

- Note: (1) Test shall be performed according to test designation no. 3-11 of MASH criteria.  
 (2) The impact location is 132" [3,353] upstream of the splice at post no. 19.  
 (3) BCT anchors are placed in  $\phi 3'$  [914] holes, then backfilled and tamped with soil.  
 (4) Critical region is between post nos. 13 and 29.



Midwest Roadside Safety Facility

MGS Strong Post on Culvert  
 Test No. CMGS-2

System Layout

DWG. NAME:  
 WI\_MGS\_on\_Culvert-2\_R2

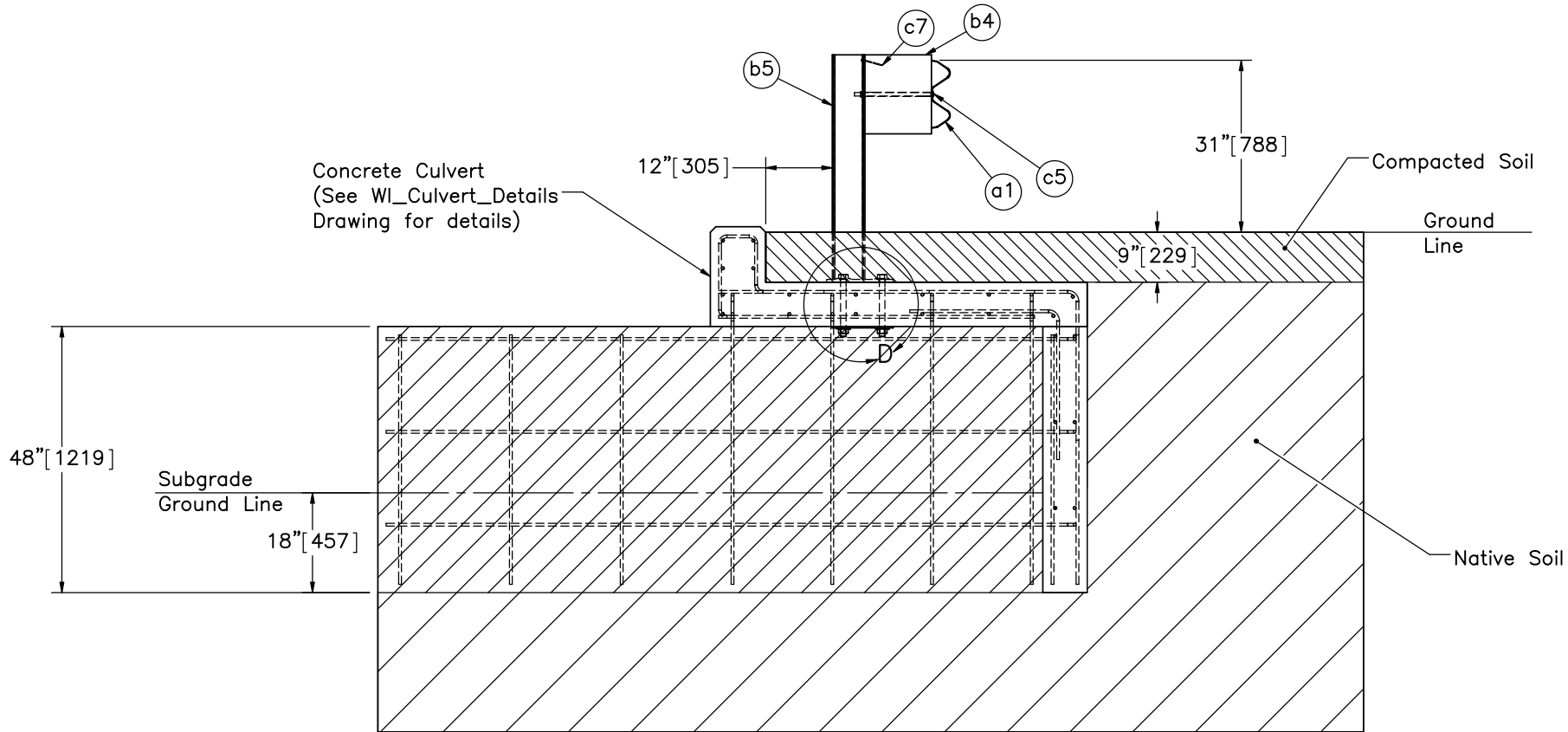
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 UNITS: in.[mm]

SHEET:  
 1 of 18

DATE:  
 11/22/2017

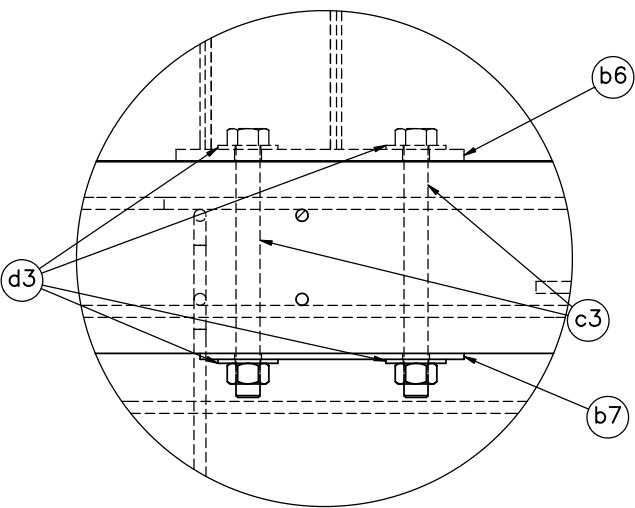
DRAWN BY:  
 MES/JEK/  
 DTM

REV. BY:  
 RWB




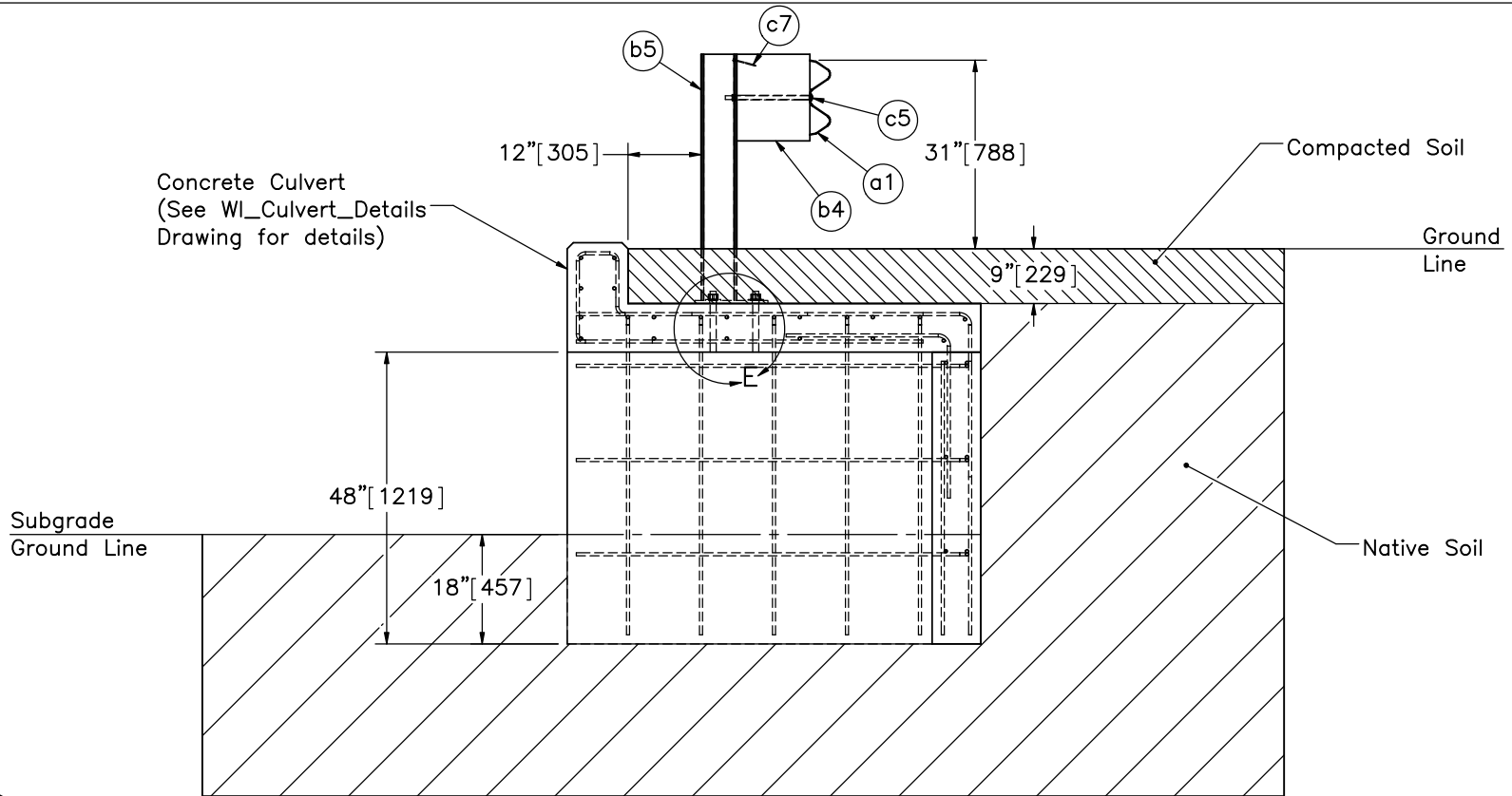
SECTION A-A  
 Post Nos. 13-15, 17-22  
 & 24-26

Note: (1) A 1" [25] dia., 12" [305] long threaded rod was substituted for bolt c3 at post nos. 14, 15, 17, 18, 21, 22, 24, and 25 to allow for proper installation in areas with deck sag.

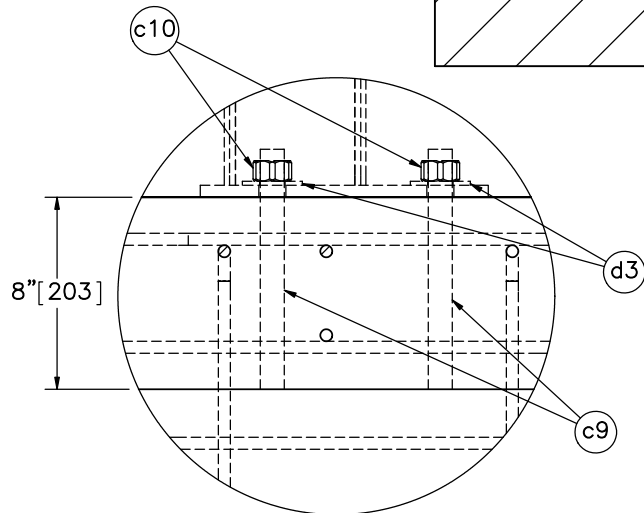


DETAIL D  
 SCALE 1 : 8

	MGS Strong Post on Culvert Test No. CMGS-2		SHEET: 2 of 18
	Post Nos. 13-15, 17-22 & 24-26 Detail		DATE: 11/22/2017
Midwest Roadside Safety Facility		DWG. NAME: WL_MGS_on_Culvert-2_R2	DRAWN BY: MES/JEK/ DTM
		SCALE: 1:30 UNITS: in.[mm]	REV. BY: RWB



SECTION B-B  
Post Nos. 16 & 23



DETAIL E  
SCALE 1 : 8

- Note: (1) Posts nos. 16 and 23 are epoxied in the concrete culvert at a depth of 8" [203] with Powers Fasteners AC100+ Gold epoxy or an equivalent epoxy with a minimum bond strength of 1,305 psi [9.0 MPa].  
 (2) The holes for the 1" [25] threaded rods (part c9) that interface only with the 8" [203] concrete deck need to be taped on the bottom side of the deck to retain the epoxy in the hole.



Midwest Roadside  
Safety Facility

MGS Strong Post on  
Culvert  
Test No. CMGS-2

Post Nos. 16 & 23 Detail

DWG. NAME:  
WI\_MGS\_on\_Culvert-2\_R2

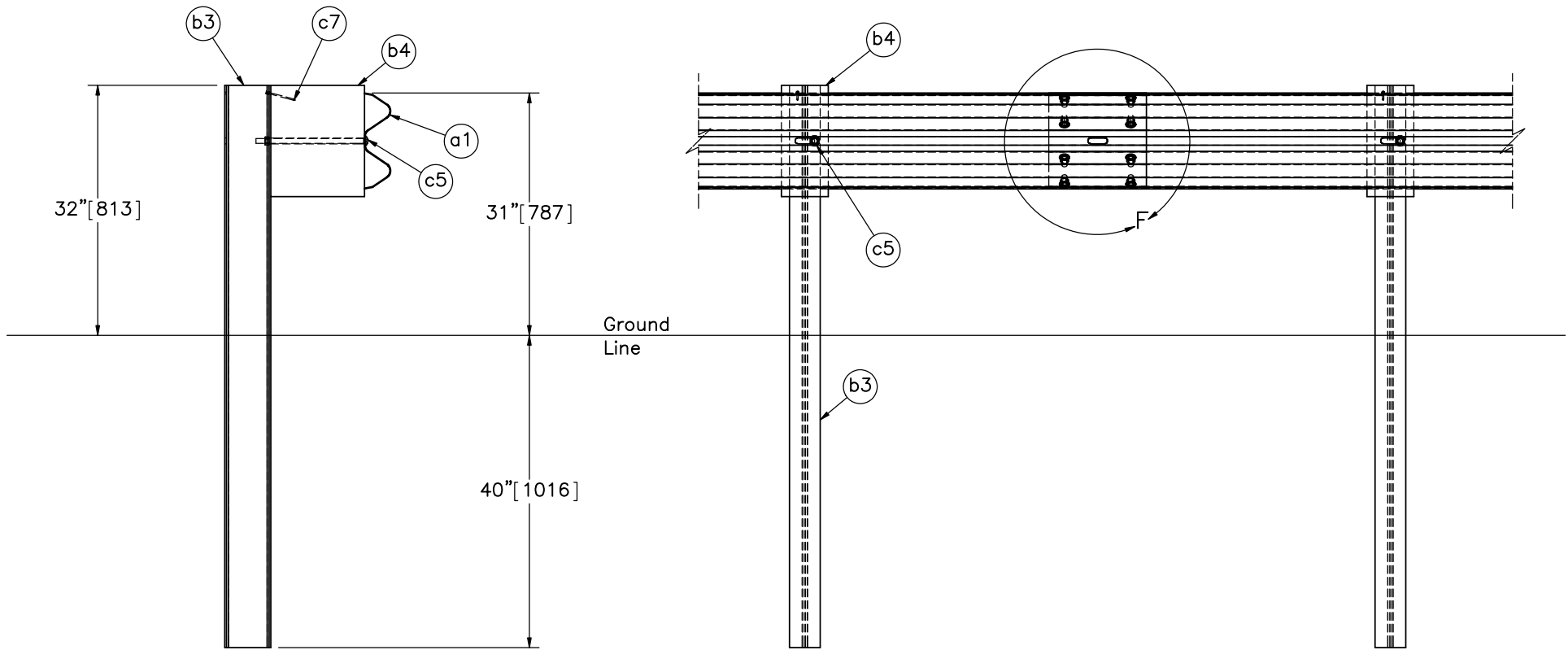
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UNITS: in.[mm]

SHEET:  
3 of 18

DATE:  
11/22/2017

DRAWN BY:  
MES/JEK/  
DTM

REV. BY:  
RWB

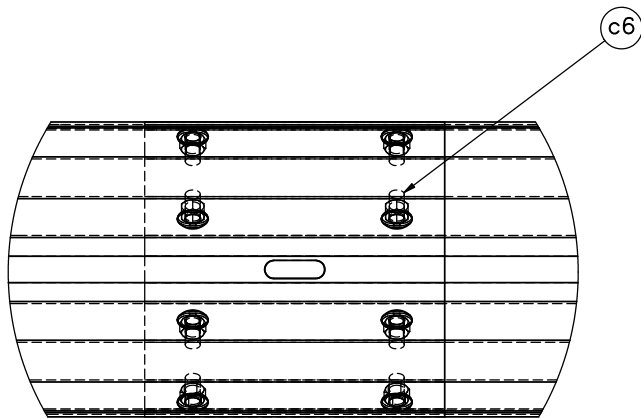


SECTION C-C

Post No. 4

Post No. 3

SPLICE DETAIL  
FRONT SIDE



DETAIL F  
SCALE 1 : 8

Note: (1) Guardrail bolts (part c5) on the upstream side of the web.



Midwest Roadside  
Safety Facility

MGS Strong Post on  
Culvert  
Test No. CMGS-2

Splice and Post Detail

DWG. NAME.  
WL\_MGS\_on\_Culvert-2\_R2

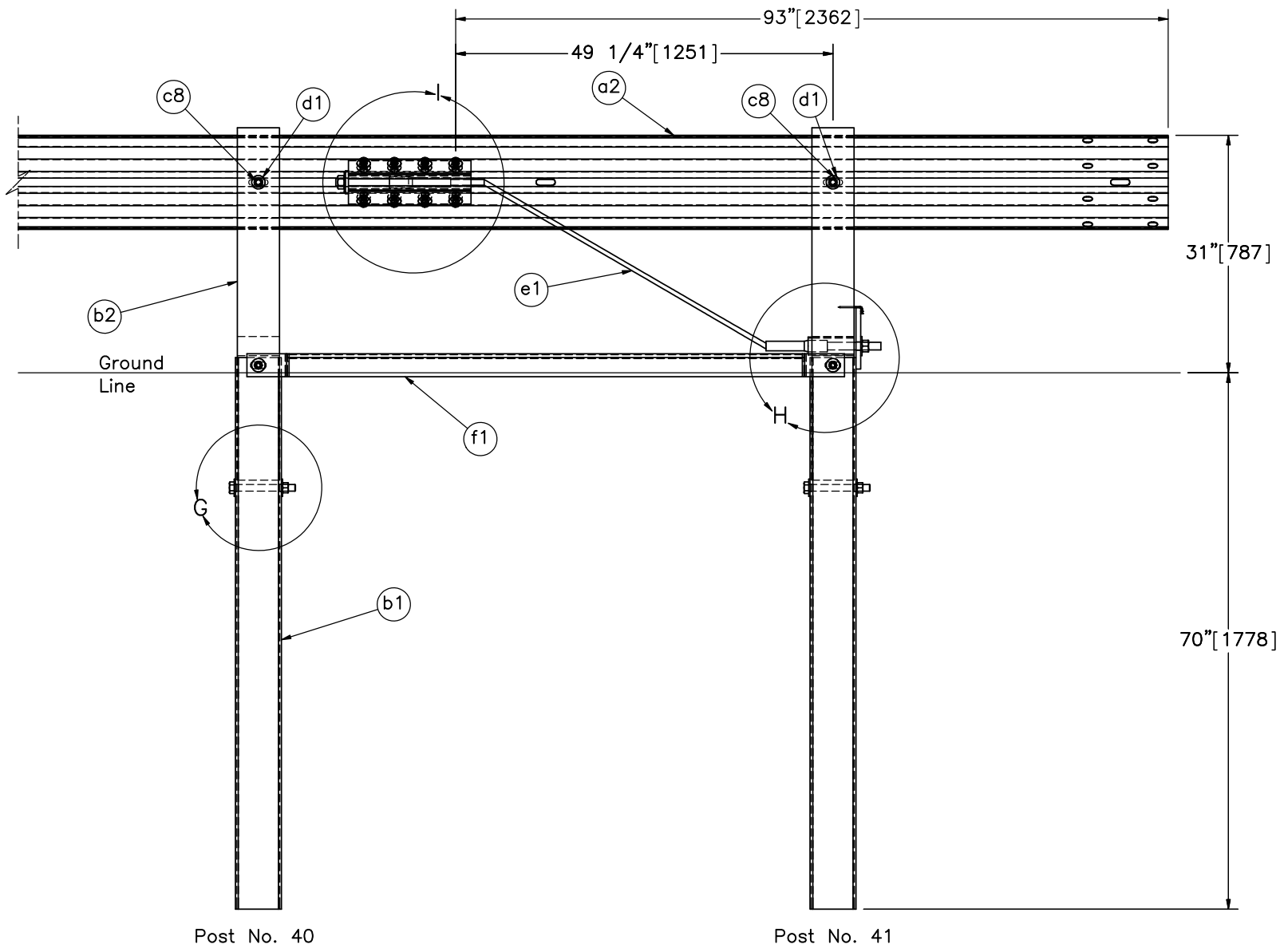
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UNITS: in.[mm]

SHEET:  
4 of 18

DATE:  
11/22/2017

DRAWN BY:  
MES/JEK/  
DTM

REV. BY:  
RWB



Post No. 40

Post No. 41

END SECTION DETAIL  
BACKSIDE (TYP)



Midwest Roadside  
Safety Facility

MGS Strong Post on  
Culvert  
Test No. CMGS-2  
End Section Details

DWG. NAME:  
WL\_MGS\_on\_Culvert-2\_R2

SCALE: 1:20  
UNITS: in.[mm]

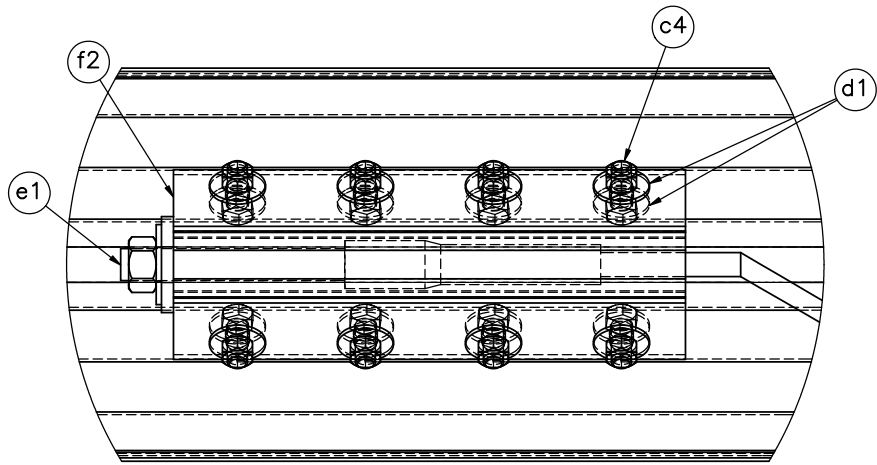
SHEET:  
5 of 18

DATE:  
11/22/2017

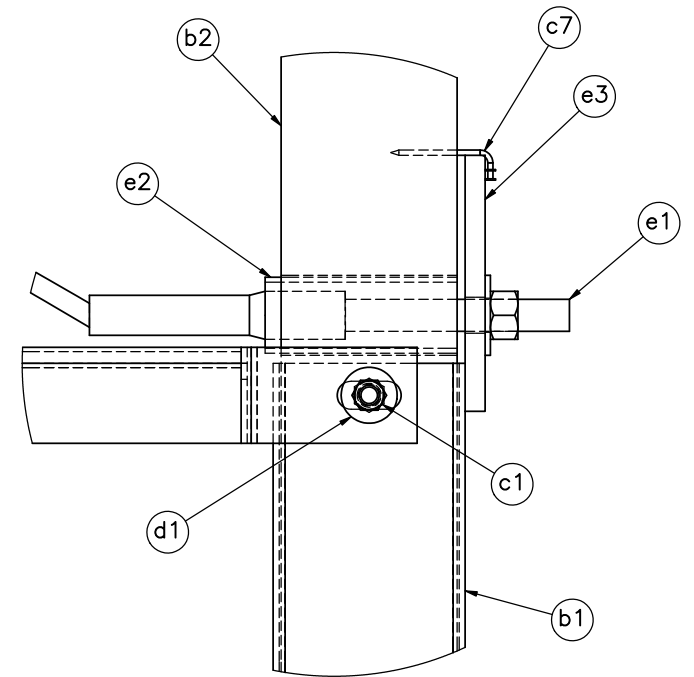
DRAWN BY:  
MES/JEK/  
DTM

REV. BY:  
RWB

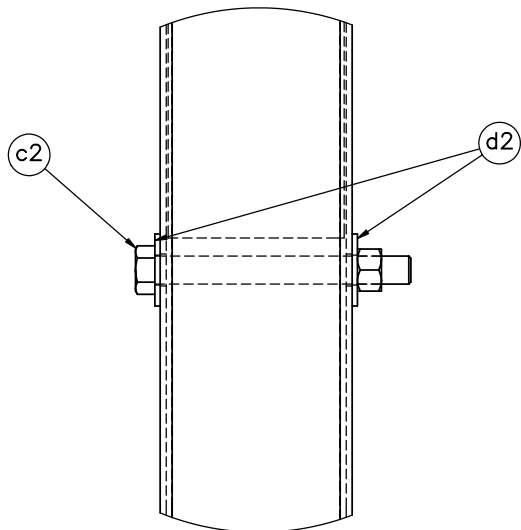
Note: (1) Downstream end section (post nos. 1 & 2) is mirrored.



DETAIL I



DETAIL H



DETAIL G

Note: (1) Additional washer (part d1) on the opposite side under the head of bolt (part c1).



Midwest Roadside  
Safety Facility

MGS Strong Post on  
Culvert  
Test No. CMGS-2

BCT Anchor Details

DWG. NAME.  
WL\_MGS\_on\_Culvert-2\_R2

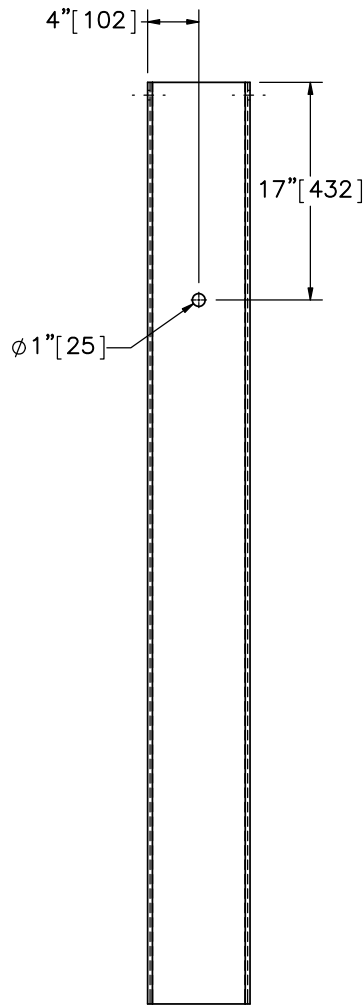
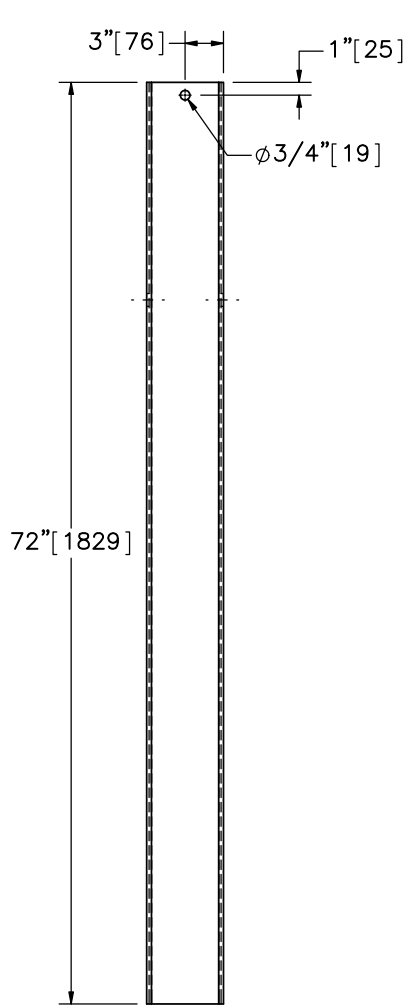
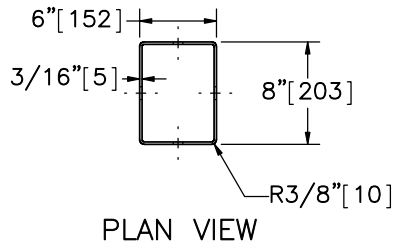
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SHEET:  
6 of 18

DATE:  
11/22/2017

DRAWN BY:  
MES/JEK/  
DTM

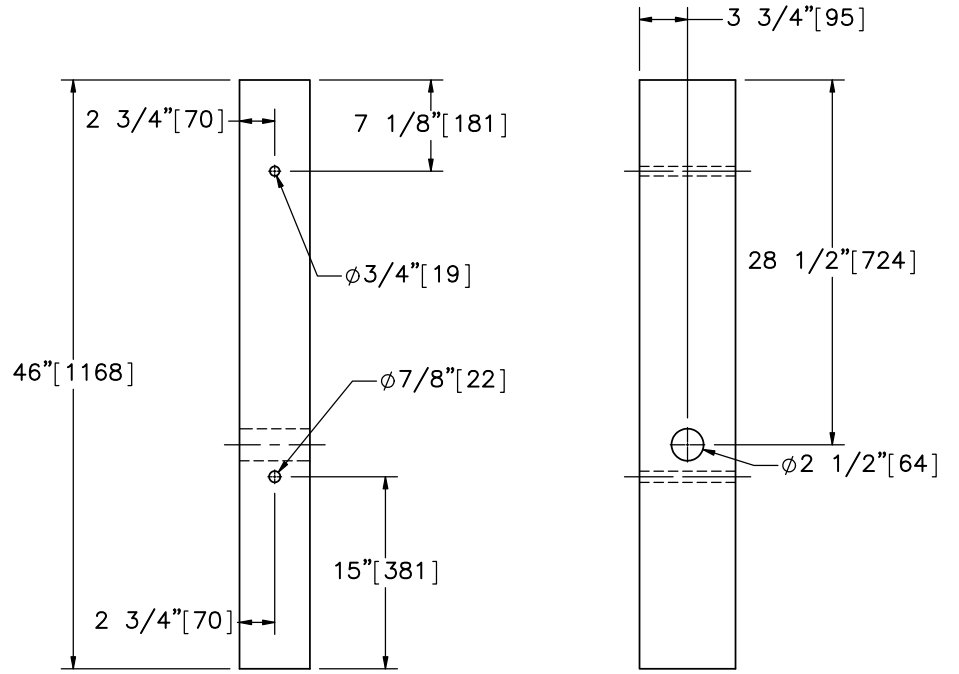
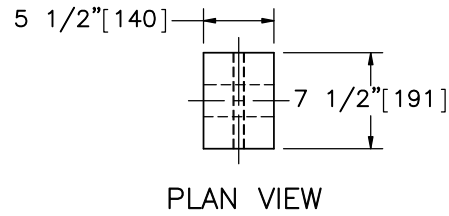
REV. BY:  
RWB



ELEVATION VIEW

PROFILE VIEW

Part b1



ELEVATION VIEW

PROFILE VIEW

Part b2



Midwest Roadside  
Safety Facility

MGS Strong Post on  
Culvert  
Test No. CMGS-2

Foundation Tube and BCT  
Timber Post Details

DWG. NAME:  
WL\_MGS\_on\_Culvert-2\_R2

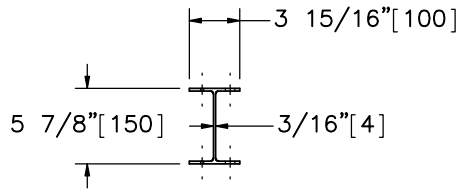
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SHEET:  
7 of 18

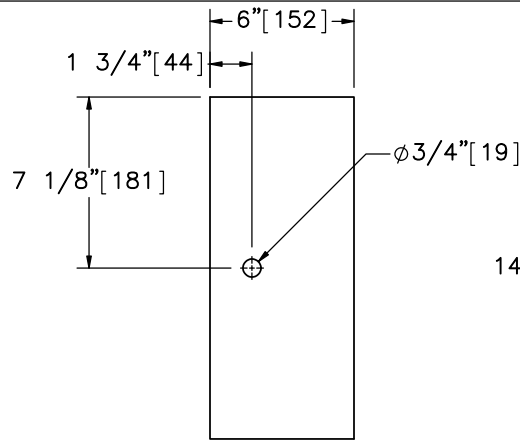
DATE:  
11/22/2017

DRAWN BY:  
MES/JEK/  
DTM

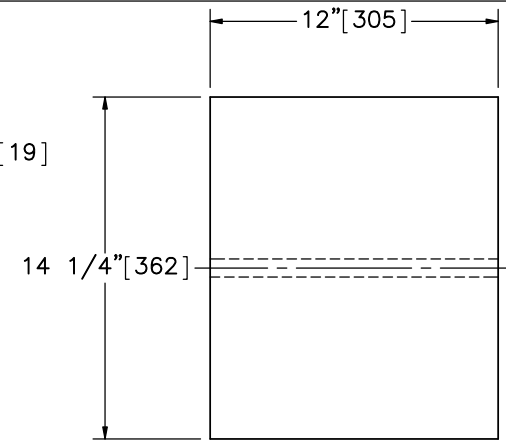
REV. BY:  
RWB



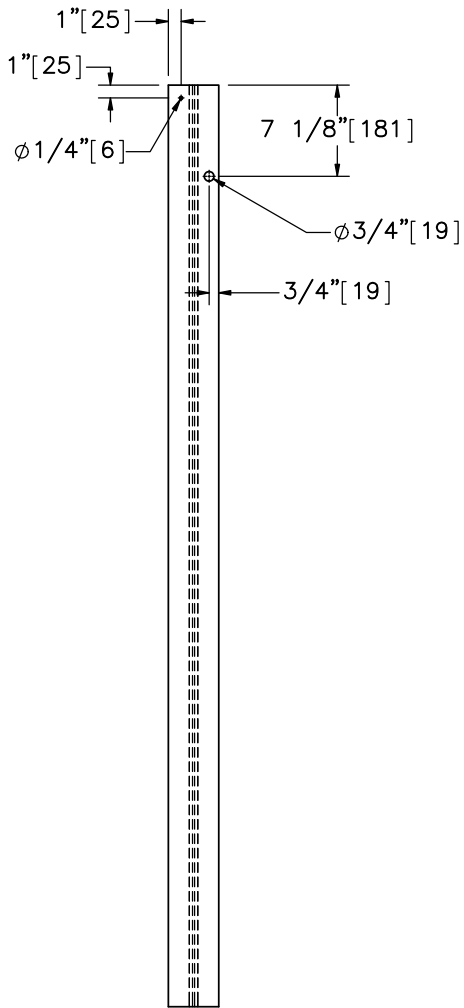
PLAN VIEW



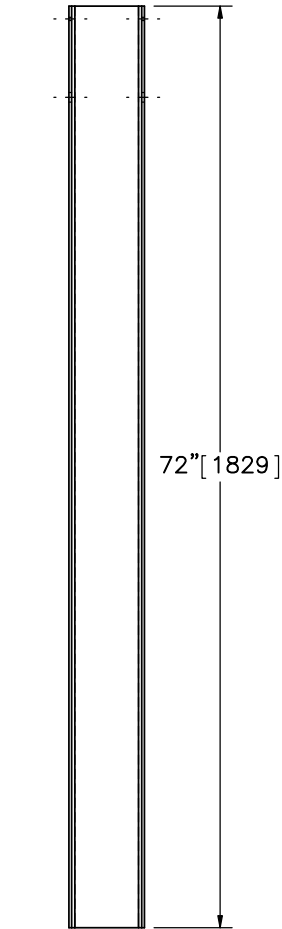
ELEVATION VIEW



PROFILE VIEW



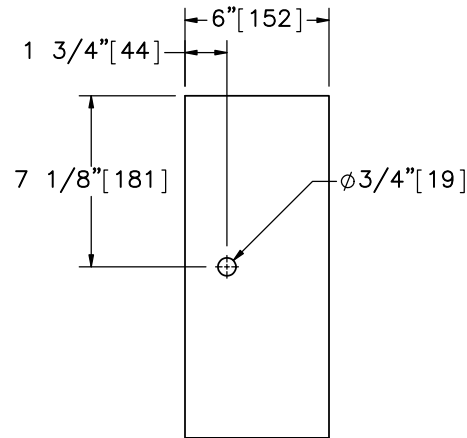
ELEVATION VIEW



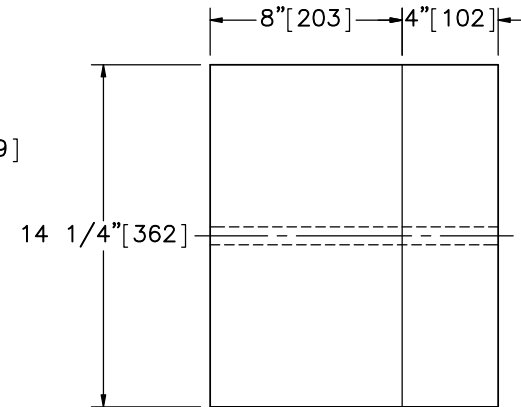
PROFILE VIEW

Part b3

Part b4  
SCALE 1:8



ELEVATION VIEW



PROFILE VIEW

SCALE 1:8

Alternate Blockout Option –  
6"x4"x14 1/4" [152x102x362] Blockout  
with 6"x8"x14 1/4" [152x203x362] Blockout



Midwest Roadside  
Safety Facility

MGS Strong Post on  
Culvert  
Test No. CMGS-2

Post Nos. 1-12 & 27-41  
Components

DWG. NAME:  
WL\_MGS\_on\_Culvert-2\_R2

SCALE: 1:15  
UNITS: in.[mm]

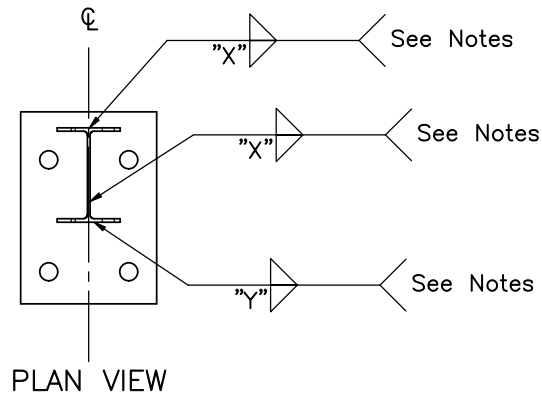
SHEET:  
8 of 18

DATE:  
11/22/2017

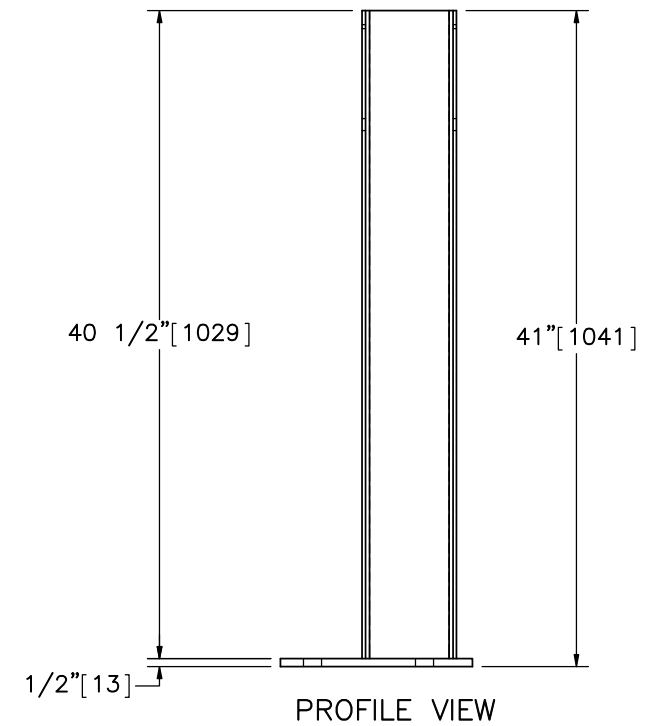
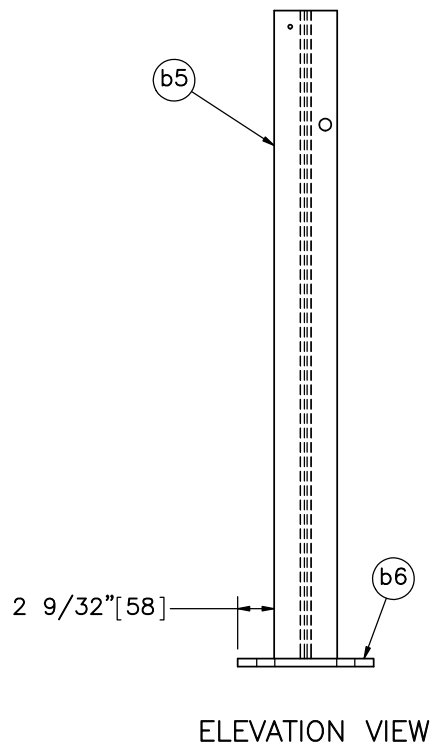
DRAWN BY:  
MES/JEK/  
DTM

REV. BY:  
RWB





Weld, "X" in. [mm]	Weld, "Y" in. [mm]
1/4" [6] – Single Pass	5/16" [8] – Triple Pass



Notes: (1) Welding is to be completed using the Gas-Metal Arc Welding (GMAW) process with ER70S-3 welding wire and argon oxygen or CO2 cover gas.  
 (2) Requires certified welder.



Midwest Roadside  
Safety Facility

MGS Strong Post on  
Culvert  
Test No. CMGS-2

Post Nos. 13-26 Assembly  
Details

DWG. NAME:  
WL\_MGS\_on\_Culvert-2\_R2

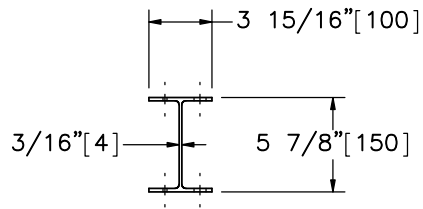
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SHEET:  
9 of 18

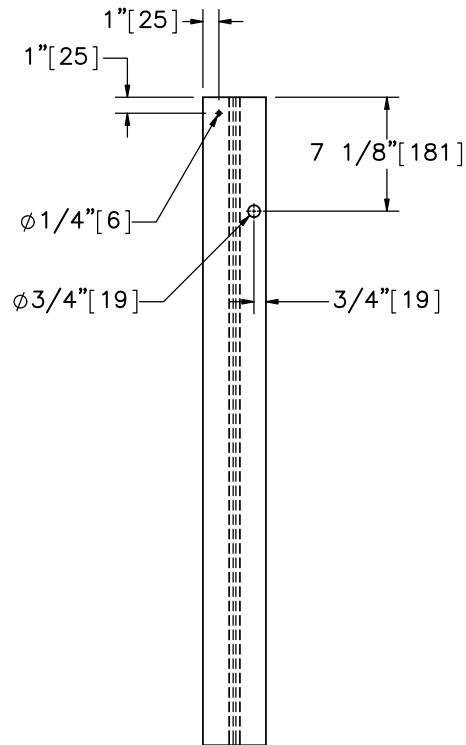
DATE:  
11/22/2017

DRAWN BY:  
MES/JEK/  
DTM

REV. BY:  
RWB

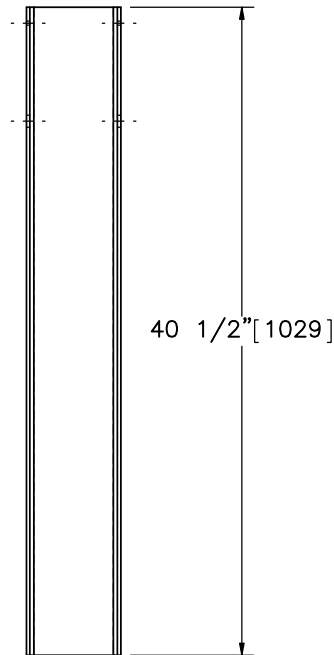


PLAN VIEW

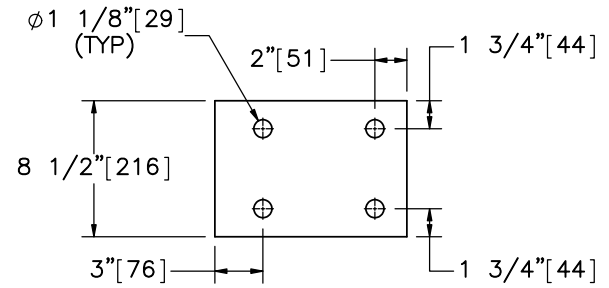


ELEVATION VIEW

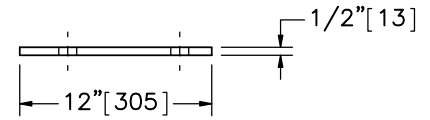
Part b5



PROFILE VIEW

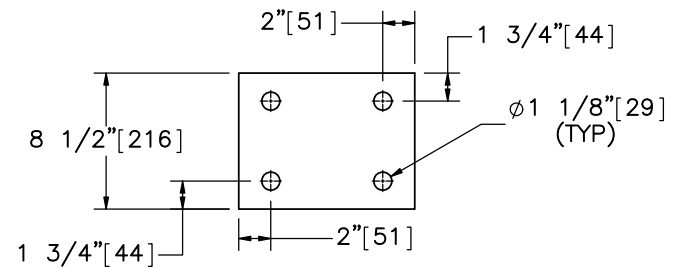


PLAN VIEW

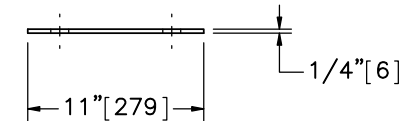


ELEVATION VIEW

Part b6



PLAN VIEW



ELEVATION VIEW

Part b7



Midwest Roadside  
Safety Facility

MGS Strong Post on  
Culvert  
Test No. CMGS-2

Pos Nos. 13-26 Component  
Details

DWG. NAME:  
WL\_MGS\_on\_Culvert-2\_R2

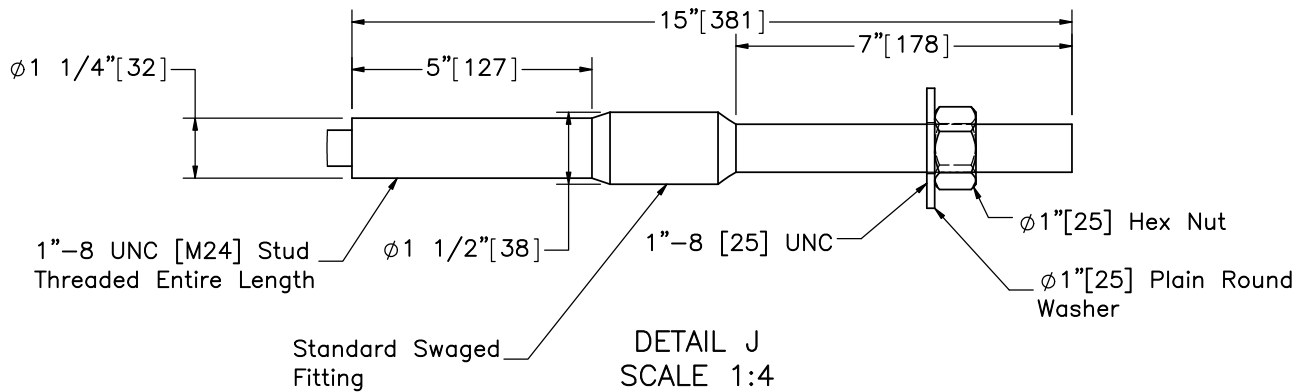
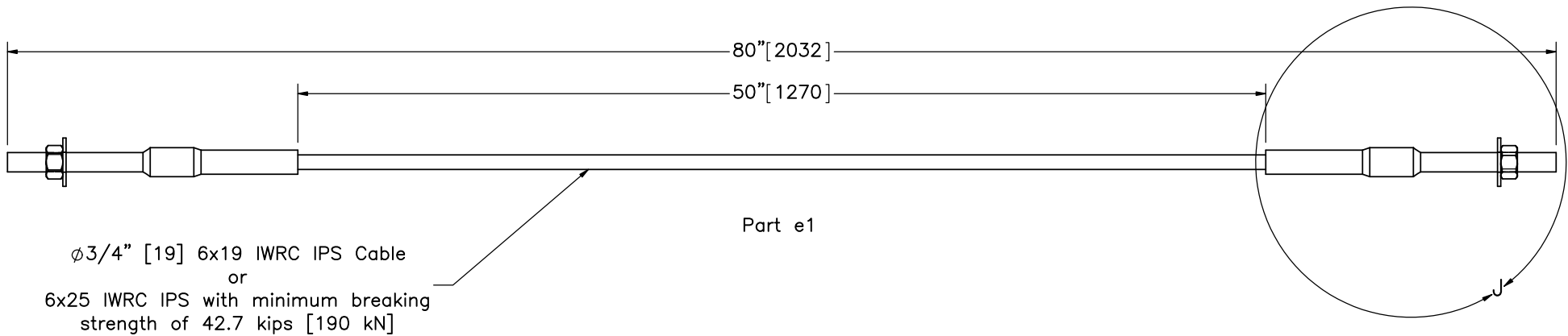
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SHEET:  
10 of 18

DATE:  
11/22/2017

DRAWN BY:  
MES/JEK/  
DTM

REV. BY:  
RWB



Midwest Roadside Safety Facility

MGS Strong Post on Culvert  
Test No. CMGS-2

BCT Anchor Cable

DWG. NAME:  
WL\_MGS\_on\_Culvert-2\_R2

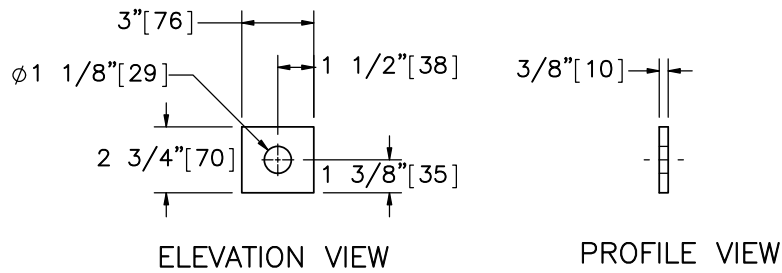
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SHEET:  
11 of 18

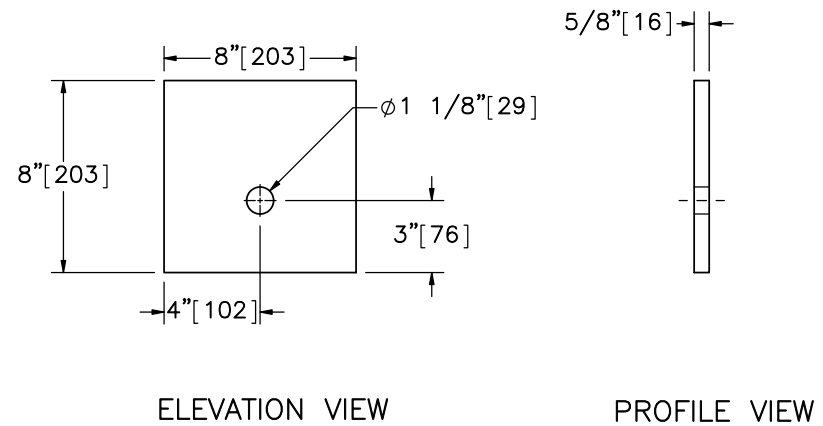
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11/22/2017

DRAWN BY:  
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DTM

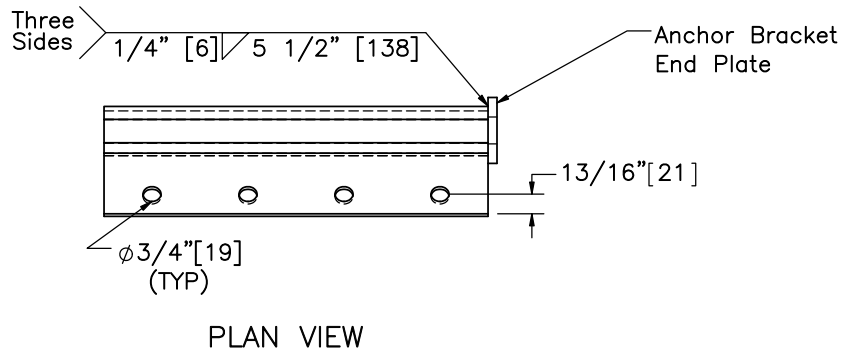
REV. BY:  
RWB



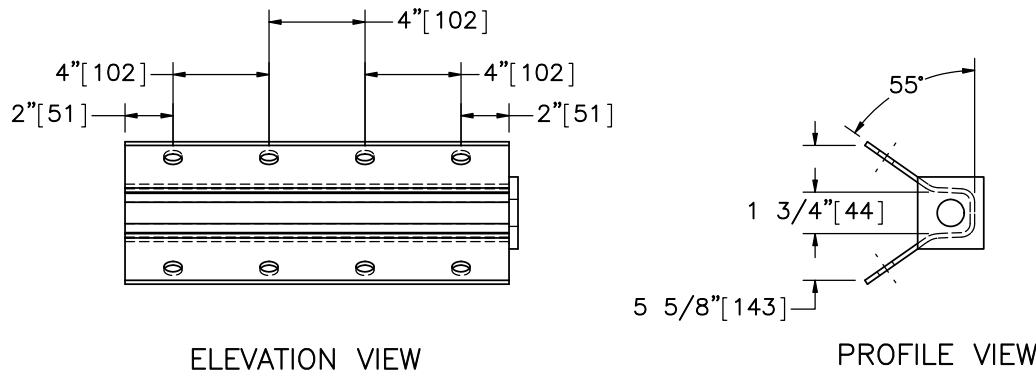
Anchor Bracket End Plate



Part e3

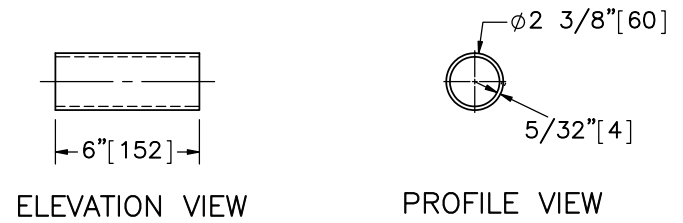


PLAN VIEW



Part f2

PROFILE VIEW



Part e2



Midwest Roadside Safety Facility

MGS Strong Post on Culvert  
Test No. CMGS-2

BCT Post Components & Anchor Bracket

DWG. NAME:  
WL\_MGS\_on\_Culvert-2\_R2

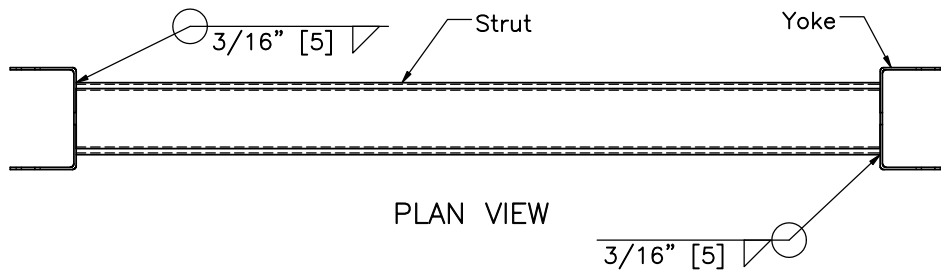
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SHEET:  
12 of 18

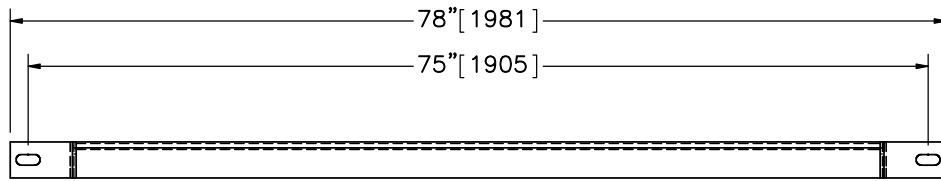
DATE:  
11/22/2017

DRAWN BY:  
MES/JEK/DTM

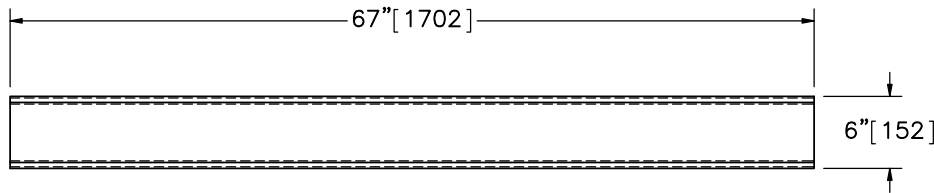
REV. BY:  
RWB



PLAN VIEW

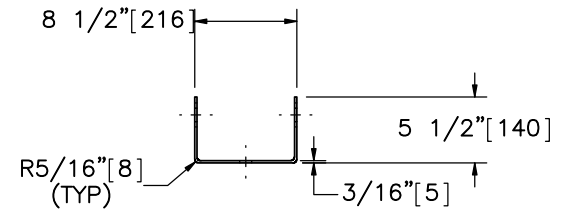


ELEVATION VIEW  
Part f1

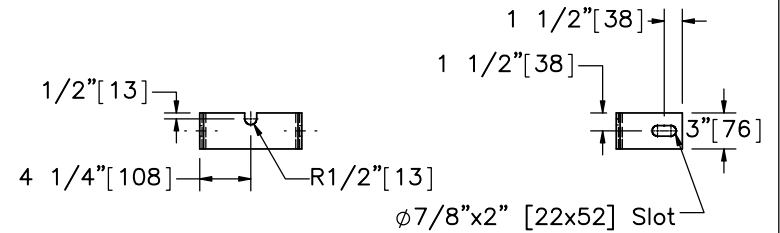


ELEVATION VIEW

6"x3" [152x76] 10 Gauge [3.4] Strut



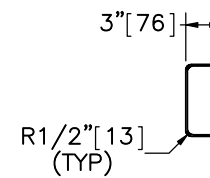
PLAN VIEW



ELEVATION VIEW

PROFILE VIEW

Yoke



PROFILE VIEW



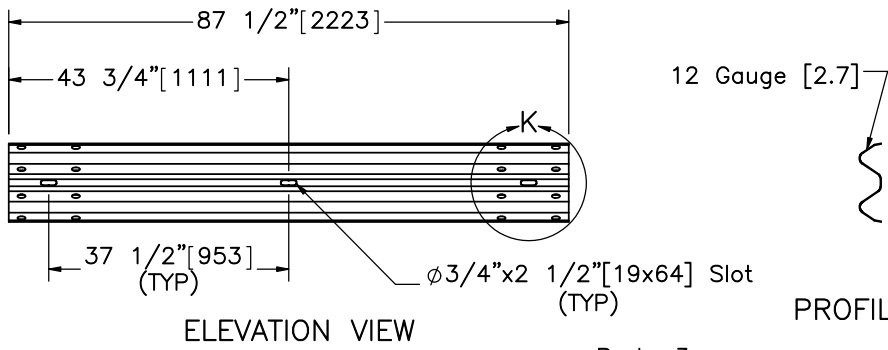
Midwest Roadside  
Safety Facility

MGS Strong Post on  
Culvert  
Test No. CMGS-2  
Ground Strut and Bearing Plate

DWG. NAME.  
WL\_MGS\_on\_Culvert-2\_R2

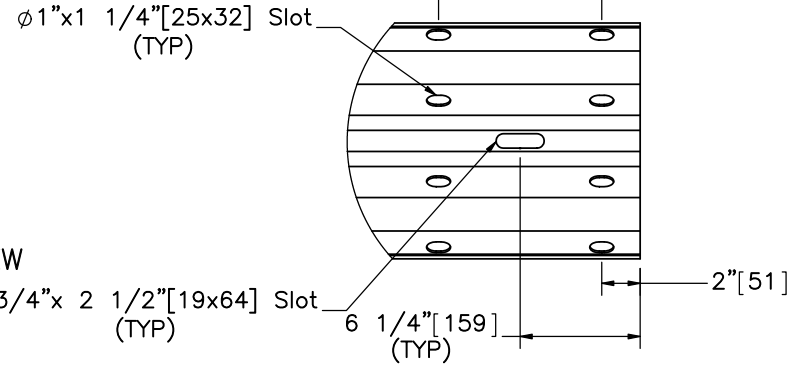
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UNITS: in.[mm]

SHEET:  
13 of 18  
DATE:  
11/22/2017  
DRAWN BY:  
MES/JEK/  
DTM  
REV. BY:  
RWB



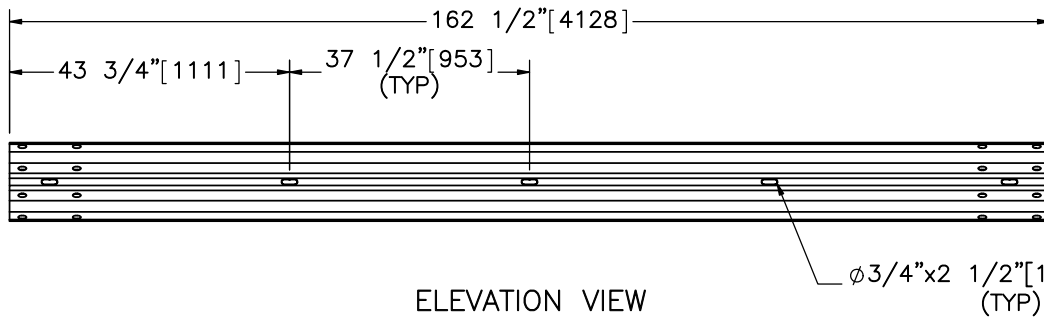
ELEVATION VIEW

Part a3



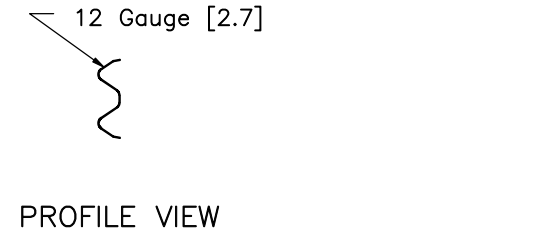
PROFILE VIEW

DETAIL K  
SCALE 1 : 10

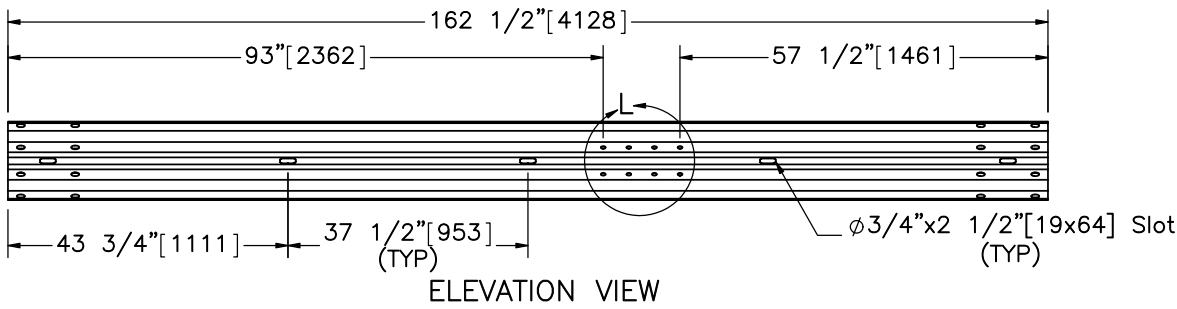


ELEVATION VIEW

Part a1

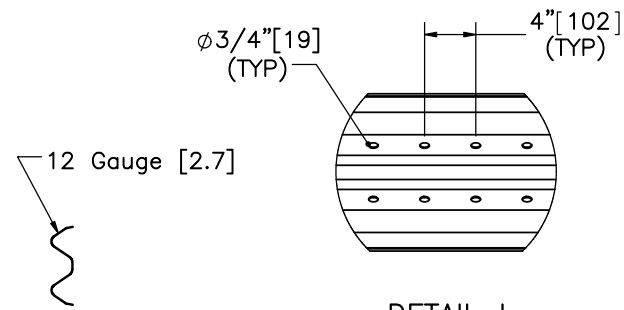


PROFILE VIEW




ELEVATION VIEW

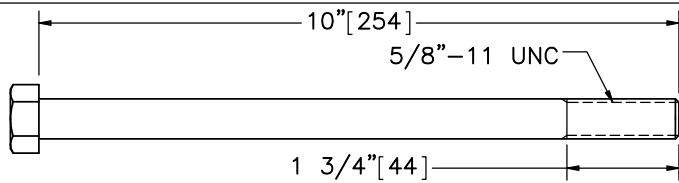
Part a2



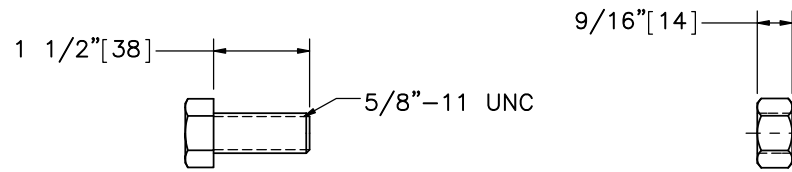
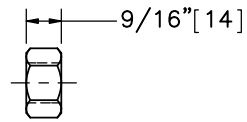
PROFILE VIEW

DETAIL L  
SCALE 1 : 15

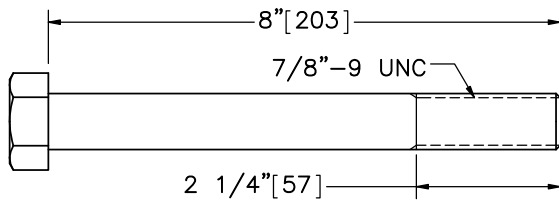
 <b>Midwest Roadside Safety Facility</b>	<b>MGS Strong Post on Culvert Test No. CMGS-2</b>	SHEET: 14 of 18
	<b>Rail Section Details</b>	DATE: 11/22/2017
DWG. NAME: WL_MGS_on_Culvert-2_R2	SCALE: 1:30 UNITS: in.[mm]	DRAWN BY: MES/JEK/ DTM
		REV. BY: RWB



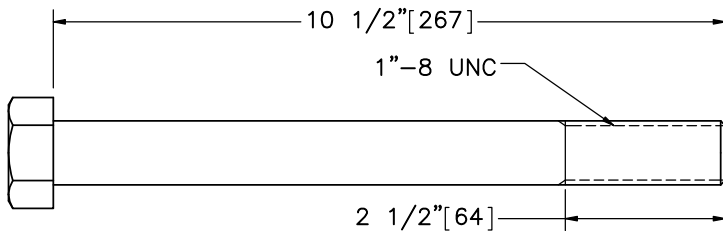
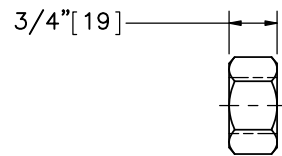
Part c1



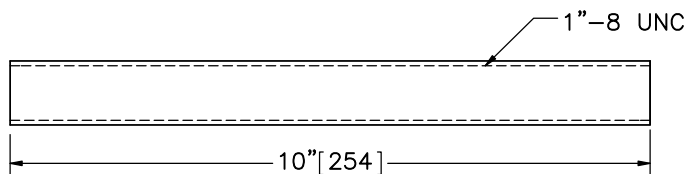
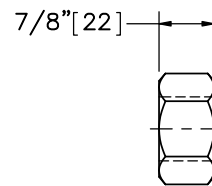
Part c4



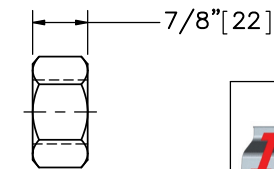
Part c2



Part c3



Part c9



Part c10



Midwest Roadside  
Safety Facility

MGS Strong Post on  
Culvert  
Test No. CMGS-2

System Hardware

DWG. NAME:  
WL\_MGS\_on\_Culvert-2\_R2

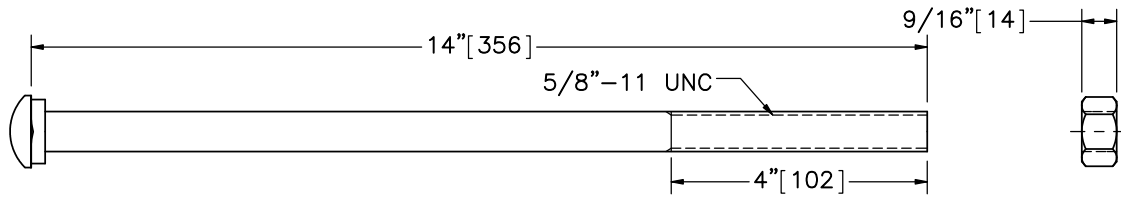
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UNITS: in.[mm]

SHEET:  
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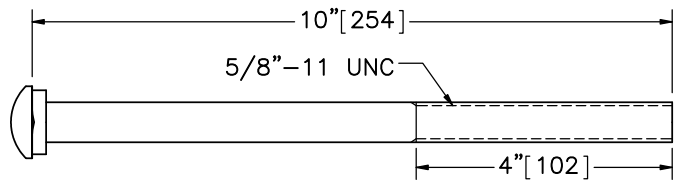
DATE:  
11/22/2017

DRAWN BY:  
MES/JEK/  
DTM

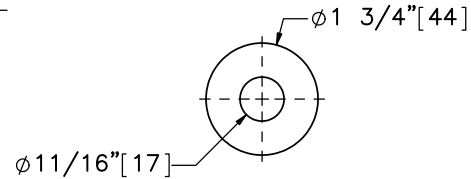
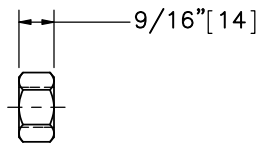
REV. BY:  
RWB



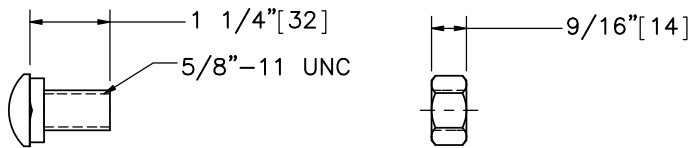
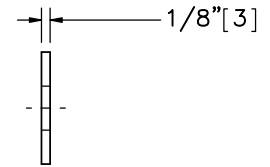
Part c5



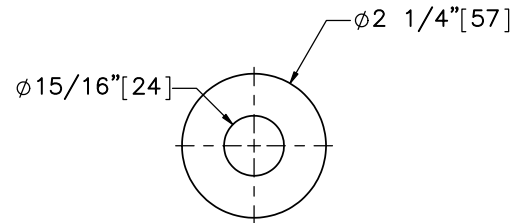
Part c8



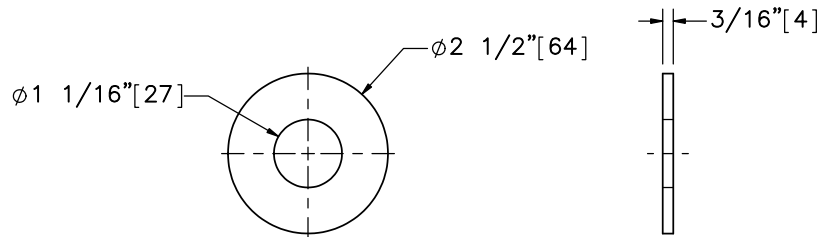
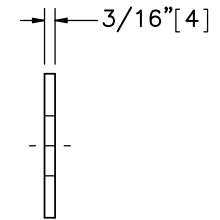
Part d1



Part c6



Part d2



Part d3



Midwest Roadside  
Safety Facility

MGS Strong Post on  
Culvert  
Test No. CMGS-2

System Hardware

DWG. NAME:  
WL\_MGS\_on\_Culvert-2\_R2

SCALE: 1:3  
UNITS: in.[mm]

SHEET:  
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DATE:  
11/22/2017

DRAWN BY:  
MES/JEK/  
DTM

REV. BY:  
RWB



Item No.	QTY.	Description	Material Specification	Galvanization Specification	Hardware Guide
a1	12	12'-6" [3,810] 12 gauge [2.7] W-Beam MGS Section	AASHTO M180	ASTM A123 or A653	RWM04a
a2	2	12'-6" [3,810] 12 gauge [2.7] W-Beam MGS End Section	AASHTO M180	ASTM A123 or A653	RWM14a
a3	1	6'-3" [1,905] 12 gauge [2.7] W-Beam MGS Section	AASHTO M180	ASTM A123 or A653	RWM04a
b1	4	72" [1829] Long Foundation Tube	ASTM A500 Gr. B	ASTM A123	PTE06
b2	4	BCT Timber Post – MGS Height	SYP Grade No. 1 or better (No knots 18" [457] above or below ground tension face)	–	PDF01
b3	23	W6x8.5 [152x12.6] or W6x9 [W152x13.4], 72" [1,829] Long Steel Post	ASTM A992	ASTM A123	PWE06
b4	37	6"x12"x14 1/4" [152x305x368] Timber Blockout for Steel Posts	SYP Grade No. 1 or better	–	PDB10a
b5	14	W6x8.5 [W152x12.6] or W6x9 [W152x13.4] Post, 40 1/2" [1029] Long	ASTM A992	ASTM A123	SGR25
b6	14	8 1/2"x12"x1/2" [216x305x13] Top Base Plate	ASTM A572 Gr. 50	ASTM A123	SGR25
b7	13	8 1/2"x11"x1/4" [216x280x6] Bottom Post Plate	ASTM A572 Gr. 50	ASTM A123	SGR25
c1	4	5/8" [16] Dia. UNC, 10" [254] Long Hex Head Bolt and Nut	Bolt – ASTM A307 Gr. A Nut – ASTM A563A	ASTM A153 or B695 Class 55 or F2329	FBX16a
c2	4	7/8" [22] Dia. UNC, 8" [203] Long Hex Head Bolt and Nut	Bolt – ASTM A307 Gr. A Nut – ASTM A563A	ASTM A153 or B695 Class 55 or F2329	–
c3	52	1" [25] Dia. UNC, 10 1/2" [267] Long Hex Head Bolt and Nut	Bolt – ASTM A307 Gr. A Nut – ASTM A563A	ASTM A153 or B695 Class 55 or F2329	FBX24a
c4	16	5/8" [16] Dia. UNC, 1 1/2" [38] Long Hex Head Bolt and Nut	Bolt – ASTM A307 Gr. A Nut – ASTM A563A	ASTM A153 or B695 Class 55 or F2329	FBX16a
c5	37	5/8" [16] Dia. UNC, 14" [356] Long Guardrail Bolt and Nut	Bolt – ASTM A307 Gr. A Nut – ASTM A563A	ASTM A153 or B695 Class 55 or F2329	FBB06
c6	112	5/8" [16] Dia. UNC, 1 1/4" [32] Long Guardrail Bolt and Nut	Bolt – ASTM A307 Gr. A Nut – ASTM A563A	ASTM A153 or B695 Class 55 or F2329	FBB01
c7	39	16D Double Head Nail	–	–	–
c8	4	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
c9	4	1" [25] Dia. UNC, 10" [254] Long Threaded Rod	ASTM A307 Gr. A	ASTM A153 or B695 Class 55 or F2329	FRR24a
c10	8	1" [25] Dia. Hex Nut	ASTM A563A	ASTM A153 or B695 Class 55 or F2329	FNX24a

Note: (1) A 25' [7.6 m] guardrail segment may be used in place of two 12.5' [3.8 m] segments outside of the critical region.



Midwest Roadside  
Safety Facility

MGS Strong Post on  
Culvert  
Test No. CMGS-2

Bill of Materials

DWG. NAME:  
WL\_MGS\_on\_Culvert-2\_R2

SCALE: None  
UNITS: in.[mm]

SHEET:  
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DATE:  
11/22/2017

DRAWN BY:  
MES/JEK/  
DTM

REV. BY:  
RWB

Item No.	QTY.	Description	Material Specification	Galvanization Specification	Hardware Guide
d1	44	5/8" [16] Dia. Plain Round Washer	ASTM F844	ASTM A123 or A153 or F2329	FWC16a
d2	8	7/8" [22] Dia. Plain Round Washer	ASTM F844	ASTM A123 or A153 or F2329	-
d3	104	1" [25] Dia. Plain Round Washer	ASTM F844	ASTM A123 or A153 or F2329	FWC24a
e1	2	BCT Anchor Cable	-	-	FCA01
e2	2	2 3/8" [60] O.D. x 6" [152] Long BCT Post Sleeve	ASTM A53 Gr. B Schedule 40	ASTM A123	FMM02
e3	2	8"x8"x5/8" [203x203x16] Anchor Bearing Plate	ASTM A36	ASTM A123	FPB01
f1	2	Ground Strut Assembly	ASTM A36	ASTM A123	PFP01
f2	2	Anchor Bracket Assembly	ASTM A36	ASTM A123	FPA01
-	1	Concrete Culvert*	Min. f'c = 4,000 psi [27.6 MPa] NE Mix 47BD	-	-

\* See WI\_Culvert\_Details\_as\_built drawing for details on concrete culvert.



Midwest Roadside  
Safety Facility

MGS Strong Post on  
Culvert  
Test No. CMGS-2

Bill of Materials

DWG. NAME:  
WI\_MGS\_on\_Culvert-2\_R2

SCALE: None  
UNITS: in.[mm]

SHEET:  
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DATE:  
11/22/2017  
DRAWN BY:  
MES/JEK/  
DTM  
REV. BY:  
RWB

REV.	DATE OF ISSUE	Page	NATURE OF CHANGES	REVIEWER	REVISED BY
0	10/23/2017	-	Created drawing from WI_MGS_on_Culvert_R9. Changed impact information.	-	MES
1	10/24/2017	2	Note added.	RWB	JEK
2	11/22/2017	2	Revised note.	RWB	DTM
		17	Added note.		