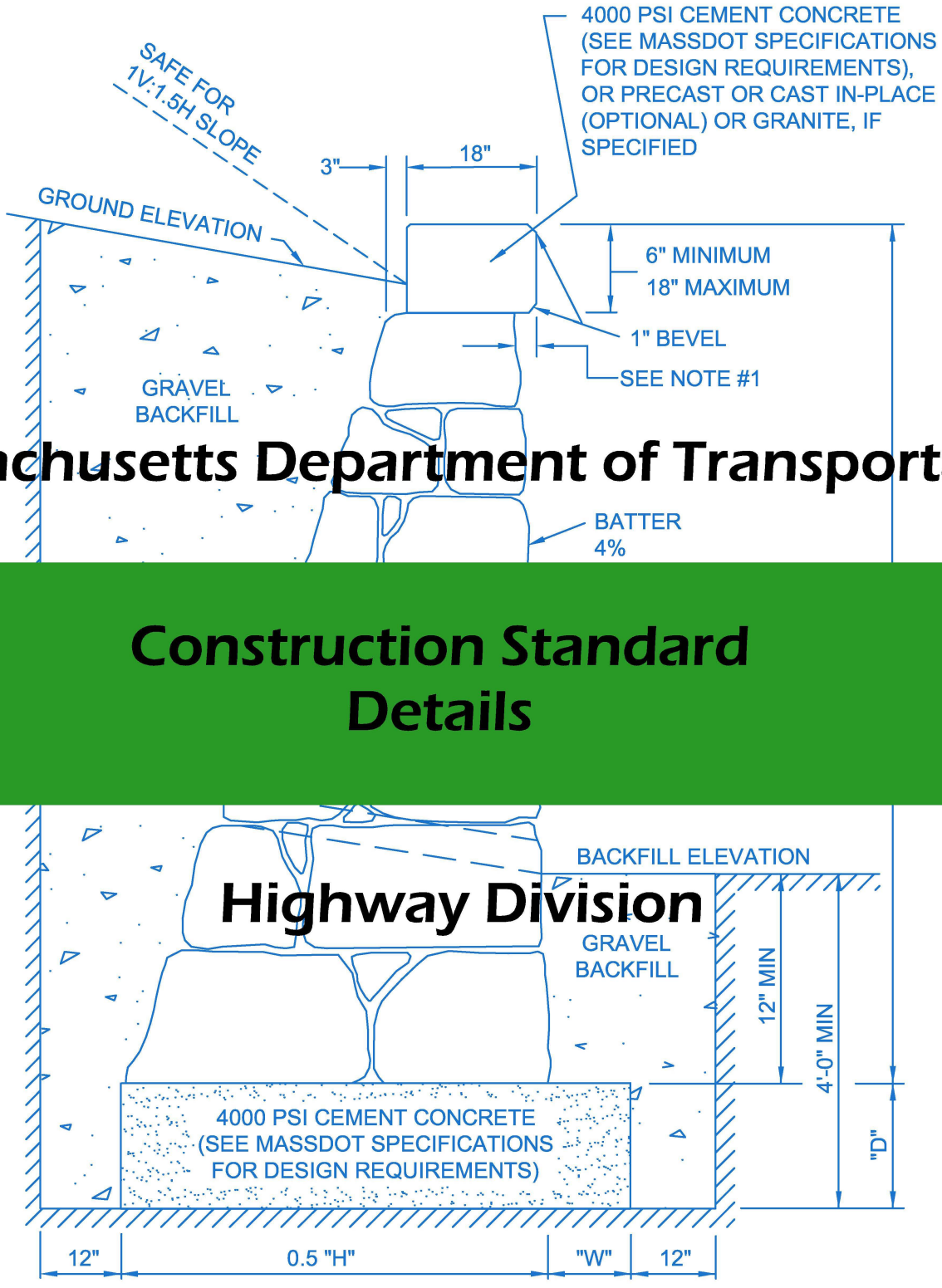



# Massachusetts Department of Transportation

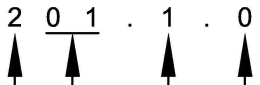
# Construction Standard Details

## Highway Division

massDOT
Massachusetts Department of Transportation
Highway Division

**DECEMBER 2016**

## EXAMPLE: DRAWING NUMBER - 201.1.0




SECTION NUMBER (1,2,3,4 OR 5)
(100, 200, 300, 400 OR 500 SERIES)

- SECTION 1 (100 SERIES)
  - HIGHWAY DESIGN AND PAVEMENT DETAILS
- SECTION 2 (200 SERIES)
  - DRAINAGE
- SECTION 3 (300 SERIES)
  - CEMENT CONCRETE, MASONRY STANDARDS
- SECTION 4 (400 SERIES)
  - HIGHWAY GUARD RAIL AND FENCES
- SECTION 5 (500 SERIES)
  - MISCELLANEOUS

CATEGORY IN SERIES:

- 01 FOR CATCH BASINS
- 02 FOR MANHOLES
- 03 FOR DROP INLETS, ETC.

DRAWING NUMBER IN EACH CATEGORY

AUXILIARY DRAWING NUMBER:
A NUMBER OTHER THAN ZERO WILL APPEAR IN THIS POSITION WHEN IT IS SUBSEQUENTLY NECESSARY TO INSERT ONE OR MORE ADDITIONAL DRAWINGS BETWEEN TWO EXISTING DRAWING NUMBERS IN THE SAME CATEGORY.

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# KEY TO NUMBERING SYSTEM

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**KEY 1**

DESCRIPTION | DRAWING NUMBER

## SECTION 1
## HIGHWAY DESIGN AND PAVEMENT DETAILS


LIMIT OF MUCK EXCAVATION..... E 101.1.0
ROCK CUT SELECTION..... E 102.1.0
METHOD OF ROUNDING SLOPES- CUT AND FILL SLOPES..... E 103.1.0
METHOD OF STEPPING SURFACE AND BASE COURSE LAYERS..... E 104.1.0
TRANSVERSE JOINTS AT EXPANSION JOINTS..... E 104.1.1
LOCATION OF SAW CUT FOR TRANSVERSE JOINTS
AT BRIDGE ABUTMENT..... E 104.1.2
SCORED CEMENT CONCRETE PAVEMENT AT RAMPS..... E 105.2.0
SHOULDER SECTION OF SCORED CEMENT CONCRETE PAVEMENT.... E 105.2.1
FREEWAY ENTRANCE RAMP DETAIL - RUMBLE STRIP
INSTALLATION AT GORE AREAS..... E 105.3.2
FREEWAY ENTRANCE RAMP DETAIL - PAVEMENT MARKING
INSTALLATION AT GORE AREAS..... E 105.3.3
RUMBLE STRIP INSTALLATION DETAILS BICYCLES PROHIBITED..... E 105.5.0
RUMBLE STRIP INSTALLATION DETAILS BICYCLES PERMITTED..... E 105.7.0
HOT MIX ASPHALT BERM TYPE A..... E 106.1.0
HOT MIX ASPHALT CURBS..... E 106.2.0
METHOD OF SETTING VERTICAL CURB..... E 106.3.0
METHOD OF SETTING SLOPED EDGING..... E 106.5.0
INTERSECTIONS..... E 107.1
WHEELCHAIR RAMPS LESS THAN 12'-4” SIDEWALK..... E 107.2.0
WHEELCHAIR RAMP ON NARROW SIDEWALK WITH
DETECTABLE WARNING PANEL..... E 107.2.1
WHEELCHAIR RAMPS GREATER THAN 12'-4” SIDEWALK..... E 107.3.0
WHEELCHAIR RAMP FOR ONE CONTINUOUS DIRECTION
OF PEDESTRIAN TRAFFIC..... E 107.6.0
WHEELCHAIR RAMP WITH 3” CURB REVEAL..... E 107.6.3
“T” INTERSECTION WHEELCHAIR RAMP..... E 107.6.4
DETECTABLE WARNING PANEL FOR WHEELCHAIR RAMPS
AND STANDARD RAMP TERMINOLOGY..... E 107.6.5
WHEELCHAIR RAMP WITH LANDSCAPING STRIP..... E 107.6.9
SIDEWALK THROUGH DRIVEWAYS WITHOUT CURB RETURNS 6'..... E 107.7.0
SIDEWALK THROUGH DRIVEWAYS WITH CURB
RETURNS 2' CURB CORNERS..... E 107.8.0
RESIDENTIAL DRIVEWAYS..... E 107.8.1
CURB TRANSITION LENGTH FOR WHEELCHAIR RAMPS..... E 107.9.0

DESCRIPTION | DRAWING NUMBER

SECTION 2
DRAINAGE


CONCRETE BLOCK CATCH BASIN..... E 201.3.0
PRECAST CONCRETE CATCH BASIN..... E 201.4.0
PRECAST CONCRETE CATCH BASIN TUB..... E 201.5.0
CATCH BASIN FRAME..... E 201.6.0
HOOK LOCK CASCADE GRATE- FLOW FROM LEFT..... E 201.7.0
HOOK LOCK CASCADE GRATE- FLOW FROM RIGHT..... E 201.7.1
FRAME AND HOOK LOCK CASCADE GRATE- FLOW FROM LEFT-
ASSEMBLY DETAILS..... E 201.9.0
FRAME AND HOOK LOCK CASCADE GRATE- FLOW FROM RIGHT-
ASSEMBLY DETAILS..... E 201.9.1
HOOK LOCK BAR GRATE..... E 201.10.0
FRAME AND HOOK LOCK BAR GRATE- FRAME ASSEMBLY DETAILS..... E 201.10.1
DROP INLET GRATE..... E 201.11.0
CATCH BASIN HOOD..... E 201.12.0
CONCRETE BLOCK MANHOLE - MANHOLES 9' OR LESS IN DEPTH..... E 202.2.0
CONCRETE BLOCK MANHOLE - MANHOLES OVER 9' IN DEPTH..... E 202.3.0
PRECAST CONCRETE MANHOLES 9' OR LESS IN DEPTH..... E 202.4.0
SPECIAL MANHOLES FOR 36” TO 84” DIAMETER R.C. PIPE..... E 202.5.0
MANHOLE FRAME AND COVER - A FRAME..... E 202.6.0
MANHOLE FRAME AND COVER - B FRAME..... E 202.7.0
MANHOLE COVER DETAILS..... E 202.8.0
CONCRETE COLLARS..... E 202.9.0
DROP INLETS TYPE A - PRECAST CONCRETE TYPE B -
CONCRETE BLOCK..... E 203.1.0
DROP INLETS TYPE AF - PRECAST CONCRETE TYPE BF -
CONCRETE BLOCK..... E 203.2.0
DROP INLET TYPE C..... E 203.3.0
DROP INLET TYPE CF..... E 203.4.0
DROP INLET TYPE D..... E 203.5.0
DROP INLET TYPE DF..... E 203.6.0
FLUSH DROP INLET THROAT..... E 203.7.0
GUTTER INLET..... E 204.2.0
DRY STONE MASONRY LEACHING BASIN..... E 205.1.0
CONCRETE BLOCK LEACHING BASIN..... E 205.2.0
CORRUGATED STEEL METAL PIPE - TABLE OF
MINIMUM WALL THICKNESS..... E 206.1.0

| DESCRIPTION | DRAWING NUMBER |
|---|---|
| **SECTION 2** | |
| **DRAINAGE CONT.** | |
| CORRUGATED STEEL METAL PIPE ARCH - TABLE OF MINIMUM WALL THICKNESS | E 206.2.0 |
| CORRUGATED METAL PIPE UNDER FILL SLOPE | E 206.3.0 |
| CONCRETE AND FIELD STONE MASONRY PIPE ENDS FOR 8” TO 30” PIPE | E 206.4.0 |
| QUANTITY TABLES FOR CONCRETE AND FIELD STONE MASONRY PIPE ENDS | E 206.4.1 |
| CONCRETE AND FIELDSTONE MASONRY PIPE ENDS FOR COMBINATION PIPES UP TO 30” | E 206.5.0 |
| CONCRETE AND FIELDSTONE MASONRY PIPE ENDS FOR 30” TO 84” PIPE CULVERTS | E 206.6.0 |
| STONE PIPE ENDS FOR PIPES 24” AND LESS IN DIA. | E 206.7.0 |
| REINFORCED CONCRETE PIPE FLARED ENDS | E 206.8.0 |
| STANDARD METAL END | E 206.9.0 |
| CONCRETE SPLASH PADS | E 208.1.0 |
| SUBDRAIN | E 209.1.0 |
| DITCH CHECK DAMS FOR EROSION CONTROL | E 210.2.0 |
| HAY BALES AND SILT FENCES FOR EROSION CONTROL | E 210.3.0 |
| HALF CIRCLE CCM PIPE WATERWAYS | E 211.1.0 |
| PAVED WATERWAYS AND APRON | E 211.2.0 |
| PAVED WATERWAYS | E 211.3.0 |
| **SECTION 3** | |
| **CEMENT CONCRETE & MASONRY STRUCTURES** | |
| CEMENTED STONE MASONRY WALL | E 302.2.0 |
| SPECIAL SLOPE PAVING UNDER BRIDGES REINFORCED CONCRETE SLAB | E 303.1.0 |
| SPECIAL SLOPE PAVING UNDER BRIDGES REINFORCED CONCRETE SLAB DETAILS | E 303.1.1 |
| CEMENT CONCRETE STEPS 1/2 | E 304.1.0 |
| CEMENT CONCRETE STEPS 2/2 | E 304.2.0 |
| TYPICAL CANTILEVER RETAINING WALL SECTION | E 305.1.0 |
| CANTILEVER RETAINING WALLS DENSE FOUNDATION SOILS, SLOPING BACKFILL | E 305.2.0 |
| CANTILEVER RETAINING WALLS DENSE FOUNDATION SOILS, LEVEL BACKFILL, SURCHARGE | E 305.3.0 |

DESCRIPTION | DRAWING NUMBER

SECTION 3
CEMENT CONCRETE & MASONRY STRUCTURES CONT.

CANTILEVER RETAINING WALLS LOOSE FOUNDATION SOILS, SLOPING BACKFILL..... E 305.4.0
CANTILEVER RETAINING WALLS LOOSE FOUNDATION SOILS, LEVEL BACKFILL, SURCHARGE..... E 305.5.0
CANTILEVER RETAINING WALLS ROCK FOUNDATION, SLOPING BACKFILL..... E 305.6.0
CANTILEVER RETAINING WALLS ROCK FOUNDATION, LEVEL BACKFILL, SURCHARGE..... E 305.7.0

SECTION 4
HIGHWAY GUARD RAIL & FENCES

STEEL W BEAM HIGHWAY GUARD ..... E 401.1.0
STEEL W BEAM HIGHWAY GUARD SECTIONS..... E 401.1.1
STEEL W BEAM HIGHWAY GUARD FOR SIGN PROTECTION..... E 401.2.0
STEEL W BEAM HIGHWAY GUARD BURIED IN BACK-SLOPE PLAN VIEW..... E 401.2.1a
STEEL W BEAM HIGHWAY GUARD BURIED IN BACK-SLOPE POST LOCATION..... E 401.2.1b
STEEL W BEAM HIGHWAY GUARD BURIED IN BACK-SLOPE POST LOCATION..... E 401.2.1c
STEEL W BEAM HIGHWAY GUARD BURIED IN BACK-SLOPE ANCHORAGE DETAILS..... E 401.2.1d
STEEL W BEAM HIGHWAY GUARD BURIED IN BACK-SLOPE END ANCHORAGE DETAILS FOR POSTS 1, 2 AND 3..... E 401.2.1e
TABLE OF OFFSETS FOR HIGHWAY GUARD FLARED ENDS..... E 401.3.0
STEEL THRIE BEAM HIGHWAY GUARD RAIL DETAILS..... E 401.5.0
BRIDGE RAIL TO HIGHWAY GUARD TRANSITION..... E 401.5.1
BRIDGE RAIL TO HIGHWAY GUARD TRANSITION SECTIONS..... E 401.5.2
STEEL THRIE BEAM HIGHWAY TERMINAL CONNECTOR ..... E 401.5.3
BRIDGE RAIL TO HIGHWAY GUARD COLLAPSING TUBE ..... E 401.5.4
BRIDGE RAIL TO HIGHWAY GUARD AT SIDEWALK ..... E 401.5.5
BRIDGE RAIL TO HIGHWAY GUARD AT SIDEWALK SECTIONS..... E 401.5.6
STEEL THRIE BEAM HIGHWAY GUARD DETAILS..... E 401.6.0
STEEL HIGHWAY GUARD TRANSITION BEAM ..... E 401.6.1
STEEL W BEAM HIGHWAY GUARD RAIL DETAILS ..... E 401.7.0
STEEL W BEAM HIGHWAY GUARD POSTS AND TERMINAL SECTION DETAILS..... E 401.8.0

DESCRIPTION | DRAWING NUMBER

SECTION 4
HIGHWAY GUARD RAIL & FENCES CONT.


STEEL BEAM HIGHWAY GUARD WITH WOOD POST..... E 401.10.0
SPECIAL BASE ANCHOR FOR HIGHWAY GUARD INSTALLATION ON CONCRETE..... E 401.11.0
MODIFIED HIGHWAY GUARD POST INSTALLATION WHERE STANDARD EMBEDMENT IS NOT FEASIBLE ..... E 401.12.0
STEEL THRIE BEAM HIGHWAY GUARD MEDIAN - BARRIER..... E 401.16.0
OFFSET BLOCKS FOR STEEL W BEAM HIGHWAY GUARD..... E 401.20.0
OFFSET BLOCKS FOR STEEL THRIE BEAM HIGHWAY GUARD ..... E 401.21.0
STEEL W BEAM HIGHWAY GUARD TERMINAL CONNECTORS ON EXIST. BRIDGE W-RAIL LEADING END AT ABUTMENTS & END POSTS..... E 402.2.0
INSTALLATION OF STEEL W BEAM HIGHWAY GUARD (TRAILING END) AT EXISTING BRIDGE ABUTMENTS AND END POSTS (W-RAIL)..... E 402.3.0
MASONRY BRACKET FOR STEEL W BEAM HIGHWAY GUARD ON ABUTMENTS AND END POSTS (TRAILING END)..... E 402.4.0
MASONRY BRACKET FOR STEEL W BEAM HIGHWAY GUARD ON ABUTMENTS AND END POSTS (TRAILING END)..... E 402.5.0
STEEL THRIE BEAM HIGHWAY GUARD TERMINAL CONNECTORS ON AN EXIST. BRIDGE LEADING END AT ABUTMENTS & END POST..... E 402.7.0
STEEL THRIE BEAM HIGHWAY GUARD (TRAILING END) AT EXISTING BRIDGE ABUTMENTS AND END POSTS..... E 402.8.0
MASONRY BRACKET FOR STEEL THRIE BEAM HIGHWAY GUARD ON ABUTMENTS AND END POSTS (TRAILING END)..... E 402.9.0
GUARDRAIL RETROFIT ON BRIDGES (PLAN VIEW)..... E 402.9.1
GUARDRAIL RETROFIT ON BRIDGES (DETAILS)..... E 402.9.2
GUARDRAIL RETROFIT ON BRIDGES (NOTES) ..... E 402.9.3
F SHAPE CONCRETE BARRIER..... E 402.10.0
F SHAPE CONCRETE BARRIER SYMMETRICAL SECTION REINFORCING DETAILS..... E 402.11.0
F SHAPE CONCRETE BARRIER ASYMMETRICAL SECTION REINFORCING DETAILS..... E 402.12.0
F SHAPE CONCRETE BARRIER DOWEL DETAILS..... E 402.13.0
F SHAPE CONCRETE BARRIER WITH CONCRETE SEPARATOR..... E 402.20.0
F SHAPE CONCRETE BARRIER WITH CONCRETE SEPARATOR REINFORCING DETAILS..... E 402.21.0
F SHAPE CONCRETE BARRIER WITH CONCRETE SEPARATOR DOWEL DETAILS..... E 402.22.0

DESCRIPTION | DRAWING NUMBER

## SECTION 4
## HIGHWAY GUARD RAIL & FENCES CONT.


TEMPORARY CONCRETE BARRIER MASH TL-2 1/3..... E 403.1.0
TEMPORARY CONCRETE BARRIER MASH TL-2 2/3..... E 403.2.0
TEMPORARY CONCRETE BARRIER MASH TL-2 3/3..... E 403.3.0
TEMPORARY CONCRETE BARRIER RETROFITTED TO MASH TL-3 1/2..... E 403.8.0
TEMPORARY CONCRETE BARRIER RETROFITTED TO MASH TL-3 2/2..... E 403.9.0
CHAIN LINK FENCE (SPRING TENSION WIRE) ..... E 404.1.0
CHAIN LINK FENCE (SPRING TENSION WIRE) ..... E 404.2.0
CHAIN LINK FENCE (PIPE TOP RAIL) ..... E 404.4.0
CHAIN LINK FENCE DETAILS OF CABLE ATTACHMENTS & POST BASES..... E 404.5.0
CHAIN LINK FENCE - SWING GATE..... E 404.6.0
CHAIN LINK FENCE CANTILEVER GATE ..... E 404.7.0
CHAIN LINK FENCE MOUNTED ON GUARD RAIL..... E 404.8.0
CHAIN LINK FENCE POST DETAILS ..... E 404.10.0

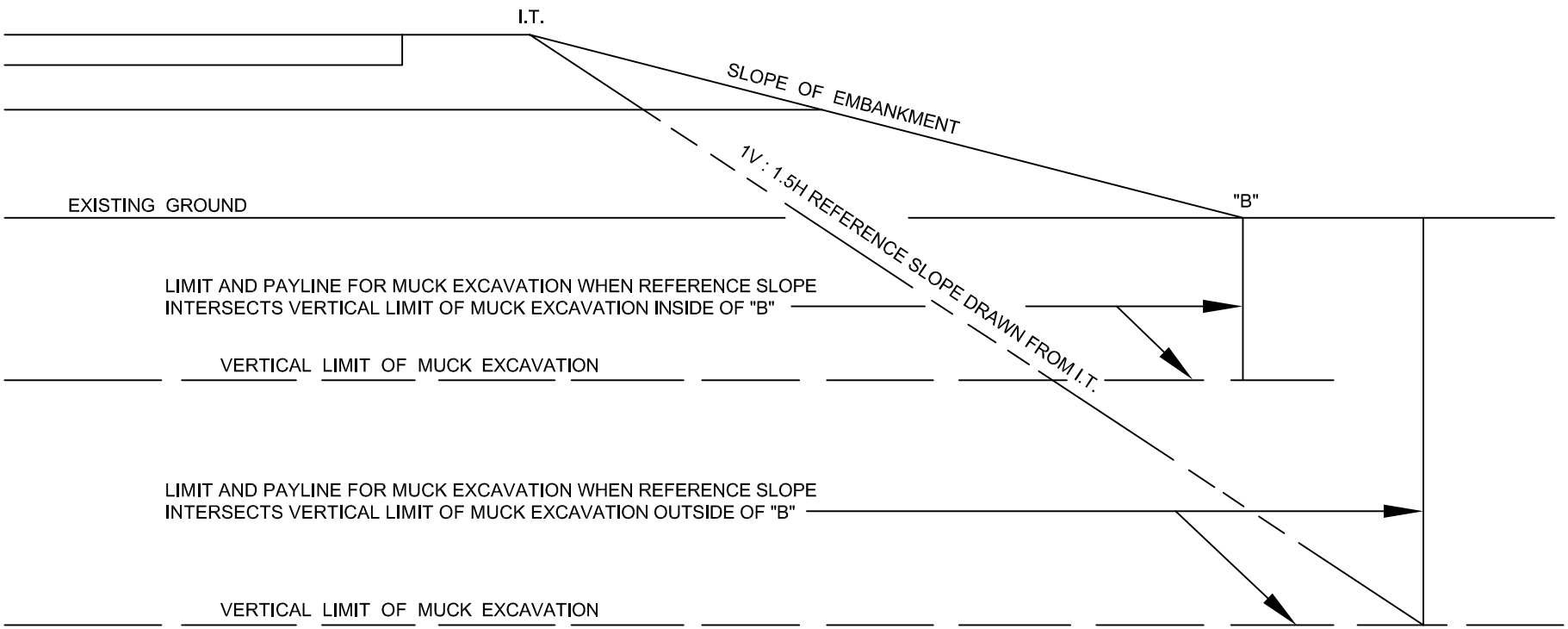

## SECTION 5
## MISCELLANEOUS


WETLANDS PROTECTION ACT SIGN..... E 501.1.0
TREE WELLS..... E 502.1.0
SETTING RURAL MAILBOXES..... E 504.1.0
DEMOUNTABLE REFLECTORIZED STATION MARKER AND PROJECT MARKER..... E 505.1.0
BOUND LETTERED GRANITE ..... E 506.2.0

CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

# LIMIT OF MUCK EXCAVATION




NOTES:

1. "B" - INTERSECTION OF EXISTING GROUND AND SLOPE OF EMBANKMENT
2. THE ABOVE METHOD MAY ALSO BE USED TO DETERMINE THE LIMIT FOR EXCAVATION OF OTHER UNSUITABLE MATERIALS
3. I.T. - INTERSECTION OF TANGENT

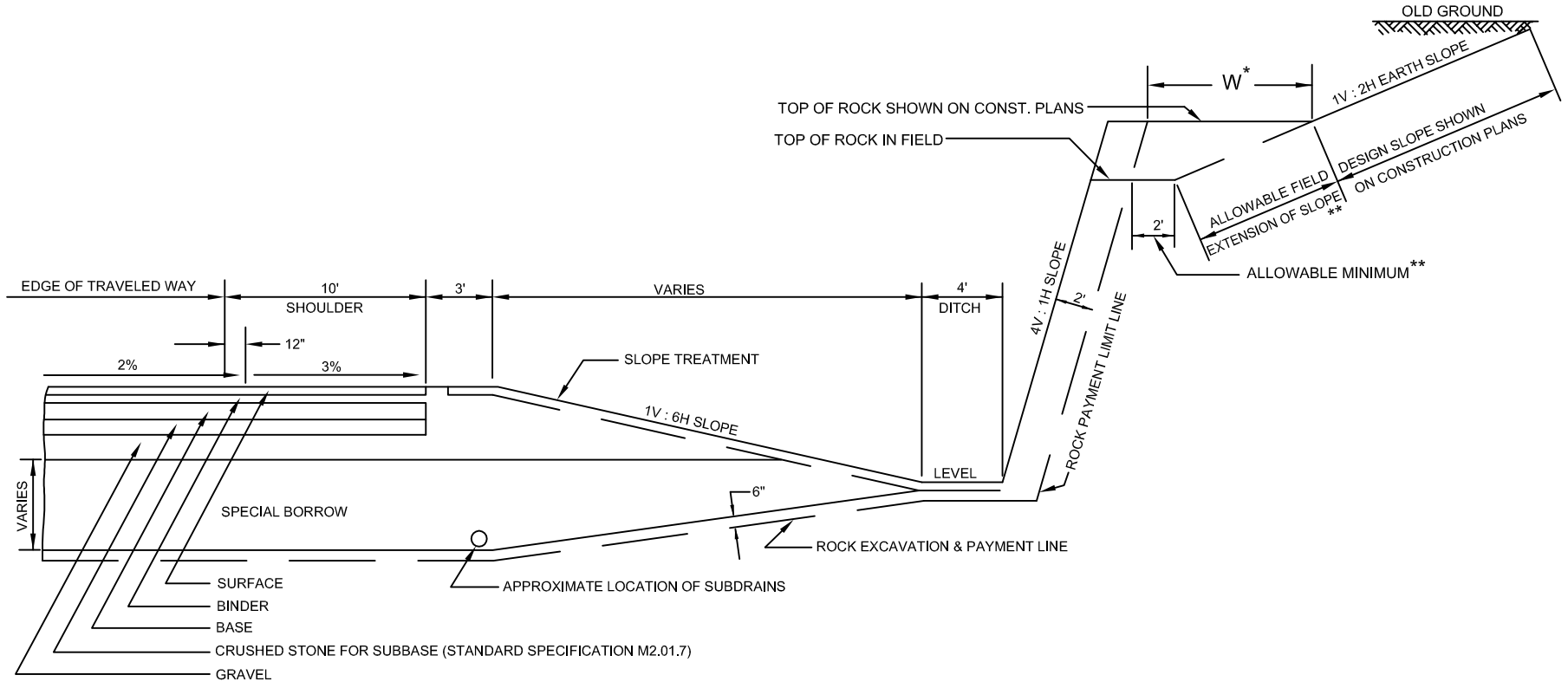
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 101.1.0**

CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

# ROCK CUT SELECTION




* DESIGN
- W=12' FOR ROCK CUTS OF 20' OR LESS
- W=17' FOR ROCK CUTS 25' OR MORE
- W-VARIES 12' - 17' FOR ROCK CUTS BETWEEN 20' - 25'; DETERMINE PROPORTIONATELY

** THE EXTENSION OF THE DESIGN SLOPE IN THE FIELD IS PERMISSIBLE WITHIN THE LIMITS SHOWN (2' SHELF ON TOP OF THE ROCK), WHEN THE HEIGHT OF THE ROCK CUT IN THE FIELD IS LESS THAN THAT SHOWN ON THE CONSTRUCTION PLANS

NOTES:

1. ONLY ROCK ACTUALLY REMOVED IS PAYABLE. NO PAYMENT WILL BE MADE BEYOND THE ROCK PAYMENT LINE

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 102.1.0**

CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

# METHOD OF ROUNDING SLOPES
# CUT AND FILL SLOPES

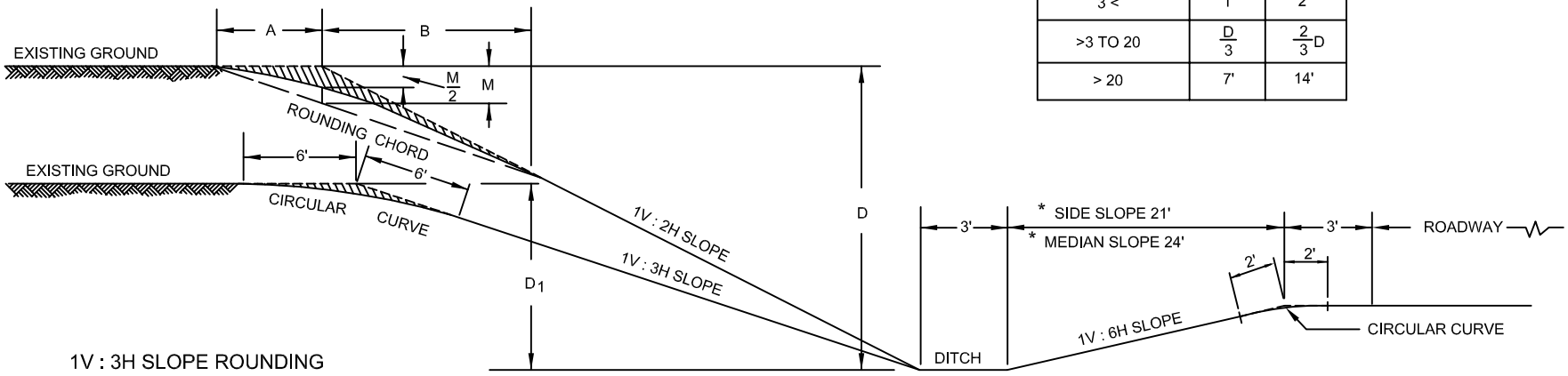
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 103.1.0**

## METHOD OF ROUNDING CUT SLOPES

ROUNDING TABLE FOR 1V : 2H SLOPE

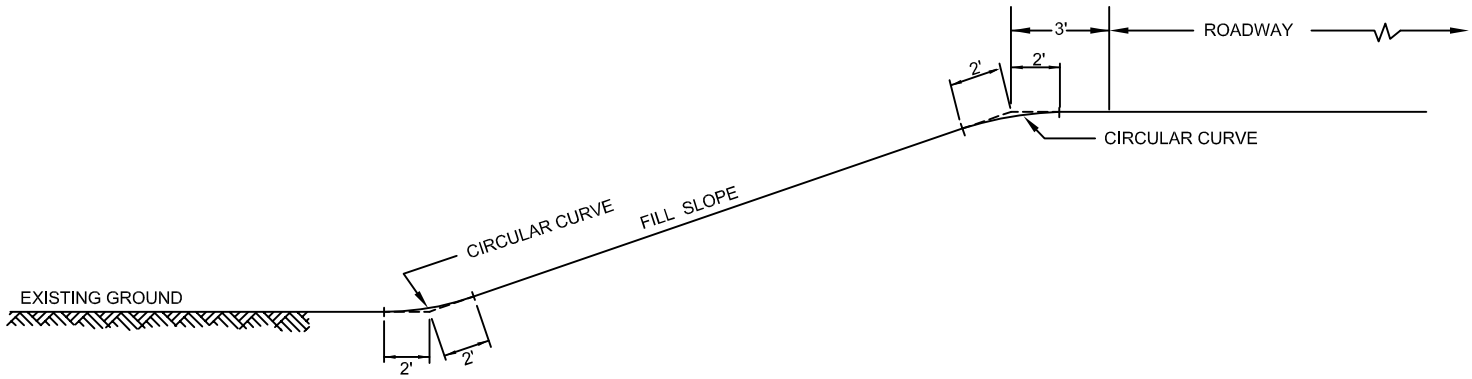
| D FEET | A | B |
|---|---|---|
| 3 < | 1' | 2' |
| >3 TO 20 | $\frac{D}{3}$ | $\frac{2}{3}$D |
| > 20 | 7' | 14' |




1V : 3H SLOPE ROUNDING

1. WHEN "D1" IS 2' OR MORE ROUND AS SHOWN IN TABLE ABOVE.
2. WHEN "D1" IS LESS THAN 2' ROUND FULL LENGTH OF SLOPE.

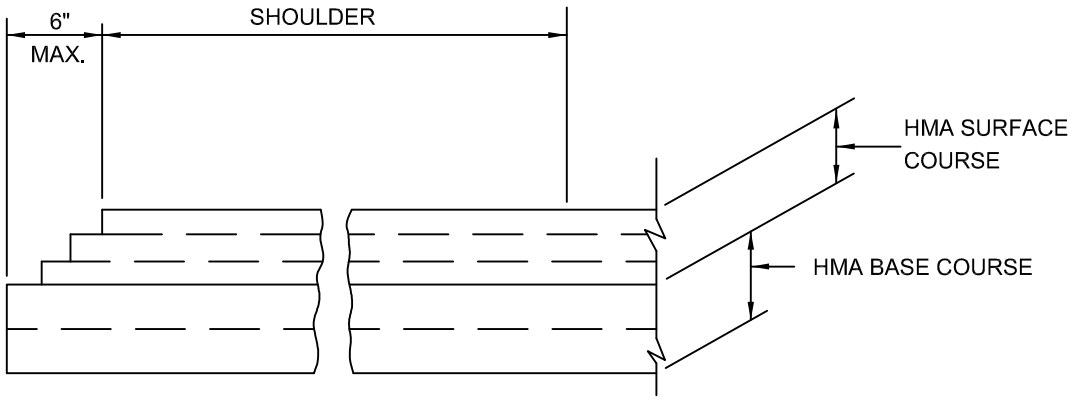
## METHOD OF ROUNDING FILL SLOPES



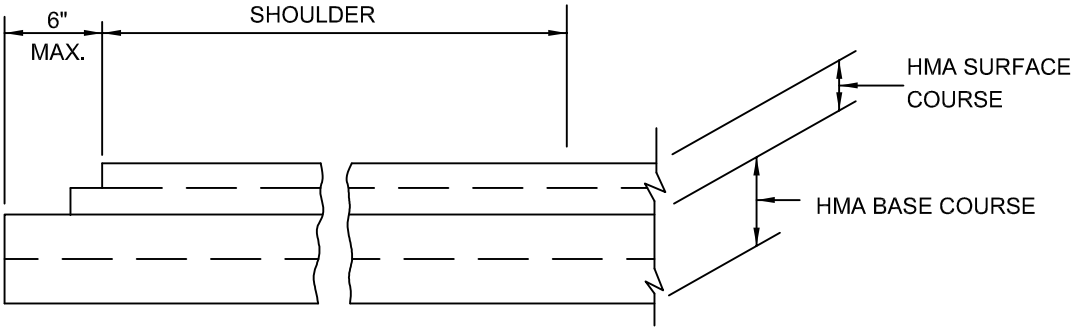

* USE SLOPE LENGTHS FOR LIMITED ACCESS OR HIGH SPEED ROADWAYS.

NOTE:

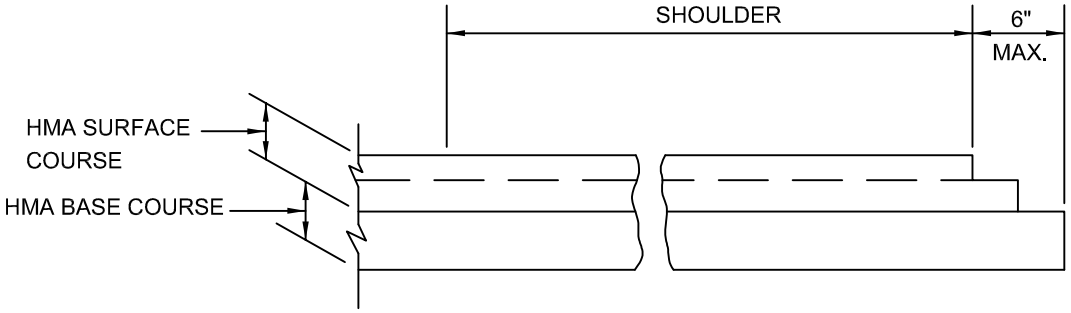
1. THE DIMENSIONS SHOWN FOR ROUNDING CUT AND FILL SLOPES ARE APPROXIMATE; THEY ARE TO BE USED AS GUIDES.




3 - LAYERED SURFACE AND 2 - LAYERED BASE COURSE




2 - LAYERED SURFACE AND 2 - LAYERED BASE COURSE




2 - LAYERED SURFACE AND 1 - LAYER BASE COURSE

NOTES:

1. ONLY APPLICABLE STEPPING METHODS OF THIS DRAWING ARE TO BE SHOWN IN THE TYPICAL SECTION OF THE CONSTRUCTION PLANS. THIS SHALL BE SHOWN AS A SEPARATE DETAIL AND NOT INCLUDED ON EACH SECTION.
2. STEPPING SHALL NOT BE SHOWN ON THE CROSS SECTION TEMPLATES.
3. ADDITIONAL MATERIAL REQUIRED FOR STEPPING SHALL BE INCLUDED IN ESTIMATED QUANTITIES.

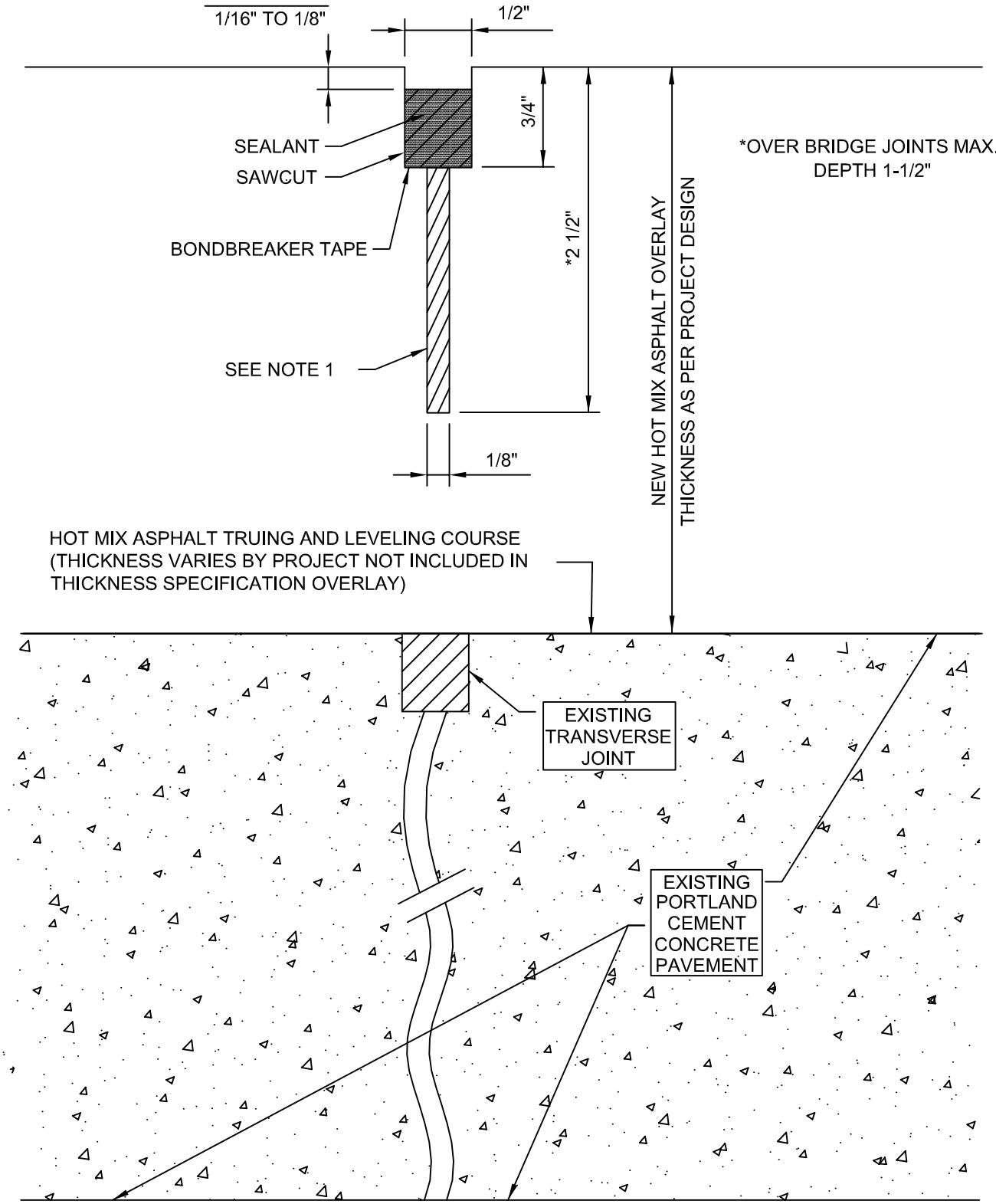
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# METHOD OF STEPPING SURFACE AND BASE COURSE LAYERS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 104.1.0**




NOTES:

1. WHEN THE TOTAL THICKNESS OF HOT MIX ASPHALT OVER THE EXISTING JOINT EXCEEDS 4-3/8", A 1/8" SAWCUT SHALL BE INCLUDED IN THE JOINT AS SHOWN TO A MINIMUM DEPTH OF 2-1/2".
2. PRIOR TO PLACING THE OVERLAY, ALL JOINTS SHALL BE LOCATED AND REFERENCED.

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# TRANSVERSE JOINTS AT EXPANSION JOINTS

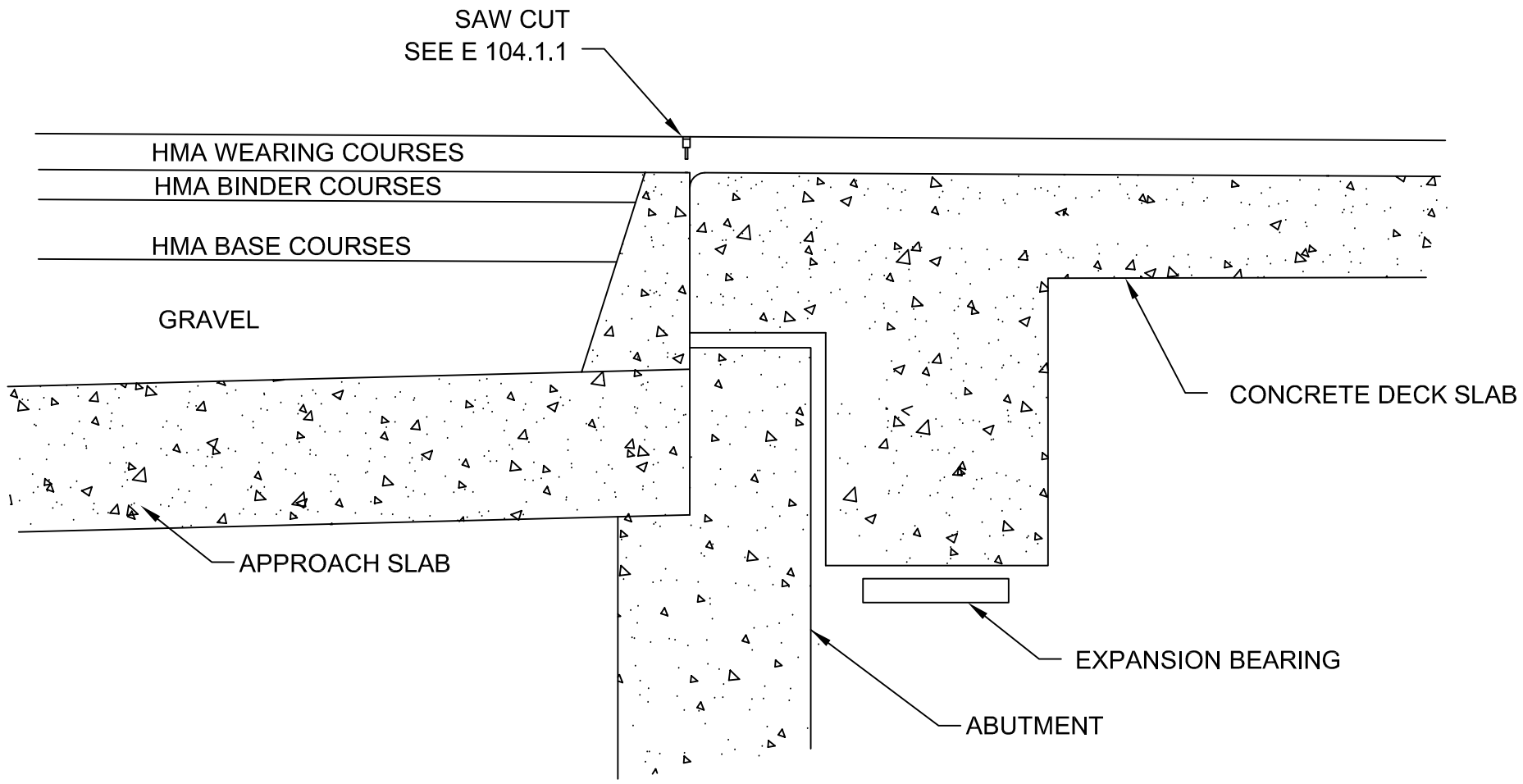
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 104.1.1**

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# LOCATION OF SAW CUT FOR TRANSVERSE JOINTS AT BRIDGE ABUTMENT




NOTES:

1. BEFORE SAW-CUTTING THE TRANSVERSE JOINT THE CONTRACTOR SHALL LOCATE THE END OF THE BRIDGE DECK. SAW-CUTTING MUST TAKE INTO ACCOUNT THE SKEW ANGLE OF THE BRIDGE.
2. ONLY EXPANSION JOINTS SHALL BE SAW-CUT AND SEALED.
3. ONLY REQUIRED WITH A CONTINUOUS BITUMINOUS CONCRETE SURFACE FROM ROADWAY TO BRIDGE.

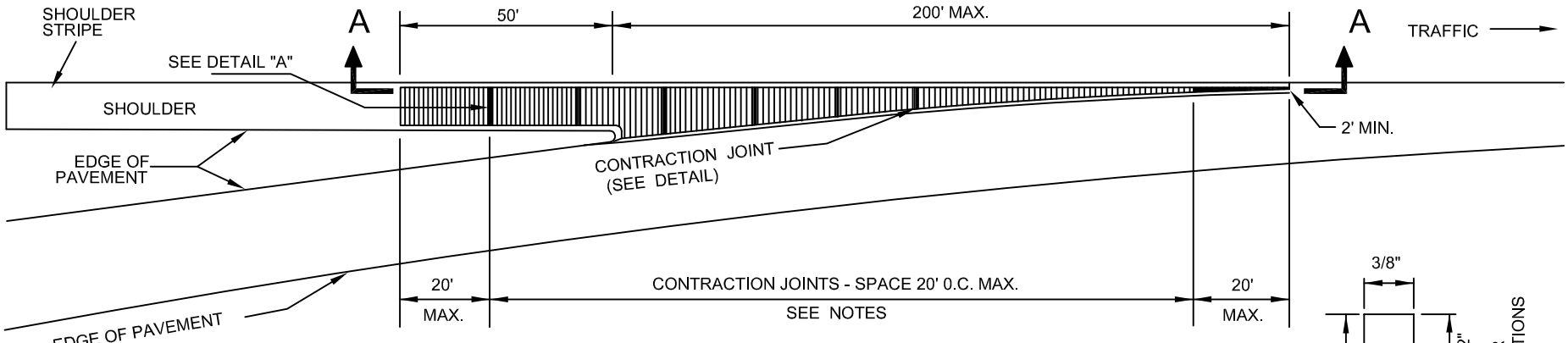
DATE OF ISSUE
DECEMBER 2016

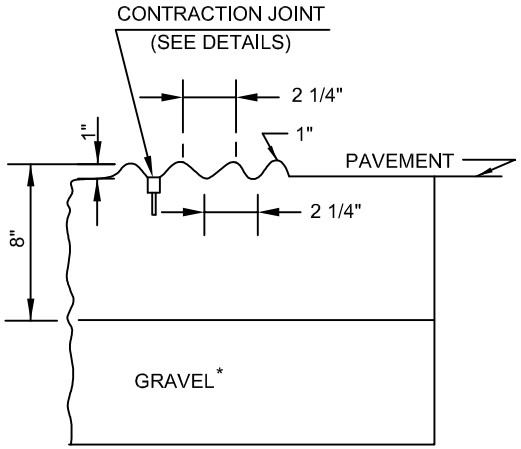
DRAWING NUMBER
**E 104.1.2**

CONSTRUCTION STANDARDS

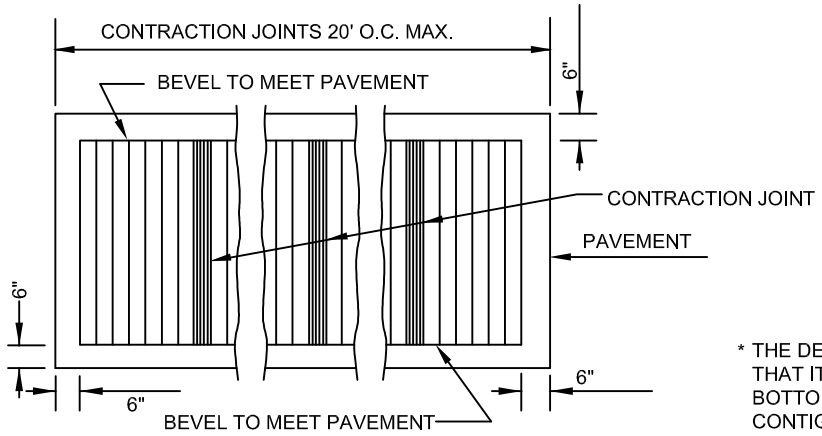
massDOT Massachusetts Department of Transportation Highway Division

# SCORED CEMENT CONCRETE PAVEMENT RAMPS

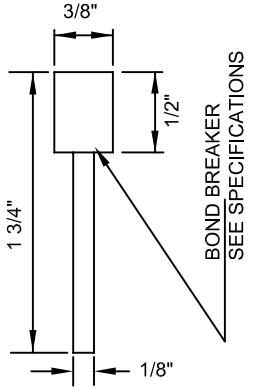



DETAIL OF CORRUGATIONS

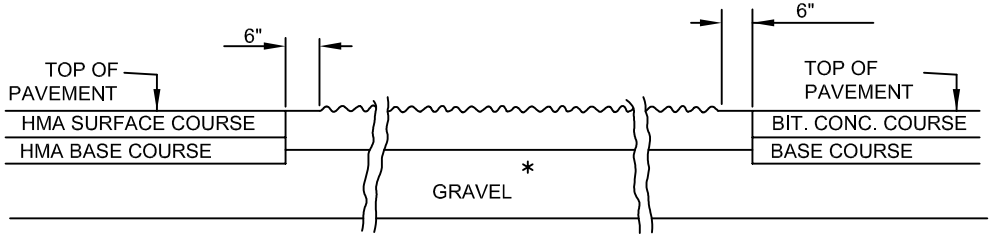



DETAIL "A"




CONTRACTION JOINT DETAIL

* THE DEPTH OF THE GRAVEL IS TO BE SUCH THAT ITS BOTTOM LINE MEETS THE BOTTOM OF THE GRAVEL LINE OF THE CONTIGUOUS PAVEMENT.




SECTION A - A

NOTES:

1. CONTRACTION JOINTS ARE TO BE SPACED AT A MAXIMUM OF 20' APART.
2. THE JOINTS ARE TO BE SAWED AND LOCATED IN THE DEPRESSIONS OF THE CORRUGATIONS, SEE DETAIL OF CORRUGATIONS.
3. END OF CORRUGATED RIDGES TO BE BEVELED.
4. FOR DESCRIPTION OF MATERIAL AND CONSTRUCTION METHODS SEE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS.
5. SCORED CEMENT CONCRETE TO BE 5000 psi. SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS.
6. TROUGH FLUSH WITH OR ABOVE ADJACENT PAVEMENT FOR DRAINAGE.

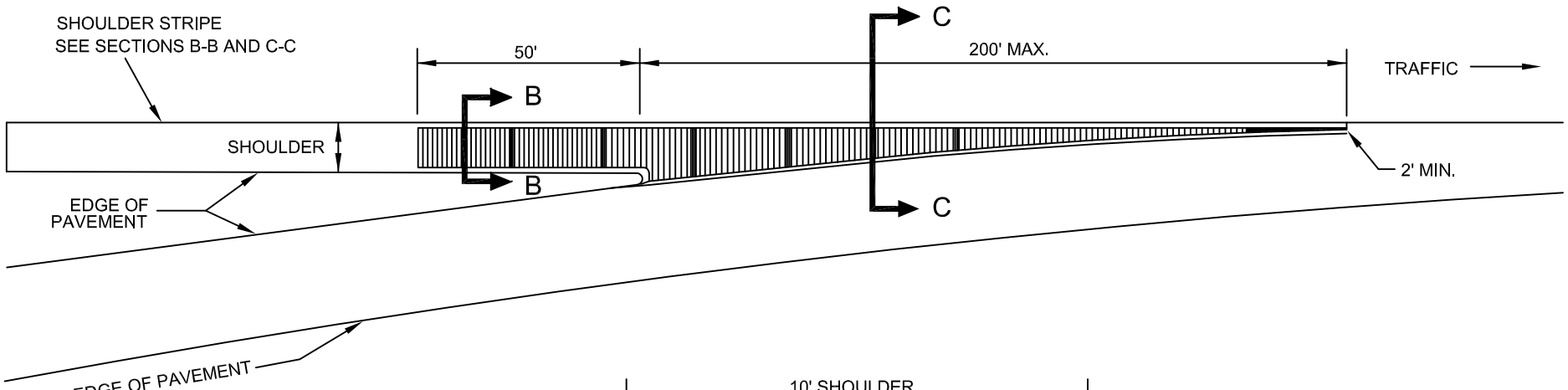
DATE OF ISSUE
DECEMBER 2016

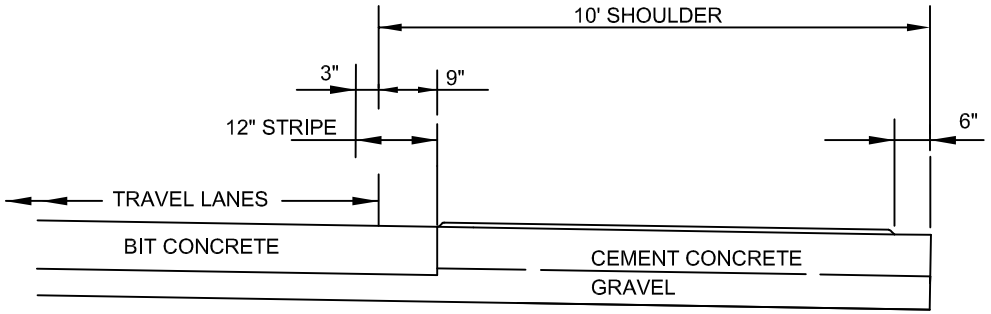
DRAWING NUMBER
**E 105.2.0**

CONSTRUCTION STANDARDS

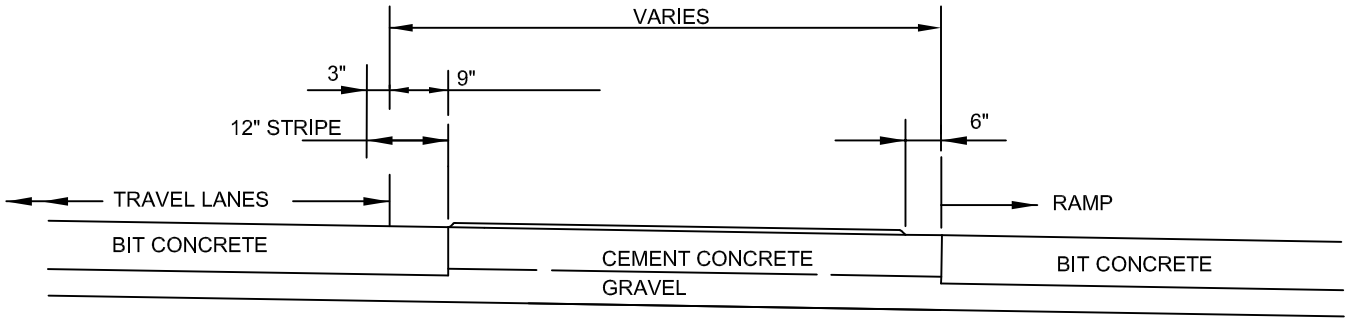
massDOT Massachusetts Department of Transportation Highway Division

# SHOULDER SECTION OF SCORED CEMENT CONCRETE PAVEMENT




SECTION B - B




SECTION C - C

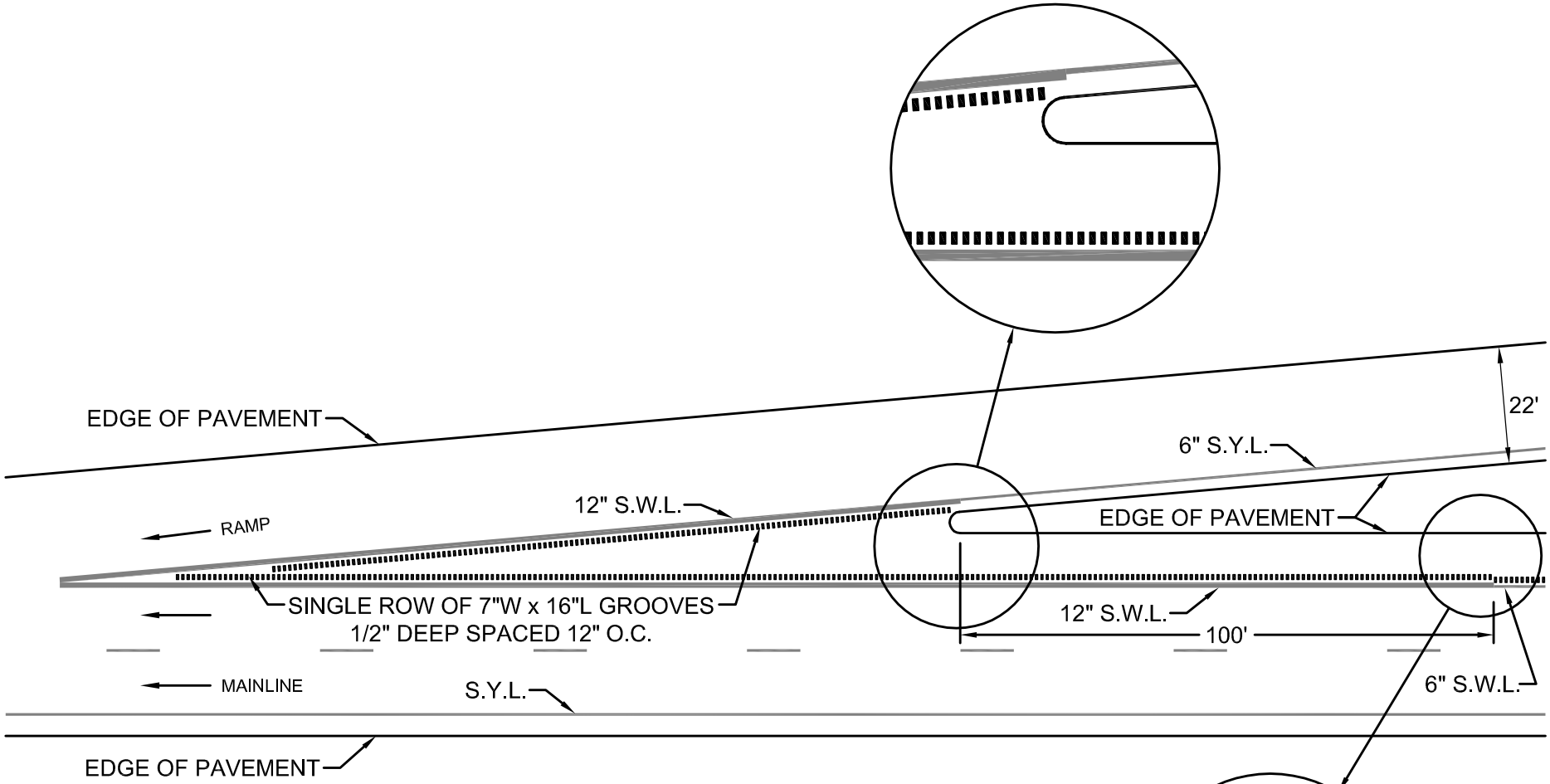
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 105.2.1**

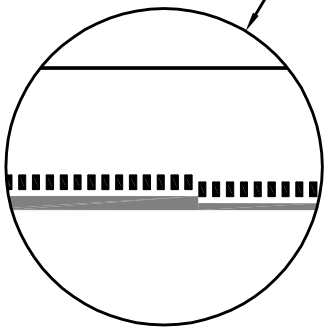
massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# FREEWAY ENTRANCE RAMP DETAIL
## RUMBLE STRIP INSTALLATION
## AT GORE AREAS




ROADWAY PLAN



6" TO 12" EDGE LINE TRANSITION

NOTE:

FOR DETAIL OF MILLING AND SPACING OF GROOVES SEE DRAWING E 105.5.0, DETAIL A AND SECTION B-B.

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 105.3.2**

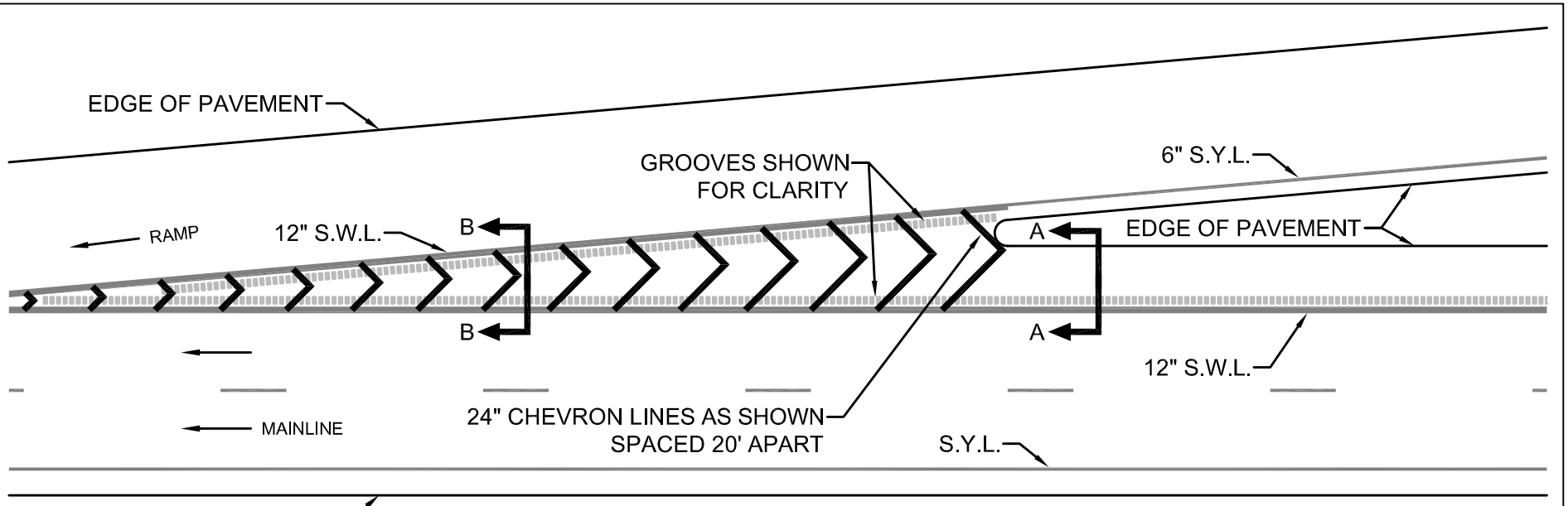
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

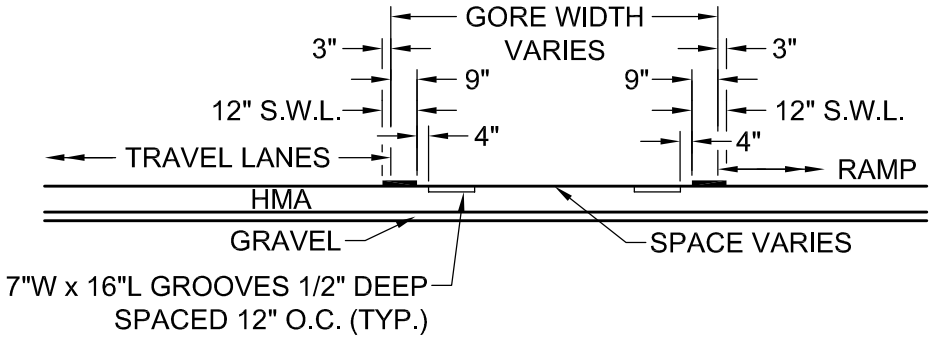
# FREEWAY ENTRANCE RAMP DETAIL
# PAVEMENT MARKING INSTALLATION
# AT GORE AREAS

DATE OF ISSUE
DECEMBER 2016

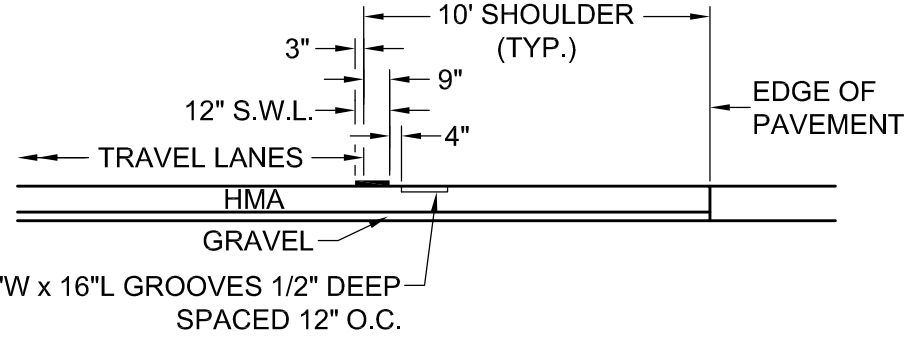
DRAWING NUMBER
**E 105.3.3**




## ROADWAY PLAN




## SECTION B-B




## SECTION A-A

NOTE:

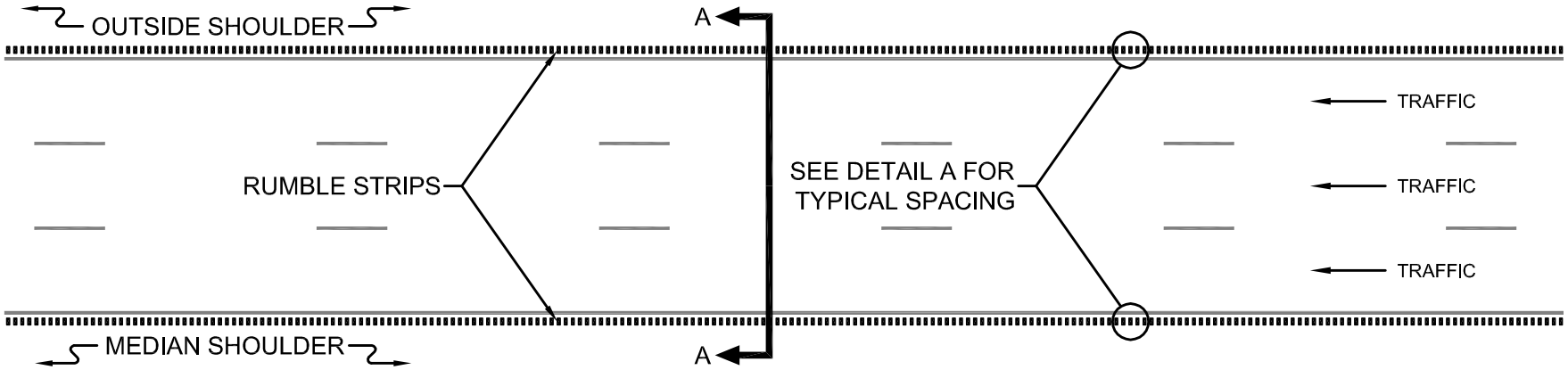
SEE DRAWING E 105.3.2 FOR TRANSITION FROM 6" TO 12" LINES AND OTHER INFORMATION.

CONSTRUCTION STANDARDS

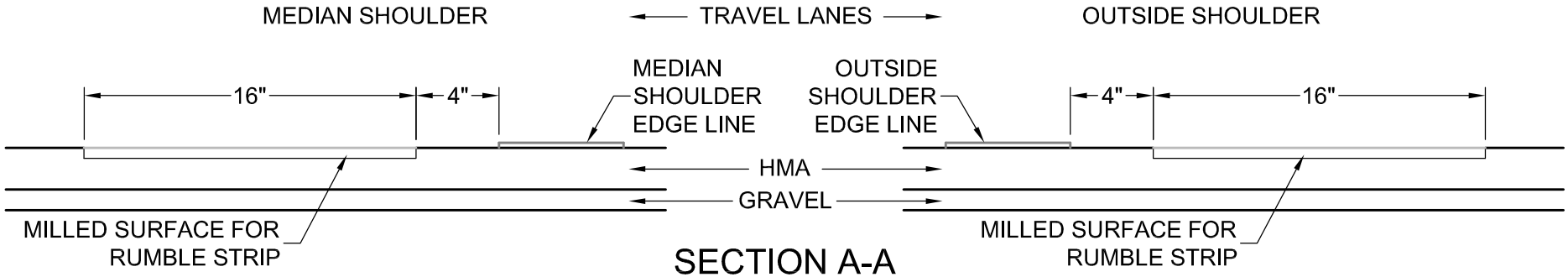
massDOT Massachusetts Department of Transportation Highway Division

# RUMBLE STRIP INSTALLATION DETAILS

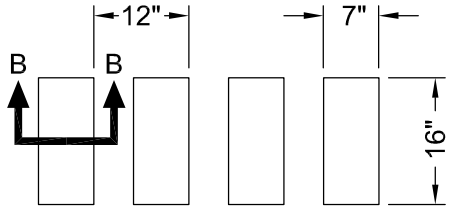
## BICYCLES PROHIBITED



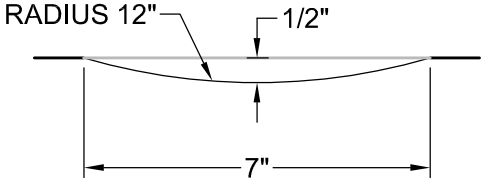

ROADWAY PLAN




SECTION A-A
ROADWAY




DETAIL A
TYPICAL SPACING PLAN




SECTION B-B

NOTES FOR RUMBLE STRIPS:

1. NOT TO BE INSTALLED ON SHOULDERS LESS THAN 2' WIDE.
2. NOT TO BE INSTALLED ON BRIDGE DECKS.

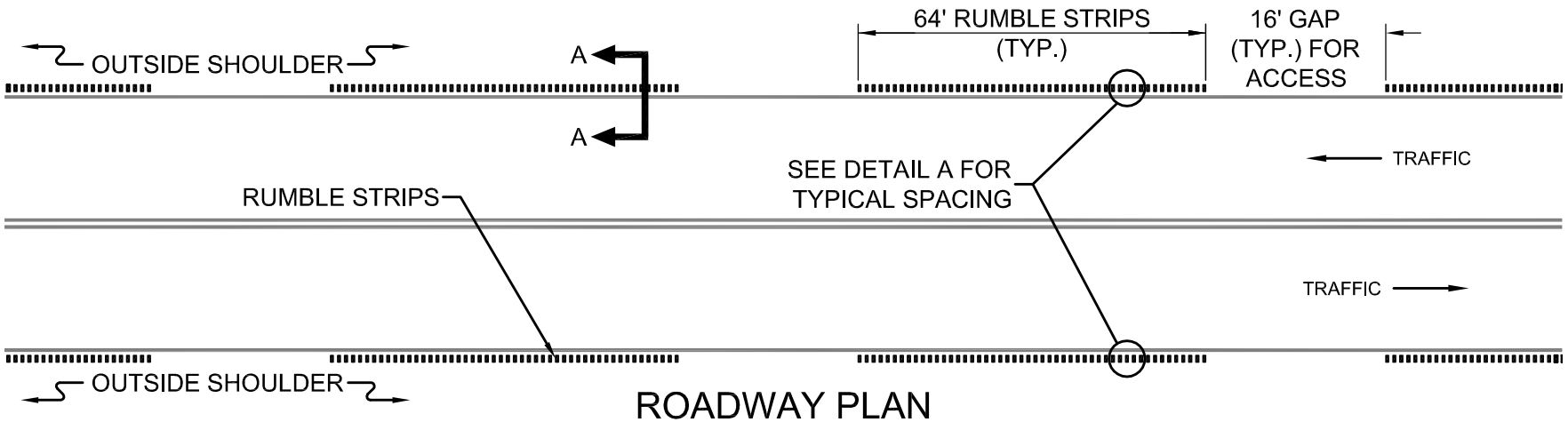
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 105.5.0**

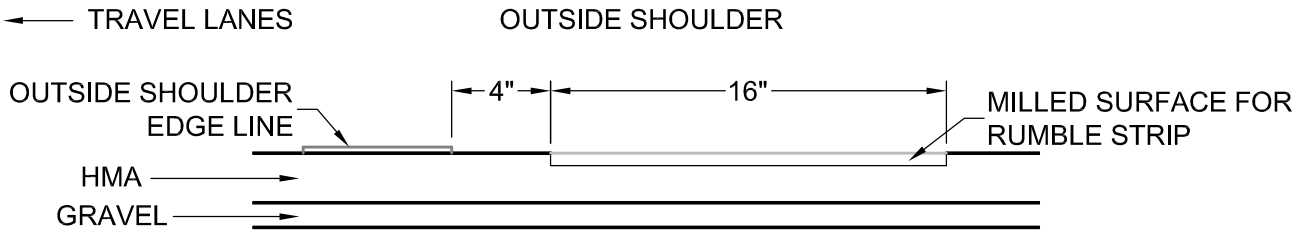
CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

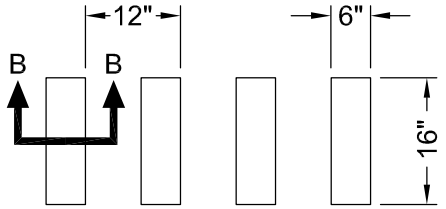
# RUMBLE STRIP INSTALLATION DETAILS BICYCLES PERMITTED



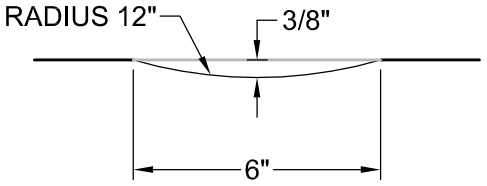

ROADWAY PLAN




SECTION A-A
ROADWAY




DETAIL A
TYPICAL SPACING PLAN




SECTION B-B

NOTES FOR RUMBLE STRIPS:

1. NOT TO BE INSTALLED ON SHOULDERS LESS THAN 8' WIDE.
2. NOT TO BE INSTALLED ON BRIDGE DECKS.

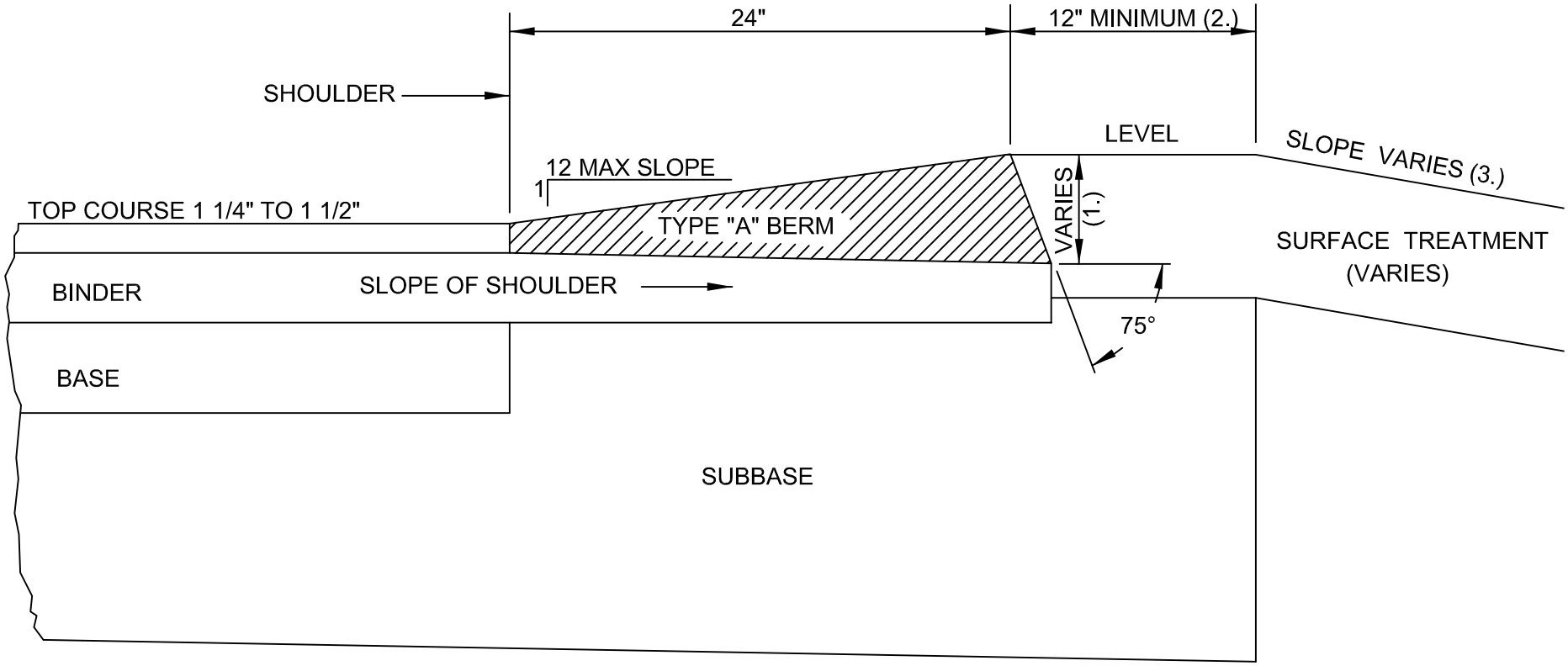
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 105.7.0**

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# HOT MIX ASPHALT BERM
## TYPE A




NOTE:

FOR MODIFIED BERM THE SLOPE REMAINS CONSTANT AT 1 (V) TO 12 (H)

1. THIS DIMENSION VARIES WITH THE THICKNESS OF THE TOP COURSE AND SLOPE OF BINDER
2. SEE E 401.1.1 FOR TYPICAL SECTION AT GUARDRAIL LOCATIONS
3. SEE TYPICAL SECTIONS FOR PROJECT

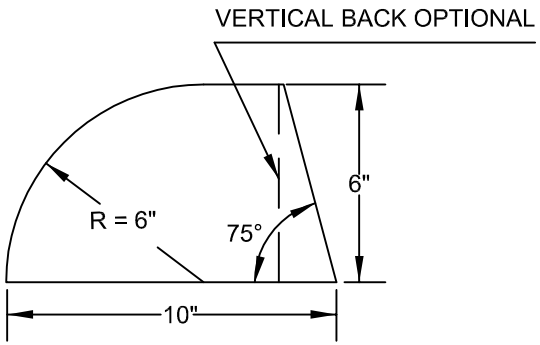
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 106.1.0**

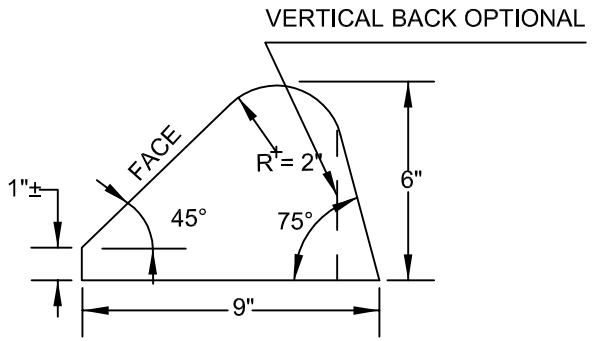
CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

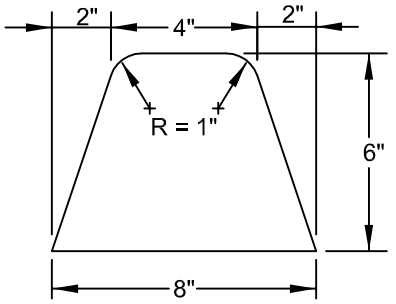
# HOT MIX ASPHALT CURBS



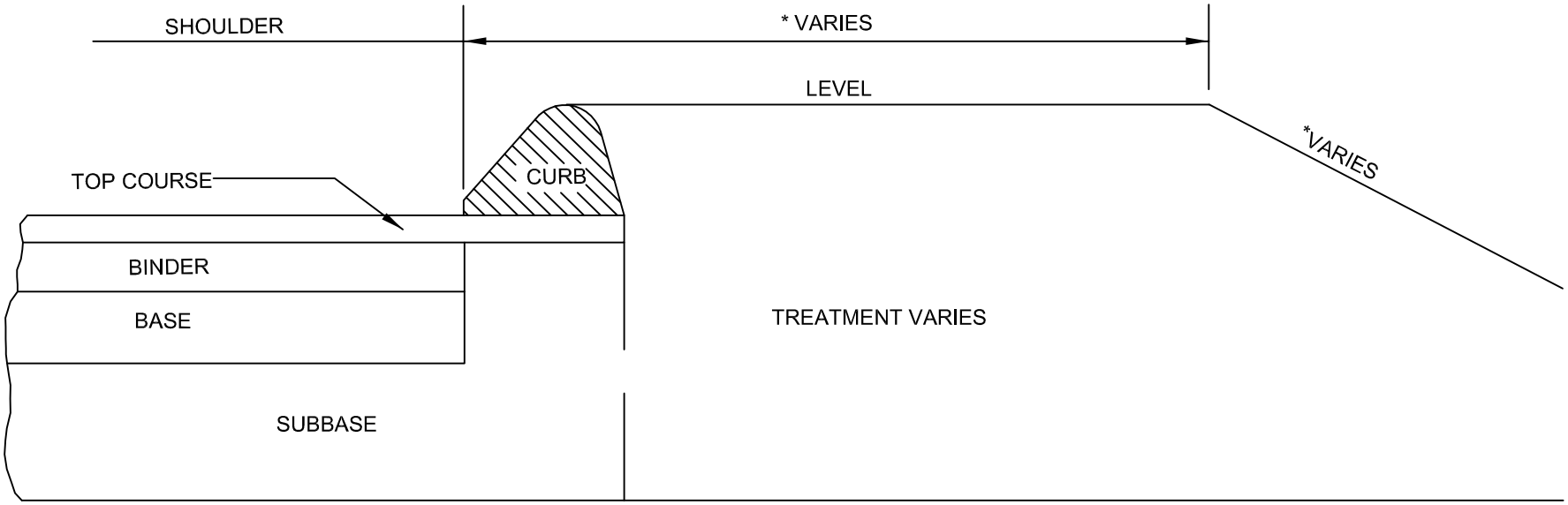

TYPE - 1




TYPE - 2




TYPE - 3




METHOD OF SETTING-TYPICAL FOR ALL TYPES

* SEE TYPICAL SECTIONS FOR PROJECT.

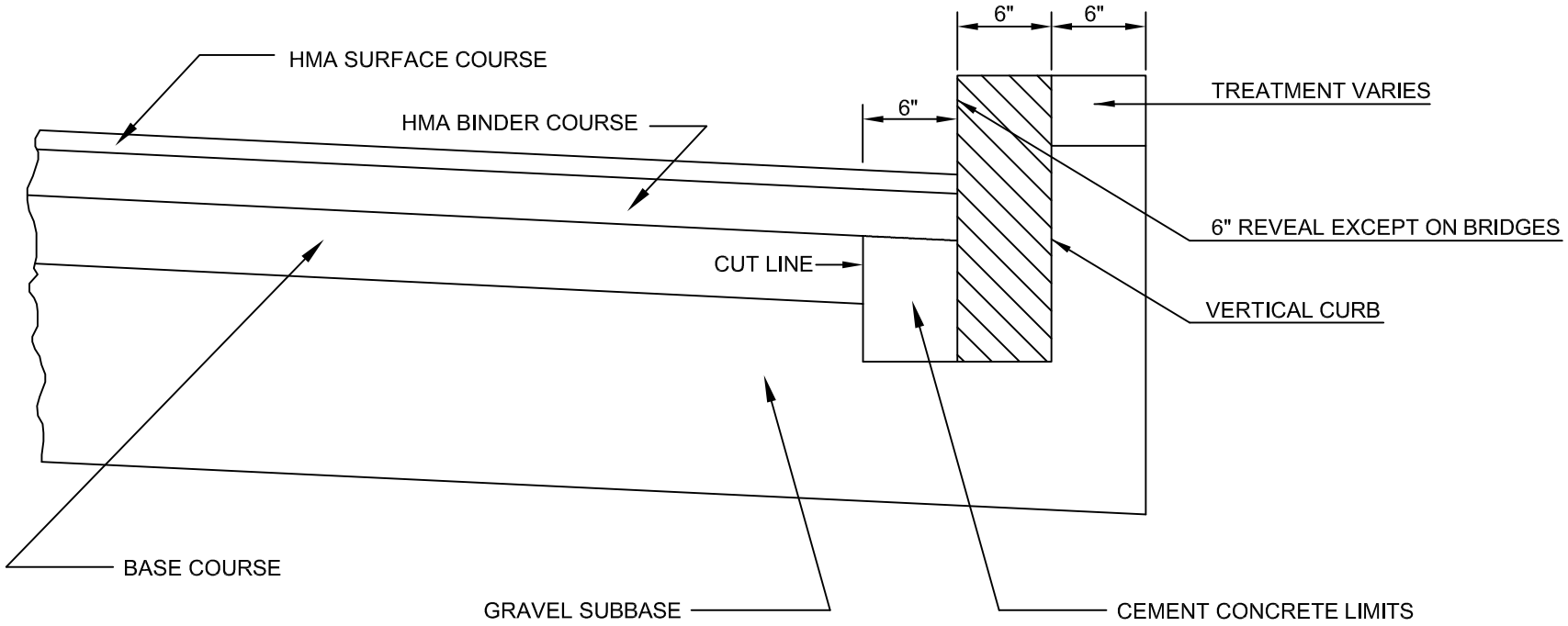
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 106.2.0**

CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

# METHOD OF SETTING VERTICAL CURB




NOTES:

1. THIS PROCEDURE IS APPLICABLE ONLY IF CURB IS TO BE SET AFTER BASE COURSE IS IN PLACE PRIOR TO BINDER AND TOP PLACEMENT.

2. CUT NEAT LINE 6" FROM CURB LINE AND REMOVE BASE AND GRAVEL. REPLACE WITH CEMENT CONCRETE.

3. ANY DESIGNATED CEMENT CONCRETE THAT IS ACCEPTABLE UNDER SECTION M4 OF THE STANDARD SPECIFICATIONS MAY BE USED; ALL TEST REQUIREMENTS ARE WAIVED. HOT MIX ASPHALT SHALL NOT TO BE USED AS A SUBSTITUTE.

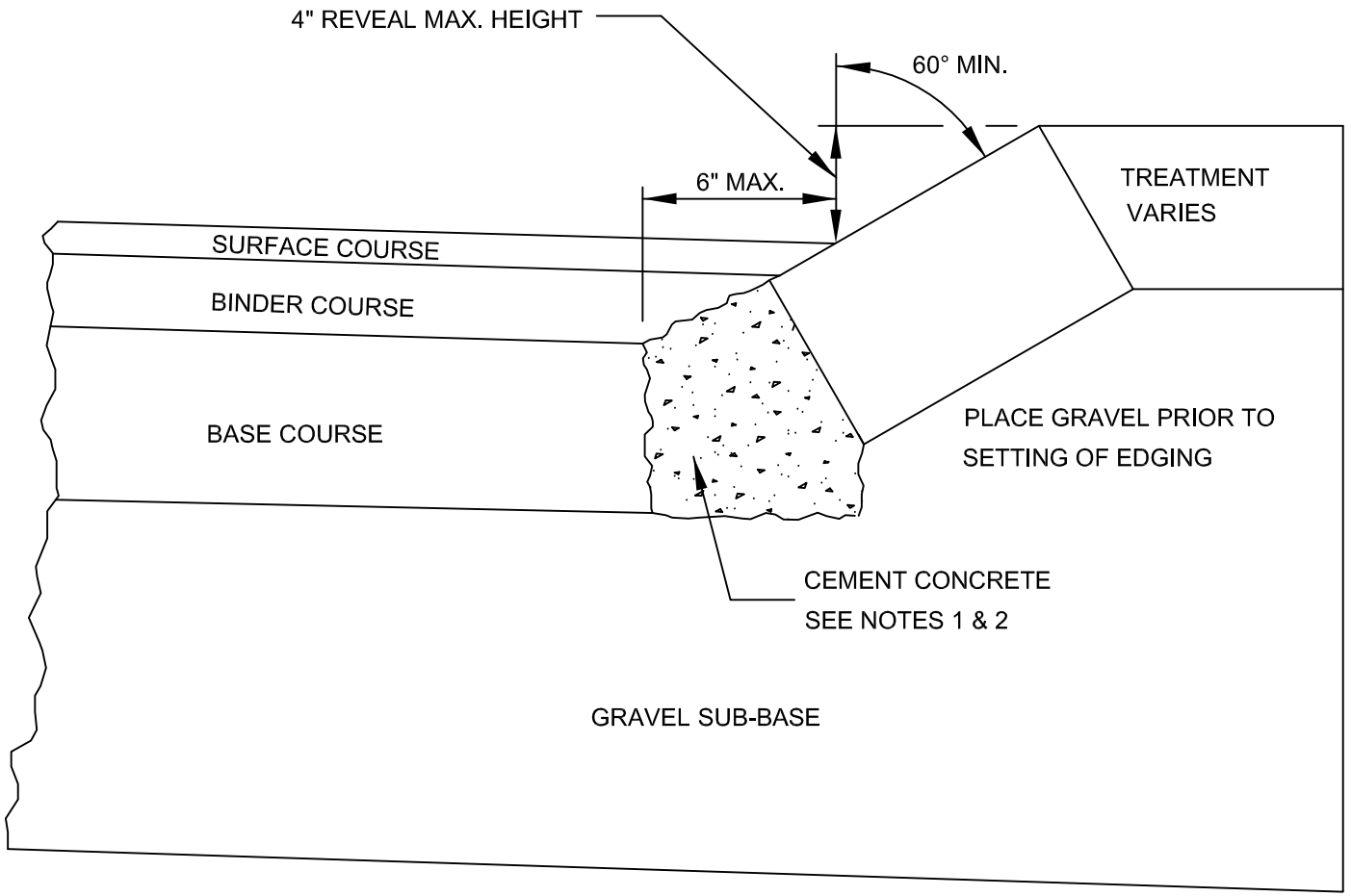
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 106.3.0**

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# METHOD OF SETTING SLOPED EDGING




## SLOPED EDGING

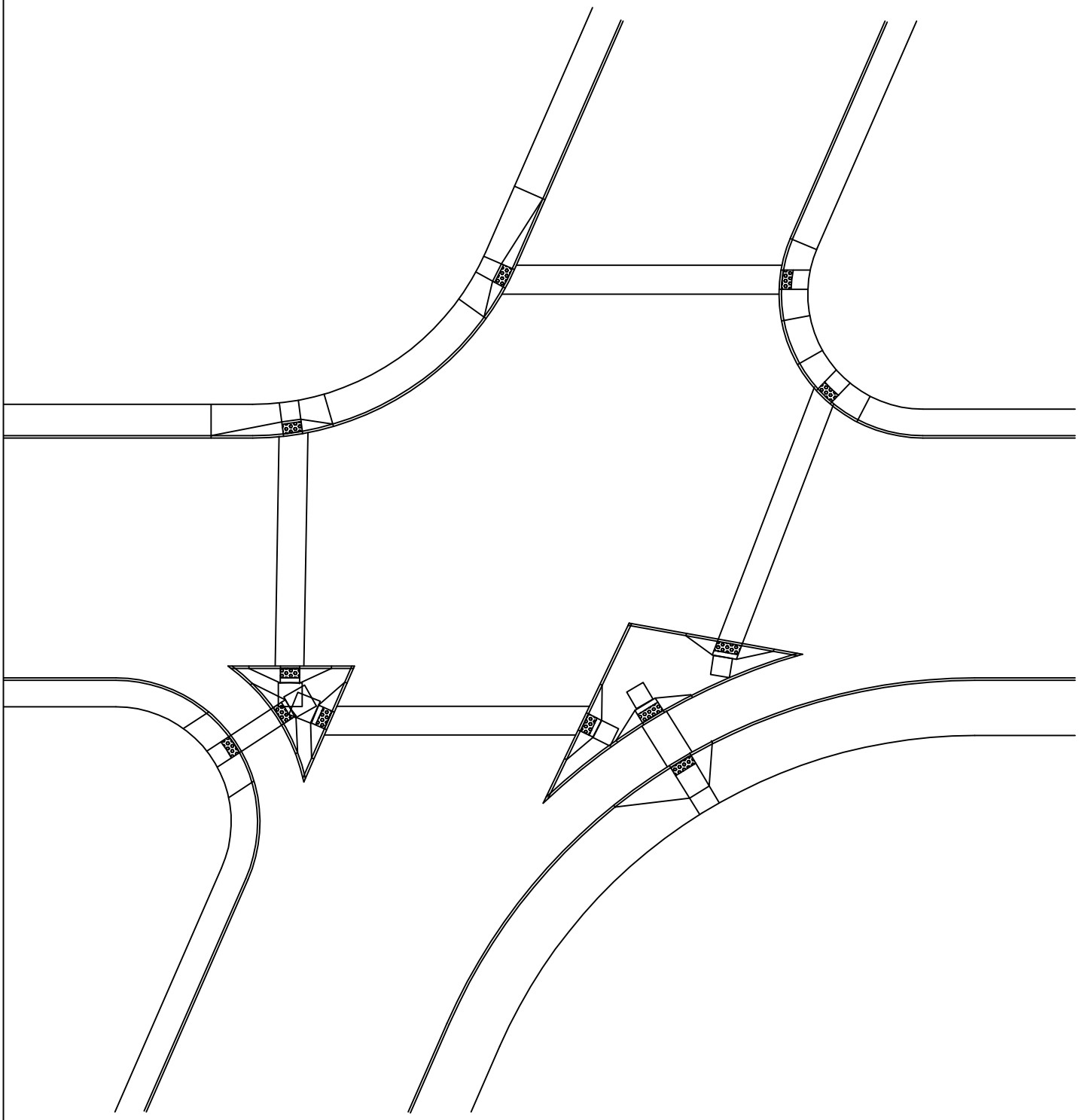
NOTES:

1. ANY DESIGNATED CEMENT CONCRETE THAT IS ACCEPTABLE TO THE DEPARTMENT UNDER SECTION M4 OF THE STANDARD SPECIFICATIONS; ALL TEST REQUIREMENTS ARE WAIVED. HOT MIX ASPHALT SHALL NOT TO BE USED AS A SUBSTITUTE.

2. THE REVEAL IS TO BE A MAXIMUM OF 4" UNDER ALL CONDITIONS, THE ANGLE IS TO BE A MINIMUM OF 60° FROM VERTICAL UNDER ALL CONDITIONS.

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 106.5.0**



NOTES:

1. LEVEL LANDINGS CAN OVERLAP
2. ISLAND AREAS SUBJECT TO TRAVEL SHOULD BE TREATED AS PLAZAS "NOT MORE THAN 2% SLOPE IN ANY DIRECTION"
3. ALL RAMPS BY REGULATION MUST BE PERPENDICULAR TO THE CURB AT THE GUTTER
4. RAMPS SHOULD BE BOTH ALIGNED TOWARD THE RECEIVING RAMP AND WITHIN THE GENERALLY PREFERRED PEDESTRIAN PHASE OF TRAFFIC

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# TYPICAL INTERSECTION CROSS WALK LAYOUT

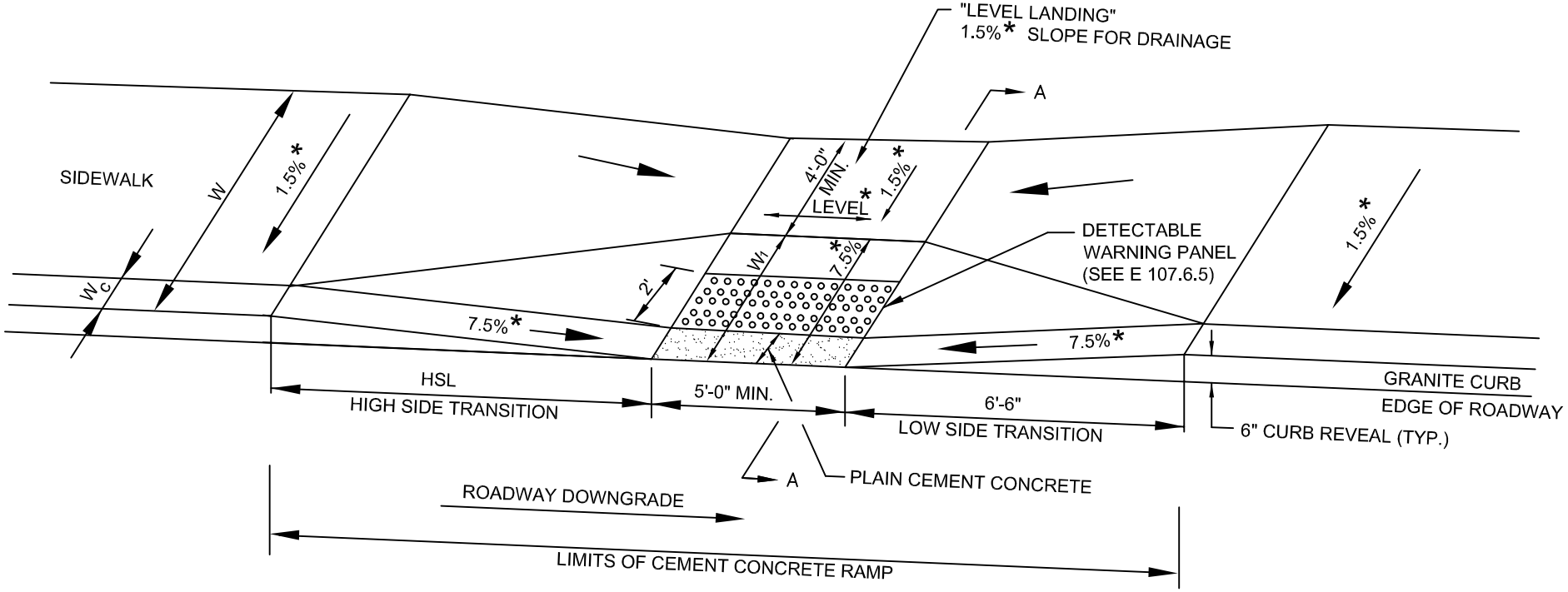
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 107.1.0**

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# WHEELCHAIR RAMPS
# LESS THAN 12'-4" SIDEWALK




## LEGEND

HSL = HIGH SIDE TRANSITION LENGTH (SEE E 107.9.0)

W = SIDEWALK WIDTH

$W_c$ = CURB WIDTH

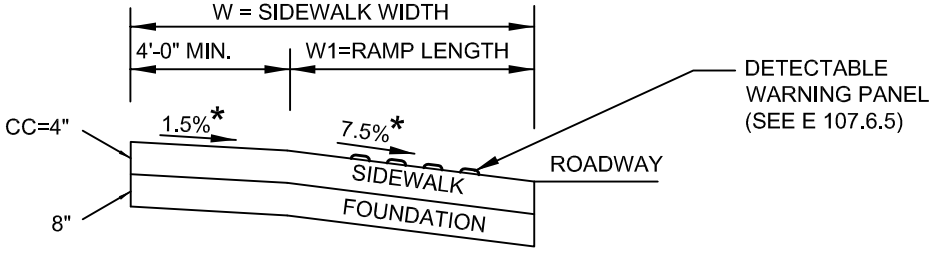
$W_1$ = PERPENDICULAR RAMP LENGTH

CC = CEMENT CONCRETE

* = TOLERANCE FOR CONSTRUCTION ±0.5%

USABLE SIDEWALK WIDTH PER AAB = W-Wc

RAMP LENGTH, W1 = W-4'-0" Min




SECTION A-A

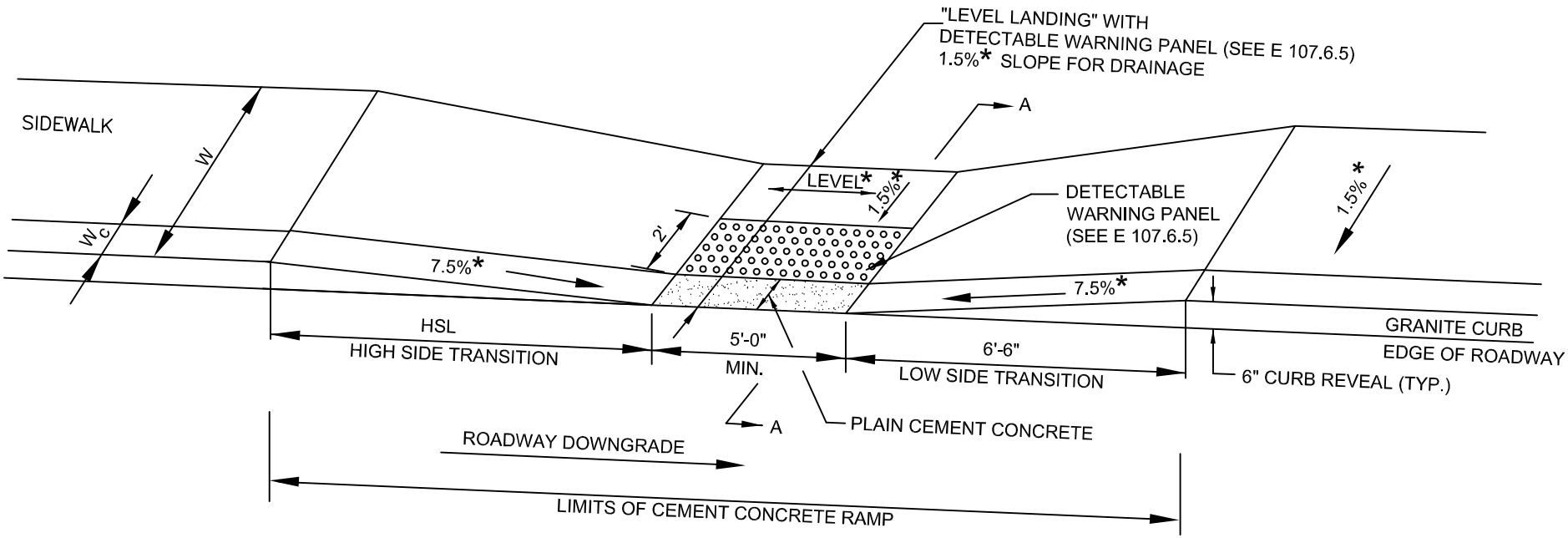
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 107.2.0**

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# WHEELCHAIR RAMP ON NARROW SIDEWALK WITH DETECTABLE WARNING PANEL




## LEGEND

HSL = HIGH SIDE TRANSITION LENGTH (SEE E 107.9.0)

W = SIDEWALK WIDTH

$W_C$ = CURB WIDTH

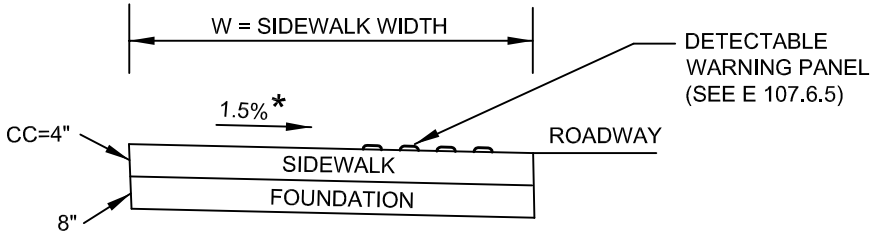
CC = CEMENT CONCRETE

* = TOLERANCE FOR CONSTRUCTION ±0.5%

USABLE SIDEWALK WIDTH PER AAB = W-Wc
USABLE SIDEWALK WIDTH PER AAB IS NOT TO BE LESS THAN 4'0"
SEE E 107.6.5 FOR DETAILS OF DETECTABLE WARNING PANEL

## NOTE:

ROADWAY, GUTTER, AND FIRST 6" OF SIDEWALK TO BE ADJUSTED FOR FIELD CONDITIONS




SECTION A-A

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 107.2.1**

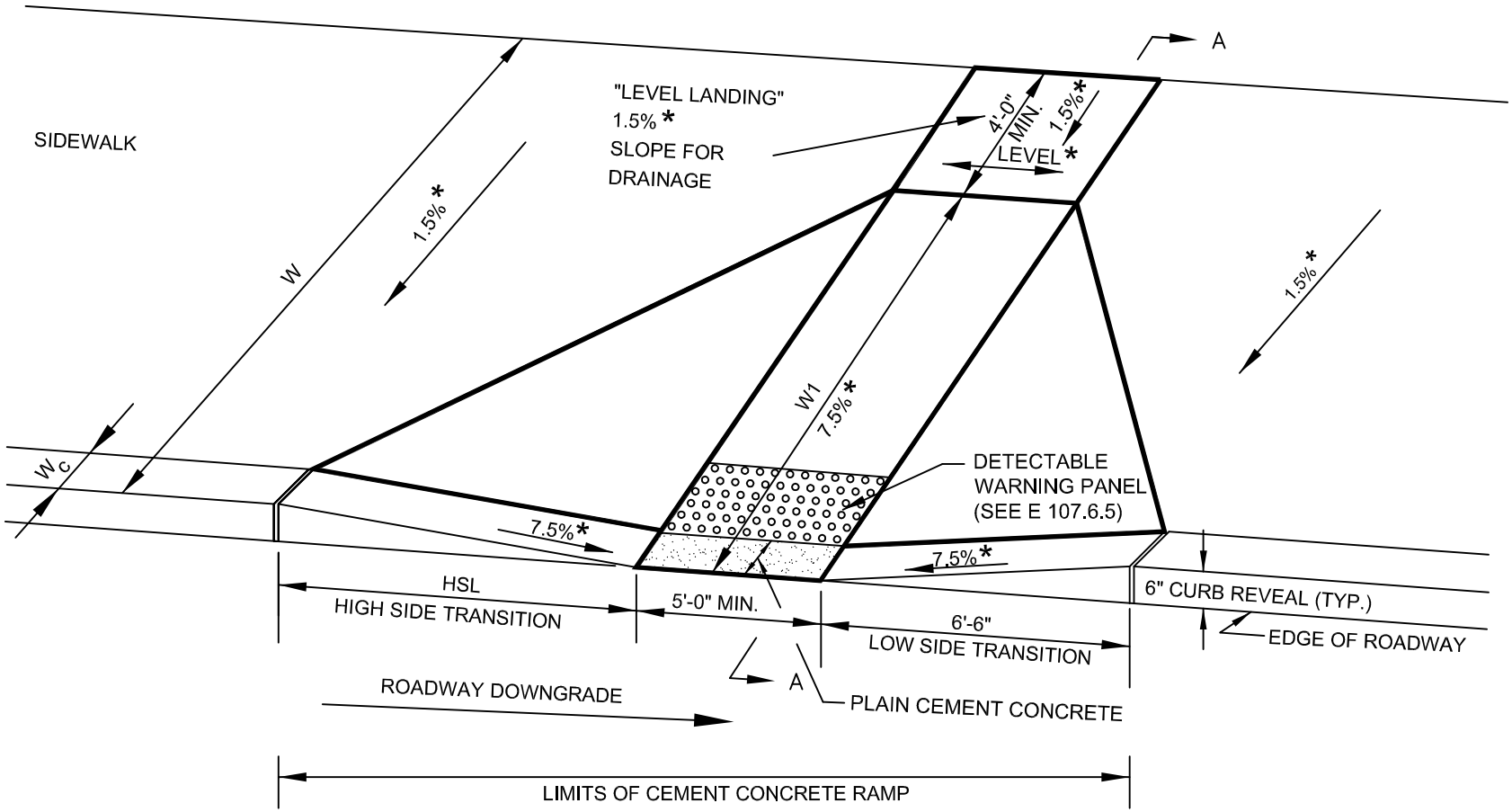
CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

# WHEELCHAIR RAMPS
# GREATER THAN 12'-4" SIDEWALK

DRAWING NUMBER
**E 107.3.0**

DATE OF ISSUE
DECEMBER 2016




## LEGEND

HSL = HIGH SIDE TRANSITION LENGTH (SEE E 107.9.0)

W = SIDEWALK WIDTH

$W_C$ = CURB WIDTH

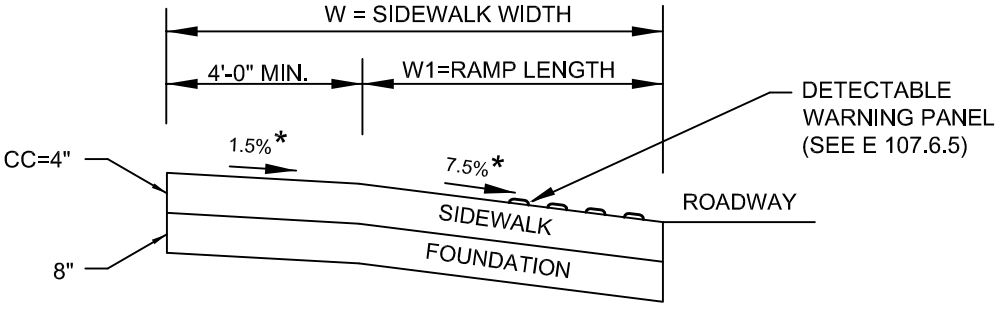
W 1 = PERPENDICULAR RAMP LENGTH

Cc = CEMENT CONCRETE

* = TOLERANCE FOR CONSTRUCTION ±0.5%

USABLE SIDEWALK WIDTH PER AAB = W-Wc

RAMP LENGTH, W1 = W-4'-0" Min

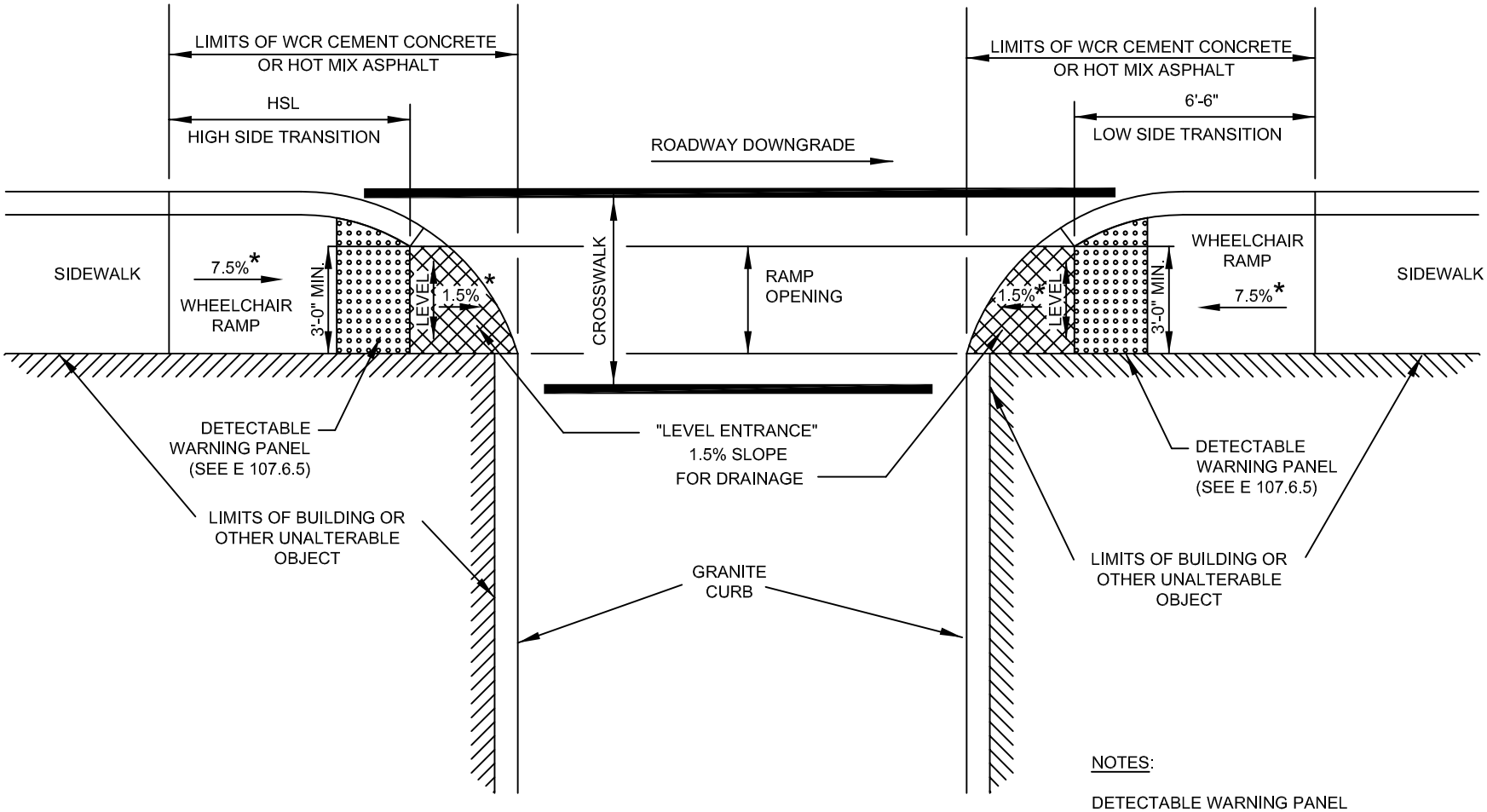



SECTION A-A

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# WHEELCHAIR RAMP FOR ONE CONTINUOUS DIRECTION OF PEDESTRIAN TRAVEL




LEGEND

HSL = HIGH SIDE TRANSITION LENGTH
(SEE E 107.9.0)

* = TOLERANCE FOR CONSTRUCTION ±0.5%

NOTES:

DETECTABLE WARNING PANEL
LOCATED NOT LESS THAN 6" OR MORE THAN 24" FROM ROADWAY EDGE (GUTTER LINE). TRUNCATED DOMES TO BE ALIGNED WITH DIRECTION OF TRAVEL.

FOR DETAILS OF TRUNCATED DOMES SEE DRAWING E 107.6.5.

ROADWAY, GUTTER, AND FIRST 6" OF SIDEWALK TO BE ADJUSTED FOR FIELD CONDITIONS.

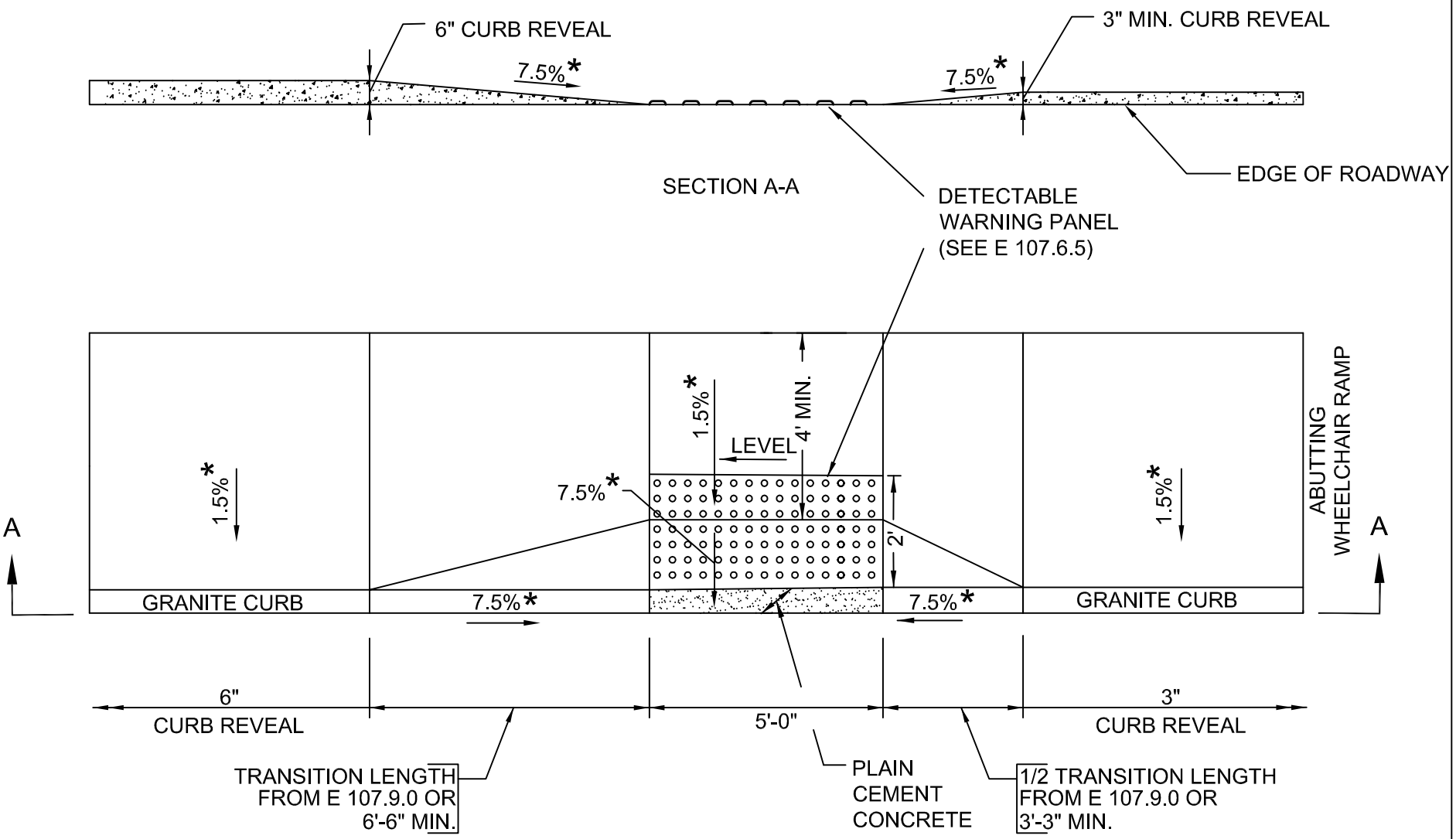
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 107.6.0**

CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

# WHEELCHAIR RAMP WITH 3" CURB REVEAL



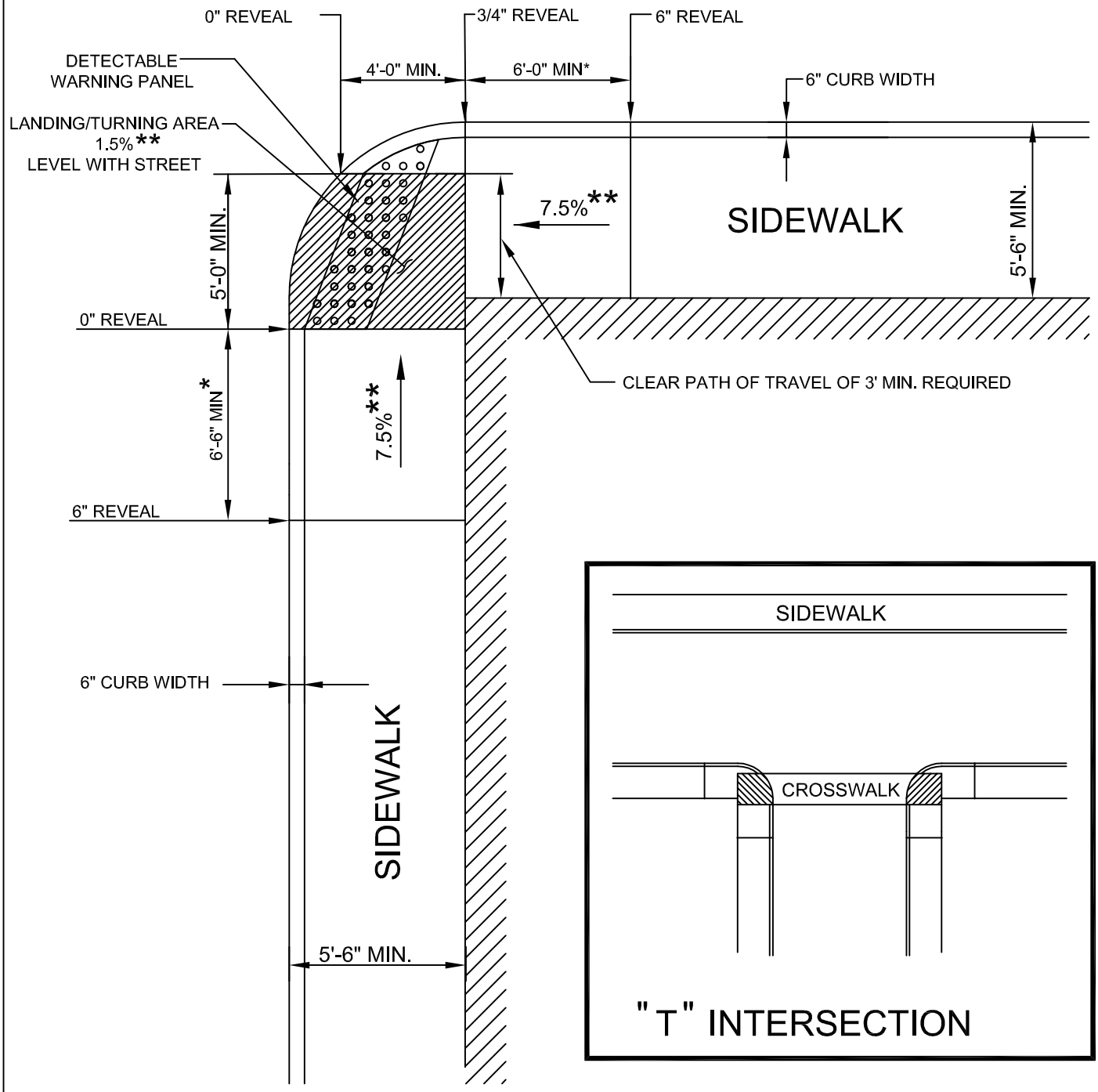

LEGEND

HSL = HIGH SIDE TRANSITION LENGTH
SEE E 107.9.0

* = TOLERANCE FOR CONSTRUCTION ±0.5%

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 107.6.3**







LEGEND

BUILDING OR OTHER UNALTERABLE CONDITION

* TRANSITION LENGTH SHOWN IS MINIMUM. (SEE E 107.9.0)

** TOLERANCE FOR CONSTRUCTION ±0.5%

NOTE:

ROADWAY, GUTTER, AND FIRST 6" OF SIDEWALK TO BE ADJUSTED FOR FIELD CONDITIONS

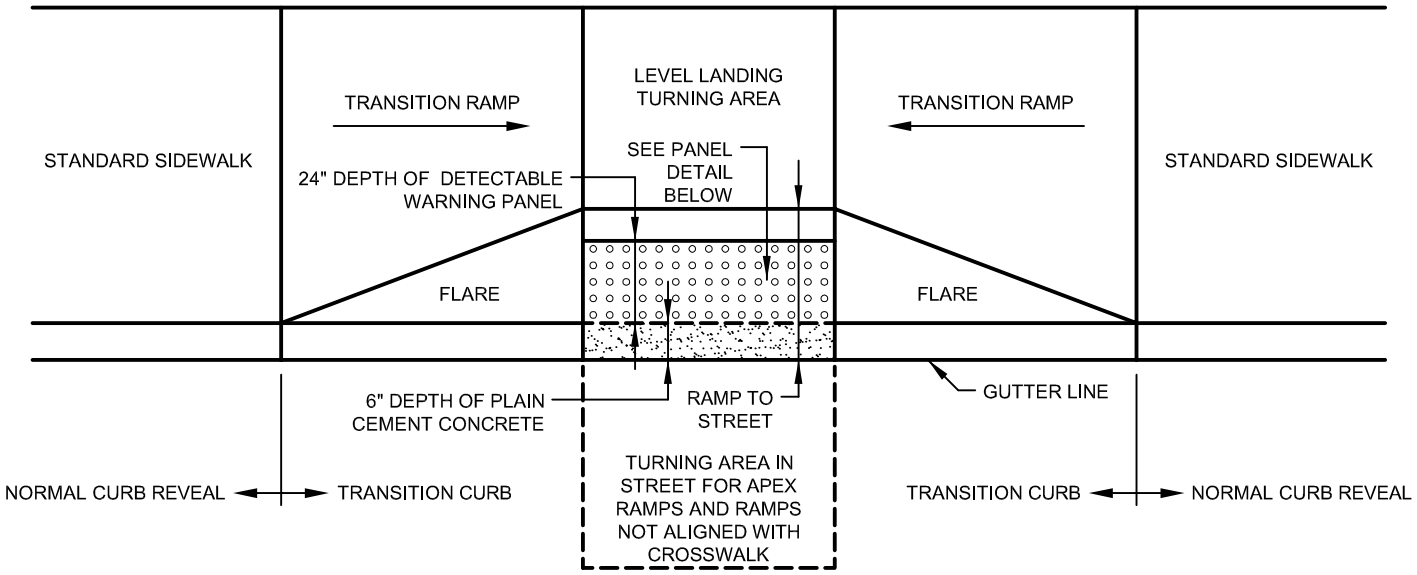
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

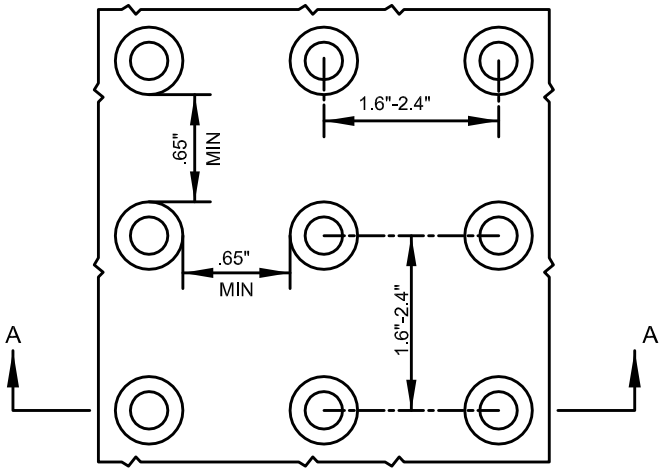
# "T" INTERSECTION WHEELCHAIR RAMP

DATE OF ISSUE
DECEMBER 2016

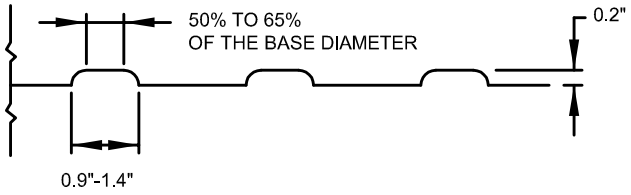
DRAWING NUMBER
**E 107.6.4**




## TYPICAL INSTALLATION




## DETAIL OF DETECTABLE WARNING PANEL




## SECTION A-A

## NOTE:

PANELS MAY BE CONCRETE PRECAST OR CAST IN PLACE OR OTHER SUITABLE MATERIAL PERMANENTLY APPLIED TO THE RAMP. DETECTABLE WARNING SURFACES SHALL CONTRAST VISUALLY WITH ADJACENT WALKING SURFACES EITHER LIGHT-ON-DARK, OR DARK-ON-LIGHT.

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# DETECTABLE WARNING PANEL FOR WHEELCHAIR RAMPS AND STANDARD RAMP TERMINOLOGY

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 107.6.5**

LEGEND

* = TOLERANCE FOR CONSTRUCTION ±0.5%

** = SEE E 107.9.0 FOR TRANSITION LENGTH

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# WHEELCHAIR RAMP WITH LANDSCAPING STRIP

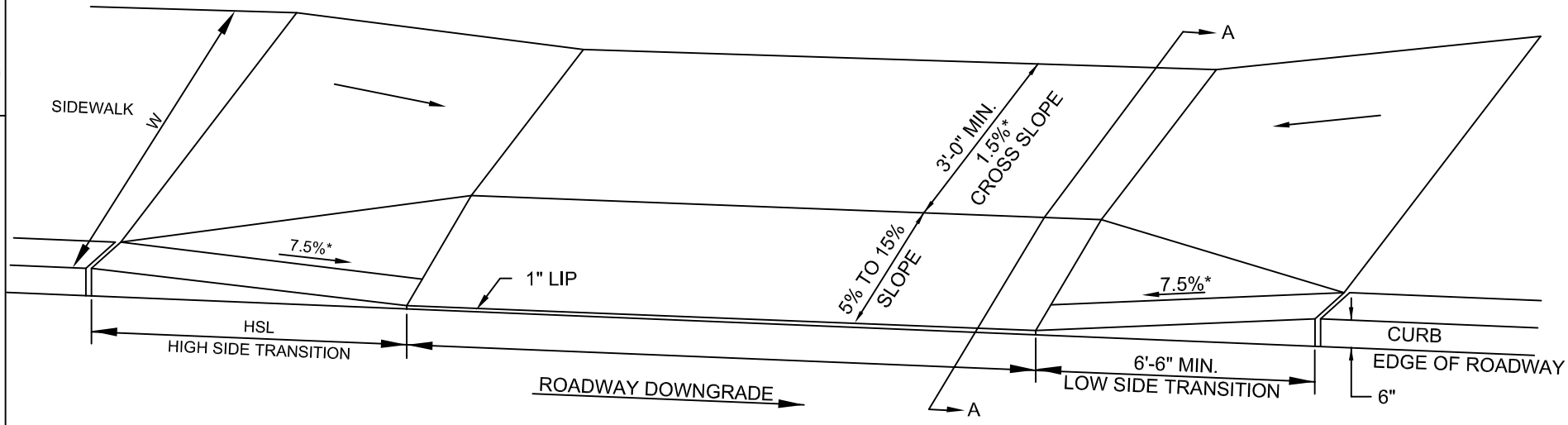
DATE OF ISSUE
DECEMBER 2016

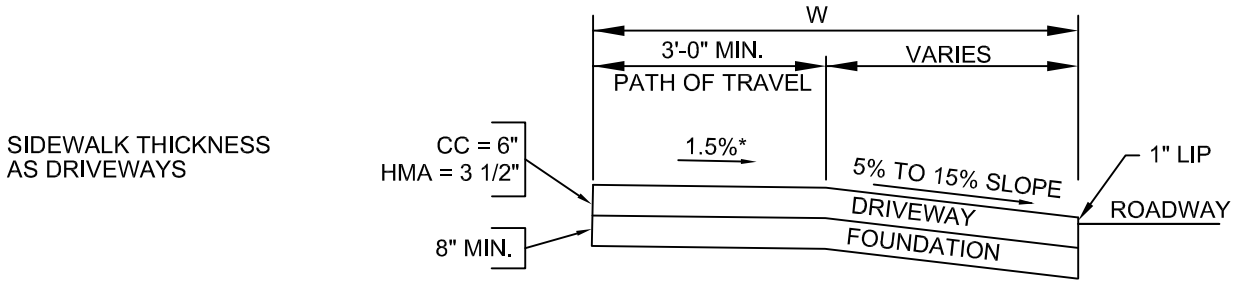
DRAWING NUMBER
**E 107.6.9**

CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

# SIDEWALK THROUGH DRIVEWAYS WITHOUT CURB RETURNS




SECTION A-A

LEGEND

HSL = HIGH SIDE TRANSITION LENGTH. SEE E 107.9.0
W = SIDEWALK WIDTH
* = TOLERANCE FOR CONSTRUCTION ±0.5%
CC = CEMENT CONCRETE
HMA = HOT MIX ASPHALT

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 107.7.0**

SECTION A-A

LEGEND

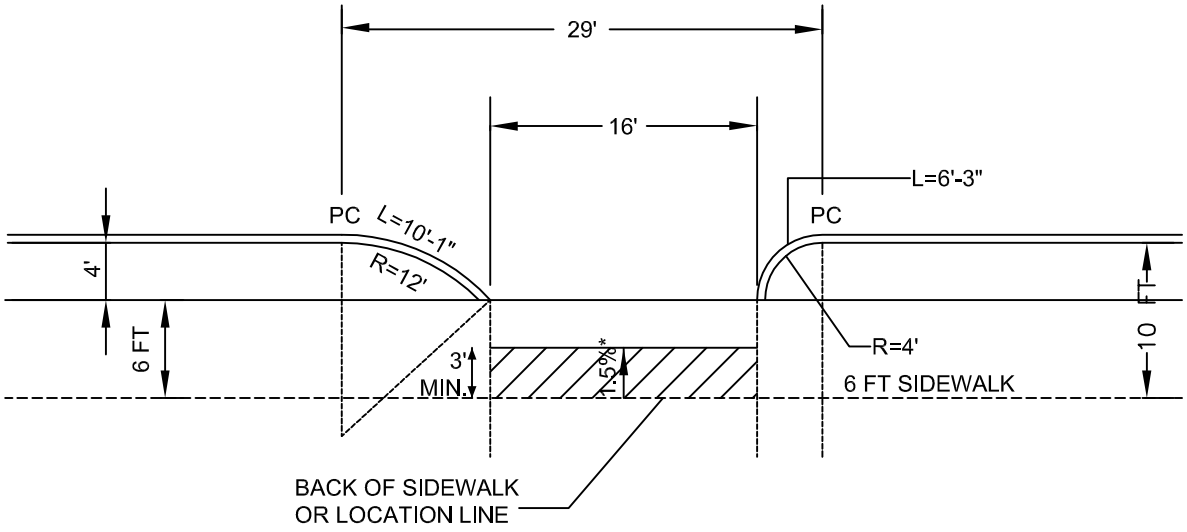
HSL = HIGH SIDE TRANSITION LENGTH. SEE E 107.9.0
W = SIDEWALK WIDTH
* = TOLERANCE FOR CONSTRUCTION ±0.5%
CC = CEMENT CONCRETE
HMA = HOT MIX ASPHALT

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

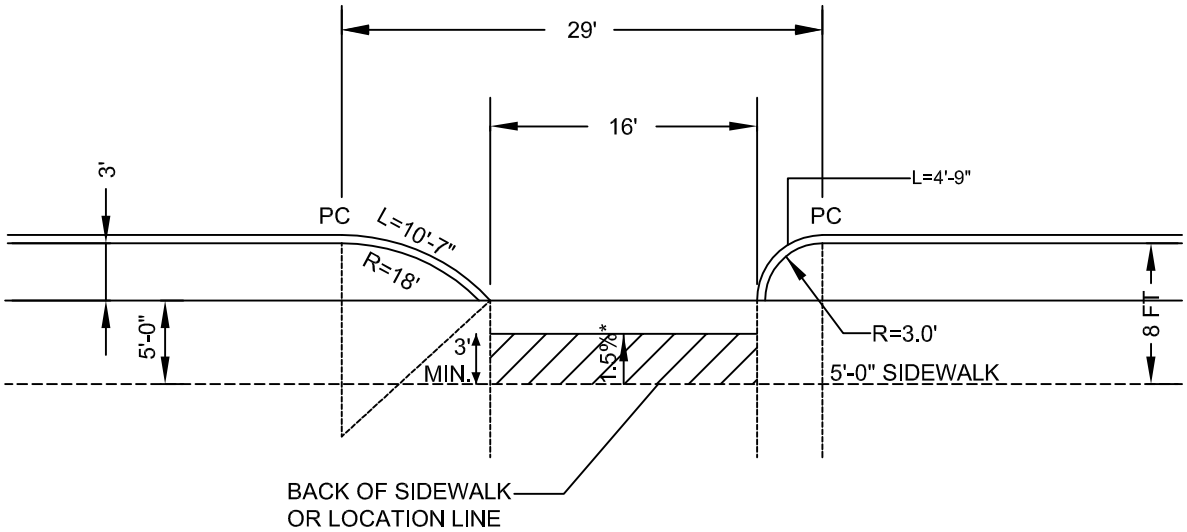
# SIDEWALK THROUGH DRIVEWAYS WITH CURB RETURNS 2' CURB CORNERS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 107.8.0**




# 10 FT SIDEWALK LAYOUT




# 8 FT SIDEWALK LAYOUT

NOTES:

1. WHEN THE SIDEWALK IS PAVED TO THE CURB LINE, USE SHORT CURB RETURNS AT THE HIGHWAY CURB LINE PC'S, SHOWN IN THESE DESIGNS.

*MUST MAINTAIN PATH OF TRAVEL WITH 1.5% CROSS SLOPE (± 0.5% CONSTRUCTION TOLERANCE)

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

## RESIDENTIAL DRIVEWAYS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 107.8.1**

CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

# CURB TRANSITION LENGTH FOR WHEELCHAIR RAMPS

| ROADWAY PROFILE GRADE | * HIGH SIDE TRANSITION LENGTH |
|---|---|
| % | ENGLISH UNITS |
| =0% | 6'-6" |
| >0% TO 1% | 7'-8" |
| >1% TO 2% | 9'-0" |
| >2% TO 3% | 11'-0" |
| >3% TO 4% | 14'-0" |
| >4% TO 5% | 15'-0" Max |

NOTE:

* BASED ON A DESIGN SLOPE OF 7.5% AND A REVEAL OF 6".

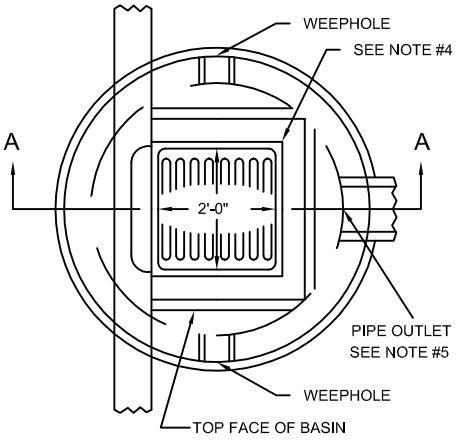
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 107.9.0**

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# CONCRETE BLOCK CATCH BASIN

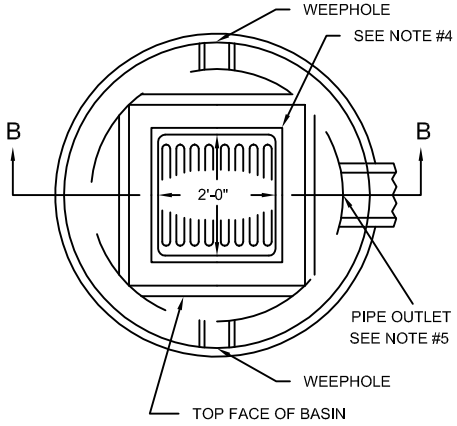



BASIN WITH CURB INLET

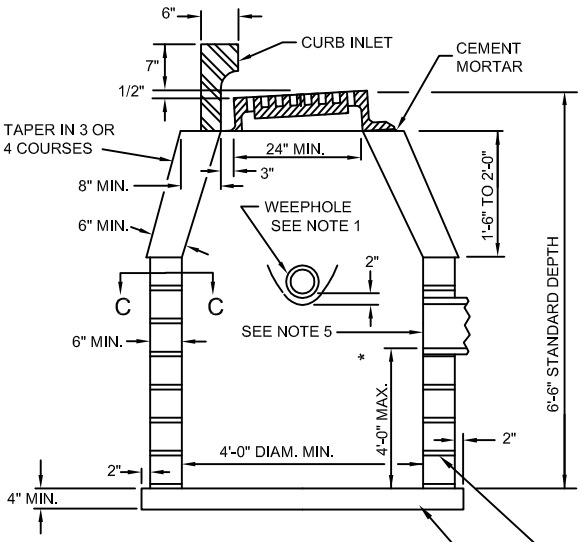
* MINIMUM DEPTH OF SUMP TO BE 2'
STANDARD DEPTH 3'

NOTES:

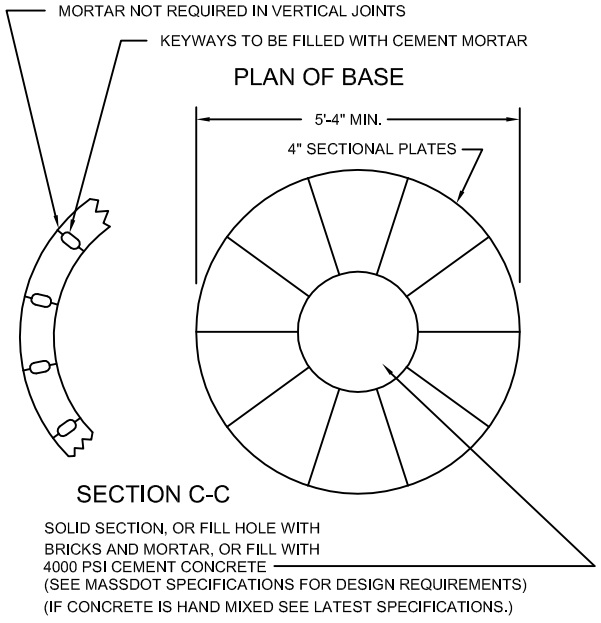
1. WEEPHOLES SHALL BE 4" PIPE OPENING OR EQUIVALENT WITH 1/4 IN. MESH, 23 GAGE GALVANIZED WIRE SCREEN COVERING. 2 CUBIC FEET OF CRUSHED STONE SHALL BE PLACED AROUND EACH WEEPHOLE.
2. BRICKS MAY BE USED BETWEEN TOP COURSE AND C.B. FRAME FOR GRADE ADJUSTMENT. FRAME SHALL BE SET IN FULL BED OF MORTAR.
3. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHODS, SEE STANDARD SPECIFICATIONS.
4. DETAILS SHOWN ON DRAWINGS E 201.6.0 - E 201.11.0
5. FACE OF PIPE FLUSH OR NOT TO PROJECT MORE THAN 4 IN. FROM FACE OF WALL ALONG CENTERLINE OF PIPE.

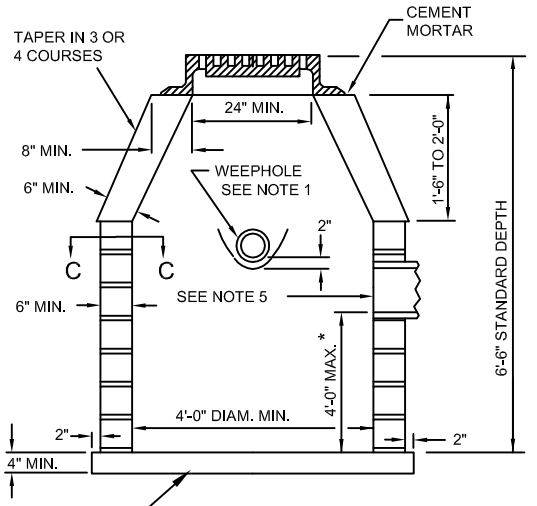



BASIN WITH 4 FLANGE INLET




SECTION A-A

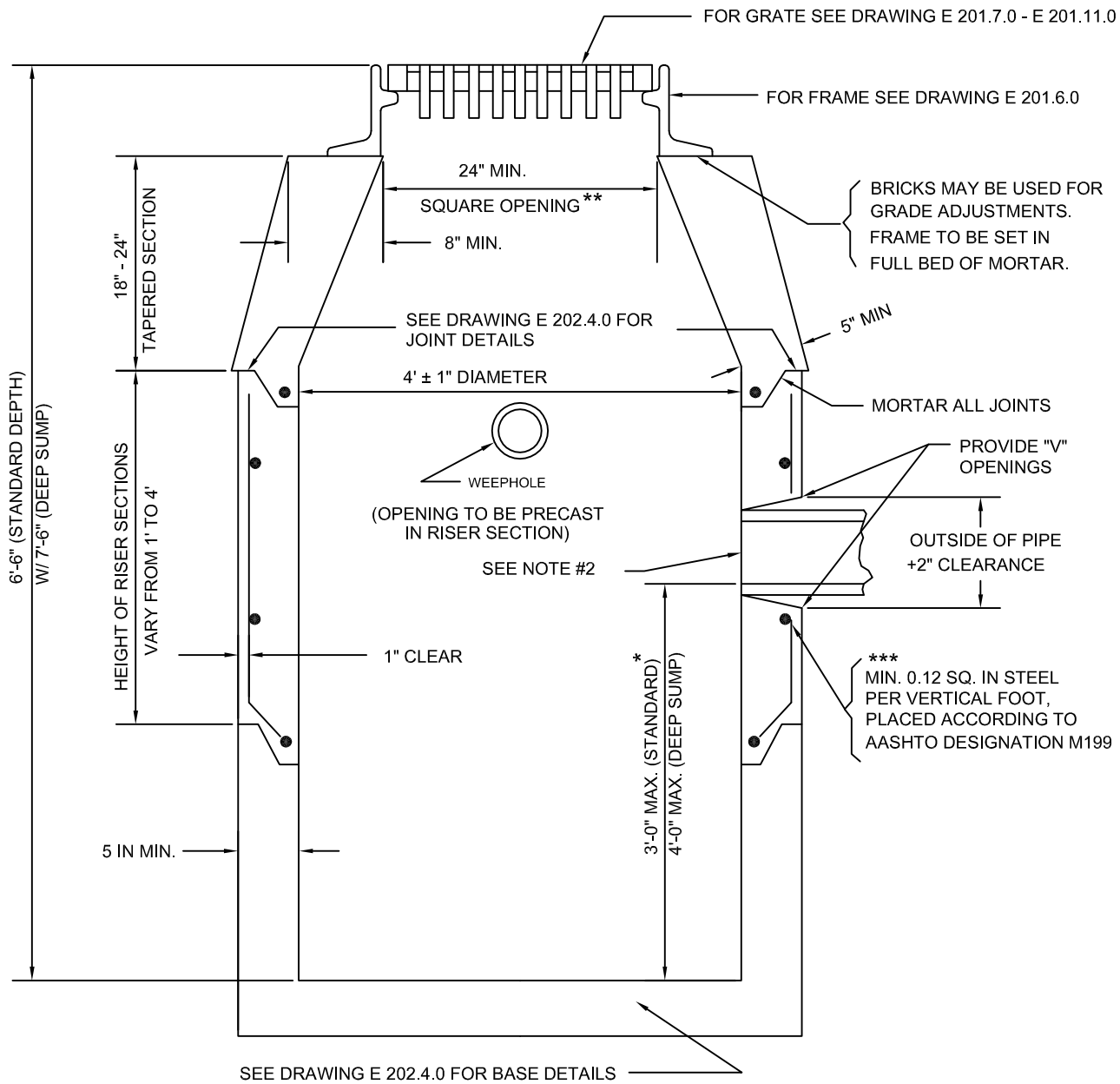



SECTION B-B

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 201.3.0**




* MINIMUM DEPTH OF SUMP TO BE 2 FT

** WHEN A CURB INLET IS INSTALLED, THE OPENING IS TO BE 24"±1" X 27"±1"

*** REINFORCING STEEL BASED ON A WALL THICKNESS OF 5".

NOTES:

1. DETAILS NOT INDICATED ABOVE ARE TO BE SIMILAR TO THOSE SHOWN ON E 201.3.0
2. FACE OF PIPE FLUSH OR NOT TO PROJECT MORE THAN 4" FROM FACE OF WALL ALONG CENTERLINE OF PIPE.
3. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHOD, SEE STANDARD SPECIFICATIONS.
4. ALL CONCRETE TO BE AIR ENTRAINED

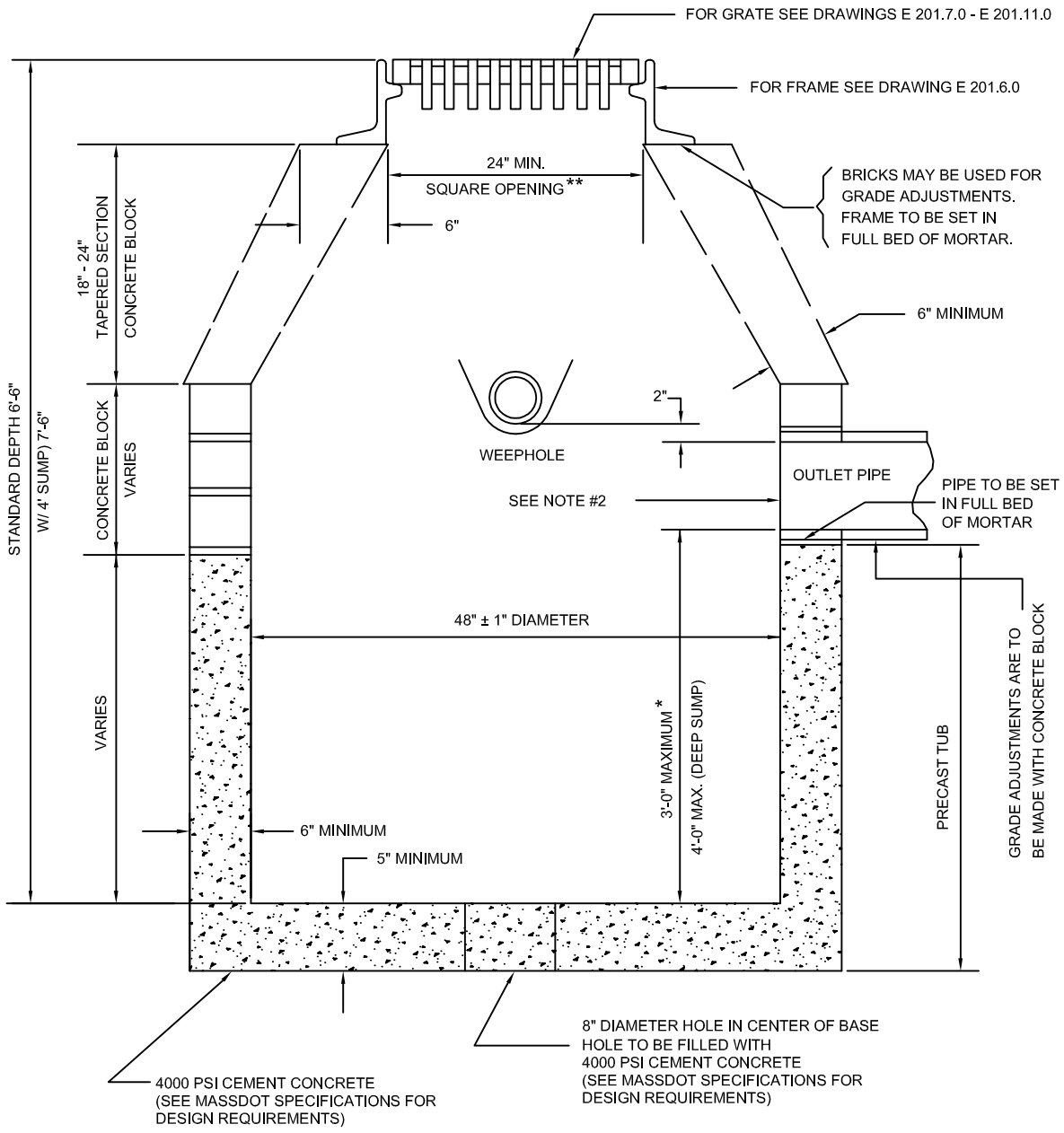
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# PRECAST CONCRETE CATCH BASIN

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 201.4.0**




* MINIMUM DEPTH OF SUMP TO BE 2'

** WHEN A CURB INLET IS INSTALLED, THE OPENING IS TO BE 24"±1" X 27"±1"

NOTES:

1. DETAILS NOT INDICATED ABOVE ARE TO BE SIMILAR TO THOSE SHOWN ON DRAWING E 201.3.0
2. FACE OF PIPE FLUSH OR NOT TO PROJECT MORE THAN 4" FROM FACE OF WALL ALONG CENTERLINE OF PIPE.
3. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHOD, SEE STANDARD SPECIFICATIONS.
4. ALL CONCRETE TO BE AIR ENTRAINED

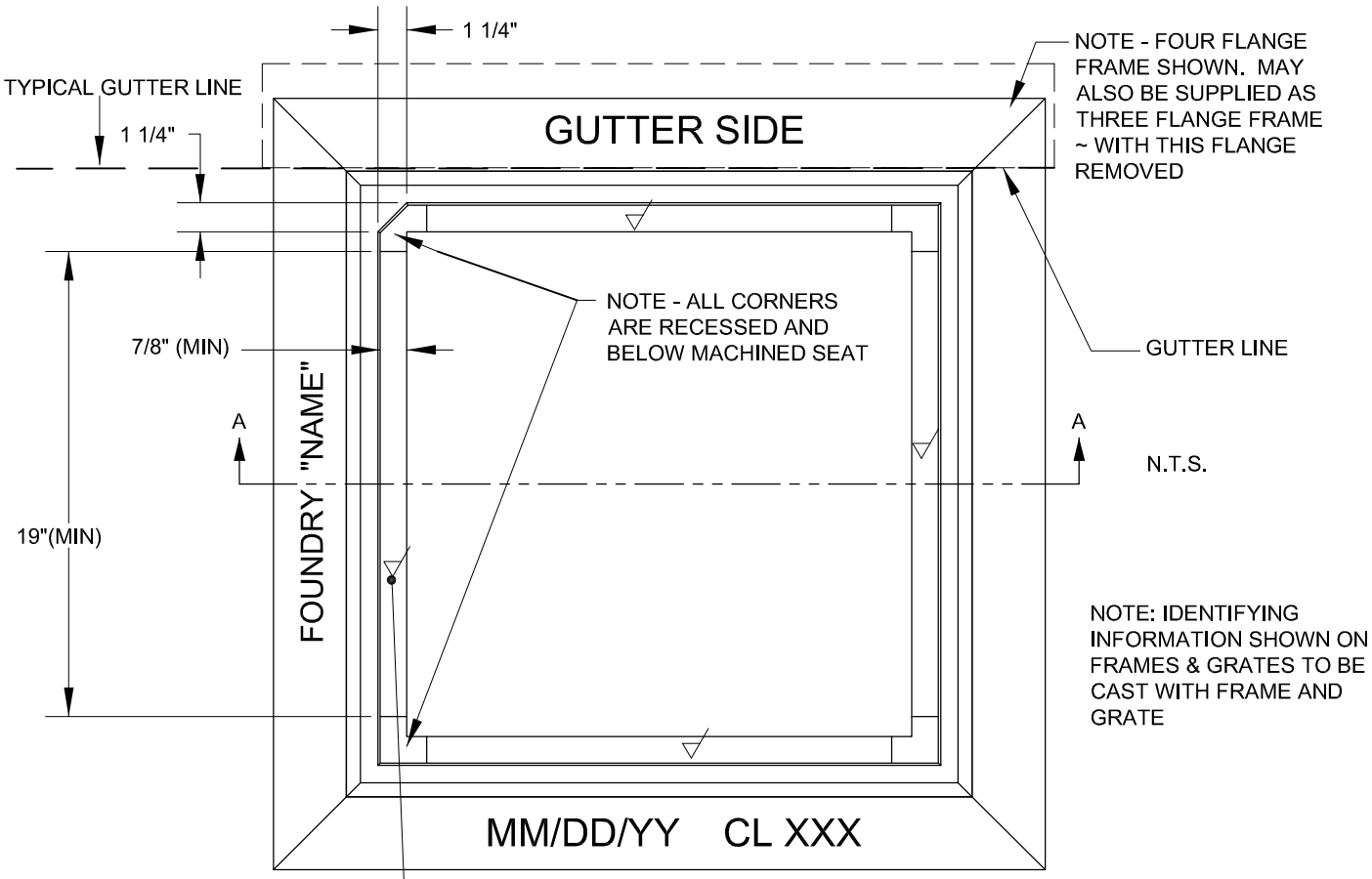
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# PRECAST CONCRETE CATCH BASIN TUB

DATE OF ISSUE
DECEMBER 2016

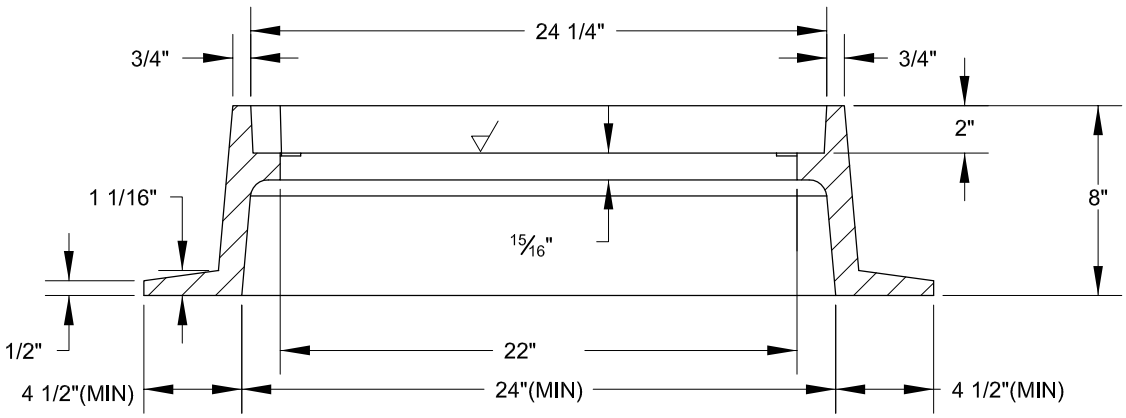
DRAWING NUMBER
**E 201.5.0**




*MACHINE TOLERANCES:*

▽ MACHINED SEATS (4) REQUIRED FLAT AND IN PLANE WITHIN .010" TOTAL INDICATOR READING

CLASSIFICATION:
**CAST IRON - SEE STANDARD SPECIFICATIONS**
WITH NO BLACK ASPHALT COATING ALLOWED




WEIGHTS:

| | |
|---|---|
| 3-FLANGE FRAME | 240 LBS. MIN |
| 4-FLANGE FRAME | 270 LBS. MIN |

AASHTO HS 20 LOAD RATED

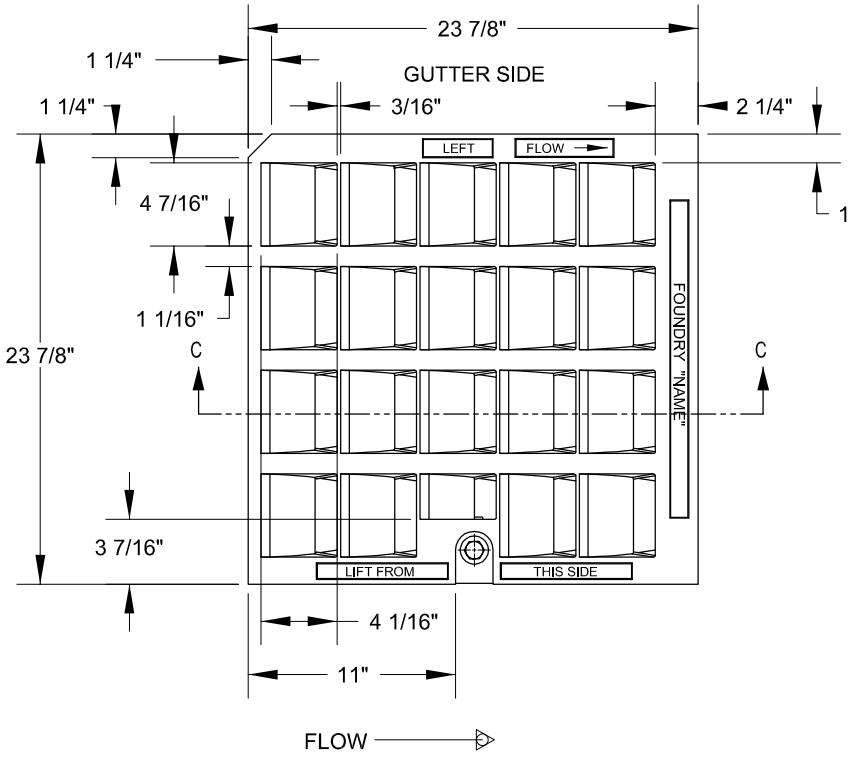
**CASTING TOLERANCES:**
SHALL CONFORM TO AASHTO M306

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# CATCH BASIN FRAME

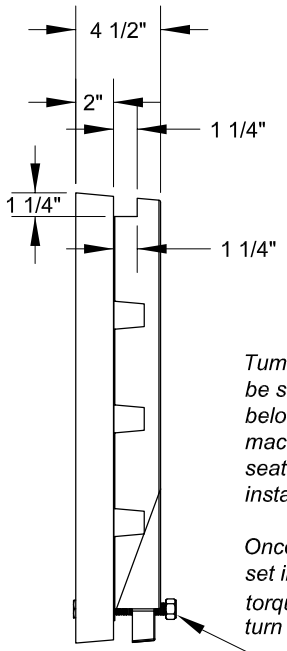
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 201.6.0**




END VIEW

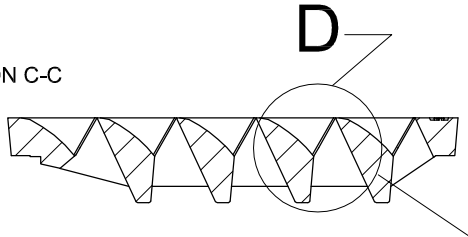
N.T.S.




*Tumbler should be set at 1 1/4" below machined grate seat for installation.*

*Once grate is set in frame, torque bolt ¼ turn past snug.*

SECTION C-C

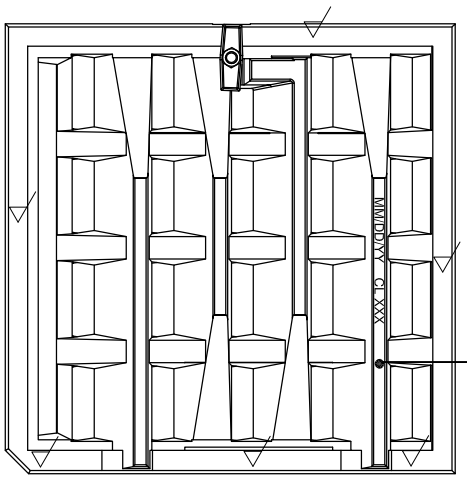



LOCK TUMBLER ASSEMBLY
(1) REQUIRED~CONSISTS OF:

5/8" x 5" ST. STL. BOLT
5/8" ST.STL. FLAT WASHER
CAST IRON TUMBLER
ST. STL. CAPTURE NUT

STAINLESS STEEL GRADE 304

CLASSIFICATION:
**CAST IRON - SEE STANDARD SPECIFICATIONS**
WITH NO BLACK ASPHALT COATING ALLOWED



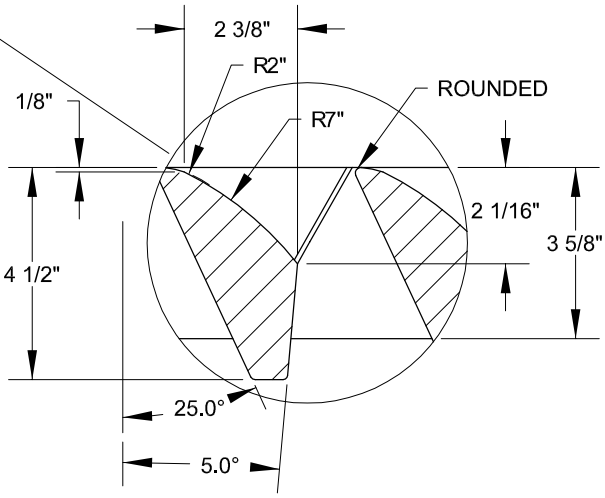

CAST BACK FACE WITH MOLD DATE AND PART NO.

WEIGHT: 265 LBS. MIN
AASHTO HS 20 PROOF LOAD

NOTE: IDENTIFYING INFORMATION SHOWN ON FRAMES & GRATES TO BE CAST WITH FRAME AND GRATE

*Machine tolerances:*

Surfaces noted ▽ must be machined flat and in-plane within .010" Total Indicator Reading




**CASTING TOLERANCES:**
SHALL CONFORM TO AASHTO M306

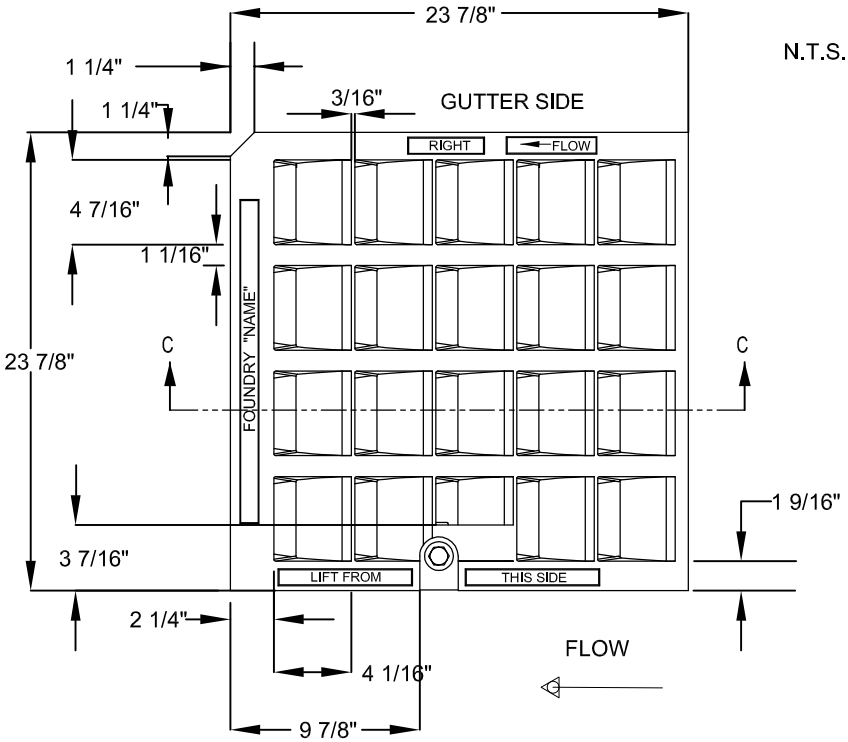
NOTE: CASCADE GRATE ONLY TO BE USED ON FACILITIES WHERE BICYCLE TRAVEL IS LEGALLY ALLOWED.

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# HOOK LOCK CASCADE GRATE FLOW FROM LEFT

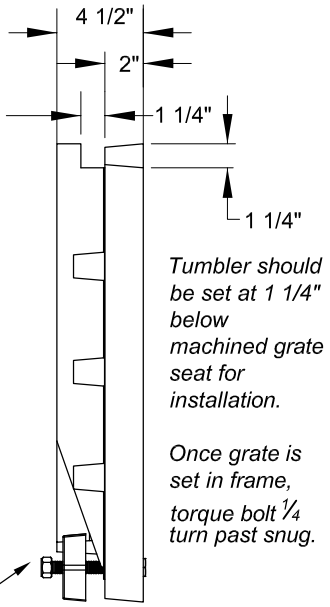
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 201.7.0**




N.T.S.

END VIEW



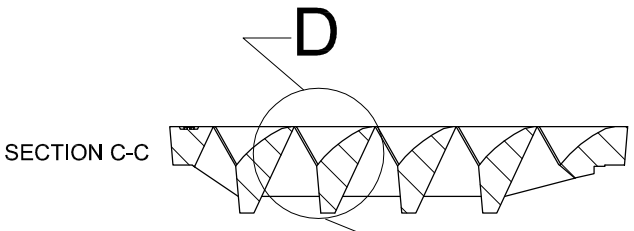

*Tumbler should be set at 1 1/4" below machined grate seat for installation.*

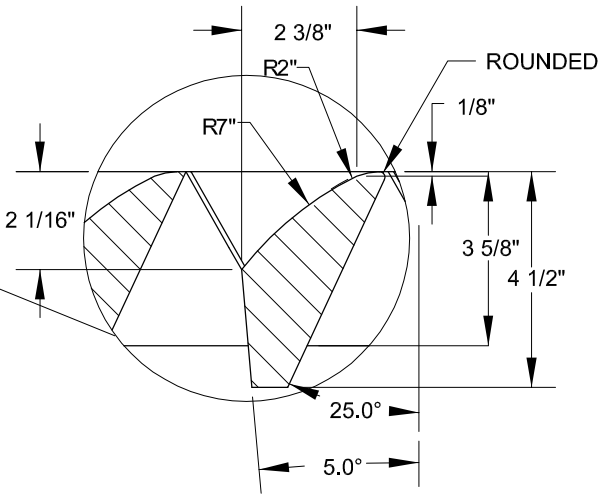
*Once grate is set in frame, torque bolt ¼ turn past snug.*

LOCK TUMBLER ASSEMBLY
(1) REQUIRED~CONSISTS OF:

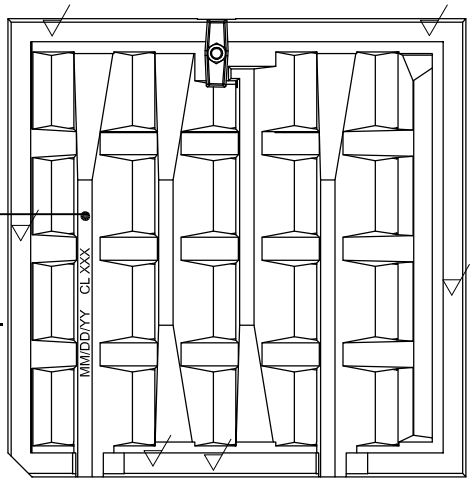
5/8" x 5" ST. STL. BOLT
5/8" ST.STL. FLAT WASHER
CAST IRON TUMBLER
ST. STL. CAPTURE NUT

STAINLESS STEEL GRADE 304




WEIGHT: 265 LBS. MIN
AASHTO HS 20 PROOF LOAD




CAST BACK FACE WITH MOLD DATE AND PART NO.

CLASSIFICATION:
**CAST IRON - SEE STANDARD SPECIFICATIONS**
WITH NO BLACK ASPHALT COATING ALLOWED

**CASTING TOLERANCES:**
SHALL CONFORM TO AASHTO M306

*Machine tolerances:*

Surfaces noted ▽ must be machined flat and in-plane within .010" Total Indicator Reading

NOTE: CASCADE GRATE ONLY TO BE USED ON FACILITIES WHERE BICYCLE TRAVEL IS LEGALLY ALLOWED.

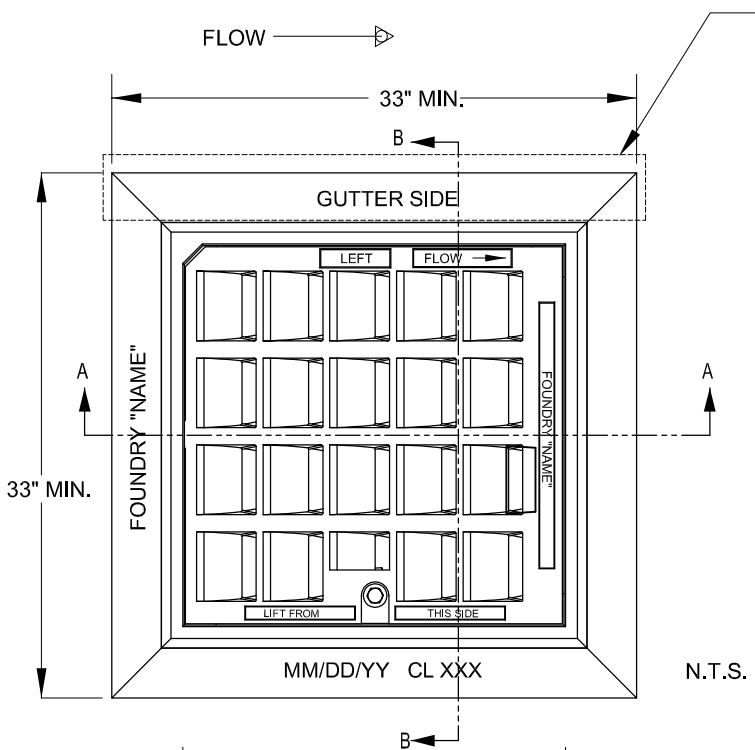
NOTE: IDENTIFYING INFORMATION SHOWN ON FRAMES & GRATES TO BE CAST WITH FRAME AND GRATE

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# HOOK LOCK CASCADE GRATE FLOW FROM RIGHT

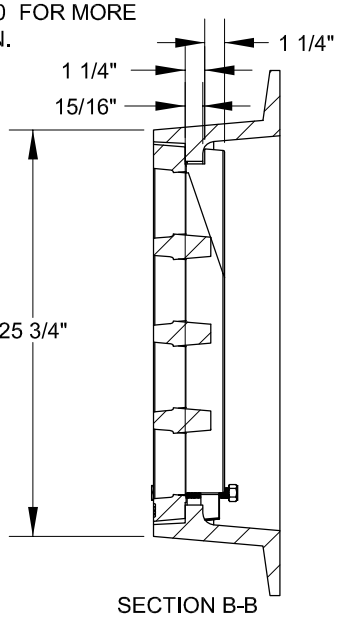
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 201.7.1**

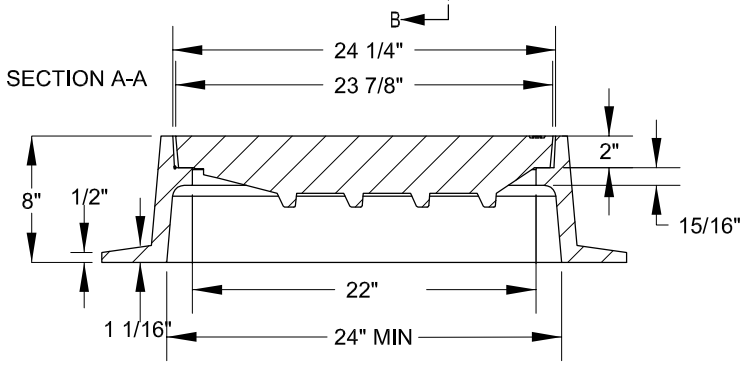



N.T.S.

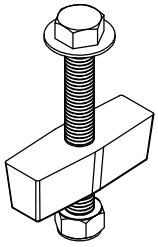
FRAME MAY BE INSTALLED WITH THIS FLANGE REMOVED FOR CURB INLET. FOUR FLANGE IS SHOWN. ~ SEE DWG E 201.6.0 FOR MORE INFORMATION.




SECTION B-B



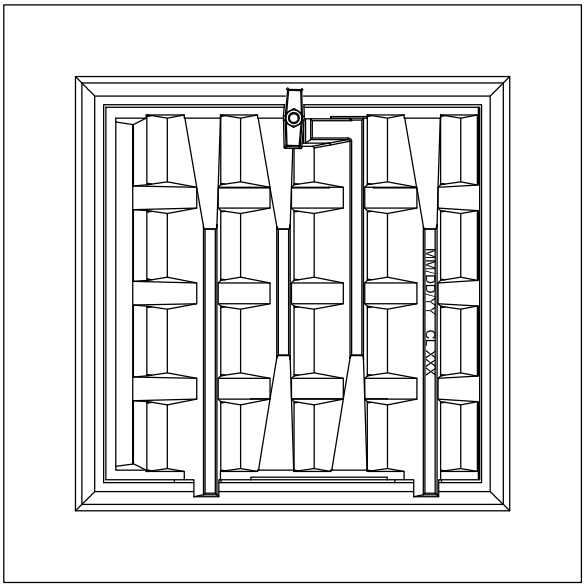

AASHTO HS 20 PROOF LOAD



LOCK TUMBLER ASSEMBLY
(1) REQUIRED~CONSISTS OF:

5/8" x 5" ST. STL. BOLT
5/8" ST.STL. FLAT WASHER
CAST IRON TUMBLER
ST. STL. CAPTURE NUT

STAINLESS STEEL GRADE 304




CLASSIFICATION:
**CAST IRON - SEE STANDARD SPECIFICATIONS**
WITH NO BLACK ASPHALT COATING ALLOWED

*Tumbler should be set at 1 1/4" below machined grate seat for installation.*

*Once grate is set in frame, torque bolt ¼ turn past snug.*

WEIGHTS:

| | |
|---|---|
| 3-FLANGE FRAME | 240 LBS. MIN |
| 4-FLANGE FRAME | 270 LBS. MIN |
| B-1 GRATE | 265 LBS. MIN |

NOTE: SEAT SURFACES ON BOTH FRAME AND GRATE ARE MACHINED AND GRATE MUST NOT ROCK IN FRAME WHEN ASSEMBLED.

**CASTING TOLERANCES:**
SHALL CONFORM TO AASHTO M306

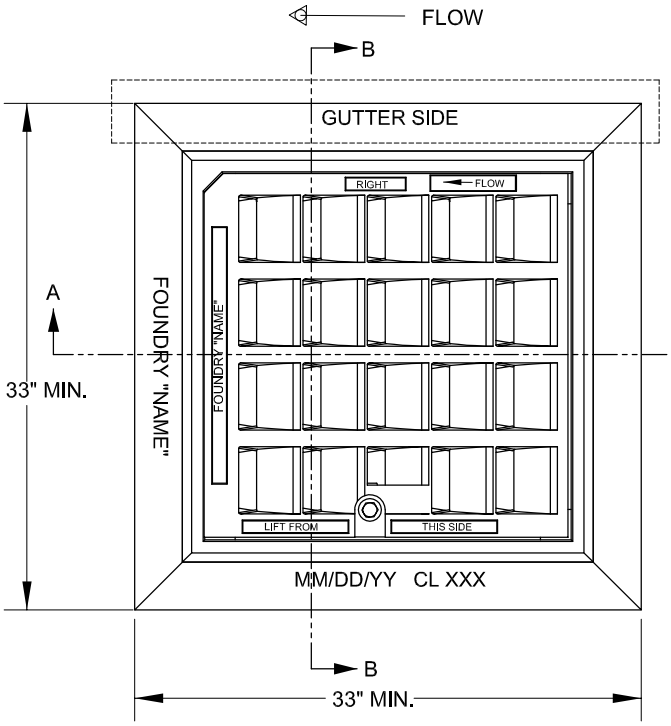
NOTE: IDENTIFYING INFORMATION SHOWN ON FRAMES & GRATES TO BE CAST WITH FRAME AND GRATE

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# FRAME AND HOOK LOCK CASCADE GRATE - FLOW FROM LEFT ASSEMBLY DETAILS

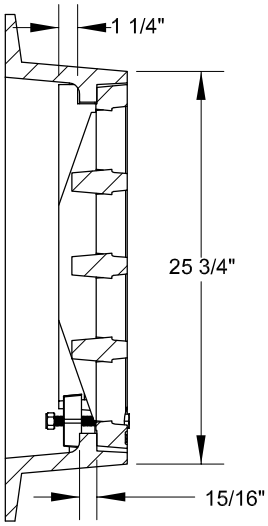
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 201.9.0**



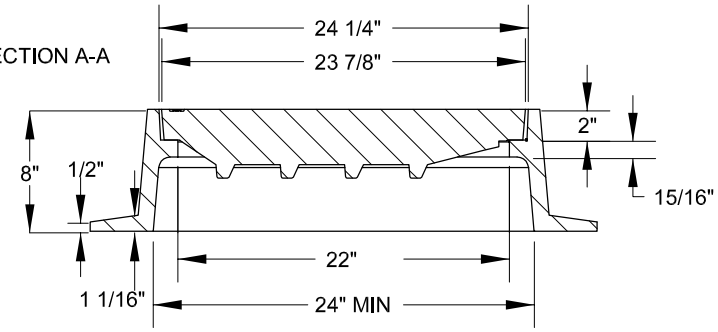

FRAME MAY BE INSTALLED WITH THIS FLANGE REMOVED FOR CURB INLET. FOUR FLANGE IS SHOWN. ~ SEE DWG E 201.6.0 FOR MORE INFORMATION.

CLASSIFICATION:
**CAST IRON - SEE STANDARD SPECIFICATIONS**
WITH NO BLACK ASPHALT COATING ALLOWED

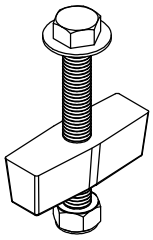



AASHTO HS 20 PROOF LOAD
N.T.S.

SECTION A-A



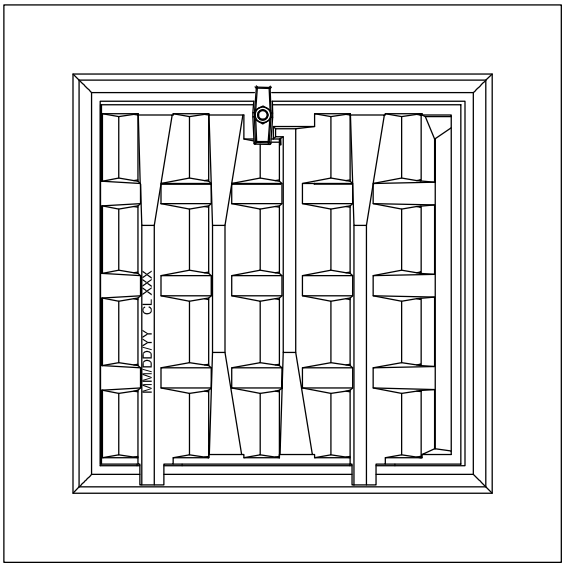

SECTION B-B



LOCK TUMBLER ASSEMBLY
(1) REQUIRED~CONSISTS OF:

5/8" x 5" ST. STL. BOLT
5/8" ST.STL. FLAT WASHER
CAST IRON TUMBLER
ST. STL. CAPTURE NUT

STAINLESS STEEL GRADE 304




*Tumbler should be set at 1 1/4" below machined grate seat for installation.*

*Once grate is set in frame, torque bolt ¼ turn past snug.*

WEIGHTS:

| | |
|---|---|
| 3-FLANGE FRAME | 240 LBS. MIN |
| 4-FLANGE FRAME | 270 LBS. MIN |
| B-2 GRATE | 265 LBS. MIN |

NOTE: SEAT SURFACES ON BOTH FRAME AND GRATE ARE MACHINED AND GRATE MUST NOT ROCK IN FRAME WHEN ASSEMBLED.

**CASTING TOLERANCES:**
SHALL CONFORM TO AASHTO M306

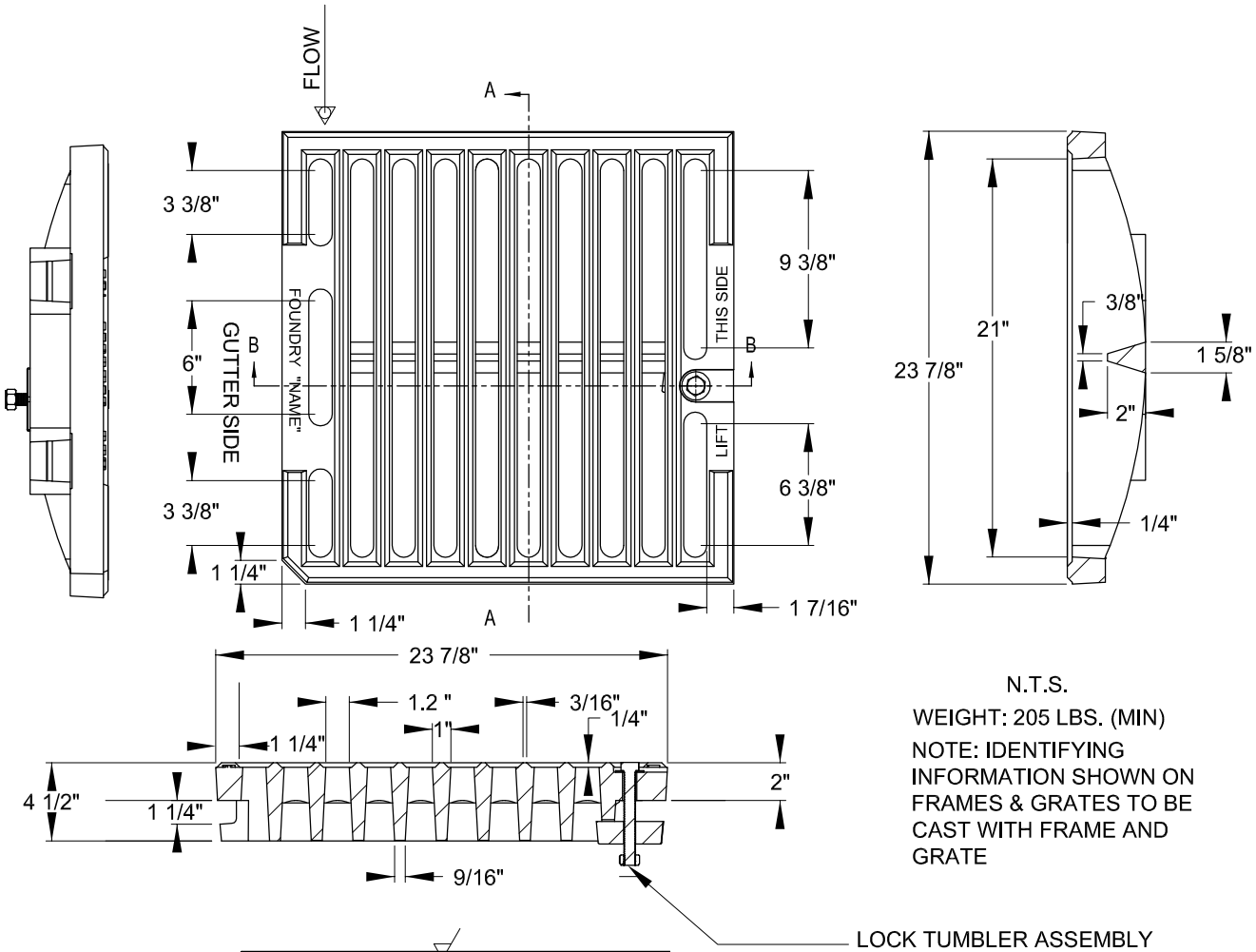
NOTE: IDENTIFYING INFORMATION SHOWN ON FRAMES & GRATES TO BE CAST WITH FRAME AND GRATE

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# FRAME AND HOOK LOCK CASCADE GRATE - FLOW FROM RIGHT ASSEMBLY DETAILS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 201.9.1**




N.T.S.

WEIGHT: 205 LBS. (MIN)

NOTE: IDENTIFYING INFORMATION SHOWN ON FRAMES & GRATES TO BE CAST WITH FRAME AND GRATE

(1) REQUIRED~CONSISTS OF:

5/8" x 5" ST. STL. BOLT
5/8" ST.STL. FLAT WASHER
CAST IRON TUMBLER
ST. STL. CAPTURE NUT
STAINLESS STEEL GRADE 304

AASHTO HS 20 PROOF LOAD

CLASSIFICATION:
**CAST IRON - SEE STANDARD SPECIFICATIONS**
WITH NO BLACK ASPHALT COATING ALLOWED

**CASTING TOLERANCES:**
SHALL CONFORM TO AASHTO M306

*Machine tolerances:*

Surfaces noted ▽ must be machined flat and in-plane within .010" Total Indicator Reading

*Tumbler should be set at 1 1/4" below machined grate seat for installation.*

*Once grate is set in frame, torque bolt $\frac{1}{4}$ turn past snug.*

NOTE: BAR GRATE NOT TO BE USED ON FACILITIES WHERE BICYCLE TRAVEL IS LEGALLY ALLOWED.

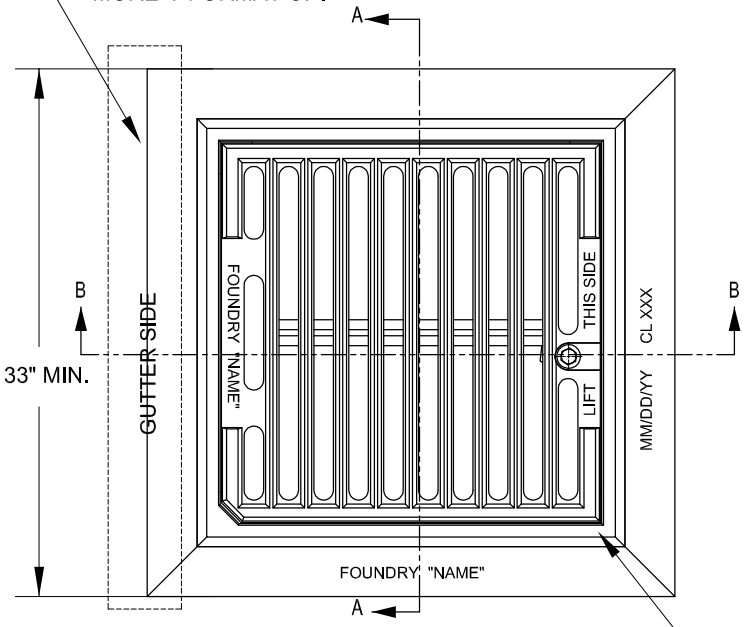
massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# HOOK LOCK BAR GRATE

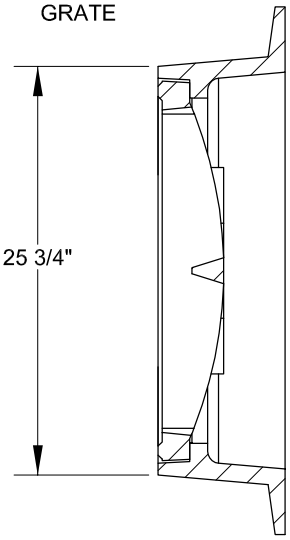
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 201.10.0**

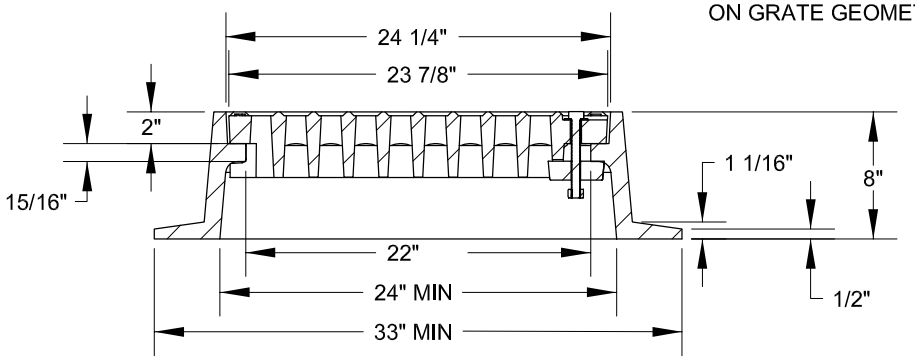
FRAME MAY BE INSTALLED WITH THIS FLANGE REMOVED FOR CURB INLET. FOUR FLANGE IS SHOWN. SEE DWG 201.6.0 R2 FOR MORE INFORMATION.



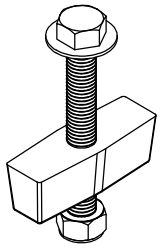

NOTE: IDENTIFYING INFORMATION SHOWN ON FRAMES & GRATES TO BE CAST WITH FRAME AND GRATE




SEE DWG # FOR MORE INFORMATION ON GRATE GEOMETRY.



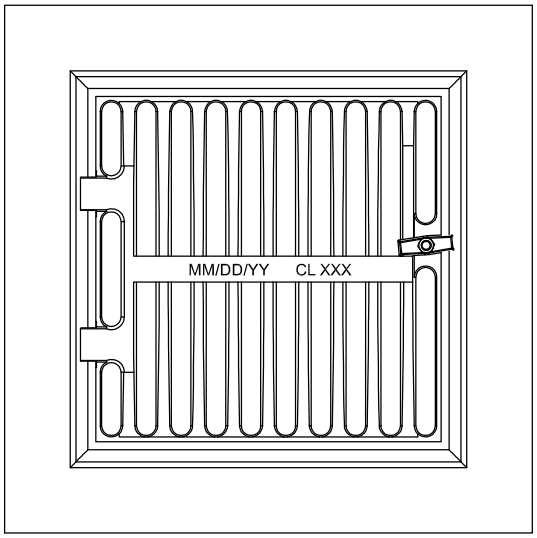

N.T.S.



LOCK TUMBLER ASSEMBLY
(1) REQUIRED~CONSISTS OF:

5/8" x 5" ST. STL. BOLT
5/8" ST.STL. FLAT WASHER
CAST IRON TUMBLER
ST. STL. CAPTURE NUT

STAINLESS STEEL GRADE 304




AASHTO HS 20 PROOF LOAD

**CASTING TOLERANCES:**
SHALL CONFORM TO AAASHTO M306

CLASSIFICATION:
**CAST IRON - SEE STANDARD SPECIFICATIONS**
WITH NO BLACK ASPHALT COATING ALLOWED

NOTE: SEAT SURFACES ON BOTH FRAME AND GRATE ARE MACHINED AND GRATE MUST NOT ROCK IN FRAME WHEN ASSEMBLED.

*Tumbler should be set at 1 1/4" below machined grate seat for installation.*

*Once grate is set in frame, torque bolt $\frac{1}{4}$ turn past snug.*

WEIGHTS:

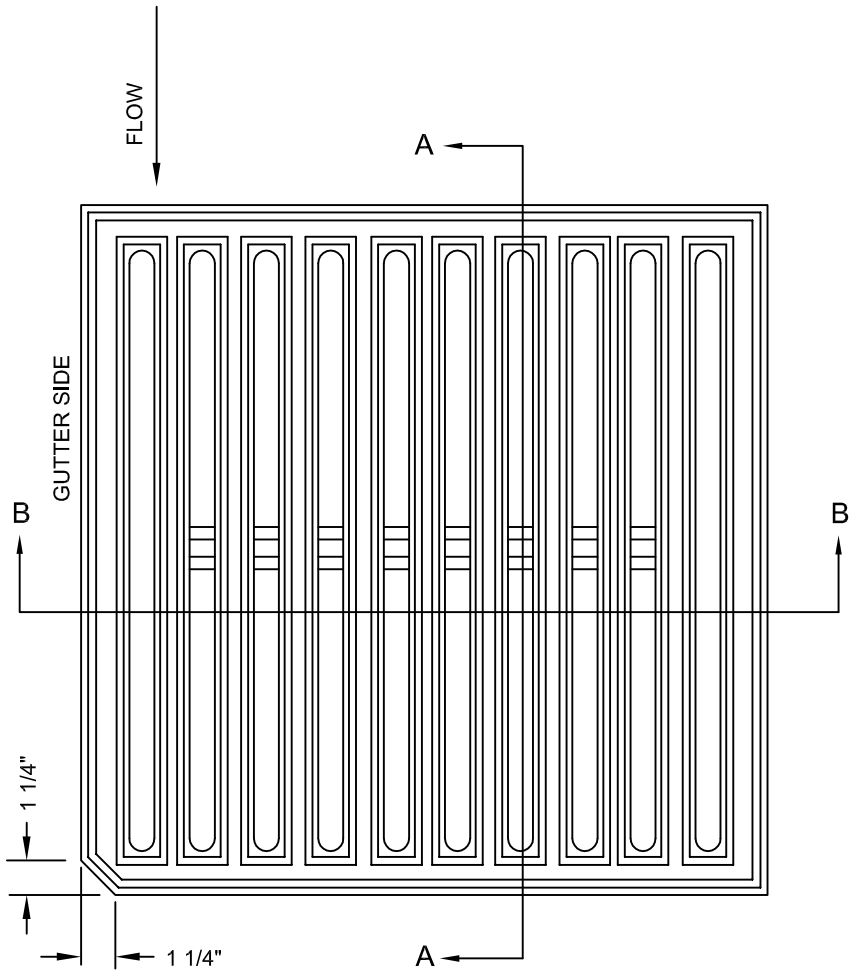
| | |
|---|---|
| 3-FLANGE FRAME | 240 LBS. MIN |
| 4-FLANGE FRAME | 270 LBS. MIN |
| A-4 GRATE | 205 LBS. MIN |

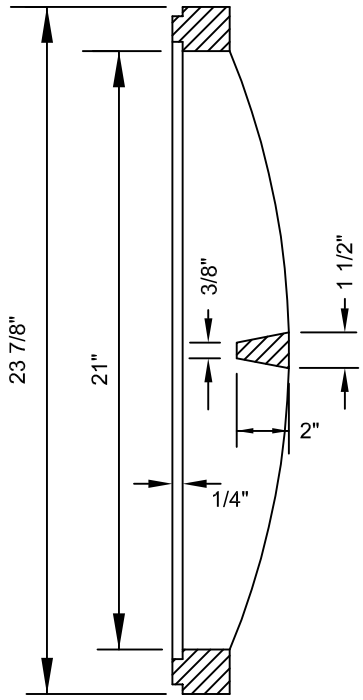
massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# FRAME AND HOOK LOCK BAR GRATE - FRAME ASSEMBLY DETAILS

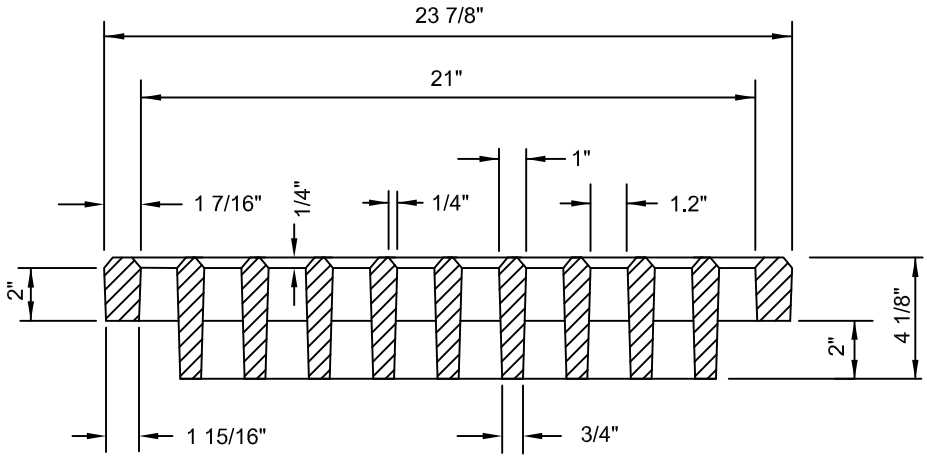
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 201.10.1**




SECTION A-A




SECTION B-B

NOTES:

1. MATERIAL - CAST IRON; SEE STANDARD SPECIFICATIONS
2. MINIMUM MASS - 210 LBS.

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# DROP INLET GRATE

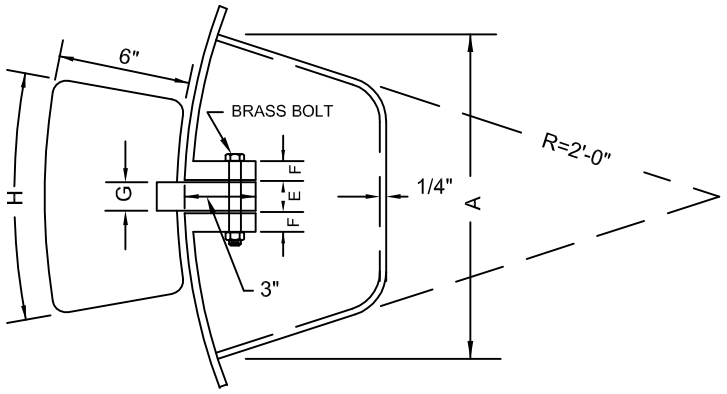
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 201.11.0**

massDOT
Massachusetts Department of Transportation
Highway Division

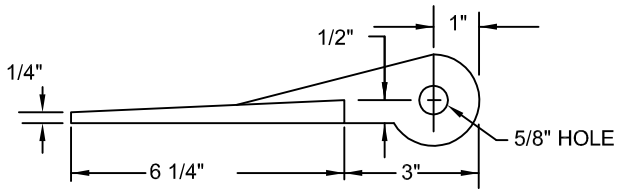
CONSTRUCTION STANDARDS

# CATCH BASIN HOOD

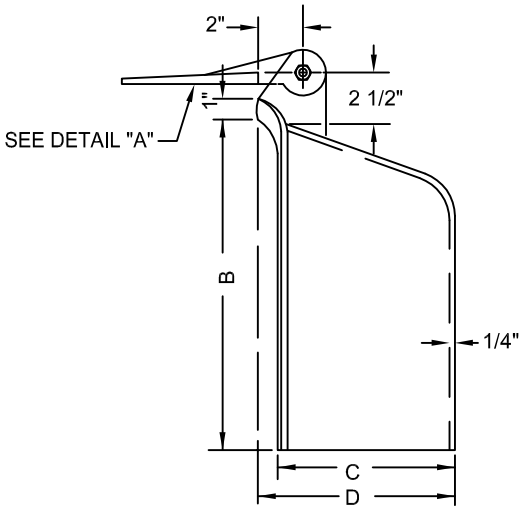



TOP

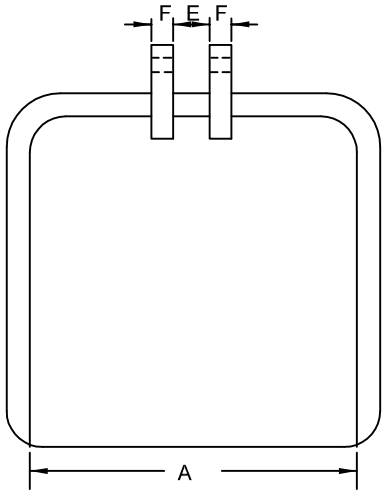
| DIMENSIONS (in.) | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 8" and 10" PIPE | 15 | 15 | 8 | 9 | 2 | 7/8 | 1 7/8 | 14 |
| 12" and 15" PIPE | 18 | 18 | 10 | 11 1/4 | 2 | 1 | 1 7/8 | 14 |



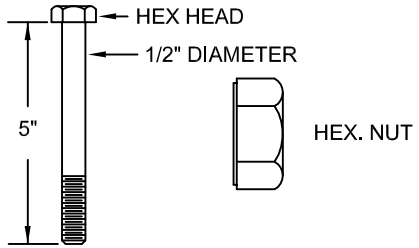

DETAIL "A" HINGE




SIDE




BACK



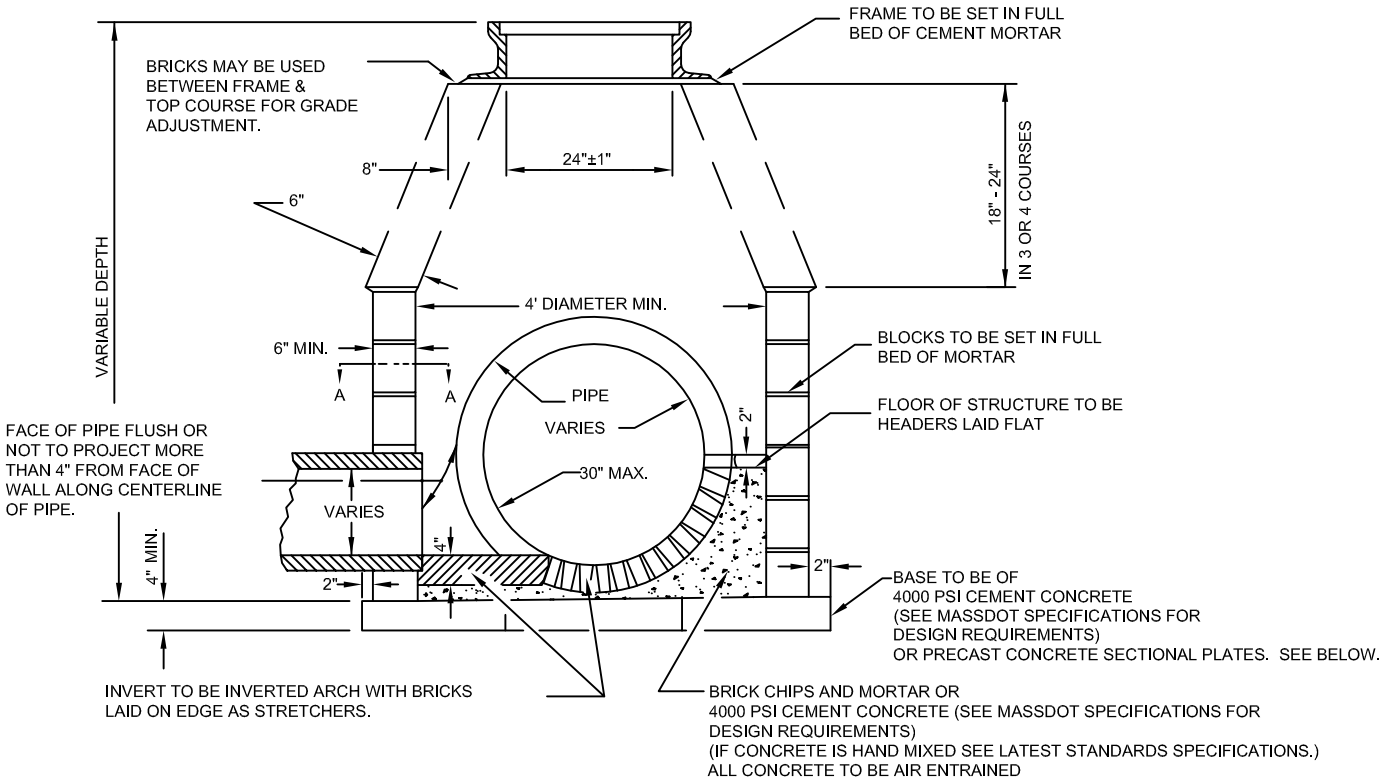

BRASS BOLT & NUT

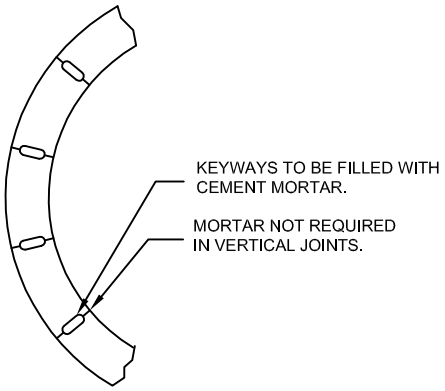
NOTE:

1. HOODS TO BE GRAY CAST IRON - SEE STANDARD SPECIFICATIONS WITH NO BLACK ASPHALT COATING ALLOWED

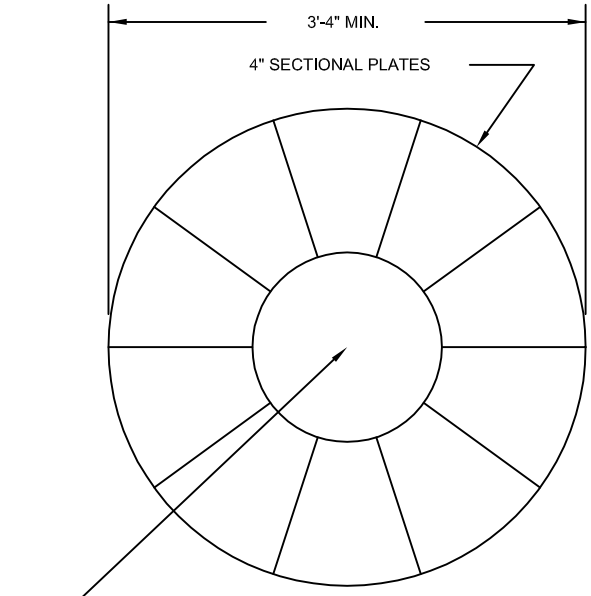
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 201.12.0**




SECTION A-A




PLAN OF BASE

SOLID SECTION; OR FILL HOLE WITH BRICKS AND MORTAR;
OR FILL WITH 4000 PSI CEMENT CONCRETE
(SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)
(IF CONCRETE IS HAND MIXED SEE LATEST STANDARD SPECIFICATIONS)

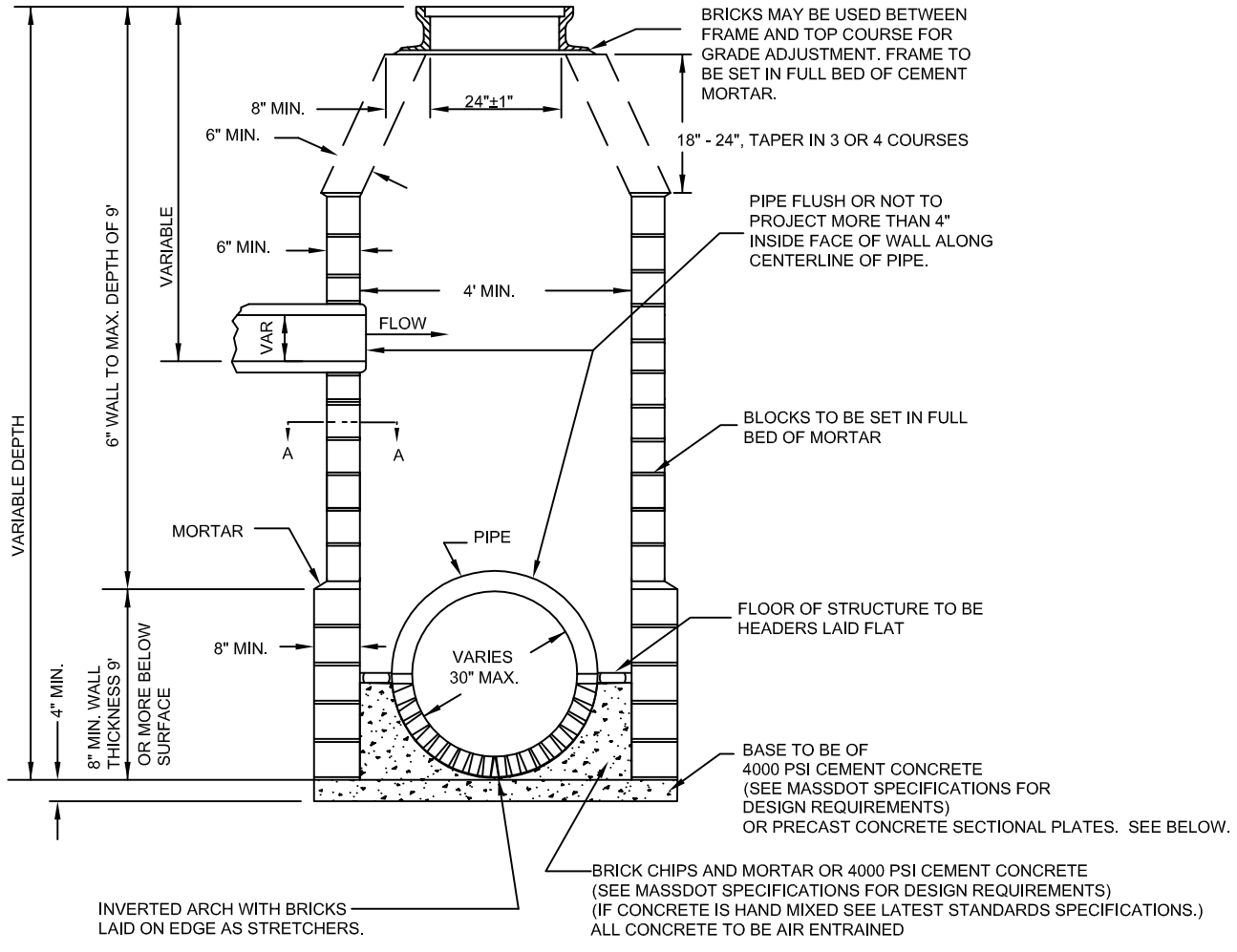
NOTE:
1. DESIGN SHOWN IS FOR MANHOLE OF 9' OR LESS AND PIPE DIAMETER OF 30" OR LESS.
2. STANDARD MANHOLE DEPTH TO BE 6'-6" OR LESS

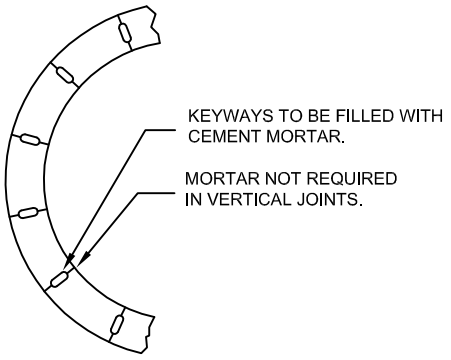
massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# CONCRETE BLOCK MANHOLE
# MANHOLES 9' OR LESS IN DEPTH

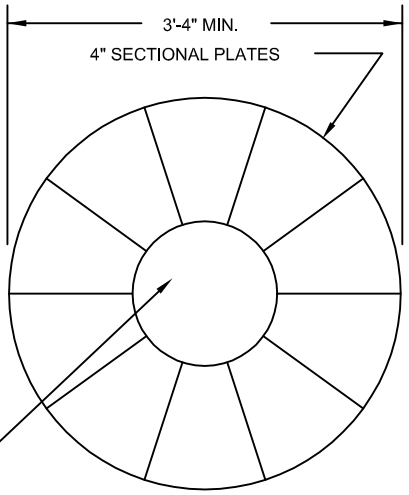
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 202.2.0**




SECTION A-A




PLAN OF BASE

SOLID SECTION; OR FILL HOLE WITH BRICKS AND MORTAR; OR FILL WITH 4000 PSI CEMENT CONCRETE (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS) (IF CONCRETE IS HAND MIXED SEE LATEST STANDARD SPECIFICATIONS)

NOTE:

1. MANHOLE DESIGN IS FOR PIPE DIAMETER OF 30" OR LESS

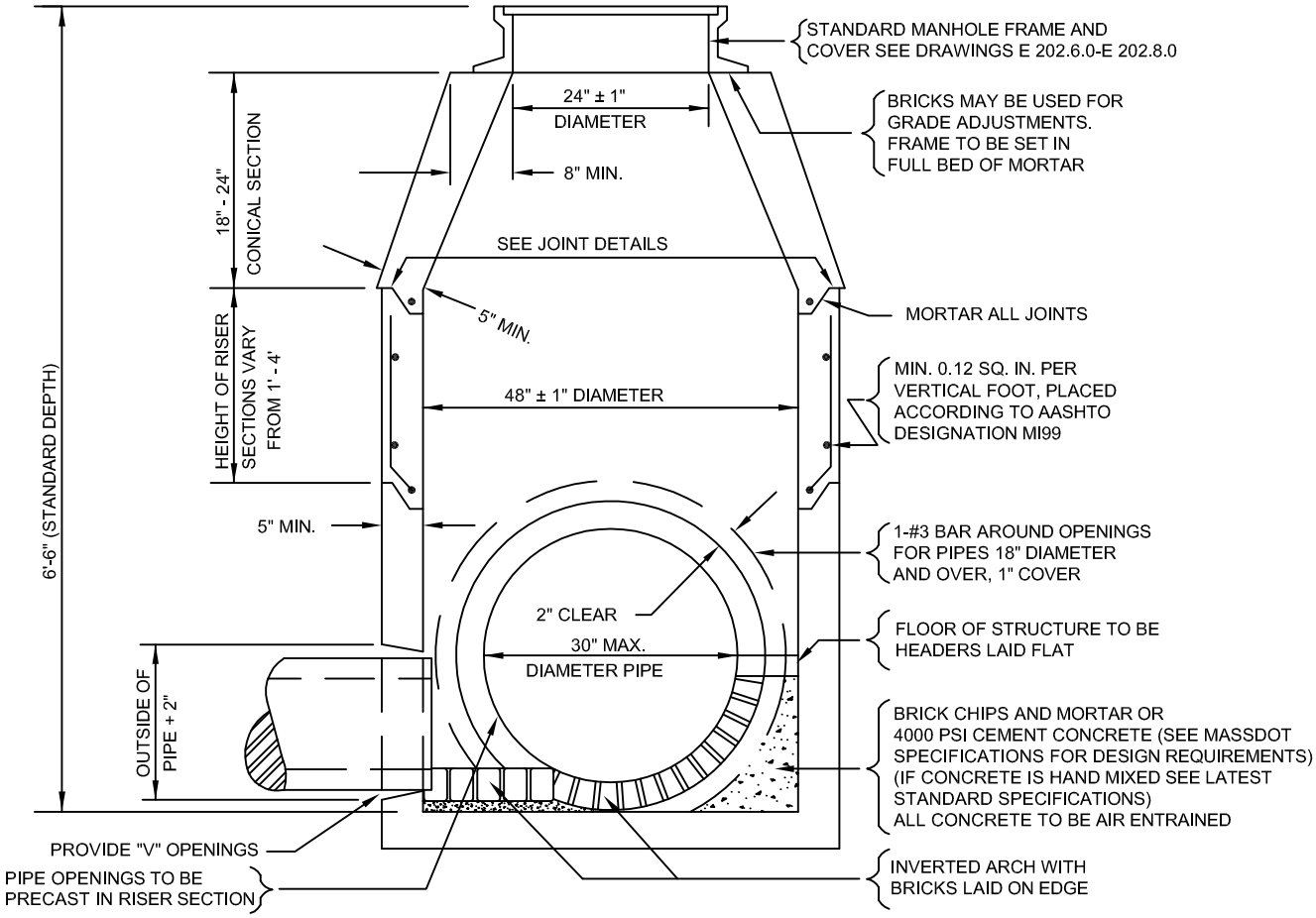
massDOT Massachusetts Department of Transportation Highway Division

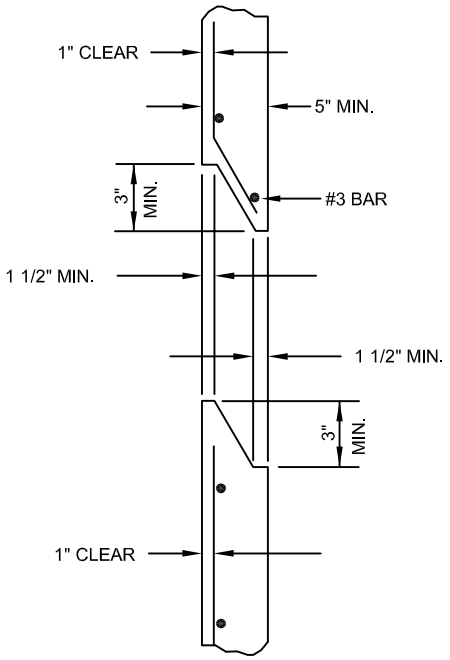
CONSTRUCTION STANDARDS

# CONCRETE BLOCK MANHOLE
# MANHOLES OVER 9' IN DEPTH

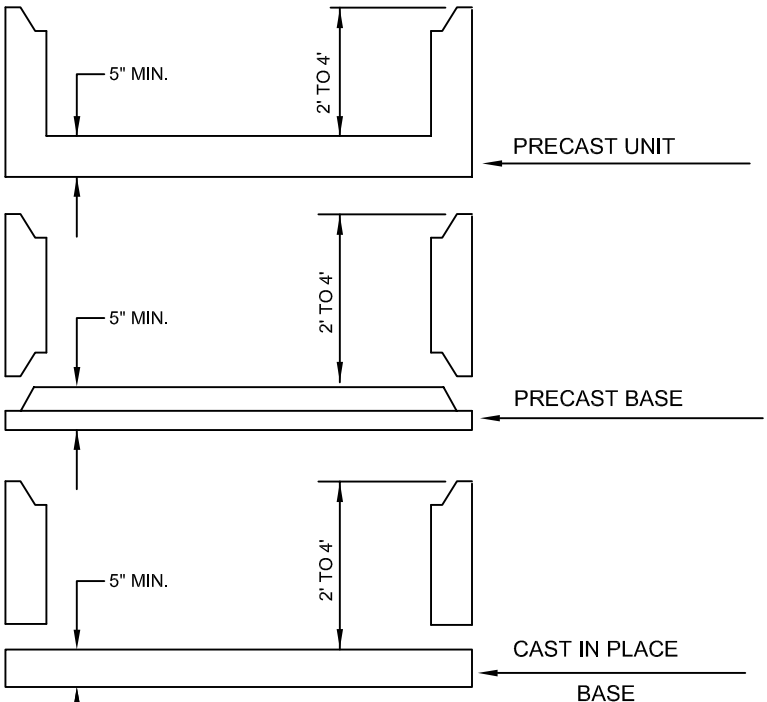
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 202.3.0**




JOINT DETAILS




BASE DETAILS

NOTE:

1. FOR DESCRIPTIONS, MATERIALS AND CONSTRUCTION METHODS, SEE LATEST STANDARD SPECIFICATIONS.

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# PRECAST CONCRETE MANHOLES 9' OR LESS IN DEPTH

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 202.4.0**

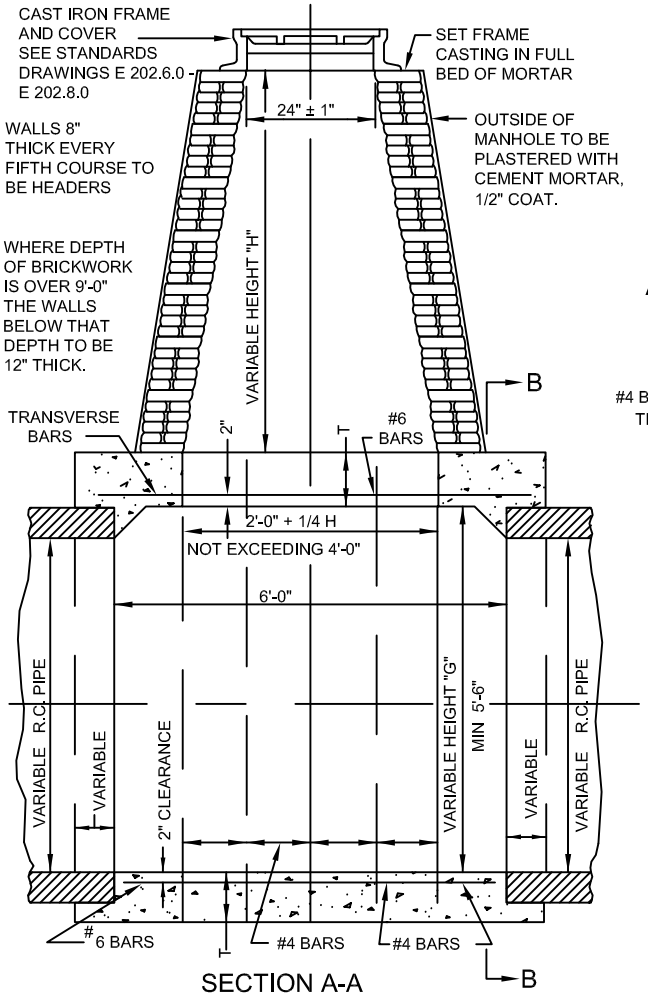
massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

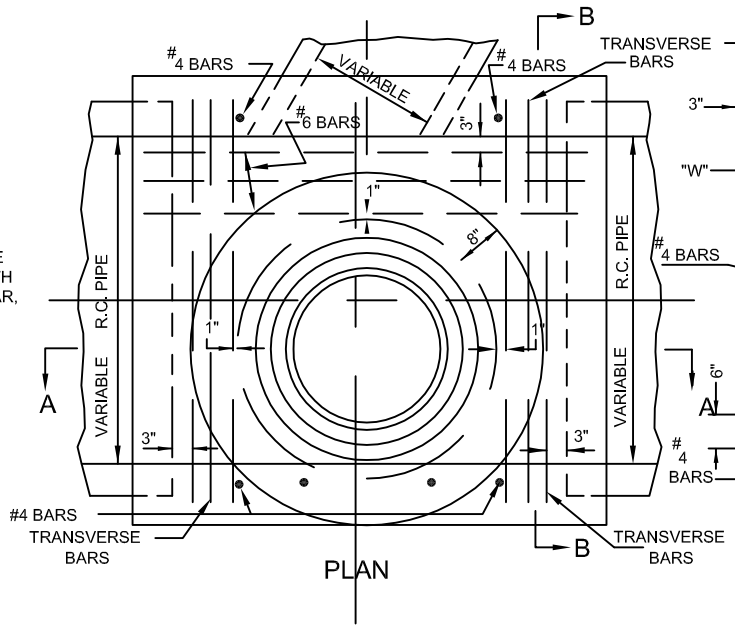
# SPECIAL MANHOLES FOR 36" TO 84" DIAMETER R.C. PIPE

DATE OF ISSUE
DECEMBER 2016

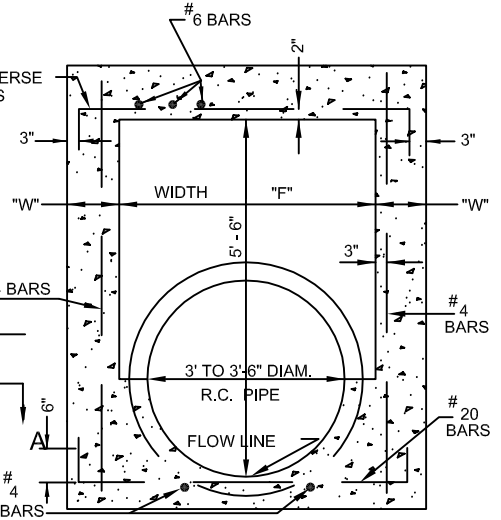
DRAWING NUMBER
**E 202.5.0**



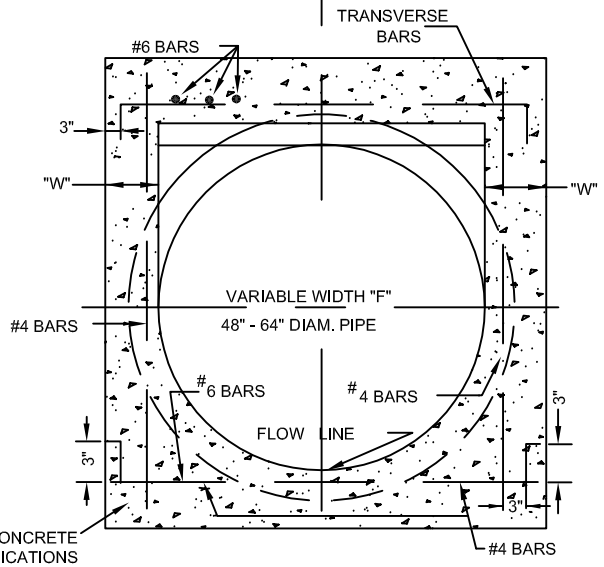

SECTION A-A




PLAN




36" TO 42" DIAM. R.C. PIPE
SECTION B-B




4000 PSI CEMENT CONCRETE
(SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)

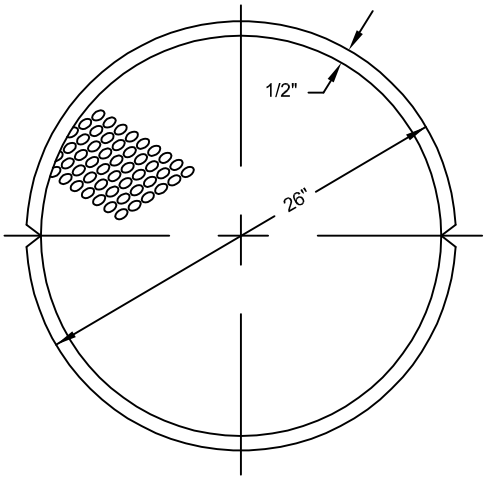
48" TO 84" DIAM. R.C. PIPE
SECTION B-B

TOP AND BOTTOM SLABS & SIDEWALLS TO BE CLASS "B" CONC.

| SIZE OF PIPE | WIDTH "F" | HEIGHT "G" | HEIGHT "H" | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 8.0'-15.9' | | 16.0'-23.9' | | 24.0'&UP | |
| | | | T | W | T | W | T | W |
| 36" | 4'-0" | 5'-6" | 8" | 10" | 8" | 12" | 9" | 12" |
| 42" | 4'-0" | 5'-6" | 8" | 10" | 8" | 12" | 9" | 12" |
| 48" | 4'-0" | 5'-6" | 8" | 10" | 8" | 12" | 9" | 12" |
| 54" | 4'-6" | 5'-6" | 8" | 10" | 8" | 12" | 10" | 12" |
| 60" | 5'-0" | 5'-6" | 8" | 10" | 9" | 12" | 11" | 12" |
| 72" | 6'-0" | 6'-0" | 9" | 10" | 10" | 12" | 12" | 12" |
| 84" | 7'-0" | 7'-0" | 10" | 10" | 11" | 12" | 13" | 12" |

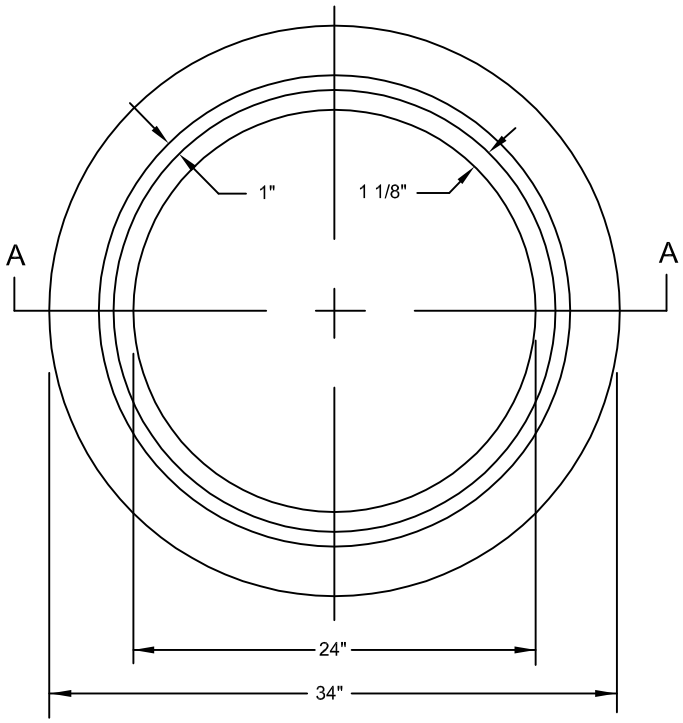
SIZE NUMBER AND SPACING OF BARS.

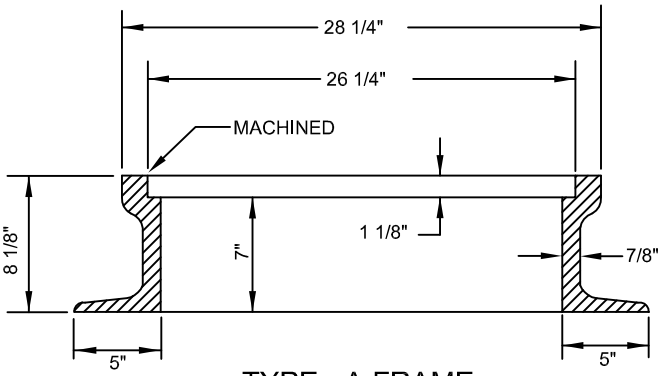
| T | TOP SLAB | | BOTTOM SLAB | | SIDEWALLS |
|---|---|---|---|---|---|
| | TRANS. BARS | LONG BARS | TRANS. #6 BARS | LONG #4 BARS | VERTICAL #4 BARS |
| 8" | 6-#7 | 3-#6 | 6 1/2" OC | 24" OC | 12" OC |
| 9" | 6-#7 | 3-#6 | 5 1/2" OC | DO | DO |
| 10" | 6-#8 | 3-#6 | 5" OC | DO | DO |
| 11" | 6-#8 | 3-#6 | 4 1/2" OC | DO | DO |
| 12" | 6-#9 | 3-#6 | 4" OC | DO | DO |
| 13" | 6-#10 | 3-#6 | 4" OC | DO | DO |




STANDARD COVER

FOR COVER DETAILS SEE DRAWING E 202.8.0




TYPE - A FRAME

NOTES:

1. MINIMUM MASS - 265 LBS.
2. MATERIAL - CAST IRON - SEE STANDARD SPECIFICATIONS WITH NO BLACK ASPHALT COATING ALLOWED

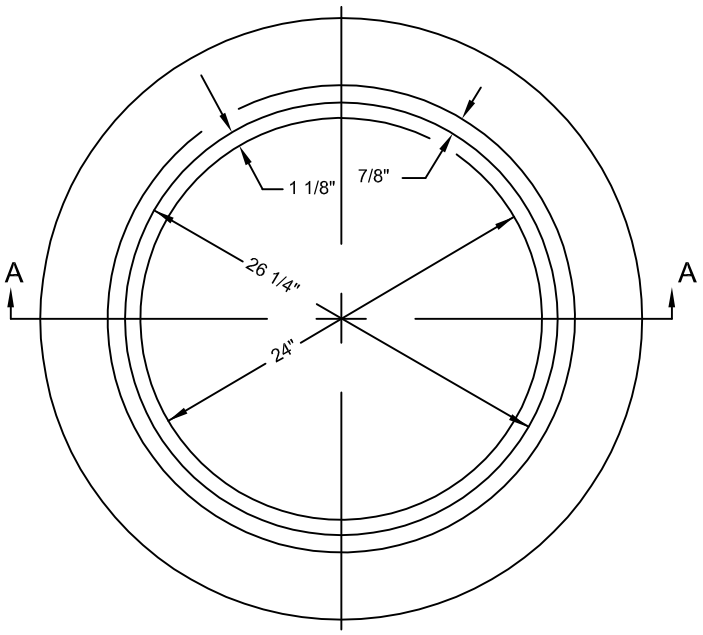
massDOT Massachusetts Department of Transportation Highway Division

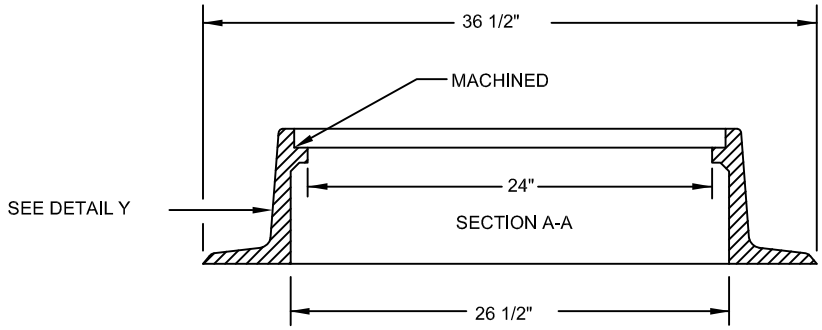
CONSTRUCTION STANDARDS

# MANHOLE FRAME AND COVER - A FRAME

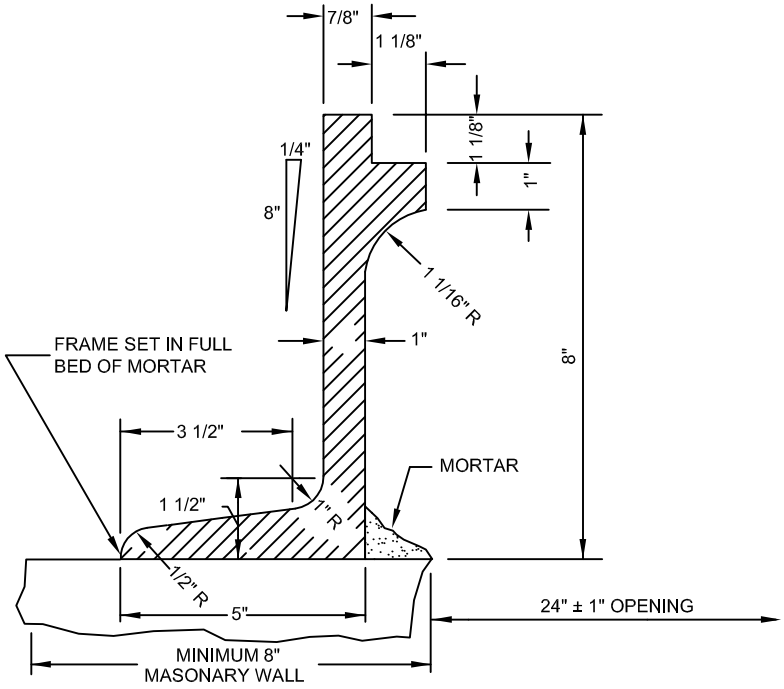
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 202.6.0**

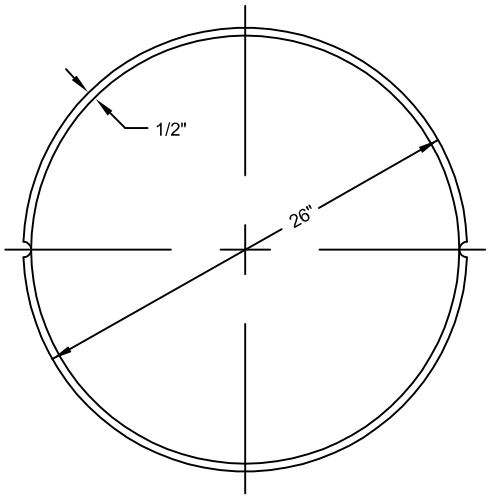



TYPE - B FRAME




DETAIL Y




STANDARD COVER

FOR COVER DETAIL, SEE DRAWING E 202.8.0

NOTES:

1. MINIMUM FRAME MASS 265 LBS.
2. MATERIAL - CAST IRON - SEE STANDARD SPECIFICATIONS WITH NO BLACK ASPHALT COATING ALLOWED

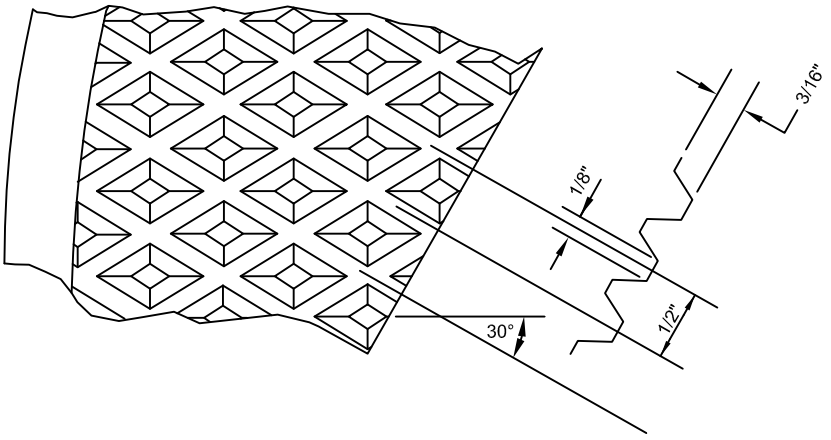
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

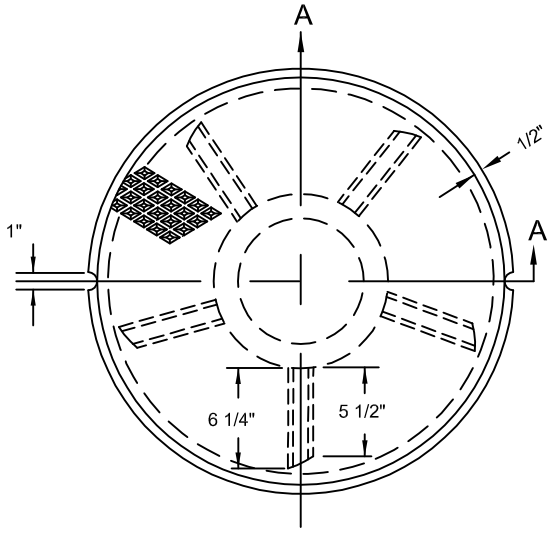
# MANHOLE FRAME AND COVER - B FRAME

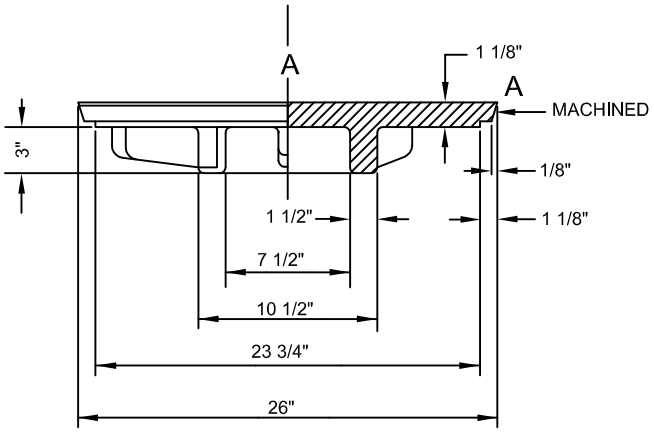
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 202.7.0**

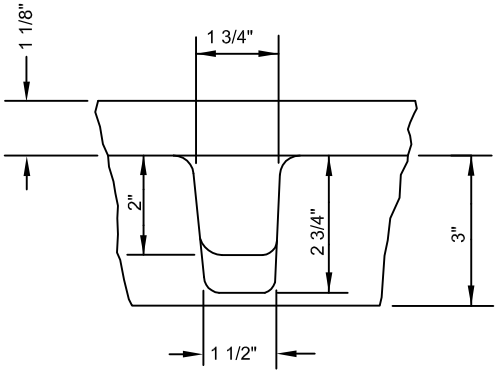



DETAIL OF TREAD




MANHOLE COVER FOR TYPE A & B FRAMES




DETAIL OF FIN

NOTES:

1. MINIMUM COVER MASS - 200 LBS.
2. MATERIAL - CAST IRON - SEE STANDARD SPECIFICATIONS WITH NO BLACK ASPHALT COATING ALLOWED

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# MANHOLE COVER DETAILS

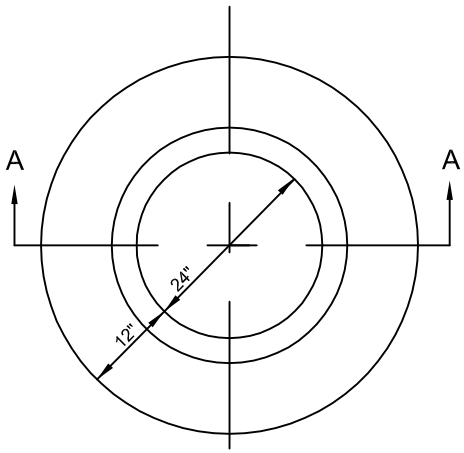
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 202.8.0**

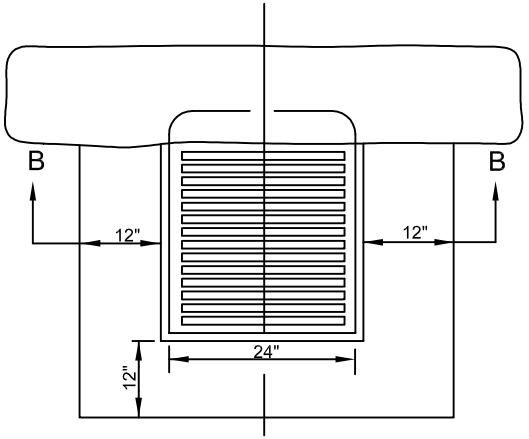
massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

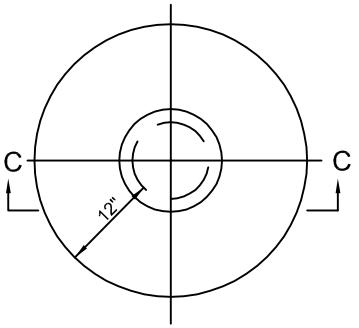
# CONCRETE COLLARS



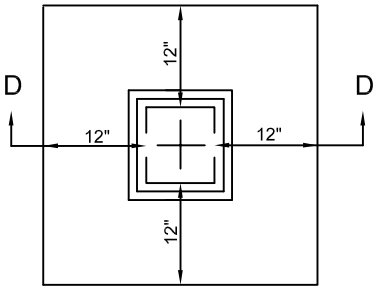

PLAN



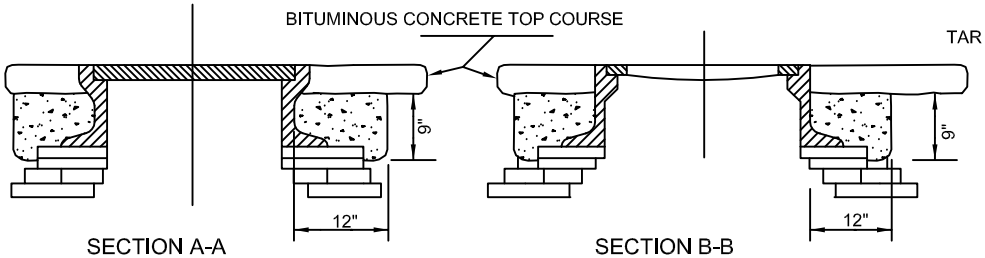

PLAN




PLAN




PLAN

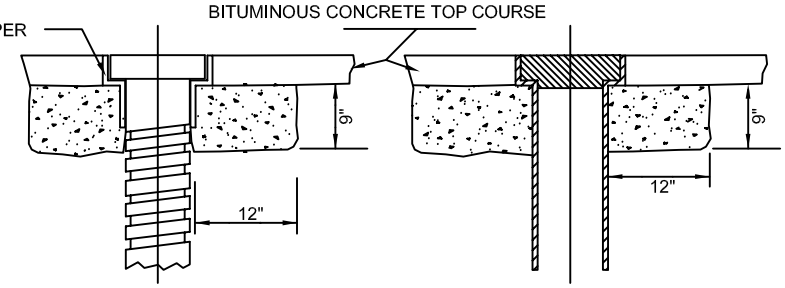



SECTION A-A

MANHOLES

SECTION B-B

CATCH BASINS




SECTION C-C

ROUND

SECTION D-D

SQUARE

WATER SERVICE BOXES

NOTES:

1. COLLARS TO BE 4000PSI CEMENT CONCRETE MASONRY REGULAR OR H.E.S. AS DIRECTED.
   (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS).
   (IF HAND MIXED, SEE LATEST STANDARD SPECIFICATIONS).
2. NO CONCRETE REQUIRED IN CONCRETE PAVEMENT.

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 202.9.0**

massDOT
Massachusetts Department of Transportation
Highway Division

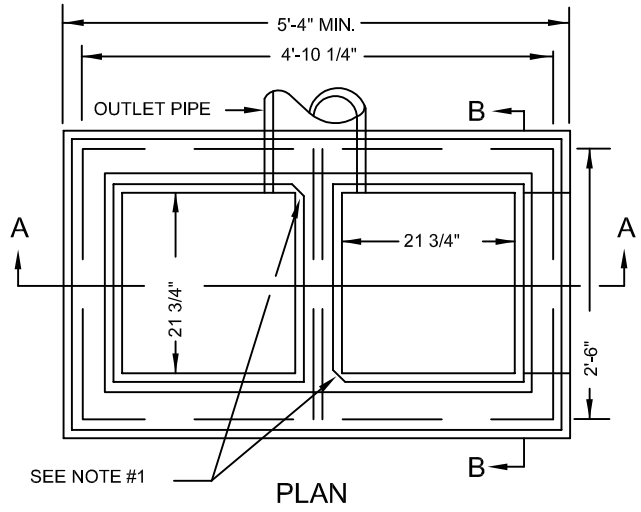
CONSTRUCTION STANDARDS

# DROP INLETS

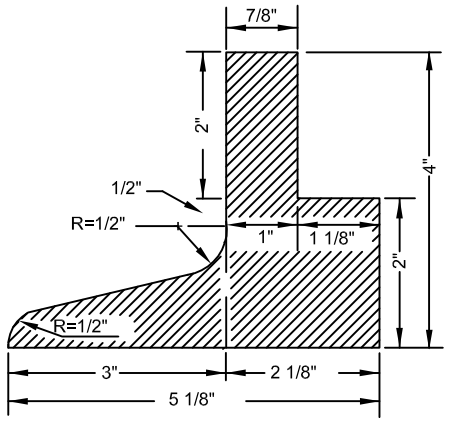
## TYPE A - PRECAST CONCRETE
## TYPE B - CONCRETE BLOCK

DATE OF ISSUE
DECEMBER 2016

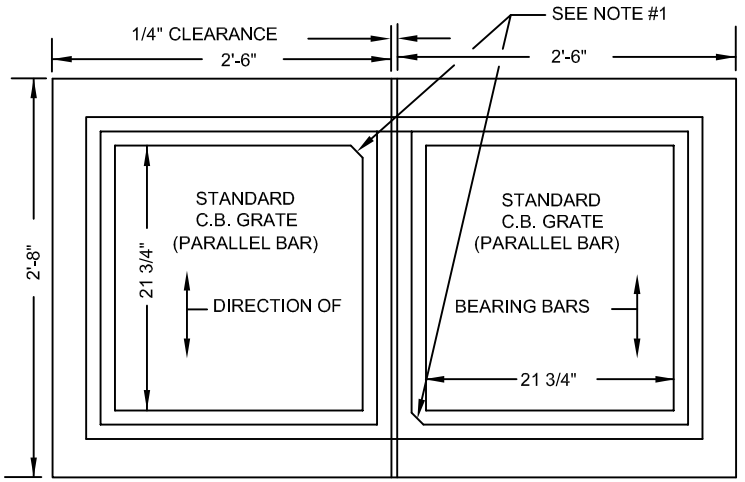
DRAWING NUMBER
**E 203.1.0**




PLAN

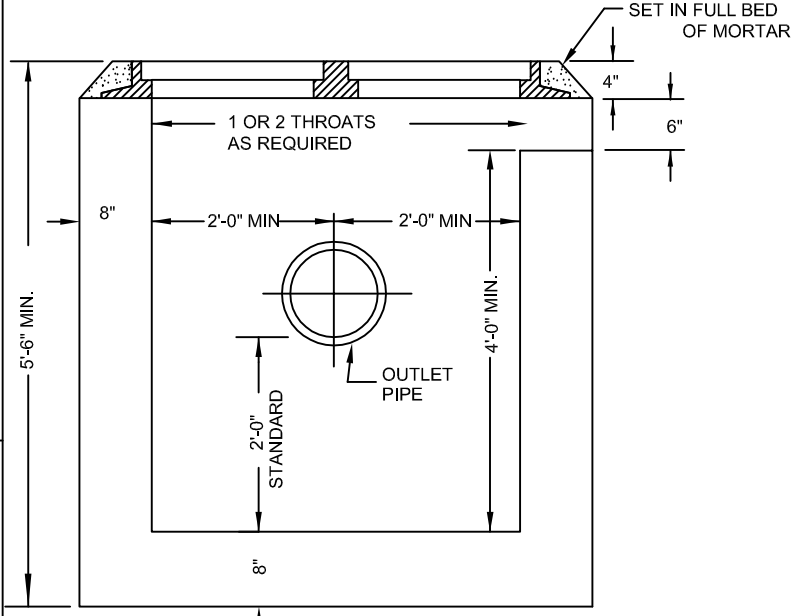



FRAME SECTIONS

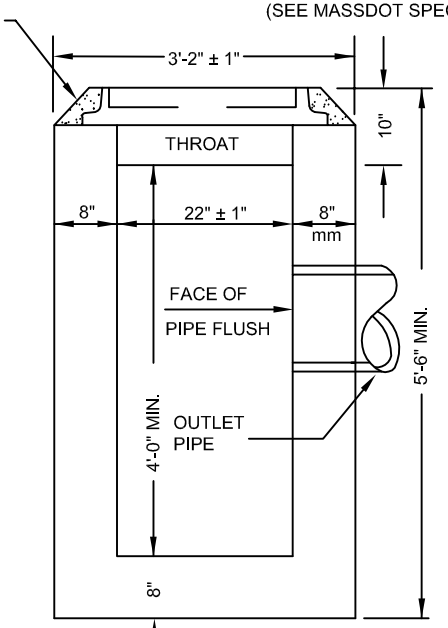



2-3 FLANGE 4" C.I. FRAMES

1. COLLARS TO BE 4000PSI CEMENT CONCRETE MASONRY REGULAR OR H.E.S. AS DIRECTED. (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS).




SECTION A-A




SECTION B-B

## NOTES:

1. STANDARD PARALLEL BAR GRATES TO BE USED. SEE DETAILS ON DRAWINGS E 201.10.0
2. MINIMUM C.I. FRAME MASS - 205 LBS. EACH
3. FOR DESCRIPTIONS, MATERIALS AND CONSTRUCTION METHODS SEE LATEST STANDARD SPECIFICATIONS

## TYPE"A"

4. 4000 PSI CEMENT CONCRETE (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS).

## TYPE"B"

5. NOMINAL CONCRETE BLOCK DIMENSIONS
   HEIGHT, 4" TO 8"
   WIDTH, 8"
   LENGTH, 8" TO 16"
6. BLOCKS TO BE SET IN FULL BED OF MORTAR
7. THIS DROP INLET IS NOT TO BE USED AT ANY LOCATION WHERE IT MAY PRESENT A HAZARD TO VEHICLES THAT RUN OFF THE ROAD. FOR FLUSH TYPE SEE DRAWING E 203.2.0

massDOT
Massachusetts Department of Transportation
Highway Division

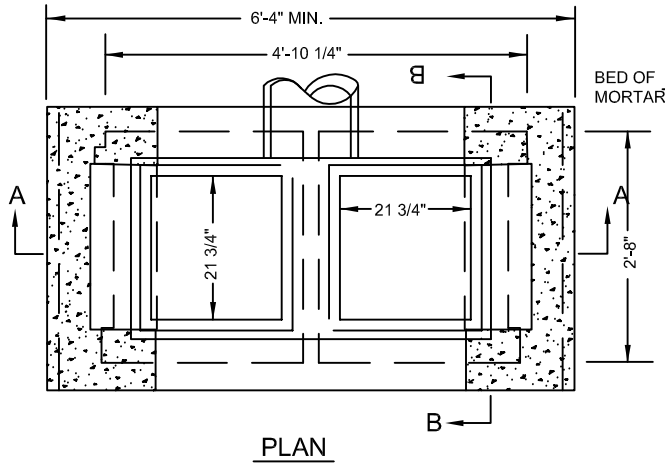
CONSTRUCTION STANDARDS

# DROP INLETS

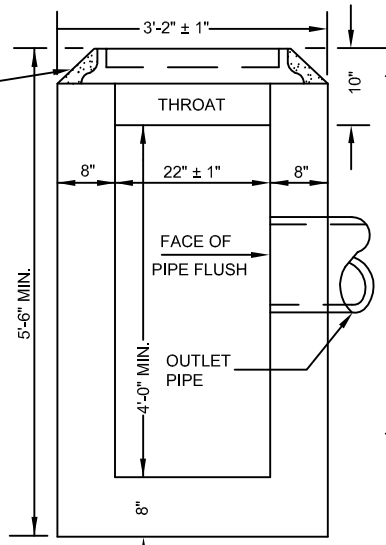
## TYPE AF - PRECAST CONCRETE
## TYPE BF - CONCRETE BLOCK

DATE OF ISSUE
DECEMBER 2016

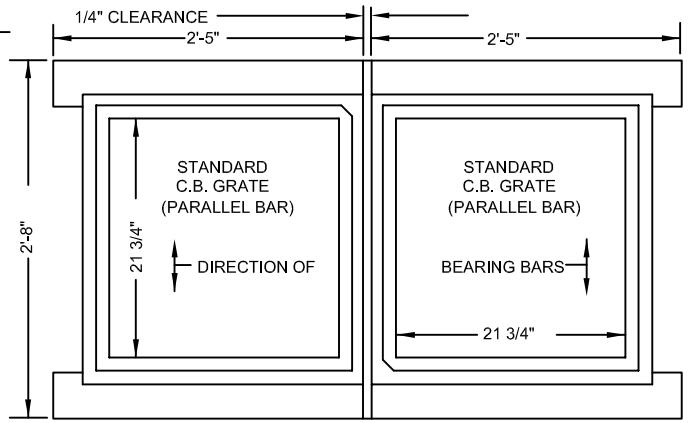
DRAWING NUMBER
**E 203.2.0**




PLAN

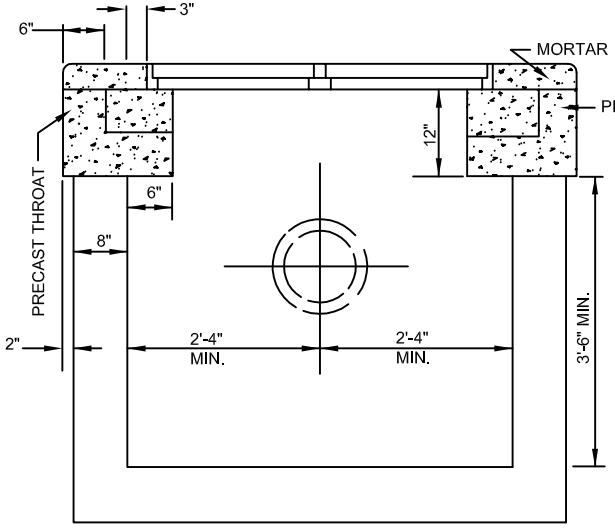



SECTION B-B

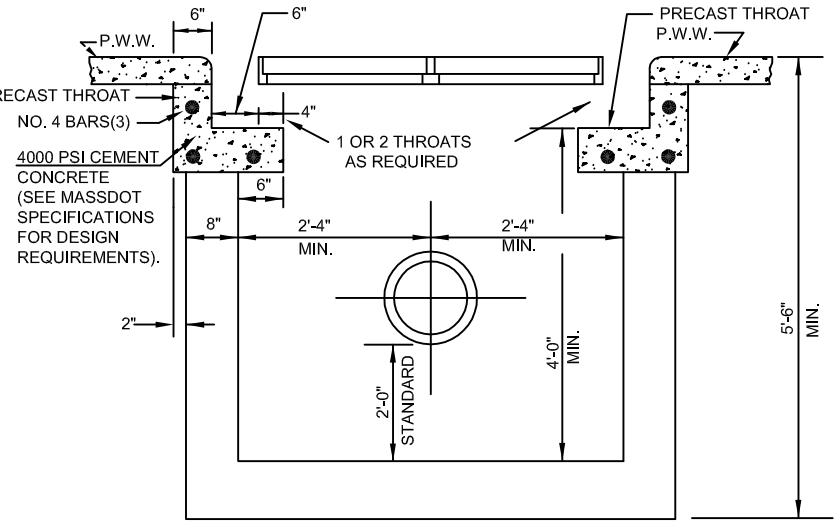



EXCESS FLANGE AREA TO BE REMOVED

2-3 FLANGE 4" C.I. FRAMES



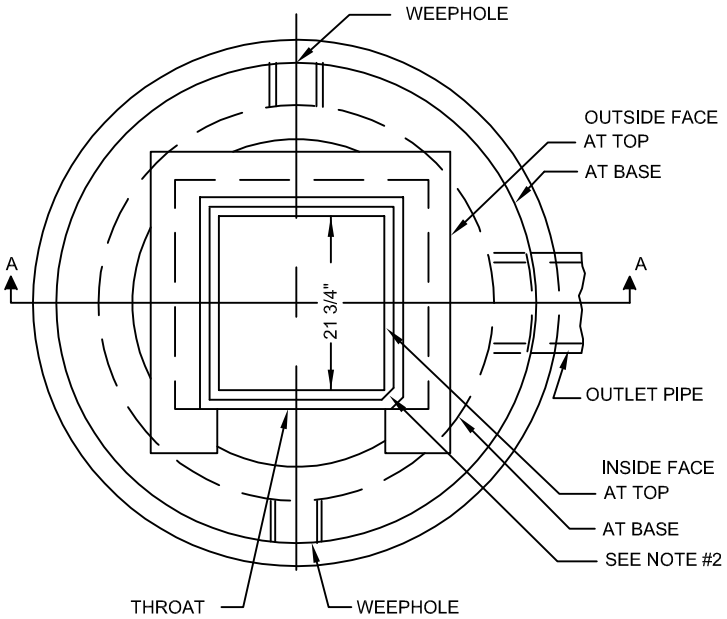

ELEVATION



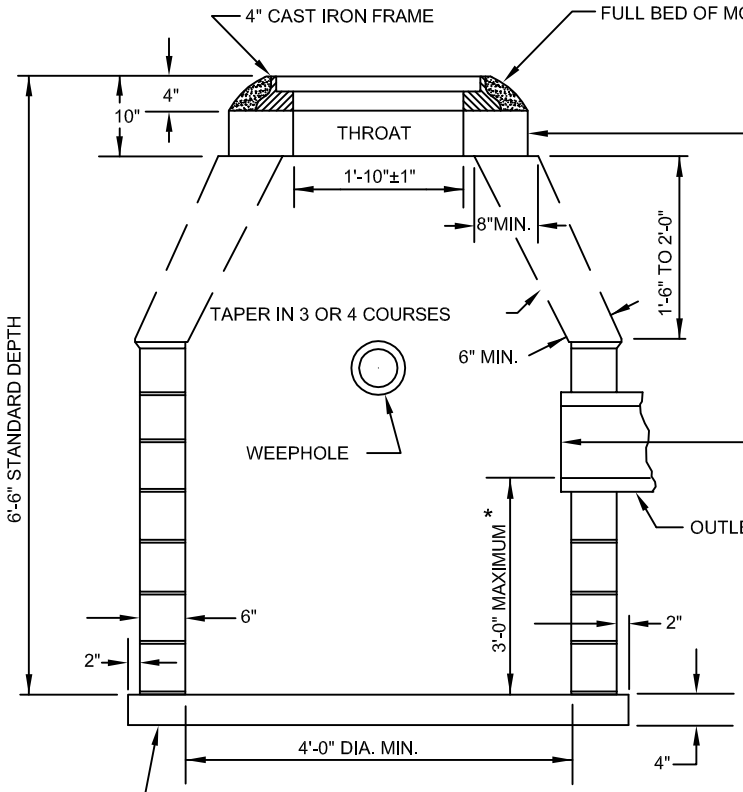

SECTION A-A

NOTES:

1. FOR DETAILS OF PRECAST THROAT SEE DRAWING E 203.7.0
2. SEE DRAWING 203.1.0 FOR DETAILS NOT SHOWN




PLAN




SECTION A-A

BRICKS MAY BE USED BETWEEN FRAME AND TOP COURSE FOR GRADE ADJUSTMENT. FRAME TO BE SET IN FULL BED OF MORTAR.

FACE OF PIPE FLUSH OR NOT TO PROJECT MORE THAN 4" FROM FACE OF WALL ALONG CENTERLINE OF PIPE.

*MIN. DEPTH TO BE 2'

4000 PSI CEMENT CONCRETE (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS) OR PRECAST CONCRETE SECTIONAL PLATES SEE DRAWING E 202.2.0

NOTES:

1. MINIMUM CAST IRON FRAME MASS - 205 LBS. SEE DETAIL ON DRAWING E 203.1.0
2. STANDARD PARALLEL BAR GRATE TO BE USED. SEE DETAILS ON DRAWINGS E 201.11.0
3. FOR DESCRIPTION, MATERIALS, AND CONSTRUCTION METHODS, SEE STANDARD SPECIFICATIONS.
4. THIS DROP INLET IS NOT TO BE USED AT ANY LOCATION WHERE IT MAY PRESENT A HAZARD TO VEHICLES THAT RUN OFF THE ROAD FOR FLUSH TYPE SEE DRAWING E 203.4.0
5. SEE DRAWING E 201.3.0 CONCRETE BLOCK CATCH BASIN FOR DETAILS

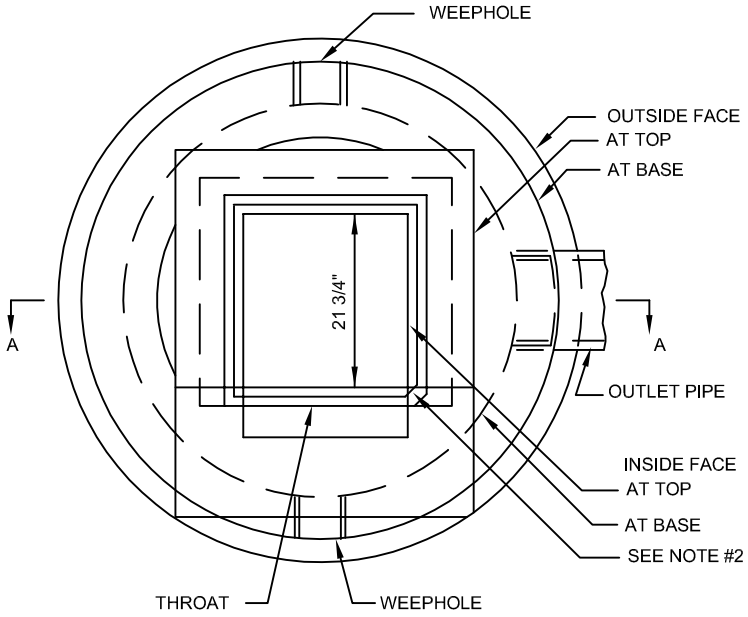
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

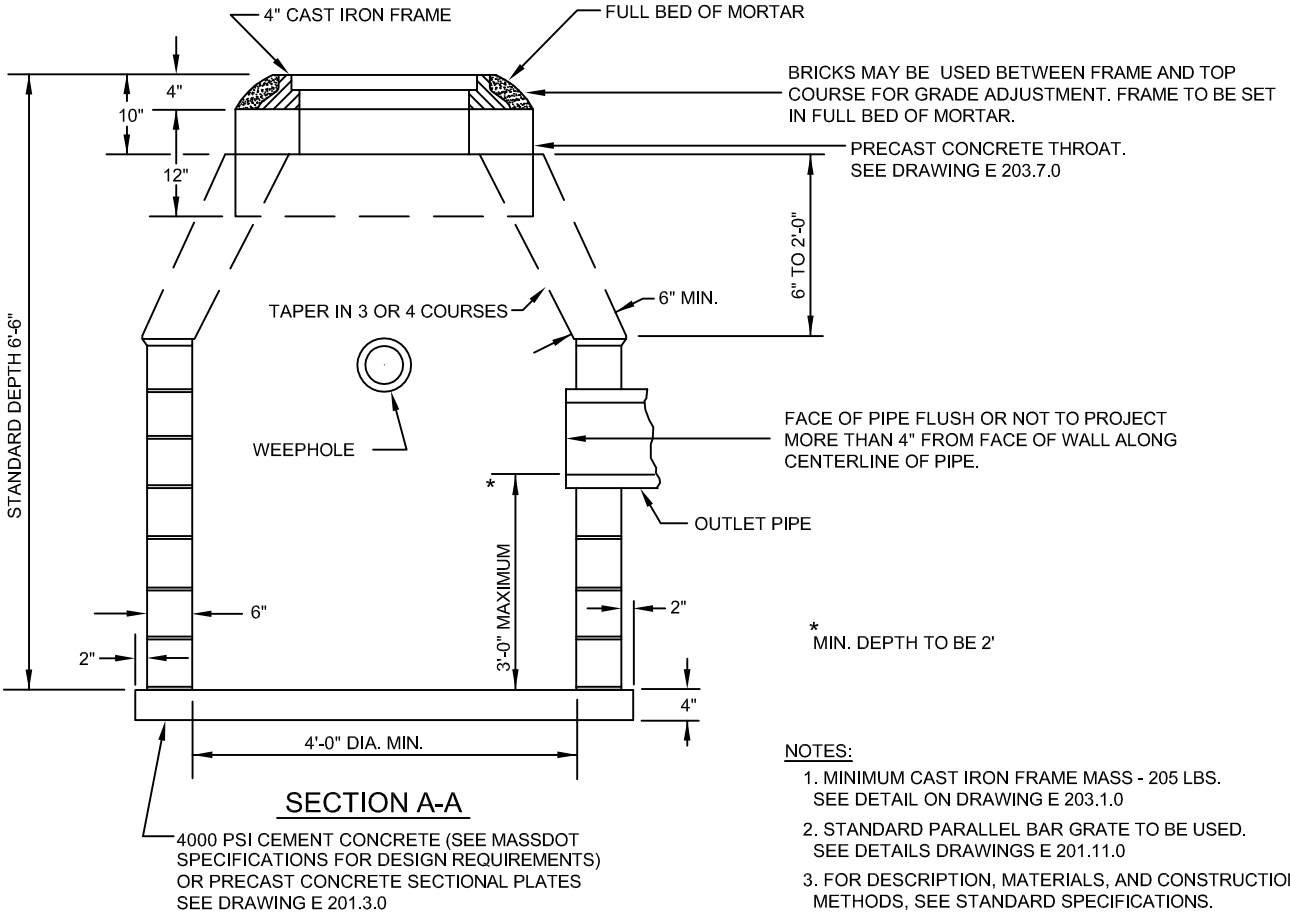
# DROP INLET TYPE C

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 203.3.0**




PLAN




SECTION A-A

4000 PSI CEMENT CONCRETE (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS) OR PRECAST CONCRETE SECTIONAL PLATES SEE DRAWING E 201.3.0

* MIN. DEPTH TO BE 2'

NOTES:

1. MINIMUM CAST IRON FRAME MASS - 205 LBS. SEE DETAIL ON DRAWING E 203.1.0
2. STANDARD PARALLEL BAR GRATE TO BE USED. SEE DETAILS DRAWINGS E 201.11.0
3. FOR DESCRIPTION, MATERIALS, AND CONSTRUCTION METHODS, SEE STANDARD SPECIFICATIONS.
4. TO BE USED IN MEDIANS AND DITCHES THAT ARE WITHIN THE RECOVERY AREA.
5. SEE DRAWING E 201.3.0 CONCRETE BLOCK CATCH BASIN FOR DETAILS

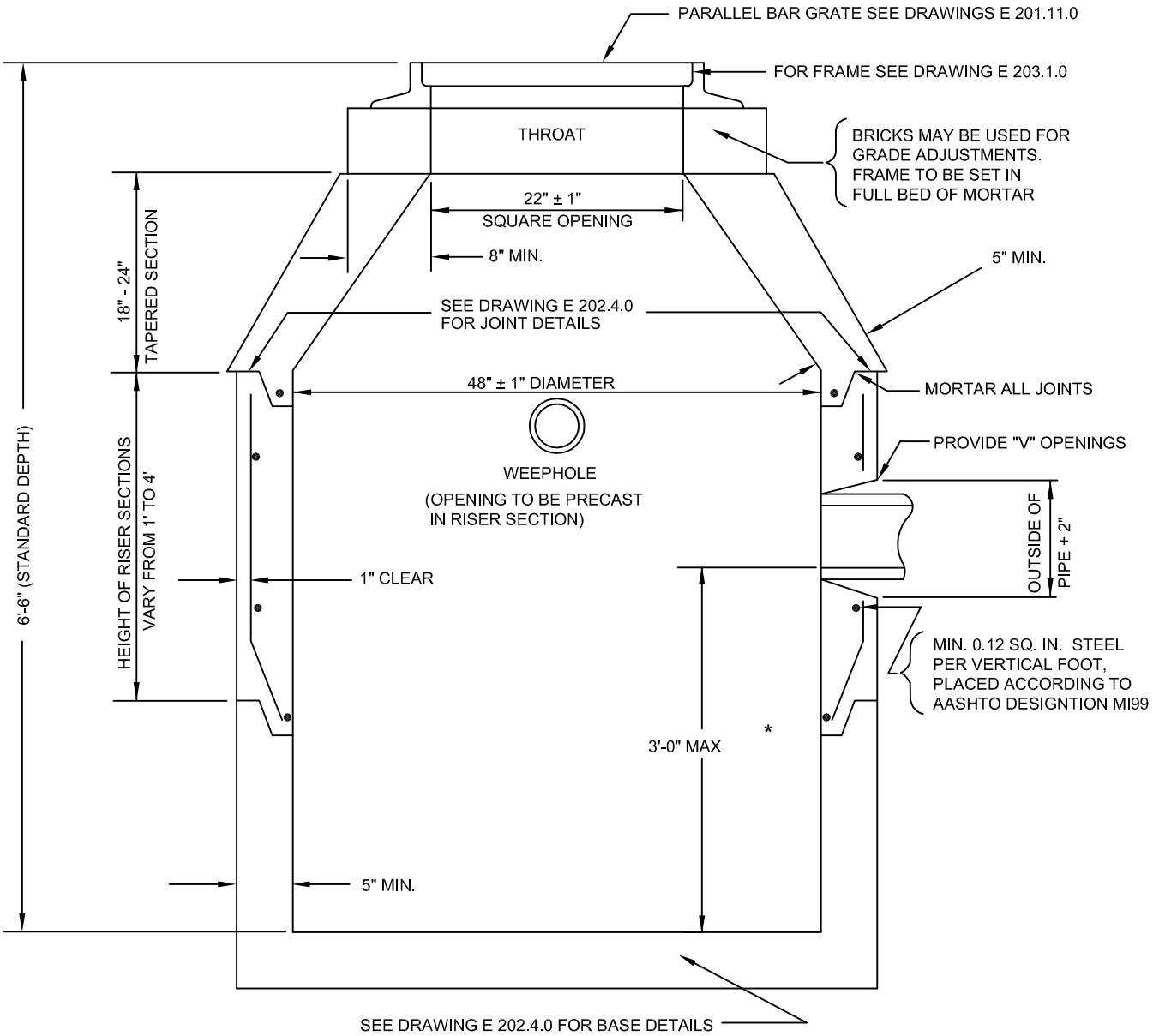
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# DROP INLET TYPE CF

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 203.4.0**




* MINIMUM DEPTH OF SUMP TO BE 2'

NOTES:

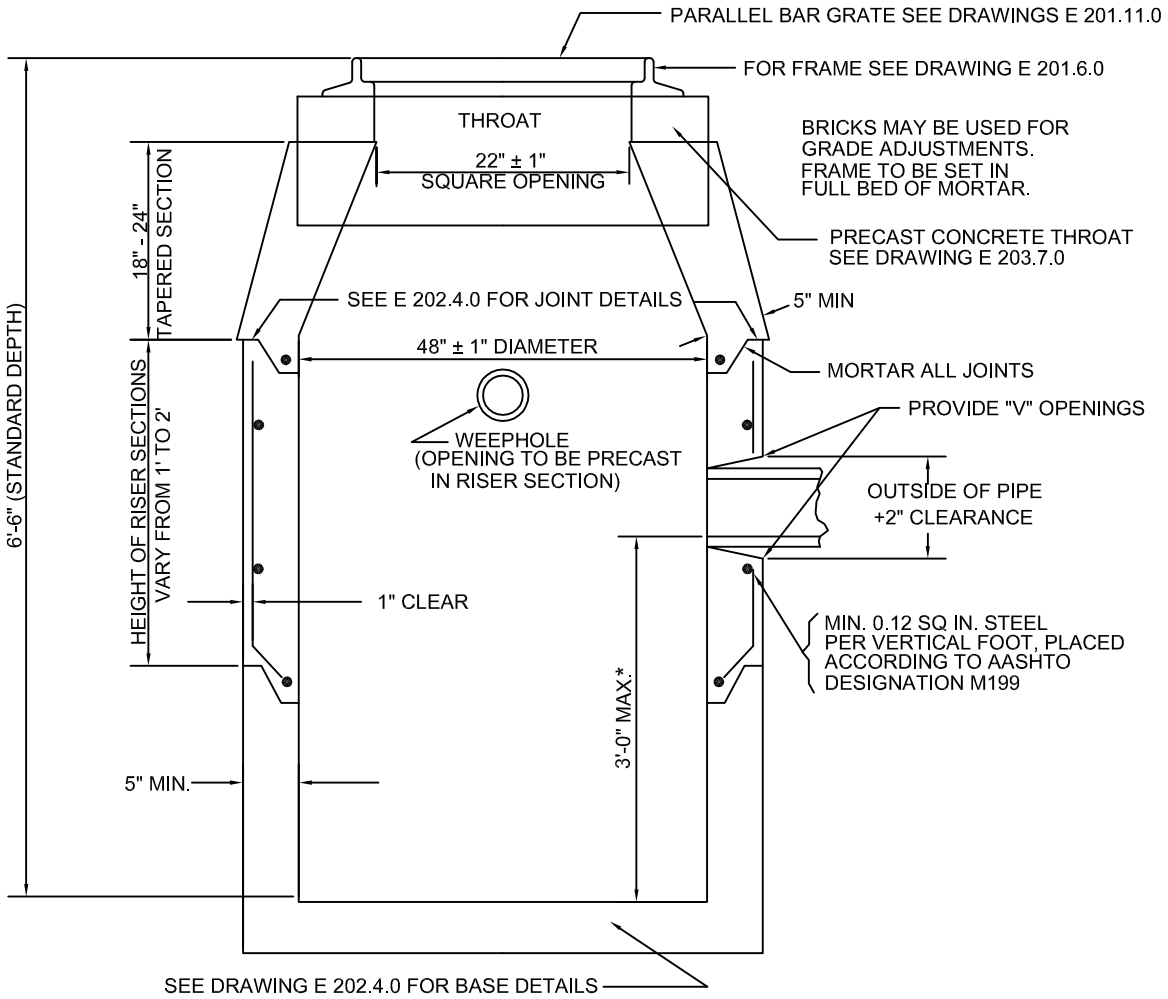
1. DETAILS NOT INDICATED ABOVE ARE TO BE SIMILAR TO THOSE SHOWN ON DRAWING E 203.3.0
2. FOR DESCRIPTIONS, MATERIALS AND CONSTRUCTION METHOD, SEE LATEST STANDARD SPECIFICATIONS
3. THIS DROP INLET IS NOT TO BE USED AT ANY LOCATION WHERE IT MAY PRESENT A HAZARD TO VEHICLES THAT RUN OFF THE ROAD. FOR FLUSH TYPE SEE DRAWING E 203.6.0

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# DROP INLET TYPE D

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 203.5.0**




*MINIMUM DEPTH OF SUMP TO BE 2'

NOTES:

1. DETAILS NOT INDICATED ABOVE ARE TO BE SIMILAR TO THOSE SHOWN ON DRAWINGS E 203.3.0 AND E 203.4.0
2. FOR DESCRIPTIONS, MATERIALS AND CONSTRUCTION METHOD, SEE LATEST STANDARD SPEFICATIONS
3. TO BE USED IN MEDIANS AND DITCHES THAT ARE WITHIN THE RECOVERY AREA

CONSTRUCTION STANDARDS

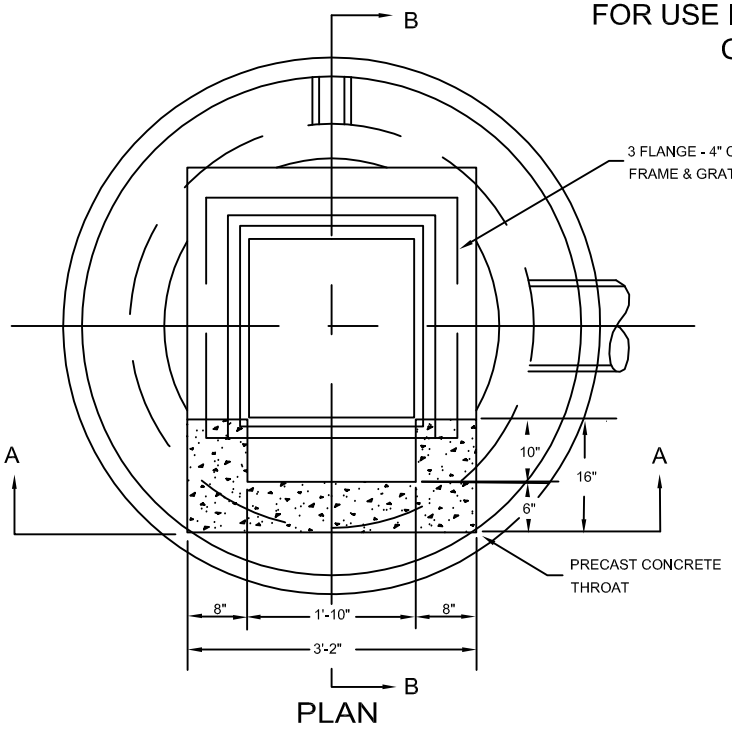
massDOT Massachusetts Department of Transportation Highway Division

# FLUSH DROP INLET THROAT

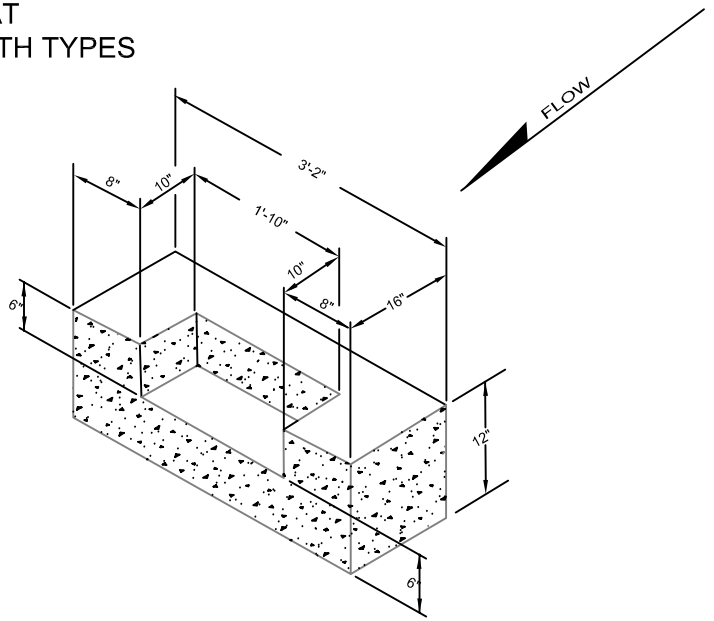
DRAWING NUMBER
**E 203.7.0**

DATE OF ISSUE
DECEMBER 2016

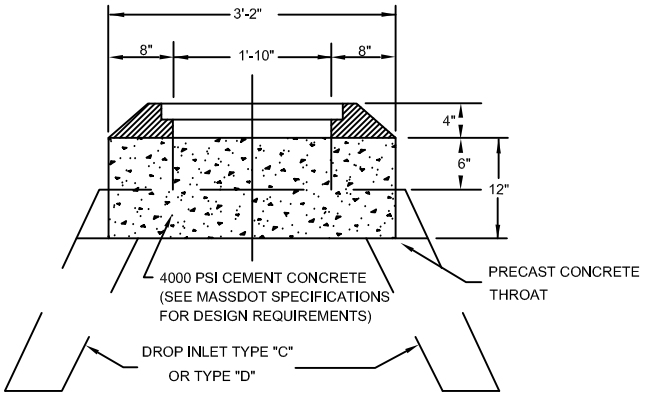
## PRECAST CONCRETE THROAT FOR USE IN MEDIANS & DITCHES WITH TYPES CF AND DF DROP INLETS



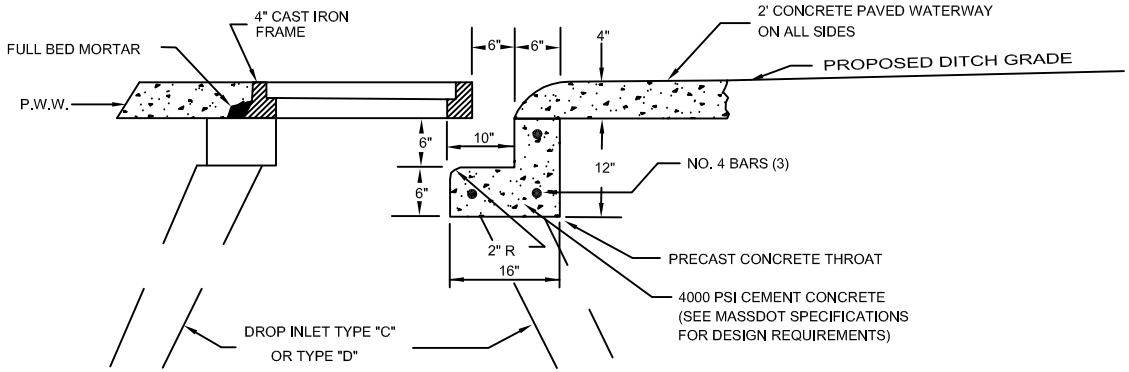

PLAN




ISOMETRIC OF PRECAST CONCRETE THROAT OPENING




SECTION A-A

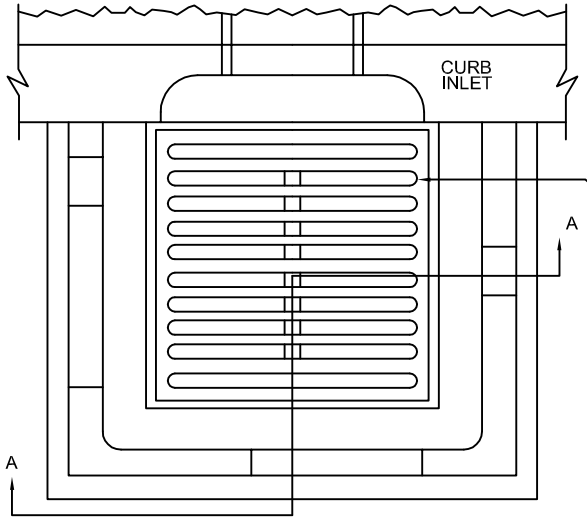



SECTION B-B

CONSTRUCTION STANDARDS

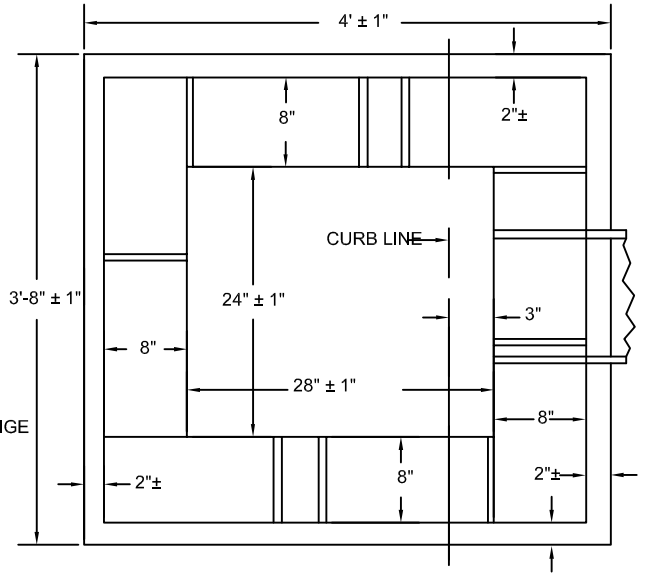
massDOT Massachusetts Department of Transportation Highway Division

# GUTTER INLET

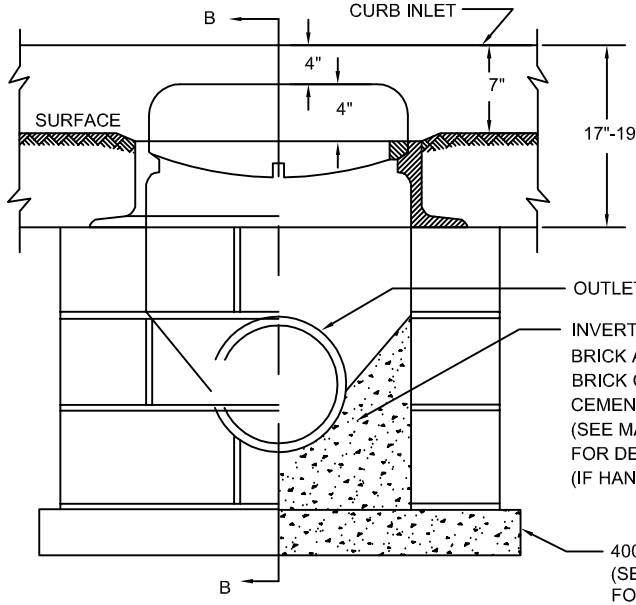



NOTES:

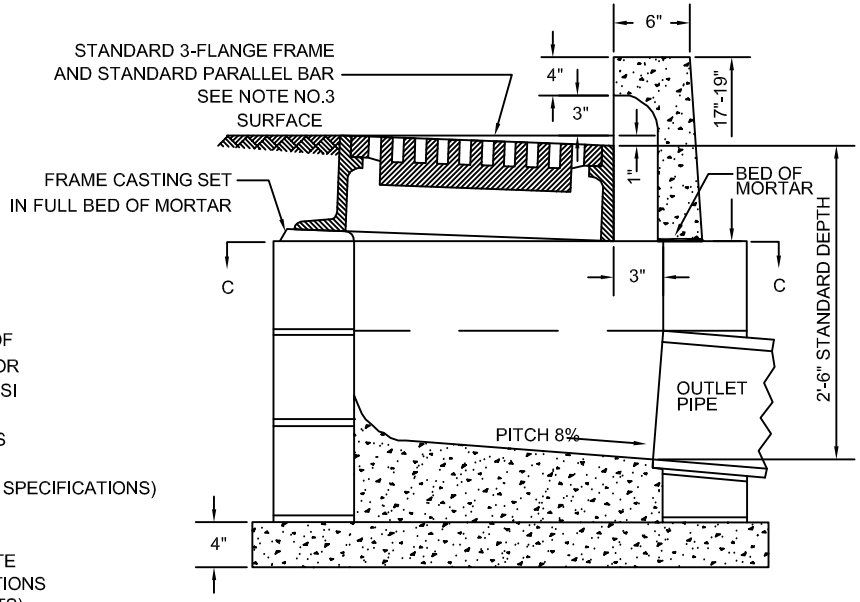
1. WHERE CURB INLET IS NOT USED THE INSIDE HORIZONTAL DIMENSIONS OF GUTTER INLET TO BE 24"±1" X 24"±1" IN WHICH CASE AND UNLESS OTHERWISE DIRECTED, A STANDARD 4-FLANGE FRAME IS TO BE USED.
2. BRICKS MAY BE USED BETWEEN TOP COURSE AND FRAME FOR GRADE ADJUSTMENT.
3. A CASCADE GRATE IS TO BE USED WHERE BICYCLE TRAVEL IS ALLOWED.
4. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHODS, SEE STANDARD SPECIFICATIONS.




SECTION C-C



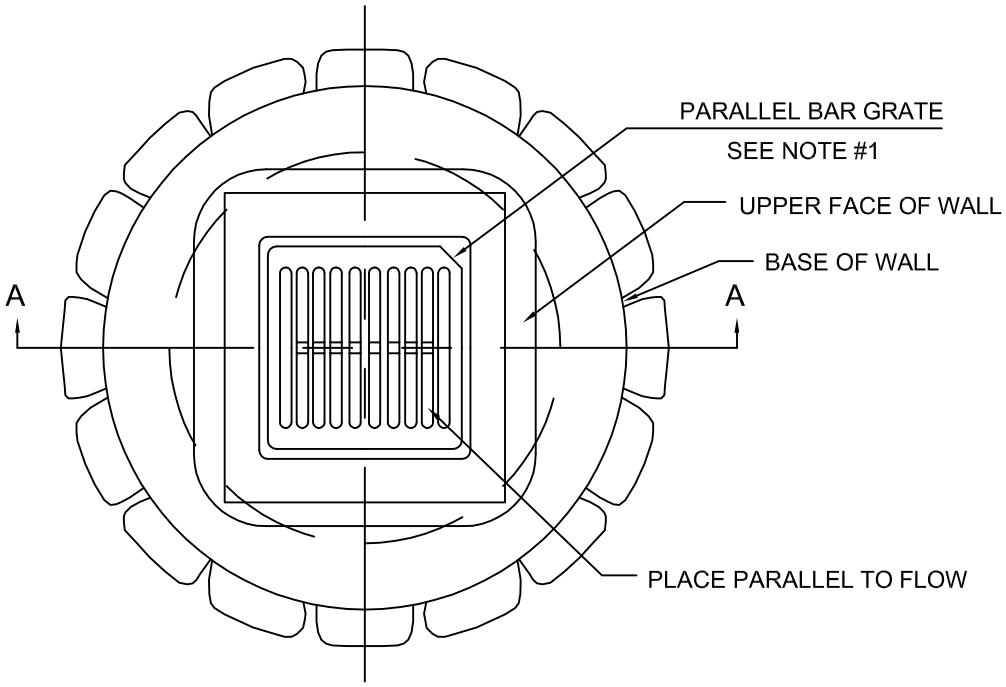

SECTION A-A




SECTION B-B

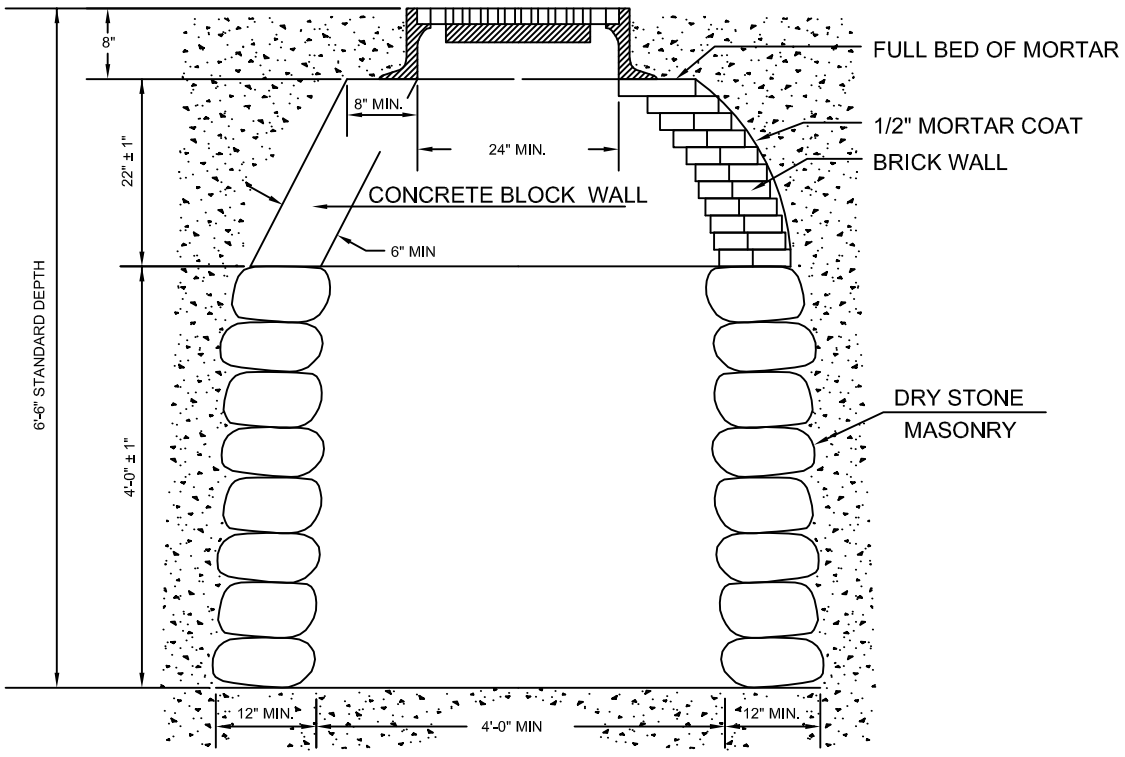
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 204.2.0**




NOTES:

1. USE CASCADE GRATE WHERE BICYCLE TRAVEL IS LEGALLY ALLOWED. SEE DRAWINGS E 201.7.0 - E 201.9.0
2. BRICK WALL TO BE 8" THICK; EVERY FIFTH COURSE TO BE HEADERS; OUTSIDE TO BE FINISHED WITH CEMENT MORTAR COATING.
3. WHEN USING CONCRETE BLOCKS, BLOCKS TO BE SET IN FULL BED OF MORTAR AND TAPERED IN 3 OR 4 COURSES.
4. BACKFILL FOR FULL DEPTH OF BASIN EXCAVATION TO BE GRAVEL.
5. FOR DESCRIPTION, MATERIALS AND METHOD OF CONSTRUCTION SEE STANDARD SPECIFICATIONS.




SECTION A-A

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# DRY STONE MASONRY LEACHING BASIN

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 205.1.0**

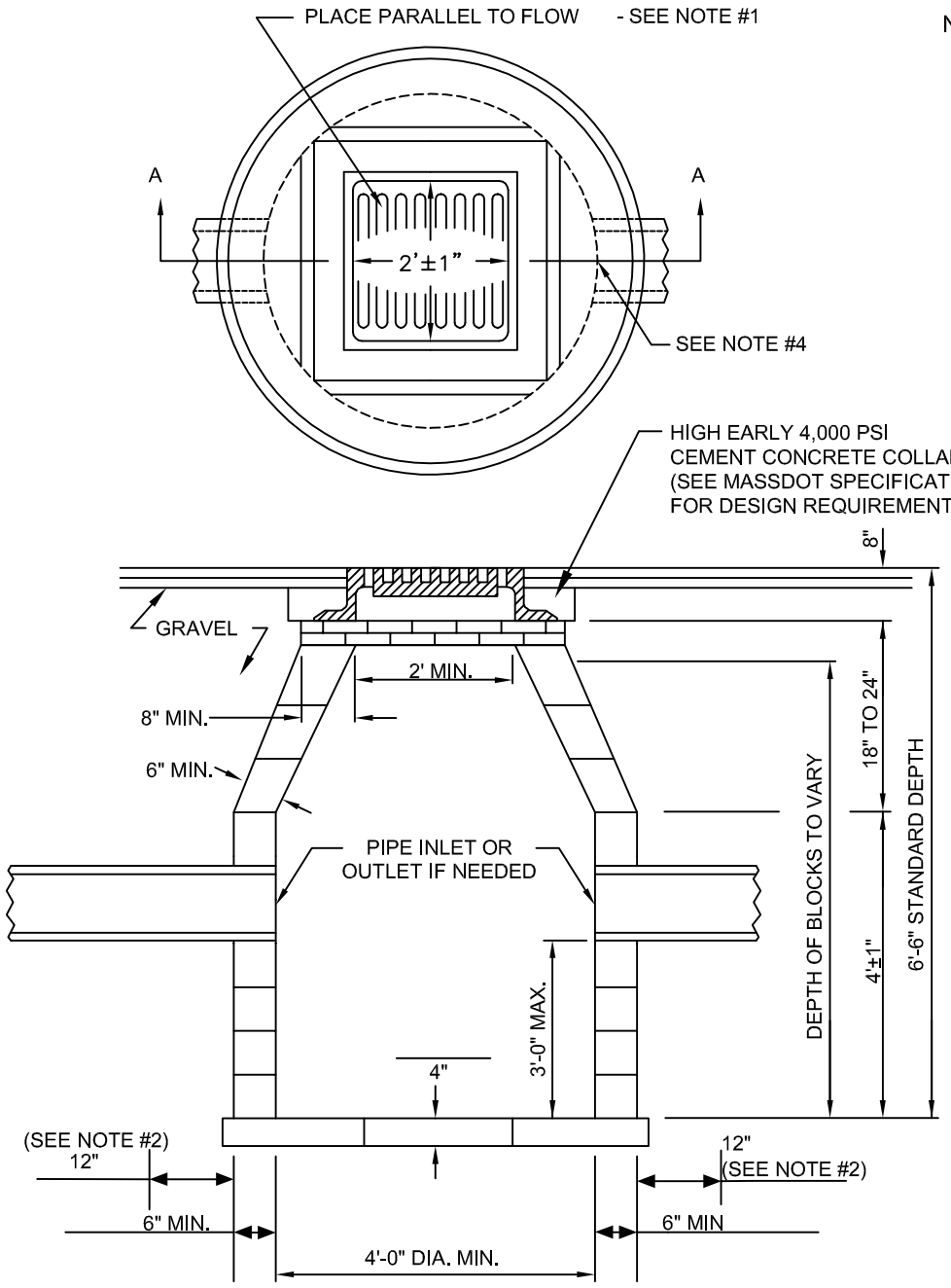
massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# CONCRETE BLOCK LEACHING BASIN

DRAWING NUMBER
**E 205.2.0**

DATE OF ISSUE
DECEMBER 2016

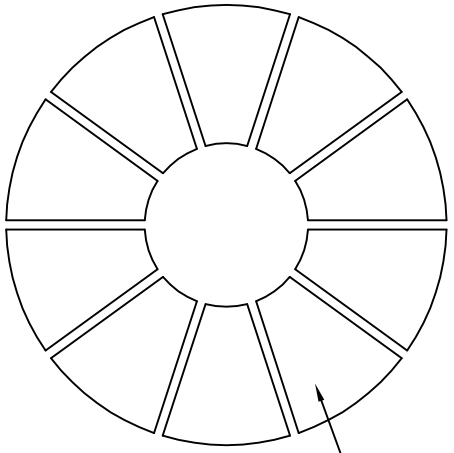



SECTION A-A

NOTES:

1. **USE CASCADE GRATE WHERE BICYCLE TRAVEL IS LEGALLY ALLOWED. SEE DRAWINGS E 201.7.0 - E 201.9.0.**
2. BACKFILL FOR FULL DEPTH OF BASIN EXCAVATION TO BE 1/2" CRUSHED STONE.
3. FOR DESCRIPTION, MATERIALS, AND METHOD OF CONSTRUCTION SEE STANDARD SPECIFICATIONS.
4. FACE OF PIPE FLUSH OR NOT TO PROJECT MORE THAN 4" FROM FACE OF WALL ALONG CENTERLINE OF PIPE.
5. THE LEACHING BASIN SHALL BE CONSTRUCTED OF CEMENT CONCRETE BLOCKS TO CONFORM TO THE REQUIREMENTS OF STANDARD SPECIFICATION SUBSECTION M4.05.1.

PLAN OF BASE



BOTTOM PLATES REQUIRE
10 PIECES PER CIRCLE WITH
1/2" SPACING BETWEEN PLATES.
4" THICK

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# CORRUGATED STEEL METAL PIPE

## TABLE OF MINIMUM WALL THICKNESS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 206.1.0**

TABLE OF MINIMUM WALL THICKNESS (FT)

(2 2/3" x 1/2" CORRUGATION)

| DIA. (IN) | HEIGHT OF COVER ABOVE TOP OF PIPE (FEET) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MIN. - 10 | 11 - 15 | 16 - 20 | 21 - 25 | 26 - 30 | 31 - 35 | 38 - 40 | 41 - 45 | 46 - 50 | 51 - 55 | 56 - 60 |
| 15 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | | | |
| 18 | 16 | 16 | 16 | 16 | 16 | 16 | 14 | 14 | 14 | | |
| 21 | 16 | 16 | 16 | 16 | 16 | 16 | 14 | 14 | 14 | 12 | |
| 24 | 16 | 16 | 16 | 14 | 14 | 14 | 14 | 12 | 12 | 10 | 10 |
| 30 | 14 | 14 | 14 | 14 | 12 | 12 | 12 | 10 | 10 | 10 | 8 |
| 36 | 14 | 14 | 12 | 12 | 10 | 10 | 10 | 10 | 8 | 8 | 8 |
| 42 | 12 | 12 | 12 | 10 | 10 | 10 | 8 | 8 | 8 | 8 | 8 |
| 48 | 12 | 12 | 12 | 10 | 8 | 8 | 10 | 10 | 10 | 8 | 8 |
| 54 | 10 | 10 | 8 | 8 | 10 | 10 | 10 | 8 | 8 | | |
| 60 | 8 | 10 | 10 | 10 | 8 | 8 | 8 | 8 | | | |
| 66 | 10 | 10 | 10 | 8 | 8 | 8 | 8 | | | | |
| 72 | 8 | 8 | 8 | 8 | 8 | | | | | | |

NOTES:
1. ALL PIPE BELOW SOLID LINE TO BE SHOP STRUTTED AS PER STATE SPECIFICATIONS
2. MINIMUM COVER IS TOP OF PIPE TO ROAD - 18" GRADE

CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

# CORRUGATED STEEL METAL PIPE ARCH - TABLE OF MINIMUM WALL THICKNESS

## TABLE OF MINIMUM WALL THICKNESS (IN.)

| MADE FROM PIPE OF DIA. (IN.) | SPAN (IN.) | RISE (IN.) | HEIGHT OF COVER ABOVE TOP OF PIPE ARCH (FEET) | | | |
|---|---|---|---|---|---|---|
| | | | MIN. - 3 | 4 - 5 | 6 - 10 | 11 - 15 |
| 15 | 18 | 11 | 16 | 16 | 16 | 16 |
| 18 | 22 | 13 | 16 | 16 | 16 | 16 |
| 24 | 29 | 18 | 14 | 14 | 14 | 14 |
| 30 | 36 | 22 | 14 | 14 | 14 | 14 |
| 36 | 43 | 27 | 12 | 12 | 12 | 12 |
| 42 | 50 | 31 | 12 | 12 | 12 | 12 |
| 48 | 58 | 36 | 10 | 12 | 12 | 10 |
| 54 | 65 | 40 | 10 | 10 | 10 | 8 |
| 60 | 72 | 44 | 8 | 8 | 8 | |

NOTES:

1. MINIMUM COVER IS TOP OF PIPE TO ROAD GRADE - 18"
2. FOR HEAVIER FILLS USE STRUCTURAL PLATE

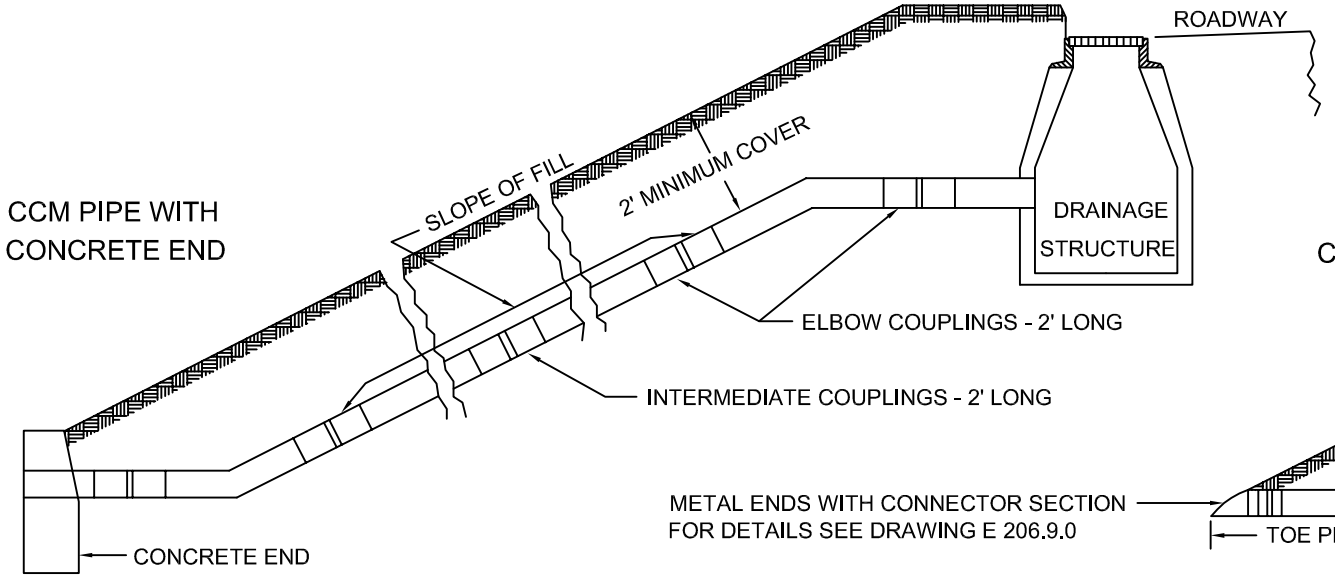
DATE OF ISSUE
DECEMBER 2016

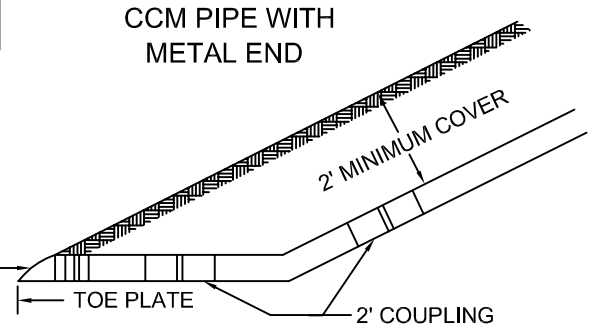
DRAWING NUMBER
**E 206.2.0**

CONSTRUCTION STANDARDS

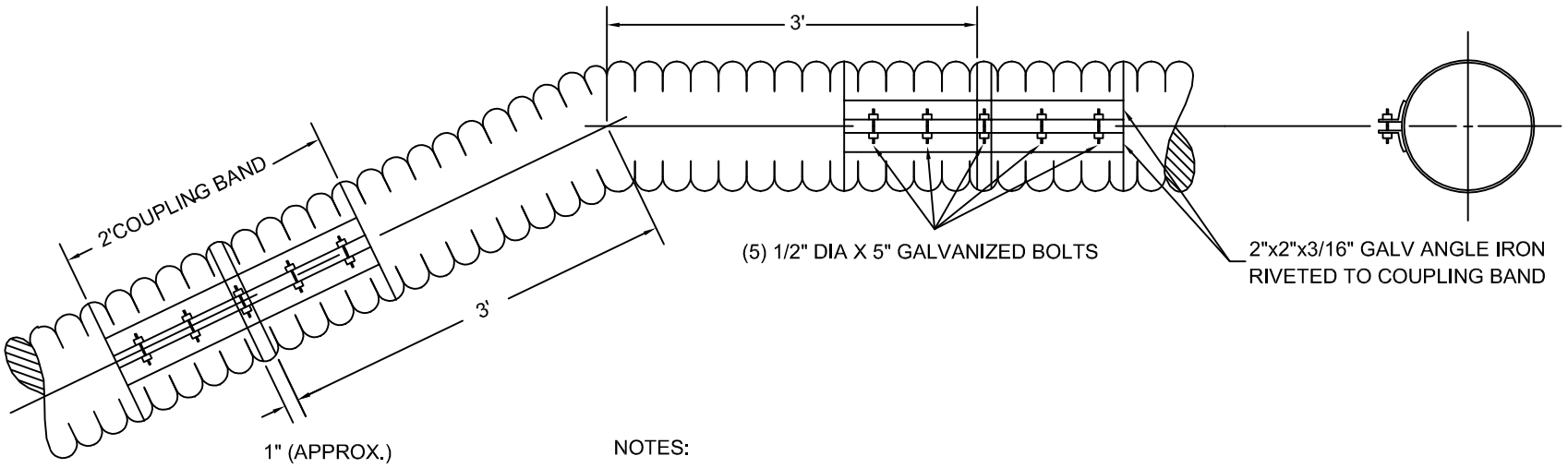
MassDOT Massachusetts Department of Transportation Highway Division

# CORRUGATED METAL PIPE UNDER FILL SLOPES




## ELBOW AND COUPLING DETAILS




NOTES:

1. A TOE PLATE IS REQUIRED FOR ALL METAL ENDS.
2. ALL METAL END UNITS AND ELBOWS TO BE SHOP FABRICATED.

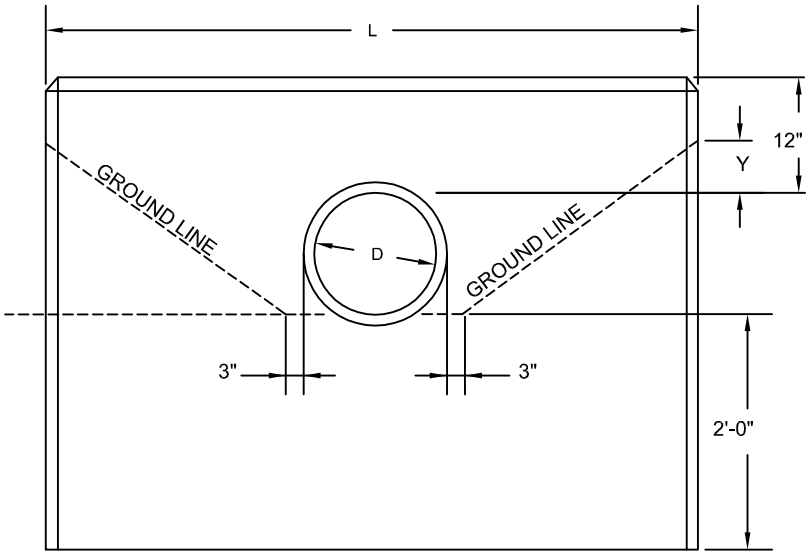
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 206.3.0**

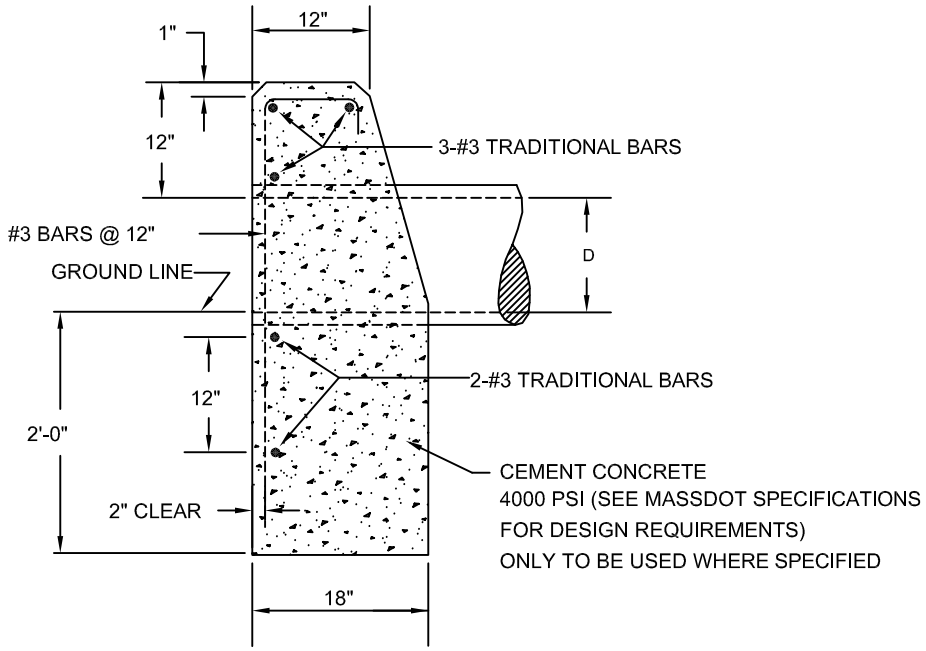
massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

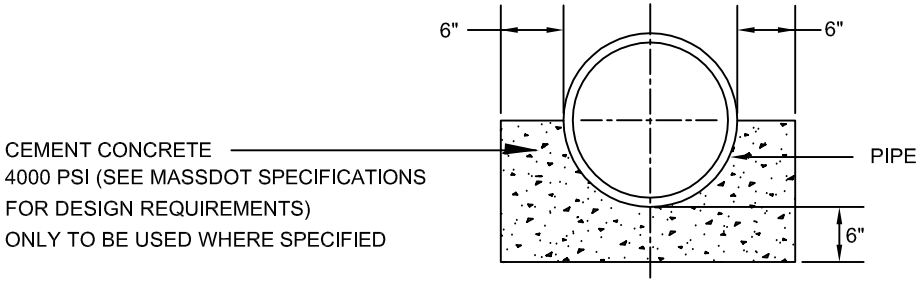
# CONCRETE AND FIELD STONE MASONRY PIPE ENDS FOR 8" TO 30" PIPE



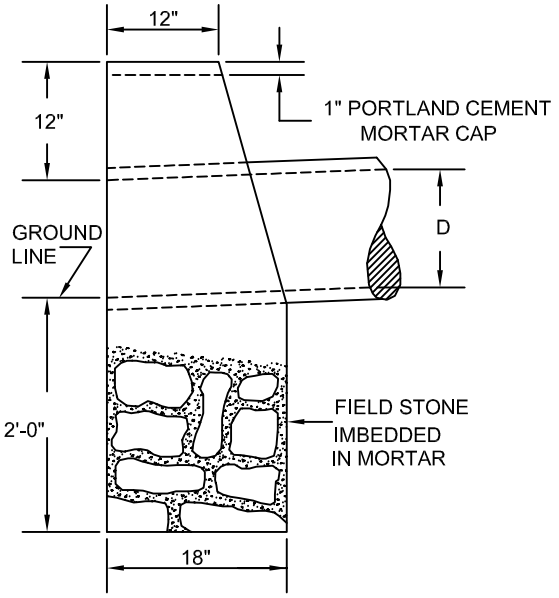

FRONT ELEVATION




END ELEVATION




CONCRETE CRADLE
FOR PIPE CULVERTS




END ELEVATION

NOTES:

1. FOR DESCRIPTIONS, MATERIALS AND CONSTRUCTION METHODS, SEE LATEST STANDARD SPECIFICATIONS.
2. ALL CONCRETE DIMENSIONS SHOWN ARE MINIMUM.
3. PAYMENTS WILL BE BASED ON THE ACCOMPANYING TABLE.
4. FOR QUANTITY TABLES SEE E 206.4.1

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 206.4.0**

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# QUANTITY TABLES FOR CONCRETE AND FIELD STONE MASONRY PIPE ENDS

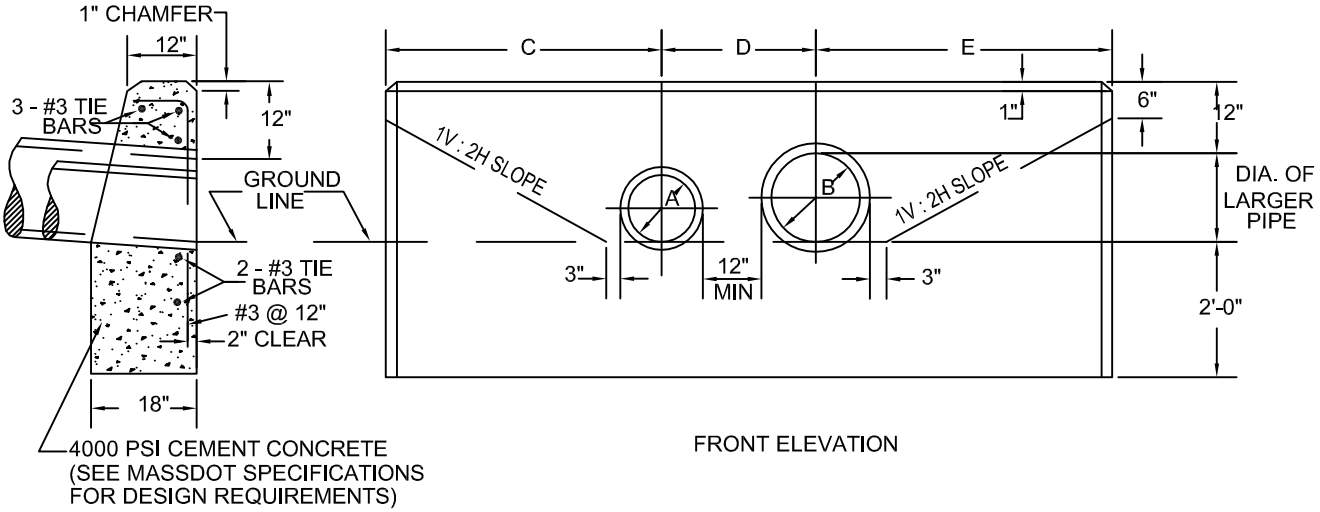
DATE OF ISSUE DECEMBER 2016

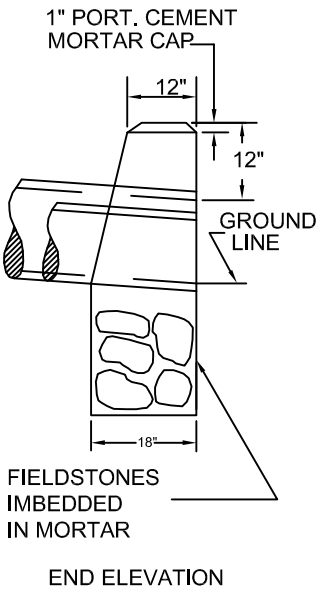
DRAWING NUMBER **E 206.4.1**

## ENGLISH UNITS

| PIPE DIAM. D | 1 1/2 : 1 SLOPE | | | | 2 : 1 SLOPE | | | |
|---|---|---|---|---|---|---|---|---|
| | L | CONC. OR F.S.M. CU. YDS. | STEEL LBS. | TRENCH EXCAV. 1'-0" DEPTH CU. FT. | L | CONC. OR F.S.M. CU. YDS. | STEEL LBS. | TRENCH EXCAV. 1'-0" DEPTH CU. FT. |
| 8" | 4'-2" | 0.77 | 15 | 21.60 | 5'-10" | 1.08 | 21 | 27.40 |
| 10" | 4'-10" | 0.92 | 20 | 23.91 | 6'-8" | 1.28 | 23 | 30.35 |
| 12" | 5'-6" | 1.08 | 21 | 26.25 | 7'-6" | 1.49 | 29 | 33.25 |
| 15" | 6'-6" | 1.34 | 24 | 29.75 | 8'-9" | 1.82 | 32 | 37.63 |
| 18" | 7'-6" | 1.61 | 30 | 33.25 | 10'-0" | 2.18 | 39 | 42.00 |
| 21" | 8'-6" | 1.95 | 34 | 37.35 | 11'-6" | 2.62 | 43 | 47.25 |
| 24" | 9'-3" | 2.16 | 35 | 39.38 | 12'-6" | 2.97 | 50 | 50.75 |
| 30" | 10'-6" | 2.63 | 44 | 43.75 | 15'-0" | 3.86 | 62 | 59.50 |

| | | |
|---|---|---|
| | Y | 4" FOR 1 1/2 : 1 SLOPE |
| | | 6" FOR 2 : 1 SLOPE |




| DESIGN NO. | DIAMETER (IN.) | | LENGTHS | | | MASONRY (CY) | STEEL (LBS) | TRENCH EXCAV. 1'-0" DEPTH (CF) |
|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | | | |
| 1 | 12 | 12 | 3'-9" | 2'-2" | 3'-9" | 1.89 | 37 | 40.85 |
| 2 | 12 | 15 | 4'-3" | 2'-4" | 4'-5" | 2.27 | 42 | 45.50 |
| 3 | 12 | 18 | 4'-9" | 2'-6" | 5'-0" | 2.66 | 48 | 49.88 |
| 4 | 12 | 21 | 5'-4" | 2'-8" | 5'-8" | 3.12 | 54 | 54.85 |
| 5 | 12 | 24 | 5'-9" | 2'-10" | 6'-3" | 3.54 | 59 | 58.91 |
| 6 | 12 | 30 | 6'-9" | 3'-0" | 7'-6" | 4.48 | 71 | 67.38 |
| 7 | 15 | 15 | 4'-5" | 2'-6" | 4'-5" | 2.32 | 41 | 46.66 |
| 8 | 15 | 18 | 4'-11" | 2'-8" | 5'-0" | 2.72 | 48 | 51.03 |
| 9 | 15 | 21 | 5'-5" | 2'-10" | 5'-8" | 3.16 | 54 | 55.72 |
| 10 | 15 | 24 | 5'-11" | 3'-0" | 6'-3" | 3.60 | 60 | 60.10 |
| 11 | 15 | 30 | 6'-11" | 3'-2" | 7'-6" | 4.54 | 72 | 68.53 |
| 12 | 18 | 18 | 5'-0" | 2'-8" | 5'-0" | 2.72 | 48 | 51.35 |
| 13 | 18 | 21 | 5'-7" | 2'-10" | 5'-8" | 3.17 | 52 | 56.28 |
| 14 | 18 | 24 | 6'-0" | 3'-0" | 6'-3" | 3.58 | 60 | 60.38 |
| 15 | 18 | 30 | 7'-0" | 3'-2" | 7'-6" | 4.53 | 72 | 68.85 |
| 16 | 21 | 21 | 5'-8" | 3'-0" | 5'-8" | 3.20 | 53 | 57.19 |
| 17 | 21 | 24 | 6'-2" | 3'-4" | 6'-3" | 3.69 | 61 | 62.13 |
| 18 | 21 | 30 | 7'-2" | 3'-6" | 7'-6" | 4.65 | 73 | 70.60 |
| 19 | 24 | 24 | 6'-3" | 3'-4" | 6'-3" | 3.67 | 61 | 62.40 |
| 20 | 24 | 30 | 7'-3" | 3'-8" | 7'-6" | 4.69 | 74 | 64.47 |
| 21 | 30 | 30 | 7'-6" | 4'-0" | 7'-6" | 4.76 | 75 | 73.50 |

NOTE:

1. FOR DESCRIPTIONS, MATERIALS AND CONSTRUCTION METHODS, SEE STANDARD SPECIFICATIONS.
2. ALL CONCRETE DIMENSIONS SHOWN ARE MINIMUM.
3. PAYMENTS WILL BE BASED ON THE QUANTITIES SHOWN IN ACCOMPANYING TABLE.

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# CONCRETE AND FIELDSTONE MASONRY PIPE ENDS FOR COMBINATION PIPES UP TO 30"

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 206.5.0**

massDOT
Massachusetts Department of Transportation
Highway Division

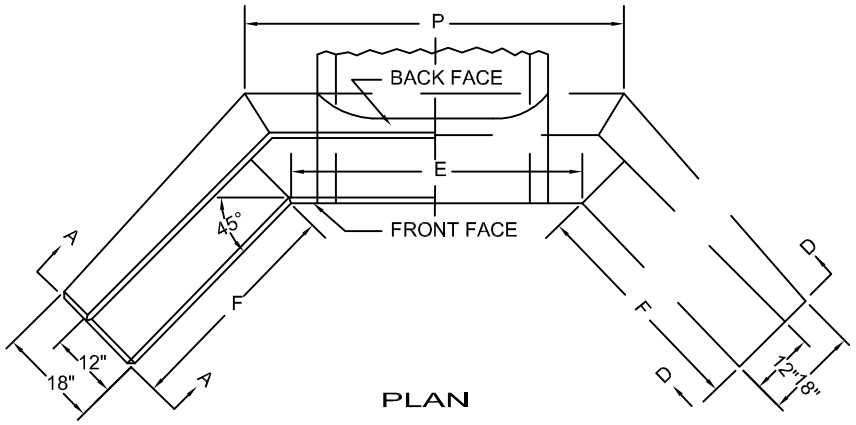
CONSTRUCTION STANDARDS

# CONCRETE AND FIELDSTONE MASONRY PIPE ENDS FOR 30" TO 84" PIPE

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 206.6.0**

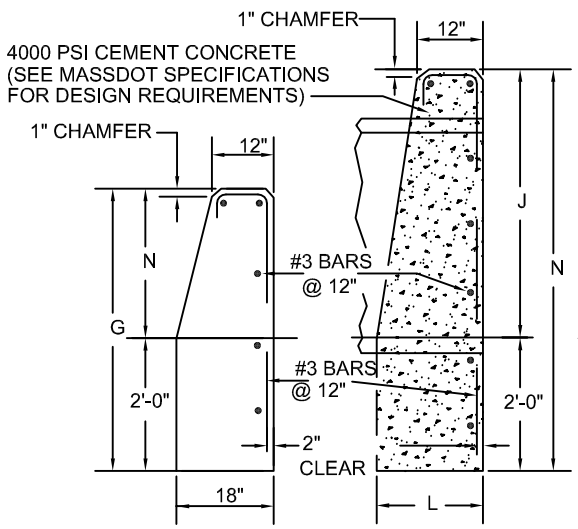
NOTE:
1. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHOD, SEE STANDARD SPECIFICATIONS.
2. ALL CONCRETE DIMENSIONS SHOWN ARE MINIMUM.
3. PAYMENTS WILL BE BASED ON THE QUANTITIES SHOWN IN THE ACCOMPANYING TABLE.



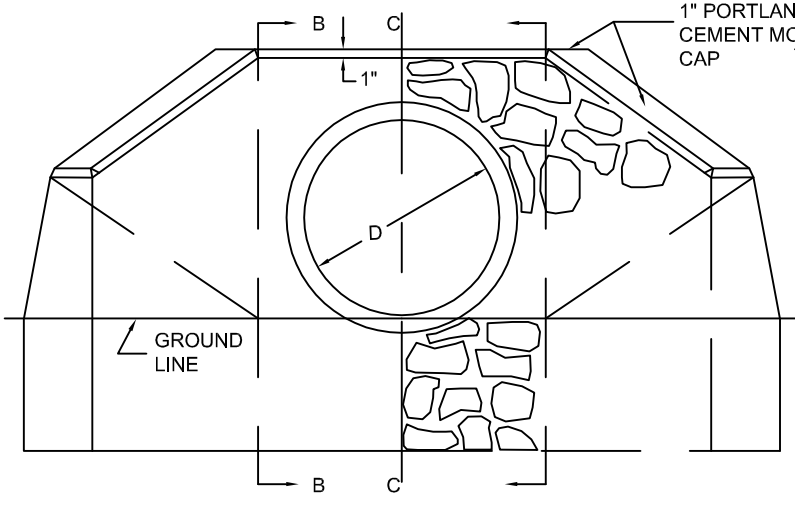

PLAN

| 1V:1.5H AND 1V:2H SLOPES | | | | | | | | 1V:1.5H SLOPE | | | 1V:2H SLOPE | | | TRENCH EXCAV. FOR 1:2 SLOPE FOR 1'-0" DEPTH CU. FT. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | E | G | H | J | L | N | P | F | CONC. MASONRY CY | STEEL LBS | F | CONC. MASONRY CY | STEEL LBS | |
| 30" | 4'-0" | 4'-0" | 5'-6" | 3'-6" | 1'-6" | 2'-0" | 5'-3" | 3'-0" | 2.60 | 45 | 4'-3" | 3.16 | 54 | 55.16 |
| 36" | 4'-6" | 4'-3" | 6'-0" | 4'-0" | 1'-8" | 2'-3" | 5'-11" | 3'-6" | 3.35 | 54 | 5'-0" | 4.15 | 64 | 64.36 |
| 42" | 5'-0" | 4'-6" | 6'-6" | 4'-6" | 1'-10" | 2'-6" | 6'-6" | 4'-0" | 4.20 | 59 | 5'-9" | 5.25 | 70 | 73.70 |
| 48" | 5'-6" | 4'-9" | 7'-0" | 5'-0" | 2'-0" | 2'-9" | 7'-2" | 4'-6" | 5.19 | 65 | 6'-6" | 6.50 | 83 | 83.96 |
| 54" | 6'-0" | 5'-0" | 7'-6" | 5'-6" | 2'-2" | 3'-0" | 7'-10" | 5'-0" | 6.26 | 73 | 7'-3" | 7.88 | 93 | 94.46 |
| 60" | 6'-6" | 5'-3" | 8'-0" | 6'-0" | 2'-4" | 3'-3" | 8'-5" | 5'-6" | 7.43 | 85 | 8'-0" | 9.37 | 106 | 105.30 |
| 72" | 7'-6" | 5'-9" | 9'-0" | 7'-0" | 2'-8" | 3'-9" | 9'-9" | 6'-6" | 10.25 | 98 | 9'-6" | 12.99 | 128 | 128.92 |
| 84" | 8'-6" | 6'-3" | 10'-0" | 8'-0" | 3'-0" | 4'-3" | 11'-0" | 7'-6" | 13.49 | 120 | 11'-0" | 17.32 | 154 | 153.86 |

## CONCRETE ENDS

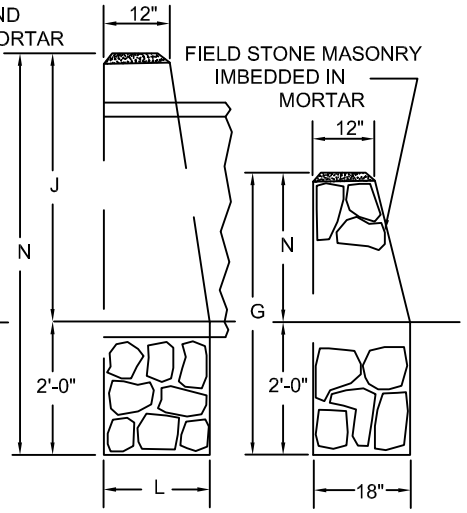



ELEV. A-A SECTION B-B




FRONT ELEVATION

## FIELD STONE MASONRY ENDS

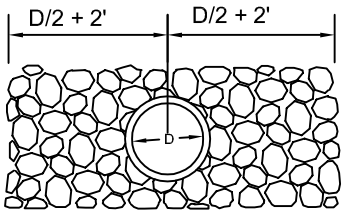



SECTION C-C ELEV. D-D

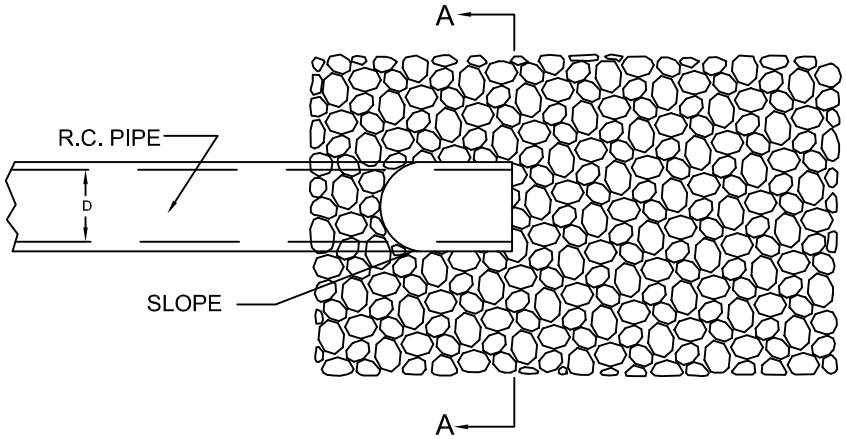
CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

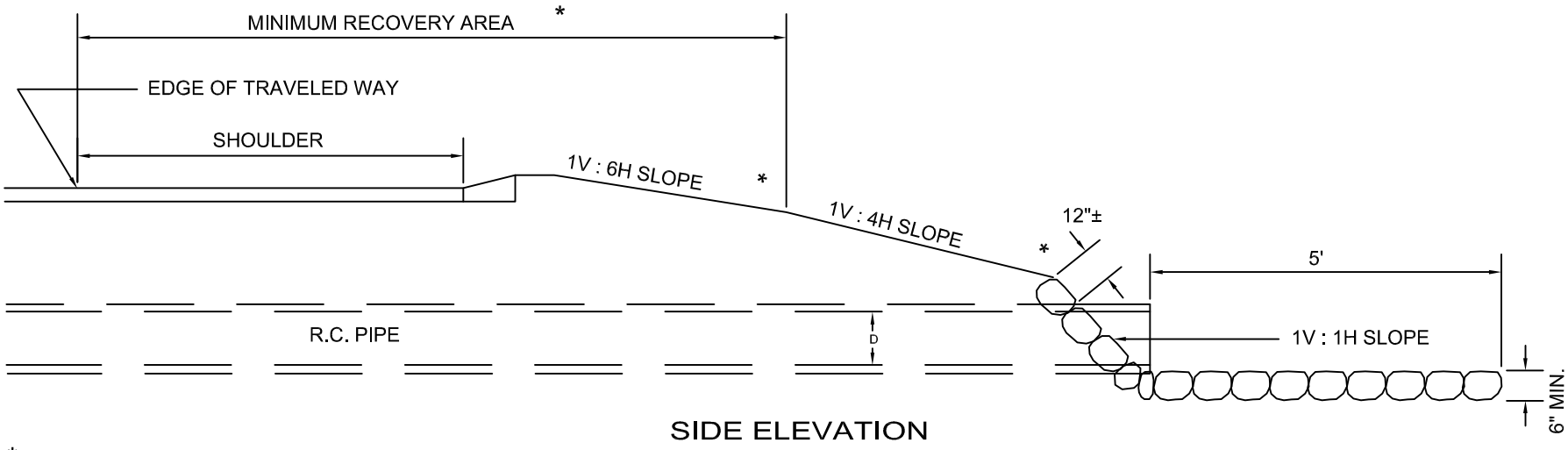
# STONE PIPE ENDS FOR PIPES 24" AND LESS IN DIA.




SECTION A-A




PLAN




SIDE ELEVATION

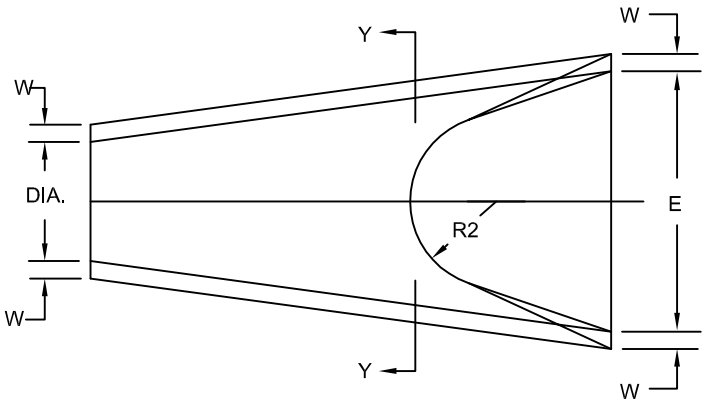
* SEE TYPICAL SECTIONS.

NOTES:

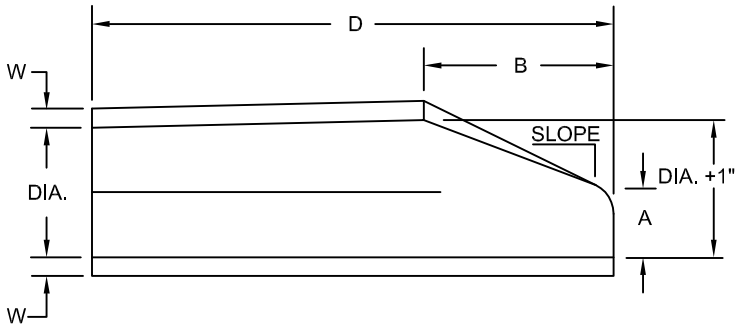
1. STONE TREATMENT OF PIPE ENDS SHALL NOT BE USED IN THE VEHICLE RECOVERY AREA.
2. MINIMUM MASS PER STONE = 50 LBS; MAXIMUM MASS PER STONE = 125 LBS.
3. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHODS, SEE STANDARD SPECIFICATIONS.

DATE OF ISSUE
DECEMBER 2016

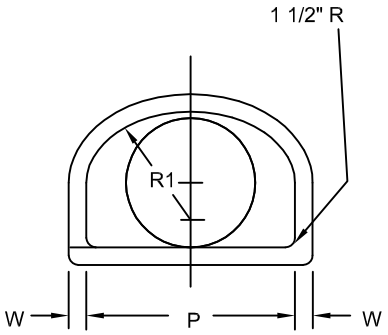
DRAWING NUMBER
**E 206.7.0**




PLAN




SECTION




SECTION Y-Y

TABLE
[ALL DIMENSIONS ARE inches OR feet]

| DIAMETER Inch | W | A | B | D | E | P | DIA. +1" | R1 | R2 | SLOPE |
|---|---|---|---|---|---|---|---|---|---|---|
| 12" | 2" | 4" | 2'-0" | 6'-0" | 2'-0" | 19 15/16" | 13" | 10 1/8" | 9" | 1V : 3H |
| 15" | 2 1/4" | 6" | 2'-3" | 6'-0" | 2'-6" | 24 5/16" | 16" | 12 1/2" | 11" | 1V : 3H |
| 18" | 2 1/2" | 9" | 2'-3" | 6'-0" | 3'-0" | 29" | 19" | 15 1/2" | 12" | 1V : 3H |
| 21" | 2 3/4" | 9" | 2'-11" | 6'-0" | 3'-6" | 31 5/8" | 22" | 16 1/8" | 13" | 1V : 3H |
| 24" | 3" | 9 1/2" | 3'-7 1/2" | 6'-0" | 4'-0" | 33 3/16" | 25" | 16 13/16" | 14" | 1V : 3H |
| 27" | 3 1/4" | 10 1/2" | 4'-0" | 6'-0" | 4'-6" | 36" | 28" | 18 9/16" | 14 1/2" | 1V : 3H |
| 30" | 3 1/2" | 12" | 4'-6" | 6'-0" | 5'-0" | 37" | 31" | 18 1/2" | 15" | 1V : 3H |
| 36" | 4" | 15" | 5'-3" | 8'-0" | 6'-0" | 47 13/16" | 37" | 24 5/16" | 20" | 1V : 3H |
| 42" | 4 1/2" | 21" | 5'-3" | 8'-0" | 6'-6" | 53 7/8" | 43" | 27 1/2" | 22" | 1V : 3H |
| 48" | 5" | 24" | 6'-0" | 8'-0" | 7'-0" | 56 1/2" | 49" | 28 1/2" | 22" | 1V : 3H |

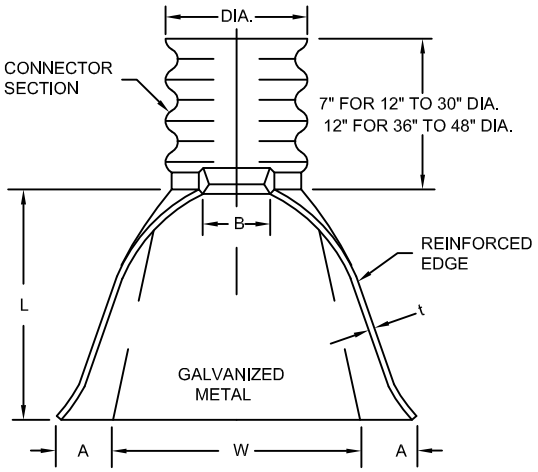
NOTES:
1. SEE STANDARD SPECIFICATIONS FOR THE TYPE OF PIPE TO BE USED (BELL & SPIGOT OR TONGUE & GROOVE)
2. SEE STANDARD SPECIFICATIONS FOR THE TYPE OF PIPE AND PLACING OF STEEL REINFORCEMENT.
3. THE JOINTS ARE TO BE COMPATIBLE WITH THE MAIN RUN OF PIPE.

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

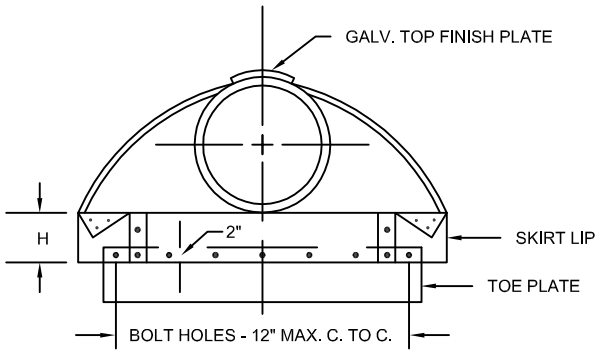
# REINFORCED CONCRETE PIPE FLARED ENDS

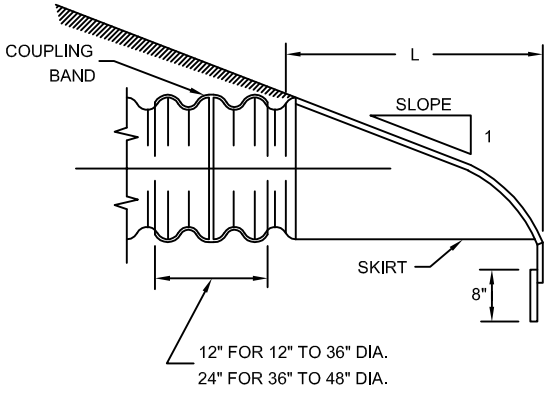
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 206.8.0**

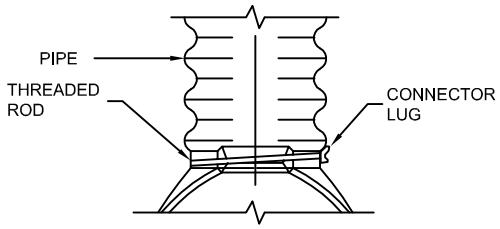



| PIPE DIA. (IN) | GA. | DIMENSIONS (IN.) | | | | | APPROX. SLOPE |
|---|---|---|---|---|---|---|---|
| | | A (± 1") | B (MAX.) | H (± 1") | L (±1 1/2") | W (± 2") | |
| 12 | 16 | 6 | 6 | 6 | 21 | 24 | 1V : 2.5H |
| 15 | 16 | 7 | 8 | 6 | 26 | 30 | 1V : 2.5H |
| 18 | 16 | 8 | 10 | 6 | 31 | 36 | 1V : 2.5H |
| 21 | 16 | 9 | 12 | 6 | 36 | 42 | 1V : 2.5H |
| 24 | 16 | 10 | 13 | 6 | 41 | 48 | 1V : 2.5H |
| 30 | 14 | 12 | 16 | 8 | 51 | 60 | 1V : 2.5H |
| 36 | 14 | 14 | 19 | 9 | 60 | 72 | 1V : 2.5H |
| 42 | 12 | 16 | 22 | 11 | 39 | 84 | 1V : 2.5H |
| 48 | 12 | 18 | 27 | 12 | 78 | 90 | 1V : 2.25H |

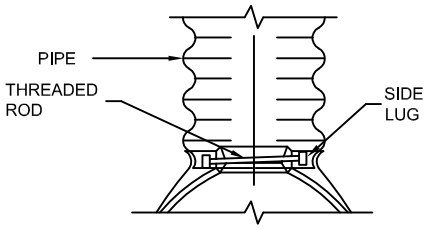



## ALTERNATE CONNECTIONS




FOR 12" TO 24" ONLY




FOR 30" AND 36" ONLY

NOTES:

1. TOE PLATE TO BE PUNCHED TO MATCH HOLES IN SKIRT LIP. 3/8" Ø GALVANIZED BOLTS TO BE FURNISHED. LENGTH OF TOE PLATE TO BE W+10" FOR 12" TO 30" DIA. PIPE AND W+22" FOR 36" TO 48" DIA.
2. SKIRT SECTION FOR 12" TO 24" DIA. PIPE TO BE MADE IN ONE PIECE. SKIRT SECTION FOR 12" TO 30" DIA. PIPE MAY BE MADE FROM TWO SHEETS JOINED BY RIVETING OR BOLTING ON CENTER LINE WITH 3/8" DIA. FASTENERS.
3. CONNECTOR SECTION, TOE PLATE AND SKIRT TO BE OF SAME THICKNESS METAL; EACH TO BE GALVANIZED AND COATED WITH A TAR BASE PAINT.
4. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHOD, SEE LATEST STANDARD SPECIFICATIONS.

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# STANDARD METAL END

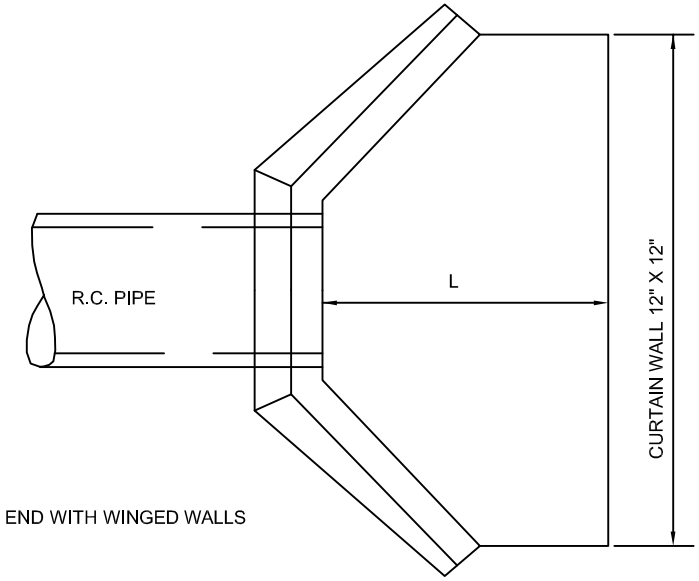
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 206.9.0**

CONSTRUCTION STANDARDS

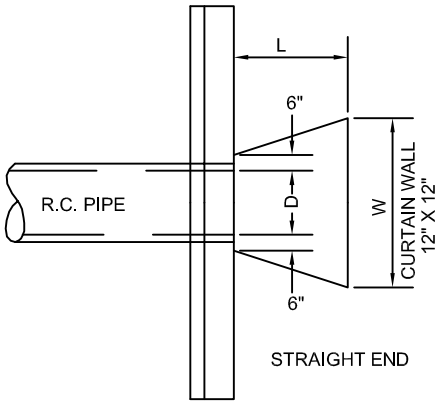
massDOT Massachusetts Department of Transportation Highway Division

# CONCRETE SPLASH PADS



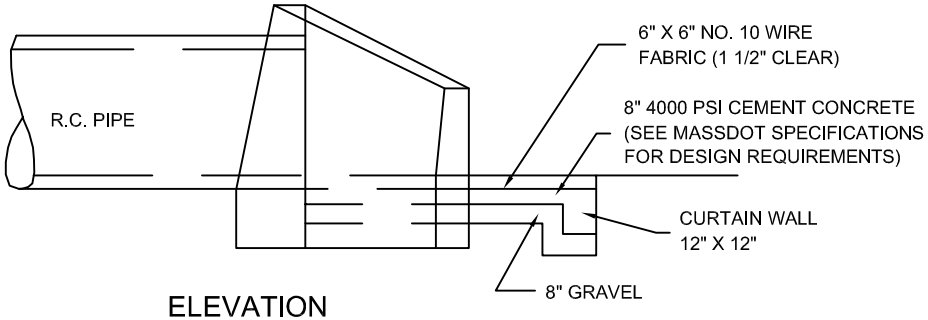

END WITH WINGED WALLS

PLAN

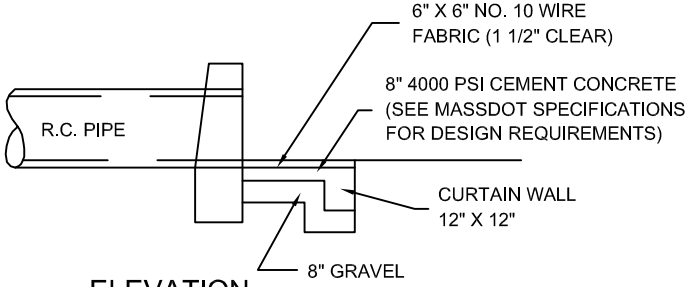



STRAIGHT END

PLAN




ELEVATION




ELEVATION

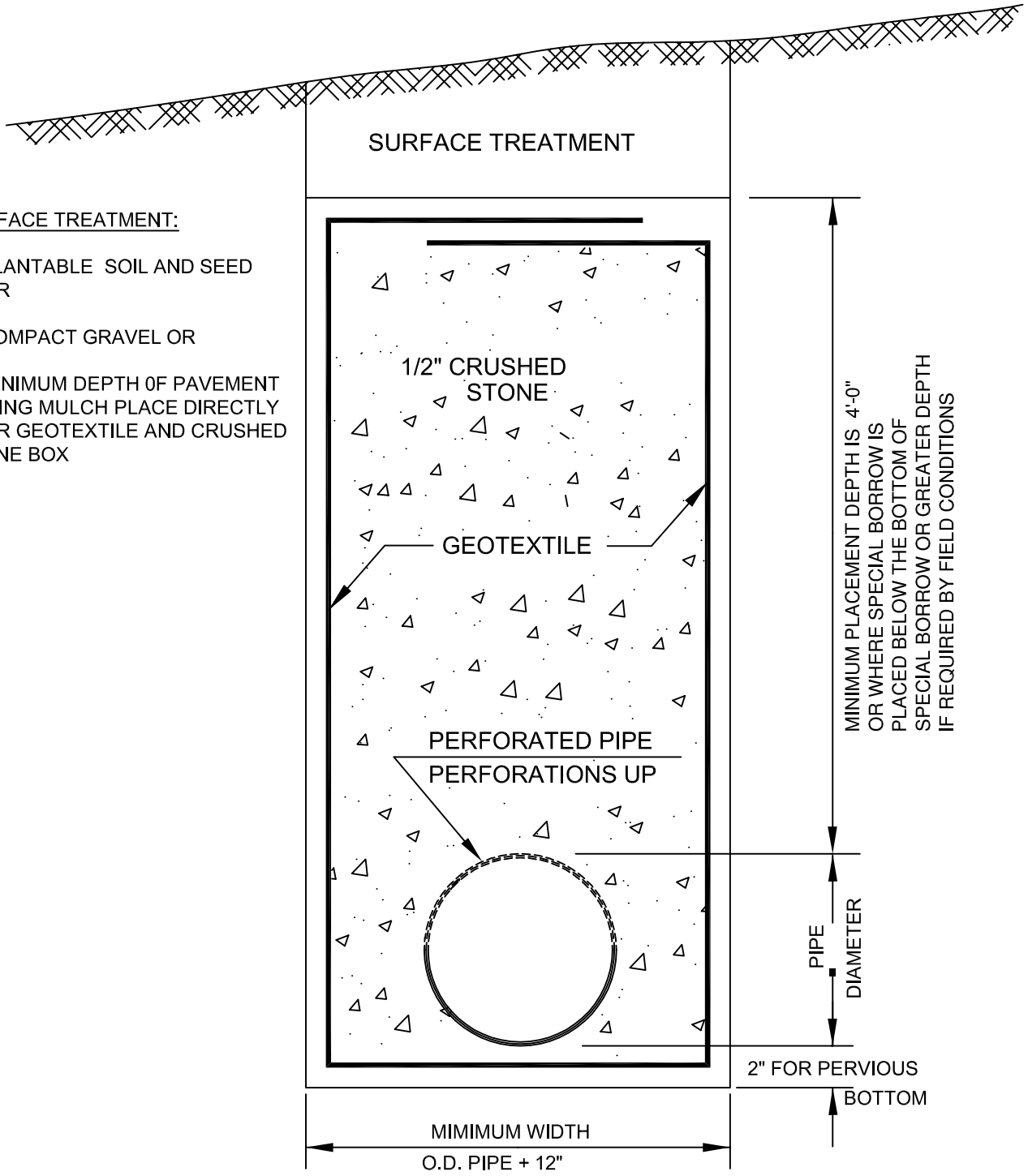
| PIPE DIAM. (IN) | 36 | 42 | 48 | 54 | 60 | 66 | 72 | 84 |
|---|---|---|---|---|---|---|---|---|
| L (FT) | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 14 |

| PIPE DIAM. (IN) | 12 | 15 | 18 | 21 | 24 | 30 |
|---|---|---|---|---|---|---|
| L | 3'-0" | 3'-0" | 3'-0" | 3'-6" | 4'-0" | 5'-0" |
| W | 4'-0" | 4'-0" | 4'-6" | 5'-3" | 6'-0" | 7'-6" |

NOTE:
1) ALL PIPE DIAMETERS NOMINAL SIZE

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 208.1.0**




SURFACE TREATMENT:

4" PLANTABLE SOIL AND SEED OVER

8" COMPACT GRAVEL OR

4" MINIMUM DEPTH 0F PAVEMENT MILLING MULCH PLACE DIRECTLY OVER GEOTEXTILE AND CRUSHED STONE BOX

NOTES:

1. GEOTEXTILE FABRIC AS DESCRIBED IN SECTION M9.50

2. PIPE SHALL BE SET AT BOTTOM OF TRENCH FOR IMPERVIOUS BOTTOM.

3. SUBDRAIN LOCATED APPROXIMATELY AT INTERSECTION OF TANGENTS (SEE DWG. E102.1.0)

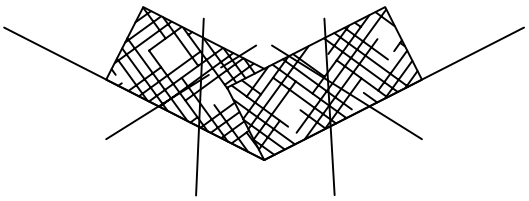
4. GRAVEL (AND SPECIAL BORROW WHERE REQUIRED) SHALL INTERSECT CRUSHED STONE FOR SUBDRAIN

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# SUBDRAIN

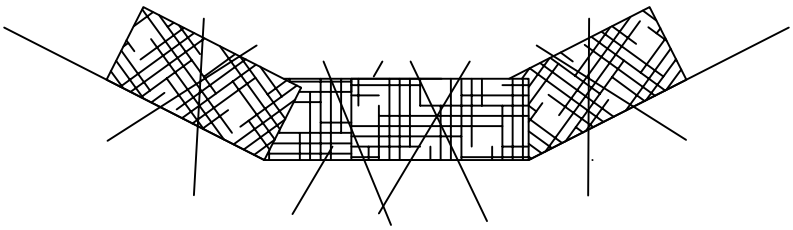
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 209.1.0**



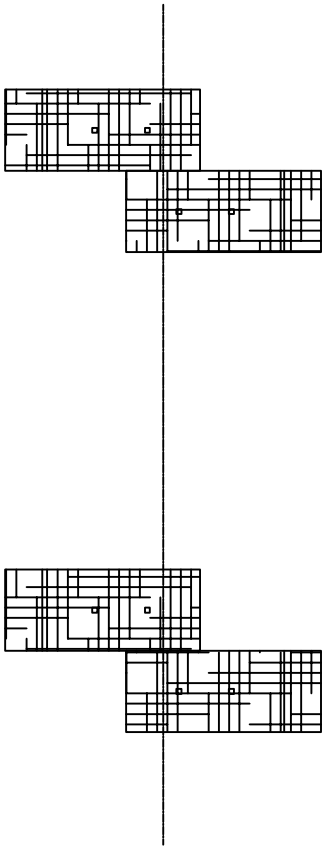
V DITCH

CROSS SECTION



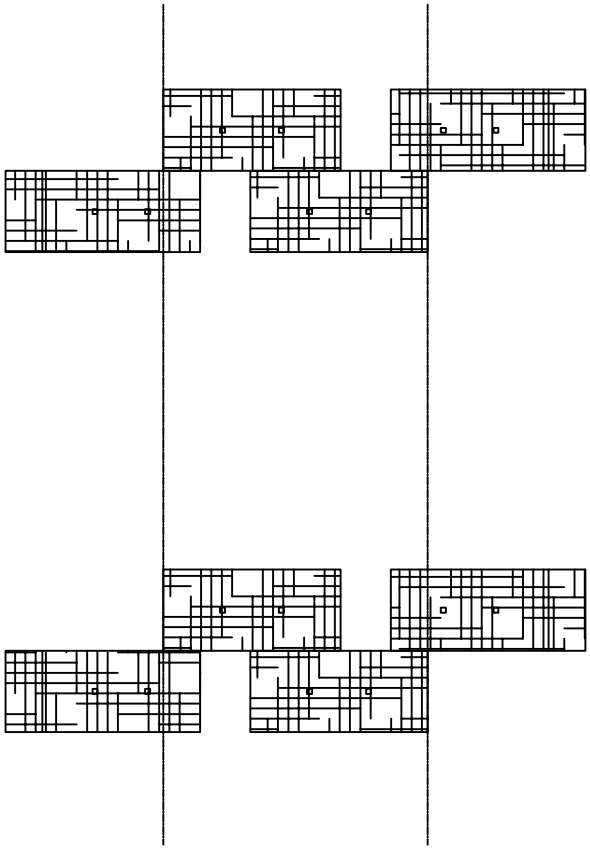
FLAT DITCH

CROSS SECTION



V DITCH

PLAN



FLAT DITCH

PLAN

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

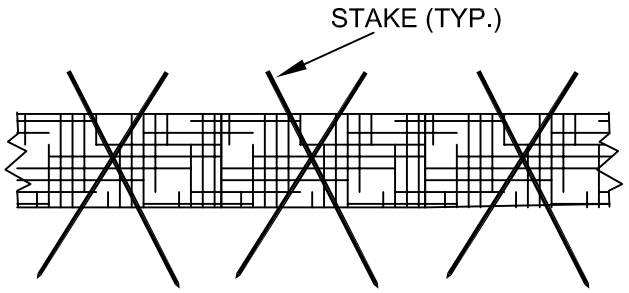
# DITCH CHECK DAMS FOR EROSION CONTROL

DATE OF ISSUE

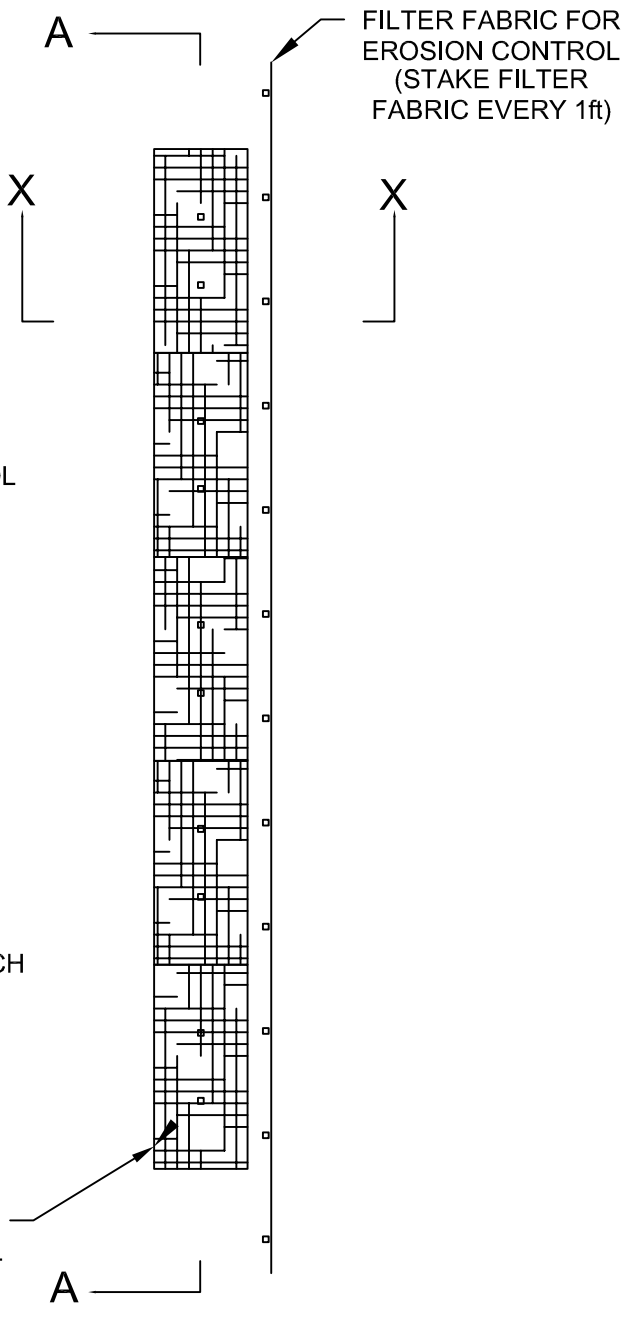
DECEMBER 2016

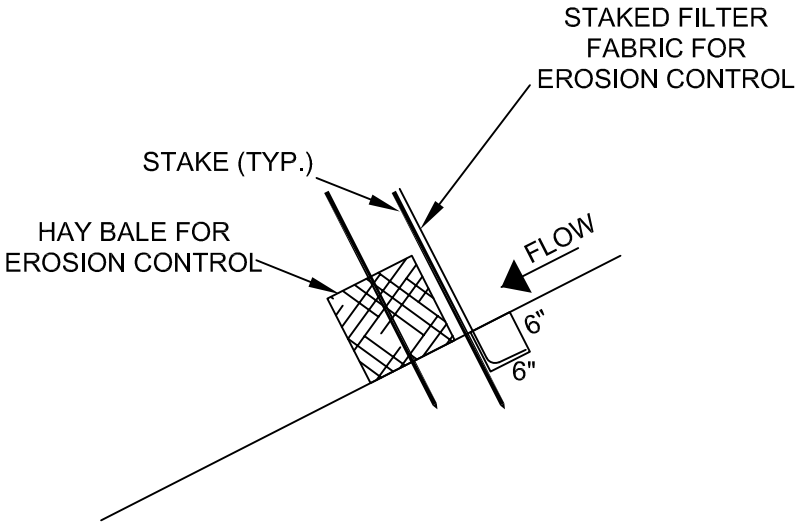
DRAWING NUMBER

**E 210.2.0**




SECTION A-A




6" X 6" TRENCH LAY FILTER FABRIC IN TRENCH
END UP SLOPE AND BACK FILL

SECTION X-X

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# HAY BALES AND SILT FENCES FOR EROSION CONTROL

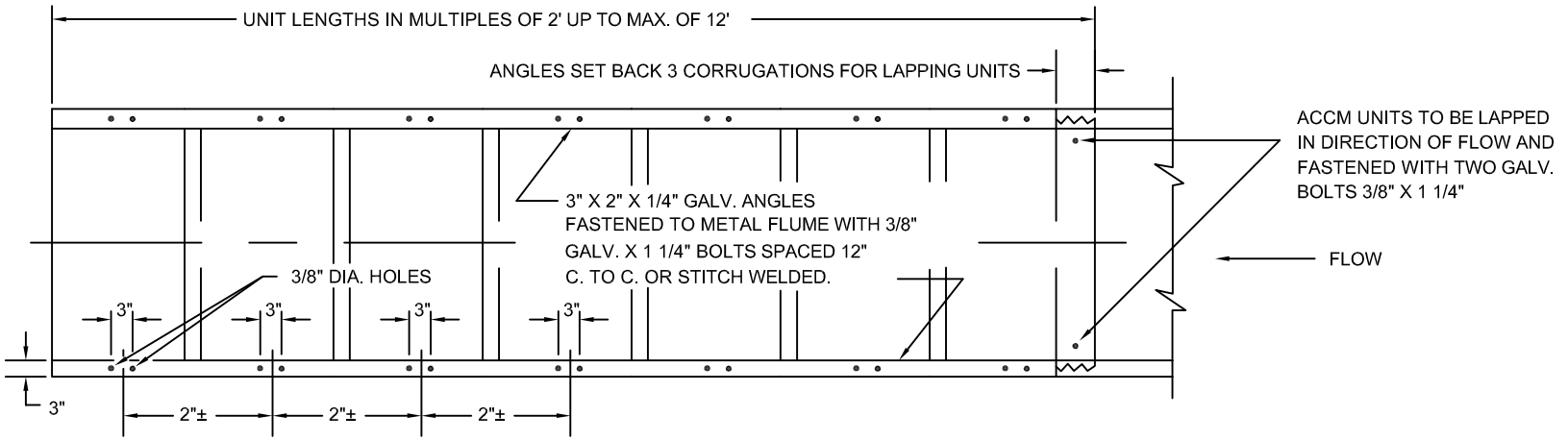
DATE OF ISSUE
DECEMBER 2016

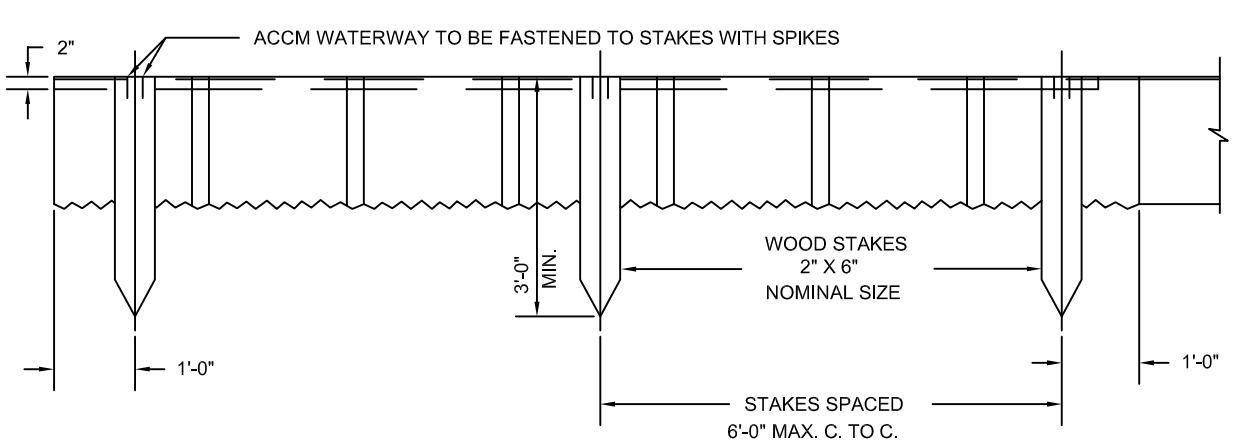
DRAWING NUMBER
**E 210.3.0**

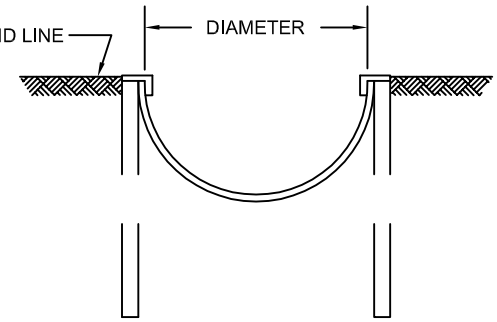
CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

# HALF CIRCLE CCM PIPE WATERWAYS




NOTE:

1. DIAMETER OF HALF CCM PIPE WATERWAY TO BE AS SPECIFIED.
2. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHODS, SEE STANDARD SPECIFICATIONS.

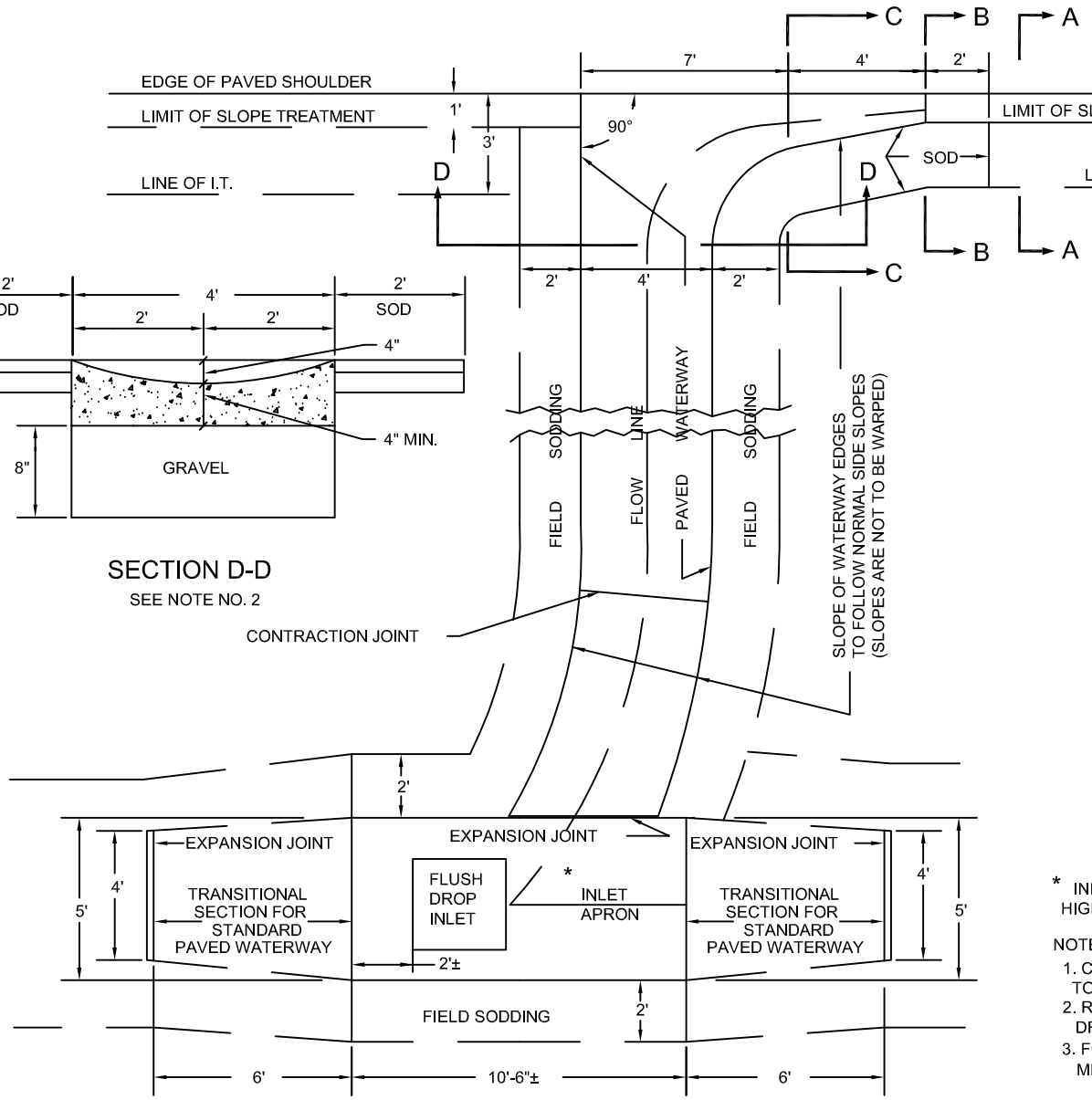
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 211.1.0**

CONSTRUCTION STANDARDS

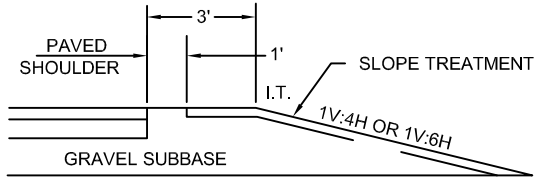
massDOT Massachusetts Department of Transportation Highway Division

# PAVED WATERWAYS AND APRON

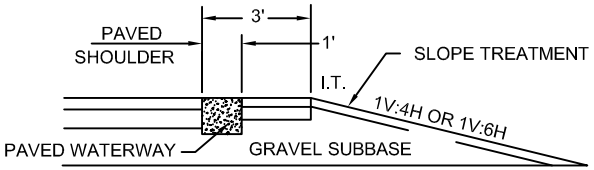



SECTION D-D

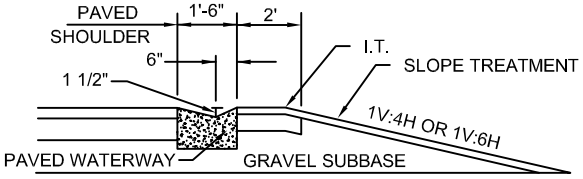
SEE NOTE NO. 2




SECTION A-A




SECTION B-B




SECTION C-C

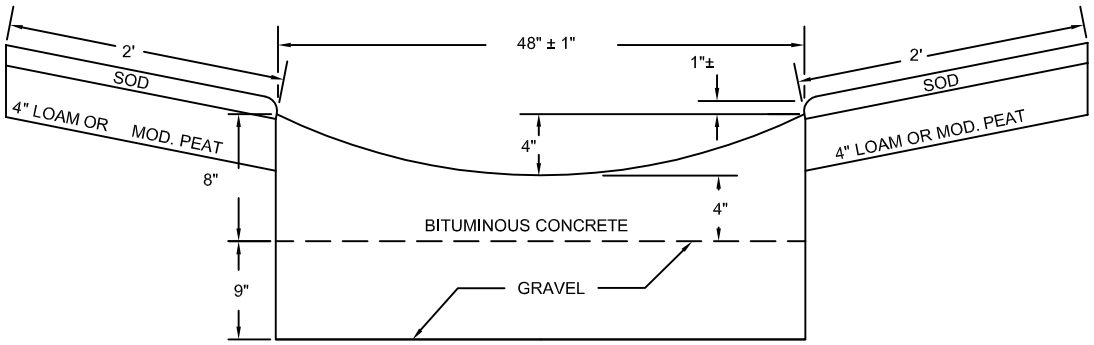
* INLET APRON TO BE SHAPED TO FIT AND SLIGHTLY HIGHER THAN DROP INLET OPENING.

NOTES:

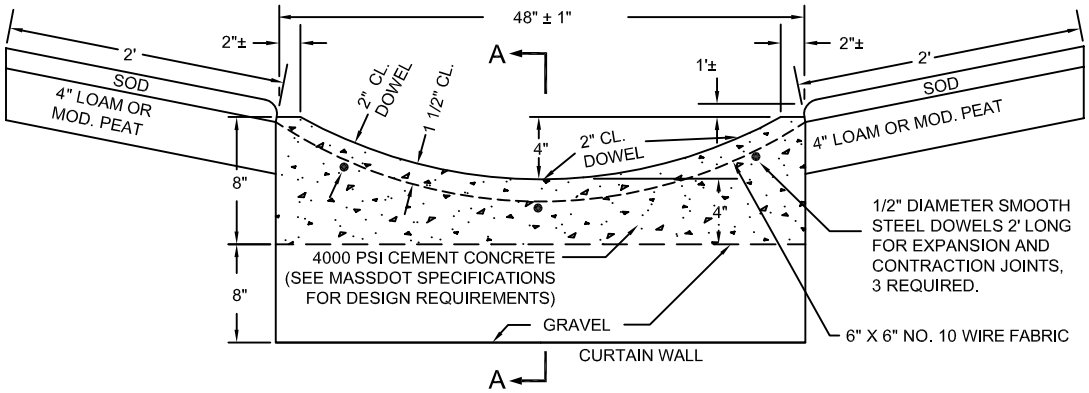
1. CONTRACTION JOINTS ARE TO BE SPACED 30' CENTER TO CENTER - FOR CEMENT CONC. SEE DRAWING 211.3.0
2. REINFORCING STEEL TO BE PLACED AS SHOWN ON DRAWING E 211.3.0 - FOR CEMENT CONC.
3. FOR DESCRIPTIONS, MATERIALS AND CONSTRUCTION METHODS, SEE LATEST STANDARD SPECIFICATIONS.

DATE OF ISSUE
DECEMBER 2016

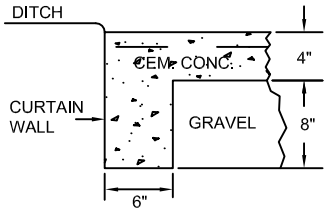
DRAWING NUMBER
**E 211.2.0**




BITUMINOUS CONCRETE

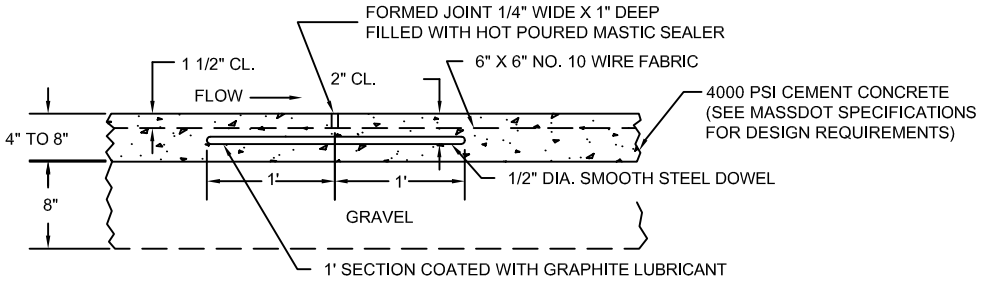



CEMENT CONCRETE



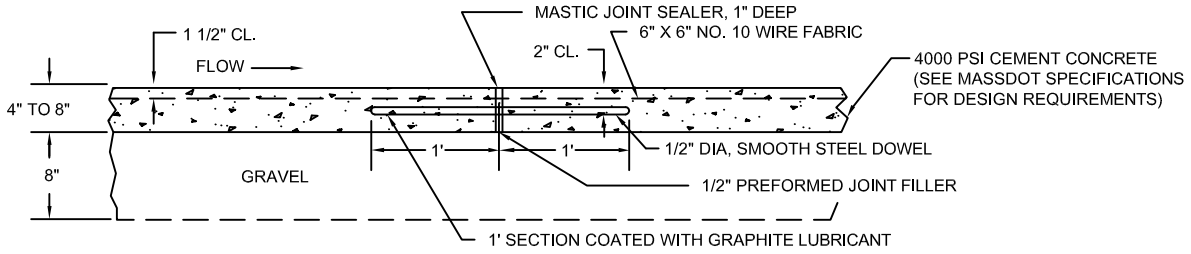

CURTAIN WALL TO BE INSTALLED AT TERMINI OF PAVING

SECTION A-A




CONTRACTION JOINT TO BE PLACED 30' MAXIMUM CENTER TO CENTER

DETAILS OF CONTRACTION JOINTS




EXPANSION JOINTS TO BE INSTALLED AT APPROACHES TO STRUCTURES

DETAILS OF EXPANSION JOINTS

NOTES:

1. ON CURVED ALIGNMENT, WATERWAYS SHALL BE BANKED AS DIRECTED.
2. FOR DESCRIPTIONS, MATERIALS AND CONSTRUCTION METHODS, SEE LATEST STANDARD SPECIFICATIONS.

massDOT Massachusetts Department of Transportation Highway Division

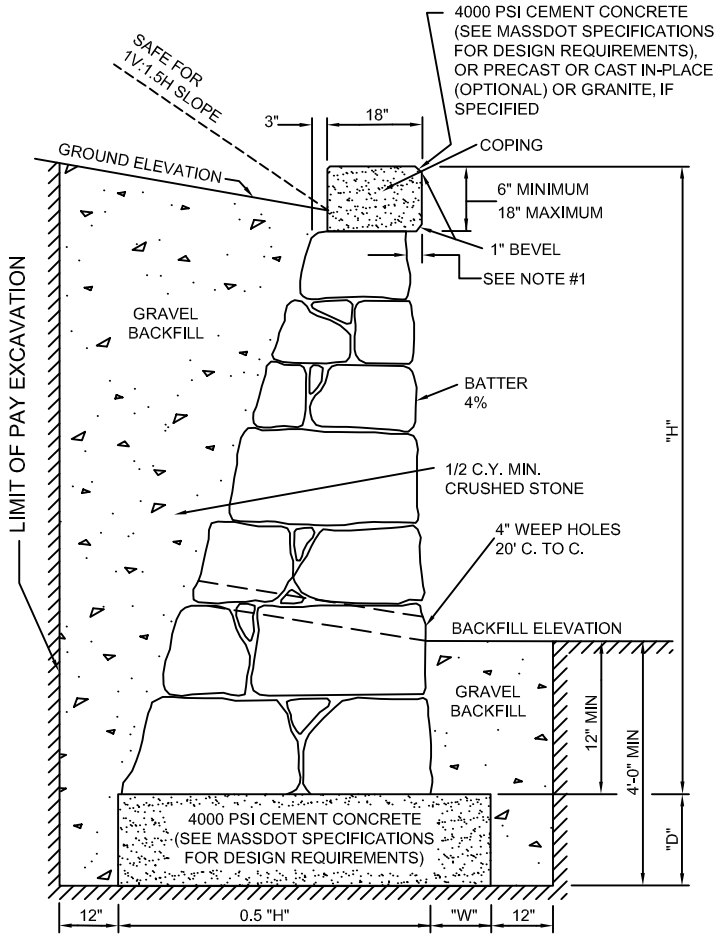
CONSTRUCTION STANDARDS

# PAVED WATERWAYS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 211.3.0**

| H (FT) | W (FT) | D (FT) | CONCRETE MASONRY FOOTING | | STONE MASONRY EXCLUDING COPING | |
|---|---|---|---|---|---|---|
| | | | SECTION AREA (SQ. FT.) | VOLUME PER UNIT LENGTH (CU.YD./LIN.FT) | SECTION AREA (SQ. FT.) | VOLUME PER UNIT LENGTH (CU.YD./LIN.FT) |
| 5.0 | 0.75 | 1.25 | 4.06 | 0.150 | 9.00 | 0.333 |
| 5.5 | | | 4.38 | 0.162 | 10.63 | 0.394 |
| 6.0 | | | 4.69 | 0.174 | 12.38 | 0.458 |
| 6.5 | | | 5.00 | 0.185 | 14.16 | 0.524 |
| 7.0 | | | 5.31 | 0.197 | 16.05 | 0.594 |
| 7.5 | | | 5.63 | 0.208 | 18.06 | 0.669 |
| 8.0 | 1.0 | 1.5 | 7.50 | 0.278 | 20.16 | 0.747 |
| 8.5 | | | 7.88 | 0.292 | 22.40 | 0.829 |
| 9.0 | | | 8.25 | 0.306 | 24.75 | 0.917 |
| 9.5 | | | 8.63 | 0.319 | 27.22 | 1.008 |
| 10.0 | 1.2 | 2.0 | 12.40 | 0.459 | 29.80 | 1.104 |
| 10.5 | | | 12.90 | 0.478 | 32.50 | 1.204 |
| 11.0 | | | 13.40 | 0.496 | 35.28 | 1.307 |
| 11.5 | | | 13.90 | 0.515 | 38.21 | 1.415 |
| 12.0 | | | 14.40 | 0.533 | 41.25 | 1.528 |
| 12.5 | | | 14.90 | 0.552 | 44.41 | 1.645 |
| 13.0 | 1.5 | 2.5 | 20.00 | 0.741 | 47.68 | 1.766 |
| 13.5 | | | 20.63 | 0.764 | 51.07 | 1.891 |
| 14.0 | | | 21.25 | 0.787 | 54.53 | 2.020 |
| 14.5 | | | 21.88 | 0.810 | 58.14 | 2.153 |
| 15.0 | | | 22.50 | 0.833 | 61.88 | 2.292 |
| 15.5 | | | 23.13 | 0.856 | 65.72 | 2.434 |
| 16.0 | | | 23.75 | 0.880 | 69.68 | 2.581 |
| 16.5 | 1.8 | 3.0 | 30.15 | 1.117 | 73.76 | 2.732 |
| 17.0 | | | 30.90 | 1.144 | 77.90 | 2.885 |
| 17.5 | | | 31.65 | 1.172 | 82.21 | 3.045 |
| 18.0 | | | 32.40 | 1.200 | 86.63 | 3.208 |
| 18.5 | | | 33.15 | 1.228 | 91.38 | 3.384 |
| 19.0 | | | 33.90 | 1.256 | 96.25 | 3.565 |
| 19.5 | | | 34.65 | 1.283 | 101.25 | 3.750 |
| 20.0 | | | 35.40 | 1.311 | 106.38 | 3.940 |
| 20.5 | | | 36.15 | 1.339 | 111.63 | 4.134 |
| 21.0 | | | 36.90 | 1.367 | 117.00 | 4.333 |
| 21.5 | | | 37.65 | 1.394 | 122.50 | 4.537 |
| 22.0 | | | 38.40 | 1.422 | 128.13 | 4.745 |
| 22.5 | | | 39.15 | 1.450 | 133.88 | 4.958 |
| 23.0 | | | 39.90 | 1.478 | 139.75 | 5.176 |
| 23.5 | | | 40.65 | 1.506 | 145.75 | 5.398 |
| 24.0 | | | 41.40 | 1.533 | 151.88 | 5.625 |
| 24.5 | | | 42.15 | 1.561 | 158.13 | 5.856 |
| 25.0 | | | 42.90 | 1.589 | 164.50 | 6.093 |
| 25.5 | | | 43.65 | 1.617 | 171.00 | 6.333 |
| 26.0 | | | 44.40 | 1.644 | 177.63 | 6.579 |
| 26.5 | | | 45.15 | 1.672 | 184.38 | 6.829 |




COPING TO BE PRECAST CONCRETE OR GRANITE OF UNIFORM DEPTH FOR THE ENTIRE LENGTH. DEPTH OF CONCRETE TO BE 1/12 THE AVERAGE "H" WITHIN THE LIMITS SHOWN. DEPTH OF GRANITE TO BE AS SHOWN ON THE PLANS, 6" OR 9".

FOR CHAIN LINK FENCE ON TOP OF WALL, THE COPING SHALL BE CONCRETE CAST-IN-PLACE WITH A MINIMUM DEPTH OF 12". THE LENGTH OF GALVANIZED PIPE SLEEVES FOR FENCE POSTS SHALL BE EQUAL TO THE DEPTH OF COPING.

## NOTES:

1. COPING OVERHANG TO BE APPROXIMATELY 3" FOR WALLS 10' OR MORE IN HEIGHT AND APPROXIMATELY 2" FOR WALLS LESS THAN 10' IN HEIGHT; IN A CONTINUOUS WALL OF VARYING HEIGHT THE OVERHANG WILL BE APPROXIMATELY 2" TO 3" FOR THE ENTIRE LENGTH.
2. ALL DIMENSIONS SHOWN ARE MINIMUM.
3. PAYMENT WILL BE BASED ON THE ACCOMPANYING TABLE.
4. TO BE FOUNDED ON SUITABLE SOIL

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# CEMENTED STONE MASONRY WALL

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 302.2.0**

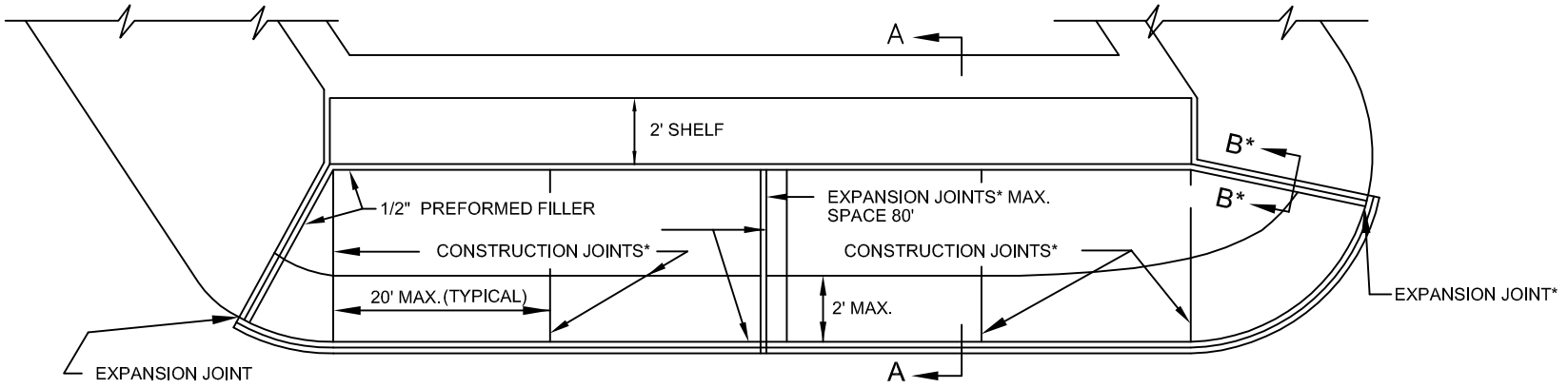
massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

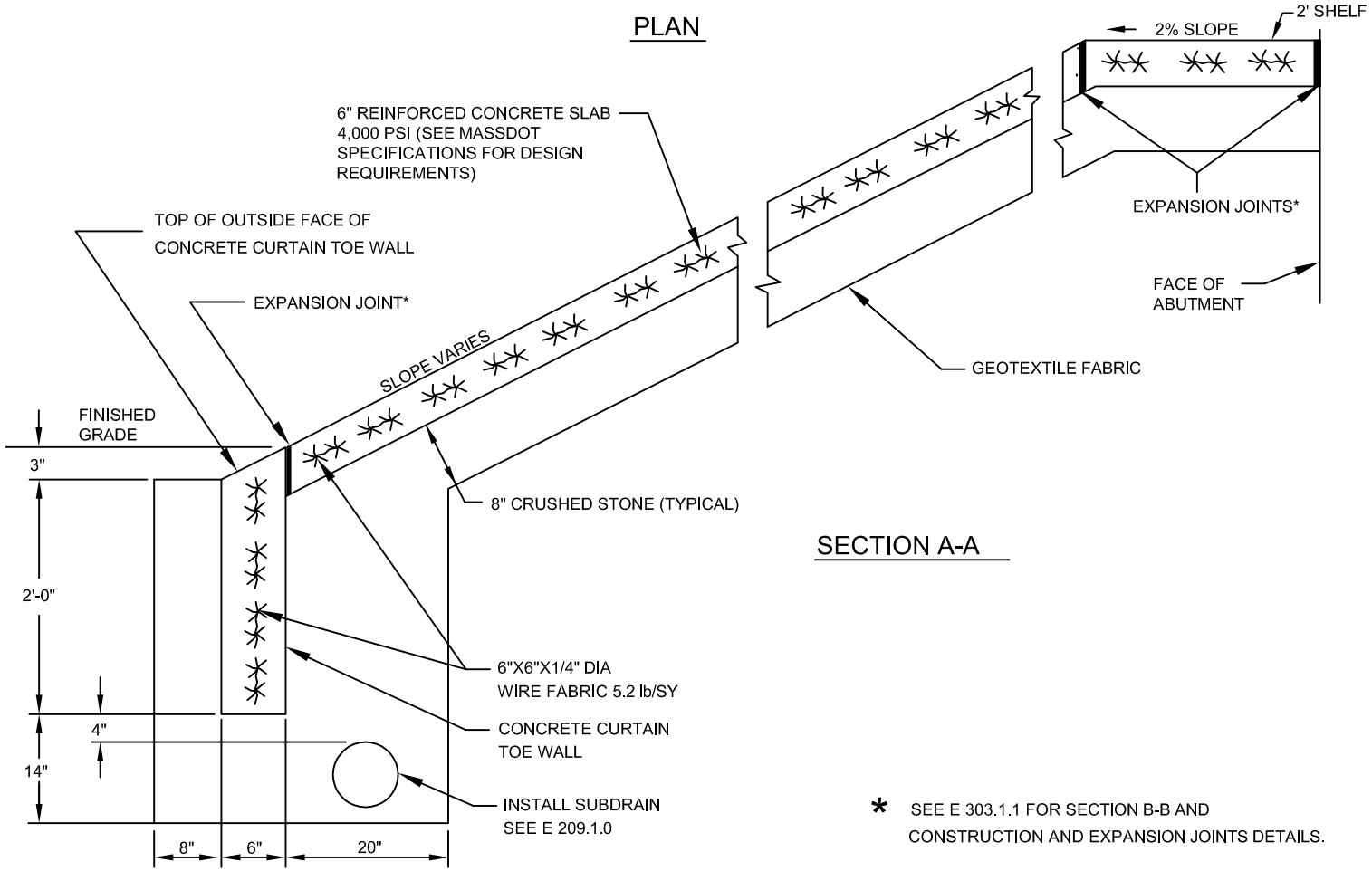
# SPECIAL SLOPE PAVING UNDER BRIDGES REINFORCED CONCRETE SLAB

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 303.1.0**




PLAN




SECTION A-A

* SEE E 303.1.1 FOR SECTION B-B AND CONSTRUCTION AND EXPANSION JOINTS DETAILS.

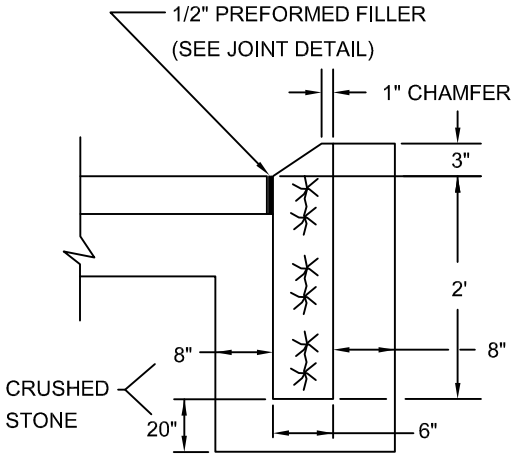
massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

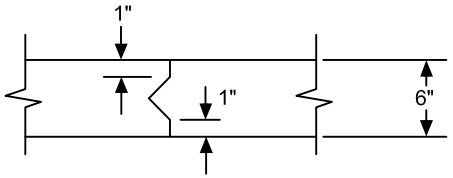
# SPECIAL SLOPE PAVING UNDER BRIDGES REINFORCED CONCRETE SLAB DETAILS

DATE OF ISSUE
DECEMBER 2016

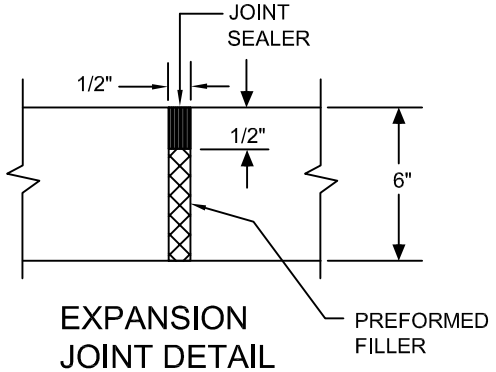
DRAWING NUMBER
**E 303.1.1**




CURTAIN WALL ON SIDES
OF SLABS SECTION B-B



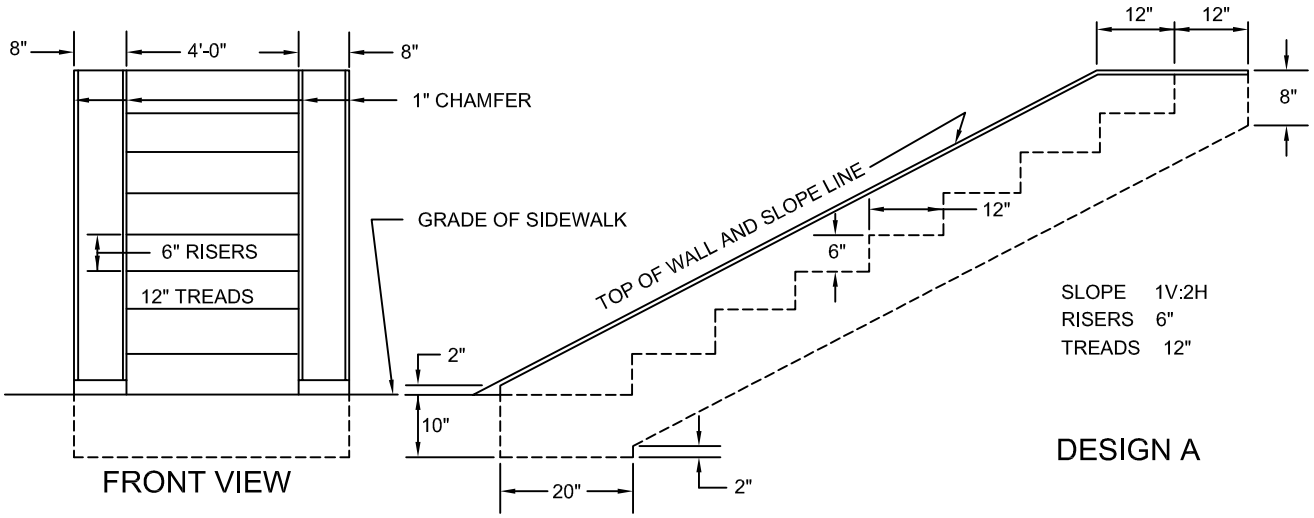

CONSTRUCTION
JOINT DETAIL



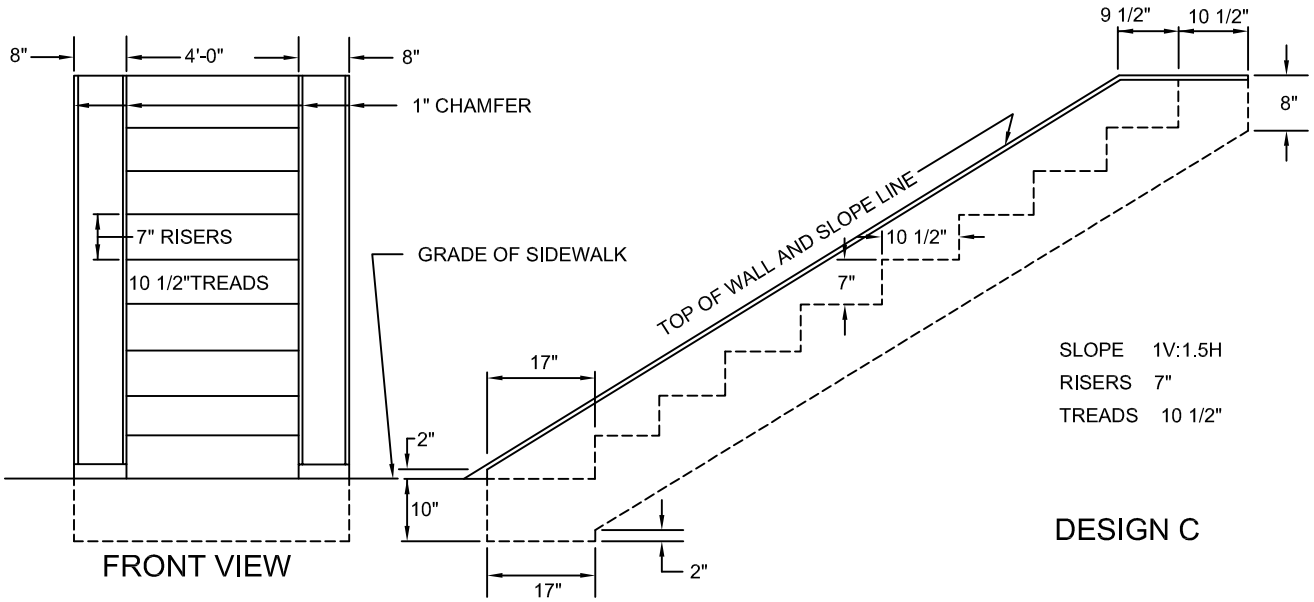

EXPANSION
JOINT DETAIL

## NOTES:

1. WIRE FABRIC TO HAVE 12" MINIMUM LAP AT SPLICE AND SHOULD EXTEND WITHIN 3" OF ALL EDGES
2. SLAB SHALL BE GROOVED PARALLEL TO AND NORMAL TO THE CURTAIN TOE WALL AT APPROXIMATELY 6' GRIDS. THE GROOVE DEPTH SHALL BE 1"
3. FOR LIMITS OF SLOPE PAVING SEE BRIDGE MANUAL.
4. CONCRETE SHALL BE 4,000 PSI (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)
5. EXTEND GEOTEXTILE FABRIC BENEATH CRUSHED STONE FROM TOP OF CONCRETE CURTAIN TOE WALL TO FACE OF ABUTMENT.
6. SEE E 303.1.0 FOR SLAB PLAN AND SECTION.




PLEASE NOTE: DESIGN B HAS BEEN DISCONTINUED




NOTES:

1. ALL CONCRETE DIMENSIONS SHOWN ARE MINIMUM EXCEPT RISERS AND TREADS WHICH HAVE 1/4" TOLERANCE.
2. FOR REINFORCING STEEL AND CONCRETE QUANTITIES SEE DRAWING E 304.2.0

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# CEMENT CONCRETE STEPS

1/2

DATE OF ISSUE
DECEMBER 2016

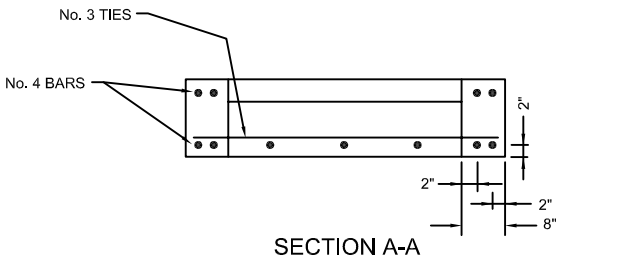
DRAWING NUMBER
**E 304.1.0**

CONSTRUCTION STANDARDS

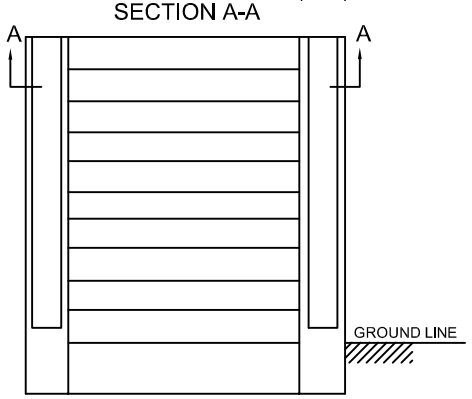
massDOT Massachusetts Department of Transportation Highway Division

# CEMENT CONCRETE STEPS

2/2

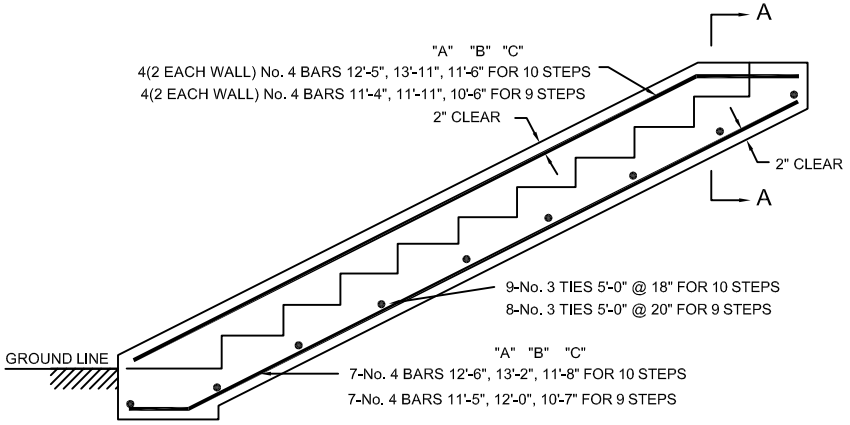



SECTION A-A




FRONT VIEW

NOTES:
1. FOR DESCRIPTIONS , MATERIALS AND CONSTRUCTION METHODS SEE STANDARD SPECIFICATIONS.
2. PAYMENT WILL BE BASED ON THE QUANTITIES SHOWN IN THE ACCOMPANYING TABLES.
3. RAILING AS REQUIRED BY AAB AND STATE BUILDING CODE




SIDE VIEW

FOR DESIGNS "A", "B" AND "C" SEE DRAWING E 304.1.0

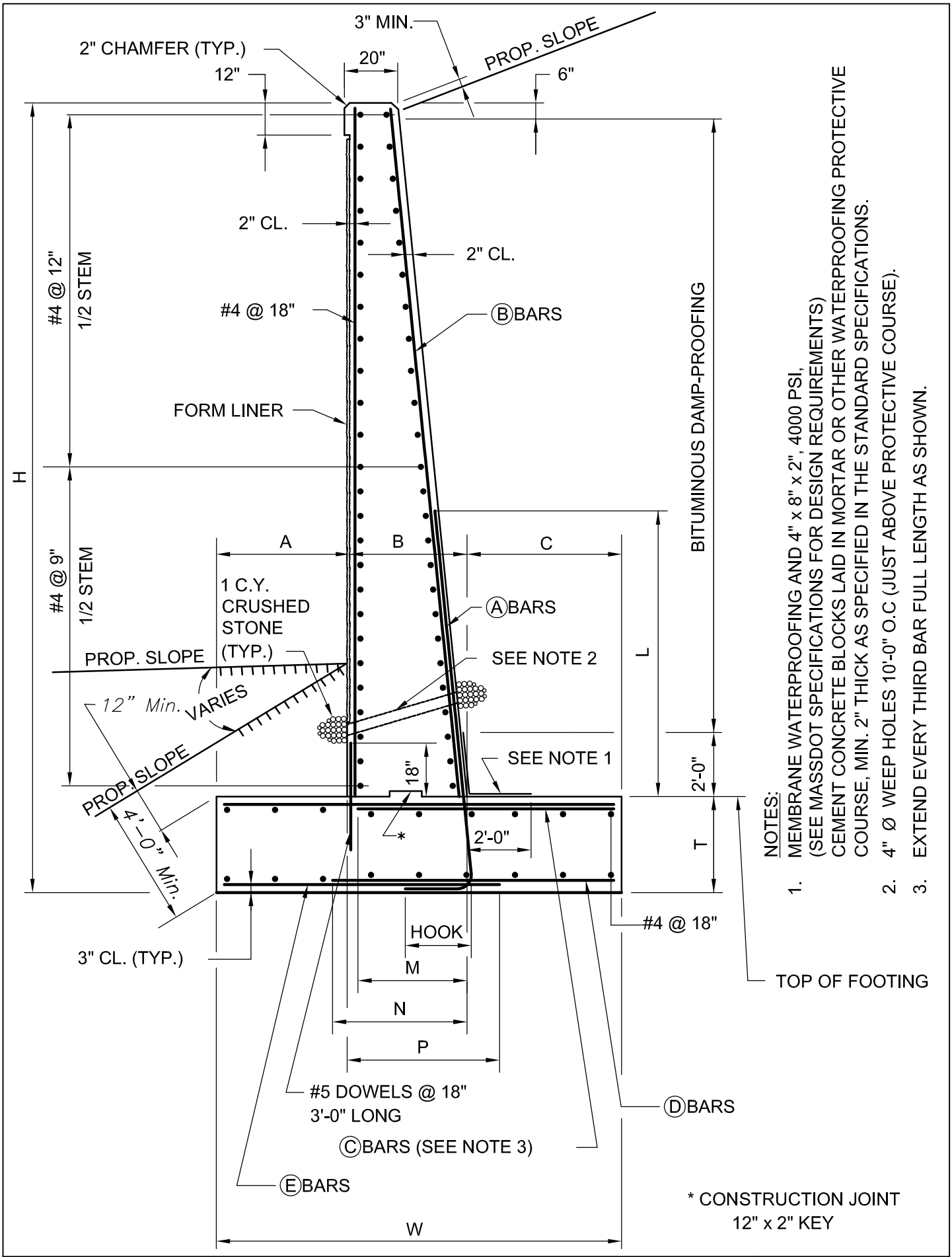
| STEP NOS. | DESIGN A | | | | | | DESIGN C | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | QUANTITIES - CU. FT. | | | | TOTAL C.Y. | REINF. STEEL LBS | QUANTITIES - CU. FT. | | | | TOTAL C.Y. | REINF. STEEL LBS |
| | BASE | STEPS | 2-WALLS | TOTAL | | | BASE | STEPS | 2-WALLS | TOTAL | | |
| 2 | 5.55 | 7.33 | 6.26 | 19.15 | 0.71 | -- | 4.72 | 6.71 | 5.65 | 17.08 | 0.63 | -- |
| 3 | 5.55 | 11.00 | 8.48 | 25.03 | 0.93 | -- | 4.72 | 10.06 | 7.69 | 22.48 | 0.83 | -- |
| 4 | 5.55 | 14.66 | 10.70 | 30.92 | 1.15 | -- | 4.72 | 13.42 | 9.73 | 27.87 | 1.03 | -- |
| 5 | 5.55 | 18.33 | 12.92 | 36.81 | 1.36 | -- | 4.72 | 16.77 | 11.78 | 33.27 | 1.23 | -- |
| 6 | 5.55 | 22.00 | 15.15 | 42.70 | 1.58 | -- | 4.72 | 20.12 | 13.82 | 38.66 | 1.43 | -- |
| 7 | 5.55 | 25.66 | 17.37 | 48.59 | 1.80 | -- | 4.72 | 23.48 | 15.86 | 44.06 | 1.63 | -- |
| 8 | 5.55 | 29.33 | 19.59 | 54.47 | 2.02 | -- | 4.72 | 26.83 | 17.90 | 49.46 | 1.83 | -- |
| 9 | 5.55 | 33.00 | 21.81 | 60.36 | 2.24 | 99 | 4.72 | 30.19 | 19.94 | 54.85 | 2.03 | 92 |
| 10 | 5.55 | 36.66 | 24.03 | 66.25 | 2.45 | 109 | 4.72 | 33.54 | 22.00 | 60.25 | 2.23 | 102 |

ALL CONCRETE SHALL BE 4,000 PSI (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)

PLEASE NOTE: DESIGN B HAS BEEN DISCONTINUED

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
E 304.2.0




NOTES:

1. MEMBRANE WATERPROOFING AND 4" x 8" x 2", 4000 PSI, CEMENT CONCRETE BLOCKS LAID IN MORTAR OR OTHER WATERPROOFING PROTECTIVE COURSE, MIN. 2" THICK AS SPECIFIED IN THE STANDARD SPECIFICATIONS. (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)
2. 4" Ø WEEP HOLES 10'-0" O.C (JUST ABOVE PROTECTIVE COURSE).
3. EXTEND EVERY THIRD BAR FULL LENGTH AS SHOWN.

* CONSTRUCTION JOINT
12" x 2" KEY

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# TYPICAL CANTILEVER RETAINING WALL SECTION

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 305.1.0**

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# CANTILEVER RETAINING WALLS
# DENSE FOUNDATION SOILS, SLOPING BACKFILL

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 305.2.0**

TABLE OF DIMENSIONS AND REINFORCING STEEL

| H | 14.0 | 15.0 | 16.0 | 17.0 | 18.0 | 19.0 | 20.0 | 21.0 | 22.0 | 23.0 | 24.0 | 25.0 | 26.0 | 27.0 | 28.0 | 29.0 | 30.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 8.500 | 9.000 | 10.000 | 10.500 | 11.000 | 12.000 | 12.500 | 13.000 | 13.500 | 14.000 | 15.000 | 15.500 | 16.500 | 17.500 | 18.000 | 19.000 | 20.000 |
| T | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.500 | 2.500 | 3.000 | 3.000 | 3.500 | 3.500 | 4.000 | 4.000 | 4.500 | 4.500 | 5.000 |
| A | 1.500 | 1.500 | 2.000 | 2.000 | 1.500 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.500 | 2.500 | 3.000 | 3.500 | 4.000 | 4.500 | 5.000 |
| B | 2.500 | 2.583 | 2.667 | 2.750 | 2.833 | 2.917 | 2.958 | 3.042 | 3.083 | 3.167 | 3.208 | 3.292 | 3.333 | 3.417 | 3.458 | 3.542 | 3.583 |
| C | 4.500 | 4.917 | 5.333 | 5.750 | 6.667 | 7.083 | 7.542 | 7.958 | 8.417 | 8.833 | 9.292 | 9.708 | 10.167 | 10.583 | 10.542 | 10.958 | 11.417 |
| | | | | | | | | | | | | | | | | | |
| L | 3.600 | 3.900 | 5.600 | 6.000 | 8.000 | 8.500 | 8.750 | 9.250 | 9.500 | 12.000 | 12.300 | 12.900 | 13.200 | 13.800 | 14.100 | 14.700 | 15.000 |
| M | 1.917 | 2.500 | 3.167 | 4.083 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 |
| N | 1.000 | 1.000 | 1.000 | 1.000 | 1.250 | 1.250 | 1.250 | 1.250 | 1.250 | 1.500 | 1.500 | 1.500 | 1.917 | 1.917 | 1.917 | 1.917 | 1.917 |
| P | 1.000 | 1.000 | 1.250 | 1.250 | 1.000 | 1.250 | 1.250 | 1.250 | 1.250 | 1.250 | 1.250 | 1.250 | 1.500 | 1.917 | 1.917 | 2.500 | 2.500 |
| HOOK | 1.000 | 1.167 | 1.167 | 1.333 | 1.333 | 1.583 | 1.583 | 1.833 | 1.833 | 1.833 | 2.000 | 2.000 | 1.583 | 1.583 | 1.583 | 1.583 | 1.833 |
| | | | | | | | | | | | | | | | | | |
| A bars | 6 @ 12 | 7 @ 12 | 7 @ 12 | 8 @ 12 | 8 @ 12 | 9 @ 12 | 9 @ 12 | 10 @ 12 | 10 @ 12 | 10 @ 12 | 11 @ 12 | 11 @ 12 | 9 @ 6 | 9 @ 6 | 9 @ 6 | 9 @ 6 | 10 @ 6 |
| B bars | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 |
| C bars | 7 @ 18 | 8 @ 18 | 9 @ 18 | 10 @ 18 | 11 @ 17 | 11 @ 14 | 11 @ 15.5 | 11 @ 13 | 11 @ 13.5 | 11 @ 12 | 11 @ 12 | 11 @ 10.5 | 11 @ 10.5 | 11 @ 9.5 | 11 @ 10.5 | 11 @ 9.5 | 11 @ 9.5 |
| D bars | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 6 @ 18 | 6 @18 | 6 @ 18 | 7 @ 18 | 7 @ 18 | 7 @ 18 | 7 @ 18 | 7 @ 18 |
| E bars | 4 @ 18 | 4 @ 18 | 5 @ 18 | 5 @ 18 | 4 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 6 @ 18 | 7 @ 18 | 7 @ 18 | 8 @ 18 | 8 @ 18 |

*Quantities of Materials*

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stem Concrete ($yd^3$/ft) | 0.9 | 1.0 | 1.1 | 1.2 | 1.3 | 1.4 | 1.4 | 1.6 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 |
| Footing Concrete ($yd^3$/ft) | 0.6 | 0.7 | 0.7 | 0.8 | 0.8 | 0.9 | 1.2 | 1.2 | 1.5 | 1.6 | 2.0 | 2.0 | 2.5 | 2.6 | 3.0 | 3.2 | 3.7 |
| | | | | | | | | | | | | | | | | | |
| Steel (lb/ft) | 98 | 117 | 152 | 171 | 200 | 233 | 243 | 280 | 292 | 399 | 454 | 470 | 488 | 510 | 524 | 550 | 631 |

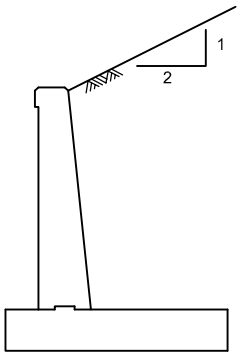
*Maximum Soil Bearing Pressure*

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $Q_{max}$ (psf) | 5123 | 5663 | 5432 | 5954 | 7019 | 6759 | 7346 | 7886 | 8482 | 9033 | 8817 | 9355 | 9178 | 8984 | 9103 | 8948 | 8892 |

*Notes:*

1. *All dimensions are in feet, unless specified otherwise.*
2. *Spacings of reinforcing bars are in inches.*
3. *Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.*

## ASSUMED DESIGN PARAMETERS
## DENSE FOUNDATION SOIL, SLOPING BACKFILL




1. BACKFILL LOADING CONDITIONS:

   2H:1V SLOPING BACKFILL

2. BACKFILL SOIL PROPERTIES:

   TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES

   Ø = ANGLE OF INTERNAL FRICTION = 37°

   $\delta$ = ANGLE OF WALL FRICTION = 22°

   $\gamma$ = EFFECTIVE UNIT WEIGHT = 120 pcf

3. FOUNDATION SOIL PROPERTIES:

   $q_f$ = FACTORED BEARING CAPACITY = 9400 psf

   FRICTION FACTOR = 0.57

   $Ø_{SLIDING}$ = PERFORMANCE FACTOR FOR SLIDING = 0.80

4. SEISMIC LOADING:

   A = 0.17g (Max.)

   Kh = 0.085

   Kv = 0

5. REINFORCED CONCRETE:

   $F'_c$ = 4000 psi

   $F_y$ = 60000 psi

   (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# CANTILEVER RETAINING WALLS
# DENSE FOUNDATION SOILS, LEVEL BACKFILL, SURCHARGE

DRAWING NUMBER
**E 305.3.0**

DATE OF ISSUE
DECEMBER 2016

TABLE OF DIMENSIONS AND REINFORCING STEEL

| H | 14.0 | 15.0 | 16.0 | 17.0 | 18.0 | 19.0 | 20.0 | 21.0 | 22.0 | 23.0 | 24.0 | 25.0 | 26.0 | 27.0 | 28.0 | 29.0 | 30.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 7.000 | 7.500 | 8.000 | 8.500 | 9.000 | 9.000 | 9.500 | 10.000 | 10.500 | 11.000 | 11.000 | 11.500 | 12.000 | 12.500 | 13.000 | 13.000 | 13.500 |
| T | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.500 | 2.500 |
| A | 2.500 | 2.500 | 2.500 | 2.500 | 3.000 | 3.000 | 3.000 | 3.000 | 3.500 | 3.500 | 3.500 | 4.000 | 4.000 | 4.000 | 4.500 | 4.500 | 4.500 |
| B | 2.500 | 2.583 | 2.667 | 2.750 | 2.833 | 2.917 | 3.000 | 3.083 | 3.167 | 3.250 | 3.333 | 3.417 | 3.500 | 3.583 | 3.667 | 3.708 | 3.792 |
| C | 2.000 | 2.417 | 2.833 | 3.250 | 3.167 | 3.083 | 3.500 | 3.917 | 3.833 | 4.250 | 4.167 | 4.083 | 4.500 | 4.917 | 4.833 | 4.792 | 5.208 |
| | | | | | | | | | | | | | | | | | |
| L | 2.400 | 2.600 | 4.200 | 4.500 | 6.400 | 6.800 | 7.200 | 9.500 | 10.000 | 10.500 | 11.000 | 13.800 | 14.400 | 15.000 | 15.600 | 15.900 | 16.500 |
| M | 1.000 | 1.000 | 1.000 | 1.250 | 1.250 | 1.250 | 1.500 | 1.917 | 1.917 | 2.500 | 2.500 | 2.500 | 3.167 | 4.083 | 4.083 | 3.167 | 4.083 |
| N | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.250 | 1.250 | 1.250 | 1.250 | 1.250 | 1.250 |
| P | 1.250 | 1.250 | 1.250 | 1.250 | 1.500 | 1.500 | 1.917 | 1.917 | 2.500 | 2.500 | 2.500 | 3.167 | 4.083 | 4.083 | 5.000 | 4.083 | 4.083 |
| HOOK | 0.833 | 1.000 | 1.000 | 1.000 | 1.000 | 1.167 | 1.333 | 1.333 | 1.333 | 1.583 | 1.583 | 1.833 | 1.833 | 1.833 | 1.833 | 2.000 | 2.000 |
| | | | | | | | | | | | | | | | | | |
| A bars | 5 @ 12 | 6 @ 12 | 6 @ 12 | 6 @ 12 | 6 @ 12 | 7 @ 12 | 8 @ 12 | 8 @ 12 | 8 @ 12 | 9 @ 12 | 9 @ 12 | 10 @ 12 | 10 @ 12 | 10 @ 12 | 10 @ 12 | 11 @ 12 | 11 @ 12 |
| B bars | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 |
| C bars | 4 @ 18 | 4 @ 18 | 4 @ 16 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 6 @ 18 | 7 @ 18 | 7 @ 18 | 8 @ 18 | 8 @ 18 | 8 @ 18 | 9 @ 18 | 10 @ 18 | 10 @ 18 | 9 @ 18 | 10 @ 18 |
| D bars | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 |
| E bars | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 6 @ 18 | 6 @ 18 | 7 @ 18 | 7 @ 18 | 8 @ 18 | 8 @ 18 | 8 @ 18 | 9 @ 18 | 10 @ 18 | 10 @ 18 | 11 @ 18 | 10 @ 18 | 10 @ 18 |

*Quantities of Materials*

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stem Concrete ($yd^3$/ft) | 0.9 | 0.9 | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 2.0 | 2.1 | 2.2 | 2.4 | 2.5 | 2.6 | 2.7 |
| Footing Concrete ($yd^3$/ft) | 0.5 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 1.0 | 1.2 | 1.3 |
| | | | | | | | | | | | | | | | | | |
| Steel (lb/ft) | 76 | 86 | 96 | 104 | 118 | 133 | 161 | 182 | 198 | 233 | 240 | 307 | 340 | 360 | 388 | 412 | 438 |

*Maximum Soil Bearing Pressure*

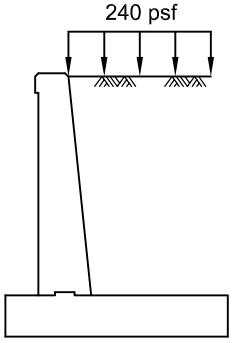
| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $Q_{max}$ (psf) | 4071 | 4328 | 4591 | 4860 | 4811 | 5491 | 5752 | 6018 | 5945 | 6208 | 6917 | 6833 | 7090 | 7352 | 7271 | 8079 | 8332 |

*Notes:*

1. *All dimensions are in feet, unless specified otherwise.*
2. *Spacings of reinforcing bars are in inches.*
3. *Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.*

## ASSUMED DESIGN PARAMETERS

## DENSE FOUNDATION SOIL, LEVEL BACKFILL, SURCHARGE




1. BACKFILL LOADING CONDITIONS:

   LEVEL BACKFILL;
   240 psf LIVE LOAD SURCHARGE.

2. BACKFILL SOIL PROPERTIES:

   TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES

   Ø = ANGLE OF INTERNAL FRICTION = 37°

   $\delta$ = ANGLE OF WALL FRICTION = 22°

   $\gamma$ = EFFECTIVE UNIT WEIGHT = 120 pcf

3. FOUNDATION SOIL PROPERTIES:

   $q_f$ = FACTORED BEARING CAPACITY = 9400 psf

   FRICTION FACTOR = 0.57

   $Ø_{SLIDING}$ = PERFORMANCE FACTOR FOR SLIDING = 0.80

4. SEISMIC LOADING:

   A = 0.17g (Max.)

   Kh = 0.085

   Kv = 0

5. REINFORCED CONCRETE:

   $F'_c$ = 4000 psi

   $F_y$ = 60000 psi

   (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# CANTILEVER RETAINING WALLS
# LOOSE FOUNDATION SOILS,
# SLOPING BACKFILL

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 305.4.0**

*TABLE OF DIMENSIONS AND REINFORCING STEEL*

| H | 14.0 | 15.0 | 16.0 | 17.0 | 18.0 | 19.0 | 20.0 | 21.0 | 22.0 | 23.0 | 24.0 | 25.0 | 26.0 | 27.0 | 28.0 | 29.0 | 30.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 10.000 | 11.000 | 11.500 | 13.000 | 14.000 | 15.000 | 15.500 | 16.500 | 17.500 | 18.500 | 20.000 | 20.500 | 22.000 | 23.000 | 24.000 | 25.000 | 26.000 |
| T | 2.000 | 2.000 | 2.000 | 2.500 | 2.500 | 3.000 | 3.000 | 3.500 | 3.500 | 4.000 | 4.000 | 4.500 | 4.500 | 5.000 | 5.500 | 5.500 | 6.000 |
| A | 1.000 | 1.000 | 1.000 | 2.000 | 2.500 | 2.500 | 2.500 | 3.000 | 3.500 | 4.000 | 5.000 | 5.000 | 6.000 | 6.500 | 7.000 | 7.500 | 8.000 |
| B | 2.500 | 2.583 | 2.667 | 2.708 | 2.792 | 2.833 | 2.917 | 2.958 | 3.042 | 3.083 | 3.167 | 3.208 | 3.292 | 3.333 | 3.375 | 3.458 | 3.500 |
| C | 6.500 | 7.417 | 7.833 | 8.292 | 8.708 | 9.667 | 10.083 | 10.542 | 10.958 | 11.417 | 11.833 | 12.292 | 12.708 | 13.167 | 13.625 | 14.042 | 14.500 |
| | | | | | | | | | | | | | | | | | |
| L | 3.600 | 3.900 | 5.600 | 5.800 | 6.200 | 6.400 | 8.500 | 8.750 | 9.250 | 9.500 | 10.000 | 10.250 | 10.750 | 13.200 | 13.500 | 14.100 | 14.400 |
| M | 4.083 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 |
| N | 1.000 | 1.250 | 1.250 | 1.250 | 1.500 | 1.500 | 1.500 | 1.917 | 1.917 | 1.917 | 1.917 | 1.917 | 2.500 | 2.500 | 3.167 | 3.167 | 3.167 |
| P | 1.000 | 1.000 | 1.000 | 1.000 | 1.250 | 1.000 | 1.250 | 1.250 | 1.500 | 1.500 | 1.917 | 1.917 | 2.500 | 2.500 | 2.500 | 3.167 | 3.167 |
| HOOK | 1.000 | 1.167 | 1.167 | 1.167 | 1.333 | 1.333 | 1.583 | 1.583 | 1.833 | 1.833 | 2.000 | 2.000 | 2.000 | 1.583 | 1.583 | 1.583 | 1.583 |
| | | | | | | | | | | | | | | | | | |
| A bars | 6 @ 12 | 7 @ 12 | 7 @ 12 | 7 @ 12 | 8 @ 12 | 8 @ 12 | 9 @ 12 | 9 @ 12 | 10 @ 12 | 10 @ 12 | 11 @ 12 | 11 @ 12 | 11 @ 12 | 9 @ 6 | 9 @ 6 | 9 @ 6 | 9 @ 6 |
| B bars | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 |
| C bars | 10 @ 18 | 11 @ 15.5 | 11 @ 13 | 11 @ 14.5 | 11 @ 12.5 | 11 @ 11.5 | 11 @ 10 | 11 @ 10.5 | 11 @ 9 | 11 @ 9 | 11 @ 8 | 11 @ 8.5 | 11 @ 7.5 | 11 @ 7.5 | 11 @ 7.5 | 11 @ 6.5 | 11 @ 6.5 |
| D bars | 4 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 6 @ 18 | 6 @ 18 | 6 @ 18 | 7 @ 18 | 7 @ 18 | 7 @ 18 | 7 @ 16 | 7 @ 16 | 8 @ 18 | 8 @ 18 | 9 @ 18 | 9 @ 18 | 9 @ 18 |
| E bars | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 5 @ 18 | 4 @ 18 | 5 @ 18 | 5 @ 18 | 6 @ 18 | 6 @ 18 | 7 @ 16 | 7 @ 16 | 8 @ 18 | 8 @ 18 | 8 @ 18 | 9 @ 18 | 9 @18 |

*Quantities of Materials*

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stem Concrete ($yd^3$/ft) | 0.9 | 1.0 | 1.1 | 1.1 | 1.2 | 1.3 | 1.4 | 1.4 | 1.6 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.2 | 2.2 | 2.2 |
| Footing Concrete ($yd^3$/ft) | 0.7 | 0.8 | 0.9 | 1.2 | 1.3 | 1.7 | 1.7 | 2.1 | 2.3 | 2.7 | 3.0 | 3.4 | 3.7 | 4.3 | 4.9 | 5.1 | 5.8 |
| | | | | | | | | | | | | | | | | | |
| Steel (lb/ft) | 126 | 158 | 173 | 189 | 219 | 309 | 351 | 379 | 422 | 440 | 500 | 516 | 557 | 588 | 625 | 653 | 664 |

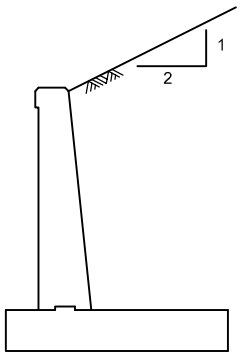
*Maximum Soil Bearing Pressure*

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $Q_{max}$ (psf) | 4918 | 5231 | 5737 | 5064 | 4998 | 5371 | 5816 | 5814 | 5771 | 5807 | 5387 | 5847 | 5473 | 5567 | 5667 | 5687 | 5797 |

*Notes:*

1. *All dimensions are in feet, unless specified otherwise.*
2. *Spacings of reinforcing bars are in inches.*
3. *Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.*

## ASSUMED DESIGN PARAMETERS
## LOOSE FOUNDATION SOIL, SLOPING BACKFILL




1. BACKFILL LOADING CONDITIONS:

   2H:1V SLOPING BACKFILL

2. BACKFILL SOIL PROPERTIES:

   TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES

   Ø = ANGLE OF INTERNAL FRICTION = 37°

   $\delta$ = ANGLE OF WALL FRICTION = 22°

   $\gamma$ = EFFECTIVE UNIT WEIGHT = 120 pcf

3. FOUNDATION SOIL PROPERTIES:

   $q_f$ = FACTORED BEARING CAPACITY = 6000 psf

   FRICTION FACTOR = 0.50

   $Ø_{SLIDING}$ = PERFORMANCE FACTOR FOR SLIDING = 0.80

4. SEISMIC LOADING:

   A = 0.17g (Max.)

   Kh = 0.085

   Kv = 0

5. REINFORCED CONCRETE:

   $F'_c$ = 4000 psi

   $F_y$ = 60000 psi

   (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# CANTILEVER RETAINING WALLS
# LOOSE FOUNDATION SOILS,
# LEVEL BACKFILL, SURCHARGE

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 305.5.0**

TABLE OF DIMENSIONS AND REINFORCING STEEL

| H | 14.0 | 15.0 | 16.0 | 17.0 | 18.0 | 19.0 | 20.0 | 21.0 | 22.0 | 23.0 | 24.0 | 25.0 | 26.0 | 27.0 | 28.0 | 29.0 | 30.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 7.500 | 8.000 | 8.000 | 8.500 | 9.000 | 9.500 | 10.000 | 10.500 | 11.000 | 11.500 | 12.000 | 13.000 | 13.500 | 14.000 | 15.000 | 15.500 | 16.000 |
| T | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.500 | 2.500 | 2.500 | 2.500 |
| A | 1.500 | 1.500 | 1.750 | 2.000 | 2.500 | 2.500 | 2.500 | 3.000 | 3.000 | 3.500 | 3.750 | 4.250 | 4.500 | 5.000 | 5.500 | 5.500 | 6.000 |
| B | 2.500 | 2.583 | 2.667 | 2.750 | 2.833 | 2.917 | 3.000 | 3.083 | 3.167 | 3.250 | 3.333 | 3.417 | 3.500 | 3.542 | 3.625 | 3.750 | 3.875 |
| C | 3.500 | 3.917 | 3.583 | 3.750 | 3.667 | 4.083 | 4.500 | 4.417 | 4.833 | 4.750 | 4.917 | 5.333 | 5.500 | 5.458 | 5.875 | 6.250 | 6.125 |
| | | | | | | | | | | | | | | | | | |
| L | 2.400 | 2.600 | 4.200 | 4.500 | 6.400 | 6.800 | 7.200 | 9.500 | 10.000 | 10.500 | 11.000 | 11.500 | 14.400 | 14.700 | 15.300 | 15.900 | 16.500 |
| M | 1.250 | 1.500 | 1.500 | 1.500 | 1.500 | 1.917 | 2.500 | 2.500 | 3.167 | 3.167 | 3.167 | 4.083 | 4.083 | 3.167 | 4.083 | 5.000 | 5.000 |
| N | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.250 | 1.250 | 1.250 | 1.250 | 1.500 | 1.250 | 1.500 | 1.500 | 1.500 |
| P | 1.000 | 1.000 | 1.000 | 1.000 | 1.250 | 1.250 | 1.500 | 1.917 | 1.917 | 2.500 | 2.500 | 3.167 | 4.083 | 3.167 | 4.083 | 4.083 | 5.000 |
| HOOK | 0.833 | 0.833 | 1.000 | 1.000 | 1.167 | 1.167 | 1.167 | 1.333 | 1.333 | 1.583 | 1.583 | 1.583 | 1.833 | 1.833 | 2.000 | 2.000 | 2.000 |
| | | | | | | | | | | | | | | | | | |
| A bars | 5 @ 12 | 5 @ 12 | 6 @ 12 | 6 @ 12 | 7 @ 12 | 7 @ 12 | 7 @ 12 | 8 @ 12 | 8 @ 12 | 9 @ 12 | 9 @ 12 | 9 @ 12 | 10 @ 12 | 10 @ 12 | 11 @ 12 | 11 @ 12 | 11 @ 12 |
| B bars | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 |
| C bars | 5 @ 18 | 6 @ 18 | 6 @ 18 | 6 @ 18 | 6 @ 18 | 7 @ 18 | 8 @ 18 | 8 @ 18 | 9 @ 18 | 9 @ 18 | 9 @ 18 | 10 @ 18 | 10 @ 16 | 9 @ 16 | 10 @ 18 | 11 @ 18 | 11 @ 18 |
| D bars | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 6 @ 18 | 5 @ 18 | 6 @ 18 | 6 @ 18 | 6 @ 18 |
| E bars | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 5 @ 18 | 5 @ 18 | 6 @ 18 | 7 @ 18 | 7 @ 18 | 8 @ 18 | 8 @ 18 | 9 @ 18 | 10 @ 18 | 9 @ 18 | 10 @ 18 | 10 @ 18 | 11 @ 18 |

*Quantities of Materials*

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stem Concrete ($yd^3$/ft) | 0.9 | 1.0 | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 2.0 | 2.1 | 2.1 | 2.3 | 2.4 | 2.6 | 2.7 |
| Footing Concrete ($yd^3$/ft) | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.9 | 0.9 | 1.0 | 1.0 | 1.3 | 1.4 | 1.4 | 1.5 |
| | | | | | | | | | | | | | | | | | |
| Steel (lb/ft) | 79 | 86 | 101 | 106 | 130 | 141 | 157 | 191 | 211 | 246 | 257 | 287 | 365 | 343 | 435 | 463 | 492 |

*Maximum Soil Bearing Pressure*

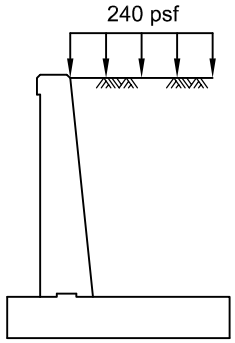
| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $Q_{max}$ (psf) | 4318 | 4614 | 5111 | 5210 | 5133 | 5412 | 5693 | 5616 | 5893 | 5824 | 5929 | 5558 | 5670 | 5733 | 5440 | 5695 | 5687 |

*Notes:*

1. *All dimensions are in feet, unless specified otherwise.*
2. *Spacings of reinforcing bars are in inches.*
3. *Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.*

## ASSUMED DESIGN PARAMETERS

## LOOSE FOUNDATION SOIL, LEVEL BACKFILL, SURCHARGE




1. BACKFILL LOADING CONDITIONS:

   LEVEL BACKFILL;
   240 psf LIVE LOAD SURCHARGE.

2. BACKFILL SOIL PROPERTIES:

   TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES

   Ø = ANGLE OF INTERNAL FRICTION = 37°

   $\delta$ = ANGLE OF WALL FRICTION = 22°

   $\gamma$ = EFFECTIVE UNIT WEIGHT = 120 pcf

3. FOUNDATION SOIL PROPERTIES:

   $q_f$ = FACTORED BEARING CAPACITY = 6000 psf

   FRICTION FACTOR = 0.5

   $Ø_{SLIDING}$ = PERFORMANCE FACTOR FOR SLIDING = 0.80

4. SEISMIC LOADING:

   A = 0.17g (Max.)

   Kh = 0.085

   Kv = 0

5. REINFORCED CONCRETE:

   $F'_c$ = 4000 psi

   $F_y$ = 60000 psi

   (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# CANTILEVER RETAINING WALLS
## ROCK FOUNDATION, SLOPING BACKFILL

DRAWING NUMBER
**E 305.6.0**

DATE OF ISSUE
DECEMBER 2016

TABLE OF DIMENSIONS AND REINFORCING STEEL

| H | 14.0 | 15.0 | 16.0 | 17.0 | 18.0 | 19.0 | 20.0 | 21.0 | 22.0 | 23.0 | 24.0 | 25.0 | 26.0 | 27.0 | 28.0 | 29.0 | 30.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 8.500 | 9.000 | 9.000 | 9.500 | 10.000 | 10.500 | 11.000 | 11.500 | 12.000 | 13.000 | 13.500 | 14.000 | 14.500 | 15.000 | 15.500 | 16.000 | 16.500 |
| T | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.500 | 2.500 | 2.500 | 2.500 | 2.500 | 2.500 | 3.000 | 3.000 | 3.500 |
| A | 1.500 | 2.000 | 2.500 | 3.000 | 3.000 | 3.500 | 3.500 | 4.000 | 4.500 | 4.500 | 4.500 | 5.000 | 5.000 | 5.500 | 5.500 | 6.000 | 6.000 |
| B | 2.500 | 2.583 | 2.667 | 2.750 | 2.833 | 2.917 | 3.000 | 3.083 | 3.125 | 3.208 | 3.292 | 3.375 | 3.458 | 3.542 | 3.583 | 3.667 | 3.708 |
| C | 4.500 | 4.417 | 3.833 | 3.750 | 4.167 | 4.083 | 4.500 | 4.417 | 4.375 | 5.292 | 5.708 | 5.625 | 6.042 | 5.958 | 6.417 | 6.333 | 6.792 |
| | | | | | | | | | | | | | | | | | |
| L | 3.600 | 3.900 | 5.600 | 6.000 | 8.000 | 8.500 | 9.000 | 11.400 | 11.700 | 12.300 | 12.900 | 13.500 | 16.450 | 17.150 | 17.500 | 18.200 | 18.550 |
| M | 1.917 | 1.917 | 1.917 | 1.917 | 1.917 | 1.917 | 2.500 | 2.500 | 1.917 | 3.167 | 4.083 | 4.083 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 |
| N | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.250 | 1.000 | 1.250 | 1.250 | 1.250 | 1.250 | 1.250 | 1.500 | 1.250 | 1.500 |
| P | 1.000 | 1.000 | 1.250 | 1.917 | 1.917 | 2.500 | 2.500 | 3.167 | 3.167 | 3.167 | 4.083 | 4.083 | 5.000 | 5.000 | 5.000 | 5.000 | 5.000 |
| HOOK | 1.000 | 1.167 | 1.167 | 1.333 | 1.333 | 1.583 | 1.583 | 1.833 | 1.833 | 2.000 | 2.000 | 1.583 | 1.583 | 1.833 | 1.833 | 1.833 | 1.833 |
| | | | | | | | | | | | | | | | | | |
| A bars | 6 @ 12 | 7 @ 12 | 7 @ 12 | 8 @ 12 | 8 @ 12 | 9 @ 12 | 9 @ 12 | 10 @ 12 | 10 @ 12 | 11 @ 12 | 11 @ 12 | 9 @ 6 | 9 @ 6 | 10 @ 6 | 10 @ 6 | 10 @ 6 | 10 @ 6 |
| B bars | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 |
| C bars | 7 @ 18 | 7 @ 18 | 7 @ 18 | 7 @ 18 | 7 @ 18 | 7 @ 17 | 8 @ 18 | 8 @ 18 | 7 @ 17 | 9 @ 18 | 10 @ 18 | 10 @ 18 | 11 @ 18 | 11 @ 18 | 11 @ 18 | 11 @ 18 | 11 @ 18 |
| D bars | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 5 @ 18 | 4 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 17 | 5 @ 18 | 5 @ 16 | 6 @ 18 | 5 @ 15 | 6 @ 17 |
| E bars | 4 @ 18 | 4 @ 18 | 5 @ 18 | 7 @ 18 | 7 @ 18 | 8 @ 18 | 8 @ 18 | 9 @ 18 | 9 @ 18 | 9 @ 18 | 10 @ 18 | 10 @ 17 | 11 @ 18 | 11 @ 16 | 11 @ 18 | 11 @ 15 | 11 @ 17 |

*Quantities of Materials*

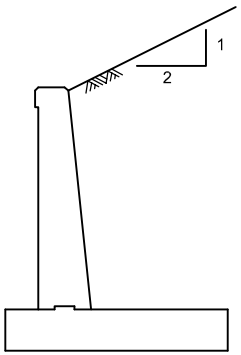
| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stem Concrete ($yd^3$/ft) | 0.9 | 0.9 | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.2 | 2.3 | 2.4 | 2.5 | 2.7 |
| Footing Concrete ($yd^3$/ft) | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.9 | 1.1 | 1.2 | 1.3 | 1.3 | 1.3 | 1.4 | 1.7 | 1.8 | 2.1 |
| | | | | | | | | | | | | | | | | | |
| Steel (lb/ft) | 98 | 120 | 125 | 148 | 164 | 197 | 213 | 272 | 276 | 342 | 379 | 382 | 446 | 503 | 543 | 558 | 580 |

*Maximum Soil Bearing Pressure*

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $Q_{max}$ (psf) | 5123 | 5161 | 5481 | 5530 | 6053 | 6103 | 6626 | 6677 | 6838 | 7053 | 7562 | 7625 | 8134 | 8197 | 8802 | 8870 | 9475 |

*Notes:*

1. *All dimensions are in feet, unless specified otherwise.*
2. *Spacings of reinforcing bars are in inches.*
3. *Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.*




## ASSUMED DESIGN PARAMETERS
## ROCK FOUNDATION, SLOPING BACKFILL

1. BACKFILL LOADING CONDITIONS:

   2H:1V SLOPING BACKFILL

2. BACKFILL SOIL PROPERTIES:

   TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES

   Ø = ANGLE OF INTERNAL FRICTION = 37°

   $\delta$ = ANGLE OF WALL FRICTION = 22°

   $\gamma$ = EFFECTIVE UNIT WEIGHT = 120 pcf

3. FOUNDATION SOIL PROPERTIES:

   $q_f$ = FACTORED BEARING CAPACITY = 20000 psf

   FRICTION FACTOR = 0.70

   $Ø_{SLIDING}$ = PERFORMANCE FACTOR FOR SLIDING = 0.80

4. SEISMIC LOADING:

   A = 0.17g (Max.)

   Kh = 0.085

   Kv = 0

5. REINFORCED CONCRETE:

   $F'_c$ = 4000 psi

   $F_y$ = 60000 psi

   (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# CANTILEVER RETAINING WALLS
## ROCK FOUNDATION, LEVEL BACKFILL, SURCHARGE

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 305.7.0**

TABLE OF DIMENSIONS AND REINFORCING STEEL

| H | 14.0 | 15.0 | 16.0 | 17.0 | 18.0 | 19.0 | 20.0 | 21.0 | 22.0 | 23.0 | 24.0 | 25.0 | 26.0 | 27.0 | 28.0 | 29.0 | 30.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 7.000 | 7.500 | 8.000 | 8.500 | 9.000 | 9.000 | 9.500 | 10.000 | 10.500 | 11.000 | 11.000 | 11.500 | 12.000 | 12.500 | 13.000 | 13.000 | 13.500 |
| T | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.500 | 2.500 |
| A | 2.500 | 2.500 | 2.500 | 2.500 | 3.000 | 3.000 | 3.000 | 3.000 | 3.500 | 3.500 | 3.500 | 4.000 | 4.000 | 4.000 | 4.500 | 4.500 | 4.500 |
| B | 2.500 | 2.583 | 2.667 | 2.750 | 2.833 | 2.917 | 3.000 | 3.083 | 3.167 | 3.250 | 3.333 | 3.417 | 3.500 | 3.583 | 3.667 | 3.708 | 3.792 |
| C | 2.000 | 2.417 | 2.833 | 3.250 | 3.167 | 3.083 | 3.500 | 3.917 | 3.833 | 4.250 | 4.167 | 4.083 | 4.500 | 4.917 | 4.833 | 4.792 | 5.208 |
| | | | | | | | | | | | | | | | | | |
| L | 2.400 | 2.600 | 4.200 | 4.500 | 6.400 | 6.800 | 7.200 | 9.500 | 10.000 | 10.500 | 11.000 | 13.800 | 14.400 | 15.000 | 15.600 | 15.900 | 16.500 |
| M | 1.000 | 1.000 | 1.000 | 1.250 | 1.250 | 1.250 | 1.500 | 1.917 | 1.917 | 2.500 | 2.500 | 2.500 | 3.167 | 4.083 | 4.083 | 3.167 | 4.083 |
| N | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.250 | 1.250 | 1.250 | 1.250 | 1.250 | 1.250 |
| P | 1.250 | 1.250 | 1.250 | 1.250 | 1.500 | 1.500 | 1.917 | 1.917 | 2.500 | 2.500 | 2.500 | 3.167 | 4.083 | 4.083 | 5.000 | 4.083 | 4.083 |
| HOOK | 0.833 | 1.000 | 1.000 | 1.000 | 1.000 | 1.167 | 1.333 | 1.333 | 1.333 | 1.583 | 1.583 | 1.833 | 1.833 | 1.833 | 1.833 | 2.000 | 2.000 |
| | | | | | | | | | | | | | | | | | |
| A bars | 5 @ 12 | 6 @ 12 | 6 @ 12 | 6 @ 12 | 6 @ 12 | 7 @ 12 | 8 @ 12 | 8 @ 12 | 8 @ 12 | 9 @ 12 | 9 @ 12 | 10 @ 12 | 10 @ 12 | 10 @ 12 | 10 @ 12 | 11 @ 12 | 11 @ 12 |
| B bars | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 | 4 @ 12 |
| C bars | 4 @ 18 | 4 @ 18 | 4 @ 16 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 6 @ 18 | 7 @ 18 | 7 @ 18 | 8 @ 18 | 8 @ 18 | 8 @ 18 | 9 @ 18 | 10 @ 18 | 10 @ 18 | 9 @ 18 | 10 @ 18 |
| D bars | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 4 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 |
| E bars | 5 @ 18 | 5 @ 18 | 5 @ 18 | 5 @ 18 | 6 @ 18 | 6 @ 18 | 7 @ 18 | 7 @ 18 | 8 @ 18 | 8 @ 18 | 8 @ 18 | 9 @ 18 | 10 @ 18 | 10 @ 18 | 11 @ 18 | 10 @ 18 | 10 @ 18 |

*Quantities of Materials*

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stem Concrete ($yd^3$/ft) | 0.9 | 1.0 | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 2.0 | 2.1 | 2.2 | 2.4 | 2.5 | 2.6 | 2.7 |
| Footing Concrete ($yd^3$/ft) | 0.5 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 1.0 | 1.2 | 1.3 |
| | | | | | | | | | | | | | | | | | |
| Steel (lb/ft) | 76 | 85 | 96 | 104 | 118 | 133 | 176 | 182 | 198 | 233 | 240 | 307 | 340 | 360 | 388 | 412 | 438 |

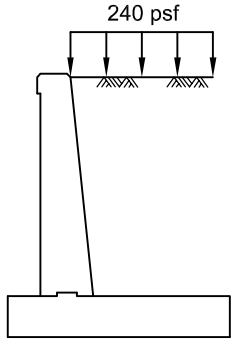
*Maximum Soil Bearing Pressure*

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $Q_{max}$ (psf) | 4071 | 4328 | 4591 | 4860 | 4811 | 5491 | 5752 | 6018 | 5945 | 6208 | 6917 | 6833 | 7090 | 7352 | 7271 | 8079 | 8332 |

*Notes:*

1. *All dimensions are in feet, unless specified otherwise.*
2. *Spacings of reinforcing bars are in inches.*
3. *Designer must confirm design parameters with Geotechnical Engineer prior to selecting wall for site.*

## ASSUMED DESIGN PARAMETERS
## ROCK FOUNDATION, LEVEL BACKFILL, SURCHARGE




1. BACKFILL LOADING CONDITIONS:

   LEVEL BACKFILL;
   240 psf LIVE LOAD SURCHARGE.

2. BACKFILL SOIL PROPERTIES:

   TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES

   Ø = ANGLE OF INTERNAL FRICTION = 37°

   $\delta$ = ANGLE OF WALL FRICTION = 22°

   $\gamma$ = EFFECTIVE UNIT WEIGHT = 120 pcf

3. FOUNDATION SOIL PROPERTIES:

   $q_f$ = FACTORED BEARING CAPACITY = 20000 psf

   FRICTION FACTOR = 0.70

   $Ø_{SLIDING}$ = PERFORMANCE FACTOR FOR SLIDING = 0.80

4. SEISMIC LOADING:

   A = 0.17g (Max.)

   Kh = 0.085

   Kv = 0

5. REINFORCED CONCRETE:

   $F'_c$ = 4000 psi

   $F_y$ = 60000 psi

   (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)

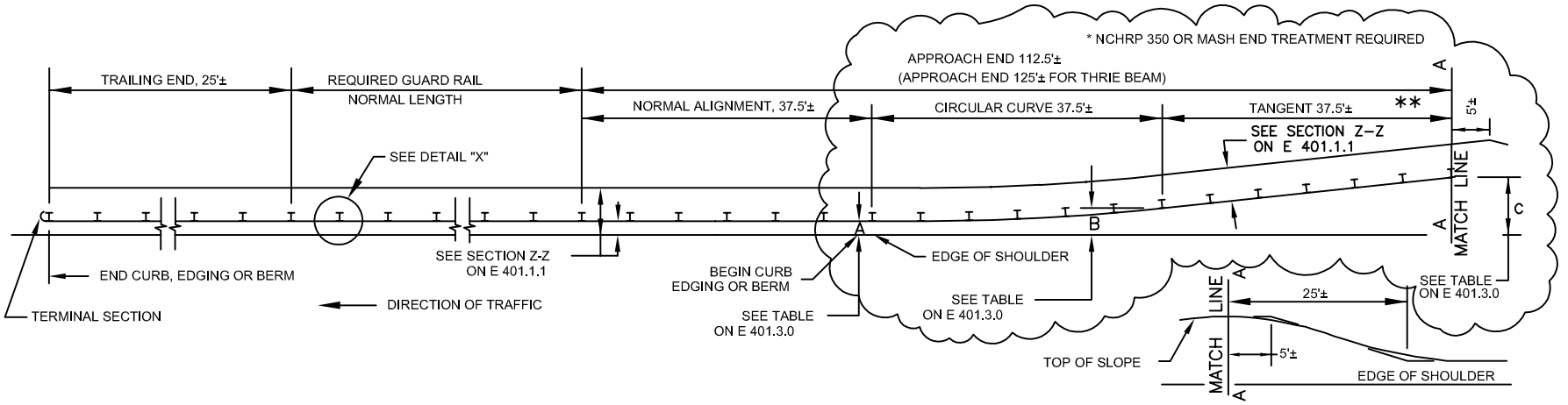
CONSTRUCTION STANDARDS

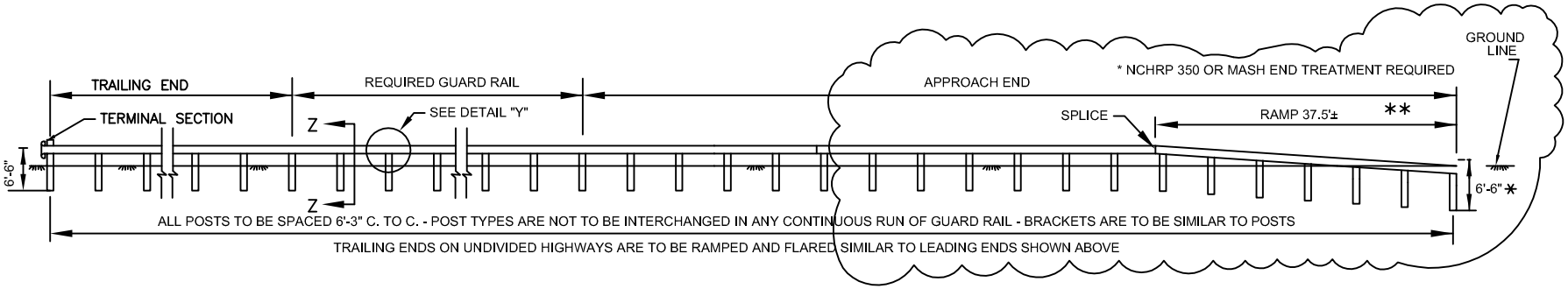
MassDOT Massachusetts Department of Transportation Highway Division

# STEEL W BEAM HIGHWAY GUARD

DRAWING NUMBER **E 401.1.0**

DATE OF ISSUE DECEMBER 2016

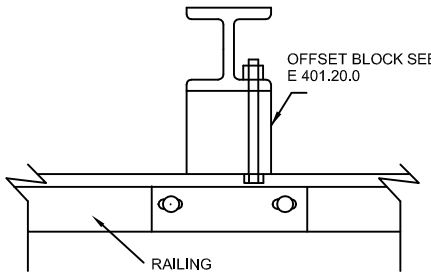


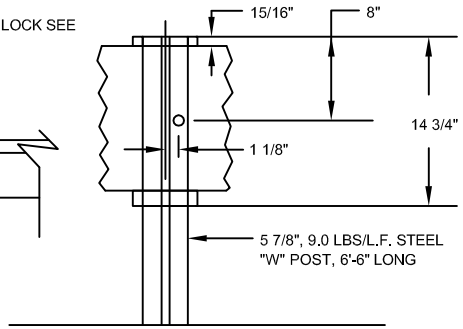

NCHRP 350 TEST LEVEL 3 OR MASH COMPLIANT GUARDRAIL TERMINAL SECTIONS ON ALL ROADWAYS WITH DESIGN SPEED OF 50 MPH OR GREATER.
BURIED ENDS ONLY FOR ROADWAYS WITH SPEEDS LESS THAN 50 MPH.

* STANDARD LENGTH POST TO BE USED IN RAMPED SECTIONS.

** 50' FOR THRIE BEAM.



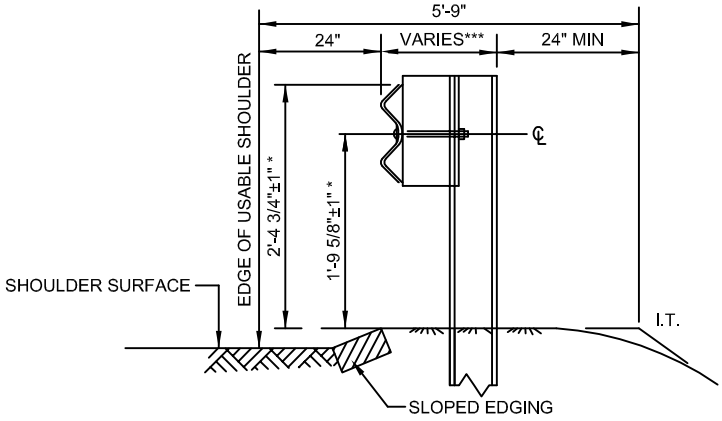

DETAIL "X"




DETAIL "Y"

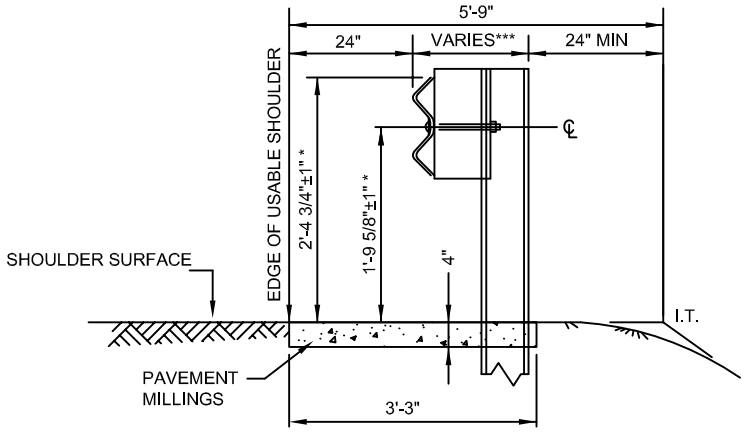
NOTES:

1. THIS METHOD OF INSTALLATION IS APPLICABLE WHEN THE EMBANKMENT SLOPE ADJACENT TO THE ROADWAY IS 1V:2H OR STEEPER.
2. WHEN PLACED IN MEDIAN, CHANGE TO THRIE BEAM AND HEIGHT 2'-8 1/2"±1". FOR SECTION Z-Z, (NOTE ℄ HEIGHT IS ALWAYS 21 1/2")
3. LENGTHS OF HIGHWAY GUARD SHOWN ARE MEASUREMENTS ALONG THE FACE OF THE RAILING.
4. OTHER DETAILS ARE SHOWN ON E 401.5.0 - E 401.10.0
5. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHODS SEE STANDARD SPECIFICATIONS.
6. DETAILS SHOWN HERE ALSO APPLY TO THRIE BEAM GUARD RAIL EXCEPT AS OTHERWISE NOTED.



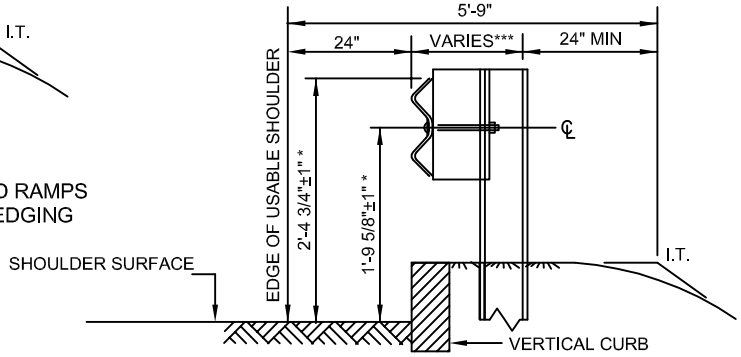

SECTION Z–Z**

SLOPED EDGING ALONG EDGE OF SHOULDER AND RAMPS
SEE E 106.5.0 FOR DETAILS OF SETTING SLOPED EDGING




SECTION Z–Z**

PAVEMENT MILLING MULCH



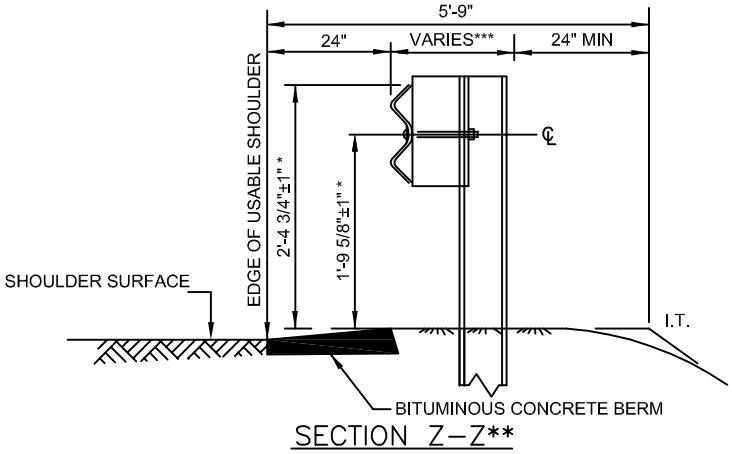

SECTION Z–Z**

VERTICAL GRANITE CURB OR BITUMINOUS
CONCRETE CURB ALONG EDGE OF SHOULDER

* WHEN PLACED IN MEDIAN, CHANGE TO THRIE BEAM AND HEIGHT TO TOP OF RAIL TO 2'-8 1/2"±1".

** SEE E 401.1.0 FOR SECTION Z-Z LOCATION

*** VARIES ACCORDING TO POST MATERIAL




SECTION Z–Z**

TYPE "A" BERM ALONG EDGE OF SHOULDER

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# STEEL W BEAM HIGHWAY GUARD SECTIONS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.1.1**

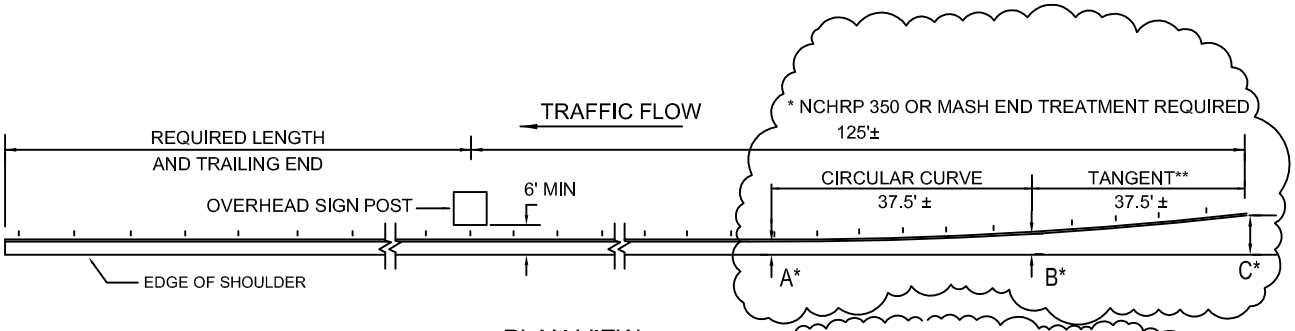
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

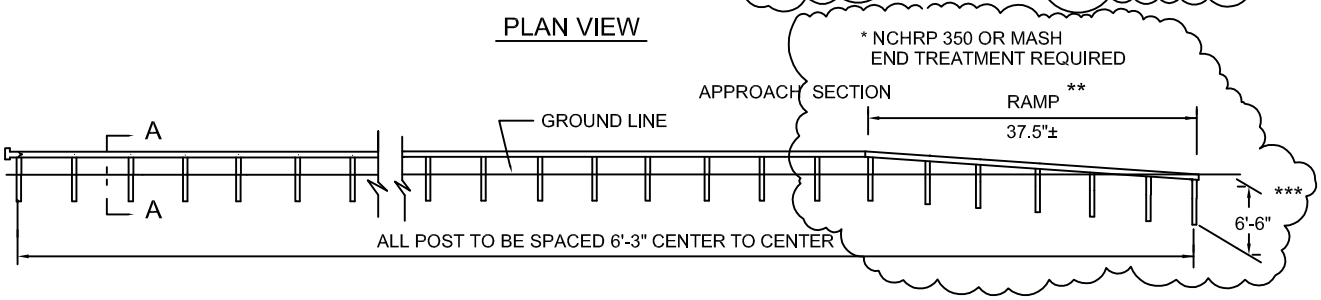
# INSTALLATION FOR STEEL W BEAM HIGHWAY GUARD FOR SIGN PROTECTION

DATE OF ISSUE DECEMBER 2016

DRAWING NUMBER **E 401.2.0**




PLAN VIEW

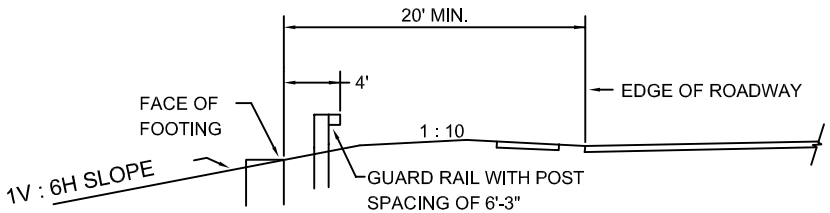



ELEVATION VIEW

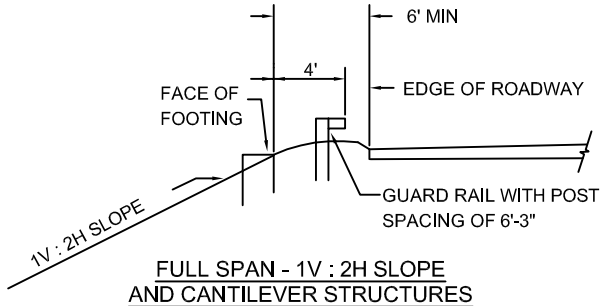
* SEE TABLE ON E 401.3.0 FOR DIMENSIONS
** 50' FOR THRIE BEAM
*** STANDARD LENGTH POSTS SHALL BE USED IN RAMPED SECTIONS

NOTES:

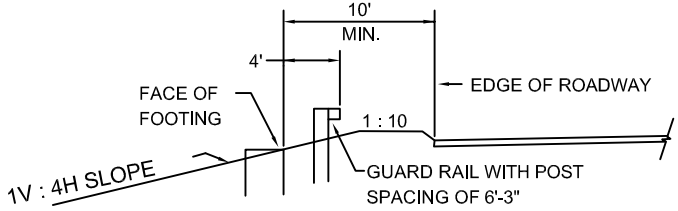
1. LENGTHS OF HIGHWAY GUARD SHOWN ARE MEASUREMENTS ALONG FACE OF RAILING.
2. FOR DESCRIPTIONS, MATERIAL AND AND CONSTRUCTION METHODS, SEE THE STANDARD SPECIFICATIONS AND CONSTRUCTION E 401.1.0 AND E 401.5.0 - E 401.10.0.
3. DETAILS SHOWN HEREIN ALSO APPLY TO THRIE BEAM GUARD RAIL, EXCEPT AS OTHERWISE NOTED.
4. WHEN PLACED IN MEDIAN, CHANGE TO THRIE BEAM & HEIGHT OF 2'-6 1/2"±1"



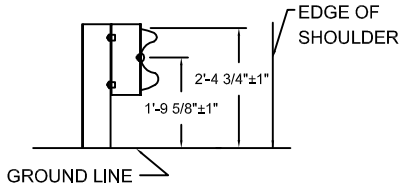

FULL SPAN - 1V : 6H SLOPE




FULL SPAN - 1V : 2H SLOPE
AND CANTILEVER STRUCTURES




FULL SPAN - 1V : 4H SLOPE

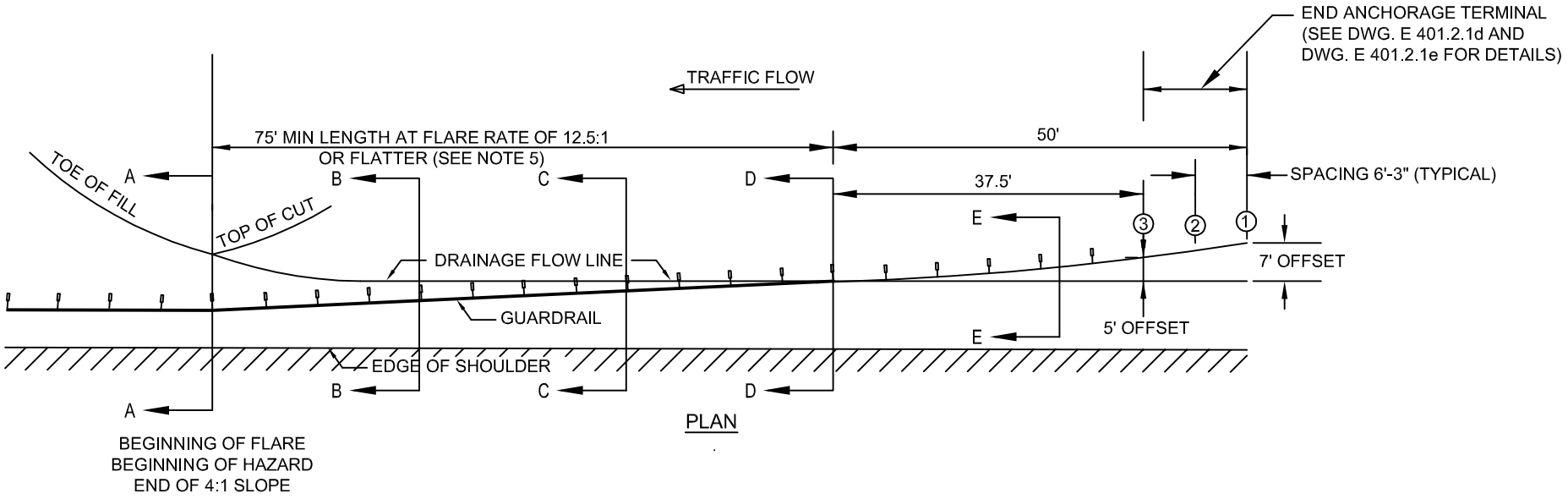



SECTION A-A

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# STEEL W BEAM HIGHWAY GUARD
## BURIED IN BACK-SLOPE
## PLAN VIEW




NOTES:

1. THE BOTTOM RAIL SHALL BE TUCKED BEHIND AND BOLTED TO POST A-A USING TWO (2) 5/8" DIA. X 1 1/2" LONG HEX. HEAD BOLT THROUGH THE UPPER AND LOWER PORTION OF THE RAIL.
2. THE BOTTOM RAIL SHALL BE BOLTED TO THE REMAINING POSTS (OTHER THAN POST 1, 2, & 3) WITH A SINGLE 5/8" DIA. X 1 1/2" LONG HEX. HEAD BOLT THROUGH THE MIDDLE OF THE RAIL ELEMENT. (FOR ATTACHMENT TO POST 3 DETAILS SEE DWG. E 401.2.1e)
3. OFFSET BLOCKS ARE NOT REQUIRED FOR THE BOTTOM RAIL.
4. MAINTAIN HEIGHT OF TOP RAIL RELATIVE TO EDGE OF SHOULDER UNTIL A MAXIMUM HEIGHT OF 45" ABOVE GROUND IS REACHED, THEN TOP OF GUARD RAIL BECOMES PARALLEL TO GROUND.
5. LOW SPEED (45 MPH OR LESS) INSTALLATIONS REQUIRE 50' OF GUARDRAIL USING A 9:1 FLARE RATE.
6. THIS END TREATMENT IS ONLY APPLICABLE WHERE THERE IS A 1:4 OR FLATTER FORE-SLOPE BETWEEN THE ROADWAY AND THE CUT-SLOPE.

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.2.1a**

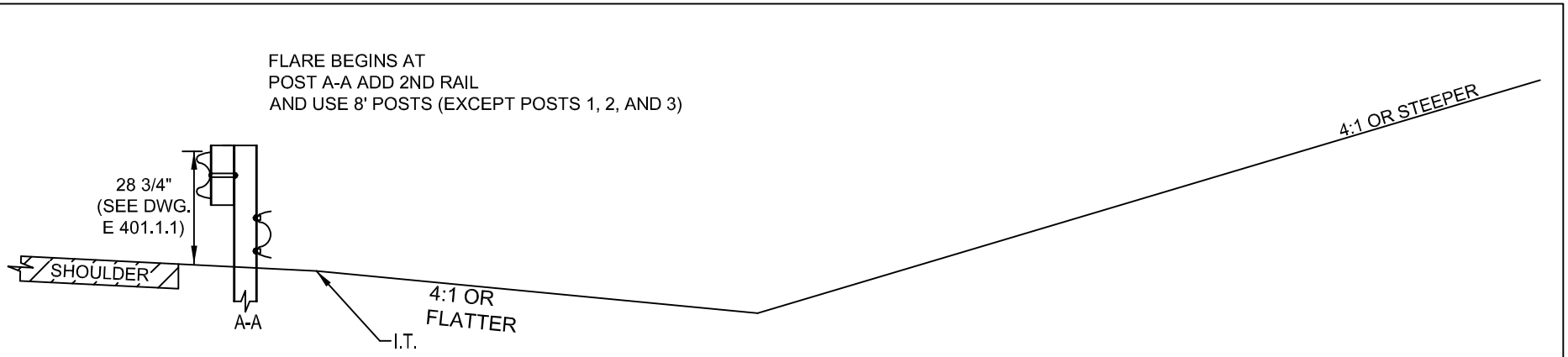
massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

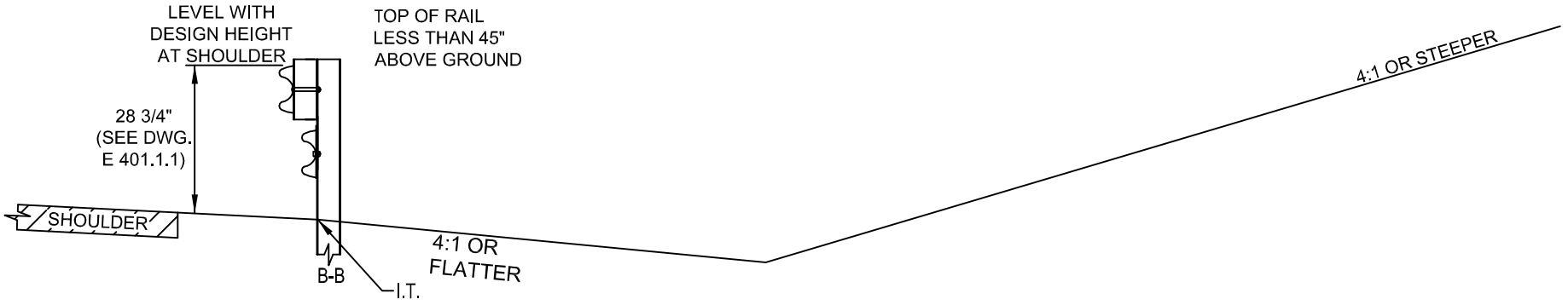
# STEEL W BEAM HIGHWAY GUARD
## BURIED IN BACK-SLOPE
## POST LOCATION

DATE OF ISSUE
DECEMBER 2016

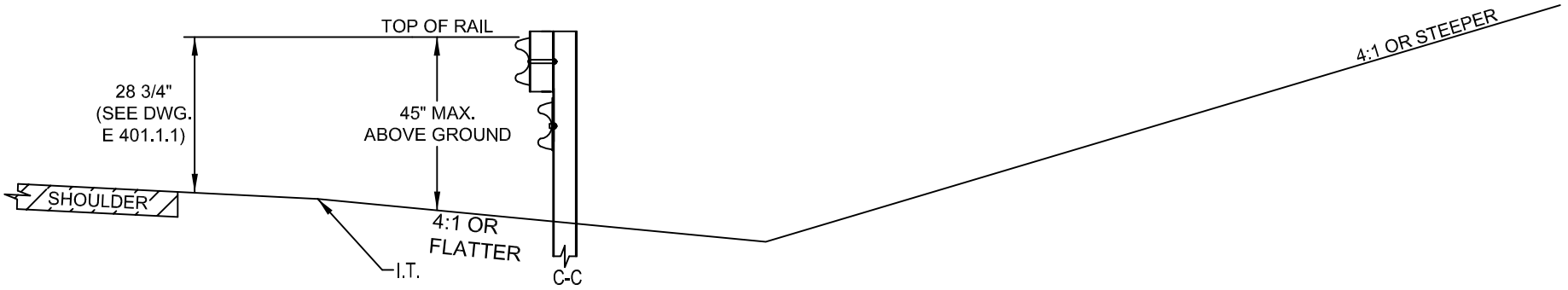
DRAWING NUMBER
**E 401.2.1b**




SECTION A-A




SECTION B-B




SECTION C-C

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# STEEL W BEAM HIGHWAY GUARD BURIED IN BACK-SLOPE POST LOCATION

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.2.1c**

NOTE: FOR BOLTING AND PLATE DETAILS SEE DWG. E 401.2.1e

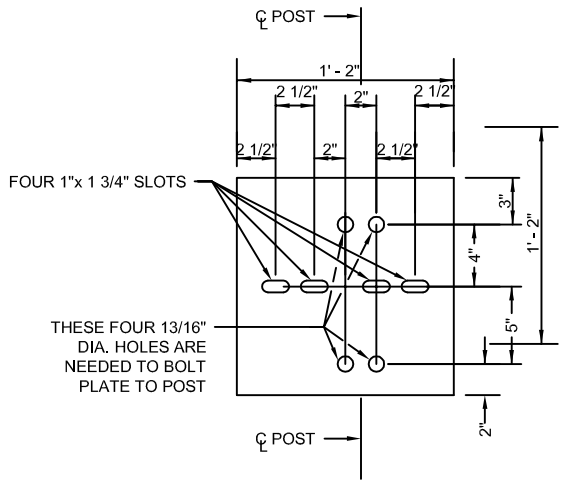
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# STEEL W BEAM HIGHWAY GUARD BURIED IN BACK-SLOPE ANCHORAGE DETAILS

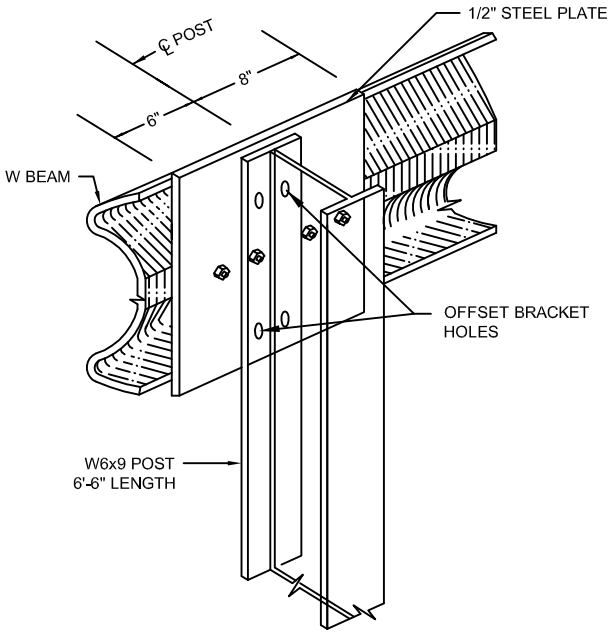
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.2.1d**

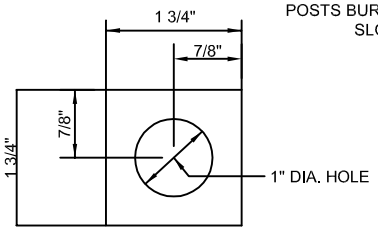



1/2" STEEL PLATE VIEW

(GALVANIZED)
BOLTED TO THE LAST THREE POSTS BURIED IN BACK SLOPE

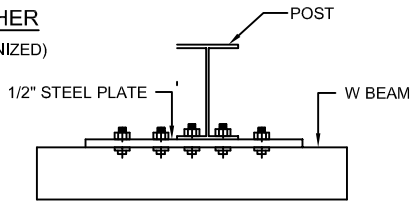



1/2" STEEL PLATE ATTACHED TO POST




SQUARE WASHER

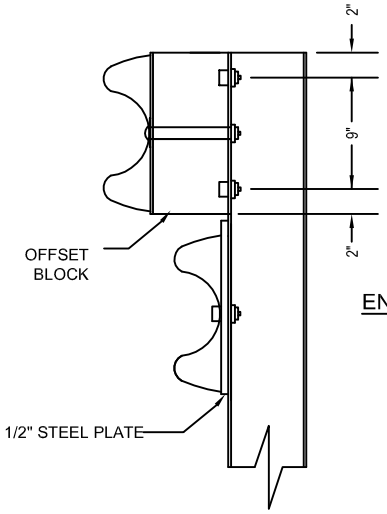
(3/16" THICK GALVANIZED)



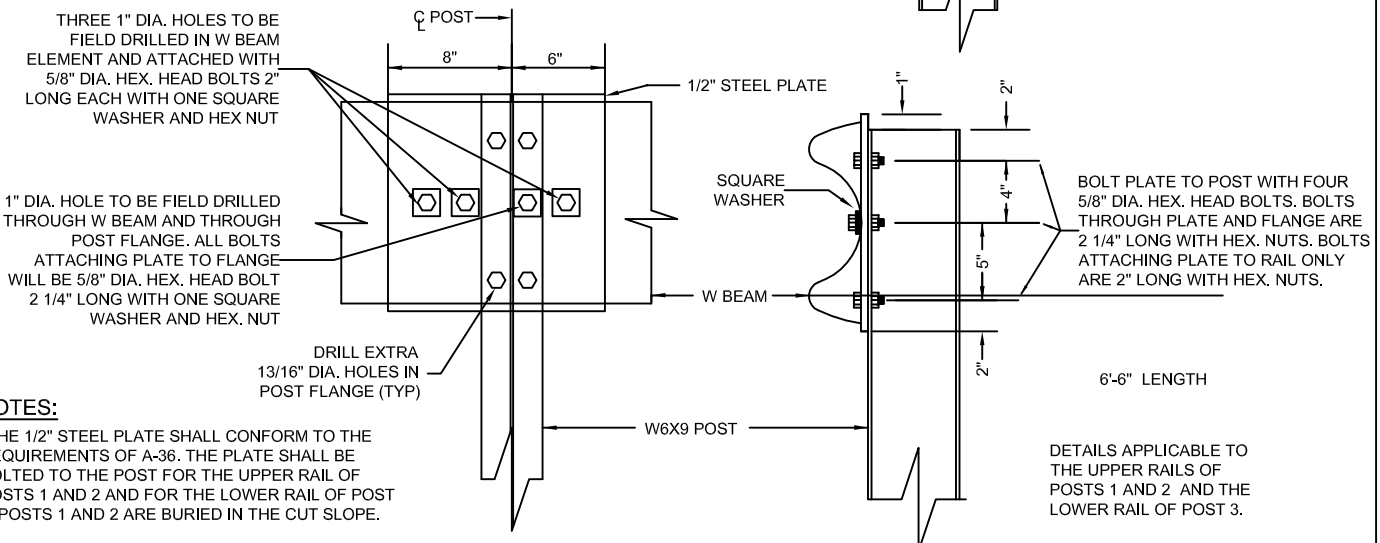

PLAN VIEW

(BOLTED)

ALL BOLTS, NUTS AND WASHERS ARE TO BE GALVANIZED




END VIEW OF POST 3




NOTES:

1. THE 1/2" STEEL PLATE SHALL CONFORM TO THE REQUIREMENTS OF A-36. THE PLATE SHALL BE BOLTED TO THE POST FOR THE UPPER RAIL OF POSTS 1 AND 2 AND FOR THE LOWER RAIL OF POST 3. POSTS 1 AND 2 ARE BURIED IN THE CUT SLOPE.
2. FIELD DRILLED HOLES SHALL BE COATED WITH ZINC RICH PAINT.

FRONT VIEW

END VIEW

1/2" STEEL PLATE BOLTED TO POST

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# STEEL W BEAM HIGHWAY GUARD BURIED IN BACK-SLOPE END ANCHORAGE DETAILS FOR POSTS 1, 2 AND 3

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.2.1e**

TYPICAL INSTALLATION*

| | A | B | C | |
|---|---|---|---|---|
| | | | W SECTION | THRIE BEAM |
| ALL GUARDRAIL CONFIGURATION SHOWN ON E 401.1.1 SECTION Z-Z | 24" ± | 3'-3" ± | 6'-6" ± | 7'-7" ± |

NOTE: ALL MEASUREMENTS ARE FROM EDGE OF USABLE SHOULDER

FOR OVERHEAD SIGN PROTECTION**

| | A | B | C | |
|---|---|---|---|---|
| | | | W SECTION | THRIE BEAM |
| 1V : 2H SLOPE 2:1 SLOPE | 24" ± | 3'-3" ± | 6'-6" ± | 7'-7" ± |
| 1V : 4H SLOPE 4:1 SLOPE | 6'-0" ± | 7'-9" ± | 11'-0" ± | 12'-1" ± |
| 1V : 6H SLOPE 6:1 SLOPE | 16'-0" ± | 17'-9" ± | 21'-0" ± | 22'-1" ± |

* SEE E 401.1.0

** SEE E 401.2.0

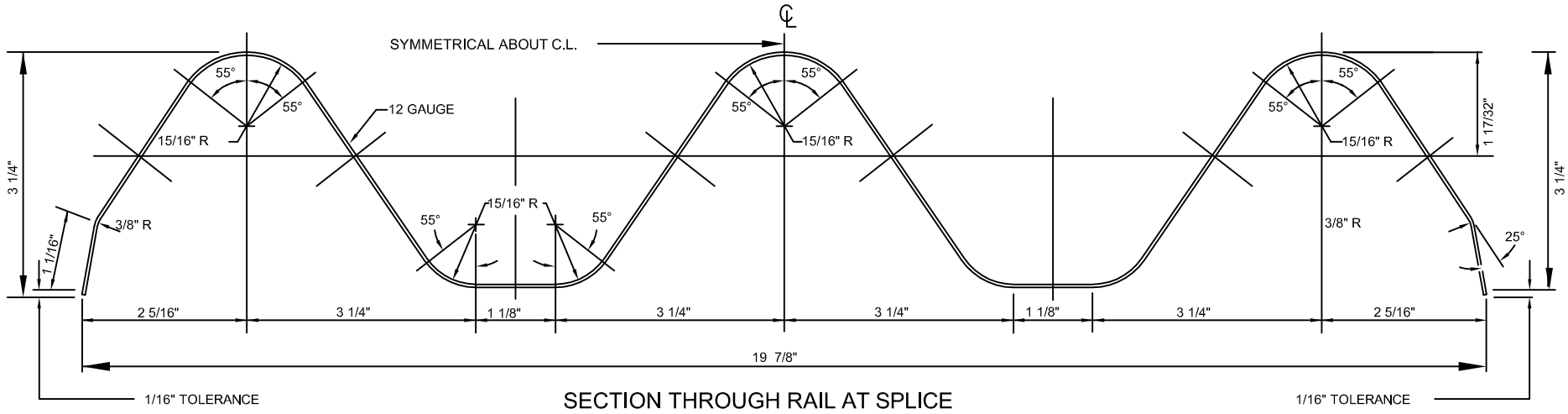
MassDOT Highway Division
Massachusetts Department of Transportation

CONSTRUCTION STANDARDS

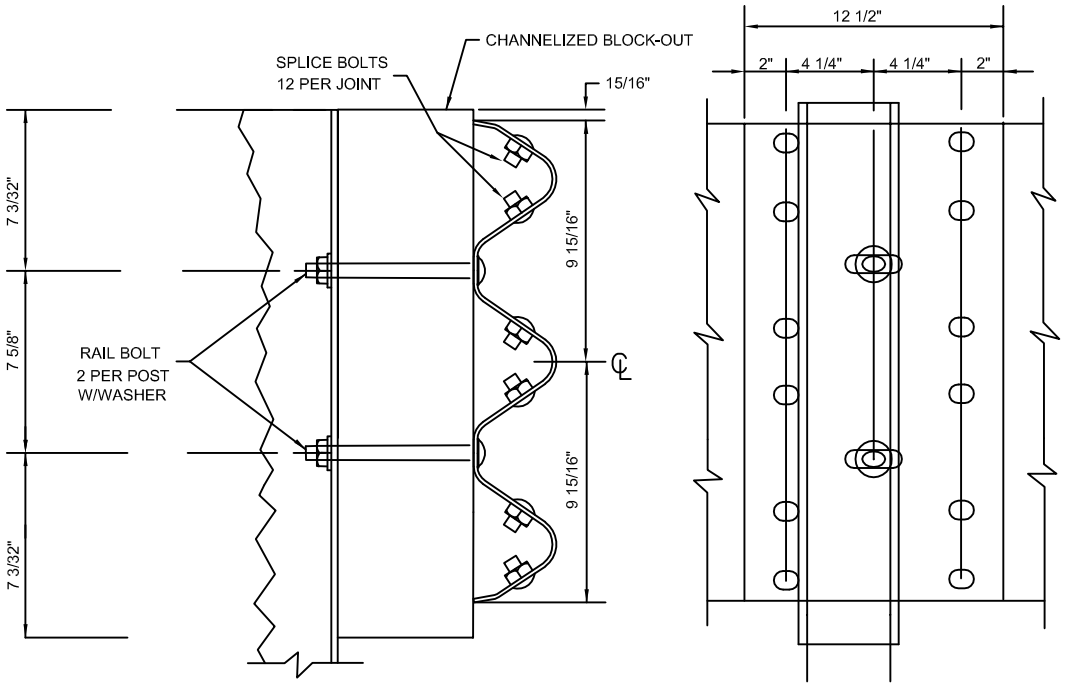
# STEEL THRIE BEAM
# HIGHWAY GUARD RAIL DETAILS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.5.0**




SECTION THROUGH RAIL AT SPLICE




RAIL SPLICE

DIRECTION OF TRAFFIC →

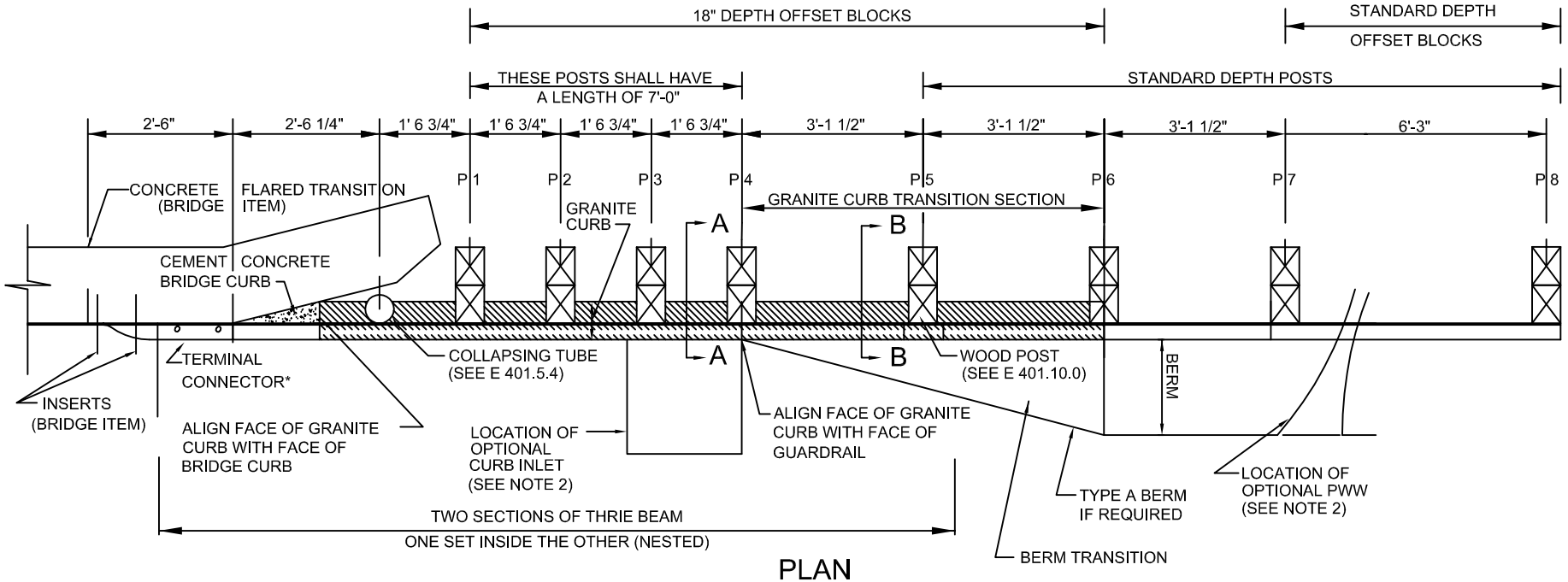
NOTES:

1. FOR POST & BLOCK-OUT DETAILS SEE E 401.6.0R AND E 401.21.0
2. FOR HARDWARE DETAILS SEE E 401.7.0R
3. LAP DOWN STREAM IN DIRECTION OF TRAFFIC

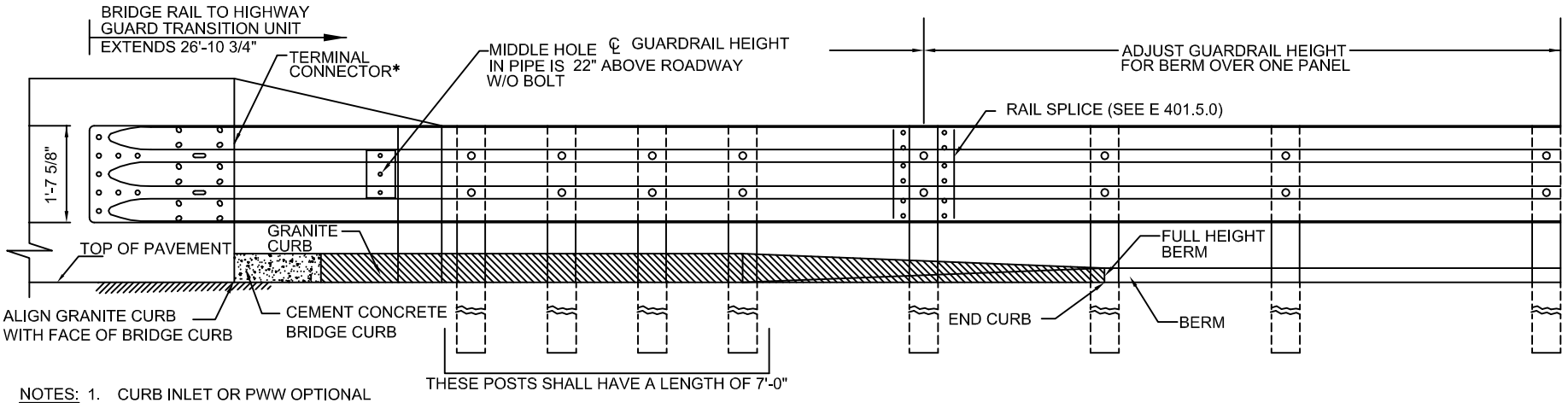
CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

# BRIDGE RAIL TO HIGHWAY GUARD TRANSITION




## PLAN




## ELEVATION

NOTES:
1. CURB INLET OR PWW OPTIONAL BASED ON GENERAL PLAN REQUIREMENTS
2. FOR SECTIONS A-A AND B-B, SEE E 401.5.2
3. THRIE BEAM TO W BEAM TRANSITION RAIL (SEE E401.6.1) IS TYPICALLY PLACED OUTSIDE BRIDGE RAIL TO HIGHWAY GUARD TRANSITION UNIT LENGTH, (26'-10 3/4") AT OR BEYOND POST P8.
4. TRANSITION FROM THRIE BEAM IS ALLOWED FROM P5 TO P7 IF REQUIRED BY SITE CONSTRAINTS. PAYMENT FOR THE TRANSITION ELEMENT IS INCLUDED IN THIS ITEM IN THAT CASE.

* SEE E 401.5.3 FOR TERMINAL CONNECTOR DIMENSIONS AND DETAILS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.5.1**

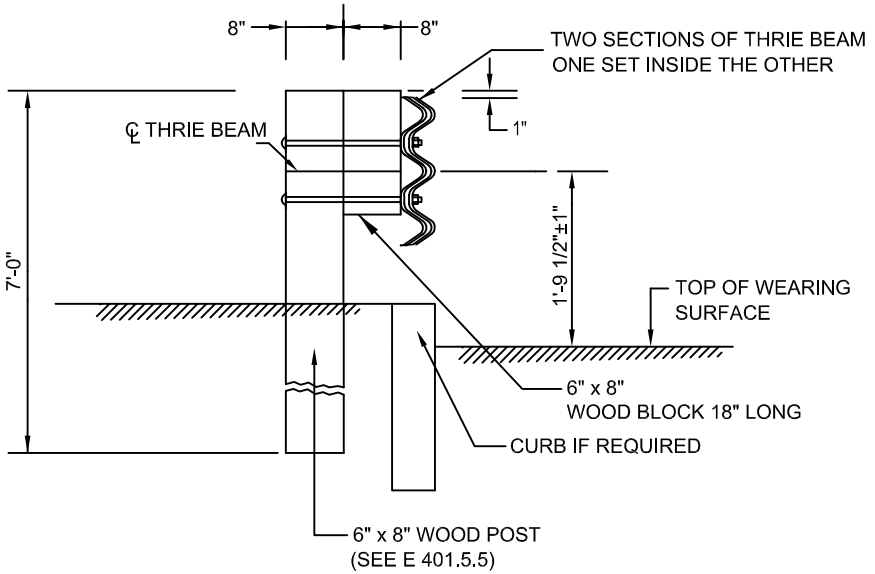
CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

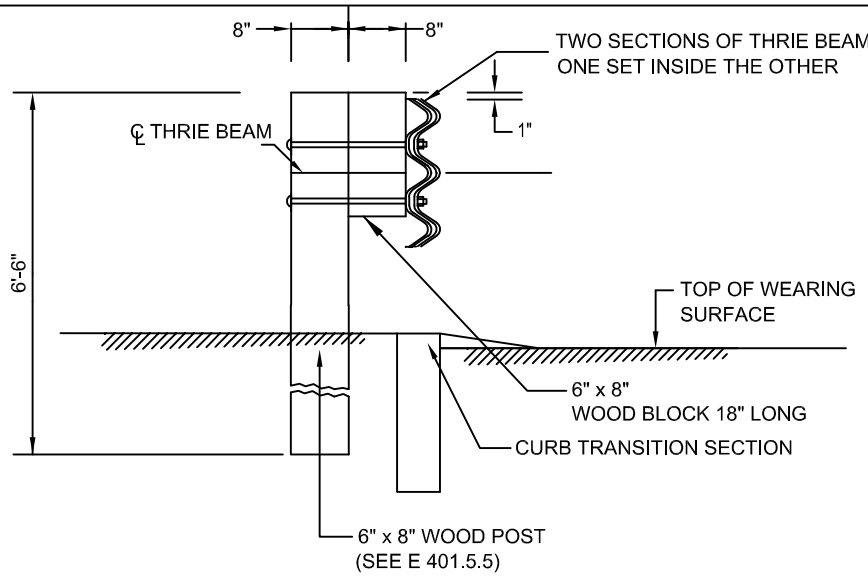
# BRIDGE RAIL TO HIGHWAY GUARD TRANSITION - SECTIONS

DATE OF ISSUE DECEMBER 2016

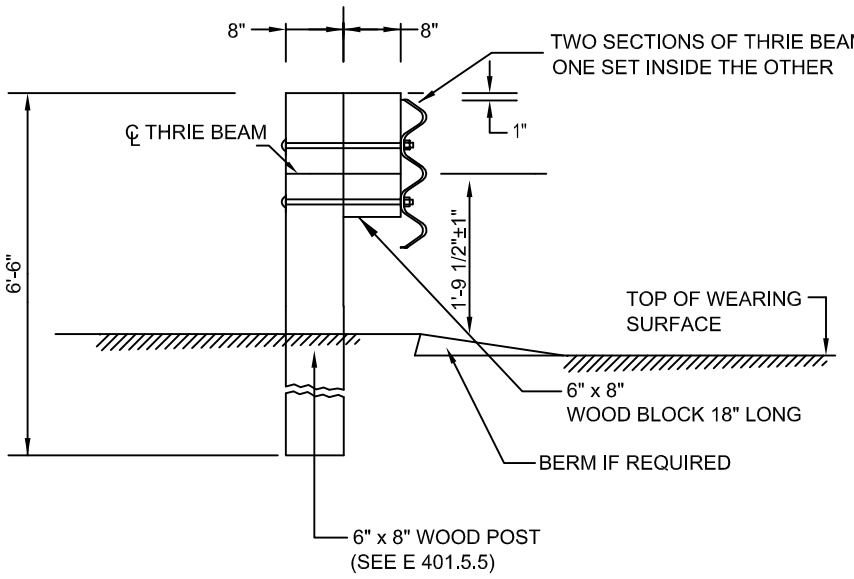
DRAWING NUMBER **E 401.5.2**



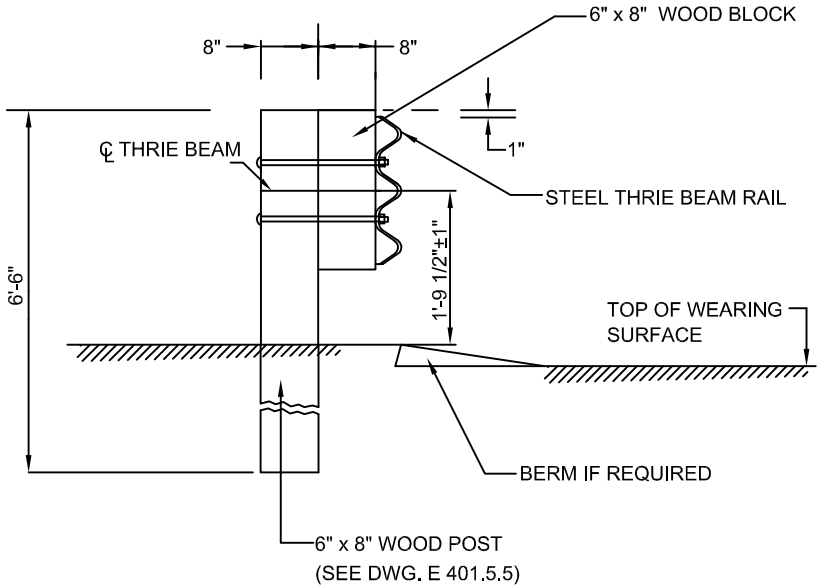

POST P1, P2, P3, P4



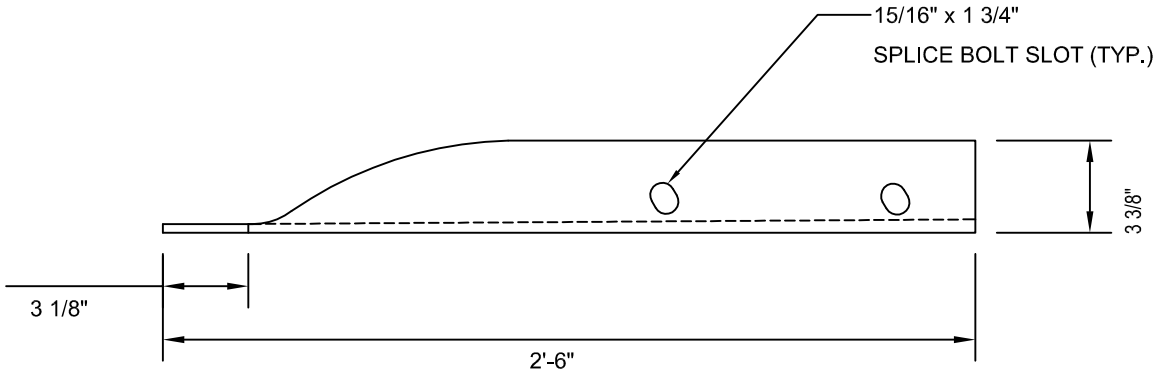

POST P5

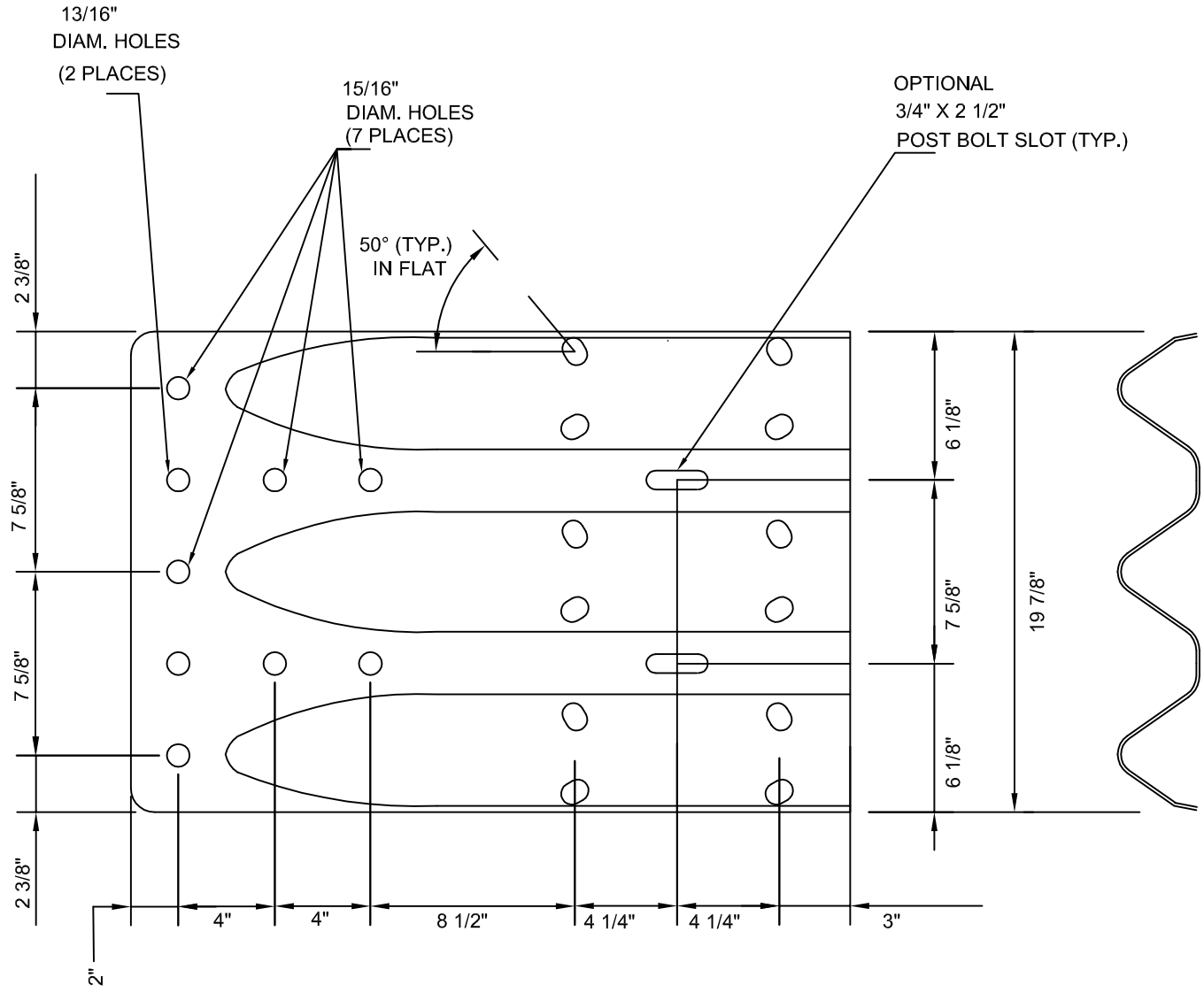



POST P6




POST P7 THROUGH END (TYPICAL GUARD RAIL INSTALLATION)




NOTES: 1. BASE METAL THICKNESS = 1/8" (10 GAGE)
2. SEE E 401.4.1

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# STEEL THRIE BEAM HIGHWAY TERMINAL CONNECTOR

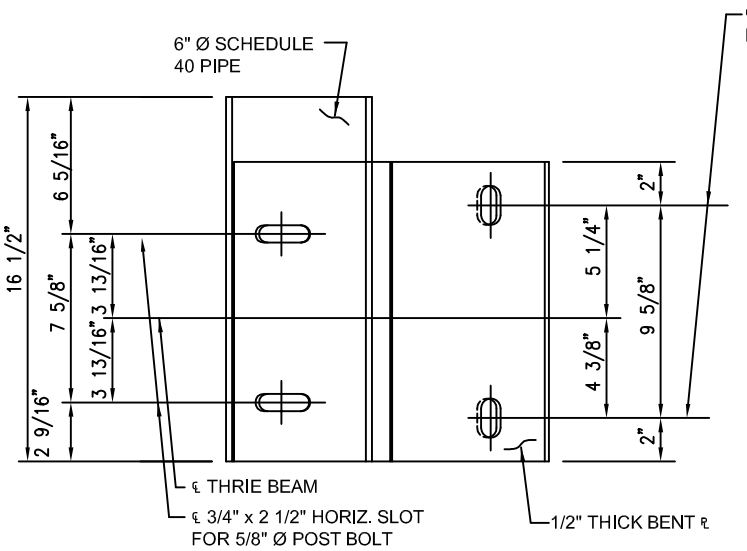
DATE OF ISSUE
DECEMBER 2016

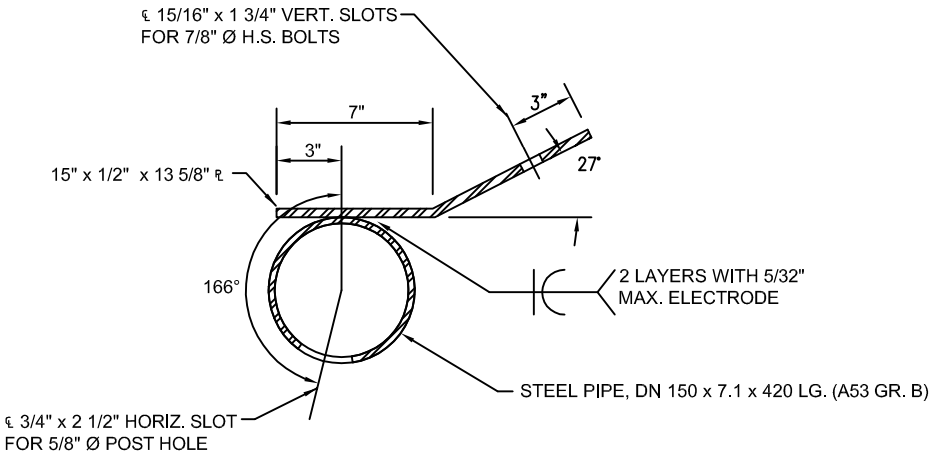
DRAWING NUMBER
**E 401.5.3**

CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

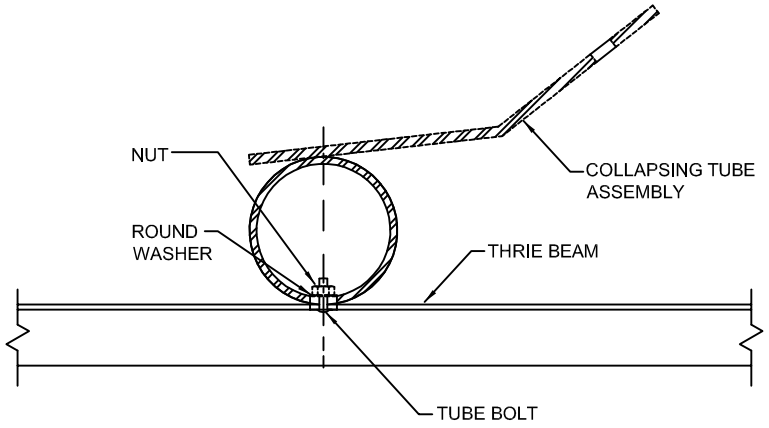
# BRIDGE RAIL TO HIGHWAY GUARD
# COLLAPSING TUBE




NOTE:
BENT PLATE/PIPE ASSEMBLY SHALL BE HOT DIP GALVANIZED

COLLAPSING TUBE ASSEMBLY




RAIL/TUBE CONNECTION

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.5.4**

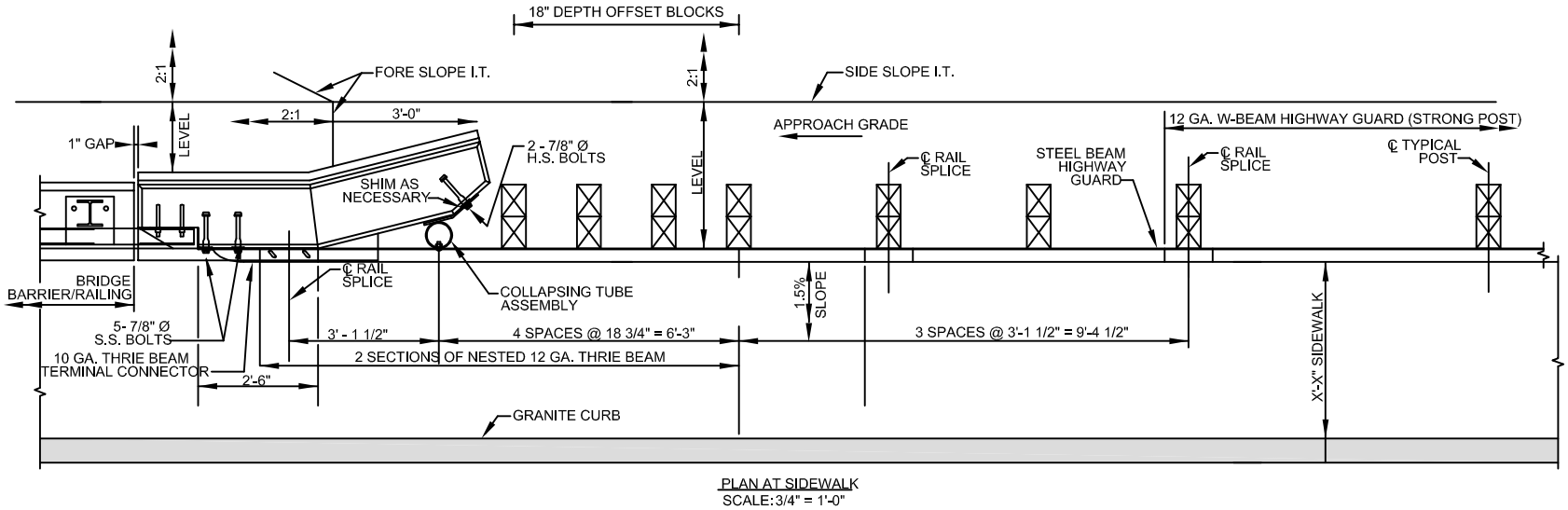
CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

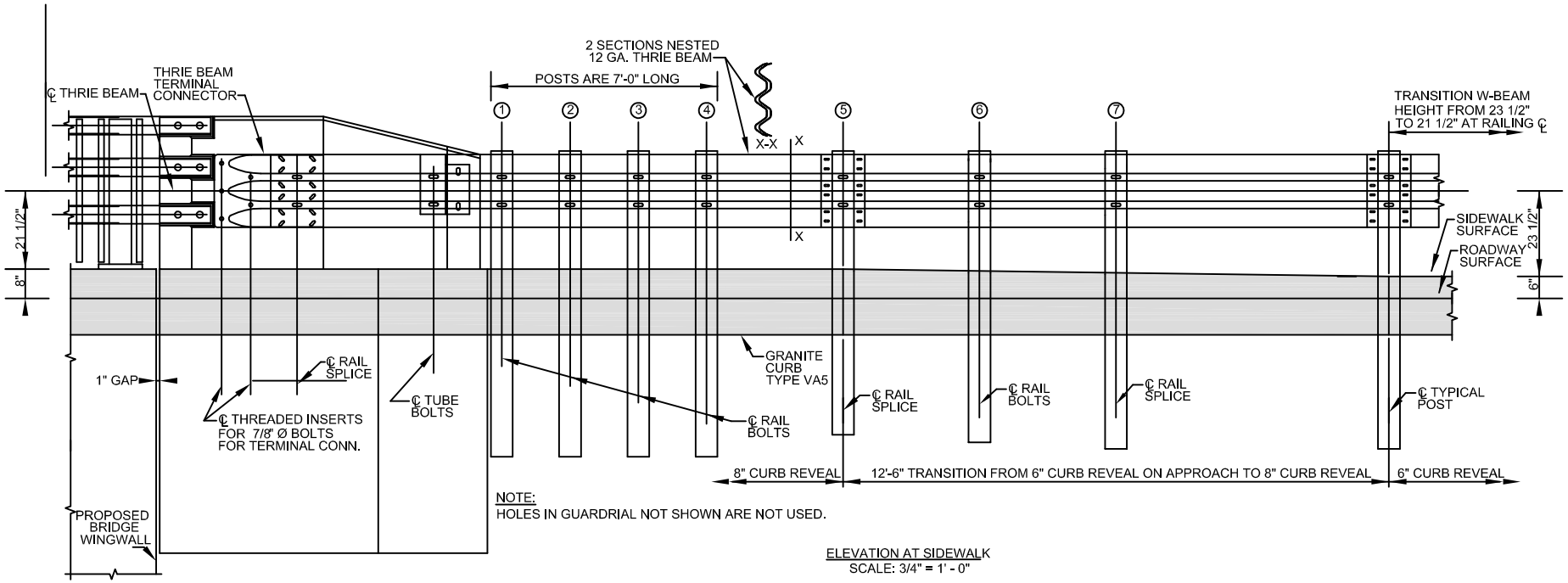
# BRIDGE RAIL TO HIGHWAY GUARD TRANSITION AT SIDEWALK

DRAWING NUMBER
**E 401.5.5**

DATE OF ISSUE
DECEMBER 2016

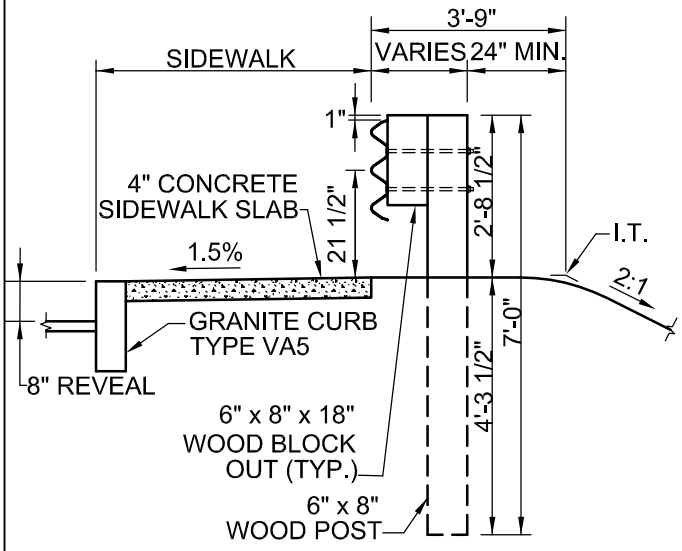



PLAN AT SIDEWALK
SCALE: 3/4" = 1'-0"

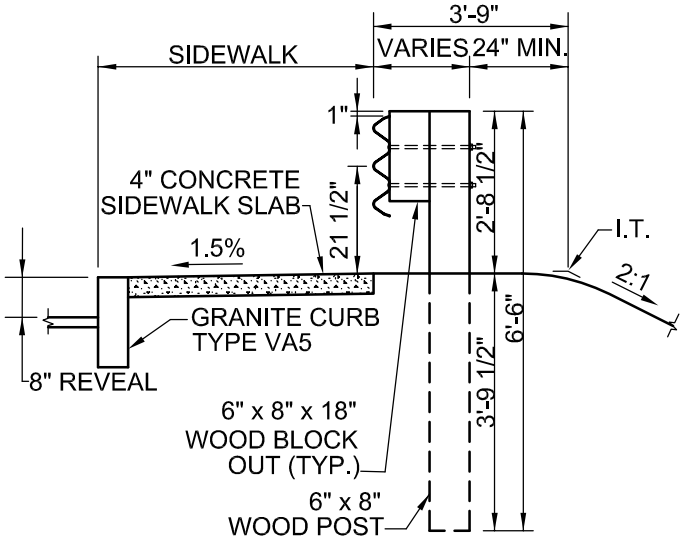



NOTE:
HOLES IN GUARDRIAL NOT SHOWN ARE NOT USED.

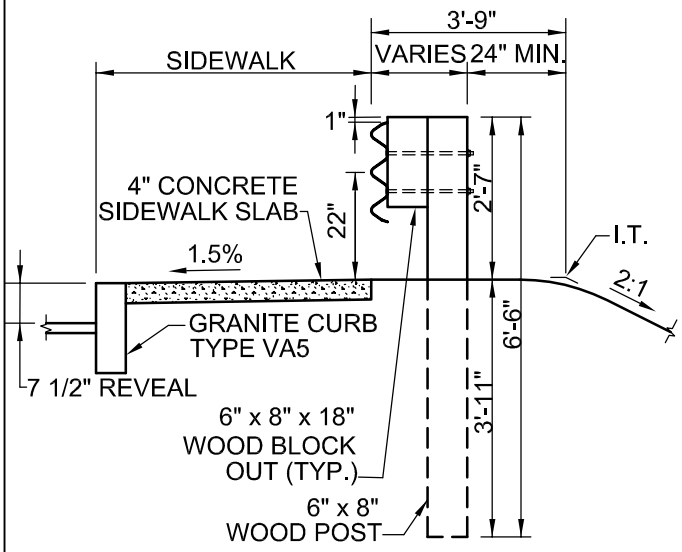
ELEVATION AT SIDEWALK
SCALE: 3/4" = 1' - 0"



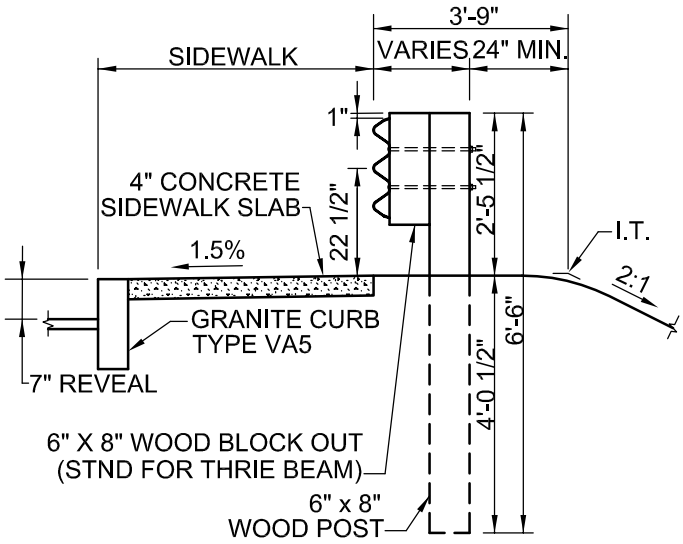

THRIE BEAM POSTS 1-4




THRIE BEAM POST 5




W TO THRIE BEAM TRANSITION POST 6




W-BEAM POST 7

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# BRIDGE RAIL TO HIGHWAY GUARD TRANSITION AT SIDEWALK - SECTIONS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.5.6**

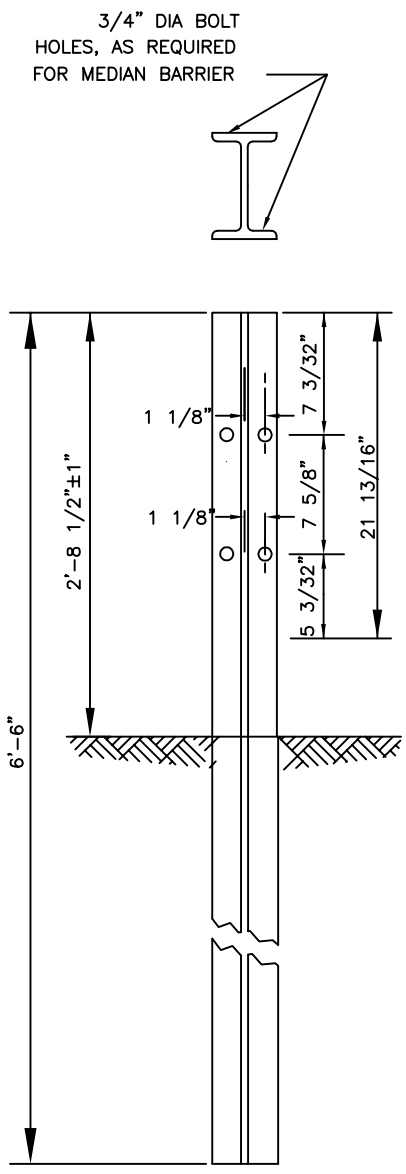
CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

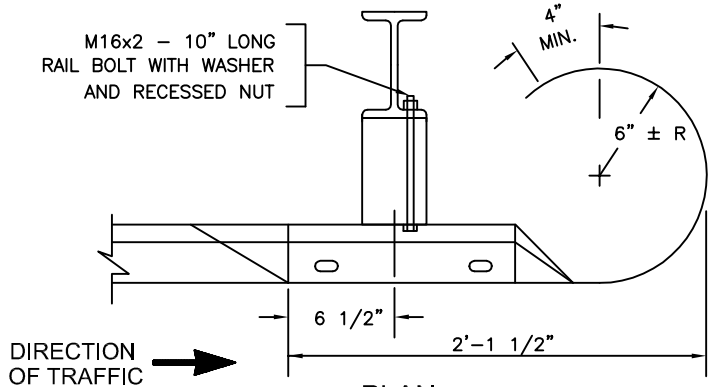
# STEEL THRIE BEAM HIGHWAY GUARD DETAILS

DRAWING NUMBER
**E 401.6.0**

DATE OF ISSUE
DECEMBER 2016

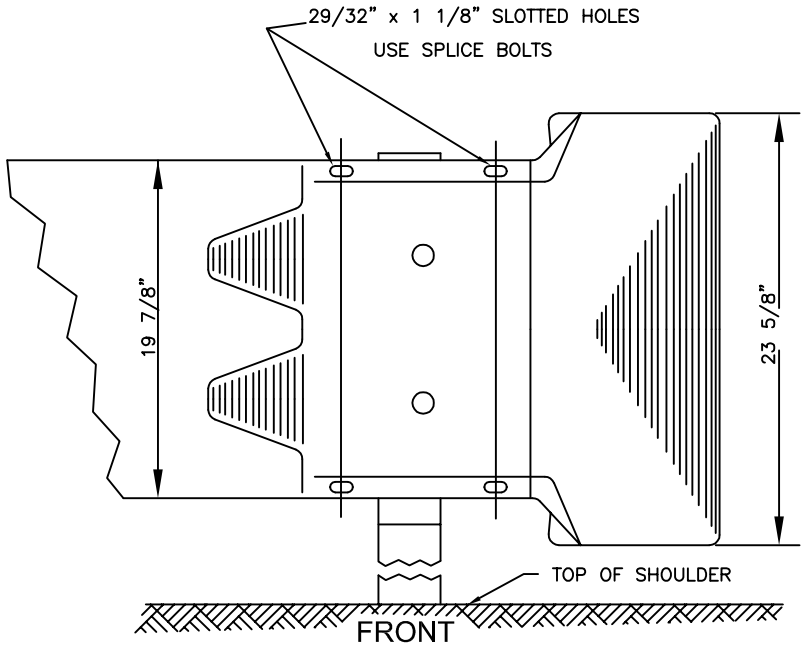



POST




PLAN

TERMINAL SECTION




FRONT

TERMINAL SECTION
DOWN STREAM OF TRAFFIC

DIRECTION OF TRAFFIC

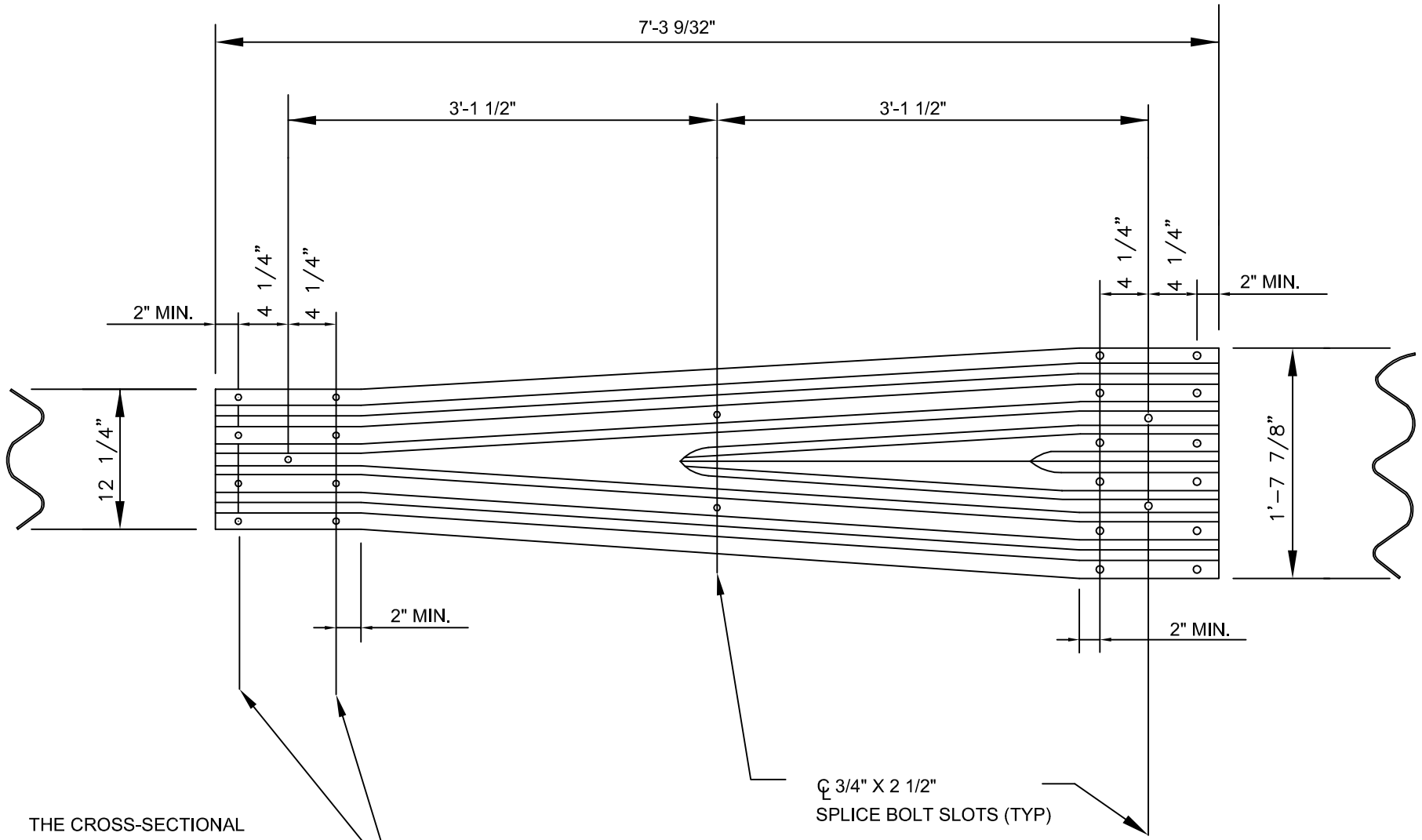
NOTES:

1. POST TO BE FABRICATED FROM W6"x9" STEEL SECTIONS AS SHOWN.
2. POST TO BE 3/4" DIA. (STD GALV WASHERS TO BE USED AT THESE CONNECTIONS).
3. FOR RAIL BOLT SLOT DETAILS SEE E 401.7.0.
4. FOR BLOCK-OUT DETAILS SEE E 401.21.0.

massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# STEEL HIGHWAY GUARD
# TRANSITION BEAM




NOTE: BASE METAL THICKNESS = 12 GAUGE

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.6.1**

CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

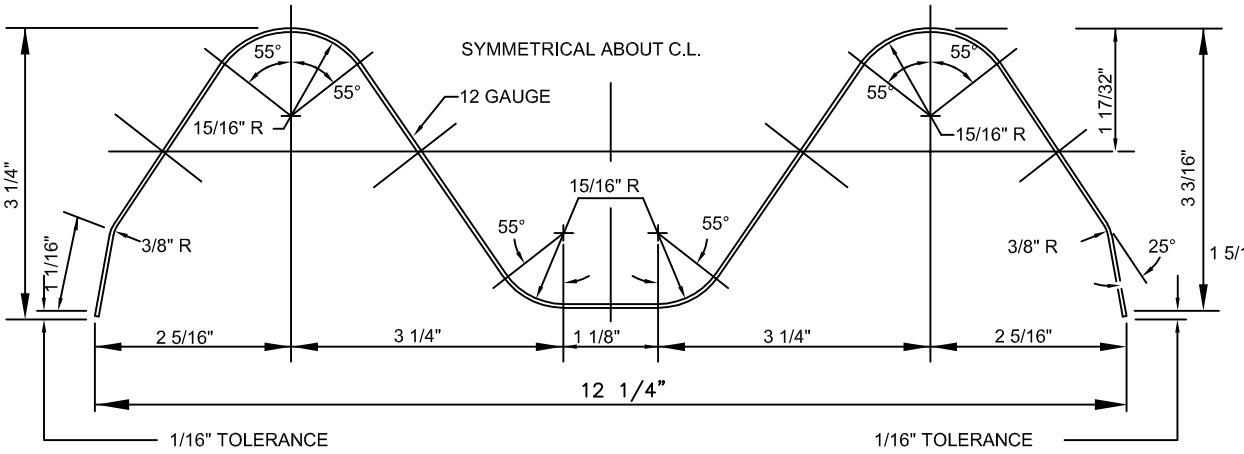
# STEEL W BEAM HIGHWAY GUARD

## RAIL DETAILS

DRAWING NUMBER **E 401.7.0**

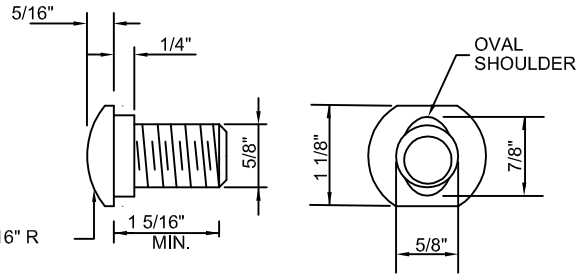
DATE OF ISSUE DECEMBER 2016

### SECTION THROUGH RAIL

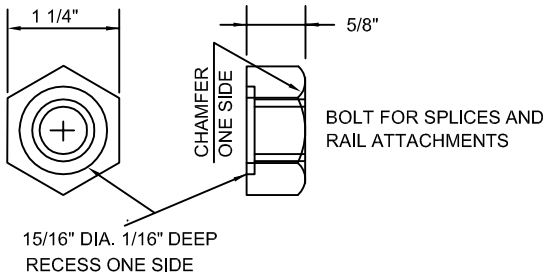



### SPLICE BOLT

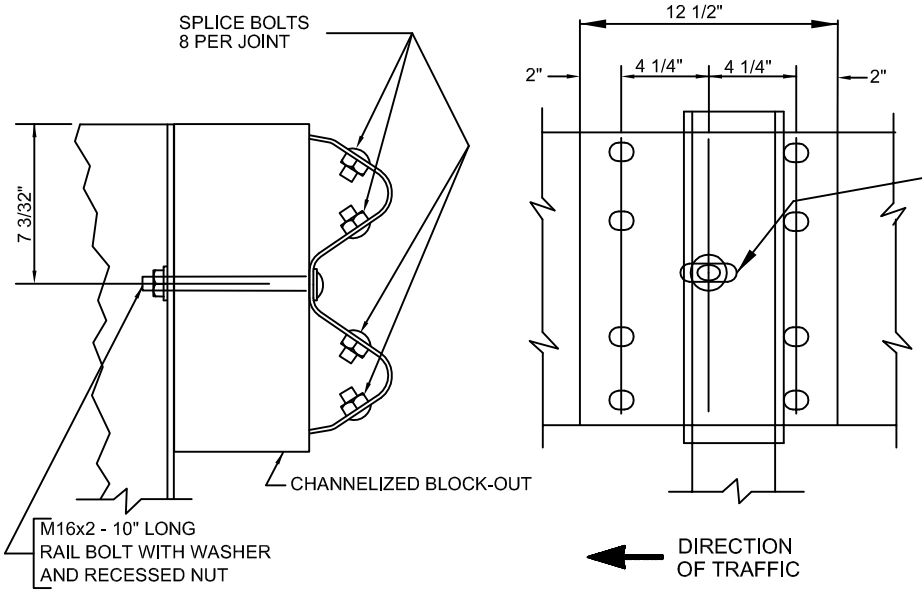
M16x2 - 1 5/16" LONG



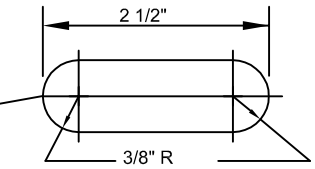

ALL BOLTS AND NUTS TO BE GALV.



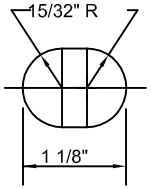

### RAIL SPLICE




### RAIL BOLT SLOT

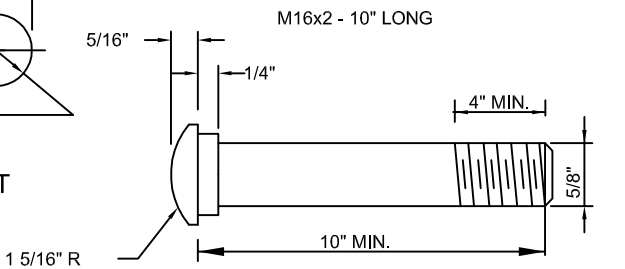


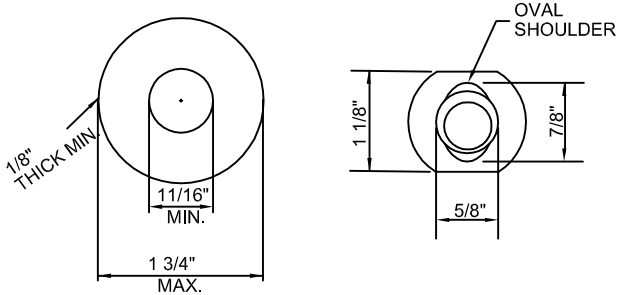

### SPLICE BOLT SLOT




### RAIL BOLT

M16x2 - 10" LONG




PLAIN ROUND WASHER

NOTES:

1. FOR POST AND BLOCK-OUT DETAILS SEE E 401.8.0 AND E 401.20.0
2. LAP DOWNSTREAM IN DIRECTION OF TRAFFIC.

massDOT Massachusetts Department of Transportation Highway Division

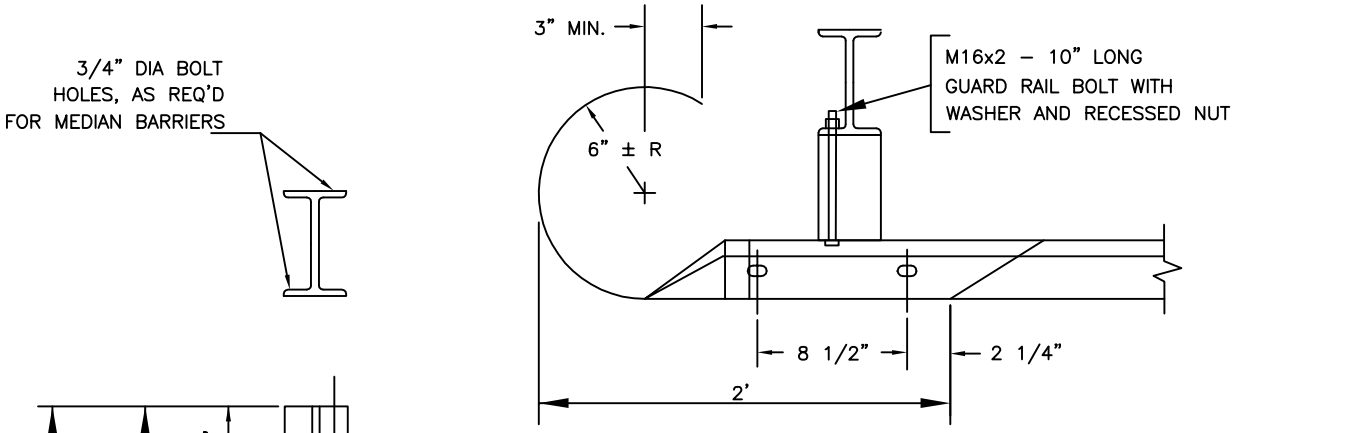
CONSTRUCTION STANDARDS

# STEEL W BEAM HIGHWAY GUARD

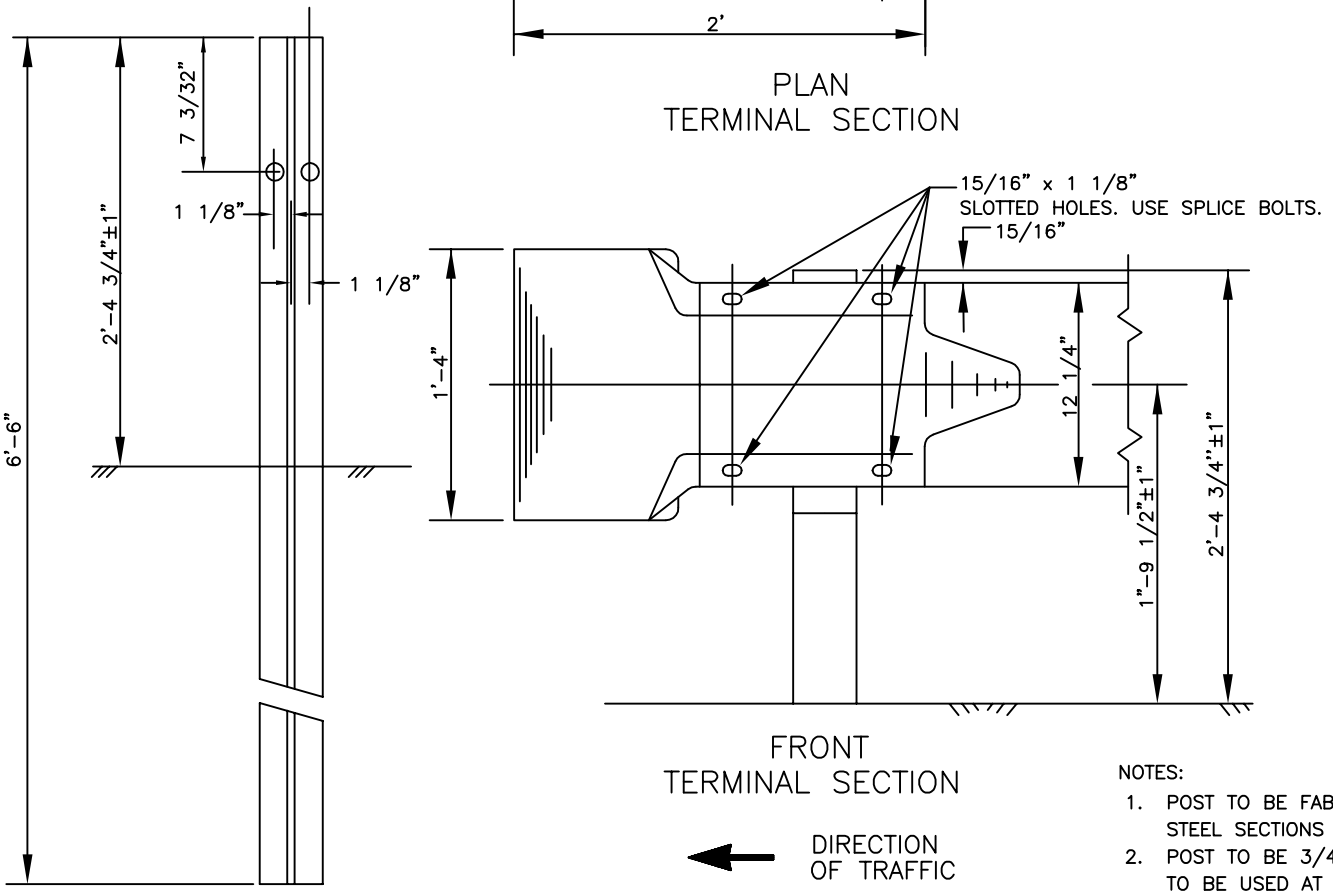
## POSTS AND TERMINAL SECTION DETAILS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.8.0**




PLAN
TERMINAL SECTION



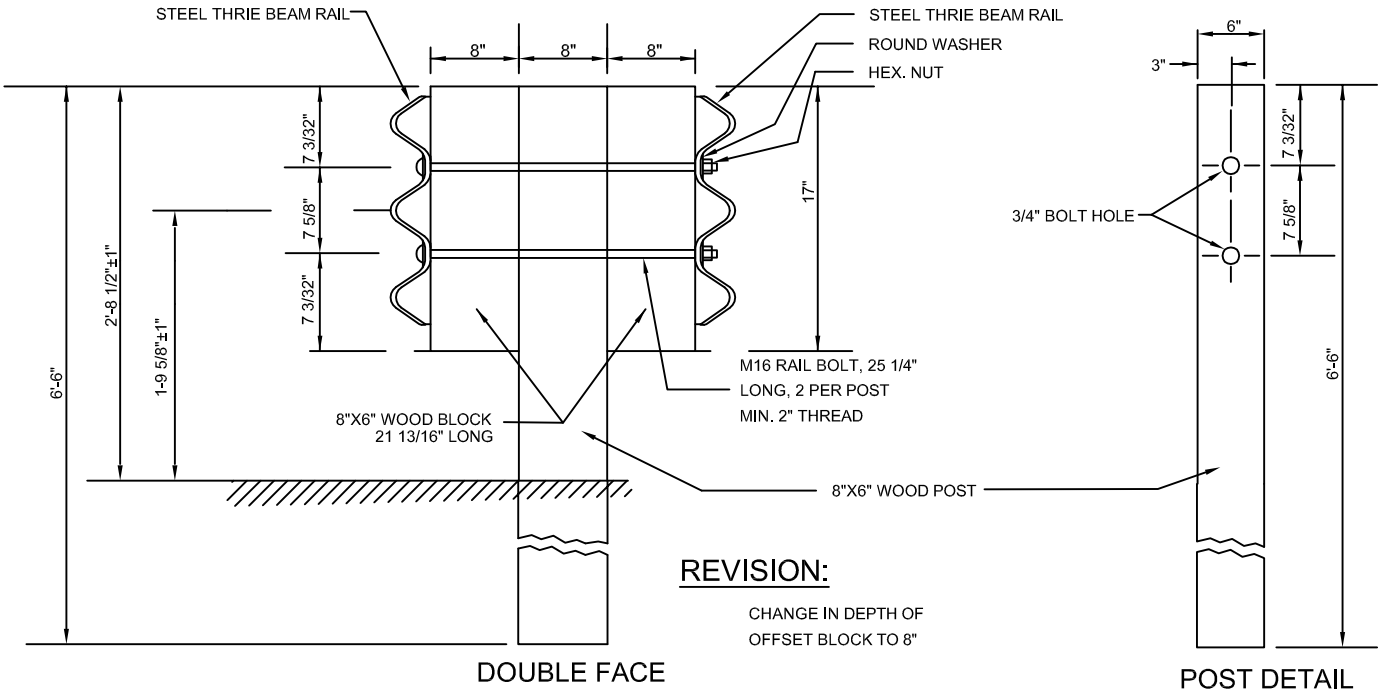

POST

FRONT
TERMINAL SECTION

DIRECTION OF TRAFFIC

NOTES:

1. POST TO BE FABRICATED FROM W6"X9" STEEL SECTIONS AS SHOWN.
2. POST TO BE 3/4" DIA. (STD GALV WASHERS TO BE USED AT THESE CONNECTIONS).
3. FOR BLOCK–OUT DETAILS SEE E 401.20.0.

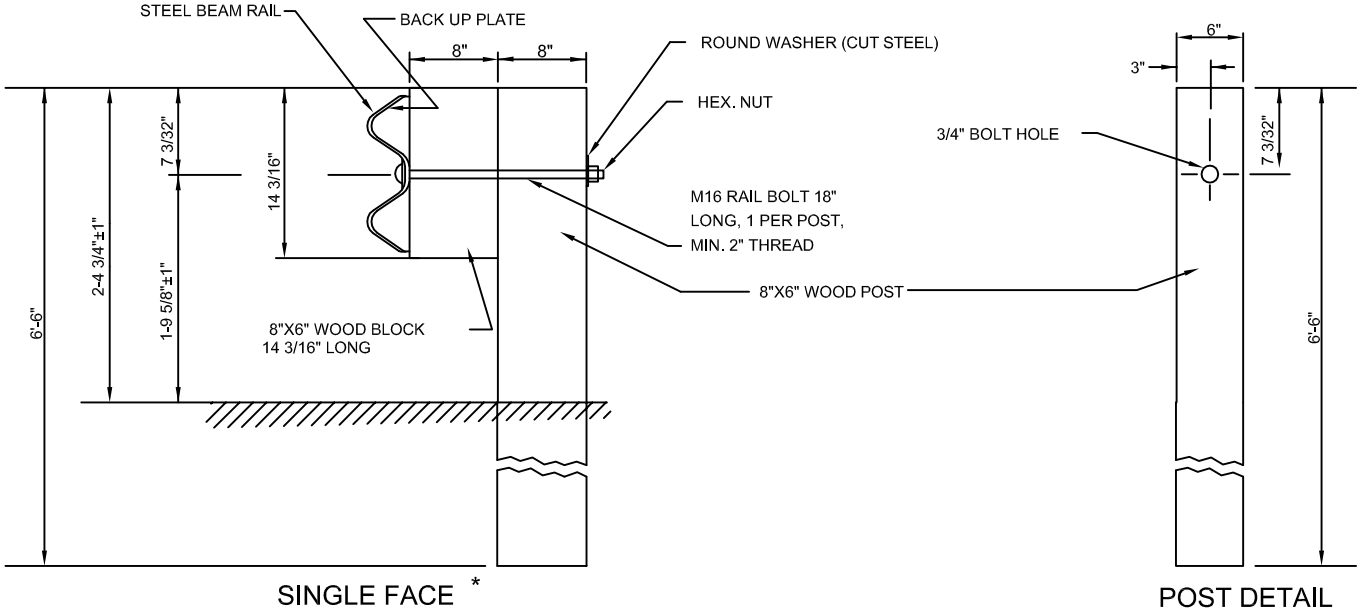



DOUBLE FACE

POST DETAIL

REVISION:

CHANGE IN DEPTH OF
OFFSET BLOCK TO 8"




SINGLE FACE *

POST DETAIL

* WHEN PLACED IN MEDIAN CHANGE TO THRIE BEAM, AND CHANGE HEIGHT TO 2'-8 1/2"±1".

NOTES:

1. POST SPACING, APPROACH END & TRAILING ENDS ARE THE SAME AS THOSE SHOWN FOR STEEL "H" POSTS.
2. ALL NUTS, BOLTS & WASHERS ARE TO BE GALVANIZED.
3. ALL MATERIALS & DIMENSIONS OF FITTINGS NOT SHOWN ABOVE ARE TO BE SIMILAR TO THE CORRESPONDING ELEMENTS SHOWN FOR STEEL "H" POSTS.
4. TERMINAL SECTIONS FOR DOUBLE FACE & SINGLE FACE GUARD RAIL ARE SHOWN ON DRAWINGS E 401.6.0, E 401.8.0
5. ALL SPLICES ARE TO BE MADE AT POSTS.
6. FOR THE TYPE OF WOOD & WOOD TREATMENT, OTHER MATERIALS & METHODS OF CONST., SEE STANDARD SPECIFICATIONS & SPECIAL PROVISIONS.
7. FOR DETAILS OF SLOT IN BACK-UP PLATE SEE E 401.7.0 & E 401.8.0
8. BACK-UP PLATE IS PLACED BEHIND RAIL ELEMENTS AT INTERMEDIATE POSTS, i.e. NON SPLICE LOCATION.
9. STEEL POSTS ARE TO BE SUBSTITUTED AT THE SAME BID PRICE, FOR CERTAIN WOOD POSTS IN A WOOD POST RUN WHEN CEMENT CONCRETE EMBEDMENT IS REQUIRED.

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# STEEL BEAM HIGHWAY GUARD WITH WOOD POST

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.10.0**

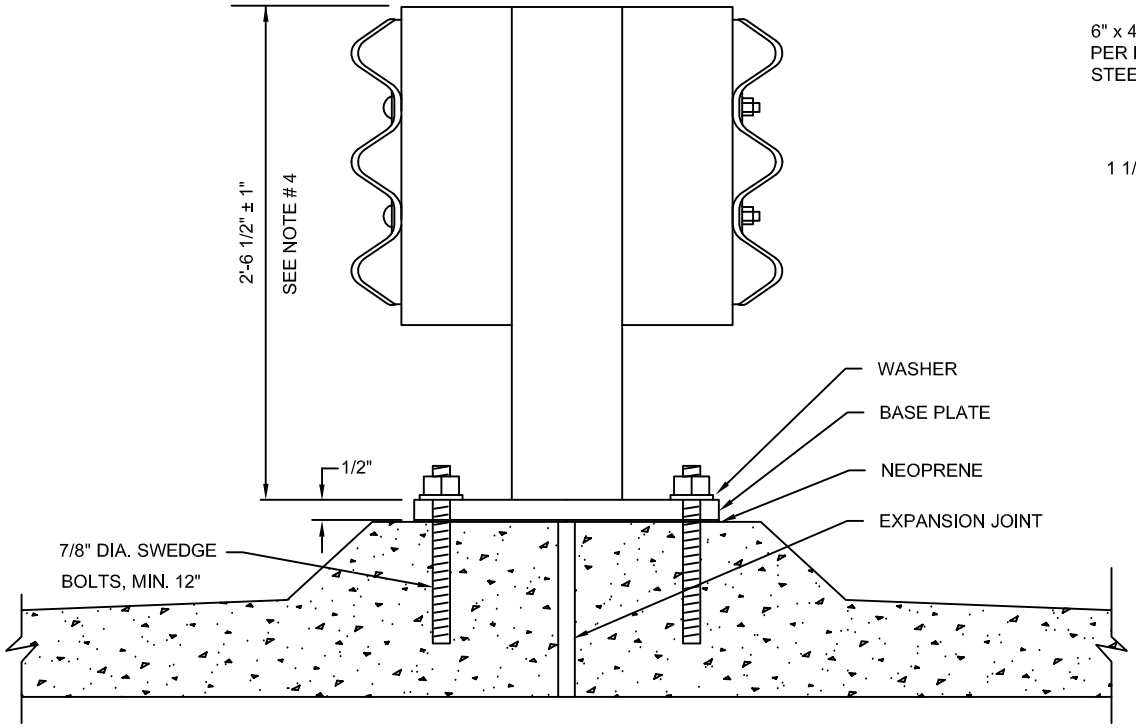
massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# SPECIAL BASE ANCHOR FOR HIGHWAY GUARD INSTALLATION ON CONCRETE

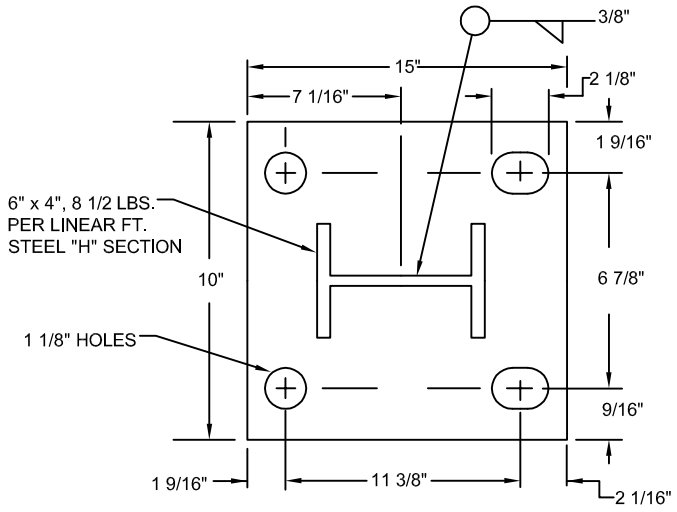
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.11.0**

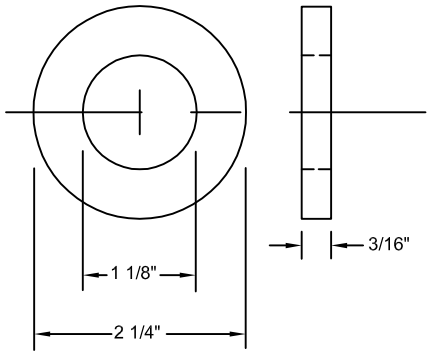



DETAIL OF POST OVER EXPANSION JOINT

SEE NOTE # 5 WHEN THERE IS NO EXPANSION JOINT.




DETAIL OF BASE PLATE

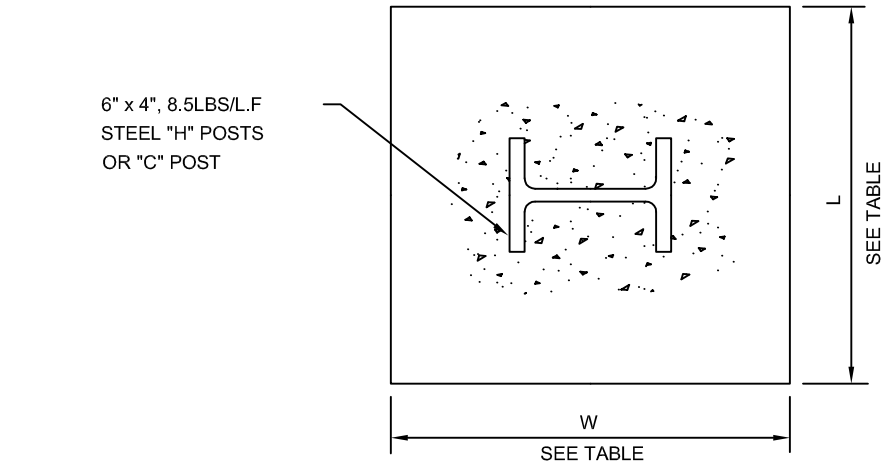



DETAIL OF WASHER

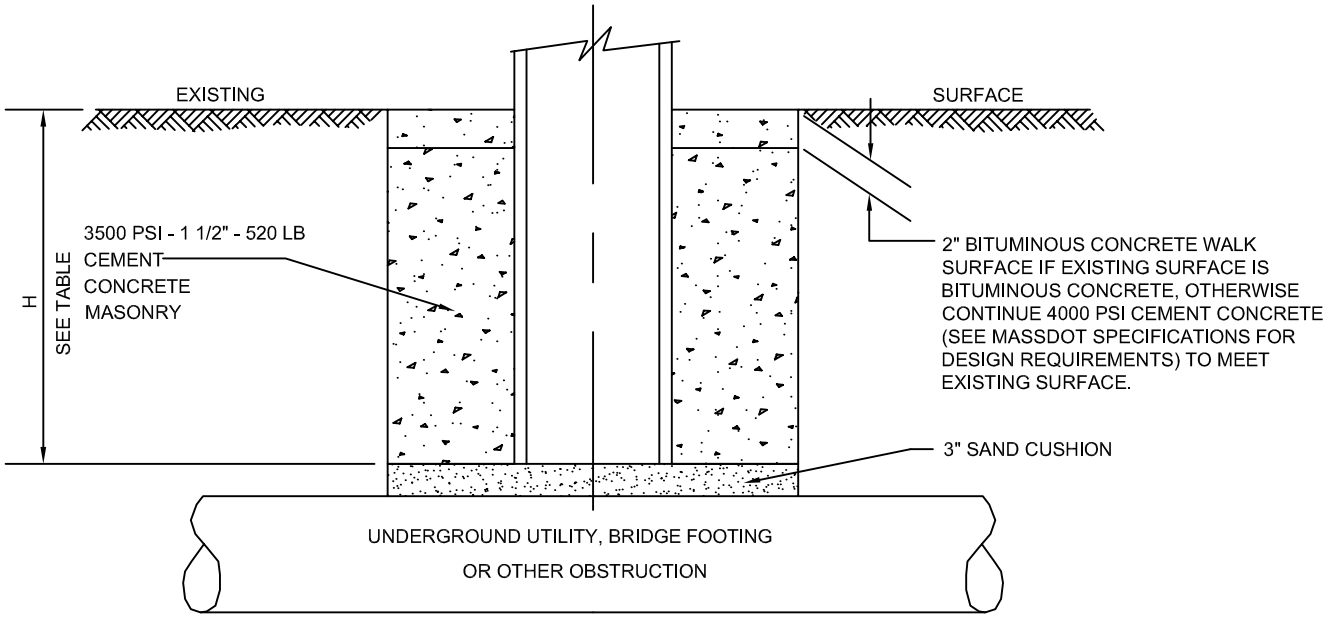
GALVANIZED

NOTES:

1. SWEDGE BOLTS, NUTS AND WASHERS ARE TO BE GALVANIZED.
2. HOLES FOR SWEDGE BOLTS SHALL BE 10" DEEP. SWEDGE BOLTS TO BE SET IN EPOXY RESIN, AS APPROVED BY THE ENGINEER.
3. BASE PLATE IS TO BE SET ON 3/32" NEOPRENE.
4. DETAILS OF HIGHWAY GUARD ARE SHOWN ON DRAWINGS E 401.1.0, E 401.5.0 & E 401.6.0
5. THE BASE PLATE AND CONSTRUCTION METHOD SHOWN ABOVE ARE ALSO USED WHEN THERE ARE NO EXPANSION JOINTS IN THE CEMENT CONCRETE.
6. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL FIELD MEASUREMENTS.
7. MAXIMUM OF TWO (2) POSTS IN A ROW OF GUARDRAIL.




PLAN




ELEVATION

| HEIGHT OF EXISTING SURFACE ABOVE TOP OF SAND CUSHION | DIMENSION OF CONCRETE ENVELOPE | | |
|---|---|---|---|
| | H HEIGHT OF SURFACE ABOVE SAND CUSHION | W | L |
| 1'-0" - 1'-6" | VARIES 1'-0" TO 1'-6" | 2'-6" | 2'-6" |
| 1'-6" - 2'-6" | VARIES 1'-6" TO 2'-6" | 2'-0" | 2'-0" |
| OVER 2'-6" | 2'-6" | 1'-6" | 1'-6" |

NOTE:

1. OFFSET BRACKETS ARE TO BE INSTALLED AND RAILS ARE TO BE MOUNTED AS SHOWN ON DRAWINGS E 401.1.0 AND E 401.5.0 - E 401.9.0
2. NOT TO BE USED ON MORE THAN 2 POSTS IN A ROW.

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# MODIFIED HIGHWAY GUARD POST INSTALLATION

## WHERE STANDARD EMBEDMENT IS NOT FEASIBLE

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.12.0**

CONSTRUCTION STANDARDS

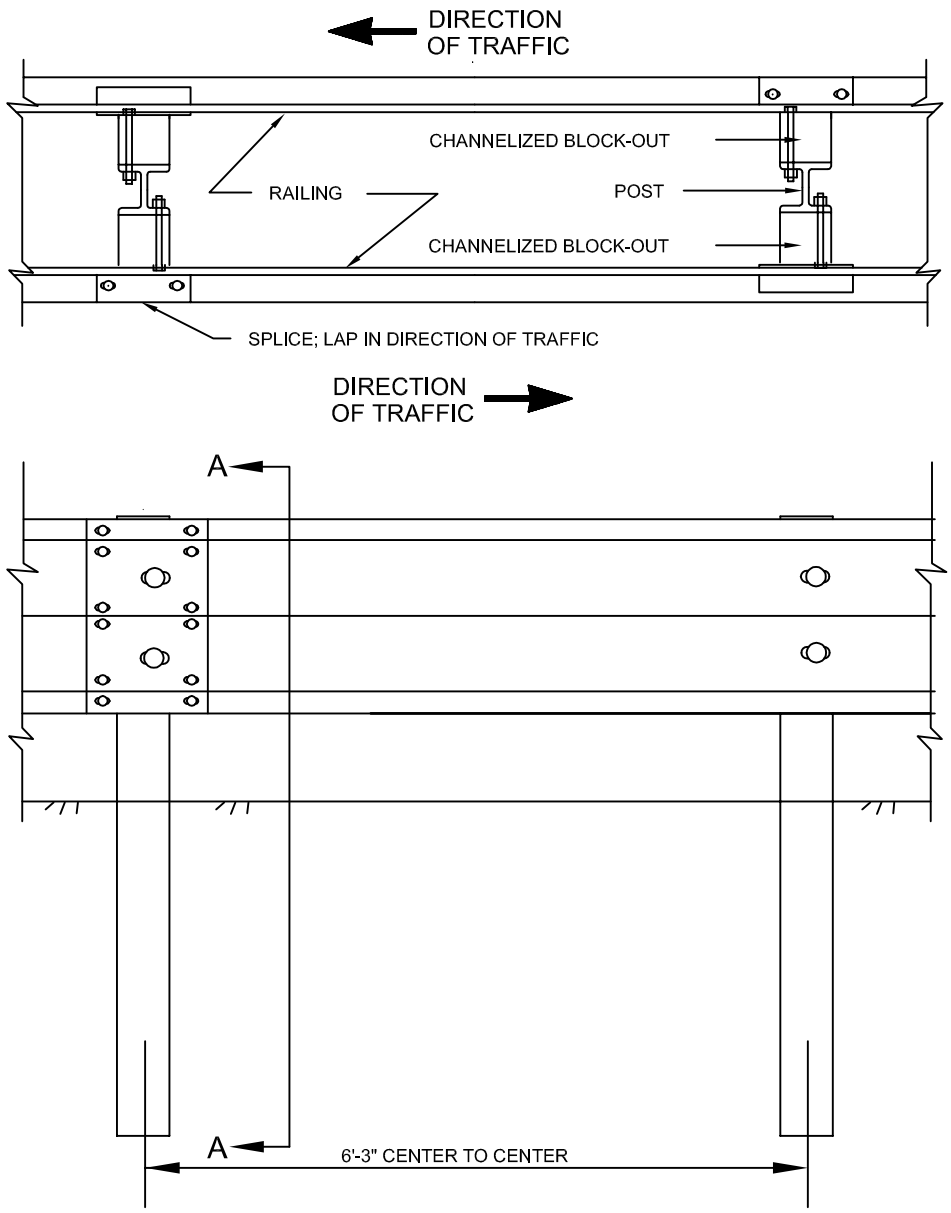
massDOT Massachusetts Department of Transportation Highway Division

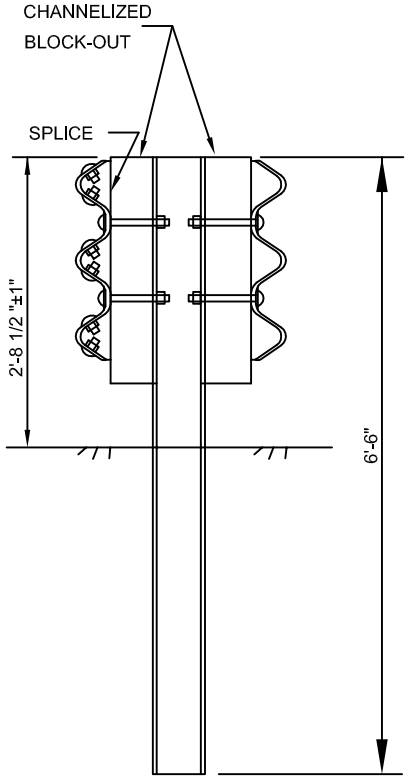
# STEEL THRIE BEAM HIGHWAY GUARD

## MEDIAN - BARRIER

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.16.0**

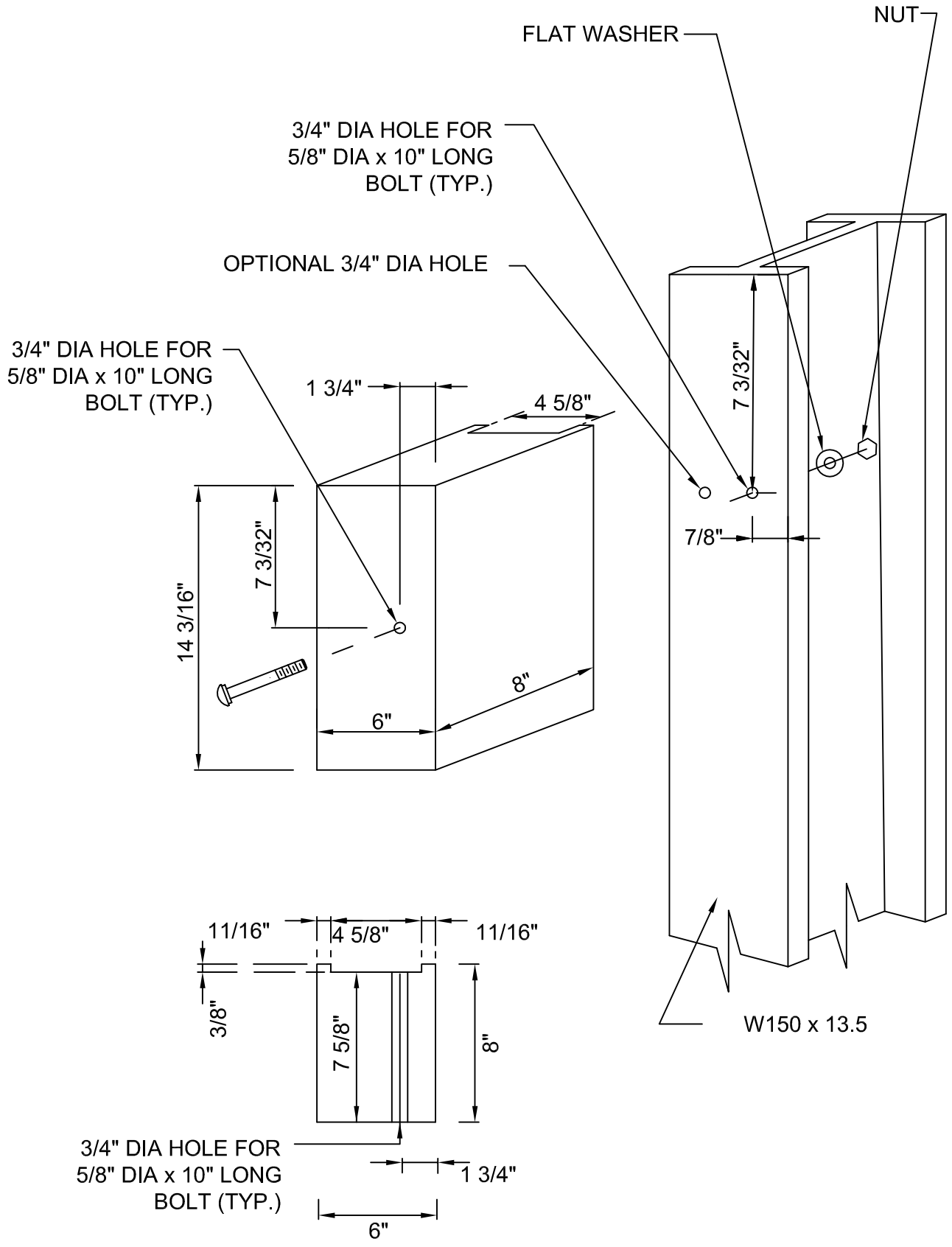



SECTION A-A

NOTES:

1. ALL POSTS TO BE SPACED 6'-3" CENTER TO CENTER
2. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHODS SEE STANDARD SPECIFICATIONS.
3. FOR DETAILS OF BARRIER COMPONENTS SEE E 401.5.0 AND E 401.6.0.
4. RAIL SPLICES ON DOUBLE FACED HIGHWAY GUARD ARE TO BE STAGGERED. (i.e, SPLICES) ARE NOT TO BE MADE ON BOTH SIDES OF THE SAME POST.



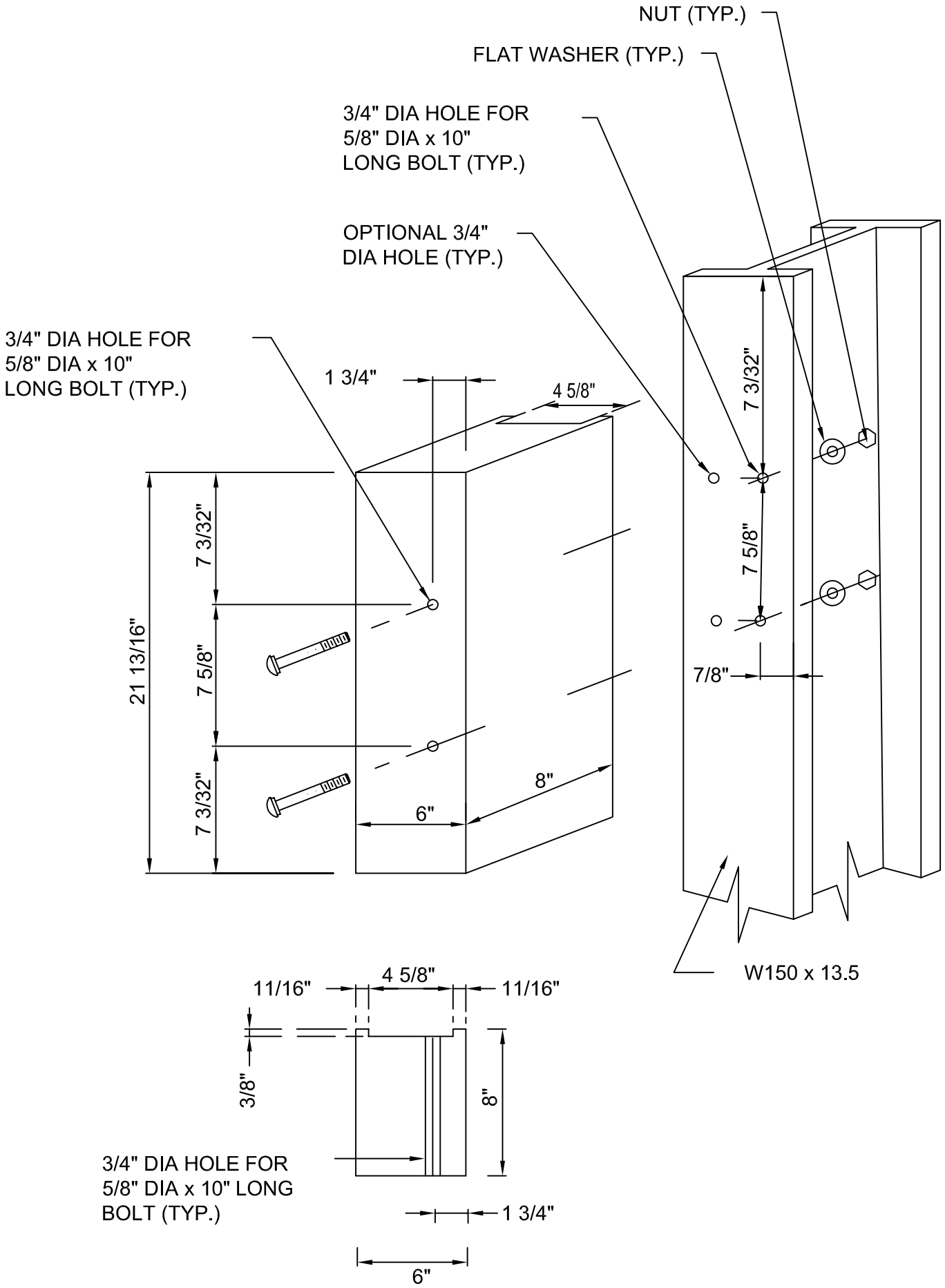

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# OFFSET BLOCKS FOR STEEL W BEAM HIGHWAY GUARD

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 401.20.0**



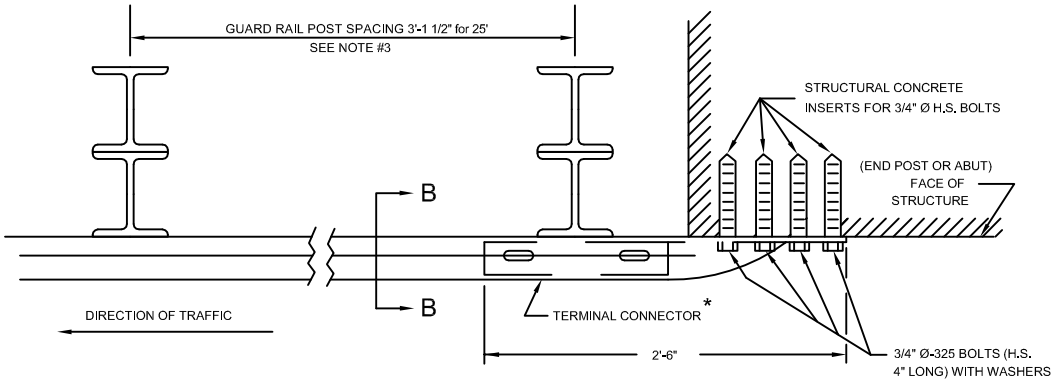

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

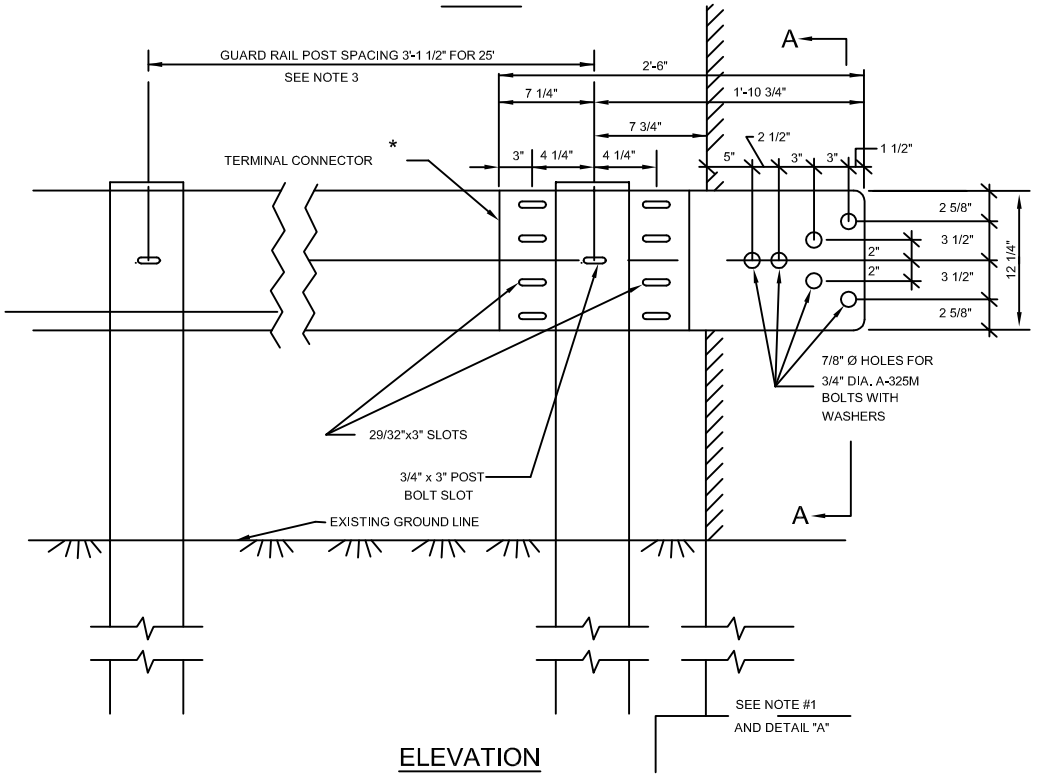
# OFFSET BLOCKS FOR STEEL THRIE BEAM HIGHWAY GUARD

DATE OF ISSUE
DECEMBER 2016

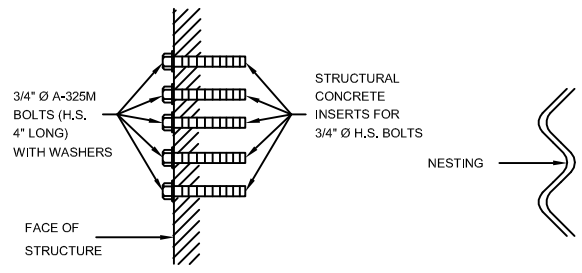
DRAWING NUMBER
**E 401.21.0**




PLAN



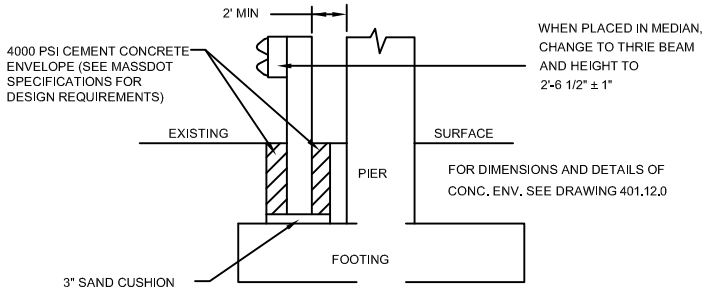

ELEVATION




SECTION A-A




SECTION B-B
2 RAILS




DETAIL "A"
SEE NOTE #1

* SEE BRIDGE STANDARDS FOR DETAILS; LAP IN DIRECTION OF TRAVEL.

NOTES:

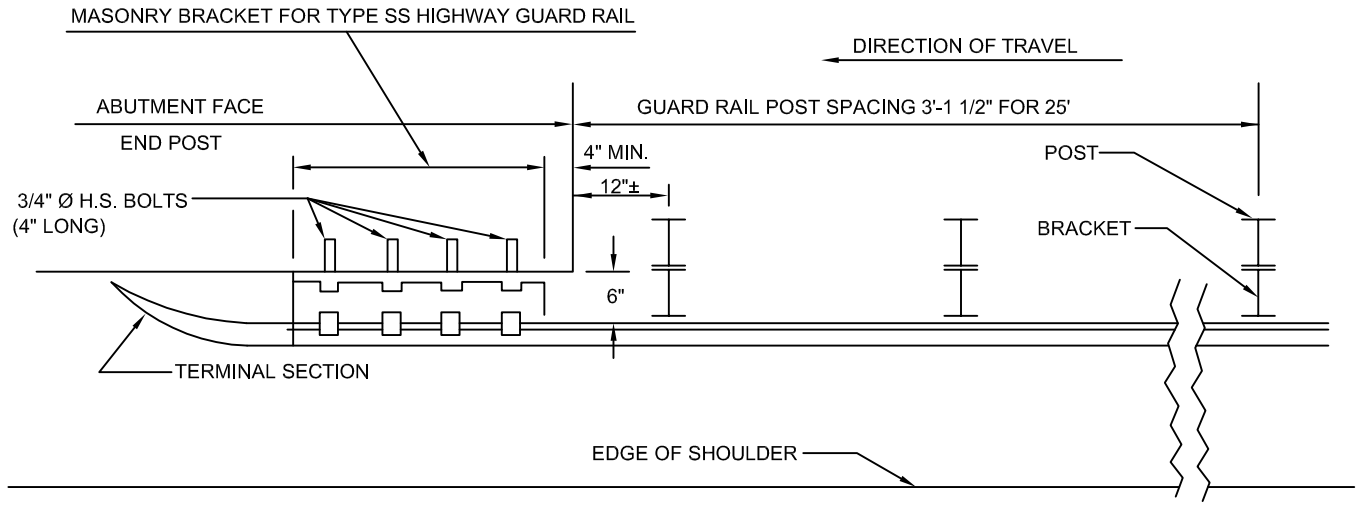
1. WHEN THE HIGHWAY GUARD POST FALLS ON THE FOOTING OF THE STRUCTURE AND THE DISTANCE FROM THE SURFACE TO THE TOP OF THE FOOTING IS LESS THAN 3'-3" THE POST SHALL BE CUT AND SET ON THE FOOTING IN A CEMENT CONCRETE ENVELOPE AS SHOWN IN DETAIL "A".
2. CONSTRUCTION DETAILS SHOWN ALSO APPLY TO WOOD AND CHARLEY (C) POST INSTALLATIONS.
3. THE DOUBLE RAIL ELEMENT IS TO CONSIST OF NESTING TWO (2) 12 GAUGE RAIL ELEMENTS FOR A DISTANCE OF 25', THE SHORT RAIL (25') IS TO BE NESTED BEHIND THE CONTINUOUS RAIL, SEE SECTION B-B.
4. BACK UP PLATE NOT REQUIRED WHERE RAIL IS TO BE NESTED.

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

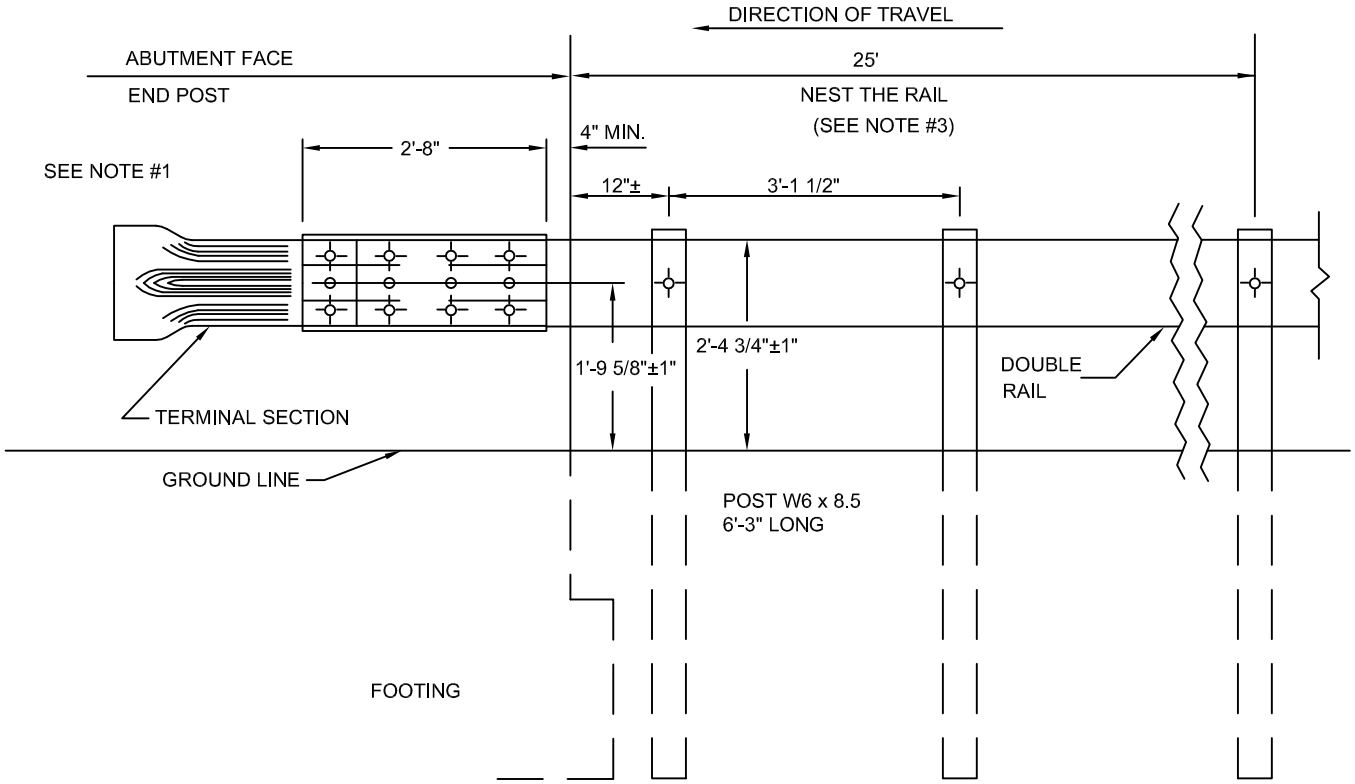
# STEEL W BEAM HIGHWAY GUARD TERMINAL CONNECTORS ON EXIST. BRIDGE W-RAIL LEADING END AT ABUTMENTS & END POSTS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 402.2.0**




PLAN




ELEVATION

NOTES:

1. FOR BRACKET DETAIL SEE DRAWINGS E 402.4.0 AND E 402.5.0
2. FOR NESTING DETAIL SEE DRAWING E 402.2.0
3. BACK UP PLATE NOT REQUIRED WHERE RAILING IS NESTED, SEE SECTION B-B DRAWING E 402.2.0

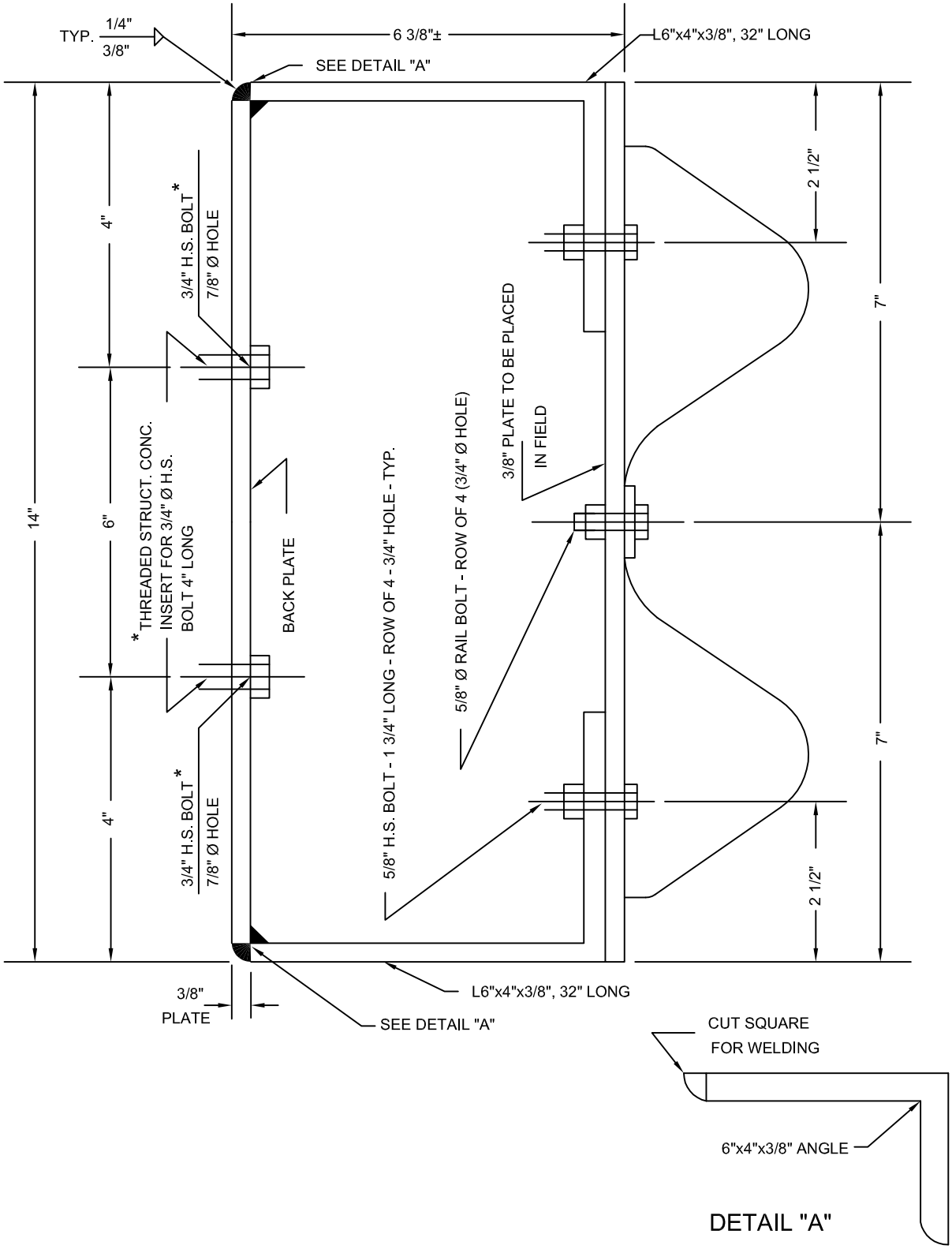
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# INSTALLATION OF STEEL W BEAM HIGHWAY GUARD (TRAILING END) AT EXISTING BRIDGE ABUTMENTS AND END POSTS (W-RAIL)

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 402.3.0**




* IF BOLT IS THRU EXISTING HWY. GD. RECESS THAT IS FILLED WITH CONCRETE ADD THE DEPTH OF RECESS TO THE 4" LENGTH OF INSERT SIMILARLY TO 3/4" BOLT.

NOTES:

1. ALL EXISTING HWY. GD. RECESSES TO BE FILLED WITH EPOXY CONCRETE.
2. ALL WELDING IS TO BE DONE IN THE SHOP

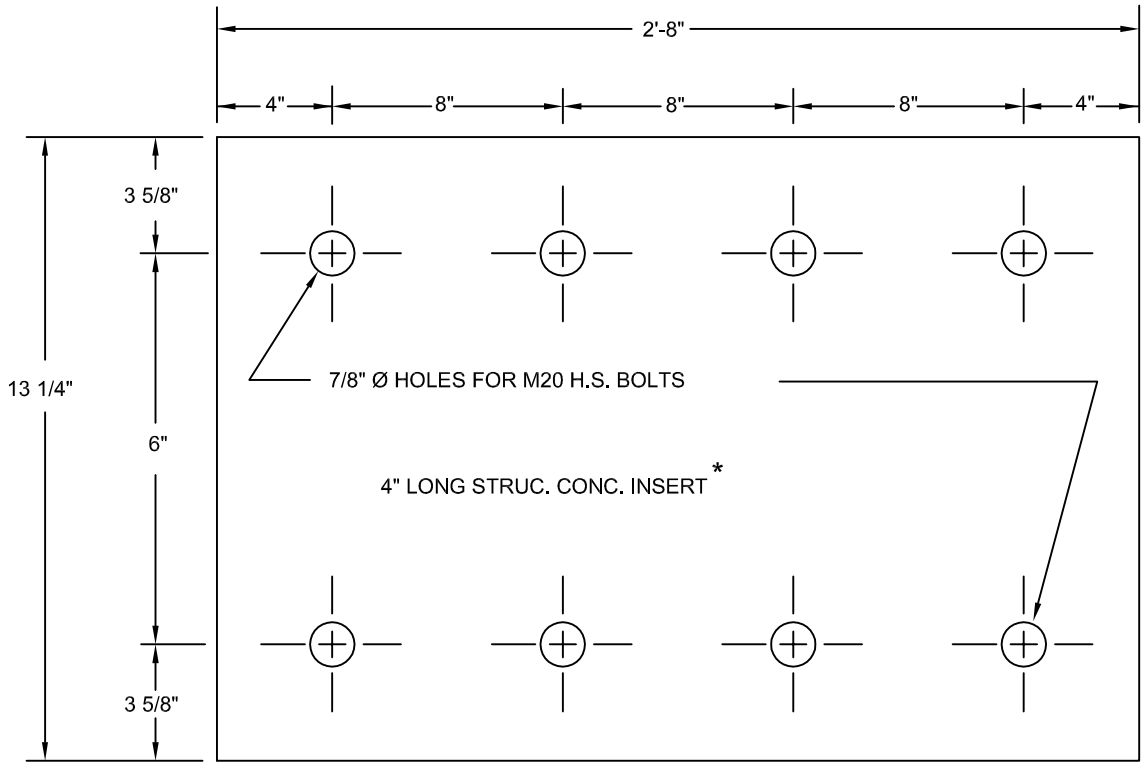
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

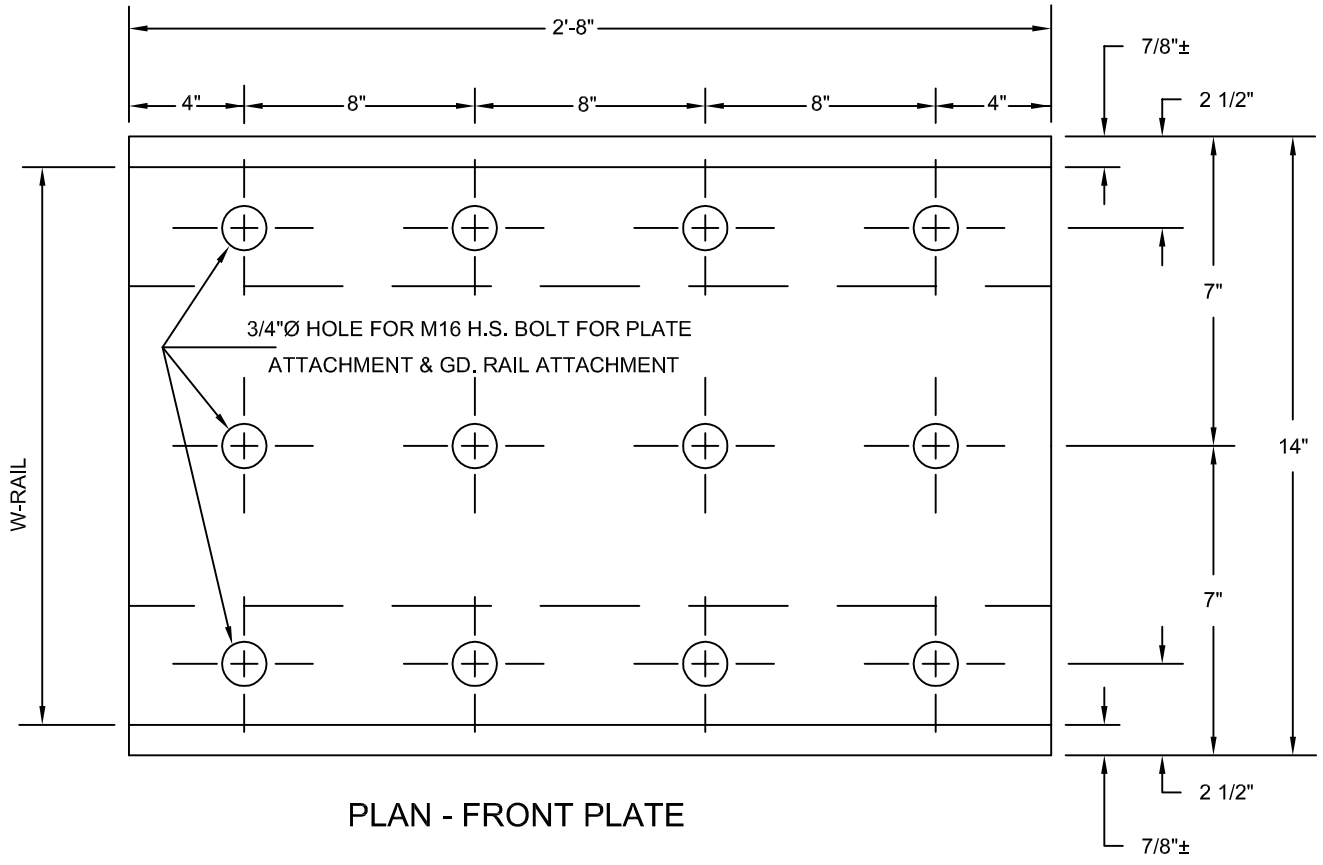
# MASONRY BRACKET FOR STEEL W BEAM HIGHWAY GUARD ON ABUTMENTS AND END POSTS (TRAILING END)

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 402.4.0**




PLAN - BACK PLATE




PLAN - FRONT PLATE

* IF BOLT IS THRU EXISTING HWY. GD. RECESS THAT IS FILLED WITH CONCRETE ADD THE DEPTH OF THE RECESS TO THE 4" LENGTH OF INSERT AND SIMILARLY TO 3/4" Ø BOLT.

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# MASONRY BRACKET FOR STEEL W BEAM HIGHWAY GUARD ON ABUTMENTS AND END POSTS (TRAILING END)

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 402.5.0**

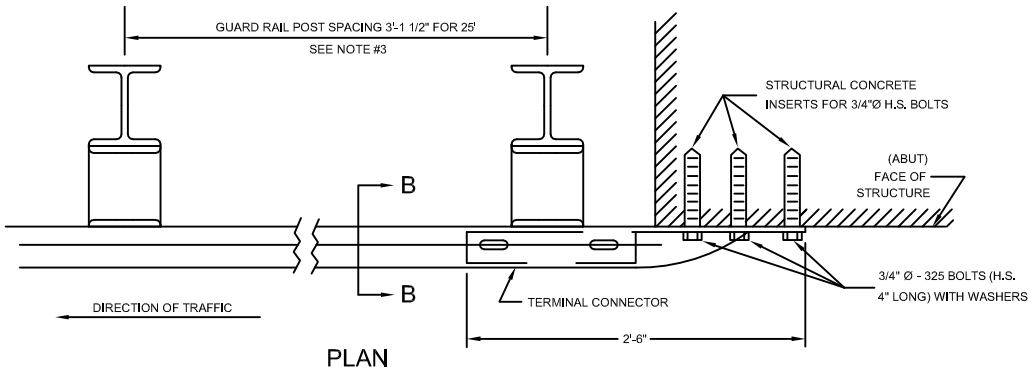
massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

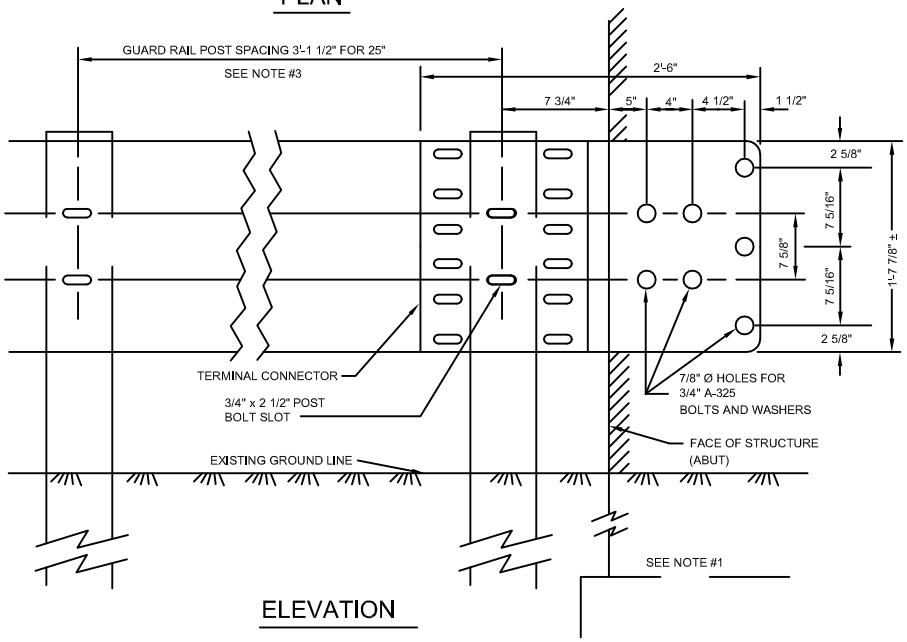
# STEEL THRIE BEAM HIGHWAY GUARD TERMINAL CONNECTORS ON AN EXIST. BRIDGE LEADING END AT ABUTMENT & END POST

DATE OF ISSUE
DECEMBER 2016

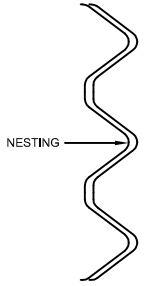
DRAWING NUMBER
**E 402.7.0**



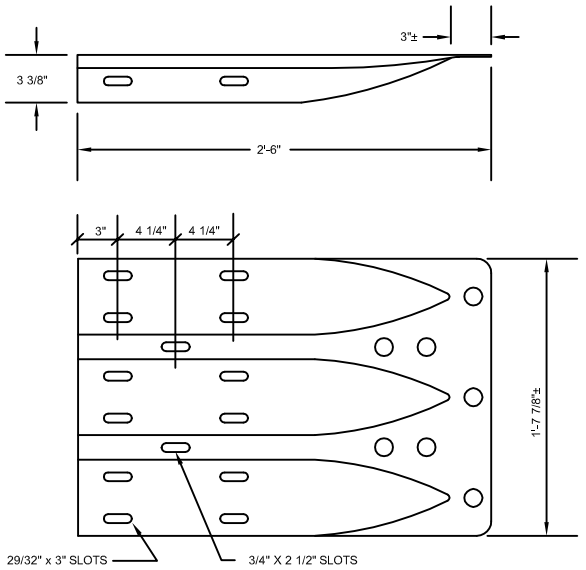

PLAN




ELEVATION



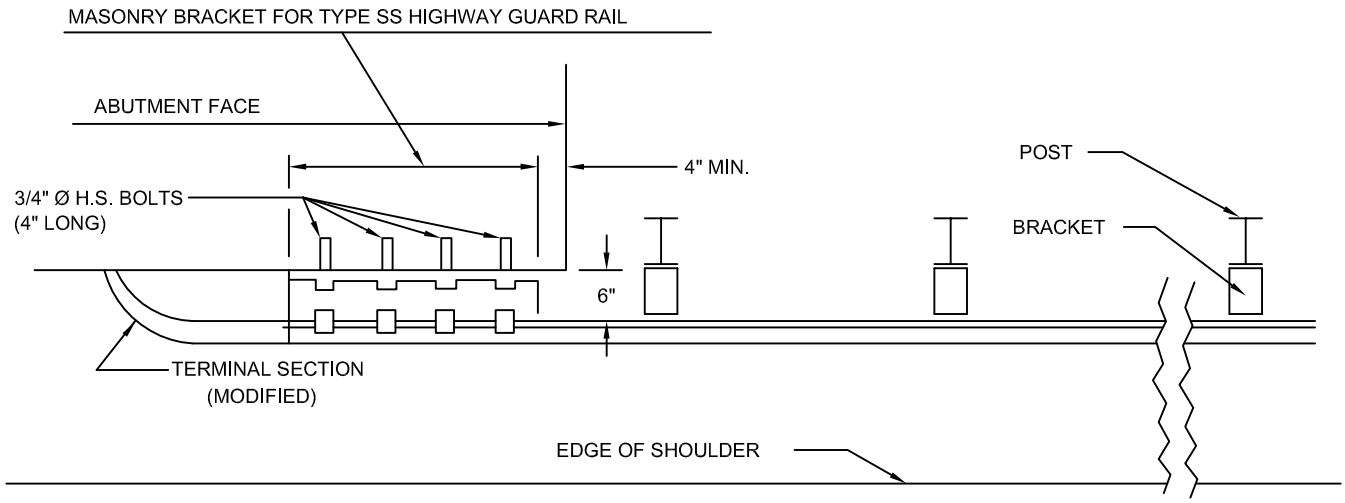

SECTION B-B
(2 RAILS)



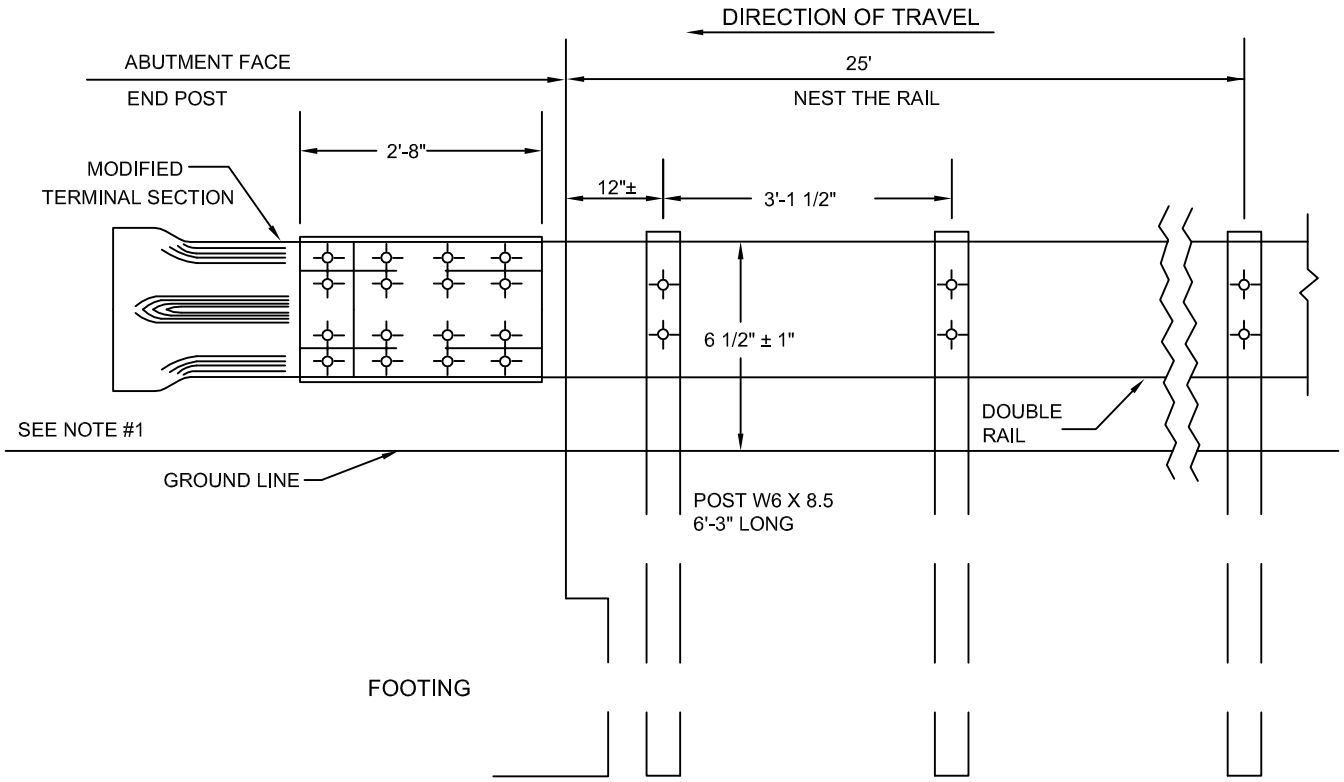

TERMINAL CONNECTOR

NOTES:

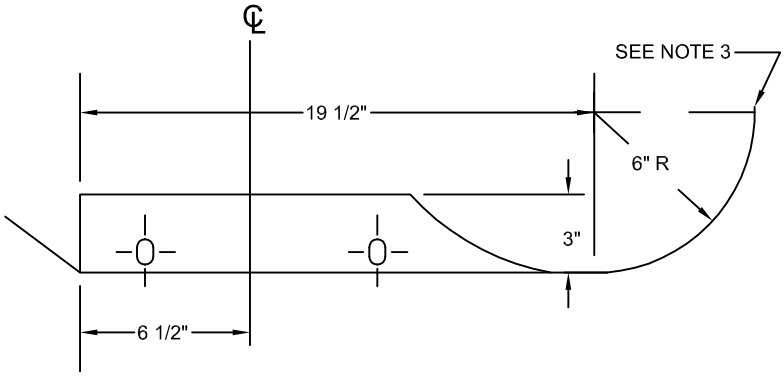
1. WHEN THE HIGHWAY GUARD POST FALLS ON THE FOOTING OF THE STRUCTURE AND THE DISTANCE FROM THE SURFACE TO THE TOP OF THE FOOTING IS LESS THAN 3'-3" THE POST SHALL BE CUT AND SET ON THE FOOTING IN A CEMENT CONCRETE ENVELOPE AS SHOWN IN DETAIL "A" DRAWINGS E 402.2.0 AND E 401.12.0
2. CONSTRUCTION DETAILS SHOWN ALSO APPLY TO WOOD AND CHARLEY (C) POST INSTALLATIONS.
3. THE DOUBLE RAIL ELEMENT IS TO CONSIST OF NESTING TWO (2) 12 GAUGE RAIL ELEMENTS FOR A DISTANCE OF 25 FEET, THE SHORT RAIL (25') IS TO BE NESTED BEHIND THE CONTINUOUS RAIL, SEE SECTION B-B.
4. BACK UP PLATE NOT REQUIRED WHERE RAIL IS TO BE NESTED.




PLAN




ELEVATION




MODIFIED TERMINAL END

NOTES:

1. FOR BRACKET DETAIL SEE DRAWINGS E 402.9.0 AND E 402.10.0
2. FOR NESTING SEE DRAWING E 402.7.0
3. STANDARD TERMINAL END MAY BE CUT AND FINISHED IN ACCORDANCE WITH STANDARD SPECIFICATIONS.
4. BACKUP PLATE NOT REQUIRED WHEN RAILING IS NESTED.
5. GUARD RAIL POST SPACING 3'-1 1/2" FOR 25 FEET.

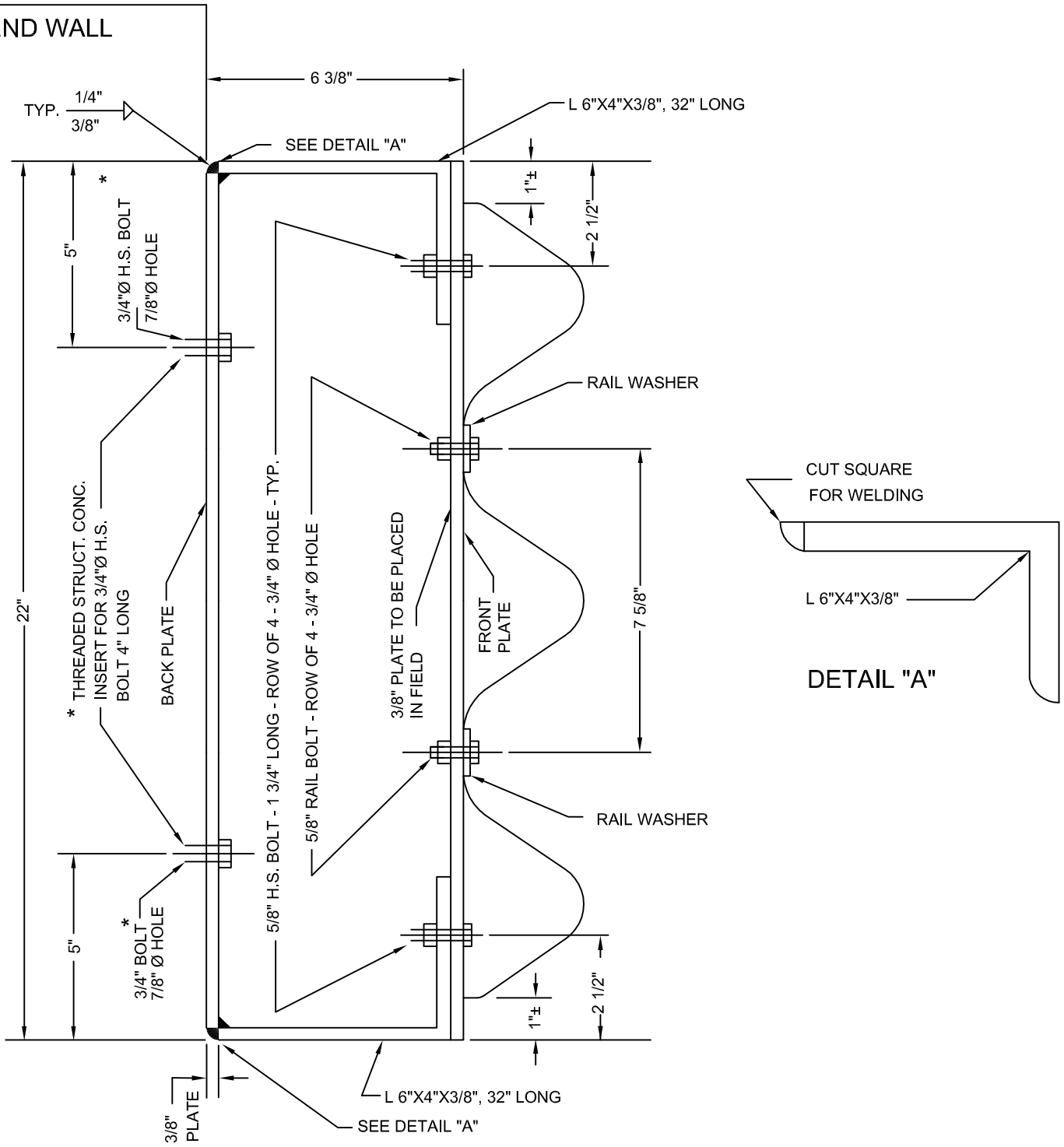
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# STEEL THRIE BEAM HIGHWAY GUARD (TRAILING END) AT EXISTING BRIDGE ABUTMENS AND END POSTS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 402.8.0**




* IF BOLT IS THRU EXISTING HWY. GD. RECESS THAT IS FILLED WITH CONCRETE ADD THE DEPTH OF RECESS TO THE 4" LENGTH OF INSERT SIMILARLY TO 3/4" BOLT.

NOTES:

1. ALL EXISTING HWY. GD. RECESSES TO BE FILLED WITH EPOXY CONCRETE
2. ALL WELDING IS TO BE DONE IN THE SHOP

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# MASONRY BRACKET FOR STEEL THRIE BEAM HIGHWAY GUARD ON ABUTMENTS AND END POSTS (TRAILING END)

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 402.9.0**

PLAN

NOT TO SCALE

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# GUARDRAIL RETROFIT ON BRIDGES (PLAN VIEW)

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 402.9.1**

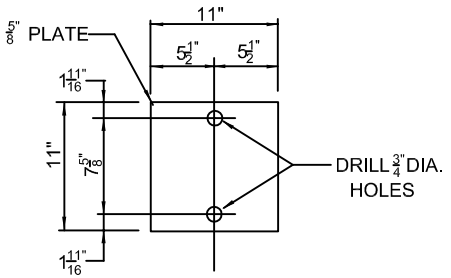
massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

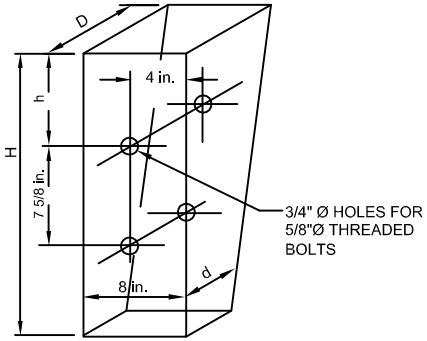
# GUARDRAIL RETROFIT ON BRIDGES (DETAILS)

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 402.9.2**

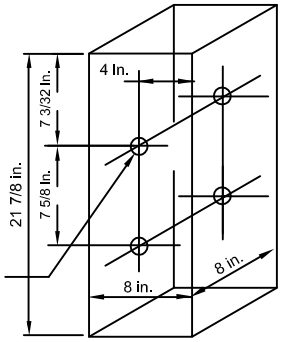



THRIE BEAM BEARING PLATE DETAIL
(TO BE USED ON VERTICAL PARAPET)
NOT TO SCALE

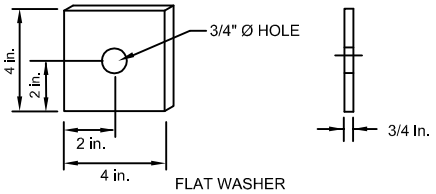



BRIDGE SPACER DETAIL
NOT TO SCALE

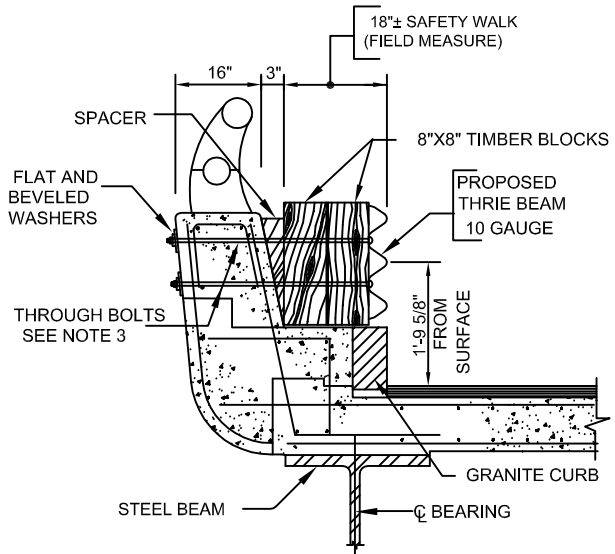
DIMENSIONS H, h D AND d WILL VARY FIELD MEASURE PRIOR TO FABRICATION.
WOOD OR COMPOSITE TIMBER BLOCKS AND SPACERS SHALL BE USED.




TIMBER BLOCK DETAIL
NOT TO SCALE




WASHER DETAILS




## SECTION A-A

THROUGH CONCRETE PARAPET WALL

NOT TO SCALE

C:\Documents and Settings\StanleyJ\Desktop\DELDOT Bridge Rail Retrofit Type 1 EDIT 2.JPG

# NOTES:

1. THIS INSTALLATION SHALL BE USED WHEN THE EXISTING SAFETY WALK IS 18" OR LESS.

2. TIMBER BLOCKS AND SPACERS SHALL BE SPACED AT 6'-3" OR LESS ON CENTERS. A MAXIMUM OF TWO NON-STANDARD POST SPACES FROM 6'-3" TO 2'-6" MAY BE USED TO ADJUST THE RAIL INSTALLATION TO MATCH THE BRIDGE LENGTH. PLACE NON-STANDARD POST SPACES ADJACENT TO EACH OTHER WITH ODD PANEL LENGTHS IN THE CENTER OF THE BRIDGE.

3. ATTACH THE PROPOSED THRIE BEAM RETROFIT TO THE EXISTING PARAPET WITH TWO 5/8"Ø ASTM A307 THREADED BOLTS, NUTS, WASHERS, TIMBER BLOCKS AND SPACERS BY DRILLING HOLES THROUGH THE PARAPET. ALL HARDWARE ITEMS SHALL BE GALVANIZED.

4. THE CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS, FURNISH AND INSTALL THE RETROFIT GUARDRAIL WITH THE TIMBER BLOCKS, SPACERS AND WASHERS AS REQUIRED TO THE PARAPET IN ACCORDANCE WITH THE TRAFFIC STANDARDS AND ALIGN THE FACE OF THE GUARDRAIL WITH THE FACE OF CURB (1/4"±).

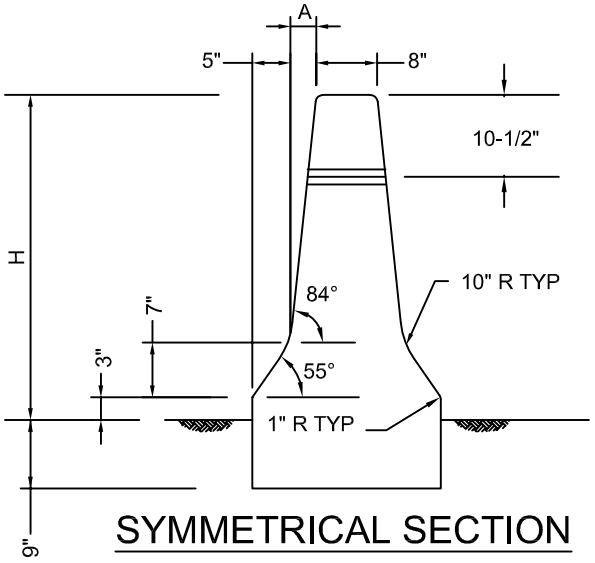
5. "THRIE BEAM EXPANSION SECTIONS" SHALL BE INSTALLED AT EACH BRIDGE EXPANSION JOINT.

6. INSTALL A DEMOUNTABLE REFLECTORIZED DELINEATOR (GUARDRAIL) IN THE UPPER VALLEY OF THE THRIE BEAM AT EACH FIFTH POST.

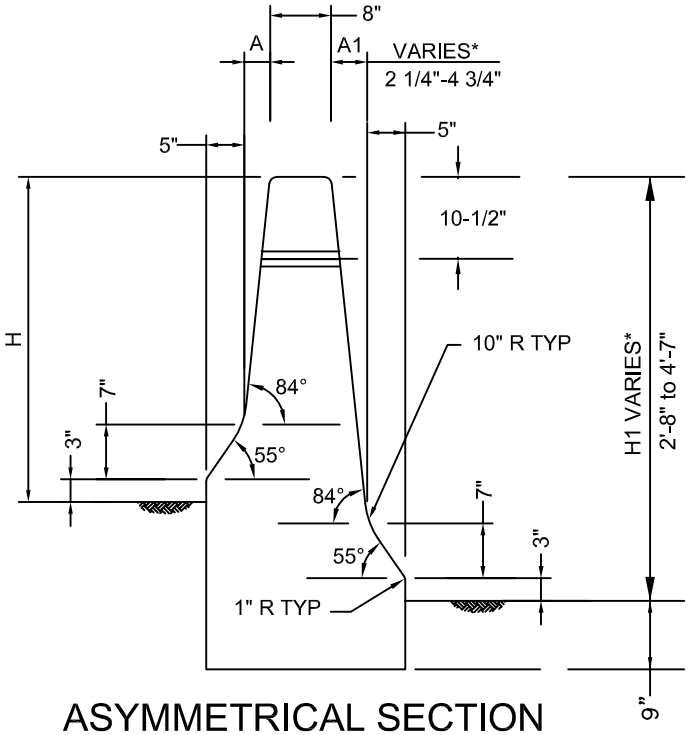
7. THE EXIT END APPLICATION SHALL ONLY BE USED ON DIVIDED HIGHWAYS. FOR ALL OTHER APPLICATIONS, THE ENTRANCE END APPLICATION SHALL BE USED AT BOTH ENDS OF BRIDGE PARAPET.

8. WITHIN THE LENGTH OF THE APPROACH AND DEPARTURE TRANSITIONS THE GUARDRAIL SHALL EXTEND IN A STRAIGHT LINE FROM THE BRIDGE WITH NO KINKS OR ANGLES VISIBLE. WHERE TAPERING IS NECESSARY TO MATCH THE OFFSET OF THE EXISTING GUARDRAIL IT SHALL BE DONE BEYOND THE APPROACH AND DEPARTURE TRANSITIONS AND HAVE A 15:1 TAPER RATE.

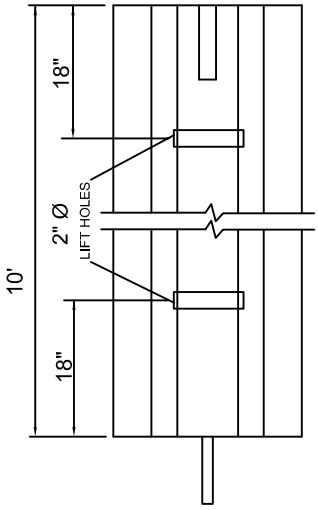
9. WOOD OR COMPOSITE OFFSET BLOCKS SHALL BE INSTALLED WITH NEW AND RESET SECTIONS OF GUARD RAIL.



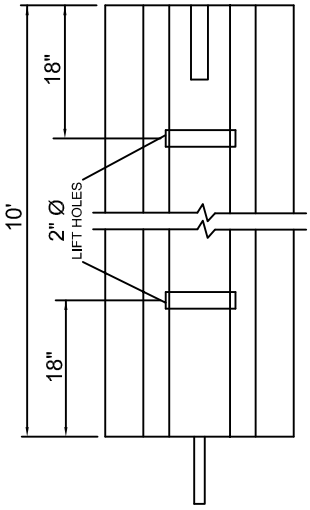

SYMMETRICAL SECTION




ASYMMETRICAL SECTION




PLAN




PLAN

| SYSTEM | A | H |
|---|---|---|
| NORMAL | 2 1/4" | 2'-8" |
| TALL | 3 1/4" | 3'-6" |

## NOTES:

1. ALL EDGES SHALL BE ROUNDED WITH A 1" RADIUS EXCEPT AS SHOWN
2. FOR DOWEL CONNECTION DETAILS SEE E 402.13.0.
3. FOR REINFORCING SEE E 402.11.0 FOR SYMMETRICAL SHAPE AND E 401.12.0 FOR ASYMMETRICAL SHAPE.
4. ALL CONCRETE IS TO BE FIELD COATED AFTER FINAL INSTALLATION WITH A CONCRETE PENETRANT/SEALER. CAST IN PLACE CONCRETE SHALL CURE NOT LESS THAN 28 DAYS PRIOR TO COATING.
5. LIFT HOLES USED ONLY ON PRECAST BARRIERS 13' AND LESS.

* VARY "A1" RELATIVE TO "H1" WHILE MAINTAINING 55° AND 84° BARRIER ANGLES. A1=4-3/4" MAX., H1=4'-7" MAX.

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# F SHAPE CONCRETE BARRIER

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 402.10.0**

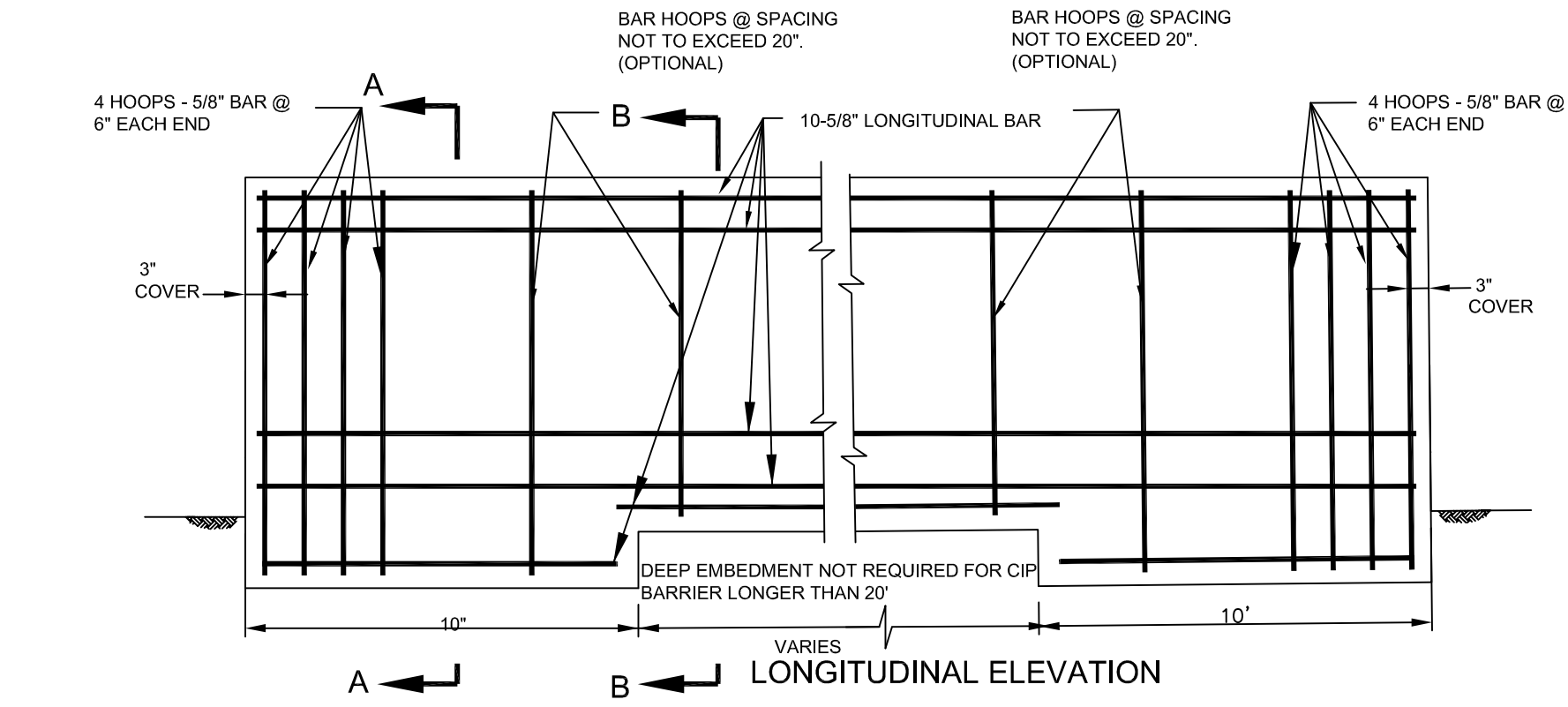
massDOT Massachusetts Department of Transportation Highway Division

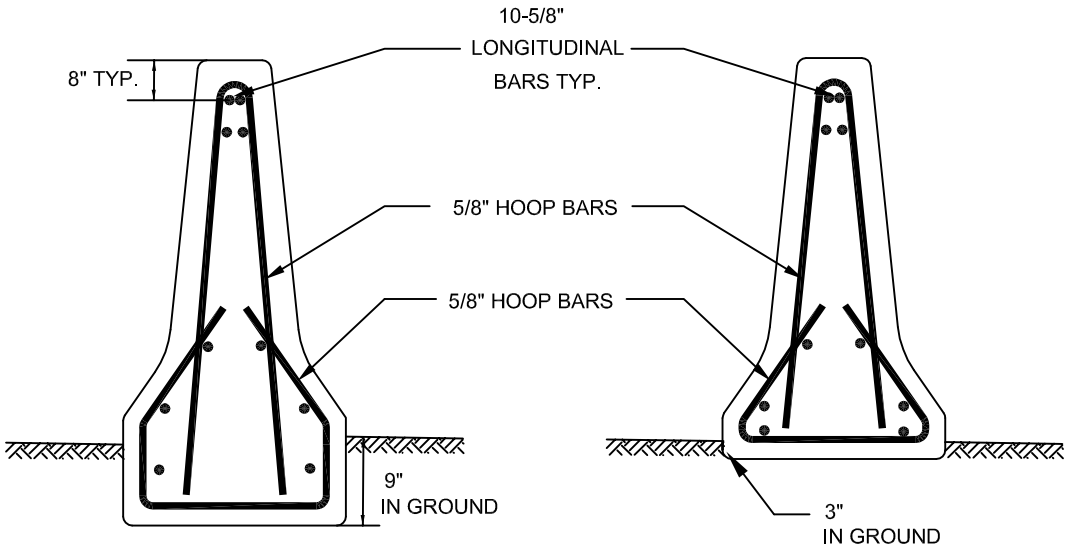
CONSTRUCTION STANDARDS

# F SHAPE CONCRETE BARRIER
## SYMMETRICAL SECTION
## REINFORCING DETAILS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 402.11.0**




NOTES:

1. CAST IN PLACE NOT TO EXCEED 200' BETWEEN EXPANSION JOINTS.
2. CONSTRUCTION JOINTS REQUIRED AT 40' INTERVALS (1/2 " PREMOULDED JOINT FILLER REQUIRED FOR PRECAST BARRIERS).
3. USE MINIMUM COVER OF 1 1/2", UNLESS OTHERWISE INDICATED.
4. MATERIAL IS 4000 PSI CEMENT CONCRETE. (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)
5. ALL STEEL REINFORCING TO BE GALVANIZED OR EPOXY COATED, AASHTO-M31, GRADE 60.
6. ALL LONGITUDINAL BARS ARE TO BE CONTINUOUS FOR BOTH PRECAST AND CAST IN PLACE BARRIERS.
7. FOR DIMENSIONS SEE E 402.10.0

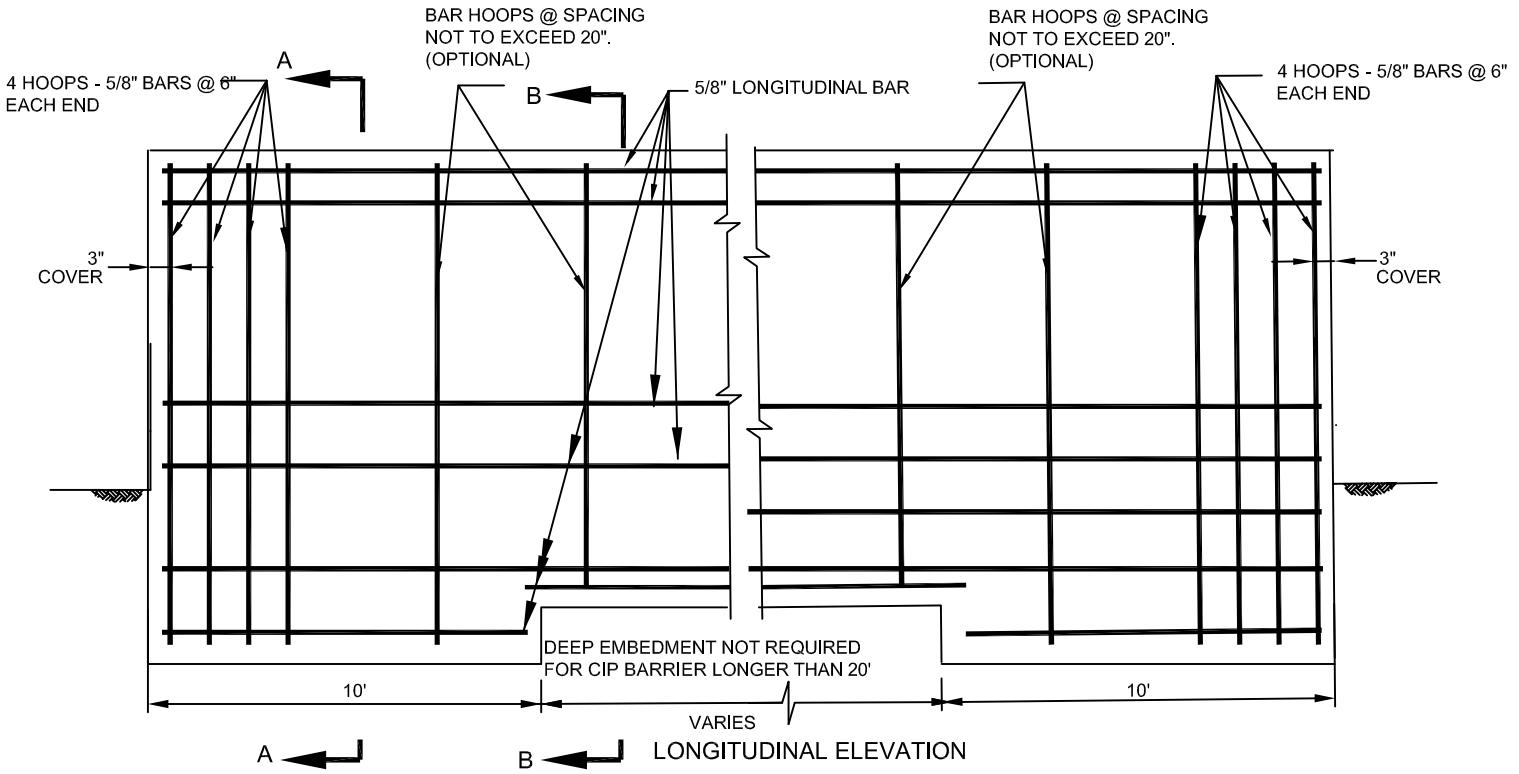
massDOT
Massachusetts Department of Transportation
Highway Division

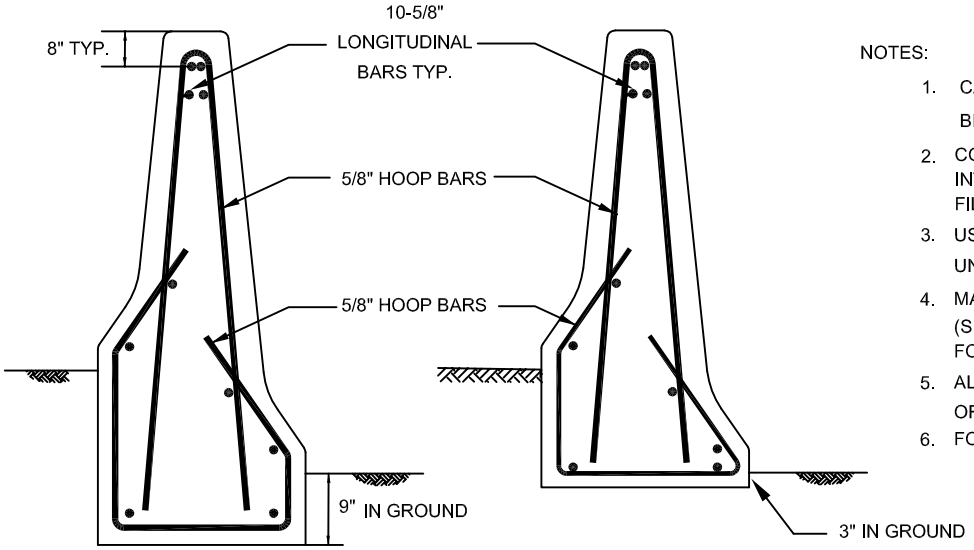
CONSTRUCTION STANDARDS

# F SHAPE CONCRETE BARRIER
## ASYMMETRICAL SECTION
## REINFORCING DETAILS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 402.12.0**




SECTION A-A

SECTION B-B

NOTES:

1. CAST IN PLACE NOT TO EXCEED 200' BETWEEN EXPANSION JOINTS.
2. CONSTRUCTION JOINTS REQUIRED AT 40' INTERVALS (1/2 " PREMOULDED JOINT FILLER REQUIRED FOR PRECAST BARRIERS).
3. USE MINIMUM COVER OF 1 1/2", UNLESS OTHERWISE INDICATED.
4. MATERIAL IS 4000 PSI CEMENT CONCRETE. (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)
5. ALL STEEL REINFORCING TO BE GALVANIZED OR EPOXY COATED, AASHTO-M31, GRADE 60.
6. FOR DIMENSIONS SEE E 402.10.0

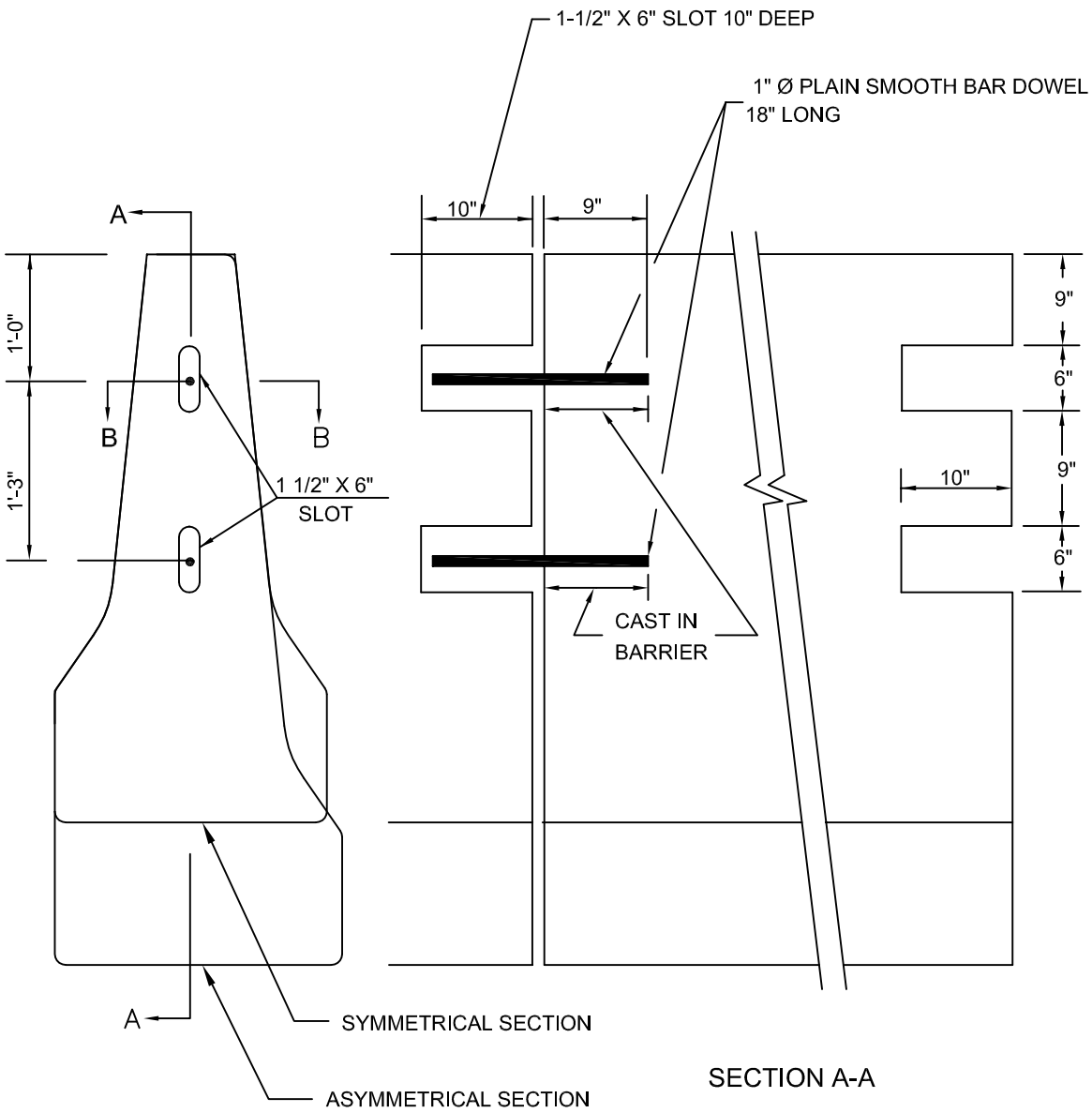
CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

# F SHAPE CONCRETE BARRIER
## DOWEL DETAILS

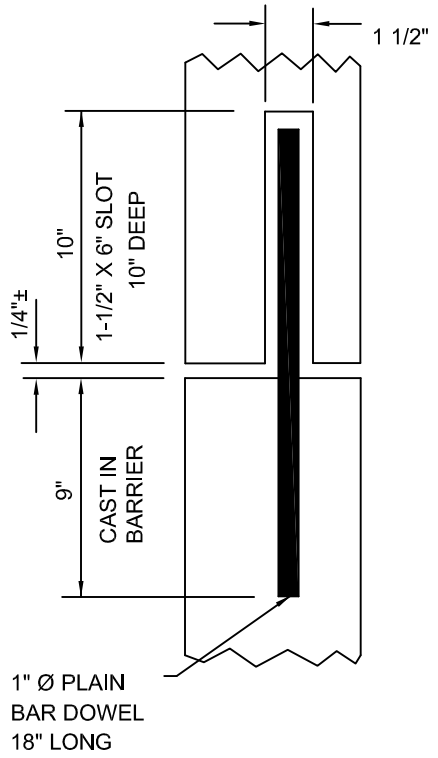
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 402.13.0**




ELEVATION

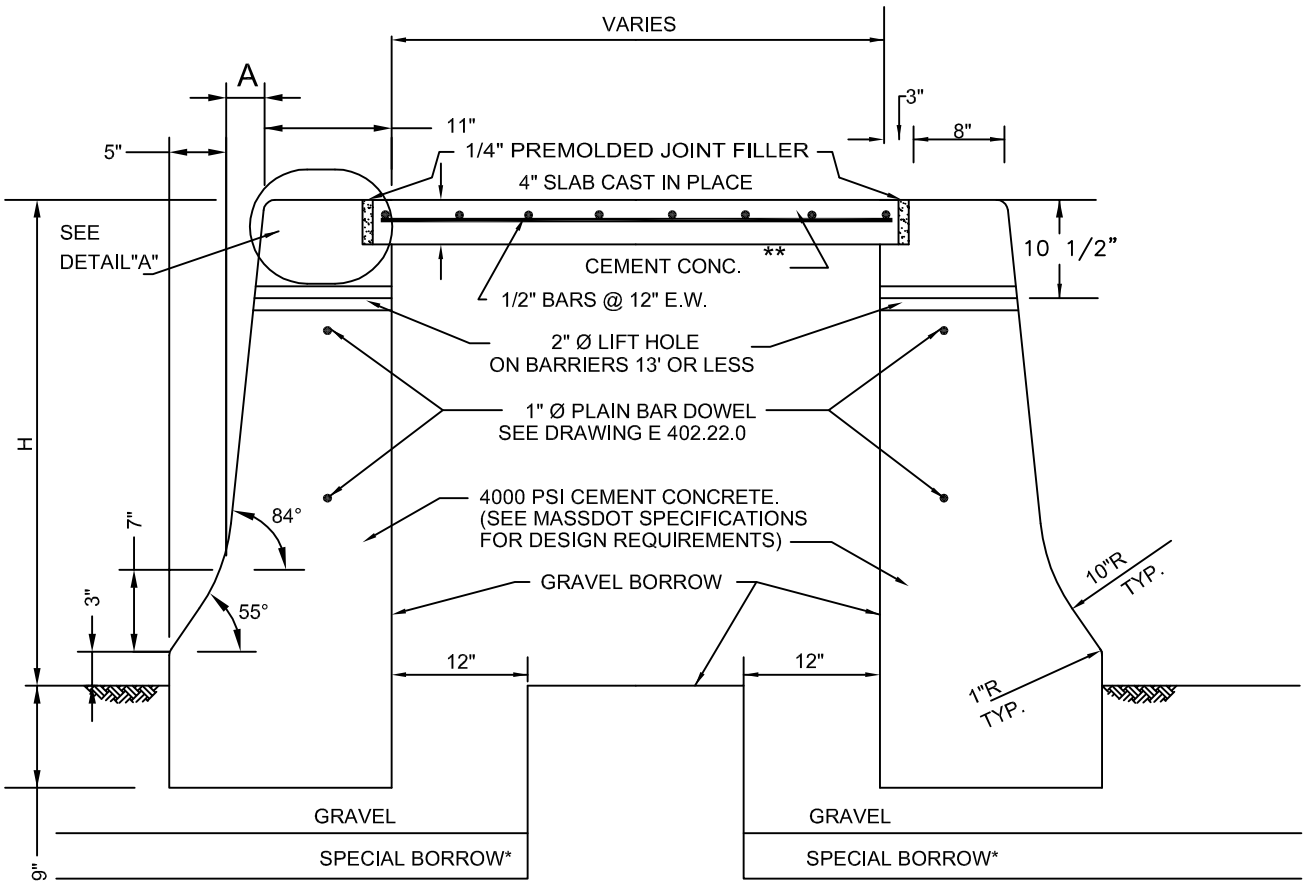
SECTION A-A

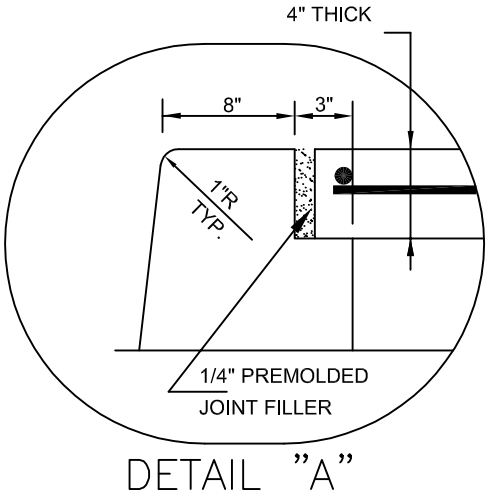



SECTION B-B

NOTES:

1. DOWELS TO BE GALVANIZED, AASHTO-M31, GRADE 60.
2. FOR ADDITIONAL DETAILS SEE E 402.10.0




DETAIL "A"

| SYSTEM | A | H |
|---|---|---|
| NORMAL | 2-3/8" | 2'-8" |
| TALL | 3-11/32" | 3'-6 1/8" |

* SAME DEPTH AS UNDER ROADWAY.

** BARRIER CAP BUILT USING 4000 PSI CEMENT CONCRETE (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS).

NOTES:

1. ALL LONGITUDINAL BARS TO BE CONTINUOUS FOR BOTH PRECAST BARRIERS AND CAST IN PLACE BARRIERS.
2. USE MINIMUM COVER OF 1 1/2", UNLESS OTHERWISE INDICATED.
3. ALL CONCRETE IS TO BE FIELD COATED AFTER FINAL INSTALLATION WITH A CONCRETE PENETRANT/SEALER. CONCRETE SHALL CURE NOT LESS THAN 28 DAYS PRIOR TO COATING.
4. FOR REINFORCING DETAILS SEE E 402.21.0
5. FOR DOWEL DETAILS SEE E 402.22.0
6. TAR PAPER TO BE PLACED INSIDE LIFT HOLES AND BARRIER JOINTS.

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# F SHAPE CONCRETE BARRIER WITH CONCRETE SEPARATOR

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 402.20.0**

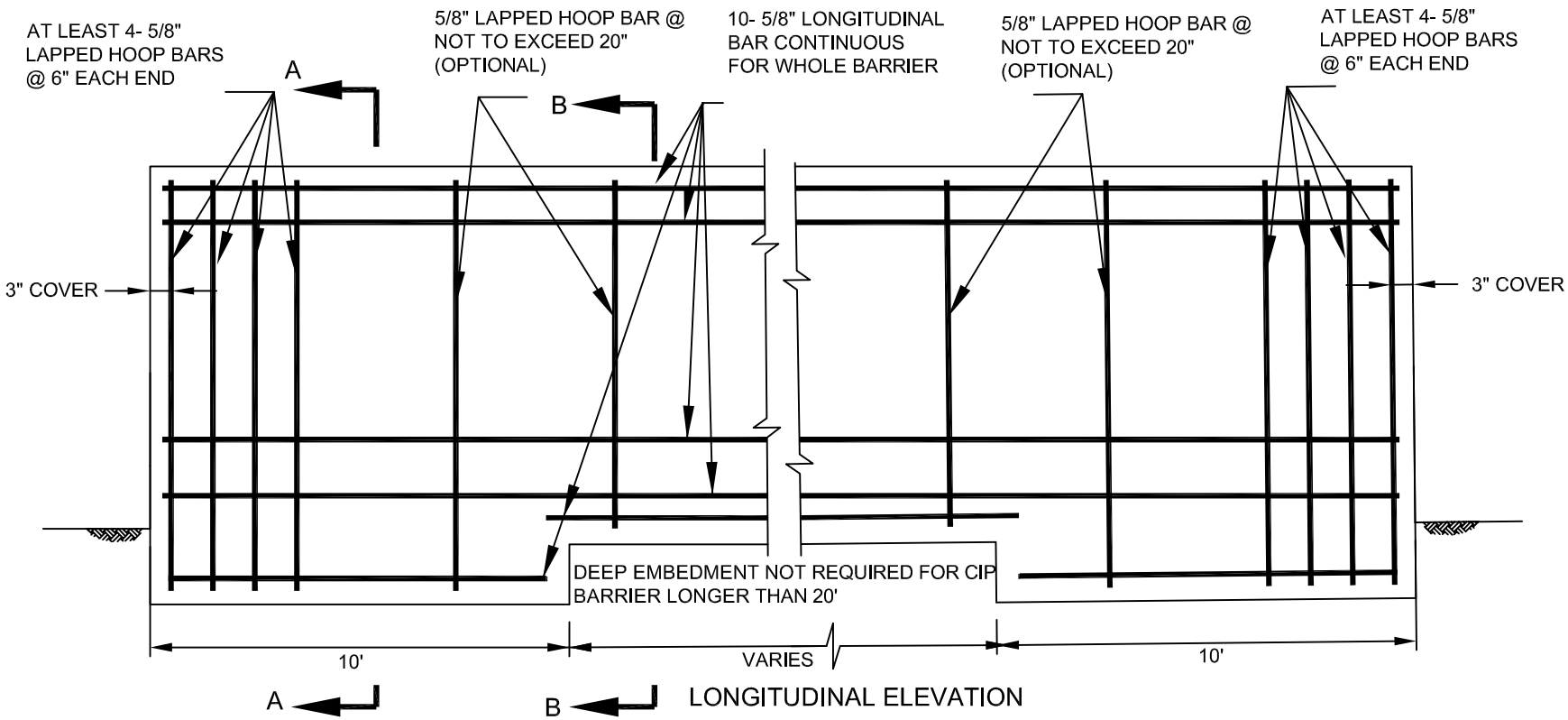
CONSTRUCTION STANDARDS

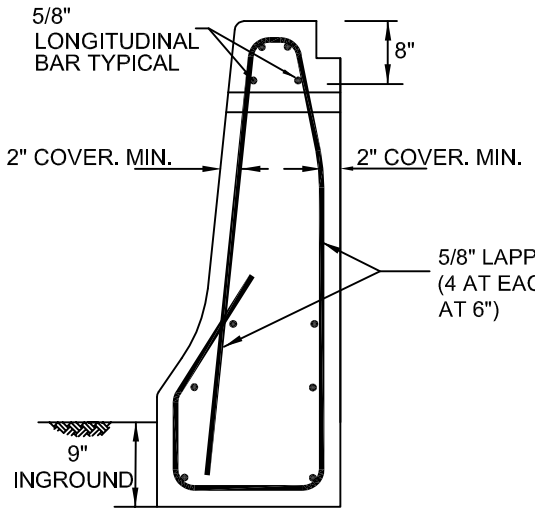
massDOT Massachusetts Department of Transportation Highway Division

# F SHAPE CONCRETE BARRIER WITH CONCRETE SEPARATOR REINFORCING DETAILS

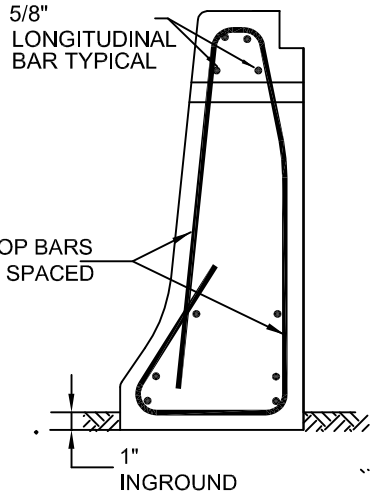
DATE OF ISSUE DECEMBER 2016

DRAWING NUMBER **E 402.21.0**




SECTION A-A




SECTION B-B

NOTES:

1. ALL LONGITUDINAL BARS ARE TO BE CONTINUOUS FOR BOTH PRECAST BARRIERS AND CAST IN PLACE BARRIERS.
2. USE MINIMUM COVER OF 1 1/2", UNLESS OTHERWISE INDICATED.
3. CAST IN PLACE (CIP) NOT TO EXCEED 200 FT BETWEEN EXPANSION JOINTS.
4. CONTRACTION JOINTS REQUIRED AT 40' INTERVALS (1/2 " PREMOULDED JOINT FILLER REQUIRED FOR PRECAST BARRIERS).
5. ALL STEEL REINFORCING TO BE GALVANIZED OR EPOXY COATED, AASHTO-M31, GRADE 60.
6. FOR DIMENSIONS SEE E 401.20.0

SECTION B-B

1" Ø PLAIN BAR DOWEL 18" LONG

SECTION A-A




ELEVATION

NOTES:

1. DOWELS TO BE GALVANIZED, AASHTO M-31, GRADE 60.
2. FOR ADDITIONAL DETAILS SEE E 402.20.0

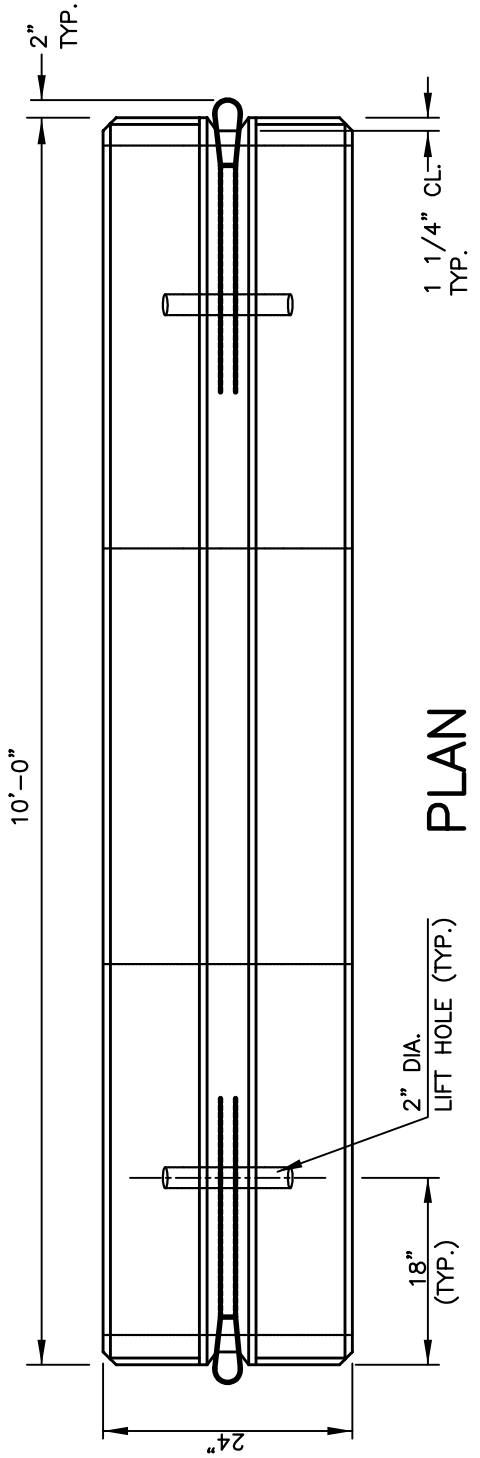
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

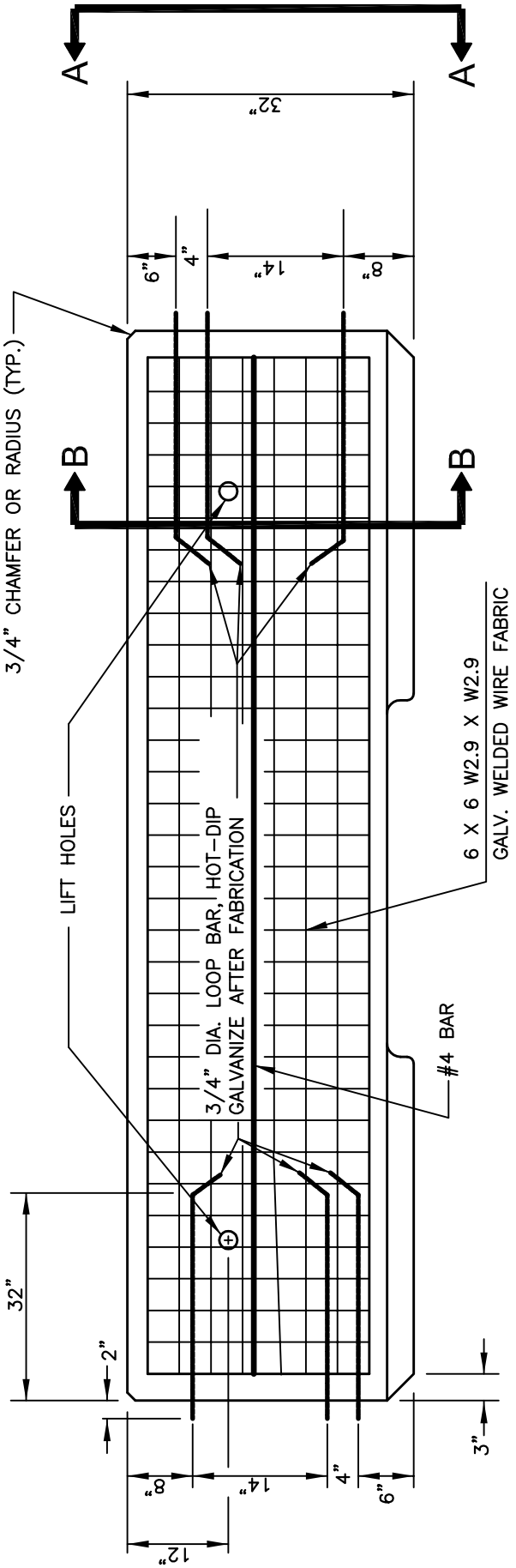
# F SHAPE CONCRETE BARRIER WITH CONCRETE SEPARATOR DOWEL DETAILS

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 402.22.0**




PLAN




ELEVATION

massDOT Massachusetts Department of Transportation Highway Division
CONSTRUCTION STANDARDS

# TEMPORARY CONCRETE BARRIER
## MASH TL-2

1/3

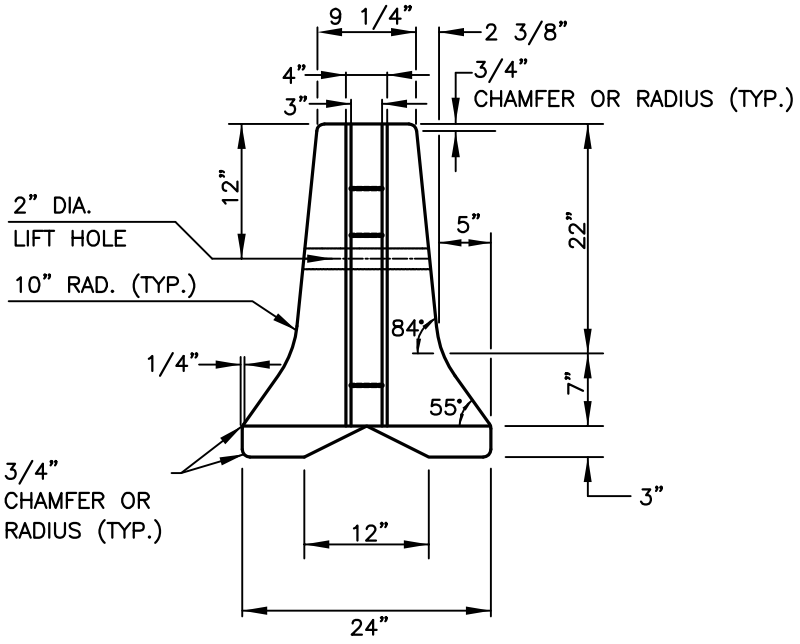
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
E 403.1.0

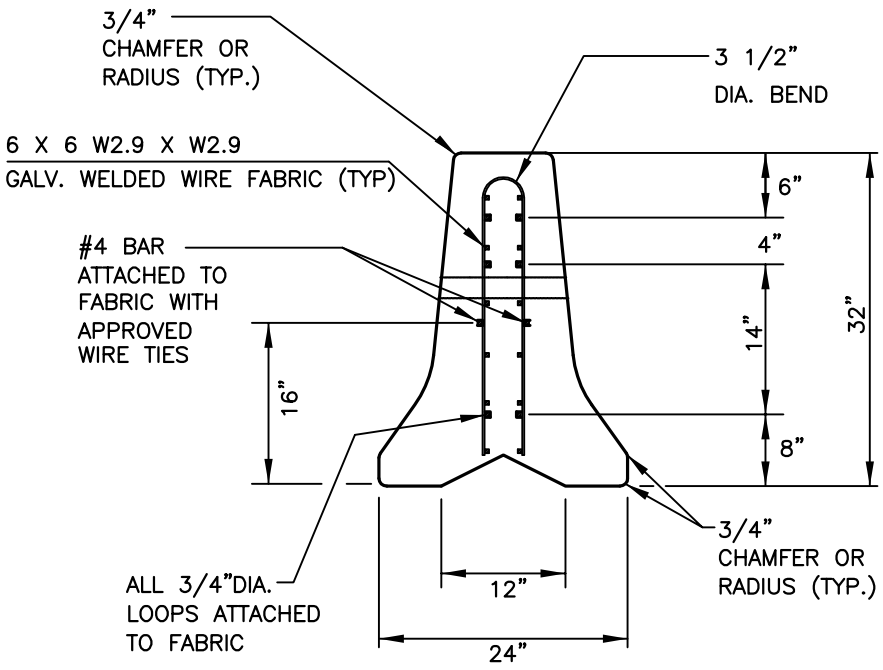
# TEMPORARY CONCRETE BARRIER
## MASH TL-2



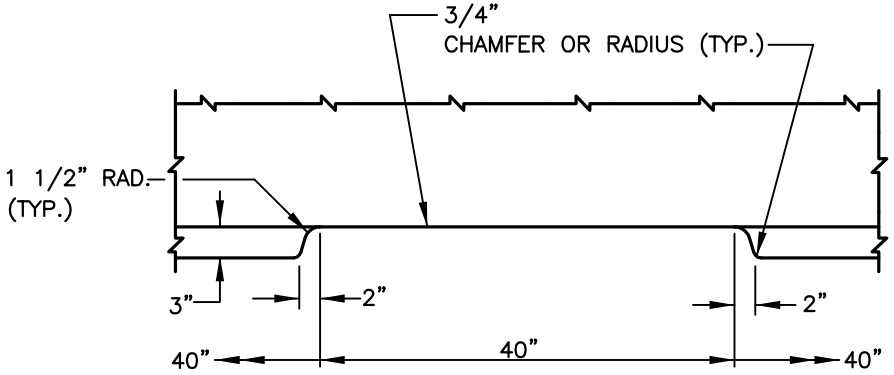
DATE OF ISSUE
DECEMBER 2016
DRAWING NUMBER
E 403.2.0




END VIEW A–A




SECTION B–B




ELEVATION DETAIL OF DRAINAGE SLOT

## TEST RESULTS
## MASH 2–11 ON CONCRETE

1. INSTALLATION LENGTH: 20 SEGMENTS
2. DYNAMIC DEFLECTION AT BASE: 29.9"
3. PERMANENT DEFLECTION AT BASE: 29.0"
4. WORKING WIDTH: 53.0"

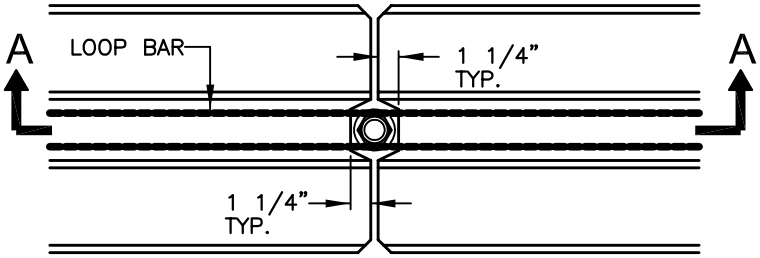
## GENERAL NOTES

1. ALL WELDED WIRE FABRIC, BARS, HOOP BARS AND PIN ASSEMBLIES ARE TO BE HOT–DIP GALVANIZED AFTER FABRICATION.
2. HOT–DIP GALVANIZED TREATMENTS ARE TO CONFORM TO MASSDOT STANDARD SPECIFICATIOS M7.10.0 AND AASHTO M111.
3. CEMENT CONCRETE IS TO CONFORM TO MASSDOT STANDARD SPECIFICATIONS M4.02.00. CEMENT CONCRETE IS TO BE 5000 PSI (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS).

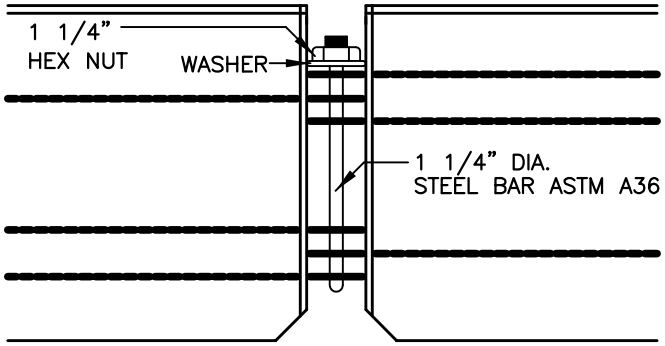
# TEMPORARY CONCRETE BARRIER
## MASH TL-2



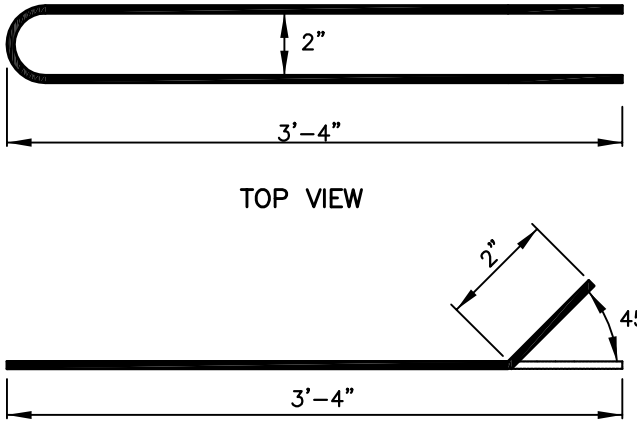
DATE OF ISSUE
DECEMBER 2016
DRAWING NUMBER
E 403.3.0



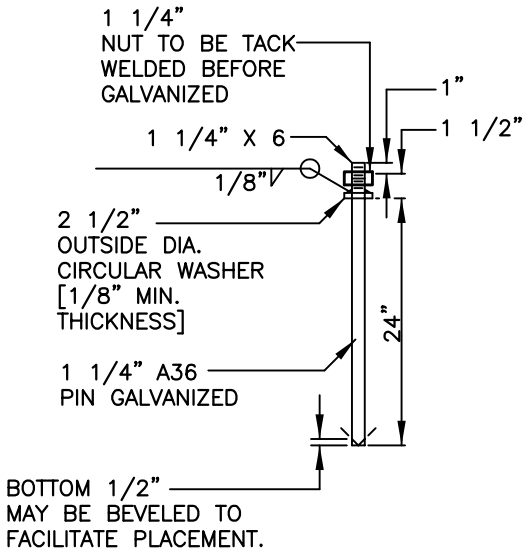

PLAN OF CONNECTION



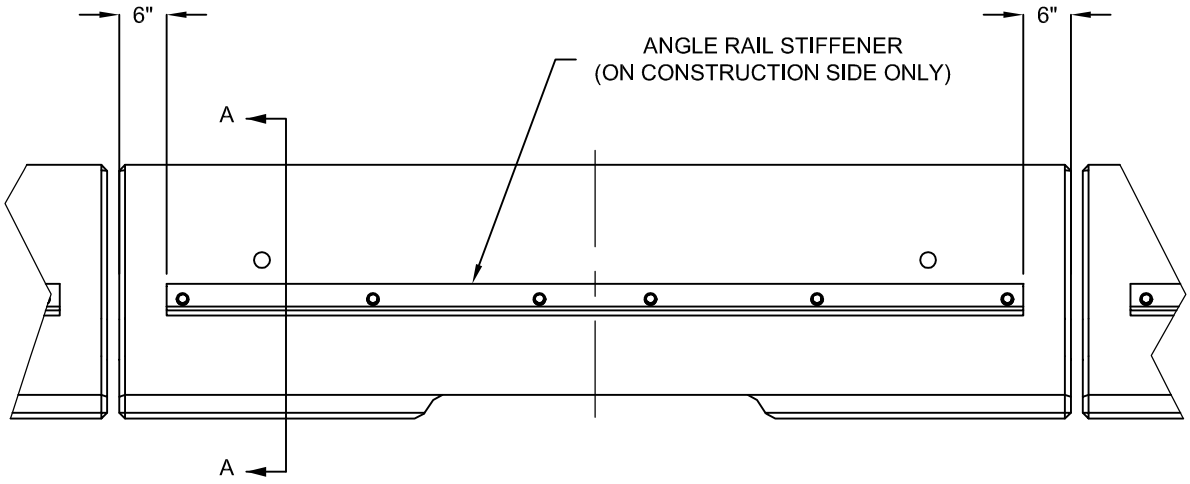

SECTION A–A



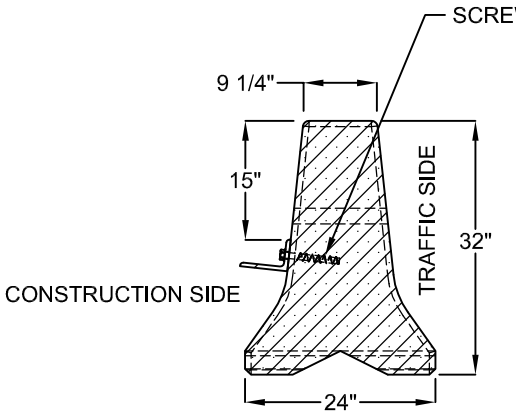

REINFORCEMENT DETAIL



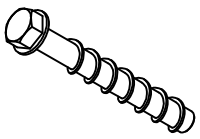

CONNECTOR PIN ASSEMBLY




ELEVATION VIEW
(CONSTRUCTION SIDE)
N.T.S.




SECTION A-A



SCREW ANCHOR

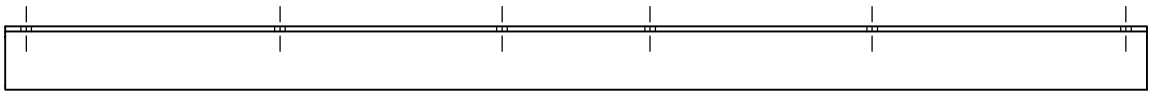
¾" X 7" SCREW ANCHOR WITH FACTORED DESIGN STRENGTHS IN 4,000 PSI CONCRETE WITH A 6 ¼" EMBEDMENT AS FOLLOWS: A MINIMUM 11,820 LBS IN TENSION AND A MINIMUM 25,455 LBS IN SHEAR.

## TEST RESULTS
## MASH 3-11 ON CONCRETE:

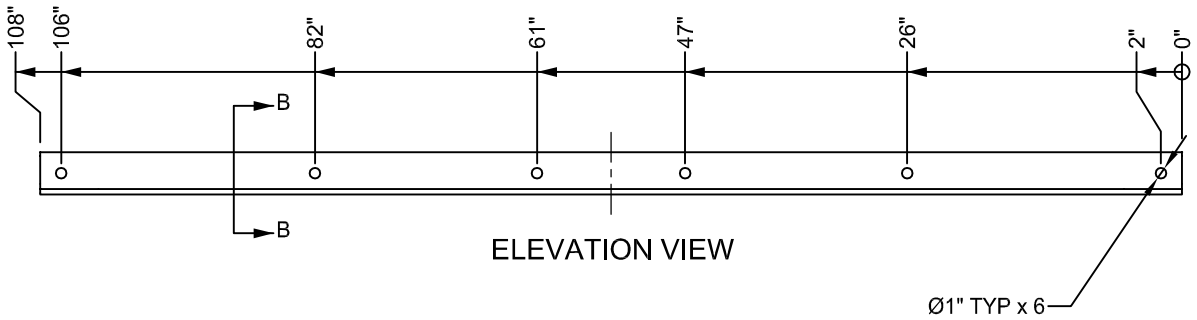
1. INSTALLATION LENGTH: 20 SEGMENTS
2. DYNAMIC DEFLECTION AT BASE: 59.0"
3. PERMANENT DEFLECTION AT BASE: 59.0"
4. WORKING WIDTH: 81.4"

## NOTES:

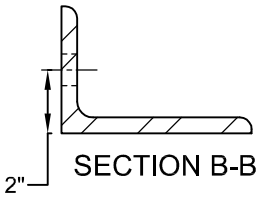
1. SEE MASSDOT DRAWING # E 403.2.0 FOR CONNECTION AND BARRIER DETAILS.
2. FOLLOW MANUFACTURER'S INSTRUCTION FOR INSTALLING SCREW ANCHORS.



PLAN VIEW



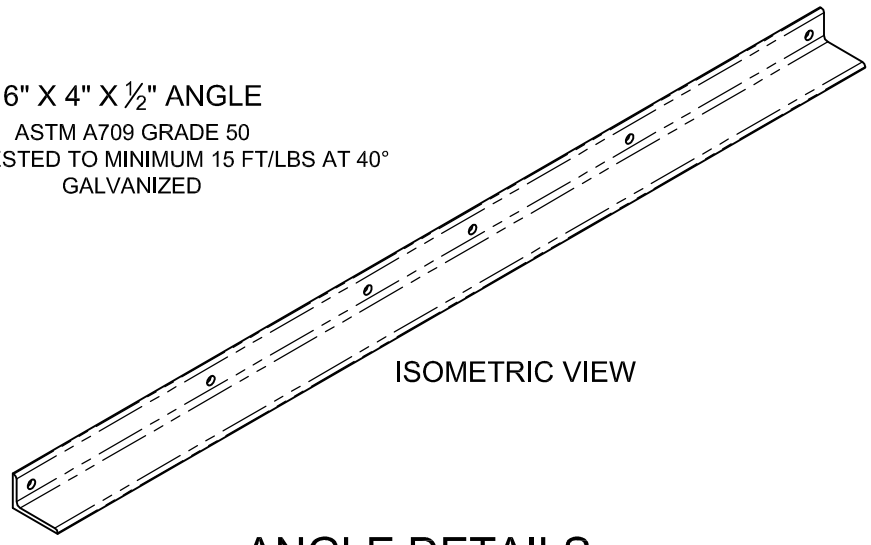

ELEVATION VIEW




SECTION B-B

6" X 4" X ½" ANGLE

ASTM A709 GRADE 50
CHARPY TESTED TO MINIMUM 15 FT/LBS AT 40°
GALVANIZED



ISOMETRIC VIEW

# ANGLE DETAILS

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

## TEMPORARY CONCRETE BARRIER RETROFITTED TO MASH TL-3

2/2

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 403.9.0**

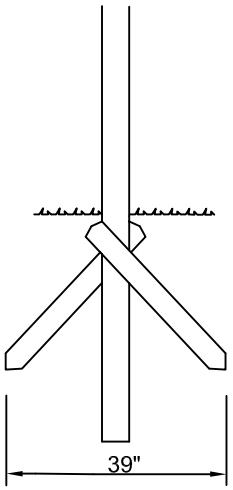
massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

# CHAIN LINK FENCE (SPRING TENSION WIRE)

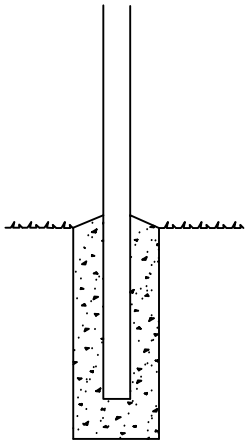
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 404.1.0**

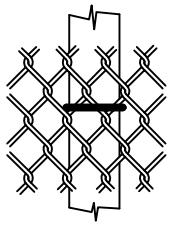



FABRIC PLACED PERPENDICULAR TO THE ANCHOR

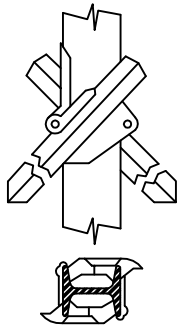
DETAIL SHOWING LINE POST SET WITH DRIVE ANCHORS



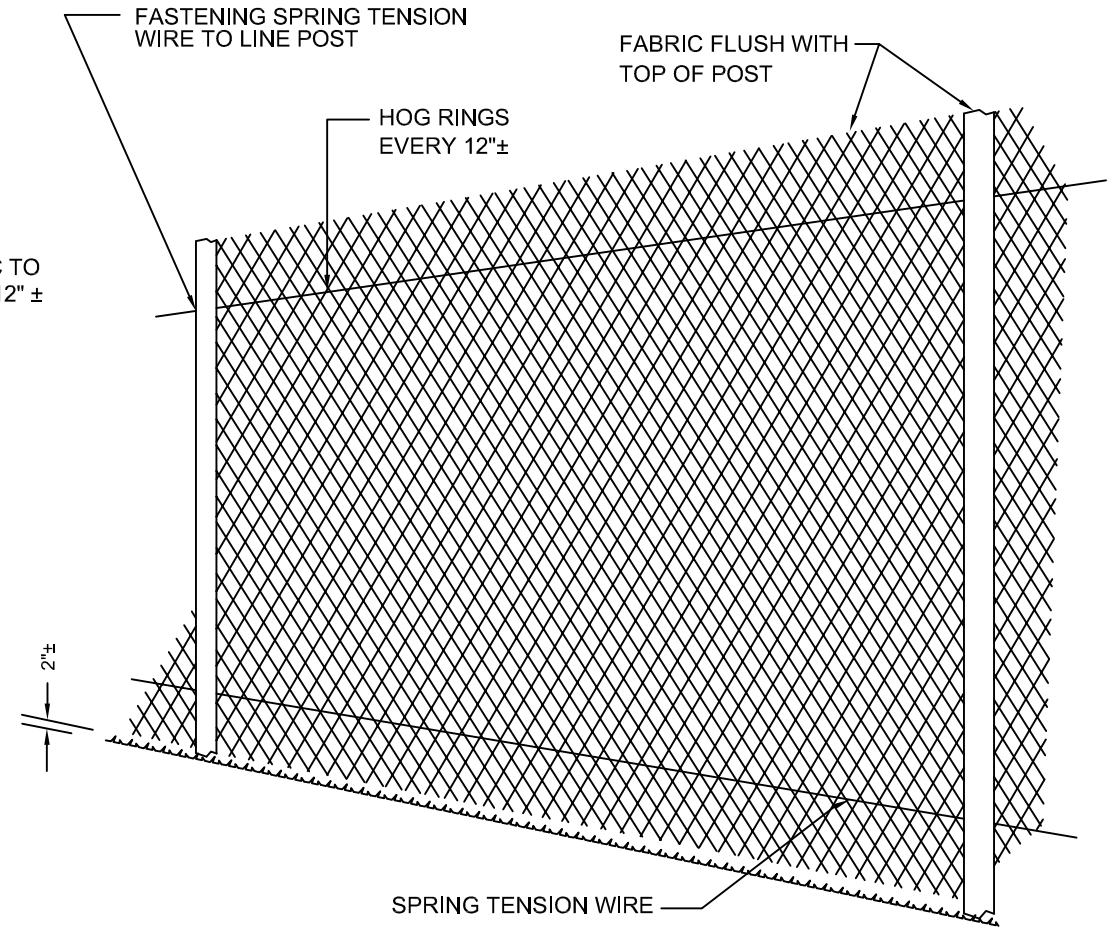
DETAIL SHOWING LINE POST SET IN CONCRETE FOOTING FOR DIMENSIONS SEE 404.5.0



FASTENING FABRIC TO LINE POST EVERY 12" ±



DETAIL OF AN ANCHOR CLAMP




CHAIN LINK FENCE WITH SPRING TENSION WIRE

LINE POSTS TO BE SPACED 10'-0" C. TO C. MAXIMUM EXCEPT ON CURVES WHERE THEY SHALL BE SPACED AS FOLLOWS:

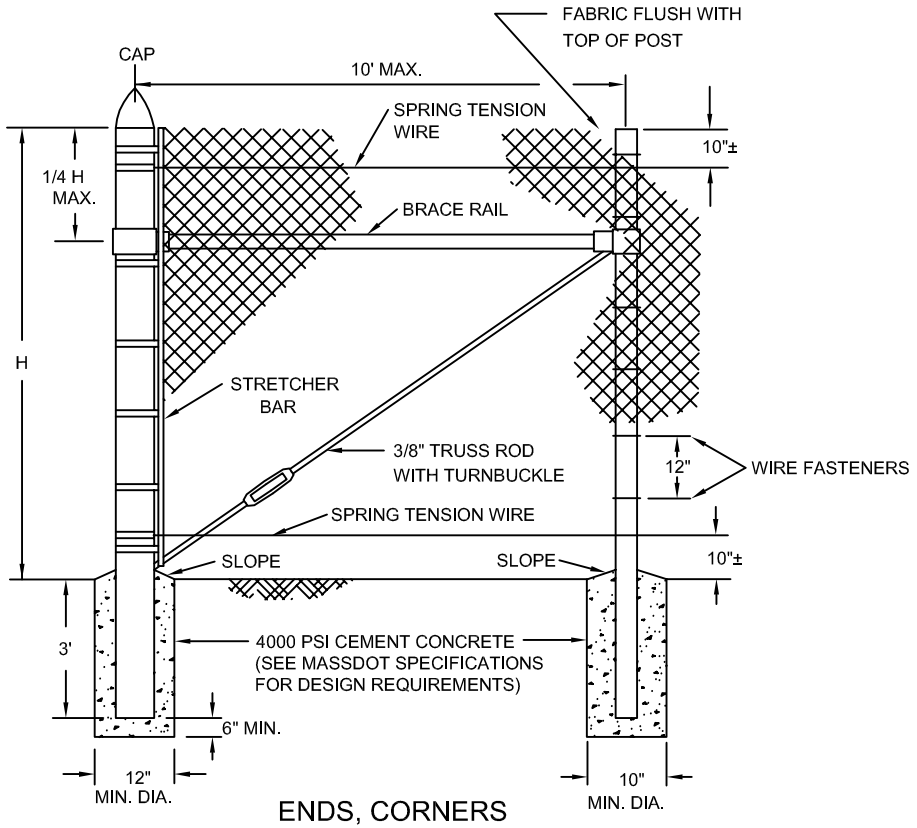
| | |
|---|---|
| CURVES 200' TO 500' RADIUS | 8'-0" C. TO C. MAXIMUM |
| CURVES 100' TO 200' RADIUS | 6'-0" C. TO C. MAXIMUM |
| CURVES LESS THAN 100' RADIUS | 5'-0" C. TO C. MAXIMUM |

LINE POST SPACING

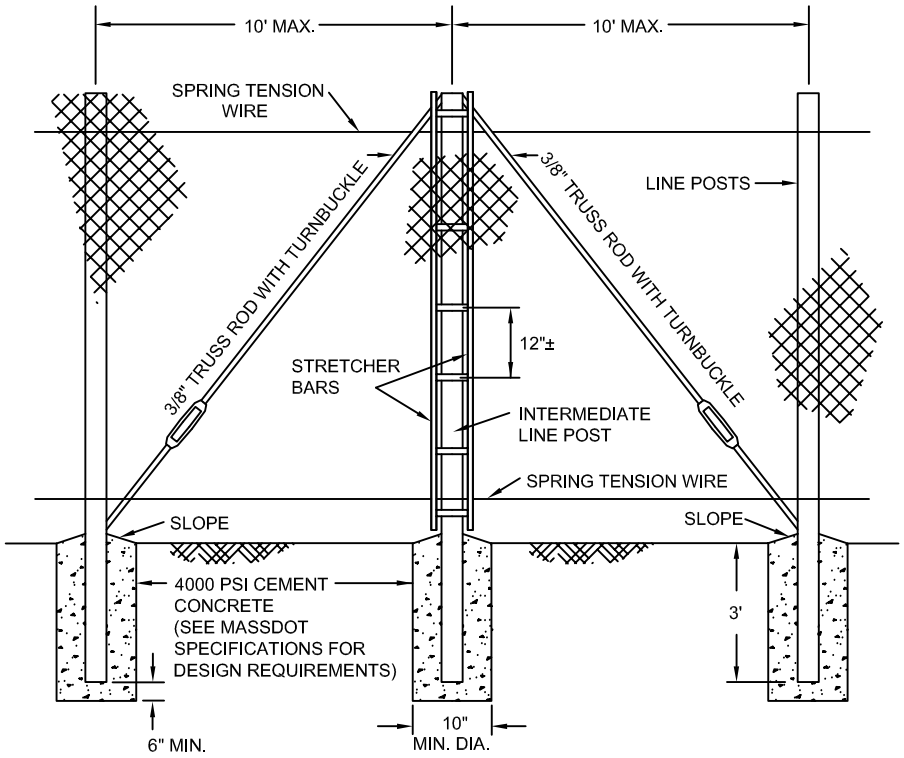
CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

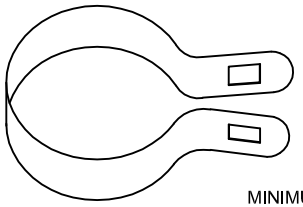
# CHAIN LINK FENCE (SPRING TENSION WIRE)




ENDS, CORNERS




INTERMEDIATE POST



END BAND

SPRING TENSION WIRE

MINIMUM OF (5) TURNS AROUND THE SPRING TENSION WIRE TO END INSTALLATION. ALL BANDS SHALL BE ROUND ON ROUND POSTS.

NOTES:

1. FABRIC FOR FENCES 4' OR LESS IN HEIGHT; TOP SELVAGE TO HAVE KNUCKLED FINISH. BOTTOM SELVAGE TO HAVE TWISTED AND BARBED FINISH UNLESS OTHERWISE NOTED. FABRIC FOR FENCES 5' OR OVER IN HEIGHT; BOTH TOP AND BOTTOM SELVAGE TO HAVE TWISTED AND BARBED FINISH UNLESS OTHERWISE NOTED.
2. GRADE OF FENCE TO BE PARALLEL WITH THE GRADE OF SIDEWALKS, CURBING, GROUND OR TOP OF WALL.
3. INTERMEDIATE POST INTERVALS NOT TO EXCEED 500 FEET.
4. SPACING OF LINE POST ON CURVES, SEE DRAWING E 404.1.0
5. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHODS, SEE STANDARD SPECIFICATIONS.
6. SPRING TENSION WIRE TO BE FASTENED TO FABRIC WITH 11 GAUGE HOG RINGS AT 1' INTERVALS.
7. SPRING TENSION WIRE TO BE FASTENED TO LINE POSTS WITH CLIPS.
8. LINE POSTS TO BE DRIVEN EXCEPT WHERE NOTED ABOVE.

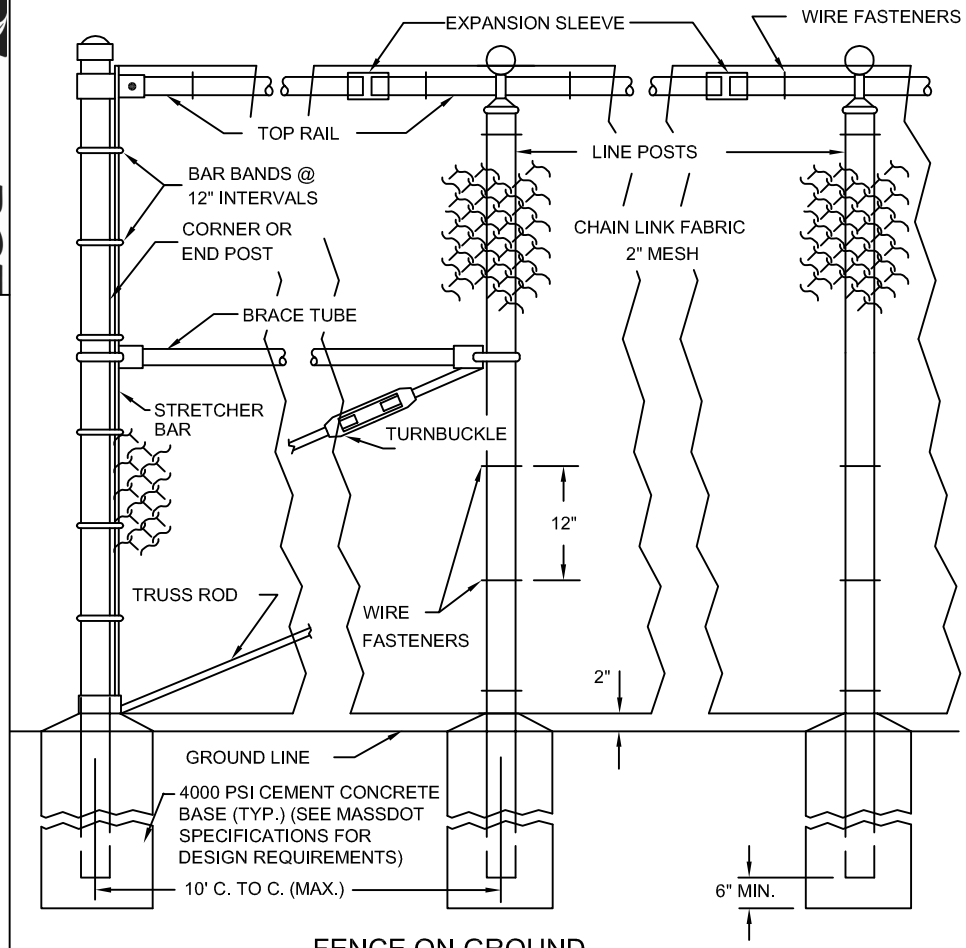
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 404.2.0**

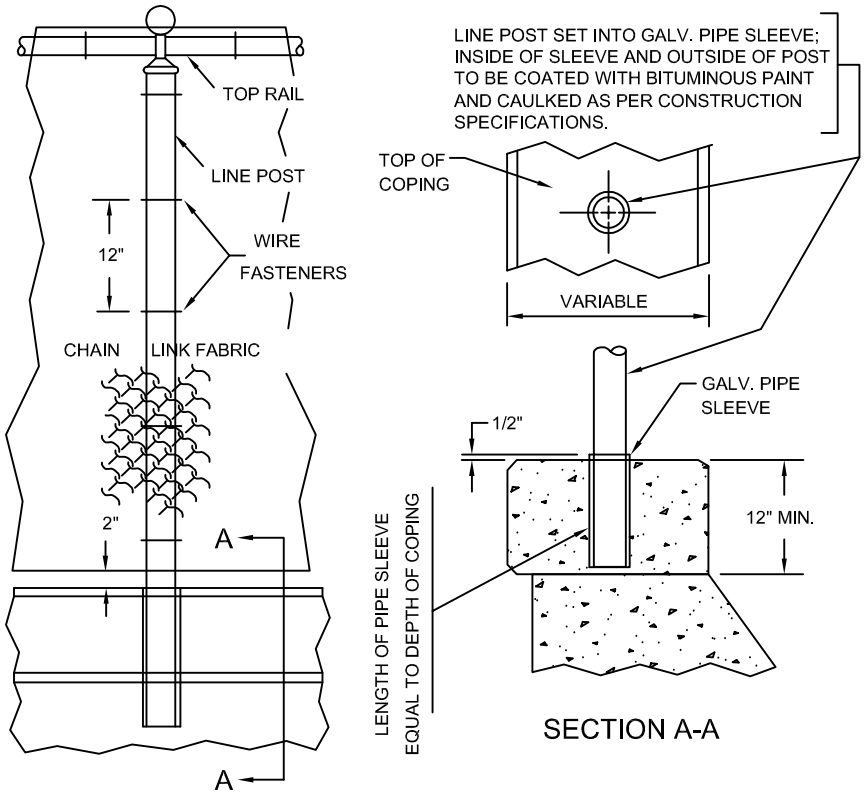
CONSTRUCTION STANDARDS

MassDOT Massachusetts Department of Transportation Highway Division

# CHAIN LINK FENCE (PIPE TOP RAIL)




FENCE ON GROUND




SECTION A-A

FENCE ON CONCRETE WALL

NOTES:

1. FABRIC FOR FENCES 4' OR LESS IN HEIGHT.
   TOP SELVAGE TO HAVE KNUCKLED FINISH. BOTTOM SELVAGE TO HAVE TWISTED AND BARBED FINISH UNLESS OTHERWISE NOTED.
   FABRIC FOR FENCES 5' OR OVER IN HEIGHT.
   BOTH TOP AND BOTTOM SELVAGE TO HAVE TWISTED AND BARBED FINISH UNLESS OTHERWISE NOTED.
2. THE HEIGHT OF FENCE TO BE AS SPECIFIED.
3. GRADE OF FENCE TO BE PARALLEL WITH THE GRADE OF SIDEWALKS, CURBING, GROUND OR TOP OF WALL.
4. LINE POSTS TO BE SPACED 10'-0" C. TO C. MAXIMUM EXCEPT ON CURVES WHERE THEY SHALL BE SPACED AS FOLLOWS:

| | |
|---|---|
| CURVES 200' TO 500' RADIUS | 8'-0" C. TO C. MAXIMUM |
| CURVES 100' TO 200' RADIUS | 6'-0" C. TO C. MAXIMUM |
| CURVES LESS THAN 100' RADIUS | 5'-0" C. TO C. MAXIMUM |

5. FOR POST BASES AND CABLE ATTACHMENTS, SEE DRAWING E 404.5.0
6. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHODS, SEE STANDARD SPECIFICATIONS.

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 404.4.0**

massDOT Massachusetts Department of Transportation Highway Division

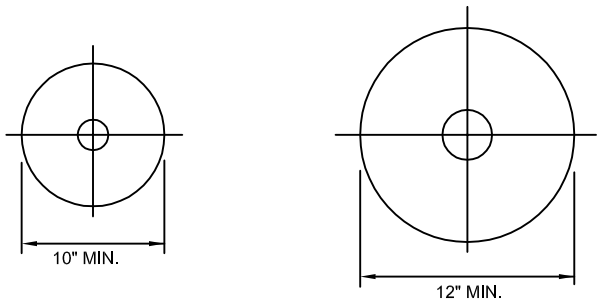
CONSTRUCTION STANDARDS

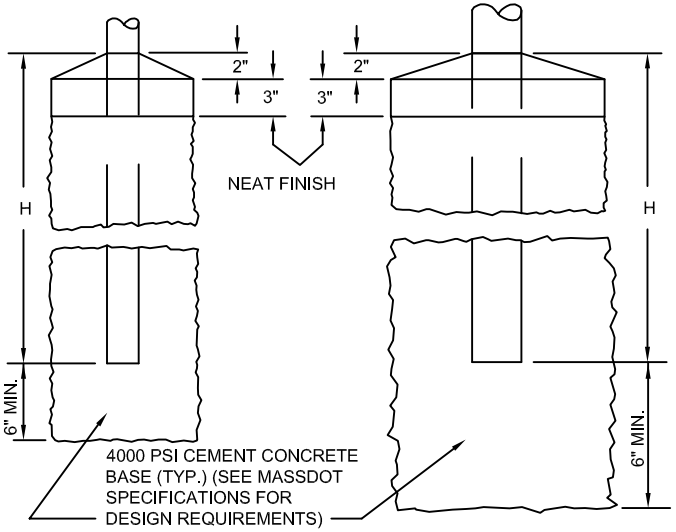
# CHAIN LINK FENCE DETAILS OF CABLE ATTACHMENTS AND POST BASES

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 404.5.0**

## POST BASES

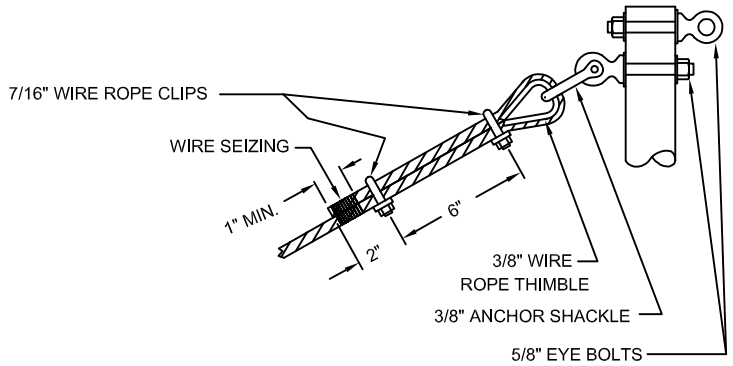


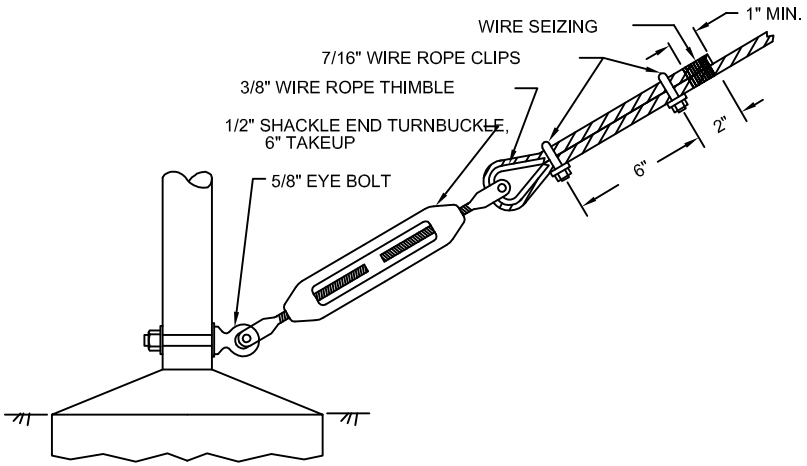

FOR CORNER, END LINE AND PULL POSTS

FOR GATE POSTS

| FENCE HEIGHT | MIN. H |
|---|---|
| 5' OR LESS | 2'-6" |
| OVER 5' | 3'-0" |




FOR END PULL POST




FOR FASTENING TO BASE OF POST

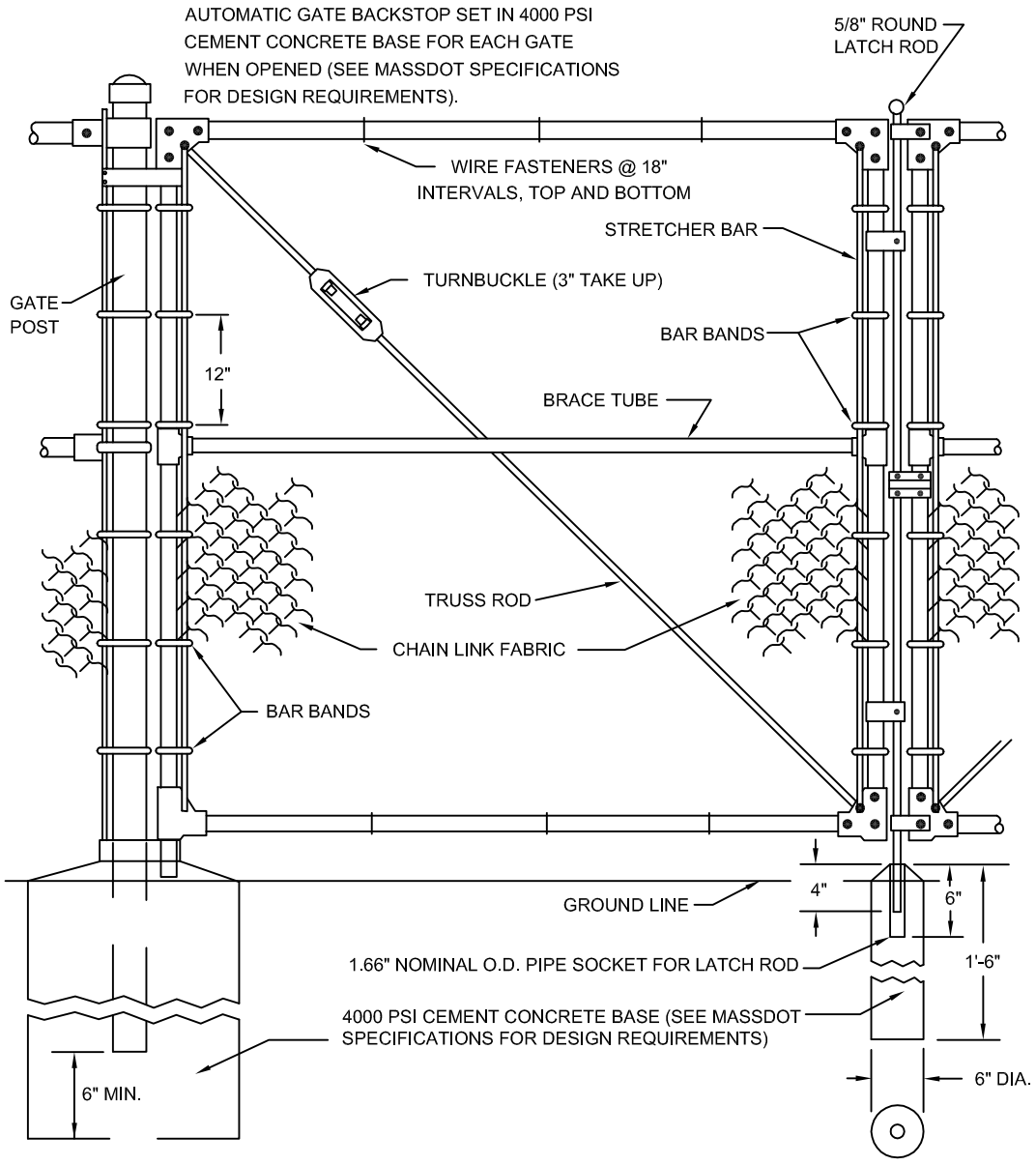
NOTE:
1. FOR EYE BOLT INSTALLATION THROUGH PIPE SECTIONS, USE 2 WASHERS ON "SHOULDER SIDE" AND 1 WASHER WITH LOCK WASHER ON "NUT SIDE" OF POSTS.

DETAILS OF CABLE ATTACHMENTS

CONSTRUCTION STANDARDS

MassDOT Massachusetts Department of Transportation Highway Division

# CHAIN LINK FENCE - SWING GATE




DOUBLE GATES

END POSTS TO BE USED ON LATCH SIDE OF SINGLE GATE OPENINGS.

1. CHAIN LINK FABRIC FOR GATES TO BE THE SAME AS REQUIRED FOR FENCE.

2. FOR GATE POST BASE, SEE DRAWING 404.5.0

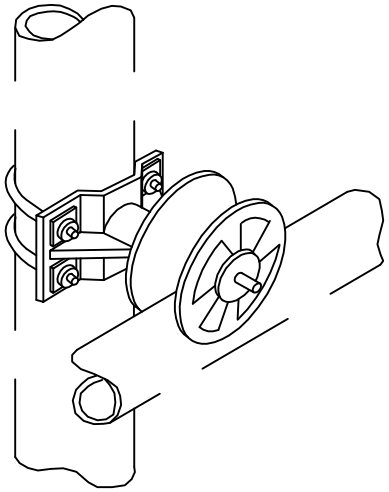
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 404.6.0**

massDOT
Massachusetts Department of Transportation
Highway Division

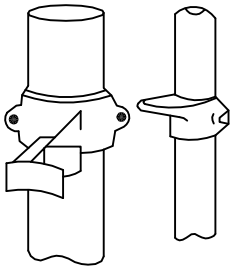
CONSTRUCTION STANDARDS

# CHAIN LINK FENCE
# CANTILEVER GATE

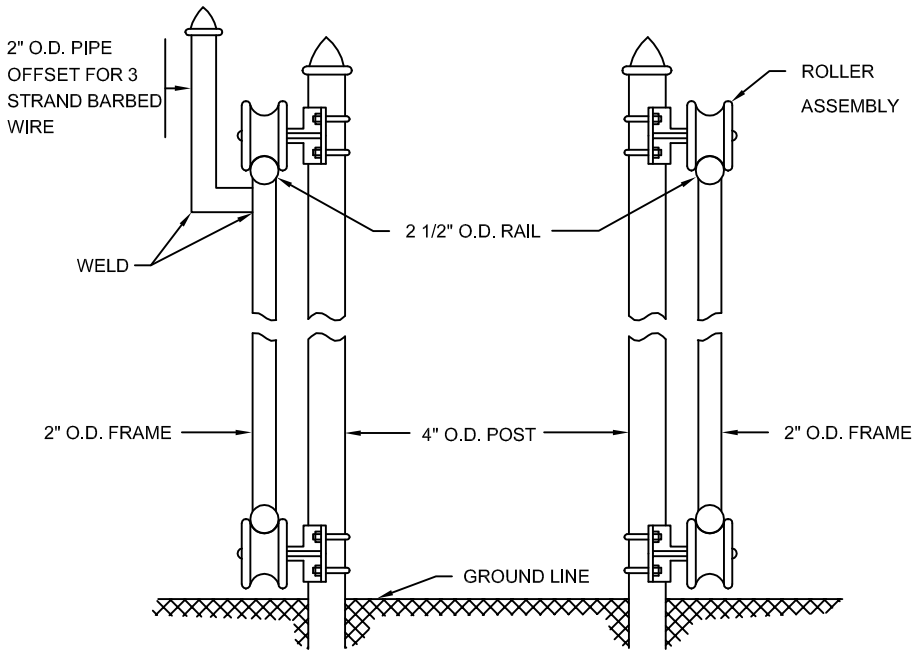


WHEEL EQUIPPED WITH ROLLER BEARINGS
AND LUBRICATION FITTING.
MASSIVE MALLEABLE CONSTRUCTION.
4 ASSEMBLIES NEEDED PER SECTION.

ROLLER ASSEMBLY



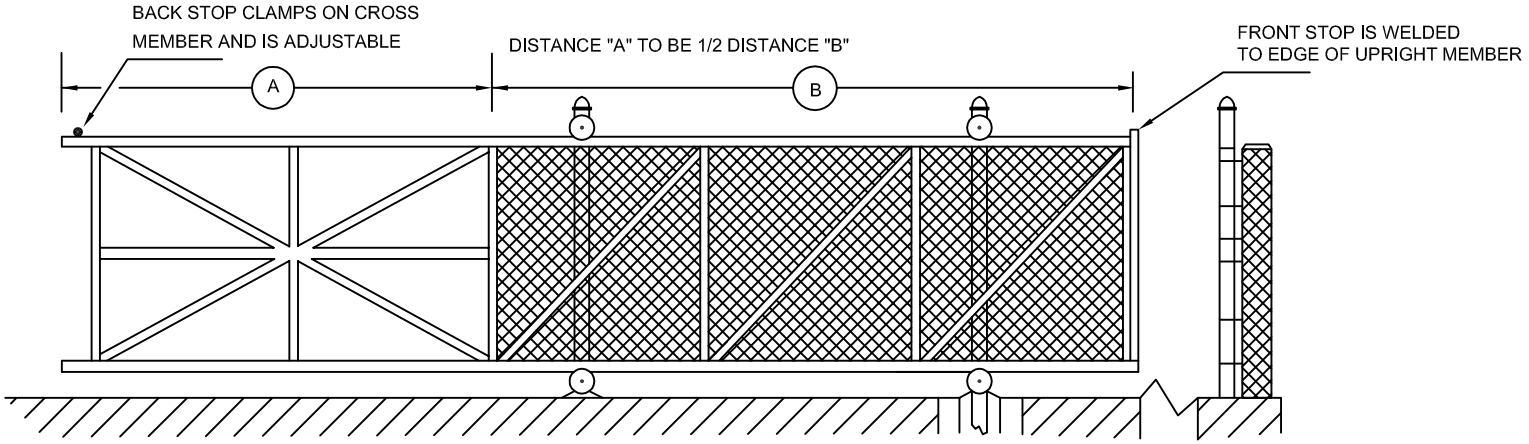
LATCH AND LOCKING ASSEMBLY




SPECIFICATIONS OF GATE FRAME

TOP AND BOTTOM MEMBER---------- 2 1/2" O.D. PIPE
UPRIGHT MEMBERS---------- 2" O.D. PIPE
HORIZONTAL AND DIAGONAL BRACES---- 1 5/8" O.D. PIPE

SIDE VIEW SHOWING TRUSS TYPE CONSTRUCTION



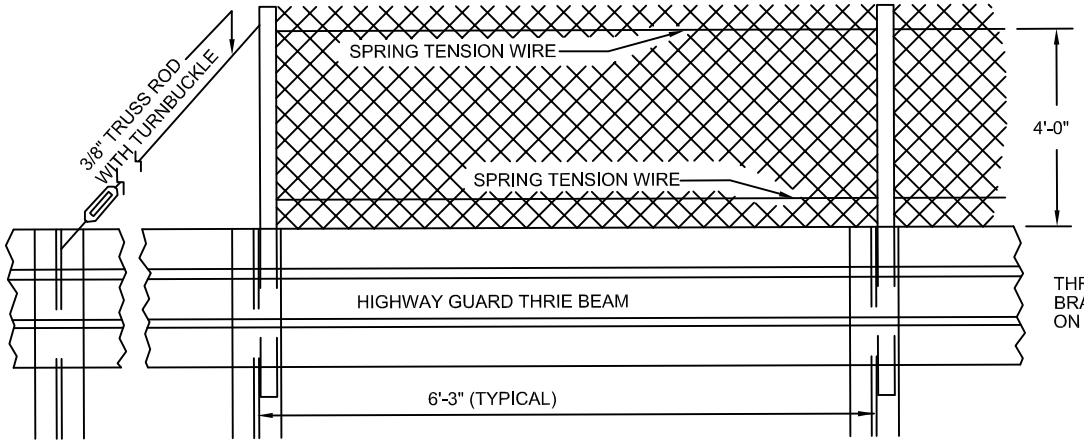

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 404.7.0**

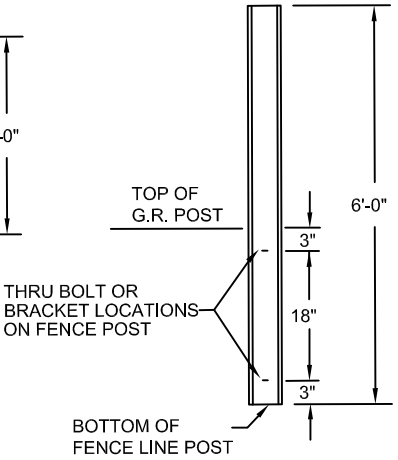
massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

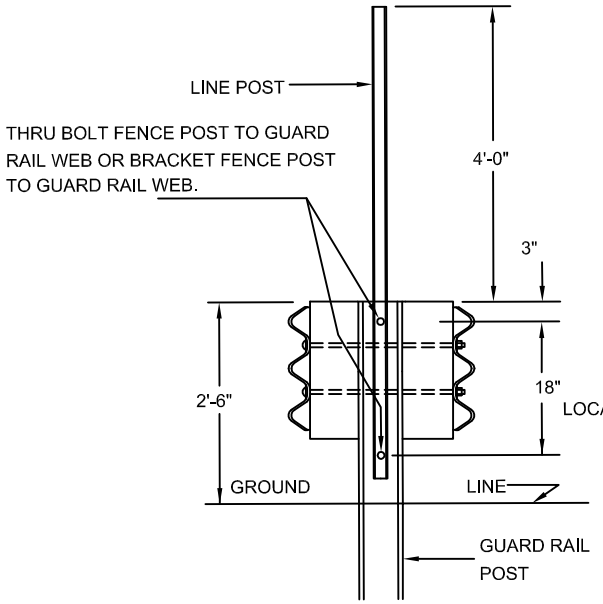
# CHAIN LINK FENCE MOUNTED ON GUARD RAIL



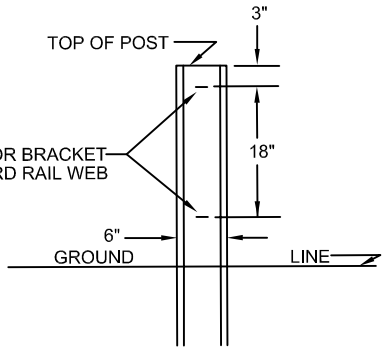

ELEVATION



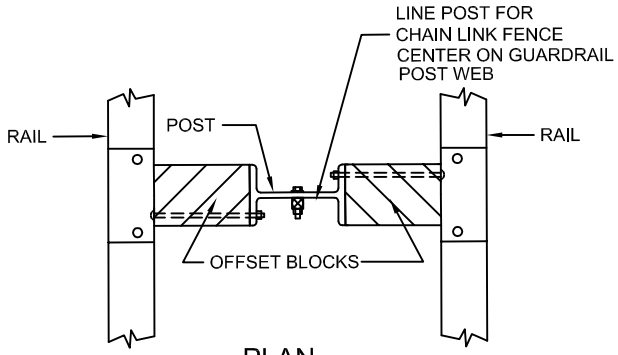

CHAIN LINK FENCE POST




ELEVATION




G.R. POST



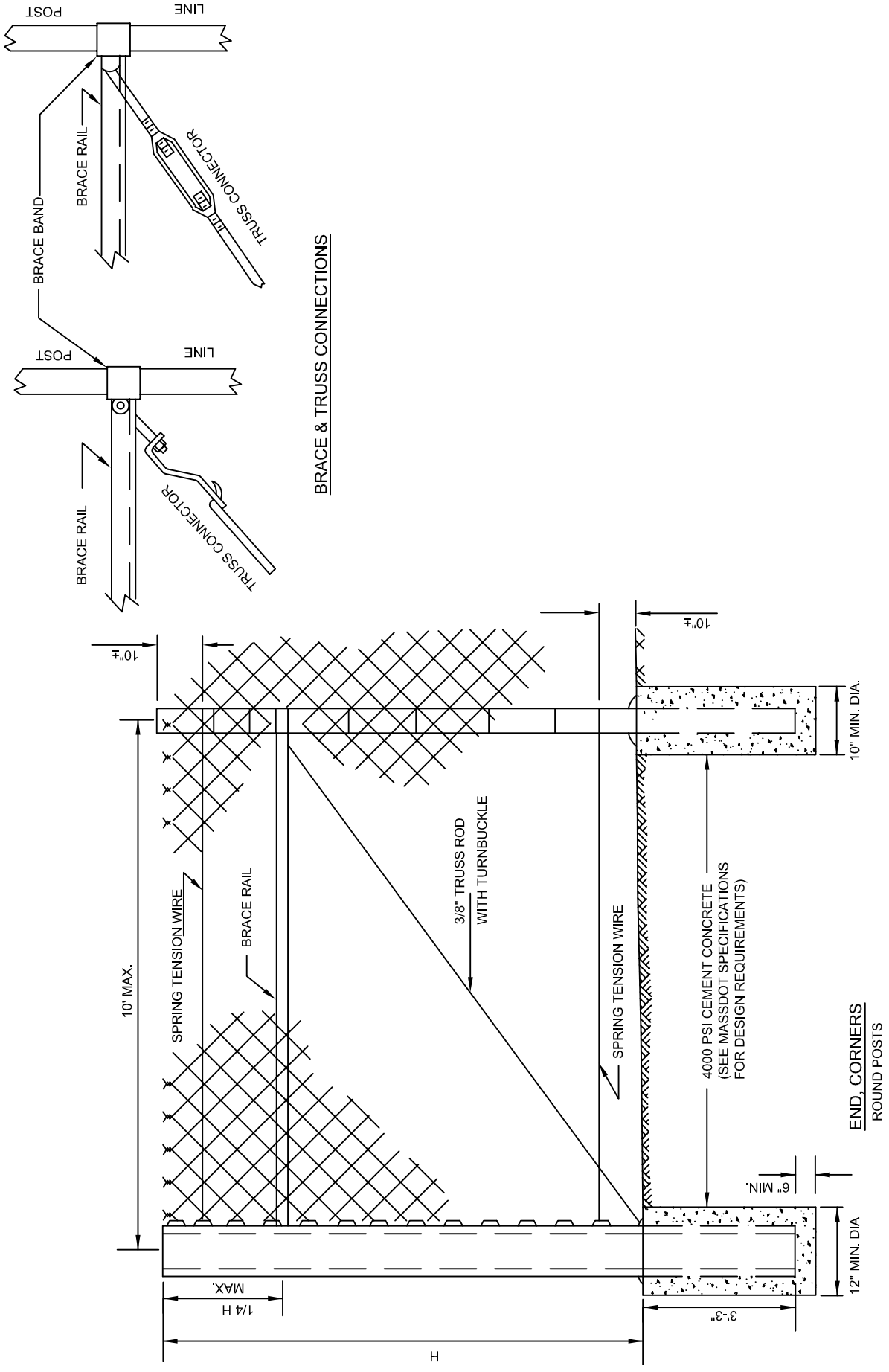

PLAN

NOTES:

1. ALL POSTS (LINE, END, AND INTERMEDIATE) SHALL CONFORM TO DETAILS SHOWN ON DRAWING E 404.1.0
2. END BRACING TO CONFORM TO DETAIL SHOWN ABOVE. INTERMEDIATE BRACING SHALL BE IN CONFORMANCE TO DETAILS SHOWN ON DRAWING E 404.2.0
3. FOR DESCRIPTION, MATERIALS AND METHODS, SEE STANDARD SPECIFICATIONS.
4. SHALL USE A ROUND OR C FENCE POST

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 404.8.0**




massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# CHAIN LINK FENCE POST DETAILS

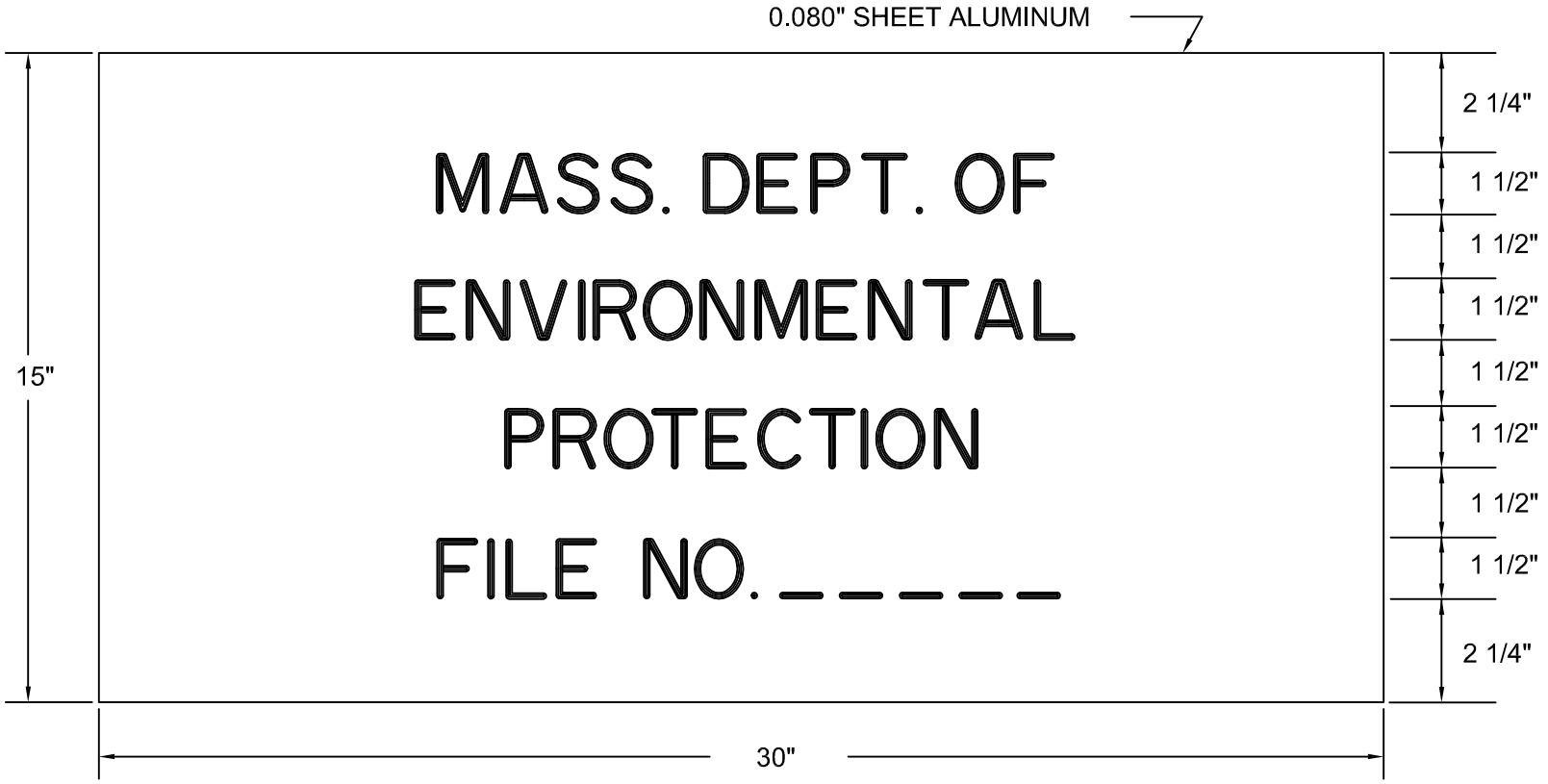
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 404.10.0**

CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

# WETLANDS PROTECTION ACT SIGN




COLORS — LEGEND - BLACK (NON-REFLECTORIZED)
BACKGROUND - WHITE (REFLECTORIZED)

THE SIGN IS TO BE MOUNTED ON A MASSDOT HIGHWAY DIVISION STANDARD "P-5" POST

NOTES:

1. THE SIGN IS PLACED ON ALL PROJECTS SUBJECT TO THE PROVISIONS OF THE MASSACHUSETTS WETLANDS PROTECTION ACT.
2. THE LOCATION OF THE SIGN IS TO BE DETERMINED BY THE ENGINEER.
3. SEE SPECIAL PROVISIONS FOR THE MANUFACTURE, MAINTENANCE, ERECTION AND REMOVAL RESPONSIBILITIES.
4. USE SERIES "D" FOR LETTERING.

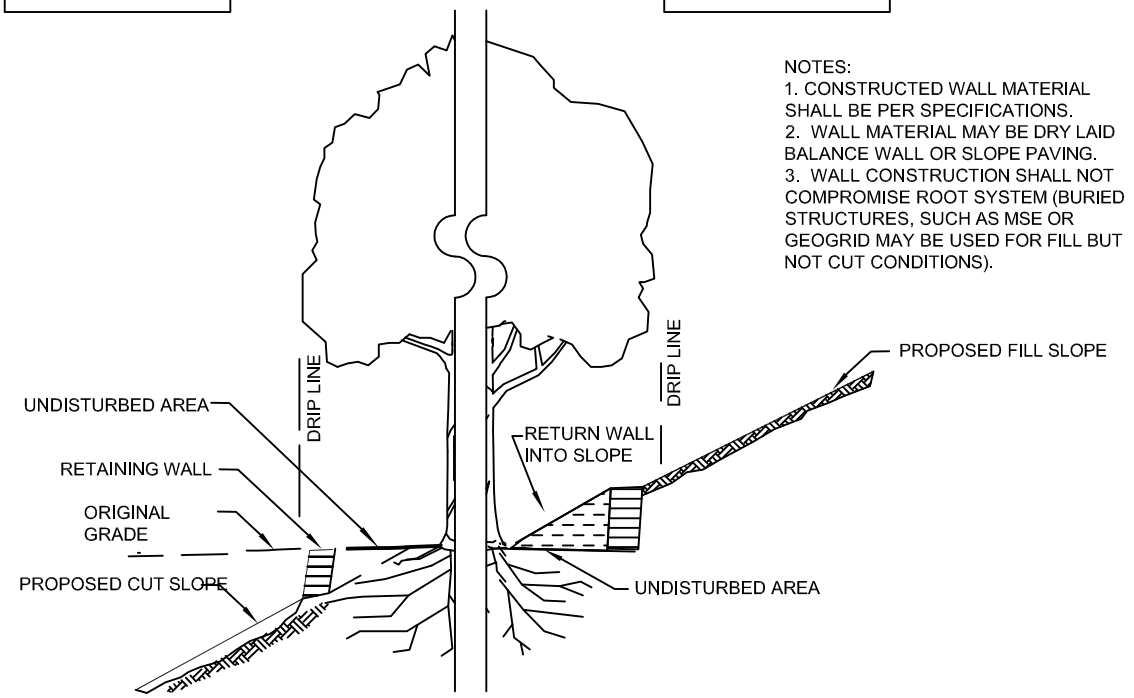
DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 501.1.0**

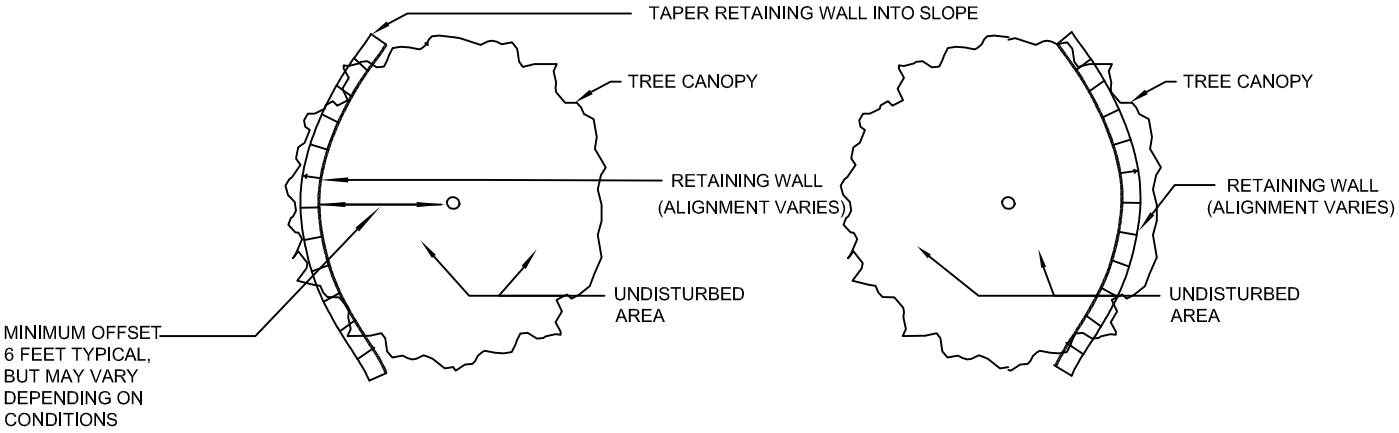
CUT CONDITION

FILL CONDITION

NOTES:
1. CONSTRUCTED WALL MATERIAL SHALL BE PER SPECIFICATIONS.
2. WALL MATERIAL MAY BE DRY LAID BALANCE WALL OR SLOPE PAVING.
3. WALL CONSTRUCTION SHALL NOT COMPROMISE ROOT SYSTEM (BURIED STRUCTURES, SUCH AS MSE OR GEOGRID MAY BE USED FOR FILL BUT NOT CUT CONDITIONS).




## SECTION VIEW




CUT CONDITION

FILL CONDITION

## PLAN VIEW

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

# TREE WELLS

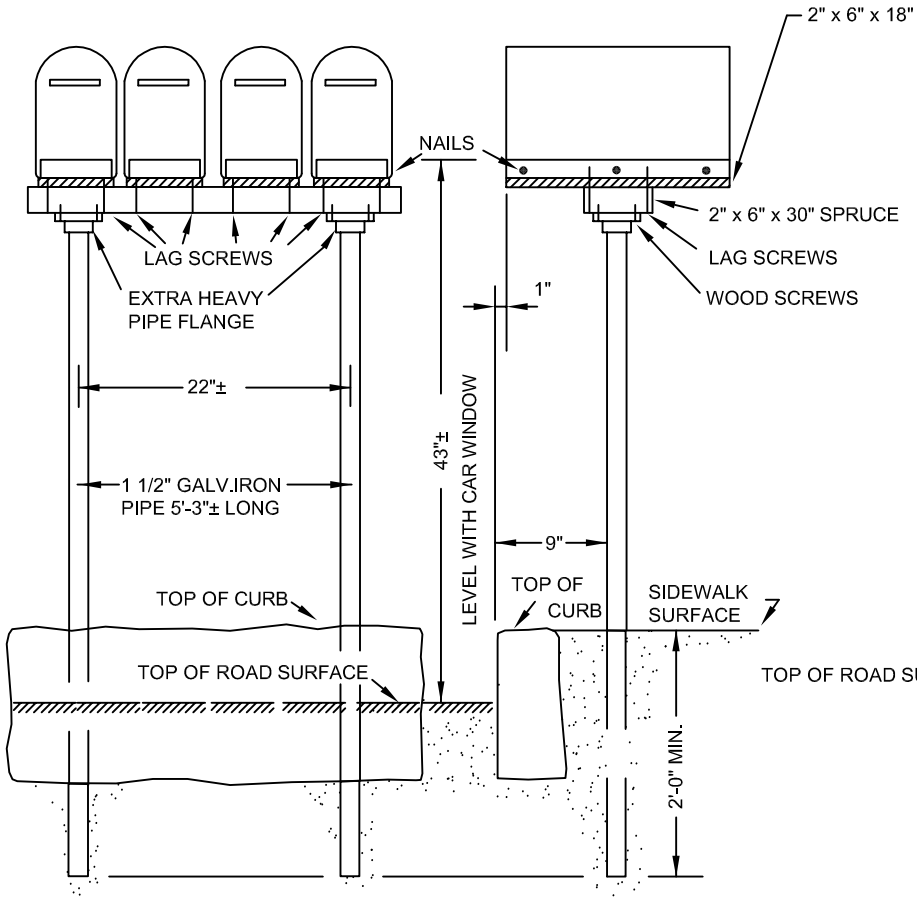
DATE OF ISSUE
DECEMBER 2016

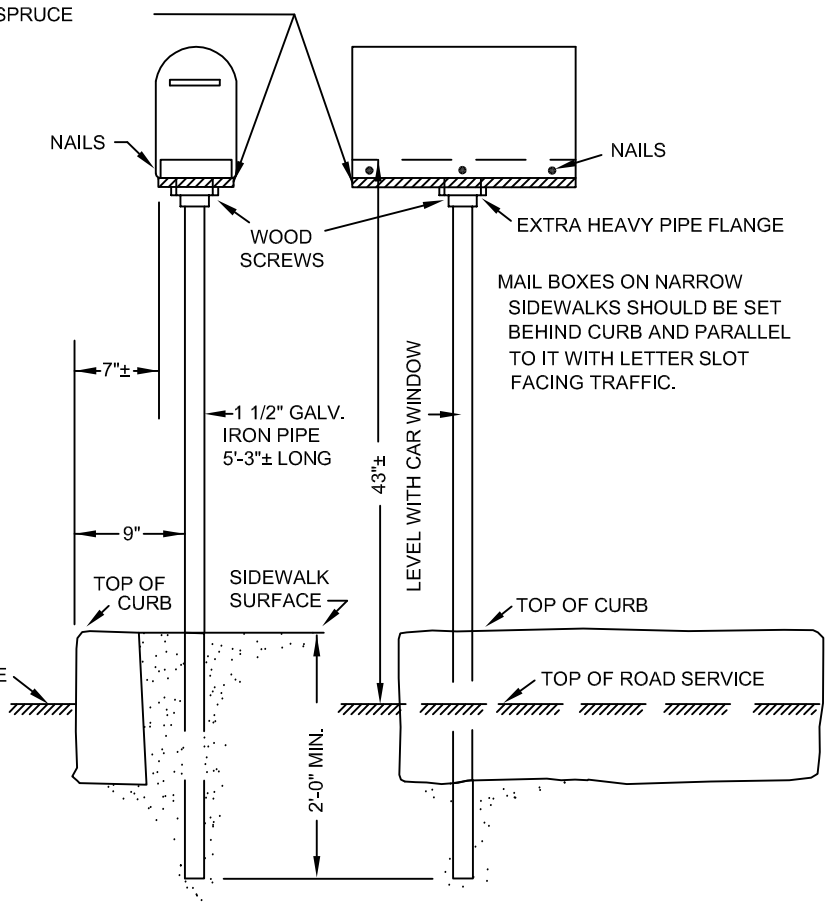
DRAWING NUMBER
**E 502.1.0**

CONSTRUCTION STANDARDS

massDOT Massachusetts Department of Transportation Highway Division

# SETTING RURAL MAILBOXES




NOTES:

1. LUMBER TO BE PLANED ON ALL FOUR SIDES TO FULL 2" x 6" SIZE TO FIT BOTTOM OF MAIL BOXES.
2. TO SET 1 1/2" GALVANIZED PIPE POST, USE DRIVING POINT OF SAME SIZE, THEN TAMP POST INTO PLACE SO AS TO BE PLUMB BOTH WAYS.
3. ALL FITTINGS (PIPE FLANGES, PIPE, SCREWS, NAILS, ETC.) ARE TO BE GALVANIZED.
4. FOR DESCRIPTIONS, MATERIALS, AND CONSTRUCTIONS METHODS SEE STANDARD SPECIFICATIONS.
5. A 4" X 4" PRESSURE TREATED WOOD POST MAY BE SUBSTITUTED FOR A PIPE POST.

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 504.1.0**

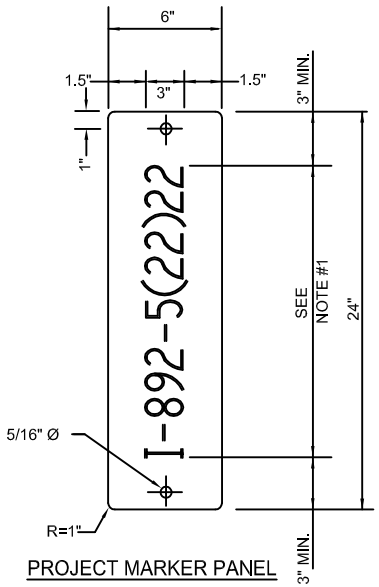
massDOT
Massachusetts Department of Transportation
Highway Division

CONSTRUCTION STANDARDS

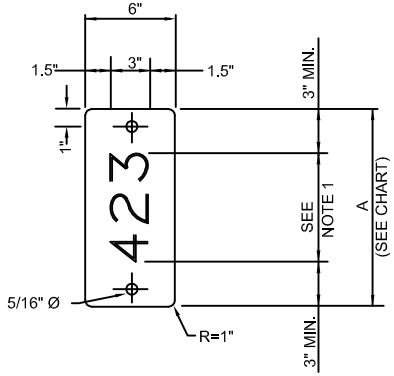
# DEMOUNTABLE REFLECTORIZED STATION MARKER AND PROJECT MARKER

DATE OF ISSUE
DECEMBER 2016

DRAWING NUMBER
**E 505.1.0**

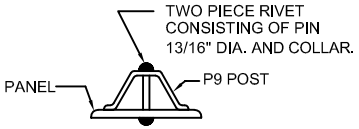



PROJECT MARKER PANEL

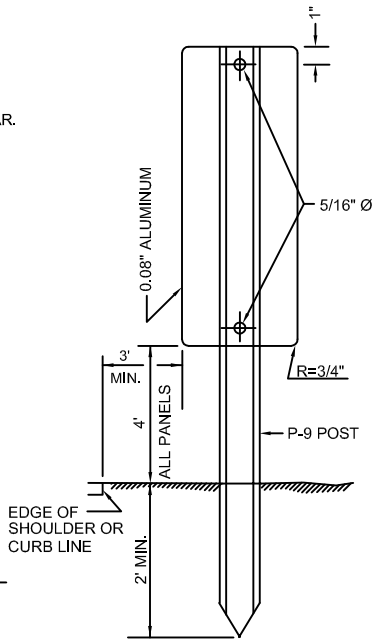



STATION MARKER PANEL

| # OF DIGITS | A Inches |
|---|---|
| 1 | 8 |
| 2 | 11 |
| 3 | 13 |



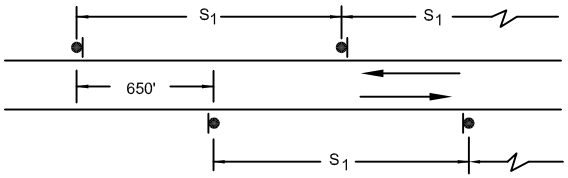

METHOD OF ATTACHING PANEL TO P-9 POST



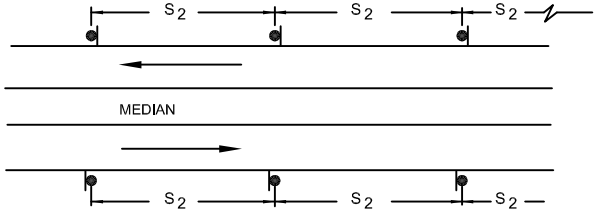

TYPICAL MARKER INSTALLATION

## SPACING OF STATION NUMBERS

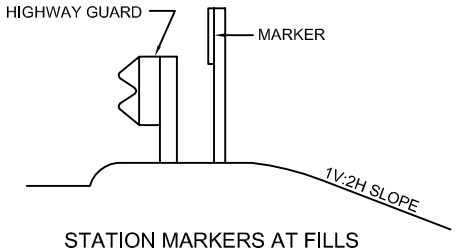
$S_1$ - 1300', BOTH SIDES, STAGGER
$S_2$ - 650', BOTH SIDES



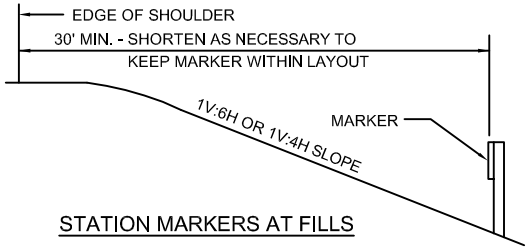

SINGLE ROADWAY



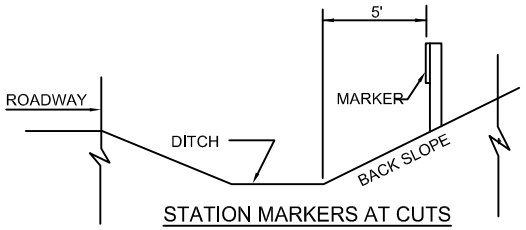

DIVIDED ROADWAY
OMIT MARKERS FROM INTERCHANGE




STATION MARKERS AT FILLS




STATION MARKERS AT FILLS




STATION MARKERS AT CUTS

NOTES:

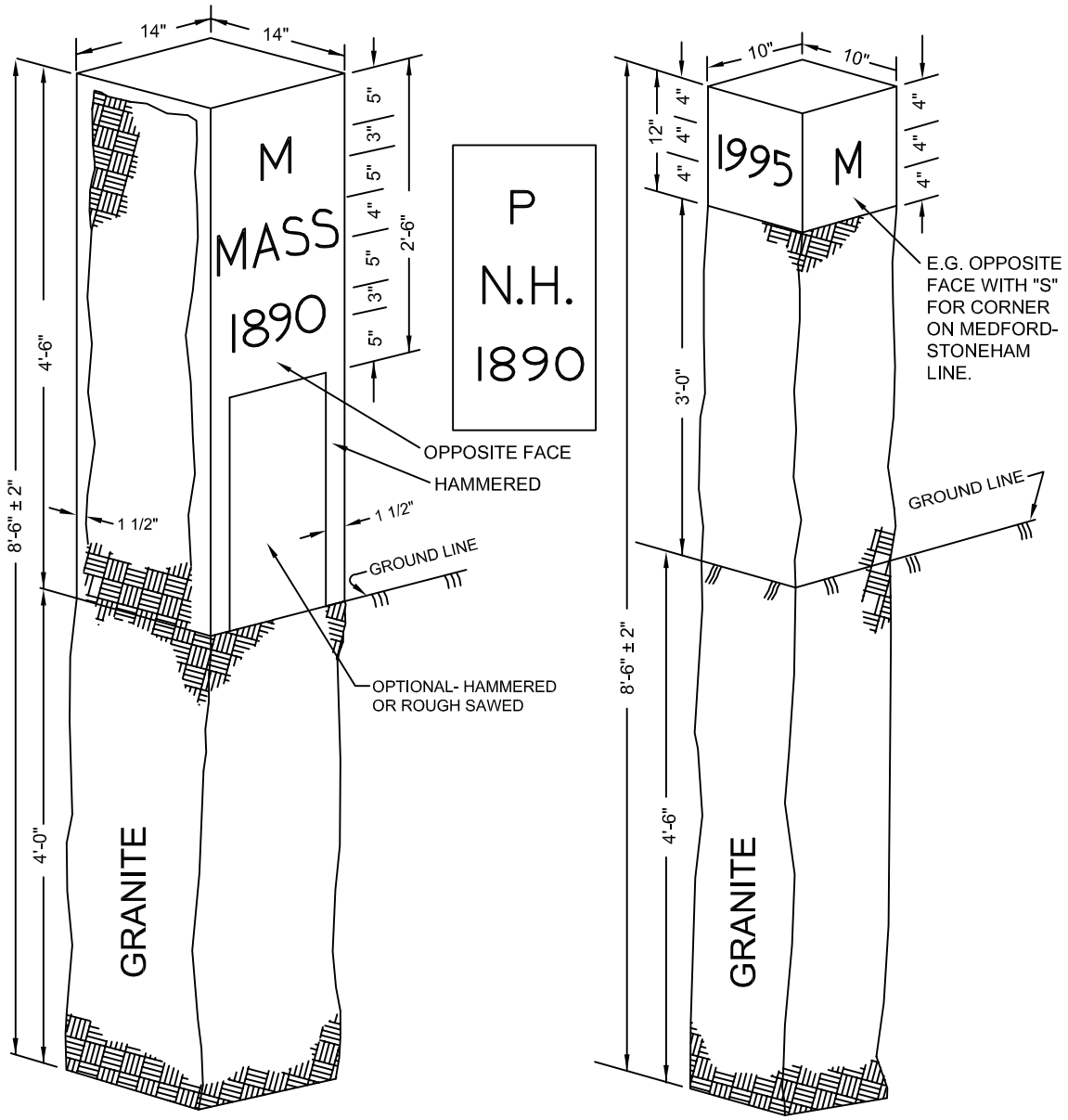
1. THE LEGEND IS TO BE CENTERED AND THE SPACING OF THE CHARACTERS IS TO CONFORM TO THE FEDERAL HIGHWAY ADMINISTRATION RECOMMENDATION FOR SERIES "C" TYPE LETTERING.
2. THE STATION DESIGNATIONS ARE TO BE EVEN STATIONS i.e. NO PLUS STATIONS.
3. THE PANELS FOR THE LEGEND ARE TO BE 0.08" SHEET ALUMINUM. FABRICATED AND FINISHED ACCORDING TO THE STANDARD SPECIFICATIONS.
4. THE LETTERS AND NUMERALS AND METHOD OF APPLICATIONS ARE DESCRIBED IN THE STANDARD SPECIFICATIONS.
5. ALL PANELS ARE TO BE MOUNTED ON NEW P-9 POST IN THE MANNER DESCRIBED IN THE STANDARD SPECIFICATIONS.
6. ONE MARKER IS TO BE PROVIDED AT CULVERT END, WHERE NO GUARD RAIL IS INSTALLED IT IS TO BE LOCATED AT THE NEAR BACK CORNER OF THE END IN THE DIRECTION OF TRAFFIC.
7. MARKERS ARE TO BE PLACED AT 650' INTERVALS; ON UNDIVIDED ROADWAY STAGGER ON EACH SIDE, ON DIVIDED ROADWAY PLACE MARKERS OPPOSITE EACH OTHER.
8. SEE DRAWING E TR.2.3 FOR P-9 POST DIMENSIONS.

REPLACEMENT OF BOUND BROKEN OR LOST WILL BE INSCRIBED WITH THE YEAR BOUND POINT WAS ESTABLISHED.

BOUNDS LOCATING NEW CORNERS WILL BE INSCRIBED WITH THE YEAR NEW CORNER WAS ESTABLISHED.

ALL LETTERING TO BE

1/2" V SUNK LETTERS




NOTES:

1. TOP AND 4 SIDES FOR A DISTANCE OF 12" TO BE HAMMERED SMOOTH.
2. IN SPECIFIED LOCATIONS, MONUMENTS MAY BE HAMMERED SMOOTH ON TOP AND 4 SIDES ABOVE GROUND LINE.
3. FOR DESCRIPTIONS, MATERIALS AND CONSTRUCTION METHODS SEE STANDARD SPECIFICATIONS.