INSTRUCTION:

This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

ARAHAN:

*Bahagian ini mengandungi **EMPAT (4)** soalan berstruktur. Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

CLO1
C2

(a) i. Compare the Modulus Of Elasticity and Modulus Of Rigidity

Bandingkan Modulus Keanjalan dan Modulus Ketegaran

[4 marks]

[*4 markah*]

ii. A tensile test has been done on a steel rod. The result stress versus strain in tensile test was shown in Figure 1(a). Fill a name of point in box below.

Ujian tegangan telah dilakukan pada rod keluli. Keputusan tegasan lawan terikan dalam ujian tegangan ditunjukkan dalam Rajah 1(a). Isikan nama titik pada kotak graf di bawah.

[6 marks]

[*6 markah*]

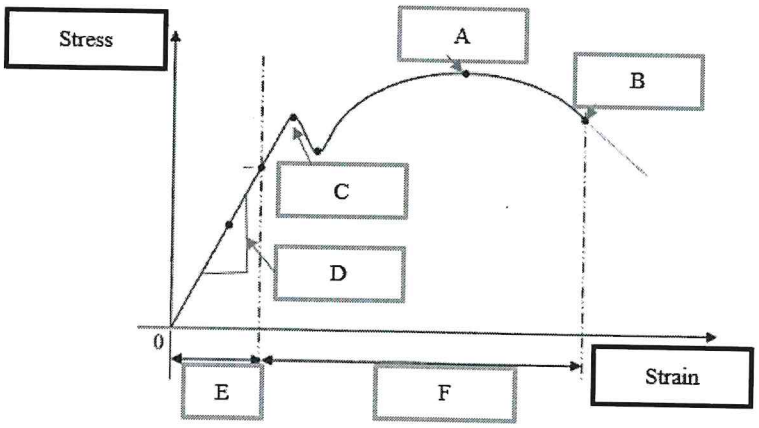


Figure 1(a) / *Rajah 1(a)*

CLO1
C2

(b) Express the distribution value of external forces, P_A, P_B and P_C when the system is in equilibrium for the compound bar of the Series connection.

Nyatakan nilai agihan daya luaran, P_A, P_B dan P_C apabila sistem berada dalam keseimbangan bagi bar majmuk sambungan Siri.

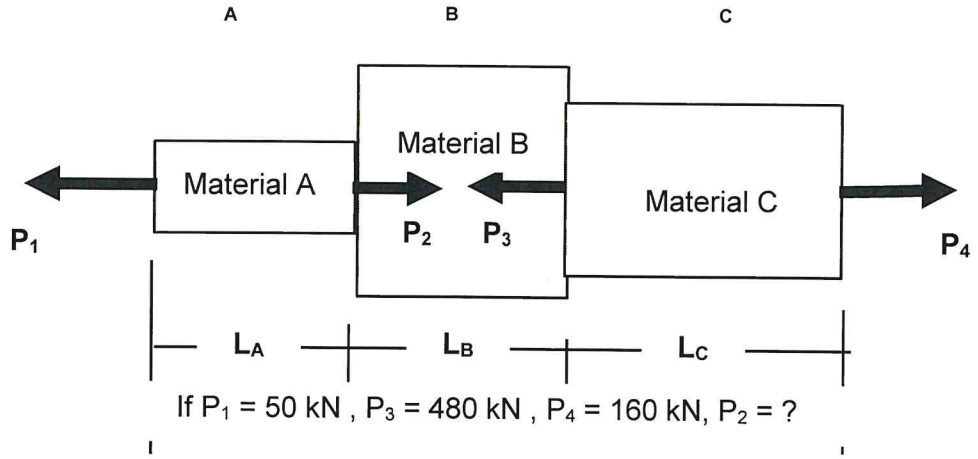


Figure 1(b) / *Rajah 1(b)*

[7 marks]

[*7 markah*]

CLO1
C3

(c) A composite aluminium and steel bar are fixed as series in between walls at temperature 85°C. Aluminium diameter is 50 mm and steel cross sectional area is 330 mm^2. Steel length is 3 times longer than Aluminium which is 753 mm. If the temparature dropped to 24°C, calculate the stress in each bar.

Satu komposit aluminium dan bar keluli ditetapkan sebagai sambungan siri di antara dinding pada suhu 85°C. Diameter aluminium ialah 50 mm dan luas keratan rentas keluli ialah 330 mm^2. Panjang keluli adalah 3 kali lebih panjang daripada aluminium iaitu 753 mm. Jika suhu turun kepada 24°C, hitung tegasan dalam setiap bar.

Given: $E_{aluminium} = 77$ GN/m^2 $E_{steel} = 220$ GN/m^2

$\langle_{aluminium} = 23.6 \times 10^{-6}$ / °C $\langle_{steel} = 12.5 \times 10^{-6}$ / °C

Diberi: $E_{aluminium} = 77$ GN/m^2 *$E_{steel} = 220$ GN/m^2*

$\langle_{aluminium} = 23.6 \times 10^{-6}$ / °C *$\langle_{steel} = 12.5 \times 10^{-6}$ / °C* [8 marks]

[*8 markah*]

QUESTION 2
SOALAN 2

A beam with 14 m length is a simply supported and fixed at both ends. The loads are applied as shown in Figure 2 below.

Sebatang rasuk dengan panjang 14 m adalah sebuah rasuk mudah disokong dan dipasang pada kedua-dua hujungnya. Beban dikenakan seperti yang ditunjukkan dalam rajah 2 di bawah.

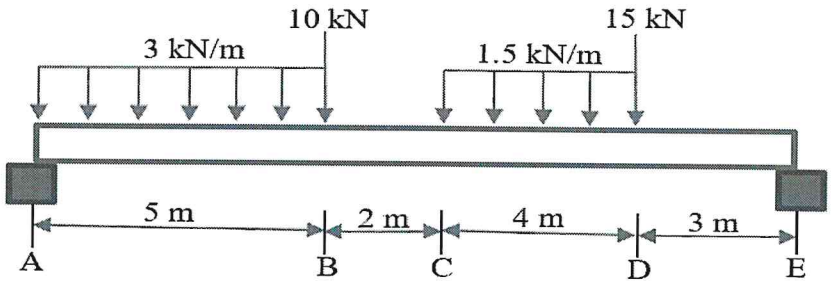


Figure 2 / *Rajah 2*

CLO1 C2 a) Referring to Figure 2, with the aid of free body diagram for the beam, express the value of reaction force.

Merujuk kepada Rajah 2, dengan bantuan gambarajah badan bebas bagi rasuk, dapatkan nilai daya tindak balas.

[5 marks]
[5 markah]

CLO1 C3 b) Calculate shear force along the beam and sketch the diagram.

Kira daya ricih di sepanjang rasuk dan lakarkan gambarajah tersebut.

[8 marks]
[8 markah]

CLO1 C3 c) Calculate bending moment along the beam and sketch the diagram

Kira momen lentur di sepanjang rasuk dan lakarkan gambarajah tersebut

[8 marks]
[8 markah]

CLO1
C3

d) Calculate the maximum bending moment and its position.
Kira momen lentur maksimum dan kedudukannya.

[4 marks]
[4 markah]

QUESTION

SOALAN 3

CLO2 C1

a) State **FIVE (5)** term from the symbol and its unit for the bending stress equation below.

*Nyatakan **LIMA (5)** istilah simbol dan unitnya bagi persamaan tegasan lentur dibawah.*

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

[5 marks]

[*5 markah*]

CLO2 C3

b) Figure 3(b) shows the cross sectional area of the beam for the simply supported beam. Calculate the Natural Axis position and Moment of Inertia of the beam.

Rajah 3(b) di bawah menunjukkan luas keratan rentas rasuk bagi rasuk yang disokong mudah. Kirakan kedudukan Paksi Natural dan Momen Inersia rasuk tersebut.

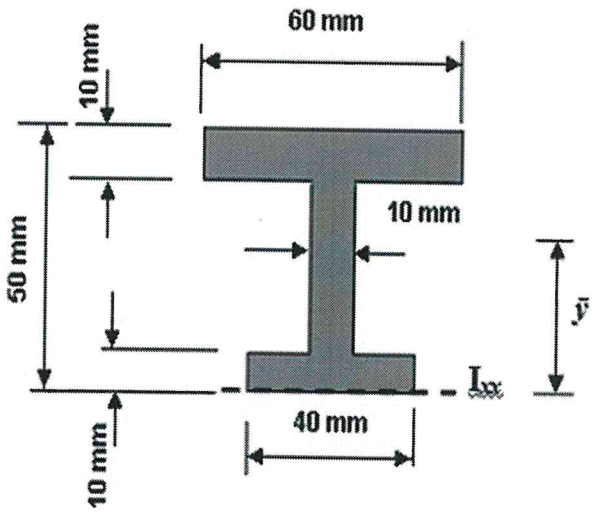


Figure 3(b) / *Rajah 3(b)*

[14 marks]

[*14 markah*]

CLO2
C4

c) Beam AB supports a uniformly distributed load of 15kN/m and length 0.76m as figure 3(c) below. The beam made from concrete high strength with diameter 46mm and E is 20GPa. Determine the slope and the maximum bending that occurred in the beam.

Rasuk AB menyokong beban teragih seragam 15kN/m dan panjang 0.76m seperti rajah 3(c) dibawah. Rasuk diperbuat daripada konkrit berkekuatan tinggi dengan diameter 46mm dan E ialah 20GPa. Tentukan kecerunan dan lenturan maksimum yang berlaku didalam rasuk.

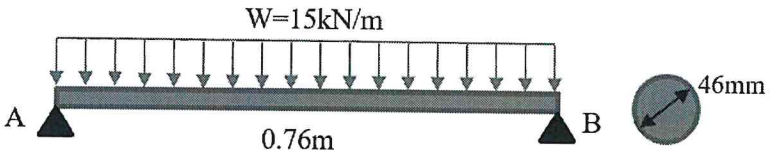


Figure 3(c) / *Rajah 3(c)*

[6 marks]
[*6 markah*]

QUESTION 4
SOALAN 4

CLO1
C1

a) State the term from the symbol and its unit for the torsional equation below.
Nyatakan istilah simbol dan unitnya bagi persamaan kilasan dibawah.

$$\frac{T}{J} = \frac{G\theta}{L}$$

[5 marks]
[*5 markah*]

CLO1 C2

b) Explain torque and give **THREE (3)** torque's application in engineering.
*Jelaskan maksud kilasan dan berikan **TIGA (3)** aplikasi kilasan dalam bidang kejuruteraan.*

[8 marks]
[8 markah]

CLO1 C3

c) A shaft with 60mm diameter and 0.8m long is subjected to a torque of 1300Nm. Given G=70Gpa. Calculate second polar moment of area and angle of twist of the shaft.
Sebuah aci dengan diameter 60mm dan 0.8m panjang dikenakan daya kilasan 1300Nm. Diberikan G=70GPa. Kirakan polar momen luas kedua dan sudut pusingan aci.

[5 marks]
[5 markah]

CLO2 C4

d) A shaft with diameter 120mm and 2.5m length is transmitting 50kW power at 600rpm. Determine Shear stress induced in the shaft.
Sebuah aci dengan diameter 120mm dan 2.5m panjang menghantar 50kW kuasa pada 600rpm. Tentukan Tegasan ricih yang berlaku didalam aci.

[7 marks]
[7 markah]

SOALAN TAMAT

LIST OF FORMULA 30103 - STRENGTH OF MATERIALS

FORCES ON MATERIALS

1. Safety factor $= \dfrac{\text{Maximum Stress}}{\text{Work Stress}}$

2. Poisson's Ratio, $\nu = \dfrac{\text{laterial strain}}{\text{longitudinal strain}}$

3. Percent Elongation $= \dfrac{\text{Elongation}}{\text{Length}} \times 100\ \%$

4. Percent reduction in area $= \dfrac{A_f - A_o}{A_o} \times 100\ \%$

5. Strain Energy, $U = \dfrac{1}{2} P\Delta L$

THERMAL STRESSES AND COMPOSITE BARS

1. Equation of a parallel composite bar subjected to a temperature change.

$$\frac{\sigma_1}{E_1} + \frac{\sigma_2}{E_2} = (\alpha_2 - \alpha_1)\,\Delta t$$

2. Equation of a series composite bar subjected to a temperature change.

$$\frac{P_1 L_1}{A_1 E_1} + \frac{P_2 L_2}{A_2 E_2} = \Delta t(\alpha_1 L_1 + \alpha_2 L_2)$$

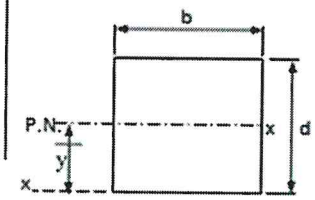
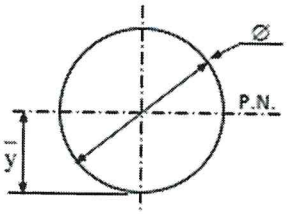
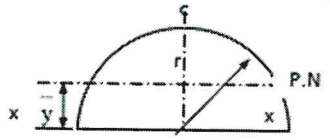
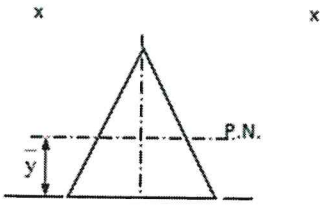
SHEAR FORCES AND BENDING MOMENT

$$\sum M_{\circlearrowleft} = \sum M_{\circlearrowright}$$

$$\sum F_{\uparrow} = \sum F_{\downarrow}$$

BENDING STRESS

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

SHAPE	CENTROID	MOMENT OF INERTIA
	$\bar{x} = b/2$ $\bar{y} = d/2$	$I_{P.N.} = \frac{bd^3}{12}$ $I_{xx} = \frac{bd^3}{3}$
	$\bar{x} = d/2$ $\bar{y} = d/2$	$I_{P.N.} = \frac{\pi d^4}{64} = \frac{\pi r^4}{4}$
	$\bar{y} = \frac{4r}{3\pi}$	$I_{P.N} = 0.11r^4$ $I_{xx} = \frac{\pi r^4}{8}$
	$\bar{y} = h/3$	$I_{P.N.} = \frac{bh^3}{36}$ $I_{xx} = \frac{bh^3}{12}$ $I_{yy} = \frac{hb^3}{48}$

TORSION OF SHAFT

1. TORSION FORMULA

$$\frac{T}{J}=\frac{\tau}{R}=\frac{G\theta}{L}$$

2. POLAR MOMENT OF INERTIA

$$J=\frac{\pi d^4}{32}$$

3. SERIES COMPOSITE SHAFT

$$T=\frac{G_1\theta J_1}{L_1}=\frac{G_2\theta_2 J_2}{L_2}$$

$$\begin{aligned}\theta_{AC}&=\theta_{AB}+\theta_{BC}\\&=\frac{T_1L_1}{G_1J_1}+\frac{T_2L_2}{G_2J_2}\\&=T\left(\frac{L_1}{G_1J_1}+\frac{L_2}{G_2J_2}\right)\end{aligned}$$

4. PARALLEL COMPOSITE SHAFT

$$T = T_1 + T_2$$

$$\theta=\left(\frac{T_1L_1}{G_1J_1}\right)=\left(\frac{T_2L_2}{G_2J_2}\right)$$