Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	REINFORCED CONCRETE DESIGN II
COURSE CODE	:	BFC32803
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS 2. OPEN BOOK EXAMINATION 3. DESIGN SHOULD BE BASED ON: BS EN1990:2002+A1:2005 BS EN1991-1-1:2002 BS EN1992-1-1:2004

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

Q1 A straight longitudinal reinforced concrete staircase is supported by reinforced concrete beam at one end and block wall at the other end as shown in **Figure Q1**. It is specifically designed for public building. Landing slab is monolithically connected to the stairs. Given the following data:

Finishing and railing	:	1.2 kN/m^2
Variable action	:	4.0 kN/m^2
Characteristic strength of concrete, f_{ck}	:	25 N/mm^2
Characteristik strength of steel, f_{yk}	:	500 N/mm^2
Unit weight of concrete	:	25 kN/m^3
Nominal concrete cover, C_{nom}	:	25 mm
Main and secondary bar diameter	:	10 mm

(a) Based on the dimensions given in the **Figure Q1** and the requirement specified in *UBBL 1984*, determine the size of riser, R and going, G of the staircase.

(2 marks)

(b) Calculate the design actions and sketch the bending moment diagram for the staircase.

(10 marks)

(c) Design the main and secondary reinforcements for the staircase. Provide reinforcement detail for the staircase.

(8 marks)

(d) Verify cracking requirement for the reinforcement

(5 marks)

Q2 (a) Explain the necessity of minimum and maximum reinforcement area of a column.

(2 marks)

(b) A non-slender reinforced concrete column was designed to carry an axial load of 1500 kN and bending moment of 48 kNm about z-axis and 35 kNm about y-axis as shown in **Figure Q2(a)**. Calculate the design moment of the column with the effect of imperfection. Given:

Effective height in z-axis, L_{oz}	= 4.0 m
Effective height in y-axis, L_{oy}	= 3.5 m
Nominal concrete cover, C_{nom}	= 30 mm
Diameter of main bar	= 16 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

(4 marks)

(c) Assessment for biaxial bending for the same column in **Q2(b)** in accordance to Clause 5.8.9 in BS EN 1992-1-1:2004 shows that further checking for biaxial bending is required. Therefore, from the column design requirement, the arrangement of reinforcement as shown in **Figure Q2(b)** is proposed. Verify the arrangement of reinforcement for biaxial bending.

(17 marks)

(d) Justify the significance of biaxial bending checking.

(2 marks)

Q3 (a) A footing as shown in **Figure Q3(a)** will be constructed with the width, B of 2.6 m and length, H of 6.5 m. The thickness of the footing is one fourth its width. By assuming the selfweight of the footing is 15% from the service load, check whether the proposed size is suitable for soil bearing capacity of 210 kN/m^2.

(4 marks)

(b) From analysis, the bending moment diagram for footing in **Q3(a)** is shown in **Figure Q3(b)**. Based on the bending moment obtained, design all the reinforcements required. Given:

Nominal concrete cover, C_{nom}	= 40 mm
Bar diameter	= 16 mm
Characteristic strength of concrete, f_{ck}	= 35 N/mm^2
Characteristic strength of steel, f_{yk}	= 500 N/mm^2

(18 marks)

(c) In your opinion, if the selfweight of pile cap is assumed far lesser than the actual selfweight, will it significantly affect your design. Justify your reason.

(3 marks)

Q4 (a) State and explain **TWO (2)** types of retaining walls.

(4 marks)

(b) **Figure Q4** shows a cantilever retaining wall to be constructed to prevent slope failure for a new development of UTHM Pagoh Campus. The backfill soil is a well-compacted laterite soil without surcharge having a density, γ = 18 kN/m^3, angle of internal friction, ϕ = 30°, cohesion, c = 0, safe bearing pressure, q = 100 kN/m^2, unit weight of concrete = 25 kN/m^3 and coefficient of friction, μ = 0.45.

(i) Calculate the total positive and negative moments, vertical load and horizontal load imposed to the retaining wall associated with the wall elements and the backfill soil.

(10 marks)

(ii) Check the stability of the retaining wall based on sliding, overturning and settlement of the proposed retaining wall. Use partial safety factor as given in the **Figure Q4**.

(9 marks)

(iii) Based on stability analysis in some cases, the proposed retaining wall is subjected to the stability failure against sliding and the high level of water table behind the cantilever wall. As a design engineer, provide the appropriate design solution to overcome this problems.

(2 marks)

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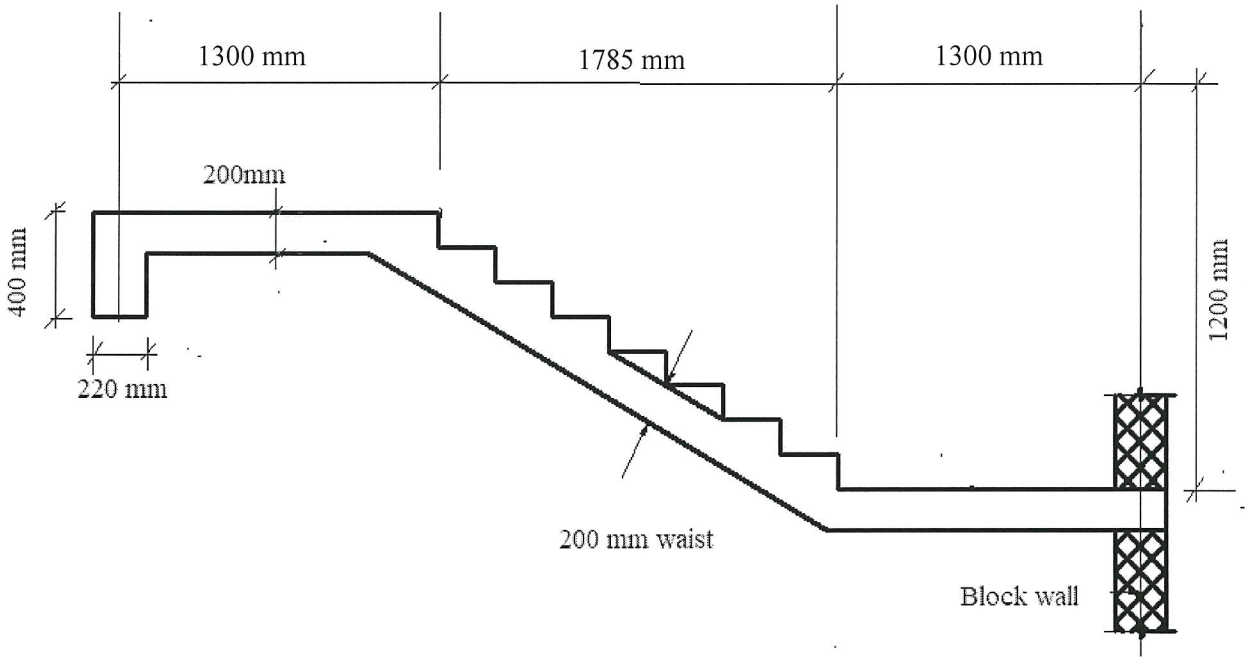

FIGURE Q1

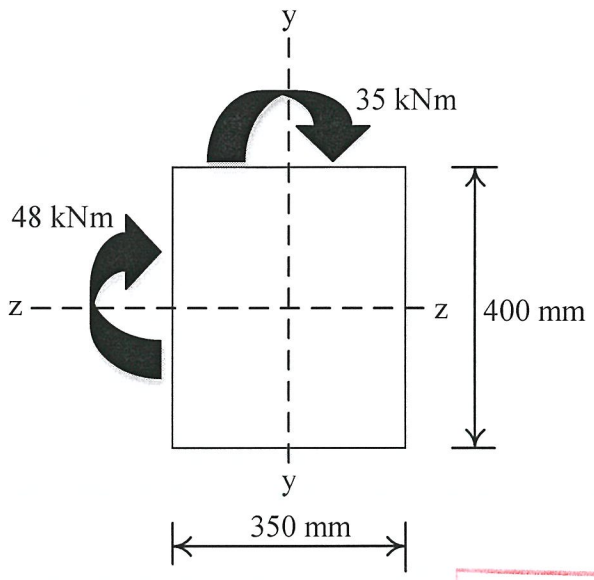

FIGURE Q2(b)

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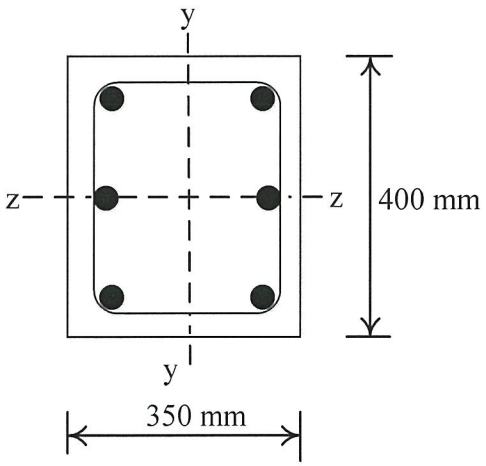

FIGURE Q2(c)

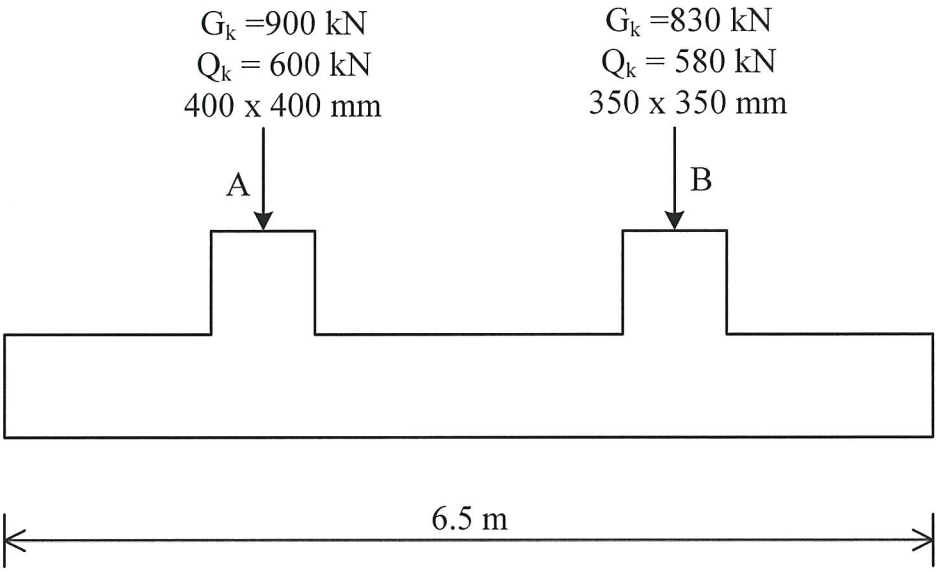

FIGURE Q3(a)

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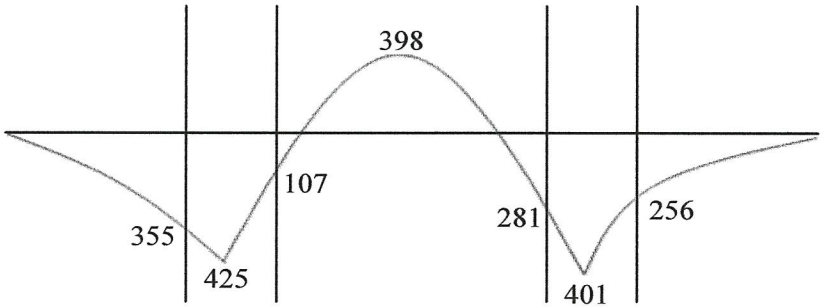
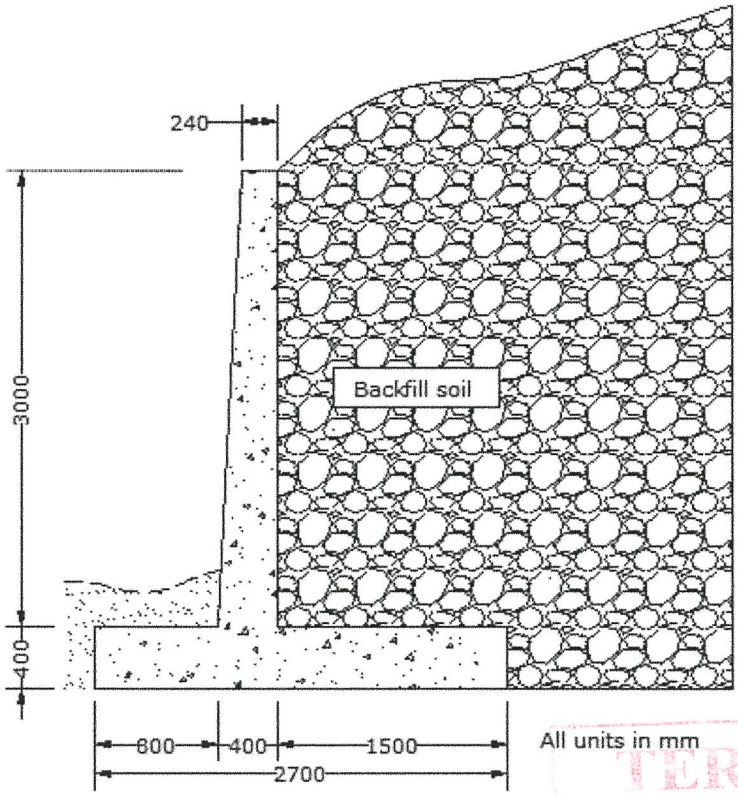


Bending moment diagram of footing (kNm)

FIGURE Q3(b)



Partial safety factor, γ		
Overturning	Overturning moment = 1.1	Restraining moment = 0.9
Sliding	Sliding force = 1.35	Resisting force = 1.0

FIGURE O4