Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	REINFORCED CONCRETE DESIGN
COURSE CODE	:	BFC 34803
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2024
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER **ALL** QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☒ Open book ☐ Closed book 3. STUDENTS ARE **ALLOWED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA OPENED BOOK

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

Q1 A cantilever retaining wall is to be constructed to retain a bank of earth 4.5 m high is shown in **Figure Q1.1**. The surface of the backfill is horizontal and will be subjected to a variable action surcharge of 40 kN/m^2. Due to unpredicted rainfall and inappropriate drainage system, the water level is assumed at the top level of the earth. The backfill is granular soil with saturated density, $\gamma = 18.5$ kN/m^3 and angle of internal friction, $\emptyset = 30^0$. Assume the unit weight of water = 10 kN/m^3.

(a) Calculate and show all the horizontal and vertical forces acting on the retaining wall.

(9 marks)

(b) Determine minimum thickness of the wall to fulfil the stability check due to overturning.

(13 marks)

(c) If the cantilever retaining wall is not fulfil the stability check due to sliding, suggest a cost-effective solution to overcome it.

(3 marks)

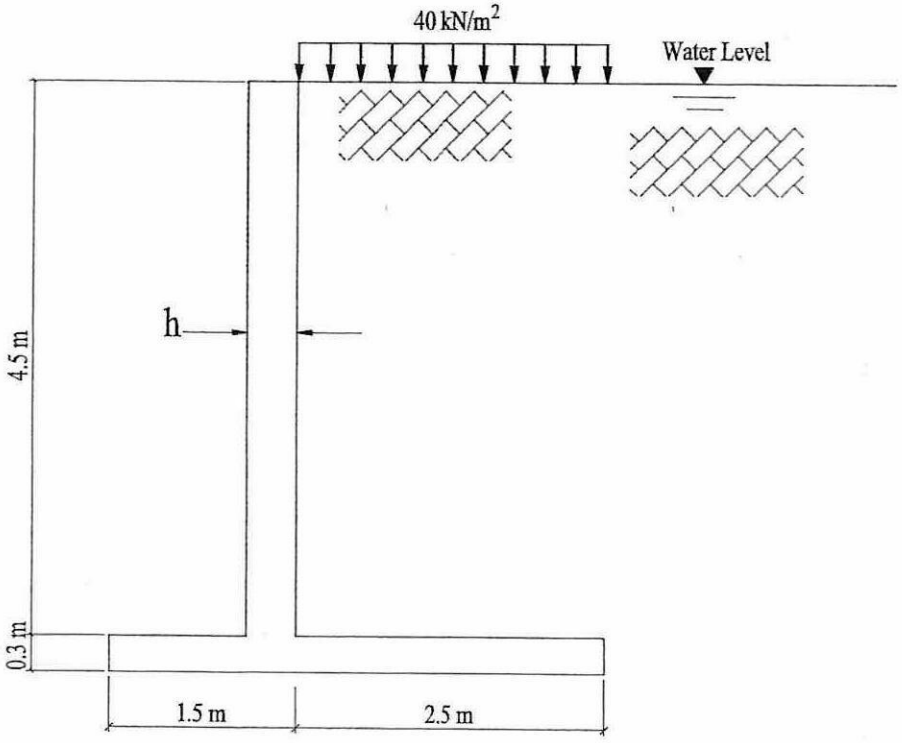

Figure Q1.1

Q2 Foundation is a crucial part of structure which transfers the load from structure to the underlaying soil or rock.

(a) With the aid of sketch, state **THREE (3)** types of foundation and its suitability condition.

(6 marks)

(b) Design a combined footing to support two square column 300 mm and 400 mm as shown in **Figure Q2.1.** The distance between two columns are 3.12 m. The safe bearing capacity of soil is 300 kN/m^2. Given the following data:

Characteristic strength of concrete, f_{ck}	=	30 N/mm^2
Characteristic strength of reinforcement, f_{yk}	=	500 N/mm^2
Diameter of reinforcement	=	12 mm
Thickness of nominal cover	=	40 mm

(i) Calculate the soil pressure underneath the combine footing. Assume the footing self-weight is 10% of total load.

(3 marks)

(ii) Determine the length of *la* and *lb* as shown in **Figure Q2.1.**

(3 marks)

(iii) Design all the transverse reinforcements required for the combined footing.

(11 marks)

(iv) Check the maximum punching shear at column perimeter.

(2 marks)

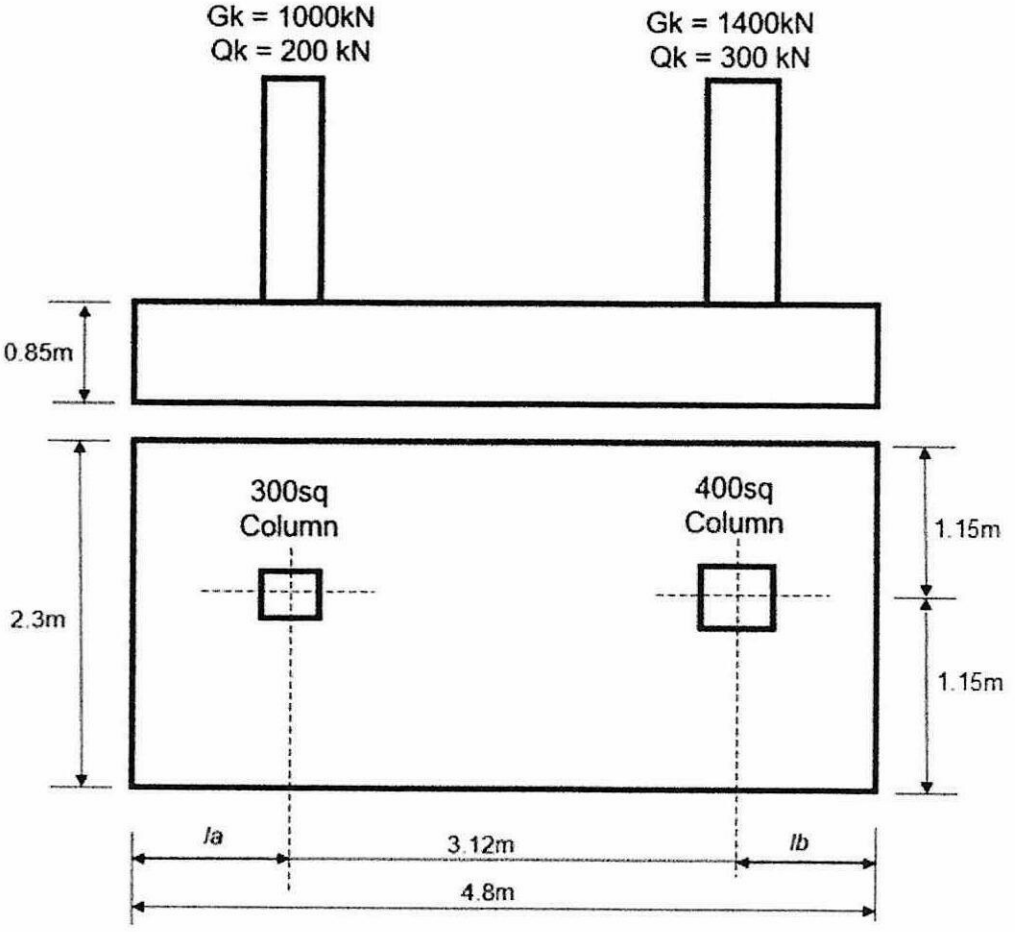

Figure Q2.1

Q3 (a) Columns is a vertical structural element that carries axial load and categorised into braced and unbraced. Clearly state the differences between these two types of column categories.

(4 marks)

(b) A non-slender column at the third floor in a six-storey residential building will be designed to resist an axial load and bending moment as shown in **Figure Q3.1**. The column is subjected to an ultimate load of 4500 kN and bending moments of 98 kNm and 77 kNm about its major and minor axes respectively. Given the following data:

Size of column	=	400 x 450 mm
Effective length of column, L_{oz}	=	3.30 m
Effective length of column, L_{oy}	=	3.15 m
Slenderness ratio, λ_z	=	24.5

Slenderness ratio, λ_y	=	32.5
Characteristic strength of concrete, f_{ck}	=	35 N/mm^2
Characteristic strength of steel, f_{yk}	=	500 N/mm^2
Diameter of main reinforcement	=	25 mm
Diameter of links	=	8 mm
h'	=	360 mm
b'	=	320 mm

(i) By considering the effect of imperfection, calculate the design moment of the non-slender column.

(4 marks)

(ii) Check the necessity for biaxial bending of the column.

(5 marks)

(iii) Design the longitudinal and transverse reinforcement of the column by using Column Design Chart, and draw the detailing.

(12 marks)

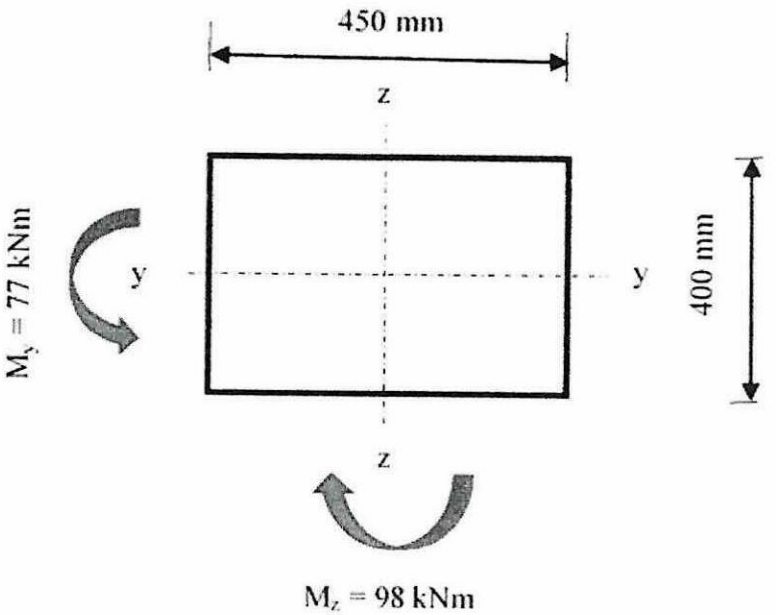

Figure Q3.1

Q4 A front view of a four storey hotel building as shown in **Figure Q4.1** will be built near the seaside at Mersing, Johor. All beam span is 5 m length for each side in plan view. The building exposed to open terrain area with few or no obstructions. The wind load is non-linear, windward wall permeable, neglected leeward wall effect and varies at different height. Based on MS 1553:2002:

(a) Determine the terrain/height multiplier, $M_{z,cat}$ for each height of this building with the suitable procedure and basic wind speed, V_s of the area. Use internal pressure coefficient, $C_{p,i} = 0.6$ and external pressure coefficient, $C_{p,e} = 0.8$.

(6 marks)

(b) Calculate the design wind load, considering the wind blows from positive direction. Then, draw the point load for each level of building.

(7 marks)

(c) Referring to Level 5, analyse and draw the axial forces in columns, shear forces and bending moments in beams and columns.

(12 marks)

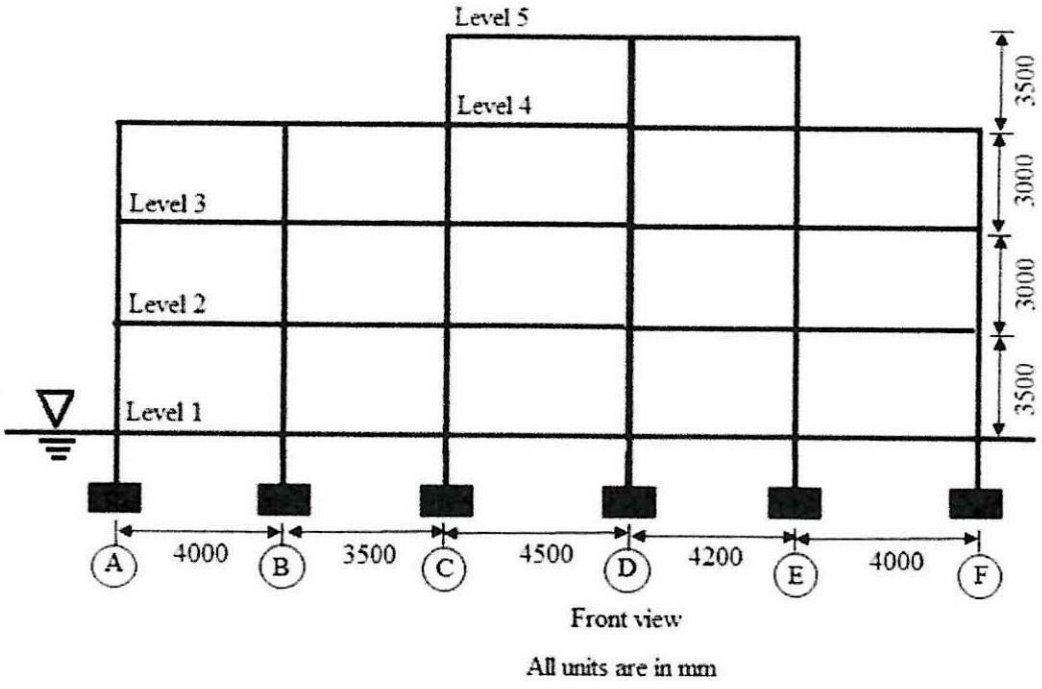

Figure Q4.1

- END OF QUESTIONS -