Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	STRUCTURAL DESIGN
COURSE CODE	:	BFC34702
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2020
DURATION	:	5 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS 2. DESIGN SHOULD BE BASED ON: BS EN1990:2002+A1:2005 BS EN1991-1-1:2002 BS EN1992-1-1:2004 BS 8110: 1: 1997 MS 544: PART 1 & 2: 2001

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) There are several steps need to be considered to fulfill the structural design process. Describe the design process which involves building form and structural arrangement.

(4 marks)

(b) Explain briefly the importance of serviceability limit state in the design stage for the structures.

(4 marks)

(c) A reinforced concrete T beam with the dimension of h_f = 100 mm, b = 800 mm, b_w = 250 mm, and d = 500 mm is shown in Figure **Q1(a)**. The tension and compression reinforcements provided are 5H32 and 2H12 respectively.

(i) Draw the stress block diagram for the beam.

(4 marks)

(ii) Determine the ultimate moment capacity of the beam section, if f_{ck} = 30 N/mm^2 and f_{yk} = 500 N/mm^2. The depth of compression reinforcement, d' is 50 mm

(8 marks)

(d) Figure **Q1(b)** shows part of a ground floor plan of a reinforced concrete office building. The slab thickness is 125 mm. Dimensions of the beams are given in the diagram. The finishes and services form a characteristics permanent action is 1.5 kN/m^2. The characteristic variable action is 3.0 kN/m^2. A 3.0 m high brick wall weighing 2.6 kN/m^2 is placed over the highlighted beams also shown in the figure. Given the additional following data:

Characteristic strength of concrete, f_{ck}	= 25 N/mm^2
Characteristic strength of steel, f_{yk}	= 500 N/mm^2
Unit weight of concrete	= 25 kN/m^3

(i) Analyze the design action carried by beam at location B/1-2.

(5 marks)

(ii) Calculate and sketch the bending moment and shear force diagram for beam at location B/1-2.

(5 marks)

Q2 **Figure Q2** shows a first floor plan of an office building. Brickwall of 112.5 mm thickness and the height of 4 m were constructed along the parameter of the building. Slabs and beams are casted monolithically. The design specifications are as follow:

Characteristic strength of concrete, f_{ck}	= 30 N/mm^2
Characteristic strength of steel bar, f_{yk}	= 500 N/mm^2
Concrete cover, c	= 30 mm
Slab thickness	= 150 mm
Finishes and services	= 0.75 kN/m^2
Weight of brickwall	= 2.6 kN/m^2
Variable action	= 4.0 kN/m^2
Concrete density	= 25 kN/m^3
Beam size (b x h)	= 250 mm x 500 mm
Diameter of main reinforcement	= 25 mm
Diameter of shear link	= 6 mm

(a) Determine the design action for beam at location 2/A-D and draw the shear force diagram (SFD) and bending moment diagram (BMD) by using Table 3.5 BS 8110 Part 1: 1997

(15 marks)

(b) Design the main reinforcement for span at location 2/A-B with b_{eff} is 1350 mm. Sketch the beam cross section.

(10 marks)

(c) Check the deflection of beam 2/A-B at mid span.

(10 marks)

Q3 (a) Determine modification factor, K_8 for Penaga 150 x 250 mm compression member of timber strength group 4 and grade dry standard, if the effective length, L_e = 2.8 m and radius of gyration, r = 33.2 mm.

(5 marks)

(b) House floor consists of a plank '*kayu tanggam alur dan lidah*' with the depth of 25 mm that been arranged and nailed on the girders (more than 4 girders). Gaps distance between the girders is 550 mm. The girders are supported by the main beams which are located 3.0 m between each other. The main beam is bolted to the column by the span distance of 4.0 m and the ends are not notched. Other criteria of main beam used in the construction of the house are strength group 4, sawn standard grade timber and under dry condition. The total load due to dead load and temporary imposed load on main beam is 4.75 kN/m.

(i) Using shearing stress criteria, propose the size of the main beam.

(8 marks)

(ii) Check the moment capacity of the proposed main beam.

(6 marks)

(iii) Give your opinion on deflection capacity of the proposed main beam.

(6 marks)

(c) Concrete is strong in compression but weak in tension and due to low tensile capacity, flexural cracks develop at early stages of loading. In order to reduce such cracks from developing, pre-stressing force is applied longitudinally along or parallel to the axis of the member, the principle involved is commonly known as linear pre-stressing.

(i) List **TWO (2)** advantages and **TWO (2)** disadvantages of using pre-stressing concrete.

(4 marks)

(ii) Write a short note on the pre-tensioning and post-tensioning methods of prestressed concrete with the aids of sketching.

(6 marks)

- END OF QUESTIONS –

FINAL EXAMINATION

SEMESTER/ SESSION: SEM II 2019/2020 PROGRAMME: 3BFF
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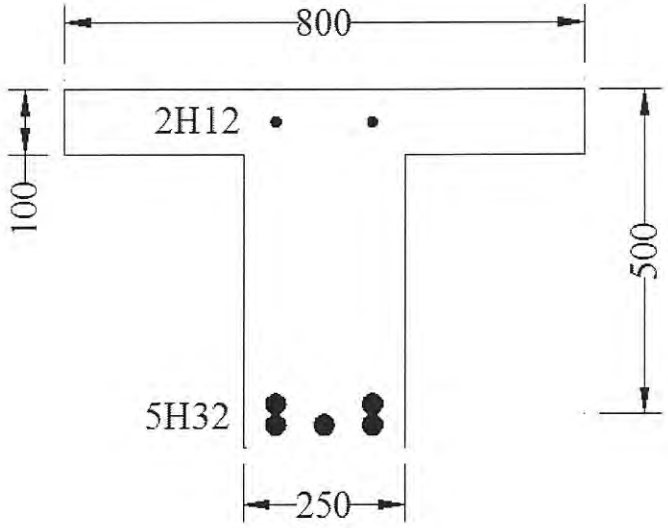

FIGURE Q1(a)

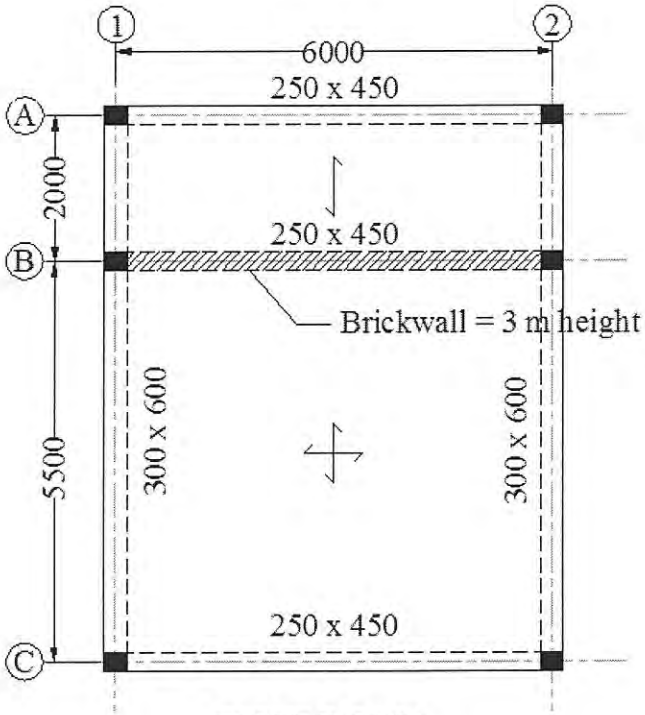

FIGURE Q1(b)

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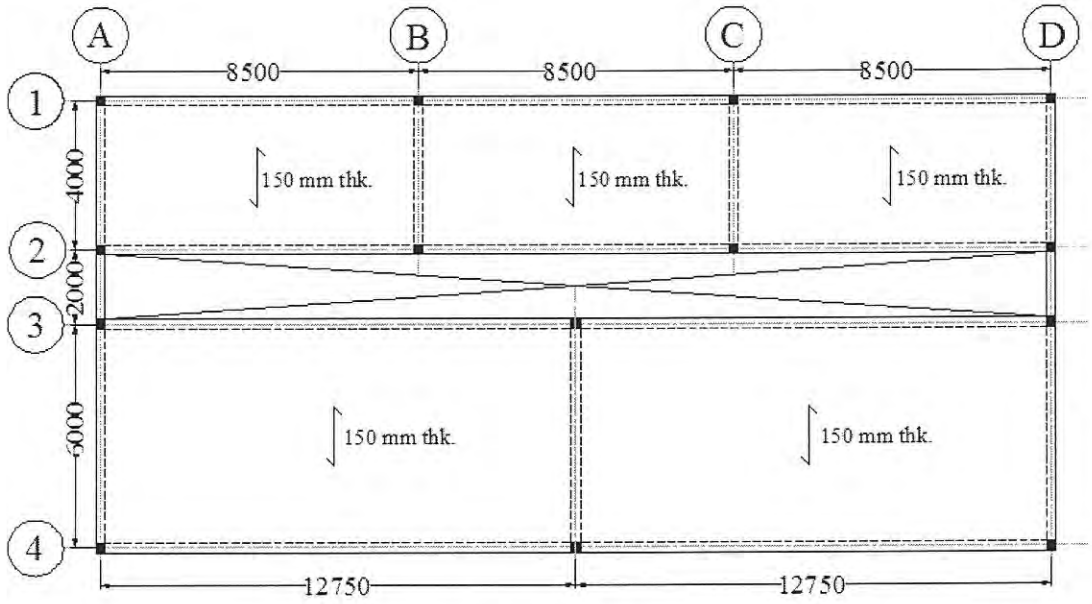

FIGURE Q2