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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	REINFORCED CONCRETE DESIGN II
COURSE CODE	:	BFC 32802/BFC 3172
PROGRAMME	:	3 BFF
EXAMINATION DATE	:	JUNE 2014
DURATION	:	2 HOURS AND 30 MINUTES
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS IN **SECTION A** AND **TWO (2)** QUESTIONS IN **SECTION B** B) 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 **TEN (10)** PAGES

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SECTION A

Q1 (a) Give **TWO (2)** most important benefit of prestressing a beam.

(2 marks)

(b) Describe **THREE (3)** basic stages of prestressing concrete.

(3 marks)

(c) Draw the mid-span stress distribution for a given uniformly distributed prestressed beam where the prestressing force is applied axially along the neutral axis of the section. Indicate the important notations in the diagram.

(5 marks)

(d) A double continuous span post-tensioned beam with cross section shown in Figure **Q1** carries a live load of 5 kN/m throughout the spans. The effective prestress force, P applied is 2000 kN. The allowable tensile and compressive stresses are -0.5 N/mm^2 and 15 N/mm^2, respectively. Take density of concrete as 25 kN/m^3. Check the actual stresses at the middle support B (section Y-Y) with the allowable stresses. Given the maximum hogging moment is equal to $\frac{WL^2}{8}$, where w is the uniformly distributed load and L is the span length.

(10 marks)

Q2 (a) Explain **THREE (3)** reasons of using pile foundation in the construction.

(3 marks)

(b) Describe briefly the theories in pile cap design.

(4 marks)

(c) A pile foundation needs to be designed for an office building at soft soil area. It is required to support permanent axial action 4000 kN and variable action 3000 kN from a 450 x 450 mm rectangular reinforced concrete column. Service load capacity for the pile is 2000 kN. The diameter of pile is 600 mm.

(i) Determine the suitable number of pile and size of pile cap.

(11 marks)

(ii) Draw the detail size of pile cap with the exact dimensions.

(2 marks)

SECTION B

Q3 A straight longitudinal reinforced concrete stairs supported by reinforced concrete beams at both ends is shown in Figure **Q3**. The staircase is specifically for the public building. Landing slabs at both ends of the stairs are monolithically connected to the stairs. The flight of staircase consists of 10 steps. The average thicknesses of staircase are 279 mm and 189 mm.Given the following data:

Permanent action	= 1.2 kN/m^2
Variable action	= 4.0 kN/m^2
Characteristic strength of concrete	= 25 N/mm^2
Characteristic strength of steel	= 500 N/mm^2
Unit weight of reinforced concrete	= 25 kN/mm^3
Nominal concrete cover	= 25 mm
Beam size	= 220 mm x 400 mm
Upper Landing area	= 1200 mm x 1000 mm
Lower Landing area	= 1500 mm x 1000 mm
Reinforcement	= 12 mm

(a) Determine the suitable size of riser, going and waist.

(5 marks)

(b) Determine all actions, bending moment and shear force.

(5 marks)

(c) Design shear resistance of the staircase if required longitudinal reinforcement is only 5.2% of maximum main reinforcement.

(15 marks)

(d) Provide a complete detailing of reinforcements for the staircase.

(5 marks)

Q4 (a) Define the differences between braced and unbraced frame.

(4 marks)

(b) A four storey braced building is given in Figure **Q4**. Perform the analysis by utilizing completed sub-frame method for ABCD. Given the following data:

Column size	= 350 mm x 300 mm
Beam size	= 300 mm x 600 mm
Permanent action (including self-weight)	= 25 kN/m
Variable action	= 10 kN/m

(i) Define the stiffness, K, for beam, upper and lower column. Then calculate the distribution factor, (DF) for each element (beam, upper and lower column).

(10 marks)

(ii) Calculate the bending moment of beam and column by utilizing moment distribution method. Use the single load case combination (all maximum).

(16 marks)

Q5 (a) By using a sketch, describe briefly the moment diagram for slender column.

(5 marks)

(b) Figure **Q5** shows a cross section of a short braced column for a building. The column is to be designed to resist an ultimate axial load of 1500 kN. The first-order eccentricities in *Z* and *Y* directions are 65 mm and 70 mm, respectively.

(i) Determine M_z and M_y

(4 marks)

(ii) Check for biaxial bending

(4 marks)

(iii) Design the main reinforcement of the column

(12 marks)

(iv) Sketch the detailing

(5 marks)

- END OF QUESTION -

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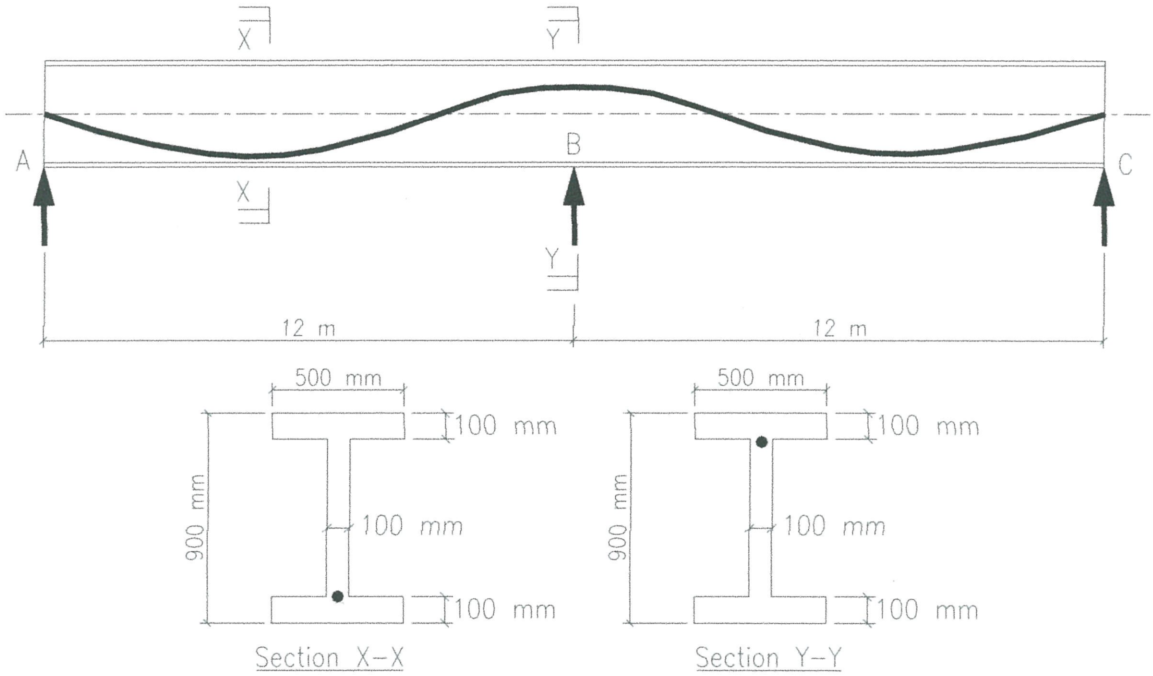

FIGURE Q1

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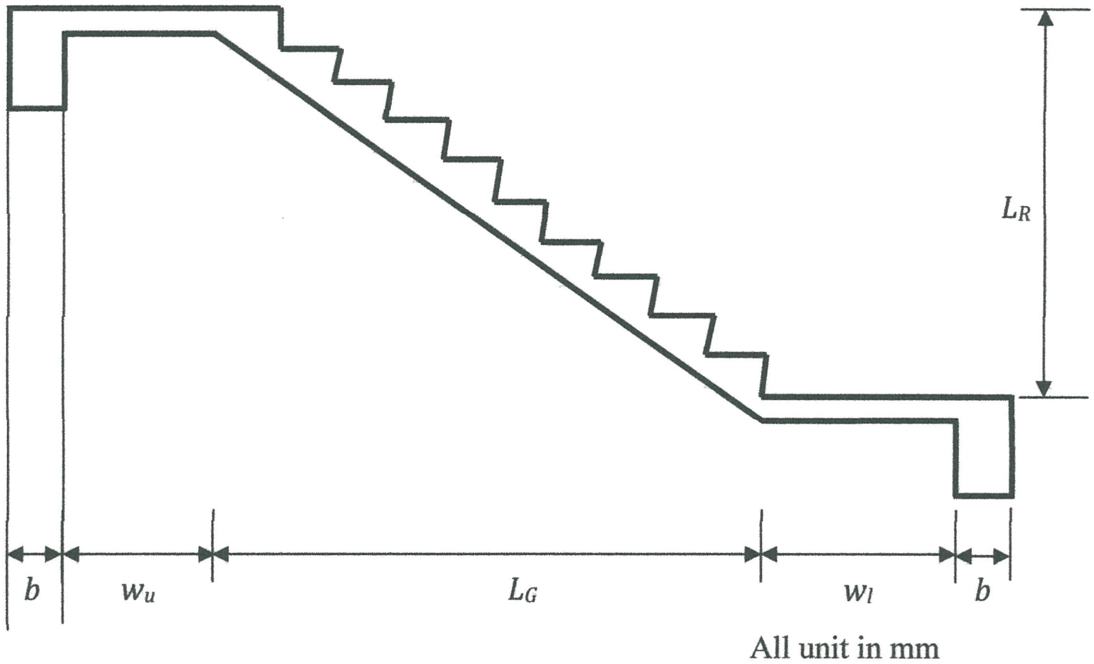

FIGURE Q3

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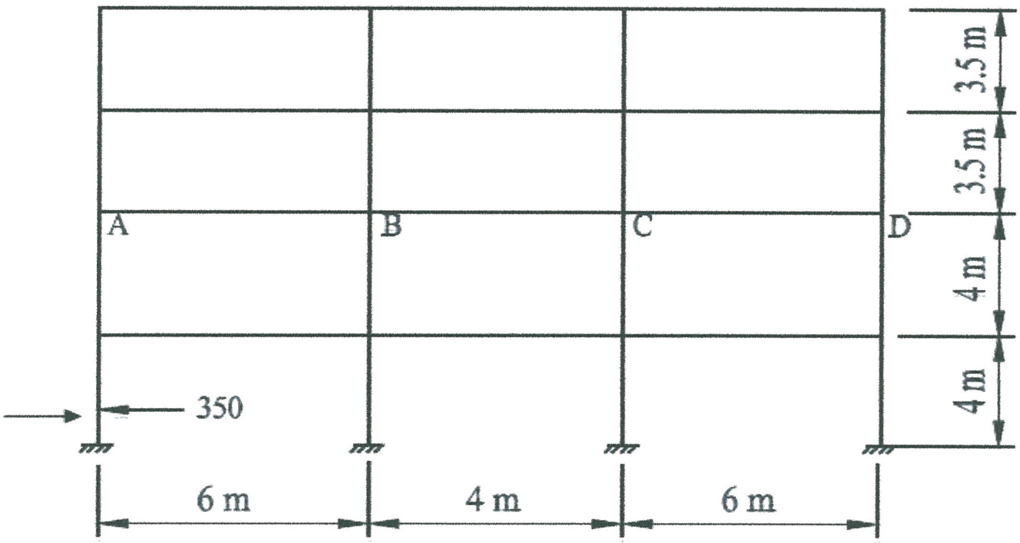

FIGURE Q4

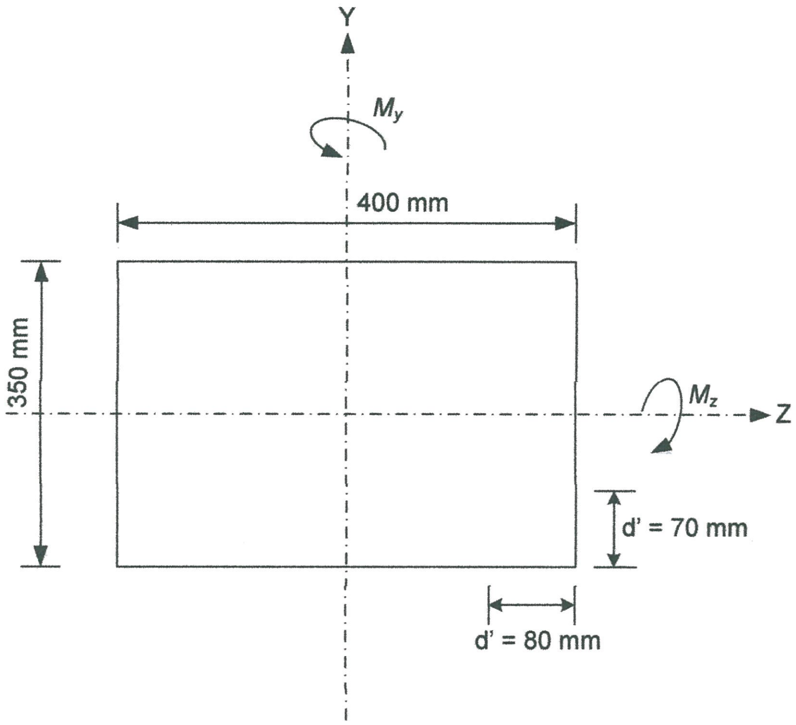

FIGURE Q5

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If $h_p \leq 550$ mm : $h = 2h_p + 100$

If $h_p > 550$ mm : $h = \frac{1}{3}(8h_p - 600)$

Where, h is the depth of pile cap and h_p is the diameter of pile.

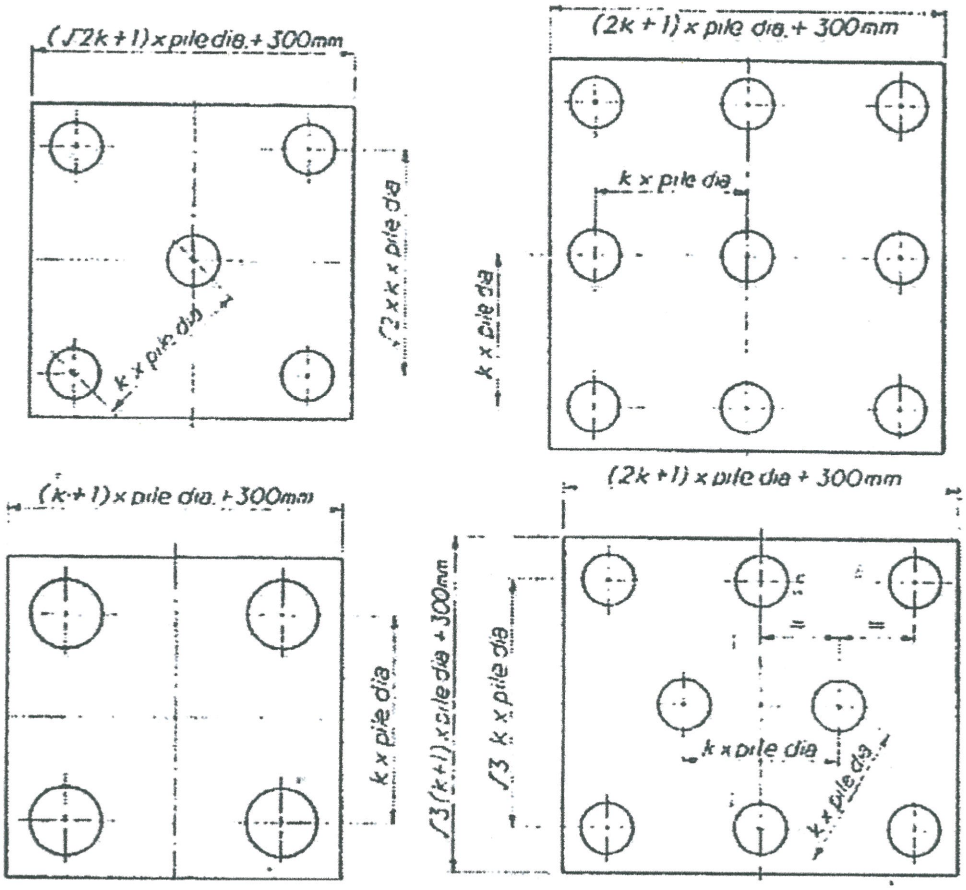

Figure 4.6: Typical size of pile cap
(Source : "Pile design and construction practice", Tomlinson[15])

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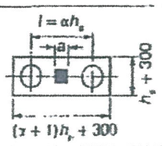
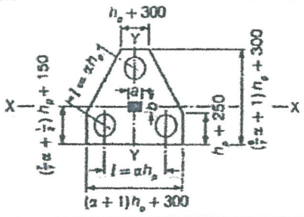
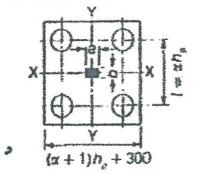
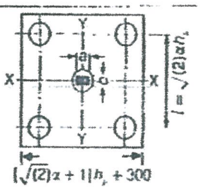
Number of piles	Dimensions of pile cap	Tensile force to be resisted by reinforcement: Neglecting of column	Tensile force to be resisted by reinforcement: Taking size of column into consideration
2		$\frac{Nl}{4d}$	$\frac{N}{12ld}(3l^2 - a^2)$
3		$\frac{Nl}{9d}$	Parallel to X-X: $\frac{N}{36ld}(4l^2 + b^2 - 3a^2)$ Parallel to Y-Y: $\frac{N}{18ld}(2l^2 - b^2)$
4		$\frac{Nl}{8d}$	Parallel to X-X: $\frac{N}{24ld}(3l^2 - a^2)$ Parallel to Y-Y: $\frac{N}{24ld}(3l^2 - b^2)$
5		$\frac{Nl}{10d}$	Parallel to X-X: $\frac{N}{30ld}(3l^2 - a^2)$ Parallel to Y-Y: $\frac{N}{30ld}(3l^2 - b^2)$

Notation h_p diameter of pile; a, b dimensions of column, α spacing factor of piles (normally between 2 and 3 depending on ground conditions)