

# Modified Midwest Guardrail System (MMGS)

## FS30 P1 Passive Barrier System

02/22/2024



**This guardrail system is intended to provide a cost-effective means for establishing passive barriers on military installations. The MMGS design is based on five primary principles:**

- Give consideration to occupant safety.
- Meet ASTM F2656-15 FS30 P1 criteria.
- Exist as a non-proprietary design that is not owned or patented.
- Utilize “standard hardware” which is defined as readily-available, off-the-shelf, and/or prefabricated structural sections.
- Reduce costs for DOD installations. Based on a 1.0 area cost adjustment factor, system costs are *estimated* at \$15,700 for two anchor sections plus \$61 per linear foot for the guardrail run (2018 prices).

**The MMGS is based off the Midwest Guardrail System design, with the following modifications:**

- Replaces the 10-gauge thrie beam with nested 12-gauge thrie beam (i.e., 2x rails per rail segment). The increased number of plies of rail will resist splice bolt pullout, increase total cross-sectional area of the rail (and thus rail tensile capacity at splices and non-splices), and reduce bearing failure at splices. *NOTE: At rail splices, maintain rail nesting such that two outer plies overlap both two inner plies. At post locations, bolt through both plies of rail. At the end anchorages, place both plies of thrie beam between the outer and inner thrie end connectors.*

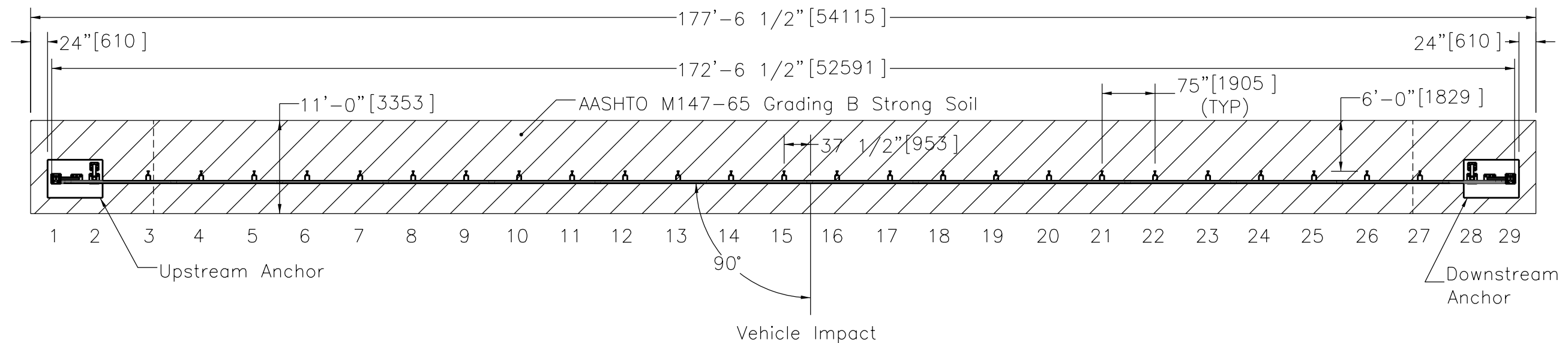
- Substitutes the standard-grade, 5/8" diameter guardrail bolts at splices for ASTM F3125 or A449, 5/8" diameter, heavy hex head bolts and nuts and ASTM F844 washers on both sides of the rail.
- Reduces the soil embedment depth by 6 inches to 45 inches.

## **General Guidance**

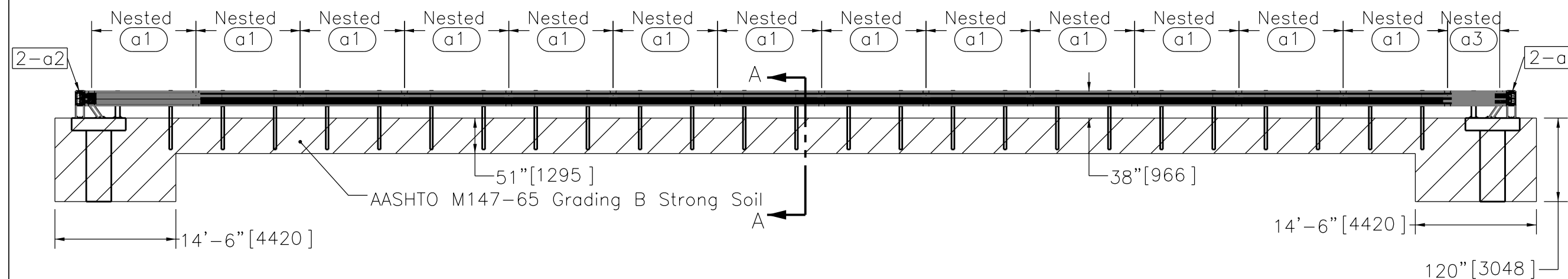
- **Blockouts** shall utilize southern yellow pine timber that conforms to AASHTO M133.
- **Guardrail dimensional tolerances** shall be consistent with state department of transportation general practices, references and guidelines.
- **Thrie beam splice bolt** locations should be drilled with 1 1/4" holes for ease of assembly and an application of galvanized coating shall be administered to prevent corrosion (the field tested MMGS splice holes were drilled in this manner).

*This guardrail system was approved on 01 May 2018 by the USACE - Protective Design Center for use as a passive barrier on DOD installations.*

*SDDCTEA requests that installations email construction costs for the MMGS as projects get awarded. EMAIL: [army.sddc.safb.traffic@mail.mil](mailto:army.sddc.safb.traffic@mail.mil)*



PLAN VIEW



ELEVATION VIEW

THE TERMS UPSTREAM AND DOWNSTREAM ARE FOR REFERENCING ONLY. THE ANCHOR DESIGNS ARE IDENTICAL WITH THE EXCEPTION OF THE COMPONENTS BEING ROTATED 180 DEGREES.

- Note: (1) The impact location is the vehicle centerline impacting at the midspan between post nos. 15 and 16.  
 (2) Impact tolerance is  $\pm 1$  ft [305] of nominal location.  
 (3) Simple splicing used according to normal traffic conventions; no sandwiching within system. At thrie terminal connection splices, the nested thrie beam was sandwiched between terminal connectors.



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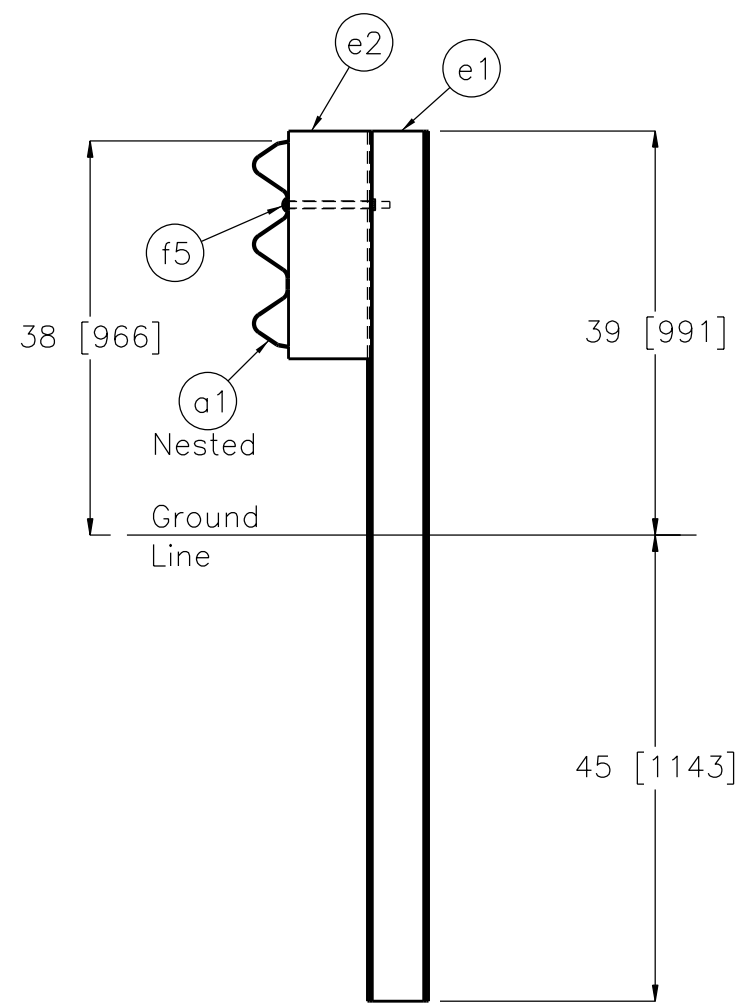
## Modified Midwest Guardrail System System Layout Overview

Rating: FS30 P1

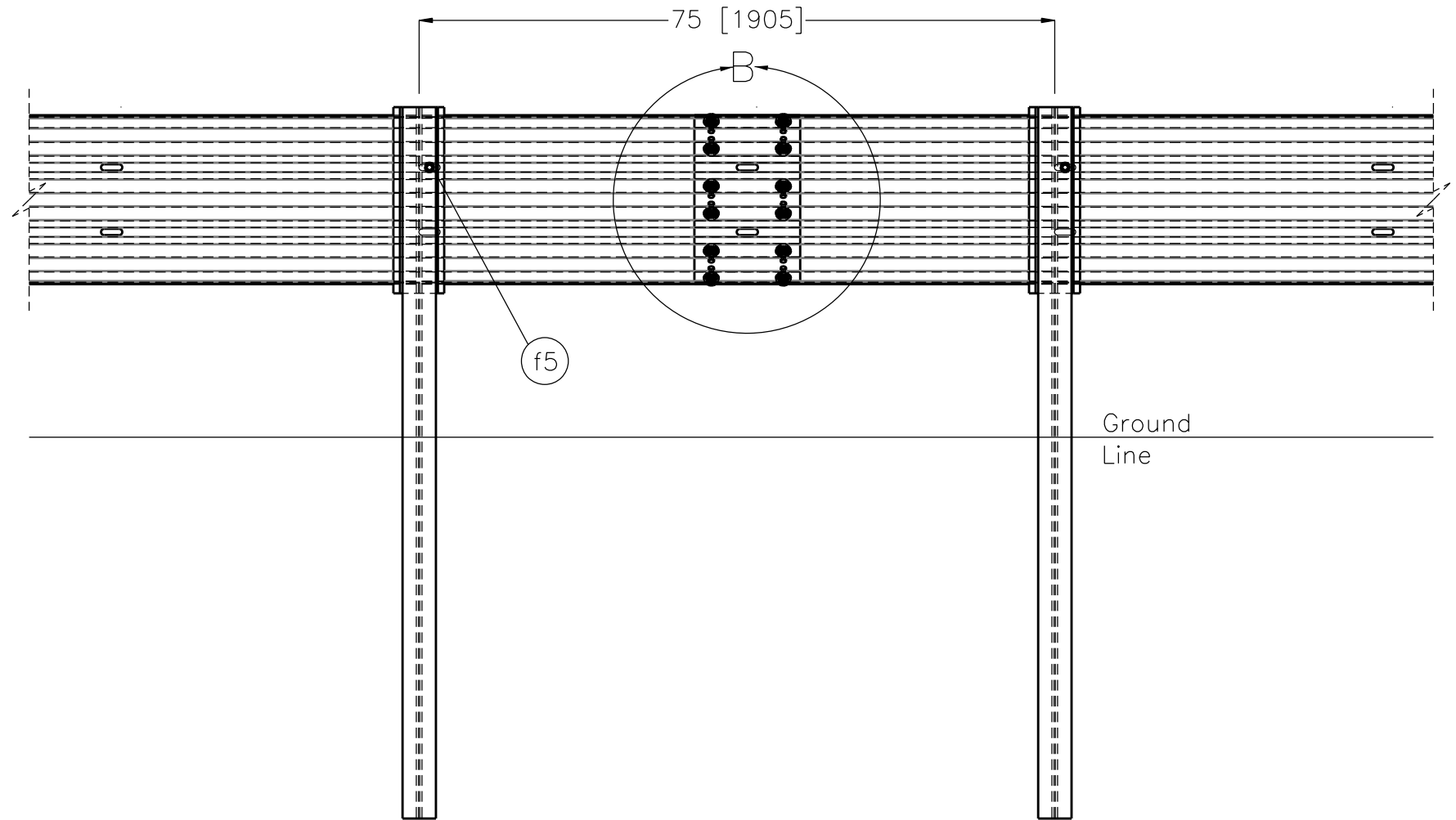
DATE:  
12/8/2017

UNITS:  
in[mm]

SHEET  
1 of 16



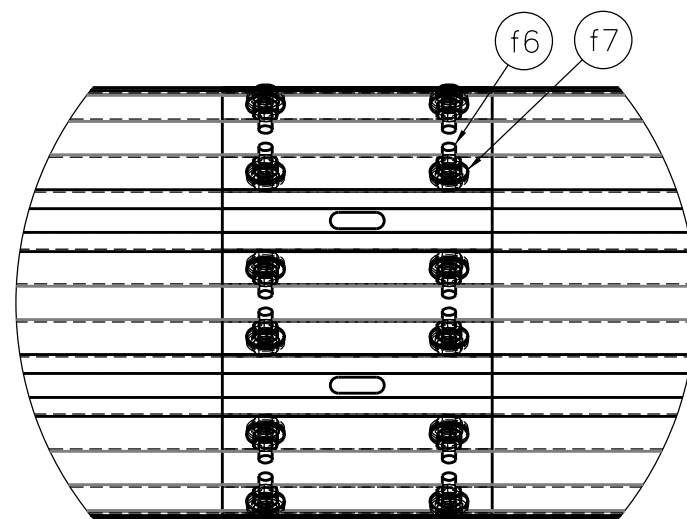
SECTION A-A



Post No. 16

SPlice DETAIL  
BACKSIDE

Post No. 15



DETAIL B

- Note: (1) Guardrail bolts (part f5) on the upstream side of the web.
- (2) A drift pin may be used to attach nested rails. If galvanization is damaged, galvanizing spray may be used to ensure proper rust protection.
- (3) Washers (part f7) used on front and back of splice bolts.



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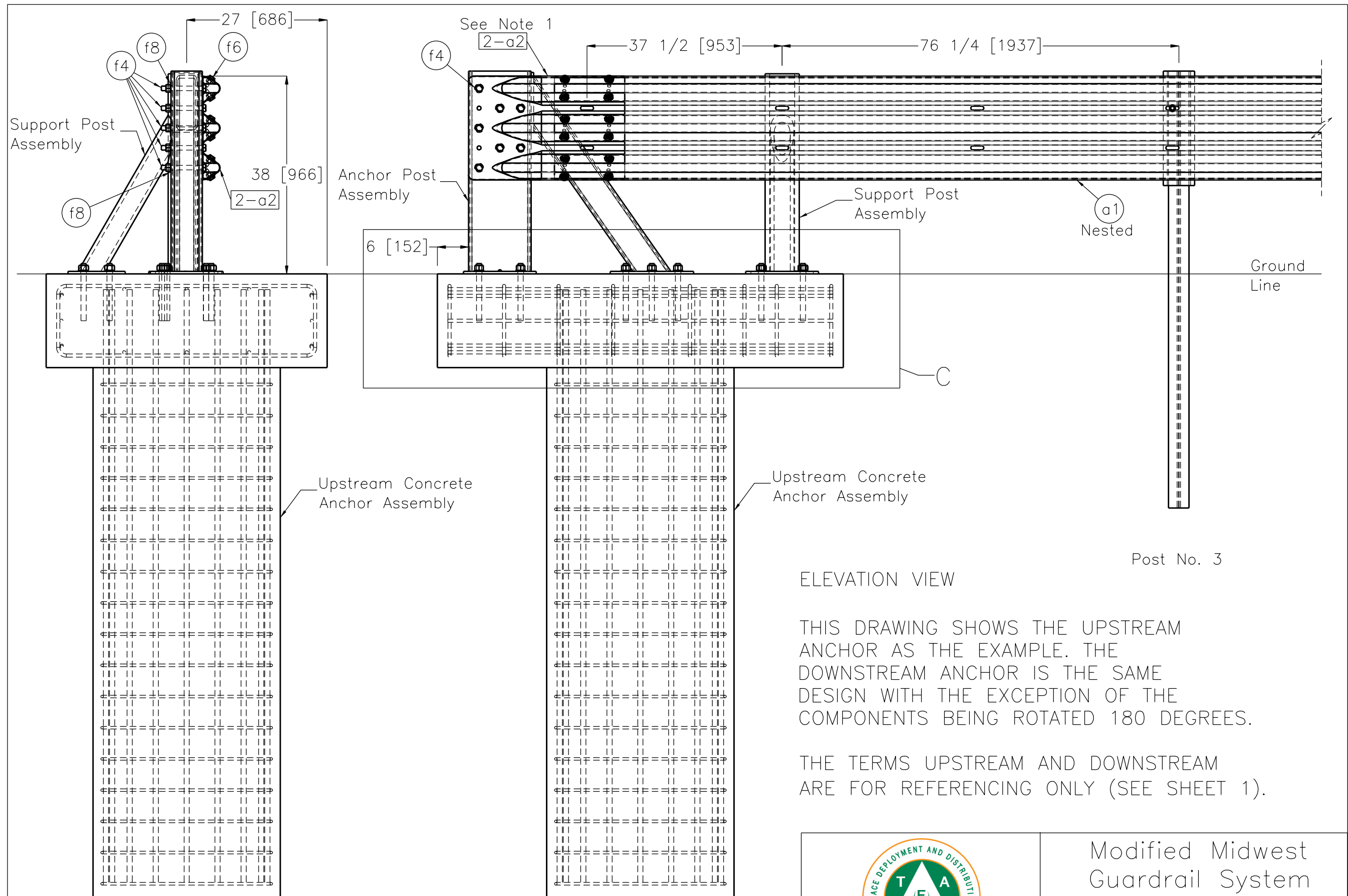
Modified Midwest  
Guardrail System  
Post and Splice Details

Rating: FS30 P1

DATE:  
12/8/2017

UNITS:  
in[mm]

SHEET  
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### ELEVATION VIEW

THIS DRAWING SHOWS THE UPSTREAM ANCHOR AS THE EXAMPLE. THE DOWNSTREAM ANCHOR IS THE SAME DESIGN WITH THE EXCEPTION OF THE COMPONENTS BEING ROTATED 180 DEGREES.

THE TERMS UPSTREAM AND DOWNSTREAM ARE FOR REFERENCING ONLY (SEE SHEET 1).

- Notes: (1) Two thrie terminal connectors (part a2) needed per end anchorage.  
 (2) A drift pin may be used to attach nested rails. If galvanization is damaged, galvanizing spray may be used to ensure proper rust protection.



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Modified Midwest  
Guardrail System

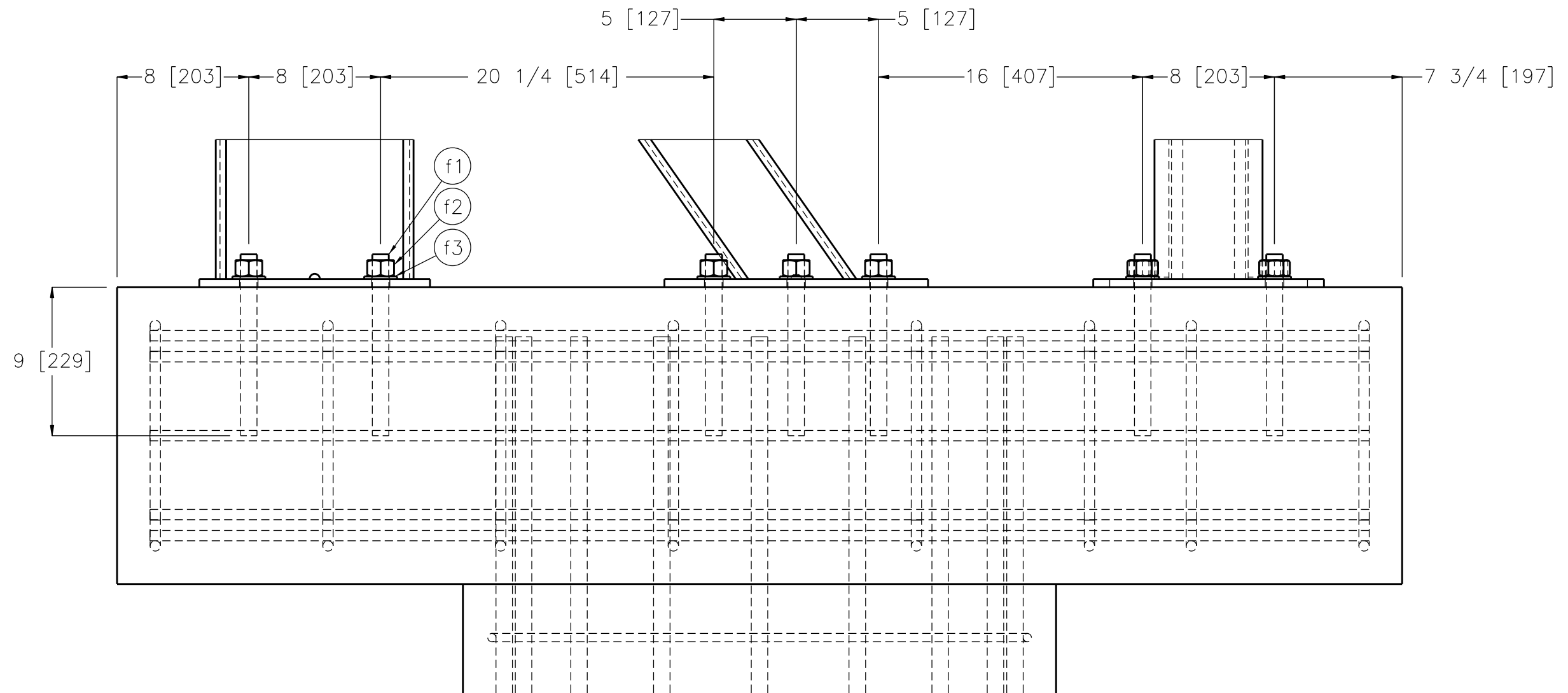
### Anchorage Overview

Rating: FS30 P1

DATE:  
12/8/2017

UNITS:  
in[mm]

SHEET  
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DETAIL C

Note: (1) Threaded rods (Part f1) anchored to concrete anchorage using Powers Fasteners AC100+ Gold epoxy or an equivalent epoxy with a minimum bond strength of 1,305 psi [9.0 MPa].



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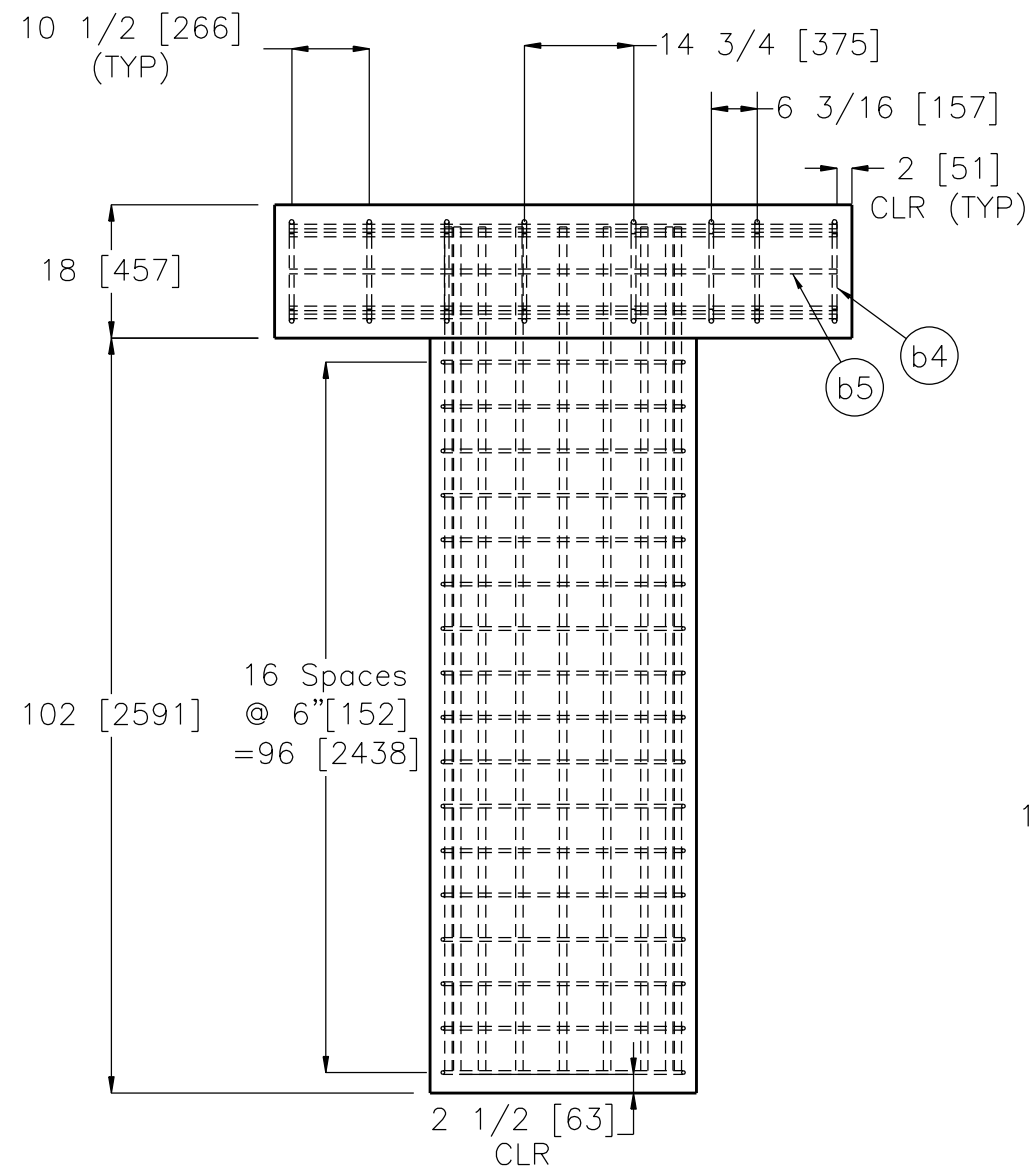
Modified Midwest  
Guardrail System  
Anchor Attachment  
Detail C

Rating: FS30 P1

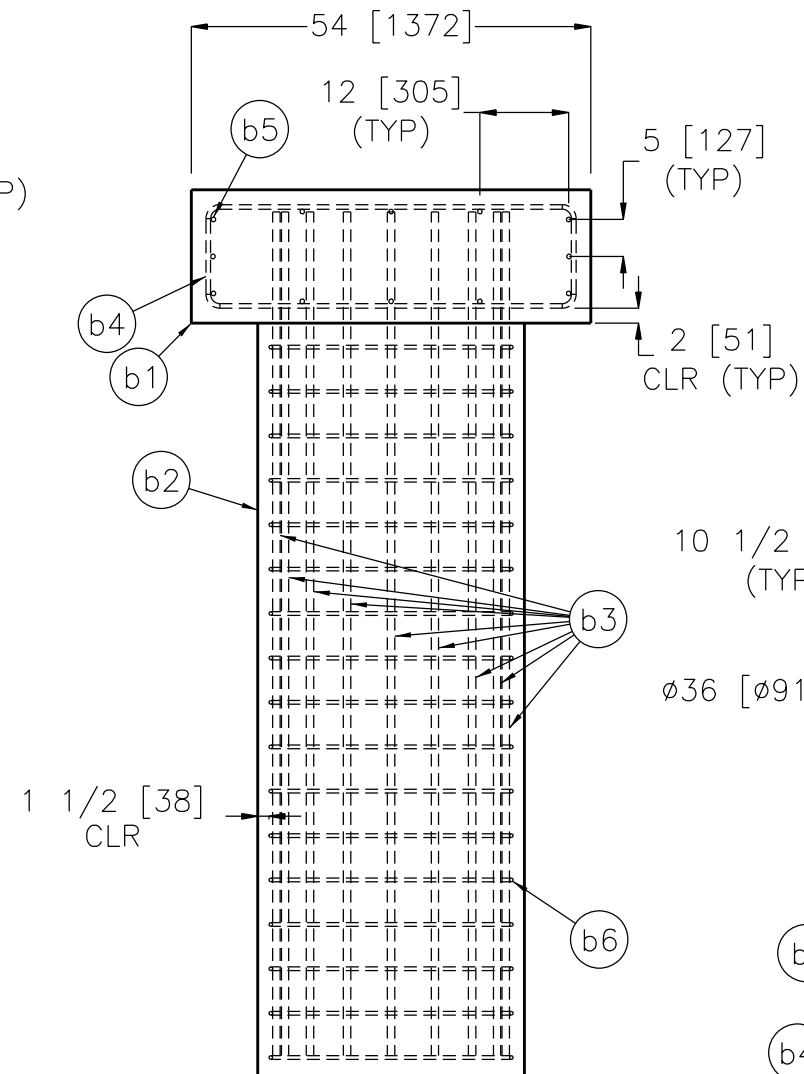
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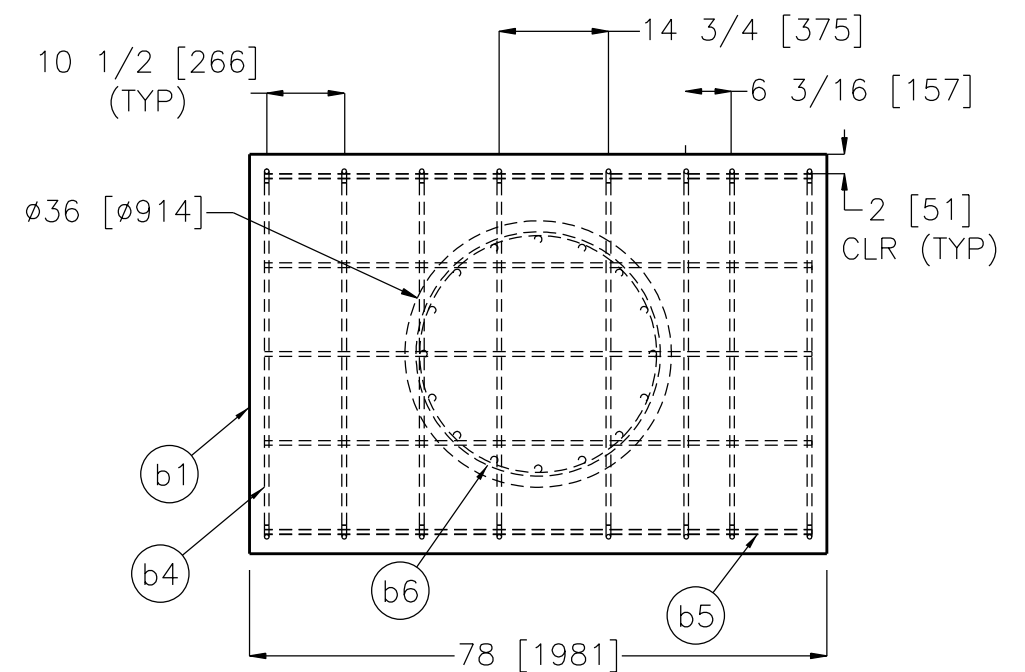
SHEET  
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ELEVATION VIEW



PROFILE VIEW



PLAN VIEW

Note: (1) Anchor is rotated 180° for downstream configuration.



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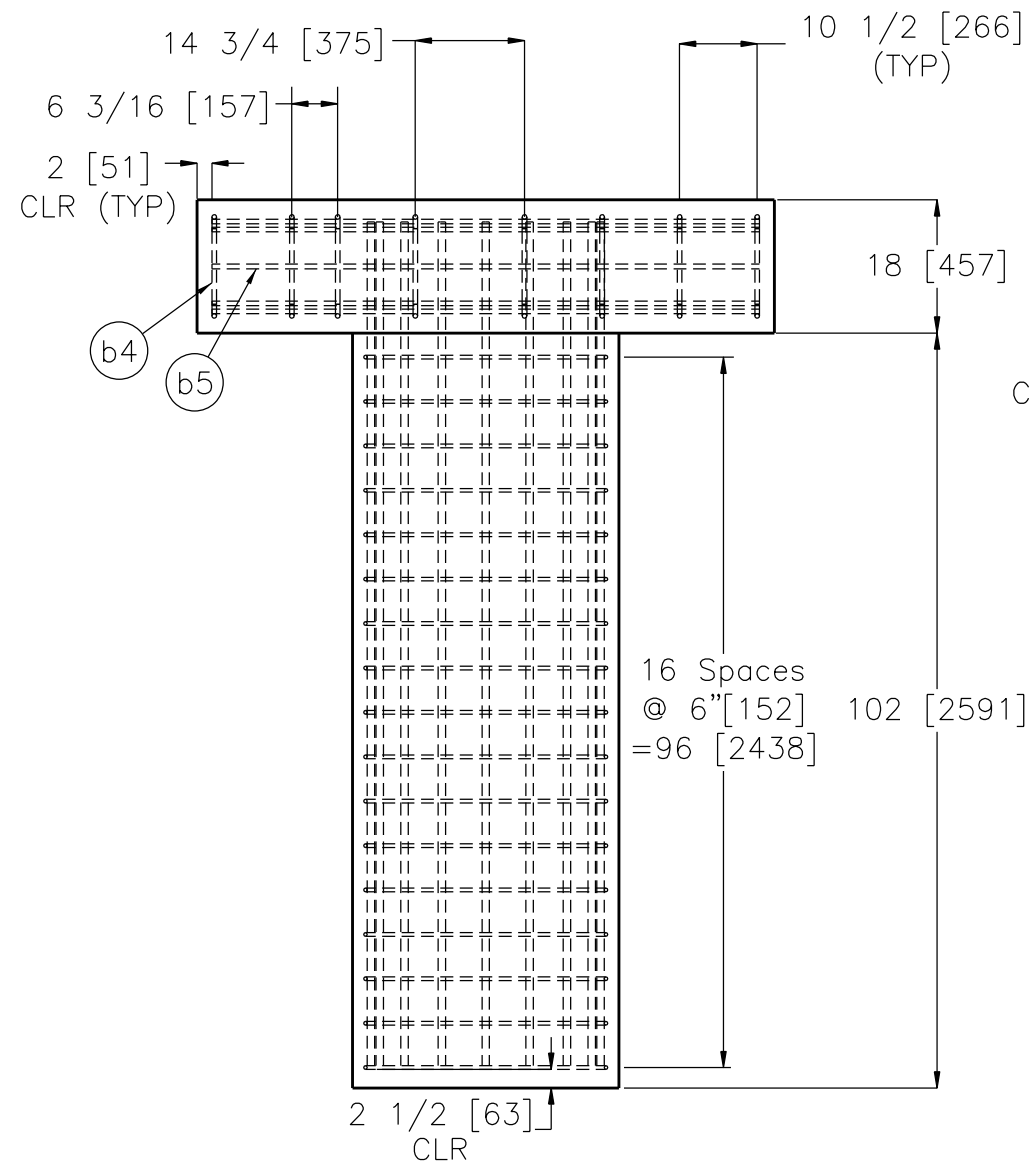
# Modified Midwest Guardrail System Upstream Anchor Concrete Anchor Details

Rating: FS30 P1

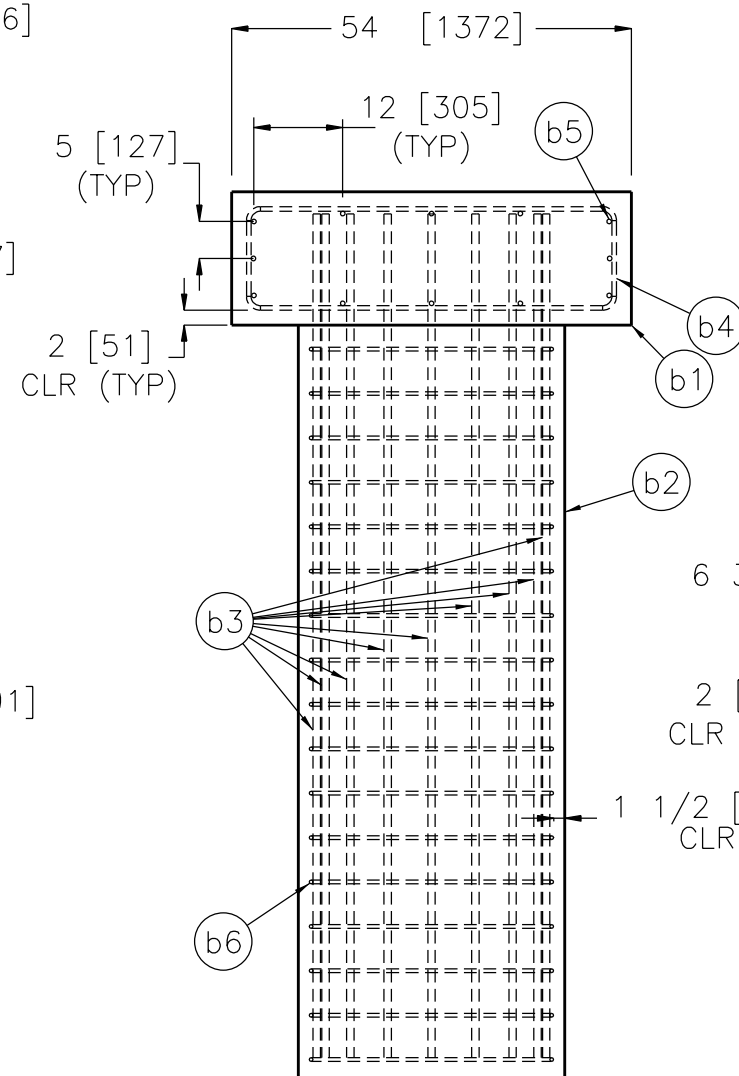
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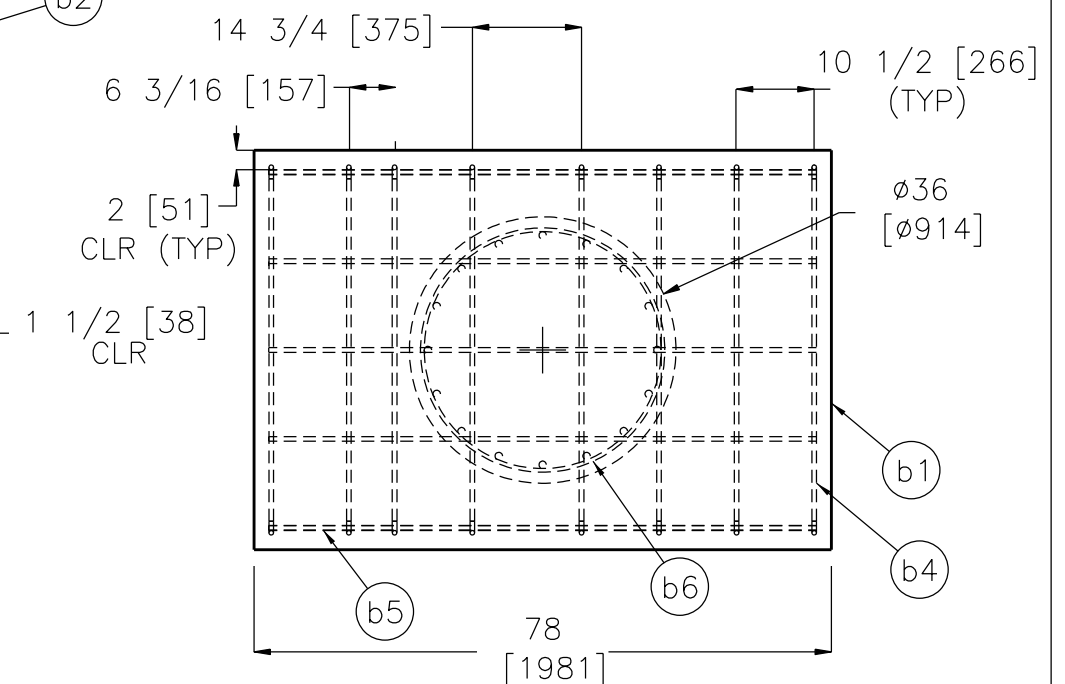
SHEET  
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ELEVATION VIEW



PROFILE VIEW



PLAN VIEW

Note: (1) Anchor is rotated 180° for upstream configuration.



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# Modified Midwest Guardrail System Downstream Anchor Concrete Anchor Details

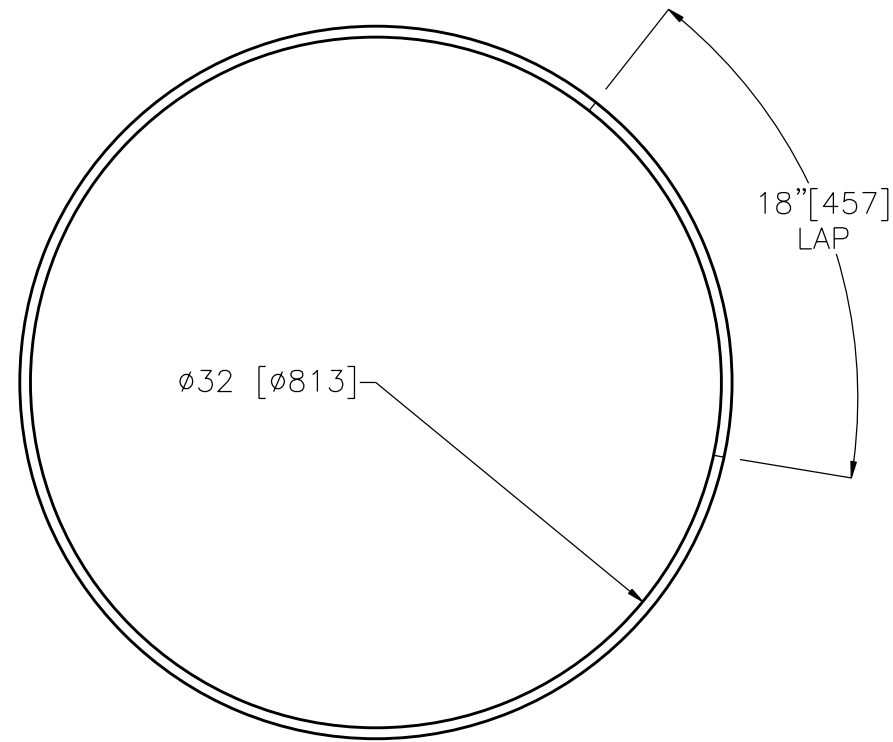
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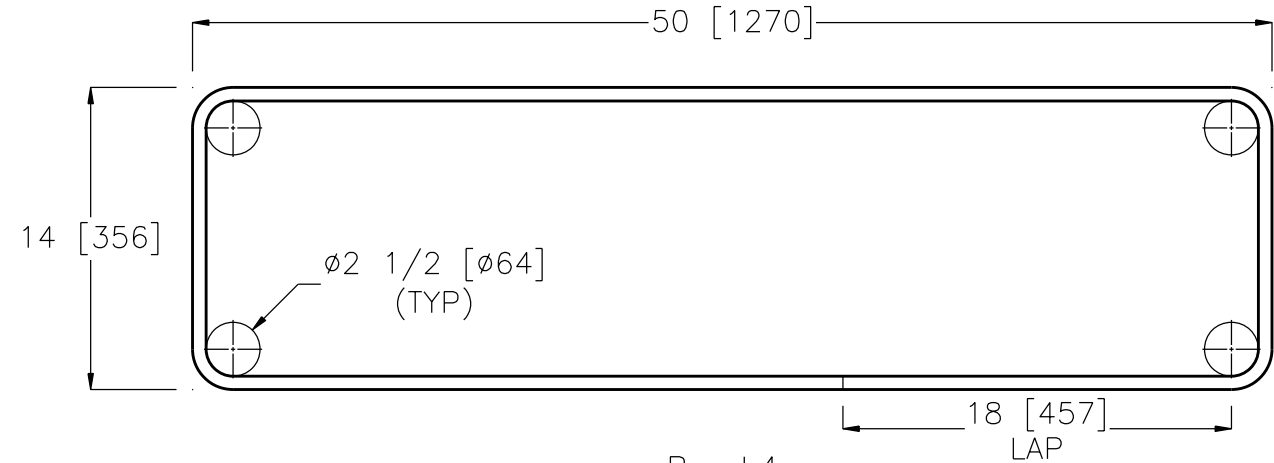
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SHEET  
6 of 16

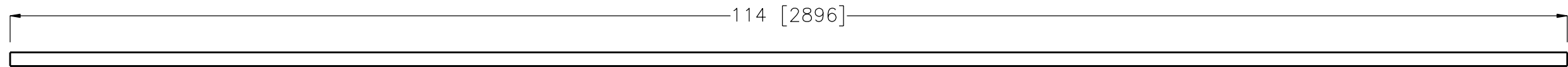




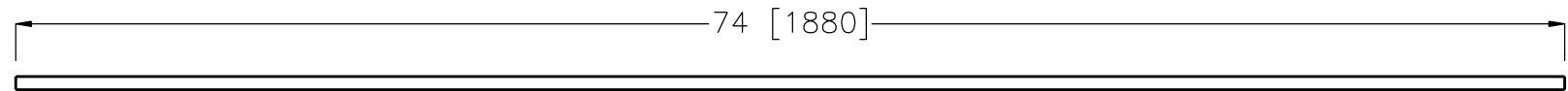
Bar b6



Bar b4

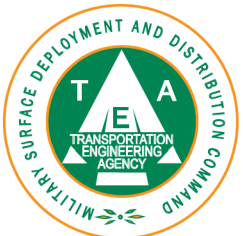


Bar b3



Bar b5

Bill of Bars				
ITEM NO.	QTY	BAR SIZE	UNBENT LENGTH	MATERIAL SPEC
b3	32	#8 [25]	114" [2,896]	ASTM A615 Gr. 60
b4	16	#5 [16]	140 3/4" [3,575]	ASTM A615 Gr. 60
b5	24	#5 [16]	74" [1,880]	ASTM A615 Gr. 60
b6	34	#4 [13]	122" [3,099]	ASTM A615 Gr. 60



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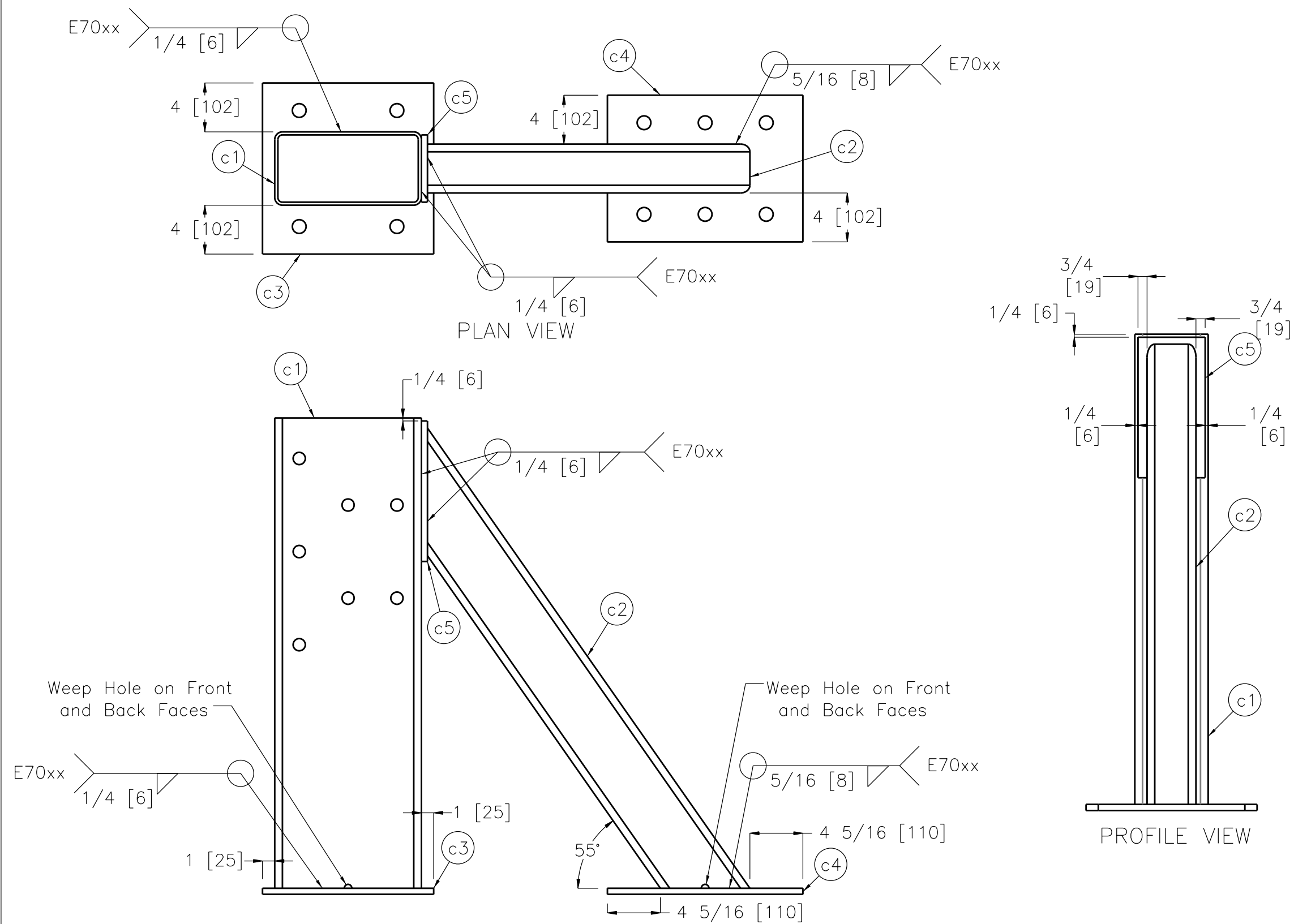
Modified Midwest  
Guardrail System  
**Concrete Anchor  
Rebar Details**

Rating: FS30 P1

DATE:  
12/8/2017

UNITS:  
in[mm]

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Distribution Command  
Transportation Engineering Agency

Modified Midwest  
Guardrail System

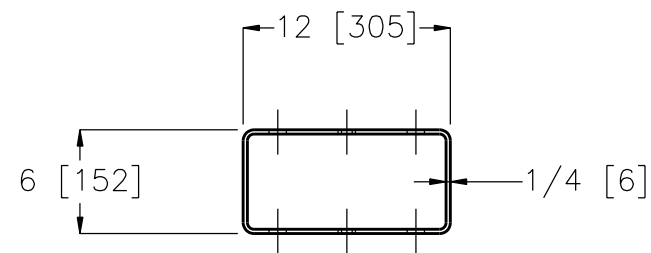
Anchor Post Assembly

Rating: FS30 P1

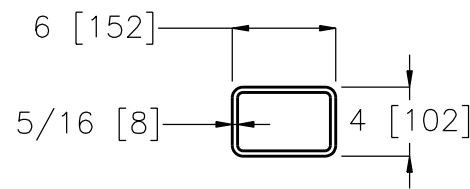
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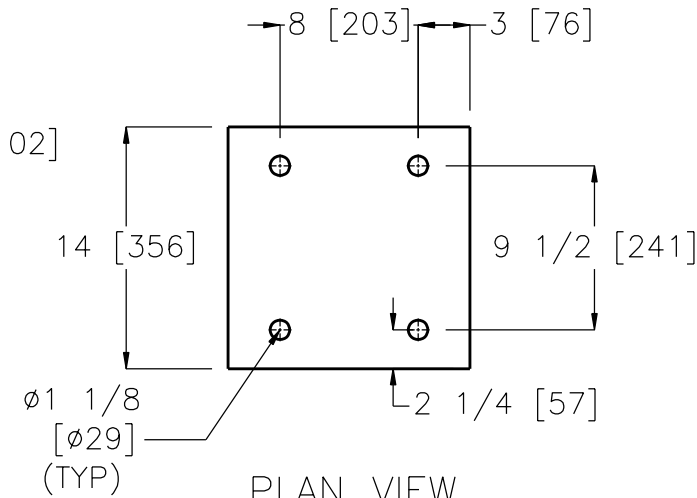
SHEET  
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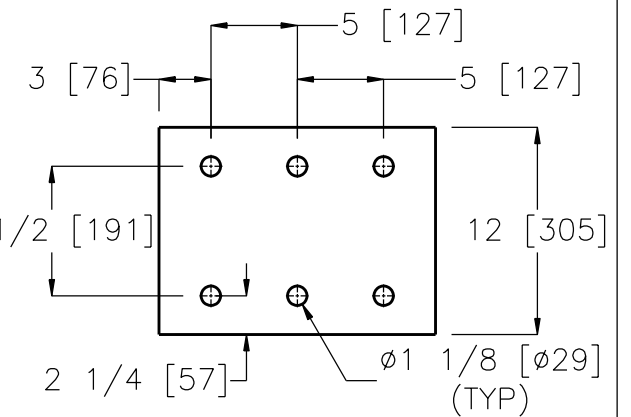
PLAN VIEW



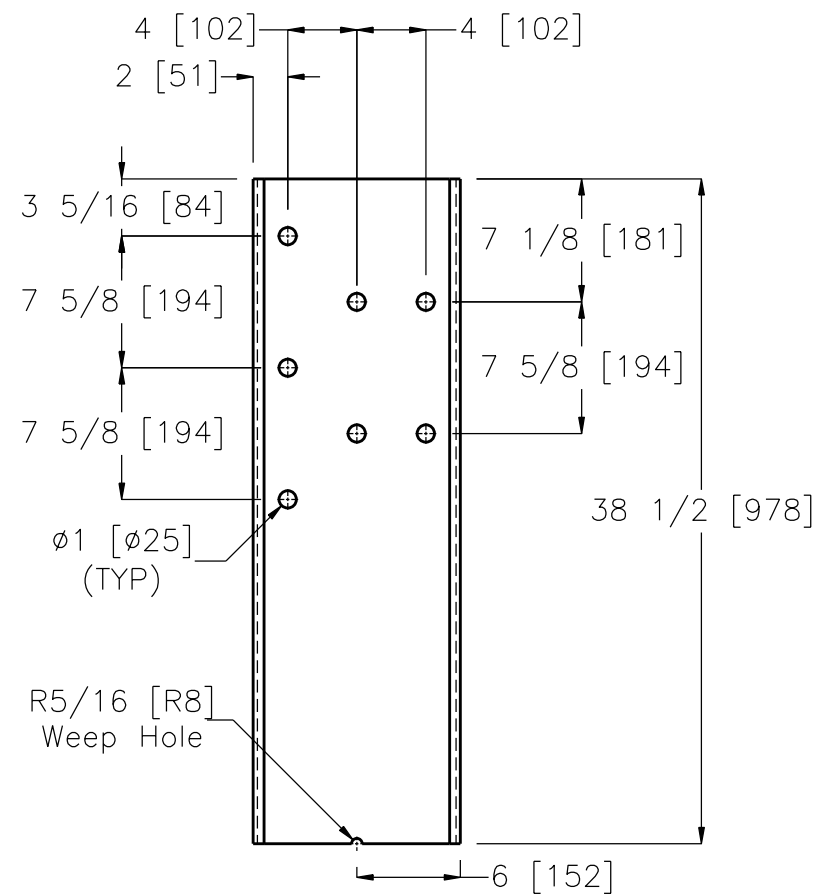
PLAN VIEW



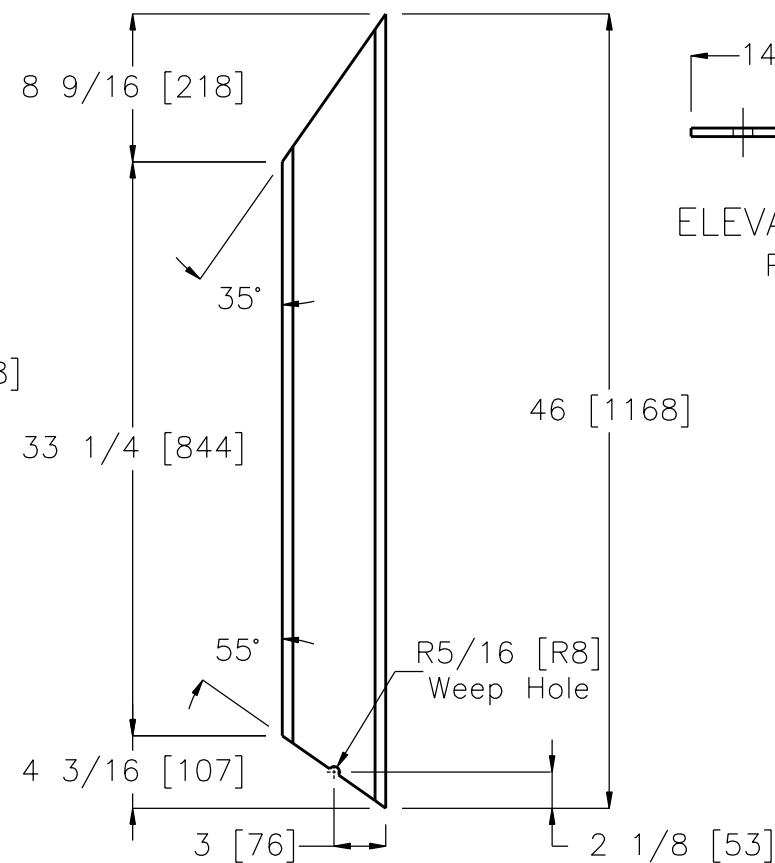
PLAN VIEW



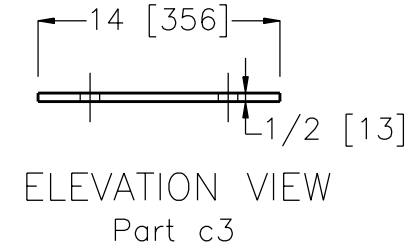
PLAN VIEW



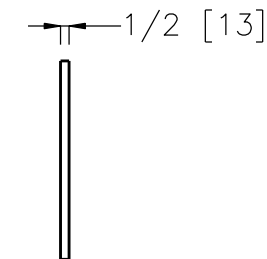
ELEVATION VIEW  
Part c1



ELEVATION VIEW  
Part c2

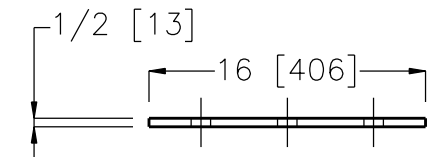


ELEVATION VIEW  
Part c3

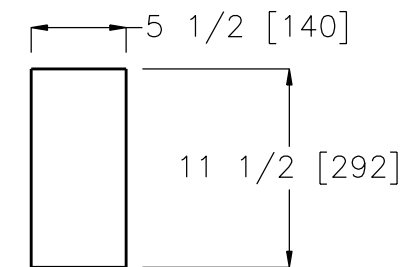


ELEVATION VIEW

Part c5



ELEVATION VIEW  
Part c4



PROFILE VIEW



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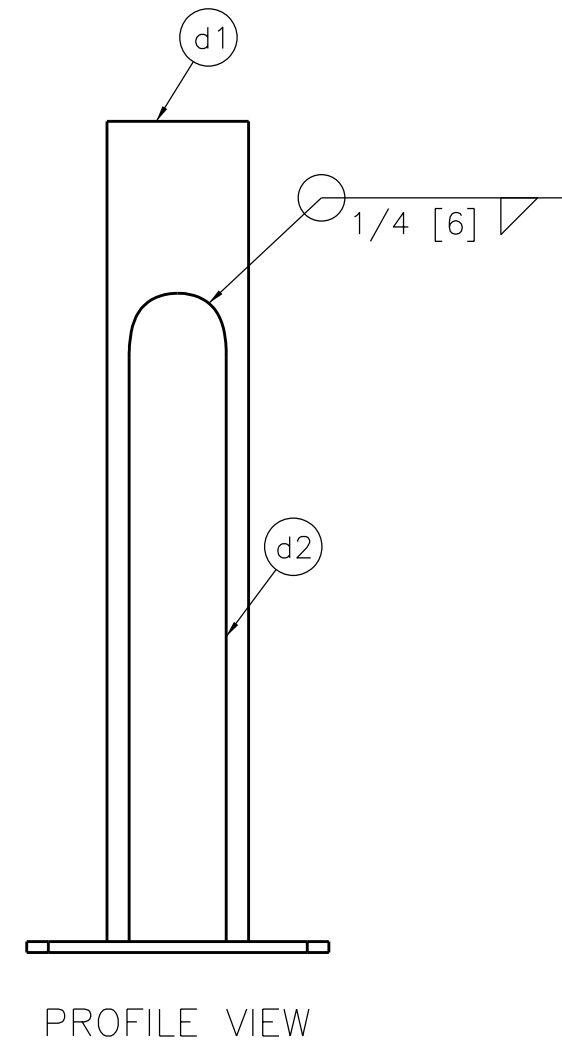
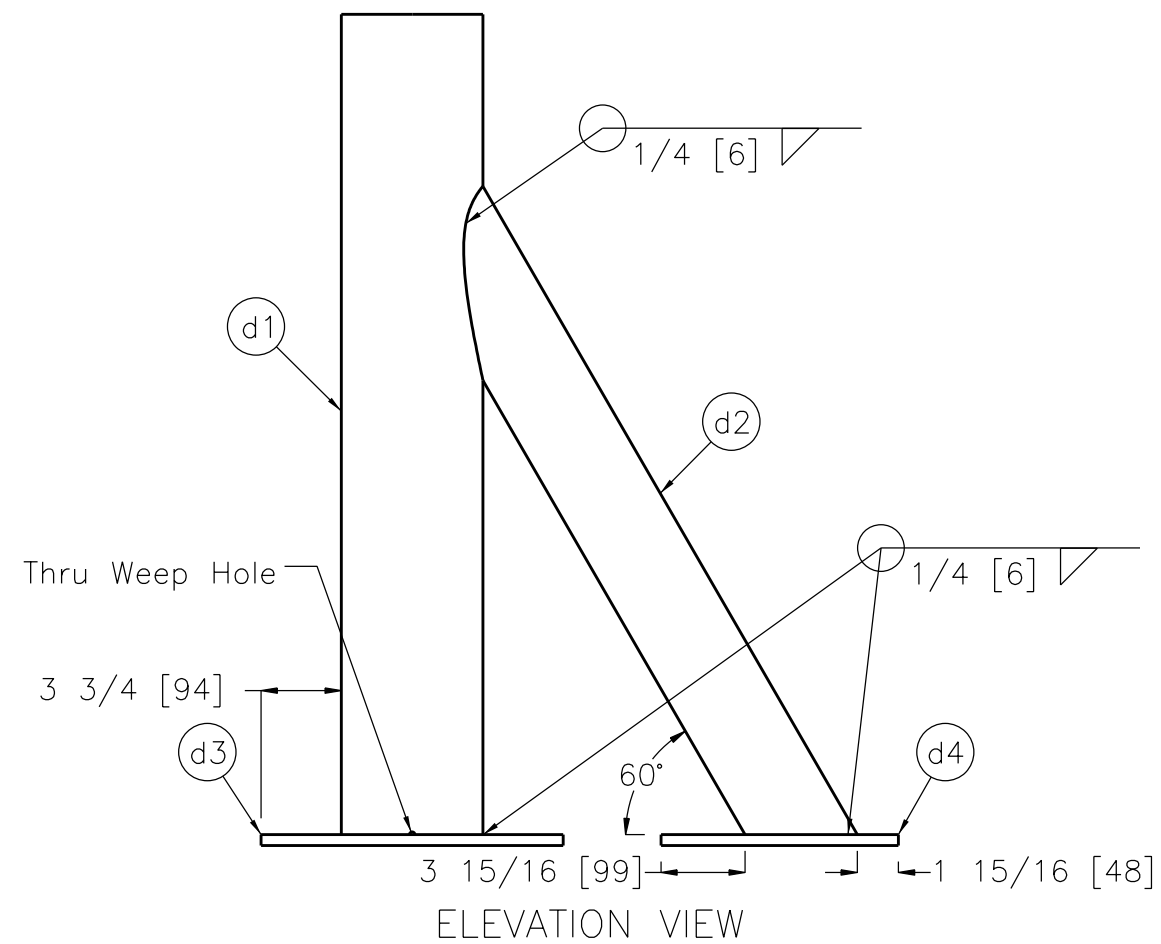
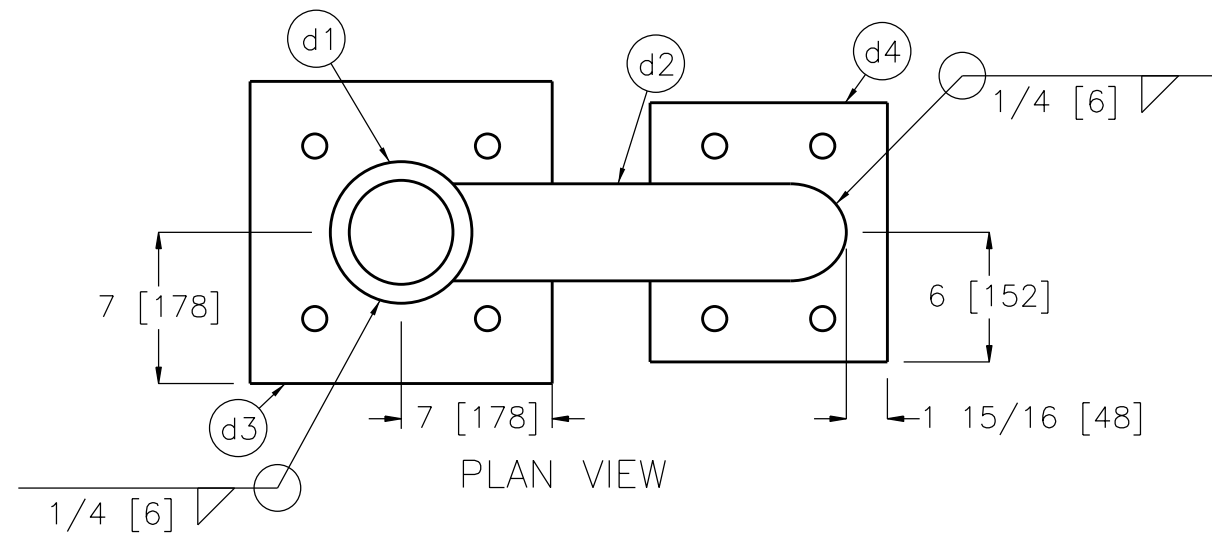
Modified Midwest  
Guardrail System  
Anchor Post Components

Rating: FS30 P1

DATE:  
12/8/2017

UNITS:  
in[mm]

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Military Surface Deployment  
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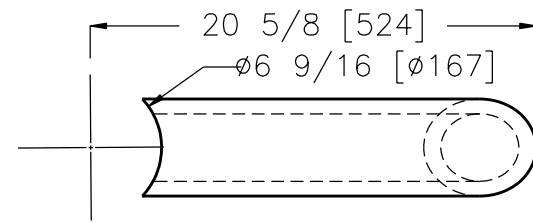
# Modified Midwest Guardrail System Anchor Support Post Assembly

Rating: FS30 P1

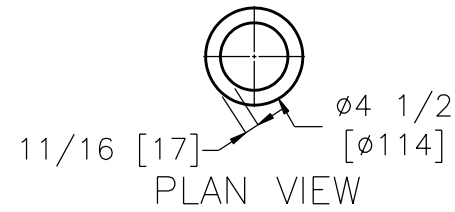
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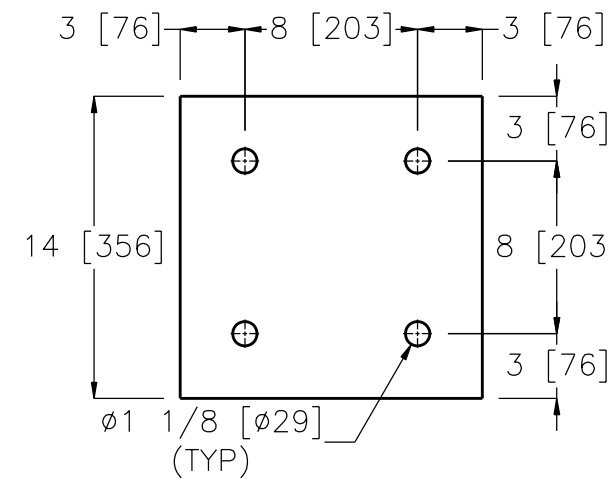
SHEET  
10 of 16



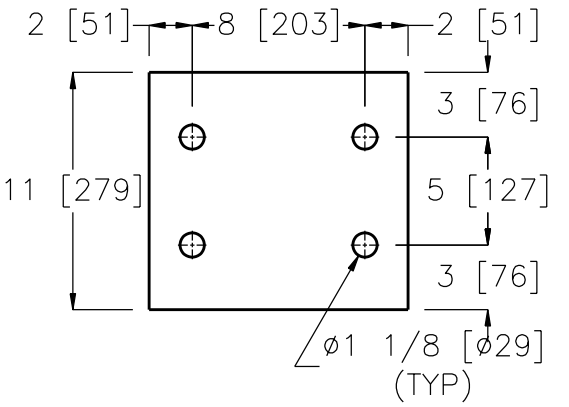
SECTION D-D



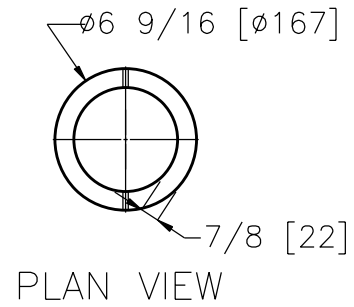
PLAN VIEW



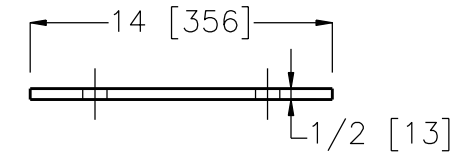
PLAN VIEW



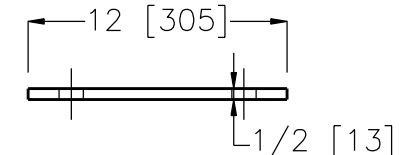
PLAN VIEW



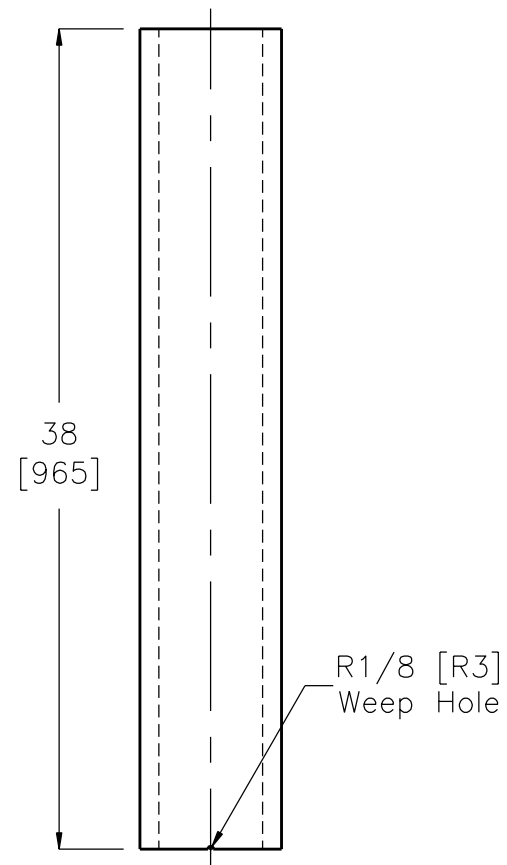
PLAN VIEW



ELEVATION VIEW  
Part d3

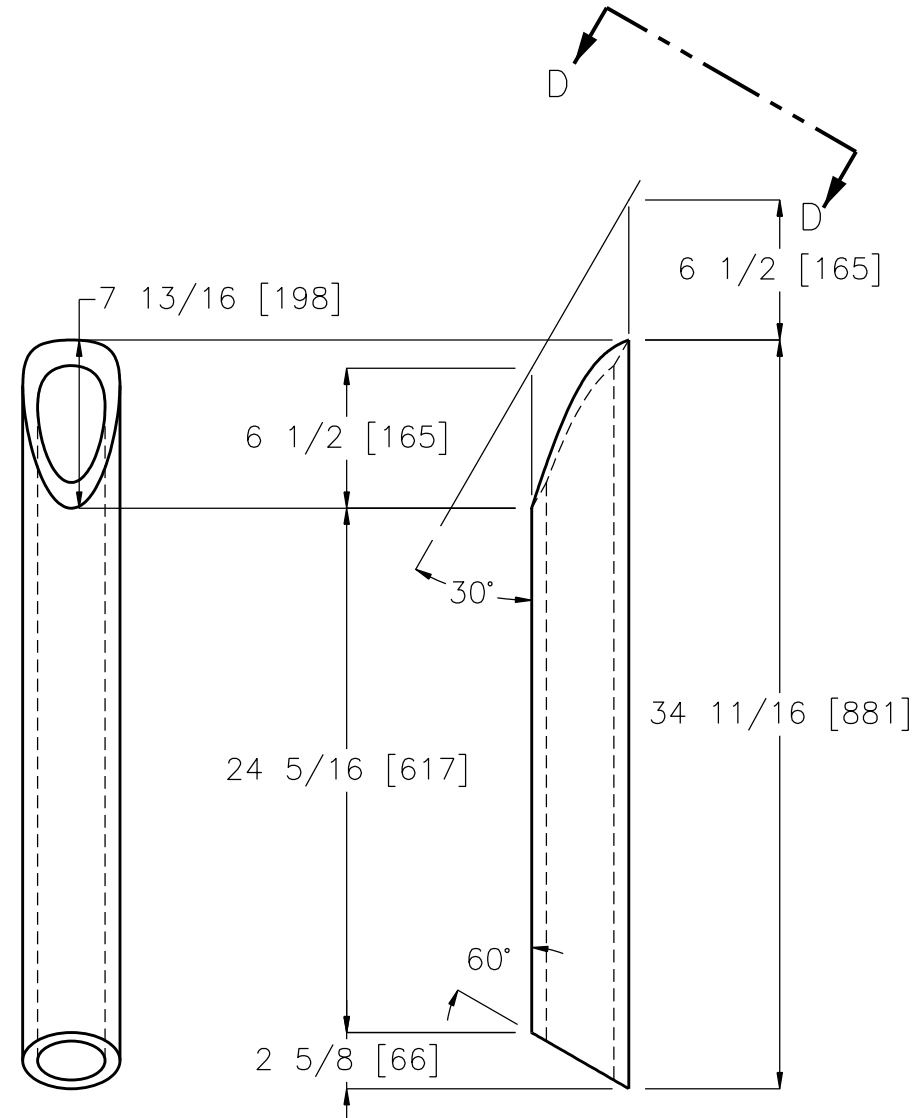


ELEVATION VIEW  
Part d4



ELEVATION VIEW  
Part d1

PROFILE VIEW



ELEVATION VIEW

Part d2



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Distribution Command  
Transportation Engineering Agency

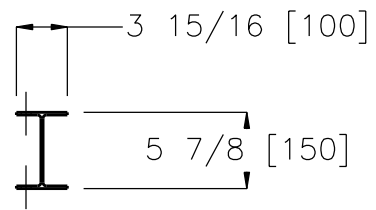
Modified Midwest  
Guardrail System  
Anchor  
Support Post Components

Rating: FS30 P1

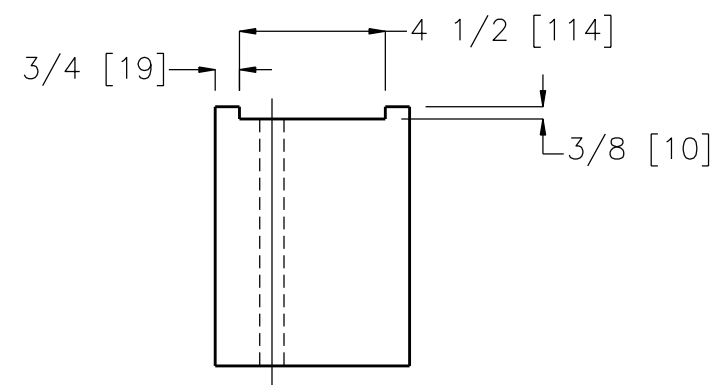
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12/8/2017

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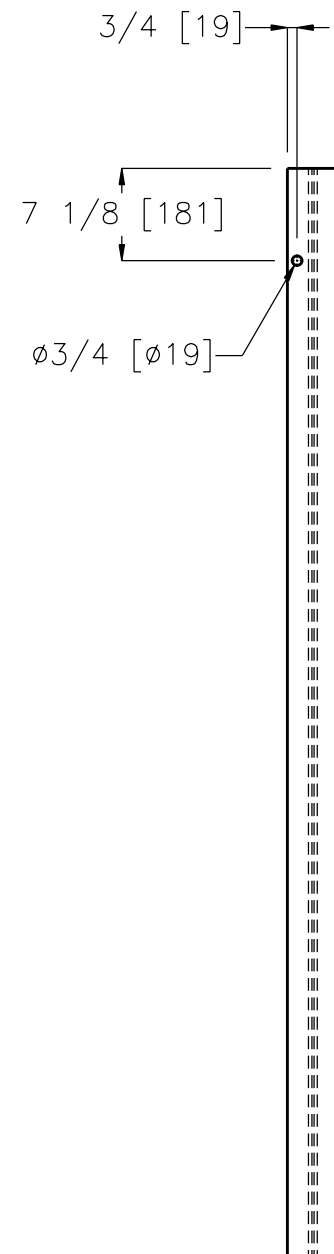
SHEET  
11 of 16



PLAN VIEW

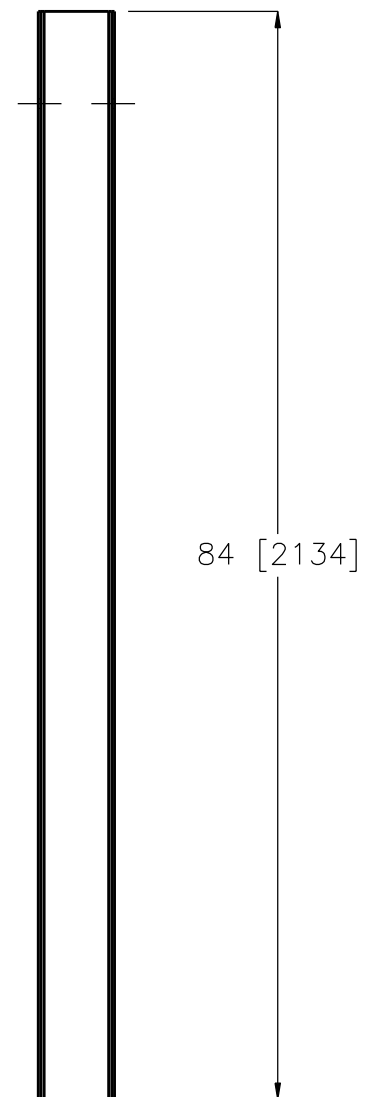


PLAN VIEW

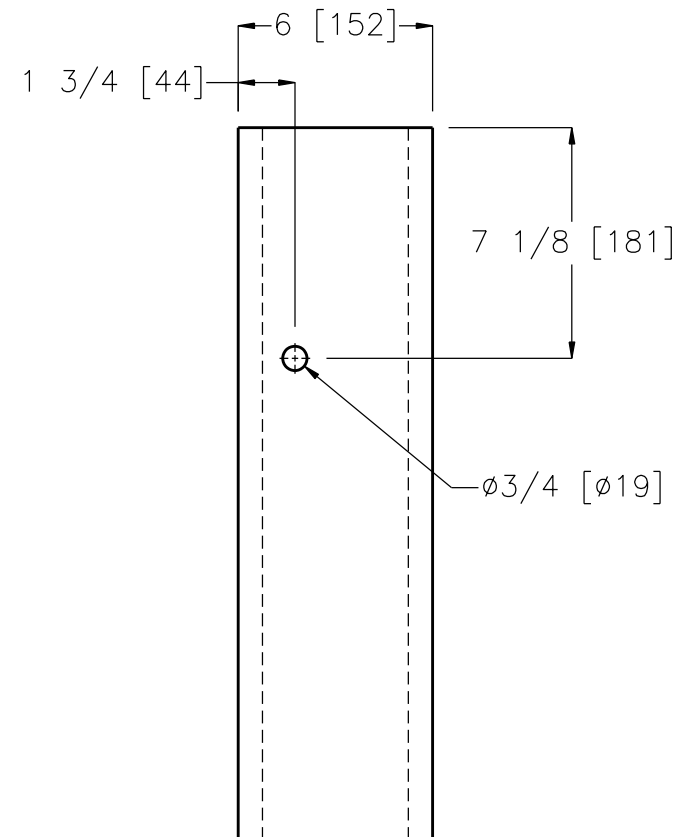


ELEVATION VIEW

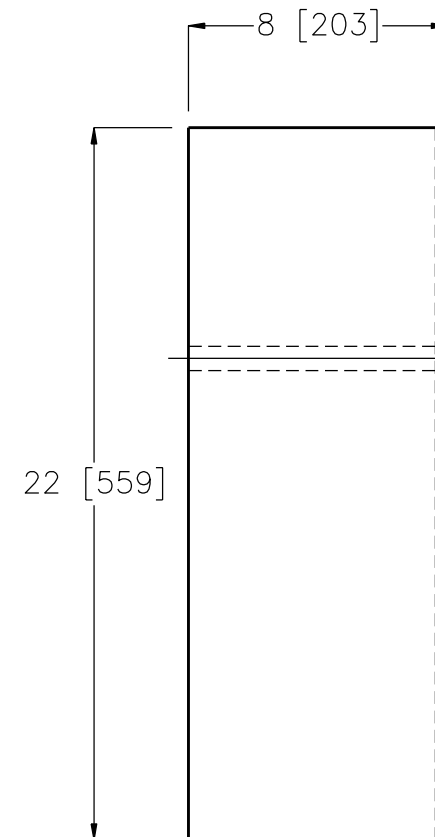
Part e1



PROFILE VIEW



ELEVATION VIEW



PROFILE VIEW

Part e2  
SCALE 1:8



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Modified Midwest  
Guardrail System

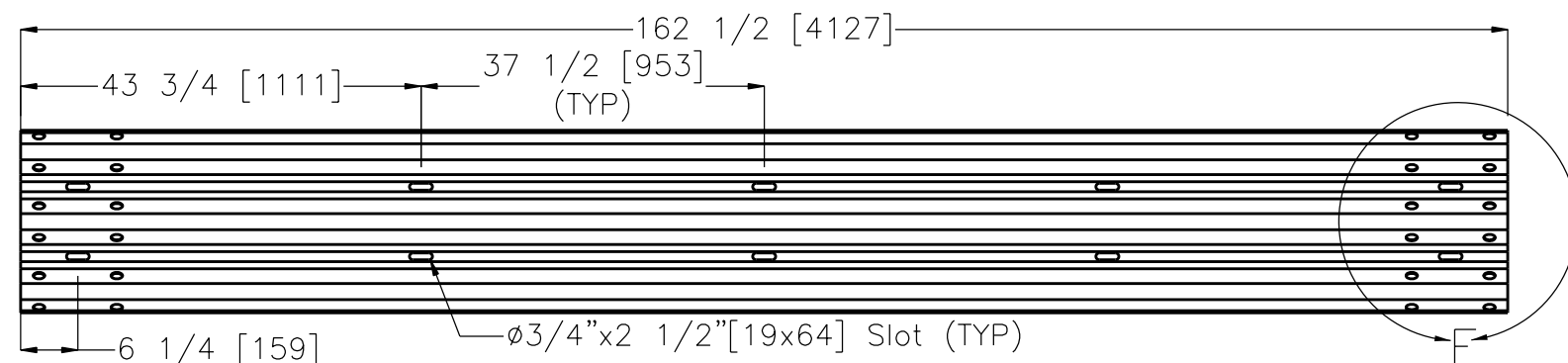
Post Nos. 3 thru 26

Rating: FS30 P1

DATE:  
12/8/2017

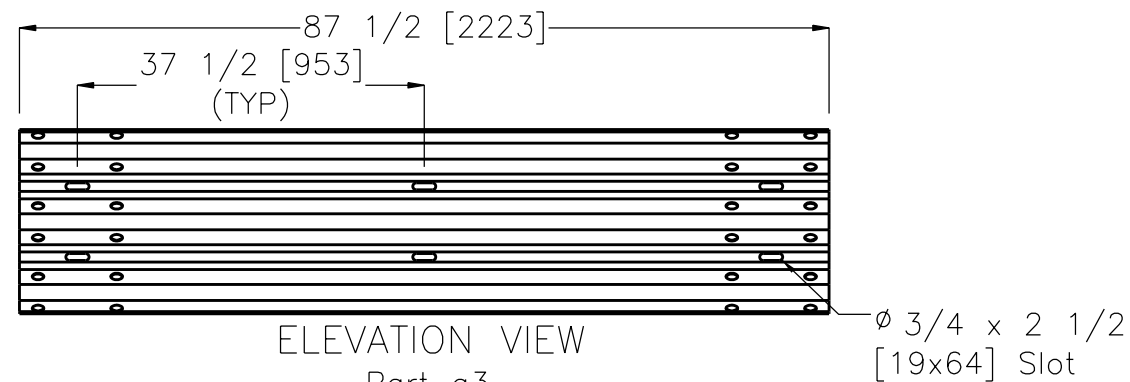
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SHEET  
12 of 16



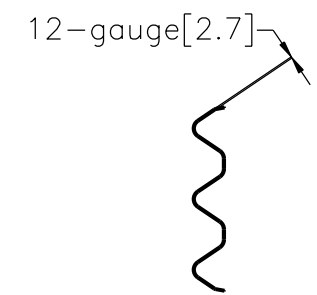
ELEVATION VIEW

Part a1

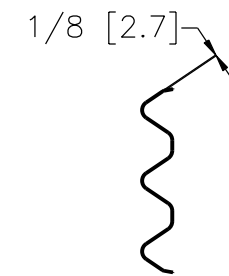


ELEVATION VIEW

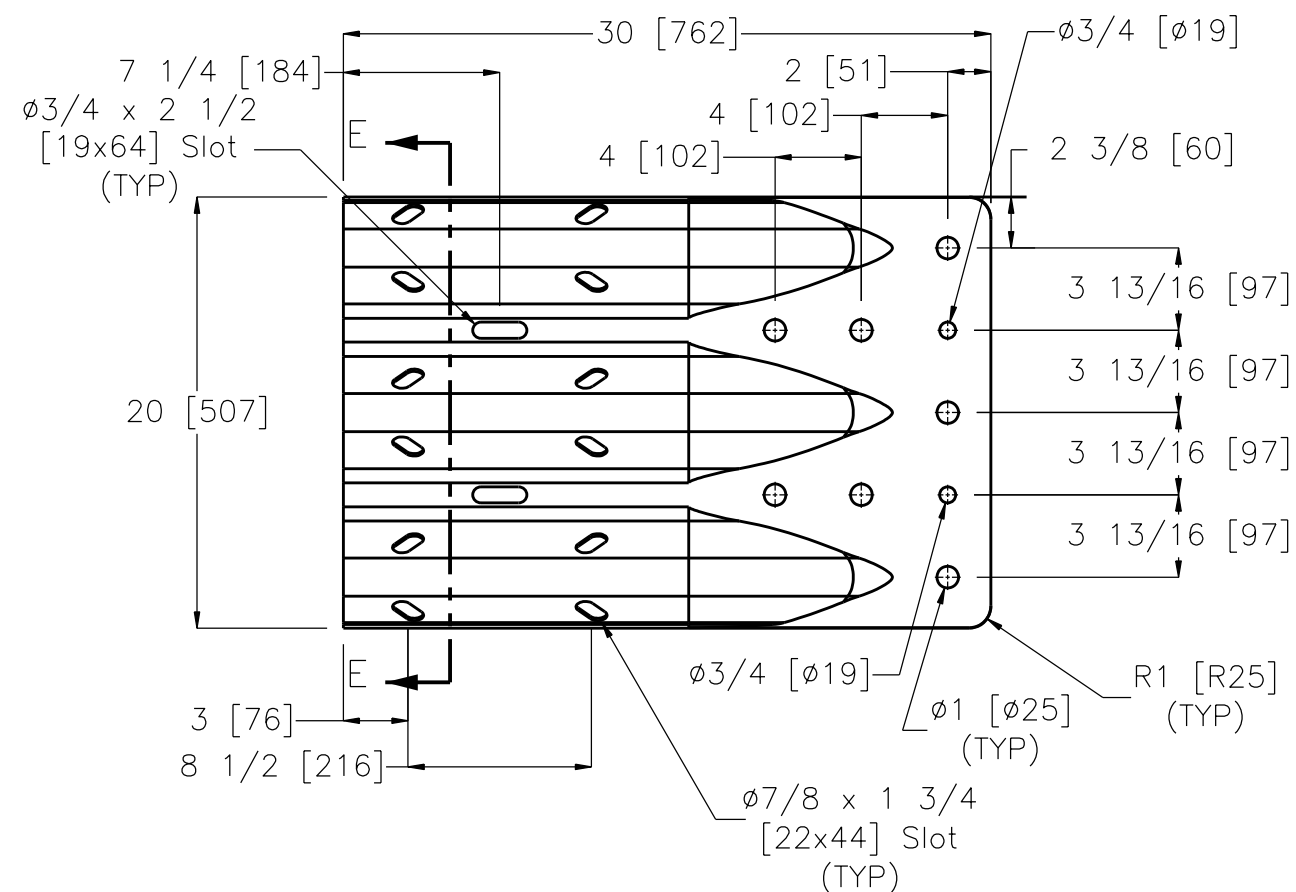
Part a3



PROFILE VIEW



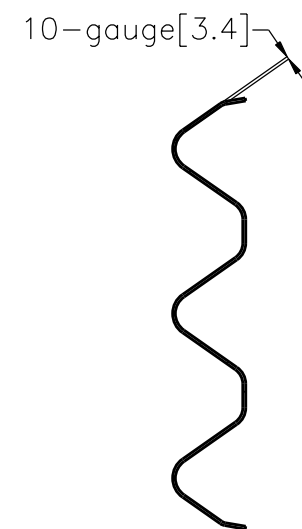
PROFILE VIEW



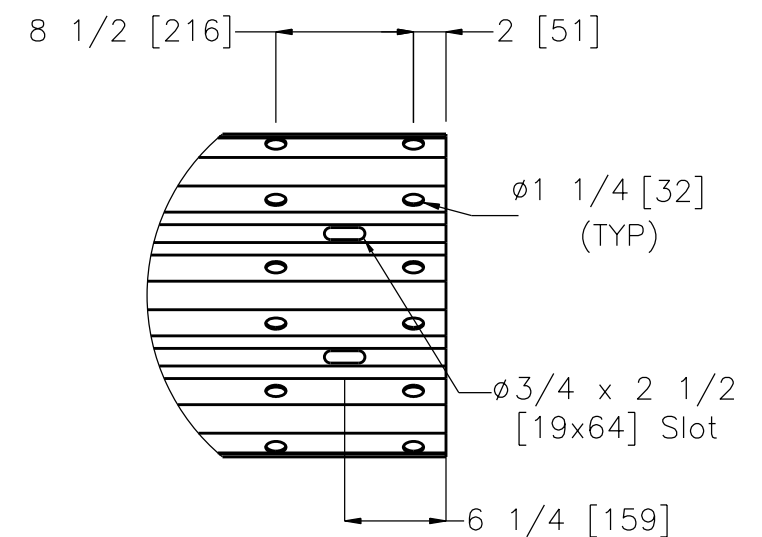
ELEVATION VIEW

Part a2

SCALE 1:12



SECTION E-E  
SCALE 1 : 12



DETAIL F  
SCALE 1 : 16

Note: (1) A drift pin may be used to attach nested rails. If galvanization is damaged, galvanizing spray may be used to ensure proper rust protection.



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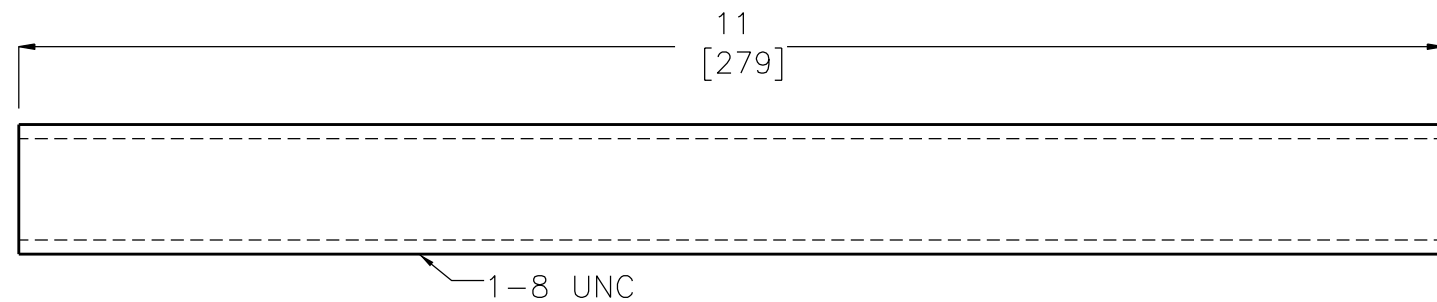
## Modified Midwest Guardrail System Rail Details

Rating: FS30 P1

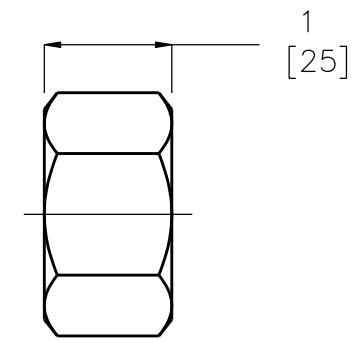
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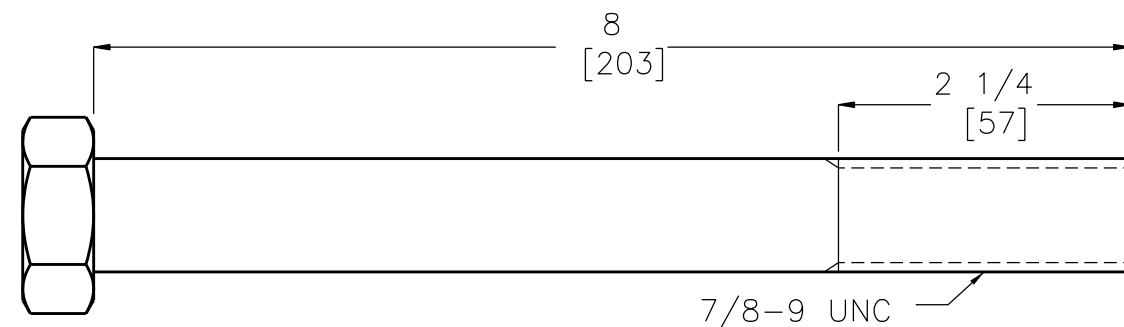
SHEET  
13 of 16



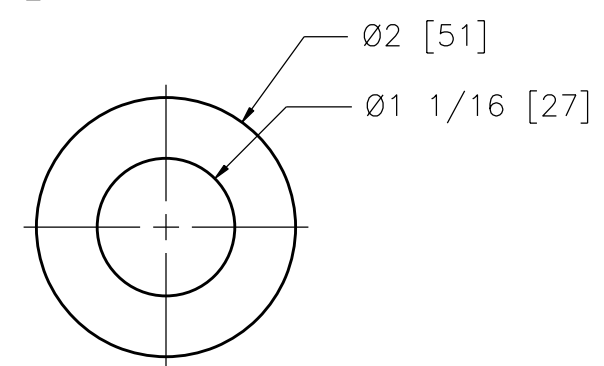
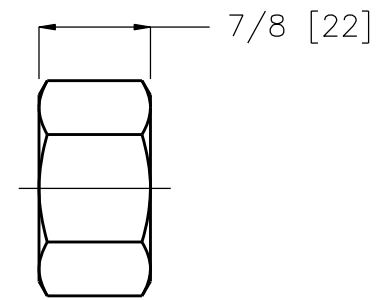
Part f1



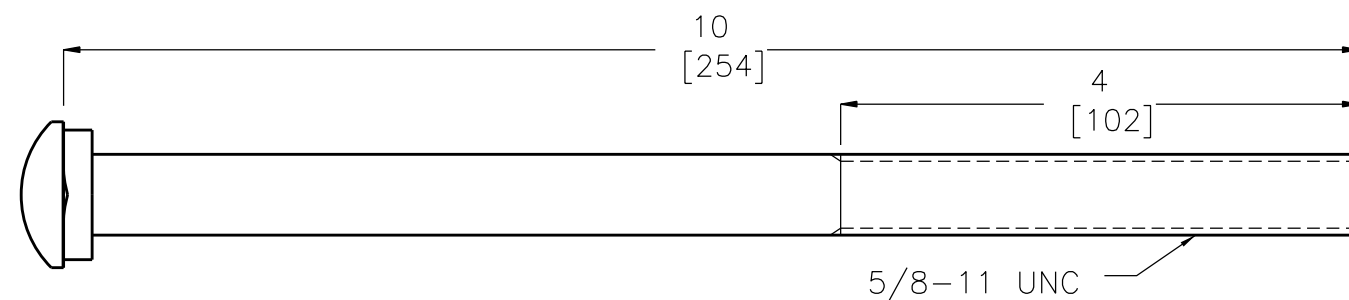
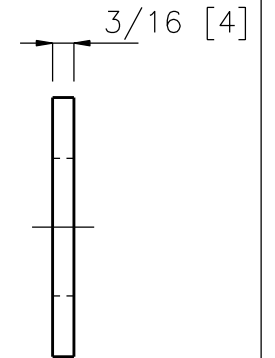
Part f2



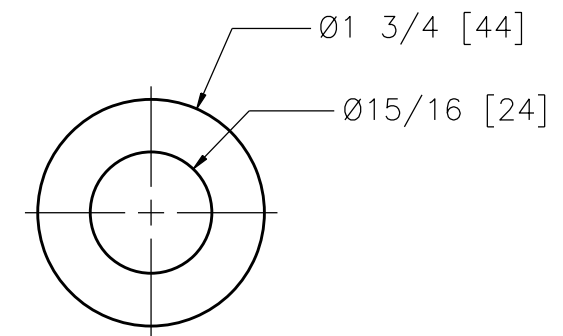
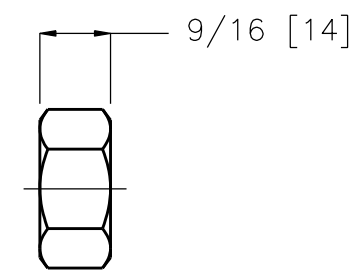
Part f4



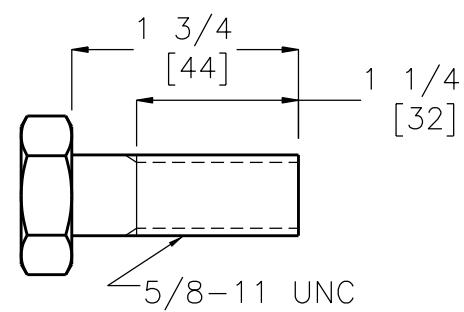
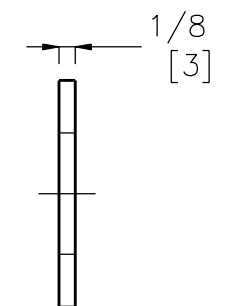
Part f3



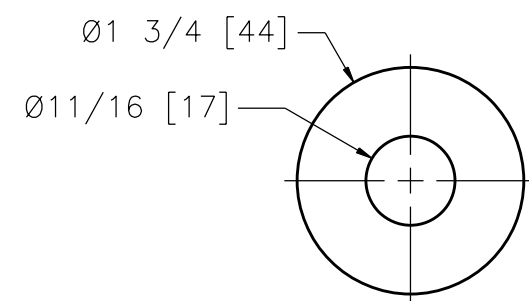
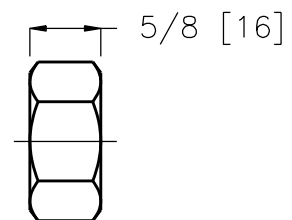
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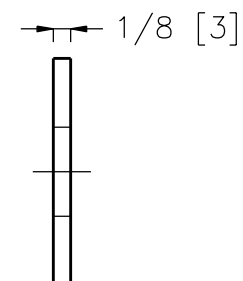
Part f8



Part f6



Part f7



Military Surface Deployment  
and  
Distribution Command  
Transportation Engineering Agency

Modified Midwest  
Guardrail System

Hardware

Rating: FS30 P1

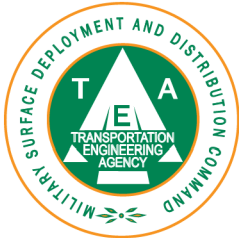
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12/8/2017

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Item No.	QTY.	Description	Material Specification	Treatment Specification	Hardware Guide
a1	26	12'-6" [3,810] 12-gauge [2.7] Thrie Beam Section, Half Post Spacing	AASHTO M180	ASTM A123 or A653	—
a2	4	10-gauge [3.4] Thrie Beam Terminal Connector	AASHTO M180 Min. tensile strength = 70 ksi [482.6 Mpa]	ASTM A123 or A653	RTE01b
a3	2	6'-3" [1,905] 12-gauge [2.7] Thrie Beam Section, Half Post Spacing	AASHTO M180	ASTM A123 or A653	—
b1	2	78"x54"x18" [1,981x1,372x457] Reinforced Concrete Anchor Block	Min. f'c = 4,000 psi [27.6 MPa]	—	—
b2	2	36" [914] Dia. Concrete Anchor, 102" [2,591] Long	Min. f'c = 4,000 psi [27.6 MPa]	—	—
b3	32	#8 [25] Straight Rebar, 114" [2,896] Long	ASTM A615 Gr. 60	Epoxy Coated (ASTM A775 or A934)	—
b4	16	#5 [16] Anchorage Stirrup, 140 3/4" [3,575] Long Unbent	ASTM A615 Gr. 60	Epoxy Coated (ASTM A775 or A934)	—
b5	24	#5 [16] Straight Rebar, 74" [1,880] Long	ASTM A615 Gr. 60	Epoxy Coated (ASTM A775 or A934)	—
b6	34	#4 [13] Anchor Hoop Rebar with 32" [813] Dia., 122" [3,099] Long Unbent	ASTM A615 Gr. 60	Epoxy Coated (ASTM A775 or A934)	—
c1	2	HSS 6"x12"x1/4" [152x305x6] Tube, 38 1/2" [978] Long	ASTM A500 Gr. B	ASTM A123*	—
c2	2	HSS 6"x4"x5/16" [152x102x8] Tube, 46" [1,168] Long	ASTM A500 Gr. B	ASTM A123*	—
c3	2	14"x14"x1/2" [356x356x13] Steel Plate	ASTM A36 or A572 Gr. 50	ASTM A123*	—
c4	2	16"x12"x1/2" [406x305x13] Steel Plate	ASTM A36 or A572 Gr. 50	ASTM A123*	—
c5	2	11 1/2"x5 1/2"x1/2" [292x140x13] Steel Plate	ASTM A36 or A572 Gr. 50	ASTM A123*	—
d1	2	Pipe 6 [152] xx—Stong Pipe, 38" [965] Long	ASTM A53 Gr. B	ASTM A123*	—
d2	2	Pipe 4 [102] xx—Stong Pipe, 34 11/16" [881] Long	ASTM A53 Gr. B	ASTM A123*	—
d3	2	14"x14"x1/2" [356x356x13] Steel Plate	ASTM A36 or A572 Gr. 50	ASTM A123*	—
d4	2	12"x11"x1/2" [305x279x13] Steel Plate	ASTM A36 or A572 Gr. 50	ASTM A123*	—
e1	25	W6x9 [W152x13.4], 84" [2,134] Long Steel Post	ASTM A992	ASTM A123	—
e2	25	6"x8"x22" [152x203x559] Timber Blockout	SYP Grade No. 1 or better	—	—
* Galvanize after welding					Modified Midwest Guardrail System
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Bill of Materials					

Item No.	QTY.	Description	Material Specification	Treatment Specification	Hardware Guide
f1	36	1" [25] Dia. UNC, 11" [279] Long Threaded Rod	ASTM A449 or A354 Gr. BC or A193 Gr. B7	ASTM A153 or B633 or B695 Class 55 or F1941 or F2329	FRR24b
f2	36	1" [25] Dia. Heavy Hex Nut	ASTM A563DH or A194 Gr. 2H	ASTM A153 or B633 or B695 Class 55 or F1941 or F2329	FNX24b
f3	36	1" [25] Dia. Hardened Flat Washer	ASTM F436	ASTM A153 or B695 Class 55 or F1136 Gr. 3 or F2329	FWC24b
f4	14	7/8" [22] Dia., 8" [203] Long Heavy Hex Head Bolt	Bolt – ASTM F3125 Gr. A325 Type 1 Nut – ASTM A563DH	ASTM A153 or B695 Class 55 or F1136 Gr. 3 or F2329 or F2833 Gr. 1	FBX22b
f5	25	5/8" [16] Dia. UNC, 10" [254] Long Guardrail Bolt and Nut	Bolt – ASTM A307 Gr. A Nut – ASTM A563A	ASTM A153 or B695 Class 55 or F2329	FBB03
f6	180	5/8" [16] Dia. UNC, 1 3/4" [44] Long Heavy Hex Bolt and Nut	Bolt – ASTM F3125 Gr. A325 Type 1 Nut – ASTM A563DH	ASTM A153 or B695 Class 55 or F1136 Gr. 3 or F2329 or F2833 Gr. 1	FBX16b
f7	360	5/8" [16] Dia. Plain Round Washer	ASTM F844	ASTM A123 or A153 or F2329	FWC16a
f8	14	7/8" [22] Dia. Hardened Flat Washer	ASTM F436	ASTM A153 or B695 Class 55 or F1136 Gr. 3 or F2329	FWC22b
–	–	Epoxy Adhesive	Min. Bond Strength = 1,305 psi [9.0 MPa]	–	–
<div><div><div></div><div><div>Military Surface Deployment and Distribution Command Transportation Engineering Agency</div></div></div><div><div>Modified Midwest Guardrail System</div><div>Bill of Materials</div><div>Rating: FS30 P1</div><div><div>DATE: 12/8/2017</div><div>UNITS: in[mm]</div><div>SHEET 16 of 16</div></div></div></div>					