SIXTH EDITION

MECHANICS OF MATERIALS

Ferdinand P. Beer

Late of Lehigh University

E. Russell Johnston

Late of University of Connects

John T. De Jif

Univers o onnecticut

I wid F. Hazurek

U d tes ast Guard Academy



```
عنوان و نام پدیدآور: [.t al.]...Arvir = ۱۲۹۲ مشخصات نشر: تهران: انتشارات علوم ایران، ۱۲۹۲ = ۲۰۱۳م.
مشخصات نشر: تهران: انتشارات علوم ایران، ۱۲۹۲ = ۲۰۱۳م.
مشخصات نظاهری: ۸۲۳ می: مصور، جدول، نمودار .
وضعیت فهرست نویسمی: فیبا
یادداشت: انگلیسمی.
کبادداشت: مولفین: David F. Mazurek
کبادداشت: مولفین: بایداشت فیلمی فردیناند بهر بیر مولف بوده است.
یادداشت: افست از روی ویراست ششم: ۲۰۱۲: نیویورک.
یادداشت: افست از روی ویراست ششم: ۲۰۱۲: نیویورک.
گواونیسمی عنوان: مکنیکس او ...
موضوع: مقاومت مصالح
موضوع: مقاومت مصالح
موشوع: Beer, Ferdinand Pier
شناب دو: Beer, Ferdinand Pier
شناب دی دیر ۲۱۲۰/۱۰۲ میلی، Beer (۱۲۰۲۰) میلی: ۲۰۲۵ میلی، دی دیر ۲۲۰/۱۰۲ به ۲۲۰۵۰ میلی، ۲۰۰۵ م
```



نشار على ان ران – تلفن ۹۹۲۲۵۳۶۷۶۲۱ و ۶۶۸۷۵۴۴۹ صندوق بر نهم ۱۳۱۶ ۱۳۱۱

انتشارات علوم ايران

mechanics of n (eri s (Sixth edition) : نام کتاب E. R sell hn بر المستدد: Davn viazurek , John DeWolf ,

ناشر: علوم ابران شابك: اقست

نوبت و سال چاپ: اول ۱۳۹۳

ثيراژ: ۲۰۰

قیمت: ۲۴۰۰۰ تومان

THE TRACE

Contents

Preface xii List of Symbols XVIII

Introduction—Concept of Stress 2

M M 1 1 1	
1.1 Introduc	tion 4

- 1.2 A Short Review of the Methods of Statics 4
- 1.3 Stresses in the Members of a Structure 7
- 1.4 Analysis and Design 8
- 1.5 Axial Loading; Normal Stress 9
- 1.6 Shearing Stress 11
- 1.7 Bearing Stress in Connections 13
- 1.8 Application to the Analysis and Design of Simple Structures 13
- Method of Problem Solution 16
- 1.10 Numerical Accuracy 17
- 1.11 Stress on an Oblique Plane under Axial Loadi
- 1.12 Stress under General Loading Conditions; Components of Stress 27
- 1.13 Design Considerations 30

Review and Summary for Chapter 1

2 Stress and Strain Loading

- 2.1 Introduction 54
- 2.2 Normal rain r Axial Loading 55
- 2.3
- Stree Stree Diagram 57
 True and True Strain 61 *2.4
- ke La Modulus of Elasticity 62 2.5
- 2.6 rsus Plastic Behavior of a Material 64
- 2.7 Repeated Loadings; Fatigue 66
- 2.8 Deformations of Members under Axial Loading 67
- 2.9 Statically Indeterminate Problems 78
- 2.10 Problems Involving Temperature Changes 82
- 2.11 Poisson's Ratio 93
- 2.12 Multiaxial Loading; Generalized Hooke's Law 94
- *2.13 Dilatation; Bulk Modulus 96

viii

2.14	Shearing	Strain	98
	Jileuming	Jiiuiii	70

- 2.15 Further Discussion of Deformations under Axial Loading: Relation among E, ν , and G 101
- *2.16 Stress-Strain Relationships for Fiber-Reinforced Composite Materials 103
 - 2.17 Stress and Strain Distribution under Axial Loadina: Saint-Venant's Principle 113
 - 2.18 Stress Concentrations 115
- 2.19 Plastic Deformations 117
- *2.20 Residual Stresses 121

Review and Summary for Chapter 2 129

3 Torsion

- 3.1 Introduction 142
- 3.2 Preliminary Discussion of the
- 3.3 Deformations in a Circular Shah
- 3.4 Stresses in the Elastic Range
- 3.5 Angle of Twist in the Ela CR
- 3.6 Statically Indeterm are she
- 3.7 Sh Design of Transmis
- Stress Conceptions 3.8 Circular Shafts
- Plastic Defo nations in circular Shafts
- nac of an Elastoplastic Material 186 *3.10 Circular Sh
- Circular Shafts 189 400 Stre
- *3.12 Tor. Inncircular Members 197
- *3.13 Thinled mollow Shafts 200

nd Summary for Chapter 3 210

Pure Bending 220

- 4.1 Introduction 222
- Symmetric Member in Pure Bending 224
- 4.3 Deformations in a Symmetric Member in Pure Bending 226
- 4.4 Stresses and Deformations in the Elastic Range 229
- 4.5 Deformations in a Transverse Cross Section 233
- Bending of Members Made of Several Materials 242 4.6
- 4.7 Stress Concentrations 246
- *4.8 Plastic Deformations 255
- *4.9 Members Made of an Elastoplastic Material 256
- *4.10 Plastic Deformations of Members with a Single Plane of Symmetry 260
- *4.11 Residual Stresses 261
- 4.12 Eccentric Axial Loading in a Plane of Symmetry 270

- 4.13 Unsymmetric Bending 279
- 4.14 General Case of Eccentric Axial Loading 284
- *4.15 Bending of Curved Members 294

Review and Summary for Chapter 4 305

5 Analysis and Design of Beams for Bending 314

- 5.1 Introduction 316
- 5.2 Shear and Bending-Moment Diagrams 319
- 5.3 Relations among Load, Shear, and Bending Moment 329
- 5.4 Design of Prismatic Beams for Bending 339
- *5.5 Using Singularity Functions to Determine Shear and Bending Moment in a Beam 350
- *5.6 Nonprismatic Beams 361

Review and Summary for Chapter 5 370

6 Shearing Stresses in Beams and Thin-Walled Members 380

- 6.1 Introduction 382
- 6.2 Shear on the Horizontal Face of a mem ame 3r
- 6.3 Determination of the Shearing Stress, in Seam 386
- **6.4** Shearing Stresses τ_{xy} in Common Type. Bec. 3 387
- *6.5 Further Discussion of the Distribution of Sasses in a
- Narrow Rectangular Beam 3 1

 6.6 Longitudinal Shear on a E 1 men, of Arbitrary
- Shape 399
 6.7 Shearing Stresses This 1 led Members 401
- *6.8 Plastic Deformation: 404
- *6.9 Unsymmetric Logical of Thin-Walled Members; Shear Cen. 4

Review and Summa for C. Jer 6 427

7 In sformations of Stress and Strain 436

- 7.1 Introduction 438
- 7.2 Transformation of Plane Stress 440
- 7.3 Principal Stresses: Maximum Shearing Stress 443
- 7.4 Mohr's Circle for Plane Stress 452
- 7.5 General State of Stress 462

	98280
0	

- 7.6 Application of Mohr's Circle to the Three-Dimensional Analysis of Stress 464
- •7.7 Yield Criteria for Ductile Materials under Plane Stress 467
- *7.8 Fracture Criteria for Brittle Materials under Plane Stress 469
- 7.9 Stresses in Thin-Walled Pressure Vessels 478
- *7.10 Transformation of Plane Strain 486
- *7.11 Mohr's Circle for Plane Strain 489
- *7.12 Three-Dimensional Analysis of Strain 491
- *7.13 Measurements of Strain; Strain Rosette 494

Review and Summary for Chapter 7 502

Principal Stresses under a Given Loading 512

- *8.1 Introduction 514
- *8.2 Principal Stresses in a Beam
- *8.3 Design of Transmission Shafts 5
- *8.4 Stresses under Combine cos nas 52/

Review and Summary for Cha 8 5 0

9 Deflect on of beams 548

- 9.1 In du on
- 9.2 Dei a Beam under Transverse Loading 552
- 9.3 Equal of the Elastic Curve 553
- *9. Direct but remination of the Elastic Curve from the Load Discoution 559
- Statically Indeterminate Beams 561
- **6** Using Singularity Functions to Determine the Slope and Deflection of a Beam 57)
- 9.7 Method of Superposition 580
- 9.8 Application of Superposition to Statically Indeterminate Beams 582
- *9.9 Moment-Area Theorems 592
- *9.10 Application to Cantilever Beams and Beams with Symmetric Loadings 595
- *9.11 Bending-Moment Diagrams by Parts 597
- *9.12 Application of Moment-Area Theorems to Beams with Unsymmetric Loadings 605
- *9.13 Maximum Deflection 607
- *9.14 Use of Moment-Area Theorems with Statically Indeterminate
 Beams 609

Review and Summary for Chapter 9 618

O Columns 630

troduction	632
	ntroduction

10.2 Stability of Structures 632

10.3 Euler's Formula for Pin-Ended Columns 635

10.4 Extension of Euler's Formula to Columns with Other End Conditions 638

*10.5 Eccentric Loading; the Secant Formula 649

10.6 Design of Columns under a Centric Load 660

10.7 Design of Columns under an Eccentric Load 675

Review and Summary for Chapter 10 684

11 Energy Methods 692

11.1 Introduction 694

11.2 Strain Energy 694

11.3 Strain-Energy Density 696

11.4 Elastic Strain Energy for Normal Stresses 698

11.5 Elastic Strain Energy for Shearing Stresses 701

11.6 Strain Energy for a General State of Stress 704

11.7 Impact Loading 716

11.8 Design for Impact Loads 718

11.9 Work and Energy under a Single Lond 7'9

11.10 Deflection under a Single Load by I Work-Energy Method 722

*11.11 Work and Energy under Several Loads 32

*11.12 Castigliano's Theorem 734

*11.13 Deflections by Castigliano' The rem 736

*11.14 Statically Indeterminate St 740

Review and Summary for Chap r 1.

Appendic s Al

A Mo its f Areas A2

B erties of Selected Materials Used in Expering A12

C Properies of Rolled-Steel Shapes A16

D Beam Deflections and Slopes A28

E Fundamentals of Engineering Examination A29

Photo Credits C1 Index II

Answers to Problems An1