UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2012/2013

June 2013

REG 367 – Design of Concrete Structures
(Rekabentuk Struktur Konkrit)

Duration : 3 hours
(Masa: 3 jam)

Please check that this examination paper consists of NINETEEN pages of printed material before you begin the examination.

Sila pastikan bahawa kertas peperiksaan ini mengandungi SEMBILANBELAS muka surat yang tercetak sebelum anda memulakan peperiksaan ini.

Students are allowed to answer all questions in English OR in Bahasa Malaysia.

Pelajar dibenarkan menjawab semua soalan dalam Bahasa Inggeris ATAU Bahasa Malaysia.

Answer **FIVE** questions only.

*Jawab **LIMA** soalan sahaja.*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai].

1. (a) Explain the structural design on the terms of its design bending moment, M_{ed} and ultimate moment resistance, M_{rd}.

Terangkan rekabentuk struktur berdasarkan terma momen rekabentuk lenturan, M_{ed} dan momen rintangan muktamad, M_{rd}.

(5 marks/*markah*)

(b) Explain the stress-strain relations for concrete under compression and ultimate strains. Discuss the relationship with the aid of a diagram sketch.

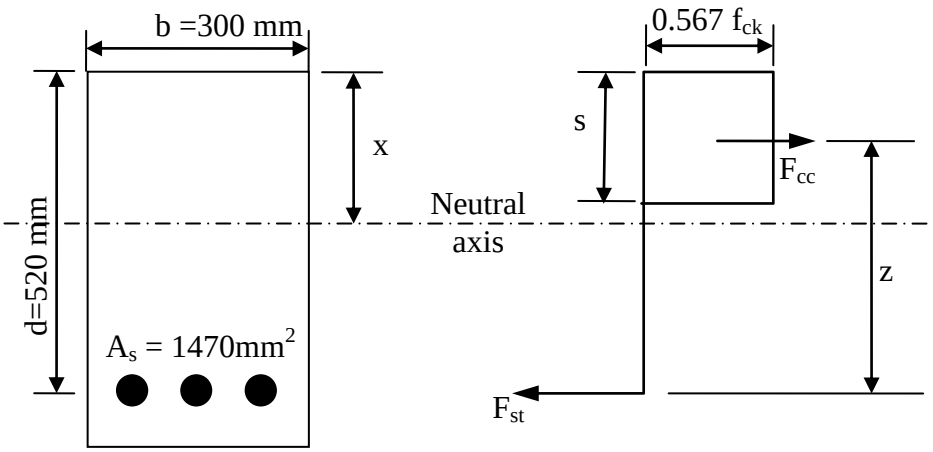
Terangkan hubungan tegasan-terikan untuk konkrit di bawah mampatan dan tekanan muktamad. Bincangkan hubungan ini dengan bantuan lakaran gambarajah.

(6 marks/*markah*)

(a) Determine the ultimate moment of resistance of the cross-section shown in the figure given that the characteristic strength f_{yk} = 500N/mm^2 for the reinforcement and f_{ck} =25N/mm^2 for the concrete.

Tentukan momen rintangan muktamad keratan rentas yang ditunjukkan dalam gambarajah yang diberikan, berdasarkan kekuatan ciri f_{yk} = 500N/mm^2 untuk tetulang dan f_{ck} = 25N/mm^2 untuk konkrit.

(9 marks/*markah*)



2. (a) In the Limit State Design method, the structure shall be designed to withstand safely all loads likely to act on it throughout its life. Discuss the design concept for limit states which involve the ultimate limit states and serviceability limit state.

Dalam kaedah rekabentuk keadaan had muktamad, struktur hendaklah direka bentuk untuk menahan dengan selamat semua beban yang bertindak ke atasnya sepanjang hayatnya. Bincangkan konsep reka bentuk keadaan had yang melibatkan keadaan had muktamad dan keadaan had kebolehkhidmatan.

(10 marks/*markah*)

(b) Durability is the ability of a material or structure to withstand its design service conditions for its design life without significant deterioration. Explain the factors contributing to the durability of the reinforced concrete structural members.

Ketahanan adalah keupayaan bahan atau struktur untuk menahan keadaan perkhidmatan rekabentuk untuk tempoh hayat rekabentuk tanpa kemerosotan ketara. Terangkan faktor-faktor yang menyumbang kepada ketahanan ahli struktur konkrit bertetulang.

(10 marks/*markah*)

3. (a) Explain the factors influencing the durability of reinforced concrete.

Jelaskan faktor yang mempengaruhi ketahanlasakan konkrit bertetulang.

(5 marks/*markah*)

(b) Describe the advantages of reinforced concrete as a structural material.

Huraikan tentang kebaikan konkrit bertetulang sebagai bahan struktur.

(5 marks/*markah*)

(c) Determine and provide the tension As and compression As' reinforcement cross section area for a 250mm x 550mm rectangular beam. Given the following data:

d' = 50 mm
d = 500 mm
M = 280 kNm
fcu= 25 N/mm^2
fy = 460 N/mm^2

Tentukan dan sediakan luas keratan rentas tetulang tegangan As dan mampatan As' bagi rasuk segiempat tepat 250mm x 550mm. Diberikan data-data berikut:

d' = 50 mm
d = 500 mm
M = 280 kNm
fcu= 25 N/mm^2
fy = 460 N/mm^2

(10 marks/*markah*)

4. (a) Failures in concrete structures can be due to poor construction methods and inadequate quality control and supervision. Discuss the above statement.

Kegagalan dalam struktur konkrit boleh disebabkan oleh kaedah pembinaan yang teruk dan kekurangan kualiti kontrol dan penyeliaan. Bincangkan kenyataan di atas.

(8 marks/*markah*)

(b) A simply supported rectangular beam of 6.5 meter span carries a characteristic uniformly distributed dead load (including self weight of beam) of 12 kN/m and an imposed load of 5.8 kN/m. The breadth of the beam is 230 mm and the effective depth is 380 mm. Find the reinforcement area required. Use grade 30 concrete and a high yield steel reinforcement.

Calculate the shear reinforcement required for the beam if yield strength of shear is 250 N/mm^2. Confirm whether the span/depth ratio is acceptable for deflection

Sebuah rasuk disokong mudah dengan rentang 6.5 m menanggung beban mati teragih seragam (termasuk berat sendiri rasuk) sebanyak 12 kN/m dan beban hidup teragih seragam sebanyak 5.8 kN/m. Lebar rasuk adalah 230 mm dan kedalaman berkesan adalah 380 mm. Dapatkan keluasan tetulang yang diperlukan. Gunakan konkrit gred 30 dan tetulang berkekuatan tinggi.

Kira tetulang ricih yang diperlukan jika kekuatan alah tetulang ricih adalah 250 N/mm^2. Pastikan samada nisbah rentang/kedalaman dibenarkan bagi pesongan.

(12 marks/*markah*)

5. (a) A pad footing as shown in **Figure 1** carries dead and imposed loads of 2000kN and 800kN respectively. Determine the size of pad footing required if the safe bearing capacity of soil 200kN/m^2. If the fcu (concrete compressive strength) = 30N/mm^2, fy (steel yield strength) = 460N/mm^2, C (nominal cover to reinforcement) = 30mm and Φ (diameter of main steel) = 16mm, compute

(i) Design moment
(ii) Ultimate moment (Mu)
(iii) Cross-sectional area of tension reinforcement (As)

*Asas pad seperti ditunjukkan dalam **Rajah 1** membawa beban mati dan beban kenaan masing-masing 2000kN dan 800kN. Tentukan saiz asas pad tersebut jika keupayaan galas tanah adalah 200kN/m^2. Jika fcu (kekuatan mampatan konkrit) = 30N/mm^2, fy (kekuatan tegangan keluli) = 460N/mm^2, C (penutup tetulang) = 30mm and Φ (garis pusat tetulang) = 16mm, kira*

(i) Momen rekabentuk
(ii) Momen muktamad (Mu)
(iii) Keluasan keratan rentas tetulang tegangan (As)

(15 marks/*markah)*

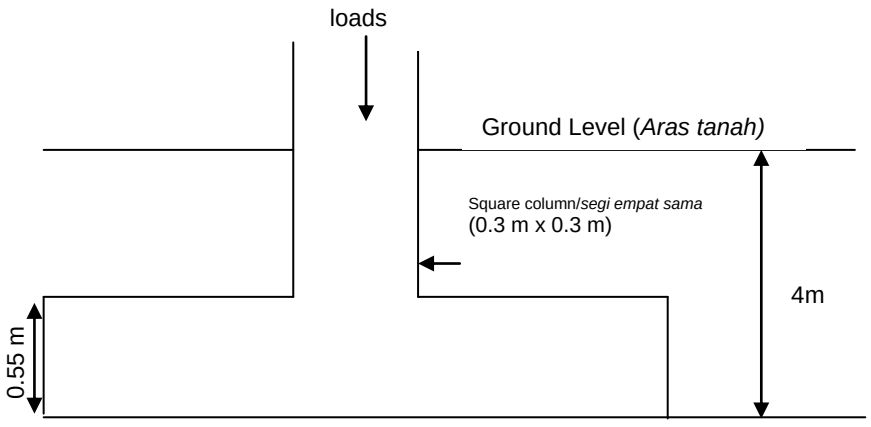


Figure 1/ *Rajah 1*

(b) Estimate the soil bearing capacity of the following soils in kN/m^2

(ii) Igneous bedrock
(iii) sand
(iv) gravel
(v) hard clay
(vi) Soft clay

Anggarkan kekuatan galas untuk tanah-tanah berikut dalam kN/m^2

(i) Bebatuan keras
(ii) Pasir
(iii) Batu kelikir
(iv) Tanah liat keras
(v) Tanah liat lembut

(5 marks/*markah*)

6. (a) Describe the effect of concrete deterioration on load carrying capacity of reinforced concrete column.

Terangkan kesan kerosakan konkrit terhadap keupayaan membawa beban tiang konkrit bertetulang.

(5 marks/*markah*)

(b) State **THREE (3)** possible causes of failure for reinforced concrete columns. Please include a rough **sketch, graph** or **formulae** if necessary.

*Nyatakan **TIGA (3)** kemungkinan sebab-sebab berlakunya kegagalan tiang. Sila masukkan **lakaran, graf** atau **formula** jika perlu.*

(15 marks/*markah*)

Table 1: Sectional areas of groups of bars (mm^2)

Bar size (mm)	Number of bars									
	1	2	3	4	5	6	7	8	9	10
6	28.3	56.6	84.9	113	142	170	198	226	255	283
8	50.3	101	151	201	252	302	352	402	453	503
10	78.5	157	236	314	393	471	550	628	707	785
12	113	226	339	452	566	679	792	905	1020	1130
16	201	402	603	804	1010	1210	1410	1610	1810	2010
20	314	628	943	1260	1570	1890	2200	2510	2830	3140
25	491	982	1470	1960	2450	2950	3440	3930	4420	4910
32	804	1610	2410	3220	4020	4830	5630	6430	7240	8040
40	1260	2510	3770	5030	6280	7540	8800	10100	11300	12600

Table 2: Perimeters and weights of bars

Bar size (mm)	6	8	10	12	16	20	25	32	40
Perimeter (mm)	18.85	25.1	31.4	37.7	50.2	62.8	78.5	100.5	125.6
Weight (kg/m)	0.222	0.395	0.616	0.888	1.579	2.466	3.854	6.313	9.864

Bar weights based on density of 7850 kg/m^3