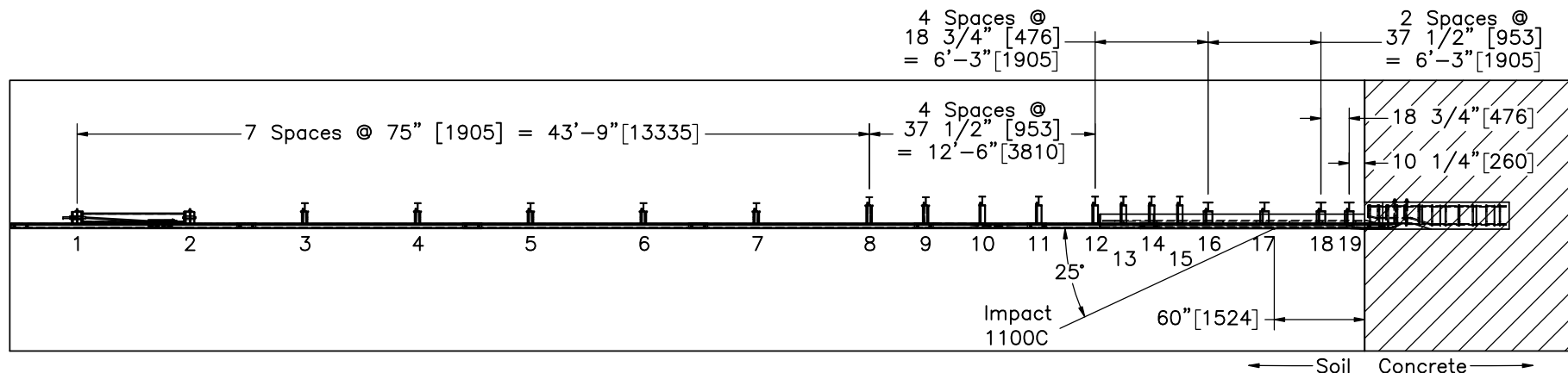
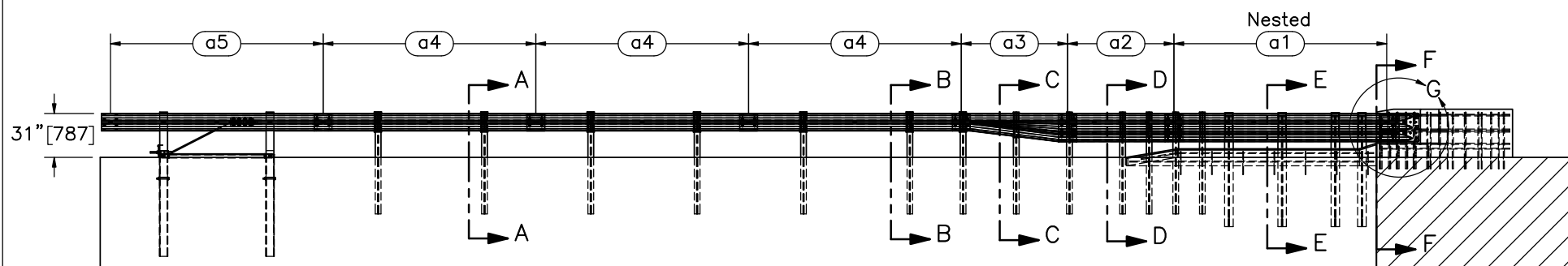




PLAN VIEW



ELEVATION VIEW

- Notes: (1) Test shall be performed according to test designation no. 3-20 of MASH 2016.
- (2) The impact location is 60" [1,524] upstream of the concrete buttress.
- (3) BCT anchors are placed in 3' [914] diameter holes, then backfilled and tamped with soil.
- (4) Critical region is located between post nos. 11 and 19.



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

System Layout

DWG. NAME.
HWTT-1_R13

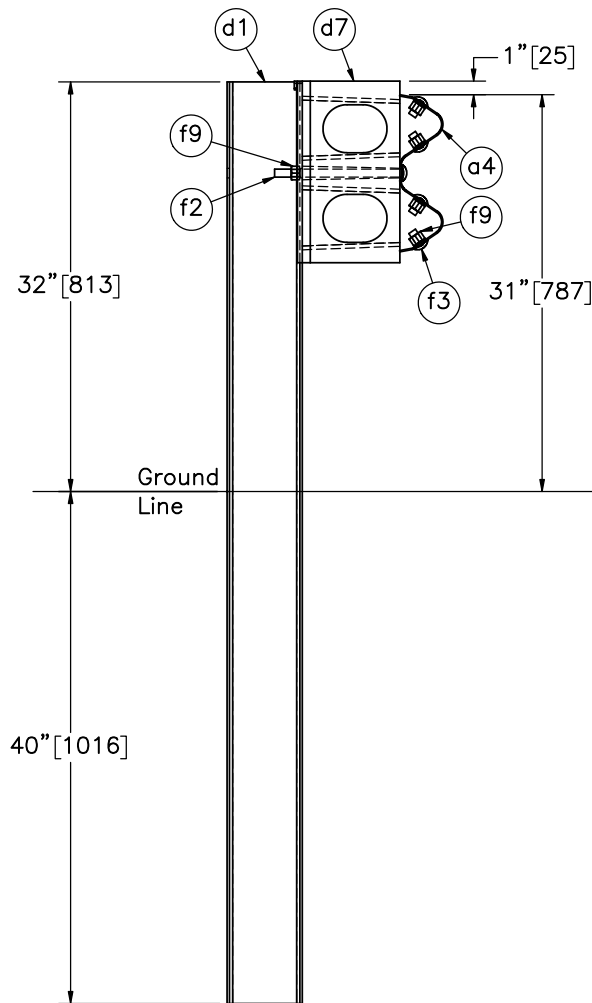
SCALE: 1:110
UNITS: in.[mm]

SHEET:
1 of 28

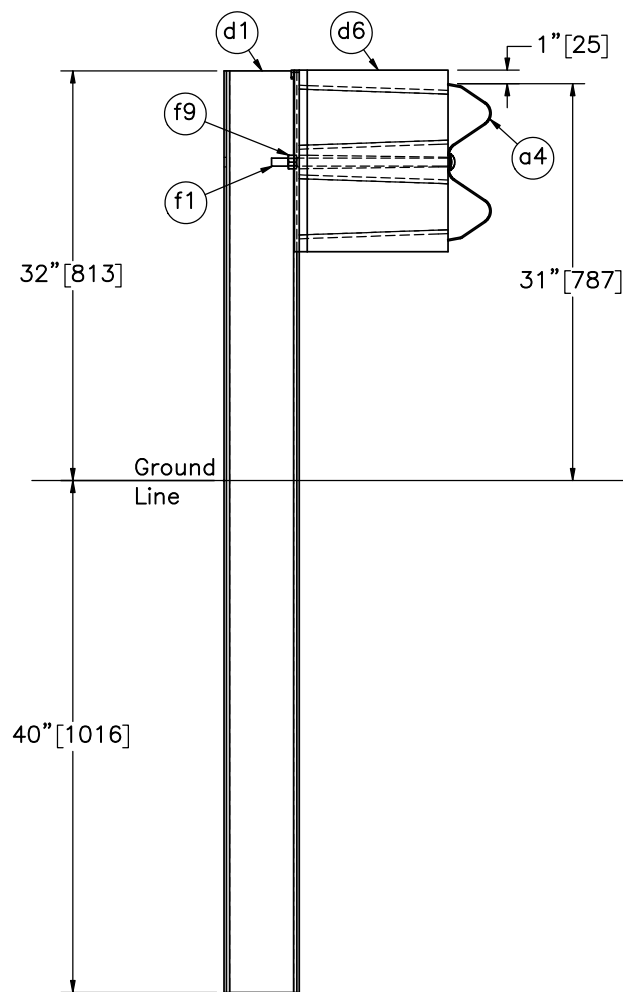
DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

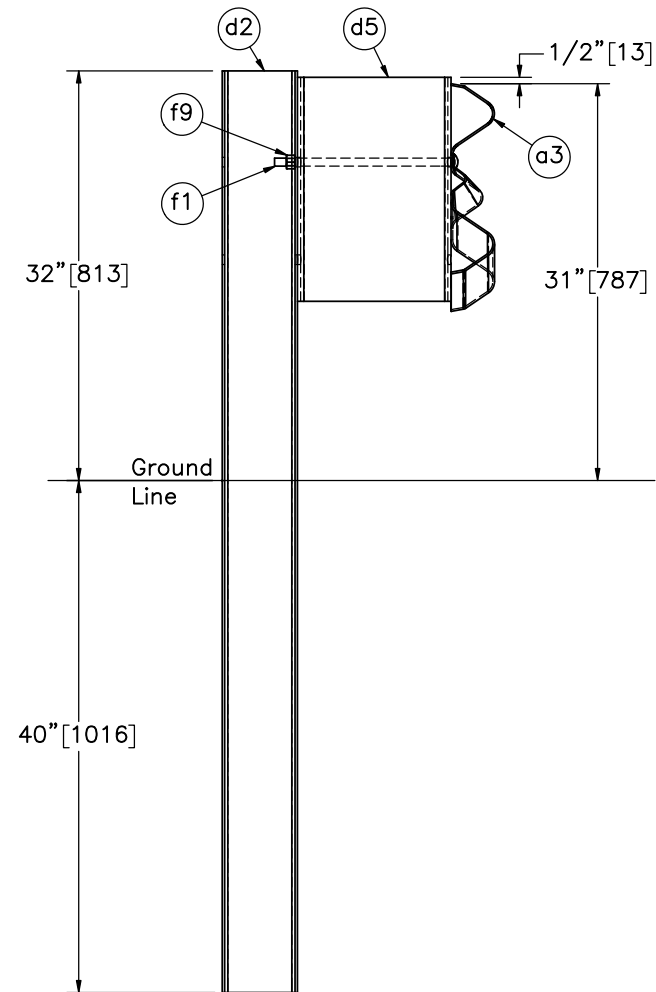
REV. BY:
SKR/JEK/
JCH/KAL



SECTION A-A
Post Nos. 3-7



SECTION B-B
Post Nos. 8-9



SECTION C-C
Post No. 10

- Notes: (1) No bolt placed in lower hole of post no. 10.
(2) Guardrail bolts (parts f1 and f2) on the upstream side of the web.



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Post Nos. 3-10 Details

DWG. NAME.
HWTT-1_R13

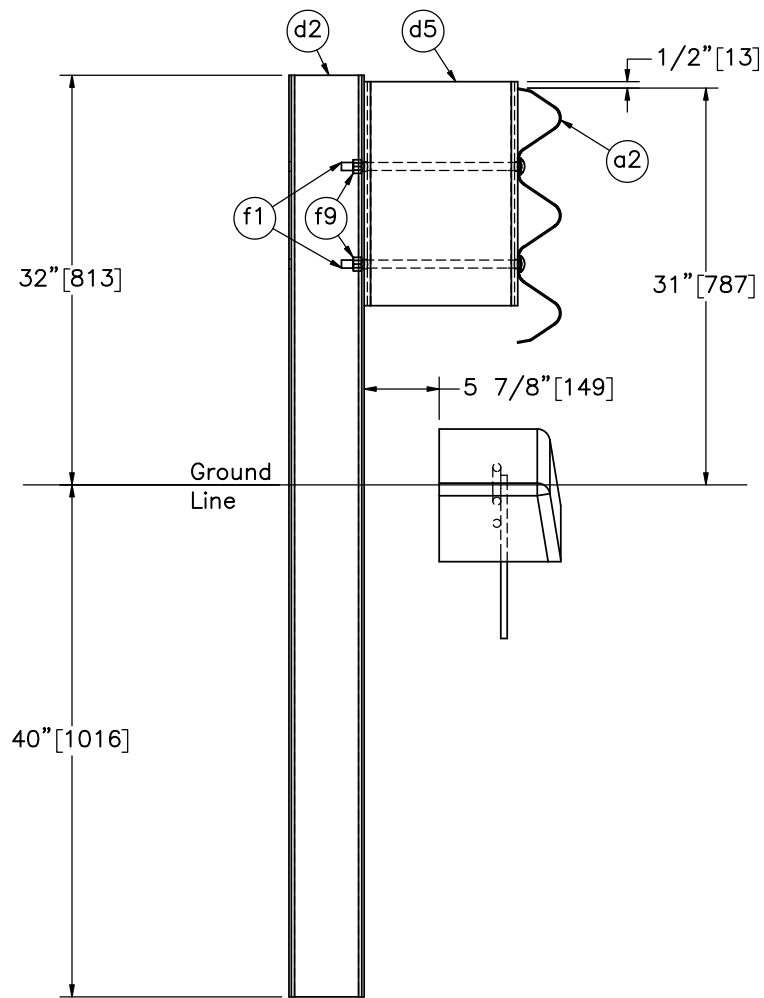
SCALE: 1:15
UNITS: in.[mm]

SHEET:
2 of 28

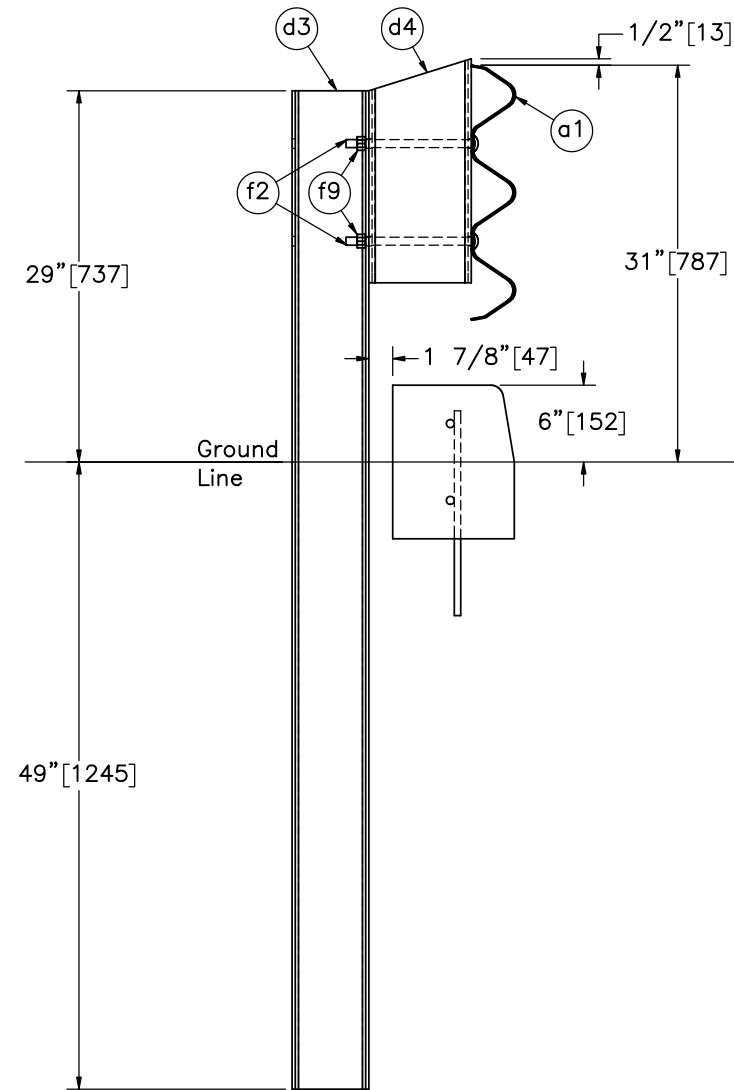
DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL



SECTION D-D
Post Nos. 11-15



SECTION E-E
Post Nos. 16-19

- Notes: (1) Guardrail bolts (parts f1 and f2) on the upstream side of the web.
 (2) Toe of curb is in line with the front of the rail.
 (3) Curb shown in Section D is in tapered region.



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Post Nos. 11-19 Details

DWG. NAME.
HWTT-1_R13

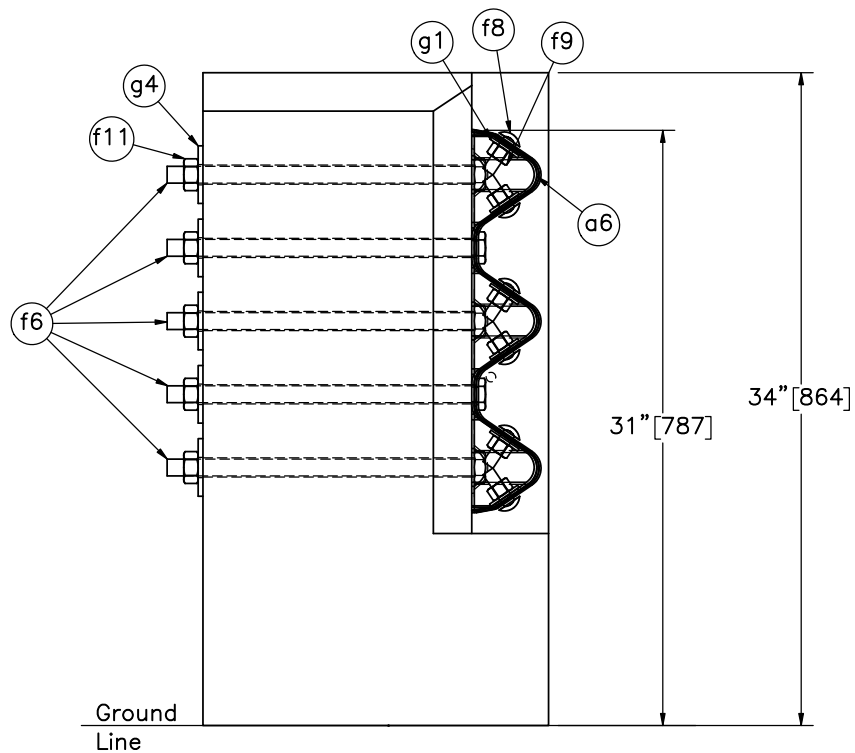
SCALE: 1:15
UNITS: in.[mm]

SHEET:
3 of 28

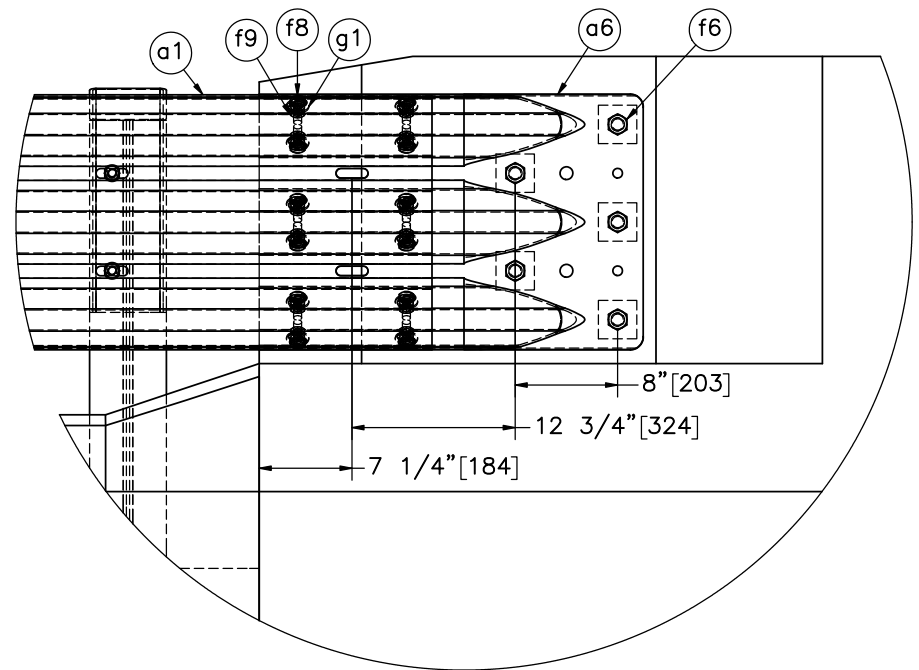
DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL



SECTION F-F
(REBAR HIDDEN)



DETAIL G
SCALE 1:15
(REBAR HIDDEN)

Note: (1) g1 washers placed between nuts and thrie beam end connector.



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Type D2 Endpost and Terminal
Connector

DWG. NAME:
HWTT-1_R13

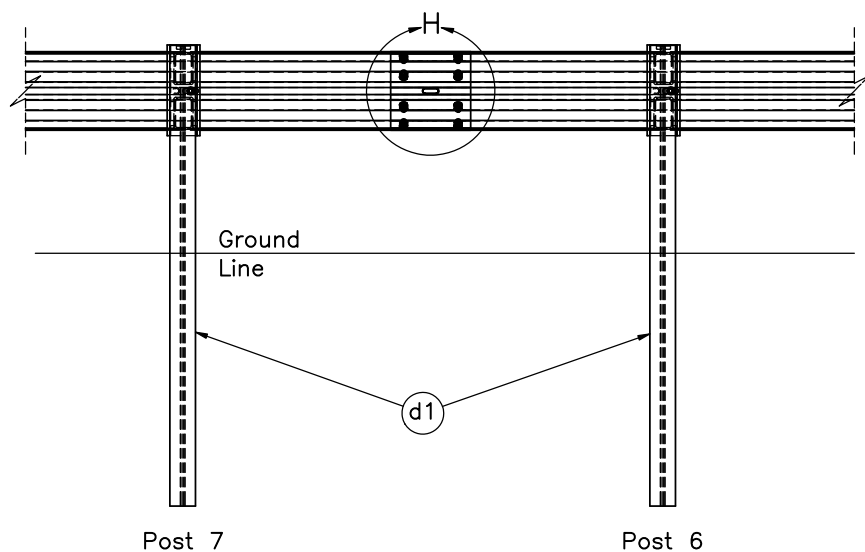
SCALE: 1:10
UNITS: in.[mm]

SHEET:
4 of 28

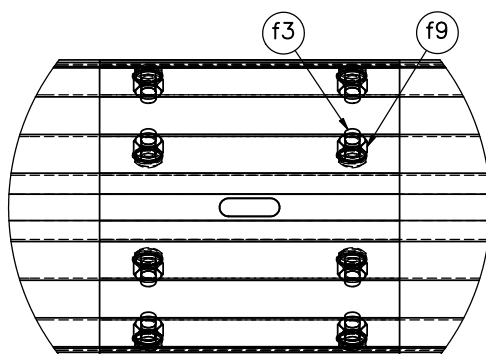
DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

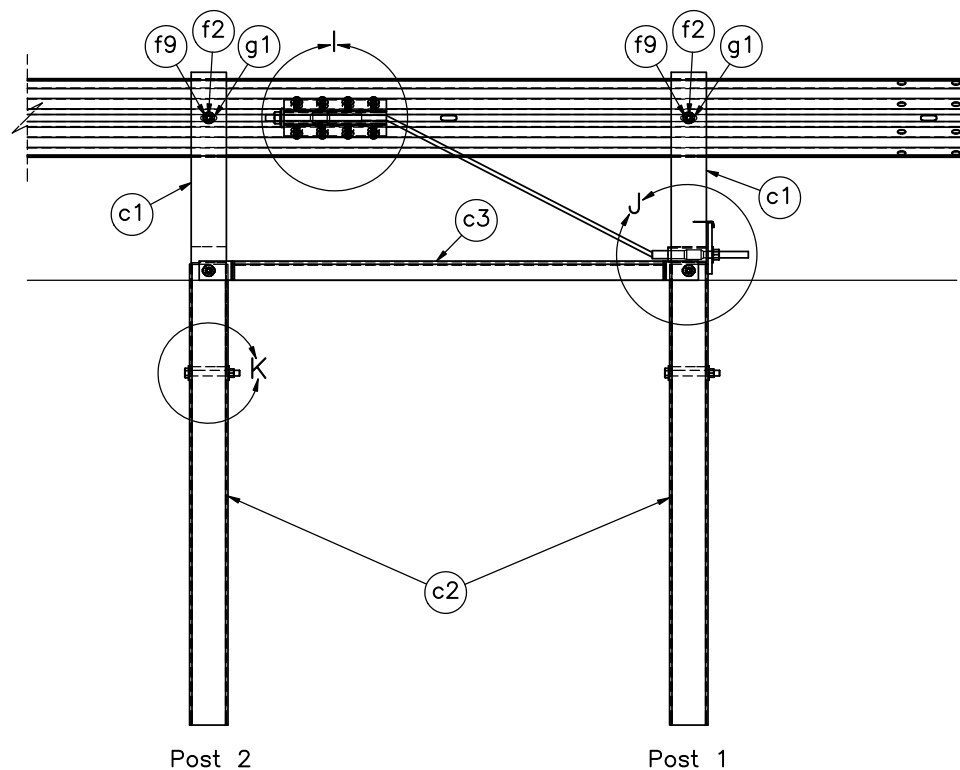
REV. BY:
SKR/JEK/
JCH/KAL



SPLICE DETAIL
BACKSIDE



DETAIL H
SCALE 1:8



END SECTION DETAIL
BACKSIDE



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

End Section and Splice Detail

DWG. NAME.
HWTT-1_R13

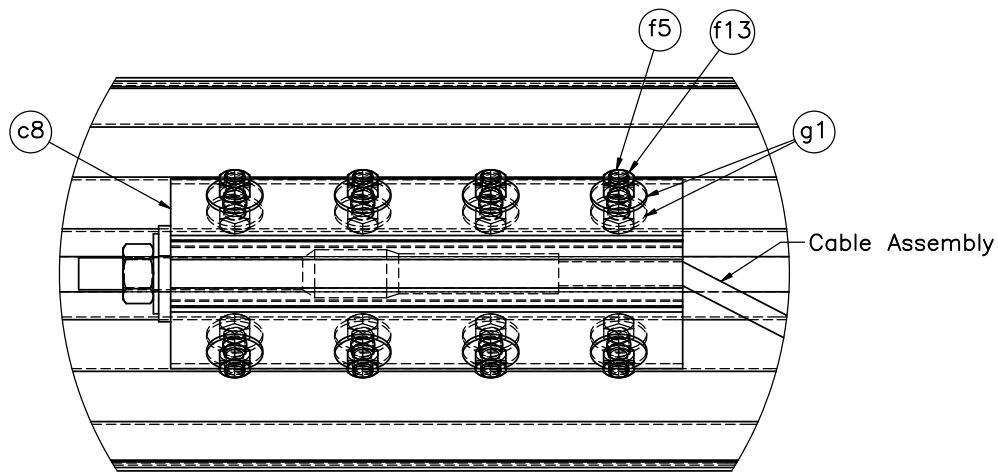
SCALE: 1:30
UNITS: in.[mm]

SHEET:
5 of 28

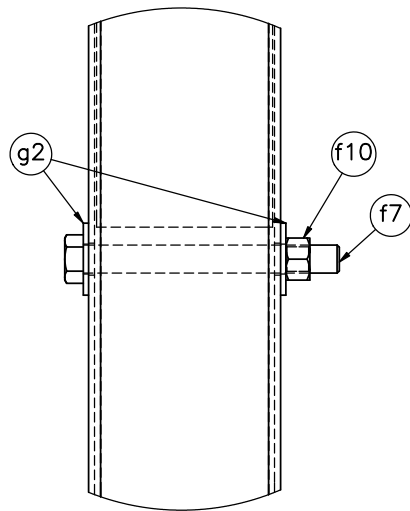
DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

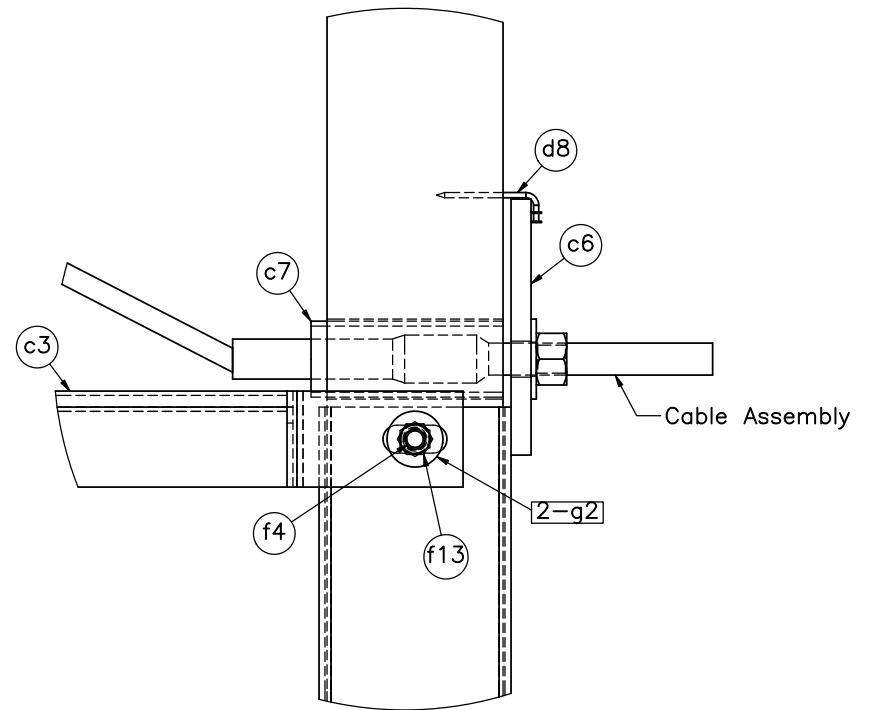
REV. BY:
SKR/JEK/
JCH/KAL



DETAIL I



DETAIL K



DETAIL J



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

BCT Anchor Details

DWG. NAME.
HWTT-1_R13

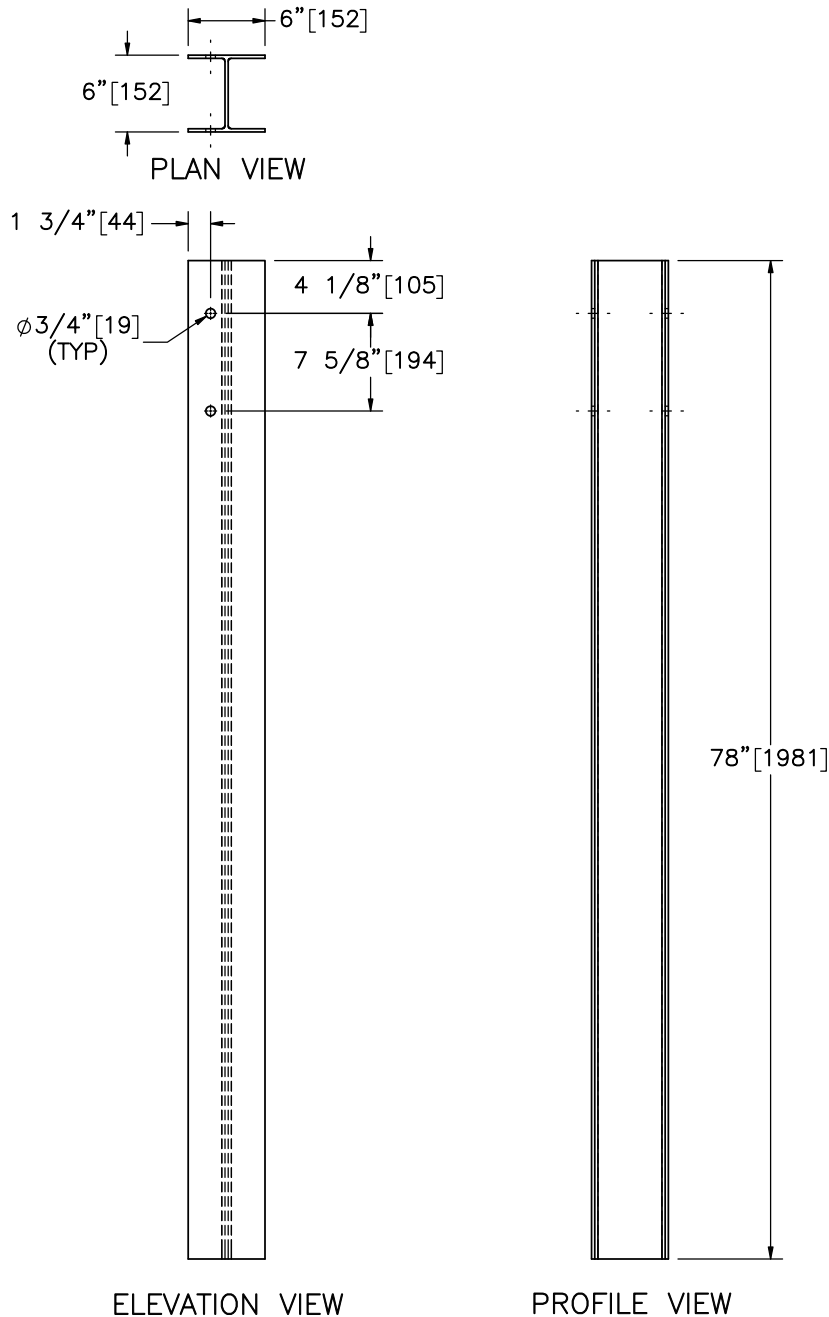
SCALE: 1:6
UNITS: in.[mm]

SHEET:
6 of 28

DATE:
3/2/2020

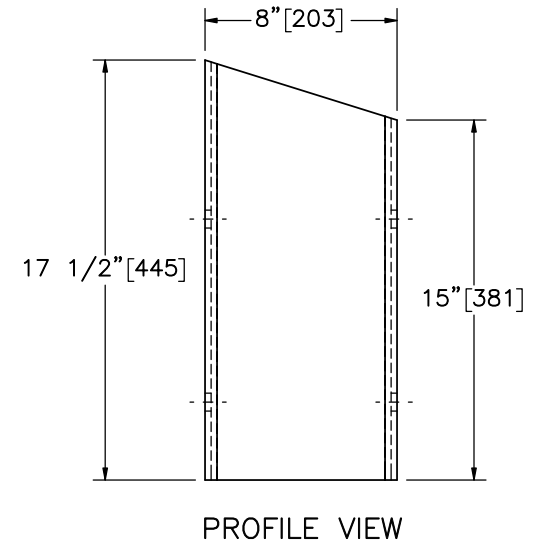
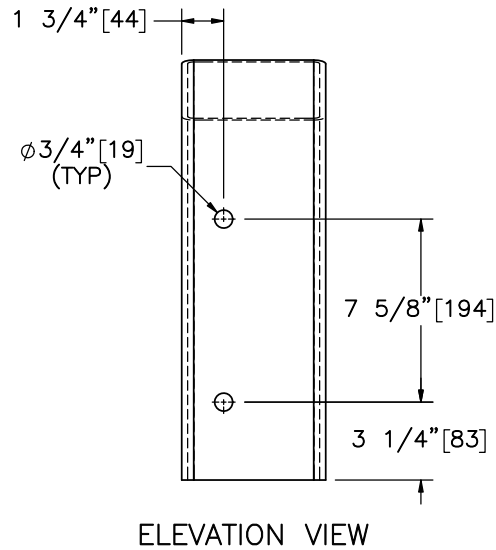
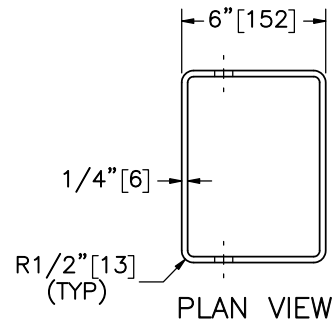
DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL



Part d3

Note: (1) This post is 3" [76] shorter than Hawaii DOT's current transition post, but has the same embedment depth. An alternative option is to keep the same length post but increase embedment depth.



Part d4
SCALE 1:8



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Post Nos. 16-19 Components

DWG. NAME.
HWTT-1_R13

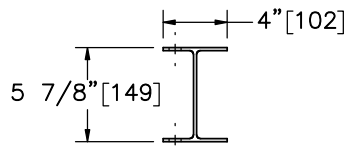
SCALE: 1:15
UNITS: in./mm

SHEET:
7 of 28

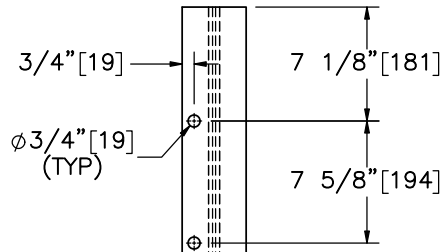
DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL

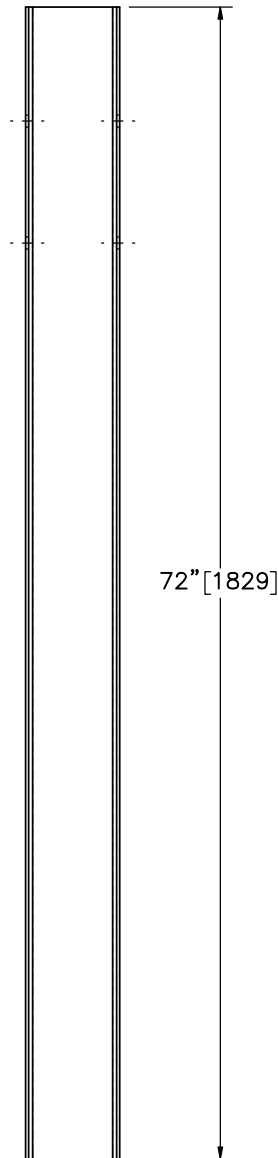


PLAN VIEW

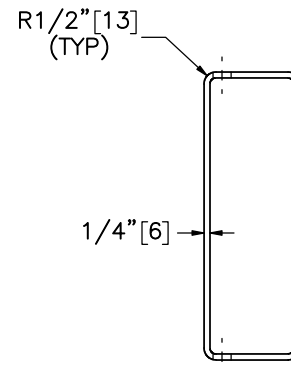


ELEVATION VIEW

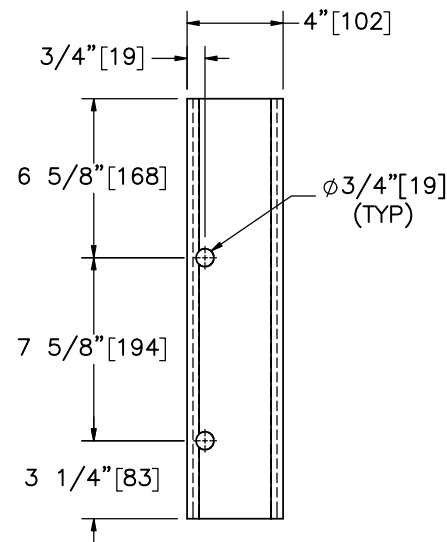
Part d2



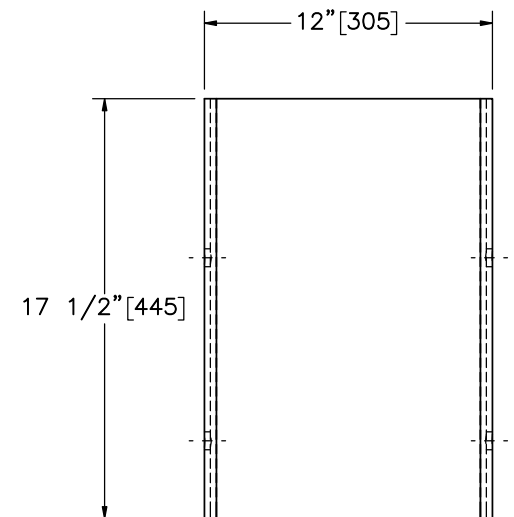
PROFILE VIEW



PLAN VIEW



ELEVATION VIEW



PROFILE VIEW

Part d5
SCALE 1:8



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Post Nos. 10-15 Components

DWG. NAME.
HWTT-1_R13

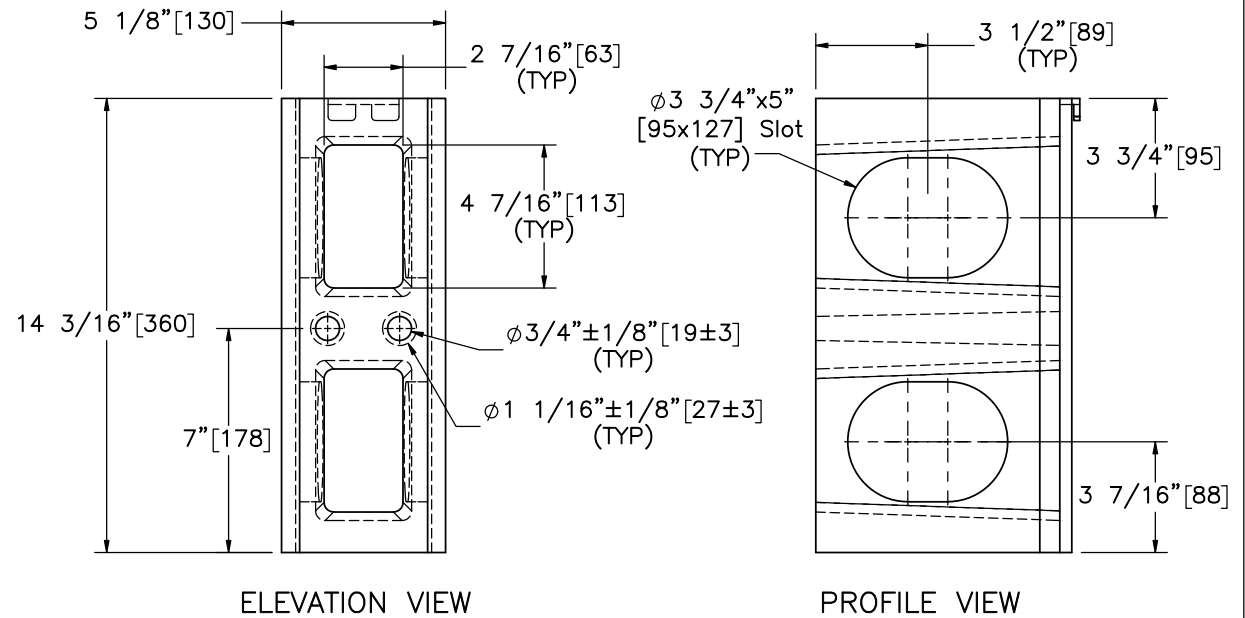
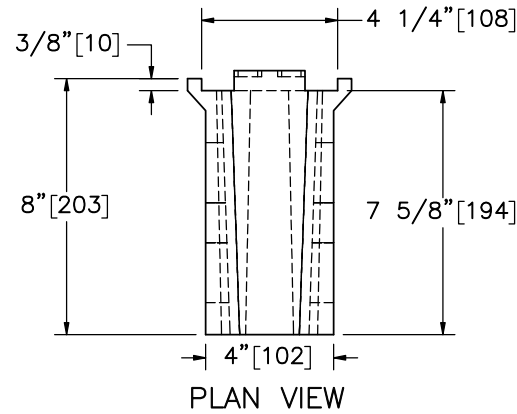
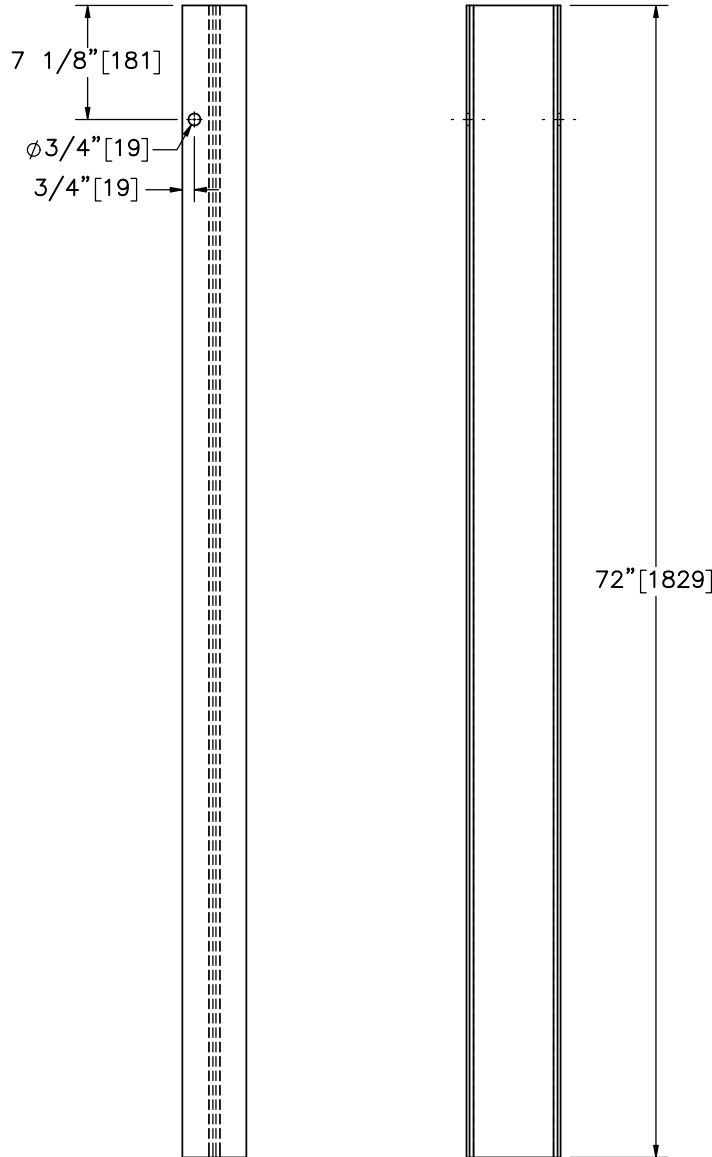
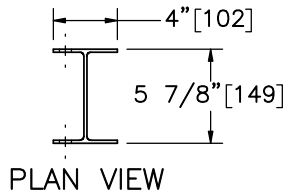
SCALE: 1:12
UNITS: in.[mm]

SHEET:
8 of 28

DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL



Part d7
SCALE 1:6



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

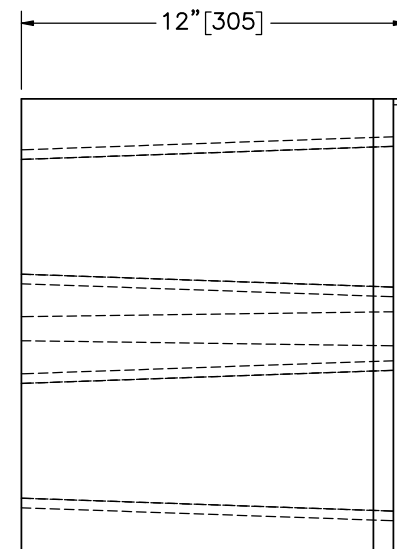
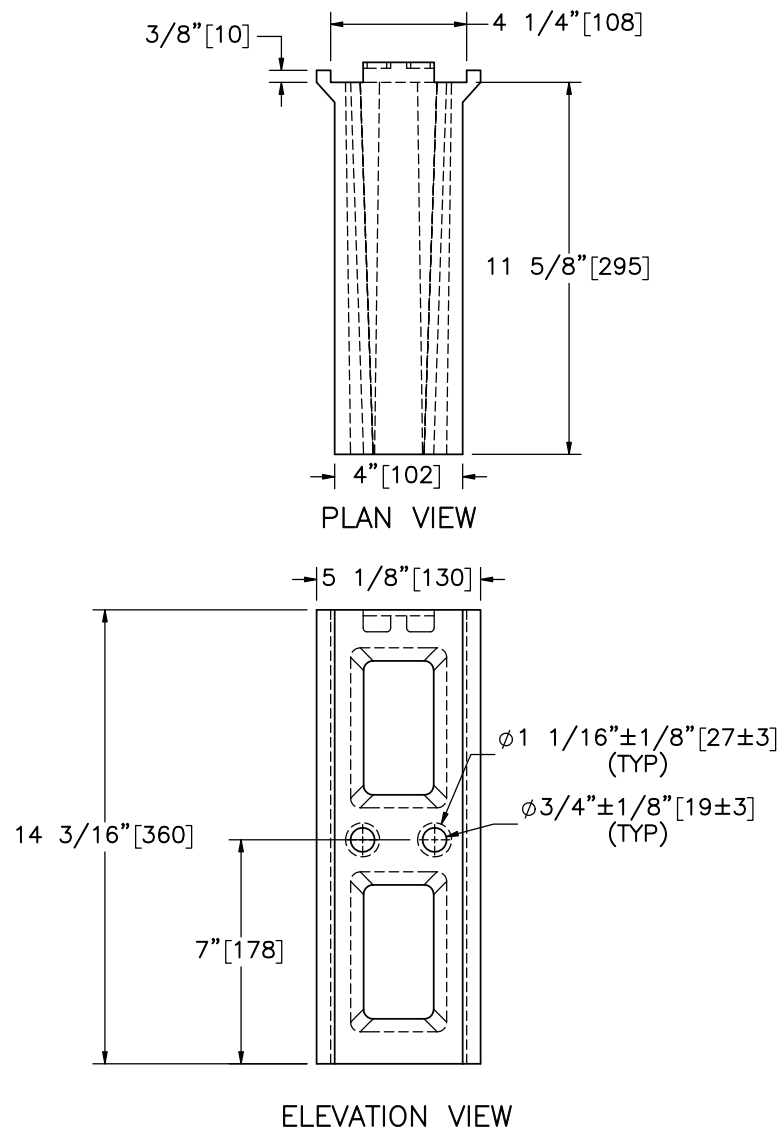
Post Nos. 3-7 Components

DWG. NAME.
HWTT-1_R13

SCALE: 1:12
UNITS: in.[mm]

SHEET:
9 of 28
DATE:
3/2/2020
DRAWN BY:
DJW/MKB/S
BW/JRF
REV. BY:
SKR/JEK/
JCH/KAL

Part d1



PROFILE VIEW

Part d6



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Post nos. 8-9 Blockout Details

DWG. NAME.
HWTT-1_R13

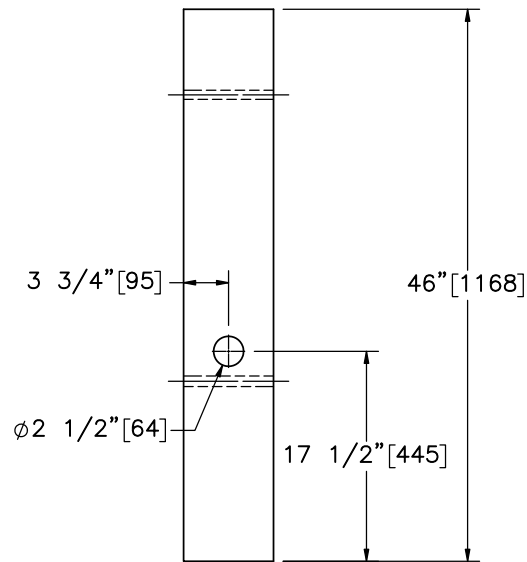
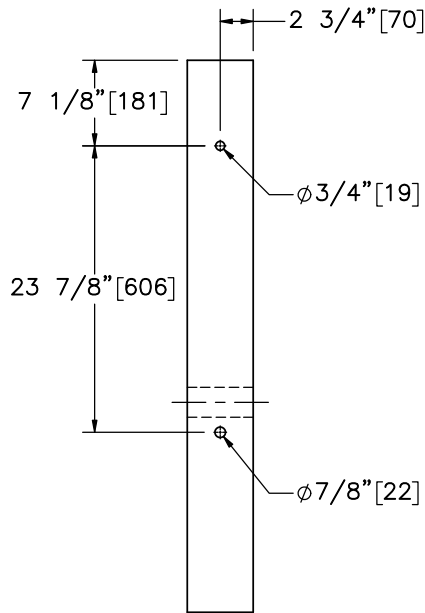
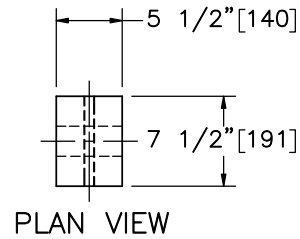
SCALE: 1:6
UNITS: in.[mm]

SHEET:
10 of 28

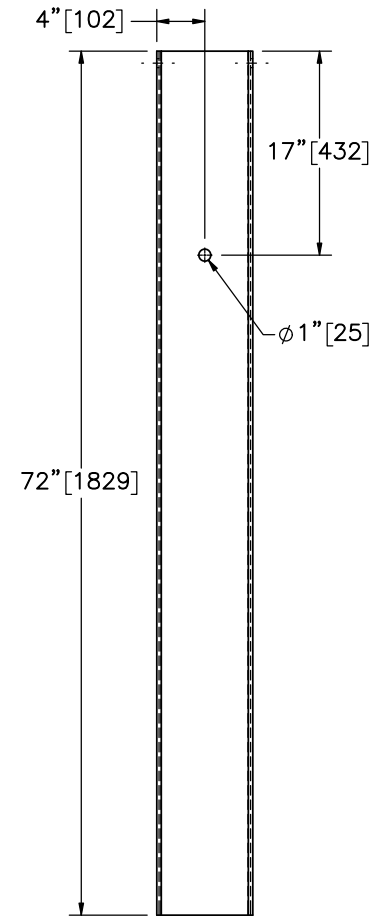
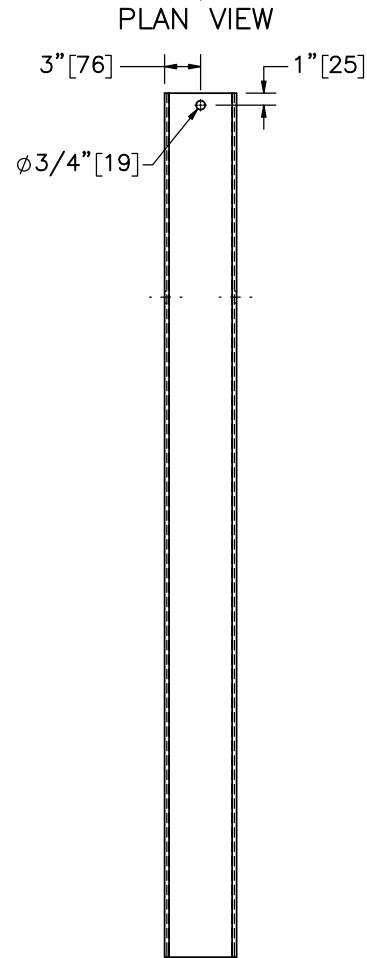
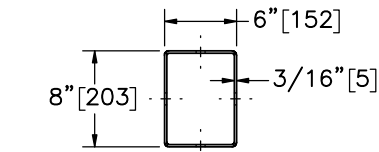
DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL



Part c1



Part c2



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

BCT Timber Post and
Foundation Tube Details

DWG. NAME.
HWTT-1_R13

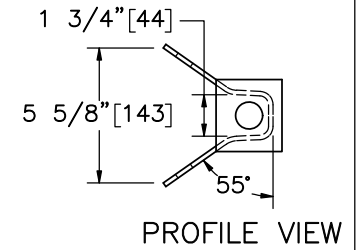
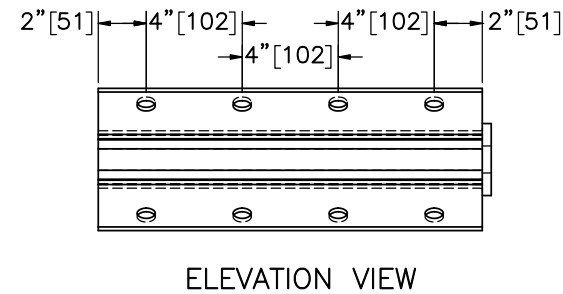
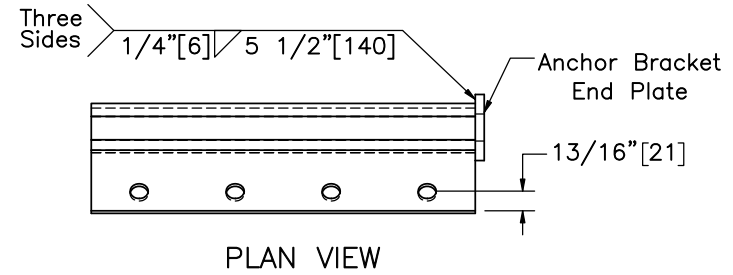
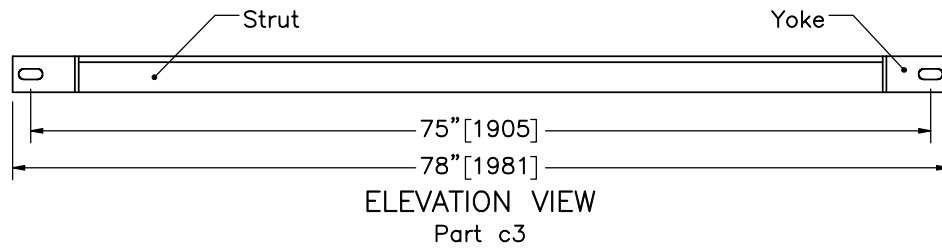
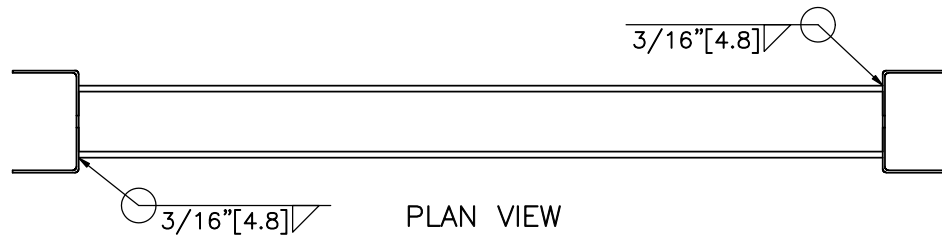
SCALE: 1:16
UNITS: in.[mm]

SHEET:
11 of 28

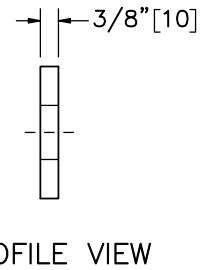
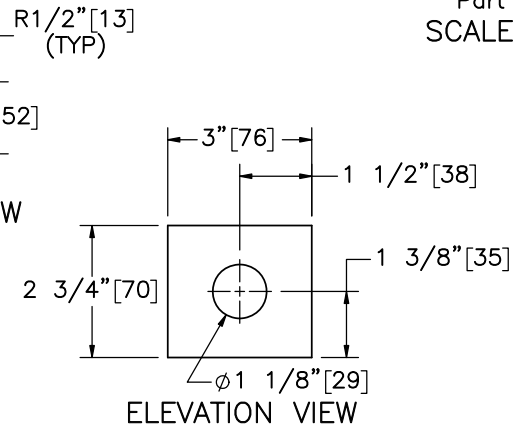
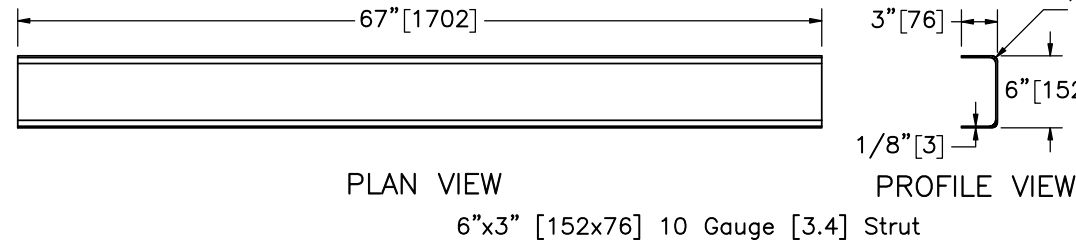
DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

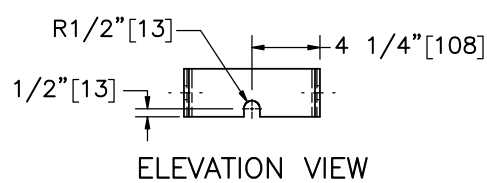
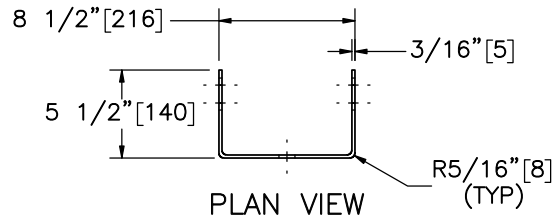
REV. BY:
SKR/JEK/
JCH/KAL



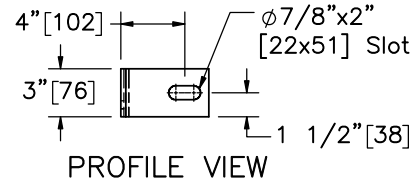
Part c8
SCALE 1:8



Anchor Bracket End Plate
SCALE 1:4



Yoke
SCALE 1:12



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Ground Strut Details

DWG. NAME.
HWTT-1_R13

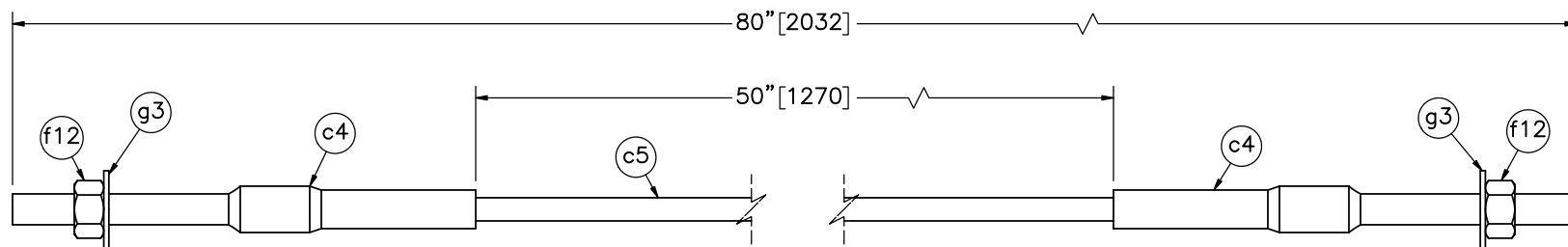
SCALE: 1:16
UNITS: in.[mm]

SHEET:
12 of 28

DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL



Cable Assembly

Item No.	QTY.	Description	Material Specification	Treatment Specification	Hardware Guide
—	1	Cable Assembly	—	—	FCA01
c4	2	BCT Anchor Cable End Swaged Fitting	Fitting — ASTM A576 Gr. 1035 Stud — ASTM F568 Class C	Fitting — ASTM A153 Stud — ASTM A153 or B695	—
c5	1	3/4" [19] Dia. 6x19 IWRC IPS Wire Rope	ASTM A741 Type 2	Class A Coating	—
f12	2	1"—8 UNC [M24x3] Heavy Hex Nut	ASTM A563DH or equivalent	ASTM A153 or B695 Class 55 or F2329	FNX24b
g3	2	1" [25] Dia. Plain USS Washer	ASTM F844	ASTM A123 or A153 or F2329	FWC24a



Midwest Roadside
Safety Facility

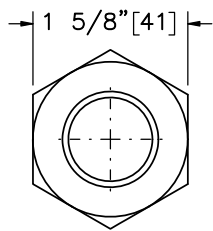
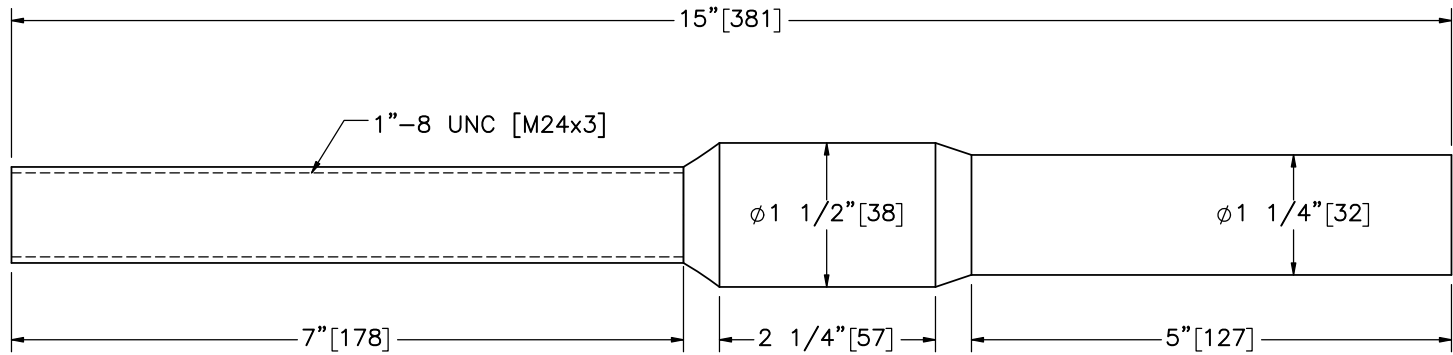
Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

BCT Anchor Cable

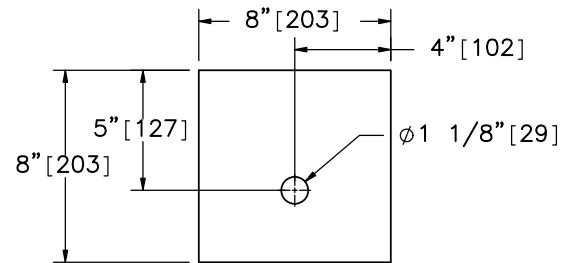
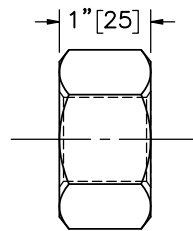
DWG. NAME.
HWTT-1_R13

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

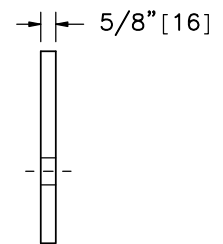
SHEET:
13 of 28
DATE:
3/2/2020
DRAWN BY:
DJW/MKB/S
BW/JRF
REV. BY:
SKR/JEK/
JCH/KAL



Part f12
SCALE 1:2

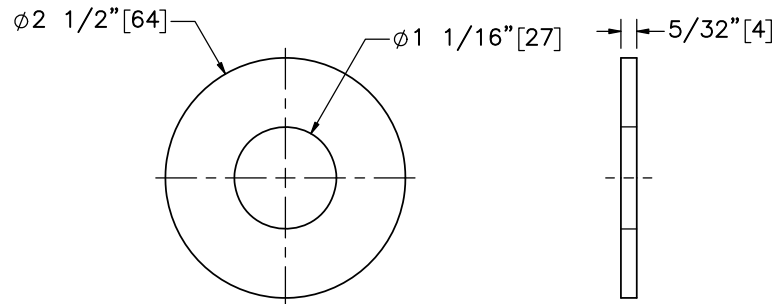


ELEVATION VIEW

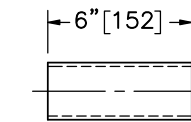


PROFILE VIEW

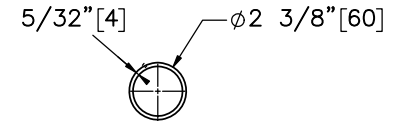
Part c6



Part g3
SCALE 1:2



ELEVATION VIEW



PROFILE VIEW

Part c7



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Cable Assembly and Anchor
Components

DWG. NAME:
HWTT-1_R13

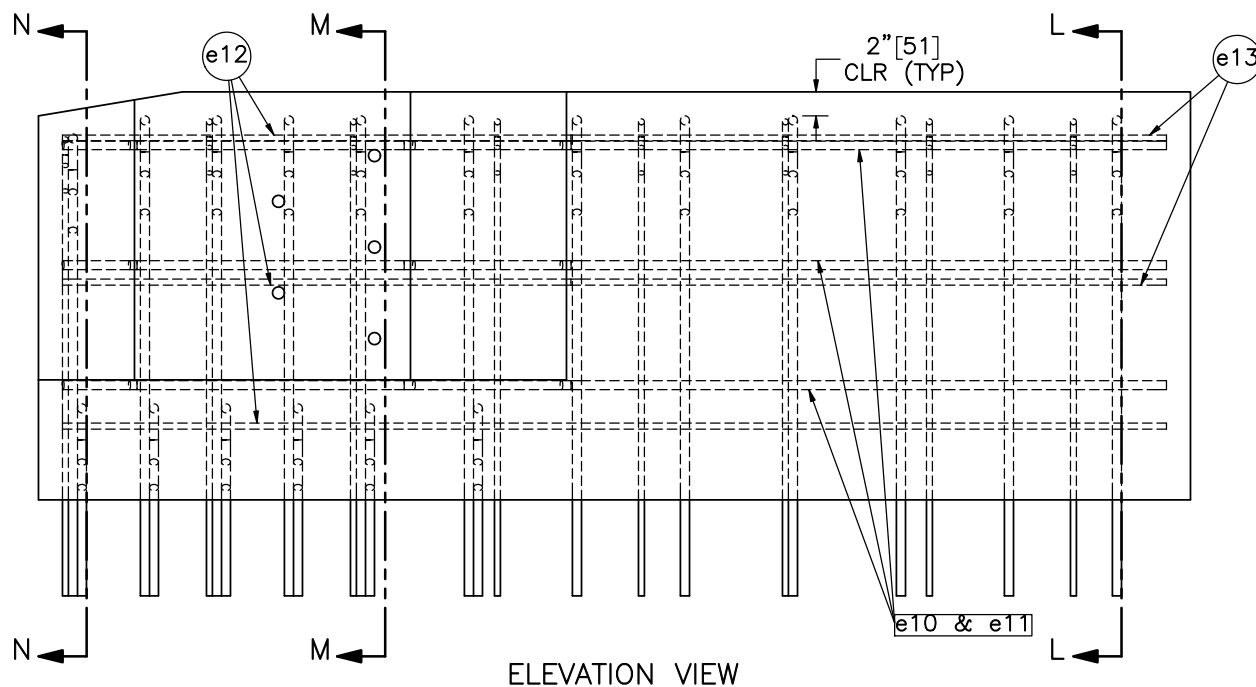
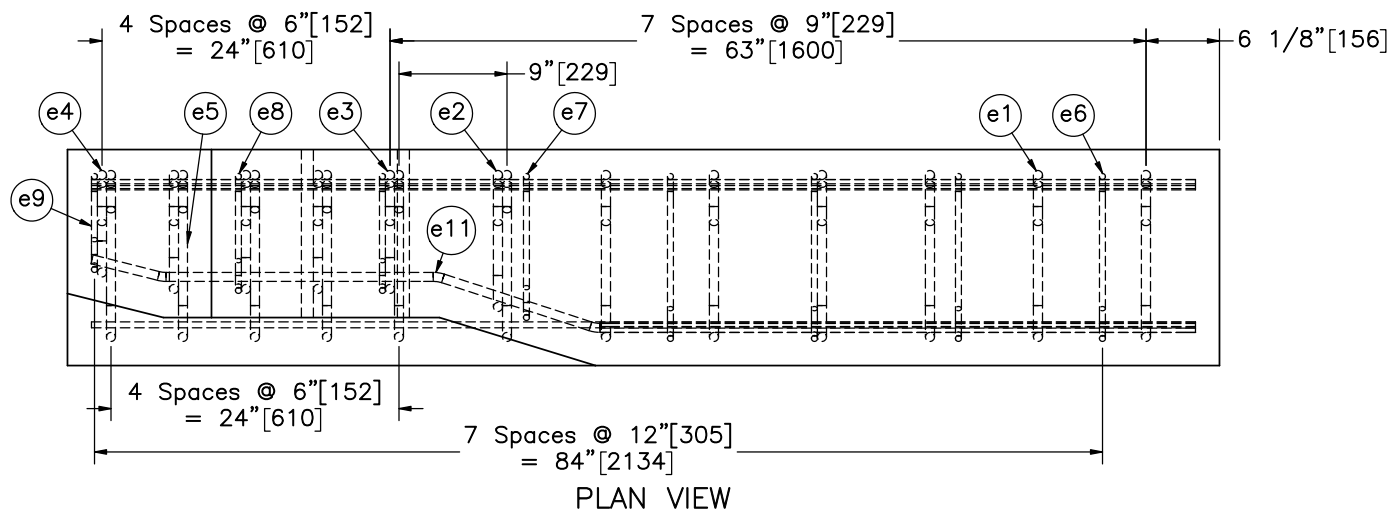
SCALE: 1:8
UNITS: in.[mm]

SHEET:
14 of 28

DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL



Notes: (1) Vertical rebar embedded in tarmac with chemical epoxy adhesive with a minimum bond strength of 1,450 psi [10.0 MPa].



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Endpost Rebar Details

DWG. NAME.
HWTT-1_R13

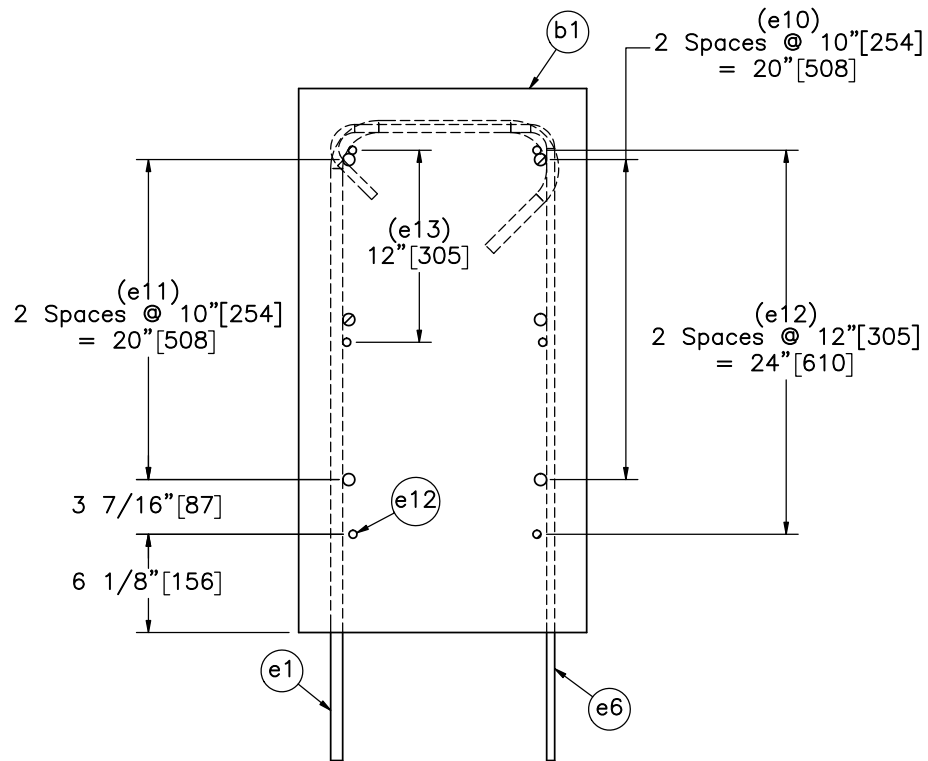
SCALE: 1:16
UNITS: in.[mm]

SHEET:
15 of 28

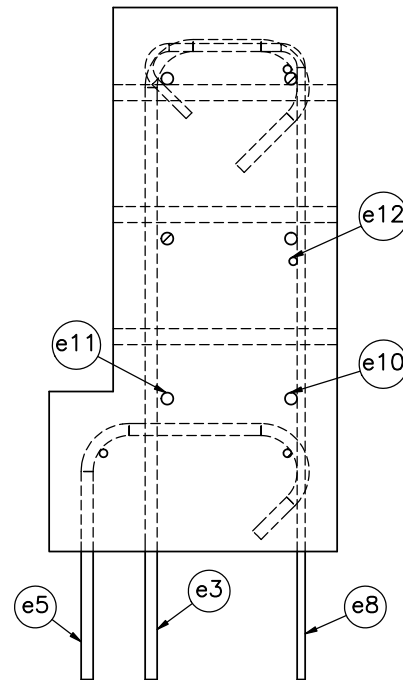
DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

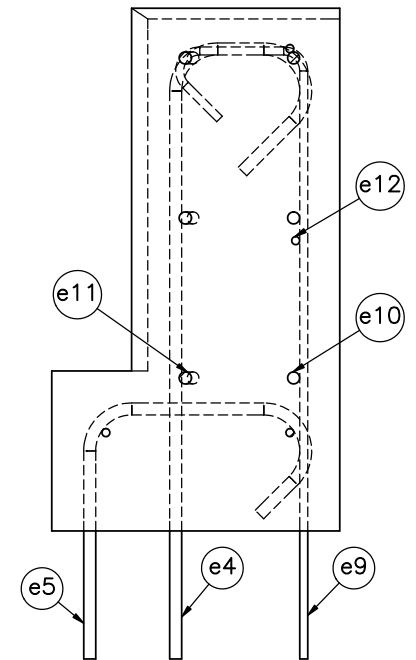
REV. BY:
SKR/JEK/
JCH/KAL



SECTION L-L



SECTION M-M



SECTION N-N

- Notes: (1) All stirrups have a minimum of 2" [51] concrete clear cover and extend 8" [203] below the bottom of the parapet.
- (2) Upper longitudinal hickey bars shown in Section N-N may require additional downward bends to ensure proper fitment.



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Type D2 Endpost Sections

DWG. NAME.
HWTT-1_R13

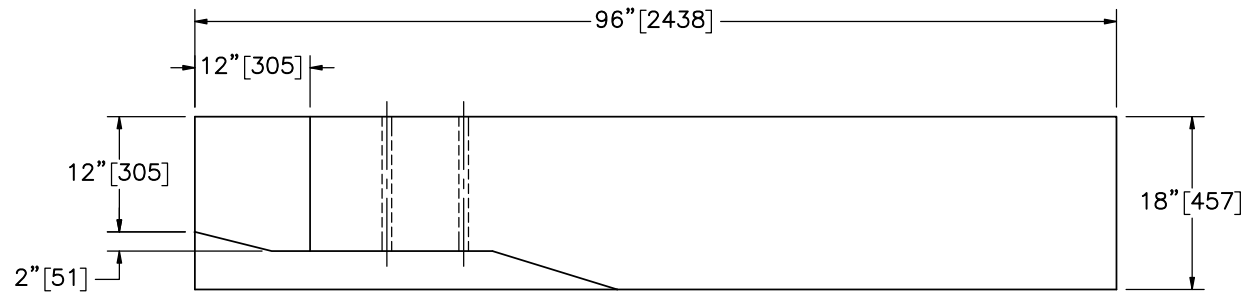
SCALE: 1:12
UNITS: in.[mm]

SHEET:
16 of 28

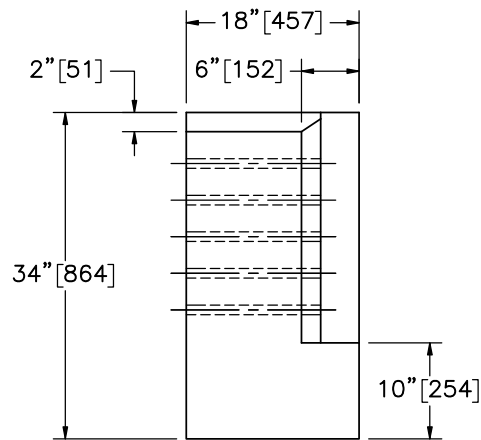
DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

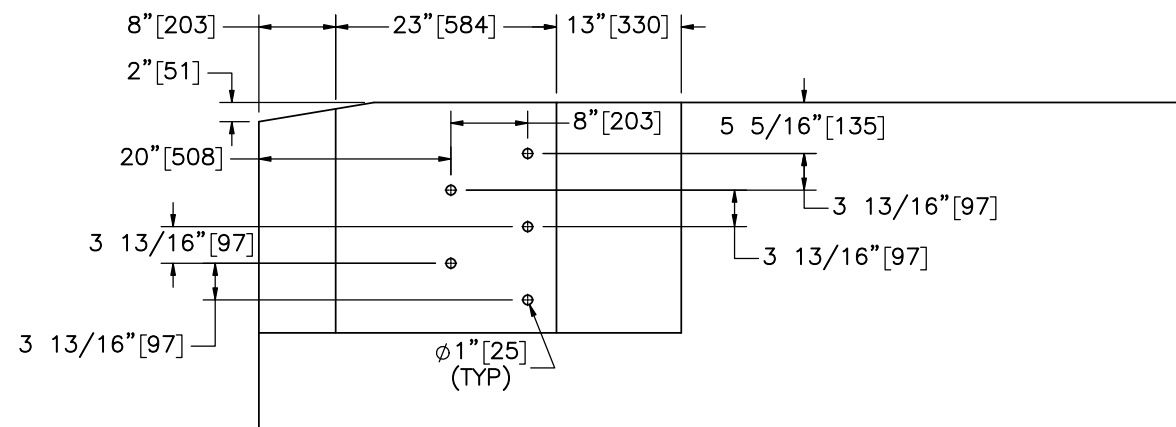
REV. BY:
SKR/JEK/
JCH/KAL



PLAN VIEW



PROFILE VIEW



ELEVATION VIEW

Part b1

Notes: (1) Five 1" [25] diameter holes are required for placement of 7/8" [22] diameter bolts.



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Type D2 Endpost Details

DWG. NAME.
HWTT-1_R13

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

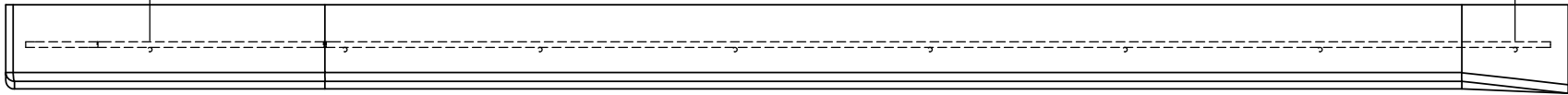
SHEET:
17 of 28

DATE:
3/2/2020

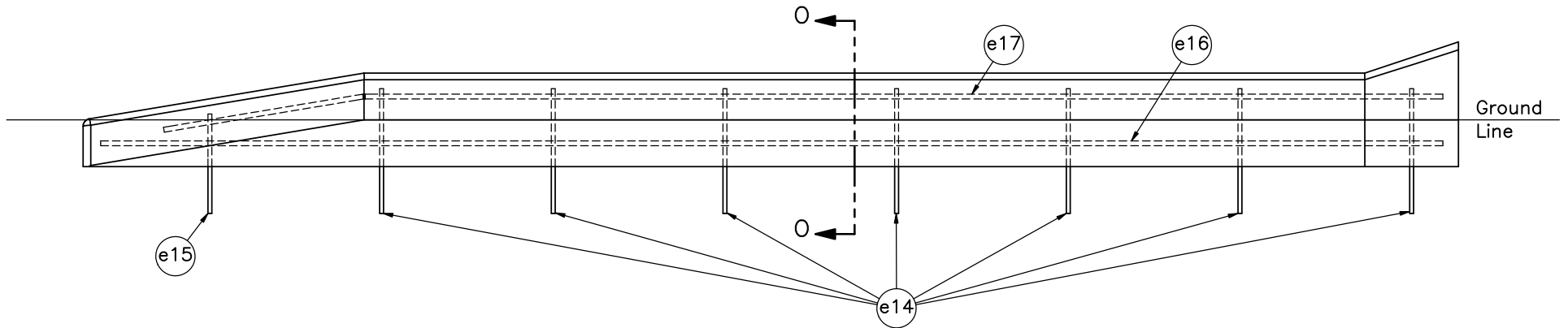
DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL

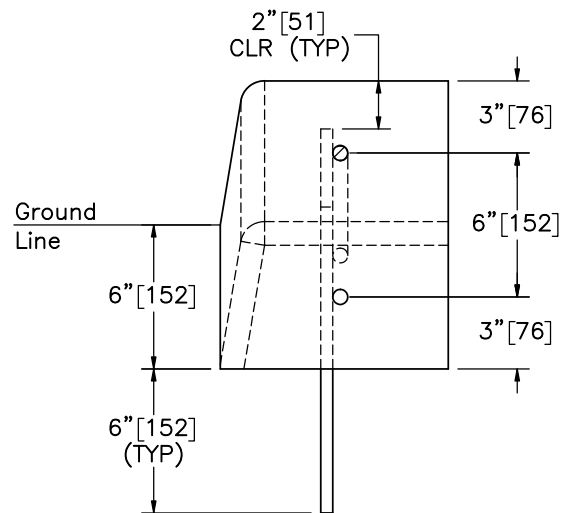
7 Spaces @ 22"[559]
= 154"[3912]



PLAN VIEW



ELEVATION VIEW



SECTION 0-0
SCALE 1:8



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Curb Reinforcement Details

DWG. NAME.
HWTT-1_R13

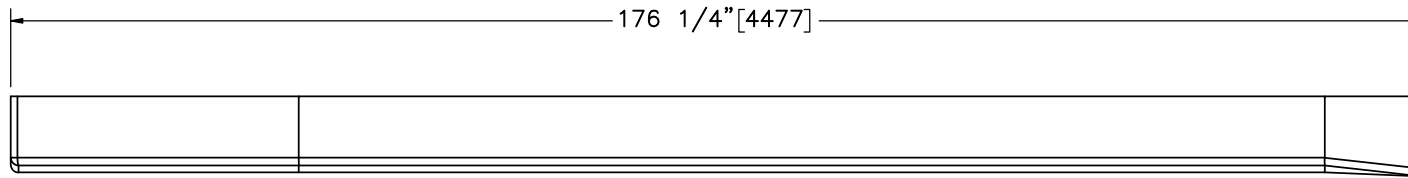
SCALE: 1:20
UNITS: in.[mm]

SHEET:
18 of 28

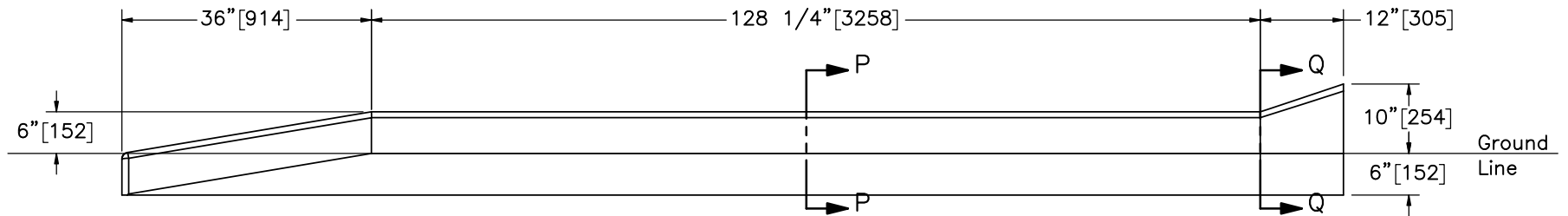
DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

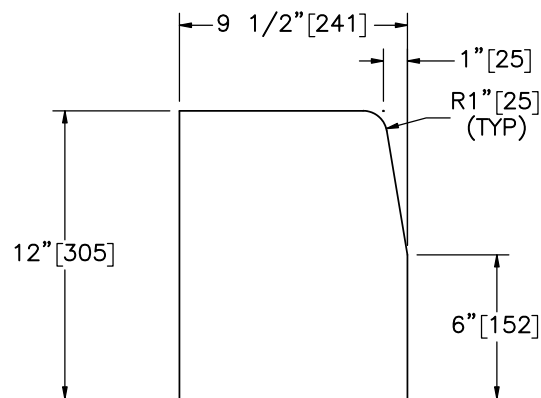
REV. BY:
SKR/JEK/
JCH/KAL



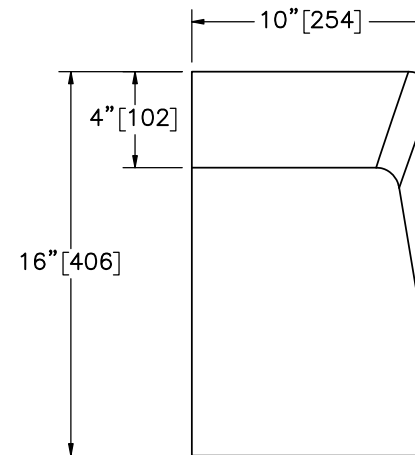
PLAN VIEW



ELEVATION VIEW



SECTION P-P
SCALE 1:8



SECTION Q-Q
SCALE 1:8



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Curb Details

DWG. NAME.
HWTT-1_R13

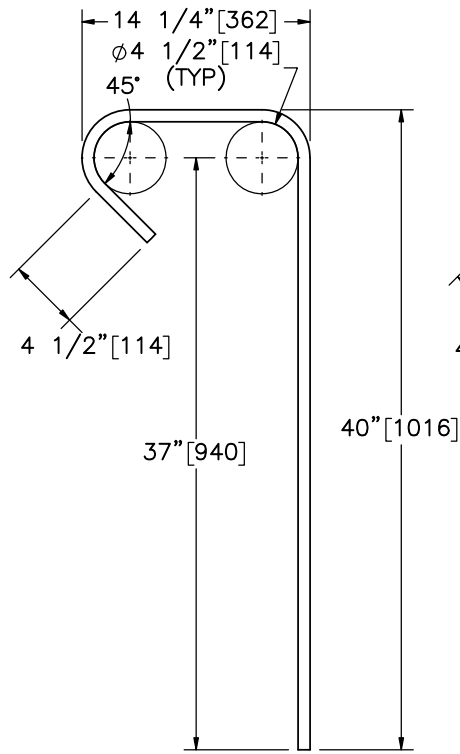
SCALE: 1:24
UNITS: in.[mm]

SHEET:
19 of 28

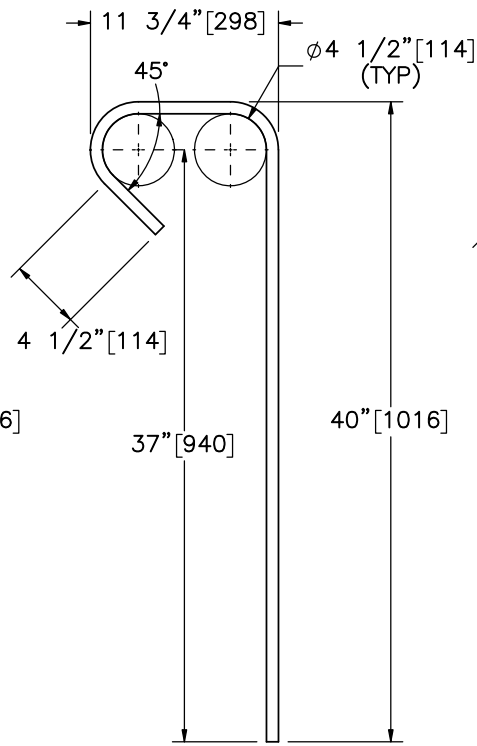
DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

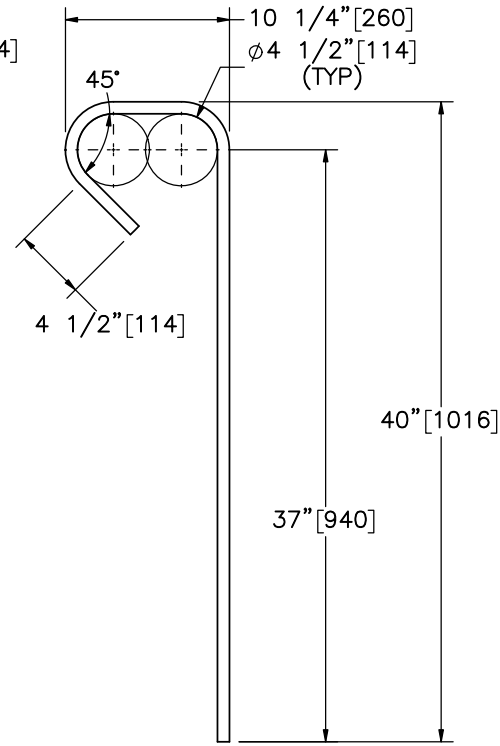
REV. BY:
SKR/JEK/
JCH/KAL



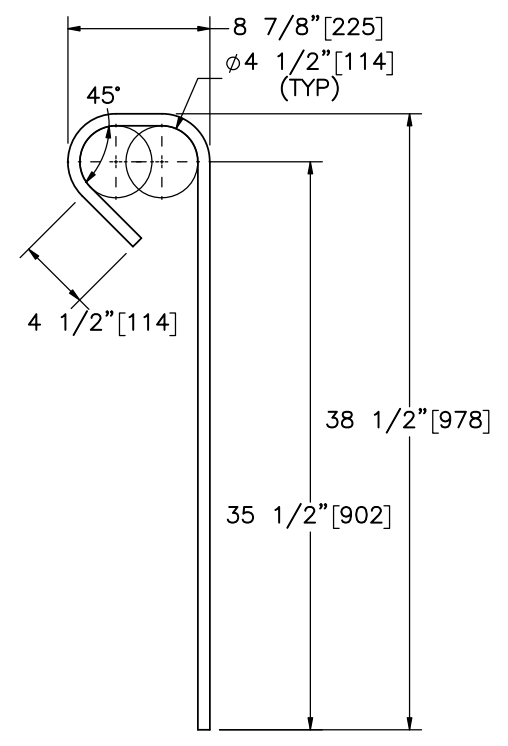
Part e1



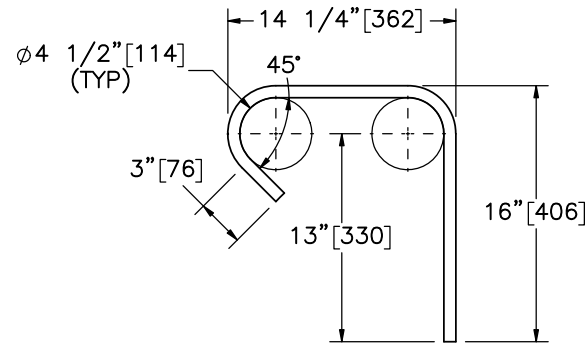
Part e2



Part e3



Part e4



Part e5

Note: (1) Bend angle and cutoff length on Part e5 may vary to ensure proper clear cover.

Bill of Bars

Part No.	Bar No.	Qty.	Unbent Length	Material Specification
e1	#6	6	60 1/16" [1526]	ASTM A615 Gr. 60
e2	#6	1	57 9/16" [1462]	ASTM A615 Gr. 60
e3	#6	4	56 1/16" [1424]	ASTM A615 Gr. 60
e4	#6	1	53 3/16" [1351]	ASTM A615 Gr. 60
e5	#6	6	34 9/16" [878]	ASTM A615 Gr. 60



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Endpost Reinforcement Details

DWG. NAME:
HWTT-1_R13

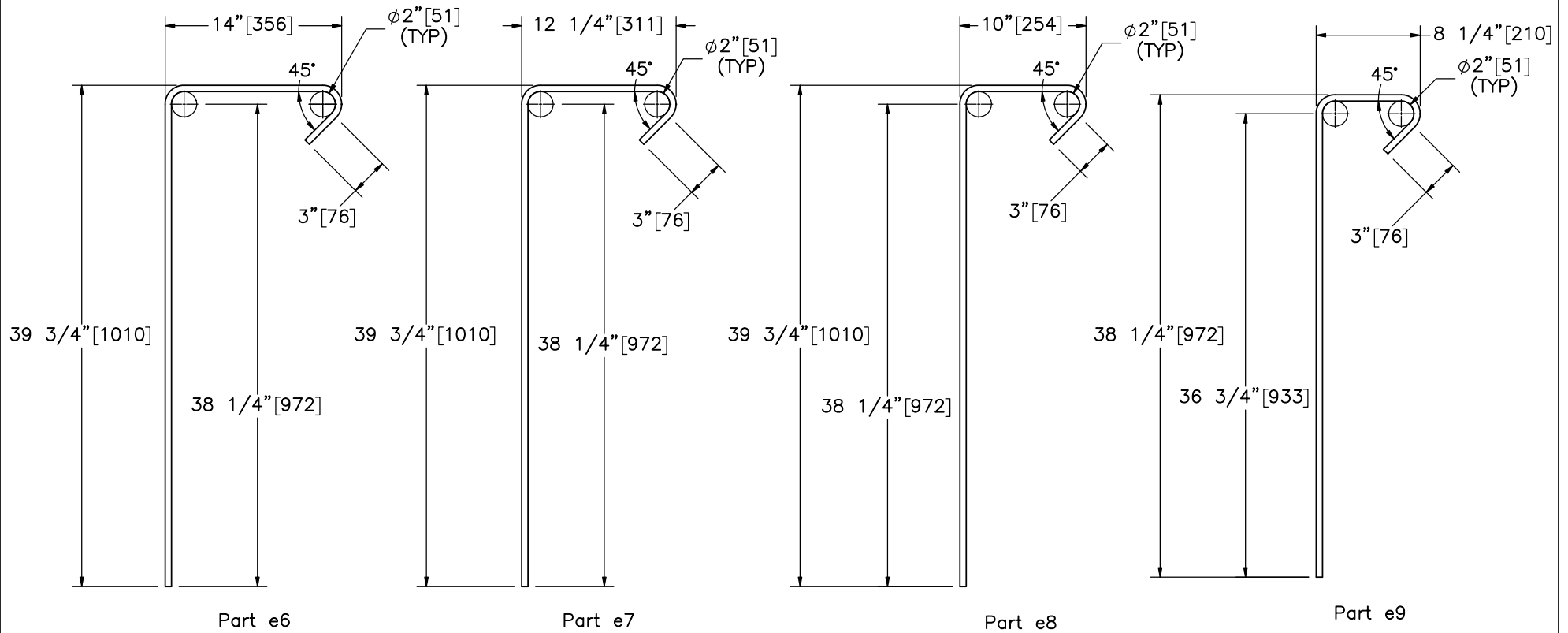
SCALE: 1:12
UNITS: in.[mm]

SHEET:
20 of 28

DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL



Bill of Bars				
Part No.	Bar No.	Qty.	Unbent Length	Material Specification
e6	#4	4	57 3/16" [1453]	ASTM A615 Gr. 60
e7	#4	1	55 7/16" [1408]	ASTM A615 Gr. 60
e8	#4	2	53 3/16" [1351]	ASTM A615 Gr. 60
e9	#4	1	49 7/8" [1267]	ASTM A615 Gr. 60



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Endpost Reinforcement Details

DWG. NAME.
HWTT-1_R13

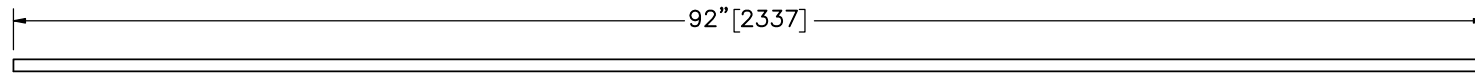
SCALE: 1:12
UNITS: in.[mm]

SHEET:
21 of 28

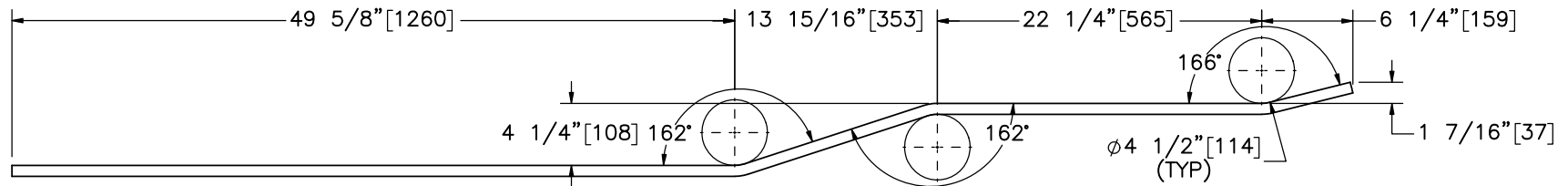
DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

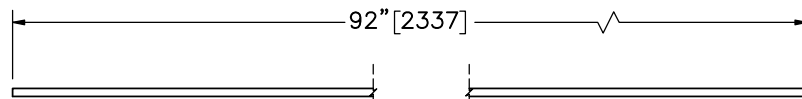
REV. BY:
SKR/JEK/
JCH/KAL



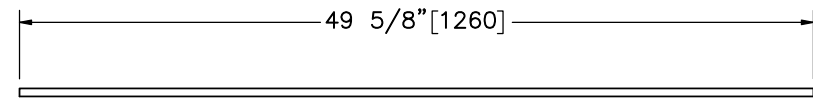
Bar e10



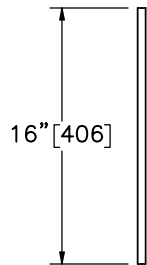
Bar e11



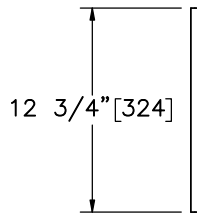
Bar e12



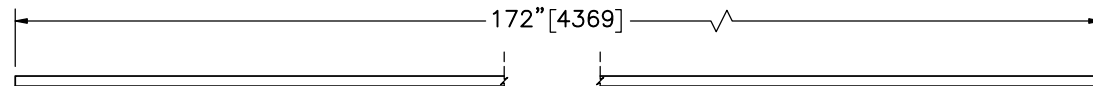
Bar e13



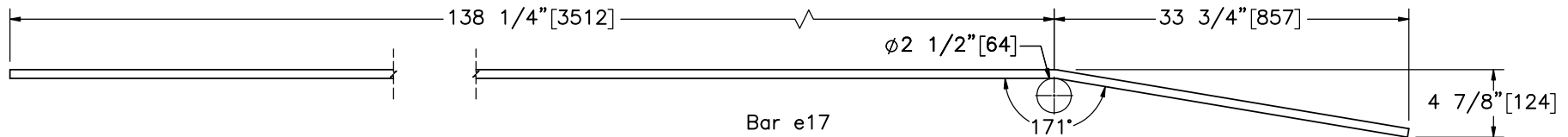
Bar e14



Bar e15



Bar e16



Bar e17

Bill of Bars

Part No.	Bar No.	Qty.	Unbent Length	Material Specification
e10	#6	3	92" [2337]	ASTM A615 Gr. 60
e11	#6	3	92 7/8" [2359]	ASTM A615 Gr. 60
e12	#4	4	92" [2337]	ASTM A615 Gr. 60
e13	#4	2	49 5/8" [1260]	ASTM A615 Gr. 60
e14	#4	7	16" [406]	ASTM A615 Gr. 60
e15	#4	1	12 3/4" [324]	ASTM A615 Gr. 60
e16	#5	1	172" [4369]	ASTM A615 Gr. 60
e17	#5	1	164 1/4" [4172]	ASTM A615 Gr. 60



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Longitudinal Endpost and Curb
Reinforcement Details

DWG. NAME:
HWTT-1_R13

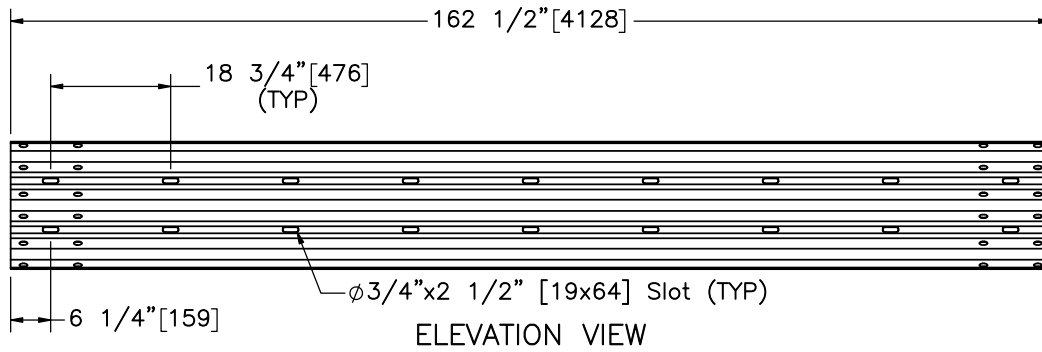
SCALE: 1:12
UNITS: in.[mm]

SHEET:
22 of 28

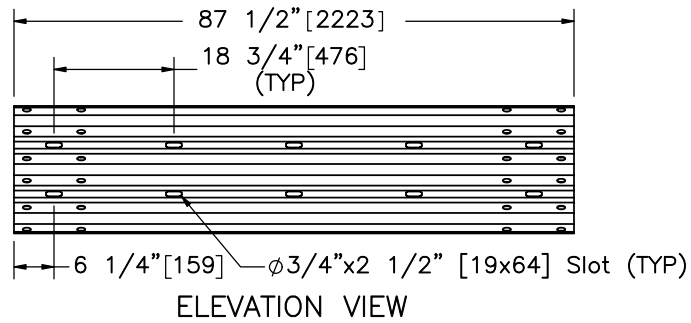
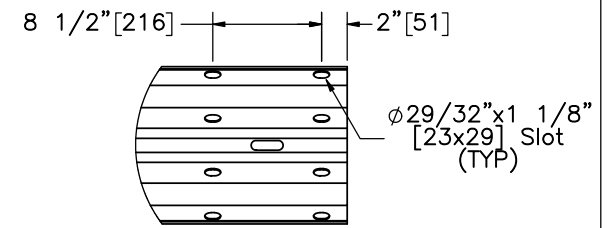
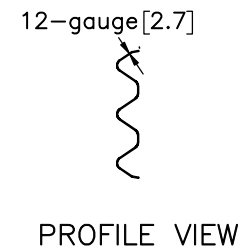
DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

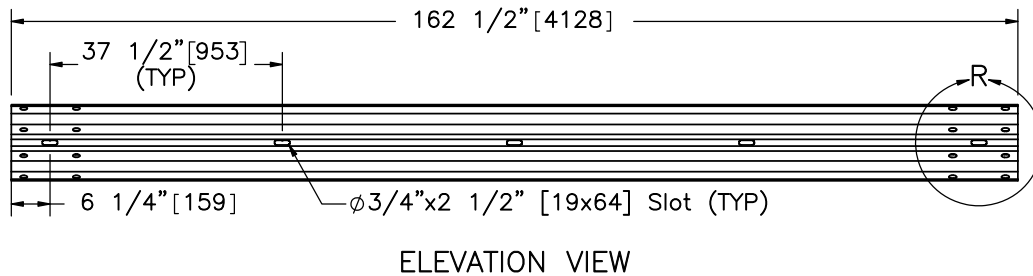
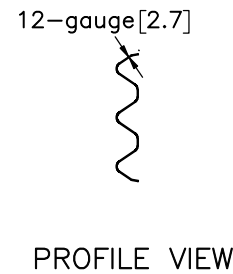
REV. BY:
SKR/JEK/
JCH/KAL



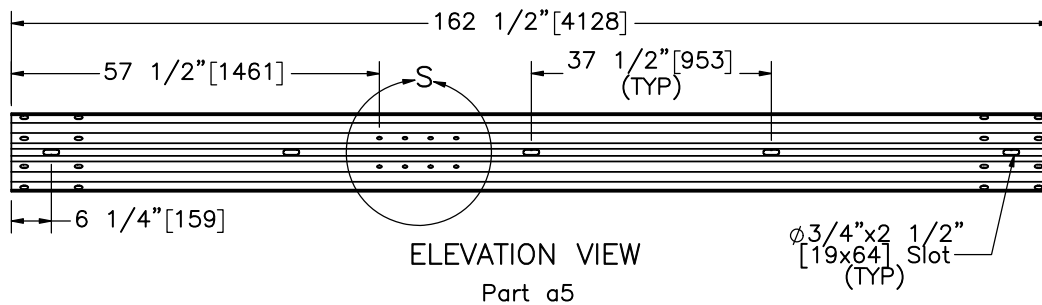
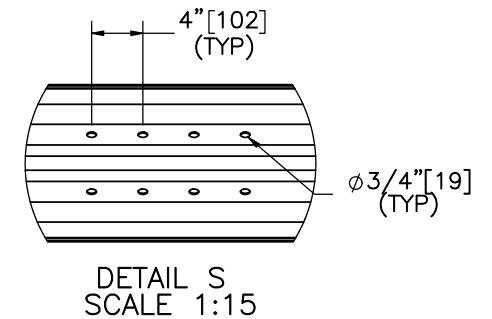
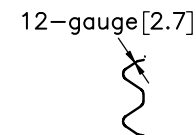
Part a1



Part a2



Part a4



Part a5



Midwest Roadside
Safety Facility

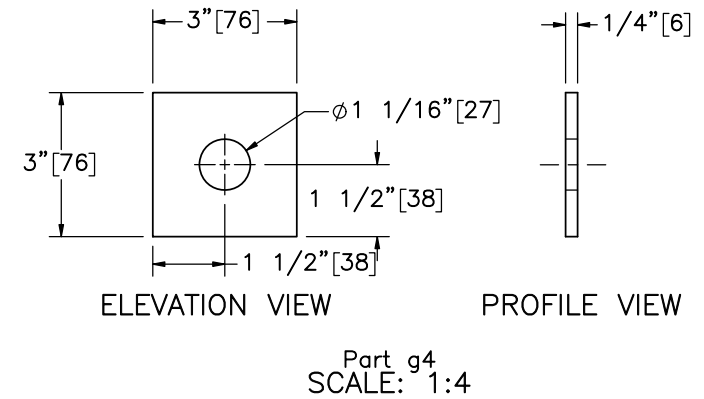
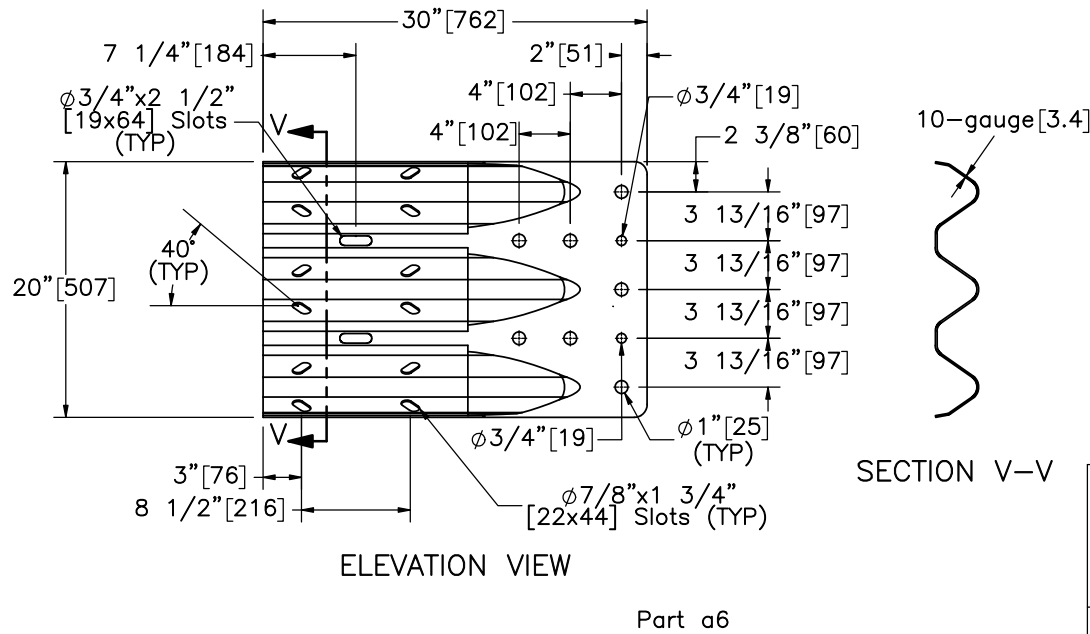
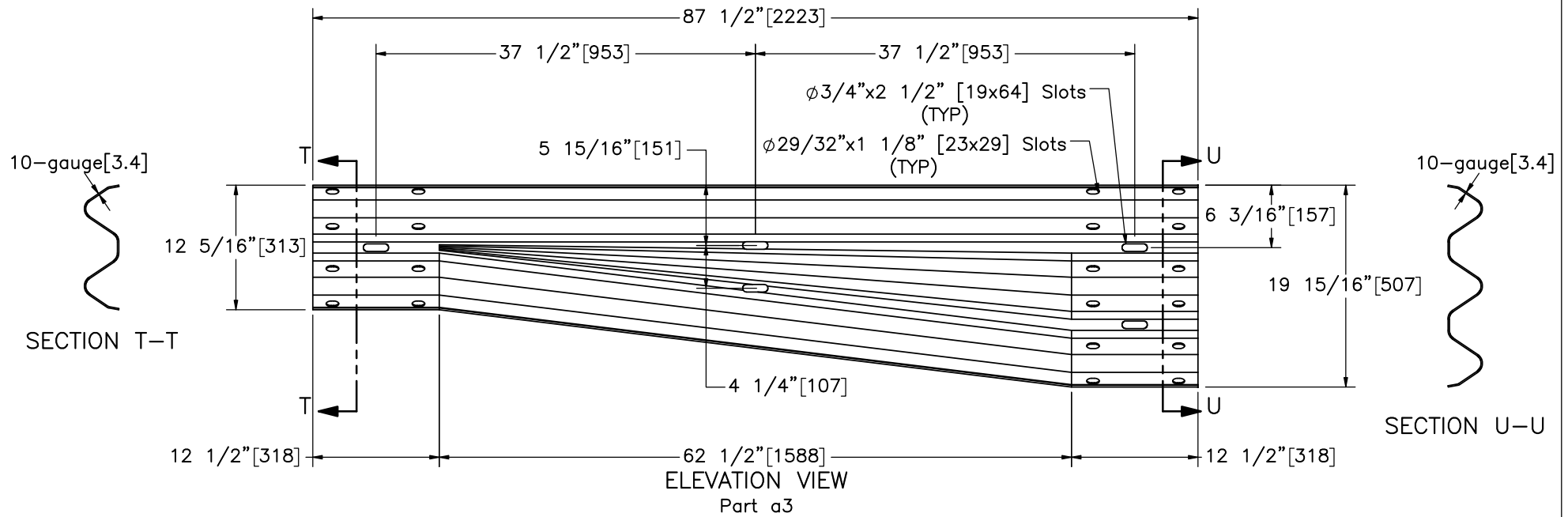
Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Guardrail Section Details

DWG. NAME.
HWTT-1_R13

SCALE: 1:30
UNITS: in./mm

SHEET:
23 of 28
DATE:
3/2/2020
DRAWN BY:
DJW/MKB/S
BW/JRF
REV. BY:
SKR/JEK/
JCH/KAL



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Rail Transition and Component
Details

DWG. NAME:
HWTT-1_R13

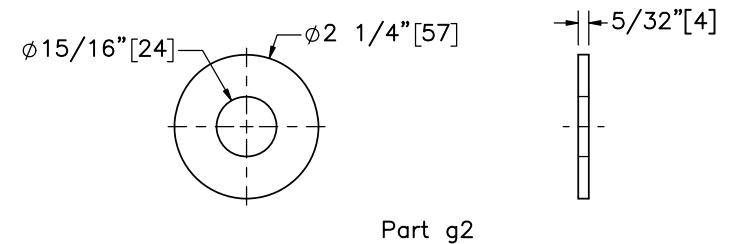
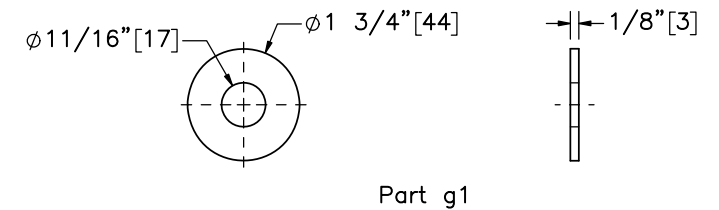
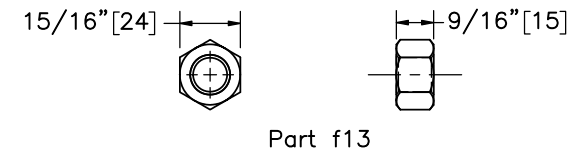
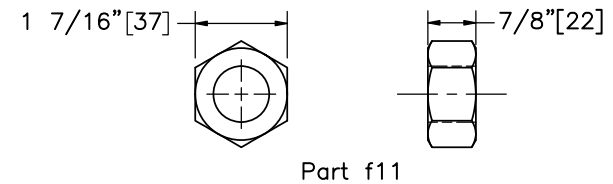
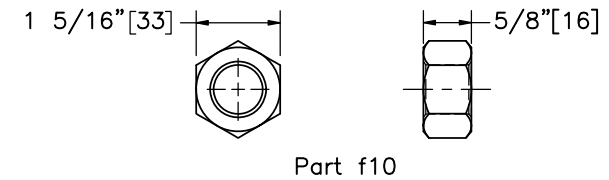
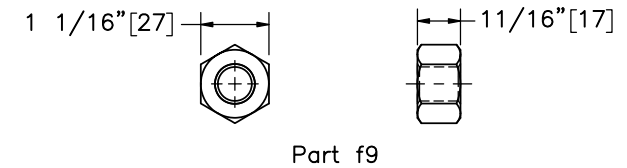
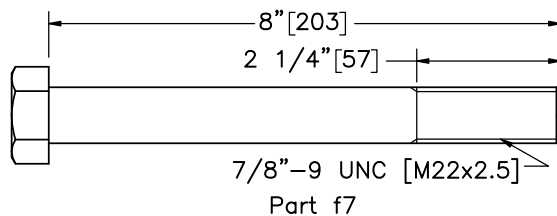
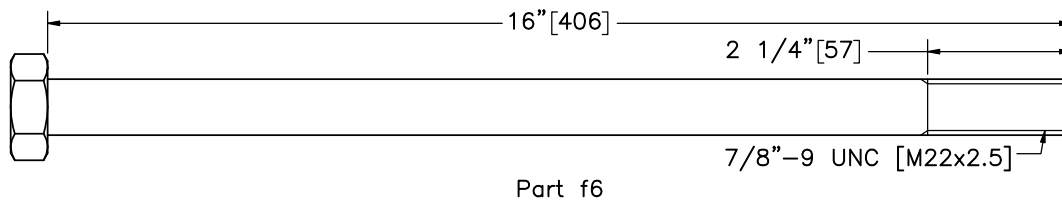
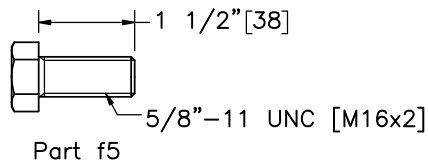
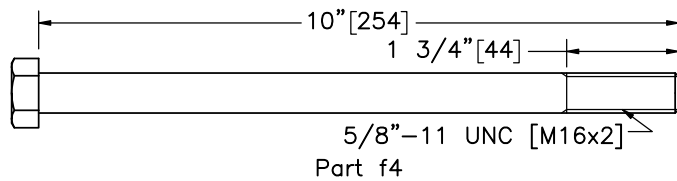
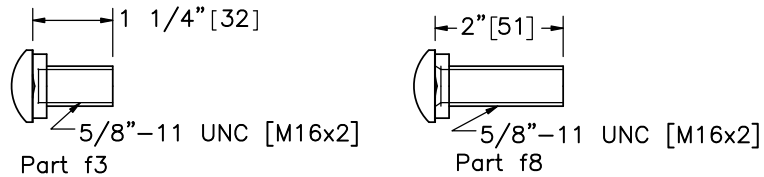
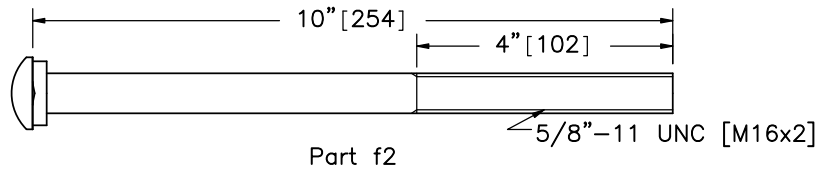
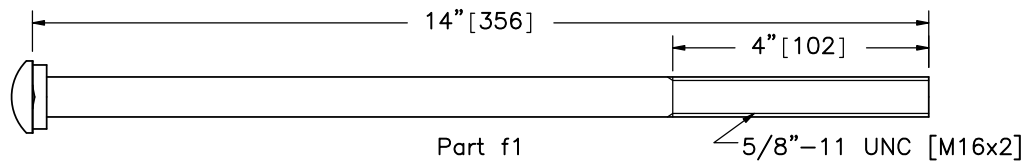
SCALE: 1:15
UNITS: in./mm

SHEET:
24 of 28

DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Hardware

DWG. NAME.
HWTT-1_R13

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

SHEET:
25 of 28

DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL

Item No.	QTY.	Description	Material Specification	Treatment Specification	Hardware Guide
a1	2	12'-6" [3,810] 12-gauge [2.7] Thrie Beam Section	AASHTO M180	ASTM A123 or A653	RTM08a
a2	1	6'-3" [1,905] 12-gauge [2.7] Thrie Beam Section	AASHTO M180	ASTM A123 or A653	RTM19a
a3	1	6'-3" [1,905] 10-gauge [3.4] W-Beam to Thrie-Beam Asymmetric Transition Section	AASHTO M180	ASTM A653	RWT02
a4	3	12'-6" [3,810] 12-gauge [2.7] W-Beam MGS Section	AASHTO M180	ASTM A123 or A653	RWM04a
a5	1	12'-6" [3,810] 12-gauge [2.7] W-Beam MGS End Section	AASHTO M180	ASTM A123 or A653	RWM14a
a6	1	10-gauge [3.4] Thrie Beam Terminal Connector	AASHTO M180 Min. yield strength = 50 ksi [345 MPa] Min. ultimate strength = 70 ksi [483 MPa]	ASTM A123 or A653	RTE01b
b1	1	Reinforced Concrete	Min. f'c = 4,000 psi [27.6 MPa] NE Mix 47BD		—
c1	2	BCT Timber Post – MGS Height	SYP Grade No. 1 or better (No knots +/- 18" [457] from ground on tension face)	—	PDF01
c2	2	72" [1,829] Long Foundation Tube	ASTM A500 Gr. B	ASTM A123	PTE06
c3	1	Ground Strut Assembly	ASTM A36	ASTM A123	PFP02
c4	2	BCT Anchor Cable End Swaged Fitting	Fitting – ASTM A576 Gr. 1035 Stud – ASTM F568 Class C	Fitting – ASTM A153 Stud – ASTM A153 or B695	—
c5	1	3/4" [19] Dia. 6x19 IWRC IPS Wire Rope	ASTM A741 Type 2	Class A Coating	—
c6	1	8"x8"x5/8" [203x203x16] Anchor Bearing Plate	ASTM A36	ASTM A123	FPB01
c7	1	2 3/8" [60] O.D. x 6" [152] Long BCT Post Sleeve	ASTM A53 Gr. B Schedule 40	ASTM A123	FMM02
c8	1	Anchor Bracket Assembly	ASTM A36	ASTM A123	FPA01
d1	7	W6x8.5 [W152x12.6] or W6x9 [W152x13.4], 72" [1,829] Long Steel Post	ASTM A992	*ASTM A123	PWE06
d2	6	W6x8.5 [W152x12.6] or W6x9 [W152x13.4], 72" [1,829] Long Steel Post	ASTM A992	*ASTM A123	PWE06
d3	4	W6x15 [W152x22.5], 78" [1,981] Long Steel Post	ASTM A992	*ASTM A123	—
d4	4	17 1/2" [445] Long, 8"x6"x1/4" [203x152x6] Steel Blockout	ASTM A500 Gr. B	*ASTM A123	—
d5	6	17 1/2" [445] Long, 12"x4"x1/4" [305x102x6] Steel Blockout	ASTM A500 Gr. B	*ASTM A123	—

* Component does not need to be galvanized for testing purposes.



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Bill of Materials

DWG. NAME.
HWTT-1_R13

SCALE: None
UNITS: in.[mm]

SHEET:
26 of 28

DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL

Item No.	QTY.	Description	Material Specification	Treatment Specification	Hardware Guide
d6	2	14 3/16"x12"x5 1/8" [360x305x130] Composite Recycled Blockout	Mondo Polymer MGS14SH or Equivalent	—	—
d7	5	14 3/16"x8"x5 1/8" [360x203x130] Composite Recycled Blockout	Mondo Polymer GB14SH2 or Equivalent	—	—
d8	1	16D Double Head Nail	—	—	—
e1	6	#6 [19] Rebar, 60 1/16" [1526] Total Unbent Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e2	1	#6 [19] Rebar, 57 9/16" [1462] Total Unbent Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e3	4	#6 [19] Rebar, 56 1/16" [1424] Total Unbent Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e4	1	#6 [19] Rebar, 53 3/16" [1351] Total Unbent Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e5	6	#6 [19] Rebar, 34 9/16" [878] Total Unbent Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e6	4	#4 [13] Rebar, 57 3/16" [1453] Total Unbent Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e7	1	#4 [13] Rebar, 55 7/16" [1408] Total Unbent Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e8	2	#4 [13] Rebar, 53 3/16" [1351] Total Unbent Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e9	1	#4 [13] Rebar, 49 7/8" [1267] Total Unbent Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e10	3	#6 [19] Rebar, 92" [2337] Total Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e11	3	#6 [19] Rebar, 92 7/8" [2359] Total Unbent Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e12	4	#4 [13] Rebar, 92" [2337] Total Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e13	2	#4 [13] Rebar, 49 5/8" [1260] Total Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e14	7	#4 [13] Rebar, 16" [406] Total Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e15	1	#4 [13] Rebar, 12 3/4" [324] Total Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e16	1	#5 [16] Rebar, 172" [4369] Total Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—
e17	1	#5 [16] Rebar, 164 1/4" [4172] Total Unbent Length	ASTM A615 Gr. 60	**Epoxy-Coated (ASTM A775 or A934)	—

** Rebar does not need to be epoxy-coated for testing purposes.



Midwest Roadside
Safety Facility

Hawaii Thrie-Beam AGT
to Bridge Rail
Test No. HWTT-1

Bill of Materials

DWG. NAME.
HWTT-1_R13

SCALE: None
UNITS: in./mm

SHEET:
27 of 28

DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL

Item No.	QTY.	Description	Material Specification	Treatment Specification	Hardware Guide
f1	13	5/8"–11 UNC [M16x2], 14" [356] Long Guardrail Bolt	ASTM A307 Gr. A	ASTM A153 or B695 Class 55 or F2329	FBB06
f2	15	5/8"–11 UNC [M16x2], 10" [254] Long Guardrail Bolt	ASTM A307 Gr. A	ASTM A153 or B695 Class 55 or F2329	FBB03
f3	44	5/8"–11 UNC [M16x2], 1 1/4" [32] Long Guardrail Bolt	ASTM A307 Gr. A	ASTM A153 or B695 Class 55 or F2329	FBB01
f4	2	5/8"–11 UNC [M16x2], 10" [254] Long Hex Head Bolt	ASTM A307 Gr. A or equivalent	ASTM A153 or B695 Class 55 or F2329	FBX16a
f5	8	5/8"–11 UNC [M16x2], 1 1/2" [38] Long Hex Head Bolt	ASTM A307 Gr. A or equivalent	ASTM A153 or B695 Class 55 or F2329	FBX16a
f6	5	7/8"–9 UNC [M22x2.5], 16" [406] Long Heavy Hex Head Bolt	ASTM F3125 Gr. A325 or equivalent	ASTM A153 or B695 Class 55 or F1136 Gr. 3 or F2329 or F2833 Gr. 1	FBX22b
f7	2	7/8"–9 UNC [M22x2.5], 8" [203] Long Hex Head Bolt	ASTM A307 Gr. A or equivalent	ASTM A153 or B695 Class 55 or F2329	–
f8	24	5/8"–11 UNC [M16x2], 2" [51] Long Guardrail Bolt	ASTM A307 Gr. A	ASTM A153 or B695 Class 55 or F2329	FBB02
f9	96	5/8"–11 UNC [M16x2] Heavy Hex Nut	ASTM A563A or equivalent	ASTM A153 or B695 Class 55 or F2329	FNX16b
f10	2	7/8"–9 UNC [M22x2.5] Hex Nut	ASTM A563A or equivalent	ASTM A153 or B695 Class 55 or F2329	–
f11	5	7/8"–9 UNC [M22x2.5] Heavy Hex Nut	ASTM A563DH	ASTM A153 or B695 Class 55 or F2329	FNX22b
f12	2	1"–8 UNC [M24x3] Heavy Hex Nut	ASTM A563DH or equivalent	ASTM A153 or B695 Class 55 or F2329	FNX24b
f13	10	5/8"–11 UNC [M16x2] Hex Nut	ASTM A563A or equivalent	ASTM A153 or B695 Class 55 or F2329	FNX16a
g1	46	5/8" [16] Dia. Plain USS Washer	ASTM F844	ASTM A123 or A153 or F2329	FWC16a
g2	4	7/8" [22] Dia. Plain Round Washer	ASTM F844	ASTM A123 or A153 or F2329	–
g3	2	1" [25] Dia. Plain USS Washer	ASTM F844	ASTM A123 or A153 or F2329	FWC24a
g4	5	3"x3"x1/4" [76x76x6] or 3 1/2"x3 1/2"x1/4" [89x89x6] Square Washer Plate	ASTM A572 Gr. 50	ASTM A123	–
–	–	Epoxy Adhesive	Hilti HIT RE–500 V3	–	–



Midwest Roadside
Safety Facility

Hawaii Thrie–Beam AGT
to Bridge Rail
Test No. HWTT–1

Bill of Materials

DWG. NAME.
HWTT–1_R13

SCALE: None
UNITS: in.[mm]

SHEET:
28 of 28

DATE:
3/2/2020

DRAWN BY:
DJW/MKB/S
BW/JRF

REV. BY:
SKR/JEK/
JCH/KAL

REV.	DATE OF ISSUE	Page	NATURE OF CHANGES	REVIEWER	REVISED BY
0	1/25/2019	–	New Drawing created.	–	DJW
1	2/1/2019	–	Guardrail bolts switched to US side of posts and blockouts.	SKR/JEK	DJW
		–	Drawing name changed from HBR-TRANS-1 to HWTT-1		
		–	Page number and order changes. Page 18 merged with 17.		
		–	Deleted section views/details K-L & P-S. Reletter remaining section views and details.		
		1	Edit Post 19 spacing. Flip section views. Title block edit. Test # and critical region added to note.		
		2,3	Section views flipped to US side of posts. Dim edits. Blockout orientation (part d5) edit for posts 3-9. Note added.		
		4	Dim add on Detail F.		
		5	Note shifts.		
		6	Removed part balloons c4, c5, g3, f12. Added assembly notes.		
		7,8,9	Fixed orientations of posts and blockouts. Note and dim edits.		
		11	Note alignment edit.		
		12	Added assembly row to table. Removed Detail K. Dim shift.		
		13	Cosmetic dim and note edits.		
		14	Moved longitudinal rebar spacing to section views. Removed farthest DS e5 bar. Removed section views P-S. Dim adds.		
		15	Added rebar spacing notes and cleaned up balloons. Added note 2. Page was created by merging what was page 17&18.		
		16	Deleted Detail L. Added vertical taper and corresponding dims.		
		17	Title block edit. Rebar dim edits. Remove hatching on section.		
		18	Curb geometry edits. Remove hatching on section views.		
		19	Part renaming. Flipped rebar to match section views. Bill of bars updated to match renamed parts. Tangent edges hidden. Dim adds to all. Title block edit.		
		20	Dim adds to all. Tangent edges hidden. Title block edit.		
		21	Title block edit. Tangent edges hidden. Update unbent lengths bars e15 and e17.		
		22	Dim edit on Detail Q.		
		23	Dim edit on Part a3.		
		24	Nut and washer dim edits. Cosmetic dim edits.		

REV.	DATE OF ISSUE	Page	NATURE OF CHANGES	REVIEWER	REVISED BY
1	2/1/2019	BOM	Description: g1. Material Spec: f1-f11. Treatment Spec: f9-f11. HWG: c5, f9, f11.	SKR/JEK	DJW
2	3/12/2019	-	Switched to 8" Mondo blockout for Posts 3-7, and 12" Mondo blockout for Posts 8-9. Updated all corresponding views and added blockout details. Shortened parts e4 and e9, updated section views and bill of bars/materials.	SKR	DJW
		1	Test designation changed to 3-20.		
		BOM	Description: d6.		
3	3/29/2019	1	Impact Location added.	SKR	MKB
4	4/1/2019	BOM	Description: f6	JCH	MKB
5	4/5/2019	8	Part d2 edit. Part d5 edit.	JCH	MKB
		9	Part d1 edit.		
		BOM	Description: d3		
6	4/16/2019	-	Flipped entire system due to construction location. Created necessary mirrored parts and assemblies, and updated all corresponding views to accomodate.	JCH/SKR	DJW
		3	Added curb into Section E to detail placement. Added note 2.		
		20	Part e5 quantity corrected to 6. All bend diameters and after bend lengths changed from 3" to 4.5". Bill of bars table updated. Note added for Part e5.		
		21	Length after bends changed from 2.5" to 3". Bill of bars updated.		
		22	Bend diameter on Part e11 changed from 3" to 4.5".		
7	4/22/2019	13	Description, material spec, and HWG# updates for part f12.	KAL	DJW
		14	Dim changes for part f12.		
		BOM	Description, material spec, and HWG# updates for part f12.		
8	4/23/2019	-	Revert changes made in Rev 7 (wrong part).	SKR	DJW
		13	Description, material spec, and HWG# updates for part f12.		
		14	Dim changes for part f12.		
		25	Dim changes for part f9.		
		BOM	Description, material spec, and HWG# updates for parts f9 & f12.		
9	4/24/2019	-	Part f9 changed back to heavy nut, addition of Part f13 (regular 5/8"-11 hex nut for anchor bracket and ground strut).	JCH	DJW
		6	Part f9 replaced with Part f13.		
		25	Addition of Part f13.		

System: Hawaii Thrie Beam AGT to Bridge Rail

Revision History

Drawing: HWTT-1

9	4/24/2019	BOM	Addition of Part f13. QTY, Description, HWG# edits for Part f9.	JCH	DJW
10	7/12/2019	3	Edited Section D to show curb. Added note 3.	KAL	DJW
11	9/6/2019	10,17	Fixed Typos	SBW	JEK
12	12/4/2019	4	Sheet description edit.	ELU	JEK
13	3/2/2020	BOM	Added Epoxy adhesive	JEK	JRF