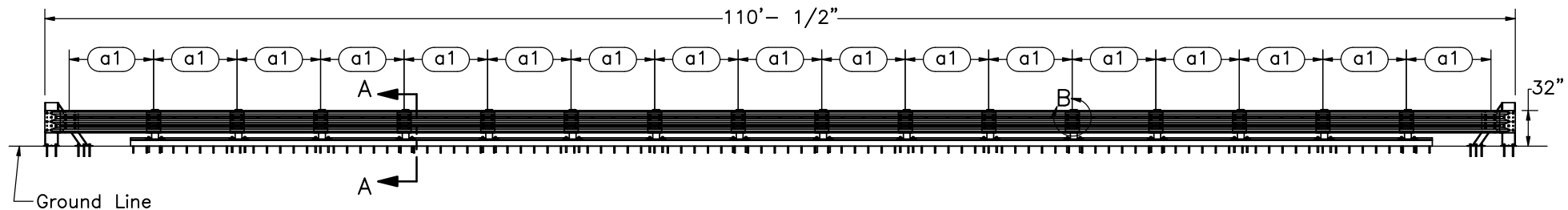



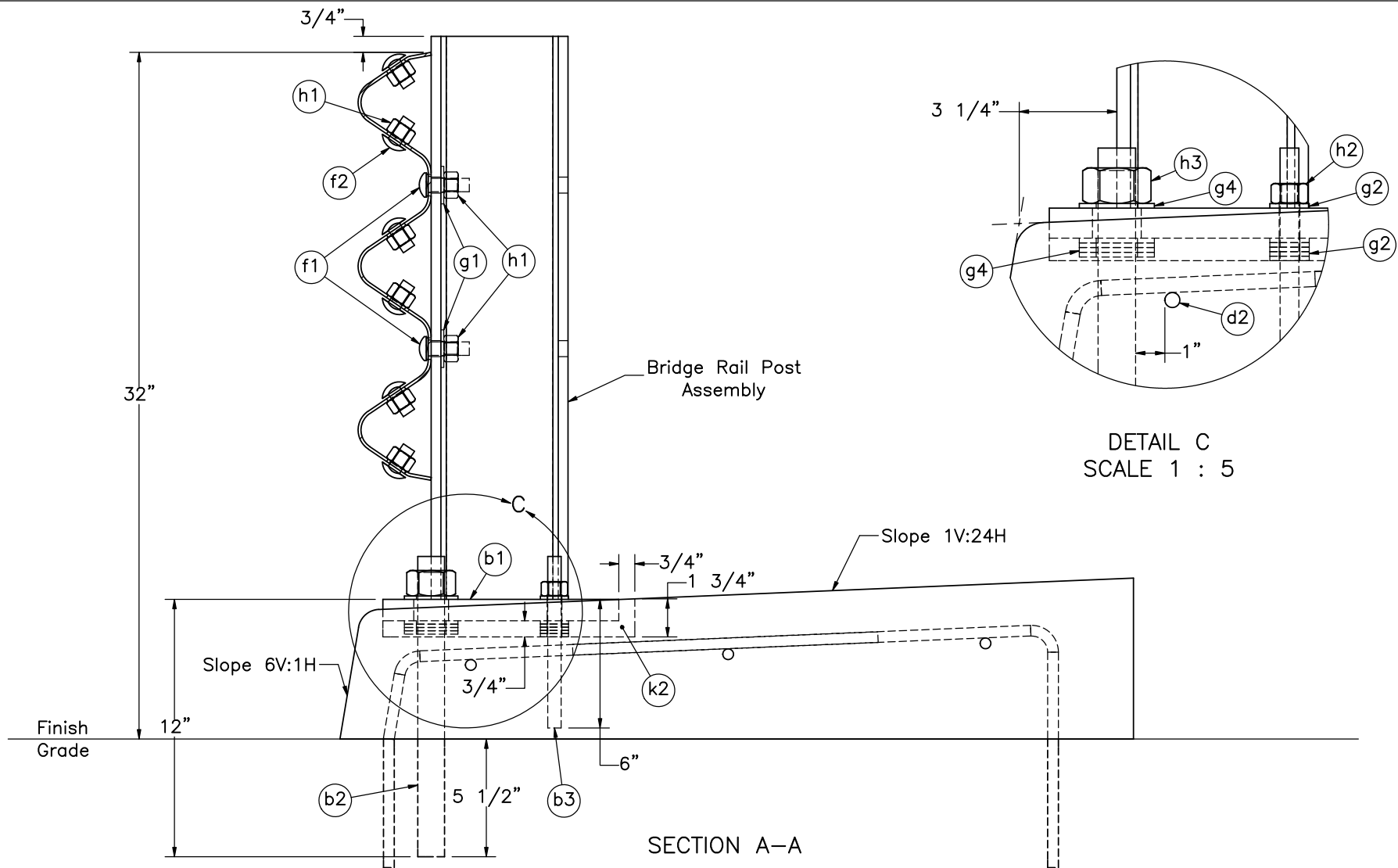
PLAN VIEW



ELEVATION VIEW

- Notes: (1) Test no. HMDBR-2 shall be performed according to test designation no. 3-10 of MASH 2016 criteria.
 (2) The impact point for test no. HMDBR-2 is 54" upstream from post no. 13.
 (3) Test no. HMDBR-3 shall be performed according to test designation no. 3-11 of MASH 2016 criteria.
 (4) The impact point for test no. HMDBR-3 is 84" upstream from post no. 7 or 9" upstream from post no. 6.
 (5) Quantities listed herein are only for one system and do not include repair parts.

| | | |
|--|--|----------------------|
|  Midwest Roadside Safety Facility | Hawaii Modified Delaware Retrofit Thrie Beam Bridge Rail | SHEET: 1 of 16 |
| | System Layout – Test Nos. HMDBR-2 & HMDBR-3 | DATE: 8/20/2021 |
| DWG. NAME: HMDBR_2-3_R9 | SCALE: 1:138 UNITS: in. | DRAWN BY: LJP/GHR |
| | | REV. BY: MP/JCH |



- Notes:
- (1) Base plate (part b1) should be counter sunk into sidewalk, slightly oversized, then backfilled with epoxy grout. Entire perimeter and bottom of baseplate should be backfilled with epoxy grout (part k2).
 - (2) Epoxy grout used to fill post cavities should be in compliance with ASTM C881 Type IV, Grade I, Class C.
 - (3) Add washers (parts g2 and g4) to level base plates.
 - (4) Anchor rods (parts b2 and b3) should be epoxied into the concrete sidewalk and concrete tarmac.
 - (5) Rebar (parts d1 and d3) 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 epoxy in compliance with Class C, C881.
 - (7) Recessed cut areas on top of the sidewalk can be saw cut.



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail

Bridge Rail Details

DWG. NAME:
HMDBR_2-3_R9

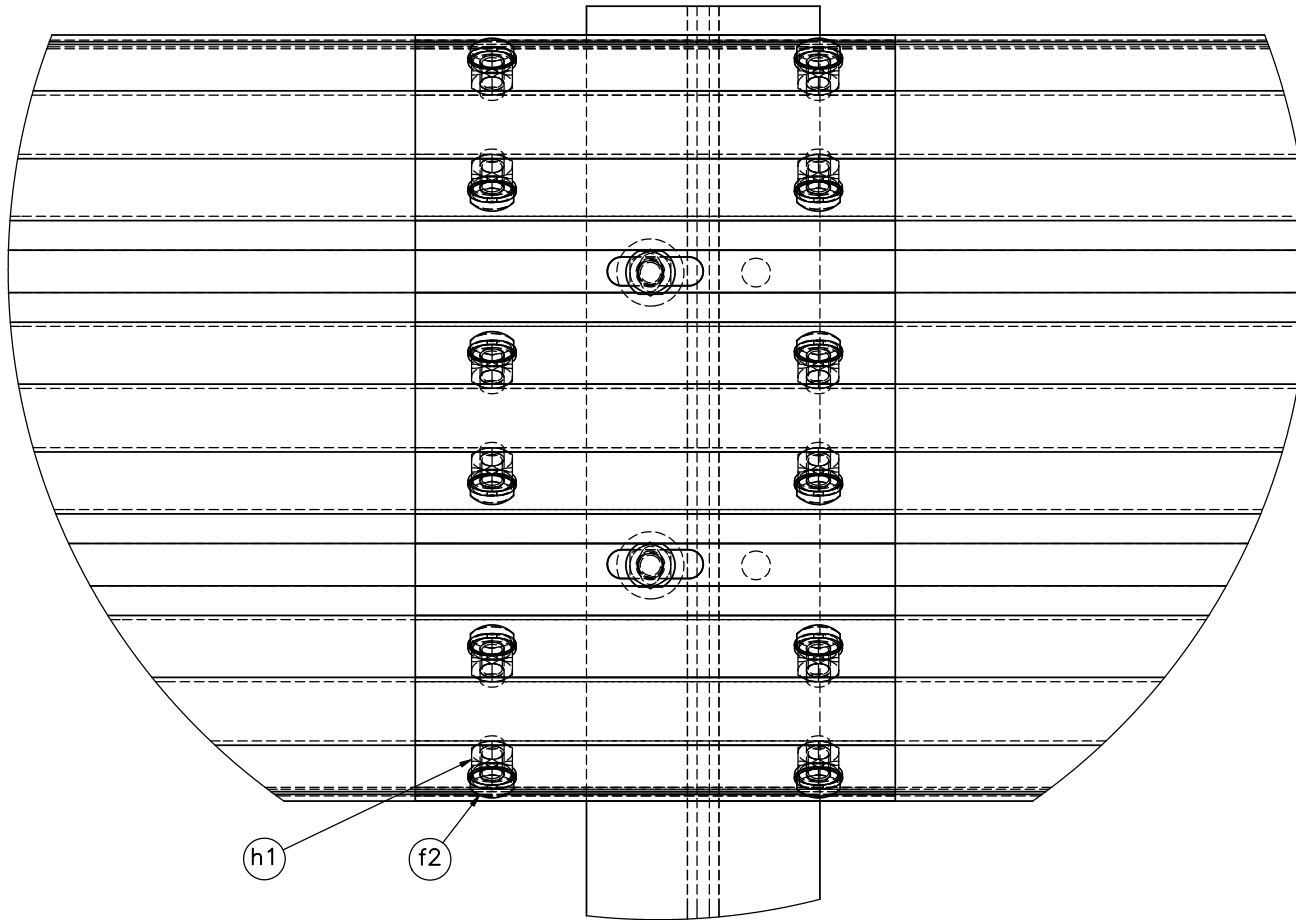
SCALE: 1:7
UNITS: in.

SHEET:
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DATE:
8/20/2021

DRAWN BY:
LJP/GHR

REV. BY:
MP/JCH



h1

f2

DETAIL B



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail

Typical Rail Splice

DWG. NAME.
HMDBR_2-3_R9

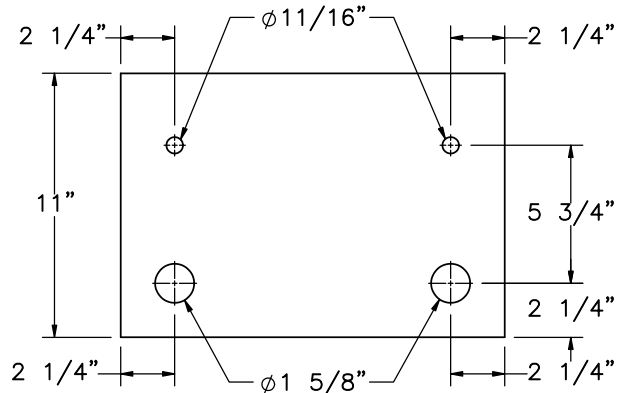
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SHEET:
3 of 16

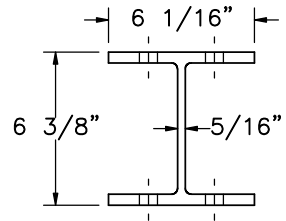
DATE:
8/20/2021

DRAWN BY:
LJP/GHR

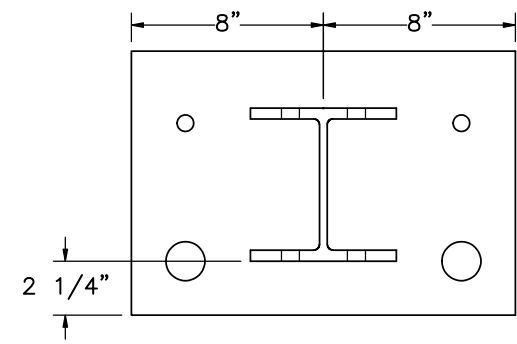
REV. BY:
MP/JCH



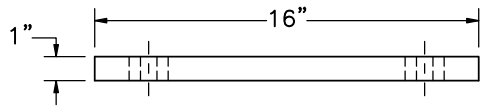
PLAN VIEW



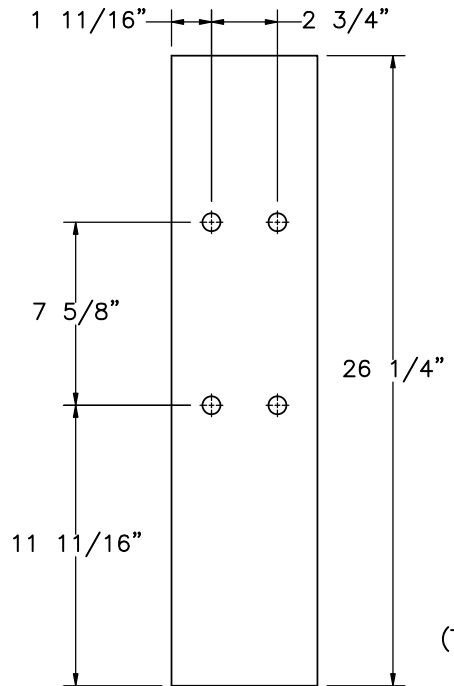
PLAN VIEW



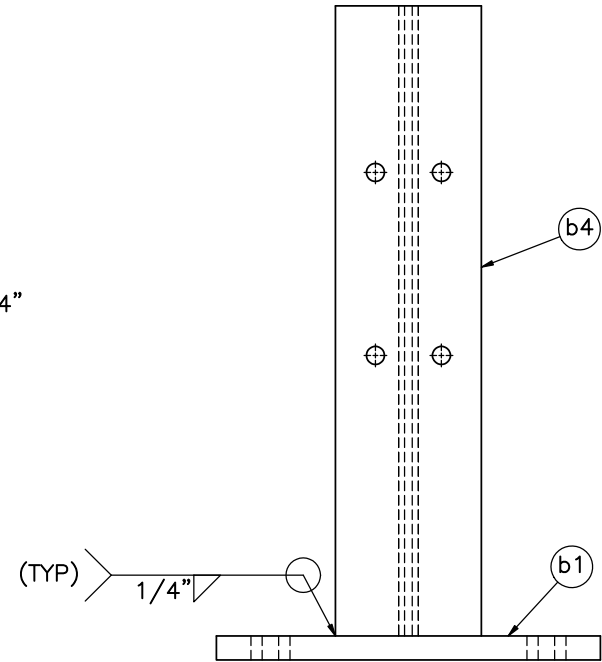
PLAN VIEW



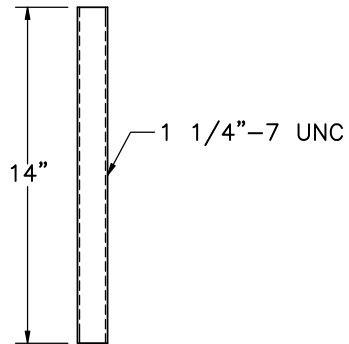
ELEVATION VIEW
Part b1



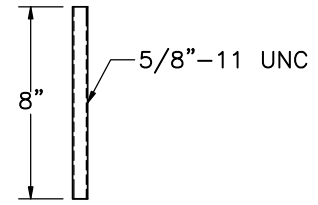
ELEVATION VIEW
Part b4



ELEVATION VIEW
Bridge Rail Post Assembly



ELEVATION VIEW
Part b2



ELEVATION VIEW
Part b3



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail

Bridge Rail Post Components

DWG. NAME:
HMDBR_2-3_R9

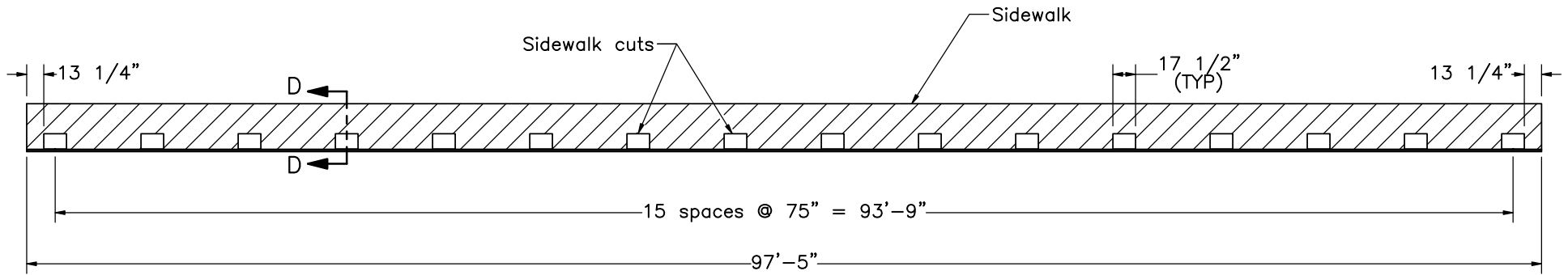
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SHEET:
4 of 16

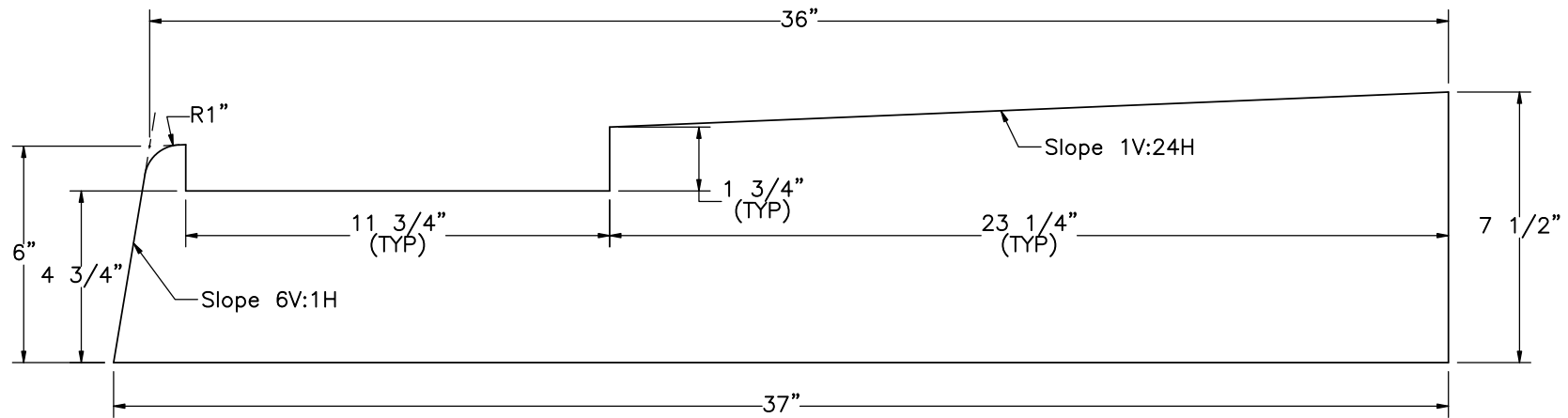
DATE:
8/20/2021

DRAWN BY:
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REV. BY:
MP/JCH



PLAN VIEW



SECTION D-D
SCALE 1 : 5



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail

Sidewalk Details

DWG. NAME.
HMDBR_2-3_R9

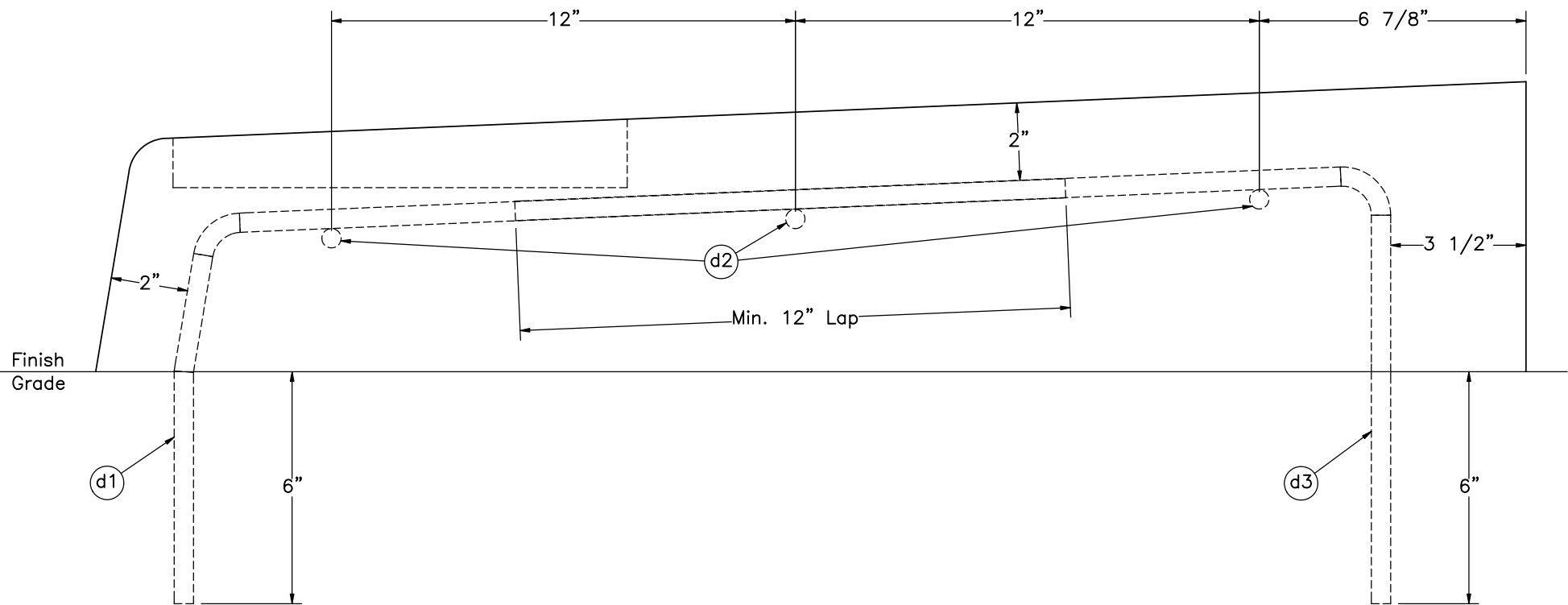
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SHEET:
5 of 16

DATE:
8/20/2021

DRAWN BY:
LJP/GHR

REV. BY:
MP/JCH



PROFILE VIEW

Note: (1) Minimum lap length for bar d2 is 18".



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail

Sidewalk Reinforcement Details

DWG. NAME.
HMDBR_2-3_R9

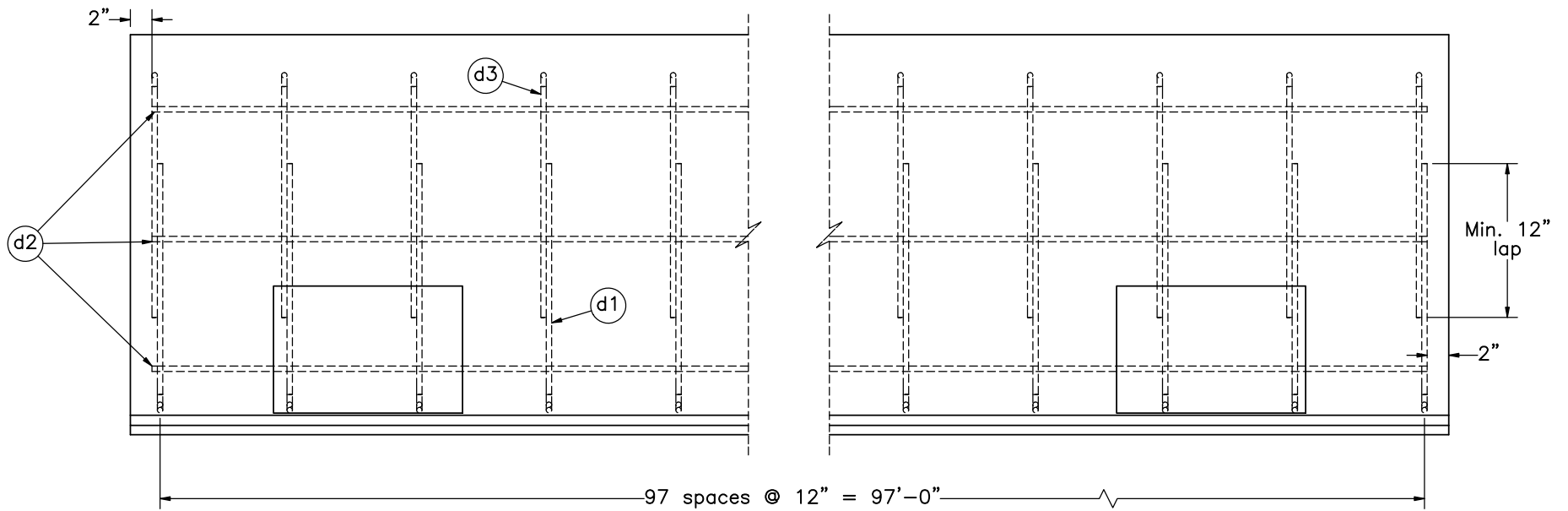
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SHEET:
6 of 16

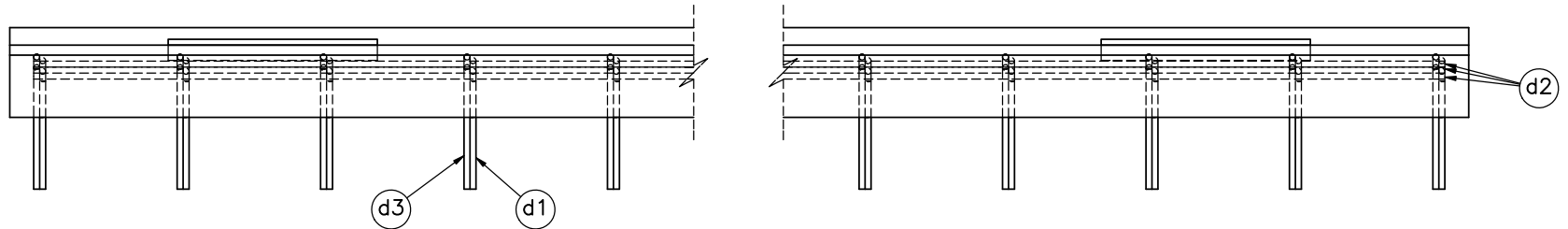
DATE:
8/20/2021

DRAWN BY:
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MP/JCH



PLAN VIEW



ELEVATION VIEW

Note: (1) Minimum lap length for bar d2 is 18".



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail

Sidewalk Reinforcement Details

DWG. NAME.
HMDBR_2-3_R9

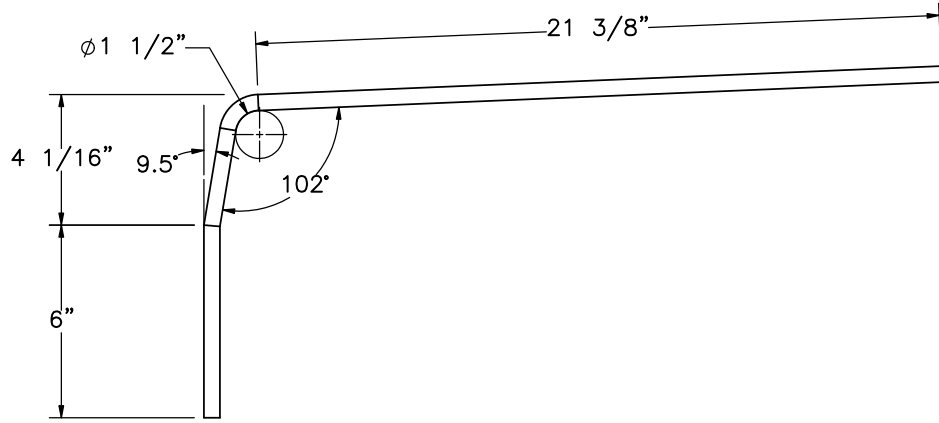
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SHEET:
7 of 16

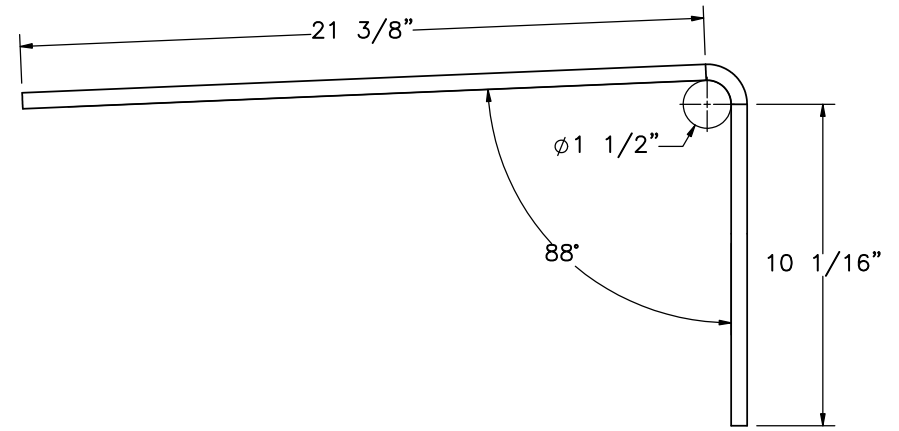
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8/20/2021

DRAWN BY:
LJP/GHR

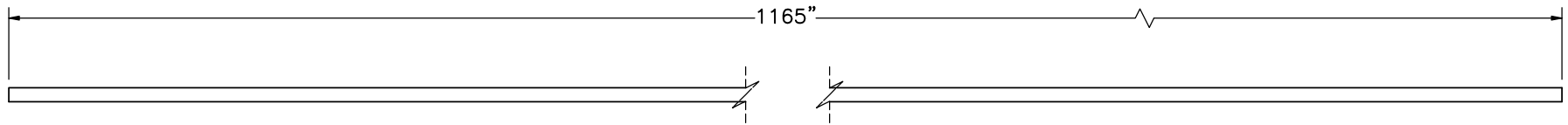
REV. BY:
MP/JCH



Bar d1



Bar d3



Bar d2

Note: (1) Minimum lap length for bar d2 is 18".

| Part No. | Bar No. | QTY | Unbent Length | Material Specification |
|----------|---------|-----|---------------|------------------------|
| d1 | #4 | 98 | 31 3/4" | ASTM A615 Gr. 50 |
| d2 | #4 | 3 | 1165" | ASTM A615 Gr. 50 |
| d3 | #4 | 98 | 33" | ASTM A615 Gr. 50 |



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail

Rebar Details

DWG. NAME:
HMDBR_2-3_R9

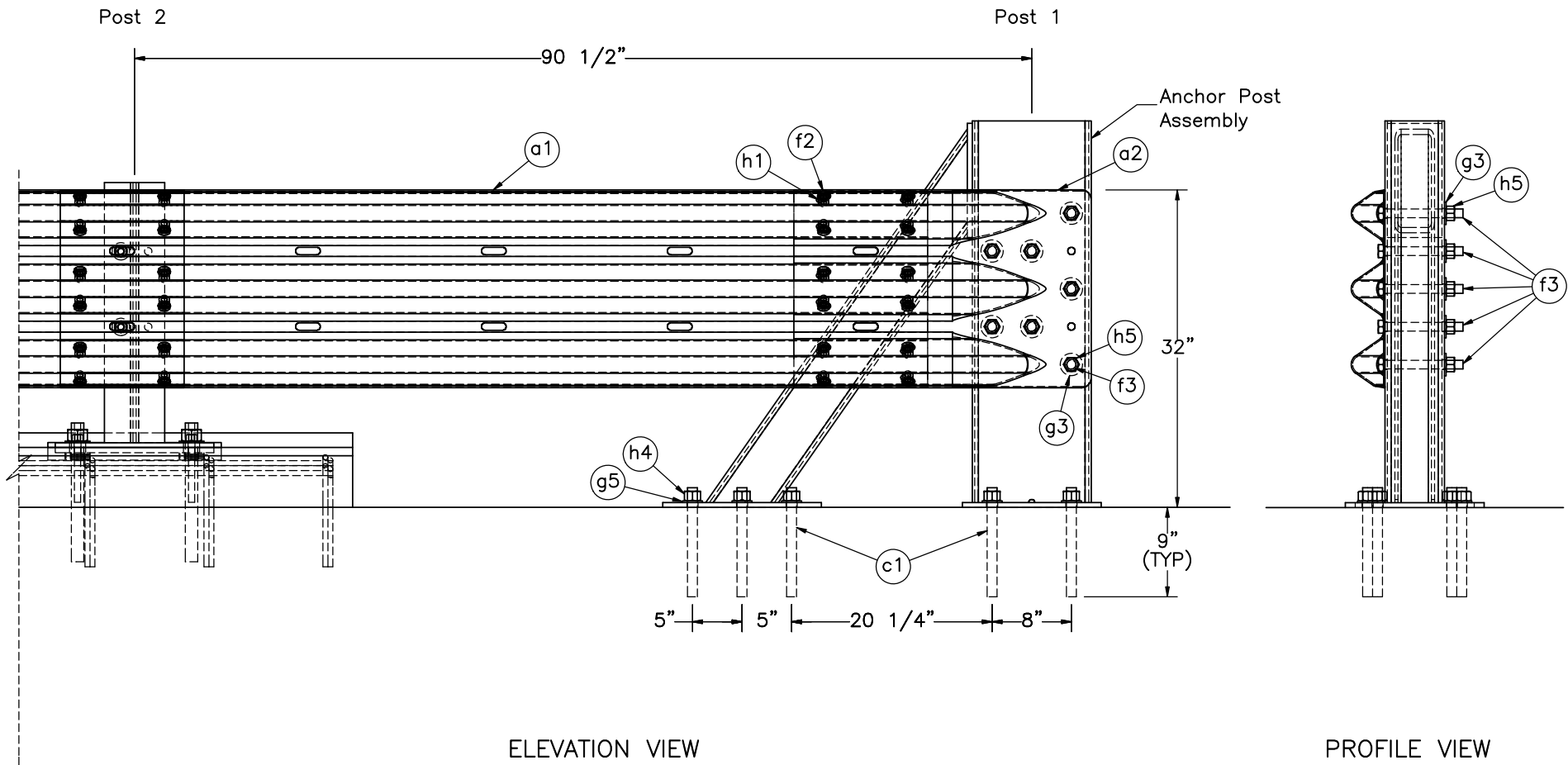
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SHEET:
8 of 16

DATE:
8/20/2021

DRAWN BY:
LJP/GHR

REV. BY:
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Note: (1) Threaded rods (part c1) 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

Upstream Anchorage

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HMDBR_2-3_R9

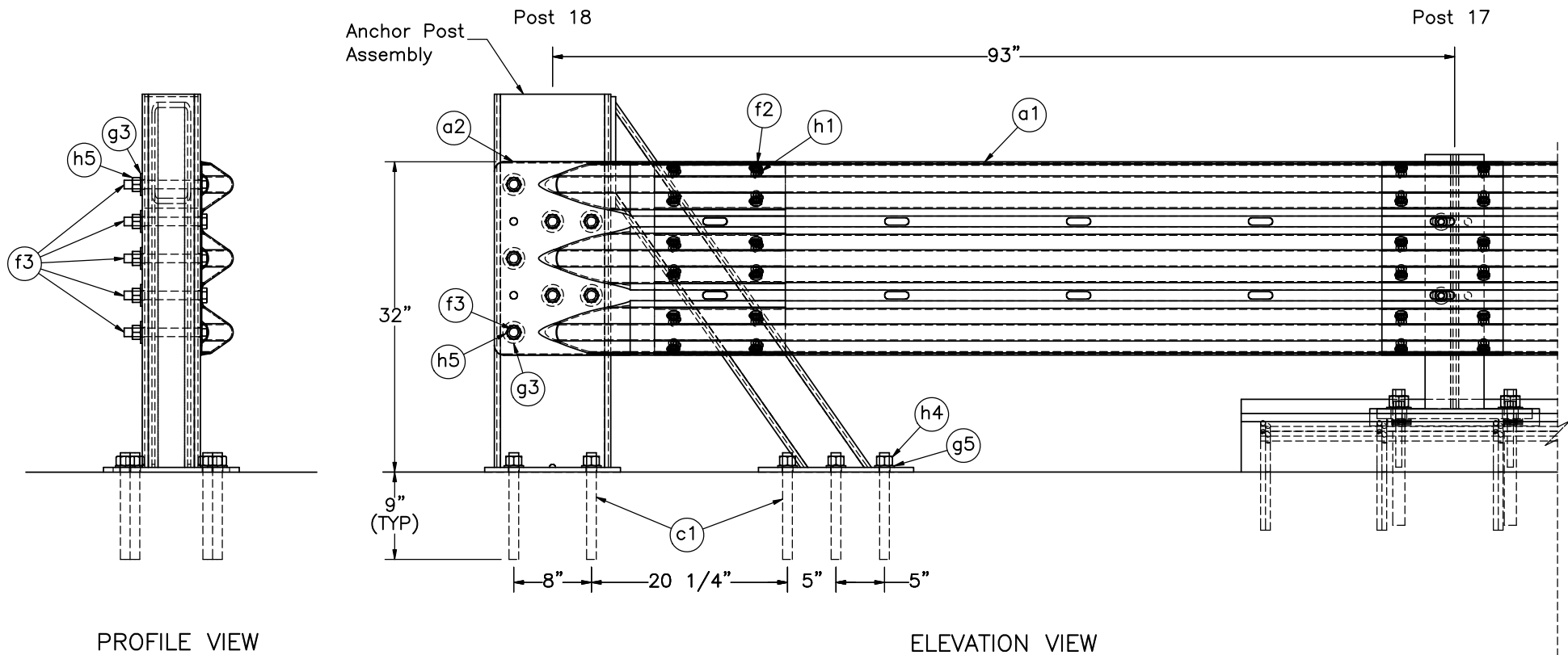
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SHEET:
9 of 16

DATE:
8/20/2021

DRAWN BY:
LJP/GHR

REV. BY:
MP/JCH



Note: (1) Threaded rods (part c1) 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

Downstream Anchorage

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HMDBR_2-3_R9

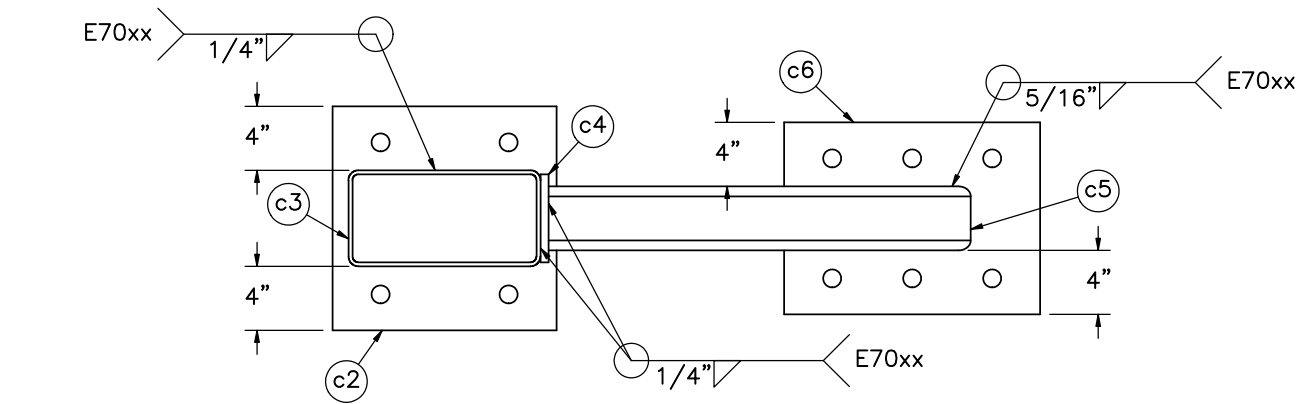
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SHEET:
10 of 16

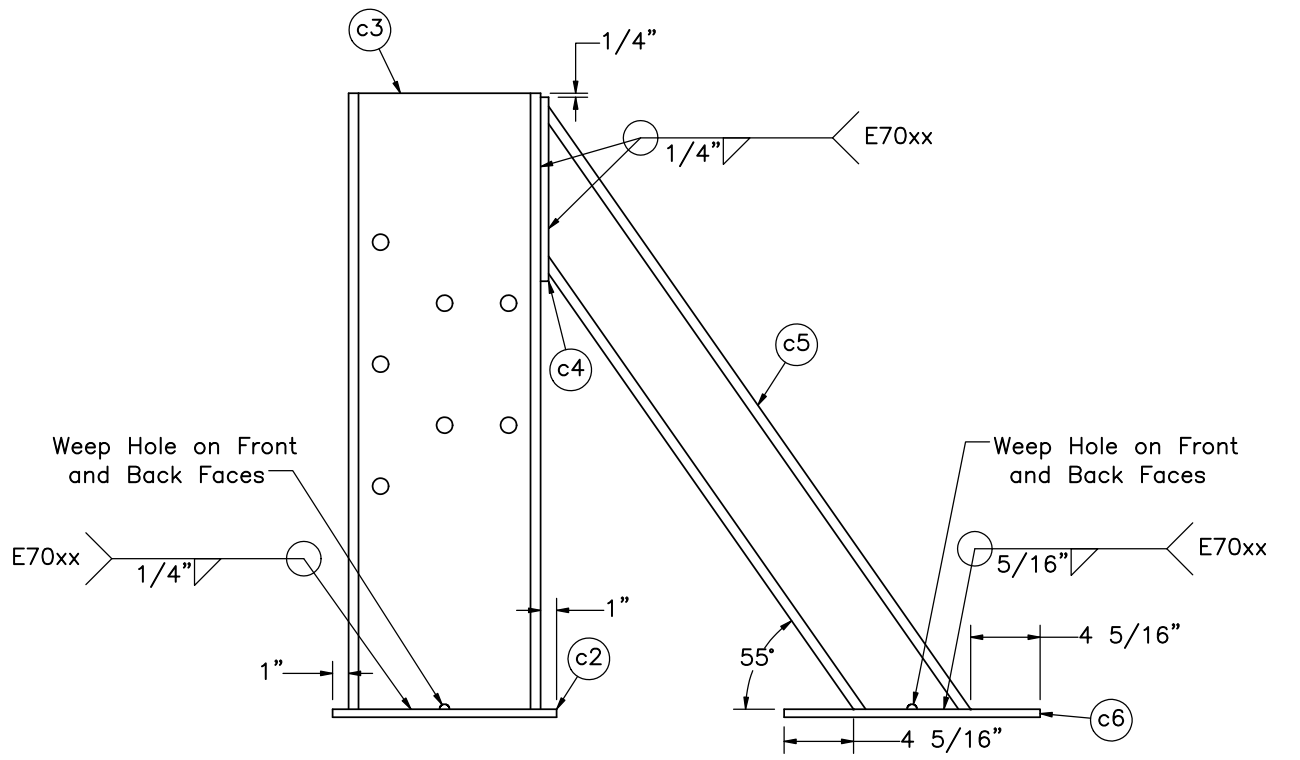
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LJP/GHR

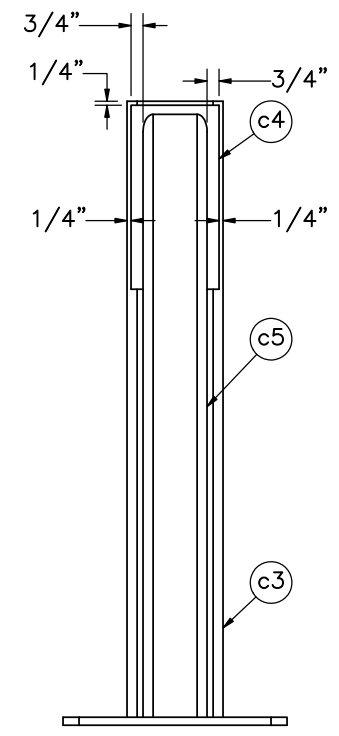
REV. BY:
MP/JCH



PLAN VIEW



ELEVATION VIEW



PROFILE VIEW



Midwest Roadside Safety Facility

Hawaii Modified Delaware Retrofit Thrie Beam Bridge Rail

Anchor Post Assembly Details

DWG. NAME:
HMDBR_2-3_R9

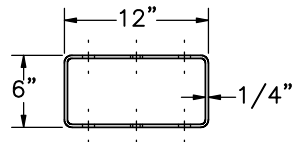
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SHEET:
11 of 16

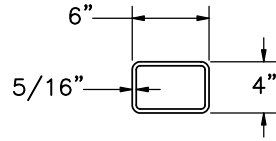
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8/20/2021

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LJF/GHR

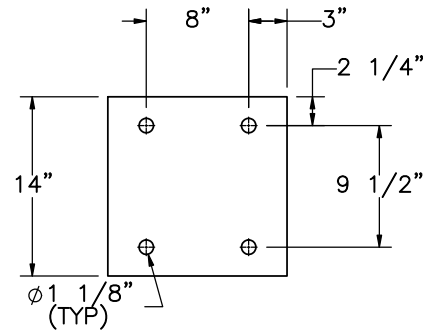
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MP/JCH



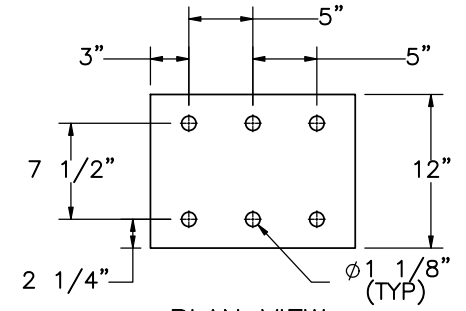
PLAN VIEW



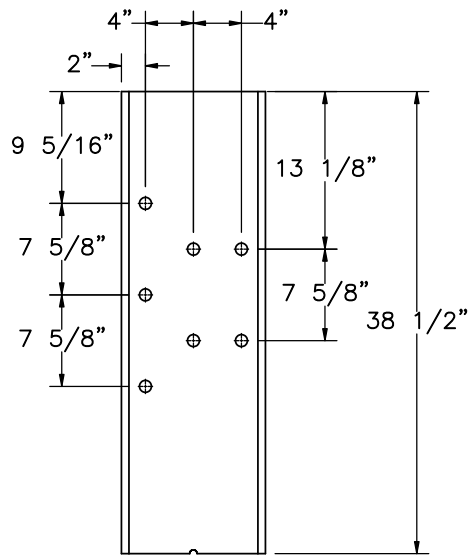
PLAN VIEW



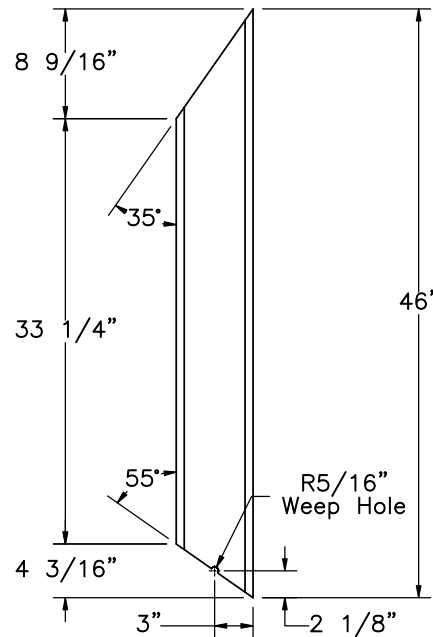
PLAN VIEW



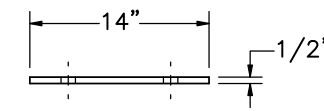
PLAN VIEW



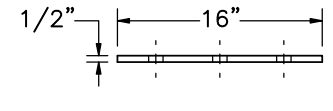
ELEVATION VIEW
Part c3



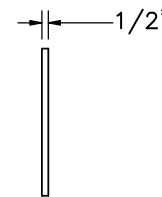
ELEVATION VIEW
Part c5



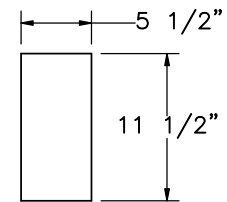
ELEVATION VIEW
Part c2



ELEVATION VIEW
Part c6



ELEVATION VIEW



PROFILE VIEW

Part c4



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail

Anchor Post Components

DWG. NAME:
HMDBR_2-3_R9

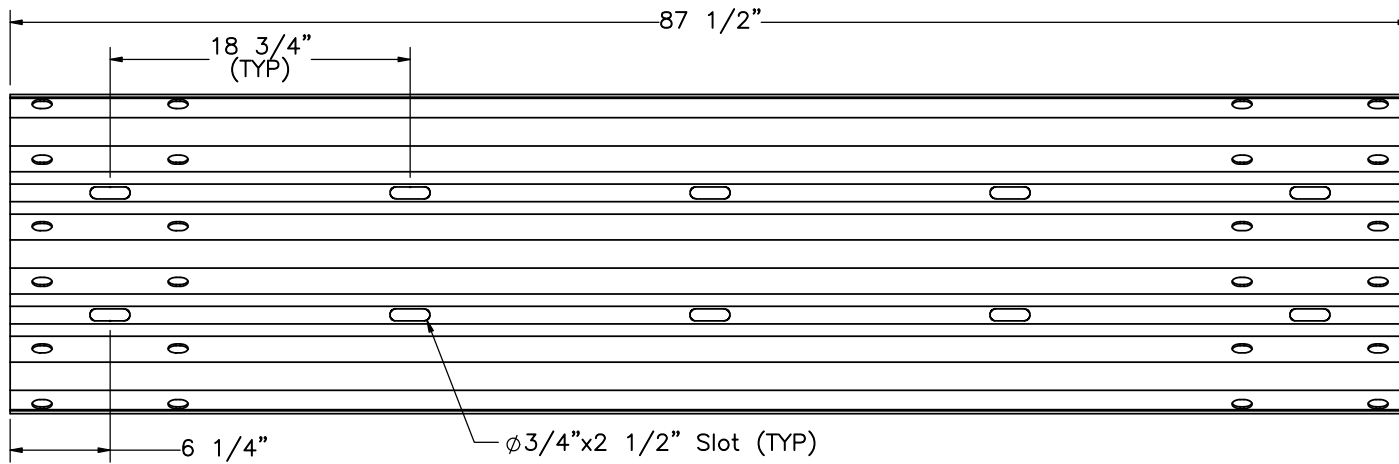
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SHEET:
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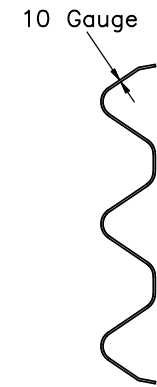
DATE:
8/20/2021

DRAWN BY:
LJP/GHR

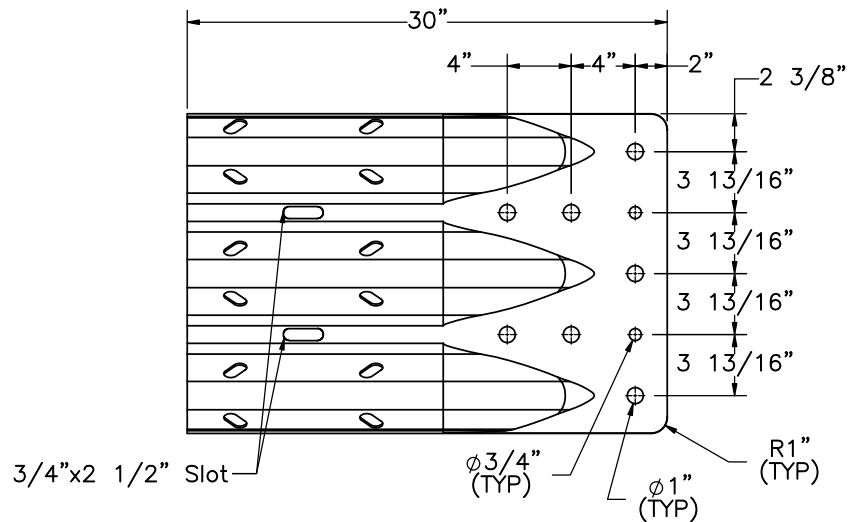
REV. BY:
MP/JCH



ELEVATION VIEW
Part a1

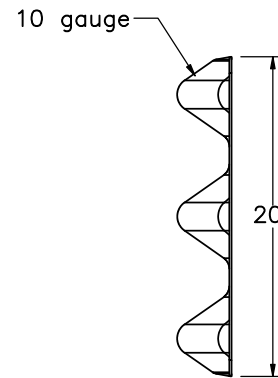


PROFILE VIEW



ELEVATION VIEW

Part a2



PROFILE VIEW



Midwest Roadside
Safety Facility

Hawaii Modified Delaware
Retrofit Thrie Beam
Bridge Rail

Thrie Beam Details

DWG. NAME:
HMDBR_2-3_R9

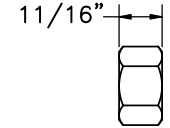
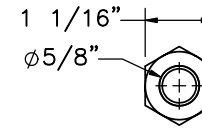
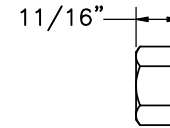
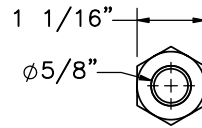
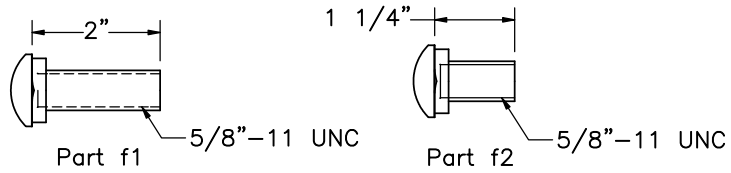
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13 of 16

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8/20/2021

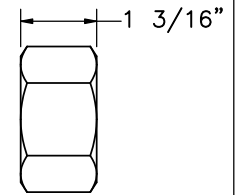
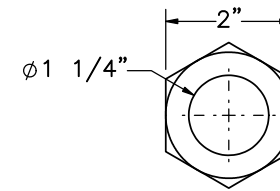
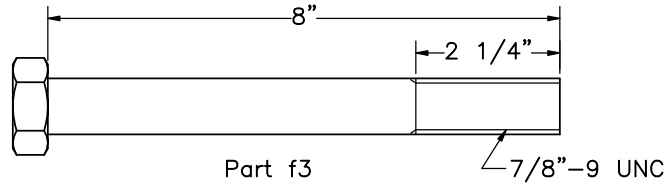
DRAWN BY:
LJP/GHR

REV. BY:
MP/JCH

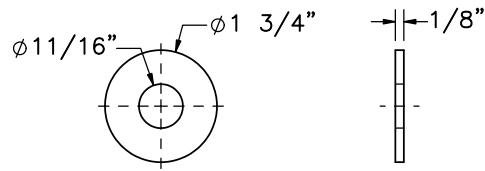


Part h1

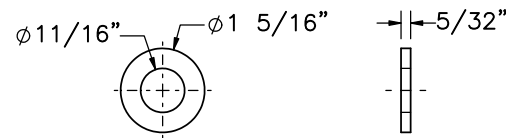
Part h2



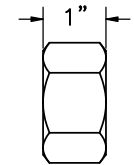
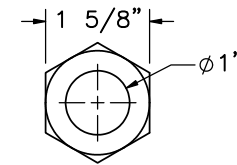
Part h3



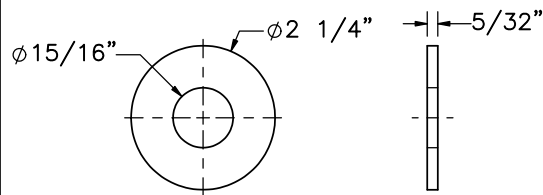
Part g1



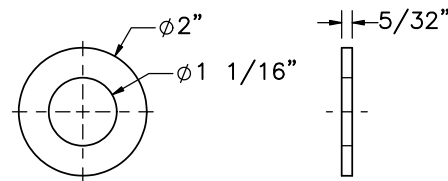
Part g2



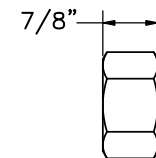
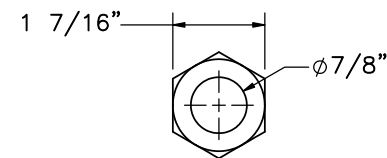
Part h4



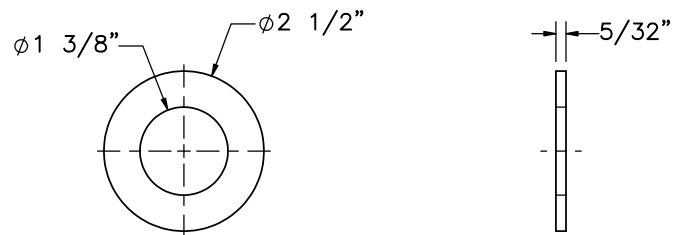
Part g3



Part g5



Part h5



Part g4



Midwest Roadside Safety Facility

Hawaii Modified Delaware Retrofit Thrie Beam Bridge Rail

Hardware

DWG. NAME:
HMDBR_2-3_R9

SCALE: 1:3
UNITS: in.

SHEET:
14 of 16

DATE:
8/20/2021

DRAWN BY:
LJP/GHR

REV. BY:
MP/JCH

| Item No. | QTY. | Description | Material Specification | Treatment Specification | Hardware Guide |
|----------|------|--|---|---|----------------|
| a1 | 17 | 6'-3" 10-gauge Thrie Beam Section | AASHTO M180 | ASTM A123 or A653 | RTM19a |
| a2 | 2 | 10-gauge Thrie Beam Terminal Connector | AASHTO M180 Min. yield strength = 50 ksi Min. tensile strength = 70 ksi | ASTM A123 or A653 | RTE01b |
| 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 | - |
| b4 | 16 | W6x25, 26 1/4" Long Steel Post | ASTM A992 | ASTM A123 | - |
| c1 | 20 | 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 |
| c2 | 2 | 14"x14"x1/2" Steel Plate | ASTM A36 or A572 Gr. 50 | ASTM A123* | - |
| c3 | 2 | HSS 6"x12"x1/4" Tube, 38 1/2" Long | ASTM A500 Gr. B | ASTM A123* | - |
| c4 | 2 | 11 1/2"x5 1/2"x1/2" Steel Plate | ASTM A36 or A572 Gr. 50 | ASTM A123* | - |
| c5 | 2 | HSS 6"x4"x5/16" Tube, 46" Long | ASTM A500 Gr. B | ASTM A123* | - |
| c6 | 2 | 16"x12"x1/2" Steel Plate | ASTM A36 or A572 Gr. 50 | ASTM A123* | - |
| d1 | 98 | #4 Rebar, 31 3/4" Total Unbent Length | ASTM A615 Gr. 60 | Epoxy-Coated (ASTM A775 or A934) | - |
| d2 | 3 | #4 Rebar, 97' 1" Total Length, 18" Min. Lap Length | ASTM A615 Gr. 60 | Epoxy-Coated (ASTM A775 or A934) | - |
| d3 | 98 | #4 Rebar, 33" Total Unbent Length | ASTM A615 Gr. 60 | Epoxy-Coated (ASTM A775 or A934) | - |
| e1 | 1 | Reinforced Concrete | Min. f'c = 4,000 psi NE Mix 47B1S/1PF4000HW | - | - |
| f1 | 32 | 5/8"-11 UNC, 2" Long Guardrail Bolt | ASTM A307 Gr. A | ASTM F2329 | FBB01 |
| f2 | 216 | 5/8"-11 UNC, 1 1/4" Long Guardrail Bolt | ASTM A307 Gr. A | ASTM F2329 | FBB01 |
| f3 | 14 | 7/8"-9 UNC, 8" Long Heavy Hex Bolt | ASTM F3125 Gr. A325 Type 1 | ASTM A153 or B695 Class 55 or F1136 Gr. 3 or F2329 or F2833 Gr. 1 | FBX22b |

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

Note: (1) Quantities listed herein are only for one system and do not include repair parts.



Midwest Roadside Safety Facility

Hawaii Modified Delaware Retrofit Thrie Beam Bridge Rail

Bill of Materials

DWG. NAME:
HMDBR_2-3_R9

SCALE: None
UNITS: in.

SHEET:
15 of 16

DATE:
8/20/2021

DRAWN BY:
LJP/GHR

REV. BY:
MP/JCH

| Item No. | QTY. | Description | Material Specification | Treatment Specification | Hardware Guide |
|----------|------|------------------------------------|-------------------------------------|---|----------------|
| g1 | 32 | 5/8" Dia. Plain Round Washer | ASTM F844 | ASTM F2329 | FWC16a |
| g2 | 192 | 5/8" Dia. Hardened Washer | ASTM F436 | ASTM F2329 | FWC16b |
| g3 | 14 | 7/8" Dia. Plain Round Washer | ASTM F844 | ASTM A123 or A153 or F2329 | FWC20a |
| g4 | 160 | 1 1/4" Dia. Hardened Washer | ASTM F436 | ASTM F2329 | FWC30b |
| g5 | 20 | 1" Dia. Hardened Round Washer | ASTM F436 | ASTM A153 or B695 Class 55 or F1136 Gr. 3 or F2329 | FWC24b |
| h1 | 248 | 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 | 32 | 1 1/4"-7 UNC Heavy Hex Nut | ASTM A563-15 Grade DH | ASTM F2329 / F2329U-15 | FNX30b |
| h4 | 20 | 1" Dia. Heavy Hex Nut | ASTM A563DH or A194 Gr. 2H | ASTM A153 or B633 or B695 Class 55 or F1941 or F2329 | FNX24b |
| h5 | 14 | 7/8" Dia. UNC Heavy Hex Nut | ASTM A563DH or ASTM A194 Gr. 2H | ASTM A153 for Class C or ASTM B695 for Class 50 | FNX22b |
| k1 | - | Hilti HIT RE-500 V3 Epoxy Adhesive | Class C, C881 | - | - |
| k2 | - | SpecChem 500 Epoxy Filler | ASTM C881 Type IV, Grade I, Class C | - | - |



Midwest Roadside
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| REV. | DATE OF ISSUE | Page | NATURE OF CHANGES | REVIEWER | REVISED BY |
|------|---------------|------|---|----------|------------|
| 0 | 10/9/2020 | - | Created from HMDBR portion of HMDT-HMDBR_R11. | - | LJP |
| 1 | 10/14/2020 | 2 | Removed washers (g1) from rail splice. Changed underground components to dashed lines. | MP | LJP |
| | | 3 | New sheet showing rail splice details. | | |
| | | 5-7 | Added note 1 specifying bar d2 lap length. | | |
| | | 8-9 | Called out nut/bolt in rail-endshoe splice. | | |
| | | BOM | Added lap length to d2 description. | | |
| 2 | 10/19/2020 | 4 | Edited weld symbol for Bridge Rail post assembly. | MP | CJN |
| | | 16 | Added note regarding galvanized components. | | |
| | | BOM | Added Epoxy Adhesive | | |
| 3 | 10/28/2020 | 1 | Edited note 5, added note 6. | MP | LJP |
| | | BOM | Edited note 1, added * note. Edited concrete mix. | | |
| 4 | 11/4/2020 | 1 | Edited note 5. | MP | LJP |
| | | 2 | Edited note 1. Added note 7. | | |
| | | 8 | Added 1" in length to bars d1 and d3. | | |
| 5 | 11/30/2020 | 4 | Added all around to weld note. Added plan view showing post location on base plate. | JCH | LJP |
| 6 | 12/15/2020 | 2 | Added note 2. Edited note 7. Deleted old note 4. | JCH | LJP |
| | | 9 | Edited note 1. | | |
| | | 10 | Edited note 1. | | |
| | | BOM | Added line for epoxy filler and updated concrete material spec. | | |
| 7 | 1/13/2021 | 1 | Changed Location of Test nos 2 and 3. Updated note to reflect change in location. Removed Note 6. | MP | SBW |
| 8 | 3/10/2021 | - | Flipped system. Fixed issue where some hardware part nos. had changed in previous version. | JCH | LJP |
| 9 | 8/20/2021 | BOM | Changed Part h3 description to "1 1/4"-7 UNC" | MP | GHR |