Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016

COURSE NAME	:	ADVANCED STRUCTURE ANALYSIS
COURSE CODE	:	BFS 40103
PROGRAMME	:	BFF
EXAMINATION DATE	:	JUNE / JULY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) An indeterminate frame shown in **FIGURE Q1(a)** is subjected to a horizontal force of 50 kN at D and uniformly distributed load of 20 kN/m along member BC. EI of member AB is two times of member BC.

(i) Determine the reaction of support A. Use force method.

(12 marks)

(ii) Sketch the shear force and bending moment diagrams.

(6 marks)

(b) **FIGURE Q1(b)** shows a simply supported beam carrying three concentrated loads. Determine the displacement at each concentrated load.

(7 marks)

Q2 (a) For the spring system shown in **FIGURE Q2(a)**, form the global stiffness matrix. The stiffness for spring 1, 2 and 3 is 100 N/mm, and spring 4 is 200 N/mm.

(8 marks)

(b) The two-member truss shown in **FIGURE Q2(b)** is pinned at node 1 and 3. The truss is subjected to a vertical concentrated load of 5 kN at node 2. Both members consist of hollow aluminum tubes having 90 mm outside diameter and 5 mm wall thickness. Assuming that Young's Modulus E = 65 GPa.

(i) Develop the structure stiffness matrix.

(15 marks)

(ii) What do think of the structure stiffness matrix if node 1 is fixed?

(2 marks)

Q3 A pin-connected truss ABC as shown in **FIGURE Q3** is composed of two bars of the same material and cross sectional area. A load P is applied at joint B at an angle Θ from the prolongation of line AB. The angle Θ may be varied from 0 to 90^{o}. Assuming that collapse occurs by buckling of the bars,

(a) Obtain a formula for the angle Θ such that the load P will be a maximum.

(23 marks)

(b) What do think of the structural stability of the truss if additional bar is connected between joint A and C?

(2 marks)

Q4 A rectangular orthotropic slab with an opening is shown in **FIGURE Q4**. Three sides AB, BD and CD are pinned, and side AC is fixed. The slab is carrying a 3 m height brickwall along both long edges of the opening. Given the following data:

Slab thickness	=	200 mm
Finishes	=	1.5 kN/m^2
Density of concrete	=	24 kN/m^3
Imposed load	=	5 kN/m^2
Brickwall	=	2.6 kN/m^2

(a) Based on the yield line pattern shown in the figure and using characteristics loads, evaluate the collapsed moment for each direction.

(23 marks)

(b) Predict the yield line pattern if the slab is solid (opening is removed).

(2 marks)

Q5 (a) Identify and sketch the possible collapse mechanisms for the structures shown in **FIGURE Q5(a)**.

(8 marks)

(b) The portal frame shown in **FIGURE Q5(b)** is subjected to a vertical concentrated load of 20 kN at C. All members have the same plastic moment, M_P.

(i) Determine the plastic moment. Ignore the sway mechanism.

(15 marks)

(ii) If another horizontal load is acting at B, what are the collapse mechanisms need to be taken into consideration?

(2 marks)

- END OF QUESTIONS-

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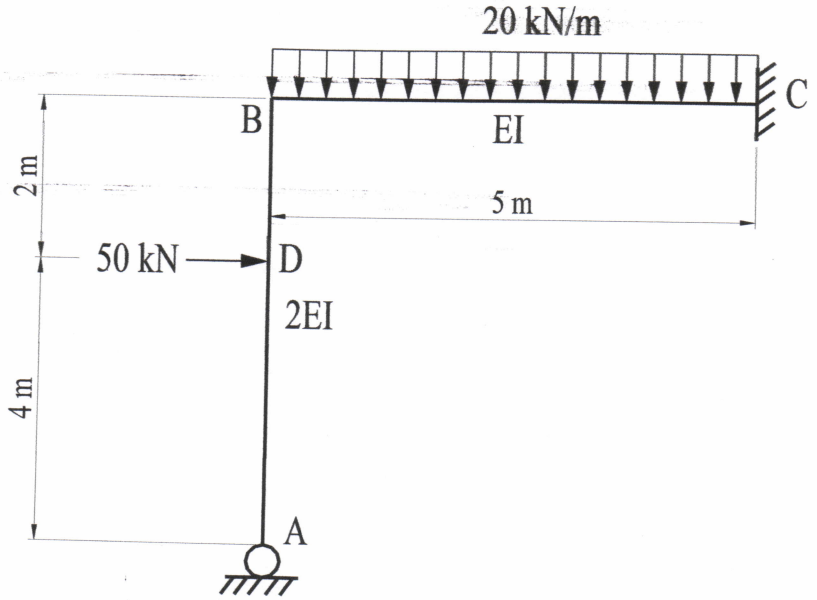

FIGURE Q1(a)

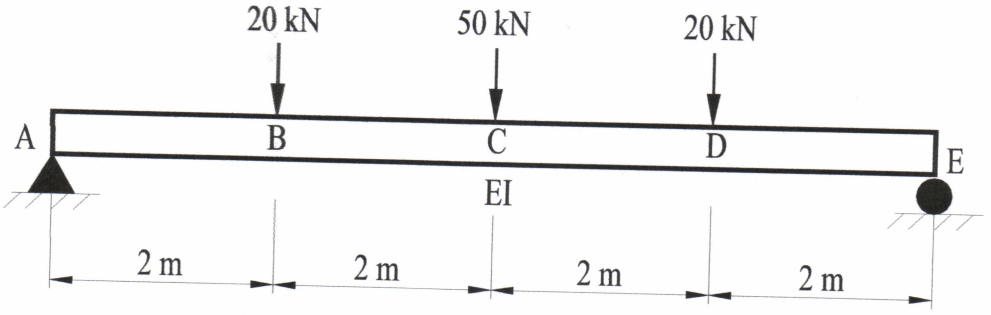

FIGURE Q1(b)

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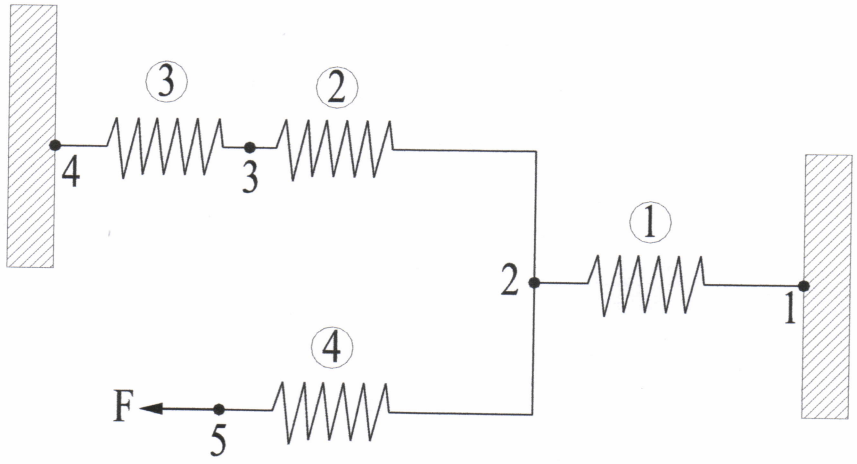

FIGURE Q2(a)

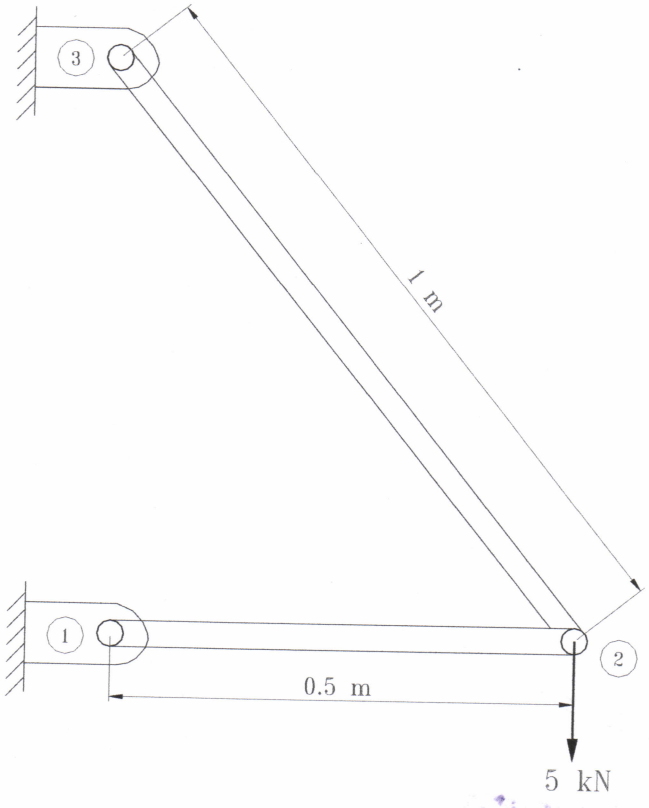

FIGURE Q2(b)

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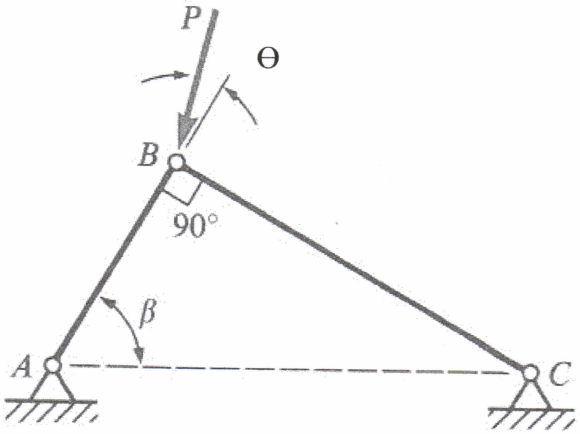

FIGURE Q3

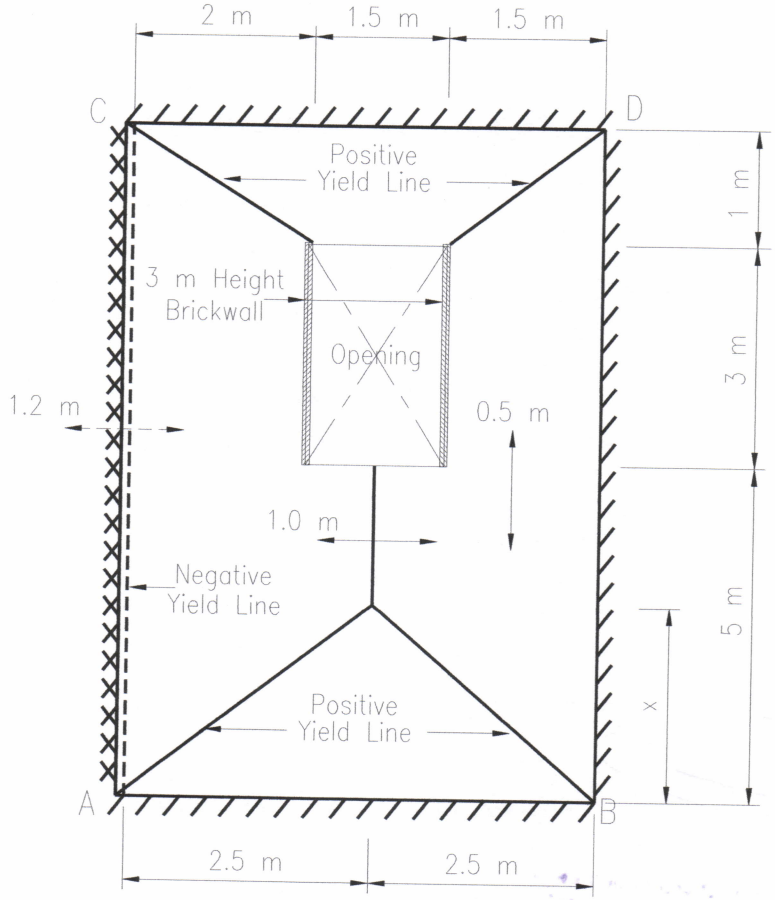

FIGURE Q4

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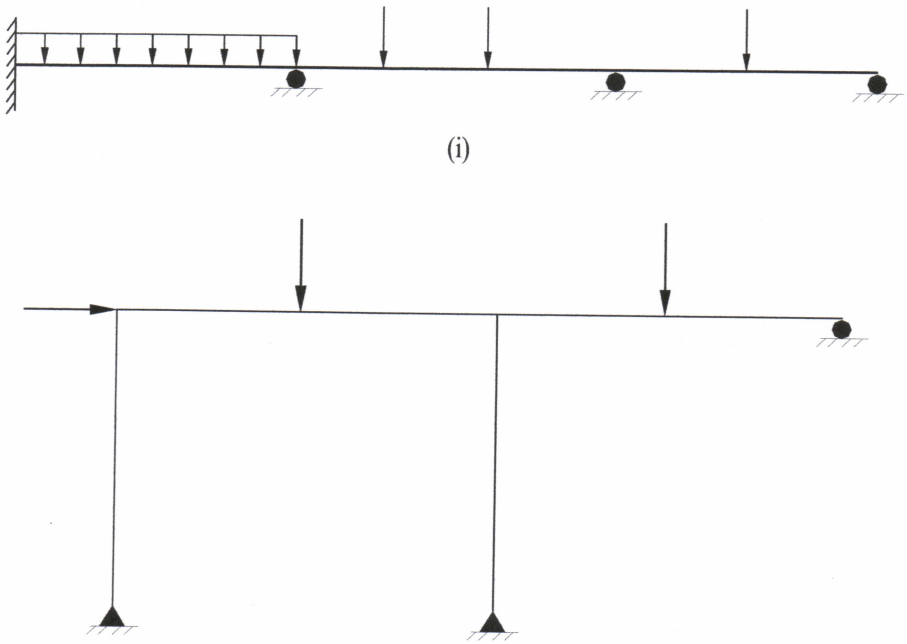

FIGURE Q5(a)

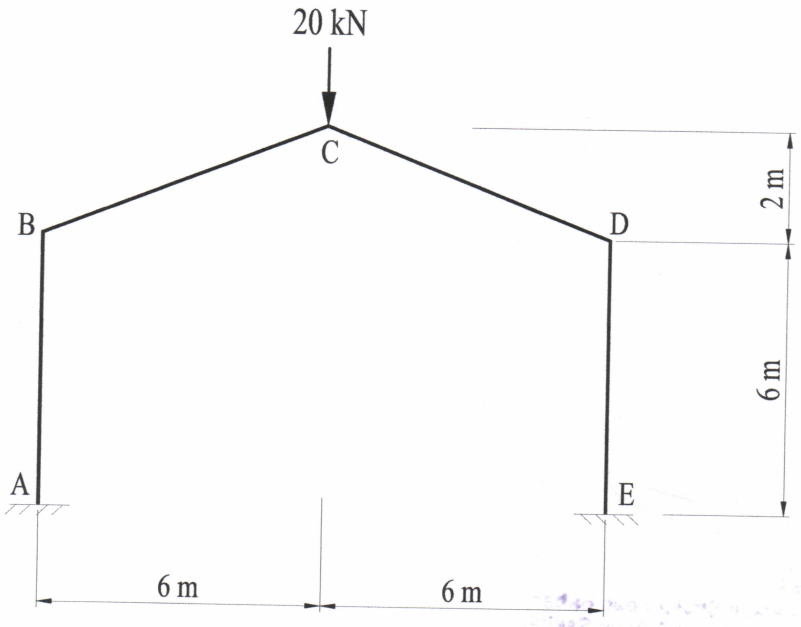

FIGURE Q5(b)

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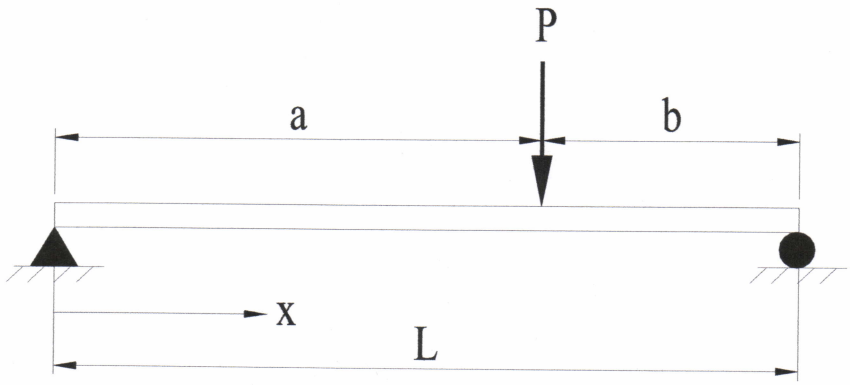
Beam Deflection Equations



For $0 \le x \le a$:

Deflection, $y = \frac{Pb}{6EIL}(x^3 + b^2x - L^2x)$

For $a \le x \le L$:

Deflection, $y = \frac{Pa(L-x)}{6EIL}(x^2 + a^2 - 2L\,x)$

Member Stiffness Matrix for Truss

$$\mathbf{k} = \frac{AE}{L}\begin{array}{c} \begin{matrix} N_x & N_y & F_x & F_y \end{matrix} \\ \begin{bmatrix} \lambda_x^2 & \lambda_x\lambda_y & -\lambda_x^2 & -\lambda_x\lambda_y \\ \lambda_x\lambda_y & \lambda_y^2 & -\lambda_x\lambda_y & -\lambda_y^2 \\ -\lambda_x^2 & -\lambda_x\lambda_y & \lambda_x^2 & \lambda_x\lambda_y \\ -\lambda_x\lambda_y & -\lambda_y^2 & \lambda_x\lambda_y & \lambda_y^2 \end{bmatrix} \end{array} \begin{matrix} N_x \\ N_y \\ F_x \\ F_y \end{matrix}$$

Where,

$$\lambda_x = \frac{X_F - X_N}{L}$$

$$\lambda_y = \frac{y_F - y_N}{L}$$