國立成功大學 80 學年度 工程科學研究所 考試(材料力學 試題) 共 2 頁 第 1 頁

1. (20 point) Shock proof and loading alignment are very important in the design of grip assemble of the creep testing machine. A grip assemble is designed as shown in the Fig. 1. A rod of material B is used in tension between the Yoke and the upper support, and a rod of material C is used in compression between the Yoke and the bottom support. Determine the Nonlinear Stiffness behavior of grip assemble (i.e. Load P vs Deflection δ of Yoke) in terms of Area, Length and Material constant E of material B & C.

By, data of tensile test, stress (σ) vs. Strain (ε) relations:

$\sigma = E_B \, \varepsilon$ for material B.

$\sigma = E_C (\varepsilon)^2$ for material C.

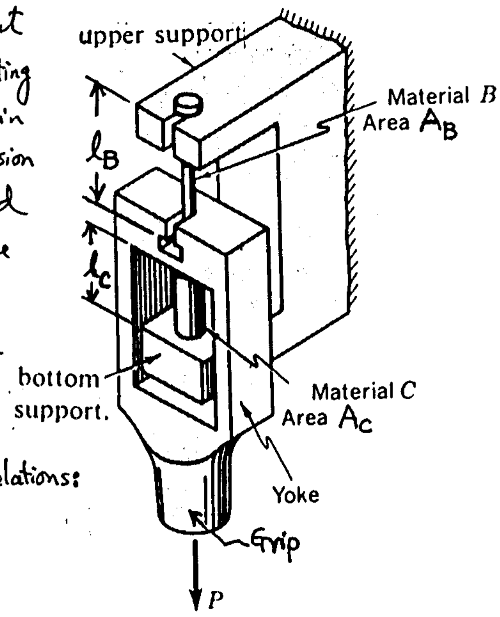


Fig. 1 Grip Assemble

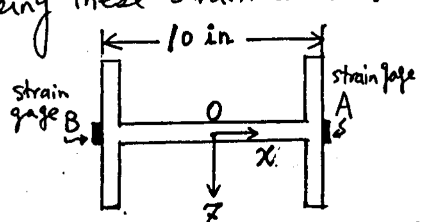
2. (20 point) An engineer uses a solid bar of radius C and length L to study a torsional test. He measures the Torque T applied and the Angle of twist ϕ. If the solid bar is made of an elastic-perfectly plastic material with shear modulus G and the yield shear stress τ_Y, then

(a) What is the maximum elastic torque T_Y.

(b) What is the relation of T vs. ϕ after the bar is yield.

(c) Prove when the deformation of solid bar is fully plastic, the plastic torque $T_P = \frac{4}{3} T_Y$.

3. (20 point) A computer table is designed to support computer equipments. A designer designs the table as shown in Fig. 3, and puts two equipments weighted W_P and W_Q on the table. Two strain gages are fixed at point A and B on the centerlines of the outside faces of the flanges as shown in Fig. 3. The gages read $\varepsilon_A = -400 \times 10^{-6}$ in/in, and $\varepsilon_B = -300 \times 10^{-6}$ in/in. The flanges are made of rolled steel with Young's modulus $E = 30 \times 10^6$ psi. Determine W_P and W_Q by using these strain data?



Area = 10.0 in^2; $I_z = 273$ in^4.

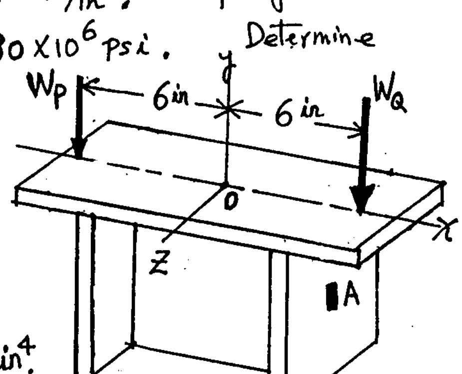
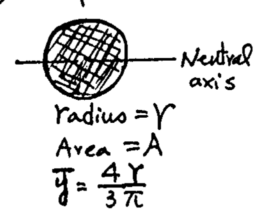


Fig. 3

4. (20 point) The two forces shown in Fig. 4 act on a traffic-signal pole which is hollow and has an outside diameter of 200 mm and a wall thickness of 10 mm. Considering the transverse section a—a of the pole and knowing that the weight of the portion of the pole located above that section is 4000N, determine the normal and shearing stresses at (a) point H, (b) point K.

(Hint: The moment of inertia of a solid bar $= \frac{1}{4}\pi r^4$,
The first moment of solid bar with respect to the Neutral axis $= \frac{1}{2}A\bar{y}$)



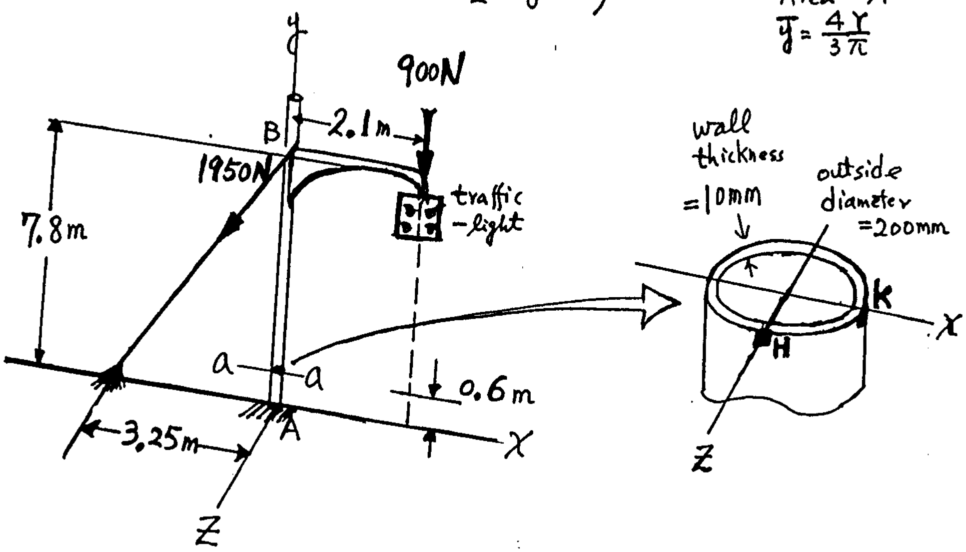


Fig. 4

5. (20 point) Use the Castigliano's Theorem to determine the horizontal and vertical deflection of point B.

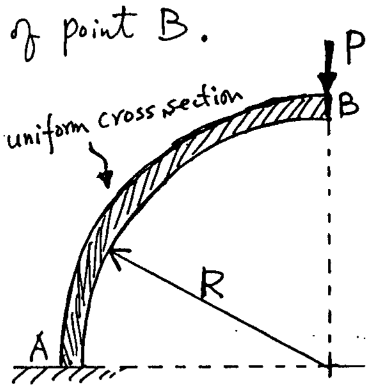


Fig. 5