1.2.3 Experiment 3: Bending of Beam

Principle

A *beam* is a structural member that can carry loads perpendicular to its longitudinal axis. This type of loading will cause the beam to bend. Examples of beams include highway overpasses and floor beams.

Objective

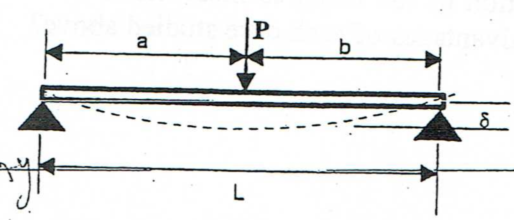
The objective of this experiment is to demonstrate bending of a beam loaded at mid-length for two cases, placing the widest side and the shortest side of its cross section on the supports.

Background

For a simply supported beam, if the load P is applied transversely at the mid-length $a = b = L/2$ then mid span deflection is

$$\delta = \frac{PL^3}{48EI}.$$

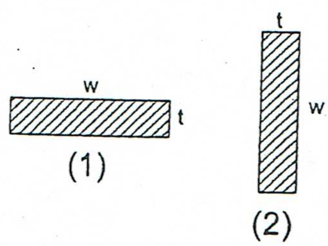
For a beam of rectangular cross section, say of width w and thickness t, the midspan deflection of the centrally loaded beam when the flat side is supported can then be compared to that when the thin side is supported. The moments of inertia for the respective situations are given by



$$I_1 = \frac{wt^3}{12}$$

and

$$I_2 = \frac{w^3t}{12}.$$



It could be readily verified that the later situation offers less deflection under the same load.

Apparatus

- Beams: metal and wood bars
- Test weights and weight hangers
- Ruler
- Stand

Procedure

Case 1 - Beam with flat side on supports:

- Measure the dimensions of the beams and calculate the cross sectional area and the moment of inertia.
- Place the beam on the stand such that the widest side of the cross section is on the supports. Reset each scale to read zero.
- Measure the clearance between the middle of the beam and the table.
- Load the beam at the mid-length in 2 lb increments up to 10 lb.
- Measure the change in clearance for every load step.

Case 2 - Beam with slim side on supports:

- Turn the beam around such that the shortest side of the cross section is on the support. Repeat the steps described under Case 1.

Presentation of Results

Plot the load versus deflection for the two cases studied. Compare measured and theoretical deflections. Obtain E from a materials handbook.

Discussion of Results

Try to find a relationship between load and deformation. Try to explain the different behaviors obtained for the same beam when turned around. Which position of the beam is more efficient to use? Why? What are the benefits and disadvantages of each case studied above?