LSF Design Examples to NBC 2005

The following design examples have been developed for use with the CSSBI publication 58-2004 “Lightweight Steel Framing Wall Stud & Floor Joist Load Tables”. These examples have been developed to provide guidance to the application of the CSSBI load tables in conformance with the 2005 National Building Code of Canada.

The tables given in CSSBI 58-2004 were created based on loads determined in accordance with NBC 1995. The load factor applied to wind now specified in the NBC 2005 has changed from 1.5 to 1.4, and the method of determining the load for serviceability (deflection) calculations has also changed. The changes from NBC 1995 to 2005 do not affect the validity of the tables in CSSBI 58-2004, only how the applicable loads are determined.

10. DESIGN EXAMPLE NO. 1 – WIND BEARING STUDS

Given:

Specified Live Load, L = 0 psf
Specified Dead Load, D = 0 psf
Specified Wind Load, W (1 in 50 year return period) = 30 psf
Wind load deflection limit = L/360
Building Category = Normal
Importance Factor for Wind, I_w (strength) = 1.0
Importance Factor for Wind, I_w (serviceability) = 0.75
Stud length = 11’ – 0”
Stud depth for architectural considerations = 6”
Stud spacing = 24” o.c.

Calculations:

Factored wind load for strength design = 1.4 I_w q = (1.4)(1.0)(30) = 42 psf
Specified wind load for checking deflection = I_w q = (0.75)(30) = 23 psf

Try 600S162-43 spaced at 24" o.c.

From the Wind Bearing Stud Allowable Height Tables:

Allowable height for deflection is based on 23 psf specified wind load derived from $q_{(1/50)}$ reference velocity pressure - conservatively use 25 psf.
Allowable height = 12.6 ft. > 11.0 ft. ***OK***

Allowable height for strength is based on 42 psf factored wind load derived from $q_{(1/50)}$ reference velocity pressure – conservatively use 45.5 psf.
Allowable height = 13.0 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 13.0 ft.

Allowable height to eliminate web crippling is based on 45.5 psf factored wind load derived from $q_{(1/50)}$ reference velocity pressure.
Allowable height = 11.3 ft. > 11.0 ft. ***OK***

Conclusion:

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

Bridging requirements are based on the recommended 5'-0" maximum spacing from Commentary Item 5.3. In addition, sheathing meeting the requirements of Commentary Item 5.3 is 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 JOISTS

Given:

Specified (unfactored) live load, L = 40 psf
Specified (unfactored) dead load, D = 15 psf
Deflection limit = L/360 for specified live load
Required joist depth for architectural considerations = 8 in.
16'-0" single span
Joist spacing = 16” o.c.

Calculations:

The combination of Principal and Companion loads are given in NBC 2005 as:

Case	Load Combination	
	Principal Loads	**Companion Loads**
1	1.4D	
2	1.25D + 1.5L	0.4W
3	N/A	N/A
4	N/A	N/A
5	N/A	N/A

N/A = Not applicable to this design example

Case 1: Dead only
Principal Loads = 1.4D= (1.4)(15) = 21 psf
Companion Loads = 0
Total = Principal + Companion = 21 psf

Case 2: Dead + Live
Principal Loads = 1.25D+1.5L= (1.25)(15)+(1.5)(40) = 78.8 psf
Companion Loads = 0
Total = Principal + Companion = 78.8 psf

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

Strength = 108 > 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 CAN/CSA-S136-01. Provide top flange floor sheathing in combination with 2 rows of bottom flange bridging to restrain the joists. Bridging requirements are based on the recommended 7'-0" maximum spacing from Commentary Item 6.8. Design sheathing and bridging and their connections in accordance with the requirements of CAN/CSA-S136-01.

Where vibration is a concern, additional engineering is required.

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

Given

Specified (Unfactored) Loads:
Axial Live Load, L = 3.9 kips
Axial Dead Load, D = 1.8 kips
Wind Load, W = 25 psf based on $q_{(1/50)}$
Building Category = Normal (NBC 2005)
Importance Factor for Wind, I_w (strength) = 1.0
Importance Factor for Wind, I_w (serviceability) = 0.75
Wind load deflection limit = L/720
Height of Studs = 10'- 0"
Stud spacing = 16” o.c.
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 combination of Principal and Companion loads are given in NBC 2005 as:

Case	Load Combination	
	Principal Loads	**Companion Loads**
1	1.4D	
2	1.25D + 1.5L	0.4W
3	N/A	N/A
4	1.25D +1.4W	0.5L
5	N/A	N/A

N/A = Not applicable to this design example

Case 1: Dead

Load Combination = 1.4D
C_f (factored axial load) = 1.4D = (1.4)(1.8)
= 2.52 psf

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

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

Case 2: Dead + Live + Wind

Load Combination = 1.25D + 1.5L + 0.4W
C_f (factored axial load) = 1.25D + 1.5L = 1.25(1.8) + 1.5(3.9)
= 8.10 kips
W_f (factored lateral load) = $0.4I_wW$ = (0.4)(1.0)(25) = 10 psf

From the unsheathed tables determine the maximum factored compressive resistance for 10 psf factored wind:
C_r = 7.73 kips < 8.10 kips ***NO GOOD***

Try thicker stud, try 600S162-68
C_r = 10.33 kips > 8.10 kips ***OK***

Case 3: N/A

Case 4: Dead + Wind + Live

Load Combination = 1.25D + 1.4W + 0.5L

W_f (factored lateral load) = $1.4I_wW$ = 1.4(1.0)(25)
= 35 psf

C_f (factored axial load) = 1.25D + 0.5L
= 1.25(1.8) + 0.5(3.9)
= 4.20 kips

From the unsheathed tables, determine the maximum factored compressive resistance of a 600S162-68, 10'-0" wall height, 16" spacing for 35 psf factored wind by interpolating between 30 and 40 psf:

C_r = 9.26 kips (at 30 psf)
C_r = 8.74 kips (at 40 psf)

C_r = 9 kips (at 35 psf by interpolation) > 4.20 kips ***OK***

Wind Load Case for Web Crippling Check

From the Wind Bearing Stud Allowable Height Tables, for 25 psf specified wind load:

Web crippling allowable height = 69.1 > 10.0 ft. ***OK***

Wind Load Case for Deflection Check

Specified wind load for checking deflection = I_w W = (0.75)(25) = 19 psf (conservatively use 20 psf specified load)

From the Wind Bearing Stud Allowable Height Tables, for 20 psf specified (unfactored) wind load, 600S162-68, 16" spacing:

L/360 allowable height = 17.9 > 10.0 ft. ***OK***

Conclusion:

Use 600S162-68 (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 CAN/CSA-S136-01.