Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2023/2024

COURSE NAME	:	REINFORCED CONCRETE DESIGN
COURSE CODE	:	BFC 34803
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JANUARY / FEBRUARY 2024
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER **FOUR** QUESTIONS ONLY. 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☒ Open book ☐ Closed book 3. STUDENTS ARE **ALLOWED** TO CONSULT THEIR OWN EUROCODE AND APROVED SUMMARY ATTACHMENT MATERIAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA OPEN BOOK

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 **Figure Q1.1** shows a second floor layout plan of a reinforced concrete shopping area in general retail building near Batu Pahat area. The floor and staircase must be designed with a maximum characteristic variable action of 4 kN/m^2. The finishes, ceiling, and services are 1.5 kN/m^2 and the staircase flight is supported by a reinforced concrete landing. Given the following specification:

Characteristic strength of concrete, f_{ck}	=	25 N/mm^2
Characteristic strength of steel, f_{yk}	=	500 N/mm^2
Nominal concrete cover, C_{nom}	=	25 mm
Unit weight of concrete	=	25 kN/m^3
Beam size	=	250 x 500 mm
Slab thickness	=	150 mm
Depth of landing and waist	=	160 mm
Width of landing	=	1500 mm
Width of going	=	260 mm
Height of riser	=	175 mm

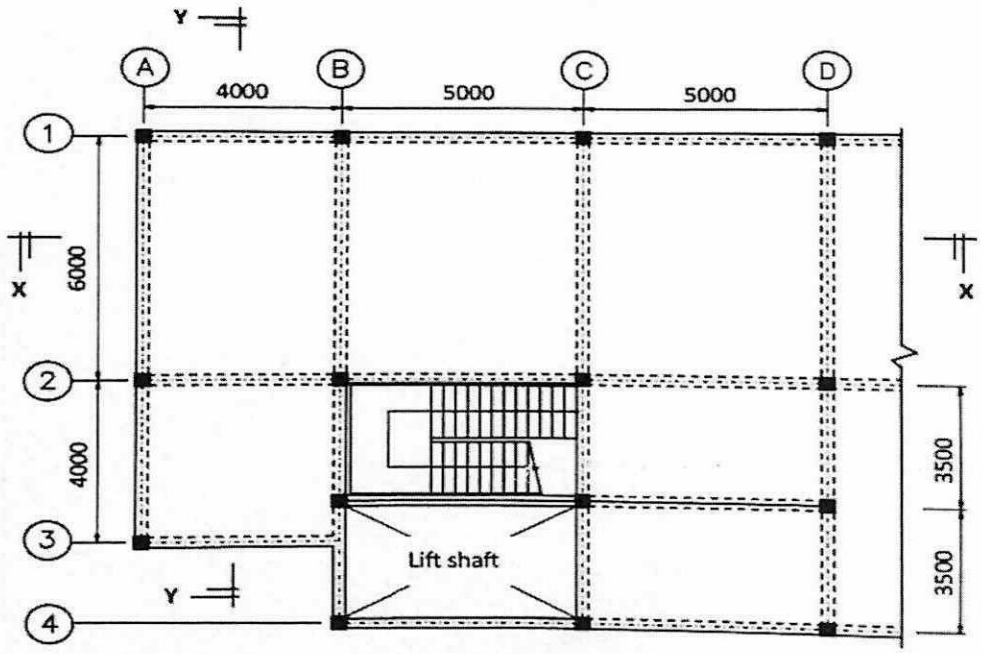

Figure Q1.1

(a) Calculate the bending moments and shear forces for restrained slab panel A-B/2-3.

(10 marks)

(b) Determine the effective length and maximum bending moment for staircase supported by landing in x-x direction.

(8 marks)

(c) H10-150 mm is used as the main and secondary reinforcements for staircase. Verify whether this reinforcement is satisfactory.

(7 marks)

Q2 **Figure Q2.1** shows a single-storey building that will be constructed on top of a hill in Cameron Highland. The height of the building is 5 meters with a length of 19.5 meters and a width of 10 meters. The roof is flat and inaccessible. The building is exposed to a total wind pressure of 6.0 kN/m^2 from the west.

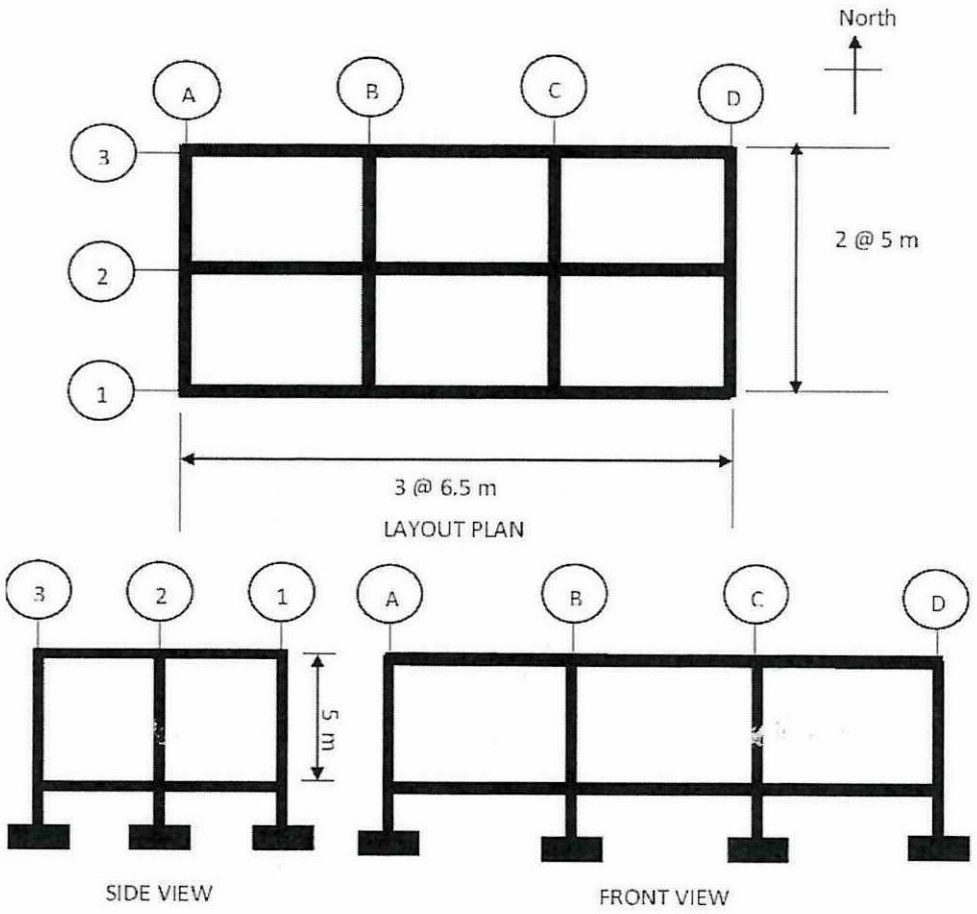

Figure Q2.1

a) Analyse the bending moments and shear forces of the roof beams 2/A-D and columns due to wind action.

(19 marks)

b) Draw the bending moments and shear forces diagrams analysed from **Q2(a).**

(6 marks)

Q3 (a) Columns may be classified into slender and non-slender columns. Clearly state the differences between these two types of column categories.

(4 marks)

(b) A short braced column in a five storey office building will be designed to resist an axial load and bending moment as shown in **Figure Q3.1**. The size of the column is 350 x 400 mm. Given the following data,

Axial load, N_{Ed}	=	2350 kN
Effective length of column, L_{oz}	=	3.8 m
Effective length of column, L_{oy}	=	3.3 m
Slenderness ratio, λ_z	=	26.5
Slenderness ratio, λ_y	=	33.5
Characteristic strength of concrete, f_{ck}	=	35 N/mm^2
Characteristic strength of steel, f_{yk}	=	500 N/mm^2
Diameter of main bar	=	25 mm
Diameter of links	=	8 mm
h'	=	350 mm
b'	=	300 mm
d_2/h	=	0.15

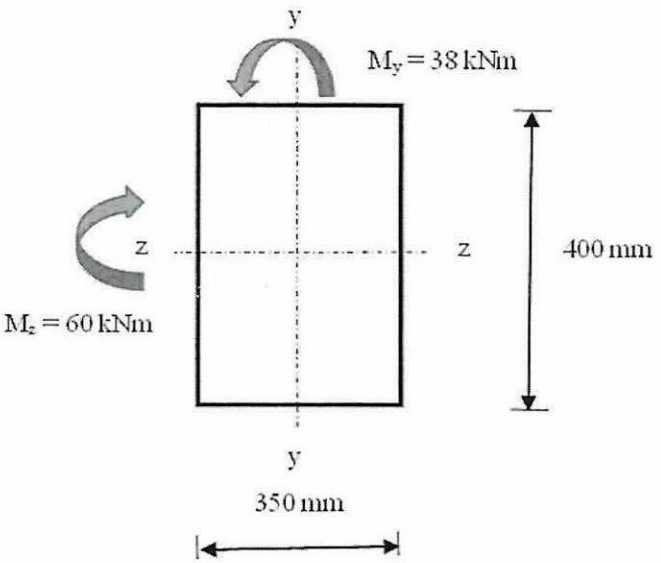

Figure Q3.1

(i) Calculate the design moment of the column including the effect of imperfection.

(4 marks)

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

(5 marks)

(iii) By using the Column Design Chart, design the longitudinal and transverse reinforcement of the column.

(12 marks)

Q4 **Figure Q4.1** shows the cross-section of cantilever retaining wall that will be constructed for a housing development at Batu Pahat with 0.4 m wall thickness. The backfill soil is a granular fill soil having a cohesion, c is 0 with height of 4.0 m. Given the following data:

Characteristic strength of concrete, f_{ck}	=	30 MPa
Characteristic strength of steel reinforcement, f_{yk}	=	500 MPa
Coefficient of friction, u	=	0.5
Concrete cover	=	40 mm
Diameter of reinforcement	=	16 mm
Unit weight of reinforced concrete	=	25 kN/m^3

Factor of safety refer to **APPENDIX A**

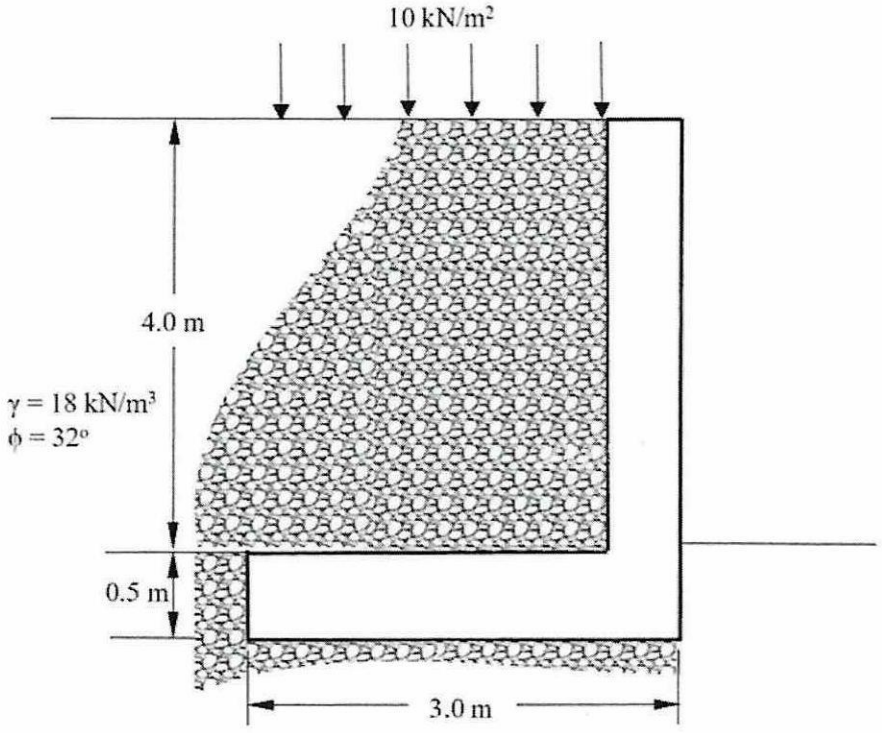

Figure Q4.1

(a) Determine the active pressure along the depth of the retaining wall.

(3 marks)

(b) Analyse the positive and negative moments as well as the vertical and horizontal loads that may occur in the retaining wall.

(10 marks)

(c) Check stability of the retaining wall against overturning and sliding.

(6 marks)

(d) If the unfactored moment at base structure is 200 kNm, design the possible main reinforcement of the base structure.

(6 marks)

Q5 (a) Explain the load transmission method of the following types of foundation:

(i) Shallow foundation

(ii) Deep foundation

(2 marks)

(b) **Figure Q5.1** shows an elevation view of single storey building. Sketch and show the load transfer mechanism from superstructures to the foundation.

(3 marks)

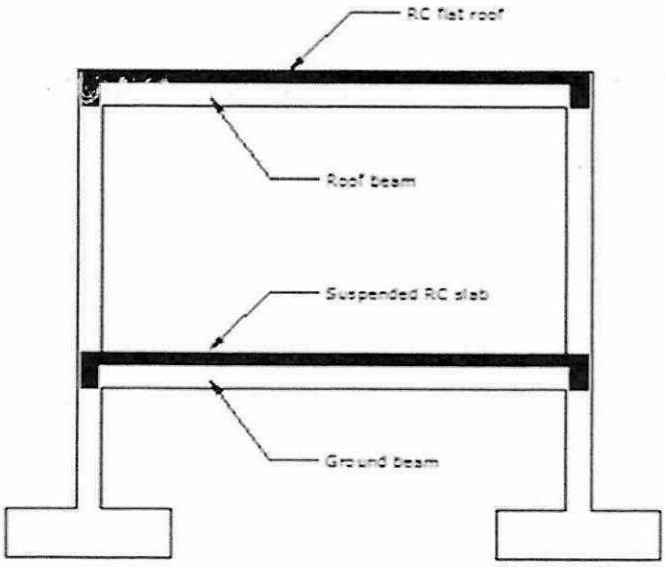

Figure Q5.1

(c) **Figure Q5.2** shows a part of ground floor key plan of a three-storey bungalow house. For economical design purposes, the footings under column 2B and 2C will be designed as a combined footing. Based the following design data:

Column size;

Column 2B	=	300 mm x 300 mm
Column 2C	=	300 mm x 300 mm

Axial load;

Column 2B	=	850 kN (Ultimate)
Column 2C	=	1050 kN (Ultimate)

Soil bearing capacity	=	150 kN/m^2
Characteristic strength of concrete, f_{ck}	=	35 N/mm^2
Characteristic strength of steel, f_{yk}	=	500 N/mm^2
Nominal cover, cnom	=	35 mm
Safety factor	=	1.4
Assumed ϕ bar	=	12 mm

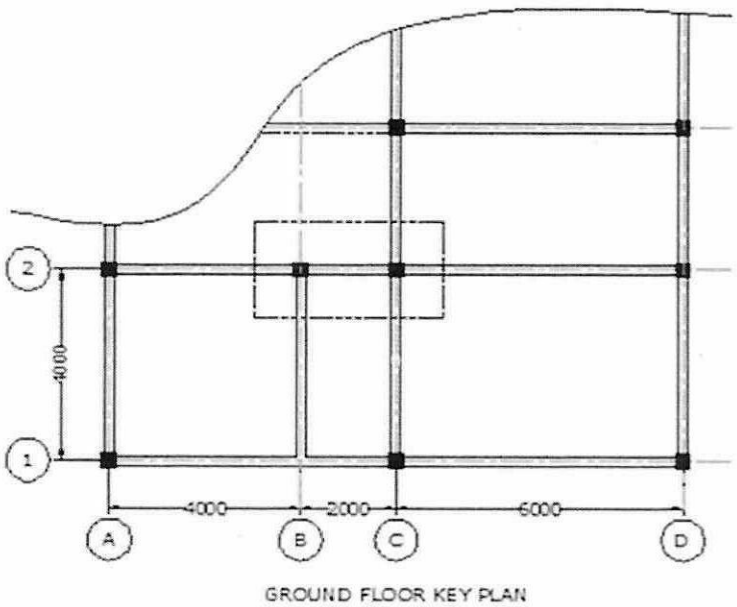

Figure Q5.2

(i) Propose the suitable size of combined footing if the width and the depth of the footing is limited to 2.10 m and 0.50 m respectively.

(4 marks)

(ii) Calculate and sketch the shear force and bending moment diagrams of the footing in longitudinal direction.

(8 marks)

(iii) Design the longitudinal reinforcement required for the footing.

(8 marks)

- END OF QUESTIONS -

APPENDIX A

Factory of safety against overturnig moment

Permanent action	Variable action
1.1	1.5

Factory of safety against restraining moment

Permanent action	Variable action
0.9	0

Stability against sliding factor of safety

Permanent action	Variable action
1.35	1.5

Friction factor = 0.5