UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Pertama
Sidang 1991/92

Oktober/November 1991

REG 462 Rekabentuk Konkrit

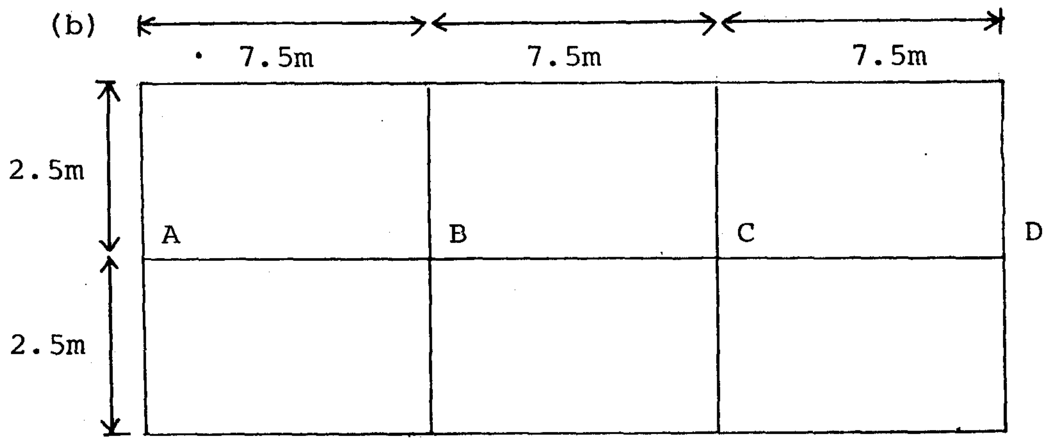
Masa : (3 Jam)

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

Jawab LIMA soalan sahaja.

1. (a) Dengan bantuan lakaran terangkan dari aspek rekabentuk perbezaan di antara papak konkrit sehala dengan papak konkrit 2 hala.

(b)



Rajah 1 - Pelan Lantai

Dengan berpandukan Rajah 1, tentukan beban rekabentuk, momen lentur dan daya ricih jika beban mati pada papak lantai ialah 4.5 kN/m^2 dan beban kenaan ialah 4.0 kN/m^2.

Berdasarkan maklumat ini, dapatkan rekabentuk saiz rasuk AB dan tetulang keluli yang diperlukan.

(20 Markah)

...2/-

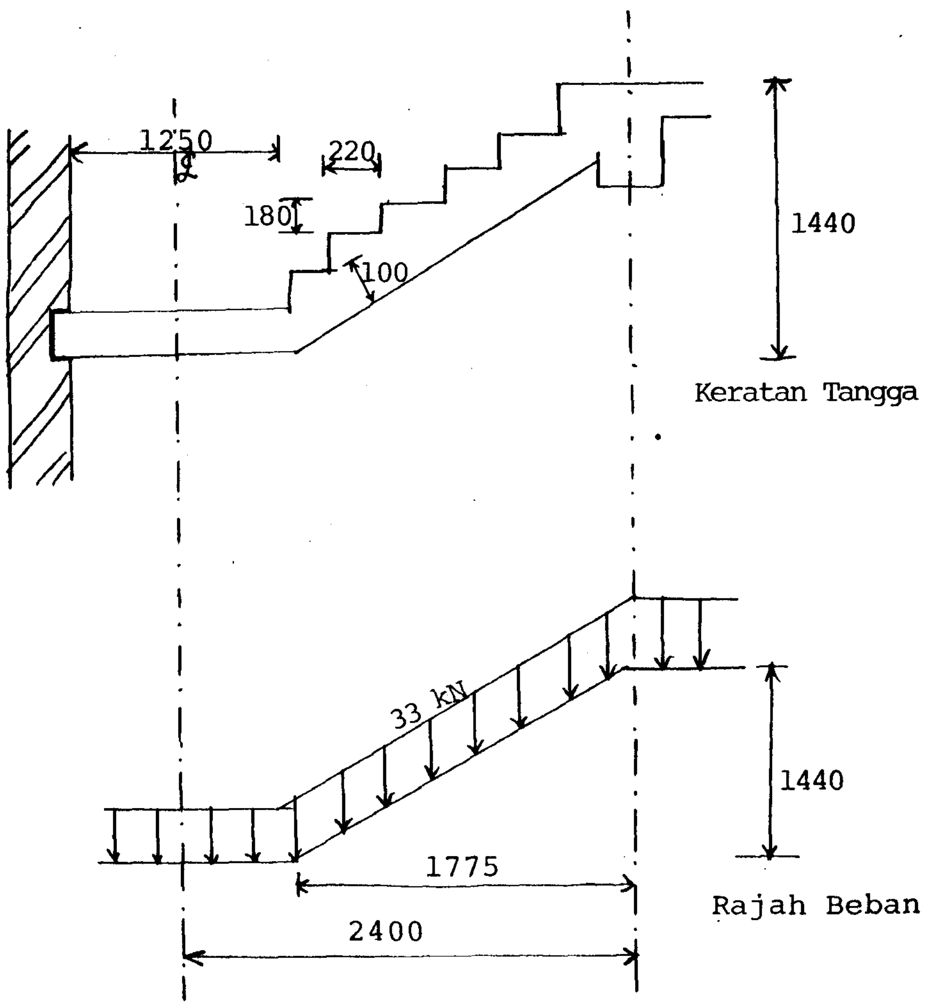
2. (a) Apakah perbezaan di antara ferosimen dengan konkrit tetulang

(b) Bincangkan ciri-ciri keistimewaan ferosimen di dalam industri binaan.

(c) Selain daripada sifat-sifat campuran bahan, teknik memplaster memainkan peranan penting dalam menjamin ketahanan struktur ferosimen. Terangkan bagaimanakah ketahanan ini boleh dicapai.

(20 Markah)

3. Sebuah tangga konkrit dengan rentang 2.500m mempunyai tebal 100mm dan penutup konkrit setebal 30mm (Rajah 2).



Rajah 2

Jika momen lentur pada tengah rentang ialah 9.0 kNm, tentukan tetulang yang diperlukan untuk tangga tersebut jika f_{cu} = 30 N/mm^2 dan fy = 250 N/mm^2.

(20 Markah)

4. (a) Apakah yang dimaksudkan dengan beban mati dan beban kenaan. Bagaimanakah beban reka bentuk diperolehi.

(b) Papak konkrit disokong mudah dengan rentang sepanjang 5m dan memikul beban mati teragih bernilai 3.5 kN/m^2, manakala beban hidup ialah 3.0 kN/m^2.

Jika konkrit gred 25 digunakan (f_{cu} = 25 N/mm^2) dan keluli lembut (f_y = 250 N/mm^2) dipilih, tentukan tebal papak lantai dan tetulang keluli di dalamnya.

Lakarkan keratan papak dan tetulang yang ada padanya.

(20 Markah)

5. (a) Apakah fungsi tiang di dalam struktur bangunan. Bagaimanakah anda menakrifkan tiang pendek dan tiang langsing.

(b) Jika piawaian BS 8110 menetapkan beban muktamat N_{muk} pada tiang konkrit yang dirembat dan dibebankan oleh beban paksian sebagai:

$$N_{muk} = 0.4\ f_{cu}\ A_c + 0.75\ f_y\ Asc.$$

dan

A_c = luas konkrit

A_{sc} = luas keratan keluli

f_{cu} = tegasan mampat kiub konkrit

f_y = tegasan alah keluli

tentukan saiz tiang dan tetulang yang diperlukan bagi memikul beban bernilai 1800 kN. Andaikan konkrit dari gred 30 dan keluli lembut, f_y = 250 N/mm^2. Tentukan saiz minimum rakap dan jarak di antara satu sama lain.

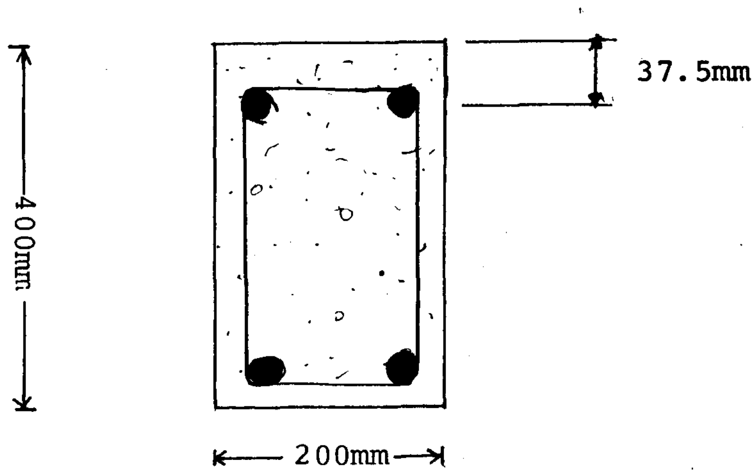
(20 Markah)

...4/-

6. Sebatang rasuk konkrit disokong mudah panjangnya ialah 8.0m. Beban yang dipikul terdiri daripada beban mati bernilai 6.5 kN/m dan beban hidup bernilai 4.5 kN/m. Lebar rasuk ialah 200mm dan tebal (kedalaman) rasuk ialah 400mm, manakala tebal penutup konkrit ialah 20mm.

Dapatkan rekabentuk tetulang keluli bagi rasuk tersebut jika gred konkrit ialah 30 (f_{cu} = 30 N/mm^2) dan keluli tegangan tinggi digunakan (f_y = 460 N/mm^2).

Jarak di antara tetulang atas dengan bahagian atas rasuk ialah 37.5mm. Lakarkan keratan rasuk dan susunan tetulang.



(20 Markah)

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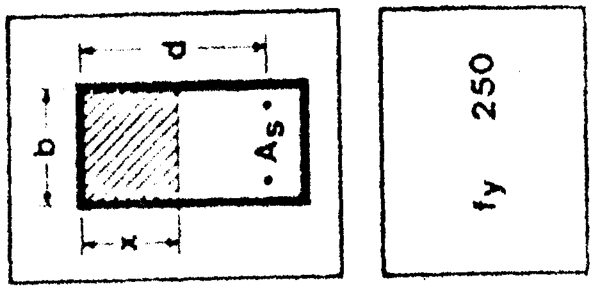
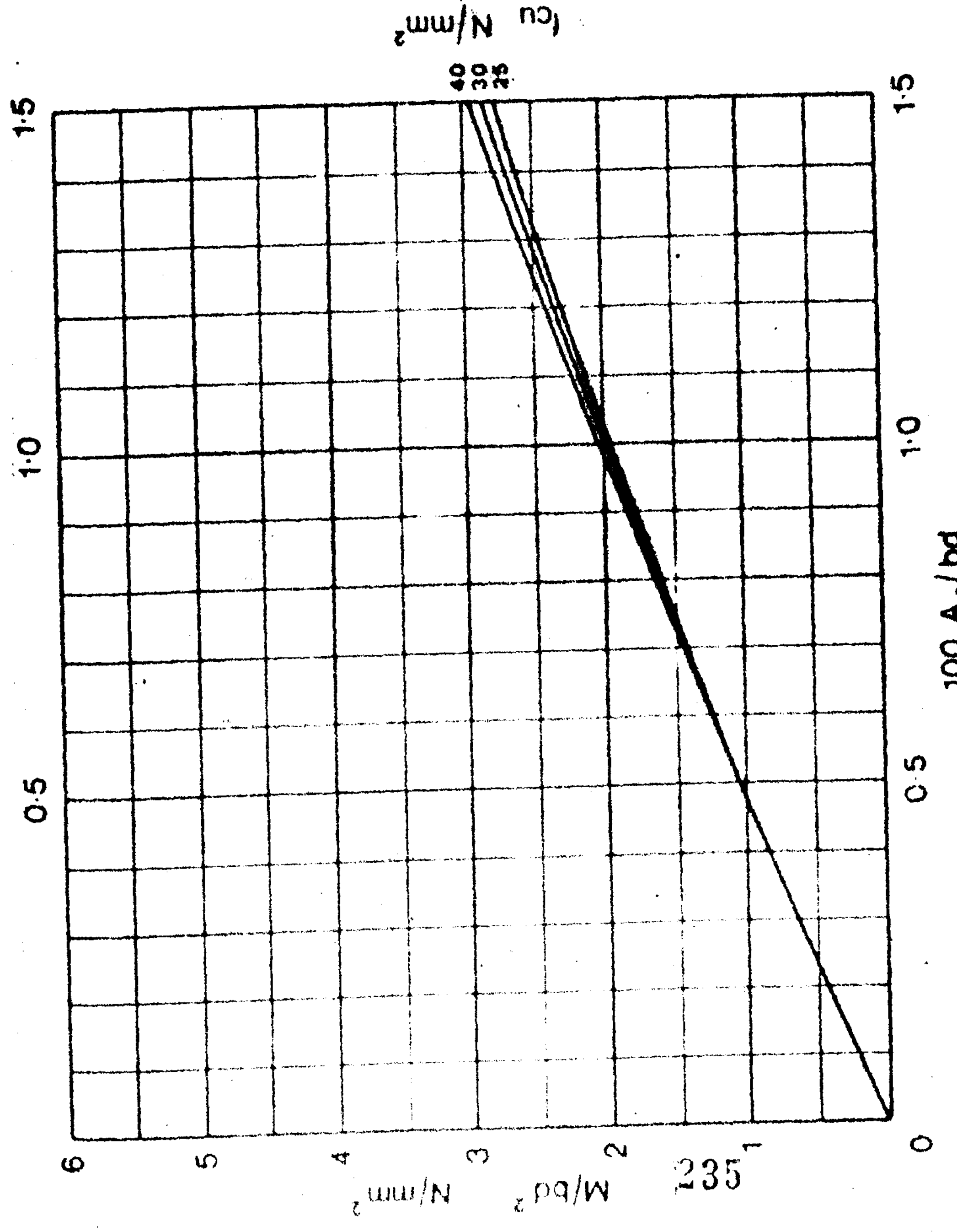
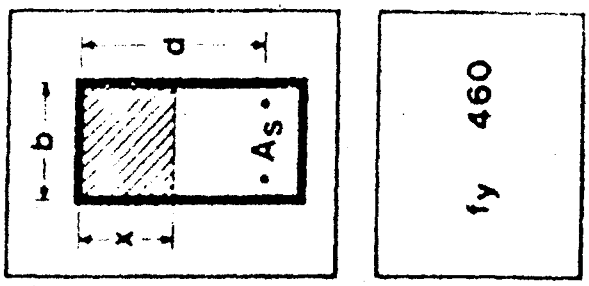
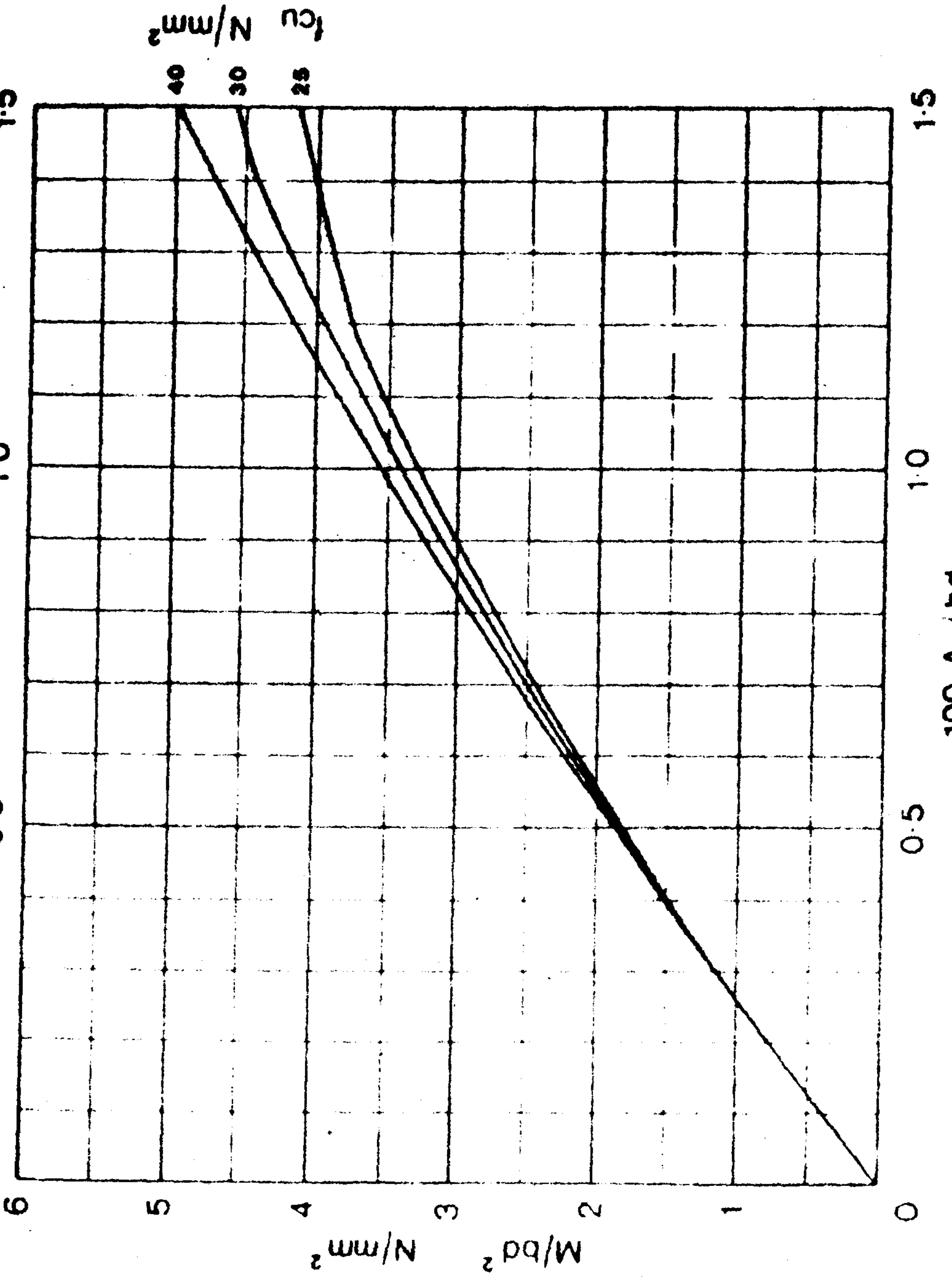


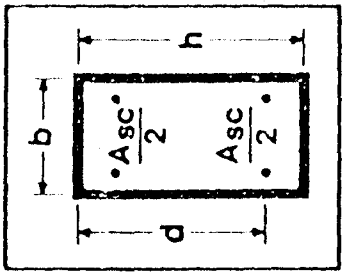


Singly reinforced beams

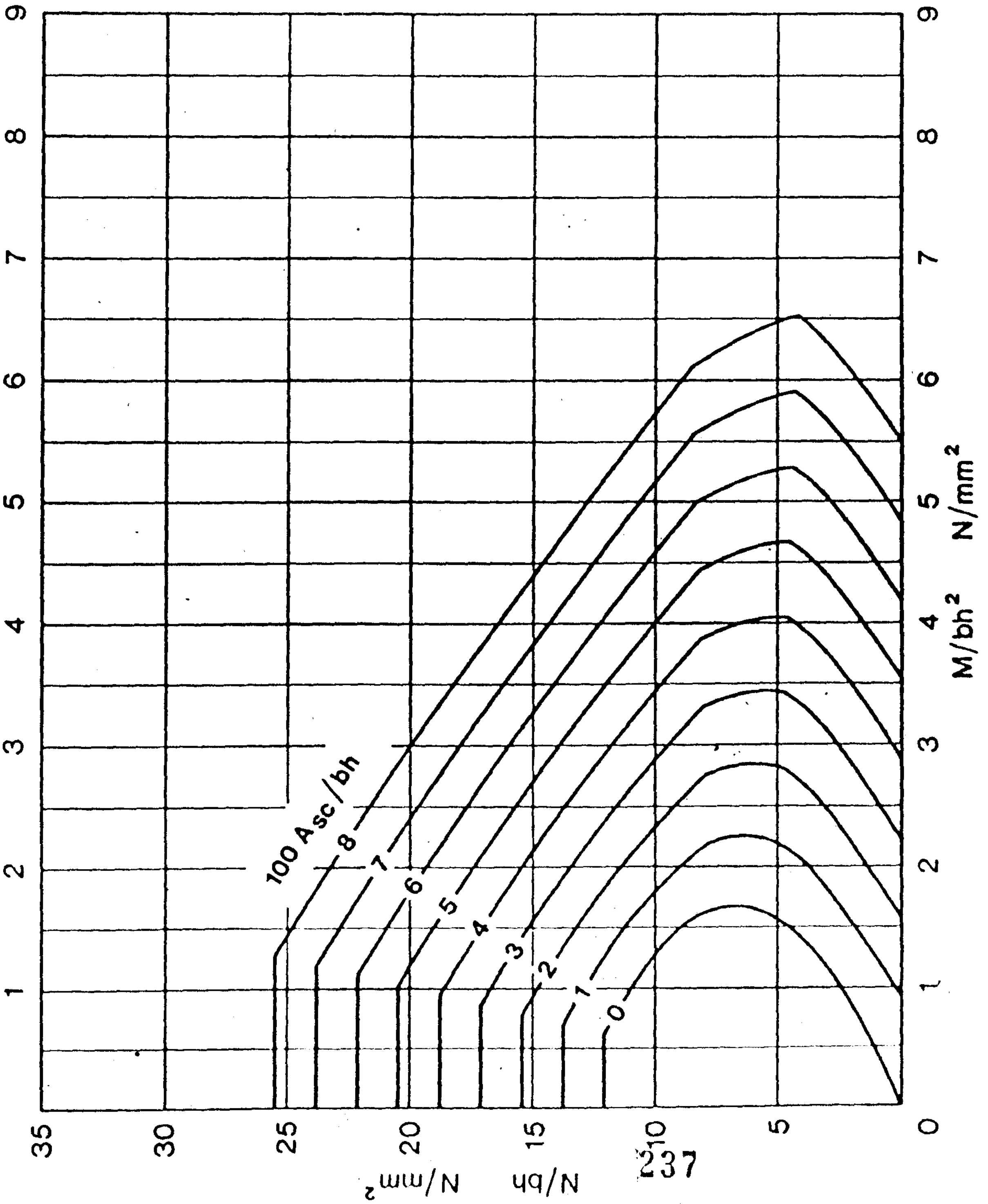




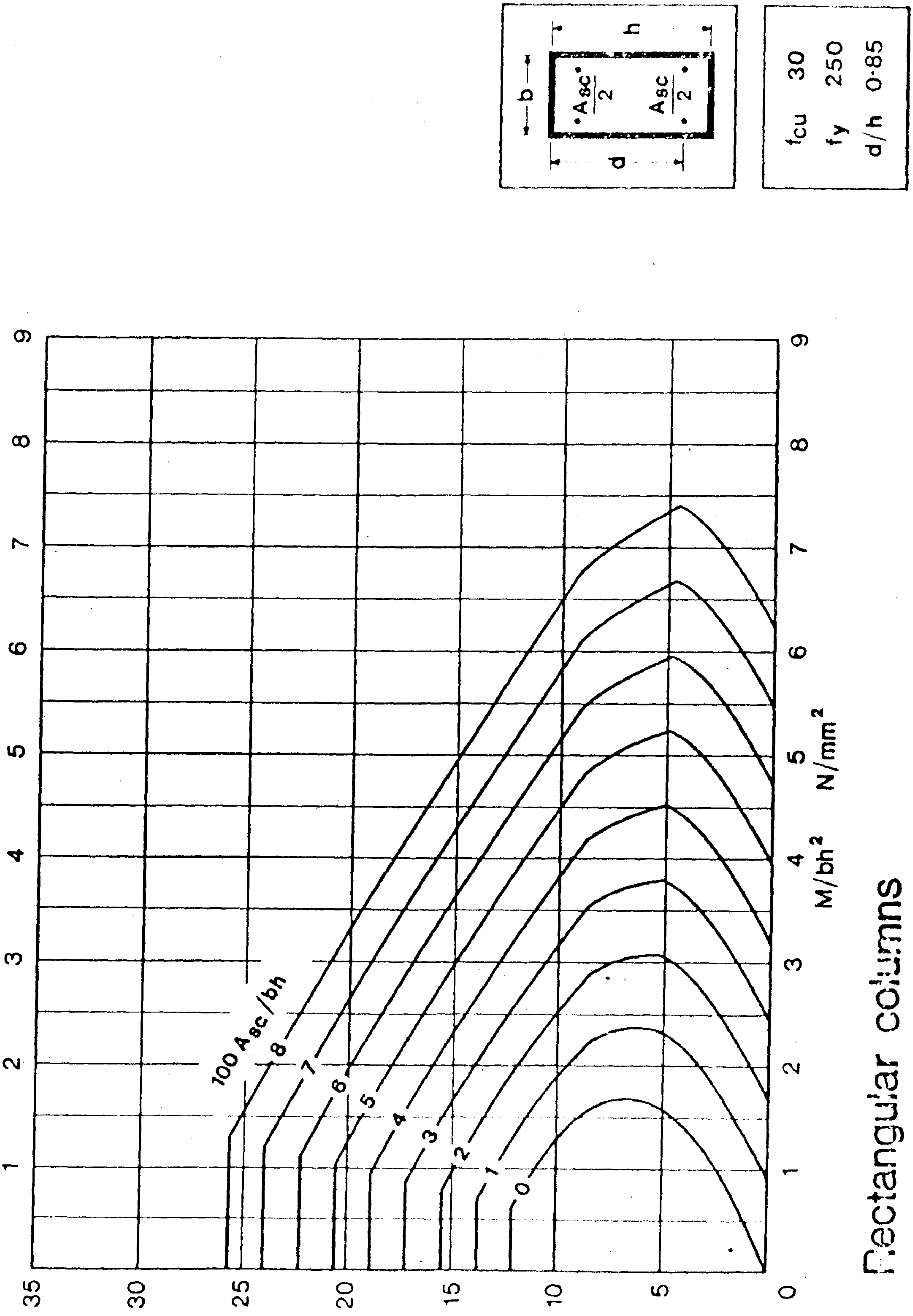
Singly reinforced beams

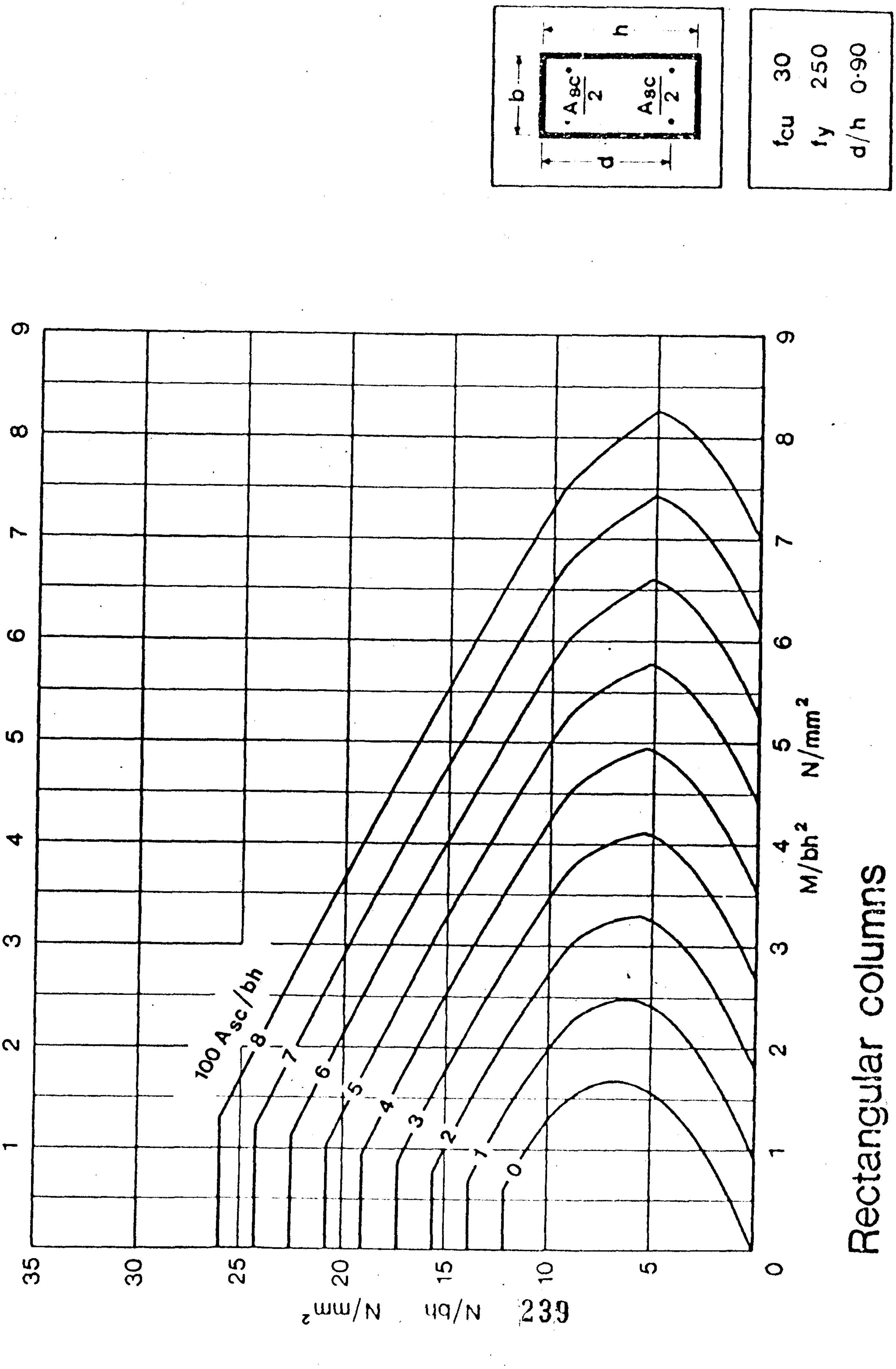


f_{cu} 30
f_y 250
d/h 0·80

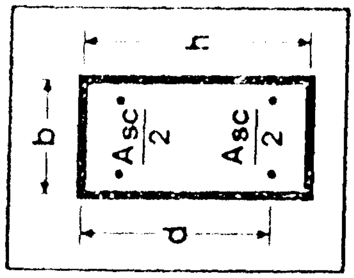


Rectangular columns

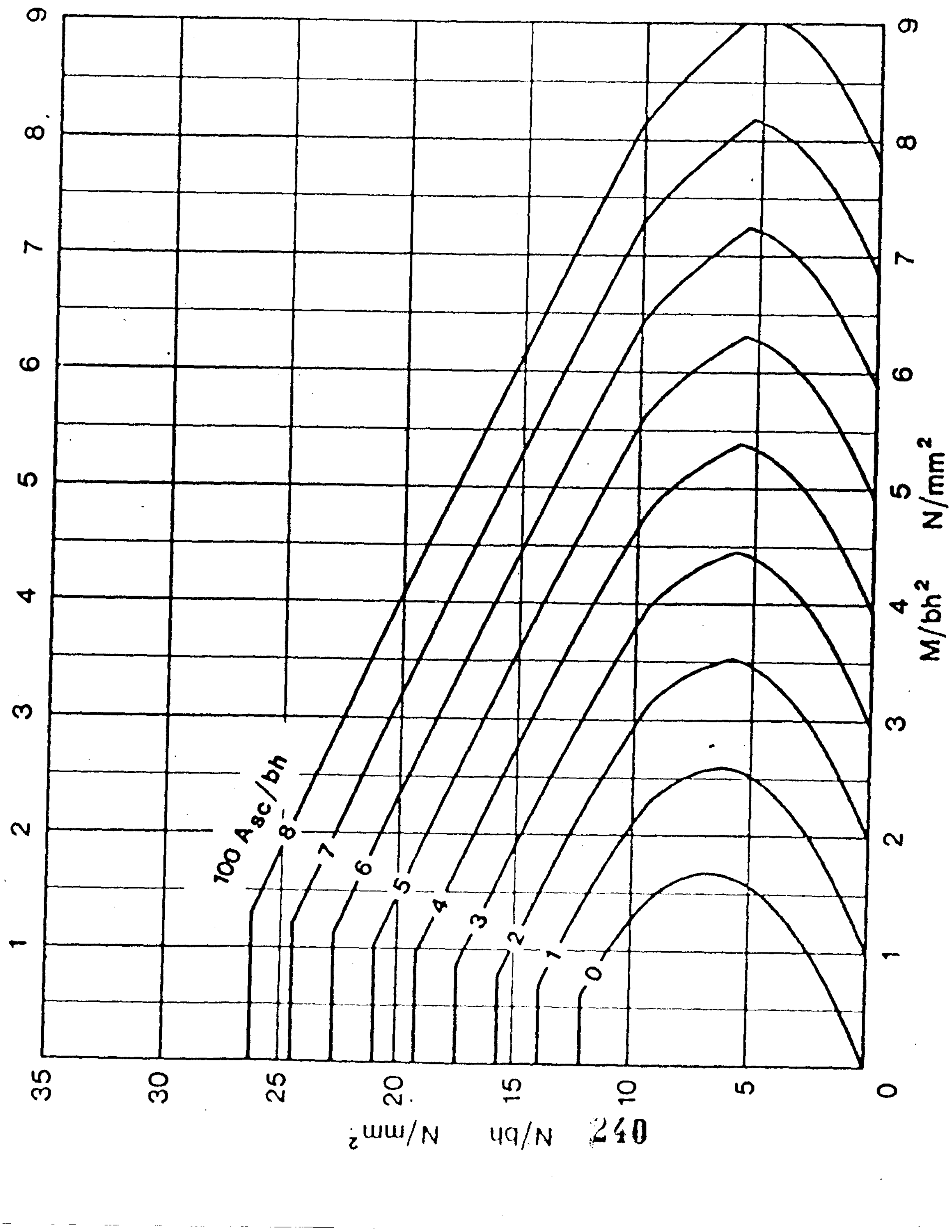

Rectangular columns
f_{cu} 30
f_y 250
d/h 0·85
b
h
d
$\frac{A_{sc}}{2}$
$\frac{A_{sc}}{2}$
100 A_{sc}/bh
8
7
6
5
4
3
2
1
0
M/bh^2 N/mm^2
N/bh N/mm^2
0
1
2
3
4
5
6
7
8
9
5
10
15
20
25
30
35



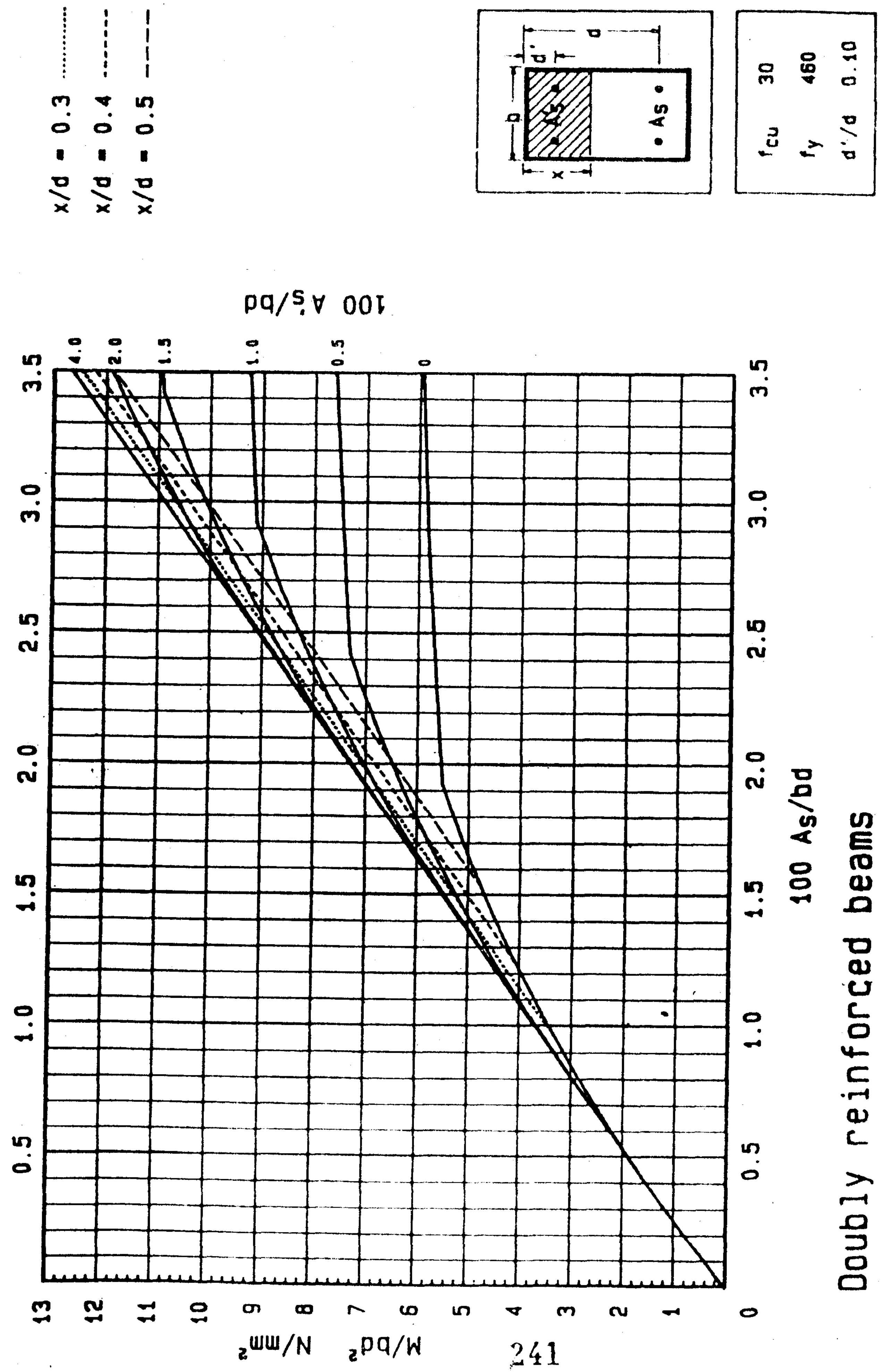
Rectangular columns

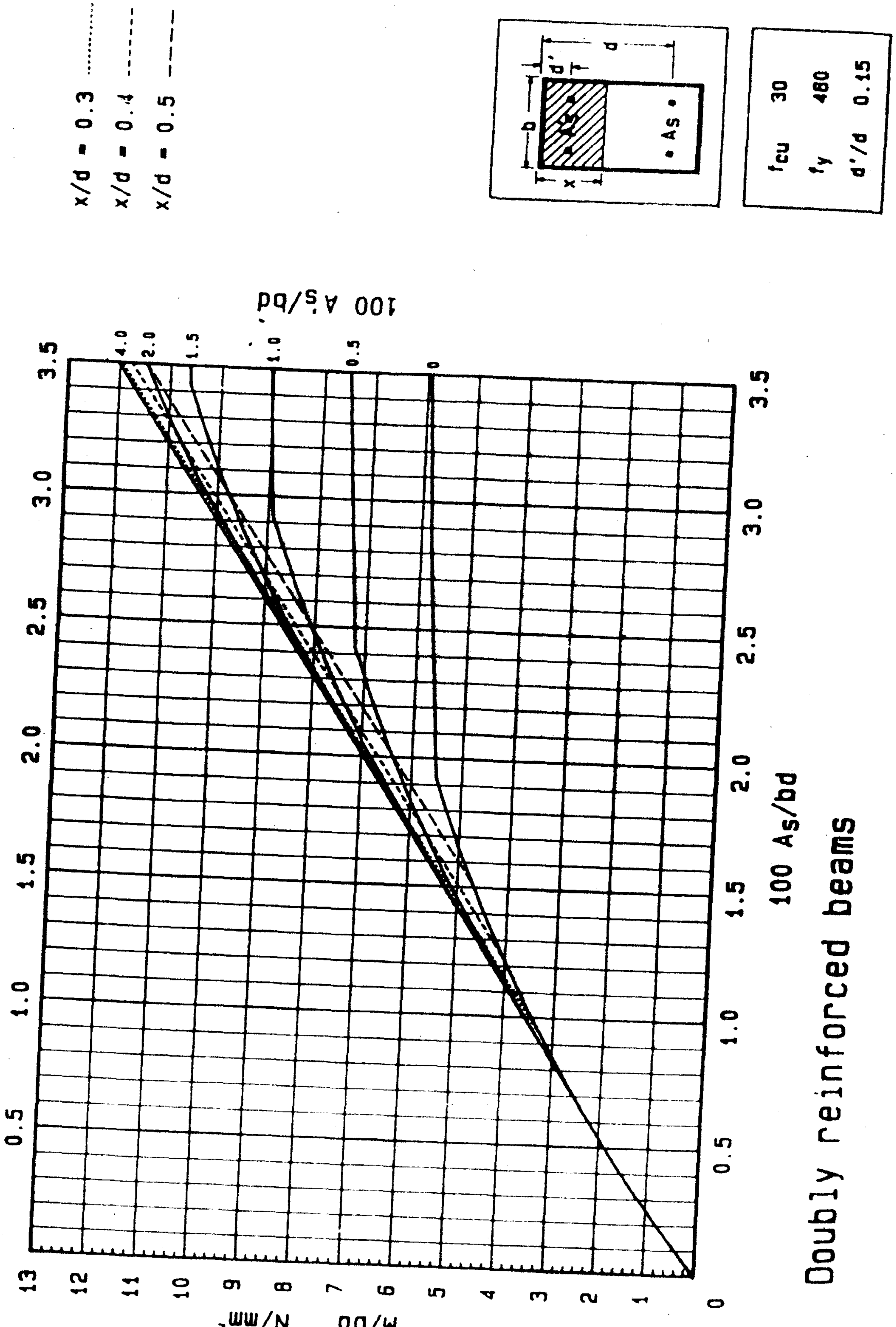


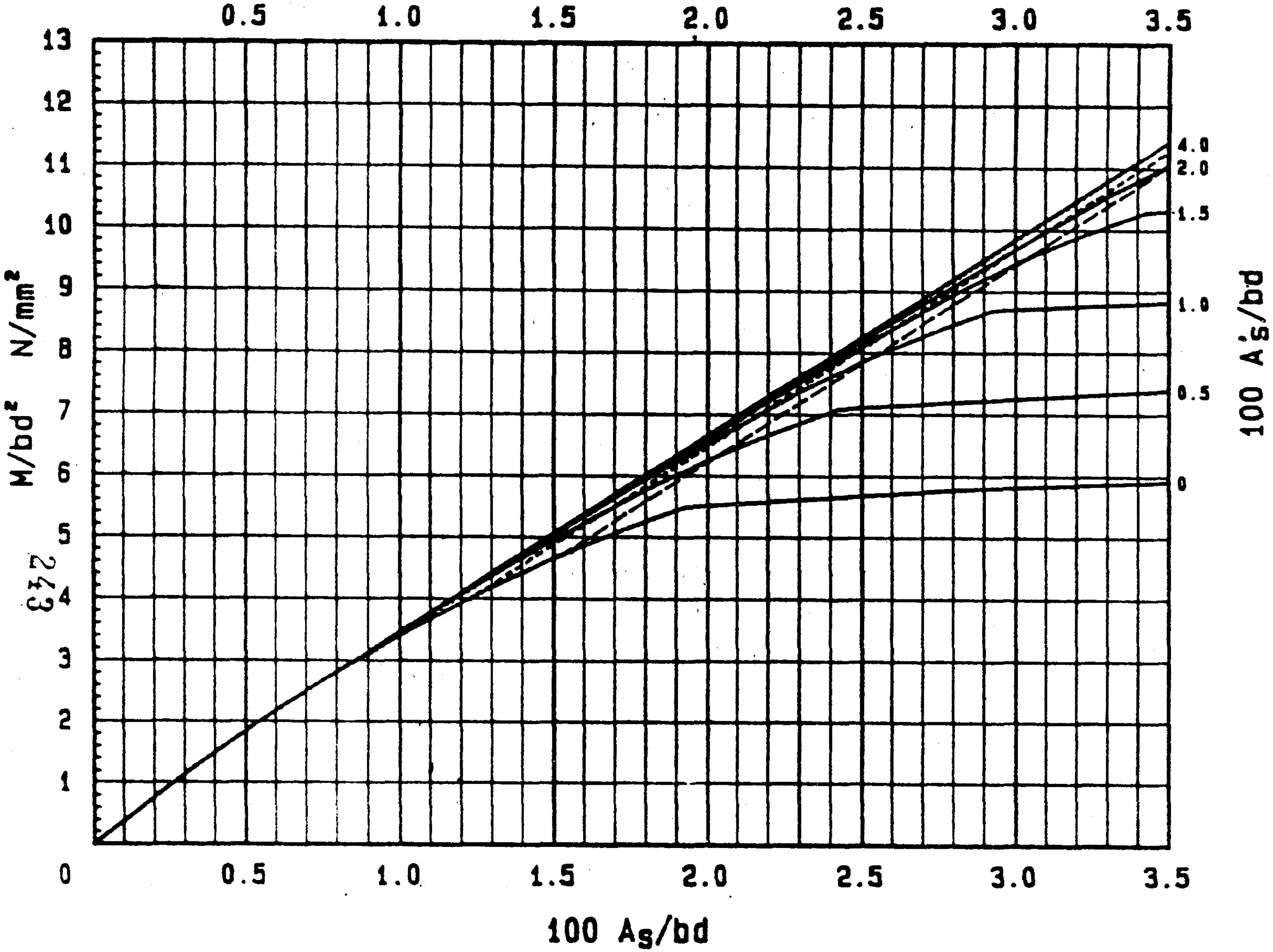
f_{cu} 30
f_y 250
d/h 0·95

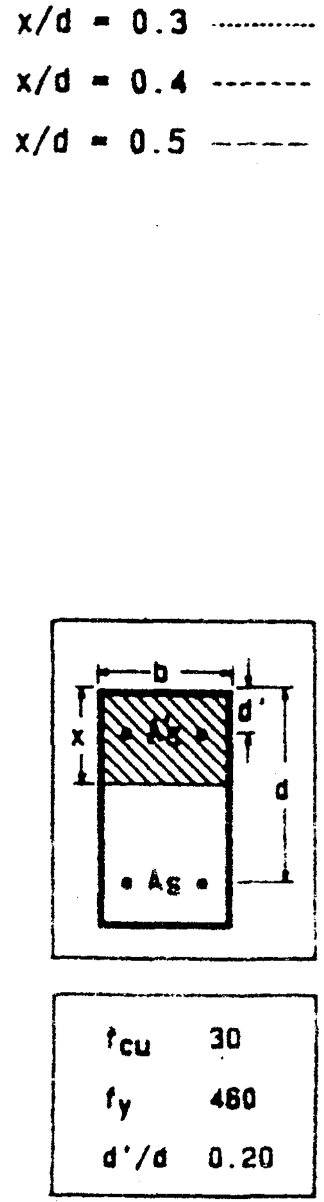


Rectangular columns


x/d = 0.3
x/d = 0.4
x/d = 0.5
d
d'
b
As'
As
x
f_{cu} 30
f_y 460
d'/d 0.10
100 As'/bd
4.0
2.0
1.5
1.0
0.5
0
M/bd² N/mm²
100 As/bd
Doubly reinforced beams


x/d = 0.3
x/d = 0.4
x/d = 0.5
b
d'
d
x
As
fcu 30
fy 480
d'/d 0.15
100 A's/bd
4.0
2.0
1.5
1.0
0.5
0
100 As/bd
M/bd² N/mm²
Doubly reinforced beams





Doubly reinforced beams

Table 2. Strength of concrete

Grade	Characteristic strength f_{cu}	Cube strength at an age of				
		7 days	2 months	3 months	6 months	1 year
	N/mm²	N/mm²	N/mm²	N/mm²	N/mm²	N/mm²
20	20.0	13.5	22	23	24	25
25	25.0	16.5	27.5	29	30	31
30	30.0	20	33	35	36	37
40	40.0	28	44	45.5	47.5	50
50	50.0	36	54	55.5	57.5	60

Design may be based on the characteristic strength or, if appropriate, the strength given in Table 2 for the age of loading.

Table 4. Ultimate bending moments and shear forces

	At outer support	Near middle of end span	At first interior support	At middle of interior spans	At interior supports
Moment	0	$\frac{Fl}{11}$	$\frac{-Fl}{9}$	$\frac{Fl}{14}$	$\frac{-Fl}{10}$
Shear	$0.45F$	—	$0.6F$	—	$0.55F$

In Table 4, l is the effective span and F is the total ultimate load ($1.4G_k + 1.6Q_k$). No redistribution of the moments found from Table 4 should be made.

Table 8. Basic span/effective depth ratios for rectangular beams

Support conditions	Ratio
Cantilever	7
Simply supported	20
Continuous	26

Table 10. Modification factor for tension reinforcement

Service stress (f_s)	$\frac{100A_s}{bd}$ 0.25	0.50	0.75	1.00	1.50	2.00	2.50	≥ 3.0
N/mm²								
145 (f_y = 250)	2.0	1.98	1.62	1.44	1.24	1.13	1.06	1.01
150	2.0	1.91	1.58	1.41	1.22	1.11	1.04	0.99
200	2.0	1.46	1.26	1.15	1.02	0.94	0.89	0.85
238 (f_y = 410)	1.60	1.23	1.09	1.00	0.90	0.84	0.80	0.77
246 (f_y = 425)	1.55	1.20	1.06	0.98	0.88	0.83	0.79	0.76
250	1.52	1.18	1.05	0.97	0.87	0.82	0.78	0.75
267 (f_y = 460)	1.41	1.11	0.99	0.92	0.84	0.78	0.75	0.72
290 (f_y = 500)	1.27	1.03	0.92	0.86	0.79	0.74	0.71	0.68
300	1.22	0.99	0.90	0.84	0.77	0.72	0.69	0.67

Table 11. Modification factor for compression reinforcement

$\frac{100A'_s}{bd}$	Factor
0.25	1.07
0.50	1.14
0.75	1.20
1.0	1.25
1.5	1.33
2.0	1.40
≥ 3.0	1.50

Intermediate values may be interpolated.

Table 12. Bending moment coefficients for slabs spanning in two directions at right angles, simply supported on four sides

l_y/l_x	1.0	1.1	1.2	1.3	1.4	1.5	1.75	2.0	2.5	3.0
α_{sx}	0.062	0.074	0.084	0.093	0.099	0.104	0.113	0.118	0.122	0.124
α_{sy}	0.062	0.061	0.059	0.055	0.051	0.046	0.037	0.029	0.020	0.014

$$M_{sx} = \alpha_{sx} n l_x^2 \quad (14)$$

$$M_{sy} = \alpha_{sy} n l_x^2 \quad (15)$$

where M_{sx} and M_{sy} are the maximum moments at mid-span on strips of unit width and spans l_x and l_y, respectively,

n is the total ultimate load per unit area ($1.4g_k + 1.6q_k$),
l_y is the length of the longer side,
l_x is the length of the shorter side,
α_{sx} and α_{sy} are moment coefficients shown in Table 12.

Floor and Roof Loads

	kN/m²
Classrooms	3.0
Dance halls	5.0
Flats and houses	1.5
Garages, passenger cars	2.5
Gymnasiums	5.0
Hospital wards	2.0
Hotel bedrooms	2.0
Offices for general use	2.5
Flat roofs, with access	1.5
Flat roofs, no access	0.75

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

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

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
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	275	3[illegible]
8	1.183	1.118	1.006	0.805	0.671	0.575	0.503	0.447	0.402	0.366	0.[illegible]
10	1.847	1.744	1.57	1.256	1.047	0.897	0.785	0.698	0.628	0.571	0.[illegible]
12	2.659	2.511	2.26	1.808	1.507	1.291	1.13	1.004	0.904	0.822	0.[illegible]
16	4.729	4.467	4.02	3.216	2.68	2.297	2.01	1.787	1.608	1.462	1.[illegible]