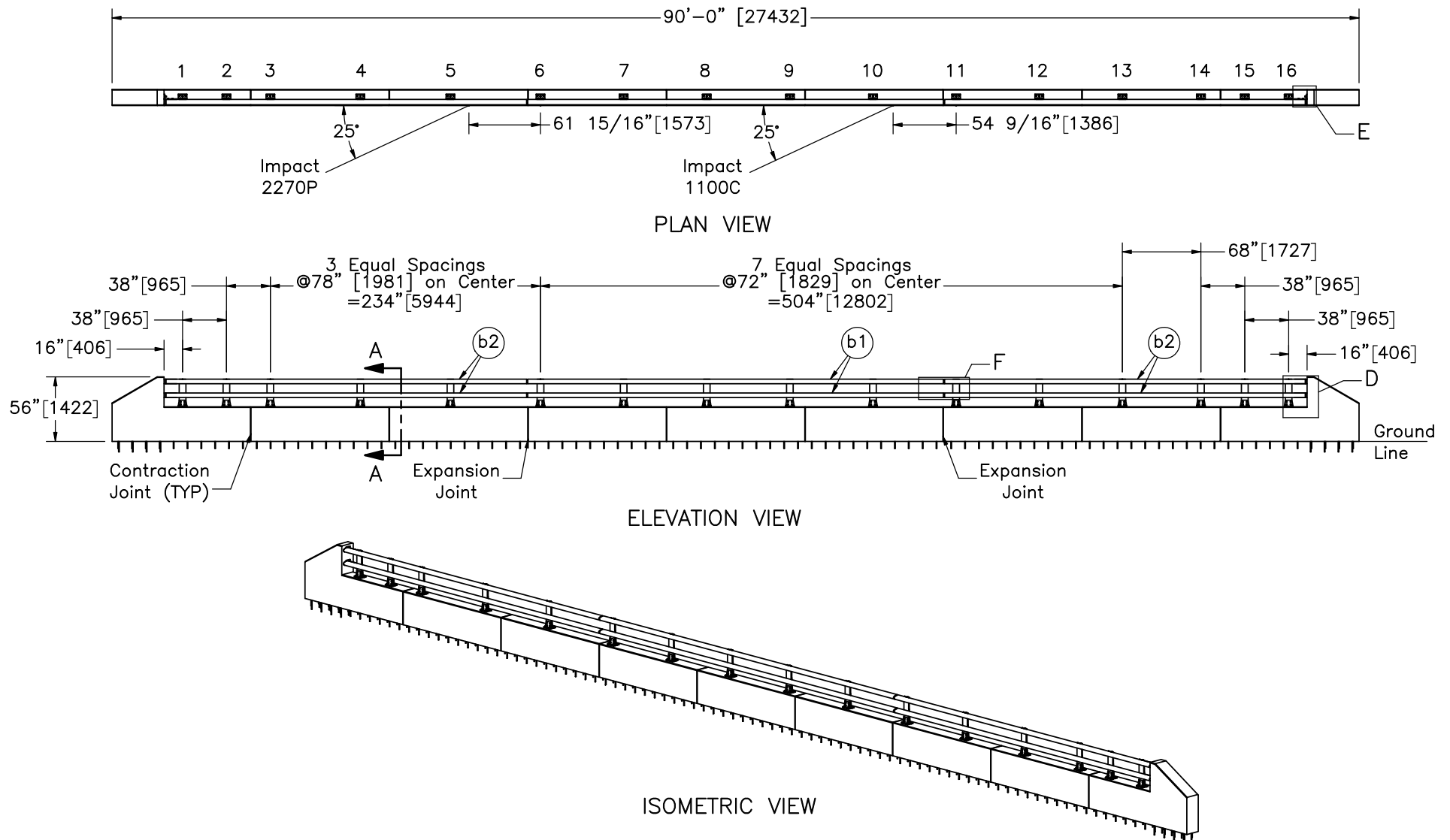




- Notes:
- (1) Test shall be performed according to test designations 3-10 and 3-11 using MASH 2016 criteria, respectively.
 - (2) The impact location for Test 1 is 54 9/16" [1386] upstream from centerline of post no. 11.
 - (3) The impact location for Test 2 is 61 15/16" [1573] upstream from centerline of post no. 6.
 - (4) Contraction joints consisting of a 1/2" [13] groove shall be inserted in the concrete parapet every 120" [3048]. An expansion joint shall be located every 360" [9144] in the parapet.
 - (5) One upstream or downstream threaded end anchor rod (part d2) must be epoxied in place and field tested to 10 kip [44.5 kN] according to NCDOT Level 1 Field Testing, described in NCDOT Spec PSP045, Form 909.



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

System Layout

DWG. NAME.
NCBR-1-2_R9

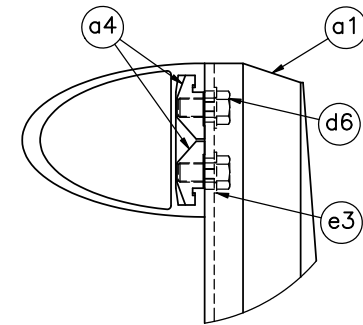
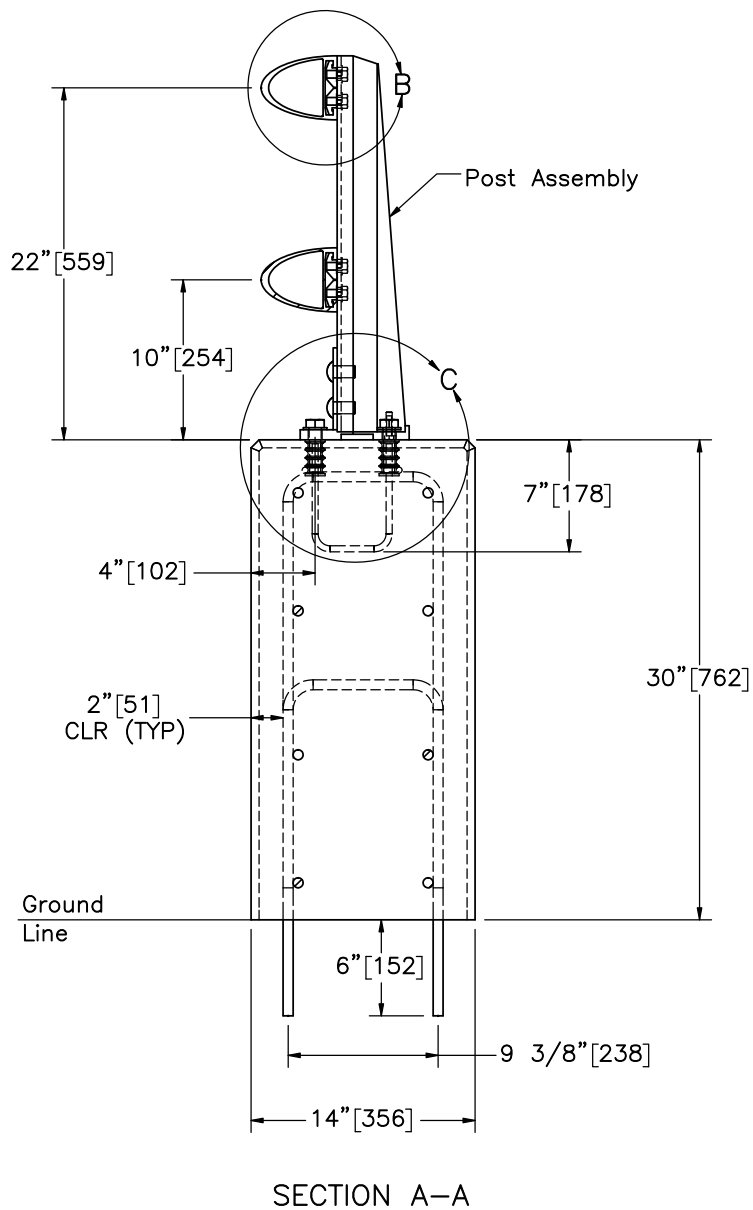
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UNITS: in./mm

SHEET:
1 of 27

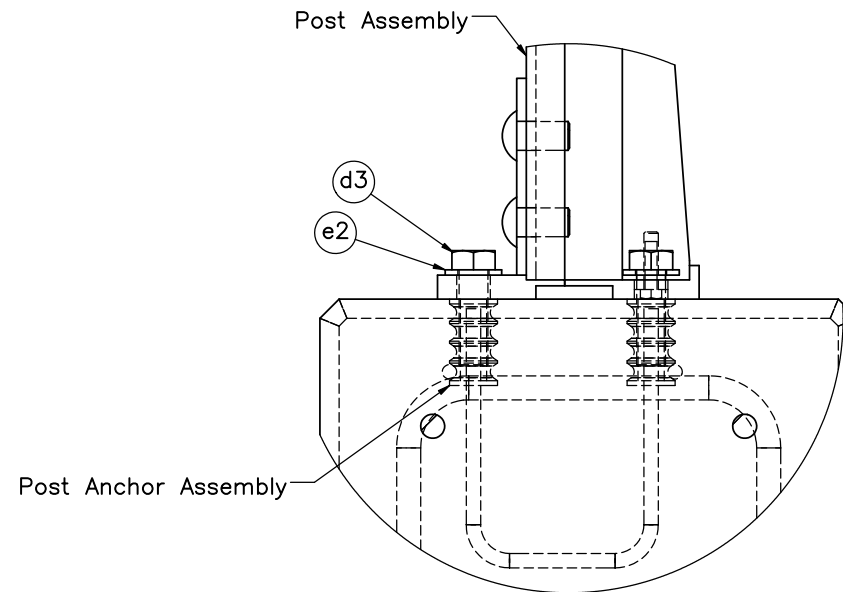
DATE:
5/8/2019

DRAWN BY:
JRD/MKB/
JEK/DJW

REV. BY:
JEK/CSS/
JCH



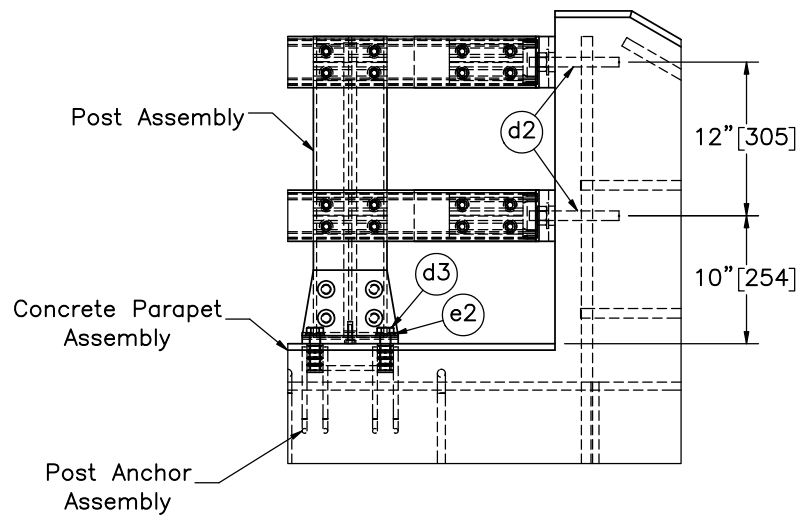
DETAIL B
SCALE 1:5



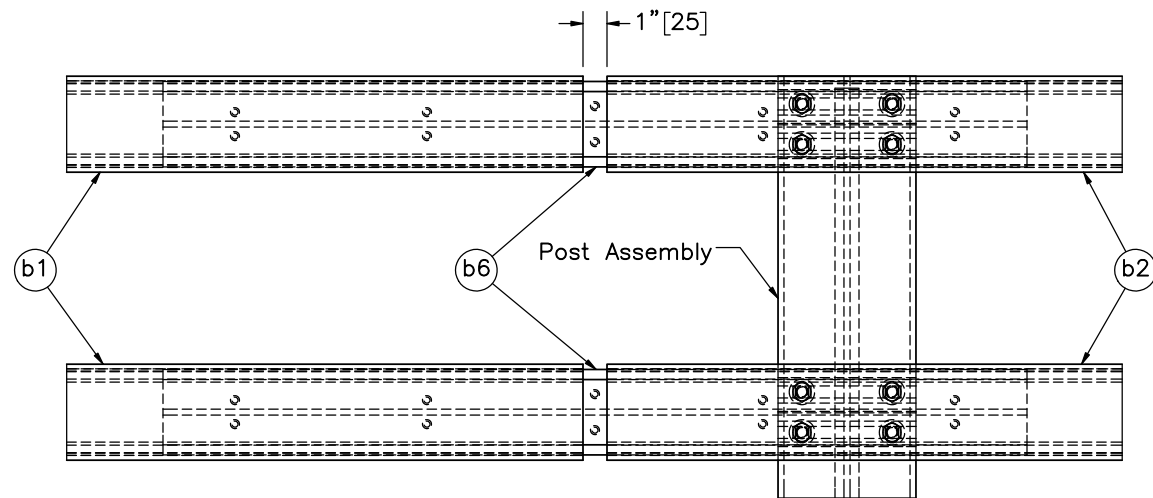
DETAIL C
SCALE 1:5

Note: (1) Bolts shall be tightened one half-turn from finger-tight position.

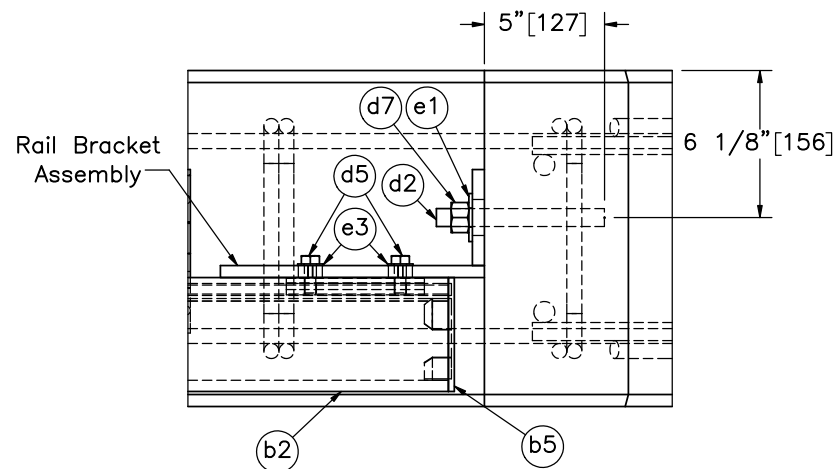
	NC Two-Bar Bridge Rail Test No. NCBR-1-2		SHEET: 2 of 27
	Section Detail		DATE: 5/8/2019
Midwest Roadside Safety Facility		DWG. NAME: NCBR-1-2_R9	DRAWN BY: JRD/MKB/ JEK/DJW
		SCALE: 1:12 UNITS: in.[mm]	REV. BY: JEK/CSS/ JCH



DETAIL D
SCALE 1:15



DETAIL F



DETAIL E

Note: (1) End Anchor (part d2) secured with Hilti RE 500 V3 or ATC Ultrabond 1 epoxy.



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Rail and Concrete Parapet
Details

DWG. NAME:
NCBR-1-2_R9

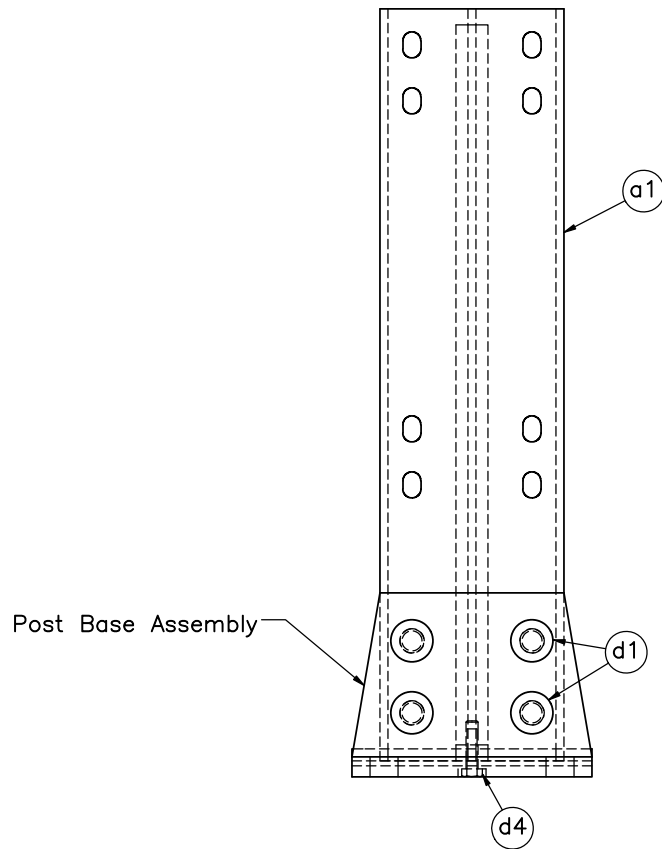
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SHEET:
3 of 27

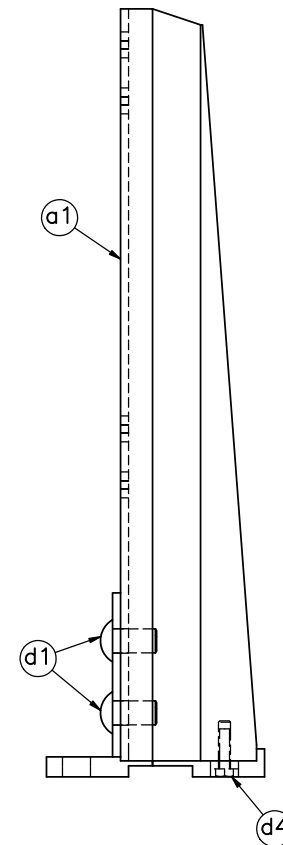
DATE:
5/8/2019

DRAWN BY:
JRD/MKB/
JEK/DJW

REV. BY:
JEK/CSS/
JCH



ELEVATION VIEW



PROFILE VIEW

Item No.	QTY.	Description	Material Specification	Treatment Specification
—	16	Post Assembly	—	—
—	1	Post Base Assembly	—	—
a1	1	5 3/4" x 4 1/4" [146x108], 23 1/2" [597] Long Post	ASTM B221 Alloy 6061-T6	—
d1	4	3/4" [19] Dia., 1 3/8" Long Rivet	ASTM B316 Alloy 6061-T6	—
d4	1	3/8"-16 UNC [M10x1.5], 1 1/2" [38] Long Cap Screw	ASTM F593 Alloy 305 Stainless Steel	—



Midwest Roadside
Safety Facility

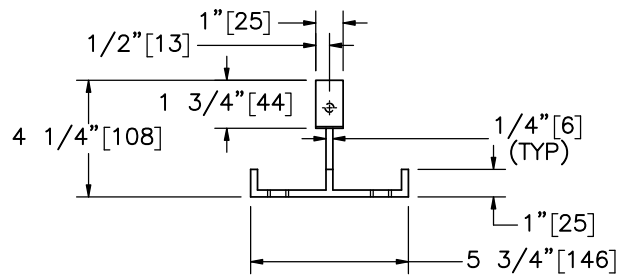
NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Post Assembly

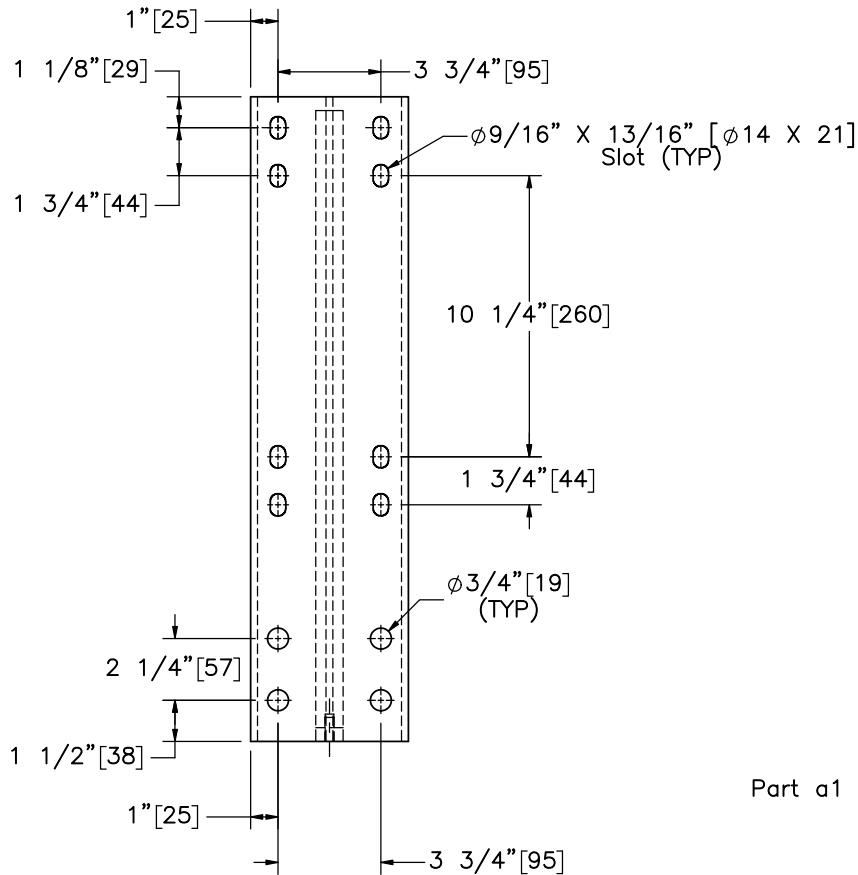
DWG. NAME.
NCBR-1-2_R9

SCALE: 1:6
UNITS: in.[mm]

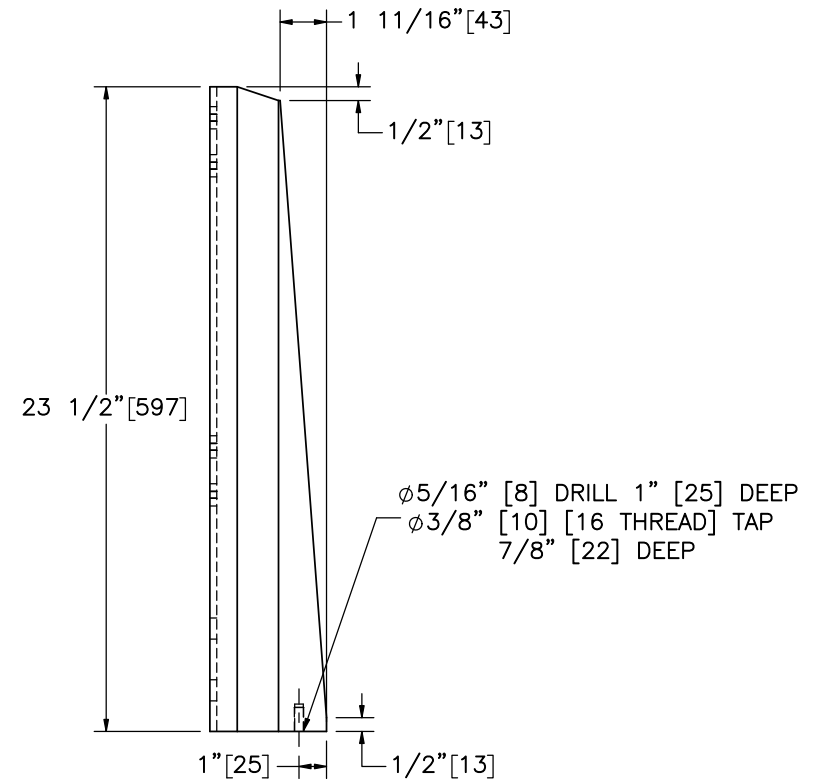
SHEET:
4 of 27
DATE:
5/8/2019
DRAWN BY:
JRD/MKB/
JEK/DJW
REV. BY:
JEK/CSS/
JCH



PLAN VIEW



ELEVATION VIEW



PROFILE VIEW

Part a1



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Post Detail

DWG. NAME.
NCBR-1-2_R9

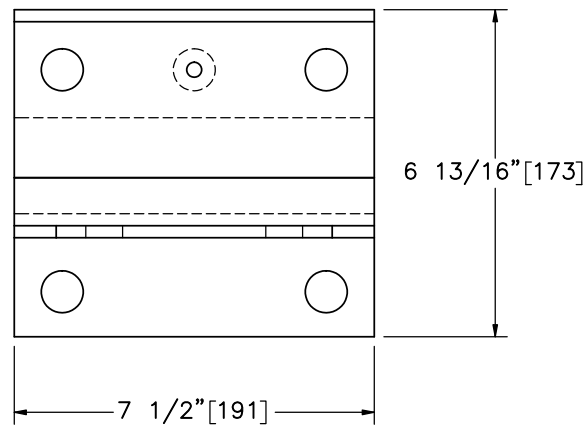
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SHEET:
5 of 27

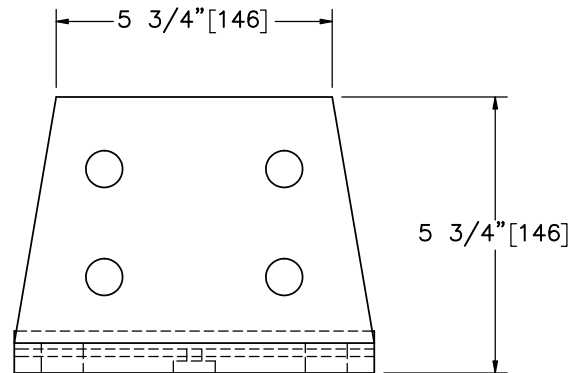
DATE:
5/8/2019

DRAWN BY:
JRD/MKB/
JEK/DJW

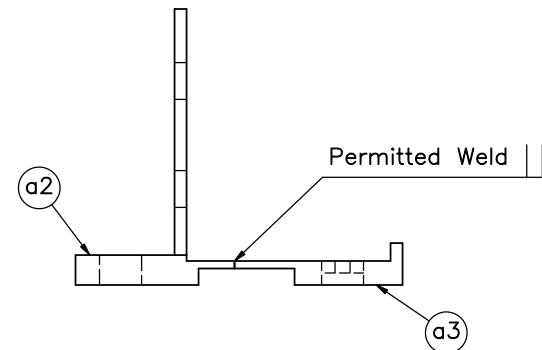
REV. BY:
JEK/CSS/
JCH



PLAN VIEW



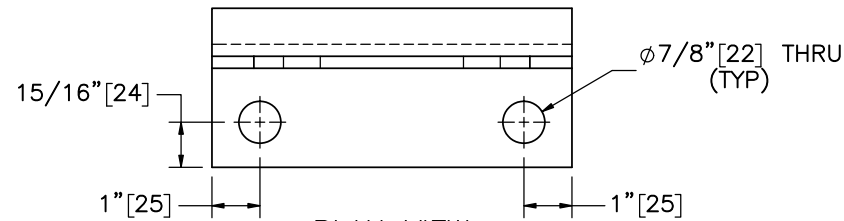
ELEVATION VIEW



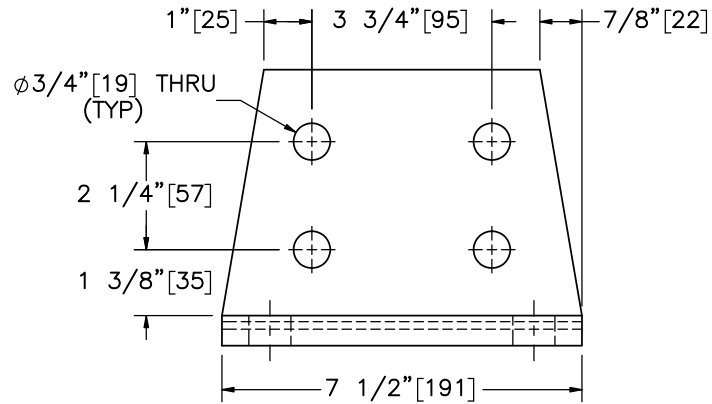
PROFILE VIEW

Note: (1) Base can be supplied as one extrusion or two extrusions welded together.

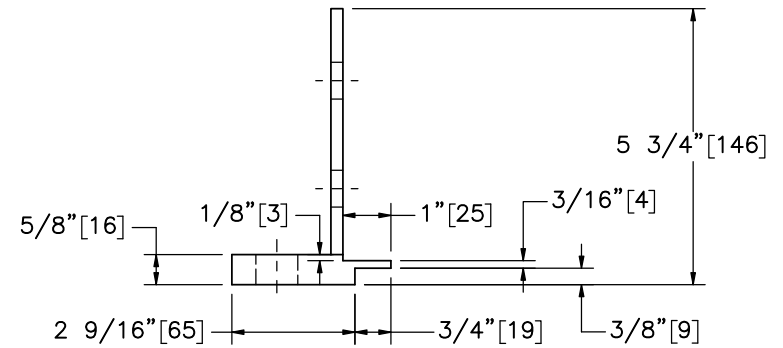
Item No.	QTY.	Description	Material Specification	Treatment Specification	 Midwest Roadside Safety Facility	NC Two-Bar Bridge Rail Test No. NCBR-1-2		SHEET: 6 of 27
-	16	Post Base Assembly	-	-		Post Base Assembly		DATE: 5/8/2019
a2	1	7 1/2"x3 5/16"x5 3/4" [191x84x146] Post Plate	ASTM B221 Alloy 6061-T6	-		DWG. NAME: NCBR-1-2_R9		DRAWN BY: JRD/MKB/ JEK/DJW
a3	1	7 1/2"x3 1/4"x7/8" [181x83x22] Post Plate	ASTM B221 Alloy 6061-T6	-		SCALE: 1:4 UNITS: in.[mm]	REV. BY: JEK/CSS/ JCH	



PLAN VIEW

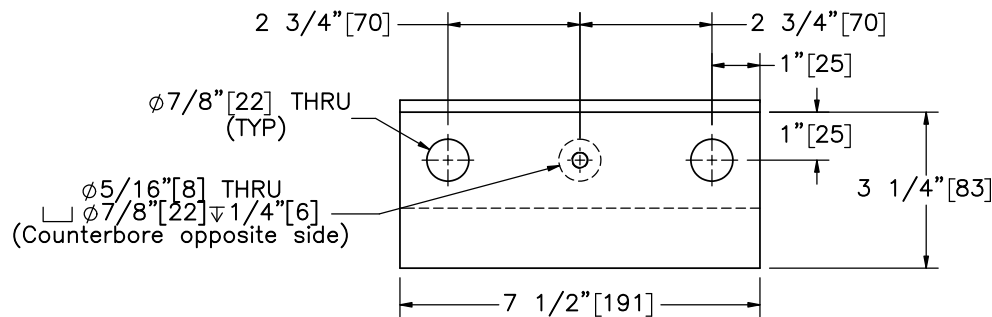


ELEVATION VIEW

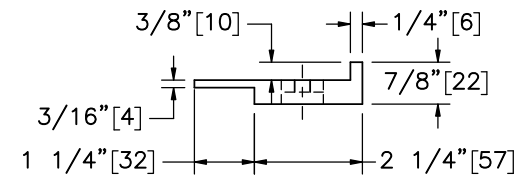


PROFILE VIEW

Part a2



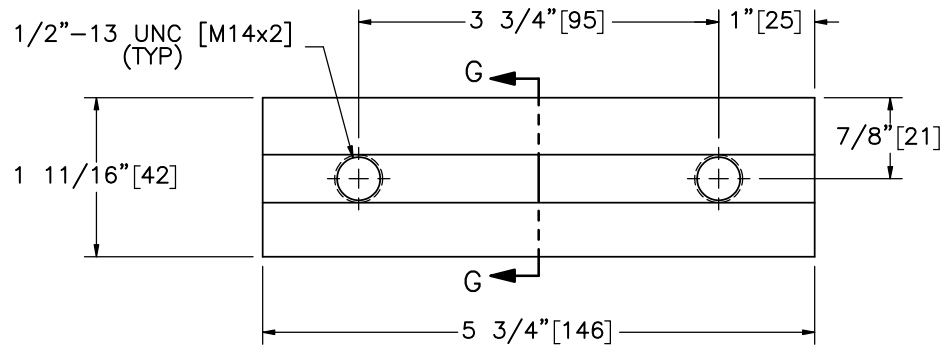
PLAN VIEW



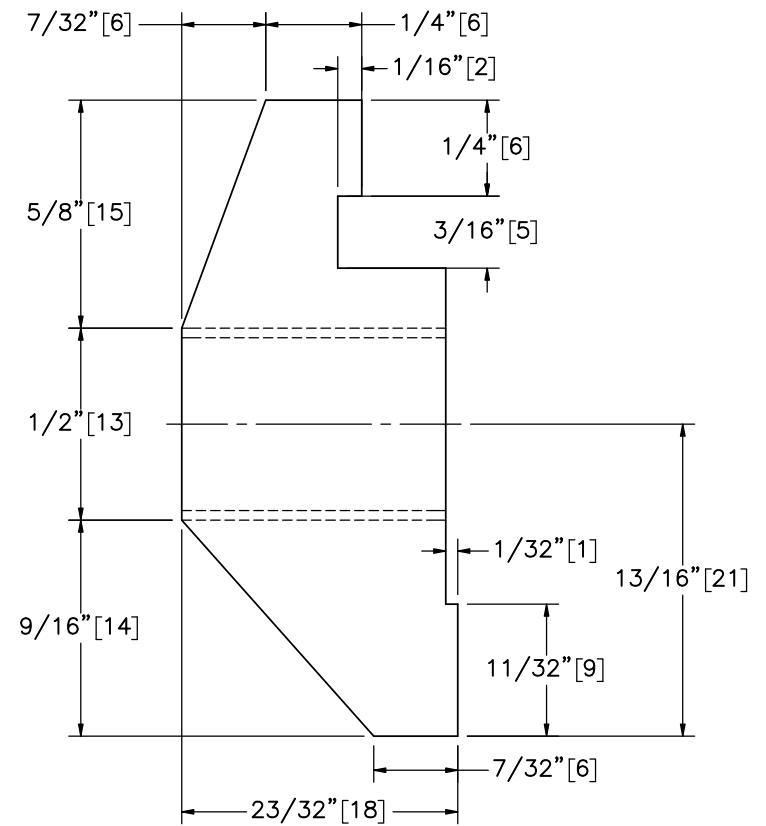
PROFILE VIEW

Part a3

	NC Two-Bar Bridge Rail Test No. NCBR-1-2		SHEET: 7 of 27
	Post Base Components		DATE: 5/8/2019
Midwest Roadside Safety Facility		DWG. NAME: NCBR-1-2_R9	DRAWN BY: JRD/MKB/ JEK/DJW
		SCALE: 1:4 UNITS: in.[mm]	REV. BY: JEK/CSS/ JCH



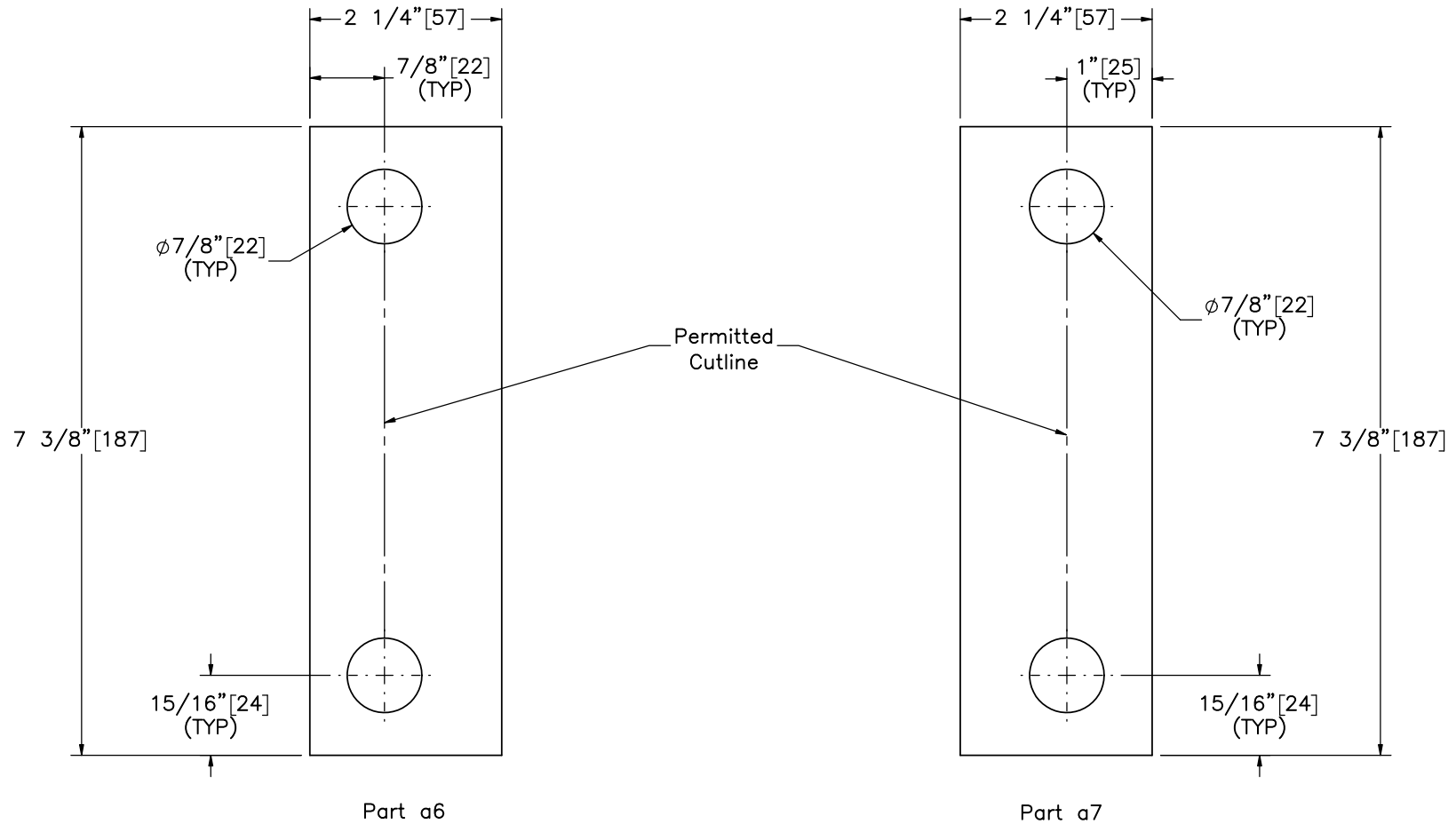
ELEVATION VIEW



SECTION G-G
SCALE 2:1

Part a4

	NC Two-Bar Bridge Rail Test No. NCBR-1-2		SHEET: 8 of 27
	Clamp Bar Detail		DATE: 5/8/2019
Midwest Roadside Safety Facility	DWG. NAME: NCBR-1-2_R9		DRAWN BY: JRD/MKB/ JEK/DJW
	SCALE: 1:2 UNITS: in.[mm]		REV. BY: JEK/CSS/ JCH



- Notes:
- (1) Shims may be used on posts as needed for alignment.
 - (2) Shims may be cut along permitted cutline or slotted to edge of plate to facilitate placement.



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Shim Details

DWG. NAME.
NCBR-1-2_R9

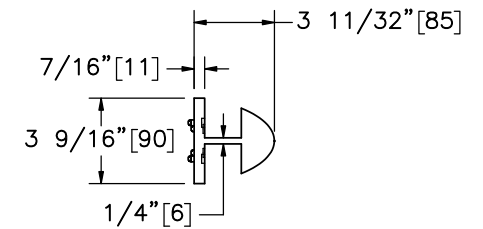
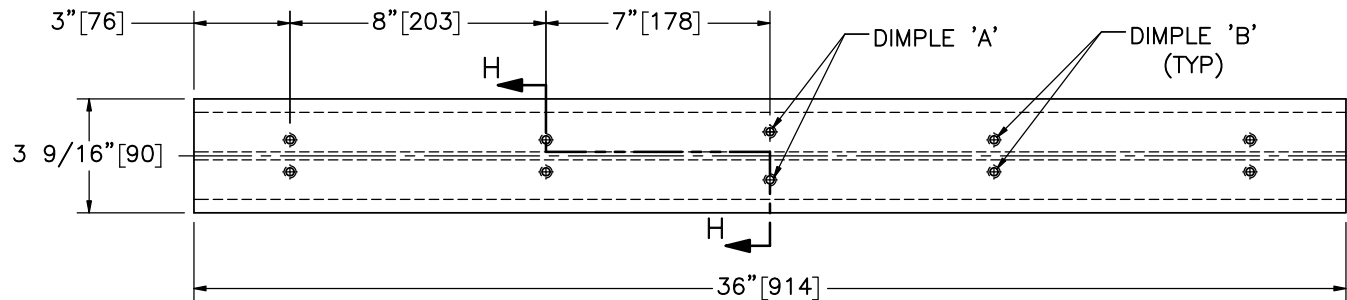
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UNITS: in.[mm]

SHEET:
9 of 27

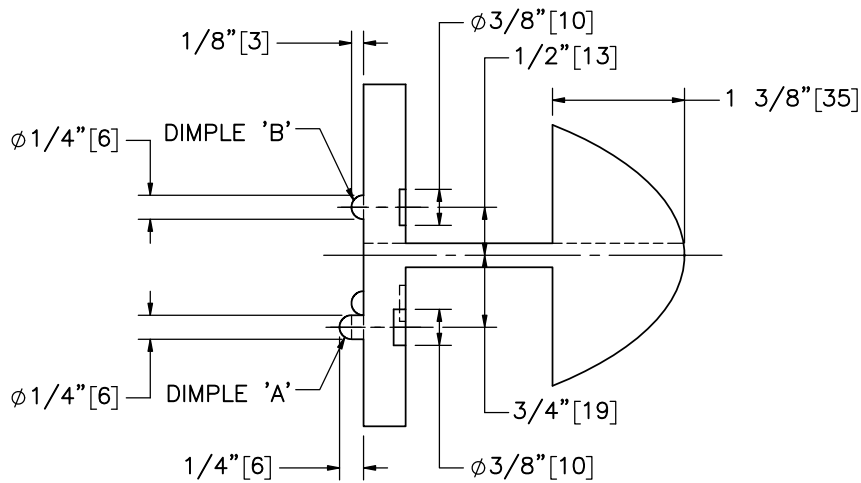
DATE:
5/8/2019

DRAWN BY:
JRD/MKB/
JEK/DJW

REV. BY:
JEK/CSS/
JCH



Part b6



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Expansion Bar Detail

DWG. NAME.
NCBR-1-2_R9

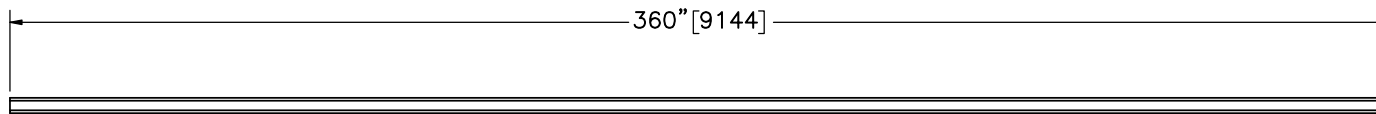
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SHEET:
10 of 27

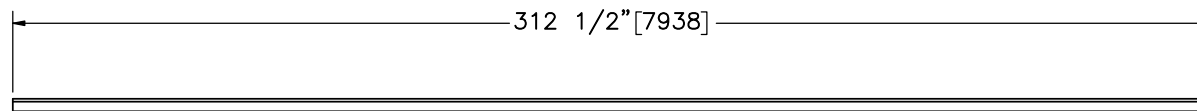
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5/8/2019

DRAWN BY:
JRD/MKB/
JEK/DJW

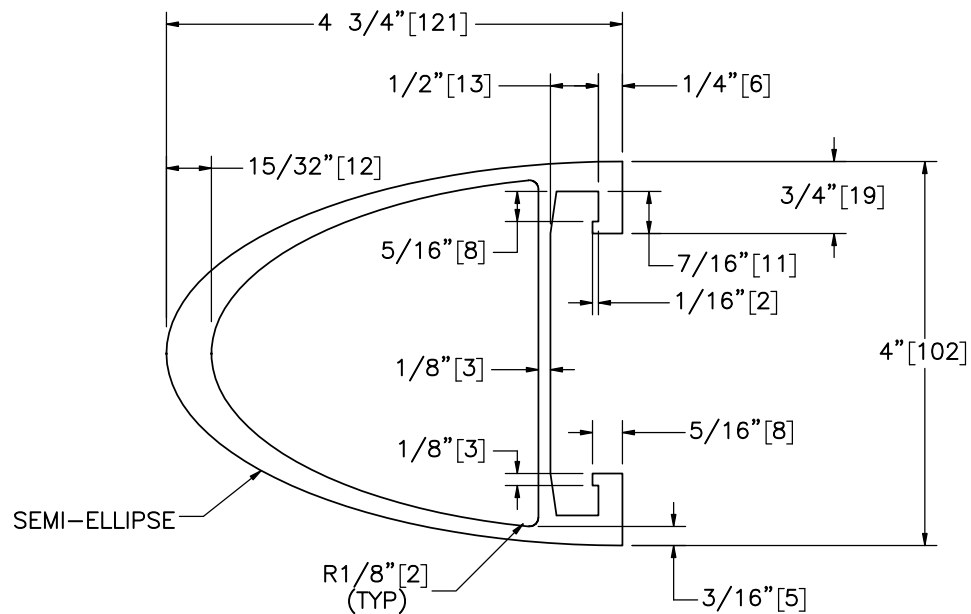
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JEK/CSS/
JCH



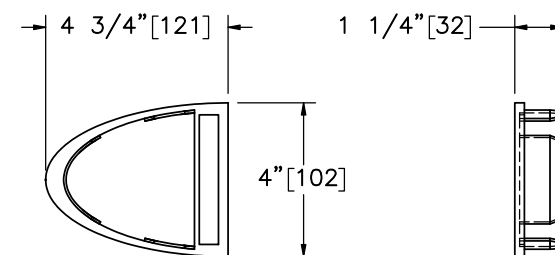
Part b1



Part b2



PROFILE VIEW
SCALE 1:2



PLAN VIEW

PROFILE VIEW

Part b5
SCALE 1:5



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Rail Components

DWG. NAME.
NCBR-1-2_R9

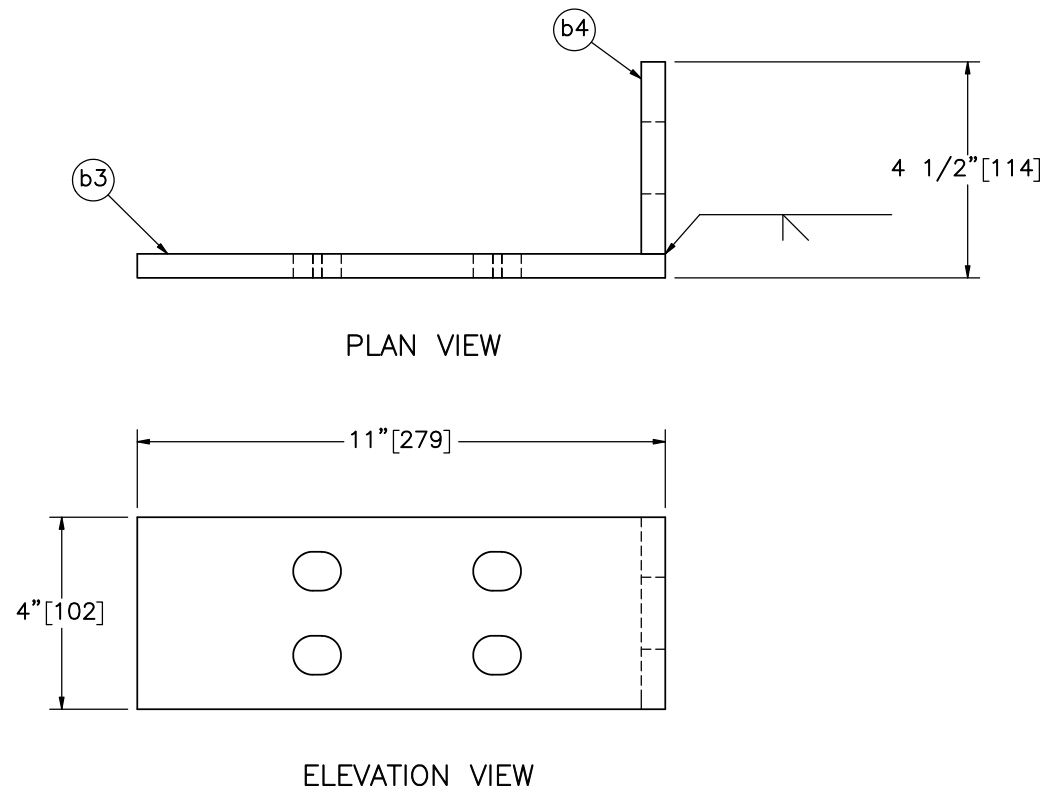
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SHEET:
11 of 27

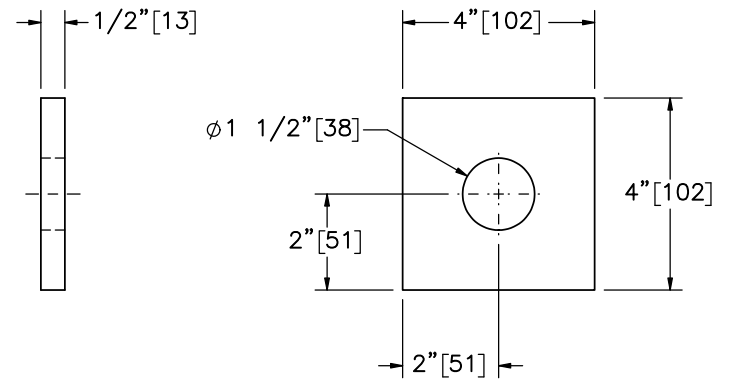
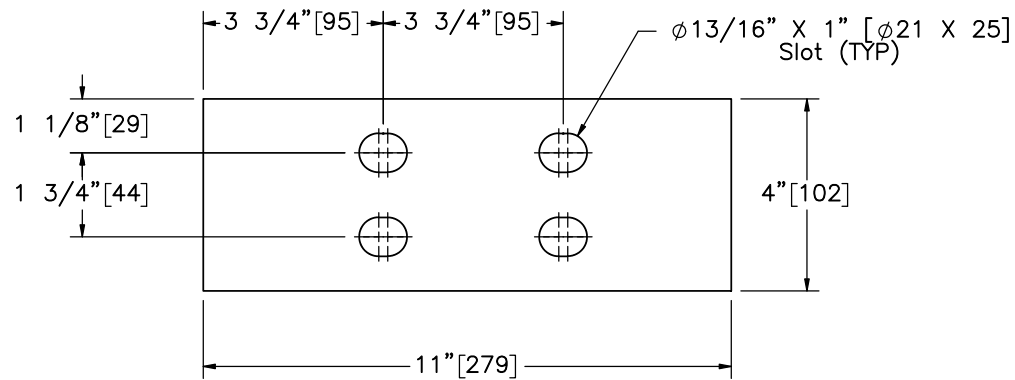
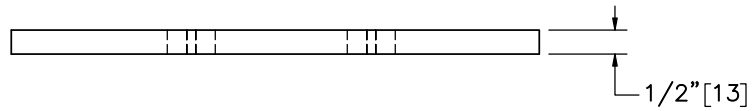
DATE:
5/8/2019

DRAWN BY:
JRD/MKB/
JEK/DJW

REV. BY:
JEK/CSS/
JCH



						NC Two-Bar Bridge Rail Test No. NCBR-1-2		SHEET: 12 of 27		
								DATE: 5/8/2019		
Item No.	QTY.	Description	Material Specification	Treatment Specification	Midwest Roadside Safety Facility		Rail Bracket Assembly		DRAWN BY: JRD/MKB/ JEK/DJW	
—	4	Rail Bracket Assembly	—	ASTM A123					REV. BY:	
b3	1	11"x4"x1/2" [279x102x13] Plate	ASTM A36	See Assembly					JEK/CSS/ JCH	
b4	1	4"x4"x1/2" [102x102x13] Plate	ASTM A36	See Assembly	DWG. NAME: NCBR-1-2_R9		SCALE: 1:4 UNITS: in.[mm]			



ELEVATION VIEW

PROFILE VIEW

Part b4



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Rail Bracket Components

DWG. NAME.
NCBR-1-2_R9

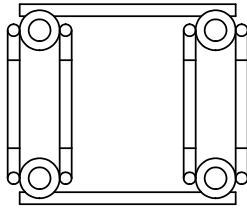
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UNITS: in.[mm]

SHEET:
13 of 27

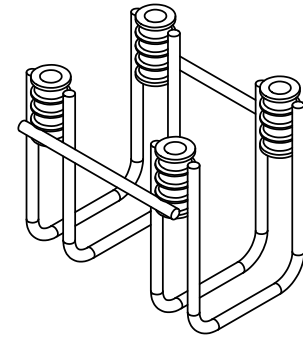
DATE:
5/8/2019

DRAWN BY:
JRD/MKB/
JEK/DJW

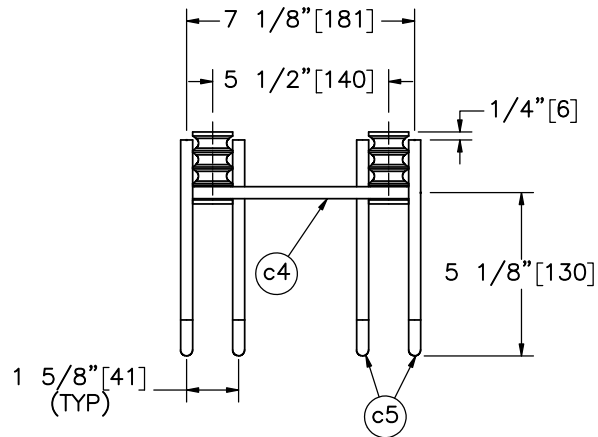
REV. BY:
JEK/CSS/
JCH



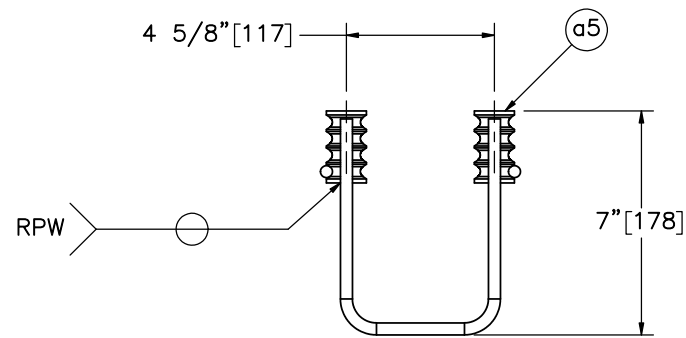
PLAN VIEW



ISOMETRIC VIEW



ELEVATION VIEW



PROFILE VIEW

Note: (1) Bolts shall be tightened one half-turn from finger-tight position.

Item No.	QTY.	Description	Material Specification	Treatment Specification
—	16	Post Anchor Assembly	—	—
a5	4	3/4" [19] Threaded Ferrule	ASTM A108 Gr. 12L14	ASTM A123
c4	2	3/8" [10] Dia. Wire Strut, 6 3/4" [171] Long	Min. Tensile Strength = 100,000 psi [690 MPa]	AASHTO M111
c5	4	3/8" [10] Dia. Wire Strut, 15 15/16" [405] Long Unbent	Min. Tensile Strength = 100,000 psi [690 MPa]	AASHTO M111



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Post Anchor Assembly

DWG. NAME.
NCBR-1-2_R9

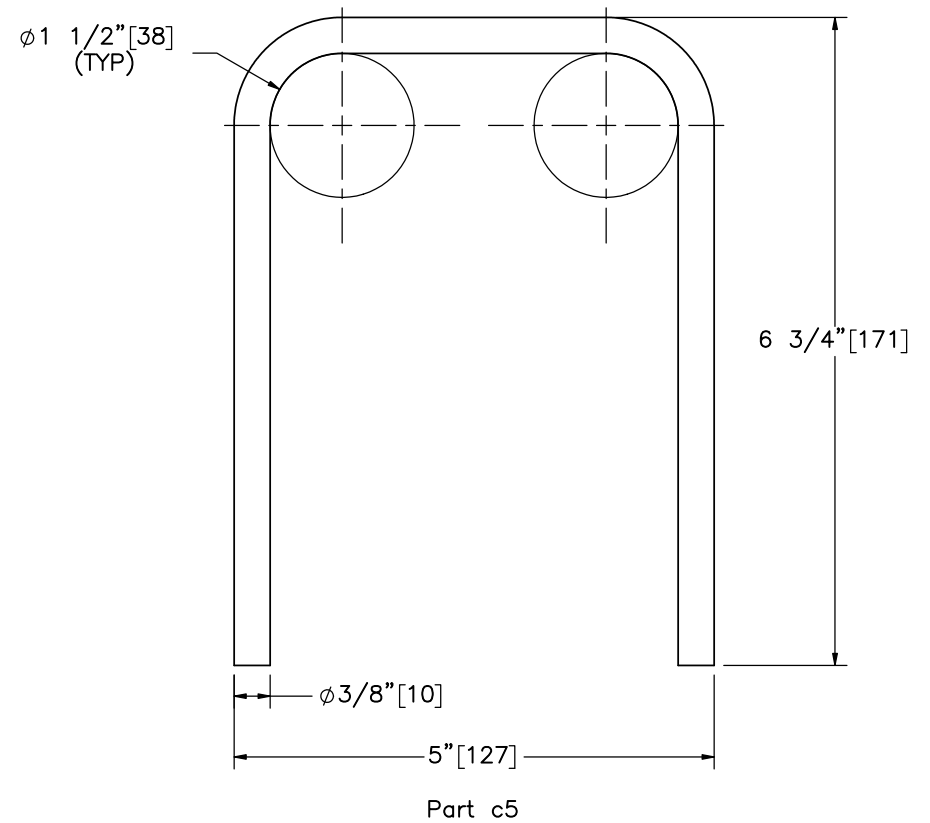
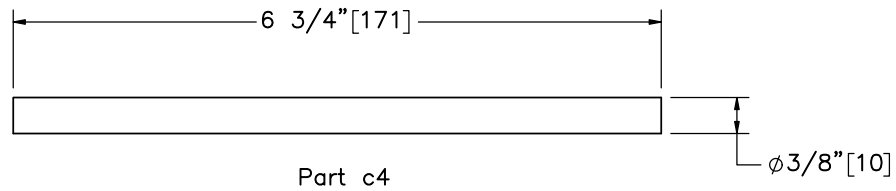
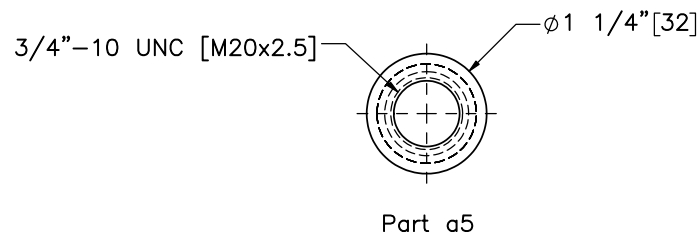
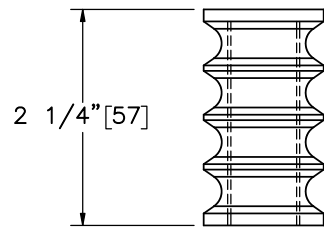
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UNITS: in./mm

SHEET:
14 of 27

DATE:
5/8/2019

DRAWN BY:
JRD/MKB/
JEK/DJW

REV. BY:
JEK/CSS/
JCH



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Concrete Anchor and Insert
Components

DWG. NAME.
NCBR-1-2_R9

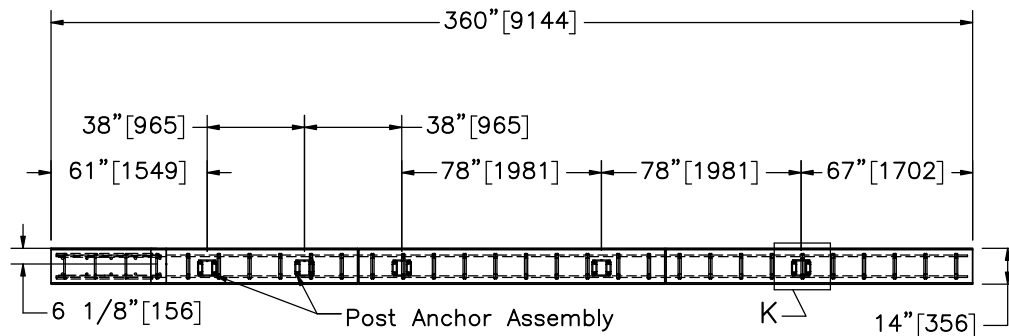
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SHEET:
15 of 27

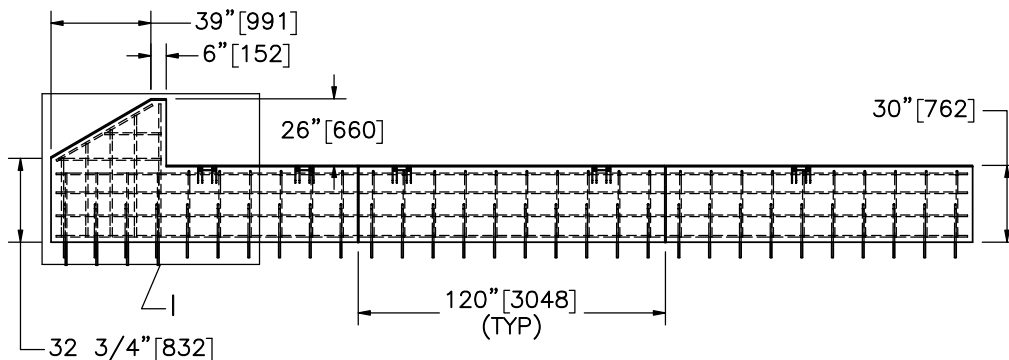
DATE:
5/8/2019

DRAWN BY:
JRD/MKB/
JEK/DJW

REV. BY:
JEK/CSS/
JCH



PLAN VIEW



ELEVATION VIEW

Item No.	QTY.	Description	Material Specification	Treatment Specification
—	1	Upstream Parapet Assembly	—	—
—	5	Post Anchor Assembly		
c1	1	Concrete	—	—
c6	26	#5 [16] 59 1/2" Long Unbent	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c8	8	#5 [16] 356" [9,042] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c9	8	#5 [16] Bar, 36" [914] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c10	30	#5 [16] Bar, 49 1/2" Long Unbent	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c11	2	#6 [19] Bar, 22" [559] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c12	2	#6 [19] Bar, 40" [1,016] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c13	2	#6 [19] Bar, 43 1/4" [1,099] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c14	2	#7 [22] Bar, 31" [787] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c15	2	#7 [22] Bar, 36 1/2" [927] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c16	2	#7 [22] Bar, 42" [1,067] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c17	2	#7 [22] Bar, 47 1/2" [1,207] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c18	2	#7 [22] Bar, 52" [1,321] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Upstream Concrete Parapet
Assembly

DWG. NAME:
NCBR-1-2_R9

SCALE: 1:75
UNITS: in.[mm]

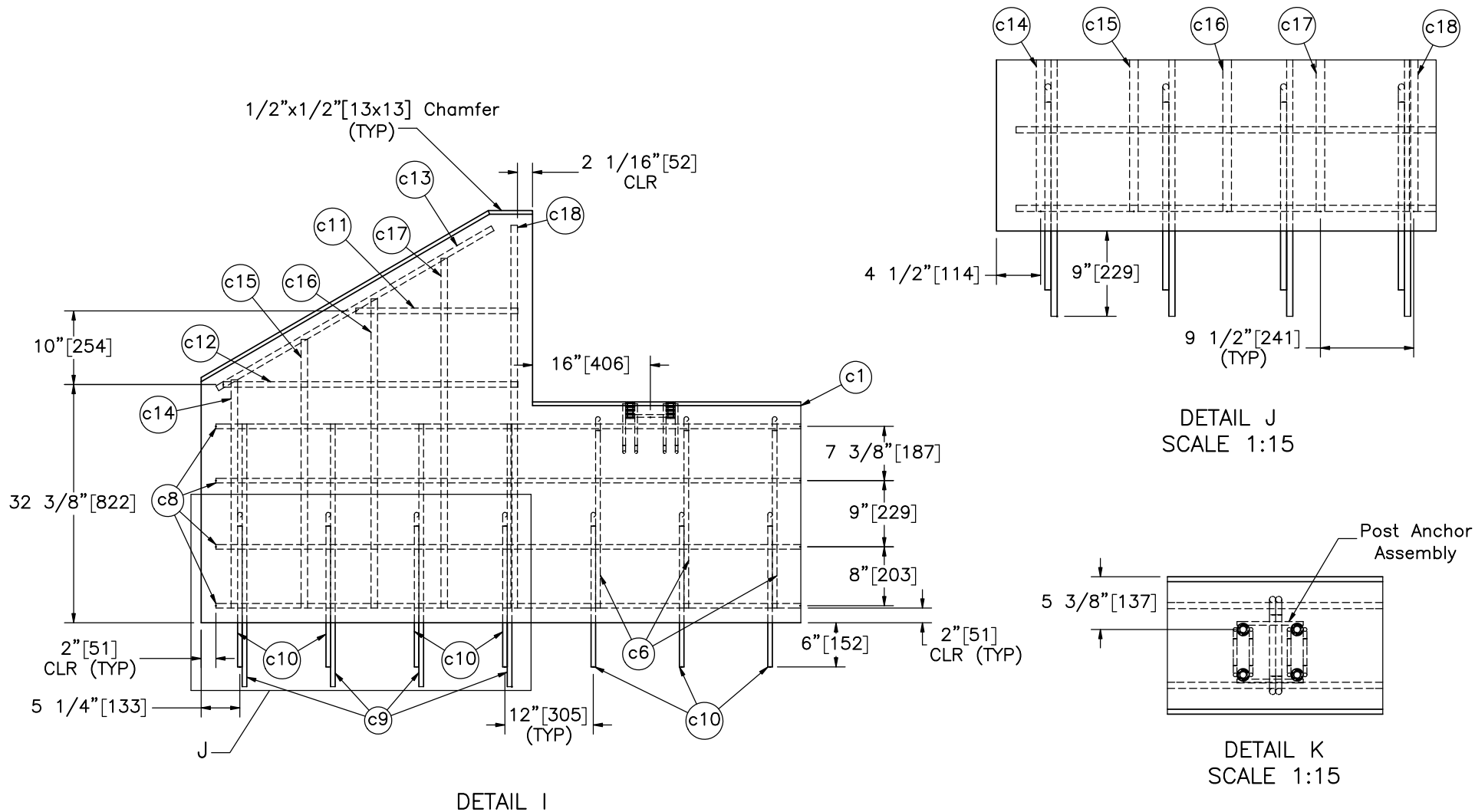
SHEET:
16 of 27

DATE:
5/8/2019

DRAWN BY:
JRD/MKB/
JEK/DJW

REV. BY:
JEK/CSS/
JCH

Notes: (1) Grooved contraction joints, 1/2" [13] in depth, shall be tooled in all exposed faces of the parapet at each third point between expansion joints.



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Upstream Concrete Parapet
Assembly Detail

DWG. NAME.
NCBR-1-2_R9

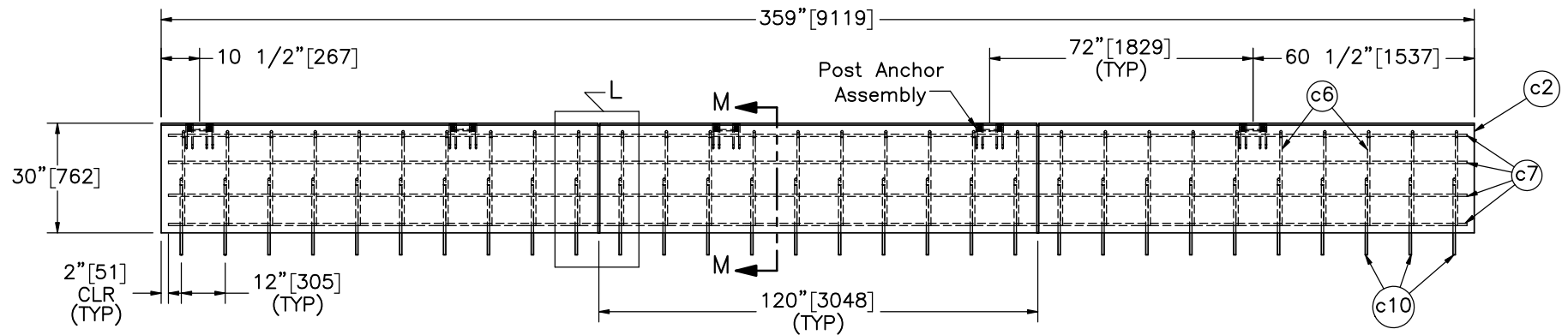
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SHEET:
17 of 27

DATE:
5/8/2019

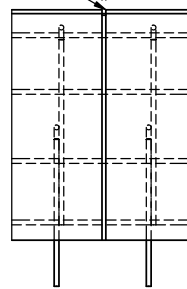
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JRD/MKB/
JEK/DJW

REV. BY:
JEK/CSS/
JCH



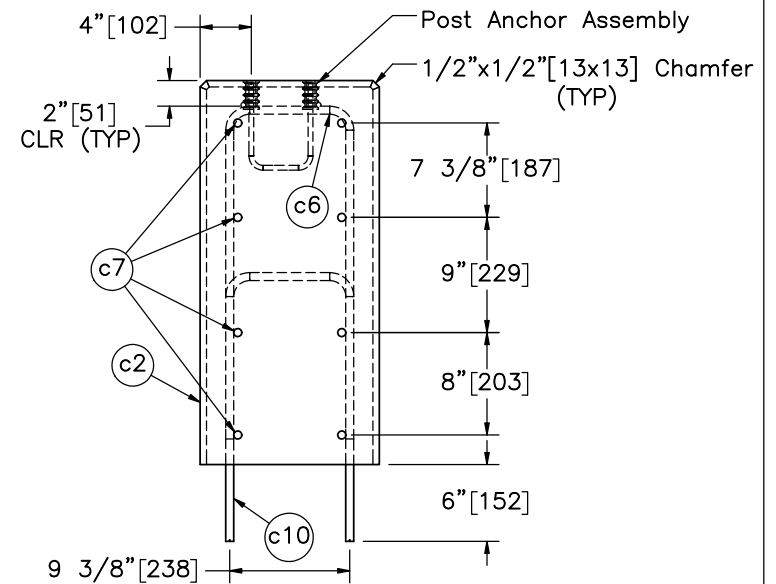
Contraction Joint 1/2" [13]

ELEVATION VIEW



DETAIL L
SCALE 1:25

Notes: (1) Grooved contraction joints, 1/2" [13] in depth, shall be tooled in all exposed faces of the parapet at each third point between expansion joints.



SECTION M-M
SCALE 1:15

Item No.	QTY.	Description	Material Specification	Treatment Specification
—	1	Center Concrete Parapet Assembly	—	—
—	5	Post Anchor Assembly	—	—
c2	1	Concrete	—	—
c6	30	#5 [16] Bar, 59 1/2" [1,511] Long Unbent	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c7	8	#5 [16] Bar, 355" [9,017] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c10	30	#5 [16] Bar, 49 1/2" [1,257] Long Unbent	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Center Concrete Parapet
Assembly

DWG. NAME:
NCBR-1-2_R9

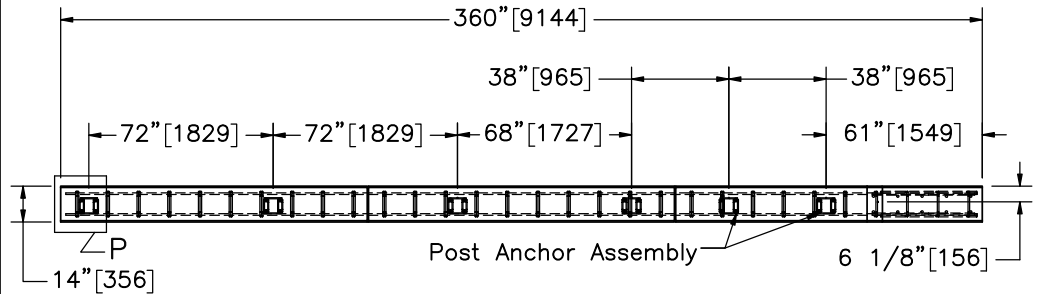
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SHEET:
18 of 27

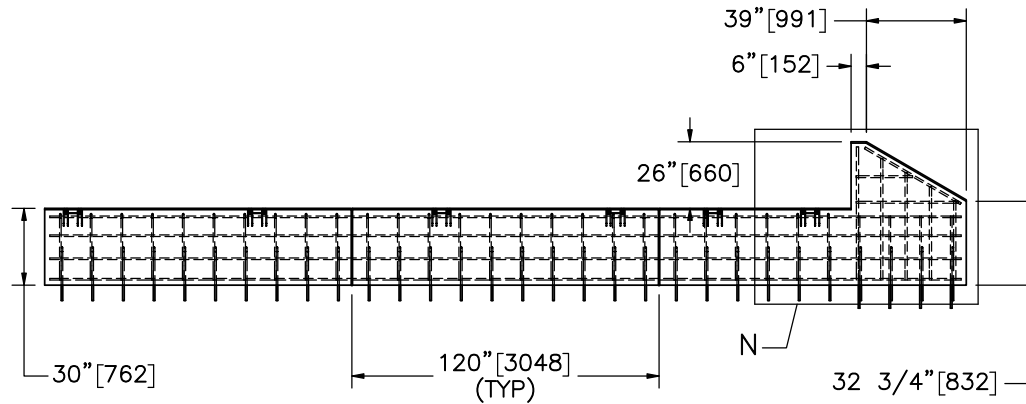
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5/8/2019

DRAWN BY:
JRD/MKB/
JEK/DJW

REV. BY:
JEK/CSS/
JCH



PLAN VIEW



ELEVATION VIEW

Notes: (1) Grooved contraction joints, 1/2" [13] in depth, shall be tooled in all exposed faces of the parapet at each third point between expansion joints.

Item No.	QTY.	Description	Material Specification	Treatment Specification
—	1	Downstream Parapet Assembly	—	—
—	6	Post Anchor Assembly		
c3	1	Concrete	—	—
c6	26	#5 [16] Bar, 1/2" [1,511] Long Unbent	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c8	8	#5 [16] Bar, 356" [9,042] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c9	8	#5 [16] Bar, 36" [914] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c10	30	#5 [16] Bar, 1/2" [1,257] Long Unbent	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c11	2	#6 [19] Bar, 22" [559] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c12	2	#6 [19] Bar, 40" [1,016] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c13	2	#6 [19] Bar, 1/4" [1,099] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c14	2	#7 [22] Bar, 31" [787] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c15	2	#7 [22] Bar, 36 1/2" [927] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c16	2	#7 [22] Bar, 42" [1,067] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c17	2	#7 [22] Bar, 1/2" [1,207] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c18	2	#7 [22] Bar, 52" [1,321] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)



Midwest Roadside Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Downstream Concrete Parapet Assembly

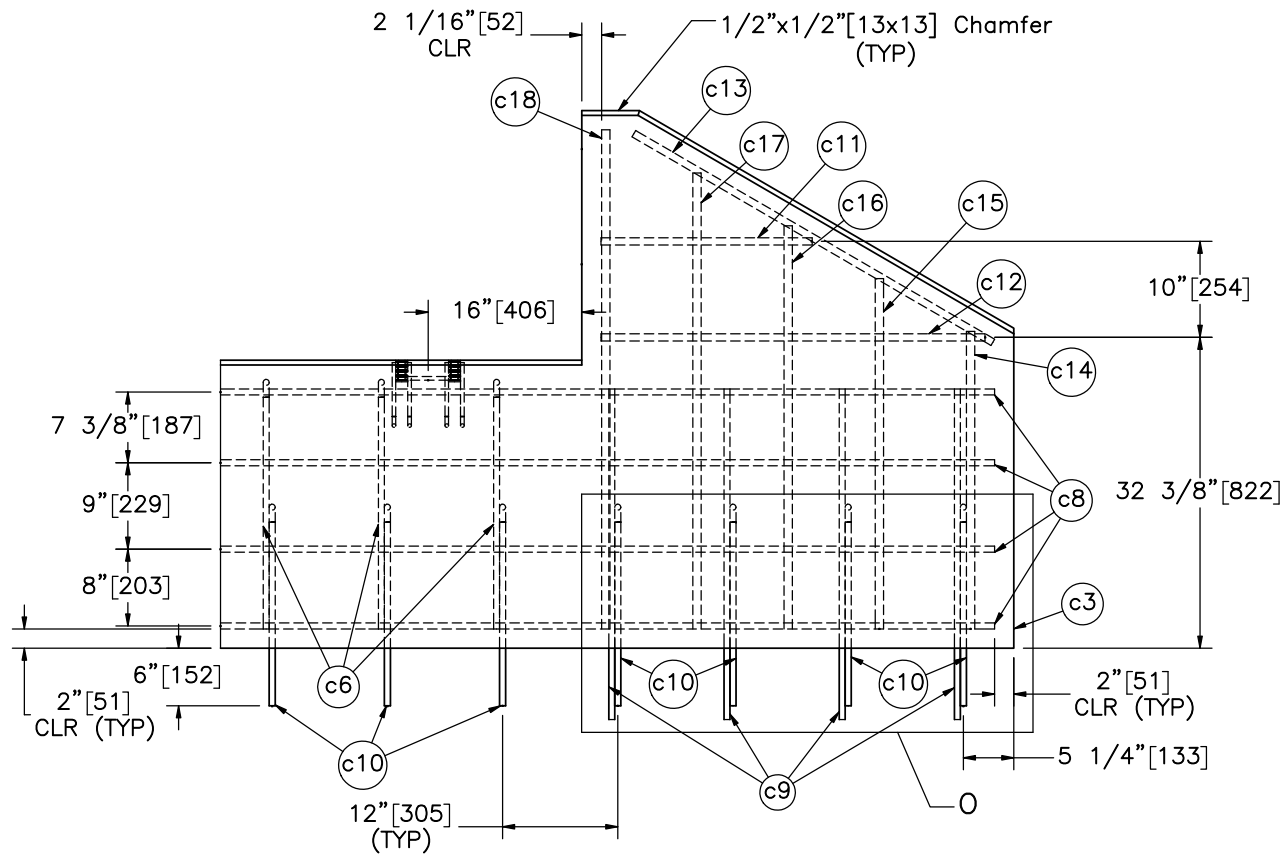
DWG. NAME:
NCBR-1-2_R9

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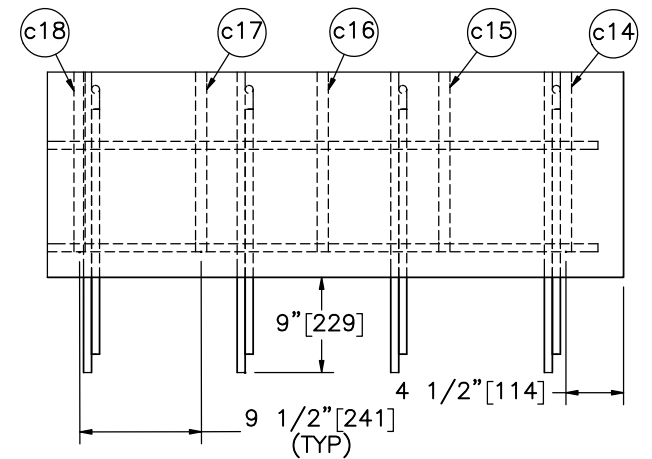
SHEET:
19 of 27

DATE:
5/8/2019

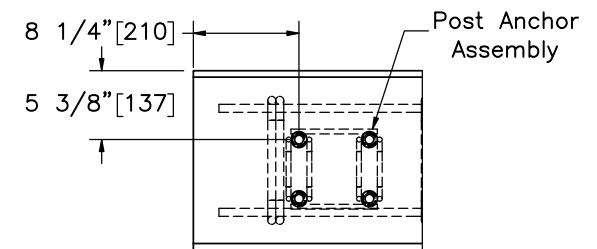
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JEK/DJW
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JEK/CSS/
JCH



DETAIL N



DETAIL O
SCALE 1:15



DETAIL P
SCALE 1:15



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Downstream Concrete Parapet
Assembly Detail

DWG. NAME.
NCBR-1-2_R9

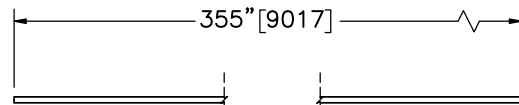
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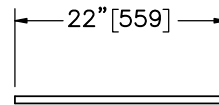
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5/8/2019

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JRD/MKB/
JEK/DJW

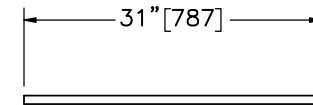
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JEK/CSS/
JCH



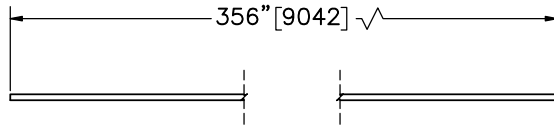
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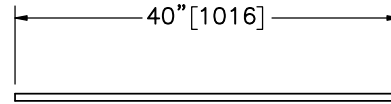
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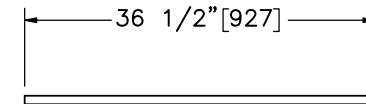
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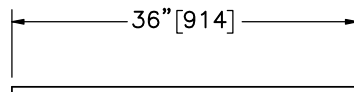
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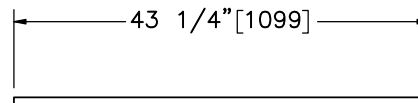
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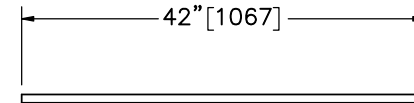
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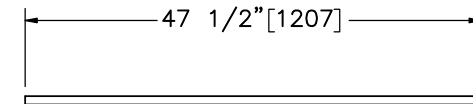
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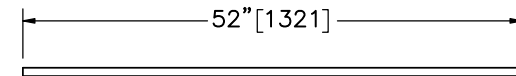
Part c13



Part c16



Part c17



Part c18

Bar	QTY.	Size	Unbent Length	Material Specification	Treatment Specification
c7	8	#5 [16]	355" [9,017]	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c8	16	#5 [16]	356" [9,042]	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c9	16	#5 [16]	36" [914]	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c11	4	#6 [19]	22" [559]	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c12	4	#6 [19]	40" [1,016]	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c13	4	#6 [19]	43 1/4" [1,099]	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c14	4	#7 [22]	31" [787]	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c15	4	#7 [22]	36 1/2" [927]	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c16	4	#7 [22]	42" [1,067]	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c17	4	#7 [22]	47 1/2" [1,207]	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c18	4	#7 [22]	52" [1,321]	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

System Rebar

DWG. NAME.
NCBR-1-2_R9

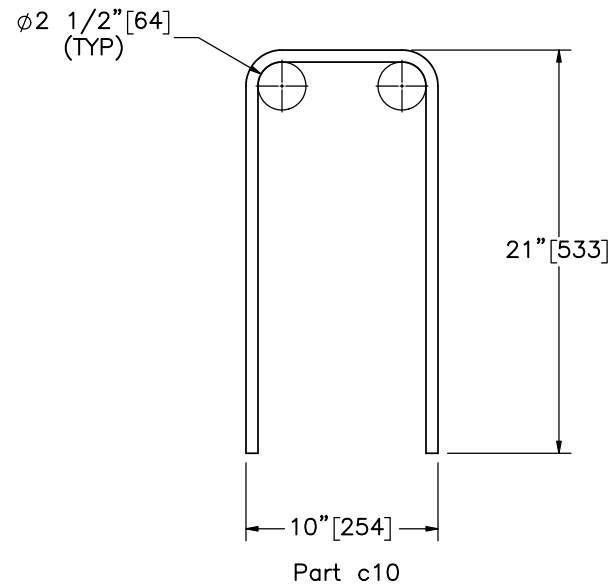
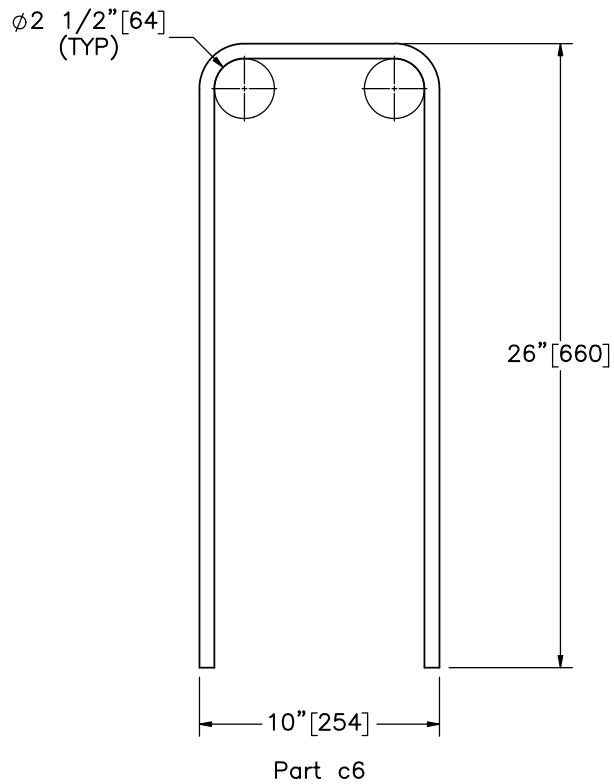
SCALE: 1:20
UNITS: in./mm

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DATE:
5/8/2019

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JCH



Bar	QTY.	Size	Unbent Length	Material Specification	Treatment Specification
c6	82	#5 [16]	59 1/2" [1,511]	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)
c10	90	#5 [16]	49 1/2" [1,257]	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

System Rebar

DWG. NAME.
NCBR-1-2_R9

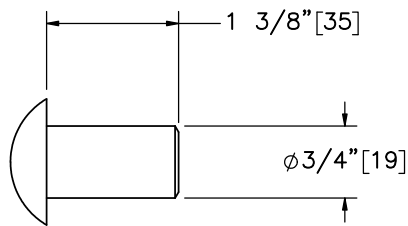
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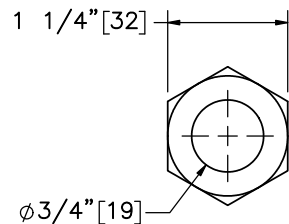
DATE:
5/8/2019

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JEK/DJW

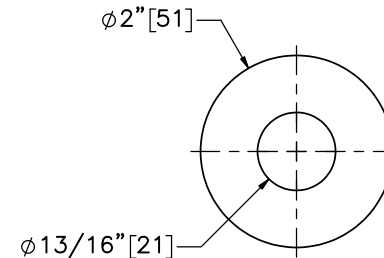
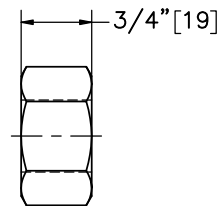
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JEK/CSS/
JCH



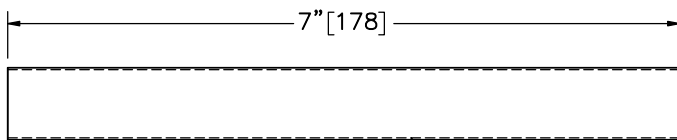
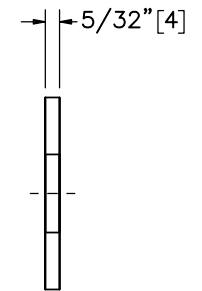
Part d1



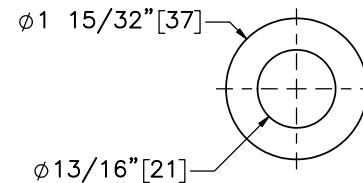
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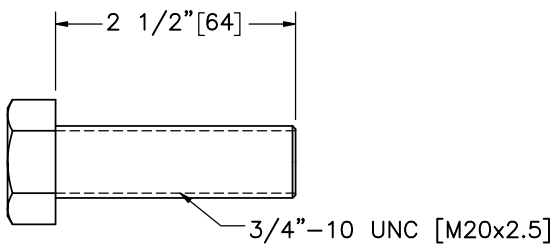
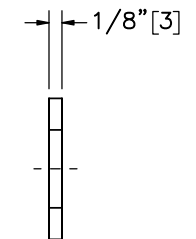
Part e1



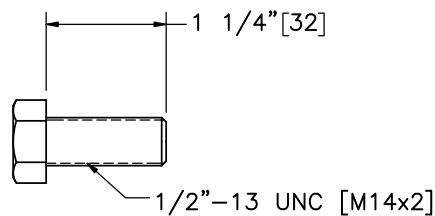
3/4"-10 UNC [M20x2.5]
Part d2



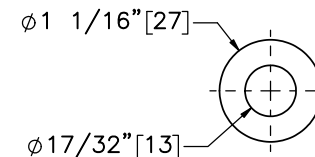
Part e2



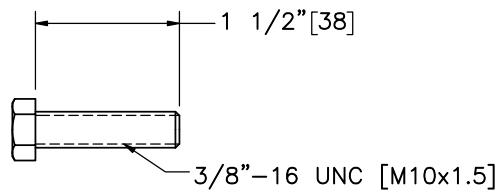
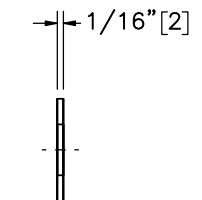
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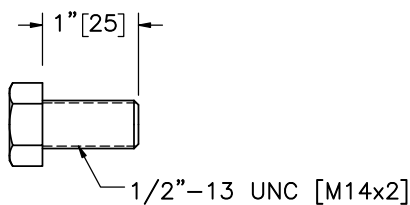
Part d5



Part e3



Part d4



Part d6



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Hardware

DWG. NAME.
NCBR-1-2_R9

SCALE: 1:2
UNITS: in.[mm]

SHEET:
23 of 27

DATE:
5/8/2019

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REV. BY:
JEK/CSS/
JCH

Item No.	QTY.	Description	Material Specification	Treatment Specification	Hardware Guide
a1	17	5 3/4"x 4 1/4" [146x108], 23 1/2" [597] Long Post	ASTM B221 Alloy 6061-T6	—	—
a2	17	7 1/2"x3 5/16"x5 3/4" [191x84x146] Post Plate	ASTM B221 Alloy 6061-T6	—	PAB02
a3	17	7 1/2"x3 1/4"x7/8" [181x83x22] Post Plate	ASTM B221 Alloy 6061-T6	—	PAB02
a4	76	5 3/4"x1 11/16"x3/4" [146x43x19] Clamp Bar	ASTM B221 Alloy 6061-T6	—	FPC01-02
a5	64	3/4" [19] Threaded Ferrule	ASTM A108 Gr. 12L14	ASTM A123	—
a6	—	7 3/8"x2 1/4" [187x57] Front Shim	ASTM B209 Alloy 6061-T6	—	—
a7	—	7 3/8"x2 1/4" [187x57] Rear Shim	ASTM B209 Alloy 6061-T6	—	—
b1	2	360" [9,144] Long Elliptical Rail	ASTM B221 Alloy 6061-T6	—	RAM06
b2	4	312 1/2" [7,938] Long Elliptical Rail	ASTM B221 Alloy 6061-T6	—	RAM06
b3	4	11"x4"x1/2" [279x102x13] Plate	ASTM A36	See Assembly	—
b4	4	4"x4"x1/2" [102x102x13] Plate	ASTM A36	See Assembly	—
b5	4	4 1/4"x4"x1 1/4" [108x102x32] Rail Cap	ASTM B221 Alloy 6061-T6	—	—
b6	4	36"x3 9/16"x3 5/8" [914x90x92] Expansion Bar	ASTM B221 Alloy 6061-T6	—	RAS06
c1	1	Concrete	—	—	—
c2	1	Concrete	—	—	—
c3	1	Concrete	—	—	—
c4	32	3/8" [10] Dia. Wire Strut, 6 3/4" [171] Long	Min. Tensile Strength = 100,000 psi [690 MPa]*	AASHTO M111	—
c5	64	3/8" [10] Dia. Wire Strut, 15 15/16" [405] Long Unbent	Min. Tensile Strength = 100,000 psi [690 MPa]*	AASHTO M111	—
c6	82	#5 [16] Bar, 59 1/2" [1,511] Long Unbent	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
c7	8	#5 [16] Bar, 355" [9,017] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
c8	16	#5 [16] Bar, 356" [9,042] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
c9	16	#5 [16] Bar, 36" [914] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—

Notes: (1) Alloy 6351-T5 may be substituted for alloy 6061-T6 where applicable.

*A 7/16" [11] wire strut with a minimum tensile strength of 90,000 psi [621 MPa] is acceptable.



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Bill of Materials

DWG. NAME.
NCBR-1-2_R9

SCALE: NONE
UNITS: in.[mm]

SHEET:
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DATE:
5/8/2019

DRAWN BY:
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JEK/DJW

REV. BY:
JEK/CSS/
JCH

Item No.	QTY.	Description	Material Specification	Treatment Specification	Hardware Guide
c10	90	#5 [16] Bar, 49 1/2" [1,257] Long Unbent	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
c11	4	#6 [19] Bar, 22" [559] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
c12	4	#6 [19] Bar, 40" [1,016] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
c13	4	#6 [19] Bar, 43 1/4" [1,099] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
c14	4	#7 [22] Bar, 31" [787] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
c15	4	#7 [22] Bar, 36 1/2" [927] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
c16	4	#7 [22] Bar, 42" [1,067] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
c17	4	#7 [22] Bar, 47 1/2" [1,207] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
c18	4	#7 [22] Bar, 52" [1,321] Long	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
d1	68	3/4" [19] Dia., 1 3/8" Long Rivet	ASTM B316 Alloy 6061-T6	—	—
d2	4	3/4"-10 UNC [M20x2.5], 7" [178] Long Fully Threaded Rod	Alloy 304 Stainless Steel	—	FRR20b
d3	68	3/4"-10 UNC [M20x2.5], 2 1/2" [64] Long Hex Bolt	ASTM F3125 Gr. A325 Type I	ASTM A153 or B695 Class 55 or F1941 or F2329 or F1136 Gr. 3 or F2833 Gr. 1	FBX20b
d4	17	3/8"-16 UNC [M10x1.5], 1 1/2" [38] Long Cap Screw	ASTM F593 Alloy 305 Stainless Steel	—	—
d5	16	1/2"-13 UNC [M14x2], 1 1/4" [32] Long Hex Head Cap Screw	ASTM F593 Alloy 305 Stainless Steel	—	FBS14
d6	136	1/2"-13 UNC [M14x2], 1" [25] Long Hex Head Cap Screw	ASTM F593 Alloy 305 Stainless Steel	—	FBS14
d7	4	3/4"-10 UNC [M20x2.5] Heavy Hex Nut	Alloy 304 Stainless Steel	—	FNX20b
e1	4	3/4" [19] Dia. Plain USS Washer	Alloy 304 Stainless Steel	—	—
e2	68	3/4" [19] Dia. Plain SAE Washer	ASTM F436*	ASTM A153 or B695 Class 55 or F1136 Gr. 3 or F2329	FWC20b
e3	152	1/2" [13] Dia. Plain SAE Washer	ASTM F844 Alloy 304 Stainless Steel	—	—
—**	—	Hilti RE 500 V3 or ATC Ultrabond 1 Epoxy	ASTM C881 Type I, II, IV & V Gr. 3, Class A, B & C	—	—

*At the contractor's option, stainless steel bolt and washer may be used as an alternative.

**Epoxy for part d2 must have a minimum bond strength of 1,100 psi [7.6 MPa]. Bond strength of 1,300 psi [9.0 Mpa] or greater is preferred.



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Bill of Materials

DWG. NAME.
NCBR-1-2_R9

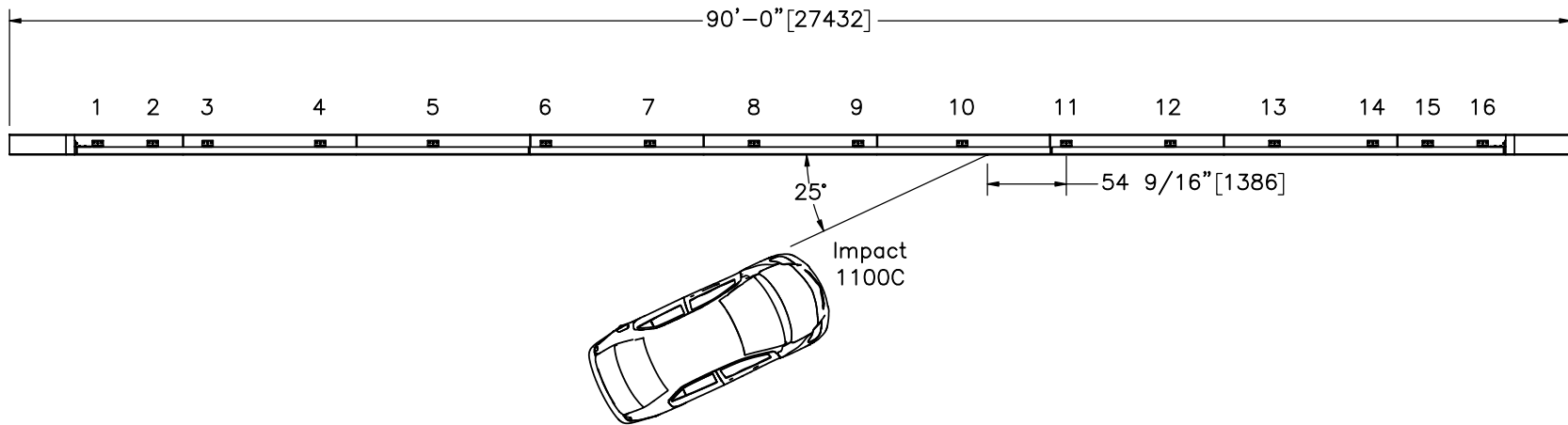
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UNITS: in.[mm]

SHEET:
25 of 27

DATE:
5/8/2019

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JEK/DJW

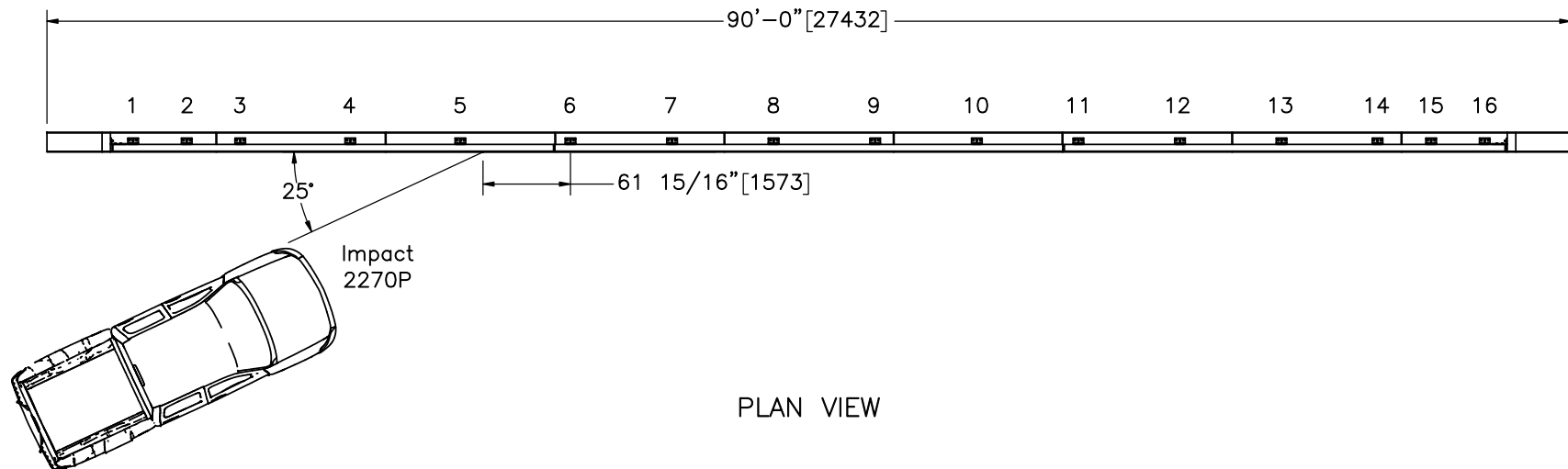
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JCH



PLAN VIEW

- Notes: (1) Test 1 shall be performed according to test designation 3-10 using MASH 2016 criteria.
 (2) The impact location for Test 1 is 54 9/16" [1386] upstream from centerline of post no. 11.

	NC Two-Bar Bridge Rail Test No. NCBR-1-2		SHEET: 26 of 27
	Test 1 with Vehicle Detail		DATE: 5/8/2019
Midwest Roadside Safety Facility	DWG. NAME: NCBR-1-2_R9		DRAWN BY: JRD/MKB/ JEK/DJW
	SCALE: 1:125 UNITS: in./mm		REV. BY: JEK/CSS/ JCH



- Notes: (1) Test 2 shall be performed according to test designation 3-11 using MASH 2016 criteria.
 (2) The impact location for Test 2 is 61 15/16" [1573] upstream from centerline of post no. 6.



Midwest Roadside
Safety Facility

NC Two-Bar Bridge Rail
Test No. NCBR-1-2

Test 2 with Vehicle Detail

DWG. NAME.
NCBR-1-2_R9

SCALE: 1:125
UNITS: in./mm

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REV. BY:
JEK/CSS/
JCH

REV.	DATE OF ISSUE	Page	NATURE OF CHANGES	REVIEWER	REVISED BY
0	1/14/2019	–	Original Drawing.	–	JRD
1	2/7/2019	–	Posts added to system and post spacing changed. Impact locations added. Detail/section relettering. Original pages 19 and 22 removed, pages renumbered	JEK	JRD
		1	Dims added. Edited existing dims. Annotated impact locations. Edited note 1 and note 2. Added note 3. Detail views added.		
		2	Detail view and dims added. Edited item balloons. Removed annotation.		
		3	Model view removed. Added detail views from original page 4.		
		4	Hardware components removed. Edited BOM.		
		5	Drill note edit. Annotation moved.		
		6	Note 1 added. Weld note edit. Model views switched.		
		7	View and dimensions added. Hole callout edit. View labels edited. Model views switched.		
		9	View labels edited. Section view edit.		
		10	View labels edited. Annotation edit.		
		11	Model orientation change. Part label edit		
		15	Dims added. Edited existing dims.		
		16	Model views and BOM moved. Dimension edit. Added note 1. Detail added.		
		17	Detail views added. Dims added. Edited existing dims. Part balloons added.		
		18	Note 1 added. Detail view and dims added.		
		19	Detail added. Model views and BOM moved. Dim edit. Added note 1. Dims edited.		
		20	Detail views added. Dims added. Edited existing dims. Part balloons added.		
		21	Model views rearranged.		
		22	Bill of bars edited.		
		23	Cosmetic thread edit.		

		BOM	Edited description for parts a5, c4, c5, c6, d1, d4, d5, and d6. Edited material specification for parts b3, b4, c4, c5, c6, d2, d3, d5, d6, e1, e2, e3. Edited treatment specification for parts b3, b4, d2, d3, e1, e2, and e3. Edited hardware guide for parts a2, a3, a4, b1, b2, b3, b4, b6, d2, d3, and e2. Note 1 and other note added. Part quantities updated.		
2	2/8/2019	1	Updated test designation callout, keeping Test No. 3-11 and removing Test No. 3-10.	JEK	MKB
		2	Dim add		
		6	Added elevation view.		
		17	Dim edit		
		20	Dim edit		
		BOM	Note edit		
3	2/14/2019	1	Added impact location for test No. 3-10. Note edit. Added isometric view	CSS	JRD
		2	Added Note 1.		
		6	Dims added.		
		13	Added overhead and isometric views. Edited dims. Added Note 1.		
		14	Added isometric view.		
		BOM	Note edit.		
4	2/26/2019	4	Corrected assembly quantity.	CSS	JEK
5	3/6/2019	–	End Structural Concrete Insert Assembly replaced with End Anchors with adhesive. Sheet 14 removed, sheet shift. Part d2 now d3, New end Anchor is new part d2. C parts renumbered.	CSS	MKB
		3	Relettered details. Moved detail to dimension End Anchor heights.		
		14	Part c5 removed		
		16	End Anchor heights removed.		
		18	End Anchor heights removed.		
		BOM	Part c5 removed. C parts renumbered. Part d2 now d3, New part d2. New adhesive part. Mtrl Spec: a5,b3,b4. Treat Spec: a5. HWG: d5,d6.		

6	3/6/2019	11	Updated Treat Spec of Assembly	JEK	MKB
		22	Added metric callout on Drill-In Anchor		
		BOM	Treat Spec: b3,b4,d3. Mtrl Spec: d3. HWG: d3		
7	3/14/2019	–	Drawing renamed from NCBR-1 to NCBR-1-2. 2270P impact details added. Post spacing mirrored per request. Rebar modifications per NCDOT request (parts c6,c9,c10).	JCH/CSS	DJW
		9	Added sheet for shim details per NCDOT request.		
8	5/7/2019	–	Replace part d2 with threaded rod and added nut (part d7).	CSS	DJW
		1	Added note 5.		
		3	Update part balloons in Detail E. Note 1 edit.		
		23	Part d2 changed. Part d7 added.		
		BOM	Added d7. Added epoxy note (pg 25). Description: d2, epoxy. Material Spec: d2. Treatment Spec: d2.		
		26	New page. Includes 1100C model for Test 1.		
9	5/8/2019	27	New page. Includes 2270P model for Test 2.	CSS	DJW
		BOM	Material Spec: d2, d7, e1. Treatment Spec: d2, d7, e1.		