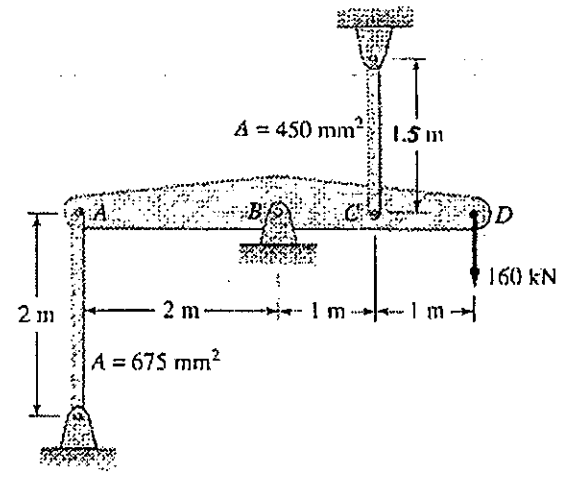
題號： 342　　國立臺灣大學 109 學年度碩士班招生考試試題

科目： 材料力學(F)

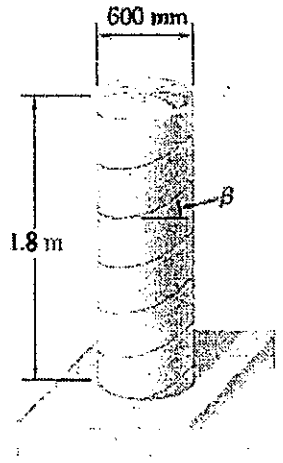
節次： 2



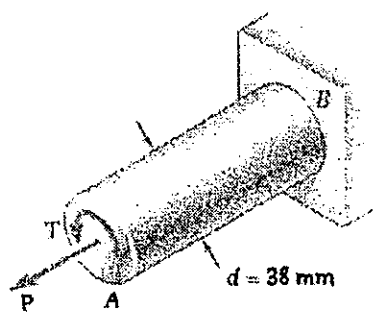
1. (10 Points) The rigid bar *ABCD* of negligible weight is initial horizontal, and the steel rods attached at *A* and *C* are stress-free. The 160 kN load is then applied and the temperature of the steel rods is changed by $\Delta T$. Find $\Delta T$ for which the stresses in the two steel rods will be equal. Use $\alpha = 12 \times 10^{-6}/°C$ and $E = 200$ GPa for steel.
2. (15 Points) The cylindrical portion of the compressed-air tank shown is fabricated of 8-mm-thick plate welded along a helix forming an angle $\beta = 30°$ with the horizontal. Knowing that the allowable stress normal to the weld is 75 MPa, determine the largest gage pressure that can be used in the tank.
3. (15 Points) The 38-mm-diameter shaft *AB* is made of a grade of steel for which the yield strength is $\sigma_Y = 250$ MPa. Using the maximum-shearing-stress criterion, determine the magnitude of the torque **T** for which yield occurs when P = 240 kN.
4. (20 Points) The solid shaft *AB* rotates at 450 rpm and transmits 20 kW from the motor *M* to machine tools connected to gears *F* and *G*. Knowing that the allowable shear stress $\tau_{all} = 55$ MPa and assuming that 8 kW is taken off at gear *F* and 12 kW is taken off at gear *G*, determine the smallest permissible diameter of shaft *AB*.
5. (20 Points) (a) Please state the reason why the linear-elastic material under the plane-stress condition is not necessary under the plane-strain condition. (b) When the linear-elastic material is subjected to the plane-strain condition on 1-2 plane, the corresponding stress-strain relationship can be obtained in the matrix form as $\begin{Bmatrix}\epsilon_{11}\\ \epsilon_{22}\\ \gamma_{12}\end{Bmatrix} = \boldsymbol{C}\begin{Bmatrix}\sigma_{11}\\ \sigma_{22}\\ \tau_{12}\end{Bmatrix}$. Please explicitly express the matrix $\boldsymbol{C}$ in terms of Young's modulus *E*, Poisson's ratio $\nu$, and the shear modulus *G*.
6. (20 Points) The circular rod *AB* is bent into a semicircular are of radius *R*. The rod is built in at *A* and carries the twisting moment $T_0$ at *B*. (a) Determine the angle of twist at *B*. (b) Compute the vertical displacement of end *B*



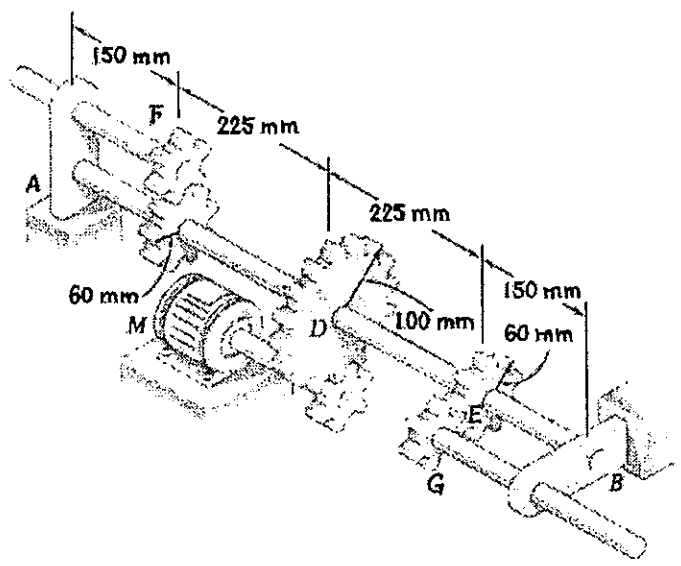

Problem 1



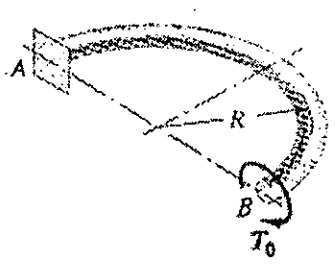

Problem 2




Problem 3




Problem 4




Problem 6

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