題號： 343
科目：材料力學(F)
節次： 2

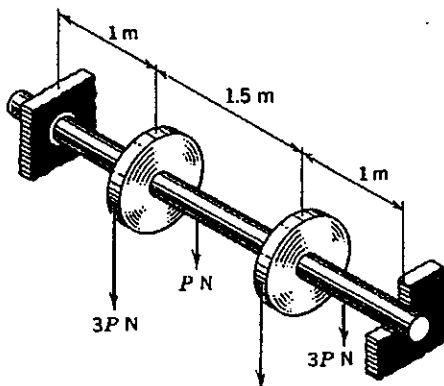國立臺灣大學 106 學年度碩士班招生考試試題

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1. (20 Points) A strain rosette composed of three resistance gages making angles of $0°$, $60°$, and $120°$ with the x axis, was mounted on the free surface of a material for which Poisson's ratio is 1/3. Under load the following strains were measured: $\varepsilon_0 = \varepsilon_x = 1000\mu$, $\varepsilon_{60} = -650\mu$, $\varepsilon_{120} = 750\mu$. (a) **Use Mohr's circle** to determine the **principal strains** and principal strain directions at this point. (b) Determine the **stress state** and the corresponding **von Mises equivalent stress** at this point. Young's modulus of the material is 30×10^6 psi. (10 Points each)

2. (20 Points) Compute the maximum von Mises equivalent stress in the horizontal portion of the bar, and indentify where it occurs on the cross-section. The left support B resists the axial force and the vertical force as well, while the right support C resists the vertical force only.

3. (20 Points) A pressure vessel of 0.25-in steel plate has a shape of a paraboloid closed by a thick flat plate, as shown in the figure. The equation of the generating parabola is $y = x^2/4$, where x and y are in inches. Determine the axial and hoop stresses in the shell at a point 16 inches above the bottom due to an internal gas pressure of 250 psi gage.

4. (20 Points) A steel shaft 100 mm in diameter is supported in flexible bearings at its ends. Two pulleys each 600 mm in diameter are keyed to the shaft. The pulleys carry belts that are loaded as shown in the figure. The steel has the following properties: yield strength 275 MPa in tension or compression and 160 MPa in shear; ultimate tensile strength 400 MPa; and Poisson's ratio 0.30. Determine the maximum allowable belt tension P according to the **maximum-distorsion-energy theory of failure**.

5. (20 Points) Two steel bars ($E_s = 200$ GPa and $\alpha_s = 11.7 \times 10^{-6} /°C$) are used to reinforce a brass bar ($E_s = 105$ GPa and $\alpha_s = 20.9 \times 10^{-6} /°C$) which is subjected to a load $P = 25$ kN. When the steel bars were fabricated, the distance between the centers of the holes, which were to fit on the pins was made 0.5 mm smaller than the 2 m needed. The steel bars were then placed in an oven to increase their length so that they would just fit on the pins. Following fabrication, the temperature in the steel bars dropped back to room temperature. Determine (a) the increase in temperature that was required to fit the steel bars on the pins, (b) the stress in the brass bar after the load is applied to it. (10 Points each)
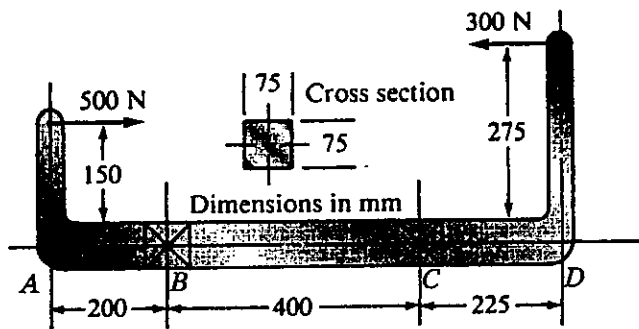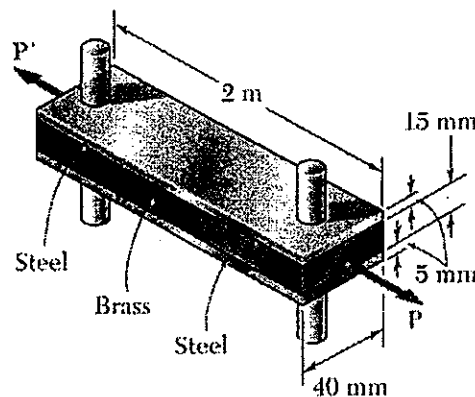

Problem 2
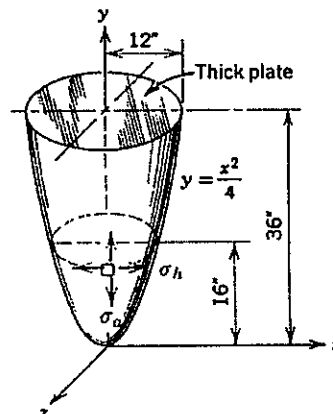
Problem 3

Problem 4

Problem 5

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