國立臺北科技大學九十九學年度碩士班招生考試

系所組別：1202 製造科技研究所

第二節　材料力學 試題（選考）

注意事項：

1. 本試題共五題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

一、Using the moment-area theorems, show that the slope and deflection for the beams in Figures 1a and 1b are given as:

1. simply-supported beam subjected to a concentrated loading (Fig. 1a):

$$\theta_A = \frac{Pb(L^2-b^2)}{6LEI}, \quad y_C = \frac{Pa^2b^2}{3EIL} \quad (10\%)$$

2. cantilever beam subjected to a concentrated loading (Fig. 1b):

$$\theta_B = \frac{PL^2}{2EI}, \quad y_B = \frac{PL^3}{3EI} \quad (10\%)$$

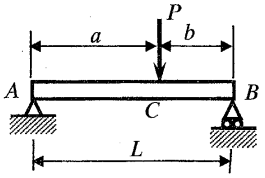


Figure 1a

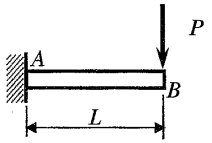


Figure 1b

二、The two beams shown in Figure 2 have the same cross section (30mm×30mm square) and are joined by a hinge at B. Use E=200 GPa. For the loading shown, determine:

1. the reaction at point B (5%)
2. the slope at point D (5%)
3. the deflection at point C (10%).

Note: The formulas provided in the previous problem can be used directly if needed.

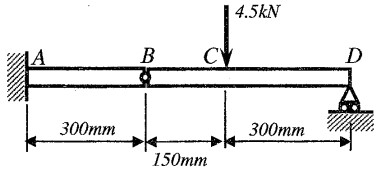


Figure 2

三、A curved beam with quarter circular arc as shown in Figure 3 is subjected to a vertical load P. The beam is made of material with Young's modulus E and has a solid circular section of diameter d which is much smaller than the radius of curvature R. Assuming the formulas for straight beam still apply,

1. determine the maximum normal stress at A; (5%)
2. calculate the total strain energy of the beam due to bending; (10%)
3. find the vertical deflection at point B due to bending of the beam. (5%)

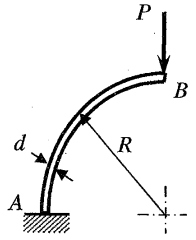


Figure 3

四、Two coaxial shafts are joined together at the ends by fitting a rigid pin through the holes in each shaft. Unfortunately, the holes are drilled with an angular misalignment ϕ=5° as shown in Figure 4. The shafts are made of material with E=200 GPa, ν=0.3. After the forced fit of the rigid pin, determine

1. the residual torque in each shaft; (7%)
2. the total strain energy of the two shafts; (7%)
3. the required diameter d of the rigid pin, if the allowable shear stress τ_{all}=250 MPa. (6%)

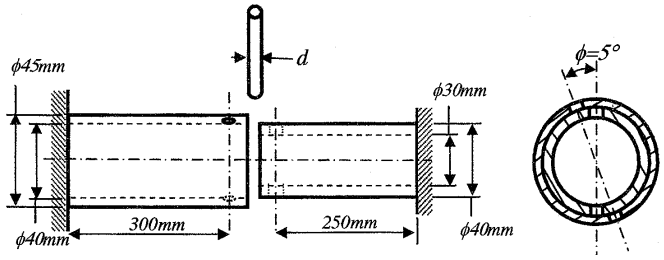
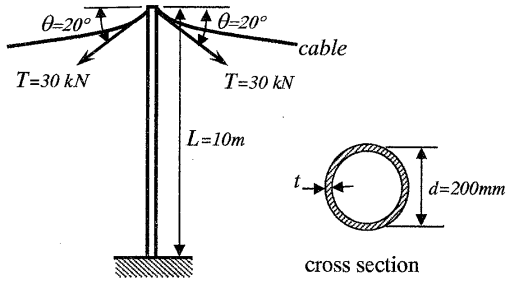


Figure 4

注意：背面尚有試題

五、An electric pole of 10-m height supports the cable as shown in the Figure 5. The pole is made of steel (E=200 GPa) and has uniform tubular cross section along its length with mean diameter d=200 mm. The end of the pole in the ground can be considered fixed. The cable tension is 30 kN. Determine the required wall thickness t of the pole based on:

1. the allowable compressive stress σ_{all}=50 MPa; (10%)
2. the buckling load of the electric pole. (10%)



cross section

Figure 5