UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	REINFORCED CONCRETE DESIGN II
COURSE CODE	:	BFC 32802 / BFC 3172
PROGRAMME	:	3 BFF
EXAMINATION DATE	:	DECEMBER 2013/ JANUARY 2014
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	A) ANSWER ANY **FOUR (4)** QUESTIONS ONLY 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 **EIGHT (8)** PAGES

Q1 Figure **Q1** shows a part of plan and cross section of a staircase that connects level one and mezzanine floor in an office building. The staircase is supported by a reinforced concrete beam at the left and right ends. The flight of staircase consists of 10 steps. The overall depth is 160 mm for both flight and landing, while the height of riser is 175 mm. Given the following data:

Finishing and services	= 1.0 kN/m^2
Variable action	= 5.0 kN/m^2
Characteristic strength of concrete, f_{ck}	= 25 N/mm^2
Characteristic strength of steel, f_{yk}	= 500 N/mm^2
Nominal cover	= 25 mm
Reinforcement diameter	= 12 mm

(a) Determine design bending moment and shear force of the staircase.

(8 marks)

(b) Design the shear resistance of staircase if the required area of main reinforcement is 1.88 bigger than the provided area of secondary reinforcement. Assume the required area of secondary reinforcement is less than minimum reinforcement area and distance between bar is 400 mm.

(12 marks)

(c) Verify the cracking requirement of the staircase.

(5 marks)

Q2 (a) Explain the method of sub-frame analysis with the aid of sketching.

(10 marks)

(b) Figure **Q2** shows a plan and side view of reinforced concrete building frame which will be built without any bracing member. All beams are designed with a size of 250 x 500 mm. All columns have a cross section of 300 x 500 mm. The building will be built at Zone 1 and flat area. The wind pressure near the location is assumed to be 0.75 kN/m^2.

(i) Determine the characteristic wind action for sub frame B/1-4 and point load due to the horizontal action at each floor level. Draw the action for each floor.

(7 marks)

(ii) Calculate the centre of gravity of the frame and column axial load. Determine shear force in beams and columns for roof level due to the horizontal action.

(8 marks)

Q3 Figure **Q3** shows a section of a braced concrete tower. The square column size is 500 x 500 mm and connected monolithically with a beam size 350 x 700 mm on both directions. All the beams are subjected to dead load of 50 kN/m and imposed load of 60 kN/m. The ultimate axial load on column B is 2010 kN. The strength of reinforced concrete, f_{ck} = 30 N/mm^2 and f_{yk} = 500 N/mm^2. The height of the column is 4.0 m.

(a) Calculate a maximum moment, My and Mz for column B.

(13 marks)

(b) Check for biaxial bending of column B. (Given: h' = b' = 60 mm)

(5 marks)

(c) Design the main reinforcement for column B

(7 marks)

Q4 A rectangular footing is designed to support two columns carrying the following loads:

Column 1	Dead load = 310 kN, imposed load = 160 kN
Column 2	Dead load = 430 kN, imposed load = 220 kN

The size of both columns is 350 x 350 mm and spaced at 2.5 m centre. The width of the base should not exceed 2.0 m. The safe bearing pressure on the ground is 160 kN/m^2. (Given: h = 600 mm, f_{ck} = 30 N/mm^2, f_{yk} = 500 N/mm^2, cover = 40 mm, $\emptyset_{bar}$= 12 mm, z = 0.95d)

(a) Determine the suitable size of the footing and centerline of the load.

(6 marks)

(b) Design the main and transverse reinforcements for the footing.

(14 marks)

(c) Check critical shear at 1.0*d* from the column face.

(5 marks)

Q5 A simply supported post-tensioned concrete beam is applied with initial prestress force of 4000 kN at an eccentricity of 525 mm below centroid. The dimension of post-tensioned concrete beam is shown in Figure **Q5**. The beam which carries a uniformly distributed service load excluding selfweight of 20 kN/m is to be designed with grade C40 concrete and to be stressed at 7 days after casting. Assume short term losses of α and β are 0.9 and 0.8 respectively. Given the following data:

Position of centroid, x and y = 375 mm and 704.413 mm from O
Moment of Inertia, I = 134.71×10^9 mm^4
Section Modulus, Z_t and Z_b = 208.66×10^6 mm^3 and 191.23×10^6 mm^3

(a) Describe the principles of stress distribution at transfer and service for the design of a simply supported post-tensioned concrete beam.

(5 marks)

(b) Determine the required section modulus of the beam.

(12 marks)

(c) Analyse the limiting stress at tansfer and service.

(8 marks)

- END OF QUESTION -

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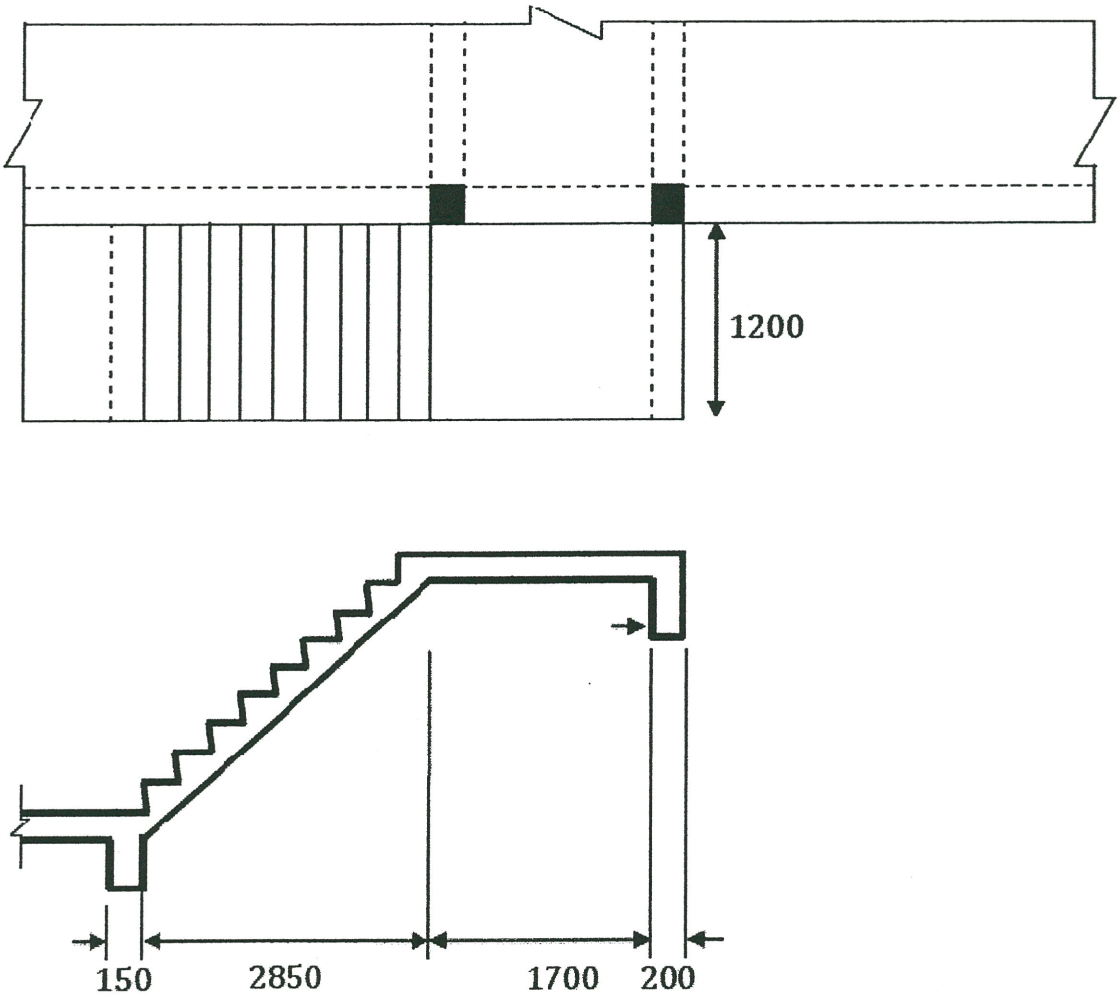

All unit in mm

FIGURE Q1

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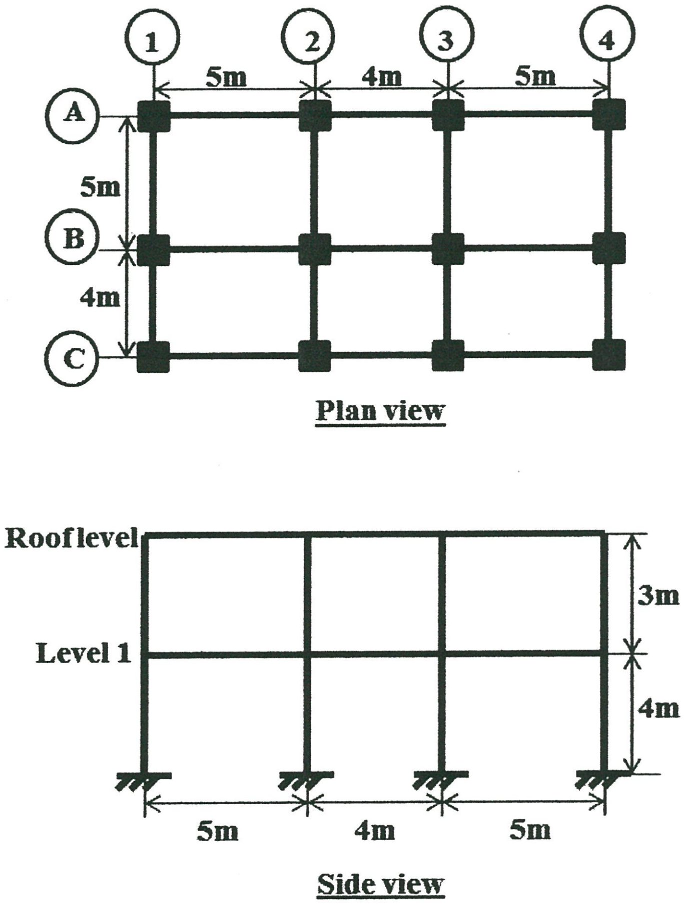

FIGURE Q2

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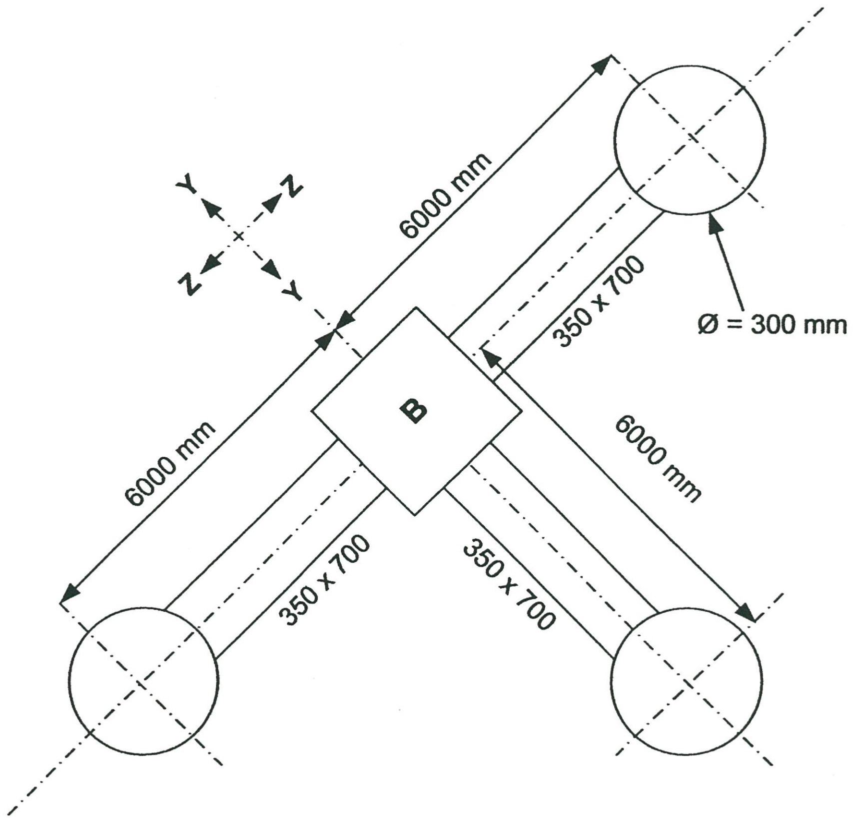

FIGURE Q3

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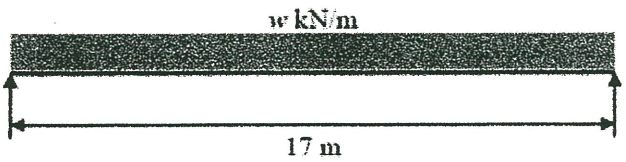
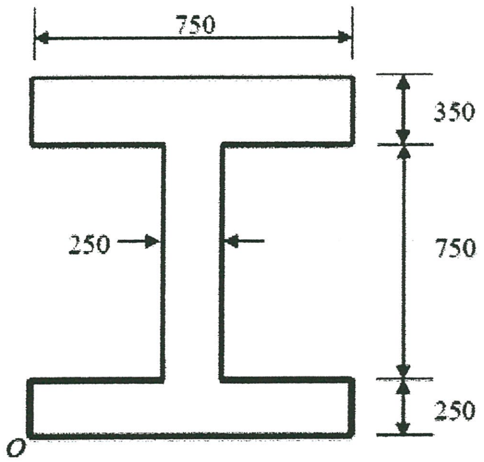
Attachment for Q4

$\rho_1 = \frac{A_s}{bd}$	Effective depth, d (mm)								
	≤ 200	225	250	300	350	400	500	600	750
0.25%	0.54	0.52	0.50	0.47	0.45	0.43	0.40	0.38	0.36
0.50%	0.59	0.57	0.56	0.54	0.52	0.51	0.48	0.47	0.45
0.75%	0.68	0.66	0.64	0.62	0.59	0.58	0.55	0.53	0.51
1.00%	0.75	0.72	0.71	0.68	0.65	0.64	0.61	0.59	0.57
1.25%	0.80	0.78	0.76	0.73	0.71	0.69	0.66	0.63	0.61
1.50%	0.85	0.83	0.81	0.78	0.75	0.73	0.70	0.67	0.65
2.00%	0.94	0.91	0.89	0.85	0.82	0.80	0.77	0.74	0.71
k	2.000	1.943	1.894	1.816	1.756	1.707	1.632	1.577	1.516

Shear resistance of slab without shear reinforcement





All unit in mm

FIGURE Q5