The Commonwealth of Massachusetts

**Deval L. Patrick**
Governor

**Timothy P. Murray**
Lieutenant Governor

**Richard A. Davey**
Secretary & CEO

**Frank DePaola, P.E.**
Administrator

Prepared by
The Massachusetts Department of Transportation- Highway Division

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EXAMPLE: DRAWING NUMBER - 201.1.0R

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.

REVISED DRAWING

KEY TO NUMBERING SYSTEM
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NOTES:
1. ONLY ROCK ACTUALLY REMOVED IS PAYABLE. NO PAYMENT WILL BE MADE BEYOND THE ROCK PAYMENT LINE
METHOD OF ROUNding CUT SLOPES

1V : 2H SLOPE ROUNDING
1. WHEN "D" IS 2 OR MORE ROUND AS SHOWN IN TABLE ABOVE.
2. WHEN "D" IS LESS THAN 2 ROUND FULL LENGTH OF SLOPE.

ROUNDING TABLE FOR 1V : 2H SLOPE

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

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.

METHOD OF STEPPING SURFACE AND BASE COURSE LAYERS
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.
NOTES:
2. ONLY EXPANSION JOINTS SHALL BE SAW-CUT AND SEALED.
3. ONLY REQUIRED WITH A CONTINUOUS BITUMINOUS CONCRETE SURFACE FROM ROADWAY TO BRIDGE.
CONTRACTION JOINTS - SPACE 20' O.C. MAX. SEE NOTES

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.

NOTES:
1. CONTRACTION JOINTS ARE TO BE SPACED AT A MAXIMUM OF 20' APART.
2. THE JOINTS ARE TO BE SAWS 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. 3'-705 lb/Cu. Yd.
6. TROUGH FLUSH WITH OR ABOVE ADJACENT PAVEMENT FOR DRAINAGE.

DATE OF ISSUE: MARCH 2012
DRAWING NUMBER: E 105.2.0
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.

4. PAYMENT PER FOOT OF CURB IS INCLUSIVE OF ALL ITEMS OF WORK REQUIRED TO COMPLETE PROPER INSTALLATION OF THE CURB.
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. PAYMENT FOR CEMENT CONCRETE WILL BE INCLUDED IN THE PRICE PER FOOT OF EDGING.

3. 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

SECTION A-A
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

USABLE SIDEWALK WIDTH PER AAB = W-Wc
USABLE SIDEWALK WIDTH PER AAB IS NOT TO BE LESS THAN 4'0"
SEE E 107.6.5R FOR DETAILS OF DETECTABLE WARNING PANEL
WHEELCHAIR RAMPS
GREATER THAN 12'-4" SIDEWALK

DATE OF ISSUE: MARCH 2012
DRAWING NUMBER: E 107.3.0R
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

HSL = HIGH SIDE TRANSITION LENGTH
SEE E 107.9.0R

* = TOLERANCE FOR CONSTRUCTION ±0.5%
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
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.
LEGEND

* = TOLERANCE FOR CONSTRUCTION ±0.5%

** = SEE E 107.9R FOR TRANSITION LENGTH
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
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>ROADWAY PROFILE GRADE</th>
<th>* HIGH SIDE TRANSITION LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>ENGLISH UNITS</td>
</tr>
<tr>
<td>=0%</td>
<td>6'-6&quot;</td>
</tr>
<tr>
<td>&gt;0% TO 1%</td>
<td>7'-8&quot;</td>
</tr>
<tr>
<td>&gt;1% TO 2%</td>
<td>9'-0&quot;</td>
</tr>
<tr>
<td>&gt;2% TO 3%</td>
<td>11'-0&quot;</td>
</tr>
<tr>
<td>&gt;3% TO 4%</td>
<td>14'-0&quot;</td>
</tr>
<tr>
<td>&gt;4% TO 5%</td>
<td>15'-0&quot; Max</td>
</tr>
</tbody>
</table>

**NOTE:**

* BASED ON A DESIGN SLOPE OF 7.5% AND A REVEAL OF 6".
NOTES:
1. WEEP HOLES 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 WEEP HOLE.
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 201.5.0 - 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

SECTIONS C-C

BLOCKS TO BE SET IN FULL BED OF CEMENT MORTAR

SECTIONS A-A

SECTIONS B-B
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.

24" MIN.
SQUARE OPENING **
8" MIN.

SEE DRAWING E 202.4.0 FOR JOINT DETAILS

4' ± 1" DIAMETER

MORTAR ALL JOINTS

OUTSIDE OF PIPE
+2' CLEARANCE

WEEPHOLE

(OPENING TO BE PRECAST IN RISER SECTION)

SEE NOTE #2

1" CLEAR

** MINIMUM DEPTH OF SUMP TO BE 2 FT

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

1' CLEAR

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

3'-0" MAX. (STANDARD)
4'-0" MAX. (DEEP SUMP)

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

DATE OF ISSUE
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DRAWING NUMBER
E 201.4.0
PRECAST CONCRETE CATCH BASIN TUB

FOR FRAME SEE DRAWING E 201.6.0
FOR GRATE SEE DRAWINGS E 201.7.0 - E 201.11.0

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

24" MIN.
SQUARE OPENING **
6"

WEEPHOLE
SEE NOTE #2

OUTLET PIPE
PIPE TO BE SET IN FULL BED OF MORTAR

48" ± 1" DIAMETER

6" MINIMUM
5" MINIMUM

3'-0" MAX. (DEEP SUMP)

4'-07" MAX. (DEEP SUMP)

8" DIAMETER HOLE IN CENTER OF BASE
HOLE TO BE FILLED WITH 4,000 PSI - 1 1/2" - 560 LB CEMENT/CY OR 4,000 PSI - 3/4" - 610 LB CEMENT/CY CONCRETE AFTER INSTALLATION

* 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 ENTRAINDED
MACHINE TOLERANCES:
- MACHINED SEATS (4) REQUIRED
- FLAT AND IN PLANE WITHIN .010"
- TOTAL INDICATOR READING

CLASSIFICATION:
- ASTM A48 CLASS 30B GRAY CAST IRON
- 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

DATE OF ISSUE
- MARCH 2012

DRAWING NUMBER
- E 201.6.0
CLASSIFICATION:
ASTM A48 CLASS 30B GRAY CAST IRON
WITH NO BLACK ASPHALT COATING ALLOWED

WEIGHT: 265 LBS. MIN
AASHTO HS 20 PROOF LOAD

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

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

CASTING TOLERANCES:
SHALL CONFORM TO AASHTO
M306

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

WEIGHT: 265 LBS, MIN AASHTO HS 20 PROOF LOAD

CLASSIFICATION:
ASTM A48 CLASS 30B
GRAY CAST IRON
WITH NO BLACK ASPHALT COATING ALLOWED

CASTING TOLERANCES:
SHALL CONFORM TO AASHTO M308

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

LOCK TUMBLER ASSEMBLY
(1) REQUIRED-CONSISTS OF:
5/8" x 5" STL. BOLT
5/8" STL. FLAT WASHER
CAST IRON TUMBLER
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.

Machine tolerances:
Surfaces noted \( \pm \) must be machined flat and in-plane within \( \pm .010" \)
Total Indicator Reading
FRAME MAY BE INSTALLED WITH THIS FLANGE REMOVED FOR CURB INLET. FOUR FLANGE IS SHOWN. – SEE DWG E 201.6.0 FOR MORE INFORMATION.

AASHTO HS 20 PROOF LOAD

LOCK TUMBLER ASSEMBLY
(1) REQUIRED—CONSISTS OF:
5/8" x 5" ST. STL BOLT
5/8" ST. STL PLAT WASHER
CAST IRON TUMBLER
ST. STL CAPTURE NUT
STAINLESS STEEL GRADE 304

CLASSIFICATION:
ASTM A48 CLASS 30B GRAY CAST IRON
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 3/4 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 201.6.0 FOR MORE INFORMATION.

CLASSIFICATION: ASTM A48 CLASS 30B GRAY CAST IRON WITH NO BLACK ASPHALT COATING ALLOWED

AASHTO HS 20 PROOF LOAD N.T.S.

SECTION A-A

24 1/4"
23 7/8"

8" 1/2"
15/16"

24 MIN

SECTION B-B

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

LOCK TUMBLER ASSEMBLY
(1) REQUIRED—CONSISTS OF:
5/8"x5" 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
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.

N.T.S.
WEIGHT: 205 LBS. (MIN)
NOTE: IDENTIFYING INFORMATION SHOWN ON FRAMES & GRATES TO BE CAST WITH FRAME AND GRATE

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

CLASSIFICATION:
ASTM A48 CLASS 30B GRAY CAST IRON
WITH NO BLACK ASPHALT COATING ALLOWED

Machine tolerances:
Surfaces noted □ must be machined flat and in-plane within .010" Total Indicator Reading

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

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

CASTING TOLERANCES:
SHALL CONFORM TO AASHTO M306

CLASSIFICATION:
ASTM A48 CLASS 30B GRAY CAST IRON
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 1/2 turn past snug.

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

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DRAWING NUMBER
E 201.10.1
NOTES:
1. MATERIAL-CAST IRON; SEE STANDARD SPECIFICATIONS
2. MINIMUM MASS - 210 LBS.
CONCRETE BLOCK MANHOLE
MANHOLES 9’ OR LESS IN DEPTH

NOTE:
1. DESIGN SHOWN IS FOR MANHOLE OF 9’ OR LESS
   AND PIPE DIAMETER OF 30” OR LESS.
2. STANDARD MANHOLE DEPTH TO BE 8’-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.

1/8" - 24", TAPER IN 3 OR 4 COURSES

PIPE 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 - 1 1/2" - 565 LB OR 4000 PSI - 3/4" - 810 LB CONCRETE CONCRETE SECTIONAL PLATES. SEE BELOW.

BRICK CHIPS AND MORTAR OR CEMENT HAND MIXED SEE LATEST STANDARDS SPECIFICATIONS.

ALL CONCRETE TO BE AIR ENTRAINED

INVERTED ARCH WITH BRICKS LAID ON EDGE AS STRETCHERS.

MORTAR NOT REQUIRED IN VERTICAL JOINTS.

SECTION A-A

PLAN OF BASE

SOLID SECTION: OR FILL HOLE WITH BRICKS AND MORTAR; OR FILL 4000 PSI - 1 1/2" - 565 LB OR 4000 PSI - 3/4" - 810 LB CONCRETE (IF CONCRETE IS HAND MIXED SEE LATEST STANDARD SPECIFICATIONS.)

NOTE:
1. MANHOLE DESIGN IS FOR PIPE DIAMETER OF 30" OR LESS
STANDARD MANHOLE FRAME AND COVER SEE DRAWINGS E 202.8.0-E 202.8.0

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

MORTAR ALL JOINTS
MIN. 0.12 SQ. IN. PER VERTICAL FOOT, PLACED ACCORDING TO AASHTO DESIGNATION M199

1-#3 BAR AROUND OPENINGS FOR PIPES 18" DIAMETER AND OVER, 1" COVER

FLOOR OF STRUCTURE TO BE HEADERS LAYED FLAT

BRICK CHIPS AND MORTAR OR 4,000 PSI - 1 1/2" 565 LB CEMENT/CY (IF HAND MIXED SEE LATEST STANDARD SPECIFICATIONS)

INVERTED ARCH WITH BRICKS LAYED ON EDGE

PROVIDE "V" OPENINGS
PIPE OPENINGS TO BE PRECAST IN RISER SECTION

OUTSIDE OF PIPE = 2" 30° MAX.
DIA. PIPE

2" CLEAR

1° CLEAR

5° MIN.

5° MIN.

3° MIN.

1 1/2° MIN.

1 1/2° MIN.

5° MIN.

5° MIN.

5° MIN.

NOTE:
1. FOR DESCRIPTIONS, MATERIALS AND CONSTRUCTION METHODS, SEE LATEST STANDARD SPECIFICATIONS.
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 DETAIL Y
SECTION A-A

TYPE - B FRAME

FRAME SET IN FULL BED OF MORTAR
MINIMUM 8" MASONARY WALL

MORTAR

1 1/8" R
1 1/2" R
5"

24" ± 1" OPENING

STANDARD COVER
FOR COVER DETAIL, SEE DRAWING E 202.8.0

NOTES:
1. MINIMUM FRAME MASS 265 LBS.
2. MATERIAL - CAST IRON

MANHOLE FRAME AND COVER - B FRAME

DATE OF ISSUE
MARCH 2012
DRAWING NUMBER
E 202.7.0
DROP INLET TYPE C

4" CAST IRON FRAME
FULL BED OF MORTAR

THROAT
1'-10"±1"
8" MIN.

OUTLET PIPE

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"

Section A-A

4000 PSI - 3/4" - .610 LB CEMENT CONCRETE 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
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
PARALLEL BAR GRATE SEE DRAWINGS E 201.11.0
FOR FRAME SEE DRAWING E 203.1.0
BRICKS MAY BE USED FOR GRADE ADJUSTMENTS.
FRAME TO BE SET IN FULL BED OF MORTAR
5" MIN.
SEE DRAWING E 202.4.0
FOR JOINT DETAILS
MORTAR ALL JOINTS
PROVIDE "V" OPENINGS
OUTSIDE OF PIPE + 2"
MIN. 0.12 SQ. IN. STEEL PER VERTICAL FOOT,
PLACED ACCORDING TO AASHTO DESIGNATION M199

THROAT
22" ± 1" SQUARE OPENING
8" MIN.
48" ± 1" DIAMETER
1" CLEAR
3'-0" MAX
5" MIN.

WEEPHOLE
(OPENING TO BE PRECAST IN RISER SECTION)

6'-6" (STANDARD DEPTH)
HEIGHT OF RISER SECTIONS
VARY FROM 1 TO 4'
18'-24" TAPERED SECTION

SEE DRAWING E 202.4.0 FOR Base DETAILS

* 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
2 1/4" X 2 1/4"
TAPERED SECTION
SEE E 202.4.0 FOR JOINT DETAILS
48" ± 1" DIAMETER
WEEPHOLE
OPENING TO BE PRECAST
IN RISER SECTION
1" CLEAR
3 1/2" MAX
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

SEE DRAWING E 202.4.0 FOR BASE 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

DATE OF ISSUE
MARCH 2012
DRAWING NUMBER
E 203.6.0
PRECAST CONCRETE THROAT
FOR USE IN MEDIANs & DITCHES WITH TYPES
CF AND DF DROP INLETS

PLAN

SECTION A-A

SECTION B-B

ISOMETRIC OF PRECAST CONCRETE THROAT OPENING
NOTES:
1. WHERE CURB INLET IS NOT USED THE INSIDE HORIZONTAL DIMENSIONS OF GUTTER INLET TO BE 24"x11" X 24"x11" 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.
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.
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
TABLE OF MINIMUM WALL THICKNESS (FT)

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

<table>
<thead>
<tr>
<th>DIA (IN)</th>
<th>MIN. - 10</th>
<th>11 - 15</th>
<th>16 - 20</th>
<th>21 - 25</th>
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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>
<thead>
<tr>
<th>SPAN (IN.)</th>
<th>RISE (IN.)</th>
<th>MADE FROM PIPE OF DIA. (IN.)</th>
<th>MIN. - 3</th>
<th>4 - 5</th>
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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.
CONCRETE AND FIELD STONE MASONRY PIPE ENDS FOR 8” to 30” PIPE

FRONT ELEVATION

END ELEVATION

CONCRETE CRADLE FOR PIPE CULVERTS

CEMENT CONCRETE
4000 PSI, 1 1/2’-565 lb/Cu.Yd.
ONLY TO BE USED WHERE SPECIFIED

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
<table>
<thead>
<tr>
<th>PIPE DIAM. D</th>
<th>1 1/2 : 1 SLOPE</th>
<th>2 : 1 SLOPE</th>
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Y

4" FOR 1 1/2 : 1 SLOPE
6" FOR 2 : 1 SLOPE
CONCRETE AND FIELDSTONE MASONRY PIPE ENDS FOR COMBINATION PIPES UP TO 30"

<table>
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<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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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.
* 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.
TABLE
[ALL DIMENSIONS ARE inches OR FEET]

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<th>DIAMETER Inch</th>
<th>W</th>
<th>A</th>
<th>B</th>
<th>D</th>
<th>E</th>
<th>P</th>
<th>DIA. +1&quot;</th>
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<th>R2</th>
<th>SLOPE</th>
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<td>22&quot;</td>
<td>1V : 3H</td>
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</table>

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.

PIPE Dia. (IN.)

<table>
<thead>
<tr>
<th>GA.</th>
<th>DIMENSIONS (IN.)</th>
<th>APPROX. SLOPE</th>
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DATE OF ISSUE
MARCH 2012

STANDARD METAL END

DRAWING NUMBER
E 206.9.0
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

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

DATE OF ISSUE
MARCH 2012

DRAWING NUMBER
E 209.1.0
STAKE (TYP.)

SECTION A-A

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

STAKED FILTER FABRIC FOR EROSION CONTROL

FLOW

HAY BALE FOR EROSION CONTROL

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

SECTION X-X

HAY BALE FOR EROSION CONTROL (2 STAKES PER BALE)
UNIT LENGTHS IN MULTIPLES OF 2' UP TO MAX. OF 12'

ANGLES SET BACK 3 CORRUGATIONS FOR LAPPING UNITS

3" X 2" X 1/4" GALV. ANGLES
FASTENED TO METAL FLUME WITH 3/8"

3" X 1 1/4" BOLTS SPACED 12"
C. TO C. OR STITCH WELDED.

3/8" DIA. HOLES

ACCM UNITS TO BE LAPPED
IN DIRECTION OF FLOW AND
FASTENED WITH TWO GALV.
BOLTS 3/8" X 1 1/4"

FLOW

ACCM WATERWAY TO BE FASTENED TO STAKES WITH SPIKES

WOOD STAKES
2" X 6"

MIN. 3-0"

STAKES SPACED
6'-0" MAX. C. TO C.

NOTE:
1. DIAMETER OF HALF CCM PIPE WATERWAY TO BE AS SPECIFIED.
2. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHODS, SEE STANDARD SPECIFICATIONS.
SECTION D-D
SEE NOTE NO. 2

CONTRACTION JOINT

EXPANSION JOINT
TRANSITIONAL SECTION FOR STANDARD PAVED WATERWAY

FIELD SODDING

EXPANSION JOINT
TRANSITIONAL SECTION FOR STANDARD PAVED WATERWAY

10'-6"±
6'
6'

EDGE OF PAVED SHOULDER
LIMIT OF SLOPE TREATMENT
LINE OF L.T.

2" SOD

2" SOD

SOD

4" MIN.

GRASS

4" SLOPE OF WATERWAY EDGES TO FOLLOW NORMAL SLOPES (SLOPES ARE NOT TO BE WARDED)

PAVED WATERWAY

SLOPE TREATMENT

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 E 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.
### Concrete Masonry Footing

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<th>H (FT)</th>
<th>W (FT)</th>
<th>D (FT)</th>
<th>Section Area (SQ. FT.)</th>
<th>Volume Per Unit Length (CU.YD./LIN.FT)</th>
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COPING TO BE PRECAST CONCRETE OR GRANITE OF UNIFORM DEPTH FOR THE ENTIRE LENGTH, DEPTH OF CONCRETE TO BE 1/12 OF THE AVERAGE "H" WITHIN THE LIMITS SHOWN. DEPTH OF GRANITE TO BE AS SHOWN ON THE PLANS. 6" OR 8".

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 FOUNDATION ON SUITABLE SOIL.

---

**Construction Standards**

**Date of Issue:** March 2012

**Drawing Number:** E 302.2.0

**Cemented Stone Masonry Wall**
**PLAN**

- 6" 4,000 PSI-1 1/2" 565 lb/Cu Yd.
  REINFORCED CONCRETE SLAB

- TOP OF OUTSIDE FACE OF CONCRETE CURTAIN TOE WALL

- EXPANSION JOINT

- SLOPE VARY

- 2% SLOPE

**SECTION A-A**

- 8" CRUSHED STONE (TYPICAL)

- 6"X8"X1/4" DIA WIRE FABRIC 5.2 lb/SY

- CONCRETE CURTAIN TOE WALL

- INSTALL SUBDRAIN
  SEE E 209.1.0

- 2% SLOPE

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

<table>
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<tr>
<th>STEP NOS</th>
<th>QUANTITIES - CU. FT.</th>
<th>TOTAL C.Y.</th>
<th>REINF. STEEL LBS</th>
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<td>BASE</td>
<td>STEPS</td>
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## DESIGN B

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<td>BASE</td>
<td>STEPS</td>
<td>2-WALLS</td>
</tr>
<tr>
<td>4(2 EACH WALL) No. 4 BARS 12'-6&quot;</td>
<td>13'-11&quot;</td>
<td>11'-4&quot; FOR 10 STEPS</td>
</tr>
<tr>
<td>2' CLEAR</td>
<td>9-No. 3 TIES 5'-0&quot;</td>
<td>@ 18&quot; FOR 10 STEPS</td>
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<tr>
<td>7-No. 4 BARS 12'-6&quot;</td>
<td>13'-2&quot;</td>
<td>11'-6&quot; FOR 10 STEPS</td>
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## DESIGN C

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

ALL CONCRETE SHALL BE 4000 PSI - 1 1/2" - 565 LB
TABLE OF DIMENSIONS AND REINFORCING STEEL

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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 | 1.000 |

P | 1.000 | 1.000 | 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 |

A bars | 6 @ 12 | 7 @ 12 | 8 @ 12 | 9 @ 12 | 10 @ 12 | 11 @ 12 | 12 @ 12 | 13 @ 12 | 14 @ 12 | 15 @ 12 | 16 @ 12 | 17 @ 12 | 18 @ 12 | 19 @ 12 | 20 @ 12 | 21 @ 12 | 22 @ 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 | 7 @ 12 | 8 @ 12 | 9 @ 12 | 10 @ 12 | 11 @ 12 | 12 @ 12 | 13 @ 12 | 14 @ 12 | 15 @ 12 | 16 @ 12 | 17 @ 12 | 18 @ 12 | 19 @ 12 | 20 @ 12 | 21 @ 12 | 22 @ 12 | 23 @ 12 |

D 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 |

E bars | 4 @ 12 | 4 @ 12 | 5 @ 12 | 5 @ 12 | 5 @ 12 | 5 @ 12 | 5 @ 12 | 5 @ 12 | 5 @ 12 | 5 @ 12 | 5 @ 12 | 5 @ 12 | 5 @ 12 | 5 @ 12 | 5 @ 12 | 5 @ 12 | 5 @ 12 |

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<td>3.7</td>
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Steel (lb/ft) | 98 | 117 | 152 | 171 | 200 | 233 | 243 | 280 | 292 | 399 | 454 | 470 | 483 | 510 | 524 | 550 | 631 |

Maximum Soil Bearing Pressure

| Qmax (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:
24:1V SLOPING BACKFILL

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

3. FOUNDATION SOIL PROPERTIES:
q* = FACTORED BEARING CAPACITY = 5400 psf
Frc = 4000 psi
FRICITON FACTOR = 0.57

4. SEISMIC LOADING:
Ks = 0.17g (Max.)
Kh = 0.085

5. REINFORCED CONCRETE:
Fy = 60000 psi

DATE OF ISSUE: MARCH 2012
DRAWING NUMBER: E 305.2.0
**TABLE OF DIMENSIONS AND REINFORCING STEEL**

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**Steel (lb/ft)**

| 76 | 86 | 95 | 104 | 118 | 133 | 161 | 182 | 198 | 233 | 240 | 307 | 340 | 388 | 412 | 438 |

**Maximum Soil Bearing Pressure**

| Q<sub>max</sub> (psf) | 4071 | 4328 | 4591 | 4860 | 5111 | 5491 | 5752 | 6018 | 6295 | 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:**
   - Ø = PERFORMANCE FACTOR FOR SLIDING = 0.80
   - TYPE: GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES

3. **FOUNDATION SOIL PROPERTIES:**
   - σ<sub>f</sub> = FACTORED BEARING CAPACITY = 9400 psf
   - FRICTION FACTOR = 0.57

4. **SEISMIC LOADING:**
   - A = 0.17g (Max.)
   - K<sub>h</sub> = 0.085
   - K<sub>u</sub> = 0

5. **REINFORCED CONCRETE:**
   - P<sub>c</sub> = 4000 psf
   - F<sub>c</sub> = 80000 psf
### Table of Dimensions and Reinforcing Steel

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### Quantities of Materials

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### Maximum Soil Bearing Pressure

| Qpmax (psf) | 4918 | 5231 | 5373 | 5064 | 4998 | 5371 | 5816 | 5814 | 5771 | 5807 | 5387 | 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
   
   \[ q = \text{Factored Bearing Capacity} = 6000 \text{ psi} \]
   
   Friction Factor = 0.50

2. **Backfill Soil Properties:**
   
   Type: Gravel Borrow for Backfilling Structures and Pipes
   
   \[ \theta = \text{Angle of Internal Friction} = 37^\circ \]
   
   \[ \delta = \text{Angle of Wall Friction} = 22^\circ \]
   
   \[ \gamma = \text{Effective Unit Weight} = 120 \text{pcf} \]

3. **Foundation Soil Properties:**

4. **Seismic Loading:**
   
   \[ A = 0.17g \text{ (Max.)} \]
   
   \[ K_h = 0.085 \]
   
   \[ K_v = 0 \]
### Table of Dimensions and Reinforcing Steel

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**Quantities of Materials**

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**Steel (lb/ft²)**

| Steel (lb/ft²) | 79 | 86 | 101 | 106 | 130 | 141 | 157 | 191 | 211 | 246 | 257 | 287 | 355 | 343 | 435 | 463 | 492 |

**Maximum Soil Bearing Pressure**

| Qₚₑₑ (psf) | 4318 | 4614 | 5111 | 5210 | 5133 | 5412 | 5693 | 5616 | 5693 | 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:**
2. **Backfill Soil Properties:**
   - Type: Gravel Borrow For Backfilling Structures and Pipes
   - 𝜃 = Angle of Internal Friction = 37°
   - 𝛿 = Angle of Wall Friction = 22°
   - γ = Effective Unit Weight = 120 psf
3. **Foundation Soil Properties:**
   - 𝜂ₚ = Factored Bearing Capacity = 6000 psf
   - Friction Factor = 0.5
4. **Seismic Loading:**
   - A = 0.17g (Max.)
   - Kₓ = 0.085
5. **Reinforced Concrete:**
   - C = 4000 psi
   - 𝐹ᵧ = 60000 psi
### Table of Dimensions and Reinforcing Steel

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### Steel (lb/ft)

- 98
- 120
- 125
- 146
- 164
- 197
- 213
- 232
- 276
- 342
- 379
- 382
- 446
- 503
- 543
- 558
- 580

### Maximum Soil Bearing Pressure

- Q_m (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
   - q = Factored Bearing Capacity = 20,000 psf
   - Friction Factor = 0.70
2. **Backfill Soil Properties:**
   - Ø = Angle of Internal Friction = 37°
   - δ = Angle of Wall Friction = 22°
   - γ = Effective Unit Weight = 120 psf
3. **Foundation Soil Properties:**
   - Kt = 0.085
   - Kv = 0
4. **Seismic Loading:**
   - V = 0
5. **Reinforced Concrete:**
   - C = 4000 psf
   - F_Y = 6000 psi
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#### Maximum Soil Bearing Pressure

| Steel (lbs/ft) | 76  | 85  | 96  | 104 | 118 | 133 | 176 | 182 | 198 | 233 | 240 | 307 | 340 | 360 | 388 | 412 | 438 |

#### 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
   - $\theta = \text{ANGLE OF INTERNAL FRICTION} = 37^\circ$
   - $\delta = \text{ANGLE OF WALL FRICTION} = 22^\circ$
   - $\gamma = \text{EFFECTIVE UNIT WEIGHT} = 120 \text{ psf}$
3. **FOUNDATION SOIL PROPERTIES:**
   - $q = \text{FACTORED BEARING CAPACITY} = 20000 \text{ psf}$
   - $F_{r} = 0.70$
   - $F_{y} = 0.80$
4. **SEISMIC LOADING:**
   - $K_{h} = 0.085$
   - $K_{v} = 0$
5. **REINFORCED CONCRETE:**
   - $f'_{c} = 4000 \text{ psi}$
   - $f'_{y} = 60000 \text{ psi}$
NCHRP 350 TEST LEVEL 3 OR MASH COMPLIANT GUARDRAIL
TERMINAL SECTIONS ON ALL ROADWAYS WITH DESIGN
SPEED OF 50 MPH OR GREATER.
BURRED ENDS ONLY FOR ROADWAYS WITH SPEEDS LESS
THAN 50 MPH.

* STANDARD LENGTH POST TO BE USED IN RAMPED SECTIONS.
** 50' FOR THRIE BEAM.

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' x 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**

VERTICAL GRANITE CURB OR BITUMINOUS CONCRETE CURB ALONG EDGE OF SHOULDER

* WHEN PLACED IN MEDIAN, CHANGE TO THRIE BEAM AND HEIGHT TO 2'-8.1/2"±1'.
  (NOTE: HEIGHT OF RAIL IS ALWAYS 1'-9.5/8"±1")

** SEE E 401.1.0 FOR SECTION Z-Z LOCATION

*** VARIATES ACCORDING TO POST MATERIAL

**SECTION Z-Z**

TYPE "A" BERM ALONG EDGE OF SHOULDER
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 A-A ADD 2ND RAIL AND USE 8' POSTS (EXCEPT POSTS 1, 2, AND 3)

SECTION A-A

LEVEL WITH DESIGN HEIGHT AT SHOULDER
TOP OF RAIL LESS THAN 45° ABOVE GROUND

SECTION B-B

TOP OF RAIL
45° MAX. ABOVE GROUND

SECTION C-C
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-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.

DETAILS APPLICABLE TO THE UPPER RAILS OF POSTS 1 AND 2 AND THE LOWER RAIL OF POST 3.

DATE OF ISSUE
MARCH 2012

DRAWING NUMBER
E 401.2.1e
**TYPICAL INSTALLATION**

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<td>W SECTION</td>
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**NOTE:** ALL MEASUREMENTS ARE FROM EDGE OF USABLE SHOULDER

**FOR OVERHEAD SIGN PROTECTION**

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<td>1V : 2H SLOPE 2:1 SLOPE</td>
<td>24° ±</td>
<td>3'-3&quot; ±</td>
<td>6'-6&quot; ±</td>
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<tr>
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<td>7'-9&quot; ±</td>
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<td>1V : 6H SLOPE 6:1 SLOPE</td>
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* SEE E 401.1.0
** SEE E 401.2.0
**BRIDGE RAIL TO HIGHWAY GUARD TRANSITION**

**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. THREE BEAM TO W BEAM TRANSITION RAIL (SEE E401.8.1) IS TYPICALLY PLACED OUTSIDE BRIDGE RAIL TO HIGHWAY GUARD TRANSITION UNIT LENGTH, (26'-10 3/4") AT OR BEYOND POST P9.

4. TRANSITION FROM THRE BEAM IS ALLOWED FROM P6 TO P7 IF REQUIRED BY SITE CONSTRAINTS. PAYMENT FOR THE TRANSITION ELEMENT IS INCLUDED IN THIS ITEM IN THAT CASE.

**ELEVATION**

- SEE E 401.5.3 FOR TERMINAL CONNECTOR DIMENSIONS AND DETAILS

**PLAN**

- THREE POSTS SHALL HAVE A LENGTH OF 7'-0"

**CONSTRUCTION STANDARDS**
POST P1, P2, P3, P4

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 P5

TWO SECTIONS OF THRIE BEAM
ONE SET INSIDE THE OTHER

TOP OF WEARING SURFACE

6" x 8" WOOD BLOCK 18" LONG
CURB TRANSITION SECTION

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

POST P6

TWO SECTIONS OF THRIE BEAM
ONE SET INSIDE THE OTHER

TOP OF WEARING SURFACE

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

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

POST P7 THROUGH END (TYPICAL GUARD RAIL INSTALLATION)
THREE BEAM POSTS 1-4

W TO THREE BEAM TRANSITION POST 6

W-BEAM POST 7
THE CROSS-SECTIONAL DIMENSIONS FOR THIS END ARE THE SAME AS FOR THE W BEAM

Σ 3/4" X 2 1/2" SPLICE BOLT SLOTS (TYP)

Σ 15/16" X 1 1/8" SPLICE BOLT SLOTS (TYP)

NOTE: BASE METAL TICKNESS = 12 GAUGE

THE CROSS-SECTIONAL DIMENSIONS FOR THIS END ARE THE SAME AS FOR THE THRIE BEAM
STEEL BEAM HIGHWAY GUARD WITH WOOD POST

REVISED:

CHANGE IN DEPTH OF OFFSET BLOCK TO 3".

DOUBLE FACE

SINGLE FACE

* 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 401.8.0, 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.
DETAIL OF POST OVER EXPANSION JOINT

SEE NOTE #5 WHEN THERE IS NO EXPANSION JOINT.

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.

DETAIL OF WASHER
GALVANIZED
6" x 4", 8.5 LBS/FLF
STEEL "H" POSTS
OR "C" POST

8" BITUMINOUS CONCRETE WALK
SURFACE IF EXISTING SURFACE
IS BITUMINOUS CONCRETE,
OTHERWISE CONTINUE
3500 PSI - 1 1/2" - 520 LB
CEMENT CONCRETE TO MEET
EXISTING SURFACE.

3" SAND CUSHION

HEIGHT OF EXISTING SURFACE ABOVE TOP OF SAND CUSHION

HEIGHT OF CONCRETE ENVELOPE

<table>
<thead>
<tr>
<th>HEIGHT OF EXISTING SURFACE ABOVE SAND CUSHION</th>
<th>H</th>
<th>W</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>1'-0&quot; - 1'-6&quot;</td>
<td></td>
<td>2'-6&quot;</td>
<td>2'-6&quot;</td>
</tr>
<tr>
<td>1'-6&quot; - 2'-6&quot;</td>
<td></td>
<td>2'-0&quot;</td>
<td>2'-0&quot;</td>
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<tr>
<td>OVER 2'-6&quot;</td>
<td></td>
<td>1'-6&quot;</td>
<td>1'-6&quot;</td>
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</tbody>
</table>

NOTE:
1. OFFSET BRACKETS ARE TO BE INSTALLED AND RAMS 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.
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 2'-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 20', 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.

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

DATE OF ISSUE
MARCH 2012

DRAWING NUMBER
E 402.5.0
MASONRY BRACKET FOR TYPE SS HIGHWAY GUARD RAIL

ABUTMENT FACE

3/4" Ø H.S. BOLTS
(4" LONG)

TERMINAL SECTION
(MODIFIED)

EDGE OF SHOULDER

PLAN

DIRECTION OF TRAVEL

ABUTMENT FACE

END POST

DED 12/10

MODIFIED
TERMINAL SECTION

NEST THE RAIL

GROUND LINE

POST W8X8.5
6'-3" LONG

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.

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

DATE OF ISSUE
MARCH 2012
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
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.


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.
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.

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>A</th>
<th>H</th>
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<tbody>
<tr>
<td>NORMAL</td>
<td>2 1/4&quot;</td>
<td>2'-8&quot;</td>
</tr>
<tr>
<td>TALL</td>
<td>3 1/4&quot;</td>
<td>3'-6&quot;</td>
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</tbody>
</table>

F SHAPE
CONCRETE BARRIER
Bar hoops @ spacing not to exceed 20".
(>Optional<)

4 hoops - 5/8" bar @ 8" each end

10-5/8" longitudinal bar

3" cover

Deep embedment not required for CIP barrier longer than 20'

Varies
Longitudinal elevation

8" typ.

10-5/8" longitudinal bars typ.

5/8" hoop bars

5/8" hoop bars

9" inground

3" inground

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-3'4"-610 lb/cu.yd.
concrete.
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" premoulded joint filler required for precast barriers).
3. Use minimum cover of 1 1/2", unless otherwise indicated.
5. All steel reinforcing to be galvanized or epoxy coated, AASHTO-A-931, Grade 60.
6. For dimensions see E 402.10.0

Notes:

- 8" TYP. LONGITUDINAL BARS TYP.
- 5/8" HOOP BARS
- 3" IN GROUND
- 5/8" HOOP BARS
- 9" INGROUND

Deep embedment not required for CIP barrier longer than 20'

Section A-A

Section B-B
F SHAPE CONCRETE BARRIER WITH CONCRETE SEPARATOR

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>A</th>
<th>H</th>
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<tbody>
<tr>
<td>NORMAL</td>
<td>2-3/8&quot;</td>
<td>2'-5&quot;</td>
</tr>
<tr>
<td>TALL</td>
<td>3-11/32&quot;</td>
<td>3'-6 1/8&quot;</td>
</tr>
</tbody>
</table>

* SAME DEPTH AS UNDER ROADWAY.

** BARRIER CAP BUILT USING 4000 psi-3/4"-610 lb/c.y. CEMENT CONCRETE.

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.
5/8" LAPPED HOOP BAR @ NOT TO EXCEED 20" (OPTIONAL.)
10- 5/8" LONGITUDINAL BAR CONTINUOUS FOR WHOLE BARRIER
5/8" LAPPED HOOP BAR @ NOT TO EXCEED 20" (OPTIONAL.)
AT LEAST 4- 5/8" LAPPED HOOP BARS @ 6" EACH END

DEEP EMBEMENT NOT REQUIRED FOR CIP BARRIER LONGER THAN 20'

LONGITUDINAL ELEVATION

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
CHAIN LINK FENCE
(SPRING TENSION WIRE)

DATE OF ISSUE
MARCH 2012

DRAWING NUMBER
E 404.1.0
ENDS, CORNERS

INTERMEDIATE POST

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

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

END BAND

4000 PSI - 1 1/2" - 565 LB CEMENT CONCRETE

12" MIN. DIA.

3’ SLOPE

10’ MAX.

1/4 H MAX.

10’ MAX.

CAP

10’ MAX.

10’ MAX.

SPRING TENSION WIRE

3/8” TRUSS ROD WITH TURNBUCKLE

SPINE RAIL

BRACE RAIL

3/8” TRUSS ROD WITH TURNBUCKLE

SLOPE

SLOPE

6” MIN.

10’ MIN. DIA.

12” MIN. DIA.

4000 PSI - 1 1/2” - 565 LB CONCRETE

SPRING TENSION WIRE

WIRE FASTENERS

12”

3’
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.
   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.
DOUBLE GATES

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

2. FOR GATE POST BASE, SEE DRAWING 404.5.0
ELEVATION

THRU BOLT FENCE POST TO GUARD RAIL WEB OR BRACKET FENCE POST TO GUARD RAIL WEB.

TOP OF G.R. POST

THRU BOLT OR BRACKET LOCATIONS ON FENCE POST

BOTTOM OF FENCE LINE POST

CHAIN LINK FENCE POST

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
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

TREE WELLS
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 TAM 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.
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 65' 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

E.G. OPPOSITE FACE WITH "S" FOR CORNER ON MEDFORD-STONEHAM LINE.

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.