SUMMARY OF MAJOR CHANGES IN PUBLIC REVIEW ONE OF AISC 360-22

Substantial changes to ANSI/AISC 360 in the 2022 edition that appear in Public Review One Draft dated August 3, 2020:

- New shear lag factors are provided for slotted round and rectangular
- HSS members connected to a gusset plate and for rectangular HSS members connected two side gusset plates.
- New provisions are provided compression members with lateral bracing offset from the shear center (also known as constrained axis torsional buckling).
- Eurocode stress-strain-temperature equations have been incorporated in Appendix 4 (fire) so users have clearer guidance on that material properties they can use for steel and concrete at elevated temperatures.
- Appendix 4, Section 4.3, "Design by Qualification Testing," now includes prescriptive steel fire protection design equations and related information based on standard ASTM E119 fire tests, which have also been contained in ASCE-29 and the IBC.
- Sections A4, Structural Design Documents and Specifications, has been expanded to list information from the Code of Standard Practice that needs to be provided in the structural design documents.
- A new Section A5, Approvals, has been added to address the review and approval of approval documents.
- Chapter I, "Design of Composite Members," has been expanded to include the coupled concrete filled composite plate shear wall system.
- New provisions added to Chapter I, "Design of Composite Members," has made this chapter the single source standard for the design of composite members and systems.
- New provisions have been added for both filled and encased members.
- A new Appendix has been added to allow for the design of filled composite members with higher strength materials ($f'c \leq 15{,}000$ psi and $F_y \leq 100$ ksi) ASTM F3148 (144 ksi) bolts have been added to the Specification.

Specification for Structural Steel Buildings

Public Review Draft dated August 3, 2020

Supersedes the *Specification for Structural Steel Buildings* dated July 7, 2016 and all previous versions of this specification

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CHAPTER B

DESIGN REQUIREMENTS

This chapter addresses general requirements for the design of steel structures applicable to all chapters of this Specification.

The chapter is organized as follows:

B1. General Provisions
B2. Loads and Load Combinations
B3. Design Basis
B4. Member Properties
B5. Fabrication and Erection
B6. Quality Control and Quality Assurance
B7. Evaluation of Existing Structures

B1. GENERAL PROVISIONS

The design of members and connections shall be consistent with the intended behavior of the structural system and the assumptions made in the structural analysis.

B2. LOADS AND LOAD COMBINATIONS

The loads, nominal loads, and load combinations shall be those stipulated by the applicable building code. In the absence of a building code, the loads, nominal loads, and load combinations shall be those stipulated in *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* (ASCE/SEI 7).

User Note: When using ASCE/SEI 7 for design according to Section B3.1 (LRFD), the load combinations in ASCE/SEI 7 Section 2.3 apply. For design, according to Section B3.2 (ASD), the load combinations in ASCE/SEI 7 Section 2.4 apply.

B3. DESIGN BASIS

Design shall be such that no applicable strength or serviceability limit state shall be exceeded when the structure is subjected to all applicable load combinations.

Design for strength shall be performed according to the provisions for load and resistance factor design (LRFD) or to the provisions for allowable strength design (ASD).

User Note: The term "design," as used in this Specification, is defined in the Glossary.

1. Design for Strength Using Load and Resistance Factor Design (LRFD)

Design according to the provisions for load and resistance factor design (LRFD) satisfies the requirements of this Specification when the design strength of each structural component equals or exceeds the required strength determined on the basis of the LRFD load combinations. All provisions of this Specification, except for those in Section B3.2, shall apply.

Design shall be performed in accordance with Equation B3-1:

$$R_u \le \phi R_n \quad \text{(B3-1)}$$

where

R_u = required strength using LRFD load combinations
R_n = nominal strength
ϕ = resistance factor
ϕR_n = design strength

The nominal strength, R_n, and the resistance factor, ϕ, for the applicable limit states are specified in Chapters D through K.

2. Design for Strength Using Allowable Strength Design (ASD)

Design according to the provisions for allowable strength design (ASD) satisfies the requirements of this Specification when the allowable strength of each structural component equals or exceeds the required strength determined on the basis of the ASD load combinations. All provisions of this Specification, except those of Section B3.1, shall apply.

Design shall be performed in accordance with Equation B3-2:

$$R_a \le \frac{R_n}{\Omega} \quad \text{(B3-2)}$$

where

R_a = required strength using ASD load combinations
R_n = nominal strength
Ω = safety factor
R_n/Ω = allowable strength

The nominal strength, R_n, and the safety factor, Ω, for the applicable limit states are specified in Chapters D through K.

3. Required Strength

The required strength of structural members and connections shall be determined by structural analysis for the applicable load combinations, as stipulated in Section B2.

Design by elastic or inelastic analysis is permitted. Requirements for analysis are stipulated in Chapter C and Appendix 1.

4. Design of Connections and Supports

Connection elements shall be designed in accordance with the provisions of Chapters J and K. The forces and deformations used in design of the connections shall be consistent with the intended performance of the connection and the assumptions used in the design of the structure. Self-limiting inelastic deformations of the connections are permitted.

At points of support, beams, girders, and trusses shall be restrained against rotation about their longitudinal axis unless it can be shown by analysis that the restraint is not required.

User Note: *Code of Standard Practice* Section 3.1.2 addresses communication of necessary information for the design of connections.

4a. Simple Connections

A simple connection transmits a negligible moment. In the analysis of the structure, simple connections may be assumed to allow unrestrained relative rotation between the framing elements being connected. A simple connection shall have sufficient rotation capacity to accommodate the required rotation determined by the analysis of the structure.

4b. Moment Connections

Two types of moment connections, fully restrained and partially restrained, are permitted, as specified below.

(a) Fully Restrained (FR) Moment Connections

A fully restrained (FR) moment connection transfers moment with a negligible rotation between the connected members. In the analysis of the structure, the connection may be assumed to allow no relative rotation. An FR connection shall have sufficient strength and stiffness to maintain the initial angle between the connected members at the strength limit states.

(b) Partially Restrained (PR) Moment Connections

Partially restrained (PR) moment connections transfer moments, but the relative rotation between connected members is not negligible. In the analysis of the structure, the moment-rotation response characteristics of any PR connection shall be included. The response characteristics of the PR connection shall be based on the technical literature or established by analytical or experimental means. The component elements of a PR connection shall have sufficient strength, stiffness, and deformation capacity such that the moment-rotation response can be realized up to and including the required strength of the connection.

5. Design of Diaphragms and Collectors

Diaphragms and collectors shall be designed for forces that result from loads, as stipulated in Section B2. They shall be designed in conformance with the provisions of Chapters C through K, as applicable.

6. Design of Anchorages to Concrete

Anchorage between steel and concrete acting compositely shall be designed in accordance with Chapter I. The design of column bases, and anchor rods shall be in accordance with Chapter J.

7. Design for Stability

The structure and its elements shall be designed for stability in accordance with Chapter C.

8. Design for Serviceability

The overall structure and the individual members and connections shall be evaluated for serviceability limit states in accordance with Chapter L.

9. Design for Structural Integrity

When design for structural integrity is required by the applicable building code, the requirements in this section shall be met.

(a) Column splices shall have a nominal tensile strength equal to or greater than $D + L$ for the area tributary to the column between the splice and the splice or base immediately below,
where
D = nominal dead load, kips (N)
L = nominal live load, kips (N)

(b) Beam and girder end connections shall have a minimum nominal axial tensile strength equal to (i) two-thirds of the required vertical shear strength for design according to Section B3.1 (LRFD) or (ii) the required vertical shear strength for design according to Section B3.2 (ASD), but not less than 10 kips in either case.

(c) End connections of members bracing columns shall have a nominal tensile strength equal to or greater than (i) 1% of two-thirds of the required column axial strength at that level for design according to Section B3.1 (LRFD) or (ii) 1% of the required column axial strength at that level for design according to Section B3.2 (ASD).

The strength requirements for structural integrity in this section shall be evaluated independently of other strength requirements. For the purpose of satisfying these requirements, bearing bolts in connections with short-slotted holes parallel to the direction of the tension force and inelastic deformation of the connection are permitted.

10. Design for Ponding

The roof system shall be investigated through structural analysis to ensure stability and strength under ponding conditions unless the roof surface is configured to prevent the accumulation of water.

Ponding stability and strength analysis shall consider the effect of the deflections of the roof's structural framing under all loads (including dead loads) present at the onset of ponding and the subsequent accumulation of rainwater and snowmelt.

The nominal strength and resistance or safety factors for the applicable limit states are specified in Chapters D through K.

11. Design for Fatigue

For members and their connections subjected to repeated loading, fatigue shall be considered in accordance with Appendix 3. Fatigue need not be considered for seismic effects or for the effects of wind loading on typical building lateral force-resisting systems and building enclosure components.

12. Design for Fire Conditions

Two methods of design for fire conditions are provided in Appendix 4: (a) by analysis and (b) by qualification testing. Compliance with the fire-protection requirements in the applicable building code shall be deemed to satisfy the requirements of Appendix 4.

This section is not intended to create or imply a contractual requirement for the engineer of record responsible for the structural design or any other member of the design team.

User Note: Design by qualification testing is the prescriptive method specified in most building codes. Traditionally, on most projects where the architect is the prime professional, the architect has been the responsible party to specify and coordinate fire protection requirements. Design by analysis is a newer engineering approach to fire-protection. Designation of the person(s) responsible for designing for fire conditions is a contractual matter to be addressed on each project.

13. Design for Corrosion Effects

Where corrosion could impair the strength or serviceability of a structure, structural components shall be designed to tolerate corrosion or shall be protected against corrosion.

B4. MEMBER PROPERTIES

1. Classification of Sections for Local Buckling

For members subject to axial compression, sections are classified as nonslender-element or slender-element sections. For a nonslender-element section, the width-to-thickness ratios of its compression elements shall not exceed λ_r from Table B4.1a. If the width-to-thickness ratio of any compression element exceeds λ_r, the section is a slender-element section.

For members subject to flexure, sections are classified as compact, noncompact or slender-element sections. For all sections addressed in Table B4.1b, flanges must be continuously connected to the web or webs. For a section to qualify as compact, the width-to-thickness ratios of its compression elements shall not exceed the limiting width-to-thickness ratios, λ_p, from Table B4.1b. If the width-to-thickness ratio of one or more compression elements exceeds λ_p, but does not exceed λ_r from Table B4.1b, the section is noncompact. If the width-to-thickness ratio of any compression element exceeds λ_r, the section is a slender-element section.

For cases where the web and flange are not continuously attached, consideration of element slenderness must account for the unattached length of the elements and the appropriate plate buckling boundary conditions.

User Note: The Commentary discusses element slenderness when web and flange are not continuously attached.

1a. Unstiffened Elements

For unstiffened elements supported along only one edge parallel to the direction of the compression force, the width shall be taken as follows: