Contents

| Preface | IX |
|---|------------|
| 1. Introduction in the Homogenization Method as Applied to Stressed Composite Materials | 1 |
| 1.1. Linear Model of a Stressed Elastic Body1.2. Homogenization Method in the Mechanics of Composites. | 3 |
| The Basic Approaches | 7 |
| 1.3. Homogenization Method in the Mechanics of Stressed Composites | 15 |
| 2. Stressed Composite Plates and Membranes | 21 |
| 2.1. Stressed Plates (2-D Model) | 21 |
| 2.2. Stressed Plates (Transition from 3-D to 2-D Model, In-Plane Initial | 27 |
| Stresses) 2.3. Stressed Plates (Transition from 3-D to 2-D Model, | |
| Moments of Initial Stresses) | 46 |
| 2.4. 2-D Boundary Conditions Derived from the 3-D Boundary Problem | 53 |
| 2.5. 3-D and 2-D "Energy Forms" for a Stressed Plate and a Stability Criterion for a Plate | 62 |
| 2.6. Membrane (2-D model) | 68 |
| 2.7. Membrane (Transition from 3-D to 2-D Model) | 71 |
| 2.8. Plates with no Initial Stresses. Computing of Resultant Initial Stresses | 78 |
| 3. Stressed Composite Beams, Rods and Strings | 83 |
| 3.1. Stressed Beam (1-D model) | 83 |
| 3.2. Stressed Beams (Transition from 3-D to 1-D Model, Initial Axial Stresses) | 87 |
| 3.3. Stressed Beams (Transition from 3-D to 1-D Model, | |
| Moments of Initial Stresses) | 108 |
| 3.4. 1-D boundary Conditions Derived from 3-D Elasticity Problem | 115 |
| 3.5. 3-D and 1-D "Energy Forms" for a Stressed Beam | 110 |
| and a Stability Criterion for a Beam | 119 127 |
| 3.6. Strings (1-D Model)3.7. Strings (Transition from a 3-D to a 1-D Model) | 127 |
| 3.8. Beams with no initial stresses. Computing of resultant initial stresses and | 129 |
| moments | 145 |

| 4. Calculation and Estimation of Homogenized Stiffnesses of Plate-Like and Beam-Like Composite Structures | 149 |
|---|------------|
| 4.1. Variational Principles for Stiffnesses of Nonhomogeneous Plates | 149 |
| 4.2. Variational Principles for Stiffnesses of Nonhomogeneous Beams | 168 |
| 4.3. The Homogenization Method Modified for Lattice Plats | 181 |
| 4.3. The Homogenization Method Modified for Lattice Beams | 193 |
| 4.5. Review of Software Suitable for Homogenization Procedures | 202 |
| Appendix A. Plates and Beams in Different Coordinate Systems A1. Homogenized Stiffnesses of a Plate in Different Coordinate Systems | 207 207 |
| A2. Homogenized Stiffnesses of a Beam in Different Coordinate Systems | 211 |
| Appendix B. Critical Loads for Some Composite Plates | 217 |
| References | 221 |
| Index | 226 |