

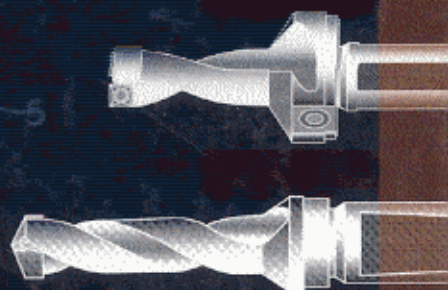
Marks'

Calculations

for Machine

Design

- Foundational Loading
- Thermal Stress and Strain
- Static Design and Column Buckling
- Fatigue and Dynamic Loading



Thomas H. Brown, Jr.

CONTENTS

Foreword	xi
Preface	xiii
Acknowledgments	xv

Part 1 Strength of Machines

Chapter 1. Fundamental Loadings	3
--	----------

- 1.1. Introduction / 3
- 1.2. Axial Loading / 4
- 1.3. Direct Shear / 11
- 1.4. Torsion / 16
- 1.5. Bending / 24

Chapter 2. Beams: Reactions, Shear Force and Bending Moment Distributions, and Deflections	33
---	-----------

- 2.1. Introduction / 33
- 2.2. Simply-Supported Beams / 35
 - 2.2.1. Concentrated Force at Midpoint / 36
 - 2.2.2. Concentrated Force at Intermediate Point / 41
 - 2.2.3. Concentrated Couple / 48
 - 2.2.4. Uniform Load / 55
 - 2.2.5. Triangular Load / 60
 - 2.2.6. Twin Concentrated Forces / 67
 - 2.2.7. Single Overhang: Concentrated Force at Free End / 73
 - 2.2.8. Single Overhang: Uniform Load / 79
 - 2.2.9. Double Overhang: Concentrated Forces at Free Ends / 86
 - 2.2.10. Double Overhang: Uniform Load / 92
- 2.3. Cantilevered Beams / 97
 - 2.3.1. Concentrated Force at Free End / 98
 - 2.3.2. Concentrated Force at Intermediate Point / 104
 - 2.3.3. Concentrated Couple / 110
 - 2.3.4. Uniform Load / 115
 - 2.3.5. Triangular Load / 120

Chapter 3. Advanced Loadings	127
-------------------------------------	------------

- 3.1. Introduction / 127
- 3.2. Pressure Loadings / 127

- 3.2.1. Thin-Walled Vessels / 128
- 3.2.2. Thick-Walled Cylinders / 130
- 3.2.3. Press or Shrink Fits / 134
- 3.3. Contact Loading / 139
 - 3.3.1. Spheres in Contact / 139
 - 3.3.2. Cylinders in Contact / 143
- 3.4. Rotational Loading / 147

Chapter 4. Combined Loadings**153**

- 4.1. Introduction / 153
- 4.2. Axial and Torsion / 156
- 4.3. Axial and Bending / 159
- 4.4. Axial and Thermal / 164
- 4.5. Torsion and Bending / 167
- 4.6. Axial and Pressure / 172
- 4.7. Torsion and Pressure / 175
- 4.8. Bending and Pressure / 184

Chapter 5. Principal Stresses and Mohr's Circle**189**

- 5.1. Introduction / 189
- 5.2. Principal Stresses / 190
- 5.3. Mohr's Circle / 205

Chapter 6. Static Design and Column Buckling**233**

- 6.1. Static Design / 233
 - 6.1.1. Static Design for Ductile Materials / 234
 - 6.1.2. Static Design for Brittle Materials / 246
 - 6.1.3. Stress-Concentration Factors / 258
- 6.2. Column Buckling / 260
 - 6.2.1. Euler Formula / 261
 - 6.2.2. Parabolic Formula / 263
 - 6.2.3. Secant Formula / 266
 - 6.2.4. Short Columns / 270

Chapter 7. Fatigue and Dynamic Design**273**

- 7.1. Introduction / 273
- 7.2. Reversed Loading / 274
- 7.3. Marin Equation / 279
- 7.4. Fluctuating Loading / 285
- 7.5. Combined Loading / 311

Part 2 Application to Machines

Chapter 8. Machine Assembly**321**

- 8.1. Introduction / 321
- 8.2. Bolted Connections / 321

- 8.2.1. The Fastener Assembly / 321
- 8.2.2. The Members / 326
- 8.2.3. Bolt Strength and Preload / 331
- 8.2.4. The External Load / 332
- 8.2.5. Static Loading / 335
- 8.2.6. Fatigue Loading / 337
- 8.3. Welded Connections / 348
 - 8.3.1. Axial and Transverse Loading / 348
 - 8.3.2. Torsional Loading / 352
 - 8.3.3. Bending Loading / 356
 - 8.3.4. Fillet Welds Treated as Lines / 360
 - 8.3.5. Fatigue Loading / 365

Chapter 9. Machine Energy**367**

- 9.1. Introduction / 367
- 9.2. Helical Springs / 367
 - 9.2.1. Loads, Stresses, and Deflection / 367
 - 9.2.2. Spring Rate / 371
 - 9.2.3. Work and Energy / 375
 - 9.2.4. Series and Parallel Arrangements / 377
 - 9.2.5. Extension Springs / 379
 - 9.2.6. Compression Springs / 380
 - 9.2.7. Critical Frequency / 383
 - 9.2.8. Fatigue Loading / 385
- 9.3. Flywheels / 388
 - 9.3.1. Inertial Energy of a Flywheel / 388
 - 9.3.2. Internal Combustion Engine Flywheels / 392
 - 9.3.3. Punch Press Flywheels / 395
 - 9.3.4. Composite Flywheels / 401

Chapter 10. Machine Motion**409**

- 10.1. Introduction / 409
- 10.2. Linkages / 410
 - 10.2.1. Classic Designs / 410
 - 10.2.2. Relative Motion / 412
 - 10.2.3. Cyclic Motion / 421
- 10.3. Gear Trains / 424
 - 10.3.1. Spur Gears / 425
 - 10.3.2. Planetary Gears / 428
- 10.4. Wheels and Pulleys / 431
 - 10.4.1. Rolling Wheels / 432
 - 10.4.2. Pulley Systems / 435

Bibliography 439**Index 441**