UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2011/2012

COURSE NAME	:	STRUCTURAL CONCRETE DESIGN II
COURSE CODE	:	BFC 3172
PROGRAMME	:	3 BFF
DATE	:	JANUARY 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS PAPER CONSISTS OF **FIFTEEN (15)** PAGES

PART A (ANSWER ALL QUESTIONS)

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

(3 marks)

(b) Explain **Two (2)** methods used for altering the prestress.

(4 marks)

(c) State **Three (3)** advantages of prestress concrete to be used in bridge construction compared to reinforced concrete.

(3 marks)

(d) A simply supported class 2 post-tensioned beam is shown in Figure **Q1**. The span of the beam is 20 m carries the service uniformly distributed and concentrated load of 10 kN/m and 10 kN respectively. The tendon is located at an eccentricity of 300 mm from the centroid of the section with an initial prestressing force of 400 kN. Given the following data:

Density of concrete	=	24 kN/m^3
Strength of concrete, f_{cu}	=	45 N/mm^2
Strength of concrete at transfer, f_{ci}	=	30 N/mm^2
Short term losses	=	10%
Total losses	=	20%

(i) Determine the cross section area and second moment of area of the beam.

(5 marks)

(ii) Based on the mid-span moment, calculate the stresses at transfer and service conditions.

(11 marks)

(iii) Check the limiting stresses.

(4 marks)

PART B (ANSWER TWO QUESTIONS ONLY)

Q2 Figure **Q2 (a)** show a plan view and cross section of staircase of three storeys school building. Staircase is supported by landing perpendicular to the stair flight and landing is supported by beams at both ends. If staircase is built 110 mm into the wall as shown in Figure **Q2 (b)** and based on given design data.

Thickness of waist & landing, h	=	200 mm
Riser, R	=	175 mm
Going, G	=	250 mm
Characteristics strength of concrete, f_{cu}	=	30 N/mm^2
Characteristics strength of steel, f_y	=	460 N/mm^2

Concrete cover, c	=	20 mm
Characteristics Imposed load	=	4.0 kN/m^2
Finishes	=	0.8 kN/m^2
Assume diameter of reinforcement	=	12 mm

(a) By using *(l/d)* approach, check whether given waist thickness, h for staircase is appropriate or not.

(3 marks)

(b) Calculate loading that subjected to staircase and landing then sketch the loading arrangement.

(8 marks)

(c) Design all reinforcement required for staircase and landing.

(12 marks)

(d) Check deflection of the staircase and landing.

(6 marks)

(e) Check cracking of the staircase and landing.

(3 marks)

(f) From your opinion, what the advantages design of staircase that built into the wall?

(3 marks)

Q3 (a) Briefly explain the followings:

(i) Braced frame
(ii) Unbraced frame

(4 marks)

(b) For un-braced frame analysis, the greatest value of moments and shearing forces to be used for design purposes are obtained from two different stages of analysis. Explain the stages analysis involved.

(6 marks)

(c) Figure **Q3** shows an isometric view of 8 storeys building that will be constructing at coastal area of Port Dickson. The building is braced and exposed to the wind load of 0.84 kN/m^2.

(i) Calculate wind load at each level for grid line C in kN.

(7 marks)

(ii) Draw bending moment diagram for columns and beams due to wind load for grid line C at level 6 and above.

(15 marks)

(d) From your opinion, what are the differences between continuous beam analysis and sub frame analysis?

(3 marks)

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

(6 marks)

(b) A circular 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 can be carried by the column if concrete grade used is 30.

(4 marks)

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

M_{1x}	=	110 kNm
M_{2x}	=	180 kNm
N	=	2100 kN
f_{cu}	=	35 N/mm^2
f_y	=	460 N/mm^2
Concrete cover	=	25 mm
Dia. of longitudinal reinforcement	=	25 mm
Dia. of shear link	=	8 mm

(i) Based on Clause 3.8.1.3: BS 8110: Part 1: 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 shear link required for the column.

(3 marks)

(d) From your opinion, what the factors that influence in column design?

(3 marks)

Q5 (a) A double storey bungalow is proposed to be built on the peat soil area. From a structural engineer point of view, what type of foundation you would like to propose for this building? Discuss **Two (2)** advantages of the foundation system.

(4 marks)

(b) A four-pile cap supports a maximum factored load of 3000 kN from a column as shown in Figure **Q5**. During the construction, pile 'D' was offset 50 mm. Due to this mistake, axial load carries by each pile was changed. Given the following data:

Axial load:		
Pile 'A'	=	700 kN
Pile 'B'	=	780 kN
Pile 'C'	=	680 kN
Pile 'D'	=	840 kN
Overall depth of pile cap	=	900 mm
Strength of concrete	=	40 N/mm^2
Strength of reinforcement	=	460 N/mm^2
Concrete cover	=	60 mm
Assume diameter of bar	=	20 mm

(i) Based on beam theory, calculate the maximum moment at the critical section for both directions. Ignore selfweight of pile cap and column size.

(8 marks)

(ii) Design all reinforcements.

(8 marks)

(iii) Determine the minimum size of the square column to fulfill the maximum shear check.

(7 marks)

(iv) Sketch the detailing.

(4 marks)

(v) During the construction, piling 'A' has encounter the problem to drive until "set" as required by the engineer. Suggest a solution to solve this problem.

(4 marks)

BAHAGIAN A (JAWAB SEMUA SOALAN)

S1 (a) Bincangkan perbezaan di antara pra-tegangan dan pasca-tegangan.

(3 markah)

(b) Terangkan **Dua (2)** kaedah yang digunakan untuk mengubah prategasan.

(4 markah)

(c) Nyatakan **Tiga (3)** kebaikan konkrit prategasan digunakan dalam pembinaan jambatan berbanding dengan konkrit bertetulang.

(3 markah)

(d) Satu rasuk pasca-tegangan kelas 2 ditunjukkan dalam Rajah **Q1**. Rentang rasuk ini ialah 20 m membawa beban khidmat teragih seragam dan beban tumpu masing-masing 10 kN/m dan 10 kN. Tendon diletakkan pada kesipian 300 mm dari sentroid keratan dan dikenakan daya tegangan awal 400 kN. Diberikan data berikut:

Ketumpatan konkrit	=	24 kN/m^3
Kekuatan konkrit, f_{cu}	=	45 N/mm^2
Kekuatan konkrit pada pindahan, f_{ci}	=	30 N/mm^2
Kehilangan jangka pendek	=	10%
Jumlah kehilangan	=	20%

(i) Tentukan luas keratan dan momen luas kedua rasuk tersebut.

(5 markah)

(ii) Berdasarkan momen pada tengah rentang, kirakan tegasan pada keadaan pindahan dan khidmat.

(11 markah)

(iii) Semak had tegasan.

(4 markah)

BAHAGIAN B (JAWAB DUA SOALAN SAHAJA)

S2 Rajah **Q2 (a)** menunjukkan pandangan pelan tangga bagi sebuah bangunan sekolah tiga tingkat. Tangga berkenaan disokong oleh pelantar yang berserenjang dengan arah larian anak tangga dan pelantar disokong oleh rasuk dikedua-dua hujungnya. Sekiranya tangga ditanam kedalam dinding sedalam 110 mm seperti yang ditunjukkan pada Rajah **Q2 (b)** dan berdasarkan data rekabentuk yang diberi.

Tebal Cekak tangga dan pelantar, h	=	200 mm
Penaik, R	=	175 mm
Jejak, G	=	250 mm
Kekuatan Ciri Konkrit, f_{cu}	=	30 N/mm^2
Kekuatan Ciri Keluli, f_y	=	460 N/mm^2

Penutup Konkrit, *c*	=	20 mm
Beban Kenaan Ciri	=	4.0 kN/m^2
Kemasan	=	0.8 kN/m^2
Anggap diameter tetulang	=	12 mm

(a) Menggunakan pendekatan *(l/d)*, semak samada tebal cekak, h yang diberi bagi tangga berkenaan bersesuaian ataupun tidak.

(3 markah)

(b) Kirakan beban yang bertindak pada tangga dan pelantar seterusnya lakarkan pembebanan tersebut.

(8 markah)

(c) Rekabentuk semua tetulang yang diperlukan bagi tangga dan pelantar.

(12 markah)

(d) Semak pesongan bagi tangga dan pelantar.

(6 markah)

(e) Semak keretakan bagi tangga dan pelantar.

(3 markah)

(f) Pada pendapat anda, apakah kelebihan bagi rekabentuk tangga yang ditanam di dalam dinding?

(3 markah)

S3 (a) Terangkan secara ringkas perkara berikut:

i) Kerangka dirembat.
ii) Kerangka tidak dirembat.

(4 markah)

(b) Bagi kerangka tidak dirembat, nilai momen lentur dan daya ricih terbesar yang digunakan bagi tujuan rekabentuk diperolehi daripada dua peringkat analisis yang berbeza. Bincangkan peringkat-peringkat analisis yang terlibat.

(6 markah)

(c) Rajah **Q3** menunjukkan pandangan isometrik bagi sebuah bangunan 8 tingkat yang akan dibina dikawasan persisiran Pantai Port Dickson. Bangunan berkenaan adalah tidak dirembat dan terdedah kepada beban angin 0.84 kN/m^2.

i) Kirakan beban angin pada setiap aras bagi garisan grid C dalam unit kN.

(10 markah)

ii) Lukiskan gambarajah momen bagi tiang dan rasuk akibat daripada beban angin pada garisan grid C bagi aras 6 dan ke atas.

(15 markah)

(d) Pada pendapat anda, apakah perbezaan diantara analisis rasuk selanjar dan analisis sub kerangka?

(3 markah)

S4 (a) Tinggi berkesan tiang boleh ditentukan menggunakan 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 dirembat.

(6 markah)

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

(4 markah)

(c) Rajah **Q4(b)** menunjukkan pandangan isometrik sebatang tiang dirembat bagi sebuah bangunan pejabat. Daripada analisis struktur, tiang mengalami lenturan terhadap paksi major sahaja. Diberi data berikut:

M_{1x}	=	110 kNm
M_{2x}	=	180 kNm
N	=	2100 kN
f_{cu}	=	35 N/mm^2
f_y	=	460 N/mm^2
Penutup konkrit	=	25 mm
Diameter tetulang memanjang	=	25 mm
Diameter tetulang perangkai	=	8 mm

(i) Berdasarkan fasal 3.8.1.3: BS 8110: Part 1: 1997, kelaskan tiang tersebut samada tiang pendek atau langsing.

(7 markah)

(ii) Rekabentuk tetulang memanjang yang diperlukan oleh tiang tersebut.

(12 markah)

(iii) Tentukan tetulang perangkai yang diperlukan oleh tiang.

(3 markah)

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

(3 markah)

S5 (a) Sebuah banglo dua tingkat telah dicadangkan untuk dibina atas kawasan tanah gambut. Daripada pandangan seorang jurutera struktur, apakah jenis penapak yang anda akan cadangkan untuk rumah ini? Bincangkan **Dua (2)** kebaikan untuk sistem penapak ini.

(4 markah)

(b) Satu tukup empat-cerucuk menyokong beban maksimum terfaktor 3000 kN dari sebuah tiang seperti ditunjukkan dalam Rajah **Q5**. Semasa pembinaan, cerucuk 'D' telah mengalami ofset 50 mm. Akibat daripada kesilapan ini, beban paksi yang dibawa oleh setiap cerucuk telah berubah. Diberikan maklumat berikut:

Beban paksi:		
Cerucuk 'A'	=	700 kN
Cerucuk 'B'	=	780 kN
Cerucuk 'C'	=	680 kN
Cerucuk 'D'	=	840 kN
Ukurdalam tukup cerucuk	=	900 mm
Kekuatan konkrit	=	40 N/mm^2
Kekuatan tetulang	=	460 N/mm^2
Penutup konkrit	=	60 mm
Anggap diameter tetulang	=	20 mm

(i) Berdasarkan teori rasuk, kirakan moment maksimum pada keratan kritikal untuk kedua-dua arah. Abaikan berat sendiri tukup cerucuk saiz tiang.

(8 markah)

(ii) Rekabentuk semua tetulang.

(8 markah)

(iii) Tentukan saiz minimum untuk tiang segiempat sama untuk memuaskan semakan ricih maksimum.

(7 markah)

(iv) Lakarkan perincian.

(4 markah)

(v) Semasa pembinaan, cerucuk 'A' telah mengalami masalah untuk menghentak sehingga 'set' seperti kehendak jurutera. Cadangkan satu penyelesaian untuk mengatasi masalah ini.

(4 markah)

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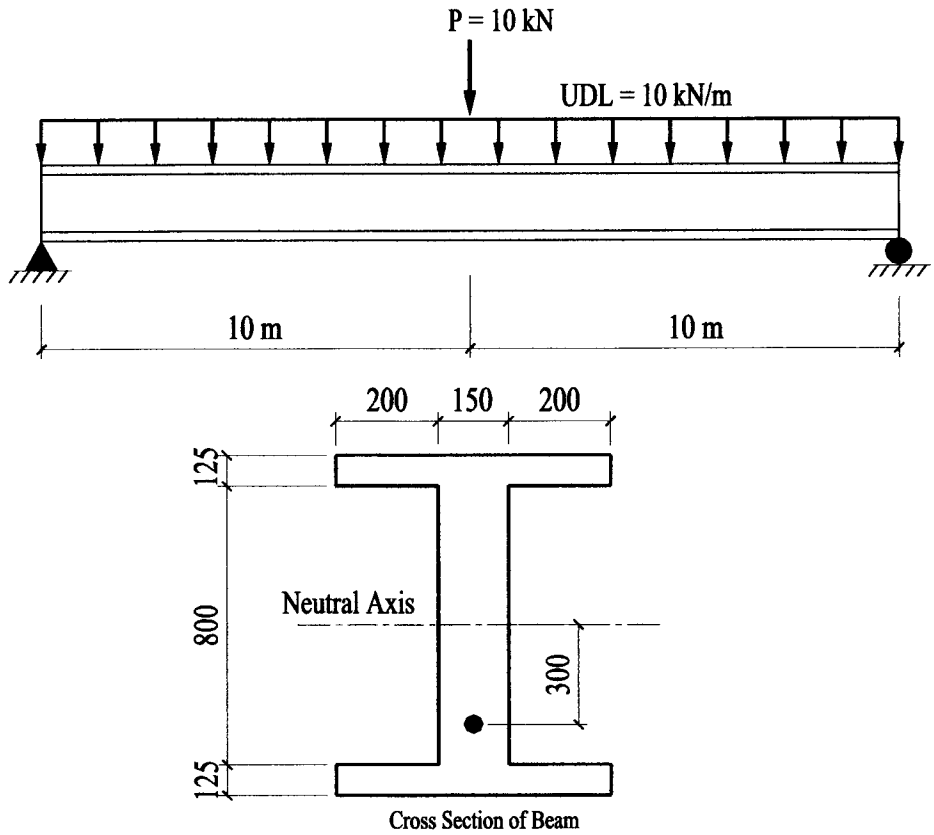

FIGURE Q1

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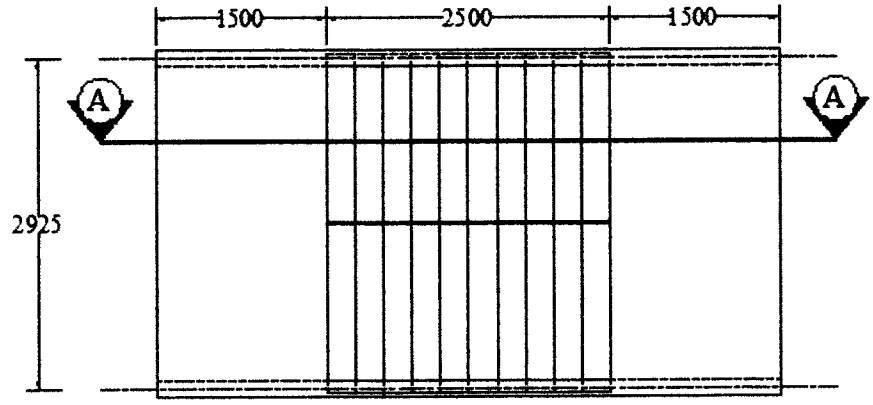
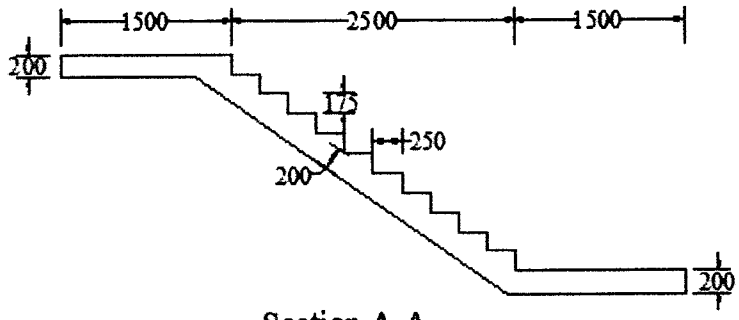


Plan View



Section A-A

FIGURE Q2(a)

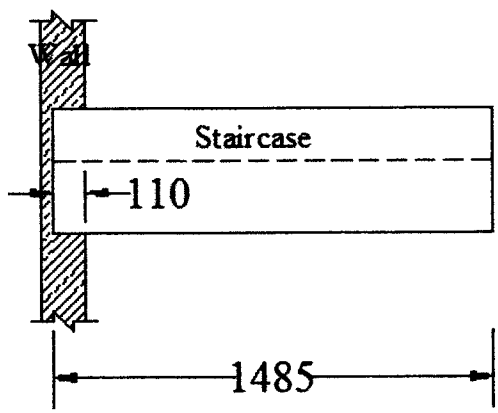


FIGURE Q2(b)

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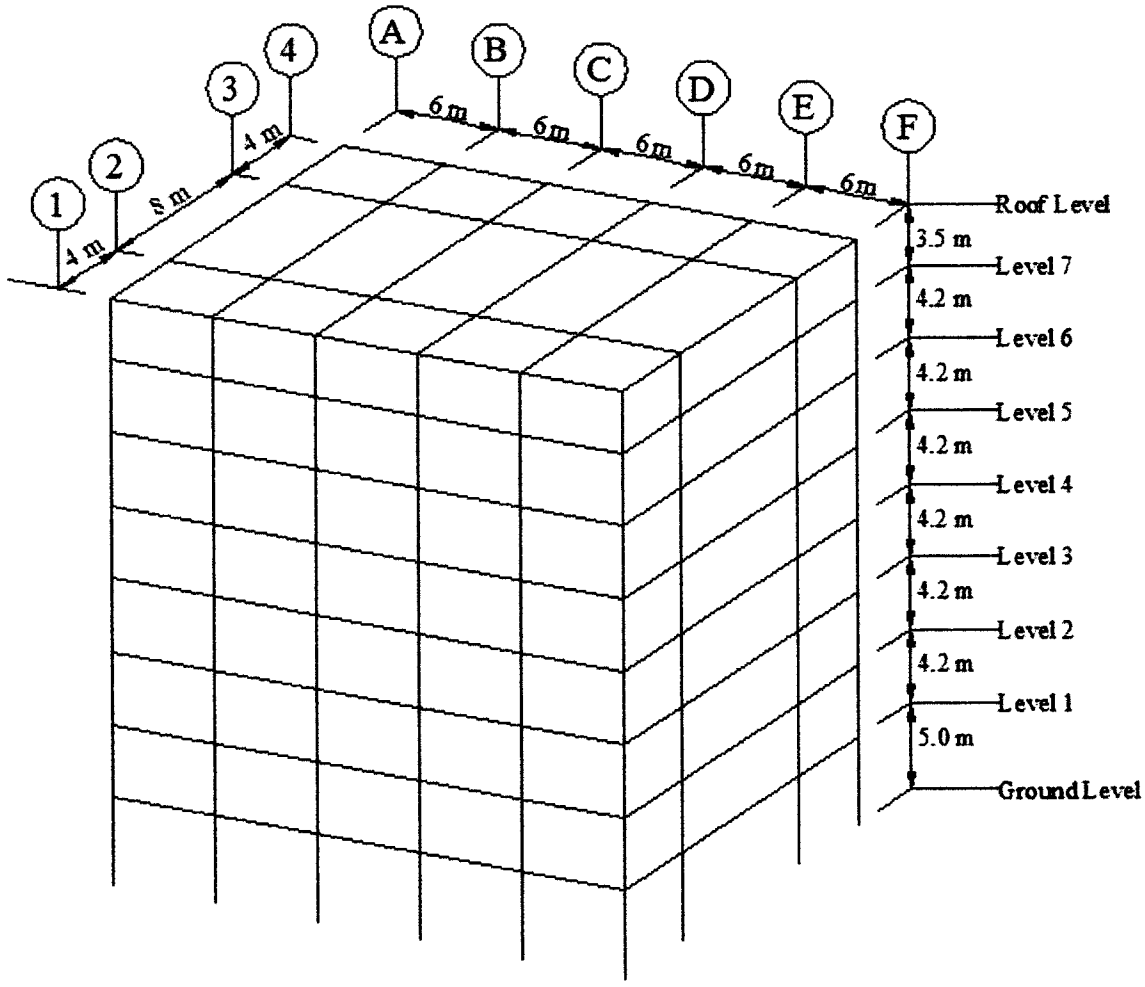

FIGURE Q3

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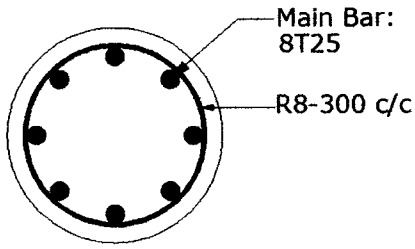

FIGURE Q4(a)

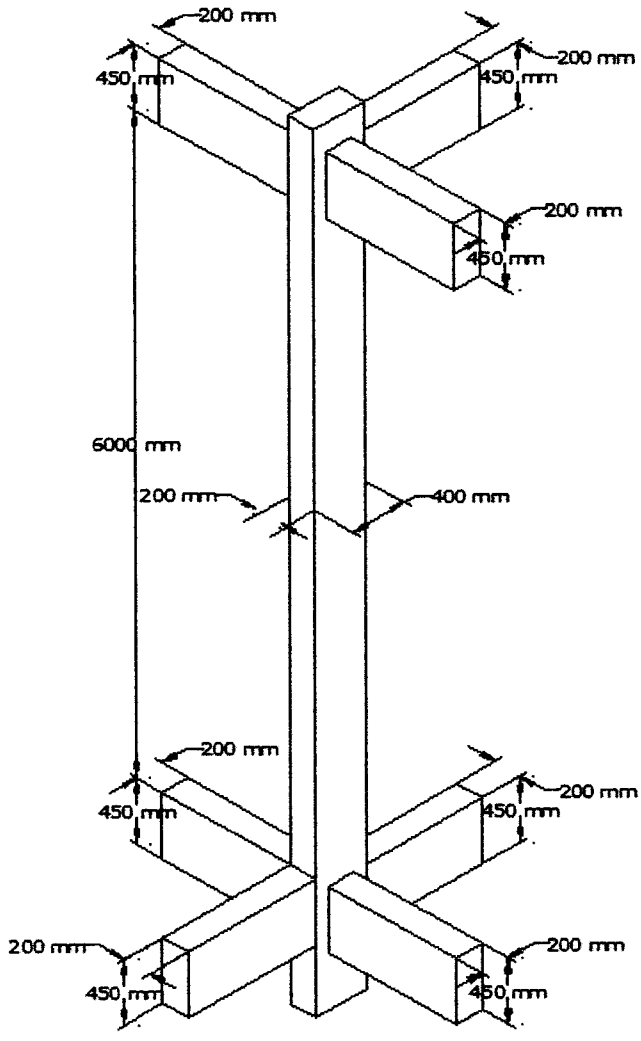

FIGURE Q4(b)

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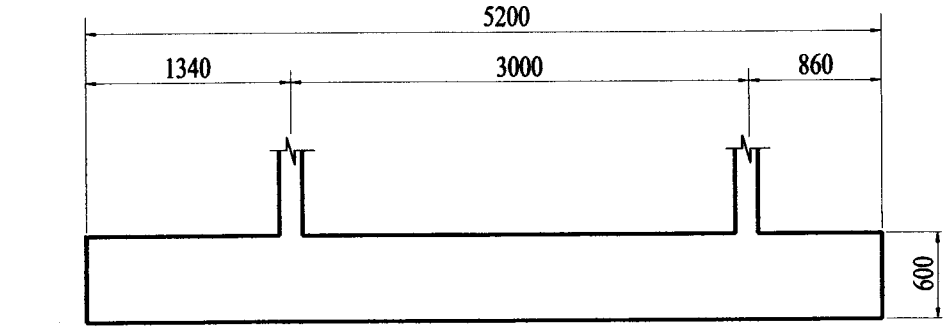
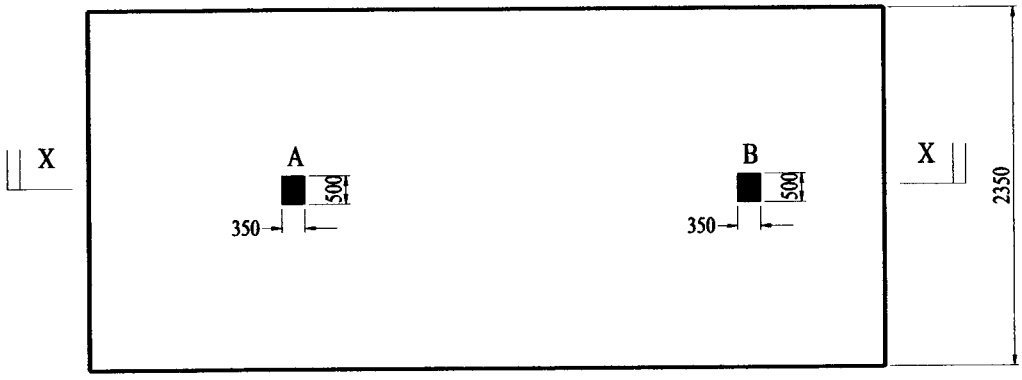


Section X-X



Plan

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