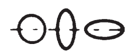
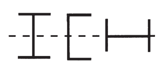
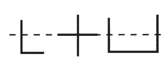
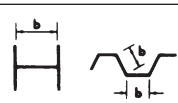
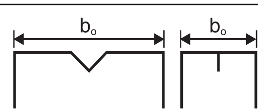
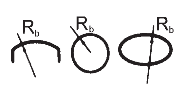
Table 3.4-3
GENERAL FORMULAS FOR DETERMINING ALLOWABLE STRESS FROM SECTION 3.4

Type of Stress	Type of Member or Element	Sub-Sec.	Allowable Stress
TENSION, axial	Any tension member gross section net section	**1**	F_{ty}/n_y $F_{tu}/(k_t n_u)$
TENSION IN BEAMS, extreme fiber, net section	Flat elements in uniform tension (flanges)	**2**	$F = \frac{F_{ty}}{n_y}$ or $F = \frac{F_{tu}}{k_t n_u}$
	Round or oval tubes 	**3**	$F = \frac{1.17F_{ty}}{n_y}$ or $F = \frac{1.24F_{tu}}{k_t n_u}$
	Flat elements in bending in their own plane (webs)	**4**	for symmetric shapes: $F = \frac{1.3F_{ty}}{n_y}$ or $F = \frac{1.42F_{tu}}{k_t n_u}$ for unsymmetric shapes see Section 3.4.4
BEARING	On rivets and bolts	**5**	$2F_{tu}/n_u$
	On flat surfaces and pins and on bolts in slotted holes	**6**	$2F_{tu}/(1.5n_u)$

For tubes with circumferential welds, equations of Sections 3.4.10, 3.4.12, and 3.4.16.1 apply for $R_b/t \leq 20$.

Type of Stress	Type of Member or Element	Sub-Sec.	Allowable Stress Slenderness ≤ S_1	Slenderness Limit S_1	Allowable Stress S_1 < Slenderness < S_2	Slenderness Limit S_2	Allowable Stress Slenderness ≥ S_2
COMPRESSION IN COLUMNS, axial, gross section	All columns	**7**	$\frac{F_{cy}}{n_y}$	$\frac{kL}{r} = \frac{B_c - \frac{n_u F_{cy}}{n_y}}{D_c}$	$\frac{1}{n_u}\left(B_c - D_c\frac{kL}{r}\right)$	$\frac{kL}{r} = C_c$	$\frac{\pi^2 E}{n_u\left(\frac{kL}{r}\right)^2}$
COMPRESSION IN COLUMN ELEMENTS, gross section	Flat elements supported on one edge—columns buckling about a symmetry axis 	**8**	$\frac{F_{cy}}{n_y}$	$\frac{b}{t} = \frac{B_p - \frac{n_u F_{cy}}{n_y}}{5.1\ D_p}$	$\frac{1}{n_u}\left(B_p - 5.1D_p\frac{b}{t}\right)$	$\frac{b}{t} = \frac{k_1 B_p}{5.1D_p}$	$\frac{k_2\sqrt{B_p E}}{n_u(5.1b/t)}$
	Flat elements supported on one edge—columns not buckling about a symmetry axis 	**8.1**	$\frac{F_{cy}}{n_y}$	$\frac{b}{t} = \frac{B_p - \frac{n_u F_{cy}}{n_y}}{5.1D_p}$	$\frac{1}{n_u}\left(B_p - 5.1D_p\frac{b}{t}\right)$	$\frac{b}{t} = \frac{C_p}{5.1}$	$\frac{\pi^2 E}{n_u(5.1b/t)^2}$
	Flat elements supported on both edges 	**9**	$\frac{F_{cy}}{n_y}$	$\frac{b}{t} = \frac{B_p - \frac{n_u F_{cy}}{n_y}}{1.6D_p}$	$\frac{1}{n_u}\left(B_p - 1.6D_p\frac{b}{t}\right)$	$\frac{b}{t} = \frac{k_1 B_p}{1.6D_p}$	$\frac{k_2\sqrt{B_p E}}{n_u(1.6b/t)}$
	Flat elements supported on one edge and with stiffener on other edge 	**9.1**	See Section 3.4.9.1				
	Flat elements supported on both edges and with an intermediate stiffener 	**9.2**	See Section 3.4.9.2				
	Curved elements supported on both edges 	**10**	$\frac{F_{cy}}{n_y}$	$\frac{R_b}{t} = \left(\frac{B_t - \frac{n_u F_{cy}}{n_y}}{D_t}\right)^2$	$\frac{1}{n_u}\left(B_t - D_t\sqrt{\frac{R_b}{t}}\right)$	$\frac{R_b}{t} = C_t$	$\frac{\pi^2 E}{16n_u\left(\frac{R_b}{t}\right)\left(1 + \frac{\sqrt{R_b/t}}{35}\right)^2}$

5.4.1 Screw Material

The material for screws used to connect aluminum parts is selected to meet strength and corrosion resistance considerations. Steel screws with a Rockwell hardness of C35 or greater may suffer hydrogen-assisted stress corrosion cracking (HASCC) where exposed to certain dissimilar metals, moisture, and tension stress due to installation or loading. For this reason, steel screws with a Rockwell hardness of C35 or greater are no longer permitted in the *Specification*. Aluminum and austenitic stainless steel screws do not experience HASCC. When fasteners will not be exposed to contact with liquid water or humidity near the dew point, certain other steels, with appropriate hardness, and appropriately coated and/or plated are also acceptable. An example is 430 stainless steel, which has a nominal composition of 16% chromium.

5.4.2 Screw Tension

5.4.2.1 Pull-Out

The equations for pull-out are derived from research conducted by AAMA, including over 400 pull-out tests (75). These equations are based on three regions of behavior: yield (circumferential stretching and bending of the aluminum around the screw), shearing of the internal threads in the hole, and a transition region between yield and shearing. For most cases they are less conservative than the pull-out equation in the 6th edition ($P_{not} = 0.85 t_c D F_{tu2}$), especially for UNC threads in aluminum parts thicker than 0.084 in. (2.1 mm). Pull-out strengths are a function of the type of thread: coarse (UNC) or spaced. A UNC thread is often referred to as a "machine" thread and a spaced thread screw is termed a "sheet metal" screw. Internal thread stripping areas (A_{sn} in equations 5.3.2.1-2 and 5.3.2.1-3) are given in Part VII Table 5-20 for Class 2B UNC threads.

5.4.2.2 Pull-Over

The pull-over strength equation for non-countersunk screws is based on Reference (17). Screws may be placed through the valley or the crown of corrugated roofing and siding. (See Figure C5.4.2-1). A coefficient of 0.7 is used when the connected parts are not in contact, such as for fastening through the crown of roofing when a spacer block is not used between the roofing and the structural member supporting the roofing. The test strengths of such screwed connections are more variable than those with the connected parts in direct contact at the connection such as the fastener through the valley in Figure C5.4.2-1.

The equation for the pull-over strength of countersunk screws is based on over 200 tests using 5 different flathead screw sizes, 6 sheet thicknesses, and 2 alloy-tempers (85). Testing was limited to commonly used screws with 82 degree nominal angle heads, so the equation is not known to apply to other head angles.

Variation in actual diameters of hand-drilled countersunk holes can have a significant effect on pull-over strength. Caution should be used to avoid excessive oversizing of countersunk holes. Oversizing should be limited so that the top of the screw head is no more than the lesser of $t_1/4$ and 1/32 in. (0.8 mm) below the top of the sheet.

5.4.3 Screw Shear and Bearing

Screw connections loaded in shear can fail in one mode or in combination of several modes. These modes are screw shear, edge tearing, tilting and subsequent pull-out of the screw and bearing of the joined materials.

Tilting of the screw followed by threads tearing out of the lower sheet reduces the connection shear capacity from that of the typical connection bearing strength. Equation 5.4.3-4 covers the cases when the screw tilting can lower the strength.

Diameter and rigidity of the fastener head assembly as well as sheet thickness and tensile strength have a significant effect on the shear failure load of a connection. There are a variety of washers and head styles in use. Washers must be at least 0.050 in. (1.3 mm) thick to withstand bending forces with little or no deformation.

Based on limited testing, it appears that the bearing force on a screw should be limited to that which produces

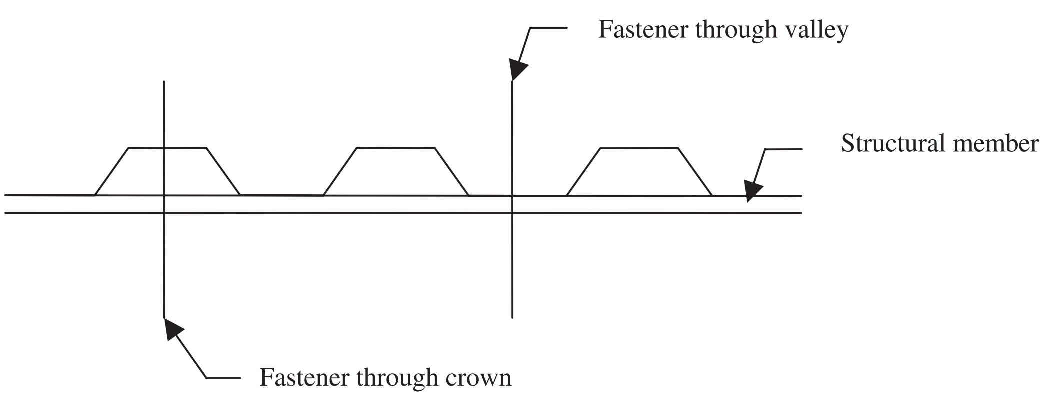


Figure C5.4.2-1 FASTENERS IN ROOFING

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For references to Parts IA and IB, see also the corresponding section in Parts IIA and IIB.

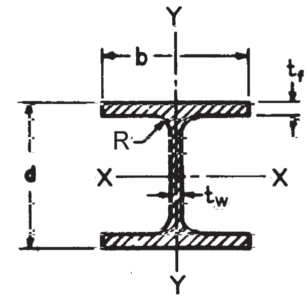

TABLE 12 – CANADIAN I-BEAMS

Designation	Depth d in.	Width b in.	Flange Thickness t_f in.	Web Thickness t_w in.	Fillet Radius R in.	Area A in^2	Axis x-x I_x in^4	Axis x-x S_x in^3	Axis x-x r_x in.	Axis y-y I_y in^4	Axis y-y S_y in^3	Axis y-y r_y in.	C_w in^6	J in^4	r_0 in.
I 3 × 2.16	3.000	2.500	0.250	0.188	0.375	1.84	2.78	1.85	1.23	0.657	0.525	0.597	1.24	0.017	1.37
I 4 × 2.68	4.000	3.000	0.250	0.188	0.375	2.28	6.28	3.14	1.66	1.13	0.754	0.705	3.98	0.017	1.80
I 5 × 4.05	5.000	3.500	0.312	0.250	0.437	3.44	14.5	5.79	2.05	2.24	1.28	0.808	12.3	0.036	2.20
I 6 × 3.92	6.000	3.000	0.312	0.250	0.375	3.34	19.2	6.40	2.40	1.42	0.945	0.652	11.5	0.026	2.49
I 6 × 4.82	6.000	3.500	0.375	0.250	0.438	4.10	24.9	8.28	2.46	2.70	1.54	0.811	21.3	0.043	2.59
I 6 × 5.46	6.000	4.000	0.375	0.281	0.437	4.64	28.2	9.40	2.47	4.02	2.01	0.931	31.8	0.048	2.64
I 7 × 5.79	7.000	4.000	0.375	0.281	0.438	4.92	40.2	11.5	2.86	4.02	2.01	0.904	44.1	0.048	3.00
I 8 × 6.12	8.000	4.000	0.375	0.281	0.437	5.20	54.6	13.6	3.24	4.02	2.01	0.880	58.5	0.048	3.36
I 8 × 8.77	8.000	5.000	0.500	0.312	0.562	7.46	82.4	20.6	3.32	10.5	4.18	1.18	147	0.116	3.53
I 10 × 9.83	10.000	5.000	0.500	0.343	0.562	8.36	139	27.8	4.08	10.5	4.19	1.12	236	0.127	4.23
I 10 × 11.3	10.000	6.000	0.500	0.375	0.562	9.65	163	32.7	4.12	18.1	6.02	1.37	408	0.140	4.34
I 12 × 12.5	12.000	5.500	0.625	0.375	0.625	10.6	252	42.0	4.88	15.7	5.70	1.22	513	0.193	5.03
I 12 × 15.5	12.000	6.500	0.625	0.437	0.625	13.2	317	52.9	4.91	28.7	8.84	1.48	929	0.245	5.13

1. Users are encouraged to check availability with suppliers.
2. Tolerances for extruded shapes are given in *Aluminum Standards and Data*.