UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 2007/2008

April 2008

IWK 302 – Kejuruteraan Kayu
[Wood Engineering]

Masa : 3 jam
[Duration : 3 hours]

Sila pastikan bahawa kertas peperiksaan ini mengandungi EMPAT BELAS muka surat yang bercetak sebelum anda memulakan peperiksaan ini.

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

[Please check that the examination paper consists of FOURTEEN pages of printed material before you begin this examination.]

*[Answer any **FIVE** questions. All questions can be answered either in Bahasa Malaysia OR English.]*

1. (a) Takrifkan keliatan seimbang dan keliatan hentaman.

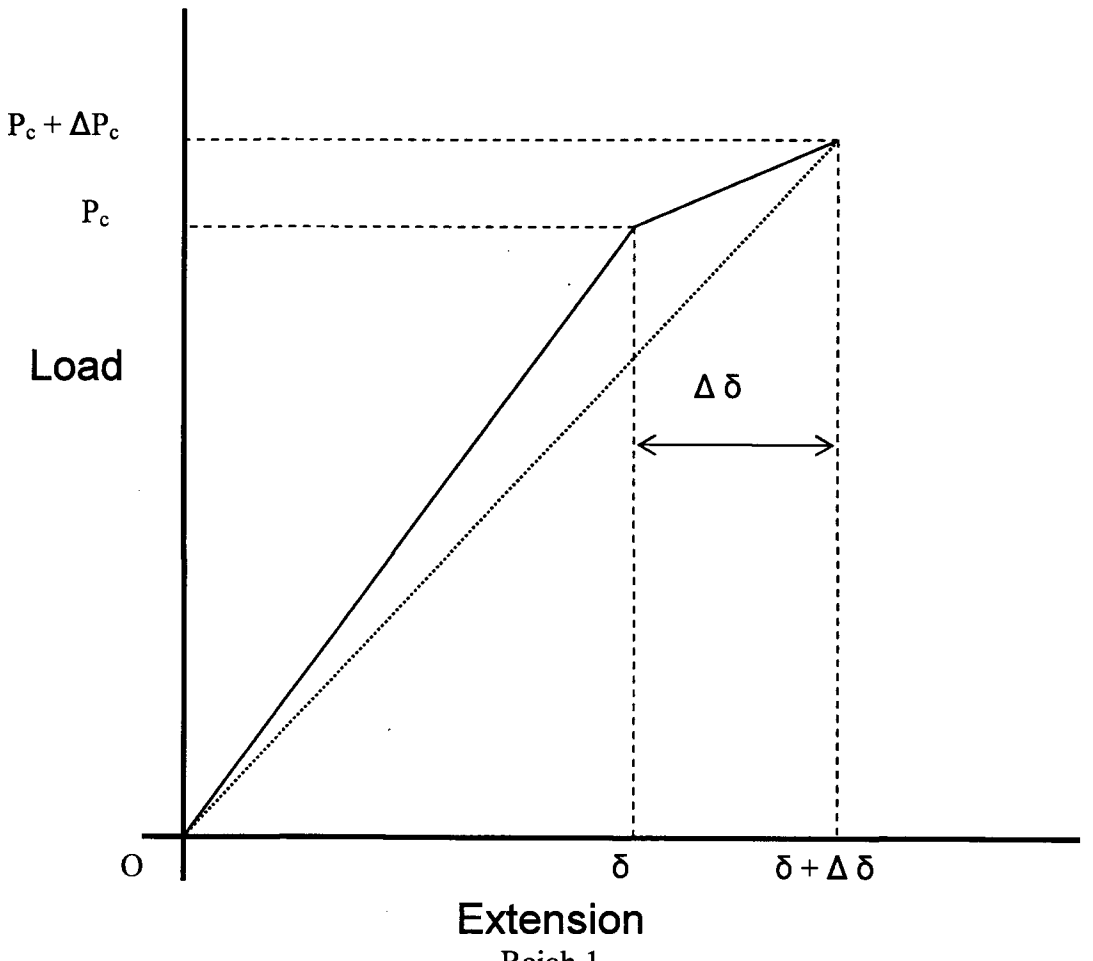
(5 markah)

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

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

dengan

P_c = Beban rekahan
B = Ketebalan
C = Komplians
a = Panjang retak

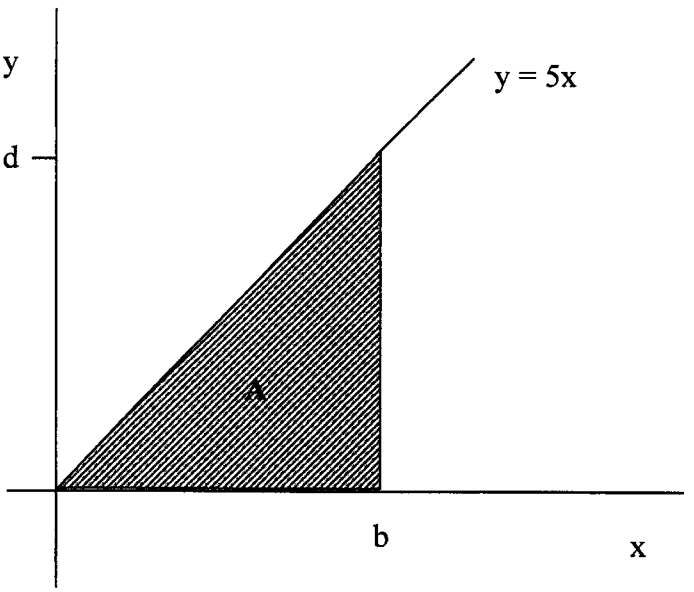


Rajah 1

(15 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

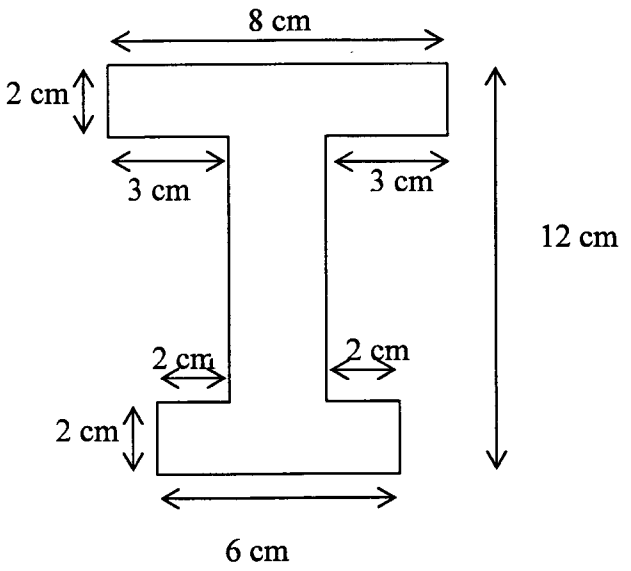


Rajah 2

(10 markah)

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

(i) Kordinat pusat bentuk
(ii) Momen inersia terhadap paksi x, I_x.

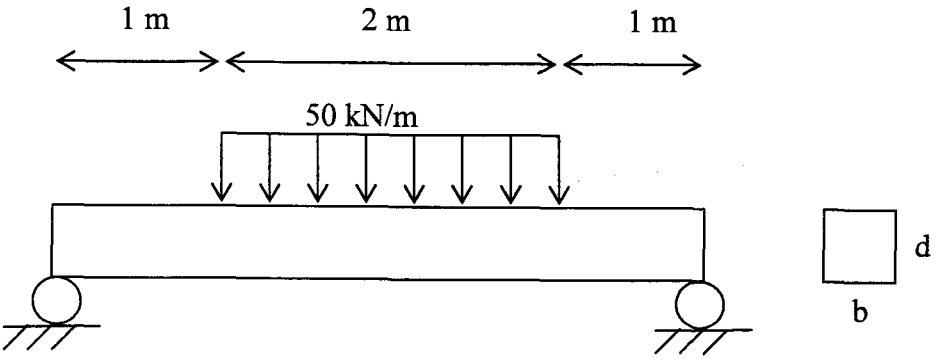


Rajah 3

(10 markah)

3. Suatu bim dibebankan dengan daya tertabur di bahagian tengahnya seperti yang ditunjukkan dalam Rajah 4 dan spesifikasi bim dalam seperti berikut

$F_{bo} = 8500\ kN/m^2$ (tegasan lenturan izin)
$F_{vo} = 750\ kN/m^2$ (tegasan ricih izin)
$b = 20\ cm$ (lebar bim)



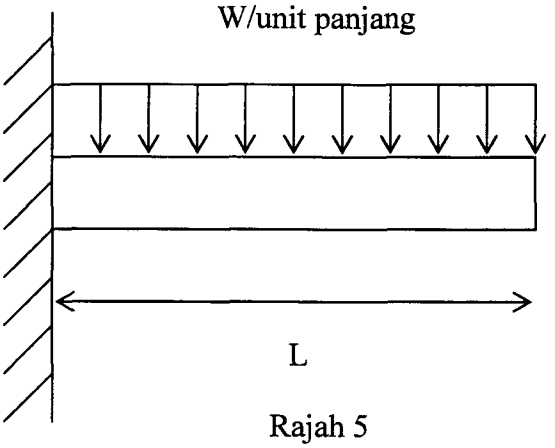
Rajah 4

Tentukan kedalaman/ketebalan (d) minimum 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 = 1.15 (factor tempoh masa pengenaan beban)
L = 20ft (panjang bim)
S = 2ft (jarak antara bim)
dl = 20Ibf/ft^2 (beban mati)
ll = 10 Ibf/ft^2 (beban hidup)
F_{bo} = 1500 Ibf/in^2 (tegasan lenturan izin)
F_{vo} = 750 Ibf/in^2 (tegasan ricih izin)
E = 1800000 Ibf/in^2 (modulus kekenyalan)
P_o = L/180 (pesongan izin)

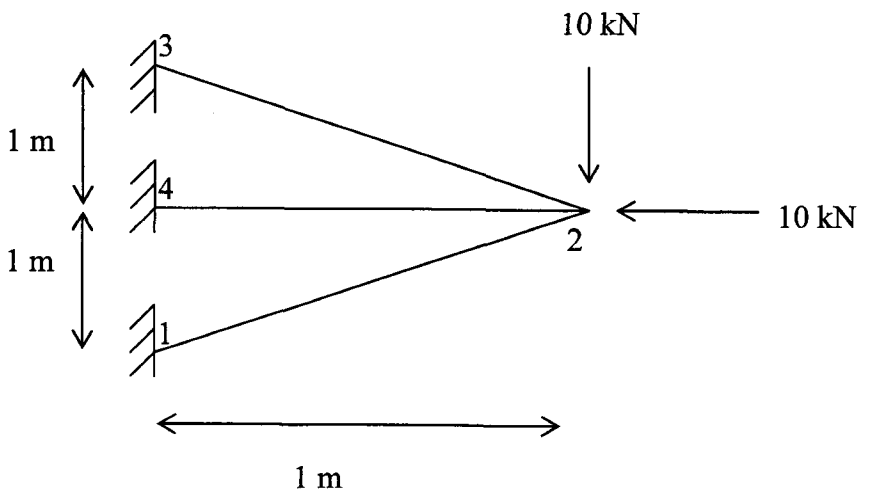
Uji kesesuaian keratan yang bersaiz 1.5 in x 9.25 in

(20 markah)

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

(i) Sesaran setiap nod
(ii) Daya tindak balas pada nod 1, 3 and 4
(iii) Daya paksian setiap elemen

Elemen	E	A
12	1	1
23	1	1
24	1	1



Rajah 6

(20 markah)

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)
$F_r = 3M/2R_mA$ (tegasan jejarian sebenar)

1. (a) *Define equilibrium toughness and impact toughness.*

(5 marks)

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

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

where

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

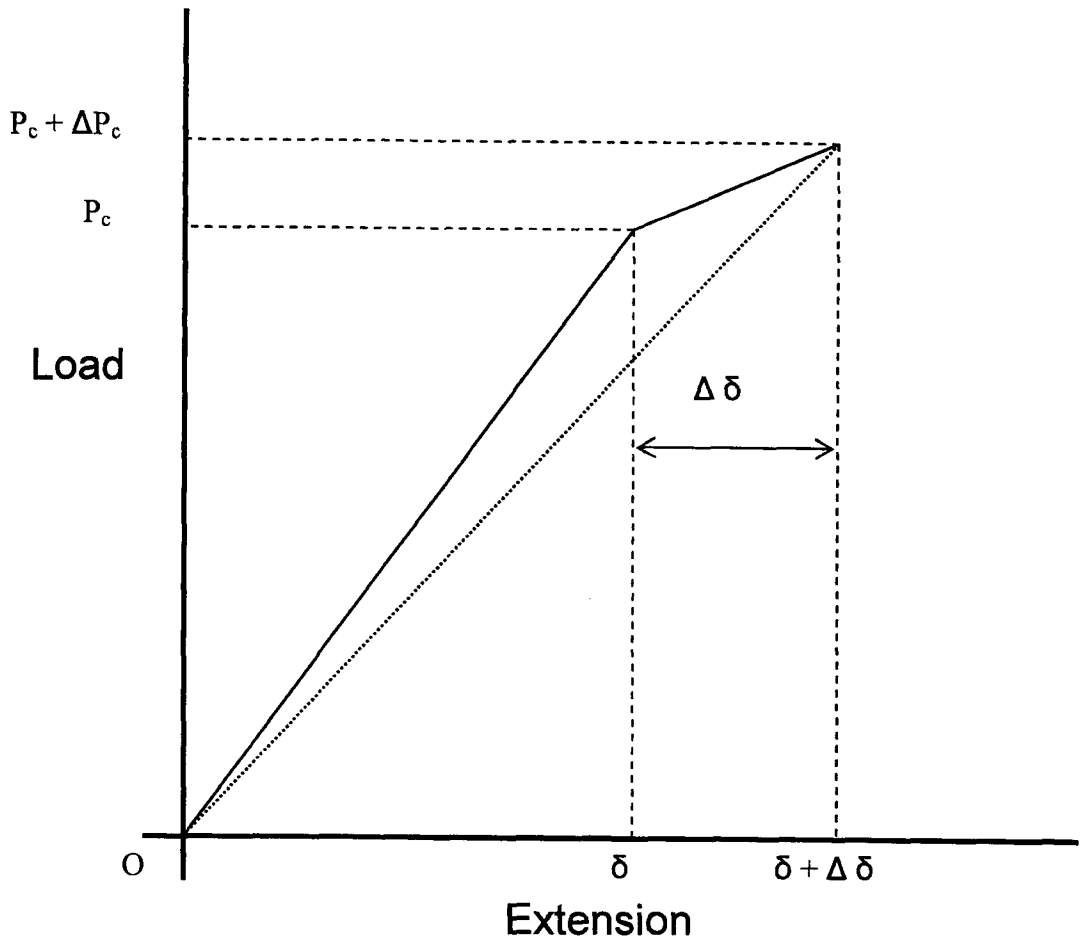


Figure 1

(15 marks)

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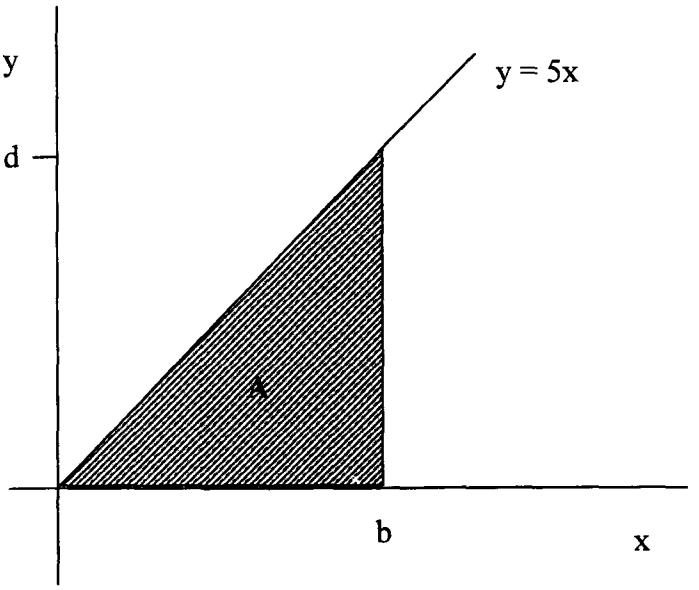
2. *(a)* *For Figure 2, determine the following using integration method.*

(i) *the area, A*
(ii) *the centroid*
(iii) *the moment of inertia, I_x*



(10 marks)

(b) *For the composite area shown in Figure 3, determine*

(i) *the coordinate of the centroid*
(ii) *the moment of inertia with respect to the x-axis, I_x.*

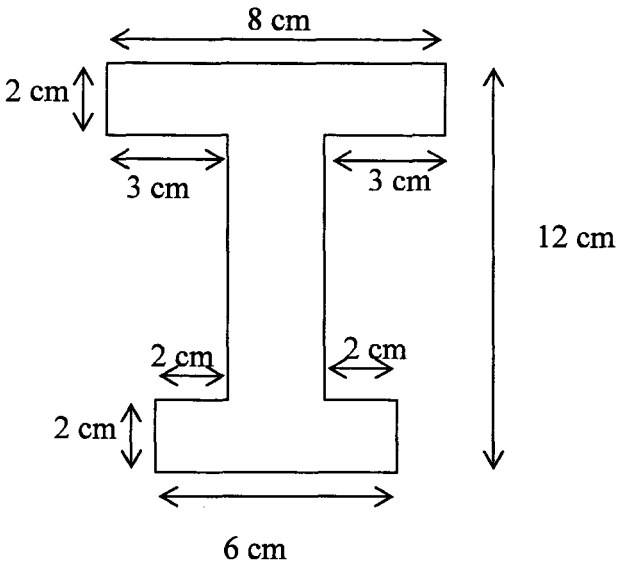


Figure 3

(10 marks)

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

$F_{bo} = 8500\ kN/m^2$
$F_{vo} = 750\ kN/m^2$
$b = 20\ cm$

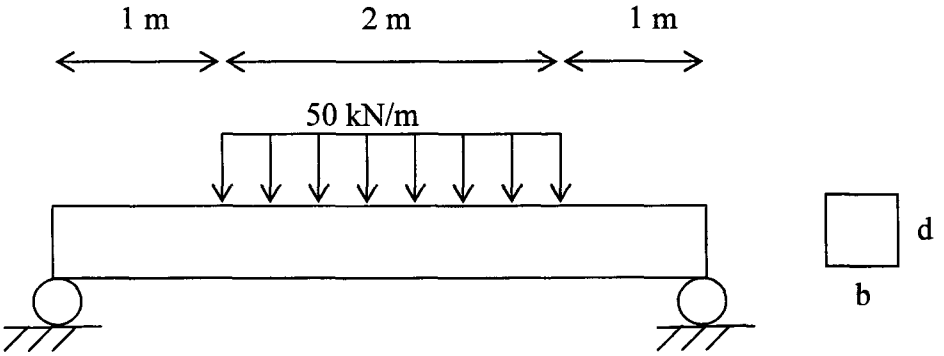


Figure 4

Determine the allowable minimum depth (d)

(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

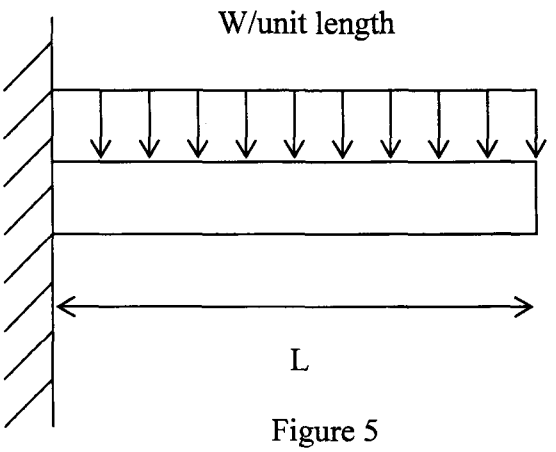


Figure 5

(20 marks)

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

C_d = *1.15 (load duration factor)*
L = *20ft (length of the beam)*
S = *2ft (space between beams)*
dl = *20Ibf/ft^2 (dead load)*
ll = *10 Ibf/ft^2 (live load)*
F_{bo} = *1500 Ibf/in^2 (allowable bending stress)*
F_{vo} = *750 Ibf/in^2 (allowable shear stress)*
E = *1800000 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*
   (a) the displacement of each node
   (b) the reaction force at node 1, 3 and 4
   (c) the axial force in each element

Element	E	A
12	1	1
23	1	1
24	1	1

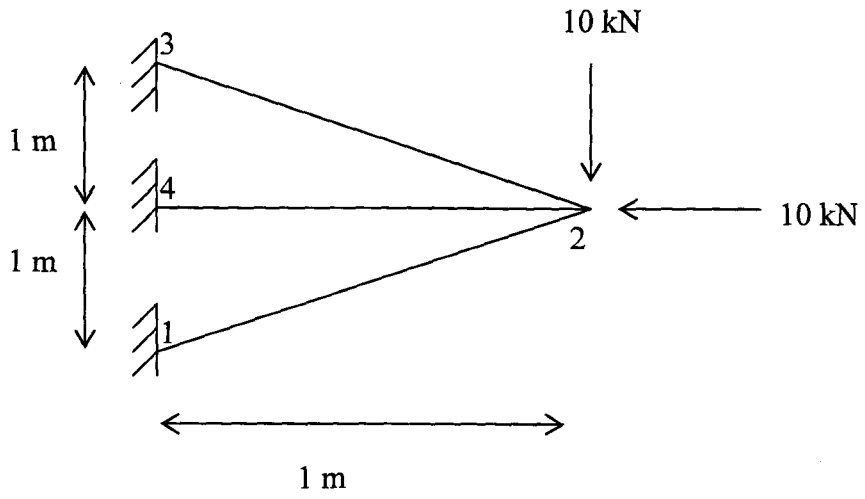


Figure 6

(20 marks)

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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 = $3M/2R_mA$ *(actual radius stress)*

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