

STRUCTURAL DESIGN GUIDELINES FOR STEEL MOMENT-RESISTING FRAMES

I. Purpose

This bulletin provides guidelines for the design of steel moment-resisting frame structures based on the recommendations from the Structural Engineers Association of Southern California (SEAOSC) Steel Committee for the application of the design requirements of the Federal Emergency Management Agency (FEMA), American Institute of Steel Construction (AISC), American Welding Society (AWS), American Society of Civil Engineers (ASCE), and other standards that improve seismic performance of steel moment-resisting frame structures. Design criteria included in this bulletin are intended to reflect knowledge and experience of these organizations to improve the performance of special, intermediate, and ordinary steel moment-resisting frames. As new research and standards are available and peer reviewed through these organizations, this bulletin will be updated with additional moment-resisting connections.

With the prevalent use of steel moment-resisting frame systems in light-frame low-rise construction or non-building structures and the limited selection of prequalified or prescriptive steel moment-resisting frame configurations recognized in the code, it is the intent and objective of this Bulletin to provide design guidelines to facilitate the appropriate use and reasonable acceptance of certain FEMA-350 prequalified connections and other connection configurations not specifically prequalified in AISC 341-05 or AISC 358-05 standards. With the appropriate limitations applied as summarized and clarified in this Bulletin, these steel moment-resisting frames can be used with reasonable confidence.

II. Codes, Standards, and Specifications

- 2008 City of Los Angeles Building Code (LABC).
- AISC 341-05, AISC Seismic Provisions for Structural Steel Buildings, including 341s1-05 Supplemental No.1 dated November 16, 2005.
- AISC 358-05, Pre-qualified Connections For Special And Intermediate Steel Moment Frames For Seismic Applications.
- AISC 360-05, Specification for Structural Steel Buildings.
- ASCE 7-05, Minimum Design Loads for Buildings and Other Structures, including Supplement No. 1 and excluding Chapter 14 and Appendix 11A.
- FEMA-350, Recommended Seismic Design Criteria for New Steel Moment Frame Buildings, including Errata dated March 16, 2001.
- AWS D1.8/D1.8M-2005, Structural Welding Code – Seismic Supplement, dated 2005.

III. CONNECTION TYPES

A. Prequalified Connection

Currently AISC 358-05 "Prequalified Connections for Special and Intermediate Steel Moment

Frames for Seismic Applications” provides three prequalified configurations of steel special and intermediate moment-resisting frames, (SMF) and (IMF) respectively. The reduced beam section (RBS), bolted unstiffened extended end-plate (BUEEP) and bolted stiffened extended end-plate (BSEEP) moment connections, as illustrated in Figure 1, are considered as prequalified for SMF and IMF applications, subject to the limitations of design and construction as described in AISC 358-05. Use of any prequalified configuration of steel SMF and IMF in future AISC 358 supplements shall be subject to the review and approval of the Department.

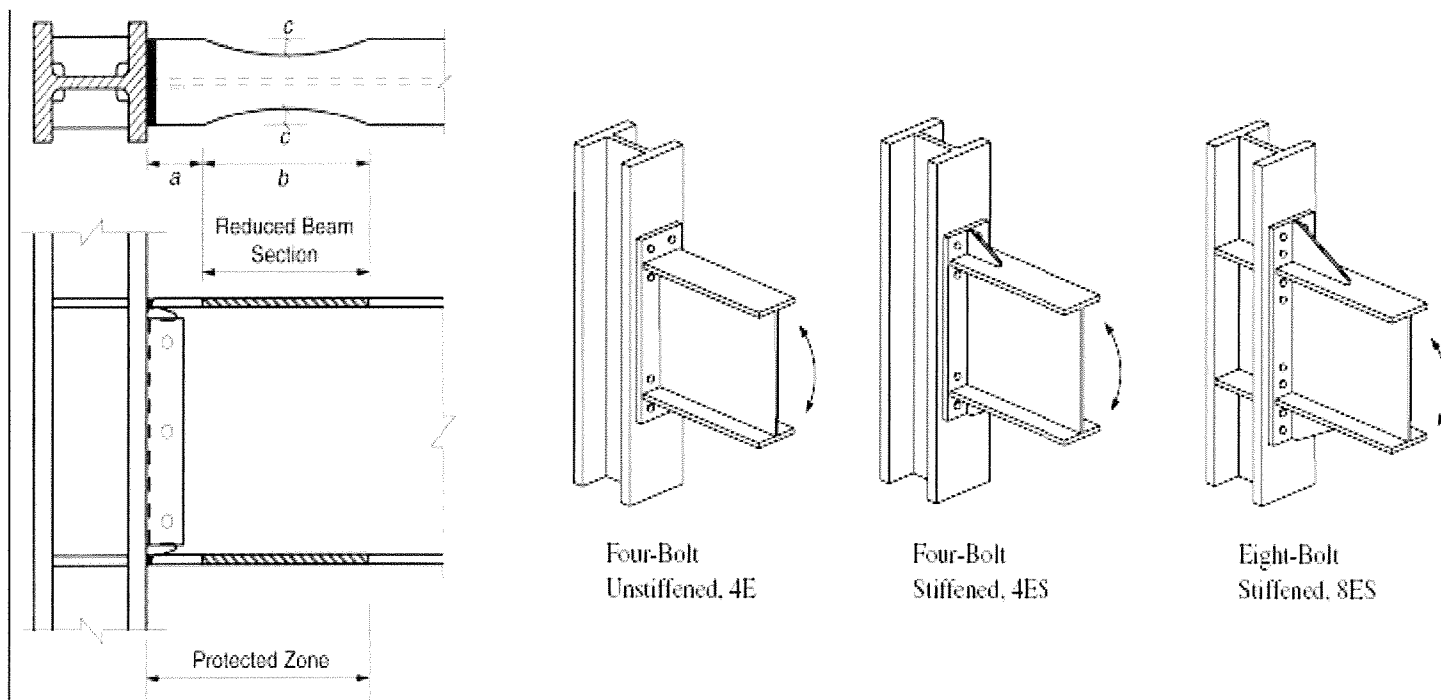


Figure 1 – RBS, BUEEP and BSEEP Connections

FEMA 350 “Recommended Seismic Design Criteria for New Steel moment-resisting frame Buildings” provides various prequalified configurations for steel moment-resisting frames. However, only the welded unreinforced flange-welded (WUF-W), welded flange plate (WFP) and bolted flange plate (BFP) moment connections, as illustrated in Figure 2, in FEMA-350 are recommended to be prequalified for use as an IMF, subject to the limitations of design and construction as described in FEMA-350 and Section 10 of AISC 341-05. To determine the appropriate design parameters for the selected FEMA-350 connections, use the criteria outlined for ordinary moment-resisting frame (OMF) in the FEMA-350 document as the term IMF was not in use at the time of FEMA-350's publication.

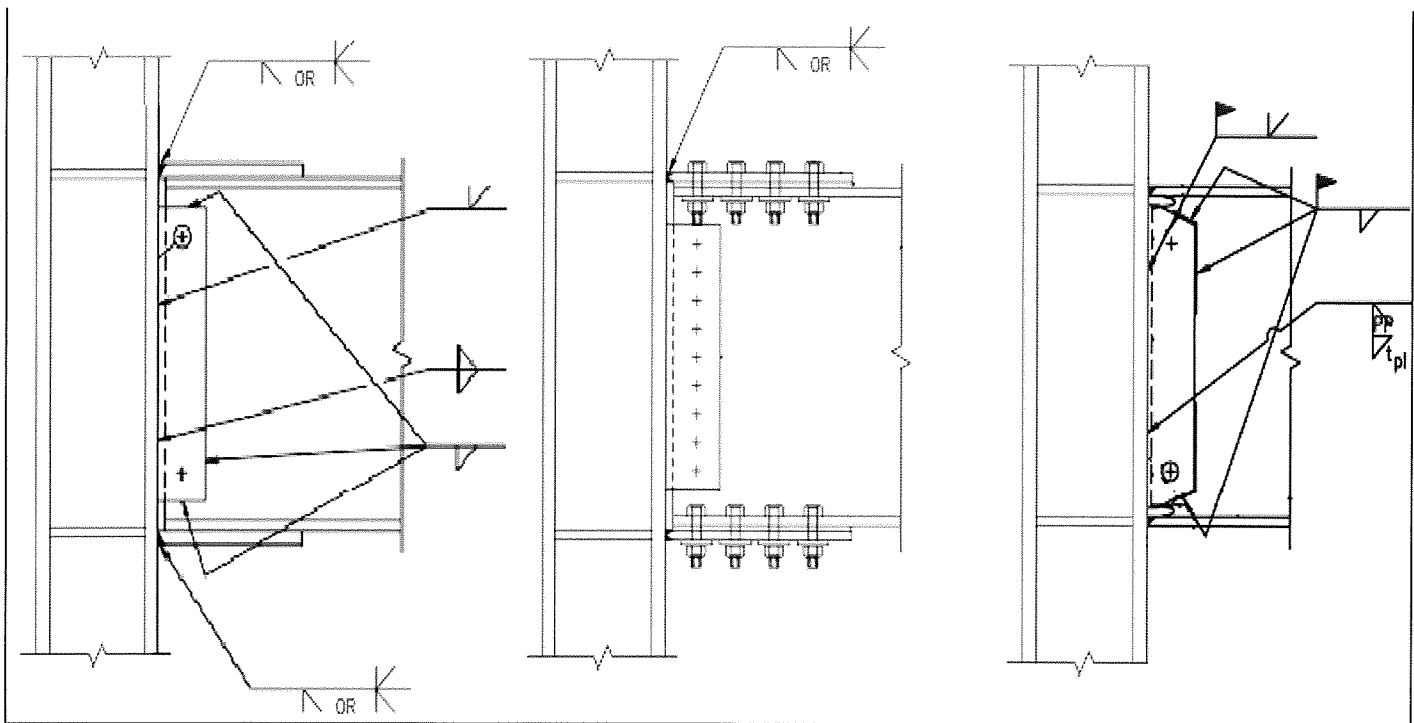


Figure 2 – WFP, BFP, and WUF-W Connections

B. Non-Prequalified Connection

Connections not prequalified by AISC 358-05 or FEMA-350 as described above, including proprietary connection systems, must be tested in accordance with Appendix S of AISC 341-05. Where connection configurations are based on previously tested special or intermediate moment frames, limit the extrapolation of tests to only those connections that are within the size and weight variation for beams and columns as specified in Appendix S of AISC 341-05.

When variations of any connection systems from the tested configuration that is being used as the basis for prequalification are proposed such as the addition of haunches or cover plates, additional welding, variations from the allowed configuration of the weld access hole at moment connections, moment connections in the weak axis direction of the column (e.g., moment connections to the column web), skewed or dual axis moment connections, project specific tests complying with Appendix S of AISC 341-05 shall be required to qualify their use.

IV. STRUCTURAL DESIGN CRITERIA

- A. The following design criteria shall be used for SMF and IMF designed and prequalified in accordance with Appendix S of AISC 341-05 or AISC 358-05 (i.e., RBS, BUEEP and BSEEP connections) or OMF designed to the prescriptive configuration in accordance with AISC 341 Seismic Provisions for rolled or built-up I-shaped sections (i.e., wide flange shapes):

1. The appropriate response modification coefficient, R , system overstrength factor, Ω_o , and the deflection amplification factor, C_d , indicated in Table 12.2-1 of ASCE 7-05 shall be

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used in determining the base shear, element design forces, and design story drift.

2. The structural system used shall be in accordance with the seismic design category and height limitations indicated in Table 12.2-1 and Section 12.2.5.5 of ASCE 7-05 (for SMF) or Sections 12.2.5.6 thru 12.2.5.9 of ASCE 7-05 (for IMF and OMF).
- B.** The following design criteria shall be used for IMF designed and prequalified in accordance with FEMA-350 (i.e., WUF-W, WFP and BFP connections) or OMF designed in accordance with AISC 341-05 for other symmetrical structural shapes such as, but not limited to, channels, built-up sections (non I-shaped), or hollow structural sections (HSS):
1. The appropriate response modification coefficient, R , system overstrength factor, Ω_o , and the deflection amplification factor, C_d , indicated in Table 1, 2, or 3 of this document shall be used in determining the base shear, element design forces, and design story drift.
 2. The structural system used shall be in accordance with the seismic design category and height limitations indicated in Table 1, 2, or 3 of this document.

Exception: *A greater allowable story drift may be permitted if it can be demonstrated from tests, conforming to Appendix S of AISC 341-05, that the connection provides a drift capacity of 1.6 times the proposed allowable story drift. The allowable story drift determined by this process shall not exceed that permitted by Table 12.2-1 of ASCE 7-05 for any story.*

V. OTHER DESIGN CONSIDERATIONS

A. Overstrength Factor at Column Base Connection

Column base connection elements, including but not limited to, anchor bolts, base plate welds and any elements transferring shear, moment and tension mechanism shall be designed using the overstrength factor, Ω_o , in accordance with Section 12.4.3.2 of ASCE 7-05. Load combinations with overstrength factor should apply to elevated structural slabs or beams supporting moment-resisting frame systems. The overstrength factor, Ω_o , need not be applied to the foundation or grade beam supporting columns; provided however that the grade beams are designed and detailed to develop ductility in accordance with the provisions of Chapter 21 of ACI-318-05.

B. Protected Zones for SMF and IMF Connections

The region at each end of the beam subject to inelastic straining shall be designated as a protected zone and shall meet the requirements of Section 7.4 of AISC 341-05. Unless determined as part of a connection prequalification in accordance with Appendix P of AISC-341-05, determined in a program of qualification testing in accordance with Appendix S of AISC 341-05 or designated in AISC 358-05, the extent of the plastic hinging zone should extend from the face of the column to one half of the beam depth beyond the plastic hinge point. Section 7.4 of AISC 341-05 prohibits discontinuities created by fabrication or erection operations and attachments or penetrations within the protected zones, unless specified otherwise in Section 7.4. Clearly identify this requirement on the structural drawings. See Figure 3 below for recommended details to prohibit attachments or penetrations in the protected zones. Furthermore, it is recommended

this detail be shown on other appropriate construction documents, including the architectural, mechanical, electrical or plumbing drawings. The importance of avoiding attachments or penetrations within the protected zones should be discussed during the preconstruction meeting with the various contractors and subcontractors prior to commencement of construction work.

Note: While the AISC 341-05 does not require protected zones for OMF connections, it is good practice to minimize or limit, whenever possible, attachments within this defined area.

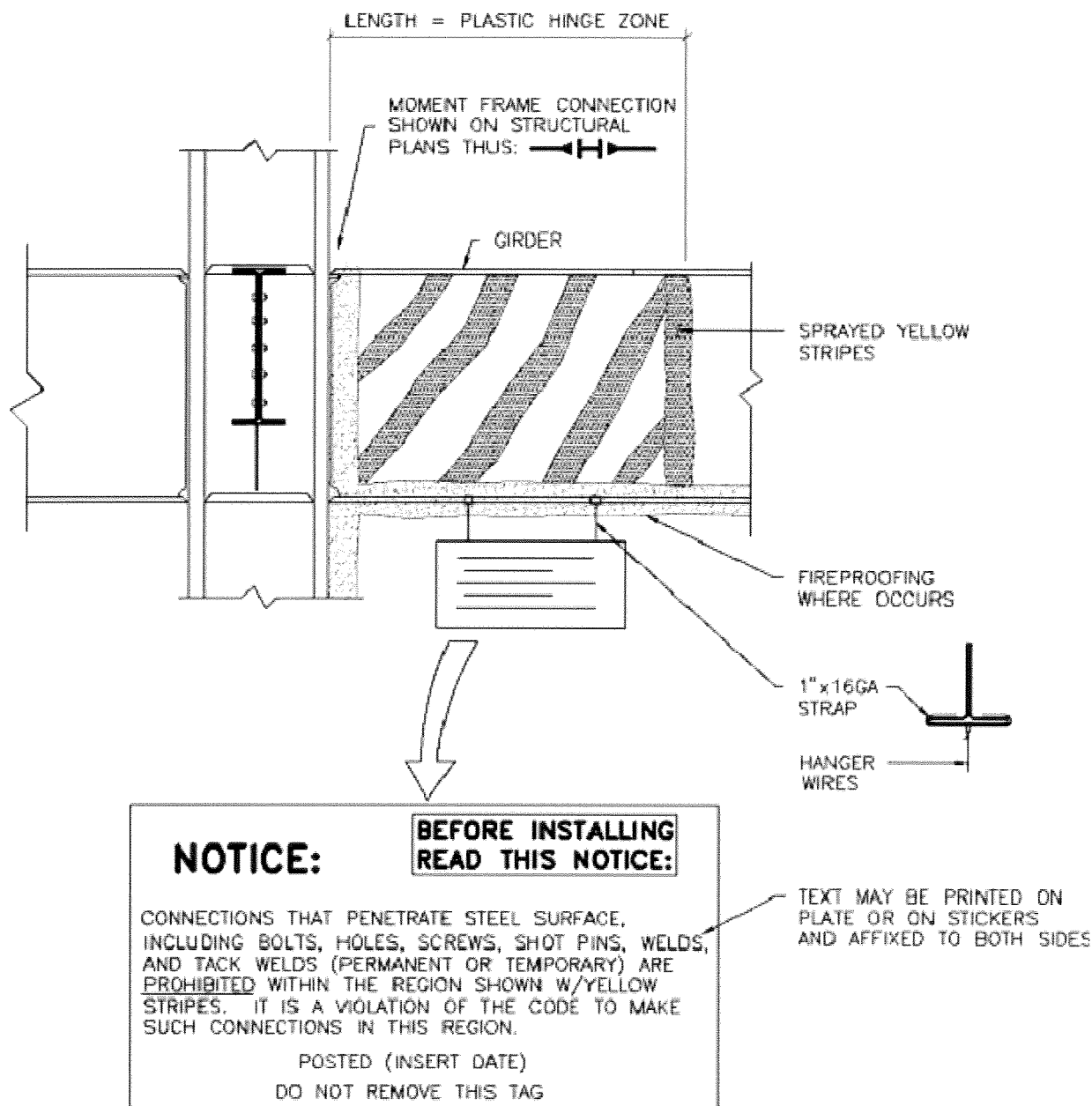


Figure 3 – Protected Zone

VI. QUALITY CONTROL AND QUALITY ASSURANCE

Quality control and quality assurance shall be in accordance with Appendix Q of AISC 341-05. Details regarding welding and welding inspection shall be in accordance with AWS D1.8-2005 Structural Welding Code - Seismic Supplement and Appendix W of AISC 341-05 or Chapter 3 of AISC 358-05.

A quality assurance plan is required to be provided with every structural plans for steel moment frames. The minimum requirements of a quality assurance plan are outlined in the Department's Quality Assurance (QA) Standard Plan. QA Standard Plan may be attached to and made part of the approved structural plans, or the Engineer of Record may submit a separate quality assurance plan provided all the minimum requirements from the Standard Plan have been incorporated.

The Department's Quality Assurance Standard Plan combines the LADBS policies, FEMA-350 Standards, AISC 341-05 - Seismic Provisions for Structural Steel Buildings, AWS D1.8-2005 and AWS D1.1-06 - Structural Welding Code - Seismic Supplement and Steel, respectively, and recommendations from engineers, inspectors, and members of the Structural Engineers Associations of Southern California Steel Committee. The QA Standard Plan can be obtained at www.ladbs.org.

TABLE 1
SUMMARY OF DESIGN COEFFICIENTS, FACTORS AND DEFORMATION FOR
STEEL MOMENT-RESISTING FRAMES SYSTEMS IN SEISMIC DESIGN CATEGORY D

LFRS	CONNECTION TYPE	STANDARD	SECTION	BUILDING AND STRUCTURE TYPES	DESIGN COEFFICIENTS AND FACTORS			SEISMIC DESIGN CATEGORY Structural System Limitations and Building Height Limit ^c				OCCUPANCY CATEGORY Allowable Story Drift Limit ^{c, i}					
					R ^a	Ω _o ^d	C _d ^b	D				≤ 4 Stories				> 4 Stories	
								HT	DL	WDL	Story	I or II	III	IV	I or II	III	IV
SMF ^e	RBS, BUEEP, and BSEEP ^j	AISC-358	CH. 5 & 6	Any Building Types	8	3	5.5	NL	NL	NL	NL	0.025h _{sx}	0.020h _{sx}	0.015h _{sx}	0.010h _{sx}		
	Connection Qualified by Cyclic Test	AISC-341	Appendix P, S	Any Building Types	8	3	5.5	NL	NL	NL	NL	0.025h _{sx}	0.020h _{sx}	0.015h _{sx}	0.010h _{sx}		
	RBS, BUEEP, and BSEEP ^{g,h}	AISC-358	CH. 5	Any Building Types	4.5	3	4	35	NL	NL	NL	0.020h _{sx}	0.015h _{sx}	0.010h _{sx}	0.010h _{sx}		
	WUF-W, WFP, and BFP ^{g,h}	FEMA-350	Sec 3.5.2/3.5.5/3.6.2	Any Building Types	4.5	3	4	35	35	20	NL	0.015h _{sx}	0.015h _{sx}	0.010h _{sx}	0.010h _{sx}		
	Connection Qualified by Cyclic Test ^{g,h}	AISC-341	Appendix P, S	Any Building Types	4.5	3	4	35	NL	NL	NL	0.020h _{sx}	0.015h _{sx}	0.010h _{sx}	0.010h _{sx}		
IMF	Moment Joint Field Connection	AISC-341	Section 10	Metal Buildings	4.5	3	4	65	20	20	1	0.020h _{sx}	NP	NP	NP		
	Constructed of Bolted End Plates ^{f,k,h}	AISC-341	Section 10	Metal Buildings	4.5	3	4	65	20	20	1	0.020h _{sx}	NP	NP	NP		
OMF	RBS, BUEEP, BSEEP ^g	AISC-358	CH. 5, 6	Light-Frame Construction	3.5	3	3	35	35	20	NL	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.010h _{sx}		
	WUF-W, WFP, and BFP ^g	FEMA-350	Sec 3.5.2/3.5.5/3.6.2	Light-Frame Construction	3.5	3	3	35	35	20	NL	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.010h _{sx}		
	Beam to Column Connection of Rolled or Built-Up I-Shaped Sections Wide Flange Shapes ^{g,k}	AISC-341	Section 11	Light-Frame Construction	3.5	3	3	35	35	20	NL	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.010h _{sx}		
	Moment Joint Field Connection	AISC-341	Section 11	Metal Buildings	3.5	3	3	65	20	20	1	0.020h _{sx}	NP	NP	NP		
	Constructed of Bolted End Plates ^{f,k}	AISC-341	Section 11	Metal Buildings	3.5	3	3	65	20	20	1	0.020h _{sx}	NP	NP	NP		
	Beam to Column Connection with Other Symmetrical Shapes ⁱ	AISC-341	Section 11	Light-Frame Construction or Miscellaneous Structures ^m	1.5	1.5	1.5	35	NL	NL	NL	0.015h _{sx}	NP	NP	NP		
		AISC-341	Section 11	Light-Frame Construction or Miscellaneous Structures ^m	1.5	1.5	1.5	35	NL	NL	NL	0.015h _{sx}	NP	NP	NP		

FOOTNOTE:
^a. Response modification coefficient R, for use throughout the standard. Note R reduces forces to a strength level, not an allowable stress level.
^b. Reflection amplification factor, Cd, for use in ASCE 7-05 Sections 12.8.6, 12.8.7, and 12.9.2
^c. NL = Not Limited, NP = Not Permitted, DL = roof or floor tributary dead load in accordance with ASCE 7-05 Section 12.2.5.6, 12.2.5.7, 12.2.5.8, WDL = exterior wall tributary dead load in accordance with ASCE 7-05 Section 12.2.5.6, 12.2.5.7, 12.2.5.8
^d. HT = Heights are measured from the base of the structure as defined in ASCE 7-05 Section 11.2. For metric units use 30.5m for 100ft and use 48.8m for 160 ft. Story as defined in ASCE 7-05 section 11.2
^e. The tabulated value of the overstrength factor, Ω_o, is permitted to be reduced by subtracting one-half for structures with flexible diaphragms, but shall not be taken as less than 2.0 for any structure except cantilever column system.
^f. See ASCE 7-05 Section 12.2.5.5 for limitations for steel SMFs in structures assigned to Seismic Design Category D through F.
^g. See ASCE 7-05 Section 12.2.5.6 and 12.2.5.8 for limitations for single-story steel OMFs and IMF in structures assigned to Seismic Design Category D through F.
^h. See ASCE 7-05 Section 12.2.5.7 for limitations for steel OMFs and IMF in structures assigned to Seismic Design Category D through F.
ⁱ. See ASCE 7-05 Section 12.12.1.1 for the allowable story drift for seismic force-resisting systems comprised solely of moment frames in Seismic Design Category D through F.
^j. See AISC 358-05 Table 2.1 for limitations for prequalified steel SMFs with concrete structural slabs in direct contact with the steel.
^k. The connection in this table is intended for rolled or built-up I-shaped sections (i.e., wide flange shapes).
^l. Other symmetrical shapes may include, but not limited to, channels, built-up sections (non I-shaped), and hollow structural sections (HSS).
^m. Miscellaneous structures may include, but not limited to, walkways, canopies, penthouses, stairs towers, and other non-building structures not part of the lateral resisting system of a building.

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TABLE 2

SUMMARY OF DESIGN COEFFICIENTS, FACTORS AND DEFORMATION FOR STEEL MOMENT-RESISTING FRAMES SYSTEMS IN SEISMIC DESIGN CATEGORY E

LFRS	CONNECTION TYPE	STANDARD	SECTION	BUILDING AND STRUCTURE TYPES	DESIGN COEFFICIENTS AND FACTORS				SEISMIC DESIGN CATEGORY Structural System Limitations and Building Height Limit ^c				OCCUPANCY CATEGORY Allowable Story Drift Limit ^{c, i}						
					R ^a	Ω _o ^d	C _d ^b	HT	DL	WDL	Story	<= 4 Stories				> 4 Stories			
												I or II	III	IV	I or II	III	IV		
SMF ^e	RBS,BUEEP, and BSEEP ^j	AISC-358	CH. 5 & 6	Any Building Types	8	3	5.5	NL	NL	NL	NL	0.025h _{sx}	0.020h _{sx}	0.015h _{sx}	0.020h _{sx}	0.015h _{sx}	0.010h _{sx}		
	Connection Qualified by Cyclic Test	AISC-341	Appendix P,S	Any Building Types	8	3	5.5	NL	NL	NL	NL	0.025h _{sx}	0.020h _{sx}	0.015h _{sx}	0.020h _{sx}	0.015h _{sx}	0.010h _{sx}		
	RBS,BUEEP, and BSEEP ^{g,h}	AISC-358	CH. 5	Any Building Types	4.5	3	4	35	35	20	NL	0.020h _{sx}	0.020h _{sx}	0.015h _{sx}	0.020h _{sx}	0.015h _{sx}	0.010h _{sx}		
IMF	WUF-W, WFP, and BFP ^{g,h}	FEMA-350	Sec 3.5.2/3.5.5/3.6.2	Any Building Types	4.5	3	4	35	35	20	NL	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.010h _{sx}		
	Connection Qualified by Cyclic Test ^{g,h}	AISC-341	Appendix P,S	Any Building Types	4.5	3	4	35	35	20	NL	0.020h _{sx}	0.020h _{sx}	0.015h _{sx}	0.020h _{sx}	0.015h _{sx}	0.010h _{sx}		
	Moment Joint Field Connection Constructed of Bolted End Plates ^{f,k,h}	AISC-341	Section 10	Metal Buildings	4.5	3	4	65	20	20	1	0.020h _{sx}	0.020h _{sx}	0.015h _{sx}	NP	NP	NP		
OMF	RBS, BUEEP,BSEEP ^g	AISC-358	CH. 5,6	Light-Frame Construction	3.5	3	3	35	35	20	NL	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.010h _{sx}		
	WUF-W, WFP, and BFP ^g	FEMA-350	Sec 3.5.2/3.5.5/3.6.2	Light-Frame Construction	3.5	3	3	35	35	20	NL	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.010h _{sx}		
	Beam to Column Connection of Rolled or Built-Up I-Shaped Sections/Wide Flange Shapes ^{g,k}	AISC-341	Section 11	Light-Frame Construction	3.5	3	3	35	35	20	NL	0.015h _{sx}		0.015h _{sx}	0.015h _{sx}	0.010h _{sx}			
	Moment Joint Field Connection Constructed of Bolted End Plates ^{f,k}	AISC-341	Section 11	Metal Buildings	3.5	3	3	65	20	20	1	0.020h _{sx}		0.015h _{sx}	NP	NP	NP		
	Beam to Column Connection with Other Symmetrical Shapes ^l	AISC-341	Section 11	Light-Frame Construction or Miscellaneous Structures ^m	1.5	1.5	1.5	35	NL	NL	NL	0.015h _{sx}	NP	NP	.015hsx	NP	NP		

FOOTNOTE:

- a. Response modification coefficient R, for use throughout the standard. Note R reduces forces to a strength level, not an allowable stress level.
b. Reflection amplification factor, Cd, for use in ASCE 7-05 Sections 12.8.6, 12.8.7, and 12.9.2
c. NL = Not Limited, NP = Not Permitted, DL = roof or floor tributary dead load in accordance with ASCE 7-05 Section 12.2.5.6, 12.2.5.7, 12.2.5.8, WDL = exterior wall tributary dead load in accordance with ASCE 7-05 Section 12.2.5.6, 12.2.5.7, 12.2.5.8
HT = Heights are measured from the base of the structure as defined in ASCE 7-05 Section 11.2. For metric units use 30.5m for 100ft and use 48.8m for 160 ft. Story as defined in ASCE 7-05 section 11.2.
d. The tabulated value of the overstrength factor, Ω_o , is permitted to be reduced by subtracting one-half for structures with flexible diaphragms, but shall not be taken as less than 2.0 for any structure except cantilever column system.
e. See ASCE 7-05 Section 12.2.5.6 for limitations for steel SMFs in structures assigned to Seismic Design Category D through F.
f. See ASCE 7-05 Section 12.2.5.8 for limitations for single-story steel OMFs and IMFs in structures assigned to Seismic Design Category D through F.
g. See ASCE 7-05 Section 12.2.5.7 for limitations for steel OMFs and IMFs in structures assigned to Seismic Design Category D through E.
h. See ASCE 7-05 Section 12.2.5.9 for limitations for steel IMFs in structure assigned to Seismic Design Category F.
i. See ASCE 7-05 Section 12.12.1.1 for the allowable story drift for seismic force-resisting systems comprised solely of moment frames in Seismic Design Category D through F.
j. See AISC 358-05 Table 2.1 for limitations for prequalified steel SMFs with concrete structural slabs in direct contact with the steel.
k. The connection in this table is intended for rolled or built-up I-shaped sections/(e.g., wide flange shapes).
l. Other symmetrical shapes may include, but not limited to, channels, built-up sections (non I-shaped), and hollow structural sections (HSS).
m. Miscellaneous structures may include, but not limited to, walkways, canopies, penthouses, stairs towers, and other non-building structures not part of the lateral resisting system of a building.

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LFRS	CONNECTION TYPE	STANDARD	SECTION	BUILDING AND STRUCTURE TYPES	DESIGN COEFFICIENTS AND FACTORS				SEISMIC DESIGN CATEGORY Structural System Limitations and Building Height Limit ^c				OCCUPANCY CATEGORY Allowable Story Drift Limit ^{c, i}			
					R ^a	Ω_o ^d	C _d ^b	F	HT	DL	WDL	Story	≤ 4 Stories			
													I or II	III	IV	> 4 Stories
SMF ^e	RBS,BUEEP and BSEEP ^j	AISC-358	CH, 5 & 6	Any Building Types	8	3	5.5		NL	NL	NL	NL	0.025h _{sx}	0.020h _{sx}	0.015h _{sx}	0.010h _{sx}
	Connection Qualified by Cyclic Test	AISC-341	Appendix P,S	Any Building Types	8	3	5.5		NL	NL	NL	NL	0.025h _{sx}	0.020h _{sx}	0.015h _{sx}	0.010h _{sx}
	RBS,BUEEP, and BSEEP ^{g,h}	AISC-358	CH, 5	Light-Frame Construction	4.5	3	4		35	35	20	NL	0.020h _{sx}	0.020h _{sx}	0.015h _{sx}	0.010h _{sx}
	WUF-W, WFP, and BFP ^{g,h}	FEMA-350	Sec 3.5.2/3.5.5/3.6.2	Light-Frame Construction	4.5	3	4		NP	NP	NP	NP	NP	NP	NP	NP
IMF ^h	Connection Qualified by Cyclic Test ^{g,h}	AISC-341	Appendix P,S	Light-Frame Construction	4.5	3	4		35	35	20	NL	0.020h _{sx}	0.020h _{sx}	0.015h _{sx}	0.010h _{sx}
	Moment Joint Field Connection	AISC-341	Section 10	Metal Buildings	4.5	3	4		65	20	20	1	0.020h _{sx}	0.020h _{sx}	0.015h _{sx}	NP
	Constructed of Bolted End Plates ^{i,k}	AISC-358	CH, 5.6	Any Building Types	3.5	3	3		35	20	20	1	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.010h _{sx}
	WUF-W, WFP, and BFP ^g	FEMA-350	Sec 3.5.2/3.5.5/3.6.2	Any Building Types	3.5	3	3		35	20	20	1	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.010h _{sx}
OMF	Beam to Column Connection of Rolled or Built-Up I-Shaped Sections/Wide Flange Shapes ^{g,k}	AISC-341	Section 11	Any Building Types	3.5	3	3		35	20	20	1	0.015h _{sx}	0.015h _{sx}	0.015h _{sx}	0.010h _{sx}
	Moment Joint Field Connection	AISC-341	Section 11	Metal Buildings	3.5	3	3		65	20	20	1	0.020h _{sx}	0.020h _{sx}	0.015h _{sx}	NP
	Constructed of Bolted End Plates ^{i,k}	AISC-341	Section 11	Metal Buildings	1.5	1.5	1.5		35	20	20	1	0.015h _{sx}	NP	NP	NP
	Beam to Column Connection with Other Symmetrical Shapes ⁱ	AISC-341	Section 11	Light-Frame Construction or Miscellaneous Structures ^m												

FOOTNOTE:

- a. Response modification coefficient R, for use throughout the standard. Note R reduces forces to a strength level, not an allowable stress level.
b. Reflection amplification factor, Cd, for use in ASCE 7-05 Sections 12.8.6, 12.8.7, and 12.9.2
c. NL = Not Limited, NP = Not Permitted, DL = roof or floor tributary dead load in accordance with ASCE 7-05 Section 12.2.5.6, 12.2.5.7, 12.2.5.8, WDL = exterior wall tributary dead load in accordance with ASCE 7-05 Section 12.2.5.6, 12.2.5.7, 12.2.5.8
d. HT = Heights are measured from the base of the structure as defined in ASCE 7-05 Section 11.2. For metric units use 30.5m for 100ft and use 48.8m for 160 ft. Story as defined in ASCE 7-05 section 11.2.
e. The tabulated value of the overstrength factor, Ω_o , is permitted to be reduced by subtracting one-half for structures with flexible diaphragms, but shall not be taken as less than 2.0 for any structure except cantilever column system.
f. See ASCE 7-05 Section 12.2.5.5 for limitations for steel SMFs in structures assigned to Seismic Design Category D through F.
g. See ASCE 7-05 Section 12.2.5.6 and 12.2.5.8 for limitations for single-story steel OMFs and IMF's in structures assigned to Seismic Design Category D through F.
h. See ASCE 7-05 Section 12.2.5.7 for limitations for steel OMFs and IMF's in structures assigned to Seismic Design Category F.
i. See ASCE 7-05 Section 12.2.5.9 for limitations for steel IMF's in structure assigned to Seismic Design Category D through E.
j. See AISC 358-05 Table 2.1 for limitations for prequalified steel SMFs with concrete structural slabs in direct contact with the steel.
k. The connection in this table is intended for rolled or built-up I-shaped sections (i.e., wide flange shapes).
l. Other symmetrical shapes may include, but not limited to, channels, built-up sections (non I-shaped), and hollow structural sections (HSS).
m. Miscellaneous structures may include, but not limited to, walkways, canopies, penthouse, stairs towers, and other non-building structures not part of the lateral resisting system of a building.

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