Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023

COURSE NAME	:	REINFORCED CONCRETE DESIGN
COURSE CODE	:	BFC34803
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	FEBRUARY 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **OPEN BOOK** 3. STUDENTS ARE **ALLOWED** TO CONSULT THEIR OWN MATERIAL AND DESIGN SHOULD BE BASED ON BS EN 1990: 2002+A1:2005, BS EN 1991-1-1:2002, BS EN 1992-1-1:2004, MS 1553: 2002

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

Q1 (a) List **THREE (3)** types of bracing member. Explain the significance of the bracing member in a braced building frame subjected to the wind load.

(5 marks)

(b) For unbraced frame building, describe briefly the structural elements that resist moment due to wind load.

(2 marks)

(c) **Figure Q1(a)**, **Q1(b)** and **Q1(c)** show a 3D view, front and side elevations of 5 storeys unbraced building frame respectively. The frame subjected to a constant wind pressure along its height of 0.95 kN/m^2. All column size is 400 mm x 400 mm and all beam size are 300 mm x 600 mm.

(i) Calculate the design wind load subjected to each level at grid C in kN.

(5 marks)

(ii) Analyse and draw the moment diagram for beams and columns at level 4 and 5 in gridline C due to wind load.

(13 marks)

Q2 A 6-storey hotel is under construction and a shear wall is located at four-sides of the building. During construction, it is found that a corner column is subjected to an additional loading for about 30% of its existing axial load as well as bending moment. The existing bending moment is as shown in **Figure Q2 (a)** while the detailing of the column is shown in **Figure Q2 (b)**. After initial assessment, the column remains as non-slender column. Given:

Existing axial load, N_{Ed}	=	2000 kN
Effective length of column, L_{oz}	=	4.2 m
Effective length of column, L_{oy}	=	4.0 m
Concrete cover. C_{nom}	=	30 mm
Diameter of main bar	=	25 mm
Diameter of link	=	8 mm
Characteristic strength of concrete, f_{ck}	=	30 N/mm^2
Characteristic strength of steel, f_{yk}	=	500 N/mm^2
Slenderness ratio, λ_z	=	25.0
Slenderness ratio, λ_y	=	32.5
h'	=	299.5 mm
b'	=	249.5 mm
d_2/h	=	0.15

(a) Calculate the new design moment, M_{Ed} of the column.

(7 marks)

(b) Check the necessity for biaxial bending as stated in Clause 5.8.9(3) BS EN 1992-1-1:2004.

(8 marks)

(c) Evaluate adequacy of the existing longitudinal reinforcement for the additional axial load and bending moment.

(10 marks)

Q3 A mosque will be built in your residential area. As a civil engineer, you are requested to design a square pad footing to support a single column with axial service load 700 kN permanent action and 400 kN variable action. Given the following data:

Column size	=	350 mm x 350 mm
Characteristic strength of concrete, f_{ck}	=	35 N/mm^2
Characteristic strength of steel, f_{yk}	=	500 N/mm^2
Unit weight of concrete,	=	25 kN/m^3
Nominal concrete cover, C_{nom}	=	35 mm
Soil bearing capacity,	=	200 kN/m^2
Assume diameter reinforment bar,	=	16 mm

Assume pad footing selfweight 10% of service load.

(a) Determine the required size for the pad footing.

(5 marks)

(b) Design the reinforcement required for the pad footing.

(15 marks)

(c) Check the punching shear.

(5 marks)

Q4 (a) State **THREE (3)** types of failure in cantilever retaining wall.

(3 marks)

(b) **Figure Q4** shows a cross section of a cantilever retaining wall. The surcharge of 12.5 kN/m^2 is imposed to the backfill behind the wall. The material under the wall has a safe bearing pressure 140 kN/m^2. Given the following data:

Soil density, γ	=	22 kN/m^3
Angle of internal friction, ϕ	=	30^o
Sand with cohesion, c	=	0
Friction coefficient	=	0.5
Concrete density	=	25 kN/m^3

(i) Determine the total horizontal load and moment of the retaining wall.

(14 marks)

(ii) Check the stability of the wall against overturning and sliding by using partial safety factor given in **Table Q4**. Propose a solution, if the stability checking is not adequate.

(8 marks)

–END OF QUESTIONS–

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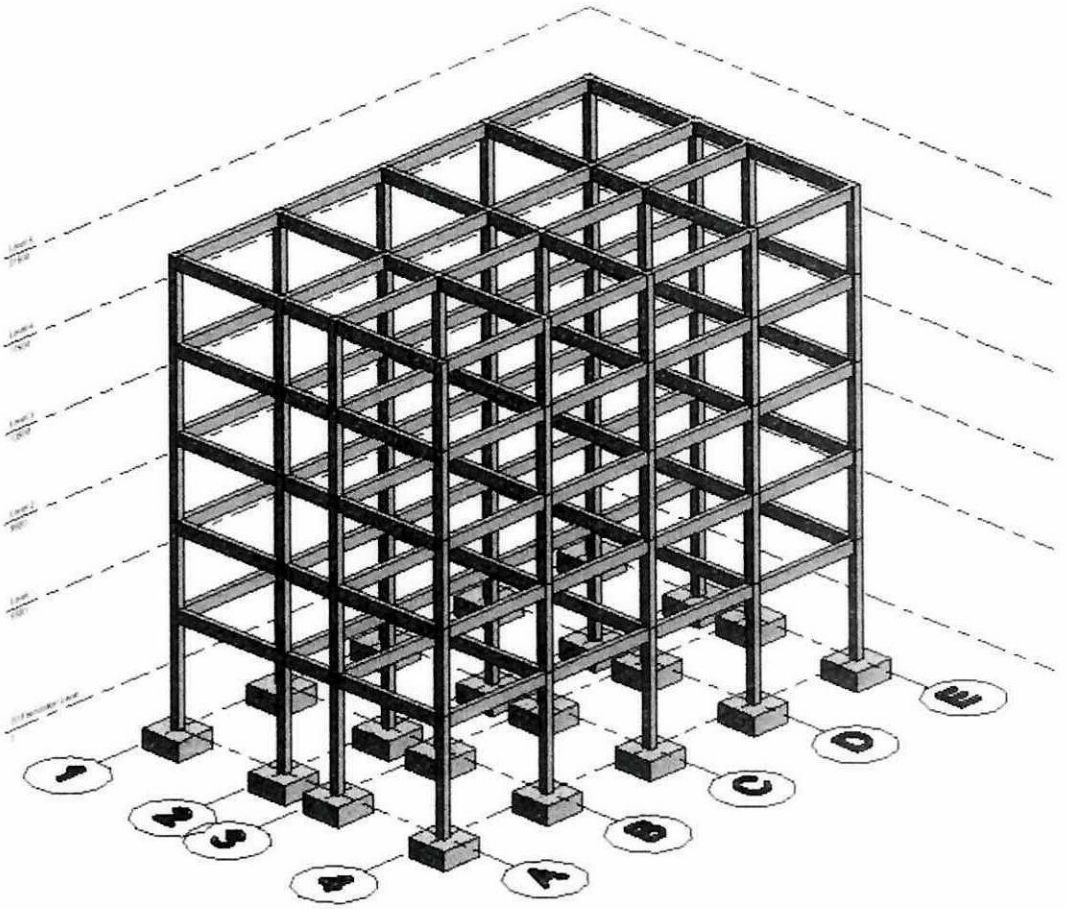

Figure Q1(a)

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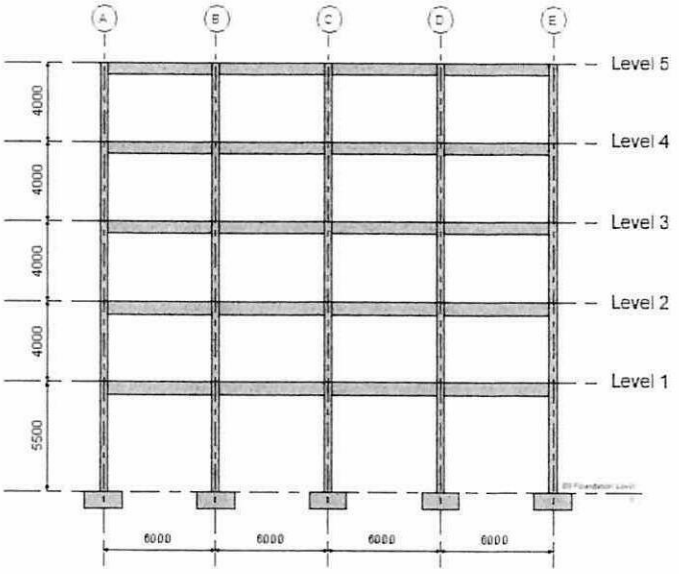

Figure Q1(b)

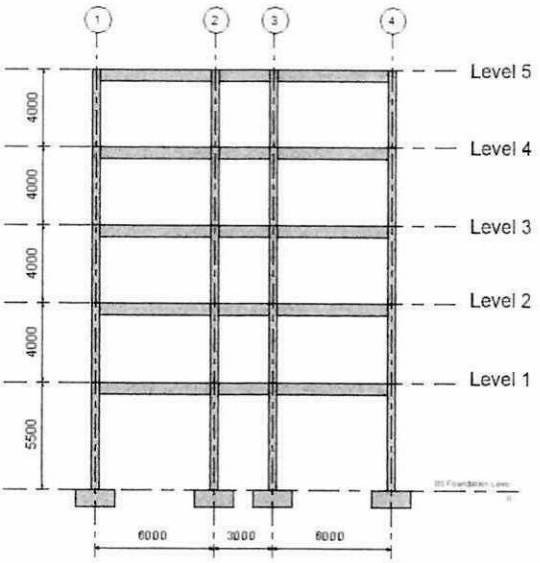

Figure Q1(c)

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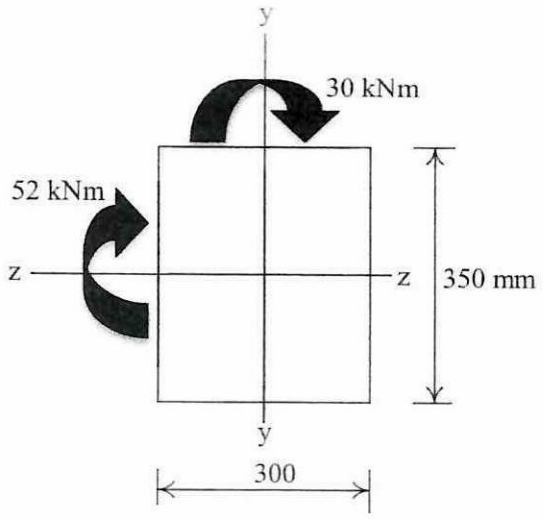

Figure Q2(a)

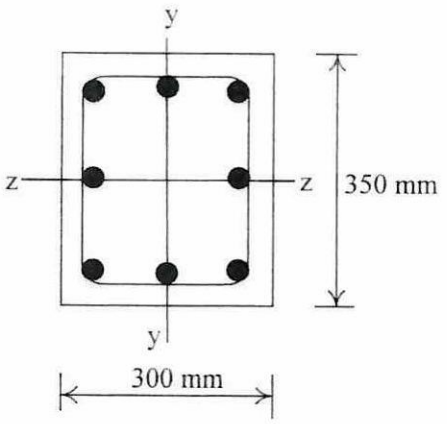

Figure Q2(b)

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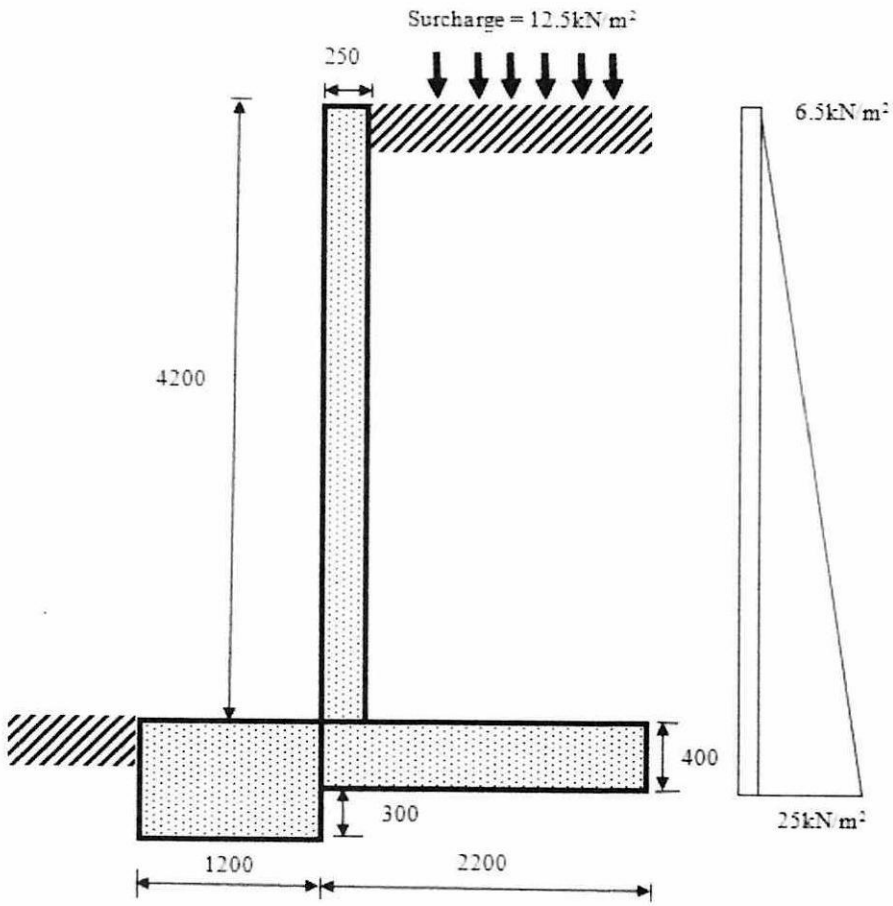
Table Q4

Type of Moment/Force	Partially Safety Factor	
	Permanent	Variable
Stability/Restraining	0.9	
Overturning	1.1	1.5
Resisting Force	1.0	
Sliding Force	1.35	1.5



All unit in mm

Figure Q4