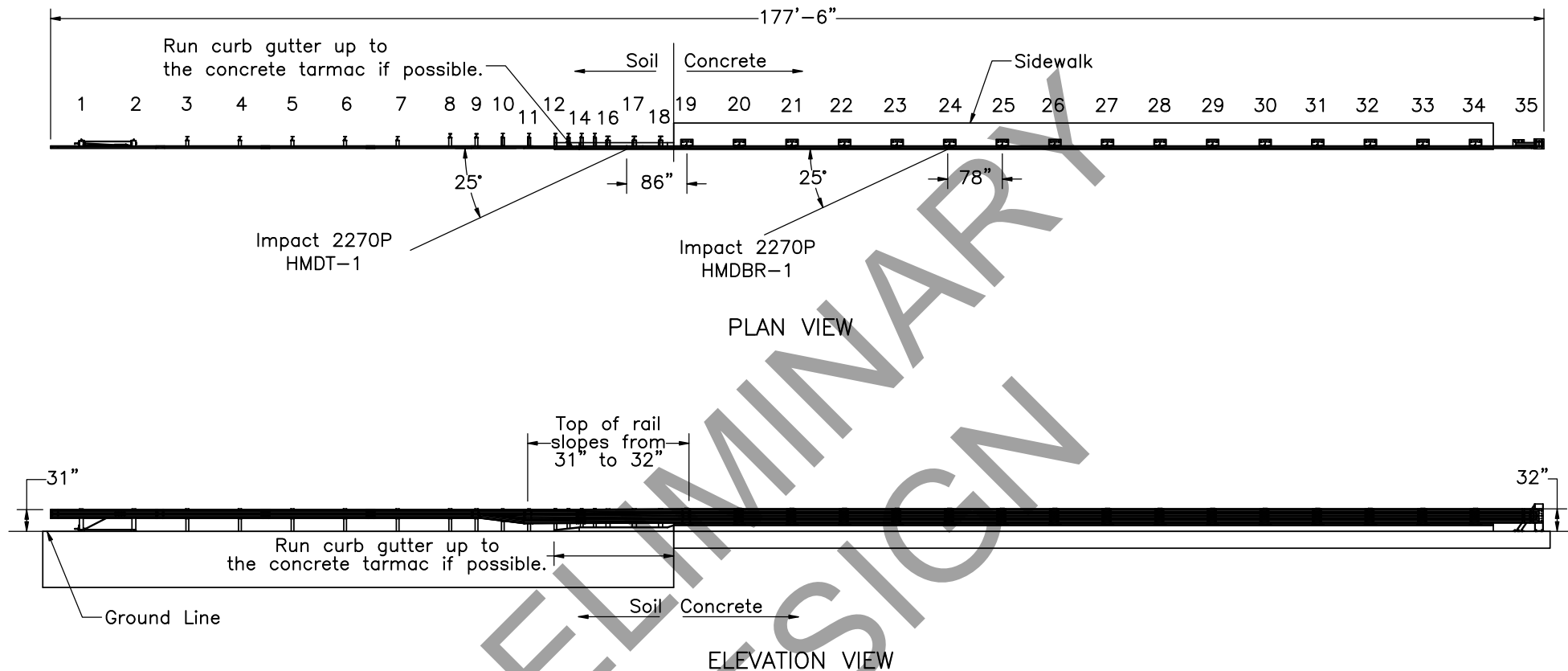




- Notes: (1) Test no. HMDBR-1 shall be performed according to test designation no. 3-11 of MASH 2016 criteria.
- (2) The impact point for test no. HMDBR-1 is 78" upstream from post no. 25, or 3" upstream from post no. 24.
- (3) Test no. HMDT-1 shall be performed according to test designation no. 3-21 of MASH 2016 criteria.
- (4) The impact point for test no. HMDT-1 is 86" upstream from post no. 19, or 11" upstream from post no. 17.
- (5) Quantities listed herein are only for one copy of the system.



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

System Layout – Test Nos.
HMDBR-1 & HMDT-1

DWG. NAME:
HMDT-HMDBR_R19

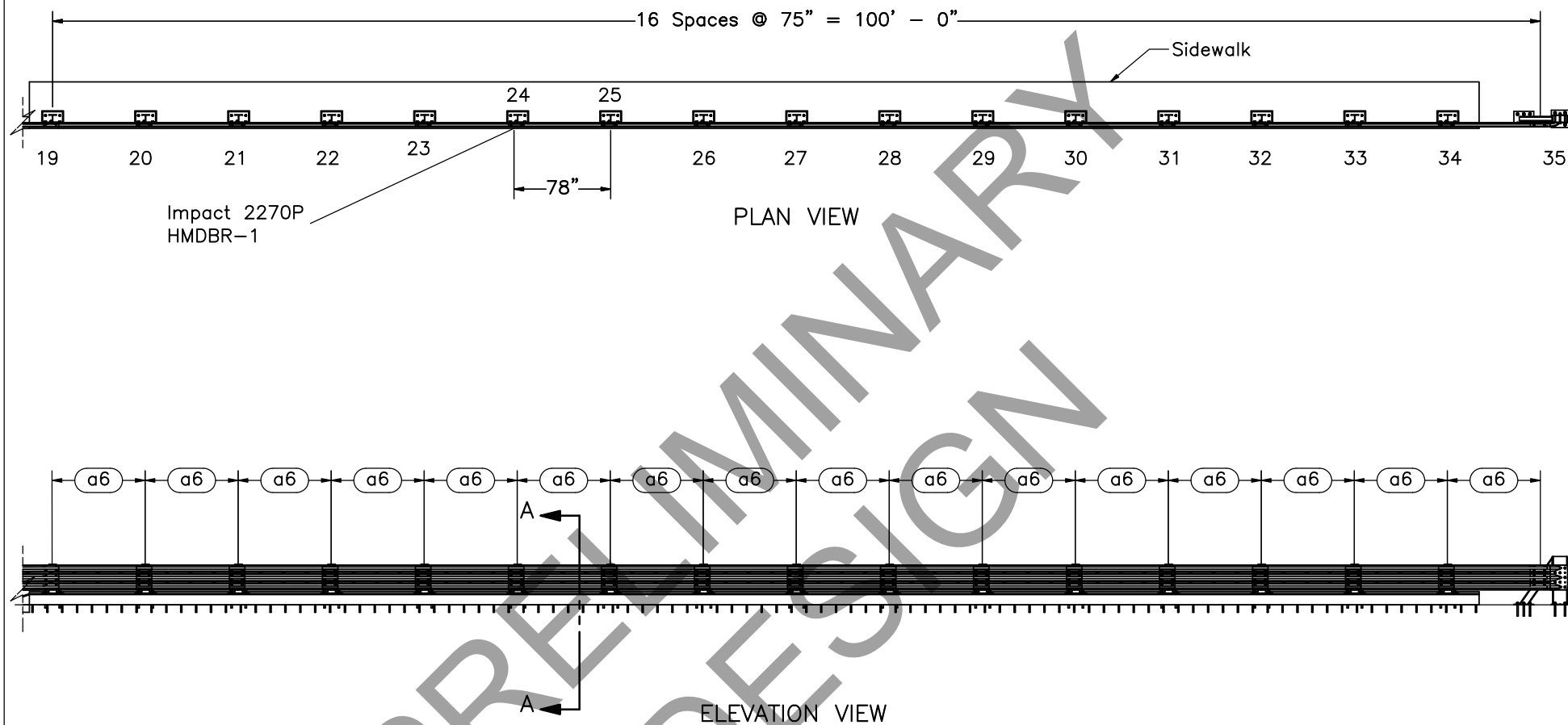
SCALE: 1:220
UNITS: in.

SHEET:
1 of 35

DATE:
8/19/2021

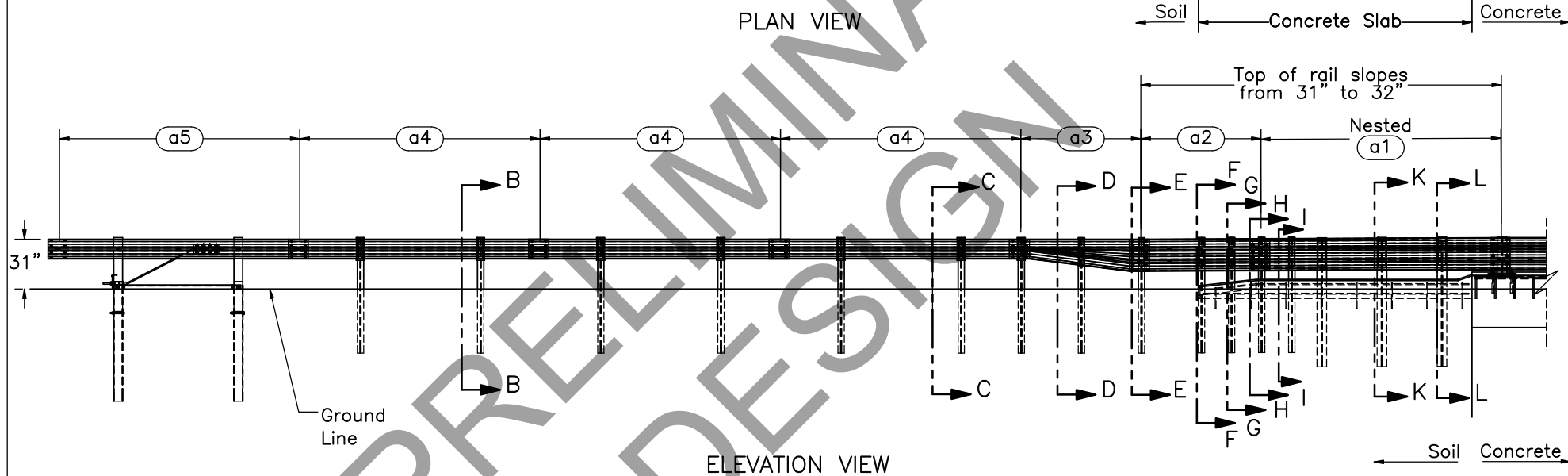
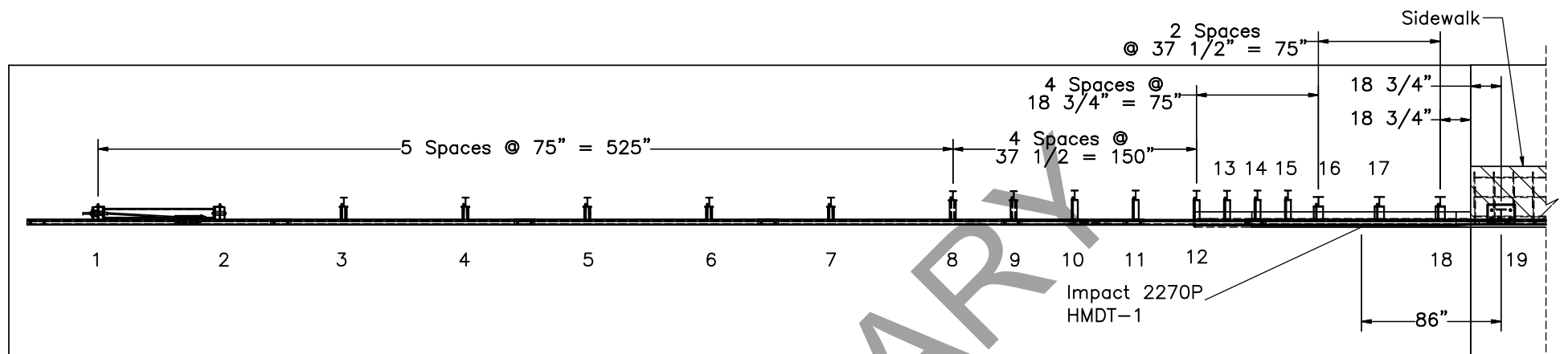
DRAWN BY:
LJP/SBW/G
HR

REV. BY:
MP/KAL/JC
H



- Notes: (1) Test no. HMDBR-1 shall be performed according to test designation no. 3-11 of MASH 2016 criteria.
- (2) The impact point for test no. HMDBR-1 is 78" upstream from post no. 25, or 3" upstream from post no. 24.

	Hawaii Modified Delaware Retrofit Thrie Beam Bridge Rail & Transition		SHEET: 2 of 35
	Bridge Rail Layout - Test No. HMDBR-1		DATE: 8/19/2021
Midwest Roadside Safety Facility	DWG. NAME: HMDT-HMDBR_R19	SCALE: 1:125 UNITS: in.	DRAWN BY: LJP/SBW/G HR
			REV. BY: MP/KAL/JC H



- Notes: (1) Test no. HMDT-1 shall be performed according to test designation no. 3-21 of MASH 2016 criteria.
- (2) The impact point for test no. HMDT-1 is 86" upstream from post no. 19, or 11" upstream from post no. 17.
- (3) BCT anchors are placed in 3' diameter holes then backfilled and tamped with soil.
- (4) Run the Curb Gutter up to the Tarmac.



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Transition Layout - Test No.
HMDT-1

DWG. NAME.
HMDT-HMDBR_R19

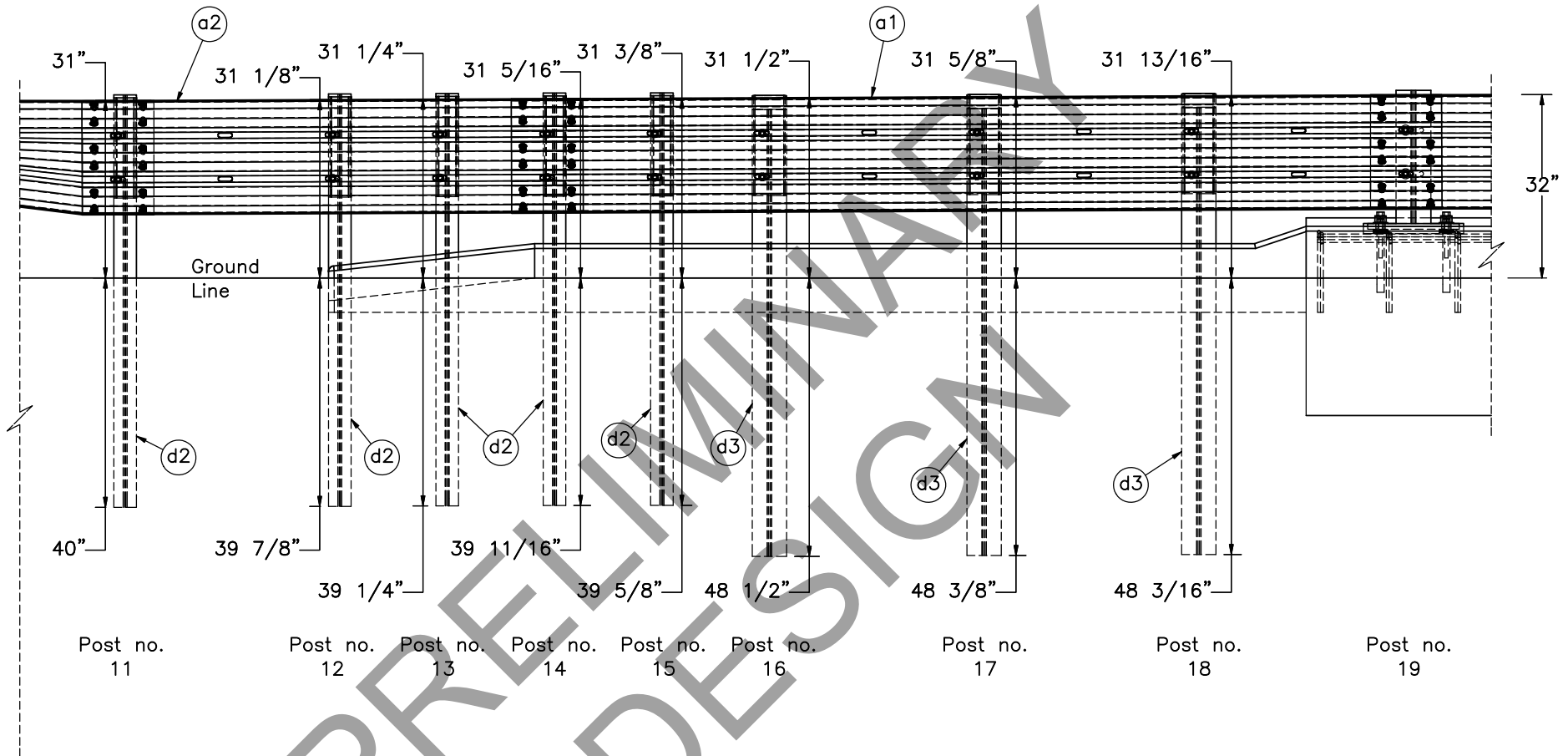
SCALE: 1:95
UNITS: in.

SHEET:
3 of 35

DATE:
8/19/2021

DRAWN BY:
LJP/SBW/G
HR

REV. BY:
MP/KAL/JC
H



- Note: (1) Curb reinforcement is hidden for clarity.
 (2) Rail height dimensions occur at the center of each post.
 (3) Run the curb gutter up to the concrete tarmac if possible. Recommend similar thickness as curb depth underground



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Post Nos. 11-19 Embedment
Depths and Rail Heights

DWG. NAME:
HMDT-HMDBR_R19

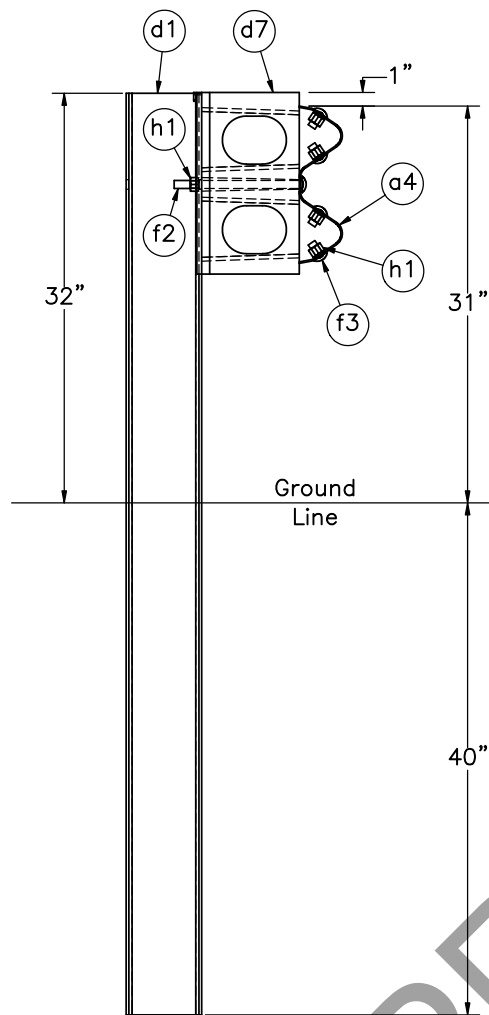
SCALE: 1:28
UNITS: in.

SHEET:
4 of 35

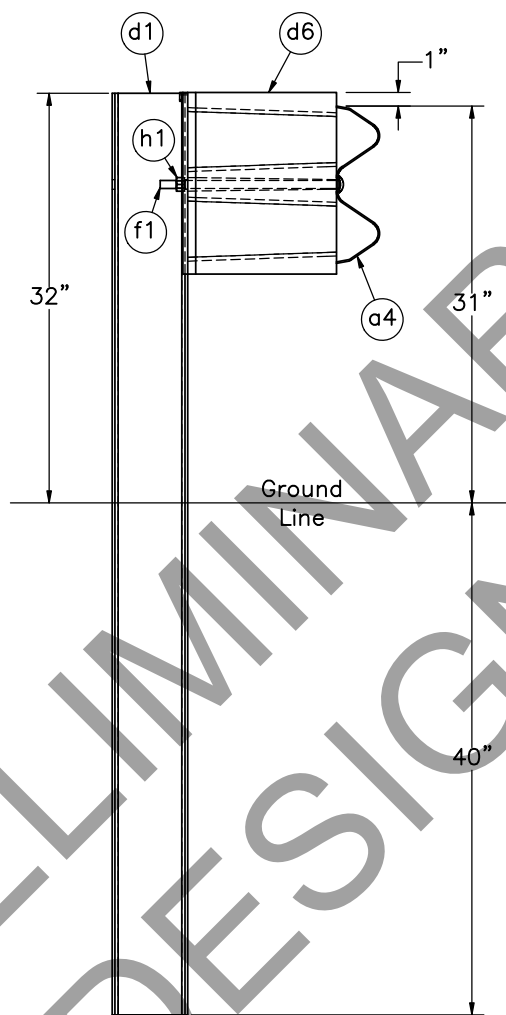
DATE:
8/19/2021

DRAWN BY:
LJP/SBW/G
HR

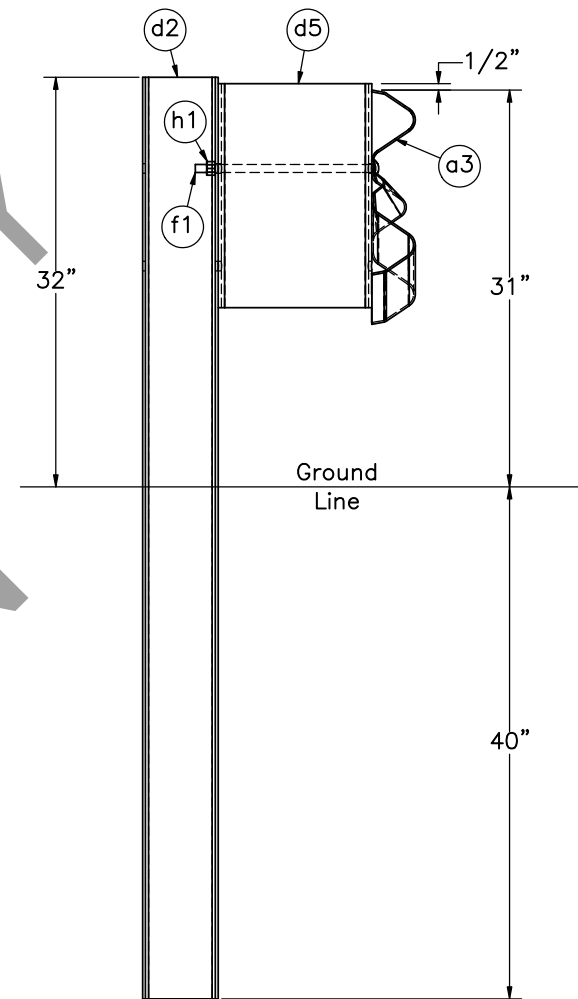
REV. BY:
MP/KAL/JC
H



SECTION B-B
Post Nos. 3-7



SECTION C-C
Post Nos. 8-9



SECTION D-D
Post No. 10

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



Midwest Roadside
Safety Facility

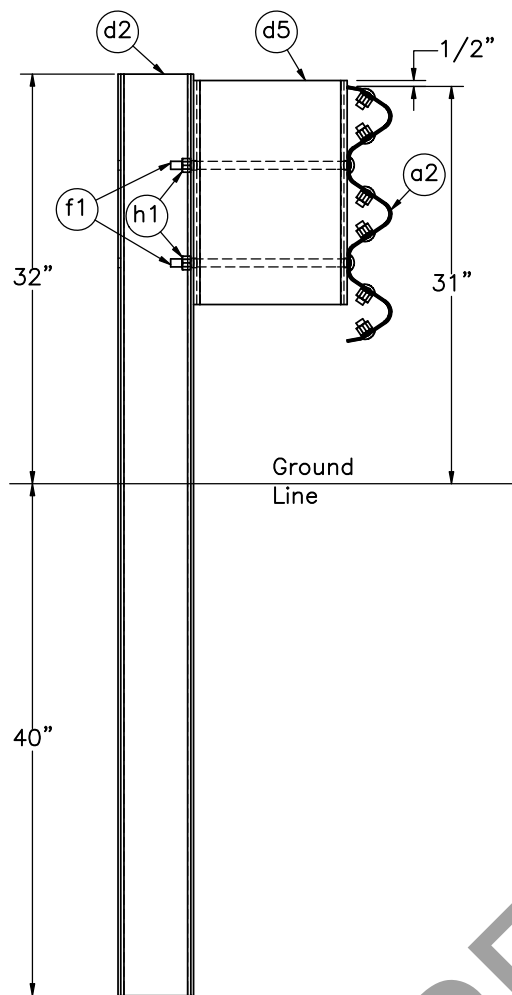
Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Post Nos. 3-10 Details

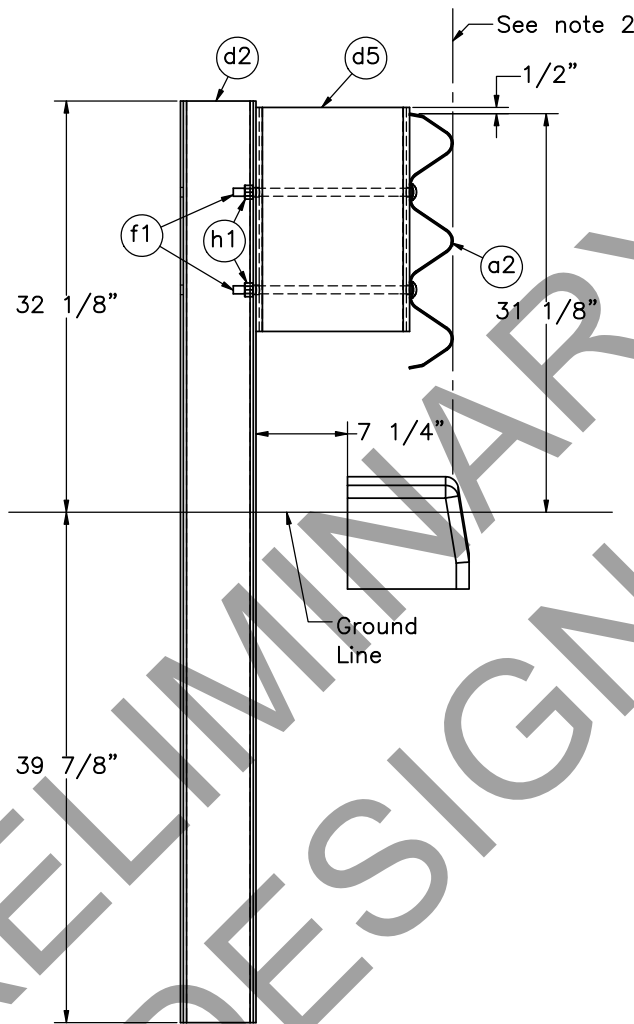
DWG. NAME.
HMDT-HMDBR_R19

SCALE: 1:15
UNITS: in.

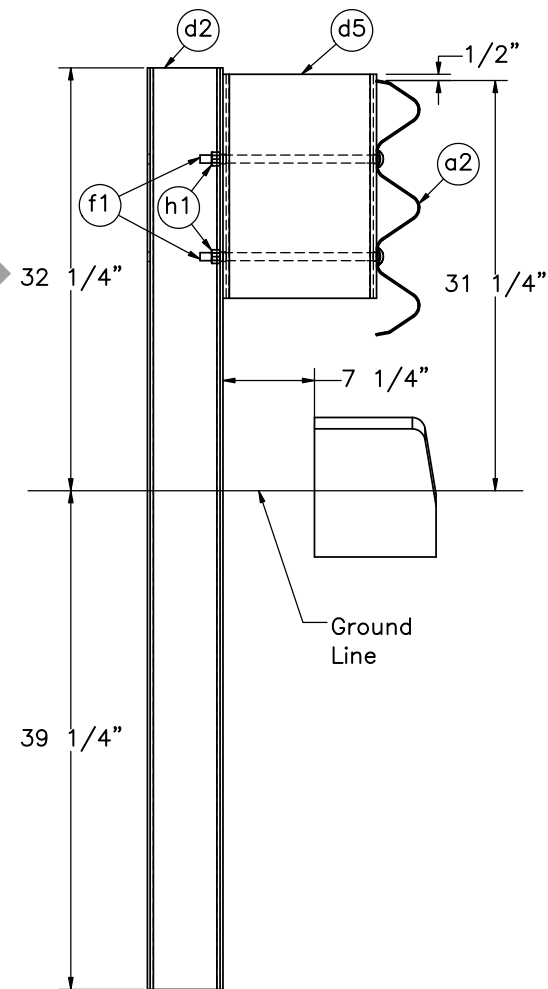
SHEET:
5 of 35
DATE:
8/19/2021
DRAWN BY:
LJP/SBW/G
HR
REV. BY:
MP/KAL/JC
H



SECTION E-E
Post No. 11



SECTION F-F
Post No. 12



SECTION G-G
Post No. 13

- Notes: (1) Guardrail bolts (part f1) are on the upstream side of the web.
 (2) Top of curb is in line with the front of the rail.
 (3) Curb reinforcement hidden for clarity.
 (4) Run the curb gutter up to the concrete tarmac if possible. Recommend similar thickness as curb depth underground.



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Post Nos. 11-13 Details

DWG. NAME.
HMDT-HMDBR_R19

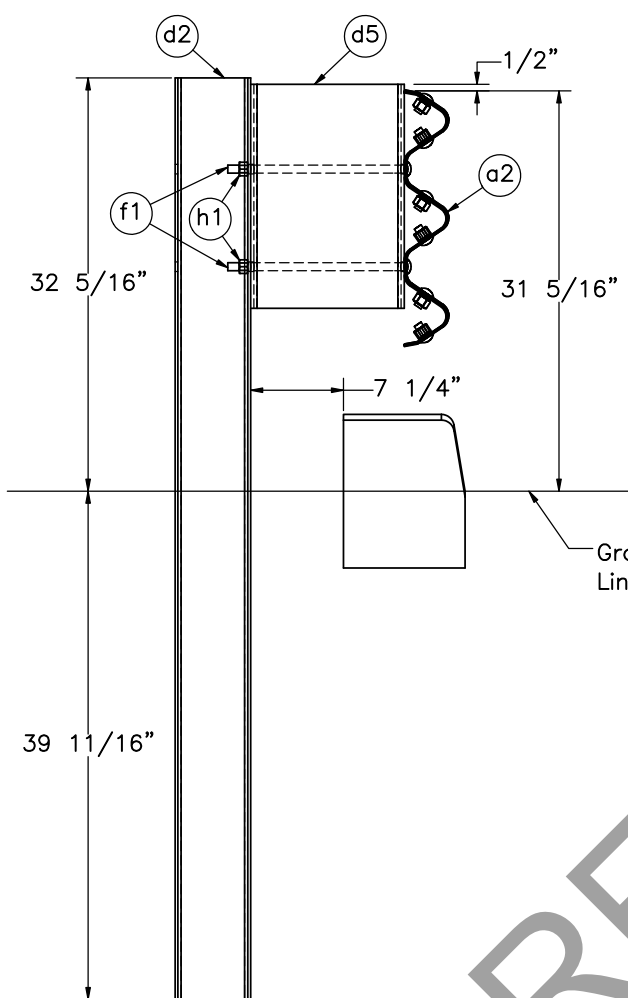
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UNITS: in.

SHEET:
6 of 35

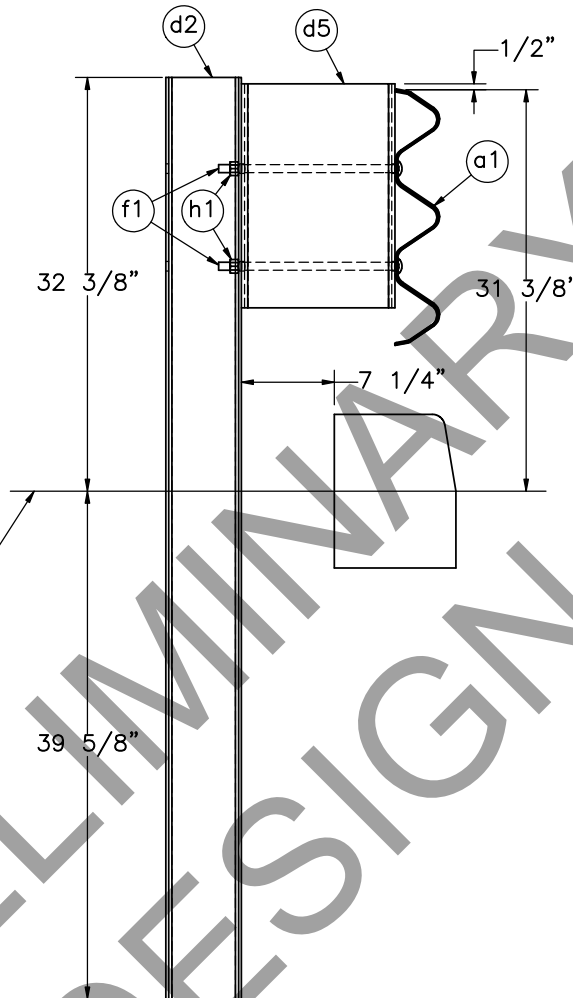
DATE:
8/19/2021

DRAWN BY:
LJP/SBW/G
HR

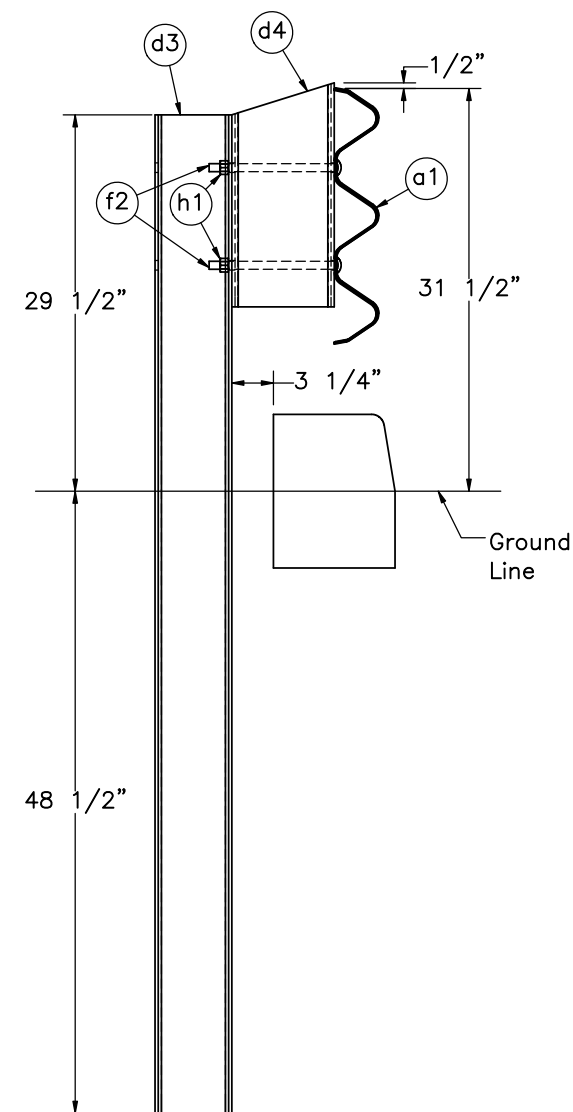
REV. BY:
MP/KAL/JC
H



SECTION H-H
Post No. 14



SECTION I-I
Post No. 15



SECTION J-J
Post No. 16

- Notes: (1) Guardrail bolts (parts f1 and f2) are on the upstream side of the web.
 (2) Top of curb is in line with the front of the rail.
 (3) Curb reinforcement hidden for clarity.
 (4) Run the curb gutter up to the concrete tarmac if possible. Recommend similar thickness as curb depth underground.



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Post Nos. 14-16 Details

DWG. NAME.
HMDT-HMDBR_R19

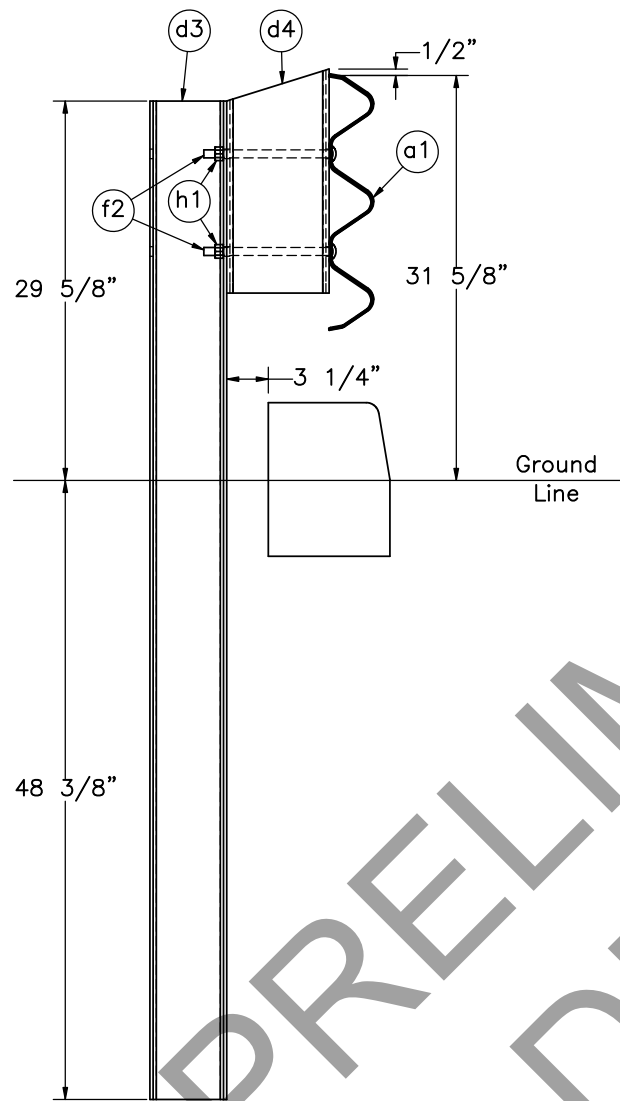
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UNITS: in.

SHEET:
7 of 35

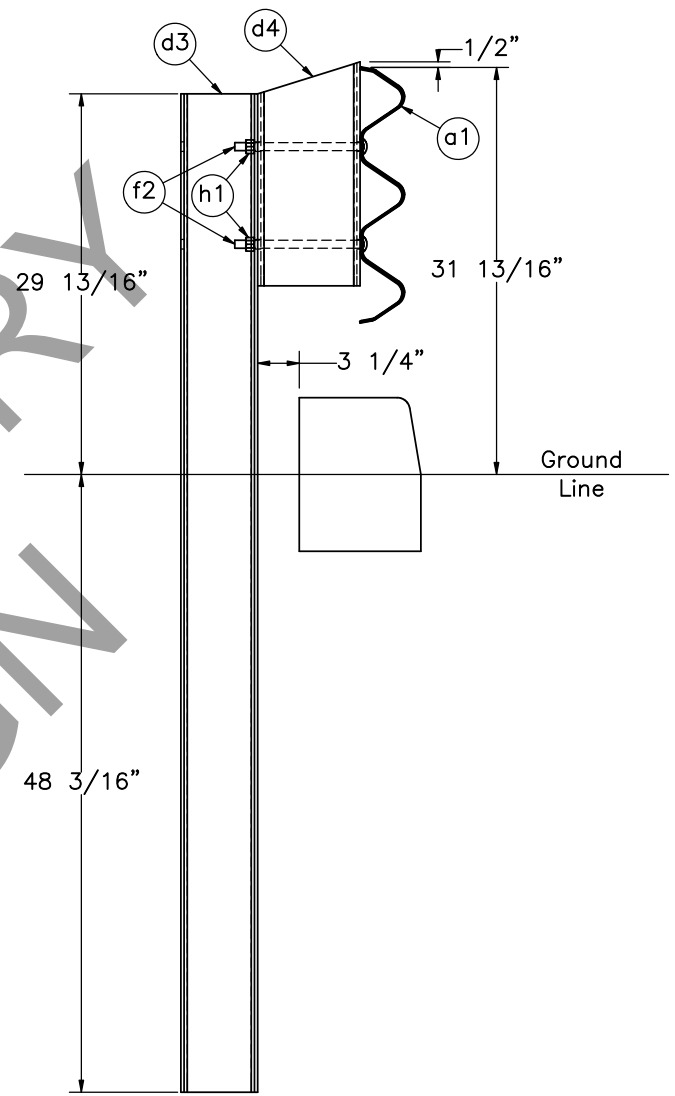
DATE:
8/19/2021

DRAWN BY:
LJP/SBW/G
HR

REV. BY:
MP/KAL/JC
H



SECTION K-K
Post No. 17



SECTION L-L
Post No. 18

- Notes:
- (1) Guardrail bolts (part f2) are on the upstream side of the web.
 - (2) Top of curb is in line with the front of the rail.
 - (3) Curb reinforcement hidden for clarity.
 - (4) Run the curb gutter up to the concrete tarmac if possible. Recommend similar thickness as curb depth underground.



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Post Nos. 17-18 Details

DWG. NAME.
HMDT-HMDBR_R19

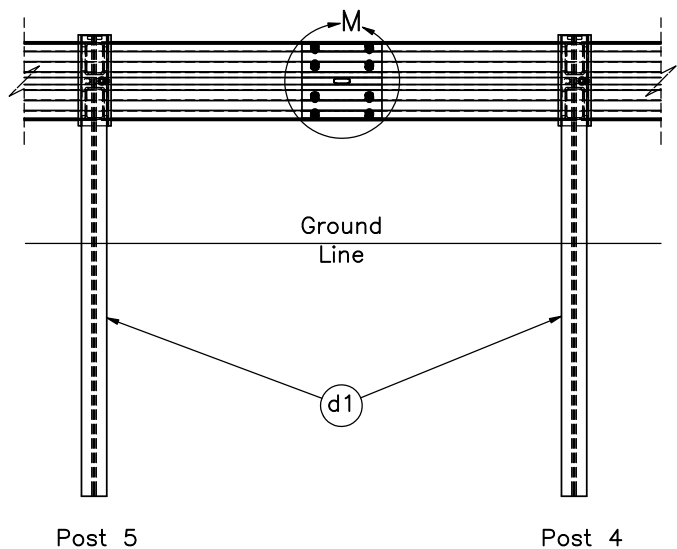
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UNITS: in.

SHEET:
8 of 35

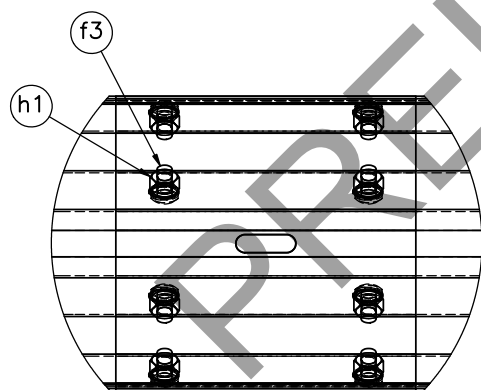
DATE:
8/19/2021

DRAWN BY:
LJP/SBW/G
HR

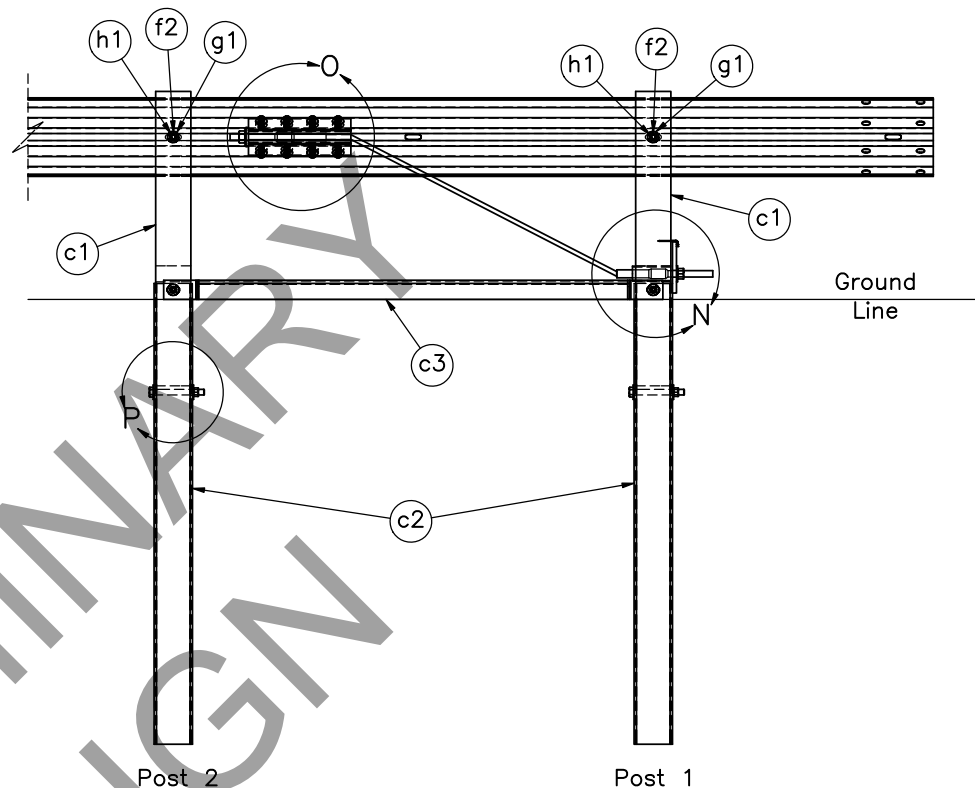
REV. BY:
MP/KAL/JC
H



SPLICE DETAIL
BACKSIDE



DETAIL M
SCALE 1:8



END SECTION DETAIL
BACKSIDE



Midwest Roadside
Safety Facility

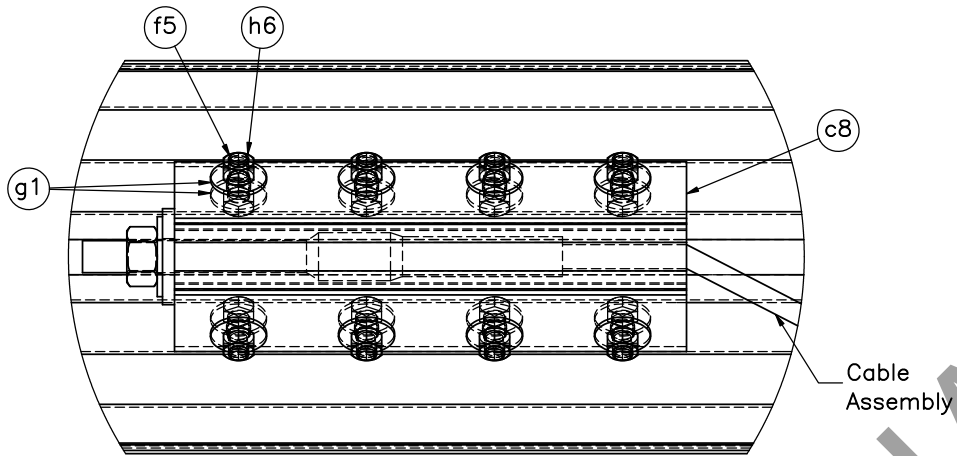
Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

End Section and Splice Detail

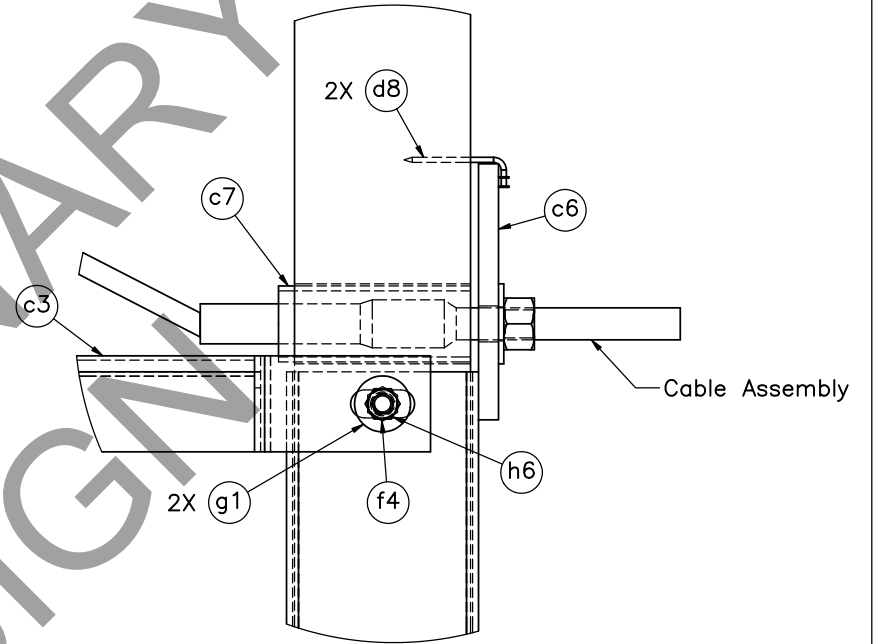
DWG. NAME.
HMDT-HMDBR_R19

SCALE: 1:30
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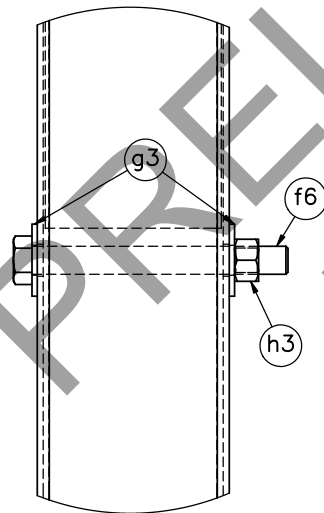
SHEET:
9 of 35
DATE:
8/19/2021
DRAWN BY:
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REV. BY:
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H



DETAIL O



DETAIL N



DETAIL P



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

End Section and Splice Detail

DWG. NAME:
HMDT-HMDBR_R19

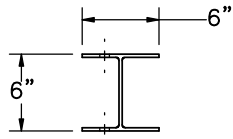
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SHEET:
10 of 35

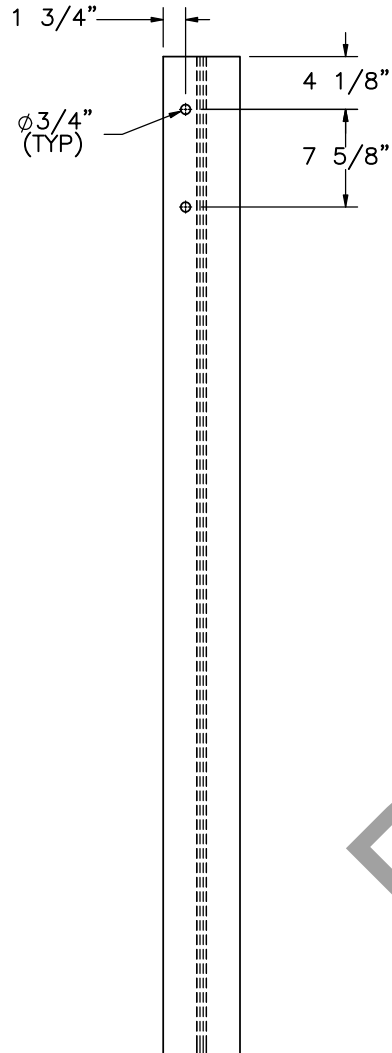
DATE:
8/19/2021

DRAWN BY:
LJP/SBW/G
HR

REV. BY:
MP/KAL/JC
H



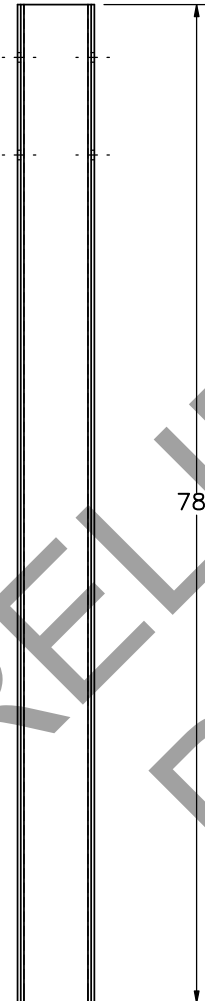
PLAN VIEW



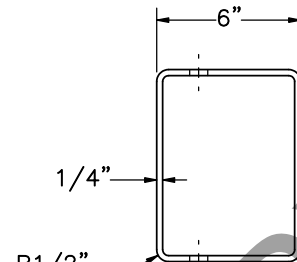
ELEVATION VIEW

Part d3

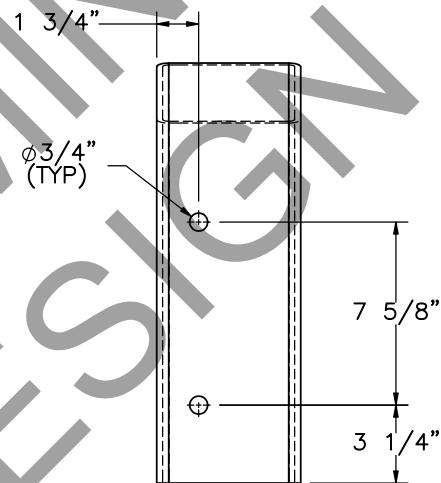
Note: (1) This post is 3" shorter than Hawaii DOT's current transition post, but it has the same embedment depth. An alternative option is to keep the same length post but increase embedment depth.



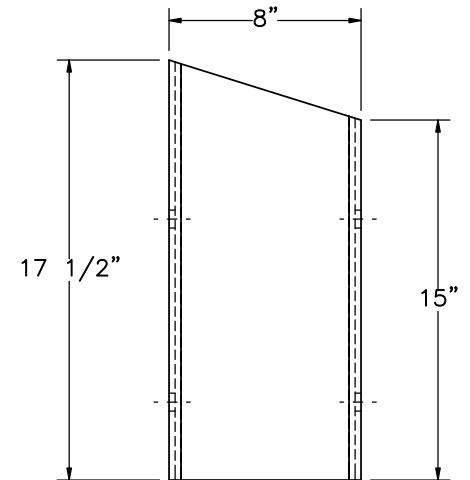
PROFILE VIEW



PLAN VIEW



ELEVATION VIEW



PROFILE VIEW

Part d4
SCALE 1:8



Midwest Roadside
Safety Facility

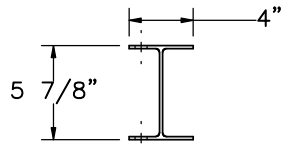
Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Post Nos. 16-18 Components

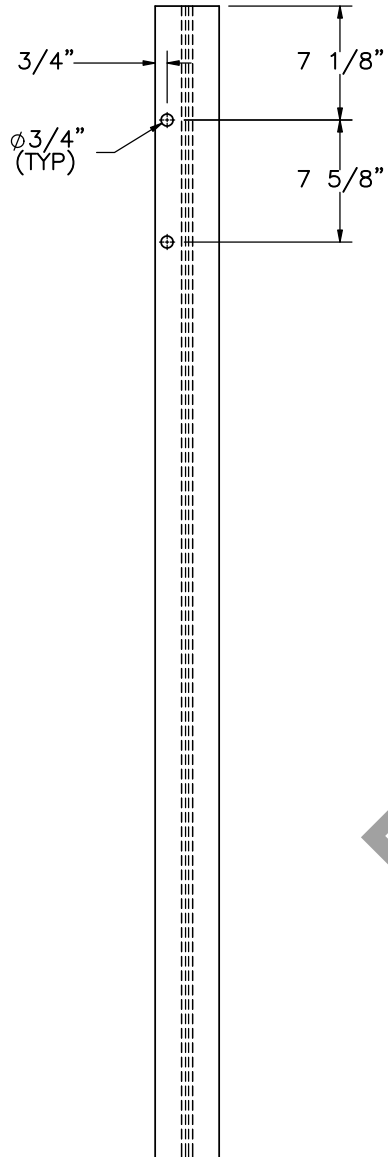
DWG. NAME.
HMDT-HMDBR_R19

SCALE: 1:15
UNITS: in.

SHEET:
11 of 35
DATE:
8/19/2021
DRAWN BY:
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HR
REV. BY:
MP/KAL/JC
H

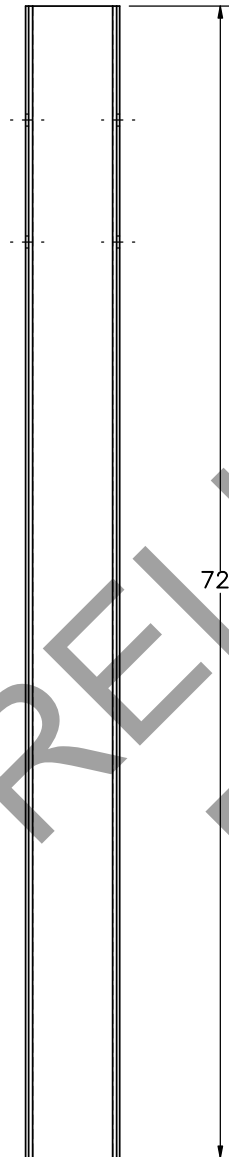


PLAN VIEW

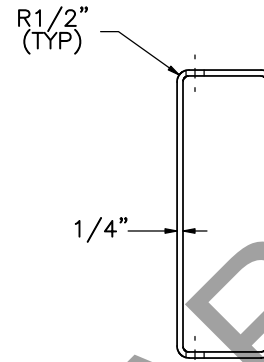


ELEVATION VIEW

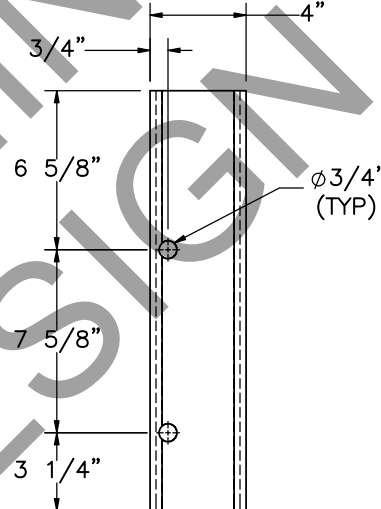
Part d2



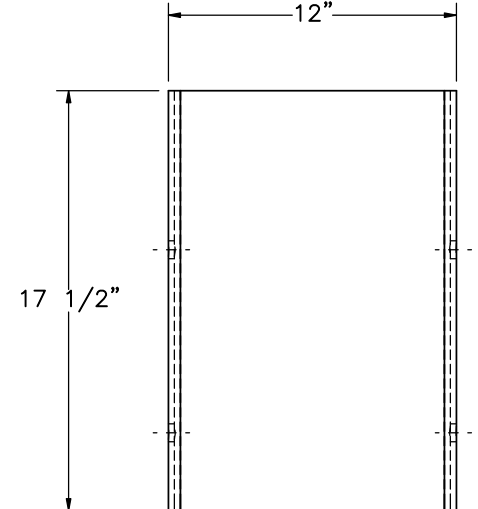
PROFILE VIEW



PLAN VIEW



ELEVATION VIEW



PROFILE VIEW

Part d5
SCALE 1:8



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Post Nos. 10-15 Components

DWG. NAME.
HMDT-HMDBR_R19

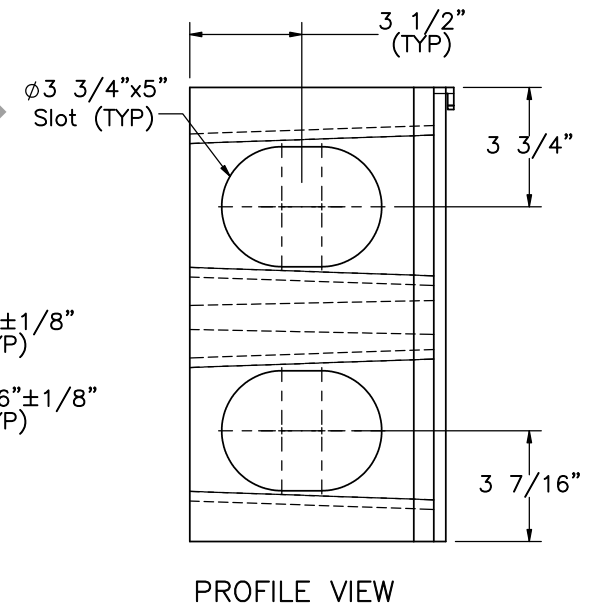
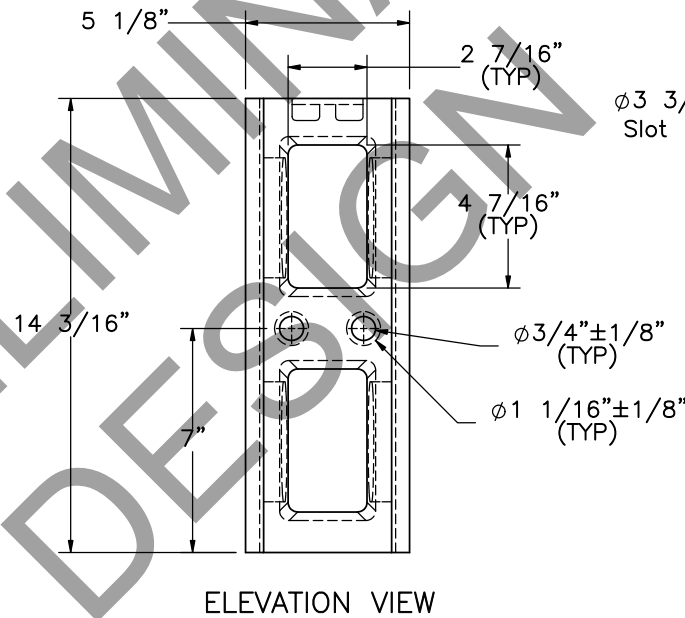
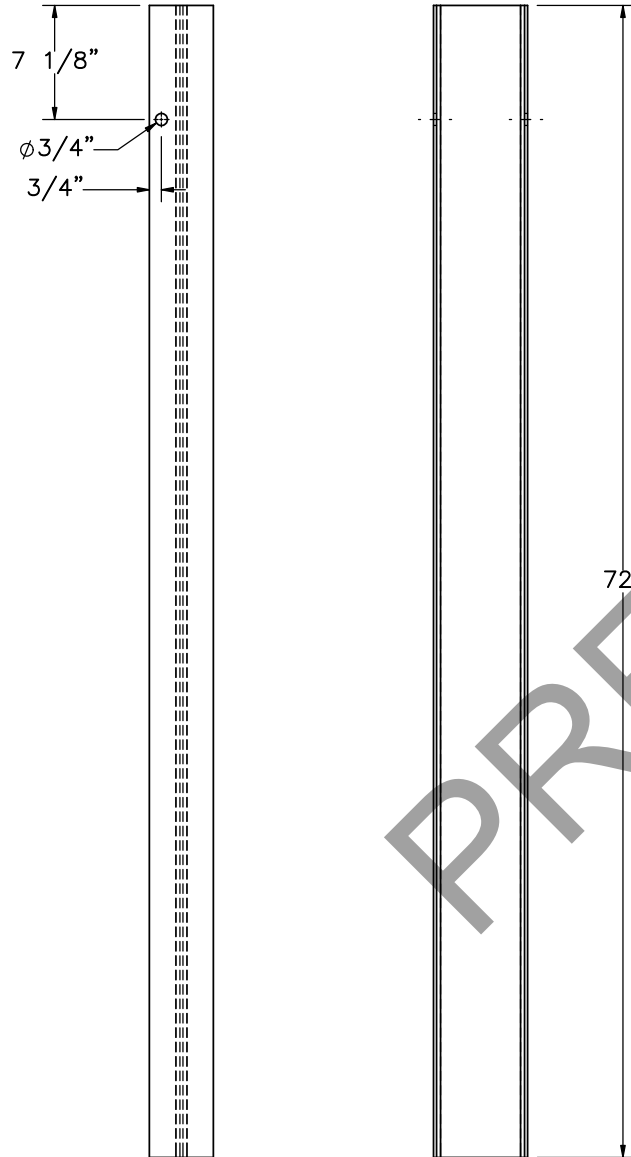
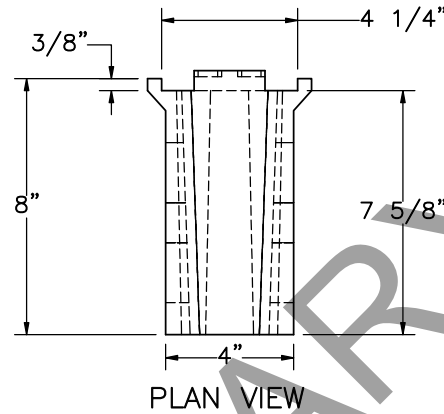
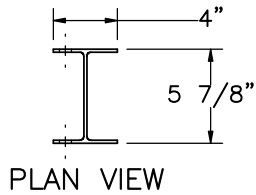
SCALE: 1:12
UNITS: in.

SHEET:
12 of 35

DATE:
8/19/2021

DRAWN BY:
LJP/SBW/G
HR

REV. BY:
MP/KAL/JC
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Part d7
SCALE 1:6

ELEVATION VIEW
Part d1

PROFILE VIEW



Midwest Roadside
Safety Facility

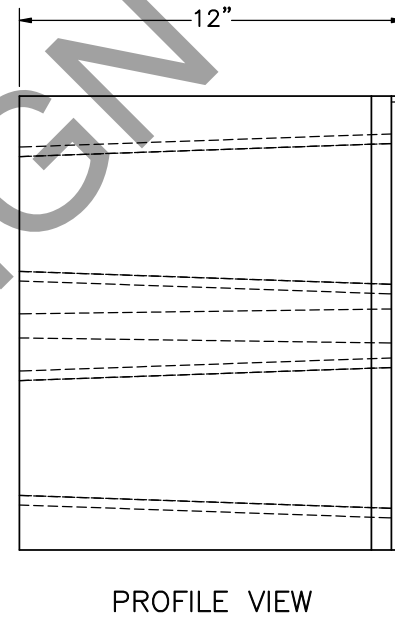
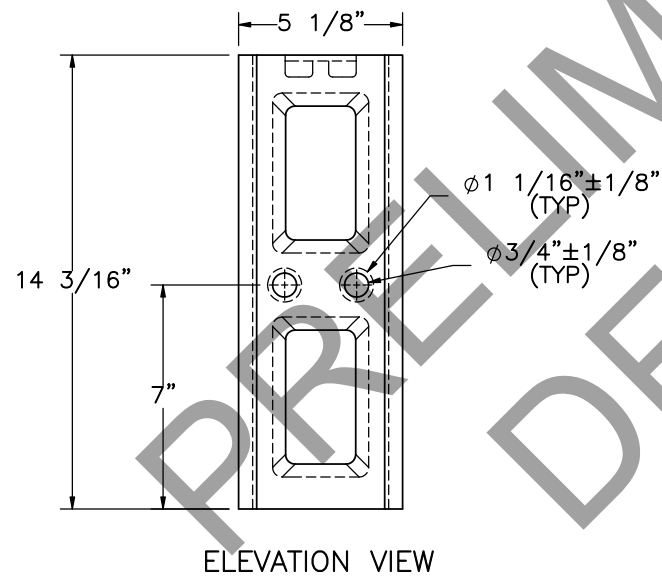
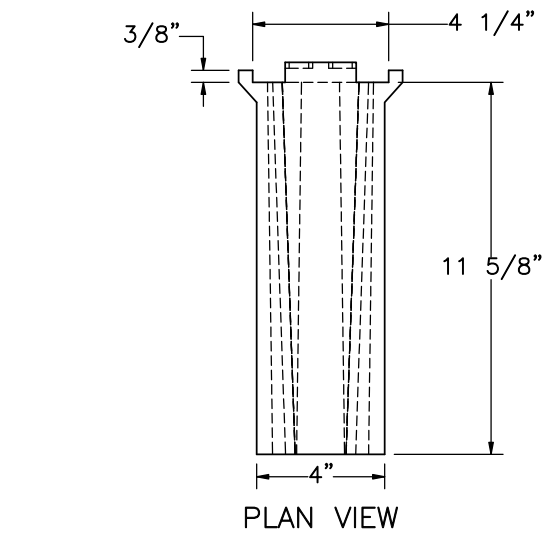
Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Post Nos. 3-7 Components

DWG. NAME.
HMDT-HMDBR_R19

SCALE: 1:12
UNITS: in.

SHEET:
13 of 35
DATE:
8/19/2021
DRAWN BY:
LJP/SBW/G
HR
REV. BY:
MP/KAL/JC
H



Part d6



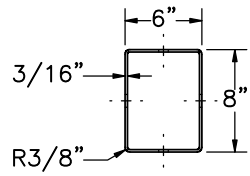
Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition
Post Nos. 8–9 Blockout Details

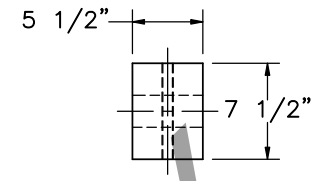
DWG. NAME.
HMDT-HMDBR_R19

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UNITS: in.

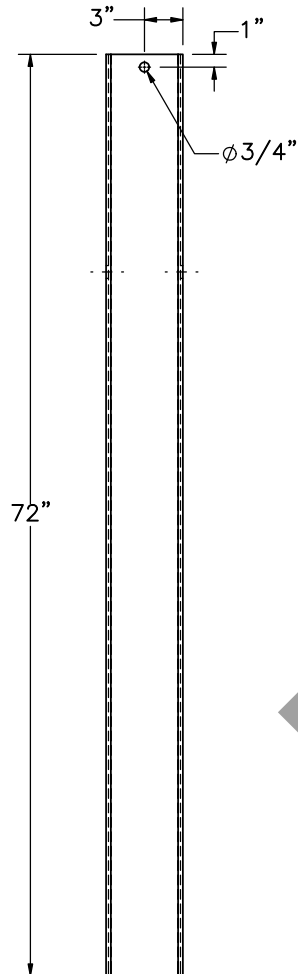
SHEET:
14 of 35
DATE:
8/19/2021
DRAWN BY:
LJP/SBW/G
HR
REV. BY:
MP/KAL/JC
H



PLAN VIEW

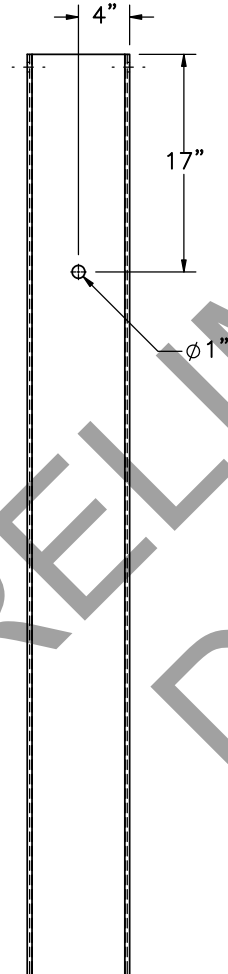


PLAN VIEW

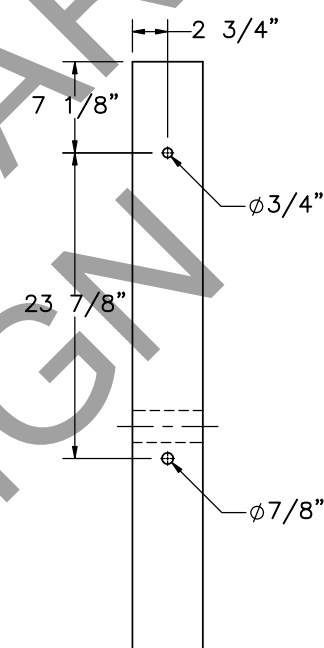


ELEVATION VIEW

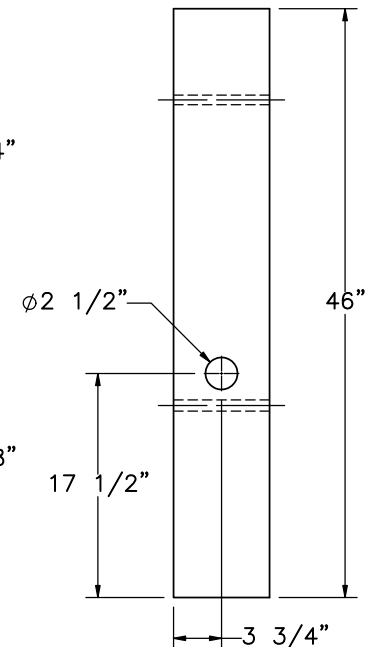
Part c2



PROFILE VIEW



ELEVATION VIEW



PROFILE VIEW

Part c1



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

BCT Timber Post and
Foundation Tube Details

DWG. NAME.
HMDT-HMDBR_R19

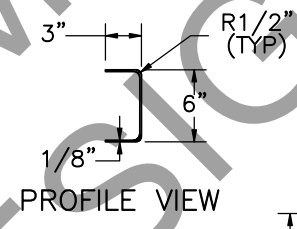
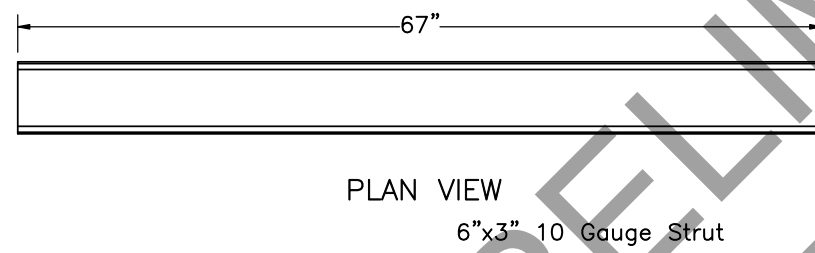
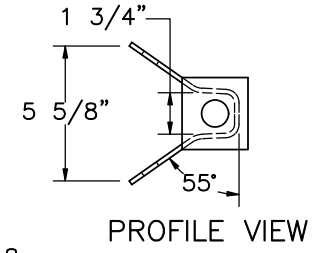
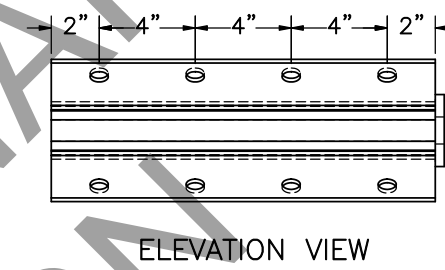
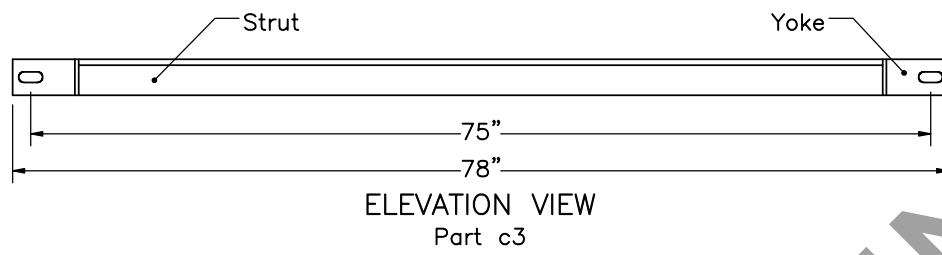
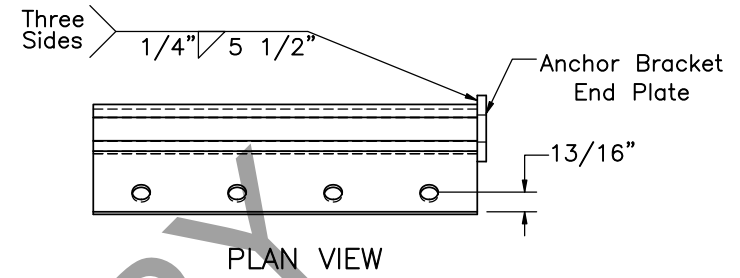
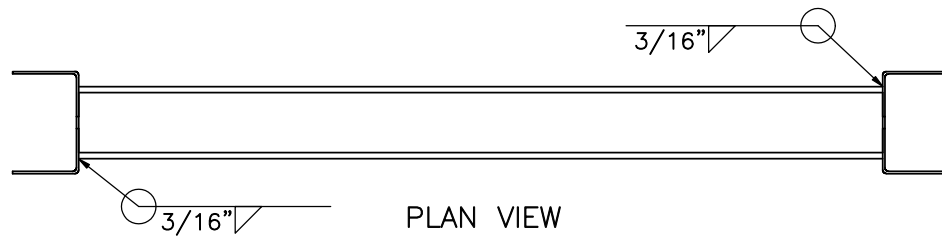
SCALE: 1:15
UNITS: in.

SHEET:
15 of 35

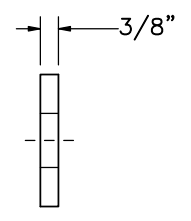
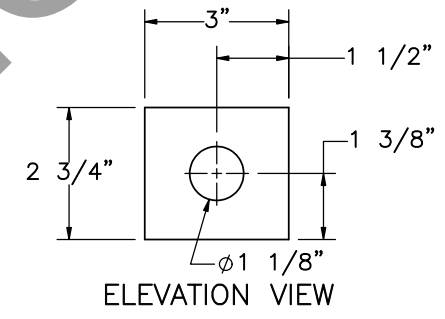
DATE:
8/19/2021

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LJP/SBW/G
HR

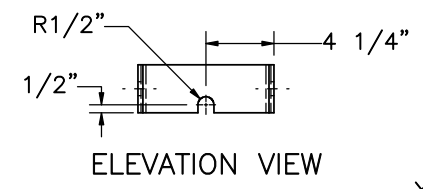
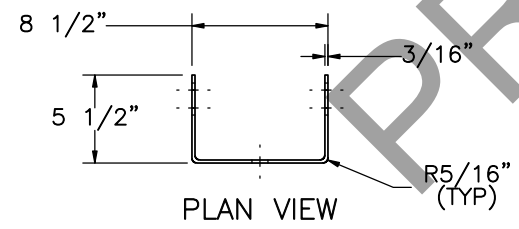
REV. BY:
MP/KAL/JC
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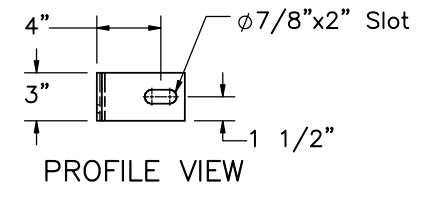
Part c8
SCALE 1:8



Anchor Bracket End Plate
SCALE 1:4



Yoke
SCALE 1:12



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Ground Strut Details

DWG. NAME.
HMDT-HMDBR_R19

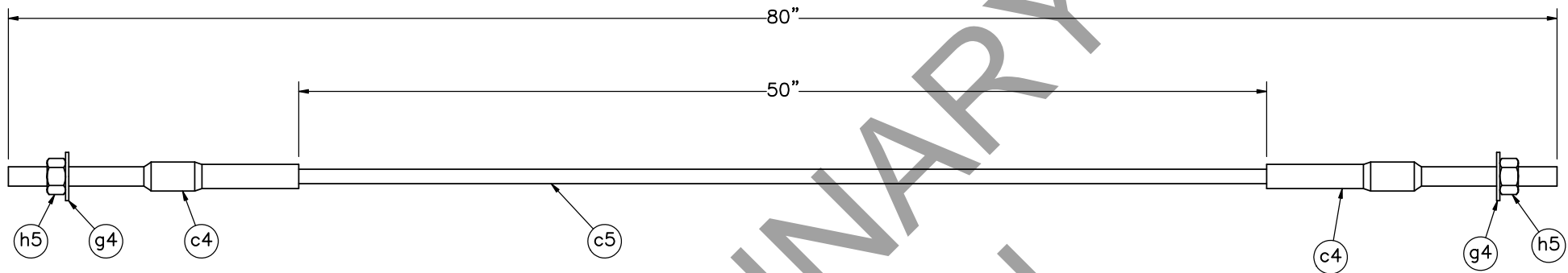
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UNITS: in.

SHEET:
16 of 35

DATE:
8/19/2021

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HR

REV. BY:
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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" Dia. 6x19 IWRC IPS Wire Rope	ASTM A741 Type 2	Class A Coating	—
h5	2	1"—8 UNC Heavy Hex Nut	ASTM A563DH or equivalent	ASTM A153 or B695 Class 55 or F2329	FNX24b
g4	2	1" Dia. Plain USS Washer	ASTM F844	ASTM A123 or A153 or F2329	FWC24a



Midwest Roadside
Safety Facility

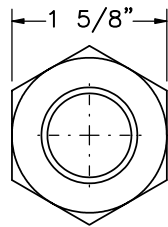
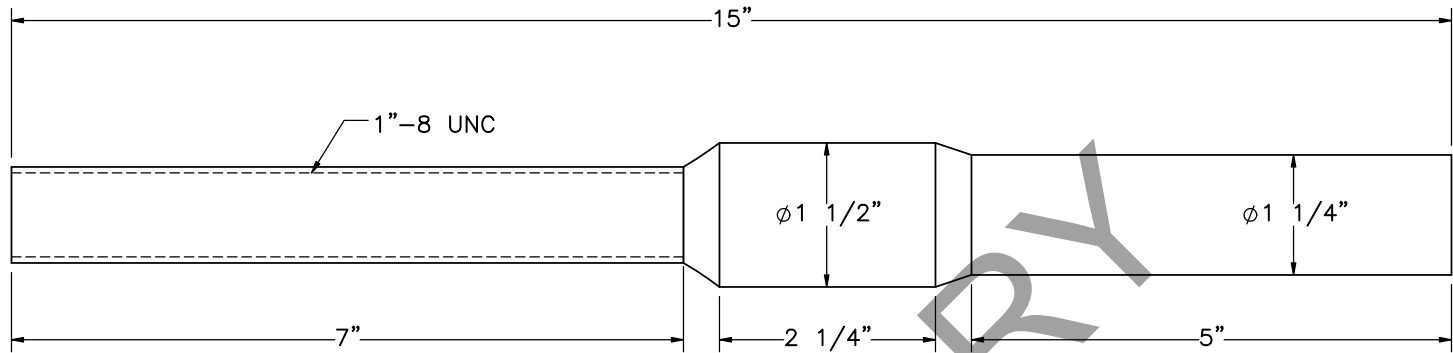
Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

BCT Anchor Cable

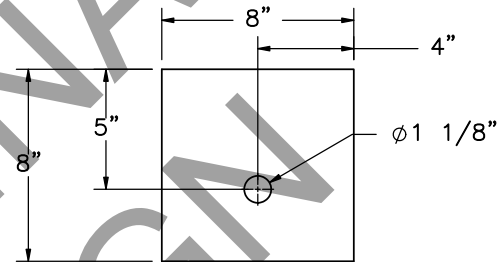
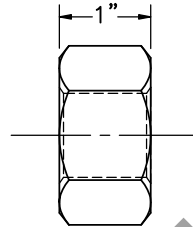
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HMDT-HMDBR_R19

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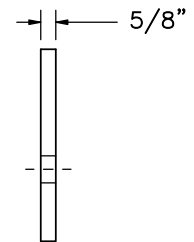
SHEET:
17 of 35
DATE:
8/19/2021
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REV. BY:
MP/KAL/JC
H



Part h5
SCALE 1:2

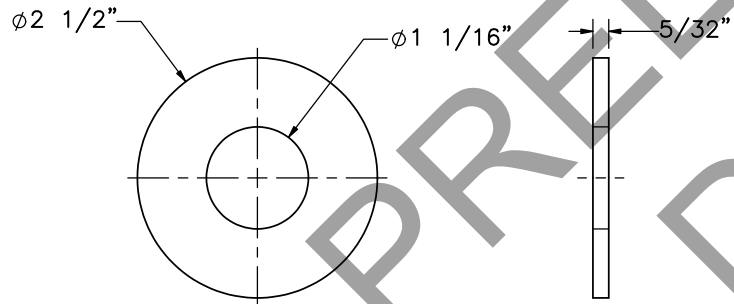


ELEVATION VIEW

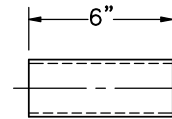


PROFILE VIEW

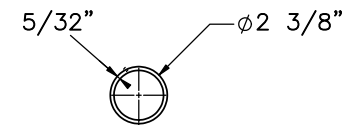
Part c6



Part g4
SCALE 1:2



ELEVATION VIEW



PROFILE VIEW

Part c7



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Cable Assembly and Anchor
Components

DWG. NAME:
HMDT-HMDBR_R19

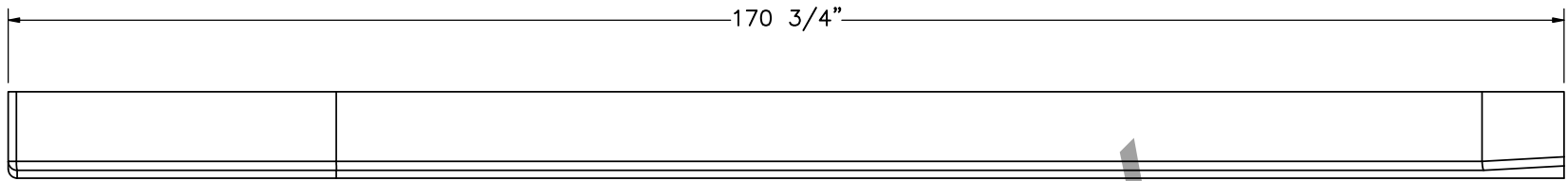
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SHEET:
18 of 35

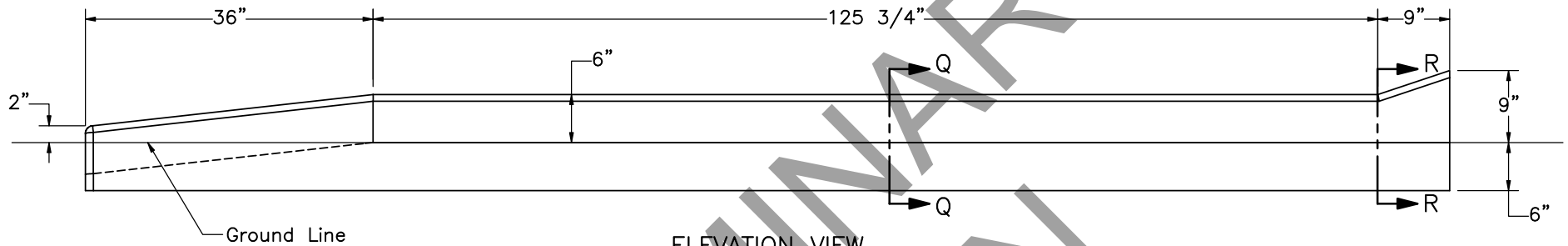
DATE:
8/19/2021

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HR

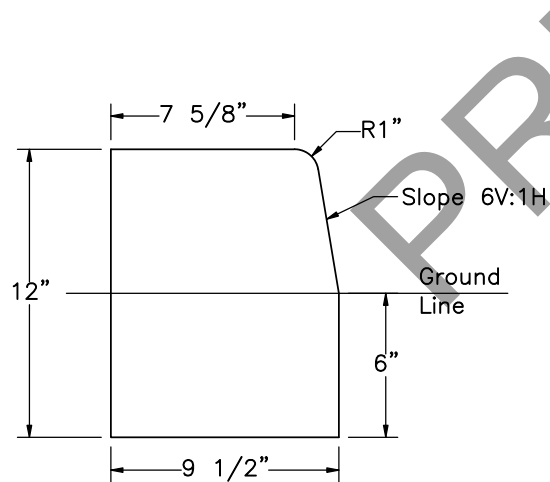
REV. BY:
MP/KAL/JC
H



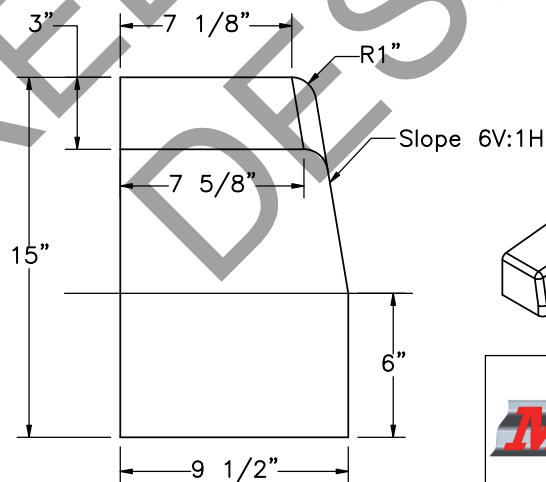
PLAN VIEW



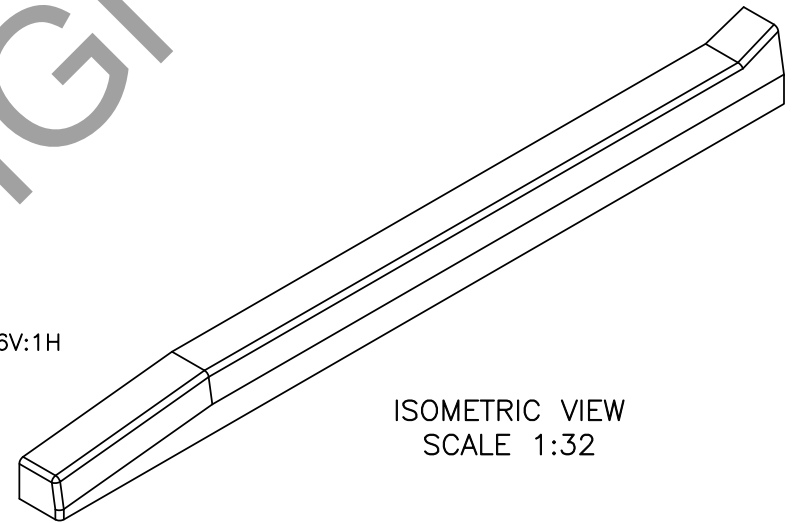
ELEVATION VIEW



SECTION Q-Q
SCALE 1:8



SECTION R-R
SCALE 1:8



ISOMETRIC VIEW
SCALE 1:32



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Transition Curb Details

DWG. NAME.
HMDT-HMDBR_R19

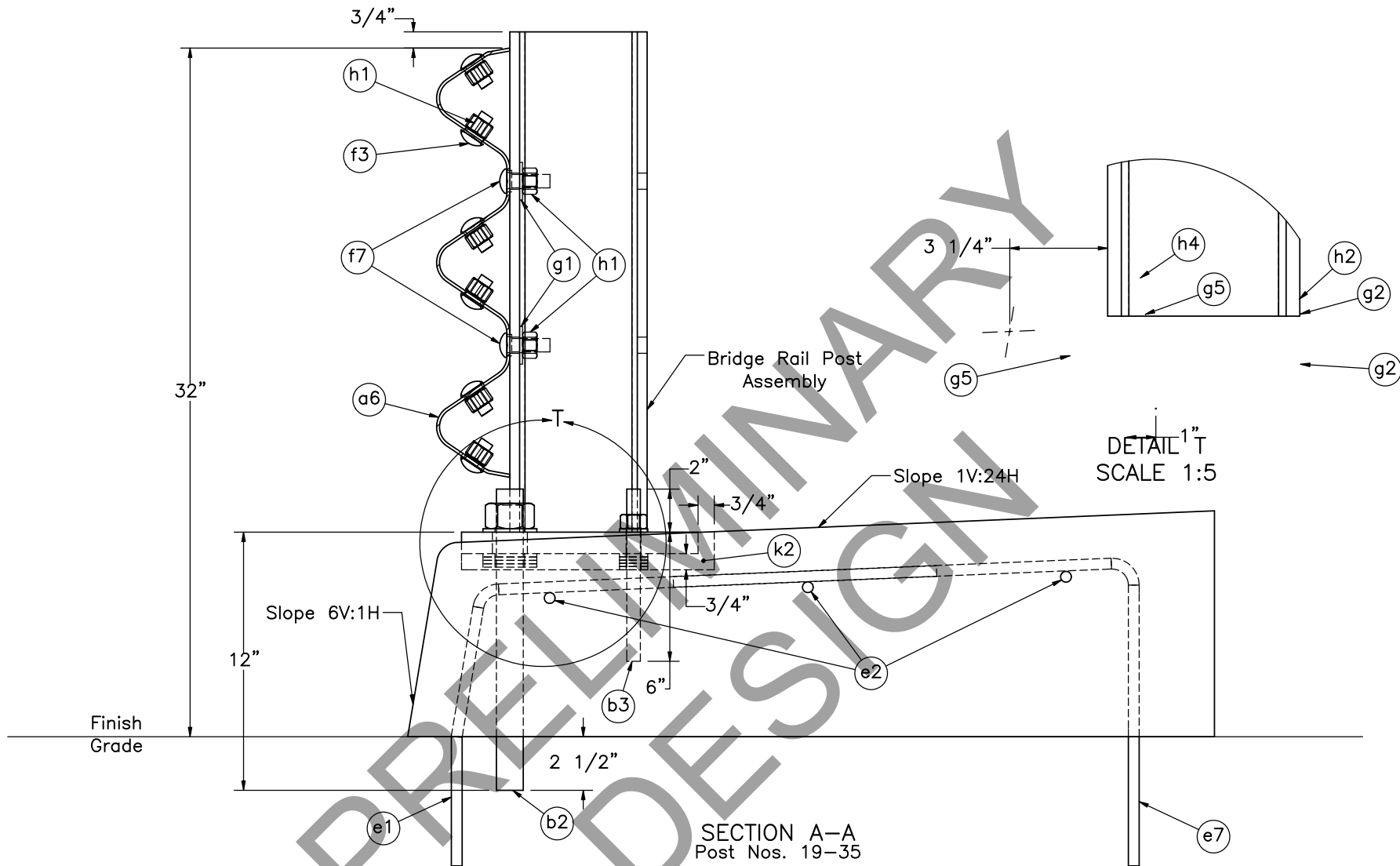
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UNITS: in.

SHEET:
19 of 35

DATE:
8/19/2021

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HR

REV. BY:
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H



- Notes: (1) Base plate (part b1) should be counter sunk into sidewalk, slightly oversized, then backfilled with epoxy grout (part k2).
 (2) Epoxy grout used to backfill post cavities should be in compliance with ASTM C881 Type IV, Grade I, Class C.
 (3) Add washers (parts g2 and g5) to level base plates.
 (4) Anchor rods (parts b2 and b3) should be epoxied into the concrete sidewalk and concrete tarmac.
 (5) Rebar (parts e1 and e7) should be epoxied into concrete tarmac for a minimum depth of 6".
 (6) Anchors and rebar should be epoxied with Hilti HIT RE-500 V3 (part k1) or equivalent, in compliance with Class C, C881.



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Bridge Rail Post Details

DWG. NAME.
HMDT-HMDBR_R19

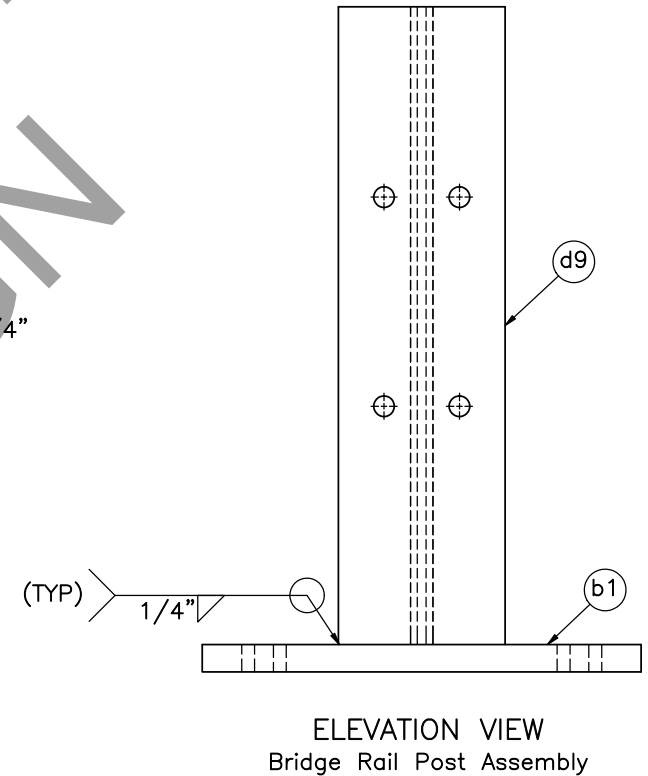
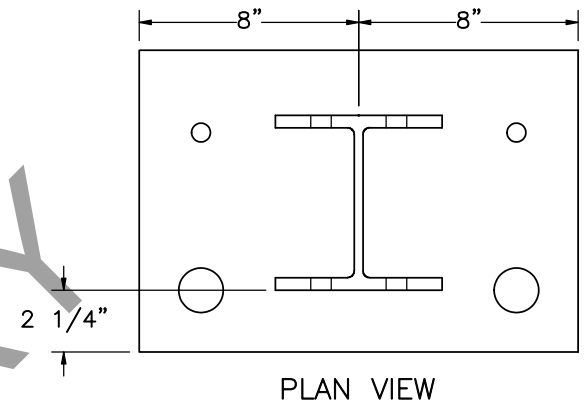
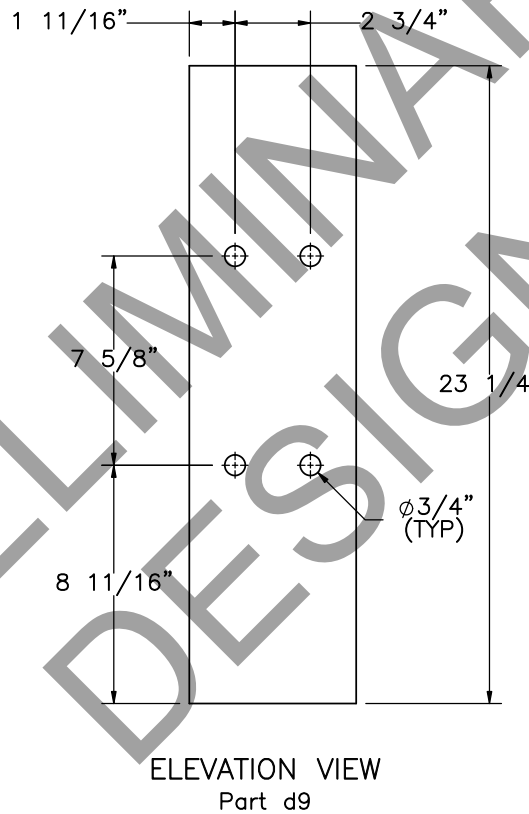
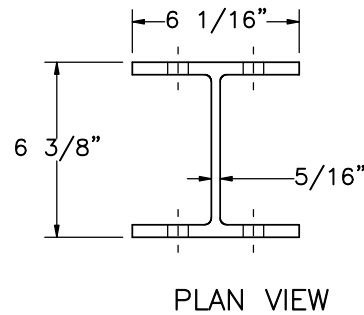
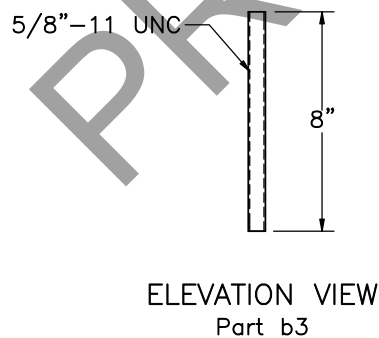
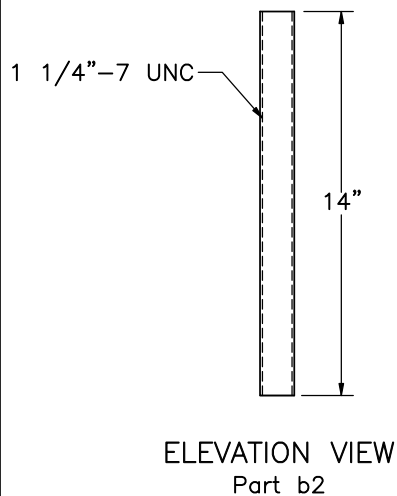
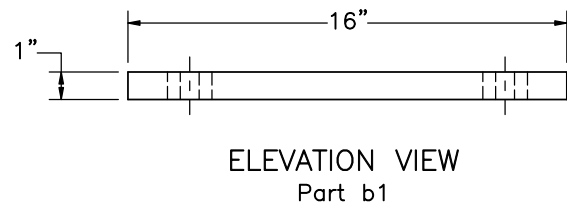
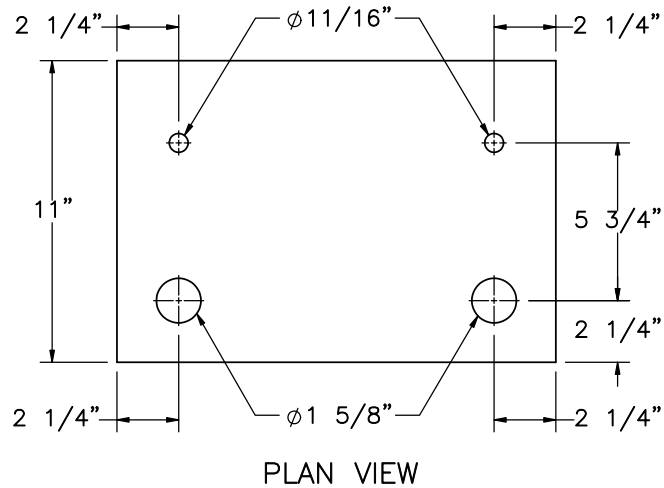
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UNITS: in.

SHEET:
21 of 35

DATE:
8/19/2021

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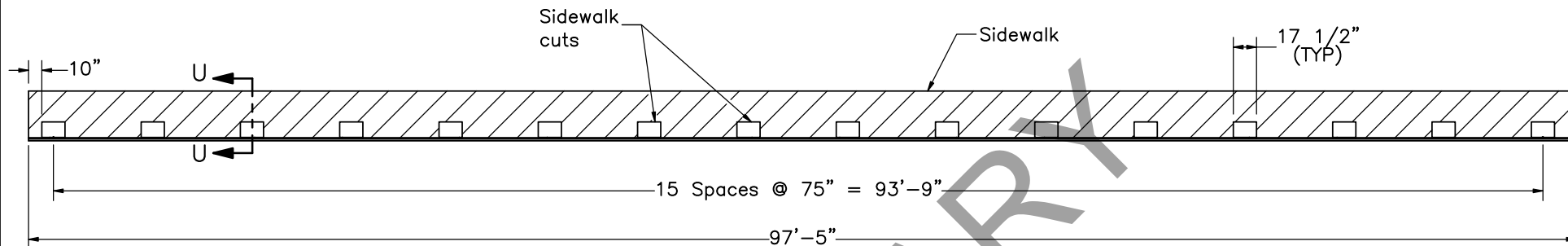


Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition
Bridge Rail Post Components

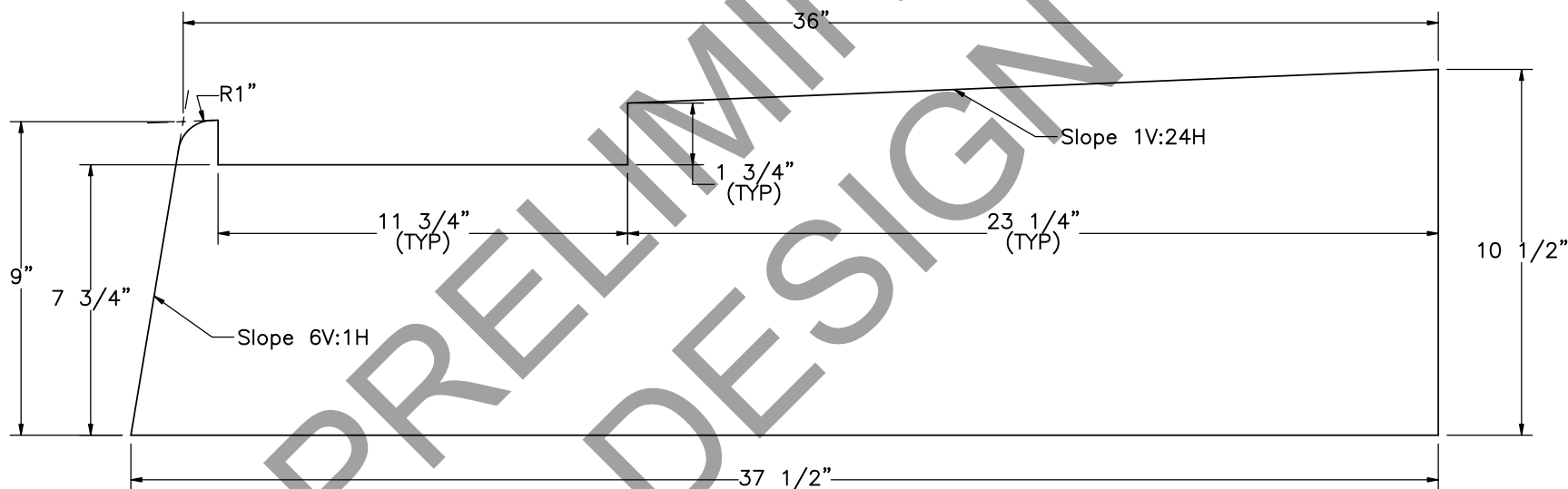
DWG. NAME.
HMDT-HMDBR_R19

SCALE: 1:7
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SHEET:
22 of 35
DATE:
8/19/2021
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H



PLAN VIEW



SECTION U-U
SCALE 1 : 5



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Bridge Rail Sidewalk Details

DWG. NAME.
HMDT-HMDBR_R19

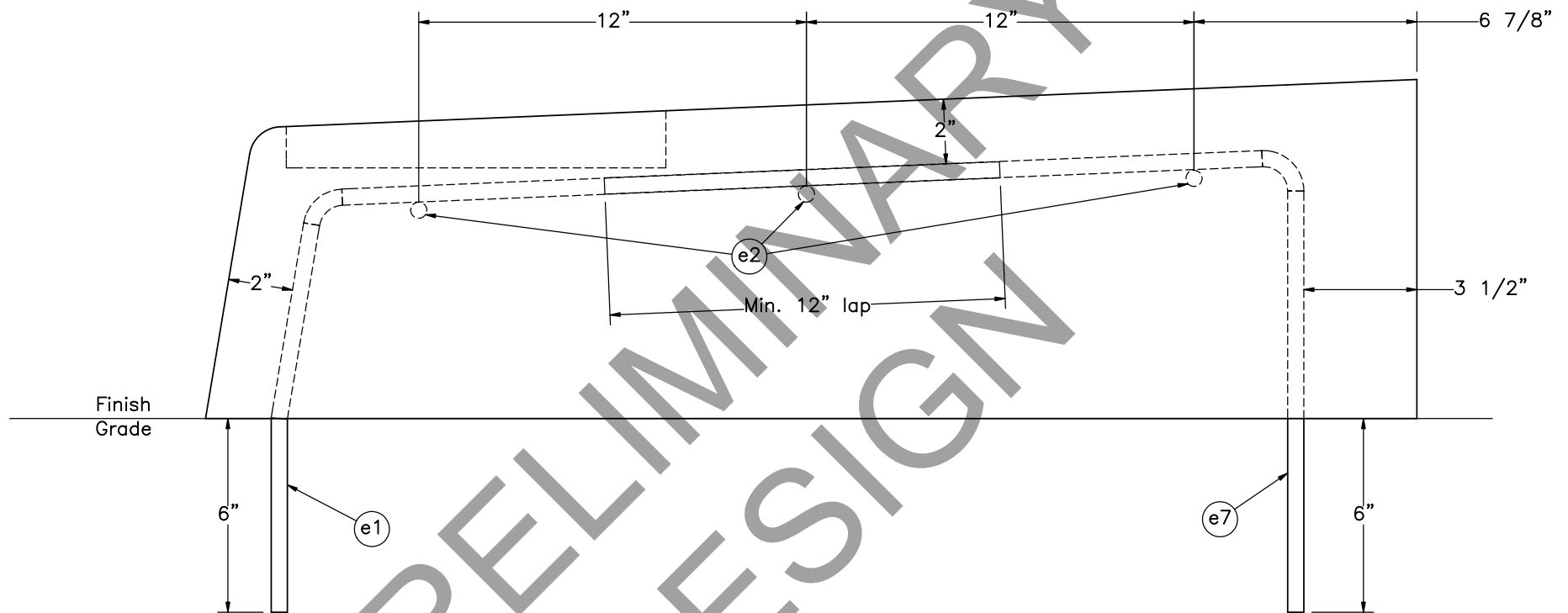
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SHEET:
23 of 35

DATE:
8/19/2021

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H



PROFILE VIEW

Notes: (1) Minimum lap length for part no. e2 is 18".



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Sidewalk Reinforcement Details

DWG. NAME.
HMDT-HMDBR_R19

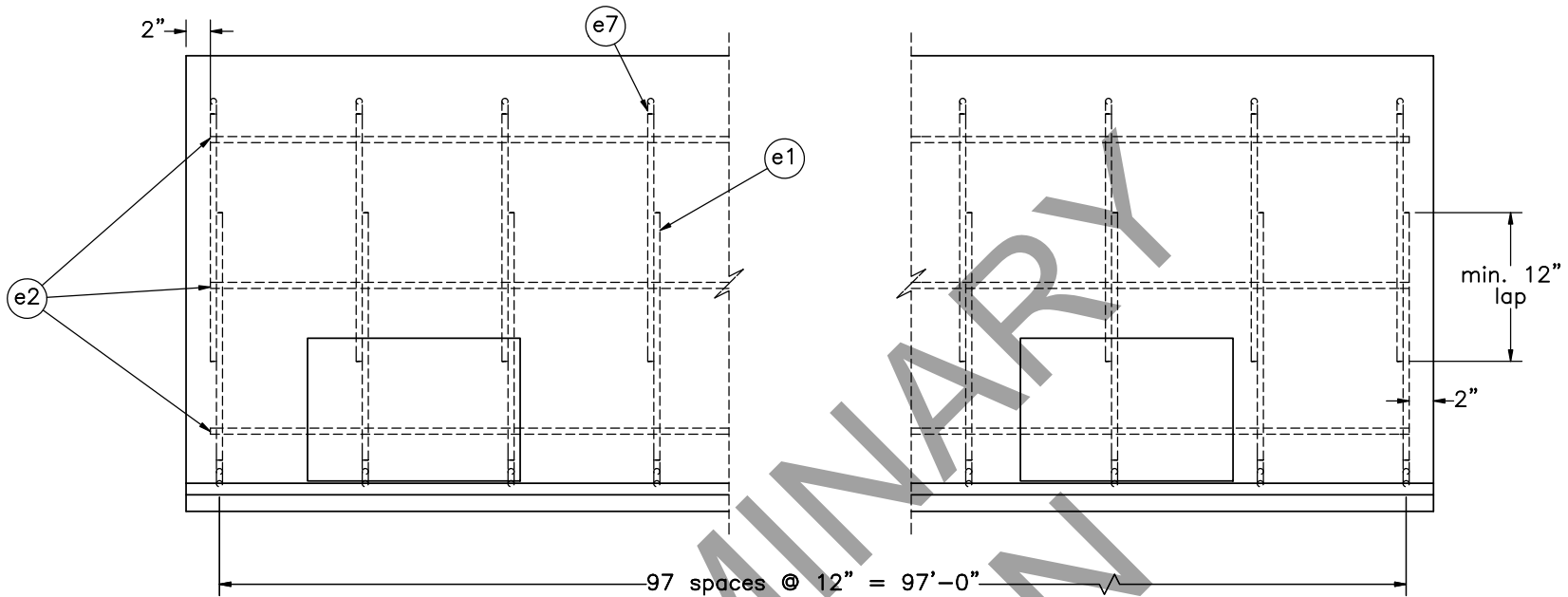
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SHEET:
24 of 35

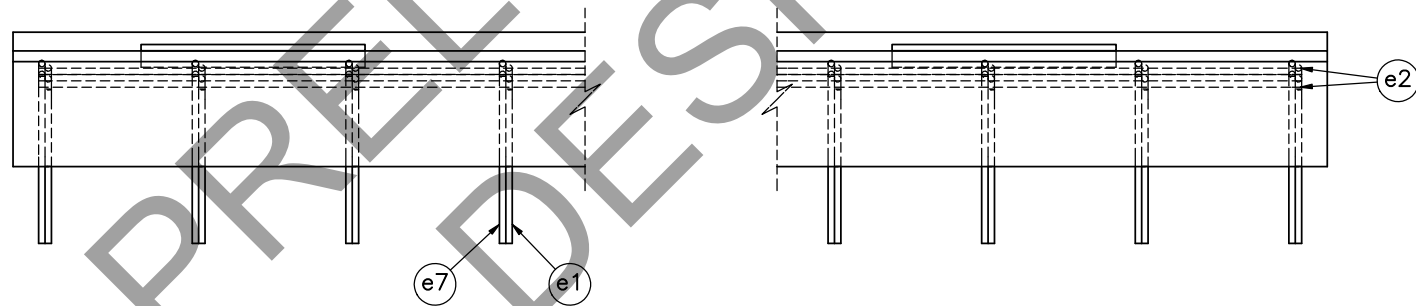
DATE:
8/19/2021

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H



PLAN VIEW



ELEVATION VIEW

Notes: (1) Minimum lap length for part no. e2 is 18".



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Sidewalk Reinforcement Details

DWG. NAME.
HMDT-HMDBR_R19

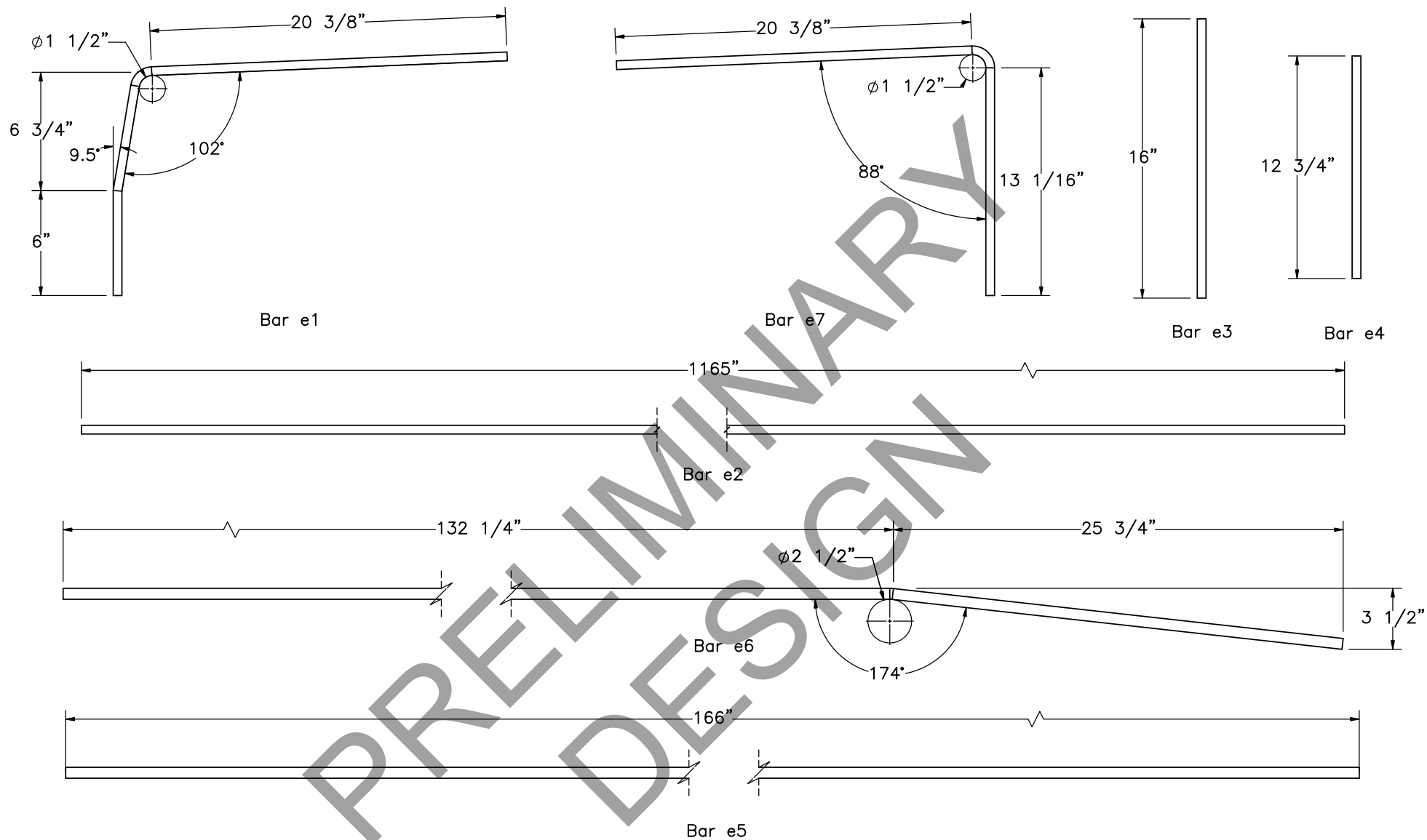
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SHEET:
25 of 35

DATE:
8/19/2021

DRAWN BY:
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H



Part No.	Bar No.	Qty.	Unbent Length	Material Specification
e1	#4	98	33 7/8"	ASTM A615 Gr. 60
e2	#4	3	1165"	ASTM A615 Gr. 60
e3	#4	7	16"	ASTM A615 Gr. 60
e4	#4	1	12 3/4"	ASTM A615 Gr. 60
e5	#5	1	166"	ASTM A615 Gr. 60
e6	#5	1	158 1/4"	ASTM A615 Gr. 60
e7	#4	98	35"	ASTM A615 Gr. 60

Notes: (1) Minimum lap length for part no. e2 is 18".



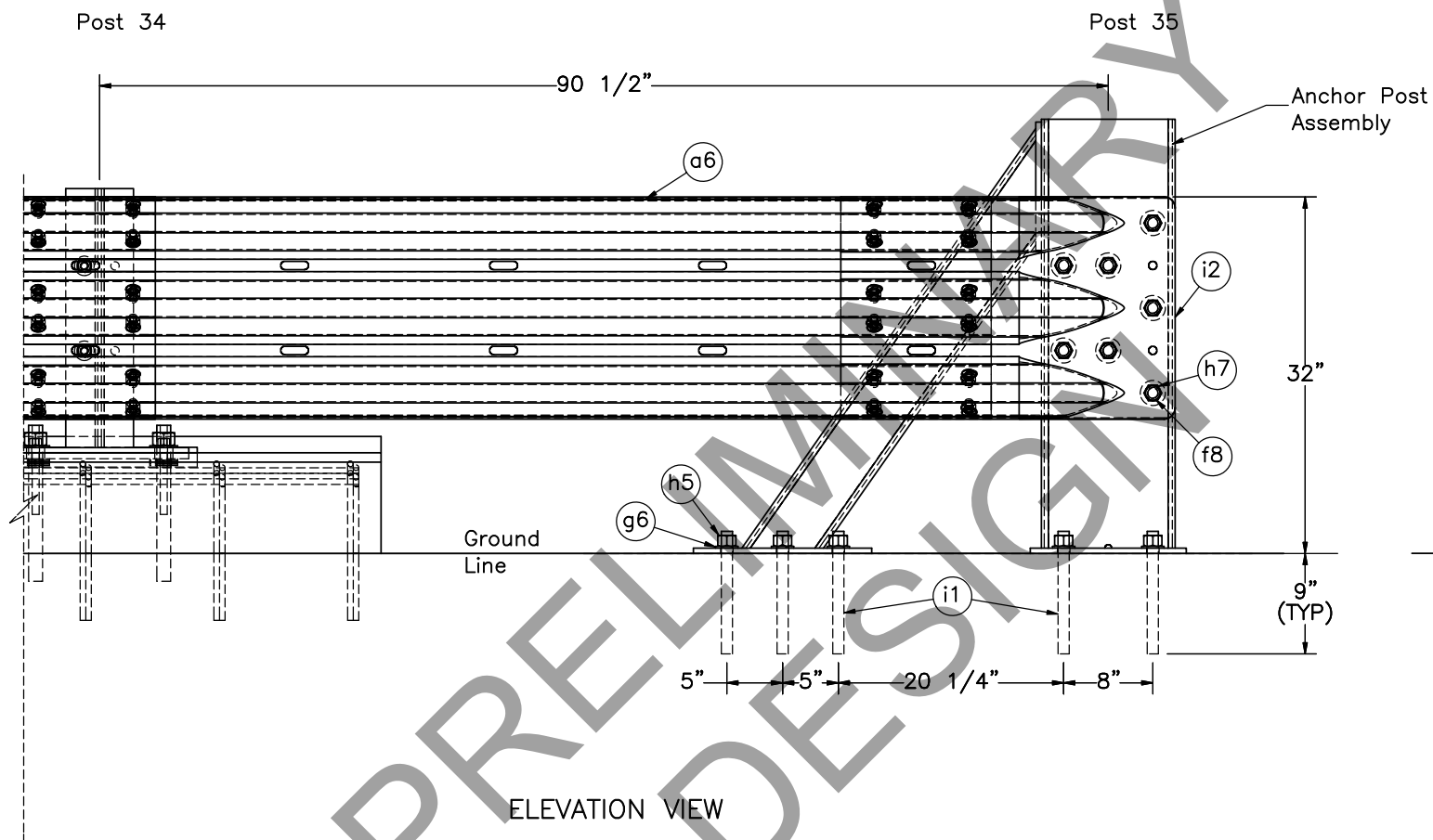
Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition
Curb Reinforcement Details

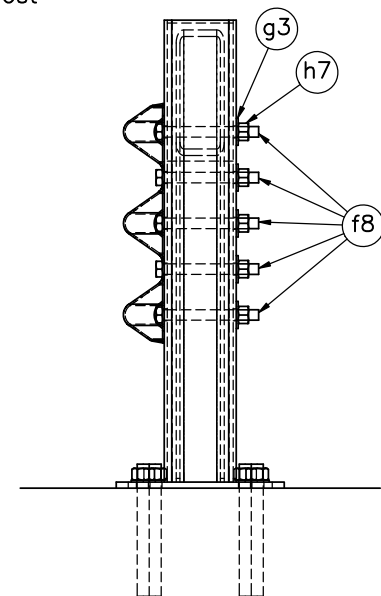
DWG. NAME.
HMDT-HMDBR_R19

SCALE: 1:8
UNITS: in.

SHEET:
26 of 35
DATE:
8/19/2021
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H



ELEVATION VIEW



PROFILE VIEW

Note: (1) Threaded rods (part i1) anchored to concrete tarmac using Hilti HIT RE-500 V3 epoxy (part k1) or an equivalent epoxy with a minimum bond strength of 1,305 psi.



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Downstream Anchorage
Assembly

DWG. NAME.
HMDT-HMDBR_R19

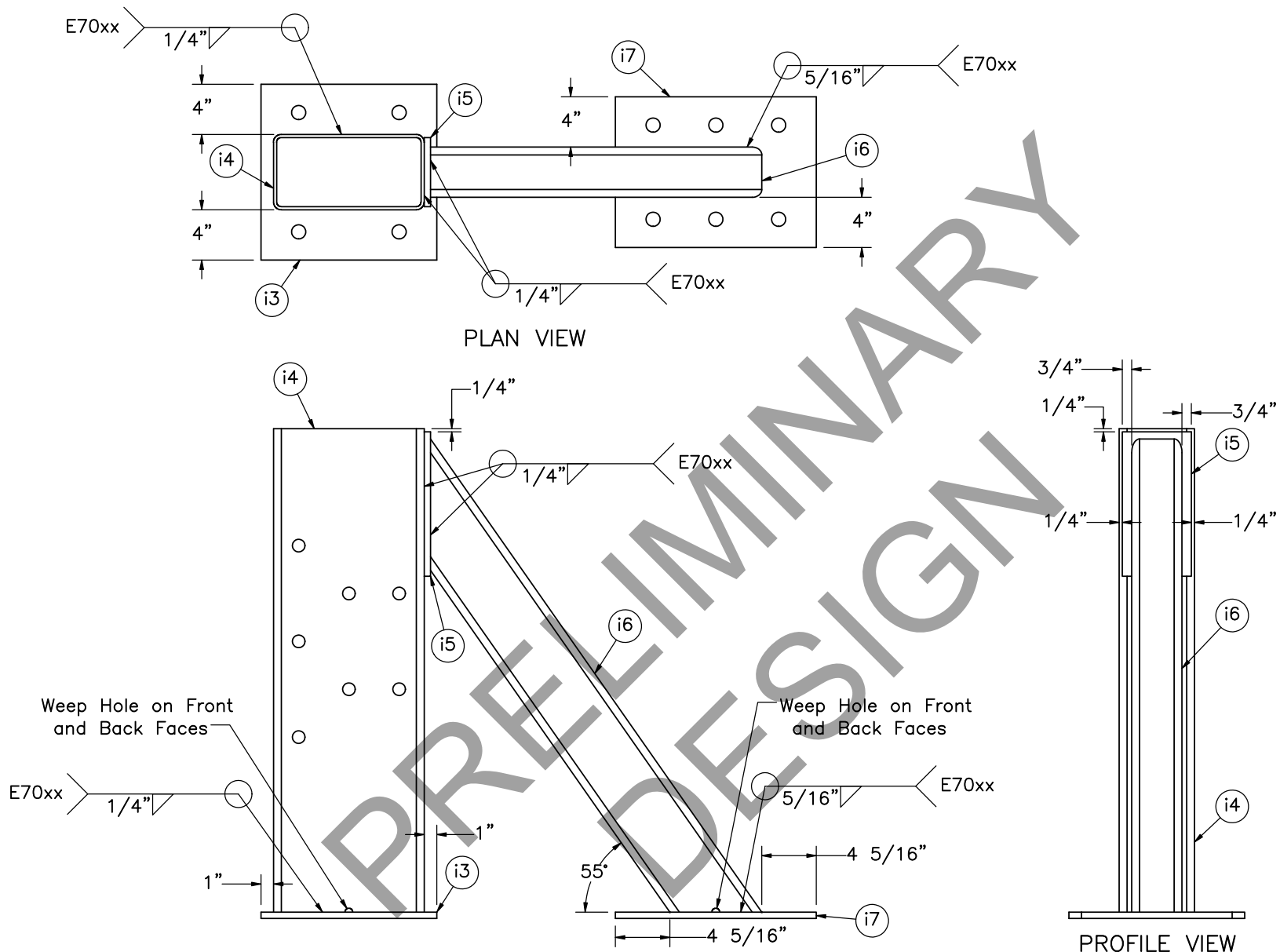
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SHEET:
27 of 35

DATE:
8/19/2021

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Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Anchor Post Assembly Details

DWG. NAME.
HMDT-HMDBR_R19

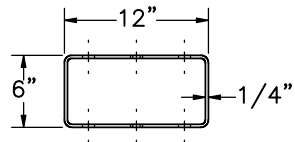
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SHEET:
28 of 35

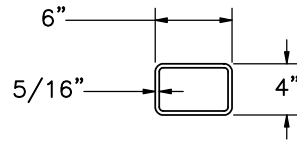
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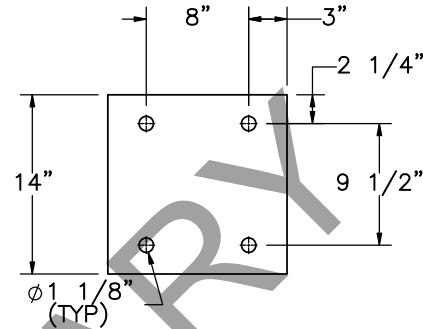
REV. BY:
MP/KAL/JC
H



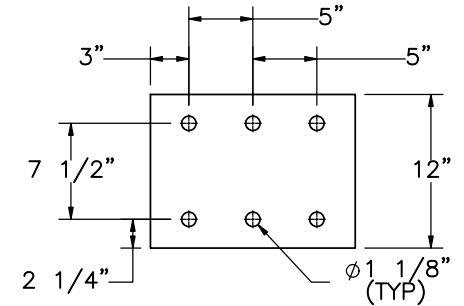
PLAN VIEW



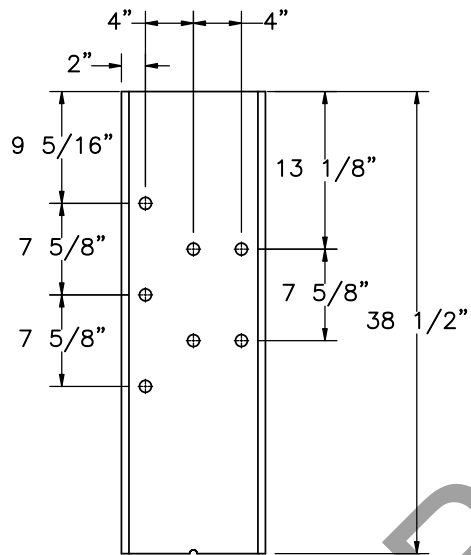
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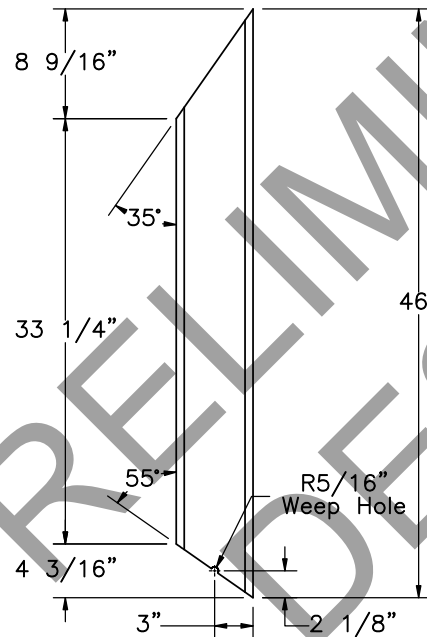
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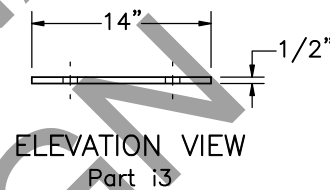
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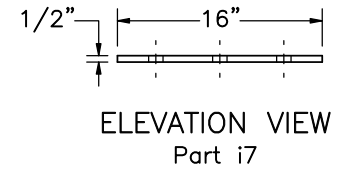
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Part i4



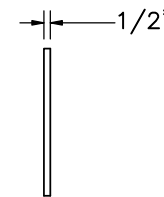
ELEVATION VIEW
Part i6



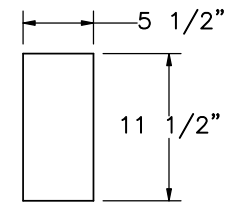
ELEVATION VIEW
Part i3



ELEVATION VIEW
Part i7



ELEVATION VIEW



PROFILE VIEW

Part i5

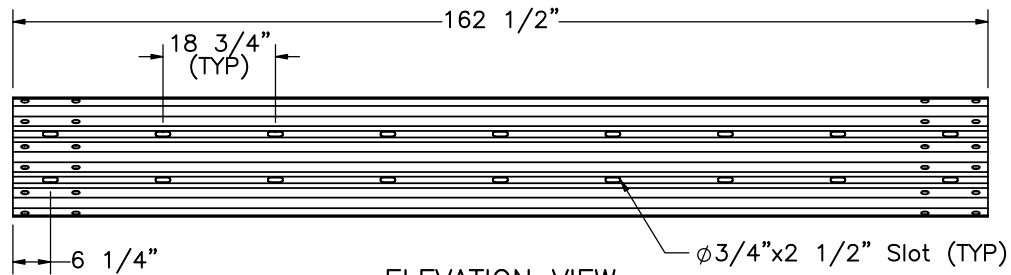


Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition
Anchor Post Components

DWG. NAME.
HMDT-HMDBR_R19

SCALE: 1:15
UNITS: in.

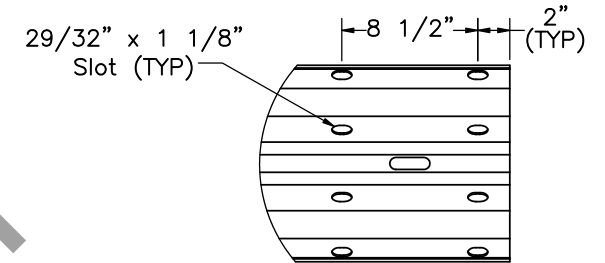
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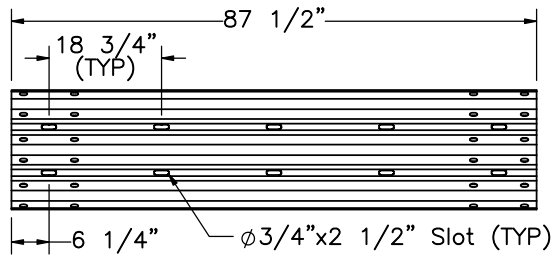
ELEVATION VIEW
Part a1

12 Gauge

PROFILE VIEW



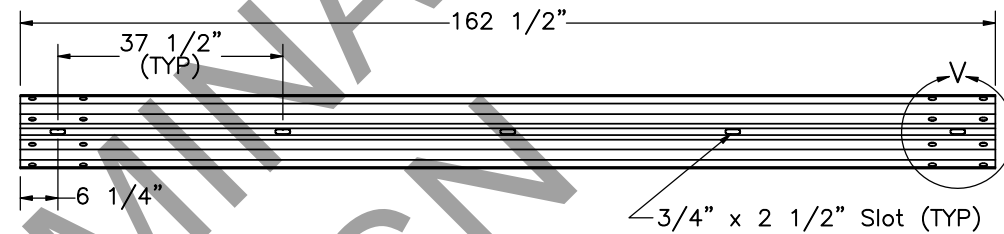
DETAIL V
SCALE 1 : 12



ELEVATION VIEW
Part a2

12 gauge

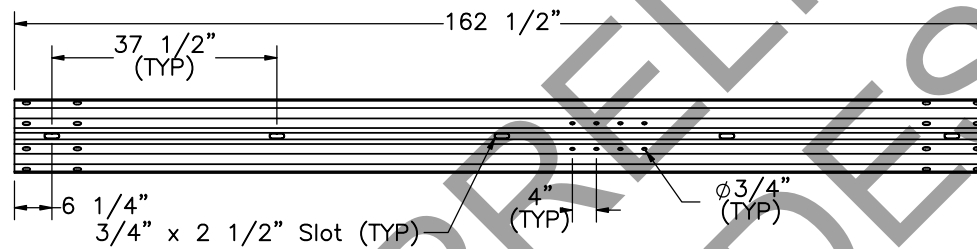
PROFILE VIEW



ELEVATION VIEW
Part a4

12 gauge

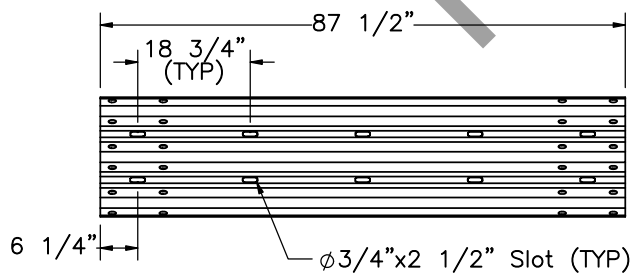
PROFILE VIEW



ELEVATION VIEW
Part a5

12 gauge

PROFILE VIEW



ELEVATION VIEW
Part a6

10 Gauge

PROFILE VIEW



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

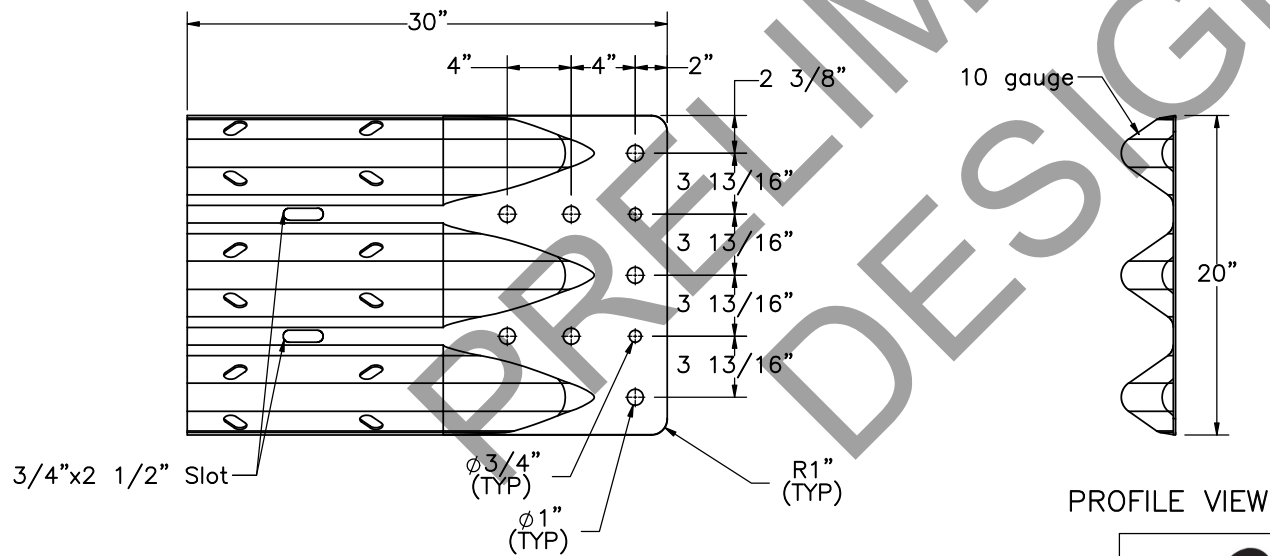
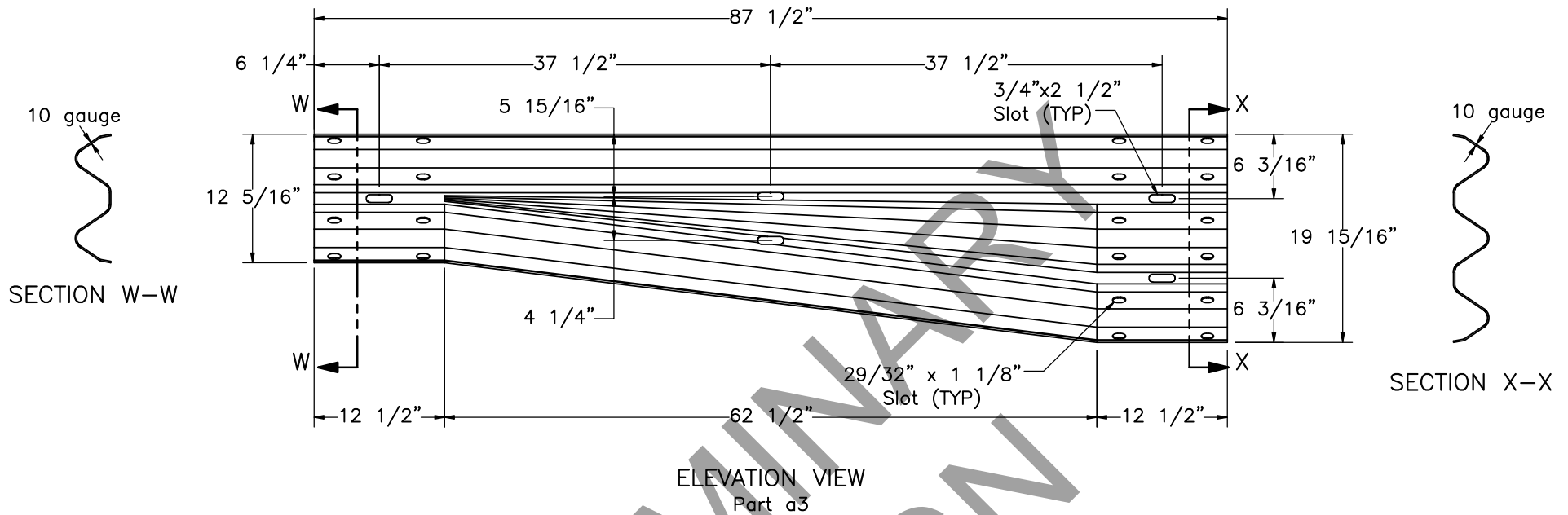
Thrie Beam Details

DWG. NAME.
HMDT-HMDBR_R19

SCALE: 1:32
UNITS: in.

SHEET:
30 of 35

DATE:
8/19/2021



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Transition Rail and End Shoe
Details

DWG. NAME:
HMDT-HMDBR_R19

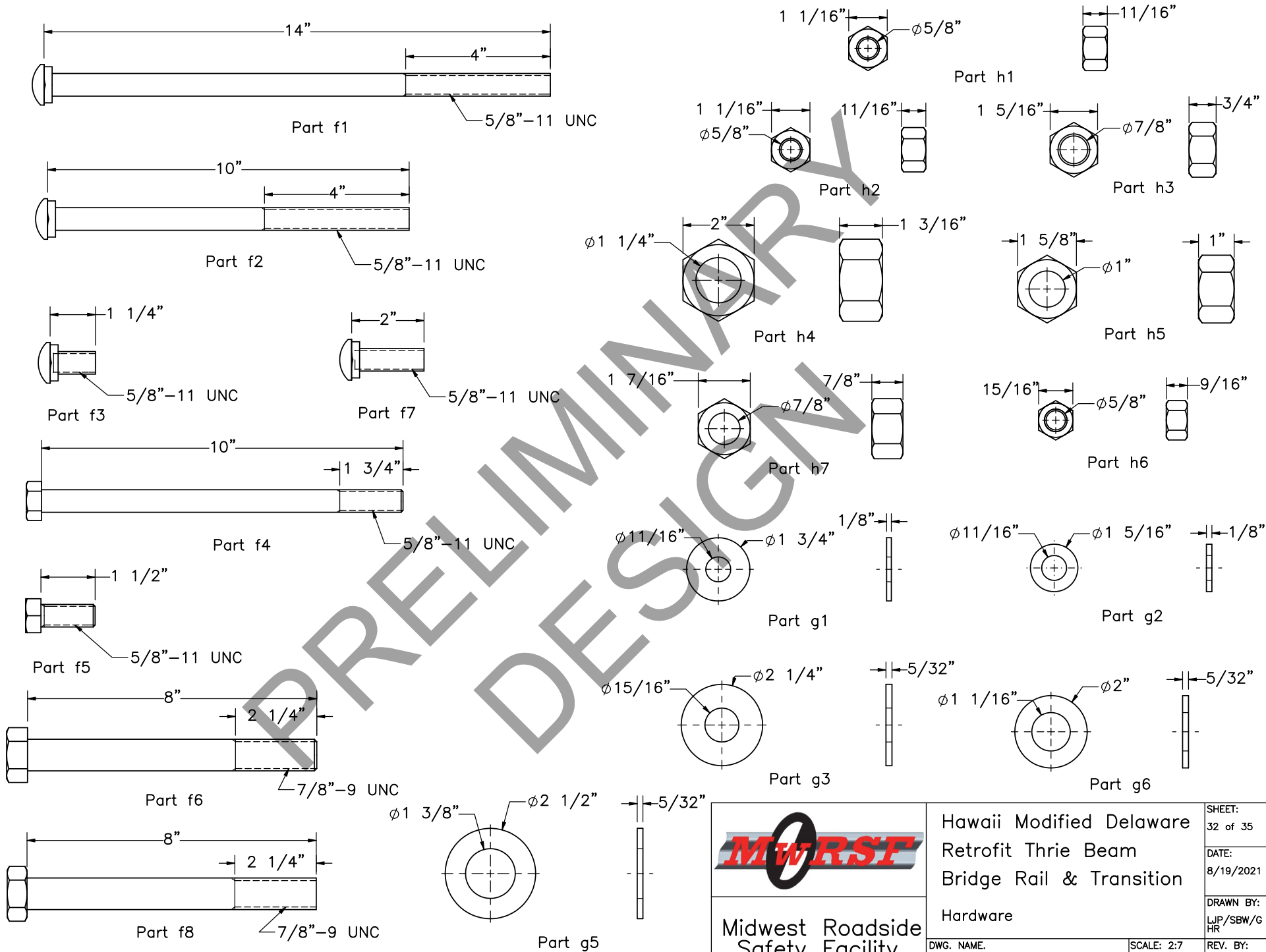
SCALE: 1:15
UNITS: in.

SHEET:
31 of 35

DATE:
8/19/2021

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H



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Hardware

DWG. NAME:
HMDT-HMDBR_R19

SCALE: 2:7
UNITS: in.

SHEET:
32 of 35

DATE:
8/19/2021

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HR

REV. BY:
MP/KAL/JC
H

Item No.	QTY.	Description	Material Specification	Treatment Specification	Hardware Guide
a1	2	12'-6" 12-gauge Thrie Beam Section	AASHTO M180	ASTM A123 or A653	RTM08a
a2	1	6'-3" 12-gauge Thrie Beam Section	AASHTO M180	ASTM A123 or A653	RTM19a
a3	1	6'-3" 10-gauge W-Beam to Thrie-Beam Asymmetric Transition Section	AASHTO M180	ASTM A653	RWT02
a4	3	12'-6" 12-gauge W-Beam MGS Section	AASHTO M180	ASTM A123 or A653	RWM04a
a5	1	12'-6" 12-gauge W-Beam MGS End Section	AASHTO M180	ASTM A123 or A653	RWM14a
a6	16	6'-3" 10-gauge Thrie Beam Section	AASHTO M180	ASTM A123 or A653	RTM19a
b1	16	16"x11"x1" Base Plate	ASTM A36	ASTM A123	—
b2	32	1 1/4" Dia., 14" Long Anchor Rod	ASTM F1554-15 Grade 105, Class 2A	ASTM F2329 / F2329M-15	—
b3	32	5/8" Dia., 8" Long Anchor Rod	ASTM F1554-15 Grade 105, Class 2A	ASTM F2329 / F2329M-15	—
c1	2	BCT Timber Post – MGS Height	SYP Grd. No. 1 or better (No knots +/- 18" from ground on tension face)	—	PDF01
c2	2	72" 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	BCT Cable Anchor Assembly	—	—	FCA01
c6	1	8"x8"x5/8" Anchor Bearing Plate	ASTM A36	ASTM A123	FPB01
c7	1	2 3/8" O.D. x 6" 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	W6x9 or W6x8.5, 72" Long Steel Post	ASTM A992	ASTM A123*	PWE06
d2	6	W6x9 or W6x8.5, 72" Long Steel Post	ASTM A992	ASTM A123*	PWE06
d3	3	W6x15, 78" Long Steel Post	ASTM A992	ASTM A123*	—
d4	3	17 1/2" Long, 8"x6"x1/4" Steel Blockout	ASTM A500 Gr. B	ASTM A123*	—
d5	6	17 1/2" Long, 12"x4"x1/4" Steel Blockout	ASTM A500 Gr. B	ASTM A123*	—
d6	2	14 3/16"x12"x5 1/8" Composite Recycled Blockout	Mondo Polymer MGS14SH or Equivalent	—	—
d7	5	14 3/16"x8"x5 1/8" Composite Recycled Blockout	Mondo Polymer GB14SH2 or Equivalent	—	—
d8	2	16D Double Head Nail	Galvanized	—	—
d9	16	W6x25, 23 1/4" Long Steel Post	ASTM A992	ASTM A123	—

* Component does not need to be galvanized for testing purposes

Notes: (1) Quantities listed herein are only for one copy of the system.
(2) Purchase additional materials to repair the barrier system following the first transition test, test no. HMDT-1.



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Item No.	QTY.	Description	Material Specification	Treatment Specification	Hardware Guide
e1	98	#4 Rebar, 33 7/8" Total Unbent Length	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
e2	3	#4 Rebar, 97' 1" Total Length*	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
e3	7	#4 Rebar, 16" Total Length	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
e4	1	#4 Rebar, 12 3/4" Total Length	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
e5	1	#5 Rebar, 166" Total Length	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
e6	1	#5 Rebar, 158 1/4" Total Unbent Length	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
e7	98	#4 Rebar, 35" Total Unbent Length	ASTM A615 Gr. 60	Epoxy-Coated (ASTM A775 or A934)	—
f1	13	5/8"—11 UNC, 14" Long Guardrail Bolt	ASTM A307 Gr. A	ASTM A153 or B695 Class 55 or F2329	FBB06
f2	13	5/8"—11 UNC, 10" Long Guardrail Bolt	ASTM A307 Gr. A	ASTM A153 or B695 Class 55 or F2329	FBB03
f3	260	5/8"—11 UNC, 1 1/4" Long Guardrail Bolt	ASTM A307 Gr. A	ASTM A153 or B695 Class 55 or F2329	FBB01
f4	2	5/8"—11 UNC, 10" 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, 1 1/2" Long Hex Head Bolt	ASTM A307 Gr. A or equivalent	ASTM A153 or B695 Class 55 or F2329	FBX16a
f6	2	7/8"—9 UNC, 8" Long Hex Head Bolt	ASTM A307 Gr. A or equivalent	ASTM A153 or B695 Class 55 or F2329	—
f7	32	5/8"—11 UNC, 2" Long Guardrail Bolt	ASTM A307 Gr. A	ASTM F2329	FBB01
f8	7	7/8" Dia., 8" Long Heavy Hex Head Bolt	ASTM F3125 Gr. A325 Type 1	ASTM A153 or B695 Class 55 or F1136 Gr. 3 or F2329 or F2833 Gr. 1	FBX22b
g1	54	5/8" Dia. Plain USS Washer	ASTM F844	ASTM F2329	FWC16a
g2	192	5/8" Dia. Hardened Washer	ASTM F436	ASTM F2329	FWC16a
g3	11	7/8" Dia. Plain Round Washer	ASTM F844	ASTM A123 or A153 or F2329	—
g4	2	1" Dia. Plain USS Washer	ASTM F844	ASTM A123 or A153 or F2329	FWC24a
g5	160	1 1/4" Dia. Hardened Washer	ASTM F436	ASTM F2329	FWC30a
g6	10	1" Dia. Hardened Flat Washer	ASTM F436	ASTM A153 or B695 Class 55 or F1136 Gr. 3 or F2329	FWC24b
h1	318	5/8"—11 UNC Heavy Hex Nut	ASTM A563A or equivalent	ASTM A153 or B695 Class 55 or F2329	FNX16b
h2	32	5/8"—11 UNC Heavy Hex Nut	ASTM A563—15 Grade DH	ASTM F2329 / F2329U—15	FNX16b
h3	2	7/8"—9 UNC Hex Nut	ASTM A563A or equivalent	ASTM A153 or B695 Class 55 or F2329	—
h4	32	1 1/4"—7 UNC Heavy Hex Nut	ASTM A563—15 Grade DH	ASTM F2329 / F2329U—15	—
h5	12	1" Dia. Heavy Hex Nut	ASTM A563DH or A194 Gr. 2H	ASTM A153 or B633 or B695 Class 55 or F1941 or F2329	FNX24b
h6	10	5/8"—11 UNC Hex Nut	ASTM A563A or equivalent	ASTM A153 or B695 Class 55 or F2329	FNX16a
h7	7	7/8" Dia. UNC Heavy Hex Nut	ASTM A563DH or ASTM A194 Gr. 2H	ASTM A153 for Class C	

Item No.	QTY.	Description	Material Specification	Treatment Specification	Hardware Guide
i1	10	1" Dia. UNC, 11" Long Threaded Rod	ASTM A449 or A354 Gr. BC or A193 Gr. B7	ASTM A153 or B633 or B695 Class 55 or F1941 or F2329	FRR24b
i2	1	10-gauge Thrie Beam Terminal Connector	AASHTO M180 Min. yield strength = 50 ksi Min. tensile strength = 70 ksi	ASTM A123 or A653	RTE01b
i3	1	14"x14"x1/2" Steel Plate	ASTM A36 or A572 Gr. 50	ASTM A123*	—
i4	1	HSS 6"x12"x1/4" Tube, 38 1/2" Long	ASTM A500 Gr. B	ASTM A123*	—
i5	1	11 1/2"x5 1/2"x1/2" Steel Plate	ASTM A36 or A572 Gr. 50	ASTM A123*	—
i6	1	HSS 6"x4"x5/16" Tube, 46" Long	ASTM A500 Gr. B	ASTM A123*	—
i7	1	16"x12"x1/2" Steel Plate	ASTM A36 or A572 Gr. 50	ASTM A123*	—
j1	1	Concrete	Min. f'c = 4,000 psi NE Mix 47BD1S/1PF4000HW	—	—
k1	—	Hilti HIT RE-500 V3 Epoxy Adhesive	Class C 881	—	—
k2	—	SpecChem 500 Epoxy Filler	ASTM C881 Type IV, Grade I, Class C	—	—

* Component does not need to be galvanized for testing purposes



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail & Transition

Bill of Materials

DWG. NAME:
HMDT-HMDBR_R19

SCALE: None
UNITS: in.

SHEET:
35 of 35
DATE:
8/19/2021
DRAWN BY:
LJP/SBW/G
HR
REV. BY:
MP/KAL/JC
H

REV.	DATE OF ISSUE	Page	NATURE OF CHANGES	REVIEWER	REVISED BY
0	4/9/2020	–	Original drawing created.	–	LJP
1	4/28/2020	–	Changed some part numbers to be the same as they were in HWTT-1.	MP	LJP
		2	Moved and flipped direction of section views.		
		4	Added splice details to section A-A. All section views were flipped.		
		5	Edited curb spacing dimensions.		
		6	Changed views to show backside of system. Changed view labels.		
		8	New sheet with post 16-19 components.		
		9	New sheet with post 10-15 components.		
		10	New sheet with post 3-7 components.		
		11	New sheet with post 8-9 components.		
		12	Added part numbers to views.		
		13	Removed dual dimensions.		
		17	Edited curb dimensions. Added section view M-M.		
		18	Removed all concrete and reinforcement below ground line.		
		19	Combined all bridge rail post components on this sheet.		
		20	New sheet showing bridge rail rebar details.		
		21	New sheet showing bridge rail rebar details.		
		22	New sheet showing bridge rail curb details.		
		23	Added bridge rail rebar details.		
		25	Added detail view N		
		26	Moved transition rail to this sheet.		
		27-32	New sheets for TEAM2-1 downstream anchorage.		
2		1	Added impact point for HMDR-1.		
		2	New sheet showing HMDT-1 impact point.		
		3	New sheet showing HMDT-2 impact point.		
		4	Showed curb reinforcement. Showed ground and created border between soil and concrete.		
		6	Split up ground lines for each post. Added dimensions between top of rail and top of post.		

2	5/14/2020	7	Split up ground lines for each post. Changed section depth of section D.	MP	LJP
		8	Added post nos. and ground lines.		
		9	Increased scale. Edited g2 part no.		
		10	Edited sheet title.		
		14	Showed all bolt holes and added centerlines.		
		18-19	Adjusted curb dimensions. Increased detail view scales. Showed hidden lines on detail views. Added ground line.		
		20	Added slope details. Added base plate countersink dimensions. Added note 4. Changed ground line to finish grade.		
		21	Added post assembly view. Added base plate dimension.		
		22	Changed ground line to finish grade. Made underground rebar dashed lines. Increased scale.		
		24	Changed plan view to show entire curb. Deleted elevation view. Increased scale of profile view.		
		26	Decreased scale so all non-transition rail could be shown on this sheet.		
		27	Added sections O and P.		
		28	Numbered posts.		
		HW	Showed holes in washer side views.		
3	5/22/2020	-	Title changed in title block. Sheets 3, 29, 30, and 31 from previous version were deleted.	MP	LJP
		1	Added impact angle. Added overall system length. Edited notes. Added concrete/soil clarification.		
		2	Combined impact locations for HMDT-1 and HMDT-2 on this sheet. Added impact angles. Edited notes.		
		3	Deleted redundant dimension. Added note about slope of rail. Added hatching and callout to clearly show bridge rail curb.		
		6	Fixed ground line. Removed post embedment depth and rail height dimensions.		
		7	New sheet showing post nos. 11-18 embedment depths.		
		8	Fixed post labels. Added callout of post d1.		
		19	Added isometric view. Fixed curb slope.		
		20	Added embedment depth dimension. Added rebar label. Added washers for leveling base plates.		

		24	Changed profile view to section view.		
		28	Removed concrete from downstream anchorage. Added views of downstream anchorage assembly and end shoe.		
		30	Showed correct dimensions for post i8.		
4	6/1/2020	–	Several sheets were re-ordered. Sheets 2 and 32 were deleted and details from these sheets were moved to other sheets.	MP	LJP
		1	Merged all impact details onto this sheet. Added soil/concrete label to plan view.		
		2	Added CIP location. Labeled sidewalk. Removed finish grade note.		
		3	Fixed rail slope note. Added CIP locations. Added soil/concrete note to plan view.		
		4	Fixed embedment depth for section A–A.		
		5	Added "see note 3". Fixed double bolt lines. Note: rail in section D–D appears as double line because of slope of rail, and more dimensions were not added as they are shown on sheet 6.		
		6	Extended view to show post 19. Showed hidden lines. Added rail height dimensions. Labeled posts and rail. Added notes 1 and 2.		
		17	Changed orientation of isometric view.		
		21	Added hatching to sidewalk. Labeled both sidewalk and cuts.		
		25	Removed extra elevation view. Increased scale of main elevation view and added details to this view. Showed everything underground as hidden lines.		
		29	Moved end shoe details to this sheet.		
		30	Combined all hardware onto one sheet.		
5	6/8/2020	1	Removed hidden lines. Showed approximate depth of tarmac. Removed hatching on tarmac. Removed note 7.	MP	LJP
		2	Added notes 1 and 2.		
		3	Added section views for each post no. 11–18. Removed hatching on tarmac. Added notes 1–4.		
		6–7	Added sheets for new section views of posts.		
		8	Reformatted dimensions and post nos.		

5	5/5/2020	19	Removed flare on curb.		
		21	Changed rebar notes to part balloons.		
		23	Sidewalk dimensions are now shown to intersection of tangent lines. Increased scale of section view.		
		24	Showed lap length.		
		25	Bar e1 from previous version was split into bars e1 and e7. Added bar e7.		
6	6/12/2020	–	Sheet showing embedment depths was moved from 8 to 4.	MP/KAL	LJP
		1	Edited notes 4 and 6. Changed HMDR to HMDBR. Removed ground block from view.		
		2	Changed HMDR to HMDBR.		
		3	Edited notes 2 and 4. Reformatted dimensions and cutting lines.		
		5	Fixed post labels.		
		6	Hid curb rebar. Added note 3.		
		7	Hid curb rebar. Added note 1. Edited post 15 dimensions.		
		8	Hid curb rebar. Added note 1. Added dimension to top of blockout.		
		18	Fixed cosmetic threads.		
		19	Added slope to detail views. Edited dimensions in detail views.		
		21	Added detail view T. Fixed slope notes.		
		22	Removed hardware from post assembly view. Added weld note.		
		23	Fixed slope notes. Added vertical dimension to section view.		
		24	Added minimum lap dimension.		
		29	Added hidden lines to part i4.		
		32	Added diameter dimensions to nuts.		
		6	Edited note 1.		
		7	Added notes 1 and 2.		
		8	Added notes 1 and 2.		
		19–20	Changed underground slope line to be dashed.		

7	6/30/2020	23	Note: Dimension to first sidewalk cutout was kept the same.	MP	LJP
		25	Added view labels.		
		29	Added total height of part i4.		
		BOM	Made concrete part j1. Added epoxy adhesive at end. Specified which rebar did not need to be epoxy coated. Changed part nos. of f7, f8, f9 since there was no part f6. Desc.: d1, d9		
8	7/9/2020	1	Edited title block. Added note 7.	MP	LJP
		2	Edited sheet description and note 2.		
		3	Changed sheet description.		
		4	Added "post no." Edited note 2.		
		5	Added "Post Nos." to sheet descriptions.		
		6	Added "Post Nos." to sheet descriptions. Added dashed line showing curb and rail alignment.		
		7-8	Added "Post Nos." to sheet descriptions.		
		10	Added second nail (part d8).		
		19-20	Adjusted scale notes and removed spaces.		
		21	Edited notes 1, 4, and 5.		
		22	Edited weld note.		
		27	Changed "concrete anchorage" to "concrete tarmac" in note 1.		
		BOM	Added notes 1 and 2. Matl.: d8, i2		
9	8/7/2020	-	Drawing name changed to HMDT-HMDBR.	MP	LJP
		32	Added new hardware used with anchor rods. Parts h2 and g2. Washer g5 dimensions updated.		
		BOM	Matl: b2, b3, g1, g5, h4. Trtmnt: b2, b3		
10	8/26/2020	4	Updated post embedment depths.	MP	LJP
		6	Edited post 13 height and embedment depth.		
		7	Edited post 16 height and embedment depth.		
		8	Edited post 17 and 18 heights and embedment depths.		

		21	Fixed part nos. in note 2.		
11	9/25/2020	1	Added note regarding concrete slab.	MP	CJN
		21	Added embedment depth dimension for threaded rod connection between Bridge Post and sidewalk.		
		BOM	Matl: d2. Trtmnt: e1, e2, e3, e4, e5, e6, e7. Desc.: j1.		
12	10/5/2020	21	Changed embedment depth dimension for threaded rod connection between Bridge Post and sidewalk. Changed the total length of threaded rod to 14".	MP	CJN
		BOM	Matl: Epoxy Desc.: b2		
13	10/9/2020	4	Added note 3.	MP	CJN
		6	Added note 4.		
		7	Added note 4.		
		8	Added note 4.		
		21	Changed Bridge Rail splice connection to f3's. Removed washers (g1) from splice connection.		
		BOM	Qty: f3, f7, g1, h1		
14	10/14/2020	1	Added notes to run concrete slab up to tarmac.	KAL	SBW
		3	Added notes to run concrete slab up to tarmac.		
		21	Changed distance between parts b3 and left most e2. Adjusted other e2 rebar accordingly.		
		24	Added lap length note for part e2.		
		25	Added lap length note for part e2.		
		26	Added lap length note for part e2.		
		34	Added lap length note for part e2.		
15	11/30/2020	22	Added all around to weld note. Added plan view with post location on plate.	JCH	LJP
16	12/15/2020	21	Added note 2. Edited note 7. Deleted old note 4.	JCH	LJP
		27	Edited note 1.		
		BOM	Added line for epoxy filler. Updated concrete material spec.		
17	2/8/2021	All	Renamed system to HMDT-1 & HMDBR-1	KAL	SBW
		1	Removed notes 5 and 6.		
		2	Removed Notes 3 and 4.		

18	4/2/202	21	Called out part g1 in drawing.	JCH	CJN
19	8/19/2021	22	Rescaled part b3 to match sheet scale.	MP	GHR
		BOM	Changed part h4 to "1 1/4"-7 UNC"		

PRELIMINARY
DESIGN