

Sila pastikan bahawa kertas peperiksaan ini mengandungi ENAM mukasurat yang tercetak sebelum anda memulakan peperiksaan ini.

Jawab SEMUA soalan.

Nyatakan dengan jelas apa-apa andaian anda. Gunakan nilai-nilai berikut untuk pengiraan bagi rekabentuk:

Kekuatan ciri kiub konkrit,	f_{cu}	=	30 N/mm ²
Kekuatan ciri tetulang,	f_y	=	460 N/mm ²
Kekuatan ciri tetulang lembut	f_{yv}	=	250 N/mm ²

1. Rekabentuk konkrit bertetulangan mengambil kira beberapa perkara penting. Nyatakan perkara-perkara ini dan bincangkan dengan ringkas dan tepat.

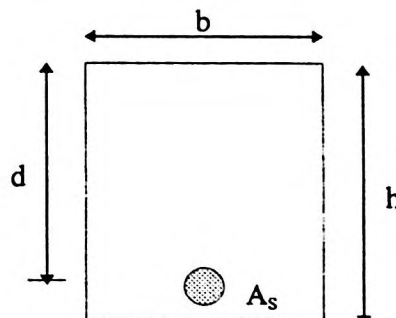
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2. (a) Dengan menggunakan kaedah bongkah tegasan segiempat buktikan:-

$$A_s = \frac{M}{0.87 f_y Z}$$

di mana	A_s	=	Luas tetulang
	M	=	Momen rintangan maksimum
	Z	=	Lengan tuil

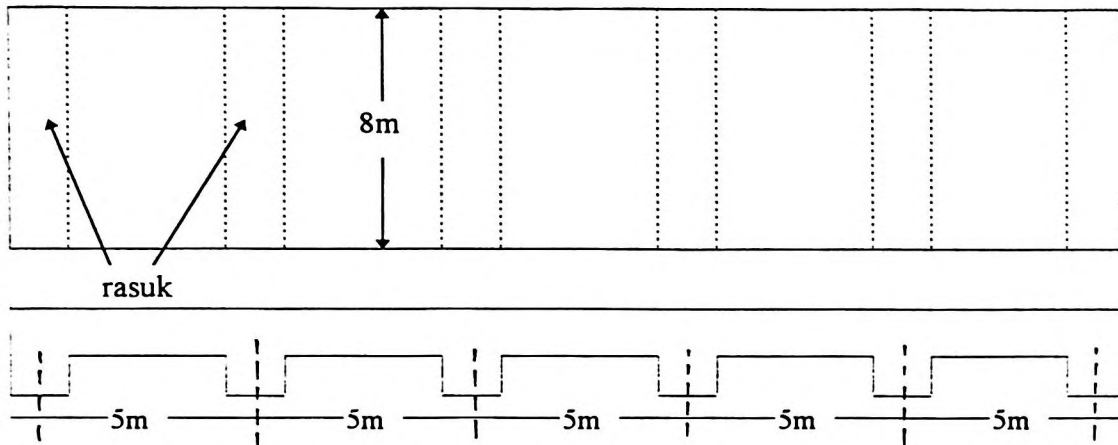
- (b) Sekiranya $b = 300$, $h = 600$ dapatkan nilai 'd' di mana $M = 200$ kNm dan $A_s = 1\%$ luas keratan.



RAJAH 1

(20 markah)

3. (a) Terangkan apa yang bermaksud
- Papak padu selangar merentang satu arah, dan
 - Papak padu merentang dalam dua arah.
- (b) Dapatkan saiz untuk papak dalam **Rajah 2** dan tunjukkan susunatur tetulang.

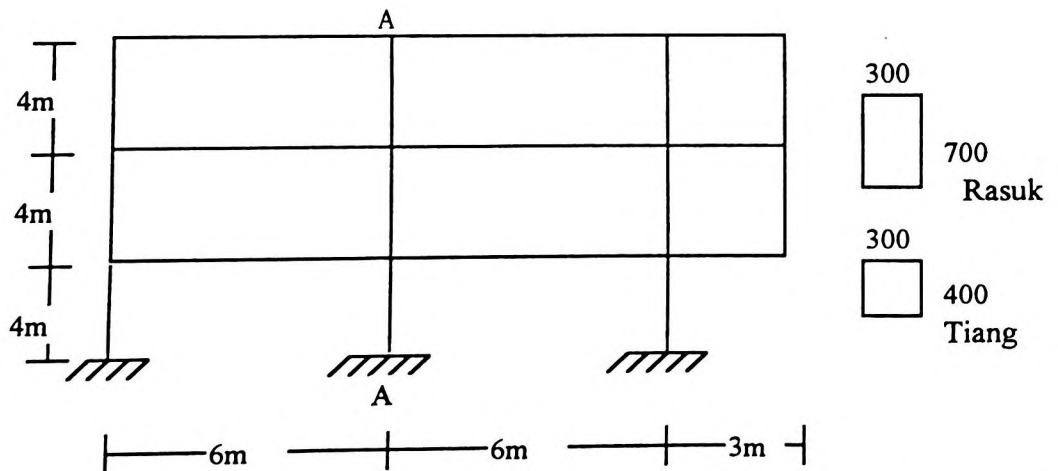
**RAJAH 2**

Diberi:

Beban hidup	=	3.0 kN/m ²
Konkrit tetulang	=	24 kN/m ³
Kemasan lantai dan beban siling	=	1.0 kN/m ²

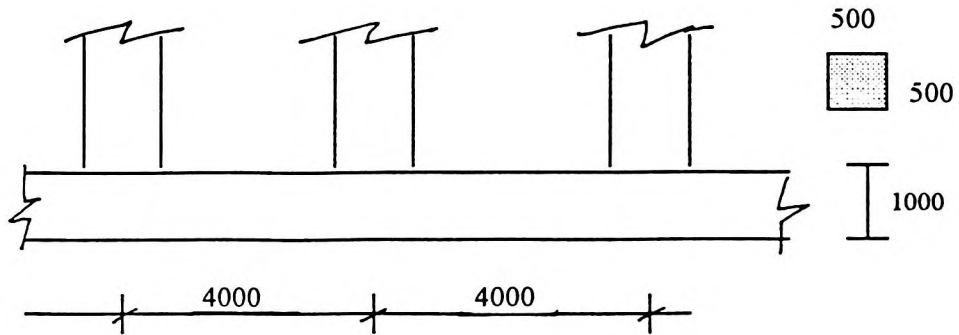
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4. **Rajah 3** menunjukkan rangka bangunan di mana semua rasuk dikenakan beban mati 40 kN/m (termasuk berat sendiri) dan beban hidup 60 kN/m. Dapatkan saiz keluli yang sesuai untuk tiang A-A. Andaikan tidak ada pengurangan beban hidup diambilkira.

**RAJAH 3**

(20 markah)

5. **Rajah 4** menunjukkan satu asas strip (strip footing) yang menahan tiang-tiang sama jarak. Tiap-tiap tiang menanggung beban mati ciri sebanyak 1200 kN dan beban tindihan ciri 400kN. Diberi tekanan asas selamat atau tanah 200 kN/m^2 , $f_{cu} = 35 \text{ N/mm}^2$ dan $f_y = 460 \text{ N/mm}^2$. Cari saiz dan tetulang yang perlu untuk asas ini.

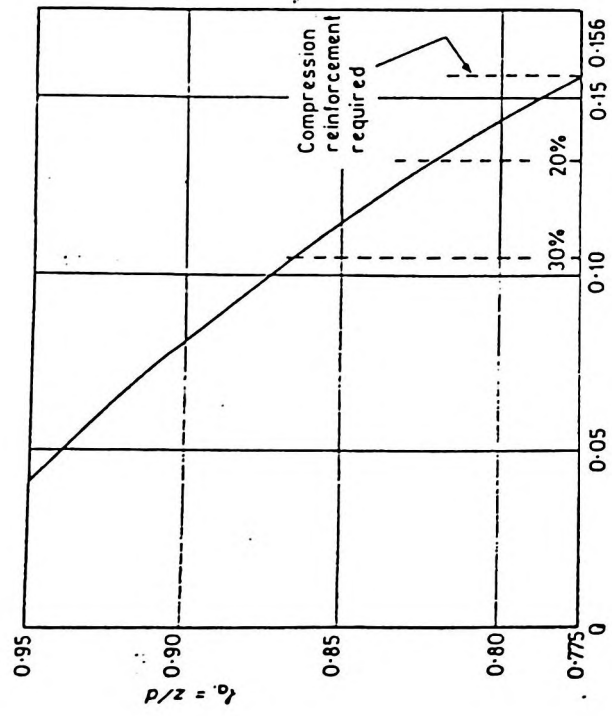


RAJAH 4

(20 markah)

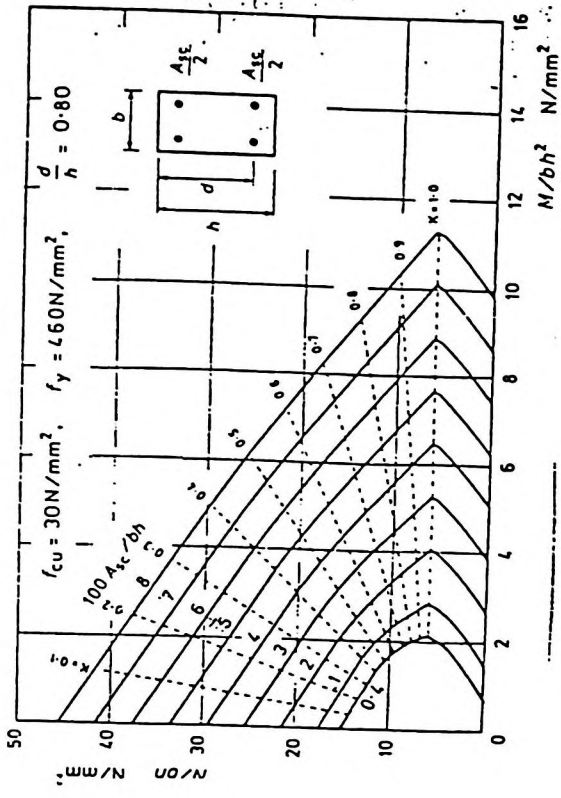
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$K = M/bd^2 f_{cu}$	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.156
$\zeta_d = z/d$	0.941	0.928	0.915	0.901	0.887	0.873	0.857	0.842	0.825	0.807	0.789	0.775



The % values on the K axis mark the limits for singly reinforced sections with moment redistribution applied

Lever-arm curve



Column design chart

Value of ultimate shear stress v_c (N/mm²) for a concrete strength of $f_{cu} = 30$ N/mm²

$100 A_s/bd$	150	175	200	225	250	300	350	400
Effective depth (mm)								
≤ 0.15	0.46	0.44	0.43	0.41	0.40	0.38	0.36	0.36
0.25	0.54	0.52	0.50	0.49	0.48	0.46	0.42	0.42
0.50	0.68	0.66	0.64	0.62	0.59	0.57	0.53	0.53
0.75	0.76	0.75	0.72	0.70	0.69	0.64	0.61	0.61
1.00	0.86	0.83	0.80	0.78	0.75	0.72	0.67	0.67
1.50	0.98	0.95	0.91	0.88	0.86	0.83	0.76	0.76
2.00	1.08	1.04	1.01	0.97	0.95	0.91	0.85	0.85
≥ 3.00	1.23	1.19	1.15	1.11	1.08	1.04	0.97	0.97

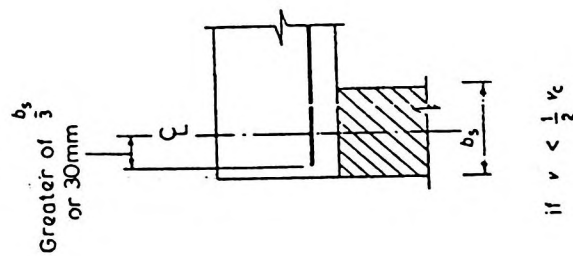
For characteristic strengths other than 30 N/mm² the values in the table may be multiplied by $(f_{cu}/25)^{1/3}/1.06$. The value of f_{cu} should not be greater than 40 N/mm².

Anchorage and Lap Requirements

Anchorage lengths (anchorage length $L = K_A \times \text{bar size}$)				
	K_A			
	$f_{cu} = 25$	30	35	40 or more
Plain (250)				
Tension	39	36	33	31
Compression	32	29	27	25
Deformed Type 1 (460)				
Tension	51	46	43	40
Compression	41	37	34	32
Deformed Type 2 (460)				
Tension	41	37	34	32
Compression	32	29	27	26

Basic lap lengths in tension and compression (lap length $= K_L \times \text{bar size}$)				
	K_L			
	$f_{cu} = 25$	30	35	40 or more
Plain (250)				
Tension	39	36	33	31
Deformed Type 1 (460)	51	46	43	40
Deformed Type 2 (460)	41	37	34	32

Minimum lap lengths : 15 X bar size or 300 mm.



Anchorage at simple support for a slab

Bar Areas and Perimeters

Sectional areas of groups of bars (mm²)

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

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 a density of 7850 kg/m³.

Tension reinforcement modification factors

Reinforcement service stress (N/mm ²)	M/bd ²									
	0.50	0.75	1.0	1.5	2.0	3.0	4.0	5.0	6.0	
100	2.0	2.0	2.0	1.86	1.63	1.36	1.19	1.08	1.01	
156	2.0	2.0	1.96	1.66	1.47	1.24	1.10	1.00	0.94	
200	2.0	1.95	1.76	1.51	1.35	1.14	1.02	0.94	0.88	
288	1.68	1.50	1.38	1.21	1.09	0.95	0.87	0.82	0.78	

Sectional areas per metre width for various bar spacings (mm²)

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	

Shear Reinforcement

A_{sv}/s_v for varying stirrup diameter and spacing

Stirrup diameter (mm)	Stirrup spacing (mm)									
	85	90	100	125	150	175	200	225	250	300
8	1.183	1.118	1.006	0.805	0.671	0.575	0.503	0.447	0.402	0.366
10	1.847	1.744	1.57	1.256	1.047	0.897	0.785	0.698	0.628	0.571
12	2.659	2.511	2.26	1.808	1.507	1.291	1.13	1.004	0.904	0.822
16	4.729	4.467	4.02	3.216	2.68	2.297	2.01	1.787	1.608	1.462

Ultimate bending moment and shear force coefficients in one-way spanning slabs

	Outer support	Middle of end span	First interior support	Middle of interior span	Interior supports
Moment	0	0.086 FL	-0.086 FL	0.063 FL	-0.063 FL
Shear	0.4 F	--	0.6 F	--	0.5 F

Note: F is the total design ultimate load on the span, and L is the effective span.