NOTES

PIPE RAILING & POSTS:
Pipe Rails and Posts shall be in accordance with ASTM A53 Grade B for standard weight pipe and
ASTM A500 Grade C, D or E. Shoring shall be in accordance with ASTM A123 for structural tube. Bars for handrail supports shall be
ASTM A36. Posts and End Rails shall be fabricated and installed plumb, ± 1" tolerance when measured
divided into 4 sections at 3'-6" above the foundation. Corners and changes in tangential longitudinal alignment, may be made
continuous with a 90° bend radius or terminated at adjoining sections with a standard end cap when handrails are not required. Changes in tangential longitudinal alignment greater than 45°, posts shall be positioned at a maximum distance of 2'-0" each side of the corner and shall not be located
at the corner apex. For curved longitudinal alignments the top and bottom rails and handrails shall be laid out to match the alignment radius.

RAILING MEMBER DIMENSIONS TABLE

<table>
<thead>
<tr>
<th>MEMBER</th>
<th>DESIGNATION</th>
<th>OUTSIDE</th>
<th>WALL THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rails</td>
<td>2&quot; NPS (Sch. 40)</td>
<td>2.275&quot;</td>
<td>0.154&quot;</td>
</tr>
<tr>
<td>Rail Joint/Splice Sleeves</td>
<td>3&quot; NPS (Sch. 40)</td>
<td>1.900&quot;</td>
<td>0.145&quot;</td>
</tr>
<tr>
<td>Handrail Support Bar</td>
<td>1&quot; Ø Round Bar</td>
<td>1.000&quot;</td>
<td>N/A</td>
</tr>
</tbody>
</table>

BASE PLATES:
Base Plates shall be in accordance with ASTM A36 or ASTM A709 Grade 36.

SHIM PLATES:
Shim Plates shall be aluminum in accordance with ASTM B209, Grades 5061 or 6063. Shim Plates shall be used for foundation height adjustments greater than 1/2" between 3 posts and localized irregularities greater than 1/8" beneath base plates. Fold-in shim plates may be used to match the contours of the foundation (See Sheet 5 for additional details). Stacked shim plates may be used in lieu of trimmed flat shim plates shown. Stacked shim plates must be piled together with adhesive bonding material and limited to a maximum total thickness of 1", unless longer anchor bolts are provided for the exposed thread length.

CONTINUITY:
The railing shall be hot-dip galvanized after fabrication in accordance with Section 962 of the Specifications.
All nuts, bolts and washers shall be hot-dip galvanized in accordance with Section 963 of the Specifications.

ANCHOR BOLTS:
Anchor bolts shall be in accordance with ASTM F1554 Grade 36. Hinged anchor bolts for Adhesive Anchors shall be threaded full length. Coating of reinforcing steel is permitted for drilled hole installation. All anchor bolts shall have single self-screwing hex nuts. Welding of the nut to the anchor bolt may be used in lieu of self-locking nuts. All nuts shall be in accordance with ASTM A563 or ASTM A194. Flat Washers shall be in accordance with ASTM F436 and Plate Washers (for long slotted holes only) shall be in accordance with ASTM A953 or ASTM A709. After the nuts have been snug tightened, distort the anchor bolt threads or disfigure the top of stud to prevent removal of the nuts. Distorted threads and tack welds shall be coated with a galvanizing compound in accordance with the Specifications.

RESILIENT AND NEOPRENE PADS:
Resilient and Neoprene pads shall be in accordance with Specification Section 932, except that testing of the finished pads shall not be required. Neoprene pads shall be durometer hardness 60 or 70.

JOINTS:
All fixed joints are to be welded all around and plug welds ground smooth. Remove burrs and weld splatter, additionally remove any sharp edges on rails to prevent injury. Expansion joints shall be spaced at a maximum of 30'-0". Field splices similar to the expansion joint detail may be approved by the Engineer to facilitate shipping and handling, but rails must be continuous as the length along the center line of the top rail, and includes rails, posts, rail splice assembly, base plates, anchor bolts, nuts, washers, resilient or neoprene pads and all incidental materials and labor required to complete the installation of the Guiderail.

ANCHOR BOLTS:
Anchor bolts shall be in accordance with ASTM F1554 Grade 36. Headless anchor bolts for Adhesive Anchors shall be in accordance with ASTM F1554 Grade 36. Anchors shall be threaded full length. Cutting of reinforcing steel is permitted for drilled hole installation. All anchor bolts shall have single self-locking hex nuts. Tack welding of the nut to the anchor bolt may be used. All anchor bolts are provided for the exposed thread length.

COATINGS:
The railing shall be hot-dip galvanized after fabrication in accordance with Section 962 of the Specifications.

ANCHOR BOLTS:
Anchor bolts shall be in accordance with ASTM F1554 Grade 36. Hinged anchor bolts for Adhesive Anchors shall be threaded full length. Coating of reinforcing steel is permitted for drilled hole installation. All anchor bolts shall have single self-screwing hex nuts. Welding of the nut to the anchor bolt may be used in lieu of self-locking nuts. All nuts shall be in accordance with ASTM A563 or ASTM A194. Flat Washers shall be in accordance with ASTM F436 and Plate Washers (for long slotted holes only) shall be in accordance with ASTM A953 or ASTM A709. After the nuts have been snug tightened, distort the anchor bolt threads or disfigure the top of stud to prevent removal of the nuts. Distorted threads and tack welds shall be coated with a galvanizing compound in accordance with the Specifications.

RESILIENT AND NEOPRENE PADS:
Resilient and Neoprene pads shall be in accordance with Specification Section 932, except that testing of the finished pads shall not be required. Neoprene pads shall be durometer hardness 60 or 70.

JOINTS:
All fixed joints are to be welded all around and plug welds ground smooth. Remove burrs and weld splatter, additionally remove any sharp edges on rails to prevent injury. Expansion joints shall be spaced at a maximum of 30'-0". Field splices similar to the expansion joint detail may be approved by the Engineer to facilitate shipping and handling, but rails must be continuous as the length along the center line of the top rail, and includes rails, posts, rail splice assembly, base plates, anchor bolts, nuts, washers, resilient or neoprene pads and all incidental materials and labor required to complete the installation of the Guiderail.

ANCHOR BOLTS:
Anchor bolts shall be in accordance with ASTM F1554 Grade 36. Headless anchor bolts for Adhesive Anchors shall be in accordance with ASTM F1554 Grade 36. Anchors shall be threaded full length. Cutting of reinforcing steel is permitted for drilled hole installation. All anchor bolts shall have single self-locking hex nuts. Tack welding of the nut to the anchor bolt may be used. All anchor bolts are provided for the exposed thread length.

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The railing shall be hot-dip galvanized after fabrication in accordance with Section 962 of the Specifications.

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RESILIENT AND NEOPRENE PADS:
Resilient and Neoprene pads shall be in accordance with Specification Section 932, except that testing of the finished pads shall not be required. Neoprene pads shall be durometer hardness 60 or 70.

JOINTS:
All fixed joints are to be welded all around and plug welds ground smooth. Remove burrs and weld splatter, additionally remove any sharp edges on rails to prevent injury. Expansion joints shall be spaced at a maximum of 30'-0". Field splices similar to the expansion joint detail may be approved by the Engineer to facilitate shipping and handling, but rails must be continuous as the length along the center line of the top rail, and includes rails, posts, rail splice assembly, base plates, anchor bolts, nuts, washers, resilient or neoprene pads and all incidental materials and labor required to complete the installation of the Guiderail.

ANCHOR BOLTS:
Anchor bolts shall be in accordance with ASTM F1554 Grade 36. Headless anchor bolts for Adhesive Anchors shall be in accordance with ASTM F1554 Grade 36. Anchors shall be threaded full length. Cutting of reinforcing steel is permitted for drilled hole installation. All anchor bolts shall have single self-locking hex nuts. Tack welding of the nut to the anchor bolt may be used. All anchor bolts are provided for the exposed thread length.

COATINGS:
The railing shall be hot-dip galvanized after fabrication in accordance with Section 962 of the Specifications.
Top of Sidewalk or Bikeway
Ground Line

Minimum from free end of concrete and expansion joints (Typ.)

Contingency Field Splice (as required) see Detail "E" Sheet 4 (Typ.)

Rail expansion joints to be located in panels above structure expansion joints * (30'-0" maximum spacing).

Rail Expansion Joint (Typ.)
See Detail "D" Sheet 4

Handrail = 1/2" NPS Sch. 40 (Typ.)

See Plans for continuation or termination limits of railing

See Plans for continuation or termination limits of railing

Top of Sidewalk

5'-0" Min.

Ramp

5'-0" Min.

Top Landing

RAMP REQUIREMENTS
For slopes greater than 5%:
Max. ramp slope = 8.33%
Max. ramp cross-slope = 2.0%

LANDING REQUIREMENTS
Max. landing slope = 2%
Max. landing cross-slope = 2%

30'-0" Max. for Slopes ≤ 6.25%
40'-0" Max. for Slopes > 6.25%

For Details "C", "D" and "E", see Sheet 4.

Wall are not considered to be expansion joints.

* Keyed construction joints in Index No. 6011 Gravity Structures Expansion Joints Note:

NPS = Nominal Pipe Size

NOTES:

ELEVATION

TYPICAL RAILING DETAILS & RAILINGS ON GRADES 0% TO 5%

RAILINGS ON GRADES STEEPER THAN 5% TO 8.33%

POST SPACING
6'-0" (Max.) ~ Equal Panels

3'-6" Min.

6'-0" Min.

Ramp

2'-6" Max.

Intermediate Landing

(Showing Inside Face of Railing)
RAILING CONTINUATION BEYOND STEPS
(Bottom shown, Top similar)

Steel Handrail required for three or more steps (Handrail and cheekwalls continuous at landings) Handrail - 1½" NPS (Sch. 40)

HANDRAIL TERMINATION
DETAIL "A" - PLAN VIEW

ELEVATION
(At-Grade Steps)

GUARDERAIL ON STEPS & STAIRS

GUIDERAIL ON STEPS & STAIRS

2016
DESIGN STANDARDS
STEEL PIPE GUARDERAIL

INDEX NO. 880 SHEET NO. 3 of 5
**SECTION B-B**

(Handrail Connection)

**SECTION C-C**

BASE PLATE DETAIL

(2-Bolt Anchorage)

**SECTION C-C**

BASE PLATE DETAIL

(4-Bolt Anchorage)

**SHIM PLATE DETAIL**

(2-Bolt Anchorage)

**SHIM PLATE DETAIL**

(4-Bolt Anchorage)

**PLATE WASHER DETAIL**

(Recommended for Steep Slopes)

**DETAIL "D" - EXPANSION JOINT**

(FIELD SPICE SLIP JOINT SIMILAR)

**DETAIL "E" - CONTINUITY FIELD SPICE**

**DETAIL "C" - RAIL CONNECTIONS**

(Handrail and 4-Bolt Anchorage Not Shown)

**DETAIL "B" - RAIL AND HANDRAIL**

(Showing Sloped Condition For Ramps with 2-Bolt Anchorage)

**CROSS REFERENCE:**

For locations of Details "C", "D" and "E", see Sheet 2.