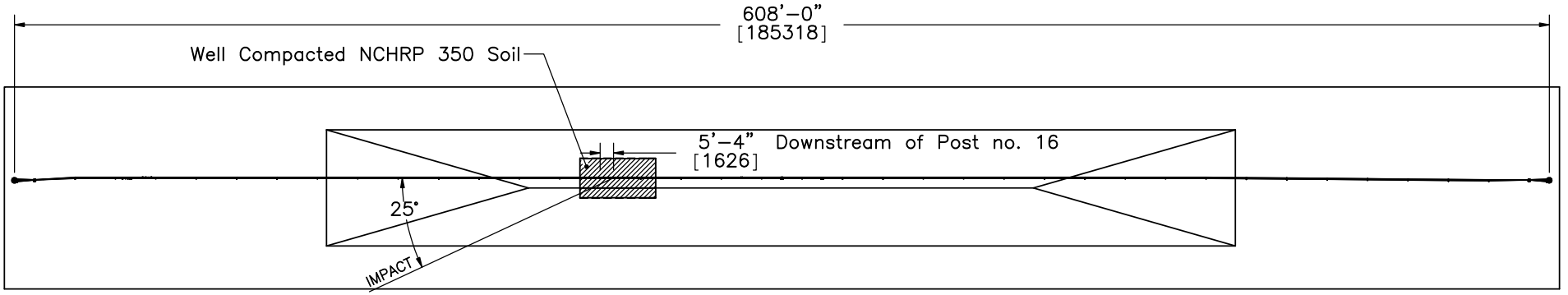
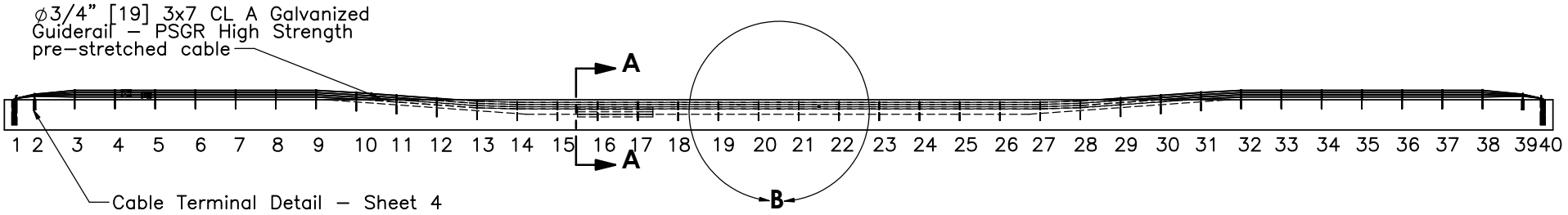
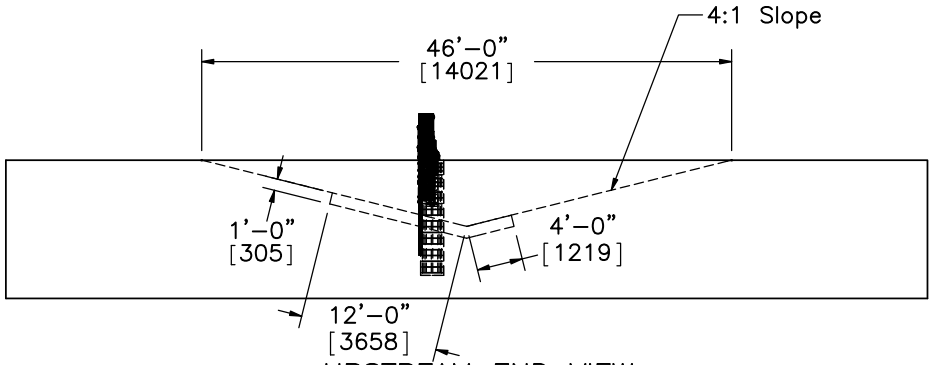


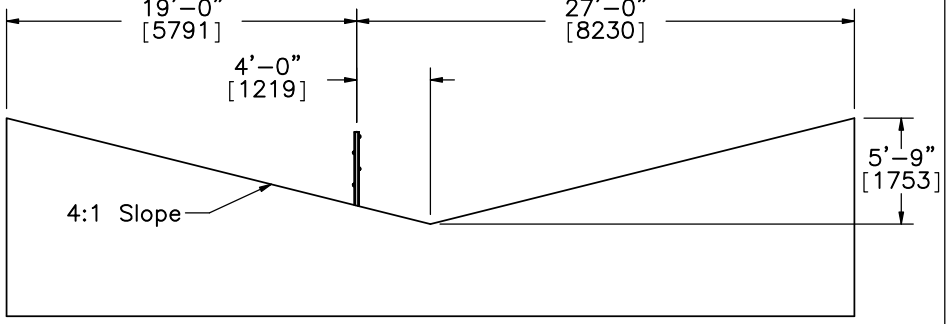
PLAN VIEW



ELEVATION VIEW



UPSTREAM END VIEW
SCALE 1 : 200



SECTION A–A
SCALE 1:125

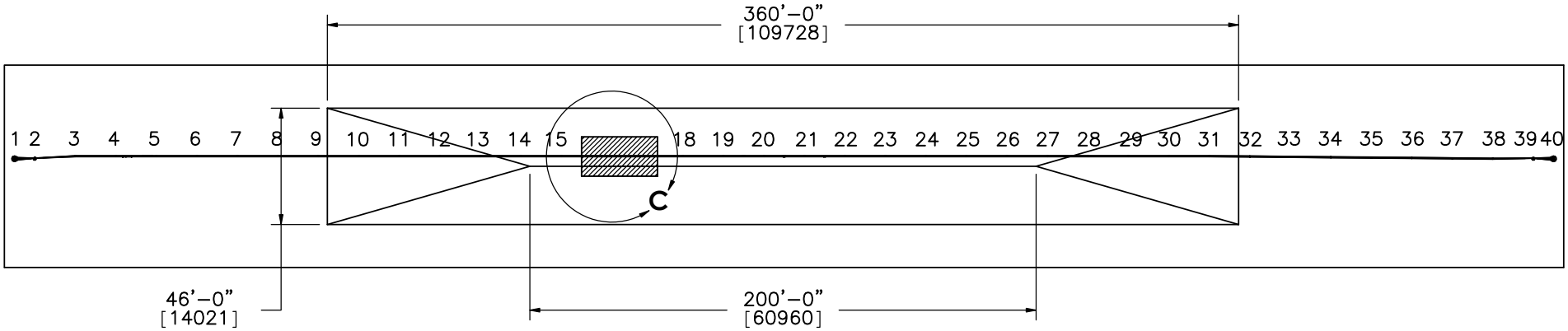
Notes: (1) Post Nos. 1–9 and 32–40 are flared over 1' [305] to account for post nos. 1 and 40 being offset 3' [914] instead of 4' [1219].

(2) Impact point at 5'–4" [1626] downstream of post no. 17 was used to allow for the potential maximum underride of the vehicle.

(3) Post nos. 15–24 placed in barrels as detailed on sheet 18.

(4) Clip type and locations noted on sheet 23.

MwRSF	4–Cable Median Barrier	SHEET: 1 of 23
	System Layout – 4CMB–4	DATE: 11/17/11
		DRAWN BY: MJW/MDM/JGP
Midwest Roadside Safety Facility	DWG. NAME. 4CMB–4_R9 / SCALE: 1:750 / UNITS: In.[mm]	REV. BY: KAL/CLM/RWB

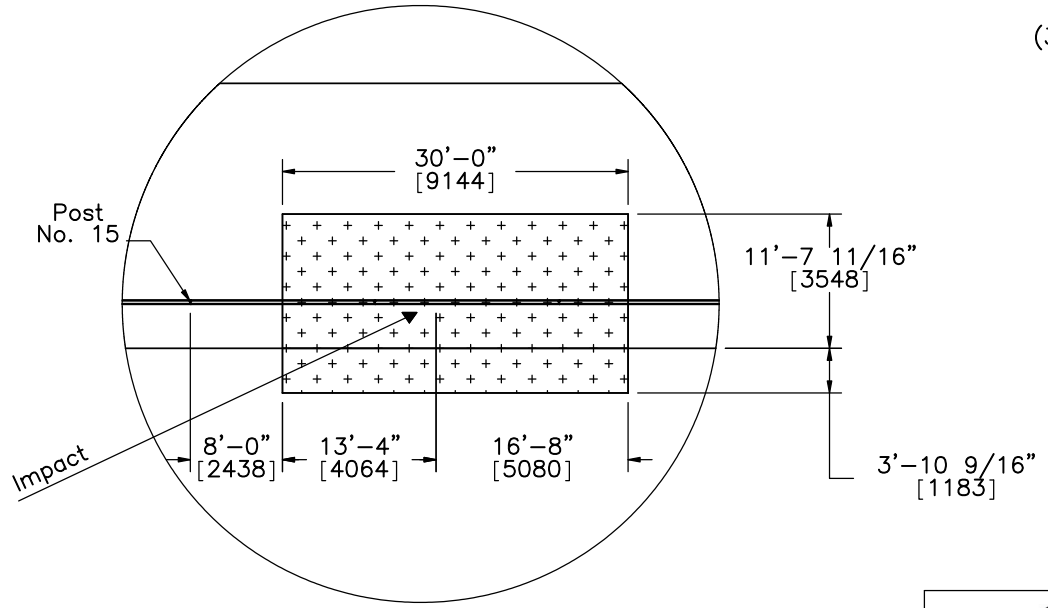


Notes:

(1) Well compacted NCHRP 350 soil region is to begin 13'–4" [4064] upstream from impact point.

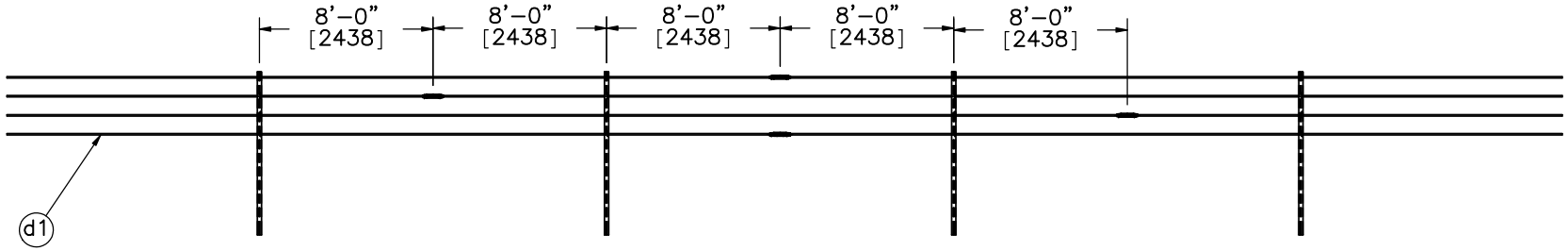
(2) Slope between post nos. 14 and 20 must be within testing tolerace of 1/4" [6.4].

(3) Slope between post nos. 20 and 23 should be reasonably close but does not have to be exact

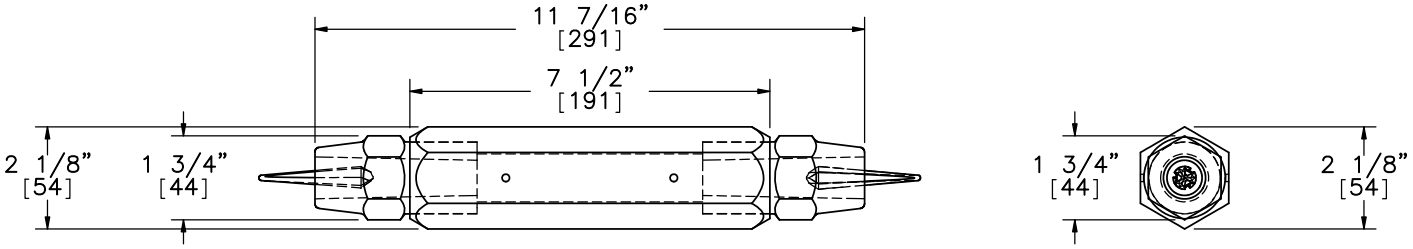


DETAIL C
SCALE 1 : 200

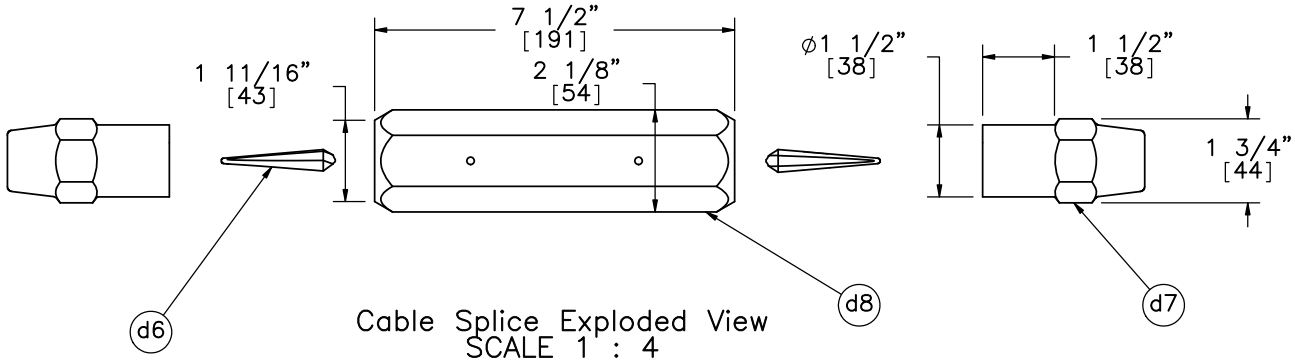
Midwest Roadside Safety Facility	4–Cable Median Barrier Soil Detail View	SHEET: 2 of 23 DATE: 11/17/11 DRAWN BY: MJW/MDM/JGP REV. BY: KAL/CLM/RWB
	DWG. NAME. 4CMB–4_R9 SCALE: 1:750 UNITS: In.[mm]	



DETAIL B
Cable Splice Location Detail
(Ground Not Shown)

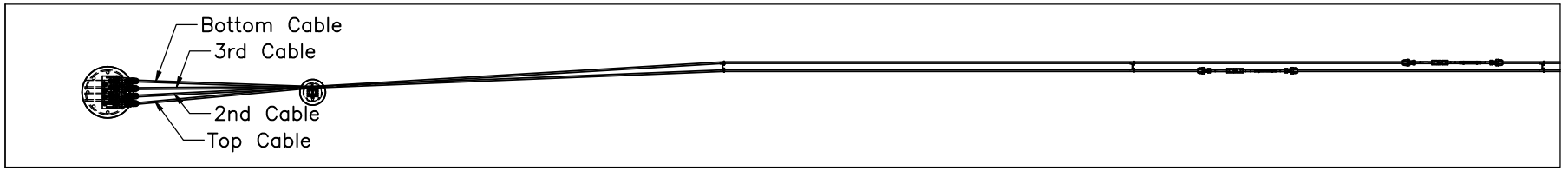


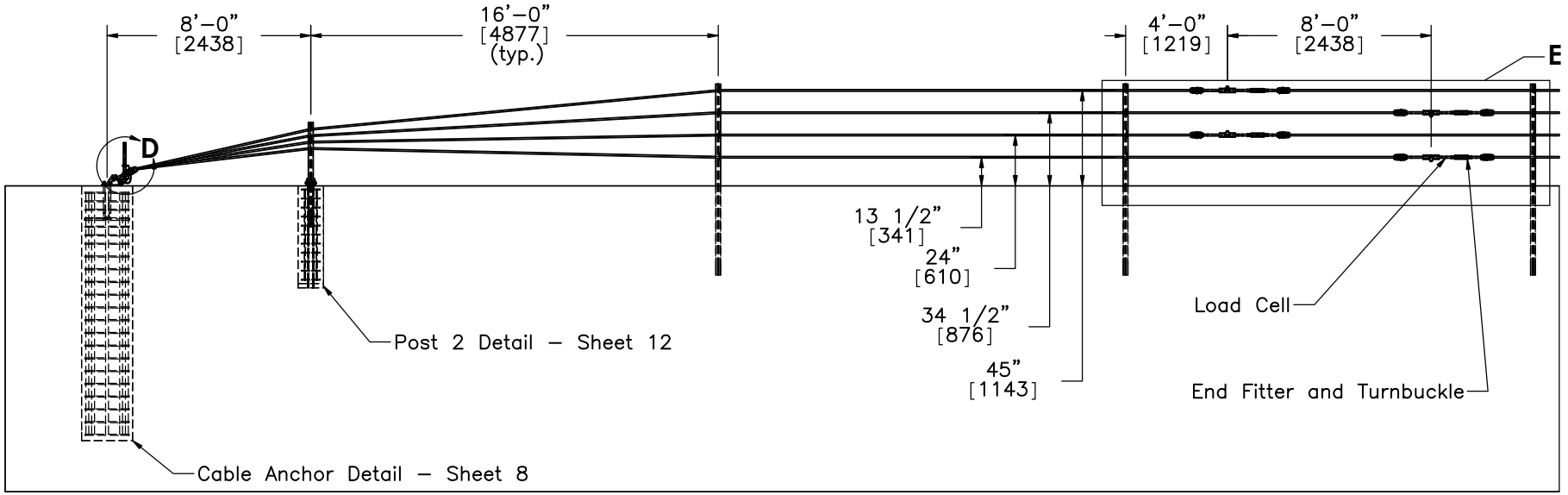
Cable Splice Detail



Cable Splice Exploded View
SCALE 1 : 4

Midwest Roadside Safety Facility	4–Cable Median Barrier Cable Splice Location and Detail	SHEET: 3 of 23 DATE: 11/17/11 DRAWN BY: MJW/MDM/JGP
	DWG. NAME. 4CMB–4_R9 SCALE: 1:100 UNITS: In.[mm]	REV. BY: KAL/CLM/RWB



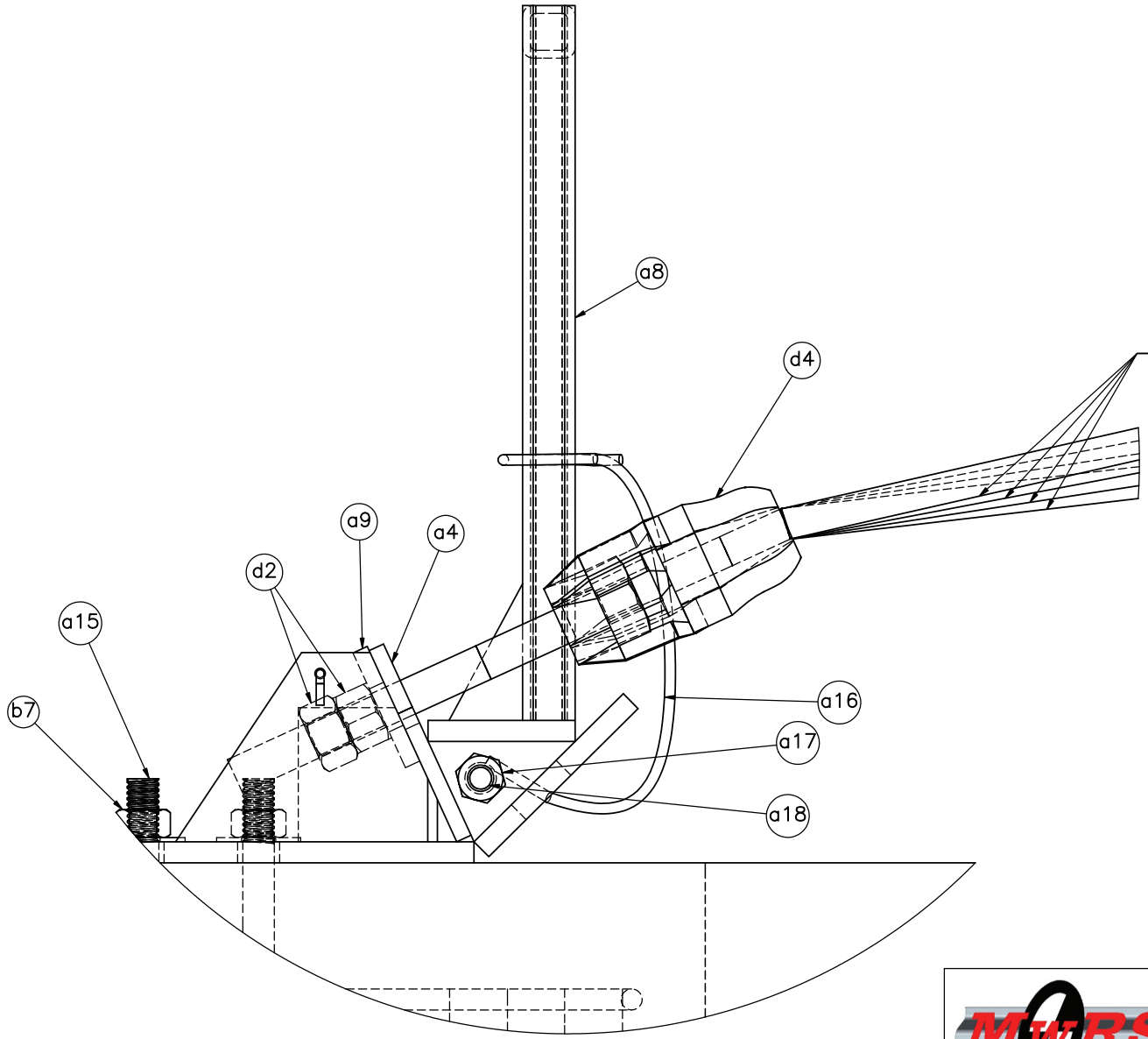


Midwest Roadside Safety Facility

4–Cable Median Barrier

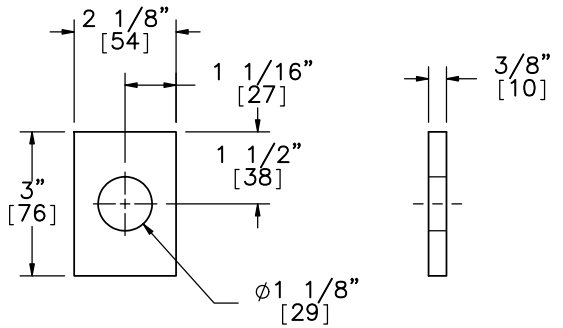
Cable Terminal Detail
As Built

SHEET:	4 of 23
DATE:	11/17/11
DRAWN BY:	MJW/MDM/JGP
REV. BY:	KAL/CLM/RWB
DWG. NAME.	4CMB–4_R9
SCALE: 1:78	
UNITS: In.[mm]	



DETAIL D

All cables run over the foot of the cable release lever. The middle two cables run through the lever uprights.



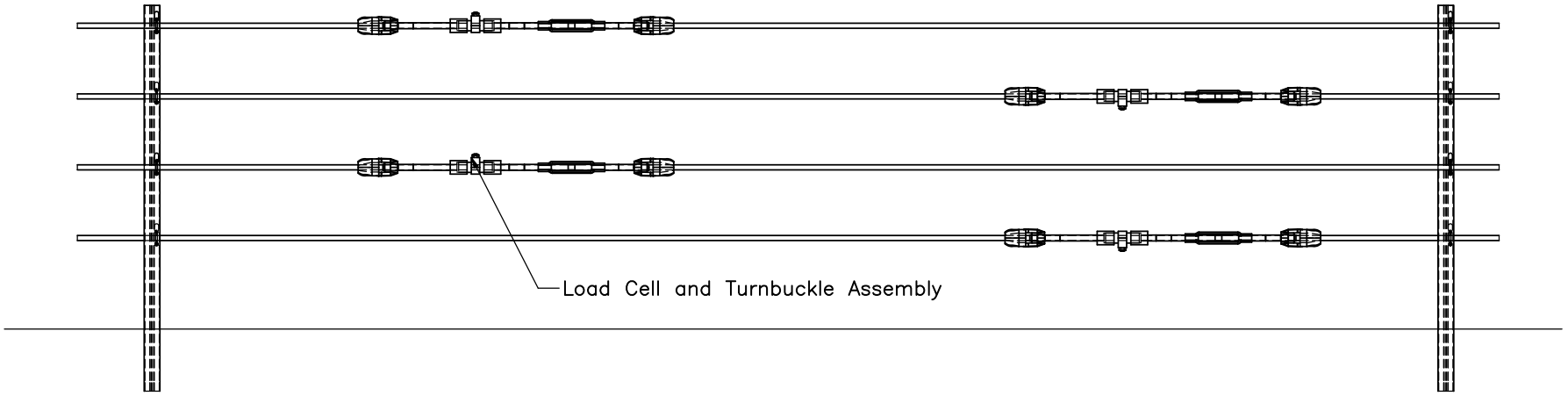
Part a9
Cable Anchor Plate Washer

Midwest Roadside Safety Facility

4—Cable Median Barrier

Cable Anchor Details

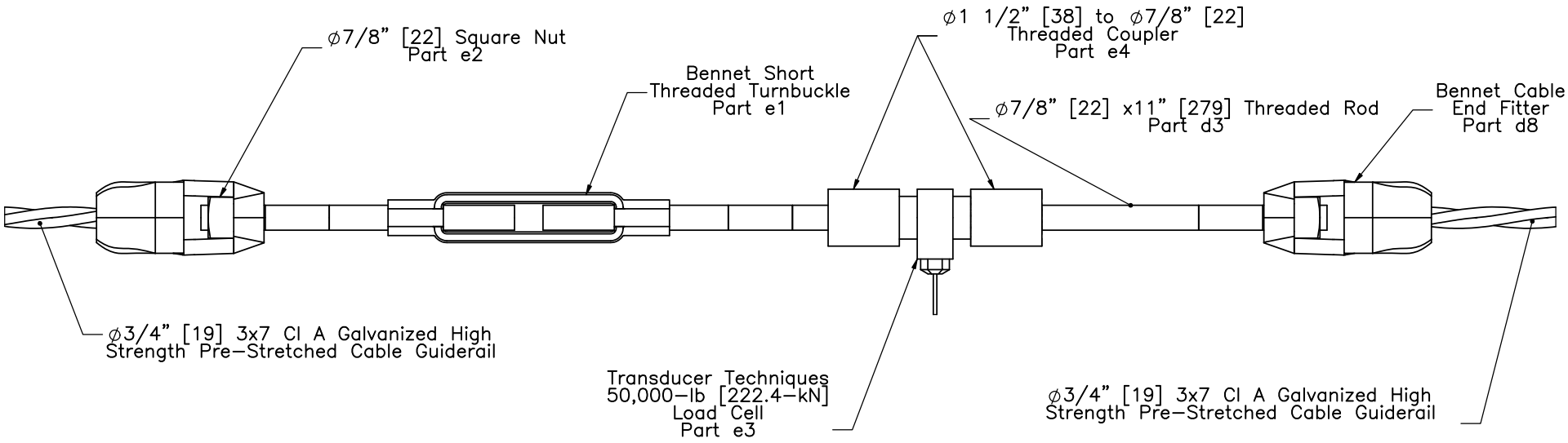
SHEET:	5 of 23
DATE:	11/17/11
DRAWN BY:	MJW/MDM/JGP
REV. BY:	KAL/CLM/RWB
DWG. NAME.	4CMB-4_R9
SCALE: 1:4	
UNITS: In.[mm]	



Post no. 4

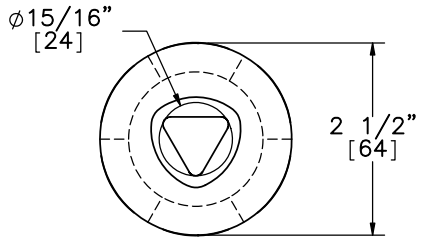
DETAIL E

Post no. 5

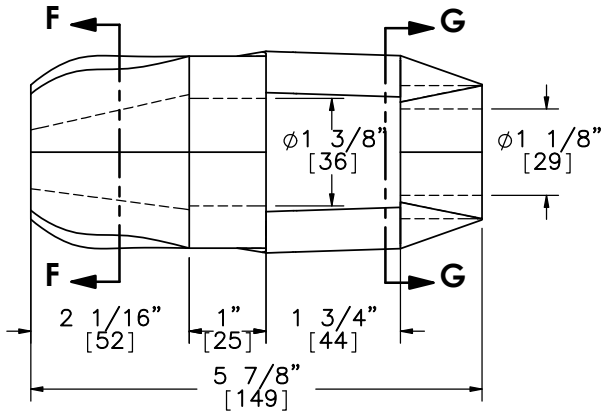


Note: Two RH-threaded rods and one LH-threaded rod required for load cell and turnbuckle assembly

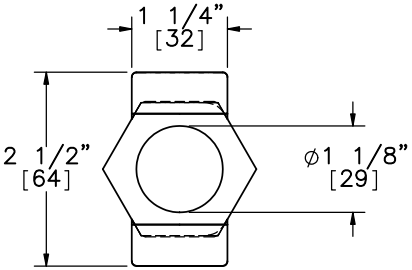
MwRSF	4-Cable Median Barrier	SHEET: 6 of 23
	Load Cell and Turnbuckle Configuration	DATE: 11/17/11
		DRAWN BY: MJW/MDM/JGP
Midwest Roadside Safety Facility	DWG. NAME. 4CMB-4_R9	SCALE: 1:25 UNITS: In.[mm]
		REV. BY: KAL/CLM/RWB



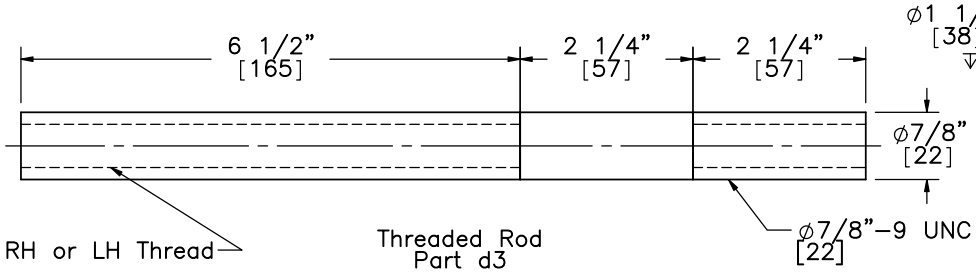
SECTION F–F



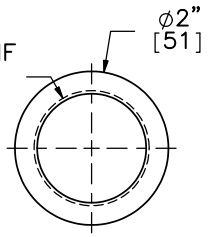
Bennet Cable End Fitter
Part d8



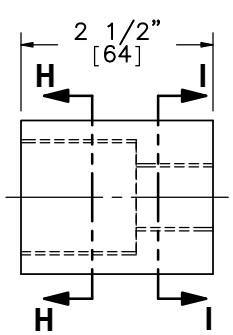
SECTION G–G

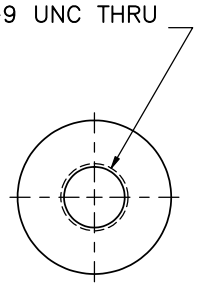


Threaded Rod
Part d3

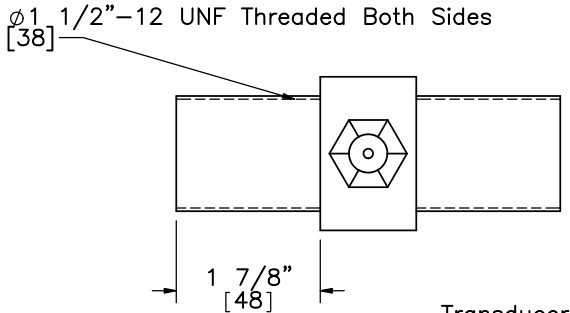


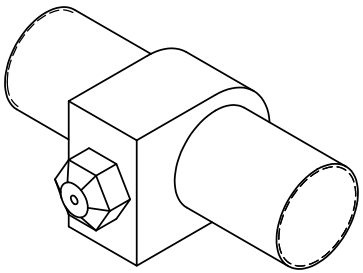
SECTION H–H



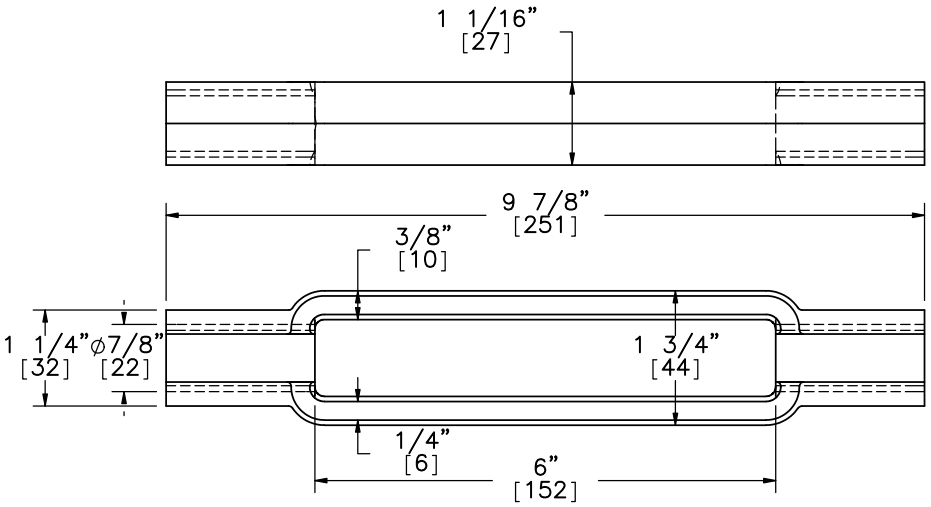


SECTION I–I





Transducer Techniques
50000–lb [222.4–kN] Rated Load Cell
Part e3



Bennet Threaded Turnbuckle
Part e1

Midwest Roadside Safety Facility

4–Cable Median Barrier

Load Cell Assemly
Component Details

SHEET: 7 of 23

DATE: 11/17/11

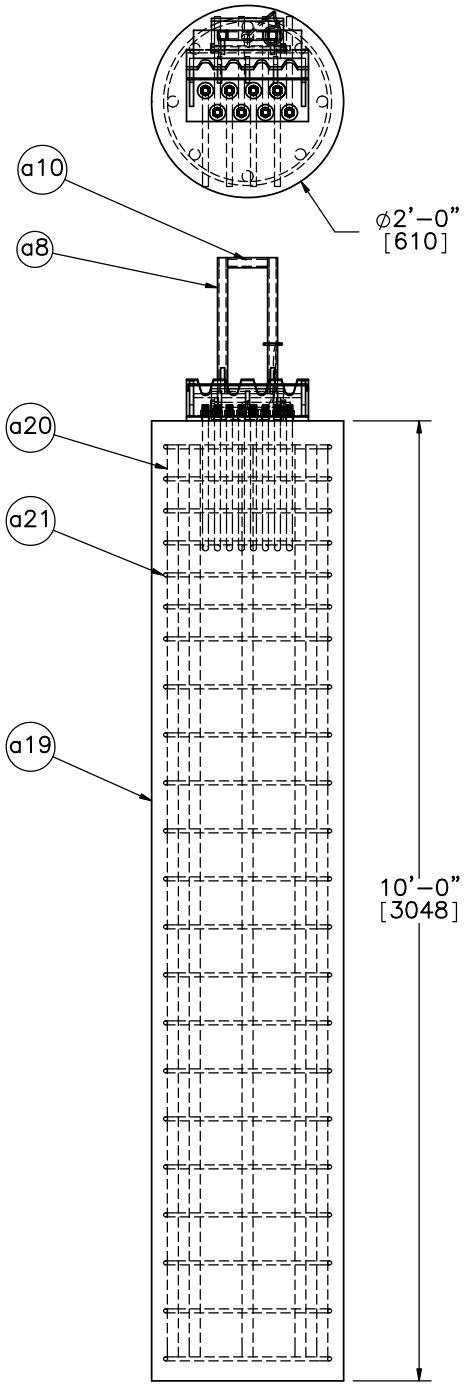
DRAWN BY: MJW/MDM/JGP

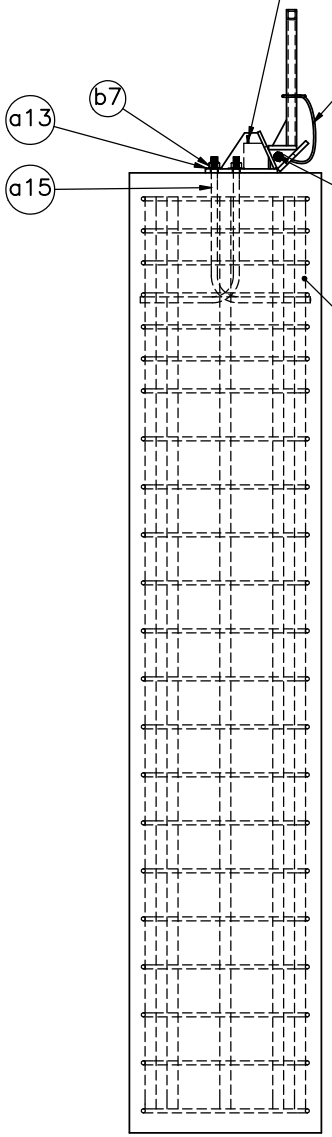
DWG. NAME. 4CMB–4_R9

SCALE: 1:2

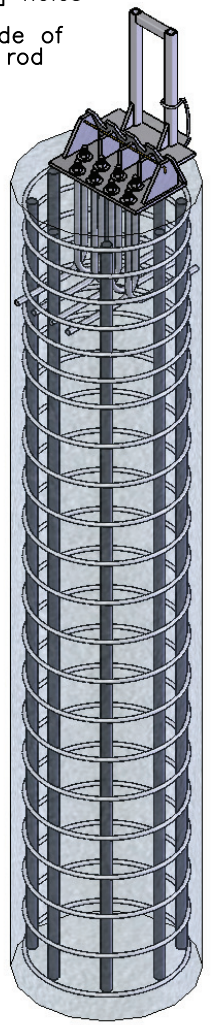
UNITS: In.[mm]

REV. BY: KAL/CLM/RWB





Note: Brass rod to be placed after all cables are installed and tensioned. Slide rod through the 1/4" [6.4] holes in the Anchor Bracket, leaving a minimum of 1" [25] on each side of the Anchor Bracket. Bend brass rod down on each side of Anchor Bracket to secure.



Notes: (1) Grade 60 reinforcement.

(2) 1 1/2" [38] clear cover on sides, 3" [76] on top clear cover, and 2 1/2" [64] clear cover on bottom.

(3) Eight No. 11 longitudinal bars.

(4) 22 – No. 4 hoops with an inner diameter of 20" [508] at 4" [102] spacing for the top 24" [610] and subsequently at 6" [152] spacing until bottom clear cover.

(5) Eight No. 6 A449 bent anchor studs having a length of 28 9/16" [725].

(6) Concrete mix for anchor and posts shall provide a minimum f'c of 4000 psi [27.6 MPa].

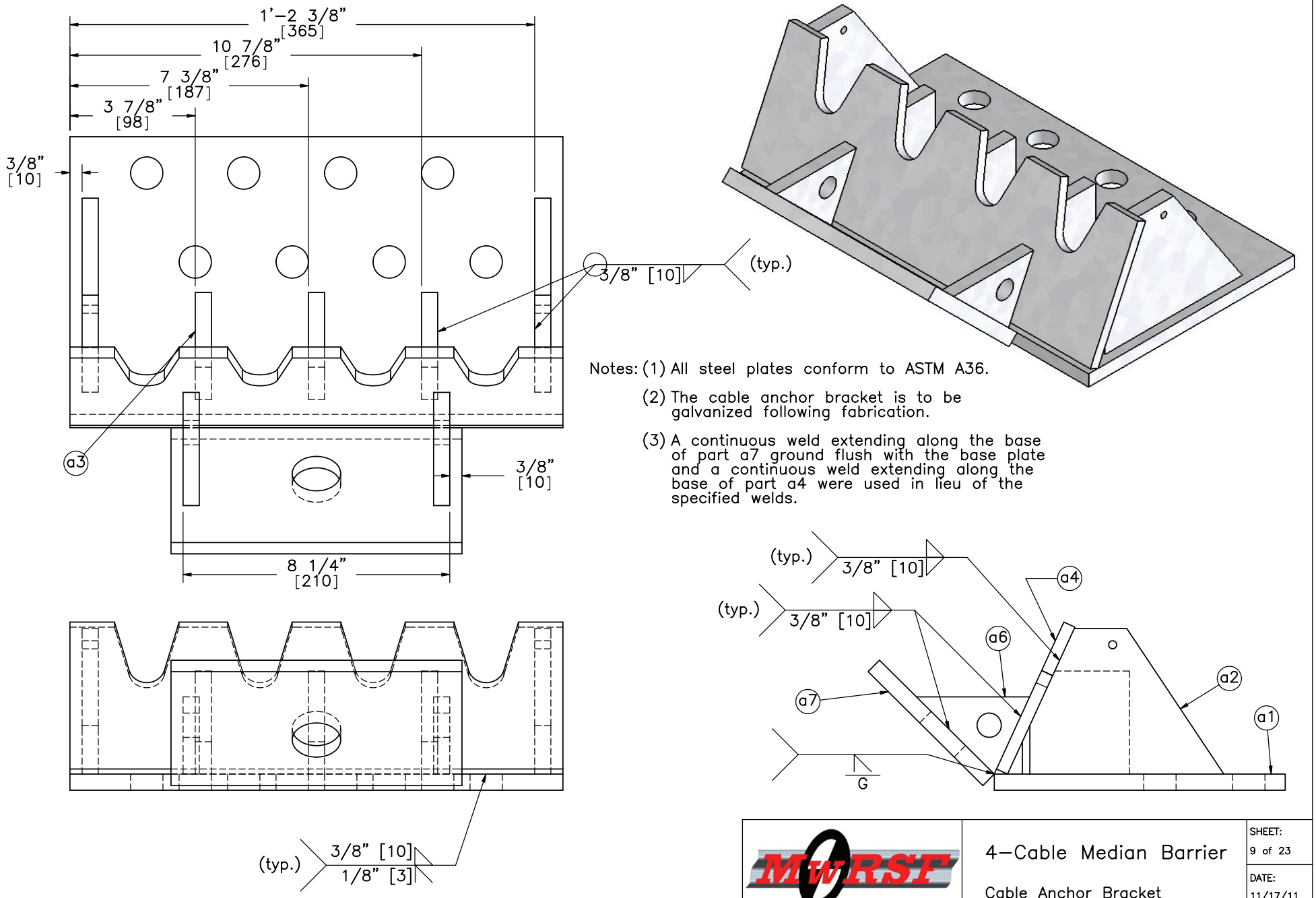
(7) The two outer bent anchor studs must be turned inward so do not stick out of concrete cover.

Midwest Roadside Safety Facility

4–Cable Median Barrier

Cable Anchor Detail
Post Nos. 1 & 40
As Built

SHEET:	8 of 23
DATE:	11/17/11
DRAWN BY:	MJW/MDM/JGP
REV. BY:	KAL/CLM/RWB
DWG. NAME.	4CMB–4_R9
SCALE: 1:24	
UNITS: In.[mm]	

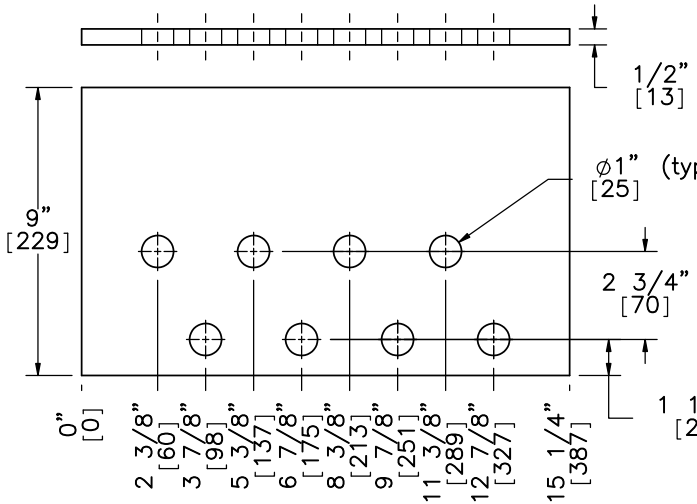


Notes: (1) All steel plates conform to ASTM A36.

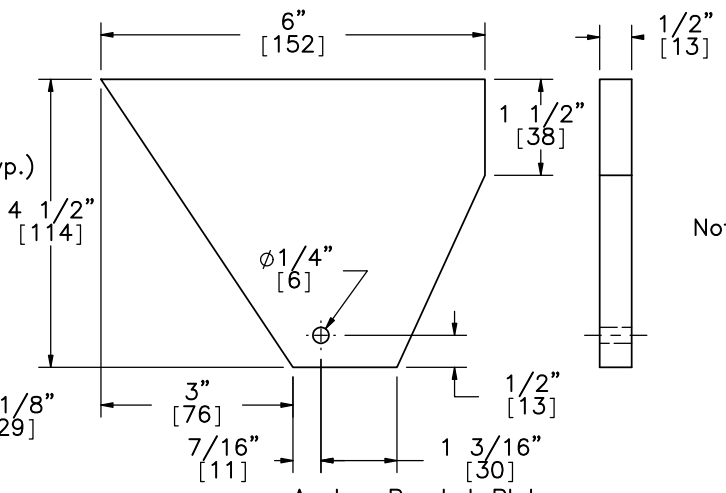
(2) The cable anchor bracket is to be galvanized following fabrication.

(3) A continuous weld extending along the base of part a7 ground flush with the base plate and a continuous weld extending along the base of part a4 were used in lieu of the specified welds.

Midwest Roadside Safety Facility	4–Cable Median Barrier Cable Anchor Bracket	SHEET: 9 of 23 DATE: 11/17/11 DRAWN BY: MJW/MDM/JGP
	DWG. NAME. 4CMB–4_R9 SCALE: 1:4 UNITS: In.[mm]	REV. BY: KAL/CLM/RWB

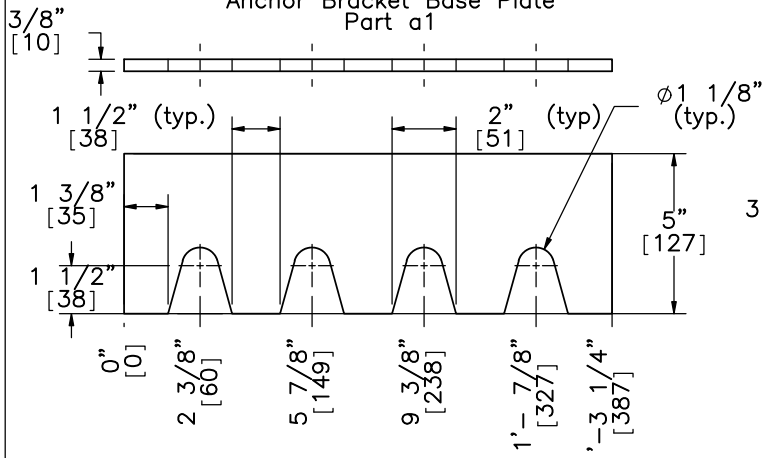


Anchor Bracket Base Plate
Part a1

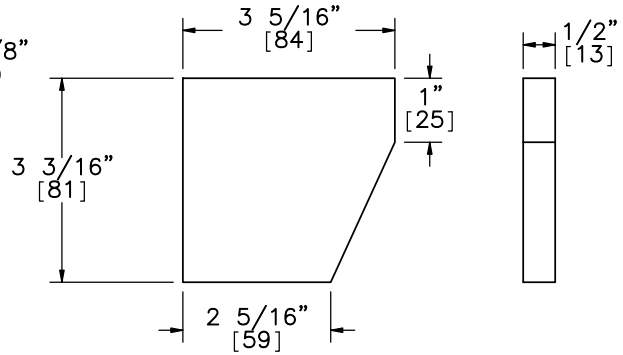


Anchor Bracket Plate
Part a2

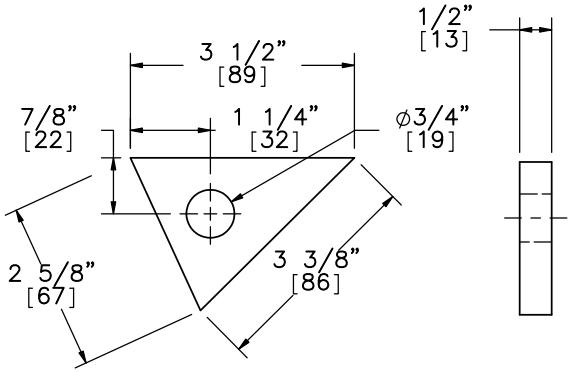
Note: All steel plates conform to ASTM A36.



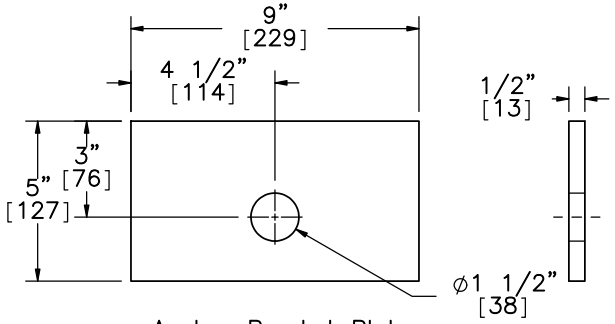
Anchor Bracket Plate
Part a4



Anchor Bracket Plate
Part a3

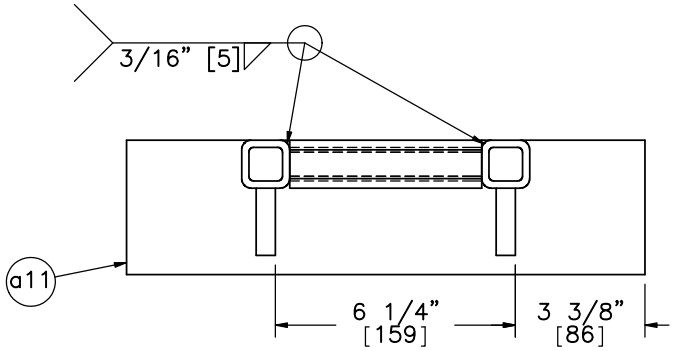


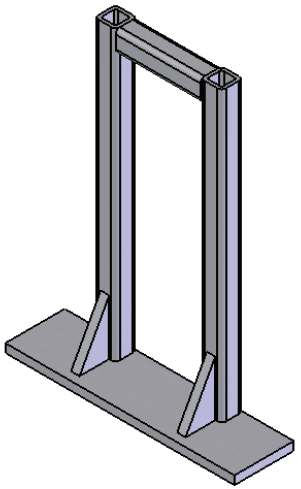
Anchor Bracket Plate
Part a6



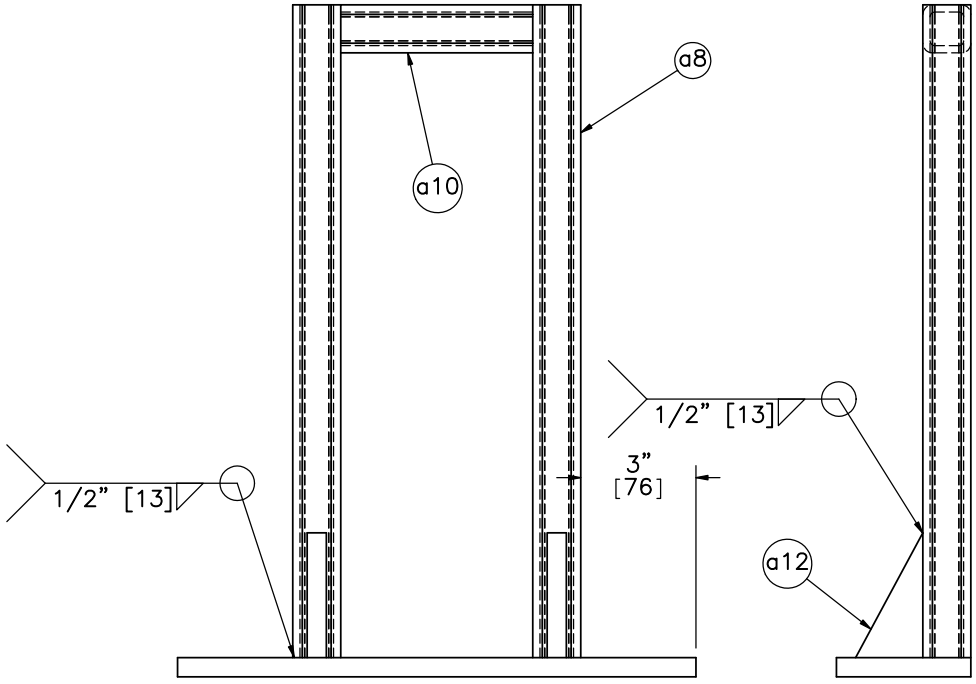
Anchor Bracket Plate
Part a7

Midwest Roadside Safety Facility	4—Cable Median Barrier Cable Anchor Bracket	SHEET: 10 of 23 DATE: 11/17/11 DRAWN BY: MJW/MDM/JGP
	DWG. NAME. 4CMB-4_R9 SCALE: 1:6 UNITS: In.[mm]	REV. BY: KAL/CLM/RWB

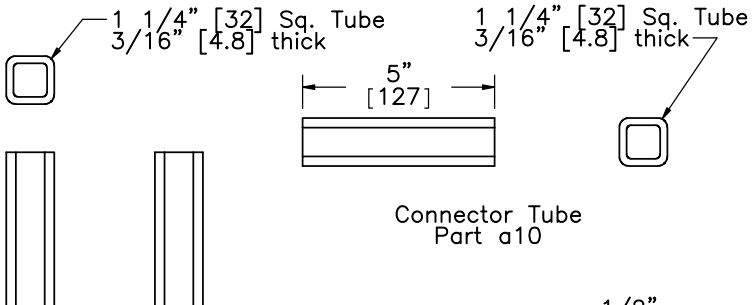




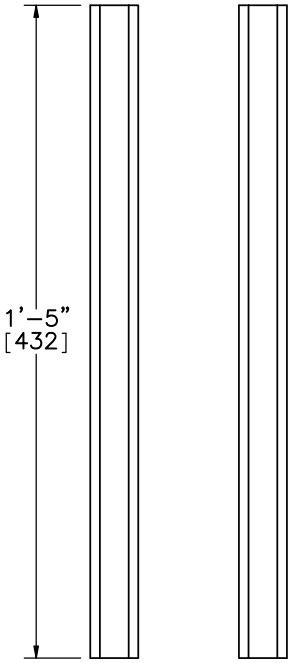
Notes:
(1) The kicker lever should be flush with the top of the kicker plate.
(2) The 3 1/4" [83] leg of the kicker plate gusset should line up with the kicker lever.
(3) The bottom of the cable release lever should rest upon part a6.
(4) All steel plates conform to ASTM A36.
(5) All steel tubing conforms to ASTM A500 Grade B.



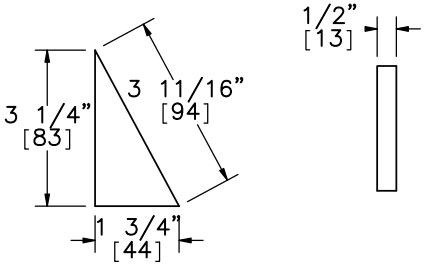
Cable Release Lever



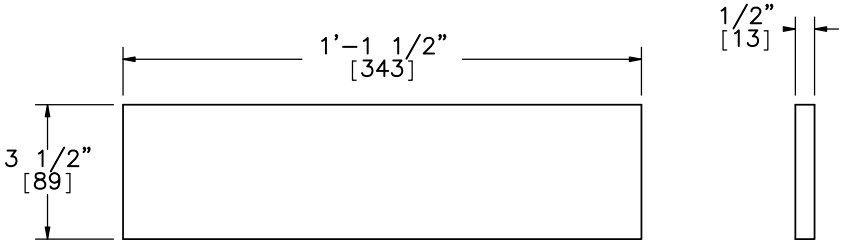
Connector Tube
Part a10



Kicker Lever
Part a8

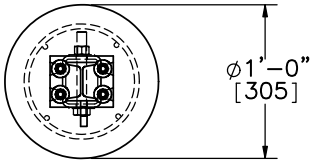


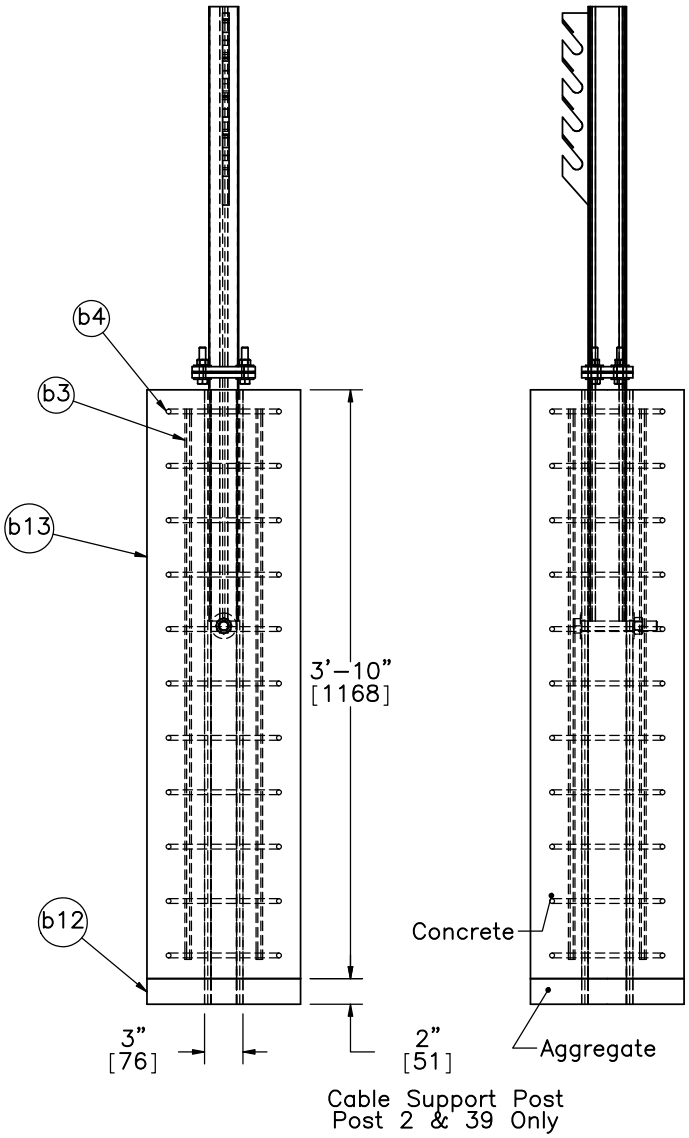
Kicker Plate Gusset
Part a12

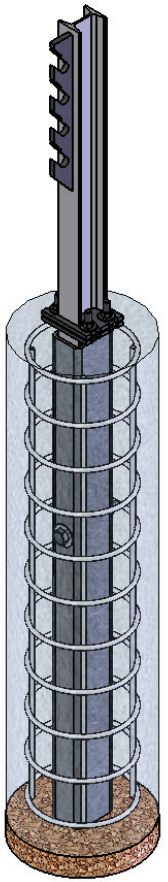


Kicker Plate
Part a11

Midwest Roadside Safety Facility	4-Cable Median Barrier Cable Release Lever	SHEET: 11 of 23 DATE: 11/17/11 DRAWN BY: MJW/MDM/JGP
	DWG. NAME. 4CMB-4_R9 SCALE: 1:5 UNITS: In.[mm]	REV. BY: KAL/CLM/RWB







Notes:
(1) Grade 60 Reinforcement.
(2) 1 1/2" [38] clear cover.
(3) 11 No. 3 hoops with an inner diameter of 7 1/4" [184] and a vertical spacing of 4 1/4" [108].
(4) 4 No. 3 longitudinal bars.
(5) Concrete mix for anchor posts shall provide a minimum f'c of 4000 psi [27.6 MPa].

MwRSF

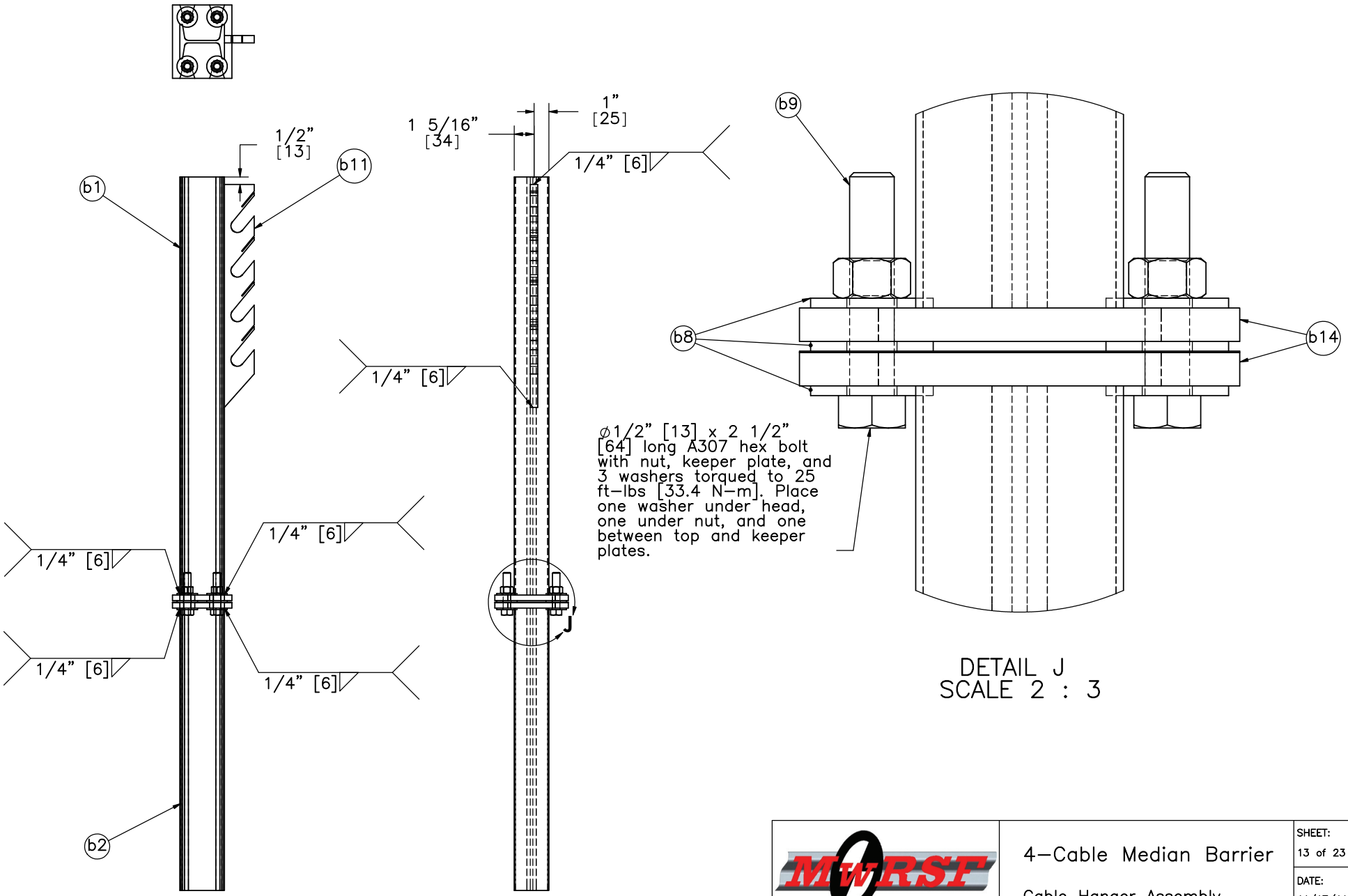
Midwest Roadside Safety Facility

4–Cable Median Barrier

Second Post Detail
Post Nos. 2 & 39
As Built

SHEET: 12 of 23
DATE: 11/17/11
DRAWN BY: MJW/MDM/JGP
REV. BY: KAL/CLM/RWB

DWG. NAME. 4CMB–4_R9
SCALE: 1:15
UNITS: In.[mm]



DETAIL J
SCALE 2 : 3

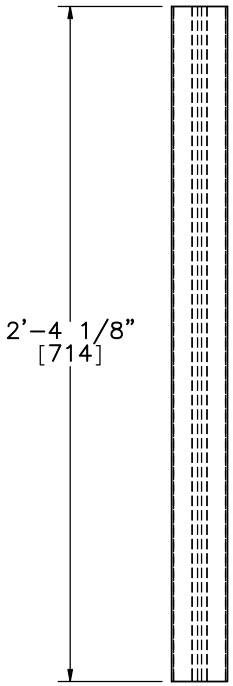
Midwest Roadside Safety Facility

4-Cable Median Barrier

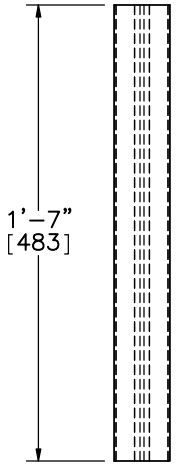
Cable Hanger Assembly
Post Nos. 2 & 39

SHEET: 13 of 23
DATE: 11/17/11
DRAWN BY: MJW/MDM/JGP
REV. BY: KAL/CLM/RWB

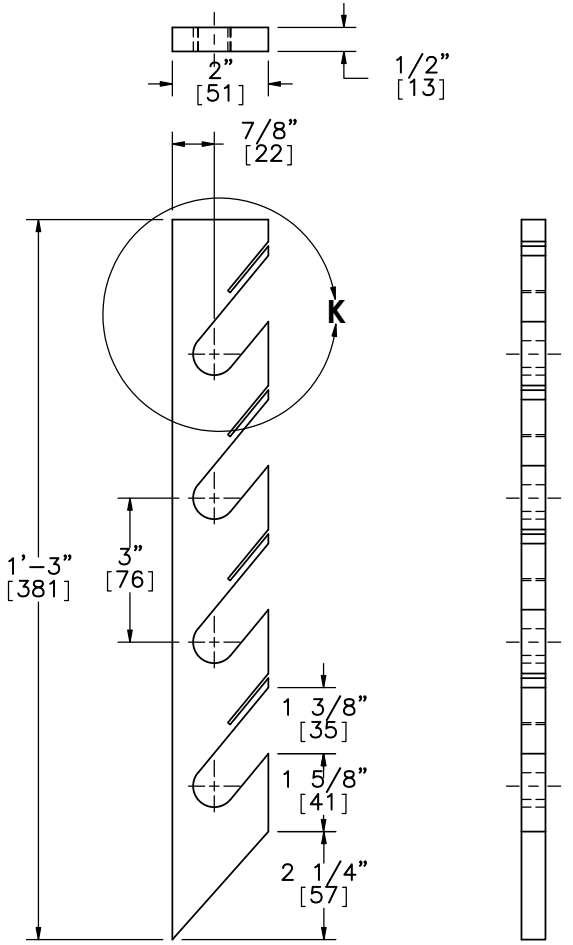
DWG. NAME. 4CMB-4_R9
SCALE: 1:9
UNITS: In.[mm]



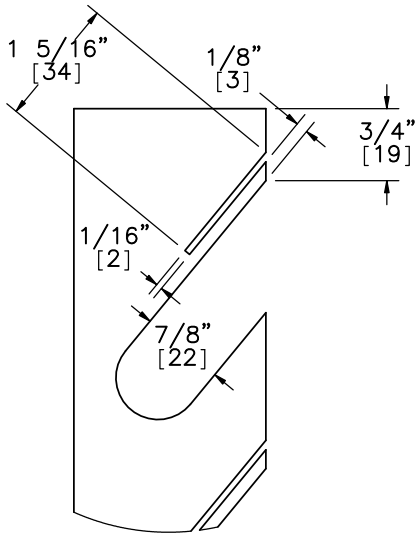
S3x5.7 [S76 x 8.5] Post
Part b1



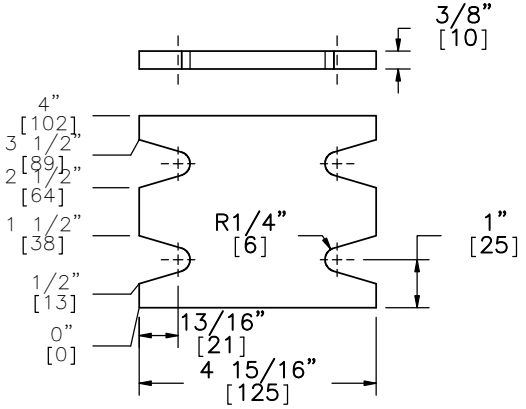
S3x5.7 [S76 x 8.5] Post
Part b2



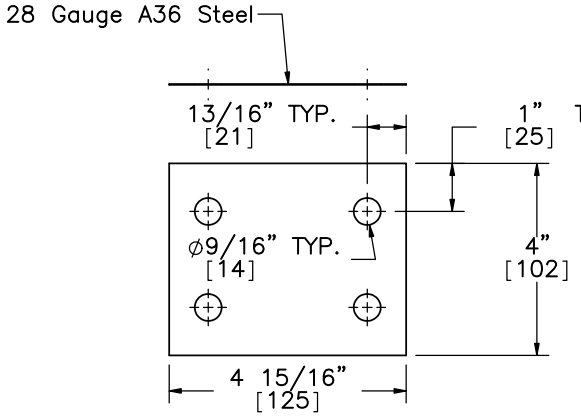
Note: Tabs to be bent after all cables have been installed and tensioned to secure.



DETAIL K



2nd Post Base Plate
Part b14



2nd Post Keeper Plate
Part b5

Cable Hanger
Part c12

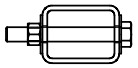
Midwest Roadside Safety Facility

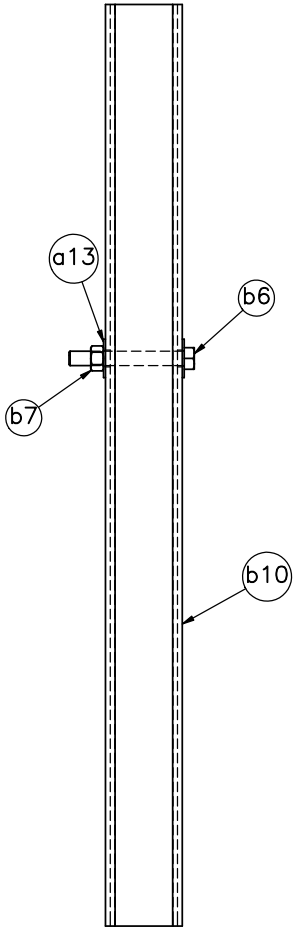
4–Cable Median Barrier

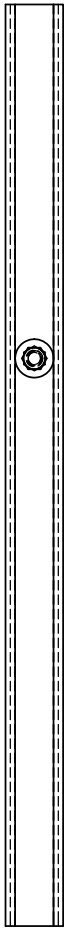
Cable Hanger Assembly
Post Nos. 2 & 39

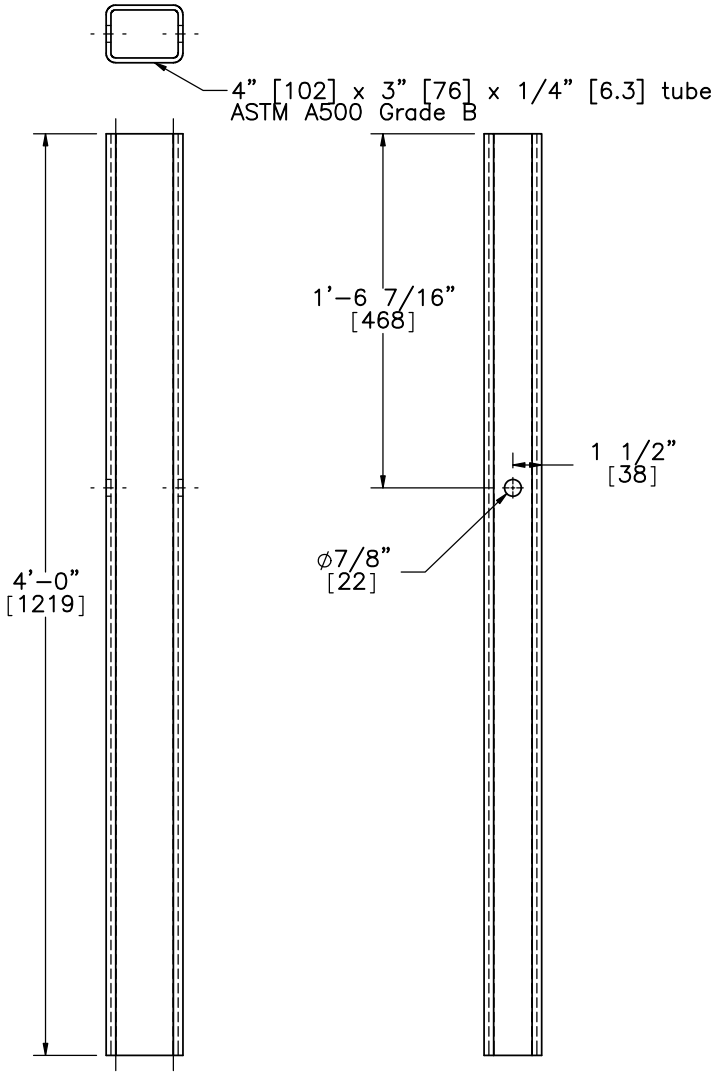
SHEET: 14 of 23
DATE: 11/17/11
DRAWN BY: MJW/MDM/JGP
REV. BY: KAL/CLM/RWB

DWG. NAME. 4CMB-4_R9
SCALE: 1:8
UNITS: In.[mm]









2nd Post Foundatoin Tube
Part b11

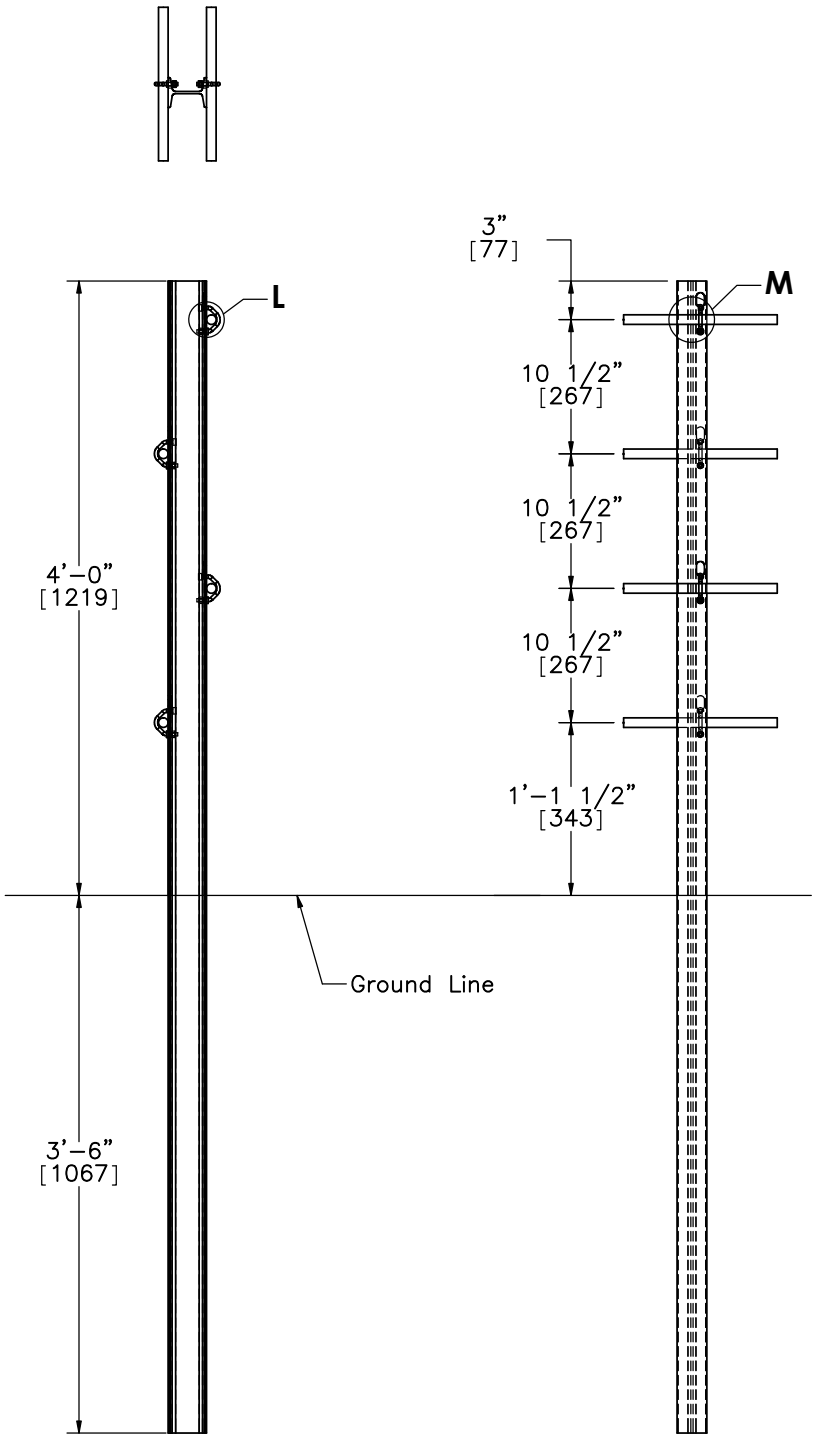
Midwest Roadside Safety Facility

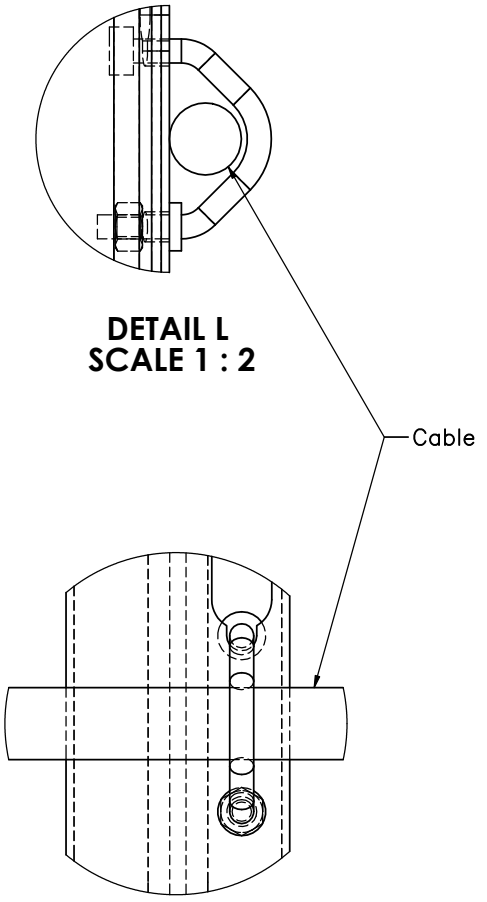
4-Cable Median Barrier

Foundation Tube Assembly
Post Nos. 2 & 39

SHEET: 15 of 23
DATE: 11/17/11
DRAWN BY: MJW/MDM/JGP
REV. BY: KAL/CLM/RWB

DWG. NAME. 4CMB-4_R9
SCALE: 1:10
UNITS: In.[mm]





DETAIL L
SCALE 1 : 2

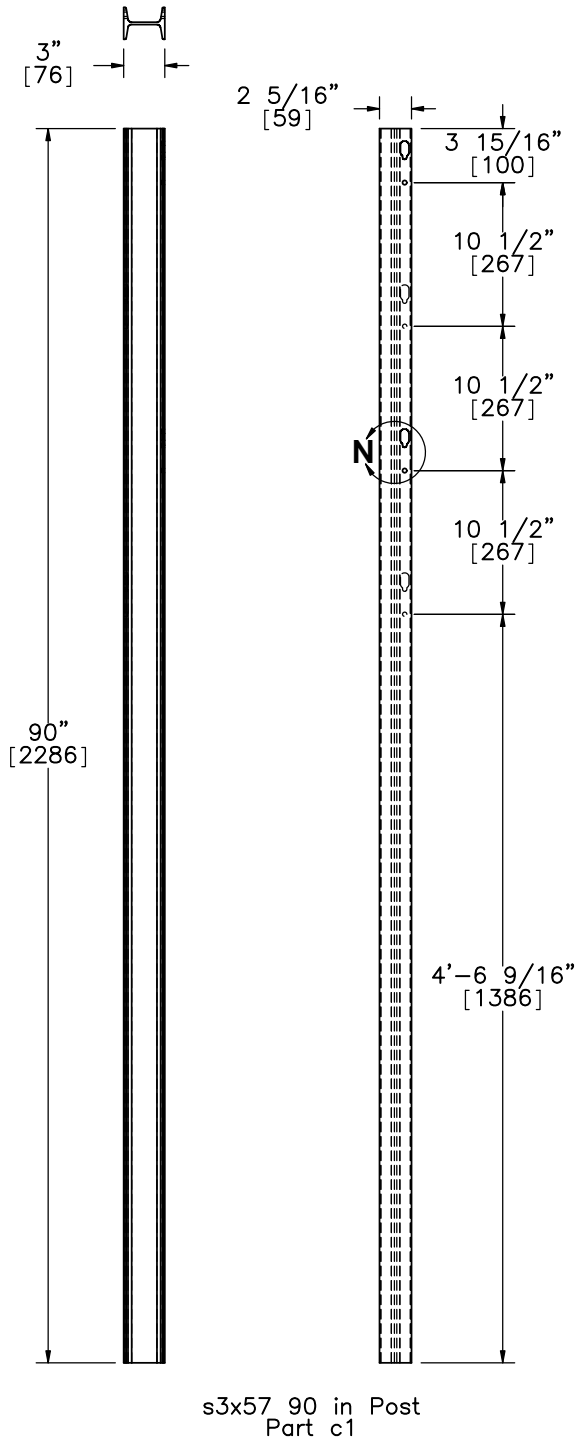
DETAIL M
SCALE 1 : 2

Midwest Roadside Safety Facility

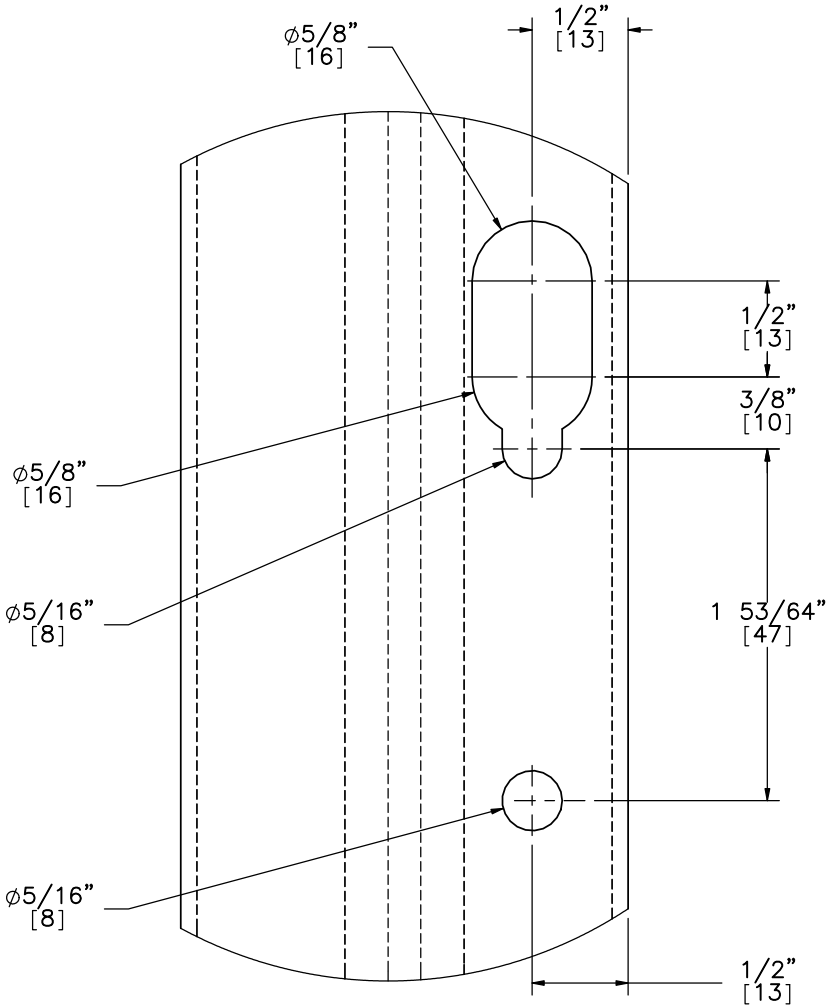
4–Cable Median Barrier

S3x5.7 Post Assembly

SHEET:	16 of 23
DATE:	11/17/11
DRAWN BY:	MJW/MDM/JGP
DWG. NAME.	4CMB–4_R9
SCALE: 1:15	
UNITS: In.[mm]	
REV. BY:	KAL/CLM/RWB

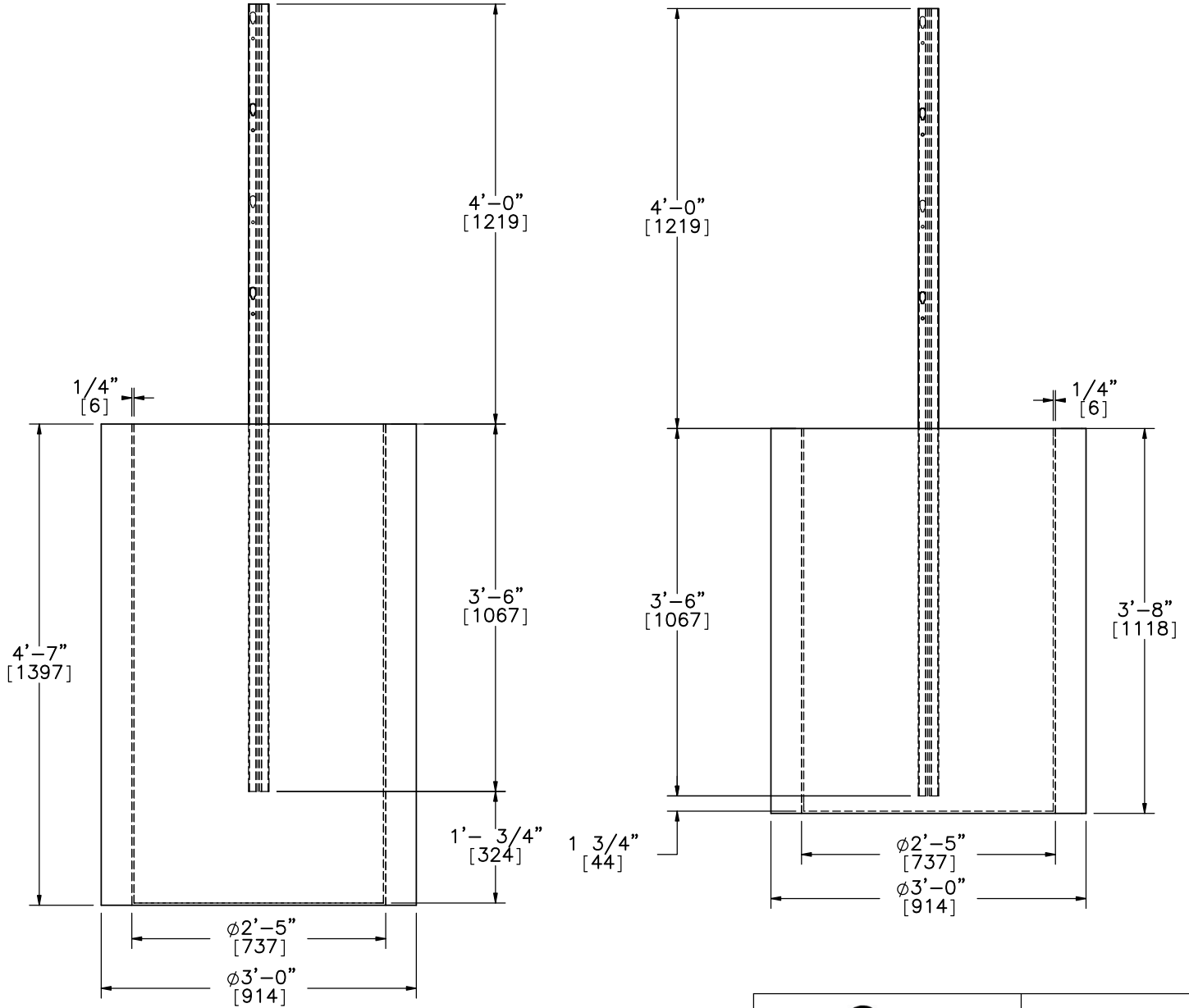


s3x57 90 in Post
Part c1



DETAIL N
SCALE 1 : 1

Midwest Roadside Safety Facility	4–Cable Median Barrier S3x5.7 90 in. Post	SHEET: 17 of 23 DATE: 11/17/11 DRAWN BY: MJW/MDM/JGP
DWG. NAME. 4CMB–4_R9	SCALE: 1:14 UNITS: In.[mm]	REV. BY: KAL/CLM/RWB



Midwest Roadside Safety Facility

4–Cable Median Barrier

Post 15–24 Barrel Details

SHEET: 18 of 23

DATE: 11/17/11

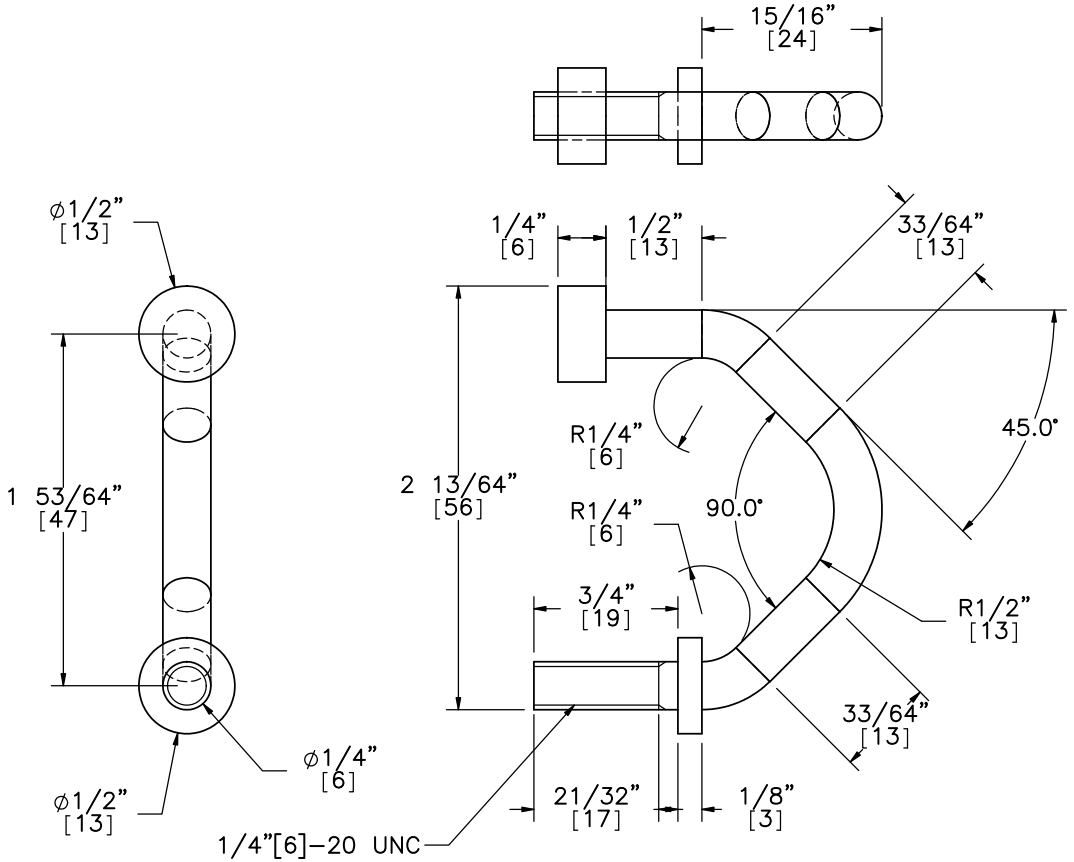
DRAWN BY: MJW/MDM/JGP

DWG. NAME. 4CMB–4_R9

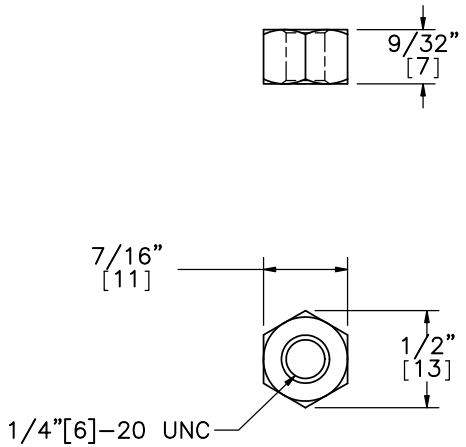
SCALE: 1:18

UNITS: In.[mm]

REV. BY: KAL/CLM/RWB



Keyway Bolt
Part c3

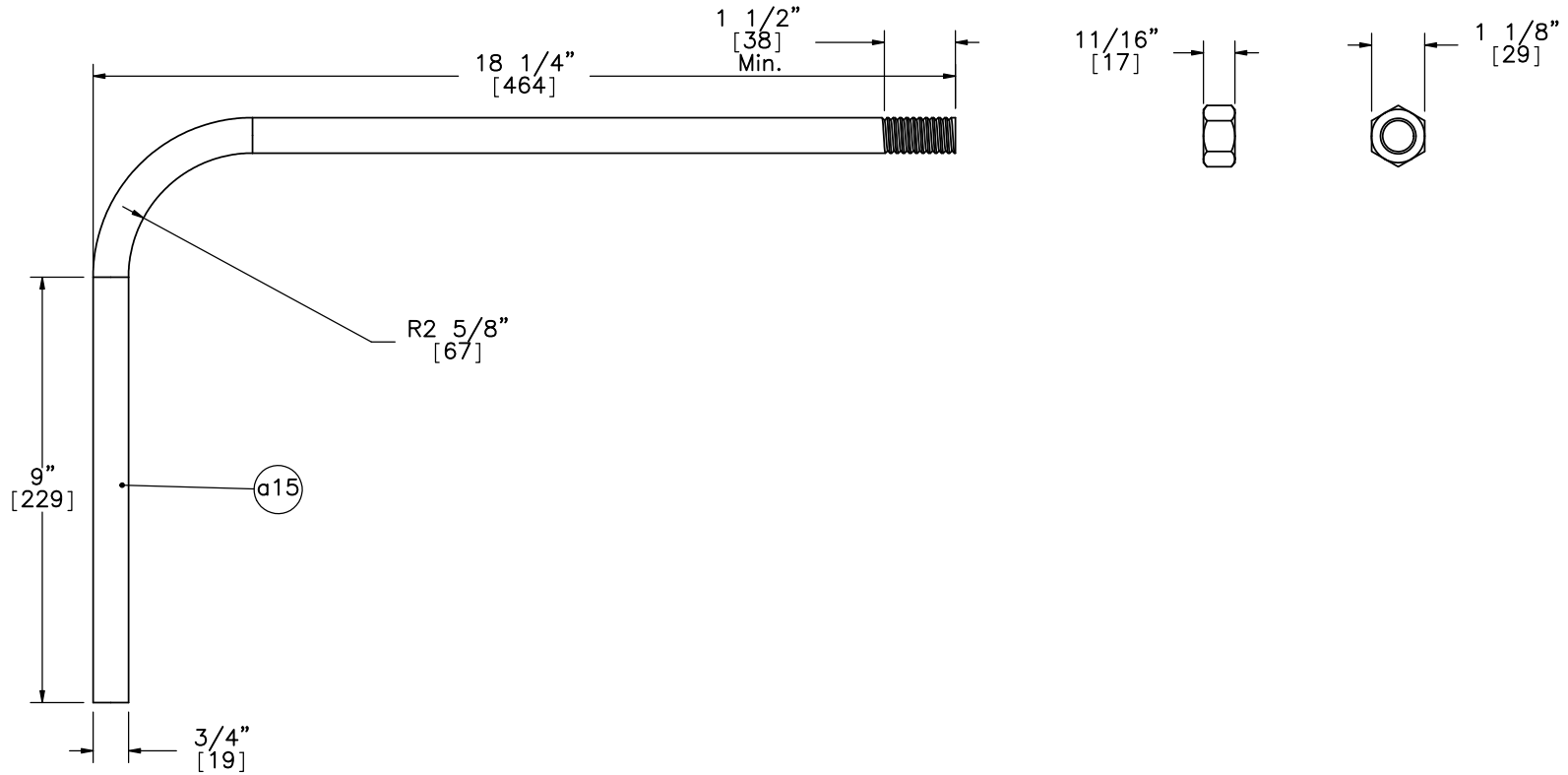


ϕ1/4" [6]–20 UNC
Grade 8 high topped
hex nut
Part c2

NOTES: (1) A449 steel should be used to fabricate the custom keyway bolts. This material has a yield strength of 92 ksi [634 MPa], and ultimate strength of 120 ksi [827 MPa], and a 16% elongation to fracture.

(2) Both the custom bolt and nut hardware are to be galvanized.

Midwest Roadside Safety Facility	4–Cable Median Barrier Keyway Bolt Details	SHEET: 19 of 23 DATE: 11/17/11 DRAWN BY: MJW/MDM/JGP
	DWG. NAME. 4CMB–4_R9 SCALE: 1:1 UNITS: In.[mm]	REV. BY: KAL/CLM/RWB



Note: (1) Total length is 28 9/16" [725].

(2) Outermost J–Hooks in anchor assembly were trimmed to fit inside reinforcement hoops.

MWRSF Midwest Roadside Safety Facility	4–Cable Median Barrier J–Hook Anchor Stud and Nut – Part a15	SHEET: 20 of 23 DATE: 11/17/11 DRAWN BY: MJW/MDM/JGP
DWG. NAME. 4CMB–4_R9	SCALE: 1:4 UNITS: In.[mm]	REV. BY: KAL/CLM/RWB

Four Cable Median Barrier Bill of Materials				
Item No.	QTY.	Description	Material Spec	Hardware Guide
a1	2	Cable Anchor Base Plate	A36 Steel	FPA02
a2	4	Exterior Cable Plate Gusset	A36 Steel	FPA02
a3	6	Interior Cable Plate Gusset	A36 Steel	FPA02
a4	2	Anchor Bracket Plate	A36 Steel	FPA02
a5	2	3/16" [5] Dia. Brass Keeper Rod, 14" [356] long	Brass	–
a6	4	Release Gusset	A36 Steel	–
a7	2	Release Lever Plate	A36 Steel	–
a8	4	1.25x1.25x0.1875" [32x32x5] TS CT Kicker Lever Tube	ASTM A500 Grade B	–
a9	8	CMB High Tension Anchor Plate Washer	A36 Steel	–
a10	2	1.25x1.25x0.1875" [32x32x5] TS CT Kicker Lever Connecting Tube	ASTM A 500 Grade B	–
a11	2	3x10x0.5" [76x254x13] Kicker Plate	A36 Steel	–
a12	4	CT kicker – gusset	A36 Steel	–
a13	20	3/4" [19] Dia. Flat Washer	Grade 2	FWC20a
a15	16	3/4" Dia. J–Hook Anchor and Nut	A449	FRJ16a
a16	2	1/4" [6] Dia. Aircraft Retaining Cable, 36" [914] long	7x19 galvanized	–
a17	2	5/8" [16] Dia. Heavy Hex Nut	Grade 5	–
a18	2	5/8" [16] Dia. x 9 1/2" [241] long Hex Bolt	Grade 5	
a19	2	24" [610] Dia. Concrete Anchor, 120" [3048] long	4,000 psi f'c	–
a20	16	#11 Straight Rebar, 114" [2896] long	Grade 60	–
a21	44	#4 Anchor Hoop Rebar with 21" [533] Dia.	Grade 60	–
b1	2	S3x5.7 [S76x8.5] Post by 28 1/8" [714]	ASTM A572 GR50–07, ASTM A709 GR50–09A, ASTM A992–06A	–
b2	2	S3x5.7 [S76x8.5] Post by 19" [483]	ASTM A572 GR50–07, ASTM A709 GR50–09A, ASTM A992–06A	
b3	8	#3 Straight Rebar, 43" [1092] long	Grade 60	–
b4	22	7 1/4" [184] Dia. No. 3 Hoop Reinforcement	Grade 60	–
b5	2	2nd Post Keeper Plate, 28 Gauge	A36	–
b6	2	3/4" [19] Dia. x 6" [152] long Hex Bolt and Nut	A307	FBX20a
b7	2	3/4" [19] Dia. Hex Nut	Grade 2	FNX20a
b8	24	1/2" [13] Dia. Washer	A307	FWC14a
b9	8	1/2" [13] Dia. x 2 1/2" [64] long Hex Bolt and Nut	A307	FBX14a
b10	2	4x3x1/4" [102x76x6] Foundation Tube, 48" [1168] long	ASTM A500 Grade B	–
b11	2	2nd Post Cable Hanger	A36	–
b12	2	2nd Post Anchor Aggregate 12 in, Depth	–	–
b13	2	12" [305] Dia. 2nd Post Concrete Anchor, 46" [1168] long	4,000 psi f'c	–
b14	4	2nd Post Base Plate	A36	–
c1	36	S3x5.7 [S76x8.5] by 90" [1524]	ASTM A572 GR50–07, ASTM A709 GR50–09A, ASTM A992–06A	–
c2	144	1/4" [6] Dia. – 20 UNC Hex Nut High Topped	Grade 8 – Galvanized	–
c3	144	1/4" [6] dia. Keyway bolt	A449 – Galvanized	–

Midwest Roadside Safety Facility

4–Cable Median Barrier

Bill of Materials

SHEET: 21 of 23

DATE: 11/17/11

DRAWN BY: MJW/MDM/JGP

DWG. NAME. 4CMB–4_R9

SCALE: None

UNITS: In.[mm]

REV. BY: KAL/CLM/RWB

Four Cable Median Barrier Bill of Materials Continued				
Item No.	QTY.	Description	Material Spec	Hardware Guide
d1	4	3/4" [19] Dia. High Strength Pre-Stretched Cable Guiderail	3x7 Cl A Galvanized	RCM01
d2	16	7/8" [22] Dia. Hex Nut	A563	RCE03
d3	20	7/8" [22] Cable End Threaded Rod	ASTM-A449	RCE03
d4	16	Bennet Cable End Fitter	ASTM-A47	RCE03
d5	16	7/8" Dia. Square Nut	Grade 5	FNS20
d6	8	CMB Splice Cable Insert	Brass (unknown)	-
d7	8	CMB Splice Threaded Rope Connector	Steel (unknown)	-
d8	4	Bennet Cable End Fitter	Steel (unknown)	-
e1	4	Bennet Short Threaded Turnbuckle	Not Specified	-
e2	8	Threaded Loadcell Coupler	N/A	-
e3	4	50,000-lb Load Cell	N/A	-

Post no. (S to N)	Clip type	Upstream or Downstream	Post set in Plastic Container	4CMB-3 Post	Other Info	A449 Bolt Grade 8 Nut
1	na - anchor	na	no	yes	same anchor hardware from previous testing	no
2	na - breakaway hanger post	na	no	no	replaced due to damage from rod clip bogie testing	no
3	Keyway bolt type (current)	upstream	no	no	installed and fabricated for upstream location	no
4	Keyway bolt type (current)	upstream	no	no	installed and fabricated for upstream location	no
5	Keyway bolt type (current)	upstream	no	no	installed and fabricated for upstream location	no
6	Keyway bolt type (current)	upstream	no	no	installed and fabricated for upstream location	no
7	Keyway bolt type (current)	upstream	no	no	installed and fabricated for upstream location	no
8	Keyway bolt type (current)	upstream	no	no	installed and fabricated for upstream location	no
9	Keyway bolt type (current)	upstream	no	no	installed and fabricated for upstream location	no
10	Keyway bolt type (current)	upstream	no	no	installed and fabricated for upstream location	no
11	Keyway bolt type (current)	upstream	no	no	installed and fabricated for upstream location	no
12	Keyway bolt type (current)	upstream	no	no	installed and fabricated for upstream location	yes
13	Keyway bolt type (current)	upstream	no	no	installed and fabricated for upstream location	yes
14	Keyway bolt type (current)	upstream	no	no	installed and fabricated for upstream location	yes
15	Keyway bolt type (current)	downstream	yes	no	refabricated and installed to match current design	yes
16	Keyway bolt type (current)	downstream	yes	no	refabricated and installed to match current design	yes
17	Keyway bolt type (current)	downstream	yes	no	refabricated and installed to match current design	yes
18	Keyway bolt type (current)	downstream	yes	no	refabricated and installed to match current design	yes
19	Keyway bolt type (current)	downstream	yes	no	refabricated and installed to match current design	yes
20	Keyway bolt type (current)	downstream	yes	no	refabricated and installed to match current design	yes
21	Keyway bolt type (current)	downstream	yes	no	refabricated and installed to match current design	no
22	Keyway bolt type (current)	downstream	yes	no	refabricated and installed to match current design	no
23	Keyway bolt type (current)	downstream	yes	no	refabricated and installed to match current design	no
24	Keyway bolt type (current)	downstream	yes	no	refabricated and installed to match current design	no
25	Keyway bolt type (current)	downstream	no	no	refabricated and installed to match current design	no
26	Keyway bolt type (current)	downstream	no	no	refabricated and installed to match current design	no
27	Keyway bolt type (current)	upstream	no	no	installed and fabricated for upstream location	no
28	Keyway bolt type (current)	downstream	no	no	refabricated and installed to match current design	no
29	Keyway bolt type (current)	upstream	no	no	installed and fabricated for upstream location	no
30	bracket type clip	downstream	no	yes	4cmb-3 post	no
31	bracket type clip	downstream	no	yes	4cmb-3 post	no
32	bracket type clip	downstream	no	yes	4cmb-3 post	no
33	bracket type clip	downstream	no	yes	4cmb-3 post	no
34	bracket type clip	downstream	no	yes	4cmb-3 post	no
35	j-bolt - ran out of brackets	downstream	no	yes	4cmb-3 post	no
36	j-bolt - ran out of brackets	downstream	no	yes	4cmb-3 post	no
37	j-bolt - ran out of brackets	downstream	no	yes	4cmb-3 post	no
38	j-bolt - ran out of brackets	downstream	no	yes	4cmb-3 post	no
39	na - breakaway hanger post	na	no	yes	4cmb-3 post	no
40	na - anchor	na	no	yes	4cmb-3 post	no

Static: pulled the north post to replace saturated soil. Could not get out saturated soil. Decided to re-set it and go with frozen soil after original installation of critical zone which go filled in with water with 2" rain. Top 6-8" froze and did a static test with bobcat to see if post would rotate or yield, it yielded. Soil started to thaw again week of 12/6 waited to re-freeze to test south static post from original soil for critical zone did not pull it, it will be tested first.

Photos of installation method and other construction work (slope standing water in all holes that have conatiners

Plastic Container locations:

Long Barrels (29 in dia x 55 in long x 0.25 in thick): Posts 15, 16, 21, 22.

Shorter Barrels (29 in dia x 44 in long x 0.25 in thick): Posts 17-20, 23, 24.

Static Post Barrels (36 in dia x 50 in long x 3/16 in thick)

Containers installed in 3' diam holes

HE8 used on all posts, container posts used current soil (stiff based on recent static), all other posts either driven or installed in 2' holes w/HE8 over a period of a few years - use previous notes and field book data if needed.

Midwest Roadside Safety Facility

4—Cable Median Barrier

Layout Info

SHEET: 23 of 23

DATE: 11/17/11

DRAWN BY: MJW/MDM/JGP

DWG. NAME. 4CMB-4_R9

SCALE: None

UNITS: In.[mm]

REV. BY: KAL/CLM/RWB