1. (25 pts)

A rod of length L, cross-sectional area A_1, and modulus of elasticity E_1, has been placed inside a tube of the same length L, but of cross-sectional area A_2 and modulus of elasticity E_2, (Fig. 1). What is the deformation of the rod and tube when a force $\vec{P}$ is exerted on a rigid end plate as shown?

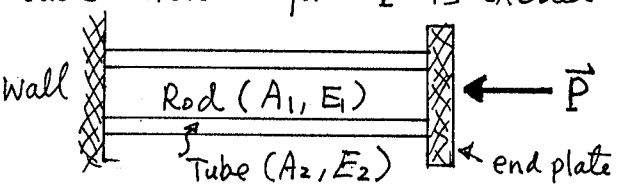


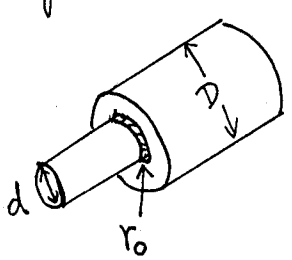
Fig. 1.

2. (50 pts)

The stepped shaft shown in Fig. 2, is to rotate at 900 rpm as it transmits power from a turbine to a generator. The grade of steel specified in the design has an allowable shearing stress of 80 MPa. (a) For a preliminary design shown, determine the maximum power that may be transmitted. (b) If in the final design, the radius of the fillet is increased so that $r_o = 2.50$ cm., what will be the percent change, relative to the preliminary design, in the power which may be transmitted?

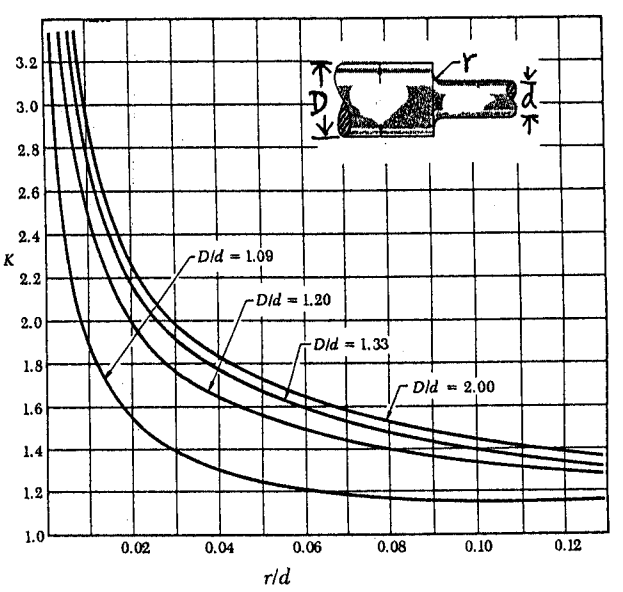
(公式: The polar moment of inertia of a circle $= \frac{1}{2}\pi (\text{radius})^4$.
The power associated with the rotation of a rigid body subjected to torque T is $P = T\omega$; ω is the angular velocity.)

Fig. 2.



$d = 20$ cm,
$D = 40$ cm
$r_o = 1.0$ cm

Stress-concentration factors for fillets in circular shafts.



(背面仍有題目,請繼續作答)

3.(25 pts)

A steel bar (E_s =210 GPa) and an aluminum bar (E_a =70 GPa) are bonded together to form the composite beam as shown in Fig. 3. Determine the safety factor(SF) of the beam, when the beam is bent about its longitudinal axis with M_o = 60 N·m.

Note the allowable stress for steel is 150 MPa.

the allowable stress for aluminum is 100 MPa.

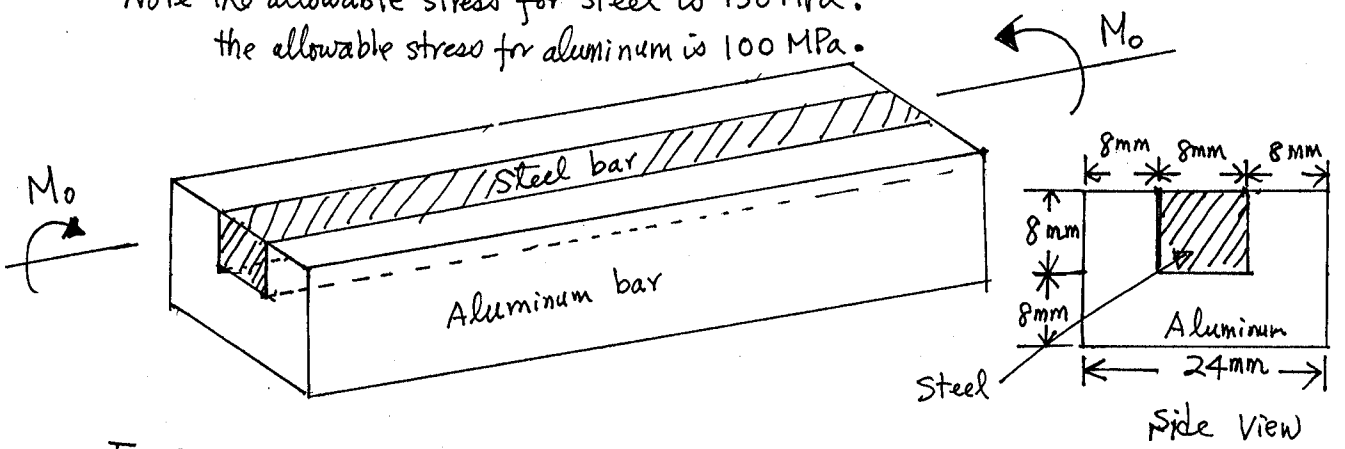


Fig. 3