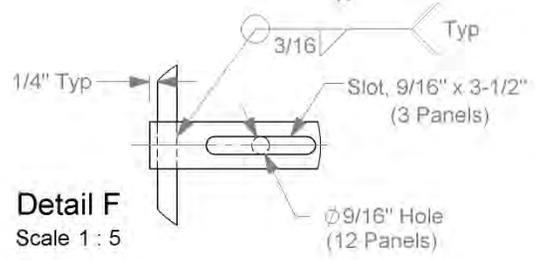


with Holes



with Slots

**Isometric Views**



**Detail F**  
Scale 1 : 5

**5a.** Need 18 Panels total, 3 with Slots and 15 with holes at same location.

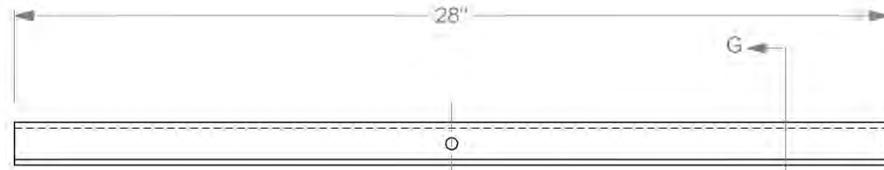
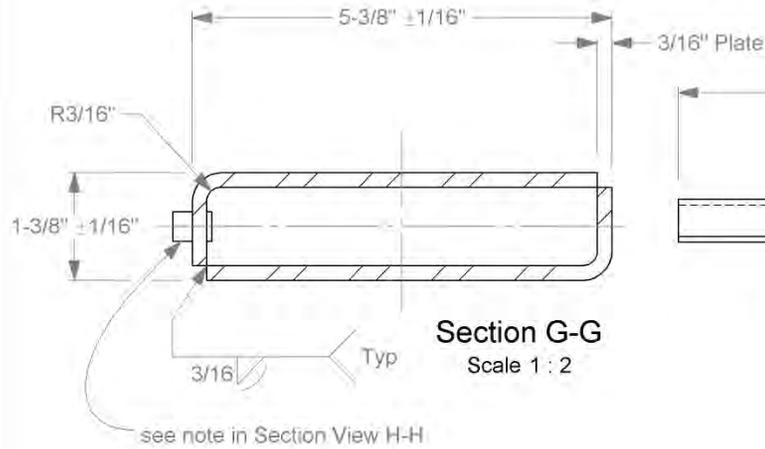


Roadside Safety and  
Physical Security Division -  
Proving Ground

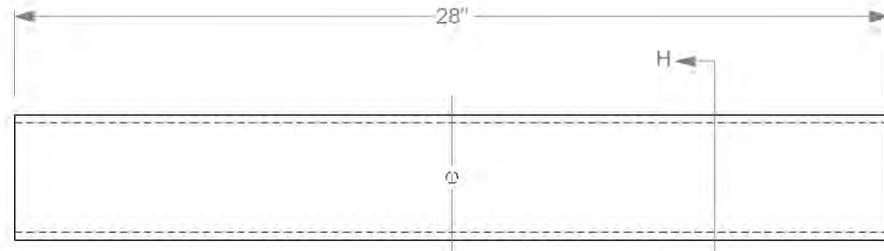
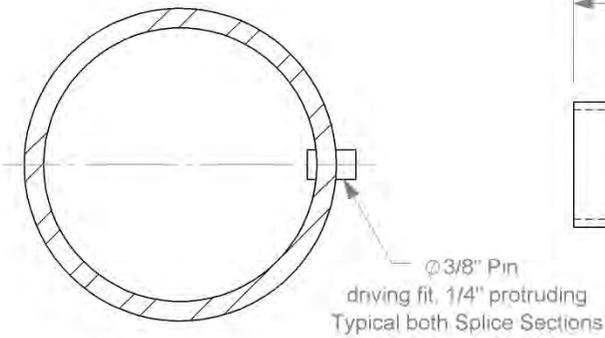
Project 490026-4 / 1-2 42" Picket Rail 2016-07-18  
Drawn By GES Scale 1:10 Sheet 5 of 14 Picket Panel

T:\11-ProjectFiles\490026-TxDOT\4 - 42 inch Picket Rail - Williams\4-2 Drafting\490026-4-2 Drawing

## Splice Sections



**Splice Section for Rectangular Rail**  
ASTM A36 Steel  
(see 6a)



**Splice Section for Round Rail**  
HSS Round 4" x 1/4" x 28"  
ASTM A500 Grade B

**6a.** Check Splice Sleeve for Rectangular Rail for loose fit in Rectangular Rail after fabrication is completed.



Roadside Safety and  
Physical Security Division -  
Proving Ground

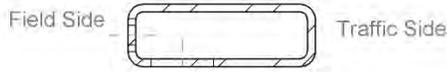
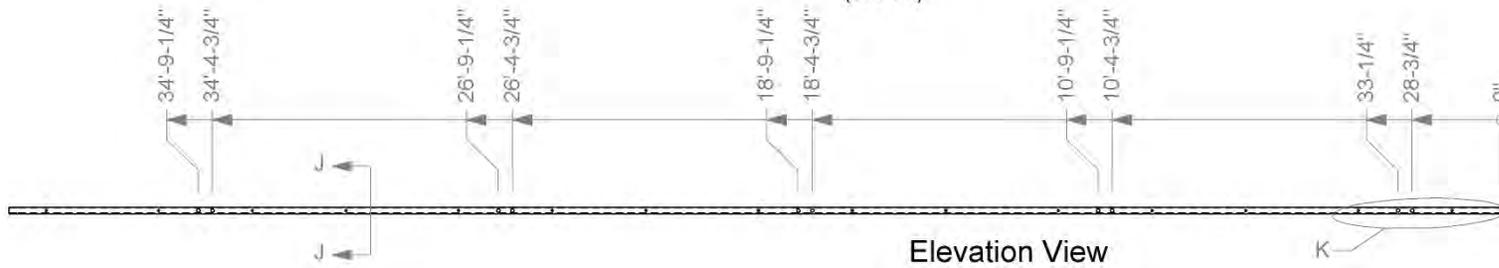
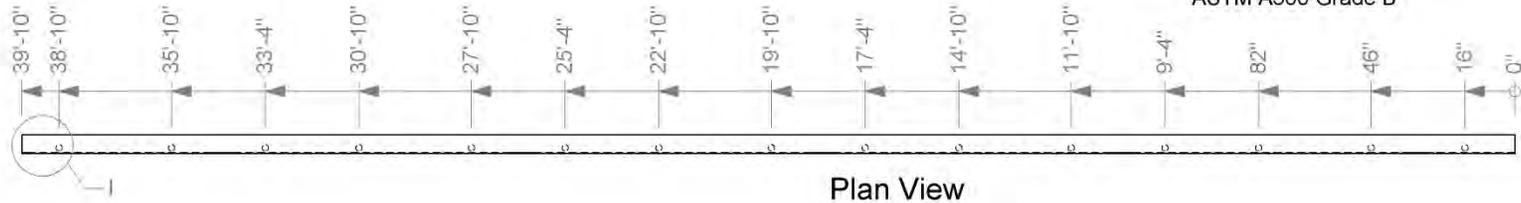
Project 490026-4 / 1-2 42" Picket Rail

2016-07-18

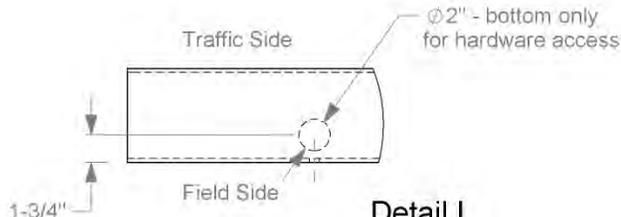
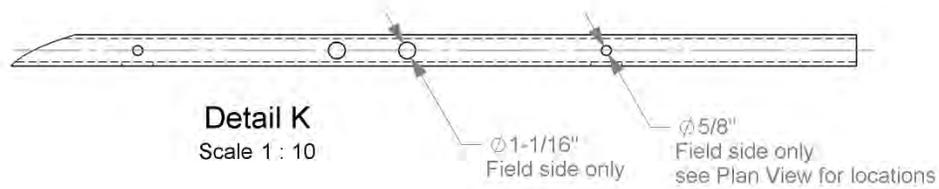
Drawn By GES Scale 1:5 Sheet 6 of 14 Splice Sections

# Rectangular Rail

HSS 6" x 2" x 1/4"  
ASTM A500 Grade B



Section J-J  
Scale 1 : 5



Detail I  
Scale 1 : 10

7a. Please note that the Plan View and Detail I are showing the Rail from the top. The holes are on bottom.



Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4 / 1-2 42" Picket Rail

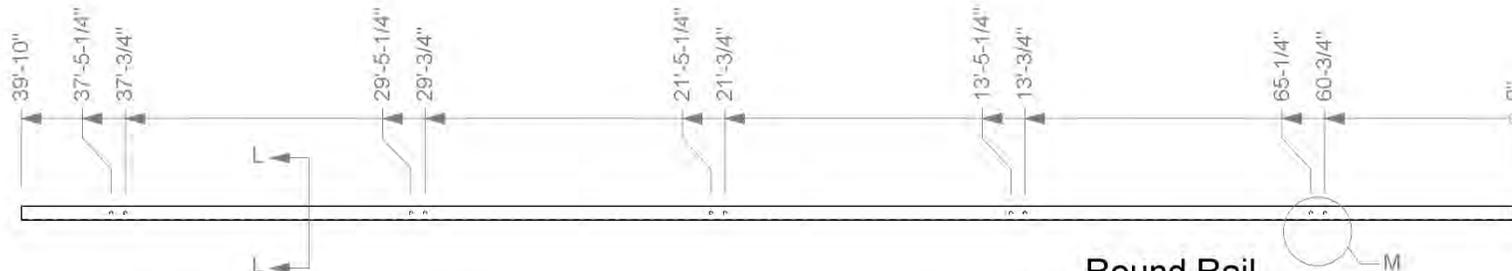
2016-07-18

Drawn By GES

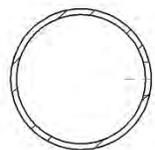
Scale 1:50

Sheet 7 of 14

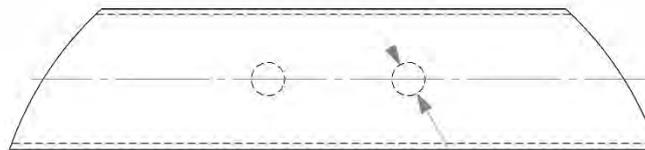
Rectangular Rail



**Round Rail**  
 HSS Round 4 1/2" x 3/16"  
 ASTM A500 Grade B  
 Elevation View

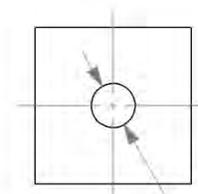


**Section L-L**  
 Scale 1 : 5



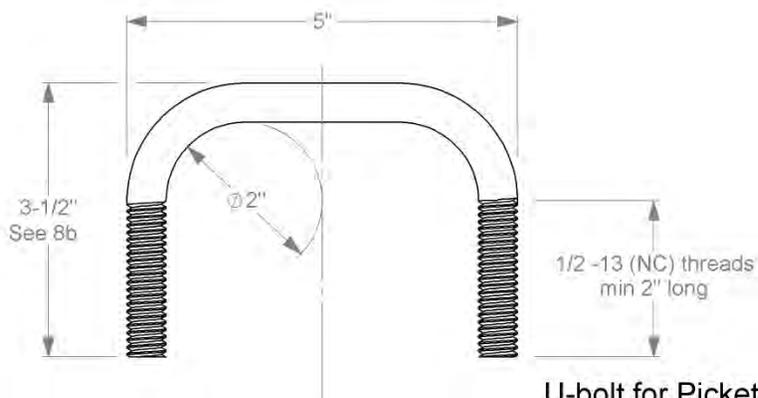
**Detail M**  
 Scale 1 : 5

Ø 1-1/16"  
 Field side only



Ø 9/16"

**Plate Washer for U-bolt**  
 Plate, 2" x 5/16" x 2"  
 ASTM A36 Steel  
 Scale 1:2



**U-bolt for Picket Rail**  
 Ø 1/2" ASTM A36 Steel  
 Scale 1:2

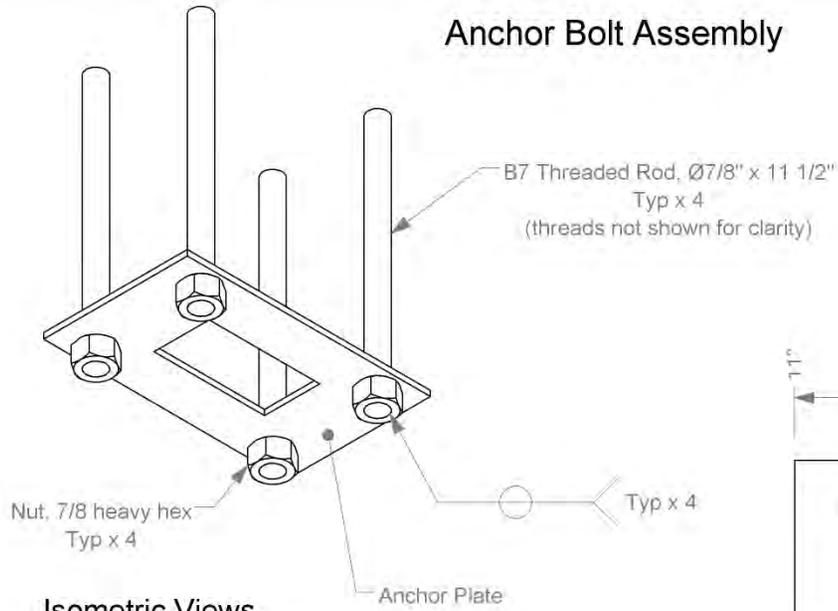
8a. Dimension is approximate. Rod is 10" long before bending.



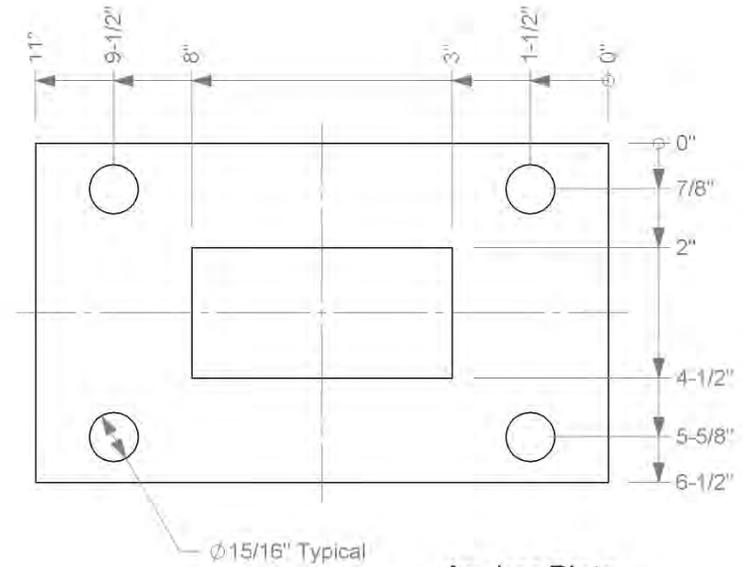
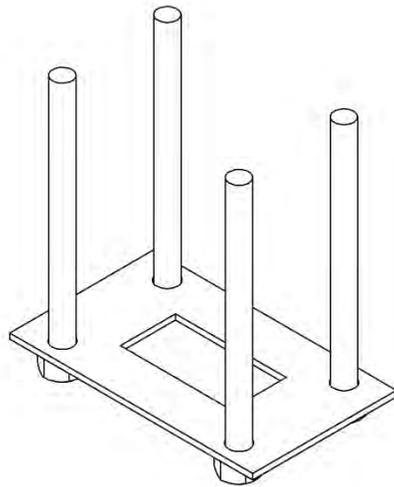
Roadside Safety and  
 Physical Security Division -  
 Proving Ground

Project 490026-4-3	42" Picket Rail	2016-07-20
Drawn By GES	Scale 1:50	Sheet 8 of 14 Round Rail, etc.

# Anchor Bolt Assembly



## Isometric Views

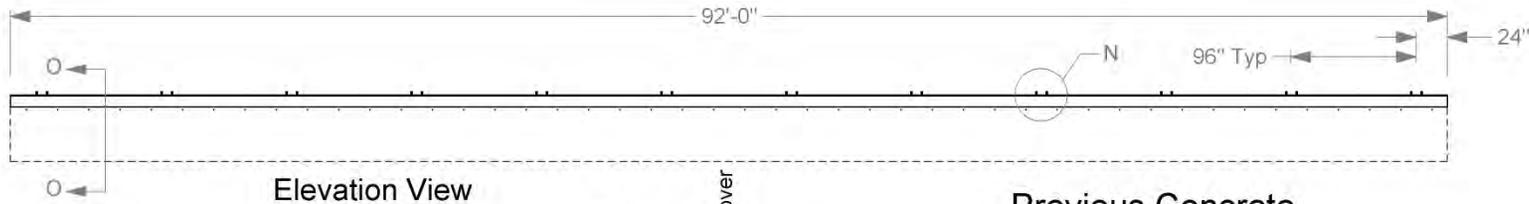


**Anchor Plate**  
Plate, 6 1/2" x 1/4" x 11"  
ASTM A36 Steel



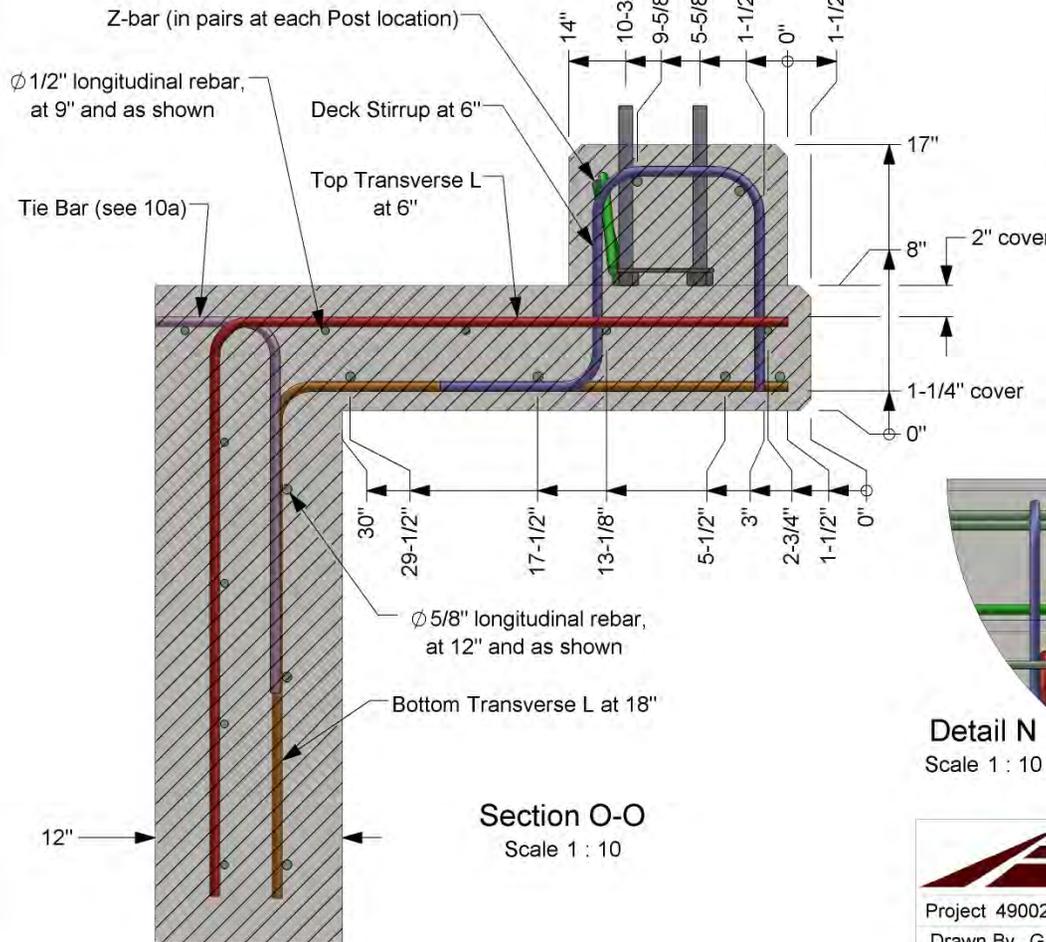
Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4-3 42" Picket Rail 2016-07-20  
Drawn By GES Scale 1:3 Sheet 9 of 14 Anchor Bolt Assembly



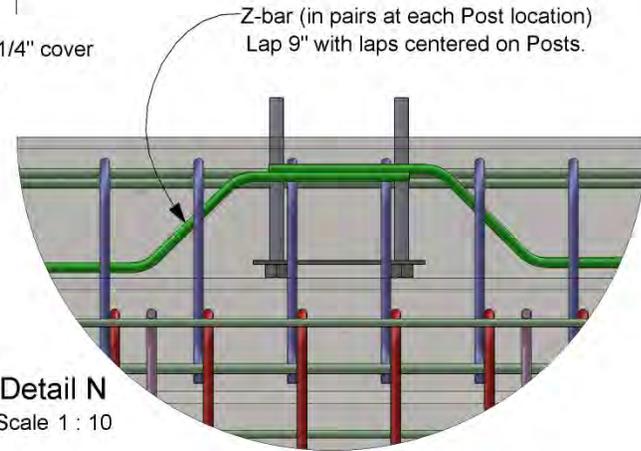
Elevation View

Previous Concrete



Section O-O  
Scale 1 : 10

- 10a.** Tie Bars spaced at 24", and welded to existing rebar protruding from the runway (not shown here).
- 10b.** All Rebar is grade 60. Minimum lap distance is 17" for Ø1/2" bars and 21" for Ø5/8" bars.
- 10c.** Concrete is TxDOT Class S (4000 psi). Chamfer edges of Deck and Curb 3/4" as shown.

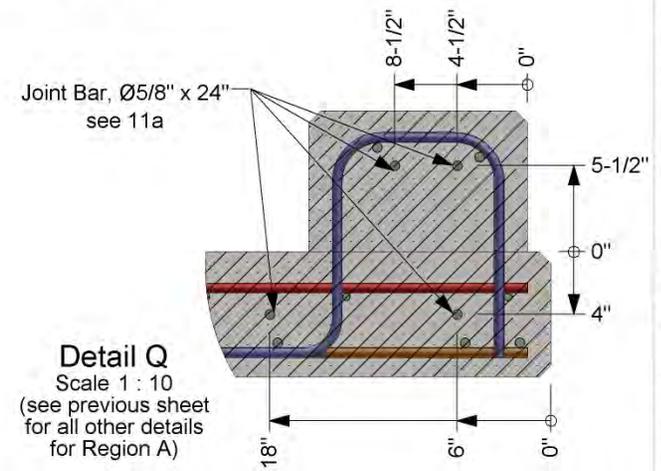
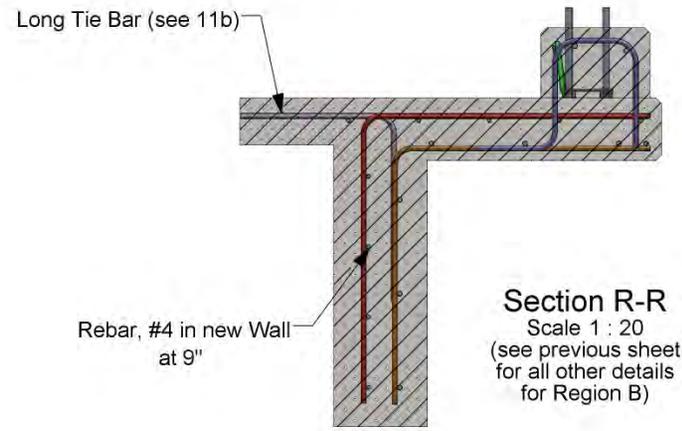
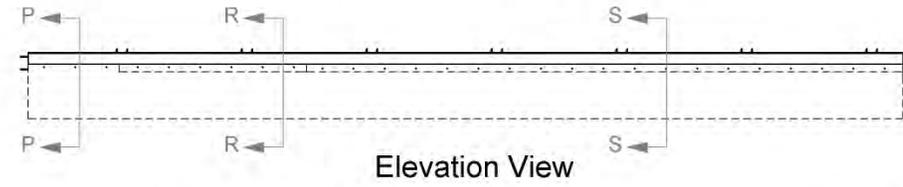
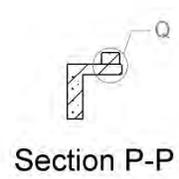
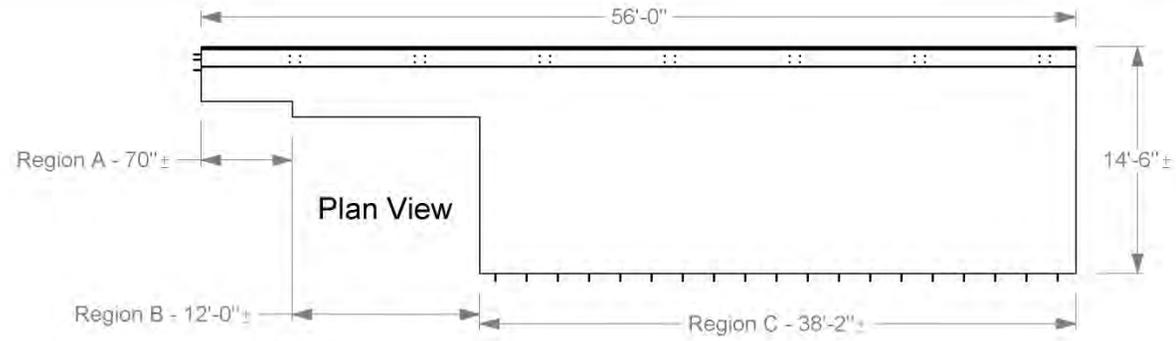


Detail N  
Scale 1 : 10

		Roadside Safety and Physical Security Division - Proving Ground	
Project 490026-4-3	42" Picket Rail	2016-07-20	
Drawn By GES	Scale: 1:120	Sheet 10 of 14	Previous Concrete

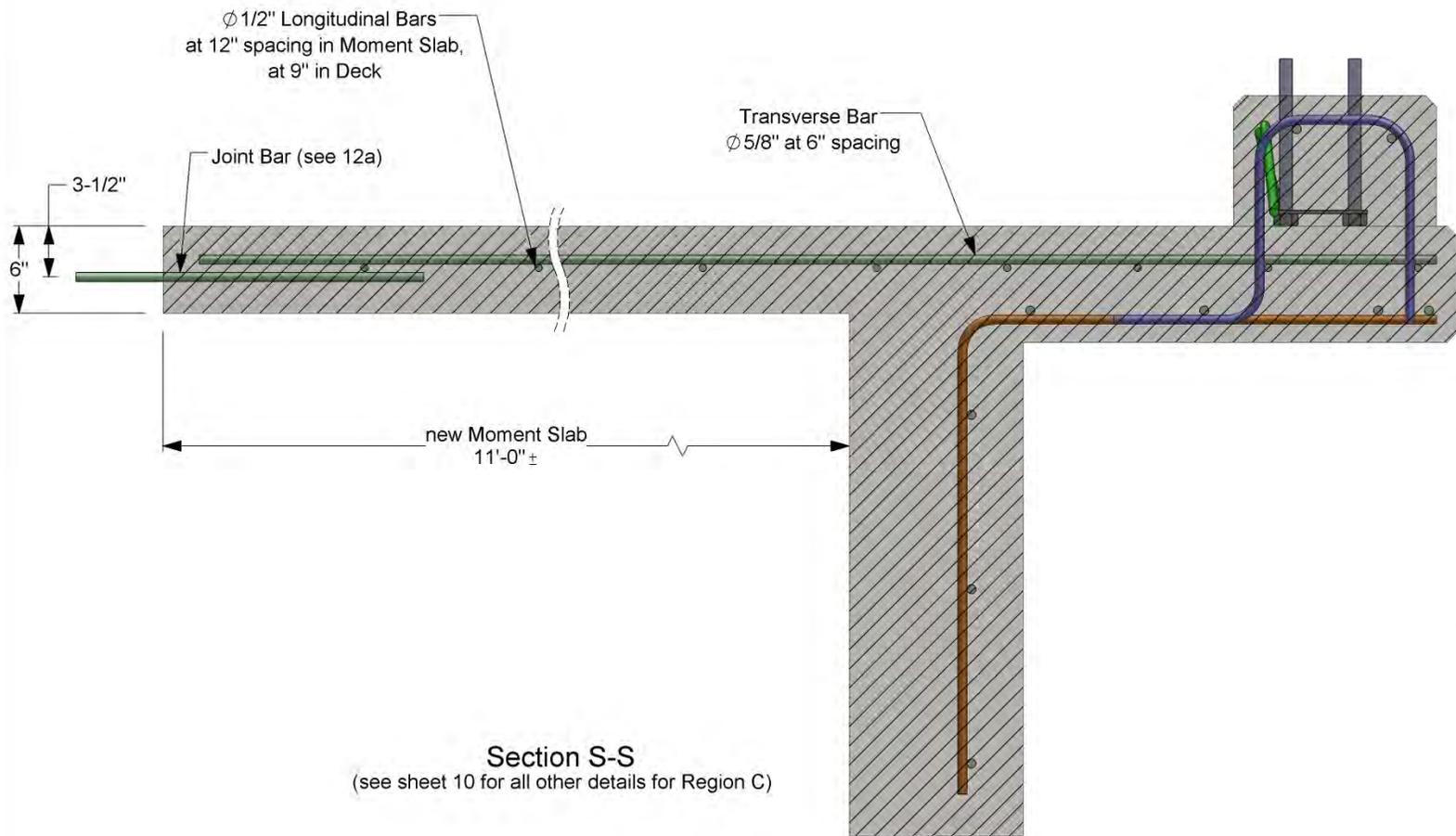
T:\11-ProjectFiles\490026-TxDOT\4 - 42 inch Picket Rail - Williams\4-3 Drafting\490026-4-3 Drawing

**New Concrete**



- 11a.** Drill minimum 6" into existing concrete and secure Joint Bars with Hilti RE-500 epoxy, according to manufacturer's instructions.
- 11b.** Long Tie Bars spaced at 24" and welded to existing rebar protruding from the runway (not shown here).

	Roadside Safety and Physical Security Division - Proving Ground		
	Project 490026-4-3	42" Picket Rail	2016-07-20
Drawn By GES	Scale: 1:120	Sheet 11 of 14	New Concrete



**Section S-S**  
 (see sheet 10 for all other details for Region C)

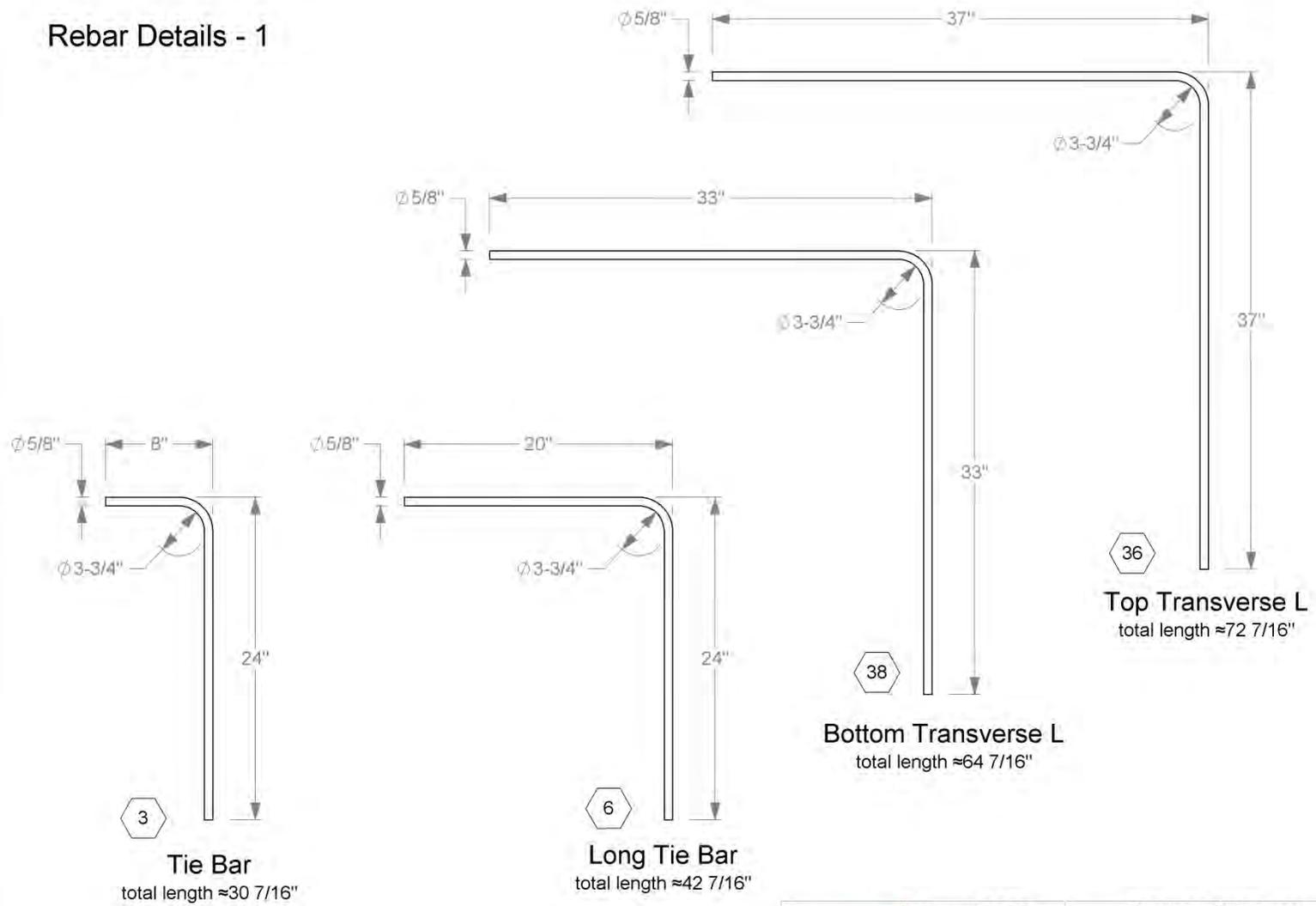
**12a.** Drill minimum 6" into existing concrete and secure Joint Bars with Hilti RE-500 epoxy, according to manufacturer's instructions. Space at 24".



Roadside Safety and  
 Physical Security Division -  
 Proving Ground

Project 490026-4-3	42" Picket Rail	2016-07-20
Drawn By GES	Scale 1:10	Sheet 12 of 14 Section View

# Rebar Details - 1



13a. The numeral in the hexagon denotes the quantity needed for each Bar.

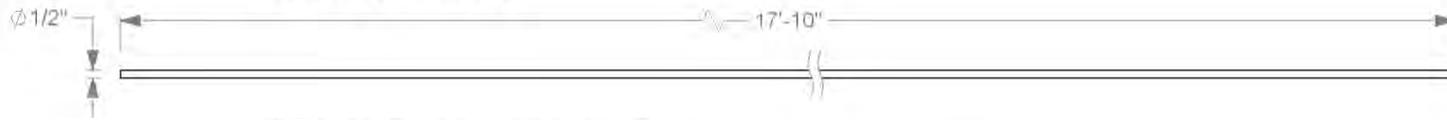


Roadside Safety and Physical Security Division - Proving Ground

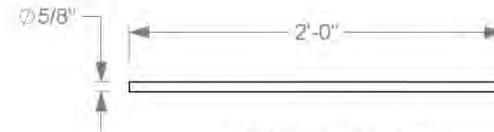
Project 490026-4-3 42" Picket Rail 2016-07-20  
 Drawn By GES Scale 1:10 Sheet 13 of 14 Rebar Details - 1

T:\11-ProjectFiles\490026-TxDOT\4 - 42 inch Picket Rail - Williams\4-3 Drafting\490026-4-3 Drawing

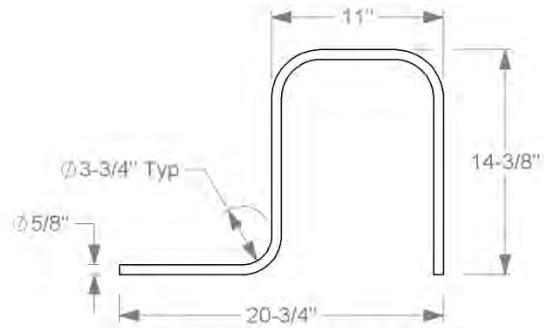
## Rebar Details - 2



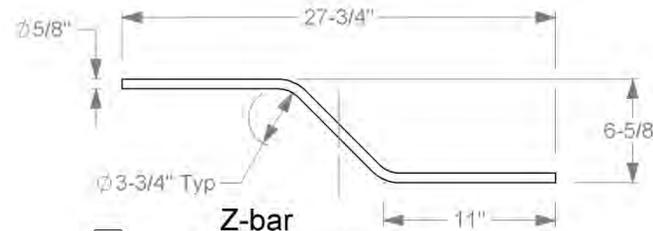
4 Rebar, #4 in new Wall



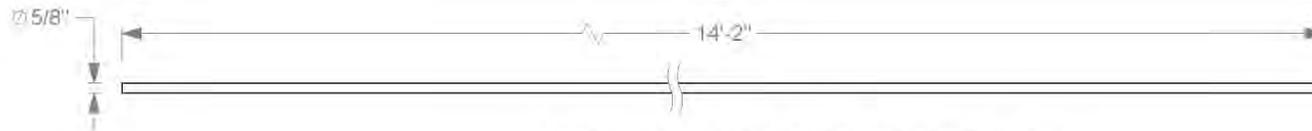
19 Joint Bar



112 Deck Stirrup  
total length  $\approx 44\ 7/8"$



14 Z-bar  
total length  $\approx 30\ 1/16"$



76 Moment Slab Transverse Bar

14a. The numeral in the hexagon denotes the quantity needed for each Bar.



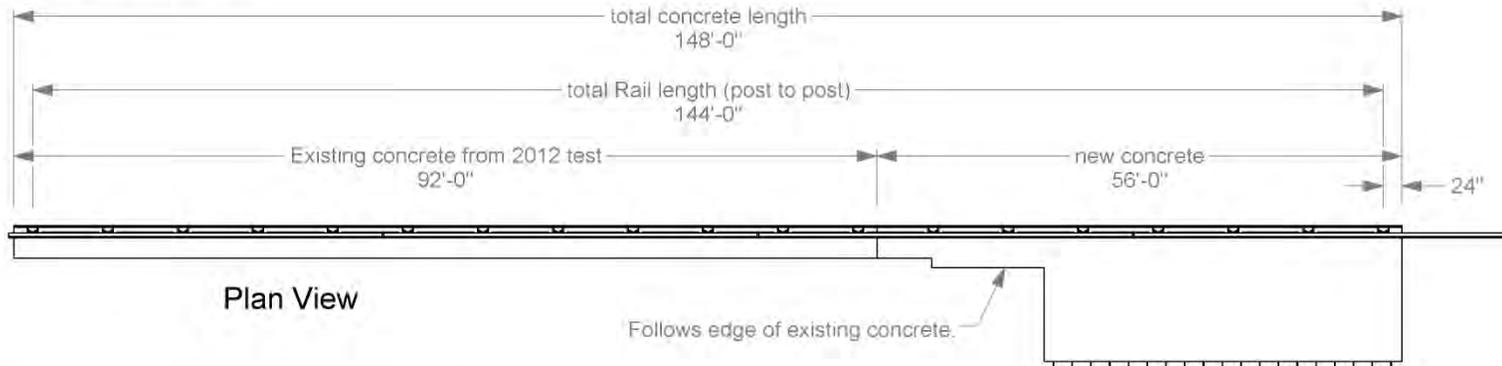
Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4-3 42" Picket Rail

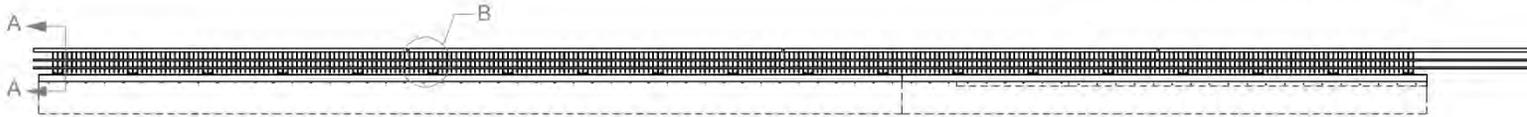
2016-07-20

Drawn By GES Scale 1:10 Sheet 14 of 14 Rebar Details - 2

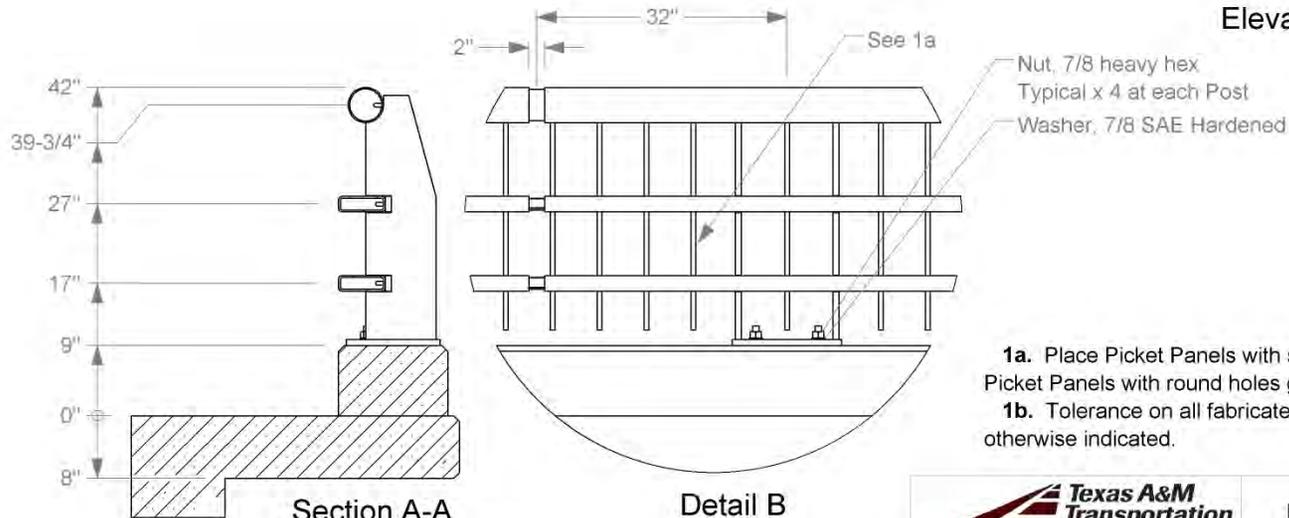
# Test Installation



Plan View



Elevation View



Section A-A

Scale 1 : 20  
(some dims rounded to nearest 1/8")

Detail B

Scale 1 : 20  
Typical each joint

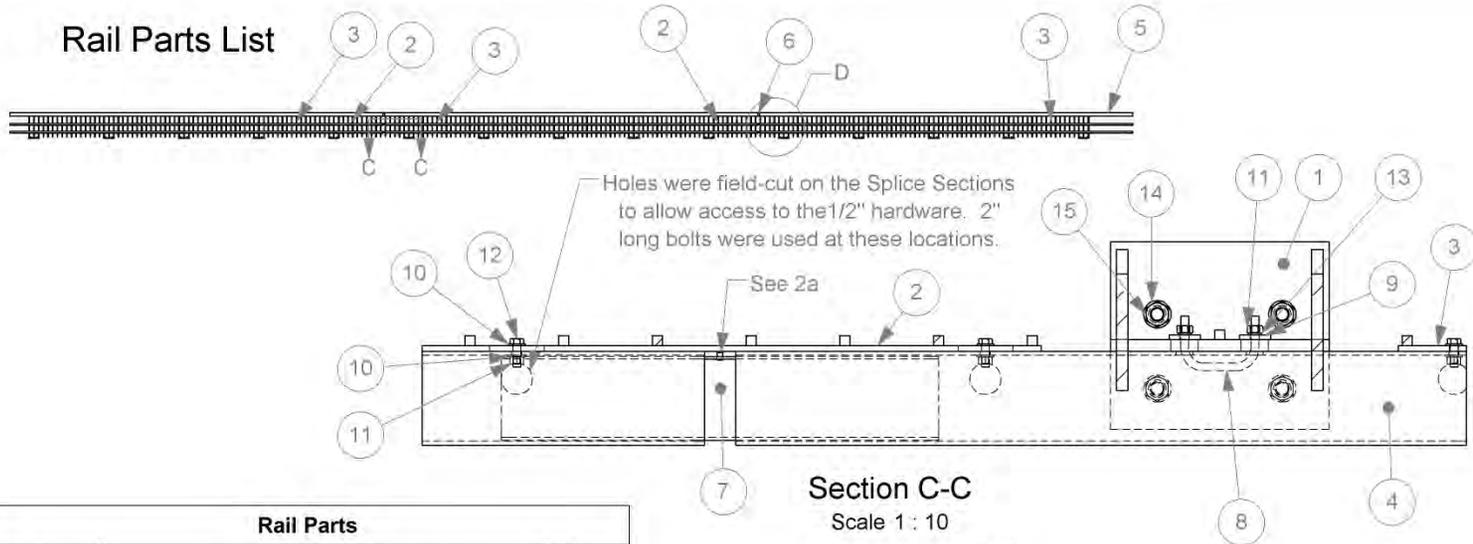
- 1a. Place Picket Panels with slots at Rail splice locations. Picket Panels with round holes go at all other locations.
- 1b. Tolerance on all fabricated parts is  $\pm 1/8"$  unless otherwise indicated.



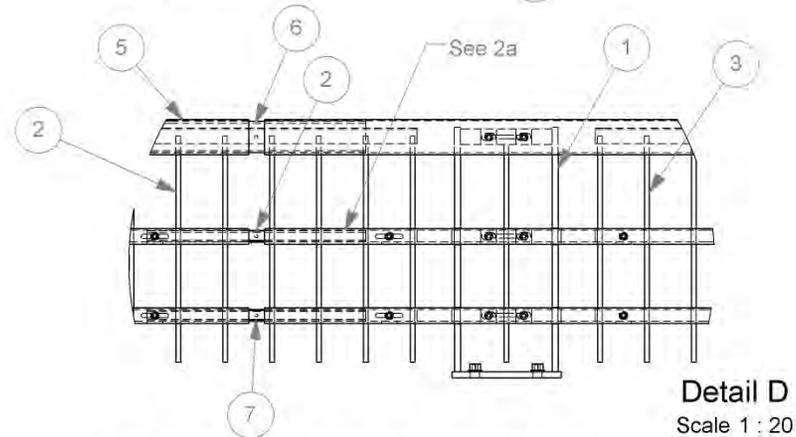
Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4-3 42" Picket Rail 2016-07-20  
Drawn By GES Scale:1:200 Sheet 1 of 14 Test Installation

## Rail Parts List



Rail Parts		
#	Part Name	Qty.
1	Post for 42" Picket Rail	15
2	Picket Rail Panel, with slots	2
3	Picket Rail Panel, with holes	12
4	Rectangular Rail	6
5	Round Rail	3
6	Splice Section for Round Rail	2
7	Splice Section for Rectangular Rail	4
8	U-bolt for Picket Rail	45
9	Plate Washer for U-bolt	90
10	Washer, 1/2 SAE Hardened	168
11	Nut, 1/2 heavy hex	174
12	Bolt, 1/2" x 1 1/2" hex	84
13	Washer, 1/2 Lock	90
14	Washer, 7/8 SAE Hardened	60
15	Nut, 7/8 heavy hex	60



Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4 / 1-2 42" Picket Rail

2016-07-18

Drawn By GES

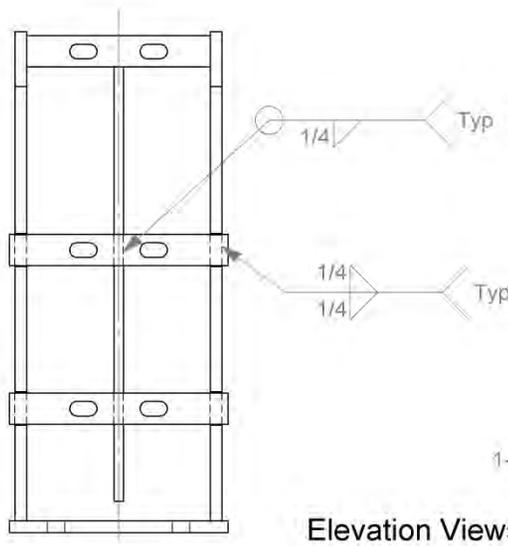
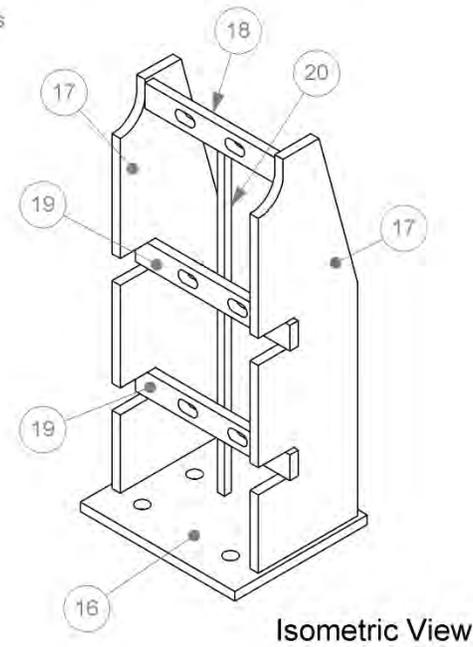
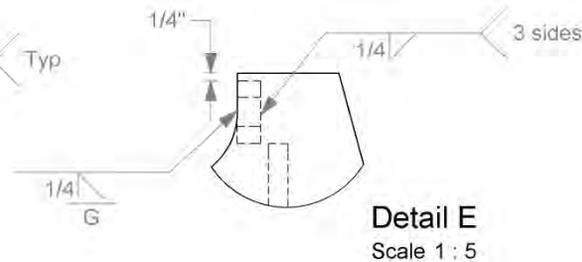
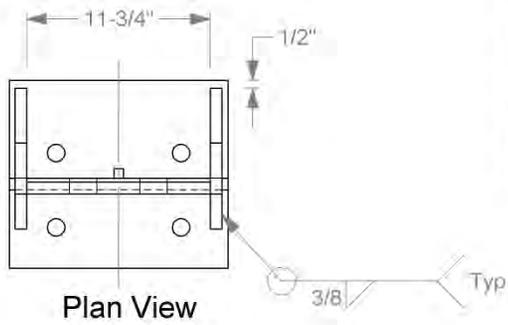
Scale: 1:200

Sheet 2 of 14

Rail Parts List

# Post

Post Parts					
#	Body Name	Description	Length	MATERIAL	Qty
16	Base Plate	Plate, 12" x 3/4"	14"	ASTM A572 Grade 50	1
17	Side Plate	Plate, 9" x 3/4"	31 1/4"	ASTM A572 Grade 50	2
18	Rail Plate, Top	Plate, 2" x 3/4"	11 3/4"	ASTM A36 Steel	1
19	Rail Plate, Bot and Mid	Plate, 2" x 3/4"	14"	ASTM A36 Steel	2
20	Picket	Plate, 5/8" x 5/8"	27 3/4"	ASTM A36 Steel	1

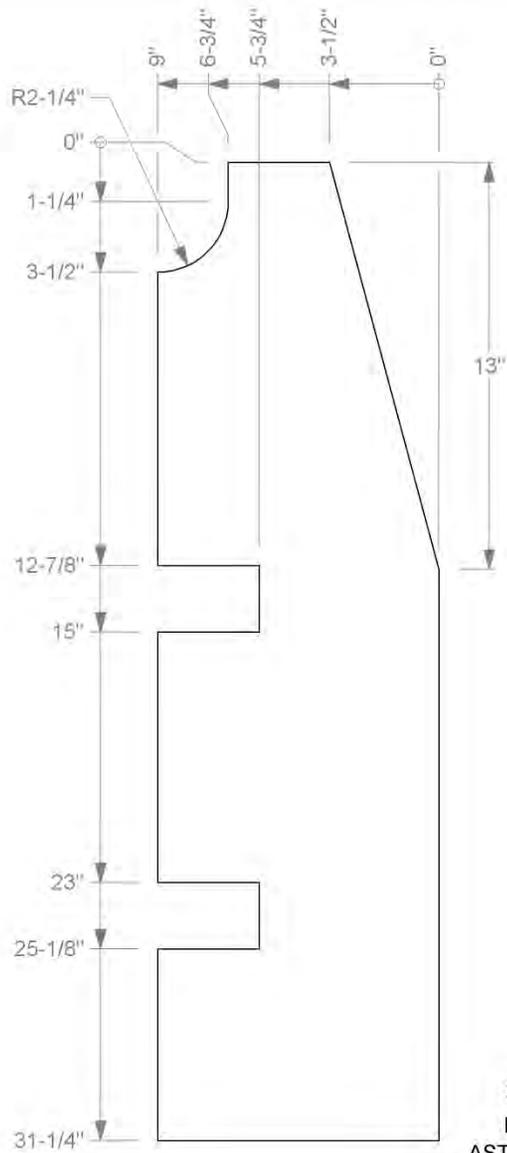


Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4 / 1-2 42" Picket Rail

2016-07-18

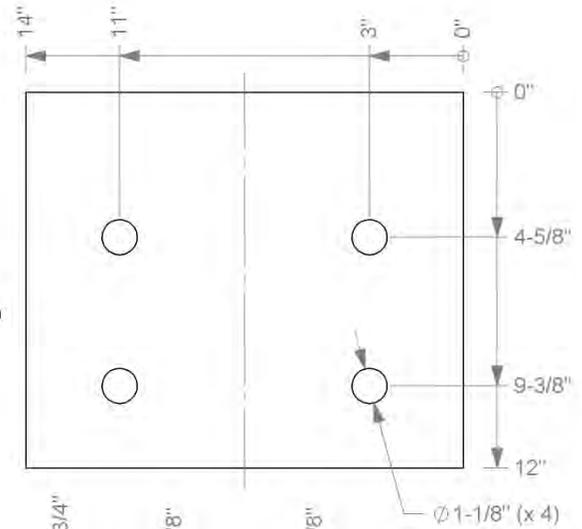
Drawn By GES Scale:1:500 Sheet 3 of 14 Post



**Side Plate**  
Plate, 9" x 3/4"  
ASTM A572 Grade 50

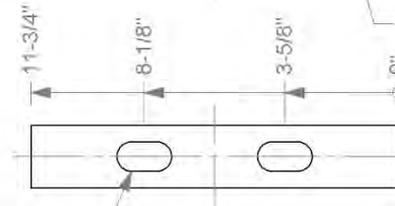
**Post Parts**  
(See Table, previous sheet,  
for Picket details)

**Base Plate**  
Plate, 12" x 3/4"  
ASTM A572 Grade 50

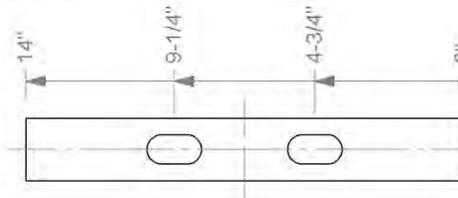


**Rail Plate, Top**  
Plate, 2" x 3/4"  
ASTM A36 Steel

Slots, 15/16" x 1-3/4"  
Typical both Rail Plates



**Rail Plate, Bot and Mid**  
Plate, 2" x 3/4"  
ASTM A36 Steel

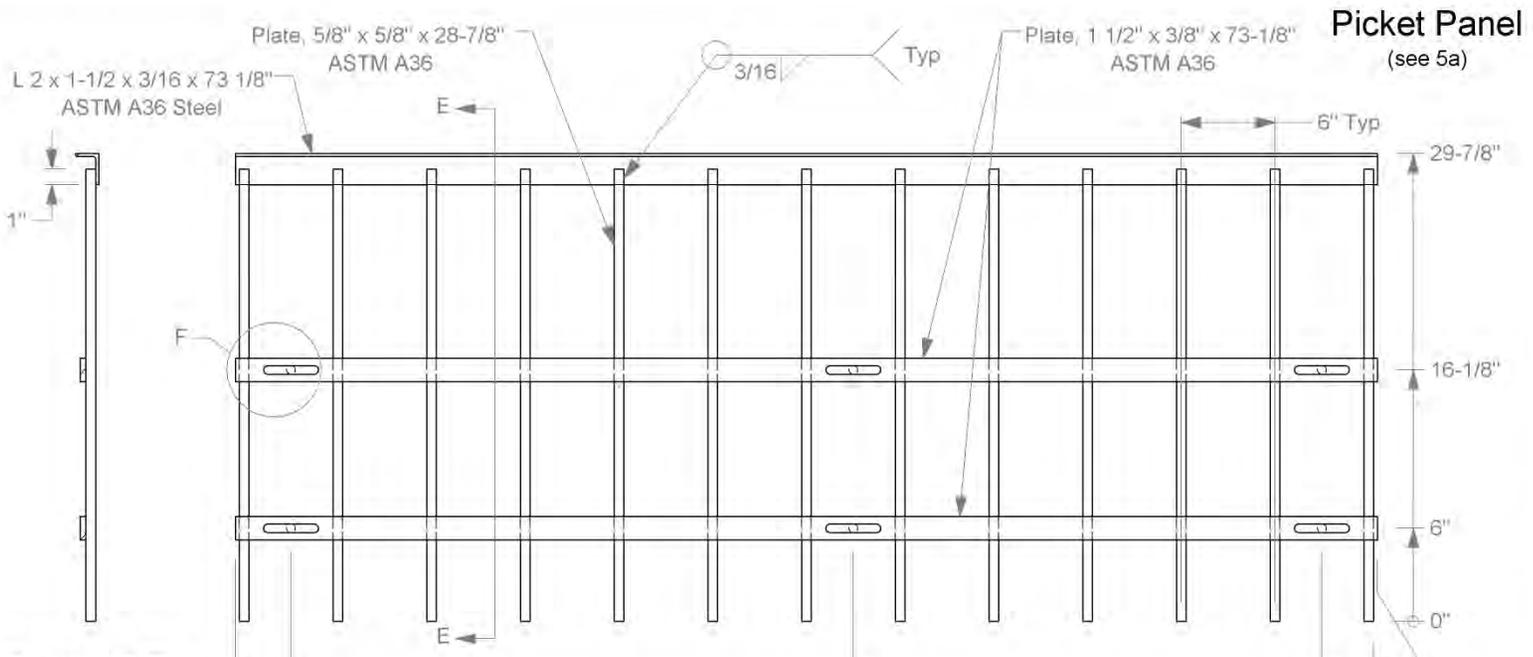


Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4 / 1-2 42" Picket Rail

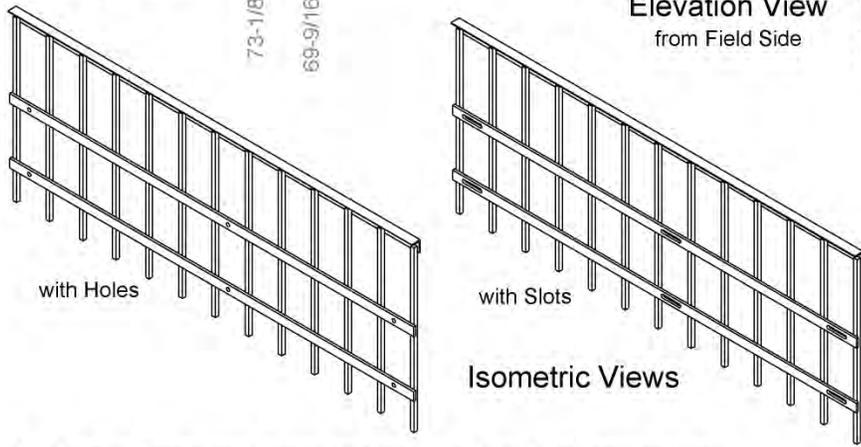
2016-07-18

Drawn By GES Scale 1:5 Sheet 4 of 14 Post Parts



Section E-E

Elevation View from Field Side



5a. Need 18 Panels total, 3 with Slots and 15 with holes at same location.

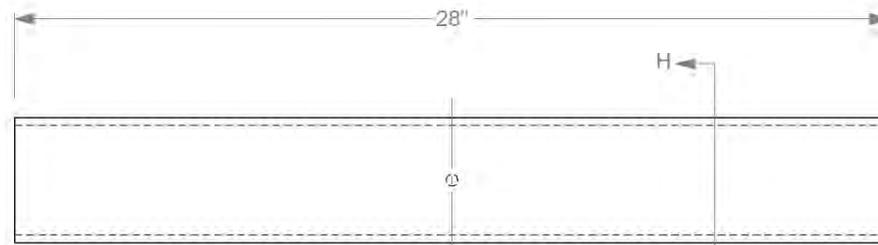
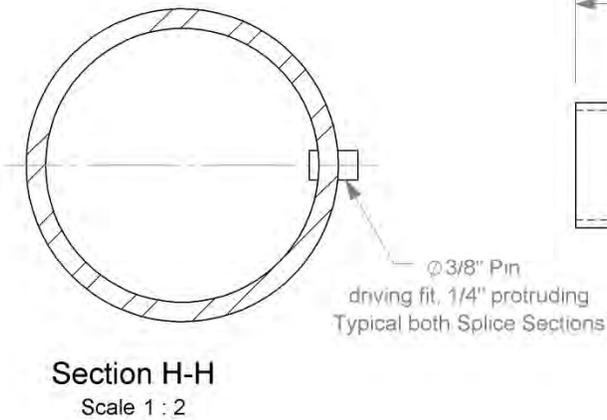
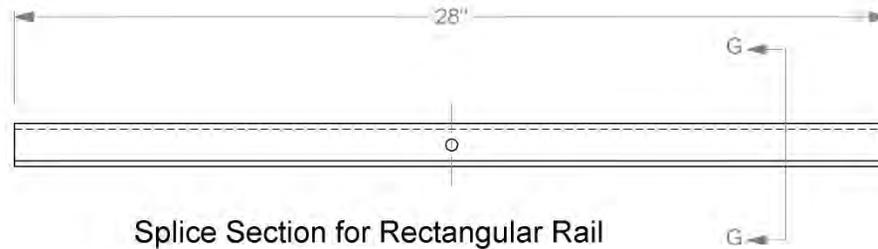
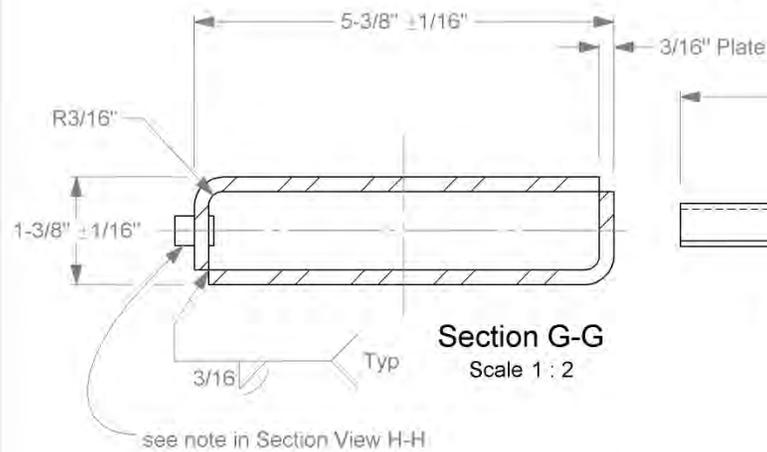


Roadside Safety and Physical Security Division - Proving Ground

Project 490026-4 / 1-2 42" Picket Rail 2016-07-18  
 Drawn By GES Scale 1:10 Sheet 5 of 14 Picket Panel

T:\11-ProjectFiles\490026-TxDOT\4 - 42 inch Picket Rail - Williams\4-2 Drafting\490026-4-2 Drawing

## Splice Sections



**6a.** Check Splice Sleeve for Rectangular Rail for loose fit in Rectangular Rail after fabrication is completed.



Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4 / 1-2 42" Picket Rail

2016-07-18

Drawn By GES

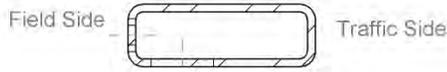
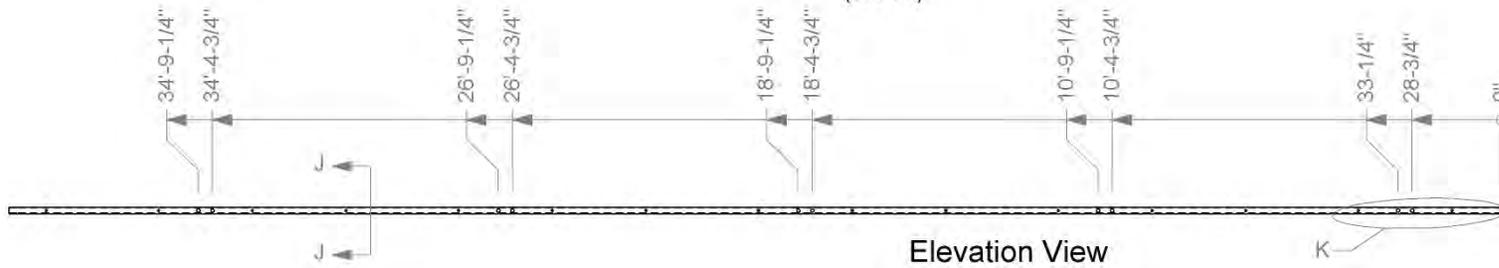
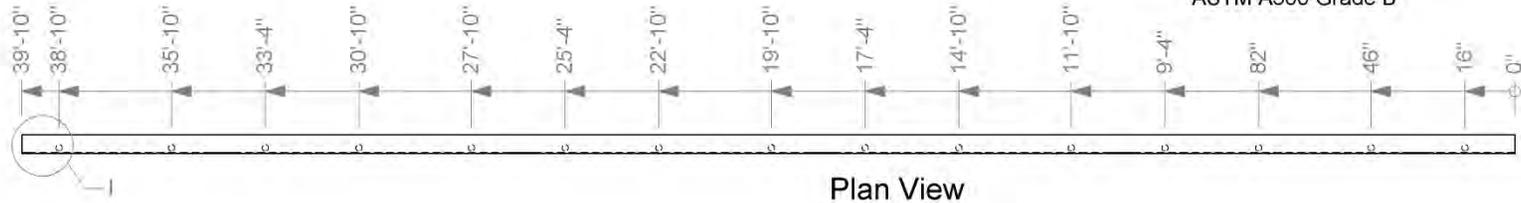
Scale 1:5

Sheet 6 of 14

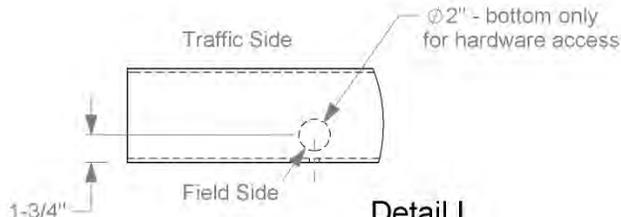
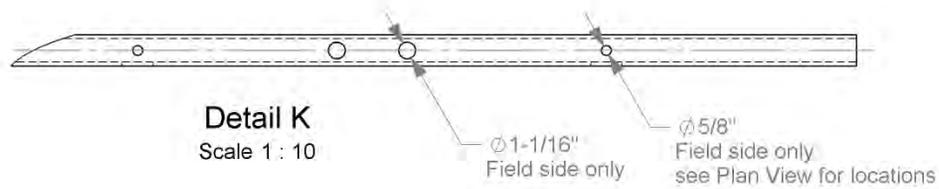
Splice Sections

# Rectangular Rail

HSS 6" x 2" x 1/4"  
ASTM A500 Grade B



**Section J-J**  
Scale 1 : 5



**Detail I**  
Scale 1 : 10

**7a.** Please note that the Plan View and Detail I are showing the Rail from the top. The holes are on bottom.



Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4 / 1-2 42" Picket Rail

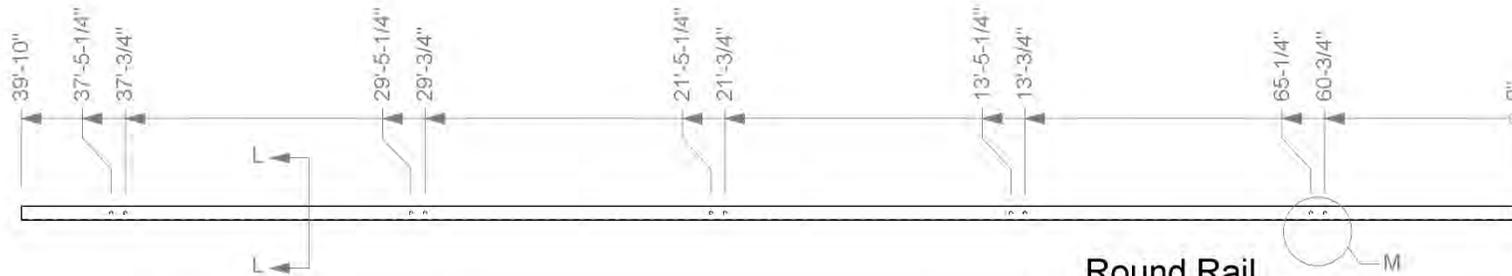
2016-07-18

Drawn By GES

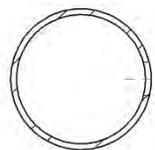
Scale 1:50

Sheet 7 of 14

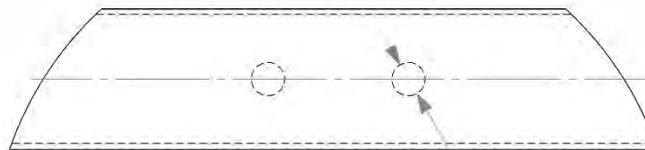
Rectangular Rail



**Round Rail**  
 HSS Round 4 1/2" x 3/16"  
 ASTM A500 Grade B  
 Elevation View

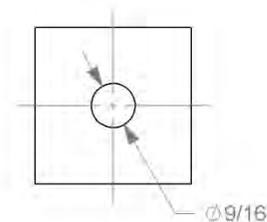


**Section L-L**  
 Scale 1 : 5

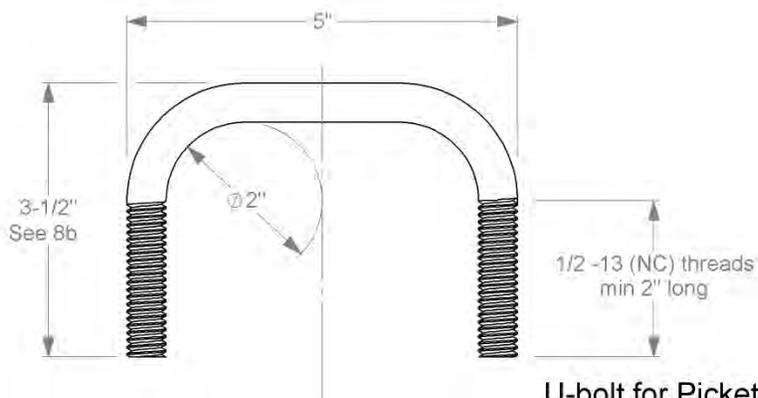


**Detail M**  
 Scale 1 : 5

Ø 1-1/16"  
 Field side only



**Plate Washer for U-bolt**  
 Plate, 2" x 5/16" x 2"  
 ASTM A36 Steel  
 Scale 1:2



**U-bolt for Picket Rail**  
 Ø 1/2" ASTM A36 Steel  
 Scale 1:2

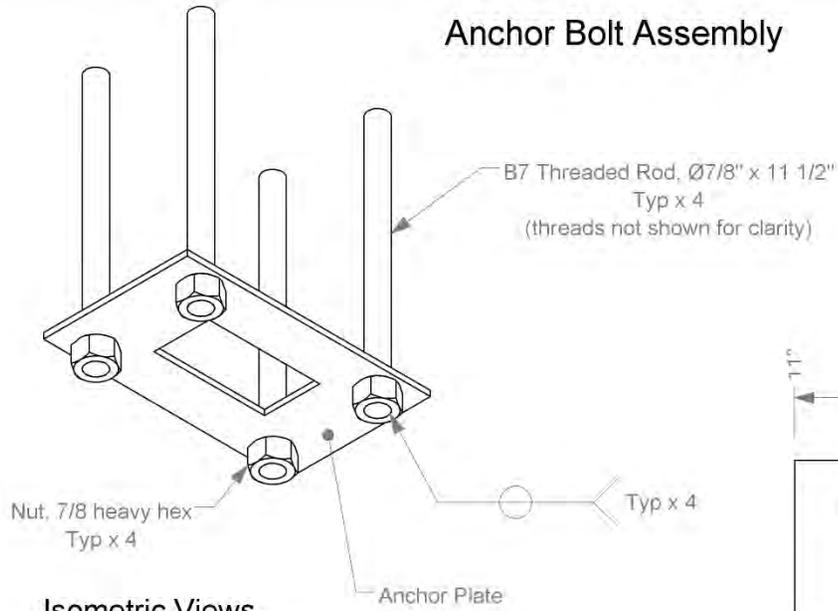
8a. Dimension is approximate. Rod is 10" long before bending.



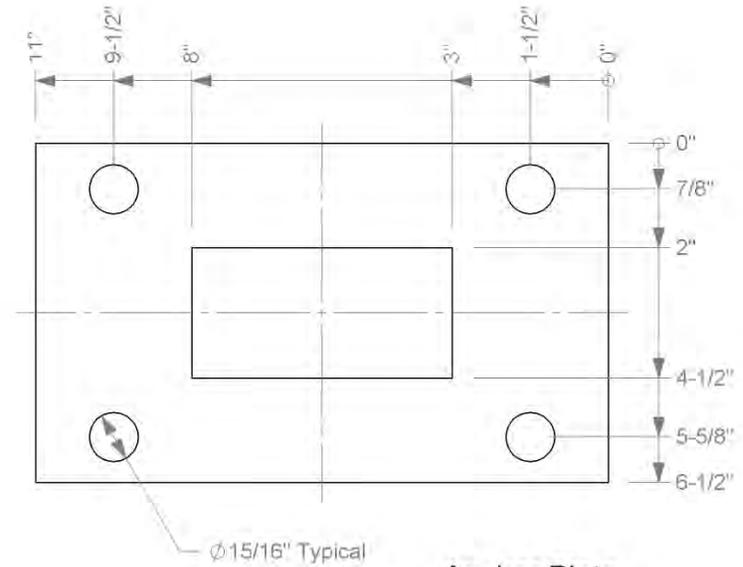
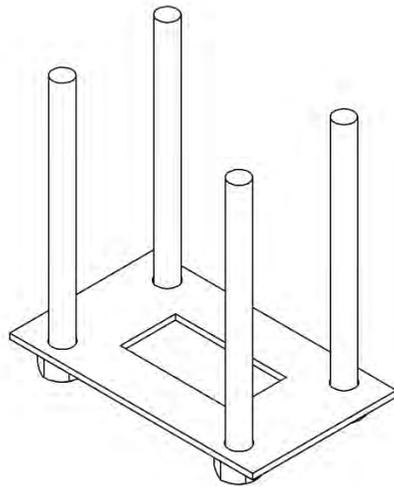
Roadside Safety and  
 Physical Security Division -  
 Proving Ground

Project 490026-4 / 1-2 42" Picket Rail 2016-07-18  
 Drawn By GES Scale 1:50 Sheet 8 of 14 Round Rail, etc.

# Anchor Bolt Assembly



## Isometric Views



**Anchor Plate**  
Plate, 6 1/2" x 1/4" x 11"  
ASTM A36 Steel

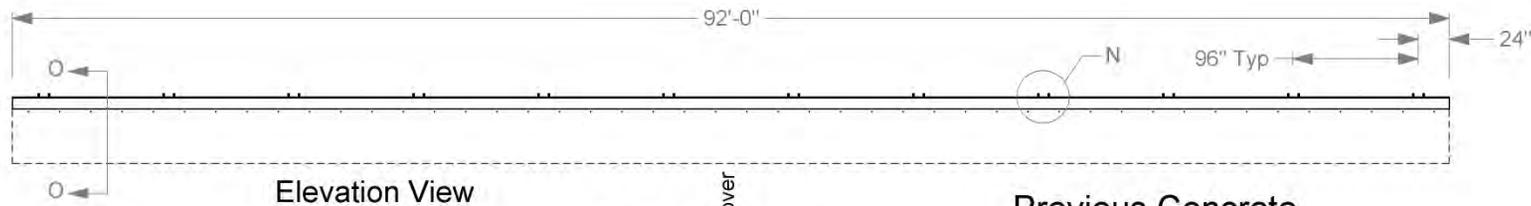


Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4 / 1-2 42" Picket Rail

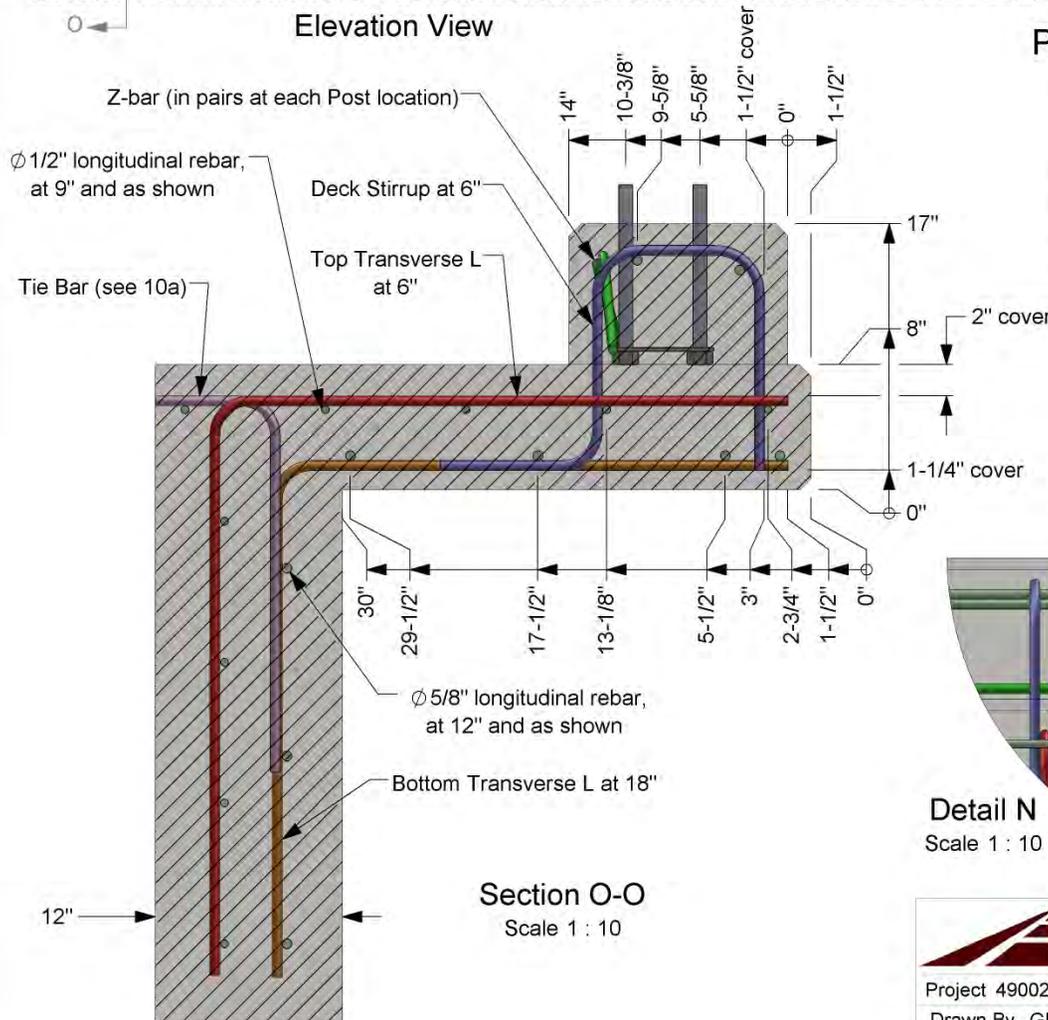
2016-07-18

Drawn By GES Scale 1:3 Sheet 9 of 14 Anchor Bolt Assembly



Elevation View

Previous Concrete

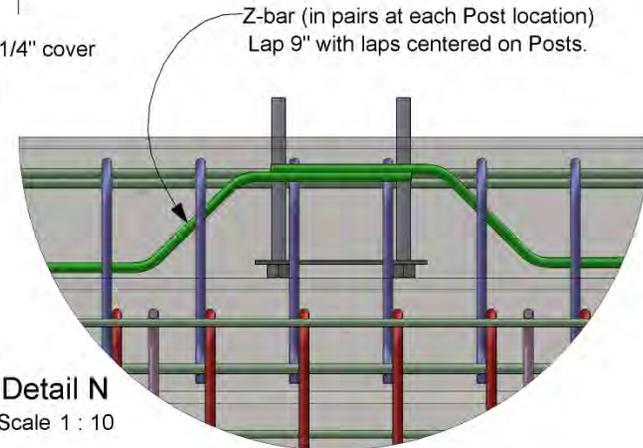


Section O-O  
Scale 1 : 10

**10a.** Tie Bars spaced at 24", and welded to existing rebar protruding from the runway (not shown here).

**10b.** All Rebar is grade 60. Minimum lap distance is 17" for Ø1/2" bars and 21" for Ø5/8" bars.

**10c.** Concrete is TxDOT Class S (4000 psi). Chamfer edges of Deck and Curb 3/4" as shown.



Detail N  
Scale 1 : 10



Roadside Safety and Physical Security Division - Proving Ground

Project 490026-4 / 1-2 42" Picket Rail

2016-07-18

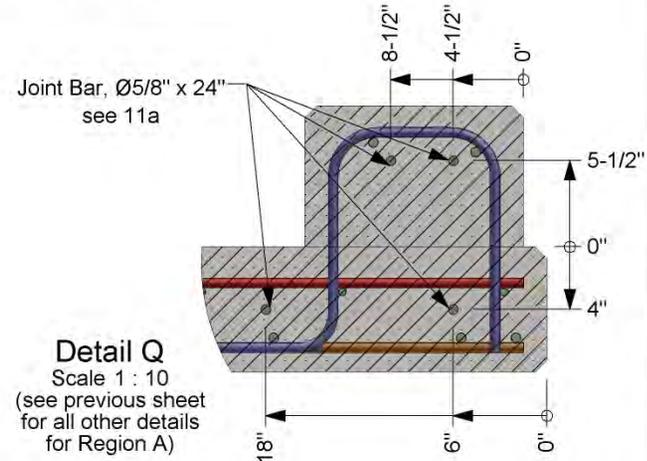
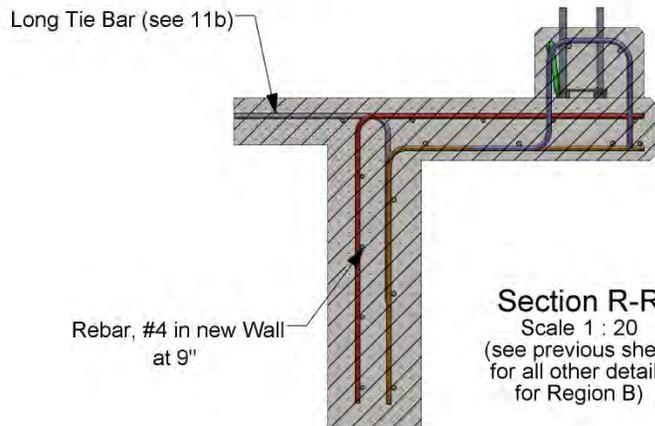
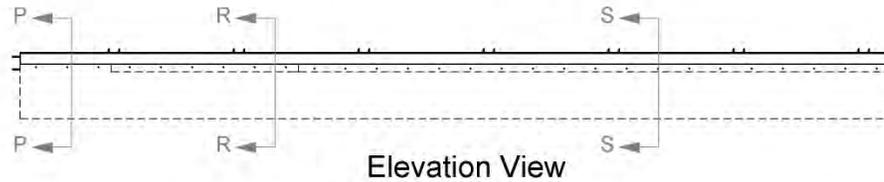
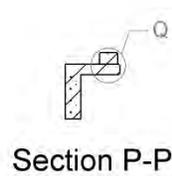
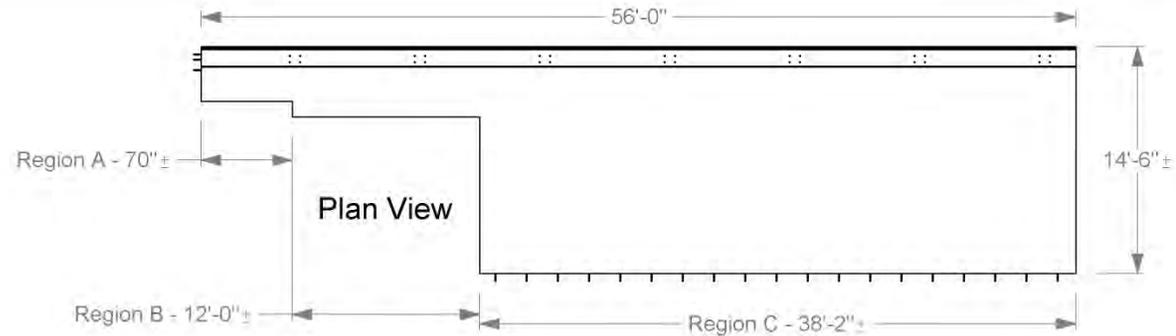
Drawn By GES

Scale: 1:120

Sheet 10 of 14

Previous Concrete

**New Concrete**



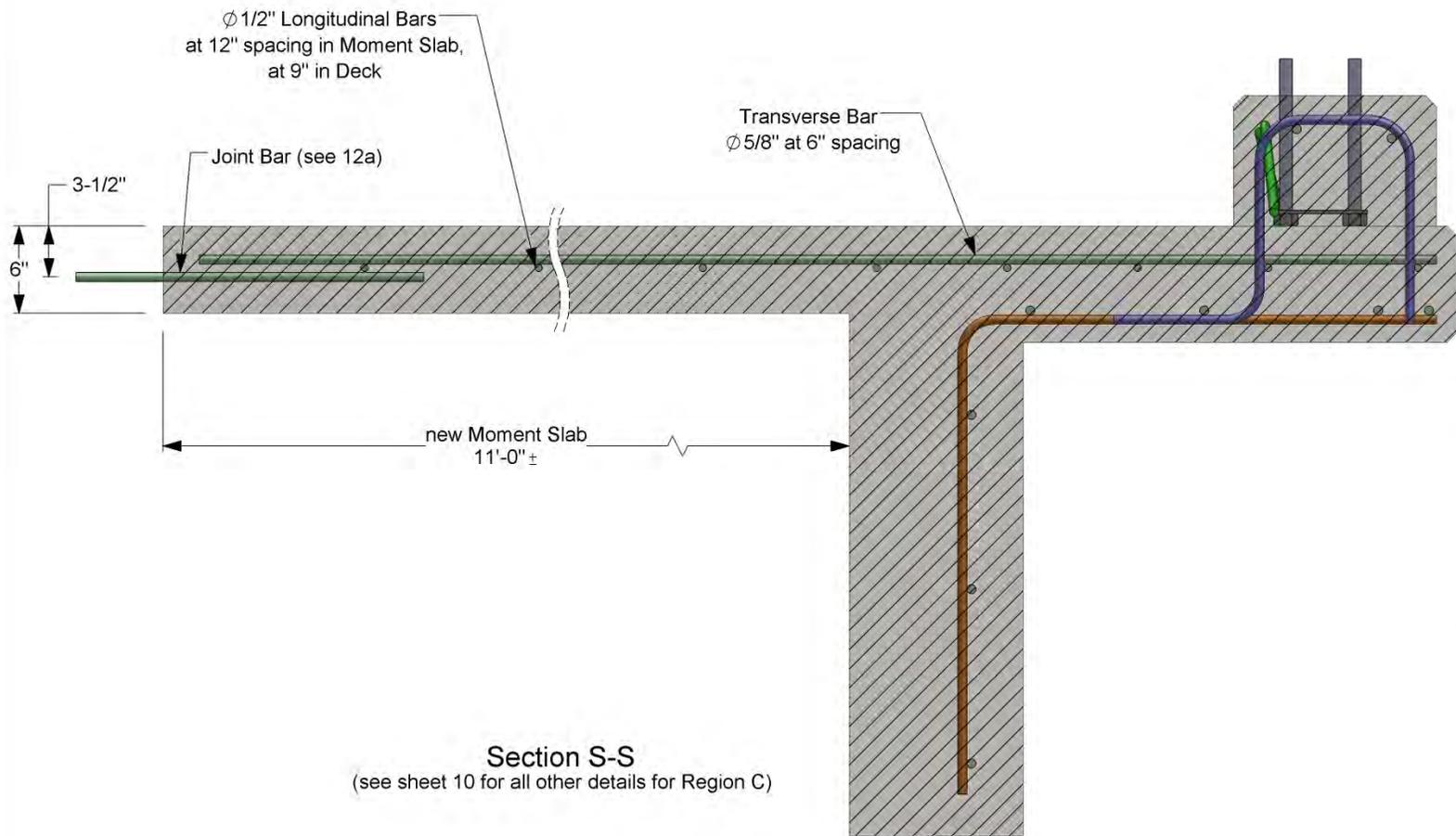
**11a.** Drill minimum 6" into existing concrete and secure Joint Bars with Hilti RE-500 epoxy, according to manufacturer's instructions.

**11b.** Long Tie Bars spaced at 24" and welded to existing rebar protruding from the runway (not shown here).



Roadside Safety and Physical Security Division - Proving Ground

Project 490026-4 / 1-2	42" Picket Rail	2016-07-18
Drawn By GES	Scale: 1:20	Sheet 11 of 14 New Concrete



**12a.** Drill minimum 6" into existing concrete and secure Joint Bars with Hilti RE-500 epoxy, according to manufacturer's instructions. Space at 24".

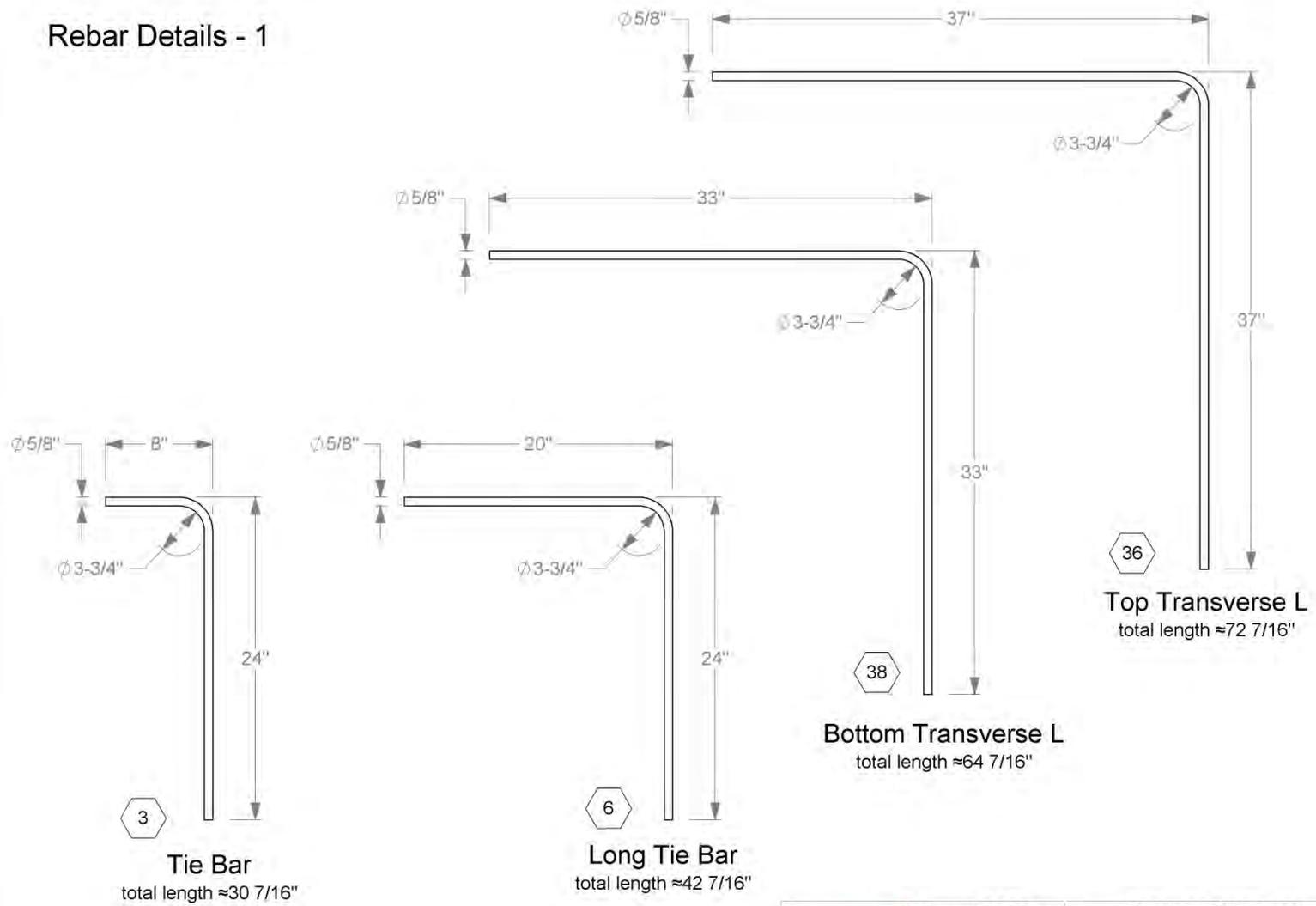


Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4 / 1-2	42" Picket Rail	2016-07-18
Drawn By GES	Scale 1:10	Sheet 12 of 14 Section View

T:\11-ProjectFiles\490026-TxDOT\4 - 42 inch Picket Rail - Williams\4-2 Drafting\490026-4-2 Drawing

# Rebar Details - 1



13a. The numeral in the hexagon denotes the quantity needed for each Bar.



Roadside Safety and Physical Security Division - Proving Ground

Project 490026-4 / 1-2 42" Picket Rail

2016-07-18

Drawn By GES

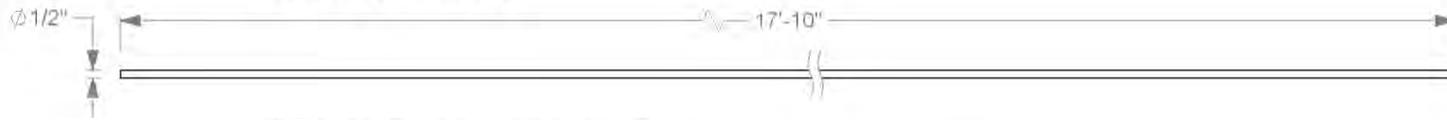
Scale 1:10

Sheet 13 of 14

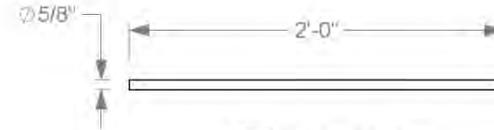
Rebar Details - 1

T:\11-ProjectFiles\490026-TxDOT\4 - 42 inch Picket Rail - Williams\4-2 Drafting\490026-4-2 Drawing

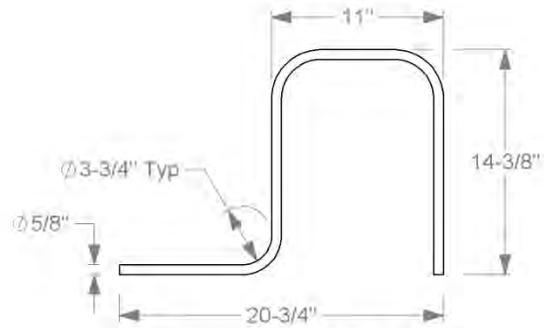
## Rebar Details - 2



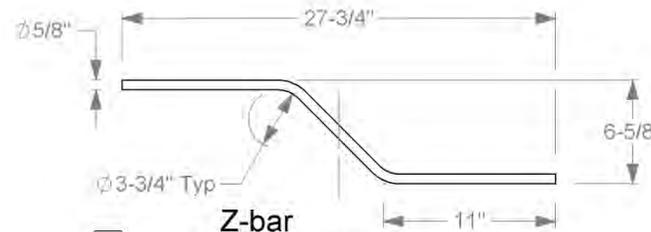
4 Rebar, #4 in new Wall



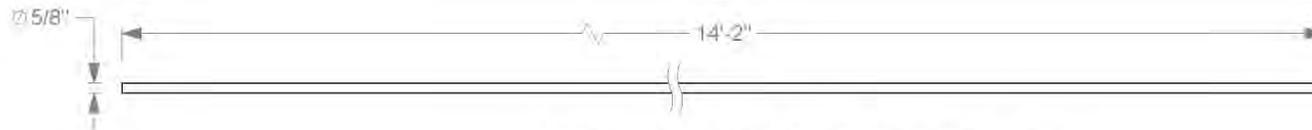
19 Joint Bar



112 Deck Stirrup  
total length  $\approx 44 \frac{7}{8}$ "



14 Z-bar  
total length  $\approx 30 \frac{1}{16}$ "



76 Moment Slab Transverse Bar

14a. The numeral in the hexagon denotes the quantity needed for each Bar.



Roadside Safety and  
Physical Security Division -  
Proving Ground

Project 490026-4 / 1-2 42" Picket Rail

2016-07-18

Drawn By GES Scale 1:10 Sheet 14 of 14 Rebar Details - 2