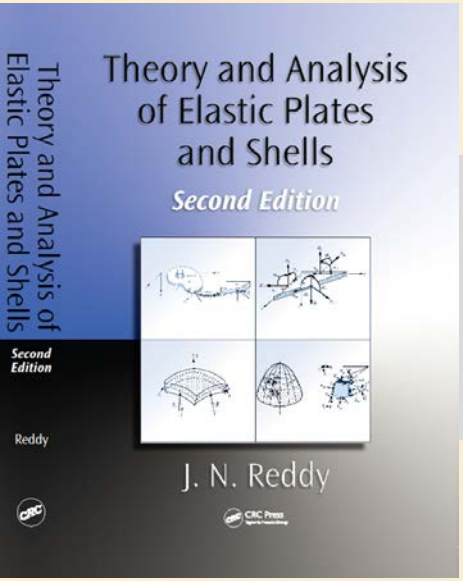
THEORIES AND ANALYSES OF BEAMS, PLATES, AND SHELLS



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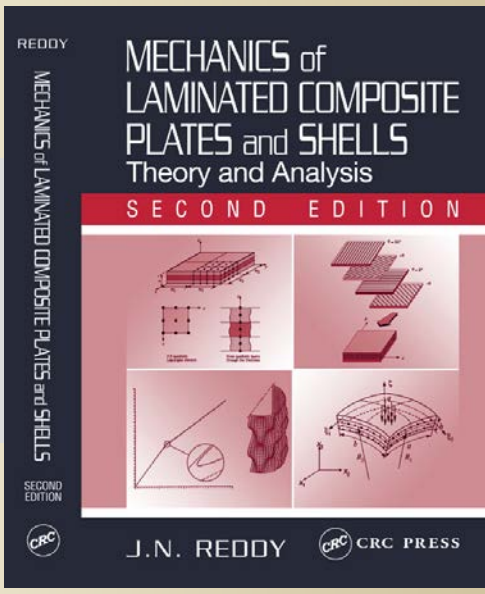


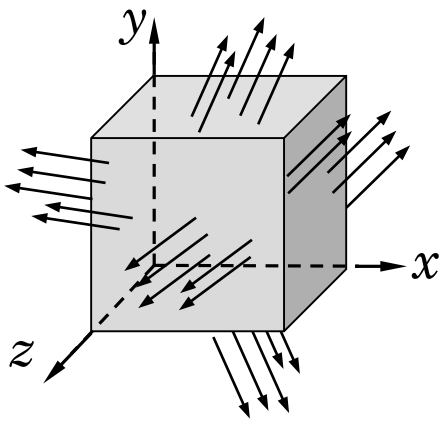
GENERAL INTRODUCTION

- The primary objective of this course is to study theories and analytical as well as numerical solutions of beam, plate, and shell structures, that is, **structural elements** undergoing stretching and bending.

- The plate and shell theories are developed using certain assumed kinematics of deformation that facilitate writing the displacement field explicitly in terms of the thickness coordinate. Then the principle of virtual displacements and integration through the thickness are used to obtain the governing equations.

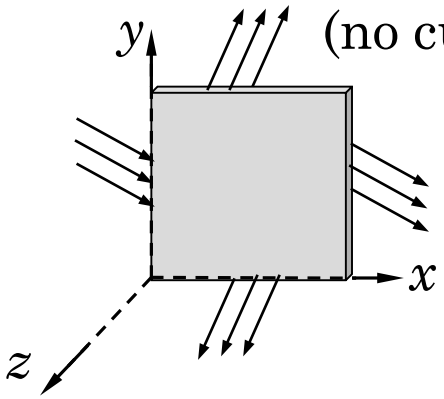
- Some recent advances involving functionally graded beams and plates, and nonlocal theories will also be discussed.

What are structural elements ?



Solid structure
All dimensions are comparable and loads in all possible directions

Flat geometries (no curvature)



Plane (stress) structure
Thickness is small compared to the other two dimensions, and loads are applied in the plane and stretch or compress in the *xy*-plane.

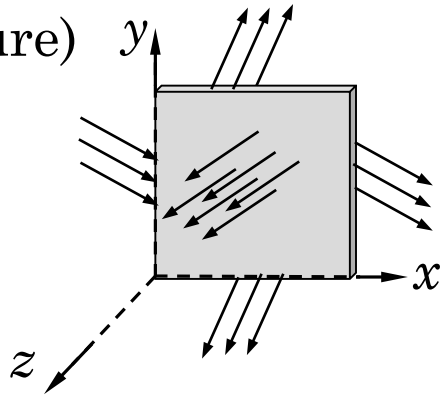
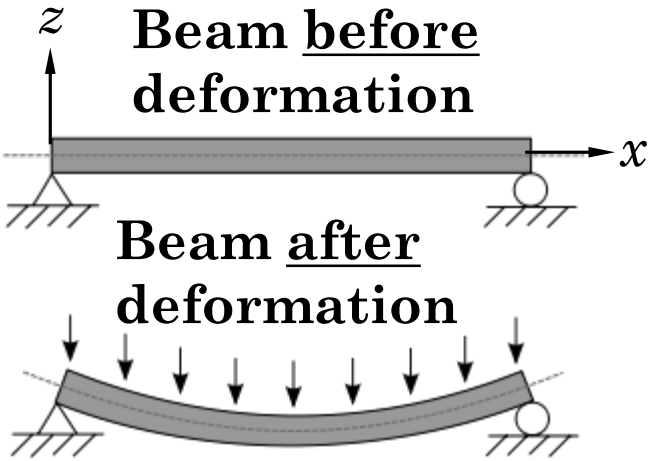


Plate structure
Thickness is small compared to the other two dimensions, and loads are applied in the plane to stretch in the *xy*-plane and bend about the *x* and *y* axes.

Structural Elements



Beam structure
Two dimensions are small to the third (length) and loads tend to bend about the y and z axes.

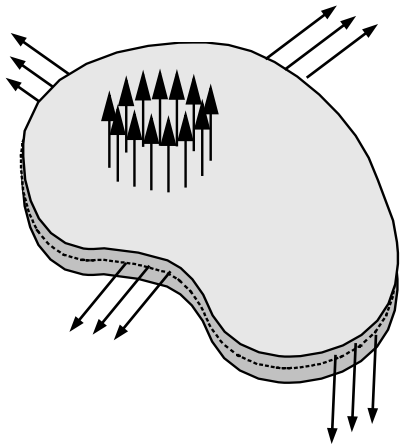
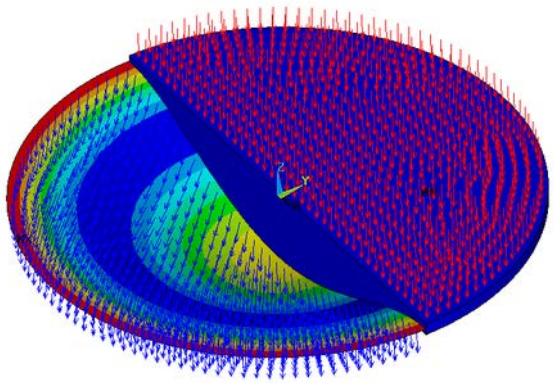


Plate of arbitrary shape before deformation

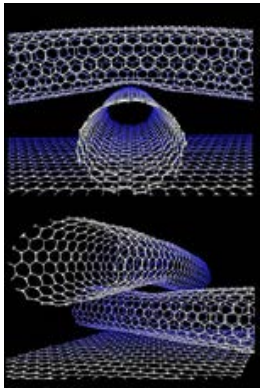


Circular plate before and after deformation

Shell Structures

Shell structure

Thickness is small compared to other two dimensions, has curvature, and subjected to loads that stretch and bend the structure. A plate with deformation (that can be seen with a naked eye) is a shell.



Most of the material included here came from author's various books and papers.