Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	STRUCTURAL STEEL AND TIMBER DESIGN
COURSE CODE	:	BFC 43003
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	1. OPEN BOOK EXAMINATION 2. PART A: ANSWER **ALL** QUESTIONS PART B: ANSWER **TWO (2)** QUESTIONS ONLY

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

PART A: ANSWER ALL QUESTIONS

Q1 **Figure Q1** shows the typical floor plan of a two storey building structures. The pre-cast concrete floor is designed to carry an imposed load of 4.5 kN/m^2 and ceiling finishes of 1 kN/m^2.

(a) Calculate the design loads acting on beams 1-2/A and 2-3/A by assuming the beam weight is 70 kg/m-run. For simplicity assume gravitational constant, g_n = 10 m/s^2.

(5 marks)

(b) Propose the minimum size for beam 2-3/A.

(5 marks)

(c) Check the suitability of section 356 x 127 x 33 UKB grade S355 for beam 1-2/A to carry the loads by conducting the following verifications:

i) Design shear resistance, $V_{c,Rd}$

(8 marks)

ii) Bending moment resistance, $M_{c,Rd}$.

(6 marks)

(d) The size of column B/1 is given as 152 x 152 x 30 UKC S355. Solve the following questions:

i) Classify the section of the column.

(4 marks)

ii) Calculate the nominal moments due to eccentricity of beams 1/A-B, 1/B-C and 1-2/B in simple construction design method. Height of column is 4.0 m and is pinned connected at the top and bottom. Given:

Reaction from Beam 1/A-B = 45.7 kN
Reaction from Beam 1/B-C = 20.3 kN
Reaction from Beam 1-2/B = 122.8 kN

(4 marks)

iii) Evaluate the capacity of the column based on simple construction approach. Use M_{cr} = 185.5 kN.

(18 marks)

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PART B: ANSWER ANY TWO (2) QUESTIONS ONLY

Q2 The simply supported roof truss is subjected to dead, live and wind loads as shown in **Figure Q2(a)**. Design data are given as follows:

Span	= 15 m
Truss spacing	= 6 m

(a) Perform section classification for a section made from double angle 2/90 x 90 x 10L back to back in steel grade S275.

(4 marks)

(b) Check the capacity of the bottom chord member (1-2) where the maximum ultimate tension force is 484.4 kN. Use double angle 2/90 x 90 x 10L back to back with a 10 mm gap in steel grade S275 using a single row of 16 mm diameter bolt. The cross-section of the member is as shown in **Figure Q2(b)**.

(6 marks)

(c) Check the capacity of the diagonal chord member (3-1) where the maximum ultimate compression force is 661 kN. Use double angle 120 x 120 x 10L with 10 mm gap in steel grade S275.

(15 marks)

Q3 Beam to column flexible end plate connection as shown in **Figure Q3** is the most common type of simple connection and designed to transmit load P from the beam to the column. Given:

Beam Size	=	305 x 165 x 54 UKB
Beam length	=	6 m
Permanent action	=	50 kN
Variable action	=	60 kN
Endplate length, h_p	=	300 mm
Endplate width, b_p	=	250 mm
Endplate thickness, t_p	=	10 mm
Steel grade	=	S355
Bolt size	=	M16 grade 8.8

(a) Calculate the factored design load, P from the beam for the connection.

(2 marks)

(b) Propose the spacing of bolt. Consider the end distance and edge distance that comply with the minimum and maximum requirement of bolt arrangement.

(4 marks)

(c) Verify the suitability of given bolt size of the connection if force P is located 150mm from the column face.

(10 marks)

(d) Propose weld size and design the welded connection.

(9 marks)

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Q4 (a) Describe **FIVE (5)** factors that affect the strength and durability of timber.

(5 marks)

(b) The nominal 125 x 200 mm strength group 4 (SG4) sawn standard grade timber under dry condition is to be used as a beam. The beam is subjected to a vertical load of 30kN as shown in **Figure Q4**. Check the adequacy of the beam for bending and shear. Ignore the weight of beam.

(11 marks)

(c) A 5m height 150 x 250mm Meranti timber column with standard grade at 19% of moisture content is required to support a roof load of 350 kN. If the timber column is used under medium term, design the column and verify its stability. Given $K_8 = 0.6962$.

(9 marks)

–END OF QUESTIONS–

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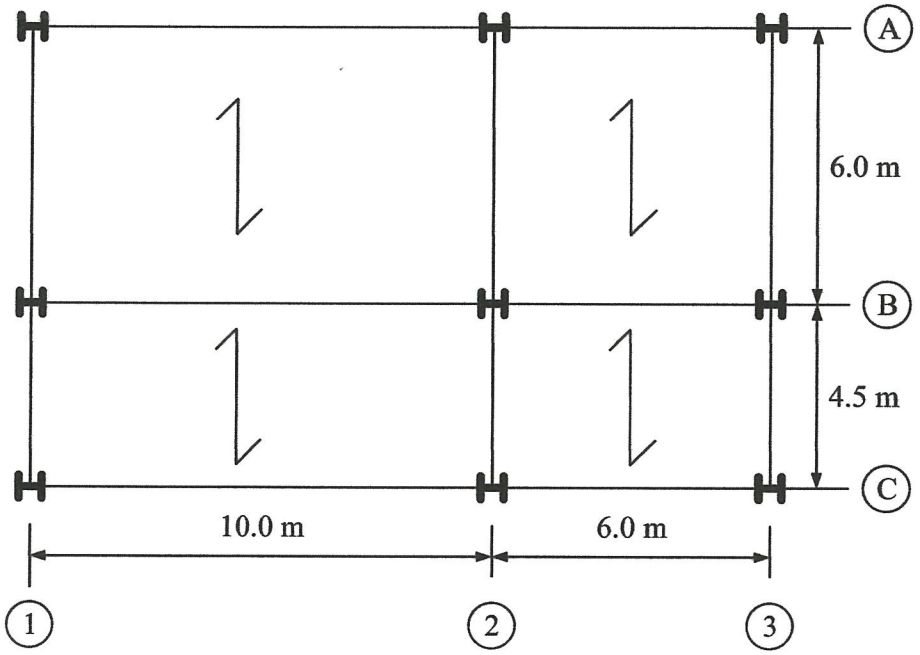

FIGURE Q1

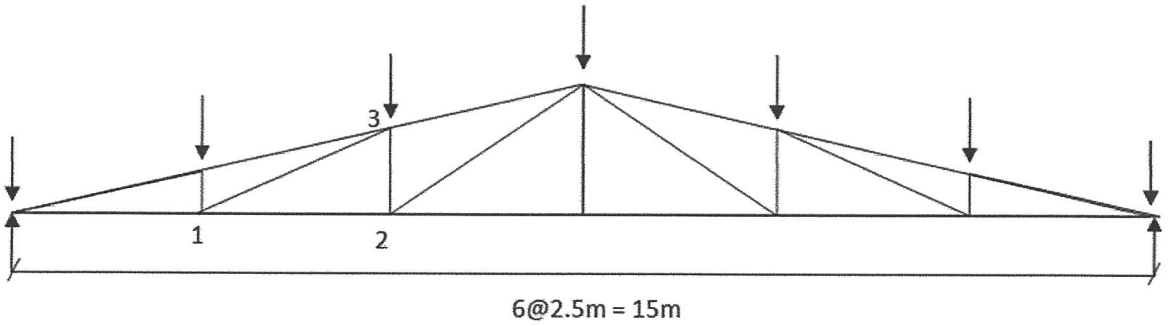

FIGURE Q2(a)

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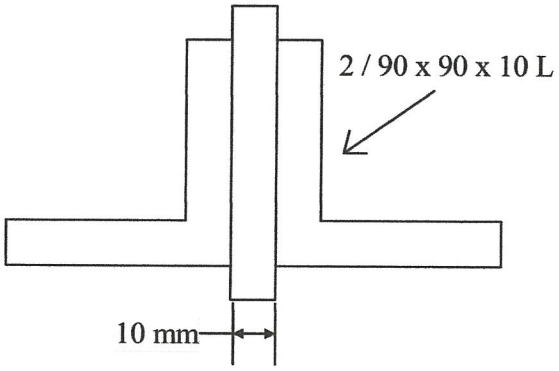

FIGURE Q2(b)

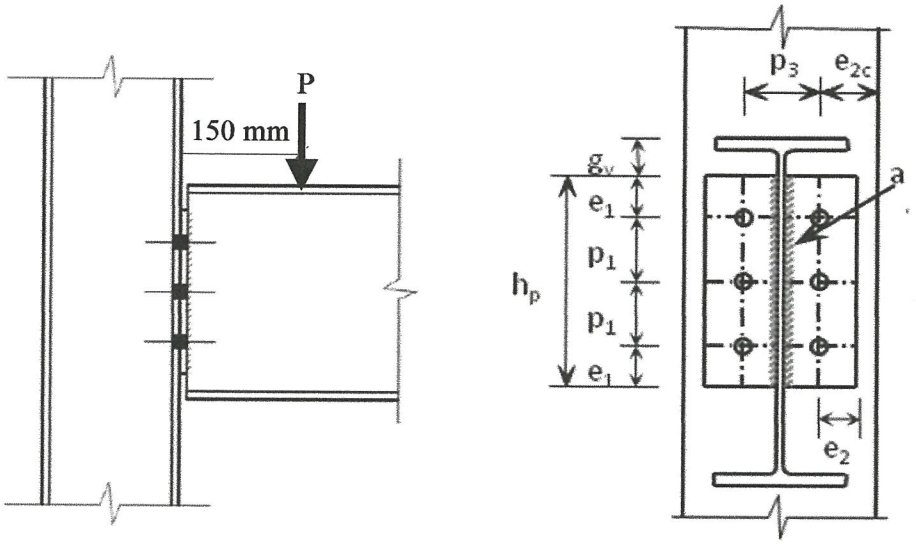

FIGURE Q3

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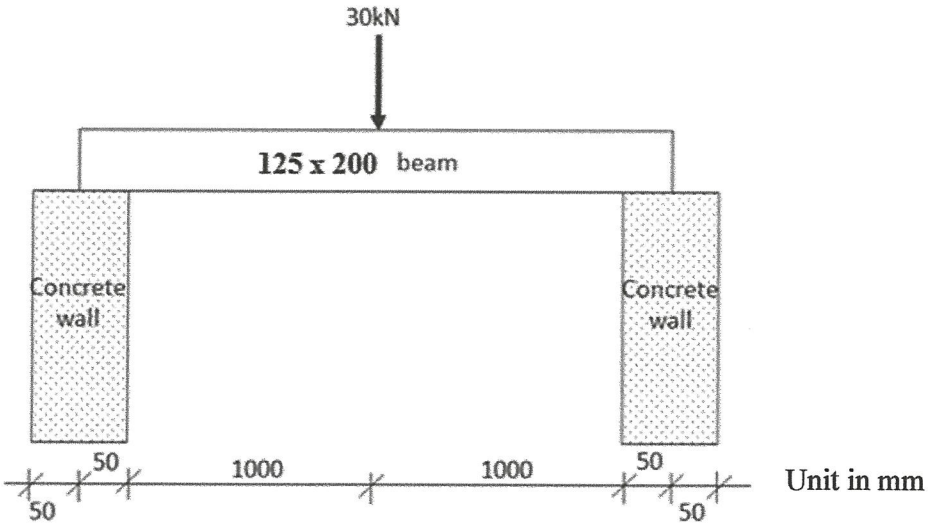

FIGURE Q4

Table 1 : Bolt Area

d (mm)	8	10	12	14	16	18	20	22	24	27	30
A (mm^2)	50	78	113	154	201	254	314	380	452	573	707
As (mm^2)	36	58	84	115	157	192	245	303	353	459	561

EQUATIONS

$$F_v = \frac{P}{n}$$

$$F_t = \frac{P.e.y_1}{2\Sigma y^2}$$

$$F_T = \frac{Pey}{I}$$

$$F_{w,Ed} = \sqrt{(F_v^2 + F_T^2)}$$

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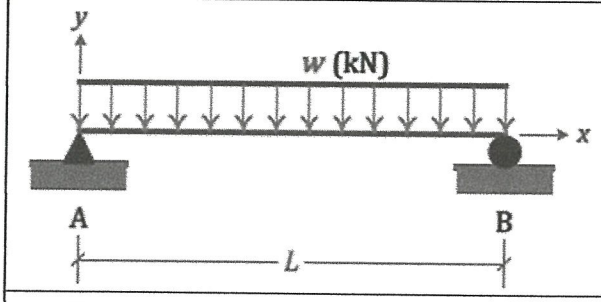
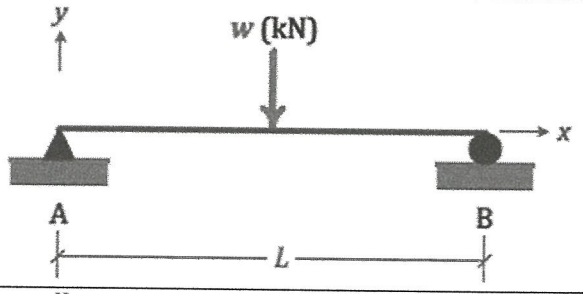
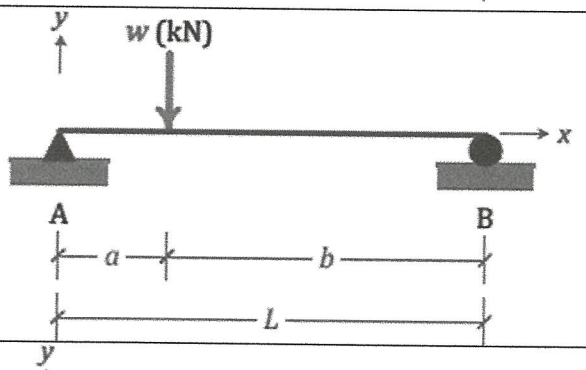
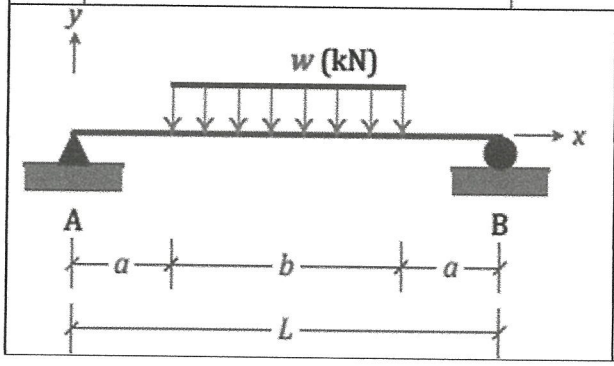
	R_A(kN)	R_B(kN)	M_{max} (kNm)	δ_{max} (mm)
	$\frac{W}{2}$		$\frac{WL}{8}$	$\frac{5}{384}\times\frac{WL^3}{EI}$
	$\frac{W}{2}$		$\frac{WL}{4}$	$\frac{1}{48}\times\frac{WL^3}{EI}$
	$\frac{Wb}{L}$	$\frac{Wa}{L}$	$\frac{Wab}{L}$	$\frac{1}{48}\times\frac{WL^3}{EI}\times\left(\frac{3a}{L}-\frac{4a^3}{L^3}\right)$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

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