LIGHTWEIGHT STEEL FRAMING MEMBER SELECTION TABLES

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Prepared for: Canadian Sheet Steel Building Institute

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CSSBI is Canada’s foremost authority on sheet steel, its products, and its many applications. They are an industry association responsible for the development and dissemination of industry standards. A source for technical information and resources, they provide expert guidance to the general public and sheet steel manufacturers alike.

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1. **INTRODUCTION**

The technical data in this publication is intended as an aid to the design professional and should not be used to replace the judgement of a qualified Engineer or Architect.

2. **PRODUCT DESIGNATOR**

Lightweight steel framing manufacturers in Canada use a common designator method for identifying their products. The designator is a four-part code that identifies depth, flange width, member type and material thickness. This designator (based on Imperial units) is used for both SI metric and Imperial units.

**Example:** 600S162-54

Member depth in 1/100ths inches. Thus 600 means 600/100 = 6"

Flange width in 1/100ths inches. Thus 162 means 162/100 = 1.62" or 1-5/8"

<table>
<thead>
<tr>
<th>Depth (600/100,000)</th>
<th>Flange Width (162/100,000)</th>
<th>Style</th>
<th>Material Thickness (54/1000,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>162</td>
<td>S</td>
<td>54</td>
</tr>
</tbody>
</table>

3. **MANUFACTURER CERTIFICATION AND PRODUCT MARKING**

3.1 Lightweight steel framing manufacturers who are members of the CSSBI and adhere to the **CSSBI Manufacturer Certification Requirements for Cold Formed Steel Framing Members** are the only companies that have authorization from the CSSBI to utilize these tables.

Under the **CSSBI Manufacturer Certification Program**, a participating manufacturer certifies that the designated structural and non-structural cold formed steel (CFS) framing members it produces meet or exceed the relevant ASTM International (ASTM), Canadian Standards Association (CSA) and American Iron and Steel Institute (AISI) standard requirements. The manufacturer’s products are validated through an independent 3rd party review of the products and production practices, by appropriate testing and inspection.
3.2 **Marking:**
Individual products shall have a legible label, stencil, or embossment on the member with the following minimum information:
(a) Initials “CSSBI”;
(b) Manufacturer’s identification (2 or 3 letters);
(c) Designation steel thickness (in mils) exclusive of protective coatings; and,
(d) A reference number identifying the source coil.

*Example:* “CSSBI-XYZ-33 ABCD” would be a 33 mil thick product manufactured by XYZ company who is a CSSBI Manufacturer Member from a coil that can be traced through the reference number “ABCD”.

Additional information may also be included at the discretion of the manufacturer.

4. **SECTION GEOMETRIES**

4.1 Section geometries are identified by the product designator method described in Section 2.

4.2 Stud, joist, track and U-channel members shall be cold formed to shape from sheet steel with a minimum base steel thickness and inside bend radius as follows:

<table>
<thead>
<tr>
<th>Designation Thickness (mil)</th>
<th>Minimum Base Steel Thickness (in.)</th>
<th>Base Steel Design Thickness (in.)</th>
<th>Inside Bend Radius (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>0.0179</td>
<td>0.0188</td>
<td>0.0843</td>
</tr>
<tr>
<td>33</td>
<td>0.0329</td>
<td>0.0346</td>
<td>0.0764</td>
</tr>
<tr>
<td>43</td>
<td>0.0428</td>
<td>0.0451</td>
<td>0.0712</td>
</tr>
<tr>
<td>54</td>
<td>0.0538</td>
<td>0.0566</td>
<td>0.0849</td>
</tr>
<tr>
<td>68</td>
<td>0.0677</td>
<td>0.0713</td>
<td>0.1069</td>
</tr>
<tr>
<td>97</td>
<td>0.0966</td>
<td>0.1017</td>
<td>0.1525</td>
</tr>
</tbody>
</table>

4.3 Stud and joist lip lengths based on the flange width are as follows:

<table>
<thead>
<tr>
<th>Section</th>
<th>Flange Width (in.)</th>
<th>Lip Length (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S125</td>
<td>1.250</td>
<td>0.1875</td>
</tr>
<tr>
<td>S162</td>
<td>1.625</td>
<td>0.500</td>
</tr>
<tr>
<td>S200</td>
<td>2.000</td>
<td>0.625</td>
</tr>
<tr>
<td>S250</td>
<td>2.500</td>
<td>0.625</td>
</tr>
<tr>
<td>S300</td>
<td>3.000</td>
<td>0.625</td>
</tr>
</tbody>
</table>
5. **SECTION PROPERTIES**


5.2 Steel shall conform to the requirements of S136-16, AISI S220-15 *North American Standard for Cold-Formed Steel Framing - Nonstructural Members* and AISI S240-15 *North American Standard for Cold-Formed Steel Structural Framing*. Products with a design thicknesses less than or equal to 0.0451" shall have a minimum yield strength of 33 ksi and products with a design thicknesses equal to or greater than 0.0566" shall have a minimum yield strength of 50 ksi.

5.3 Section properties are computed for the base steel design thicknesses (exclusive of coating) shown in the tables.

5.4 When provided, factory punchouts shall be located along the centreline of the webs of the members and shall have a minimum centre-to-centre spacing of 24". Punchouts for members greater than 2.5" deep are a maximum of 1.5" wide by 4.5" in length. Any configuration or combination of holes that fit within the punchout width and length limitations stated above shall be permitted; other punchout configurations and locations not in compliance with the stated limitations must be approved by a design professional.

5.5 Increase in yield strength from cold work of forming has been included whenever applicable.

5.6 The effective moment of inertia for deflection, \( I_{xd} \), is based on local buckling at an assumed specified live load stress of 0.6\( F_y \). This moment of inertia is only appropriate for checking serviceability limit states.
6. **SYMBOLS**

**Gross Properties**
- $I_x$: Moment of inertia about $x$-axis
- $I_y$: Moment of inertia about $y$-axis
- $r_x$: Radius of gyration about $x$-axis
- $r_y$: Radius of gyration about $y$-axis
- $V_{rg}$: Factored shear resistance along $y$-axis of unperforated section

**Effective Properties**
- $I_{xd}$: Moment of inertia about $x$-axis for deflection calculations
- $M_{rx}$: Factored moment resistance for track, U-channel and furring channel sections based on local buckling
- $M_{rxDB}$: Factored moment resistance about $x$-axis based on distortional buckling, assuming $K_p = 0$
- $M_{rxLB}$: Factored moment resistance about $x$-axis based on local buckling
- $M_{ryDB}$: Factored moment resistance about $y$-axis based on distortional buckling with lip in compression
- $M_{ryLB}$: Factored moment resistance about $y$-axis based on local buckling with web/lip in compression
- $S_{xe}$: Effective section modulus about $x$-axis
- $V_{rm}$: Factored shear resistance along $y$-axis of perforated section

**Torsional and other Properties**
- $\beta$: $1 - (x_o/r_o)^2$
- $C_w$: Torsional warping constant
- $J$: Saint-Venant torsion constant. The values shown in the tables have been multiplied by 1,000. To obtain the actual values, divide table values by 1,000
- $L_u$: Limiting unbraced length below which lateral-torsional buckling is not considered
- $m$: Distance from shear centre to mid-plane of web
- $r_o$: Polar radius of gyration about shear centre
- $x_o$: Distance from shear centre to centroid along principle $x$-axis
Web Depth to Thickness Ratio (h/t)

<table>
<thead>
<tr>
<th>Designation Thickness (mil)</th>
<th>18</th>
<th>33</th>
<th>43</th>
<th>54</th>
<th>68</th>
<th>97</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Thickness (in.)</td>
<td>0.0188</td>
<td>0.0346</td>
<td>0.0451</td>
<td>0.0566</td>
<td>0.0713</td>
<td>0.1017</td>
</tr>
<tr>
<td>Section Depth (in.)</td>
<td>h(in.)</td>
<td>h/t</td>
<td>h(in.)</td>
<td>h/t</td>
<td>h(in.)</td>
<td>h/t</td>
</tr>
<tr>
<td>1.625</td>
<td>1.42</td>
<td>75.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.50</td>
<td>2.29</td>
<td>122</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.625</td>
<td>3.42</td>
<td>182</td>
<td>3.40</td>
<td>98.3</td>
<td>3.39</td>
<td>75.2</td>
</tr>
<tr>
<td>4</td>
<td>3.79</td>
<td>202</td>
<td>3.78</td>
<td>109</td>
<td>3.77</td>
<td>83.5</td>
</tr>
<tr>
<td>6</td>
<td>5.79</td>
<td>*</td>
<td>5.78</td>
<td>167</td>
<td>5.77</td>
<td>128</td>
</tr>
<tr>
<td>8</td>
<td>7.78</td>
<td>225</td>
<td>7.77</td>
<td>172</td>
<td>7.72</td>
<td>136</td>
</tr>
<tr>
<td>12</td>
<td>11.8</td>
<td>*</td>
<td>11.8</td>
<td>*</td>
<td>11.7</td>
<td>207</td>
</tr>
<tr>
<td>14</td>
<td>13.8</td>
<td>*</td>
<td>13.8</td>
<td>*</td>
<td>13.7</td>
<td>242</td>
</tr>
</tbody>
</table>

1 h/t exceeds 200; * h/t exceeds 260

7. DESIGN EXAMPLES

7.1 LOAD BEARING WALL STUDS – Concentric load only

Given:
Specified (unfactored) Loads: Axial live load (L) = 4.8 kips/stud
Axial dead load (D) = 2.0 kips/stud

Stud height = 14'-0"
Stud spacing = 16” o.c.
Assume studs are braced by bridging only
Select a stud section

Solution:
Factored load combination = 1.25D + 1.5L
Cr = 1.25(2.0) + 1.5(4.8) = 9.70 kips/stud

Try 600S162-68 studs at 16” o.c.

From Combined Axial and Lateral Load table, the limiting factored compressive resistance for 0 psf factored lateral load
Cr = 10.4 kips/stud
Since Cr = 10.4 kips/stud > Cr = 9.70 kips/stud ∴ OK

Conclusion:
Use 600S162-68 section spaced at 16” o.c. with 3 bridging lines arranged so that the maximum spacing does not exceed 48” o.c.
7.2 LOAD BEARING WALL STUDS – Combined loading

Given:
Specified (unfactored) Loads:
- Axial live load (L) = 3.6 kips/stud
- Axial dead load (D) = 1.8 kips/stud
- Wind load (W) = 25 psf

Stud height = 10'-0"
Stud spacing = 16" o.c.
Deflection limit = L/600
Assume studs are braced by bridging only
Select a stud section

Solution:

Try 600S162-54 studs at 16" o.c.

1) Dead load only
   Factored load combination = 1.4D
   \( C_f (\text{factored axial load}) = 1.4D = 1.4(1.8) = 2.52 \text{ kips/stud} \)
   From Combined Axial and Lateral Load table, the limiting factored compressive resistance for 0 psf factored lateral load
   \( C_r = 8.24 \text{ kips/stud} \)
   Since \( C_r = 8.24 \text{ kips/stud} > C_f = 2.52 \text{ kips/stud} \) \:: \text{OK}

2) Dead + Wind + Live Load
   a) Factored load combination # 1
      \( W_f (\text{factored wind load}) = 0.4W = 0.4(25) = 10.0 \text{ psf} \)
      \( C_f (\text{factored axial load}) = 1.25D + 1.5L = 1.25(1.8) + 1.5(3.6) = 7.65 \text{ kips/stud} \)
      From Combined Axial and Lateral Load table, the limiting factored compressive resistance for 10 psf factored lateral load
      \( C_r = 7.67 \text{ kips/stud} \)
      Since \( C_r = 7.67 \text{ kips/stud} > C_f = 7.65 \text{ kips/stud} \) \:: \text{OK}

   b) Factored load combination # 2
      \( W_f (\text{factored wind load}) = 1.4W = 1.4(25) = 35.0 \text{ psf} \)
      \( C_f (\text{factored axial load}) = 1.25D + 0.5L = 1.25(1.8) + 0.5(3.6) = 4.05 \text{ kips/stud} \)
      From Combined Axial and Lateral Load table, the limiting factored compressive resistance for 30 and 40 psf factored lateral load
      \( C_r = 6.57 \text{ kips/stud} \) (for 30 psf)
      \( C_r = 6.04 \text{ kips/stud} \) (for 40 psf)
      By interpolation for 35 psf, \( C_r = 6.31 \text{ kips/stud} > 4.05 \text{ kips/stud} \) \:: \text{OK}

3) Web crippling check
   From Single Span Curtain Wall Limiting Heights table for a 25 psf specified wind load, web crippling does not control.
4) Deflection check (L/600)
From Single Span Curtain Wall Limiting Heights table, the limiting stud height for a specified wind load of 25 psf and a deflection limit of L/600 is 14'-4". Since 14'-4" > 10'-0" : OK

Conclusion:
Use 600S162-54 section spaced at 16" o.c. with 2 bridging lines arranged so that the maximum spacing does not exceed 48" o.c.

7.3 FLOOR JOIST – Single span

Given:
Specified (unfactored) Loads: Live load (L) = 40 psf
Dead load (D) = 15 psf

Single span length = 16'-0"
Joist spacing = 16" o.c.
Deflection limit = L/360
Select a joist section

Solution:
Strength
Factored load combination = 1.25D + 1.5L
Pf = 1.25(15) + 1.5(40) = 78.8 psf
Try 800S162-54 joists at 16" o.c.

From Floor Joist Load table, the factored uniformly distributed single span Strength Resistance = 91 psf
Since 91 psf > 78.8 psf : OK

Deflection
From Floor Joist Load table, the specified uniformly distributed single span L/360 deflection load is 44 psf
Since 44 psf > 40 psf : OK

Conclusion:
Use 800S162-54 section spaced at 16" o.c. Web stiffeners are not required based on an end bearing length of 3.5". If end bearing length is less than 3.5", web crippling must be checked.

7.4 CURTAIN WALL – Single span

Given:
Specified (unfactored) wind load = 30 psf
Stud height = 12'-0"
Stud spacing = 24" o.c.
Deflection limit = L/360
Select a stud section

Solution:
Try 600S162-43 studs at 24" o.c.
From Single Span Curtain Wall Limiting Heights table under 30 psf specified wind load, the limiting stud height is 12'-4"
Since 12'-4" > 12'-0" .: OK

**Conclusion:**
Use 600S162-43 section spaced at 24" o.c. Web stiffeners are not required.

### 7.5 CURTAIN WALL – Double span

**Given:**
Specified (unfactored) wind load = 50 psf
Stud height = 10'-0"
Stud spacing = 24" o.c.
Deflection limit = L/360
Select a stud section

**Solution:**
Try 800S162-43 studs at 24" o.c.
From Double Span Curtain Wall Limiting Heights table under 50 psf specified wind load, the limiting stud height is 10'-3"
Since 10'-3" > 10'-0" .: OK

**Conclusion:**
Use 800S162-43 section spaced at 24" o.c. Web stiffeners are required at end and interior supports.

### 7.6 USE OF WEB CRIPPLING DATA TABLE – Single Web Member

**Given:**
Single web C-section
Depth = 8 in.
Designation thickness = 54 mil; Base Design Thickness, \( t = 0.0566 \) in.
Bearing length, \( N = 3 \) in.

_Determine the factored end-one-flange (EOF) web crippling resistance._

**Solution:**
From the Factored Web Crippling Data table for Single Web Members
\[ P_{eo1} = 305 \text{ lb}; \quad P_{eo2} = 107 \text{ lb} \]
\[ P_{EOF} = P_{eo1} + P_{eo2} \sqrt{\frac{N}{t}} = 305 + 107 \sqrt{\frac{3}{0.0566}} = 1,084 \text{ lb} \]

**Conclusion:**
The factored end-one-flange (EOF) web crippling resistance, \( P_{EOF} = 1,084 \text{ lb} \).