Contents

About the Author v

Preface xi

1 Introduction

- **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

2 Concepts in Structural Steel Design

21

3

- **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 30
- 2.6 Steel Construction Manual 34
- 2.7 Design Computations and Precision 36 Problems 38

3 Tension Members

- **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 76
- **3.8** Tension Members in Roof Trusses 79
- **3.9** Pin-Connected Members 88 Problems 90

4 Compression Members 109

- 4.1 Introduction 109
- 4.2 Column Theory 110
- **4.3** AISC Requirements 117
- 4.4 Local Stability 121
- **4.5** Tables for Compression Members 130
- 4.6 Design 132
- **4.7** More on Effective Length 138
- **4.8** Torsional and Flexural-Torsional Buckling 155
- **4.9** Built-Up Members 162 Problems 171

41

viii Contents

5 Beams

5.1	Introduction 189
5.2	Bending Stress and the Plastic
	Moment 190
5.3	Stability 196
5.4	Classification of Shapes 198
5.5	Bending Strength of Compact Shapes 199
5.6	Bending Strength of Noncompact
	Shapes 211
5.7	Summary of Moment Strength 215
5.8	Shear Strength 216
5.9	Deflection 224
5.10	Design 226
5.11	Floor and Roof Framing Systems 239
5.12	Holes in Beams 245
5.13	Open-Web Steel Joists 248
5.14	Beam Bearing Plates and Column
	Base Plates 251
5.15	Biaxial Bending 265
5.16	Bending Strength of Various
	Shapes 276
	Problems 281

6 Beam–Columns

- 6.1 Definition 299
- 6.2 Interaction Formulas 300
- **6.3** Methods of Analysis for Required Strength 305
- **6.4** The Moment Amplification Method 307
- **6.5** Braced versus Unbraced Frames 310
- **6.6** Members in Braced Frames 311
- **6.7** Members in Unbraced Frames 327
- 6.8 Design of Beam–Columns 339
- 6.9 Trusses with Top-Chord Loads Between Joints 358 Problems 363

7 Simple Connections 377

- 7.1 Introduction 377
- **7.2** Bolted Shear Connections: Failure Modes 380

- **7.3** Bearing Strength, Spacing, and Edge-Distance Requirements 382
- 7.4 Shear Strength 388

189

299

- 7.5 Installation of High-Strength Bolts 394
- **7.6** Slip-Critical and Bearing-Type Connections 396
- 7.7 Design Examples 402
- 7.8 High-Strength Bolts in Tension 416
- 7.9 Combined Shear and Tension in Fasteners 428
- **7.10** Welded Connections 441
- 7.11 Fillet Welds 443 Problems 461

8 Eccentric Connections 477

- **8.1** Examples of Eccentric Connections 477
- 8.2 Eccentric Bolted Connections: Shear Only 478
- **8.3** Eccentric Bolted Connections: Shear Plus Tension 491
- 8.4 Eccentric Welded Connections: Shear Only 496
- 8.5 Eccentric Welded Connections: Shear Plus Tension 511
- 8.6 Moment-Resisting Connections 519
- **8.7** Column Stiffeners and Other Reinforcement 536
- **8.8** End Plate Connections 558
- **8.9** Concluding Remarks 572 Problems 572

9 Composite Construction 593

- 9.1 Introduction 593
- **9.2** Shored versus Unshored Construction 604
- **9.3** Effective Flange Width 606
- 9.4 Steel Headed Stud Anchors 610
- 9.5 Design 613
- 9.6 Deflections 620
- 9.7 Composite Beams with Formed Steel Deck 624
- **9.8** Tables for Composite Beam Analysis and Design 636
- **9.9** Continuous Beams 644
- **9.10** Composite Columns 645 Problems 655