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American Iron and Steel Institute

AISI STANDARD

North American Standard for Cold-Formed Steel Framing – Lateral Design 2007 Edition with Supplement No. 1

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Endorsed by:

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With anticipated improvements in understanding of the behavior of cold-formed steel framing and the continuing development of new technology, this material will become dated. It is anticipated that AISI will publish updates of this material as new information becomes available, but this cannot be guaranteed.

The materials set forth herein are for general purposes only. They are not a substitute for competent professional advice. Application of this information to a specific project should be reviewed by a design professional. Indeed, in many jurisdictions, such review is required by law. Anyone making use of the information set forth herein does so at their own risk and assumes any and all liability arising therefrom.

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PREFACE

The American Iron and Steel Institute Committee on Framing Standards has developed AISI S213, the *North American Standard for Cold-Formed Steel Framing – Lateral Design*, to address the design of lateral force resisting systems to resist wind and seismic forces in a wide range of buildings constructed with cold-formed steel framing. This standard is intended for adoption and use in the United States, Canada and Mexico.

This standard provides an integrated treatment of Allowable Strength Design (ASD), Load and Resistance Factor Design (LRFD), and Limit States Design (LSD). This is accomplished by including the appropriate resistance factors (ϕ) for use with LRFD and LSD, and the appropriate factors of safety (Ω) for use with ASD. It should be noted that LSD is limited to Canada and LRFD and ASD are limited to Mexico and the United States.

Changes made in Supplement No. 1 to the 2007 Edition include the following:

- R_d values in Table A4-1 for diagonal *strap* braced (concentric) walls were adjusted to match the values approved by the Canadian National Committee on Earthquake Engineering (CANCEE) for inclusion in the National Building Code of Canada (NBCC) seismic provisions.
- Language in C1.1 was modified to clarify when design must comply with the special seismic requirements.
- The existing provisions on setbacks in Section C2, which the Committee thought should be limited to prescriptive methods with defined limits of applicability, were replaced with a requirement deemed to be more appropriate for a design standard.
- Adjustments were made to Table C2.1-3 for 0.027" steel sheet, one side, based on testing at the University of North Texas (Yu, 2007). Designation thickness for stud, track and blocking associated with the existing tabulated values was increased from 33 mils (min.) to 43 mils (min.). New values were added for designation thickness for stud, track and blocking equal to 33 mils (min.).
- Equation C2.1-1 for determining the design deflection of a blocked wood structural panel or sheet steel shear wall was consolidated for US Customary and SI units.
- The word "countersunk" was deleted and commentary added to clarify provisions for tapping screws to attach wood structural panel sheathing in Section C2.2.2.
- Language in C3.3.2 was modified to clarify when the uplift anchorage and boundary chords must comply with the special seismic requirements.
- The design provisions of Section C5.3, Seismic Forces Contributed by Masonry and Concrete Walls, and Section C5.4, Seismic Forces from Other Concrete or Masonry Construction, were relocated under Section C1, General.
- A definition for *amplified seismic load* was added under Section A2, Definitions.
- Equation D2.1-1 for determining the design deflection of a blocked wood structural panel diaphragm was consolidated for US Customary and SI units.

The report referenced above, *Steel Sheet Sheathing Options for Cold-Formed Steel Framed Shear Wall Assemblies Providing Shear Resistance* (Yu, 2007), is available as a free download from the American Iron and Steel Institute (www.steel.org) and Steel Framing Alliance (www.steelframing.org).

The Committee acknowledges and is grateful for the contributions of the numerous engineers, researchers, producers and others who have contributed to the body of knowledge on the subjects. The Committee wishes to also express its appreciation for the support of the

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Steel Framing Alliance and the Canadian Sheet Steel Building Institute.

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NORTH AMERICAN STANDARD FOR COLD-FORMED STEEL FRAMING –LATERAL DESIGN

A. GENERAL

A1 Scope

The design and installation of *cold-formed steel* light-framed *shear walls,* diagonal *strap bracing* (that is part of a structural wall) and *diaphragms* to resist wind, seismic and other in-plane lateral loads shall be in accordance with the provisions of AISI S200, the additional requirements of this standard and the *applicable building code*.

This standard shall not preclude the use of other materials, assemblies, structures or designs not meeting the criteria herein, when the other materials, assemblies, structures or designs demonstrate equivalent performance for the intended use to those specified in this standard. Where there is a conflict between this standard and other reference documents, the requirements contained within this standard shall govern.

This standard shall include Sections A through D inclusive.

A2 Definitions

Where terms appear in this standard in italics, such terms shall have meaning as defined in AISI S200 or as defined herein. Where a country is indicated in brackets following the definition, the definition shall apply only in the country indicated. Where terms are not italicized, such terms shall have ordinary accepted meaning in the context for which they are intended.

Amplified Seismic Load. Load determined in accordance with the *applicable building code* load combinations that include the system overstrength factor, Ω_o, for strength design (LRFD). [USA and Mexico]

Capacity Based Design. Method for designing a *seismic force resisting system* in which a) specific elements or mechanisms are designed to dissipate energy; b) all other elements are sufficiently strong for this energy dissipation to be achieved; c) structural integrity is maintained; d) elements and connections in the horizontal and vertical load paths are designed to resist these seismic loads and corresponding principal and companion loads as defined by the *NBCC*; e) *diaphragms* and *collector* elements are capable of transmitting the loads developed at each level to the vertical *seismic force resisting system*; and f) these loads are transmitted to the foundation. [Canada]

Fiberboard. A fibrous, homogeneous panel made from lignocellulosic fibers (usually wood or cane) and having a density of less than 31 pounds per cubic foot (pcf) (497 kg/m^3) but more than 10 pcf (160 kg/m^3).

Seismic Force Resisting System. That part of the structural system that has been considered in the design to provide the required resistance to the earthquake forces and effects. [Canada]

Type II Shear Wall Segment. Section of *shear wall* (within a *Type II shear wall*) with full-height sheathing (i.e., with no openings) and which meets specific aspect ratio limits.

A3 Symbols and Notations

C = Boundary chord force (tension/compression) (lbs, kN)

C_a = Shear resistance adjustment factor from Table C3.2-1

E = Effect of horizontal and vertical seismic forces as defined in the *applicable building code*

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F_a = Acceleration-based site coefficient, as defined in *NBCC* [Canada]
F_v = Velocity-based site coefficient, as defined in *NBCC* [Canada]
I_E = Earthquake importance factor of the structure, as defined in *NBCC* [Canada]
L_i = Width of *Type II shear wall segment* (inches, mm)
R = Seismic response modification coefficient as defined by the *applicable building code*
R_n = *Nominal strength*
R_d = Ductility-related force modification factor reflecting the capability of a structure to dissipate energy through inelastic behavior, to be used with *NBCC* [Canada]
R_o = Overstrength-related force modification factor accounting for the dependable portion of reserve strength in a structure, to be used with *NBCC* [Canada]
$S_a(T)$ = 5% damped spectral response acceleration, expressed as a ratio to gravitational acceleration, for a period T, as defined in *NBCC* [Canada]
V = Shear force in *Type II shear wall* (lbs, kN)
h = Height of a *shear wall* measured as (1) the maximum clear height from top of foundation to bottom of *diaphragm* framing above, or (2) the maximum clear height from top of a *diaphragm* to bottom of *diaphragm* framing above
ΣL_i = Sum of widths of *Type II shear wall segments* (feet, m)
v = Unit shear force (plf, kN/m)
w = Width of a *shear wall,* pier or *diaphragm* in the direction of application of force measured as the sheathed dimension of the *shear wall,* pier or *diaphragm*
ϕ = *Resistance factor* to be used in determining the *design strength* in *LRFD* and *LSD*
Ω = *Safety factor* to be used in determining the *allowable strength* in *ASD*
Ω_o = System overstrength factor as defined by the *applicable building code*

A4 Loads and Load Combinations

Buildings or other structures and all parts therein shall be designed to safely support all loads that are expected to affect the structure during its life in accordance with the *applicable building code*. In the absence of an *applicable building code*, the loads, forces, and combinations of loads shall be in accordance with accepted engineering practice for the geographical area under consideration as specified by the applicable sections of *Minimum Design Loads for Buildings and Other Structures* (*ASCE 7)* in the United States and Mexico, and the *National Building Code of Canada* (*NBCC)* in Canada.

A4.1 Modification Factors and Limitations in Canada

Ductility related force modification factors, R_d, overstrength related force modification factors, R_o, and restrictions for *cold-formed steel* light-framed structures that are to be designed for seismic loads in conjunction with the *National Building Code of Canada* shall be as listed in Table A4-1. In addition, gypsum board shear walls shall not be used alone to resist lateral loads and the use of gypsum board in shear walls shall be limited to structures four stories or less, in accordance with Table A4-2.

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Table A4-1
Canada
Design Coefficients and Factors for Seismic Force Resisting Systems in Canada

Type of Seismic Force Resisting System	R_d	R_o	Building Height (m) Limitations [1]				
			Cases Where $I_E F_a S_a(0.2)$				Cases Where $I_E F_v S_a(1.0)$
			< 0.2	≥0.2 to <0.35	≥0.35 to ≤0.75	>0.75	>0.3
Shear Walls [2]							
Screw connected shear walls: wood-based structural panel	2.5	1.7	20	20	20	20	20
Screw connected shear walls: wood based structural and gypsum panels in combination	1.5	1.7	20	20	20	20	20
Diagonal Strap Braced (Concentric) Walls [3]							
Limited ductility braced wall [4]	1.9	1.3	20	20	20	20	20
Conventional construction [5]	1.2	1.3	15	15	NP	NP	NP
Other Cold-Formed Steel SFRS(s) Not Listed Above	1.0	1.0	15	15	NP	NP	NP

1. NP = Not Permitted.
2. *Seismic Force Resisting System* specifically detailed for ductile seismic performance. *Capacity based design* approach is applied, assuming the sheathing connections act as the energy-dissipating element (See Section C5.1).
3. *Seismic Force Resisting System* specifically detailed so that all members of the bracing system are subjected primarily to axial forces. The eccentric effect due to single sided bracing is neglected for purposes of this classification, but shall be considered in accordance with C5.2.2.3.
4. *Seismic Force Resisting System* specifically detailed for ductile seismic performance. *Capacity based design* approach is applied, assuming the braces act as the energy-dissipating element (gross cross-section yielding). See Section C5.2.
5. Lateral system not specifically detailed for ductile seismic performance (*Capacity based design* approach not required. See Section C5.2).

Table A4-2
Canada
Maximum Percentage of Total Shear Forces Resisted by Gypsum Board in a Story

Story	Percentage of Shear Forces			
	Stories in Building			
	4	3	2	1
4th	80	-	-	-
3rd	60	80	-	-
2nd	40	60	80	-
1st	40	40	60	80

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A5 Referenced Documents

The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document.

1. AHA A194.1-85, *Cellulosic Fiberboard*, 1985 Edition, American Hardwood Association, Palatine, IL.
2. AISI S100-07, *North American Specification for the Design of Cold Formed Steel Structural Members*, American Iron and Steel Institute, Washington, DC.
3. AISI S200-07, *North American Standard for Cold-Formed Steel Framing – General Provisions*, American Iron and Steel Institute, Washington, DC.
4. ASCE 7-05 Including Supplement No. 1, *Minimum Design Loads for Buildings and Other Structures*, American Society of Civil Engineers, Reston, VA.
5. ASTM A1003/A1003M-05, *Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members*, ASTM International, West Conshohocken, PA.
6. ASTM C208-95(2001), *Standard Specification for Cellulosic Fiber Insulating Board*, ASTM International, West Conshohocken, PA.
7. ASTM C954-04, *Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness*, ASTM International, West Conshohocken, PA.
8. ASTM C1002-04, *Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs*, ASTM International, West Conshohocken, PA.
9. ASTM C1396/C1396M–06, *Standard Specification for Gypsum Board*, ASTM International, West Conshohocken, PA.
10. ASTM C1513-04, *Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections*, ASTM International, West Conshohocken, PA.
11. ASTM E2126-05, *Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Walls for Buildings*, ASTM International, West Conshohocken, PA.
12. CAN/CSA-O325.0-92 (R2003), *Construction Sheathing*. Canadian Standards Association, Mississauga, Ontario, Canada.
13. CAN/CSA-S136-07, *North American Specification for the Design of Cold-Formed Steel Structural Members*, Canadian Standards Association, Mississauga, Ontario, Canada.
14. CSA-O121-M1978 (R2003), *Douglas Fir Plywood*. Canadian Standards Association, Mississauga, Ontario, Canada.
15. CSA-O151-04, *Canadian Softwood Plywood*. Canadian Standards Association, Mississauga, Ontario, Canada.
16. DOC PS 1-07, *Structural Plywood*, United States Department of Commerce, National Institute of Standards and Technology, Gaithersburg, MD.
17. DOC PS 2-04, *Performance Standard for Wood-Based Structural-Use Panels*, United States Department of Commerce, National Institute of Standards and Technology, Gaithersburg, MD.
18. NBCC 2005, *National Building Code of Canada*, 2005 Edition, National Research Council of Canada, Ottawa, Ontario, Canada.

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B. GENERAL DESIGN REQUIREMENTS

B1 General

The proportioning, design and detailing of *cold-formed steel* light-framed systems, members, connections and connectors shall be in accordance with AISI S100 [CSA S136], AISI S200 and the referenced documents except as modified by the provisions of this standard.

The lateral force resisting systems shall be subject to the limitations in the *applicable building code*.

B2 Shear Resistance Based on Principles of Mechanics

The shear resistance of *diaphragms*, diagonal *strap bracing* and *shear walls* is permitted to be calculated by principles of mechanics using values of fastener strength and sheathing shear resistance. The *nominal strength* [*nominal resistance*] so calculated defines the maximum resistance that the *diaphragm*, *shear wall*, or diagonal *strap bracing* is capable of developing. *Available strength* [*factored resistance*] shall be computed based on the wind and seismic force requirements in the *applicable building code*. Calculated values for systems defined in this standard shall be scaled to the values in this standard.

B3 Framing and Anchorage

Boundary members, *chords*, *collectors* and connections thereto shall be proportioned to transmit the induced forces and, where required by this standard, the following:

(a) ***In the United States and Mexico***: *Amplified seismic loads*.

(b) ***In Canada***: Probable seismic resistance of the shear wall or diagonal *strap bracing* following a capacity based design approach.

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C. WALLS

C1 General

The design of *shear walls* or systems using diagonal *strap bracing* that resist wind, seismic or other in-plane lateral loads, as permitted, shall comply with the requirements of this section. *Shear walls* shall be classified as either *Type I shear walls*, which shall meet the requirements of Section C2, or shall be classified as *Type II shear walls*, which shall meet the requirements of Section C3. Diagonal *strap bracing*, as part of a structural wall, shall meet the requirements of Section C4.

Where setbacks of structural walls create an offset between them on an upper and lower story, the floor diaphragm and floor framing shall be designed to transfer overturning and shear forces through the offset in accordance with this standard and the *applicable building code*.

C1.1 Seismic Requirements

The design shall comply with these provisions exclusive of those in Section C5 when the following is applicable:

(a) ***In the United States and Mexico:*** The seismic response modification coefficient, R, (for steel systems) is taken equal to or less than 3, in accordance with the *applicable building code*.

(b) ***In Canada:*** R_dR_o is taken equal to or less than 2 for sheathed *shear walls*, and equal to or less than 1.625 for diagonal strap braced walls, in accordance with the *applicable building code*. For sheathed *shear walls*, the height restrictions in Table A4-1 shall apply. For diagonal strap braced walls, the height restrictions corresponding to conventional construction shall apply.

The design shall comply with these provisions inclusive of those in Section C5 when the following is applicable:

(a) ***In the United States and Mexico:*** The seismic response modification coefficient, R, (for steel systems) is taken greater than 3, in accordance with the *applicable building code*.

(b) ***In Canada:*** R_dR_o is taken greater than 2 for sheathed *shear walls*, and greater than 1.625 for diagonal strap braced walls, in accordance with the *applicable building code*. The height restrictions in Table A4-1 shall apply.

C1.2 Seismic Forces Contributed by Masonry and Concrete Walls

Shear walls, diagonal *strap bracing* and *diaphragms* shall be permitted to be used to resist seismic forces contributed by masonry or concrete walls in structures under the following conditions:

(a) *Cold-formed steel* floor and roof members shall be permitted to be used in *diaphragms* to resist horizontal seismic forces contributed by masonry or concrete walls in structures over one story in height, provided such forces do not result in torsional force distribution through the *diaphragm*.

(b) Wood structural panel or steel sheet sheathed *shear walls* shall be permitted to be used to provide resistance to seismic forces in two-story structures of masonry or concrete walls, provided the following requirements are met:

(1) Story-to-story wall heights shall not exceed 12 feet (3.66 m).

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(2) *Diaphragms* shall not be considered to transmit lateral forces by torsional force distribution or cantilever past the outermost supporting *shear wall*.

(3) Combined deflections of *diaphragms* and *shear walls* shall not permit per story drift of supported masonry or concrete walls to exceed 0.7% of the story height at *LRFD design* [*LSD factored*] *load* levels.

(4) Wood structural panel sheathing in *diaphragms* shall have all unsupported edges blocked. Wood structural panel or steel sheet sheathing for both stories of *shear walls* shall have all unsupported edges blocked and, for the lower story, shall have a minimum thickness of 15/32″ (12 mm) wood structural panel or 0.027″ (0.683 mm) steel sheet sheathing.

(5) There shall be no out-of-plane horizontal offsets between the first and second stories of wood structural panel or steel sheet sheathed *shear walls* or diagonal *strap bracing*.

C1.3 Seismic Forces from Other Concrete or Masonry Construction

Cold-formed steel members and systems shall be permitted to be designed to resist seismic forces from other concrete or masonry components, including but not limited to: chimneys, fireplaces, concrete or masonry veneers, and concrete floors.

C2 Type I Shear Walls

A *Type I shear wall* shall be fully sheathed and shall be provided with *hold-down anchors* at each end of the wall segment. *Type I shear walls* sheathed with wood structural or sheet steel panels are permitted to have openings, between *hold-down anchors* at each end of a wall segment, where details are provided to account for force transfer around openings.

The *nominal strength* [*nominal resistance*] for *Type I shear walls*, as shown in Tables C2.1-1 through C2.1-5 for wind, seismic and other in-plane lateral loads, as permitted and applicable, shall be permitted to establish *available strength* for such walls. The *available strength* [*factored resistance*] shall be determined using the *safety factor* (Ω) or the *resistance factor* (ϕ) as set forth in Section C2.1.

The height to width aspect ratio (h/w) of a wall pier in a *Type I shear wall* with openings shall be limited to a maximum of 2:1. The height of a wall pier (h) shall be defined as the height of the opening adjacent to the sheathed wall. The width of a wall pier (w) shall be defined as the sheathed width of the pier adjacent to the opening. The width of a wall pier shall not be less than 24 inches (610 mm).

The height to width aspect ratio (h/w) of the *Type I shear wall* shall not exceed the values in Tables C2.1-1, C2.1-2, C2.1-3, C2.1-4 and C2.1-5, unless permitted in a footnote to the table. The width of a *Type I shear wall* shall not be less than 24 inches (610 mm).

C2.1 Available Strength (Factored Resistance)

The *available strength* [*factored resistance*] shall be determined by using the *nominal strength* [*nominal resistance*] shown in Tables C2.1-1 through C2.1-5, as permitted and applicable, and dividing by the appropriate *safety factor* (Ω) or multiplying by the appropriate *resistance factor* (ϕ), as follows:

Ω = 2.50 for ASD (seismic)

Ω = 2.00 for ASD (wind or other in-plane lateral loads)

ϕ = 0.60 for LRFD (seismic)

ϕ = 0.65 for LRFD (wind or other in-plane lateral loads)

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ϕ = 0.70 for LSD (except as noted below)

ϕ = 0.60 for LSD (gypsum sheathed walls)

Where a height to width aspect ratio (h/w) of a *shear wall* segment is greater than the tabulated value, as permitted in footnotes to Tables C2.1-1, C2.1-3 and C2.1-4, the *available strength* [*factored resistance*] shall be multiplied by 2w/h, but in no case shall the height to width aspect ratio (h/w) exceed 4:1.

The *available strength* [*factored resistance*] for shear panels with different sheathing materials and fastener configurations applied to the same side of a wall is not cumulative. For walls with material of the same type and *nominal strength* [*nominal resistance*] applied to opposite faces of the same wall, the *available strength* [*factored resistance*] of material of the same capacity is cumulative. Where the material *nominal strengths* [*nominal resistances*] are not equal, the *available strength* [*factored resistance*] shall be either two times the *available strength* [*factored resistance*] of the material with the smaller value or shall be taken as the value of the stronger side, whichever is greater. Summing the *available strengths* [*factored resistance*] of dissimilar material applied to opposite faces or to the same wall line is not allowed unless permitted by Table C2.1-1

C2.1.1 Design Deflection

The deflection of a blocked wood structural panel or sheet steel *shear wall* fastened throughout shall be permitted to be calculated in accordance with the following:

$$\delta = \frac{2vh^3}{3E_s A_c b} + \omega_1 \omega_2 \frac{vh}{\rho G t_{sheathing}} + \omega_1{}^{5/4} \omega_2 \omega_3 \omega_4 \left(\frac{v}{\beta}\right)^2 + \frac{h}{b}\delta_v \qquad (Eq.\ C2.1\text{-}1)$$

where

A_c = Gross cross-sectional area of *chord* member, in square inches (mm^2)

b = Width of the *shear wall*, in inches (mm)

E_s = Modulus of elasticity of steel = 29,500,000 psi (203,000 MPa)

G = Shear modulus of sheathing material, in pounds per square inch (MPa)

h = Wall height, in inches (mm)

s = Maximum fastener spacing at panel edges, in inches (mm)

$t_{sheathing}$ = Nominal panel thickness, in inches (mm)

t_{stud} = Framing designation thickness, in inches (mm)

v = Shear demand (V/b), in pounds per linear inch (N/mm)

V = Total lateral load applied to the *shear wall*, in pounds (N)

β = 67.5 for plywood and 55 for OSB for U.S. Customary ($lb/in^{1.5}$)

= 2.35 for plywood and 1.91 for OSB for SI units ($N/mm^{1.5}$)

= 41.67 ($t_{sheathing}/0.018$) for sheet steel (for $t_{sheathing}$ in inches) ($lb/in^{1.5}$)

= 1.45 ($t_{sheathing}/0.457$) for sheet steel (for $t_{sheathing}$ in mm) ($N/mm^{1.5}$)

δ = Calculated deflection, in inches (mm)

δ_v = Vertical deformation of anchorage/attachment details, in inches (mm)

ρ = 1.85 for plywood and 1.05 for OSB

= $0.075(t_{sheathing}/0.018)$ for sheet steel (for $t_{sheathing}$ in inches)

= $0.075(t_{sheathing}/0.457)$ for sheet steel (for $t_{sheathing}$ in mm)

ω_1 = s/6 (for s in inches) and s/152.4 (for s in mm) (*Eq.* C2.1-2a)

ω_2 = $0.033/t_{stud}$ (for t_{stud} in inches) and $0.838/t_{stud}$ (for t_{stud} in mm) (*Eq.* C2.1-2b)

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$$\omega_3 = \sqrt{\frac{(h/b)}{2}} \qquad (Eq.\ C2.1\text{-}3)$$

$$\omega_4 = 1 \text{ for wood structural panels}$$

$$= \sqrt{\frac{33}{F_y}} \text{ (for } F_y \text{ in ksi)} \qquad (Eq.\ C2.1\text{-}4a)$$

$$= \sqrt{\frac{227.5}{F_y}} \text{ (for } F_y \text{ in MPa) for sheet steel} \qquad (Eq.\ C2.1\text{-}4b)$$

C2.2 Limitations for Tabulated Systems

The lateral resistant systems listed in Tables C2.1-1, C2.1-2, C2.1-3, C2.1-4 and C2.1-5 shall conform to the following requirements:

1. *Studs* shall be *C-shape* members with a minimum thickness of 33-mil, minimum *flange* width of 1-5/8 inches (41.3 mm), minimum *web* depth of 3-1/2 inches (89 mm) and minimum *edge stiffener* of 3/8 inches (9.5 mm) unless otherwise noted.
2. *Track* shall be a minimum thickness of 33 mils with a minimum *flange* width of 1-1/4 inches (31.8 mm) and a minimum *web* depth of 3-1/2 inches (89 mm) unless otherwise noted.
3. Framing screws shall be a minimum No. 8 in accordance with ASTM C1513.
4. Fasteners along the edges in shear panels shall be placed in from panel edges not less than the following, as applicable:
   (a) ***In the United States and Mexico***: 3/8 inches (9.5 mm).
   (b) ***In Canada***: 12.5 mm (1/2 inch).
5. Panel thicknesses shown shall be minimums.
6. Panels less than 12 inches (305 mm) wide shall not be used.
7. Maximum framing spacing shall be 24 inches (610 mm) on center.
8. Unless otherwise noted, all sheathing edges shall be attached to framing members or *blocking*. Where used as *blocking*, flat strapping shall be a minimum thickness of 33 mils with a minimum width of 1-1/2 inches (38.1 mm) and shall be either installed on top of or below sheathing. For other than steel sheathing, the screws shall be installed through the sheathing to the *blocking*.

C2.2.1 Sheet Steel Sheathing in the United States and Mexico

Steel sheets, attached to *cold-formed steel* framing, shall be permitted to resist horizontal forces produced by wind, seismic or other in-plane lateral loads subject to the following:

1. Steel sheets shall have a minimum *base steel thickness* as shown in Tables C2.1-1 or C2.1-3, and shall be of the following grade of steel: ASTM A1003 Structural Grade 33 (Grade 230) Type H.
2. *Nominal strengths* shall be given in Tables C2.1-1 for wind and other in-plane lateral loads and Table C2.1-3 for seismic loads. Table C2.1-3 shall also be permitted for calculating the *nominal strength* for wind and other in-plane lateral loads.
3. Steel sheets shall be permitted to be applied either parallel to or perpendicular to framing.
4. In lieu of *blocking*, panel edges shall be permitted to be overlapped and attached to each other with screw spacing as required for panel edges. Where such a connection is used, tabulated design values shall be reduced 30 percent.

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5. Screws used to attach steel sheets shall be a minimum No. 8 or No. 10 in accordance with Table C2.1-3.

C2.2.2 Wood Structural Panel Sheathing

Cold-formed steel framed wall systems, sheathed with wood structural panels, shall be permitted to resist horizontal forces produced by wind, seismic or other in-plane lateral loads subject to the following:

1. Wood structural panels shall be manufactured using exterior glue and shall comply with the following, as applicable:
   (a) ***In the United States and Mexico:*** DOC PS 1 or PS 2.
   (b) ***In Canada:*** CSA O121, O151 or CAN/CSA O325.0.
2. *Nominal strengths* [*resistances*] shall be as given in the following tables, as applicable:
   (a) ***In the United States and Mexico:*** Tables C2.1-1, for wind and other in-plane lateral loads and Table C2.1-3, for seismic loads. Table C2.1-3 shall also be permitted for calculating the *nominal strength* for wind and other in-plane lateral loads.
   (b) ***In Canada:*** Table C2.1-4 for wind, seismic and other in-plane lateral loads.
3. Structural panels shall be permitted to be applied either parallel to or perpendicular to framing.
4. Wood structural panels shall be attached to steel framing with a minimum No. 8, tapping screws with a minimum head diameter of 0.285 inch (7.24 mm) or No. 10, tapping screws with a minimum head diameter of 0.333 inch (8.46 mm), in accordance with Table C2.1-3.
5. Screws used to attach wood structural panel sheathing shall be in accordance with ASTM C1513.
6. ***In the United States and Mexico:*** Where 7/16" OSB is specified, 15/32" Structural 1 Sheathing (plywood) shall be permitted for the values in Table C2.1-1 (wind loads).
7. Increases of the *nominal strengths* shown in Tables C2.1-1 and C2.1-3 as allowed by other standards shall not be permitted.

C2.2.3 Gypsum Board Panel Sheathing

Cold-formed steel framed wall systems, sheathed with gypsum board, shall be permitted to resist horizontal forces produced by wind or seismic loads subject to the following:

1. Gypsum board shall comply with ASTM C1396/C1396M.
2. *Nominal strengths* [*resistances*] shall be as given in the following tables, as applicable:
   (a) ***In the United States and Mexico:*** Table C2.1-2.
   (b) ***In Canada:*** Table C2.1-5.
3. Gypsum board shall be applied perpendicular to framing with strap *blocking* behind the horizontal joint and with solid *blocking* between the first two end *studs*, at each end of the wall, or applied vertically with all edges attached to framing members. Unblocked assemblies are permitted provided the *nominal strength* [*resistance*] values are multiplied by 0.35.
4. Screws used to attach gypsum board shall be a minimum No. 6 in accordance with ASTM C954 or ASTM C1002, as applicable.

C2.2.4 Fiberboard Panel Sheathing in the United States and Mexico

Cold-formed steel framed wall systems, sheathed with *fiberboard*, shall be permitted to resist horizontal forces produced by wind or seismic loads in *seismic design categories* A, B and C subject to the following:

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1. *Fiberboard* panels shall comply with AHA A194.1 or ASTM C 208.
2. *Nominal* shear strengths shall be given in Table C2.1-2.
3. *Fiberboard* shall be applied perpendicular to framing with strap *blocking* behind the horizontal joint and with solid *blocking* between the first two end *studs*, at each end of the wall, or applied vertically with all edges attached to framing members.
4. Screws used to attach *fiberboard* shall be a minimum No. 8 in accordance with ASTM C1513. Head style shall be selected to provide a flat bearing surface in contact with the sheathing with a head diameter not less than 0.43 inches (10.9 mm). Screws shall be driven so that their flat bearing surface is flush with the surface of the sheathing.

Table C2.1-1
United States and Mexico
Nominal Shear Strength (R_n) for Wind and Other In-Plane Loads for Shear Walls [1,4,6,7,8]
(Pounds Per Foot)

Assembly Description	Maximum Aspect Ratio (h/w)	Fastener Spacing at Panel Edges[2] (inches)			
		6	4	3	2
15/32" structural 1 sheathing (4-ply), one side	2:1	1065 [3]	-	-	-
7/16" rated sheathing (OSB), one side	2:1	910 [3]	1410	1735	1910
7/16" rated sheathing (OSB), one side oriented perpendicular to framing	2:1	1020	-	-	-
7/16" rated sheathing (OSB), one side	2:1 [5]	-	1025	1425	1825
0.018" steel sheet, one side	2:1	485	-	-	-
0.027" steel sheet, one side	4:1	-	1,000 [9]	1085 [9]	1170 [9]
	2:1 [5]	647	710	778	845

1. *Nominal strengths* shall be multiplied by the *resistance factor* (ϕ) to determine *design strength* or divided by the *safety factor* (Ω) to determine *allowable strengths* as set forth in Section C2.1.
2. Screws in the field of the panel shall be installed 12 inches (305 mm) o.c. unless otherwise shown.
3. Where fully blocked gypsum board is applied to the opposite side of this assembly, per Table C2.1-2 with screw spacing at 7 inches (178 mm) o.c. edge and 7 inches (178 mm) o.c. field, these *nominal strengths* are permitted to be increased by 30%.
4. See Section C2.1 for requirements for sheathing applied to both sides of wall.
5. *Shear wall* height to width aspect ratio's (h/w) greater than 2:1, but not exceeding 4:1, shall be permitted provided the *nominal strength* is multiplied by 2w/h. See Section C2.1.
6. Shear values are permitted for use in seismic design where the seismic response modification factor, R, is taken equal to or less than 3, subject to the limitations in Section C1.1.
7. For wood structural panel sheathed shear walls, tabulated R_n values shall be applicable for short-term load duration (wind loads). For other in-plane lateral loads of normal or permanent load duration as defined by the AF&PA NDS, the values in the table above for wood structural panel sheathed shear walls shall be multiplied by 0.63 (normal) or 0.56 (permanent).
8. For SI: 1" = 25.4 mm, 1 foot = 0.305 m, 1 lb = 4.45 N.
9. For these assemblies, the *designation thickness* of *stud*, *track* and *blocking* shall be a minimum of 43 mils.

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Table C2.1-2
United States and Mexico
Nominal Shear Strength (R_n) for Wind and Seismic Loads
for Shear Walls Faced with Gypsum Board or Fiberboard [1,2,3,4]
(Pounds Per Foot)

Assembly Description	Maximum Aspect Ratio (h/w)	Fastener Spacing at Panel Edges/Field (inches)						
		7/7	4/4	4/12	8/12	4/6	3/6	2/6
½" gypsum board on one side of wall; studs max. 24" o.c.	2:1	290	425	295	230	-	-	-
½" fiberboard on one side of wall; studs max. 24" o.c.	1:1	-	-	-	-	425	615	670

1. *Nominal strengths* shall be multiplied by the *resistance factor* (ϕ) to determine *design strength* or divided by the *safety factor* (Ω) to determine *allowable strengths* as set forth in Section C2.1.
2. See Section C2.1 for requirements for sheathing applied to both sides of wall.
3. For gypsum or fiberboard sheathed shear walls, tabulated values shall be applicable for short-term load duration only (wind or seismic loads).
4. For SI: 1" = 25.4 mm, 1 foot = 0.305 m, 1 lb = 4.45 N.

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