

Maan H. Jawad

Contents

Pretac		X
Ackno	wledgements	xii
Abbre	viations for Organizations	XV
Chapter 1: Bending of Simply Supported Rectangular Plates		
1-1	Introduction]
1-2	Strain-Deflection Equations	3
1-3	Stress-Deflection Expressions	7
1-4	Force-Stress Expressions	10
1-5	Governing Differential Equations	13
1-6	Boundary Conditions	16
1-7	Double Series Solution of Simply Supported Plates	24
1-8	Single Series Solution of Simply Supported Plates	28
1-9	Design of Rectangular Plates	32
Chapt	er 2: Bending of Various Rectangular Plates	38
2-1	Plates with Various Boundary Conditions	38
2-2	Continuous Plates	49
2-3	Plates on an Elastic Foundation	55
2-4	Thermal Stress	59
2-5	Design of Various Rectangular Plates	64
Chapt	er 3: Bending of Circular Plates	66
3-1	Plates Subjected to Uniform Loads in the θ -Direction	66
3-2	Plates with Variable Thickness and Subjected to Uniform Loads	
	in the θ -Direction	80
3-3	Plates Subjected to Nonuniform Loads in the θ-Direction	86
3-4	Plates on an Elastic Foundation	93
3-5	Plates with Variable Boundary Conditions	98
3-6	Design of Circular Plates	103
Chapt	er 4: Plates of Various Shapes and Properties	104
4-1	Introduction	104

viii Contents

4-2	Elliptic Plates	104
4-3	Triangular Plates	107
4-4	Orthotropic Plate Theory	110
4-5	Orthotropic Materials and Structural Components	115
4-6	Design of Plates of Various Shapes and Properties	122
Chapt	er 5: Approximate Analysis of Plates	124
5-1	The Strain Energy (Ritz) Method	124
5-2	Yield Line Theory	132
5-3	Further Application of the Yield Line Theory	142
5-4	Finite Difference Method	151
5-5	Design Concepts	162
Chapt	er 6: Buckling of Plates	167
6-1	Circular Plates	167
6-2	Rectangular Plates	171
6-3	Rectangular Plates with Various Boundary Conditions	178
6-4	Finite Difference Equations for Buckling	183
6-5	Other Aspects of Buckling	185
6-6	Application of Buckling Expressions to Design Problems	188
Chapt	er 7: Vibration of Plates	192
7-1	Introduction	192
7-2	General Equations for Rectangular Plates	192
7-3	Simply Supported Rectangular Plates	196
7-4	Rectangular Plates with Various Boundary Conditions	199
7-5	Circular Plates	201
Chapt	er 8: Membrane Theory of Shells of Revolution	202
8-1	Basic Equations of Equilibrium	202
8-2	Ellipsoidal and Spherical Shells Subjected to Axisymmetric Loads	208
8-3	Conical Shells	219
8-4	Cylindrical Shells	223
8-5	Wind Loads	226
8-6	Design of Shells of Revolution	230b
Chapt	er 9: Various Applications of the Membrane Theory	233
9-1	Analysis of Multi-Component Structures	233
9-2	Pressure-Area Method of Analysis	242
9-3	One-Sheet Hyperboloids	251
9-4	Deflection Due to Axisymmetric Loads	258

Contents ix

Chapter 10: Bending of Thin Cylindrical Shells Due to Axisymmetric				
_	Loads	263		
10-1	Basic Equations	263		
10-2	Long Cylindrical Shells	268		
10-3	Long Cylindrical Shells with End Loads	277		
10-4	Short Cylindrical Shells	283		
10-5	Stress Due to Thermal Gradients in the Axial Direction	286		
10-6	Stress Due to Thermal Gradients in the Radial Direction	289		
10-7	Discontinuity Stresses	296		
Chapter	11: Bending of Shells of Revolution Due to Axisymmetric			
	Loads	299		
11-1	Basic Equations	299		
11-2	Spherical Shells	306		
11-3	Conical Shells	318		
11-4	Design Considerations	328		
Chapter	· 12: Various Structures	331		
12-1	Introduction	331		
12-2	Hyperbolic Paraboloid Shells	335		
12-3	Elliptic Paraboloid Shells	337		
12-4	Folded Plates	339		
12-5	Barrel Roofs	346		
Chapter	· 13: Buckling of Cylindrical Shells	348		
13-1	Basic Equations	348		
13-2	Lateral Pressure	353		
13-3	Lateral and End Pressure	359		
13-4	Axial Compression	362		
13-5	Donnell's Equations	368		
13-6	Design Equations	374		
Chapter	· 14: Buckling of Shells of Revolution	386		
14-1	Buckling of Spherical Shells	386		
14-2	Buckling of Stiffened Spherical Shells	390		
14-3	Buckling of Conical Shells	392		
14-4	Design Considerations	396		
Chapter	· 15: Vibration of Shells	398		
15-1	Cylindrical Shells	398		
15-2	Spherical Shells	406		

x Contents

Chapter 16: Basic Finite Element Equations		409
16-1	Definitions	409
16-2	One-Dimensional Elements	414
16-3	Linear Triangular Elements	421
16-4	Axisymmetric Triangular Linear Elements	429
16-5	Higher Order Elements	432
Appendix A: Fourier Series		433
Appendix B: Bessel Functions Appendix C: Matrix Operations		445
		453
Append	465	
Answer	466	
References		470
Index	474	