BAILEY METAL PRODUCTS LIMITED

PREFACE

BAILEY METAL PRODUCTS LIMITED

Founded in 1950, Bailey Metal Products has grown to be Canada's largest manufacturer of lightweight steel framing products for commercial and residential construction. Our products include structural Lightweight Steel Framing (LSF), Non-loadbearing steel framing, drywall trims and accessories, ceiling grid, ComSlab® composite floor system, and vinyl and paper-faced metal bead. Bailey manufacturing facilities are located in Vancouver, Calgary, Edmonton, Toronto, and Montreal. We ship across Canada and the United States, as well as to our export customers around the world.

LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED®)

The LEED® rating system is a third party certification program for green buildings. It was developed to foster innovative, environmentally friendly and energy efficient design and construction of buildings in North America. Bailey products contribute greatly towards building LEED® certification in the **Materials & Resources** LEED® credit category. More specifically, our products can contribute to LEED® credit attainment within **MR** sub-categories of **Construction Waste Management**, **Recycled Content** and **Regional Materials**.

Additionally, through our partnership with ArcelorMittal Dofasco, Bailey Metal Products is an authorized manufacturer of building products eligible for use of both the EcoLogo and Asthma Society of Canada designation. When designing your next LEED® building project, please contact your nearest Bailey Division for more information.

Asthma.ca
Asthma Society of Canada
Building products made with ArcelorMittal Dofasco steel promote a healthy indoor air environment.

EcoLogo
ArcelorMittal Dofasco steel is certified to Ecologo™ standard CCD-150 "Steel for Use in Construction Products"

REFERENCE STANDARDS

NBCC	National Building Code of Canada
CAN/CSA-S136	North American Specification for the Design of Cold-Formed Steel Structural Members
ASTM A653/A653M	Standard Specification for Steel Sheet Zinc-Coated (Galvanized or Zinc-Iron Alloy Coated [Galvannealed]) by the Hot-Dip Process
ASTM C1007	Standard Specification for Installation of Load Bearing (Transverse & Axial) Steel Studs and Related Accessories
ASTM C955	Standard Specification for Load Bearing (Transverse & Axial) Steel Studs, Runners (Tracks), & Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
CAN/ULC-S101	Standard Methods of Fire Endurance Tests of Building Construction and Materials

This document provides load tables for Bailey cold-formed steel studs and joists, supplemented by section property data for the component parts.

Computer output has typically been rounded to three significant figures. Trailing zeros after the third significant digit have no meaning.

There are significant changes from the 2004 issue of these tables:

- S136-07 (North American Specification for the Design of Cold-Formed Steel Structural Members) with S136S2-10 (Supplement 2) and the 2010 National Building Code of Canada are followed.
- Distortional buckling has been introduced in S136-07 as a new limit state. To assist users with this new criterion, section properties data is expanded to include the basic parameters necessary for calculating distortional buckling of studs and joists. Also, a new parameter, $k_{\phi min}$, is introduced which represents the threshold sheathing stiffness necessary to raise the distortional buckling moment or axial load to its yield value. This should make it easier for users to choose an appropriate sheathing to reduce the effect of distortional buckling where it governs.
- S136-07 has introduced a new interaction requirement – combined torsion and bending. This effect is captured as a reduction factor on fully restrained moment. Only the unsheathed axial load bearing studs are affected by this interaction and then only when axial load stresses are small relative to wind load stresses.
- The lip lengths for joists with 2.5" and 3" flange widths have been reduced from 0.75" to 0.625". These lip lengths have been adjusted for conformance with the North American Standard for Cold-Formed Steel Framing - Product Data, 2007 Edition, AISI S210-07.
- The load and importance factors are revised in accordance with the requirements of the 2010 National Building Code of Canada.

Disclaimer: Please note that we have taken all possible steps to ensure that the information within this publication is accurate and complies with accepted industry practice at the time of publication. However, Bailey Metal Products Limited assumes no responsibility and expressly disclaims all liability for errors or omissions in, and use or interpretation by others, of any direct, indirect, special, incidental or consequential damage or any other damages whatsoever and howsoever caused, arising out of or in connection with the use of or in reliance on the information included in this brochure. We strongly recommend that this information only be used in conjunction with advice from a qualified professional regarding its suitability for any specific application, and we reserve the right to change the information included herein without notification.

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1.) INTRODUCTION

The technical data in these reports 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.) SECTION GEOMETRIES

2.1) Section geometries are identified by the product designation method described in Commentary Item 9.

2.2) Stud and joist lip lengths are as follows:

Section	Flange Width (in.)	Lip Length (in.)
S125	1.250	0.1875
S162	1.625	0.5000
S200	2.000	0.6250
S250	2.500	0.6250
S300	3.000	0.6250

2.3) Stud, Joist, Track and Bridging Channel Inside Bend Radii are as follows:

Thickness (in.)	Inside Radius (in.)
0.0346	0.0764
0.0451	0.0712
0.0566	0.0849
0.0713	0.1069
0.1017	0.1525

3.) STUD AND JOIST SECTION PROPERTIES TABLES

3.1) Structural properties are computed in accordance with CSA Standard S136-07, North American Specification for the Design of Cold-Formed Steel Structural Members with S136S2-10 (Supplement 2).

3.2) Steel shall meet the requirements of S136-07 and S136S2-10 (Supplement 2) with a minimum yield strength of 33 ksi for design thicknesses less than or equal to 0.0451" and 50 ksi for design thicknesses greater than or equal to 0.0566".

3.3) Section properties are computed on the basis of the design thicknesses shown in the tables. Design thicknesses are exclusive of coating.

3.4) Perforations are assumed to be located at mid-depth and spaced at a minimum of 24" o.c. The distance from the centreline of the last perforation to the end of a wall stud or joist is assumed to be 12" minimum.

3.5) The increase in yield from the cold work of forming is conservatively neglected.

3.6) The maximum unbraced length, L_u, which precludes lateral buckling in beams is calculated from the formulae in the Commentary on North American Specification for the Design of Cold-Formed Steel Structural Members, 2007 Edition, AISI S100-2007-C, published by the American Iron and Steel Institute (*Formulae C-C3.1.2.1-11, C-C3.1.2.1-12 & C-C3.1.2.1-14*). K_y, K_t and C_b are set equal to one.

***3.) STUD AND JOIST SECTION PROPERTIES TABLES** (continued)*

3.7) Factored resistances include the following resistance factors:

Moment	Φ_b = 0.90 for local buckling and global buckling Φ_b = 0.85 for distortional buckling
Axial Compression	Φ_c = 0.80 for local buckling and global buckling Φ_b = 0.80 for distortional buckling
Shear	Φ_v = 0.80
Web Crippling	Φ_w = 0.75 (see Item 3.9)

3.8) The deflection inertia, I_x, includes the effects of local buckling at the stress level resulting from specified live loads (approximated by 0.6 x F_y). This inertia is only appropriate for checking serviceability limit states.

3.9) Web Crippling

3.9.1) Studs

For the web crippling capacity of steel stud flexural members with stud to track connections susceptible to web crippling, S136-07 refers to the North American Standard for Cold-Formed Steel Framing – Wall Stud Design, AISI S211-07.

The wall stud web crippling calculations assume the following:

- Track thickness equal to or greater than the stud thickness
- Both flanges of the stud attached to the track
- Studs not adjacent to wall openings or discontinuities in the track
- Minimum bearing length = 1"
- The distance from the centreline of the last perforation to the end of the stud = 305 mm (12") minimum (*for R_c = 1 from S136-07 C3.4.2*)

3.9.2) Joists

Web crippling capacities are based on the provisions of S136-07 with the end one-flange loading fastened to support condition. A 88.9 mm (3.5") minimum bearing length is assumed. The distance from the centreline of the last perforation to the end of the joist = 305 mm (12") minimum. (*for R_c = 1 from S136-07 C3.4.2*)

3.10) Distortional Buckling

3.10.1) Distortional buckling properties and factored resistances are based on the unperforated section.

3.10.2) Neither S136-07, Sections A - G, nor do these tables include provisions for the weak axis distortional buckling of studs or joists (lips in compression). Where weak axis distortional buckling is a concern, additional calculation is required.

3.10.3) A new property $k_{\Phi min}$ is provided which represents the threshold sheathing stiffness, k_Φ, necessary to raise the distortional buckling moment or axial nominal resistance to its yield value.

4.) TRACK AND BRIDGING CHANNEL SECTION PROPERTIES TABLES

4.1) The previous Commentary Items 3.1 - 3.3, 3.6 and 3.8 apply except that for bridging channels minimum yield strengths of 33 ksi and 50 ksi are provided for each thickness.

4.2) The actual inside to inside track depth is the nominal track depth given in the tables plus one inside bend radius. For bridging channels the actual outside to outside depth is the depth given in the tables.

4.3) The factored moment resistance, Mrx, is derived using effective section properties with the cold work of forming conservatively neglected. Factored shear and moment resistances, V_r and Mr_x, include a 0.8 and 0.9 resistance factor respectively.

5.) WIND BEARING STUD ALLOWABLE HEIGHT TABLES

5.1) The allowable heights are computed in accordance with the requirements of the National Building Code of Canada 2010 and S136-07, North American Specification for the Design of Cold-Formed Steel Structural Members with S136S2-10 (Supplement 2).

5.2) Stud material, geometry and properties conform to the Stud Section Property Tables and Commentary Item 3.

5.3) Strength allowable heights are limited by end shear or midspan moment at the factored load level shown. The factored shear resistance is based on the perforated section. Factored moment resistance is the lesser of the fully restrained resisting moment for local buckling (*based on the perforated section with a resistance factor of 0.9*) and the resisting moment for distortional buckling (*based on the unperforated section with a resistance factor of 0.85*). Since the sheathing is not relied on to reduce the effect of distortional buckling, k_Φ is set to zero in the distortional buckling calculations.

5.4) Sheathing providing full lateral support on both sides of the studs is assumed. The sheathings are to have adequate durability, strength & rigidity to prevent the studs from buckling laterally and to resist the torsional component of loads not applied through the shear centre. In addition to the sheathing requirements outlined above, you must also:

- provide bridging at 5'-0" o.c. or less in order to align members and to provide the necessary structural integrity during construction and in the completed structure.
- design the bridging to prevent stud rotation and translation about the minor axis.
- provide periodic anchorage and/or blocking-in for the bridging as required structurally.

5.5) Wind loads are assumed to be uniformly distributed. Seismic loads are not considered.

5.6) The deflection allowable height (L/360) is calculated for the specified wind loads shown without imposing any strength limit states. In no case shall the deflection allowable height exceed the strength allowable height.

Allowable heights for deflection limits not shown can be calculated by multiplying the L/360 allowable heights by the following factors:

Required Deflection Limit	Factor
L/1000	0.711
L/720	0.794
L/600	0.843
L/360	1.000
L/240	1.145
L/180	1.260

5.) WIND BEARING STUD ALLOWABLE HEIGHT TABLES (continued)

5.7) Web crippling allowable heights are limited by stud web crippling in the top or bottom track at factored loads.

5.8) Design end connections for the applied wind shear. Asterisks indicate heights where the factored end reaction exceeds the factored web crippling resistance, P_r. Reduce the allowable height to the value provided for web crippling or design end connections that are not susceptible to web crippling.

5.9) Refer to the Design Example for Wind Bearing Stud (*Commentary Item 10*).

6.) COMBINED WIND AND AXIAL LOAD BEARING STUD TABLES

6.1) SHEATHED AND UNSHEATHED

6.1.1) The factored loads are computed in accordance with the requirements of the National Building Code of Canada 2010 and S136-07, North American Specification for the Design of Cold-Formed Steel Structural Members with S136S2-10 (Supplement 2).

6.1.2) Stud material, geometry and properties conform to the Stud Section Properties Table and Commentary Item 3.

6.1.3) Wind loads shown are factored and uniformly distributed over the surface of the wall. Axial loads are factored and are per stud.

6.1.4) Loads without asterisks do not exceed L/360 deflection under wind alone. Loads with asterisks do not exceed L/180 deflection under wind alone. The wind loads used to calculate these deflection limits are specified wind loads given by the factored wind load shown divided by 1.4 and multiplied by 0.75 (*1.4 is the load factor and 0.75 the SLS importance factor*). The magnification of deflection by axial load is neglected.

Other deflections limits can be checked using the Wind Bearing Stud Allowable Height Tables.

6.1.5) Seismic loads are not considered

6.1.6) Web crippling is not checked. Design the stud end connections to transmit the applied wind shear and axial load. Refer to the Wind Bearing Stud Tables for limiting stud heights to determine where web crippling applies. Where web crippling is critical, bearing stiffeners at the top and bottom track may be required. Refer to S136-07.

6.1.7) Where dead, live, snow and wind loads are combined, the appropriate load combination factors must be applied before using the tables.

6.1.8) Refer to the Design Example for Combined Wind & Axial Load Bearing Stud (*Commentary Item 12*).

6.2) SHEATHED TABLES

6.2.1) The factored axial loads are limited by the interaction of axial load and major axis bending due to wind. End shear due to wind alone is also checked.

- The factored shear resistance is based on the perforated section.
- The factored moment resistance used in the interaction equation is the lesser of the fully restrained resisting moment for local buckling (*based on the perforated section with a resistance factor of 0.9*) and the resisting moment for distortional buckling (*based on the unperforated section with a resistance factor of 0.85*). Since the sheathing is not relied on to reduce the effect of distortional buckling, k_Φ is set to zero in the distortional buckling flexural calculations.

***6.) COMBINED WIND AND AXIAL LOAD BEARING STUD TABLES** (continued)*

6.2) SHEATHED TABLES (continued)

6.2.1) (continued)

- The factored axial resistance used in the interaction equation is the lesser of the global/local buckling value (*based on the perforated section with a resistance factor of 0.80*) and the distortional buckling value (*based on the unperforated section with a resistance factor of 0.80*). Since the sheathing is not relied on to reduce the effect of distortional buckling, k_Φ is set to zero in the distortional buckling axial calculations. Global axial buckling is based on major axis flexural buckling over the height of the stud.

6.2.2) Ideal sheathing providing full lateral support on both sides of the studs is assumed. The sheathing and its fasteners are assumed to have adequate durability, strength and rigidity to prevent the studs from buckling laterally and to resist the torsional component of loads not applied through the shear centre. (*Many wallboard and sheathing materials are less than ideal and provide partial support only. S136-07, Section D4, references the North American Standard for Cold-Formed Steel Framing Wall Stud Design, AISI S211-07 for a less than ideal sheathed design methodology. Alternatively, sheathing braced design in accordance with an appropriate theory, tests, or rational engineering analysis is permitted.*)

6.2.3) Axial loads are assumed to be concentrically applied to studs with respect to the X and Y axes. (*Some end connection details can introduce significant eccentricities which will reduce the stud capacities given in the tables.*)

6.2.4) Provide bridging at 4'-0" o.c. or less in order to align members and to provide the necessary structural integrity during construction and in the completed structure. Design the bridging to prevent stud rotation and translation about the minor axis. Provide periodic anchorage for the bridging as required structurally.

6.2.5) Effective lengths are calculated as follows (only major axis buckling is considered):

- $K_x = 1$
- L_x = the overall length of the stud

6.2.6) Studs are treated as compressive members in frames that are braced against joint translation. Provide the necessary bracing to adequately control the sidesway of the overall structure either due to wind, seismic loads or P-Δ (delta) effects.

6.3 UNSHEATHED TABLES

6.3.1) The factored axial loads are limited by the interaction of axial load and major axis bending due to wind. End shear due to wind alone is also checked.

- The factored shear resistance is based on the perforated section.
- The factored moment resistance used in the interaction equation is the lesser of the resisting moment for lateral torsional/local buckling (*based on the perforated section with a resistance factor of 0.9*) and the resisting moment for distortional buckling (*based on the unperforated section with a resistance factor of 0.85*). Since the sheathing is not relied on to reduce the effect of distortional buckling, k_Φ is set to zero in the distortional buckling flexural calculations.

6.) COMBINED WIND AND AXIAL LOAD BEARING STUD TABLES *(continued)*

6.3 UNSHEATHED TABLES *(continued)*

6.3.1) (continued)

- The factored axial resistance used in the interaction equation is the lesser of the global/local buckling value (*based on the perforated section with a resistance factor of 0.80*) and the distortional buckling value (*based on the unperforated section with a resistance factor of 0.80*). Since the sheathing is not relied on to reduce the effect of distortional buckling, k_{Φ} is set to zero in the distortional buckling axial calculations. Global buckling is based on the lesser of major axis flexural buckling over the height of the stud, minor axis flexural buckling between lines of bridging and torsional-flexural buckling between lines of bridging.

6.3.2) The combined bending and warping torsion limit state (*S136-07 Section C3.6*) is checked under wind alone. The worst case with a line of bridging at midheight is considered. The torsional eccentricity due to wind is taken as the distance from the shear centre to the centreline of the web. *The provisions of S136-07 Section C3.6 are modified for the purposes of these tables. Full unreduced section properties are conservatively used to calculate bending stresses and then when combined bending and torsion at the tip of the lip governs a correction is applied to the S136-07 provisions for the reduction factor, R.*

6.3.3) Sheathing is not relied on to restrain the studs. Periodic lateral and torsional support is assumed to be provided by bridging spaced at a maximum of 48" o.c. The bridging need not be spaced equally over the height of the stud provided that the 48" spacing limit between lines of bridging and between the last line of bridging and the end of the stud is adhered to. The ends of the studs are also assumed to be laterally and torsionally restrained.

Design bridging for the accumulated torsion between bridging lines (*S136-07 Section D3.2.1*) in combination with the discrete bracing requirements (*S136-07 Section D3.3*). Provide periodic anchorage for the bridging as required structurally.

6.3.4) Axial loads are assumed to be concentrically applied to studs with respect to the X and Y axes. (*Some end connection details can introduce significant eccentricities which will reduce the stud capacities given in the tables.*)

6.3.5) Effective lengths are calculated as follows (*major axis, minor axis and torsional-flexural buckling is considered*):

- K_x, K_y and K_t = 1
- L_x = the overall length of the stud
- L_y, L_t = maximum distance between lines of bridging

6.3.6) Studs are treated as compressive members in frames that are braced against joint translation. Provide the necessary bracing to adequately control the sidesway of the overall structure either due to wind, seismic loads or P-Δ (delta) effects.

7.) FLOOR JOIST LOAD TABLES

7.1) The load tables are computed in accordance with the requirements of the National Building Code of Canada 2010 and S136-07, North American Specification for the Design of Cold-Formed Steel Structural Members with S136S2-10 (Supplement 2).

7.2) Joist material, geometry & properties conform to the Joist Section Property Tables and Commentary Item 3.

***7.) FLOOR JOIST LOAD TABLES** (continued)*

7.3) Strength loads are limited by end shear or midspan moment at the factored load shown. Strength loads are to be checked against the sum of the factored live and dead loads. The live load factor is 1.5 and the dead load factor is 1.25. Deflection loads are to be checked against specified (unfactored) design live loads.

- The factored shear resistance is based on the perforated section.
- For the $k_\Phi = 0$ joist tables, the sheathing is not relied on to reduce the effect of distortional buckling. The factored moment resistance is the lesser of the fully restrained resisting moment for local buckling (*based on the perforated section with a resistance factor of 0.9*) and the resisting moment for distortional buckling, assuming $k_\Phi = 0$ (*based on the unperforated section with a resistance factor of 0.85*).
- For the $k_\Phi \geq k_{\Phi min}$ joist tables, the sheathing is relied on to control distortional buckling. The factored moment resistance is the lesser of the fully restrained resisting moment for local buckling (*based on the perforated section with a resistance factor of 0.9*) and the resisting moment for yield (*based on the unperforated section unreduced for local buckling with a resistance factor of 0.85*).
- The parameter $k_{\Phi min}$ is the threshold sheathing stiffness necessary to raise the distortional buckling moment to its yield value. Additional calculation is required to determine whether or not a particular sheathing provides adequate restraint. For many sheathing and joist combinations, it is difficult to achieve $k_\Phi \geq k_{\Phi min}$ and partial restraint only is available meaning $0 \leq k_\Phi \leq k_{\Phi min}$. For this case, the distortional buckling resisting moment can be calculated to determine if it governs or, conservatively, the $k_\Phi = 0$ tables can be used.

7.4) No vibration limit state is imposed. Additional calculation is required.

7.5) Concentrated loading is not considered in the load tables. Additional calculation is required.

7.6) Joists are analyzed as single span members with adequate web stiffeners provided at the location of reactions or concentrated loads. Spans are not limited by web crippling. Design web stiffeners to accommodate concentrated loads or reactions. Refer to S136-07.

7.7) Joists are assumed to be fully restrained with respect to lateral instability and with respect to torsionally eccentric loads not applied through the shear centre. Loads are assumed to be uniformly distributed.

7.8) Allowable specified loads for other deflection limits can be calculated by multiplying the L/360 specified loads by the following factors:

Required Deflection Limit	Factor
L/480	0.750
L/360	1.000
L/300	1.200
L/240	1.500
L/180	2.000

7.9) Provide floor sheathing supplemented by bridging as required by S136-07. (S136-07 references the North American Standard for Cold-Formed Steel Framing – Floor and Roof System Design, AISI S210-07, where detailed requirements are provided.)

7.10) Refer to the Design Example for Floor Joist (Commentary Item 11).

8.) COMPUTER OUTPUT SYMBOLS

A = out to out depth of stud (in. or mm)
= out to out depth of bridging channel (in. or mm)
= nominal depth of track (in. or mm)

Area = fully effective (unreduced for local buckling) area (in.^{2} or mm^2)

B = out to out width of flange (in. or mm)

C = out to out depth of lip stiffener (in. or mm)

C_w = warping torsional constant (in.^{6} or mm^6)

F_d = elastic distortional buckling stress (ksi or MPa)

F_y = minimum yield strength (ksi or Mpa)

I_x = fully effective (unreduced for local buckling) moment of inertia about the major axis (in.4 or mm4)

I_x (deflect.) = effective moment of inertia about the major axis for checking deflections with specified (unfactored) loads (in.4 or mm4)

I_y = fully effective (unreduced for local buckling) moment of inertia about the minor axis (in.4 or mm4)

J = St. Venant torsional constant (in.4 or mm4)

j = torsional-flexural buckling parameter for singly symmetric beam-columns (in. or mm)

k_Φ = rotational stiffness provided by a restraining element (kips or kN)

$k_{\Phi min}$ = threshold sheathing stiffness necessary to raise the distortional buckling moment or axial load to its yield value (kips or kN)

$k_{\Phi fe}$ = elastic rotation stiffness provided by the flange to the flange/web juncture (kips or kN)

$\tilde{k}_{\Phi fg}$ = geometric rotational stiffness demanded by the flange from the flange/web juncture (in.2 or mm2)

$k_{\Phi we}$ = elastic rotational stiffness provided by the web to the flange/web juncture (kips or kN)

$\tilde{k}_{\Phi wg}$ = geometric rotational stiffness demanded by the web from the flange/web juncture(in.2 or mm2)

L_{cr} = distortional buckling critical unbraced length (in. or mm)

L_u = maximum unbraced length of flexural members which precludes lateral buckling (in. or mm)

m = distance from centreline web to the shear centre (in. or mm)

M_{rx} = fully braced factored moment resistance about the major axis with a resistance factor of 0.9 (in.kips or kN.m)

M_{rx_DB} = distortional buckling factored moment resistance about the major axis with a resistance factor of 0.85 (in.kips or kN.m)

*8.) **COMPUTER OUTPUT SYMBOLS** (continued)*

Mr_{x_Fy} = factored moment resistance at yield used in distortional buckling calculations and taken about the major axis with a resistance factor of 0.85 (in.kips or kN.m)

M_{rx_LB} = fully braced local buckling factored moment resistance about the major axis with a resistance factor of 0.9 (in.kips or kN.m)

M_{ry_LB} = fully braced local buckling factored moment resistance about the minor axis with the web in compression or with the lips in compression with a resistance factor of 0.9 (in.kips or kN.m)

P_r = factored web crippling resistance with a resistance factor of 0.75 (kips or kN)

P_{r_DB} = distortional buckling factored axial resistance with a resistance factor of 0.80 (kips or kN)

P_{r_Fy} = factored axial resistance at yield used in distortional buckling calculations with a resistance factor of 0.80 (kips or kN)

r = inside bend radius (in. or mm)

r_x = fully effective (unreduced for local buckling) radius of gyration about the major axis (in. or mm)

r_y = fully effective (unreduced for local buckling) radius of gyration about the minor axis (in. or mm)

S_f = fully effective (unreduced for local buckling) section modulus (in.3)

t = design steel thickness exclusive of coating (in. or mm)

V_r = factored shear resistance with a resistance factor of 0.80 (kips or kN)

Weight = weight per foot based on uncoated, unperforated steel (lbs./ft. or kg/m)

Wn1 = normalized unit warping parameter at the end of the lip (in.2 or mm2)

Wn2 = normalized unit warping parameter at the intersection of the lip and the flange (in.2 or mm2)

Wn3 = normalized unit warping parameter at the intersection of the flange and the web (in.2 or mm2)

x_{cg} = distance to centroid from back of web for the fully effective section (unreduced for local buckling) (in. or mm)

x_o = distance from shear centre to centroid (in. or mm).

Notes:

1.) For metric section properties, the units shown in the section property tables may be adjusted by E+03 or E+06 which means the section property values are to be multiplied by 1,000 or 1,000,000 respectively.

2.) All distortional buckling properties and resistances are based on the unperforated section unreduced for local buckling.

9.) PRODUCT IDENTIFICATION

The cold-formed steel framing manufacturers use a universal designator system for their products. The designator is a four part code which identifies depth, flange width, member type and material thickness.

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"

600 S 162 - 54

Style:
S = Stud or joist sections
T = Track sections
U = Channel sections
F = Furring channel sections

Material thickness in 1/1000ths inches.
Thus 54 means 54/1000 = 0.054"

Notes:

1. *Material thickness is given as the minimum thickness exclusive of coatings and represents 95% of the design thickness. See S136-07 Section A2.4.*
2. *For those sections available in two different yield strengths, the yield strength used in the design, if greater than 33 ksi, needs to be identified (i.e., 600S162-54 (50 ksi)). In any case, it is good practice to always show the yield strength and eliminate any potential ambiguity.*
3. *For track, "T", sections, member depth is a nominal inside to inside dimension plus one inside radius. Other dimensions are out to out.*
4. *This product designation method is also known as "STUF" nomenclature.*
5. *This product labelling is independent of units. For example 600S162-54 (50ksi) applies whether imperial or metric units are used.*

10.) DESIGN EXAMPLE NO. 1 – WIND BEARING STUD

Given:

Specified (unfactored) design wind load for strength calculations = 30 psf (I_w = 1)

Specified (unfactored) design wind load for deflection calculations = 22.5 psf (I_w = 0.75)

Height of studs = 11'-0"

Maximum allowable deflection = L/360

Stud depth for architectural considerations = 6"

10.) DESIGN EXAMPLE NO. 1 – WIND BEARING STUD *(continued)*

Calculations:

Try 600S162-43 (33 ksi) spaced at 24" o.c.

From the Wind Bearing Studs Tables:

Allowable height for deflection is based on 22.5 psf specified wind load – conservatively use 25 psf.
Allowable height at L/360 = 12.6 ft. > 11.0 ft. ***OK***

Allowable height for strength is based on 30 psf specified wind load (42 psf factored)
Allowable height = 12.4 ft. > 11.0 ft. ***OK***

The asterisk on the strength allowable height indicates that an end connection not susceptible to web crippling is required or the allowable height is to be reduced below 12.4 ft.

Allowable height to eliminate web crippling is based on 30 psf specified wind load (42 psf factored)
Web Crippling Allowable height = 11.9 ft. > 11.0 ft. ***OK***

Conclusion:

Use 600S162-43 (33 ksi) spaced at 24" o.c. with 2 rows of bridging.

Bridging requirements are based on the recommended 5'-0" maximum spacing from Commentary Item 5.4. In addition, sheathing meeting the requirements of Commentary Item 5.4 are required on both sides of the studs. Provide bridging and bridging connection details in accordance with industry standard practice.

11.) DESIGN EXAMPLE NO. 2 – FLOOR JOIST

Given:

Specified (unfactored) live load = 40 psf

Specified (unfactored) dead load = 15 psf

Required joist depth for architectural considerations = 8 in.

16'-0" single span

Sheathing is not relied on to reduce distortional buckling

Calculations:

Factored load = (1.25)(15) + (1.50)(40)
= 78.8 psf

Try 800S162-54 (50 ksi) joist spaced at 16" o.c.

From the $k_\Phi = 0$ Floor Joist Load Tables (*sheathing is not relied on to reduce the effect of distortional buckling*)

Strength = 91 > 78.8 psf ***OK***
L/360 = 44 > 40 psf ***OK***

Conclusion:

Use 800S162-54 (50 ksi) joist spaced at 16" o.c.

Provide web stiffeners over the supports designed in accordance with the requirements of S136-07. Provide top flange floor sheathing in combination with bottom flange bridging to meet the requirements of S136-07. See Commentary Item 6.9.

Where vibration or point loads are a concern, additional engineering is required.

***11.) DESIGN EXAMPLE NO. 2 – FLOOR JOIST** (continued)*

Alternative Approach:

Although not required in the context of this example, the $k_\Phi \geq k_{\Phi min}$ tables could be used where the sheathing is assumed to have adequate stiffness such that the distortional buckling moment is raised to its yield value.

To compare:

$k_\Phi = 0$ tables – strength value = 91 psf
$k_\Phi \geq k_{\Phi min}$ tables – strength value = 108 psf

The $k_\Phi \geq k_{\Phi min}$ tables show a 19% increase in strength. To take advantage of this extra strength, sheathing must satisfy the requirement that:

$k_\Phi \geq k_{\Phi min}$
≥ 0.653 kips from the Joist Section Property Tables

The calculation of the sheathing k_Φ value is outside the scope of this design example. Refer to: CFSEI Tech Note TECHNOTE-G100-08, September 2008, Design Aids and Examples for Distortional Buckling.

In any case, it may be difficult to achieve $k_\Phi \geq k_{\Phi min}$ and partial restraint only is available meaning $0 \leq k_\Phi \leq k_{\Phi min}$. The resulting strength value will fall somewhere between 91 and 108 psf. Additional calculation is required.

12.) DESIGN EXAMPLE NO. 3 – COMBINED WIND AND AXIAL LOAD BEARING STUD

Given:

Specified (Unfactored) Loads:

Axial Live Load = 3.6 kips
Axial Dead Load = 1.8 kips
Wind Load = 25 psf (for strength with Iw = 1)
= 18.8 psf (for deflection with Iw = 0.75)

Height of Studs = 10'- 0"

Restraint of sheathing to be neglected. Axial loads are applied concentrically with respect to both the X and the Y axes.

Calculations:

Try 600S162-54 (50 ksi) spaced at 16" o.c.

The required factored load combinations are given in the 2010 National Building Code.

Dead Only Load Case

<u>Factored Load Combination</u> = 1.40D

W_f (factored wind load) = 0

C_f (factored axial load) = 1.40D
= 1.40(1.8)
= 2.52 kips

From the unsheathed tables determine the maximum factored compressive resistance for 0 psf factored wind

C_r = 8.24 kips > 2.52 kips ***OK***

12.) DESIGN EXAMPLE NO. 3 – COMBINED WIND AND AXIAL LOAD BEARING STUD (continued)

Dead + Wind + Live Load Cases

<u>Factored Load Combination #1</u>	= 1.25D + 1.50L + 0.4W
W_f (factored wind load)	= 0.40W = 0.40(25) = 10.0 psf
C_f (factored axial load)	= 1.25D + 1.50L = 1.25(1.8) + 1.50(3.6) = 7.65 kips

From unsheathed tables, determine the maximum factored compressive resistance for 10.0 psf factored wind.

C_r = 7.69 kips > 7.65 kips **OK**

<u>Factored Load Combination #2</u>	= 1.25D + 1.40W + 0.5L
W_f (factored wind load)	= 1.40W = 1.40(25) = 35.0 psf
C_f (factored axial load)	= 1.25D + 0.50L = 1.25(1.8) + 0.50(3.6) = 4.05 kips

From the unsheathed tables, determine the maximum factored compressive resistance for 35.0 psf factored wind by interpolation

C_r = 6.62 kips (at 30 psf)
C_r = 6.10 kips (at 40 psf)

C_r = 6.36 kips (at 35 psf by interpolation) > 4.05 kips **OK**

Wind Load Case for Web Crippling Check

From the Wind Bearing Stud Allowable Height Tables, for 25 psf specified (35.0 psf factored) wind load

Web crippling allowable height = 48.6 > 10.0 ft. **OK**

Wind Load Case for Deflection Check

From the Wind Bearing Stud Allowable Height Tables, for 18.8 psf specified (unfactored) wind load – conservatively use 20 psf

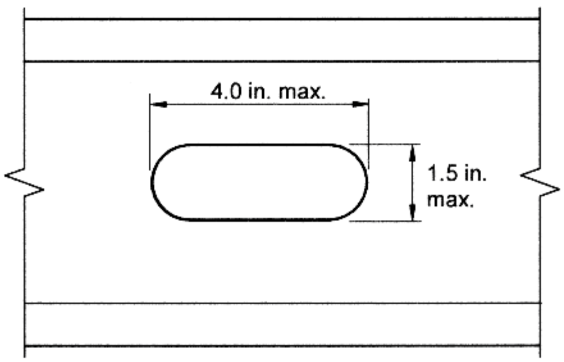
L/360 allowable height = 16.7 > 10.0 ft. **OK**

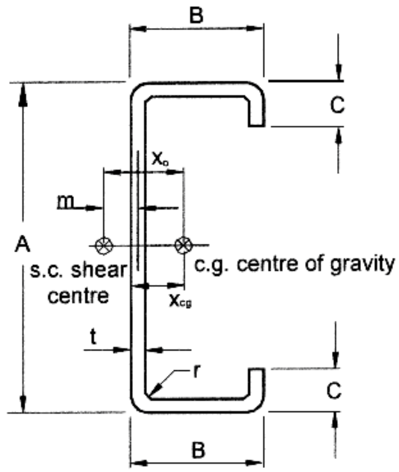
Conclusion:

Use 600S162-54 (50 ksi) spaced at 16" o.c. with 2 lines of bridging arranged so that the maximum spacing does not exceed 48" o.c. See Commentary Item 7.3.3.

Detail end connections to insure concentric axial loading with respect to the X and the Y axes and to transmit the end shear. Design bridging and its anchorage in accordance with the requirements of S136-07.

STUD & JOIST SECTION DIMENSIONS





TRACK & BRIDGING CHANNEL SECTION DIMENSIONS