Tutorial Session 2: Statically Determinate Beams - Homework

Mentor Guide Knowledge & Skills Question

1.1 State or derive the algebraic relationships between applied pressure, shearing force and bending moment (P, F and M).

1.2 *Sketch the shearing force and bending moment diagrams for an example beam problem* – this is covered by the examples below.

Numerical Questions

1) A cantilever of length L has one end encastre (i.e. fixed) and the other end free. A point load, W, is applied at the free end. Draw the shearing force and bending moment diagrams. What is the maximum bending moment and where does it act?

2) A cantilever of length L has one end encastre (i.e. fixed) and the other end free. It is subject to a uniformly distributed load, W. Draw the shearing force and bending moment diagrams. What is the maximum bending moment and where does it act?

<u>Plant Example</u>

3) The rotor bars on the ****** gas circulator motors are currently being replaced. They can be treated as simple straight bars of solid circular cross-section oriented horizontally. Some of the replacement bars were found to contain casting flaws. These took the form of flat, crack-like, inclusions in the horizontal radial-axial plane (at the 3 o'clock position). They extended uniformly along the length of the bars. The bars are subject primarily to a vertical load causing bending in the axial-vertical plane. The flaws do not, therefore, impair the strength of the bars as regards this dominant (axial) bending stress. However, there is also the beam shear to be considered.

Is the beam shear in an orientation which causes the bars to be weakened by the flaws?

If the flaws were in the vertical-axial plane (say at the 12 o'clock position) would the bars be weakened by the flaws?

The axial distance between supports is L, the maximum bending moment is M and the cross section of the bars is A, make a rough estimate of the maximum shear stress using beam theory as the guide. [Hint: treat as a beam encastre at both ends and subject to a uniformly distributed load W so that the maximum bending moment is at the ends and of magnitude $M = WL/12$].