CONTENTS

		ure Mechanics of Foams	1
1	Fundamentals of Fracture Mechanics		1
	1.1	Introduction	1
	$\begin{array}{c} 1.2\\ 1.3\end{array}$		3
		tropic materials	12
2	-	erimental Determination of Fracture Tough- s of Foam Materials	16
	2.1 2.2	Tear Test for Flexible Cellular Materials Standard Test Methods for Plane-Strain Fracture Toughness and Strain Energy Release Rate of Pla-	17
		stic Materials	18
	$\begin{array}{c} 2.3\\ 2.4\end{array}$	Fracture Toughness Experimental ResultsImpact Fracture Toughness	24 29
3	Mic	romechanical Models for Foams Fracture	34
4	Con	cluding Remarks	42
Bi	bliog	raphy	43
Fi	nite	Element Modeling of Foams	
		Daxner	47
1	Intr	oduction	47
2	Hon	nogenization and the Unit Cell Method	49
3	Mic	ro-Mechanical Finite Element Models	
	of C	ellular Materials	57
	3.1	Introduction	57

	$3.2 \\ 3.3 \\ 3.4$	Open-Cell Foams	63 67 72
4	Mic sult 4.1 4.2 4.3	ro-Mechanical Models — Methods and Re- s Elastic Properties	73 74 75 80
	4.4 4.5	Densification	91 93
5	Opt	imization of Foam Density Distribution	96
6	\mathbf{Sun}	nmary	98
Bi	bliog	raphy	98
P	laeti	aity of Three dimensional Forms	
		city of Three-dimensional Foams	107
	A. Ö		107 107 109 112
by	A. Ö Fun 1.1 1.2 1.3 1.4 Con	chsner damentals of Continuum Mechanics damentals of Continuum Mechanics Stress Tensor and Decomposition Invariants Constitutive Equations Linear Elastic Behaviour: Generalised Hooke's	107 107 109 112

	3.5		
4		ocedures to Determine the Influence of the drostatic Stress on the Yield Behaviour	141
5	Imp	elementation of New Constitutive Equations	
	into	Commercial Finite Element Codes	146
	5.1	One-Dimensional Drucker-Prager Yield Condition	146
	5.2	Integration of the Constitutive Equations	148
	5.3	Mathematical Derivation of the Fully Implicit	
		0	152
	5.4	Example Problem: Return Mapping for Ideal Plas-	
		ticity and Linear Hardening	158
Bi	ibliog	graphy	164
		walled Structures Made of Foams Altenbach and V.A. Eremeyev 1	67
	H. A	Altenbach and V.A. Eremeyev 1	.67 168
by	H. A	Altenbach and V.A. Eremeyev 1 coduction	
by	H. A	Itenbach and V.A. Eremeyev 1 coduction 1 Plates as Structural Elements 1	168
by	<i>H. A</i> Intr 1.1 1.2	Altenbach and V.A. Eremeyev 1 coduction 1 Plates as Structural Elements 1 Foams as a Material for Structural Elements 1	168 168
by 1	<i>H. A</i> Intr 1.1 1.2	Altenbach and V.A. Eremeyev 1 coduction 1 Plates as Structural Elements 1 Foams as a Material for Structural Elements 1 ect Two-dimensional Plate Theory 1	168 168 169
by 1	<i>H. A</i> Intr 1.1 1.2 Dire	Altenbach and V.A. Eremeyev 1 coduction 1 Plates as Structural Elements 1 Foams as a Material for Structural Elements 1 ect Two-dimensional Plate Theory 1 Classical Approaches in the Plate Theory 1	168 168 169 171
by 1	 <i>H. A</i> Intr 1.1 1.2 Dire 2.1 	Altenbach and V.A. Eremeyev 1 coduction 1 Plates as Structural Elements 1 Foams as a Material for Structural Elements 1 ect Two-dimensional Plate Theory 1 Classical Approaches in the Plate Theory 1 Governing Equations 1	168 168 169 171 171
by 1	 <i>H. A</i> Intr 1.1 1.2 Dire 2.1 2.2 	Altenbach and V.A. Eremeyev 1 coduction 1 Plates as Structural Elements 1 Foams as a Material for Structural Elements 1 ect Two-dimensional Plate Theory 1 Classical Approaches in the Plate Theory 1 Governing Equations 1 Material-independent Equations 1	168 168 169 171 171
by 1	 <i>H. A</i> Intr 1.1 1.2 Dire 2.1 2.2 2.3 	Altenbach and V.A. Eremeyev 1 coduction 1 Plates as Structural Elements 1 Foams as a Material for Structural Elements 1 ect Two-dimensional Plate Theory 1 Classical Approaches in the Plate Theory 1 Governing Equations 1 Material-independent Equations 1 Two-dimensional Constitutive Equations 1	168 169 1 71 171 173 174
by 1	 <i>H. A</i> Intr 1.1 1.2 Dire 2.1 2.2 2.3 2.4 2.5 	Altenbach and V.A. Eremeyev 1 coduction 1 Plates as Structural Elements 1 Foams as a Material for Structural Elements 1 ect Two-dimensional Plate Theory 1 Classical Approaches in the Plate Theory 1 Governing Equations 1 Material-independent Equations 1 Two-dimensional Constitutive Equations 1 Basic Equations in Cartesian Coordinates 1	168 169 169 171 171 173 174 175
by 1 2	 <i>H. A</i> Intr 1.1 1.2 Dire 2.1 2.2 2.3 2.4 2.5 	Intenbach and V.A. Eremeyev 1 coduction 1 Plates as Structural Elements 1 Foams as a Material for Structural Elements 1 ect Two-dimensional Plate Theory 1 Classical Approaches in the Plate Theory 1 Governing Equations 1 Material-independent Equations 1 Two-dimensional Constitutive Equations 1 Fasic Equations in Cartesian Coordinates 1 fness Identification 1	168 169 171 171 173 174 175 176
by 1 2	 <i>H. A</i> Intr 1.1 1.2 Dirc 2.1 2.2 2.3 2.4 2.5 Stiff 	Altenbach and V.A. Eremeyev 1 coduction 1 Plates as Structural Elements 1 Foams as a Material for Structural Elements 1 ect Two-dimensional Plate Theory 1 Classical Approaches in the Plate Theory 1 Governing Equations 1 Material-independent Equations 1 Two-dimensional Constitutive Equations 1 Basic Equations in Cartesian Coordinates 1 fness Identification 1 Orthotropic Material Behavior 1	 168 169 171 173 174 175 176 179
by 1 2	 <i>H. A</i> Intr 1.1 1.2 Dire 2.1 2.2 2.3 2.4 2.5 Stiff 3.1 	Idenbach and V.A. Eremeyev 1 coduction 1 Plates as Structural Elements 1 Foams as a Material for Structural Elements 1 ect Two-dimensional Plate Theory 1 Classical Approaches in the Plate Theory 1 Governing Equations 1 Material-independent Equations 1 Two-dimensional Constitutive Equations 1 Basic Equations in Cartesian Coordinates 1 Orthotropic Material Behavior 1 Classical Stiffness Values 1	168 169 171 171 173 174 175 176 179 180

4	$\mathbf{E}\mathbf{x}$	amples of Effective Stiffness Properties Esti-	
	ma	tes	186
	4.1	Homogeneous Plate	186
	4.2	Classical Sandwich Plate in Reissner's Sense	187
	4.3	Functionally Graded Materials and Foams	188
	4.4	On the Plates Made of Nanofoams	193
5	Syn	nmetric Orthotropic Plate - Static Case	196
	5.1	Bending Problem - One-dimensional Case	198
	5.2	Bending Problem - Two-dimensional Case	198
	5.3	Bending of an Isotropic Plate	199
	5.4	Bending of an Elastic Plate Made of FGM (Sym-	
		metric Case)	200
6	Dyı	namics of Plates Made of an Elastic Foam	201
	6.1	Equations of Motion for a Symmetric Isotropic Plate	201
	6.2	Free Oscillations and Dispersion curves of a Rect-	201
	0.2	angular Plate	203
7	Pla	te Made of a Linear Viscoelastic Material	209
7	Pla 7.1	te Made of a Linear Viscoelastic Material Constitutive Equations	209 209
7		Constitutive Equations	
7	7.1	Constitutive Equations	209 210
7	$7.1 \\ 7.2$	Constitutive Equations	209
7	$7.1 \\ 7.2 \\ 7.3$	Constitutive Equations	209 210 214
7	$7.1 \\ 7.2 \\ 7.3$	Constitutive EquationsEffective Properties	209 210 214
7	7.1 7.2 7.3 7.4	Constitutive Equations	209 210 214 215
7	7.1 7.2 7.3 7.4	Constitutive Equations	209 210 214 215 217
8	 7.1 7.2 7.3 7.4 7.5 7.6 	Constitutive Equations	209 210 214 215 217
	 7.1 7.2 7.3 7.4 7.5 7.6 Plate 	Constitutive Equations	209 210 214 215 217
	 7.1 7.2 7.3 7.4 7.5 7.6 Plate 	Constitutive Equations	209 210 214 215 217 222
	 7.1 7.2 7.3 7.4 7.5 7.6 Plating 	Constitutive Equations	209 210 214 215 217 222 226
	 7.1 7.2 7.3 7.4 7.5 7.6 Plating 8.1 	Constitutive Equations	209 210 214 215 217 222 226
	 7.1 7.2 7.3 7.4 7.5 7.6 Plating 8.1 8.2 	Constitutive Equations	209 210 214 215 217 222 226 226

Plasticity of Porous and Powder Metals by S. Alexandov			243	
1	Int	roduction	243	
2	Fur	ndamentals of the Theory of Plasticity	245	
	2.1	Rigid Perfectly/Plastic Solids	245	
	2.2	Rigid Plastic Hardening Solids	252	
	2.3	Rigid Viscoplastic Solids	253	
	2.4	Maximum Friction Law and Singular Velocity		
		Fields (Rigid Perfectly/Plastic Material)	254	
	2.5	Maximum Friction Law and Other Models of		
		Pressure–independent Plasticity	261	
3	Plasticity Theory for Porous and Powder Metals			
		ed on the Associated Flow Rule	262	
	3.1	Preliminaries	262	
	3.2	Yield Criteria and the Associated Flow Rule for		
		Porous and Powder Materials	265	
	3.3	Additional Remarks on the Yield Criteria	270	
	3.4	Simple Analytic Example	271	
4	Pla	sticity Theory for Porous and Powder Metals		
		ed on Non-associated Flow Rules	277	
	4.1	Stress Equations	277	
	4.2	Kinematic Theories	280	
	4.3	The Coaxial Model	281	
	4.4	The Double-shearing Model		
	4.5	The Double-slip and Rotation Model	284	
5	Qualitative Behavior of Plastic Solutions for			
	Por	ous and Powder Metals in the Vicinity of		
	Fric	ctional Interfaces	285	
	5.1			
	5.2	Statement of the Problem	285	

	5.3	Solution for Stresses	289
	5.4	Solutions for Velocities	290
	5.5	Frictional Boundary Condition	292
	5.6	Solution for Pressure-independent Plasticity	
	5.7	Singularity in Velocity Fields	
6	Ар	olications	302
Bi	bliog	graphy	305
In	npa	ct of Cellular Materials	
	-	Can and S. Qu	309
1	Intr	oduction	309
2	Way	ve Propagation in a Cellular Rod	311
3	Rig	id Object Strikes on a Cellular Rod of Fixed	
	End	l	316
	3.1	Basic Assumptions	316
	3.2	Shock Wave Analysis	317
4	Rig	id Object Strikes on a Free Cellular Rod	325
5	Con	cluding Remarks	333
Bi	bliog	graphy	333