

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: 11/1/2020 – 01/31/2021

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:

A 10 month no-cost time extension was executed in December to permit completion of the programmed research tasks. Based on progress in January and the projected test schedule, the project is on schedule based on the modified time line.

2. Percentage of overall work completed.

50%

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 test installation drawings for the box beam transition were approved last quarter. The test installation drawings for the MGS transition system were updated and sent to WYDOT for review and approval on October 23. WyDOT approval of the drawings, including approval to proceed with construction and full-scale crash testing, was received on November 5, 2020. The approved test installation drawings are included in Attachment A and Attachment B, respectively. The test installation will include 20 ft of C2P bridge rail anchored to a moment slab. A transition, approach guardrail, and terminal will be attached to each end of the bridge rail section. The box beam transition will be attached to one side of the C2P bridge rail section and the MGS transition will be attached to the other side of the C2P bridge rail system.

Upon receipt of approval to proceed, the test installation construction process was initiated at the TTI Proving Ground. Parts lists were created from the approved test installation drawings for construction of the C2P bridge rail section, box beam transition, and MGS transition systems. The parts lists include items required for both initial construction and repair between tests.

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

TTI researchers have developed a test plan for both the box beam and MGS transition systems. The *MASH* test matrix for transitions consists of two tests: Test 3-20 with a passenger car, and Test 3-21 with a pickup truck. In both tests, the vehicle impacts the more flexible of the two barrier systems being connected at a nominal speed and angle of 62 mi/h and 25 degrees.

For the box beam transition, *MASH* Test 3-20 and Test 3-21 will be performed on both the downstream and upstream ends of the 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. 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 tentative tests dates selected for evaluation of the box beam transition system are as follows:

- April 13 – Test 3-20 on downstream end of box beam transition
- April 19 – Test 3-21 on downstream end of box beam transition
- April 30 – Test 3-20 on upstream end of box beam transition

- May 4 – 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.

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

After completion of the testing for the box beam guardrail transition, the MGS transition system will be installed. 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 box beam transition system are as follows:

- May 11 – Test 3-20 on downstream end of MGS transition
- May 25 – 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.

- 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. Materials required for construction of both the C2P bridge rail and transition systems will be acquired. Construction of the simulated bridge rail system and attached box beam transition will be completed. Crash testing of the box beam transition will be initiated.

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:

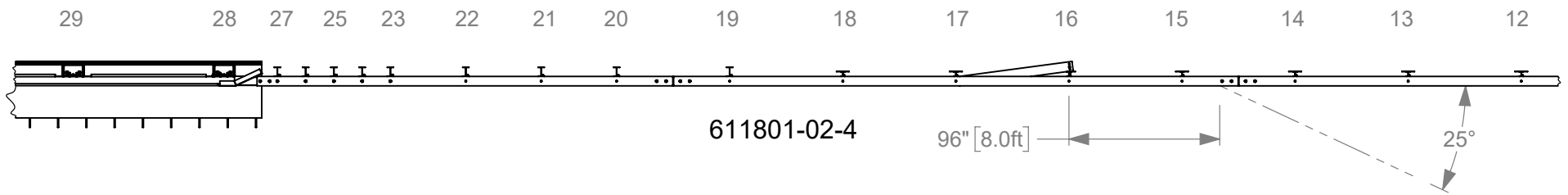
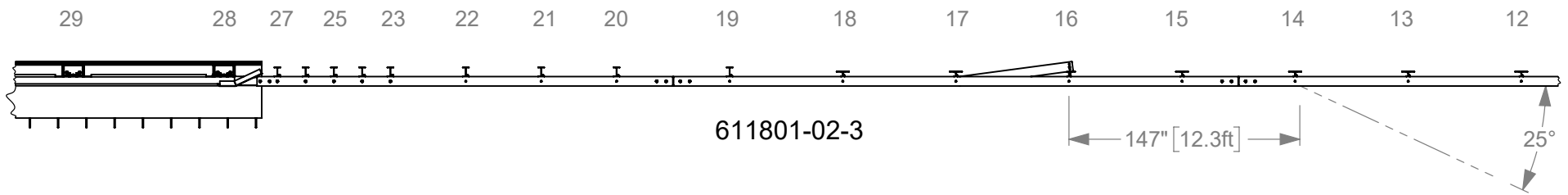
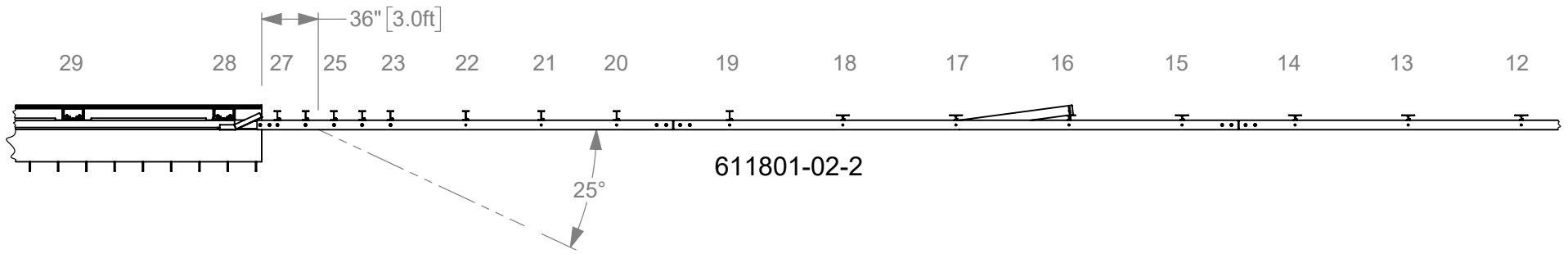
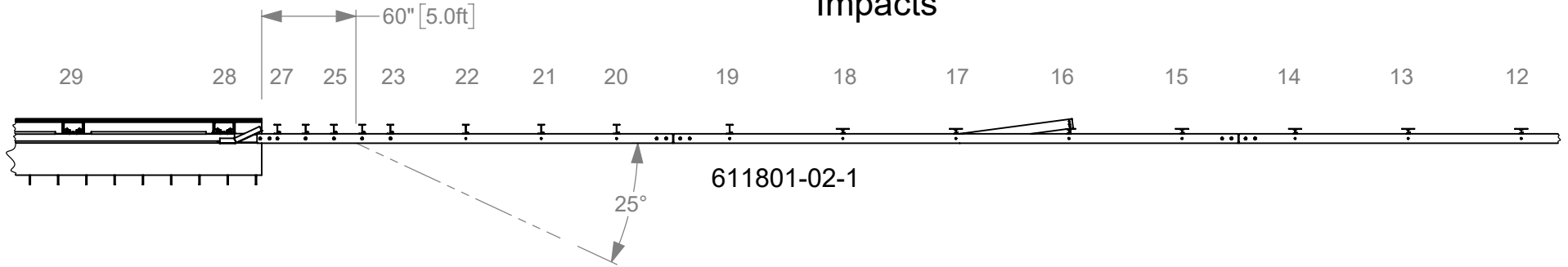
1. Scope of work or objectives of the project.
2. Changes in key persons.
3. Disengagement from the project for more than three (3) months, or a twenty five (25) percent reduction in time devoted to the project.
4. The inclusion of costs that require prior approval.
5. The transfer of funds between line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

Nothing to report.

ATTACHMENT 1

Box Beam Guardrail Transition Test Installation Details

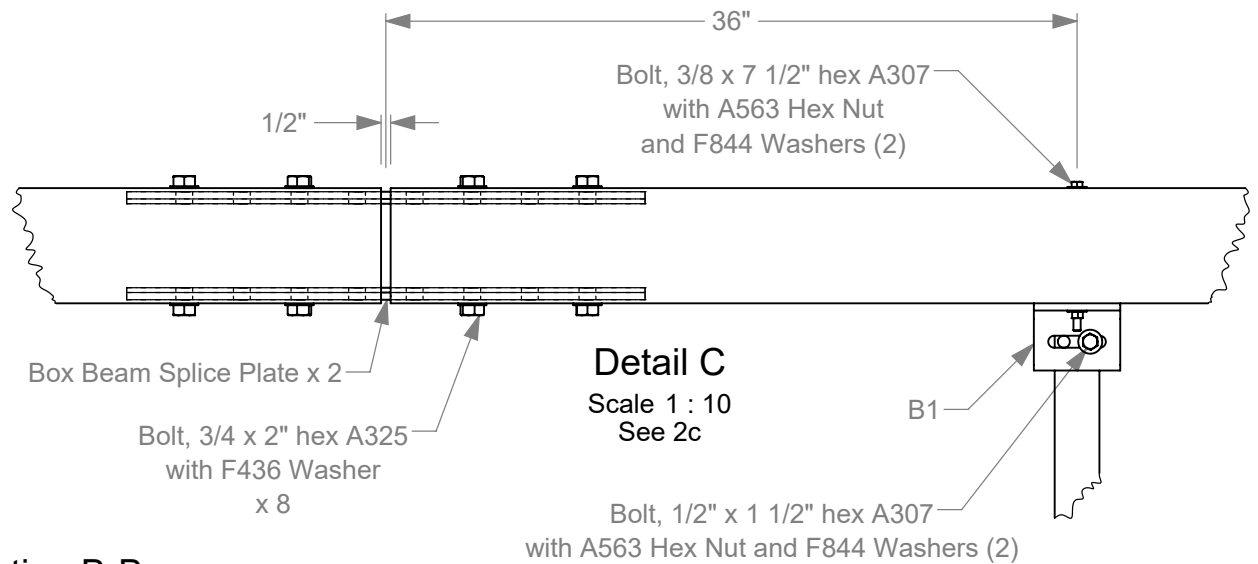
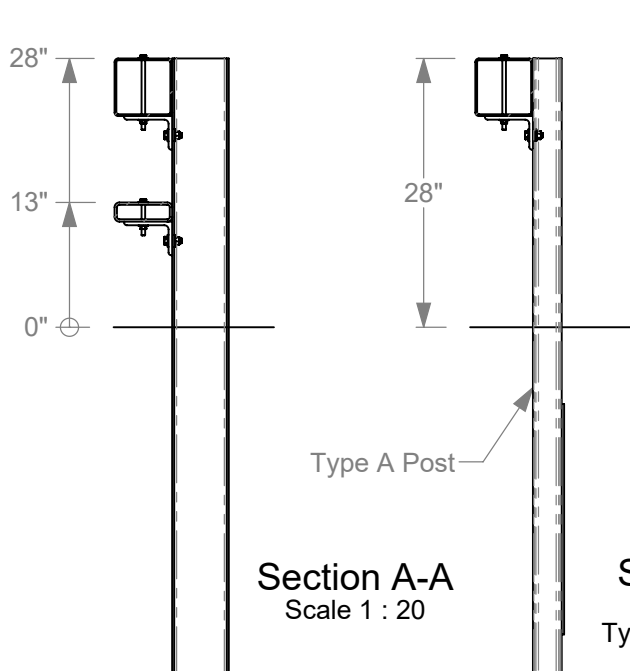
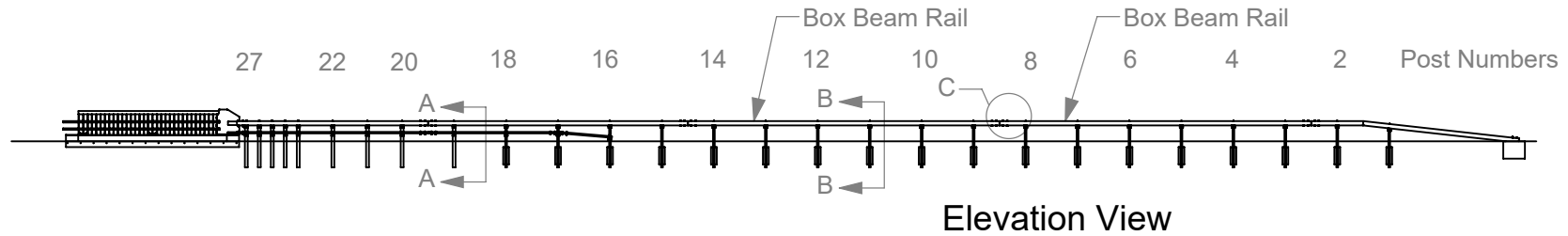
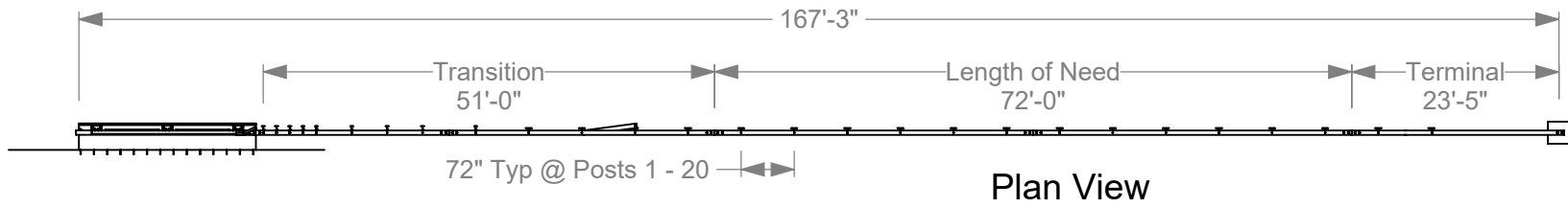
Impacts



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Proving Ground

Project #611801 Wyoming Box Beam Transition		2021-01-06
Drawn by GES	Scale 1:100	Sheet 1 of 26 Impacts

Test Installation



- 2a. All steel components, including fasteners, shall be galvanized.
- 2b. Threads not shown on Bolts for clarity.
- 2c. Rail Joint hardware typical 4 places. Post bracket and hardware typical from Post 1 to 22.



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Project #611801 Wyoming Box Beam Transition

2021-01-06

Drawn by GES

Scale 1:250

Sheet 2 of 26 Test Installation

Transition Details

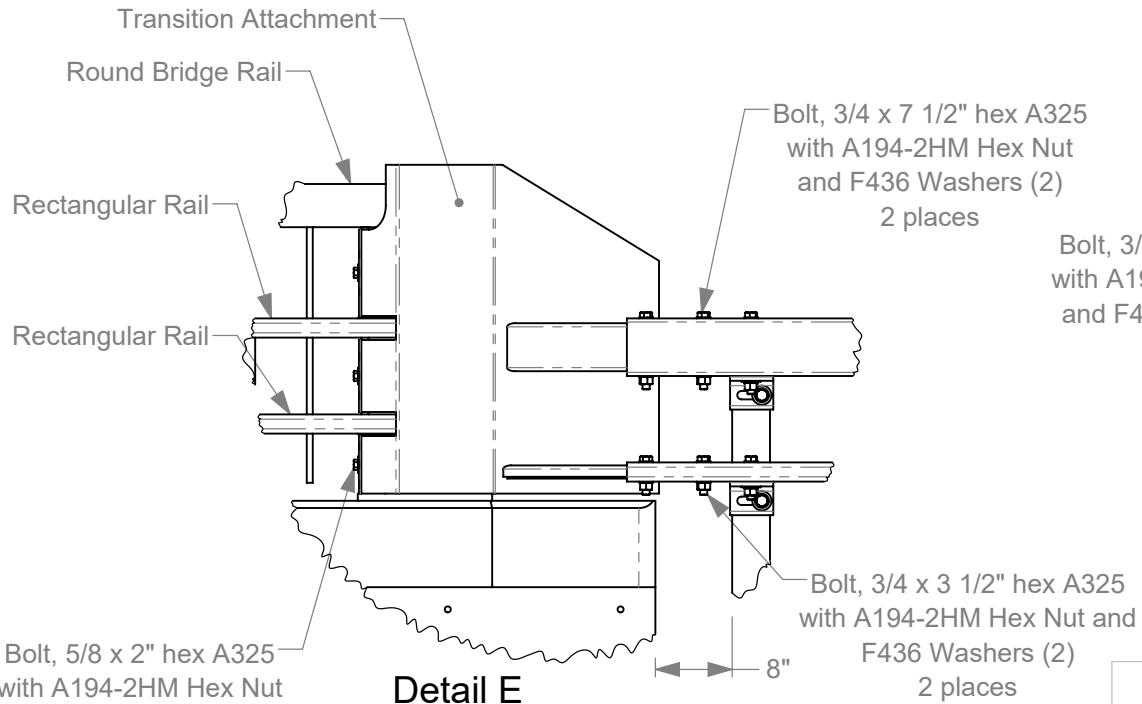
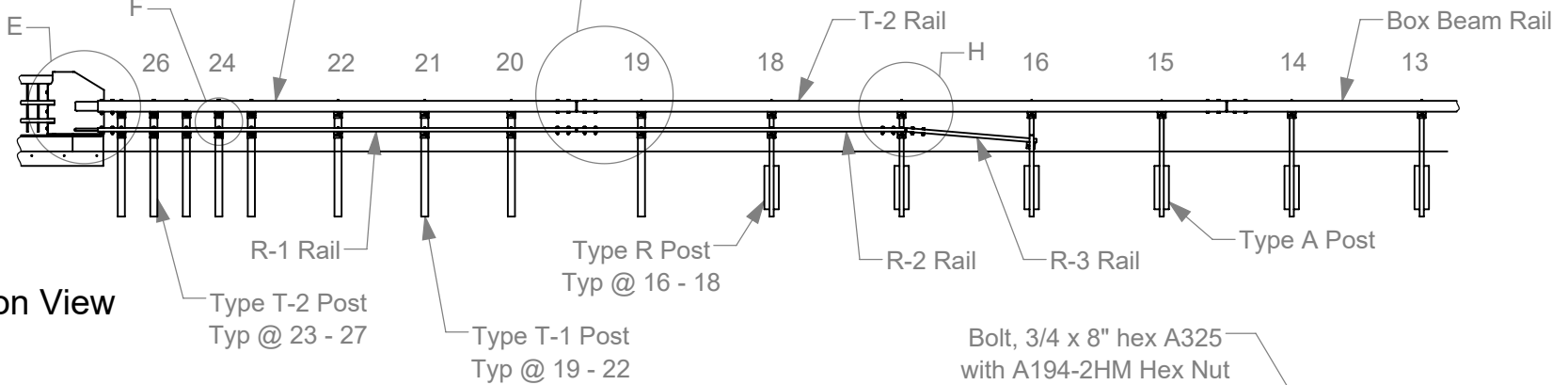
some Detail Views on next sheet

4 sp @ 18"
72" 3 sp @ 48"
12'-0"

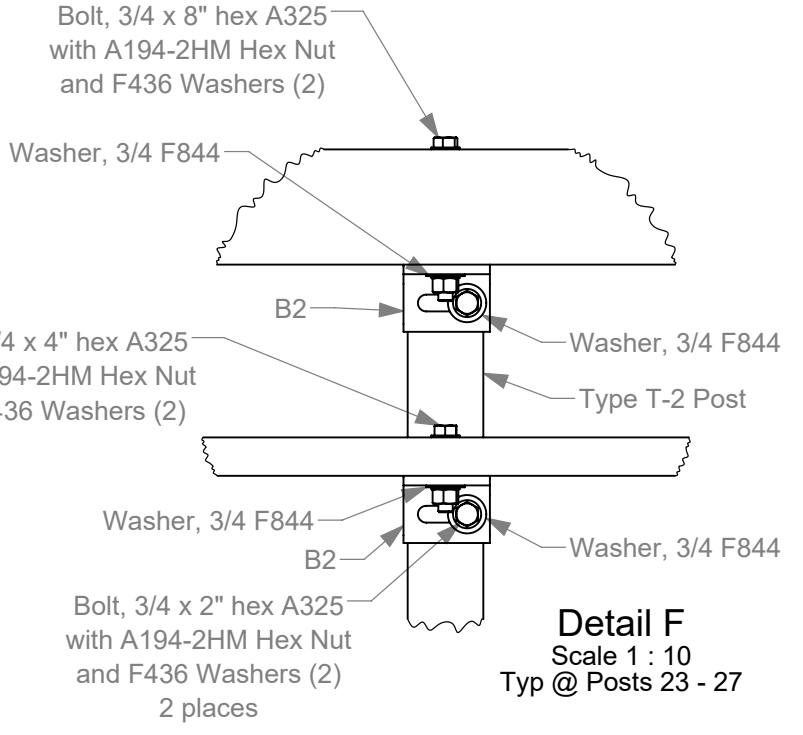


Plan View

Elevation View



Detail E
Scale 1 : 20



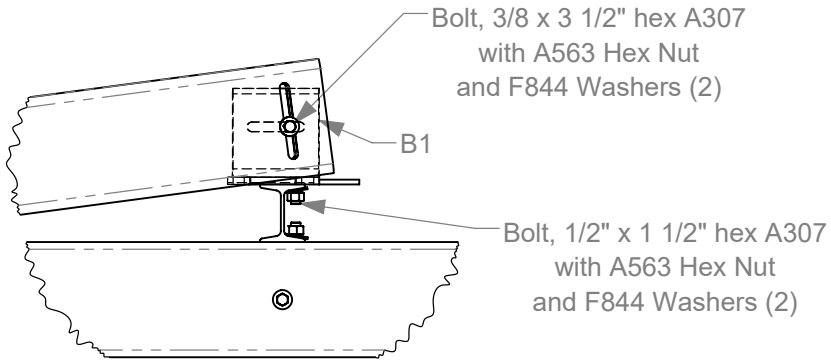
Detail F
Scale 1 : 10
Typ @ Posts 23 - 27



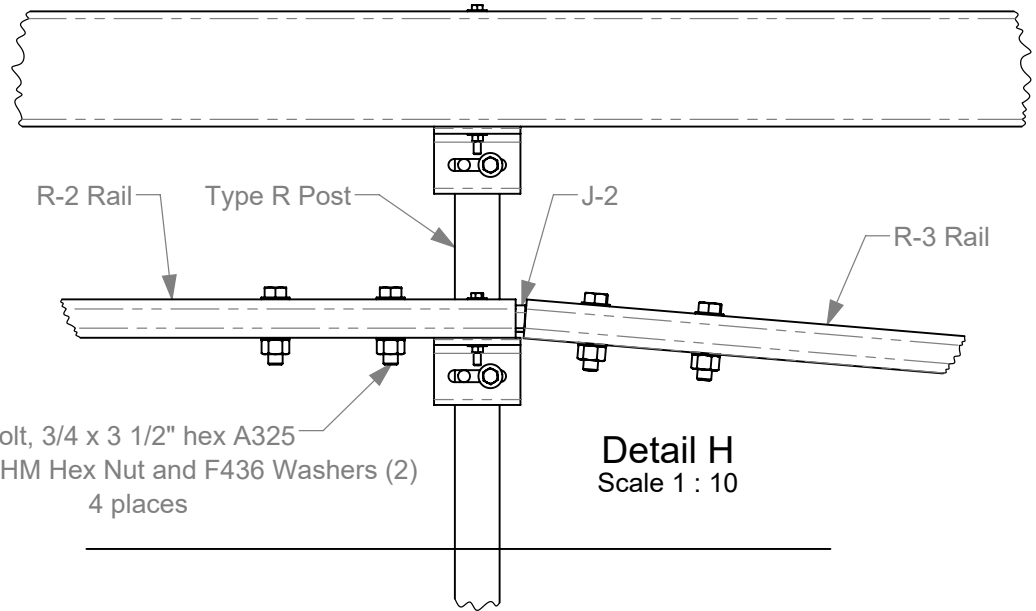
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Project #611801 Wyoming Box Beam Transition		2021-01-06
Drawn by GES	Scale 1:100	Sheet 3 of 26 Transition Details

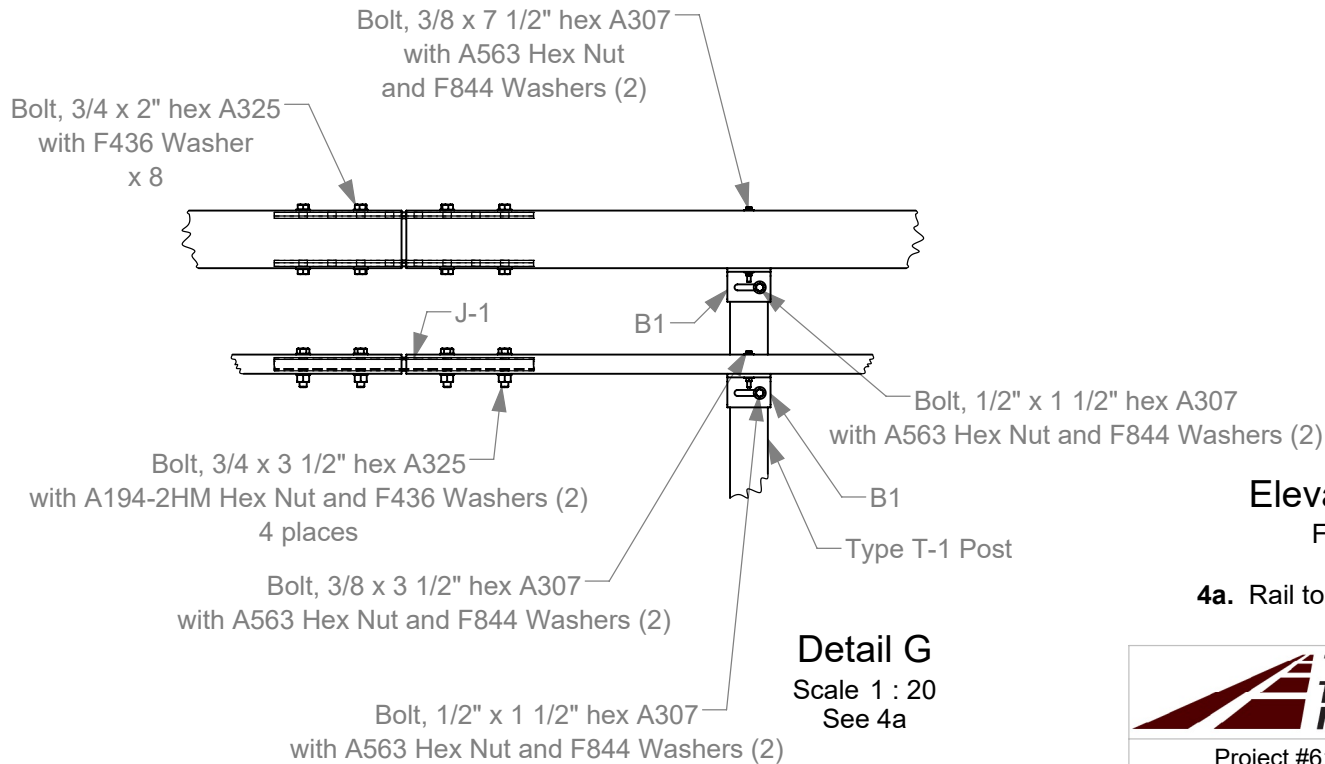
Transition Detail Views



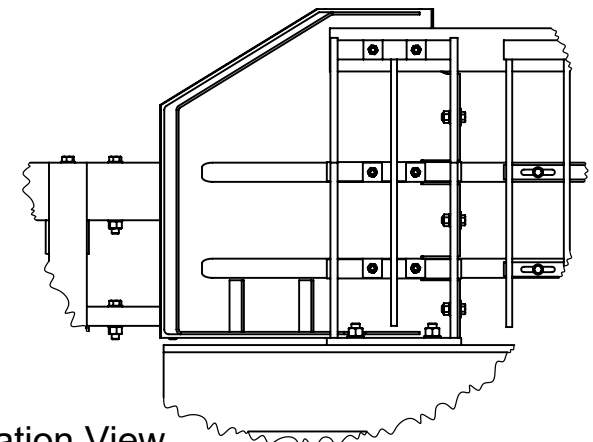
Detail D
Scale 1 : 10



Detail H
Scale 1 : 10



Detail G
Scale 1 : 20
See 4a



Elevation View
Field Side

4a. Rail to Post connection details typical at Posts 17 - 22.



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Project #611801 Wyoming Box Beam Transition

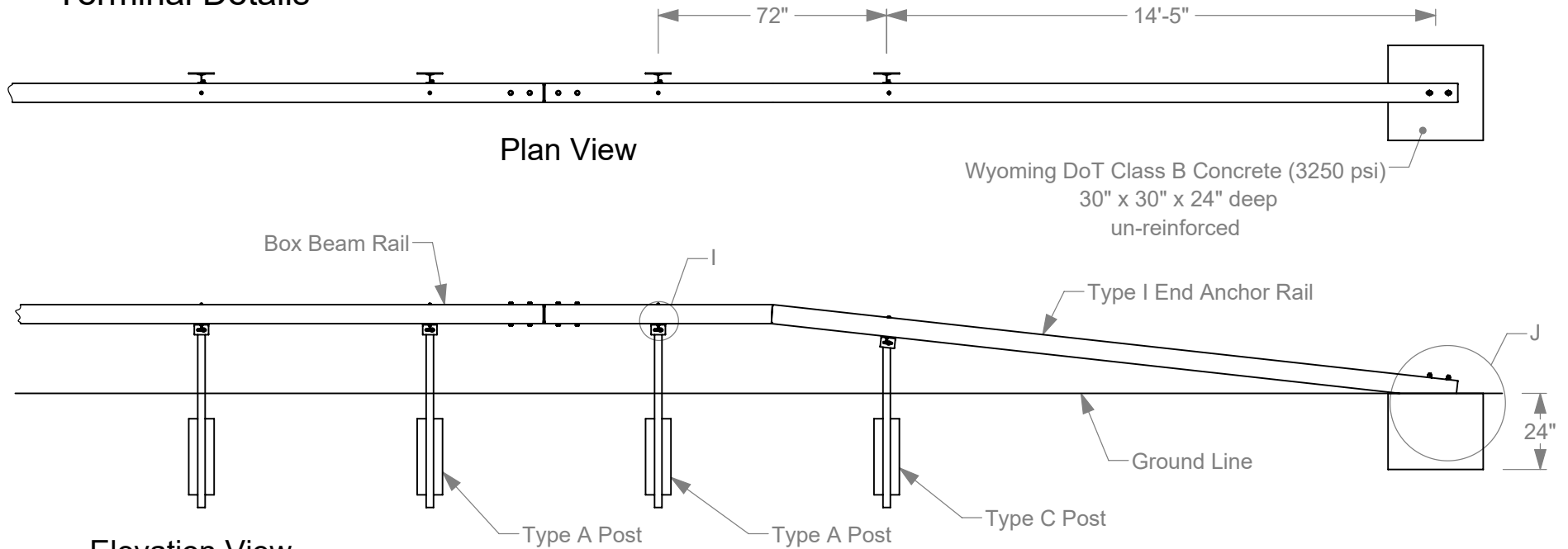
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Drawn by GES

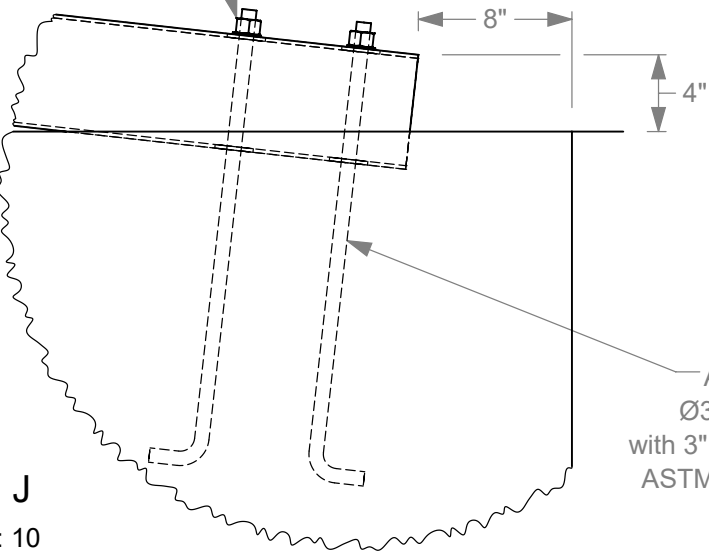
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Sheet 4 of 26 Transition Detail Views

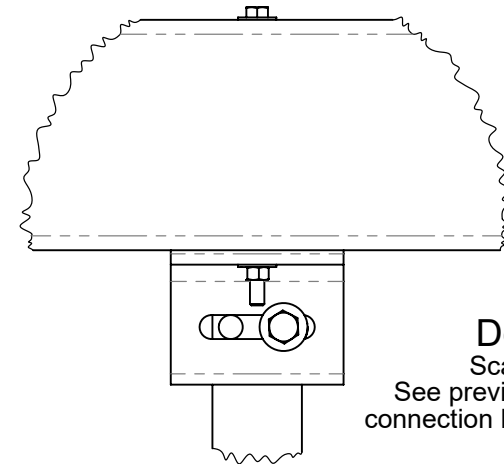
Terminal Details



Nut, 3/4 heavy hex
with F436 Washer



Detail J
Scale 1 : 10



Detail I
Scale 1 : 5
See previous sheets for
connection hardware details.



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Project #611801 Wyoming Box Beam Transition

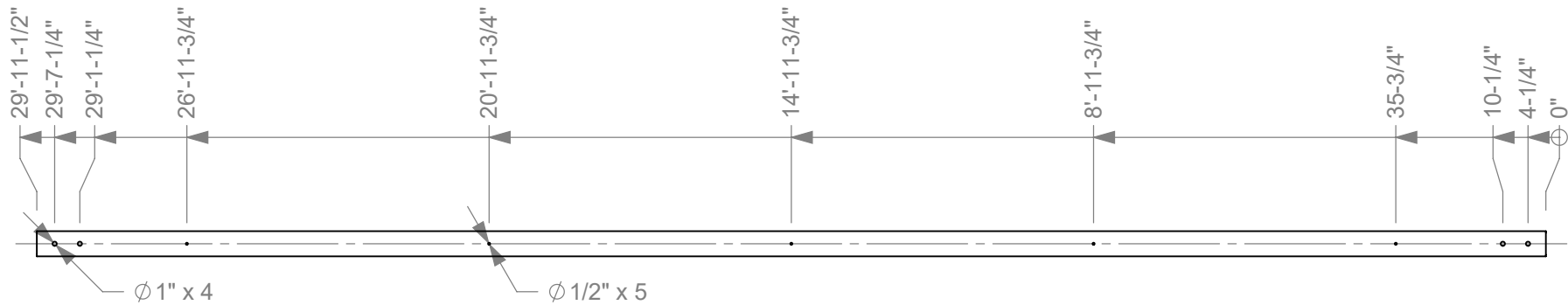
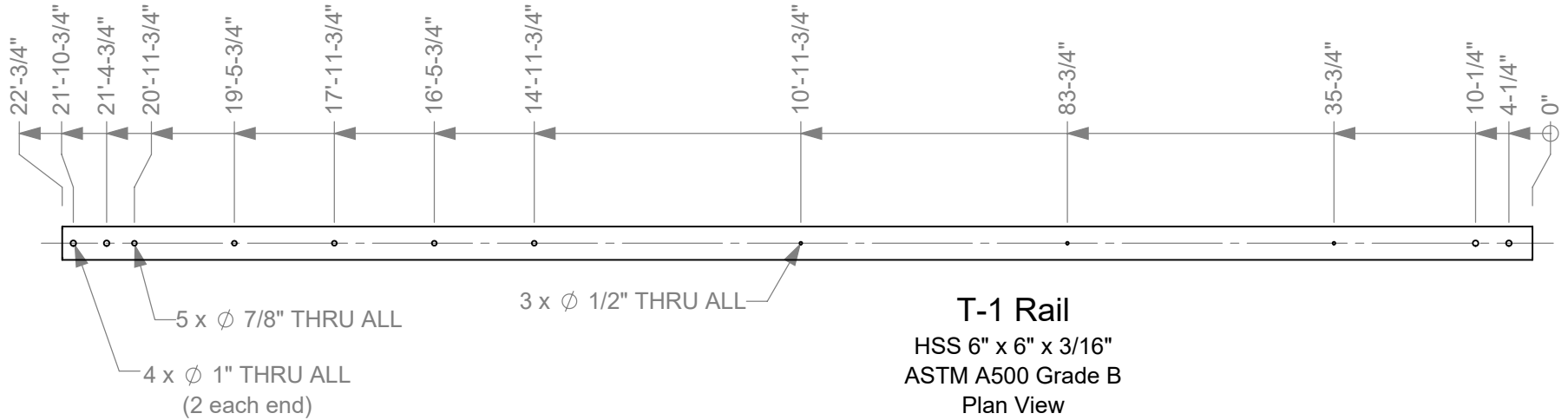
2021-01-06

Drawn by GES

Scale 1:50

Sheet 5 of 26 Terminal Details

Transition Rails



6a. Galvanize all components after fabrication is complete.



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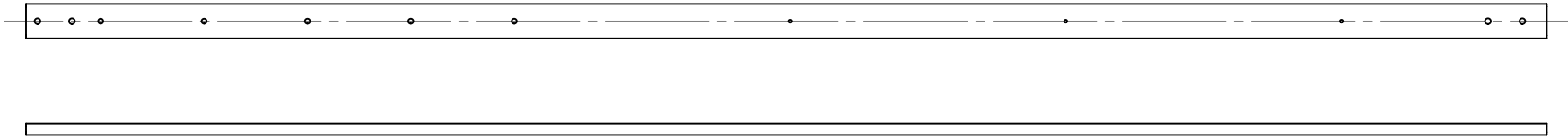
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Drawn by GES

Scale 1:30

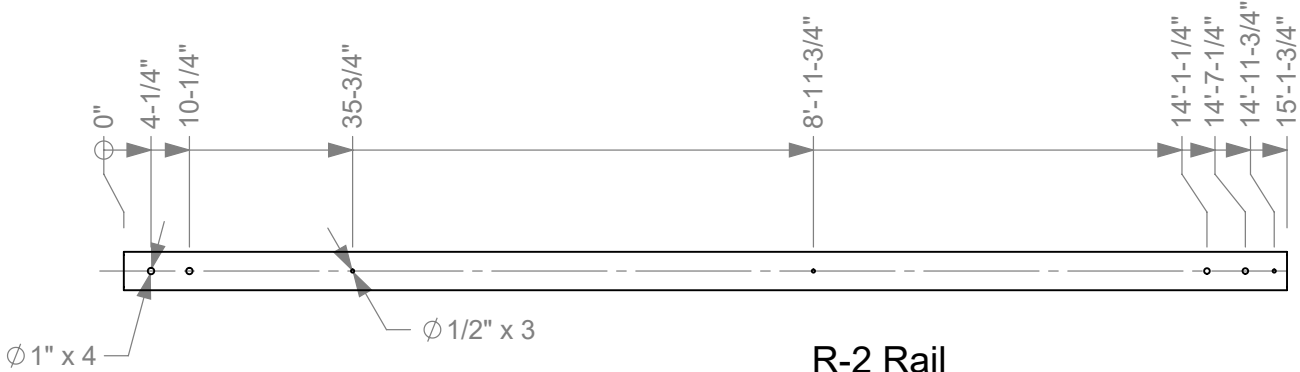
Sheet 6 of 26 Transition Rails

Rub Rails



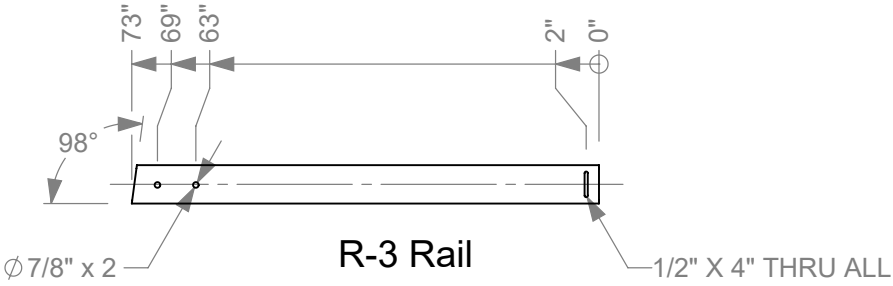
R-1 Rail

HSS 6" x 2" x 1/4"
 ASTM A500 Grade B
 See T-1 Rail on previous sheet for all other details.
 Plan and Elevation Views



R-2 Rail

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



R-3 Rail

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

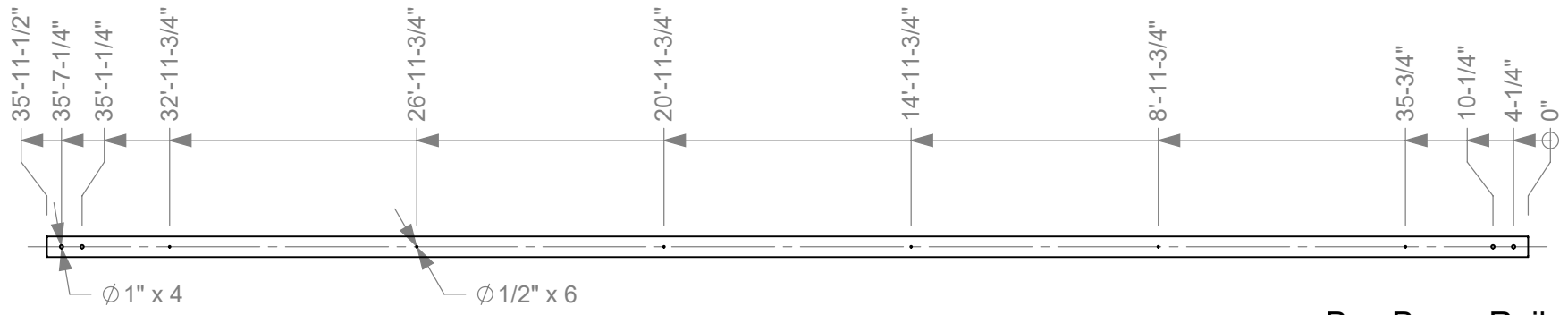
7a. Galvanize all components after fabrication is complete.



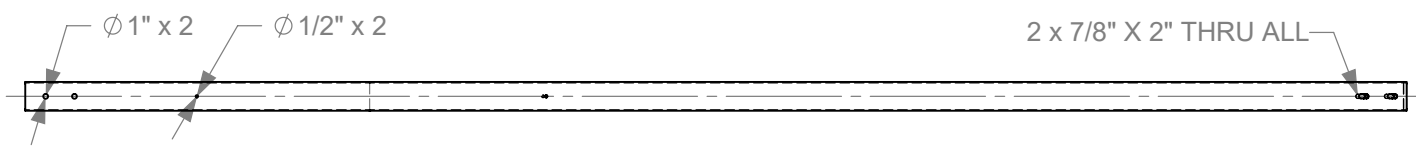
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Project #611801 Wyoming Box Beam Transition		2021-01-06
Drawn by GES	Scale 1:30	Sheet 7 of 26 Rub Rails

LON and Terminal Rails

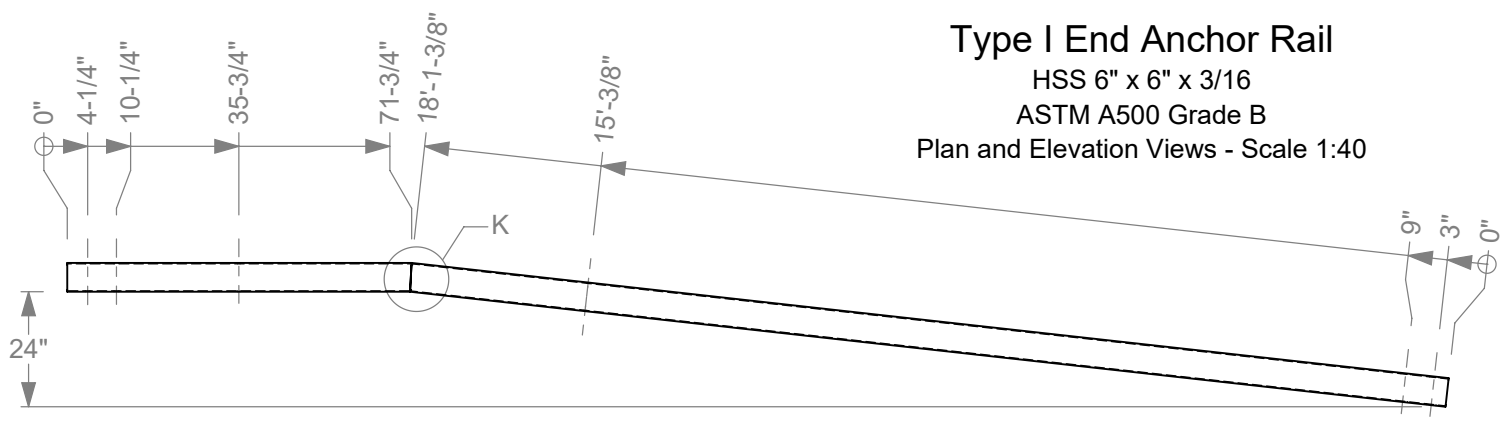


Box Beam Rail
 HSS 6" x 6" x 3/16"
 ASTM A500 Grade B
 Plan View

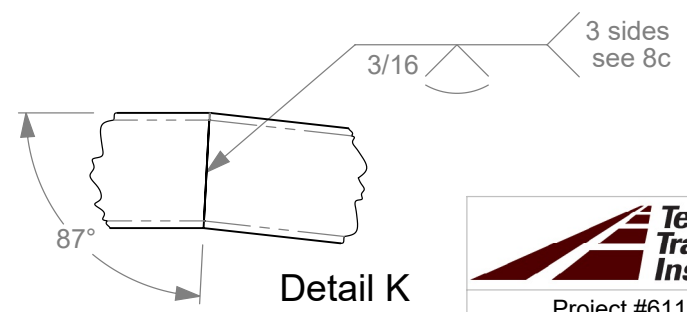


Type I End Anchor Rail

HSS 6" x 6" x 3/16"
 ASTM A500 Grade B
 Plan and Elevation Views - Scale 1:40

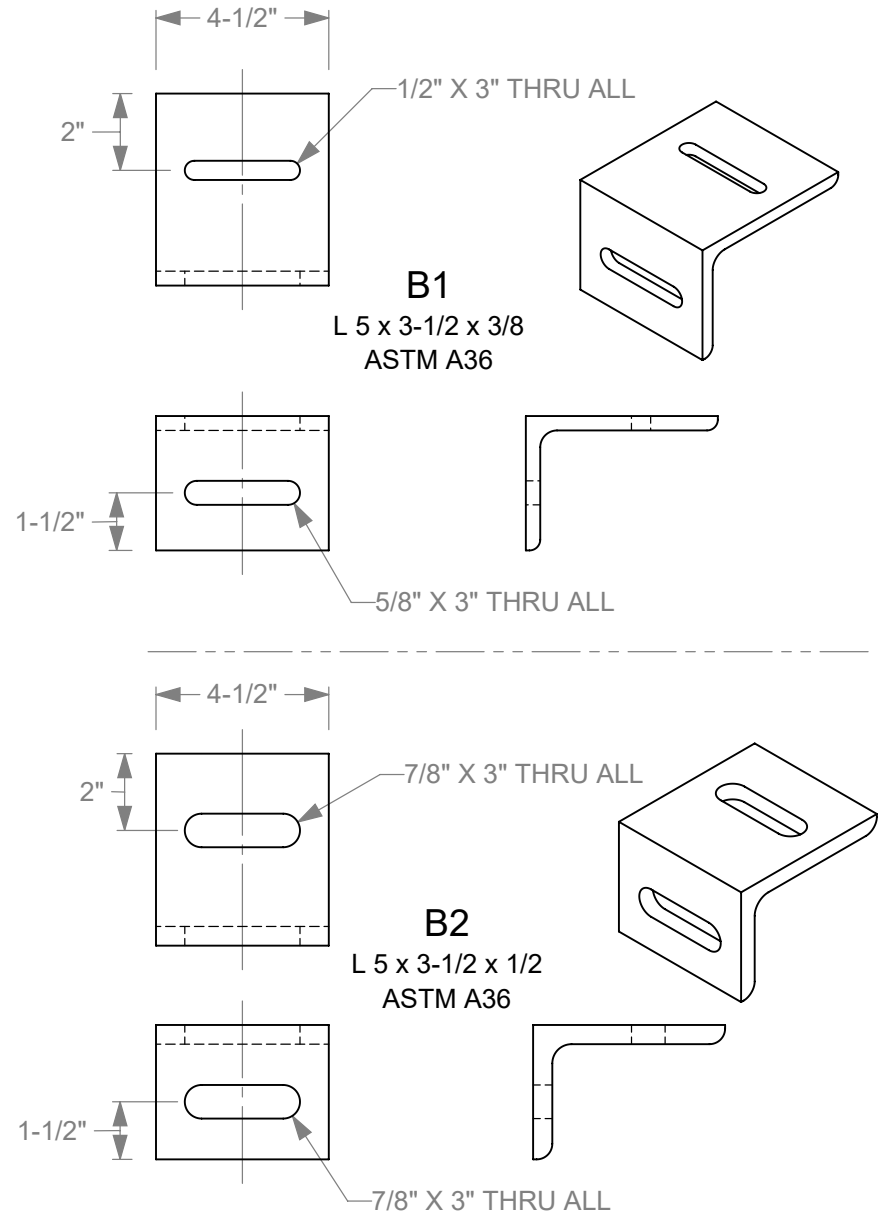
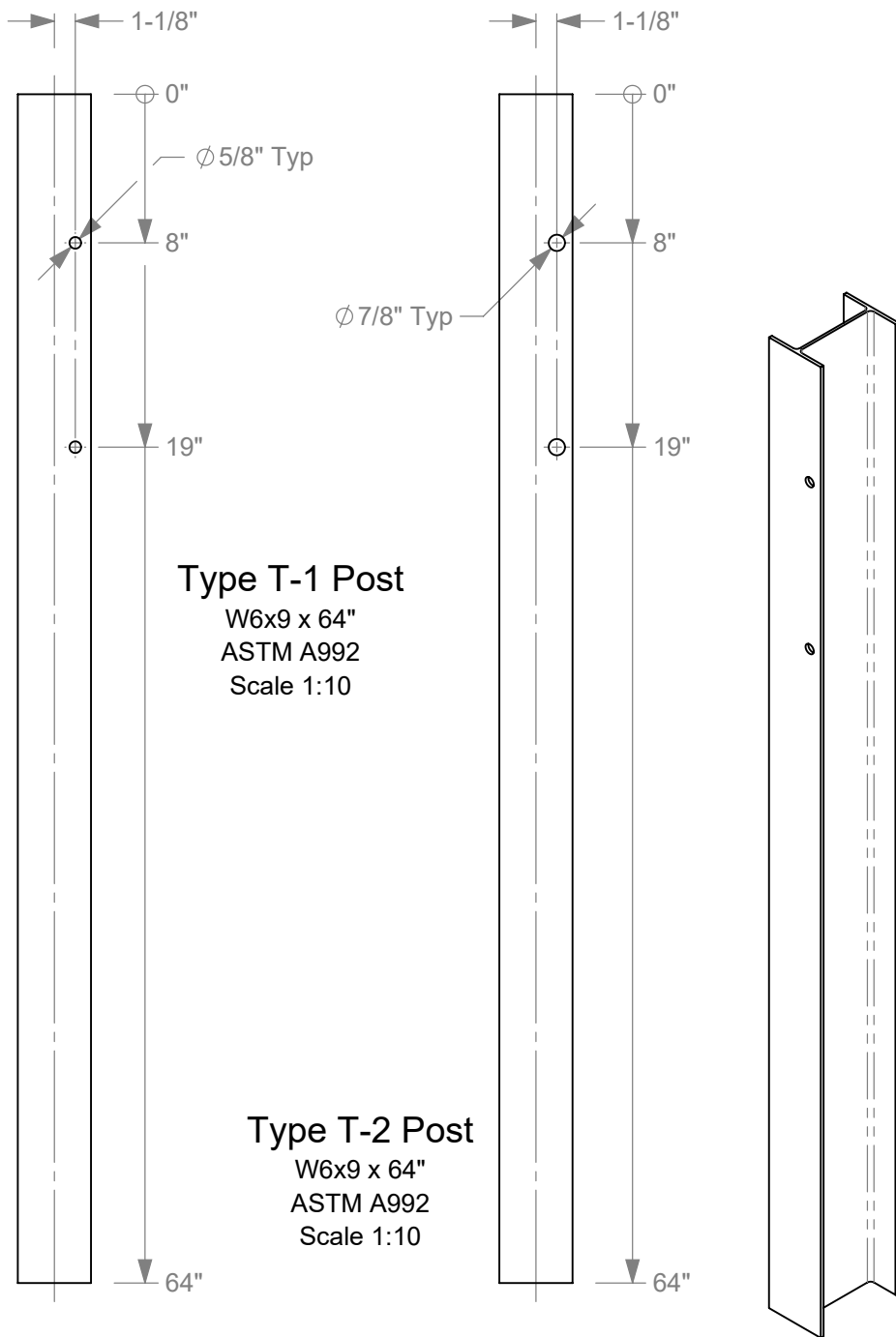


- 8a.** All welding must be performed by certified welders using industry standard practices.
- 8b.** Galvanize all components after fabrication is complete.
- 8c.** Cut 3 sides (inverted V-shape, 5/8" wide at bottom), bend, and weld.



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Project #611801 Wyoming Box Beam Transition		2021-01-06
Drawn by GES	Scale 1:50	Sheet 8 of 26 LON and Terminal Rails



9a. Galvanize all components after fabrication is complete.



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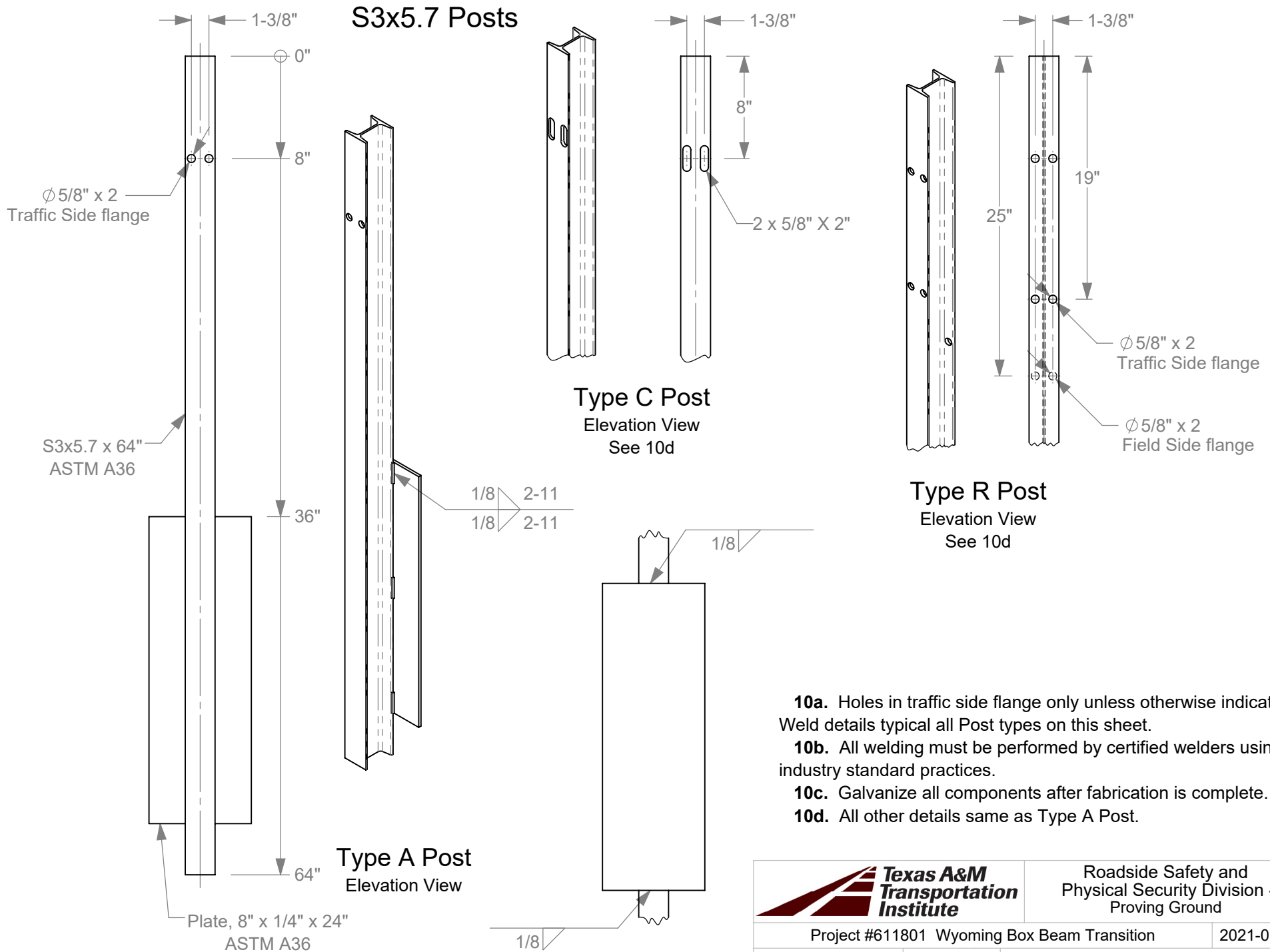
Project #611801 Wyoming Box Beam Transition

2021-01-06


Drawn by GES

Scale 1:5

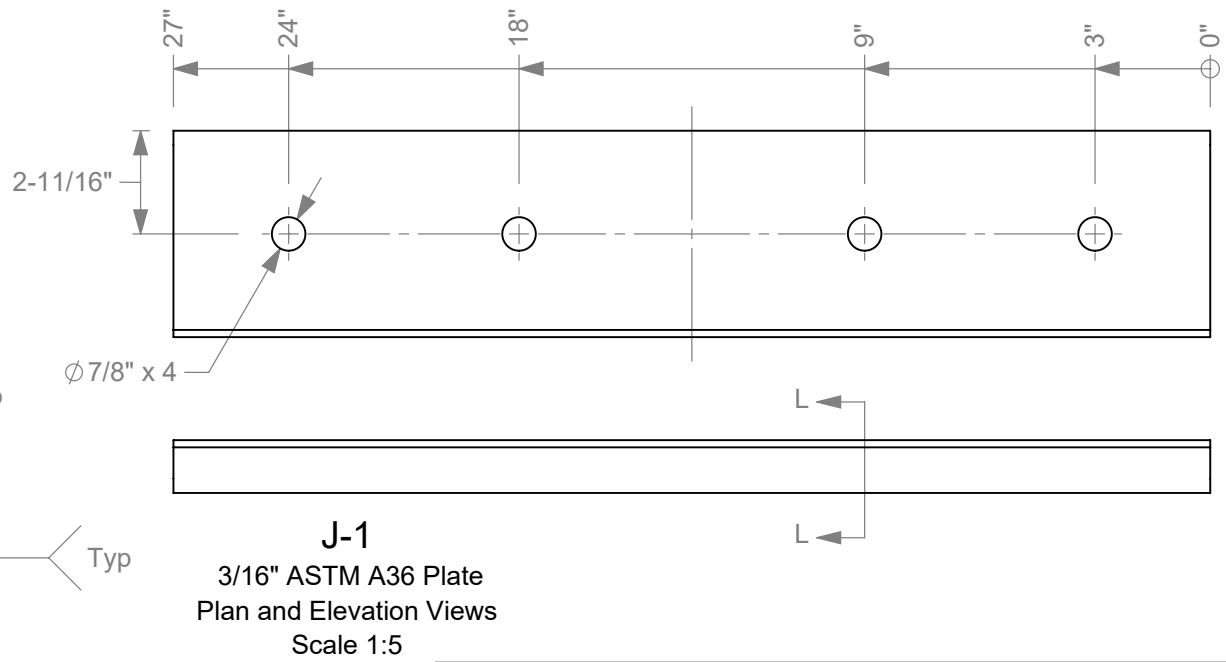
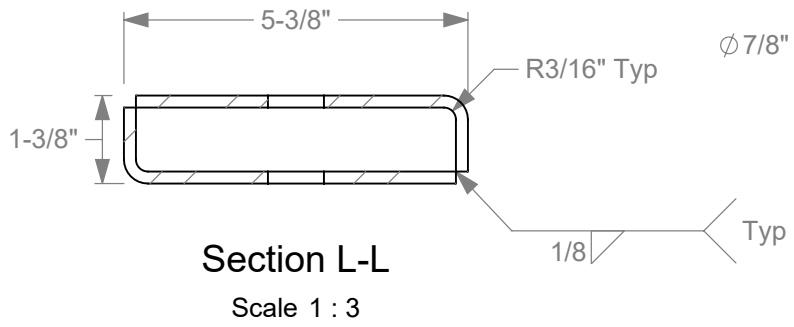
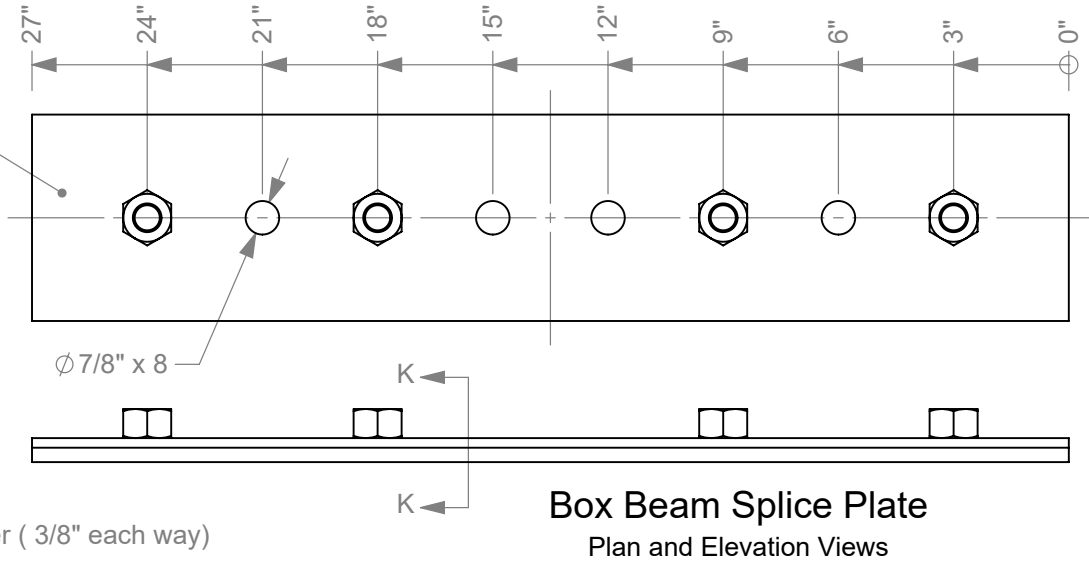
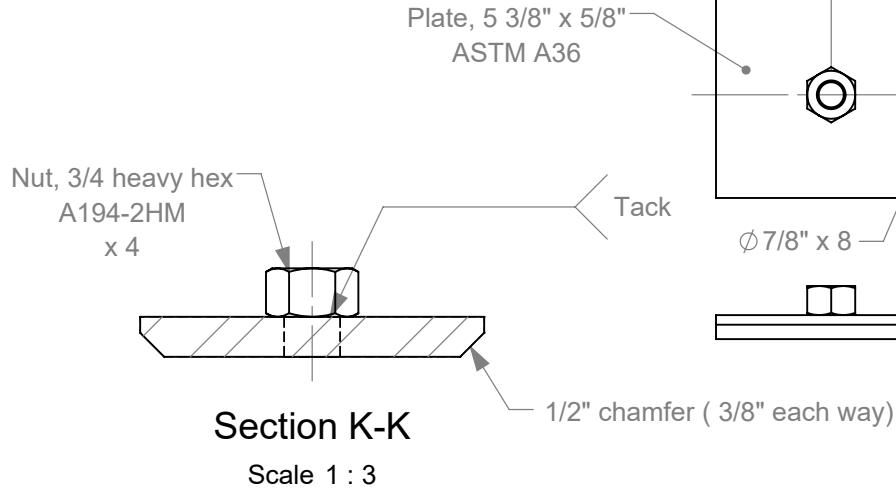
Sheet 9 of 26 Type T Posts and Brackets



- 10a.** Holes in traffic side flange only unless otherwise indicated. Weld details typical all Post types on this sheet.
- 10b.** All welding must be performed by certified welders using industry standard practices.
- 10c.** Galvanize all components after fabrication is complete.
- 10d.** All other details same as Type A Post.

		Roadside Safety and Physical Security Division - Proving Ground	
Project #611801 Wyoming Box Beam Transition		2021-01-06	
Drawn by GES	Scale 1:10	Sheet 10 of 26 S3x5.7 Posts	

Rail Splices



- 11a.** All welding must be performed by certified welders using industry standard practices.
- 11b.** Galvanize all components after fabrication is complete.

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Drawn by GES	Scale 1:5	Sheet 11 of 26 Rail Splices

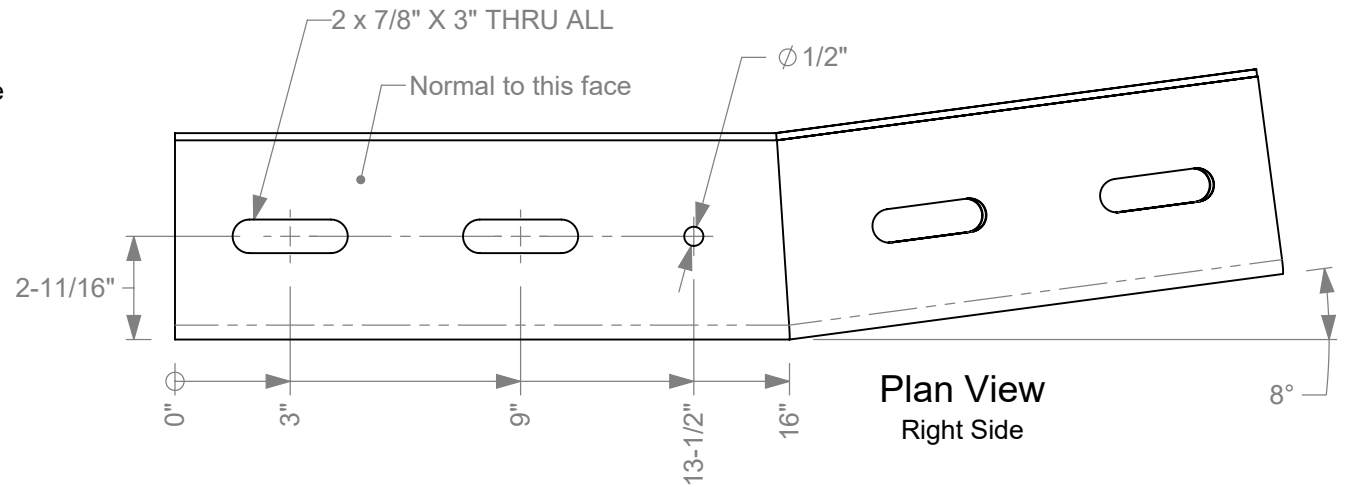
J-2
 3/16" ASTM A36 Plate
 See 12a



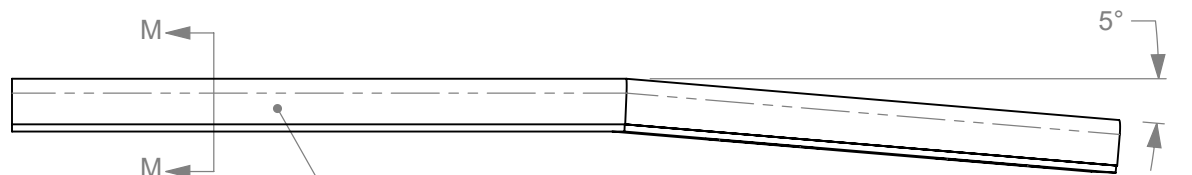
Section M-M

Scale 1 : 3

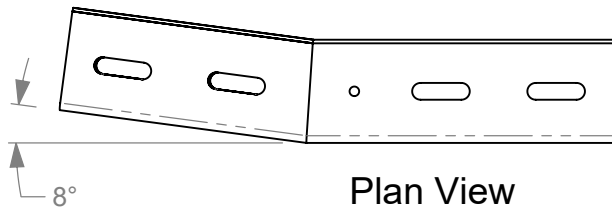
See J-1 Section View on previous sheet.



Plan View
 Right Side

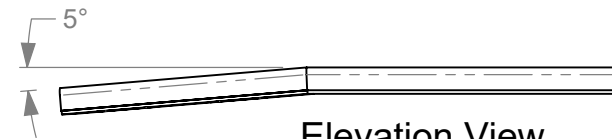


Elevation View
 Right Side



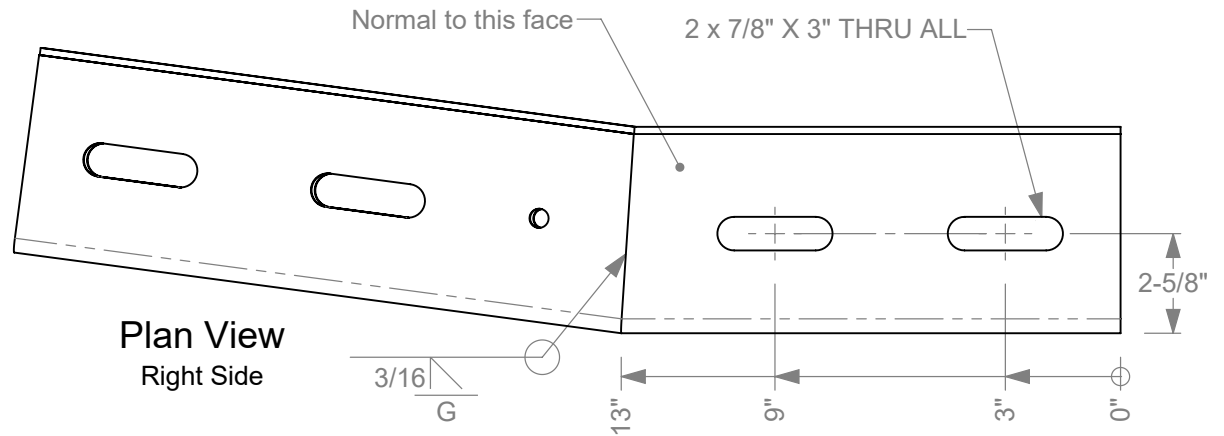
Plan View

Left Side
 Scale 1:10



Elevation View

Left Side
 Scale 1:10



Plan View
 Right Side

12a. Need one Right Side and one Left Side part for each installation. The Parts are mirror images of each other, so plate lengths, hole sizes, and hole locations are typical for both Parts.



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Project #611801 Wyoming Box Beam Transition

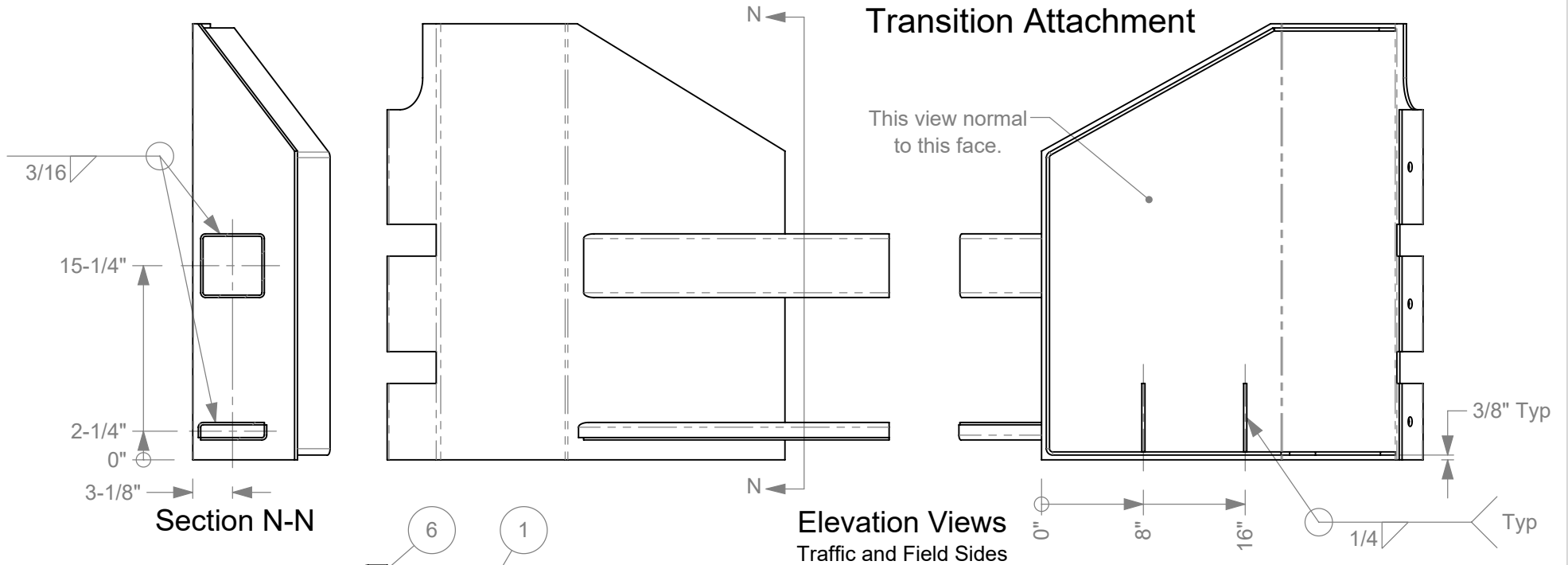
2021-01-06

Drawn by GES

Scale 1:5

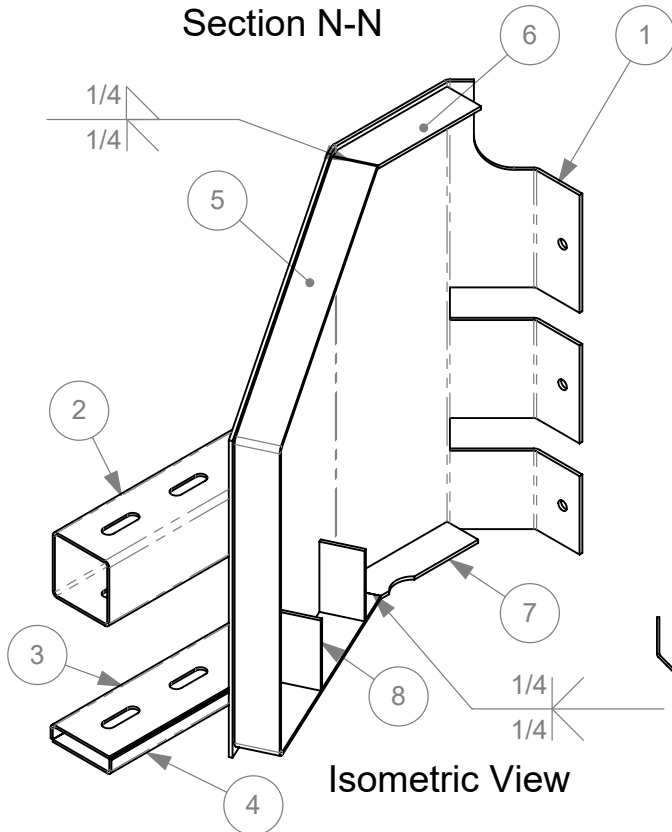
Sheet 12 of 26 J-2

Transition Attachment



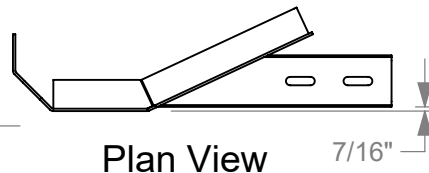
Section N-N

Elevation Views
Traffic and Field Sides



Isometric View

#	Body Name	Description	Length	MATERIAL	Qty
1	Main Plate	Plate, 34 1/4" x 1/4"	38 3/8"	ASTM A572 Grade 50	1
2	Main Rail Attachment	HSS 5" x 5" x 3/16"	24"	ASTM A500 Grade B	1
3	Rub Rail Attachment	Plate, 24 1/2" x 3/16"	6 1/16"	ASTM A572 Grade 50	1
4	Rub Rail Attachment	Plate, 24" x 3/16"	6 1/16"	ASTM A572 Grade 50	1
5	Side Stiffener	Plate, 3" x 1/4"	61 7/8"	ASTM A572 Grade 50	1
6	Top Stiffener	Plate, 3" x 1/4"	10 5/16"	ASTM A572 Grade 50	1
7	Bottom Stiffener	Plate, 2 3/4" x 1/4"	9 7/8"	ASTM A572 Grade 50	1
8	Gusset	Plate, 3" x 1/4"	5 3/8"	ASTM A572 Grade 50	2



Plan View
Scale 1:20

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

13b. Galvanize after fabrication is complete.



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Drawn by GES

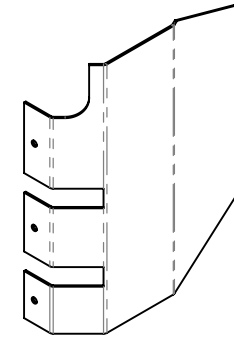
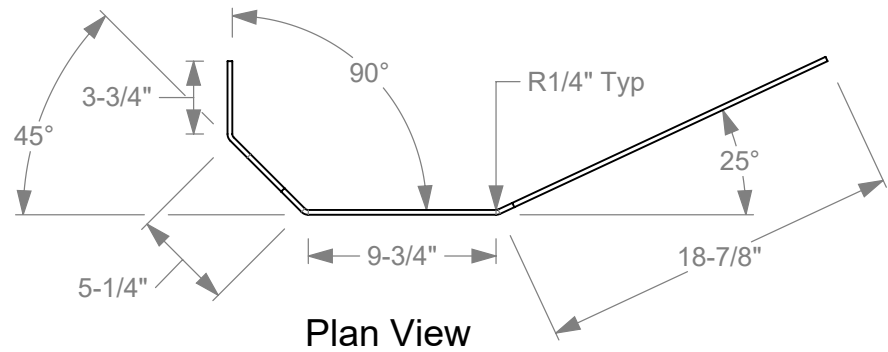
Scale 1:12

Sheet 13 of 26 Transition Attachment

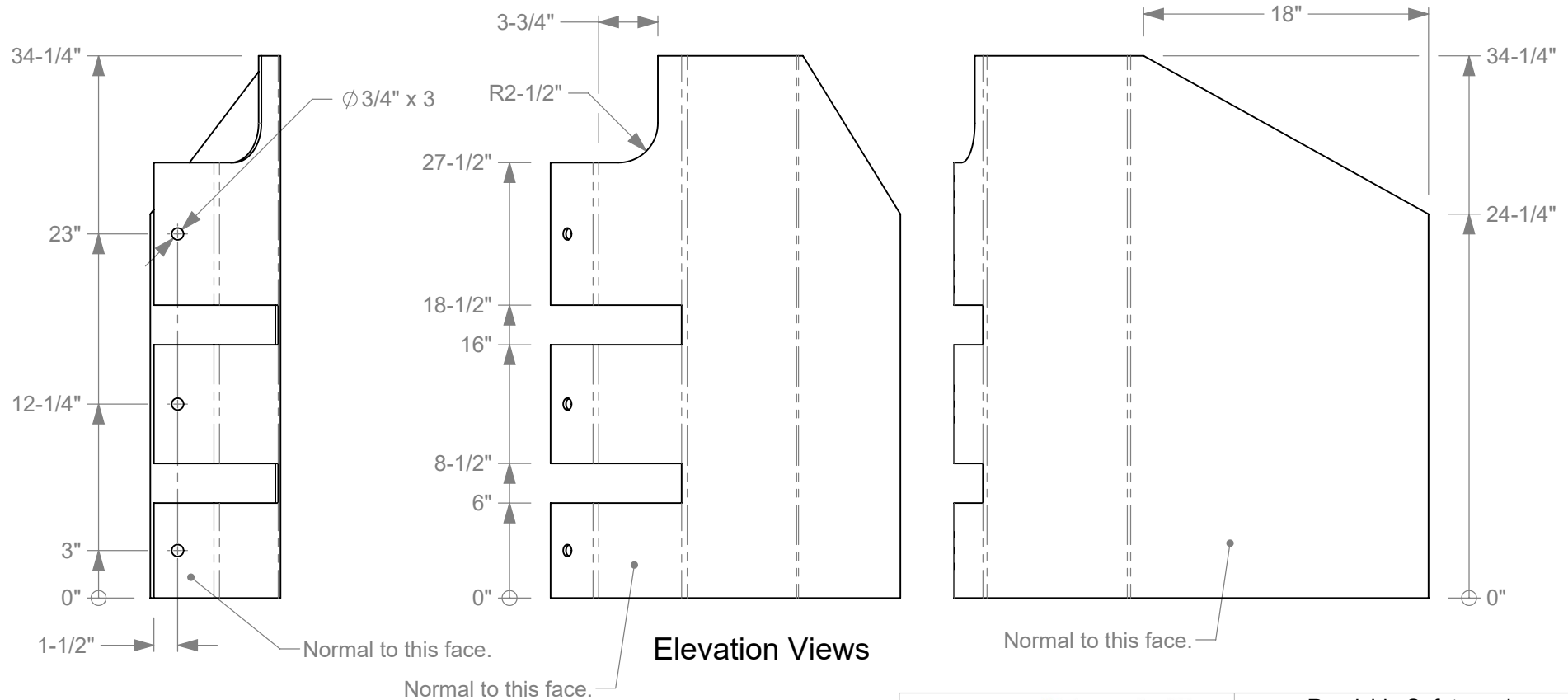
1

Main Plate

Plate, 34 1/4" x 1/4" x 38 3/8"
 ASTM A572 Grade 50
 See 14a




Isometric View

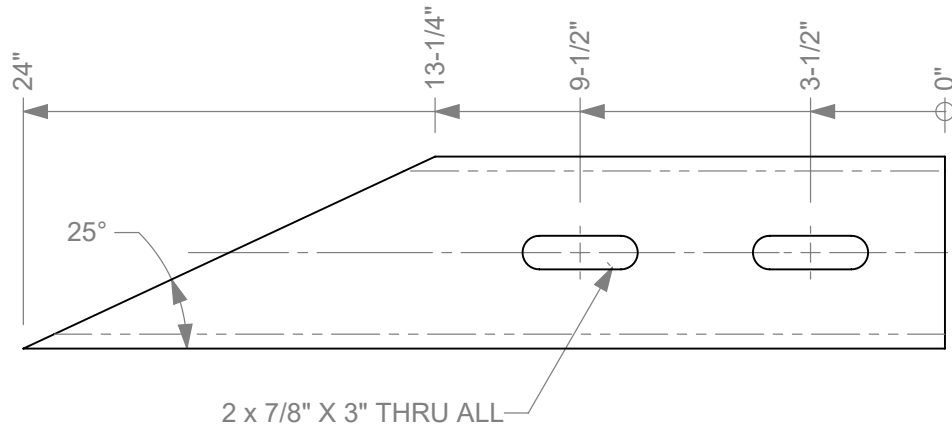


Elevation Views

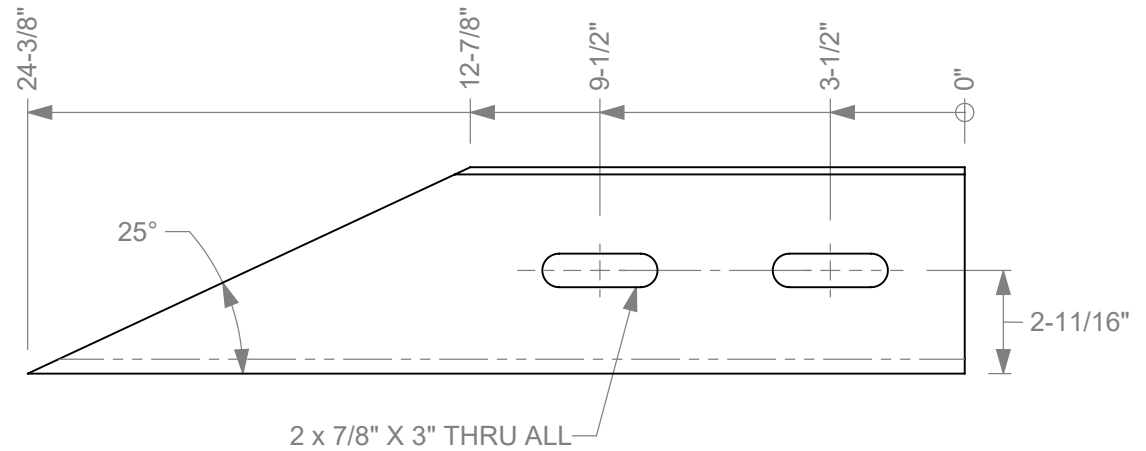
14a. Main Plate details shown are for right side Transition Attachment part. Main Plate for left side is a mirror image of this one (pre-bend details are identical, but bent in opposite directions).

	Roadside Safety and Physical Security Division - Proving Ground	
	Project #611801 Wyoming Box Beam Transition	2021-01-06
Drawn by GES	Scale 1:10	Sheet 14 of 26 Main Plate

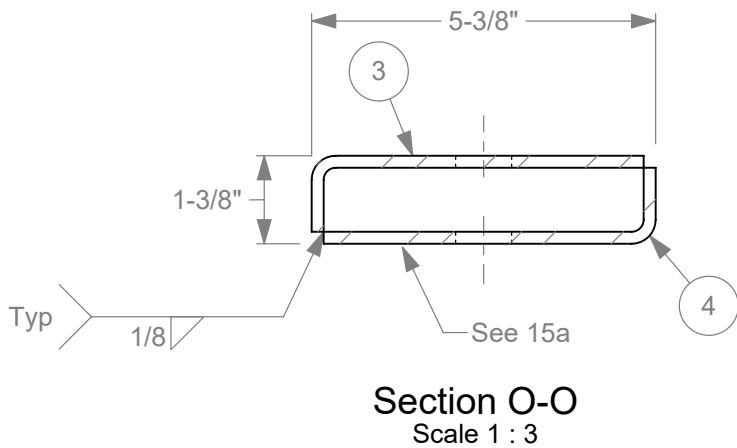
Rail Attachments




2 Main Rail Attachment
 HSS 5" x 5" x 3/16" x 24"
 ASTM A500 Grade B
 Plan View



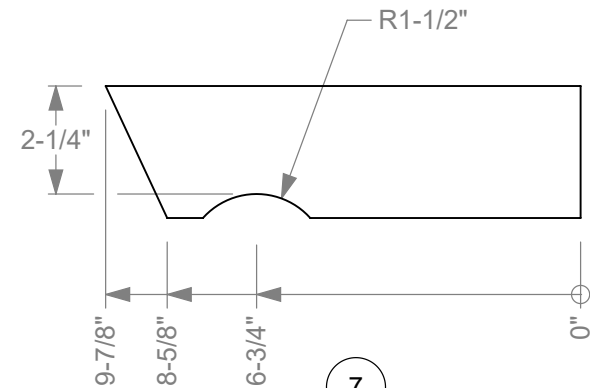
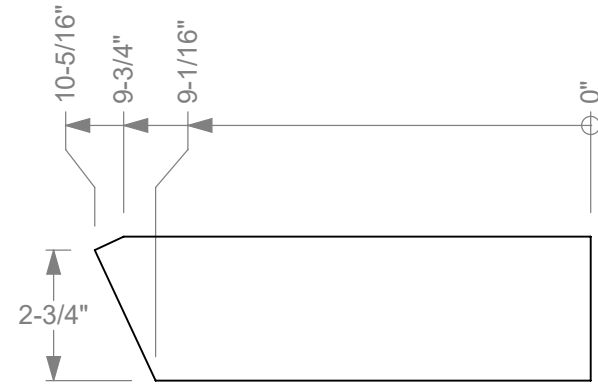
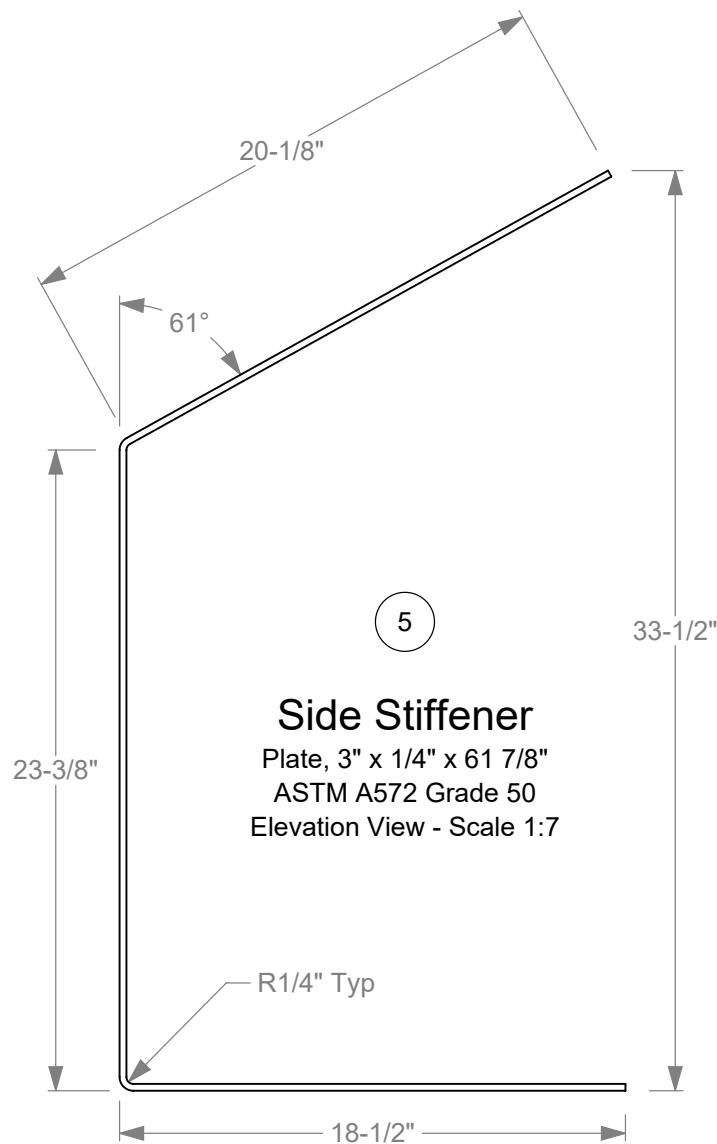
Rub Rail Attachment
 Plate, 24 1/2" x 3/16" x 6 1/16"
 ASTM A572 Grade 50
 Plan and Elevation Views



- 15a. Check Rub Rail Attachment for fit in HSS 6 x 2 x 1/4 after welding.
- 15b. All welding must be performed by certified welders using industry standard practices.

	Roadside Safety and Physical Security Division - Proving Ground	
	Project #611801 Wyoming Box Beam Transition	2021-01-06
Drawn by GES	Scale 1:5	Sheet 15 of 26 Rail Attachments

Stiffeners and Gussets



Roadside Safety and
 Physical Security Division -
 Proving Ground

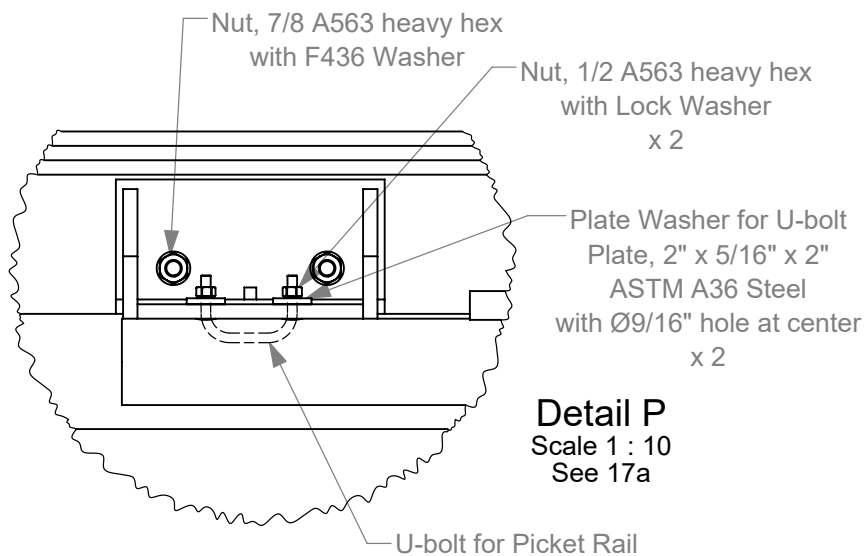
Project #611801 Wyoming Box Beam Transition

2021-01-06

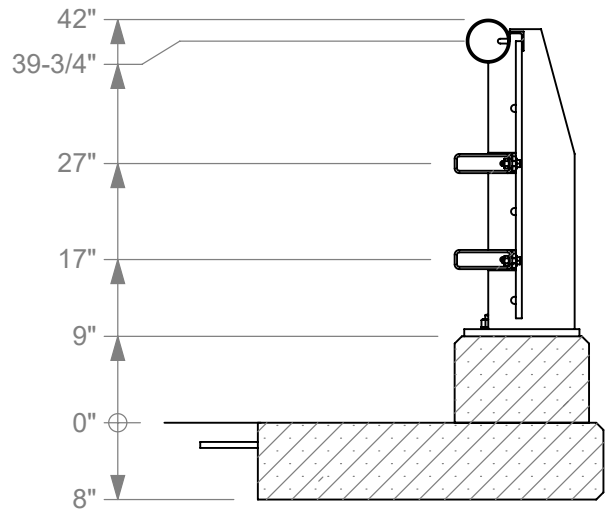
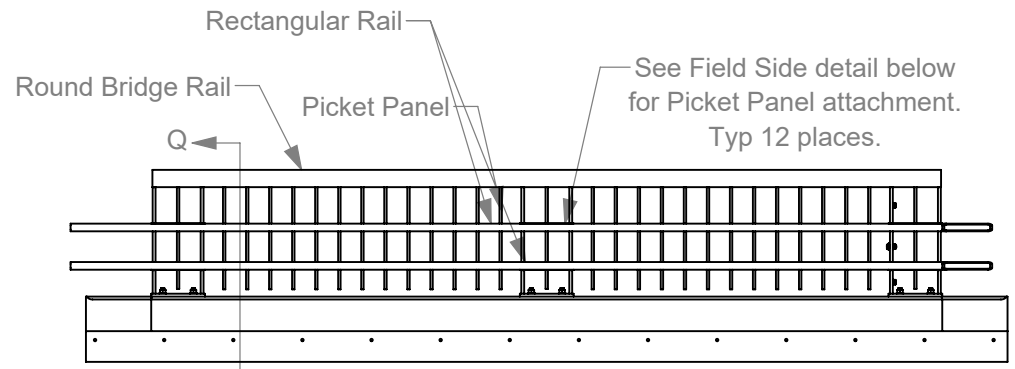
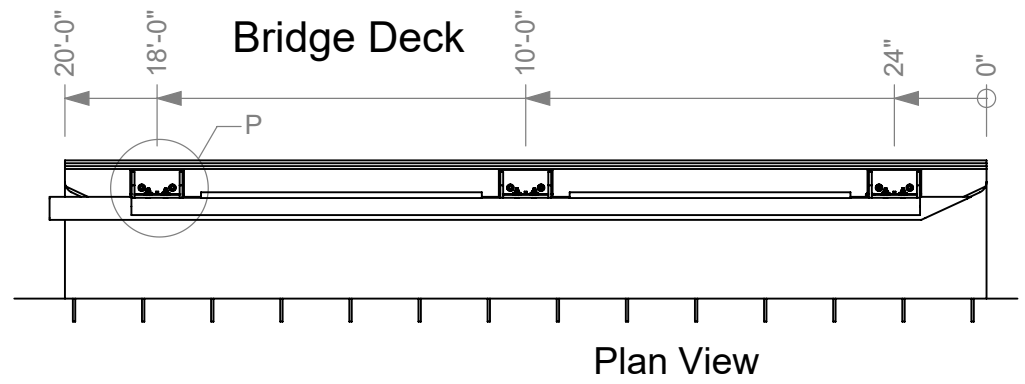
Drawn by GES

Scale 1:4

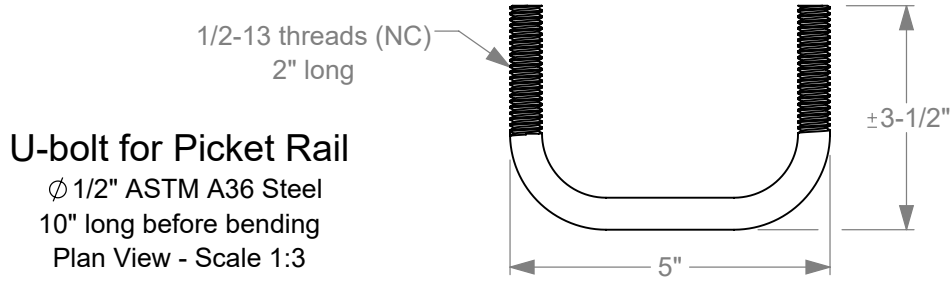
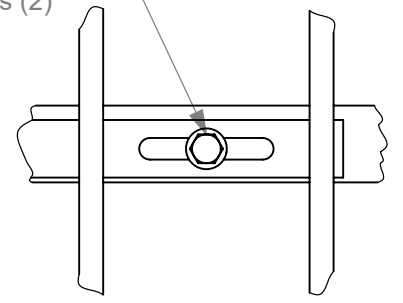
Sheet 16 of 26 Stiffeners and Gussets



Detail P
Scale 1 : 10
See 17a



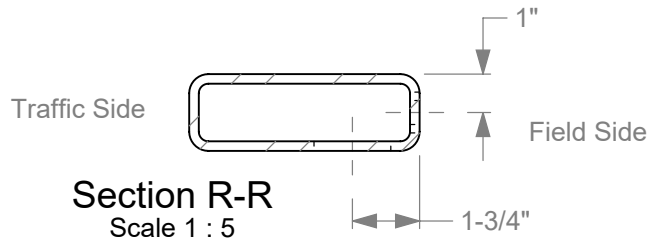
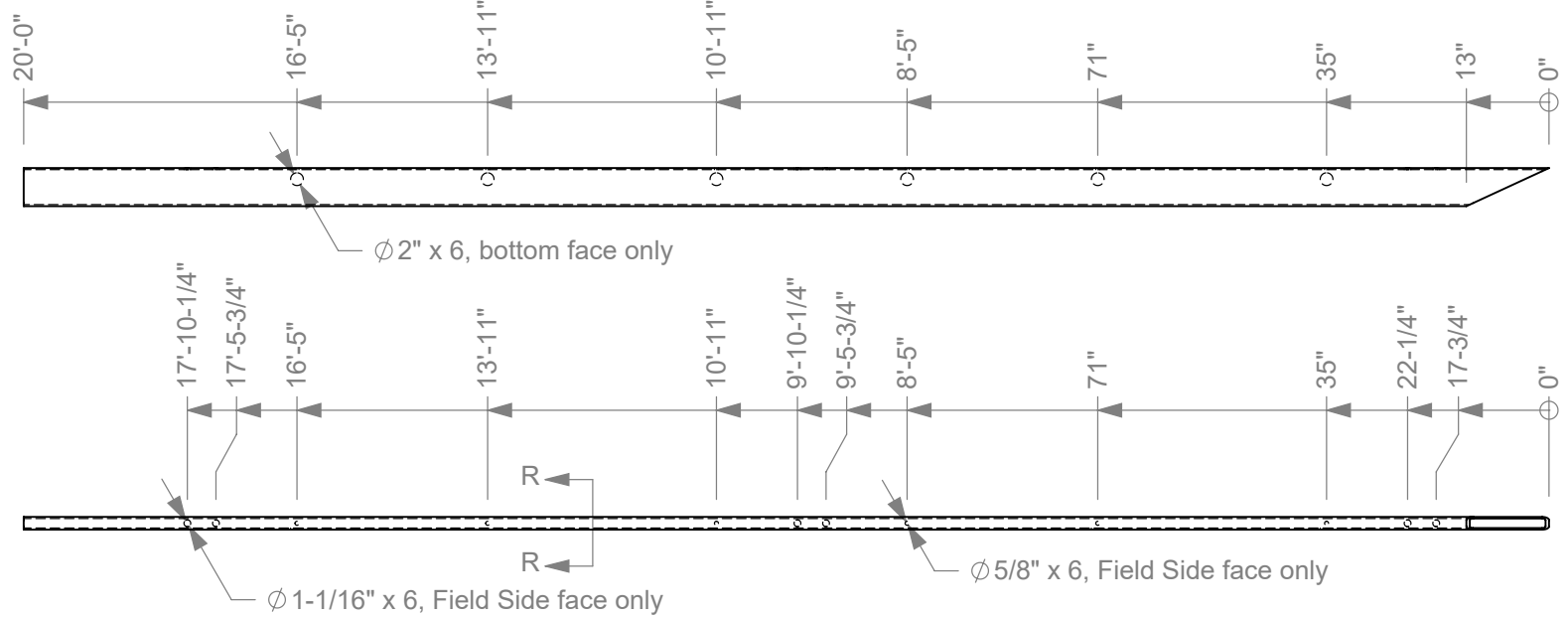
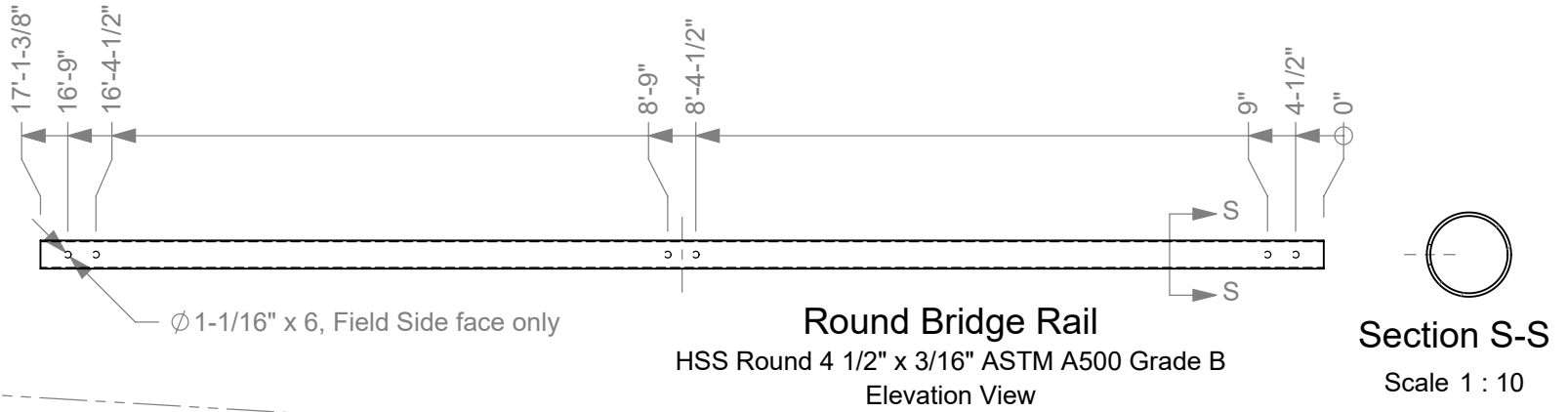
Bolt, 1/2" x 1 1/2" hex A325 with A194-2HM Hex Nut and F436 Washers (2)



17a. 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 Wyoming Box Beam Transition		2021-01-06	
Drawn by GES	Scale 1:50	Sheet 17 of 26 Bridge Deck	

Bridge Rails

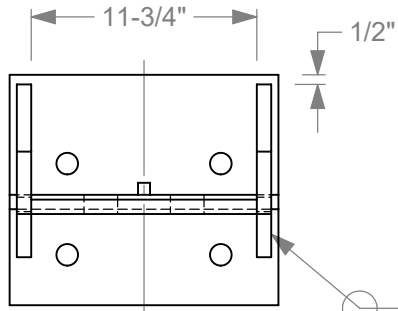


Roadside Safety and Physical Security Division - Proving Ground

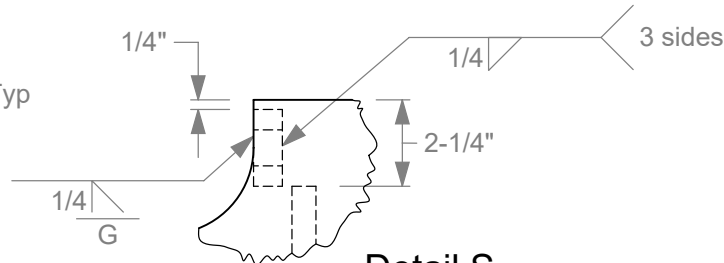
Project #611801 Wyoming Box Beam Transition		2021-01-06
Drawn by GES	Scale 1:30	Sheet 18 of 26 Bridge Rails

Bridge Post

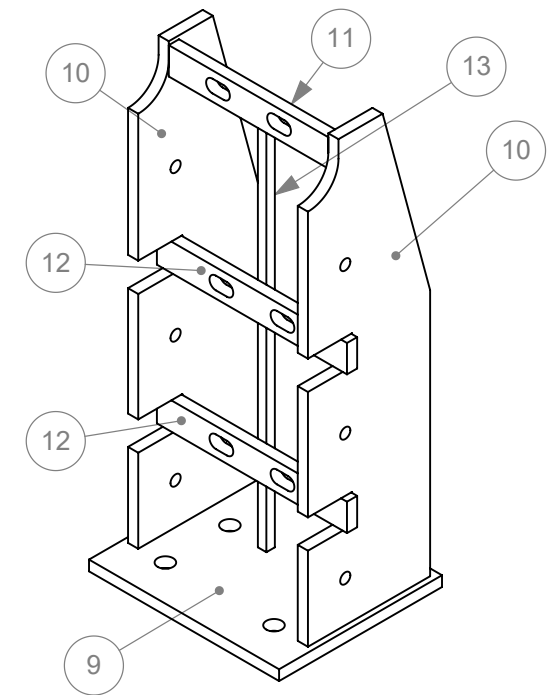
#	Body Name	Description	Length	Material	Qty
9	Base Plate	Plate, 12" x 3/4"	14"	ASTM A572 Grade 50	1
10	Side Plate	Plate, 9" x 3/4"	31-1/4"	ASTM A572 Grade 50	2
11	Rail Plate, Top	Plate, 2" x 3/4"	11-3/4"	ASTM A36	1
12	Rail Plate, Lower	Plate, 2" x 3/4"	14"	ASTM A36	2
13	Picket	Plate, 5/8" x 5/8"	27-3/4"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



Plan View

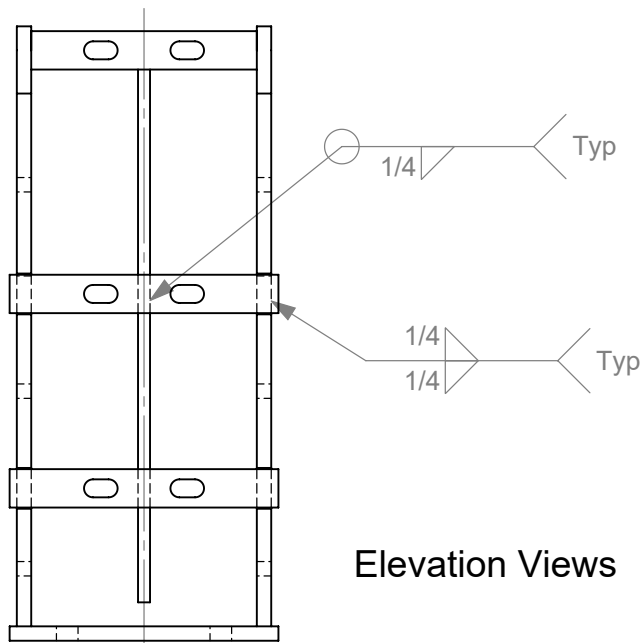


Detail S
Scale 1 : 5

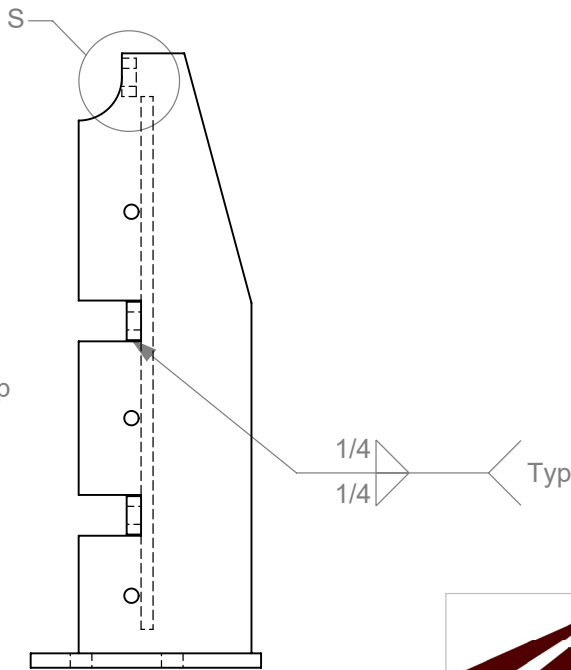


Isometric View

19a. All welding must be performed by certified welders using industry standard practices.
19b. Galvanize after fabrication is complete.



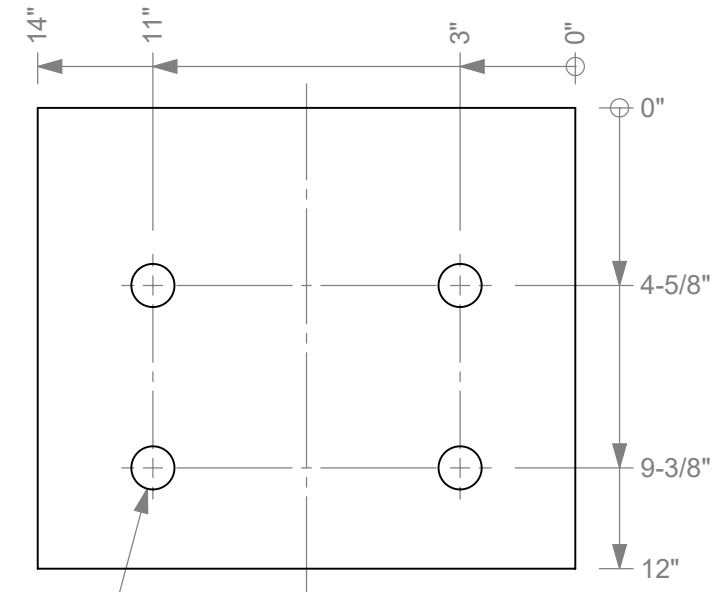
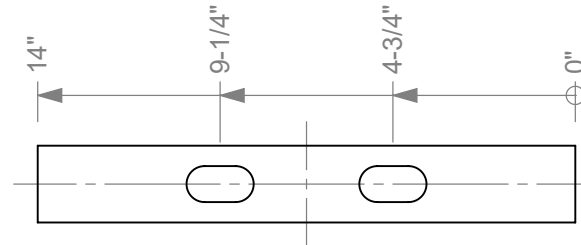
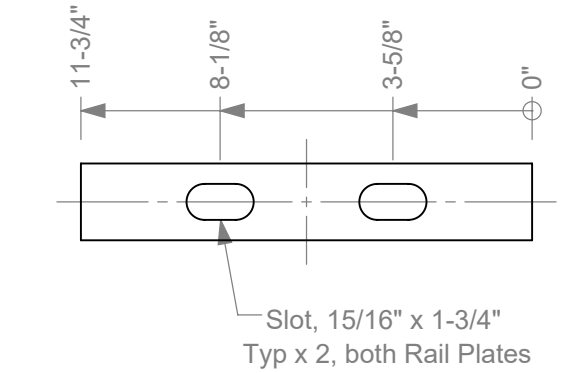
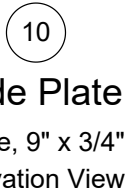
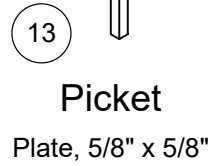
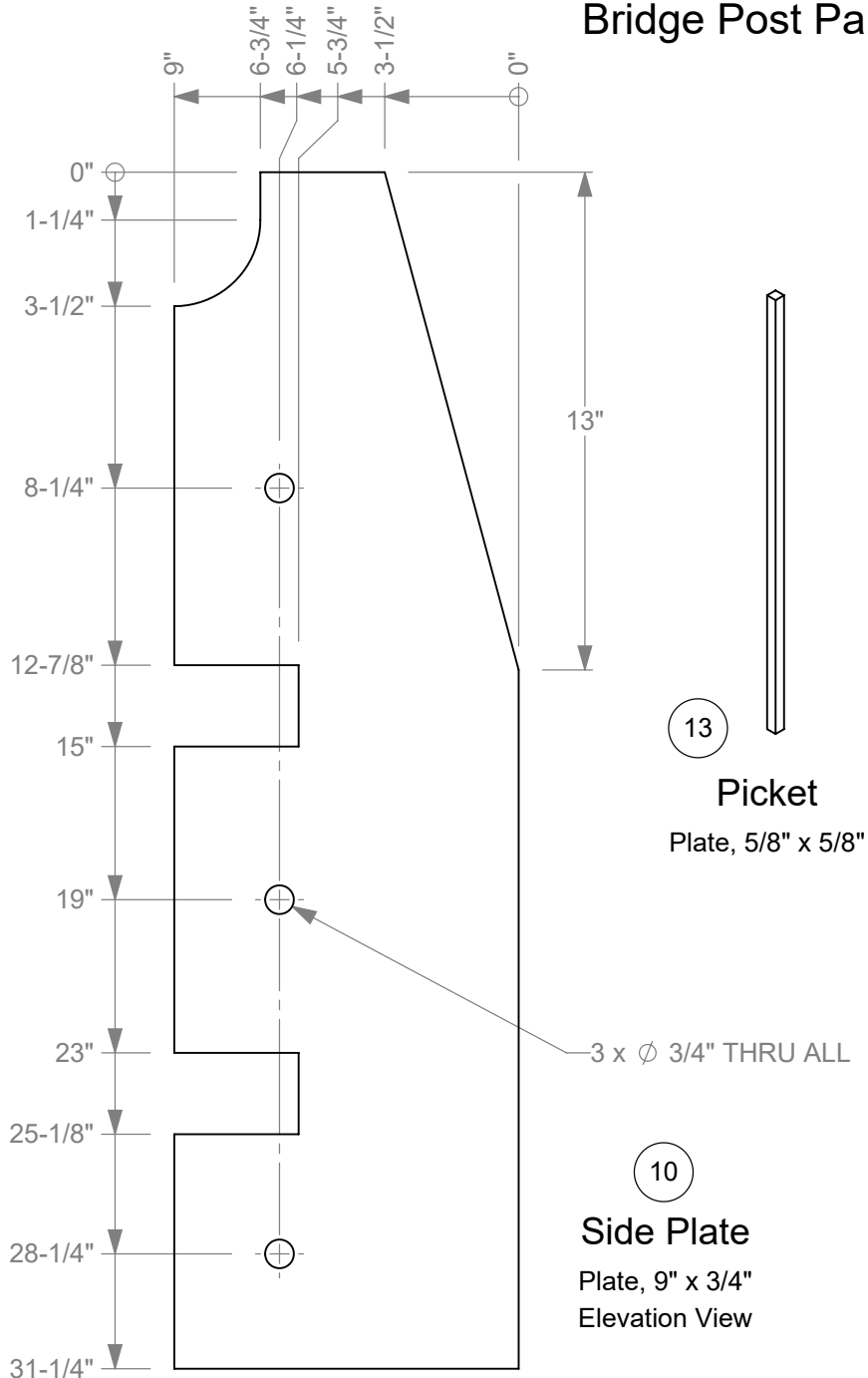
Elevation Views



Roadside Safety and
Physical Security Division -
Proving Ground

Project #611801 Wyoming Box Beam Transition		2021-01-06
Drawn by GES	Scale 1:10	Sheet 19 of 26 Bridge Post

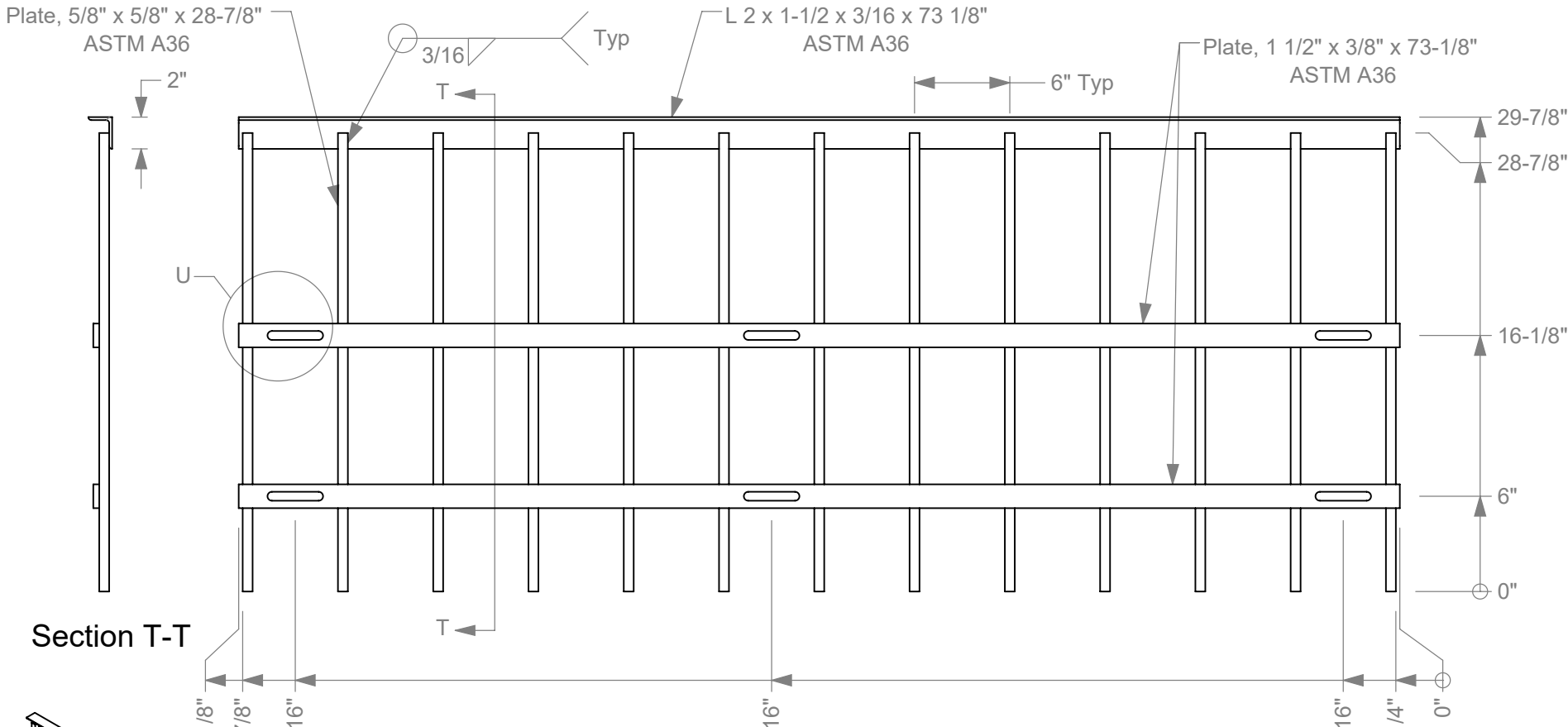
Bridge Post Parts



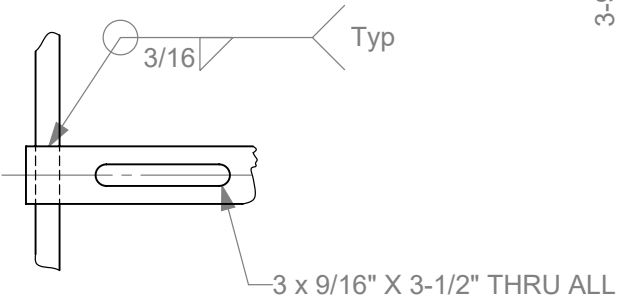
Roadside Safety and Physical Security Division - Proving Ground

Project #611801 Wyoming Box Beam Transition		2021-01-06
Drawn by GES	Scale 1:5	Sheet 20 of 26 Bridge Post Parts

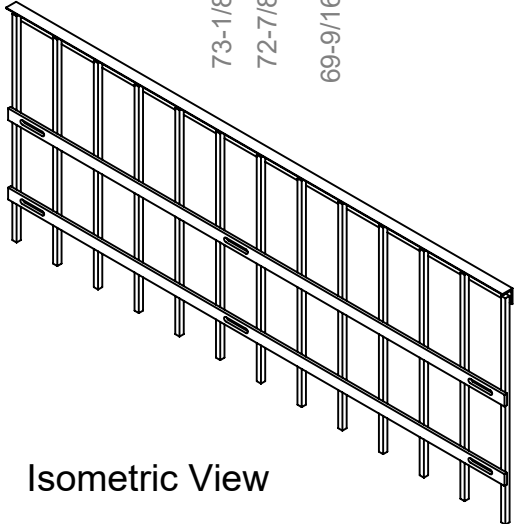
Picket Panel




Elevation View
from Traffic Side



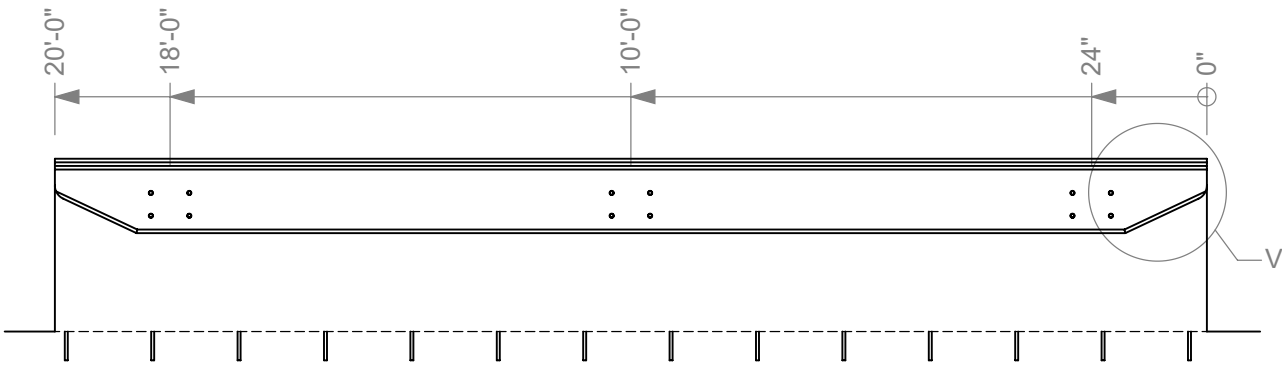
Detail U
Scale 1 : 5



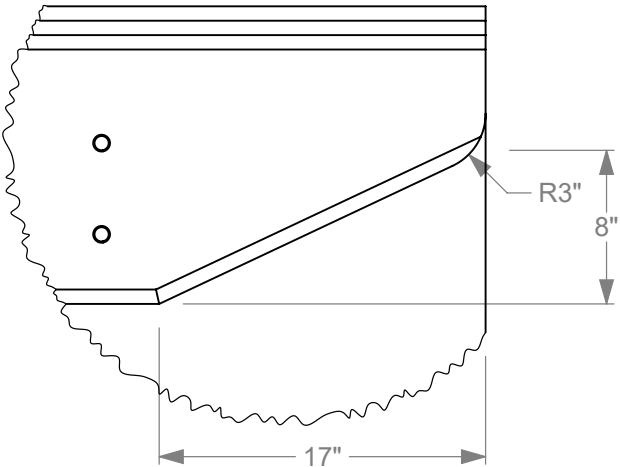
Isometric View

	Roadside Safety and Physical Security Division - Proving Ground	
	Project #611801 Wyoming Box Beam Transition	2021-01-06
Drawn by GES	Scale 1:10	Sheet 21 of 26 Picket Panel

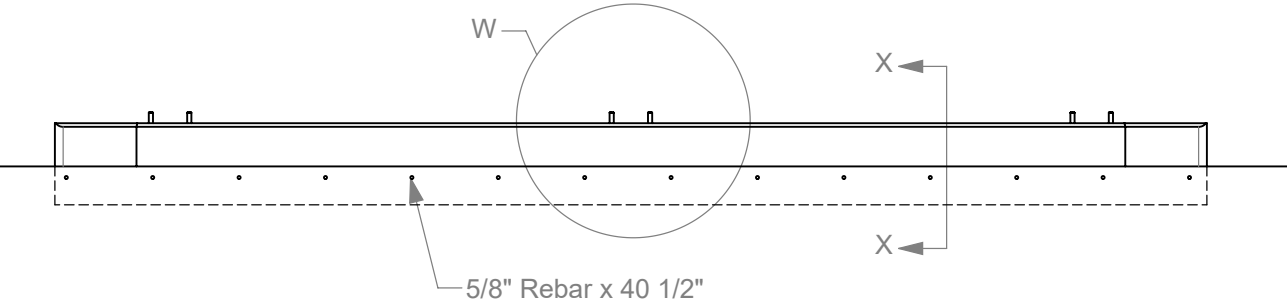
Moment Slab and Curb



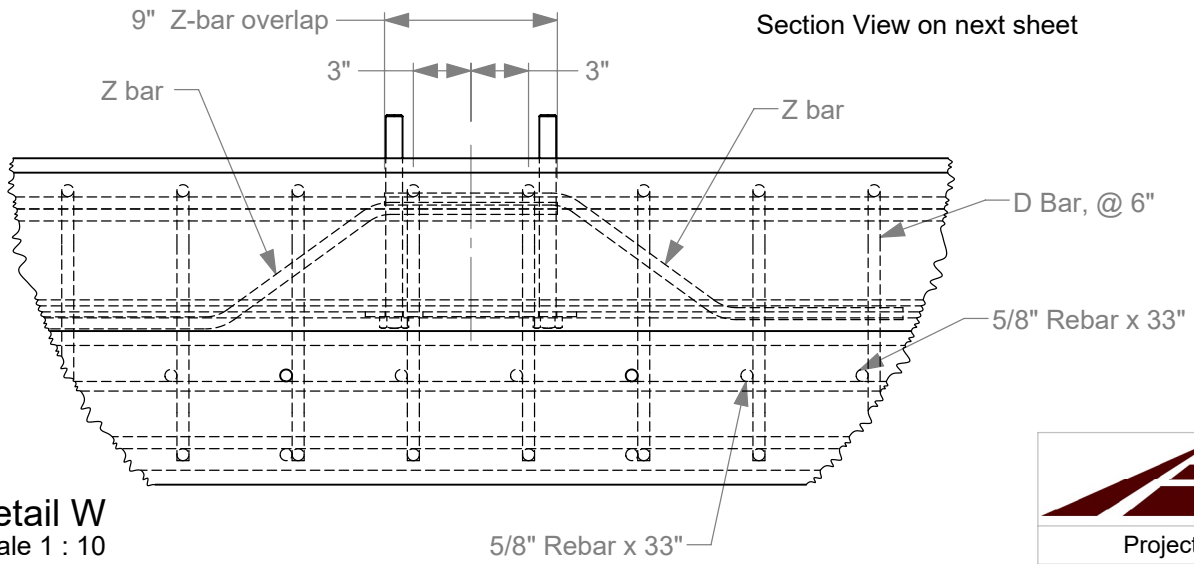
Plan View




Detail V
Scale 1 : 10
Typ each end



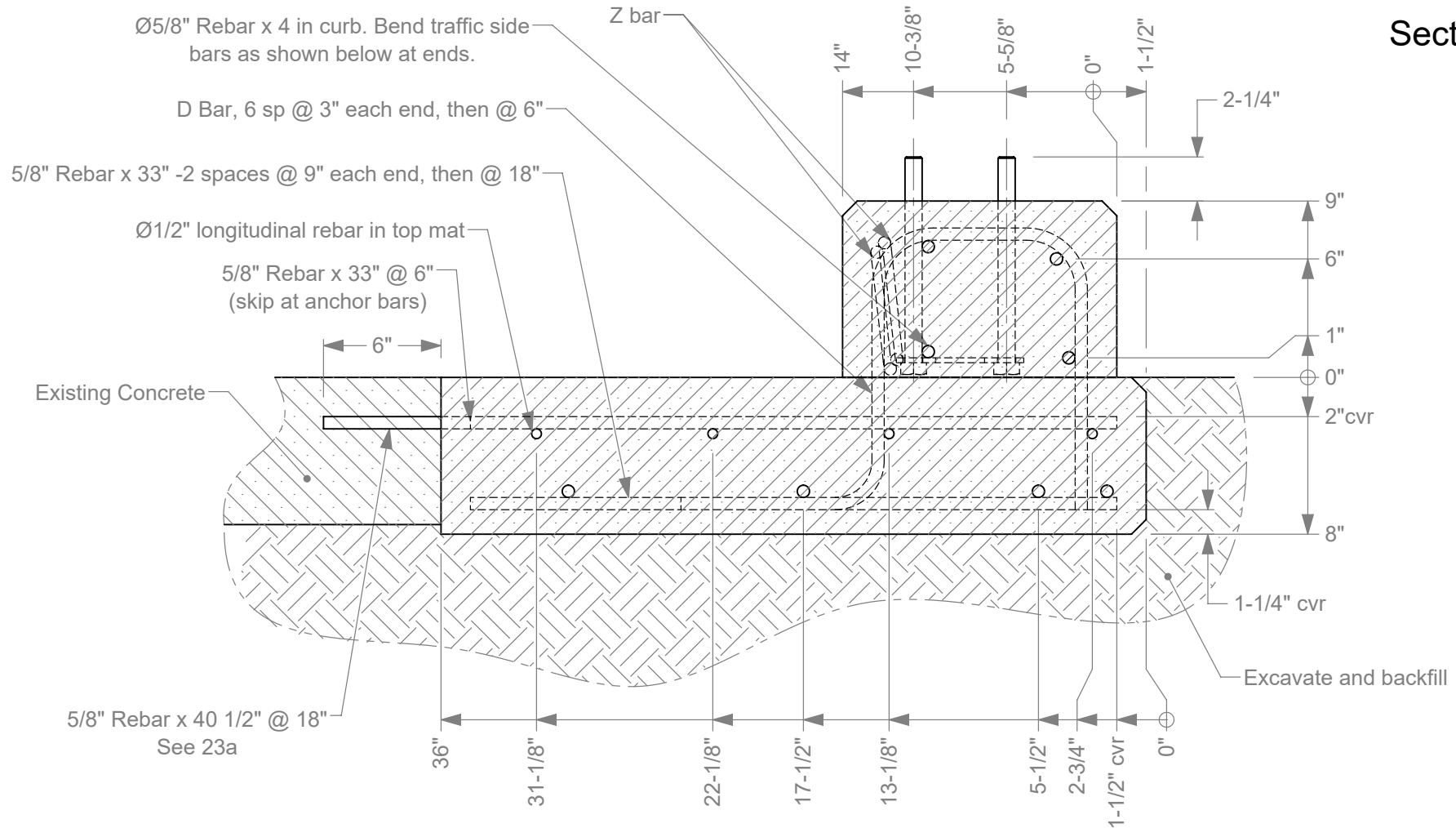
Elevation View
Section View on next sheet



Detail W
Scale 1 : 10

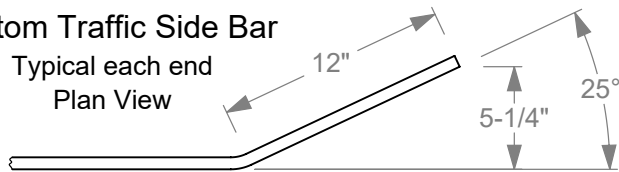
	Roadside Safety and Physical Security Division - Proving Ground	
	Project #611801 Wyoming Box Beam Transition	2021-01-06
Drawn by GES	Scale 1:40	Sheet 22 of 26 Moment Slab and Curb

Section X-X



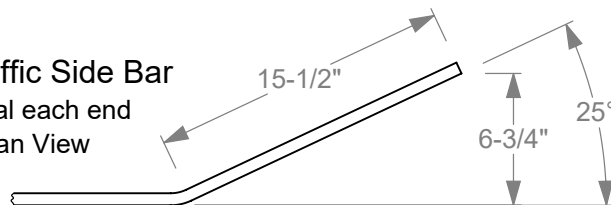
Bottom Traffic Side Bar

Typical each end
Plan View



Top Traffic Side Bar

Typical each end
Plan View



23a. Secure in existing concrete with Hilti HIT-RE 500 V3 epoxy according to manufacturer's instructions.

23b. All rebar is grade 60.

23c. All rebar dimensions are to center of bar unless otherwise indicated by "cvr" (cover).

23d. Concrete is 4000 psi.

23e. 1" chamfer (3/4" each way) edges of Deck and Curb as shown.



Roadside Safety and
Physical Security Division -
Proving Ground

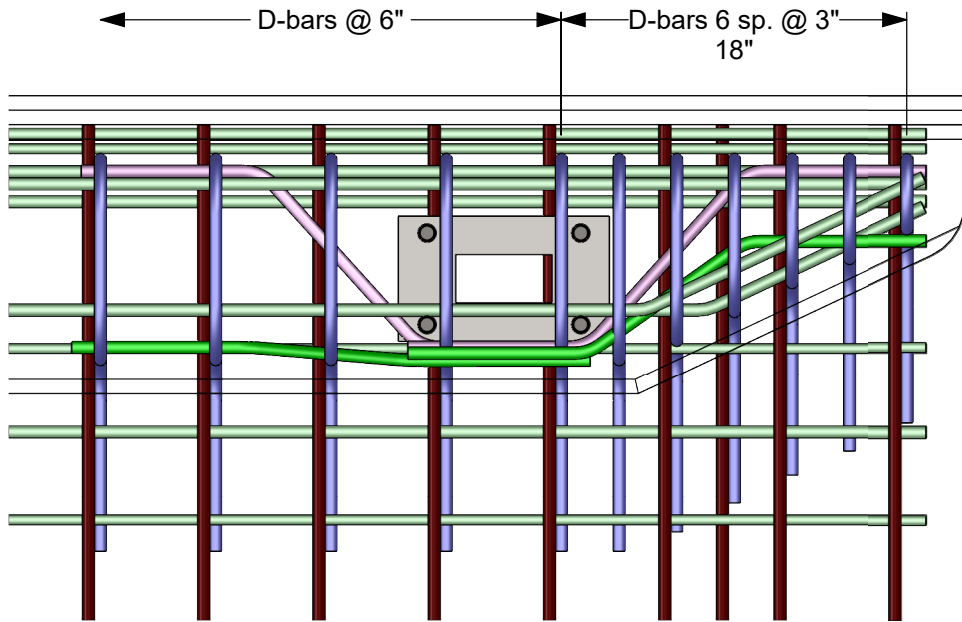
Project #611801 Wyoming Box Beam Transition

2021-01-06

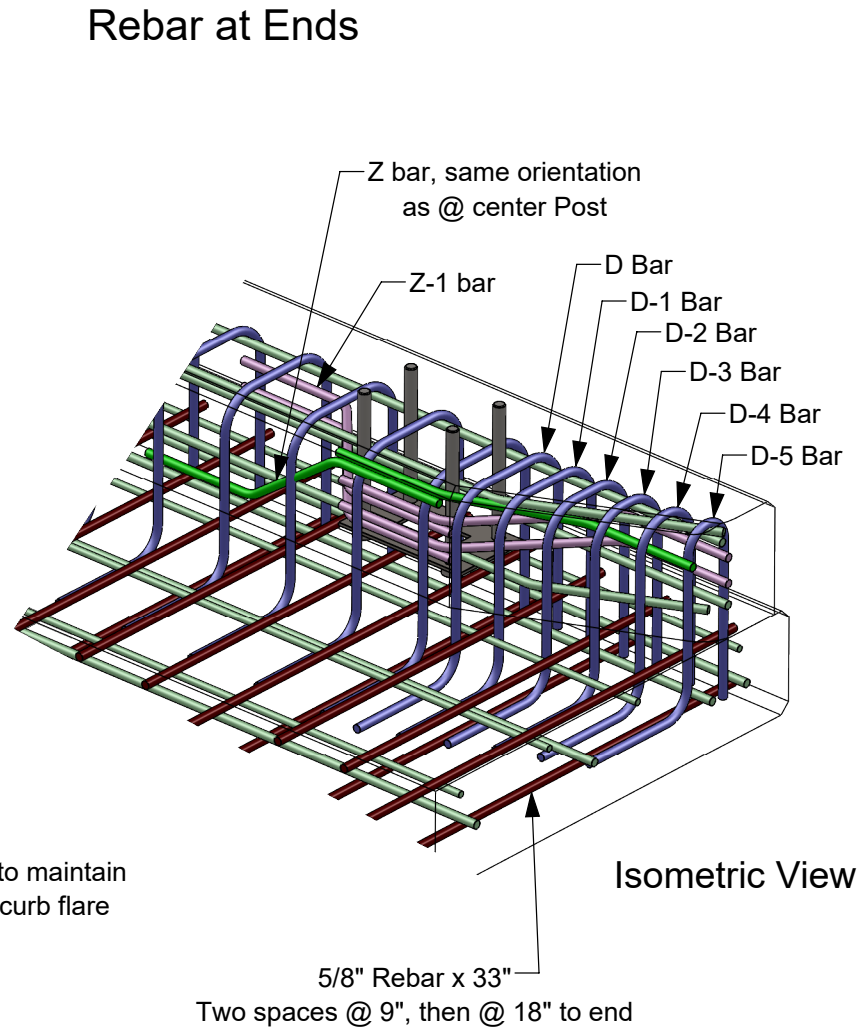
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Scale 1:8

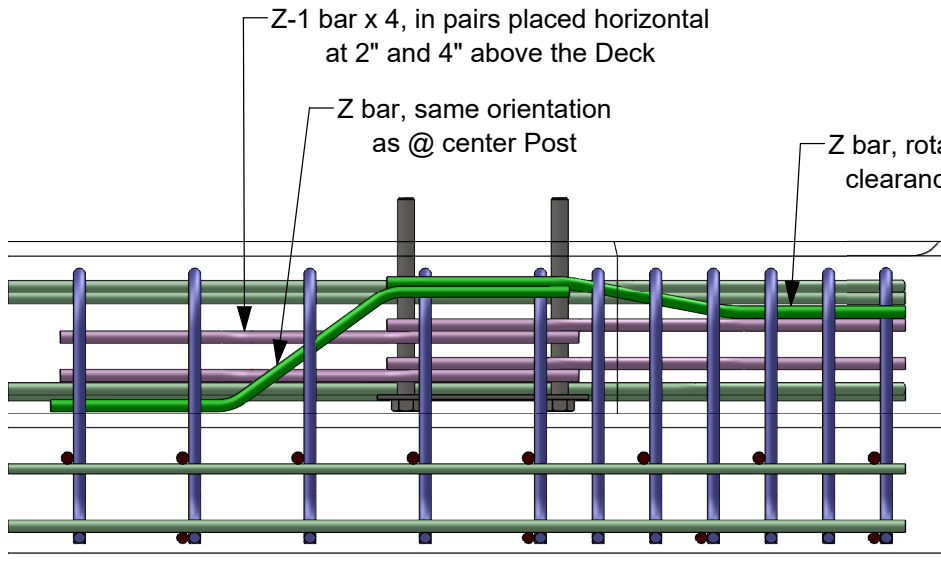
Sheet 23 of 26 Concrete Section



Plan View



Isometric View



Elevation View

Anchor Bars not shown for clarity



Roadside Safety and Physical Security Division - Proving Ground

Project #611801 Wyoming Box Beam Transition

2021-01-06

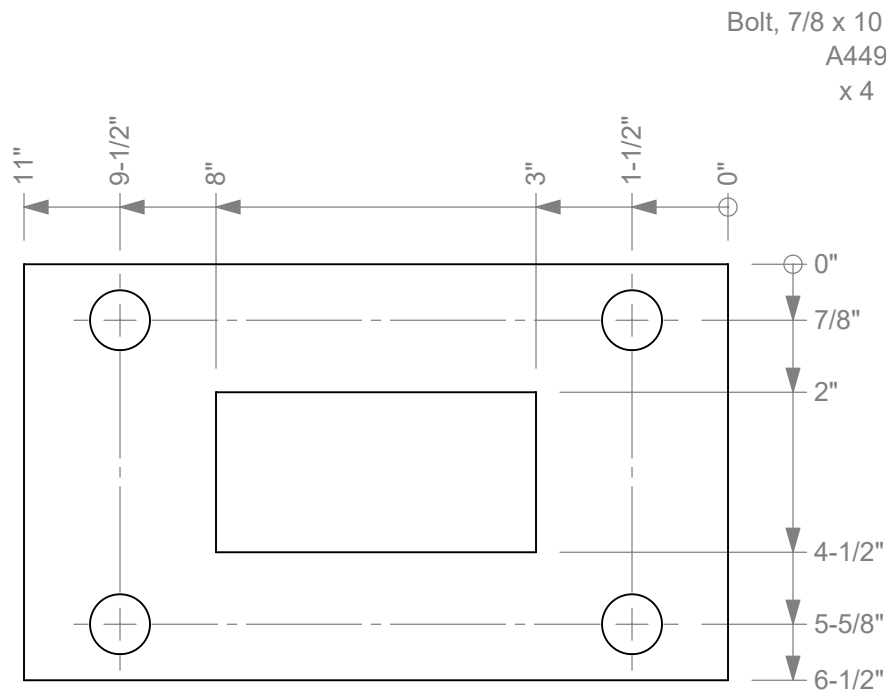
Drawn by GES

Scale 1:10

Sheet 24 of 26 Rebar at Ends

Anchor Bolt Assembly

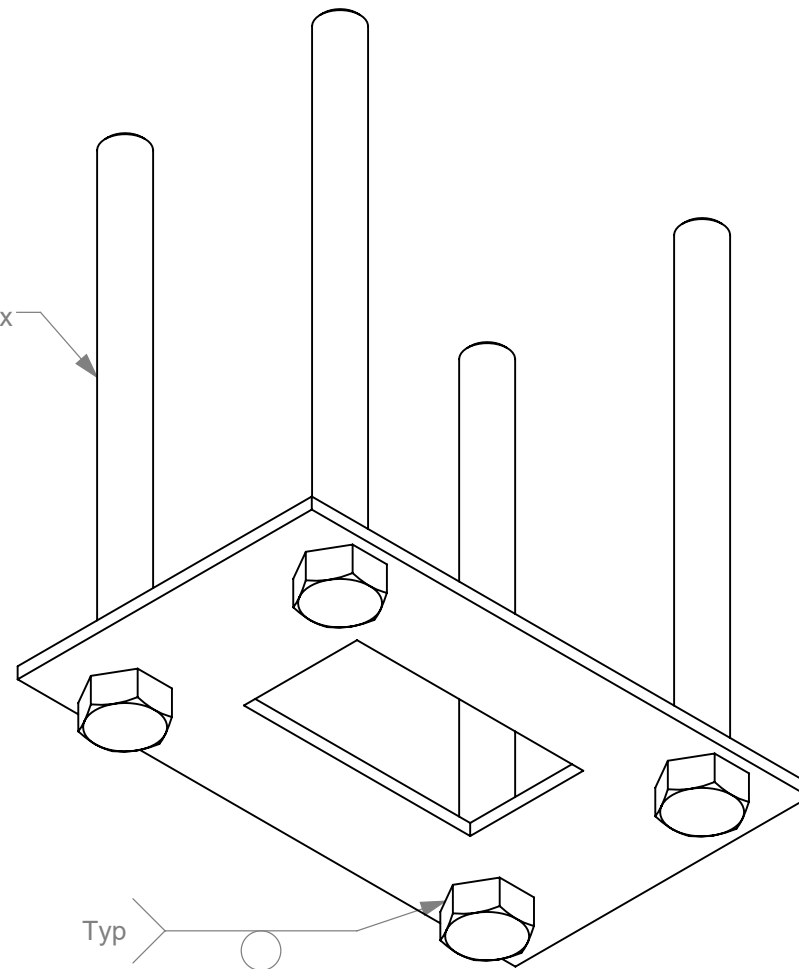
Threads not shown for clarity



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

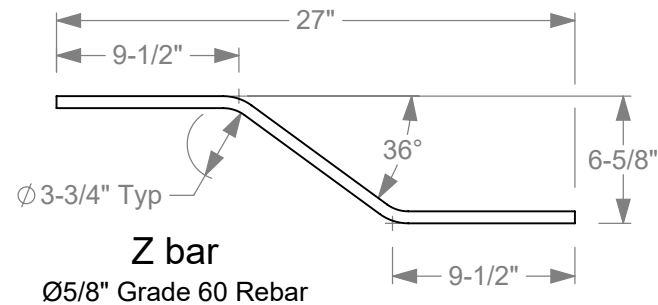
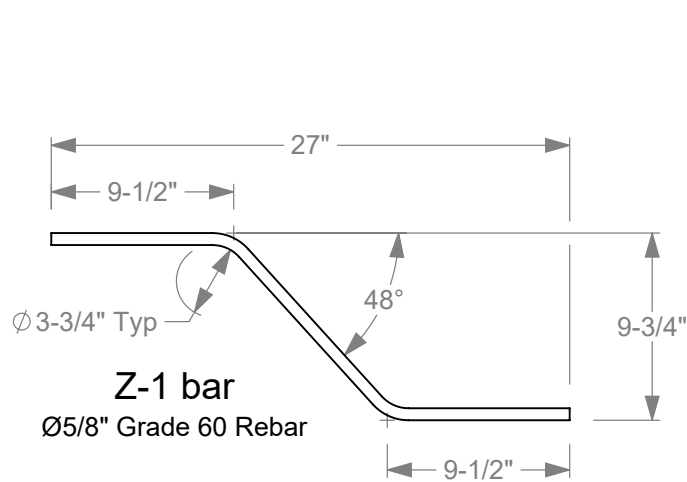
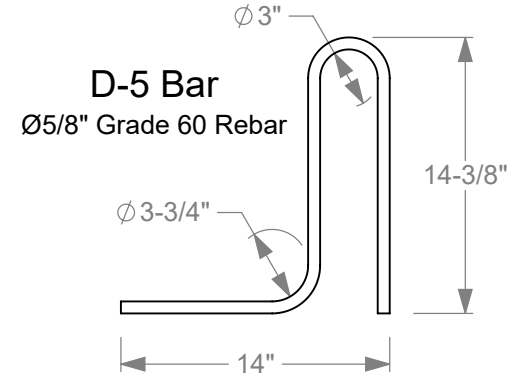
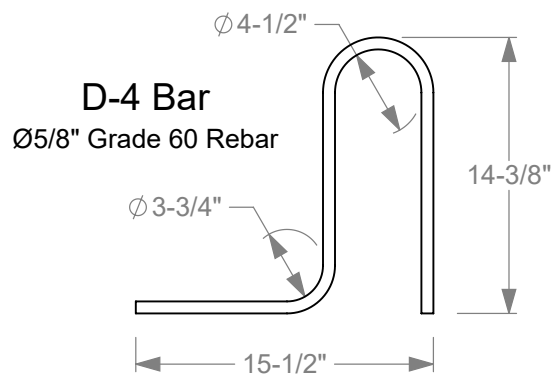
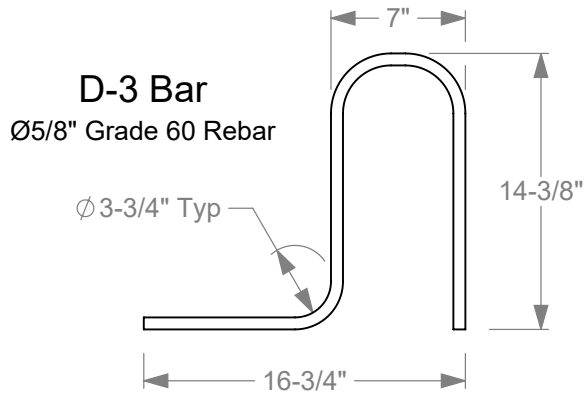
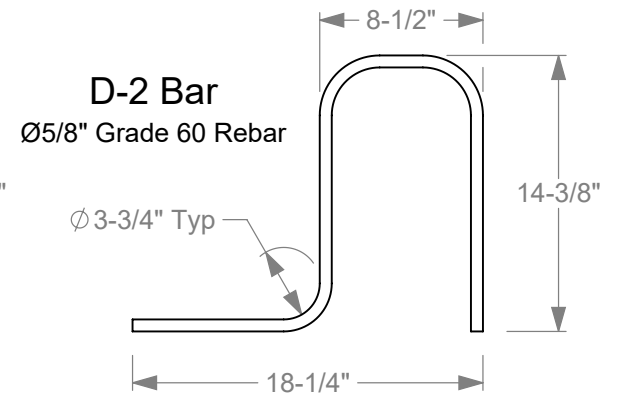
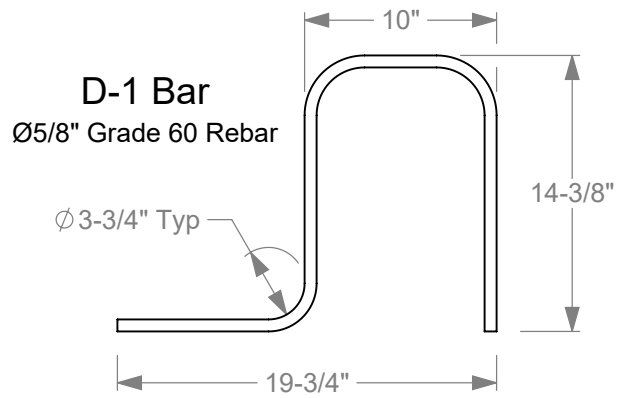
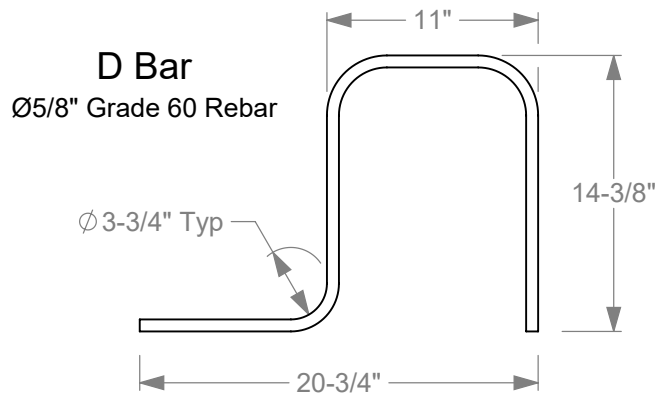
Project #611801 Wyoming Box Beam Transition

2021-01-06

Drawn by GES

Scale 1:3

Sheet 25 of 26 Anchor Bolt Assembly



Roadside Safety and
 Physical Security Division -
 Proving Ground

Project #611801 Wyoming Box Beam Transition

2021-01-06

Drawn by GES

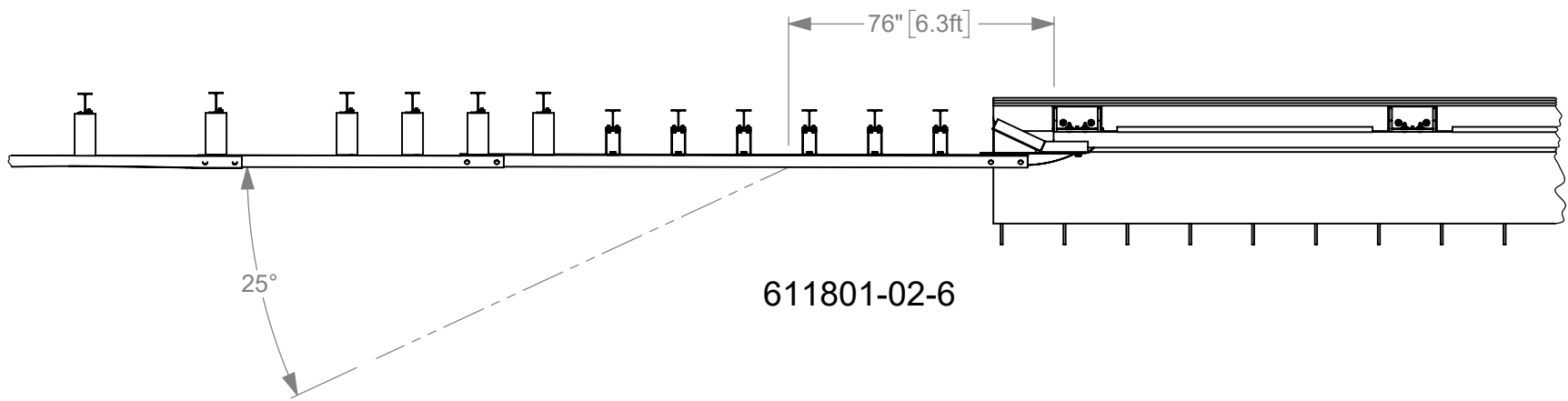
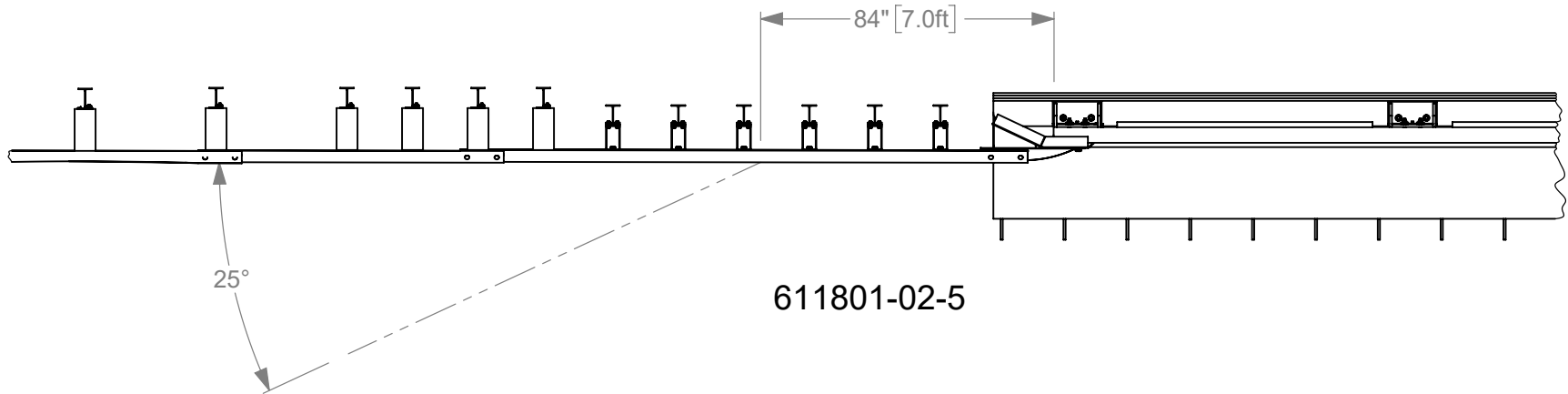
Scale 1:10

Sheet 26 of 26 Rebar

ATTACHMENT 1

MGS Transition Test Installation Details

Impacts



Roadside Safety and
Physical Security Division -
Proving Ground

Project #611801 5-6 Wyoming MGS Transition

2021-01-12

Drawn by GES

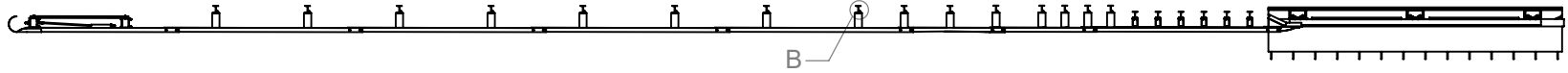
Scale 1:50

Sheet 1 of 19 Impacts

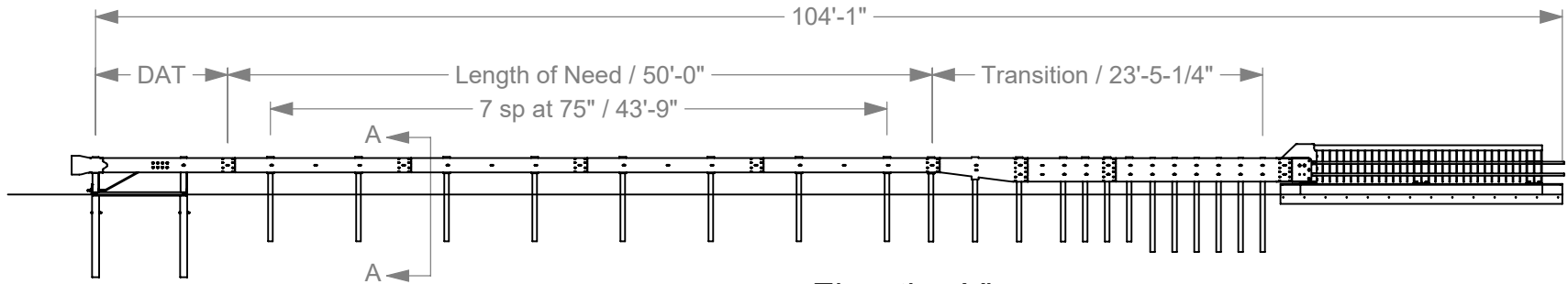
Test Installation

Post Numbers

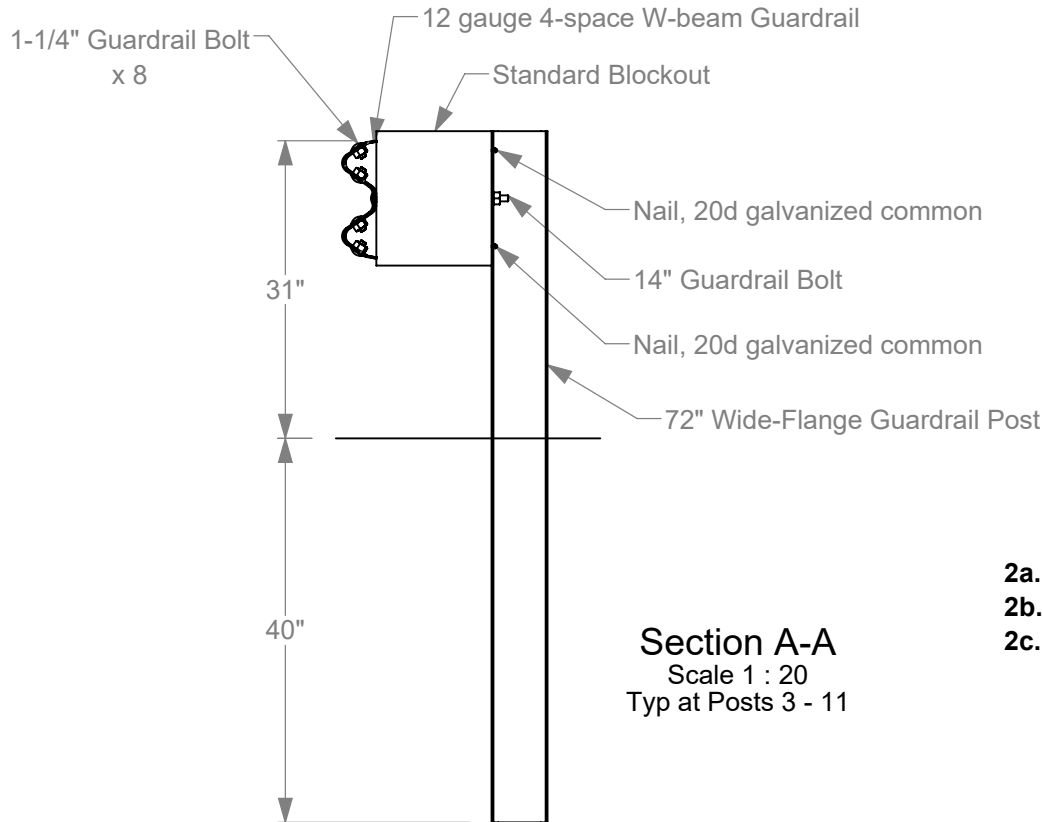
1 2 3 4 5 6 7 8 9 10 12 14 18 22 24 25 26



Plan View

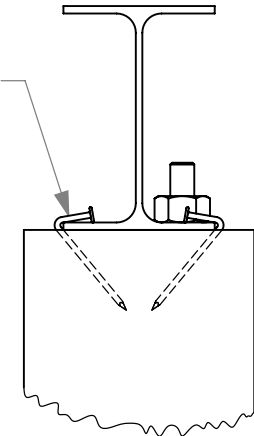


Elevation View



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.



Roadside Safety and
Physical Security Division -
Proving Ground

Project #611801 5-6 Wyoming MGS Transition

2021-01-12

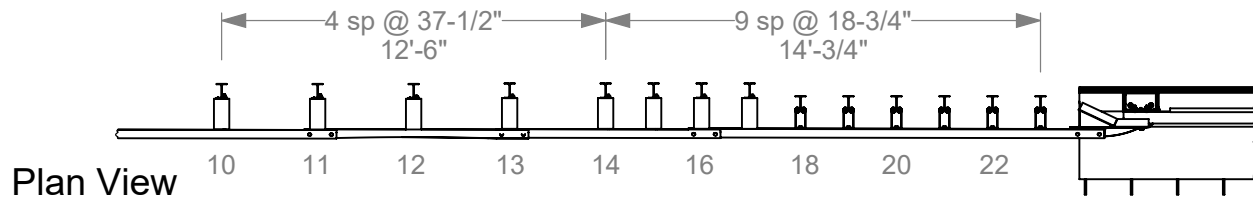
Drawn by GES

Scale 1:150

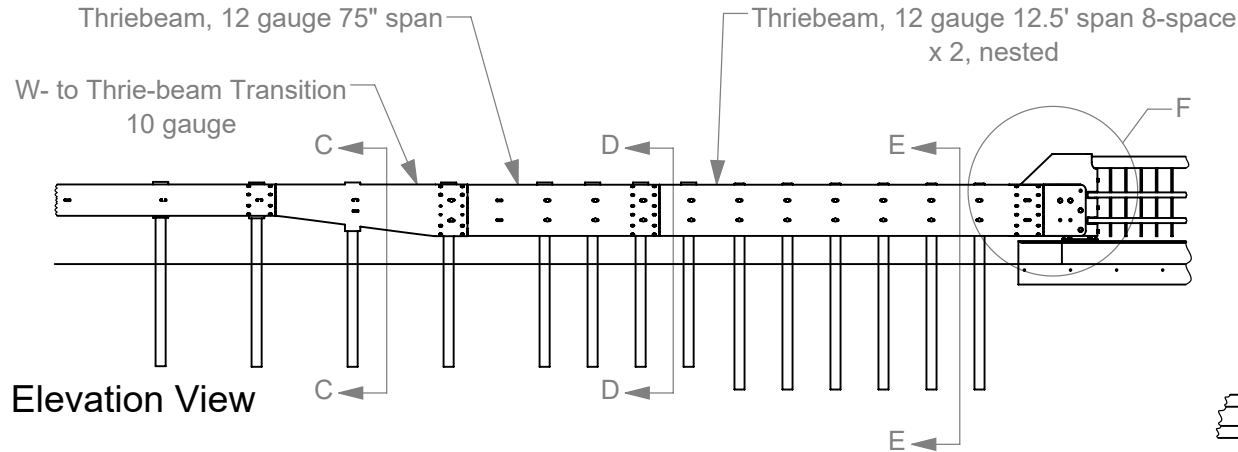
Sheet 2 of 19 Test Installation

Transition Details

Section views on next sheet

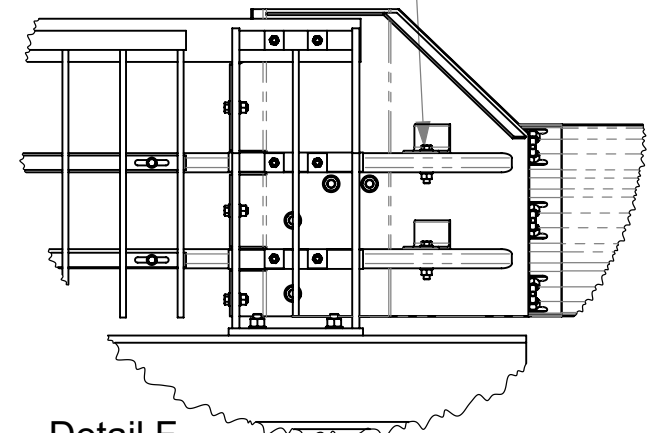


Plan View

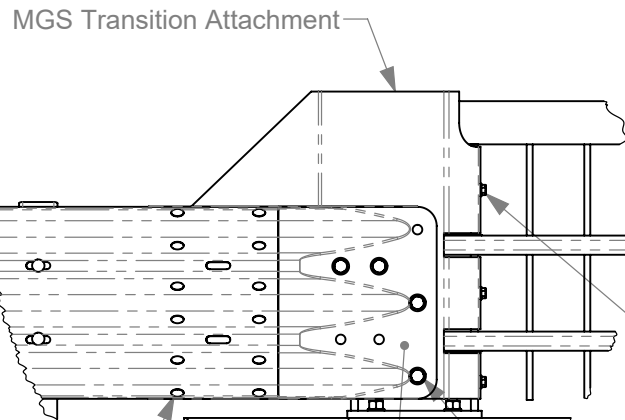


Elevation View

Bolt, 5/8 x 3 1/2" hex A325
with A194-2HM Hex Nut
and F436 Washers (2)
2 places



Detail F
Field Side



Detail F
Scale 1 : 20

Bolt, 5/8 x 2" hex A325
with A194-2HM Hex Nut
and F436 Washers (2)
3 places

2" Guardrail Bolt
with Rectangular Guardrail Washer
12 places

Bolt, 7/8 x 2" hex A325
with Heavy Hex Nut and
F436 Washers (2)
4 places

Thrie-beam Terminal Connector



Roadside Safety and
Physical Security Division -
Proving Ground

Project #611801 5-6 Wyoming MGS Transition

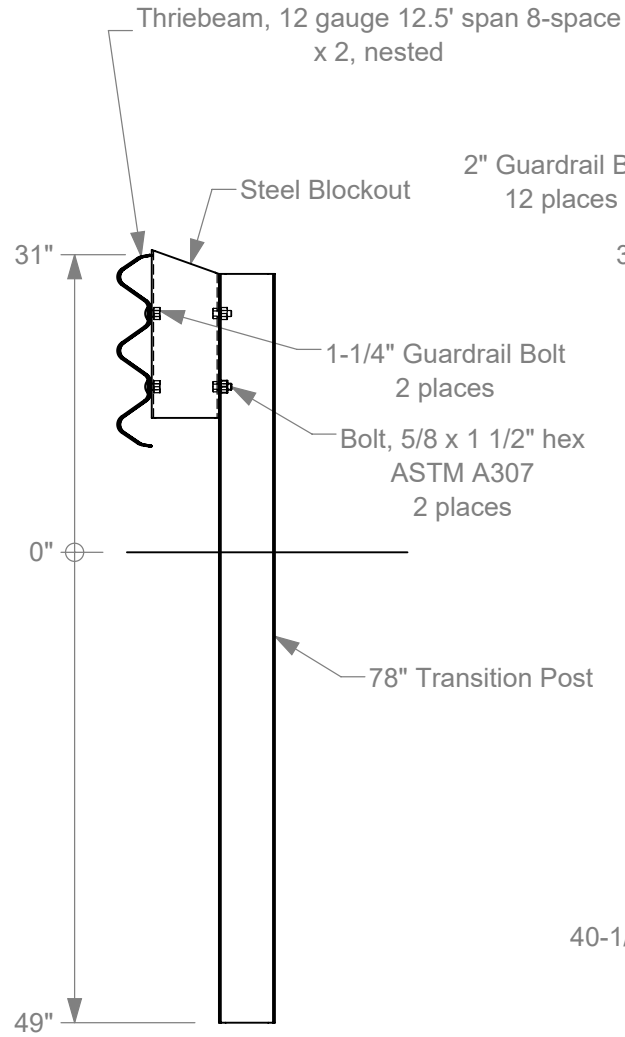
2021-01-12

Drawn by GES

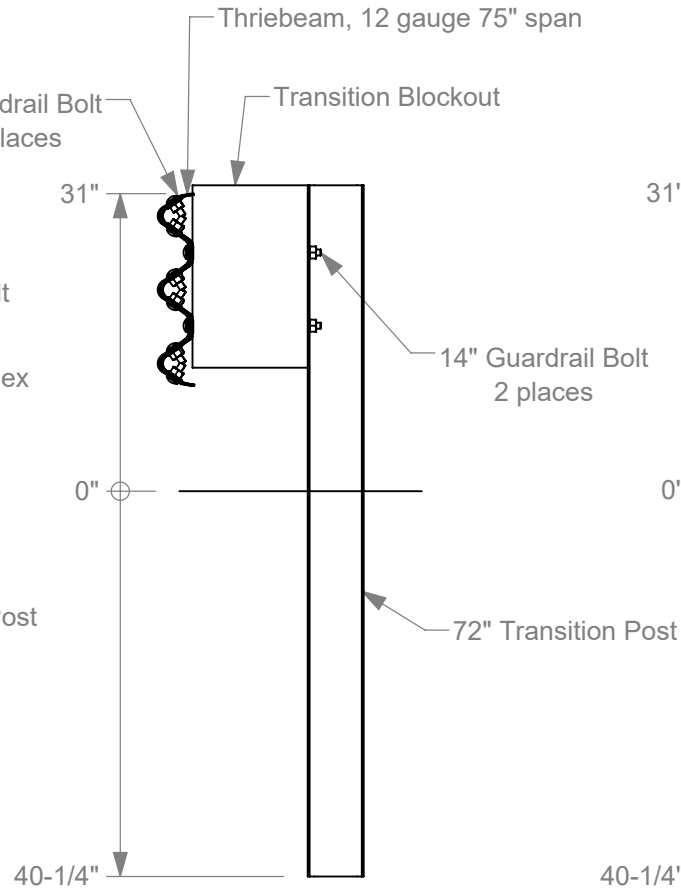
Scale 1:75

Sheet 3 of 19 Transition Details

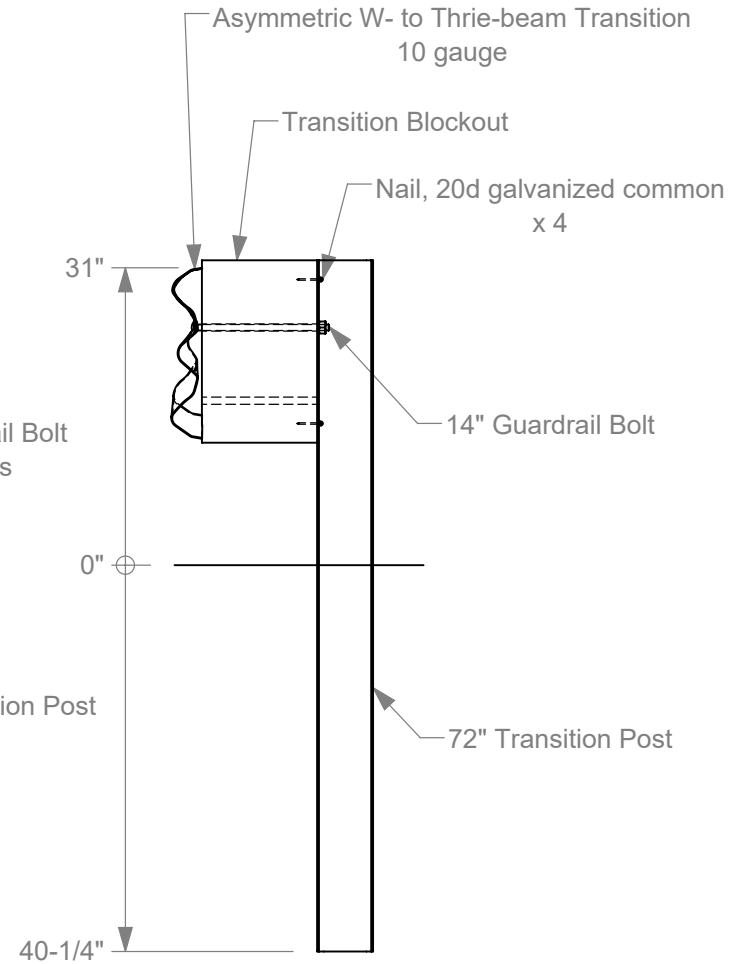
Section Views



Section E-E
Typ @ Posts 18 - 23



Section D-D
Typ @ Posts 13 - 17



Section C-C
@ Post 12



Roadside Safety and
Physical Security Division -
Proving Ground

Project #611801 5-6 Wyoming MGS Transition

2021-01-12

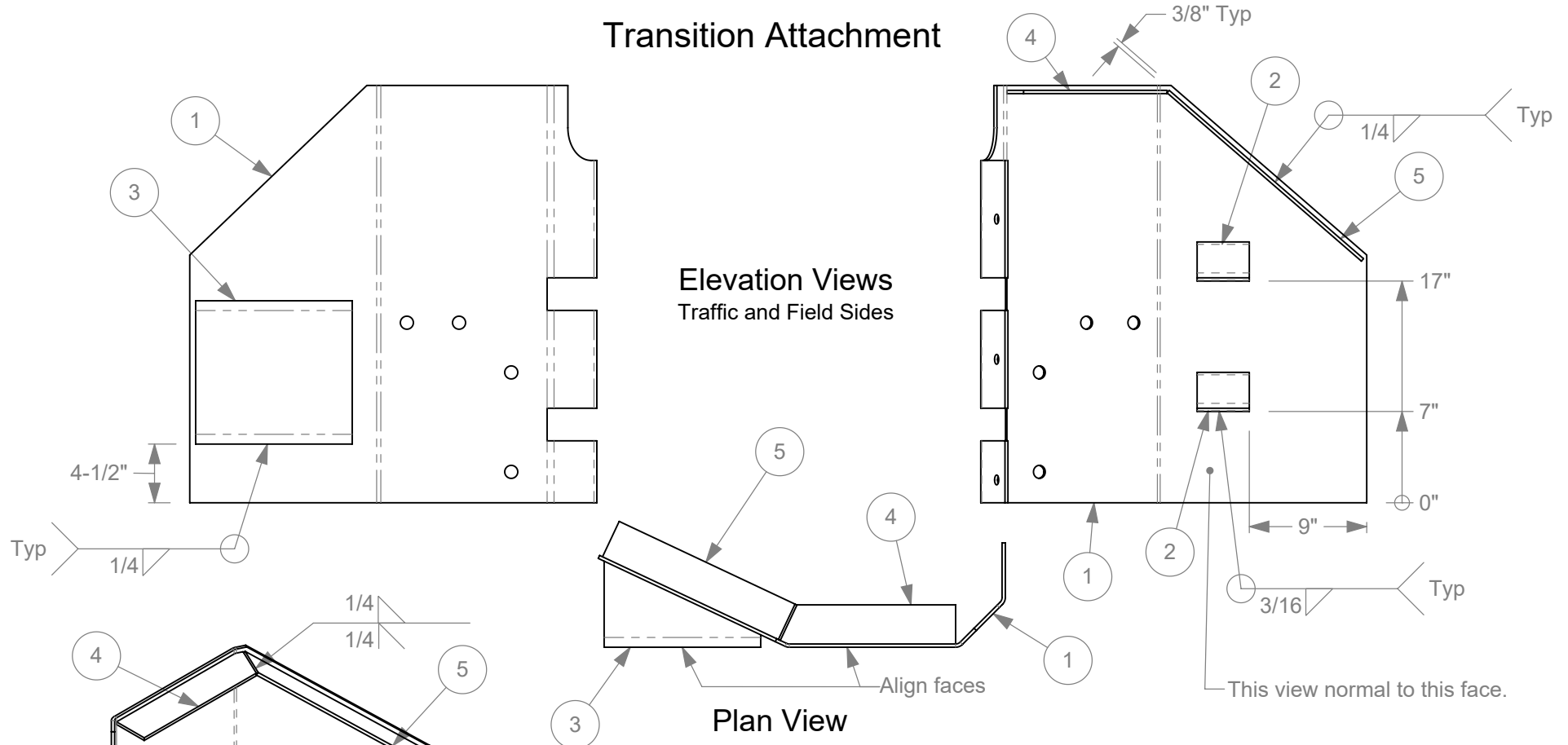
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Scale 1:20

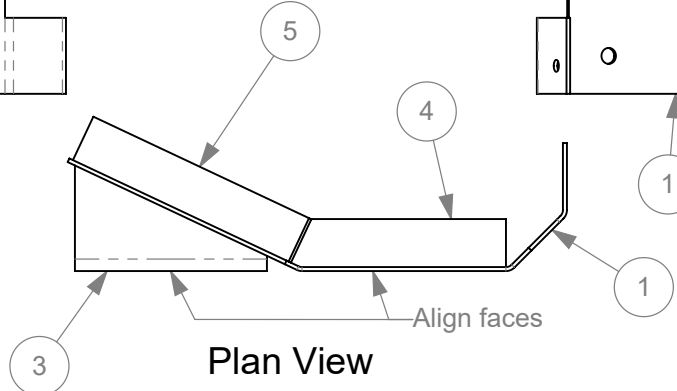
Sheet 4 of 19 Section Views

Transition Attachment

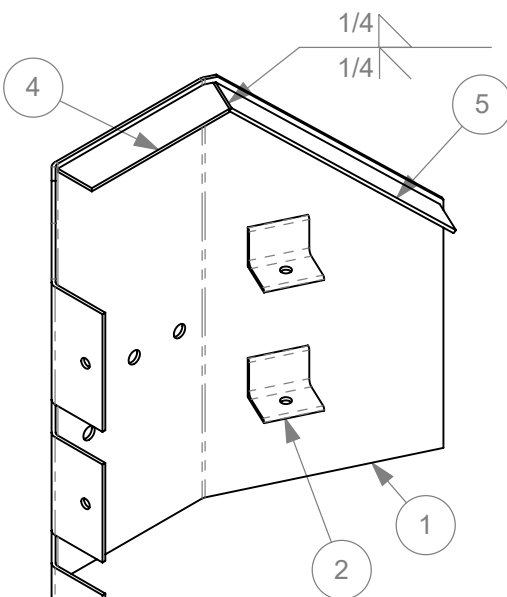
Elevation Views Traffic and Field Sides



Plan View



Isometric View



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

#	Body Name	Description	Length	Material	Qty
1	Bent Plate	Plate, 32" x 1/4"	38 3/8"	ASTM A36	1
2	Tab	L 3 x 3 x 1/4	4"	ASTM A36	2
3	Thrie-beam Support	Plate, 12" x 1/4"	23 1/8"	ASTM A36	1
4	Top Stiffener	Plate, 3" x 1/4"	13 7/16"	ASTM A36	1
5	Side Stiffener	Plate, 3" x 1/4"	19 11/16"	ASTM A36	1



Roadside Safety and
Physical Security Division -
Proving Ground

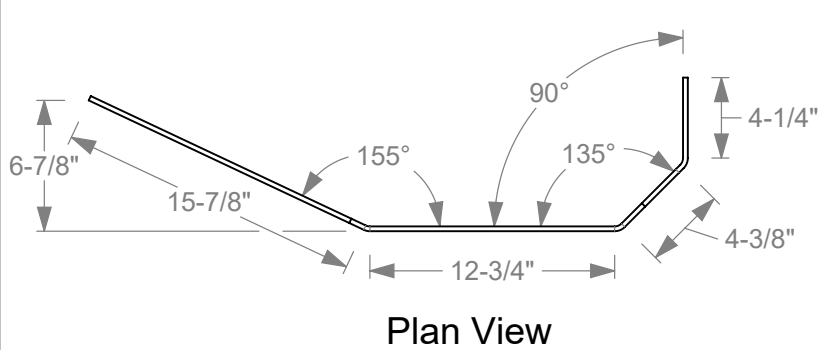
Project #611801 5-6 Wyoming MGS Transition

2021-01-12

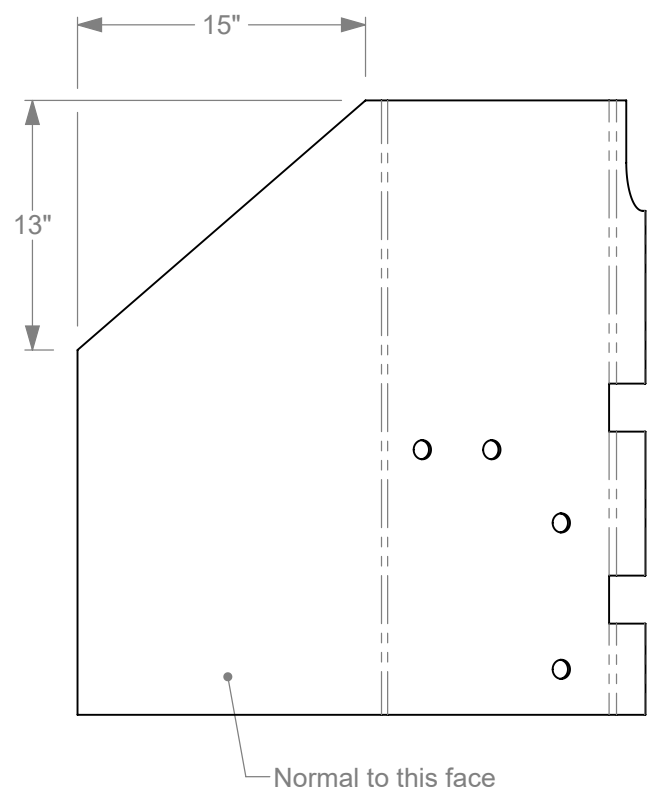
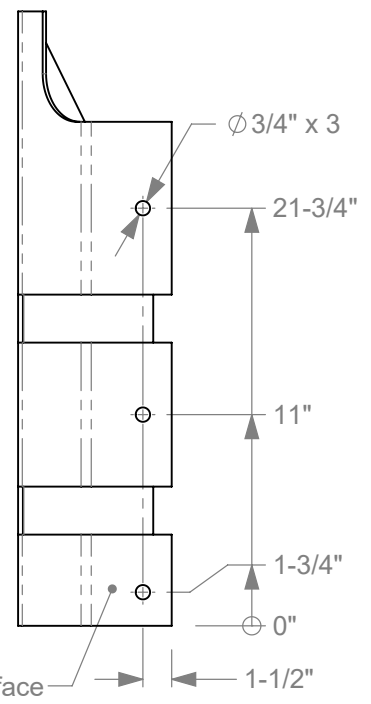
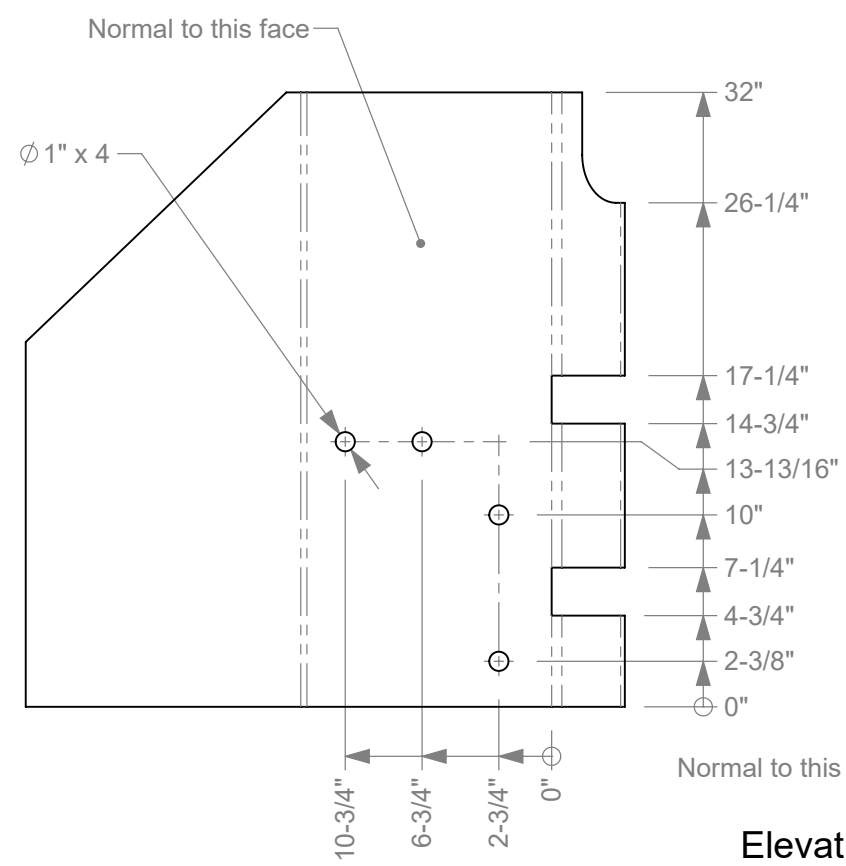
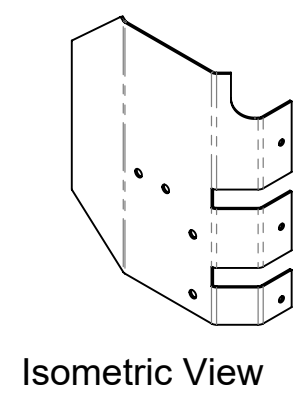
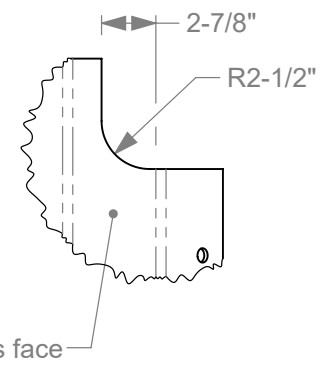
Drawn by GES

Scale 1:12

Sheet 5 of 19 Transition Attachment



1
Bent Plate
 Plate, 32" x 1/4" x 38 3/8"
 ASTM A36

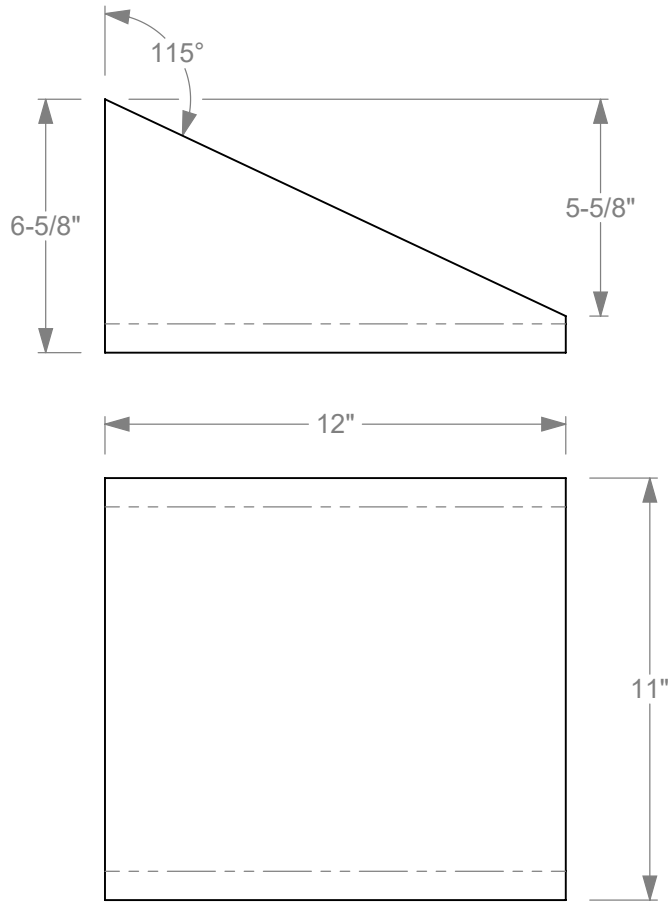


Elevation Views



Roadside Safety and
 Physical Security Division -
 Proving Ground

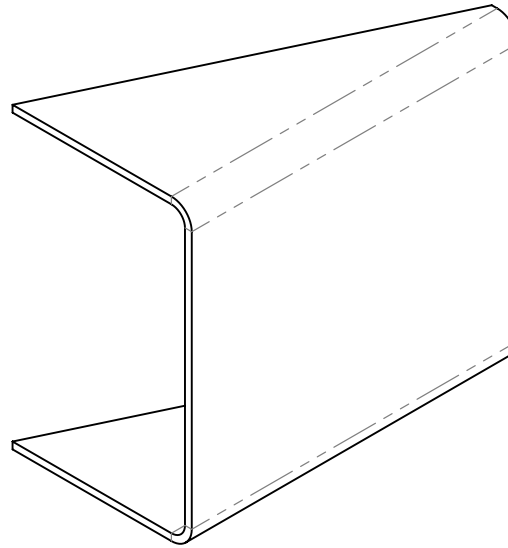
Project #611801 5-6 Wyoming MGS Transition		2021-01-12
Drawn by GES	Scale 1:10	Sheet 6 of 19 Bent Plate



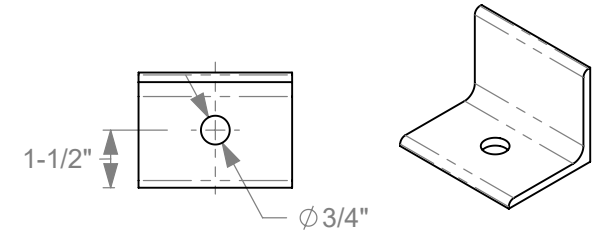
3 **Thrie-beam Support**
Plate, 12" x 1/4" x 23 1/8"
ASTM A36



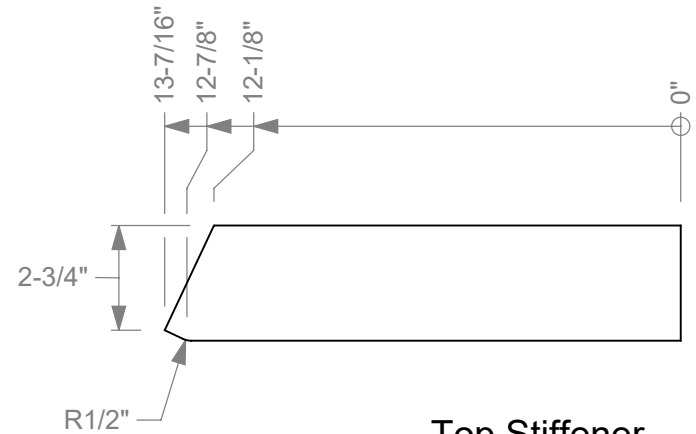
5 **Side Stiffener**
Plate, 3" x 1/4" x 19 11/16"
ASTM A36



Attachment Parts



2 **Tab**
L 3 x 3 x 1/4 x 4"
ASTM A36
Plan and Isometric Views



4 **Top Stiffener**
Plate, 3" x 1/4" x 13 7/16"
ASTM A36



Roadside Safety and
Physical Security Division -
Proving Ground

Project #611801 5-6 Wyoming MGS Transition

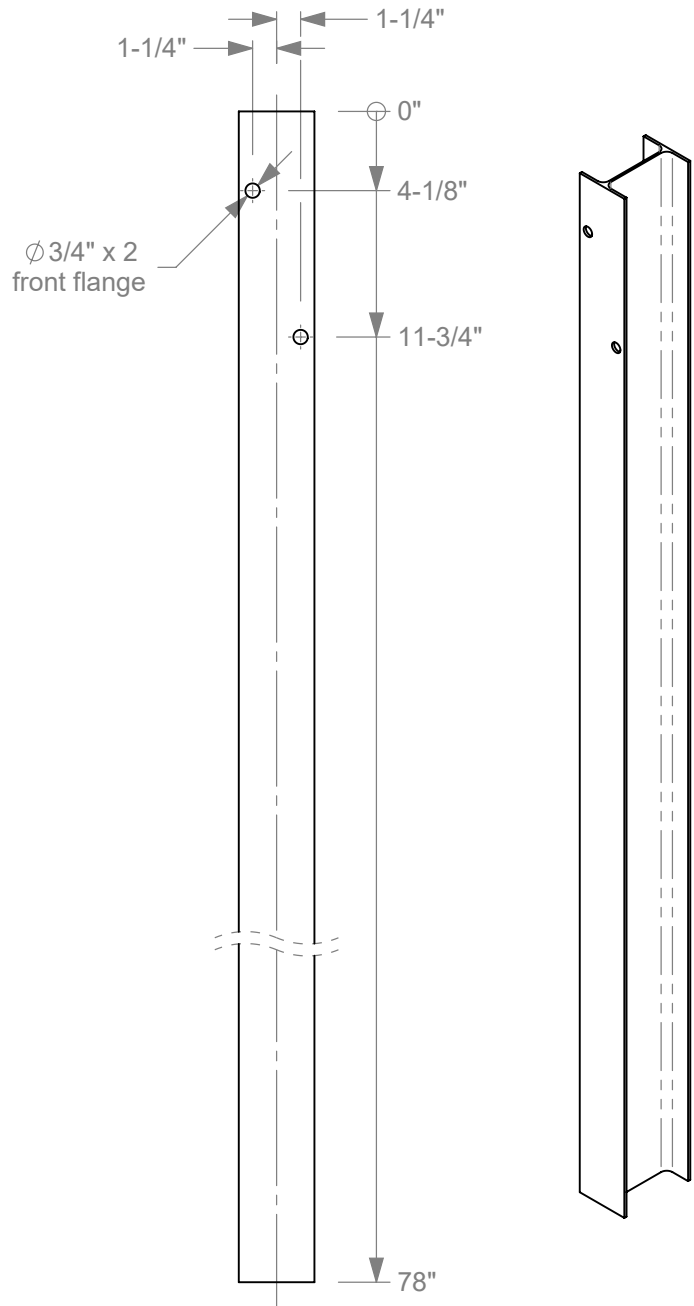
2021-01-12

Drawn by GES

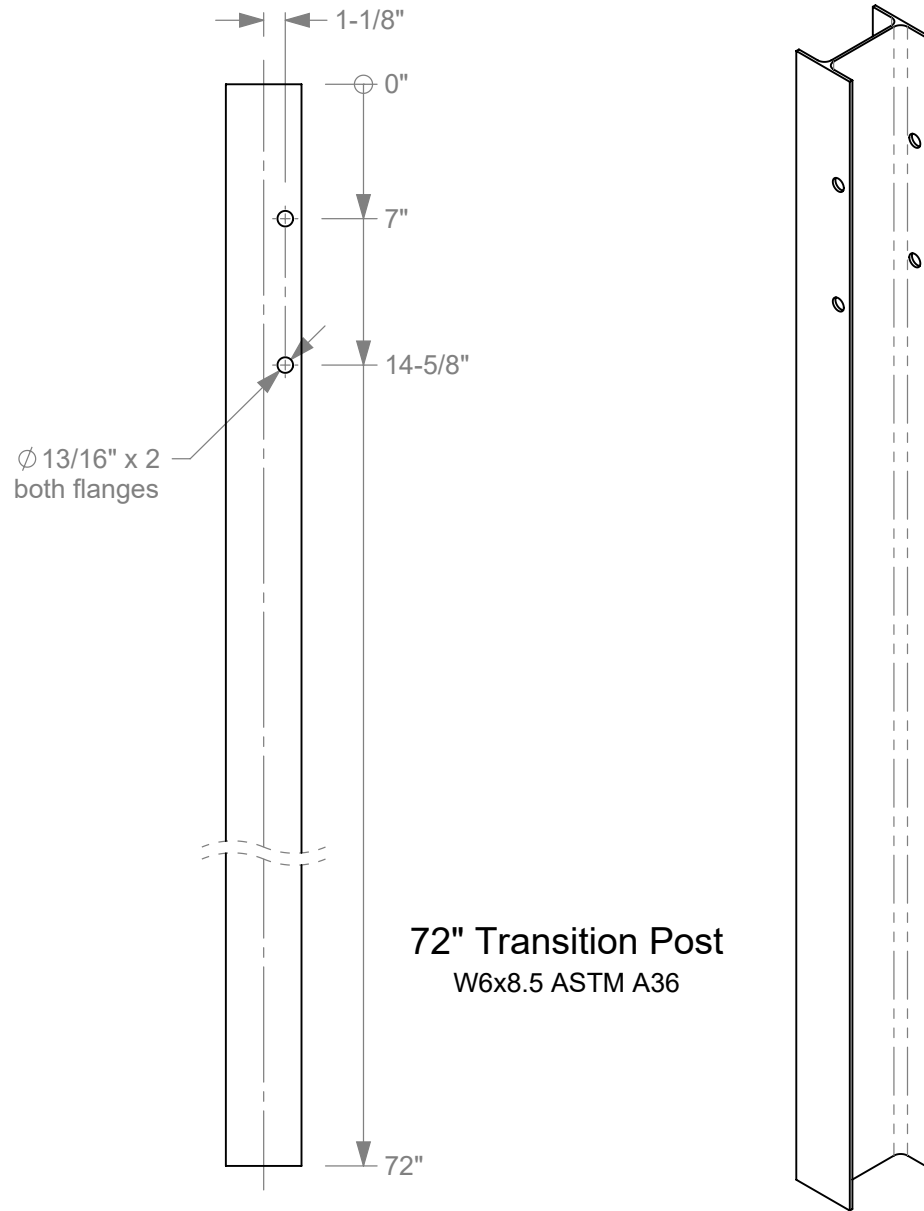
Scale 1:5

Sheet 7 of 19 Attachment Parts

Transition Posts



78" Transition Post
W6x8.5 ASTM A36



72" Transition Post
W6x8.5 ASTM A36



Roadside Safety and
Physical Security Division -
Proving Ground

Project #611801 5-6 Wyoming MGS Transition

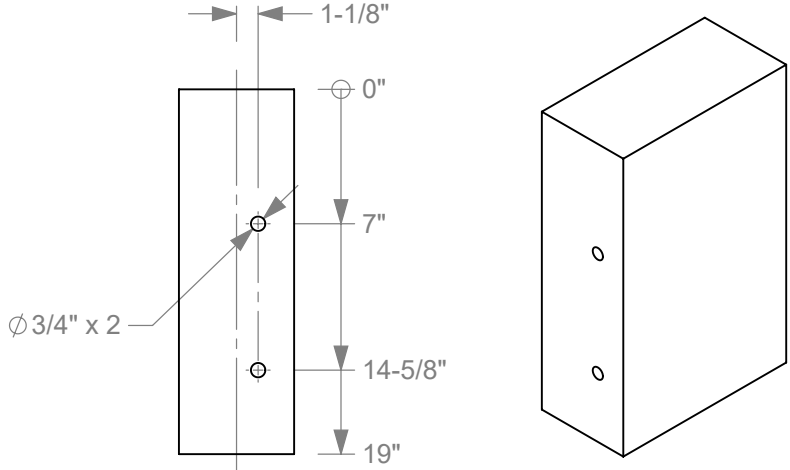
2021-01-12

Drawn by GES

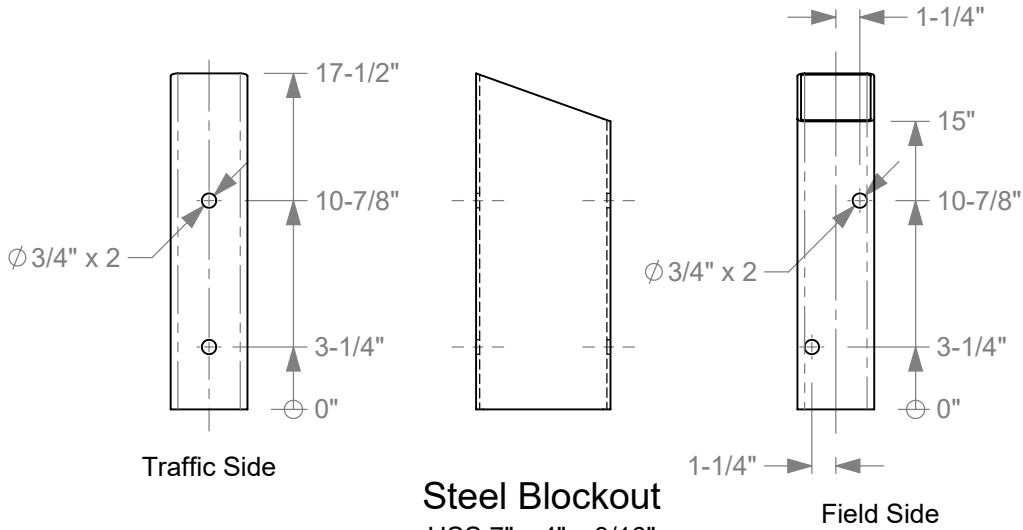
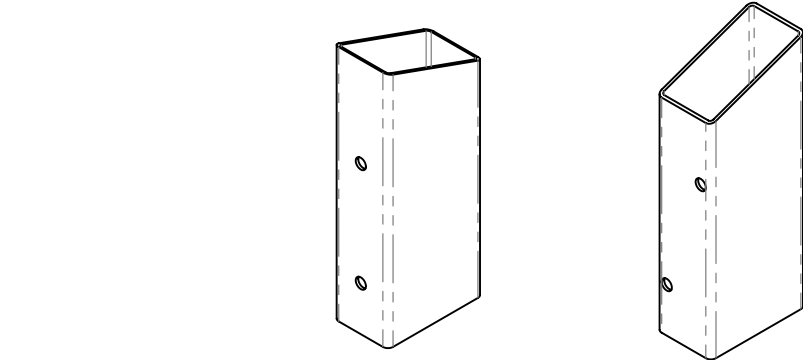
Scale 1:10

Sheet 8 of 19 Transition Posts

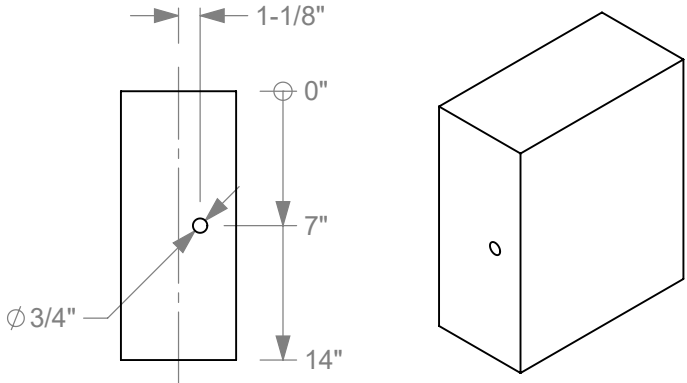
Transition Blockouts



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

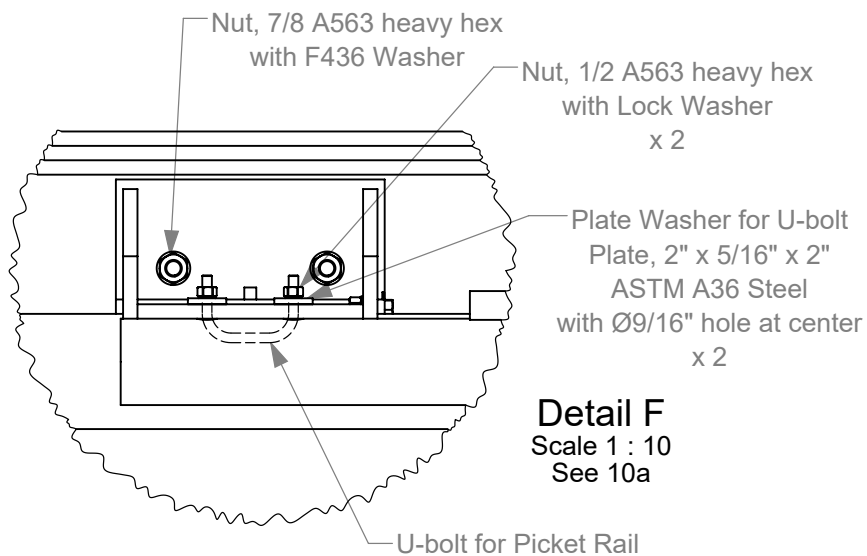


Standard Blockout
 Pressure-treated Yellow Pine Timber
 6" x 12" x 14"

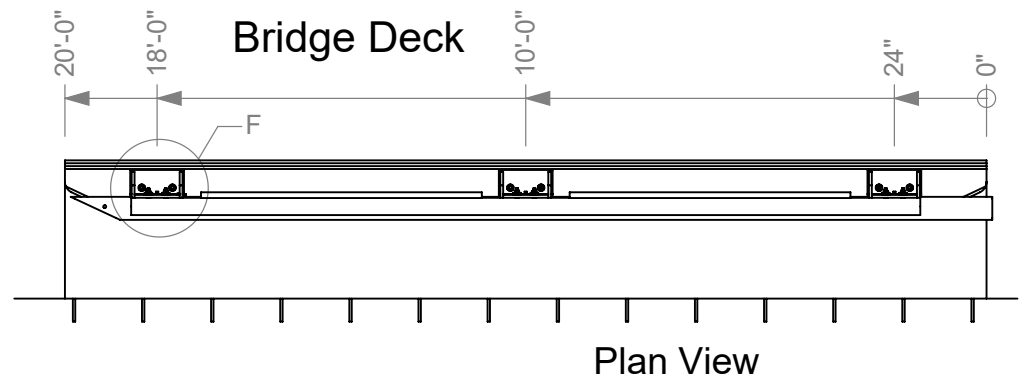


Roadside Safety and
 Physical Security Division -
 Proving Ground

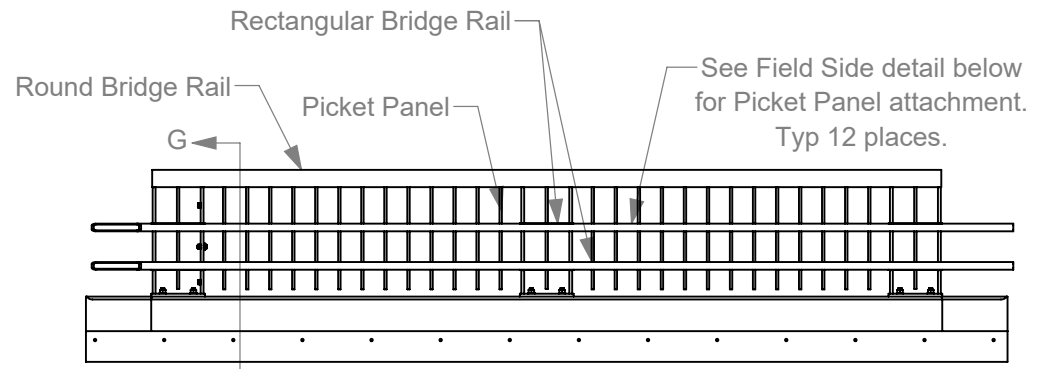
Project #611801 5-6 Wyoming MGS Transition		2021-01-12
Drawn by GES	Scale 1:10	Sheet 9 of 19 Transition Blockouts



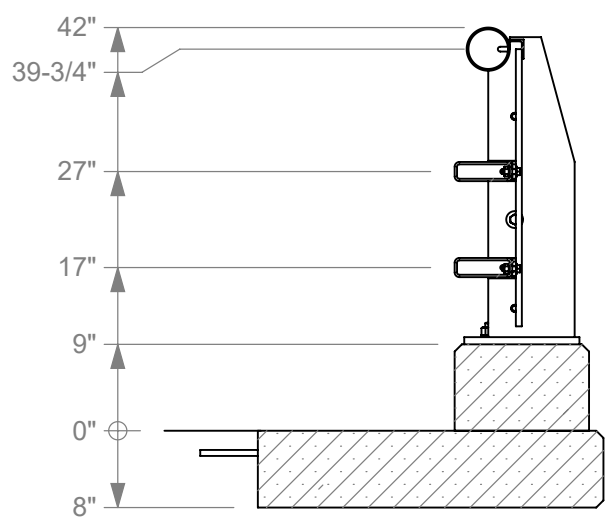
Detail F
Scale 1 : 10
See 10a



Plan View

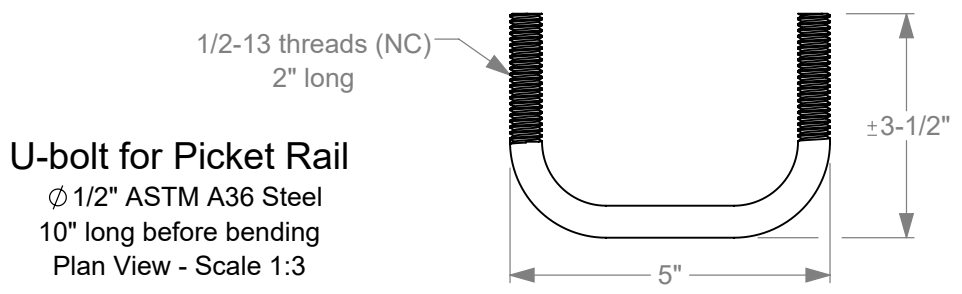
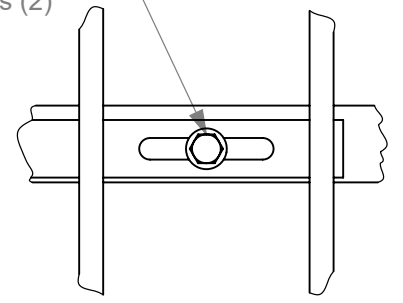


Elevation View



Section G-G
Scale 1 : 20

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

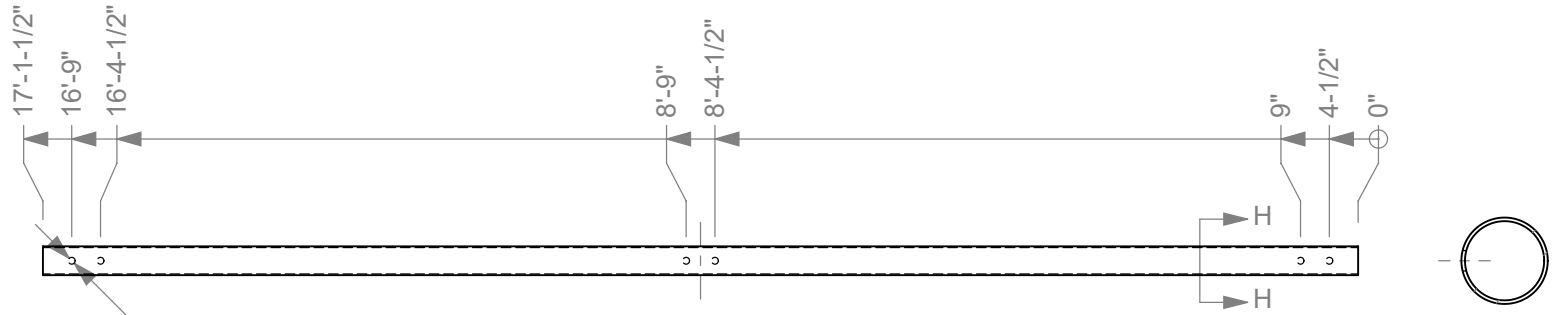


U-bolt for Picket Rail
Ø 1/2" ASTM A36 Steel
10" long before bending
Plan View - Scale 1:3

10a. U-bolt and hardware typical 3 places at each Post.
Anchor hardware typical 4 places at each Post.

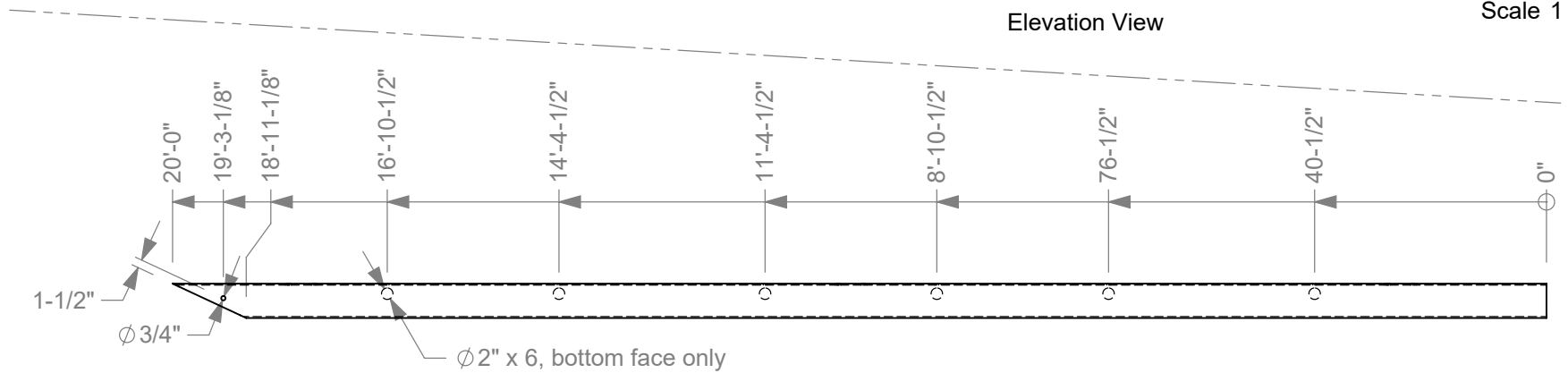
		Roadside Safety and Physical Security Division - Proving Ground	
Project #611801 5-6 Wyoming MGS Transition			2021-01-12
Drawn by GES	Scale 1:50	Sheet 10 of 19 Bridge Deck	

Bridge Rails

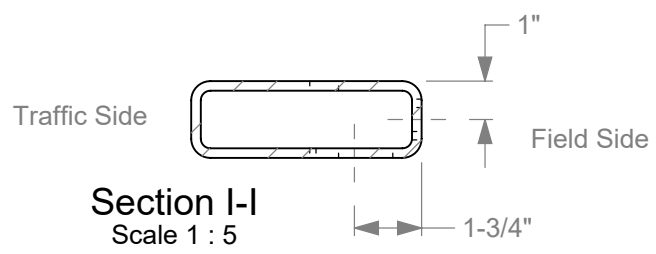
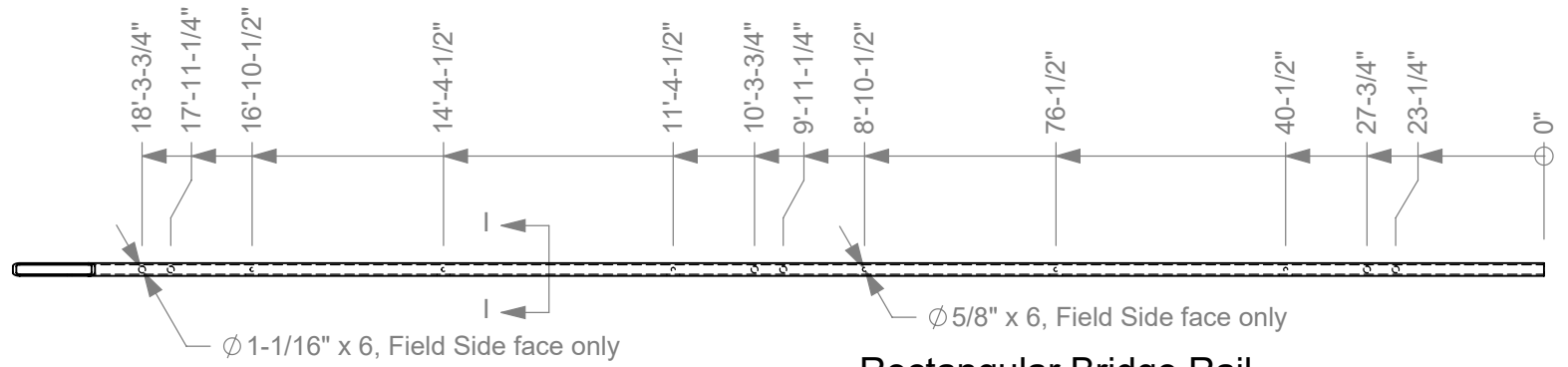


Round Bridge Rail
 HSS Round 4 1/2" x 3/16" ASTM A500 Grade B
 Elevation View

Section H-H
 Scale 1 : 10



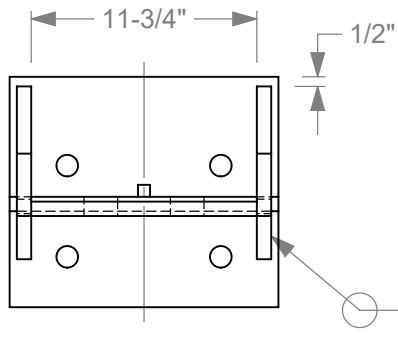
Rectangular Bridge Rail
 HSS 6 x 2 x 1/4" ASTM A500 Grade B
 Plan and Elevation Views



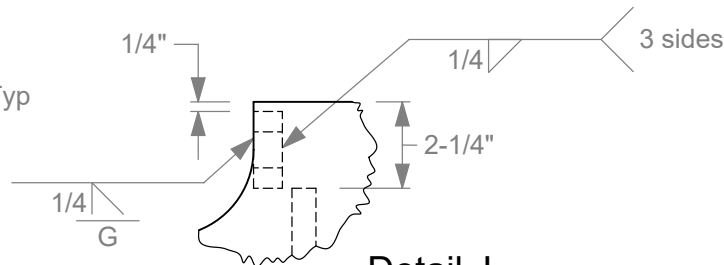
		Roadside Safety and Physical Security Division - Proving Ground	
Project #611801 5-6 Wyoming MGS Transition			2021-01-12
Drawn by GES	Scale 1:30	Sheet 11 of 19 Bridge Rails	

Bridge Post

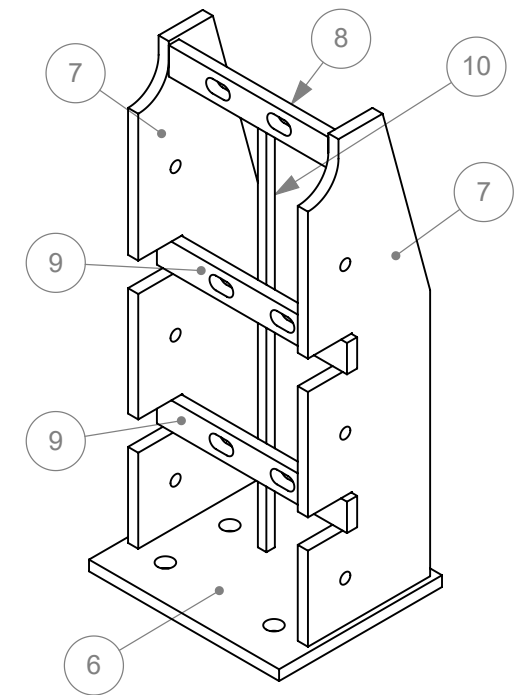
#	Body Name	Description	Length	Material	Qty
6	Base Plate	Plate, 12" x 3/4"	14"	ASTM A572 Grade 50	1
7	Side Plate	Plate, 9" x 3/4"	31-1/4"	ASTM A572 Grade 50	2
8	Rail Plate, Top	Plate, 2" x 3/4"	11-3/4"	ASTM A36	1
9	Rail Plate, Lower	Plate, 2" x 3/4"	14"	ASTM A36	2
10	Picket	Plate, 5/8" x 5/8"	27-3/4"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



Plan View

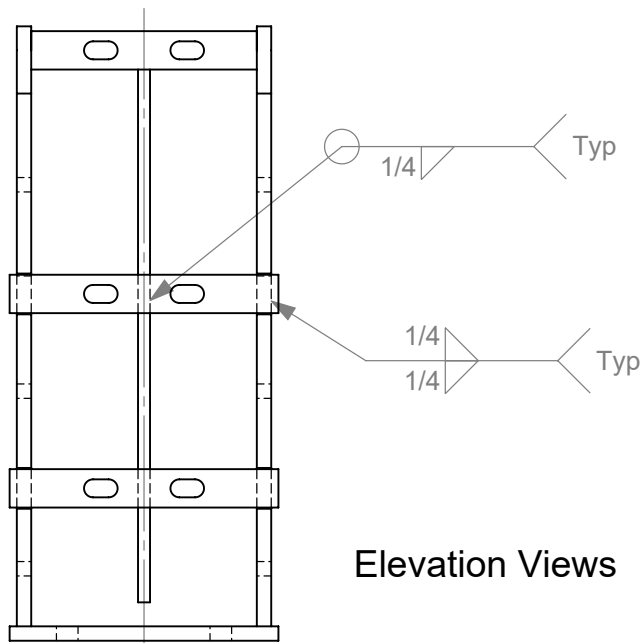


Detail J
Scale 1 : 5



Isometric View

12a. All welding must be performed by certified welders using industry standard practices.
12b. Galvanize after fabrication is complete.



Elevation Views



Roadside Safety and Physical Security Division - Proving Ground

Project #611801 5-6 Wyoming MGS Transition

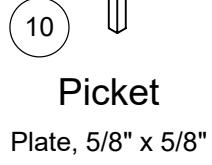
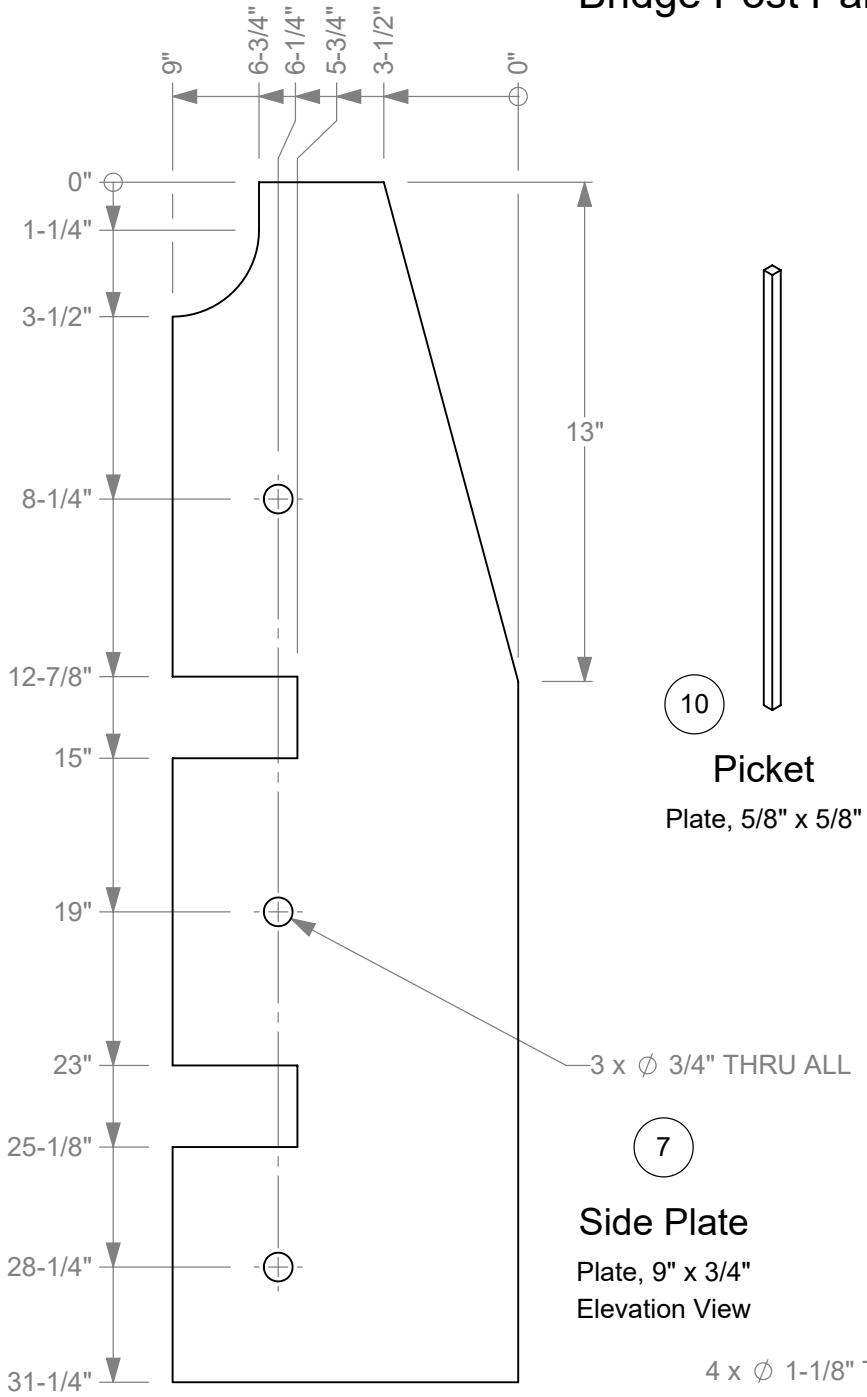
2021-01-12

Drawn by GES

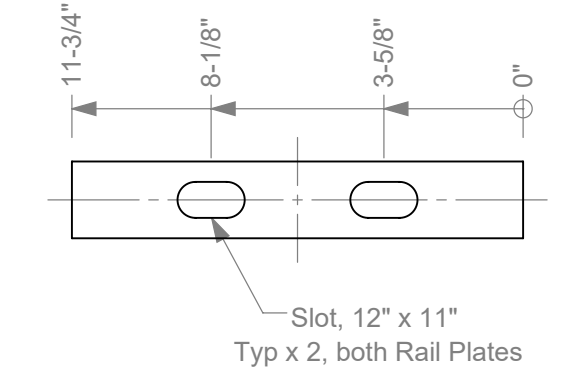
Scale 1:10

Sheet 12 of 19 Bridge Post

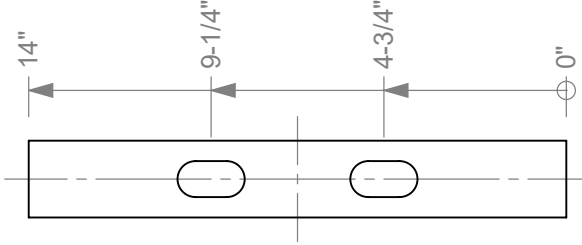
Bridge Post Parts



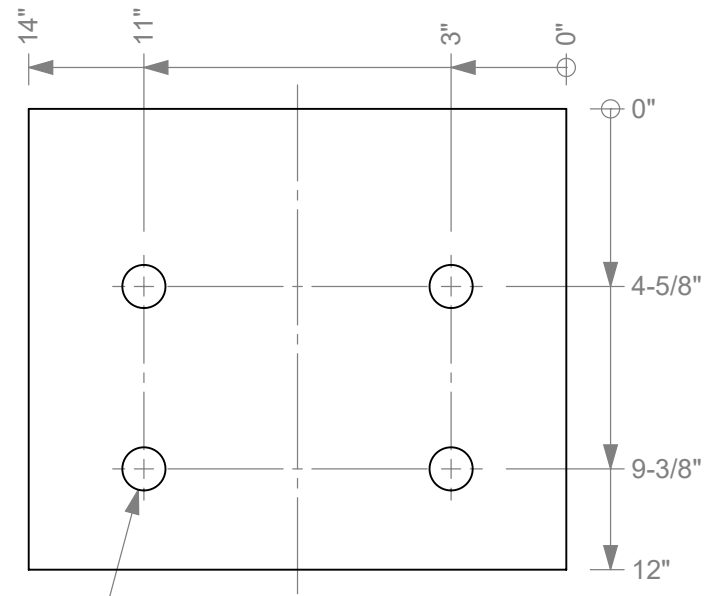
7
Side Plate
 Plate, 9" x 3/4"
 Elevation View



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



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



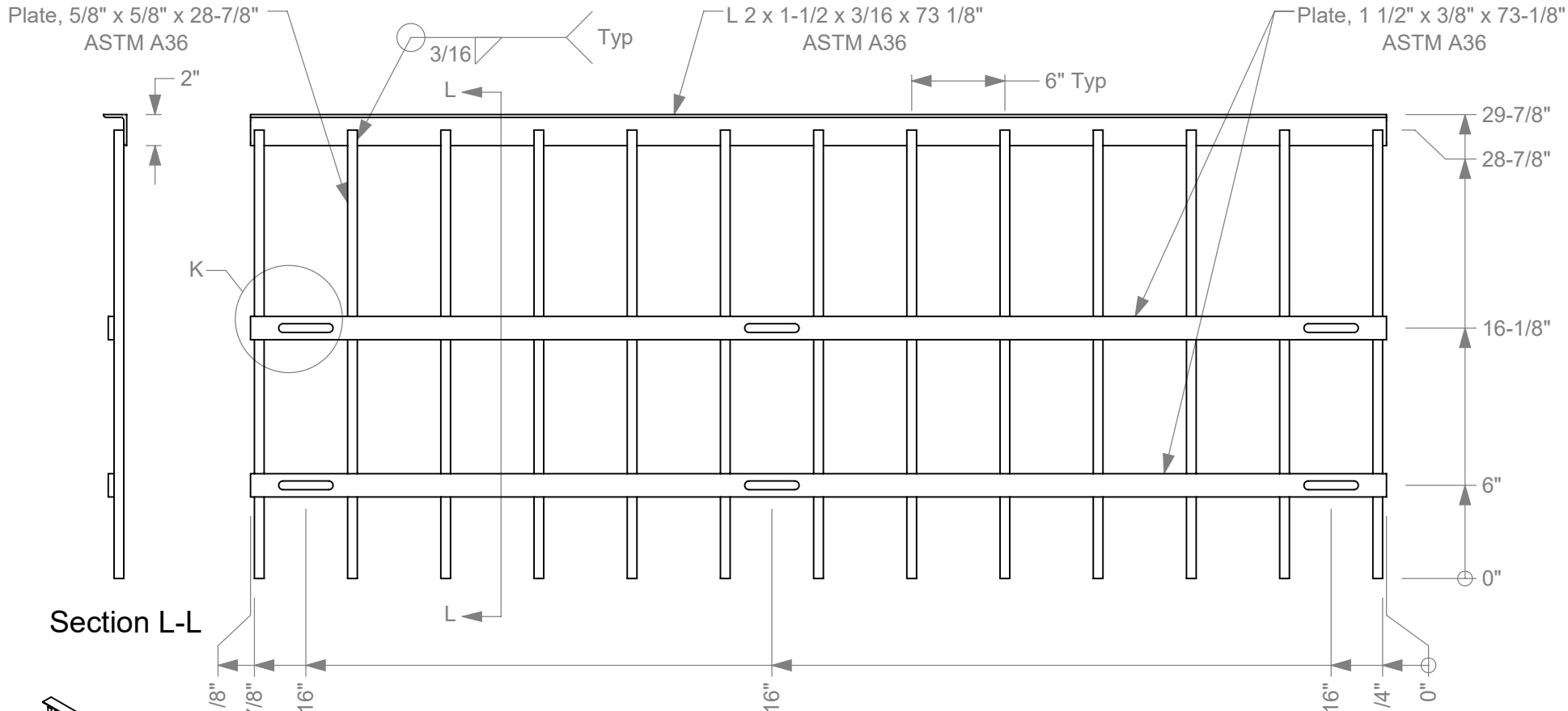
6
Base Plate
 Plate, 12" x 3/4"
 Plan View



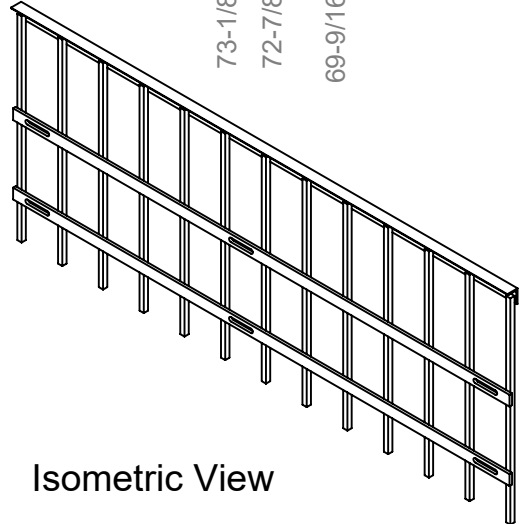
Roadside Safety and Physical Security Division - Proving Ground

Project #611801 5-6 Wyoming MGS Transition		2021-01-12
Drawn by GES	Scale 1:5	Sheet 13 of 19 Bridge Post Parts

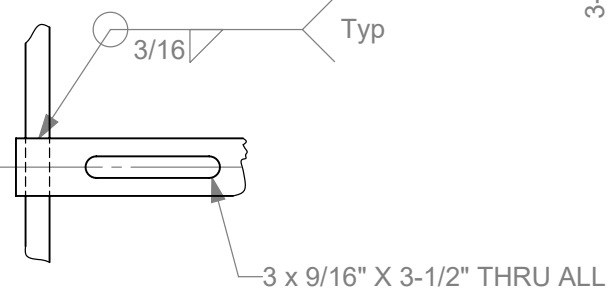
Picket Panel




Elevation View
from Traffic Side

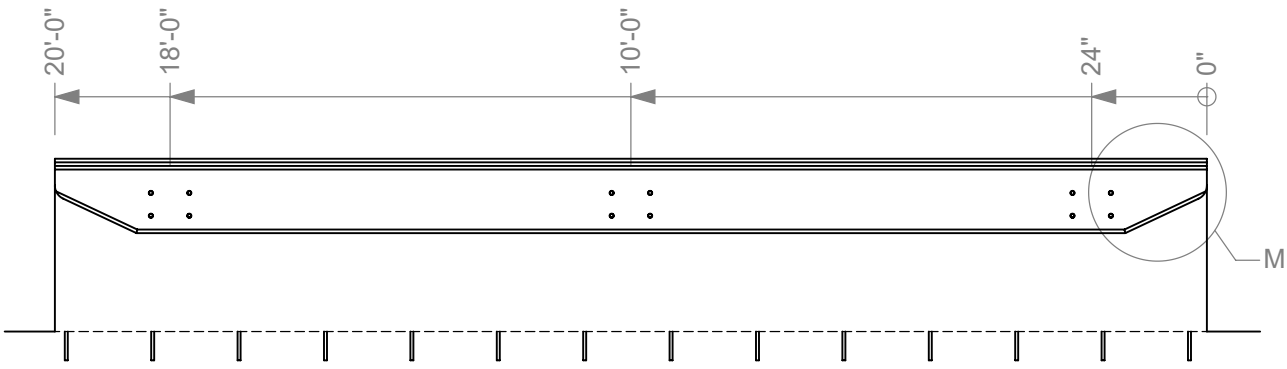


Detail K
Scale 1 : 5

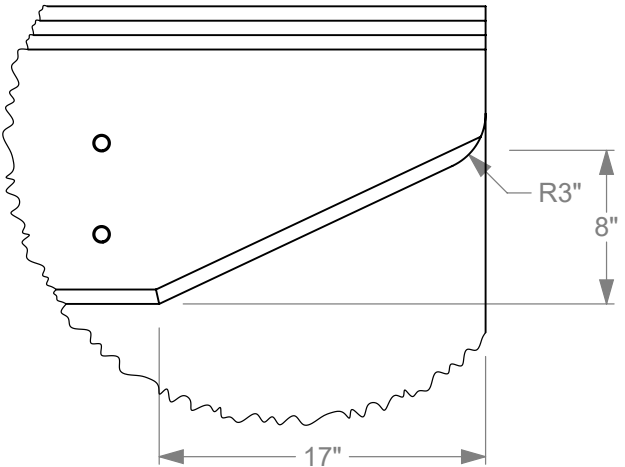


	Roadside Safety and Physical Security Division - Proving Ground	
	Project #611801 5-6 Wyoming MGS Transition	2021-01-12
Drawn by GES	Scale 1:10	Sheet 14 of 19 Picket Panel

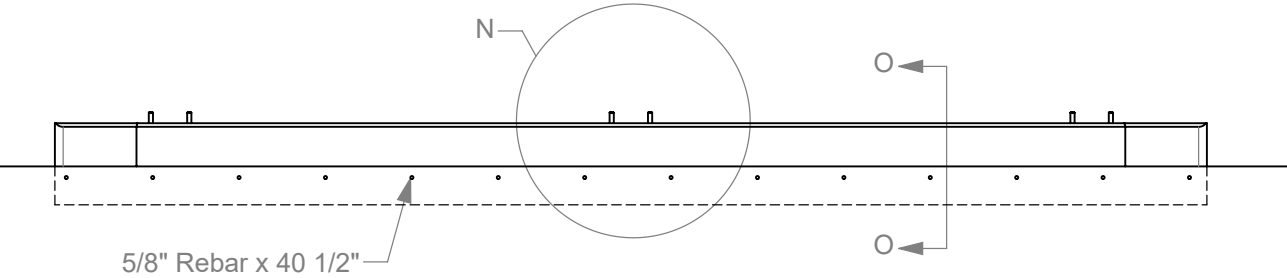
Moment Slab and Curb



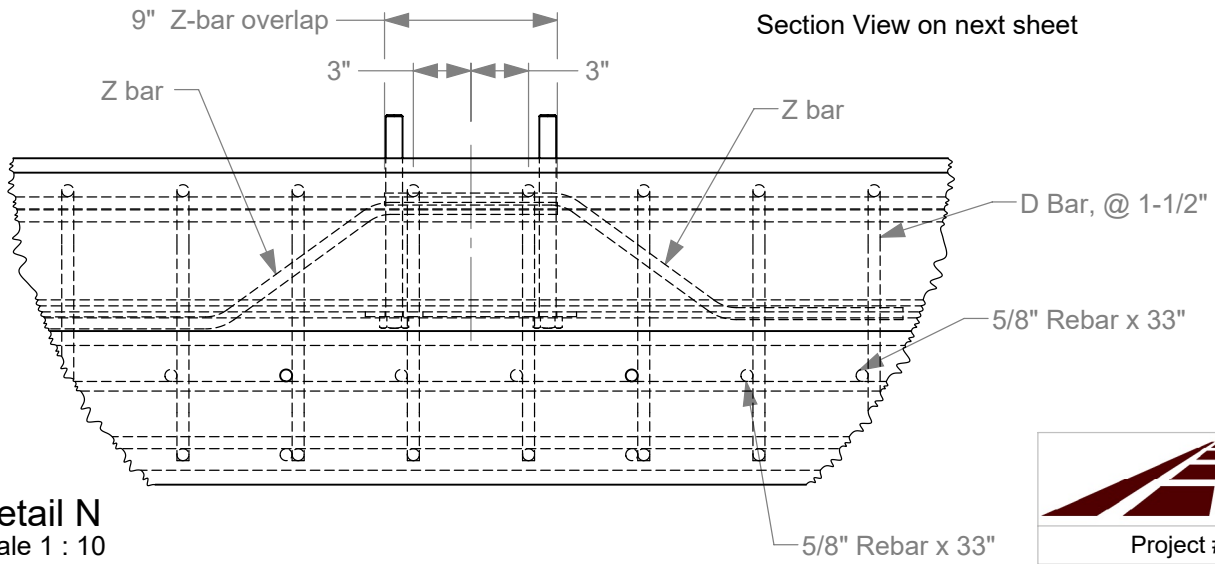
Plan View



Detail M
Scale 1 : 10
Typ each end



Elevation View
Section View on next sheet



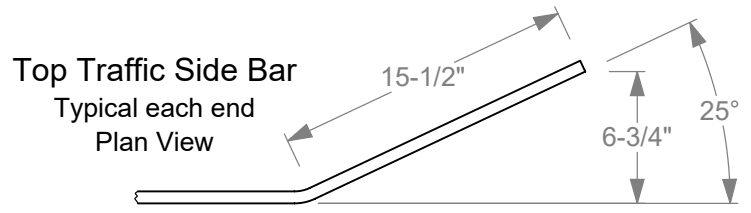
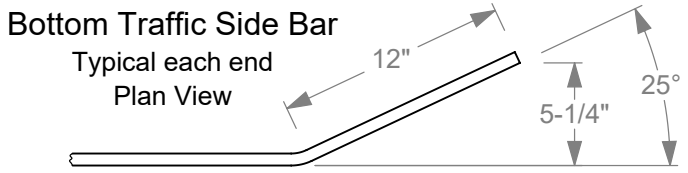
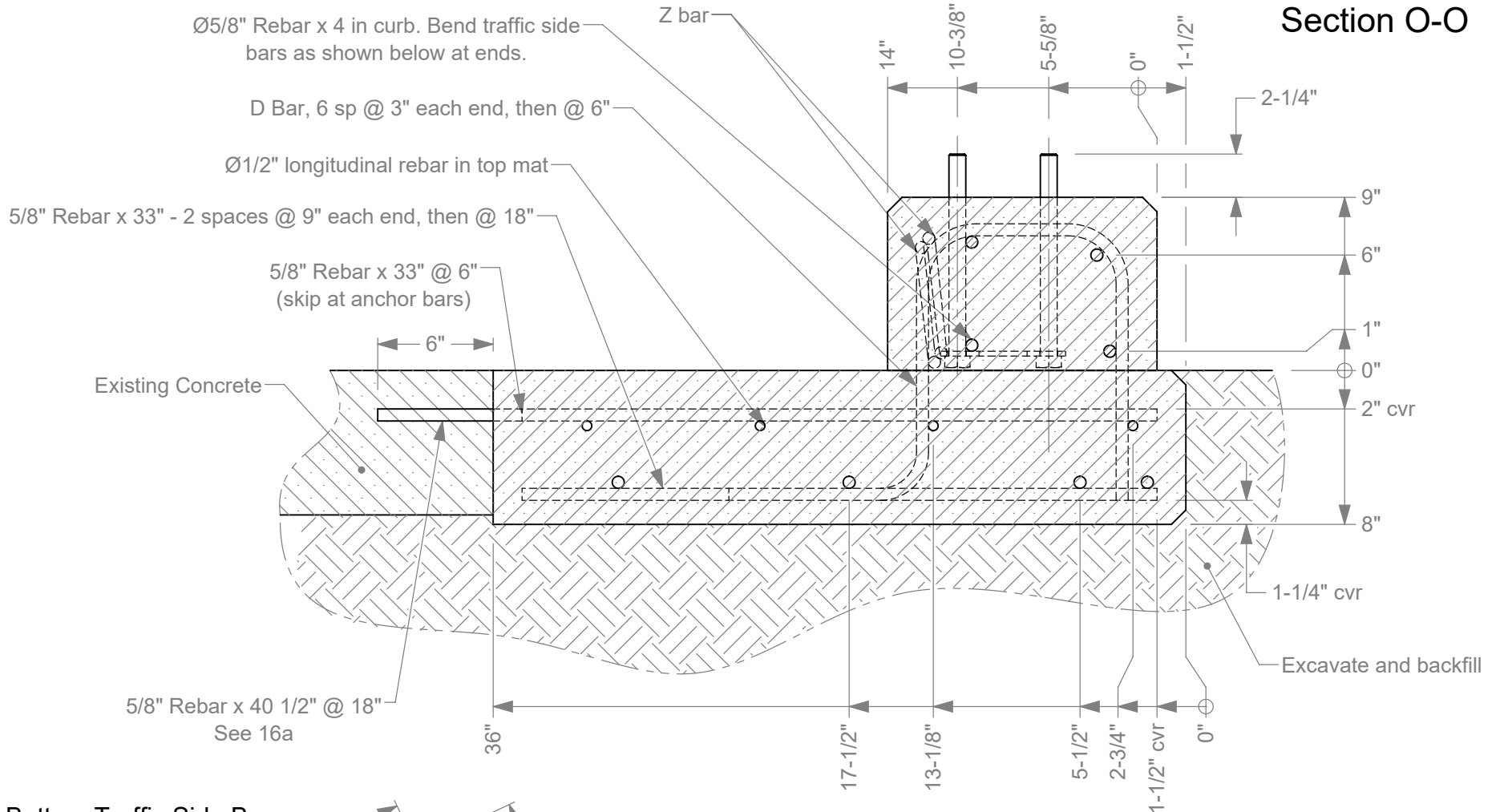
Detail N
Scale 1 : 10




Roadside Safety and
Physical Security Division -
Proving Ground

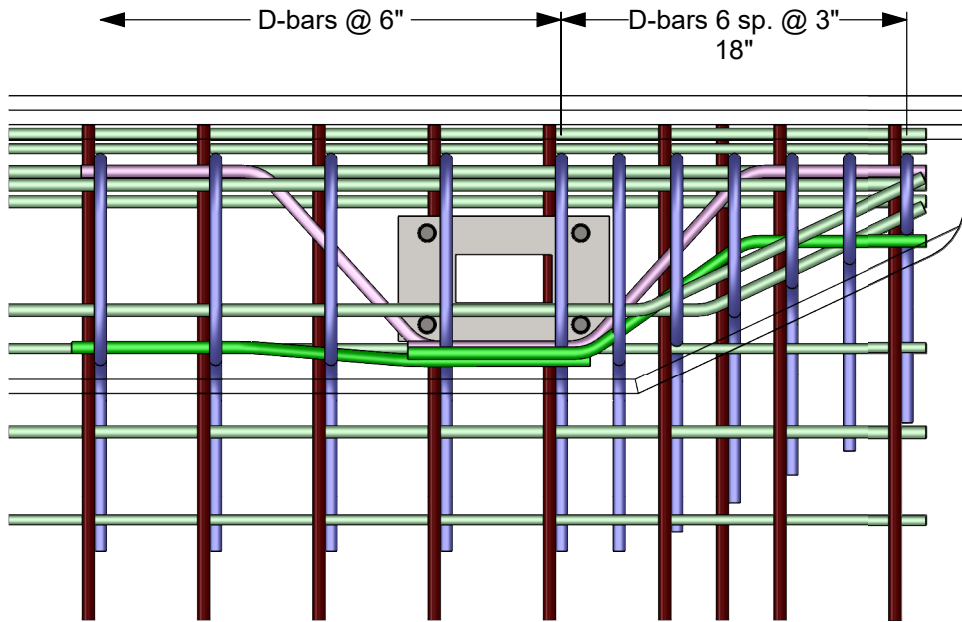
Project #611801 5-6 Wyoming MGS Transition		2021-01-12
Drawn by GES	Scale 1:40	Sheet 15 of 19 Moment Slab and Curb

Section O-O

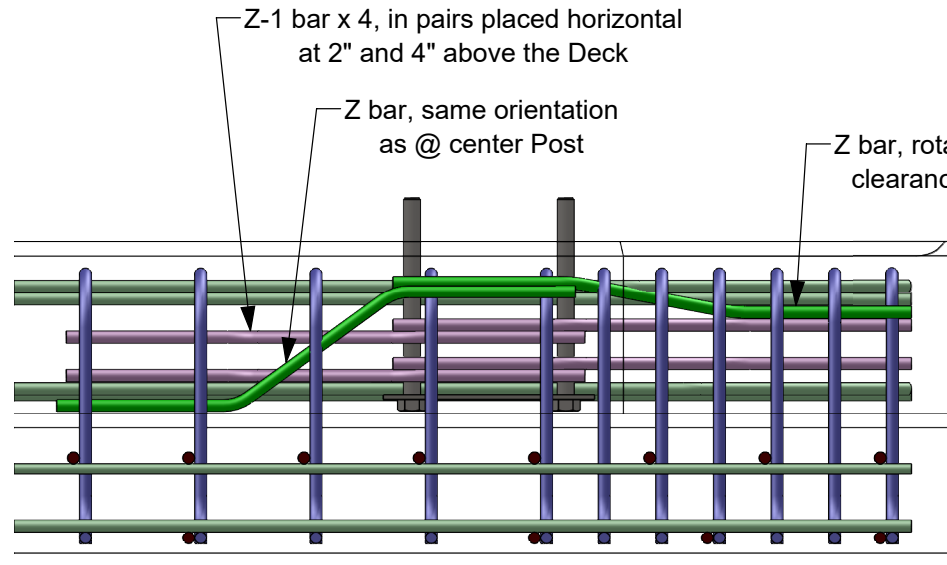


- 16a.** Secure in existing concrete with Hilti HIT-RE 500 V3 epoxy according to manufacturer's instructions.
- 16b.** All rebar is grade 60.
- 16c.** All rebar dimensions are to center of bar unless otherwise indicated by "cvr" (cover).
- 16d.** Concrete is 4000 psi.
- 16e.** 1" chamfer (3/4" each way) edges of Deck and Curb as shown.

		Roadside Safety and Physical Security Division - Proving Ground
Project #611801 5-6 Wyoming MGS Transition		2021-01-12
Drawn by GES	Scale 1:8	Sheet 16 of 19 Concrete Section



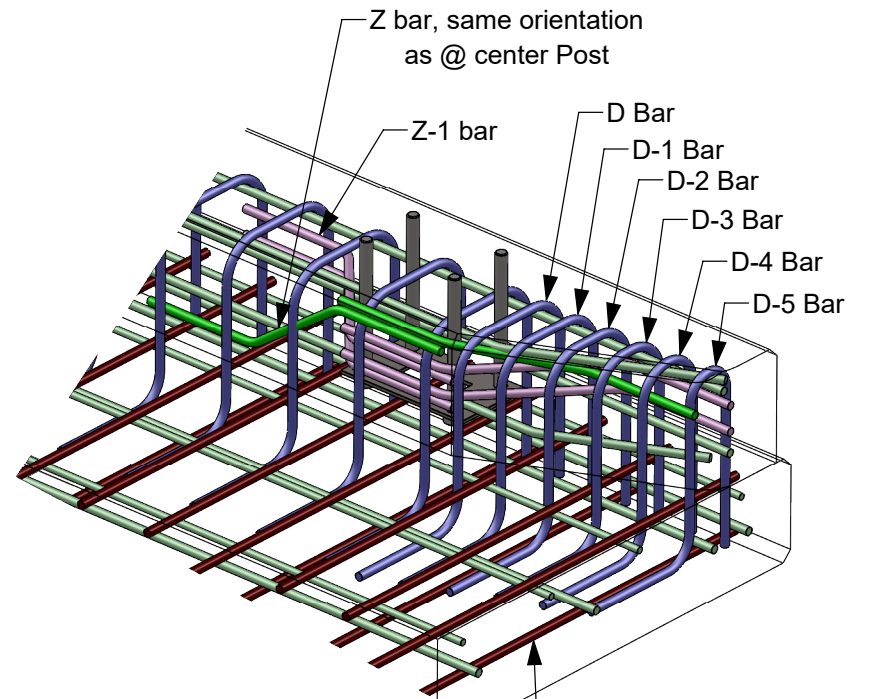
Plan View



Elevation View

Anchor Bars not shown for clarity

Rebar at Ends



Isometric View

5/8" Rebar x 33"
Two spaces @ 9", then @ 18" to end



Roadside Safety and
Physical Security Division -
Proving Ground

Project #611801 5-6 Wyoming MGS Transition

2021-01-12

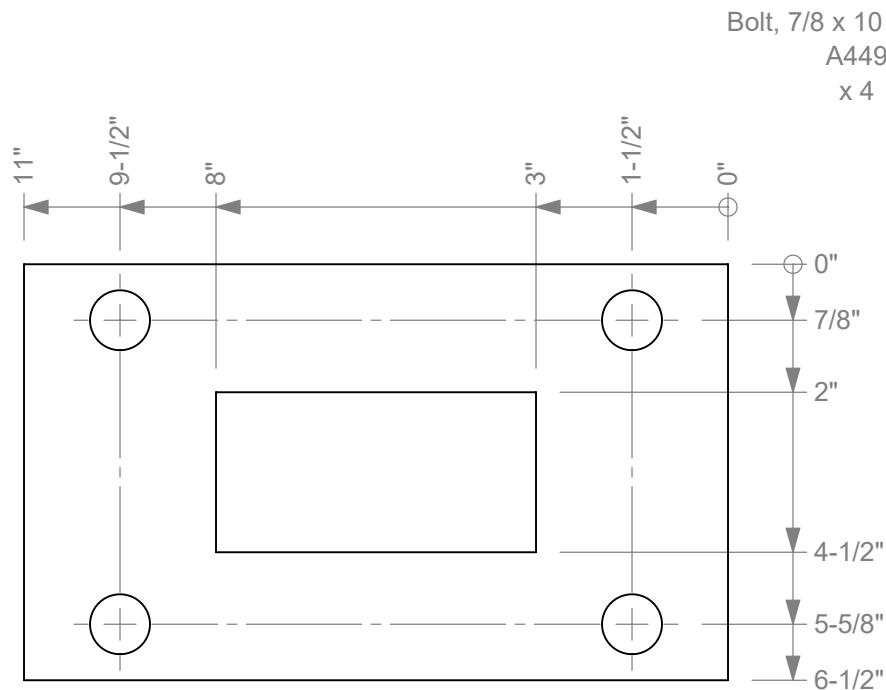
Drawn by GES

Scale 1:10

Sheet 17 of 19 Rebar at Ends

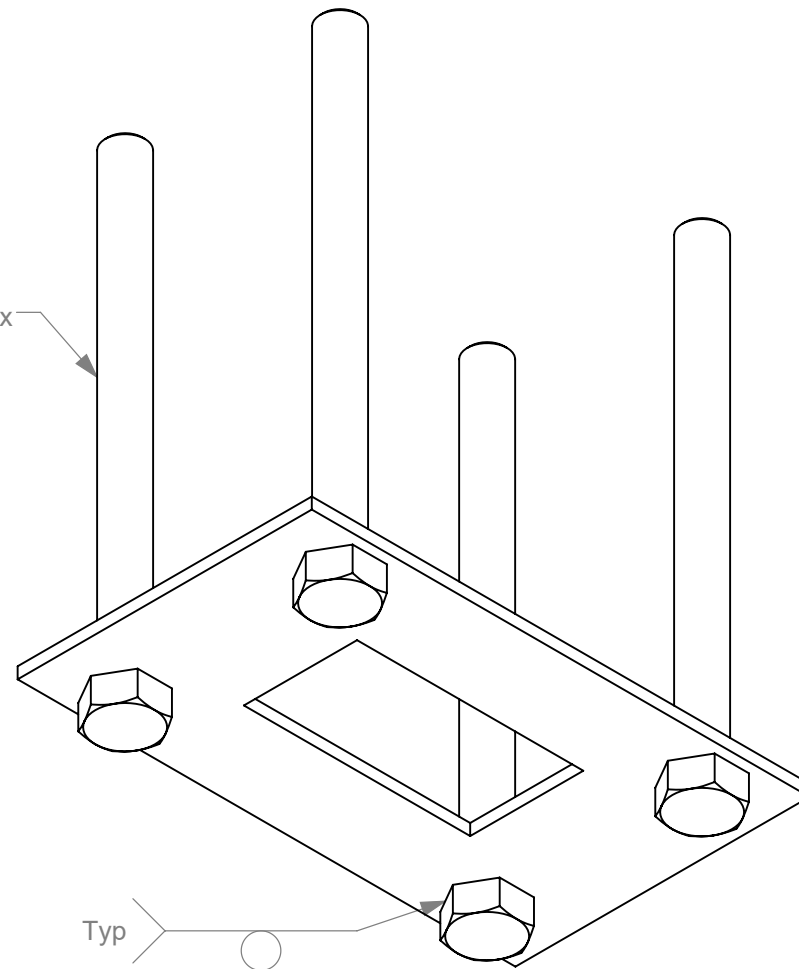
Anchor Bolt Assembly

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

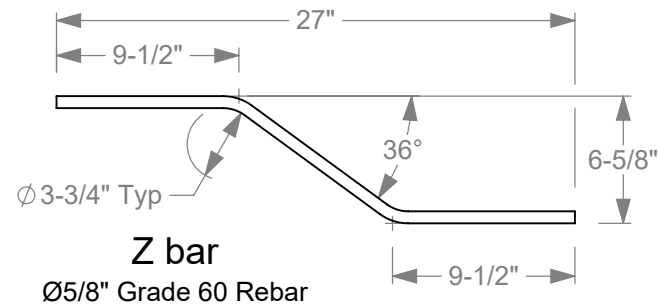
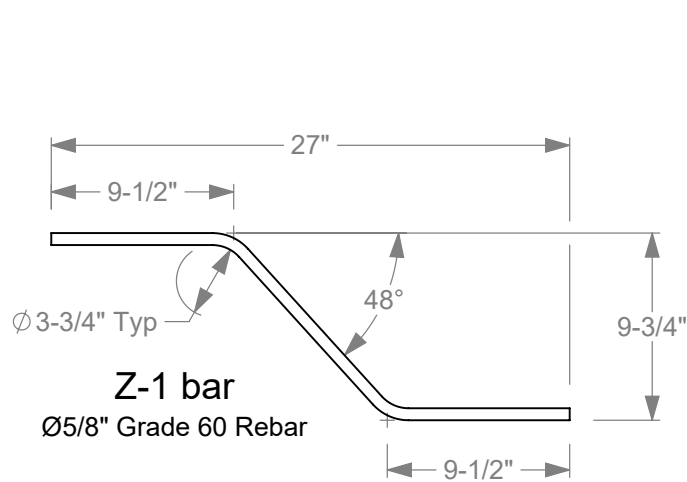
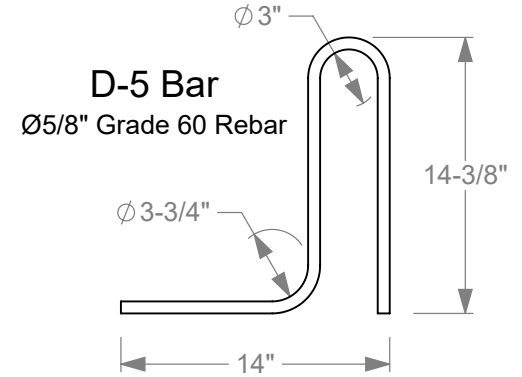
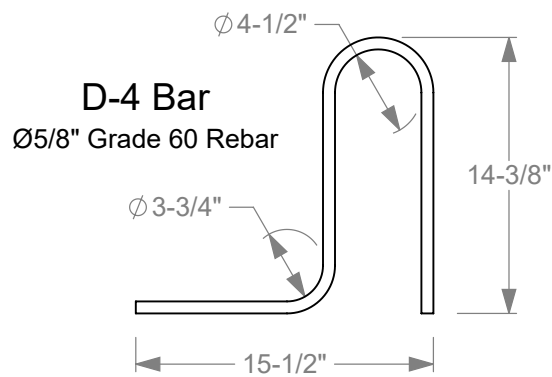
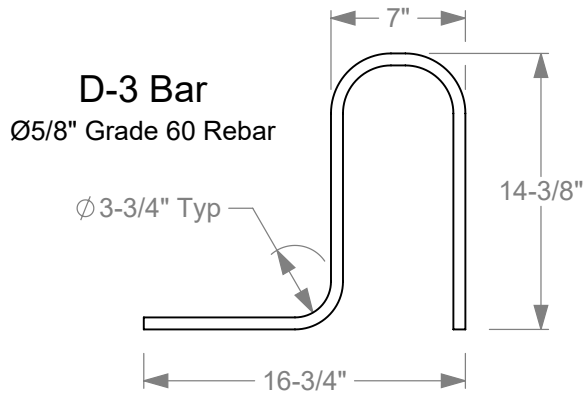
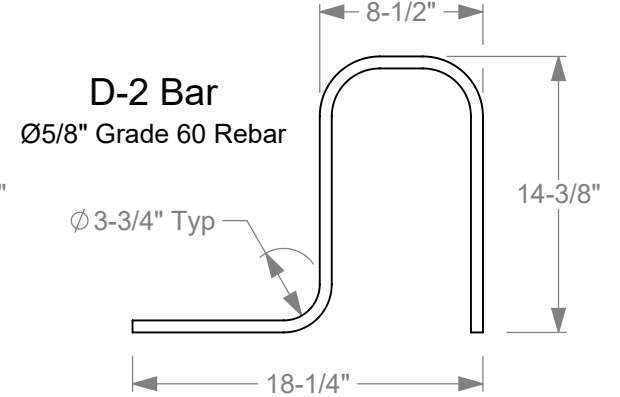
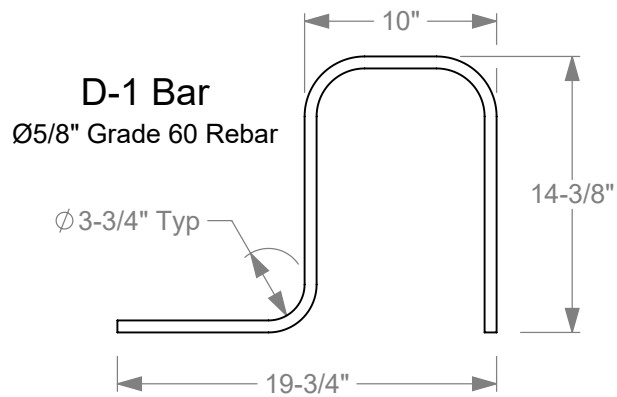
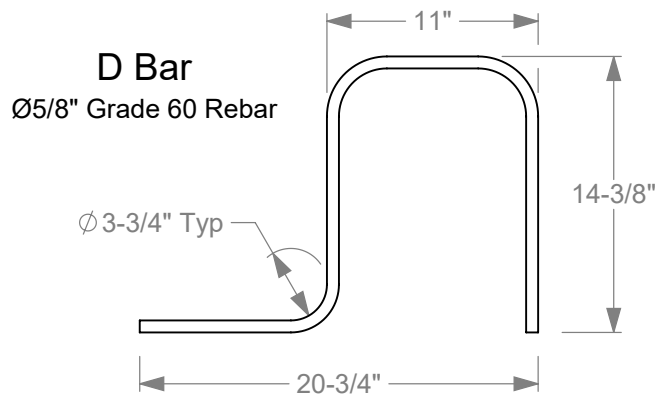
Project #611801 5-6 Wyoming MGS Transition

2021-01-12

Drawn by GES

Scale 1:3

Sheet 18 of 19 Anchor Bolt Assembly



Roadside Safety and
 Physical Security Division -
 Proving Ground

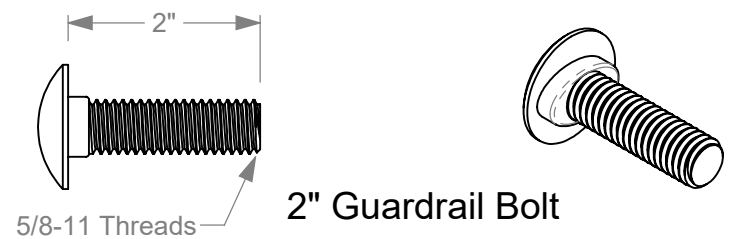
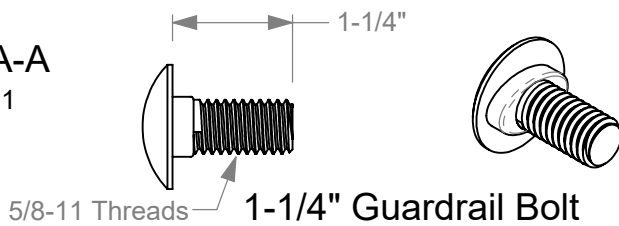
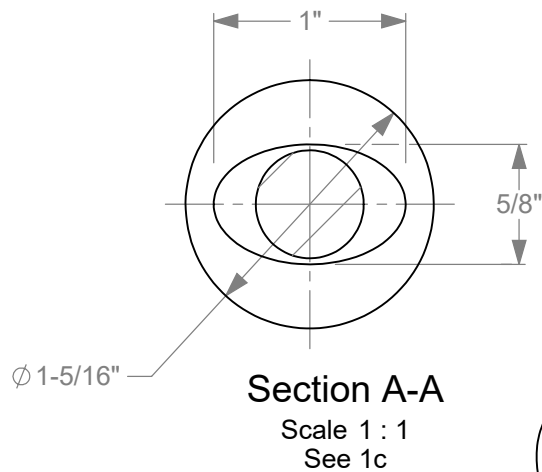
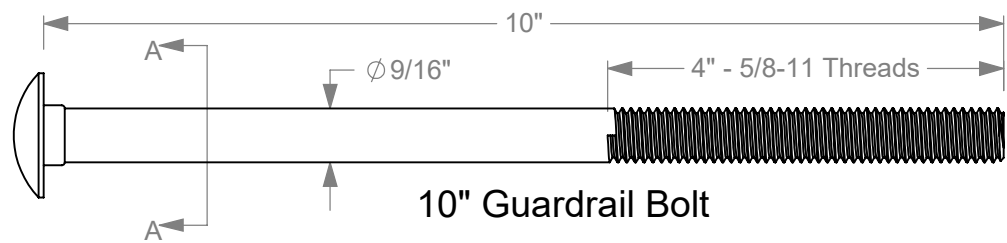
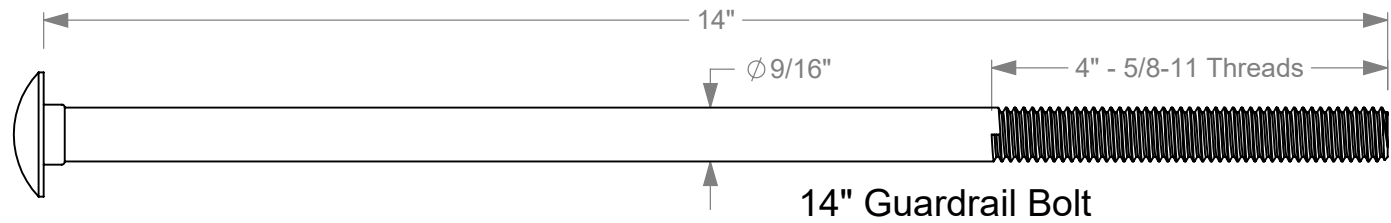
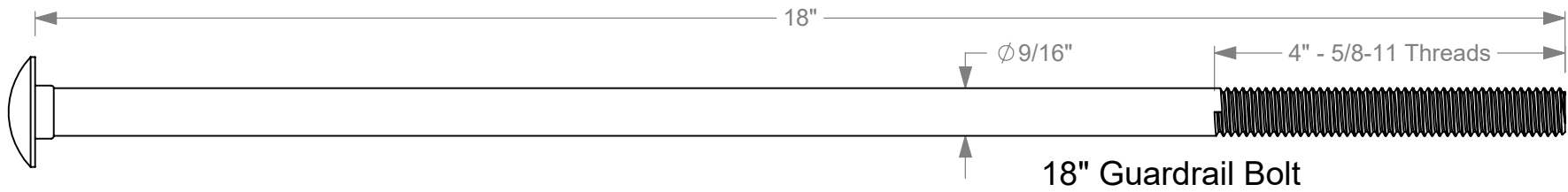
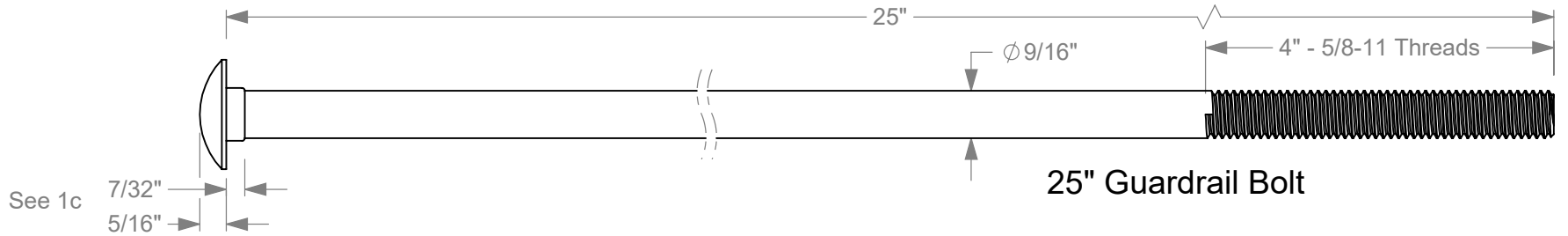
Project #611801 5-6 Wyoming MGS Transition

2021-01-12

Drawn by GES

Scale 1:10

Sheet 19 of 19 Rebar



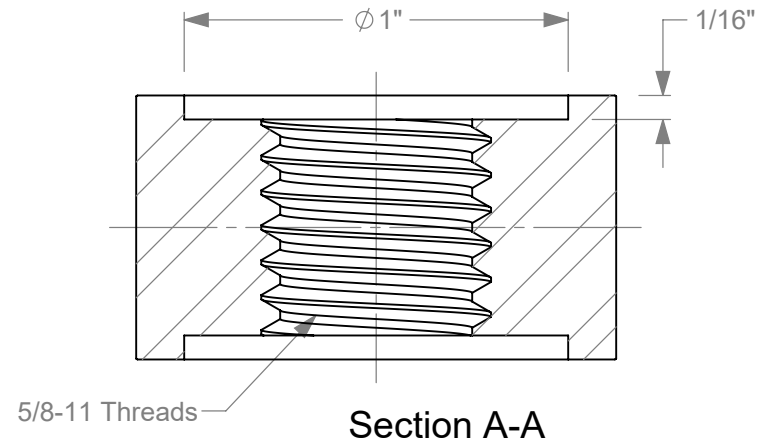
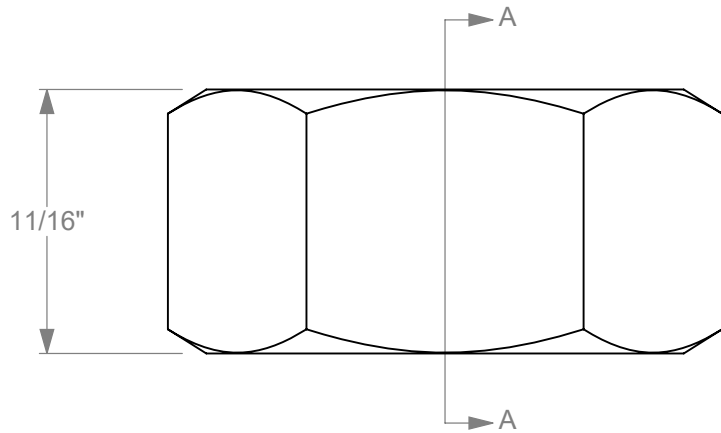
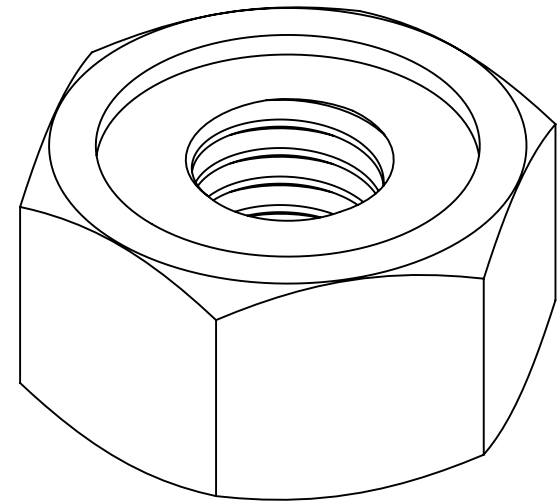
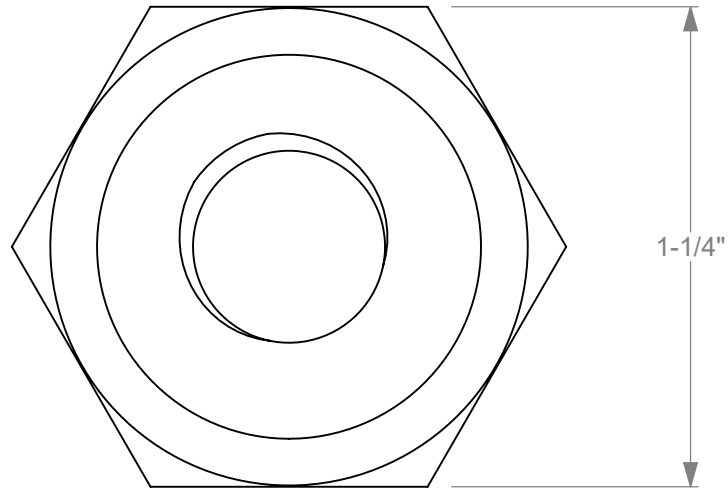
- 1a. Material is ASTM A307.
- 1b. All bolt sizes not used in all projects. See system drawing.
- 1c. Head and shoulder dimensions typical all sizes.



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



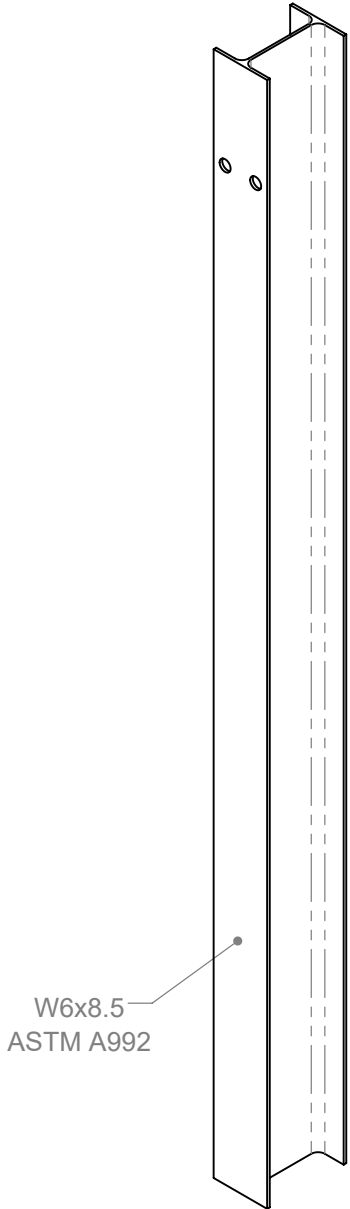
1a. Material is ASTM A 563 Grade A.



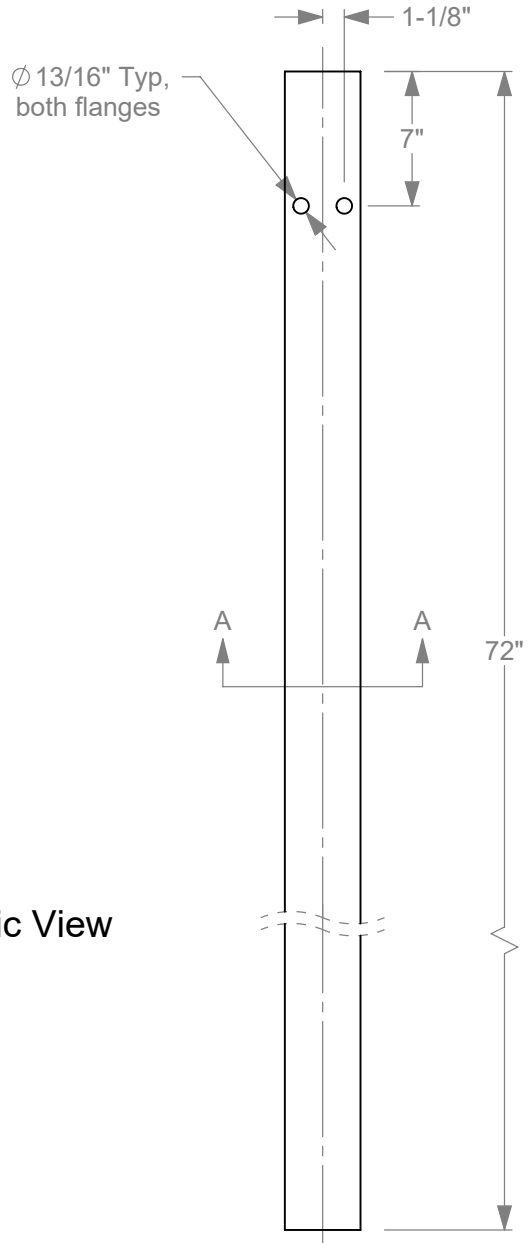
Roadside Safety and
Physical Security Division -
Proving Ground

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

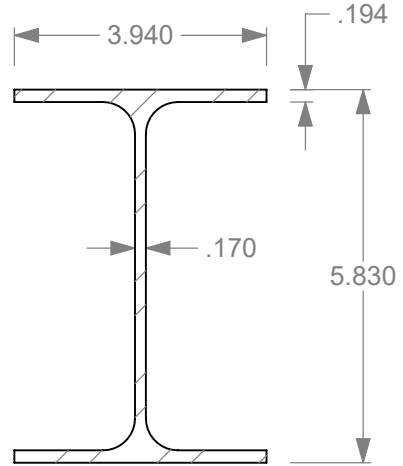
72" Wide-Flange Guardrail Post



Isometric View



Elevation View



Section A-A
Scale 1 : 3

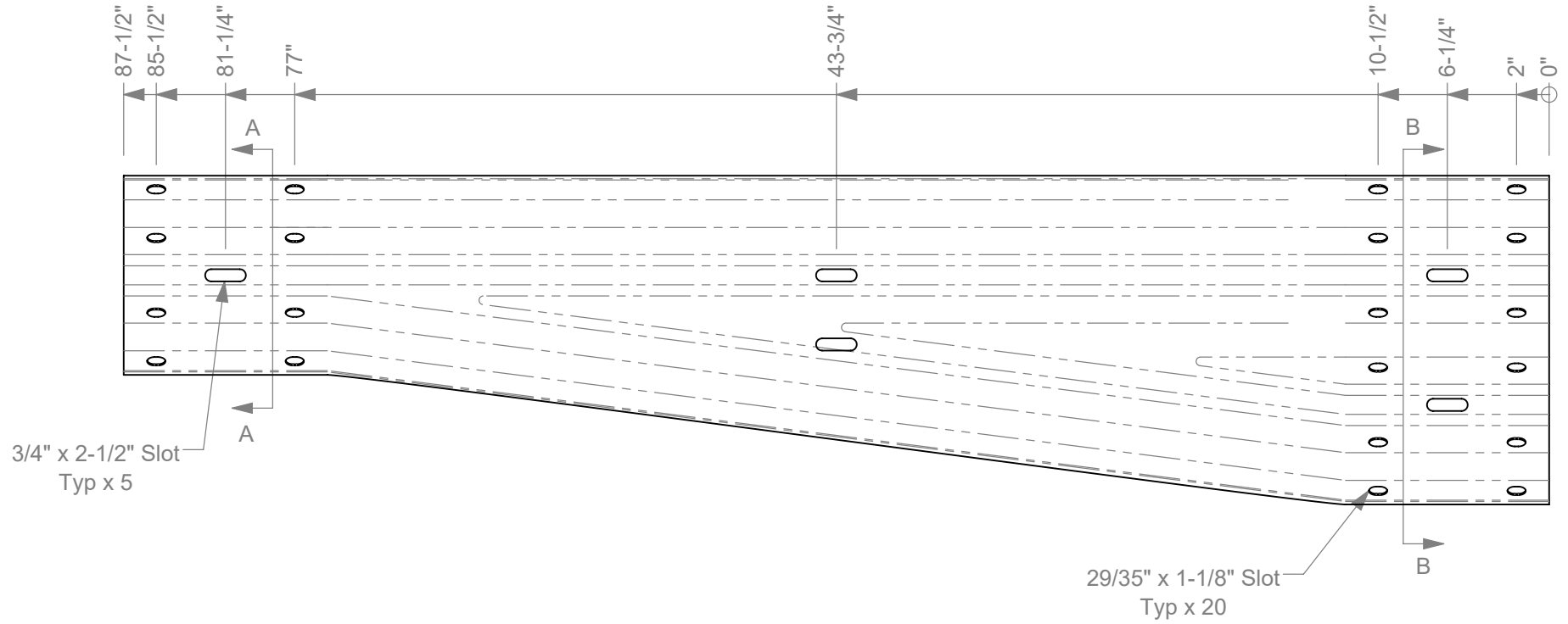


Roadside Safety and
Physical Security Division -
Proving Ground

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

W- to Thrie-beam, asymmetric


10 gauge



Section A-A
See W-beam Drawing

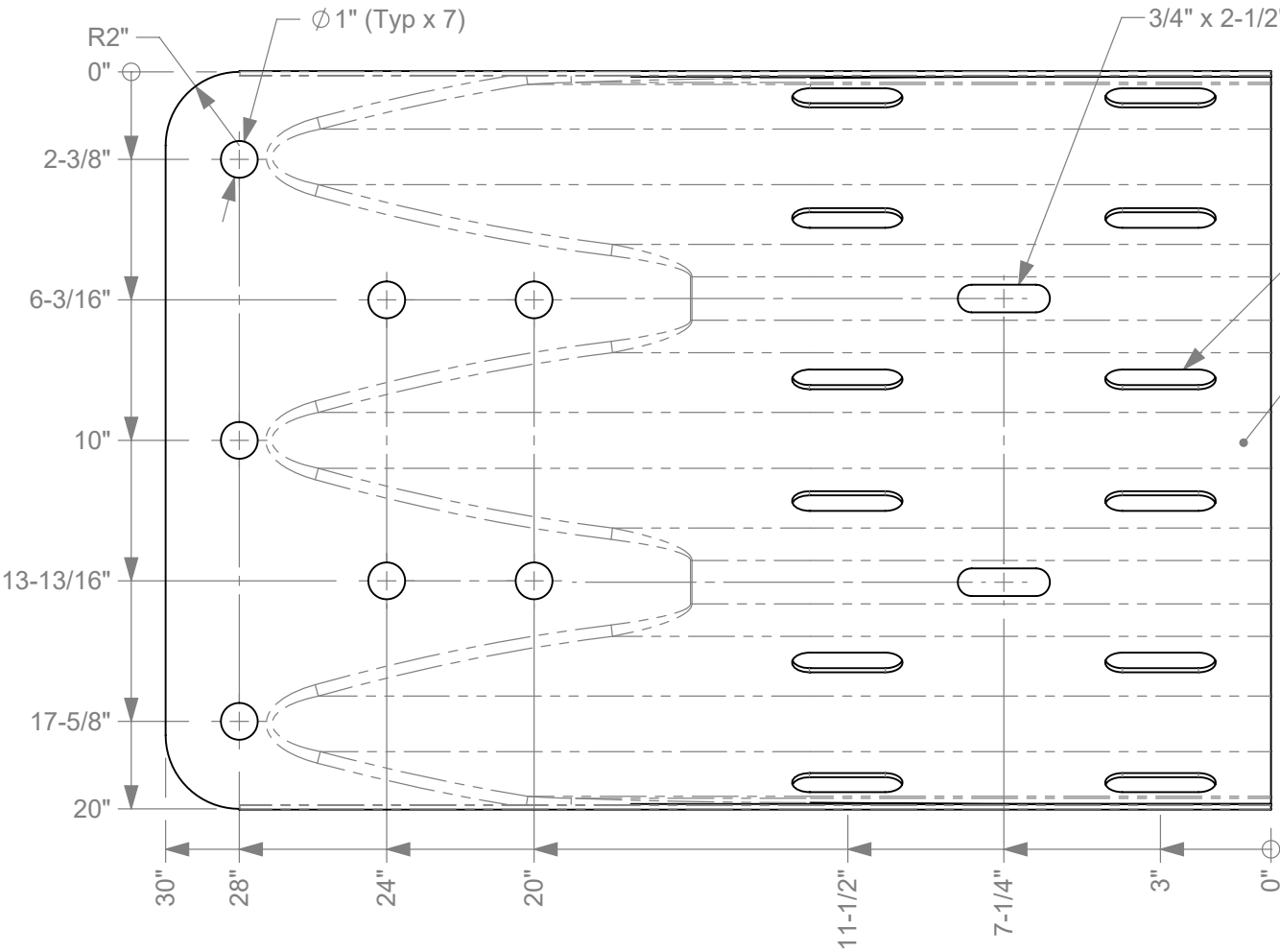


Section B-B
See W-beam Drawing

		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	

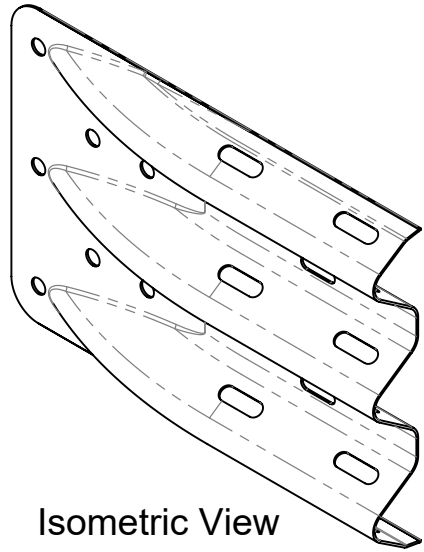
Thrie-beam End Shoe

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.



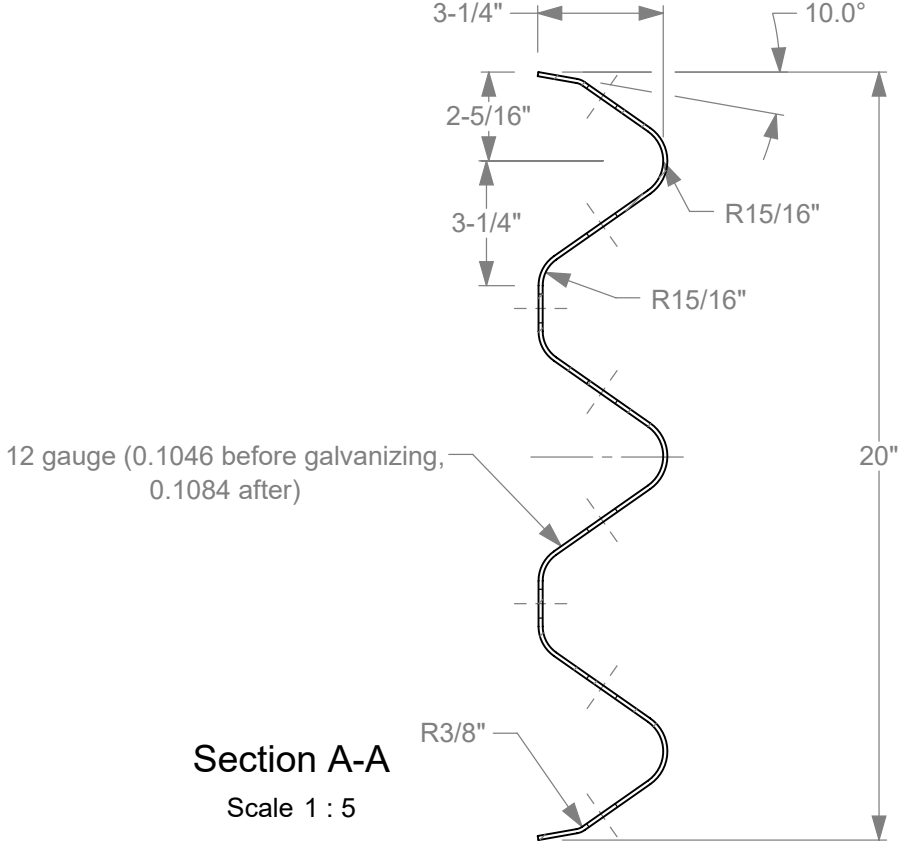
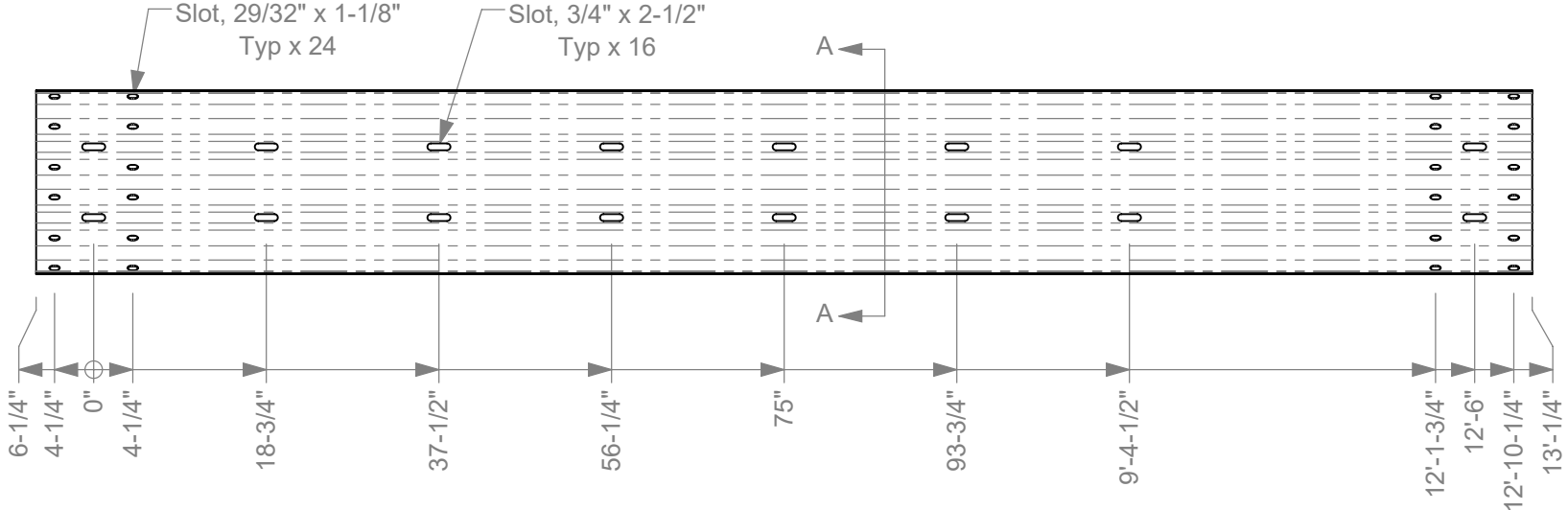
Isometric View



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

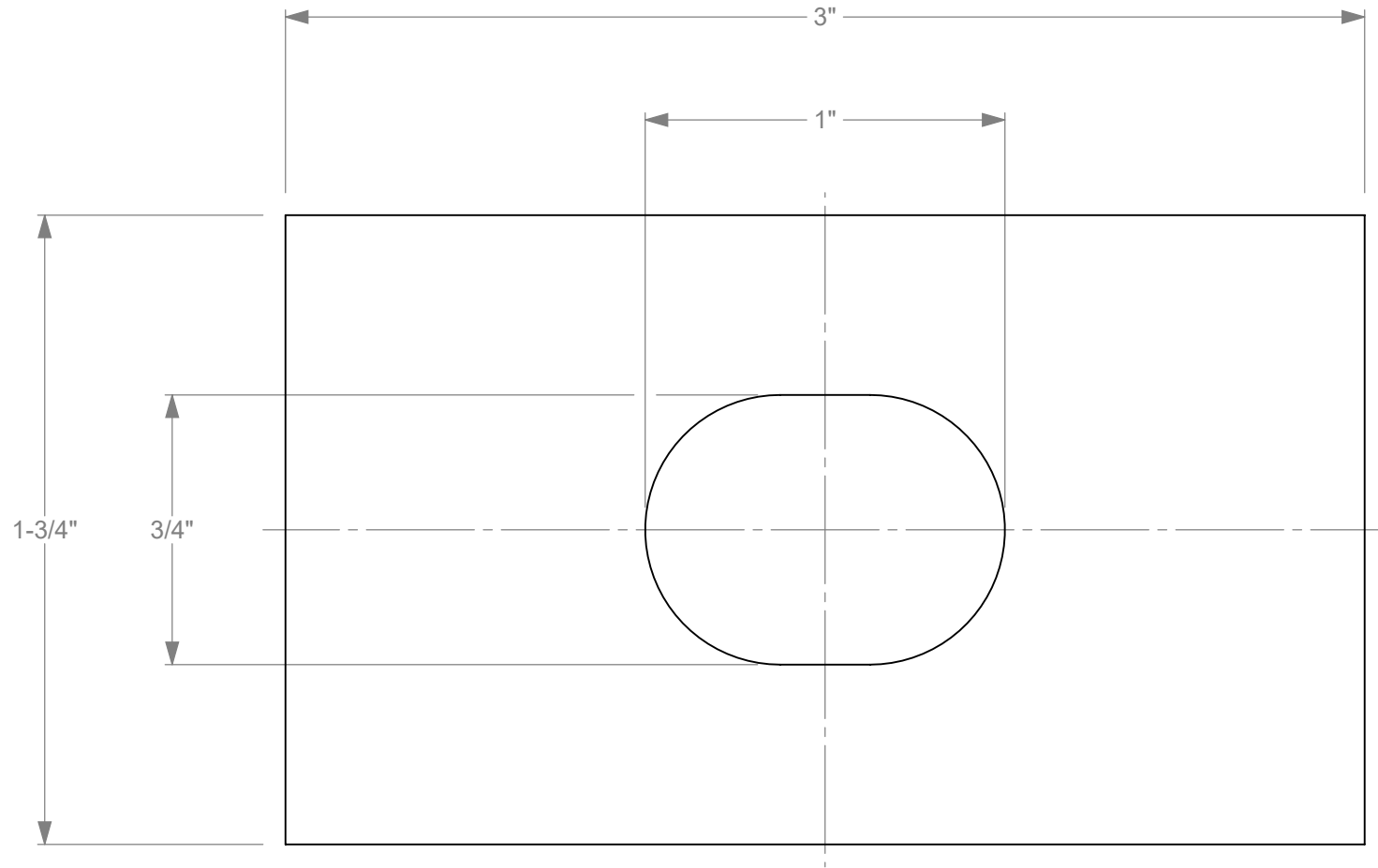


Roadside Safety and Physical Security Division - Proving Ground

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

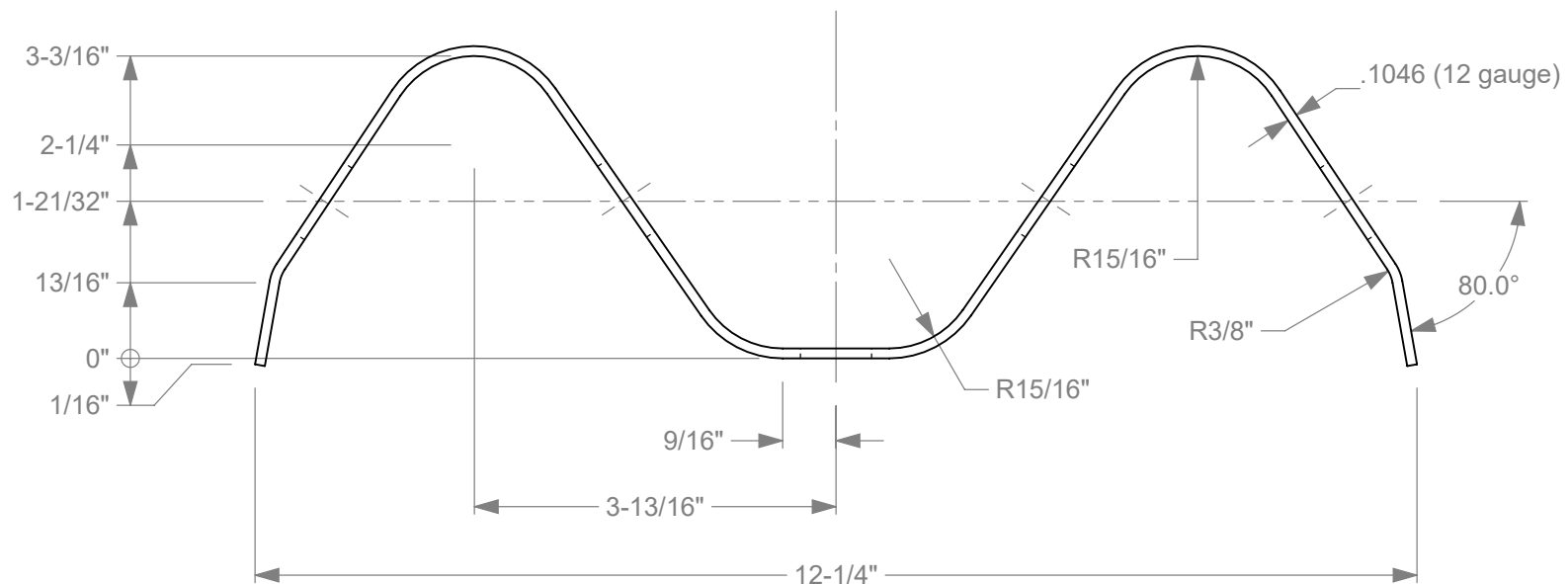
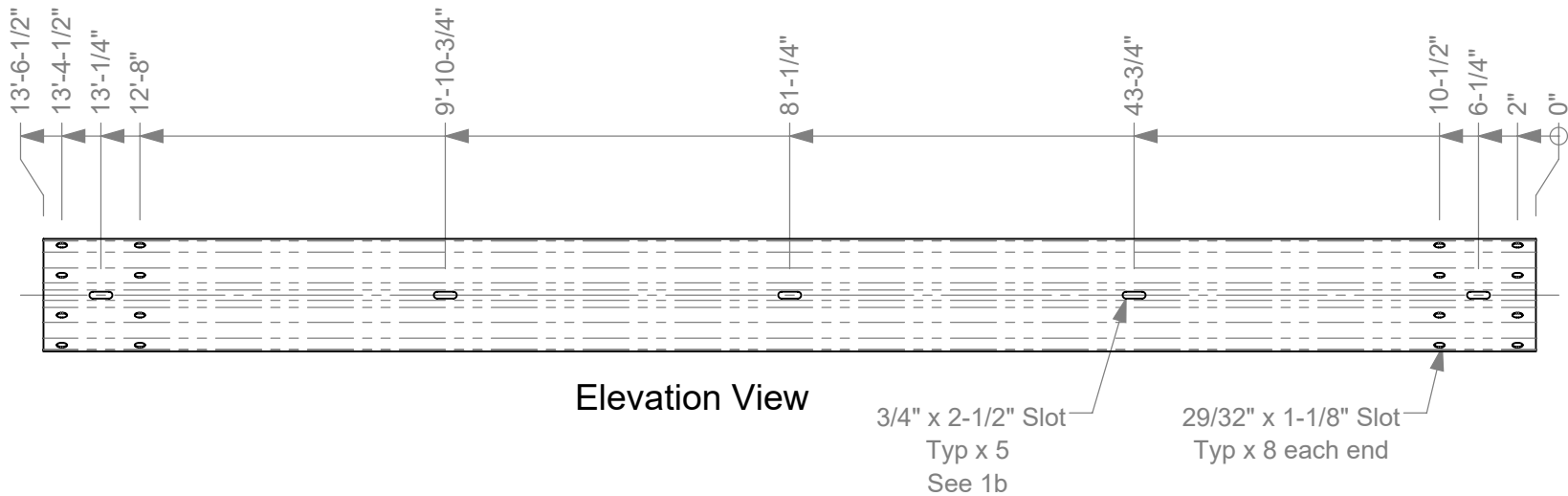
Rectangular Guardrail Washer

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
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4-space W-beam Guardrail

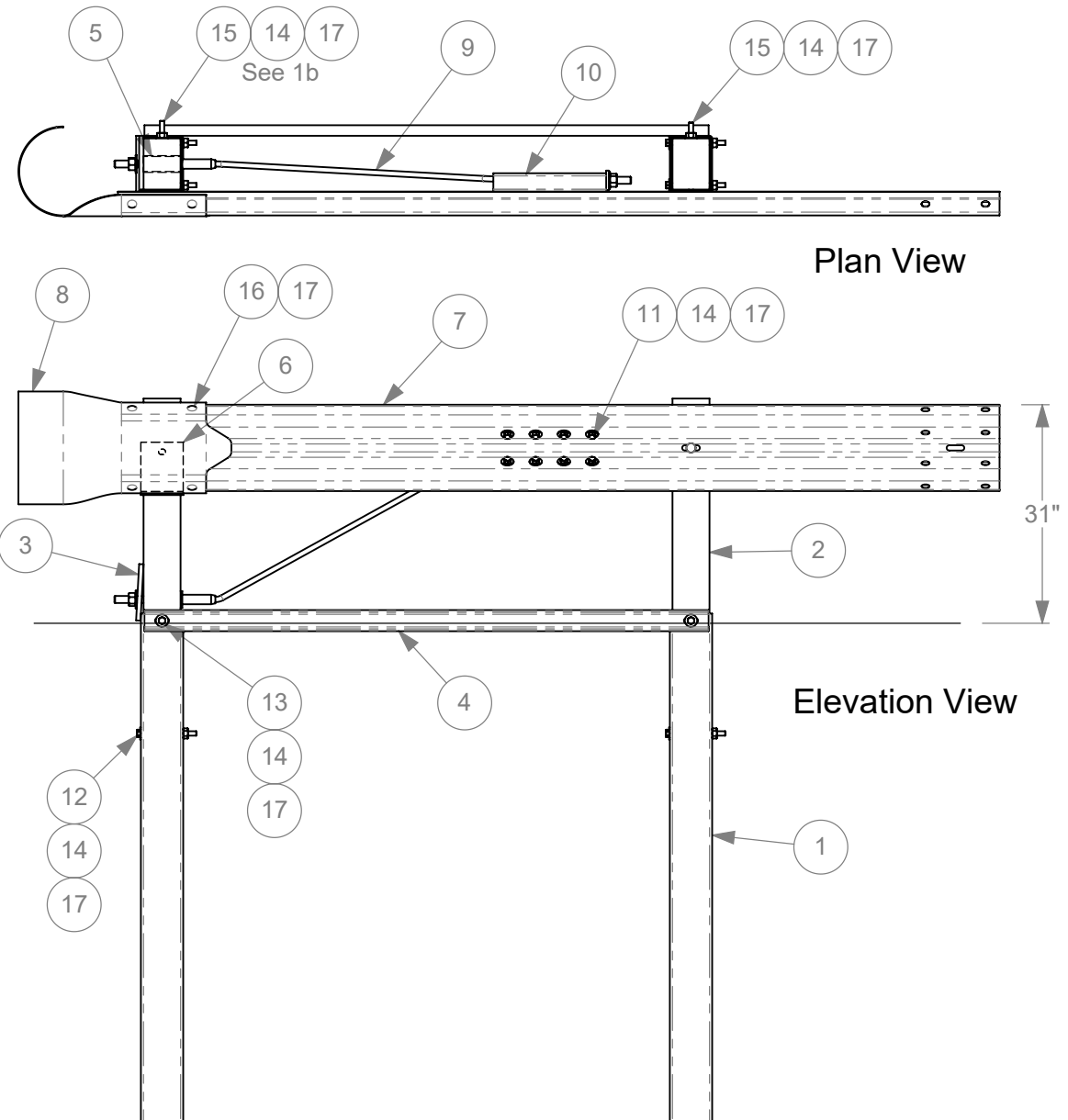
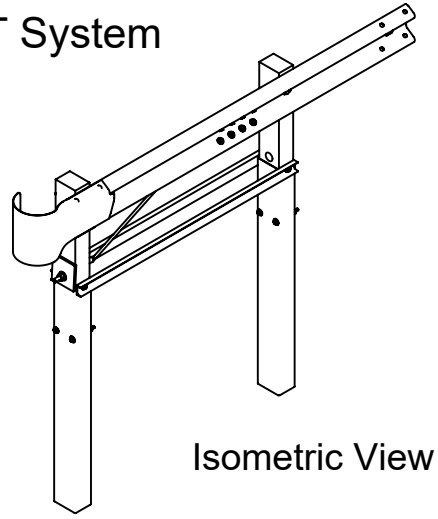
2020-06-05

Drawn by GES

Scale 1:20

Sheet 1 of 1

DAT System

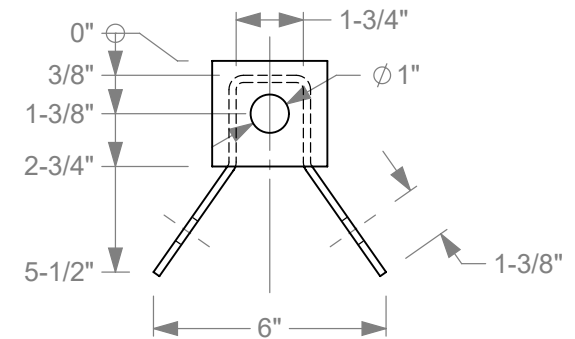
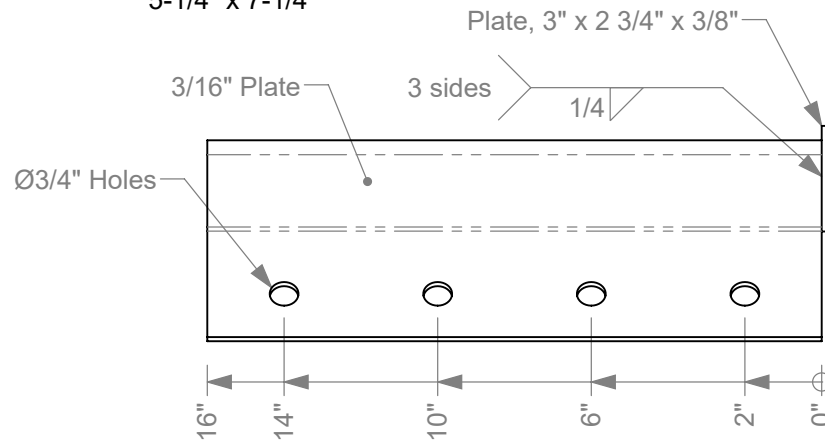
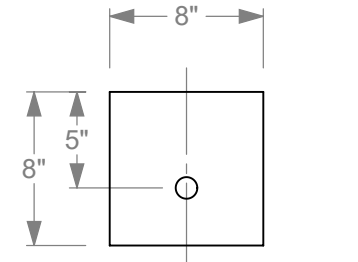
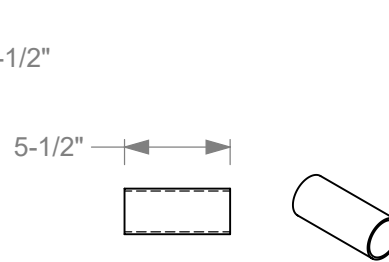
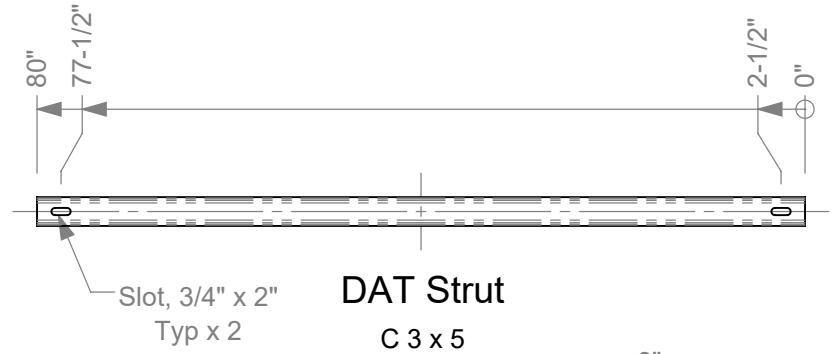
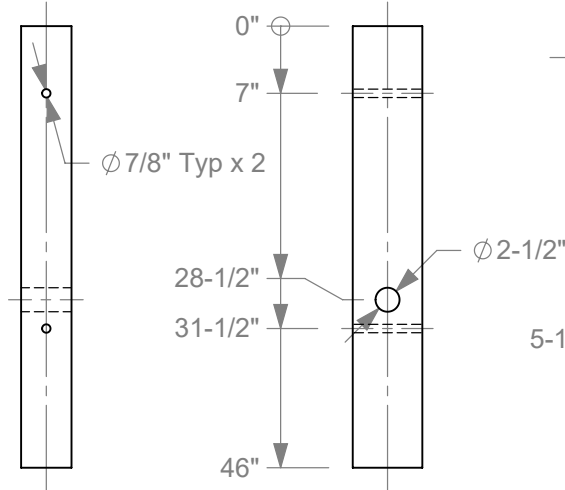
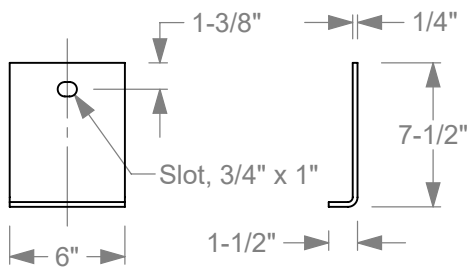
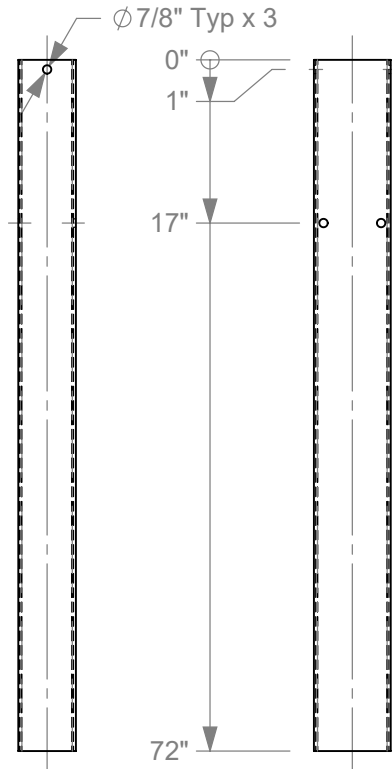


#	Part Name	Qty.
1	Foundation Tube	2
2	Terminal Timber Post	2
3	BCT Bearing Plate	1
4	DAT Strut	2
5	BCT Post Sleeve	1
6	Shelf Angle Bracket	1
7	DAT Terminal Rail	1
8	W-beam End Section	1
9	Anchor Cable Assembly	1
10	Guardrail Anchor Bracket	1
11	Bolt, 5/8 x 2" hex	8
12	Bolt, 5/8 x 8" hex	4
13	Bolt, 5/8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

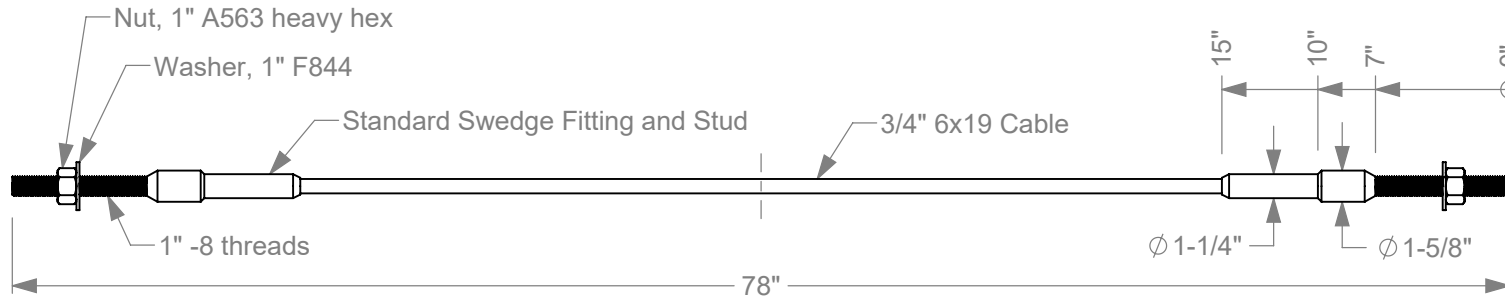
DAT Parts sheet 1



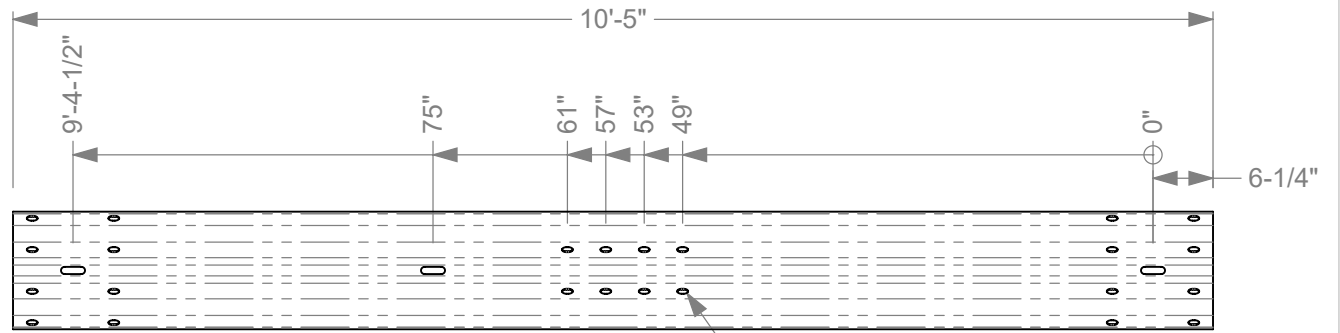
Roadside Safety and Physical Security Division - Proving Ground

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

DAT Parts sheet 2

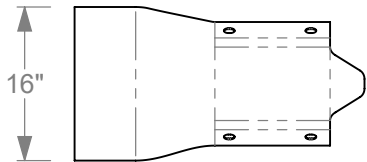
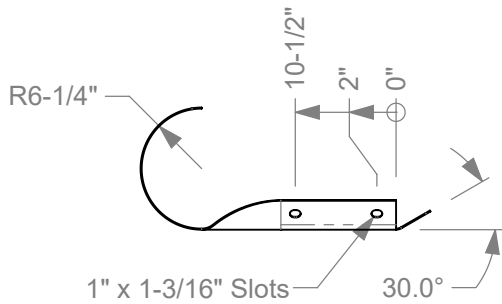


Anchor Cable Assembly



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	Sheet 3 of 3