GRAVEL BACKFILL

GROUND ELEVATION

SAFE FOR 1V:1.5H SLOPE

GRAVEL BACKFILL

BATTER 4%

1" BEVEL

18" MINIMUM

18" MAXIMUM

6" MINIMUM

SEE NOTE #1

4000 PSI CEMENT CONCRETE (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS), OR PRECAST OR CAST IN-PLACE (OPTIONAL) OR GRANITE, IF SPECIFIED

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Construction Standard Details

Highway Division

Massachusetts Department of Transportation

JUNE 2014
The Commonwealth of Massachusetts

Deval L. Patrick
Governor

Richard A. Davey
Secretary & CEO

Frank DePaola, P.E.
Administrator

Prepared by
The Massachusetts Department of Transportation - Highway Division

June 2014
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.
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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
ROCK CUT SELECTION

**NOTES:**

1. ONLY ROCK ACTUALLY REMOVED IS PAYABLE. NO PAYMENT WILL BE MADE BEYOND THE ROCK PAYMENT LINE
METHOD OF Rounding Cut SLOPES

ROUNDING TABLE FOR 1V : 2H SLOPE

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<th>D FEET</th>
<th>A</th>
<th>B</th>
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<tr>
<td>3 &lt;</td>
<td>1'</td>
<td>2'</td>
</tr>
<tr>
<td>&gt;3 TO 20</td>
<td>D/3</td>
<td>2/3 D</td>
</tr>
<tr>
<td>&gt; 20</td>
<td>7'</td>
<td>14'</td>
</tr>
</tbody>
</table>

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.
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.

NEW HOT MIX ASPHALT OVERLAY
THICKNESS AS PER PROJECT DESIGN

"OVER BRIDGE JOINTS MAX.
DEPTH 1-1/2"

"1/8", TO 1/8"

"2 1/2"

SEE NOTE 1

SEALANT
SAWCUT
BONDBREAKER TAPE

(THICKNESS VARIES BY PROJECT NOT INCLUDED IN THICKNESS SPECIFICATION OVERLAY)
LOCATION OF SAW CUT FOR TRANSVERSE JOINTS AT BRIDGE ABUTMENT

NOTES:


2. ONLY EXPANSION JOINTS SHALL BE SAW-CUT AND SEALED.

3. ONLY REQUIRED WITH A CONTINUOUS BITUMINOUS CONCRETE SURFACE FROM ROADWAY TO BRIDGE.
**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.

* THE DEPTH OF THE GRAVEL IS TO BE SUCH THAT ITS BOTTOM LINE MEETS THE BOTTOM OF THE GRAVEL LINE OF THE CONTIGUOUS PAVEMENT.
NOTE:
FOR DETAIL OF MILLING AND SPACING OF GROOVES SEE DRAWING E 105.5.0, DETAIL A AND SECTION B-B.
EDGEE OF PAVEMENT

GROOVES SHOWN FOR CLARITY

24" CHEVRON LINES AS SHOWN SPACED 20' APART

S.Y.L.

EDGEE OF PAVEMENT

ROADWAY PLAN

SECTION B-B

3"  GORE WIDTH VARIES

12" S.W.L.  9"

12" S.W.L.  4"

TRAVEL LANES

HMA

GRAVEL

SPACE VARIES

7"W x 16"L GROOVES 1/2" DEEP SPACED 12" O.C. (TYP.)

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

SECTION A-A

3"

10' SHOULDER (TYP.)

12" S.W.L.  9"

12" S.W.L.  4"

TRAVEL LANES

HMA

GRAVEL

7"W x 16"L GROOVES 1/2" DEEP SPACED 12" O.C.
NOTES FOR RUMBLE STRIPS:
1. NOT TO BE INSTALLED ON SHOULDERS LESS THAN 2' WIDE.
2. NOT TO BE INSTALLED ON BRIDGE DECKS.
NOTES FOR RUMBLE STRIPS:
1. NOT TO BE INSTALLED ON SHOULDERS LESS THAN 8' WIDE.
2. NOT TO BE INSTALLED ON BRIDGE DECKS.
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
HOT MIX ASPHALT CURBS

METHOD OF SETTING-TYPICAL FOR ALL TYPES

* SEE TYPICAL SECTIONS FOR PROJECT.
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.
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.
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
LEGEND

HSL = HIGH SIDE TRANSITION LENGTH
(SEE E 107.9.0R)

W = SIDEWALK WIDTH

Wc = CURB WIDTH

W1 = 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

W = SIDEWALK WIDTH

W1 = RAMP LENGTH

4'-0" MIN.

D 5'-0" MIN.

w Curb Reveal (Typ.)

6' Curb Reveal (Typ.)

ROADWAY DOWNGRADE

LIMITS OF CEMENT CONCRETE RAMP

SECTION A-A

DETECTABLE WARNING PANEL
(SEE E 107.6.5R)

ROADWAY

SIDEWALK

FOUNATION

G E R A N T I C CURB
LEGEND

HSL = HIGH SIDE TRANSITION LENGTH
(SEE E 107.9.0R)
W = SIDEWALK WIDTH
WC = CURB WIDTH
CC = CEMENT CONCRETE
* = TOLERANCE FOR CONSTRUCTION ±0.5%

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

W = SIDEWALK WIDTH

SECTION A-A

USABLE SIDEWALK WIDTH PER AAB = W-Wc
USABLE SIDEWALK WIDTH PER AAB IS NOT TO BE LESS THAN 40" 
SEE E 107.6.5R FOR DETAILS OF DETECTABLE WARNING PANEL
LEGEND

HSL = HIGH SIDE TRANSITION LENGTH
(SEE E 107.9.0R)
W = SIDEWALK WIDTH
W_c = CURB WIDTH
W_1 = PERPENDICULAR RAMP LENGTH
C_c = CEMENT CONCRETE
* = TOLERANCE FOR CONSTRUCTION ±0.5%
USABLE SIDEWALK WIDTH PER AAB = W - W_c
RAMP LENGTH, W_1 = W - 4' - 0" Min

SIDEWALK WIDTH
W = W_1 + 4' - 0"

DETECTABLE WARNING PANEL
(SEE E 107.6.5R)

LIMITS OF CEMENT CONCRETE RAMP
**LEGEND**

HSL = HIGH SIDE TRANSITION LENGTH
(SEE E 107.9.0R)

* = 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 107.6.5R.

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

- BUILDING OR OTHER UNALTERABLE CONDITION

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

** TOLERANCE FOR CONSTRUCTION ±0.5%

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

"T" INTERSECTION
WHEELCHAIR RAMP
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.
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)
<table>
<thead>
<tr>
<th>ROADSIDE TRANSITION LENGTH</th>
<th>ENGLISH UNITS</th>
<th>NOTE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH SIDE</td>
<td>6'-6&quot;</td>
<td>7.5% AND A REVEAL OF 6&quot;.</td>
</tr>
<tr>
<td></td>
<td>7'-8&quot;</td>
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<td></td>
<td>9'-0&quot;</td>
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<tr>
<td></td>
<td>11'-0&quot;</td>
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</tr>
<tr>
<td></td>
<td>14'-0&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15'-0&quot; Max</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ROADWAY PROFILE GRADE</th>
<th>%</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>=0%</td>
<td>&gt;0% TO 1%</td>
<td></td>
</tr>
<tr>
<td>&gt;1% TO 2%</td>
<td>&gt;2% TO 3%</td>
<td></td>
</tr>
<tr>
<td>&gt;3% TO 4%</td>
<td>&gt;4% TO 5%</td>
<td></td>
</tr>
</tbody>
</table>
MINIMUM DEPTH OF SUMP TO BE 2
STANDARD DEPTH 3

NOTES:
1. WEEPOLES 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 WEEPOLE.
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.

PLAN OF BASE

SECTION C-C
SOLID SECTION, OR FILL HOLE WITH
BRICKS AND MORTAR, OR FILL WITH
4000 PSI CEMENT CONCRETE
(SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)
OR PRECAST CONCRETE SECTIONAL PLATES,
SEE ABOVE.

SECTION A-A
BLOCKS TO BE SET IN FULL BED OF CEMENT MORTAR

SECTION B-B

CONCRETE BLOCK
CATCH BASIN

DRAWING NUMBER
DATE OF ISSUE
JUNE 2014
E 201.3.0
FOR GRATE SEE DRAWING E 201.7.0 - E 201.11.0

FOR FRAME SEE DRAWING E 201.6.0

BRICKS MAY BE USED FOR GRADE ADJUSTMENTS. FRAME TO BE SET IN FULL BED OF MORTAR.

5" MIN

MORTAR ALL JOINTS

PROVIDE "V" OPENINGS

OUTSIDE OF PIPE +2" CLEARANCE

(OPENING TO BE PRECAST IN RISER SECTION)

SEE NOTE #2

1" CLEAR

WEEPHOLE

HEIGHT OF RISER SECTIONS VARY FROM 1' TO 4'

5 IN MIN.

6'-5" (STANDARD DEPTH)

W/-7'-5" (DEEP SUMP)

24" MIN.

SQUARE OPENING**

8" MIN.

SEE DRAWING E 202.4.0 FOR JOINT DETAILS

4' ± 1" DIAMETER

3'-6" MAX. (STANDARD)

4'-7" MAX. (DEEP SUMP)

SEE DRAWING E 202.4.0 FOR BASE DETAILS

** 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".

MINIMUM DEPTH OF SUMP TO BE 2 FT

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
PRECAST CONCRETE
CATCH BASIN TUB

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

* MINIMUM DEPTH OF SUMP TO BE 2'
** WHEN A CURB INLET IS INSTALLED, THE OPENING IS TO BE 24"x1" X 27"x1"*

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

FOR GRATE SEE DRAWINGS E 201.7.0 - E 201.11.0
FOR FRAME SEE DRAWING E 201.6.0
BRICKS MAY BE USED FOR
GRADE ADJUSTMENTS,
FRAME TO BE SET IN
FULL BED OF MORTAR,
6" MINIMUM
OUTLET PIPE
PIPE TO BE SET
IN FULL BED
OF MORTAR
WEEPHOLE
SEE NOTE #2
48" ± 1" DIAMETER
3'-0" MAX. DEEP SUMP
6" MINIMUM
5" MINIMUM
24" MIN.
SQUARE OPENING **
6"
8" DIAMETER HOLE IN CENTER OF BASE
HOLE TO BE FILLED WITH
4000 PSI CEMENT CONCRETE
(SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)

DATE OF ISSUE
JUNE 2014
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

CASTING TOLERANCES:
SHALL CONFORM TO AASHTO M306

AASHTO HS 20 LOAD RATED
Tumbler should be set at 1 1/4" below machined grate seat for installation.

Once grate is set in frame, torque bolt 1/4 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

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

NOTE: CASCADE GRATE ONLY TO BE
USED ON FACILITIES WHERE BICYCLE
TRAVEL IS LEGALLY ALLOWED.
HOOK LOCK CASCADE GRATE
FLOW FROM RIGHT

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

CAST BACK FACE WITH MOLD DATE AND PART NO.

WEIGHT: 265 LBS. MIN 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

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

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

D

SECTION C-C

WEIGHT: 265 LBS. MIN AASHTO HS 20 PROOF LOAD

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

CAST BACK FACE WITH MOLD DATE AND PART NO.

END VIEW

N.T.S.

FLOW

TUMBLER SIDE

C C

1 1/4"

3/16"

4 7/16"

1 1/16"

23 7/8"

2 1/4"

4 1/16"

9 7/8"

3 7/16"

23 7/8"

4 1/2"

2"

1 1/4"

1 1/4"

1 9/16"
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 A-A

24 1/4"
23 7/8"
8" 1/2"
2"
15/16"
22"
1 1/16"
24" MIN

SECTION B-B

1 1/4"
15/16"
25 3/4"

AASHTO HS 20 PROOF LOAD

LOCK TUMBLER ASSEMBLY
(1) REQUIRED—CONSISTS OF:
5/8" x 5" ST. STL BOLT
5/8" ST. STL. F. W. 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 1/4 turn past snug.

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

CASTING TOLERANCES:
SHALL CONFORM TO AASHTO M306

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

NOTE: IDENTIFYING INFORMATION SHOWN ON FRAMES & GRATES TO BE CAST WITH FRAME AND GRATE
FRAME MAY BE INSTALLED WITH THIS FLANGE REMOVED FOR CURB INLET. FOUR FLANGE IS SHOWN. SEE DWG E 201.8.0 FOR MORE INFORMATION.

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

AASHTO HS 20 PROOF LOAD N.T.S.

SECTION 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 1/4 turn past snug.

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

CASTING TOLERANCES:
SHALL CONFORM TO AASHTO M306

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

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

FRAME AND HOOK LOCK CASCADE GRATE - FLOW FROM RIGHT ASSEMBLY DETAILS
CASTING TOLERANCES:
SHALL CONFORM TO AASHTO M306

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

Once grate is set in frame, torque bolt 1/2 turn past snug.

NOTE: BAR GRATE NOT TO BE USED ON FACILITIES WHERE BICYCLE TRAVEL IS LEGALLY ALLOWED.
Tumbler should be set at 1 1/4" below machined grate seat for installation.

Once grate is set in frame, torque bolt 1/2 turn past snug.

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

CASTING TOLERANCES:
SHALL CONFORM TO AASHTO 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.
NOTES:

1. MATERIAL - CAST IRON; SEE STANDARD SPECIFICATIONS
2. MINIMUM MASS - 210 LBS.
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>2</td>
<td>7/8</td>
<td>17/8</td>
<td>14</td>
<td>18</td>
<td>10</td>
<td>11/14</td>
</tr>
</tbody>
</table>

**Dimensions (in.)**
- 8" and 10" Pipe
- 12" and 15" Pipe

**NOTE:**
- Hoods to be gray cast iron; see standard specifications
- Without black asphalt coating allowed

**DATE OF ISSUE**
JUNE 2014

**DRAWING NUMBER**
E 201.12.0

**CATCH BASIN HOOD**
KEYWAYS TO BE FILLED WITH CEMENT MORTAR,  
MORTAR NOT REQUIRED IN VERTICAL JOINTS,

BRICKS MAY BE USED BETWEEN FRAME & TOP COURSE FOR GRADE ADJUSTMENT.

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

INVERT TO BE INVERTED ARCH WITH BRICKS LAID ON EDGE AS STRETCHERS.

SECTION A-A

PLAN OF BASE

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

16" - 24", TAPER IN 3 OR 4 COURSES

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

BLOCKS TO BE SET IN FULL BED OF MORTAR

FLOOR OF STRUCTURE TO BE HEADERS LAID FLAT

BASE TO BE OF 4000 PSI CEMENT CONCRETE (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS) OR PRECAST CONCRETE SECTIONAL PLATES. SEE BELOW.

BRICK CHIPS AND MORTAR OR 4000 PSI CEMENT CONCRETE (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS) (IF CONCRETE IS HAND MIXED SEE LATEST STANDARDS SPECIFICATIONS.) ALL CONCRETE TO BE AIR ENTRAINED

INVERTED ARCH WITH BRICKS LAID ON EDGE AS STRETCHERS.

KEYWAYS TO BE FILLED WITH CEMENT MORTAR.

MORTAR NOT REQUIRED IN VERTICAL JOINTS.

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
PRECAST CONCRETE MANHOLES
9' OR LESS IN DEPTH

NOTE:
1. FOR DESCRIPTIONS, MATERIALS AND CONSTRUCTION METHODS, SEE LATEST STANDARD SPECIFICATIONS.
STANDARD COVER
FOR COVER DETAILS SEE DRAWING E 202.8.0

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

MANHOLE FRAME AND COVER - A FRAME
MANHOLE FRAME AND COVER - B FRAME

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

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
PLAN

OUTSIDE FACE
AT TOP
AT BASE

INSIDE FACE
AT TOP
AT BASE
SEE NOTE #2

THROAT

WEEPHOLE

OUTLET PIPE

FULL BED OF MORTAR

4" CAST IRON FRAME

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"

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

SECTION A-A

4000 PSI CEMENT CONCRETE (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS) OR PRECAST CONCRETE SECTIONAL PLATES SEE DRAWING E 202.2,0

MassDOT

CONSTRUCTION STANDARDS

DATE OF ISSUE
JUNE 2014

DRAWING NUMBER
E 203.3.0
**DROP INLET TYPE CF**

**SECTION A-A**

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

SEE DRAWING E 201.3.0

**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 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

**DATE OF ISSUE**

JUNE 2014

**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
PARALLEL BAR GRATE SEE DRAWINGS E 201.11.0
FOR FRAME SEE DRAWING E 201.6.0

THROAT
22" ± 1"
SQUARE OPENING

BRICKS MAY BE USED FOR
GRADE ADJUSTMENTS.
FRAME TO BE SET IN
FULL BED OF MORTAR.

PRECAST CONCRETE THROAT
SEE DRAWING E 203.7.0

5" MIN

MORTAR ALL JOINTS
PROVIDE "V" OPENINGS

OUTSIDE OF PIPE
+2" CLEARANCE

MIN. 0.12 SQ IN. STEEL
PER VERTICAL FOOT, PLACED
ACCORDING TO AASHTO
DESIGNATION M199

HEIGHT OF RISER SECTIONS
VARY FROM 1' TO 2'
6'-0" (STANDARD DEPTH)
18'-24"
TAPERED SECTION

48" ± 1" DIAMETER

WEEPHOLE
(OPENSING TO BE PRECAST
IN RISER SECTION)

1" CLEAR

3'-0" MAX.

SEE DRAWING E 202.4.0 FOR BASE DETAILS

SEE E 202.4.0 FOR JOINT DETAILS

*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 SPECIFICATIONS

3. TO BE USED IN MEDIANs AND DITCHES THAT ARE WITHIN THE RECOVERY AREA

DROP INLET TYPE DF

DATE OF ISSUE
JUNE 2014
DRAWING NUMBER
E 203.6.0
PRECAST CONCRETE THROAT FOR USE IN MEDIANS & DITCHES WITH TYPES CF AND DF DROP INLETS

ISOMETRIC OF PRECAST CONCRETE THROAT OPENING

SECTION B-B

PLAN

SECTION A-A

FLUSH DROP INLET THROAT

DATE OF ISSUE
JUNE 2014

DRAWING NUMBER
E 203.7.0
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.

OUTLET PIPE

INVERT TO BE CONSTRUCTED OF BRICK AS SHOWN IN DETAILS FOR BRICK GUTTER INLET OR 4000 PSI CEMENT CONCRETE MASONRY (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS) (IF HANDMIXED SEE STANDARD SPECIFICATIONS)

4000 PSI CEMENT CONCRETE (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS) OR PRECAST CONCRETE SECTIONAL PLATES
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.
CONSTRUCTION STANDARDS

CONCRETE BLOCK LEACHING BASIN

NOTES:

1. USE CASCADE GRATE WHERE BIKE 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.

---

SECTION A-A

---

PLAN OF BASE

BOTTOM PLATES REQUIRE 10 PIECES PER CIRCLE WITH 1/2" SPACING BETWEEN PLATES. 4" THICK
# Table of Minimum Wall Thickness (FT)

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

<table>
<thead>
<tr>
<th>DIAMETER (IN)</th>
<th>MIN. - 10</th>
<th>11 - 15</th>
<th>16 - 20</th>
<th>21 - 25</th>
<th>26 - 30</th>
<th>31 - 35</th>
<th>38 - 40</th>
<th>41 - 45</th>
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</tr>
</tbody>
</table>

**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
# Table of Minimum Wall Thickness (In.)

<table>
<thead>
<tr>
<th>MADE FROM PIPE OF DIA. (IN.)</th>
<th>SPAN (IN.)</th>
<th>RISE (IN.)</th>
<th>HEIGHT OF COVER ABOVE TOP OF PIPE ARCH (FEET)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>MIN. - 3</td>
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<tr>
<td>60</td>
<td>72</td>
<td>44</td>
<td>8</td>
</tr>
</tbody>
</table>

**NOTES:**
1. MINIMUM COVER IS TOP OF PIPE TO ROAD GRADE - 18”
2. FOR HEAVIER FILLS USE STRUCTURAL PLATE
CONCRETE AND FIELD STONE
MASONRY PIPE ENDS FOR
8" TO 30" PIPE

FRONT ELEVATION

END ELEVATION

CEMENT CONCRETE
4000 PSI (SEE MASSDOT SPECIFICATIONS
FOR DESIGN REQUIREMENTS)
ONLY TO BE USED WHERE SPECIFIED

CONCRETE CRADLE
FOR PIPE CULVERTS

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
<table>
<thead>
<tr>
<th>PIPE DIAM.</th>
<th>1 1/2 : 1 SLOPE</th>
<th>2 : 1 SLOPE</th>
<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>L</td>
<td>CONC. OR F.S.M. CU. YDS.</td>
<td>STEEL LBS.</td>
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<tr>
<td>8&quot;</td>
<td>4'-2&quot;</td>
<td>0.77</td>
<td>15</td>
</tr>
<tr>
<td>10&quot;</td>
<td>4'-10&quot;</td>
<td>0.92</td>
<td>20</td>
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<td>12&quot;</td>
<td>5'-6&quot;</td>
<td>1.08</td>
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<td>8'-6&quot;</td>
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<td>30&quot;</td>
<td>10'-6&quot;</td>
<td>2.63</td>
<td>44</td>
</tr>
</tbody>
</table>

Y

4" FOR 1 1/2 : 1 SLOPE

6" FOR 2 : 1 SLOPE
<table>
<thead>
<tr>
<th>DESIGN NO.</th>
<th>DIAMETER (IN.)</th>
<th>LENGTHS</th>
<th>MASONRY (CY)</th>
<th>STEEL (LBS)</th>
<th>TRENCH EXCAV. 1'-0&quot; DEPTH (CF)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
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<td>C</td>
<td>D</td>
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</tbody>
</table>

**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.
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.

<table>
<thead>
<tr>
<th>DEGHJLNPF</th>
<th>CONC. MASONRY</th>
<th>STEEL</th>
<th>F CONC. MASONRY</th>
<th>STEEL</th>
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<td>30°</td>
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<td>8'-0&quot;</td>
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<td>36°</td>
<td>4'-0&quot;</td>
<td>4'-0&quot;</td>
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<td>42°</td>
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<td>4'-0&quot;</td>
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<tr>
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<td>8'-0&quot;</td>
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<tr>
<td>84°</td>
<td>8'-0&quot;</td>
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<td>11'-0&quot;</td>
<td>9'-0&quot;</td>
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<table>
<thead>
<tr>
<th>1V:1.5H AND 1V:2H SLOPES</th>
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<th>1V:2H SLOPE</th>
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<tbody>
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<td>8'-0&quot;</td>
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</table>

TRENCH DESIGN FOR 10 SLOPE FOR 10" DEPTH/CY.FT.

FIELD STONE MASONRY ENDS

CONCRETE ENDS

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

#3 BARS @ 12"

GROUND LINE

ELEV. A-A  SECTION B-B  FRONT ELEVATION  SECTION C-C  ELEV. D-D
MINIMUM RECOVERY AREA

EDGE OF TRAVELED WAY

SHOULDER

1V : 6H SLOPE

R.C. PIPE

SIDE ELEVATION

1V : 4H SLOPE

12"±

5'

1V : 1H SLOPE

NOTE:

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.
### TABLE
[ALL DIMENSIONS ARE inches OR feet]

<table>
<thead>
<tr>
<th>DIAMETER</th>
<th>W</th>
<th>A</th>
<th>B</th>
<th>D</th>
<th>E</th>
<th>P</th>
<th>DIA. +1&quot;</th>
<th>R1</th>
<th>R2</th>
<th>SLOPE</th>
</tr>
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<td>2'-3&quot;</td>
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<td>2'-4&quot;</td>
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<td>11&quot;</td>
<td>1V : 3H</td>
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<td>2'-3&quot;</td>
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### 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.
**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.

**STANDARD METAL END**

**DATE OF ISSUE**
JUNE 2014

**DRAWING NUMBER**
E 206.9.0
END WITH WINGED WALLS

PLAN

CURTAIN WALL 12" X 12"

R.C. PIPE

L

6" X 6" NO. 10 WIRE FABRIC (1 1/2" CLEAR)

8" 4000 PSI CEMENT CONCRETE (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)

CURTAIN WALL 12" X 12"

8" GRAVEL

ELEVATION

R.C. PIPE

PIECE DIAM. (IN)

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PIECE DIAM. (IN)

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<td>3'-6&quot;</td>
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</table>
| W  | 4'-0" | 4'-0" | 4'-6" | 5'-3" | 6'-0" | 7'-6"

NOTE:
1) ALL PIPE DIAMETERS NOMINAL SIZE

STRAIGHT END
SURFACE TREATMENT:
4" PLANTABLE SOIL AND SEED OVER
8" COMPACT GRAVEL OR
4" MINIMUM DEPTH OF PAVEMENT MILLING MULCH PLACE DIRECTLY OVER GEOTEXTILE AND CRUSHED STONE BOX

SURFACE TREATMENT:

1/2" CRUSHED STONE
GEOTEXTILE
PERFORATED PIPE
PERFORATIONS UP
PIPE DIAMETER
2" FOR PERVIOUS BOTTOM
MINIMUM WIDTH
O.D. PIPE + 12"

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
DITCH CHECK DAMS
FOR EROSION CONTROL

DATE OF ISSUE
JUNE 2014
DRAWING NUMBER
E 210.2.0
SECTION A-A

STAKE (TYP.)

FILTER FABRIC FOR EROSION CONTROL (STAKE FILTER FABRIC EVERY 1ft)

SECTION X-X

STAKED FILTER FABRIC FOR EROSION CONTROL

HAY BALE FOR EROSION CONTROL

FLOW

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

HAY BALES FOR EROSION CONTROL (2 STAKES PER BALE)
SECTION A-A
- PAVED SHOULDER
- 1' I.T.
- SLOPE TREATMENT
- 1V/4H OR 1V/6H

SECTION B-B
- PAVED WATERWAY
- 3' I.T.
- SLOPE TREATMENT
- 1V/4H OR 1V/6H

SECTION C-C
- PAVED WATERWAY
- 1' 6" I.T.
- SLOPE TREATMENT
- 1V/4H OR 1V/6H

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.
NOTES:
1. ON CURVED ALIGNMENT, WATERWAYS SHALL BE BANKED AS DIRECTED.
2. FOR DESCRIPTIONS, MATERIALS AND CONSTRUCTION METHODS, SEE LATEST STANDARD SPECIFICATIONS.
Cemented Stone Masonry Wall

<table>
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<tr>
<th>H (FT)</th>
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<th>D (FT)</th>
<th>Concrete Masonry Footing</th>
<th>Stone Masonry Excluding Coping</th>
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<td>Section Area (SQ. FT.)</td>
<td>Volume Per Unit Length (CU. YD./LIN. FT.)</td>
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Coping to be Precast Concrete or Granite of Uniform Depth for the Entire Length. Depth of Concrete to be 1/2 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 5" 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.
NOTES:

1. WIRE FABRIC TO HAVE 12" MINIMUM LAP AT SPLICE AND SHOULD EXTEND WITHIN 3" OF ALL EDGES
2. SLAB SHALL BE CROSSED 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.
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
<table>
<thead>
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<th>STEP NOS.</th>
<th>QUANTITIES - CU. FT.</th>
<th>DESIGN A</th>
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**NOTE:**
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 MAB and State Building Code.

**PLEASE NOTE:** Design B has been discontinued.

All concrete shall be 4,000 psi (See MassDOT specifications for design requirements).
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**Quantities of Materials**

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</table>

| 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 (psi) | 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:
   - 2:1 V SLOPING BACKFILL

2. BACKFILL SOIL PROPERTIES:
   - TYPE: GRAVEL BORROW FOR BACKFILL STRUCTURES AND PIPES
   - θ = ANGLE OF INTERNAL FRICTION = 37°
   - δ = ANGLE OF WALL FRICTION = 22°
   - γ = EFFECTIVE UNIT WEIGHT = 120 pcf

3. FOUNDATION SOIL PROPERTIES:
   - q = FACTORED BEARING CAPACITY = 9400 psi
   - Fc = 4000 psi
   - Fr = 60000 psi
   - γ = PERFORMANCE FACTOR FOR SLIDING = 0.80
   - Kθ = 0.085
   - Kv = 0

4. SEISMIC LOADING:
   - A = 0.17g (Max.)

5. REINFORCED CONCRETE:
   - (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)
TABLE OF DIMENSIONS AND REINFORCING STEEL

| H   | 14.0 | 15.0 | 18.0 | 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 |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 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| 2.000|
| 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| 4.000| 4.000|
| L   | 2.400| 2.600| 4.200| 4.500| 5.000| 5.500| 6.000| 6.500| 7.000| 7.500| 8.000| 8.500| 9.000| 9.500| 10.000| 10.500|
| M   | 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000|
| N   | 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000|
| P   | 1.250| 1.250| 1.250| 1.250| 1.250| 1.250| 1.250| 1.250| 1.250| 1.250| 1.250| 1.250| 1.250| 1.250| 1.250| 1.250|
| Hook| 0.833| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000| 1.000|

Quantities of Materials

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<td>B bars</td>
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</tr>
<tr>
<td>D bars</td>
<td>4 @ 18</td>
</tr>
<tr>
<td>E bars</td>
<td>5 @ 18</td>
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Steel (lb/ft)

|            | 76   | 86   | 96   | 104  | 118  | 133  | 161  | 182  | 198  | 233  | 240  | 307  | 340  | 360  | 388  | 412  | 488  |

Maximum Soil Bearing Pressure

| Q<sub>max</sub> (psf) | 4071 | 4328 | 4591 | 4860 | 4811 | 5491 | 5752 | 6018 | 5945 | 6208 | 6917 | 6833 | 7090 | 7352 | 7271 | 8079 | 8322 |

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°
   - δ = ANGLE OF WALL FRICTION = 22°
   - γ = EFFECTIVE UNIT WEIGHT = 120 psf
3. FOUNDATION SOIL PROPERTIES:
   - q<sub>f</sub> = FACTORED BEARING CAPACITY = 9400 psf
   - FRICTION FACTOR = 0.57
4. SEISMIC LOADING:
   - A = 0.17g (Max.)
   - Kh = 0.085
5. REINFORCED CONCRETE:
   - F<sub>c</sub> = 4000 psi
   - F<sub>y</sub> = 60000 psi
   - (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)
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### Quantities of Materials

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### Steel (lb/ft²)

- 126
- 158
- 173
- 189
- 219
- 309
- 351
- 379
- 422
- 440
- 500
- 516
- 557
- 568
- 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
  - 5717

### 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
   - \( \theta \) = Angle of Internal Friction = 37°
   - \( \delta \) = Angle of Wall Friction = 22°
   - \( \gamma \) = Effective Unit Weight = 120 pcf

3. **Foundation Soil Properties:**
   - C = Factored Bearing Capacity = 6000 psf
   - Friction Factor = 0.50

4. **Seismic Loading:**
   - A = 0.17g (Max.)
   - \( K_h = 0.065 \)
   - \( K_v = 0 \)

5. **Reinforced Concrete:**
   - \( f_c = 4000 \text{ psi} \)
   - \( f_y = 60000 \text{ psi} \)

(See MassDOT Specifications for Design Requirements)
## Table of Dimensions and Reinforcing Steel

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### Quantities of Materials

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<th>Steel (lb/ft)</th>
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### 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
   - \( \phi = \text{Angle of Internal Friction} = 37^\circ \)
   - \( \delta = \text{Angle of Wall Friction} = 22^\circ \)
   - \( \gamma = \text{Effective Unit Weight} = 120 \text{ psf} \)
3. **Foundation Soil Properties:**
   - \( f_c = 4000 \text{ psi} \)
   - Friction Factor = 0.5
   - \( \phi = \text{Performance Factor for Sliding} = 0.80 \)
4. **Seismic Loading:**
   - \( A = 0.17g \) (Max.)
   - \( K_h = 0.085 \)
   - \( K_v = 0 \)

### Diagram

- 240 psf
- 1.25 ft
- 2.5 ft
- 3.0 ft
- 3.5 ft
- 4.0 ft
- 4.5 ft
- 5.0 ft
- 5.5 ft
- 6.0 ft
- 6.5 ft
- 7.0 ft
- 7.5 ft
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### Maximum Soil Bearing Pressure

- 4318 psi
- 4614 psi
- 5111 psi
- 5210 psi
- 5133 psi
- 5412 psi
- 5693 psi
- 5616 psi
- 5893 psi
- 5824 psi
- 5929 psi
- 5558 psi
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- 5440 psi
- 5695 psi
- 5687 psi
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| M  | 1.917| 1.917| 1.917| 1.917| 1.917| 1.917| 1.917| 1.917| 3.167| 4.083| 4.083| 5.000| 5.000| 5.000| 6.000| 6.000| 6.000|
| N  | 1.000| 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| 1.500| 1.500|
| P  | 1.000| 1.000| 1.250| 1.917| 1.917| 1.917| 2.500| 2.500| 3.167| 3.167| 3.167| 3.167| 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| 2.000| 2.000| 2.000| 2.000| 1.953| 1.953| 1.833| 1.833| 1.833|

Quantities of Materials

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| Steel (lb/ft) | 98 | 120 | 125 | 148 | 164 | 197 | 213 | 272 | 276 | 342 | 379 | 382 | 446 | 503 | 543 | 558 | 580 |

Maximum Soil Bearing Pressure

| Qmax (psi) | 5123 | 5151 | 5481 | 5530 | 6053 | 6103 | 6626 | 6677 | 6838 | 7053 | 7562 | 7625 | 8134 | 8197 | 8802 | 8870 | 5475 |

**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 BACKFILL STRUCTURES AND PIPES
   \( \Theta \) = ANGLE OF INTERNAL FRICTION = 37°
   \( \delta \) = ANGLE OF WALL FRICTION = 22°
3. **FOUNDATION SOIL PROPERTIES:**
   \( c' \) = FACTORED BEARING CAPACITY = 20000 psi
   \( f_{c'} \) = FRICTION FACTOR = 0.70
4. **SEISMIC LOADING:**
   \( A = 0.12g \) (Max.)
   \( K_h = 0.85 \)
5. **REINFORCED CONCRETE:**
   \( f_{c'} = 4000 \) psi
   \( f_{y} = 60000 \) psi

(SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS)
## TABLE OF DIMENSIONS AND REINFORCING STEEL

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Steel (lb/ft):

| 76 | 85 | 96 | 104 | 118 | 133 | 176 | 182 | 198 | 233 | 240 | 307 | 340 | 386 | 412 | 433 |

### Maximum Soil Bearing Pressure

| Qmax (psf) | 4071 | 4328 | 4591 | 4850 | 4811 | 5491 | 5752 | 6018 | 5945 | 6208 | 6917 | 6833 | 7090 | 7352 | 7271 | 8079 | 8322 |

### 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
   - $\phi = \text{angle of internal friction} = 37^\circ$
   - $\delta = \text{angle of wall friction} = 22^\circ$
   - $\gamma = \text{effective unit weight} = 120 \text{pcf}$
3. **Foundation Soil Properties:**
   - $q_f = \text{factored bearing capacity} = 20000 \text{ psf}$
   - Friction factor $= 0.70$
4. **Seismic Loading:**
   - $A = 0.17g \text{ (Max.)}$
   - $K_h = 0.085$
   - $K_v = 0$
5. **Reinforced Concrete:**
   - $F_c = 4000 \text{ psi}$
   - $F_y = 60000 \text{ psi}$

(See MassDOT specifications for design requirements)
STEEL W BEAM HIGHWAY GUARD

E 401.1.0

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 THRE BEAM AND HEIGHT 2’-8 1/2” PLUS FOR SECTION Z-Z, (NOTE 6’ 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 THR BEAM GUARD RAIL EXCEPT AS OTHERWISE NOTED.
SECTION Z-Z**
SLOPED EDGING ALONG EDGE OF SHOULDER AND RAMP
SEE E 106.5.0 FOR DETAILS OF SETTING SLOPED EDGING

SECTION Z-Z**
VERTICAL GRANITE CURB OR BITUMINOUS
CONCRETE CURB ALONG EDGE OF SHOULDER

* WHEN PLACED IN MEDIAN, CHANGE TO
THREE 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
**NOTES:**

1. LENGTHS OF HIGHWAY GUARD SHOWN ARE MEASUREMENTS ALONG FACE OF RAILING.
2. FOR DESCRIPTIONS, MATERIAL AND CONSTRUCTION METHODS, SEE THE STANDARD SPECIFICATIONS AND CONSTRUCTION E 401.1.0 AND E 401.10.0.
3. DETAILS SHOWN HEREIN ALSO APPLY TO THREE BEAM GUARD RAIL, EXCEPT AS OTHERWISE NOTED.
4. WHEN PLACED IN MEDIANS, CHANGE TO THREE BEAM GUARD RAIL & HEIGHT OF 2'-6" 1/2"±1"
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.
FLARE BEGINS AT POST AA ADD 2ND RAIL AND USE 6" POSTS (EXCEPT POSTS 1, 2, AND 3)

SECTION A-A

4:1 OR FLATTER

LEVEL WITH DESIGN HEIGHT AT SHOULDER (SEE DWG. E 401.1.1)

TOP OF RAIL LESS THAN 45° ABOVE GROUND

SECTION B-B

4:1 OR FLATTER

TOP OF RAIL MAX 45° ABOVE GROUND

SECTION C-C

4:1 OR FLATTER

28 3/4" (SEE DWG. E 401.1.1)
STEEL W BEAM HIGHWAY GUARD BURIED IN BACK-SLOPE END ANCHORAGE DETAILS FOR POSTS 1, 2 AND 3

NOTES:

1. THE 1/2" STEEL PLATE SHALL CONFORM TO THE REQUIREMENTS OF A-38, 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.
### TYPICAL INSTALLATION

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL GUARDRAIL CONFIGURATION SHOWN ON E 401.1.1 SECTION Z-Z</td>
<td>24&quot; ±</td>
<td>3'-3&quot; ±</td>
<td>6'-6&quot; ±</td>
</tr>
</tbody>
</table>

NOTE: ALL MEASUREMENTS ARE FROM EDGE OF USEABLE SHOULDER

### FOR OVERHEAD SIGN PROTECTION

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1V : 2H SLOPE 2:1 SLOPE</td>
<td>24&quot; ±</td>
<td>3'-3&quot; ±</td>
<td>6'-6&quot; ±</td>
</tr>
<tr>
<td>1V : 4H SLOPE 4:1 SLOPE</td>
<td>6'-0&quot; ±</td>
<td>7'-9&quot; ±</td>
<td>11'-0&quot; ±</td>
</tr>
<tr>
<td>1V : 6H SLOPE 6:1 SLOPE</td>
<td>16'-0&quot; ±</td>
<td>17'-9&quot; ±</td>
<td>21'-0&quot; ±</td>
</tr>
</tbody>
</table>

* SEE E 401.1.0

** SEE E 401.2.0
TWO SECTIONS OF THRIE BEAM
ONE SET INSIDE THE OTHER

TOP OF WEARING SURFACE

6" x 8" WOOD BLOCK 18" LONG
CURB IF REQUIRED

6" x 8" WOOD POST
(SEE E 401.5.5)

POST P1, P2, P3, P4

POST P5

8" x 8" WOOD BLOCK
(SEE E 401.5.5)

6" x 8" WOOD POST

TOP OF WEARING SURFACE

TWO SECTIONS OF THRIE BEAM
ONE SET INSIDE THE OTHER

6" x 8" WOOD BLOCK 18" LONG
BERM IF REQUIRED

6" x 8" WOOD POST
(SEE E 401.5.5)

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

COLLAPSING TUBE ASSEMBLY

NUT

COLLAPSING TUBE
ASSEMBLY

TUBE BOLT

REAR WHEELER

DRAWING NUMBER

DATE OF ISSUE
JUNE 2014

E 401-5.4
**3/4" DIA BOLT HOLES, AS REQUIRED FOR MEDIAN BARRIER**

**M16x2 - 10" LONG RAIL BOLT WITH WASHER AND RECESSED NUT**

**PLAN**

**TERMINAL SECTION**

**DIRECTION OF TRAFFIC**

**NOTES:**

1. POST TO BE FABRICATED FROM W8"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.
The cross-sectional dimensions for this end are the same as for the W Beam.

NOTE: Base metal thickness = 12 gauge
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.
3/4" DIA BOLT HOLES, AS REQ'D FOR MEDIAN BARRIERS

M16x2 - 10" LONG GUARD RAIL BOLT WITH WASHER AND RECESSSED NUT

8 1/2"  2 1/4"

2'

PLAN TERMINAL SECTION

15/16" x 1 1/8" SLOTTED HOLES. USE SPlice BOLTS. 15/16"

1 1/8" 1 1/8" 1 - 4" 12 1/4" 2 - 4 3/4" 2 1/2"

FRONT TERMINAL SECTION

DIRECTION OF TRAFFIC

POST

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.
STEEL BEAM HIGHWAY GUARD WITH WOOD POST

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 401.8.0, 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.
SPECIAL BASE ANCHOR
FOR HIGHWAY GUARD
INSTALLATION ON CONCRETE

1. SWEDE BOLTS, NUTS AND WASHERS ARE TO BE GALVANIZED.
2. HOLES FOR SWEDE BOLTS SHALL BE 10" DEEP. SWEDE BOLTS
   TO BE SET IN EPOXY RESIN, AS APPROVED BY THE ENGINEER.
3. BASE PLATE IS TO BE SET ON 3/4" NEOPRENE
4. DETAILS OF HIGHWAY GUARD ARE SHOWN ON DRAWINGS E 401.11.0, E 401.50, 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**

6" x 4", 8.5 LBS/LF
STEEL "H" POSTS
OR "C" POST

See Table

W

L

**ELEVATION**

EXISTING

SURFACE

H

SEE TABLE

3500 PSI - 1 1/2" - 520 LB
CEMENT
CONCRETE
MASONRY

SEE TABLE

2" BITUMINOUS CONCRETE WALK
SURFACE IF EXISTING SURFACE IS
BITUMINOUS CONCRETE, OTHERWISE
CONTINUE 4000 PSI CEMENT CONCRETE
(SEE MASSDOT SPECIFICATIONS FOR
DESIGN REQUIREMENTS) TO MEET
EXISTING SURFACE.

3" SAND CUSHION

UNDERGROUND UTILITY, BRIDGE FOOTING
OR OTHER OBSTRUCTION

**DIMENSION OF CONCRETE ENVELOPE**

<table>
<thead>
<tr>
<th>HEIGHT OF EXISTING SURFACE ABOVE TOP OF SAND CUSHION</th>
<th>DIMENSION OF CONCRETE ENVELOPE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H</td>
</tr>
<tr>
<td>H: HEIGHT OF SURFACE ABOVE SAND CUSHION</td>
<td></td>
</tr>
<tr>
<td>1'-0&quot; - 1'-6&quot;</td>
<td></td>
</tr>
<tr>
<td>1'-6&quot; - 2'-6&quot;</td>
<td>Varies 1'-0&quot; TO 1'-6&quot;</td>
</tr>
<tr>
<td>OVER 2'-6&quot;</td>
<td>2'-6&quot;</td>
</tr>
</tbody>
</table>

**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.
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.
OFFSET BLOCKS FOR
STEEL W BEAM HIGHWAY GUARD

DATE OF ISSUE
JUNE 2014
DRAWING NUMBER
E 401.20.0
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 IS NOT REQUIRED WHERE RAIL IS TO BE NESTED.

* SEE BRIDGE STANDARDS FOR DETAILS; LAP IN DIRECTION OF TRAVEL.
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
* 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. RECESES TO BE FILLED WITH EPOXY CONCRETE.
2. ALL WELDING IS TO BE DONE IN THE SHOP
7/8" Ø HOLES FOR M20 H.S. BOLTS

4" LONG STRUC. CONC. INSERT *

3/4" Ø HOLE FOR M16 H.S. BOLT FOR PLATE
ATTACHMENT & GD. RAIL ATTACHMENT

* 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.
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.
MASONRY BRACKET FOR TYPE SS HIGHWAY GUARD RAIL

ABUTMENT FACE

3/4" Ø H.S. BOLTS (4" LONG)

TERMINAL SECTION (MODIFIED)

EDGE OF SHOULDIER

PLAN

DIRECTION OF TRAVEL

ABUTMENT FACE

END POST

MODIFIED TERMINAL SECTION

NEST THE RAIL

25'

12'

3'-1 1/2'

6 1/2" ± 1"

POST W6 X 8.5
6'-3" LONG

GROUND LINE

FOOTING

ELEVATION

MODIFIED TERMINAL END

SEE NOTE #1

SEE NOTE 3

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.
* 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
THREE BEAM BEARING PLATE DETAIL
(TO BE USED ON VERTICAL PARAPET)
NOT TO SCALE

SECTION A-A
THROUGH CONCRETE PARAPET WALL
NOT TO SCALE
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.
F SHAPE
CONCRETE BARRIER

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.
NOTES:

1. CAST IN PLACE NOT TO EXCEED 200' BETWEEN EXPANSION JOINTS.
2. CONSTRUCTION JOINTS REQUIRED AT 40' INTERVALS (1/2" PREMOLDED 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
1. CAST IN PLACE NOT TO EXCEED 200' BETWEEN EXPANSION JOINTS.

2. CONSTRUCTION JOINTS REQUIRED AT 40' INTERVALS (1/2" PREMOLDED 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
NOTES:
1. DOWELS TO BE GALVANIZED, AASHTO-M31, GRADE 60.
2. FOR ADDITIONAL DETAILS SEE E 402.10.0
**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.
**F SHAPE CONCRETE BARRIER REINFORCING DETAILS**

**E 402.21.0**

**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
NOTES:

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

SECTION B–B

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 MASSACHUSETTS HIGHWAY STANDARD SPECIFICATIONS M7.10.0 AND AASHTO M111.

3. CEMENT CONCRETE IS TO CONFORM TO MASSACHUSETTS HIGHWAY STANDARD SPECIFICATIONS M4.02.00. CEMENT CONCRETE IS TO BE 5000 PSI (SEE MASSDOT SPECIFICATIONS FOR DESIGN REQUIREMENTS).
PLAN OF CONNECTION

SIDE VIEW
LOOP BAR
3/4" DIA. A36

REINFORCEMENT DETAIL

SECTION A-A

CONNECTOR PIN ASSEMBLY

1 1/4"
HEX NUT
WASHER

1 1/4" DIA.
STEEL BAR ASTM A36

1 1/4"
NUT TO BE TACK WELDED BEFORE GALVANIZED

1 1/4" X 6

1 1/2"

2 1/2"
OUTSIDE DIA.
CIRCULAR WASHER
[1/8" MIN. THICKNESS]

1 1/4" A36 PIN GALVANIZED

BOTTOM 1/2" MAY BE BEVELED TO FACILITATE PLACEMENT.
NOTES:

1. BACK SIDE OF FENCES AND BARRICADES SHALL FACE CONSTRUCTION SITE. FRONT SIDE SHALL FACE PUBLIC AREA.
2. FASTENER SIDE OF LINE POST TIES SHALL BE ON BACK SIDE OF FENCES AND BARRICADES.
3. CHAIN LINK MESH SHALL BE 9 GAUGE CORE WIRE SIZE 2" MESH, SELVAGES SHALL BE KNUCKLED.
4. ANTI-DUST FABRIC SCREEN SHALL BE ATTACHED TO FENCE MESH WITH PLASTIC ZIP TIES.
TYPICAL PEDESTRIAN RAIL SECTION

45° SPLITTER PVC PIPE FITTING
8" x 3/4" PLASTIC TRIM BOARD
(SEE INSET DETAIL)

90° T SPLITTER PVC PIPE FITTING
SHIM AS NECESSARY (TYP.)

2" PVC PIPE (2.375" O.D., TYP.)

BARRIER SLEEVE
(3.5" O.D., 2.96" I.D.)

12"
8"
0.5"
24"
32"
24"
38"
TYPICAL MODIFIED PEDESTRIAN RAIL SECTION

8" x ½" PLASTIC TRIM BOARD
90° T SPLITTER PVC PIPE FITTING
90° ELBOW PVC PIPE FITTING
SHIM AS NECESSARY (TYP.)
2" PVC PIPE (2.375" O.D., TYP.)

BARRIER SLEEVE
(3.5" O.D., 2.96" I.D.)

DATE OF ISSUE
JUNE 2014

DRAWING NUMBER
E 403.7.0
CHAIN LINK FENCE WITH SPRING TENSION WIRE

FASTENING FABRIC TO LINE POST EVERY 12" ±

FABRIC PLACED PERPENDICULAR TO THE ANCHOR

DETAIL SHOWING LINE POST SET WITH DRIVE ANCHORS

FASTENING SPRING TENSION WIRE TO LINE POST

HOG RINGS EVERY 12" ±

FABRIC FLUSH WITH TOP OF POST

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

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

DETAIL OF AN ANCHOR CLAMP
**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.**
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
   - CURVES 100' TO 200' RADIUS
   - CURVES LESS THAN 100' RADIUS
5. FOR POST Bases AND CABLE ATTACHMENTS, SEE DRAWING E 404.5.0
6. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHODS, SEE
   STANDARD SPECIFICATIONS.
**POST BASES**

10" MIN.

12" MIN.

FOR END PULL POST

7/16" WIRE ROPE CLIPS

WIRE SEIZING

3/8" WIRE ROPE THIMBLE

3/8" ANCHOR SHACKLE

5/8" EYE BOLTS

FOR CORNER, END LINE AND PULL POSTS

NEAT FINISH

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

FOR GATE POSTS

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**

<table>
<thead>
<tr>
<th>FENCE HEIGHT</th>
<th>MIN. H</th>
</tr>
</thead>
<tbody>
<tr>
<td>5' OR LESS</td>
<td>2'-6&quot;</td>
</tr>
<tr>
<td>OVER 5'</td>
<td>3'-0&quot;</td>
</tr>
</tbody>
</table>
WHEEL EQUIPPED WITH ROLLER BEARINGS AND LUBRICATION FITTING. MASSIVE MALLEABLE CONSTRUCTION. 4 ASSEMBLIES NEEDED PER SECTION.

ROLLER ASSEMBLY

LATCH AND LOCKING ASSEMBLY

2" O.D. PIPE OFFSET FOR 3 STRAND BARBED WIRE

WELD

2 1/2" O.D. RAIL

2" O.D. FRAME

4" O.D. POST

2" O.D. FRAME

GROUND LINE

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

BACK STOP CLAMPS ON CROSS MEMBER AND IS ADJUSTABLE

DISTANCE "A" TO BE 1/2 DISTANCE "B"

FRONT STOP IS WELDED TO EDGE OF UPRIGHT MEMBER
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
MASS. DEPT. OF ENVIRONMENTAL PROTECTION
FILE NO.______

0.080" SHEET ALUMINUM

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.
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

PLAN VIEW
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.
**CONSTRUCTION STANDARDS**

**DEMULTABLE REFLECTORIZED**

**STATION MARKER AND PROJECT MARKER**

**DATE OF ISSUE:** JUNE, 2014

**DRAWING NUMBER:** E 505.1.0

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**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 designation are to be even stations (i.e. no plus stations).
3. The panels for the legend are to be 0.080" sheet aluminum, fabricated and finished according to the standard specifications.
4. The letters and numerals and method of application 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. Station markers are to be placed at 650' intervals, on undivided roadway: stagger on each side. On divided roadway: place markers opposite each other, stagger on each side.
8. See drawing R T.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.