LightweightSteelFraming

August 2002

Technical BULLETIN

▸ Report on:

Structural Performance of Steel Framed Walls

Volume 8, Number 1

Lateral Load Resistance of Lightweight Steel Framed Walls for Residential Construction - A Laboratory Study

Lightweight Steel Framing (LSF) is a high quality, engineered product. Homes constructed with LSF benefit not only from the efficiency of steel itself but from the excellent performance that steel affords floors, walls and other assemblies in the structure. A couple of the reasons why LSF can outperform other framing materials are its high strength and stringent design requirements. Exploring this in more detail:

- LSF can have up to seven times the strength-to-weight ratio of dimensional lumber.
- LSF houses is designed to very stringent criteria. Whether the framing members are determined by an engineer or the perspective method developed by the Canadian Sheet Steel Building Institute, the design rules for the structure follow the requirements of Part 4 of the *National Building Code of Canada*.

A concern in residential construction, regardless of the framing material, is the lateral load resistance of exterior walls. This is the resistance to movement or deflection from lateral wind loading. Lateral load deflection is particularly important for walls having finishes such as exterior masonry (brick veneer) or stucco and interior drywall. These generally cannot tolerate movement in excess of L/240, where L is the span (height) of the wall, without jeopardizing aesthetics or increasing water penetration through the exterior finish. For brick veneer, NBCC Part 4, references Canadian Standards Association S304.1, which limits deflection in all flexible backup systems, including steel. The rule was developed with highrise structures in mind, not houses. NBCC Part 9 does not specify a limiting wall deflection. Conventional wood framed houses depend on the interaction of the wall frame with attached claddings and other adjoining walls to provide satisfactory lateral deflection performance. The LSF prescriptive method has taken lateral wall deflection into account witha limit of L/360 <u>for the steel frame alone.</u> Cladding and system interactions would further enhance the stiffness of a steel framed wall. The L/360 deflection limit was incorporated into the CSSBI *Residential Steel Framing Member Selection Tables*, which makes up part of the LSF prescriptive method.[1]

In order to explore the lateral resistance capability of LSF for the wall frame alone, and to gauge the performance relative to conventional wood framing, a series of tests were conducted. The testing was carried out under the direct supervision of Prof. R.M. Schuster, P.Eng., Director of Canadian Cold Formed Steel Research Group at the University of Waterloo.

Testing Programme

Wall frame panel specimens were fabricated using LSF and wood, then subjected to an equivalent uniformly distributed lateral load. A total of six tests were conducted, three for each material. The wall panel specimens were fabricated in accordance with common and prescribed construction practices for the material used.

The panels were 1.22 m (4 ft.) wide and 2.44 m (8 ft.) long. The four studs in each panel were placed 406 mm (16 inch) o.c. The panels were tested in a horizontal position. Since the limiting deflection criteria for LSF is based on the steel framing alone, sheets of drywall were placed on, but not connected to the studs, in order to avoid composite action and to provide a more accurate deflection assessment of the framing members alone. The drywall also provided a surface upon which the load could be placed.

Deflection transducers were placed at each interior centreline stud location. Uniform loading was progressively applied using bar bell weights distributed over the panel surface. Three successive load applications were applied, 0.68, 1.35 and 2.02 kPa (14.1, 28.2 and 42.2 psf).

1 The CSSBI *Residential Steel Framing Installation Manual* is another part of the LSF prescriptive method.

Canadian Sheet Steel Building Institute
652 Bishop St. N., Unit 2A
Cambridge, Ontario N3H 4V6
Tel.: (519) 650-1285
Fax: (519) 650-8081
Web Site: www.cssbi.ca

Report on:

Structural Performance of Steel Framed Walls

Steel Panel Specimens

All LSF (stud and track) was supplied by a CSSBI rollforming member in conformance with the requirements outlined in the CCMC approved CSSBI *Residential Steel Framing Member Selection Tables*. The studs were C-sections with nominal dimensions of 41 x 92 x 0.84 mm (1-5/8 x 3-5/8 x 0.033 inch). The track sections also had a nominal base steel thickness of 0.84 mm (0.033 inch). All stud C-sections had the typical pre-punched holes, 38 (deep) x 102 (long) mm (1-1/2 x 4 inch), spaced at 610 mm (24 inches) o.c. along each stud web centreline. Each stud was attached to the top and bottom track section with two #8 self-drilling wafer head screws, connecting each stud flange to the track according to the CCMC approved installation procedures.

Tensile coupon test specimens were cut from randomly selected steel specimens to verify conformance with the material requirements in the LSF prescriptive method.

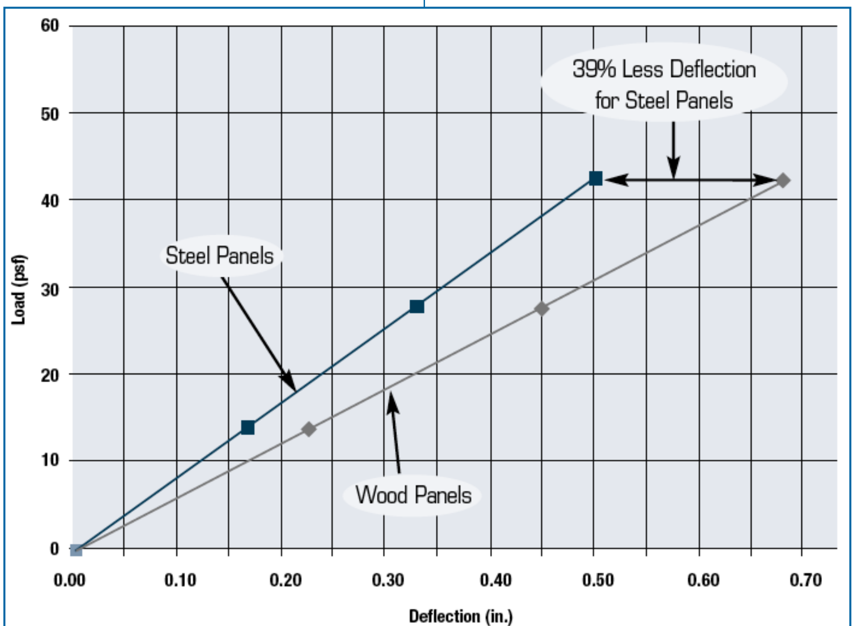

Figure 1 - Average Load-Deflection Curves of Wall Panels

Averages determined from 3 panel tests in each case.

- Steel
- Wood

Wood Panel Specimens

All wood material, 2 x 4 inch nominal, SPF S-Dry, was purchased from a local lumber yard. The actual measured dimensions of the wood members were 38 x 89 mm (1-1/2 x 3-1/2 inch). The size and spacing of the nails (common, 3-1/4 inch) used to fabricate the panels was in accordance with NBCC Table 9.23.3.4. No notching or drilling was done to any of the wood members so the full gross cross sectional area of the member was used in the test panels.

Test Results & Conclusions

Load-deflection curves were generated for each test specimen using the recorded deflection data. Curves of the average test values were created as shown in Figure 1.

Based on result of testing, it can be seen that the steel panel specimens, even when constructed with the thinnest nominal loadbearing LSF stud material, outperform the wood specimens. In addition the deflection measured in LSF panels was more consistent than in the wood framed panels.

Interpolation of the average deflection measurements show that at the imposed L/360 deflection limit for LSF (6.7 mm), the corresponding load is approximately 1.08 kPa (22.5 psf). This exceeds the reference velocity wind load, q (l/30), for all but one locale listed in the climatic data in Appendix C in the NBCC.

The testing programme clearly demonstrates that steel wall panels outperform wood in resisting lateral loading in a laboratory setting by demonstrating less deflection (by as much as 39% at full test load). This means less chances of drywall or veneer cracking and improved structural performance.

For More Information from CSSBI

For more information on sheet steel building products, or to obtain other CSSBI publications, contact the CSSBI at the address shown below or visit the website at www.cssbi.ca.