Lightweight Steel Framing

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Lightweight Steel Framing Shear Walls

A new standard, *North American Standard for Cold-Formed Steel Framing – Lateral Design*, AISI S213, is available for the design of shear walls in buildings constructed with lightweight steel framing. AISI S213 addresses both wind and seismic forces and is intended for adoption and use in the United States, Canada and Mexico. The Canadian portion of AISI S213 is consistent with the National Building Code of Canada 2005 and in particular, the new seismic requirements.

Both the wind and seismic provisions in AISI S213 assume a shear wall with steel stud chords, infill steel studs and attached sheathing acting as a shear element. Alternatively, the sheathing can be replaced by diagonal strap braces.

For the sheathed wall systems, design data is provided including factored shear resistances and the seismic ductility and overstrength force modification factors, R_d and R_o. The following sheathing materials are included:

- wood based panels screw attached (*CSP, DFP or OSB in various thicknesses*)
- gypsum panels screw attached (*12.5 mm thick*).

A deflection equation is also provided for wood sheathed walls.

For diagonal strap shear walls, R_d and R_o values are provided. Factored resistances are to be calculated by CSA S136 with some additional design rules in AISI S213 to insure ductile behaviour of the straps.

For both sheathed and diagonal strap shear walls, building height limitations are imposed for seismic design. These limitations are a function of site specific seismic data taken from NBC 2005. The use of gypsum sheathed shear walls (*for both wind and seismic*) is limited by both height and the percentage of shear walls relying on gypsum sheathing. There must be a mix of gypsum shear walls and wood sheathed shear walls since it is not permitted to rely on gypsum shear walls for 100% of the lateral load resistance of the building.

In AISI S213, sheathed shear walls are treated as either Type I or Type II as illustrated in the attached figures taken from the AISI S213 Commentary. Figure 1 illustrates a Type I shear wall without detailing for force transfer around the openings. In this case, the portion of the wall with openings is neglected resulting in two independent shear walls each with their own hold-down anchors. If force transfer around the openings is accommodated, then the shear wall behaves as one large Type I wall with hold-down anchors at the ends as illustrated in Figure 2. Figure 3 illustrates a Type II shear wall which includes openings but here there is no special detailing for force transfer around the openings. For this case, AISI S213 requires a reduction in shear capacity to reflect the structural inefficiency of the openings.

Fundamental to the Canadian seismic provisions in AISI S213 is the concept of capacity based design. This approach provides a fuse element in the seismic force resisting system which must be able to carry seismic loads over extensive inelastic displacements without sudden failure. For sheathed shear walls, the shear walls themselves can be thought of as the fuse elements but more specifically, it is the wood sheathing-to-steel framing connections that fail in a ductile fashion. For diagonal strap shear walls, it is the strap itself that is the fuse element. The capacity based design approach also stipulates that all other elements in the lateral load carrying path must be designed to withstand the probable capacity of the fuse element which takes into account any overstrength that may exist. AISI S213 provides specific design guidance for these overstrength requirements and also provides threshold R_dR_o values when capacity based design is not required.

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The Canadian design provisions in AISI S213 are substantially based on research undertaken at McGill University under the supervision of professor Colin Rogers. AISI S213 will eventually be referenced in CSA S136 and as such will be recognized directly by the National Building Code of Canada. In the interim, AISI S213 will meet either of the following provisions in NBC 2005:

- NBC/05 Clause 4.1.1.5 (2): Here structural systems that are "not amenable to analysis" can be accepted if the appropriate testing is done by a person "especially qualified in the specific methods applied" to meet "a level of safety and performance in accordance with the requirements of Part 4." The McGill testing as presented in AISI S213 meets the requirements of this clause.
- NBC/05 Division A, Clause 1.2.1.1 (1) (b): Here structural systems "that will achieve at least the minimum level of performance required by Division B" are permitted as "alternate solutions". Once again, AISI S213 meets these requirements.

To take advantage of these new shear wall provisions, the following documents should be obtained:

- CSA S136 (*order from www.csa.ca*)
- AISI S213 & AISI S200 (*order from www.steel.org*)

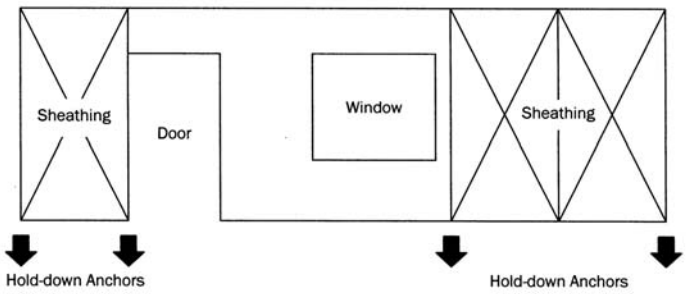

Figure 1 • Type I Shear Walls Without Detailing for Force Transfer Around Openings (from AISI S213 Commentary)

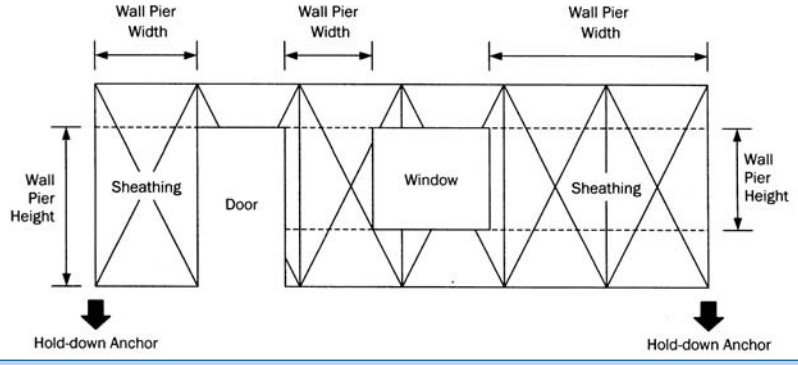

Figure 2 • Type I Shear Walls With Detailing for Force Transfer Around Openings (from AISI S213 Commentary)

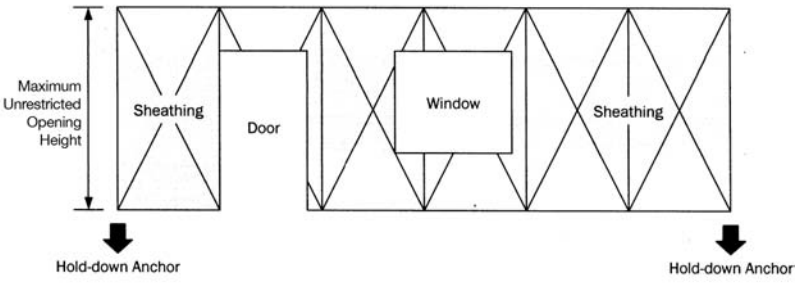

Figure 3 • Typical Type II Shear Wall (from AISI S213 Commentary)

References

(AISI S200) American Iron and Steel Institute. 2007. *North American Standard for Cold-Formed Steel Framing – General Provisions*, AISI S200-07

(AISI S213) American Iron and Steel Institute. 2007. *North American Standard for Cold-Formed Steel Framing – Lateral Design*, AISI S213-07

(CSA S136) Canadian Standards Association. 2007. *North American Specification for the Design of Cold-Formed Steel Structural Members*, CSA S136-07

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