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ANSI

AISI S200–07

American Iron and Steel Institute

AISI STANDARD

North American Standard for Cold-Formed Steel Framing– General Provisions

2007 Edition

Revision of AISI/COFS/GP–2004

Endorsed by:

Steel Framing Alliance™

DISCLAIMER

The material contained herein has been developed by the American Iron and Steel Institute Committee on Framing Standards. The Committee has made a diligent effort to present accurate, reliable, and useful information on cold-formed steel framing design and installation. The Committee acknowledges and is grateful for the contributions of the numerous researchers, engineers, and others who have contributed to the body of knowledge on the subject. Specific references are included in the *Commentary*.

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 S200, the *North American Standard for Cold-Formed Steel Framing - General Provisions*, to address requirements for construction with cold-formed steel framing that are common to prescriptive and engineered design. This standard is intended for adoption and use in the United States, Canada and Mexico.

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 their appreciation for the support of the Steel Framing Alliance and the Canadian Sheet Steel Building Institute.

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NORTH AMERICAN STANDARD FOR COLD-FORMED STEEL FRAMING – GENERAL PROVISIONS

A. GENERAL

A1 Scope

This standard shall apply to the design and installation of *structural members* and *non-structural members* utilized in *cold-formed steel* framing applications where the specified minimum *base steel thickness* is between 18 *mils* (0.0179 inches) (0.455mm) and 118 *mils* (0.1180 inches) (2.997 mm). Elements not specifically addressed by this standard shall be constructed in accordance with *applicable building code* requirements or an *approved* design.

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 E inclusive.

A2 Definitions

Where the following terms appear in this standard in italics they shall have the meaning herein indicated. Terms included in square brackets shall be specific to *LSD* terminology. Where a country is indicated in square brackets following the definition, the definition shall apply only in the country indicated. Terms not defined in Section A2 shall have the ordinary accepted meaning for the context for which they are intended.

Adjusted Shear Resistance. In *Type II shear walls*, the *unadjusted shear resistance* multiplied by the shear resistance adjustment factor.

ASD (Allowable Strength Design). Method of proportioning *structural components* such that the *allowable strength* equals or exceeds the *required strength* of the *component* under the action of the *ASD load combinations*. [USA and Mexico]

ASD Load Combination. Load combination in the *applicable building code* intended for *allowable stress design* (*allowable strength design*). [USA and Mexico]

Allowable Strength. Nominal strength divided by the *safety factor* R_n/Ω. [USA and Mexico]

Allowable Stress Design. Also known as *allowable strength design*, an out-dated term used in some reference documents. [USA and Mexico]

Applicable Building Code. The building code under which the building is designed.

*Approved***.** Approved by the authority having jurisdiction or *design professional*.

Available Strength. Design Strength or *allowable strength*, as appropriate. [USA and Mexico]

Average Grade. The average elevation of the finished ground level adjoining the building at all exterior walls.

Base Steel Thickness. The thickness of bare steel exclusive of all coatings.

Bearing Stiffener. Additional material that is attached to the *web* to strengthen the member against web crippling. Also called a *web* stiffener.

Blocking. C-shaped, *track*, break shape, or flat *strap* material attached to *structural members*, flat *strap* or sheathing panels to transfer shear forces.

Boundary Member. *Diaphragm* and *shear wall boundary member* to which the *diaphragm* transfers forces. *Boundary members* include chords and drag struts at *diaphragm* and *shear wall* perimeters, interior openings, discontinuities and re-entrant corners.

Braced Wall Line. A wall that is constructed to resist racking from seismic or wind forces and that contains a series of *Type I braced wall panels* or *Type II braced walls*.

Bracing. Structural elements that are installed to provide restraint or support (or both) to other framing members so that the complete assembly forms a stable structure.

Building Designer. Also referred to as *design professional* and registered building designer, but hereinafter referred to as *building designer*, is an individual or organization responsible for the overall building design in accordance with the statutes and regulations governing the professional registration and certification of architects or engineers of the jurisdiction where the building will be located.

Ceiling Joist. A horizontal *structural member* that supports ceiling components and which may be subject to attic loads.

Chord. Member of a *shear wall* or *diaphragm* that forms the perimeter, interior opening, discontinuity or re-entrant corner.

Chord Member. A *structural member* that forms the top or bottom component of a truss.

Chord Splice. The connection region between two *truss chord members* where there is no change in slope.

Chord Stud. Axial load-bearing *studs* located at the ends of *Type I braced wall panels* or *Type II braced walls*.

Clip Angle. An L-shaped short piece of steel (normally with a 90-degree bend) typically used for connections.

Cold-Formed Sheet Steel. Sheet steel or strip steel that is manufactured by (1) press braking blanks sheared from sheets or cut length of coils or plates, or by (2) continuous roll forming of cold- or hot-rolled coils of sheet steel; both forming operations are performed at ambient room temperature, that is, without any addition of heat such as would be required for hot forming.

Cold-Formed Steel. See *Cold-Formed Sheet Steel*.

Collector Also known as a drag strut, member that serves to transfer forces between *diaphragms* and members of the lateral force resisting system.

Component. See *structural component*.

Connection. Combination of structural elements and joints used to transmit forces between two or more members.

Cripple Stud. A *stud* that is placed between a *header* and a window or door head *track*, a *header* and wall top *track*, or a window sill and a bottom *track* to provide a backing to attach finishing and sheathing material.

C-Shape. A *cold-formed steel* shape used for *structural* and *non-structural members* consisting of a *web*, two (2) *flanges* and two (2) *lips* (*edge stiffeners*).

Curtain Wall. A wall that transfers transverse (out of plane) loads and is limited to a superimposed vertical load, exclusive of sheathing materials, of not more than 100 lb/ft (1.46 kN/m), or a superimposed vertical load of not more than 200 lbs (0.890 kN).

Deflection Track. A *track* manufactured with extended *flanges* and used at the top of a wall to provide for vertical movement of the structure, independent of the wall *stud*.

Design Load. Applied *load* determined in accordance with either *LRFD load combinations* or *ASD load combinations*, whichever is applicable. [USA and Mexico]

Design Professional. An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the state, province or territory in which the project is to be constructed.

Design Strength. *Resistance Factor* multiplied by the *nominal strength*, ϕR_n. [USA and Mexico]

Design Thickness. The steel thickness used in design.

Designation Thickness. The minimum *base steel thickness* expressed in *mils* and rounded to a whole number.

Diaphragm. Roof, floor or other membrane or bracing system that transfers in-plane forces to the lateral force resisting system.

Eave Overhang. The horizontal projection of the roof measured from the outside face of exterior wall framing to the outside edge of the roof.

Edge Stiffener. See *Lip*.

Factored Load. Product of a *specified load* and appropriate load factor. [Canada]

Factored Resistance. Product of *nominal resistance* and appropriate *resistance factor*. [Canada]

Flange. For a *C-shape*, U-shape or *track*, that portion of the framing member that is perpendicular to the *web*. For a furring channel, that portion of the framing member that connects the *webs*.

Floor Joist. A horizontal *structural member* that supports floor loads and superimposed vertical loads.

Grade. The designation of the minimum *yield strength*.

Gusset Plate. A *structural member* used to facilitate the connection of *truss chord* or *web members* at a *heel*, *ridge*, other pitch break, or *panel point*.

Hat-Shape. A singly-symmetric shape consisting of at least two vertical webs and a horizontal stiffened flange which is used as a *chord member* in a *truss*.

Heel. The connection region between the top and bottom *truss chords* of a non-parallel *chord truss*.

Header. A horizontal structural framing member used over floor, roof or wall openings to transfer loads around the opening to supporting structural framing members.

Hold Down Anchor. An anchor system that connects the wall or floor system to the wall below or to the foundation below and which primarily resists uplift forces due to wind or seismic events.

Jack Stud. A *stud* that does not span the full height of the wall and provides bearing for *headers*.

Joist. A *structural member* primarily used in floor and ceiling framing.

King Stud. A *stud*, adjacent to a *jack stud*, that spans the full height of the wall and supports vertical and lateral loads.

Light-Frame Construction. Construction where the vertical and horizontal structural elements are primarily formed by a system of repetitive *cold-formed steel* or wood framing members.

Limit States. Those conditions in which a structural member ceases to fulfill the function for which it was designed. Those states concerning safety are called the ultimate limit states. The ultimate limit state for strength is the maximum load-carrying capacity. Limit states that restrict the intended use of a member for reasons other than safety, such as deflection and vibration are called serviceability limit states. [Canada]

LSD (Limit States Design). Method of proportioning *structural components* (members, connectors, connecting elements and assemblages) such that no applicable *limit state* is exceeded when the structure is subjected to all appropriate load combinations. [Canada]

Lip. That part of a framing member that extends from the *flange* as a stiffening element.

Load. Force or other action that results from the weight of building materials, occupants and their possessions, environmental effects, differential movement, or restrained dimensional changes.

Load Effect. Forces, stresses, and deformations produced in a *structural component* by the applied *loads*.

Load Factor. Factor that accounts for deviations of the actual *load* from the *nominal load*, for uncertainties in the analysis that transforms the load into a load effect, and for the probability that more than one extreme load will occur simultaneously. [USA and Mexico]

LRFD (Load and Resistance Factor Design). Method of proportioning *structural components* such that the *design strength* equals or exceeds the *required strength* of the *component* under the action of the *LRFD load combinations*. [USA and Mexico]

LRFD Load Combination. Load combination in the *applicable building code* intended for *Strength Design* (*Load and Resistance Factor Design*). [USA and Mexico]

Mean Roof Height. The average of the roof eave height and the height to the highest point on the roof surface, except that eave height shall be used for roof angles less than or equal to 10 degrees (0.18 rad).

Mil. A unit of measurement equal to 1/1000 inch.

Multiple Span. The *span* made by a continuous member having intermediate supports.

Nominal Load. Magnitude of the load specified by the *applicable building code*. [USA and Mexico]

Nominal Resistance. Capacity of a structure or *component* to resist the effects of *loads*, determined in accordance with this Specification using specified material strengths and dimensions. [Canada]

Nominal Strength. Strength of a structure or *component* (without the *resistance factor* or *safety factor*) to resist the *load effects*, as determined in accordance with this Specification. [USA and Mexico]

Non-Structural Member. A member in a steel framed system which is limited to a transverse (out-of-plane) load of not more than 10 lb/ft^2 (0.48 kPa), a superimposed axial load, exclusive of sheathing materials, of not more than 100 lb/ft (1.46 kN/m), or a superimposed axial load of not more than 200 lbs (0.89 kN).

Panel Point. The connection region between a *web* and *chord member*.

Pitch Break. The connection region between two *truss chord members* where there is a change in slope, excluding the *heel*.

Plan Aspect Ratio. The ratio of the length (longer dimension) to the width (shorter dimension) of the building.

Punchout. A hole made during the manufacturing process in the *web* of a steel framing member.

Rake Overhang. The horizontal projection of the roof measured from the outside face of a gable endwall to the outside edge of the roof.

Repetitive Framing. A framing system where the wall, floor and roof *structural members* are spaced no greater than 24 inches (610 mm) on center. Larger spaces are permitted at openings where the structural loads are transferred to headers or lintels and supporting *studs*, *joists* or *rafters*.

Required Strength. Forces, stresses, and deformations produced in a structural component, determined by either structural analysis, for the *LRFD* or *ASD load combinations*, as appropriate, or as specified by this Specification or Standard. [USA and Mexico]

Resistance Factor (ϕ). Factor that accounts for unavoidable deviations of the actual strength from the *nominal strength* [nominal value] and for the manner and consequences of failure.

Ridge. The horizontal line formed by the joining of the top edges of two upward sloping roof surfaces.

Rim Track. A horizontal *structural member* that is connected to the end of a *floor joist*.

Roof Rafter. A horizontal or sloped, *structural member* that supports roof loads.

Safety Factor (Ω). Factor that accounts for the desired level of safety, including deviations of the actual *load* from the *nominal load* and uncertainties in the analysis that transforms the *load* into a *load effect*, in determining the *nominal strength* and for the manner and consequences of failure. [USA and Mexico]

Seismic Design Category (SDC). Classification assigned to a building based upon its importance and the severity of the design earthquake ground motion at the building site as given in the *applicable building code*.

Shear Wall. Wall that provides resistance to lateral loads in the plane of the wall and provides stability for the structural system.

Single Span. The *span* made by one continuous structural member without any intermediate supports.

Span. The clear horizontal distance between bearing supports.

Specified Load. Magnitude of the load specified by the *applicable building code*, not including load factors. [Canada]

Static Load. A load or series of loads that are supported by or are applied to a structure so gradually that forces caused by change in momentum of the load and structural elements can be neglected and all parts of the system at any instant are essentially in equilibrium.

Steel Sheet. A thin steel panel used in lieu of structural sheathing for wall bracing applications.

Strap. Flat or coiled sheet steel material typically used for *bracing* and *blocking*, which transfers loads, by tension and/or shear.

Strap Bracing. Steel straps, applied diagonally to form a vertical truss that form part of the lateral force resisting system.

Strength Design. Also known as *load and resistance factor design*, an out-dated term used in some reference documents. [USA and Mexico]

Structural Component. Member, connector, connecting element or assemblage.

Structural Member. A member that resists *design loads [factored loads]*, as required by the *applicable building code*, except when defined as a *non-structural member*.

Structural Sheathing. The covering (e.g. plywood or oriented strand board) used directly over *structural members* (e.g. *studs* or *joists*) to distribute loads, brace walls, and generally strengthen the assembly.

Stud. A vertical framing member in a wall system or assembly.

Track. A framing member consisting of only a *web* and two (2) *flanges*. *Track web* depth measurements are taken to the inside of the *flanges*.

Truss. A coplanar system of *structural members* joined together at their ends usually to construct a series of triangles that form a stable beam-like framework.

Truss Designer. Also referred to as *truss* engineer, design engineer and registered engineer, but hereinafter referred to as *truss designer*, is an individual or organization responsible for the design of *cold formed steel trusses*.

Truss Manufacturer. An individual or organization engaged in the manufacturing of site-built or in-plant *trusses*.

Type I Braced Wall Panel. *Type I braced wall panels* are sheathed for the full height of the wall with wood *structural sheathing* panels or *steel sheet* on one side, have no openings, and have continuous sheathing between *hold down anchors*.

Type I Shear Wall. Wall designed to resist in-plane lateral forces that is fully sheathed and that is provided with hold-down anchors at each end of the wall segment. *Type I shear walls* are only permitted to have openings where detailing for force transfer around the openings is provided.

Type II Braced Wall. *Type II braced walls* are fully sheathed for the full height of the wall with wood *structural sheathing* panels or *steel sheet* on one side, and are permitted to have openings between *hold down anchors*.

Type II Shear Wall. Wall designed to resist in-plane lateral forces that is sheathed with wood structural panels or sheet steel that contains openings, but which has not been specifically designed and detailed for force transfer around wall openings. Hold-down anchors for *Type II shear walls* are only required at the ends of the wall.

Web. That portion of a framing member that connects the *flanges*.

Web Member. A structural member in a *truss* that is connected to the top and bottom *chords*, but is not a *chord member*.

Wind Exposure. Wind exposure in accordance with the *applicable* building code.

Yield Strength. Stress at which a material exhibits a specified limiting deviation from the proportionality of stress to strain as defined by ASTM.

Z-Shape. A point-symmetric or non-symmetric section that is used as a *chord member* in a *truss*.

A3 Material

Structural members and *non-structural members* utilized in *cold-formed steel* framed construction shall be cold-formed to shape from sheet steel complying with the requirements of ASTM A1003/A1003M.

A4 Corrosion Protection

Structural members and *non-structural members* utilized in *cold-formed steel* framed construction shall have a minimum metallic coating complying with the requirements of ASTM

A1003/A1003M. Additional corrosion protection shall not be required on edges of metallic-coated steel framing members, shop or field cut, punched or drilled. Unless additional corrosion protection is provided, framing members shall be located within the building envelope and adequately shielded from direct contact with moisture from the ground or the outdoor climate. Dissimilar metals shall not be used in direct contact with *cold-formed steel* framing members unless *approved* for that application. *Cold-formed steel* framing members shall not be embedded in concrete unless *approved* for that application.

Fasteners shall have rust inhibitive coating suitable for the installation in which they are being used, or be manufactured from material not susceptible to corrosion.

A5 Products

A5.1 Base Steel Thickness

The material thickness of framing members, in their end-use, shall meet or exceed the minimum *base steel thickness* values given in an *approved* design or *approved* product standard, such as AISI S201. In no case shall the minimum *base steel thickness* be less than 95% of the *design thickness*.

A5.2 Product Designator

References to *structural members* and *non-structural members* shall use a four-part product designator that identifies the size (both *web* depth and *flange* width), style, and thickness. The standard designator as described (i.e. based on U.S. Customary units) shall be used for either U.S. Customary or SI Metric units. The product designator shall consist of the following sequential codes:

A three or four-digit numeral indicating member *web* depth in 1/100 inch. A letter indicating:

S = *Stud* or *joist* framing member which have *lips*
T = *Track* section
U = channel or *stud* framing section which do not have *lips*
F = furring channels
L = angle or L-*header*

A three-digit numeral indicating *flange* width in 1/100 inch, followed by a dash. A two or three-digit numeral indicating *designation thickness*.

When specifying material for use in structural applications, the material *grade* used in design shall be identified on the contract documents and when ordering the material.

A5.3 Manufacturing Tolerances

Structural members utilized in *cold-formed steel* framed construction shall comply with the manufacturing tolerances listed in ASTM C955. *Non-structural members* utilized in *cold-formed steel* framed construction shall comply with the manufacturing tolerances listed in ASTM C645.

A5.4 Product Identification

Framing members used in *cold-formed steel* framed construction shall be identified with a legible sticker, stamp, stencil, or embossment, spaced a maximum of 96 inches (2440 mm) on center in accordance with AISI S201 or ASTM A1003/A1003M.

A6 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. AISI S100-07, *North American Specification for the Design of Cold-Formed Steel Structural Members*, American Iron and Steel Institute, Washington, DC.
2. AISI S201-07, *North American Standard for Cold-Formed Steel Framing – Product Data,* American Iron and Steel Institute, Washington, DC.
3. ASTM A1003/A1003M-05, *Standard Specification for Sheet Steel, Carbon, Metallic and Non-Metallic Coated for Cold-Formed Framing Members*, ASTM International, West Conshohocken, PA.
4. ASTM C645–06*, Standard Specification for Nonstructural Steel Framing Members*, ASTM International, West Conshohocken, PA.
5. ASTM C754–04, *Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products*, ASTM International, West Conshohocken, PA.
6. 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.
7. ASTM C955–06, *Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases*, ASTM International, West Conshohocken, PA.
8. ASTM C1002–04, *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, C1513-04, *Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections*, ASTM International, West Conshohocken, PA.
10. AWS, D1.3, *Structural Welding Code-Sheet Steel*, 1998 edition, American Welding Society, Miami, FL.
11. CAN/CSA-S136-07, *North American Specification for the Design of Cold-Formed Steel Structural Members*, Canadian Standards Association, Mississauga, Ontario, Canada.

B. MEMBER DESIGN

B1 Members

Framing members shall be designed in accordance with AISI S100 [CSA S136]

B2 Member Condition

Framing members shall be as specified by an *approved* design or *approved* design standard. The members shall be in good condition. Damaged members shall be replaced or repaired in accordance with the above referenced design or design standard.

B2.1 Web Holes

Holes in *webs* of *studs*, *joists* and *tracks* shall be in conformance with an *approved* design, AISI S100 [CSA S136], or an *approved* design standard. *Webs* with holes not conforming to the above shall be reinforced or patched in accordance with an *approved* design or *approved* design standard.

B2.2 Cutting, Patching and Splicing

B2.2.1 Cutting and Patching

All cutting of framing members shall be done by sawing, abrasive cutting, shearing, plasma cutting or other *approved* methods. Cutting or notching of *structural members*, including *flanges* and *lips* of *joists*, *studs*, *headers*, *rafters*, and *ceiling joists*, or the patching of those cuts shall not be permitted without an *approved* design or in accordance with an *approved* design standard.

B2.2.2 Splicing

Splicing of *joists*, *studs* and other *structural members* shall not be performed without an *approved* splice design or in accordance with an *approved* design standard.

C. INSTALLATION

C1 In-Line Framing

Each *joist*, *rafter*, *truss*, and structural wall *stud* (above or beneath) shall be aligned vertically according to the limits depicted in Figure C1-1. The alignment tolerance shall not be required when a structural load distribution member is specified in accordance with an *approved* design or *approved* design standard.

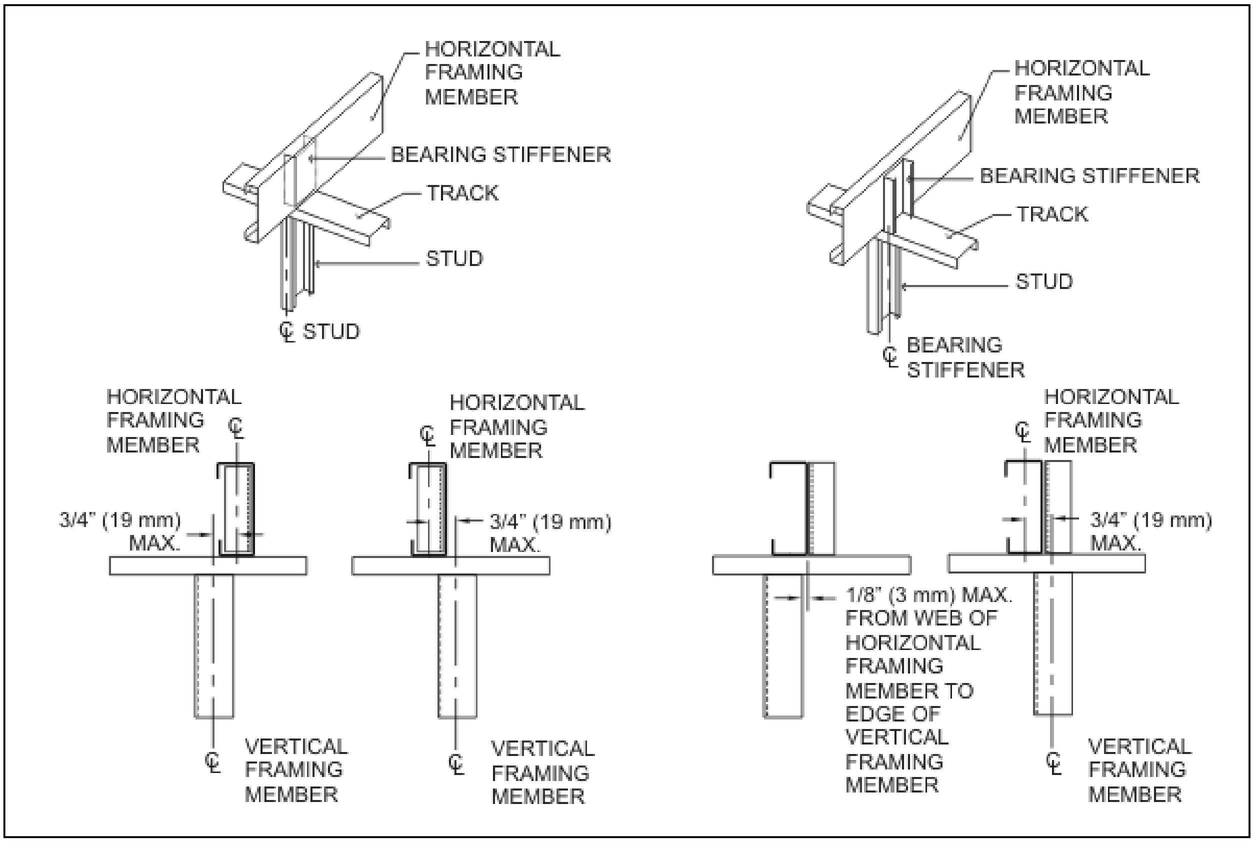

Figure C1-1 In-Line Framing

C2 Non-Structural Wall Framing

Installation of non-structural wall framing shall be in accordance with ASTM C754.

C3 Installation Tolerances

C3.1 Foundation

The foundation shall be level and free from defects beneath load bearing walls. If the foundation is not level, provisions shall be made to provide a uniform bearing surface with a maximum 1/4 inch (6.4 mm) gap between the bottom *track* or rim *track* and the foundation. This shall be accomplished through the use of load bearing shims or grout provided between the underside of the wall bottom *track* or *rim track* and the top of the foundation wall or slab at *stud* or *joist* locations.

C3.2 Ground Contact

Framing shall not be in direct contact with the ground unless specified by an *approved* design. Framing not in direct contact with the ground shall be installed at a height above the ground in accordance with the *applicable building code*.

C3.3 Floors

C3.3.1 Plumbness and Levelness

Floor joists and floor *trusses* shall be installed plumb and level, except where designed as sloping members.

C3.3.2 Floor Span Capacity

Floor joist and floor *truss* spacing shall not exceed the span capacity of the floor sheathing material.

C3.3.3 Alignment

Floor joists and floor *trusses* shall comply with the alignment requirements of Section C1.

C3.3.4 Bearing Width

Floor joists and floor *trusses* shall be installed with full bearing over the width of the bearing wall beneath, a minimum 1-1/2 inch (38 mm) bearing end, or in accordance with an *approved* design or *approved* design standard.

C3.3.5 Web Separation

Floor joist webs shall not be in direct contact with *rim track webs*.

C3.4 Walls

C3.4.1 Straightness, Plumbness and Levelness

Wall *studs* shall be installed plumb, except where designed as sloping members. Wall *track* members shall be installed level except where designed as sloping members.

C3.4.2 Sheathing Span Capacity

Wall *stud* spacing shall not exceed the span capacity of the sheathing material.

C3.4.3 Alignment

Structural wall *studs* shall comply with the alignment requirements of Section C1 for inline framing.

C3.4.4 End Bearing

Ends of structural wall *studs* shall have square end cuts and shall be seated tight against the *tracks*. For the purpose of this section, seated tight shall mean that a maximum gap tolerance of 1/8 inch (3.2 mm) will be acceptable between the end of wall framing member and the *track*.

C3.5 Roofs and Ceilings

C3.5.1 Plumbness and Levelness

Roof and ceiling framing members shall be installed plumb and level, except where designed as sloping members.

C3.5.2 Sheathing Span Capacity

The spacing of roof and ceiling framing members shall not exceed the span capacity of the ceiling or roof sheathing material.

C3.5.3 Alignment

Roof and ceiling framing members shall comply with the alignment requirements of Section C1 for inline framing.

C3.5.4 Bearing

Ceiling joists and roof *trusses* shall be installed with full bearing over the width of the bearing wall beneath, or a minimum 1-1/2 inch (38 mm) bearing end condition, or in accordance with an *approved* design or *approved* design standard.

D. CONNECTIONS

D1 Screw Connections

D1.1 Steel to Steel Screws

Self-drilling tapping screw fasteners for steel-to-steel connections shall be in compliance with ASTM C1513 or an *approved* design or *approved* design standard. Use of a larger than specified screw size shall not be prohibited, providing that the design and installation is in accordance with the minimum spacing and edge distance requirements.

D1.2 Sheathing Screws

Self-drilling tapping screw fasteners for structural sheathing to steel connections shall be in compliance with ASTM C1513 or an *approved* design or *approved* design standard.

D1.3 Installation

Screw fasteners shall extend through the steel connection a minimum of three (3) exposed threads. Screw fasteners shall penetrate individual components of connections without causing permanent separation between components.

D1.4 Stripped Screws

Stripped screw fasteners in direct tension shall be considered ineffective. Stripped screw fasteners in shear shall only be considered effective when the number of stripped screw fasteners considered effective does not exceed twenty-five percent (25%) of the total number of screw fasteners considered effective in the connection.

D1.5 Spacing and Edge Distance

For screw fasteners in steel-to-steel connections to be considered fully effective, the minimum center-to-center spacing and edge distance shall be 3 times the nominal diameter, except where the edge is parallel to the direction of the applied force the minimum edge distance of screw fasteners shall be 1.5 times the nominal diameter. Where the minimum center-to-center spacing is 2 times the nominal diameter, screw fasteners shall be considered 80 percent effective.

D1.6 Gypsum Board

Gypsum board shall be attached to *cold-formed steel* framing in accordance with the *applicable building code* or an *approved* design standard. Self-drilling tapping screw fasteners for gypsum board to steel connections shall be in compliance with either ASTM C954 or ASTM C1513 with a bugle head style. Self-piercing tapping screw fasteners for gypsum board to steel connections shall be in compliance with either ASTM C1002 or ASTM C1513 with a bugle head style.

D2 Welded Connections

Welded connections shall be in accordance with AISI S100 [CSA S136] and AWS D1.3. The design capacity of welds shall be in accordance with AISI S100 [CSA S136].

Welded areas shall be treated with an *approved* treatment to retain the corrosion resistance of the welded area.

D3 Other Connections

D3.1 Bolts

Bolted *cold-formed steel* connections shall be in accordance with AISI S100 [CSA S136].

D3.2 Other Connectors

Other types of connections (e.g. Pneumatically Driven Fasteners, Powder-Actuated Fasteners, Rivet Fasteners and Clinch Joining) shall be designed, fabricated and installed in accordance with the design requirements as set forth by an *approved* design or *approved* design standard, and the fastener manufacturer's requirements.

D3.3 Connection to Other Materials

Bolts, nails, anchor bolts or other fasteners used to connect *cold-formed steel* framing to wood, masonry, concrete or other steel components shall be designed and installed in accordance with the *applicable building code*, an *approved* design or *approved* design standard.

E. MISCELLANEOUS

E1 Utilities

E1.1 Holes

Holes shall comply with the requirements specified in Section B2.1. Penetrations of floor, wall and ceiling/roof assemblies which are required to have a fire resistance rating shall be protected in accordance with the *applicable building code* or in accordance with the requirements as stipulated by the authority having jurisdiction.

E1.2 Plumbing

All piping shall be provided with an isolative non-corrosive system to prevent galvanic action or abrasion between framing members and piping.

E1.3 Electrical

Wiring not enclosed in metal conduit shall be separated from the framing members by non-conductive non-corrosive grommets or by other *approved* means.

E2 Insulation

E2.1 Mineral Fiber Insulation

Mineral fiber insulation (e.g. rock wool, glass fiber, etc.) for installation within cavities of framing members shall be full width type insulation and shall be installed in accordance with the requirements as set forth by the *applicable building code* and insulation manufacturer. Compression of the insulation shall be permitted to occur at the open side of the *C-shaped* framing member.

E2.2 Other Insulation

Other types of insulation (e.g. foams, loose fill, etc.) for installation within cavities of framing members shall be installed in accordance with the *applicable building code* and insulation manufacturer's requirements. The width of insulation shall be dimensionally compatible with the *cold-formed steel* framing.

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American
Iron and Steel
Institute

AISI STANDARD

Commentary on the North American Standard for Cold-Formed Steel Framing– General Provisions

2007 Edition

Endorsed by:

Steel Framing Alliance™

DISCLAIMER

The material contained herein has been developed by the American Iron and Steel Institute Committee on Framing Standards. The Committee has made a diligent effort to present accurate, reliable, and useful information on cold-formed steel framing design and installation. The Committee acknowledges and is grateful for the contributions of the numerous researchers, engineers, and others who have contributed to the body of knowledge on the subject. Specific references are included in this *Commentary*.

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.

1st Printing – June 2007

PREFACE

This *Commentary* is intended to facilitate the use, and provide an understanding of the background, of AISI S200, the *North American Standard for Cold-Formed Steel Framing – General Provisions*. The *Commentary* illustrates the substance and limitations of the various provisions of the standard.

In the *Commentary*, sections, equations, figures, and tables are identified by the same notation as used in the standard. Words that are italicized are defined in AISI S200. Terms included in square brackets are specific to LSD terminology.

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COMMENTARY ON THE NORTH AMERICAN STANDARD FOR COLD-FORMED STEEL FRAMING – GENERAL PROVISONS

A. GENERAL

A1 Scope

AISI S200 (AISI, 2007b) applies to the design and installation of both *structural members* and *non-structural members* utilized in *cold-formed steel* framing applications for load carrying purposes in buildings. Although the standard addresses the application of framing members having *base steel thickness* between 18 *mils* (0.0179 inches) (0.4557 mm) and 118 *mils* (0.1180 inches) (2.997 mm), the standard does not preclude the use of other *cold-formed steel* members, assemblies, structures, or designs when they demonstrate equivalent performance for the intended use to those specified in the standard.

The standard is intended to serve as a supplement to AISI S100 [CSA S136], (AISI, 2007a; CSA, 2007).

A2 Definitions

Codes and standards by their nature are technical, and as such specific words and phrases can change the intent of the provisions if not properly defined. As a result, it is necessary to establish a common platform by clearly stating the meaning of specific terms for the purpose of this standard and other standards that reference this standard.

A3 Material

The sheet steel approved for use with this standard for either *structural members* or *non-structural members* must comply with ASTM A1003/1003M (ASTM, 2005). ASTM A1003/1003M covers the chemical, mechanical and coating requirements for steel sheet used in the manufacture of *cold-formed steel* framing members such as *studs*, *joists*, and *track*.

ASTM A1003/1003M is a relatively new standard that was developed in order to incorporate requirements for metallic-coated, painted metallic-coated, or painted nonmetallic-coated steel sheet used for *cold-formed steel* framing members into a single standard. According to the ASTM A1003/1003M standard, Structural Grade Types H and L steel are intended for *structural members* and Non-structural Grade Type NS steel is intended for *non-structural members.*

A4 Corrosion Protection

The minimum coating specified by this standard must comply with ASTM A1003/1003M. ASTM A1003/1003M minimum coating designations assume normal exposure conditions that are best defined as having the framing members enclosed within a building envelope or wall assembly within a controlled environment. When more severe exposure conditions are probable, such as industrial atmospheres and marine atmospheres, consideration should be given to specifying a heavier coating. Coating is specified by weight or mass.

This standard does not require the edges of metallic-coated *cold-formed steel* framing members, shop or field cut in accordance with B2.2.1, punched or drilled, to be touched up with zinc-rich paint, which is able to galvanically protect steel. When base steel is exposed, such as at a cut or scratch, the steel is cathodically protected by the sacrificial corrosion of the zinc coating, because zinc is more electronegative (more reactive) than steel in the galvanic series. A zinc coating will not be undercut by rusting steel because the steel cannot corrode adjacent to the zinc coating. Therefore, any exposure of the underlying steel at an edge or scratch will not result in corrosion of the steel away from the edge or scratch and thus will not affect the performance of the coating or the steel structure (AISI, 2004).

Direct contact with dissimilar metals (e.g. copper, brass, etc.) should be avoided in order to prevent unwanted galvanic action from occurring. Methods for preventing the contact from occurring may be through the use of non-conductive non-corrosive grommets at *web* penetrations or through the use of non-metallic brackets (a.k.a. isolators) fastened to hold the dissimilar metal building products (e.g. piping) away from the *cold-formed steel* framing. In 2006 a change was made to this standard allowing the use of dissimilar metals in contact with *cold-formed steel* framing provided the specific application is approved. It was recognized that dissimilar metals in contact might not always be a problem. For example, there are no galvanic concerns where there is no moisture. A special case of dissimilar metals occurs in Canada where, for certain climatic conditions and building heights, the use of stainless steel brick ties is required. When these ties are connected to steel stud backup, contact between dissimilar metals can occur. For guidance on this dissimilar metals issue, refer to the Canadian standard, CAN/CSA-A370-04, Connectors for Masonry (CSA, 2004).

When there is direct contact of *cold-formed steel* framing with pressure treated wood, the treated wood, *cold-formed steel* framing, connector and/or fastener manufacturers should be contacted for recommendations. Methods that should be considered may include specifying the less corrosive sodium borate pressure treatment, isolating the *cold-formed steel* and wood components, or changing details to avoid use of pressure treated wood altogether.

Design professionals should take into account both the initial contact with wet or damp building materials, as well as the potential for those materials to absorb water during the building's life, as both circumstances may accelerate corrosion.

In 2004, the American Iron and Steel Institute updated the 1996 document, entitled *Durability of Cold-Formed Steel Framing Members* (AISI, 2004), to give engineers, architects, builders and homeowners a better understanding of how galvanizing (zinc and zinc alloy coatings) provides long-term corrosion protection to *cold-formed steel* framing members. Additional information can be obtained from the American Galvanizers Association publication entitled *Hot Dip Galvanizing For Corrosion Protection - A Specifier's Guide* (AGA, 2002) and the Light Gauge Steel Engineers Association's publication entitled *Corrosion Protection for Cold-Formed Steel Framing in Coastal Areas* (LGSEA, 2003).

A5 Products

AISI S100 [CSA S136], (AISI, 2007a; CSA, 2007) permits the minimum delivered *base steel thickness* (exclusive of any coatings) of a *cold-formed steel* member to be 95% of the *design thickness*. This standard therefore specifies the minimum *base steel thickness* that complies with AISI S100 [CSA S136]. The thickness designations are consistent with standard industry practice, as published in AISI S201 (AISI, 2007c). It is recommended that thickness measurements be taken in the middle of the flat of the *flange* or *web* of the cross section.

AISI S201 has adopted a standard designator system for identifying *cold-formed steel* framing members. The intent for using a standard designator system was to overcome the varied designators that were produced by each individual manufacturer. In addition, the designator is used to identify not only a specific *cold-formed steel* framing member, but also in identifying the section properties of that same member through the use of the manufacturer's product technical information documents.

The following presents an example of the standard designator for a *cold-formed steel stud*:

350S162-33 represents a member with the following:

350S162-33

- 33 for 33 *mil* (0.0329 inch) (0.836mm) minimum thickness
- 162 for 1.625 inch (41.3 mm) *flange* width
- "S" for *stud* or joist
- 350 for 3.50 inch (89.9 mm) *web* depth

This standard employs the use of ASTM C955 (ASTM, 2003a) and C645 (ASTM, 2003b), which are the documents that establish the minimum tolerances for the manufacture of *structural members* and *non-structural members* utilized in *cold-formed steel* framing. Both standards contain information regarding the manufacturing tolerances for length, *web* width, camber, bow, twist, etc. of framing members. ASTM C955 covers steel *studs*, *tracks*, and *bracing* having a *base steel thickness* of not less than 0.0329 in. (0.836 mm) for screw application of gypsum panel products and metal plaster bases. ASTM C645 covers steel *studs* and *tracks* having a *base steel thickness* of not less than 0.0179 inches (0.455 mm) for screw application of gypsum panel products and metal plaster bases for interior construction assemblies.

The manufacturing tolerances listed in Tables A5-1 and A5-2 are reproduced, with permission, from ASTM C955–03, *Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases* and ASTM C645–03, *Standard Specification for Nonstructural Steel Framing Members*, copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standards may be obtained from ASTM (www.astm.org).

To aid in shop and field verification, all framing members are to carry a product identification to indicate conformance with the minimum *base steel thickness*, coating designation, minimum *yield strength*, and manufacture's name. A list of the specific information is contained in the "marking and identification" sections of ASTM C645, C955 and A1003/1003M (ASTM, 2005).

Table A5-1
Manufacturing Tolerances for Structural Members

Dimension[1]	Item Checked	Studs, in. (mm)	Tracks, in. (mm)
A	Length	+3/32 (2.38)	+ 1/2 (12.7)
		-3/32 (2.38)	-1/4 (6.35)
B[2]	Web Depth	+1/32 (0.79)	+1/32 (0.79)
		-1/32 (0.79)	+1/8 (3.18)
C	Flare	+1/16 (1.59)	+0 (0)
	Overbend	-1/16 (1.59)	-3/32 (2.38)
D	Hole Center Width	+1/16 (1.59)	NA
		-1/16 (1.59)	NA
E	Hole Center Length	+1/4 (6.35)	NA
		-1/4 (6.35)	NA
F	Crown	+1/16 (1.59)	+1/16 (1.59)
		-1/16 (1.59)	-1/16 (1.59)
G	Camber	1/32 per ft (2.6 per m)	1/32 per ft (2.6 per m)
		1/2 max (12.7)	1/2 max (12.7)
H	Bow	1/32 per ft (2.6 per m)	1/32 per ft (2.6 per m)
		1/2 max (12.7)	1/2 max (12.7)
I	Twist	1/32 per ft (2.6 per m)	1/32 per ft (2.6 per m)
		1/2 max (12.7)	1/2 max (12.7)

1 All measurements shall be taken not less than 1 ft (305 mm) from the end.
2 Outside dimension for *stud*; inside for *track*.

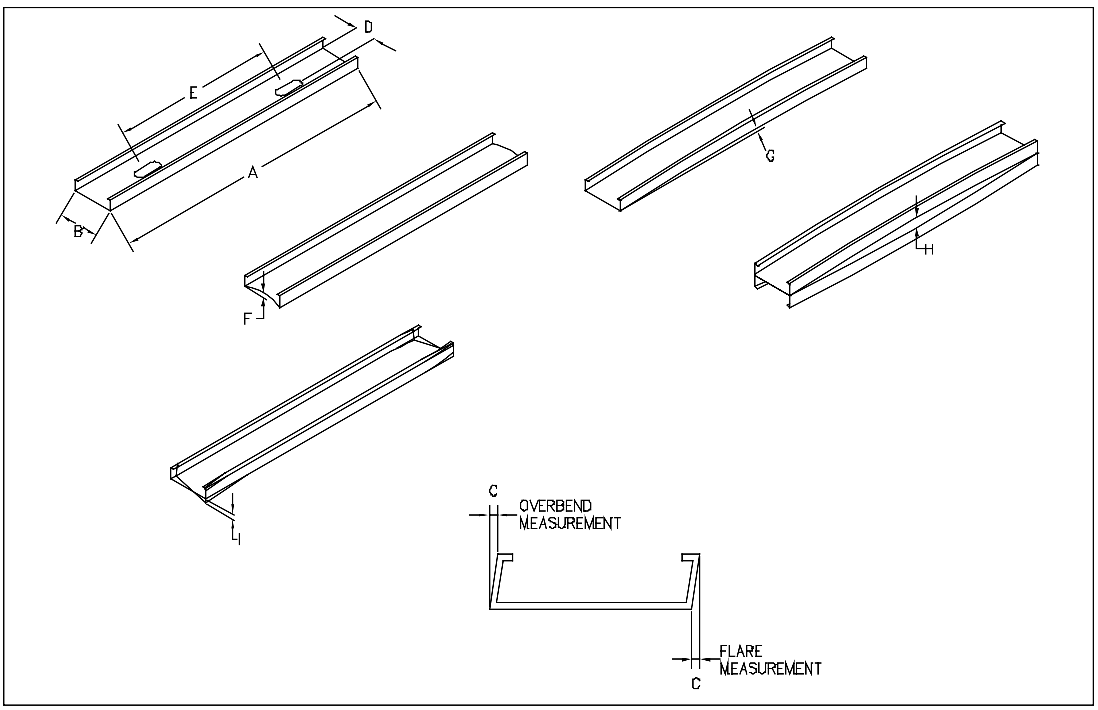

Figure A5-1 Manufacturing Tolerances for Structural Members

Table A5-2
Manufacturing Tolerances for Non-Structural Members

Dimension[1]	Item Checked	Studs, in. (mm)	Tracks, in. (mm)
A	Length	+1/8 (3.18)	+ 1(25.40)
		-1/4 (6.35)	-1/4 (6.35)
B[2]	Web Depth	+1/32 (0.79)	+1/8 (3.18)
		-1/32 (0.79)	-0 (0)
C	Flare	+1/16 (1.59)	+0 (0)
	Overbend	-1/16 (1.59)	-3/16 (4.76)
D	Hole Center Width	+1/8 (3.18)	NA
		-1/8 (3.18)	NA
E	Hole Center Length	+1/4 (6.35)	NA
		-1/4 (6.35)	NA
F	Crown	+1/8 (3.18)	+ 1/8 (3.18)
		-1/8 (3.18)	- 1/8 (3.18)
G	Camber	1/32 per ft. (2.6 per m)	1/32 per ft (2.6 per m)
		1/2 max (12.7)	1/2 max (12.7)
H	Bow	1/32 per ft (2.6 per m)	1/32 per ft (2.6 per m)
		1/2 max (12.7)	1/2 max (12.7)
I	Twist	1/32 per ft (2.6 per m)	1/32 per ft (2.6 per m)
		1/2 max (12.7)	1/2 max (12.7)

1 All measurements shall be taken not less than 1 ft (305 mm) from the end.
2 Outside dimension for *stud*; inside for *track*.

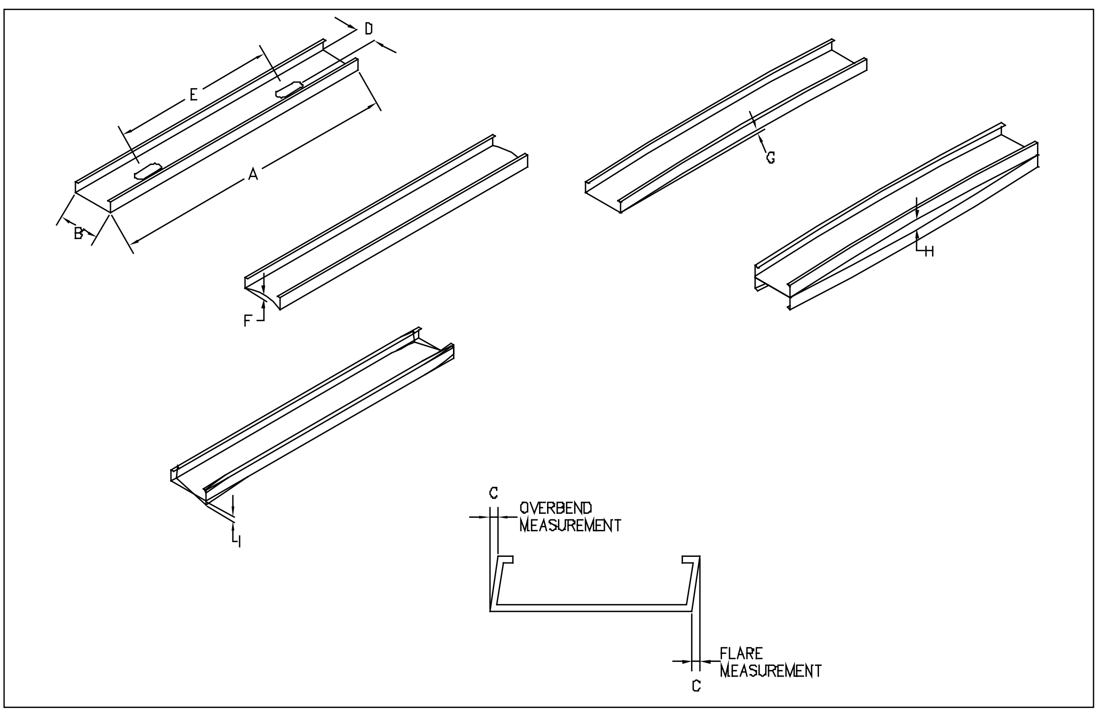

Figure A5-2 Manufacturing Tolerances for Non-Structural Members

B. MEMBER DESIGN

B1 Members

The strength determinations required by this standard are to be in accordance with AISI S100 [CSA S136], (AISI, 2007a; CSA, 2007). For design guidance on the application of AISI S100 [CSA S136] to typical *cold-formed steel* construction refer to *Design Guide for Cold-Formed Steel Framing* (AISI, 2002a) and *Cold-Formed Steel Design* (Yu, 2000).

B2 Member Condition

To ensure structural performance is in compliance with the engineered design, framing members must not be damaged. Damage assessment is not within the purview of this standard. The *design professional* should be consulted when damage alters the cross-section geometry of a framing member beyond the specified tolerances.

B2.1 Web Holes

AISI S100 [CSA S136] stipulates design requirements for members with standard *web* holes. In the field these "*web* holes" may also be referred to as "*punchouts*", "utility holes", "perforations" and "*web* penetrations". In *structural members*, *web* holes are typically 1.5 in. (38 mm) wide x 4 in. (102 mm) long and are located on the centerline of the *web*. The *web* holes are generally spaced 24 in. (610 mm) on-center.

B2.2 Cutting, Patching, and Splicing

This standard places restrictions on acceptable methods for cutting of framing members so that cut edges are not excessively rough or uneven and protective metallic coatings are not damaged in areas away from cut edges. It is noted that shearing includes a variety of mechanical methods including but not limited to the use of hydraulic shears and hole punches during manufacturing, and portable hydraulic shears, and hand-held electric shears, aviation snips and hole punches during fabrication and installation.

Coping, cutting or notching of *flanges* and *edge stiffeners* is not permitted for *structural members* without an *approved* design. For guidance on design for coped members in *trusses* refer to AISI S214 (AISI, 2007d).

Structural members may be spliced, however splicing of *studs* and *joists* is not a common practice and is not recommended. If a *structural member* requires splicing, the splice connection must be installed in accordance with an *approved* design.

C. INSTALLATION

C1 In-Line Framing

In-line framing is the preferred and most commonly used framing method. The advantage of in-line framing is that it provides a direct load path for transfer of forces from *joists* to *studs*. The standard stipulates maximum framing alignment to minimize secondary moments on the framing members. Weak axis bending strength of *track* is minimal and therefore the *track* cannot function as a load transfer member. In the absence of in-line framing, a load distribution member, such as a structural *track*, may be required for this force transfer.

Industry practice has accepted in-line framing to mean that the *joist*, *rafter*, *truss* and structural wall *stud* framing would be aligned so that the centerline (mid-width) is within ¾ inch (19 mm) of the centerline (mid-width) of the load bearing members beneath. However, the ¾ inch allowable offset creates the possibility for a misalignment in the load path from an upper story load bearing *stud* wall, through a *joist* with a *bearing stiffener* and onto a load bearing *stud* or foundation wall below. In 2003, a total of 110 end- and interior-two-flange loading tests of various floor *joist* assemblies were carried out at the University of Waterloo (Fox, 2003) to determine the effect that an offset loading has on the strength of typical floors. It was concluded that an additional limit should be placed on the *bearing stiffener* offset to the load bearing members above or beneath for cases where the *bearing stiffener* is attached to the back of the *joist* as depicted in Figure C1-1.

As an alternative to in-line framing, the standard permits the use of a structural load distribution member that is specified in accordance with an *approved* design or *approved* design standard. As an aid to designers, strength and stiffness have been determined experimentally for various load bearing top track assemblies (NAHB-RC, 2003; Dawe, 2005), including standard steel *track*, deep-leg steel *track*, and steel *track* with a 2x wood top plate.

C2 Non-Structural Wall Framing

The standard does not require in-line framing for non-structural wall framing. Non-structural framing is to be installed as prescribed by ASTM C754 (ASTM, 2004a). ASTM C754 covers the minimum requirements for the installation of interior non-structural steel framing and furring designed to receive screw-attached gypsum board.

C3 Installation Tolerances

C3.1 Foundations

An uneven foundation may cause problems. The specified ¼ in. (6.4 mm) gap has been deemed acceptable industry practice.

C3.2 Ground Contact

To minimize the potential for corrosion, care must be taken to avoid direct contact between the *cold-formed steel* framing and the ground. In addition to direct contact, it is important to minimize the potential for corrosion resulting from ambient moisture. The *applicable building code* is cited as the authoritative document that will provide guidance concerning minimum separation distances from the ground to the framing member, installation requirements for moisture barriers, and the necessary ventilation of the space.

C3.3 Floors

To avoid premature failure at a support and to achieve in-line framing, full bearing of the *joist* on its supporting wall is necessary. The intent of specifying that the *track* and *joist webs* are not to be in direct contact with each other is to prevent floors from creating an unwanted noise (e.g. squeaks).

C3.4 Walls

Wall *studs* must be installed plumb to avoid the potential for secondary bending moments in the member from occurring. The *stud* should be nested or seated into the *track* to provide for adequate transfer of the forces. The maximum gap tolerance specified by the standard is based on accepted industry practice and is not required for non-structural walls.

Axial loads in a wall *stud* in excess of the capacity of the screw connection may be transferred between the *stud* and *track* in bearing. Therefore, relative movement between the *stud* and *track* may occur to close any gap between end of the *stud* and the *track*. To determine the influence of this relative movement between the *stud* and *track* on the serviceability of sheathed wall assemblies, a testing program was conducted at the University of Missouri-Rolla (Findlay, 2005). The UMR test program only considered the stud and track having the same thickness. For thinner *stud* and *track* materials (0.054 inches (1.37 mm) or less), testing showed that relative movement between the *stud* and *track* was accommodated through a combination of *track* deformation and screw tilting. In these cases the connection remained intact and was capable of resisting uplift forces and providing resistance to rotation caused by the torsional component developed in the *stud*. For thicker materials (greater than 0.054 inches), testing showed that the relative movement between the *stud* and *track* could result in shear failure of the screws. In these cases, a smaller gap tolerance (e.g., 1/16 inch (1.6 mm)) would be desirable. A smaller gap tolerance may also be desirable in multi-story structures where the accumulation of these gap closures may become significant. Depending on *track* radius, it may be necessary to oversize the depth of the *track* to assure that the *stud flanges* do not prematurely engage the *track* radius and result in an excessive gap. For all thickness of materials, testing has shown that the gap between the sheathing and the floor should be equal to or greater than the gap between the *stud* and the *track*.

C3.5 Roofs and Ceilings

Proper installation and alignment of *roof joists* and *ceiling joists* is necessary to ensure the proper load transfer from the *rafter/ceiling joist* connection to the wall framing. To avoid premature failure at a support and to achieve in-line framing, full bearing of the *joist* on its supporting wall framing member or a minimum 1-1/2 inch (38 mm) end bearing is necessary.

D. CONNECTIONS

D1 Screw Connections

D1.1 Steel to Steel Screws

Self-drilling screws are the primary fastener type used in *cold-formed steel* framed construction, although the standard does not preclude the use of other fastener types. In 2001, ASTM C1513 (ASTM, 2004b) was first published, covering steel self-drilling and self-piercing tapping screws for the connection of *cold-formed steel* members manufactured in accordance with ASTM Specifications C 645 (ASTM, 2003b) and C 955 (ASTM, 2003a). This specification also covers test methods for determining performance requirements and physical properties. However, the tensile or shear strength must be determined by test in accordance with AISI S904-02 (AISI, 2002b). General guidance on the selection of self-drilling screws is given by the Light Gauge Steel Engineers Association document *Screw Fastener Selection for Light Steel Framing* (LGSEA, 1997).

Proper selection and installation of screws is necessary to ensure the design performance. Self-drilling screws are specified using a nominal size designator, not by diameter. Table D1-1 defines suggested nominal screw diameters. The installation requirements stated in the *General Provisions* are based on industry practice. Selection of a minimum screw size is based on the total sheet thickness of the connection. Where recommendations are not available, Table D1-2 provides suggested screw size for steel-to-steel connections as a function of point style, per ASTM C1513, and total combined thickness of all connected steel members.

Table D1-1
Suggested Screw Body Diameter

Screw Nominal Size	Nominal Screw Diameter, d	
	(inches)	(mm)
No. 6	0.138	3.51
No. 8	0.164	4.17
No. 10	0.190	4.83
No. 12	0.216	5.49
1/4"	0.250	6.35

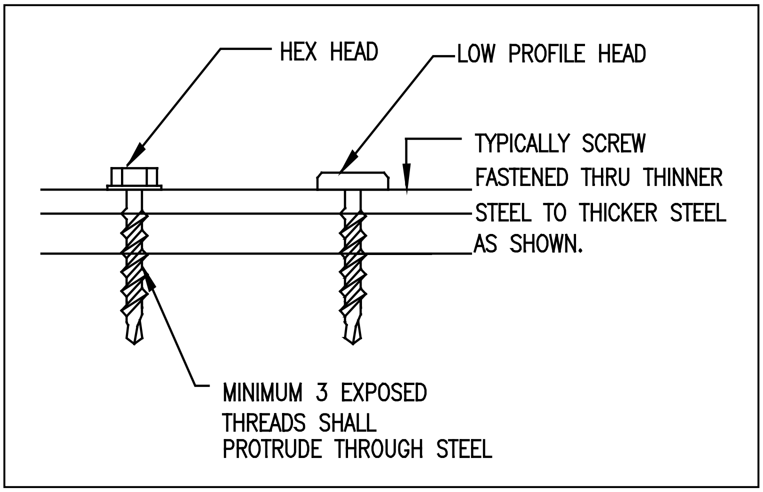

Figure D1-1 - Screw Grip Range

Table D1-2
Suggested Screw Sizes For Steel-to-Steel Connections

Screw Size	Point Style	Total Thickness of Steel [1]	
		(inches)	(mm)
¼	1	0.024 – 0.095	0.61 – 2.41
6	2	0.036 – 0.100	0.91 – 2.54
8	2	0.036 – 0.100	0.91 – 2.54
10	2	0.036 – 0.110	0.91 – 2.79
12	2	0.050 – 0.140	1.27 – 3.56
14	2	0.060 – 0.120	1.52 – 3.05
18	2	0.060 – 0.120	1.52 – 3.05
8	3	0.100 – 0.140	2.54 – 3.56
10	3	0.110 – 0.175	2.79 – 4.45
12	3	0.090 – 0.210	2.29 – 5.33
14	3	0.110 – 0.250	2.79 – 6.35
12	4	0.175 – 0.250	4.45 – 6.35
¼	4	0.175 – 0.250	4.45 – 6.35
12	4.5	0.145 – 0.312	3.68 – 7.92
12	5	0.250 – 0.500	6.35 – 12.7
¼	5	0.250 – 0.500	6.35 – 12.7

[1] Combined thickness of all connected steel members

D1.4 Stripped Screws

It is unreasonable to expect that there will be no stripped screws in a connection. Research at the University of Missouri-Rolla, (Sokol et al., 1999) has shown that the structural performance of a single-shear screw connection is not compromised if screws in the connection have been inadvertently stripped during installation. This research serves as the basis for the requirements of the standard.

D1.5 Spacing and Edge Distance

AISI S100 [CSA S136], (AISI, 2007a; CSA, 2007) stipulates that the center-to-center spacing of screws be at least 3 times the screw diameter. During installation if this spacing is only 2 times the diameter, research at the University of Missouri-Rolla (Sokol et al., 1999) has shown that the structural performance of the connection is reduced. Guidelines for center-to-center spacing of less the 2 times the diameter are not stipulated because the screw head diameter precludes a smaller spacing. The University of Missouri-Rolla research serves as the basis for the requirements in the standard.

D1.6 Gypsum Board

The standard employs the use of the *applicable building code* as the guide for provisions that cover the installation and attachment of gypsum panels to *cold-formed steel* framing. The model building codes in the United States reference ASTM C754 (ASTM, 2004a) and C1007 (ASTM, 2004c) as the appropriate standards for the gypsum board attachment to *cold-formed steel* framing.

D2 Welded Connections

To maintain acceptable durability of a welded connection, the weld area must be treated with a corrosion resistant coating, such as a zinc-rich paint. Additional guidance on welding of *cold-formed steel* members is provided in the Light Gauge Steel Engineers Association document *Welding Cold-Formed Steel* (LGSEA, 1999a).

D3 Other Connections

The standard permits the use of bolts and proprietary fasteners, such as pneumatically driven pins, powder-actuated fasteners, rivets, adhesives, and clinches. Bolts can be designed by AISI S100 [CSA S136] equations. However, proprietary fasteners must be designed and installed in accordance with the manufacturers' requirements. The factor of safety to be used in design is to be determined by Chapter F of AISI S100 [CSA S136]. The Light Gauge Steel Engineers Association publishes technical notes pertaining to powder actuated fasteners, clinching, and pneumatically driven pins (LGSEA, 2001; LGSEA, 1999b; LGSEA, 1998).

E. MISCELLANEOUS

E1 Utilities

E1.1 Holes

The design should include references to pre-punch hole sizes or limitations to accommodate electrical, telecommunication, plumbing and mechanical systems. Field-cut holes are generally discouraged, but are not uncommon. Field cut holes, if necessary, are required to comply with Section B2.1. There are several methods whereby holes can be cut in the field, such as a hole-punch, hole saws, and plasma cutters.

Holes that penetrate an assembly, containing steel framing that has a fire resistance rating, will need to be designed with through-penetration firestop systems. The acceptance of this fire resistance design is based on the *applicable building code*.

E1.2 Plumbing

Direct contact with copper piping should be avoided in order to prevent galvanic action from occurring. Methods for preventing the contact from occurring may be through the use of non-conductive non-corrosive grommets at *web* penetrations or through the use of non-metallic brackets (a.k.a. isolators) fastened to hold the dissimilar metal building products (e.g. piping) away from the steel framing. Plastic pipe does not require protection if it is in contact with the *cold-formed steel* framing member, but consideration should be made for the installation of non-metallic brackets to hold the pipe away from the hole in the steel in order to prevent noise and prevent the steel from cutting into the pipe.

E1.3 Electrical

Non-metallic sheathed wiring must be separated from the *cold-formed steel* framing member in order to comply with the *National Electrical Code* (NFPA, 2005). Contained within the *National Electrical Code* is a provision that requires non-metallic sheathed cable to "be protected by bushings or grommets securely fastened in the opening prior to the installation of the cable." Cable following the length of a framing member will need to be secured (e.g. supported) at set lengths, for this purpose small holes in the *web* may be beneficial for the attachment of tie-downs (e.g. nylon cable ties, nylon zipper ties, etc). When installing wiring or cables within a framing member (e.g. through or parallel to member) the intent of the *National Electrical Code* further requires that the wiring or cables be located 1-1/4 inches (32 mm) from the edge of the framing member. When 2-1/2 inch (64 mm) wide wall *studs* are used, the restrictions concerning edge clearance apply.

E2 Insulation

The cavity insulation must be installed such that the width of the insulation extends from the face of the *web* of one framing member to the face of the *web* of the next framing member. In the case of *cold-formed steel* framing, designs should specify "full width" insulation in order to differentiate the insulation that is normally supplied (a.k.a. nominal width).

To enhance the thermal performance of *cold-formed steel* framed construction, board insulation (a.k.a. continuous insulation or insulating sheathing) may be used in conjunction with cavity insulation. Guidance on the use of board and batt insulation is given in *Thermal Design Guide for Exterior Walls* (AISI, 1995). Designs should also take into consideration the effects of moisture when assessing the application of both cavity and continuous insulation, in this case dew point. The ASHRAE *Handbook of Fundamentals*, Chapters 23 and 24 of the 2001 edition, contained information useful for determining dew point. (ASHRAE, 2005).

For additional information pertaining to thermal performance of *cold-formed steel* framing in homes see *Energy Code and Related Thermal Performance Issues Associated With Steel Framing in Homes* (NAHB-RC, 1997).

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Advisory Note: The Light Gauge Steel Engineers Association (LGSEA) in 2006 changed their name to Cold-Formed Steel Engineers Institute (CFSEI).