

TABLE OF CONTENTS

Preface

Chapter 1 Mathematical models of elastic-plastic problems

1.1	Spring-mass system with one degree of freedom	1
1.2	Spring-mass system with multiple degrees of freedom	9
1.3	Two-dimensional problems	10

Chapter 2 Elastic-plastic vibration of a spring-mass system
with one degree of freedom

2.1	Function of bounded right derivative	17
2.2	Equation of motion (kinematic hardening problem)	18
2.3	Energy inequalities	24
2.4	Behaviour of the solution as $t \rightarrow \infty$	31
2.5	A weak form of the stress-strain relation	32
2.6	Isotropic hardening problem	37

Chapter 3 Elastic-plastic vibration of a spring-mass system
with multiple degrees of freedom

3.1	Equation of motion (kinematic hardening problem)	48
3.2	Energy inequalities	52
3.3	Behaviour of the solution as $t \rightarrow \infty$	56
3.4	A weak form	57
3.5	Isotropic hardening problem	58

Chapter 4	Quasi-static problems of a spring-mass system with multiple degrees of freedom	
4.1	Continuation of the solution (kinematic hardening problem)	62
4.2	Isotropic hardening problem	73
Chapter 5	Two-dimensional dynamic semidiscrete system	
5.1	A finite element approximation	79
5.2	Continuation of the solution	82
5.3	Energy inequalities	88
5.4	A weak form	93
5.5	Isotropic hardening problem	96
Chapter 6	Two-dimensional quasi-static semidiscrete system	
6.1	Semidiscrete finite element approximation	103
6.2	Determination of the first derivative	103
6.3	Determination of the higher derivatives	110
6.4	Isotropic hardening problem	117
Chapter 7	Numerical stability in dynamic elastic-plastic problems	
7.1	Finite difference approximation of the acceleration	121
7.2	Numerical stability (1)	126
7.3	Numerical stability (2)	129
7.4	Isotropic hardening problem	141
Chapter 8	Explicit schemes for quasi-static problems	

Contents

xi

8.1	An explicit method for the system with multiple degrees of freedom	147
8.2	The order of convergence with respect to Δt	152
8.3	Two-dimensional problems	156
8.4	Isotropic hardening problem	165
Chapter 9	Elastic-plastic deformation of continuous bodies	
9.1	Some theorems in the theory of integration and functional analysis	176
9.2	Elastic-plastic vibration of a rod	181
9.3	Two-dimensional dynamic problem	189
9.4	Isotropic hardening problem	196
9.5	Two-dimensional quasi-static problem	201
9.6	Strong convergence and error estimates of the finite element solutions	202
Chapter 10	Introduction to an elastic-plastic problem with geometrical nonlinearity	
10.1	A nonlinear beam problem	207
10.2	Continuation of the semidiscrete solutions	210
10.3	The fully continuous problem	224
Appendix		
(A)	An elementary proof of Korn's inequality	228
(B)	Johnson's implicit method	239
References		245
Index		247