UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2010/2011

COURSE NAME	:	REINFORCED CONCRETE DESIGN 1
COURSE CODE	:	BFC 3142
PROGRAMME	:	3 BFF
EXAMINATION DATE	:	NOVEMBER / DECEMBER 2010
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWER **ONE (1)** QUESTION FROM PART A AND **TWO (2)** QUESTIONS FROM PART B

DESIGN SHOULD BE BASED ON:
BS 8110:PART 1:1997
BS 8110:PART 2:1985
BS 8110:PART 3:1985
BS 6399:PART 1:1996

THIS PAPER CONSISTS OF EIGHTTEEN (18) PAGES

PART A

Q1 Figure **Q1** shows the shear force and bending moment diagrams for three span reinforced concrete beams. The cross section of the beam is rectangular with a dimension of 300 x 600 mm. Based on the design data given;

Concrete cover, c	= 25 mm
f_{cu}	= 30 N/mm^2
f_y	= 460 N/mm^2
f_{yv}	= 250 N/mm^2

Assumed;

Diameter of tension reinforcement	= 25 mm
Diameter of compression reinforcement	= 16 mm
Diameter of shear reinforcement	= 10 mm

(a) Design the longitudinal reinforcement at mid span AB and support B of the beam.
(13 marks)

(b) Design the shear reinforcement required for span AB.
(10 marks)

(c) Check the deflection for span AB
(5 marks)

(d) From your opinion, what the significances of deflection check?
(2 marks)

Q2 (a) Give slab the definition.
(3 marks)

(b) List with aid of sketches **Three (3)** types of slab.
(3 marks)

(c) Figure **Q2** shows a continuous slab of 175 mm thickness. Given the following data:

Concrete density	= 24 kN/m^3
Finishes	= 0.75 kN/m^2
Characteristics Imposed Load	= 2.0 kN/m^2
Concrete Grade	= 30
Steel Grade	= 460 N/mm^2
Concrete Cover	= 20 mm
Bar diameter (Assumed)	= 16 mm

For slab Panel 1,

(i) Design all reinforcement needed for Panel 1. Ignore torsional reinforcement.
(6 marks)

(ii) Check for shear.
(5 marks)

(iii) Check the cracking and deflection.
(5 marks)

(iv) Draw the detailing.
(4 marks)

(d) A solid slab is supported on its four edges transfer the load through beam. However, in some cases such as flat slab, loading from the slab is transferred directly through the column. Discuss the critical design criteria for the flat slab.
(4 marks)

PART B

Q3 (a) Why steel reinforcement is used in concrete?

(4 marks)

(b) Give **Two (2)** importance of concrete cover, *c* in reinforced concrete structure?

(4 marks)

(c) What is meant by *limit state*? Discuss the different *limit state* to be considered in reinforced concrete design.

(8 marks)

(d) Figure **Q3** shows a stress-strain curve for normal-weight concrete as stated in BS 8110. From the figure,

(i) can concrete be assumed to be a linear elastic material? Discuss.

(8 marks)

(ii) why does the BS8110 limit the stress in structural design to 0.67 (f_{cu}/γ_m) and not (f_{cu}/γ_m)?

(3 marks)

(iii) what is value for strain at failure?

(3 marks)

(e) What should we consider to increase the durability and fire resistances in reinforced concrete?

(5 marks)

Q4 (a) Why is partial safety factors applied to the strength of the materials and to the loadings?

(5 marks)

(b) Figure **Q4** shows the plan view of slab-beam system in one building. The loading criteria are given as follows:

Concrete density	= 24 kN/m^3
Slab Thickness	= 150 mm
Finishes	= 1.0 kN/m^2
Ceiling	= 0.5 kN/m^2
Characteristics Imposed Load	= 2.5 kN/m^2
Brickwall (3.5 m height)	= 2.6 kN/m^2
Beam size, b x h	= 200 mm x 500 mm

(i) Calculate the characteristic dead load and imposed load on beam B/1-4.

(24 marks)

(ii) From Q4(b)(i), sketch the critical load arrangements for beam B/1-4 as stated in Clause 3.2.1.2.2 BS: Part 1:1997.

(6 marks)

Q5 Figure **Q5** shows cross-section of a simply supported concrete beam with grade 25. The applied moment which can be supported by this beam is 260 kNm. By using cross-section design method,

(a) Determine the beam effective depth, d.

(3 marks)

(b) Prove the upper layer reinforcement (2T16) is required.

(6 marks)

(c) Draw the complete stress distribution diagram by showing the location and equation of the stress and forces.

(7 marks)

(d) Calculate the neutral axis of the beam.

(7 marks)

(e) Determine the ultimate resistance moment of the beam and does the beam is adequate enough to support the applied moment given.

(7 marks)

(f) In your opinion, why $x \leq 0.5d$ checking needs to be considered in designing the reinforced concrete beam?

(5 marks)

Q6 (a) Figure **Q6(a)** show a section of concrete block with four nos of starter bars. If the concrete grade 35 and the reinforcement (Deformed type 2) grade 460 with diameter of 20 mm are used.

(i) Define the term of anchorage length.

(4 marks)

(ii) Calculate the bond stress, f_b between concrete and starter bars.

(4 marks)

(iii) Calculate the anchorage length required, if the forces exist, f_s to pulling out all the starter bars out are 400 kN.

(7 marks)

(b) Figure **Q6(b)** shows a cross section of a rectangular beam subjected to ultimate design moment at mid span of 186 kNm. Given the following data:

f_{cu}	= 35 N/mm^2
Concrete cover, c	= 25 mm
E_c	= 13 kN/mm^2
E_s	= 200 kN/mm^2

Calculate the maximum crack width occured at the beam.

(15 marks)

(c) From your opinion what the differences between checking the deflection and calculation of deflection?

(5 marks)

BAHAGIAN A

S1 Rajah **Q1** menunjukkan gambarajah daya ricih dan momen lentur bagi tiga rentang rasuk konkrit. Keratan rentas bagi rasuk tersebbut adalah segiempat dengan ukuran 300 x 600 mm. Berpandukan data rekabentuk yang diberi:

Penutup Konkrit,c	= 25 mm
fcu	= 30 N/mm^2
fy	= 460 N/mm^2
fyv	= 250 N/mm^2

Anggap;

Diameter tetulang tegangan	= 25 mm
Diameter tetulang mampatan	= 16 mm
Diameter tetulang ricih	= 10 mm

(a) Rekabentuk tetulang memanjang pada pertengahan bagi rasuk AB dan penyokong B. (13 markah)

(b) Rekabentuk tetulang ricih yang diperlukan bagi rentang AB. (10 markah)

(c) Semak lenturan pada rentang AB. (5 markah)

(d) Pada pendapat anda, apakah kepentingan semakan lenturan? (2 markah)

S2 (a) Berikan definisi papak. (3 markah)

(b) Berbantukan lakaran, senaraikan **Tiga (3)** jenis papak. (3 markah)

(c) Sebuah papak selanjar dengan ketebalan 175 mm seperti yang ditunjukkan dalam Rajah **Q2**. Data-data rekabentuk adalah seperti berikut.

Ketumpatan konkrit	= 24 kN/m^3
Kemasan	= 0.75 kN/m^2
Beban hidup ciri	= 2.0 kN/m^2
Gred konkrit	= 30
Gred keluli	= 460 N/mm^2
Penutup konkrit	= 20 mm
Diameter bar (anggapan)	= 16 mm

untuk papak Panel 1,

(i) Rekabentukkan semua tetulang. Tetulang puntiran diabaikan. (6 markah)

(ii) Lakukan semakan ricih.

(5 markah)

(iii) Semak lenturan dan keretakan.

(5 markah)

(iv) Lukiskan perincian.

(4 markah)

(d) Papak padu yang disokong di keempat-empat sisinya memindahkan beban melalui rasuk. Namun begitu, bagi kes-kes tertentu seperti papak rata, beban dipindahkan dari papak terus kepada tiang. Bincangkan kriteria yang kritikal bagi papak rata.

(4 markah)

BAHAGIAN B

S3 (a) Kenapakah tetulang besi digunakan di dalam konkrit?

(4 markah)

(b) Berikan **Dua (2)** kepentingan penutup, *c* di dalam struktur konkrit bertetulang?

(4 markah)

(c) Apakah maksud *keadaan had*? Bincangkan perbezaan *keadaan had* yang perlu dipertimbangkan dalam merekabentuk konkrit bertetulang.

(8 markah)

(d) Rajah **Q3** menunjukkan lengkung tegasan-terikan bagi konkrit berkekuatan biasa seperti dinyatakan dalam BS 8110. Berdasarkan rajah,

(i) bolehkah konkrit dianggap sebagai bahan anjal lelurus? Bincangkan.

(8 markah)

(ii) kenapakah BS8110 menghadkan tegasan dalam rekabentuk struktur kepada 0.67 (fcu/γ_m) dan bukan (fcu/γ_m)?

(3 markah)

(iii) berapakah nilai terikan pada kegagalan?

(3 markah)

(e) Apakah yang perlu di pertimbangkan bagi meningkatkan ketahananlasakan dan rintangan terhadap kebakaran dalam konkrit bertetulang.

(5 markah)

S2 (a) Kenapakah faktor keselamatan separa diaplikasikan pada kekuatan bahan dan beban?

(5 markah)

(b) Rajah **Q2** menunjukkan satu pandangan pelan lantai dan rasuk padu satu sistem bangunan. Agihan beban adalah seperti di bawah:

Ketumpatan Konkrit	= 24 kN/m^3
Tebal Papak	= 150 mm
Kemasan	= 1.0 kN/m^2
Siling	= 0.5 kN/m^2
Beban Kenaan Ciri	= 2.5 kN/m^2
Dinding Bata (3.5 m Tinggi	= 2.6 kN/m^2
Saiz rasuk, b x h	= 200 mm x 500 mm

(i) Kirakan beban mati dan kenaan cirri pada rasuk B/1-4.

(24 markah)

(ii) Daripada S2(b)(i), lakarkan agihan beban bagi rasuk B/1-4 mengikut Fasal 3.2.1.2.2 BS: Part 1:1997.

(6 markah)

S5 Rajah **Q5** menunjukkan keratan rentas bagi satu rasuk konkrit sokong mudah dengan gred 25. Momen kenaan yang boleh ditanggung oleh rasuk tersebut adalah sebanyak 260 kNm dengan gred konkrit 25. Dengan mengggunakan kaedah rekabentuk keratan,

(a) Tentukan ukur dalam berkesan rasuk

(3 markah)

(b) Buktikan penggunaan tetulang di lapisan atas (2T16) diperlukan.

(6 markah)

(c) Lukiskan rajah taburan tegasan dan daya dengan lengkap yang menunjukkan kedudukan dan persamaan tegasan dan daya tersebut.

(7 markah)

(d) Kirakan ukurdalam paksi neutral rasuk.

(7 markah)

(e) Tentukan momen rintangan muktamad keratan rasuk terebut. Adakah rasuk tersebut selamat menanggung momen yang dikenakan.

(7 markah)

(f) Pada pendapat anda, kenapakah semakan $x \leq 0.5d$ perlu dipertimbangkan dalam merekabentuk rasuk konkrit bertetulang?

(5 markah)

S6 (a) Rajah **Q6(a)** menunjukkan satu keratan blok konkrit dengan empat batang bar pemula. Konkrit gred 35 dan tetulang keluli (*Deformed type 2*) gred 460 dengan diameter 20mm digunakan.

(i) Apakah istilah panjang tambatan.

(4 markah)

(ii) Kirakan tegasan ikatan, f_b diantara konkrit dan bar pemula.

(4 markah)

(iii) Kirakan panjang tambatan yang diperlukan sekiranya daya, f_s untuk menarik bar pemula keluar adalah 400 kN.

(7 markah)

(b) Rajah **Q6(b)** menunjukkan satu keratan rentas rasuk segiempat yang dikenakan beban muktamad di pertengahan rentang sebanyak 186 kNm. Diberi data seperti berikut:

f_{cu}	$= 35\ N/mm^2$
Penutup konkrit, c	$= 25$ mm
E_c	$= 13\ kN/mm^2$
E_s	$= 200\ kN/mm^2$

Kirakan lebar keretakan maksimum pada rasuk.

(15 markah)

(c) Pada pendapat anda apakah perbezaan di antara semakan pesongan dan pengiraan pesongan.

(5 markah)

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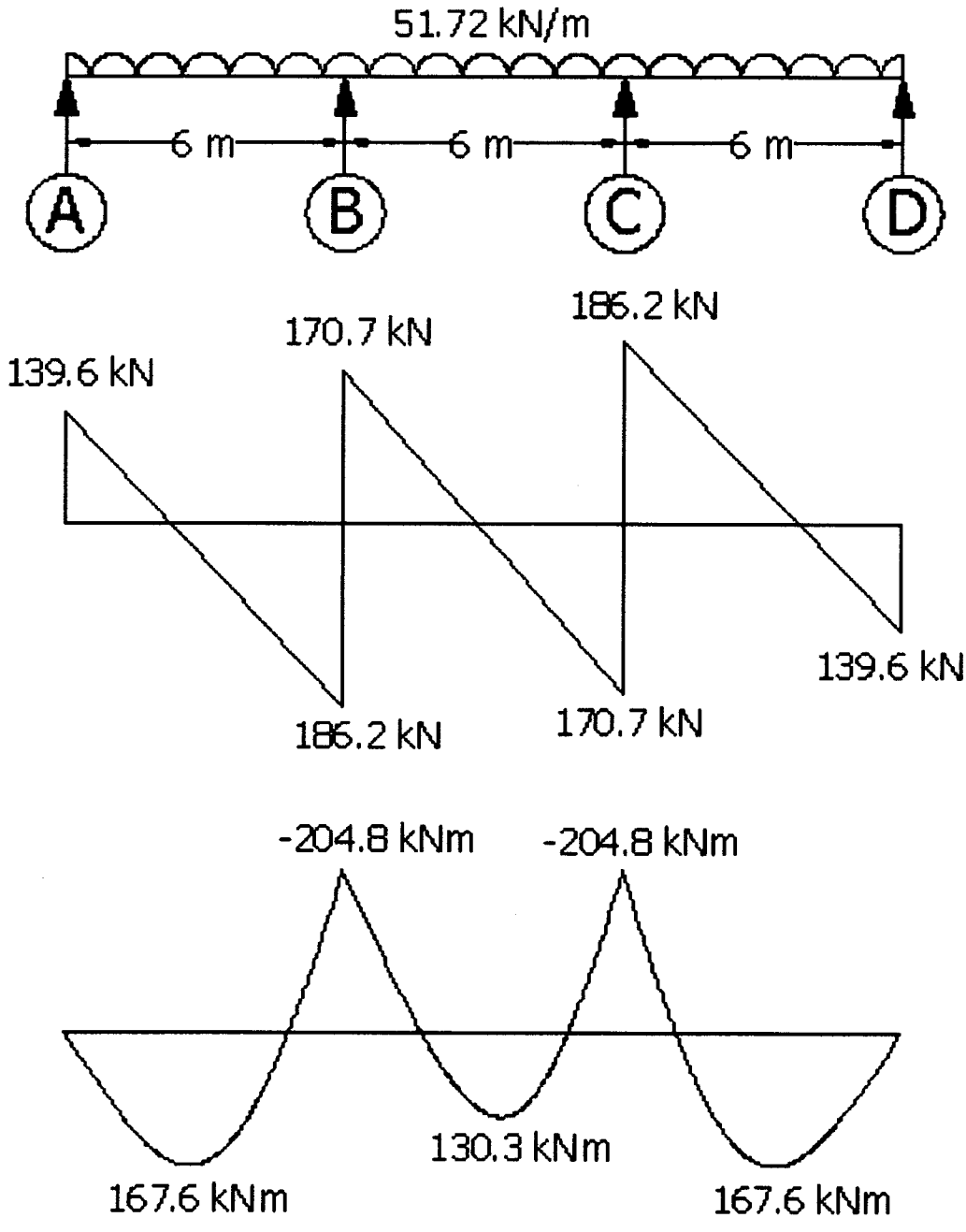

FIGURE Q1

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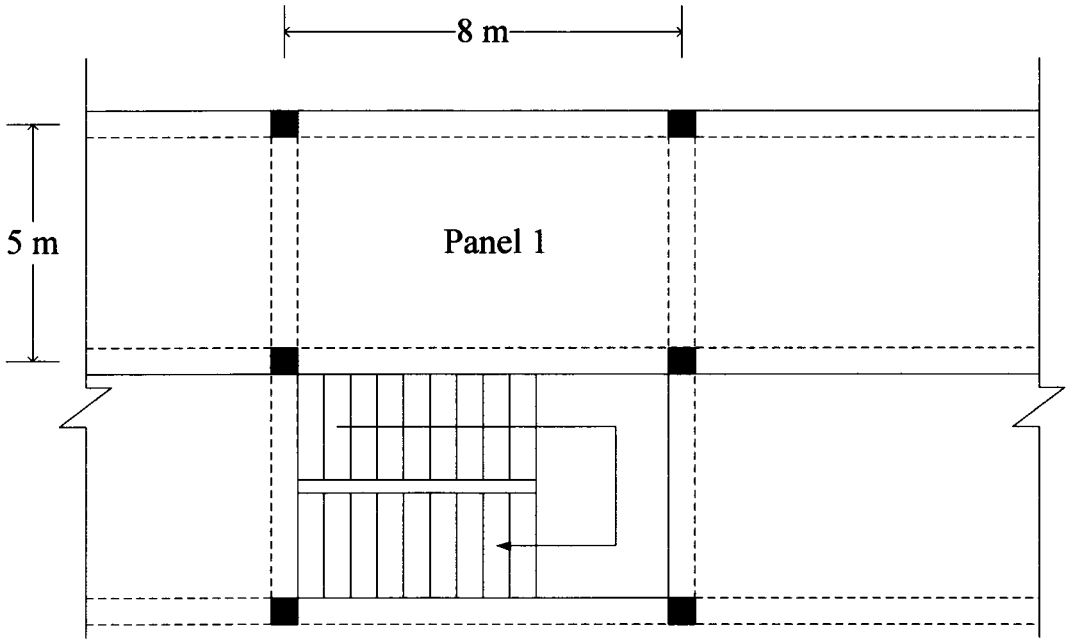

FIGURE Q2

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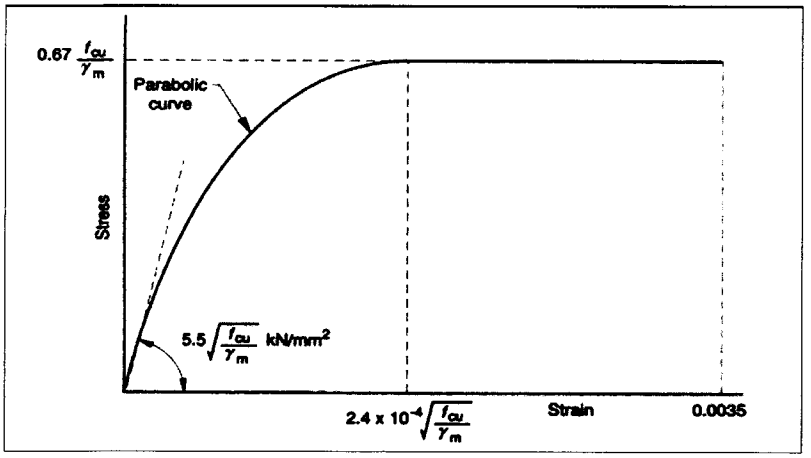

FIGURE Q3

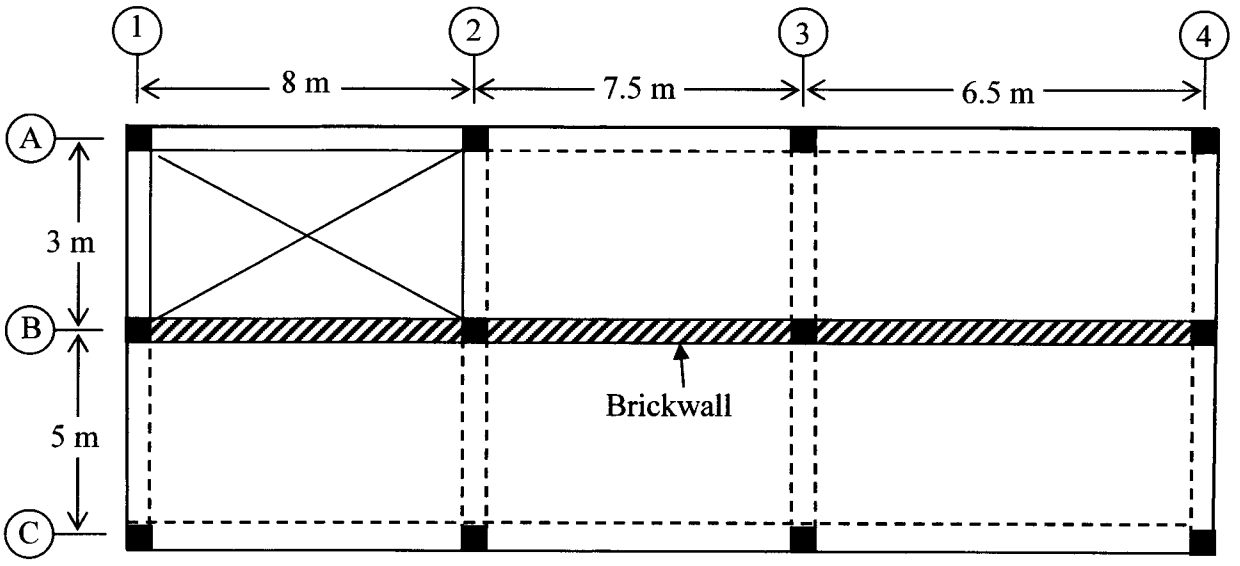

FIGURE Q4

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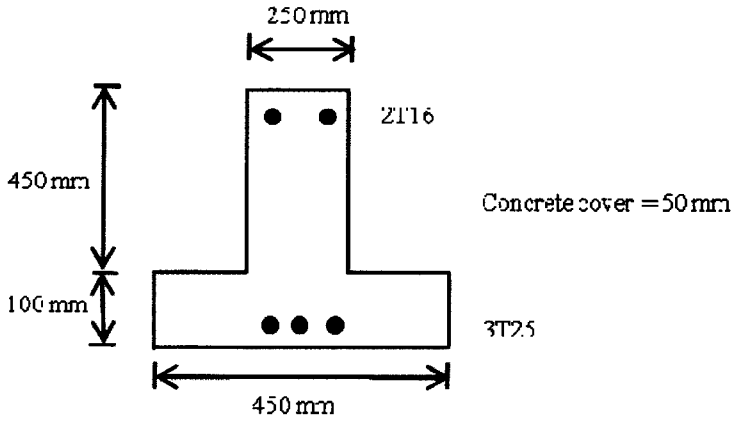

FIGURE Q5

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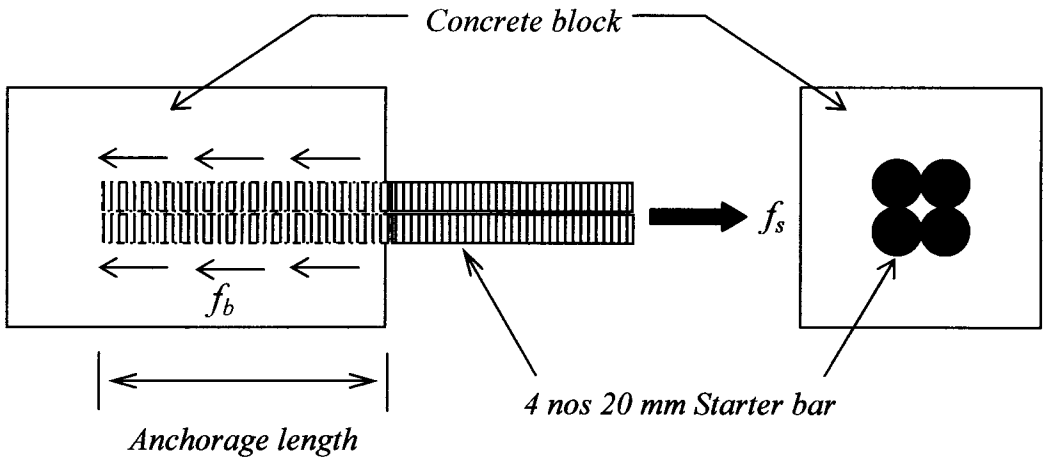

Longitudinal Section **Cross Section**

FIGURE Q6(a)

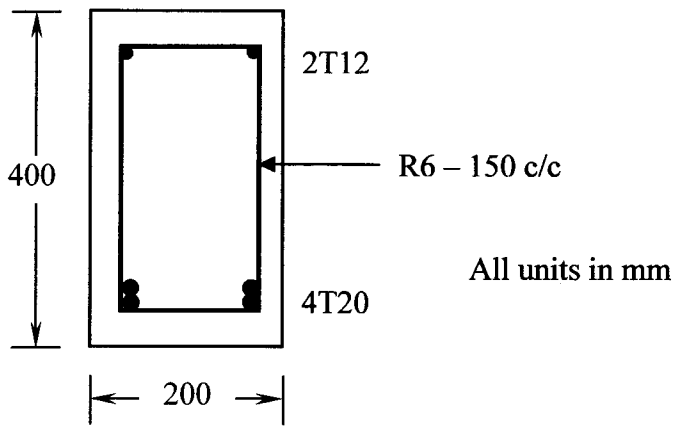

FIGURE Q6(b)

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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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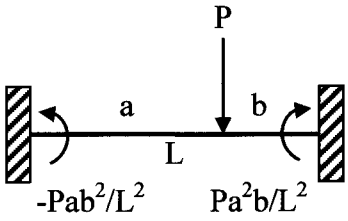
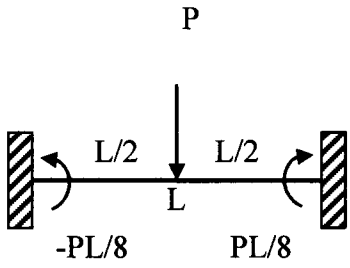
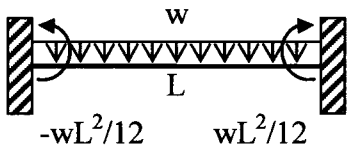
Fixed End Moment, FEM':







Crack width of flexural member

Depth of neutral axis, x

$$x = \left[-\alpha_e.\rho + \sqrt{\alpha_e.\rho(2+\alpha_e.\rho}\right]d$$

or;

$$\frac{1}{2}bx^2 + \frac{E_s}{E_c}A_s x - \frac{E_s}{E_c}A_s d = 0$$

Surface strain, ε_1

$$\varepsilon_1 = \left(\frac{h-x}{d-x}\right)\varepsilon_s$$

Strain due to stiffening effect, ε_2

$$\varepsilon_2 = \frac{1.0b_t(h-x)(a'-x)}{3E_s As(d-x)}$$

Crack width, w

$$w = \frac{3a_{cr}\varepsilon_m}{1+2\left(\frac{a_{cr}-c_{\min}}{h-x}\right)}$$