

**WYOMING DEPARTMENT OF TRANSPORTATION**  
**QUARTERLY PROGRESS REPORT**

**Project title:** Pooled Fund for the Development of Approach Guardrail Transitions for Box Beam and MGS

**Project Number:** TPF-5(393)

**Progress period:** 2/1/2021 – 04/30/2021

**Principal Investigator and all others who have worked on the project (provide name and ORCID number):** Roger Bligh (#0000-0001-5699-070X), Nauman Sheikh (#0000-0003-1718-4881), Nathan Schulz (#0000-0002-7527-9419), James Kovar (#0000-0002-1542-7010)

**1. Please state whether the project is ahead of schedule, on time, or behind schedule:**

The construction process has taken longer than anticipated due to delays in the state procurement process and material lead times required by the selected contractor. Material prices have escalated dramatically, and additional efforts were required to procure materials and construction services within project resources. Additionally, some tolerance issues were identified on the transition connection plates that required modification. This has created a need for the plates to be refabricated after review and approval by WyDOT. The combined construction delays have delayed the full-scale crash testing by 3 months. The research team will attempt to make up some of the lost time during the reporting process. However, the report cannot be finished until all testing has been completed.

**2. Percentage of overall work completed.**

60%

**3. Activities and Accomplishments:**

**a. What are the major goals and objectives of the project?**

The research objective is to develop two non-proprietary approach guardrail transition systems from box beam and MGS guardrail that are MASH Test Level 3 (TL-3) compliant. The transitions are being designed to connect the guardrail systems to the Texas Department of Transportation (TxDOT) Type C2P TL-4 bridge rail system. Direct connection between the transition section and bridge rail is desired to avoid use of a solid concrete parapet end that could hinder snow clearing operations. The work plan for the project is divided into seven tasks. These include:

Task 1: Engineering Design and Drawing Development

Task 2: Finite Element Modeling & Simulation

Task 3: Test Installation Construction

Task 4: Crash Testing of the Box Beam Transition

Task 5: Crash Testing of the MGS Transition

Task 6: Final Report

Task 7: FHWA Eligibility Letter

**b. Describe what was accomplished under these goals.**

**Task 1: Engineering Design and Drawing Development (previously completed)**

**Task 2: Finite Element Modeling & Simulation (previously completed)**

**Task 3: Test Installation Construction (ongoing)**

Work on Task 3 continued during the reporting period. The construction process has taken longer than anticipated due to delays in the state procurement process, material lead times required by the selected contractor, and a redesign of the transition connection plates that was required to provide needed construction tolerance.

The position of the transition connection plate was constrained by the C2P rail elements on the upstream end and the C2P post on the downstream end. There was no construction tolerance for small deviations in post placement. To incorporate reasonable field tolerance, some design changes to the transition connection plate are recommended. Note that these changes relate to the method in which the transition connection plate is attached to the C2P bridge rail and do not affect the shape or outward appearance of the initial design that was previously approved.

Rather than bolting tabs on the plate to the downstream flange of the first C2P post, angles are welded to the field side of the plate and the horizontal legs of the angles are bolted through the tubular rail elements. Slots in the angles provide tolerance for small differences in post placement due to anchor bolt position. Bent tabs on the downstream end of the plate are still present to mitigate snagging from the reverse direction, but the portion of the tabs that bolted to the C2P post is removed to provide the needed longitudinal tolerance for post placement, which is defined by the anchor bolts cast into the concrete curb. Revised drawings showing changes to the connection plate on the MGS transition are attached in Appendix A. Similar changes are proposed for the connection plate for the box beam transition.

The simulated bridge deck and curb for the C2P bridge rail system has been completed. Parts required for installation of the box beam transition, box beam approach guardrail, and box beam terminals have been received. Parts for the MGS transition, MGS approach guardrail, and terminal anchorage have also been received. The tolerance issue with the connection plates was identified during the construction process.

**Task 4: Crash Testing of the Box Beam Transition (ongoing)**

The test installation drawings and test plan for evaluation of the box beam transition were previously submitted and approved. Revisions to the transition connection plate are recommended to provide needed in-field construction tolerance. The modified drawings are

being resubmitted to WyDOT for review and approval. If approved, the transition connection plates will be refabricated. The testing program will then be executed after completion of construction under Task 3.

#### **Task 5: Crash Testing of the MGS Transition (ongoing)**

The test installation drawings and test plan for the MGS transition were previously submitted and approved. Revisions to the transition connection plate are recommended to provide needed in-field construction tolerance. The modified drawings are being resubmitted to WyDOT for review and approval. If approved, the transition connection plates will be refabricated. The testing program will then be executed after completion of Task 4.

- c. What opportunities for training and professional development has the project provided? If the research is not intended to provide training and professional development, state “Nothing to Report”. Otherwise, describe opportunities for training and professional development, training activities, and professional development.**

Nothing to report.

- d. How have the results been disseminated to communities of interest? Describe what results have been disseminated and in what manner, including publications, conference papers, and presentation. Please list ALL derivative reports/publications which were generated from this project, and provide an electronic copy of the report/publication.**

Nothing to report.

- e. What do you plan to do during the next reporting period to accomplish the goals and objectives? Describe briefly what you plan to do during the next reporting period to accomplish the goals and objectives.**

Work on Task 3 will be completed. This includes completion of construction of the simulated bridge rail system, box beam transition system, and MGS transition system. The box beam and MGS transition systems are being installed on opposite ends of the C2P bridge rail system.

Crash testing of the box beam transition will be completed under Task 4. *MASH* Test 3-20 and Test 3-21 will be performed on both the downstream and upstream ends of the box beam transition system. The downstream end is where the transition attaches to the C2P bridge rail. The upstream end is where the box beam approach guardrail attaches to the transition. Test 3-20 involves a 2,420-lb passenger car impacting the transition at a nominal speed and angle of 62 mi/h and 25 degrees. Test 3-21 involves a 5,000-lb pickup truck impacting the transition at the same nominal impact conditions.

Finite element impact simulations were used to determine the critical impact point for each test. On the downstream end of the box beam transition, the CIPs for *MASH* Test 3-20 and Test 3-21 were determined to be 36 inches and 60 inches upstream from the end of the bridge rail curb,

respectively. On the upstream end of the box beam transition, the CIPs for *MASH* Test 3-20 and Test 3-21 were determined to be 8 ft and 12.25 ft upstream of the end of the lower rubrail element, respectively.

The tests dates for evaluation of the box beam transition system have been adjusted to account for the construction delays. The anticipated test dates are as follows:

- June 1 – Test 3-20 on downstream end of box beam transition
- June 14 – Test 3-21 on downstream end of box beam transition
- June 18 – Test 3-20 on upstream end of box beam transition
- July 6 – Test 3-21 on upstream end of box beam transition

Time is included between tests to permit for repair of both the C2P bridge rail, box beam transition system, and box beam guardrail as needed.

After completion of the testing of the box beam transition, the MGS transition system will be installed. Crash testing of the MGS transition will then be completed under Task 5. The test plan for the MGS transition includes *MASH* Test 3-20 and Test 3-21 on the downstream end of the transition system where it attaches to the C2P bridge rail. Based on the Task 2 simulation analyses, the CIPs for *MASH* Test 3-20 and Test 3-21 were determined to be 76 inches and 84 inches upstream from the upstream flange of the first C2P bridge rail post.

The upstream end of the MGS transition will not be evaluated because it is similar in design to a system that was already crash tested and determined to be *MASH* compliant. The tentative tests dates selected for evaluation of the MGS transition system are as follows:

- July 9 – Test 3-20 on downstream end of MGS transition
- July 27 – Test 3-21 on downstream end of MGS transition

Time is included between tests to permit for repair of both the C2P bridge rail and MGS transition system as needed. Note that the order of testing may be shifted to expedite overall completion of the testing program.

Work on the final report will be initiated under Task 6.

**f. List any products resulting from the project during the reporting period. Include in this list:**

1. Publications, conference papers, and presentations.
2. Website(s) or other internet sites (List the URL).
3. Technologies or techniques.
4. Inventions, patent applications, and/or licenses.
5. Other products, such as data or databases, physical collections, audio or video products, software or NetWare, models, educational aids or curricula, instruments or equipment.

Nothing to report.

**g. Impact:**

1. How will this project impact WYDOT?
2. How will this project impact other agencies?

WYDOT's Mission Statement is to "provide a safe, high quality and efficient transportation system." One of the goals within the mission statement is to "improve safety on the state transportation system." Successful implementation of the transitions developed under this project into WYDOT's standard plans will provide an improved level of safety. The transitions will provide continuity of motorist safety from MASH guardrail systems to MASH bridge rail systems. Full implementation of MASH compliant roadside safety devices, including transition systems, will provide an enhanced level of safety that will help reduce the severity of lane departure crashes that represent over 75% of highway fatalities in Wyoming. Additionally, the AASHTO/FHWA MASH Implementation Agreement requires state DOTs to provide MASH compliant roadside safety features to obtain federal funding reimbursement on projects. The results of this research will be useful to other agencies. This project is being funded as a pooled fund effort between WYDOT and Montana DOT. It will provide transition details that will be immediately implementable by both of these agencies as well as other agencies that use similar guardrail and bridge rail systems.

**h. Changes to Scope of Work. Provide the following changes, if applicable:**

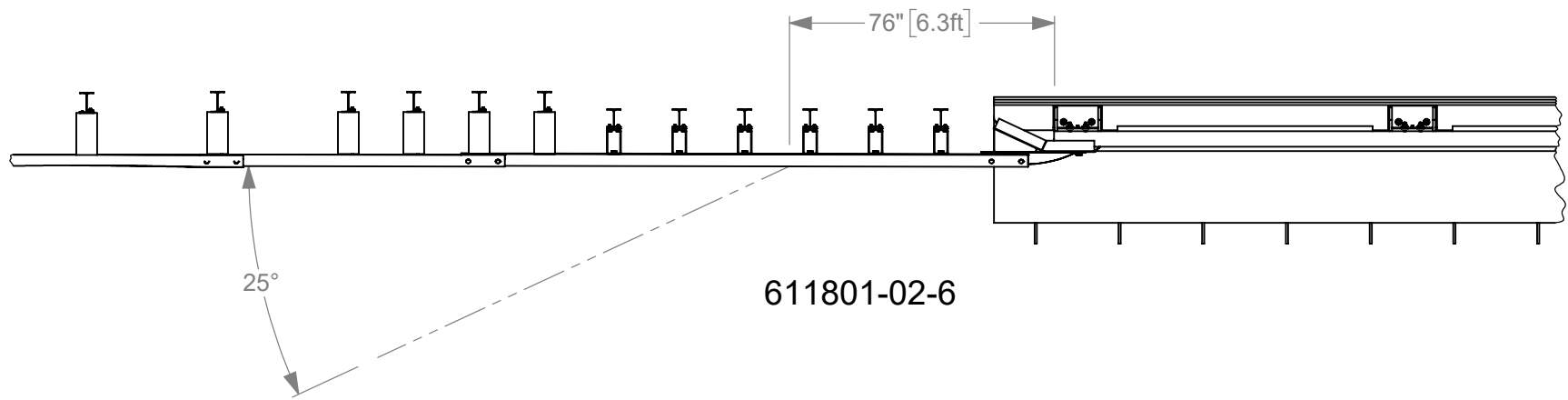
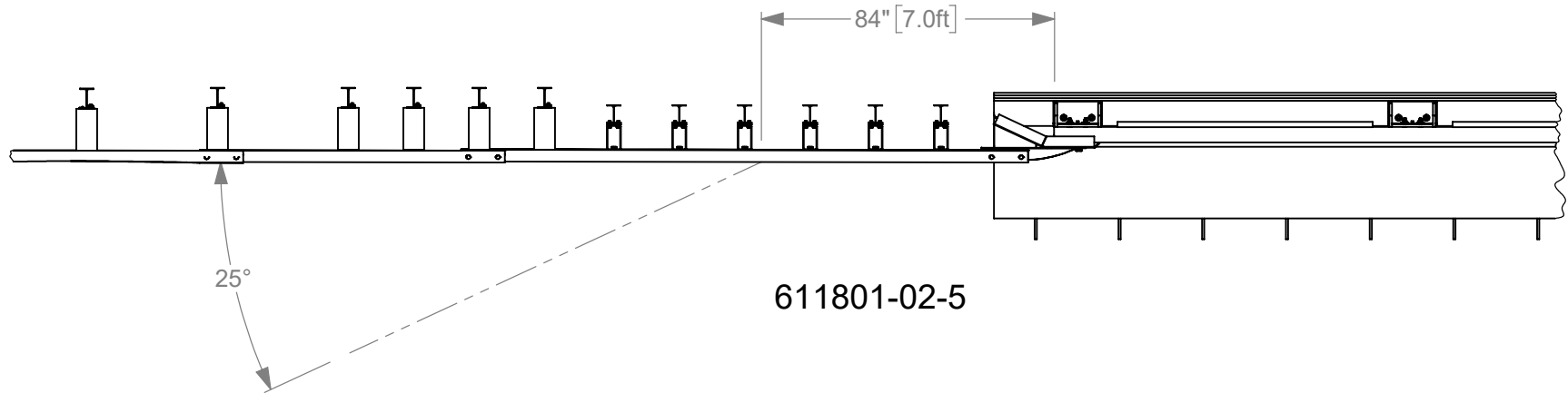
1. Scope of work or objectives of the project.
2. Changes in key persons.
3. Disengagement from the project for more than three (3) months, or a twenty five (25) percent reduction in time devoted to the project.
4. The inclusion of costs that require prior approval.
5. The transfer of funds between line items in the budget.
6. The subawarding, transferring or contracting of work.
7. Changes in the approved cost-sharing or match.

At the request of Wyoming DOT, a modification to the current project agreement was prepared and submitted. The modification adds additional tasks to the project scope. These additional tasks relate to the development and testing of a box beam transition to concrete parapet. The modification includes additional scope, time, and budget for the proposed work. The documents were submitted to WyDOT on January 25, 2021. The researchers are awaiting approval of the modified agreement to begin work on the new transition system.

## **APPENDIX A**

### **MGS Transition Test Installation Drawings with Modified Transition Connection Plate**

# Impacts



Roadside Safety and  
Physical Security Division -  
Proving Ground

Project #611801 5-6 Wyoming MGS Transition

2021-05-07

Drawn by GES\WS

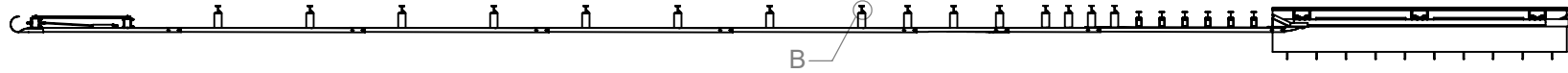
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Sheet 1 of 20 Impacts

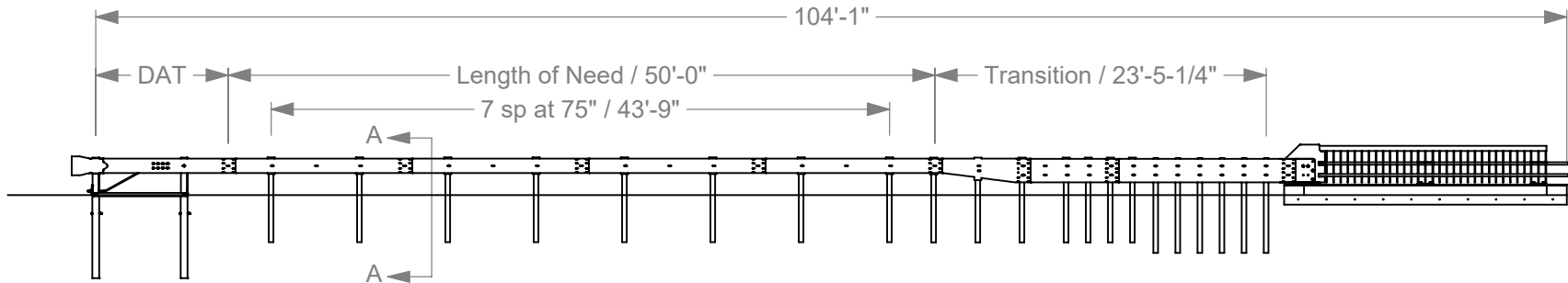
# Test Installation

Post Numbers

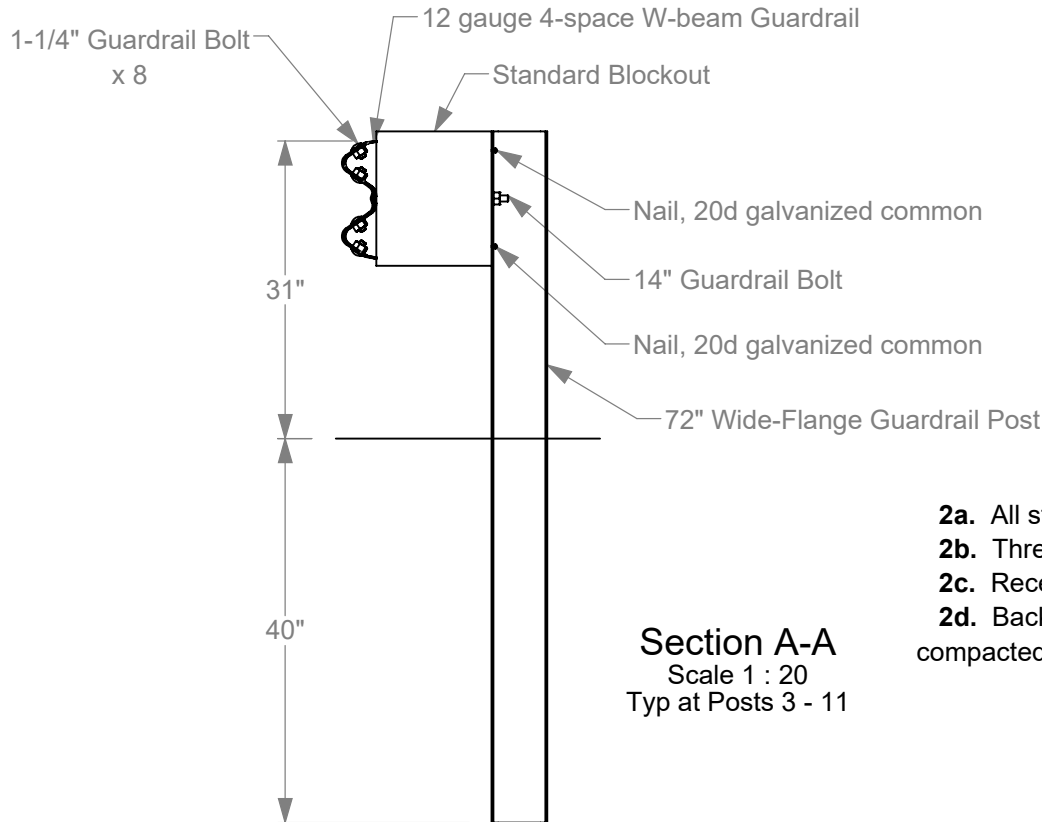
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Plan View

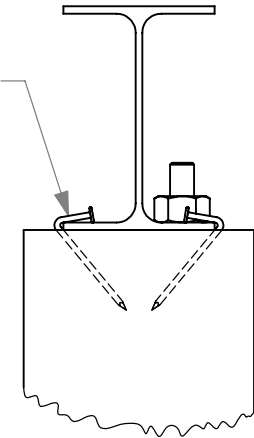


Elevation View



Section A-A  
Scale 1 : 20  
Typ at Posts 3 - 11

Nail, 20d galvanized common  
Clinch over flange as shown,  
4 places at Posts 3 - 12



Detail B  
Scale 1 : 5

- 2a. All steel components, including fasteners, shall be galvanized.
- 2b. Threads not shown on Bolts for clarity.
- 2c. Recessed Guardrail Nut on all Guardrail Bolts.
- 2d. Backfill Post holes with Type B grade 2 crushed limestone road base, compacted according to TTI Proving Ground Work Instruction WI-C001.



Roadside Safety and  
Physical Security Division -  
Proving Ground

Project #611801 5-6 Wyoming MGS Transition

2021-05-07

Drawn by GES\WS

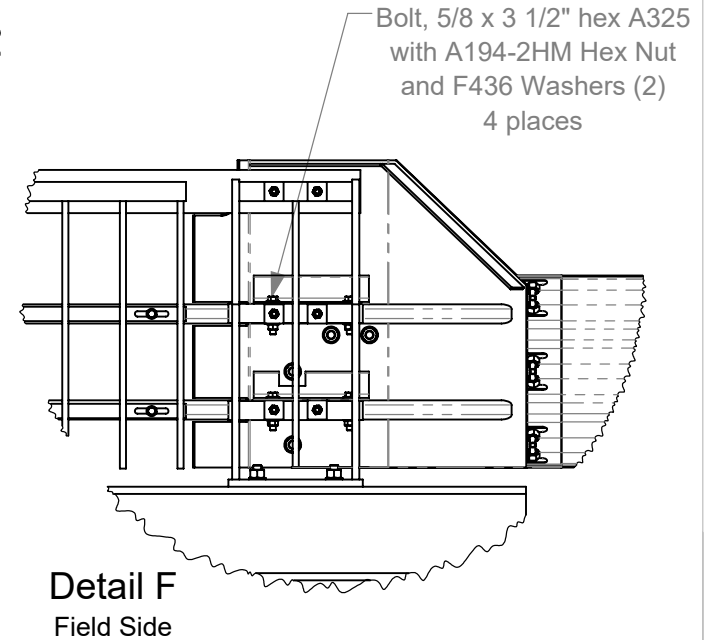
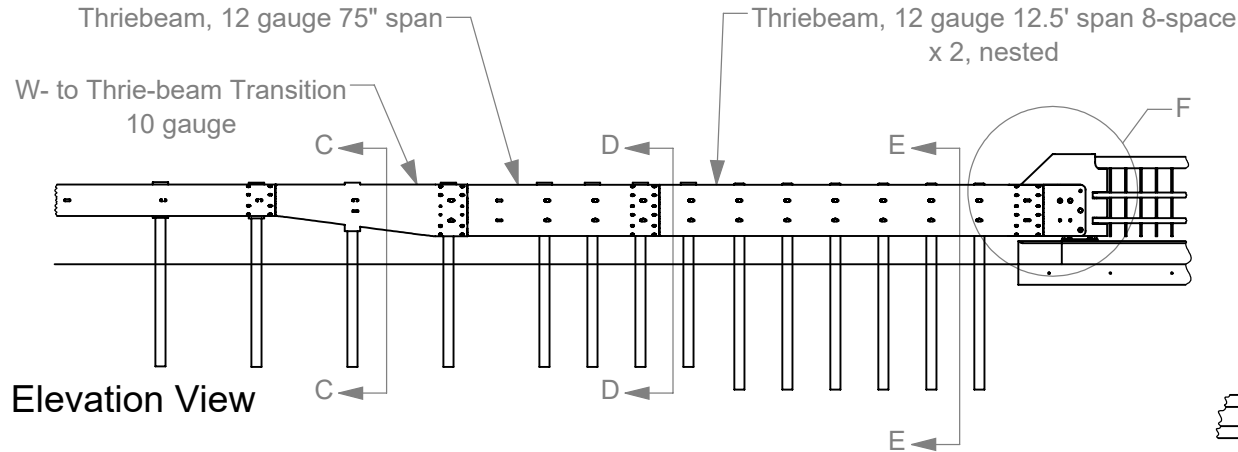
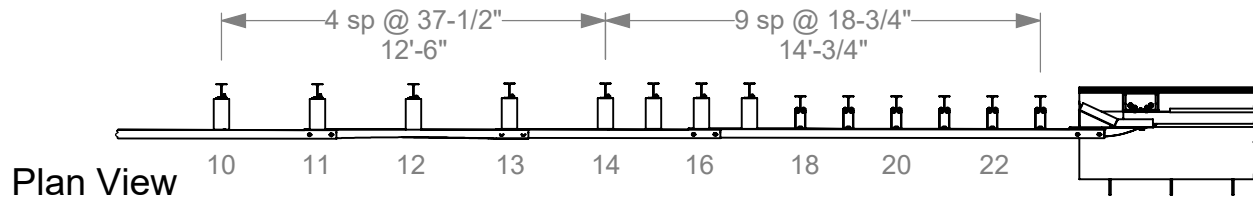
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Sheet 2 of 20 Test Installation

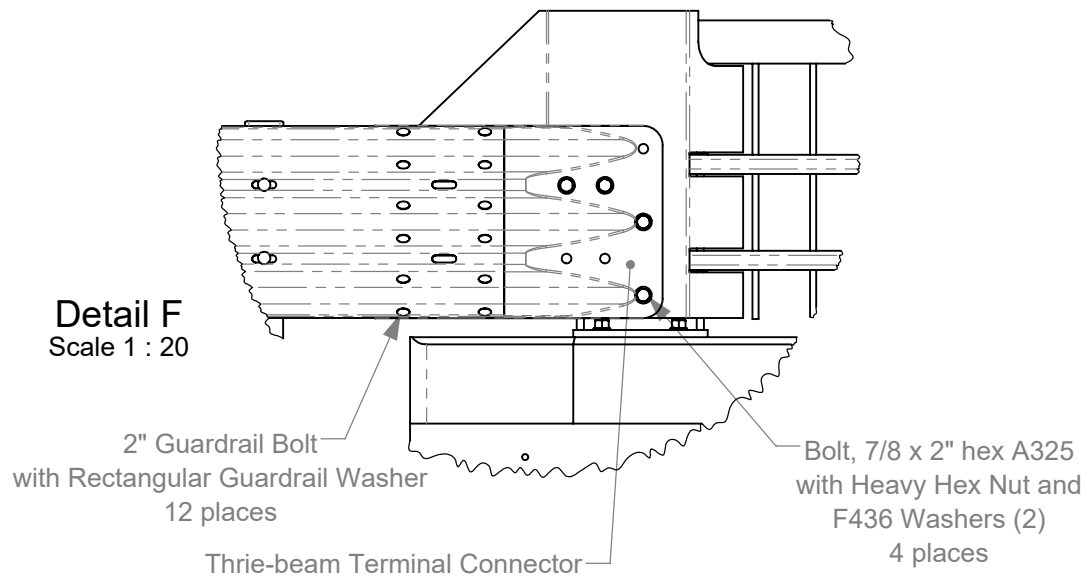


# Transition Details

Section views on next sheet



Detail F  
Scale 1 : 20



Roadside Safety and Physical Security Division - Proving Ground

Project #611801 5-6 Wyoming MGS Transition

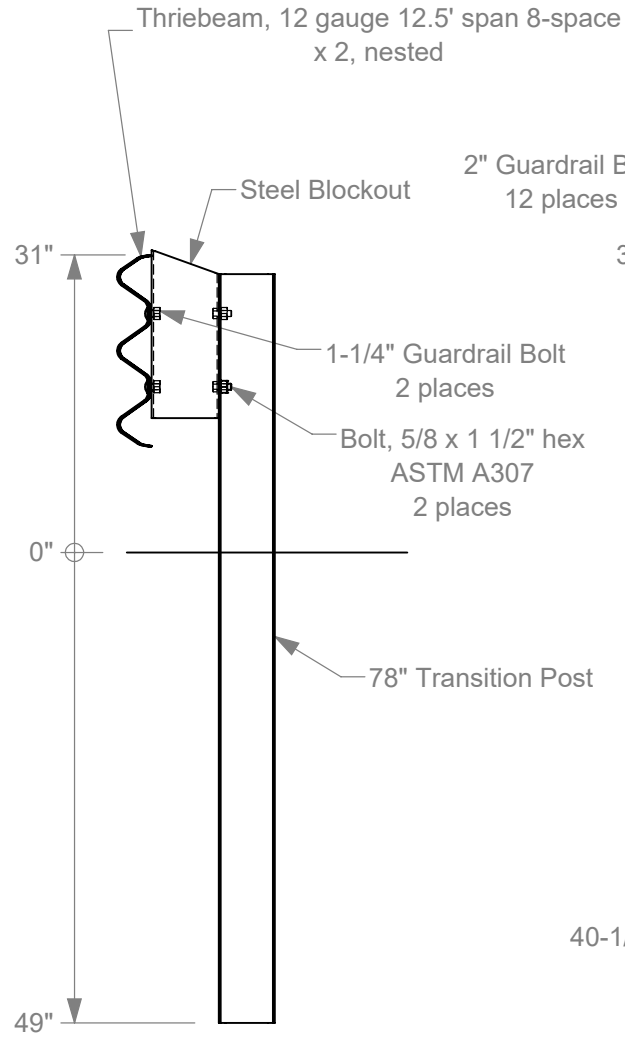
2021-05-07

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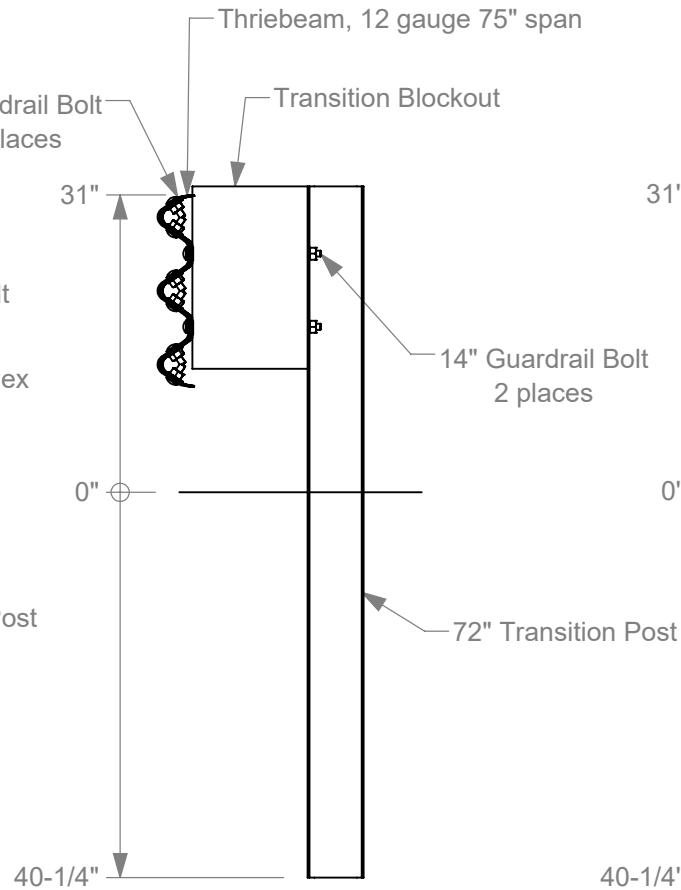
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Sheet 3 of 20 Transition Details

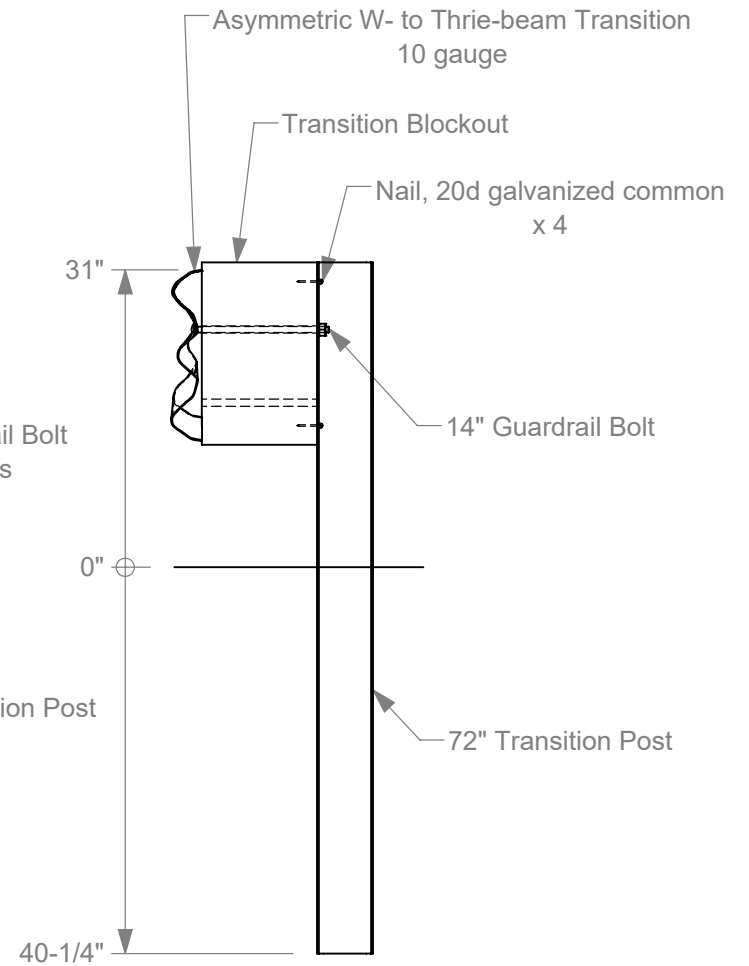
# Section Views



**Section E-E**  
Typ @ Posts 18 - 23



**Section D-D**  
Typ @ Posts 13 - 17



**Section C-C**  
@ Post 12



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Project #611801 5-6 Wyoming MGS Transition

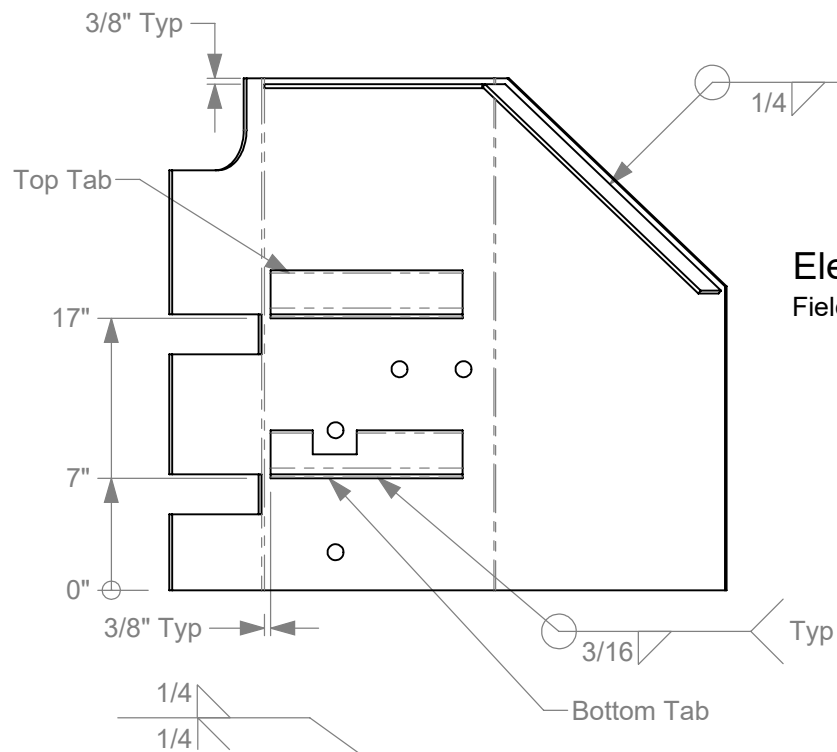
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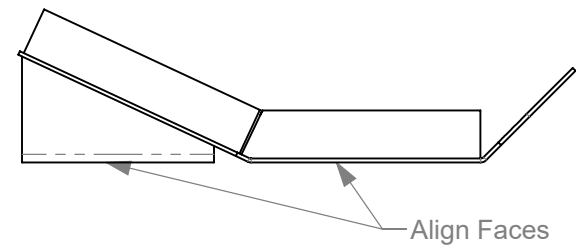
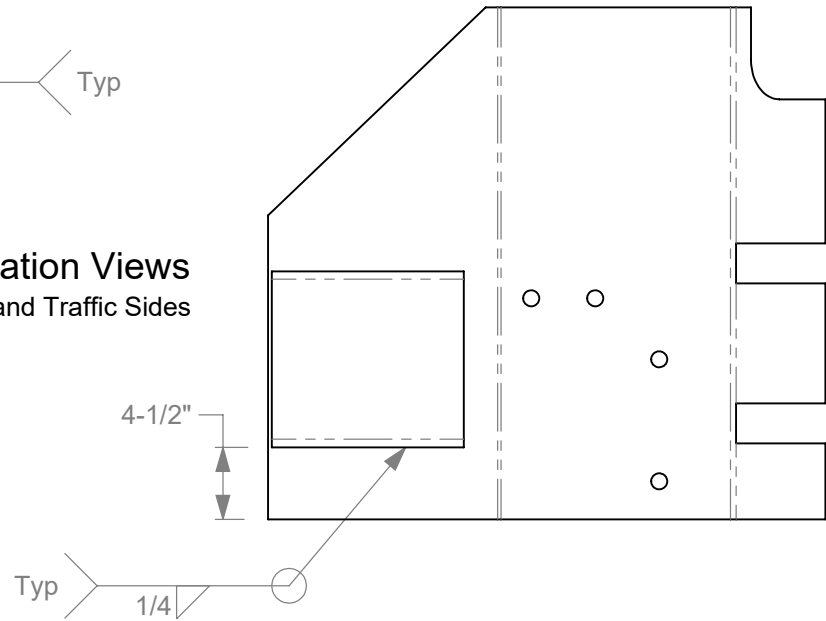
Scale 1:20

Sheet 4 of 20 Section Views

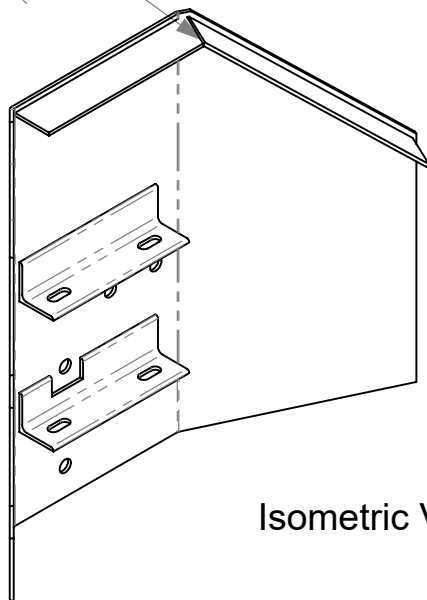
# Transition Attachment



**Elevation Views**  
Field and Traffic Sides




**Plan View**



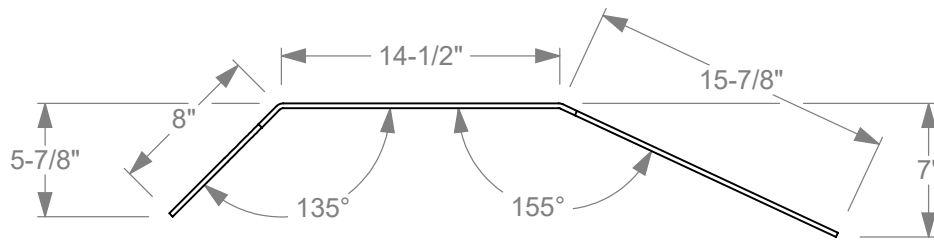
**Isometric View**

- 5a.** All welding must be performed by certified welders using industry standard practices.
- 5b.** Galvanize after fabrication is complete.

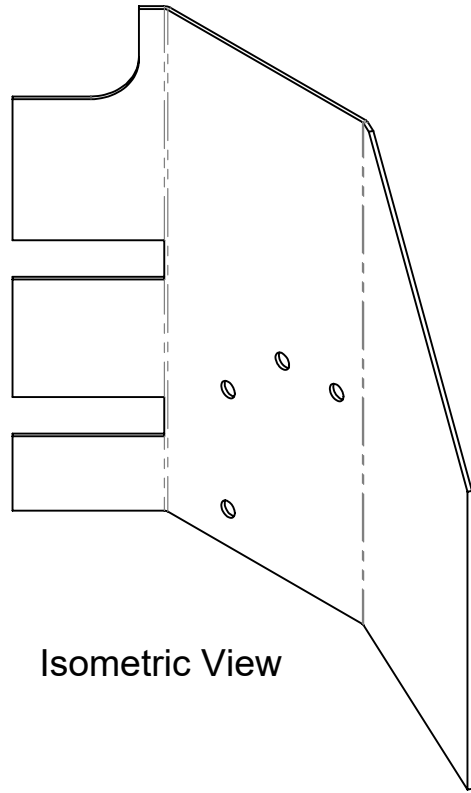
		Roadside Safety and Physical Security Division - Proving Ground	
Project #611801 5-6 Wyoming MGS Transition			2021-05-07
Drawn by GES\WS	Scale 1:12	Sheet 5 of 20	Transition Attachment

# Bent Plate

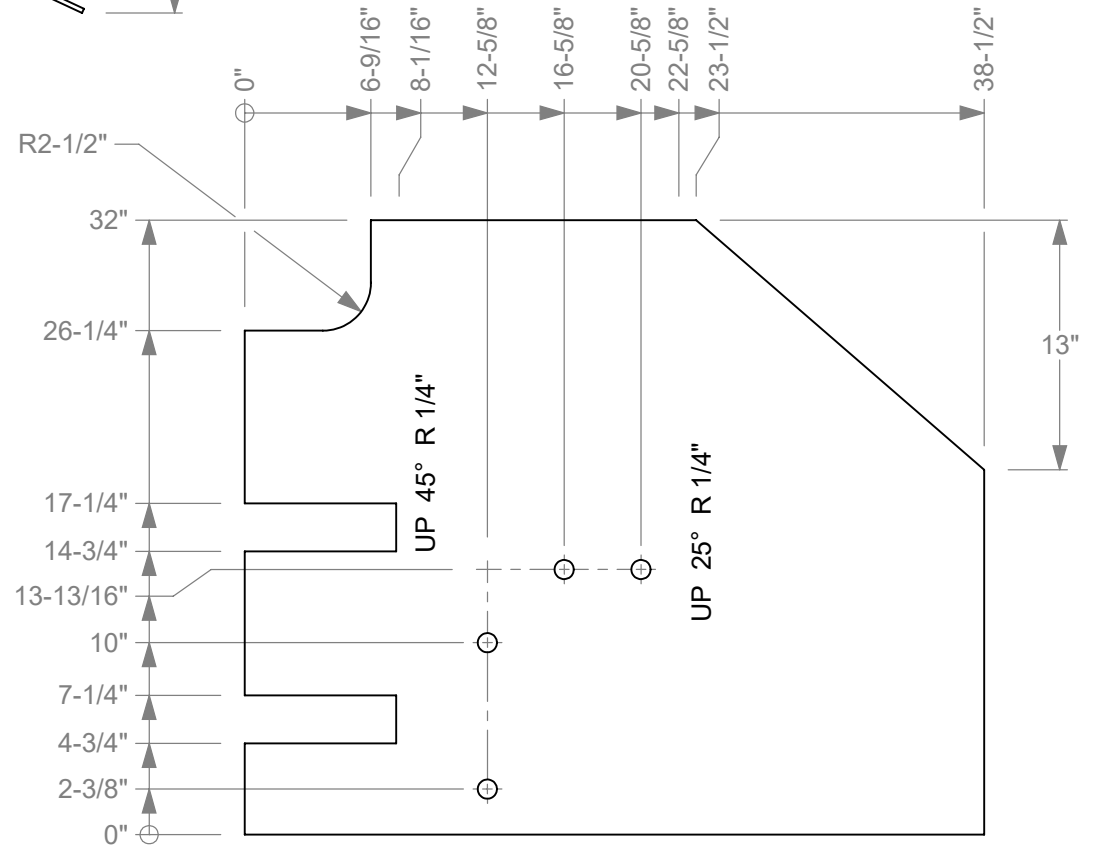
Plate, 32" x 1/4" x 38-1/2"  
ASTM A572 Grade 50



Plan View



Isometric View



Elevation View

Flat Pattern



Roadside Safety and  
Physical Security Division -  
Proving Ground

Project #611801 5-6 Wyoming MGS Transition

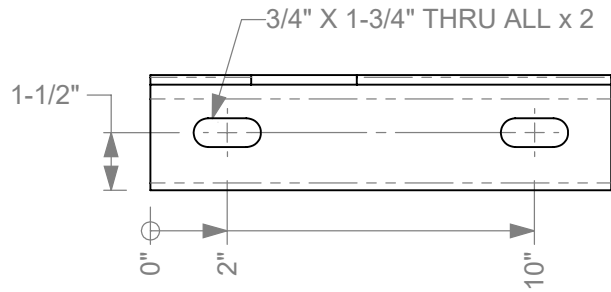
2021-05-07

Drawn by GES\WS

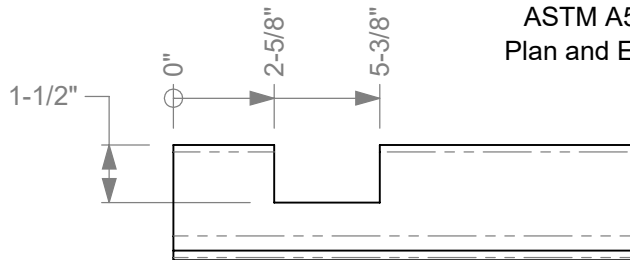
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Sheet 6 of 20 Bent Plate

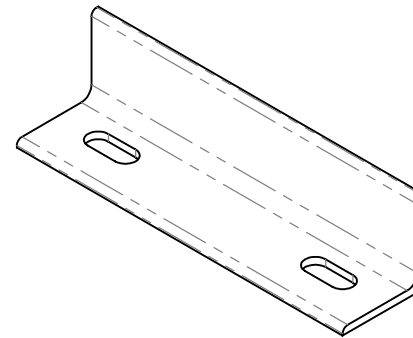
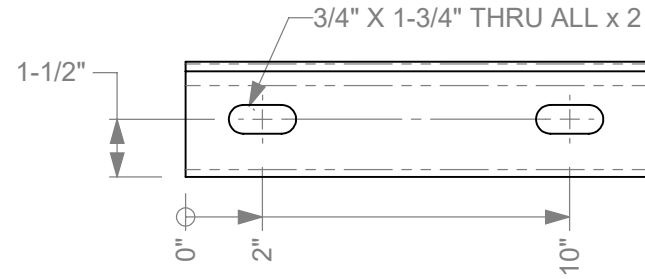
# Attachment Parts



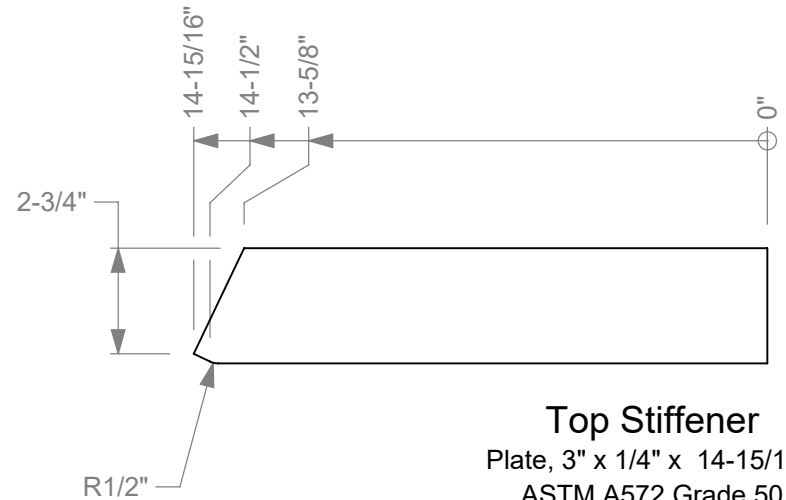
**Bottom Tab**  
 L 3 x 3 x 1/4 x 12"  
 ASTM A572 Grade 50  
 Plan and Elevation Views



**Top Tab**  
 L 3 x 3 x 1/4 x 12"  
 ASTM A572 Grade 50  
 Plan and Isometric Views



**Side Stiffener**  
 Plate, 3" x 1/4" x 19 11/16"  
 ASTM A572 Grade 50



**Top Stiffener**  
 Plate, 3" x 1/4" x 14-15/16"  
 ASTM A572 Grade 50



Roadside Safety and  
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Project #611801 5-6 Wyoming MGS Transition

2021-05-07

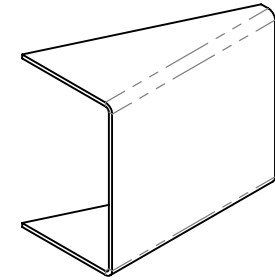
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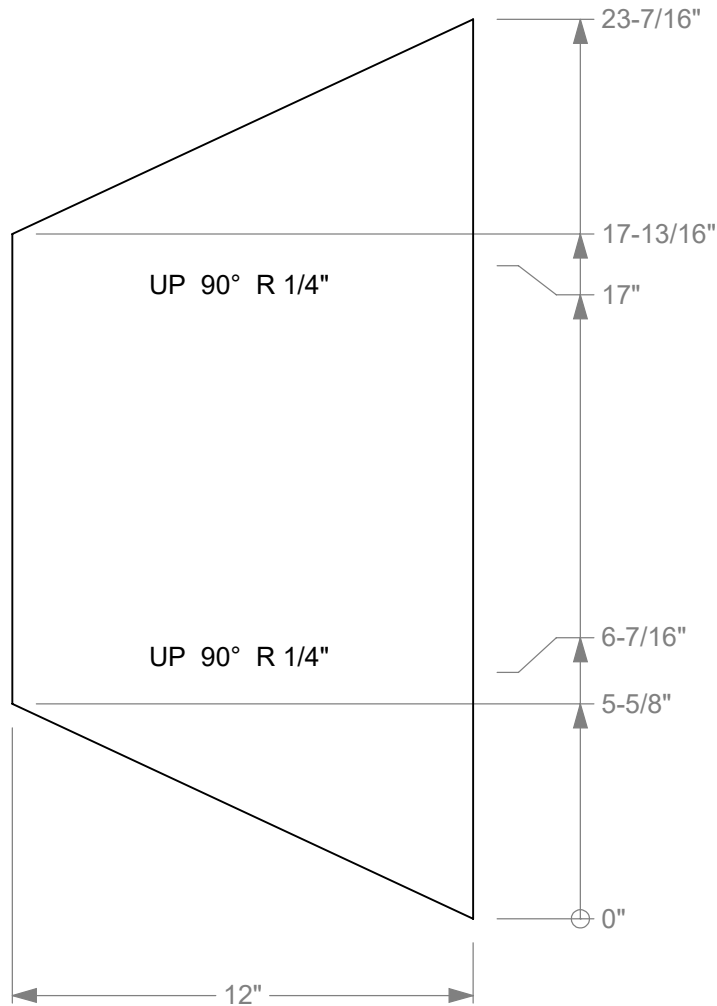
Sheet 7 of 20 Attachment Parts

# Thrie-Beam Support

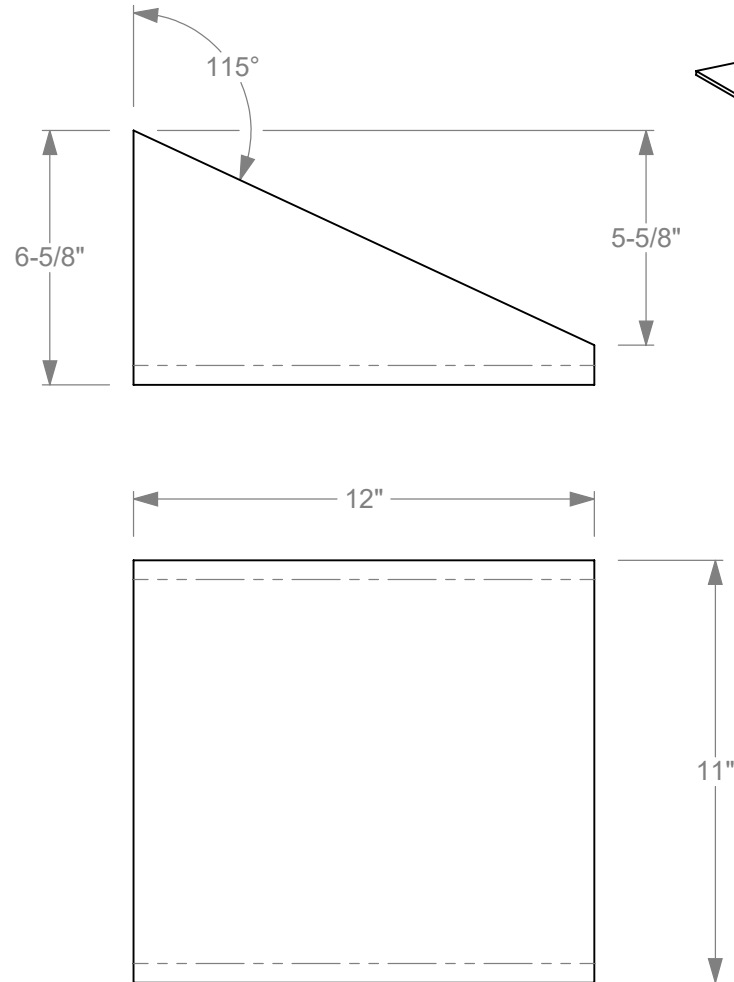
Plate, 12" x 1/4" x 23-7/16"  
ASTM A572 Grade 50



Isometric View



Flat Pattern



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Proving Ground

Project #611801 5-6 Wyoming MGS Transition

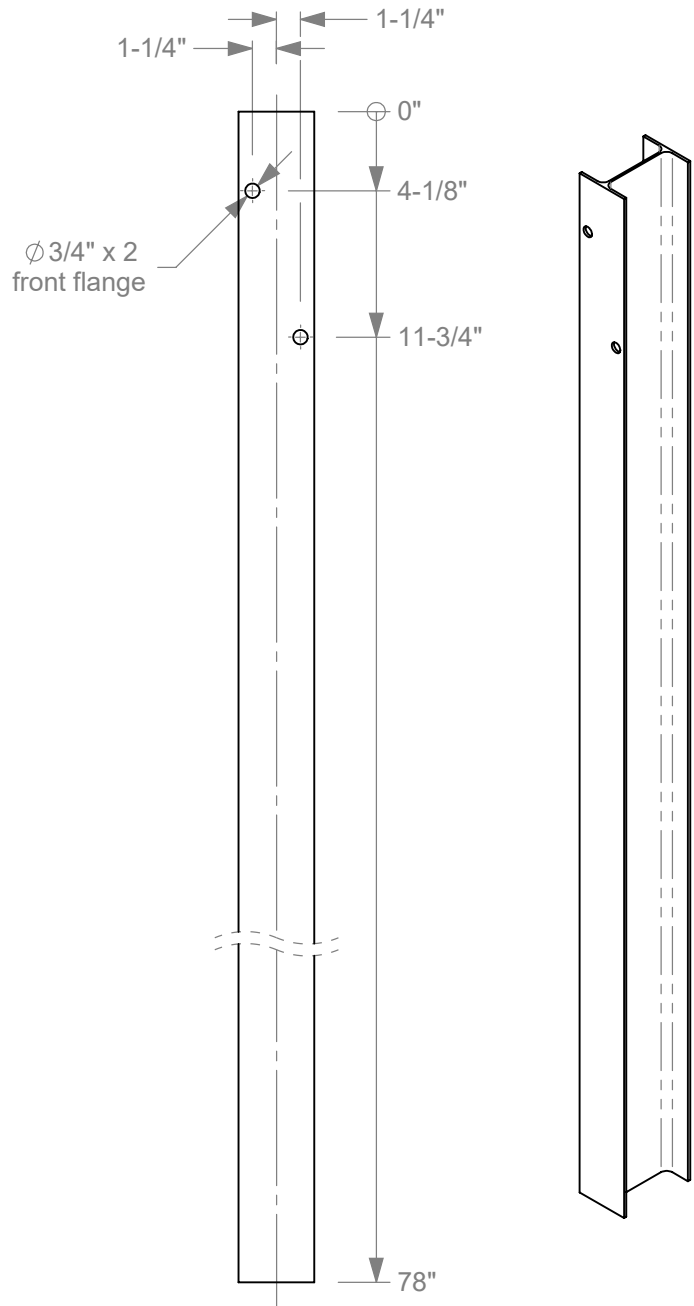
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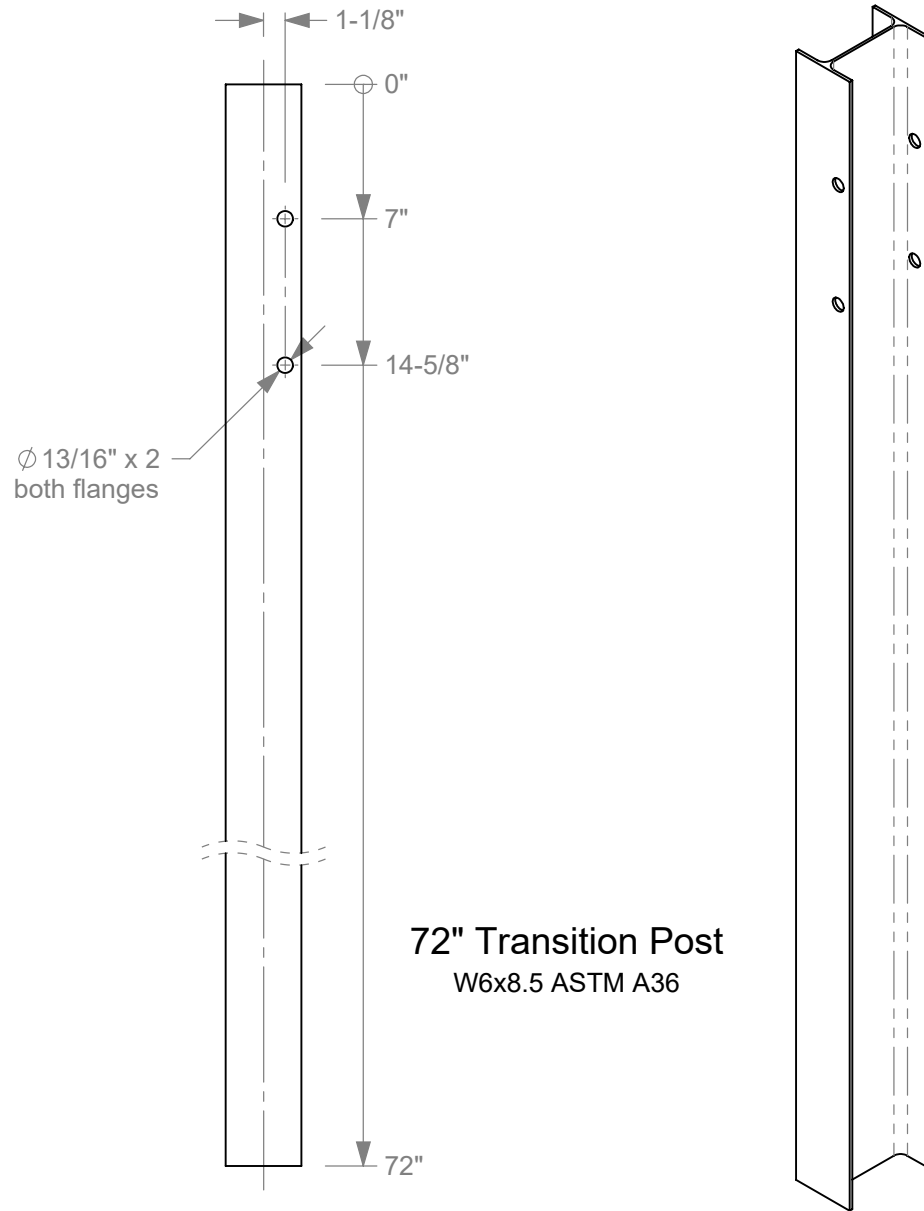
Scale 1:5

Sheet 8 of 20 Thrie-Beam Support

# Transition Posts



**78" Transition Post**  
W6x8.5 ASTM A36



**72" Transition Post**  
W6x8.5 ASTM A36



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Project #611801 5-6 Wyoming MGS Transition

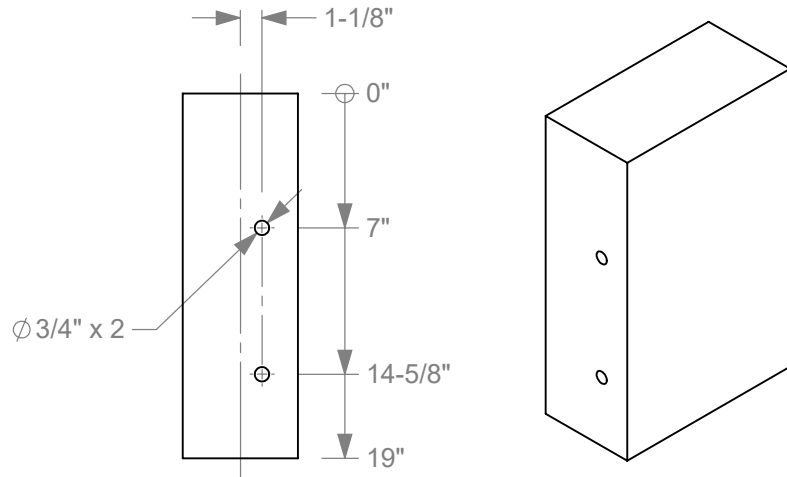
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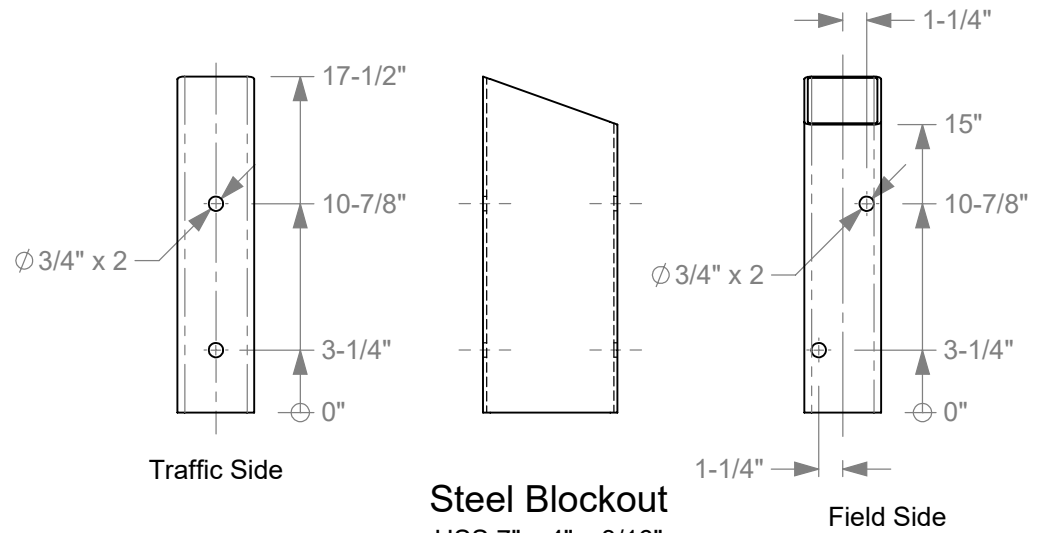
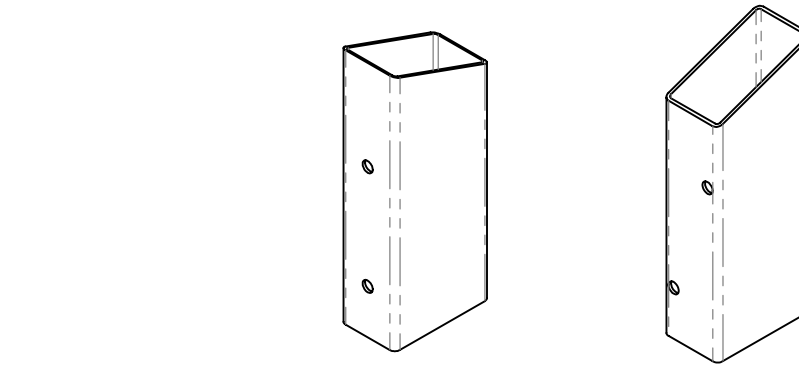
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Sheet 9 of 20 Transition Posts

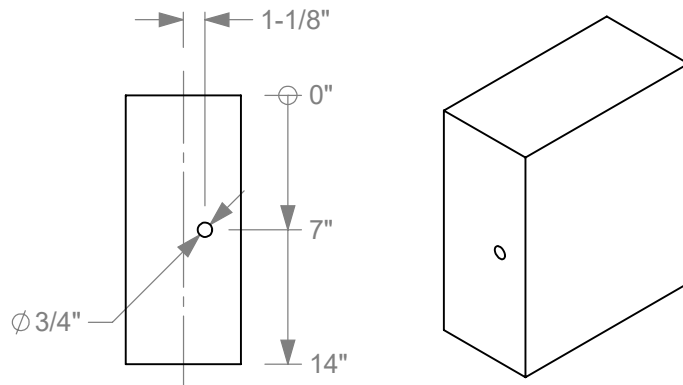
# Transition Blockouts



**Transition Blockout**  
 Pressure-treated Yellow Pine Timber  
 6" x 12" x 19"



**Steel Blockout**  
 HSS 7" x 4" x 3/16"  
 ASTM A500 Grade B



**Standard Blockout**  
 Pressure-treated Yellow Pine Timber  
 6" x 12" x 14"



Roadside Safety and  
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Project #611801 5-6 Wyoming MGS Transition

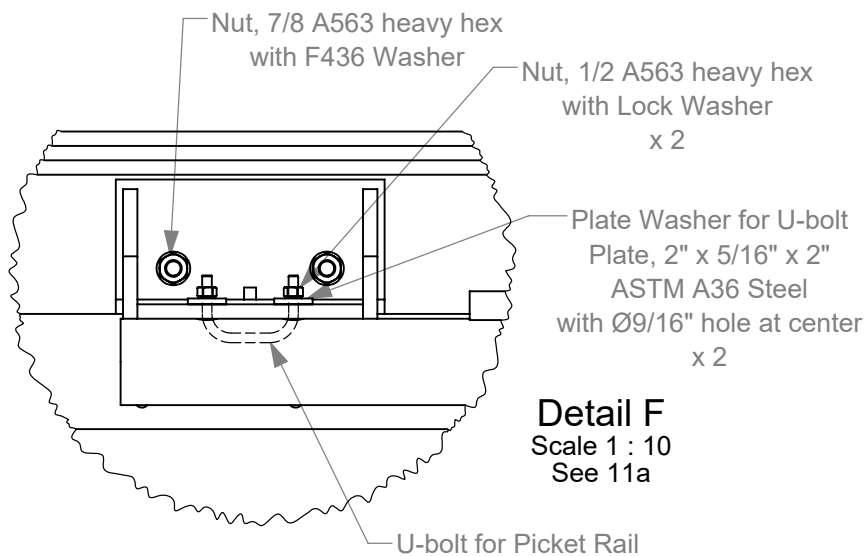
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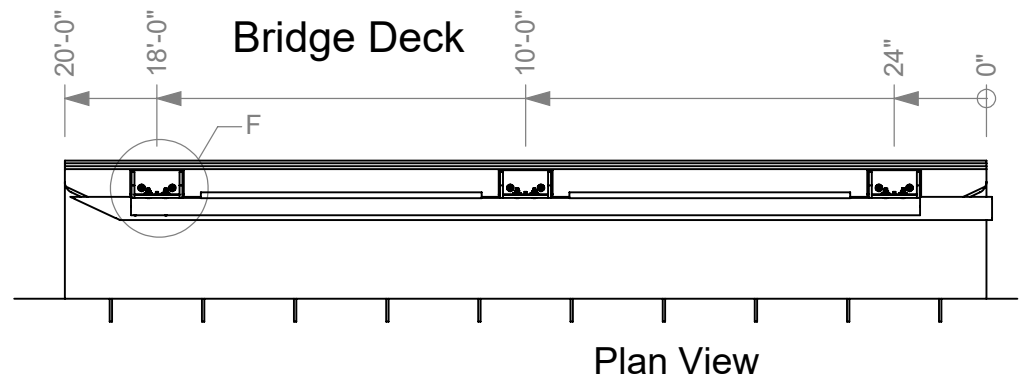
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Sheet 10 of 20 Transition Blockouts

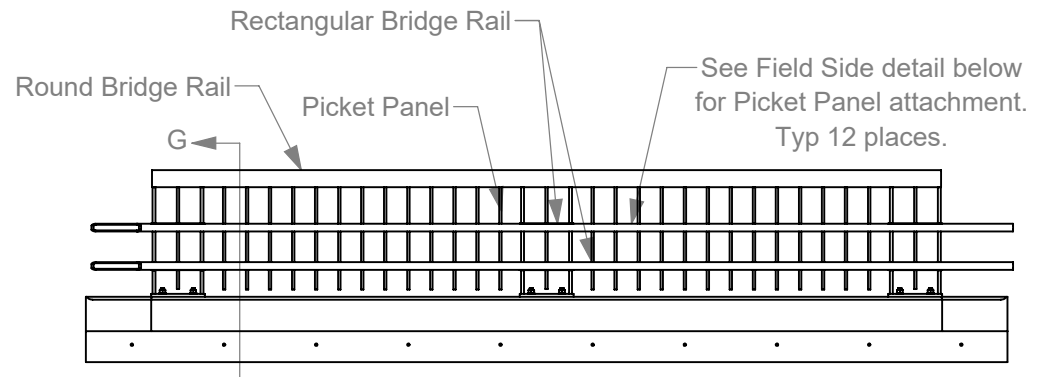




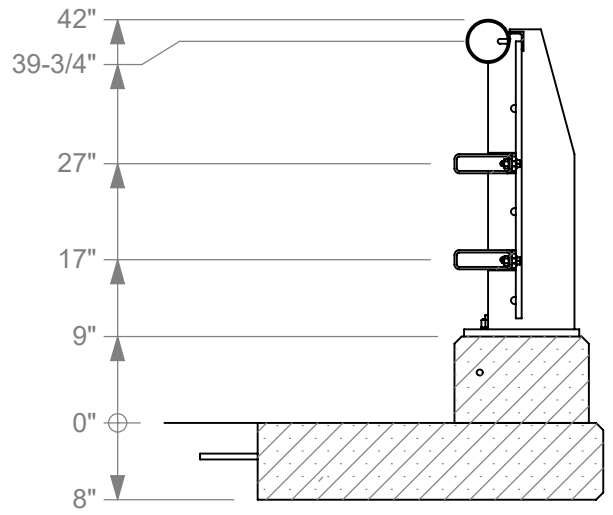
**Detail F**  
Scale 1 : 10  
See 11a



**Plan View**

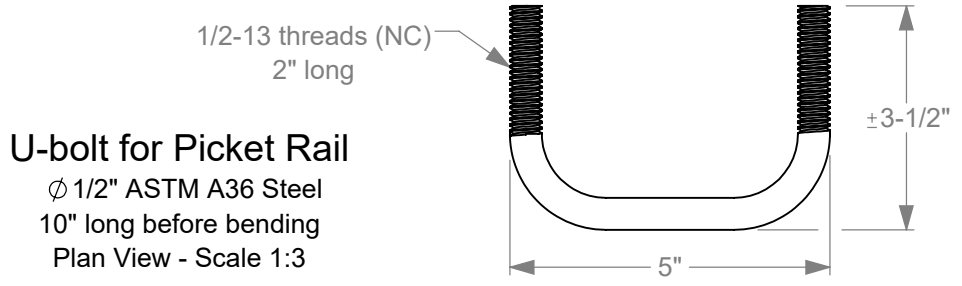
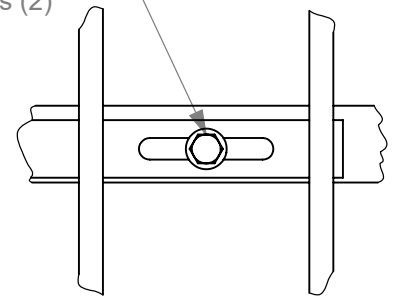


**Elevation View**



**Section G-G**  
Scale 1 : 20

Bolt, 1/2\" x 1 1/2\" hex A325  
with A194-2HM Hex Nut  
and F436 Washers (2)

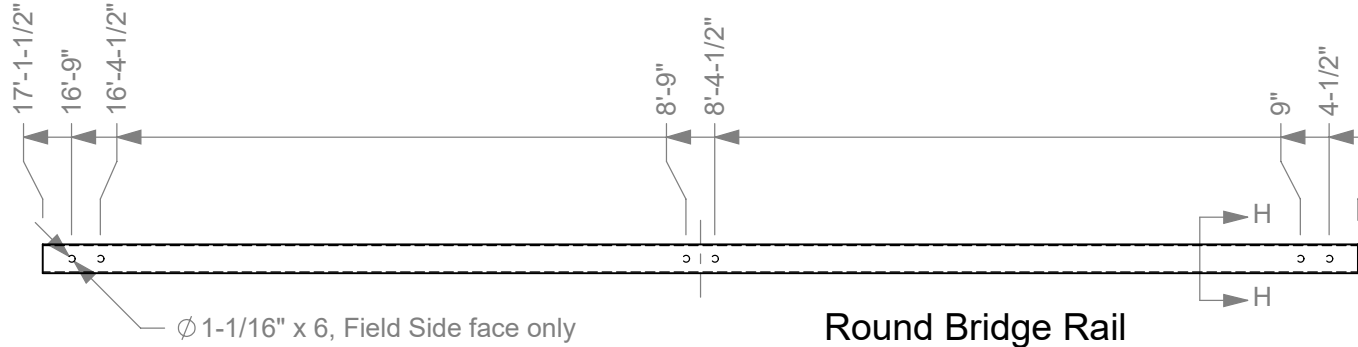


**U-bolt for Picket Rail**  
Ø 1/2\" ASTM A36 Steel  
10\" long before bending  
Plan View - Scale 1:3

**11a.** U-bolt and hardware typical 3 places at each Post.  
Anchor hardware typical 4 places at each Post.

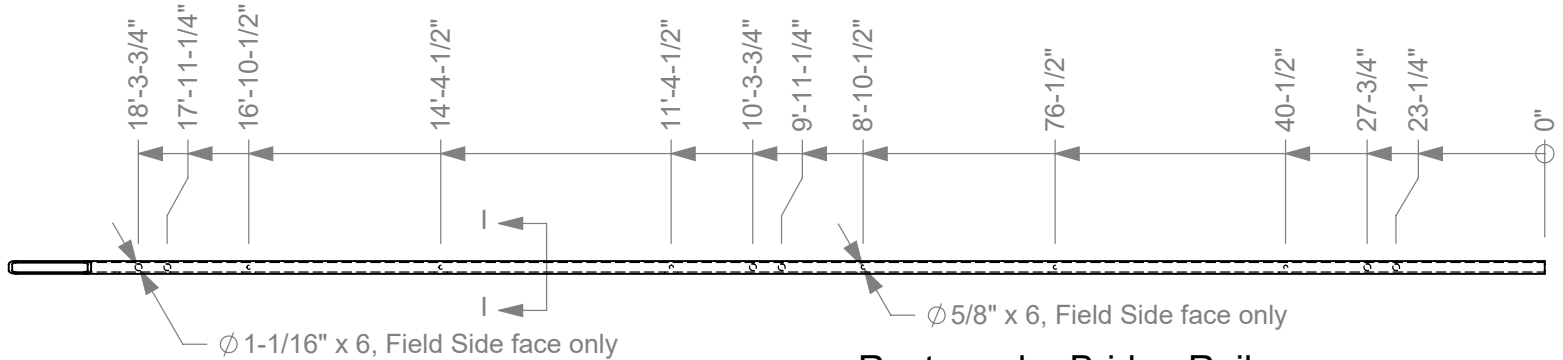
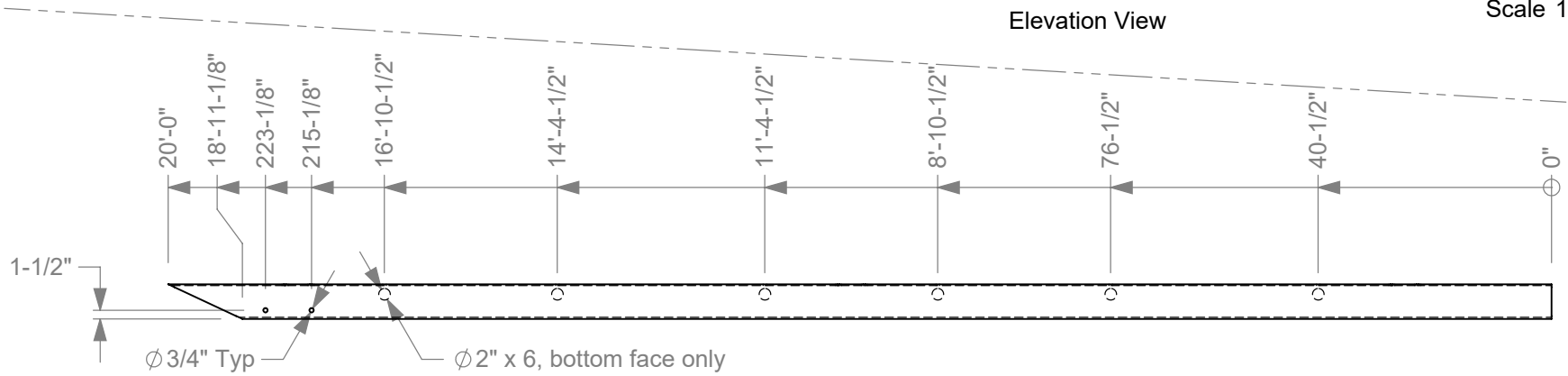
		Roadside Safety and Physical Security Division - Proving Ground	
Project #611801 5-6 Wyoming MGS Transition		2021-05-07	
Drawn by GES\WS	Scale 1:50	Sheet 11 of 20 Bridge Deck	

# Bridge Rails

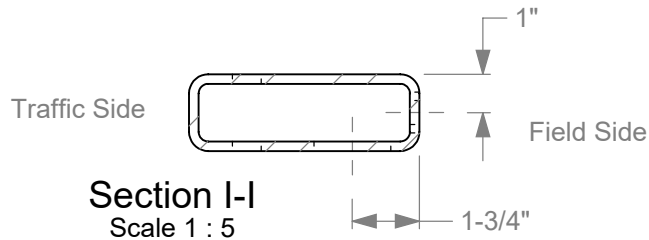


**Round Bridge Rail**  
 HSS Round 4 1/2" x 3/16" ASTM A500 Grade B  
 Elevation View

**Section H-H**  
 Scale 1 : 10



**Rectangular Bridge Rail**  
 HSS 6 x 2 x 1/4" ASTM A500 Grade B  
 Plan and Elevation Views



Roadside Safety and  
 Physical Security Division -  
 Proving Ground

Project #611801 5-6 Wyoming MGS Transition

2021-05-07

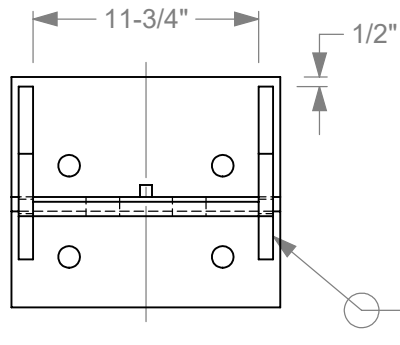
Drawn by GES\WS

Scale 1:30

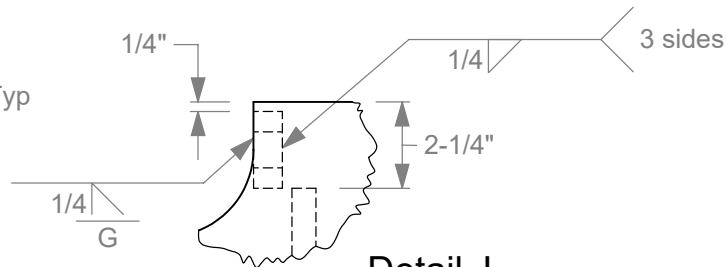
Sheet 12 of 20 Bridge Rails

# Bridge Post

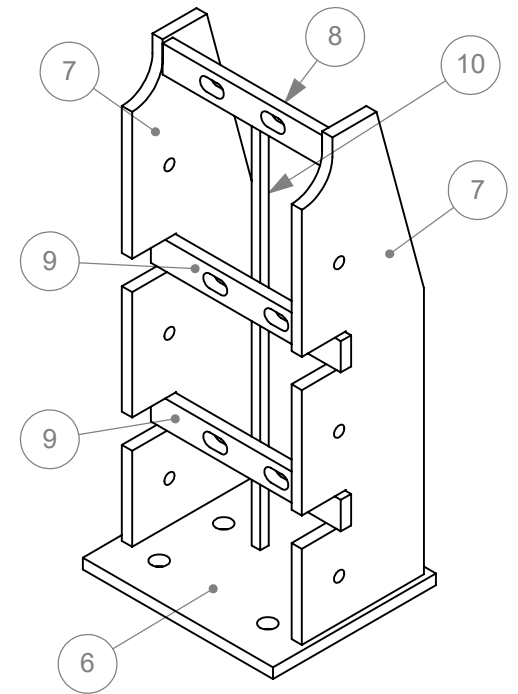
#	Body Name	Description	Length	Material	Qty
6	Base Plate	Plate, 12" x 3/4"	14"	ASTM A572 Grade 50	1
7	Side Plate	Plate, 9" x 3/4"	31-1/4"	ASTM A572 Grade 50	2
8	Rail Plate, Top	Plate, 2" x 3/4"	11-3/4"	ASTM A36	1
9	Rail Plate, Lower	Plate, 2" x 3/4"	14"	ASTM A36	2
10	Picket	Plate, 5/8" x 5/8"	27-3/4"	ASTM A36	1



Plan View



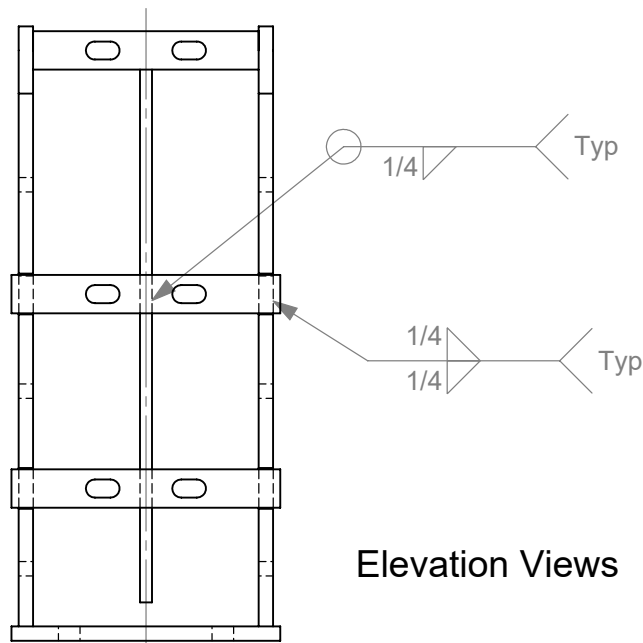
Detail J  
Scale 1 : 5



Isometric View

**13a.** All welding must be performed by certified welders using industry standard practices.

**13b.** Galvanize after fabrication is complete.



Elevation Views



Roadside Safety and  
Physical Security Division -  
Proving Ground

Project #611801 5-6 Wyoming MGS Transition

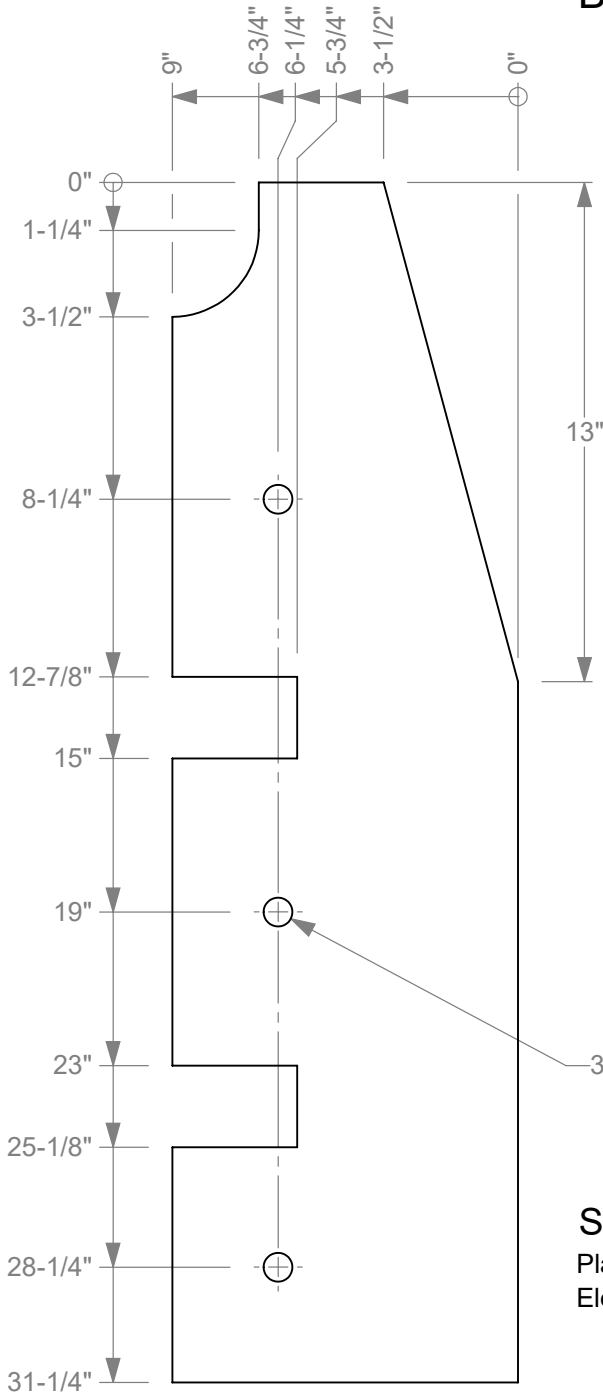
2021-05-07

Drawn by GES\WS

Scale 1:10

Sheet 13 of 20 Bridge Post

# Bridge Post Parts

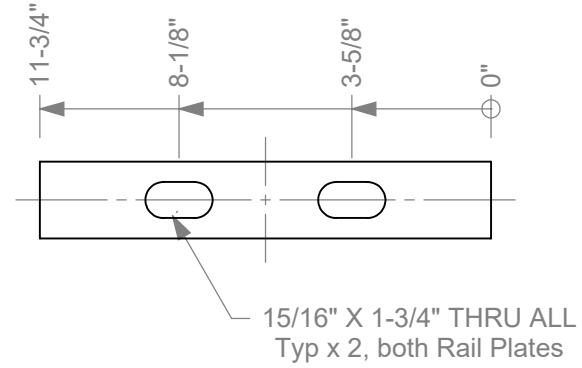


10  
**Picket**  
 Plate, 5/8" x 5/8"

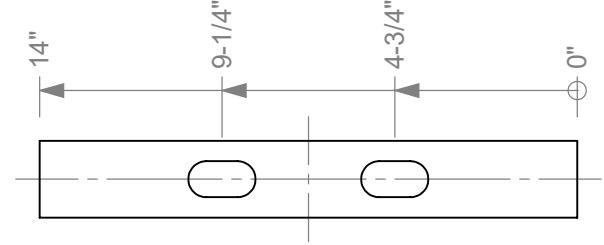
7  
**Side Plate**  
 Plate, 9" x 3/4"  
 Elevation View

3 x  $\varnothing$  3/4" THRU ALL

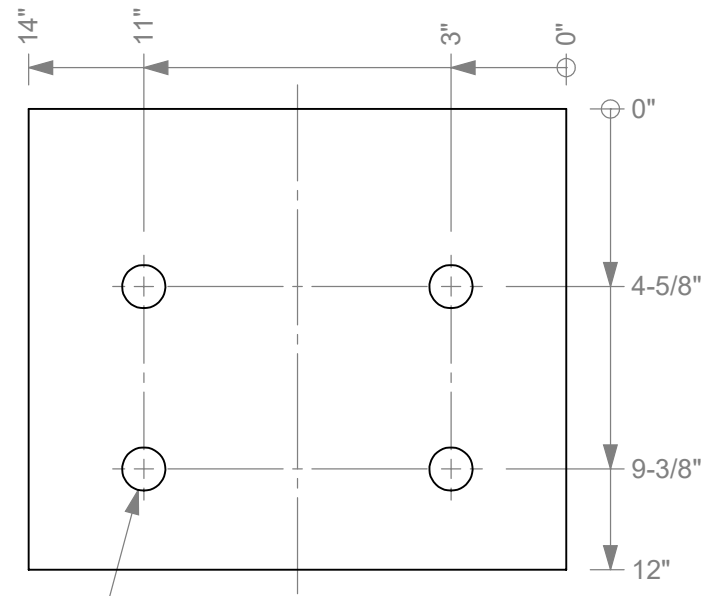
4 x  $\varnothing$  1-1/8" THRU ALL



8  
**Rail Plate, Top**  
 Plate, 2" x 3/4"  
 Elevation View



9  
**Rail Plate, Lower**  
 Plate, 2" x 3/4"  
 Elevation View



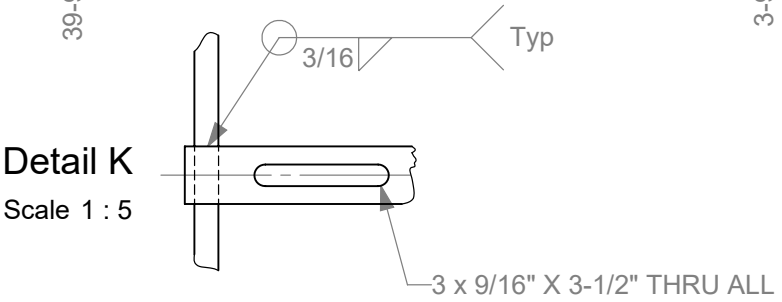
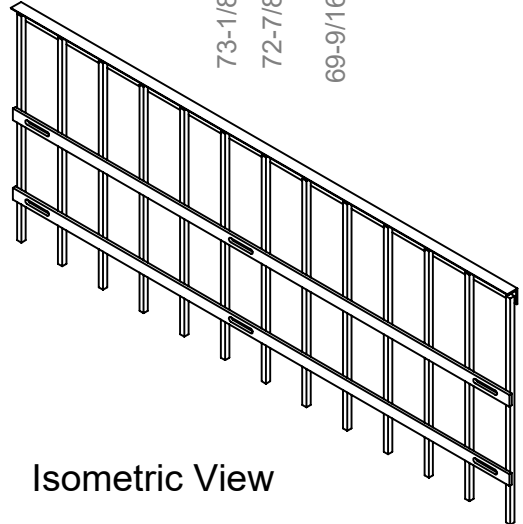
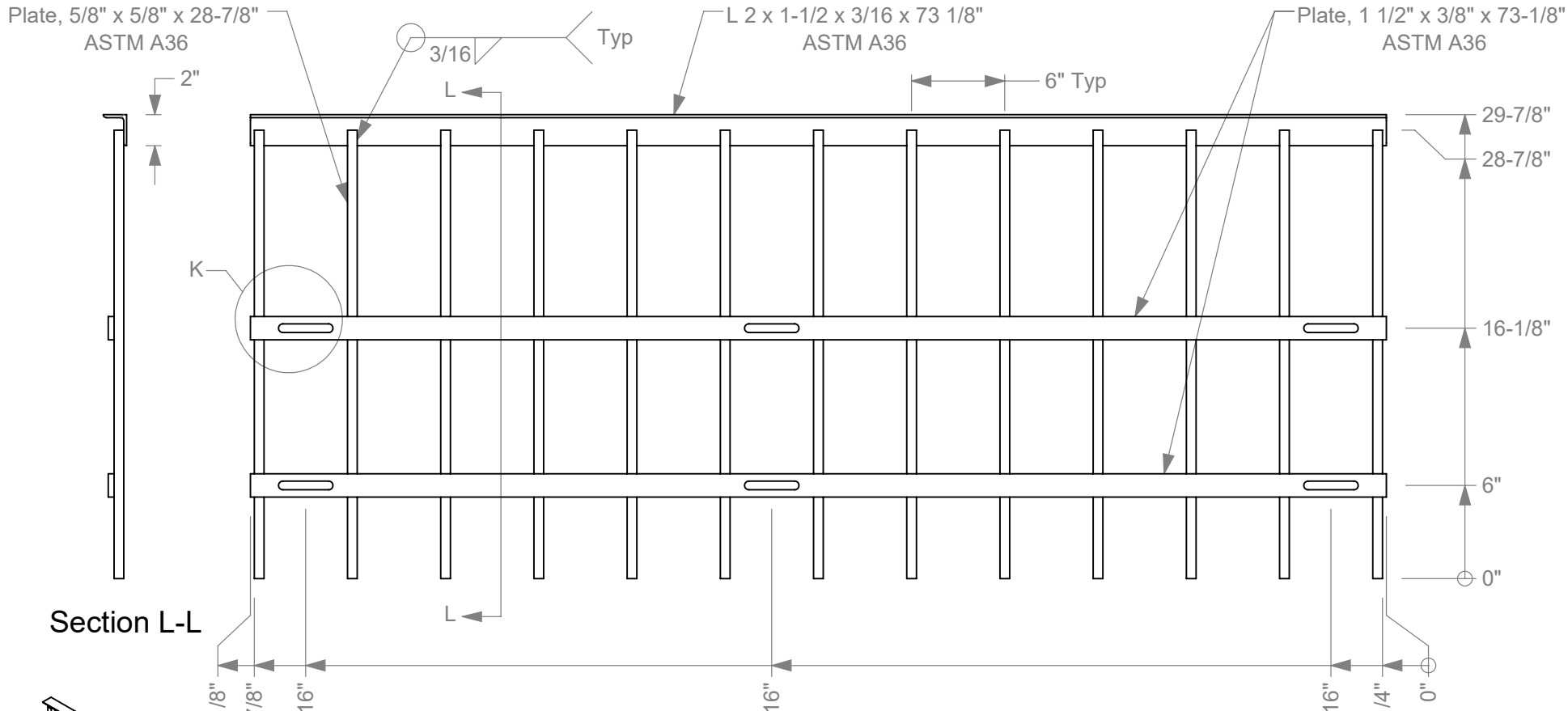
6  
**Base Plate**  
 Plate, 12" x 3/4"  
 Plan View




Roadside Safety and Physical Security Division - Proving Ground

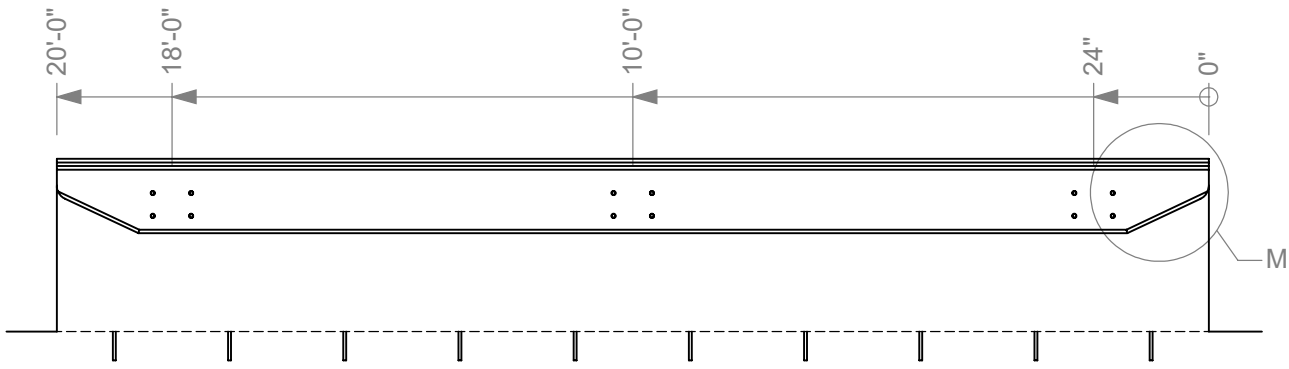
Project #611801 5-6 Wyoming MGS Transition		2021-05-07
Drawn by GES\WS	Scale 1:5	Sheet 14 of 20 Bridge Post Parts

# Picket Panel

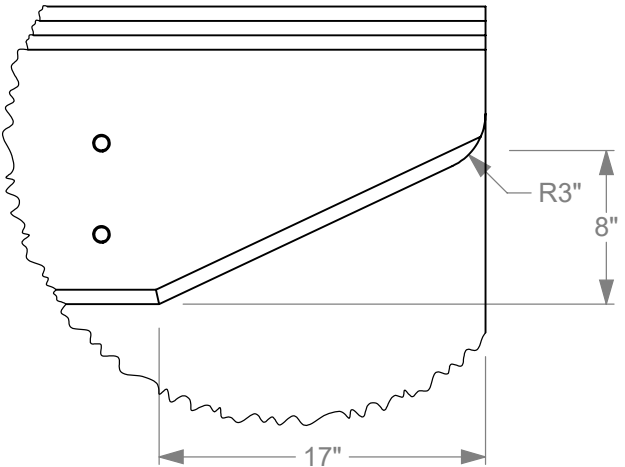


	Roadside Safety and Physical Security Division - Proving Ground	
	Project #611801 5-6 Wyoming MGS Transition	2021-05-07
Drawn by GES\WS	Scale 1:10	Sheet 15 of 20 Picket Panel

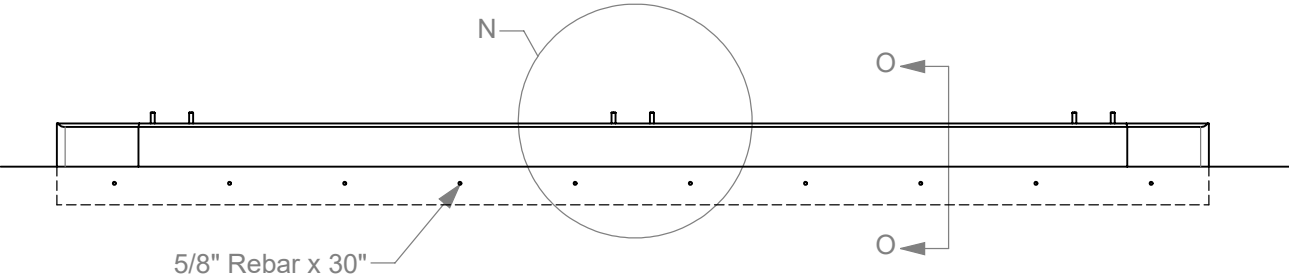
# Moment Slab and Curb



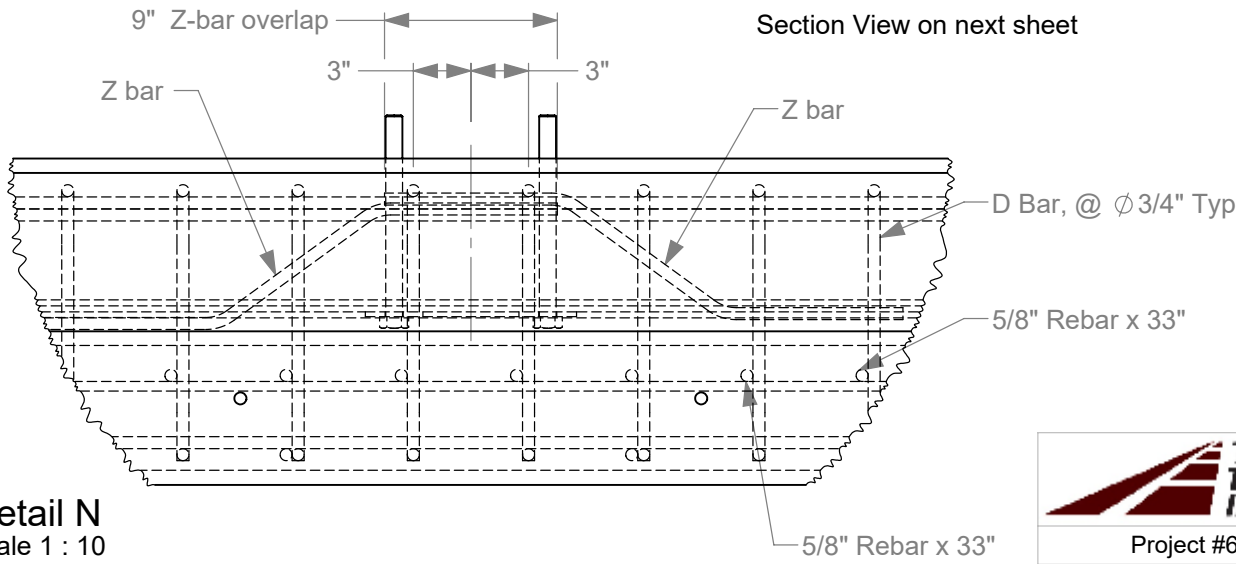
Plan View




Detail M  
Scale 1 : 10  
Typ each end



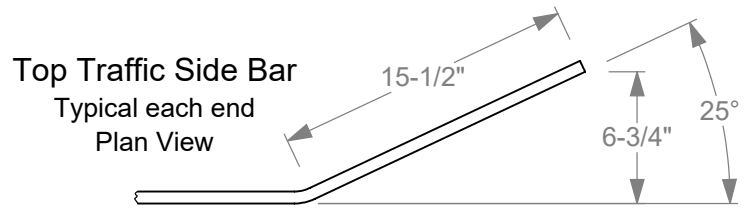
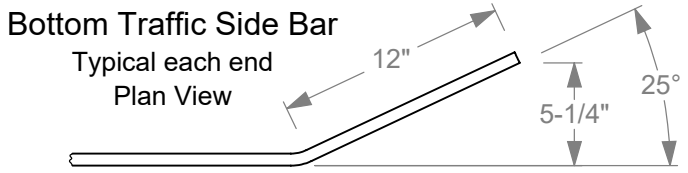
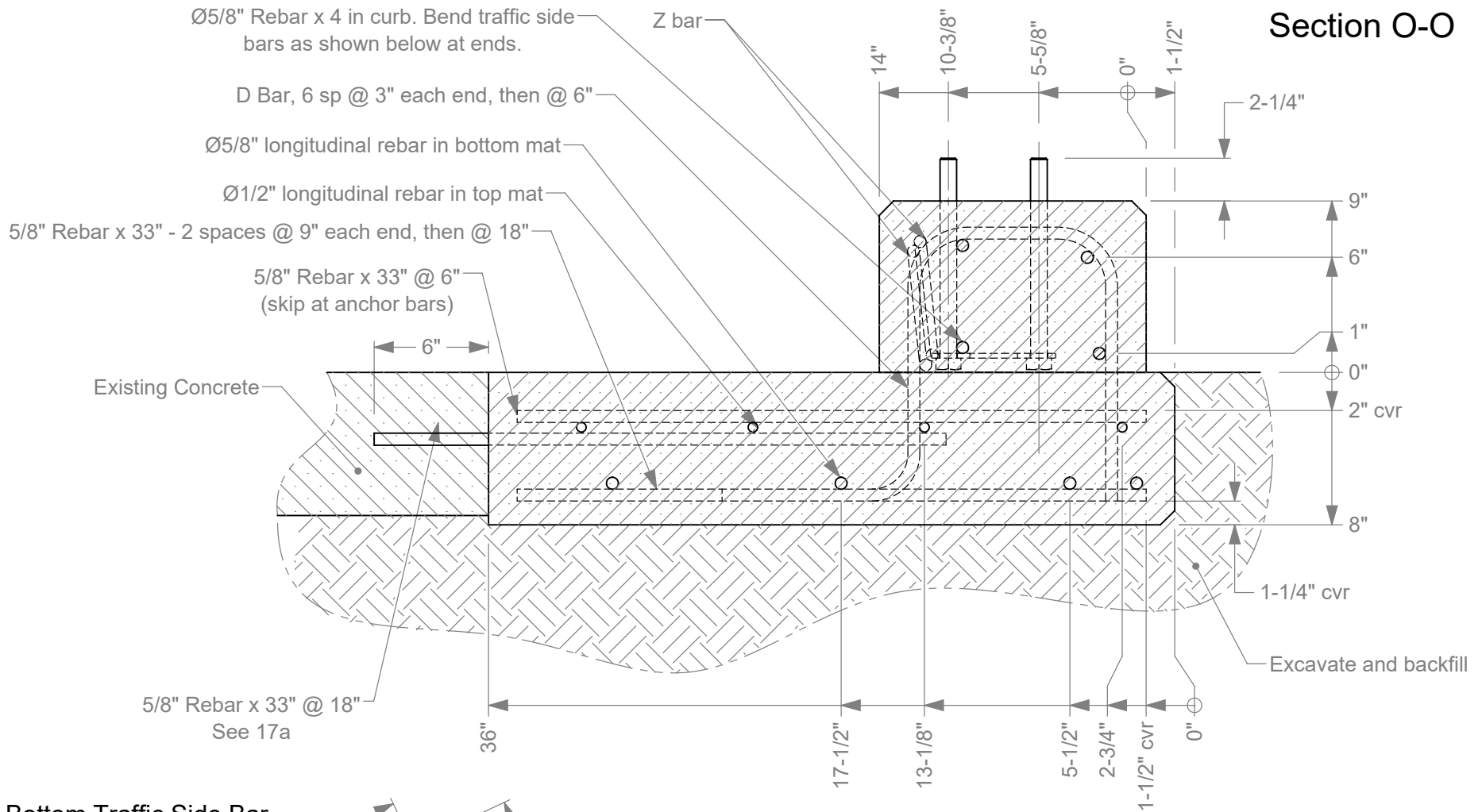
Elevation View  
Section View on next sheet




Detail N  
Scale 1 : 10

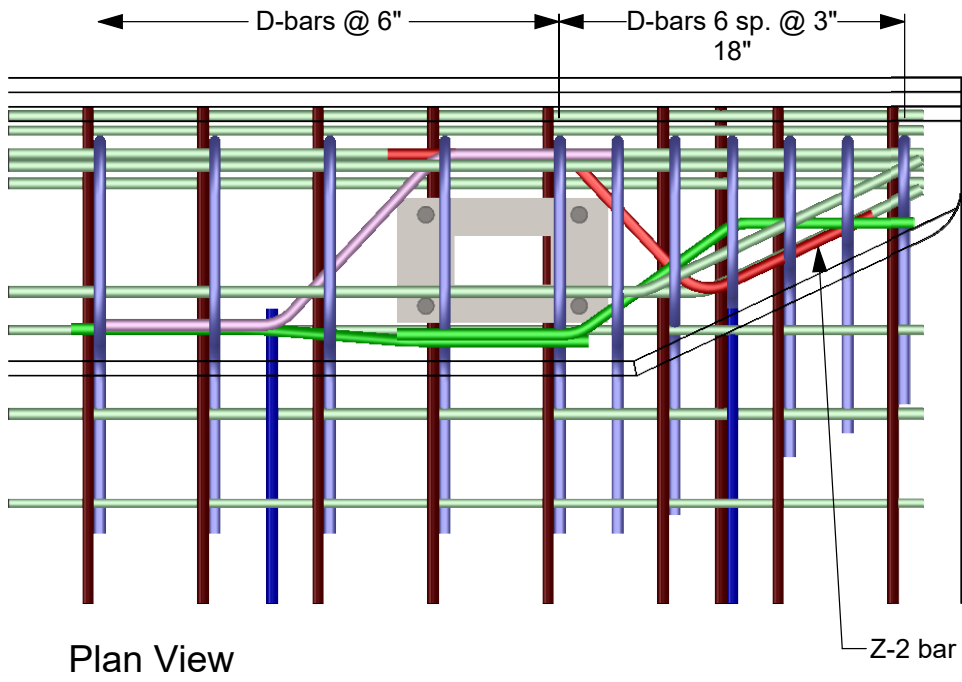
	Roadside Safety and Physical Security Division - Proving Ground	
	Project #611801 5-6 Wyoming MGS Transition	2021-05-07
Drawn by GES\WS	Scale 1:40	Sheet 16 of 20 Moment Slab and Curb

# Section O-O

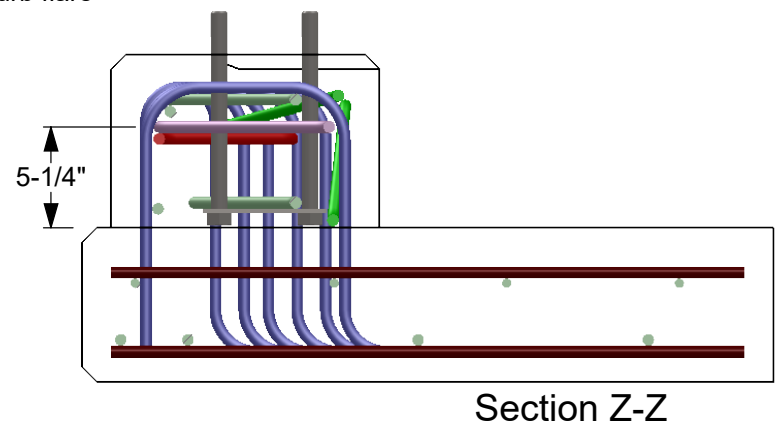
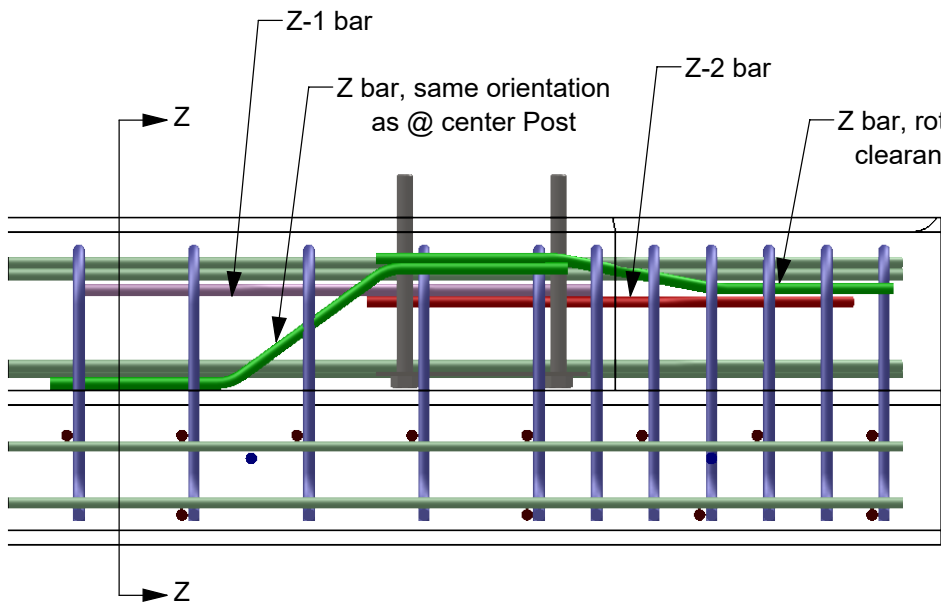
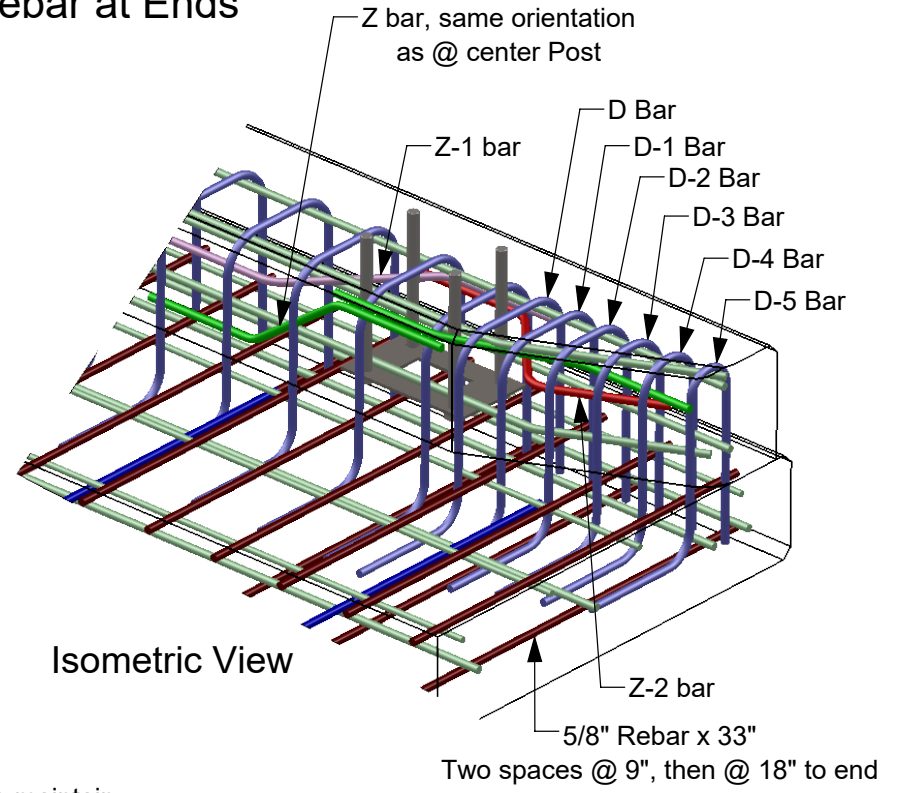


- 17a.** Secure in existing concrete with Hilti HIT-RE 500 V3 epoxy according to manufacturer's instructions.
- 17b.** All rebar is grade 60.
- 17c.** All rebar dimensions are to center of bar unless otherwise indicated by "cvr" (cover).
- 17d.** Concrete is 4000 psi.
- 17e.** 1" chamfer (3/4" each way) edges of Deck and Curb as shown.

		Roadside Safety and Physical Security Division - Proving Ground
Project #611801 5-6 Wyoming MGS Transition		2021-05-07
Drawn by GES\WS	Scale 1:8	Sheet 17 of 20 Concrete Section



### Rebar at Ends

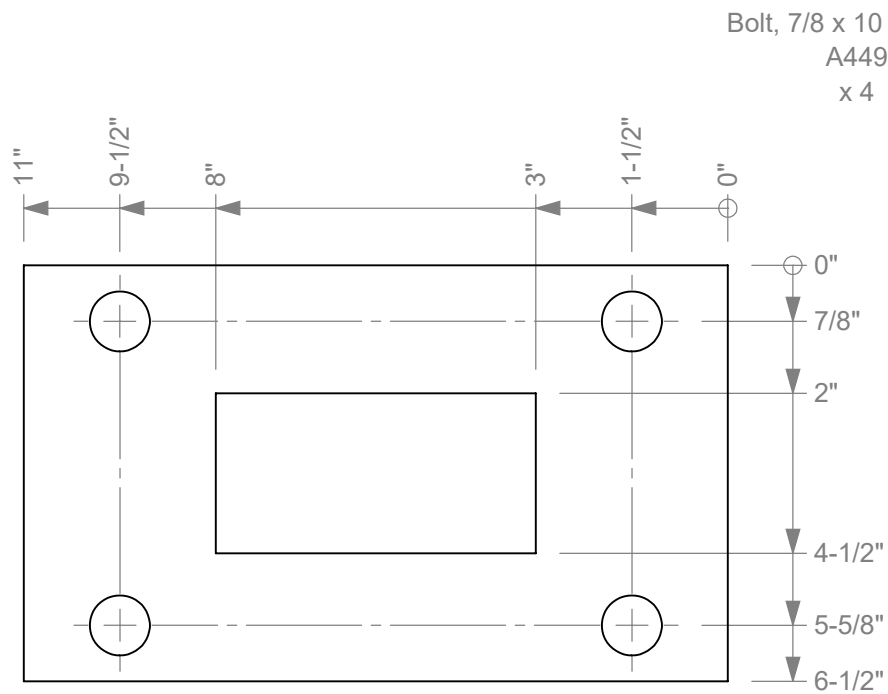


	Roadside Safety and Physical Security Division - Proving Ground	
	Project #611801 5-6 Wyoming MGS Transition	2021-05-07
Drawn by GES\WS	Scale 1:10	Sheet 18 of 20 Rebar at Ends



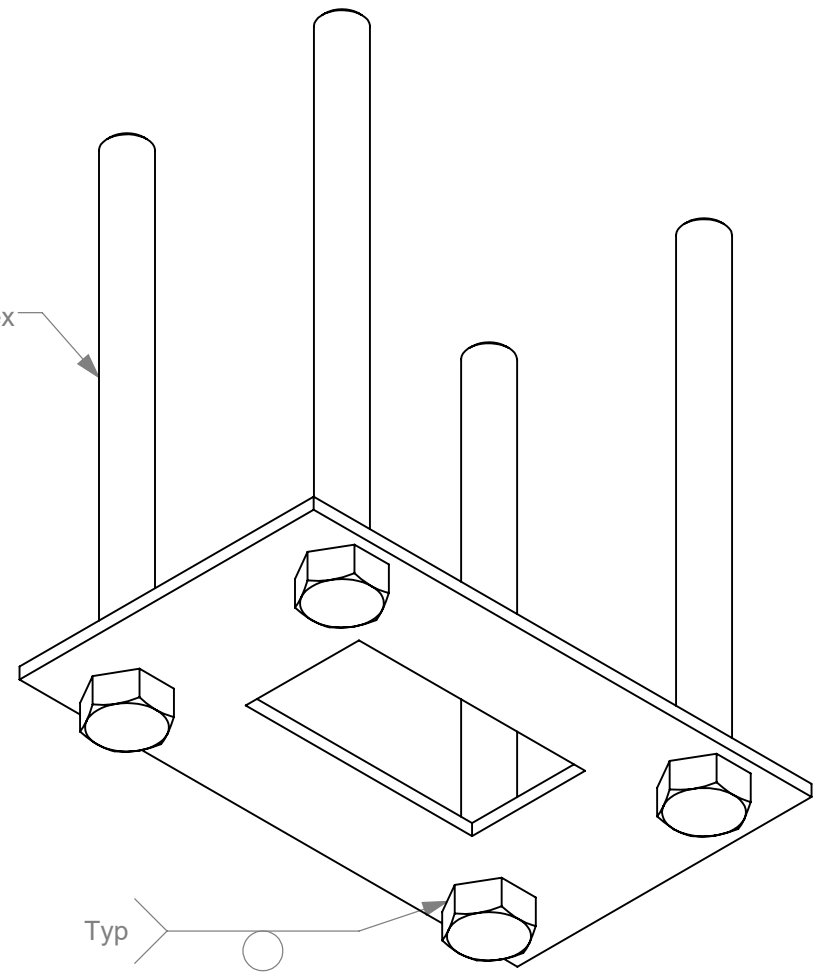
# Anchor Bolt Assembly

Threads not shown for clarity




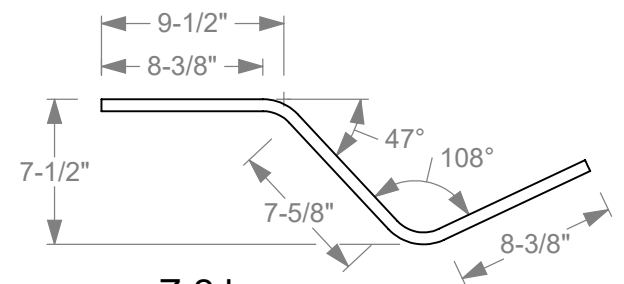
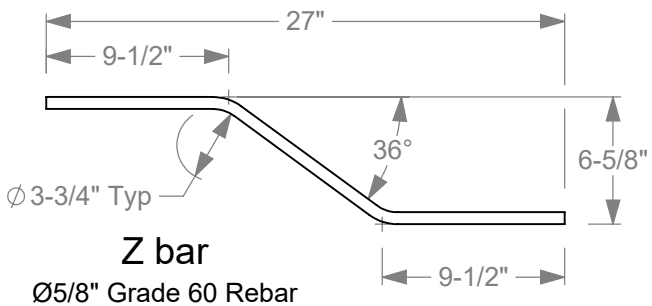
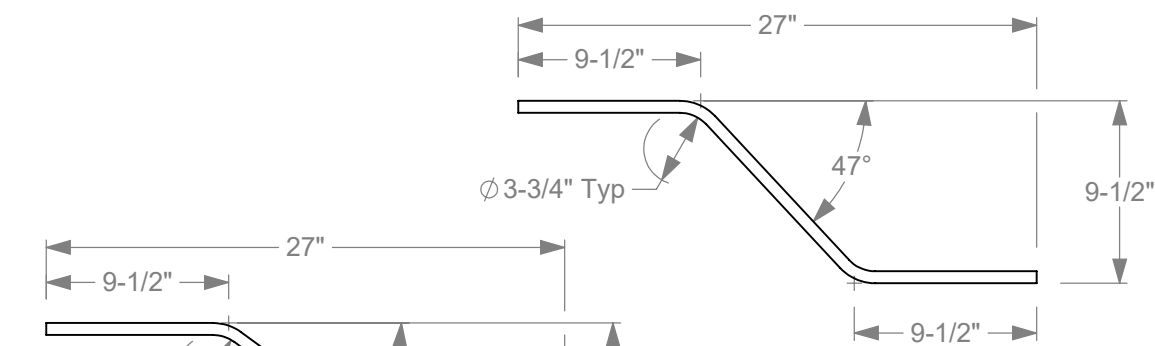
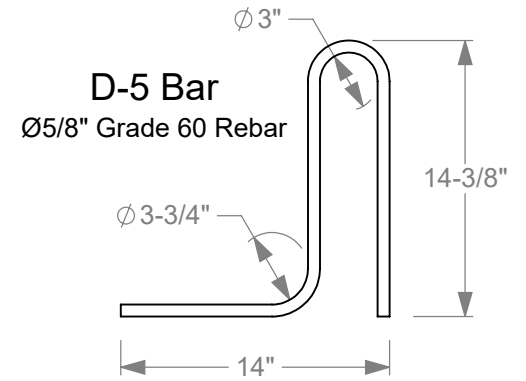
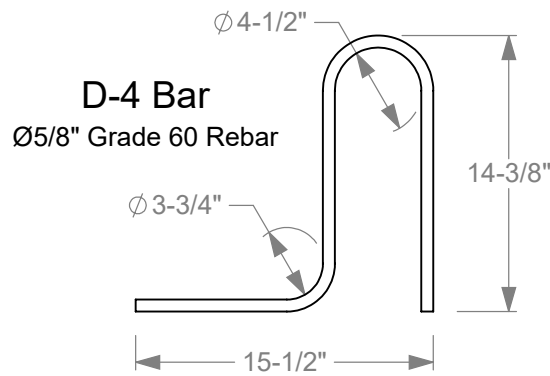
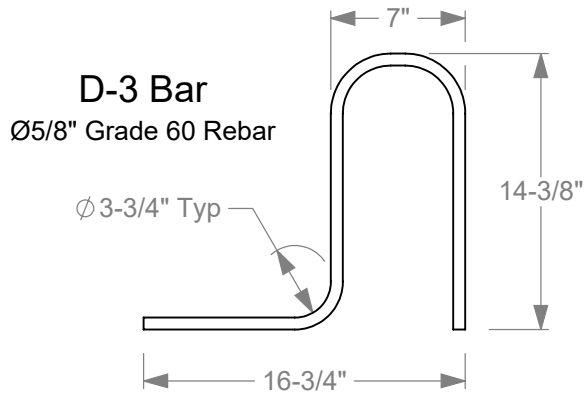
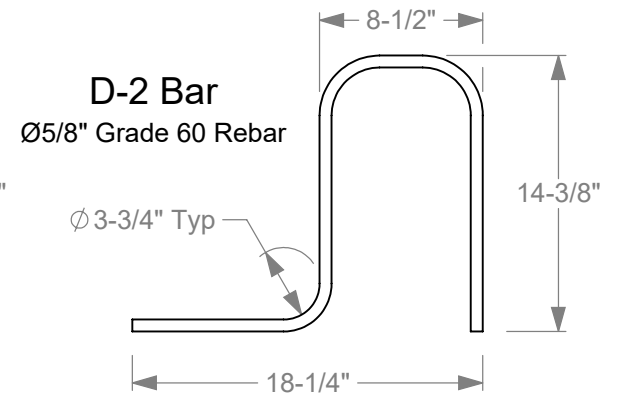
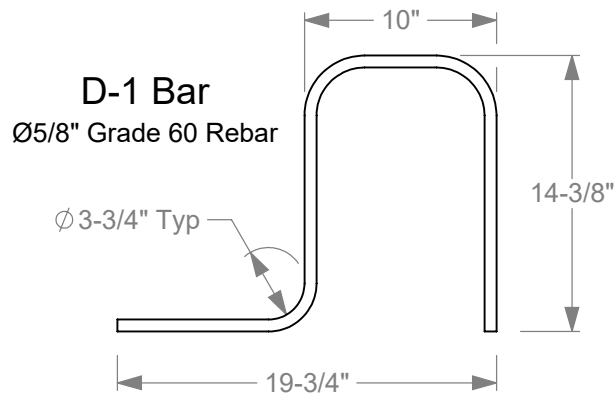
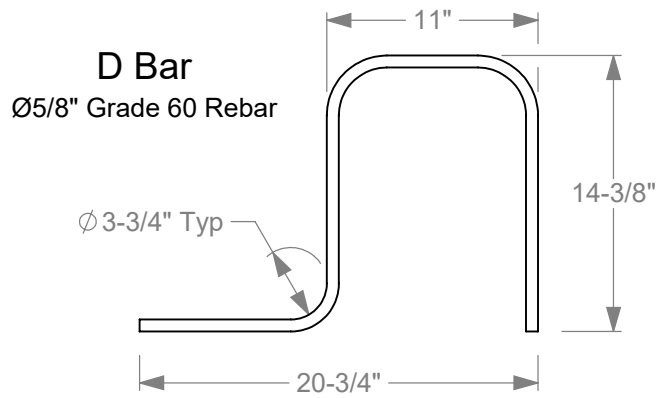
**Anchor Plate**  
 Plate, 6 1/2" x 1/4"  
 ASTM A36 Steel  
 Plan View

Bolt, 7/8 x 10 1/2" hex  
 A449  
 x 4



**Isometric View**

	Roadside Safety and Physical Security Division - Proving Ground	
	Project #611801 5-6 Wyoming MGS Transition	2021-05-07
Drawn by GES\WS	Scale 1:3	Sheet 19 of 20 Anchor Bolt Assembly



Roadside Safety and  
Physical Security Division -  
Proving Ground

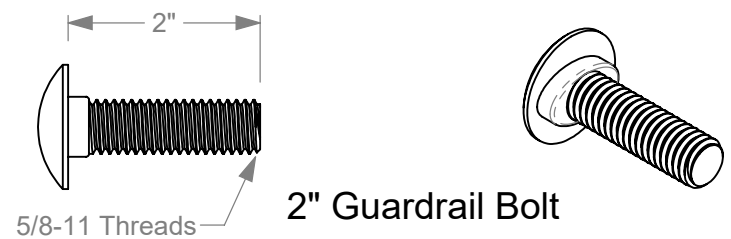
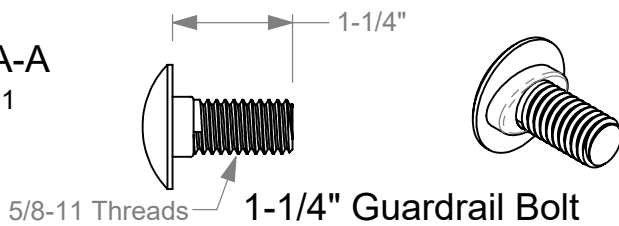
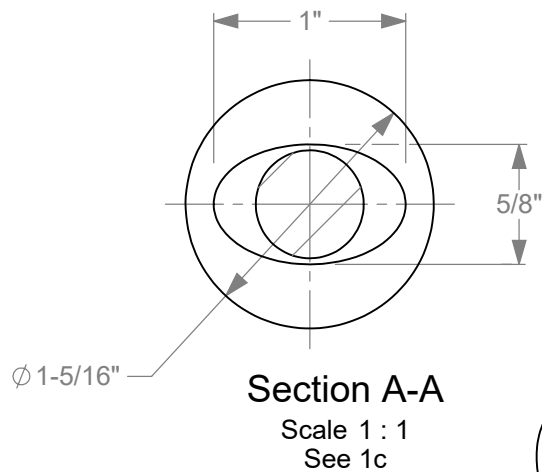
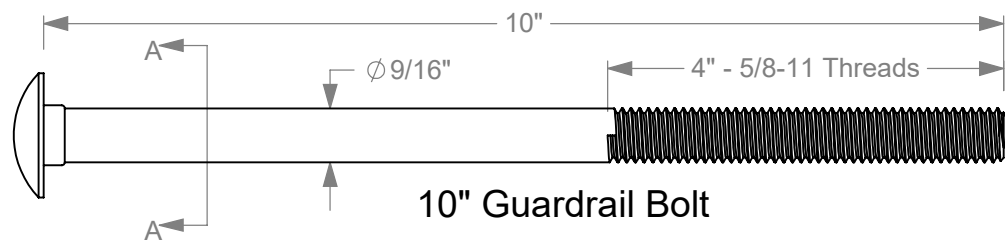
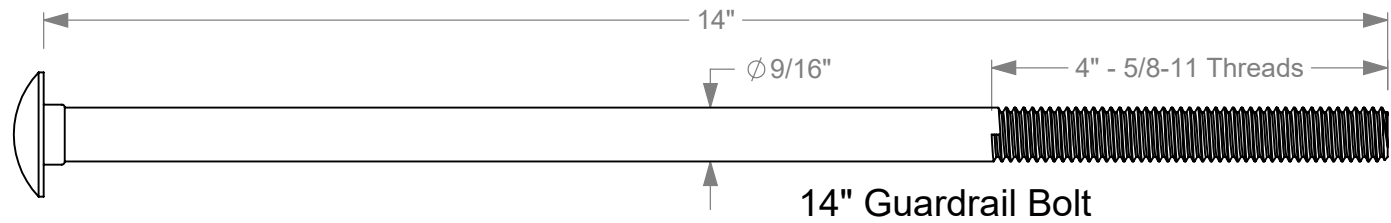
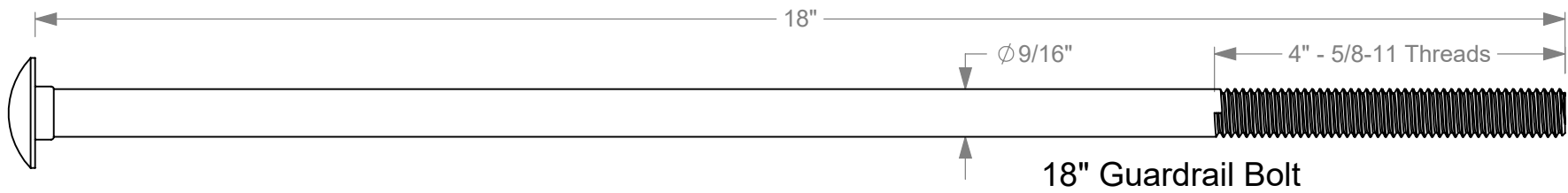
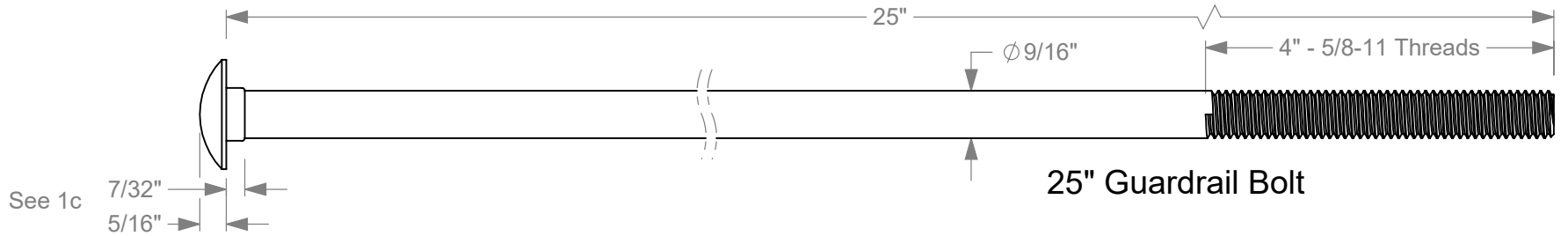
Project #611801 5-6 Wyoming MGS Transition

2021-05-07

Drawn by GES\WS

Scale 1:10

Sheet 20 of 20 Rebar



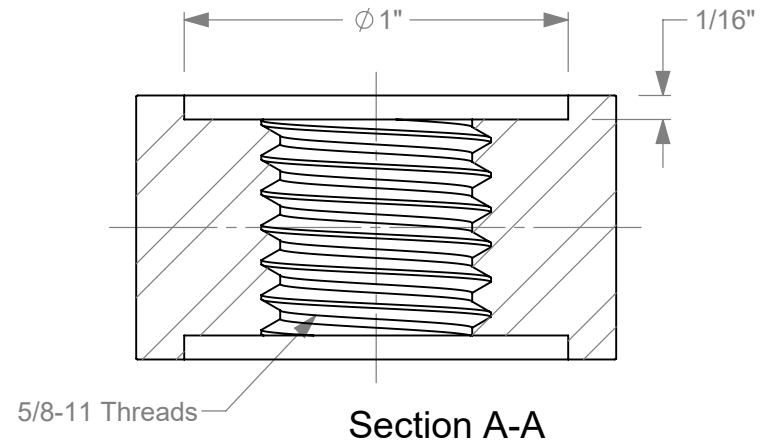
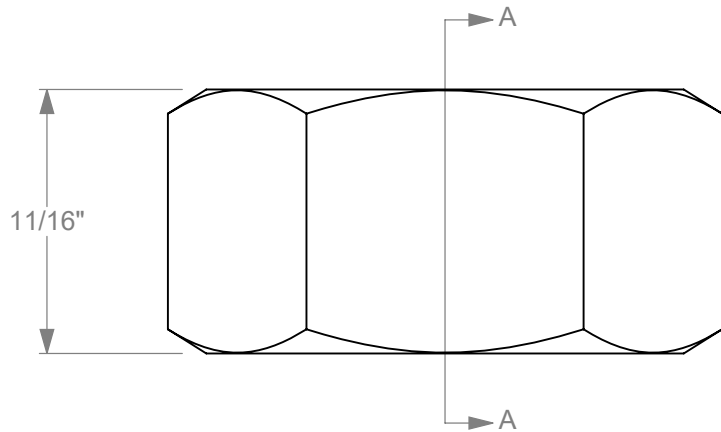
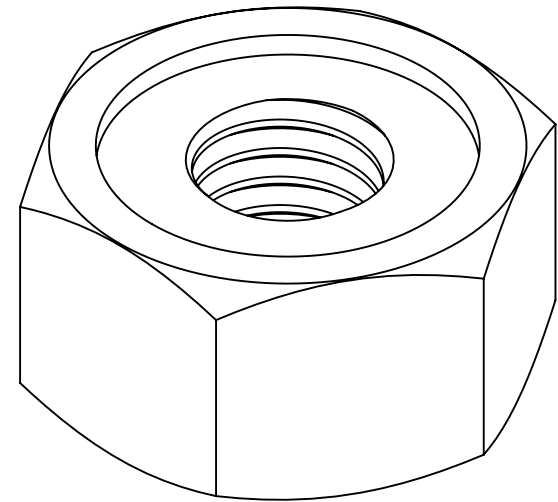
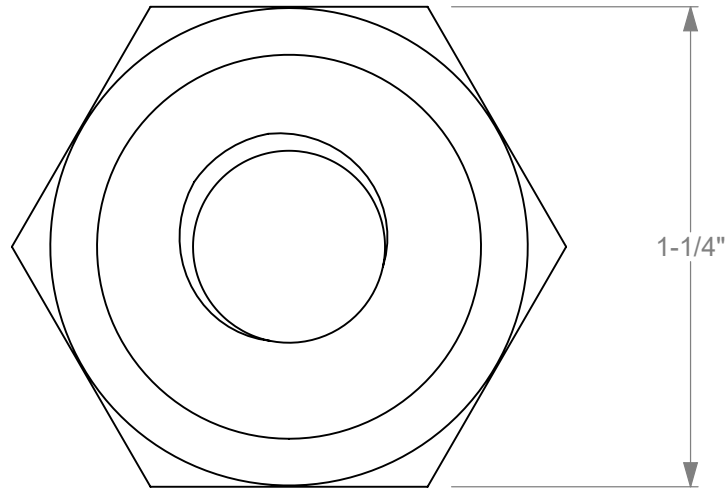
- 1a. Material is ASTM A307.
- 1b. All bolt sizes not used in all projects. See system drawing.
- 1c. Head and shoulder dimensions typical all sizes.



Roadside Safety and  
Physical Security Division -  
Proving Ground

Guardrail Bolt		2020-04-22
Drawn by GES/WS	Scale 1:2	Sheet 1 of 1

# Recessed Guardrail Nut



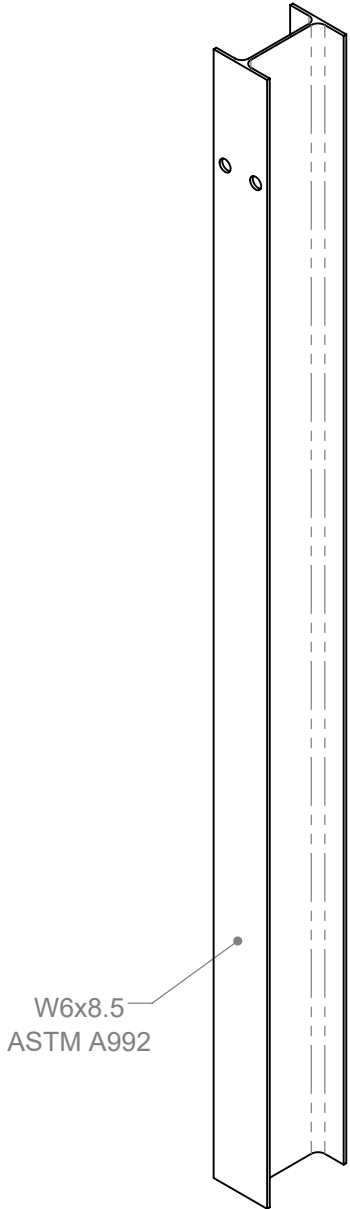
1a. Material is ASTM A 563 Grade A.



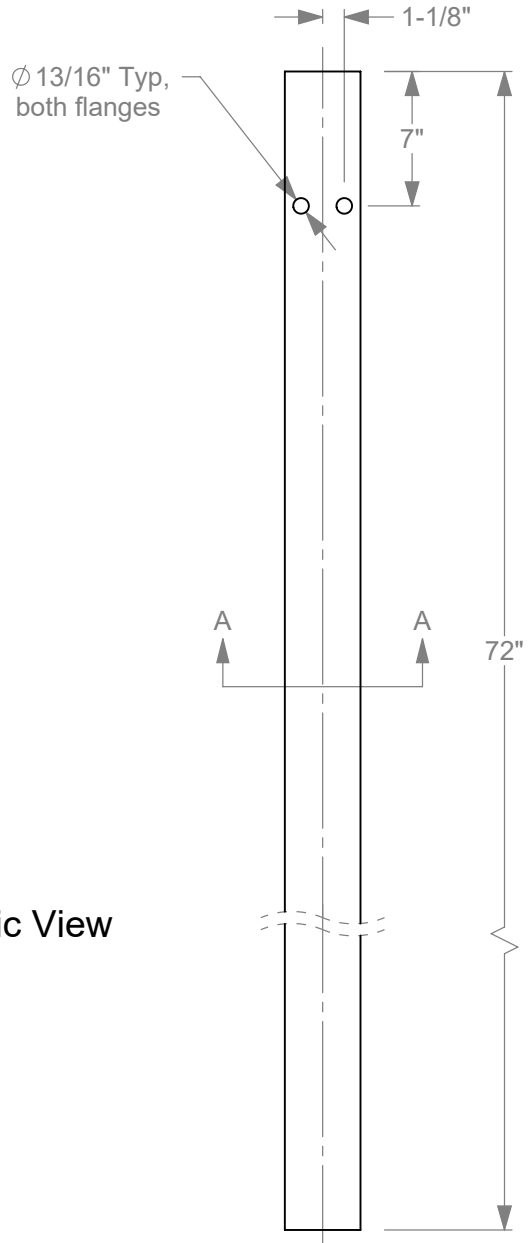
Roadside Safety and  
Physical Security Division -  
Proving Ground

Recessed Guardrail Nut		2019-06-27
Drawn by GES	Scale 2:1	Sheet 1 of 1

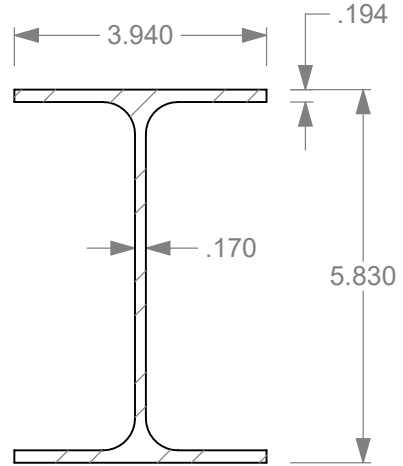
# 72" Wide-Flange Guardrail Post



Isometric View



Elevation View



Section A-A  
Scale 1 : 3

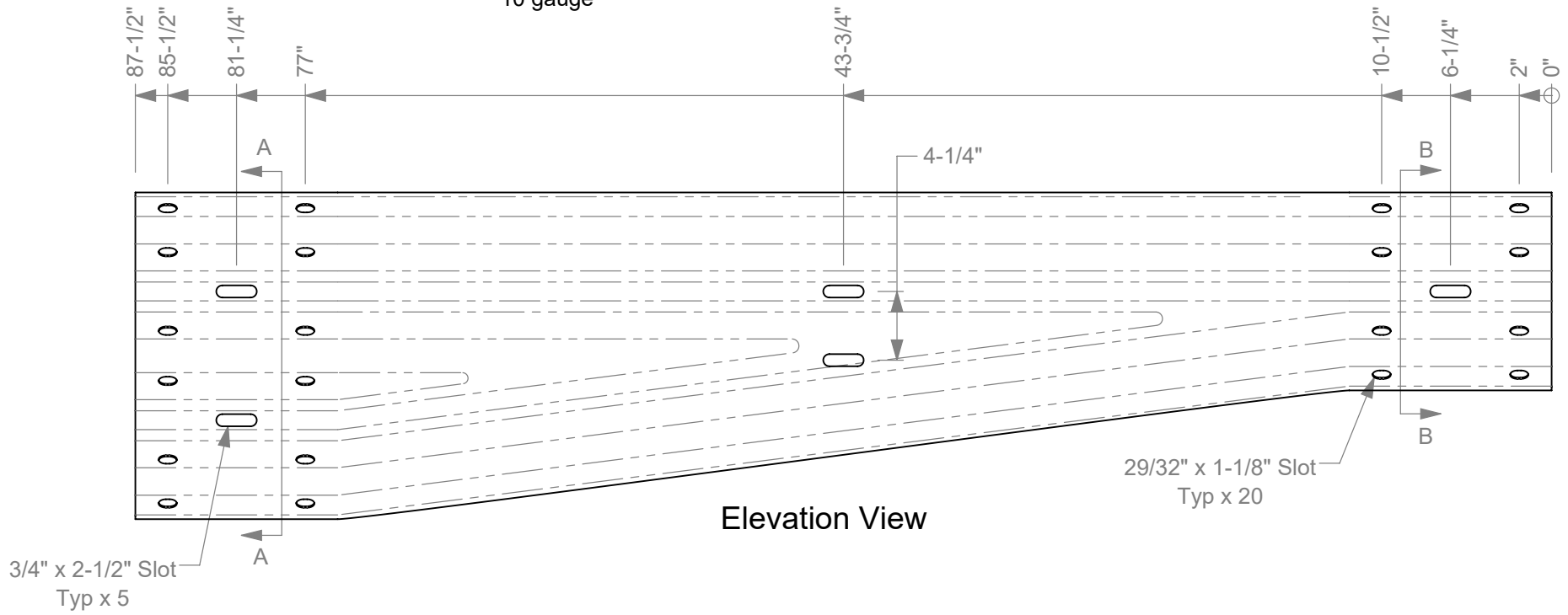


Roadside Safety and  
Physical Security Division -  
Proving Ground

72" Wide-Flange Guardrail Post		2020-01-06
Drawn by GES	Scale 1:10	Sheet 1 of 1

# Thrie to W-Beam, asymmetric

10 gauge



Elevation View



Section A-A  
See Thrie-beam Drawing



Section B-B  
See W-beam Drawing

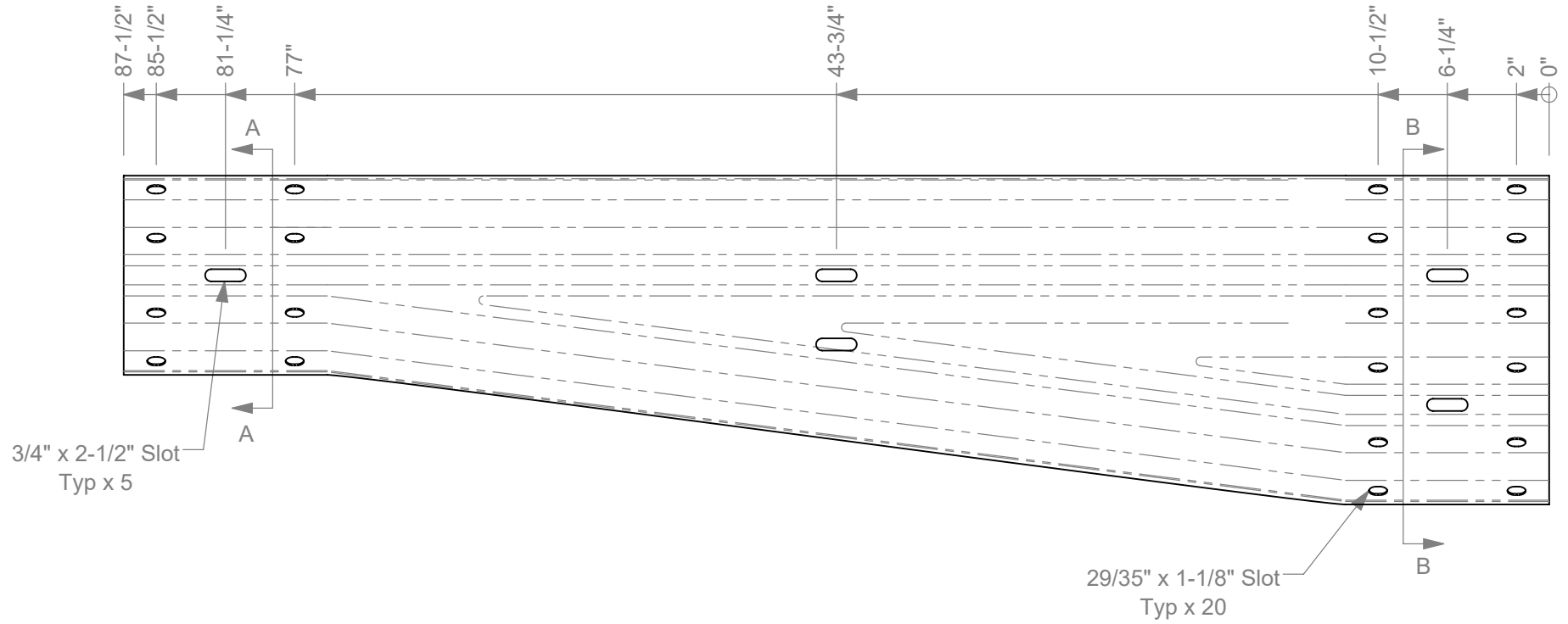


Roadside Safety and  
Physical Security Division -  
Proving Ground

Thrie- to W-beam Transition		2019-08-22
Drawn by GES	Scale 1:10	Sheet 1 of 1

# W- to Thrie-beam, asymmetric

10 gauge



**Section A-A**  
See W-beam Drawing



**Section B-B**  
See W-beam Drawing

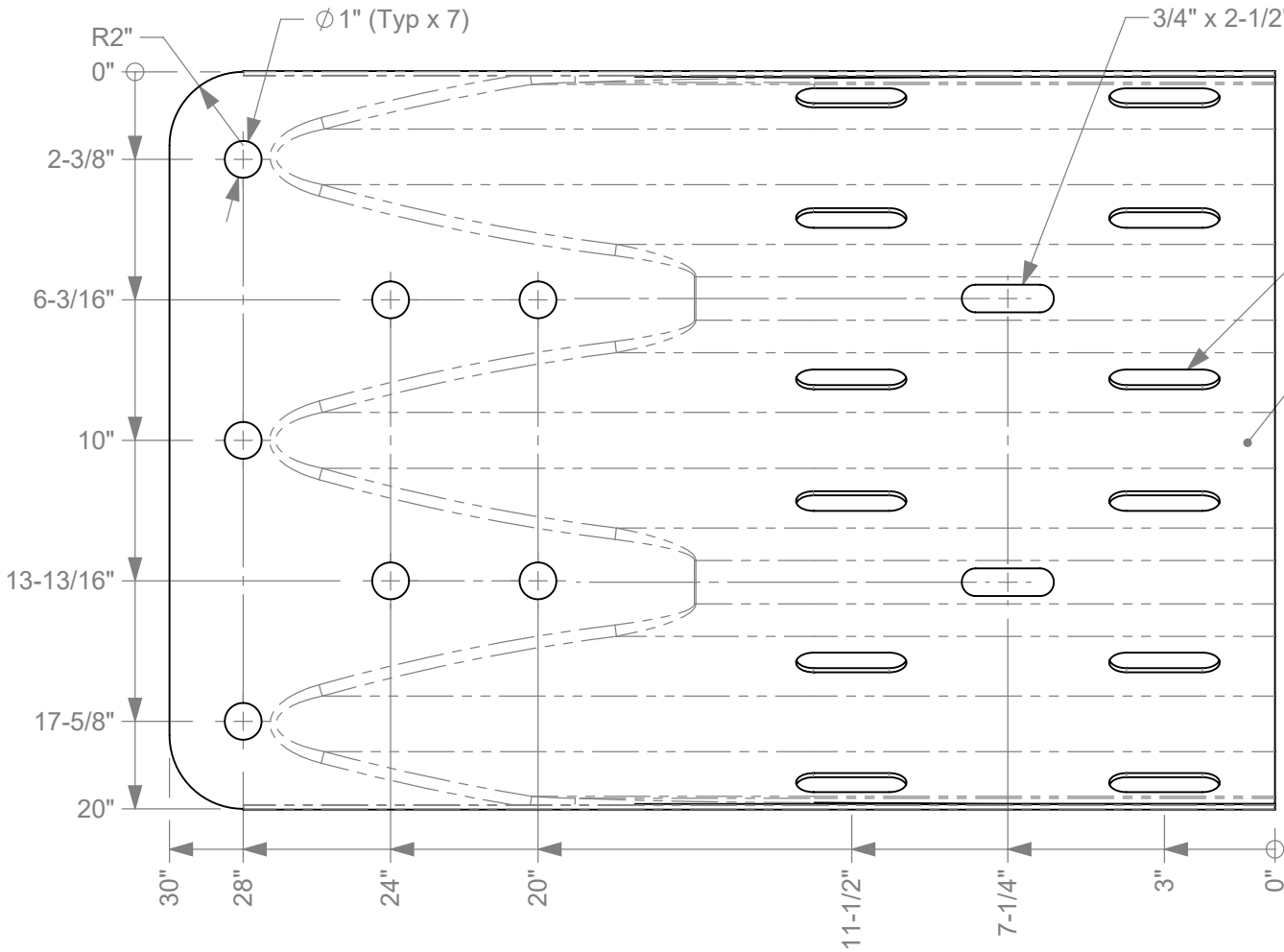


Roadside Safety and  
Physical Security Division -  
Proving Ground

W- to Thrie-beam Connection		2020-09-04
Drawn by GES	Scale 1:10	Sheet 1 of 1

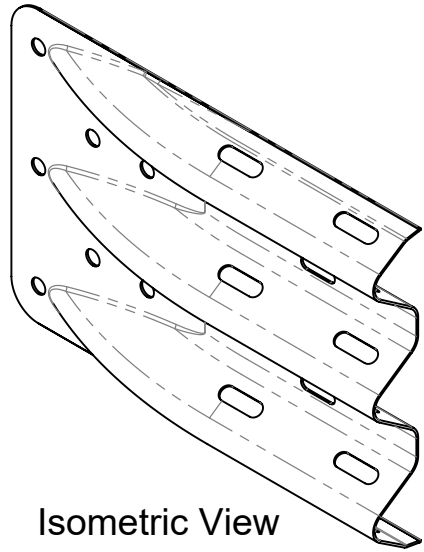
# Thrie-beam End Shoe

10 gauge (0.1345" before galvanizing)



Elevation View

3/4" x 2-1/2" Slots  
 Slot, 15/16" x 3"  
 Typ x 12  
 See Thrie-beam drawing  
 for cross-section.



Isometric View

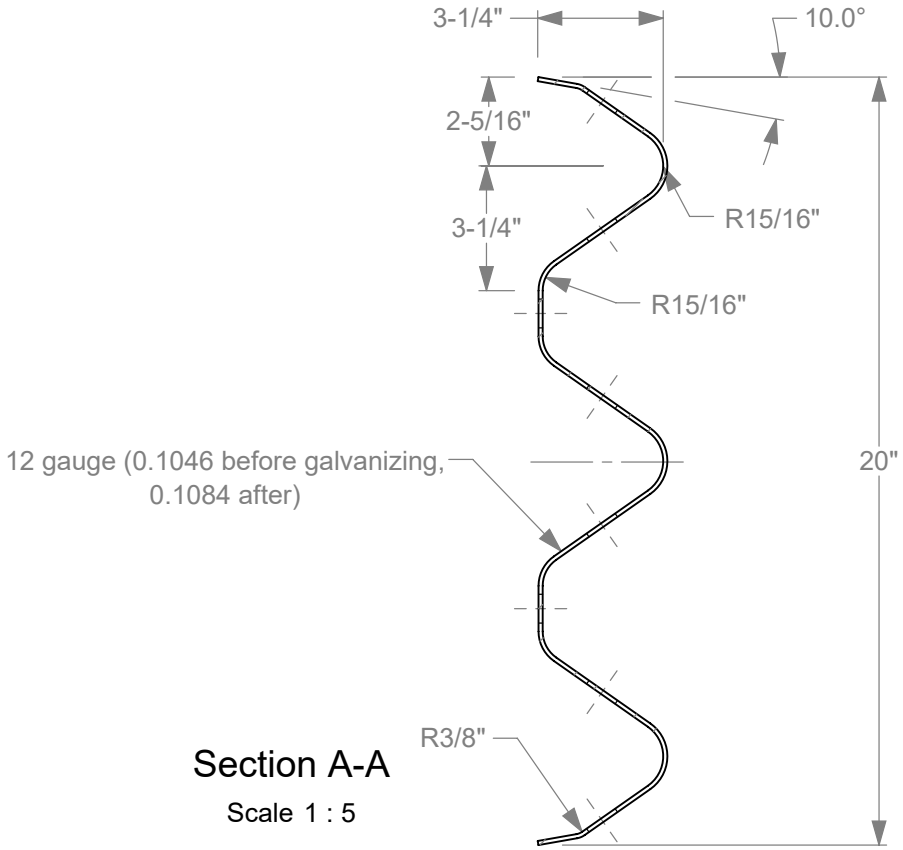
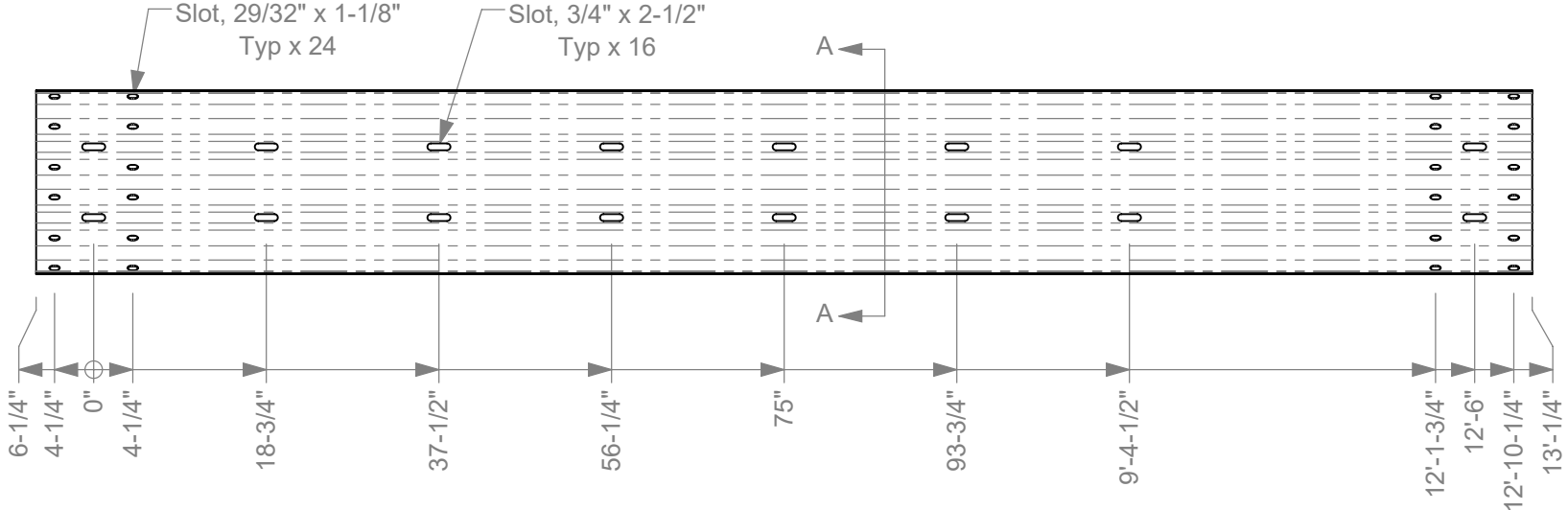


Roadside Safety and  
 Physical Security Division -  
 Proving Ground

Thrie-beam Terminal Connector		2019-07-29
Drawn by GES	Scale 1:5	Sheet 1 of 1



# Thrie-Beam for Transition



**Section A-A**  
Scale 1 : 5

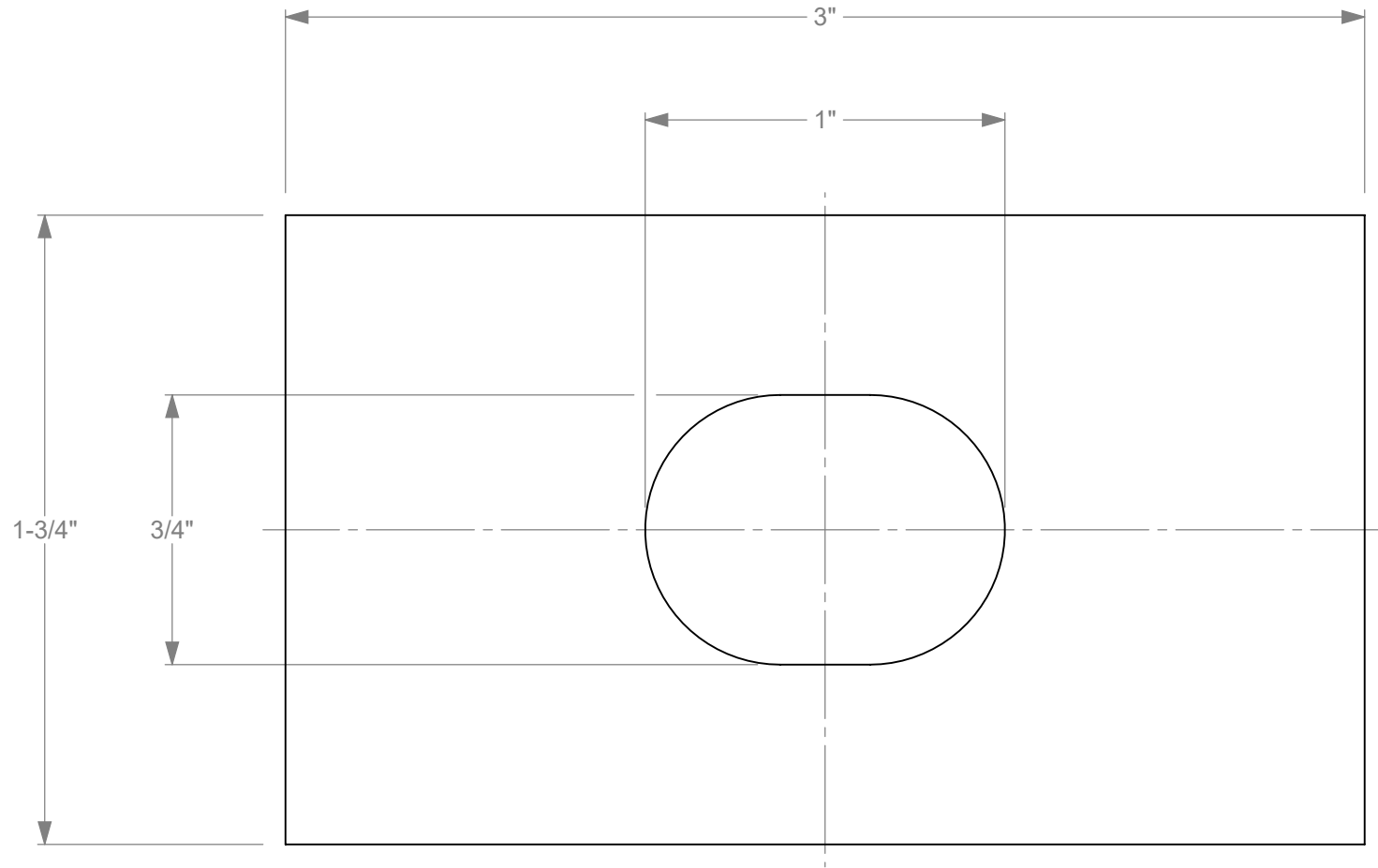


Roadside Safety and  
Physical Security Division -  
Proving Ground

Transition 12 gauge Thrie-beam		2019-07-30
Drawn by GES	Scale 1:20	Sheet 1 of 1

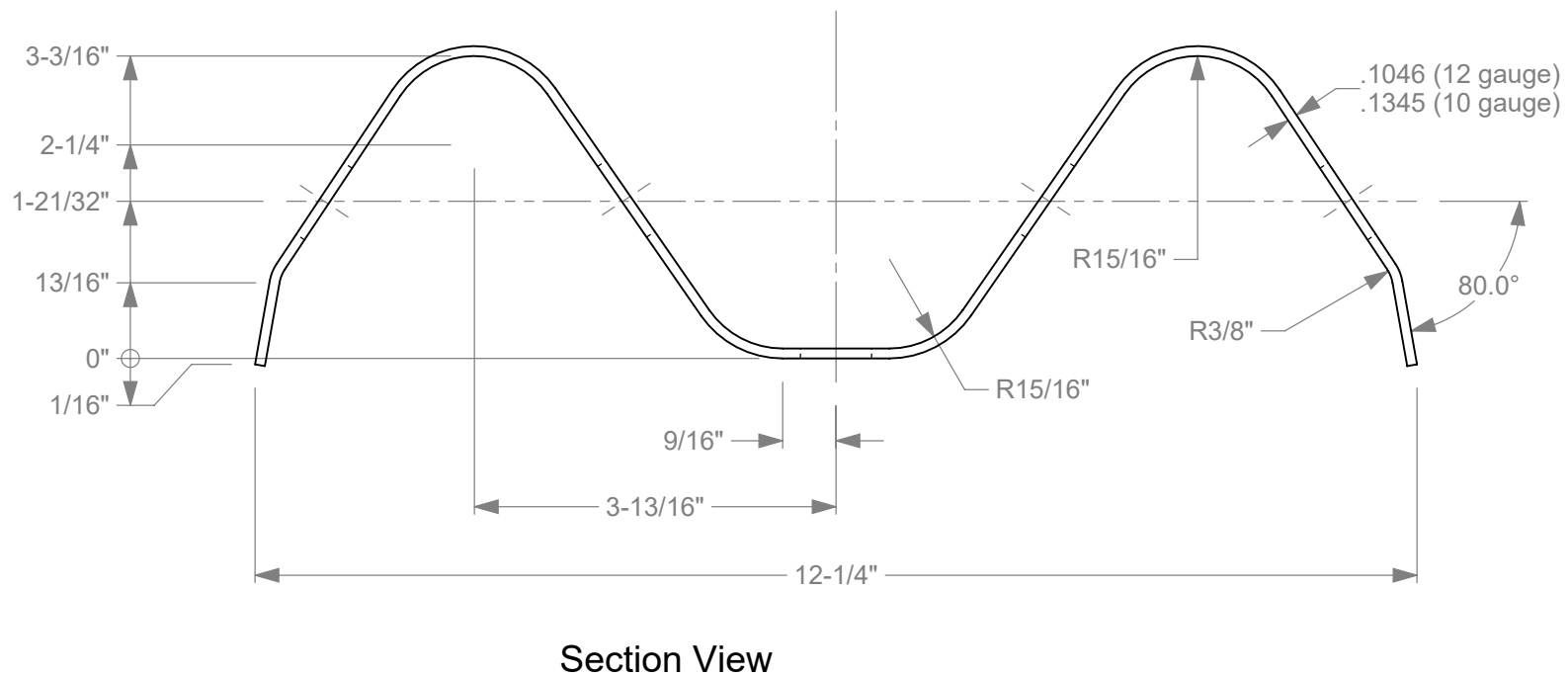
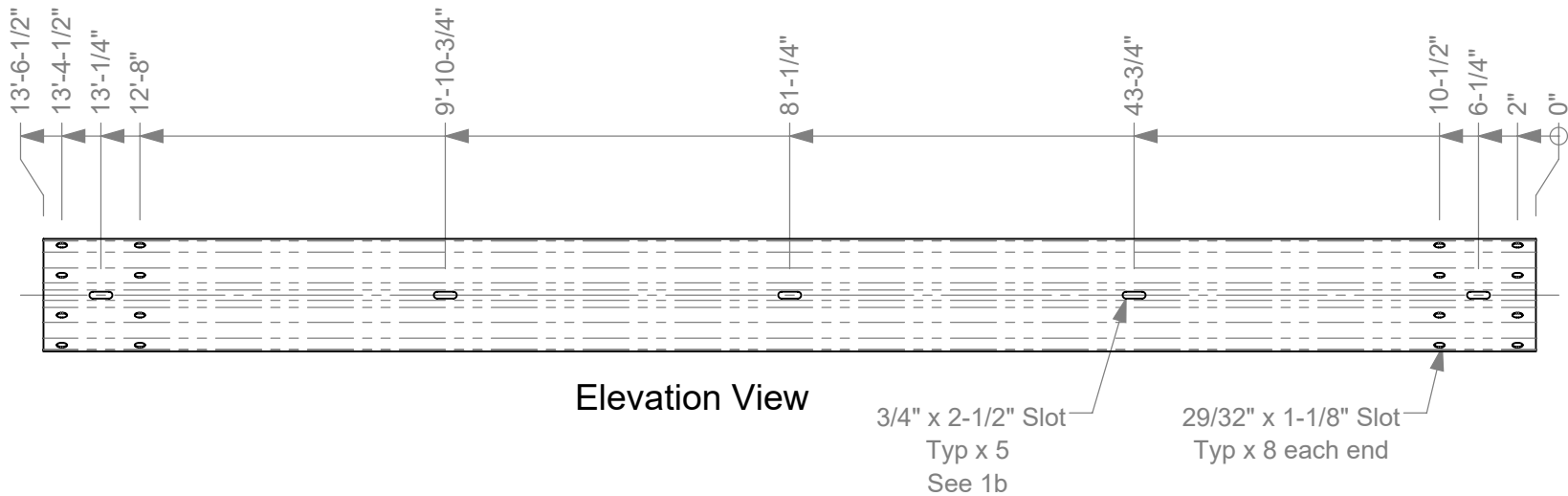
# Rectangular Guardrail Washer

0.20" thick



Roadside Safety and  
Physical Security Division -  
Proving Ground

Rectangular Guardrail Washer		2019-08-08
Drawn by GES	Scale 2:1	Sheet 1 of 1



**1a.** Manufacture per AASHTO M180 specifications.

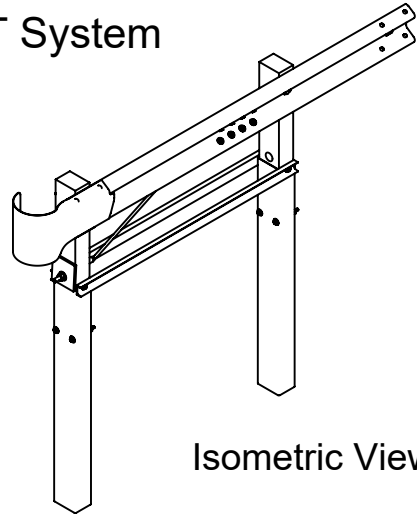
**1b.** 4-space Guardrail is shown. Slots typical x 3 for 2-space W-beam spaced at 75", and typical x 9 for 8-space W-beam spaced at 18-3/4". Slots are typical x 4 at 37-1/2" for 9'-4-1/2" span W-beam.



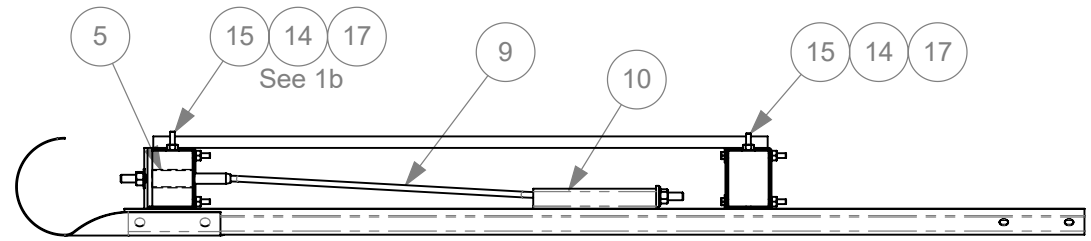
Roadside Safety and  
Physical Security Division -  
Proving Ground

4-space W-beam Guardrail		2020-06-05
Drawn by GES	Scale 1:20	Sheet 1 of 1

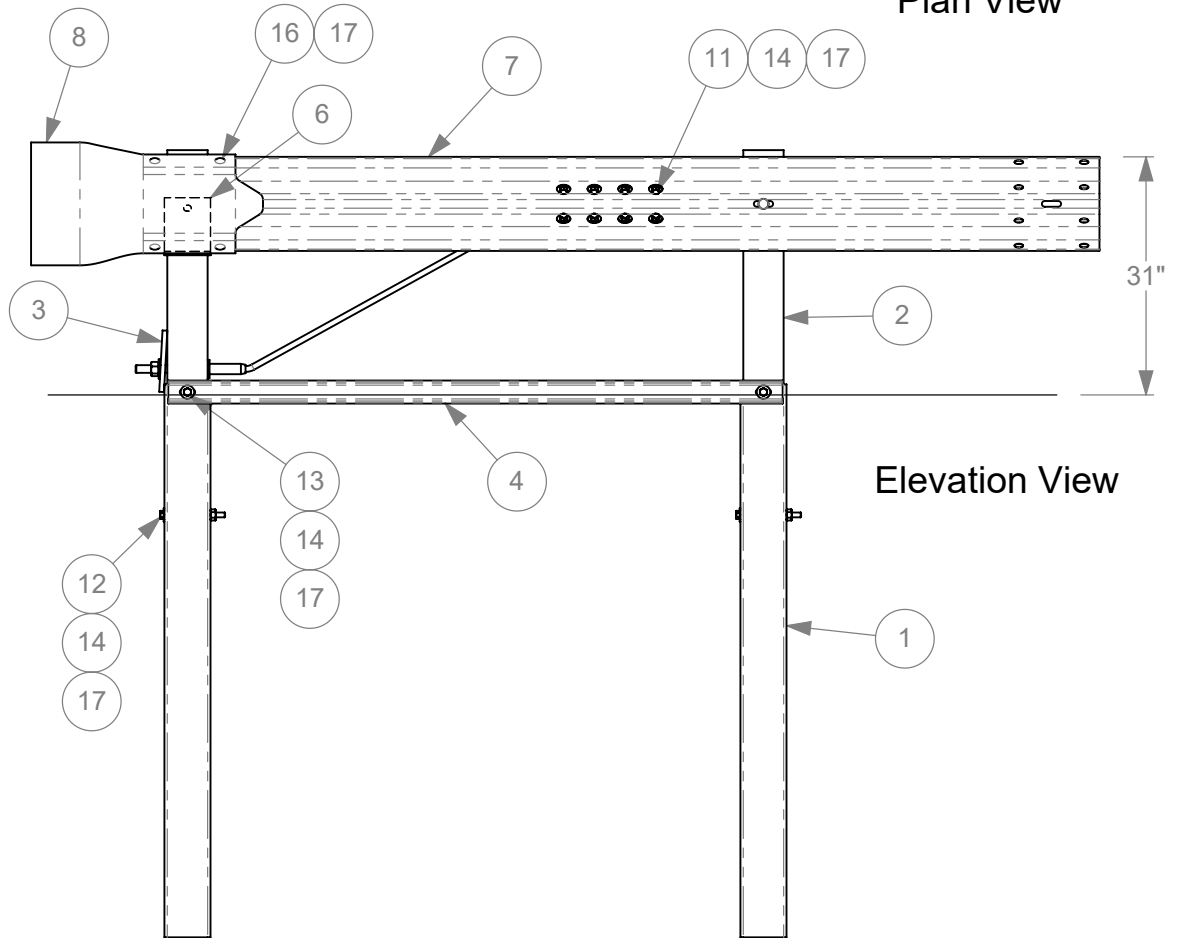
# DAT System



Isometric View



Plan View



Elevation View

#	Part Name	Qty.
1	Foundation Tube	2
2	Terminal Timber Post	2
3	BCT Bearing Plate	1
4	DAT Strut	2
5	BCT Post Sleeve	1
6	Shelf Angle Bracket	1
7	DAT Terminal Rail	1
8	W-beam End Section	1
9	Anchor Cable Assembly	1
10	Guardrail Anchor Bracket	1
11	Bolt, 5/8 x 2" hex	8
12	Bolt, 5/8 x 8" hex	4
13	Bolt, 5/8 x 10" hex	2
14	Washer, 5/8 F844	16
15	10" Guardrail Bolt	2
16	1-1/4" Guardrail Bolt	4
17	Recessed Guardrail Nut	20

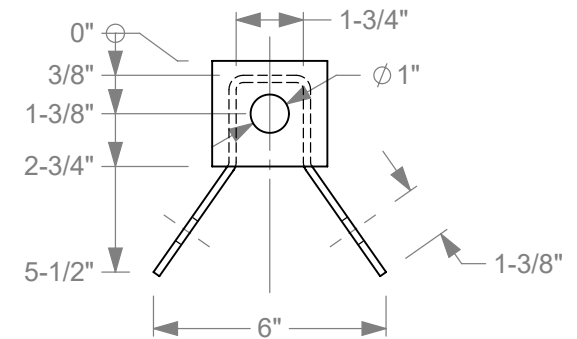
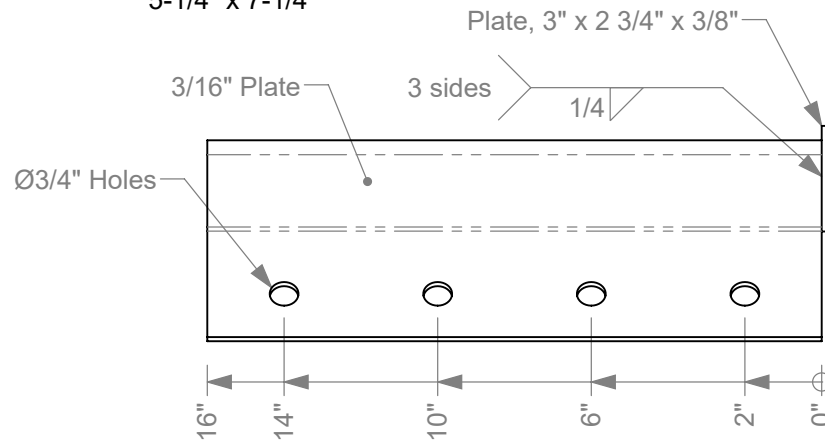
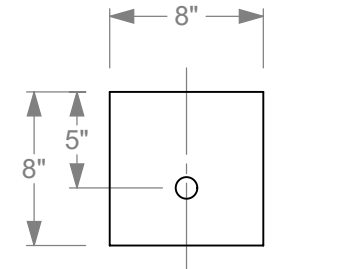
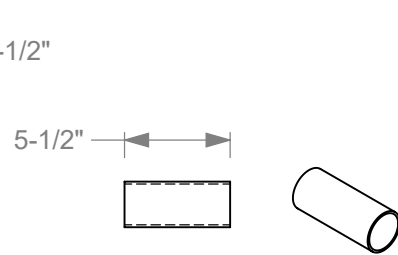
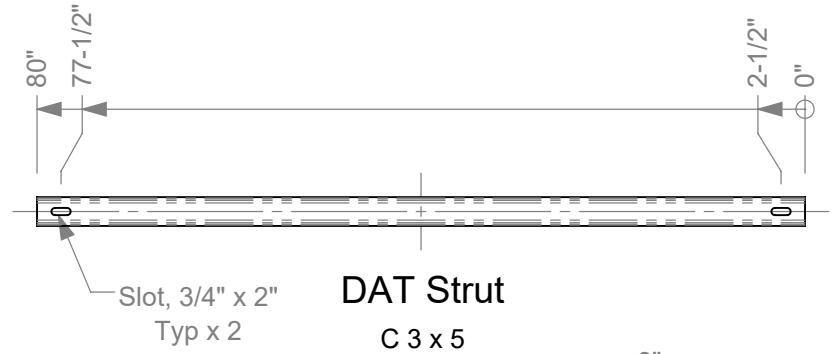
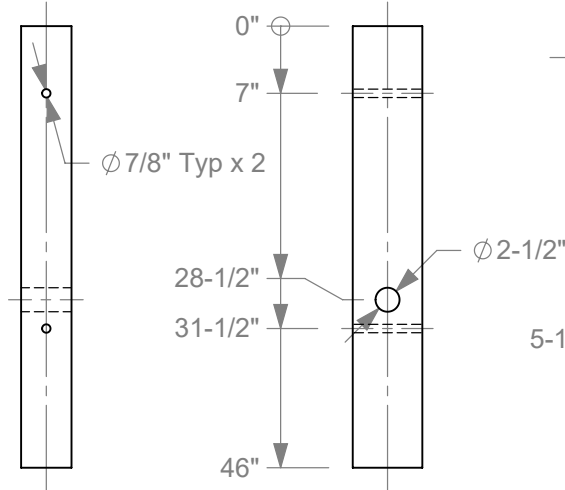
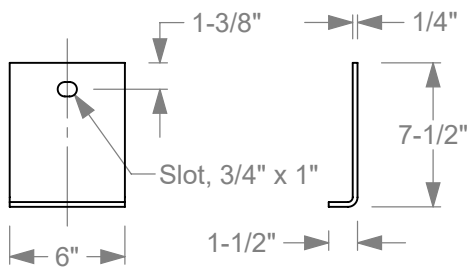
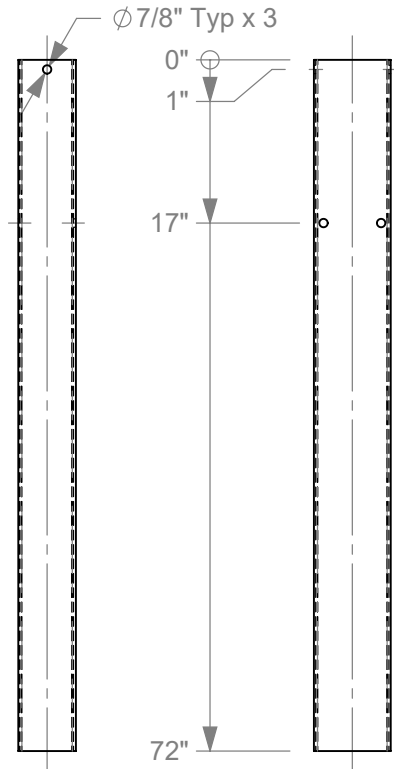
**1a.** All bolts are ASTM A307.  
**1b.** Hardware secures Shelf Angle Bracket to Post. Rail is supported by Shelf Angle Bracket and does not attach directly to Post.



Roadside Safety and Physical Security Division - Proving Ground

DAT (Downstream Anchor Terminal)		2019-07-26
Drawn by GES	Scale 1:25	Sheet 1 of 3

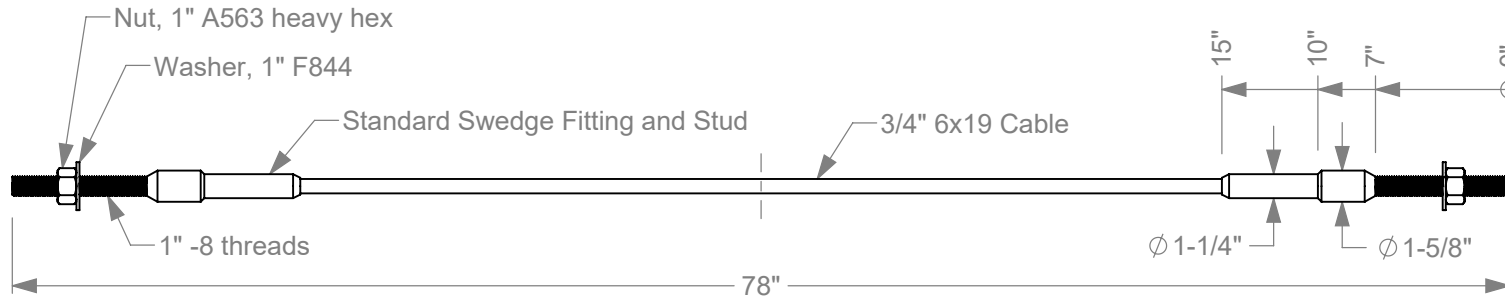
# DAT Parts sheet 1



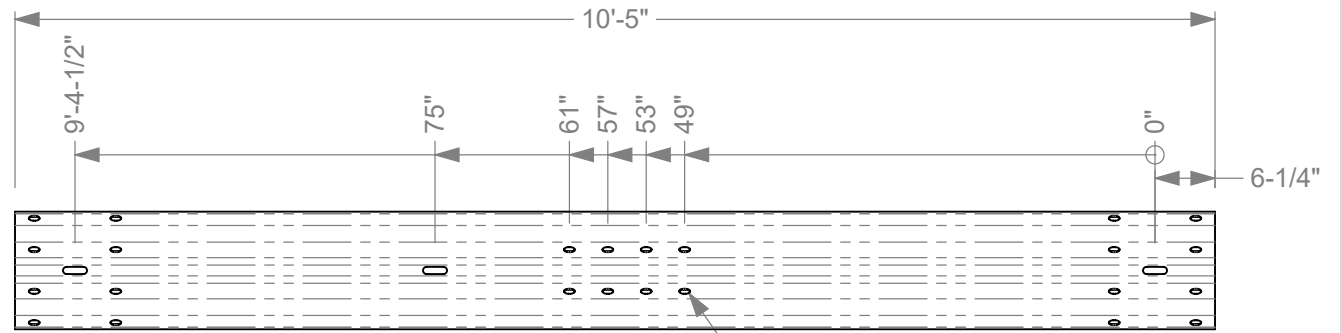
Roadside Safety and Physical Security Division - Proving Ground

DAT (Downstream Anchor Terminal)		2019-07-26
Drawn by GES	Scale 1:20	Sheet 2 of 3

# DAT Parts sheet 2

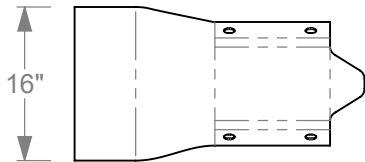
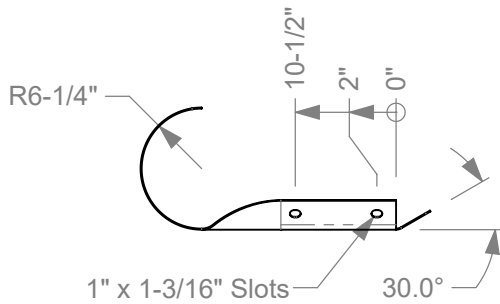


**Anchor Cable Assembly**



## DAT Terminal Rail

Scale 1:20 - See 4-space W-beam Guardrail drawing for cross-section and other dimensions.



## W-beam End Section

12 gauge steel - Scale 1:20



Roadside Safety and Physical Security Division - Proving Ground

DAT (Downstream Anchor Terminal)

2019-07-26

Drawn by GES

Scale 1:10

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