UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 2003/2004

Februari / Mac 2004

JNK 320/3 – Mekanik Pepejal I

Masa : 3 jam

ARAHAN KEPADA CALON :

Sila pastikan bahawa kertas soalan ini mengandungi **TUJUH (7)** mukasurat dan **ENAM (6)** soalan yang bercetak serta **SATU (1)** halaman lampiran sebelum anda memulakan peperiksaan.

Jawab **LIMA** soalan sahaja. Soalan **bahagian A** mesti dijawab dalam **Bahasa Inggeris.**

Setiap soalan mestilah dimulakan pada mukasurat yang baru.

Lampiran :

1. Jadual Beam Deflection Formulas. [1 mukasurat]

Serahkan **KESELURUHAN** soalan dan jawapan kertas peperiksaan ini kepada Ketua Pengawas di akhir sidang peperiksaan. Pelajar yang gagal berbuat demikian akan diambil tindakan disiplin.

KETUA PENGAWAS : Sila pungut :

(a) **KESELURUHAN** kertas soalan ini (tanpa diceraikan mana-mana muka surat) dan mana-mana kertas soalan peperiksaan ini yang berlebihan untuk dikembalikan kepada Bahagian Peperiksaan, Jabatan Pendaftar, USM.

Peringatan :

1. **Sila pastikan bahawa anda telah menulis angka giliran dengan betul.**

Bahagian A

S1. [a] **Pengandung tekanan silinder yang mempunyai keratan rentas berbentuk bulat dan bergarispusat D dan tebal t dikenakan tekanan dalaman P. Pengandung tersebut ditutup dikedua-dua hujung. Terbitkan persamaan untuk tegasan hoop dan tegasan paksi.**

A cylindrical pressure vessel of circular cross section of mean diameter D and thickness t is subjected to an internal pressure P. The vessel is closed at both the ends. Derive expressions for the hoop and longitudinal stresses.

(30 markah)

[b] **Silinder hidraulik yang berukuran garispusat luaran 120 mm dan garispusat dalaman 60 mm dikenakan tekanan dalaman sebanyak 100 MN/m^2.**

A hydraulic cyclinder of 120 mm external diameter and 60 mm internal diameter is subjected to an internal pressure of 100 MN/m^2.

(i) **Tentukan tegasan hoop pada permukaan dalaman dan luaran**

Determine the hoop stresses at the inner and outer surfaces.

(ii) **Plotkan agihan tegasan hoop dan tegasan radii disepanjang ketebalan.**

Plot the distribution of hoop and radial stresses through the thickness.

(70 markah)

S2. [a] **Rajah S2[a] menunjukkan keadaan tegasan suatu titik pada anggota struktur.**

Figure Q2[a] shows the state of stress at a point on a structural member.

(i) **Lukis bulatan Mohr untuk kes yang ditunjukkan dan terangkan prosidurnya.**

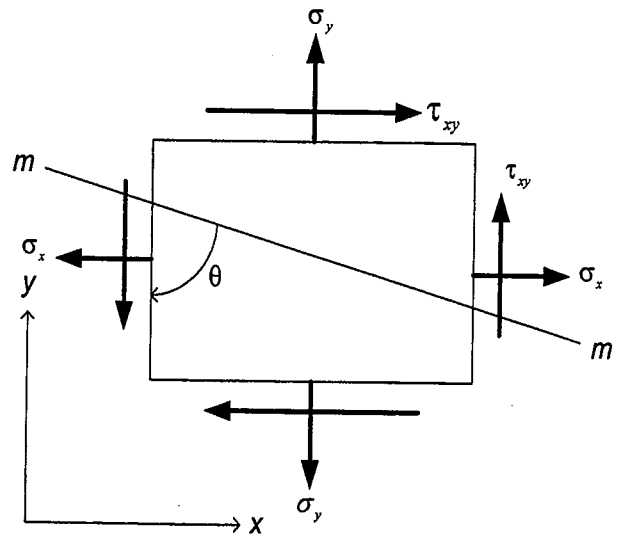
Draw the Mohr's circle for the above case and explain the procedure.

(ii) **Tandakan dalam rajah, tegasan pada satah condong m-m.**

Mark, on the diagram, the stresses on an inclined plane m-m.

(iii) **Tandakan dalam rajah, tegasan utama dan nilai θ yang berkenaan.**

Mark, on the diagram, the principal stresses and the corresponding θ values.

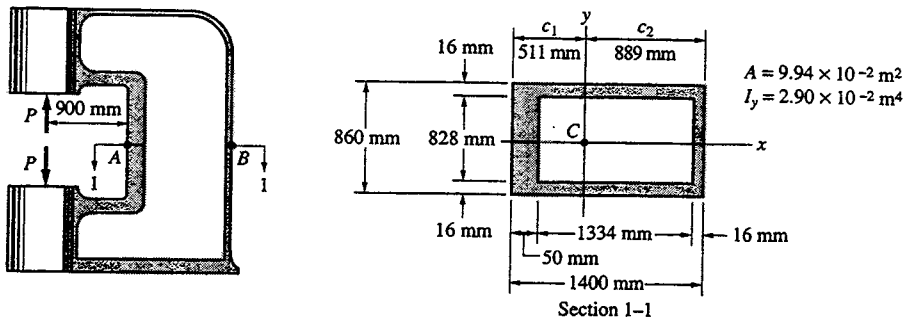


Rajah S2[a]
Figure Q2[a]

(30 markah)

[b] **Bingkai tekanan hidraulik mempunyai ukuran dan ciri-ciri bahagian 1-1 seperti yang ditunjukkan dalam Rajah S2[b]. Jika P = 1600 kN, tentukan tegasan paksi pada titik-titik A dan B.**

The frame of the hydraulic press has the dimensions and the properties of section 1-1 shown in Figure Q2[b]. If P = 1600 kN, determine the normal stresses at points A and B.



Rajah S2[b]
Figure Q2[b]

(70 Markah)

S3. **[a]** **Definasikan perkara-perkara berikut:**

(i) **rasuk tidak tentu statik**

(ii) **penahan berbagai**

(iii) **darjah tidak tentu**

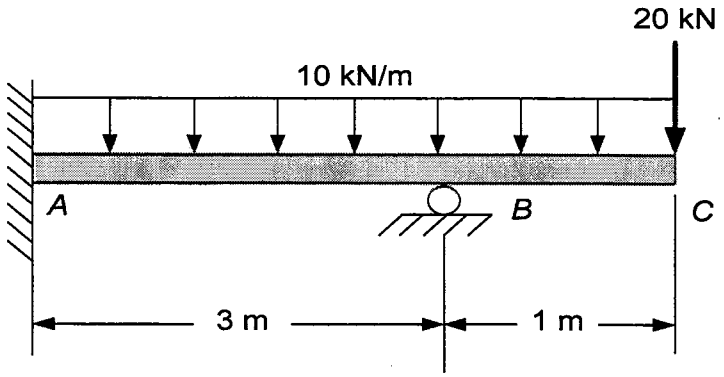
Define the following terms :

(i) statically indeterminate beam
(ii) redundant constraints
(iii) degree of indeterminacy.

(20 markah)

[b] Rasuk yang ditunjukkan dalam Rajah S3[b] mempunyai ketegaran lenturan tetap EI disepanjang AC. Gunakan kaedah tindihan untuk menentukan tindakbalas di A dan B dan plotkan rajah ricih dan momen.

The beam shown in Figure Q3[b] has constant flexural rigidity EI through its length AC. Use the method of superposition to determine the reactions at A and B and plot the shear and moment diagrams.



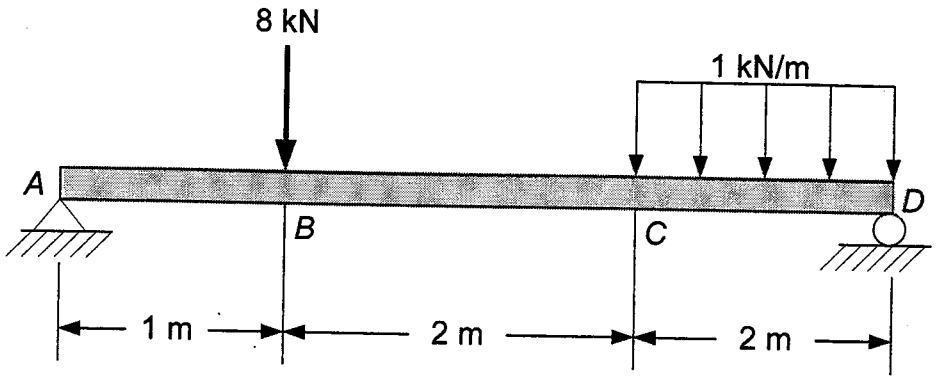
Rajah S3[b]
Figure Q3[b]

(80 markah)

Bahagian B

S4. [a] Lukis rajah ricih dan rajah momen untuk rasuk seperti yang ditunjukkan dalam Rajah S4[a] serta tentukan lokasi daya ricih sifar (jika ada) dan momen pada keratan tersebut.

Draw the shear force and bending moment diagrams for the beam as shown in Figure Q4[a], and locate the section with zero shear force (if any) and determine the moment at the section.

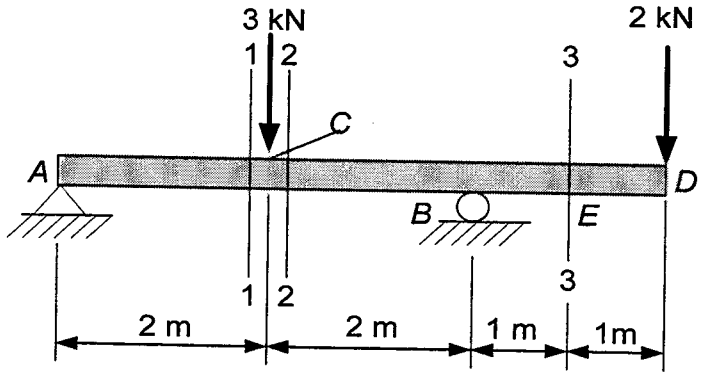


Rajah S4[a]
Figure Q4[a]

(50 markah)

[b] **Tentukan daya ricih dan momen lentur pada rasuk di keratan 1-1, 2-2 dan 3-3 seperti yang ditunjukkan dalam Rajah S4[b].**

Find the shear forces and bending moments at sections 1-1, 2-2 and 3-3 for the beam as shown in Figure Q4[b].



Rajah S4[b]
Figure Q4[b]

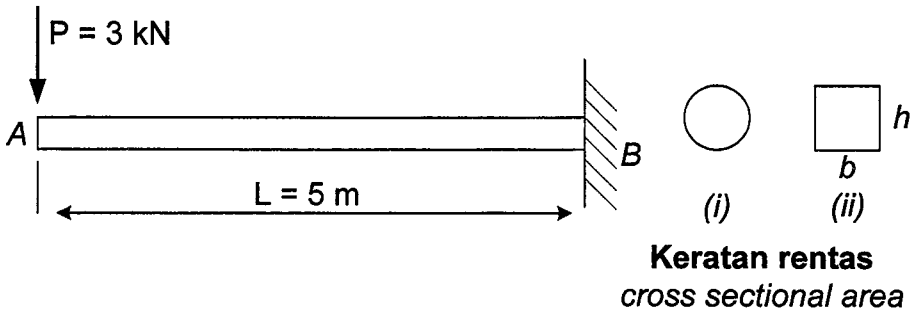
(50 markah)

S5. [a] **Rasuk jalur AB dalam Rajah S5[a] panjangnya 5 m dikenakan beban tumpu P = 3 kN di hujung A. Tentukan tegasan lenturan maksimum untuk rasuk jalur di bawah jika keratan rentasnya:**

(i) bulat bergaris pusat 50 mm
(ii) segiempat tepat (b x h; 40 x 80 mm)

A cantilever beam AB in Figure Q5[a] with a length of 5 m is subjected to a concentrated load P = 3 kN at its end A. Find the maximum bending stress for the cantilever beam if the cross-sectional area is:

(i) circular with a diameter of 50 mm
(ii) a rectangular (b x h; 40 x 80 mm)

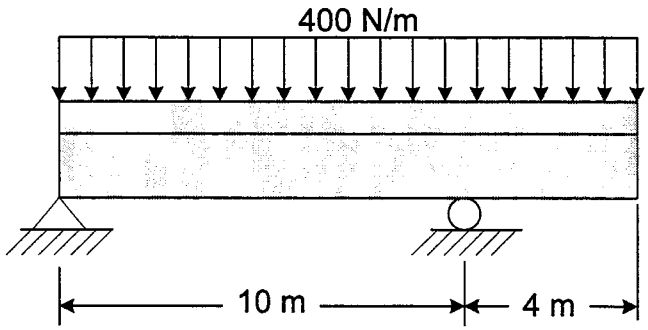


Rajah S5[a]
Figure Q5[a]

(50 markah)

[b] **Rasuk tergantung seperti yang ditunjukkan dalam Rajah S5[b] diperbuat daripada kayu segiempat (b x h; 40 x 80 mm). Rasuk tersebut dikenakan beban seragam sebanyak 400 N/m termasuk berat rasuk. Tentukan tegasan tegangan maksima dalam rasuk tersebut.**

The overhanging beam in Figure Q5[b] is built up from a rectangular timber (b x h; 40 x 80 mm). The beam is subjected to a uniform load of 300 N/m, which includes the weight of the beam. Determine the maximum tensile stress in the beam.

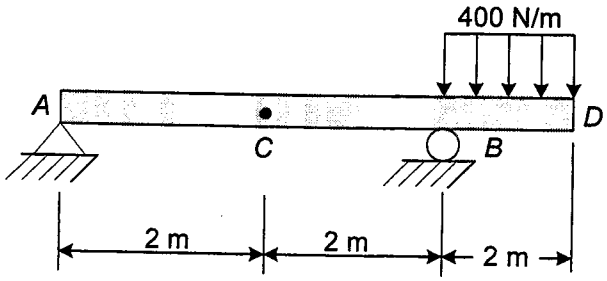


Rajah S5[b]
Figure Q5[b]

(50 markah)

S6. **Tentukan pesongan pada tengah rasuk C dan pada hujung bebas D untuk rasuk tergantung seperti yang ditunjukkan dalam Rajah S6. Guna nilai ketegaran lenturan EI seperti yang dinyatakan.**

Determine the deflection at midspan C and the free end D of overhanging beam due to loading shown in Figure Q6. Use the flexural rigidity EI value indicated in the figure.



$EI = 2.2x10^5 N m^2$

Rajah S6
Figure Q6

(100 markah)

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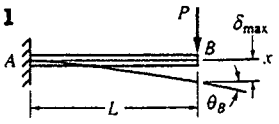
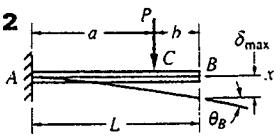
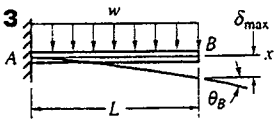
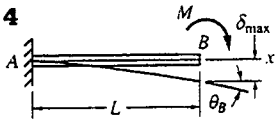
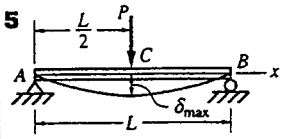
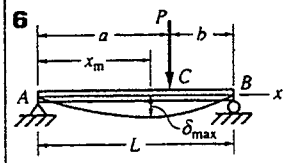
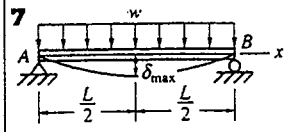
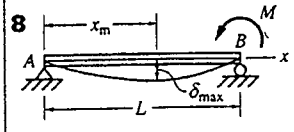
Beam Deflection Formulas

Beam Loading and Deflection	Maximum Deflection	Slope at End(s)	Deflection Equations
1 	$\delta_{max} = \frac{PL^3}{3EI}$	$\theta_B = \frac{PL^2}{2EI}$	$\delta = \frac{Px^2}{6EI}(3L - x)$
2 	$\delta_{max} = \frac{Pa^2}{6EI}(3L - a)$	$\theta_B = \frac{Pa^2}{2EI}$	$\delta_{AC} = \frac{Px^2}{6EI}(3a - x)$ $\delta_{CB} = \frac{Pa^2}{6EI}(3x - a)$
3 	$\delta_{max} = \frac{wL^4}{8EI}$	$\theta_B = \frac{wL^3}{6EI}$	$\delta = \frac{wx^2}{24EI}(x^2 - 4Lx + 6L^2)$
4 	$\delta_{max} = \frac{ML^2}{2EI}$	$\theta_B = \frac{ML}{EI}$	$\delta = \frac{Mx^2}{2EI}$
5 	$\delta_{max} = \frac{PL^3}{48EI}$	$\theta_A = \theta_B = \frac{PL^2}{16EI}$	$\delta_{AC} = \frac{Px}{48EI}(3L^2 - 4x^2)$
6 	For $a > b$: $\delta_{max} = \frac{Pb(L^2 - b^2)^{3/2}}{9\sqrt{3}EIL}$ at $x_m = \sqrt{\frac{L^2 - b^2}{3}}$	$\theta_A = \frac{Pb(L^2 - b^2)}{6EIL}$ $\theta_B = \frac{Pa(L^2 - a^2)}{6EIL}$	$\delta_{AC} = \frac{Pbx}{6EIL}(L^2 - x^2 - b^2)$ $\delta_{CB} = \frac{Pb}{6EIL}\left[\frac{L}{b}(x - a)^3 + (L^2 - b^2)x - x^3\right]$
7 	$\delta_{max} = \frac{5wL^4}{384EI}$	$\theta_A = \theta_B = \frac{wL^3}{24EI}$	$\delta = \frac{wx}{24EI}(L^3 + x^3 - 2Lx^2)$
8 	$\delta_{max} = \frac{ML^2}{9\sqrt{3}EI}$ at $x_m = \frac{L}{\sqrt{3}}$	$\theta_A = \frac{ML}{6EI}$ $\theta_B = \frac{ML}{3EI}$	$\delta = \frac{Mx}{6EIL}(L^2 - x^2)$