國立交通大學 107 學年度碩士班考試入學試題

科目：工程力學(3052)　　　　　　　　　　考試日期：107 年 2 月 2 日　第 2 節
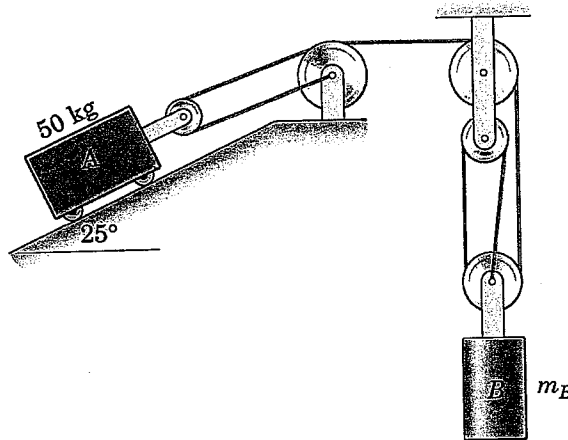系所班別：土木工程學系　　組別：土木系甲組一般生　　第 1 頁, 共 2 頁
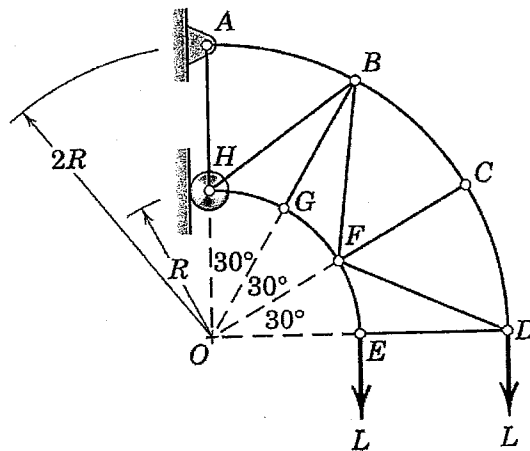【可使用計算機】＊作答前請先核對試題、答案卷(試卷)與准考證之所組別與考科是否相符！！

1. (20%)
Determine the mass m_B that will cause the system to be in equilibrium. Neglect all friction.

2. (30%)
(a) Determine the force in member ED of the truss.
(b) Determine the force in member CD of the truss.
(c) Determine the force in member BF of the truss.

3. (20%)
A solid circular concrete cylinder is encased in a hollow circular copper tube. The temperature of the cylinder and tube is increased by ΔT °C. The concrete cylinder has diameter $D_1 = 1.8$ m, thermal expansion coefficient $\alpha_1 = 1.0\times10^{-7}/$°C, and modulus of elasticity $E_1 = 20$ GPa, the copper tube has diameter $D_2 = 2.0$ m, thermal expansion coefficient $\alpha_2 = 1.6\times10^{-7}/$°C and modulus $E_2 = 120$ GPa, and both parts have length $H = 4$ m. Assume that the cylinder and tube are perfectly bonded together and the materials behave elastically. The Poisson effect is negligible.

(a) (10%) Find the axial stress changes $\Delta\sigma$ induced in the concrete cylinder and the copper tube. Express the answer as a function of ΔT. (*hint:* $\Delta\sigma_1 A_1 + \Delta\sigma_2 A_2 = 0$, where A_1 and A_2 are the cross-section areas of the concrete cylinder and hollow circular copper tube respectively)

(b) (5 %) Suppose the debonding between the concrete cylinder and the copper tube will occur if the interfacial (average) shear stress change $\Delta\tau$ exceeds 20 kPa. What is the maximum temperature increase ΔT before the debonding occurs? (*hint: the interfacial shear stress change is **not** equal to the axial stress change*)

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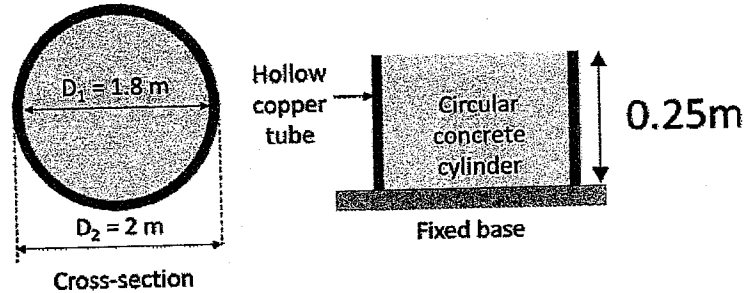
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(c) (5%) If the copper tube is replaced with steel tube, which has thermal expansion coefficient $\alpha_s = 1.0 \times 10^{-7}/°C$ and $E_s = 205$ GPa, what will be stress changes in the cylinder and the tube?

Cross-section

4. (30%)
A box girder bridge is being designed. The cross section of the girder is shown in the figure.

(a) (10%) Find the second moment of area I_{c-c} of the box girder cross-section about the neutral axis. Assume $t = 0.3$m, where t is the wall thickness of the box girder. (hints: locate the centroid first and apply parallel axis theorem to determine I_{c-c})

(b) (10%) If the allowable compressive bending stress for the section is $\sigma_{c,allow} = -200$ MPa and the allowable tensile bending stress is $\sigma_{t,allow} = 300$ MPa respectively, what are maximum sagging (positive) and hogging (negative) moments can be resisted by the girder?

(c) (10%) Suppose the allowable shear stress is $\tau_{allow} = 180$ MPa. Determine the maximum shear resistance of the girder.