UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2010/2011

COURSE NAME	:	STRUCTURAL CONCRETE DESIGN II
COURSE CODE	:	BFC 3172
PROGRAMME	:	3 BFF
EXAMINATION DATE	:	NOVEMBER/DECEMBER 2010
DURATION	:	2 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 Figure **Q1** shows a class 2 post-tensioned pre-stressed concrete beam with the service load of 30 kN/m and does not include the selfweight of the beam. Prestressing force losses at transfer are 10 % and 20 % at service. Other data are given as followed.

Prestressing force for tendon 1 and 3	=	2000 kN
Prestressing force for tendon 2	=	500 kN
Concrete grade at transfer	=	C30
Concrete grade at service	=	C40
Cross-sectional area	=	52×10^4 mm^2
Moment of inertia	=	12.85×10^{10} mm^4
Tendon eccentricity	=	500 mm

(a) Calculate moment due to the beam selfweight.
(2 marks)

(b) Calculate moment due to superimposed load (Dead Load + Live Load).
(2 marks)

(c) Calculate stresses at initial stage.
(9 marks)

(d) Calculate stresses at service stage.
(9 marks)

(e) Draw the complete stress distribution diagram at initial and service stages.
(4 marks)

(f) Compare all the stresses value with the stress limit suggested in BS 8110.
(4 marks)

PART B

Q2 Figure **Q2** 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.

(5 marks)

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

(15 marks)

(c) Check shear resistance of the stair flight.

(5 marks)

(d) Check deflection and cracking of stair flight.

(7 marks)

(e) In design aspect, what the differences between transverse spanning staircase and longitudinal span staircase?

(3 marks)

Q3 (a) Clause 3.2.1.1 BS 8110: Part 1: 1997 states that the frame analysis may be simplified appropriately to three levels of sub-frames. By using aid of sketch, explain each of them.

(6 marks)

(b) For unbraced 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) State **Four (4)** assumptions made in analysing horizontal load using Portal Method.

(4 marks)

(d) Figure **Q3** shows an elevation view of 3 storeys building of un-braced frame to be constructed at hill area. The frame is subjected to 5 kN/m unfactored wind load, draw bending moment diagram of the building frame due to wind load.

(16 marks)

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

(3 marks)

Q4 (a) A braced concrete column 400 mm x 300 mm sized is subjected to biaxial bending as shown in Figure Q4. 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

(8 marks)

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

(17 marks)

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

(5 marks)

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

(5 marks)

Q5 (a) Sketch the distribution of bearing stress underlying the footing according to

(i) eccentricity, e = 0
(ii) eccentricity, e < D/6
(iii) eccentricity, e > D/6

Label all the parameters clearly and write the soil ultimate pressure equation for each condition.

(12 marks)

(b) Figure **Q5** shows a square reinforced concrete footing to support an 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

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

(7 marks)

(ii) Calculate the maximum shear.

(3 marks)

(iii) Check the footing ability towards normal shear.

(5 marks)

(iv) Check the footing ability towards punching shear.

(5 marks)

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

(3 marks)

BAHAGIAN A

S1 Rajah **Q1** menunjukkan satu rasuk konkrit pasca-tegasan kelas 2 dengan beban khidmat sebanyak 30 kN/m dan tidak termasuk berat sendiri rasuk. Kehilangan daya pra-tegasan pada pindahan ialah 10 % manakala 20 % ketika khidmat. Data –data lain adalah di beri seperti berikut,

Daya pra-tegasan untuk tendon 1 dan 3	=	2000 kN
Daya pra-tegasan untuk tendon 2	=	500 kN
Gred konkrit pada pindahan	=	C30
Gred konkrit pada khidmat	=	C40
Luas keratan rentas	=	52×10^4 mm^2
Momen sifatekun	=	12.85×10^{10} mm^4
Kesipian tendon	=	500 mm

(a) Kirakan momen akibat dari berat sendiri rasuk.

(2 markah)

(b) Kirakan momen bagi beban kenaan (beban hidup + beban mati).

(2 markah)

(c) Kirakan tegasan di peringkat pindahan.

(9 markah)

(d) Kirakan tegasan di peringkat khidmat.

(9 markah)

(e) Lukiskan taburan tegasan yang lengkap di semasa pindahan dan semasa khidmat. .

(4 markah)

(f) Bandingkan semua nilai-nilai tegasan tersebut dengan had tegasan yang dicadangkan dalam BS 8110.

(4 markah)

BAHAGIAN B

S2 Rajah **Q2** 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.

(5 markah)

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

(15 markah)

(c) Semak keupayaan ricih pada anak tangga.

(5 markah)

(d) Semak pesongan dan keretakan pada anak tangga.

(7 markah)

(e) Di dalam aspek rekabentuk, apakah perbezaan diantara tangga merentang secara melintang dan tangga merentang secara memanjang?

(3 markah)

S3 (a) Fasal 3.2.1.1 BS 8110: Part 1: 1997 menyatakan bahawa analisis kerangka boleh dipermudahkan kepada tiga tahap sub kerangka. Dengan bantuan lakaran, terangkan setiap satu daripadanya.

(6 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) Nyatakan **Empat (4)** andaian yang dibuat di dalam menganalisis beban ufuk menggunakan Kaedah Portal.

(4 markah)

(d) Rajah **Q3** menunjukkan pandangan sisi kerangka bangunan 3 tingkat tidak dirembat yang akan dibina di kawasan pergunungan. Kerangka terdedah kepada beban angin tidak terfaktor sebanyak 5 kN/m, lukiskan gambarajah momen lentur kerangka bangunan disebabkan oleh beban angin.

(16 markah)

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

(3 markah)

S4 (a) Sebuah tiang pendek konkrit dirembat bersaiz 400 mm x 300 mm mengalami lenturan pada kedua-dua paksi seperti dalam Rajah **Q4**. 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.

(8 markah)

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

(17 markah)

(b) Terangkan mengenai jenis dan kelas tiang yang ada

(5 markah)

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

(5 markah)

S5 (a) Lakarkan taburan tegasan galas pada bahagian bawah penapak mengikut kepada

(i) kesipian, e = 0
(ii) kesipian, e < D/6
(iii) kesipian, e > D/6

Labelkan semua parameter dengan jelas dan tulis persamaan tegasan galas muktamad untuk setiap keadaan.

(12 markah)

(b) Rajah **Q5** 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

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

(7 markah)

(ii) Kirakan ricih maksimum.

(3 markah)

(iii) Semak keupayaan penapak terhadap ricih normal.

(5 markah)

(iv) Semak keupayaan penapak terhadap ricih tebuk.

(5 markah)

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

(3 markah)

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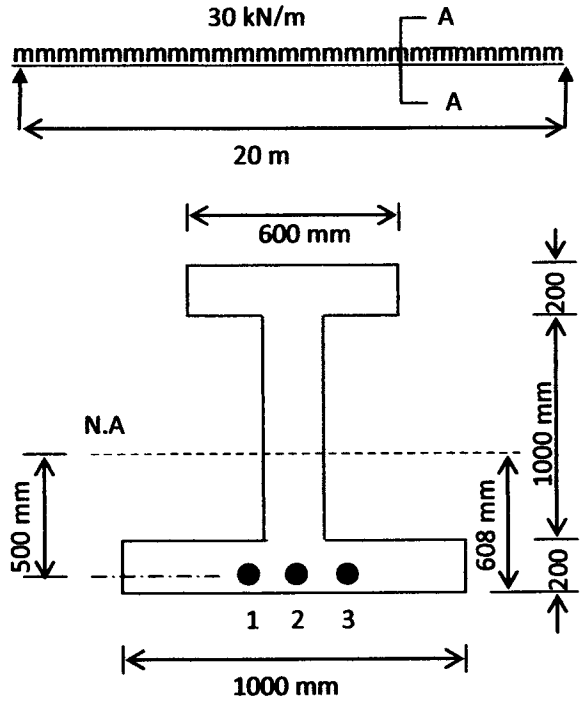

FIGURE Q1

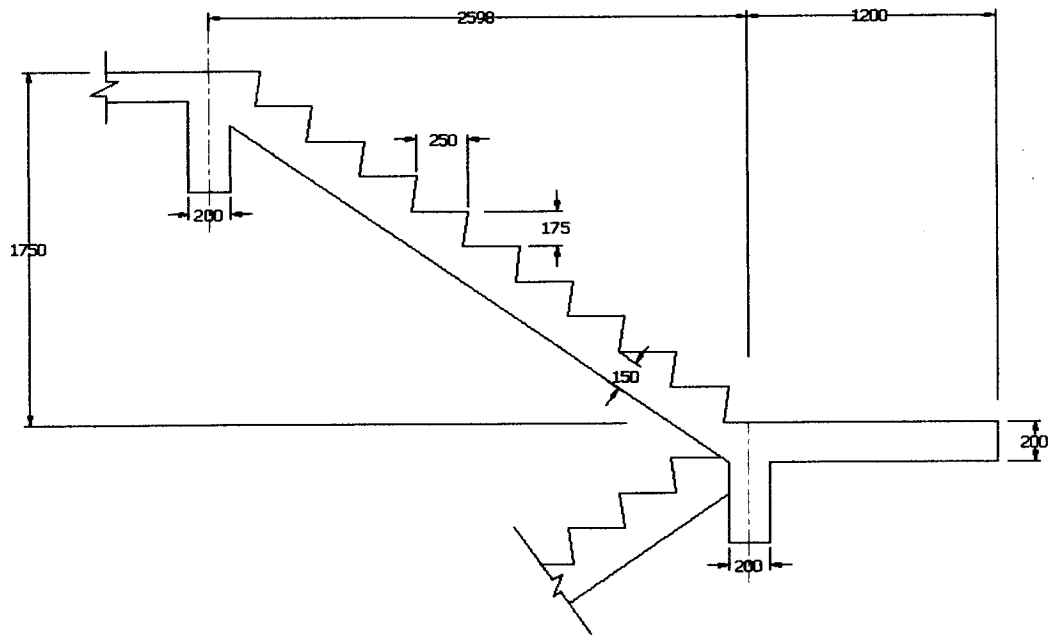

FIGURE Q2

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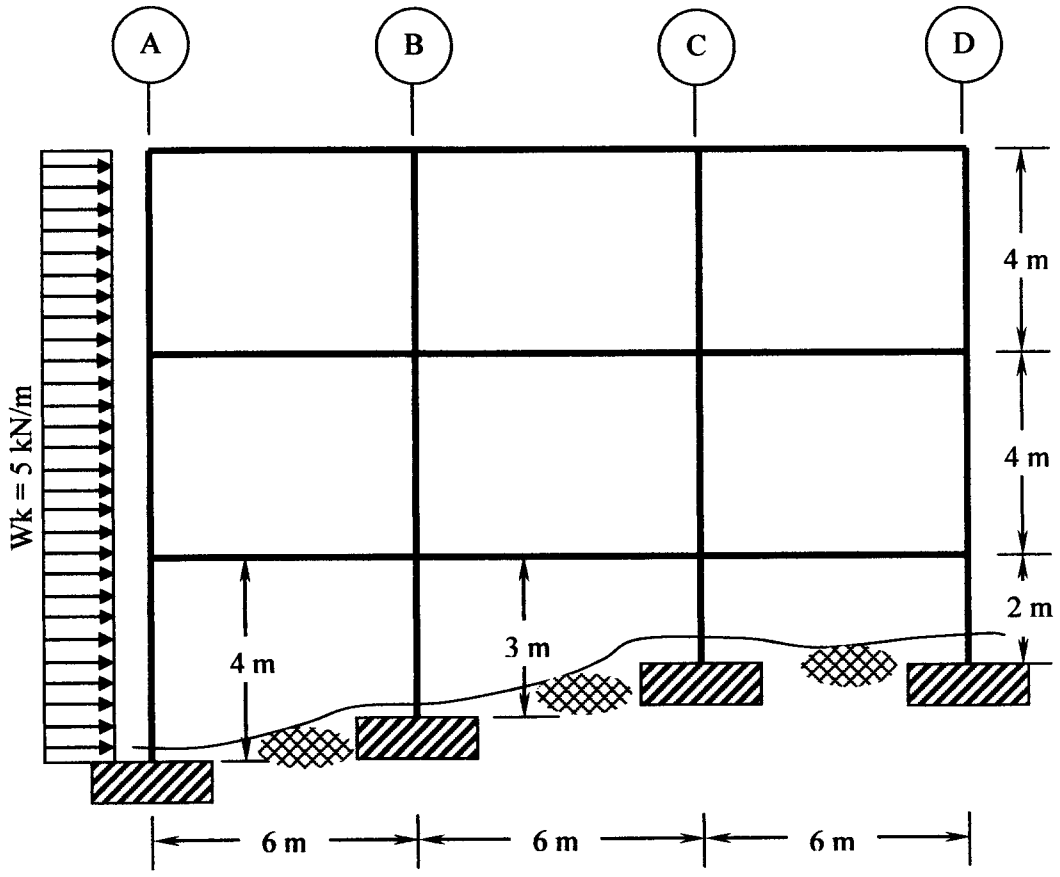

FIGURE Q3

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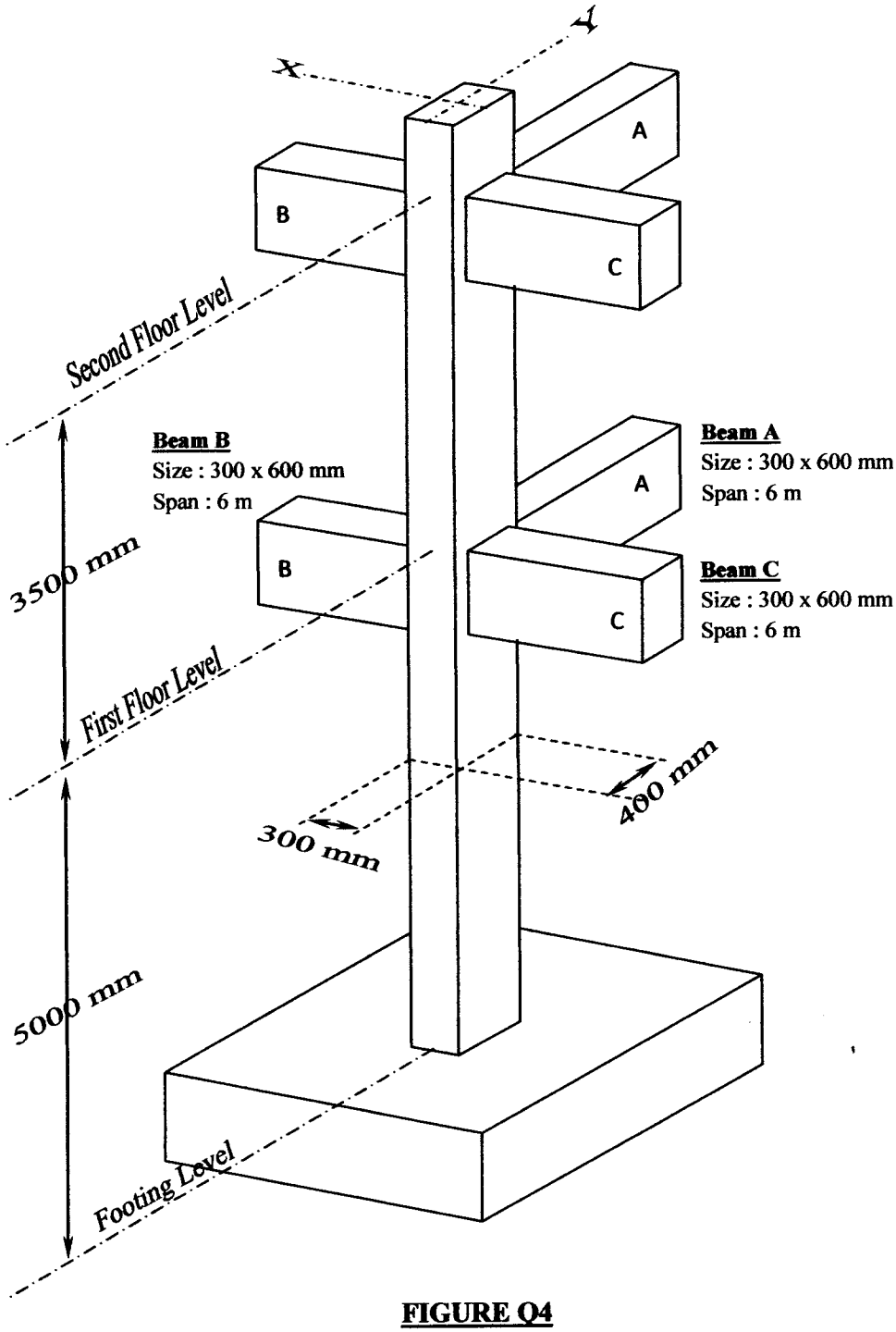

FIGURE Q4

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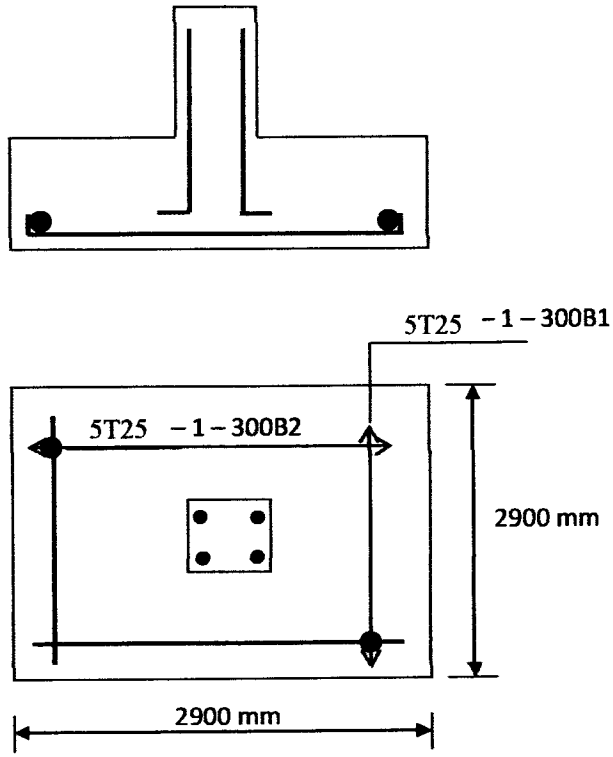

FIGURE Q5

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