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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	REINFORCED CONCRETE DESIGN II
COURSE CODE	:	BFC32803
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE 2017
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **FOUR (4)** QUESTIONS ONLY 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 **NINE (9)** PAGES

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Q1 (a) Define the following terms:

(i) Stair spanning longitudinally.

(ii) Stair spanning horizontally.

(2 marks)

(b) For stairs spanning longitudinally and stairs spanning horizontally, illustrate the followings with the aid of sketches.

(i) Effective span.

(ii) Main reinforcement.

(iii) Secondary reinforcement.

(3 marks)

(c) **Figure Q1** shows a plan view and a cross-section of proposed staircases. The stairs are supported on the landing slab at both ends. The dimension of the riser and going are based on the comfort consideration. The finish loads and live loads imposed on the staircases, landings and slab are 1.0 kN/m^2 and 3.0 kN/m^2 respectively. Use concrete grade = 30 and steel grade = 500, f_{ctm} = 2.6 N/mm^2, unit weight of concrete = 25 kN/m^3, cover 25 mm, $\emptyset_{bar}$ = 12 mm for main reinforcement and $\emptyset_{bar}$ = 10 mm for secondary reinforcement.

(i) Calculate the design load on the staircase.

(3 marks)

(ii) Calculate the shear force and bending moment of the staircase.

(3 marks)

(iii) Design the main and secondary reinforcement of the staircase.

(9 marks)

(iv) Check the deflection at the midspan.

(5 marks)

MOHAMMAD SOFFI BIN MD. NOH
Lecturer
Department of Structures and Materials Engineering
Faculty of Civil and Environmental Engineering
University Tun Hussein Onn Malaysia
86400 Parit Raja, Batu Pahat,
Johor Darul Ta'zim

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Q2 **Figure Q2(a)** shows a plan view of a new apartment reinforced concrete building which will be built at Johor Bahru area. An elevation view of the five storey building is shown in **Figure Q2(b)**. Beams and columns are designed with the size of 250 x 450 mm and 350 x 400 mm respectively. Given the maximum design load is 65.50 kN/m and the minimum design load is 35.50 kN/m.

(a) Calculate the stiffness and distribution factor for continuous beams 2/A-D.
(5 marks)

(b) Analyse the moment distribution of continuous beam 2/A-D, considering the maximum load for both end span and minimum for middle span.
(10 marks)

(c) Analyse the bending moment of the upper and lower columns 2/A and 2/B at Level 1 and draw the bending moment by showing all the important values.
(10 marks)

Q3 A new five storeys reinforced concrete apartment building will be built in the Johor Bahru area. Referring to **Figure Q3(a)** and **Figure Q3(b)**, the column should be designed as a braced member. All beams and columns are designed with the size of 250 x 450 mm and 350 x 400 mm respectively. From the loading analysis, the first lift of the column carried an ultimate axial load of 2500 kN. Bending moments of 50 kN/m and 35 kN/m about major and minor axes respectively. Given the maximum bar diameter = 25 mm, minimum bar diameter = 16 mm, link diameter = 6 mm, concrete cover = 30 mm, f_{ck} = 25 N/mm^2, f_{yk} = 500 N/mm^2 and slenderness limit, λ_{lim} = 31.

(a) Describe the differences between EC2 Clause 5.8.3.2(3) and conservative approach in BS 8110 in determining the effective length of the columns.
(2 marks)

(b) Calculate effective length of the column C/2, Ground level to Level 1 by using the BS 8110 approach.
(3 marks)

(c) Classify the column C/2, Ground level to Level 1 whether it is short or slender for both axes and determine the design moment for the column as shown in **Figure Q3(c)**.
(6 marks)

(d) Design all reinforcements for column C/2 bent about both axes and provide detailing.
(14 marks)

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Q4 (a) Discuss the followings;
(i) Shallow foundation
(ii) Deep foundation

(2 marks)

(b) **Figure Q4(a)** shows an elevation view of single storey building. Sketch and show the load transfer mechanism from superstructures to the foundation.

(3 marks)

(c) **Figure Q4(b)** shows a part of ground floor key plan of a light industrial building. For economical design purposes, the footing under column 2/B and 2/C has been decided to be designed as a combined footing. Based the following design data;

Column size;
Column 2/B = 300 mm x 300 mm
Column 2/C = 300 mm x 300 mm
Axial load;
Column 2/B = 850 kN (Ultimate)
Column 2/C = 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, c_{nom}	=	35 mm
Safety factor	=	1.4
Assumed ϕ_{bar}	=	12 mm

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

(4 marks)

(ii) Calculate and sketch 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)

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Q5 (a) Differentiate between Counterfort wall and Buttress wall.

(2 marks)

(b) With the aids of the sketch, illustrate the failure mechanism of cantilever retaining wall associated with stability analysis.

(3 marks)

(c) **Figure Q5** shows a cantilever retaining wall to be constructed to retain the backfill soil for a new rural road construction at Parit Raja area. To consolidate the backfill soil, the surcharge of 15 kN/m^2 will be imposed on its surface for a six month period. The backfill soil is a well-compacted gravel with a density, γ = 18 kN/m^3, angle of internal friction, ϕ = 30°, cohesion, c = 0, safe bearing pressure, q = 150 kN/m^2, and coefficient of friction, μ = 0.45.

(i) Calculate the active earth pressure to the retaining wall due to surcharge and backfill soil.

(3 marks)

(ii) Determine the bearing pressure, q of the retaining wall if the total vertical load, V_k and eccentricity, e are 154.5 kN and 0.10 m respectively.

(5 marks)

(ii) Design all the reinforcements required for the retaining wall. Given the following design data:

Characteristic strength of concrete, f_{ck}	=	35 N/mm^2
Characteristic strength of steel, f_{yk}	=	500 N/mm^2
Nominal cover, c_{nom}	=	40 mm
Assumed bar diameter	=	12 mm

(12 marks)

- END OF QUESTIONS –

Lecturer
Department of Structures and Materials Engineering
Faculty of Civil and Environmental Engineering
Universiti Tun Hussein Onn Malaysia
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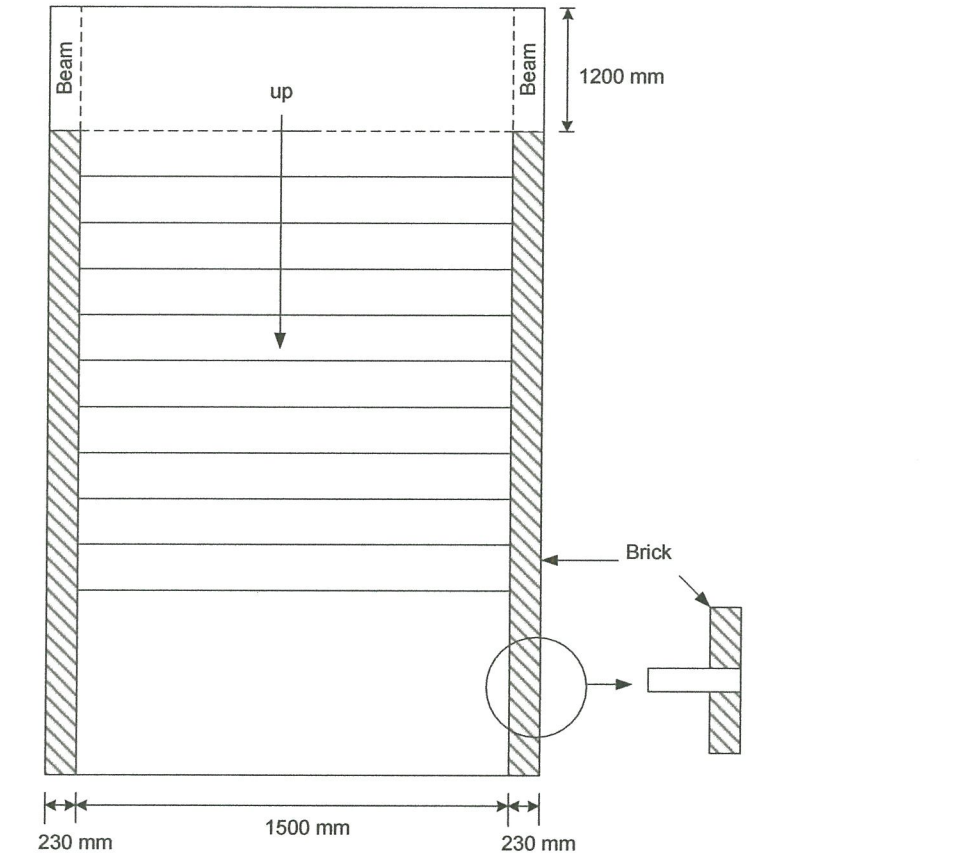

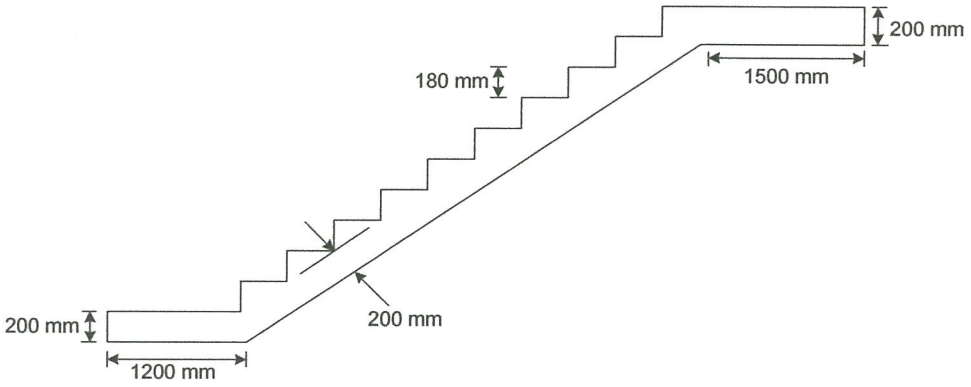

FIGURE Q1

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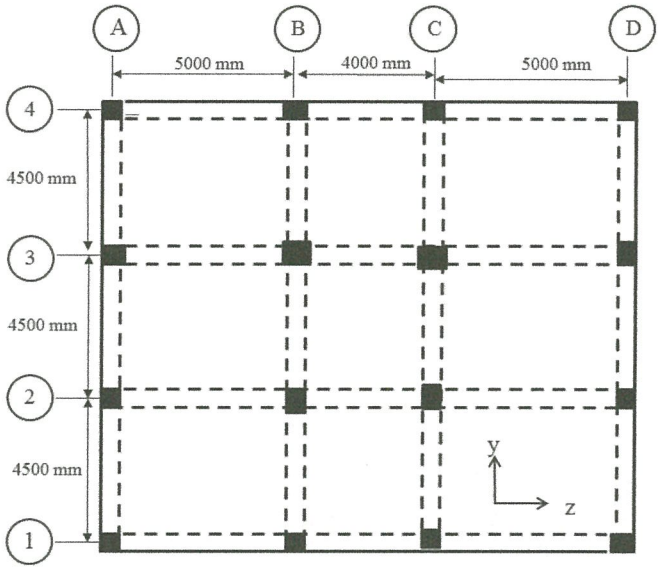

FIGURE Q2(a) / FIGURE Q3(a)

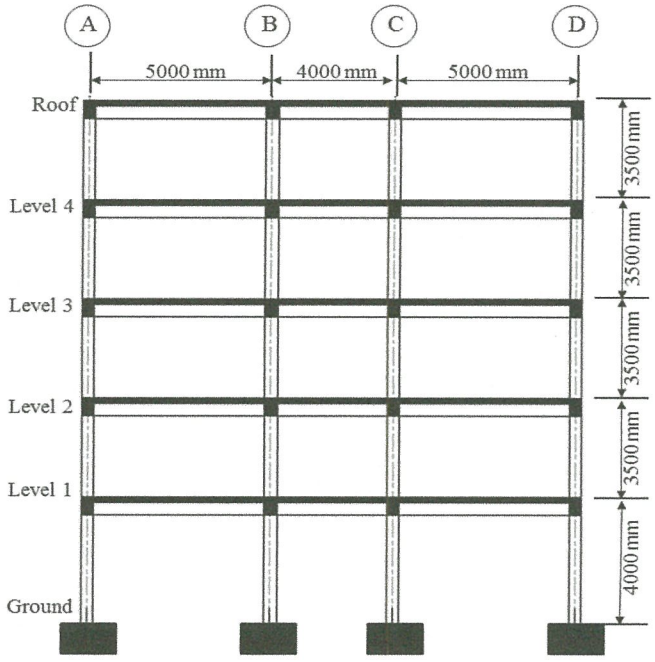

FIGURE Q2(b) / FIGURE Q3(b)

MOHAMMAD SOFFI BIN MD. NOH
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Faculty of Civil and Environmental Engineering
Universiti Tun Hussein Onn Malaysia
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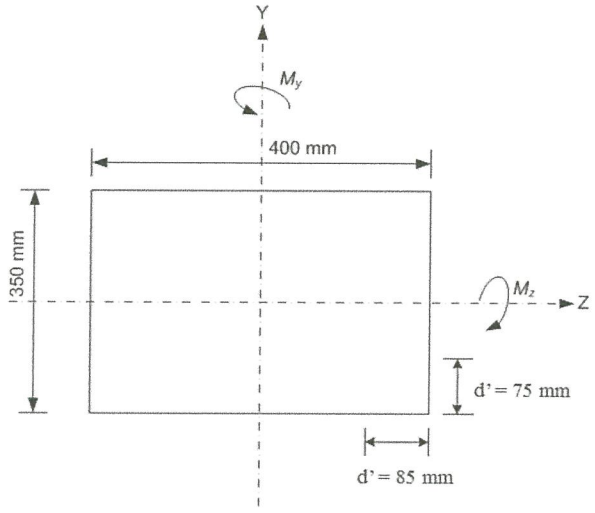

FIGURE Q3(c)

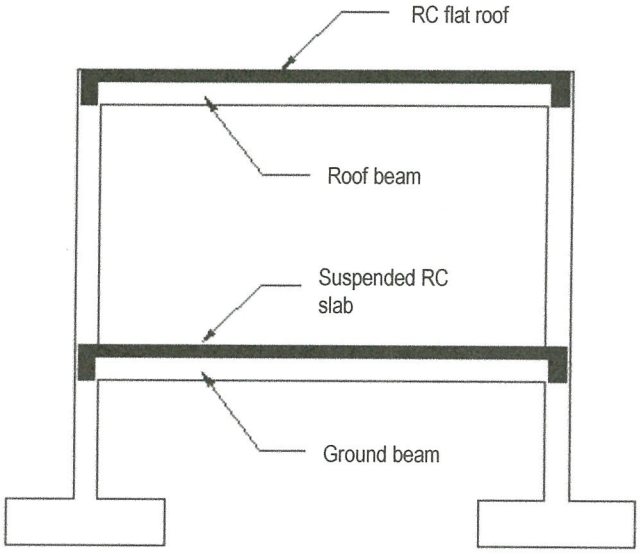

FIGURE Q4(a)

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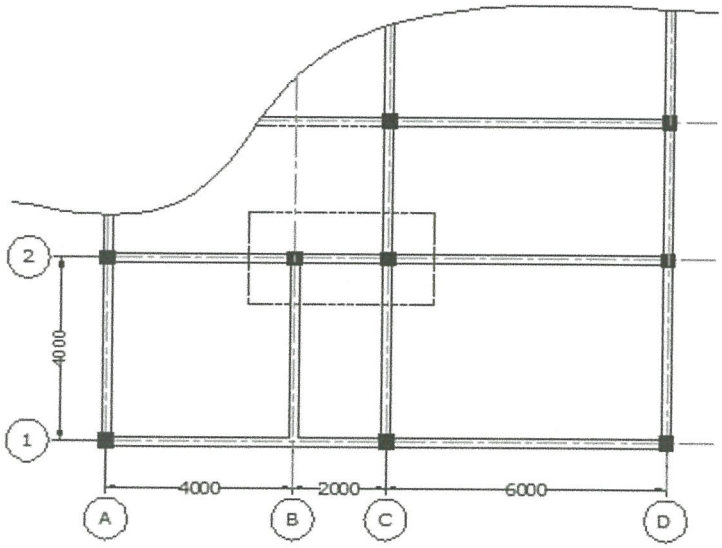

GROUND FLOOR KEY PLAN

FIGURE Q4(b)

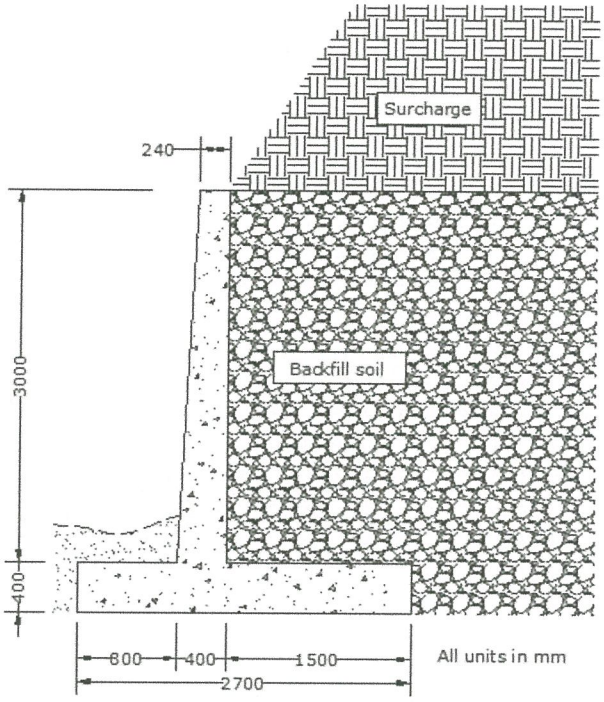

FIGURE Q5