Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	STRUCTURAL DESIGN
COURSE CODE	:	BFC34702
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY/AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **OPEN BOOK** 3. ALL CALCULATION MUST BE BASED ON **MS EN1990, MS EN1991, MS EN1992** AND **MS 544**

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

Q1 (a) Answer the following questions:

(i) When constructing precast prestressed concrete structures, what type of prestressing method is more suitable for producing repeating typical precast components? Please explain **Two (2)** reasons.

(5 marks)

(ii) Determine the mean strength of a concrete with a characteristic strength of 45 N/mm^2, assuming the standard deviation is 10 N/mm^2, and only 5% of the sample is allowed to be less than the characteristic strength.

(5 marks)

(b) **Figure Q1** shows a cross section for a reinforced concrete beam. The characteristic strengths of the concrete and steel reinforcement are 30 N/mm^2 and 500 N/mm^2, respectively.

(i) Determine ultimate moment of resistance of the beam.

(25 marks)

(ii) If the beam is simply supported over a 6 m length and subjected to a concentrated load at the mid-span. Calculate the maximum concentrated load based on the moment capacity in **Q1(b)(i)**. Ignore the self-weight.

(5 marks)

Q2 **Figure Q2(a)** shows a roof plan of a building, and a reinforced concrete (RC) gutter is proposed to surround the perimeter of the roof. The gutter is supported by the roof beams. The detail of the RC gutter is shown in **Figure Q2(b)**. Given the following data:

Unit weight of reinforced concrete	=	25 kN/m^3
Unit weight of water	=	10 kN/m^3
Finishes of RC gutter	=	1.5 kN/m^2
Permanent action of roof	=	1.0 kN/m^2
Variable action of roof	=	0.5 kN/m^2
All roof beams size	=	200 mm x 500 mm
Nominal concrete cover	=	30 mm
Characteristic strength of concrete, f_{ck}	=	25 N/mm^2
Characteristic strength of steel reinforcement, f_{yk}	=	500 N/mm^2
Diameter of shear reinforcement	=	10 mm
Diameter of main reinforcement (assume single layer)	=	16 mm

(a) Determine the maximum action on beam 4/A-C. Use area method to distribute the action of the roof to the roof beam.

(8 marks)

(b) Calculate the maximum bending moment and shear force for beam 4/A-C.

(4 marks)

(c) Design the main reinforcement for beam 4/A-C. Ignore the torsion.

(6 marks)

(d) Design the shear reinforcement for beam 4/A-C.

(9 marks)

(e) Sketch the detailing for beam 4/A-C.

(3 marks)

Q3 **Figure Q3** shows a timber platform consisting of cantilever timber beams jointed to timber columns with steel brackets, which are considered fixed joints. The top end of the columns is braced by tie beams, and the bottom end is fixed to the concrete floor. Both ends of the columns are assumed to be fixed in all direction. All the timber beams and columns are from Strength Group 2 of Standard Grade Dry-Dressed Sawn Timber. The dead load, which includes the self-weight and floor deck, and the imposed load are 0.75 kN/m^2 and 2 kN/m^2, respectively. The loads are assumed permanently to act (long-term load duration) on the timber beams.

(a) Determine the minimum width of the timber beam to comply with the deflection check (ignore shear deflection). The depth of the timber beam is redistricted to 200 mm. Given:

$$\text{maximum deflection, } \delta_{max} = \frac{wL^4}{8EI}$$

(10 marks)

(b) Check the adequacy of the timber column (200 mm x 200 mm) in resisting the combine axial force and bending moment. The bending moment is determined based on the eccentricity of the beam reaction. Assume the reaction from the beam is acting with an eccentricity of 100 mm from the edge of the column.

(20 marks)

- END OF QUESTIONS-

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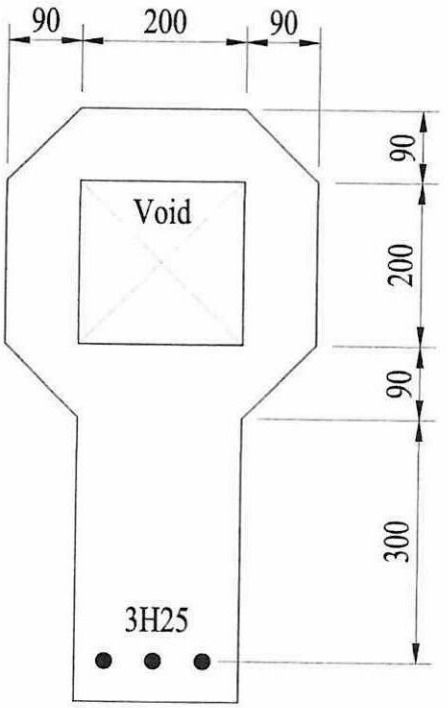

All unit are in mm

Figure Q1

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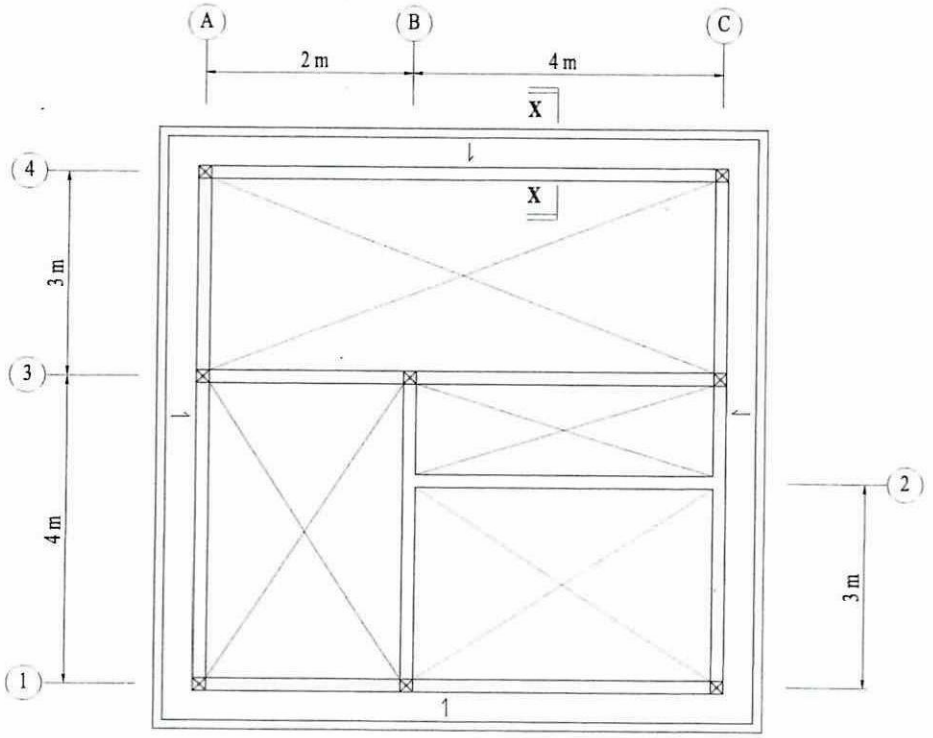
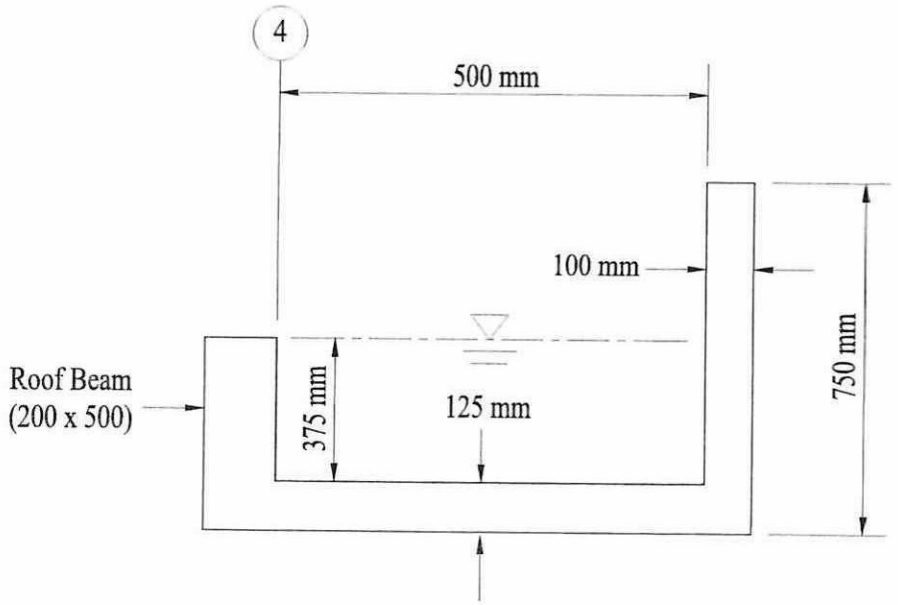


Roof Plan

Figure Q2(a)



Section X-X (Typical Detail of RC Gutter)

Figure Q2(b)

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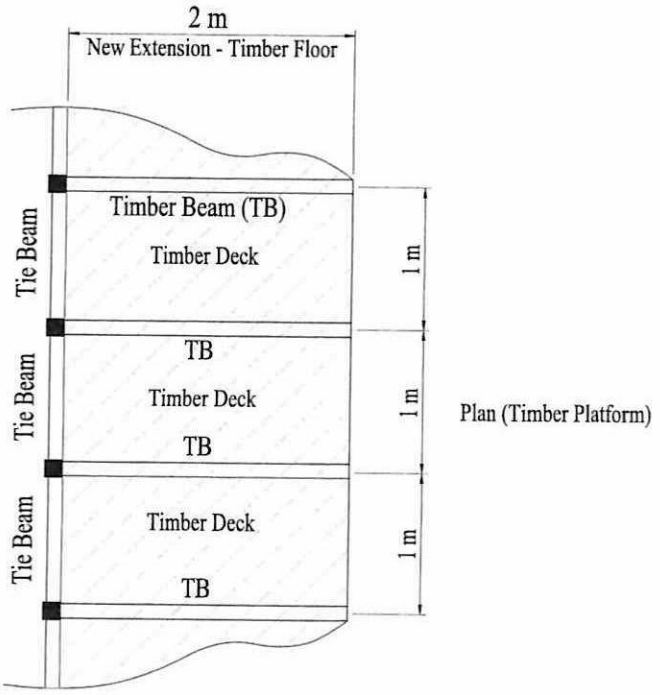

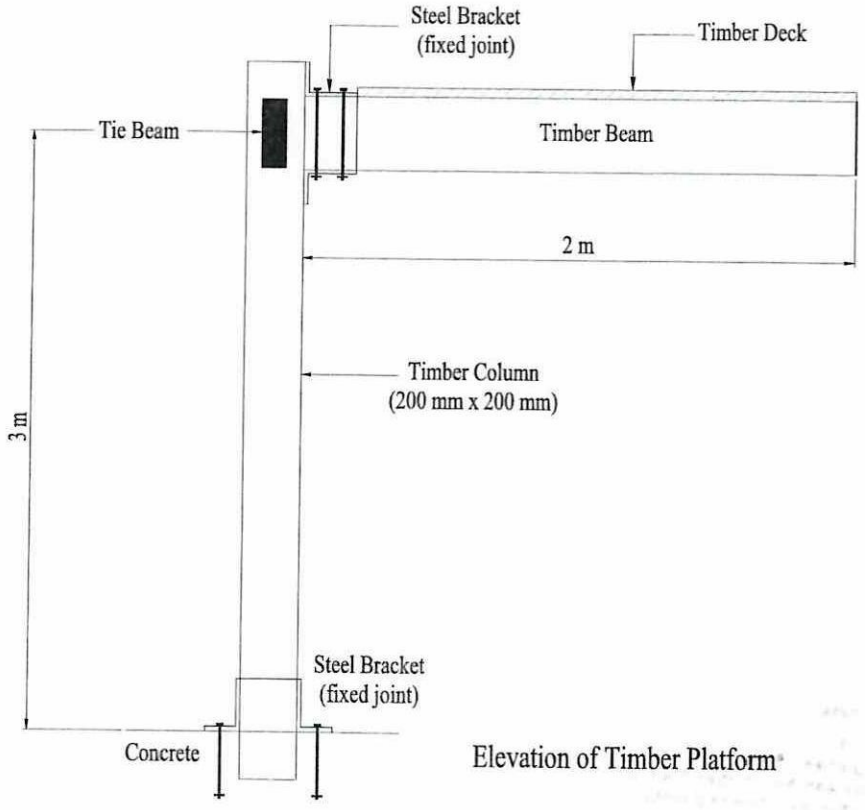

Figure Q3