Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023

COURSE NAME	:	STRUCTURAL DESIGN
COURSE CODE	:	BFC34702
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	FEBRUARY 2023
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	1.	ANSWER **ALL** QUESTIONS
	2.	THIS FINAL EXAMINATION IS CONDUCTED VIA OPEN BOOK. ALL CALCULATION MUST BE BASED ON **BS EN 1990, BS EN 1991, BS EN 1992-1** AND **MS544: PART 2**
	3.	STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

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

Q1 (a) Explain why the partial safety factor for concrete is larger than steel in reinforced concrete design.

(4 marks)

(b) State **THREE (3)** reasons partial safety factor is introduced in calculating the design action.

(3 marks)

(c) **Figure Q1(a)** shows an idealised stress strain curve for a mild steel. The characteristic strength (f_{yk}) and partial factor for the mild steel (γ_s) are 250 N/mm^2 and 1.05, respectively. If the strain of a mild steel is equal to 0.0015, determine the design stress.

(6 marks)

(d) **Figure Q1(b)** shows an upper floor plan for a reinforced concrete building.

(i) Identify type of panel for each slab.

(3 marks)

(ii) Illustrate the actions carrying on beam C/1-4. Sketch the bending moment and shear force diagrams.

(4 marks)

(e) An elevated rectangular steel water tank of 4 m x 4 m x 2 m height supported by the steel frame is to be constructed on a rectangular pad footing of 2 m x 2 m x 1.2 m depth is shown in **Figure Q1(c)**. Given the following data:

Unit weight of reinforced concrete	=	25 kN/m^3
Unit weight of water	=	10 kN/m^3
Wind load	=	1.2 kN/m^2
Notional horizontal load	=	1.5% of total axial load

Based on the partial factor for actions in Table A1.2(A), EN 1990, evaluate the maximum height (H) of the water tank to comply the stability check due to the horizontal load. Ignore weight of the steel structure.

(20 marks)

Q2 **Figure Q2(a)** shows the typical first floor plan of a double storey building. The floor of the building is constructed using precast solid slab and cast-in-situ concrete beam. The detail of the first floor beam is shown in **Figure Q2(b)**. Given the following data:

Characteristic strength of main reinforcement	=	460 N/mm^2
Characteristic strength of shear reinforcement	=	250 N/mm^2
Characteristic strength of concrete	=	30 N/mm^2
Unit weight of concrete	=	25 kN/m^3
Finishes and services	=	2.5 kN/m^2
Variable action	=	4 kN/m^2

(a) Evaluate the ultimate moment capacity of the first floor beam. Assume strength of the T10 bars is limited to 80% of the characteristic strength.

(15 marks)

(b) Check the adequacy of first floor beam (FB) in resisting the design moment.

(8 marks)

(c) Check the adequacy of the shear reinforcement. Ignore the upstand section (200 mm x 150 mm) of the beam.

(7 marks)

Q3 A timber floor system is proposed for a new extension attached to an existing concrete floor as shown in **Figure Q3(a)**. The timber beams are attached to the existing reinforced concrete (RC) beam by using the steel brackets as shown in **Figure Q3(b)**. The steel bracket joint is a rigid connection able to restraint the rotation and translation in all direction at the supporting end of the timber beams. The proposed timber beams (150 mm x 200 mm) are from strength group 2 of standard grade dry dressed sawn timber. The dead load (self-weight and floor deck) and imposed load are 0.75 kN/m^2 and 2 kN/m^2, respectively. The loads are permanently (long-term load duration) acting on the timber beams.

(a) Determine the maximum bending moment and shear force for the timber beam (TB).

(6 marks)

(b) Evaluate adequacy of the timber beam (TB) in term of:

(i) Bending stress
(ii) Shear stress
(iii) Lateral stability

(18 marks)

(c) What would be the changes on the timber beam design if the timber deck is changed to cast in-situ concrete?

(6 marks)

- END OF QUESTIONS-

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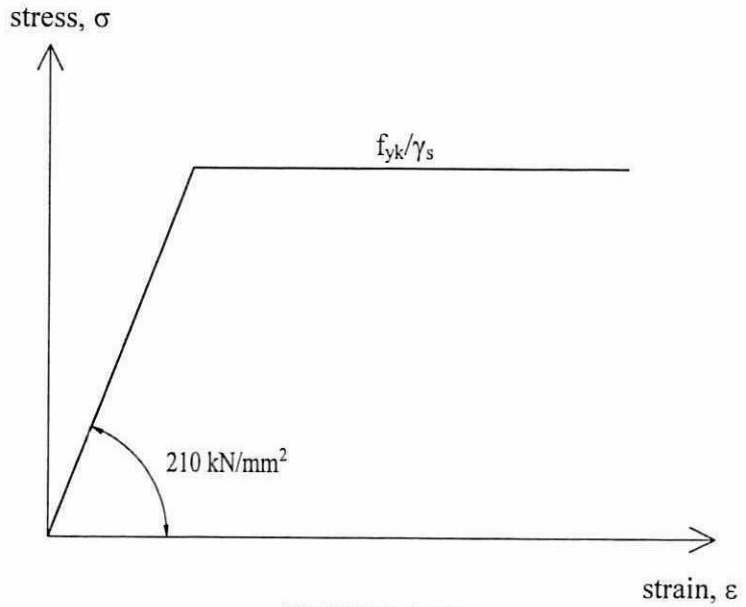

FIGURE Q1(a)

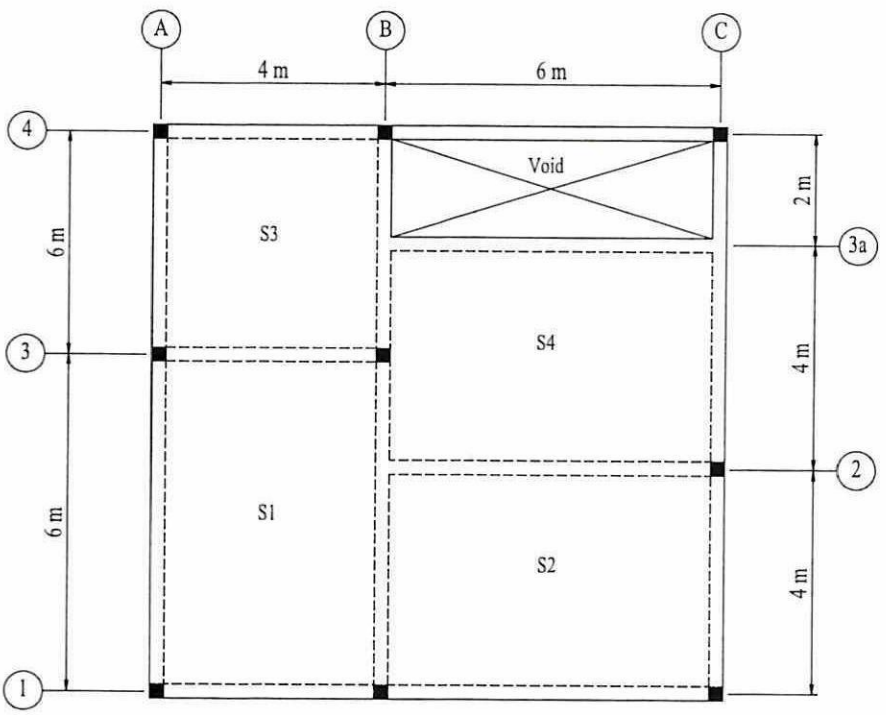

FIGURE Q1(b)

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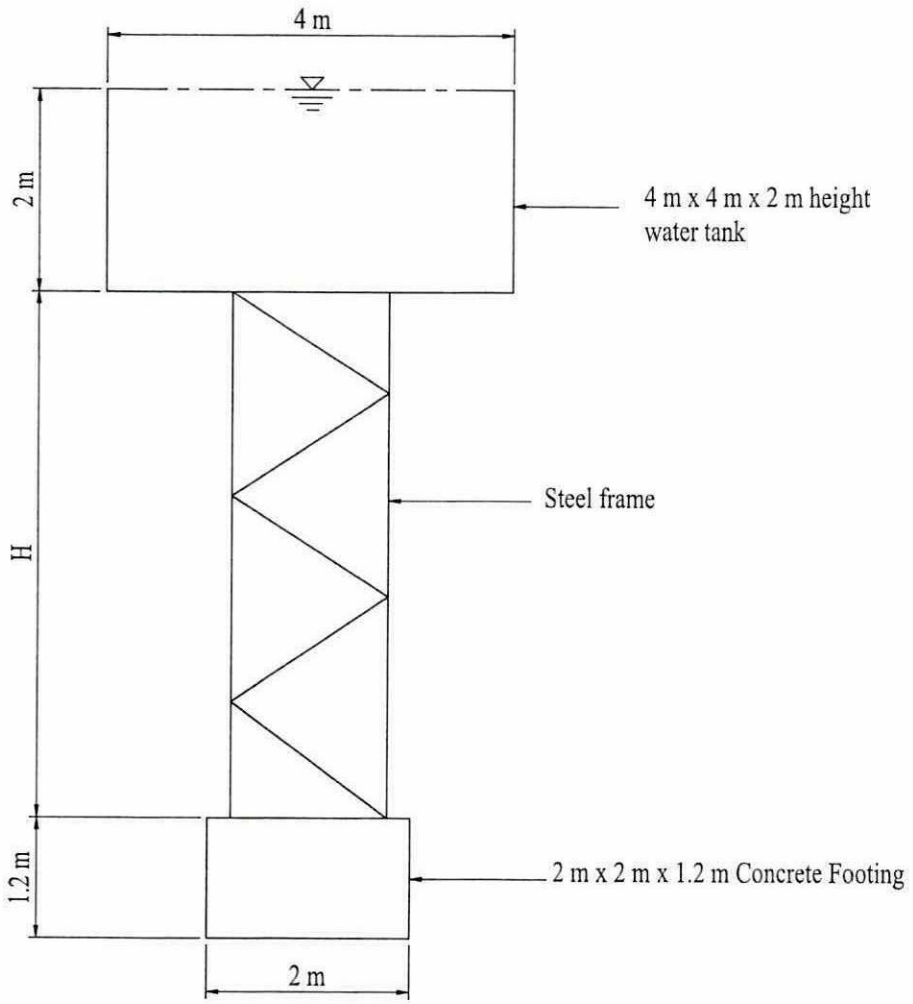

FIGURE Q1(c)

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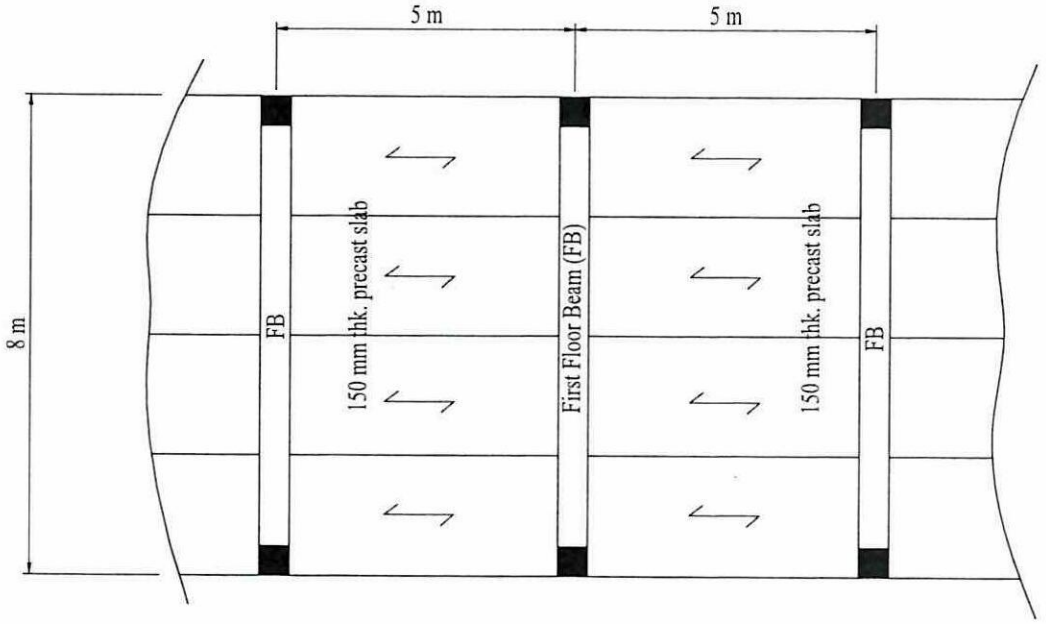
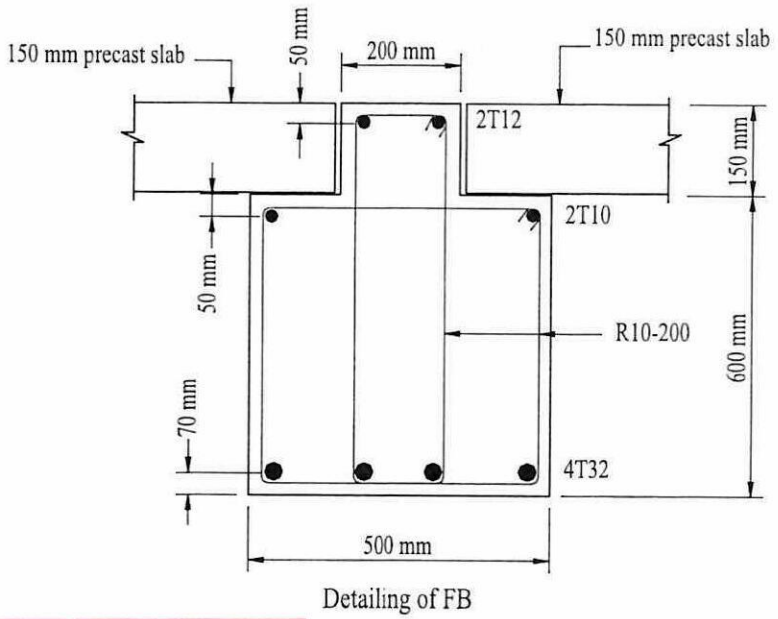


FIGURE Q2(a)



Detailing of FB

FIGURE Q2(b)

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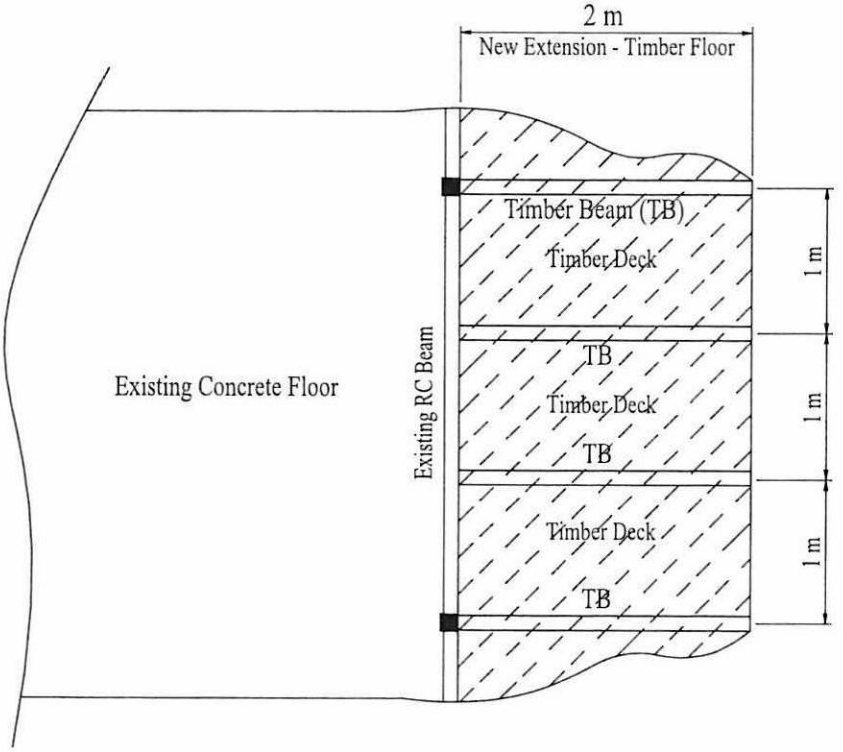

FIGURE Q3(a)

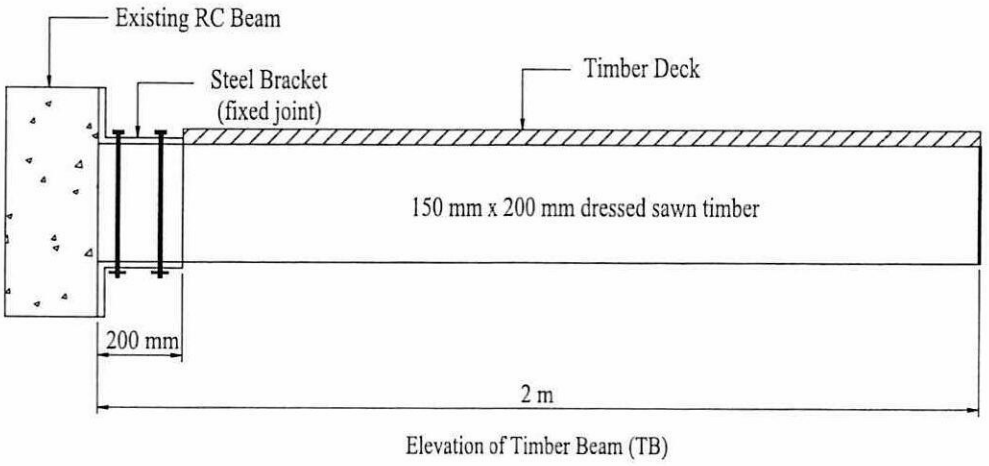

FIGURE Q3(b)