Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	REINFORCED CONCRETE DESIGN 2
COURSE CODE	:	BFC 32803
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2018/ JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	1. OPEN BOOK EXAMINATION
		2. ANSWER **ALL** QUESTIONS
		3. DESIGN SHOULD BE BASED ON: BS EN 1990:2002+A1:2005, BS EN 1991-1-1:2002, BS EN 1992-1-1:2004

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

ANSWER ALL QUESTIONS

Q1 **FIGURE Q1** shows an unbraced frame system of reinforced concrete building located at exposed terrain with scattered obstructions. The wind load is non-linear and varies at different height, in which fully depending on the value of $\rho = 4.67M_{z,cat}$ kN/m. If the wind load is imposed at the left side of reinforced concrete building,

(a) Determine and draw the distribution of wind load on the frame.

(4 marks)

(b) Analyse and draw the shear forces of the frame from Levels D to E.

(17 marks)

(c) Describe the contribution of vertical load on the envelope response of the frame.

(4 marks)

Q2 (a) Describe the requirements of main and shear reinforcements, as according to EC2, in column design.

(5 marks)

(b) **FIGURE Q2(b)** shows a schematic view and cross section of the reinforced concrete braced column for an office building. The column carries an ultimate axial load of 2750 kN and bending moment about major axis of 45 kNm (+ve) at the upper end and 35 kNm (-ve) at the lower end. Given the following data:

Column size	= 300 mm x 400 mm
Main beam size	= 250 mm x 500 mm
Secondary beam size	= 200 mm x 400 mm
Characteristic strength of concrete, f_{ck}	= 30 N/mm^2
Characteristic strength of steel, f_{yk}	= 500 N/mm^2
Maximum bar diameter	= 25 mm
Minimum bar diameter	= 12 mm
Diameter of link	= 6 mm
Concrete cover, C_{nom}	= 30 mm
Main beam length each side	= 6000 mm
Secondary beam length each side	= 5500 mm
Effective length, l_o	= 3500 mm
Slenderness ratio, λ	= 30

(i) Calculate the slenderness limit and classify whether the column is short or slender.

(5 marks)

(ii) Calculate the design bending moment.

(4 marks)

(ii) Design the column at major axis and draw the complete detailing.

(11 marks)

Q3 The square pad footing, as shown in **FIGURE Q3**, is subjected to permanent action of 1200 kN and variable action of 250 kN from a 300 mm square column. The pad footing has 2.78 m^2 base and thickness of 600 mm. The characteristic material strength for concrete is 30 N/mm^2 and rebar yield strength is 500 N/mm^2.

(a) By assuming pad footing weight of 150 kN, check whether the proposed size is suitable for soil bearing of 200 kN/m^2.

(5 marks)

(b) Check the adequacy of the punching shear stress. Assume concrete cover is 50 mm and diameter bar of 16 mm.

(10 marks)

(c) Determine the reinforcement required to resist bending moment and sketch the simple detailing.

(10 marks)

Q4 (a) State and sketch **TWO (2)** types of retaining wall that are commonly constructed in Malaysia and discuss the selection criteria of each type.

(3 marks)

(b) Briefly explain the design procedure of cantilever retaining wall starting from preliminary element sizing up to providing all the reinforcement required.

(6 marks)

(c) **FIGURE Q4(c)** shows the cross section of a cantilever retaining wall to be constructed for a rural road development at Batu Pahat area. The backfill soil is a well-compacted laterite soil having a density, $\gamma = 17\ kN/m^3$, angle of internal friction, $\phi = 32^o$, cohesion, $c = 0$, friction coefficient, $\mu = 0.45$, and ultimate bearing capacity, $= 200\ kN/m^2$. The surcharge load of 20 kN/m^2 has been imposed on top of backfill soil for a 6 months period in order to monitor the settlement of the backfill soil.

(i) Calculate the total positive and negative moments, vertical load and horizontal load imposed to the retaining wall associated with the wall elements, surcharge and the backfill soil. Use unit weight of reinforced concrete of 25 kN/m^3.

(10 marks)

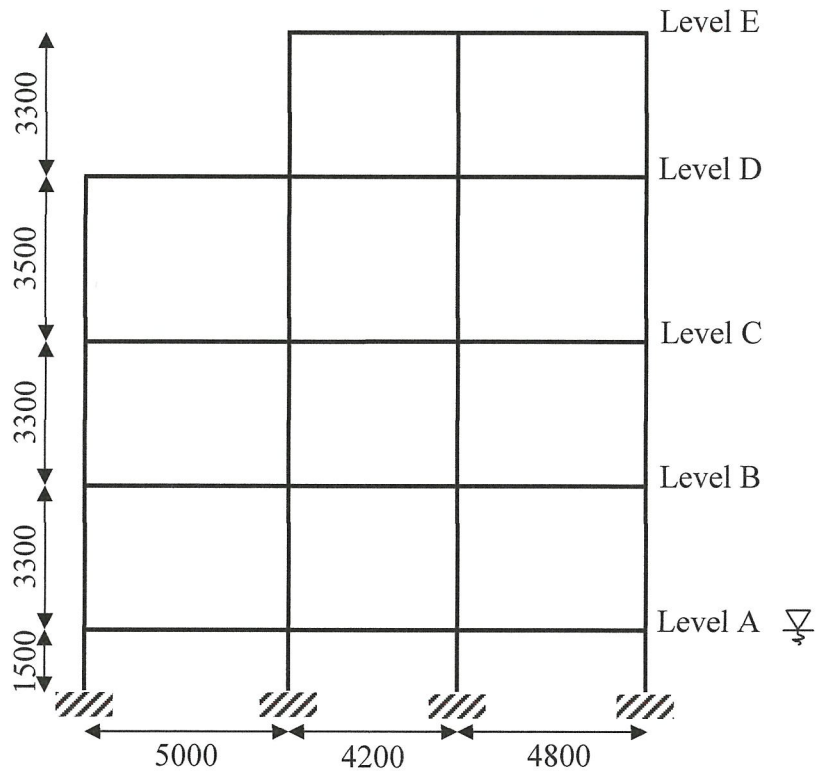
(ii) Check stability of the retaining wall against overturning and sliding. Use safety factor for overturning moment = 1.1 (permanent) and 1.5 (variable), restraining moment = 0.9, sliding force = 1.35 (permanent) and 1.5 (variable), and resisting force = 1.0.

(6 marks)

- END OF QUESTIONS -

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2018/2019
COURSE NAME : REINFORCED CONCRETE DESIGN 2
PROGRAMME : 3 BFF
COURSE CODE : BFC32803



All unit in mm

FIGURE Q1

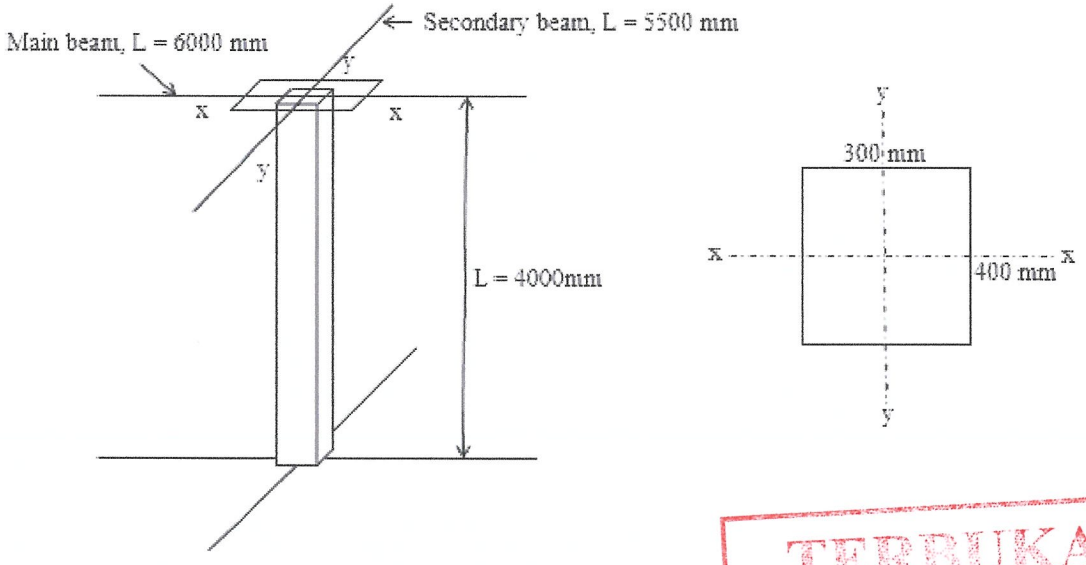


FIGURE Q2(b)

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2018/2019
COURSE NAME : REINFORCED CONCRETE DESIGN 2
PROGRAMME : 3 BFF
COURSE CODE : BFC32803

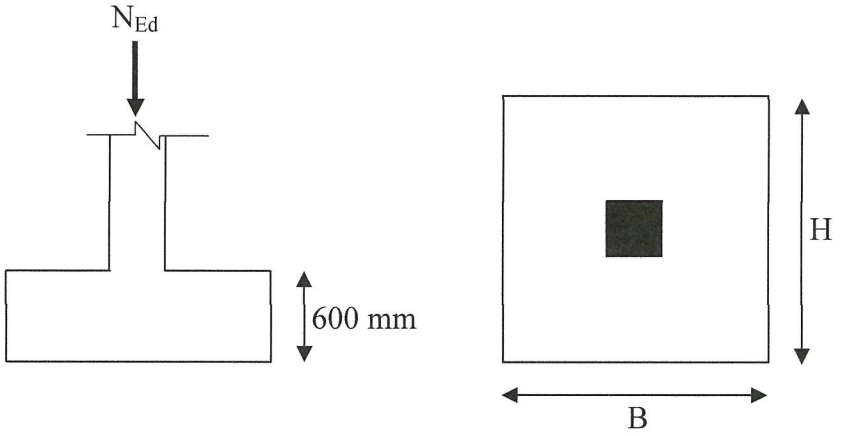


FIGURE Q3

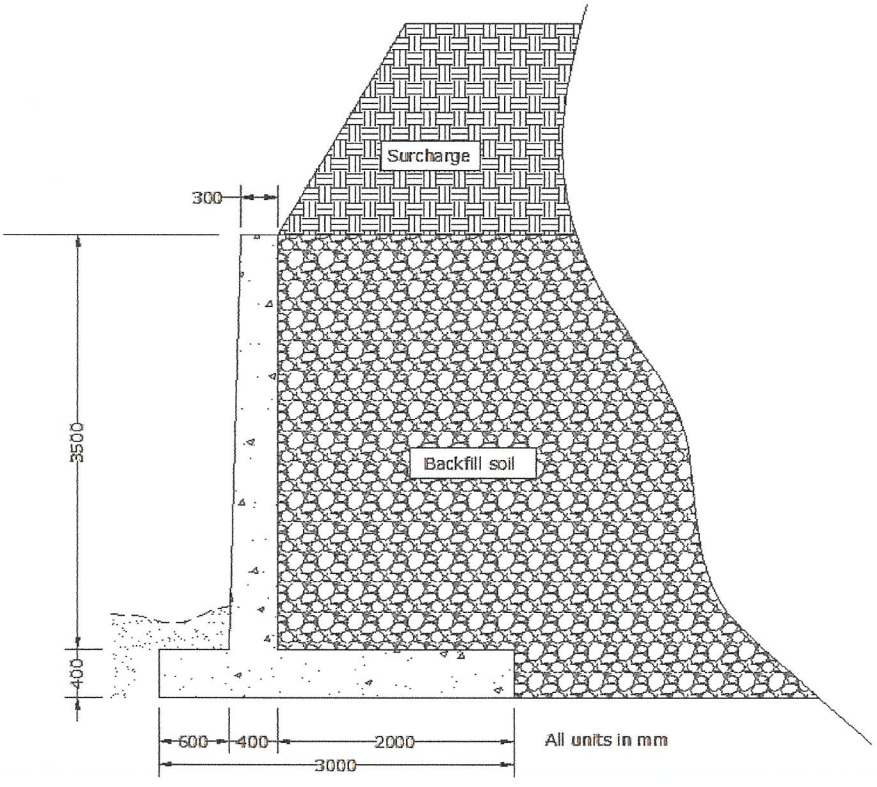


FIGURE Q4(c)