

Contents

About the Author v

Preface x

MindTap Online Course xiii

CHAPTER 1: Introduction 3

1.1 Structural Design 3

1.2 Loads 6

1.3 Building Codes 7

1.4 Design Specifications 7

1.5 Structural Steel 8

1.6 Standard Cross-Sectional Shapes 12

Problems 17

CHAPTER 2: Concepts in Structural Steel Design 21

2.1 Design Philosophies 21

2.2 American Institute of Steel Construction Specification 23

2.3 Load Factors, Resistance Factors, and Load Combinations for LRFD 24

2.4 Safety Factors and Load Combinations for ASD 26

2.5 Probabilistic Basis of Load and Resistance Factors 29

2.6 Steel Construction Manual 33

2.7 Design Computations and Precision 35

Problems 38

CHAPTER 3: Tension Members 41

3.1 Introduction 41

3.2 Tensile Strength 42

3.3 Effective Area 50

3.4 Staggered Fasteners 57

3.5 Block Shear 64

3.6 Design of Tension Members 67

3.7 Threaded Rods and Cables 75

3.8 Tension Members in Roof Trusses 78

3.9 Pin-Connected Members 88

Problems 90

CHAPTER 4: Compression Members 107

- 4.1 Introduction 107
- 4.2 Column Theory 108
- 4.3 AISC Requirements 115
- 4.4 Local Stability 119
- 4.5 Tables for Compression Members 125
- 4.6 Design 127
- 4.7 More on Effective Length 134
- 4.8 Torsional and Flexural-Torsional Buckling 151
- 4.9 Built-Up Members 158
- Problems 167

CHAPTER 5: Beams 185

- 5.1 Introduction 185
- 5.2 Bending Stress and the Plastic Moment 186
- 5.3 Stability 192
- 5.4 Classification of Shapes 194
- 5.5 Bending Strength of Compact Shapes 195
- 5.6 Bending Strength of Noncompact Shapes 207
- 5.7 Summary of Moment Strength 210
- 5.8 Shear Strength 212
- 5.9 Deflection 220
- 5.10 Design 222
- 5.11 Floor and Roof Framing Systems 238
- 5.12 Holes in Beams 243
- 5.13 Open-Web Steel Joists 246
- 5.14 Beam Bearing Plates and Column Base Plates 250
- 5.15 Biaxial Bending 264
- 5.16 Bending Strength of Various Shapes 274
- Problems 280

CHAPTER 6: Beam-Columns 297

- 6.1 Definition 297
- 6.2 Interaction Formulas 298
- 6.3 Methods of Analysis for Required Strength 303
- 6.4 The Moment Amplification Method 305
- 6.5 Braced versus Unbraced Frames 308
- 6.6 Members in Braced Frames 309
- 6.7 Members in Unbraced Frames 323

- 6.8 Design of Beam–Columns 335
- 6.9 Trusses with Top-Chord Loads Between Joints 355
- Problems 361

CHAPTER 7: Simple Connections 375

- 7.1 Introduction 375
- 7.2 Bolted Shear Connections: Failure Modes 378
- 7.3 Bearing Strength, Spacing, and Edge-Distance Requirements 380
- 7.4 Shear Strength 386
- 7.5 Installation of High-Strength Bolts 392
- 7.6 Slip-Critical and Bearing-Type Connections 394
- 7.7 Design Examples 400
- 7.8 High-Strength Bolts in Tension 414
- 7.9 Combined Shear and Tension in Fasteners 426
- 7.10 Welded Connections 439
- 7.11 Fillet Welds 441
- Problems 460

CHAPTER 8: Eccentric Connections 475

- 8.1 Examples of Eccentric Connections 475
- 8.2 Eccentric Bolted Connections: Shear Only 476
- 8.3 Eccentric Bolted Connections: Shear Plus Tension 489
- 8.4 Eccentric Welded Connections: Shear Only 494
- 8.5 Eccentric Welded Connections: Shear Plus Tension 509
- 8.6 Moment-Resisting Connections 517
- 8.7 Column Stiffeners and Other Reinforcement 534
- 8.8 End Plate Connections 557
- 8.9 Concluding Remarks 571
- Problems 572

CHAPTER 9: Composite Construction 591

- 9.1 Introduction 591
- 9.2 Shored versus Unshored Construction 602
- 9.3 Effective Flange Width 604
- 9.4 Steel Headed Stud Anchors 608
- 9.5 Design 611
- 9.6 Deflections 618
- 9.7 Composite Beams with Formed Steel Deck 622
- 9.8 Tables for Composite Beam Analysis and Design 635

- 9.9 Continuous Beams 644
 9.10 Composite Columns 645
 Problems 654

CHAPTER 10: Plate Girders 665

- 10.1 Introduction 665
 10.2 General Considerations 667
 10.3 AISC Requirements for Proportions of Plate Girders 670
 10.4 Flexural Strength 672
 10.5 Shear Strength 675
 10.6 Bearing Stiffeners 680
 10.7 Design 696
 Problems 714

Appendix: Plastic Analysis and Design 721

- A.1 Introduction 721
 A.2 AISC Requirements 723
 A.3 Analysis 724
 A.4 Design 729

References 733

Answers to Selected Problems 737

Index 741