
UNIVERSITI SAINS MALAYSIA

Supplementary Semester Examination
Academic Session 2009/2010

June 2010

IWK 302 – WOOD ENGINEERING
[KEJURUTERAAN KAYU]

Duration: 3 hours
[Masa: 3 jam]

Please check that the examination paper consists of **FIFTEEN (15)** pages of printed material before you begin this examination.

Answer **FIVE** questions. All questions can be answered in Bahasa Malaysia OR English.

In the event of any discrepancies, the English version shall be used.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **LIMABELAS (15)** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

*Jawab **LIMA** soalan. Semua soalan boleh dijawab dalam Bahasa Malaysia ATAU Bahasa Inggeris.*

Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai].

1. Based on Irwin-kies Relationship and Figure 1, indicate that strain energy release rate (G) is

$$G = P_c^2/2B(dC/da),$$

where

P_c = Crack load
 B = Thickness
 C = Compliance
 a = Crack length

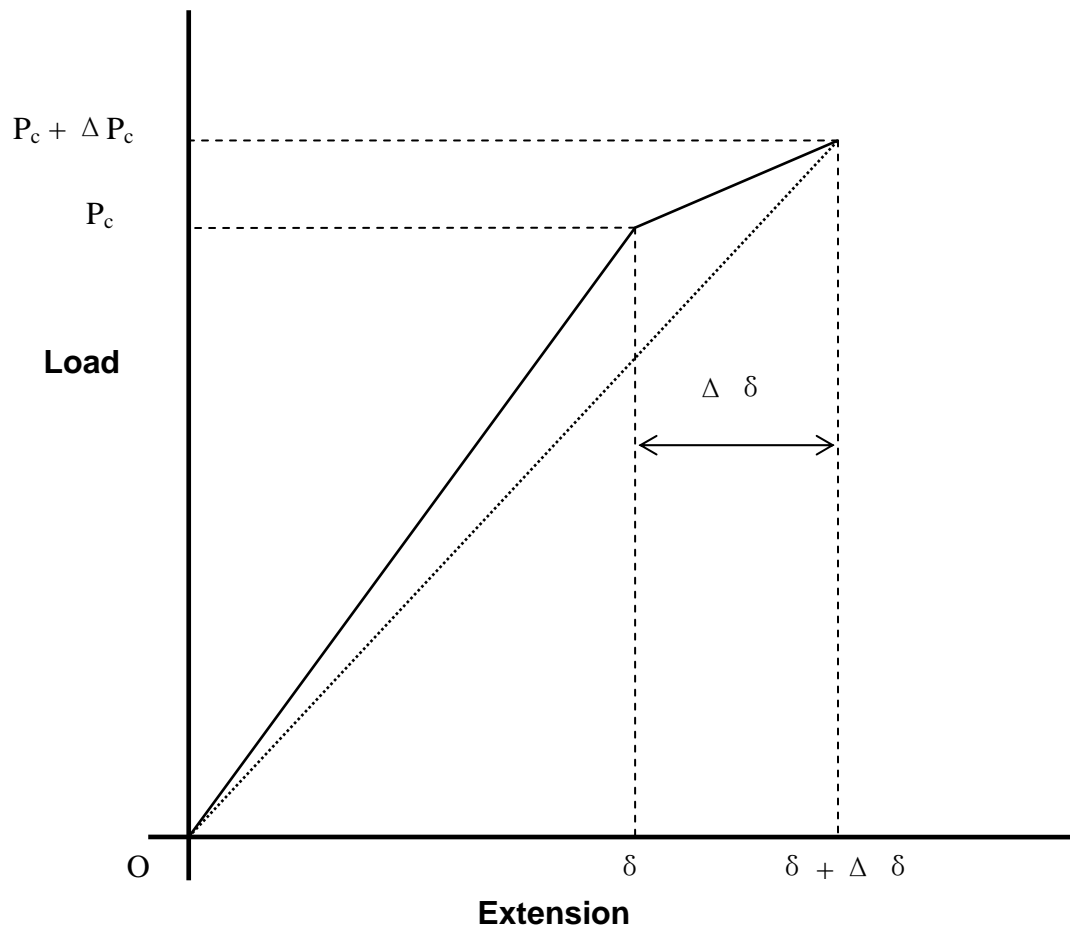


Figure 1

(20 marks)

...3/-

2. (a) For Figure 2, determine the following using integration method.
- (i) the area, A
 - (ii) the centroid
 - (iii) the moment of inertia, I_x

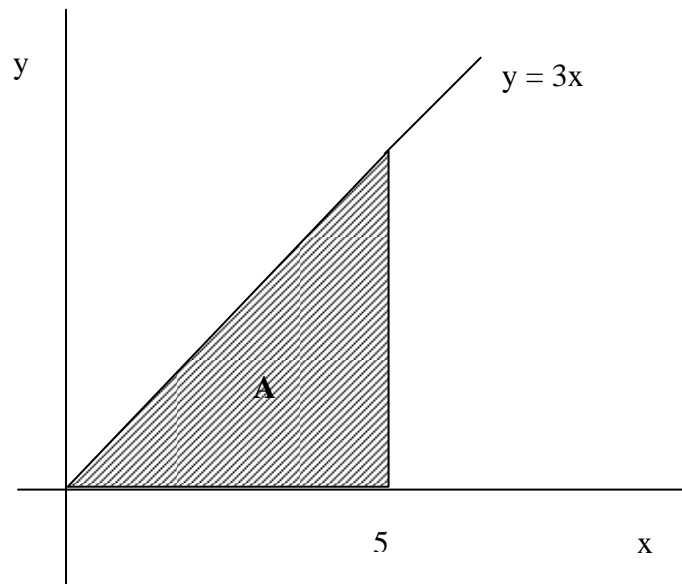


Figure 2

(10 marks)

- (b) For the composite area shown in Figure 3, determine
- the coordinate of the centroid
 - the moment of inertia with respect to the x-axis, I_x .

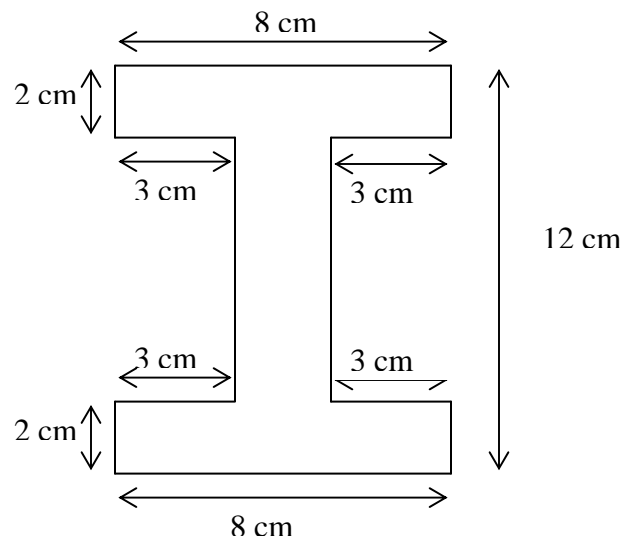


Figure 3

(10 marks)

3. A beam is loaded by a force as shown in Figure 4, the specifications of the beam are as follow;

$$\begin{aligned} F_{bo} &= 8500 \text{ kN/m}^2 && \text{(allowable bending stress)} \\ F_{vo} &= 750 \text{ kN/m}^2 && \text{(allowable shear stress)} \\ b &= 20 \text{ m} && \text{(width of beam)} \\ d &= 1 \text{ m} && \text{(thickness of beam)} \end{aligned}$$

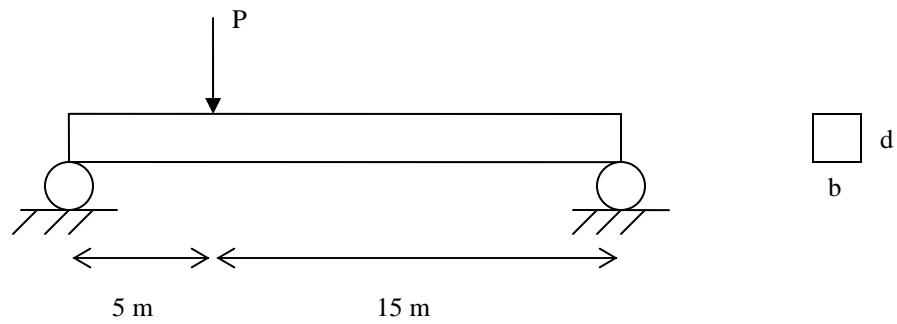


Figure 4

Determine the allowable force (P)

(20 marks)

4. A cantilever beam is loaded as shown in Figure 5. Indicate that the maximum deflection is $WL^4/8EI$, where;

W = load/ per unit length

L = length of the beam

E = modulus of elasticity

I = moment of inertia computed about the neutral axis

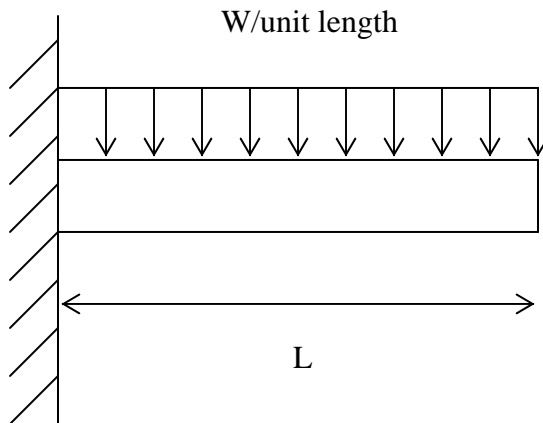


Figure 5

(20 marks)

5. A roof made of solid wood has the following specifications;

C_d	= 1.25 (load duration factor)
L	= 18ft (length of the beam)
S	= 2ft (space between beams)
d_l	= 20Ibf/ft ² (dead load)
l_l	= 10 Ibf/ft ² (live load)
F_{bo}	= 1600 Ibf/in ² (allowable bending stress)
F_{vo}	= 750 Ibf/in ² (allowable shear stress)
E	= 1700000 Ibf/in ² (modulus of elasticity)
P_o	= $L/180$ (allowable deflection)

Test the suitability of a section with size 1.5 in x 9.25 in.

(20 marks)

6. A two dimensional structure in Figure 6 has dimensions in arbitrary units. Using Finite Element Method, determine
- the displacement of each node
 - the reaction force at node 1 and 2
 - the axial force in each element

Element	E	A
13	1	1
23	1	1

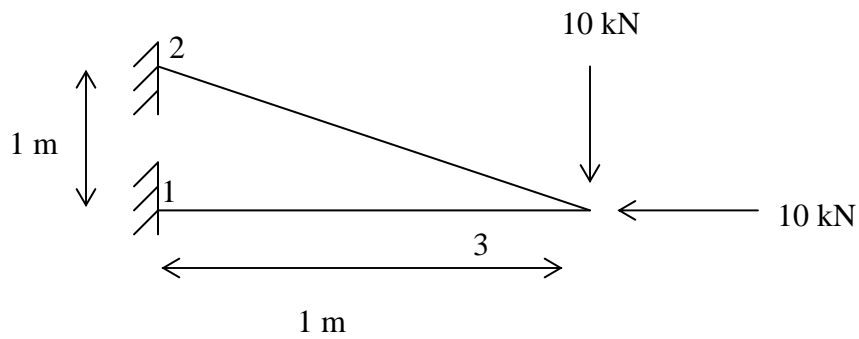


Figure 6

(20 marks)

1. Berdasarkan hubungan Irwin-kies dan Rajah 1, tunjukkan bahawa kadar pembebasan tenaga terikan (G) adalah diberikan oleh

$$G = P_c^2/2B(dC/da),$$

dengan

P_c = Beban rekahan

B = Ketebalan

C = Komplians

a = Panjang retak

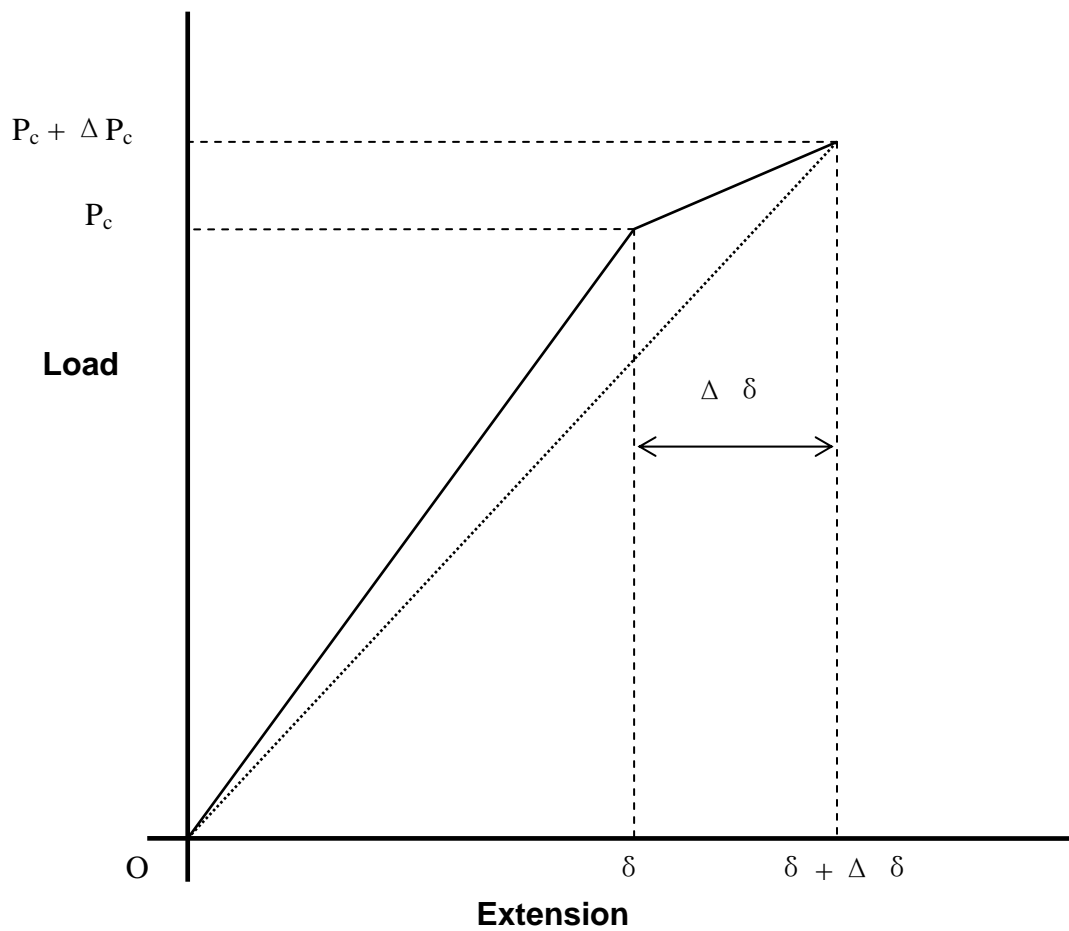
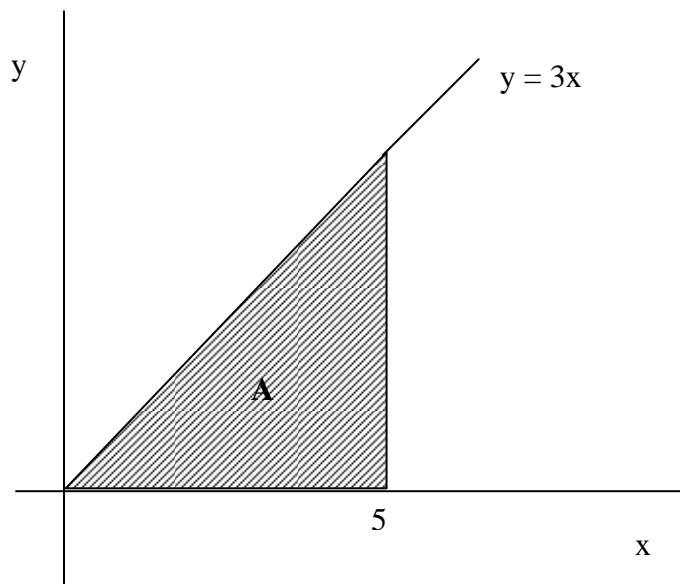


Figure 1

(20 markah)

2. (a) Untuk kawasan yang terlorek dalam Rajah 2, tentukan yang berikut dengan menggunakan kaedah pengamiran.
- (i) Keluasan kawasan terlorek, A
 - (ii) Pusat bentuk
 - (iii) Momen inersia terhadap paksi x , I_x

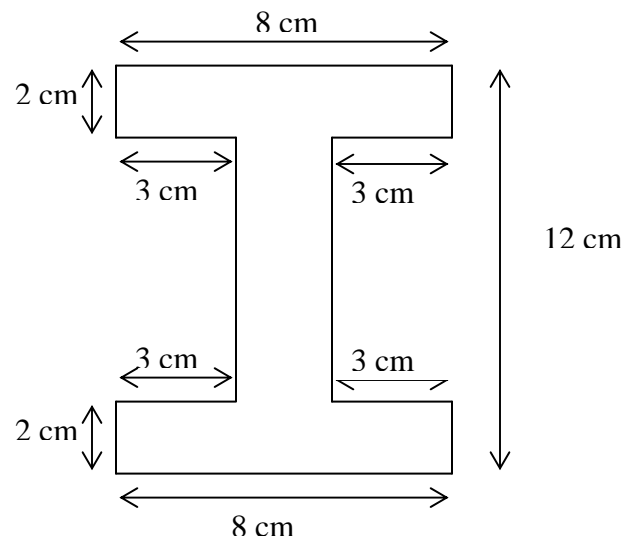
**Rajah 2**

(10 markah)

(b) Untuk rajah komposit yang ditunjukkan dalam Rajah 3, tentukan

(i) Kordinat pusat bentuk

(ii) Momen inersia terhadap paksi x , I_x .



Rajah 3

(10 markah)

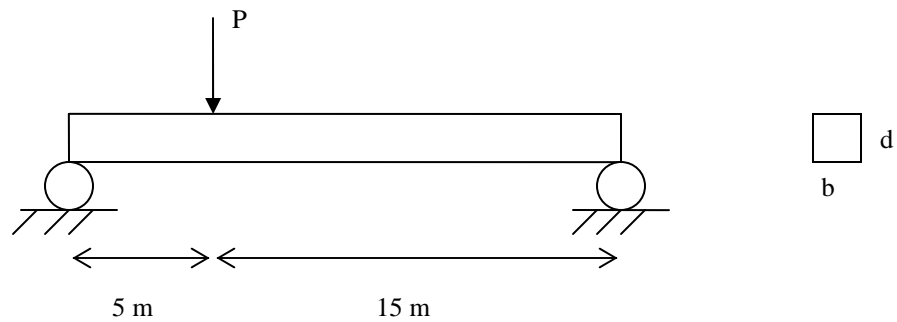
3. Suatu bim dibebankan dengan suatu daya seperti yang ditunjukkan dalam Rajah 4 dan spesifikasi bim dalam seperti berikut

$$F_{bo} = 8500 \text{ kN/m}^2 \quad (\text{tegasan lenturan izin})$$

$$F_{vo} = 750 \text{ kN/m}^2 \quad (\text{tegasan ricih izin})$$

$$b = 20 \text{ m} \quad (\text{lebar bim})$$

$$d = 1 \text{ m} \quad (\text{ketebalan bim})$$



Rajah 4

Tentukan daya (P) yang dibenarkan

(20 markah)

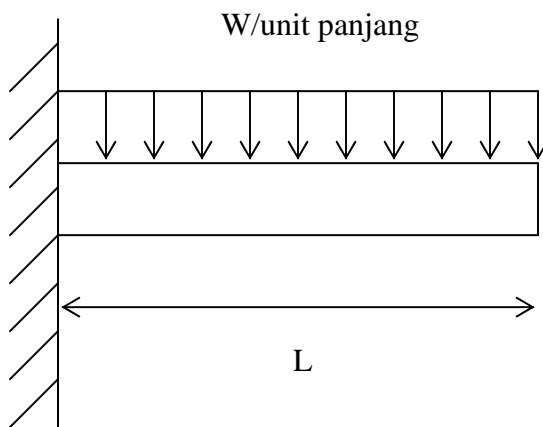
4. Suatu bim kantilever dibebankan seperti yang ditunjukkan dalam Rajah 5. Tunjukkan pesongan maksimum bim tersebut adalah bersamaan dengan $WL^4/8EI$, dengan;

W = Beban/ unit panjang

L = Panjang bim

E = Modulus kekenyalan

I = Moment inersia terhadap paksi neutral



Rajah 5

(20 markah)

5. Suatu bim bumbung lurus yang diperbuat daripada kayu pejal mempunyai spesifikasi berikut;

C_d	= 1.25 (factor tempoh masa pengenalan beban)
L	= 18ft (panjang bim)
S	= 2ft (jarak antara bim)
dl	= 20Ibf/ft ² (beban mati)
ll	= 10 Ibf/ft ² (beban hidup)
F_{bo}	= 1600 Ibf/in ² (tegasan lenturan izin)
F_{vo}	= 750 Ibf/in ² (tegasan ricih izin)
E	= 1700000 Ibf/in ² (modulus kekenyalan)
P_o	= $L/180$ (pesongan izin)

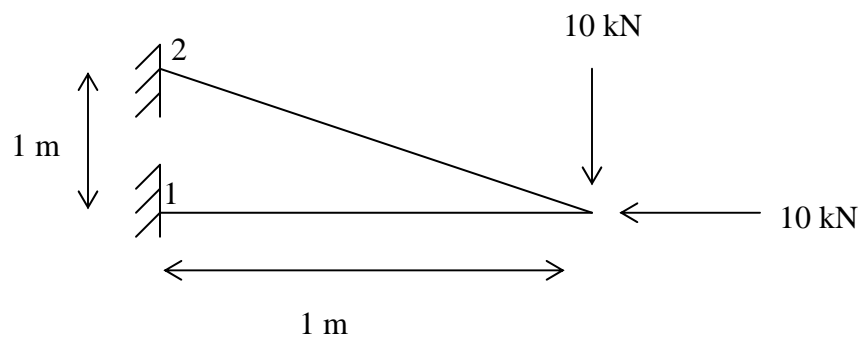
Uji kesesuaian keratan yang bersaiz 1.5 in x 9.25 in

(20 markah)

6. Suatu struktur dua dimensi dalam Rajah 6 dengan ukurannya diberikan dalam unit sebarang. Dengan menggunakan Kaedah Elemen Terhingga, tentukan

- (i) Sesaran setiap nod
- (ii) Daya tindak balas pada nod 1 dan 2
- (iii) Daya paksian setiap elemen

<i>Elemen</i>	<i>E</i>	<i>A</i>
13	1	1
23	1	1



Rajah 6

(20 markah)

List of formulations

Z	= $bd^2/6$ (section modulus)
I	= $bd^3/12$ (moment of inertia)
L_e	= $L - 2d$ (effective length)
V	= $wL_e/2$ (maximum shear force)
M	= $wL^2/8$ (maximum bending moment)
F_b	= M/Z (actual bending stress)
F_v	= $3V/2A$ (actual shear stress)
P	= $5wL^4/384EI$ (actual deflection)
C_f	= $(12/d)^{1/9}$ (size factor)
C_c	= $1 - 2000 (t/R)^2$ (curve factor)
F_r	= $3M/2R_m A$ (actual radius stress)

Senarai formula

Z	= $bd^2/6$ (modulus keratan)
I	= $bd^3/12$ (momen inertia)
L_e	= $L - 2d$ (panjang berkesan)
V	= $wL_e/2$ (tegasan ricih maksimum)
M	= $wL^2/8$ (momen lenturan maksimum)
F_b	= M/Z (tegasan lenturan sebenar)
F_v	= $3V/2A$ (tegasan ricih sebenar)
P	= $5wL^4/384EI$ (pesongan sebenar)
C_f	= $(12/d)^{1/9}$ (faktor saiz)
C_c	= $1 - 2000 (t/R)^2$ (faktor lengkukan)
F_r	= $3M/2R_m A$ (tegasan jejarian sebenar)