Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	STRUCTURAL STEEL AND TIMBER DESIGN
COURSE CODE	:	BFC 43003
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	PART A: ANSWER **ALL** QUESTIONS PART B: ANSWER ONLY **TWO (2)** QUESTIONS. OPEN BOOK EXAMINATIONS

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

PART A: ANSWER **ALL** QUESTIONS

Q1 **Figure Q1** is part of floor plan for 2 storey steel building which has been loaded by characteristic dead load of 5.0 kN/m^2 and characteristic imposed load of 4.0 kN/m^2. The steel section is grade S275. Based on beam B/1-3, calculate all the followings:

(a) Loading supported by beam that ignores its self-weight, shear force and bending moment for beam.

(7 marks)

(b) If the beam is simply supported with lateral resistant between the span and beam size is 457 x 152 x 82 UB, check the section classification, shear resistance, bending moment resistance and vertical deflection.

(15 marks)

(c) If the moment resistance checked in **Q1(b)** is not adequate, suggest a solution.

(3 marks)

Q2 (a) List **THREE (3)** steel sections suitable to be used as column.

(3 marks)

(b) A pinned ended steel column 305 x 305 x 97 UC with grade S275 as shown in **Figure Q2** is loaded with factored load of 2500 kN. A tie beam at mid height of the column provides restraint in y-y axis.

(i) Check the classification of the section

(4 marks)

(ii) Check the adequacy of the column according to BS EN 1993-1-1.

(15 marks)

(c) Explain why CHS is the best section to be used as column.

(3 marks)

PART B: ANSWER **TWO (2)** QUESTIONS ONLY

Q3 (a) In roof design, actions from purlins are transferred to the joints as concentric point load. State **FOUR (4)** conditions where additional load may occur on roof truss.

(2 marks)

(b) **Figure Q3** shows plane truss of a roof in a building.

(i) Find internal force in member AF and member AC respectively.

(3 marks)

(ii) Check the cross-sectional classification of a 45 x 30 x 4L S275 subjected to pure compression.

(3 marks)

(iii) Conduct verification check of member AF if shorter leg of steel section 45 x 30 x 4L S275 is connected to gusset plate.

(7 marks)

(iv) Conduct verification check of member AC. Take out-of-plane of the truss is critical.

(10 marks)

Q4 (a) **Figure Q4 (a)** shows double-lap bolted steel joint and the respective steel plate is given in **Figure Q4 (b)**.

(i) Bolted joints can fail in bolt shear, tearing of plates and plate bearing. Provide sketches of each of these failure modes.

(6 marks)

(ii) If 20 kN of tensile force is applied to both steel plate edges in Figure **Q4(a)**, what is the likely failure modes that may occur. What should be provided by engineer in order to enhance the resistance of the failure modes.

(8 marks)

(iii) Check the joint efficiency as compared to un-notched plate.

(4 marks)

(b) The ultimate stress of steel plate is given as 410 MPa with factor of safety of 3, calculate the force resisted by the welded joints. Take weld thickness and weld length as 1 mm and 20 mm respectively.

(7 marks)

Q5 (a) Consider a timber column with an axial load demand of 1000 kN. The height of the column is 3 m and pin-ended. The column supports a floor load above it. The proposed material for the column is SG1 timber, Dry and from Select grade. The proposed size is a Double 200 × 200 nominal size (finished size 194 × 194). Using Permissible Stress Design method recommended in MS544 Part 2, attempt the following questions:

(i) Calculate the k_8 factor for the proposed column.

(6 marks)

(ii) Check whether the proposed column is adequate to sustain the 1000 kN axial load demand.

(6 marks)

(b) Consider a series of tie members supporting a roof. The tie members are spaced at 600 mm centres with end moment connection of 20 kNm at both ends. Being a tie member, it is under tension stress. With end moments at the connections, it is also subjected to bending. The proposed tie member is timber from SG1, Dry, Select Grade with size 100 × 200 nominal size (finished size 95 × 194). Calculate the largest tensile force in kN each tie member can sustain.

(13 marks)

– END OF QUESTIONS–

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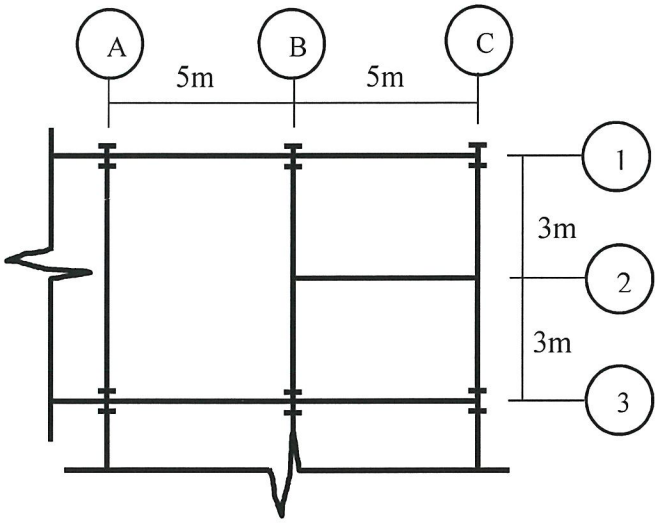

FIGURE Q1

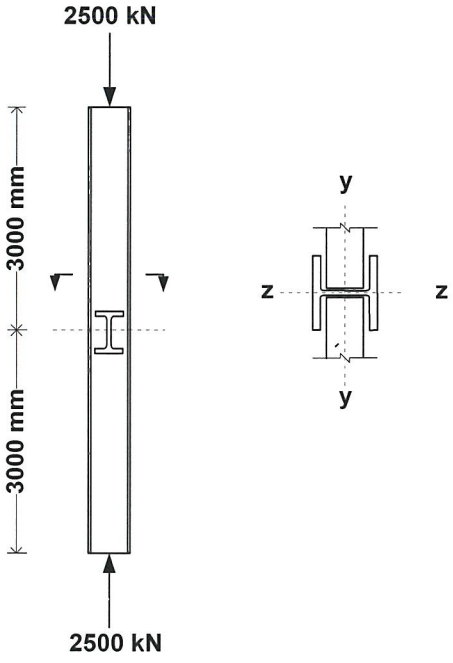

FIGURE Q2

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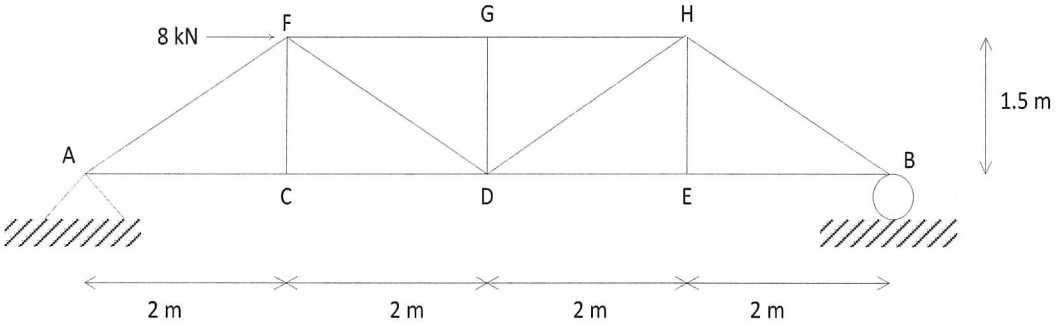

FIGURE Q3

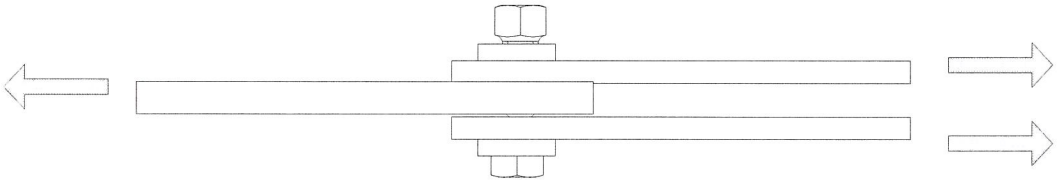

FIGURE Q4 (a)

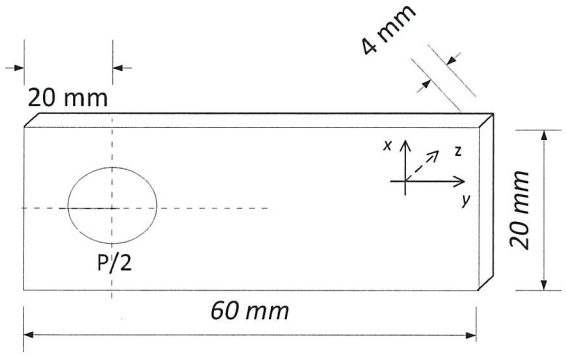

FIGURE Q4 (b)

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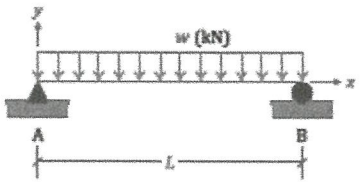
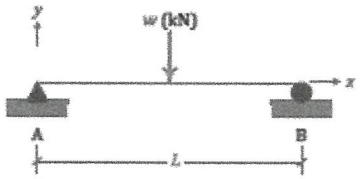
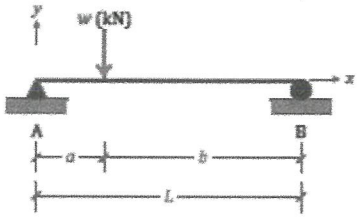
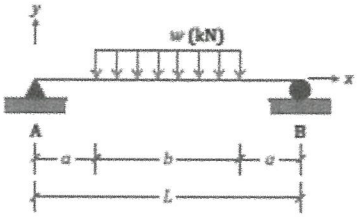
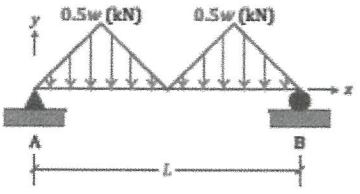
Table 3.4 Deflection formula

	R_A (kN)	R_B (kN)	M_{max} (kNm)	δ_{max} (m)
(a) 	$\frac{W}{2}$		$\frac{WL}{8}$	$\frac{5}{384}\times\frac{WL^3}{EI}$
(b) 	$\frac{W}{2}$		$\frac{WL}{4}$	$\frac{1}{48}\times\frac{WL^3}{EI}$
(c) 	$\frac{Wb}{L}$	$\frac{Wa}{L}$	$\frac{Wab}{L}$	$\frac{1}{48}\times\frac{WL^3}{EI}\times\left(\frac{3a}{L}-\frac{4a^3}{L^3}\right)$
(d) 	$\frac{W}{2}$		$W\left(\frac{a}{2}+\frac{b}{8}\right)$	$\frac{1}{48}\times\frac{W}{EI}\times\left(8L^3-4Lb^2+b^3\right)$
(e) 	$\frac{W}{2}$		$\frac{WL}{8}$	$\frac{1}{73.14}\times\frac{WL^3}{EI}$

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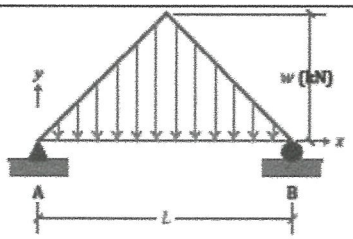
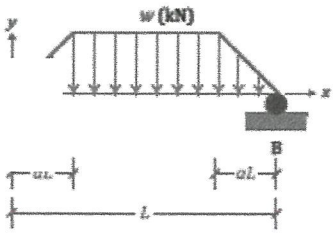
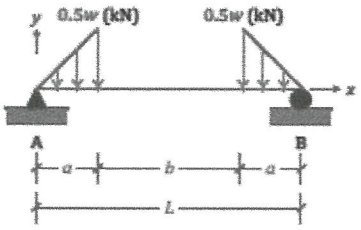
	R_A (kN)	R_B (kN)	M_{max} (kNm)	δ_{max} (m)
(f) 	$\frac{WL}{4}$		$\frac{WL^2}{12}$	$\frac{1}{120}\times\frac{WL^2}{EI}$
(g) 	$0.5W(L-a)$		$\frac{3-4a^2}{24(1-a)}WL$	$\frac{(4a^2-5)^2 WL^3}{1920(1-a)EI}$ (occurs at mid span)
(h) 	$\frac{W}{2}$		$\frac{Wa}{3}$	$\frac{w}{120EI}(16a^3+20ab+5b^2)$

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