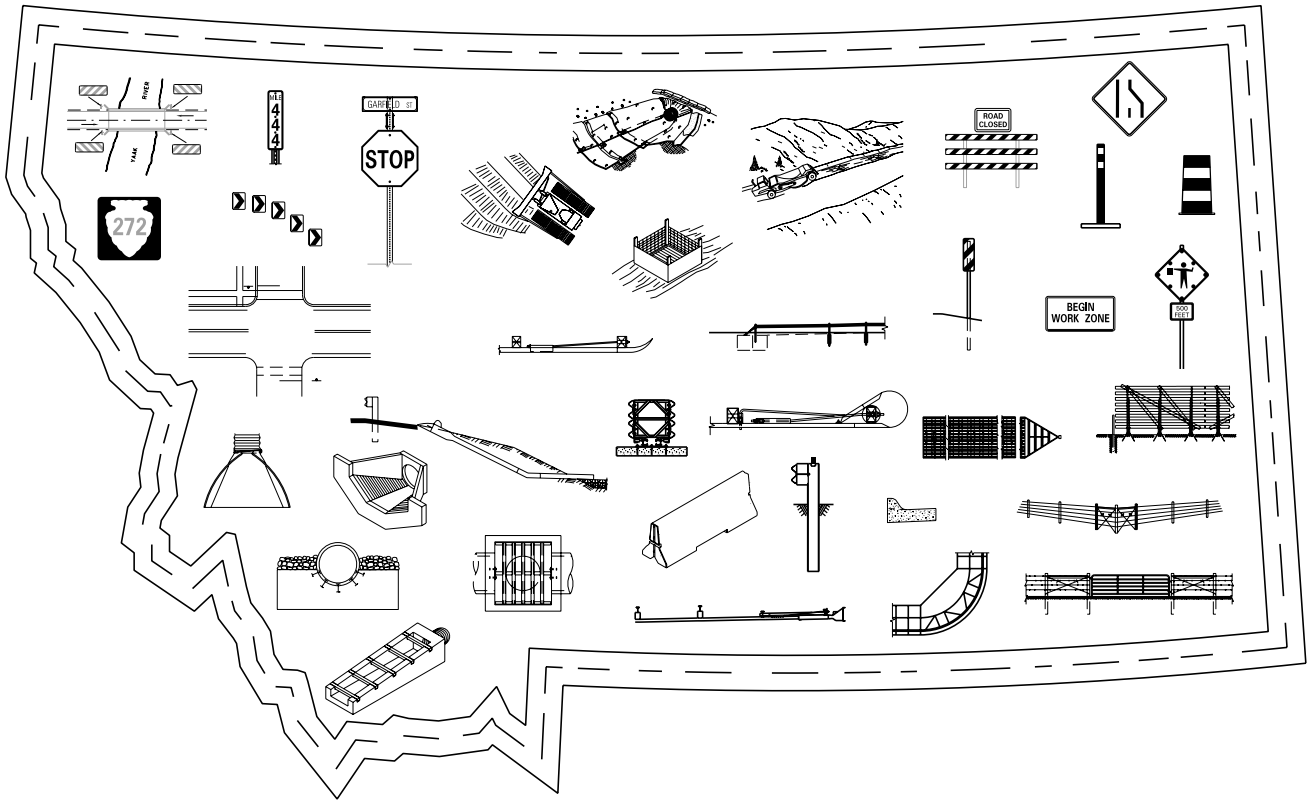
# DETAILED DRAWINGS

SUPPLEMENTAL TO
THE STANDARD
SPECIFICATIONS FOR
ROAD AND BRIDGE
CONSTRUCTION




SUPPLEMENT TO THE SEPTEMBER 2014 EDITION
EFFECTIVE: JANUARY 2018

MDT *MONTANA DEPARTMENT OF TRANSPORTATION*

# *DETAILED DRAWINGS*

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**EFFECTIVE: JANUARY 2018**

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| STANDARD SPECIFICATION SECTION AND DRAWING TITLE | DRAWING NUMBER |
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## SECTION 607: FENCES



## SECTION 608: CONCRETE SIDEWALKS



## SECTION 609: CURBS AND GUTTERS



## SECTION 610: ROADSIDE RE–VEGETATION



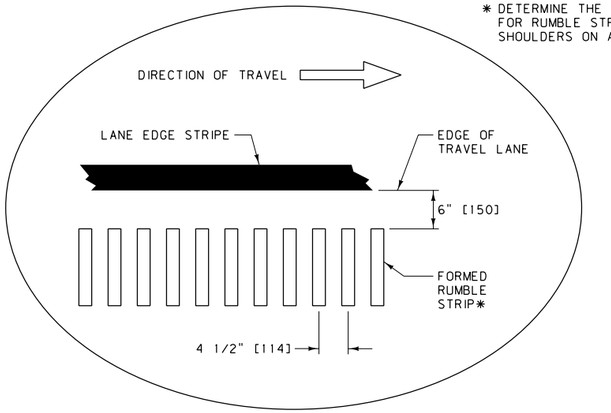
## SECTION 611: CATTLE GUARDS



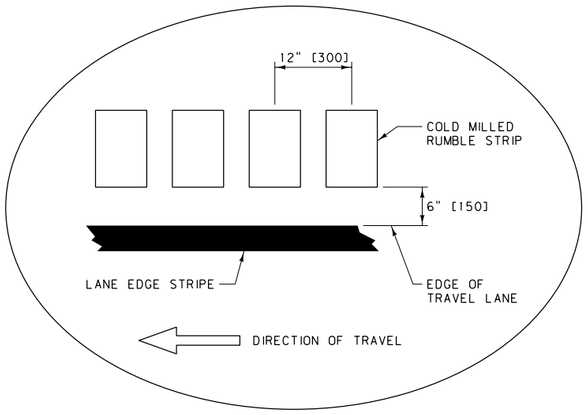
## SECTION 613: RIPRAP AND SLOPE AND BANK PROTECTION

| STANDARD SPECIFICATION SECTION AND DRAWING TITLE | DRAWING NUMBER |
|---|---|

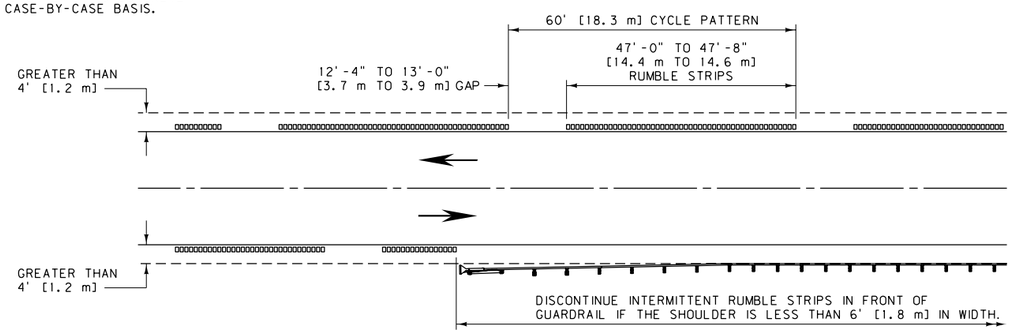
* DETERMINE THE METHOD OF INSTALLATION FOR RUMBLE STRIPS ON EXISTING CONCRETE SHOULDERS ON A CASE-BY-CASE BASIS.



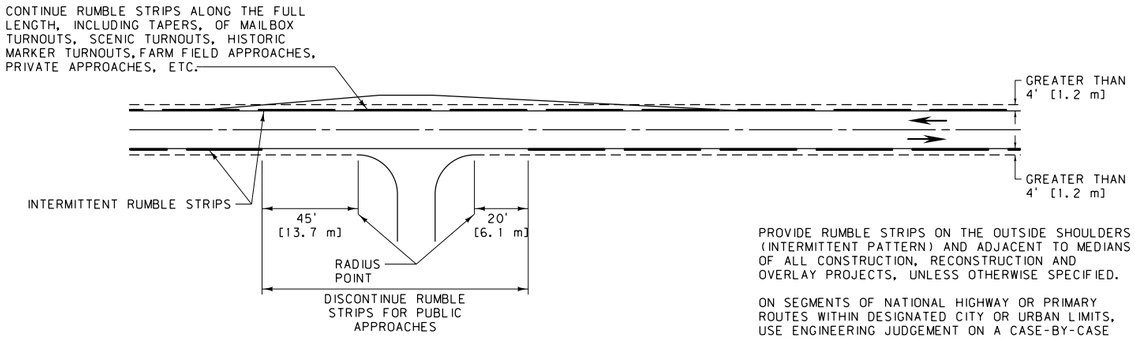

TYPICAL SHOULDER INSTALLATION
(CONCRETE PAVEMENT)




TYPICAL SHOULDER INSTALLATION
(ASPHALT PAVEMENT)



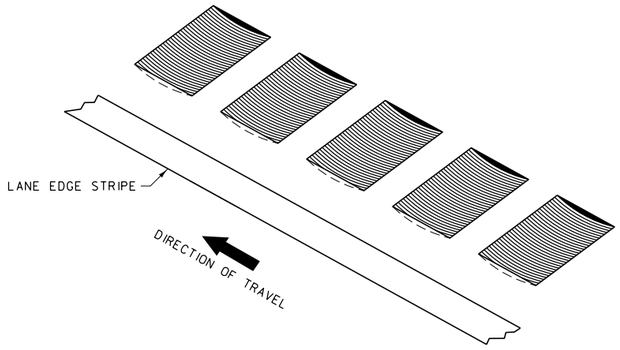

INTERMITTENT RUMBLE STRIP SPACING



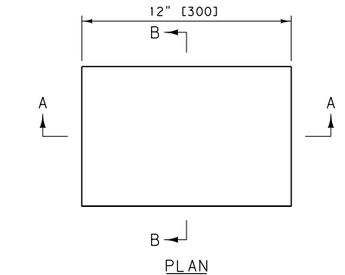

TYPICAL APPLICATION

PROVIDE RUMBLE STRIPS ON THE OUTSIDE SHOULDERS (INTERMITTENT PATTERN) AND ADJACENT TO MEDIANS OF ALL CONSTRUCTION, RECONSTRUCTION AND OVERLAY PROJECTS, UNLESS OTHERWISE SPECIFIED.

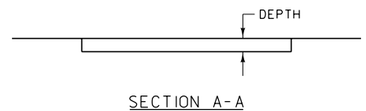
ON SEGMENTS OF NATIONAL HIGHWAY OR PRIMARY ROUTES WITHIN DESIGNATED CITY OR URBAN LIMITS, USE ENGINEERING JUDGEMENT ON A CASE-BY-CASE BASIS TO DETERMINE IF RUMBLE STRIP INSTALLATION IS APPROPRIATE.



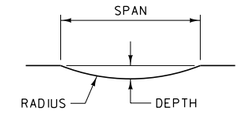

ISOMETRIC VIEW




PLAN




SECTION A-A

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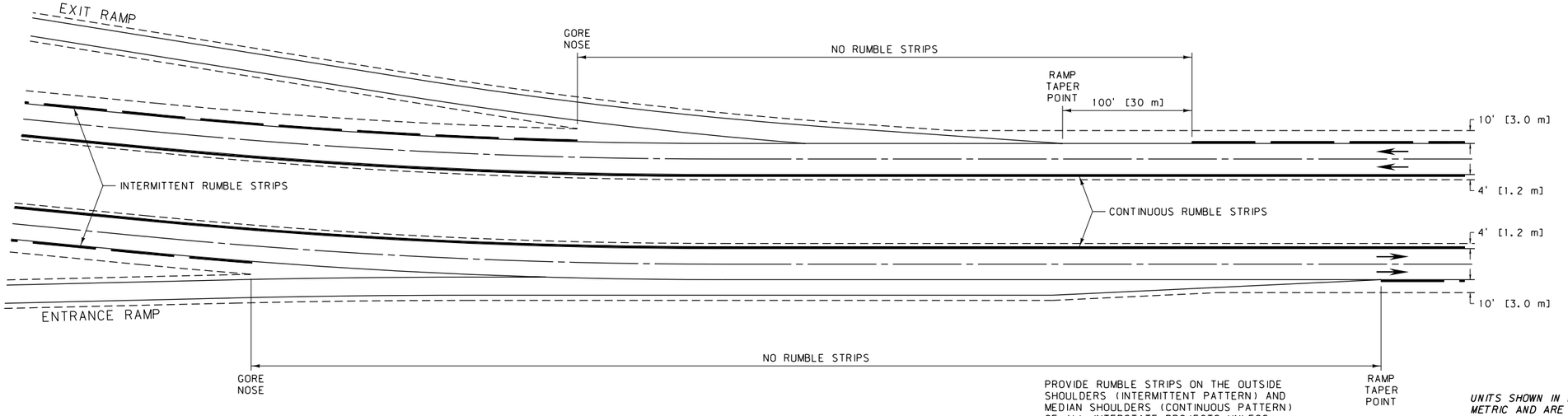



INTERSTATE APPLICATION

PROVIDE RUMBLE STRIPS ON THE OUTSIDE SHOULDERS (INTERMITTENT PATTERN) AND MEDIAN SHOULDERS (CONTINUOUS PATTERN) OF ALL INTERSTATE PROJECTS UNLESS OTHERWISE SPECIFIED.

DISCONTINUE RUMBLE STRIPS IN FRONT OF EXIT AND ENTRANCE RAMPS.

| | DEPTH | RADIUS | SPAN |
|---|---|---|---|
| CONCRETE | 1" | 1" | 2" |
| ASPHALT | 1/2" TO 3/4" | 12" MAX. | 6 7/8" TO 8 3/8" |

| | DEPTH (mm) | RADIUS (mm) | SPAN (mm) |
|---|---|---|---|
| CONCRETE | 25 | 25 | 50 |
| ASPHALT | 13 TO 19 | 300 MAX. | 175 TO 200 |

RUMBLE STRIP DETAIL

NOTE:

DO NOT INSTALL RUMBLE STRIPS OVER CONCRETE BRIDGE DECKS OR WHERE OBSTACLES, SUCH AS CONCRETE BARRIER RAIL, PREVENT PROPER PLACEMENT.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 411

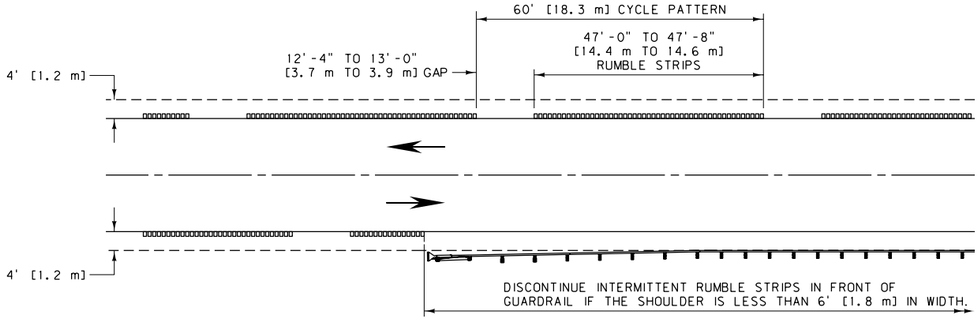
DWG. NO. 411-02

# SHOULDER RUMBLE STRIPS

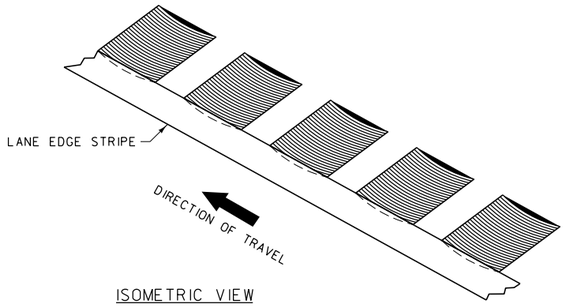
--REVISED--
JANUARY 2018

EFFECTIVE: SEPTEMBER 2014

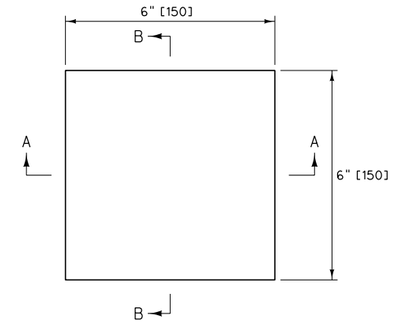
MDT MONTANA DEPARTMENT OF TRANSPORTATION



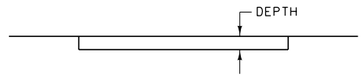

INTERMITTENT RUMBLE STRIP SPACING



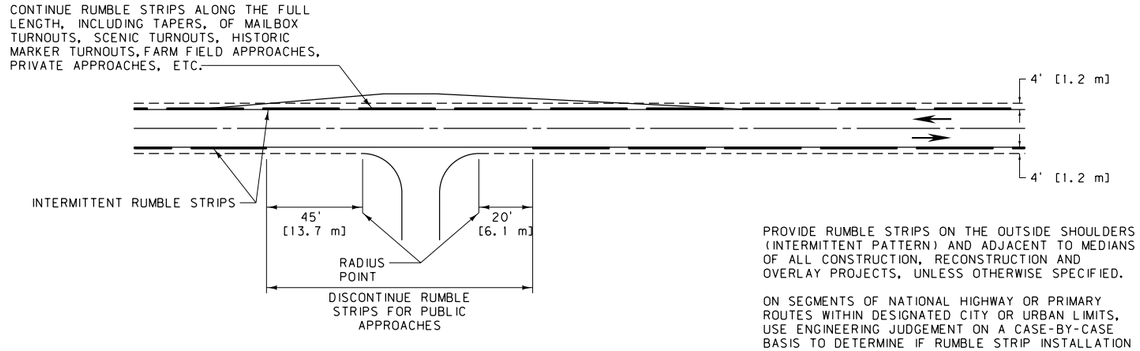

ISOMETRIC VIEW




PLAN



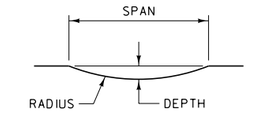

SECTION A-A




TYPICAL APPLICATION

PROVIDE RUMBLE STRIPS ON THE OUTSIDE SHOULDERS (INTERMITTENT PATTERN) AND ADJACENT TO MEDIANS OF ALL CONSTRUCTION, RECONSTRUCTION AND OVERLAY PROJECTS, UNLESS OTHERWISE SPECIFIED.

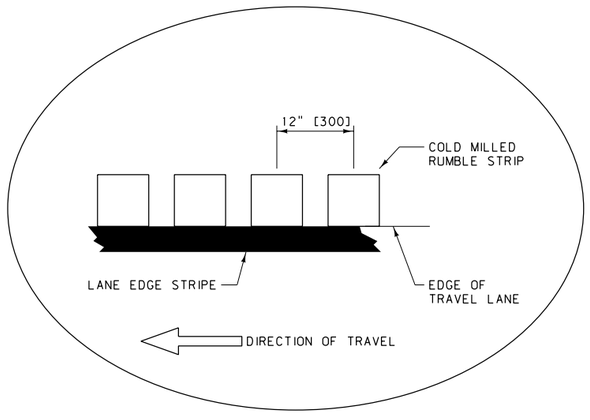
ON SEGMENTS OF NATIONAL HIGHWAY OR PRIMARY ROUTES WITHIN DESIGNATED CITY OR URBAN LIMITS, USE ENGINEERING JUDGEMENT ON A CASE-BY-CASE BASIS TO DETERMINE IF RUMBLE STRIP INSTALLATION IS APPROPRIATE.




SECTION B-B

| | DEPTH | RADIUS | SPAN |
|---|---|---|---|
| ASPHALT | 1/2" TO 3/4" | 12" MAX. | 6 7/8" TO 8 3/8" |

| | DEPTH (mm) | RADIUS (mm) | SPAN (mm) |
|---|---|---|---|
| ASPHALT | 13 TO 19 | 300 MAX. | 175 TO 200 |




TYPICAL SHOULDER INSTALLATION
(ASPHALT PAVEMENT)

RUMBLE STRIP DETAIL

NOTE:

1. DO NOT INSTALL RUMBLE STRIPS OVER CONCRETE BRIDGE DECKS OR WHERE OBSTACLES, SUCH AS CONCRETE BARRIER RAIL, PREVENT PROPER PLACEMENT.

2. INSTALLATION ON SHOULDERS LESS THAN 4-FT [1.2 m] WILL BE DECIDED ON A CASE-BY-CASE BASIS.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

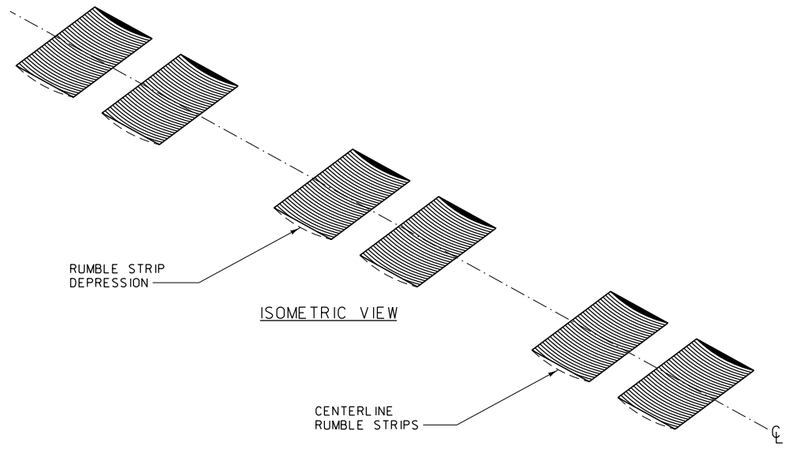
REFERENCE STANDARD SPEC. SECTION 411

DWG. NO. 411-03

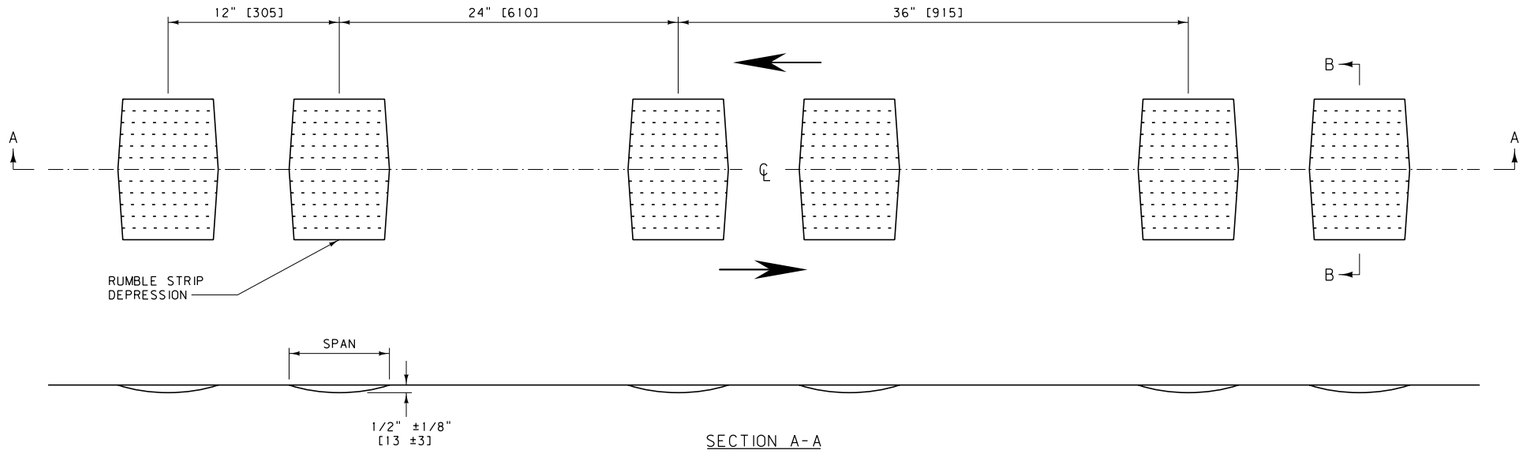
MODIFIED SHOULDER RUMBLE STRIPS

EFFECTIVE: JANUARY 2018

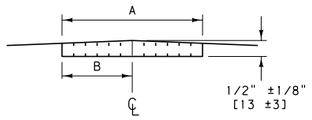
MDT MONTANA DEPARTMENT OF TRANSPORTATION




ISOMETRIC VIEW



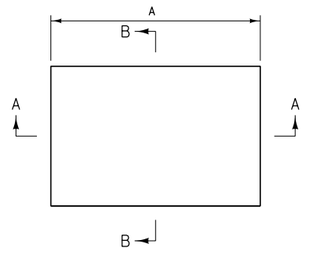

SECTION A-A



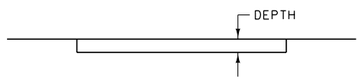

SECTION B-B

| ENGLISH DIMENSIONS | | | |
|---|---|---|---|
| TYPE | | INCHES | |
| | | A | B |
| 1 | NO SHOULDER | 6 | 3 |
| 2 | ≤ 2.0' SHOULDER | 8 | 4 |
| 3 | > 2.0' SHOULDER | 12 | 6 |

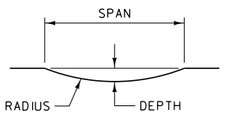
| METRIC DIMENSIONS | | | |
|---|---|---|---|
| TYPE | | mm | |
| | | A | B |
| 1 | NO SHOULDER | 150 | 75 |
| 2 | ≤ 0.6 m SHOULDER | 200 | 100 |
| 3 | > 0.6 m SHOULDER | 300 | 150 |




PLAN




SECTION A-A

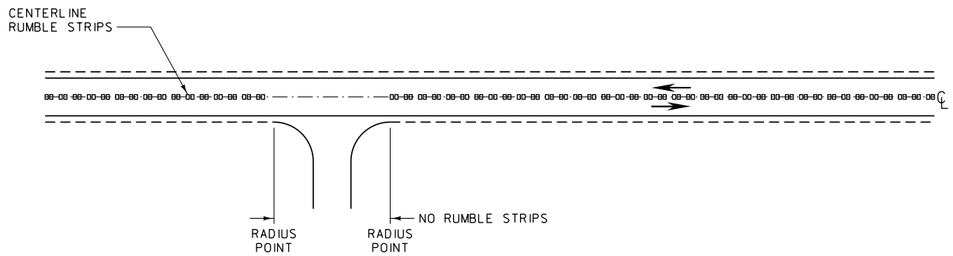



SECTION B-B

| | DEPTH | SPAN |
|---|---|---|
| ASPHALT | 1/2" ±1/8" | 6" TO 7" |

| | DEPTH (mm) | SPAN (mm) |
|---|---|---|
| ASPHALT | 13 ±3 | 150 TO 175 |

RUMBLE STRIP DETAIL




PUBLIC APPROACH②

NOTES:

① ROUTES WITHIN DESIGNATED CITY OR URBAN LIMITS, USE ENGINEERING JUDGEMENT ON A CASE-BY-CASE BASIS TO DETERMINE IF CENERLINE RUMBLE STRIP INSTALLATION IS APPROPRIATE.

② BREAK CENTERLINE RUMBLE STRIPS FOR PUBLIC APPROACHES ONLY.

③ CONSIDER REMILLING EXISTING CENTERLINE RUMBLE STRIPS PRIOR TO A SECOND SEAL AND COVER APPLICATION.

④ DO NOT INSTALL CENTERLINE RUMBLE STRIPS ON CONCRETE BRIDGE DECKS.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 411

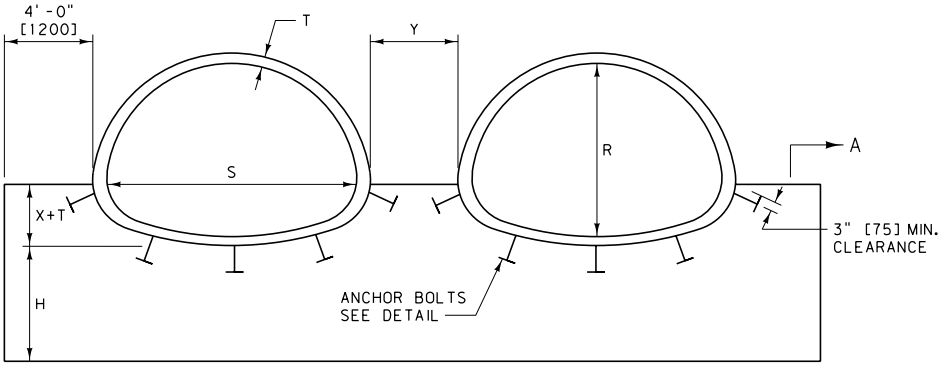
DWG. NO. 411-05

CENTERLINE RUMBLE STRIPS

--REVISED--
JANUARY 2018

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION




## MULTIPLE ARCH CULVERTS

(METAL CULVERTS SHOWN)

X: VARIABLE. FOR METAL CULV. SEE DTL. DWG. 603-32 (CIRCULAR) OR 603-34 (ARCH), AND FOR CONCRETE CULV. WITH FETS SEE DTL. DWG. 603-08 (ROUND) OR 603-10 (ARCH), AND FOR CONCRETE CULV. WITH SQUARE ENDS, THE "X" DIMENSIONS IS D/4 OR R/3

Y: FOR METAL CULV. AND CULV. WITHOUT FETS: Y = 4'-0" [1200] (OUTSIDE WALL TO OUTSIDE WALL)

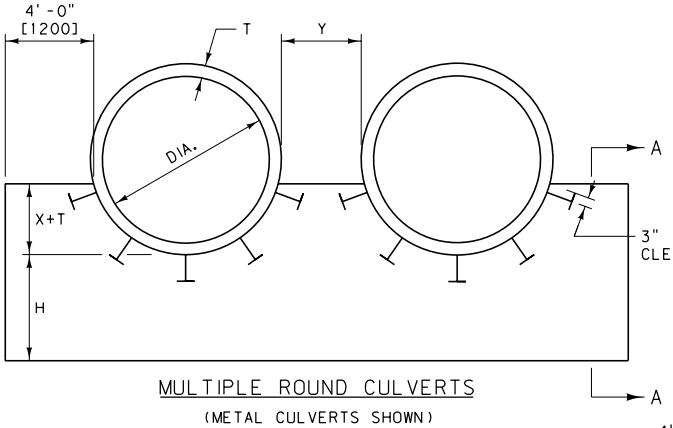
FOR CONCRETE CULV. WITH FETS: USE Y AS REQUIRED FOR PARALLEL PIPE INSTALLATION, PER DTL. DWG. NO. 613-08

NOTE: Y MAY BE INCREASED ON LARGE DIAMETER PIPES (UP TO A MAX. OF 8'-0" [2400]) TO AID IN INSTALLATION AND BACKFILL. THE QUANTITIES SHOWN IN 552-04, 06 & 08 WERE FIGURED USING Y = 4'-0" [1200]. ADJUST QUANTITIES AS NEEDED WHEN Y IS OTHER THAN 4'-0" [1200].

H: 3'-0" [900] MIN. OR 1'-0" [300] BELOW BOTTOM OF FOUNDATION MATERIAL IF SPECIFIED.

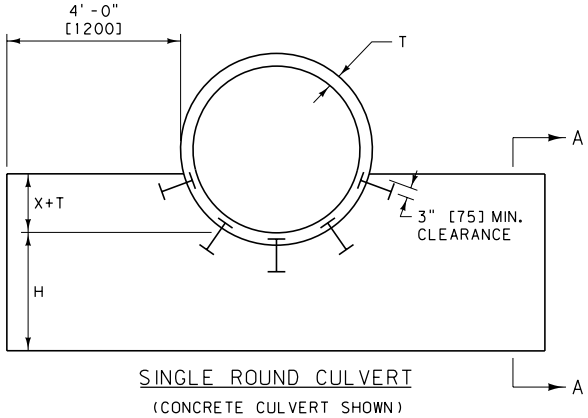
T: CULVERT WALL THICKNESS FOR CONCRETE OR CORRUGATION DEPTH FOR METAL.

S: INSIDE PIPE SPAN



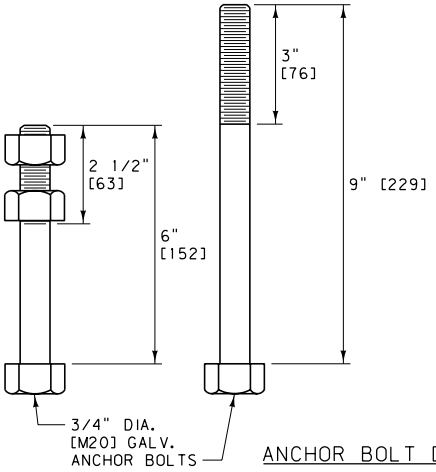

## MULTIPLE ROUND CULVERTS

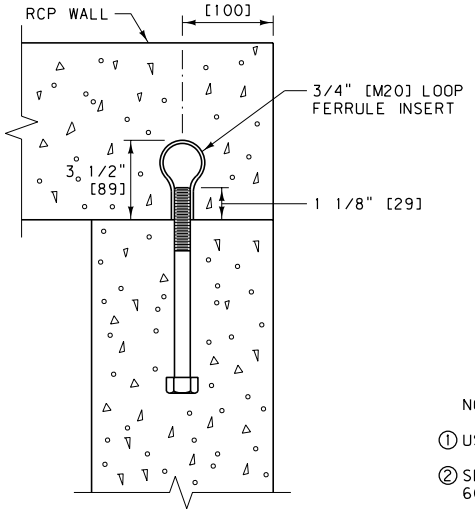
(METAL CULVERTS SHOWN)

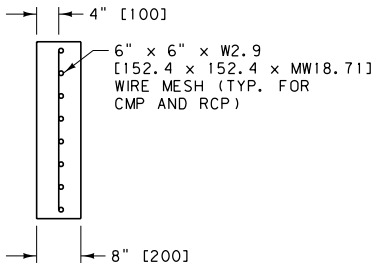



## SINGLE ROUND CULVERT

(CONCRETE CULVERT SHOWN)




## SECTION A-A

## ANCHOR BOLT DETAILS

6" [152] LONG FOR METAL PIPE
9" [229] LONG FOR CONCRETE PIPE

ANCHOR BOLT SPACING:
MIN. OF FIVE 3/4" DIA. [M20] GALV. ANCHOR BOLTS IN WALL. USE MAX. SPACING OF 1.5' [455].

REINFORCING STEEL:
USE REBAR DOWELS MEETING THE REQUIREMENTS OF AASHTO M 31 GRADE 60 (GRADE 420).

EPOXY RESIN BONDING ADHESIVE:
MEET THE REQUIREMENTS OF AASHTO M 235 TYPE 4.

NOTES:

① USE CLASS GENERAL CONCRETE OR EQUAL.

② SEE DTL. DWG. NO. 603-18 AND 603-19 FOR BEDDING UNDER CULVERTS.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 552, 603, 613

DWG. NO. 552-00

# CONCRETE CUTOFF WALLS FOR CULVERTS

--REVISED--
JANUARY 2018

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

## CULVERT INSTALLATION QUANTITIES

| DIAMETER OR SPAN x RISE | CUBIC YARDS OF CLASS GENERAL CONCRETE (EACH END) | | | | | | | | CUBIC YARDS OF RIPRAP (EACH END) ① (DTL. DWG. NO. 613-14) | | CUBIC YARDS GRANULAR BEDDING MATERIAL PER FOOT OF PIPE (DTL. DWG. NO. 603-19) ② | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CUTOFF WALL (DTL. DWG. NO. 552-00) | | | | | | CONCRETE EDGE PROTECTION (DTL. DWG. NO. 613-08) | | | | | |
| | H=3ft | | H=4ft | | H=5ft | | 2:1 | | 2:1 | | | |
| | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. |
| RCP (SQ. END) | | | | | | | | | | | | |
| 54" | 1.4 | 2.3 | 1.7 | 2.9 | 2.0 | 3.4 | 2.7 | 4.0 | 11.3 | 18.2 | 0.7 | 1.4 |
| 60" | 1.5 | 2.5 | 1.8 | 3.1 | 2.2 | 3.7 | 3.0 | 4.4 | 12.2 | 19.7 | 0.8 | 1.5 |
| 66" | 1.6 | 2.6 | 1.9 | 3.3 | 2.3 | 3.9 | 3.2 | 4.8 | 13.1 | 21.3 | 0.8 | 1.7 |
| 72" | 1.7 | 2.8 | 2.0 | 3.5 | 2.4 | 4.1 | 3.5 | 5.2 | 14.0 | 22.8 | 0.9 | 1.8 |
| 78" | 1.8 | 3.0 | 2.1 | 3.7 | 2.5 | 4.4 | 3.8 | 5.6 | 14.9 | 24.3 | 1.0 | 2.0 |
| 84" | 1.9 | 3.2 | 2.3 | 3.9 | 2.7 | 4.6 | 4.0 | 6.0 | 15.8 | 25.9 | 1.1 | 2.1 |
| 90" | 2.0 | 3.4 | 2.4 | 4.1 | 2.8 | 4.8 | 4.3 | 6.4 | 16.8 | 27.5 | 1.2 | 2.3 |
| 96" | 2.1 | 3.6 | 2.5 | 4.3 | 2.9 | 5.1 | 4.6 | 6.9 | 17.7 | 29.1 | 1.2 | 2.5 |
| RCPA (SQ. END) | | | | | | | | | | | | |
| 65.00" x 40.00" | 1.4 | 2.4 | 1.8 | 3.0 | 2.1 | 3.6 | 2.3 | 3.5 | 10.1 | 16.6 | 0.7 | 1.4 |
| 73.00" x 45.00" | 1.5 | 2.6 | 1.9 | 3.2 | 2.3 | 3.8 | 2.5 | 3.8 | 11.0 | 18.1 | 0.7 | 1.5 |
| 88.00" x 54.00" | 1.7 | 2.9 | 2.1 | 3.6 | 2.5 | 4.3 | 3.0 | 4.6 | 12.6 | 20.9 | 0.9 | 1.8 |
| 102.00" x 62.00" | 1.9 | 3.2 | 2.3 | 4.0 | 2.8 | 4.8 | 3.4 | 5.2 | 14.1 | 23.7 | 1.0 | 2.0 |
| 115.00" x 72.00" | 2.1 | 3.5 | 2.5 | 4.4 | 3.0 | 5.2 | 3.8 | 5.9 | 15.7 | 26.4 | 1.1 | 2.2 |
| 122.00" x 77.25" | 2.2 | 3.7 | 2.6 | 4.6 | 3.1 | 5.5 | 4.1 | 6.4 | 16.6 | 28.1 | 1.2 | 2.4 |
| 138.00" x 87.13" | 2.4 | 4.1 | 2.9 | 5.0 | 3.4 | 6.0 | 4.6 | 7.3 | 18.6 | 31.6 | 1.3 | 2.7 |
| 154.00" x 95.88" | 2.6 | 4.5 | 3.1 | 5.5 | 3.7 | 6.5 | 5.2 | 8.2 | 20.7 | 35.3 | 1.5 | 3.0 |
| 168.75" x 106.50" | 2.7 | 4.7 | 3.3 | 5.8 | 3.9 | 6.9 | 5.6 | 8.9 | 22.2 | 38.0 | 1.6 | 3.2 |

## CULVERT INSTALLATION QUANTITIES

| DIAMETER OR SPAN x RISE (mm) | CUBIC METERS OF CLASS GENERAL CONCRETE (EACH END) | | | | | | | | CUBIC METERS OF RIPRAP (EACH END) ① (DTL. DWG. NO. 613-14) | | CUBIC METERS GRANULAR BEDDING MATERIAL PER METER OF PIPE (DTL. DWG. NO. 603-19) ② | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CUTOFF WALL (DTL. DWG. NO. 552-00) | | | | | | CONCRETE EDGE PROTECTION (DTL. DWG. NO. 613-08) | | | | | |
| | H=915 mm | | H=1220 mm | | H=1525 mm | | 2:1 | | 2:1 | | | |
| | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. |
| RCP (SQ. END) | | | | | | | | | | | | |
| 1350 | 1.1 | 1.8 | 1.3 | 2.2 | 1.5 | 2.6 | 2.1 | 3.1 | 8.6 | 13.9 | 1.8 | 3.5 |
| 1500 | 1.1 | 1.9 | 1.4 | 2.4 | 1.7 | 2.8 | 2.3 | 3.4 | 9.3 | 15.1 | 2.0 | 3.8 |
| 1650 | 1.2 | 2.0 | 1.5 | 2.5 | 1.8 | 3.0 | 2.4 | 3.7 | 10.0 | 16.3 | 2.0 | 4.3 |
| 1800 | 1.3 | 2.1 | 1.5 | 2.7 | 1.8 | 3.1 | 2.7 | 4.0 | 10.7 | 17.4 | 2.3 | 4.5 |
| 1950 | 1.4 | 2.3 | 1.6 | 2.8 | 1.9 | 3.4 | 2.9 | 4.3 | 11.4 | 18.6 | 2.5 | 5.0 |
| 2100 | 1.5 | 2.4 | 1.8 | 3.0 | 2.1 | 3.5 | 3.1 | 4.6 | 12.1 | 19.8 | 2.8 | 5.3 |
| 2250 | 1.5 | 2.6 | 1.8 | 3.1 | 2.1 | 3.7 | 3.3 | 4.9 | 12.8 | 21.0 | 3.0 | 5.8 |
| 2400 | 1.6 | 2.8 | 1.9 | 3.3 | 2.2 | 3.9 | 3.5 | 5.3 | 13.5 | 22.2 | 3.0 | 6.3 |
| RCPA (SQ. END) | | | | | | | | | | | | |
| 1650 x 1015 | 1.1 | 1.8 | 1.4 | 2.3 | 1.6 | 2.8 | 1.8 | 2.7 | 7.7 | 12.7 | 1.8 | 3.5 |
| 1895 x 1145 | 1.1 | 2.0 | 1.5 | 2.4 | 1.8 | 2.9 | 1.9 | 2.9 | 8.4 | 13.8 | 1.8 | 3.8 |
| 2235 x 1370 | 1.3 | 2.2 | 1.6 | 2.8 | 1.9 | 3.3 | 2.3 | 3.5 | 9.6 | 16.0 | 2.3 | 4.5 |
| 2590 x 1575 | 1.5 | 2.4 | 1.8 | 3.1 | 2.1 | 3.7 | 2.6 | 4.0 | 10.8 | 18.1 | 2.5 | 5.0 |
| 2920 x 1830 | 1.6 | 2.7 | 1.9 | 3.4 | 2.3 | 4.0 | 2.9 | 4.5 | 12.0 | 20.2 | 2.8 | 5.5 |
| 3100 x 1960 | 1.7 | 2.8 | 2.0 | 3.5 | 2.4 | 4.2 | 3.1 | 4.9 | 12.7 | 21.5 | 3.0 | 6.0 |
| 3505 x 2215 | 1.8 | 3.1 | 2.2 | 3.8 | 2.6 | 4.6 | 3.5 | 5.6 | 14.2 | 24.2 | 3.3 | 6.8 |
| 3910 x 2460 | 2.0 | 3.4 | 2.4 | 4.2 | 2.8 | 5.0 | 4.0 | 6.3 | 15.8 | 27.0 | 3.8 | 7.5 |
| 4285 x 2705 | 2.1 | 3.6 | 2.5 | 4.4 | 3.0 | 5.3 | 4.3 | 6.8 | 17.0 | 29.1 | 4.0 | 8.0 |

| DIAMETER OR SPAN x RISE | CUBIC YARDS OF CLASS GENERAL CONCRETE (EACH END) | | | | | | | | CUBIC YARDS OF RIPRAP (EACH END) ① (DTL. DWG. NO. 613-14) | | CUBIC YARDS GRANULAR BEDDING MATERIAL PER FOOT OF PIPE (DTL. DWG. NO. 603-19) ② | | SLOPE ③ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CUTOFF WALL (DTL. DWG. NO. 552-00) | | | | | | CONCRETE EDGE PROTECTION (DTL. DWG. NO. 613-08) | | | | | | |
| | H=3ft | | H=4ft | | H=5ft | | | | | | | | |
| | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | |
| RCP (FETS) | | | | | | | | | | | | | |
| 54" | 1.8 | 3.0 | 2.2 | 3.7 | 2.6 | 4.4 | 3.0 | 4.7 | 10.1 | 17.0 | 0.7 | 1.4 | 2.0:1 |
| 60" | 2.0 | 3.3 | 2.4 | 4.0 | 2.8 | 4.8 | 2.6 | 4.2 | 10.6 | 18.0 | 0.8 | 1.5 | 1.9:1 |
| 66" | 1.9 | 3.2 | 2.3 | 3.9 | 2.7 | 4.7 | 2.9 | 4.6 | 12.0 | 20.3 | 0.8 | 1.7 | 1.7:1 |
| 72" | 2.0 | 3.4 | 2.5 | 4.2 | 2.9 | 5.0 | 3.1 | 4.9 | 13.0 | 22.1 | 0.9 | 1.8 | 1.9:1 |
| 78" | 2.1 | 3.5 | 2.5 | 4.3 | 3.0 | 5.2 | 3.4 | 5.5 | 14.2 | 24.2 | 1.0 | 2.0 | 1.8:1 |
| 84" | 2.1 | 3.6 | 2.6 | 4.4 | 3.1 | 5.3 | 3.5 | 5.6 | 14.0 | 23.9 | 1.1 | 2.1 | 1.5:1 |
| 90" | 2.5 | 4.2 | 3.0 | 5.2 | 3.5 | 6.2 | 3.9 | 6.4 | 15.8 | 27.5 | 1.2 | 2.3 | 1.5:1 |
| RCPA (FETS) | | | | | | | | | | | | | |
| 65.00" x 40.00" | 1.7 | 2.9 | 2.1 | 3.6 | 2.6 | 4.4 | 2.8 | 4.5 | 14.4 | 24.5 | 0.7 | 1.4 | 3.0:1 |
| 73.00" x 45.00" | 1.9 | 3.2 | 2.3 | 3.9 | 2.7 | 4.7 | 2.8 | 4.5 | 14.7 | 25.2 | 0.7 | 1.5 | 3.0:1 |
| 88.00" x 54.00" | 2.1 | 3.5 | 2.6 | 4.4 | 3.0 | 5.2 | 2.8 | 4.5 | 12.7 | 21.9 | 0.9 | 1.8 | 2.0:1 |
| 102.00" x 62.00" | 2.1 | 3.7 | 2.6 | 4.6 | 3.2 | 5.6 | 3.7 | 6.0 | 15.5 | 26.9 | 1.0 | 2.0 | 2.0:1 |

| DIAMETER OR SPAN x RISE (mm) | CUBIC METERS OF CLASS GENERAL CONCRETE (EACH END) | | | | | | | | CUBIC METERS OF RIPRAP (EACH END) ① (DTL. DWG. NO. 613-14) | | CUBIC METERS GRANULAR BEDDING MATERIAL PER METER OF PIPE (DTL. DWG. NO. 603-19) ② | | SLOPE ③ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CUTOFF WALL (DTL. DWG. NO. 552-00) | | | | | | CONCRETE EDGE PROTECTION (DTL. DWG. NO. 613-08) | | | | | | |
| | H=915 mm | | H=1220 mm | | H=1525 mm | | | | | | | | |
| | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | |
| RCP (FETS) | | | | | | | | | | | | | |
| 1350 | 1.4 | 2.3 | 1.7 | 2.8 | 2.0 | 3.4 | 2.3 | 3.6 | 7.7 | 13.0 | 1.8 | 3.5 | 2.0:1 |
| 1500 | 1.5 | 2.5 | 1.8 | 3.1 | 2.1 | 3.7 | 2.0 | 3.2 | 8.1 | 13.8 | 2.0 | 3.8 | 1.9:1 |
| 1650 | 1.5 | 2.4 | 1.8 | 3.0 | 2.1 | 3.6 | 2.2 | 3.5 | 9.2 | 15.5 | 2.0 | 4.3 | 1.7:1 |
| 1800 | 1.5 | 2.6 | 1.9 | 3.2 | 2.2 | 3.8 | 2.4 | 3.7 | 9.9 | 16.9 | 2.3 | 4.5 | 1.9:1 |
| 1950 | 1.6 | 2.7 | 1.9 | 3.3 | 2.3 | 4.0 | 2.6 | 4.2 | 10.9 | 18.5 | 2.5 | 5.0 | 1.8:1 |
| 2100 | 1.6 | 2.8 | 2.0 | 3.4 | 2.4 | 4.1 | 2.7 | 4.3 | 10.7 | 18.3 | 2.8 | 5.3 | 1.5:1 |
| 2250 | 1.9 | 3.2 | 2.3 | 4.0 | 2.7 | 4.7 | 3.0 | 4.9 | 12.1 | 21.0 | 3.0 | 5.8 | 1.5:1 |
| RCPA (FETS) | | | | | | | | | | | | | |
| 1650 x 1015 | 1.3 | 2.2 | 1.6 | 2.8 | 2.0 | 3.4 | 2.1 | 3.4 | 11.0 | 18.7 | 1.8 | 3.5 | 3.0:1 |
| 1895 x 1145 | 1.5 | 2.4 | 1.8 | 3.0 | 2.1 | 3.6 | 2.1 | 3.4 | 11.2 | 19.3 | 1.8 | 3.8 | 3.0:1 |
| 2235 x 1370 | 1.6 | 2.7 | 2.0 | 3.4 | 2.3 | 4.0 | 2.1 | 3.4 | 9.7 | 16.7 | 2.3 | 4.5 | 2.0:1 |
| 2590 x 1575 | 1.6 | 2.8 | 2.0 | 3.5 | 2.4 | 4.3 | 2.8 | 4.6 | 11.9 | 20.6 | 2.5 | 5.0 | 2.0:1 |

NOTES:

① CULVERT RIPRAP IS USED ONLY IN SPECIAL CICRUMSTANCE. QUANTITIES ARE BASED ON A THICKNESS OF 2 FT. [600]AND ARE PROPORTIONED WHEN A DIFFERENT THICKNESS IS SPECIFIED.

② GRANULAR BEDDING QUANTITIES FOR CONCRETE PIPES ARE BASED ON BEDDING DETAILS SHOWN ON DTL. DWG. NO. 603-19 WITH A WIDTH EQUAL TO (DIAMETER OR SPAN) + 4 FT. [1200]+ (2 TIMES CONCRETE SHELL THICKNESS) AND A DEPTH EQUAL TO 1 FT. [300] + (D/4 OR R/3) + (CONCRETE SHELL THICKNESS). TO COMPUTE THE TOTAL BEDDING QUANTITY MULTIPLY BY (LENGTH OF PIPE MINUS 1.3 FT. [0.40 m]). EXTEND GRANULAR BEDDING TO BACK OF CUTOFF WALL.

③ FETS, CONCRETE EDGE PROTECTION, AND RIPRAP SLOPE

④ SEE DTL. DWG. NO 603-08 AND 603-10 FOR "X" DIMENSIONS FOR RCP AND RCPA WITH FETS. THE "X" DIMENSION FOR RCP AND RCPA WITH SQUARE ENDS IS D/4 OR R/3.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 552, 603, 613

DWG. NO. 552-04

CONCRETE, RIPRAP AND GRANULAR BEDDING MATERIAL QUANTITIES FOR SING. AND DBL. CULVERT INSTALLATION

--REVISED--
JANUARY 2018

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

## CULVERT INSTALLATION QUANTITIES

| DIAMETER OR SPAN x RISE | CUBIC YARDS OF CLASS GENERAL CONCRETE (EACH END) ④ | | | | | | | | CUBIC YARDS OF RIPRAP (EACH END) ① (DTL. DWG. ④ NO. 613-14) | | CUBIC YARDS GRANULAR BEDDING ② MATERIAL PER FOOT OF PIPE (DTL. DWG. NO. 603-19) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CUTOFF WALL (DTL. DWG. NO. 552-00) | | | | | | CONCRETE EDGE PROTECTION (DTL. DWG. NO. 613-06) | | | | | |
| | H=3ft | | H=4ft | | H=5ft | | 2:1 | | 2:1 | | | |
| | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. |
| SSPPA 6" X 2" CORRUGATIONS 18" CORNER RADIUS | | | | | | | | | | | | |
| 6'-1" x 4'-7" | 1.5 | 2.4 | 1.8 | 3.1 | 2.2 | 3.7 | 2.6 | 3.8 | 10.9 | 17.8 | 0.7 | 1.4 |
| 6'-4" x 4'-9" | 1.5 | 2.5 | 1.9 | 3.1 | 2.2 | 3.8 | 2.6 | 4.0 | 11.2 | 18.4 | 0.7 | 1.5 |
| 6'-9" x 4'-11" | 1.5 | 2.6 | 1.9 | 3.2 | 2.3 | 3.9 | 2.7 | 4.1 | 11.6 | 19.0 | 0.8 | 1.5 |
| 7'-0" x 5' 1" | 1.6 | 2.6 | 1.9 | 3.3 | 2.3 | 4.0 | 2.8 | 4.3 | 11.9 | 19.5 | 0.8 | 1.6 |
| 7'-3" x 5'-3" | 1.6 | 2.7 | 2.0 | 3.4 | 2.4 | 4.0 | 2.9 | 4.4 | 12.2 | 20.1 | 0.8 | 1.6 |
| 7'-8" x 5'5" | 1.6 | 2.8 | 2.0 | 3.5 | 2.4 | 4.2 | 3.0 | 4.6 | 12.6 | 20.7 | 0.8 | 1.7 |
| 7'-11" x 5'-7" | 1.7 | 2.8 | 2.1 | 3.5 | 2.5 | 4.2 | 3.1 | 4.7 | 12.9 | 21.3 | 0.9 | 1.7 |
| 8'-2" x 5'-9" | 1.7 | 2.9 | 2.1 | 3.6 | 2.5 | 4.3 | 3.2 | 4.8 | 13.2 | 21.8 | 0.9 | 1.7 |
| 8'-7" x 5'-11" | 1.8 | 3.0 | 2.2 | 3.7 | 2.6 | 4.5 | 3.3 | 5.0 | 13.6 | 22.5 | 0.9 | 1.8 |
| 8'-10" x 6'-11" | 1.8 | 3.0 | 2.2 | 3.8 | 2.6 | 4.5 | 3.4 | 5.2 | 13.9 | 23.1 | 0.9 | 1.8 |
| 9'-4" x 6'-3" | 1.8 | 3.2 | 2.3 | 3.9 | 2.7 | 4.7 | 3.5 | 5.4 | 14.4 | 24.0 | 1.0 | 2.0 |
| 9'-6" x 6'-5" | 1.9 | 3.2 | 2.3 | 4.0 | 2.7 | 4.8 | 3.5 | 5.5 | 14.6 | 24.4 | 1.0 | 1.9 |
| 9'-9" x 6'-7" | 1.9 | 3.2 | 2.3 | 4.0 | 2.8 | 4.8 | 3.6 | 5.6 | 14.9 | 25.0 | 1.0 | 2.0 |
| 10'-3" x 6'-9" | 2.0 | 3.4 | 2.4 | 4.2 | 2.9 | 5.0 | 3.8 | 5.8 | 15.4 | 25.9 | 1.0 | 2.1 |
| 10'-8" x 6'-11" | 2.0 | 3.5 | 2.5 | 4.3 | 3.0 | 5.2 | 3.9 | 6.0 | 15.8 | 26.6 | 1.1 | 2.2 |
| 10'-11" x 7'-1" | 2.0 | 3.5 | 2.5 | 4.4 | 3.0 | 5.2 | 4.0 | 6.2 | 16.2 | 27.3 | 1.1 | 2.2 |
| 11'-5" x 7'-3" | 2.1 | 3.7 | 2.6 | 4.6 | 3.1 | 5.4 | 4.1 | 6.4 | 16.7 | 28.2 | 1.2 | 2.4 |
| 12'-4" x 7'-9" | 2.2 | 3.9 | 2.7 | 4.8 | 3.2 | 5.7 | 4.4 | 6.9 | 17.8 | 30.2 | 1.2 | 2.5 |
| 12'-6" x 7'-11" | 2.2 | 3.9 | 2.7 | 4.8 | 3.3 | 5.8 | 4.5 | 7.0 | 18.1 | 30.7 | 1.2 | 2.5 |
| 12'-8" x 8'-1" | 2.2 | 3.9 | 2.8 | 4.8 | 3.3 | 5.8 | 4.5 | 7.2 | 18.4 | 31.2 | 1.2 | 2.5 |
| 12'-10" x 8'-4" | 2.3 | 3.9 | 2.8 | 4.9 | 3.3 | 5.8 | 4.7 | 7.3 | 18.7 | 31.8 | 1.2 | 2.5 |
| 13'-5" x 8'-5" | 2.3 | 4.1 | 2.9 | 5.1 | 3.4 | 6.0 | 4.8 | 7.6 | 19.3 | 32.9 | 1.3 | 2.6 |
| 13'-11" x 8'-7" | 2.4 | 4.2 | 3.0 | 5.2 | 3.5 | 6.2 | 4.9 | 7.8 | 19.8 | 33.8 | 1.4 | 2.8 |
| 14'-1" x 8'-9" | 2.4 | 4.3 | 3.0 | 5.3 | 3.5 | 6.3 | 5.0 | 7.9 | 20.1 | 34.4 | 1.4 | 2.8 |
| 14'-3" x 8'-11" | 2.4 | 4.3 | 3.0 | 5.3 | 3.6 | 6.3 | 5.1 | 8.1 | 20.4 | 34.9 | 1.4 | 2.7 |
| 14'-10" x 9'-1" | 2.5 | 4.5 | 3.1 | 5.5 | 3.7 | 6.5 | 5.2 | 8.3 | 21.0 | 36.1 | 1.5 | 2.9 |
| 15'-4" x 9'-2" | 2.6 | 4.6 | 3.2 | 5.7 | 3.8 | 6.8 | 5.3 | 8.5 | 21.5 | 36.9 | 1.5 | 3.1 |
| 15'-6" x 9'-5" | 2.6 | 4.6 | 3.2 | 5.7 | 3.8 | 6.8 | 5.5 | 8.7 | 21.9 | 37.6 | 1.5 | 3.1 |
| 15'-8" x 9'-7" | 2.6 | 4.6 | 3.2 | 5.7 | 3.8 | 6.8 | 5.6 | 8.9 | 22.2 | 38.2 | 1.5 | 3.0 |
| 15'-10" x 9'-9" | 2.6 | 4.6 | 3.2 | 5.7 | 3.8 | 6.8 | 5.6 | 9.0 | 22.5 | 38.7 | 1.5 | 3.0 |
| 16'-5" x 9'-11" | 2.7 | 4.8 | 3.3 | 6.0 | 4.0 | 7.1 | 5.8 | 9.3 | 23.2 | 40.0 | 1.6 | 3.2 |
| 16'-7" x 10'-1" | 2.7 | 4.8 | 3.4 | 6.0 | 4.0 | 7.1 | 5.9 | 9.5 | 23.5 | 40.5 | 1.6 | 3.2 |
| SSPPA 6" X 2" CORRUGATIONS 31" CORNER RADIUS | | | | | | | | | | | | |
| 13'-3" x 9'-4" | 2.4 | 4.3 | 3.0 | 5.2 | 3.5 | 6.2 | 5.0 | 7.9 | 19.9 | 33.8 | 1.4 | 2.9 |
| 13'-6" x 9'-6" | 2.5 | 4.3 | 3.0 | 5.3 | 3.5 | 6.3 | 5.1 | 8.0 | 20.3 | 34.5 | 1.4 | 2.9 |
| 14'-0" x 9'-8" | 2.5 | 4.5 | 3.1 | 5.5 | 3.6 | 6.5 | 5.3 | 8.3 | 20.9 | 35.5 | 1.5 | 3.0 |
| 14'-3" x 9'-10" | 2.6 | 4.5 | 3.1 | 5.5 | 3.7 | 6.5 | 5.4 | 8.5 | 21.3 | 36.2 | 1.5 | 3.0 |
| 14'-5" x 10'-0" | 2.6 | 4.5 | 3.1 | 5.5 | 3.7 | 6.6 | 5.5 | 8.6 | 21.5 | 36.7 | 1.5 | 3.0 |
| 14'-11" x 10'-2" | 2.7 | 4.7 | 3.2 | 5.7 | 3.8 | 6.8 | 5.6 | 8.8 | 22.1 | 37.8 | 1.6 | 3.2 |
| 15'-4" x 10'-4" | 2.7 | 4.8 | 3.3 | 5.9 | 3.9 | 6.9 | 5.7 | 9.0 | 22.5 | 38.5 | 1.7 | 3.3 |
| 15'-7" x 10'-6" | 2.7 | 4.8 | 3.3 | 5.9 | 3.9 | 7.0 | 5.8 | 9.2 | 23.0 | 39.3 | 1.7 | 3.3 |
| 15'-10" x 10'-8" | 2.8 | 4.9 | 3.4 | 6.0 | 4.0 | 7.1 | 5.9 | 9.4 | 23.4 | 40.1 | 1.7 | 3.3 |
| 16'-3" x 10'-10" | 2.8 | 5.0 | 3.4 | 6.1 | 4.1 | 7.2 | 6.0 | 9.6 | 23.8 | 40.8 | 1.7 | 3.5 |
| 16'-6" x 11'-0" | 2.9 | 5.1 | 3.5 | 6.2 | 4.1 | 7.3 | 6.2 | 9.8 | 24.2 | 41.6 | 1.7 | 3.5 |
| 17'-0" x 11'-2" | 2.9 | 5.2 | 3.6 | 6.4 | 4.2 | 7.5 | 6.3 | 10.1 | 24.8 | 42.7 | 1.8 | 3.6 |
| 17'-2" x 11'-4" | 3.0 | 5.2 | 3.6 | 6.4 | 4.2 | 7.5 | 6.4 | 10.2 | 25.1 | 43.3 | 1.8 | 3.6 |
| 17'-5" x 11'-6" | 3.0 | 5.3 | 3.6 | 6.4 | 4.2 | 7.6 | 6.5 | 10.4 | 25.6 | 44.1 | 1.8 | 3.6 |
| 17'-11" x 11'-8" | 3.1 | 5.4 | 3.7 | 6.6 | 4.4 | 7.8 | 6.7 | 10.7 | 26.1 | 45.2 | 1.9 | 3.8 |
| 18'-1" x 11'-10" | 3.1 | 5.4 | 3.7 | 6.6 | 4.4 | 7.8 | 6.7 | 10.8 | 26.5 | 45.7 | 1.9 | 3.8 |
| 18'-7" x 12'-0" | 3.2 | 5.6 | 3.8 | 6.8 | 4.5 | 8.1 | 6.9 | 11.1 | 27.1 | 46.8 | 2.0 | 4.0 |
| 18'-9" x 12'-2" | 3.2 | 5.6 | 3.8 | 6.8 | 4.5 | 8.1 | 7.0 | 11.2 | 27.4 | 47.4 | 2.0 | 3.9 |
| 19'-3" x 12'-4" | 3.3 | 5.8 | 3.9 | 7.1 | 4.6 | 8.3 | 7.1 | 11.5 | 28.0 | 48.5 | 2.1 | 4.1 |
| 19'-6" x 12'-6" | 3.3 | 5.8 | 4.0 | 7.1 | 4.6 | 8.4 | 7.3 | 11.7 | 28.4 | 49.4 | 2.1 | 4.1 |
| 19'-8" x 12'-8" | 3.3 | 5.8 | 4.0 | 7.1 | 4.7 | 8.4 | 7.3 | 11.9 | 28.8 | 50.0 | 2.0 | 4.1 |
| 19'-11" x 12'-10" | 3.3 | 5.8 | 4.0 | 7.1 | 4.7 | 8.4 | 7.5 | 12.1 | 29.2 | 50.8 | 2.0 | 4.1 |
| 20'-3" x 13'-0" | 3.4 | 6.0 | 4.1 | 7.3 | 4.8 | 8.6 | 7.6 | 12.2 | 29.5 | 51.4 | 2.1 | 4.2 |
| 20'-7" x 13'-2" | 3.4 | 6.0 | 4.1 | 7.4 | 4.8 | 8.7 | 7.7 | 12.5 | 30.2 | 52.6 | 2.1 | 4.2 |

## CULVERT INSTALLATION QUANTITIES

| DIAMETER OR SPAN x RISE (m) | CUBIC METERS OF CLASS GENERAL CONCRETE (EACH END) ④ | | | | | | | | CUBIC METERS OF RIPRAP (EACH END) ① (DTL. DWG. ④ NO. 613-14) | | CUBIC METERS GRANULAR BEDDING ② MATERIAL PER METER OF PIPE (DTL. DWG. NO. 603-19) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CUTOFF WALL (DTL. DWG. NO. 552-00) | | | | | | CONCRETE EDGE PROTECTION (DTL. DWG. NO. 613-06) | | | | | |
| | H=915 mm | | H=1220 mm | | H=1525 mm | | 2:1 | | 2:1 | | | |
| | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. |
| SSPPA 152 mm X 51 mm CORRUGATIONS 457 mm CORNER RADIUS | | | | | | | | | | | | |
| 1.850 x 1.400 | 1.1 | 1.8 | 1.4 | 2.4 | 1.7 | 2.8 | 2.0 | 2.9 | 8.3 | 13.6 | 1.8 | 3.5 |
| 1.930 x 1.450 | 1.1 | 1.9 | 1.5 | 2.4 | 1.7 | 2.9 | 2.0 | 3.1 | 8.6 | 14.1 | 1.8 | 3.8 |
| 2.060 x 1.500 | 1.1 | 2.0 | 1.5 | 2.4 | 1.8 | 3.0 | 2.1 | 3.1 | 8.9 | 14.5 | 2.0 | 3.8 |
| 2.130 x 1.550 | 1.2 | 2.0 | 1.5 | 2.5 | 1.8 | 3.1 | 2.1 | 3.3 | 9.1 | 14.9 | 2.0 | 4.0 |
| 2.210 x 1.600 | 1.2 | 2.1 | 1.5 | 2.6 | 1.8 | 3.1 | 2.2 | 3.4 | 9.3 | 15.4 | 2.0 | 4.0 |
| 2.340 x 1.650 | 1.2 | 2.1 | 1.5 | 2.7 | 1.8 | 3.2 | 2.3 | 3.5 | 9.6 | 15.8 | 2.0 | 4.3 |
| 2.410 x 1.700 | 1.3 | 2.1 | 1.6 | 2.7 | 1.9 | 3.2 | 2.4 | 3.6 | 9.9 | 16.3 | 2.3 | 4.3 |
| 2.490 x 1.750 | 1.3 | 2.2 | 1.6 | 2.8 | 1.9 | 3.3 | 2.4 | 3.7 | 10.1 | 16.7 | 2.3 | 4.3 |
| 2.620 x 1.800 | 1.4 | 2.3 | 1.7 | 2.8 | 2.0 | 3.4 | 2.5 | 3.8 | 10.4 | 17.2 | 2.3 | 4.5 |
| 2.690 x 1.850 | 1.4 | 2.3 | 1.7 | 2.9 | 2.0 | 3.4 | 2.6 | 4.0 | 10.6 | 17.7 | 2.3 | 4.5 |
| 2.840 x 1.510 | 1.4 | 2.4 | 1.8 | 3.0 | 2.1 | 3.6 | 2.7 | 4.1 | 11.0 | 18.3 | 2.5 | 5.0 |
| 2.900 x 1.960 | 1.5 | 2.4 | 1.8 | 3.1 | 2.1 | 3.7 | 2.7 | 4.2 | 11.2 | 18.7 | 2.5 | 4.8 |
| 2.970 x 2.010 | 1.5 | 2.4 | 1.8 | 3.1 | 2.1 | 3.7 | 2.8 | 4.3 | 11.4 | 19.1 | 2.5 | 5.0 |
| 3.120 x 2.060 | 1.5 | 2.6 | 1.8 | 3.2 | 2.2 | 3.8 | 2.9 | 4.4 | 11.8 | 19.8 | 2.5 | 5.3 |
| 3.250 x 2.110 | 1.5 | 2.7 | 1.9 | 3.3 | 2.3 | 4.0 | 3.0 | 4.6 | 12.1 | 20.3 | 2.8 | 5.5 |
| 3.330 x 2.160 | 1.5 | 2.7 | 1.9 | 3.4 | 2.3 | 4.0 | 3.1 | 4.7 | 12.4 | 20.9 | 2.8 | 5.5 |
| 3.480 x 2.210 | 1.6 | 2.8 | 2.0 | 3.5 | 2.4 | 4.1 | 3.1 | 4.9 | 12.8 | 21.6 | 3.0 | 6.0 |
| 3.760 x 2.360 | 1.7 | 3.0 | 2.1 | 3.7 | 2.4 | 4.4 | 3.4 | 5.3 | 13.6 | 23.1 | 3.0 | 6.3 |
| 3.810 x 2.410 | 1.7 | 3.0 | 2.1 | 3.7 | 2.5 | 4.4 | 3.4 | 5.4 | 13.8 | 23.5 | 3.0 | 6.3 |
| 3.860 x 2.460 | 1.7 | 3.0 | 2.1 | 3.7 | 2.5 | 4.4 | 3.4 | 5.5 | 14.1 | 23.9 | 3.0 | 6.3 |
| 3.910 x 2.540 | 1.8 | 3.0 | 2.1 | 3.7 | 2.5 | 4.4 | 3.6 | 5.6 | 14.3 | 24.3 | 3.0 | 6.3 |
| 4.090 x 2.570 | 1.8 | 3.1 | 2.2 | 3.9 | 2.6 | 4.6 | 3.7 | 5.8 | 14.8 | 25.2 | 3.3 | 6.5 |
| SSPPA 152 mm X 51 mm CORRUGATIONS 787 mm CORNER RADIUS | | | | | | | | | | | | |
| 4.040 x 2.840 | 1.8 | 3.3 | 2.3 | 4.0 | 2.7 | 4.7 | 3.8 | 6.0 | 15.2 | 25.8 | 3.5 | 7.3 |
| 4.110 x 2.900 | 1.9 | 3.3 | 2.3 | 4.1 | 2.7 | 4.8 | 3.9 | 6.1 | 15.5 | 26.4 | 3.5 | 7.3 |
| 4.270 x 2.950 | 1.9 | 3.4 | 2.4 | 4.2 | 2.8 | 5.0 | 4.1 | 6.3 | 16.0 | 27.1 | 3.8 | 7.5 |
| 4.320 x 3.000 | 2.0 | 3.4 | 2.4 | 4.2 | 2.8 | 5.0 | 4.1 | 6.5 | 16.3 | 27.7 | 3.8 | 7.5 |
| 4.390 x 3.050 | 2.0 | 3.4 | 2.4 | 4.2 | 2.8 | 5.0 | 4.2 | 6.6 | 16.4 | 28.1 | 3.8 | 7.5 |
| 4.550 x 3.100 | 2.1 | 3.6 | 2.4 | 4.4 | 2.9 | 5.2 | 4.3 | 6.7 | 16.9 | 28.9 | 4.0 | 8.0 |
| 4.670 x 3.150 | 2.1 | 3.7 | 2.5 | 4.5 | 3.0 | 5.3 | 4.4 | 6.9 | 17.2 | 29.4 | 4.3 | 8.3 |
| 4.750 x 3.200 | 2.1 | 3.7 | 2.5 | 4.5 | 3.0 | 5.4 | 4.4 | 7.0 | 17.6 | 30.0 | 4.3 | 8.3 |
| 4.830 x 3.250 | 2.1 | 3.7 | 2.6 | 4.6 | 3.1 | 5.4 | 4.5 | 7.2 | 17.9 | 30.7 | 4.3 | 8.3 |
| 4.950 x 3.300 | 2.1 | 3.8 | 2.6 | 4.7 | 3.1 | 5.5 | 4.6 | 7.3 | 18.2 | 31.2 | 4.3 | 8.8 |
| 5.030 x 3.350 | 2.2 | 3.9 | 2.7 | 4.7 | 3.1 | 5.6 | 4.7 | 7.5 | 18.5 | 31.8 | 4.3 | 8.8 |
| 5.180 x 3.400 | 2.2 | 4.0 | 2.8 | 4.9 | 3.2 | 5.7 | 4.8 | 7.7 | 19.0 | 32.6 | 4.5 | 9.0 |
| 5.230 x 3.490 | 2.3 | 4.0 | 2.8 | 4.9 | 3.2 | 5.7 | 4.9 | 7.8 | 19.2 | 33.1 | 4.5 | 9.0 |
| 5.310 x 3.510 | 2.3 | 4.1 | 2.8 | 4.9 | 3.2 | 5.8 | 5.0 | 8.0 | 19.6 | 33.7 | 4.5 | 9.0 |
| 5.460 x 3.560 | 2.4 | 4.1 | 2.8 | 5.0 | 3.4 | 6.0 | 5.1 | 8.2 | 20.0 | 34.6 | 4.8 | 9.5 |
| 5.510 x 3.610 | 2.4 | 4.1 | 2.8 | 5.0 | 3.4 | 6.0 | 5.1 | 8.3 | 20.3 | 34.9 | 4.8 | 9.5 |
| 5.660 x 3.660 | 2.4 | 4.3 | 2.9 | 5.2 | 3.4 | 6.2 | 5.3 | 8.5 | 20.7 | 35.8 | 5.0 | 10.0 |
| 5.720 x 3.710 | 2.4 | 4.3 | 2.9 | 5.2 | 3.4 | 6.2 | 5.4 | 8.6 | 20.9 | 36.2 | 5.0 | 9.8 |
| 5.870 x 3.710 | 2.5 | 4.4 | 3.0 | 5.4 | 3.5 | 6.3 | 5.4 | 8.8 | 21.4 | 37.1 | 5.3 | 10.3 |
| 5.940 x 3.810 | 2.5 | 4.4 | 3.1 | 5.4 | 3.5 | 6.4 | 5.6 | 8.9 | 21.7 | 37.8 | 5.3 | 10.3 |
| 5.990 x 3.860 | 2.5 | 4.4 | 3.1 | 5.4 | 3.6 | 6.4 | 5.6 | 9.1 | 22.0 | 38.2 | 5.0 | 10.3 |
| 6.070 x 3.910 | 2.5 | 4.4 | 3.1 | 5.4 | 3.6 | 6.4 | 5.7 | 9.3 | 22.3 | 38.8 | 5.0 | 10.3 |
| 6.220 x 3.960 | 2.6 | 4.6 | 3.1 | 5.6 | 3.7 | 6.6 | 5.8 | 9.3 | 22.6 | 39.3 | 5.3 | 10.5 |
| 6.270 x 4.010 | 2.6 | 4.6 | 3.1 | 5.7 | 3.7 | 6.7 | 5.9 | 9.6 | 23.1 | 40.2 | 5.3 | 10.5 |

NOTES:

① CONCRETE EDGE PROTECTION IS STANDARD FOR METAL CULVERT INLET AND OUTLET PROTECTION. CULVERT RIPRAP IS ONLY USED IN SPECIAL CIRCUMSTANCES. QUANTITIES ARE BASED ON A THICKNESS OF 2 FT. [600]AND ARE PROPORTIONED WHEN A DIFFERENT THICKNESS IS SPECIFIED.

② GRANULAR BEDDING QUANTITIES FOR METAL PIPES ARE BASED ON BEDDING DETAILS SHOWN ON DTL. DWG. NO. 603-19 WITH A WIDTH EQUAL TO (DIAMETER OR SPAN) + 4 FT. [1200]+ (2 TIMES CORRUGATION DEPTH) AND A DEPTH EQUAL TO 1FT. [300]+ "X" + (CORRUGATION DEPTH). TO COMPUTE THE TOTAL BEDDING QUANTITY MULTIPLY BY (LENGTH OF PIPE MINUS 1.3 FT. [0.40 m]). EXTEND GRANULAR BEDDING TO BACK OF CUTOFF WALL.

③ SEE DTL. DWG. NO. 603-32 AND 603-34 FOR "X" DIMENSIONS OF METAL PIPES.

④ FOR PIPES WITH SKEW BEVEL ENDS - DIVIDE THE QUANTITIES SHOWN BY COSINE OF SKEW ANGLE.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 552, 603, 613

DWG. NO. 552-06

CONCRETE, RIPRAP AND GRANULAR BEDDING MATERIAL QUANTITIES FOR SING. AND DBL. CULVERT INSTALLATION

--REVISED-- JANUARY 2018

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

## CULVERT INSTALLATION QUANTITIES

| DIAMETER OR SPAN x RISE | CUBIC YARDS OF CLASS GENERAL CONCRETE (EACH END)④ | | | | | | | | CUBIC YARDS OF RIPRAP (EACH END)① (DTL. DWG. ④ NO. 613-14) | | CUBIC YARDS GRANULAR BEDDING② MATERIAL PER FOOT OF PIPE (DTL. DWG. NO. 603-19) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CUTOFF WALL (DTL. DWG. NO. 552-00) | | | | | | CONCRETE EDGE PROTECTION (DTL. DWG. NO. 613-06) | | | | | |
| | H=3ft | | H=4ft | | H=5ft | | 2:1 | | 2:1 | | | |
| | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. |
| CSP 3" x 1" OR 5" x 1" CORRUGATIONS | | | | | | | | | | | | |
| 54" | 1.2 | 2.0 | 1.5 | 2.6 | 1.9 | 3.1 | 2.5 | 3.6 | 10.3 | 16.5 | 0.6 | 1.2 |
| 60" | 1.3 | 2.2 | 1.6 | 2.7 | 2.0 | 3.3 | 2.7 | 4.0 | 11.1 | 17.9 | 0.6 | 1.3 |
| 66" | 1.4 | 2.3 | 1.7 | 2.9 | 2.1 | 3.5 | 2.9 | 4.3 | 12.0 | 19.3 | 0.7 | 1.4 |
| 72" | 1.5 | 2.5 | 1.8 | 3.1 | 2.2 | 3.7 | 3.2 | 4.7 | 12.8 | 20.7 | 0.7 | 1.5 |
| 78" | 1.5 | 2.6 | 1.9 | 3.2 | 2.3 | 3.8 | 3.4 | 5.0 | 13.6 | 22.1 | 0.8 | 1.6 |
| 84" | 1.6 | 2.7 | 2.0 | 3.4 | 2.4 | 4.0 | 3.6 | 5.4 | 14.4 | 23.5 | 0.9 | 1.7 |
| 90" | 1.7 | 2.9 | 2.1 | 3.6 | 2.5 | 4.2 | 3.9 | 5.7 | 15.2 | 24.8 | 0.9 | 1.9 |
| 96" | 1.8 | 3.0 | 2.2 | 3.7 | 2.6 | 4.4 | 4.1 | 6.1 | 16.1 | 26.2 | 1.0 | 2.0 |
| 102" | 1.9 | 3.2 | 2.3 | 3.9 | 2.7 | 4.6 | 4.3 | 6.5 | 16.9 | 27.7 | 1.1 | 2.1 |
| 108" | 1.9 | 3.3 | 2.4 | 4.1 | 2.8 | 4.8 | 4.6 | 6.9 | 17.7 | 29.1 | 1.1 | 2.3 |
| 114" | 2.0 | 3.5 | 2.5 | 4.3 | 2.9 | 5.0 | 4.8 | 7.2 | 18.6 | 30.5 | 1.2 | 2.4 |
| 120" | 2.1 | 3.7 | 2.6 | 4.5 | 3.0 | 5.3 | 5.1 | 7.6 | 19.5 | 32.0 | 1.3 | 2.6 |
| SSPP 6" x 2" CORRUGATIONS | | | | | | | | | | | | |
| 10'-6" | 2.2 | 3.9 | 2.7 | 4.7 | 3.2 | 5.5 | 5.4 | 8.1 | 20.5 | 33.9 | 1.4 | 2.8 |
| 11'-0" | 2.3 | 4.0 | 2.8 | 4.9 | 3.3 | 5.8 | 5.6 | 8.5 | 21.4 | 35.4 | 1.5 | 2.9 |
| 11'-6" | 2.4 | 4.2 | 2.9 | 5.1 | 3.4 | 6.0 | 5.9 | 8.9 | 22.3 | 37.0 | 1.5 | 3.1 |
| 12'-0" | 2.5 | 4.4 | 3.0 | 5.3 | 3.5 | 6.2 | 6.2 | 9.3 | 23.2 | 38.5 | 1.6 | 3.2 |
| 12'-6" | 2.6 | 4.6 | 3.1 | 5.5 | 3.6 | 6.4 | 6.4 | 9.7 | 24.2 | 40.1 | 1.7 | 3.4 |
| 13'-0" | 2.7 | 4.7 | 3.2 | 5.7 | 3.7 | 6.6 | 6.7 | 10.1 | 25.1 | 41.7 | 1.8 | 3.6 |
| 13'-6" | 2.8 | 4.9 | 3.3 | 5.9 | 3.9 | 6.9 | 6.9 | 10.6 | 26.0 | 43.3 | 1.9 | 3.7 |
| 14'-0" | 2.9 | 5.1 | 3.4 | 6.1 | 4.0 | 7.1 | 7.2 | 11.0 | 27.0 | 45.0 | 2.0 | 3.9 |
| 14'-6" | 3.0 | 5.3 | 3.5 | 6.3 | 4.1 | 7.3 | 7.5 | 11.4 | 27.9 | 46.7 | 2.1 | 4.1 |
| 15'-0" | 3.1 | 5.4 | 3.6 | 6.5 | 4.2 | 7.6 | 7.8 | 11.9 | 28.9 | 48.3 | 2.1 | 4.3 |
| 15'-6" | 3.2 | 5.6 | 3.8 | 6.7 | 4.3 | 7.8 | 8.0 | 12.3 | 29.9 | 50.0 | 2.2 | 4.5 |
| 16'-0" | 3.3 | 5.8 | 3.9 | 6.9 | 4.5 | 8.0 | 8.3 | 12.8 | 30.8 | 51.8 | 2.3 | 4.7 |
| 16'-6" | 3.4 | 6.0 | 4.0 | 7.1 | 4.6 | 8.3 | 8.6 | 13.2 | 31.8 | 53.5 | 2.4 | 4.9 |
| 17'-0" | 3.5 | 6.2 | 4.1 | 7.4 | 4.7 | 8.5 | 8.9 | 13.7 | 32.8 | 55.3 | 2.5 | 5.0 |
| 17'-6" | 3.6 | 6.4 | 4.2 | 7.6 | 4.8 | 8.8 | 9.2 | 14.1 | 33.9 | 57.0 | 2.6 | 5.2 |
| 18'-0" | 3.7 | 6.6 | 4.3 | 7.8 | 5.0 | 9.0 | 9.4 | 14.6 | 34.9 | 58.8 | 2.7 | 5.5 |
| 18'-6" | 3.8 | 6.8 | 4.4 | 8.0 | 5.1 | 9.3 | 9.7 | 15.1 | 35.9 | 60.7 | 2.8 | 5.7 |
| 19'-0" | 3.9 | 7.0 | 4.6 | 8.3 | 5.2 | 9.5 | 10.0 | 15.5 | 37.0 | 62.5 | 2.9 | 5.9 |
| 19'-6" | 4.0 | 7.2 | 4.7 | 8.5 | 5.4 | 9.8 | 10.3 | 16.0 | 38.0 | 64.4 | 3.0 | 6.1 |
| 20'-0" | 4.1 | 7.4 | 4.8 | 8.7 | 5.5 | 10.0 | 10.6 | 16.5 | 39.1 | 66.2 | 3.2 | 6.3 |
| 20'-6" | 4.2 | 7.6 | 4.9 | 8.9 | 5.6 | 10.3 | 10.9 | 17.0 | 40.1 | 68.1 | 3.3 | 6.5 |
| 21'-0" | 4.3 | 7.8 | 5.1 | 9.2 | 5.8 | 10.5 | 11.2 | 17.5 | 41.2 | 70.0 | 3.4 | 6.8 |
| CSPA 2 2/3" x 1/2" CORRUGATIONS | | | | | | | | | | | | |
| 64" x 43" | 1.3 | 2.1 | 1.6 | 2.7 | 1.9 | 3.2 | 2.1 | 3.1 | 9.2 | 15.0 | 0.6 | 1.1 |
| 71" x 47" | 1.3 | 2.2 | 1.7 | 2.8 | 2.0 | 3.4 | 2.2 | 3.4 | 9.8 | 16.1 | 0.6 | 1.2 |
| 77" x 52" | 1.4 | 2.4 | 1.8 | 3.0 | 2.1 | 3.6 | 2.4 | 3.7 | 10.5 | 17.2 | 0.7 | 1.3 |
| 83" x 57" | 1.5 | 2.5 | 1.8 | 3.1 | 2.2 | 3.8 | 2.6 | 3.9 | 11.1 | 18.3 | 0.7 | 1.4 |
| CSPA 3" x 1" CORRUGATIONS | | | | | | | | | | | | |
| 60" x 46" | 1.3 | 2.1 | 1.6 | 2.7 | 1.9 | 3.2 | 2.2 | 3.3 | 9.6 | 15.5 | 0.6 | 1.2 |
| 66" x 51" | 1.4 | 2.3 | 1.7 | 2.9 | 2.0 | 3.4 | 2.4 | 3.6 | 10.3 | 16.7 | 0.7 | 1.3 |
| 73" x 55" | 1.4 | 2.4 | 1.8 | 3.0 | 2.2 | 3.6 | 2.6 | 3.9 | 11.0 | 17.9 | 0.7 | 1.4 |
| 81" x 59" | 1.5 | 2.5 | 1.9 | 3.2 | 2.2 | 3.8 | 2.8 | 4.1 | 11.6 | 18.9 | 0.8 | 1.5 |
| 87" x 63" | 1.6 | 2.7 | 2.0 | 3.4 | 2.4 | 4.0 | 2.9 | 4.4 | 12.3 | 20.2 | 0.8 | 1.6 |
| 95" x 67" | 1.7 | 2.8 | 2.1 | 3.5 | 2.5 | 4.2 | 3.1 | 4.7 | 12.9 | 21.3 | 0.9 | 1.7 |
| 103" x 71" | 1.8 | 3.0 | 2.2 | 3.7 | 2.6 | 4.5 | 3.3 | 5.1 | 13.7 | 22.6 | 0.9 | 1.9 |
| 112" x 75" | 1.8 | 3.2 | 2.3 | 3.9 | 2.7 | 4.7 | 3.5 | 5.4 | 14.4 | 23.8 | 1.0 | 2.0 |
| 117" x 79" | 1.9 | 3.3 | 2.4 | 4.1 | 2.8 | 4.9 | 3.7 | 5.7 | 15.1 | 25.1 | 1.1 | 2.1 |
| 128" x 83" | 2.0 | 3.5 | 2.5 | 4.3 | 2.9 | 5.1 | 3.9 | 6.0 | 15.8 | 26.4 | 1.1 | 2.2 |
| 137" x 87" | 2.1 | 3.6 | 2.6 | 4.5 | 3.0 | 5.3 | 4.1 | 6.3 | 16.6 | 27.7 | 1.2 | 2.4 |
| 142" x 91" | 2.2 | 3.8 | 2.7 | 4.6 | 3.1 | 5.5 | 4.2 | 6.6 | 17.2 | 28.9 | 1.2 | 2.5 |

## CULVERT INSTALLATION QUANTITIES

| DIAMETER OR SPAN x RISE (mm or m) | CUBIC METERS OF CLASS GENERAL CONCRETE (EACH END)④ | | | | | | | | CUBIC METERS OF RIPRAP (EACH END)① (DTL. DWG. ④ NO. 613-14) | | CUBIC METERS GRANULAR BEDDING② MATERIAL PER METER OF PIPE (DTL. DWG. NO. 603-19) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CUTOFF WALL (DTL. DWG. NO. 552-00) | | | | | | CONCRETE EDGE PROTECTION (DTL. DWG. NO. 613-06) | | | | | |
| | H=915 mm | | H=1220 mm | | H=1525 mm | | 2:1 | | 2:1 | | | |
| | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. | SING. | DBL. |
| CSP 75 mm x 25 mm OR 125 mm x 25mm CORRUGATIONS | | | | | | | | | | | | |
| 1350 | 0.9 | 1.5 | 1.1 | 2.0 | 1.5 | 2.4 | 1.9 | 2.8 | 7.9 | 12.6 | 1.5 | 3.0 |
| 1500 | 1.0 | 1.7 | 1.2 | 2.1 | 1.5 | 2.5 | 2.1 | 3.1 | 8.5 | 13.7 | 1.5 | 3.3 |
| 1650 | 1.1 | 1.8 | 1.3 | 2.2 | 1.6 | 2.7 | 2.2 | 3.3 | 9.2 | 14.8 | 1.8 | 3.5 |
| 1800 | 1.1 | 1.9 | 1.4 | 2.4 | 1.7 | 2.8 | 2.4 | 3.6 | 9.8 | 15.8 | 1.8 | 3.8 |
| 1950 | 1.1 | 2.0 | 1.5 | 2.4 | 1.8 | 2.9 | 2.6 | 3.8 | 10.4 | 16.9 | 2.0 | 4.0 |
| 2100 | 1.2 | 2.1 | 1.5 | 2.6 | 1.8 | 3.1 | 2.8 | 4.1 | 11.0 | 18.0 | 2.3 | 4.3 |
| 2250 | 1.3 | 2.2 | 1.6 | 2.8 | 1.9 | 3.2 | 3.0 | 4.4 | 11.6 | 19.0 | 2.3 | 4.8 |
| 2400 | 1.4 | 2.3 | 1.7 | 2.8 | 2.0 | 3.4 | 3.1 | 4.7 | 12.3 | 20.0 | 2.5 | 5.0 |
| 2550 | 1.5 | 2.4 | 1.8 | 3.0 | 2.1 | 3.5 | 3.3 | 5.0 | 12.9 | 21.2 | 2.8 | 5.3 |
| 2700 | 1.5 | 2.5 | 1.8 | 3.1 | 2.1 | 3.7 | 3.5 | 5.3 | 13.5 | 22.2 | 2.8 | 5.8 |
| 2850 | 1.5 | 2.7 | 1.9 | 3.3 | 2.2 | 3.8 | 3.7 | 5.5 | 14.2 | 23.3 | 3.0 | 6.0 |
| 3000 | 1.6 | 2.8 | 2.0 | 3.4 | 2.3 | 4.1 | 3.9 | 5.8 | 14.9 | 24.5 | 3.3 | 6.5 |
| SSPP 152mm x 51 mm CORRUGATIONS | | | | | | | | | | | | |
| 3.205 | 1.7 | 3.0 | 2.1 | 3.6 | 2.4 | 4.2 | 4.1 | 6.2 | 15.7 | 25.9 | 3.5 | 7.0 |
| 3.360 | 1.8 | 3.1 | 2.1 | 3.7 | 2.5 | 4.4 | 4.3 | 6.5 | 16.4 | 27.1 | 3.8 | 7.3 |
| 3.515 | 1.8 | 3.2 | 2.2 | 3.9 | 2.6 | 4.6 | 4.5 | 6.8 | 17.0 | 28.3 | 3.8 | 7.8 |
| 3.670 | 1.9 | 3.4 | 2.3 | 4.1 | 2.7 | 4.7 | 4.7 | 7.1 | 17.7 | 29.4 | 4.0 | 8.0 |
| 3.825 | 2.0 | 3.5 | 2.4 | 4.2 | 2.8 | 4.9 | 4.9 | 7.4 | 18.5 | 30.7 | 4.3 | 8.5 |
| 3.980 | 2.1 | 3.6 | 2.4 | 4.4 | 2.8 | 5.0 | 5.1 | 7.7 | 19.2 | 31.9 | 4.5 | 9.0 |
| 4.135 | 2.1 | 3.7 | 2.5 | 4.5 | 3.0 | 5.3 | 5.3 | 8.1 | 19.9 | 33.1 | 4.8 | 9.3 |
| 4.290 | 2.2 | 3.9 | 2.6 | 4.7 | 3.1 | 5.4 | 5.5 | 8.4 | 20.6 | 34.4 | 5.0 | 9.8 |
| 4.445 | 2.3 | 4.1 | 2.7 | 4.8 | 3.1 | 5.6 | 5.7 | 8.7 | 21.3 | 35.7 | 5.3 | 10.3 |
| 4.600 | 2.4 | 4.1 | 2.8 | 5.0 | 3.2 | 5.8 | 6.0 | 9.1 | 22.1 | 36.9 | 5.3 | 10.8 |
| 4.755 | 2.4 | 4.3 | 2.9 | 5.1 | 3.3 | 6.0 | 6.1 | 9.4 | 22.9 | 38.2 | 5.5 | 11.3 |
| 4.910 | 2.5 | 4.4 | 3.0 | 5.3 | 3.4 | 6.1 | 6.3 | 9.8 | 23.5 | 39.6 | 5.8 | 11.8 |
| 5.065 | 2.6 | 4.6 | 3.1 | 5.4 | 3.5 | 6.3 | 6.6 | 10.1 | 24.3 | 40.9 | 6.0 | 12.3 |
| 5.220 | 2.7 | 4.7 | 3.1 | 5.7 | 3.6 | 6.5 | 6.8 | 10.5 | 25.1 | 42.3 | 6.3 | 12.5 |
| 5.375 | 2.8 | 4.9 | 3.2 | 5.8 | 3.7 | 6.7 | 7.0 | 10.8 | 25.9 | 43.6 | 6.5 | 13.0 |
| 5.530 | 2.8 | 5.0 | 3.3 | 6.0 | 3.8 | 6.9 | 7.2 | 11.2 | 26.7 | 45.0 | 6.8 | 13.8 |
| 5.685 | 2.9 | 5.2 | 3.4 | 6.1 | 3.9 | 7.1 | 7.4 | 11.5 | 27.4 | 46.4 | 7.0 | 14.3 |
| 5.840 | 3.0 | 5.4 | 3.5 | 6.3 | 4.0 | 7.3 | 7.6 | 11.9 | 28.3 | 47.8 | 7.3 | 14.8 |
| 5.995 | 3.1 | 5.5 | 3.6 | 6.5 | 4.1 | 7.5 | 7.9 | 12.2 | 29.1 | 49.2 | 7.5 | 15.3 |
| 6.150 | 3.1 | 5.7 | 3.7 | 6.7 | 4.2 | 7.6 | 8.1 | 12.6 | 29.9 | 50.6 | 8.0 | 15.8 |
| 6.305 | 3.2 | 5.8 | 3.7 | 6.8 | 4.3 | 7.9 | 8.3 | 13.0 | 30.7 | 52.1 | 8.3 | 16.3 |
| 6.460 | 3.3 | 6.0 | 3.9 | 7.0 | 4.4 | 8.0 | 8.6 | 13.4 | 31.5 | 53.5 | 8.5 | 17.1 |
| CSPA 68 mm x 13 mm CORRUGATIONS | | | | | | | | | | | | |
| 1620 x 1100 | 1.0 | 1.6 | 1.2 | 2.1 | 1.5 | 2.4 | 1.6 | 2.4 | 7.0 | 11.5 | 1.5 | 2.8 |
| 1800 x 1300 | 1.0 | 1.7 | 1.3 | 2.1 | 1.5 | 2.6 | 1.7 | 2.6 | 7.5 | 12.3 | 1.5 | 3.0 |
| 1950 x 1320 | 1.1 | 1.8 | 1.4 | 2.3 | 1.6 | 2.8 | 1.8 | 2.8 | 8.0 | 13.2 | 1.8 | 3.3 |
| 2100 x 1450 | 1.1 | 1.9 | 1.4 | 2.4 | 1.7 | 2.9 | 2.0 | 3.0 | 8.5 | 14.0 | 1.8 | 3.5 |
| CSPA 75 mm x 25 mm CORRUGATIONS | | | | | | | | | | | | |
| 1520 x 1170 | 1.0 | 1.6 | 1.2 | 2.1 | 1.5 | 2.4 | 1.7 | 2.5 | 7.3 | 11.9 | 1.5 | 3.0 |
| 1670 x 1300 | 1.1 | 1.8 | 1.3 | 2.2 | 1.5 | 2.6 | 1.8 | 2.8 | 7.9 | 12.8 | 1.8 | 3.3 |
| 1850 x 1400 | 1.1 | 1.8 | 1.4 | 2.3 | 1.7 | 2.8 | 2.0 | 3.0 | 8.4 | 13.7 | 1.8 | 3.5 |
| 2050 x 1500 | 1.1 | 1.9 | 1.5 | 2.4 | 1.7 | 2.9 | 2.1 | 3.1 | 8.9 | 14.4 | 2.0 | 3.8 |
| 2200 x 1620 | 1.2 | 2.1 | 1.5 | 2.6 | 1.8 | 3.1 | 2.2 | 3.4 | 9.4 | 15.4 | 2.0 | 4.0 |
| 2400 x 1720 | 1.3 | 2.1 | 1.6 | 2.7 | 1.9 | 3.2 | 2.4 | 3.6 | 9.9 | 16.3 | 2.3 | 4.3 |
| 2600 x 1820 | 1.4 | 2.3 | 1.7 | 2.8 | 2.0 | 3.4 | 2.5 | 3.9 | 10.5 | 17.3 | 2.3 | 4.8 |
| 2840 x 1920 | 1.4 | 2.4 | 1.8 | 3.0 | 2.1 | 3.6 | 2.7 | 4.1 | 11.0 | 18.2 | 2.5 | 5.0 |
| 2970 x 2020 | 1.5 | 2.5 | 1.8 | 3.1 | 2.1 | 3.7 | 2.8 | 4.4 | 11.5 | 19.2 | 2.8 | 5.3 |
| 3240 x 2120 | 1.5 | 2.7 | 1.9 | 3.3 | 2.2 | 3.9 | 3.0 | 4.6 | 12.1 | 20.2 | 2.8 | 5.5 |
| 3470 x 2220 | 1.6 | 2.8 | 2.0 | 3.4 | 2.3 | 4.1 | 3.1 | 4.8 | 12.7 | 21.2 | 3.0 | 6.0 |
| 3600 x 2320 | 1.7 | 2.9 | 2.1 | 3.5 | 2.4 | 4.2 | 3.2 | 5.0 | 13.2 | 22.1 | 3.0 | 6.3 |

NOTES:

① CONCRETE EDGE PROTECTION IS STANDARD FOR METAL CULVERT INLET AND OUTLET PROTECTION. CULVERT RIPRAP IS ONLY USED IN SPECIAL CIRCUMSTANCES. QUANTITIES ARE BASED ON A THICKNESS OF 2 FT. [600]AND ARE PROPORTIONED WHEN A DIFFERENT THICKNESS IS SPECIFIED.

② GRANULAR BEDDING QUANTITIES FOR METAL PIPES ARE BASED ON BEDDING DETAILS SHOWN ON DTL. DWG. NO. 603-19 WITH A WIDTH EQUAL TO (DIAMETER OR SPAN) + 4 FT. [1200]+ (2 TIMES CORRUGATION DEPTH) AND A DEPTH EQUAL TO 1 FT. [300]+ "X" + (CORRUGATION DEPTH). TO COMPUTE THE TOTAL BEDDING QUANTITY MULTIPLY BY (LENGTH OF PIPE MINUS 1.3 FT. [0.40 m]). EXTEND BEDDING TO BACK OF CUTOFF WALLS.

③ SEE DTL. DWG. NO. 603-32 AND 603-34 FOR "X" DIMENSIONS OF METAL PIPES.

④ FOR PIPES WITH SKEW BEVEL ENDS - DIVIDE THE QUANTITIES SHOWN BY COSINE OF SKEW ANGLE.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 552, 603, 613

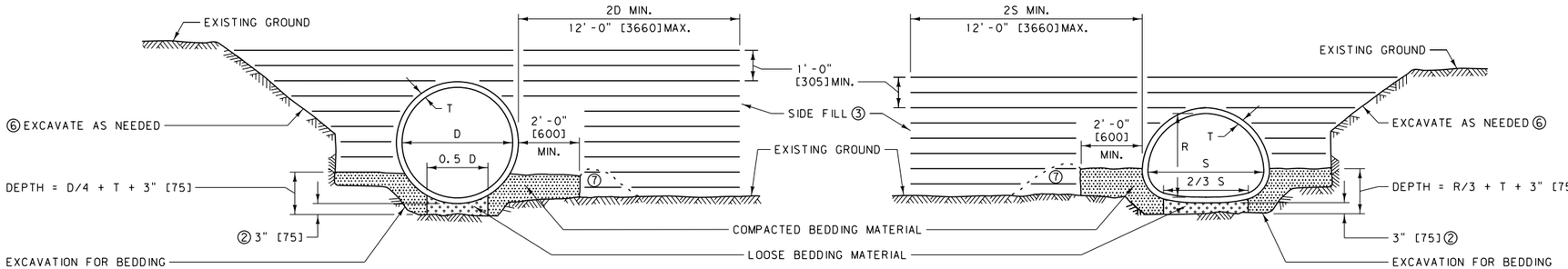
DWG. NO. 552-08

CONCRETE, RIPRAP AND GRANULAR BEDDING MATERIAL QUANTITIES FOR SING. AND DBL. CULVERT INSTALLATION

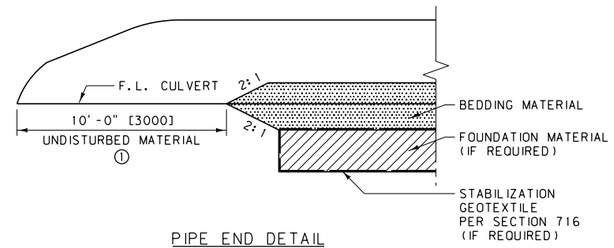
--REVISED--
JANUARY 2018

EFFECTIVE: SEPTEMBER 2014

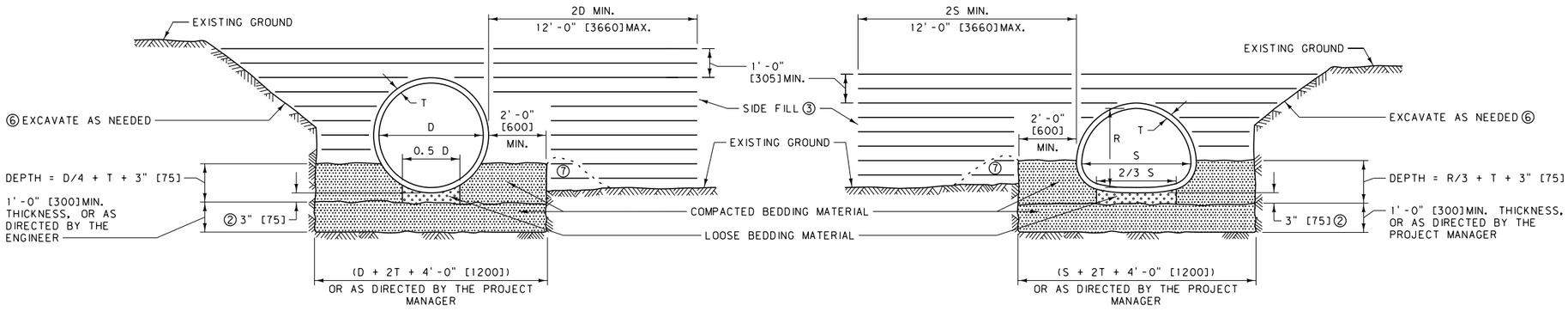
MDT MONTANA DEPARTMENT OF TRANSPORTATION



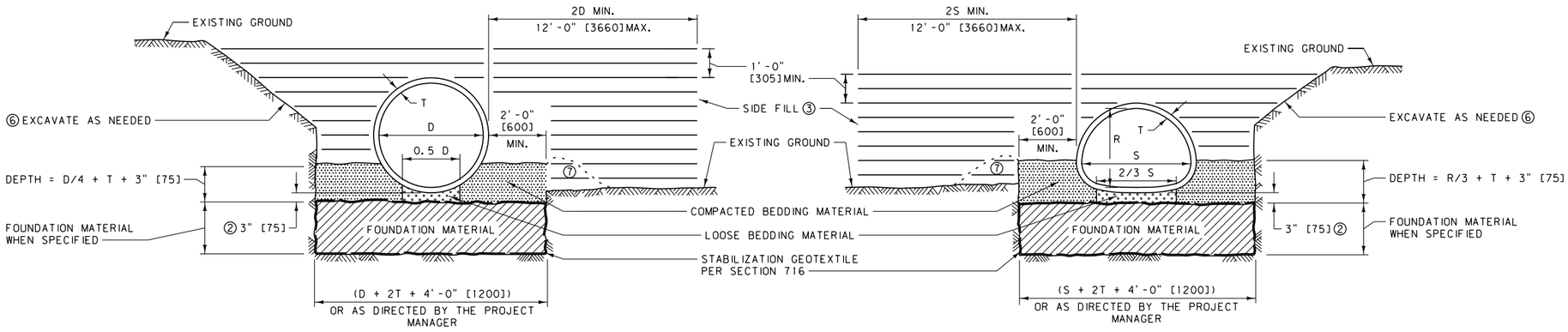

1-STANDARD BEDDING INSTALLATION




PIPE END DETAIL




2-ROCK




3-FOUNDATION STABILIZATION

NOTES:

① DO NOT EXTEND BEDDING MATERIAL TO THE END OF THE PIPE. LEAVE 10' [3000]OF UNDISTURBED MATERIAL AT EACH END UNLESS OTHERWISE NOTED IN PLANS. SEE PIPE END DETAIL.

② PLACE LOOSE BEDDING MATERIAL UNIFORMLY IN THE BOTTOM OF THE TRENCH AND SHAPE TO FIT BOTTOM OFPIPE. THE MINIMUM THICKNESS BEFORE PLACING PIPE IS 3" [75]. 42" [1050] AND 48" [1200] RCP IRR. REQUIRE 4" [100] DEPTH OF LOOSE BEDDING MATERIAL TO ACCOMODATE BELL THICKNESS. AFTER LAYING CULVERT, COMPACT BEDDING MATERIAL AT HAUNCHES AND SIDES OF PIPE.

③ COMPACT AND PLACE SIDE FILL PER SECTION 603 AND 203.

④ FURNISH BEDDING AND FOUNDATION MATERIAL PER SECTION 701.

⑤ DIMENSIONS D, S AND R ARE INSIDE PIPE DIAMETER, SPAN AND RISE. DIMENSION T IS THE CULVERT WALL THICKNESS FOR CONCRETE OR CORRUGATION DEPTH FOR METAL. CORRUGATION WIDTHS ARE TYPICALLY 1/2" [13] FOR 48" [1200] EQUIVALENT SIZE METAL CULVERTS AND SMALLER.

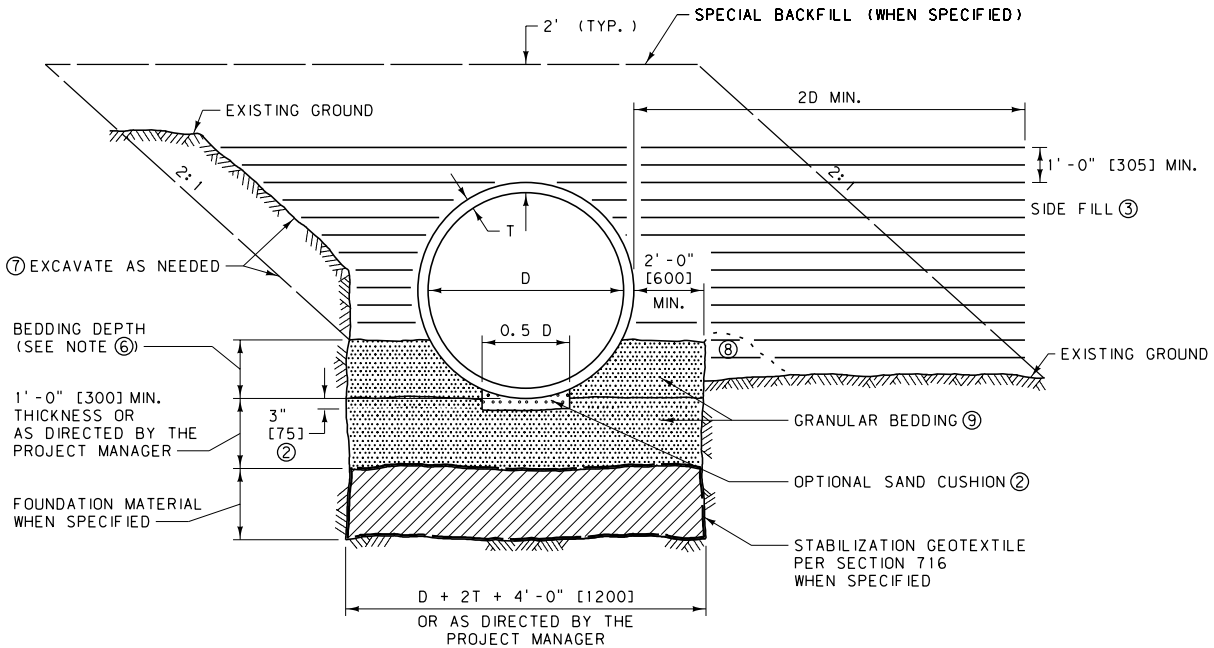
⑥ EXCAVATE A SUFFICIENT AMOUNT TO PROVIDE A SAFE WORKING ENVIRONMENT AND TO ALLOW ACHIEVEMENT OF ALL CULVERT INSTALLATION AND COMPACTION REQUIREMENTS. SLOPE, BENCH OR PROVIDE SHORING FOR ALL EXCAVATIONS IN ACCORDANCE WITH THE U.S. DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION.

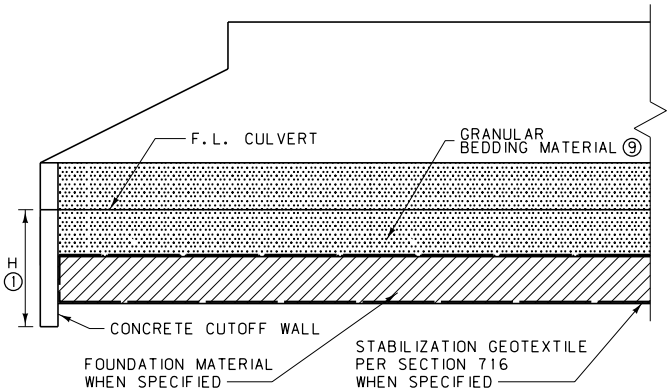
⑦ BUILD BERM WITH FILL MATERIAL AS NEEDED TO CONTAIN THE BEDDING MATERIAL TO THE PROPER DEPTH.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

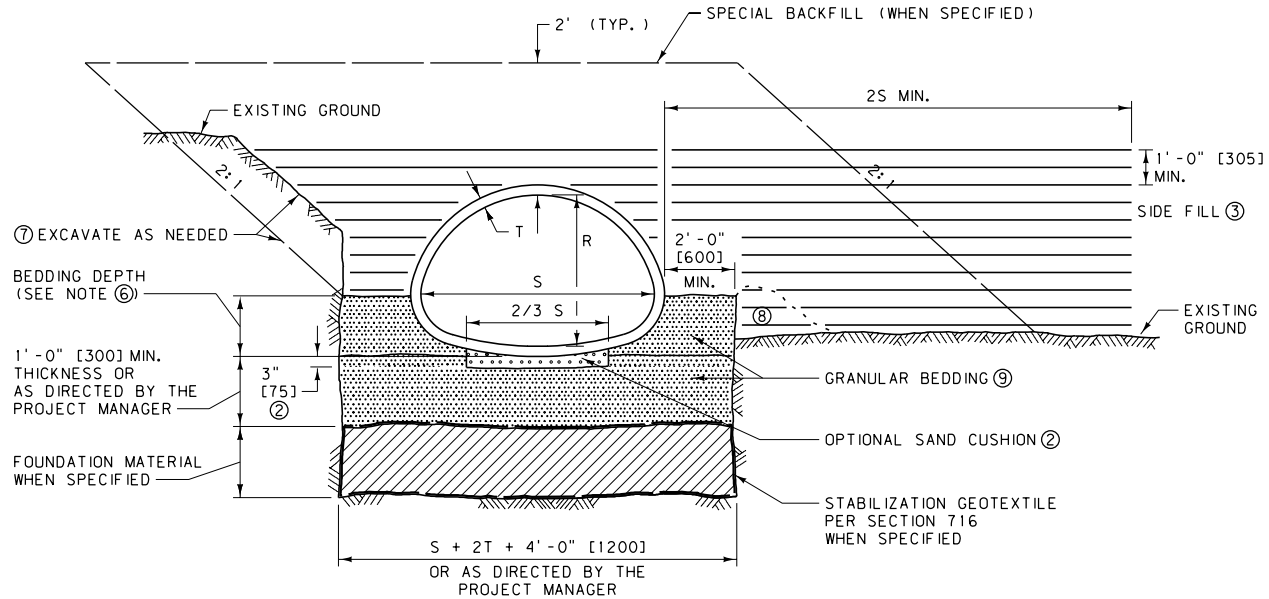
| DETAILED DRAWING | |
|---|---|
| REFERENCE STANDARD SPEC. SECTION 203, 207, 603, 701 | DWG. NO. 603-18 |
| BEDDING FOR MAINLINE & PUBLIC APPROACH CULVERTS 48" [1200 mm]EQUIVALENT & SMALLER | |
| --REVISED-- JANUARY 2018 | EFFECTIVE: SEPTEMBER 2014 |

MDT MONTANA DEPARTMENT OF TRANSPORTATION




PIPE END DETAIL




NOTES:

① 3'-0" [900] MIN. OR 1'-0" [300] BELOW BOTTOM OF FOUNDATION MATERIAL IF SPECIFIED.

② THE CONTRACTOR HAS THE OPTION OF USING A SAND CUSHION AS APPROVED BY THE PROJECT MANAGER TO FACILITATE CULVERT INSTALLATION. IF A SAND CUSHION IS USED, THAT MATERIAL WILL BE MEASURED AND PAID FOR AS GRANULAR BEDDING.

③ COMPACT AND PLACE SIDE FILL PER SECTION 603 AND 203.

④ FURNISH GRANULAR BEDDING AND FOUNDATION MATERIAL PER SECTION 701.

⑤ DIMENSIONS D, S, AND R ARE THE INSIDE PIPE DIAMETER, SPAN, AND RISE. DIMENSION T IS THE CULVERT SHELL THICKNESS FOR CONCRETE OR CORRUGATION DEPTH FOR METAL.

⑥ THE BEDDING DEPTH FOR CONCRETE PIPE IS D/4 + T OR R/3 + T. THE BEDDING DEPTH FOR METAL PIPE IS "X" + T. SEE DTL. DWG. NO. 603-32 AND 603-34 FOR "X" DIMENSIONS OF METAL PIPES. AFTER LAYING CULVERT, COMPACT GRANULAR BEDDING AT HAUNCHES AND SIDES.

⑦ EXCAVATE A SUFFICIENT AMOUNT TO PROVIDE A SAFE WORKING ENVIRONMENT AND TO ALLOW ACHIEVEMENT OF ALL CULVERT INSTALLATION AND COMPACTION REQUIREMENTS. SLOPE, BENCH OR PROVIDE SHORING FOR ALL EXCAVATIONS IN ACCORDANCE WITH THE U.S. DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION.

⑧ BUILD BERM WITH FILL MATERIAL AS NEEDED TO CONTAIN THE GRANULAR BEDDING MATERIAL TO THE PROPER DEPTH.

⑨ COMPACT GRANULAR BEDDING BY PROOF ROLLING WITH A VIBRATORY COMPACTOR IN 12 INCH LIFTS OR BY USING A METHOD APPROVED BY THE PROJECT MANAGER.

(METAL CULVERT SHOWN)

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 203, 207, 603, 701

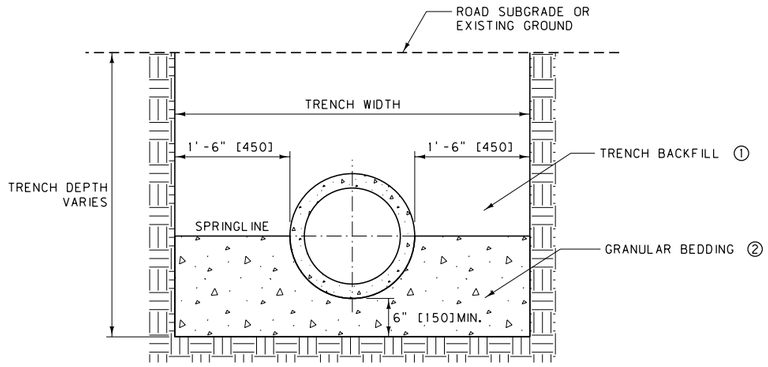
DWG. NO. 603-19

# GRANULAR BEDDING FOR CULVERTS 54" [1350 mm] EQUIVALENT & LARGER

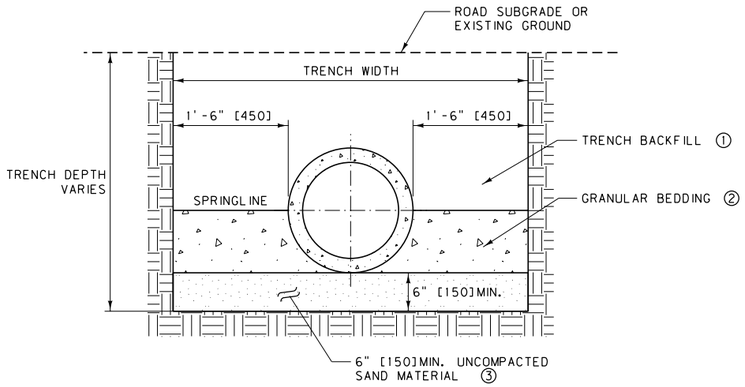
--REVISED-- JANUARY 2018

EFFECTIVE: SEPTEMBER 2014

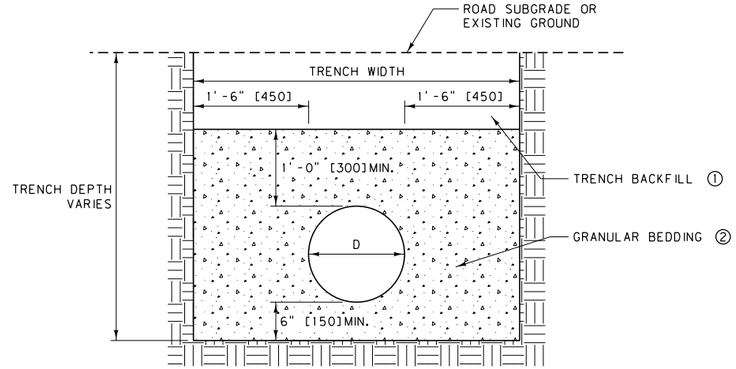
MDT MONTANA DEPARTMENT OF TRANSPORTATION




RIGID PIPE
TRENCH/BEDDING DETAIL
FOR 12" [300]TO 54" [1350]DIA.




RIGID PIPE
TRENCH/BEDDING DETAIL
FOR 60" [1500]TO 84" [2100]DIA.




FLEXIBLE PIPE
TRENCH/BEDDING DETAIL
FOR 12" [300]TO 48" [1200]DIA.

| QUANTITIES* | | METRIC QUANTITIES | |
|---|---|---|---|
| RIGID PIPE 12" TO 54" DIA. | | RIGID PIPE 300 TO 1350 DIA. | |
| DIAMETER | GRANULAR BEDDING (C.Y. PER Ft.) | DIAMETER (mm) | GRANULAR BEDDING ($m^3$ PER m) |
| 12" | 0.15 | 300 | 0.39 |
| 18" | 0.20 | 450 | 0.50 |
| 24" | 0.25 | 600 | 0.63 |
| 30" | 0.30 | 750 | 0.75 |
| 36" | 0.35 | 900 | 0.88 |
| 42" | 0.41 | 1050 | 1.02 |
| 48" | 0.46 | 1200 | 1.16 |
| 54" | 0.52 | 1350 | 1.30 |

* BASED ON RCP B WALL PIPE.

| QUANTITIES* | | METRIC QUANTITIES | |
|---|---|---|---|
| RIGID PIPE 60" TO 84" DIA. | | RIGID PIPE 1500 TO 2100 DIA. | |
| DIAMETER | GRANULAR BEDDING (C.Y. PER Ft.) | DIAMETER (mm) | GRANULAR BEDDING ($m^3$ PER m) |
| 60" | 0.48 | 1500 | 1.19 |
| 66" | 0.54 | 1650 | 1.35 |
| 72" | 0.60 | 1800 | 1.51 |
| 78" | 0.67 | 1950 | 1.68 |
| 84" | 0.74 | 2100 | 1.85 |

* BASED ON RCP B WALL PIPE.

| QUANTITIES* | | METRIC QUANTITIES | |
|---|---|---|---|
| FLEXIBLE PIPE 12" TO 48" DIA. | | FLEXIBLE PIPE 300 TO 1200 DIA. | |
| DIAMETER | GRANULAR BEDDING (C.Y. PER Ft.) | DIAMETER (mm) | GRANULAR BEDDING ($m^3$ PER m) |
| 12" | 0.37 | 300 | 0.93 |
| 18" | 0.47 | 450 | 1.17 |
| 24" | 0.57 | 600 | 1.42 |
| 30" | 0.67 | 750 | 1.67 |
| 36" | 0.77 | 900 | 1.94 |
| 42" | 0.88 | 1050 | 2.22 |
| 48" | 1.00 | 1200 | 2.51 |

* BASED ON 1" [25 mm]NOMINAL WALL THICKNESS.

## NOTES

① TRENCH BACKFILL: PLACE PER STANDARD SPECIFICATION 603.03.4. GRANULAR BEDDING MAY BE SUBSTITUTED AT NO ADDITIONAL COST.

② THE BEDDING MATERIAL DIRECTLY UNDERNEATH THE PIPE SHOULD BE LEFT UNCOMPACTED TO FACILITATE THE INSTALLATION OF THE PIPE.

COMPACT GRANULAR BEDDING BY PROOF ROLLING WITH VIBRATORY COMPACTOR IN 8 INCH [200]LIFTS OR BY USING A METHOD APPROVED BY THE PROJECT MANAGER.

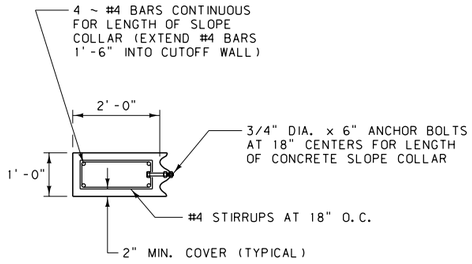
③ SAND CUSHION: USE GRADE 5 MATERIAL PER TABLE 701-7 IN STANDARD SPECIFICATION 701.02.3.

THE SAND MATERIAL SHOULD BE LEFT UNCOMPACTED TO FACILITATE THE INSTALLATION OF THE PIPE.

INCLUDE THE SAND MATERIAL IN THE COST OF THE GRANULAR BEDDING.

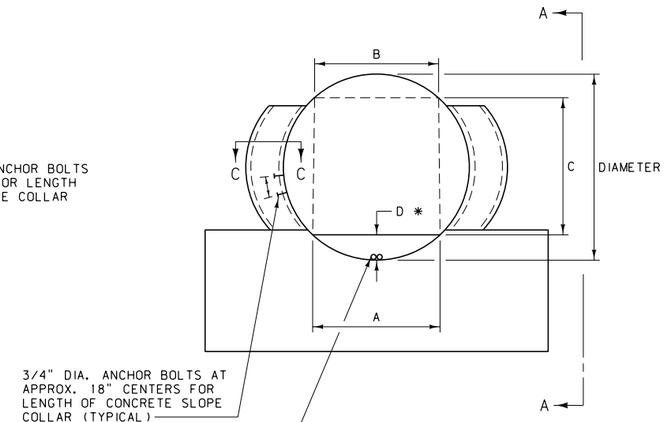
*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

| DETAILED DRAWING | |
|---|---|
| REFERENCE STANDARD SPEC. SECTION 603, 701 | DWG. NO. 603-20 |
| STORM DRAIN TRENCH BEDDING DETAIL | |
| --REVISED-- JANUARY 2018 | EFFECTIVE: SEPTEMBER 2014 |
| | MDT MONTANA DEPARTMENT OF TRANSPORTATION |

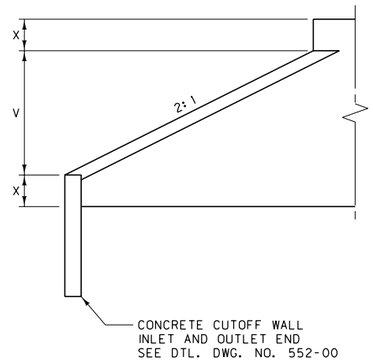



NOTE:
SEE DTL. DWG. NO. 552-00 FOR ANCHOR BOLT DETAILS.

SECTION C-C




ELEVATION




SECTION A-A

NOTES:

① DESIGNATE THESE STRUCTURES, IN PLANS AND PROPOSAL, AS "VEHICULAR UNDERPASS." USE THE TERM "VEHICULAR UNDERPASS," REGARDLESS OF THE USE OR PURPOSE OF THE STRUCTURE.

② PROVIDE END TREATMENT FOR ALL VEHICULAR UNDERPASSES INCLUDING CUTOFF WALLS, BACKFILL RETAINING WALLS AND CONCRETE SLOPE COLLARS.

③ PROVIDE SURFACING FOR THE INSIDE OF THE STRUCTURE, CROSS-SLOPED TO ALLOW A DRAINAGE COURSE DOWN THE CENTERLINE.

④ FOR PLATE THICKNESS SEE ROAD DESIGN MANUAL FILL HEIGHT TABLES.

⑤ USE CLASS GENERAL CONCRETE OR EQUAL.

⑥ SEE DTL. DWG. NO. 552-08 FOR QUANTITIES.

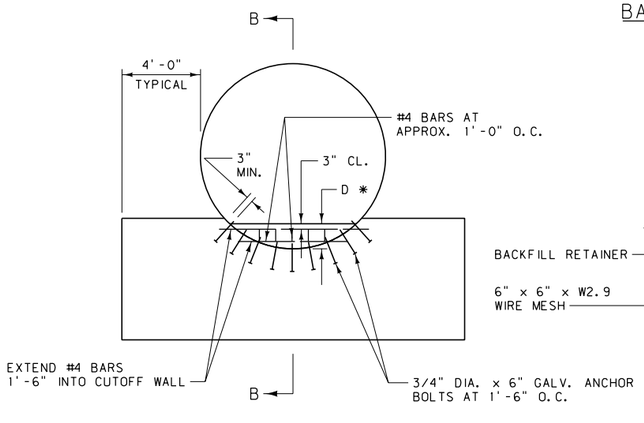
⑦ SEE DTL. DWG. NO. 603-31 FOR ALTERNATIVE "C" PCCP TRANSVERSE JOINT AND BACKFILL RETAINER DETAILS.

| DEPTH OF SURFACING * | | | |
|---|---|---|---|
| MATERIAL | ALTERNATE "A" | ALTERNATE "B" | ALTERNATE "C" |
| PL. MIX SURF. | — | 0.20' | — |
| PORT. CEM. CONC. PAVE. | — | — | 0.67' |
| CRUSHED AGGREGATE COURSE | BAL. | BAL. | BAL. |

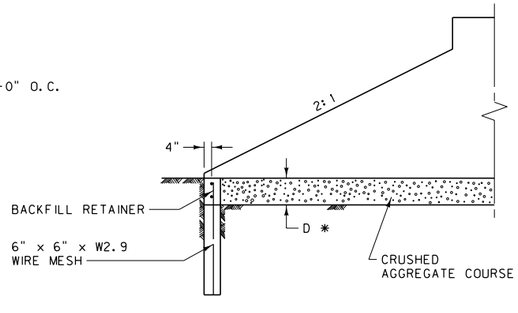
| DIAMETER | A | B | C | V | X | D * | BACKFILL RETAINER (C.Y.) | CONCRETE COLLAR (C.Y.) |
|---|---|---|---|---|---|---|---|---|
| 96" | 4' | 4' | 6.9' | 4.0' | 2.0' | 0.5' | 0.04 | 0.66 |
| 120" | 7' | 7' | 7.1' | 5.0' | 2.5' | 1.4' | 0.17 | 0.82 |
| 150" | 10' | 8' | 8.6' | 6.25' | 3.13' | 2.5' | 0.43 | 1.08 |
| 162" | 10' | 8' | 10.0' | 6.75' | 3.38' | 2.2' | 0.38 | 1.16 |
| 186" | 12' | 10' | 10.8' | 7.75' | 3.88' | 2.9' | 0.59 | 1.34 |
| 192" | 12' | 10' | 11.5' | 8.0' | 4.0' | 2.7' | 0.55 | 1.38 |
| 204" | 12' | 10' | 12.9' | 8.5' | 4.25' | 2.5' | 0.51 | 1.46 |
| 216" | 12' | 10' | 14.2' | 9.0' | 4.50' | 2.3' | 0.47 | 1.54 |
| 228" | 16' | 12' | 12.5' | 9.5' | 4.75' | 4.4' | 1.23 | 1.72 |
| 240" | 16' | 12' | 14.0' | 10.0' | 5.0' | 4.0' | 1.10 | 1.72 |

| SURFACING QUANTITIES PER LINEAR FOOT FOR DEPTH "D" * | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ALTERNATE "A" | ALTERNATE "B" | | | | | | ALTERNATE "C" | |
| | C.Y. SURFACING | TONS SURFACING | | C.Y. SURFACING | TONS BIT. MATL. | | | C.Y. SURFACING | S.Y. SURFACING |
| DIAMETER | CRUSHED AGGREGATE COURSE | COVER MATERIAL | PLANT MIX | CRUSHED AGGREGATE COURSE | PLANT MIX | PRIME | SEAL | CRUSHED AGGREGATE COURSE | PORT. CEM. CONCRETE PAVEMENT |
| 96" | 0.054 | 0.0056 | 0.052 | 0.027 | 0.0031 | 0.0005 | 0.0007 | — | 0.444 |
| 120" | 0.255 | 0.0097 | 0.097 | 0.205 | 0.0058 | 0.0009 | 0.0012 | 0.096 | 0.778 |
| 150" | 0.647 | 0.0139 | 0.141 | 0.574 | 0.0084 | 0.0014 | 0.0017 | 0.413 | 1.111 |
| 162" | 0.563 | 0.0139 | 0.140 | 0.489 | 0.0084 | 0.0014 | 0.0017 | 0.332 | 1.111 |
| 186" | 0.882 | 0.0167 | 0.169 | 0.794 | 0.0102 | 0.0017 | 0.0020 | 0.615 | 1.333 |
| 192" | 0.830 | 0.0167 | 0.168 | 0.744 | 0.0101 | 0.0016 | 0.0020 | 0.550 | 1.333 |
| 204" | 0.769 | 0.0167 | 0.169 | 0.680 | 0.0102 | 0.0016 | 0.0020 | 0.486 | 1.333 |
| 216" | 0.702 | 0.0167 | 0.168 | 0.615 | 0.0101 | 0.0016 | 0.0020 | 0.423 | 1.333 |
| 228" | 1.842 | 0.0222 | 0.227 | 1.725 | 0.0136 | 0.0022 | 0.0026 | 1.453 | 1.778 |
| 240" | 1.656 | 0.0222 | 0.226 | 1.539 | 0.0136 | 0.0022 | 0.0026 | 1.273 | 1.778 |

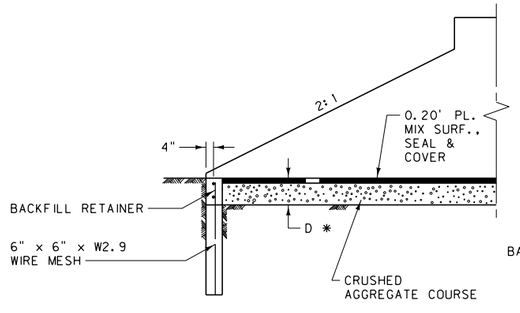
## BACKFILL RETAINER & CUTOFF WALL DETAIL




ELEVATION

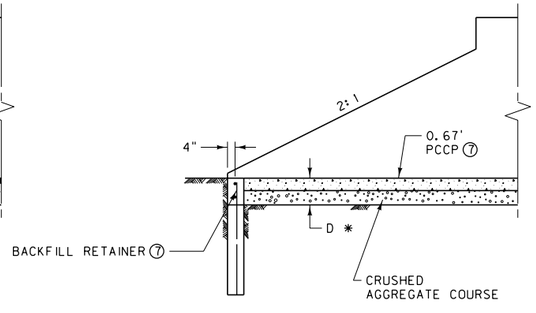



SECTION B-B
(ALTERNATE "A")




SECTION B-B
(ALTERNATE "B")

NOTE:
INCLUDE CONCRETE COLLAR WHEN SPECIFIED.

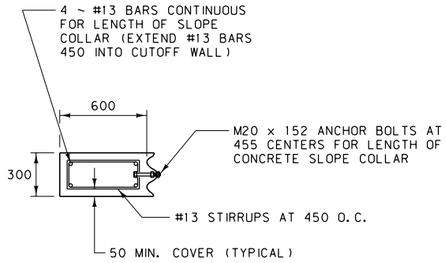



SECTION B-B
(ALTERNATE "C")

| DETAILED DRAWING | |
|---|---|
| REFERENCE STANDARD SPEC. SECTION 552, 603 | DWG. NO. 603-30 |

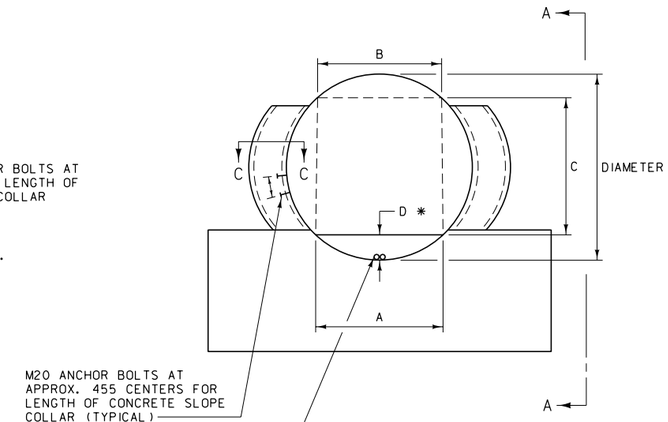
VEHICULAR UNDERPASS AND BACKFILL RETAINER & CUTOFF WALL DETAIL

| --REVISED-- | EFFECTIVE: SEPTEMBER 2014 |
|---|---|
| JANUARY 2018 | MDT MONTANA DEPARTMENT OF TRANSPORTATION |

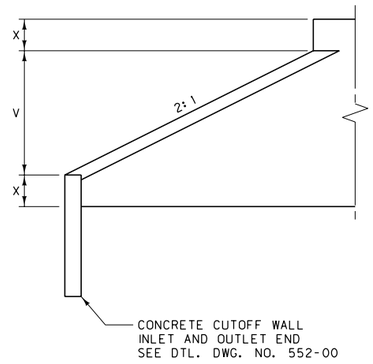



NOTE:
SEE DTL. DWG. NO. 552-00 FOR ANCHOR BOLT DETAILS.

SECTION C-C




ELEVATION




SECTION A-A

NOTES:

① DESIGNATE THESE STRUCTURES, IN PLANS AND PROPOSAL, AS "VEHICULAR UNDERPASS." USE THE TERM "VEHICULAR UNDERPASS," REGARDLESS OF THE USE OR PURPOSE OF THE STRUCTURE.

② PROVIDE END TREATMENT FOR ALL VEHICULAR UNDERPASSES INCLUDING CUTOFF WALLS, BACKFILL RETAINING WALLS AND CONCRETE SLOPE COLLARS.

③ PROVIDE SURFACING FOR THE INSIDE OF THE STRUCTURE, CROSS-SLOPED TO ALLOW A DRAINAGE COURSE DOWN THE CENTERLINE.

④ FOR PLATE THICKNESS SEE ROAD DESIGN MANUAL FILL HEIGHT TABLES.

⑤ USE CLASS GENERAL CONCRETE OR EQUAL.

⑥ SEE DTL. DWG. NO. 552-08 FOR QUANTITIES.

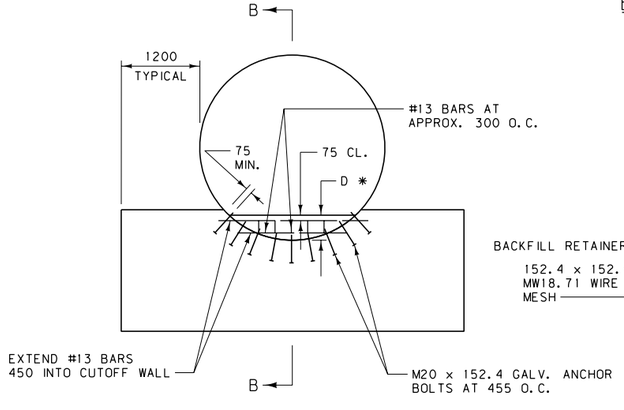
⑦ SEE DTL. DWG. NO. 603-31 FOR ALTERNATIVE "C" PCCP TRANSVERSE JOINT AND BACKFILL RETAINER DETAILS.

| DEPTH OF SURFACING * | | | |
|---|---|---|---|
| MATERIAL | ALTERNATE "A" | ALTERNATE "B" | ALTERNATE "C" |
| PL. MIX SURF. | — | 60 | — |
| PORT. CEM. CONC. PAVE. | — | — | 203 |
| CRUSHED AGGREGATE COURSE | BAL. | BAL. | BAL. |

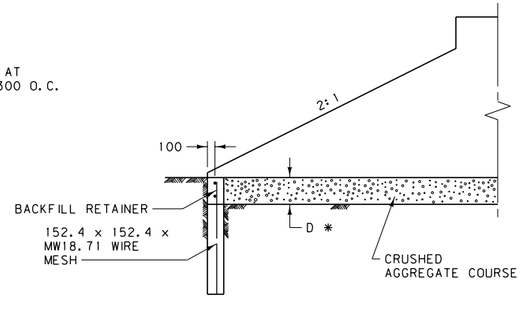
| DIAMETER | A (m) | B (m) | C (m) | V (m) | X (m) | D * | BACKFILL RETAINER (m³) | CONCRETE COLLAR (m³) |
|---|---|---|---|---|---|---|---|---|
| 2400 | 1.2 | 1.2 | 2.078 | 1.200 | 0.600 | 173 | 0.03 | 0.50 |
| 3000 | 2.1 | 2.1 | 2.142 | 1.500 | 0.750 | 441 | 0.13 | 0.63 |
| 3.825 m | 3.0 | 2.4 | 2.683 | 1.916 | 0.957 | 750 | 0.32 | 0.80 |
| 4.135 m | 3.0 | 2.4 | 3.114 | 2.071 | 1.035 | 669 | 0.28 | 0.87 |
| 4.755 m | 3.6 | 3.0 | 3.407 | 2.381 | 1.190 | 848 | 0.43 | 1.00 |
| 4.910 m | 3.6 | 3.0 | 3.622 | 2.459 | 1.229 | 809 | 0.41 | 1.03 |
| 5.220 m | 3.6 | 3.0 | 4.035 | 2.613 | 1.307 | 744 | 0.38 | 1.10 |
| 5.530 m | 3.6 | 3.0 | 4.431 | 2.770 | 1.384 | 690 | 0.35 | 1.16 |
| 5.840 m | 4.8 | 3.6 | 3.975 | 2.924 | 1.462 | 1279 | 0.87 | 1.23 |
| 6.150 m | 4.8 | 3.6 | 4.428 | 3.079 | 1.540 | 1176 | 0.80 | 1.29 |

| SURFACING QUANTITIES PER METER FOR DEPTH "D" * | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ALTERNATE "A" | ALTERNATE "B" | | | | | | ALTERNATE "C" | |
| | m³ SURFACING | TONS SURFACING | | m³ SURFACING | TONS BIT. MATL. | | | m³ SURFACING | m² SURFACING |
| DIAMETER | CRUSHED AGGREGATE COURSE | COVER MATERIAL | PLANT MIX | CRUSHED AGGREGATE COURSE | PLANT MIX | PRIME | SEAL | CRUSHED AGGREGATE COURSE | PORT. CEM. CONCRETE PAVEMENT |
| 2400 | 0.147 | 0.0175 | 0.158 | 0.078 | 0.0095 | 0.0015 | 0.0020 | — | 1.200 |
| 3000 | 0.649 | 0.0299 | 0.284 | 0.525 | 0.0170 | 0.0029 | 0.0034 | 0.259 | 2.100 |
| 3.825 m | 1.604 | 0.0429 | 0.414 | 1.423 | 0.0248 | 0.0042 | 0.0049 | 0.998 | 3.000 |
| 4.135 m | 1.420 | 0.0430 | 0.414 | 1.239 | 0.0248 | 0.0042 | 0.0049 | 0.822 | 3.000 |
| 4.755 m | 2.159 | 0.0513 | 0.496 | 1.942 | 0.0298 | 0.0051 | 0.0059 | 1.429 | 3.600 |
| 4.910 m | 2.056 | 0.0514 | 0.496 | 1.839 | 0.0298 | 0.0051 | 0.0059 | 1.327 | 3.600 |
| 5.220 m | 1.882 | 0.0514 | 0.496 | 1.665 | 0.0298 | 0.0051 | 0.0059 | 1.159 | 3.600 |
| 5.530 m | 1.741 | 0.0515 | 0.496 | 1.524 | 0.0298 | 0.0050 | 0.0059 | 1.023 | 3.600 |
| 5.840 m | 4.368 | 0.0681 | 0.661 | 4.079 | 0.0397 | 0.0068 | 0.0078 | 3.372 | 4.800 |
| 6.150 m | 3.985 | 0.0681 | 0.661 | 3.696 | 0.0397 | 0.0068 | 0.0078 | 2.998 | 4.800 |

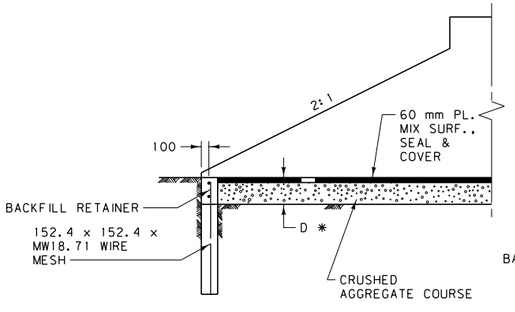
## BACKFILL RETAINER & CUTOFF WALL DETAIL



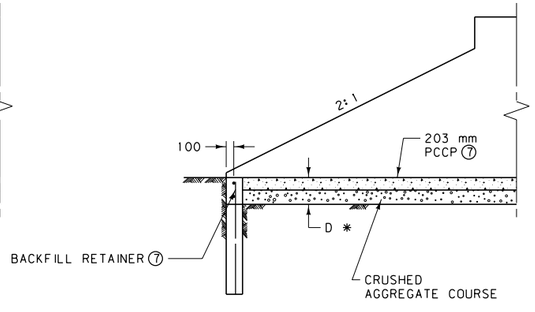

ELEVATION




SECTION B-B
(ALTERNATE "A")




NOTE:
INCLUDE CONCRETE COLLAR WHEN SPECIFIED.

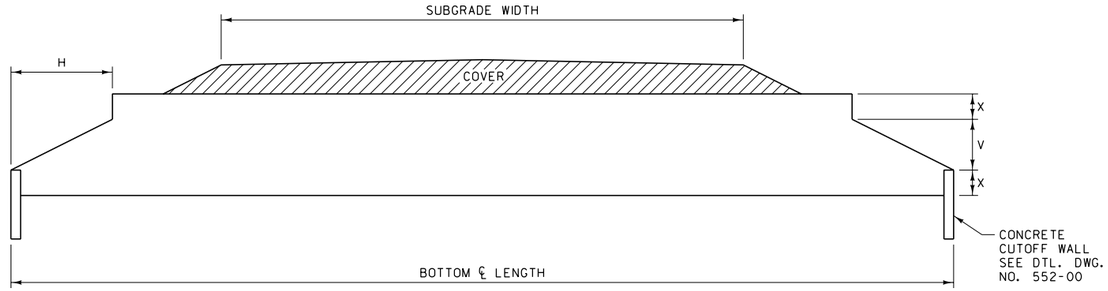



SECTION B-B
(ALTERNATE "C")

*ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.*

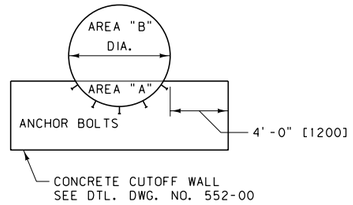
| DETAILED DRAWING | |
|---|---|
| REFERENCE STANDARD SPEC. SECTION 552, 603 | DWG. NO. 603-30 |
| VEHICULAR UNDERPASS AND BACKFILL RETAINER & CUTOFF WALL DETAIL (METRIC) | |
| --REVISED-- JANUARY 2018 | EFFECTIVE: SEPTEMBER 2014 |

MDT MONTANA DEPARTMENT OF TRANSPORTATION




| DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| DIA. | X (FT.) | V (FT.) | H (FT.) FOR BEVELS: 1.5:1 | H (FT.) FOR BEVELS: 2:1 | AREA "A" (SQ. FT.) * | AREA "B" (SQ. FT.) |
| CSP 3" x 1" OR 5" x 1" CORRUGATIONS (SEE NOTE ③) | | | | | | |
| 54" | 1.125 | 2.250 | 3.375 | 4.500 | 3 | 13 |
| 60" | 1.250 | 2.500 | 3.750 | 5.000 | 4 | 16 |
| 66" | 1.375 | 2.750 | 4.125 | 5.500 | 5 | 19 |
| 72" | 1.500 | 3.000 | 4.500 | 6.000 | 6 | 23 |
| 78" | 1.625 | 3.250 | 4.875 | 6.500 | 6 | 27 |
| 84" | 1.750 | 3.500 | 5.250 | 7.000 | 8 | 31 |
| 90" | 1.875 | 3.750 | 5.625 | 7.500 | 9 | 36 |
| 96" | 2.000 | 4.000 | 6.000 | 8.000 | 10 | 40 |
| 102" | 2.125 | 4.250 | 6.375 | 8.500 | 11 | 46 |
| 108" | 2.250 | 4.500 | 6.750 | 9.000 | 12 | 51 |
| 114" | 2.375 | 4.750 | 7.125 | 9.500 | 14 | 57 |
| 120" | 2.500 | 5.000 | 7.500 | 10.000 | 15 | 63 |
| SSPP 6" x 2" CORRUGATIONS | | | | | | |
| 10'-6" | 2.625 | 5.250 | 7.875 | 10.500 | 17 | 70 |
| 11'-0" | 2.750 | 5.500 | 8.250 | 11.000 | 19 | 76 |
| 11'-6" | 2.875 | 5.750 | 8.625 | 11.500 | 20 | 84 |
| 12'-0" | 3.000 | 6.000 | 9.000 | 12.000 | 22 | 91 |
| 12'-6" | 3.125 | 6.250 | 9.375 | 12.500 | 24 | 99 |
| 13'-0" | 3.250 | 6.500 | 9.750 | 13.000 | 26 | 107 |
| 13'-6" | 3.375 | 6.750 | 10.125 | 13.500 | 28 | 115 |
| 14'-0" | 3.500 | 7.000 | 10.500 | 14.000 | 30 | 124 |
| 14'-6" | 3.625 | 7.250 | 10.875 | 14.500 | 32 | 133 |
| 15'-0" | 3.750 | 7.500 | 11.250 | 15.000 | 35 | 142 |
| 15'-6" | 3.875 | 7.750 | 11.625 | 15.500 | 37 | 152 |
| 16'-0" | 4.000 | 8.000 | 12.000 | 16.000 | 39 | 162 |
| 16'-6" | 4.125 | 8.250 | 12.375 | 16.500 | 42 | 172 |
| 17'-0" | 4.250 | 8.500 | 12.750 | 17.000 | 44 | 183 |
| 17'-6" | 4.375 | 8.750 | 13.125 | 17.500 | 47 | 194 |
| 18'-0" | 4.500 | 9.000 | 13.500 | 18.000 | 50 | 205 |
| 19'-0" | 4.750 | 9.500 | 14.250 | 19.000 | 55 | 228 |
| 20'-0" | 5.000 | 10.000 | 15.000 | 20.000 | 61 | 253 |
| 21'-0" | 5.250 | 10.500 | 15.750 | 21.000 | 68 | 279 |

* AREA "A" IS TO THE MIDDLE OF THE CORRUGATIONS.




NOTES:

① BEVEL TO TOP OF CORNER PLATE.

② PIPE ENDS ARE SQUARE (PERPENDICULAR TO CENTERLINE OF PIPE) AND FILL SLOPES ARE WARPED TO ACCOMMODATE THE SQUARE ENDS UNLESS SPECIFIED OTHERWISE ON PLANS.

③ TABULATED VALUES BASED ON NOMINAL PIPE DIMENSIONS. IN PLACE DIMENSIONS SUBJECT TO TOLERANCE REQUIREMENTS OF SECTION 709.

| METRIC DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| DIA. # | X (m) | V (m) | H (m) FOR BEVELS: 1.5:1 | H (m) FOR BEVELS: 2:1 | AREA "A" (m²) * | AREA "B" (m²) |
| CSP 75 x 25 OR 125 x 25 CORRUGATIONS (SEE NOTE ③) | | | | | | |
| 1350 mm | 0.345 | 0.685 | 1.030 | 1.370 | 0.28 | 1.21 |
| 1500 mm | 0.380 | 0.760 | 1.145 | 1.525 | 0.37 | 1.49 |
| 1650 mm | 0.420 | 0.840 | 1.255 | 1.675 | 0.46 | 1.77 |
| 1800 mm | 0.460 | 0.915 | 1.370 | 1.830 | 0.56 | 2.14 |
| 1950 mm | 0.495 | 0.990 | 1.485 | 1.980 | 0.56 | 2.51 |
| 2100 mm | 0.535 | 1.065 | 1.600 | 2.135 | 0.74 | 2.88 |
| 2250 mm | 0.570 | 1.145 | 1.715 | 2.285 | 0.84 | 3.34 |
| 2400 mm | 0.610 | 1.220 | 1.830 | 2.440 | 0.93 | 3.72 |
| 2550 mm | 0.650 | 1.295 | 1.945 | 2.590 | 1.02 | 4.27 |
| 2700 mm | 0.685 | 1.370 | 2.055 | 2.745 | 1.11 | 4.74 |
| 2850 mm | 0.725 | 1.450 | 2.170 | 2.895 | 1.30 | 5.30 |
| 3000 mm | 0.760 | 1.525 | 2.285 | 3.050 | 1.39 | 5.85 |
| SSPP 150 x 50 CORRUGATIONS | | | | | | |
| 3.150 m | 0.800 | 1.600 | 2.400 | 3.200 | 1.58 | 6.50 |
| 3.300 m | 0.840 | 1.675 | 2.515 | 3.355 | 1.77 | 7.06 |
| 3.450 m | 0.875 | 1.755 | 2.630 | 3.505 | 1.86 | 7.80 |
| 3.600 m | 0.915 | 1.830 | 2.745 | 3.660 | 2.04 | 8.45 |
| 3.750 m | 0.955 | 1.900 | 2.860 | 3.810 | 2.23 | 9.20 |
| 3.900 m | 0.990 | 1.980 | 2.970 | 3.960 | 2.42 | 9.94 |
| 4.050 m | 1.030 | 2.055 | 3.085 | 4.115 | 2.60 | 10.68 |
| 4.200 m | 1.065 | 2.135 | 3.200 | 4.265 | 2.79 | 11.52 |
| 4.350 m | 1.105 | 2.210 | 3.315 | 4.420 | 2.97 | 12.36 |
| 4.500 m | 1.145 | 2.285 | 3.430 | 4.570 | 3.25 | 13.19 |
| 4.650 m | 1.180 | 2.360 | 3.545 | 4.725 | 3.44 | 14.12 |
| 4.800 m | 1.220 | 2.440 | 3.660 | 4.875 | 3.62 | 15.05 |
| 4.950 m | 1.255 | 2.515 | 3.770 | 5.030 | 3.90 | 15.98 |
| 5.100 m | 1.295 | 2.590 | 3.885 | 5.180 | 4.09 | 17.00 |
| 5.250 m | 1.335 | 2.665 | 4.000 | 5.335 | 4.37 | 18.02 |
| 5.400 m | 1.370 | 2.745 | 4.115 | 5.485 | 4.65 | 19.05 |
| 5.700 m | 1.450 | 2.895 | 4.345 | 5.790 | 5.11 | 21.18 |
| 6.000 m | 1.525 | 3.050 | 4.570 | 6.095 | 5.67 | 23.50 |
| 6.300 m | 1.600 | 3.200 | 4.800 | 6.400 | 6.32 | 25.92 |

* AREA "A" IS TO THE MIDDLE OF THE CORRUGATIONS.

# NOMINAL DIAMETER

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 552, 603, 709

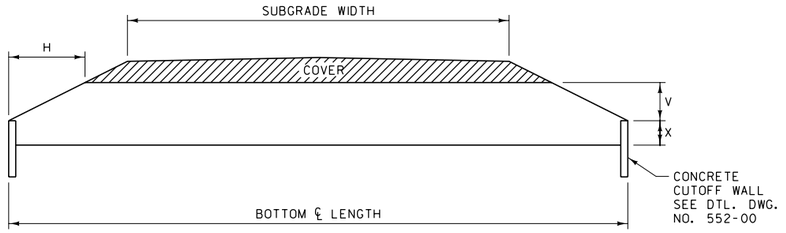
DWG. NO. 603-32

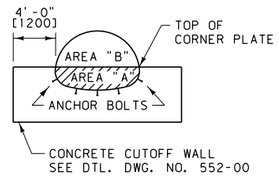
# STEP BEVEL FOR CIRCULAR METAL CULVERT

--REVISED-- JANUARY 2018

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION




NOTES:

① BEVEL TO TOP OF CORNER PLATE.

② PIPE ENDS ARE SQUARE (PERPENDICULAR TO CENTERLINE OF PIPE) AND FILL SLOPES ARE WARPED TO ACCOMMODATE THE SQUARE ENDS UNLESS SPECIFIED OTHERWISE ON PLANS.

③ TABULATED VALUES BASED ON NOMINAL PIPE DIMENSIONS. IN PLACE DIMENSIONS SUBJECT TO TOLERANCE REQUIREMENTS OF SECTION 709.

| DIMENSIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SPAN | RISE | EQUIV. DIA. | X (FT.) | V (FT.) | H (FT.) FOR BEVELS: 1.5:1 | 2:1 | 2.5:1 | AREA "A" (SQ. FT.) | AREA "B" (SQ. FT.) |
| SSPPA 6" x 2" CORRUGATIONS WITH 18" CORNER RADIUS | | | | | | | | | |
| 6'-1" | 4'-7" | 66" | 2.3 | 2.3 | 3.4 | 4.6 | 5.7 | 12 | 10 |
| 6'-9" | 4'-11" | 72" | 2.4 | 2.5 | 3.8 | 5.0 | 6.3 | 14 | 12 |
| 7'-3" | 5'-3" | 78" | 2.1 | 3.2 | 4.7 | 6.3 | 7.9 | 13 | 17 |
| 7'-11" | 5'-7" | 84" | 2.3 | 3.3 | 4.9 | 6.6 | 8.2 | 16 | 19 |
| 8'-7" | 5'-11" | 90" | 2.3 | 3.6 | 5.4 | 7.2 | 9.0 | 17 | 23 |
| 9'-4" | 6'-3" | 96" | 2.5 | 3.8 | 5.6 | 7.5 | 9.4 | 20 | 26 |
| 9'-9" | 6'-7" | 102" | 2.2 | 4.4 | 6.6 | 8.8 | 11.0 | 19 | 32 |
| 10'-8" | 6'-11" | 108" | 2.8 | 4.1 | 6.2 | 8.2 | 10.3 | 25 | 32 |
| 11'-5" | 7'-3" | 114" | 2.8 | 4.5 | 6.7 | 8.9 | 11.1 | 27 | 37 |
| 11'-10" | 7'-7" | 120" | 2.5 | 5.1 | 7.6 | 10.2 | 13.6 | 25 | 45 |
| 12'-6" | 7'-11" | 126" | 2.7 | 5.2 | 7.8 | 10.4 | 13.0 | 29 | 49 |
| 12'-10" | 8'-4" | 132" | 2.3 | 6.0 | 8.9 | 11.9 | 14.9 | 26 | 60 |
| SSPPA 6" x 2" CORRUGATIONS WITH 31" CORNER RADIUS | | | | | | | | | |
| 13'-3" | 9'-4" | ~ | 3.9 | 5.5 | 8.2 | 10.9 | 13.6 | 44 | 54 |
| 13'-6" | 9'-6" | ~ | 3.8 | 5.7 | 8.6 | 11.5 | 14.3 | 44 | 58 |
| 14'-0" | 9'-8" | 144" | 4.0 | 5.7 | 8.5 | 11.4 | 14.2 | 48 | 59 |
| 14'-2" | 9'-10" | ~ | 3.8 | 6.1 | 9.1 | 12.1 | 15.2 | 46 | 64 |
| 14'-5" | 10'-0" | ~ | 3.7 | 6.3 | 9.5 | 12.7 | 15.9 | 46 | 69 |
| 14'-11" | 10'-2" | ~ | 4.0 | 6.2 | 9.3 | 12.4 | 15.5 | 51 | 68 |
| 15'-4" | 10'-4" | 156" | 4.3 | 6.0 | 9.1 | 12.1 | 15.1 | 56 | 68 |
| 15'-7" | 10'-6" | ~ | 4.1 | 6.4 | 9.6 | 12.8 | 16.1 | 54 | 74 |
| 15'-10" | 10'-8" | ~ | 3.9 | 6.8 | 10.2 | 13.6 | 17.0 | 53 | 80 |
| 16'-3" | 10'-10" | ~ | 4.3 | 6.5 | 9.8 | 13.1 | 16.4 | 59 | 79 |
| 16'-6" | 11'-0" | 168" | 4.1 | 6.9 | 10.4 | 13.9 | 17.3 | 58 | 85 |
| 17'-0" | 11'-2" | ~ | 4.4 | 6.8 | 10.2 | 13.6 | 17.0 | 63 | 85 |
| 17'-2" | 11'-4" | ~ | 4.3 | 7.1 | 10.6 | 14.1 | 17.6 | 63 | 90 |
| 17'-5" | 11'-6" | ~ | 4.1 | 7.4 | 11.2 | 14.9 | 18.6 | 61 | 97 |
| 17'-11" | 11'-8" | 180" | 4.3 | 7.4 | 11.1 | 14.8 | 18.5 | 65 | 98 |
| 18'-1" | 11'-10" | ~ | 4.2 | 7.7 | 11.5 | 15.3 | 19.2 | 65 | 103 |
| 18'-7" | 12'-0" | ~ | 4.5 | 7.5 | 11.3 | 15.0 | 18.8 | 70 | 103 |
| 18'-9" | 12'-2" | ~ | 4.3 | 7.9 | 11.8 | 15.8 | 19.7 | 68 | 111 |
| 19'-3" | 12'-4" | 192" | 4.6 | 7.7 | 11.6 | 15.5 | 19.4 | 74 | 110 |
| 19'-6" | 12'-6" | ~ | 4.4 | 8.1 | 12.2 | 16.3 | 20.3 | 72 | 118 |
| 19'-8" | 12'-8" | ~ | 4.3 | 8.4 | 12.6 | 16.8 | 21.0 | 72 | 124 |
| 19'-11" | 12'-10" | ~ | 4.1 | 8.8 | 13.2 | 17.6 | 22.0 | 69 | 132 |
| 20'-5" | 13'-0" | 204" | 4.4 | 8.6 | 12.9 | 17.3 | 21.6 | 76 | 132 |
| 20'-7" | 13'-2" | ~ | 4.3 | 8.9 | 13.4 | 17.8 | 22.3 | 75 | 137 |

| DIMENSIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SPAN | RISE | EQUIV. DIA. | X (FT.) | V (FT.) | H (FT.) FOR BEVELS: 1.5:1 | 2:1 | 2.5:1 | AREA "A" (SQ. FT.) | AREA "B" (SQ. FT.) |
| CSPA 3" x 1" CORRUGATIONS (SEE NOTE ③) | | | | | | | | | |
| 60" | 46" | 54" | 1.7 | 2.3 | 3.5 | 4.7 | 5.8 | 7 | 9 |
| 66" | 51" | 60" | 1.9 | 2.6 | 3.9 | 5.2 | 6.5 | 8 | 11 |
| 73" | 55" | 66" | 2.1 | 2.8 | 4.1 | 5.5 | 6.9 | 11 | 13 |
| 81" | 59" | 72" | 2.0 | 3.2 | 4.8 | 6.5 | 8.1 | 11 | 16 |
| 87" | 63" | 78" | 2.1 | 3.5 | 5.2 | 6.9 | 8.6 | 12 | 20 |
| 95" | 67" | 84" | 2.3 | 3.7 | 5.5 | 7.3 | 9.2 | 15 | 22 |
| 103" | 71" | 90" | 2.5 | 3.9 | 5.8 | 7.7 | 9.6 | 18 | 25 |
| 112" | 75" | 96" | 2.6 | 4.1 | 6.1 | 8.1 | 10.2 | 19 | 29 |
| 117" | 79" | 102" | 2.8 | 4.3 | 6.4 | 8.5 | 10.7 | 23 | 32 |
| 128" | 83" | 108" | 3.0 | 4.5 | 6.7 | 8.9 | 11.2 | 26 | 35 |
| 137" | 87" | 114" | 3.1 | 4.7 | 7.0 | 9.4 | 11.7 | 28 | 39 |
| 142" | 91" | 120" | 3.3 | 4.9 | 7.3 | 9.7 | 12.2 | 32 | 43 |
| CSPA 2 2/3" x 1/2" CORRUGATIONS (SEE NOTE ③) | | | | | | | | | |
| 57" | 38" | 48" | 1.1 | 2.1 | 3.1 | 4.2 | 5.2 | 4 | 7 |
| 64" | 43" | 54" | 1.2 | 2.4 | 3.5 | 4.7 | 5.9 | 5 | 10 |
| 71" | 47" | 60" | 1.4 | 2.6 | 3.8 | 5.1 | 6.4 | 7 | 11 |
| 77" | 52" | 66" | 1.5 | 2.8 | 4.3 | 5.7 | 7.1 | 8 | 14 |
| 83" | 57" | 72" | 1.6 | 3.1 | 4.7 | 6.3 | 7.8 | 10 | 17 |

| METRIC DIMENSIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SPAN (mm) | RISE (mm) | X (m) | V (m) | H (m) FOR BEVELS: 1.5:1 | 2:1 | 2.5:1 | AREA "A" (m²) | AREA "B" (m²) | |
| CSPA 75 x 25 CORRUGATIONS (SEE NOTE ③) | | | | | | | | | |
| 1520 | 1170 | 0.520 | 0.650 | 0.975 | 1.300 | ~ | 0.65 | 0.84 | |
| 1670 | 1300 | 0.580 | 0.720 | 1.080 | 1.440 | ~ | 0.74 | 1.02 | |
| 1850 | 1400 | 0.640 | 0.760 | 1.140 | 1.520 | ~ | 1.02 | 1.21 | |
| 2050 | 1500 | 0.610 | 0.890 | 1.335 | 1.780 | ~ | 1.02 | 1.49 | |
| 2200 | 1620 | 0.640 | 0.980 | 1.470 | 1.960 | ~ | 1.11 | 1.86 | |
| 2400 | 1720 | 0.700 | 1.020 | 1.530 | 2.040 | ~ | 1.39 | 2.04 | |
| 2600 | 1820 | 0.760 | 1.060 | 1.590 | 2.120 | ~ | 1.67 | 2.32 | |
| 2840 | 1920 | 0.790 | 1.130 | 1.695 | 2.260 | ~ | 1.77 | 2.69 | |
| 2970 | 2020 | 0.855 | 1.165 | 1.750 | 2.330 | ~ | 2.14 | 2.97 | |
| 3240 | 2120 | 0.915 | 1.205 | 1.810 | 2.410 | ~ | 2.42 | 3.25 | |
| 3470 | 2220 | 0.945 | 1.275 | 1.915 | 2.550 | ~ | 2.60 | 3.62 | |
| 3600 | 2320 | 1.005 | 1.315 | 1.975 | 2.630 | ~ | 2.97 | 3.99 | |
| CSPA 68 x 13 CORRUGATIONS (SEE NOTE ③) | | | | | | | | | |
| 1440 | 970 | 0.335 | 0.635 | 0.955 | 1.270 | ~ | 0.37 | 0.65 | |
| 1620 | 1100 | 0.365 | 0.735 | 1.105 | 1.470 | ~ | 0.46 | 0.93 | |
| 1800 | 1200 | 0.425 | 0.775 | 1.165 | 1.550 | ~ | 0.65 | 1.02 | |
| 1950 | 1320 | 0.455 | 0.865 | 1.300 | 1.730 | ~ | 0.74 | 1.30 | |
| 2100 | 1450 | 0.490 | 0.960 | 1.440 | 1.920 | ~ | 0.93 | 1.58 | |

| METRIC DIMENSIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SPAN (m) | RISE (m) | X (m) | V (m) | H (m) FOR BEVELS: 1.5:1 | 2:1 | 2.5:1 | AREA "A" (m²) | AREA "B" (m²) | |
| SSPPA 150 x 50 CORRUGATIONS WITH 457 CORNER RADIUS | | | | | | | | | |
| 1.850 | 1.400 | 0.701 | 0.701 | 1.036 | 1.402 | 1.737 | 1.11 | 0.93 | |
| 1.930 | 1.450 | 0.640 | 0.810 | 1.215 | 1.620 | 2.025 | 1.04 | 1.14 | |
| 2.060 | 1.500 | 0.732 | 0.762 | 1.158 | 1.524 | 1.920 | 1.30 | 1.11 | |
| 2.130 | 1.550 | 0.700 | 0.850 | 1.275 | 1.700 | 2.125 | 1.30 | 1.30 | |
| 2.210 | 1.600 | 0.640 | 0.975 | 1.433 | 1.920 | 2.408 | 1.21 | 1.58 | |
| 2.340 | 1.650 | 0.700 | 0.950 | 1.425 | 1.900 | 2.375 | 1.39 | 1.67 | |
| 2.410 | 1.700 | 0.701 | 1.006 | 1.494 | 2.012 | 2.500 | 1.49 | 1.77 | |
| 2.490 | 1.750 | 0.610 | 1.140 | 1.710 | 2.280 | 2.850 | 1.30 | 2.14 | |
| 2.620 | 1.800 | 0.701 | 1.097 | 1.646 | 2.195 | 2.743 | 1.58 | 2.14 | |
| 2.690 | 1.850 | 0.670 | 1.180 | 1.770 | 2.360 | 2.950 | 1.58 | 2.42 | |
| 2.840 | 1.910 | 0.762 | 1.158 | 1.707 | 2.286 | 2.865 | 1.86 | 2.42 | |
| 2.900 | 1.960 | 0.700 | 1.260 | 1.890 | 2.520 | 3.150 | 1.77 | 2.79 | |
| 2.970 | 2.010 | 0.671 | 1.341 | 2.012 | 2.682 | 3.353 | 1.77 | 2.97 | |
| 3.120 | 2.060 | 0.730 | 1.330 | 1.995 | 2.660 | 3.325 | 1.95 | 3.07 | |
| 3.250 | 2.110 | 0.853 | 1.250 | 1.890 | 2.500 | 3.139 | 2.32 | 2.97 | |
| 3.330 | 2.160 | 0.790 | 1.370 | 2.055 | 2.740 | 3.425 | 2.23 | 3.34 | |
| 3.480 | 2.210 | 0.853 | 1.372 | 2.042 | 2.713 | 3.383 | 2.51 | 3.44 | |
| 3.530 | 2.260 | 0.820 | 1.440 | 2.160 | 2.880 | 3.600 | 2.42 | 3.81 | |
| 3.610 | 2.310 | 0.762 | 1.554 | 2.316 | 3.109 | 4.145 | 2.32 | 4.18 | |
| 3.760 | 2.360 | 0.850 | 1.510 | 2.265 | 3.020 | 3.775 | 2.69 | 4.18 | |
| 3.810 | 2.410 | 0.823 | 1.585 | 2.377 | 3.170 | 3.962 | 2.69 | 4.55 | |
| 3.860 | 2.460 | 0.760 | 1.700 | 2.550 | 3.400 | 4250 | 2.51 | 5.02 | |
| 3.910 | 2.540 | 0.701 | 1.829 | 2.713 | 3.627 | 4.542 | 2.42 | 5.57 | |
| SSPPA 150 x 50 CORRUGATIONS WITH 787 CORNER RADIUS | | | | | | | | | |
| 4.040 | 2.840 | 1.189 | 1.676 | 2.499 | 3.322 | 4.145 | 4.09 | 5.02 | |
| 4.110 | 2.900 | 1.158 | 1.737 | 2.621 | 3.505 | 4.359 | 4.09 | 5.39 | |
| 4.270 | 2.950 | 1.219 | 1.737 | 2.591 | 3.475 | 4.328 | 4.46 | 5.48 | |
| 4.320 | 3.000 | 1.158 | 1.859 | 2.774 | 3.688 | 4.633 | 4.27 | 5.95 | |
| 4.390 | 3.050 | 1.128 | 1.920 | 2.896 | 3.871 | 4.846 | 4.27 | 6.41 | |
| 4.550 | 3.100 | 1.219 | 1.890 | 2.835 | 3.780 | 4.724 | 4.74 | 6.32 | |
| 4.670 | 3.150 | 1.311 | 1.829 | 2.774 | 3.688 | 4.602 | 5.20 | 6.32 | |
| 4.750 | 3.200 | 1.250 | 1.951 | 2.926 | 3.900 | 4.907 | 5.02 | 6.87 | |
| 4.830 | 3.250 | 1.189 | 2.073 | 3.109 | 4.145 | 5.182 | 4.92 | 7.43 | |
| 4.950 | 3.300 | 1.311 | 1.981 | 2.987 | 3.993 | 4.999 | 5.48 | 7.34 | |
| 5.030 | 3.350 | 1.250 | 2.103 | 3.170 | 4.237 | 5.273 | 5.39 | 7.90 | |
| 5.180 | 3.400 | 1.341 | 2.073 | 3.109 | 4.145 | 5.182 | 5.85 | 7.90 | |
| 5.230 | 3.450 | 1.311 | 2.164 | 3.231 | 4.298 | 5.364 | 5.85 | 8.36 | |
| 5.310 | 3.510 | 1.250 | 2.256 | 3.414 | 4.542 | 5.669 | 5.67 | 9.01 | |
| 5.460 | 3.560 | 1.311 | 2.256 | 3.383 | 4.511 | 5.639 | 6.04 | 9.10 | |
| 5.510 | 3.610 | 1.280 | 2.347 | 3.505 | 4.663 | 5.852 | 6.04 | 9.57 | |
| 5.660 | 3.660 | 1.372 | 2.286 | 3.444 | 4.572 | 5.730 | 6.50 | 9.57 | |
| 5.720 | 3.710 | 1.311 | 2.408 | 3.597 | 4.816 | 6.005 | 6.32 | 10.31 | |
| 5.870 | 3.760 | 1.402 | 2.347 | 3.537 | 4.724 | 5.913 | 6.87 | 10.22 | |
| 5.940 | 3.810 | 1.341 | 2.469 | 3.719 | 4.968 | 6.187 | 6.69 | 10.96 | |
| 5.990 | 3.860 | 1.311 | 2.560 | 3.840 | 5.121 | 6.401 | 6.69 | 11.52 | |
| 6.070 | 3.910 | 1.250 | 2.682 | 4.023 | 5.364 | 6.706 | 6.41 | 12.26 | |
| 6.220 | 3.960 | 1.341 | 2.621 | 3.932 | 5.273 | 6.584 | 7.06 | 12.26 | |
| 6.270 | 4.010 | 1.311 | 2.713 | 4.084 | 5.425 | 6.797 | 6.97 | 12.73 | |

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 603, 709

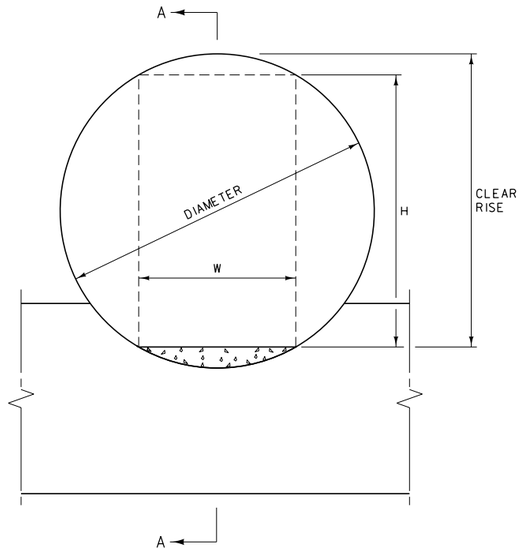
DWG. NO. 603-34

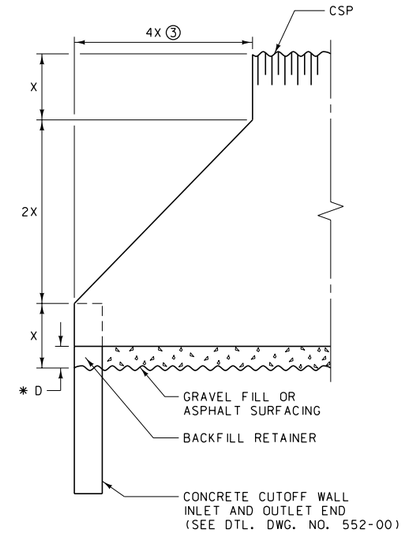
# BEVEL ON ARCH METAL CULVERT

--REVISED--
JULY 2016
JANUARY 2018

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION




SECTION A-A

| DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| DIAMETER | X | * D | CLEAR RISE | H | W | BACKFILL RETAINER (CUBIC YARDS) |
| 84" | 21.0" | 0.50' | 6.5' | 6.0' | 3.6' | 0.1 |
| 90" | 22.5" | 0.75' | 6.75' | 6.0' | 4.5' | 0.1 |
| 96" | 24.0" | 0.83' | 7.17' | 6.34' | 4.9' | 0.1 |

| METRIC DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| DIAMETER (mm) | X (m) | * D (mm) | CLEAR RISE (m) | H (m) | W (m) | BACKFILL RETAINER ($m^3$) |
| 2100 | 0.525 | 168 | 1.944 | 1.789 | 1.1 | 0.03 |
| 2250 | 0.563 | 257 | 2.006 | 1.761 | 1.4 | 0.05 |
| 2400 | 0.600 | 276 | 2.137 | 1.873 | 1.5 | 0.06 |

| * SURFACING QUANTITIES PER LINEAR FOOT FOR DEPTH "D" | | | | | |
|---|---|---|---|---|---|
| | FULL DEPTH GRAVEL | 0.20' PMS AND REMAINING DEPTH GRAVEL | | | |
| | C.Y. SURF. | TONS SURF. | C.Y. SURF. | TONS BIT. MATERIAL | |
| DIAMETER | CR. TOP SURF. | PLANT MIX | CR. TOP SURF. | PLANT MIX | PRIME |
| 84" | 0.045 | 0.046 | 0.021 | 0.0028 | 0.0004 |
| 90" | 0.085 | 0.060 | 0.054 | 0.0036 | 0.0006 |
| 96" | 0.102 | 0.066 | 0.068 | 0.0040 | 0.0006 |

NOTES:

① UNLESS OTHERWISE SPECIFIED, INSTALL STOCKPASSES WITH CUTOFF WALLS AND BACKFILL RETAINERS AT EACH END, GRAVEL FILL AND GRANULAR BEDDING.

② WHEN COMBINATION STOCKPASSES AND DRAINS ARE SPECIFIED, INSTALL WITH CUTOFF WALLS, BACKFILL RETAINERS AT BOTH ENDS, CONCRETE EDGE PROTECTION AT THE INLET END AND OUTLET END, GRANULAR BEDDING AND ASPHALT SURFACING; CROSS SLOPE ASPHALT SURFACING TO ALLOW DRAINAGE COURSE ALONG ONE SIDE. (SEE DTL. DWG. NO. 613-14 AND 613-06.)

③ STEP BEVEL PIPE ENDS AT A 2:1 SLOPE.

④ THE MINIMUM THICKNESS FOR 84" [2100]DIAMETER AND 90" [2250]DIAMETER CORRUGATED STEEL PIPE STOCKPASS IS 0.079" [2.01]. THE MINIMUM THICKNESS FOR 96" [2400]DIAMETER CORRUGATED STEEL PIPE STOCKPASS IS 0.109" [2.77]. (SEE FILL HEIGHT TABLES FOR OTHER THAN THE MINIMUM REQUIREMENTS.)

⑤ SEE DTL. DWG. NO. 552-00, 603-30 AND 603-19.

| * METRIC SURFACING QUANTITIES PER METER FOR DEPTH "D" | | | | | |
|---|---|---|---|---|---|
| | FULL DEPTH GRAVEL | 60 mm PMS AND REMAINING DEPTH GRAVEL | | | |
| | $m^3$ SURF. | TONS SURF. | $m^3$ SURF. | TONS BIT. MATERIAL | |
| DIAMETER (mm) | CR. TOP SURF. | PLANT MIX | CR. TOP SURF. | PLANT MIX | PRIME |
| 2100 | 0.131 | 0.144 | 0.068 | 0.0086 | 0.0013 |
| 2250 | 0.253 | 0.188 | 0.171 | 0.0113 | 0.0018 |
| 2400 | 0.291 | 0.201 | 0.203 | 0.0121 | 0.0020 |

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 603

DWG. NO. 603-36

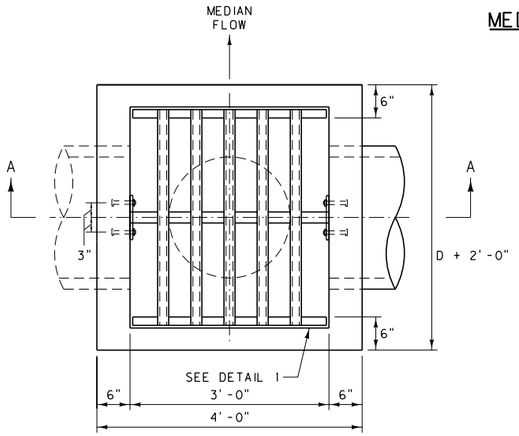
CORRUGATED STEEL PIPE STOCKPASS

--REVISED--
JANUARY 2018

EFFECTIVE: SEPTEMBER 2014

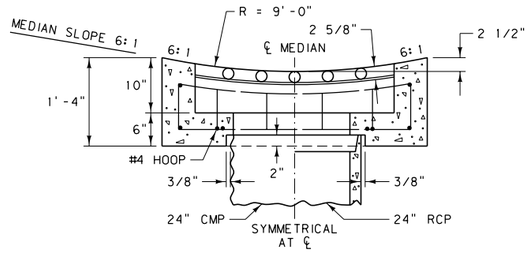
MDT MONTANA DEPARTMENT OF TRANSPORTATION

# MEDIAN INLET



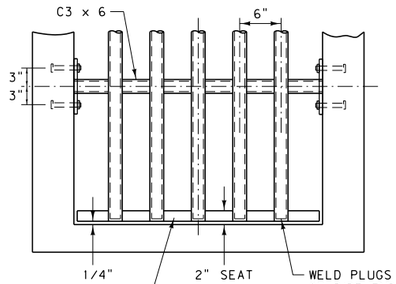

PLAN VIEW

TYPICAL FOR TYPES 1, 2 AND 3

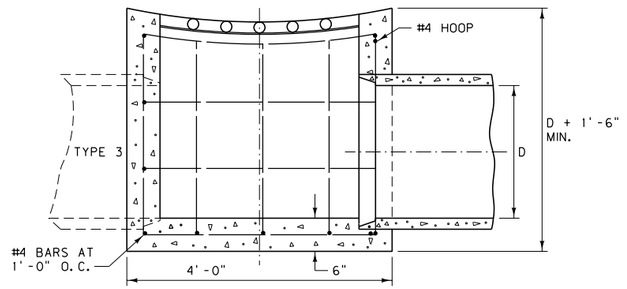



SECTION A-A

TYPE 1

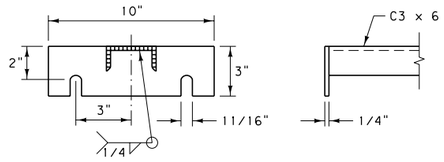



DETAIL 1

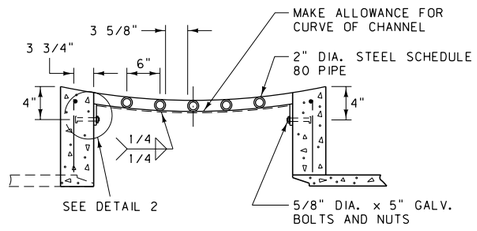



SECTION A-A

TYPE 2 HAS 1 PIPE CONNECTION
TYPE 3 HAS 2 PIPE CONNECTIONS




DETAIL 2




COVER DETAIL

TYPES 2 & 3

| GRATE AND REINFORCING STEEL (LB.) ✱ | | | |
|---|---|---|---|
| TYPE | CMP AND RCP | | |
| | 24" | 30" | 36" |
| 1 | 50 | ~ | ~ |
| 2 | 85 | 95 | 105 |
| 3 | 85 ⊛ | 95 ⊛ | 105 ⊛ |
| GRATE | 165 | 185 | 210 |

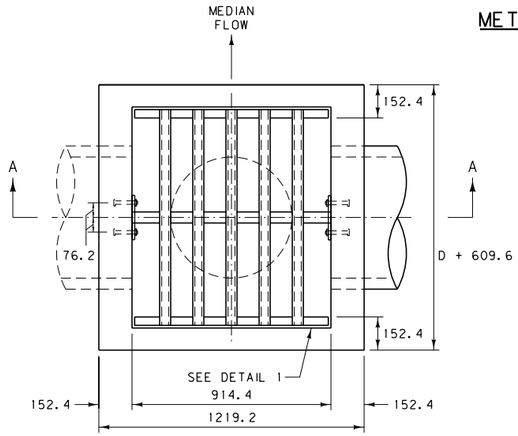
| CLASS GENERAL CONCRETE OR EQUAL (C.Y.) ✱ | | | | | | |
|---|---|---|---|---|---|---|
| TYPE | 24" | | 30" | | 36" | |
| | CMP | RCP | CMP | RCP | CMP | RCP |
| 1 | 0.4 | 0.4 | ~ | ~ | ~ | ~ |
| 2 | 1.0 | 1.0 | 1.1 | 1.0 | 1.2 | 1.1 |
| 3 | 0.9 ⊛ | 0.9 ⊛ | 1.0 ⊛ | 0.9 ⊛ | 1.0 ⊛ | 0.9 ⊛ |

✱ QUANTITIES ARE FOR ESTIMATING PURPOSES ONLY.
⊛ TYPE 3 IS A SPECIAL CASE TO BE FIGURED FOR THE PARTICULAR INSTALLATION.

NOTE:
① PAINT ALL EXPOSED METAL PARTS WITH ONE COAT OF ZINC RICH PAINT AND TWO COATS OF ALUMINUM PAINT PER SECTION 710.

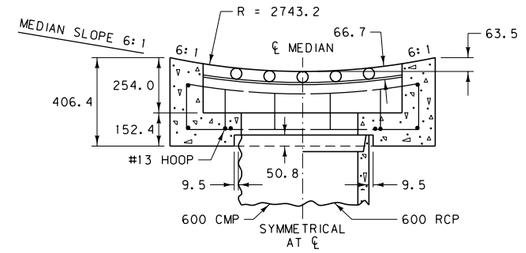
② WHEN MEDIAN INLET COVER IS INSTALLED OVER PIPES LARGER THAN 36", WITHOUT ADEQUATE COVER TO PERMIT THE USE OF TYPE 1 INSTALLATION, PROVIDE A DETAIL OF THE INSTALLATION IN THE PLANS.

# METRIC MEDIAN INLET



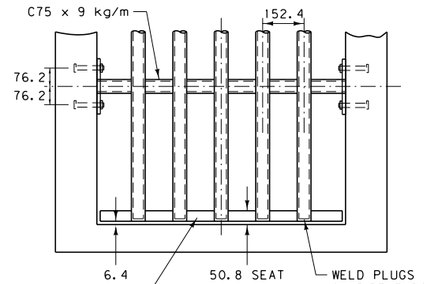

PLAN VIEW

TYPICAL FOR TYPES 1, 2 AND 3

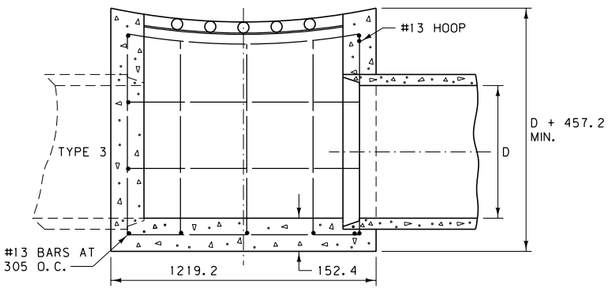



SECTION A-A

TYPE 1

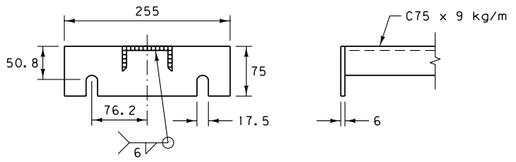



DETAIL 1

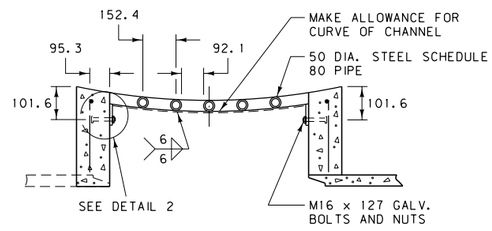



SECTION A-A

TYPE 2 HAS 1 PIPE CONNECTION
TYPE 3 HAS 2 PIPE CONNECTIONS




DETAIL 2




COVER DETAIL

TYPES 2 & 3

| GRATE AND REINFORCING STEEL (kg) ✱ | | | |
|---|---|---|---|
| TYPE | CMP AND RCP | | |
| | 600 mm | 750 mm | 900 mm |
| 1 | 22.7 | ~ | ~ |
| 2 | 38.6 | 43.1 | 47.6 |
| 3 | 38.6 ⊛ | 43.1 ⊛ | 47.6 ⊛ |
| GRATE | 74.8 | 83.9 | 95.3 |

| CLASS GENERAL CONCRETE OR EQUAL (CUBIC METERS) ✱ | | | | | | |
|---|---|---|---|---|---|---|
| TYPE | 600 mm | | 750 mm | | 900 mm | |
| | CMP | RCP | CMP | RCP | CMP | RCP |
| 1 | 0.31 | 0.31 | ~ | ~ | ~ | ~ |
| 2 | 0.76 | 0.76 | 0.84 | 0.76 | 0.92 | 0.84 |
| 3 | 0.69 ⊛ | 0.69 ⊛ | 0.76 ⊛ | 0.69 ⊛ | 0.76 ⊛ | 0.69 ⊛ |

✱ QUANTITIES ARE FOR ESTIMATING PURPOSES ONLY.
⊛ TYPE 3 IS A SPECIAL CASE TO BE FIGURED FOR THE PARTICULAR INSTALLATION.

NOTE:
① PAINT ALL EXPOSED METAL PARTS WITH ONE COAT OF ZINC RICH PAINT AND TWO COATS OF ALUMINUM PAINT PER SECTION 710.

② WHEN MEDIAN INLET COVER IS INSTALLED OVER PIPES LARGER THAN 900 mm, WITHOUT ADEQUATE COVER TO PERMIT THE USE OF TYPE 1 INSTALLATION, PROVIDE A DETAIL OF THE INSTALLATION IN THE PLANS.

*ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 604, 710

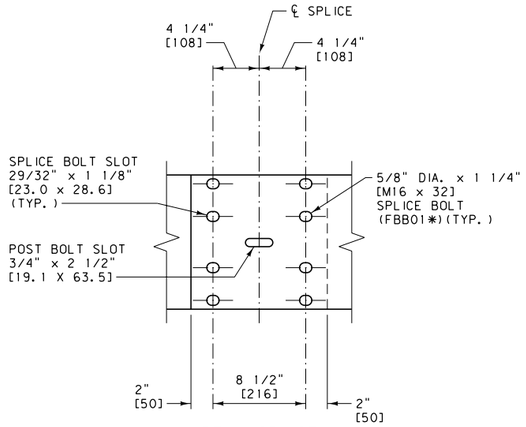
DWG. NO. 604-00

MEDIAN INLET

--REVISED--
JANUARY 2018

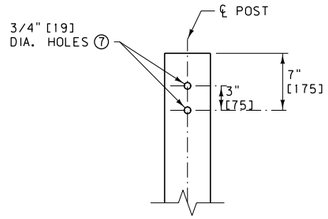
EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

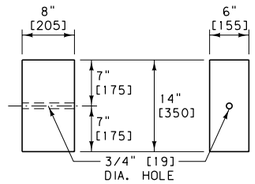



BEAM SPLICE

(LAP IN DIRECTION OF ADJACENT TRAFFIC)

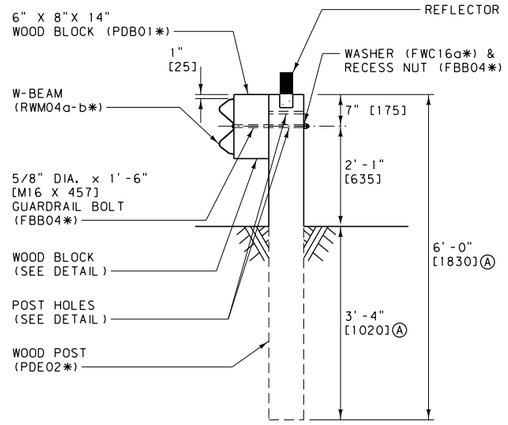



POST HOLE DETAIL



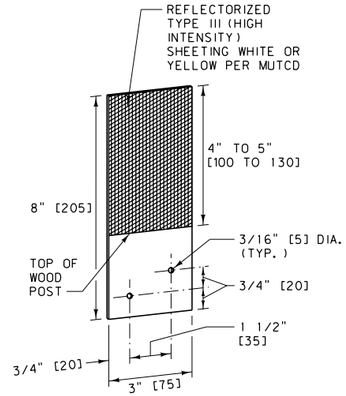

WOOD BLOCK

PDB01*



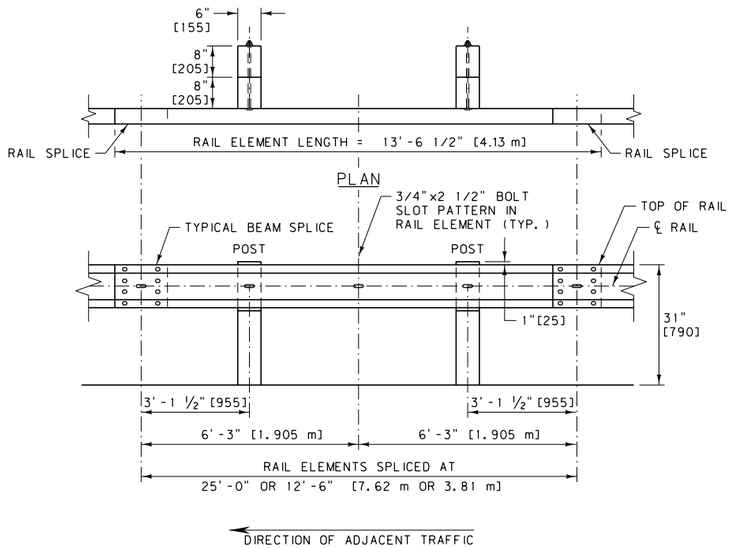

WOOD POST AND MOUNTING DETAIL

Ⓐ STANDARD UNLESS SPECIFIED OTHERWISE IN PLANS.

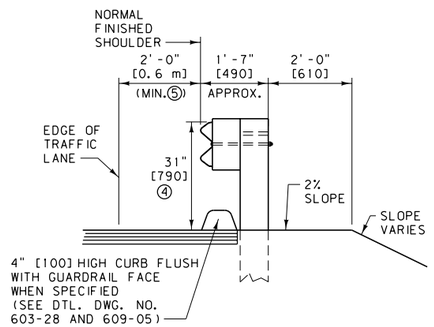



REFLECTOR

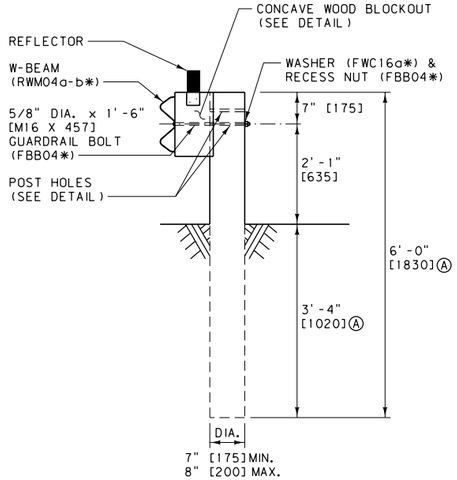
(SEE NOTE 3)




ELEVATION

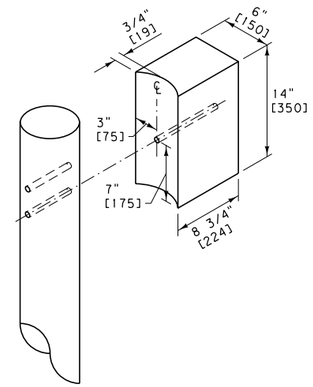



TYPICAL INSTALLATION




OPTIONAL ROUND WOOD POST MOUNTING DETAIL

Ⓐ STANDARD UNLESS SPECIFIED OTHERWISE IN PLANS.




CONCAVE WOOD BLOCKOUT FOR USE WITH ROUND POST

NOTES:

① INSTALL ALL BOLTS WITH HEADS ON TRAFFIC SIDE OF INSTALLATION.

② USE WOOD BLOCKS OR OTHER "MASH" APPROVED BLOCKS. AFFIX BLOCKS TO POSTS WITH TWO 16 PENNY GALV. NAILS OR 14 GAUGE WIRE WRAP.

③ ATTACH REFLECTORS TO POSTS EVERY 25 FEET [7.62 m], INCLUDING TERMINAL SECTIONS, WITH THE REFLECTORIZED SURFACE FACING ADJACENT TRAFFIC. FABRICATE REFLECTORS FROM 0.063" [1.6] THICK ALUMINUM ALLOY PER SECTION 704 OR PLASTIC REFLECTORS WITH A URETHANE HINGE. FASTEN REFLECTOR TO WOOD POST USING TWO 16 PENNY RING-SHANKED GALVANIZED NAILS AND TWO 3/16" [4.8] DIA. WASHERS IN PRE-DRILLED HOLES.

④ ON EXISTING GUARDRAIL INSTALLATIONS, THE MINIMUM RAIL HEIGHT IS 27 3/4" [705].

⑤ WIDENING IS REQUIRED IF FINISHED SHOULDER IS LESS THAN 2'-0" [0.6 m] FROM THE TRAFFIC LANE.

⑥ DO NOT INSTALL W-BEAM GUARDRAIL FOR OBSTACLES WITHIN 5.3' [1.6 m] OF THE FACE OF THE RAIL.

⑦ USE LOWER HOLE ON NEW CONSTRUCTION INSTALLATIONS.

⑧ USE 6' [1830] POSTS FOR STANDARD INSTALLATIONS.

* SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 606, 704

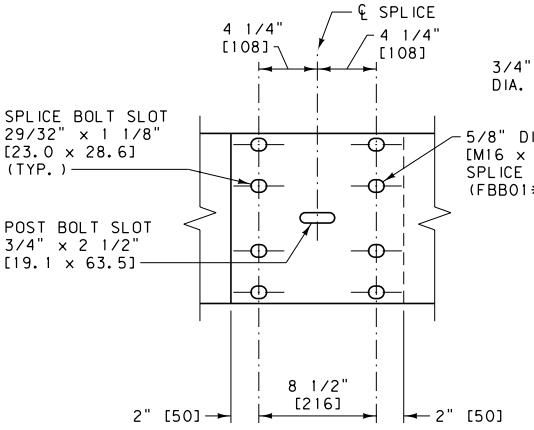
DWG. NO. 606-05A

# METAL GUARDRAIL - WOOD POSTS (MGS)

--REVISED--
JANUARY 2018

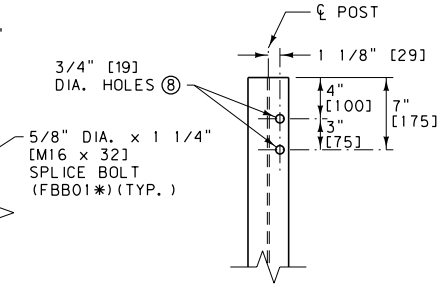
EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

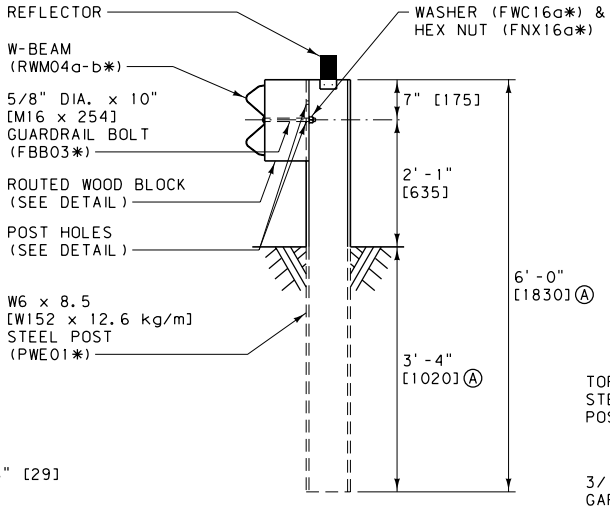



BEAM SPLICE

(LAP IN DIRECTION OF ADJACENT TRAFFIC)

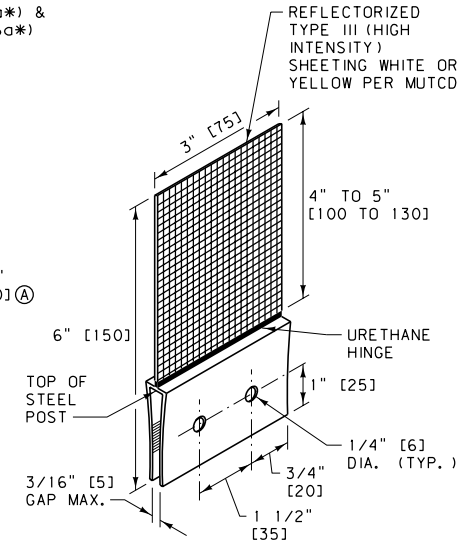



POST HOLE DETAIL



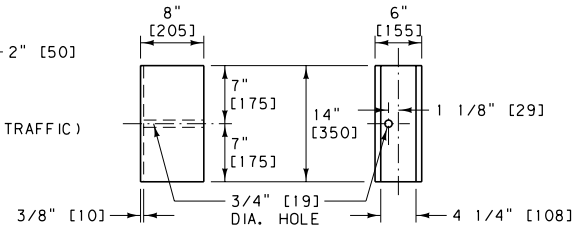

STEEL POST AND MOUNTING DETAIL

Ⓐ STANDARD UNLESS SPECIFIED OTHERWISE IN PLANS.



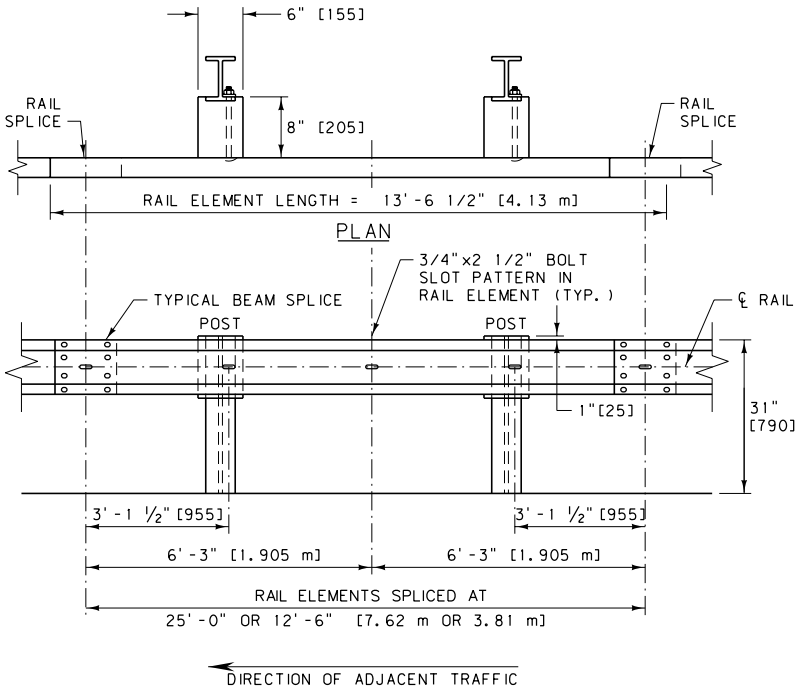

REFLECTOR

(SEE NOTE 3)




ROUTED WOOD BLOCK

PDB01*




ELEVATION

NOTES:

① INSTALL ALL BOLTS WITH HEADS ON TRAFFIC SIDE OF INSTALLATION.

② USE ROUTED WOOD BLOCKS OR OTHER "MASH" APPROVED BLOCKS.

③ ATTACH REFLECTORS TO POSTS EVERY 25 FEET [7.62 m], INCLUDING TERMINAL SECTIONS, WITH THE REFLECTORIZED SURFACE FACING ADJACENT TRAFFIC. FASTEN REFLECTOR TO STEEL POST USING AN APPROVED ADHESIVE. REFLECTORS MAY BE BOLTED TO POSTS PROVIDED HOLES IN POSTS ARE DRILLED BEFORE BEING GALVANIZED.

④ ON EXISTING GUARDRAIL INSTALLATIONS, THE MINIMUM RAIL HEIGHT IS 27 3/4" [705].

⑤ WIDENING IS REQUIRED IF FINISHED SHOULDER IS LESS THAN 2'-0" [0.6 m]FROM THE TRAFFIC LANE.

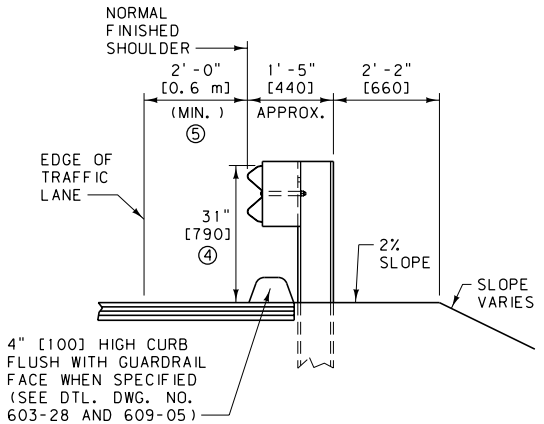
⑥ STEEL POSTS WITH OTHER POST HOLE CONFIGURATIONS MAY BE ACCEPTED, PROVIDED THEY HAVE AT LEAST THE HOLES DETAILED ON THIS DRAWING AND THEY MEET AASHTO'S PUBLICATION, "A GUIDE TO STANDARDIZED HIGHWAY BARRIER HARDWARE" AND "MASH" REQUIREMENTS.

⑦ DO NOT INSTALL W-BEAM GUARDRAIL FOR OBSTACLES WITHIN 5.3' [1.6 m]OF THE FACE OF THE RAIL.

⑧ USE LOWER HOLE ON NEW CONSTRUCTION INSTALLATIONS.

⑨ USE 6' [1830] POSTS FOR STANDARD INSTALLATIONS.

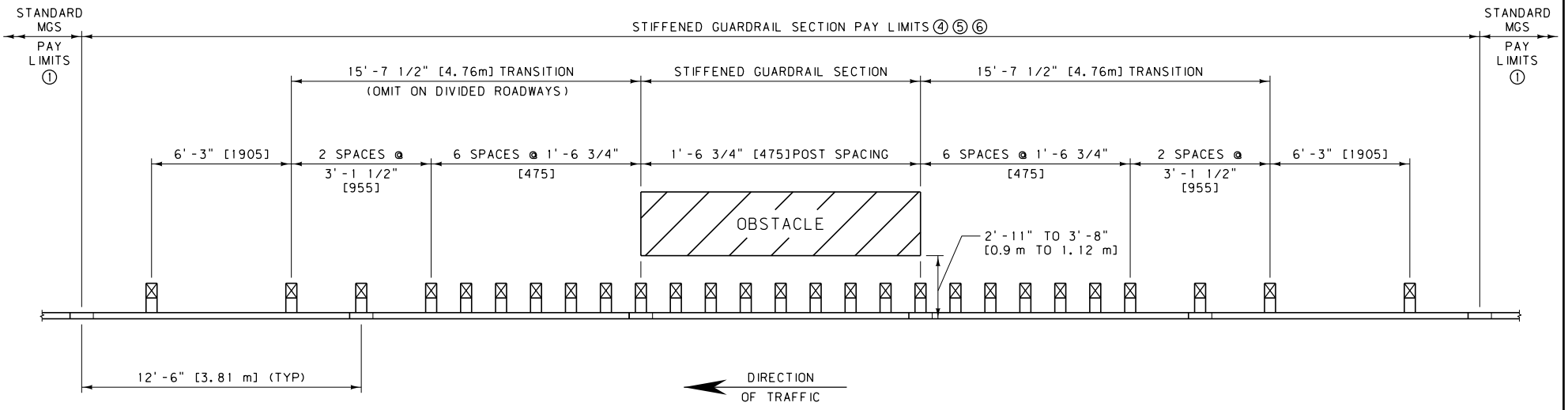
* SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.



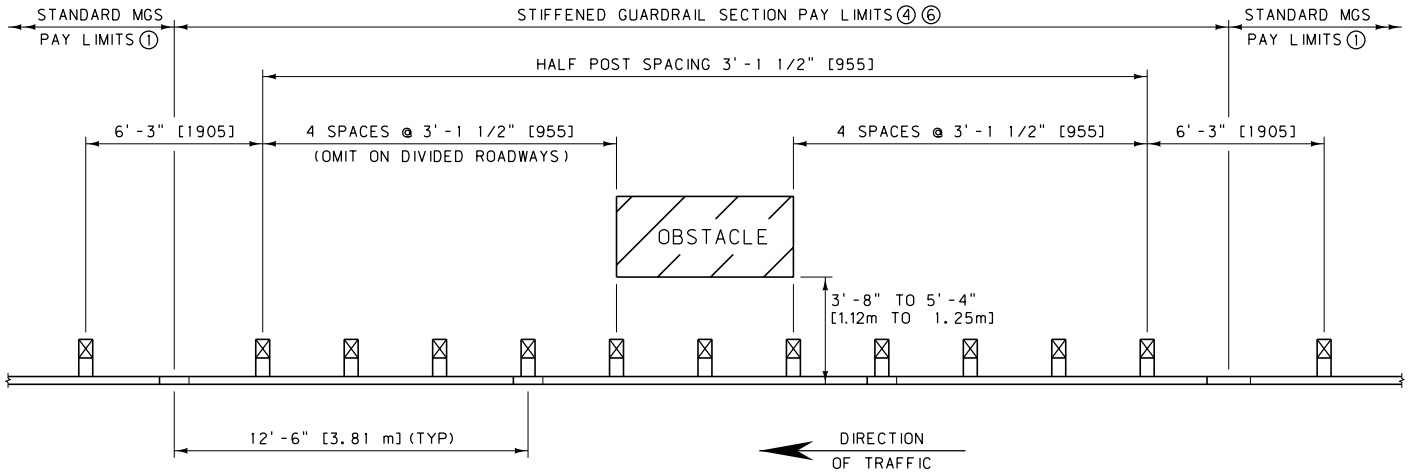

TYPICAL INSTALLATION

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

| DETAILED DRAWING | |
|---|---|
| REFERENCE STANDARD SPEC. SECTION 606 | DWG. NO. 606-05B |
| METAL GUARDRAIL - STEEL POSTS (MGS) | |
| --REVISED-- JANUARY 2018 | EFFECTIVE: SEPTEMBER 2014 |
| | MDT MONTANA DEPARTMENT OF TRANSPORTATION |




QUARTER POST SPACING




HALF POST SPACING

NOTES:

① SEE DTL. DWG. NO. 606-05A AND 606-05B FOR STANDARD MGS GUARDRAIL AND ASSOCIATED HARDWARE.

② OBSTACLES CLOSER TO THE FACE OF RAIL THAN THE INDICATED LIMITS REQUIRE THE USE OF A RIGID BARRIER SYSTEM WITH LITTLE TO NO DYNAMIC DEFLECTION.

③ LAP ALL RAIL IN THE DIRECTION OF ADJACENT TRAFFIC.

④ ALL POSTS AND BLOCKS ARE STANDARD DIMENSIONS AS PER DETAILED DRAWING NO. 606-05A AND 606-05B.

⑤ RAIL IS RWM08a-b*.

⑥ PAY LIMIT DEFINED BY RAILS CONTAINING A SECTION OF REDUCED POST SPACING. LIMITS SHOWN ARE FOR EXAMPLE ONLY. ACTUAL PAY LIMITS WILL DIFFER DEPENDING UPON SPLICE LOCATIONS.

* SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

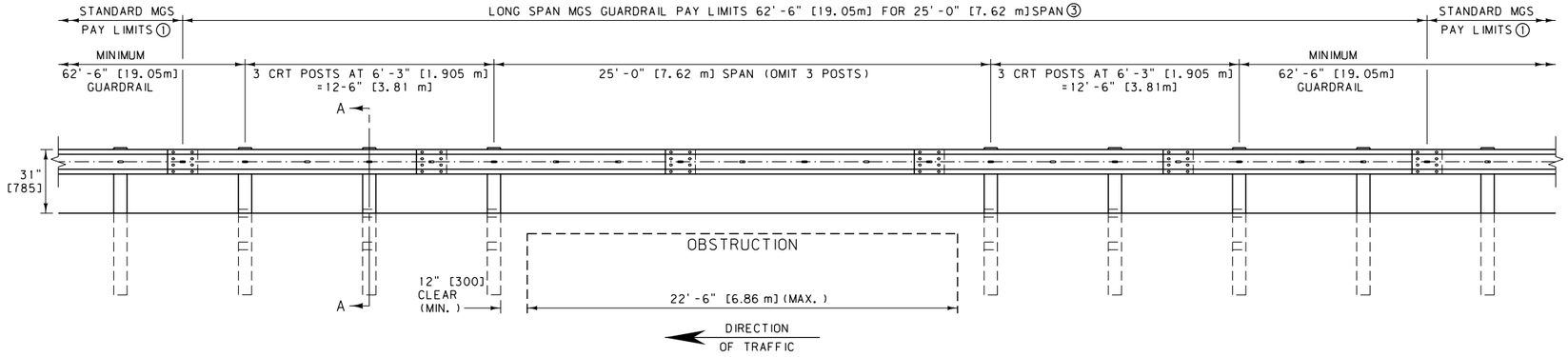
DETAILED DRAWING

| REFERENCE STANDARD SPEC. SECTION 606 | DWG. NO. 606-07 |
|---|---|

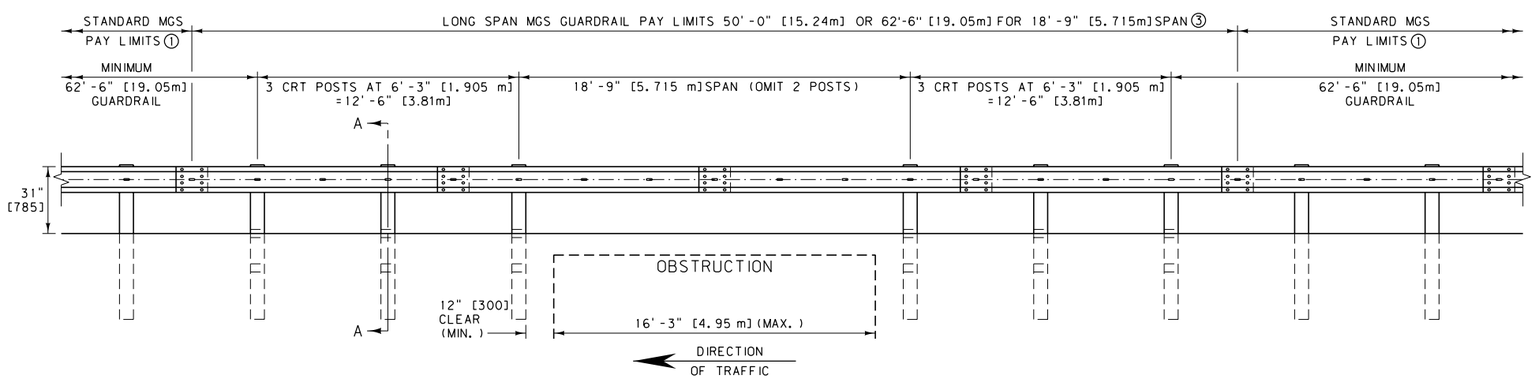
STIFFENED GUARDRAIL SECTIONS (MGS)

| --REVISED-- JANUARY 2018 | EFFECTIVE: SEPTEMBER 2014 |
|---|---|

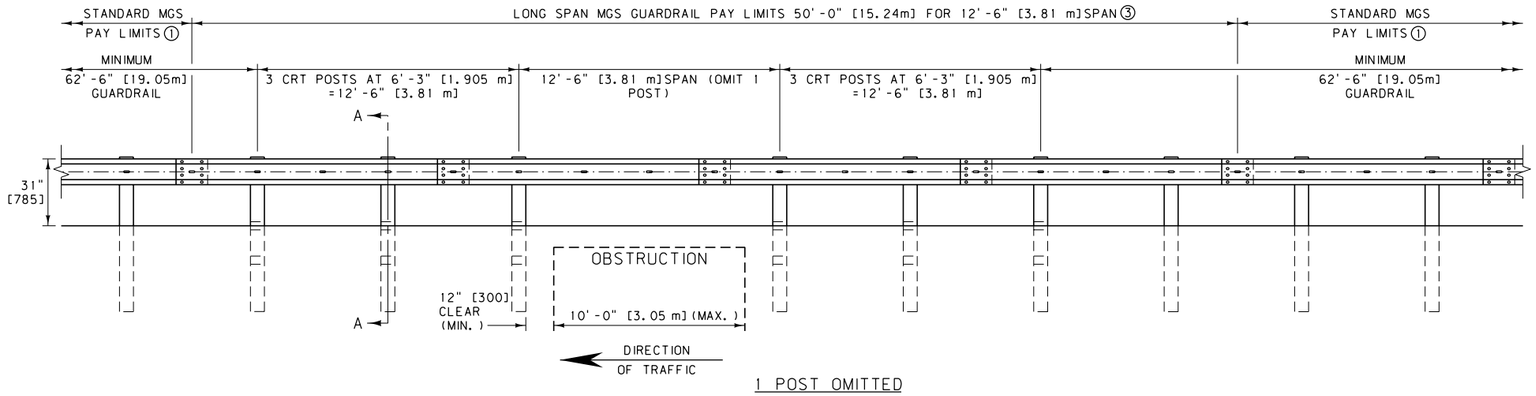
MDT MONTANA DEPARTMENT OF TRANSPORTATION



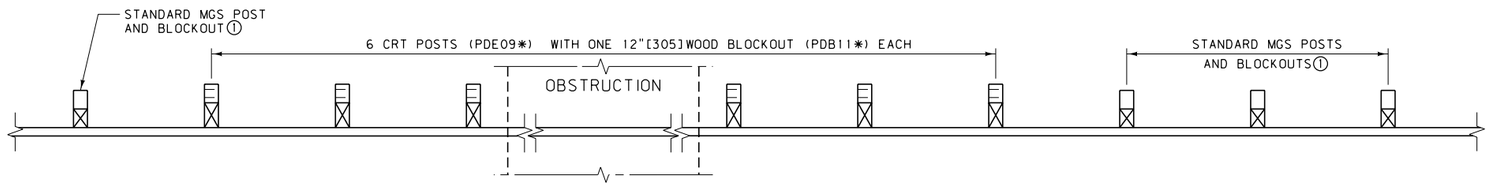

3 POSTS OMITTED



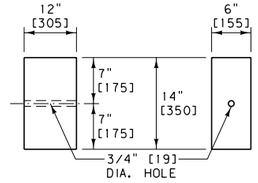

2 POSTS OMITTED




1 POST OMITTED

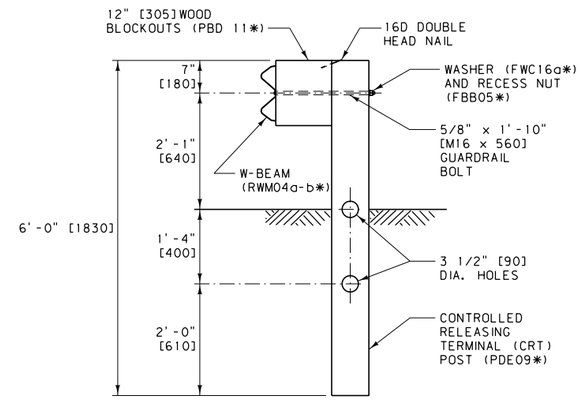



PLAN VIEW




12" WOOD BLOCK

PDB11✱




SECTION A-A

NOTES:

① SEE DTL. DWG. NO. 606-05A AND 606-05B FOR STANDARD MGS GUARDRAIL AND ASSOCIATED HARDWARE.

② LAP ALL RAIL IN THE DIRECTION OF ADJACENT TRAFFIC.

③ TYPICAL SPLICE LOCATIONS SHOWN, MAY VARY BASED ON ACTUAL RAIL SEGMENTS INSTALLED. PAY LIMITS NOT DEPENDENT ON SPLICE LOCATION.

④ DO NOT INSTALL MGS LONG SPAN GUARDRAIL FOR ABOVE-GRADE OBSTACLES WITHIN 8' [2.4m] OF THE FACE OF THE RAIL.

✱ SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 606

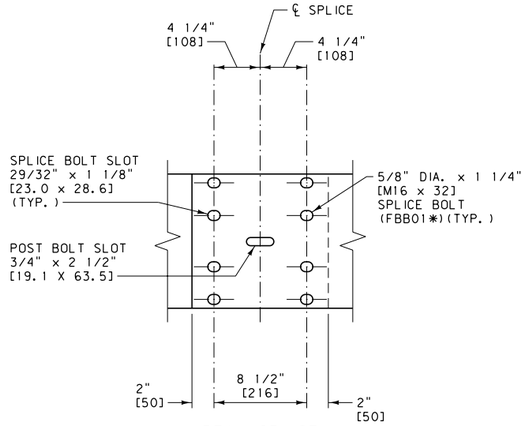
DWG. NO. 606-09

# LONG SPAN GUARDRAIL (MGS)

EFFECTIVE: SEPTEMBER 2014

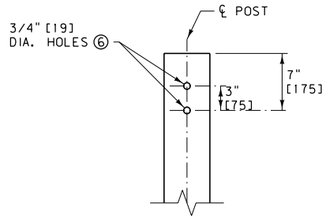
--REVISED--
JANUARY 2018

MDT MONTANA DEPARTMENT OF TRANSPORTATION

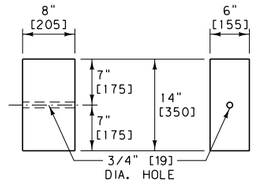



BEAM SPLICE

(LAP IN DIRECTION OF ADJACENT TRAFFIC)

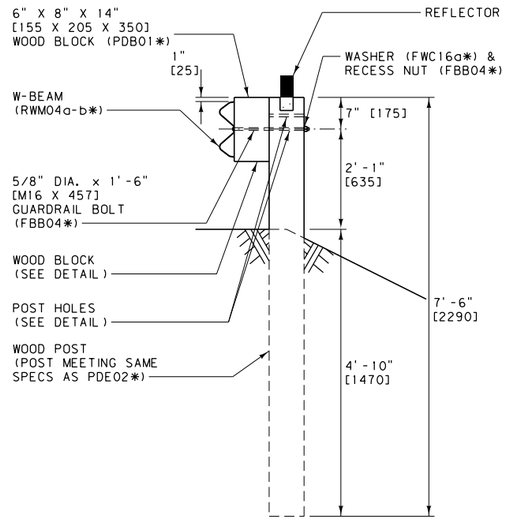



POST HOLE DETAIL

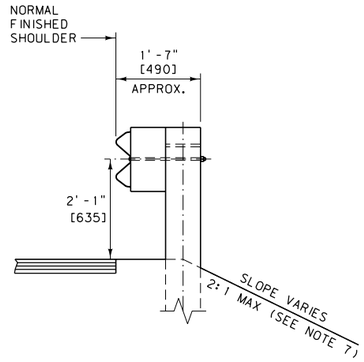



WOOD BLOCK

PDB01*

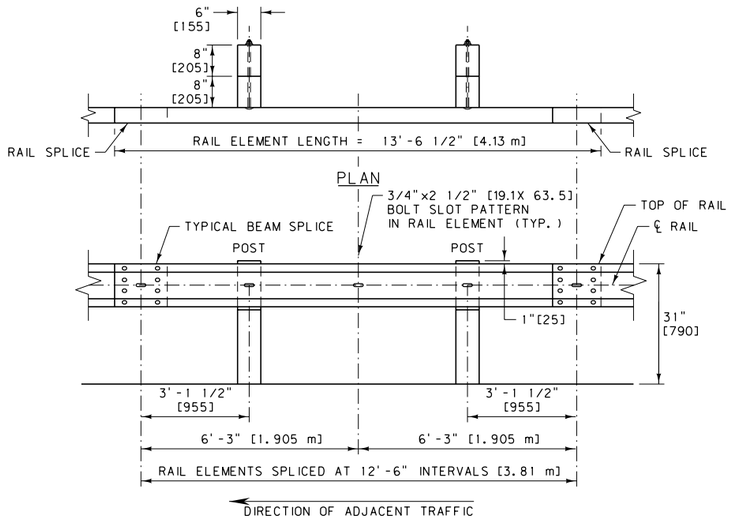



WOOD POST AND MOUNTING DETAIL




NOTE:
THIS GUARDRAIL SYSTEM IS USED WHEN THE 2'-0" [610] WIDENING BEHIND THE POSTS CANNOT BE PROVIDED, AS PER DTL. DWG. NO. 606-05A & 606-05B.

PROFILE




ELEVATION

NOTES:

① INSTALL ALL BOLTS WITH HEADS ON TRAFFIC SIDE OF INSTALLATION.

② USE WOOD BLOCKS OR OTHER "MASH" APPROVED BLOCKS. AFFIX BLOCKS TO POSTS WITH TWO 16 PENNY GALV. NAILS OR 14 GAUGE WIRE WRAP.

③ ATTACH REFLECTORS TO POSTS EVERY 25' [7.62 m], INCLUDING TERMINAL SECTIONS, WITH THE REFLECTORIZED SURFACE FACING ADJACENT TRAFFIC. FABRICATE REFLECTORS FROM 0.063" [1.6] THICK ALUMINUM ALLOY PER SECTION 704 OR PLASTIC REFLECTORS WITH A URETHANE HINGE. FASTEN REFLECTOR TO WOOD POST USING TWO 16 PENNY RING-SHANKED GALVANIZED NAILS AND TWO 3/16" [4.8] DIA. WASHERS IN PRE-DRILLED HOLES.

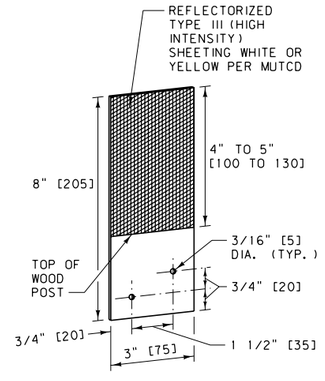
④ ON EXISTING GUARDRAIL INSTALLATIONS, THE MINIMUM RAIL HEIGHT IS 27 3/4" [705].

⑤ DO NOT INSTALL LONG POST W-BEAM GUARDRAIL FOR OBSTACLES WITHIN 5'-6" [1.65 m] OF THE FACE OF THE RAIL.

⑥ USE LOWER HOLE ON NEW CONSTRUCTION INSTALLATIONS.

⑦ BEGIN INSLOPE BREAK AT CENTER OF POST.

* SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.




REFLECTOR

(SEE NOTE 3)

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 606, 704

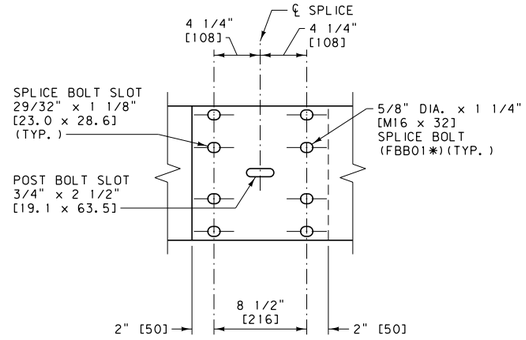
DWG. NO. 606-11A

METAL GUARDRAIL - LONG POSTS - WOOD (MGS)

EFFECTIVE: SEPTEMBER 2014

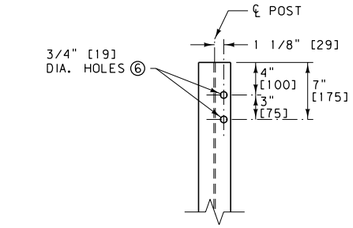
--REVISED--
JANUARY 2018

MDT MONTANA DEPARTMENT OF TRANSPORTATION

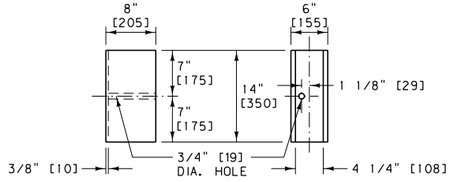



BEAM SPLICE

(LAP IN DIRECTION OF ADJACENT TRAFFIC)

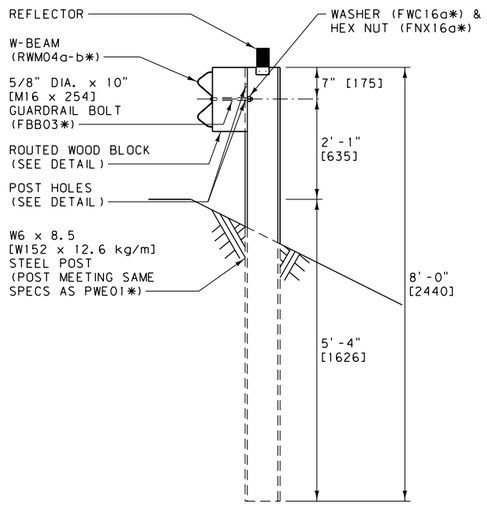



POST HOLE DETAIL

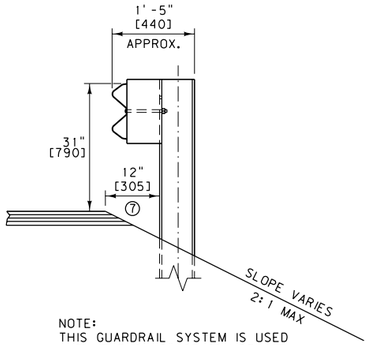



ROUTED WOOD BLOCK

PDB01*

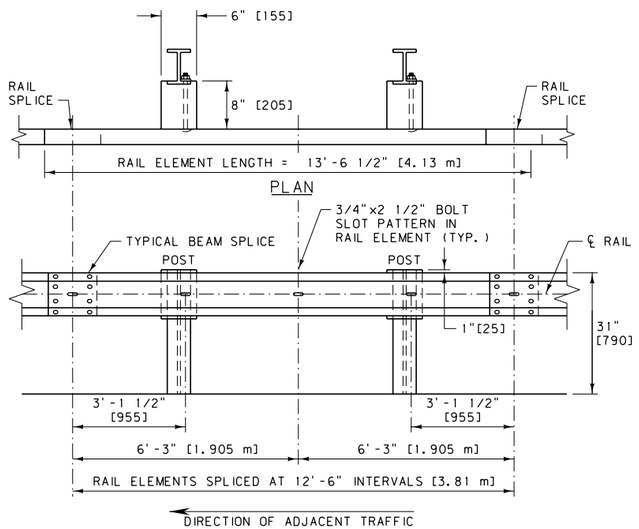



STEEL POST AND MOUNTING DETAIL




NOTE:
THIS GUARDRAIL SYSTEM IS USED WHEN THE 2'-0" [610] WIDENING BEHIND THE POSTS CANNOT BE PROVIDED, AS PER DTL. DWG. NO. 606-05A & 606-05B.

PROFILE




ELEVATION

NOTES:

① INSTALL ALL BOLTS WITH HEADS ON TRAFFIC SIDE OF INSTALLATION.

② USE ROUTED WOOD BLOCKS OR OTHER "MASH" APPROVED BLOCKS.

③ ATTACH REFLECTORS TO POSTS EVERY 25' [7.62 m], INCLUDING TERMINAL SECTIONS, WITH THE REFLECTORIZED SURFACE FACING ADJACENT TRAFFIC. FASTEN REFLECTOR TO STEEL POST USING AN APPROVED ADHESIVE. REFLECTORS MAY BE BOLTED TO POSTS PROVIDED HOLES IN POSTS ARE DRILLED BEFORE BEING GALVANIZED.

④ ON EXISTING GUARDRAIL INSTALLATIONS, THE MINIMUM RAIL HEIGHT IS 27 3/4" [705].

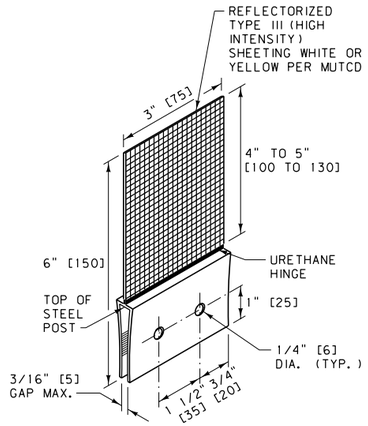
⑤ DO NOT INSTALL LONG POST W-BEAM GUARDRAIL FOR OBSTACLES WITHIN 5'-6" [1.65 m] OF THE FACE OF THE RAIL.

⑥ USE LOWER HOLE ON NEW CONSTRUCTION INSTALLATIONS.

⑦ LOCATE POST 12" [305] (MAXIMUM) FROM INSLOPE BREAK.

⑧ STEEL POSTS WITH OTHER POST HOLE CONFIGURATIONS MAY BE ACCEPTED, PROVIDED THEY HAVE AT LEAST THE HOLES DETAILED ON THIS DRAWING AND THEY MEET AASHTO'S PUBLICATION, "A GUIDE TO STANDARDIZED HIGHWAY BARRIER HARDWARE" AND "MASH" REQUIREMENTS.

* SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.




REFLECTOR

(SEE NOTE 3)

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

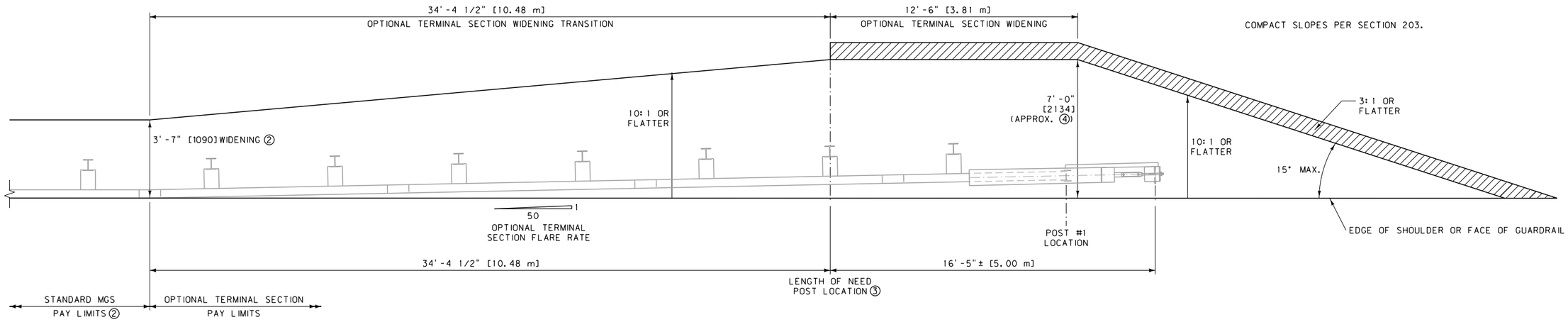
| DETAILED DRAWING | |
|---|---|
| REFERENCE STANDARD SPEC. SECTION 606 | DWG. NO. 606-11B |

METAL GUARDRAIL - LONG POSTS - STEEL (MGS)

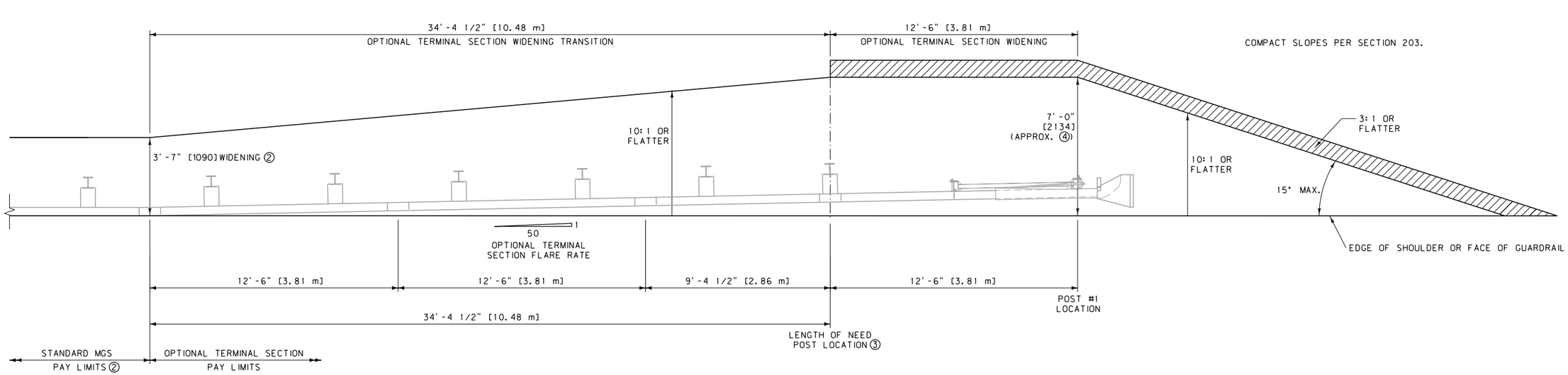
EFFECTIVE: SEPTEMBER 2014

--REVISED--
JANUARY 2018

MDT MONTANA DEPARTMENT OF TRANSPORTATION




TRINITY SOFTSTOP ①




ROAD SYSTEMS MSKT WITH 9'-4 1/2" RAIL PANEL ①

① OPTIONAL TERMINAL SECTION SYSTEMS VARY, REFER TO MANUFACTURER'S DETAIL AND ASSEMBLY INSTRUCTIONS.

② SEE DTL. DWG. NO. 606-05A AND 606-05B FOR MGS GUARDRAIL. SEE DTL. DWG. NO. 606-20 IF CONNECTING TO EXISTING RAIL THAT IS NOT WITHIN THE MANAFACTURER'S HEIGHT TOLERANCE.

③ LENGTH OF NEED POST LOCATION EQUALS STATION LIMITS INDICATED IN THE PLANS.

④ 7'-0" [2.13m] WIDENING DIMENSION ALLOWS FOR OPTIONAL TERMINAL SECTION FLARE AND SYSTEM WIDTH. A MINIMUM WIDENING DISTANCE OF 5'-0" [1.52m] IS REQUIRED BEHIND POST LOCATION #1.

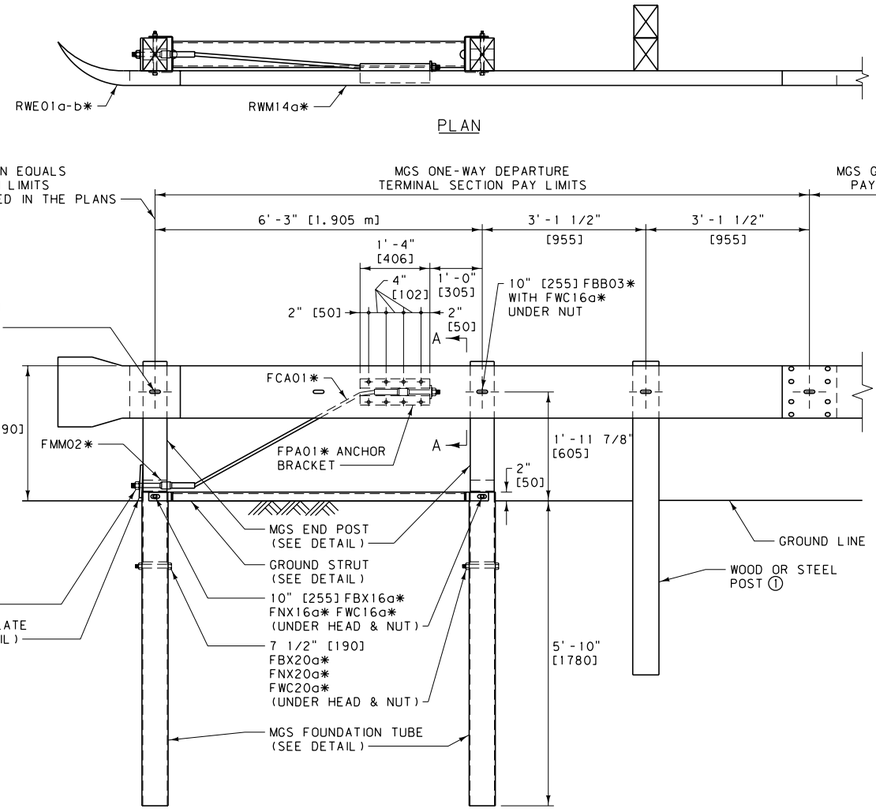
*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

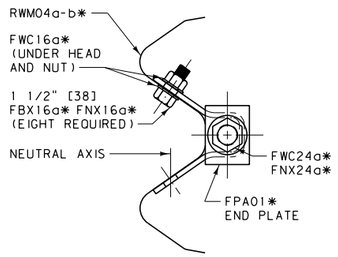
| DETAILED DRAWING | |
|---|---|
| REFERENCE<br>STANDARD SPEC.<br>SECTION 606, 203 | DWG. NO.<br>606-13 |

MASH OPTIONAL TERMINAL SECTIONS

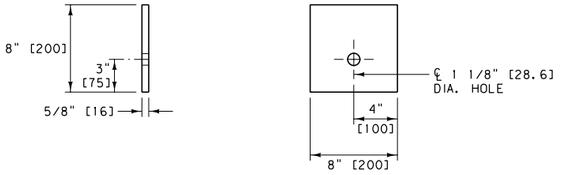
EFFECTIVE: JANUARY 2018

MDT MONTANA DEPARTMENT OF TRANSPORTATION



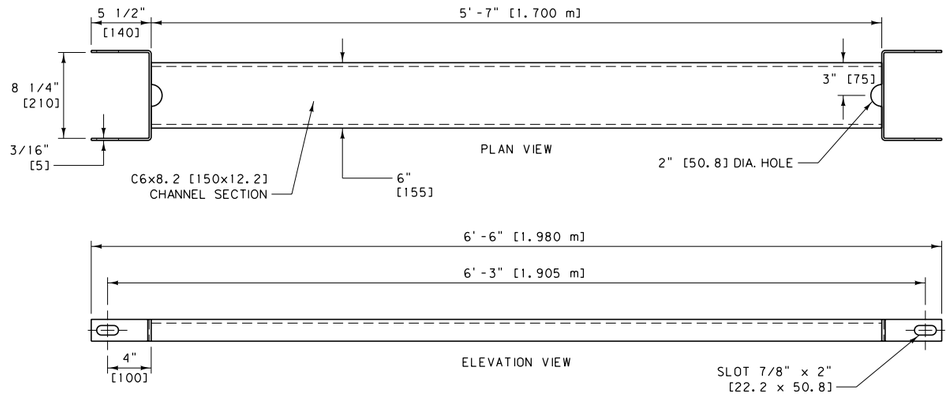




SECTION A-A



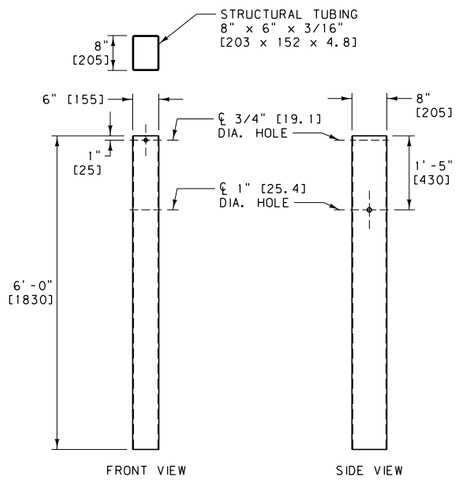

BEARING PLATE DETAIL

FPB01*



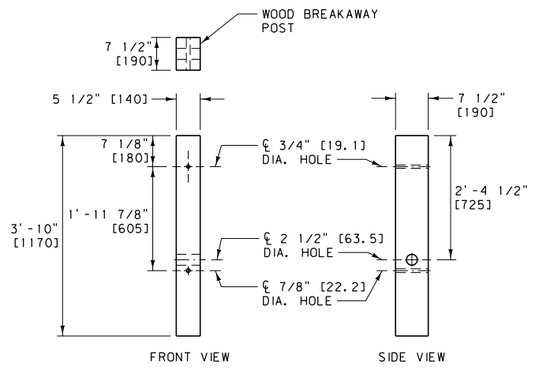

GROUND STRUT DETAIL

PFP01*




MGS FOUNDATION TUBE DETAILS

PTE06*




MGS END POST DETAILS

PDF01* - MGS HEIGHT

NOTE:

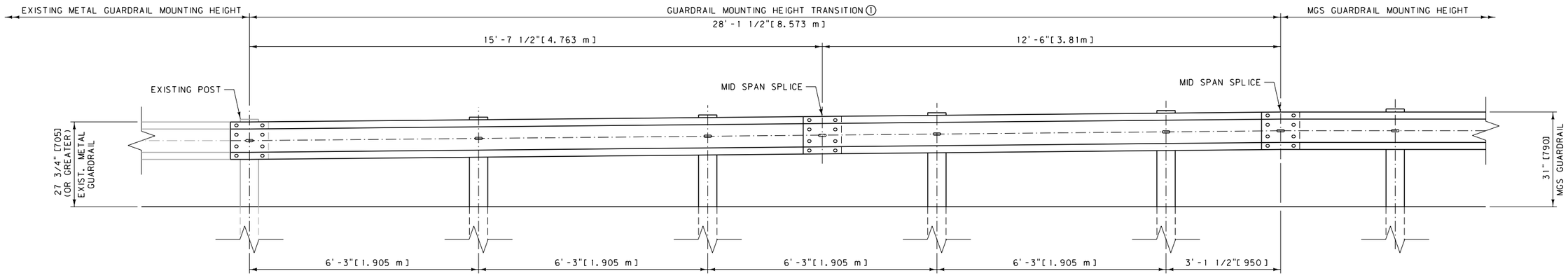
① SEE DTL. DWG. NO. 606-05A AND 606-05B FOR MGS GUARDRAIL.

* SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

| DETAILED DRAWING | |
|---|---|
| REFERENCE STANDARD SPEC. SECTION 606 | DWG. NO. 606-18 |
| ONE-WAY DEPARTURE TERMINAL SECTION (MGS) | |
| EFFECTIVE: SEPTEMBER 2014 | |
| --REVISED-- JANUARY 2018 | |

MONTANA DEPARTMENT OF TRANSPORTATION




TRANSITION FROM 27 3/4" [705] (OR GREATER) TO 31" [775] GUARDRAIL MOUNTING HEIGHT

NOTES:

① THE MGS TO METAL GUARDRAIL TRANSITION IS PAID FOR AS LINEAR FEET OF MGS GUARDRAIL.

② SEE DTL. DWG. NO. 606-05A, 606-05B, 606-11A, AND 606-11B FOR MGS GUARDRAIL AND ASSOCIATED HARDWARE.

③ LAP ALL W-BEAM RAIL IN THE DIRECTION OF ADJACENT TRAFFIC.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

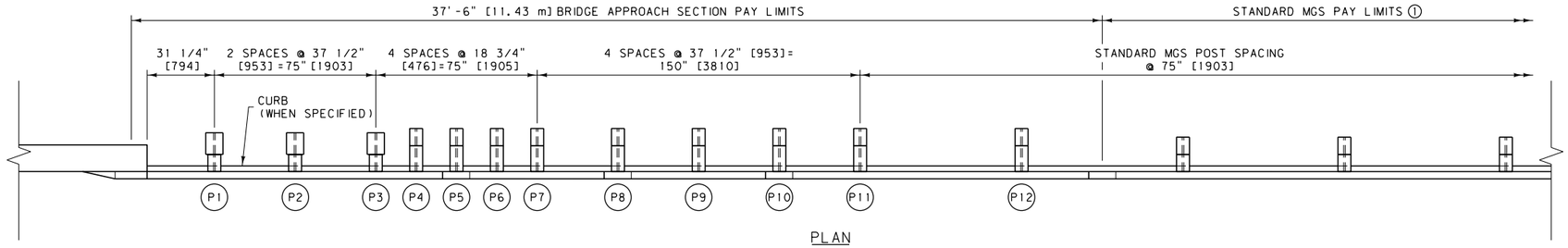
REFERENCE STANDARD SPEC. SECTION 606

DWG. NO. 606-20

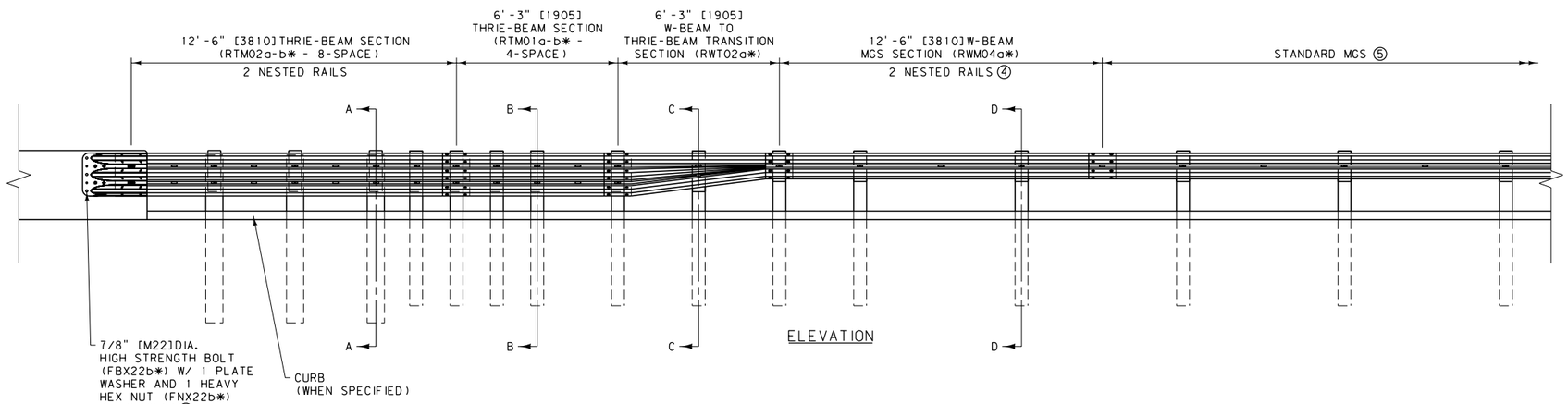
MGS TO METAL GUARDRAIL TRANSITION

EFFECTIVE: JANUARY 2018

MDT MONTANA DEPARTMENT OF TRANSPORTATION




PLAN




ELEVATION

NOTES:

① SEE DTL. DWG. NO. 606-05A FOR STANDARD MGS GUARDRAIL AND ASSOCIATED HARDWARE.

② LAP GUARDRAIL IN THE DIRECTION OF THE ADJACENT TRAFFIC LANE.

③ DO NOT FLARE BRIDGE APPROACH SECTIONS.

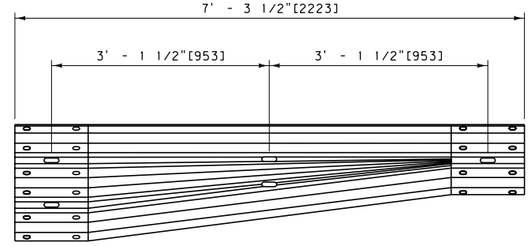
④ WHERE CURB EXTENDS UPSTREAM OF POST NO. 5, FURNISH 2 NESTED 12-GAUGE W-BEAM RAILS FOR THIS 12'-6" [3810] SECTION. INCLUDE THIS ADDITIONAL RAIL IN THE COST OF THE BRIDGE APPROACH SECTION.

⑤ A MINIMUM OF 12'-6" [3810] OF W-BEAM RAIL IS REQUIRED BEFORE END TREATMENT.

⑥ USE WOOD BLOCKS OR OTHER "MASH" APPROVED BLOCKS. AFFIX BLOCKS TO POSTS WITH TWO 16 PENNY GALV. NAILS OR 14 GAUGE WIRE WRAP.

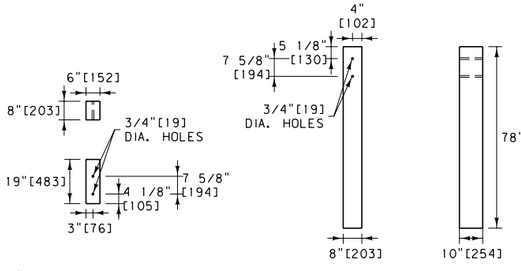
⑦ SEE BRIDGE PLANS FOR CONNECTION DETAILS AND BOLT LOCATIONS.

* SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.




W-BEAM TO THRIE-BEAM TRANSITION SECTION
RWT02a*
(RWT02b* FOR OPPOSITE DIRECTION)

POSTS P1 P2 P3

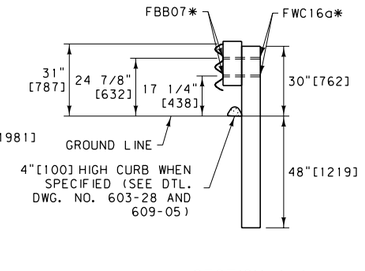



8"[203] BLOCKOUT



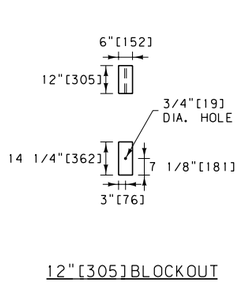

POST DETAIL



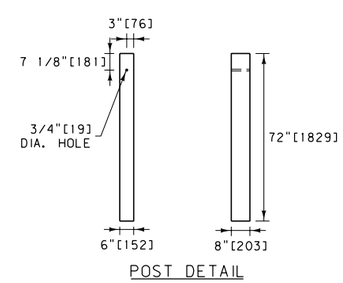




SECTION A-A

POSTS P10 P11 P12

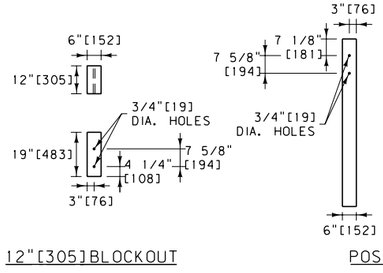



12"[305] BLOCKOUT




POST DETAIL

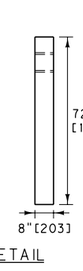
POSTS P4 P5 P6 P7 P8 P9

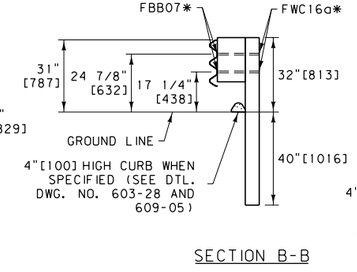



12"[305] BLOCKOUT

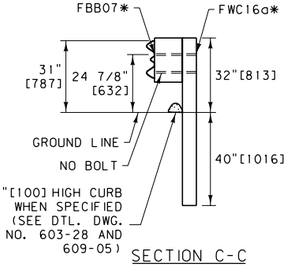



POST DETAIL

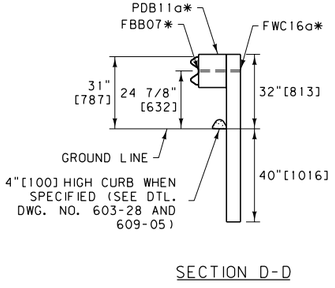


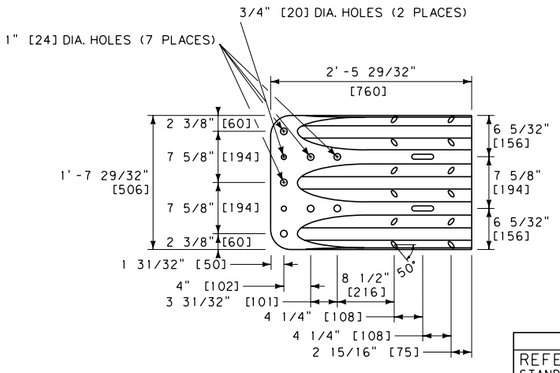

SECTION B-B




SECTION C-C




SECTION D-D




THRIE-BEAM TERMINAL CONNECTOR
RTE01b*

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

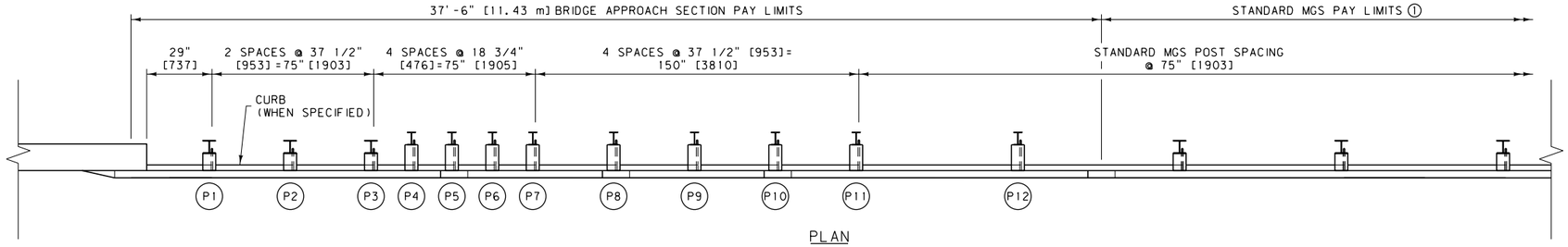
REFERENCE STANDARD SPEC. SECTION 606

DWG. NO. 606-23A

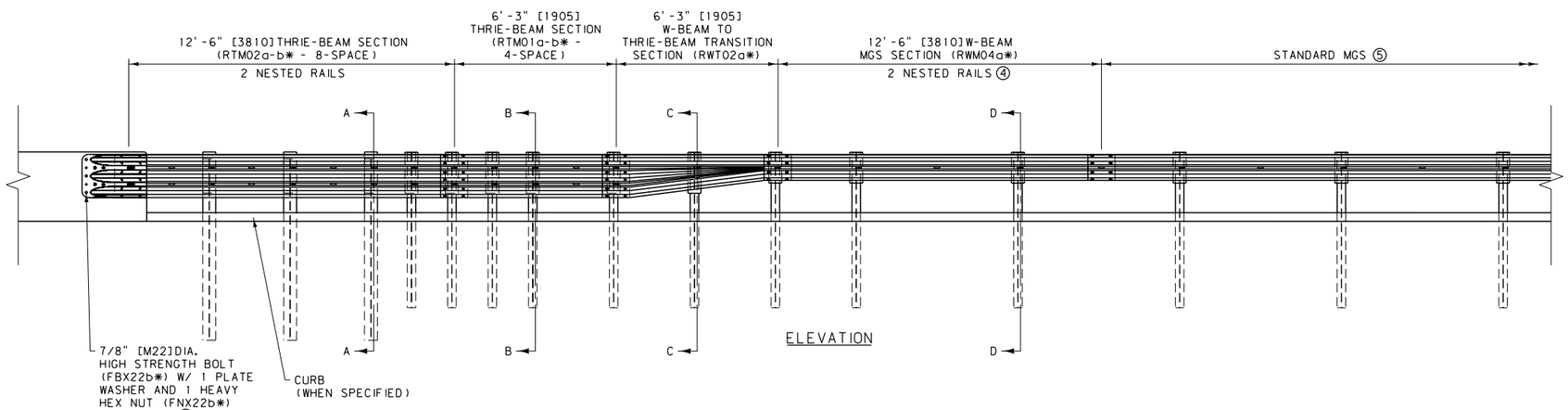
MGS THRIE BEAM BRIDGE APPROACH SECTION - WOOD POSTS

EFFECTIVE: JANUARY 2018

MDT MONTANA DEPARTMENT OF TRANSPORTATION




PLAN




ELEVATION

NOTES:

① SEE DTL. DWG. NO. 606-05A FOR STANDARD MGS GUARDRAIL AND ASSOCIATED HARDWARE.

② LAP GUARDRAIL IN THE DIRECTION OF THE ADJACENT TRAFFIC LANE.

③ DO NOT FLARE BRIDGE APPROACH SECTIONS.

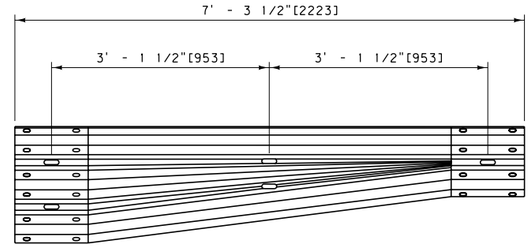
④ WHERE CURB EXTENDS UPSTREAM OF POST NO. 5, FURNISH 2 NESTED 12-GAUGE W-BEAM RAILS FOR THIS 12'-6" [3810] SECTION. INCLUDE THIS ADDITIONAL RAIL IN THE COST OF THE BRIDGE APPROACH SECTION.

⑤ A MINIMUM OF 12'-6" [3810] OF W-BEAM RAIL IS REQUIRED BEFORE END TREATMENT.

⑥ USE WOOD BLOCKS OR OTHER "MASH" APPROVED BLOCKS. AFFIX BLOCKS TO POSTS WITH TWO 16 PENNY GALV. NAILS OR 14 GAUGE WIRE WRAP.

⑦ SEE BRIDGE PLANS FOR CONNECTION DETAILS AND BOLT LOCATIONS.

* SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.

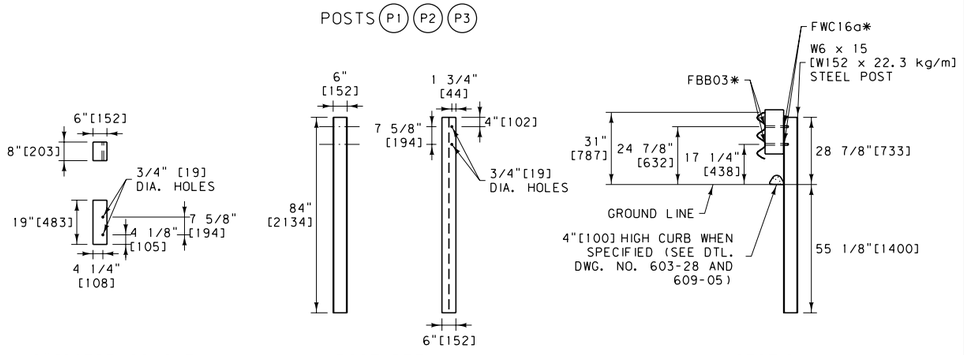



W-BEAM TO THRIE-BEAM TRANSITION SECTION

RWT02a*

(RWT02b* FOR OPPOSITE DIRECTION)

POSTS P1 P2 P3

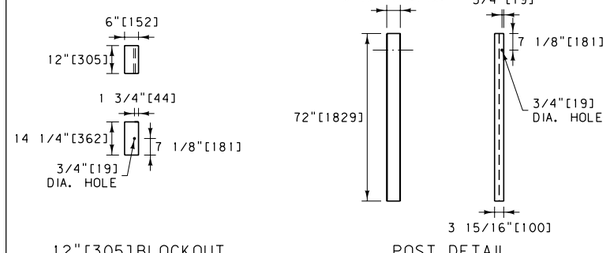



8" [203] BLOCKOUT

POST DETAIL

SECTION A-A

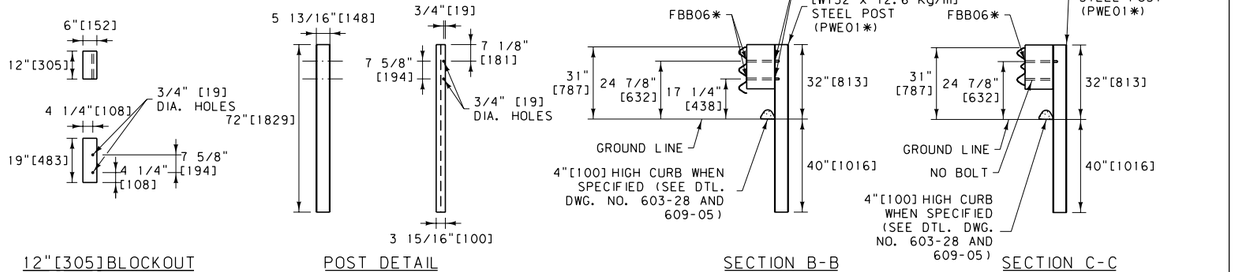
POSTS P10 P11 P12




12" [305] BLOCKOUT

POST DETAIL

POSTS P4 P5 P6 P7 P8 P9

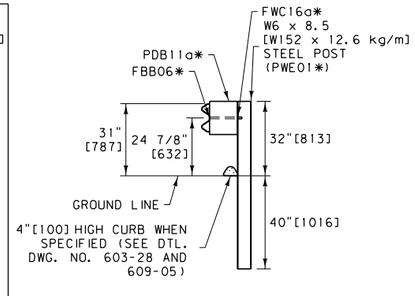



12" [305] BLOCKOUT

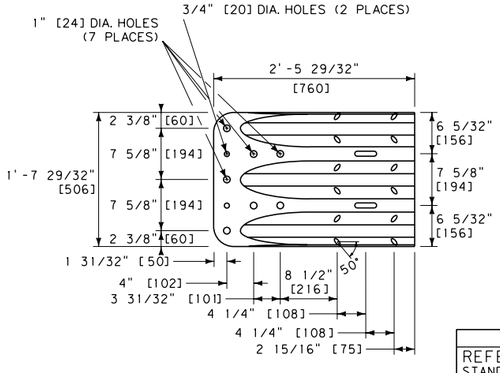
POST DETAIL

SECTION B-B

SECTION C-C




SECTION D-D




THRIE-BEAM TERMINAL CONNECTOR

RTE01b*

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

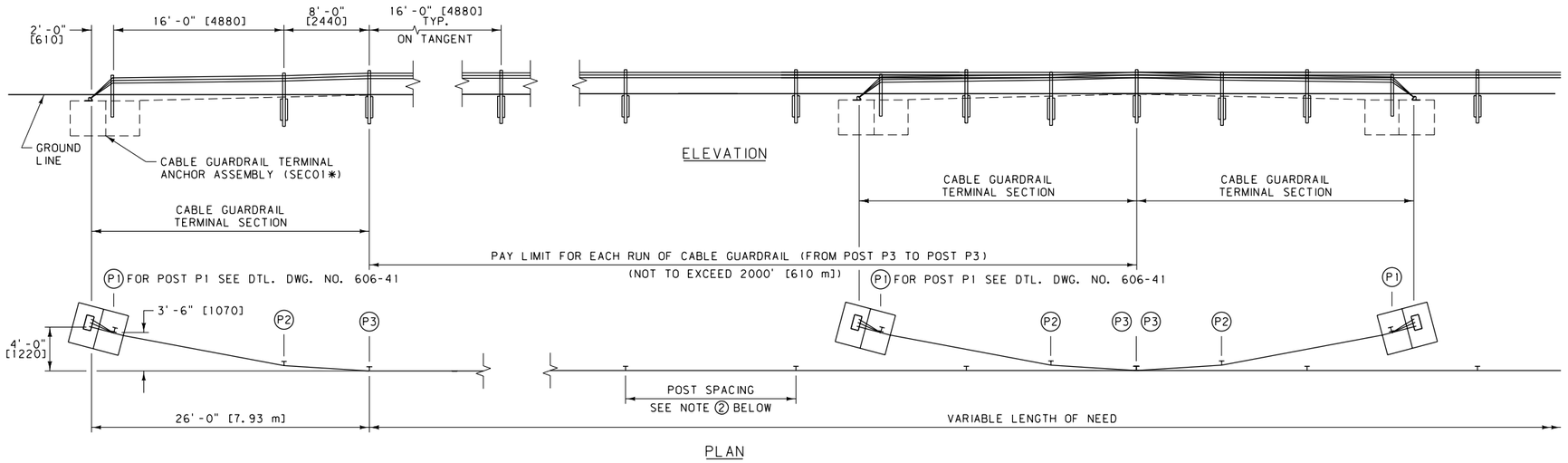
REFERENCE STANDARD SPEC. SECTION 606

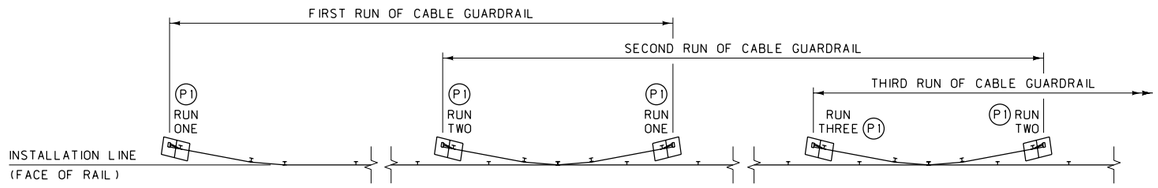
DWG. NO. 606-23B

MGS THRIE BEAM BRIDGE APPROACH SECTION - STEEL POSTS

EFFECTIVE: JANUARY 2018

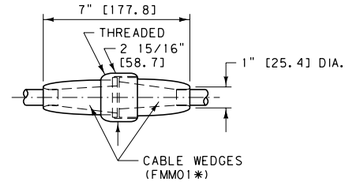
MDT MONTANA DEPARTMENT OF TRANSPORTATION



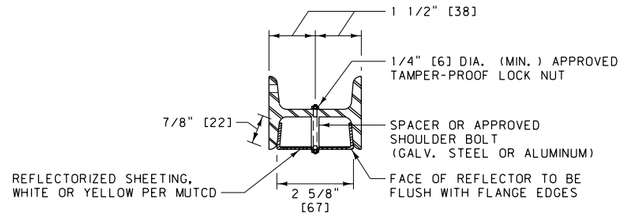

TYPICAL LAYOUT FOR MULTIPLE RUNS OF CABLE GUARDRAIL

EACH RUN OF CABLE GUARDRAIL CONTAINS TWO TERMINAL SECTIONS WITH ANCHOR ASSEMBLIES.

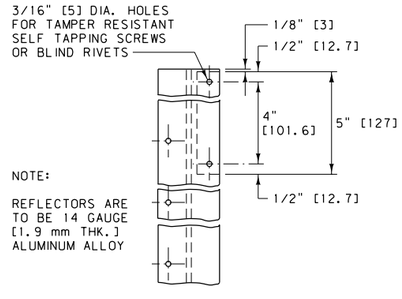



CABLE SPLICE

SPLICE CABLE USING A COUPLING DEVICE AS SHOWN, OR AN ALTERNATE METHOD APPROVED BY THE PROJECT MANAGER




REFLECTOR ALT. "B"




REFLECTOR ALT. "A"

NOTES:

(1) FOR CABLE GUARDRAIL RUNS OF:

1044 FT. [318.42 m] OR LESS: USE COMPENSATING CABLE END ASSEMBLY (RCE01*) ON ONE END AND TURNBUCKLE CABLE END ASSEMBLY * ON THE OTHER END OF EACH CABLE.

GREATER THAN 1044 FT. [318.42 m], UP TO 2052 FT. [625.86 m] MAXIMUM: USE COMPENSATING CABLE END ASSEMBLY (RCE01*) ON BOTH ENDS OF EACH CABLE.

(2) LINE POST SPACING:

TANGENTS AND CURVES WITH RADII 700 FT. [220 m] AND GREATER: 16 FT. [4880 mm].

CURVES WITH RADII LESS THAN 700 FT. [220 m] DOWN TO 440 FT. [135 m]: 12 FT. [3660 mm].

NOTE: DO NOT INSTALL CABLE GUARDRAIL ON THE INSIDE SHOULDER OF ANY CURVE.

(3) UNIFORMLY TENSION ALL CABLES TO COMPRESS SPRINGS BY 3 1/2" [90 mm].

(4) DO NOT INSTALL CABLE GUARDRAIL FOR OBSTACLES WITHIN 12 FT. [3.7 m] OF THE INSTALLATION LINE.

(5) DO NOT USE CABLE GUARDRAIL WITH FILL SLOPES STEEPER THAN 2:1, UNLESS THE DISTANCE BETWEEN THE BACK OF THE POSTS AND THE BREAK IN THE FILL SLOPE IS AT LEAST 8 FT. [2.5 m].

(6) ATTACH REFLECTORS TO EVERY OTHER LINE POST (32 FT. [9.76 m] TYP.), BEGINNING AT POST P3. DO NOT ATTACH REFLECTORS TO POSTS P1 AND P2.

(7) WIDENING IS REQUIRED IF FINISHED SHOULDER IS LESS THAN 2'-0" [0.6 m] FROM THE TRAFFIC LANE.

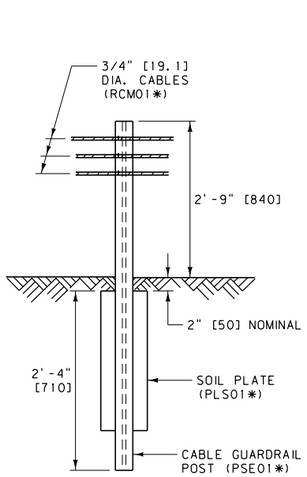
(8) GUIDANCE FOR TENSIONING CABLES USING THE TURNBUCKLES IS GIVEN IN CABLE TENSIONING TABLES.
CABLE TENSIONING - NCHRP 230 TESTS HR 22-4 (1986)
METRIC CABLE TENSIONING - NYDOT STD. M606-1R1 (1996)

* SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.

| CABLE TENSIONING | |
|---|---|
| TEMPERATURE (°F) | COMPR. # (INCHES) |
| 120 TO 110 | 1.00" |
| 109 TO 100 | 1.25" |
| 99 TO 90 | 1.50" |
| 89 TO 80 | 1.75" |
| 79 TO 70 | 2.00" |
| 69 TO 60 | 2.25" |
| 59 TO 50 | 2.50" |
| 49 TO 40 | 2.75" |
| 39 TO 30 | 3.00" |
| 29 TO 20 | 3.25" |
| 19 TO 10 | 3.50" |
| 9 TO 0 | 3.75" |
| -1 TO -10 | 4.00" |
| -11 TO -20 | 4.25" |

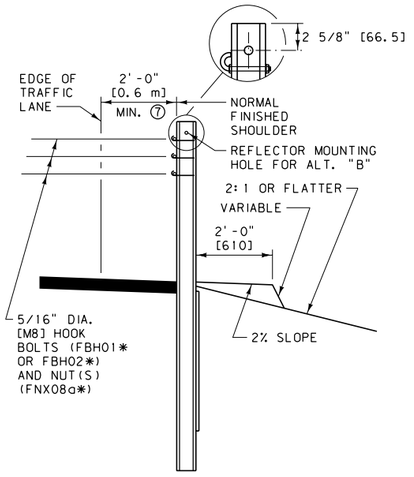
| METRIC CABLE TENSIONING | |
|---|---|
| TEMPERATURE (°C) | COMPR. # (mm) |
| 50 TO 43 | 25 |
| 42 TO 38 | 32 |
| 37 TO 32 | 38 |
| 31 TO 27 | 45 |
| 26 TO 21 | 50 |
| 20 TO 16 | 57 |
| 15 TO 10 | 64 |
| 9 TO 5 | 70 |
| 4 TO -1 | 75 |
| -2 TO -7 | 83 |
| -8 TO -12 | 89 |
| -13 TO -18 | 95 |
| -19 TO -23 | 100 |
| -24 TO -29 | 108 |

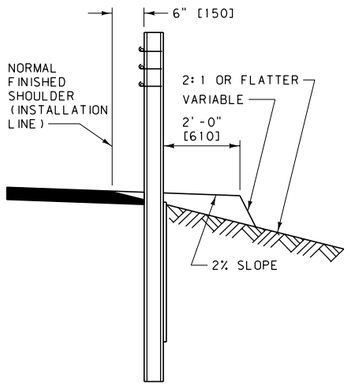
# - SPRING COMPRESSION FROM UNLOADED POSITION




TYPICAL INSTALLATION DETAIL

LINE POST & POST P3




TYPICAL INSTALLATION DETAIL

POST P2

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 606

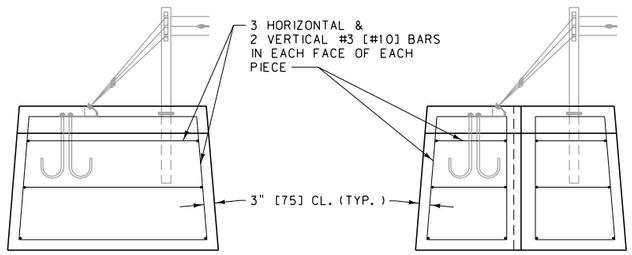
DWG. NO. 606-40

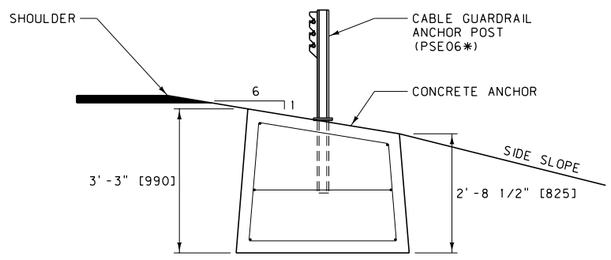
LOW-TENSION CABLE GUARDRAIL

EFFECTIVE: SEPTEMBER 2014

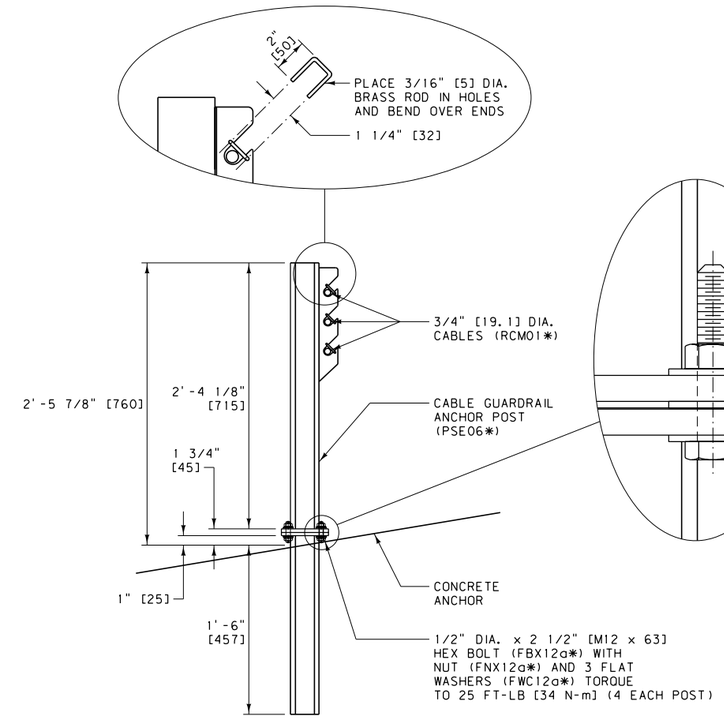
--REVISED--
JANUARY 2018

MDT MONTANA DEPARTMENT OF TRANSPORTATION

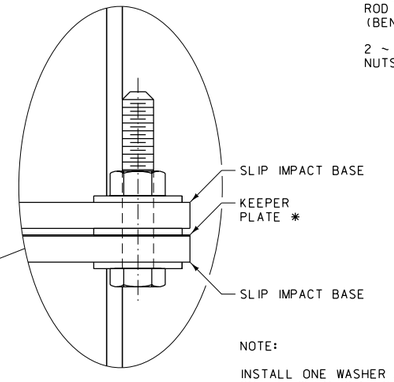



ANCHOR UNIT & REBAR INSTALLATION DETAILS

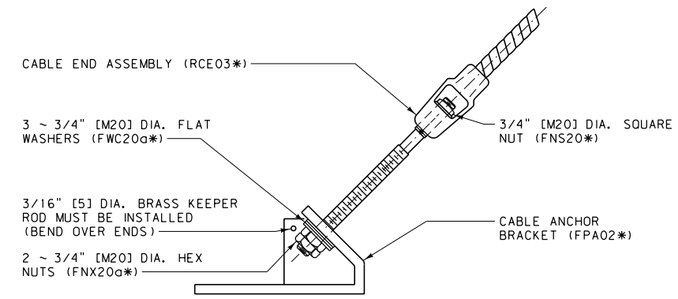



ANCHOR POST DETAIL




NOTE:

INSTALL ONE WASHER UNDER HEAD, ONE BETWEEN PLATES & ONE UNDER NUT. AN ADDITIONAL WASHER MAY BE PLACED BETWEEN PLATES TO PLUMB THE ANCHOR POST.




CABLE END ASSEMBLY TO ANCHOR BRACKET DETAIL

NOTES:

① INSTALL THE CONCRETE ANCHOR INTO THE EXCAVATION, AS DETAILED, SO THAT THE BOTTOM OF THE ANCHOR HAS A FULL AND EVEN BEARING ON THE SURFACE UNDER IT. BACKFILL AROUND THE CONCRETE ANCHOR PER SECTION 203.

② THE CONCRETE ANCHOR CAN BE PLACED AS ONE OR TWO PIECES. THIS DETAIL PRIMARILY SHOWS A TWO PIECE INSTALLATION. FOR ONE PIECE INSTALLATIONS, USE ALL THE SAME DIMENSIONS, LESS THE TAPERED KEYWAY AND THE ADDITIONAL REBAR, AS SHOWN.

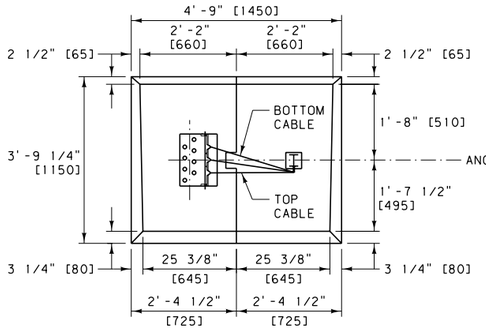
③ IF LIFTING DEVICES ARE EMBEDDED INTO THE CONCRETE ANCHORS, ENSURE THAT THEY HAVE A SAFE WORKING LOAD OF 4 TONS [3.6 METRIC TONS]FOR THE ONE PIECE ANCHOR AND 2 TONS [1.8 METRIC TONS]EACH FOR EACH OF THE HALVES OF THE TWO PIECE ANCHOR UNIT.

④ USE CLASS GENERAL CONCRETE TO CONSTRUCT ANCHOR.

SEE DTL. DWG. NO. 606-80 FOR SCHEDULE * OF GUARDRAIL HARDWARE.

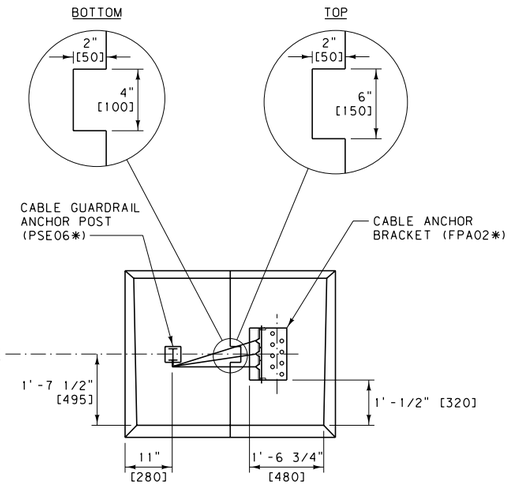
NOTE:

DIMENSIONS FOR LEFT AND RIGHT HAND ANCHOR UNITS ARE THE SAME, WITH THE POSITION OF THE ANCHOR POST AND ANCHOR BRACKET BEING THE ONLY DIFFERENCE.

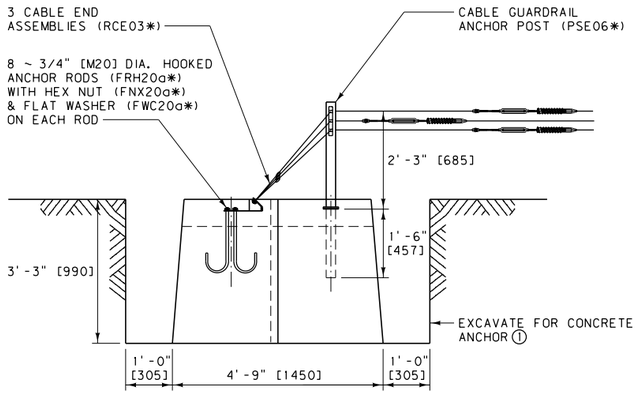



PLAN
(LEFT HAND ANCHOR UNIT)

TAPERED KEYWAY DETAIL
(TWO PIECE INSTALLATION)




PLAN
(RIGHT HAND ANCHOR UNIT)




ELEVATION
(LEFT HAND ANCHOR UNIT)

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 606

DWG. NO. 606-41

LOW-TENSION CABLE GUARDRAIL TERMINAL ANCHOR ASSEMBLY

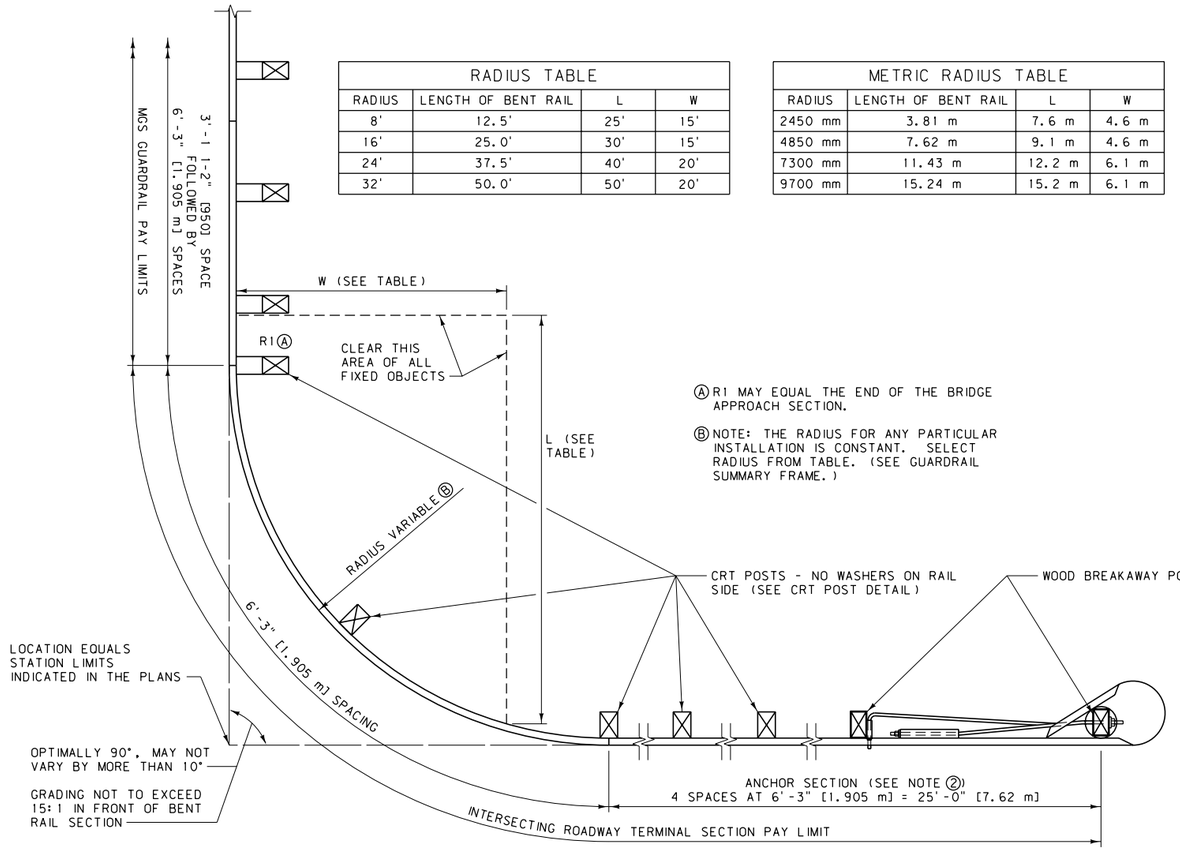
EFFECTIVE: SEPTEMBER 2014

--REVISED--
JANUARY 2018

MDT MONTANA DEPARTMENT OF TRANSPORTATION

| RADIUS TABLE | | | |
|---|---|---|---|
| RADIUS | LENGTH OF BENT RAIL | L | W |
| 8' | 12.5' | 25' | 15' |
| 16' | 25.0' | 30' | 15' |
| 24' | 37.5' | 40' | 20' |
| 32' | 50.0' | 50' | 20' |

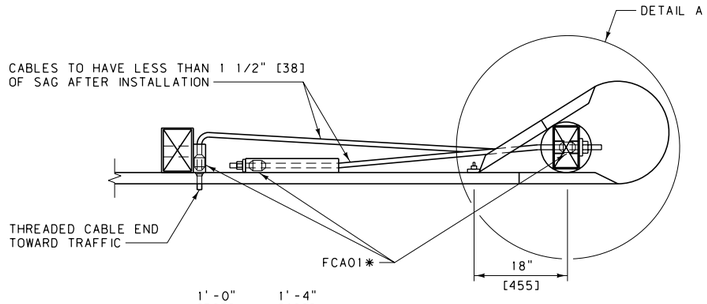
| METRIC RADIUS TABLE | | | |
|---|---|---|---|
| RADIUS | LENGTH OF BENT RAIL | L | W |
| 2450 mm | 3.81 m | 7.6 m | 4.6 m |
| 4850 mm | 7.62 m | 9.1 m | 4.6 m |
| 7300 mm | 11.43 m | 12.2 m | 6.1 m |
| 9700 mm | 15.24 m | 15.2 m | 6.1 m |

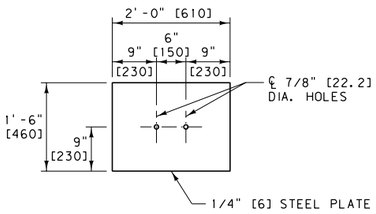



Ⓐ R1 MAY EQUAL THE END OF THE BRIDGE APPROACH SECTION.

Ⓑ NOTE: THE RADIUS FOR ANY PARTICULAR INSTALLATION IS CONSTANT. SELECT RADIUS FROM TABLE. (SEE GUARDRAIL SUMMARY FRAME.)

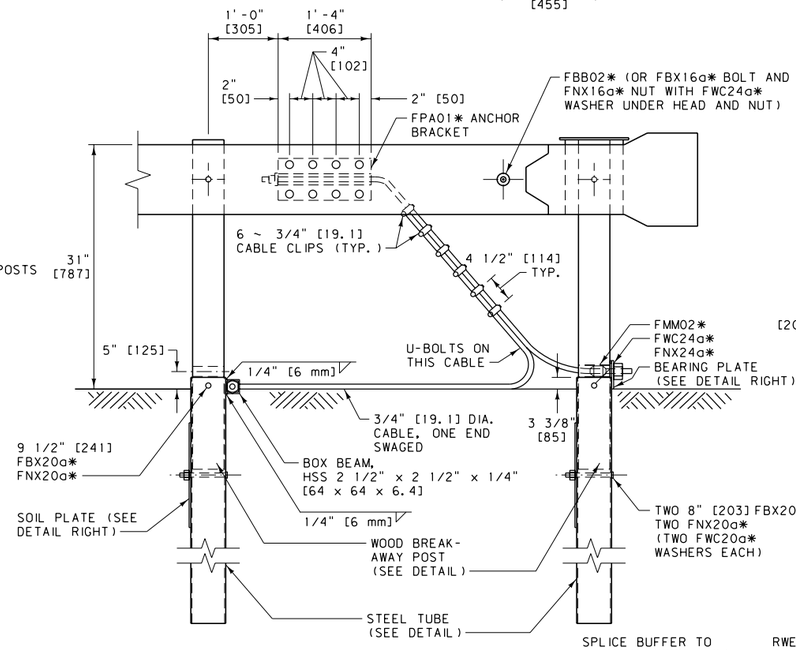
PLAN

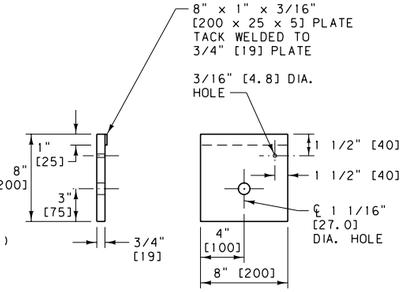



SOIL PLATE DETAIL

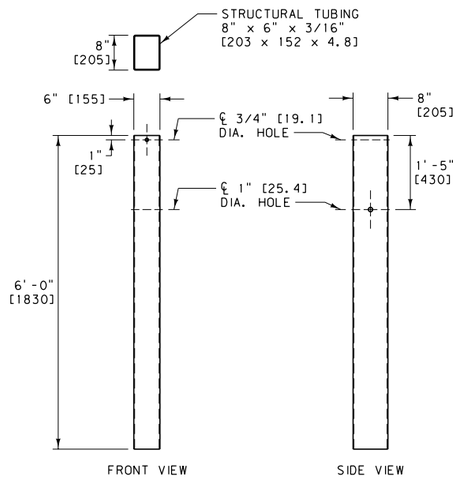
PLS03✱



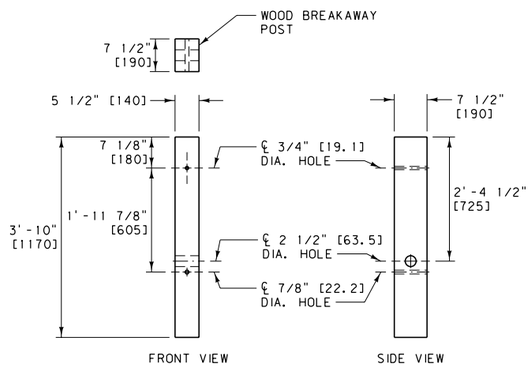

BEARING PLATE DETAIL

FPB01✱



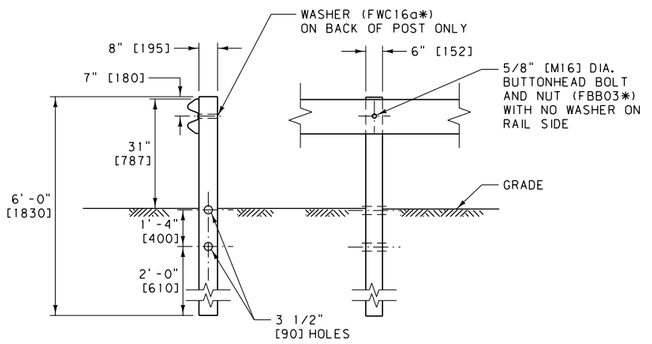

MGS FOUNDATION TUBE DETAILS

PTE06✱




WOOD BREAKAWAY POST DETAILS

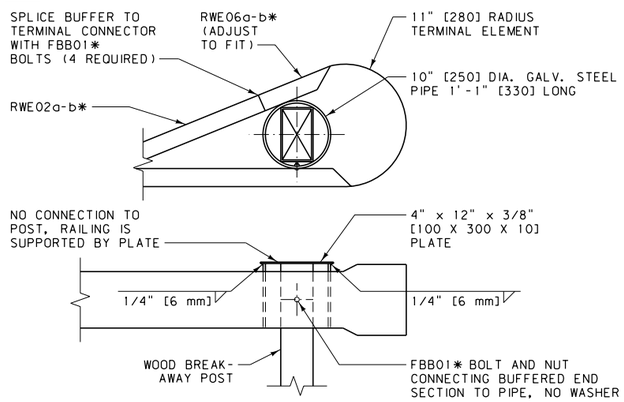
PDF04✱




CONTROLLED RELEASING TERMINAL (CRT) POST

CRT POST DETAIL

PDE09✱




DETAIL A

NOTES:

① DO NOT INSTALL ON SLOPES STEEPER THAN 2:1.

② DO NOT OMIT OR SHORTEN ANCHOR SECTION.

③ SEE DTL. DWG. NO. 606-05A FOR GUARDRAIL WIDENING REQUIREMENTS.

✱ SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

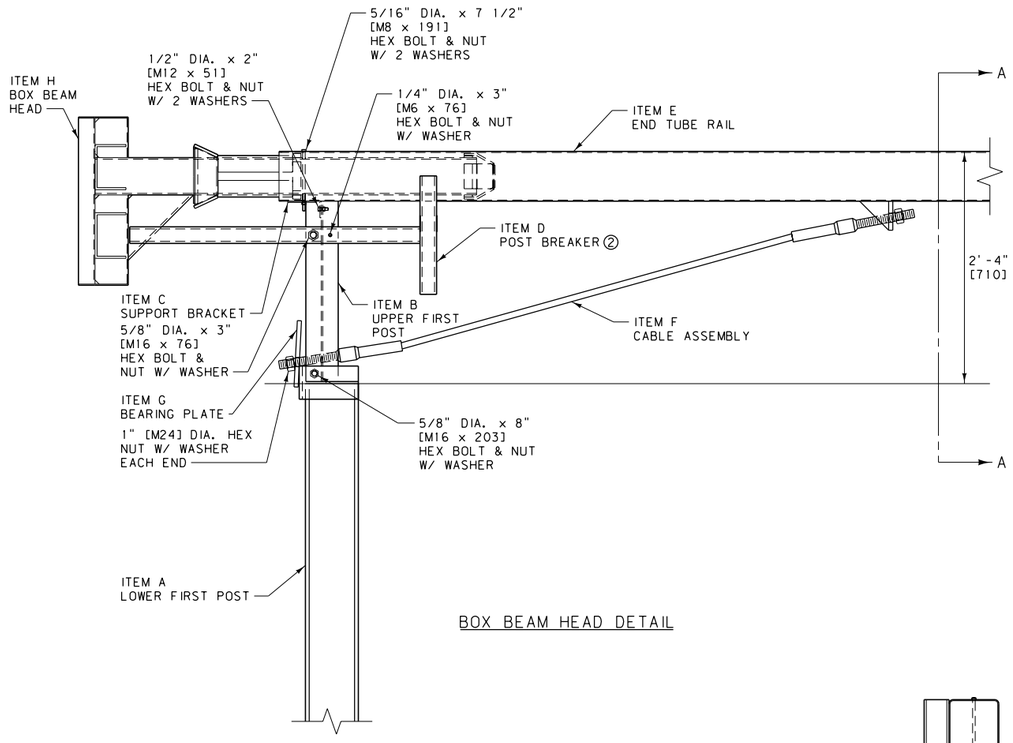
REFERENCE STANDARD SPEC. SECTION 606 — DWG. NO. 606-46

# INTERSECTING ROADWAY TERMINAL SECTION (MGS)

--REVISED--
JANUARY 2018

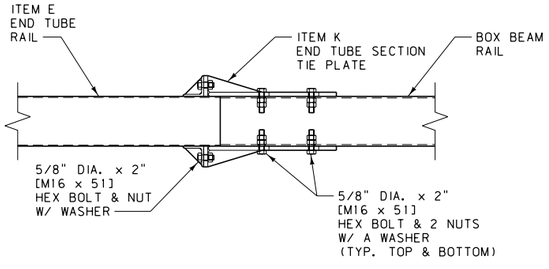
EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

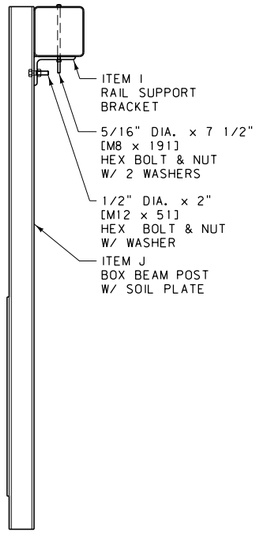



BOX BEAM HEAD DETAIL

| BILL OF MATERIAL | | | |
|---|---|---|---|
| ITEM | QTY | DESCRIPTION | METRIC DESCRIPTION |
| A | 1 | LOWER FIRST POST, W6x15, 8'-0" LG. | LOWER FIRST POST, W152 x 22.3 kg/m, 2440 LG. |
| B | 1 | UPPER FIRST POST, W6x9, 1'-9 1/2" LG. | UPPER FIRST POST, W152 x 13.4 kg/m, 546 LG. |
| C | 1 | SUPPORT BRACKET, 10 GAUGE BENT PLATE | SUPPORT BRACKET, 10 GA. (3.5 THK.) BENT PLATE |
| D | 1 | POST BREAKER | POST BREAKER |
| E | 1 | END TUBE RAIL, TS 6" x 6" x 1/8" x 12'-0" | END TUBE RAIL, TS 152 x 152 x 3.2 x 3660 |
| F | 1 | CABLE ASSEMBLY | CABLE ASSEMBLY |
| G | 1 | BEARING PLATE | BEARING PLATE |
| H | 1 | BOX BEAM HEAD | BOX BEAM HEAD |
| I | 1 | RAIL SUPPORT BRACKET, L 5" x 3 1/2" x 3/8" x 4 1/2" | RAIL SUPPORT BRACKET, L 127 x 89 x 9.5 x 115 |
| J | 1 | BOX BEAM POST W/ SOIL PLATE | BOX BEAM POST W/ SOIL PLATE |
| K | 2 | END TUBE SECTION TIE PLATE | END TUBE SECTION TIE PLATE |
| a | 2 | 5/16" DIA. x 7 1/2" HEX BOLT (GRADE 5) | M8 x 191 HEX BOLT (GRADE 5) |
| b | 1 | 1/4" DIA. x 3" HEX BOLT (GRADE 2) | M6 x 76 HEX BOLT (GRADE 2) |
| c | 2 | 1/2" DIA. x 2" HEX BOLT (GRADE 2) | M12 x 51 HEX BOLT (GRADE 2) |
| d | 8 | 5/8" DIA. x 2" HEX BOLT (GRADE 5) | M16 x 51 HEX BOLT (GRADE 5) |
| e | 1 | 5/8" DIA. x 8" HEX BOLT (GRADE 5) | M16 x 203 HEX BOLT (GRADE 5) |
| f | 1 | 5/8" DIA. x 3" HEX BOLT (GRADE 5) | M16 x 76 HEX BOLT (GRADE 5) |
| g | 2 | 5/16" DIA. HEX NUT | M8 HEX NUT |
| h | 1 | 1/4" DIA. HEX NUT | M6 HEX NUT |
| j | 2 | 1/2" DIA. HEX NUT | M12 HEX NUT |
| k | 14 | 5/8" DIA. HEX NUT | M16 HEX NUT |
| n | 2 | 1" DIA. ANCHOR CABLE HEX NUT | M24 ANCHOR CABLE HEX NUT |
| p | 4 | 5/16" DIA. WASHER | M8 WASHER |
| q | 1 | 1/4" DIA. WASHER | M6 WASHER |
| r | 3 | 1/2" DIA. WASHER | M12 WASHER |
| s | 10 | 5/8" DIA. WASHER | M16 WASHER |
| u | 2 | 1" DIA. ANCHOR CABLE WASHER | M24 ANCHOR CABLE WASHER |




FIRST RAIL TIE DETAIL




SECTION "A-A"

NOTES:

① BEAT TERMINAL SECTION TO INCLUDE 36'-0" [10.98 m] OF BOX BEAM GUARDRAIL AS SHOWN ON DTL. DWG. NO. 606-55B.

② PLACE POST BREAKER ON TRAFFIC SIDE OF FIRST POST.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 606

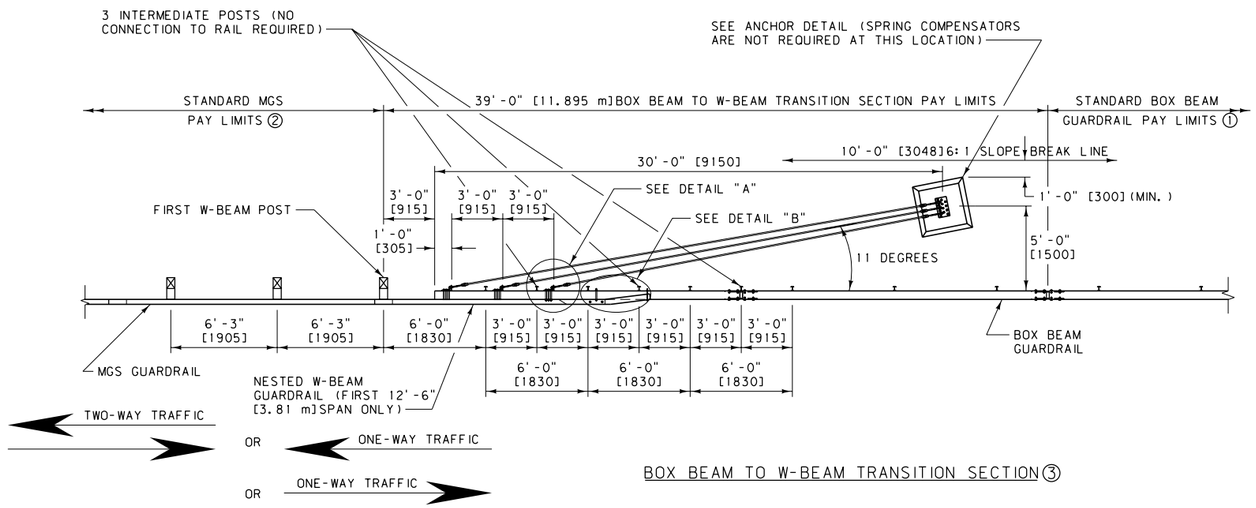
DWG. NO. 606-56B

# BEAT BOX BEAM TERMINAL SECTION DETAILS

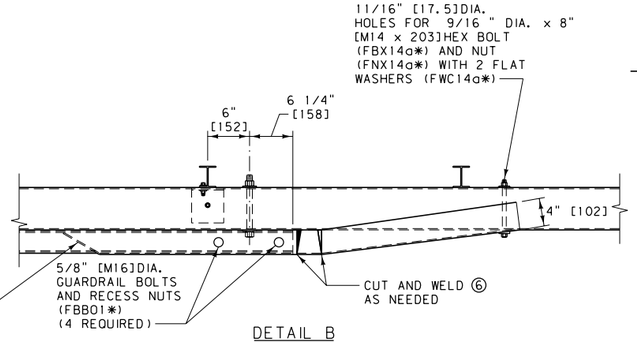
*--REVISED--*
JANUARY 2018

EFFECTIVE: SEPTEMBER 2014

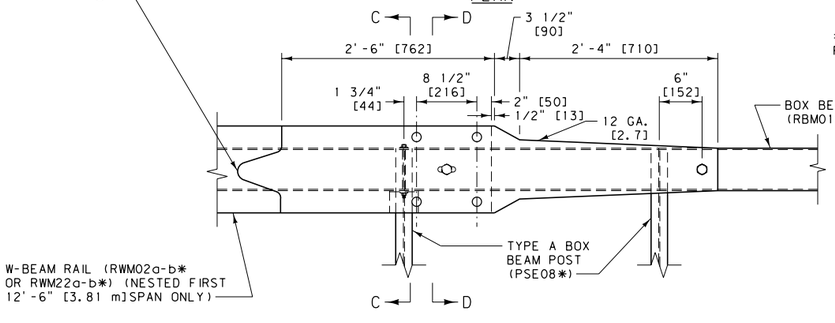
MDT MONTANA DEPARTMENT OF TRANSPORTATION



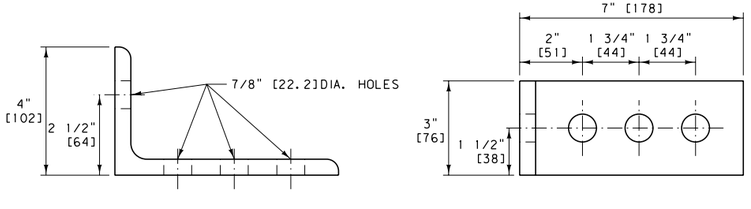

BOX BEAM TO W-BEAM TRANSITION SECTION ③



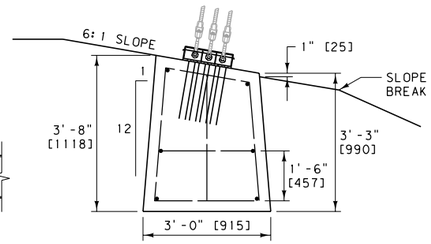

DETAIL B
PLAN



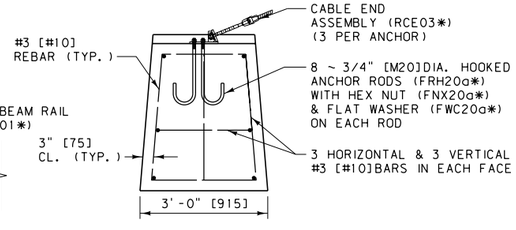

DETAIL B
ELEVATION



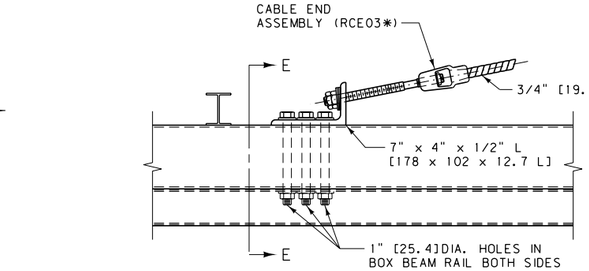

7" x 4" x 1/2" L [178 x 102 x 12.7]
DETAIL



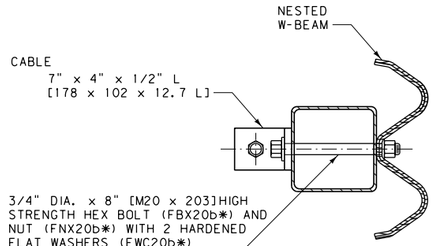

SECTION A-A



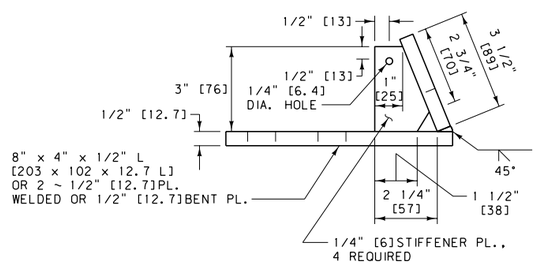

SECTION B-B



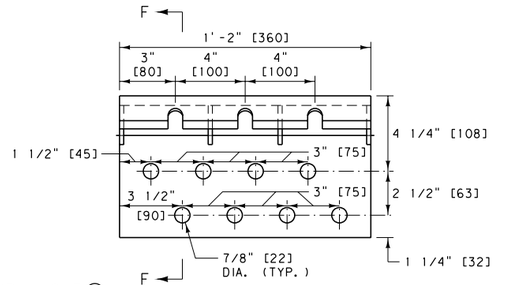

DETAIL A
PLAN




SECTION E-E

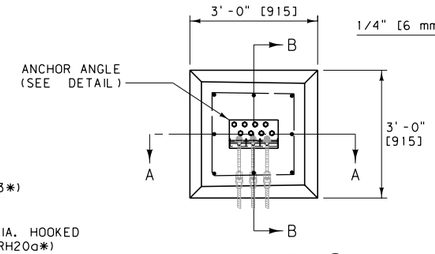



SECTION F-F

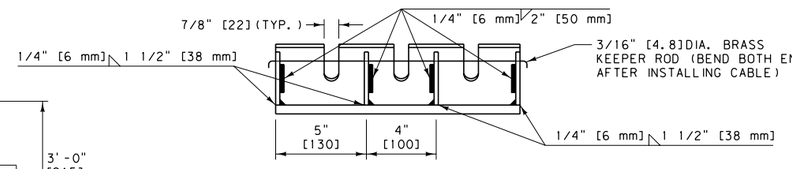



PLAN

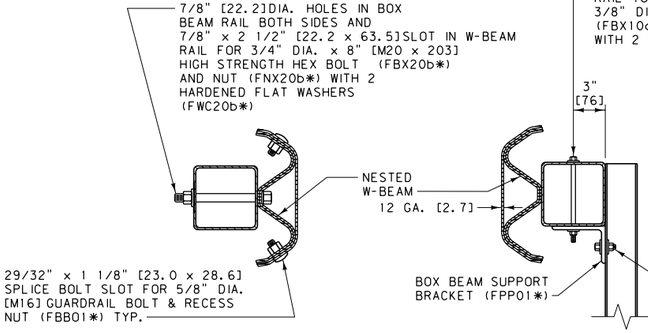
ANCHOR ANGLE ④
DETAIL



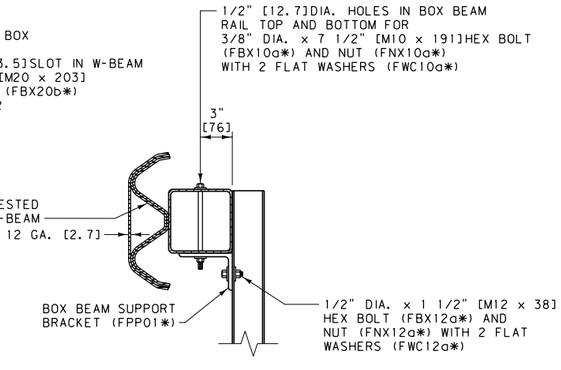

ANCHOR DETAIL ⑤
PLAN




ELEVATION




SECTION D-D




SECTION C-C

NOTES:

① SEE DTL. DWG. NO. 606-50 FOR STANDARD BOX BEAM GUARDRAIL AND ASSOCIATED DETAILS.

② SEE DTL. DWG. NO. 606-05A AND 606-05B FOR STANDARD MGS GUARDRAIL AND ASSOCIATED DETAILS. SEE DTL. DWG. NO. 606-20 FOR HEIGHT AND SPLICE TRANSITION DETAILS.

③ MANUFACTURE ANCHOR ANGLES USING AASHTO M 270 [270M] GRADE 36 [250] STEEL MEETING SECTION 711. WELD PER SECTION 711.

④ GALVANIZE ANCHOR ANGLES PER SECTION 711. NO PUNCHING, DRILLING, WELDING OR CUTTING IS PERMITTED ON COMPONENTS AFTER GALVANIZING.

⑤ USE CLASS GENERAL CONCRETE TO CONSTRUCT ANCHOR.

⑥ PAINT ANY AREAS WHERE GALVANIZING IS BROKEN OR METAL IS BARE ON W-BEAM OR BOX BEAM RAIL WITH ONE COAT OF ZINC RICH PAINT AND TWO COATS OF ALUMINUM PAINT PER SECTION 710.

⑦ LAP ALL W-BEAM SPLICES IN THE DIRECTION OF ADJACENT TRAFFIC.

* SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 606, 710, 711

DWG. NO. 606-58

# BOX BEAM TO MGS TRANSITION SECTION

--REVISED--
JANUARY 2018

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

## SCHEDULE OF GUARDRAIL HARDWARE

| DESIGNATION ① | DESCRIPTION | METRIC DESCRIPTION | DTL. DWG. NO. (606-###) | GUARDRAIL TYPE ② | DTL. DWGS. WHERE PARTS USED: 606-05A | 606-05B | 606-07 | 606-09 | 606-11A | 606-11B | 606-18 | 606-23A | 606-23B | 606-24A | 606-24B | 606-25A | 606-25B | 606-40 | 606-41 | 606-46 | 606-50 | 606-52 | 606-53 | 606-53A | 606-54 | 606-58 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FBB01-05 | 5/8" DIA. GUARDRAIL BOLT & RECESS NUT | M16 GUARDRAIL BOLT & RECESS NUT | 82 | W | X | | | X | X | | X | | X | | | | | | X | | | | | | | X |
| FBB01-05 | 5/8" DIA. GUARDRAIL BOLT | M16 GUARDRAIL BOLT | 82 | W | | X | | | | X | | | | | | | | | | | | | | | | |
| FBB06-07 | 5/8" DIA. GUARDRAIL BOLT & RECESS NUT | M16 GUARDRAIL BOLT & RECESS NUT | 82 | W | | | | | | | | X | X | | | | | | | | | | | | | |
| FBH01 | 5/16" DIA. HOOK BOLT | M8 HOOK BOLT | 92 | C | | | | | | | | | | | | | | X | | | | | | | | |
| FBH02 | 5/16" DIA. ALTERNATE HOOK BOLT | M8 ALTERNATE HOOK BOLT | 92 | C | | | | | | | | | | | | | | X | | | | | | | | |
| FBX10a | 3/8" DIA. HEX BOLT | M10 HEX BOLT | 82 | B | | | | | | | | | | | | | | | | | X | X | X | X | | X |
| FBX12a | 1/2" DIA. HEX BOLT | M12 HEX BOLT | 82 | B, C | | | | | | | | | | | | | | | X | | X | X | X | X | | X |
| FBX14a | 9/16" DIA. HEX BOLT | M14 HEX BOLT | 82 | B | | | | | | | | | | | | | | | | | | | | | | X |
| FBX16a | 5/8" DIA. HEX BOLT | M16 HEX BOLT | 82 | W | | | | | | | X | | | | | | | | | X | | | | | | |
| FBX20a | 3/4" DIA. HEX BOLT | M20 HEX BOLT | 82 | W | | | | | | | | | | | | | | | | X | | | | | | |
| FBX20b | 3/4" DIA. HIGH STRENGTH HEX BOLT* | M20 HIGH STRENGTH HEX BOLT* | 82 | B | | | | | | | | | | | | | | | | | X | | X | X | X | X |
| FBX22a | 7/8" DIA. HEX BOLT | M22 HEX BOLT | 82 | W | | | | | | | X | | | | | | | | | | | | | | | |
| FBX22b | 7/8" DIA. HIGH STRENGTH HEX BOLT* | M22 HIGH STRENGTH HEX BOLT* | 82 | W | | | | | | | | X | X | X | X | | | | | | | | | | | |
| FBX24b | 1" DIA. HIGH STRENGTH HEX BOLT* | M24 HIGH STRENGTH HEX BOLT* | 82 | B | | | | | | | | | | | | | | | | | | | | X | | |
| FCA01 | CABLE ASSEMBLY | CABLE ASSEMBLY | 84 | W | | | | | | | X | | | | | | | | | X | | | | | | |
| FMM01 | CABLE WEDGE | CABLE WEDGE | 94 | C | | | | | | | | | | | | | | X | | | | | | | | |
| FMM02 | POST SLEEVE | POST SLEEVE | 84 | W | | | | | | | X | | | | | | | | | X | | | | | | |
| FNS20 | 3/4" DIA. SQUARE NUT | M20 SQUARE NUT | 82 | C | | | | | | | | | | | | | | | X | | | | | | | |
| FNX08a | 5/16" DIA. HEX NUT | M8 HEX NUT | 82 | C | | | | | | | | | | | | | | X | | | | | | | | |
| FNX10a | 3/8" DIA. HEX NUT | M10 HEX NUT | 82 | B | | | | | | | | | | | | | | | | | X | X | X | X | | X |
| FNX12a | 1/2" DIA. HEX NUT | M12 HEX NUT | 82 | B, C | | | | | | | | | | | | | | | X | | X | X | X | X | | X |
| FNX14a | 9/16" DIA. HEX NUT | M14 HEX NUT | 82 | B | | | | | | | | | | | | | | | | | | | | | | X |
| FNX16a | 5/8" DIA. HEX NUT | M16 HEX NUT | 82 | W | | X | | | | X | X | | | | | | | | | X | | | | | | |
| FNX20a | 3/4" DIA. HEX NUT | M20 HEX NUT | 82 | C, W | | | | | | | | | | | | | | | X | X | | | | | | X |
| FNX20b | 3/4" DIA. HIGH STRENGTH HEX NUT | M20 HIGH STRENGTH HEX NUT | 82 | B | | | | | | | | | | | | | | | | | | | X | X | X | X |
| FNX22b | 7/8" DIA. HIGH STRENGTH HEX NUT | M22 HIGH STRENGTH HEX NUT | 82 | B | | | | | | | | X | X | X | X | | | | | | | | | | | |
| FNX24a | 1" DIA. HEX NUT | M24 HEX NUT | 82 | W | | | | | | | X | | | | | | | | | X | | | | | | |
| FNX24b | 1" DIA. HIGH STRENGTH HEX NUT | M24 HIGH STRENGTH HEX NUT | 82 | B | | | | | | | | | | | | | | | | | | | | X | | |
| FPA01 | GUARDRAIL ANCHOR BRACKET & END PLATE | GUARDRAIL ANCHOR BRACKET & END PLATE | 84 | W | | | | | | | X | | | | | | | | | X | | | | | | |
| FPA02 | CABLE ANCHOR BRACKET | CABLE ANCHOR BRACKET | 95 | C | | | | | | | | | | | | | | | X | | | | | | | |
| FPB01 | BEARING PLATE | BEARING PLATE | 18 & 46 | W | | | | | | | X | | | | | | | | | X | | | | | | |
| FPP01 | BOX BEAM SUPPORT BRACKET | BOX BEAM SUPPORT BRACKET | 97 | B | | | | | | | | | | | | | | | | | X | X | X | X | | X |
| FRH20a | 3/4" DIA. HOOKED ANCHOR ROD | M20 HOOKED ANCHOR ROD | 82 | C | | | | | | | | | | | | | | | X | | | | | | | X |
| FWC10a | 3/8" DIA. FLAT WASHER | M10 FLAT WASHER | 82 | B | | | | | | | | | | | | | | | | | X | X | X | X | | X |
| FWC12a | 1/2" DIA. FLAT WASHER | M12 FLAT WASHER | 82 | B, C | | | | | | | | | | | | | | | X | | X | X | X | X | | X |
| FWC14a | 9/16" DIA. FLAT WASHER | M14 FLAT WASHER | 82 | B | | | | | | | | | | | | | | | | | | | | | | X |
| FWC16a | 5/8" DIA. FLAT WASHER | M16 FLAT WASHER | 82 | W | X | X | | X | X | X | X | X | X | | | | | | | X | | | | | | |
| FWC20a | 3/4" DIA. FLAT WASHER | M20 FLAT WASHER | 82 | C, W | | | | | | | | | | | | | | | X | X | | | | | | X |
| FWC20b | 3/4" DIA. HARDENED FLAT WASHER | M20 HARDENED FLAT WASHER | 82 | B | | | | | | | | | | | | | | | | | X | | X | X | X | X |
| FWC24a | 1" DIA. FLAT WASHER | M24 FLAT WASHER | 82 | W | | | | | | | X | | | | | | | | | X | | | | | | |
| FWR03 | RECTANGULAR PLATE WASHER | RECTANGULAR PLATE WASHER | 84 | W | | | | | | | X | | | | | | | | | | | | | | | |
| PDB01 | 8" WOOD BLOCKOUT | 205 WOOD BLOCKOUT | 05A & 05B, 11A & 11B | W | X | X | | | X | X | | | | | | | | | | | | | | | | |
| PDB11 | 12" WOOD BLOCKOUT | 305 WOOD BLOCKOUT | 09, 23A & 23B | W | | | | X | | | | X | X | | | | | | | | | | | | | |
| PDE02 | WOOD GUARDRAIL POST | WOOD GUARDRAIL POST | 05A & 11A | W | X | | | | X | | | | | | | | | | | | | | | | | |
| PDE09 | CRT POST | CRT POST | 46 | W | | | | X | | | | | | | | | | | | X | | | | | | |
| PDF01 | WOOD BREAKAWAY POST | WOOD BREAKAWAY POST | 46 | W | | | | | | | X | | | | | | | | | X | | | | | | |
| PFP01 | STRUT AND YOKE ASSEMBLY | STRUT AND YOKE ASSEMBLY | 18 | W | | | | | | | X | | | | | | | | | | | | | | | |
| PLS01 | SOIL PLATE | SOIL PLATE | 92 & 97 | B, C | | | | | | | | | | | | | | X | | | X | X | X | | | |
| PLS03 | SOIL PLATE | SOIL PLATE | 46 | W | | | | | | | | | | | | | | | | X | | | | | | |
| PSE01 | CABLE GUARDRAIL LINE POST | CABLE GUARDRAIL LINE POST | 92 | C | | | | | | | | | | | | | | X | | | | | | | | |
| PSE05 | TYPE D BOX BEAM POST | TYPE D BOX BEAM POST | 97 | B | | | | | | | | | | | | | | | | | | | X | | | |
| PSE06 | CABLE GUARDRAIL ANCHOR POST | CABLE GUARDRAIL ANCHOR POST | 95 | C | | | | | | | | | | | | | | | X | | | | | | | |
| PSE08 | TYPE A BOX BEAM POST | TYPE A BOX BEAM POST | 97 | B | | | | | | | | | | | | | | | | | X | | X | | | X |
| PTE05 | STEEL TUBE | STEEL TUBE | 46 | W | | | | | | | | | | | | | | | | X | | | | | | |
| PTE06 | STEEL TUBE | STEEL TUBE | 18 | W | | | | | | | X | | | | | | | | | | | | | | | |
| PWE01 | STEEL GUARDRAIL POST | STEEL GUARDRAIL POST | 05B | W | | X | | | | X | | | | | X | | | | | | | | | | | |
| RBM01 | BOX BEAM RAIL | BOX BEAM RAIL | 98 | B | | | | | | | | | | | | | | | | | X | | X | | X | X |
| RBM05 | BOX BEAM TERMINAL RAIL | BOX BEAM TERMINAL RAIL | 98 | B | | | | | | | | | | | | | | | | | | X | | | | |
| RBS01 | BOX BEAM SPLICE PLATE | BOX BEAM SPLICE PLATE | 98 | B | | | | | | | | | | | | | | | | | X | | | | | |
| RCE01 | COMPENSATING CABLE END ASSEMBLY | COMPENSATING CABLE END ASSEMBLY | 94 | C | | | | | | | | | | | | | | X | | | | | | | | |
| RCE03 | CABLE END ASSEMBLY | CABLE END ASSEMBLY | 94 | C | | | | | | | | | | | | | | | X | | | | | | | X |
| RCM01 | 3/4" DIA. CABLE | 19.1 DIA. CABLE | 94 | C | | | | | | | | | | | | | | X | X | | | | | | | |
| RTE01b | THRIE-BEAM TERMINAL CONNECTOR | THRIE-BEAM TERMINAL CONNECTOR | 23A & 23B | W | | | | | | | | X | X | | | | | | | | | | | | | |
| RTM01a-b | 4-SPACE THRIE-BEAM (6'-3" LENGTH) | 4-SPACE THRIE-BEAM (1.905 m LENGTH) | 23A & 23B | W | | | | | | | | X | X | | | | | | | | | | | | | |
| RTM02a-b | 8-SPACE THRIE-BEAM (12'-6" LENGTH) | 8-SPACE THRIE-BEAM (3.81 m LENGTH) | 23A & 23B | W | | | | | | | | X | X | | | | | | | | | | | | | |
| RWE01a-b | W-BEAM END SECTION (FLARED) | W-BEAM END SECTION (FLARED) | 88 | W | | | | | | | X | | | | | | | | | | | | | | | |
| RWE02a-b | W-BEAM TERMINAL CONNECTOR | W-BEAM TERMINAL CONNECTOR | 88 | W | | | | | | | | | | X | X | X | X | | | X | | | | | | |
| RWE06a-b | W-BEAM END SECTION (BUFFER) | W-BEAM END SECTION (BUFFER) | 88 | W | | | | | | | | | | | | | | | | X | | | | | | |
| RWM02a-b | 2-SPACE W-BEAM (12'-6" LENGTH) | 2-SPACE W-BEAM (3.81 m LENGTH) | 88 | W | | | | | | | | | | | | | | | | | | | | | | X |
| RWM04a-b | 4-SPACE W-BEAM (12'-6" LENGTH) | 4-SPACE W-BEAM (3.81 m LENGTH) | 88 | W | X | X | | X | X | X | X | X | X | | | | | | | | | | | | | |
| RWM08a-b | 8-SPACE W-BEAM (12'-6" LENGTH) | 8-SPACE W-BEAM (3.81 m LENGTH) | 88 | W | | | X | | | | | | | | | | | | | | | | | | | |
| RWM14a | BCT TERMINAL RAIL SECTION | BCT TERMINAL RAIL SECTION | 18 | W | | | | | | | X | | | | | | | | | | | | | | | |
| RWM22a-b | W-BEAM (25'-0" LENGTH) | W-BEAM (7.62 m LENGTH) | 88 | W | X | X | | X | X | X | X | | | | | | | | | | | | | | | X |
| RWT02a-b | W-BEAM TO THRIE-BEAM TRANSITION SECTION (7'-3 1/2" LENGTH) | W-BEAM TO THRIE-BEAM TRANSITION SECTION (2.223 m LENGTH) | 23A & 23B | W | | | | | | | | X | X | | | | | | | | | | | | | |
| SEC01 | CABLE GUARDRAIL TERMINAL ANCHOR ASSEMBLY | CABLE GUARDRAIL TERMINAL ANCHOR ASSEMBLY | 41 | C | | | | | | | | | | | | | | X | X | | | | | | | |
| N/A | TURNBUCKLE CABLE END ASSEMBLY | TURNBUCKLE CABLE END ASSEMBLY | 94 | C | | | | | | | | | | | | | | X | | | | | | | | |
| N/A | KEEPER PLATE | KEEPER PLATE | 95 | C | | | | | | | | | | | | | | | X | | | | | | | |
| N/A | TYPE B BOX BEAM POST | TYPE B BOX BEAM POST | 97 | B | | | | | | | | | | | | | | | | | | | X | | | |
| N/A | SUPPORT BRACKET WITH TS6 x 6 x 3/16 BLOCKOUT | SUPPORT BRACKET WITH TS152 x 152 x 4.8 BLOCKOUT | 97 | B | | | | | | | | | | | | | | | | | | | | X | | |
| N/A | TRANSITION POST | TRANSITION POST | 97 | B | | | | | | | | | | | | | | | | | | | | X | | |
| N/A | TS6 x 6 x 3/16 BR. APP. SECT. UPPER RAIL NO. 1 | TS152 x 152 x 4.8 BR. APP. SECT. UPPER RAIL NO. 1 | 98 | B | | | | | | | | | | | | | | | | | | | X | | | |
| N/A | TS6 x 2 x 1/4 BR. APP. SECT. LOWER RAIL NO. 1 | TS152 x 51 x 6.4 BR. APP. SECT. LOWER RAIL NO. 1 | 98 | B | | | | | | | | | | | | | | | | | | | X | | | |
| N/A | TS6 x 2 x 1/4 BR. APP. SECT. LOWER RAIL NO. 2 | TS152 x 51 x 6.4 BR. APP. SECT. LOWER RAIL NO. 2 | 98 | B | | | | | | | | | | | | | | | | | | | X | | | |
| N/A | TS6 x 2 TO TS6 x 6 CONNECTION SLEEVE | TS152 x 51 TO TS152 x 152 CONNECTION SLEEVE | 98 | B | | | | | | | | | | | | | | | | | | | X | | | |
| N/A | TS6 x 2 CONNECTION SLEEVE | TS152 x 51 CONNECTION SLEEVE | 98 | B | | | | | | | | | | | | | | | | | | | X | | | |
| N/A | TS6 x 6 x 3/16 TRANSITION RAIL | TS152 x 152 x 4.8 TRANSITION RAIL | 98 | B | | | | | | | | | | | | | | | | | | | | X | | |
| N/A | 1/4" SHIM PLATE | 6.4 SHIM PLATE | 99 | B | | | | | | | | | | | | | | | | | | | | X | | |
| N/A | ANCHOR RAIL SECTION | ANCHOR RAIL SECTION | 99 | B | | | | | | | | | | | | | | | | | | | | X | | |
| N/A | RUB RAIL ANCHOR BRACKET (JERSEY RAIL) | RUB RAIL ANCHOR BRACKET (JERSEY RAIL) | 99 | B | | | | | | | | | | | | | | | | | | | | X | | |
| N/A | RUB RAIL ANCHOR BRACKET (VERTICAL BRIDGE RAIL) | RUB RAIL ANCHOR BRACKET (VERTICAL BRIDGE RAIL) | 99 | B | | | | | | | | | | | | | | | | | | | | X | | |
| N/A | TS6 x 2 x 3/16 RUB RAIL | TS152 x 51 x 4.8 RUB RAIL | 99 | B | | | | | | | | | | | | | | | | | | | | X | | |

* FURNISH HIGH STRENGTH BOLTS IN ACCORDANCE WITH ASTM F3125 GRADE A325.

NOTES:

① SEE AASHTO-AGC-ARTBA JOINT COMMITTEE TASK FORCE 13 REPORT "A GUIDE TO STANDARDIZED HIGHWAY BARRIER HARDWARE" PUBLICATION FOR ADDITIONAL AND DETAILED HARDWARE SPECIFICATIONS.

② GUARDRAIL TYPE CODES:

W = W-BEAM METAL GUARDRAIL
C = CABLE GUARDRAIL
B = BOX BEAM GUARDRAIL

*ALL METRIC DESCRIPTION DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.*

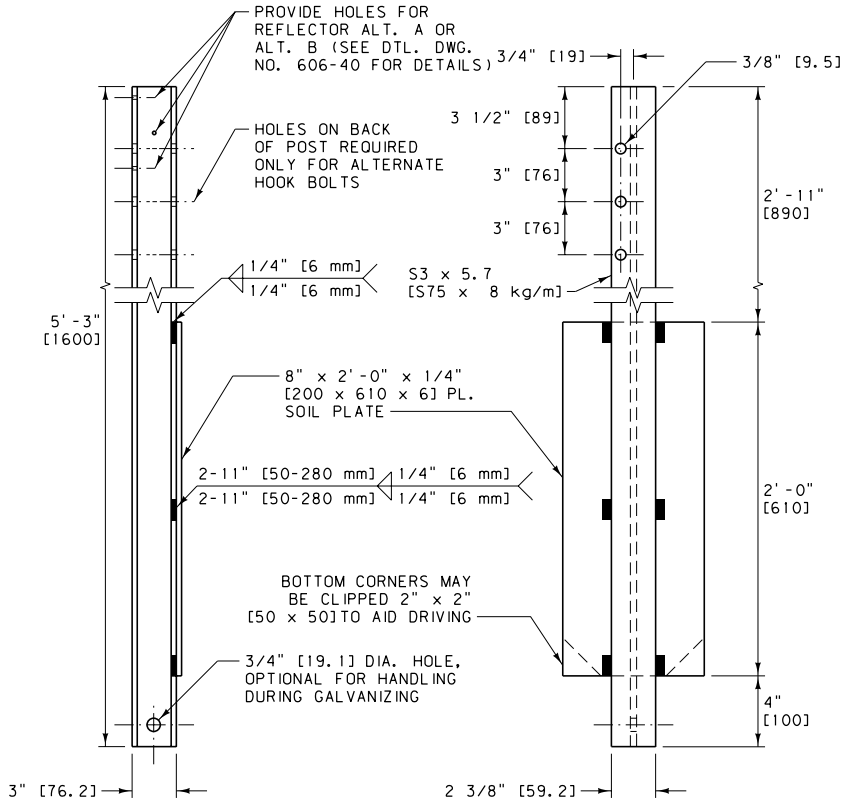
--REVISED--
JANUARY 2018

MDT MONTANA DEPARTMENT OF TRANSPORTATION

EFFECTIVE: SEPTEMBER 2014

SCHEDULE OF GUARDRAIL HARDWARE

DETAILED DRAWING
REFERENCE STANDARD SPEC. SECTION 606
DWG. NO. 606-80



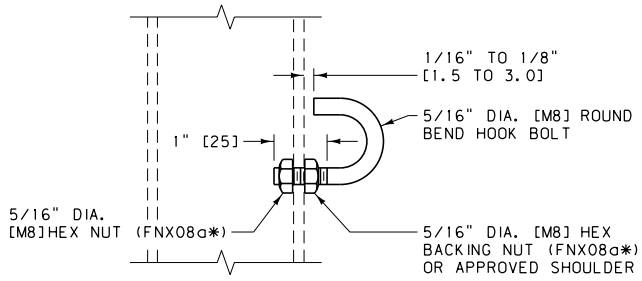

NOTES:

1. ALL HOLES ARE 3/8" [9.5] DIA. EXCEPT AS NOTED.
2. MANUFACTURE POSTS AND SOIL PLATES USING AASHTO M 270 [270M] (ASTM A 709 [A709M]) GRADE 36 [250] STEEL. ALL WELDING IS TO CONFORM TO THE APPLICABLE AWS CODE.
3. HOOK BOLTS ARE TO CONFORM TO THE REQUIREMENTS OF ASTM 568 [568M] CLASS 4.6. NUTS ARE TO CONFORM TO THE REQUIREMENTS OF AASHTO M 291 [291M] (ASTM A 563 [A563M]) CLASS 5.
4. GALVANIZE FABRICATED PARTS IN ACCORDANCE WITH SUBSECTION 711.08. GALVANIZE HOOK BOLTS AND NUTS IN ACCORDANCE WITH AASHTO M 232 [232M] (ASTM A 153 [A153M]). DO NOT PUNCH, DRILL, OR CUT AFTER GALVANIZING.
5. NUTS ARE OF THE HEAVY HEX TYPES. INSTALL BOLTS TO DEVELOP AN ULTIMATE PULL OPEN STRENGTH FROM 500 LB. TO 1000 LB. [2225 N TO 4450 N] APPLIED IN A DIRECTION NORMAL TO THE LONGITUDINAL AXIS OF THE POST.

* SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.

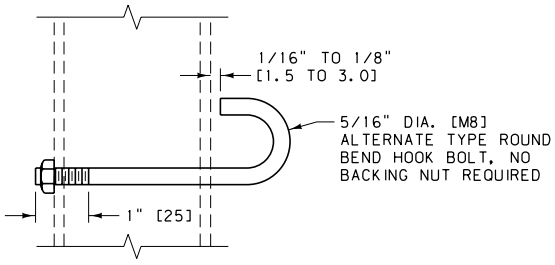
## CABLE GUARDRAIL POST AND SOIL PLATE

PSE01* AND PLS01*




## 5/16" DIA. [M8] HOOK BOLT

FBH01*




## ALTERNATE 5/16" DIA. [M8] HOOK BOLT

FBH02*

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 606

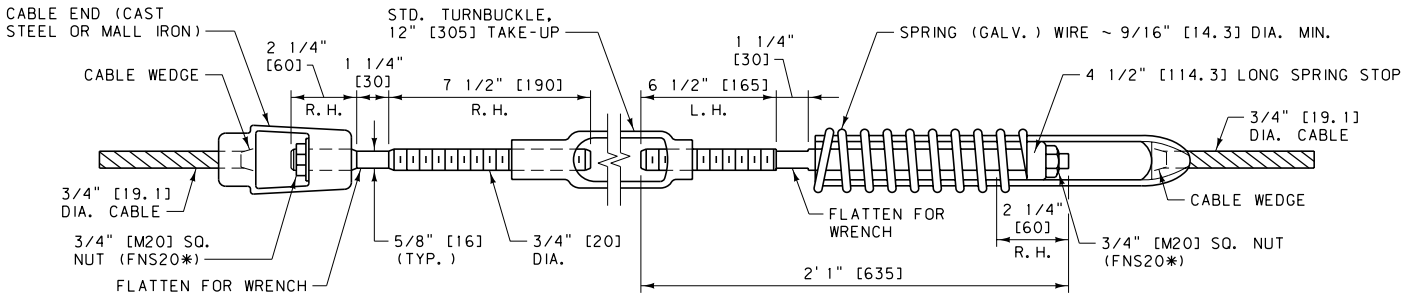
DWG. NO. 606-92

LOW-TENSION CABLE GUARDRAIL HARDWARE

--REVISED--
JANUARY 2018

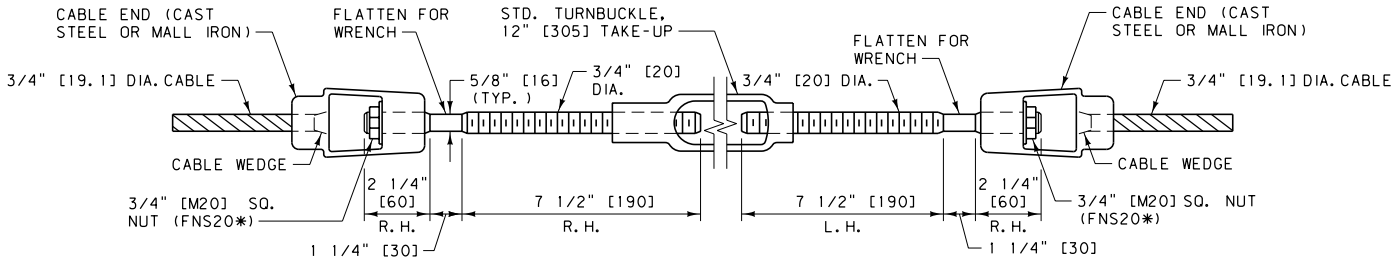
EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

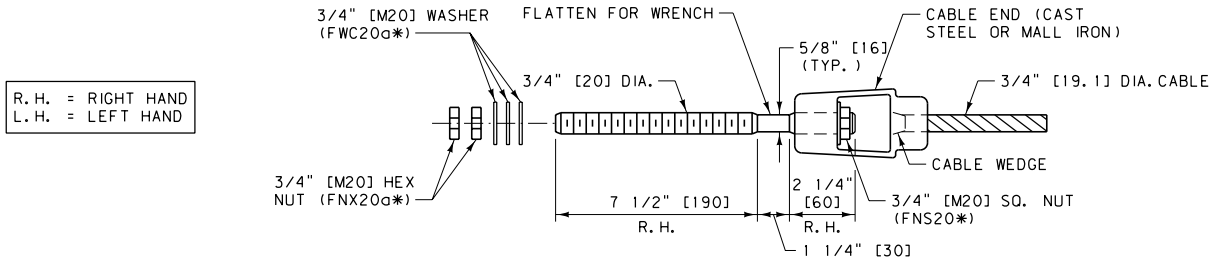



COMPENSATING CABLE END ASSEMBLY

RCE01*



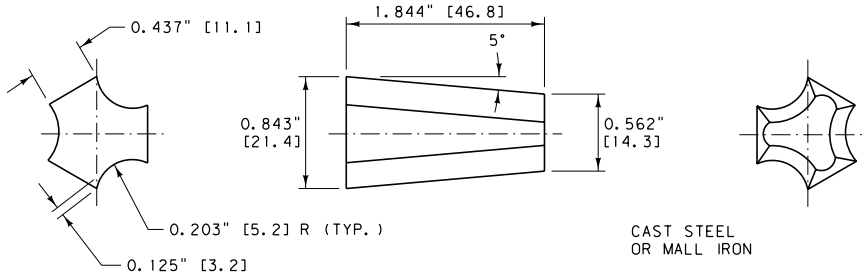

TURNBUCKLE CABLE END ASSEMBLY




R. H. = RIGHT HAND
L. H. = LEFT HAND

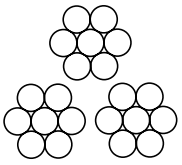
CABLE END ASSEMBLY

RCE03*




CABLE WEDGE

FMM01*



3/4" [19.1] DIA. - 3 x 7 WIRE ROPE

3/4" [19.1] DIA. CABLE

RCM01*

NOTES:

① WIRE ROPE AND CONNECTING HARDWARE ARE TO CONFORM TO THE REQUIREMENTS OF AASHTO M30 [M30M] TYPE 1 CLASS A, 3/4" [19.1] ROPE. CONNECTING HARDWARE MUST DEVELOP THE FULL STRENGTH OF A SINGLE CABLE (25,000 LB [111.2 kN]). CAST STEEL COMPONENTS ARE TO CONFORM TO THE REQUIREMENTS OF AASHTO M103 [M103M] (ASTM A27 [A27M]). MALLEABLE IRON CASTINGS ARE TO CONFORM TO THE REQUIREMENTS OF ASTM A47 [A47M].

② AT ALL LOCATIONS WHERE THE CABLE IS CONNECTED TO A CABLE SOCKET WITH A WEDGE TYPE CONNECTION, CRIMP ONE WIRE OF THE CABLE OVER THE BASE OF THE WEDGE TO HOLD IT FIRMLY IN PLACE.

③ COMPENSATING DEVICES ARE TO HAVE SPRING CONSTANTS OF 450 POUNDS PER INCH [78.8 N/mm], PLUS OR MINUS 50 POUNDS PER INCH [8.8 N/mm], AND PERMIT A TRAVEL OF 6 INCHES [150] PLUS OR MINUS 1 INCH [25].

④ DESIGN SOCKET BASKETS FOR USE WITH THE WEDGE DETAILED IN THIS DRAWING.

⑤ ALTERNATE HARDWARE DESIGNS WILL BE CONSIDERED FOR APPROVAL PROVIDED THEIR CONNECTION DETAILS, FOR THE PURPOSE OF MAINTENANCE SUBSTITUTIONS, ARE COMPATIBLE WITH THE DETAILS OF THIS DRAWING AND THEIR OPERATING CHARACTERISTICS ARE SIMILAR TO THOSE OF THE HARDWARE IN THIS DRAWING.

*SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

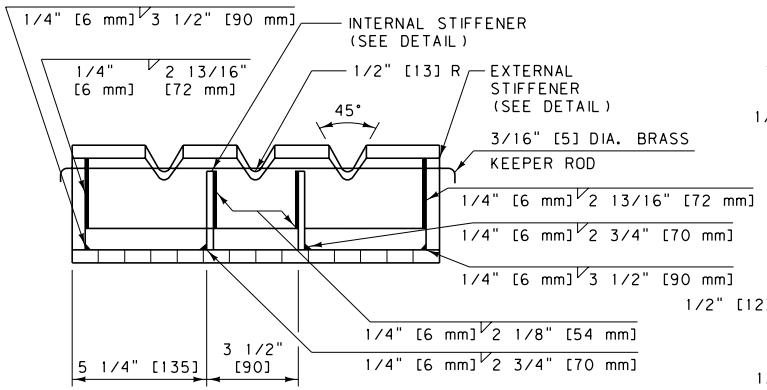
| DETAILED DRAWING | |
|---|---|
| REFERENCE STANDARD SPEC. SECTION 606 | DWG. NO. 606-94 |

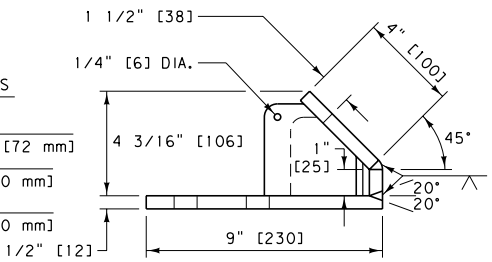
LOW-TENSION CABLE GUARDRAIL HARDWARE

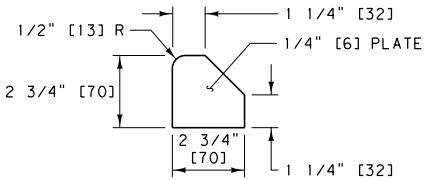
| --REVISED-- |
|---|
| JANUARY 2018 |

EFFECTIVE: SEPTEMBER 2014

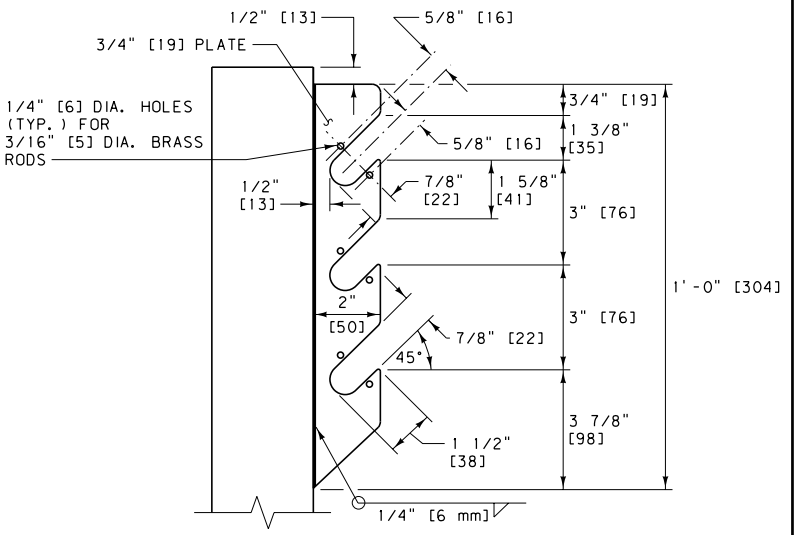
MDT MONTANA DEPARTMENT OF TRANSPORTATION



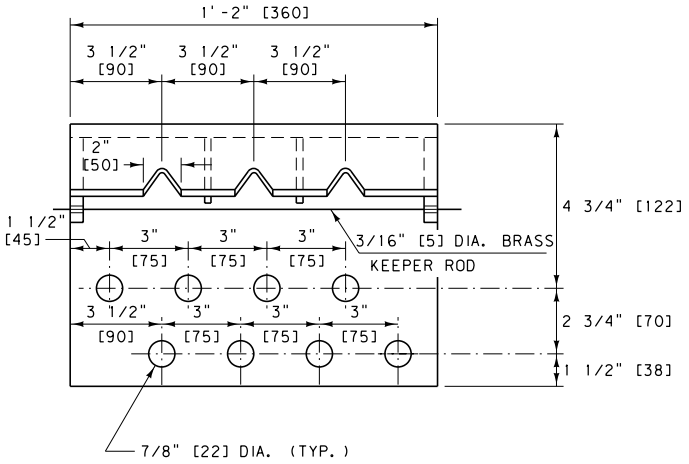




INTERNAL STIFFENER

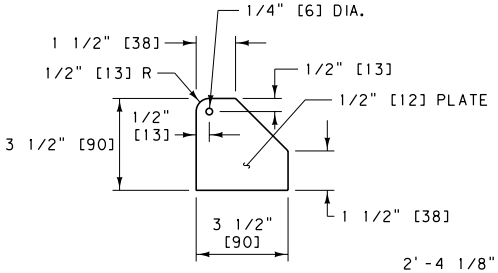



CABLE SUPPORT DETAIL

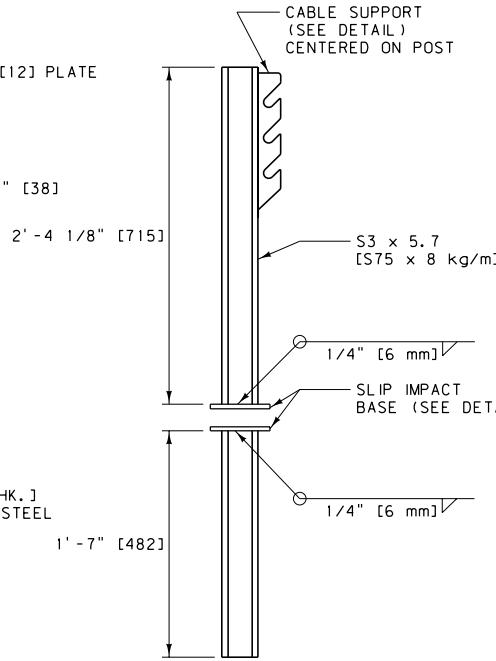



CABLE ANCHOR BRACKET

FPA02*




EXTERNAL STIFFENER

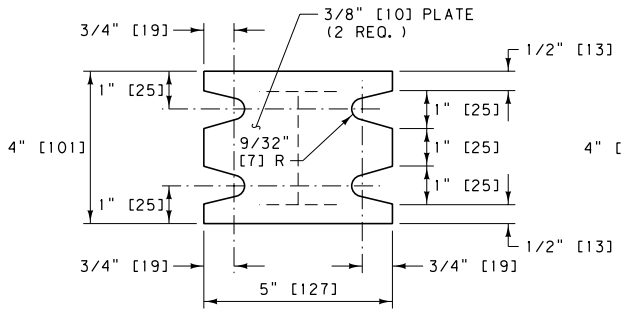



NOTES:

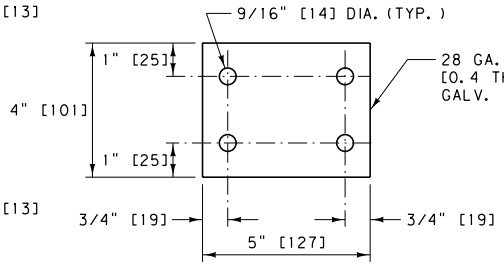
① MANUFACTURE ANCHOR POSTS AND BRACKETS USING AASHTO M 270 [270M] (ASTM A709 [A709M]) GRADE 36 [250] STEEL. ALL WELDING IS TO CONFORM TO THE APPLICABLE AWS CODE.

② GALVANIZE FABRICATED PARTS IN ACCORDANCE WITH SUBSECTION 711.08. DO NOT PUNCH, DRILL, OR CUT AFTER GALVANIZING.

* SEE DTL. DWG. NO. 606-80 FOR SCHEDULE OF GUARDRAIL HARDWARE.




SLIP IMPACT BASE
(KEEPER PLATE NOT SHOWN)




KEEPER PLATE

CABLE GUARDRAIL ANCHOR POST

PSE06*

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 606

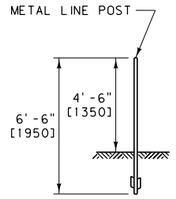
DWG. NO. 606-95

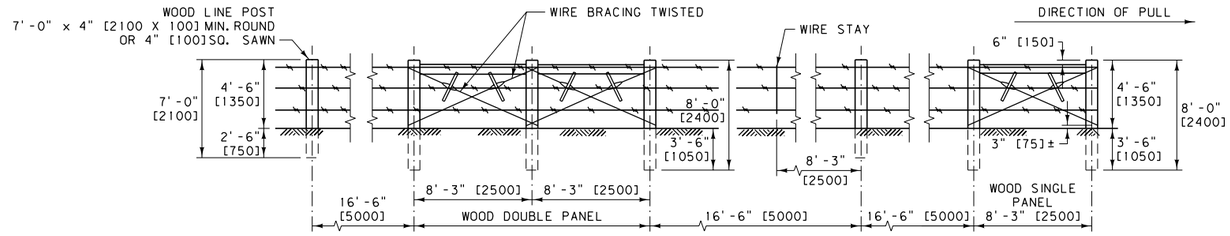
LOW-TENSION CABLE GUARDRAIL HARDWARE

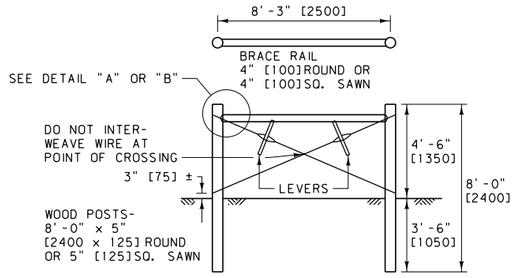
EFFECTIVE: SEPTEMBER 2014

--REVISED--
JANUARY 2018

MDT MONTANA DEPARTMENT OF TRANSPORTATION

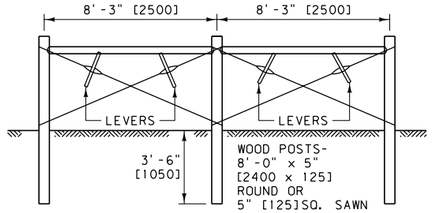


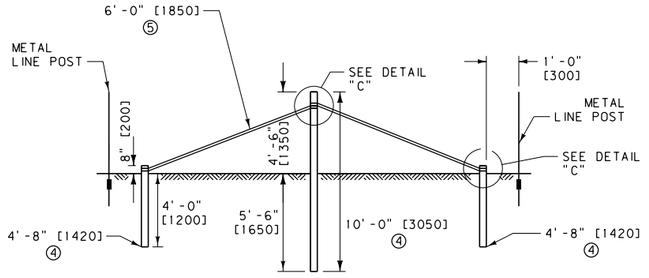

SINGLE WOOD PANEL

FOR PULLING, STRETCHING, CHANGES IN VERTICAL ALIGNMENT OR PANELS ON A RUN OF LESS THAN 330' [100 m].

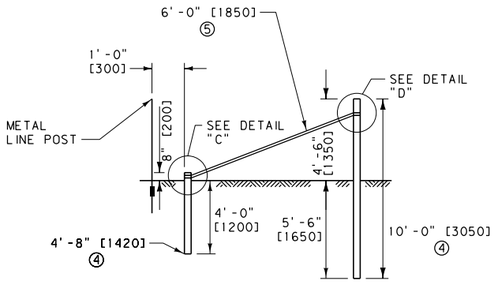



DOUBLE WOOD PANEL

FOR CORNERS, PULLING, STRETCHING, AND CHANGES IN HORIZONTAL ALIGNMENT.

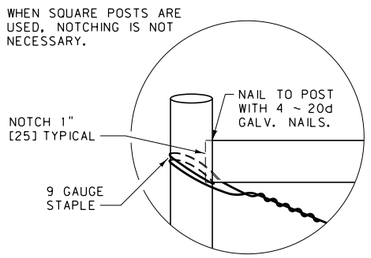



DOUBLE STEEL PANEL




SINGLE STEEL PANEL

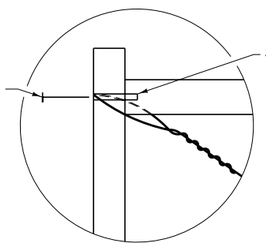
FENCE PANEL



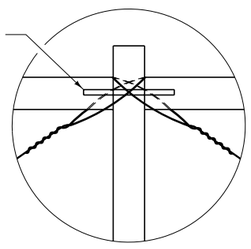

DETAIL "A"

BRACE WIRES - PROVIDE MINIMUM 12 1/2 GAUGE SMOOTH WIRE DOUBLED TO FORM A FOUR WIRE BRACE. ATTACH BRACE WIRES TO POSTS BY WRAPPING AROUND THE POST AT LEAST TWO TIMES AND THEN WRAPPING AROUND ITSELF FIVE TIMES.

LEVERS - 1 1/2" x 2" x 12" [37.5 x 50 x 300] MINIMUM SIZE. LEAVE IN PLACE AFTER TWISTING




DRIVE 12" x 3/8" [300 x 9.5] DIA. SPIKE THROUGH POST AND 4" [100] INTO BRACE POST.



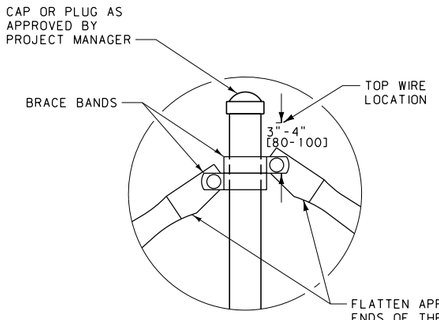

POSTS ARE NOT NOTCHED. PILOT HOLE DIAMETER IS 5/16" [7.9].

FURNISH AND INSTALL BRACE WIRES AND LEVERS IN ACCORDANCE WITH NOTES ON DETAIL "A".

INSTALL A 20" x 3/8" [500 x 9.5] ROD IN THE MIDDLE POST PRIOR TO SETTING THE BRACES. PIN THE BRACES IN PLACE FROM THE OUTSIDE.

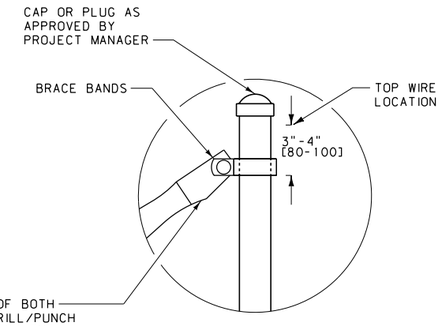
DETAIL "B"

ALTERNATE PANEL BRACING




DETAIL "C"

STEEL POST DOUBLE PANEL BRACING




DETAIL "D"

STEEL POST SINGLE PANEL BRACING

NOTES:

① SEE THE SPECIFICATIONS FOR POST AND WIRE REQUIREMENTS.

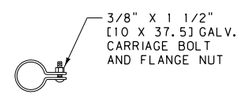
② LINE POST SPACING IS 16'-6" [5000] CENTER TO CENTER. LINE POST SPACING FROM BRACE OR PANEL POST IS 16'-6" [5000] CENTER TO CENTER.

③ SEE DTL. DWG. NO. 607-00, 607-10 AND 607-15 FOR ADDITIONAL FENCING DETAILS.

④ 2 1/2" [65] DIA. NOMINAL STEEL PIPE- SCHEDULE 40 OR BETTER

⑤ 1 1/2" [40] DIA. NOMINAL STEEL PIPE- SCHEDULE 40 OR BETTER

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*




BRACE BAND DETAIL

FOR STEEL PANELS
(SEE SUB SECTION 712.01.5.)

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 607

DWG. NO. 607-05

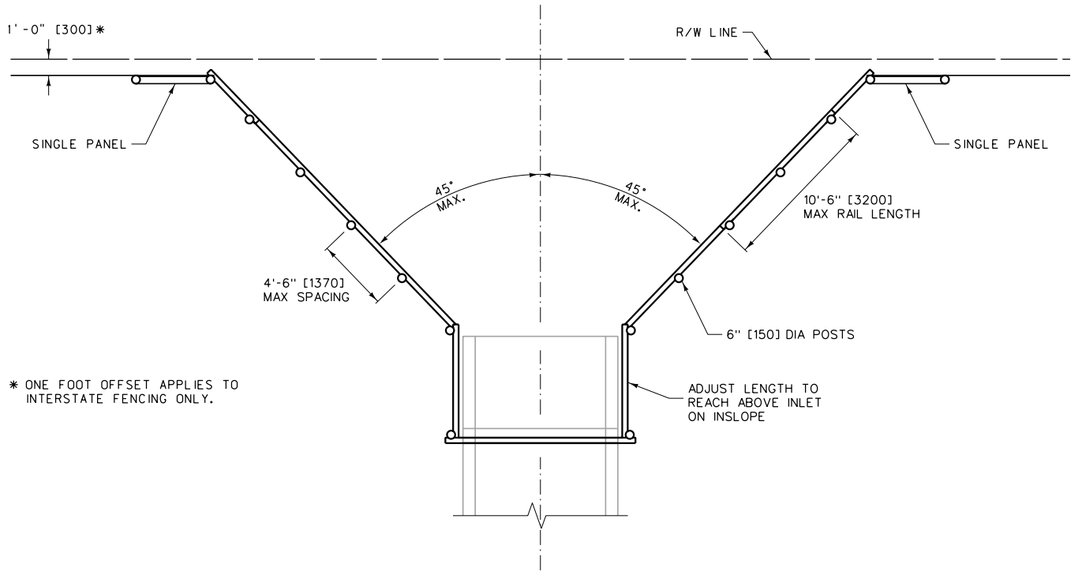
FENCE DETAILS

--REVISED--
JANUARY 2018

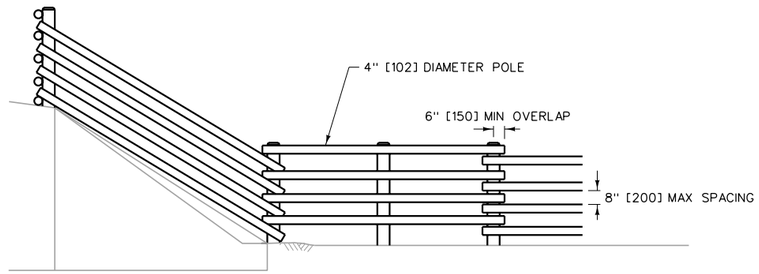
EFFECTIVE: SEPTEMBER 2014

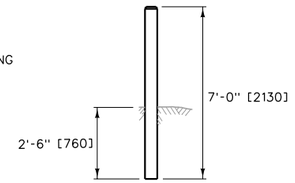
MDT MONTANA DEPARTMENT OF TRANSPORTATION

## UPSLOPE FENCE LAYOUT AT CORRUGATED STEEL PIPE (CSP) STOCKPASS

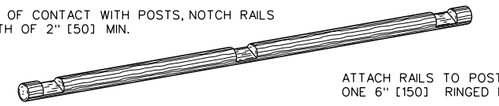



* ONE FOOT OFFSET APPLIES TO INTERSTATE FENCING ONLY.



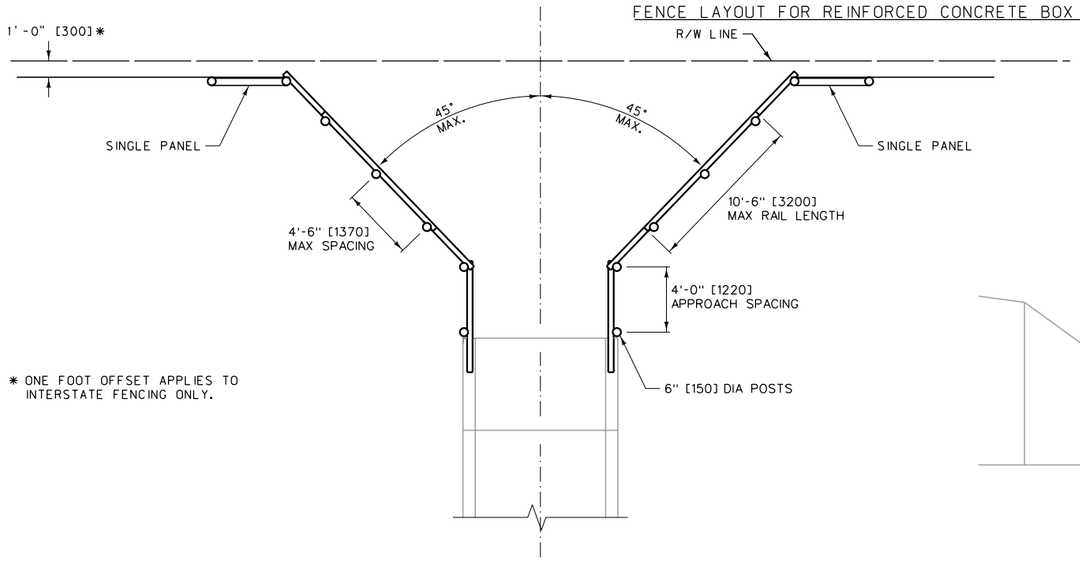

X-SEC VIEW



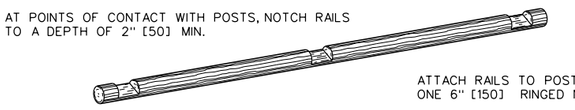

RAIL NOTCHING

NOTE: ALL POLES, POSTS, RAILS, OR WOOD ITEMS WILL BE TREATED

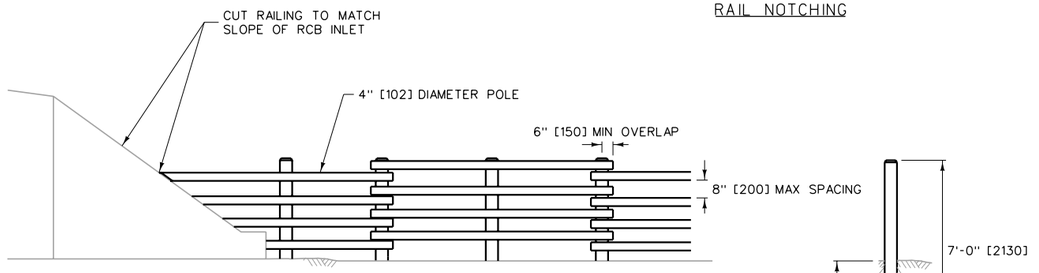
## FENCE LAYOUT FOR REINFORCED CONCRETE BOX (RCB) STOCKPASS




* ONE FOOT OFFSET APPLIES TO INTERSTATE FENCING ONLY.




RAIL NOTCHING




X-SEC VIEW

NOTE: ALL POLES, POSTS, RAILS, OR WOOD ITEMS WILL BE TREATED

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 607

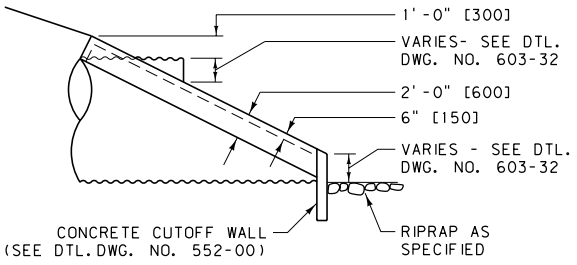
DWG. NO. 607-17

# FENCE DETAILS

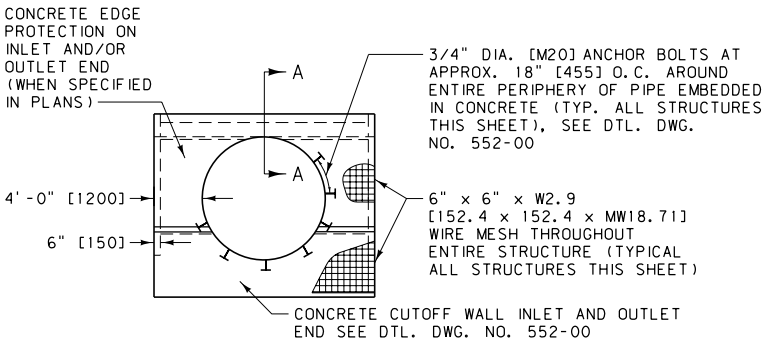
EFFECTIVE: JANUARY 2018

MDT MONTANA DEPARTMENT OF TRANSPORTATION

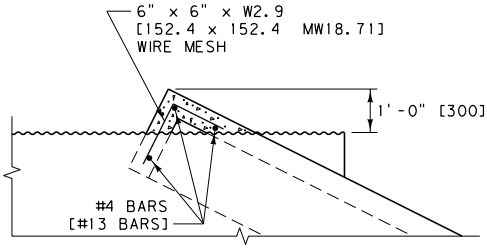
## ROUND PIPE



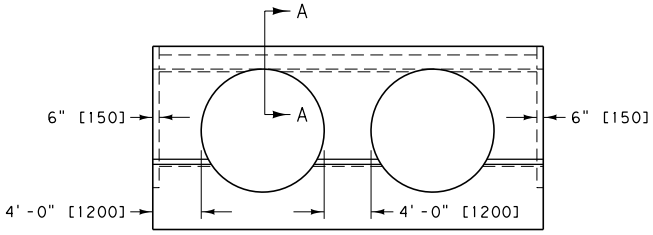

SIDE ELEVATION




FRONT ELEVATION

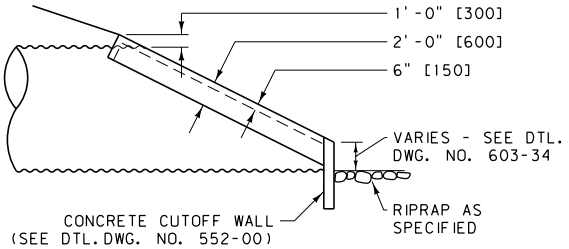



SECTION A-A

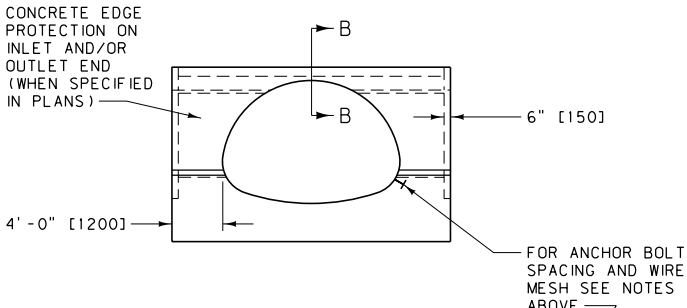



FRONT ELEVATION MULTIPLE PIPES

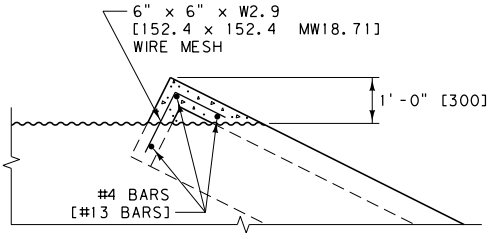
## ARCH PIPE



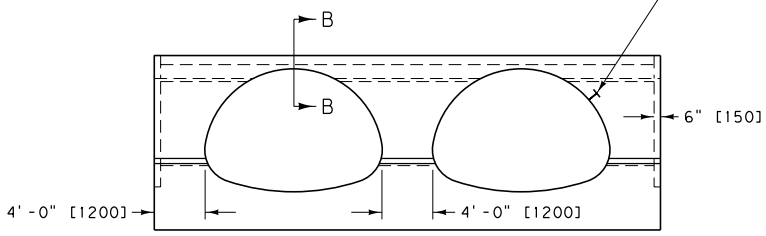

SIDE ELEVATION




FRONT ELEVATION




SECTION B-B




FRONT ELEVATION MULTIPLE PIPES

NOTE:
ALL CONCRETE IS CLASS GENERAL OR EQUAL.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 613, 603, 552

DWG. NO. 613-06

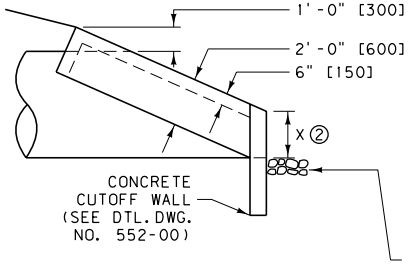
CONCRETE EDGE PROTECTION FOR METAL CULVERTS

*--REVISED--*
JANUARY 2018

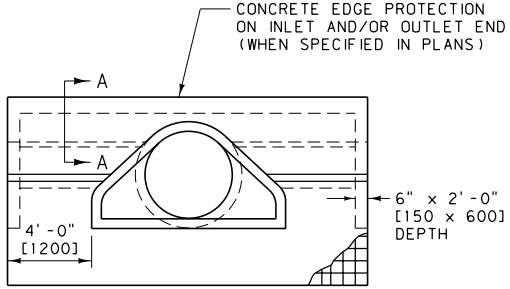
EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION

## ROUND PIPE
(FETS SHOWN)

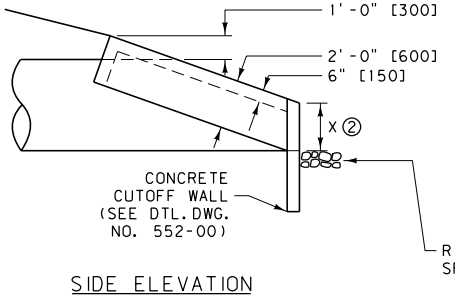



SIDE ELEVATION

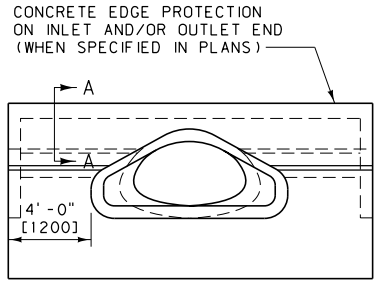



FRONT ELEVATION

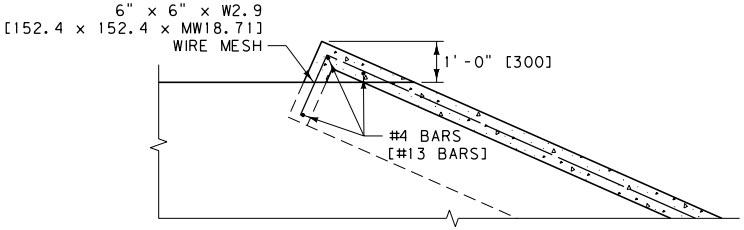
## ARCH PIPE
(FETS SHOWN)



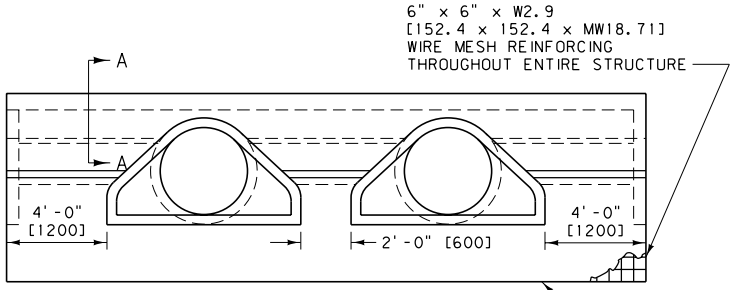

SIDE ELEVATION



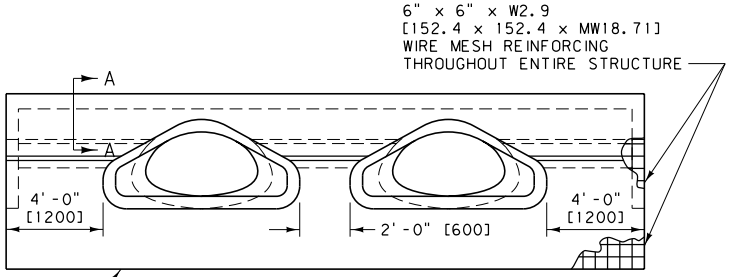

FRONT ELEVATION




SECTION A-A




FRONT ELEVATION MULTIPLE PIPES




FRONT ELEVATION MULTIPLE PIPES

CONCRETE CUTOFF WALL INLET AND OUTLET END SEE DTL. DWG. NO. 552-00 (WHEN SPECIFIED IN PLANS)

NOTES:

① ALL CONCRETE IS CLASS GENERAL CONCRETE OR EQUAL.

② SEE DTL. DWG. NO. 603-08 AND 603-10 FOR RCP AND RCPA CULVERTS WITH FETS. FOR RCP AND RCPA CULVERTS WITH SQUARE ENDS, THE "X" DIMENSION IS D/4 OR R/3.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 613, 603, 552

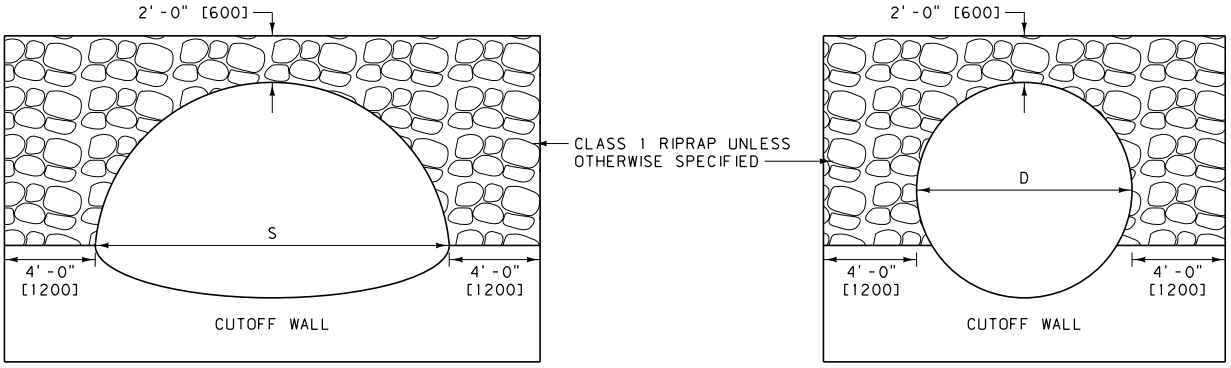
DWG. NO. 613-08

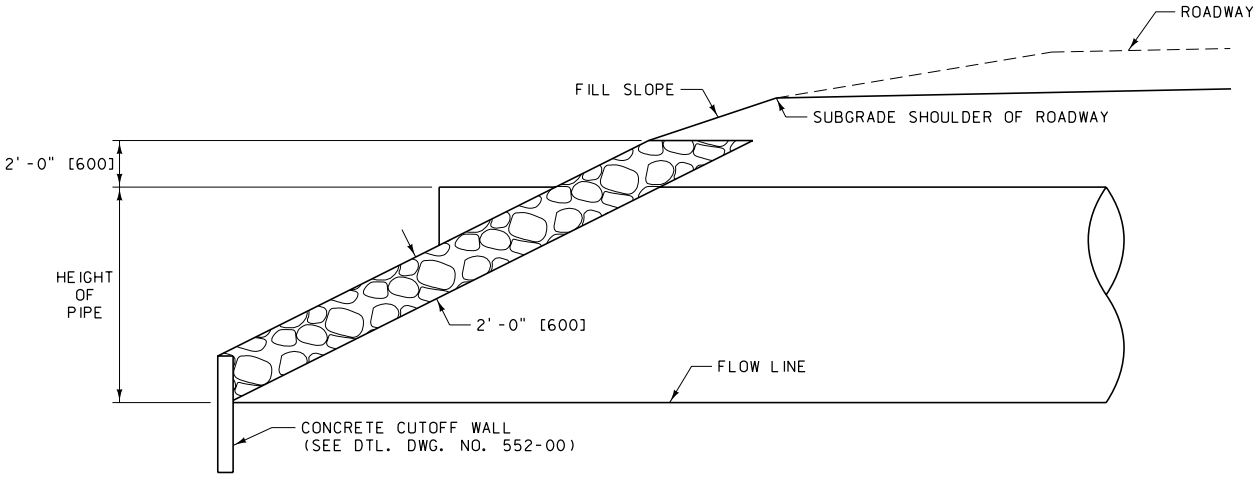
# CONCRETE EDGE PROTECTION FOR CONCRETE CULVERTS

*--REVISED--*
JANUARY 2018

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION




NOTES:

① CULVERT RIPRAP IS ONLY USED IN SPECIAL CIRCUMSTANCES.

② KEY ENDS OF RIPRAP WALLS INTO THE EMBANKMENT SLOPES A MINIMUM OF 2 FEET [600 mm] FROM OUTER FACE OF THE RIPRAP FOR THE FULL HEIGHT OF THE RIPRAP WALL.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

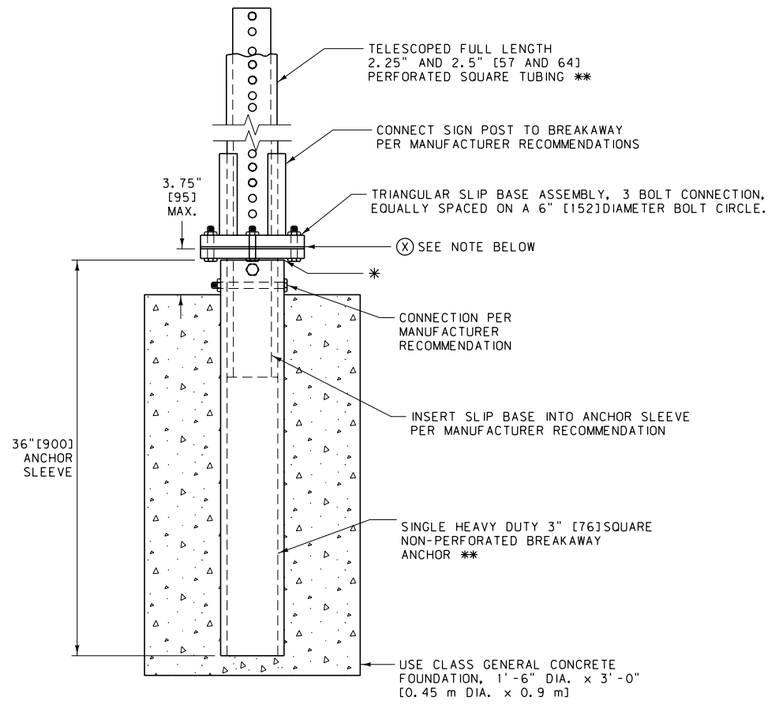
| REFERENCE STANDARD SPEC. SECTION 613 | DWG. NO. 613-14 |
|---|---|

CULVERT RIPRAP

| --REVISED-- | EFFECTIVE: SEPTEMBER 2014 |
|---|---|
| JANUARY 2018 | MDT MONTANA DEPARTMENT OF TRANSPORTATION |

## TELESCOPED SQUARE TUBES SIGN POST INSTALLATION ON SLIP BASE

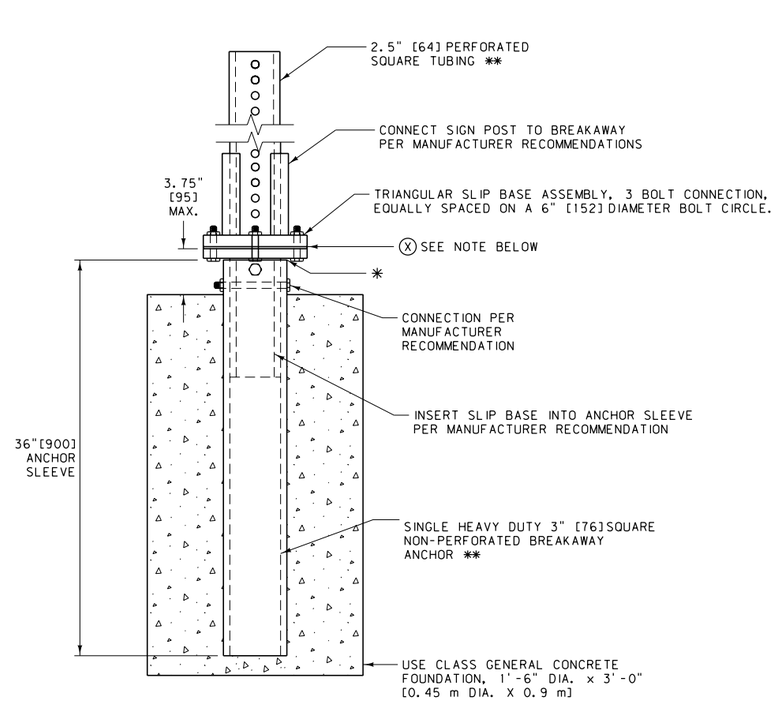
AS NOTED BY THE STAR SYMBOL ★ ON THE LOCATION AND SPECIFICATION SHEETS.




* SHIM AS REQUIRED PER MANUFACTURER RECOMMENDATION TO TAKE UP TOLERANCE BETWEEN SLIP BASE STUB AND ANCHOR SLEEVE.

## SINGLE SQUARE TUBE SIGN TO POST INSTALLATION ON SLIP BASE

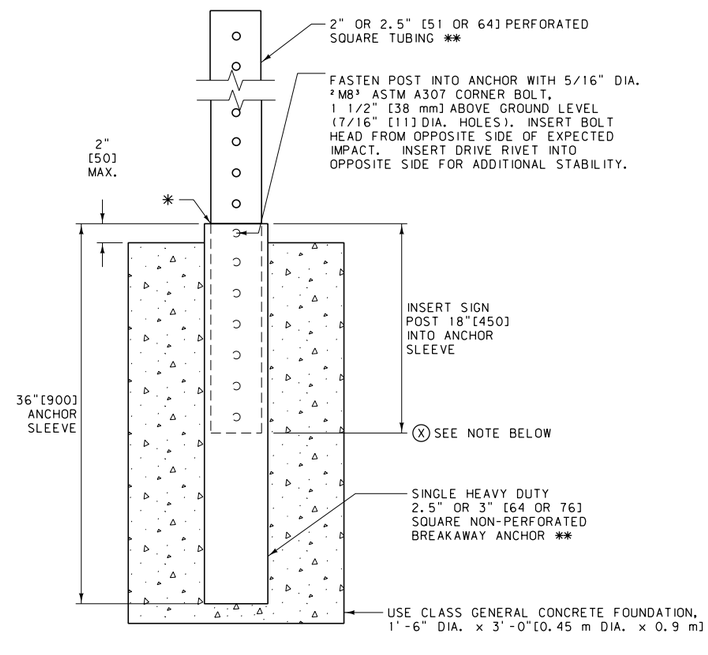
AS NOTED BY THE CIRCLE SYMBOL ● ON THE LOCATION AND SPECIFICATION SHEETS.




* SHIM AS REQUIRED PER MANUFACTURER RECOMMENDATION TO TAKE UP TOLERANCE BETWEEN SLIP BASE STUB AND ANCHOR SLEEVE.

## SINGLE SQUARE TUBE SIGN POST INSTALLATION

AS NOTED BY THE TRIANGLE SYMBOL ▲ ON THE LOCATION AND SPECIFICATION SHEETS.




* MINIMUM OF 2 SHIMS REQUIRED PER INSTALLATION TO TAKE UP TOLERANCE BETWEEN SUPPORT AND ANCHOR SLEEVE.

| ** SUPPORT AND CORRESPONDING ANCHOR | | | | | |
|---|---|---|---|---|---|
| SUPPORT | | | ANCHOR | | |
| TUBE SIZE | WEIGHT | WALL THICKNESS | TUBE SIZE | WEIGHT | WALL THICKNESS |
| 2" [51] | 2.42 LB./FT. [3.6 kg/m] | 0.105" (12 GAUGE) [2.7 (12 GAUGE)] | 2.5" [64] | 18.36 LB. EA. [8.33 kg EACH] | 0.135" (7 GAUGE) [3.4 (7 GAUGE)] |
| 2.25" [57] | 2.77 LB./FT. [4.12 kg/m] | 0.105" (12 GAUGE) [2.7 (12 GAUGE)] | 3" [76] | 22.98 LB. EA. [10.43 kg EACH] | 0.188" (7 GAUGE) [4.8 (7 GAUGE)] |
| 2.5" [64] | 3.14 LB./FT. [4.67 kg/m] | 0.105" (12 GAUGE) [2.7 (12 GAUGE)] | | | |

NOTES:

① BREAKAWAY DEVICES MUST BE LISTED ON THE DEPARTMENT'S QUALIFIED PRODUCTS LIST.

② USE CLASS GENERAL CONCRETE WITH WOOD FLOAT FINISH ON TOP. FORM TOP 6" [150] OF FOUNDATION.

③ GALVANIZE PIPE PER AASHTO M 111.

④ PAINT PIPE WITH ONE SHOP COAT AND ONE FIELD COAT OF ZINC RICH BASED PAINT AND ONE FIELD COAT OF ALUMINUM PAINT, AS SPECIFIED IN THE STANDARD SPECIFICATIONS SECTION 710, ON ALL SURFACES NOT IN CONTACT WITH THE CONCRETE.

⑤ CONFORM STEEL PIPE TO THE REQUIREMENTS OF ASTM A 53 TYPE E OR S, GRADE B.

⑥ SUBMIT SHOP DRAWINGS TO BE APPROVED BY THE MONTANA DEPARTMENT OF TRANSPORTATION BEFORE FABRICATION IS BEGUN.

⑦ STEEL POSTS AND FOOTINGS IN PLACE, INCLUDING ALL CONCRETE, WELDING, EXCAVATION, AND ALL INCIDENTALS ARE INCLUDED IN THE UNIT PRICE BID PER POUND FOR TUBULAR STEEL POSTS.

⑧ USE HARDWARE MEETING THE REQUIREMENTS OF SECTION 704.

Ⓧ BASE POINT OF POST LENGTH MEASUREMENT. TYPE OF POSTS AND FOUNDATIONS, AS WELL AS LENGTHS ARE NOTED IN THE SIGNING QUANTITIES.

*UNITS SHOWN IN BRACKETS [] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.*

DETAILED DRAWING

REFERENCE STANDARD SPEC. SECTION 556, 619, 704, 710

DWG. NO. 619-14

# SQUARE TUBULAR SIGN POST BREAKAWAY DEVICES

--REVISED--
JULY 2016
JANUARY 2018

EFFECTIVE: SEPTEMBER 2014

MDT MONTANA DEPARTMENT OF TRANSPORTATION