



AISI S110-07/S1-09 (2012)



AISI STANDARD

Standard for Seismic Design of Cold-Formed Steel Structural Systems– Special Bolted Moment Frames with Supplement No. 1

October 2009 (Reaffirmed 2012)

The material contained herein has been developed by the American Iron and Steel Institute Committee on Specifications for the Design of Cold-Formed Steel Structural Members. The Committee has made a diligent effort to present accurate, reliable, and useful information on seismic design for cold-formed steel structures. 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* on the *Standard*.

With anticipated improvements in understanding of the behavior of cold-formed steel and the continuing development of new technology, this material may eventually 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 registered professional engineer. Indeed, in many jurisdictions, such a 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.

First Publishing – March 2010
Second Publishing – April 2014

Produced by American Iron and Steel Institute

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PREFACE

The American Iron and Steel Institute's (AISI) Committee on Specifications for the Design of Cold-Formed Steel Structural Members has developed this first edition of the *Standard for Seismic Design of Cold-Formed Steel Structural Systems – Special Bolted Moment Frames* (hereinafter referred to as this *Standard* in general) in 2007. This *Standard* is intended to address the design and construction of cold-formed steel members and connections used in the seismic force resisting systems in buildings and other structures. In the 2007 edition with *Supplement No. 1*, the *Standard* is focused on the Special Bolted Moment Frame (SBMF) System, which is widely used in industrial work platforms. In addition, many seismic design requirements stipulated in this *Standard* are based on the ANSI/AISC 341-05, *Seismic Provisions for Structural Steel Buildings*, and ANSI/AISC 341s1-05, *Supplement No. 1*, developed by the American Institute of Steel Construction (AISC). The application of this *Standard* should be in conjunction with ANSI/AISI S100-07, *North American Specification for the Design of Cold-Formed Steel Structural Members* (hereinafter referred to as AISI S100).

Supplement No. 1 revisions and additions were made to ensure that the application of the design provisions is within the configurations used in the initial research of special bolted moment frames.

AISI Subcommittee 32, Seismic Design, of the Committee on Specifications, is responsible for the ongoing development of this *Standard*. The AISI Committee on Specifications gives the final approval of this document through an ANSI accredited balloting process. The membership of these committees follows this Preface.

The Committee acknowledges and is grateful to the numerous engineers, researchers, producers and others who have contributed to the body of knowledge on these subjects. AISI further acknowledges the permission of the American Institute of Steel Construction for adopting many provisions from its *Seismic Provisions for Structural Steel Buildings*.

American Iron and Steel Institute
October 2009

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SYMBOLS

Symbol	Definition	Section
a	Bolt spacing	Table D1-1
b	Bolt spacing	Table D1-1
$C_B, C_{B,0}$	Coefficients for determining bearing strength and deformation	D1.2.3.1, Table D1-1
C_d	Deflection amplification factor	1.2
C_{DB}	Bearing deformation adjustment factor	Table D1-2
C_{DS}, C_S	Coefficients for determining slip strength and deformation	D1.2.3.1, Table D1-1
c	Bolt spacing	Table D1-1
d	Bolt diameter	D1.2.3.1
E	Horizontal component of earthquake load	A1.3, A3
E	Modulus of elasticity of steel, 29,500 ksi (203,000 MPa)	D1.2.1, D1.2.2
E_{mh}	Seismic load effect with overstrength	
F_y	Specified minimum yield stress	A1.3, B1.1, D1.2.1, D1.2.2
F_u	Specified minimum tensile strength	A1.3, B1.1, D1.2.3.1, Table D1-2
h	Story height	D1.2.3.1
h_{os}	Hole oversize	D1.2.3.1
K	Structural lateral stiffness	D1.2.3.1
k	Slip coefficient	D1.2.3.1
M_e	Expected moment at a bolt group	D1.2.3.1, D1.2.3.2
M_{no}	Nominal flexural strength determined in accordance with Section C3.1.1(b) of AISI S100	B1.1
M_{bp}	Required moment of a bolt bearing plate	D1.2.3.2
M_y	Nominal flexural yield strength	B1.1
N	Number of channels in a beam	D1.2.3.1

n	Number of columns in a frame line	D1.2.3.1
R	Seismic response modification coefficient	A1.2, A1.3
R_{BS}	Relative bearing strength	D1.2.3.1, Table D1-2
R_{cf}	Factor considering strength increase due to cold work of forming	A1.3, B1.1, D1.1
R_n	Nominal strength	A1.3
R_0	Governing value of dtF_u of connected components	D1.2.3.1
R_{re}	Factor considering inelastic bending reserve capacity	B1.1, D1.1
R_t	Ratio of expected tensile strength and specified minimum tensile strength	A1.3, B1.1, D1.2.3.1
R_y	Ratio of expected yield stress to specified minimum yield stress	A1.3, B1.1, D1.1
S_e	Effective section modulus at yield stress, F_y	B1.1
T	Snug-tight bolt tension	D1.2.3.1
T_S	S_{D1}/S_{DS} in accordance with applicable building code	D1.3
t	Thickness of the connected component	D1.2.3.1, Table D1-2
t_p	Thickness of bearing plate	D1.2.3.2
t_w	Thickness of beam web	D1.2.3.2
V_B	Bearing column shear of a bolt group	D1.2.3.1
$V_{B,max}$	Ultimate bearing column shear of a bolt group	D1.2.3.1
V_S	Slip column shear of a bolt group	D1.2.3.1
Δ	Design story drift	D1.2.3.1, D1.3
Δ_B	Component of story drift causing bearing deformation in a bolt group	D1.2.3.1
$\Delta_{B,max}$	Adjusted ultimate bearing drift deformation	D1.2.3.1
Δ_S	Component of story drift corresponding to bolt slip deformation	D1.2.3.1
λ	Slenderness of compression element	B1.1
ϕ	Resistance factor for LRFD	A1.3
Ω	Safety factor for ASD	A1.3
Ω_o	System overstrength factor	A1.3, A3, 1.2

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STANDARD FOR SEISMIC DESIGN OF COLD-FORMED STEEL STRUCTURAL SYSTEMS – SPECIAL BOLTED MOMENT FRAMES WITH SUPPLEMENT NO. 1

A. GENERAL

A1 Limits of Applicability and Terms

A1.1 Scope

This *Standard for Seismic Design of Cold-Formed Steel Structural Systems – Special Bolted Moment Frames*, hereinafter referred to as this *Standard*, is applicable for the design and construction of cold-formed steel members and connections in *seismic force resisting systems* (SFRS) in buildings and *other structures*.

A1.2 Applicability

This *Standard* shall govern when *seismic response modification coefficient*, R , used to determine the seismic design forces, is taken as greater than 3, and the main seismic resisting system is the cold-formed steel – special bolted moment frame (CFS-SBMF) system as specified in this *Standard*.

This *Standard* shall be applied in conjunction with the ANSI/AISI S100, *North American Specification for the Design of Cold-Formed Steel Structural Members* and the applicable building code. Where there is no applicable building code, the *loads*, *load combinations*, system limitations and general design requirements shall be in accordance with ASCE/SEI 7.

When the *seismic response modification coefficient*, R , used to determine the seismic design forces, is equal to or less than 3, the cold-formed steel members and connections need only be designed in accordance with AISI S100.

Buildings and structures designed and constructed, and within the scope and limitations of the following documents, need not comply with this *Standard*:

- ANSI/AISC 341, *Seismic Provisions for Structural Steel Buildings*, American Institute of Steel Construction
- RMI, *Specification for the Design, Testing and Utilization of Industrial Steel Storage Racks*, Rack Manufacturers Institute
- AISI S213, *North American Cold-Formed Steel Framing–Lateral Design*, American Iron and Steel Institute

A1.3 Definitions

The terms defined in this section are italicized when they appear for the first time in each section except in the titles. Terms designated with $\star$ are common AISC-AISI terms that are coordinated between the two standards developers. Terms defined by other standards developers are indicated in square brackets.

ASD (Allowable Strength Design) $\star$. 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*.

ASD Load Combination $\star$. Load combination in the *applicable building code* intended for allowable stress design (*allowable strength design*).

Allowable Strength. Nominal strength divided by the safety factor, R_n/Ω .

Amplified Seismic Load. The horizontal component of earthquake load E multiplied by Ω_o , where E and the horizontal component of E are defined in the applicable building code. [ANSI/ AISC 341]

Applicable Building Code[†]. Building code under which the structure is designed.

Authority Having Jurisdiction. Organization, political subdivision, office or individual charged with the responsibility of administering and enforcing the provisions of this *Standard*. [ANSI/ AISC 341]

Available Strength[†]. Design strength or allowable strength as appropriate.

Bearing[†]. Limit state of local compressive yielding due to the action of a member bearing against another member or surface.

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

Contract Document. Document including, but not limited to, plans and specifications, which defines the responsibilities of the parties involved in bidding, purchasing, designing, supplying, and installing cold-formed steel members and systems.

Design Earthquake. The earthquake represented by the design response spectrum as specified in the applicable building code. [ANSI/ AISC 341]

Design Strength[†]. Resistance factor multiplied by the nominal strength, ϕR_n .

Design Story Drift. Amplified story drift (drift under the *design earthquake*, including the effects of inelastic action), determined as specified in the applicable building code except as modified by this *Standard*.

Expected Yield Stress. The probable yield stress of the material, equal to the *specified minimum yield stress*, F_y , multiplied by R_y .

Expected Tensile Strength. The probable tensile strength of the material, equal to the *specified minimum tensile strength*, F_u , multiplied by R_t .

Joint[†]. Area where two or more ends, surfaces or edges are attached. Categorized by type of fastener or weld used and the method of force transfer.

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.

LRFD Load Combination[†]. Load combination in the applicable building code intended for strength design (Load and Resistance Factor Design).

Modified Expected Yield Stress. The probable yield stress of the material, equal to the *specified minimum yield stress*, F_y , multiplied by $R_{re}R_{cf}R_y$.

Moment Frame[†]. Framing system that provides resistance to lateral loads and provides stability to the structural system primarily by shear and flexure of the framing members and their connections.

Nominal Load[†]. Magnitude of the *load* specified by the applicable building code.

Nominal Strength⁺. Strength of a structure or component (without the *resistance factor* or *safety factor* applied) to resist the *load effects*, as determined in accordance with this *Standard*.

Occupancy Category. A category assigned by the applicable building code or ASCE/SEI 7, which is used to determine structural requirements based on occupancy.

Owner. An individual or entity organizing and financing the design and construction of a project.

Owner's Representative. An *owner* or individual designated contractually to act for the owner.

Other Structures. Structures designed and constructed in a manner similar to buildings, with building-like vertical and lateral load-resisting elements.

Professional Engineer. An individual who is registered or licensed to practice his/her respective design profession as defined by the statutory requirements of the state in which the project is to be constructed. [AISI S200]

Quality Control. System of shop and field controls implemented by the fabricator and erector to ensure that contract and company fabrication and erection requirements are met. [ANSI/ AISC 341]

Required Strength⁺. Forces, stresses, and deformations acting on a structural component, determined by either structural analysis, for the *LRFD* or *ASD* load combinations, as appropriate, or as specified by this *Standard*.

Resistance Factor, ϕ ⁺. Factor that accounts for unavoidable deviations of the *nominal strength* from the actual strength and for the manner and consequences of failure.

Safety Factor, Ω ⁺. Factor that accounts for unavoidable deviations of the *nominal strength* from the actual strength and for the manner and consequences of failure.

Seismic Design Category (SDC). Classification assigned to a structure by the applicable building code based on its *occupancy category* and the severity of the design earthquake ground motion at the site. [ASCE/SEI 7]

Seismic Force Resisting System. The assembly of structural elements in the building that resists seismic loads, including struts, collectors, chords, diaphragms and trusses.

Seismic Response Modification Coefficient, *R*. Factor that reduces seismic load effects to strength level as specified by the applicable building code. [ANSI/ AISC 341]

Snug-Tightened Bolt. Bolt in a joint in which tightness is attained by either a few impacts of an impact wrench, or the full effort of a worker with an ordinary spud wrench, that brings the connected plies into firm contact.

Specified Minimum Yield Stress. Lower limit of *yield stress* specified for a material as defined by ASTM.

Specified Minimum Tensile Strength. Lower limit of tensile strength specified for a material as defined by ASTM.

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

A2 Seismic Design Requirements

A2.1 General

The *required strength* and other seismic provisions for *seismic design categories* (SDCs), and limitations on height and irregularity shall be determined in accordance with the *applicable*

building code.

A2.2 Story Drift

The *design story drift* and story drift limits shall be determined as specified in the *applicable building code*, except as modified throughout this *Standard*.

A3 Loads and Load Combinations

The *loads* and *load combinations* shall be determined as specified in accordance with the *applicable building code*. Where *amplified seismic loads* are required by this *Standard*, the horizontal earthquake load E (as defined in the applicable building code) shall be multiplied by the system overstrength factor, Ω_o . Where the applicable building code does not contain design coefficients for CSF-SBMF systems, the provisions of Appendix 1 shall apply.

A4 Nominal Strength

The *nominal strength* of systems, members and *connections* shall be determined in accordance with AISI S100, except as modified throughout this *Standard*.

A5 Referenced Documents

The following documents or portions thereof are referenced in this *Standard* and shall be considered part of the requirements of this *Standard*.

1. American Institute of Steel Construction (AISC), One East Wacker Drive, Suite 700, Chicago, IL 60601-1802:
ANSI/AISC 341-05, *Seismic Provisions for Structural Steel Buildings*, March 9, 2005
ANSI/AISC 341s1-05, *Supplement No. 1*, November 16, 2005
ANSI/AISC 360-05, *Specification for Structural Steel Buildings*, Chicago, IL, March 9, 2005
2. American Iron and Steel Institute (AISI), 1140 Connecticut Avenue, NW, Suite 705, Washington, DC 20036:
AISI S100-07, *North American Specification for the Design of Cold-Formed Steel Structural Members*, 2007
AISI S213-07, *Lateral Standard for Cold-Formed Steel Framing—Lateral Design*, 2007
3. American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, Virginia 20191-4400:
ASCE/SEI 7-05, *Minimum Design Loads for Buildings and Other Structures*, 2005
4. American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959:
ASTM A36/A36M-05, *Standard Specification for Carbon Structural Steel*
ASTM A242/A242M-04e1, *Standard Specification for High-Strength Low-Alloy Structural Steel*
ASTM A283/A283M-03, *Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates*

- ASTM A500-03a, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- ASTM A529/A529M-05, Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
- ASTM A572/A572M-06, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
- ASTM A588/A588M-05, Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi [345 MPa] Minimum Yield Point to 4-in. [100 mm] Thick
- ASTM A606-04, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
- ASTM A653/A653M-06a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- ASTM A792/A792M-05, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
- ASTM A847/A847M-05, Standard Specification for Cold-Formed Welded and Seamless High-Strength, Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance
- ASTM A875/A875M-05, Standard Specification for Steel Sheet, Zinc-5% Aluminum Alloy-Coated by the Hot-Dip Process
- ASTM A1003/A1003M-05, Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members
- ASTM A1008/A1008M-05b, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened and Bake Hardenable
- ASTM A1011/A1011M-05a, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
5. American Welding Society (AWS), 550 N.W. LeJeune Road, Miami, Florida 33135:
AWS D1.1/D1.1M-2006, *Structural Welding Code-Steel*
AWS D1.3-98, *Structural Welding Code-Sheet Steel*
6. Rack Manufacturers Institute (RMI), 8720 Red Oak Blvd., Suite 201, Charlotte, NC 28217:
RMI, *Specification for the Design, Testing and Utilization of Industrial Steel Storage Racks*, Rack Manufacturers Institute, 2004

B. MATERIALS

B1 Material Specifications

The use of steels intended for structural applications in this *Standard* shall be as defined by the following specifications of the American Society for Testing and Materials, subject to the additional limitations specified in Section D:

ASTM A36/A36M, Standard Specification for Carbon Structural Steel

ASTM A242/A242M, Standard Specification for High-Strength Low-Alloy Structural Steel

ASTM A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

ASTM A500 (Grade B or C), Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A529/A529M, Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality

ASTM A572/A572M (Grade 42 (290), 50 (345), or 55 (380)), Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

ASTM A588/A588M, Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi [345 MPa] Minimum Yield Point to 4-in. [100 mm] Thick

ASTM A606, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance

ASTM A653/A653M (SS Grades 33 (230), 37 (255), 40 (275), and 50 (340) Class 1 and Class 3; HSLAS Types A and B, Grades 40 (275), 50 (340), 60 (410)), Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A792/A792M (Grades 33 (230), 37 (255), 40 (275), and 50 Class 1 (340 Class 1)), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

ASTM A847, Standard Specification for Cold-Formed Welded and Seamless High-Strength, Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance

ASTM A875/A875M (SS Grades 33 (230), 37 (255), 40 (275), and 50 (340) Class 1 and Class 3; HSLAS Types A and B, Grades 50 (340), 60 (410)), Standard Specification for Steel Sheet, Zinc-5% Aluminum Alloy-Coated by the Hot-Dip Process

ASTM A1003/A1003M (Grades ST33H, ST37H, ST40H, ST50H), Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members

ASTM A1008/A1008M (SS Grades 25 (170), 30 (205), 33 (230) Types 1 and 2, and 40 (275) Types 1 and 2; HSLAS Classes 1 and 2, Grades 45 (310), 50 (340), 55 (380), 60 (410), and 65 (450)); HSLAS-F Grades 50 (340), 60 (410)), Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

ASTM A1011/A1011M (SS Grades 30 (205), 33 (230), 36 (250) Types 1 and 2, 40 (275), 45 (310), 50 (340), and 55 (380); HSLAS Classes 1 and 2, Grades 45 (310), 50 (340), 55 (380), 60 (410), and 65 (450)); HSLAS-F Grades 50 (340), and 60 (410)), Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

B1.1 Material Properties for Determining Required Strength

Where required in this *Standard*, the *required strength* of a connection or member shall be determined from the modified *expected yield stress*, $R_{re}R_{cf}R_yF_y$ and the *expected tensile strength*, R_tF_u , of the connected member, where F_y is the *specified minimum yield stress* of the grade of steel to be used, F_u is the *specified minimum tensile strength* of the grade of steel to be used, and R_y and R_t are factors given in Table B1.1, unless otherwise modified in Chapter D.

The factor to account for the increase in yield stress due to cold work of forming averaged over the cross section, R_{cf} , shall be taken as 1.10.

Alternately, R_{cf} shall be permitted to be determined in accordance with Section A7.2 of AISI S100, except that the calculated R_{cf} shall be taken greater than or equal to 1.1.

The factor considering the inelastic reserve capacity for a compact section in bending, R_{re} , shall be determined as follows:

For $\lambda < 0.673$,

$$R_{re} = M_{no}/M_y \quad (Eq. B1.1-1)$$

For $\lambda \geq 0.673$ and for other than bending members

$$R_{re} = 1$$

where

λ = Slenderness of compression flange of member considered, as defined in accordance with AISI S100

M_{no} = Nominal strength determined in accordance with AISI S100, Section C3.1.1(b)

M_y = S_eF_y , nominal flexural yield strength

where

S_e = Effective section modulus at yield stress, F_y

F_y = Specified minimum yield stress

Where both the *required strength* and the *available strength* calculations are made for the same member or connecting element, the modified *expected yield stress*, $R_{re}R_{cf}R_yF_y$, of the connected member, and the *expected tensile strength*, R_tF_u , of the connected member, shall be permitted to be used for determination of the *available strength*.

Values of R_y and R_t , other than those listed in Table B1.1, shall be permitted to be used, if the values are determined by testing specimens representative of the product thickness and source, and such tests are conducted in accordance with the ASTM requirements for the specified grade of steel in Section B1.

Table B1.1
 R_y and R_t Values for Various Product Types

Steel	R_y	R_t
Plates and bars: A36/A36M, A283/A283M	1.3	1.2
A242/A242M, A529/A529M, A572/A572M, A588/A588M	1.1	1.2
Hollow Structural Sections: A500 and A847	1.4	1.3
Sheet and strip (A606, A653/A653M, A792/A792M, A875, A1003/A1003M, A1008/A1008M, A1011/A1011M):		
$F_y < 37 \text{ ksi (255 MPa)}$	1.5	1.2
$37 \text{ ksi (255 MPa)} \leq F_y < 40 \text{ ksi (275 MPa)}$	1.4	1.1
$40 \text{ ksi (275 MPa)} \leq F_y < 50 \text{ ksi (340 MPa)}$	1.3	1.1
$F_y \geq 50 \text{ ksi (340 MPa)}$	1.1	1.1

Note:

R_y = Ratio of *expected yield stress* to *specified minimum yield stress*.

R_t = Ratio of *expected tensile strength* to *specified minimum tensile strength*.

F_y = *Specified minimum yield stress*

C. CONNECTIONS, JOINTS, AND FASTENERS

Connections, joints and fasteners that are part of the seismic force resisting system shall meet the requirements of AISI S100, except as modified in Chapter C or Chapter D of this Standard.

Connections for members that are a part of the seismic force resisting system shall be configured such that a ductile limit-state in the member or at the joint controls the design.

C1 Bolted Joints

Bolts shall be high-strength bolts, and bolted *joints* shall not be designed to share load in combination with welds.

The bearing strength of bolted joints shall be provided using standard holes or short-slotted holes perpendicular to the line of force, unless an alternative hole-type is approved by a *professional engineer*.

C2 Welded Joints

Welded *joints* shall be permitted to join members that are a part of the *seismic force resisting system*, in accordance with AISI S100.

C3 Other Joints and Connections

Alternative *joints and connections* shall be permitted if the *professional engineer* demonstrates performance equivalent to the permitted joints and connections of this *Standard*.