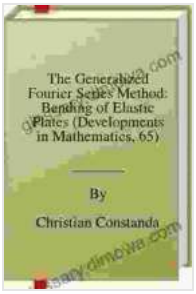
The Bending of Elastic Plates: A Guide to the Mathematical Theory

The bending of elastic plates is a fundamental problem in engineering and physics. Elastic plates are used in a wide variety of applications, including bridges, buildings, aircraft, and ships. The mathematical theory of the bending of elastic plates is a well-developed field, and there are many books and articles that cover the subject. However, most of these books and articles are written for specialists in the field, and they can be difficult for non-specialists to understand.



The Generalized Fourier Series Method: Bending of Elastic Plates (Developments in Mathematics Book 65)

by Fred Pearce

4.5 out of 5

Language	: English
File size	: 8960 KB
Screen Reader	: Supported
Print length	: 267 pages
X-Ray for textbooks	: Enabled
Paperback	: 30 pages
Item Weight	: 2.88 ounces
Dimensions	: 5 x 0.07 x 8 inches

This book is intended to provide a comprehensive to the mathematical theory of the bending of elastic plates. It is written for mathematicians, engineers, and physicists who are interested in the mathematical foundations of the theory of elasticity. The book covers a wide range of

topics, including the basic equations of elasticity, the theory of plates, and the numerical methods used to solve the equations of elasticity.

Basic Equations of Elasticity

The basic equations of elasticity are a set of partial differential equations that describe the behavior of elastic materials. These equations can be derived from the conservation laws of mass, momentum, and energy. The basic equations of elasticity are:

$$\nabla \cdot \sigma = \rho \mathbf{a}$$

$$\sigma = \mathbf{C}: \varepsilon$$

$$\varepsilon = \frac{1}{2}(\nabla \mathbf{u}+ \nabla \mathbf{u}^T)$$

where σ is the stress tensor, ρ is the density, $\mathbf{a}$ is the acceleration, $\mathbf{C}$ is the elasticity tensor, ε is the strain tensor, and $\mathbf{u}$ is the displacement vector.

Theory of Plates

The theory of plates is a special case of the theory of elasticity that is used to analyze the behavior of thin plates. Plates are structures that have a small thickness compared to their other dimensions. The theory of plates is based on the assumption that the stresses and strains in a plate are constant through the thickness of the plate. This assumption simplifies the equations of elasticity and makes them easier to solve.

The basic equations of the theory of plates are:

$$\nabla^4 w = \frac{q}{D}$$

$$M = -D \nabla^2 w$$

$$V = -D \nabla^4 w$$

where w is the deflection of the plate, q is the load applied to the plate, D is the flexural rigidity of the plate, M is the bending moment, and V is the shear force.

Numerical Methods

The equations of elasticity and the theory of plates are partial differential equations, and they cannot be solved analytically in general. However, there are a number of numerical methods that can be used to solve these equations. These methods include the finite element method, the boundary element method, and the finite difference method.

The finite element method is the most widely used method for solving the equations of elasticity and the theory of plates. The finite element method divides the plate into a number of small elements, and it solves the equations of elasticity for each element. The solutions for the elements are then combined to obtain the solution for the entire plate.

Applications

The theory of the bending of elastic plates has a wide range of applications in engineering and physics. These applications include the design of bridges, buildings, aircraft, and ships. The theory of the bending of elastic plates can also be used to analyze the behavior of other structures, such as MEMS devices and nanostructures.

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