STRUCTURAL STABILITY OF STEEL: CONCEPTS AND APPLICATIONS FOR STRUCTURAL ENGINEERS

THEODORE V. GALAMBOS
ANDREA E. SUROVEK

LIBRARY O
CONGRES
SURPLUS
DUPLICATE

WILEY

JOHN WILEY & SONS, INC.

CONTENTS

PREFACE ix

CHAPTER 1 FUNDAMENTALS OF STABILITY THEORY 1

1.1 Introduction 1
1.2 Basics of Stability Behavior: The Spring-Bar System 3
1.3 Fundamentals of Post-Buckling Behavior 7
1.4 Snap-Through Buckling 18
1.5 Multi-Degree-of-Freedom Systems 20
1.6 Summary 23
Problems 24

CHAPTER 2 ELASTIC BUCKLING OF PLANAR COLUMNS 28

2.1 Introduction 28
2.2 Large-Deflection Solution of an Elastic Column 29
2.3 Differential Equation of Planar Flexure 32
2.4 The Basic Case: Pin-Ended Column 36
2.5 Five Fundamental Cases 39
2.6 The Effect of Imperfections 43
2.7 Stability of a Rigid Frame 52
2.8 End-Restrained Columns 55
2.9 Restrained Column Examples 62
2.10 Continuously Restrained Columns 74
2.11 Summary 80
Problems 80
Appendix 85

CHAPTER 3 INELASTIC COLUMN BUCKLING 87

3.1 Tangent and Reduced Modulus Concepts 87
3.2 Shanley's Contribution 93
3.3 Example Illustrating the Tangent Modulus and the Reduced Modulus Concepts 98
3.4 Buckling Strength of Steel Columns 101
3.5 Illustration of the Effect of Residual Stresses on the Buckling Strength of Steel Columns 103

3.6 Effect of Initial Out-of-Straightness and Load Eccentricity 108
3.7 Design Formulas For Metal Columns 123
3.8 Summary 130
Problems 131

CHAPTER 4 BEAM-COLUMNS 134

4.1 Introduction 134
4.2 General Discussion of the Behavior of Beam-Columns 135
4.3 Elastic In-Plane Behavior of Beam-Columns 138
4.4 Elastic Limit Interaction Relationships 147
4.5 Example Problems of Beam-Column Strength 149
4.6 Systematic Methods of Analysis: Flexibility Method 159
4.7 Systematic Methods of Analysis: The Stiffness Method 170
4.8 Inelastic Strength of Beam-Columns 186
4.9 Design of Beam-Columns 197
Problems 199

CHAPTER 5 FRAME STABILITY 203

5.1 Introduction 203
5.2 Two-Bay Frame Examples 206
5.3 Summary 230
5.4 Selected References on Frames with Partially Restrained Joints 231
Problems 232

CHAPTER 6 LATERAL-TORSIONAL BUCKLING 236

6.1 Introduction 236
6.2 Basic Case: Beams Subjected to Uniform Moment 237
6.3 The Effect of Boundary Conditions 246
6.4 The Effect of Loading Conditions 249
6.5 Lateral-Torsional Buckling of Singly-Symmetric Cross-Sections 259
6.6 Beam-Columns and Columns 270
6.7 Inelastic Lateral-Torsional Buckling 278
6.8 Summary 288
Problems 289

CHAPTER 7 BRACING 290

7.1 Introduction 290
7.2 Discrete Bracing 292
7.3 Relative Bracing 297
7.4 Lean-on Bracing 299
7.5 Effects of Imperfections 300
7.6 Column Bracing Provisions 302
7.7 Beam Bracing 306
7.8 AISC Design Provisions for Beam Bracing 308
7.9 Summary 314
Suggested Reading 315
Problems 315

CHAPTER 8 SPECIFICATION-BASED APPLICATIONS OF STABILITY IN STEEL DESIGN 318

8.1 Introduction 318
8.2 Development of the Beam-Column Interaction Equations 319
8.3 Assessment of Column Strength 323
8.4 Assessment of Beam Strength 324
8.5 Specification-Based Approaches for Stability Assessment 330
8.6 Effective Length Factors, K-factors 344
8.7 Design Assessment by Two Approaches 354
8.8 Frame Design Requirements in Canada and Europe 359
8.9 Summary 361
Problems 361

REFERENCES 364

INDEX 369