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
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.
**Transition Detail Views**

**Detail D**  
Scale 1 : 10

- Bolt, 3/8 x 3 1/2" hex A307 with A563 Hex Nut and F844 Washers (2)
- Bolt, 1/2" x 1 1/2" hex A307 with A563 Hex Nut and F844 Washers (2)
- Bolt, 3/4 x 2" hex A325 with F436 Washer x 8

**Detail H**  
Scale 1 : 10

- Bolt, 3/4 x 3 1/2" hex A325 with A194-2HM Hex Nut and F436 Washers (2)  
  4 places
- Bolt, 1/2" x 1 1/2" hex A307 with A563 Hex Nut and F844 Washers (2)
- Bolt, 3/4 x 3 1/2" hex A325 with A194-2HM Hex Nut and F436 Washers (2)

**Detail G**  
Scale 1 : 20

- Bolt, 3/8 x 7 1/2" hex A307 with A563 Hex Nut and F844 Washers (2)
- Bolt, 3/8 x 3 1/2" hex A307 with A194-2HM Hex Nut and F436 Washers (2)  
  4 places
- Bolt, 1/2" x 1 1/2" hex A307 with A563 Hex Nut and F844 Washers (2)

**Elevation View**  
Field Side

- R-2 Rail
- Type R Post
- J-2
- R-3 Rail

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

- Box Beam Rail
- Type A Post
- Type A Post
- Type C Post

**Elevation View**

- Nut, 3/4 heavy hex with F436 Washer
- Anchor Bolt Ø3/4" x 3" x 24" with 3" of 3/4-10 threads
  ASTM A572 Grade 50 x 2

**Detail I**

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

**Detail J**

- Scale 1:10

**Wyoming DoT Class B Concrete (3250 psi)**

- 30" x 30" x 24" deep
- un-reinforced
Transition Rails

T-1 Rail
HSS 6" x 6" x 3/16"
ASTM A500 Grade B
Plan View

T-2 Rail
HSS 6" x 6" x 3/16"
ASTM A500 Grade B
Plan View - Scale 1:40

6a. Galvanize all components after fabrication is complete.
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

R-3 Rail
HSS 6" x 2" x 1/4"
ASTM A500 Grade B

7a. Galvanize all components after fabrication is complete.

Roadside Safety and Physical Security Division - Proving Ground

Project #611801 Wyoming Box Beam Transition 2021-01-06
Drawn by GES Scale 1:30 Sheet 7 of 26 Rub Rails
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.
9a. Galvanize all components after fabrication is complete.
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.
11a. All welding must be performed by certified welders using industry standard practices.

11b. Galvanize all components after fabrication is complete.
**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**
Left Side
Scale 1:10

**Elevation View**
Left Side
Scale 1:10

**Plan View**
Right Side

**Elevation 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.

C:\Users\g-schroeder\Documents\work from home files\611801\1-4\611801 1-4 Drawing
Transition Attachment

This view normal to this face.

Plan View
Scale 1:20

Section N-N

Isometric View

Elevation Views
Traffic and Field Sides

<table>
<thead>
<tr>
<th>#</th>
<th>Body Name</th>
<th>Description</th>
<th>Length</th>
<th>MATERIAL</th>
<th>Qty</th>
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<td>1</td>
<td>Main Plate</td>
<td>Plate, 34 1/4&quot; x 1/4&quot;</td>
<td>38 3/8&quot;</td>
<td>ASTM A572 Grade 50</td>
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<td>Main Rail Attachment</td>
<td>HSS 5&quot; x 5&quot; x 3/16&quot;</td>
<td>24&quot;</td>
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<td>Plate, 24&quot; x 3/16&quot;</td>
<td>6 1/16&quot;</td>
<td>ASTM A572 Grade 50</td>
<td>1</td>
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<tr>
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<td>Plate, 3&quot; x 1/4&quot;</td>
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<td>Bottom Stiffener</td>
<td>Plate, 2 3/4&quot; x 1/4&quot;</td>
<td>9 7/8&quot;</td>
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<td>8</td>
<td>Gusset</td>
<td>Plate, 3&quot; x 1/4&quot;</td>
<td>5 3/8&quot;</td>
<td>ASTM A572 Grade 50</td>
<td>2</td>
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</tbody>
</table>

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

13b. Galvanize after fabrication is complete.

Roadside Safety and Physical Security Division - Proving Ground

Project #611801 Wyoming Box Beam Transition
2021-01-06

Drawn by GES
Scale 1:12
Sheet 13 of 26
Main Plate
Plate, 34 1/4" x 1/4" x 38 3/8"
ASTM A572 Grade 50
See 14a

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).
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.
Stiffeners and Gussets

Side Stiffener
Plate, 3" x 1/4" x 61 7/8"
ASTM A572 Grade 50
Elevation View - Scale 1:7

Top Stiffener
Plate, 3" x 1/4" x 10 5/16"
ASTM A572 Grade 50
Plan View

Gusset
Plate, 3" x 1/4" x 5 3/8"
ASTM A572 Grade 50
Elevation View
2 needed

Bottom Stiffener
Plate, 2 3/4" x 1/4" x 9 7/8"
ASTM A572 Grade 50
Plan View
U-bolt for Picket Rail

- **5"**
- **3"-1/2"**

**U-bolt for Picket Rail**

- **1/2"** ASTM A36 Steel
- **10" long before bending**

**Plan View - Scale 1:3**

- **1/2-13 threads (NC)**

**Section Q-Q**

Scale 1 : 20

- **42"**
- **39-3/4"**
- **27"**
- **17"**
- **9"**
- **0"**
- **8"**

**Nut, 7/8 A563 heavy hex with F436 Washer**

- **Nut, 1/2 A563 heavy hex with Lock Washer x 2**

**Plate Washer for U-bolt Plate, 2" x 5/16" x 2"**

- **ASTM A36 Steel**
- **with Ø9/16" hole at center x 2**

**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)**

- **Nut, 7/8 A563 heavy hex with F436 Washer**

- **Nut, 1/2 A563 heavy hex with Lock Washer**

- **Plate Washer for U-bolt Plate, 2" x 5/16" x 2"**

- **ASTM A36 Steel with Ø9/16" hole at center x 2**

**U-bolt for Picket Rail**

- **10" long before bending**

**Plan View**

- **Rectangular Rail**

- **Round Bridge Rail**

- **Picket Panel**

- **See Field Side detail below for Picket Panel attachment. Typ 12 places.**

**Elevation View**

- **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.**
Bridge Rails

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

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

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

Traffic Side

Field Side

Section R-R
Scale 1 : 5

Section S-S
Scale 1 : 10

Roadside Safety and Physical Security Division - Proving Ground

Project #611801  Wyoming Box Beam Transition  2021-01-06
Drawn by GES  Scale 1:30  Sheet 18 of 26  Bridge Rails
19a. All welding must be performed by certified welders using industry standard practices.

19b. Galvanize after fabrication is complete.
Picket Panel

Section T-T

Elevation View from Traffic Side

Detail U

Scale 1 : 5

Isometric View

Plate, 5/8" x 5/8" x 28-7/8"
ASTM A36

L 2 x 1-1/2 x 3/16 x 73 1/8"
ASTM A36

Plate, 1 1/2" x 3/8" x 73-1/8"
ASTM A36

3/16 Typ

2"

3/16 Typ

3 x 9/16" X 3-1/2" THRU ALL

3/16 Typ

39-9/16" THRU ALL

29-7/8"

28-7/8"

16-1/8"

6"

0"

72-7/8"

69-9/16"

62-7/8"

0"

3/16 Typ

6" Typ

Roadside Safety and Physical Security Division - Proving Ground

Project #611801 Wyoming Box Beam Transition

Drawn by GES | Scale 1:10 | Sheet 21 of 26 Picket Panel

C:\Users\g-schroeder\Documents\work from home files\611801\1-4\611801 1-4 Drawing
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.
Elevation View
Anchor Bars not shown for clarity

Plan View
Z-1 bar x 4, in pairs placed horizontal at 2" and 4" above the Deck
Z bar, same orientation as @ center Post
Z bar, rotated to maintain clearance at curb flare

D-bars @ 6"
D-bars 6 sp. @ 3" 18"

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

Rebar at Ends
Z bar, same orientation as @ center Post

D Bar
D-1 Bar
D-2 Bar
D-3 Bar
D-4 Bar
D-5 Bar
Anchor Bolt Assembly
Threads not shown for clarity

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

Isometric View

Bolt, 7/8 x 10 1/2" hex
A449
x 4
D Bar
Ø5/8" Grade 60 Rebar

D-1 Bar
Ø5/8" Grade 60 Rebar

D-2 Bar
Ø5/8" Grade 60 Rebar

D-3 Bar
Ø5/8" Grade 60 Rebar

D-4 Bar
Ø5/8" Grade 60 Rebar

D-5 Bar
Ø5/8" Grade 60 Rebar

Z bar
Ø5/8" Grade 60 Rebar

Z-1 bar
Ø5/8" Grade 60 Rebar

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
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.
Plan View

Thriebeam, 12 gauge 75" span

W- to Thrie-beam Transition
10 gauge

Elevation View

Thriebeam, 12 gauge 12.5' span 8-space
x 2, nested

MGS Transition Attachment

Detail F
Scale 1 : 20

2" Guardrail Bolt
with Rectangular Guardrail Washer
12 places

Thrie-beam Terminal Connector

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

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

Detail F
Field Side

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

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 E-E
Typ @ Posts 18 - 23

Section D-D
Typ @ Posts 13 - 17

Section C-C
@ Post 12
Transition Attachment

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

Isometric View

Plan View

Elevation Views
Traffic and Field Sides

This view normal to this face.

<table>
<thead>
<tr>
<th>#</th>
<th>Body Name</th>
<th>Description</th>
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<th>Qty</th>
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<td>2</td>
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<td>L 3 x 3 x 1/4</td>
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<td>ASTM A36</td>
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<td>3</td>
<td>Thrie-beam Support</td>
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<td>Top Stiffener</td>
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<td>ASTM A36</td>
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<tr>
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<td>Side Stiffener</td>
<td>Plate, 3&quot; x 1/4&quot;</td>
<td>19 11/16&quot;</td>
<td>ASTM A36</td>
<td>1</td>
</tr>
</tbody>
</table>
Transition Posts

78" Transition Post
W6x8.5 ASTM A36

72" Transition Post
W6x8.5 ASTM A36
Transition Blockout
Pressure-treated Yellow Pine Timber
6" x 12" x 19"

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

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

Drawn by GES  Scale 1:10  Sheet 9 of 19  Transition Blockouts
U-bolt for Picket Rail
∅ 1/2" ASTM A36 Steel
10" long before bending
Plan View - Scale 1:3

Nut, 7/8 A563 heavy hex with F436 Washer
Nut, 1/2 A563 heavy hex with Lock Washer x 2
Plate Washer for U-bolt Plate, 2" x 5/16" x 2"
ASTM A36 Steel with Ø9/16" hole at center x 2

Detail F
Scale 1 : 10
See 10a

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

Section G-G
Scale 1 : 20

10a. U-bolt and hardware typical 3 places at each Post.
Anchor hardware typical 4 places at each Post.
12a. All welding must be performed by certified welders using industry standard practices.
12b. Galvanize after fabrication is complete.
6-3/4" 15-1/2" Top Traffic Side Bar

Typical each end
Plan View

25°

5/8" Rebar x 33" - 2 spaces @ 9" each end, then @ 18"

(2-1/4"
1-1/4"
8"
9"
1"
6"
0"
0"
1"
2"
1-1/4"
cvr
1-1/4"
cvr

2021-01-12

Drawn by GES  Scale 1:8  Sheet 16 of 19  Concrete Section

Q:\Accreditation-17025-2017\EIR-000 Project Files\611801-02 - Wyoming DOT - Bligh\Drafting, 611801\Drafting, 611801 5-6\611801 5-6 Drawing

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.
Plan View

Z-1 bar x 4, in pairs placed horizontal at 2" and 4" above the Deck

Z bar, same orientation as @ center Post

Elevation View

Anchor Bars not shown for clarity

Isometric View

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

D-bar, rotated to maintain clearance at curb flare

D-bar, same orientation as @ center Post

Rebar at Ends
Anchor Bolt Assembly
Threads not shown for clarity

Isometric View

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

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

Roadside Safety and
Physical Security Division -
Proving Ground

Project #611801 5-6  Wyoming MGS Transition  2021-01-12
Drawn by GES  Scale 1:3  Sheet 18 of 19  Anchor Bolt Assembly
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.
1a. Material is ASTM A 563 Grade A.
72" Wide-Flange Guardrail Post

Elevation View

Isometric View

$\phi$ 13/16" Typ, both flanges

W6x8.5 ASTM A992

Section A-A

Scale 1 : 3
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
Thrie-beam End Shoe
10 gauge (0.1345" before galvanizing)

Elevation View

Isometric View

See Thrie-beam drawing for cross-section.

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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

12 gauge (0.1046 before galvanizing, 0.1084 after)

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Transition 12 gauge Thrie-beam

2019-07-30

Drawn by GES  Scale 1:20  Sheet 1 of 1
Rectangular Guardrail Washer

0.20" thick
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.
DAT System

Isometric View

Plan View

Elevation View

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

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.
DAT Parts sheet 2

Anchor Cable Assembly

3/4" 6x19 Cable

Washer, 1" F844

Nut, 1" A563 heavy hex

1" -8 threads

1-1/4" 1-5/8"

78"

DAT Terminal Rail

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

DAT (Downstream Anchor Terminal)

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2019-07-26

Drawn by GES | Scale 1:10 | Sheet 3 of 3