UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2010/2011

COURSE NAME	:	CONCRETE DESIGN
COURSE CODE	:	BFC 3113
PROGRAMME	:	3 BFA
EXAMINATION DATE	:	NOVEMBER/DECEMBER 2009
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY
		DESIGN SHOULD BE BASED ON BS8110:PART 1:1997 BS8110:PART 2:1985 BS8110:PART 3:1985

THIS PAPER CONSISTS OF SIXTEEN (16) PAGES

Q1 (a) Why steel reinforcement is used in concrete?

(2 marks)

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

(2 marks)

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

(6 marks)

(d) Figure **Q1** shows a stress-strain curve for normal-weight concrete as stated in BS 8110. From the figure,

(i) discuss the relationship between stress and strain.

(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)?

(2 marks)

(iii) what is value for strain at failure?

(2 marks)

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

(3 marks)

Q2 Figure **Q2** 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
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.

(12 marks)

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

(7 marks)

(c) Check the deflection for span AB

(3 marks)

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

(3 marks)

Q3 (a) Give slab the definition.

(2 marks)

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

(3 marks)

(c) Figure **Q3** 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)

Q4 Figure **Q4** shows a staircase which continuous at the supporting beam upper and lower and spanning parallel to the stair flight. The landing of staircase is cantilever about 1200 mm from lower support of stair flight. The following data are given;

Going, G	=	250 mm
Riser, R	=	175 mm
Waist, W	=	150 mm
Landing thickness	=	200 mm
Finishing	=	1.5 kN/m^2
Imposed load	=	4.0 kN/m^2
f_{cu}	=	30 N/mm^2
f_y	=	460 N/mm^2
Bar size	=	12 mm
Concrete cover	=	25 mm

(a) Calculate the design ultimate load of stair flight and landing.

(4 marks)

(b) Design all reinforcement required for stair flight and landing.

(10 marks)

(c) Check shear resistance of the stair flight.

(5 marks)

(d) Check deflection and cracking of stair flight.

(6 marks)

Q5 (a) A braced concrete column 400 mm x 300 mm sized is subjected to biaxial bending as shown in Figure **Q5**. Given,

f_{cu}	=	30 N/mm^2
f_y	=	460 N/mm^2
N	=	1000 kN
Mx	=	100 kNm
My	=	75 kNm
Nominal cover	=	75 mm
Main reinforcement diameter	=	40 mm
Link diameter	=	8 mm

(i) Prove that the column is short column

(6 marks)

(ii) Determine the suitable reinforcement bar size and sketch the column cross section detailing.

(12 marks)

(b) Explain the types and classes of the column.

(4 marks)

(c) Explain types of failure that can occur at column and methods to overcome the problem.

(3 marks)

Q6 Figure **Q6** shows a square reinforced concrete footing to support a 450 mm square tied concrete column. The design data are as follows,

Dead load	= 1150 kN
Live load	= 250 kN
Allowable soil pressure	= 240 kN/m^2
Concrete strength (column)	= 30 N/mm^2
Concrete strength (footing)	= 20 N/mm^2
Steel characteristic strength	= 460 N/mm^2
Concrete cover	= 50 mm
Footing thickness	= 650 mm
Footing size	= 2.9 m x 2.9 m

(a) Prove that the provided reinforcement is adequate to support the ultimate design load.

(8 marks)

(b) Calculate the maximum shear.

(4 marks)

(c) Check the footing ability towards normal shear.

(5 marks)

(d) Check the footing ability towards punching shear.

(5 marks)

(e) Suggest a suitable foundation for soft soil ground. Why?

(3 marks)

S1 (a) Kenapakah tetulang besi digunakan di dalam konkrit?

(2 markah)

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

(2 markah)

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

(6 markah)

(d) Rajah **Q1** menunjukkan lengkung tegasan-terikan bagi konkrit berkekuatan biasa seperti dinyatakan dalam BS 8110. Berdasarkan rajah,

(i) bincangkan hubungan antara tegasan dan terikan .

(8 markah)

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

(2 markah)

(iii) berapakah nilai terikan pada kegagalan?

(2 markah)

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

(3 markah)

S2 Rajah **Q2** 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
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.

(12 markah)

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

(7 markah)

(c) Semak lenturan pada rentang AB.

(3 markah)

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

(3 markah)

S3 (a) Berikan definisi papak.

(2 markah)

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

(3 markah)

(c) Sebuah papak selanjar dengan ketebalan 175 mm seperti yang ditunjukkan dalam Rajah **Q3**. 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)

S4 Rajah **Q4** menunjukkan tangga yang selanjar pada penyokong rasuk atas dan rasuk bawah dan rentangnya selari dengan arah larian anak tangga. Pelantar tangga adalah terjulur sebanyak 1200 mm daripada penyokong bawah anak tangga. Diberi data-data berikut;

Jejak, G	=	250 mm
Penaik, R	=	175 mm
Tebal cekak, W	=	150 mm
Tebal pelantar	=	200 mm
Kemasan	=	1.5 kN/m^2
Beban kenaan	=	4.0 kN/m^2
f_{cu}	=	30 N/mm^2
f_y	=	460 N/mm^2
Saiz bar	=	12 mm
Penutup konkrit	=	25 mm

(a) Kira beban rekabentuk muktamad bagi anak tangga dan pelantar.

(4 markah)

(b) Rekabentuk semua tetulang yang diperlukan oleh anak tangga dan pelantar.

(10 markah)

(c) Semak keupayaan ricih pada anak tangga.

(5 markah)

(d) Semak pesongan dan keretakan pada anak tangga.

(6 markah)

S5 (a) Sebuah tiang pendek konkrit dirembat bersaiz 400 mm x 300 mm mengalami lenturan pada kedua-dua paksi seperti dalam Rajah **Q5**. Diberi,

f_{cu}	=	30 N/mm^2
f_y	=	460 N/mm^2
N	=	1000 kN
Mx	=	100 kNm
My	=	75 kNm
Penutup nominal	=	40 mm
Anggap diameter tetulang utama	=	25 mm
Anggap diameter perangkai	=	8 mm

(i) Buktikan bahawa tiang tersebut adalah tiang pendek.

(6 markah)

(ii) Tentukan saiz tetulang yang sesuai dan lakarkan perincian karatan tiang.

(12 markah)

(b) Terangkan mengenai jenis dan kelas tiang yang ada

(4 markah)

(c) Terangkan mengenai jenis-jenis kegagalan yang boleh berlaku pada tiang dan cara-cara mengatasinya

(3 markah)

S6 Rajah **Q6** menunjukkan penapak konkrit bertetulang segiempat sama yang menanggung 450 mm segiempat sama tiang konkrit. Data rekabentuk adalah seperti berikut,

Beban mati	= 1150 kN
Beban kenaan	= 250 kN
Tegasan tanah yang dibenarkan	= 240 kN/m^2
Kekuatan konkrit (tiang)	= 30 N/mm^2
Kekuatan konkrit (penapak)	= 20 N/mm^2
Kekuatan ciri keluli	= 460 N/mm^2
Penutup konkrit	= 50 mm
Ketebalan penapak	= 650 mm
Saiz penapak	= 2.9 m x 2.9 m

(a) Buktikan bahawa tetulang yang disediakan mampu untuk menanggung beban rekabentuk muktamad.

(8 markah)

(b) Kirakan ricih maksimum.

(4 markah)

(c) Semak keupayaan penapak terhadap ricih normal.

(5 markah)

(d) Semak keupayaan penapak terhadap ricih tebuk.

(5 markah)

(e) Cadangkan satu sistem asas yang sesuai digunakan untuk tanah lembut. Kenapa?

(3 markah)

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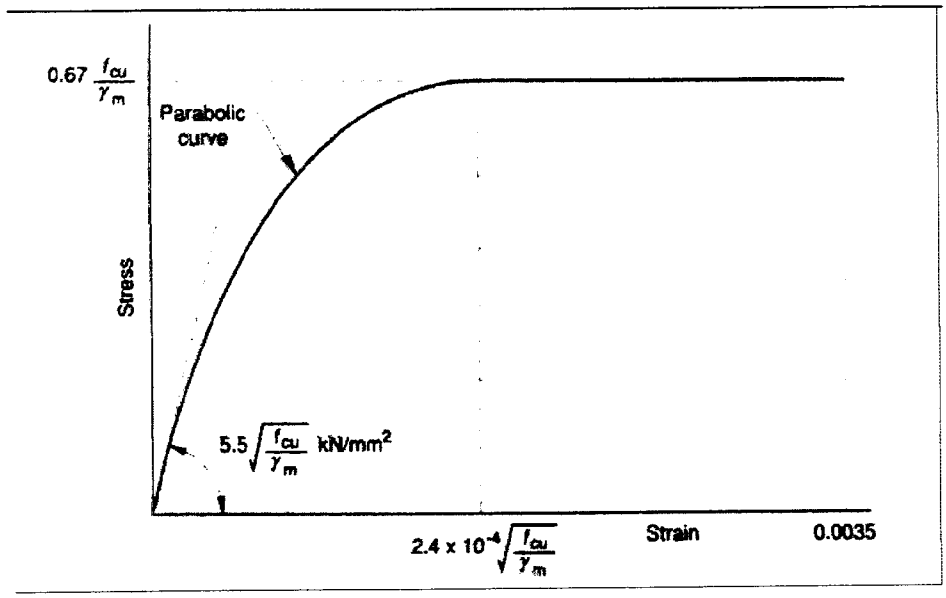

FIGURE Q1

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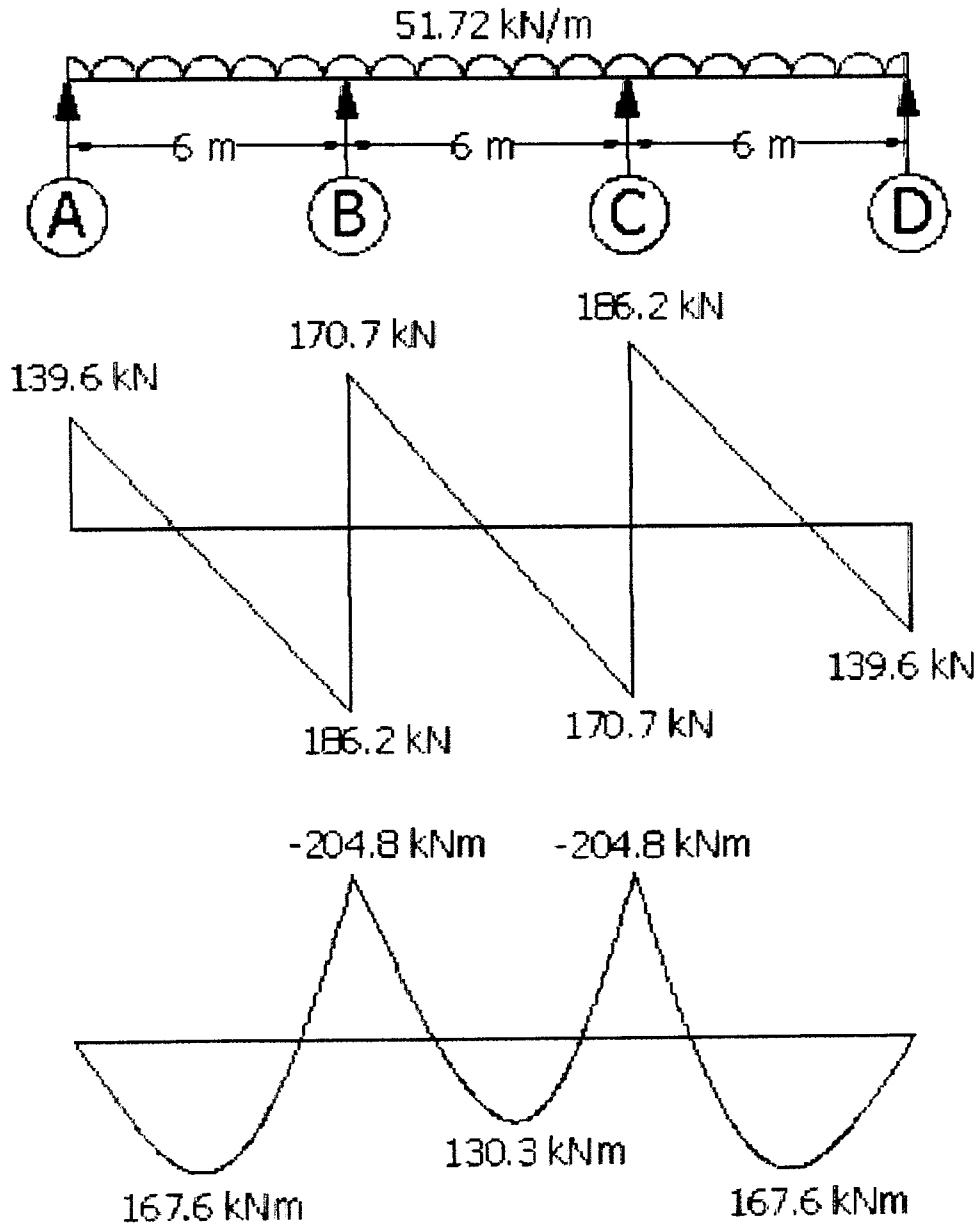

FIGURE Q2

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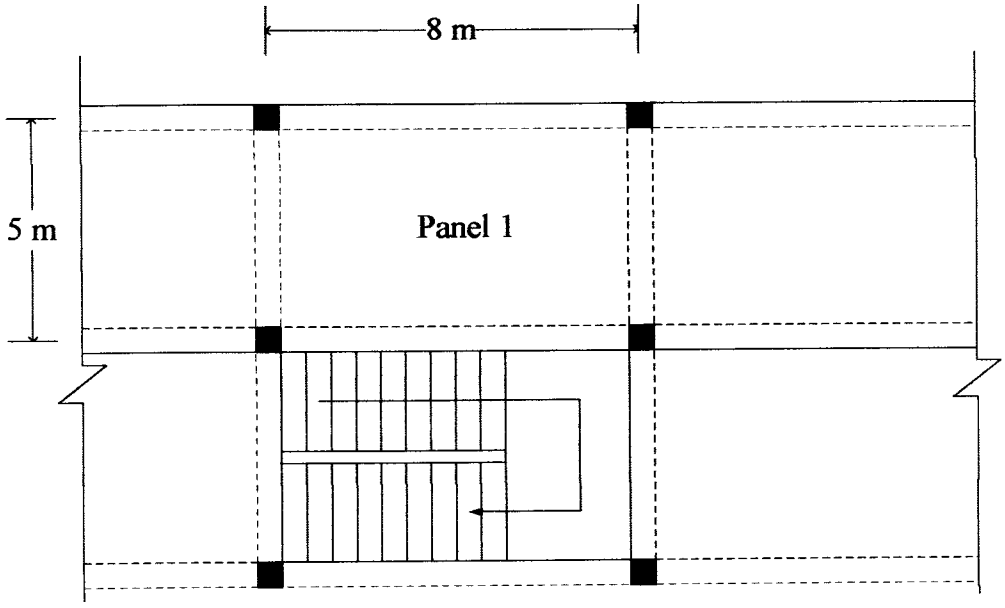

FIGURE Q3

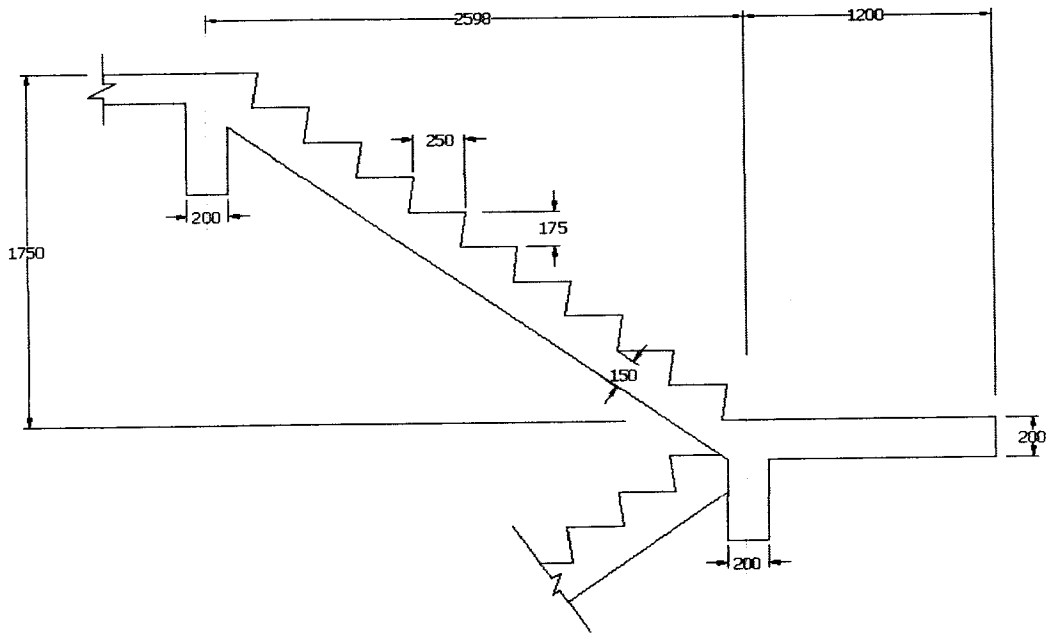

FIGURE Q4

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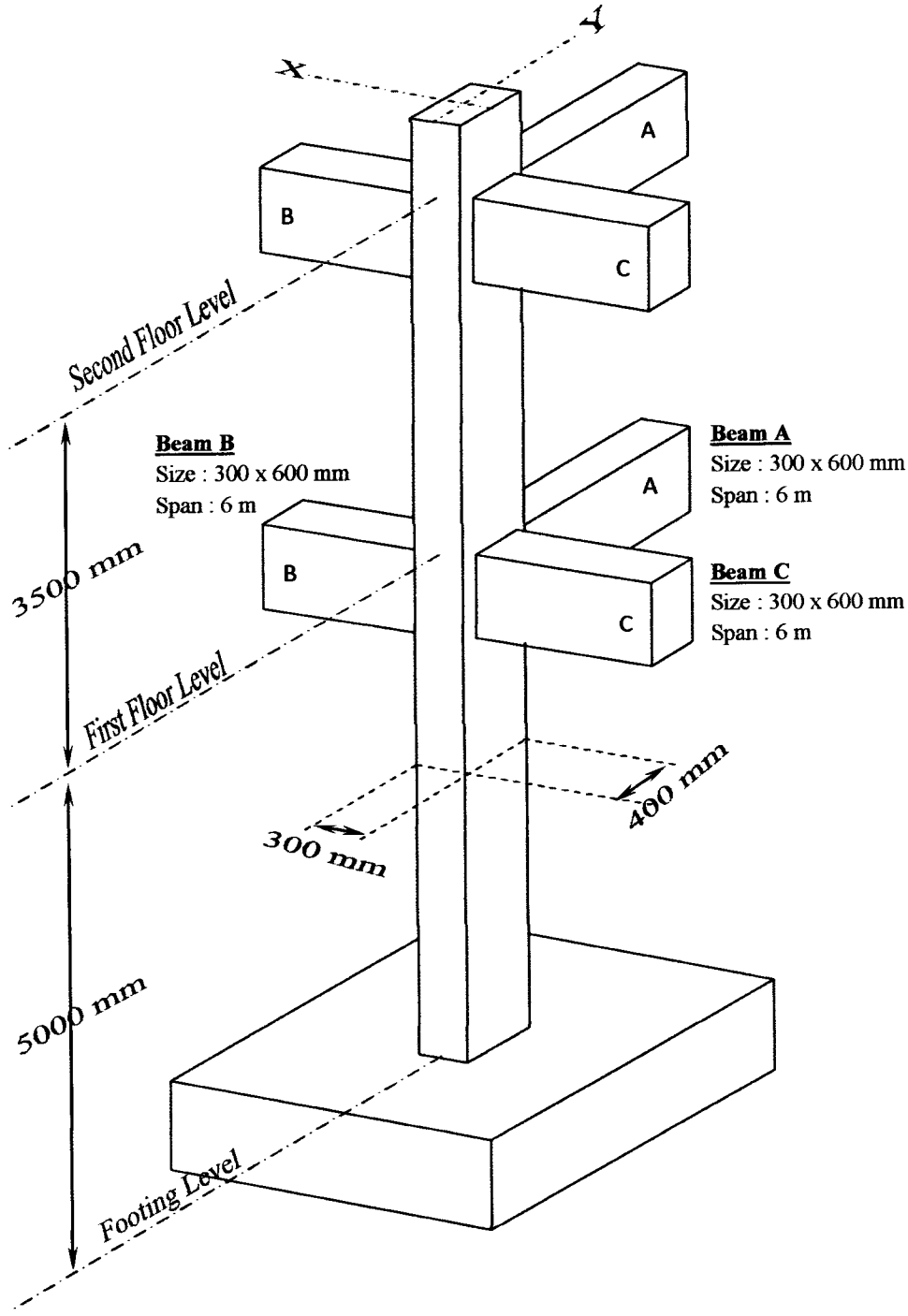

FIGURE Q5

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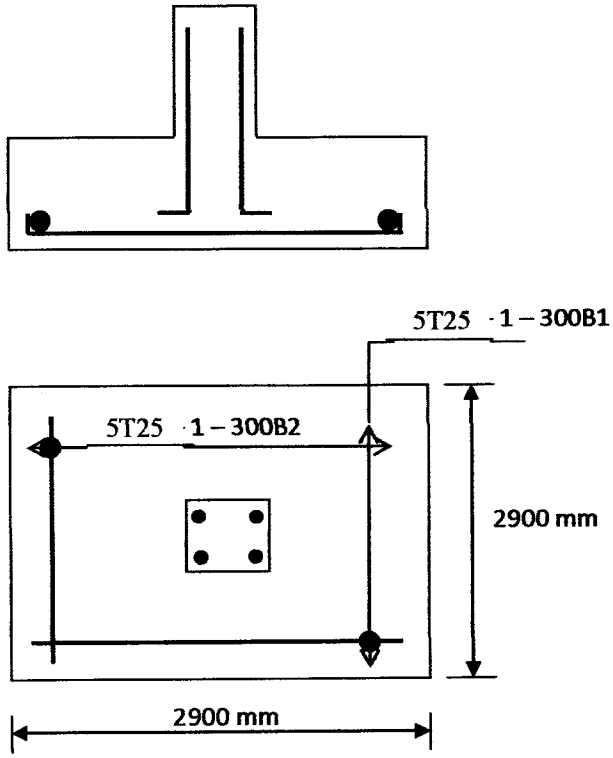

FIGURE Q6

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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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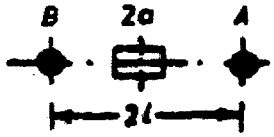
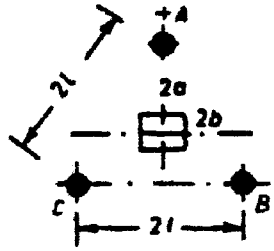
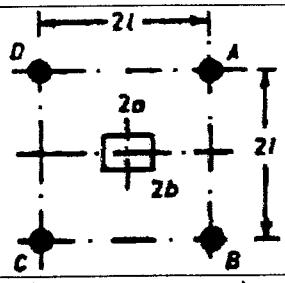
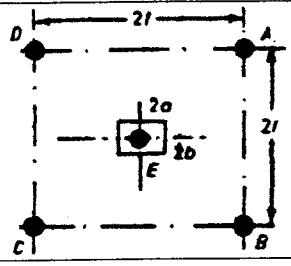
Appendix A

Pile Group		Column size is included	Column size not included
2		$T_{AB} = \frac{N}{6ld}(3l^2 - a^2)$	$T_{AB} = \frac{Nl}{2d}$
3		$T_{BC} = \frac{N}{18ld}(4l^2 + b^2 - 3a^2)$ $T_{AB} = T_{AC} = \frac{N}{9ld}(2l^2 - b^2)$	$T_{AB} = T_{BC} = T_{CA} = \frac{2Nl}{9d}$
4		$T_{AB} = T_{CD} = \frac{N}{12ld}(3l^2 - b^2)$ $T_{AD} = T_{BC} = \frac{N}{12ld}(3l^2 - a^2)$	$T_{AB} = T_{BC} = T_{CD} = T_{DA} = \frac{Nl}{4d}$
5		$T_{AB} = T_{CD} = \frac{0.8N}{12ld}(3l^2 - b^2)$ $T_{AD} = T_{BC} = \frac{0.8N}{12ld}(3l^2 - a^2)$	$T_{AB} = T_{BC} = T_{CD} = T_{DA} = \frac{0.8Nl}{4d}$

Formula:

$$M_f = (0.45f_{cu}.b.h_f)\left(d - \frac{h_f}{2}\right)$$

$$Mu_f = 0.156.f_{cu}.b_w.d^2 + (0.45f_{cu})(b - b_w)h_f.\left(d - \frac{h_f}{2}\right)$$

$$As' = \frac{M - Mu_f}{0.95fy(d - d')}$$

$$As = \frac{0.2.f_{cu}.b_w.d + 0.45f_{cu}.((b - b_w)h_f}{0.95f_y} + As'$$