UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Tambahan
Sidang Akademik 1991/92

Jun 1992

REG 462 - Rekabentuk Konkrit

Masa : 3 Jam

Sila pastikan bahawa kertas peperiksaan ini mengandungi **LIMABELAS** muka surat tercetak sebelum anda memulakan peperiksaan ini.

Jawab LIMA soalan sahaja.

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

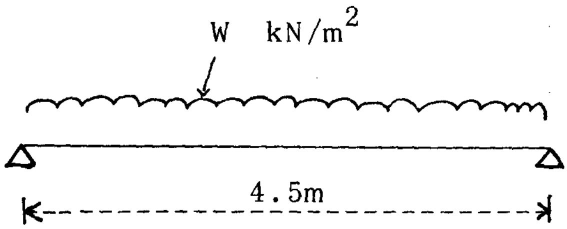
   (b) Papak konkrit disokong mudah dengan rentang sepanjang 4m dan memikul beban mati teragih bernilai 4.5 kN/m^2, manakala beban hidup ialah 3.5 kN/m^2.

   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)

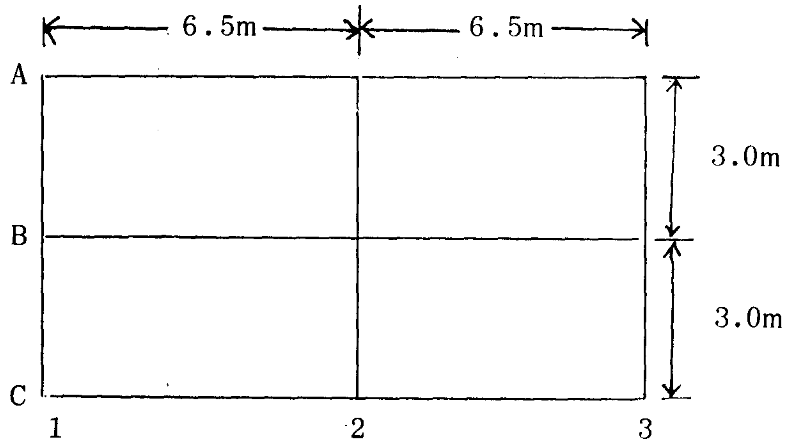
2. Sebuah bumbung konkrit rata direka bentuk bagi memikul beban mati 4.5 kN/m^2 dan beban kenaan 4.0 kN/m^2. Rentang bagi bumbung yang disokong mudah ialah 4.5m dan konkrit dari gred 25 digunakan.



Tentukan tebal bumbung konkrit dan tetulang yang diperlukan pada papak bumbung.

(20 markah)

3. Berdasarkan pelan lantai di dalam Rajah 1, tentukan momen, daya ricih dan seterusnya tetulang pada rasuk B/2-3. Beban reka bentuk daripada lantai ialah 10 kN/m^2.



Rajah 1 (20 markah)

4. (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)

...3/-

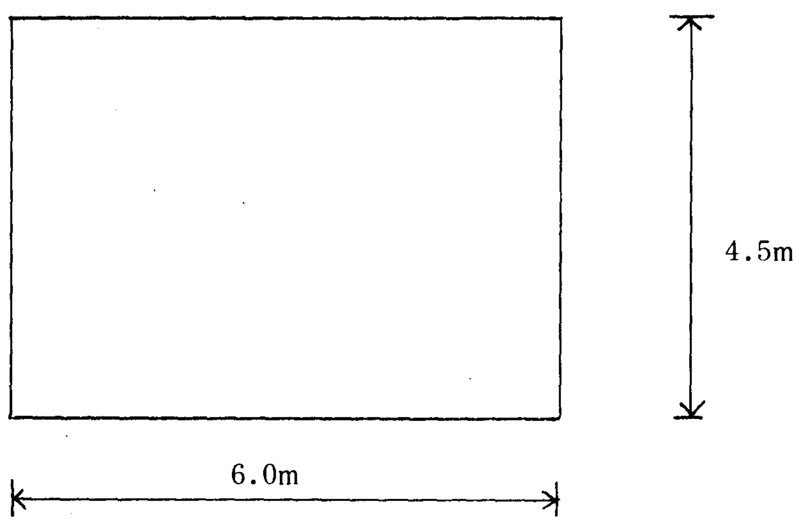
5. (a) Terangkan perbezaan di antara konkrit tetulang dengan ferosimen.

(b) Bincangkan kegunaan utama ferosimen di dalam struktur bangunan, struktur marin dan juga pertanian.

(c) Selain dari kadar campuran, kualiti struktur ferosimen bergantung juga pada kaedah memplaster. Terangkan kadar campuran yang sesuai untuk struktur marin serta langkah tambahan yang sangat diperlukan untuk menjamin ketahanan ferosimen.

(20 markah)

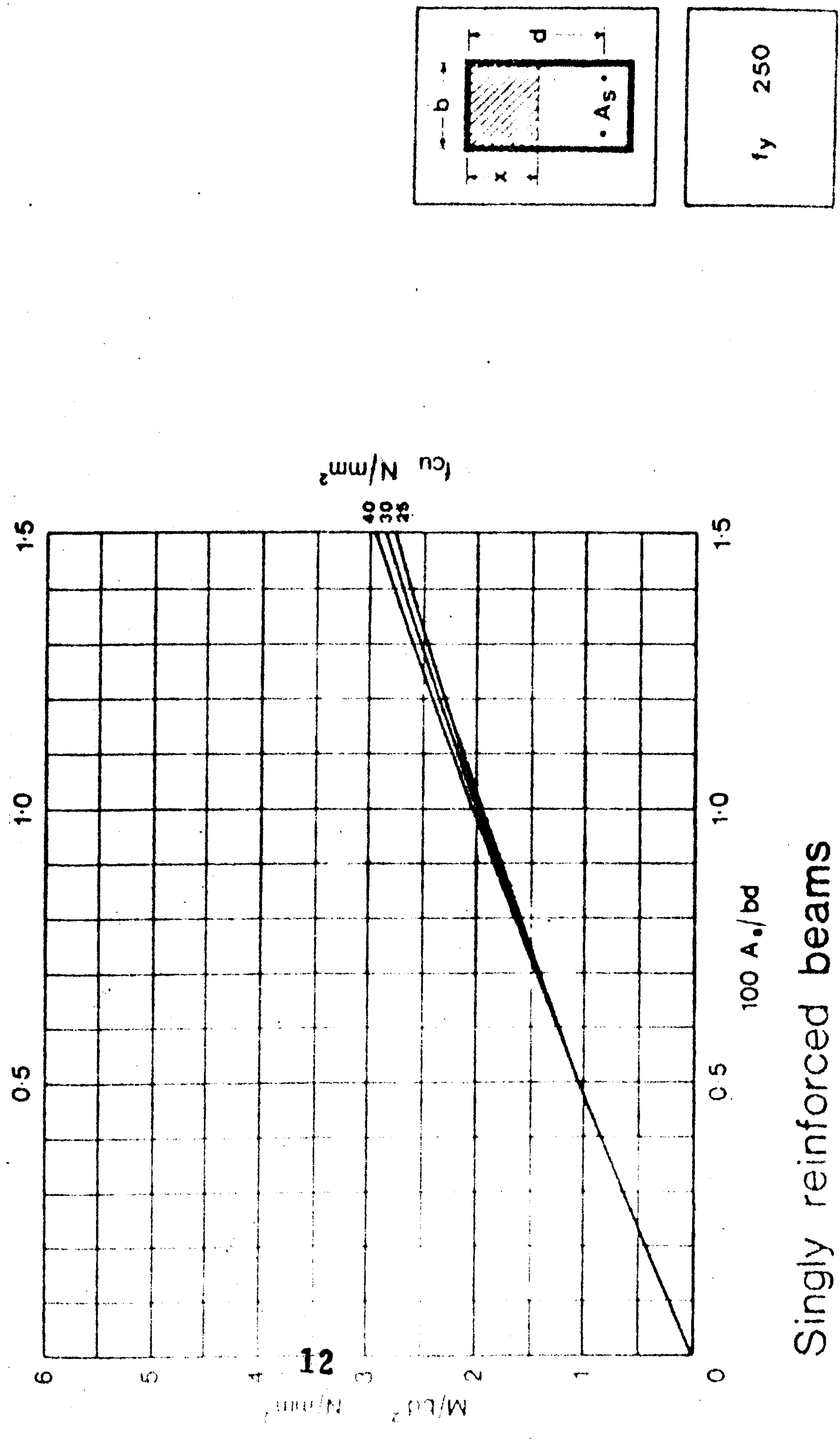
6. Sebuah lantai konkrit setebal 125mm disokong mudah di kedua-dua hujung. Papak lantai ini diperbuat dari konkrit gred 25 dan berukuran 4.5m lebar dan 6.0m panjang seperti di Rajah 2. Sekiranya beban kenaan untuk lantai ialah 3.5 kN/m^2, tentukan momen lentur M_{sx}, M_{sy} dan tetulang yang diperlukan untuknya.

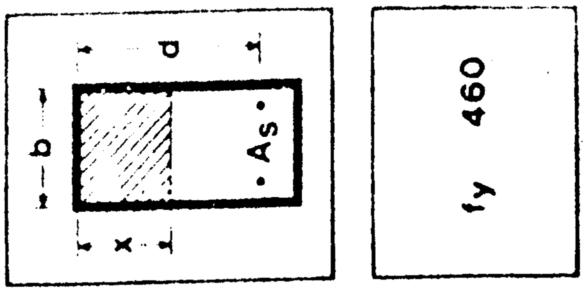


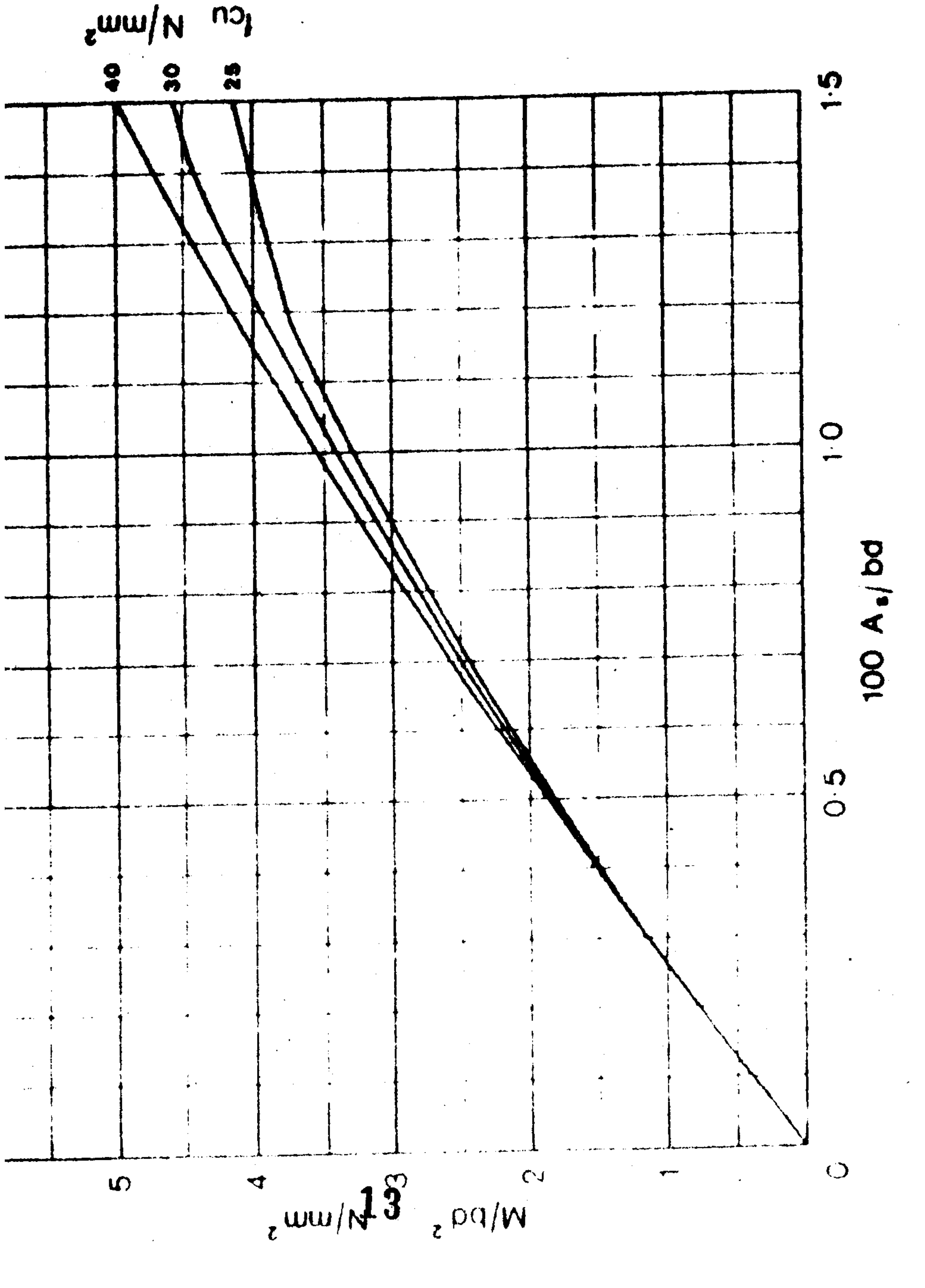
(20 markah)

Rajah 2

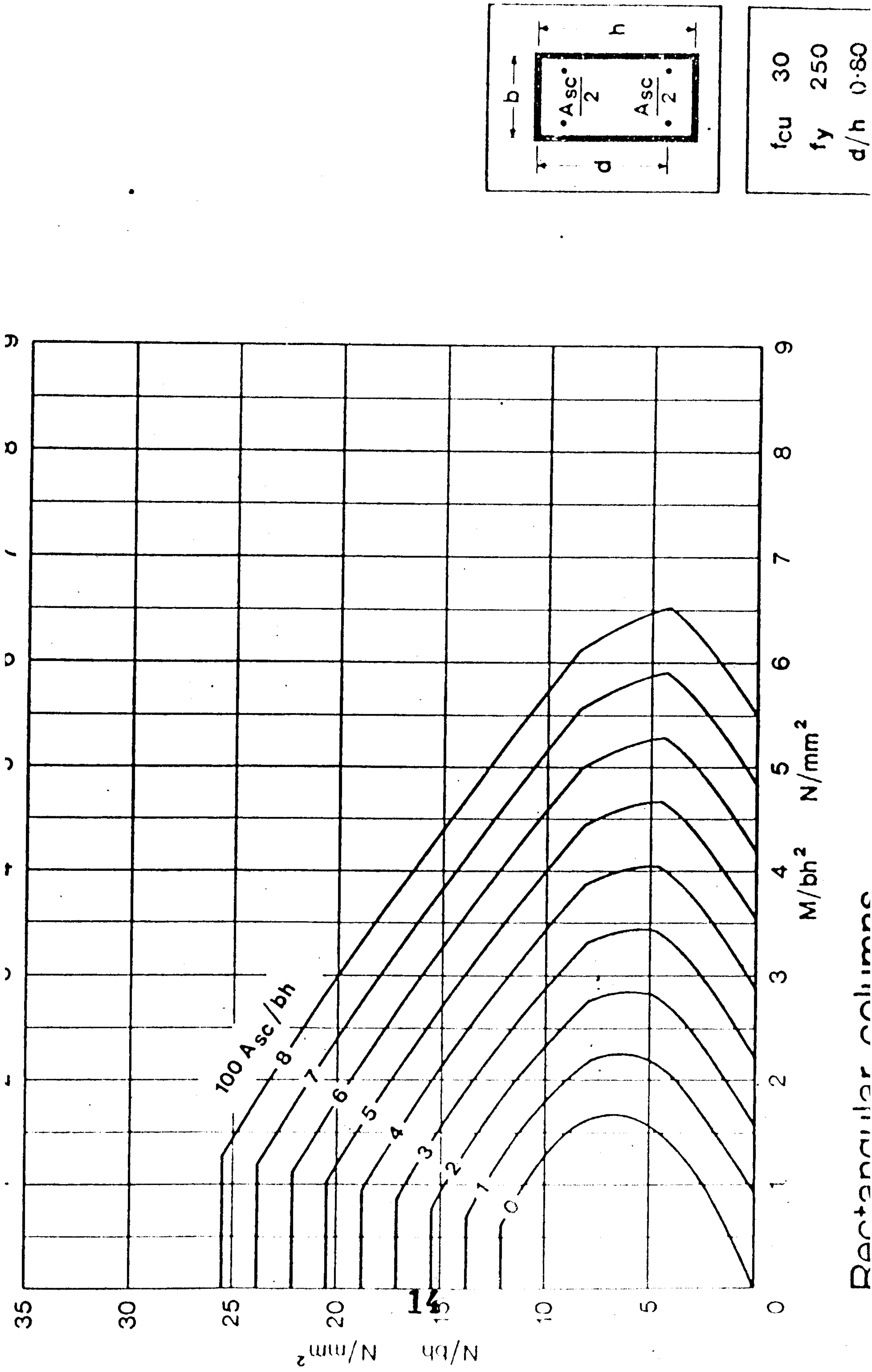
-ooo0Oooo-


b
d
x
As
fy 250
fcu N/mm²
40
30
25
0.5
1.0
1.5
100 As/bd
0
1
2
3
4
5
6
M/bd² N/mm²
12
Singly reinforced beams



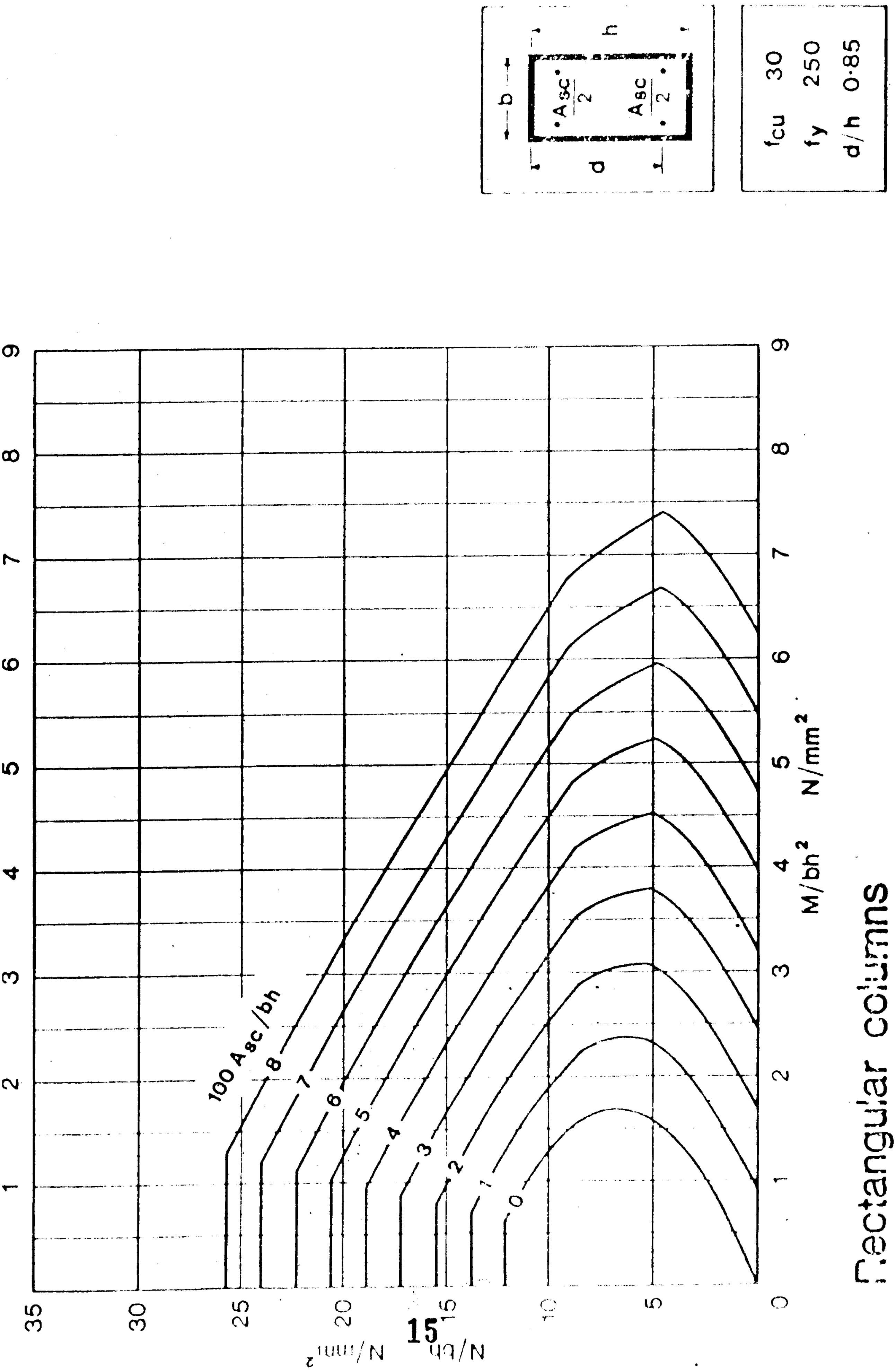


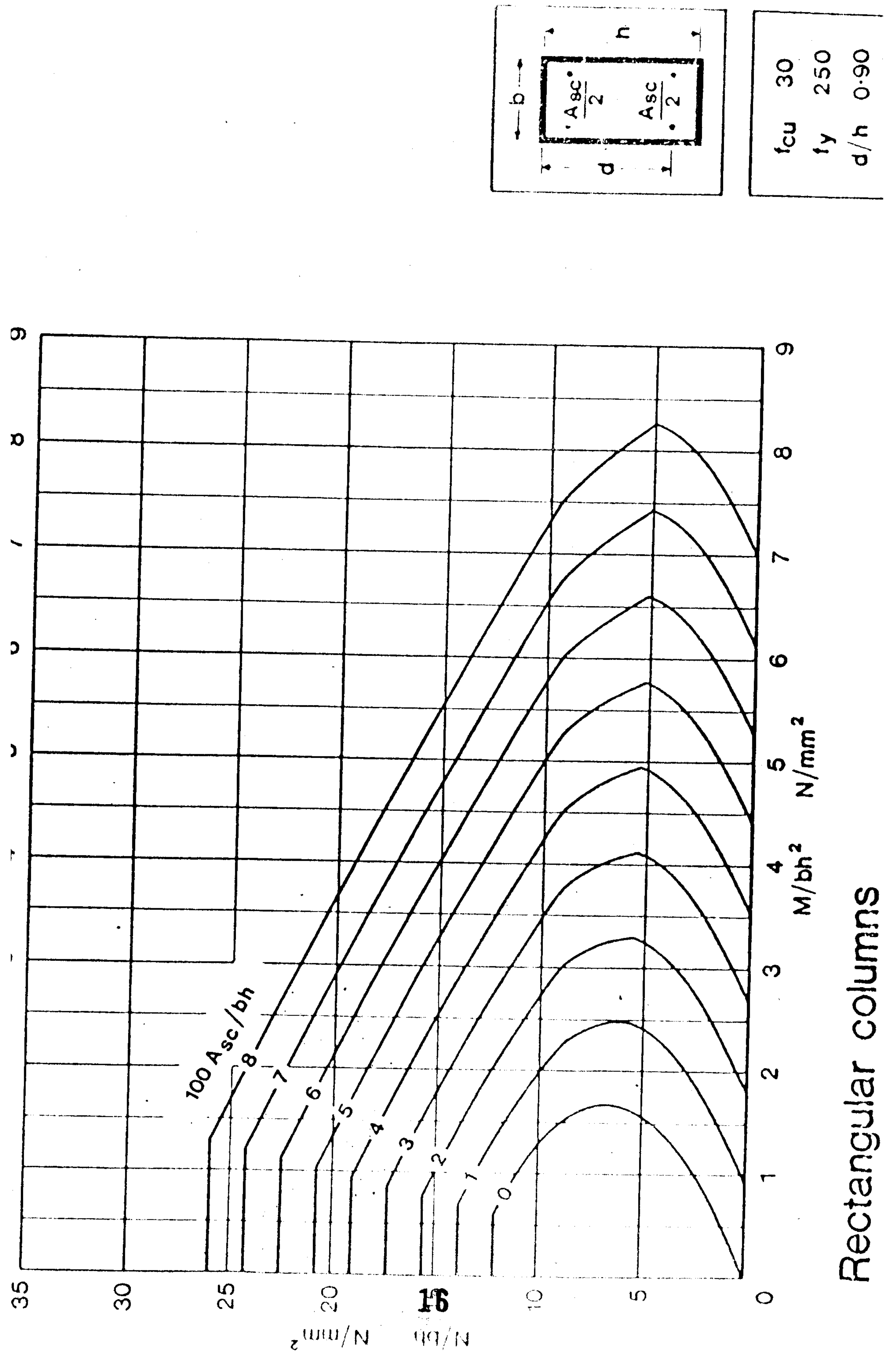
Singly reinforced beams

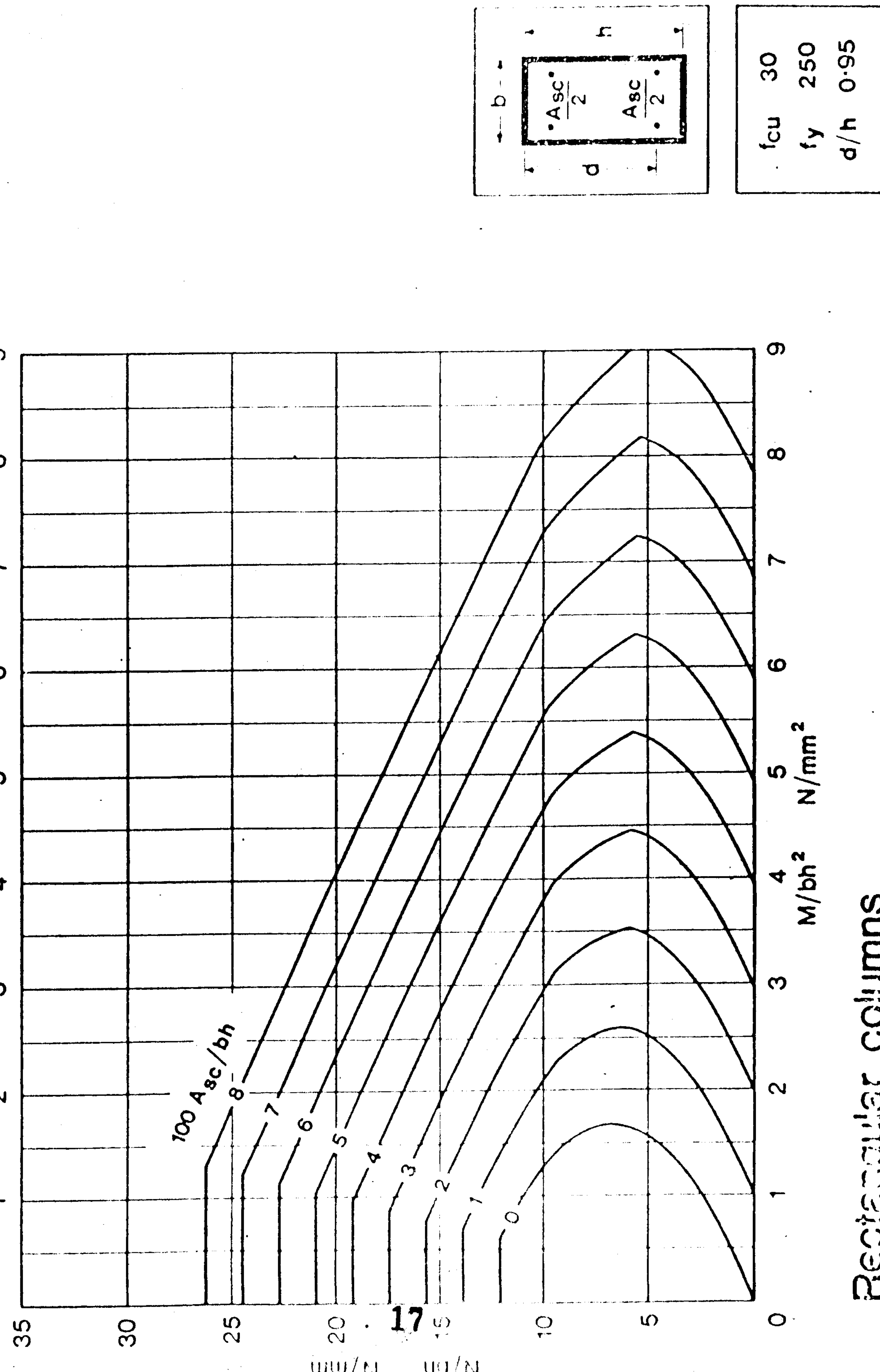


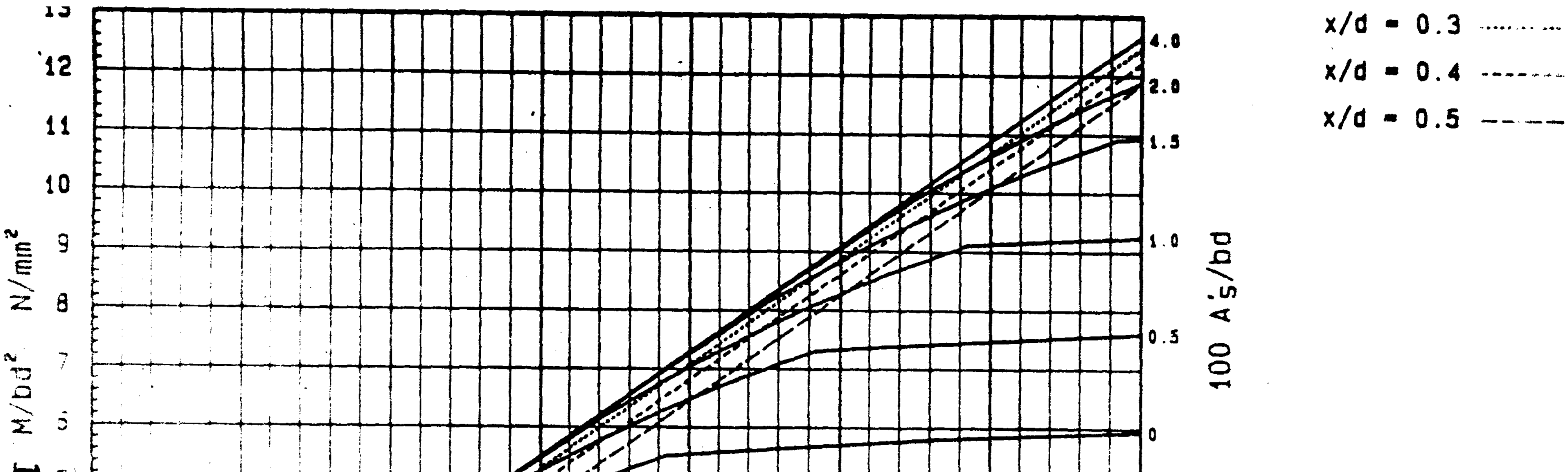
Rectangular columns

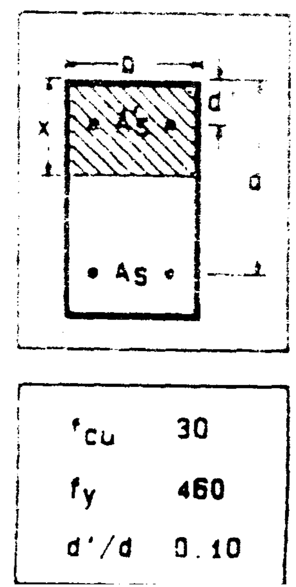
CP 110 : Part 2 : 1972



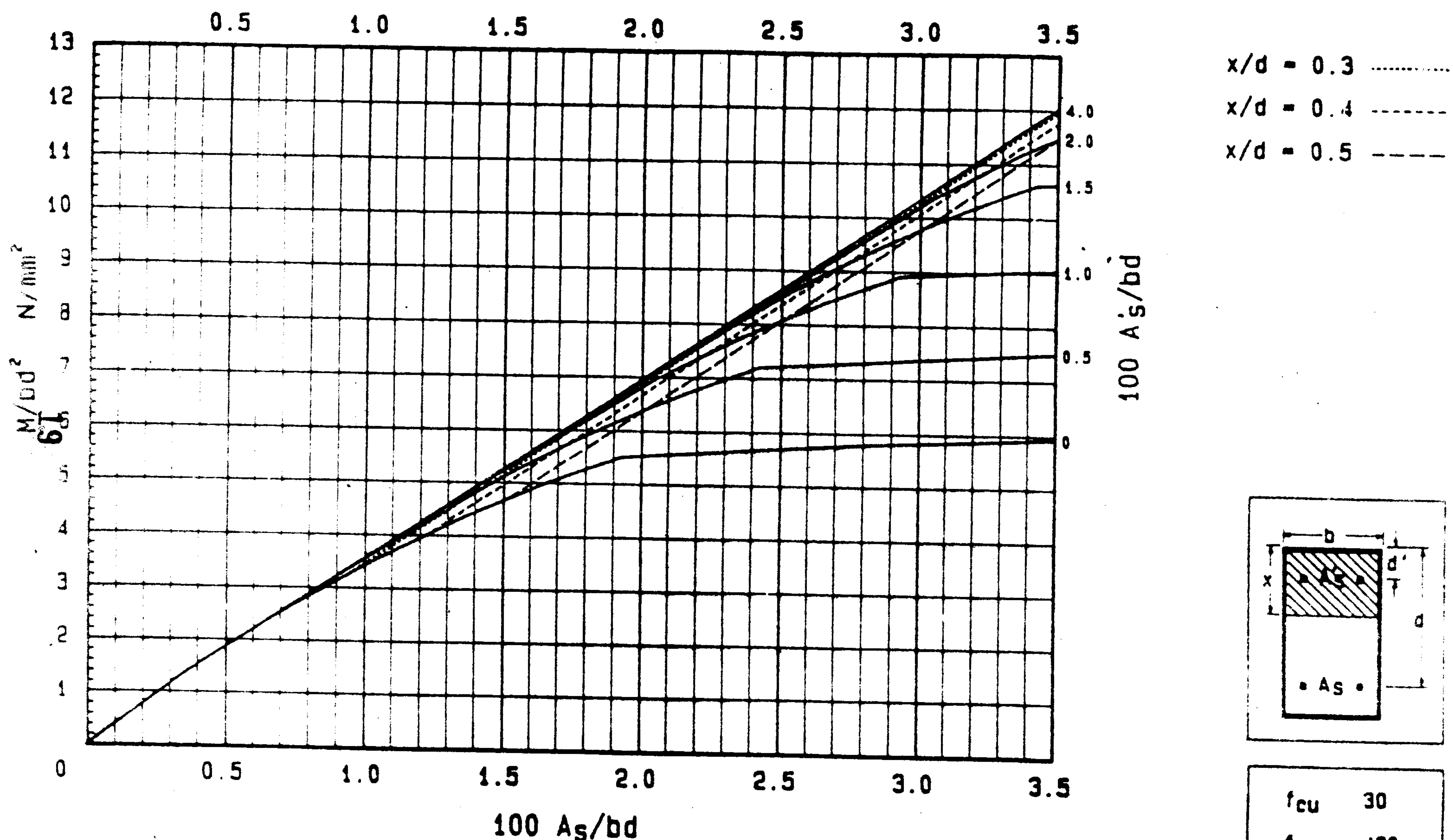

b
h
d
$\frac{A_{sc}}{2}$
$\frac{A_{sc}}{2}$
f_{cu} 30
f_y 250
d/h 0·90
100 A_{sc}/bh
0
1
2
3
4
5
6
7
8
0 1 2 3 4 5 6 7 8 9
M/bh² N/mm²
0 5 10 15 20 25 30 35
N/bh N/mm²
Rectangular columns


fcu 30
fy 250
d/h 0·95
b
h
d
Asc/2
Asc/2
100 Asc/bh
M/bh² N/mm²
N/bh N/mm²
Rectangular columns
17

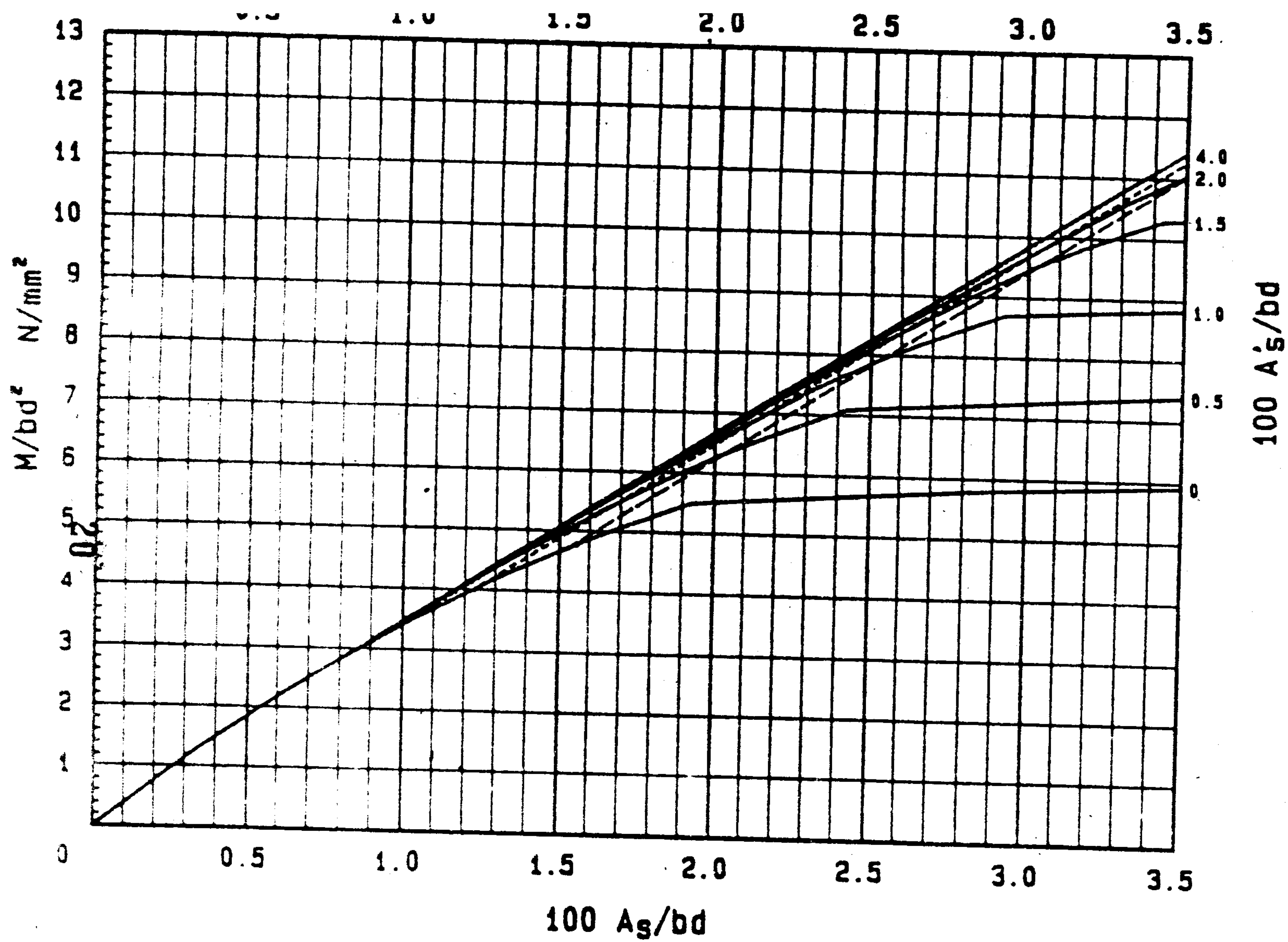




Doubly reinforced beams



Doubly reinforced beams

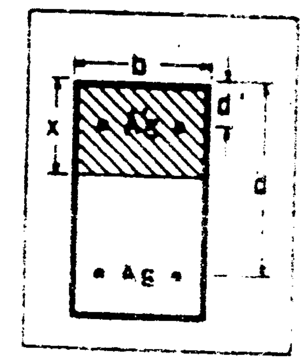


x/d = 0.3 ....

x/d = 0.4 - - - - - -

x/d = 0.5 — - — -

Doubly reinforced beams



f_{cu}	30
f_y	460
d'/d	0.20

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

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

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

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 (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

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
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]