UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	STRUCTURAL ANALYSIS
COURSE CODE	:	BFC21403
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2020
DURATION	:	6 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

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Q1 **Figure Q1** shows a truss that is pinned supported at A and roller supported at B and C. The truss is subjected to inclined load of 100 kN and 50 kN at D and E, respectively. The cross section area for the truss member is 400 mm² and the Young's Modulus for all truss members is 200 kN/mm².

(a) Prove the truss is statically external indeterminate.

(3 marks)

(b) Determine the virtual force for all internal member when support B is taken as redundant (redundant force acting downward).

(3 marks)

(c) Based on **Q1(b)** calculate the internal forces of the truss member using alternative method.

(19 marks)

Q2 **Figure Q2** shows a continuous beam fixed at both ends A and D. The beam carries two uniformly distributed load of 8 kN/m and 10 kN/m on span AB and CD, respectively. The length of the span is shown in the figure and EI is constant.

(a) Calculate the Stiffness, Distribution Factor (DF) and Fixed End Moment for each span of the beam.

(8 marks)

(b) Determine the internal moments at each support of the beam.

(7 marks)

(c) Calculate the reaction force at each support of the beam.

(5 marks)

(d) Draw the shear force and bending-moment diagram for the entire beam.

(5 marks)

Q3 (a) Briefly discuss the reason for the importance of influence lines in the designs of the heavy structures such as bridges, industrial crane rails, conveyor and other structures where loads move across their span.

(2 marks)

(b) A steel frame has been designed and will be installed at a factory. The designed frame with pin support at point A and roller support at Point B is shown in **Figure Q3(b)**. As a junior structural engineer, you are responsible to prepare the monthly report for the management. In the report, you should explain and calculate;

(i)   The influence line for the shear at Point C.

(6 marks)

(ii)   Maximum shear if concentrated load of 20 kN and 30 kN are applied at Point C and D, respectively.

(3 marks)

(c)   The Warren truss bridge is designed to cross Sungai Kampung Nipah with a pin and roller supports at point A and E, respectively as shown in Figure Q3(c). The maximum vehicle size that can crossed the bridge is limited up to 3-axle rigid truck only.

(i)   As a structural engineer, interpret the influence line for member FC to the client.

(4 marks)

(ii)   The client is happy with your presentation of influence line member FC, however the client is curious about the shear of member FC when a series of three concentrated loads from truck are moving from right to left. Calculate and summarize the shear for member FC to convince the client.

(10 marks)

Q4   (a)   Plastic hinge is the basis in plastic analysis. Explain briefly how plastic hinge is developed in a beam with point load acting on its mid-span.

(5 marks)

(b)   **Figure Q4(b)** shows a continuous beam with point load acting at 4 m from point A, 2 m from point D. Uniform load of 10 kN/m and 30 kN/m each is acting on span AB and span BC, respectively.

(i)   Draw all the possible mechanisms

(4 marks)

(ii)   Calculate the maximum plastic moment, M_p. Given: $W_1 = 10$ kN/m, $P_1 = 45$ kN, $W_2 = 30$ kN/m and $P_2 = 60$ kN, M_p is constant for all beam's spans.

(16 marks)

– END OF QUESTIONS –

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FIGURE Q1
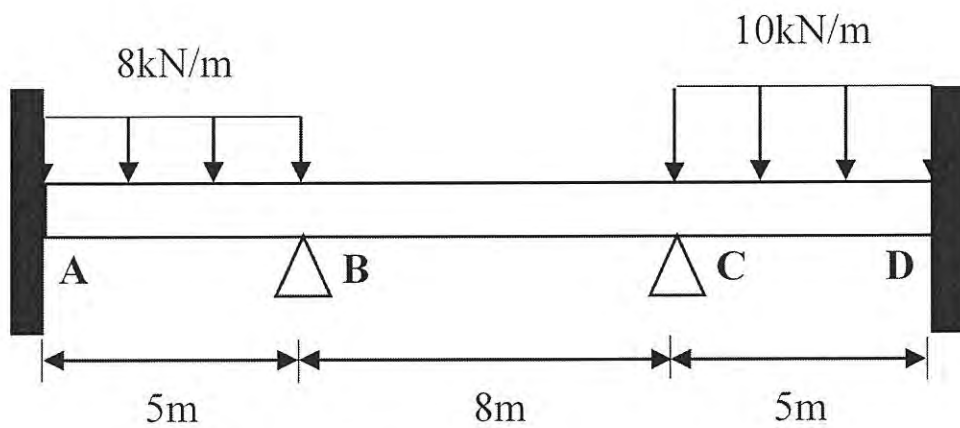
FIGURE Q2

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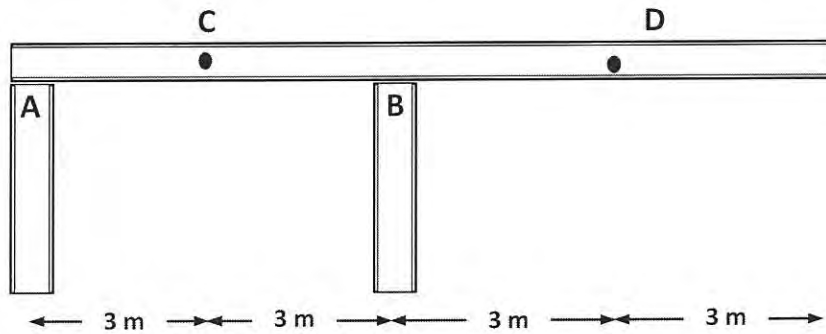
FIGURE Q3(b)

FIGURE Q3(c)

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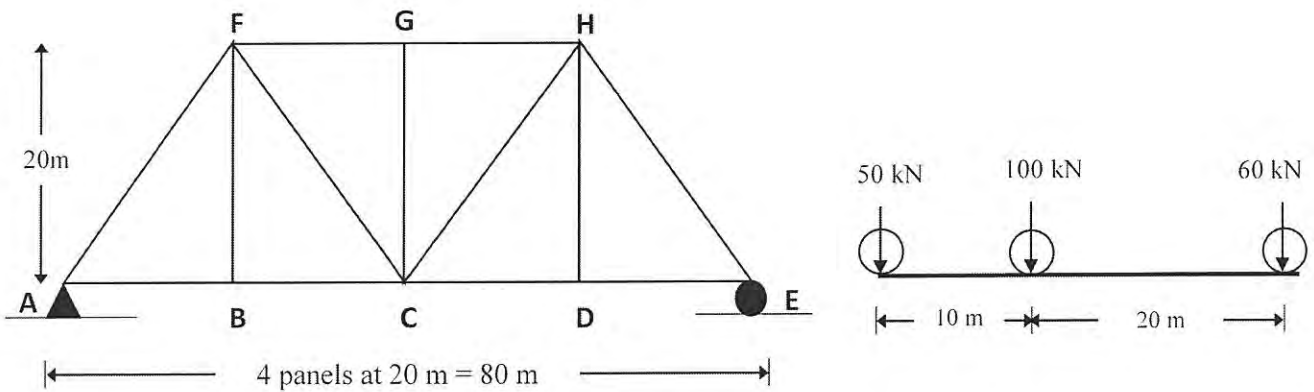
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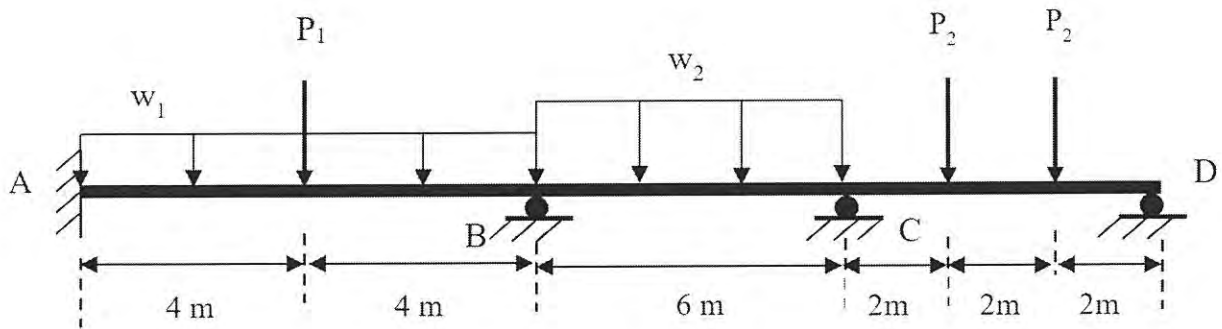
FIGURE Q4(b)

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Fixed End Moment

$(FEM)_{AB} = \dfrac{PL}{8}$, $(FEM)_{BA} = \dfrac{PL}{8}$

$(FEM)_{AB} = \dfrac{wL^2}{12}$, $(FEM)_{BA} = \dfrac{wL^2}{12}$

$(FEM)_{AB} = \dfrac{Pb^2a}{L^2}$, $(FEM)_{BA} = \dfrac{Pa^2b}{L^2}$

$(FEM)_{AB} = \dfrac{11wL^2}{192}$, $(FEM)_{BA} = \dfrac{5wL^2}{192}$

$(FEM)_{AB} = \dfrac{2PL}{9}$, $(FEM)_{BA} = \dfrac{2PL}{9}$

$(FEM)_{AB} = \dfrac{wL^2}{20}$, $(FEM)_{BA} = \dfrac{wL^2}{30}$

$(FEM)_{AB} = \dfrac{5PL}{16}$, $(FEM)_{BA} = \dfrac{5PL}{16}$

$(FEM)_{AB} = \dfrac{5wL^2}{96}$, $(FEM)_{BA} = \dfrac{5wL^2}{96}$

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