



3D VIEW OF RAILING WITH TYPE 1 - PICKET INFILL PANEL
(42" Height shown, 54" Height Similar)

TABLE 1 - RAILING MEMBERS

MEMBER	DESIGNATION	OUTSIDE DIMENSION	WALL THICKNESS
Post "A"	HSS2x2x $\frac{1}{8}$	2.00" x 2.00"	0.125"
Post "B"	HSS2x2x $\frac{3}{16}$	2.00" x 2.00"	0.188"
Top Rail	2 $\frac{1}{2}$ " NPS (Sch. 10)	2.875"	0.120"
	HSS3.000x0.120	3.000"	0.120"
End Hoops	2 $\frac{1}{2}$ " NPS (Sch. 10)	2.875"	0.120"
	HSS3.000x0.120	3.000"	0.120"
Top Rail Joint/Splice Sleeves	HSS2.500x0.125	2.500"	0.125"
Intermediate & Bottom Rail	HSS2x2x $\frac{3}{16}$	2.00" x 2.00"	0.188" ⁽¹⁾
Int. & Bottom Rail Post Connection Sleeve	HSS1.500x0.125	1.500"	0.125" ⁽¹⁾
Handrail Joint/Splice Sleeves	1" NPS (Sch. 40)	1.315"	0.133"
Handrails	1 $\frac{1}{2}$ " NPS (Sch. 40)	1.900"	0.145"
Handrail Support Bar	$\frac{3}{4}$ " \emptyset Round Bar	0.750"	N/A
Pickets (Type 1 Infill Panel)	$\frac{3}{4}$ " \emptyset Round Bar	0.750"	N/A
Infill Panel Members (Types 2 - 5)	Varies (See Details)	Varies	Varies

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 1 $\frac{1}{4}$ " 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 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 A36 for bars. Structural Tube shall be in accordance with ASTM A500 Grade A, B, C or D, or ASTM A501. Perforated panels (Type 5), U-Channels and filler plates shall be ASTM A36 or A1011 (Grade 36). Posts and End Rails shall be fabricated and installed plumb, \pm 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 infills may be fabricated parallel to the longitudinal grade. Corners and changes in tangential longitudinal alignment shall be made continuous with a 9" bend radius or terminate at adjoining sections with mitered end sections when handrails are not required. For 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 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 steel in accordance with ASTM B209, Alloy 6061 or 6063. Shim plates shall be used for foundation height adjustments greater than $\frac{1}{4}$ " and localized irregularities greater than $\frac{1}{8}$ ". Field trim shim plates when necessary to match the contours of the foundation. Beveled shim plates 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 $\frac{1}{2}$ ", unless longer anchor bolts are provided for the exposed thread length.

ANCHOR BOLTS:

Anchor bolts shall be in accordance with ASTM F1554 Grade 36. 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 hex 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 long slotted holes only), shall be in accordance with ASTM A36 or ASTM A709 Grade 36. After the nuts have been snug tightened, the anchor bolt threads shall be distorted 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 to 80.

JOINTS:

All welded joints are to be ground smooth. Expansion joints shall be spaced at a maximum 40'-0". 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. Only use the Continuity Field Splice (Detail "E") to make the top rail continuous for unforeseen field adjustments.

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 Section 962 of the Specifications mill finish unless otherwise noted in the Contract Documents. All nuts, bolts and washers shall be hot-dip galvanized in accordance with Section 962 of the Specifications.

SHOP DRAWINGS:

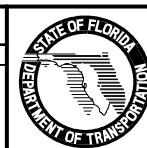
Complete details addressing project specific geometry (line & grade) showing post and expansion joint locations, post and panel type, anchor bolt installation "Case" or lengths, must be submitted by the Contractor for the Engineer's approval prior to fabrication of the railing. Shop drawings shall be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

PAYMENT:

Railing shall be paid for per linear foot (Item No. 515-2-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.

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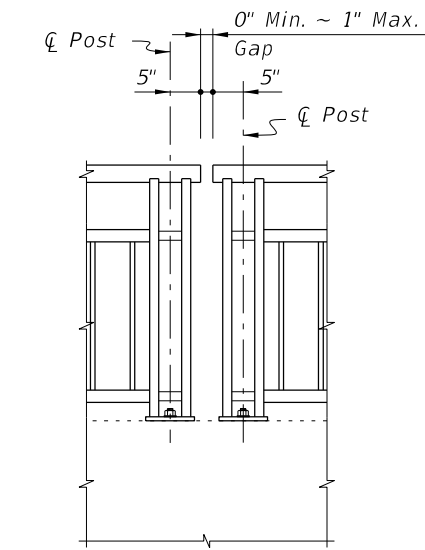
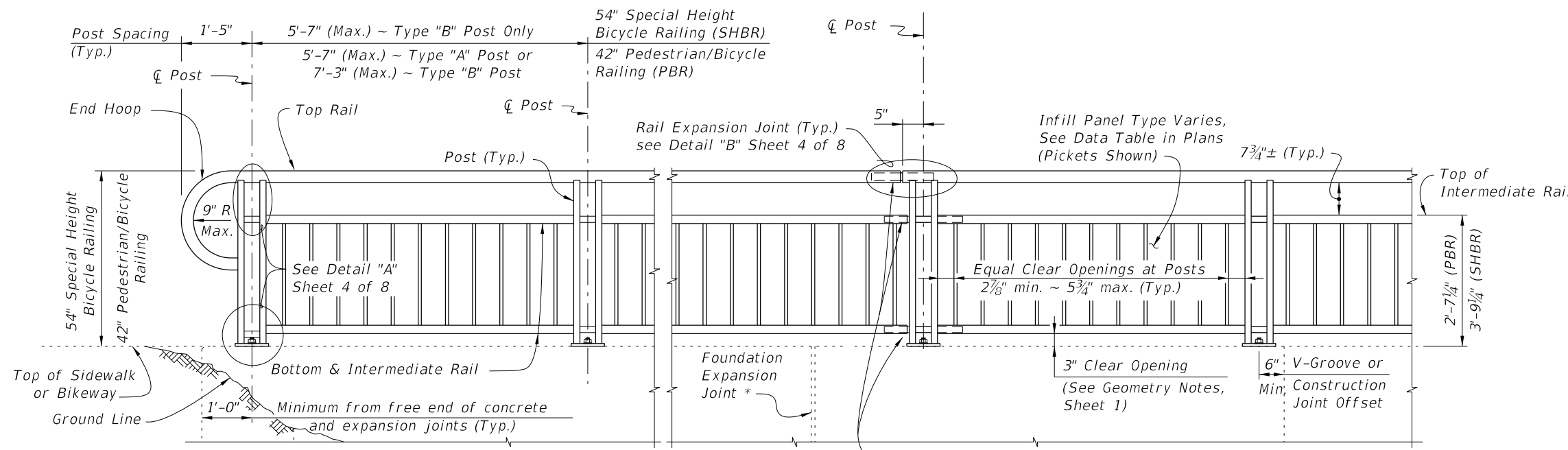
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Note: Non-continuous corners are permitted when handrails are not required.

ELEVATION
(Showing Outside Face of Railing with Type "A" Posts)

EXPANDED ELEVATION AT CORNERS

TYPICAL RAILING DETAILS & RAILINGS ON GRADES 0% TO 5%
(Type 1 - Picket Railing Shown, Other Types Similar)

DETAIL FOR NON-CONTINUOUS RAILING AT CORNERS

NOTES:

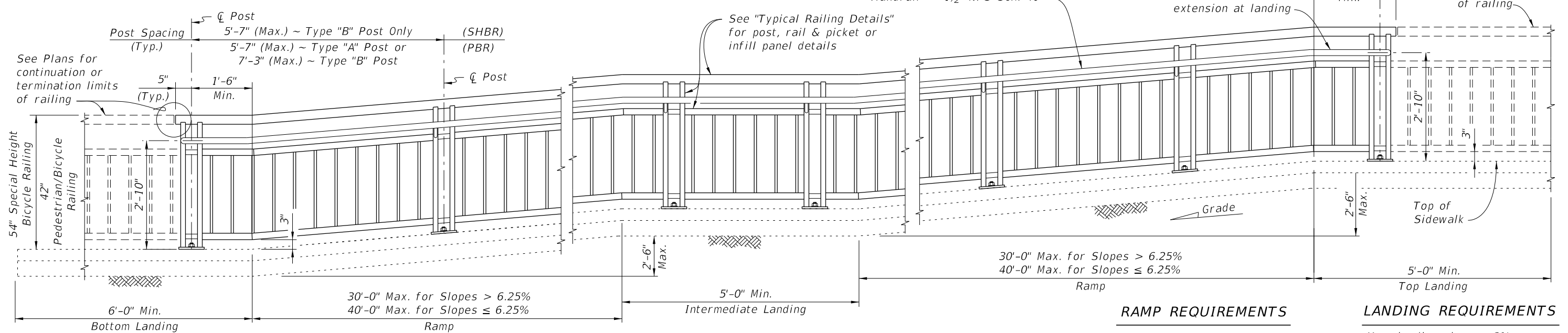
* Keyed construction joints in Index No. 6011 Gravity Wall are not considered to be expansion joints.

NPS = Nominal Pipe Size

CROSS REFERENCE:
For Details "C", "D" and "E", see Sheet 4 of 8.

Handrail required for ramps (Handrail continuous at landings between runs)
Handrail ~ 1 1/2" NPS Sch. 40

See Plans for continuation or termination limits of railing



RAMP REQUIREMENTS

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

LANDING REQUIREMENTS

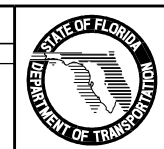
Max. landing slope = 2%
Max. landing cross-slope = 2%

ELEVATION
(Showing Inside Face of Railing with Type "A" Posts)

RAILINGS ON GRADES STEEPER THAN 5%
(Type 1 - Picket Railing Shown, Other Types Similar)

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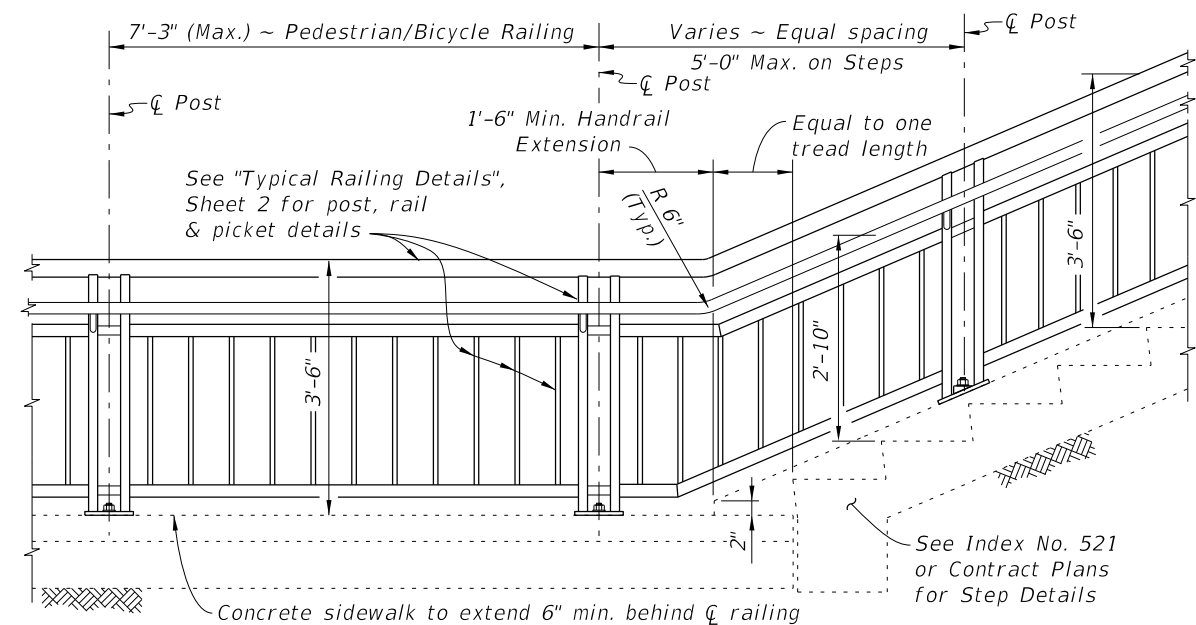
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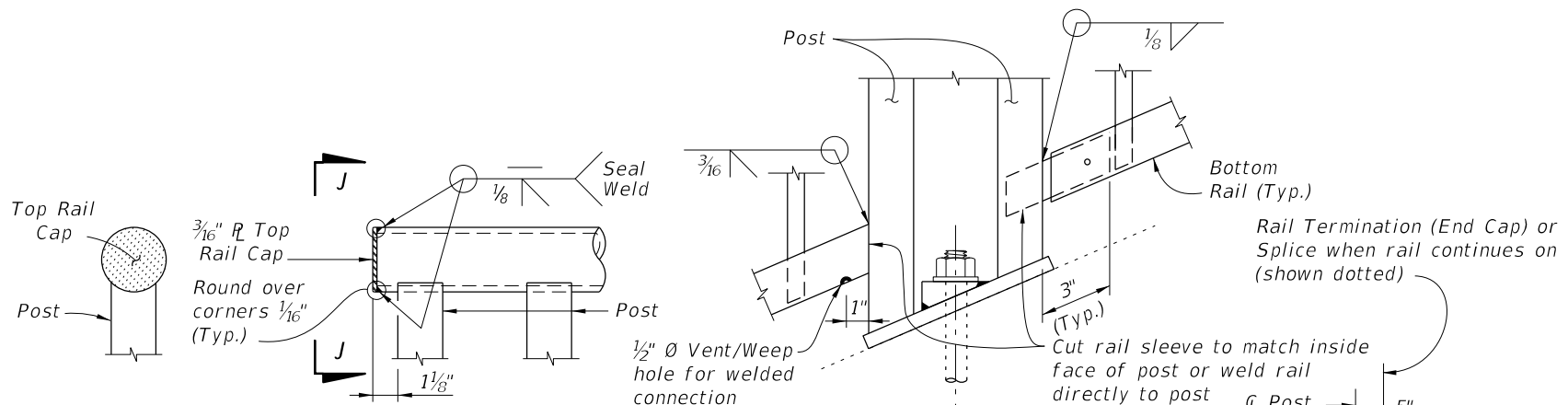
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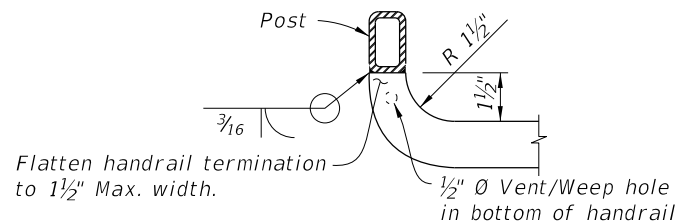
RAILING CONTINUATION BEYOND STEPS OR STAIRS
(Bottom shown, Top similar)



VIEW J-J DETAIL "J" - ELEVATION VIEW TOP RAIL TERMINATION

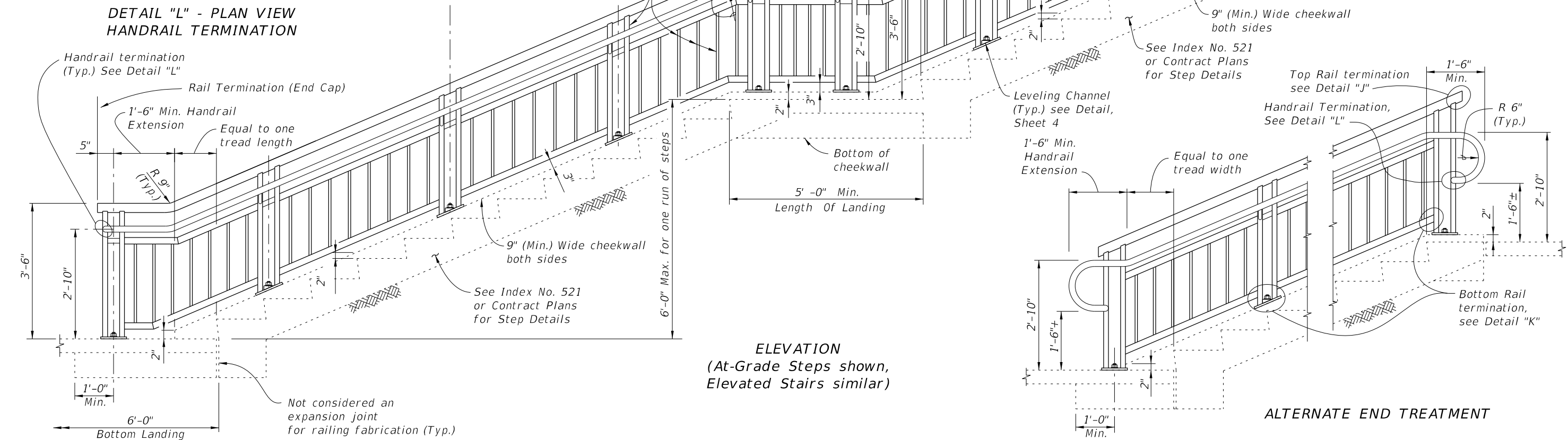
DETAIL "K" - ELEVATION VIEW BOTTOM RAIL CONNECTION

RAIL TERMINATION DETAILS



DETAIL "L" - PLAN VIEW HANDRAIL TERMINATION

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



ELEVATION
(At-Grade Steps shown, Elevated Stairs similar)

ALTERNATE END TREATMENT

RAILINGS ON STEPS & STAIRS

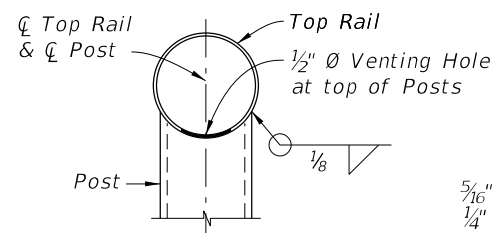
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SECTION A-A
(Top Rail Connection)

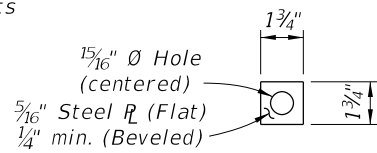
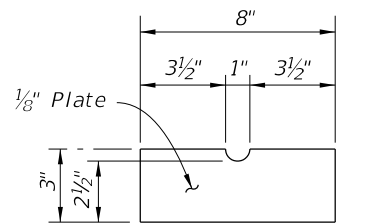
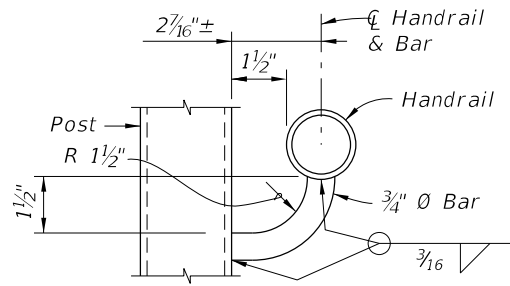


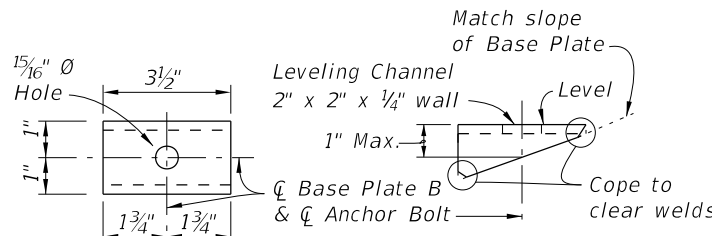
PLATE WASHER
DETAIL



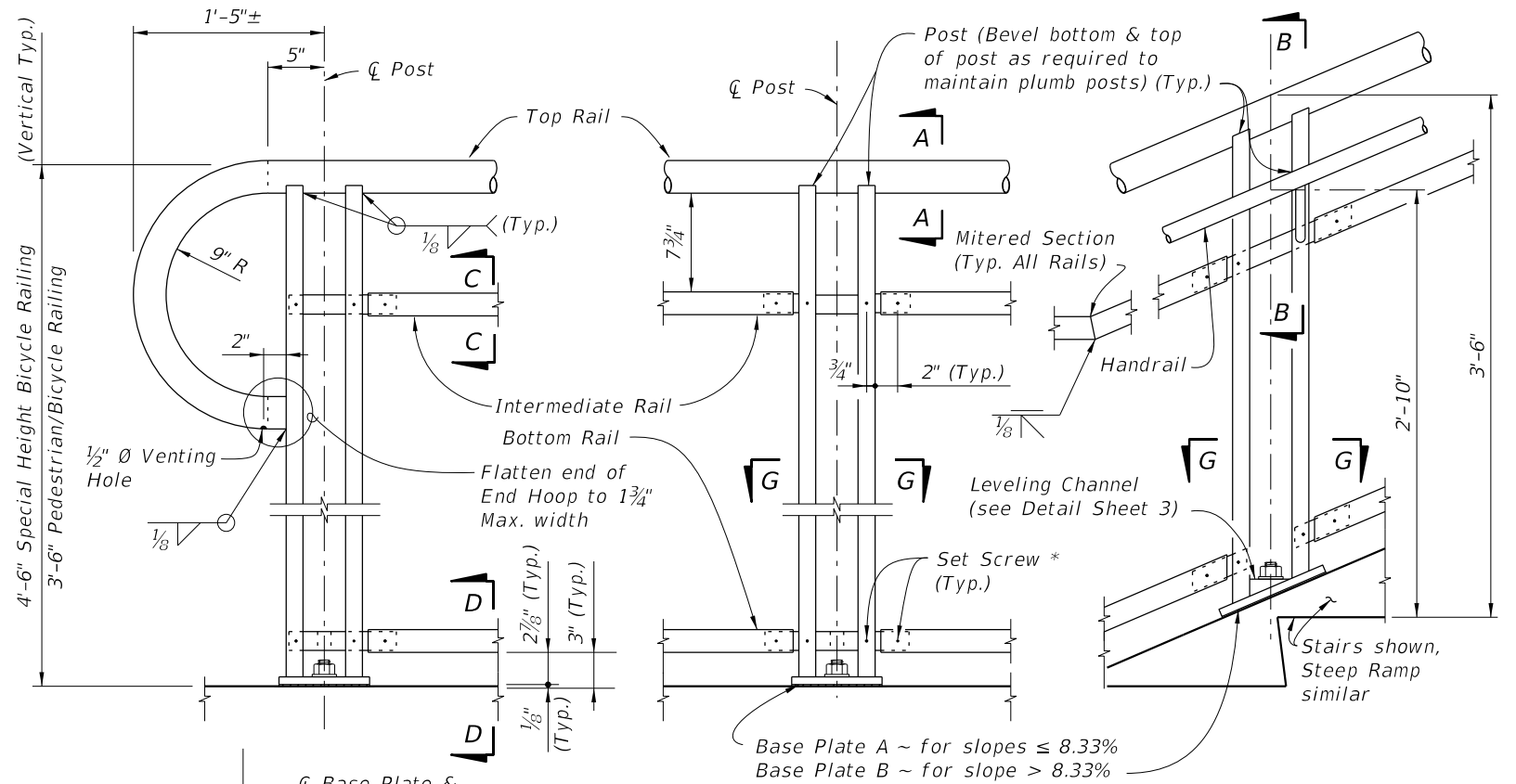
SHIM PLATE DETAIL



SECTION B-B
(Handrail Connection)

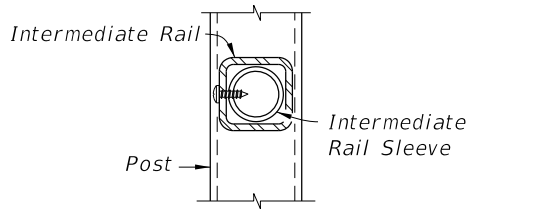


TOP VIEW
SIDE VIEW
LEVELING CHANNEL DETAIL

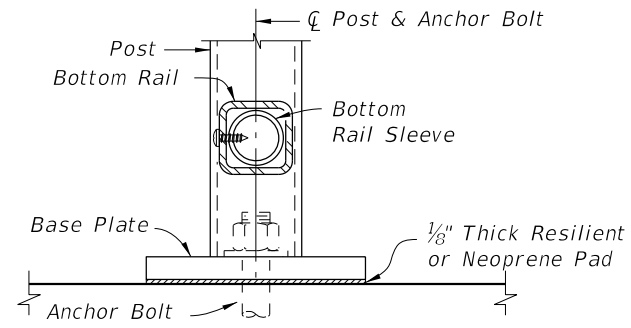


DETAIL "A" - RAIL CONNECTIONS
(Pickets/Panels Not Shown for Clarity)

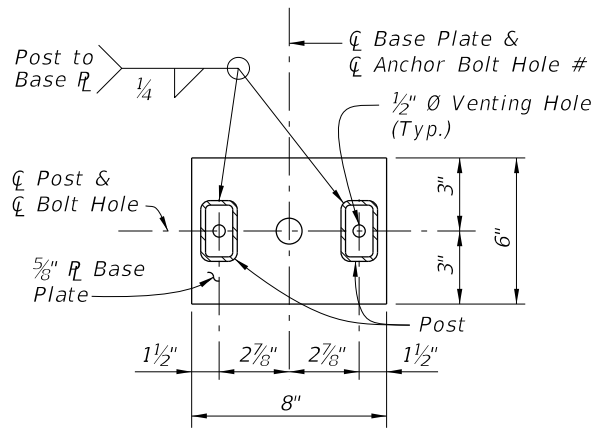
- NOTES:
- # Base Plate A (Ramps - Bolts normal) use 1 1/16 inch diameter holes for anchor bolts with flat washers for slopes less than or equal to 8.33%.
 - ## Base Plate B (Stairs - Bolts plumb) use 1/4 inch diameter holes for anchor bolts with beveled plate and washers for slopes greater than 8.33% to less than or equal to 15%; use 1 5/16 inch x 1 1/2 inch slotted holes with leveling channel for slopes greater than 15%.
 - * 1/4 inch diameter x 3/4 inch pan head stainless steel (Type 316 or 18-8 Alloy) set screws. Screws must be set flush against the outside face of rails & posts and underside of handrails. 1/2 inch diameter plug welds may be substituted for the set screws.
 - ** Embedded length may be 4 inches for plug welded connection.



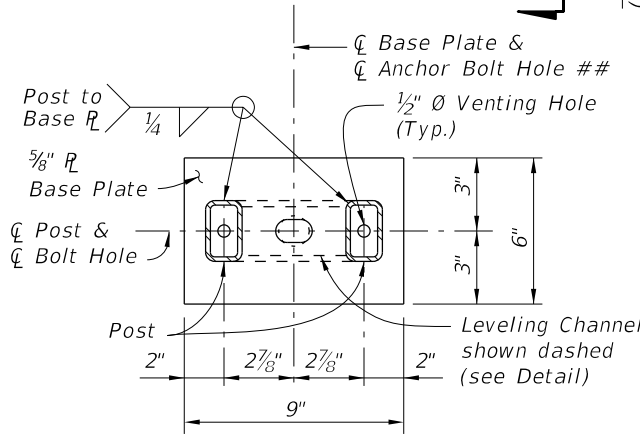
SECTION C-C
(Intermediate Rail Connection)



SECTION D-D
(Bottom Rail Connection)

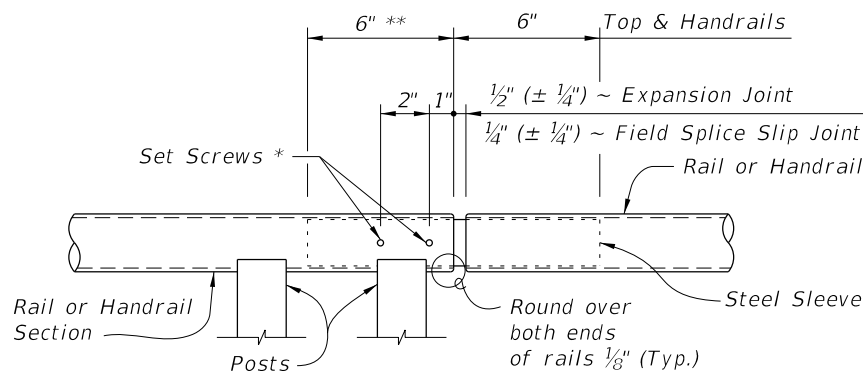


BASE PLATE A



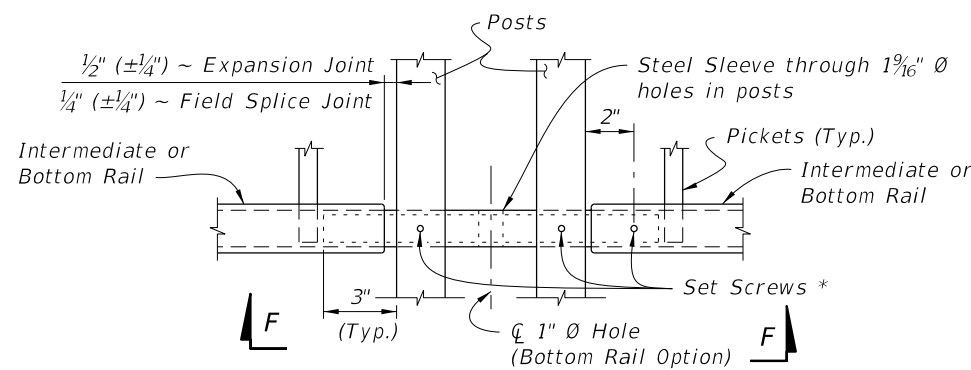
BASE PLATE B

SECTION G-G - BASE PLATE DETAILS

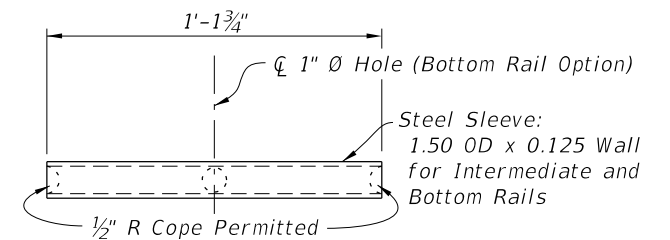


ROUND RAILS - TOP RAIL OR HANDRAIL
(Top Rail at Expansion Joint Shown)

DETAIL "B" - EXPANSION JOINT (FIELD SPLICE SLIP JOINT SIMILAR)



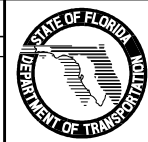
SQUARE RAILS - INTERMEDIATE OR BOTTOM RAIL
(Bottom Rail Shown at Expansion Joint Shown)



VIEW F-F
INTERMEDIATE OR BOTTOM RAIL -
STEEL SLEEVE DETAIL (Bottom Side Shown)

CROSS REFERENCE:
For location of Details "B", See Sheet 2.

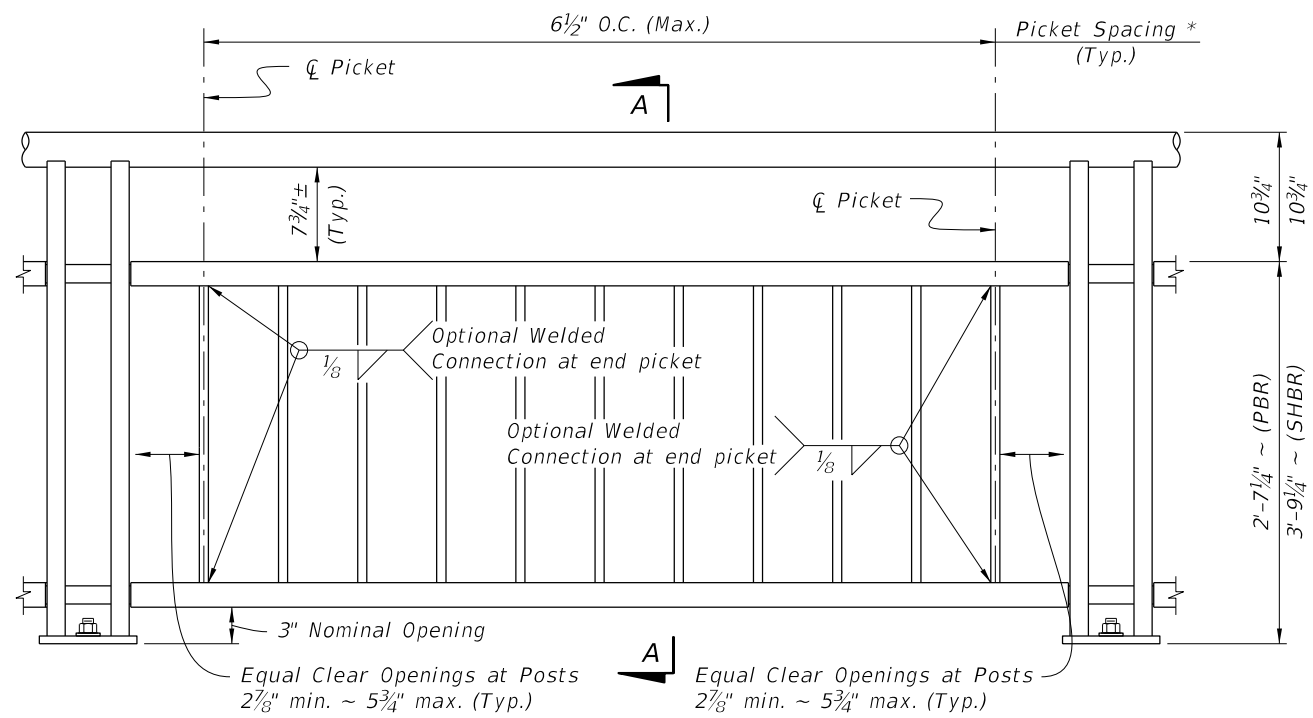
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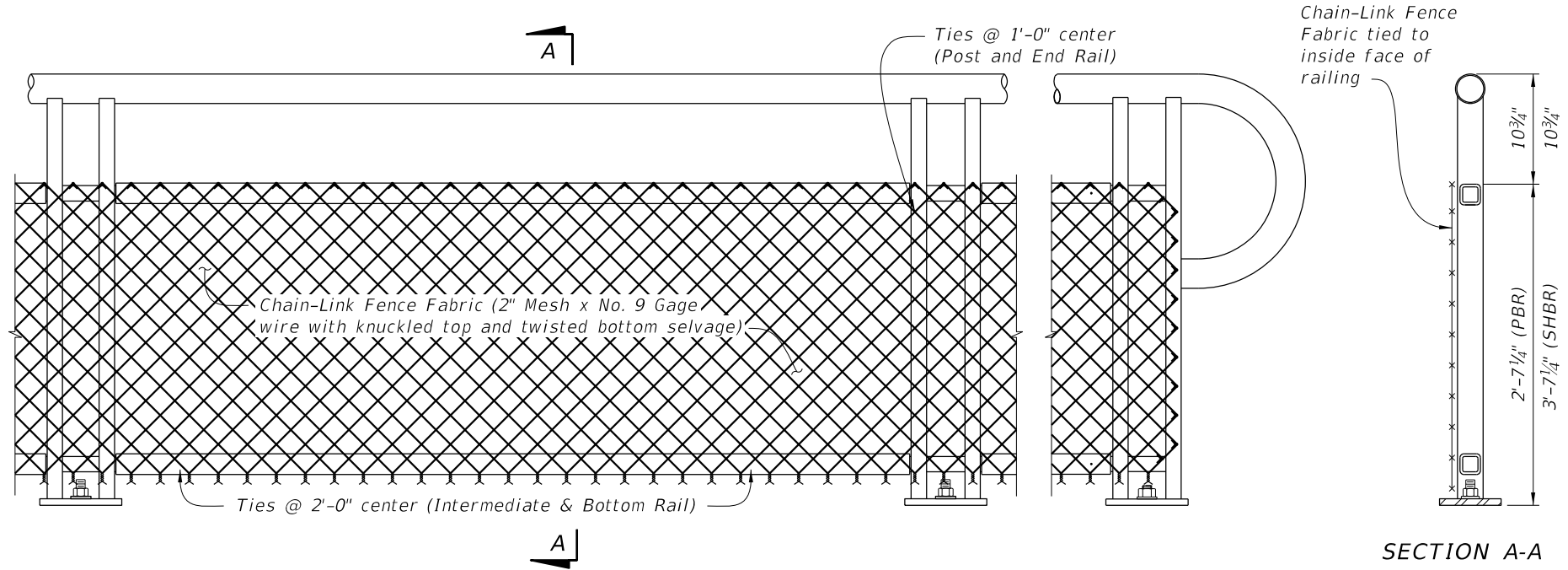
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TYPE 1 - PICKET INFILL PANEL

PICKET NOTES:

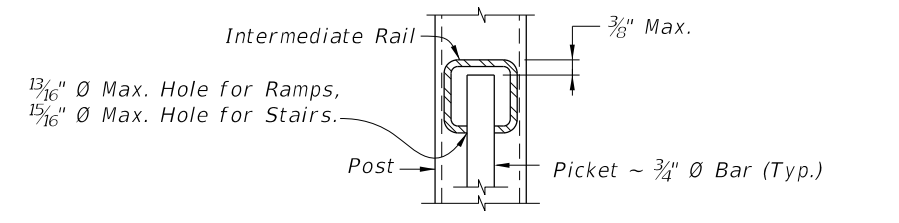
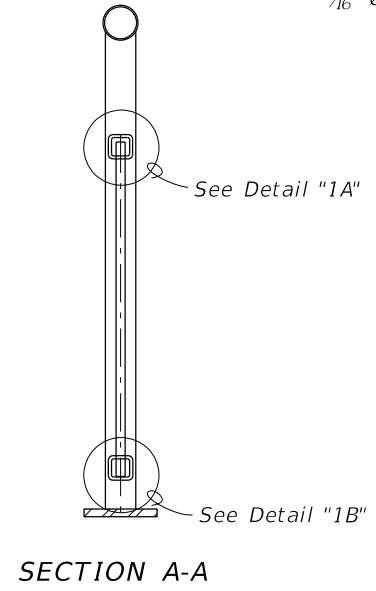
* Picket Spacing of 6 1/2" centers is based on a 3/4" NPS for standard applications. When shown in the Contract Plans a 4 1/2" picket spacing may be required. If an alternate design is used, maintain a maximum clear opening of 5 7/8" for standard installations and 3 7/8" for special conditions.



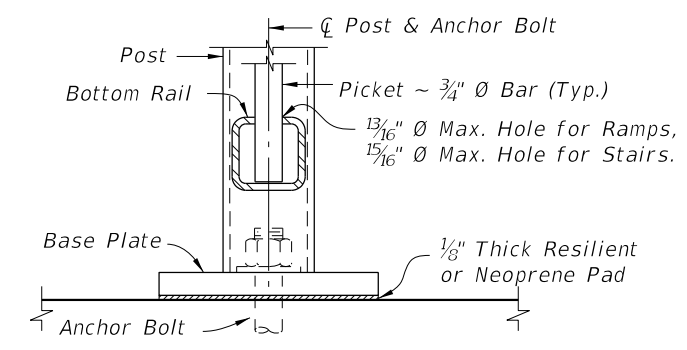
TYPE 2 - CHAIN-LINK (Continuous Infill Panel)

NOTES:

1. See Plans for Infill Panel option required.



DETAIL "1A" (Top of Picket Connection)



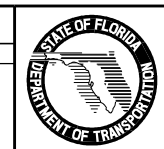
DETAIL "1B" (Bottom of Picket Connection)

TABLE 2 - CHAIN-LINK PANEL COMPONENT MATERIALS		
COMPONENT	ASTM	COMPONENT INFORMATION
Chain-Link Fence Fabric (2" mesh with twisted bottom and knuckled top selvage)	A 392	Zinc-Coated Steel - No. 9 gage (coated wire diameter), Class 2 Coating
	A 491	Aluminum-Coated Steel - No. 9 gage (coated wire diameter)
	F 668	Polyvinyl Chloride (PVC) Coated Steel - No. 9 gage Zinc-Coated Wire (metallic-coated core wire diameter) ~ See Plans for specified color of PVC.
Tie Wires	F 626	Zinc-Coated Steel Wire - No. 9 gage with coating to match Chain-Link Fence Fabric.
Tension Bars	F 626	3/16" (min. thickness) x 3/4" (min. width) x 2'-3" (min. height) Steel Bars
Miscellaneous Fence Components	F 626	Zinc-Coated Steel

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.

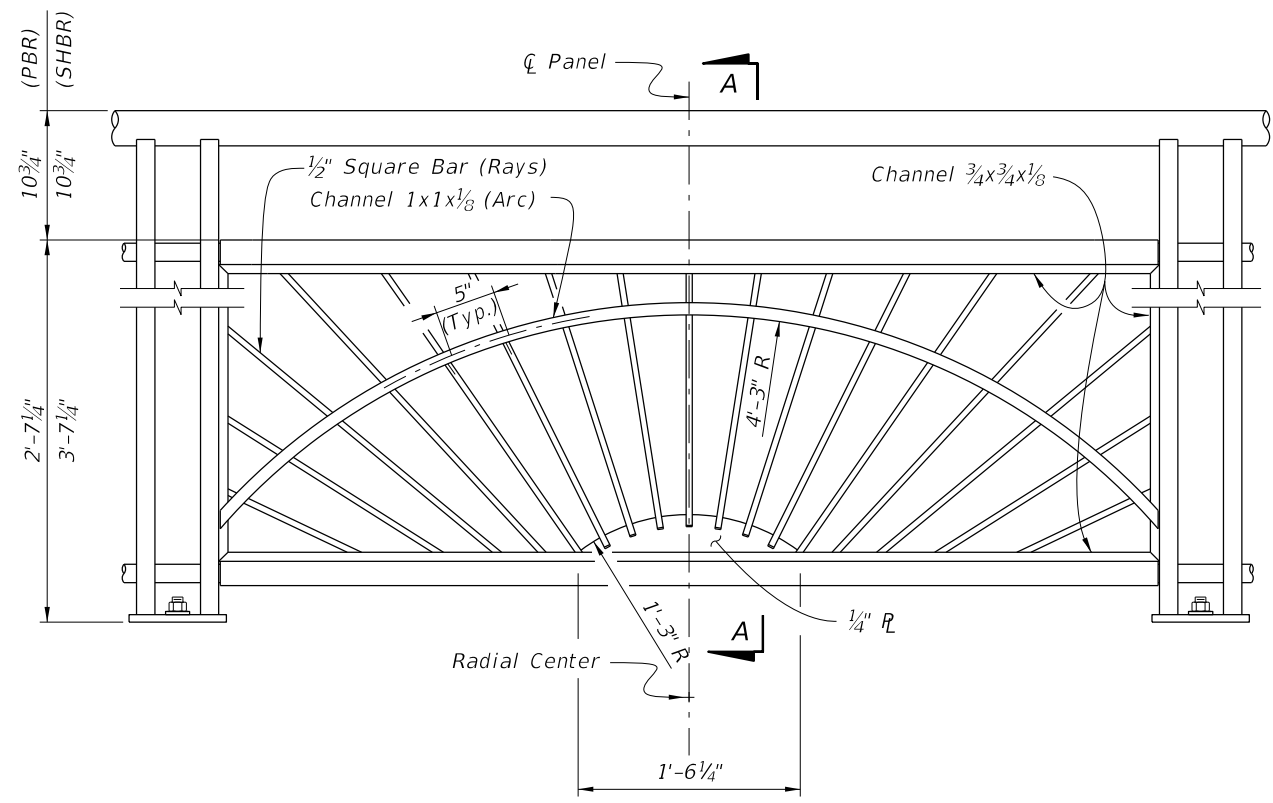
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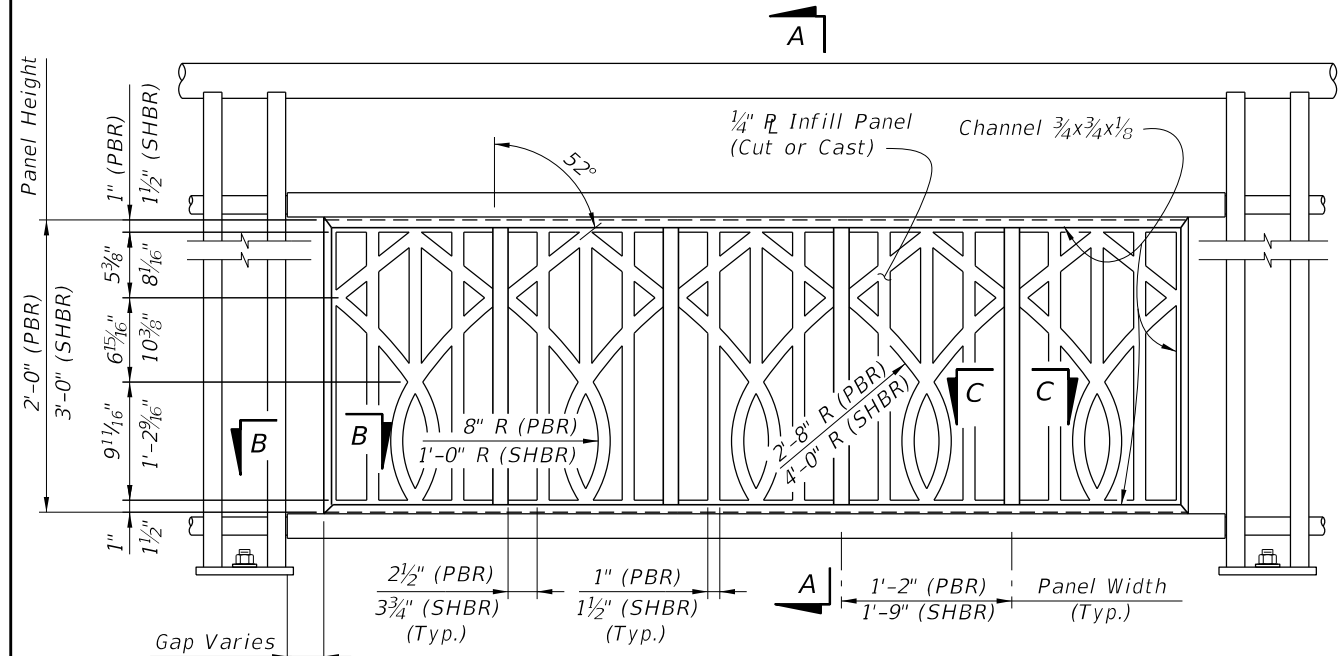
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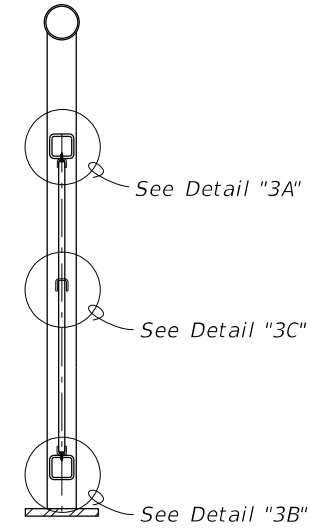
TYPE 3 - SUNSHINE INFILL PANEL



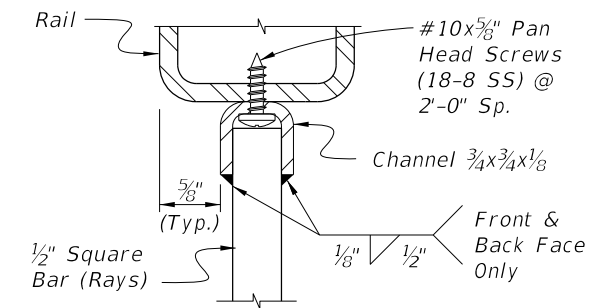
TYPE 4 - BROADWAY INFILL PANEL

NOTES:

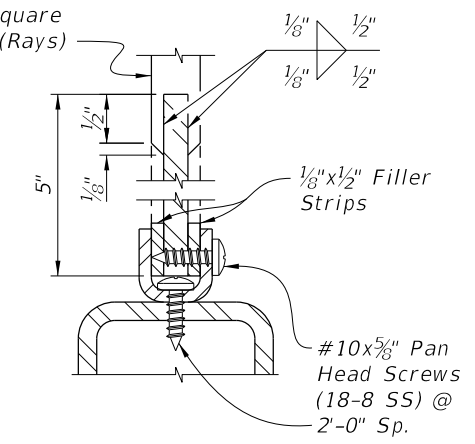
1. See Plans for Infill Panel Option required.



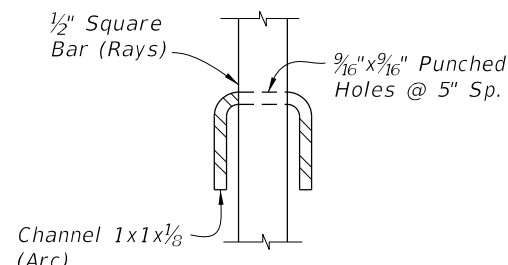
SECTION A-A



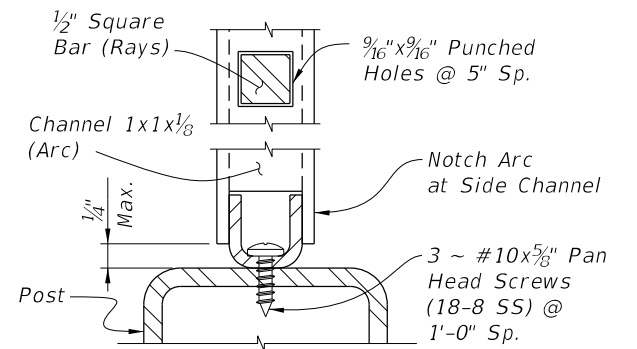
**DETAIL "3A"
INTERMEDIATE RAIL/RAY
CONNECTION**



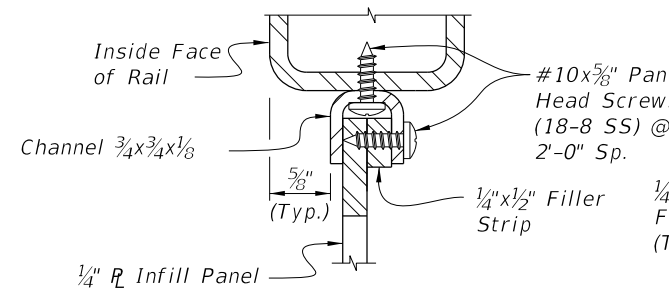
**DETAIL "3B"
BOTTOM RAIL/RAY CONNECTION**



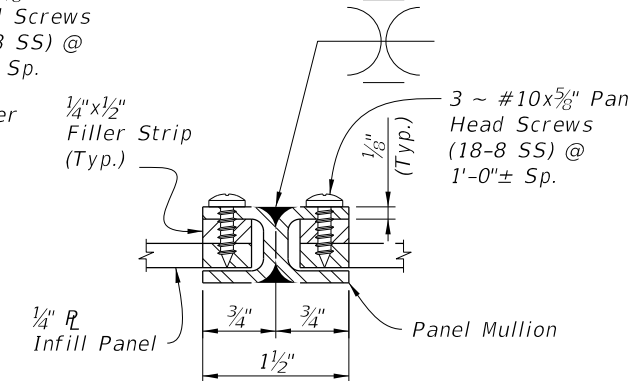
**DETAIL "3C"
RAY/ARC CONNECTION**



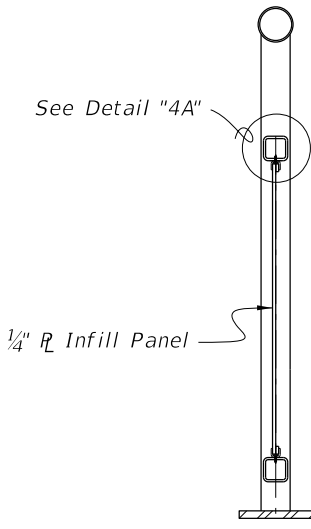
**DETAIL "3D"
ARC/POST CONNECTION**



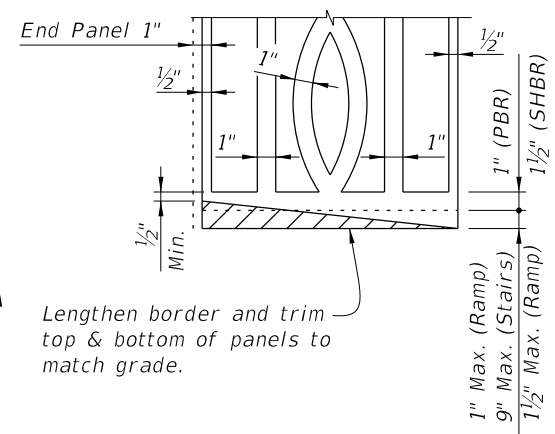
**DETAIL "4A"
PANEL/RAIL CONNECTION
(Top Shown, Bottom Similar)**



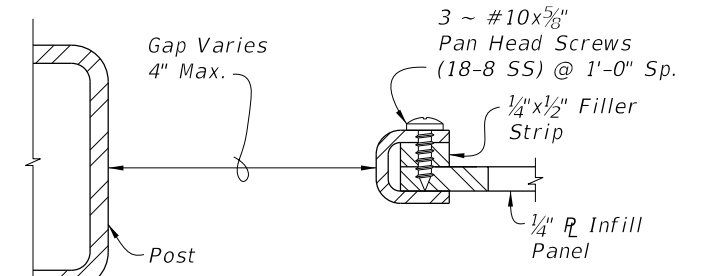
**SECTION C-C
PANEL/SPLICE CONNECTION**



SECTION A-A



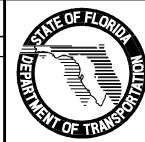
**PANEL ADJUSTMENT FOR RAILINGS
ON GRADES**



**SECTION B-B
PANEL END CAP**

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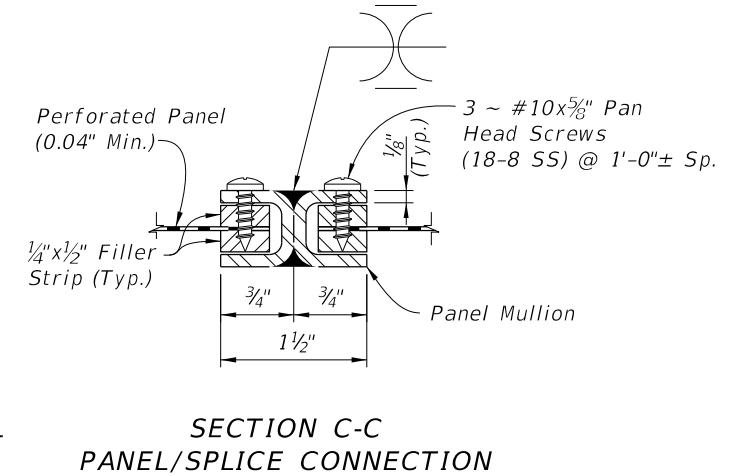
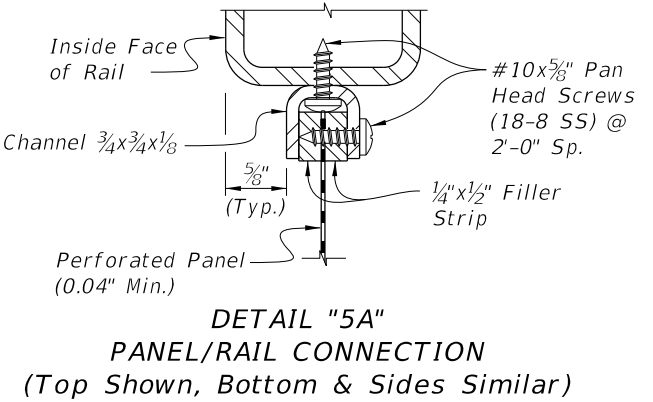
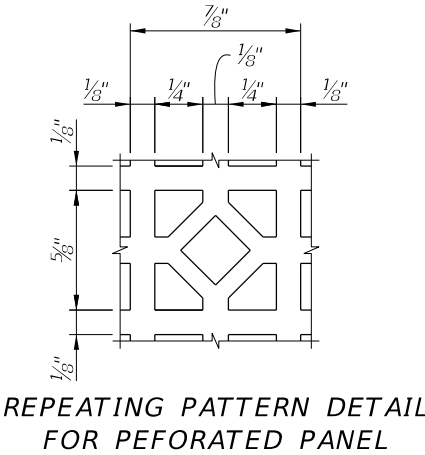
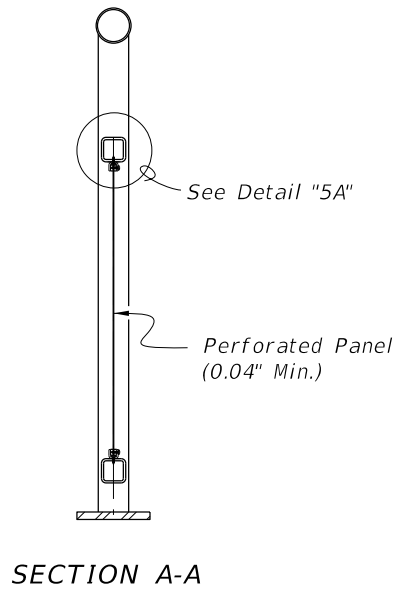
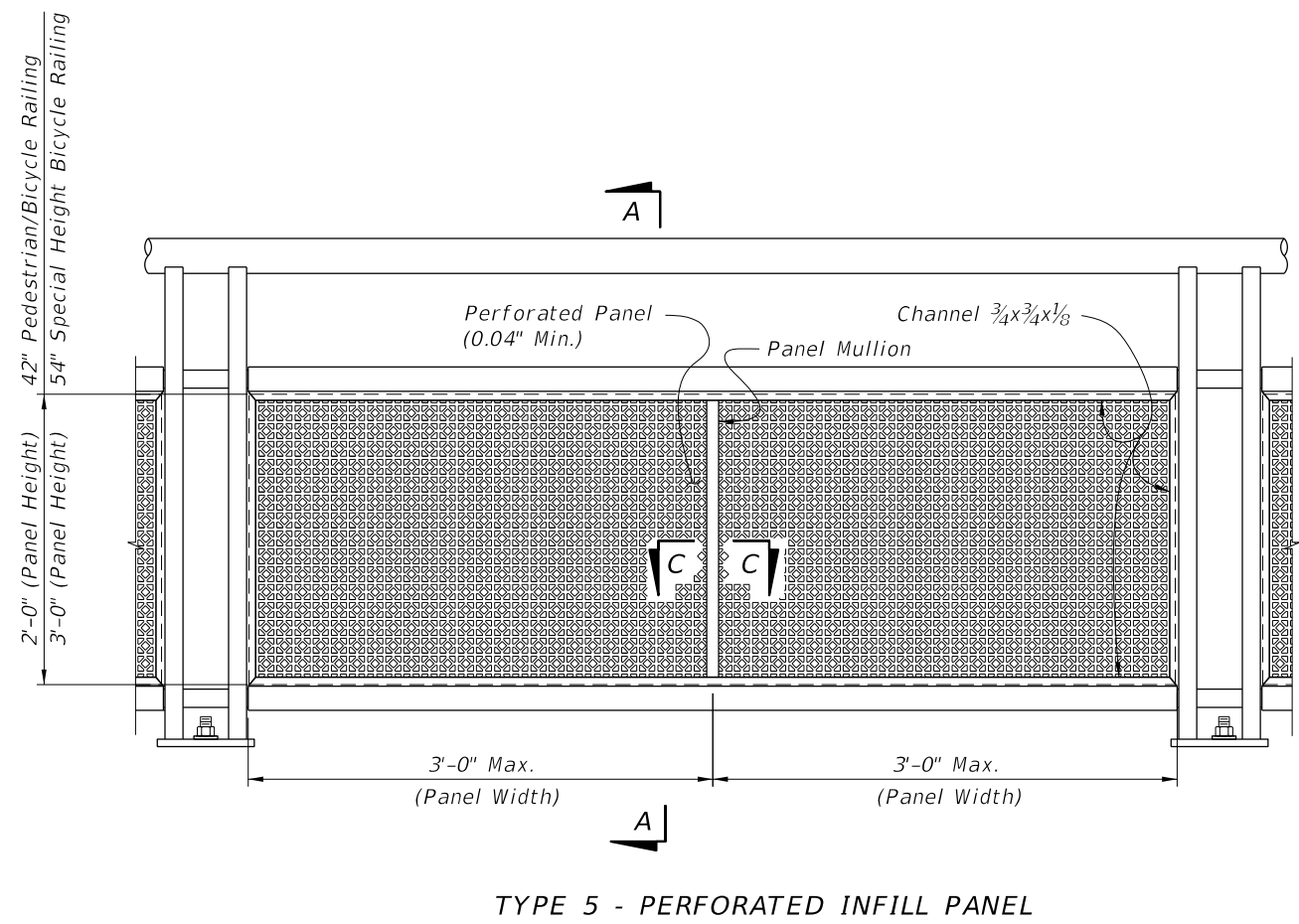
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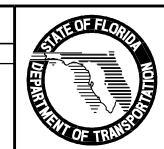
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NOTES:

1. See Plans for Infill Panel Type required.

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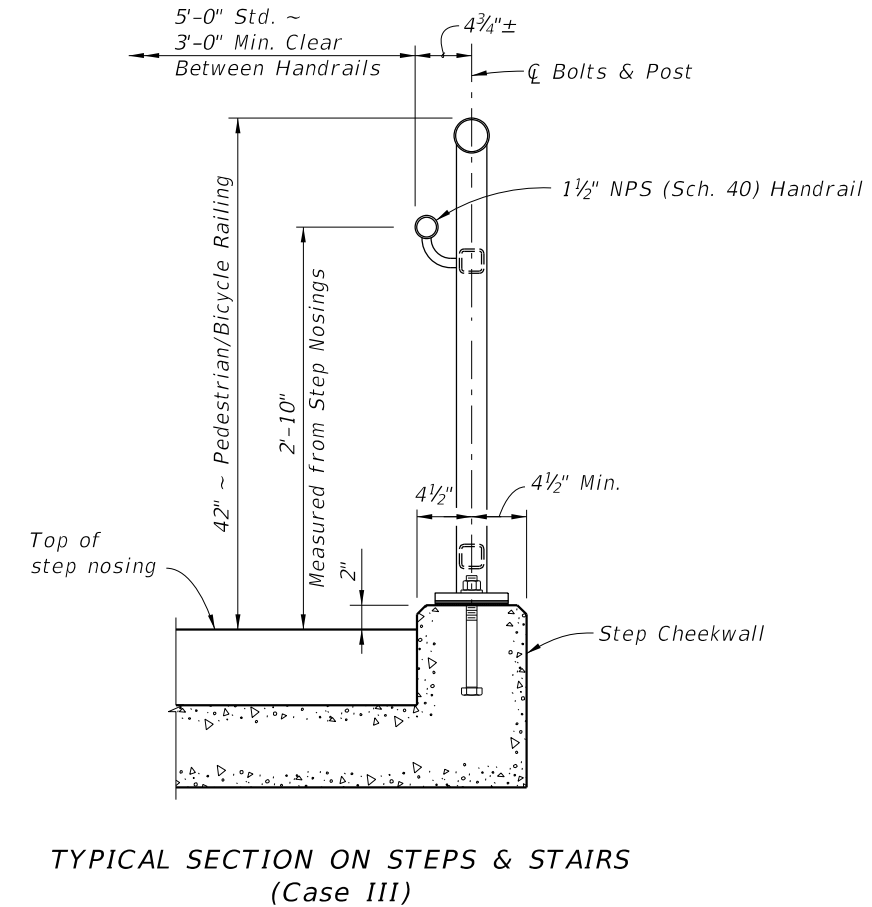
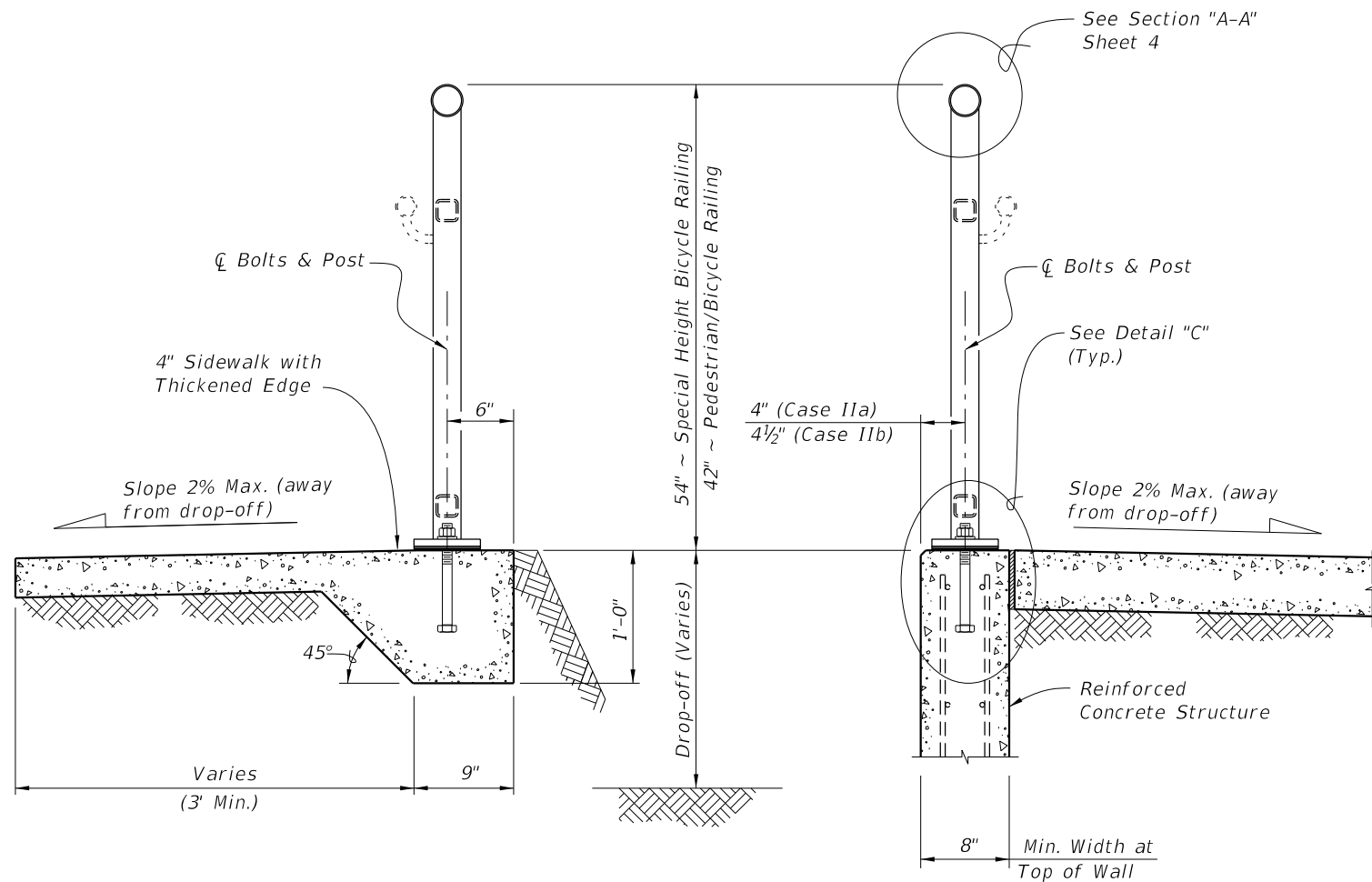
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STEEL PEDESTRIAN/BICYCLE RAILING

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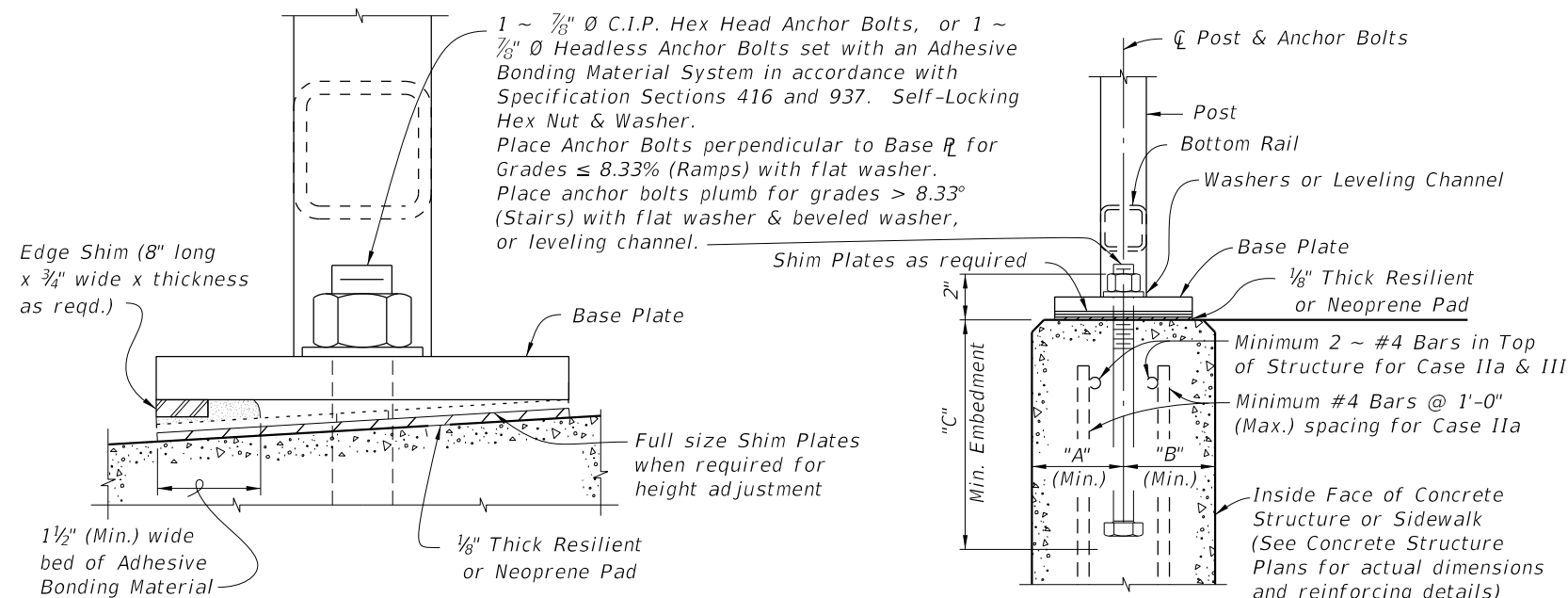
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TYPICAL SECTION ON CONCRETE SIDEWALK (Case I)

TYPICAL SECTION ON RETAINING WALL (Case II)

TYPICAL SECTION ON STEPS & STAIRS (Case III)



ANCHOR BOLT TABLE							
CASE	STRUCTURE TYPE	DIMENSIONS			ANCHOR LENGTH		ANCHOR SIZE
		"A" Edge Dist.	"B" Edge Dist.	"C" Embedment	C.I.P Hex Head Bolt	Adhesive Anchor	
I	Unreinforced Concrete	6"	1'-2"	9"	10 1/2"	11"	7/8" Ø
IIa	Reinforced Concrete	4"	4"	9"	10 1/2"	11"	7/8" Ø
IIb	Gravity Wall Index No. 6011	4 1/2"	3 1/2" @ top	1'-0" *	1'-1 1/2"	1'-2"	7/8" Ø
III	Step Cheekwall	4 1/2"	4 1/2"	9"	10 1/2"	11"	7/8" Ø

* 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".

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION
01/01/11	SJN	New Design Standard			

