University of Nottingham
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Mechanics of Solids

MMME2053

Shear Stresses

Lecture 1

Learning Objectives

1. Appreciate that in addition to longitudinal bending stresses, beams also carry transverse shear stresses arising from the vertical shear loads acting within the beam (knowledge)
2. Be able to derive a general formula, in both integral and discrete form, for evaluating the shear stress distribution through a cross-section (comprehension);
3. Determine the shear stress distribution through the thickness in a rectangular, circular and I-section beam (application);

Learning Objectives

4. Understand that in an I-section, in addition to the transverse vertical shear stresses in the flange and web, more dominant horizontal shear stresses also occur in the flange (comprehension);
5. Recognise that the resultant of the shear stresses always act through one point, known as the 'shear centre' (comprehension);
6. Calculate the position of the shear centre (application);
7. Understand that if the applied loads do not act through the shear centre, then there is a resultant torsional load, which can result in twisting of the section if the torsional rigidity of the section is low e.g. thin walled sections (comprehension).

Contents

- Introduction/Context/Definitions
  - Shear Stresses
- Shear Stresses in Beams
  - Transverse shear stress derivation
  - Determination of shear stress distribution for different cross-sectional shapes
    - Rectangular section
    - Circular section
    - I-section

Introduction

- What do you already know about beams?

For long slender beams, the shear stresses can generally be neglected, and it is only necessary to do a bending calculation for the beam

$$\sigma = \frac{My}{I}$$

Where:

σ = Bending Stress

M = Bending Moment

y = Distance from Neutral Axis

I = Second Moment of Area

Introduction

- As the beam span to depth ratio reduces, i.e. if the beam is shorter and thicker, shear stresses become more important and should be calculated in any design evaluation

- This can be important for laminated beams, e.g. plywood or composite beams, where the transverse shear can cause failure between individual layers (plies) making up the beam