UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2010/2011

COURSE NAME	:	STRUCTURAL CONCRETE DESIGN II
COURSE CODE	:	BFC3172
PROGRAMME	:	3 BFF
EXAMINATION DATE	:	APRIL / MAY 2011
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER QUESTION Q1 IN PART A AND TWO (2) QUESTIONS IN PART B. DESIGN SHOULD BE BASED ON BS8110.

THIS PAPER CONSISTS OF FOURTEEN (14) PAGES

PART A

Q1 (a) Explain the difference between pre-tensioned concrete and post-tensioned concrete.

(4 marks)

(b) List **Four (4)** types of prestressed loss.

(4 marks)

(c) Creep and shrinkage are two of the main problem of concrete. Briefly explain how these problem affect the loss of prestressing force.

(6 marks)

(d) A 500 mm x 750 mm prestressed rectangular simply supported beam of 7.3 m span is loaded by a uniformly distributed load of 45 kN/m including the self weight. The prestressing tendon is located as shown in Figure **Q1** and produces an effective prestress of 2000 kN. If the beam was designed as class 1 structure, check whether all limiting stresses are satisfied. Given:

Loss of prestressing force (initial and service)	=	15% and 25%
Concrete grade at service, f_{cu}	=	35 N/mm^2
Concrete grade at initial, f_{ci}	=	25 N/mm^2

(16 marks)

PART B

Q2 Figure **Q2** shows a side elevation of a staircase that connects level one and a mezzanine floor in a hotel building. Prepare a design for the staircase and the landing accordingly using the following data:

Rise	=	175 mm
Going	=	275 mm
Waist	=	150 mm
Concrete characteristic strength,fcu	=	30 N/mm^2
Steel characteristic strength,fy	=	460 N/mm^2
Concrete cover	=	20 mm
Reinforcement diameter	=	12 mm
Finishing and services	=	1.0 kN/m^2
Live load	=	5.0 kN/m^2

(a) Calculate the design load for the staircase and the landing.

(5 marks)

(b) Using the formula $\frac{FL}{10}$, determine the bending moments.

(5 marks)

(c) Design the reinforcements for the staircase and landing.

(10 marks)

(d) Given the maximum shear is 27 kN/m, verify the shear capacity.

(5 marks)

(e) Verify the actual deflection and cracking.

(4 marks)

(f) Draw the detailing for the staircase and landing.

(6 marks)

Q3 Figure **Q2** shows the typical floor plan and elevations of a four storey unbraced reinforced concrete frame. The horizontal wind pressure from all directions is 5 kN/m^2.

(a) Calculate the static horizontal load at nodes due to the wind pressure for the 2-dimensional frame at grid B/1-4 and 2/A-D.

(8 marks)

(b) For the reinforced concrete frame at grid B/1-4, using Portal Method:

(i) Calculate axial force for the lowest level columns.

(7 marks)

(ii) Calculate the shear force for level 4 beams, axial and horizontal forces for the highest level column.

(10 marks)

(iii) Sketch the bending moment diagram for level 4 beams and the highest level columns due to the horizontal load.

(5 marks)

(c) If the shear wall is to be used to brace the reinforced concrete frame, identify with sketch the suitable locations for the shear wall.

(5 marks)

Q4 (a) Effective height of column can be determined based on methods given in clause 3.8.1.6, BS8110: Part 1: 1997 and clause 2.5, BS8110: Part 2: 1985. Briefly explain both of methods for determining effective height of braced column.

(6 marks)

(b) A short braced column supporting an approximately symmetrical beam arrangement with diameter of 300 mm as shown in Figure **Q4(a)**. Calculate the maximum axial loads that can be carried by the column if concrete grade used is 30.

(4 marks)

(c) Figure **Q4(b)** shows an isometric view of the column in braced office building. From the structural analysis, the column was bending about major axis only with double curvature. Given the following data:

M_{1x}	=	46 kNm
M_{2x}	=	80 kNm
N	=	800 kN
f_{cu}	=	30 N/mm^2
f_y	=	460 N/mm^2
Concrete cover	=	25 mm
Dia. of longitudinal reinforcement	=	16 mm
Dia. of shear link	=	6 mm

(i) Based on Clause 3.8.1.3: BS 8110: Part 2: 1997, classify the column either it short or slender column.

(7 marks)

(ii) Design the longitudinal reinforcement required for the column.

(12 marks)

(iii) Determine the link required for the column.

(3 marks)

(d) From your opinion, what are the factors that influencing column design?

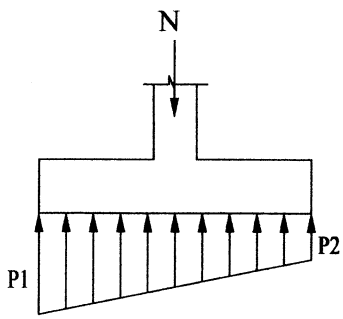
(3 marks)

Q5 Figure **Q5** shows an isolated pad footing subjected to the maximum axial load of 600 kN and bending moment of 150 kNm due to the load eccentricity at both directions. Given the following data:

Characteristic strength of concrete	=	35 N/mm^2
Characteristic strength of reinforcement	=	460 N/mm^2
Soil bearing capacity	=	250 kN/m^2
Effective depth of footing	=	400 mm

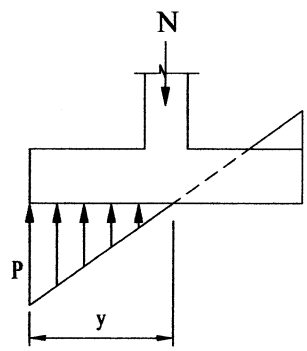
(a) Calculate the stress and sketch its distribution underneath the pad footing. Ignore selfweight of the footing. Given:

Case 1: e < D/6



$$P = \frac{N}{BD} \pm \frac{6M}{BD^2}$$

Case 2: e > D/6



$$P = \frac{2N}{By} \text{ where } y = 3\left(\frac{D}{2} - e\right)$$

(6 marks)

(b) Design all of the reinforcements.

(9 marks)

(c) Check the maximum shear at the perimeter of the column and vertical shear at distance,d from the surface of the column. Use average stress to represent uniform stress distribution.

(9 marks)

(d) Check the cracking.

(4 marks)

(e) Sketch the detailing. Assume reinforcement distribution is uniform.

(3 marks)

(f) Propose **One (1)** method with justification to reduce the bending moment of the above pad footing during the construction.

(4 marks)

BAHAGIAN A

S1 (a) Terangkan perbezaan di antara konkrit prategasan dan konkrit pascategasan.

(4 markah)

(b) Senaraikan **Empat (4)** jenis kehilangan prategasan.

(4 markah)

(c) Rayapan dan pengecutan merupakan dua masalah utama konkrit. Secara ringkas terangkan bagaimana masalah-masalah ini mempengaruhi kehilangan daya prategasan.

(6 markah)

(d) Satu rasuk prategasan sokong mudah segiempat tepat berukuran 500 mm x 750 mm mempunyai panjang rentang 7.3 m dan dikenakan beban teragih seragam sebanyak 45 kN/m termasuk berat sendiri rasuk. Tendon prategasan diletakkan seperti yang ditunjukkan dalam Rajah **Q1** dan menghasilkan prategasan efektif sebanyak 2000 kN. Jika rasuk dikelaskan sebagai kelas 1, semak samada semua had tegasan dipenuhi. Diberi:

Kehilangan daya tegasan (pindah dan khidmat)	=	15% dan 25%
Gred konkrit (khidmat), f_{cu}	=	35 N/mm^2
Gred konkrit (pindah), f_{ci}	=	25 N/mm^2

(16 markah)

BAHAGIAN B

S2 Rajah **Q1** menunjukkan pandangan sisi sebuah tangga daripada paras bawah ke tingkat menzanin sebuah bangunan hotel. Sediakan satu rekabentuk bagi larian tangga dan pelantar mengikut data yang diberikan:

Penaikan	=	175 mm
Pemijak	=	275 mm
Tebal cekak	=	150 mm
Kekuatan ciri konkrit,fcu	=	30 N/mm^2
Kekuatan ciri keluli,fy	=	460 N/mm^2
Penutup konkrit	=	20 mm
Diameter tetulang	=	12 mm
Kemasan dan perkhidmatan	=	1.0 kN/m^2
Beban hidup	=	5.0 kN/m^2

(a) Kirakan beban rekabentuk bagi larian tangga dan pelantar.

(5 markah)

(b) Dengan menggunakan formula FL/10, tentukan nilai-nilai momen.

(5 markah)

(c) Sediakan rekabentuk tetulang bagi larian tangga dan pelantar.

(10 markah)

(d) Diberi nilai ricih maksimum 27 kN/m, lakukan semakan ricih.

(5 markah)

(e) Lakukan semakan pesongan dan keretakan.

(4 markah)

(f) Lukiskan perincian bagi larian tangga dan pelantar.

(6 markah)

S3 Rajah **Q2** menunjukkan pelan lantai tipikal dan pandangan untuk satu kerangka konkrit bertetulang empat tingkat yang tidak dirembat. Tekanan angin secara ufuk pada semua arah ialah 5 kN/m^2.

(a) Kirakan beban statik ufuk pada nod untuk kerangka 2-dimensi pada grid B/1-4 dan 2/A-D akibat daripada beban angin.

(8 markah)

(b) Untuk kerangka konkrit bertetulang pada grid B/1-4, dengan menggunakan Kaedah Portal:

(i) Kirakan daya paksi tiang pada aras paling bawah.

(7 markah)

(ii) Kirakan daya ricih untuk rasuk aras 4, daya paksi dan daya ufuk untuk tiang pada aras paling atas.

(10 markah)

(iii) Lakarkan gambarajah momen lentur untuk rasuk aras 4 dan tiang pada aras paling atas akibat daripada beban ufuk ini.

(5 markah)

(c) Sekiranya dinding ricih akan digunakan untuk merembat kerangka konkrit bertetulang ini, kenalpasti dengan lakaran tempat yang sesuai untuk dinding ricih.

(5 markah)

S4 (a) Tinggi berkesan tiang boleh ditentukan berdasarkan kaedah-kaedah yang diberikan dalam fasal 3.8.1.6, BS8110: Part 1: 1997 dan fasal 2.5, BS8110: Part 2: 1985. Terangkan secara ringkas kedua-dua kaedah bagi menentukan tinggi berkesan tiang yang dirembat.

(6 markah)

(b) Sebatang tiang pendek yang dirembat menanggung susunan rasuk yang simetri dengan diameter 300 mm seperti yang ditunjukkan pada Rajah **Q4(a)**. Kirakan beban paksi maksimum yang boleh ditanggung oleh tiang tersebut sekiranya gred konkrit yang digunakan adalah 30.

(4 markah)

(c) Rajah **Q4(b)** menunjukkan pandangan isometri sebatang tiang yang dirembat pada sebuah bangunan pejabat. Daripada analisis struktur, tiang tersebut melentur pada paksi major sahaja dengan dua kelengkungan. Diberi data-data berikut:

M_{1x}	=	46 kNm
M_{2x}	=	80 kNm
N	=	800 kN
f_{cu}	=	30 N/mm^2
f_y	=	460 N/mm^2
Penutup konkrit	=	25 mm
Diameter tetulang memanjang	=	16 mm
Diameter tetulang perangkai	=	6 mm

(i) Berdasarkan fasal 3.8.1.3: BS 8110: Part 2: 1997, klasifikasikan tiang tersebut samada ianya pendek atau selanjar.

(7 markah)

(ii) Rekabentuk tetulang memanjang yang diperlukan oleh tiang.

(12 markah)

(iii) Tentukan tetulang perangkai yang diperlukan oleh tiang.

(3 markah)

(d) Pada pendapat anda, apakah faktor-faktor yang mempengaruhi di dalam rekabentuk tiang?

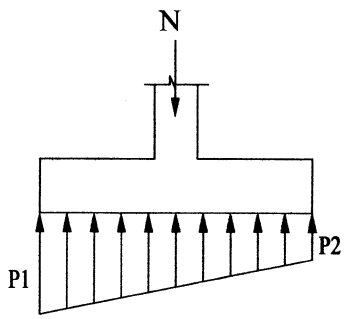
(3 markah)

S5 Rajah **Q5** menunjukkan satu penapak tunggal dikenakan beban paksi maksimum 600 kN dan momen lentur 150 kNm yang disebabkan oleh kesipian beban pada kedua-dua arah. Diberikan data berikut:

Kekuatan ciri konkrit,fcu	=	35 N/mm^2
Kekuatan ciri tetulang,fy	=	460 N/mm^2
Kekupayaan galas tanah	=	250 kN/m^2
Ukur dalam berkesan penapak	=	400 mm

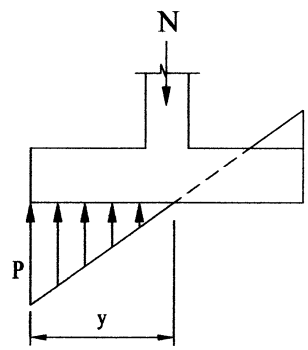
(a) Kirakan tegasan di bawah penapak tunggal dan lakarkan taburannya. Abaikan berat sendiri penapak. Diberikan:

Kes 1: e < D/6



$$P = \frac{N}{BD} \pm \frac{6M}{BD^2}$$

Kes 2: e > D/6



$$P = \frac{2N}{By} \text{ where } y = 3\left(\frac{D}{2} - e\right)$$

(6 markah)

(b) Rekabentuk semua tetulang.

(9 markah)

(c) Semak ricih maksimum pada perimeter tiang dan rich pugak pada jarak 'd' dari permukaan tiang. Gunakan tegasan purata untuk mewakili taburan tegasan yang seragam.

(9 markah)

(d) Semak keretakan

(4 markah)

(e) Lakarkan perincian. Anggapkan taburan tetulang adalah seragam.

(3 marks)

(f) Cadangkan **Satu (1)** kaedah dengan justifikasinya untuk mengurangkan momen lentur semasa pembinaan untuk penapak di atas.

(4 markah)

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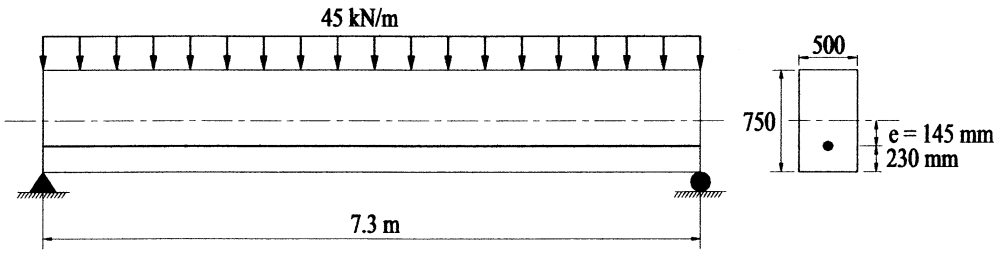

FIGURE Q1

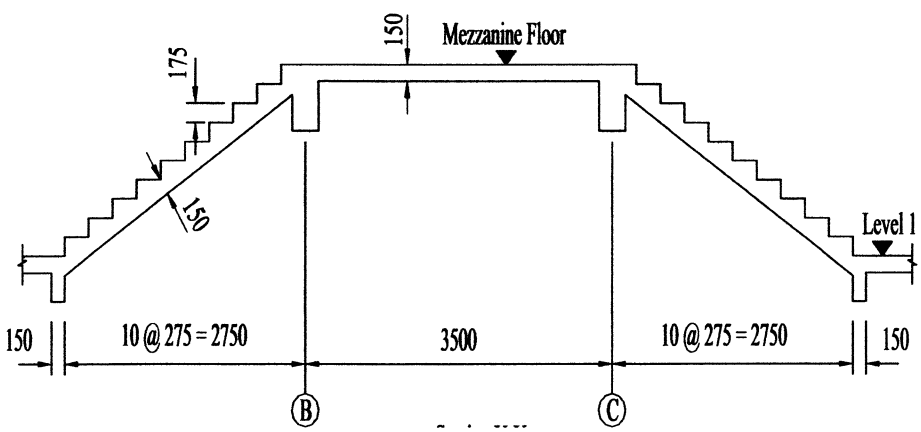

FIGURE Q2

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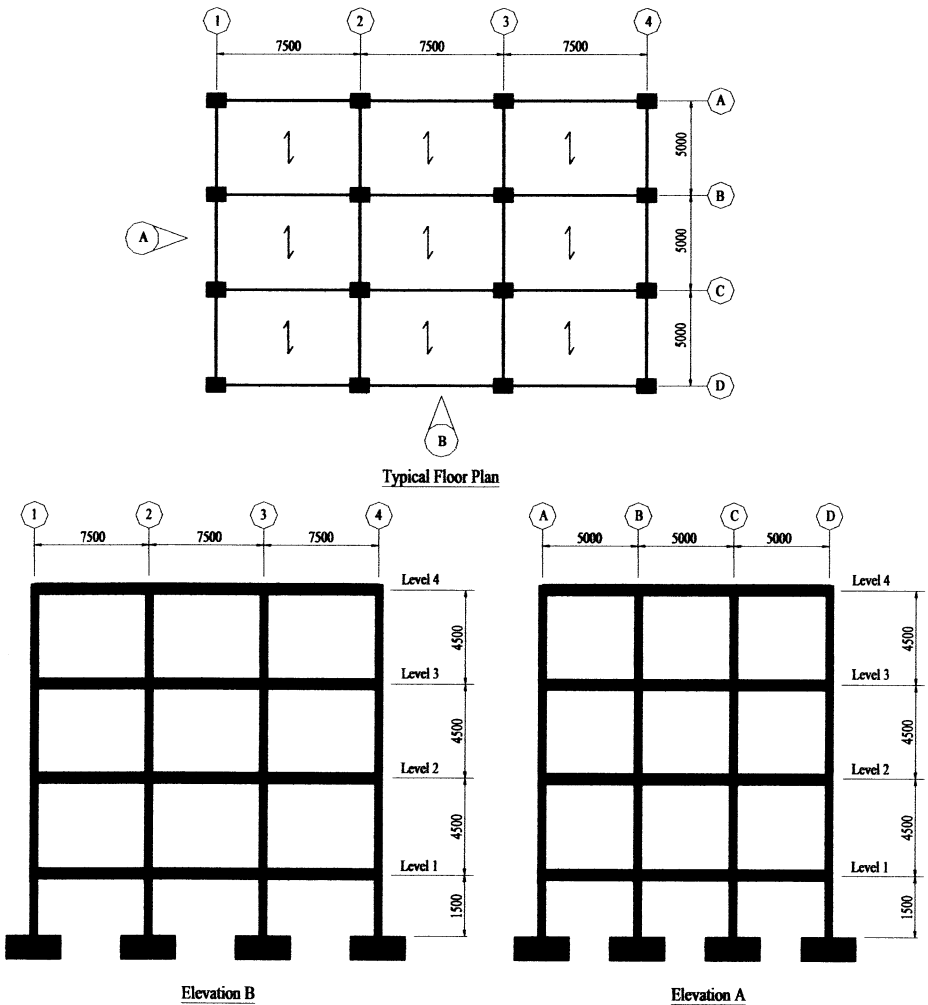

FIGURE Q3

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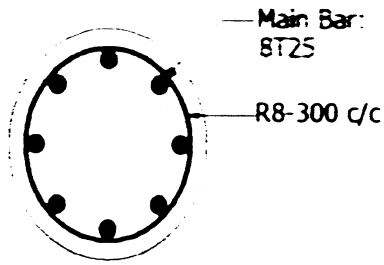

FIGURE Q4(a)

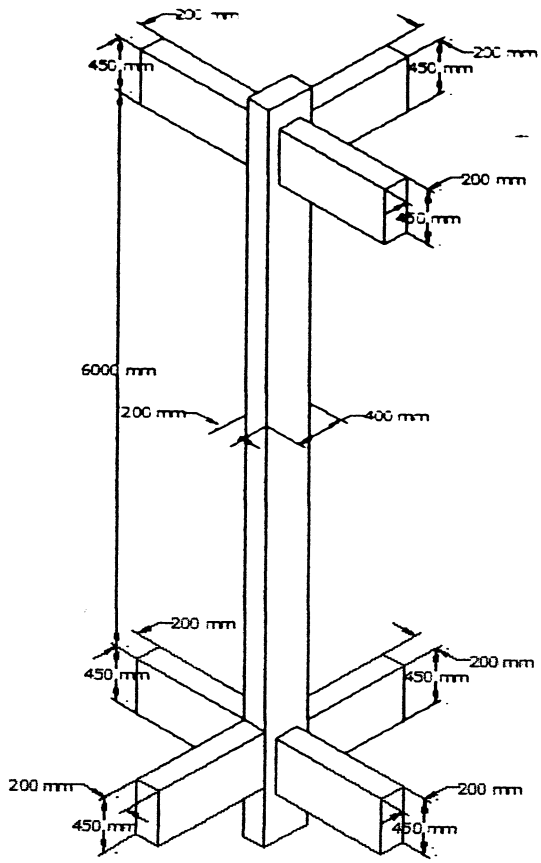

FIGURE Q4(b)

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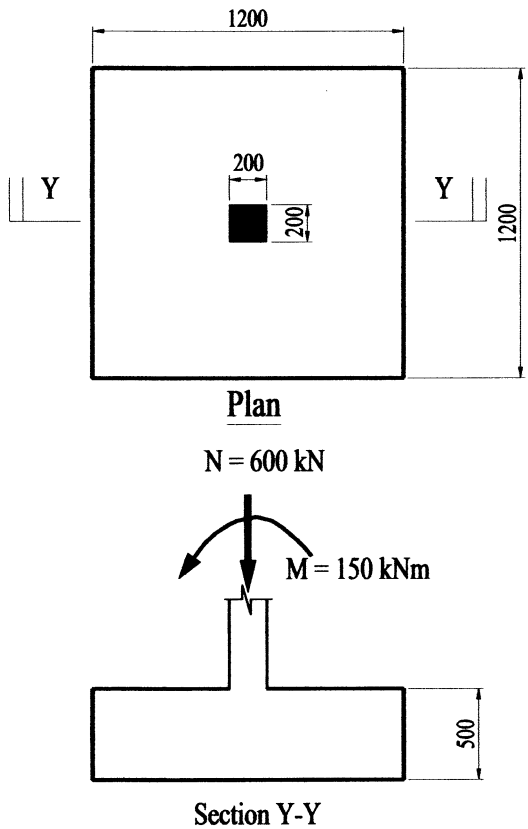

FIGURE Q5

Appendix (Cross Sectional Area of Reinforcement)

Table 1: Cross Sectional Area (mm^2) according to Size and Numbers of Bar

Bar Size (mm)	Number of bar								Perimeter (mm)
	1	2	3	4	5	6	7	8	
6	28.3	56.6	84.9	113	141	170	198	226	18.9
8	50.3	101	151	201	251	302	352	402	25.1
10	78.6	157	236	314	393	471	550	629	31.4
12	113	226	339	453	566	679	792	905	37.7
16	201	402	603	805	1006	1207	1408	1609	50.3
20	314	629	943	1257	1571	1886	2200	2514	62.9
25	491	982	1473	1964	2455	2946	3438	3929	78.6
32	805	1609	2414	3218	4023	4827	5632	6437	100.6
40	1257	2514	3771	5029	6286	7543	8800	10057	125.7

Table 2: Cross Sectional Area (mm^2) for every meter width at distance between bar

Bar Size (mm)	Distance between Bar (mm)								
	50	75	100	125	150	175	200	250	300
6	566	377	283	226	189	162	141	113	94
8	1006	670	503	402	335	287	251	201	168
10	1571	1048	786	629	524	449	393	314	262
12	2263	1509	1131	905	754	647	566	453	377
16	4023	2682	2011	1609	1341	1149	1006	805	670
20	6286	4190	3143	2514	2095	1796	1571	1257	1048
25	9821	6548	4911	3929	3274	2806	2455	1964	1637
32	16091	10728	8046	6437	5364	4598	4023	3218	2682
40	25143	16762	12571	10057	8381	7184	6286	5029	4190