DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
EGM1180: MECHANICS OF ENGINEERING MATERIALS
FINAL EXAMINATION: JANUARY 2020 SESSION

Instruction: This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) Three solid cylindrical rods AB, BC and CD are welded together at B and C, and loaded as shown in Figure Q1(a). The maximum allowable average normal stress must not exceed 150 MPa in either of the rods, determine the smallest allowable diameter of rod AB, BC and CD.

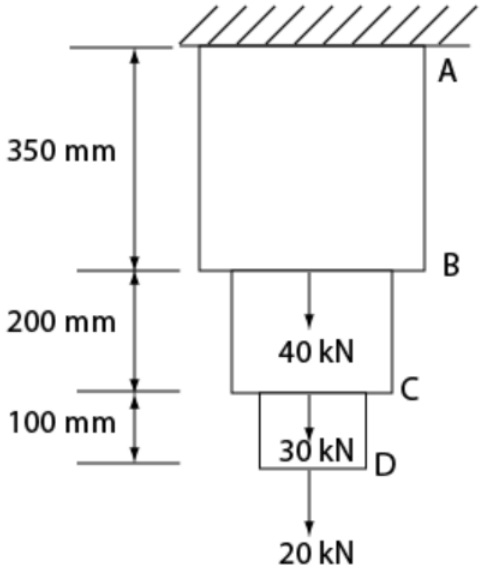

Figure Q1 (a)

(13marks)

(b) A rod consisting of two cylindrical portions AB and BC is restrained at both ends as shown in Figure Q1(b). Portion AB is made of steel with E= 200 GPa, α_s=11.7x10^{-6}/°C and portion BC is made of brass with E=120 GPa, α_b=18.7x10^{-6}/°C. Diameters of rod AB is 31.75mm and for rod BC is 57.15 mm. The rods are initially unstressed at room temperature 26 °C, determine the normal stresses induced in portions AB and BC if the temperature increase to 46 °C.

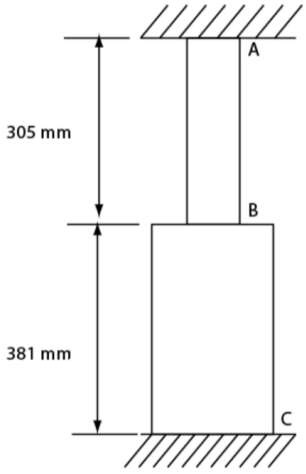

Figure Q1 (b) (Dimensions are in mm)

(12 marks)
(Total: 25 marks)

Question 2

(a) The torques shown are exerted on pulleys A, B and C, as shown in Figure Q2(a). Given that both shafts are solid and made of brass with G = 40 GPa. Determine the angle of twist in degree between (i) A and B, and (ii) A and C.

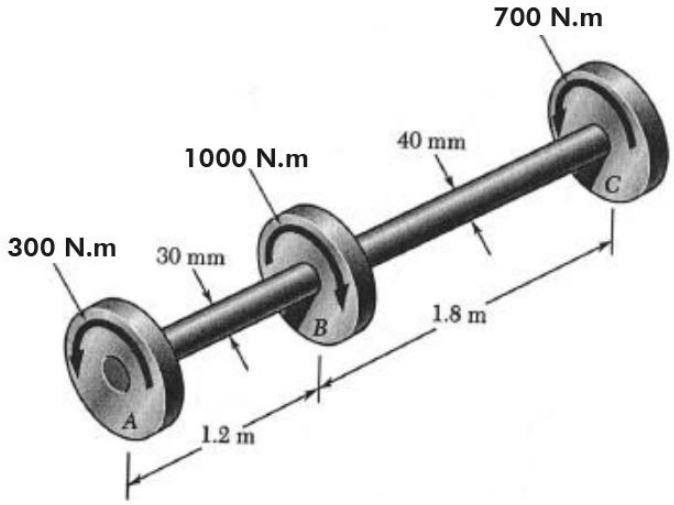

Figure Q2 (a)

(12 marks)

(b) For the given state of stress shown in Figure Q2(b), determine by drawing Mohr's circle, the normal and shearing stresses after the element shown has been rotated

(i) 25° clockwise

(ii) 10° counterclockwise

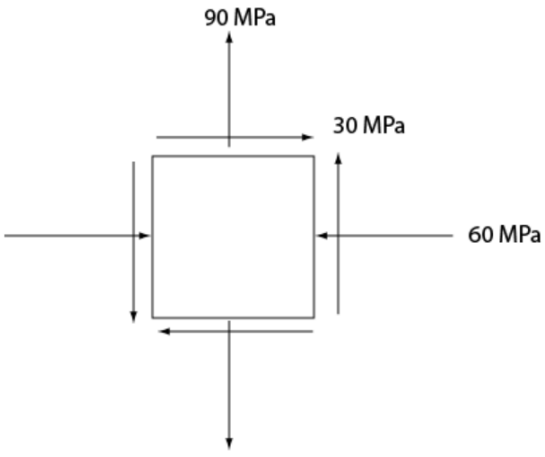

Figure Q2(b)

(13 marks)

(Total: 25 marks)

Question 3

(a) Two vertical forces are applied to a beam as shown in Figure Q3(a)(i) and Figure Q3(a)(ii) shows the cross section of the beam. Determine the maximum tensile tensile and compressive stresses in portion BC of the beam.

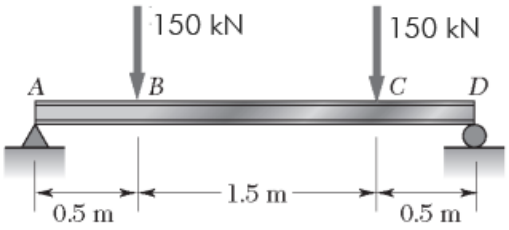

Figure 3(a)(i)

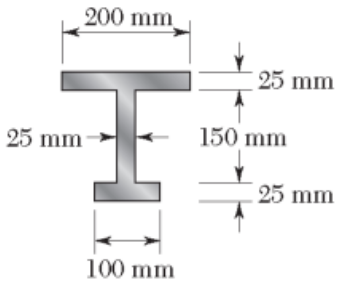

Figure 3(a)(ii)

(15 marks)

(b) Determine the maximum shear stress in the strut shown in Figure Q3(b) if it is subjected to a shear force of V = 20 kN.

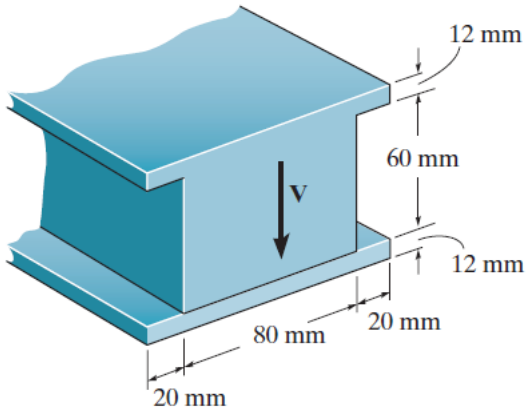

Figure Q3(b)

(10 marks)

(Total: 25 marks)

Question 4

(a) Figure Q4(a) show a beam AE which is a W360x101 rolled shape and that M_0 = 310 k N.m, L= 2.4 m, a= 0.5 m, and E = 200 GPa, determine the equation of elastic curve for portion BD and the deflection at point C.

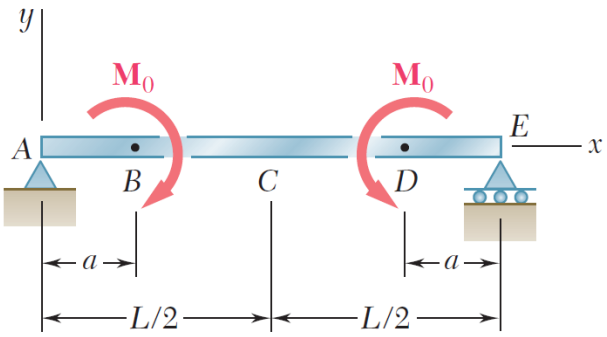

Figure Q4(a)

(15 marks)

(c) Using the method of work-energy, determine the slope at point D caused by the couple M_0 as shown in Figure Q4(b).

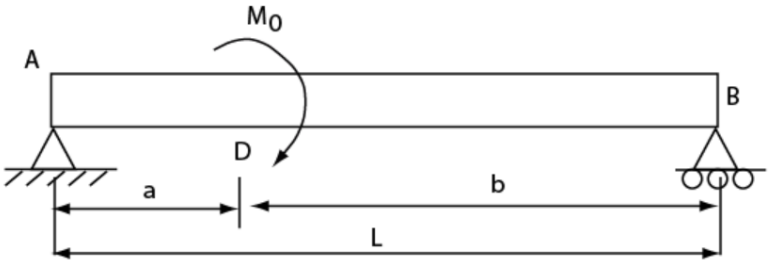

Figure Q4(b)

(10 marks)

(Total: 25 marks)

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