UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2010/2011

COURSE NAME	:	REINFORCED CONCRETE DESIGN I
COURSE CODE	:	BFC3142
PROGRAMME	:	3 BFF
EXAMINATION DATE	:	APRIL / MAY 2011
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWER THREE (3) QUESTIONS ONLY. DESIGN SHOULD BE BASED ON : BS8110: PART 1:1997 BS8110: PART 2:1985 BS8110: PART 3:1985 BS6399: PART 1:1996

THIS PAPER CONSISTS OF THIRTEEN (13) PAGES

Q1 (a) State **Five (5)** factors to be considered in the design process.

(5 marks)

(b) Explain the concept of design for durability. State the **Two (2)** limit states in reinforced concrete design according to BS8110.

(5 marks)

(c) Using a sketch of a normal distribution curve, describe the relationship between characteristic strength, mean strength, probability factor and standard deviation for materials used in the design of reinforced concrete structure.

(5 marks)

(d) Show mathematically the effect of the values of partial safety factor for steel reinforcement and concrete on the design formula according to BS8110:1985 and BS8110:1997.

(5 marks)

(e) Sketch and label the stress-strain curve for grade 60 concrete and high yield steel reinforcement.

(5 marks)

Q2 (a) What is moment redistribution and give the maximum percentage of moment redistribution in the concrete beam as stated in BS8110.

(3 marks)

(b) Figure **Q2** shows a continuous beam carrying the characteristic dead load (including selfweight) of 10 kN/m and characteristic imposed load of 8 kN/m for all spans.

(i) Draw the bending moment diagram of the beam using moment distribution method with modified stiffness.

(6 marks)

(ii) Reduce the moment at support by 20% and calculate the redistributed moments.

(10 marks)

(iii) Draw the shear force and bending moment diagram after redistrubion.

(6 marks)

Q3 A simply supported rectangular beam shown in Figure **Q3(a)** carries uniform distributed load of dead load (Gk) = 50 kN/m and imposed load (Qk) = 30 kN/m. with dimension is shown in Figure **Q3(b)**. Determine the area of reinforcement required. Given,

Beam length, L	= 4 m
Concrete compressive strength, fcu,	= 35 Mpa
Steel strength ,fy	= 460 MPa
Reinforcement diameter	= 20 mm

(25 marks)

Q4 (a) Calculate short term deflection for the 7 m span simply supported beam with cross section shown in Figure **Q4(a)**. The beam was designed to carry the dead load including selfweight of 25 kN/m and imposed load of 15 kN/m. The materials are grade 30 concrete and grade 460 reinforcement. Assumed E_c and E_s are 26 kN/mm^2 and 200 kN/mm^2 respectively. Use concrete cover 25 mm.

(15 marks)

(b) Figure **Q4(b)** shows a cross section.of a rectangular beam with dimension 250 mm x 850 mm. Indentify,

(i) the limitation of crack

(7 marks)

(ii) the size of control bar crack that should be used.

(3 marks)

Q5 Figure **Q5(a)** shows beam ABC supported at A and B. The beam is loaded with dead load 30 kN/m (selfweight not included) and live load 20 kN/m. Figure **Q5(b)** shows the cross section of the beam. Properties of the beam are given below,

Concrete characteristice strength f_{cu}	= 30 N/mm^2
Steel characteristic strength,f_y	= 460 N/mm^2
Shear link characteristic strength, f_{yv}	= 250 N/mm^2
Concrete cover,c	= 30 mm
Diameter of main reinforcement	= 25 mm
Diameter of compression reinforcement	= 16 mm
Diameter of link	= 10 mm
Flange depth,h_f	= 150 mm

(a) Calcuate the design load of the beam and draw the shear force and bending moment diagram

(5 marks)

(b) Design the main reinforcement for the beam. Use 1300 mm effective width.

(6 marks)

(c) Design the shear reinforcement for the whole span of the beam.

(6 marks)

(d) Check the deflection of span AB.

(3 marks)

(e) Draw the details of beam AB longitudinally and it cut-section view.

(5 marks)

Q6 Figure **Q6** shows part of a floor plan for an office building. Using the following data,

Grade of concrete, f_{cu}	= 25 N/mm^2
Grade of steel, f_y	= 460 N/mm^2
Concrete cover,c	= 20 mm
Slab thickness	= 125 mm
Density of 25 mm thick cement plastering as floor finishes	= 24 kN/m^2
Building services	= 1.0 kN/m^2
Live load	= 4.0 kN/m^2

(a) Estimate the design load (kN/m^2) for slab

(2 marks)

(b) Using10 mm diameter reinforcement bar, design all the reinforcement for panel **S2** slab by ignoring the torsion reinforcement.

(10 marks)

(c) Check for the shear, deflection and cracking of the slab

(8 marks)

(d) Sketch the detailing that fulfills the requirement in BS 8110

(5 marks)

S1 (a) Nyatakan **Lima (5)** faktor yang perlu dipertimbangkan dalam proses rekabentuk.
(5 markah)

(b) Terangkan konsep rekabentuk bagi ketahanlasakan. Berikan **Dua (2)** keadaan had dalam rekabentuk konkrit bertetulang menurut BS8110.
(5 markah)

(c) Menggunakan lakaran lengkung taburan normal, jelaskan hubungan antara kekuatan ciri, kekuatan purata, faktor kebarangkalian dan sisihan piawai bagi bahan yang digunakan dalam rekabentuk struktur konkrit bertetulang.
(5 markah)

(d) Tunjukkan secara matematik kesan nilai faktor keselamatan separa untuk tetulang keluli dan konkrit terhadap formula rekabentuk menurut BS8110:1985 dan BS8110:1997.
(5 markah)

(e) Lakar dan labelkan lengkung tegasan-terikan bagi konkrit gred 60 dan tetulang keluli alah tinggi.
(5 markah)

S2 (a) Apakah yang dimaksudkan dengan agihan semula momen dan berapakah peratus maksimum agihan momen yang di benarkan menurut BS8110.
(3 markah)

(b) Rajah **Q2** menunjukkan rasuk selanjar yang membawa beban mati termasuk berat sendiri rasuk sebanyak 10 kN/m dan beban hidup sebanyak 8 kN/m sepanjang rentang rasuk tersebut.

(i) Lukiskan gambarajah momen lentur mengunakan kaedah ubahsui kekukuhan
(6 markah)

(ii) Kurangkan momen pada sokong sebanyak 20% dan kira agihan semula momen
(10 markah)

(iii) Lukiskan gambarajah momen lentur dan daya ricih selepas pengagihan
(6 markah)

S3 Rasuk sokong mudah segiempat sepertididalam Rajah **Q3(a)** membawa beban mati teragih seragam ,Gk sebanyak 50 kN/m dan beban hidup sebanyak 30 kN/m. Tentukan luas tetulang yang diperlukan. Diberi,

Panjang rasuk, L	= 4 m
Kekuatanh mampatan konkrit, fcu,	= 35 Mpa
Kekuatan anjal keluli ,fy	= 460 MPa
Diameter tetulang	= 20 mm

(25 markah)

S4 (a) Kirakan pesongan jangka pendek bagi rasuk sokong mudah yang mempunyai rentang 7 m dan keratan rentas rasuk seperti didalam Rajah **Q4(a)**. Rasuk berkenaan telah direkabentuk untuk menanggung beban mati termasuk berat sendiri 25 kN/m dan beban kenaan sebanyak 15 kN/m. Bahan-bahan adalah terdiri daripada konkrit gred 30 dan tetulang keluli gred 460. Anggap E_c dan E_s masing-masing adalah 26 kN/mm^2 dan 200 kN/mm^2. Dengan mengunakan penutup konkrit 25 mm.

(15 markah)

(b) Rajah **Q4(b)** menunjukkan keratan rentas rasuk segiempat berdimensi 250 mm x 850 mm. Kenal pasti,

(i) Takat had retakan yang dibenarkan

(7 markah)

(ii) Saiz bar kawalan retak yang perlu digunakan.

(3 markah)

S5 Rajah **Q5(a)** menunjukkan rasuk AB dengan penyokong pada A dan B. Rasuk tersebut dikenakan beban mati 30 kN/m (tidak termasuk berat sendiri) dan beban hidup 20 kN/m. Rajah **Q5(b)** menunjukkan keratan rentas rasuk tersebut. Ciri-ciri pada rasuk tersebut adalah seperti berikut:

Kekuatan mampatan konkrit f_{cu}	= 30 N/mm^2
Kekuatan anjal keluli ,f_y	= 460 N/mm^2
Kekuatan perangkai, f_{yv}	= 250 N/mm^2
Penutup konkrit,c	= 30 mm
Diameter tetulang utama	= 25 mm
Diameter tetulang mampatan	= 16 mm
Diameter link	= 10 mm
Ukurdalam berbibir,h_f	= 150 mm

(a) Kirakan beban rekabentuk rasuk dan lukiskan gambarajah daya ricih dan moment lentur bagi rasuk tersebut

(5 markah)

(b) Rekabentuk tetulang utama rasuk tersebut dengan menggunakan 1300 mm sebagai lebar berkesan.

(6 markah)

(c) Rekabentuk tetulang ricih untuk keseluruhan rasuk tersebut

(6 markah)

(d) Tentukan lenturan yang berlaku pada rentang AB

(3 markah)

(e) Lukiskan perincian pada sudut memanjang dan keratan rentas rasuk AB

(5 markah)

S6 Rajah **S6** menunjukkan sebahagian pelan lantai sebuah bangunan pejabat. Menggunakan data berikut,

Gred konkrit,f_{cu}	= 25 N/mm^2
Gred keluli,f_y	= 460 N/mm^2
Penutup konkrit,c	= 20 mm
Tebal papak,h	= 125 mm
Ketumpatan 25 mm tinggi simen melepa sebagai kemasan lantai	= 24 kN/m^2
Perkhidmatan bangunan	= 1.0 kN/m^2
Beban hidup	= 4.0 kN/m^2

(a) Kirakan beban rekabentuk (kN/m^2) bagi papak.

(2 markah)

(b) Mengunakan tetulang bersaiz 10 mm, rekabentuk semua tetulang pada panel **S2** dengan mengabaikan tetulang puntiran.

(10 markah)

(c) Semak ricih, pesongan dan keretakan bagi papak tersebut

(8 markah)

(d) Lakarkan perincian bagi tetulang yang direkabentuk di menurut keperluan BS8110.

(5 markah)

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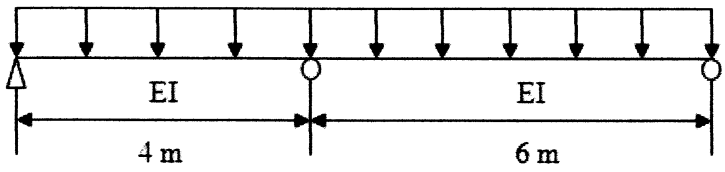

FIGURE Q2

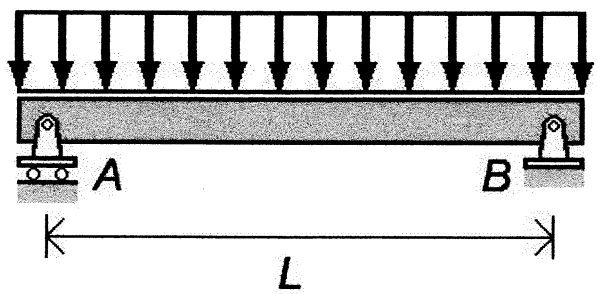

FIGURE Q3(a)

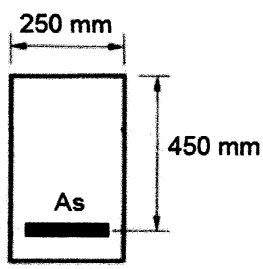

FIGURE Q3(b)

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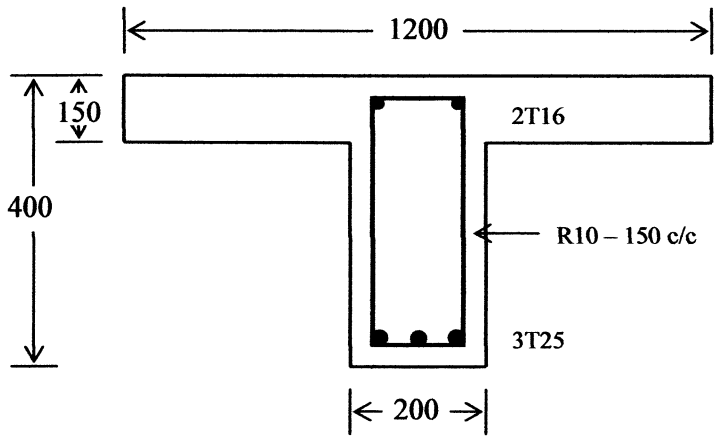

FIGURE Q4(a)

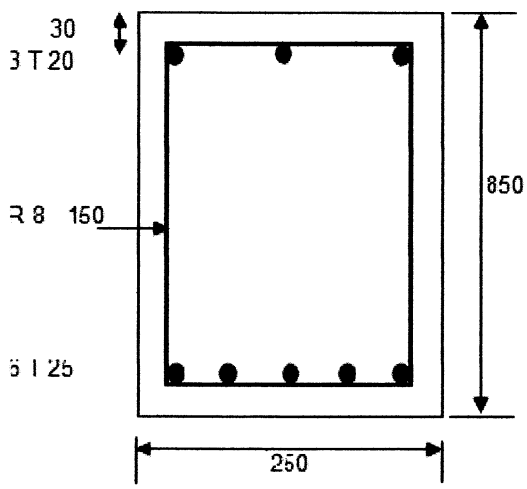

FIGURE Q4 (b)

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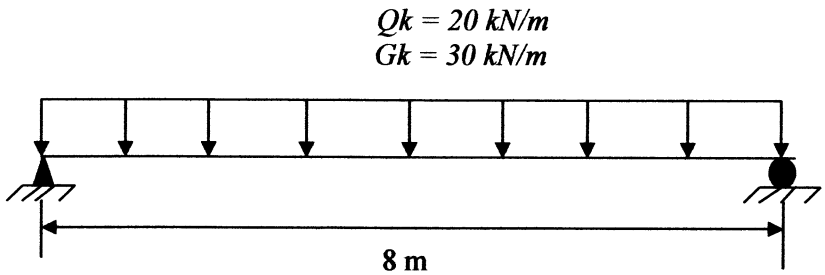
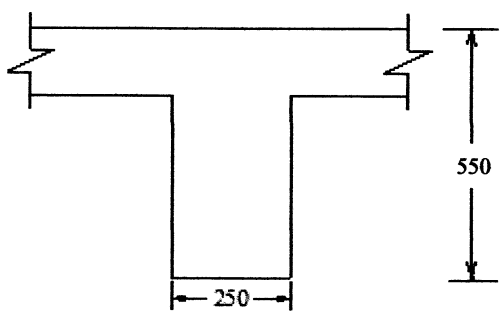


FIGURE Q5(a)



All units in mm

FIGURE Q5(b)

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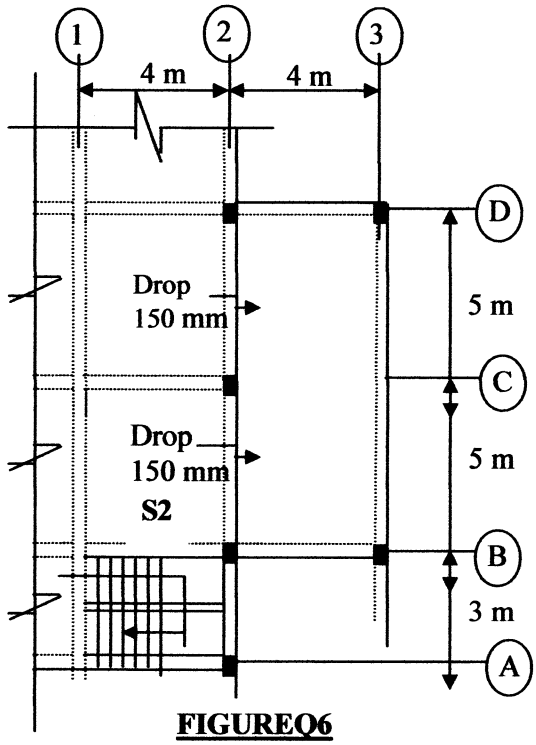

FIGUREQ6

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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

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Short term deflection

Depth of neutral axis, x can be found by taking moment the *x-x* axis to give the equation:

$$0.5bx^2 + \alpha_e As'(x-d) - \alpha_e As(d-x) = 0$$

Moment of Inertia about *x-x* axis

$$I_{xx} = 0.34bx^3 + \alpha_e As'(x-d)^2 + \alpha_e As(d-x)^2$$

The stress at outer fiber of concrete

$$fct = \frac{1.0(h-x)}{(d-x)}$$

The force in concrete in tension

$$Fct = 0.5 f_{ct} b \frac{(h-x)^2}{(d-x)}$$

The moment resistance of concrete in tension

$$M_c = F_{ct} \frac{2}{3}(h-x)$$