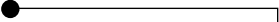


Preface



The knowledge and expertise required for the design of steel-framed structures is essential to architectural, civil, and structural engineers, as well as to students intending to pursue careers in the field of structural design and construction. This textbook provides the fundamentals of structural steel design from a structural systems framework that involves not only the isolated design of individual structural steel elements or components, but the design of these elements within the context of the entire structural system. This enables the reader to see the connection between each structural element and how and where they fit within the entire structural system, in addition to engendering a big picture view of structural steel design.

We strive to bridge the divide between engineering education and professional practice by exposing the reader to structural engineering principles and theory as well as practical applications of the design methods, so that what is learned in this text is directly applicable and relevant to professional design practice. We go beyond standard textbook-style exercises to include real-world-type structural engineering exercises, together with a project-based approach that instills the fundamentals of structural behavior and design, and enables the student to gain an appreciation of the design constraints, and learn from the iterative nature of the structural design process.

The intent is that by the time the reader has worked through all the chapters of the text and the corresponding design project tasks related to each chapter, they will have completed the design of an entire steel structure, enabling them to see the big picture and thus reinforcing the connections between the design of individual structural steel elements and the design of a complete structural system.

The American Institute for Steel Construction encourages the exposure of students to the design of structural steel elements within a realistic building context. We present practical details, real-world examples, and end-of-chapter exercises that not only provide the reader with an essential background on structural steel design, but also provide subject material that closely mirrors the details and examples found in professional engineering practice, thus making the relevance of the material studied to engineering practice more apparent to the student. Many of the examples and the end-of-chapter exercises presented are characteristic of the types of technical exercises that the reader will encounter in professional engineering practice.

This approach of balancing theory and practical applications will enhance the learning of structural steel design and engender design creativity in the reader.

INTENDED AUDIENCE

This text is ideal for students in any undergraduate course in structural steel design and will sufficiently prepare them to apply the fundamentals of structural steel design to typical projects that they might come across in professional engineering practice. It is suitable for students in civil engineering, architectural engineering, structural engineering, and construction engineering programs, as well as architecture programs and civil engineering technology, construction engineering technology, and construction management programs. This text can also serve as a good resource and reference for practicing structural engineers, and as a useful tool for the mentorship of entry-level civil/structural engineers in industry. It is also a helpful reference and study guide for the Fundamentals of Engineering (FE), the Professional Engineering (PE), and the Structural Engineering (SE) exams. This text covers the course content for the Steel Design I course and a majority of the course content for the Steel Design II course in the curriculum for basic education of a structural engineer proposed by the National Council for Structural Engineering Associations (NCSEA).

UNIQUE FEATURES OF THIS TEXT

We blend the “how’s” and “why’s” of structural steel design into a balanced structural steel design text that bridges the gap between theory and engineering practice.

We present numerous realistic details and diagrams to help illustrate the structural steel design process, similar to what is done in professional engineering practice, while at the same time discussing the theory behind the design equations. In Chapter 14, we introduce two student design projects to expose the reader to the important aspects of a real-world structural steel building project and a pedestrian steel bridge design project. Several other unique features of this text are listed below:

1. The use of real-world structural plans and details, and practical real-world examples, including practical information on structural drawings.
2. An introduction to the techniques for laying out floor and roof framing, and for sizing floor and roof decks for gravity loads, as well as how to lay out and distribute lateral forces to the the lateral force resisting systems in buildings. General rules of thumb for selecting beam spacing, depth and thickness of deck, and the direction of framing for the beams and girders are discussed.
3. A discussion of other rules of thumb for sizing of structural steel to allow for the quick selection of common structural members (e.g., open-web steel joists, beams, and columns).
4. The calculation of gravity and lateral loads in accordance with the ASCE 7 provisions is included.
5. The design of column base plates and anchor rods for axial loads, shear, uplift, and moments.
6. Step-by-step design of moment frames with a design example, as well as the design of moment connections.
7. An introduction to floor vibration analysis and design based on AISC Design Guide No. 11.
8. A chapter on practical considerations helps to reinforce the connection between structural element/member design and structural system design in practice.
9. The behavior, analysis and design of horizontal diaphragms, chords, and collectors (or drag struts) is discussed. A discussion of practical details that ensures adequate and identifiable lateral load path from the roof and floor diaphragms to the lateral force resisting systems is presented.

10. An introduction to the flexure analogy method for the analysis of torsion in steel members is discussed, and practical real-world examples are provided.
11. An introduction to the strengthening and rehabilitation of steel structures, and to performance-based design.
12. Coverage of other important topics, including beam copes and beam web holes and their reinforcing; X-braces using tension rods, clevises, and turnbuckles; stability bracing of beams and columns; beam design for net wind uplift loads; and introduction to coatings for structural steel.
13. The impact of differential axial shortening of columns in tall steel buildings is discussed.
14. The axial compression load capacity and the bending moment capacity of WT and double angle sections, which are frequently used as the top and bottom chords of floor and roof trusses, are discussed. The axial compression load capacity of a plane and flanged cruciform section is also discussed.
15. The vertical and lateral deflection criteria for beams and girders, and the lateral vibration criteria for tall buildings are discussed.
16. Sample structural steel plans, bracing elevations, moment connection details, and details of the connection of collectors or drag struts to the lateral force resisting system, and sample roof and floor plan notes are presented to acquaint the reader with the information that should be included in a structural drawing package for a typical project.

NEW TO THE FOURTH EDITION

- Content has been updated to correspond to the latest AISC Specification for Structural Steel Buildings (ANSI/AISC 360-22) and the 16th edition of the *AISC Steel Construction Manual*.
- Load calculations have been revised to conform to the ASCE 7-22 load standard, and examples involving uplift forces at the columns of the lateral force resisting systems are presented. Calculation of additional vertical forces (compression or tension) on the columns of the lateral force resisting systems (LFRS) caused by the overturning moments from lateral wind and seismic loads. Discussion of vehicular impact loads on exposed columns and parking garage edge barriers.
- Composite columns—embedded steel columns and concrete-filled tubes and box section—subject to axial compression loads and flexure are covered.
- Roof and floor deck selection examples using both LRFD and ASD methods are presented, including discussion of deck fireproofing methods, and the impact of fire resistance rating requirements on roof and floor deck sizes.
- Expanded discussion of residual stresses and brittle fracture, and the AISC Code requirements for heavy shapes (i.e., members thicker than 2 inches) to prevent brittle fracture.
- Torsional buckling of steel members with lateral bracing that is offset from the shear center (new AISC Sections E4d and E4e); and coverage of torsional bracings.
- Other topics covered include ductility requirements for shear studs and where the requirements can be neglected; construction joint requirements in large composite floor decks, the various categories of Architecturally Exposed Structural Steel (AESS), and web sidesway buckling and web compression buckling; discussions of structural integrity requirements, and prevention of progressive or disproportionate collapse; and discussion of fire protection

requirements and the various methods of fireproofing steel framing; tension rods in entrance canopies, and expanded discussions of the instantaneous center method for eccentrically loaded welded connections.

- Additional end-of-the-chapter exercises that mimic steel design exercises from professional practice have been added.
- Additional real-world examples of structural steel framing, structural details, bracing elevations, and moment connection details, and photos are included.
- Additional topics include wind loads on parapets, seismic analysis of podium structures, and the requirements for foundation ties in seismic design.

INSTRUCTOR'S RESOURCES

Upon adoption, an online Instructor's Manual is available to qualified instructors for download by contacting the publisher at *info@merclearning.com*.