Lightweight Steel Framing

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Steel Studs as Back-up for Brick Veneer Changes in NBC 2005

The structural design of steel stud brick veneer wall systems has undergone a number of changes with the implementation of NBC 2005 (*NRC 2005*) and CSA S304.1-04 (*CSA 2004a*). The major changes include:

- Load and importance factors for wind load are revised.
- Deflection limit is liberalized to L/360.
- Staggered ties are now permitted.
- Flexural bond strength is required to be not less than 0.2 MPa (29 psi).

These changes are discussed below in summary form. For other changes and more detail, refer to the appropriate code or standard.

Revised Load and Importance Factors for Wind Load

The current CSSBI wind bearing tables (*CSSBI 2004*) are based on the load factors in the 1995 National Building Code of Canada (*NRC 1995*). These CSSBI tables can be used for wind bearing stud selections conforming to the new load and importance factors in the NBC 2005 provided the procedure in the design example below is followed.

L/360 Deflection Limit

CSA S304.1-04 contains a new more liberal deflection limit for steel studs acting as back-up for brick veneer. The new limit is L/360 which has been relaxed from the previous deflection limit of L/720. (*In addition, the previous S304.1-94 (CSA 1994) required ties to have special mechanical play and stiffness requirements to be used in conjunction with the L/720 deflection limit. These special requirements have been removed. See CAN/CSA-A370-04 (CSA 2004b) for current requirements.*)

Deflection limits are imposed on steel stud back-up as a means of controlling the flexural crack width in the brick veneer and the resulting infiltration of rainwater that may occur. The new more liberal L/360 limit recognizes that there are a number of other effective strategies to control the infiltration of rainwater and the L/720 limit, as a minimum requirement, is no longer necessary. The other effective strategies include:

- Pressure moderation
- Air space free of accumulated mortar droppings
- Moisture barrier on the outside of the back-up system
- Well filled and tooled mortar joints
- Horizontal and vertical movement joints weatherproofed with appropriate sealants
- Robust & durable flashings with end dams, well sealed laps and appropriate drip detailing
- Protective overhangs.

Note that the new L/360 deflection limit can have a significant positive effect on the cost of the steel stud back-up. For the design example included here, the previous L/720 deflection criterion resulted in an 800S162-54 typical stud whereas the current L/360 limit only requires a 600S162-43 typical stud. See Note 1. The 600S162-43 stud represents a savings of 33% in steel weight and 2" reduction in wall thickness.

Staggered Ties

S304.1-04 now permits ties to be staggered horizontally on alternating studs provided that the stud spacing does not exceed 410 mm (16") o.c. and the resulting horizontal tie spacing does not exceed 820 mm (32") o.c. The stagger must be arranged so that

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that all studs have ties including the top row of ties. Refer to S304.1-04 Clause 9.1.3.1 for details.

This new stagger provision will result in a significant reduction in the number and therefore the cost of providing brick ties.

Flexural Bond Strength

Flexural bond strength is now required by S304.1-04 to be not less than 0.2 MPa (29 psi). This provision was introduced to provide a minimum level of strength, serviceability and resistance to moisture penetration for the brick veneer.

Design Example

Given:

Refer to a CSSBI Wind Bearing Stud Allowable Height Tables (CSSBI 2004) with the following details:

- Height = 14'-0"
- Spacing = 16" o.c.
- Specified wind load = 32 psf
- Deflection limit = L/360

Try 600S162-43 stud @ 16" o.c.

Note 1: 600S162-43 is a universal designator system adopted by LSF manufacturers for their products. For a description of the system, see CSSBI 2004.)

For strength (moment & shear):

Load factor for wind = 1.4
Factored wind, $w_f = 1.4(32) = 44.8$ psf

From CSSBI tables (*CSSBI 2004*), conservatively choose next highest factored wind load = 45 psf. (*Although not used here interpolation between factored wind loads is acceptable when required.*)

$H_{MAX} = 16.0' > 14.0'$ OK

For web crippling:

No asterisk appears on the strength allowable height, therefore, web crippling does not control. OK

For deflection:

Importance factor for wind, $I_w = 0.75$
Specified wind load for deflection = I_w (32) = 0.75(32) = 24 psf

From CSSBI tables (*CSSBI 2004*), conservatively choose next highest specified wind load = 25 psf. (*Although not used here interpolation between specified wind loads is acceptable when required.*)

$H_{MAX} = 14.5' > 14.0'$ OK

Final typical stud selection:

The 600S162-43 stud at 16" o.c. is satisfactory as brick veneer back-up for both strength and deflection. See Note 2.

Note 2: The previous code requirements for SSBV were based on a steel stud deflection requirement of L/720. For this design example, a deflection limit of L/720 would result in an 800S162-54 stud selection.

References

(*CSA 1994*) Canadian Standards Association. 1994. Masonry Design for Buildings (Limit States Design). S304.1-94.

(*CSA 2004a*) Canadian Standards Association. 2004. Design of Masonry Structures. S304.1-04.

(*CSA 2004b*) Canadian Standards Association. 2004. Connectors for Masonry. CAN/CSA-A370-04.

(*CSSBI 2004*) Canadian Sheet Steel Building Institute. 2004. Lightweight Steel Framing Wall Stud and Floor Joist Load Tables. CSSBI 58-04.

(*NRC 1995*) National Research Council of Canada. 1995. National Building Code of Canada 1995.

(*NRC 2005*) National Research Council of Canada. 2005. National Building Code of Canada 2005.