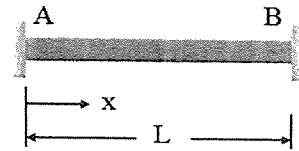


Problem 1 (20%)

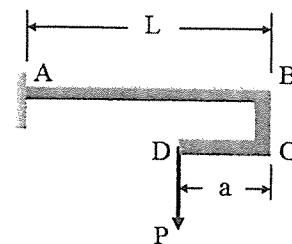
A bar AB of length L is held between rigid supports and heated non-uniformly in such a manner that temperature increase ΔT at distance x from end A is given by the expression $\Delta T = \Delta T_1 x^2/L^2$, where ΔT_1 is the increase in temperature at end B of the bar (see figure). Assume that the material has modulus of elasticity E and coefficient of thermal expansion α .



- (a) Determine the elongation of the bar if end B is allowed to move freely.
- (b) Determine the compressive stress in the bar if end B is rigidly supported.

Problem 2 (30%)

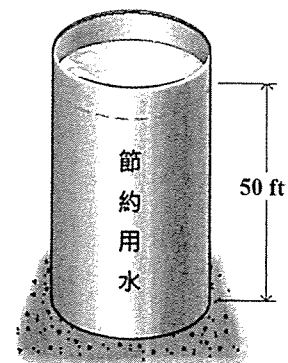
The cantilever beam AB shown in the figure has an extension BCD attached to its free end. A force P acts at the end of the extension.



- (c) Find the ratio a/L so that the vertical deflection of point B will be zero.
- (d) Find the ratio a/L so that the angle of rotation at point B will be zero.

Problem 3 (20%)

A standpipe 12 ft in external diameter is being constructed for use as a storage tank for water with a specific weight of 62.4 lb/ft^3 . The wall thickness of the vessel is 0.5 in. The water height is 50 ft tall as shown in the right figure. Neglect stress concentrations, weight of standpipe and thickness of bottom plate of the vessel.



- (e) Determine the axial and hoop stresses at the bottom end of the water tank.
- (f) Determine the axial and hoop stresses at the point 50 ft above the bottom end of the water tank.

Problem 4 (30%)

The homogeneous advertising billboard as shown in the figure has a mass of 250 kg and is subjected to a wind load of 1.5 kPa (assumed uniformly distributed over the area of the billboard). The billboard is supported by a solid circular cylinder of outside diameter 900 mm. Determine the principal stress and maximum shear stresses at points A and B on the outside surface of the cylinder. Neglect the weight of the pipe and stress concentrations.

