Problem 1 (25%)

The thin-walled cylindrical pressure vessel as shown in **Fig. 1** has an inside diameter of 20 in. and a wall thickness of 3/8 in. The vessel is subjected to an internal pressure of p and a torque of T. At a point on the outside surface of the steel (E =30,000 ksi and ν = 0.30) vessel, the strain rosette as shown above the vessel was used to obtain the following normal strain data: ε_a = +36 μin./in., ε_b = +310 μin./in., and ε_c = +150 μin./in. Gage a and c are oriented in the axial and hoop directions of the vessel, respectively. Determine the pressure p and the torque T.

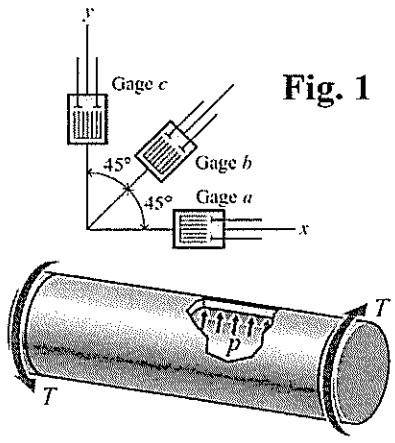

Fig. 1

Problem 2 (25%)

A timber beam 150 mm wide × 300 mm deep is loaded and supported as shown in **Fig. 2** below. The modulus of elasticity of the timber is 10 GPa. A pointer is attached to the right end of the beam. The load acts at the midpoint of the span.

Determine

(a) The deflection of the right end of the pointer.

(b) The maximum deflection of the beam.

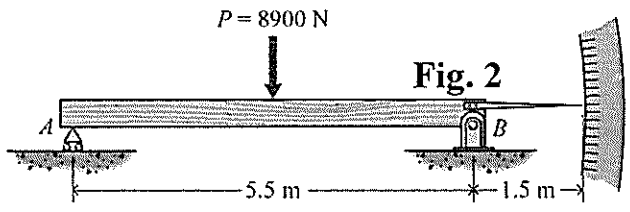

Fig. 2

Problem 3 (24%)

A circular bar AB of polar moment of inertia I_P and length L is fixed at both ends (see **Fig. 3**). A distributed torque $q(x)$ acts along the length of the bar and varies linearly in intensity from zero at A to q_0 at B. Obtain formulas for the fixed-end torques T_a and T_b.

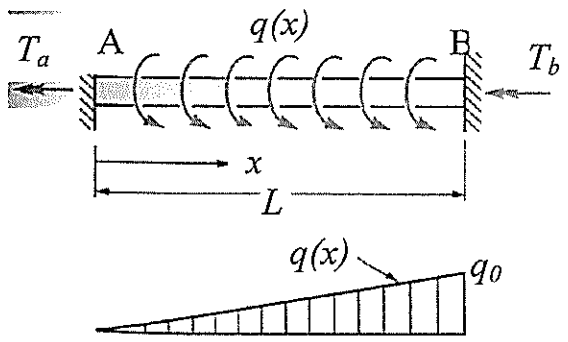

Fig. 3

$$q(x) = \frac{q_0 x}{L}$$

Problem 4 (26%)

See **Fig. 4**

(a) Determine the equation of deflection curve $v(x)$ for a simple beam AB supporting a uniform load of intensity q. **(10 pts)**

(b) Determine the maximum deflection δ at the middle of the beam. **(6 pts)**

(c) Determine the angle of rotation θ_a at support A. **(5 pts)**

(d) Determine the angle of rotation θ_b at support B. **(5 pts)**

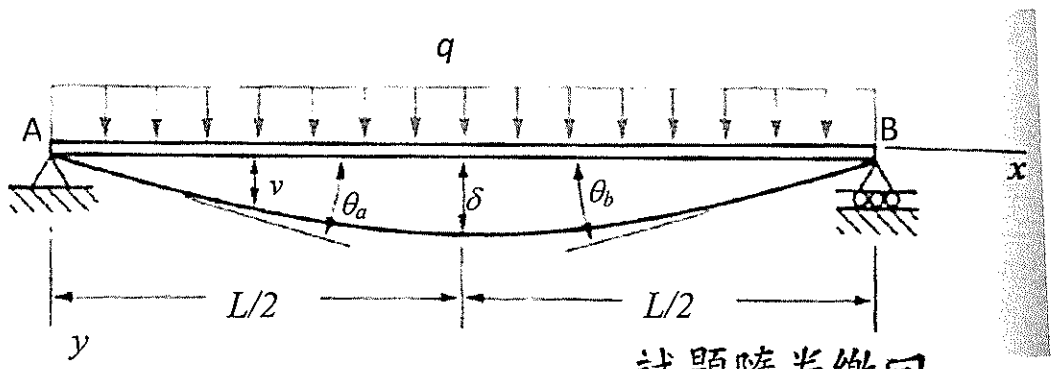

Fig. 4

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