UNIVERSITI SAINS MALAYSIA

First Semester Examination
2012/2013 Academic Session

January 2013

EAA 455/2 – Reinforced Concrete Structural Design II
[Rekabentuk Struktur Konkrit Bertetulang II]

Duration : 2 hours
[*Masa : 2 jam*]

Please check that this examination paper consists of **TWELVE (12)** pages of printed material including 1 appendix before you begin the examination.

[*Sila pastikan bahawa kertas peperiksaan ini mengandungi **DUA BELAS (12)** muka surat yang bercetak termasuk 1 lampiran sebelum anda memulakan peperiksaan ini.*]

Instructions : This paper contains **FIVE (5)** questions. Answer **FOUR (4)** questions.

[***Arahan** : Kertas ini mengandungi **LIMA(5)** soalan. Jawab **EMPAT (4)** soalan.*

You may answer the question either in Bahasa Malaysia or English.

[*Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris*].

All questions **MUST BE** answered on a new page.

[*Semua soalan **MESTILAH** dijawab pada muka surat baru*].

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

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

1. Design and provide relevant detailing for a pile cap on the following requirements:

(i)	Column service load	=	1900 kN
(ii)	Self-weight of pile cap	=	50kN
(iii)	Allowable pile working capacity	=	640 kN
(iv)	Pile size	=	350 mm diameter Class A Spun pile
(v)	Pile spacing	=	1050 mm
(vi)	Edge distance	=	150 mm
(vii)	Pile embedded length	=	75 mm
(viii)	Concrete grade	=	35 N/mm^2
(ix)	Main reinforcement size	=	20 mm diameter
(x)	Main reinforcement grade,f_y	=	460 N/mm^2
(xi)	Column size	=	300 mm x 300 mm

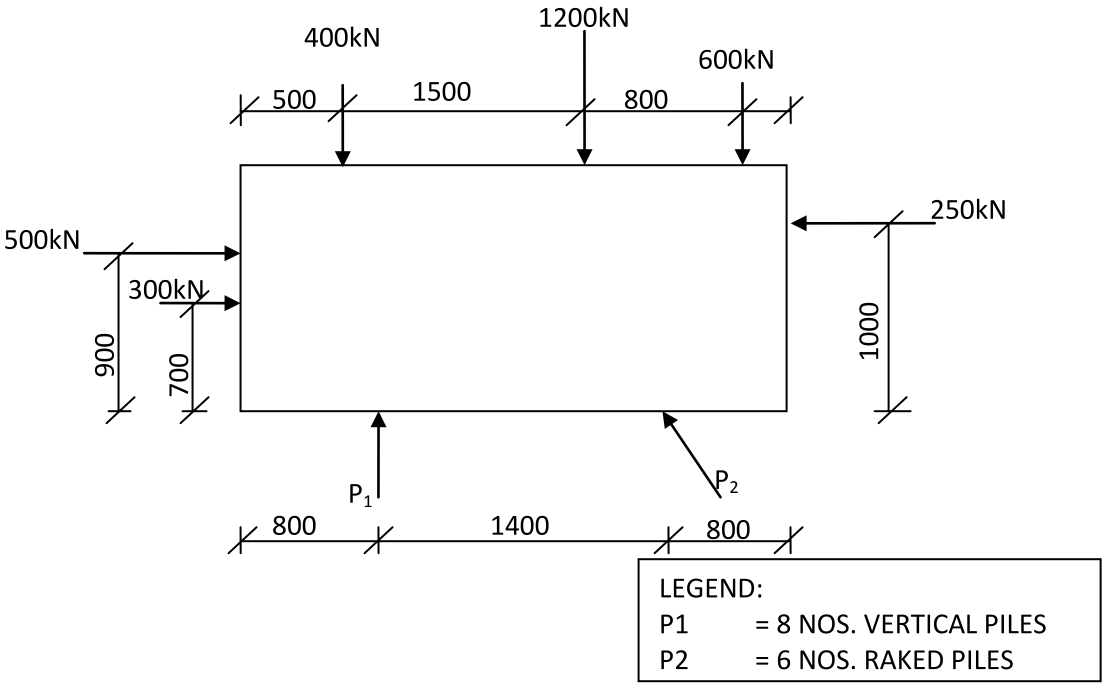
[25 marks]

2 (a) The function of any foundation is to safely sustain and transmit the loads to the ground on which it rests the combined dead, imposed and wind loads in such a manner as not to cause any settlement or other movement which would impair the stability or cause damage to any part of the building. Unlike building, structures like bridges, maritime structures, elevated water tanks, elevated flood light would experience multiple load sources and lateral load which may cause unbalance to the load distribution. Discuss in detail the factors that need to take into consideration to overcome the issue of the unbalance of the load distribution to the foundation.

[10 marks]

(b) A typical cross section of an abutment wall having vertical and raked piles is shown in Figure 1. Calculate the adequacy of the pile arrangement if the allowable pile working load is 400kN. The ratio of the raked pile is taken as 1:4.

[15 marks]



(All dimension in mm)

Figure 1 Typical across section of an abutment wall

3. (a) There are two methods of prestressing force for prestressed concrete. With the aid of sketches, explain and compare the two methods of prestressing.

[10 marks]

(b) A single-span simply supported rectangular beam as shown in Figure 2. Assume the losses to be 20% and permissible tensile stresses 2.5 N/mm^2 at transfer and 2.0 N/mm^2 in service. The permissible stresses are 20 N/mm^2 at transfer and at service. Fine the suitable size of the rectangular section for the member assuming the density of prestressed concrete to be 24 kN/m$^{2.}$

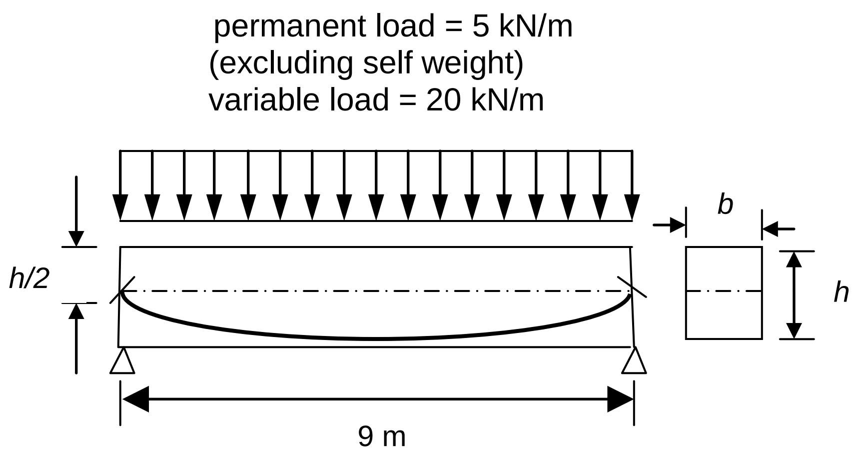


Figure 2 Simply-supported rectangular prestressed beam

[15 marks]

4. Figure 3 shows part of an office flat slab layout plan with column. The imposed load is 4.0 kN/m^2 and the specific load is 1.0 kN/m^2 for finishes. Perimeter load is assumed to be 10 kN/m^2 with grade 30 concrete and 250 graden of reinforcement. The slab is 300 mm thick and column are 400 mm square. The floor slabs are at 4.5 m vertical centres and 2 hour fire rating.

Calculate the amount of reinforcement required (C-D/1-2) at column and middle strips of the flat slab.

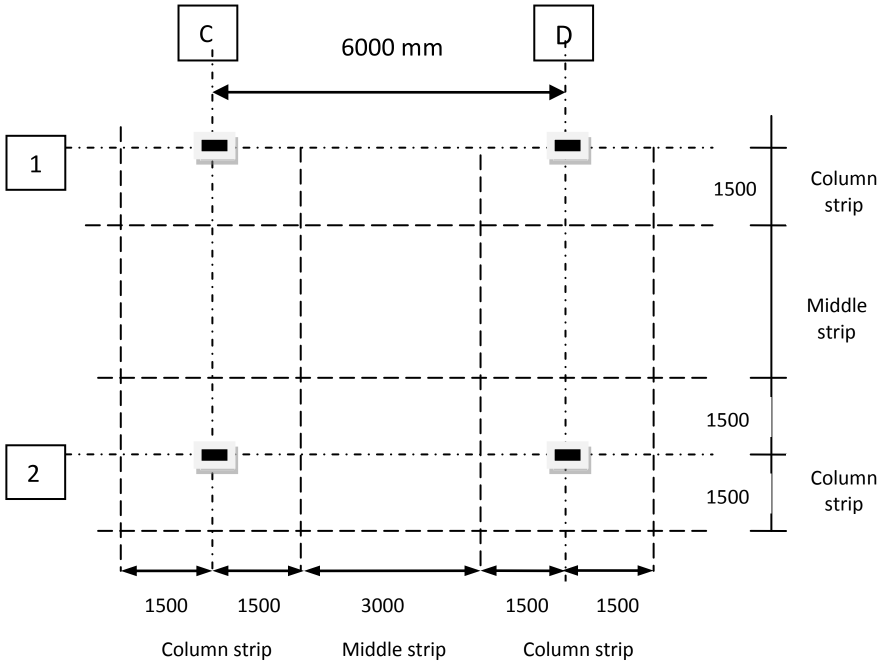


Figure 3 Position of column and middle strips

With the aid of sketches, indicate the position of all reinforcements at column and middle strips.

[25 marks]

5. (a) A retaining wall shown in Figure 4 is proposed to support earth of 4.0 m high. The top surface is horizontal with a dead load surcharge of 20 kN/m^2. Well drained sand is placed behind the wall, of unit weight 17.6 kN/m^3, and internal angle of friction of 30 degrees. The material under the wall has a safe bearing pressure of 120 kN/m^2. The coefficient of friction between the base and soil is 0.5. The retaining wall is constructed using grade 30 concrete and the steel reinforcement characteristic strength (f_y) is 460 N/mm^2. The wall is to be reinforced by T10 and T16 bars, the slab is reinforced by T10 and T12 bars, and the concrete cover is 50 mm. Assuming that there is no need for compression steel reinforcements. Find that the proposed dimensions of the retaining wall is adequate for design.

[15 marks]

(b) The horizontal pressure for retaining wall shown in Figure 4 was calculated. At serviceability state, the horizontal pressure at the base of the retaining wall (z = 4.0 m) is 30.0 kN/m^2 and the top of the retaining wall (z = 0.0 m) is 5 kN/m^2. The retaining wall is constructed using grade 30 concrete and the steel reinforcement characteristic strength (f_y) is 460 N/mm^2. The wall is to be reinforced by T16 bars and the concrete cover is 50 mm. Calculate the structural reinforcements for cantilever wall.

[10 marks]

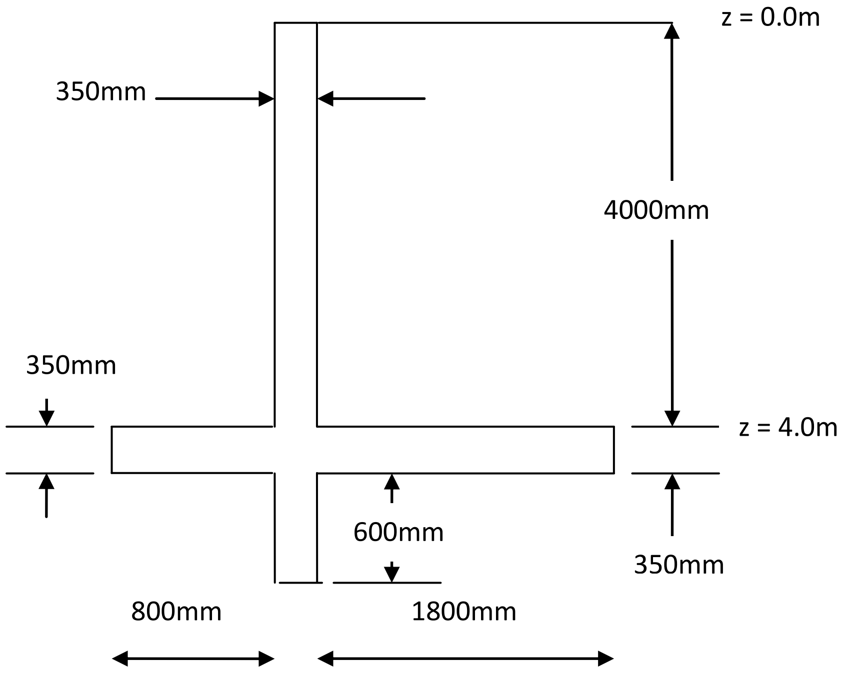


Figure 4 Horizontal pressure for retaining wall

1. *Rekabentuk dan sediakan perincian yang bersesuaian untuk satu tetopi cerucuk yang memenuhi syarat berikut:*

(i)	*Beban kebolehkhidmatan tiang*	=	*3500 kN*
(ii)	*Berat diri tetopi cerucuk*	=	*50kN*
(iii)	*Keupayaan cerucuk dibenarkan*	=	*640 kN*
(iv)	*Saiz cerucuk*	=	*350 mm diameter Class A cerucuk Spun*
(v)	*Selaan cerucuk*	=	*1050 mm*
(vi)	*Jarak tepi*	=	*150 mm*
(vii)	*Kedalaman keseluruhan tetopi cerucuk*	=	*75 mm*
(viii)	*Gred konkrit*	=	*35 N/mm^2*
(ix)	*Saiz tetulang utama*	=	*20 mm diameter*
(x)	*Gred tetulang utama,f_y*	=	*460 N/mm^2*
(xi)	*Saiz tiang*	=	*300 mm x 300 mm*

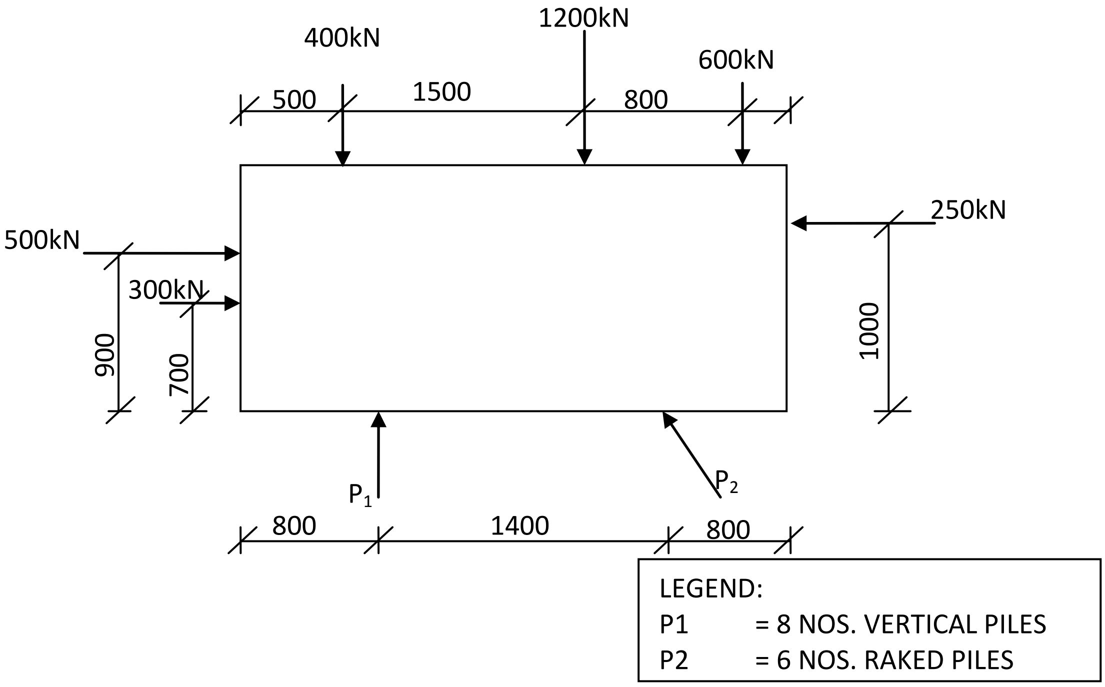
[25 markah]

2. (a) *Fungsi mana-mana asas adalah untuk menanggung dan memindahkan beban gabungan, beban kenaan dan beban angin dengan selamat ke bumi dengan tidak menyebabkan enapan atau pergerakkan yang akan menjejaskan kestabilan dan kerosakan pada bangunan. Tidak seperti struktur bangunan, struktur seperti jambatan, struktur laut dan tangki air ternaik akan terdedah kepada punca beban yang pelbagai dan beban sisi yang akan menyebabkan ketidakseimbangan pengagihan beban. Bincangkan faktor-faktor yang perlu dipertimbangkan untuk menyelesaikan isu ketidakseimbangan pengagihan pada struktur asas.*

[10 markah]

(b) *Satu keratan tipikal tembok landas yang mempunyai cerucuk pugak dan sadak adalah seperti di Rajah 1. Tentukan susunan cerucuk sekiranya keupayaan kerja dibenarkan cerucuk tersebut adalah 400 kN. Nisbah cerucuk sadak di ambil sebagai 1:4.*

[15 markah]

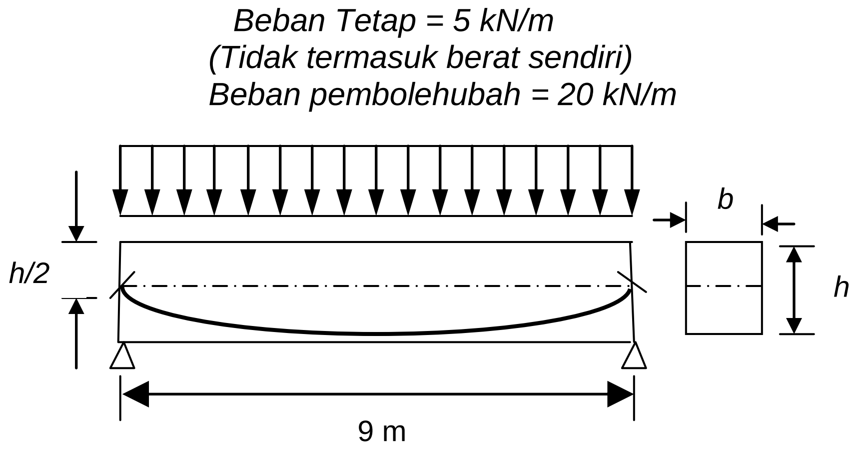


(Semua dimensi dalam mm)
Rajah 1 Keratan tipikal tembok landas

3. (a) *Dua kaedah digunakan untuk mengenakan daya pra-tegasan ke atas konkrit pra-tegasan. Dengan bantuan lakaran, terang dan bandingkan kedua-dua kaedah pra-tegasan.*

[10 markah]

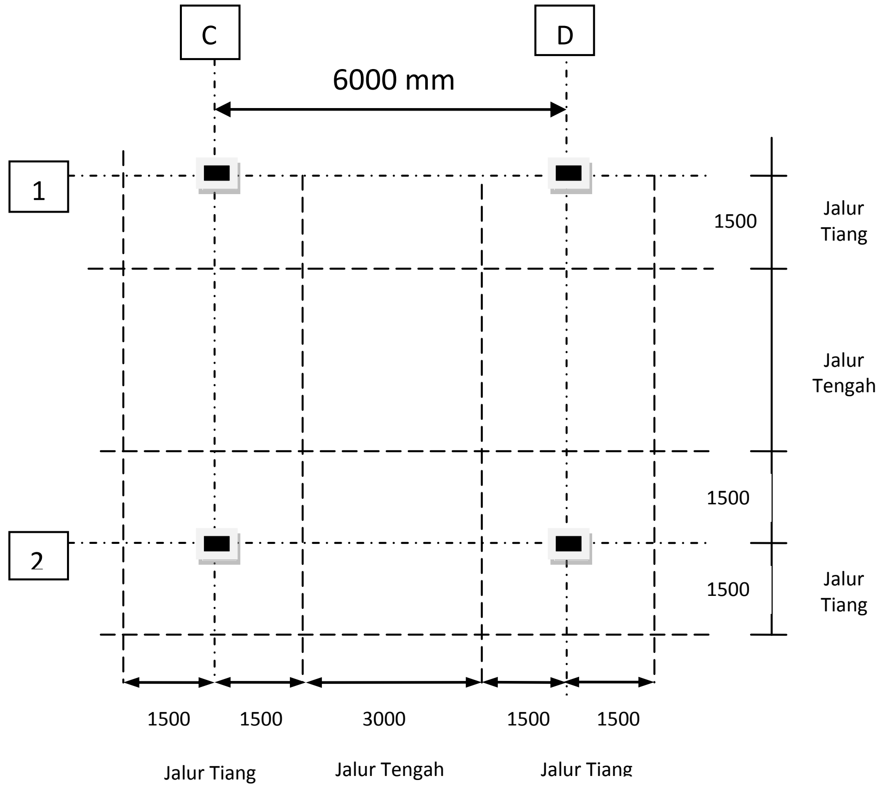
(b) *Sebuah rasuk segiempat rentang tunggal yang disokong mudah seperti yang ditunjukkan dalam Rajah 2. Dengan mengambilkira kehilangan akan berlaku sebesar 20% iaitu tegasan izin tegangan 2.5 N/mm^2 pada pemindahan tegasan dan 2.0 N/mm^2 semasa berkhidmat. Tegasan izin semasa pemindahan dan perkhidmatan ialah 20 N/mm^2. Tentukan saiz keratan rentas anggota yang sesuai dengan menganggap ketumpatan konkrit prategasan ialah 24 kN/m$^{2.}$*



Rajah 2 Rasuk Segiempat Pra-tegasan di sokong mudah

[15 markah]

4. *Rajah 3 menunjukkan pelan bentangan sebahagian daripada papak rata sebuah pejabat dan tiang. Beban kenaan ialah 4.0 kN/m^2 dan beban khas untuk kemasan ialah 1.0 kN/m^2. Beban perimeter dianggap 10 kN/m^2 dengan konkrit gred 30 dan tetulang gred 250. Ketebalan lantai 300 mm dan tiang adalah 400 mm segiempat sama. Kedudukan lantai adalah 4.50 m memugak dan mempunyai 2 jam kadar rintangan api.*



Rajah 3 Kedudukan Jalur Tiang dan Jalur Tengah

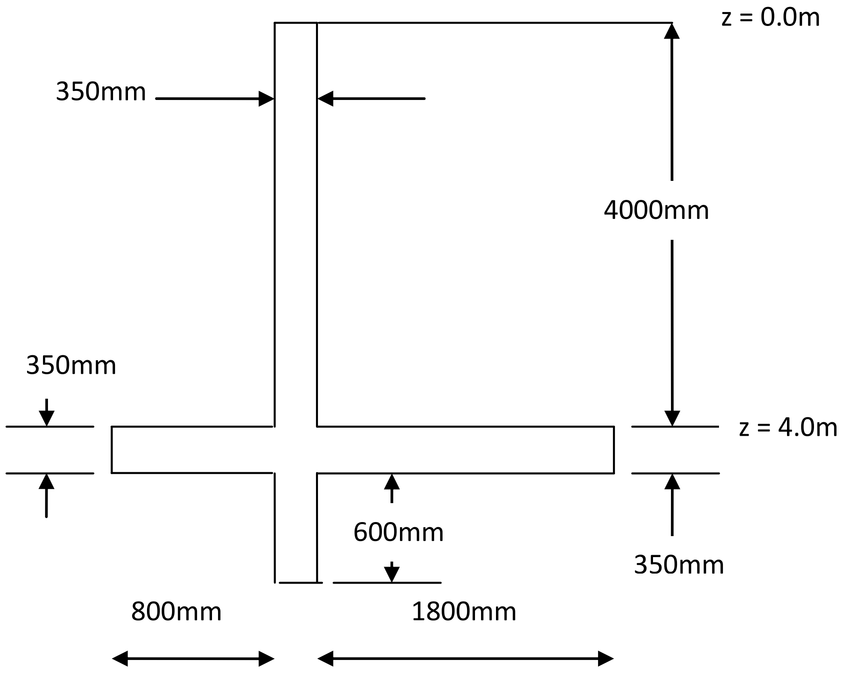
[25 markah]

5. (a) *Sebuah dinding penahan seperti di Rajah 4 di cadangkan untuk menahan tanah setinggi 4.0 m. Permukaan atas adalah mendatar dengan beban mati tambahan 20 kN/m^2. Pasir salir terdapat dibelakang dinding, iaitu berat unitnya 17.6 kN/m^3, dan sudut geseran dalaman 30 darjah. Bahan dibawah dinding mempunyai tekanan galas selamat 120 kN/m^2. Pekali geseran antara tapak dan tanah ialah 0.5. Dinding direkabentuk dengan menggunakan konkrit gred 30 dan kekuatan ciri tetulang besi (f_y) ialah 460 N/mm^2. Dinding akan dipasang dengan tetulang T10 dan T16, papak dipasang dengan tetulang T10 dan T12, dan lapis konkrit ialah 50mm. Jika diandaikan bahawa tiada tetulang mampatan diperlukan, buktikan bahawa dimensi dinding penahan yang dicadangkan tersebut adalah sesuai untuk direkabentuk.*

[15 markah]

(b) *Tekanan mendatar untuk dinding penahan yang ditunjukkan dalam Rajah 4 telah di kira. Pada keadaan had keboleh khidmatan, tekanan mendatar di tapak dinding penahan (z = 4.0 m) ialah 30.0 kN/m^2 dan diatas dinding penahan (z = 0.0 m) ialah 5.0 kN/m^2. Dinding direkabentuk dengan menggunakan konkrit gred 30 dan kekuatan ciri tetulang besi (f_y) ialah 460 N/mm^2. Dinding akan dipasang dengan tetulang T16, dan lapis konkrit ialah 50 mm. Rekabentuk tetulang struktur untuk papak dinding jejulur.*

[10 markah]



Rajah 4   Dinding Penahan

Appendix

Lampiran

Bar Areas and Perimeters

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

Sectional areas per metre width for various bar spacings (mm^2)

Bar size (mm)	Spacing of bars								
	50	75	100	125	150	175	200	250	300
6	566	377	283	226	189	162	142	113	94.3
8	1010	671	503	402	335	287	252	201	168
10	1570	1050	785	628	523	449	393	314	262
12	2260	1510	1130	905	754	646	566	452	377
16	4020	2680	2010	1610	1340	1150	1010	804	670
20	6280	4190	3140	2510	2090	1800	1570	1260	1050
25	9820	6550	4910	3930	3270	2810	2450	1960	1640
32	16100	10700	8040	6430	5360	4600	4020	3220	2680
40	25100	16800	12600	10100	8380	7180	6280	5030	4190

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