

HANDBUCH DER PHYSIK

HERAUSGEgeben VON

S. FLÜGGE

BAND VI

ELASTIZITÄT UND PLASTIZITÄT

MIT 254 FIGUREN

Springer-Verlag
GOTTINGEN



SPRINGER-VERLAG
BERLIN · GÖTTINGEN · HEIDELBERG
1958

Contents.

	Page
The Classical Theory of Elasticity. By IAN NAISMITH SNEDDON, Simson Professor of Mathematics in the University of Glasgow, Glasgow (Great Britain), and Dr. DENIS STANLEY BERRY, Senior Research Assistant, University of Nottingham, Mathematics Department, Nottingham (Great Britain). (With 16 Figures)	1
A. General theory	2
I. The analysis of strain	2
II. The analysis of stress	8
III. The relation between stress and strain	15
B. Torsion and flexure	27
I. The torsion problem	27
II. Bending of beams	38
C. Two-dimensional problems in elasto-statics	40
I. General theory	40
II. Airy stress function	42
III. Complex potentials	48
IV. Cauchy integral methods	58
V. Fourier transform methods	72
VI. Real potential methods	78
D. Three-dimensional problems in elasto-statics	84
I. General theory	84
II. BETTI's method	94
III. The method of integral transforms	98
IV. Applications of curvilinear coordinates	102
E. Dynamical problems	107
I. Elastic waves	107
II. Boundary value problems of dynamic elasticity	118
F. Thermoelasticity	123
Bibliography	126
Photoelasticity. By HERBERT T. JESSOP, T. D., M. Sc., F. Inst. P., Senior Lecturer, Department of Civil and Municipal Engineering, University College, London (Great Britain). (With 114 Figures)	127
Introduction	127
A. Theory	128
I. History	128
II. The optical basis of photoelasticity	130
III. The mechanical basis of photoelasticity	136
IV. Theory of photoelasticity	145
B. Exploration of two-dimensional stress systems	155
I. Photoelastic equipment	155
II. Photoelastic materials	161
III. Exploration of two-dimensional stresses	166

C. Exploration of three-dimensional stress systems	177
I. Frozen stress materials and techniques	177
II. The determination of the stresses	180
III. The tilting stage method of exploration of three-dimensional stresses	186
IV. The scattered light method of observation	193
D. Practical applications	202
I. Two-dimensional examples	202
II. Three-dimensional examples	215
III. Present state and possible future developments	225
Bibliography	228
The Mathematical Theories of the Inelastic Continuum. By Dr. ALFRED M. FREUDENTHAL, Professor of Civil Engineering, Columbia University, New York/N. Y. (USA), and Dr. HILDA GEIRINGER, Professor of Mathematics, Cambridge/Massachusetts (USA). (With 60 Figures)	229
First part. The inelastic continuum	229
A. Mechanics and thermodynamics of the inelastic continuum	229
I. The inelastic behavior of solids	229
II. Mechanics of deformable media	234
III. Thermodynamic considerations	243
B. Stress-strain relations	256
I. General formulation	256
II. Anelastic relations	263
III. Visco-elastic relations	269
IV. Plastic relations	278
V. Combined quasi-linear relations	289
C. The visco-elastic and the visco-plastic medium	293
I. The visco-elastic continuum	293
II. The visco-plastic medium	301
D. Problems of structural mechanics	308
I. Visco-elastic structures	308
II. Elastic-plastic structures	313
Second part. The ideal plastic body	322
E. The basic equations	322
I. The three-dimensional problem	322
II. Discontinuous solutions	333
a) Characteristics. Application to the three-dimensional problem of the perfectly plastic body	333
b) General consideration of discontinuous solutions	340
c) HADAMARD's theory	343
d) Shock conditions. Stress discontinuities	346
F. The problem of plane strain	349
I. Plane strain, plane stress, and generalizations	349
II. The theory of plane strain	353
a) Differential relations	353
b) Integration. Particular solutions	360
G. The general plane problem	367
I. Basic theory	367
a) The equations	367
b) Characteristics of the complete plane problem	372
c) Remarks on integration. Examples	381

Contents.	VII
	Page
II. Singular solutions and various remarks	384
a) Limit line singularities and branch line singularities	384
b) Simple waves	390
c) Various remarks	396
H. Boundary-value problems	399
I. Some elastic-plastic problems	399
a) The torsion problem	399
b) The thick walled tube	408
c) Flat ring and flat sheet in plane stress. Further elastic-plastic problems	418
II. Some plastic-rigid problems	425
a) Introductory remarks	425
b) Wedge with pressure on one face	427
c) Plastic mass between rough rigid plates	429
Reference Books	432
Rheology. By Dr. MARCUS REINER, Professor of Applied Mechanics, Israel Institute of Technology, Haifa (Israel). (With 45 Figures)	434
A. Preliminaries	434
I. Introduction	434
II. The classical bodies	448
B. Macrorheology	452
I. First-order phenomena	452
II. Higher order phenomena	487
III. Strength	519
C. Microrheology	522
D. Rheometry	535
E. Addenda	542
Symbols	549
Bibliography	549
Fracture. By Dr. GEORGE R. IRWIN, Superintendent of Mechanics Division, U. S. Naval Research Laboratory, Washington/D.C. (USA). (With 10 Figures)	551
I. Tensile strength of liquids	551
II. Stress and force relations in fracture	556
III. Forming and spreading of cracks	567
IV. Stress field, velocity, and division of a running crack	575
V. Effects of size upon fracturing	580
Bibliography references	589
Fatigue. By Dr. ALFRED M. FREUDENTHAL, Professor of Civil Engineering, Columbia University, New York/N. Y. (USA). (With 9 Figures)	591
I. The fatigue phenomenon	591
II. Micromechanics of progressive damage	596
III. Fatigue theories	603
IV. Cumulative damage	608
References	612
Sachverzeichnis (Deutsch-Englisch)	614
Subject Index (English-German)	628