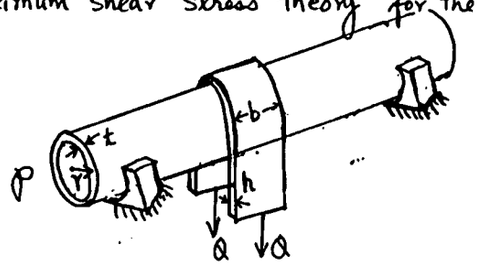
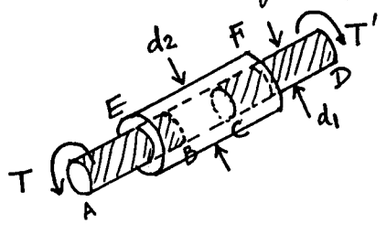
國立成功大學 78 學年度研究所招生考試(材料力學 試題) 共 2 頁 第 1 頁

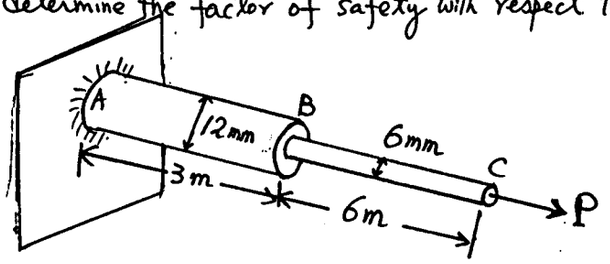
1. (20 pt) A thin-walled, closed end cylinder of mean radius r and thickness t is designed to support a flexible belt of thickness h and width b as shown. (a) What is the internal pressure P exerted in the cylinder in order to support the flexible belt under tensile force Q ? . If the material used to made of cylinder has the shear modulus G and the shear yield stress τ_Y, and the factor of safety n is also given, then (b) how to measure the tension force Q by using only two strain gages ? (c) What is the allowable Q can be applied in the belt, according to the maximum shear stress theory for the yielding criterion ?



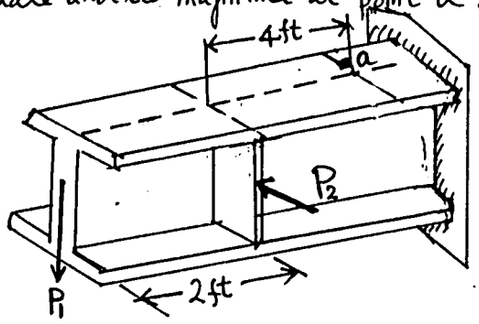
2. (10 pt) Two solid brass rods AB and CD are brazed to a brass sleeve EF. If the maximum shearing stress occurs in the rods and in the sleeve are the same, then what is the numerical method can you propose to find the ratio d_2/d_1 ?

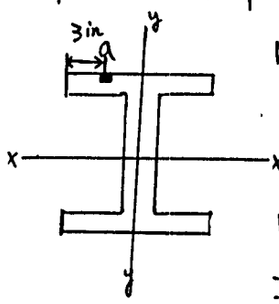


3. (10 pt) The steel rods AB and BC are made of a steel for which the tensile yield stress $\sigma_Y = 300\,MPa$ and the Young's modulus $E = 200\,GPa$. Knowing that a strain energy of 5 Joules must be acquired by the assembly as the axial load P is applied, determine the factor of safety with respect to permanent deformation.



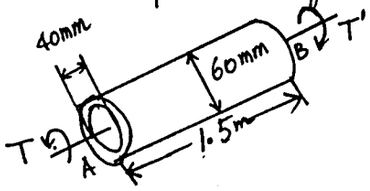
4.(20pt) Two forces P_1 and P_2 are applied as shown in directions perpendicular to the longitudinal axis of a W12×40 beam. Known that $P_1 = 5$ kips and $P_2 = 3$ kips, determine the stress state and its magnitude at point a.





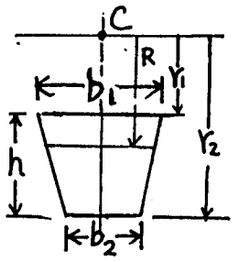
W12×40
Area $A = 11.8\ in^2$
Depth $d = 11.94$ in
Width $t_f = 8.005$ in
Thickness $t_f = 0.515$ in
Web Thickness $t_w = 0.295$ in
$I_x = 310\ in^4$
$I_y = 44.1\ in^4$

5.(20pt) Shaft AB is made of mild steel which is assumed to be elastic-perfect plastic with $G = 80$ GPa and $\tau_{yield} = 150$ MPa. A torque T is applied and gradually increased in magnitude. Determine the magnitude of T and the corresponding angle of twist (a) when yield first occurs, (b) when the deformation has become fully plastic, (c) determine the residual stresses and the permanent angle of twist after the torque at problem(b) has been removed.

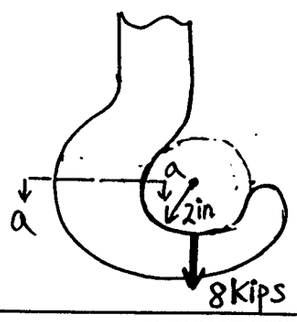


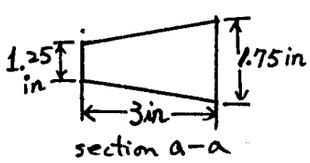
6.(20pt) For the crane hook and loading shown, determine (a) the distance R from the center of curvature C to the neutral surface can be expressed by

$$R = \frac{\frac{1}{2}h^2(b_1 + b_2)}{(b_1 r_2 - b_2 r_1)\ln\frac{r_2}{r_1} - h(b_1 - b_2)}$$



(b) the largest tensile stress in section a-a.





section a-a