3D VIEW OF RAILING WITH TYPE 1 - PICKET INFILL PANEL
(42" Height shown, 48" Height Similar)

**TABLE 1 - RAILING MEMBERS**

<table>
<thead>
<tr>
<th>MEMBER</th>
<th>DESIGNATION</th>
<th>OUTSIDE DIMENSION</th>
<th>WALL THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post &quot;A&quot;</td>
<td>HSS2x[1]x[1]</td>
<td>2.25&quot; x 1.50&quot;</td>
<td>0.125&quot;</td>
</tr>
<tr>
<td>Post &quot;B&quot;</td>
<td>HSS2x[1]x[1]</td>
<td>2.25&quot; x 1.50&quot;</td>
<td>0.125&quot;</td>
</tr>
<tr>
<td>Top Rail</td>
<td>2½&quot; NPS (Sch. 10)</td>
<td>2.875&quot;</td>
<td>0.120&quot;</td>
</tr>
<tr>
<td>End Hoops</td>
<td>2½&quot; NPS (Sch. 10)</td>
<td>2.875&quot;</td>
<td>0.120&quot;</td>
</tr>
<tr>
<td>Top Rail Joint/Splice Sockets</td>
<td>HSS2½x0.125</td>
<td>2.500&quot;</td>
<td>0.125&quot;</td>
</tr>
<tr>
<td>Int. &amp; Bottom Rail Post Connection Sleeve</td>
<td>HSS1½x0.125</td>
<td>2.00&quot; x 2.00&quot;</td>
<td>0.188&quot;</td>
</tr>
<tr>
<td>Handrail Joint/Splice Sockets</td>
<td>1½&quot; NPS (Sch. 40)</td>
<td>1.315&quot;</td>
<td>0.133&quot;</td>
</tr>
<tr>
<td>Handrail</td>
<td>1½&quot; NPS (Sch. 40)</td>
<td>1.300&quot;</td>
<td>0.145&quot;</td>
</tr>
<tr>
<td>Handrail Support Bar</td>
<td>½&quot; Ø Round Bar</td>
<td>0.750&quot;</td>
<td>N/A</td>
</tr>
<tr>
<td>Pickets (Type 1 Infill Panel)</td>
<td>½&quot; Ø Round Bar</td>
<td>0.750&quot;</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**TABLE 1 NOTES:**
(1) 0.125" wall thickness permitted for rails with post spacings less than 5'-8" except that Post Connection Sleeve must be 1½" NPS (Sch. 40).

**DESIGN LOADS, GEOMETRY AND APPLICABILITY:**
See the Instructions for Design Standards for the design loads, geometry and applicability requirements.

**GENERAL:**
Adequate foundation support shall be provided for anchorage and stability against overturning (See Sheet B). See Index No. 851 for special requirements and modifications for use on bridges. The railing shown on these drawings requires a handrail for ramps steeper than a 5% grade to conform with the requirements of the Americans with Disabilities Act (ADA).

**RAILS, PANELS AND POSTS:**
Pipe Rails and Pickets shall be in accordance with ASTM A500 Grade B, C or D, or ASTM A53 Grade B for standard weight pipe (Schedule 40) or ASTM A53 Grade A for bars. Structural Tube shall be in accordance with ASTM A500 Grade A, B, C or D, or ASTM A563. Perforated panels (Type S), U-Channels and filler plates shall be ASTM A536 or A1011 (Grade 36). Posts and End Rails shall be fabricated and installed plain, ± 1" tolerance when measured at 3'-6" above the foundation. Pickets and vertical panel elements shall be fabricated parallel to the posts, except that Type 2, 3 & 5 panel inffills may be fabricated parallel to the longitudinal grade. Corners and changes in tangential longitudinal alignment shall be made continuous with a 2½" bend radius or terminate at adjoining sections with mitered apex angles when handrails are not required. For changes in tangential longitudinal alignment greater than 45°, posts shall be positioned at a maximum distance of 2½" each side of the corner and shall not be located at the corner apex. For curled longitudinal alignments the top and bottom rails and handrails shall be shop bent to match the alignment radius.

**BASE PLATES AND RAIL CAPS:**
Base Plates and Rail Cap Plates shall be in accordance with ASTM A36 or ASTM A709 Grade 36.

**SHIM PLATES:**
Shim Plates shall be aluminum in accordance with B509, Alloy 6061 or 6063. Shim plates shall be used for foundation height adjustments greater than ½" between 3 posts and localized irregularities greater than ½" beneath base plates. Shim plates are necessary to match the contours of the foundation. Bases shall be shimmed where necessary to provide a smooth surface for flashing. Bases may be used in lieu of trimmed flat shim plates shown. Stacked shim plates must be bonded together with adhesive bonding material and limited to a maximum total thickness of ½"; unless longer anchor bolts are provided for the exposed threaded length.

**ANCHOR BOLTS:**
Anchor bolts shall be in accordance with ASTM F1554 (Grade 36 for ½" Ø and Grade 55 for ¾" Ø Bolt Anchorage). Headless anchor bolts for Adhesive. Anchors shall be threaded full length. Cutting of reinforcing steel is permitted for drilled hole installation. Expansion Anchors are not permitted. All anchor bolts shall have single self-locking nuts. Tack 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 drilled holes only), shall be in accordance with ASTM A36 or ASTM A709 Grade 36. After the nuts have been snug tightened, distort the anchor bolt threads to prevent removal of the nuts. Distorted threads and tack welds shall be coated with a galvanizing compound in accordance with Specifications.

**RESILIENT AND NEOPRENE PADS:**
Resilient and Neoprene pads shall be in accordance with Specification Section 922 except that testing of the finished pads shall not be required. Neoprene pads shall be durometer hardness 60 to 80.

**Joints:**
Grind welded joints as necessary to remove burs and weld splatter, additionally, remove any sharp edges on rails to prevent injury. Grind all plug welds smooth. Expansion Joints shall be spaced at a maximum 40°. Field splices similar to the expansion joint detail may be approved by the Engineer to facilitate handling, but top rail must be continuous across a minimum of two posts. For intermediate and bottom horizontal rails the screwed joints shown on Sheet 4 may be substituted with alternate joints shown on Sheet 3 "Detail K".

**WELDING:**
All welding shall be in accordance with the American Welding Society Structural Welding Code (Steel) ANSI/AWS D1.1 (current edition). Weld metal shall be E60XX or E70XX. Nondestructive testing of welds is not required.

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

**SHOP DRAWINGS:**
Details addressing project specific geometry (line & grade) showing post and expansion joint locations, post and panel type, anchor bolt installation "Case" or lengths, must be submitted by the Contractor for the Engineer's approval prior to fabrication of the railing. Shop drawings shall be in accordance with the Specifications.

**PAYMENT:**
Railing shall be paid for per linear foot (Item No. S15-2-ABB). Payment will be plan quantity measured as the length along the center line of the top rail, and includes rails, posts, pickets, panels, rail splice assembly, base plates, anchor bolts, nuts, washers, resilient or neoprene pads and all incidental materials and labor required to complete installation of the railing.
**ELEVATION (Showing Outside Face of Railing with Type "A" Posts)**

**TYPICAL RAILING DETAILS & RAILINGS ON GRADIENTS 0% TO 5%**

*Type 1 - Picket Railing Shown, Other Types Similar*

**NOTES:**

* Keyed construction joints in Index No. 6011 Gravity Wall are not considered to be expansion joints.

** Construction joints (Tooled or Saw Cut) in sidewalks do not require a 6" minimum offset.

**EXPANDED ELEVATION AT CORNERS**

**DETAIL FOR NON-CONTINUOUS RAILING AT CORNERS**

**RAILINGS ON GRADIENTS STEEPER THAN 5%**

*Type 1 - Picket Railing Shown, Other Types Similar*

**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%
RAILINGS ON STEPS & STAIRS

RAIL TERMINATION DETAILS

Steel handrail required for three or more steps (handrail and cheekwalls continuous at landings)
Handrails = 1 1/2” NPS (Sch. 40) pipe

Equal to one tread length

Flatten handrail termination to 1 1/2” Max. width.

See “Typical Railing Details”, Sheet 2 for post, rail & picket details

5'-0" Max. on Steps

5'-0" Min. Handrail Extension

Equal to one tread length

See Index No. 521 or Contract Plans for Step Details

RAILING CONTINUATION BEYOND STEPS OR STAIRS
(Bottom shown, Top similar)

Concrete sidewalk to extend 6" Min. behind railing

DETAIL "L" - PLAN VIEW
HANDRAIL TERMINATION

See “Typical Railing Details”, Sheet 2 for post, rail & picket details

Varies - Equal spacing

5'-0" Max. on Steps

1'-6" Min. Handrail Extension

Equal to one tread length

See Index No. 521 or Contract Plans for Step Details

DETAIL "F" - ELEVATION VIEW
TOP RAIL TERMINATION

Steel Handrail required for three or more steps (handrail and cheekwalls continuous at landings)
Handrails = 1 1/2” NPS (Sch. 40) pipe

Equal to one tread length

Flatten handrail termination to 1 1/2” Max. width.

See “Typical Railing Details”, Sheet 2 for post, rail & picket details

5'-0" Max. on Steps

1'-6" Min. Handrail Extension

Equal to one tread length

See Index No. 521 or Contract Plans for Step Details

DETAIL "K" - ELEVATION VIEW
BOTTOM RAIL CONNECTION
(Intermediate Rail Similar)

Steel Handrail required for three or more steps (handrail and cheekwalls continuous at landings)
Handrails = 1 1/2” NPS (Sch. 40) pipe

Equal to one tread length

Flatten handrail termination to 1 1/2” Max. width.

See “Typical Railing Details”, Sheet 2 for post, rail & picket details

5'-0" Max. on Steps

1'-6" Min. Handrail Extension

Equal to one tread length

See Index No. 521 or Contract Plans for Step Details

ALTERNATE HANDRAIL END TREATMENT OR MOUNTING LOCATION FOR SLOPED WALLS

Steel Handrail required for three or more steps (handrail and cheekwalls continuous at landings)
Handrails = 1 1/2” NPS (Sch. 40) pipe

Equal to one tread length

Flatten handrail termination to 1 1/2” Max. width.

See “Typical Railing Details”, Sheet 2 for post, rail & picket details

5'-0" Max. on Steps

1'-6" Min. Handrail Extension

Equal to one tread length

See Index No. 521 or Contract Plans for Step Details

NOT CONSIDERED AN EXPANSION JOINT FOR RAILING FABRICATION (Typ.)
**TYPE 1 - PICKET INFILL PANEL**

* Picket Spacing of 6½" centers is based on a ½" Ø Bar for standard applications. When shown in the Contract Plans a 4½" picket spacing may be required. If an alternate design is used, maintain a maximum clear opening of 5½" for standard installations and 3½" for special conditions.

**NOTES:**
1. See Plans for Infill Panel option required.

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**PICKET NOTES:**

- Chain-Link Fence Fabric shall be continuous along limits of railing.
- Splicing of Chain-Link panels using Tension Bars at 20'-0" minimum increments is permitted.

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**TYPE 2 - CHAIN-LINK (Continuous Infill Panel)**

**CHAIN-LINK PANEL NOTE:**

- Chain-Link Fence Fabric shall be continuous along limits of railing.
- Splicing of Chain-Link panels using Tension Bars at 20'-0" minimum increments is permitted.

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**TABLE 2 - CHAIN-LINK PANEL COMPONENT MATERIALS**

<table>
<thead>
<tr>
<th>COMPONENT INFORMATION</th>
<th>ASTM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chain-Link Fence Fabric (2&quot; mesh with twisted bottom and knuckled top selvage)</td>
<td></td>
</tr>
<tr>
<td>Zinc-Coated Steel - No. 9 gage (coated wire diameter), Class 2 Coating</td>
<td>A 392</td>
</tr>
<tr>
<td>Aluminum-Coated Steel - No. 9 gage (coated wire diameter)</td>
<td>A 491</td>
</tr>
<tr>
<td>Polyvinyl Chloride (PVC) Coated Steel - No. 9 gage Zinc-Coated Wire (metallic-coated core wire diameter) - See Plans for specified color of PVC</td>
<td>F 668</td>
</tr>
<tr>
<td>Tie Wires</td>
<td>F 626</td>
</tr>
<tr>
<td>Tension Bars</td>
<td>F 626</td>
</tr>
<tr>
<td>Miscellaneous Fence Components</td>
<td>F 626</td>
</tr>
<tr>
<td>Zinc-Coated Steel</td>
<td></td>
</tr>
</tbody>
</table>
NOTES:
1. See Plans for Infill Panel Type required.
**TYPICAL SECTION ON CONCRETE SIDEWALK (Case I)**

- Edge Shim (8" long x 3/4" wide x thickness as reqd.)
- Base Plate
- Optional 4-Bolt Anchorage (shown dashed)

**TYPICAL SECTION ON RETAINING WALL (Case II)**

- Edge Shim (8" long x 3/4" wide x thickness as reqd.)
- Base Plate
- Optional 4-Bolt Anchorage (shown dashed)

**ANCHOR BOLT TABLE**

<table>
<thead>
<tr>
<th>CASE</th>
<th>STRUCTURE TYPE</th>
<th>DIMENSIONS</th>
<th>ANCHOR LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Edge Dist.</td>
<td>Edge Dist.</td>
</tr>
<tr>
<td>I</td>
<td>Unreinforced Concrete</td>
<td>6&quot;</td>
<td>1'-2&quot;</td>
</tr>
<tr>
<td>IIa</td>
<td>Reinforced Concrete</td>
<td>4&quot;</td>
<td>4&quot;</td>
</tr>
<tr>
<td>IIb</td>
<td>Gravity Wall Index No. 6011</td>
<td>4½&quot;</td>
<td>3½&quot;</td>
</tr>
<tr>
<td>III</td>
<td>Step Cheekwall</td>
<td>4½&quot;</td>
<td>4½&quot;</td>
</tr>
<tr>
<td>IV</td>
<td>Varies</td>
<td>9&quot;</td>
<td>5&quot;</td>
</tr>
</tbody>
</table>

* Embedment length "C" may be reduced to 9" for the 42" height railings for Case IIb, when the post spacing does not exceed 5'-0".

**For Cross Slope Correction**

- TYPICAL SECTION ON STEPS & STAIRS (Case III)

- TYPICAL SECTION FOR 4-BOLT ANCHORAGE (Case IV)

**DETAIL "D"** (Optional Shimming detail for cross slope correction)

- (Used in lieu of beveled shim plates)

**DETAIL "C"**

- (Cast-In-Place Anchor Bolts shown, Adhesive Anchors similar)