UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Pertama
Sidang Akademik 1994/95

OKTOBER/NOVEMBER 1994

REG 531 - Sistem Dan Rekabentuk Struktur

Masa : (3 jam)

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

Jawab SEMUA soalan.

1. (a) Bincangkan beberapa kaedah rekabentuk bangunan tinggi di negara ini.

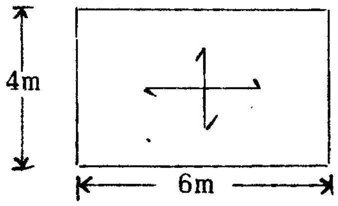
   (b) Dinding ricih dan dinding teras merupakan di antara elemen struktur yang begitu penting di dalam pembinaan bangunan tinggi. Bagaimanakah struktur ini mengekalkan kestabilan bangunan tinggi?

   (c) Salah satu kaedah pembinaan menara konkrit yang cukup popular ialah menggunakan acuan gelongsor. Bincangkan kaedah pembinaan ini dan sertakan lakaran jika perlu.

(20 markah)

2. (a) Penggunaan papak konkrit 2 hala lebih ekonomis berbanding dengan papak sehala. Beri pendapat anda tentang kenyataan ini.

   (b) Sebuah bangunan pejabat didirikan menggunakan papak konkrit 2 hala pada tingkat 1. Andaikan papak ini disokong mudah, tentukan tebal lantai, tetulang yang diperlukan supaya pesongan yang terjadi adalah selamat. Anggap berat konkrit bernilai 24 kN/m³.



(20 markah)

...2/-

3. Struktur acuan kayu diperlukan untuk menyokong papah konkrit tetulang, 3.0m di atas aras tanah. Sekiranya kayu terdiri daripada kelas kekuatan SC4 (regularized), dapatkan saiz anggota kayu yang digunakan dengan mengambilkira beban rekabentuk bernilai 30 kN/m^2.

(Rujuk Rajah 3.1 hingga Rajah 3.3)

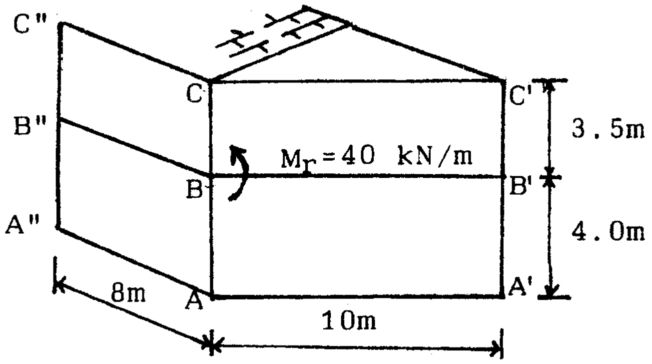
(20 markah)

4. (a) Bincangkan perbezaan utama antara rasuk tetulang tunggal dengan rasuk tetulang ganda.

(b) Sebatang rasuk jambatan konkrit sepanjang 20m dibina merentasi sungai. Beban rekabentuk jambatan ialah 30 kN/m. Dengan mengandaikan berat konkrit bernilai 24 kN/m^3, dapatkan rekabentuk saiz rasuk, tetulang atas dan bawah dan semak pesongan selamat.

(20 markah)

5.



Rajah 5

Diberi Rajah 5, yang menunjukkan keratan bangunan 2 tingkat yang dikenakan momen sebesar 40 kN/m pada rasuk 10m (BB').

(a) Dengan menggunakan analisis struktur, tentukan momen pada tiang AB, dan beban paksian pada tiang tersebut.

(b) Tentukan saiz tiang yang sesuai.

...3/-

(c) Dapatkan tetulang yang diperlukan dan semak pesongan jika nisbah modular untuk tiang pendek $l/h < 15$, di mana; l = tinggi tiang

h = lebar tiang (terkecil)

(20 markah)

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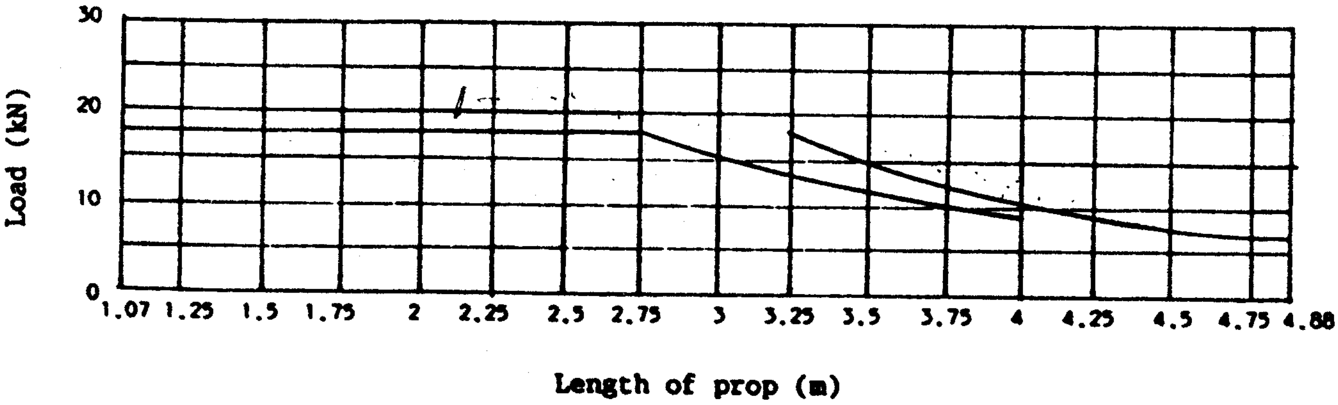
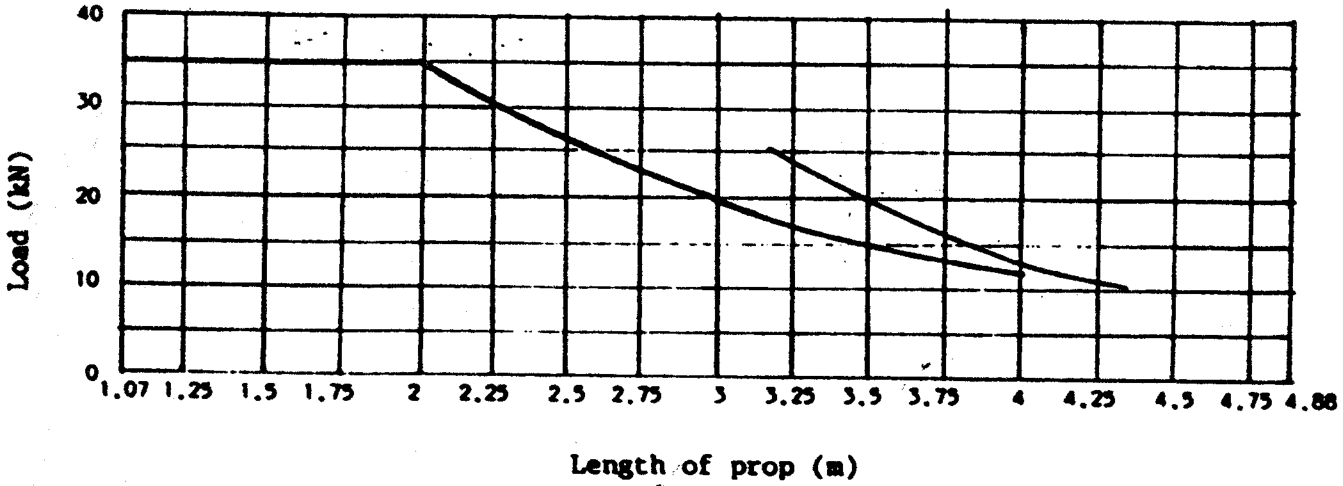
Rajah 3.1 : Penetuan Panjang Tupang (prop).

(a)



(b)

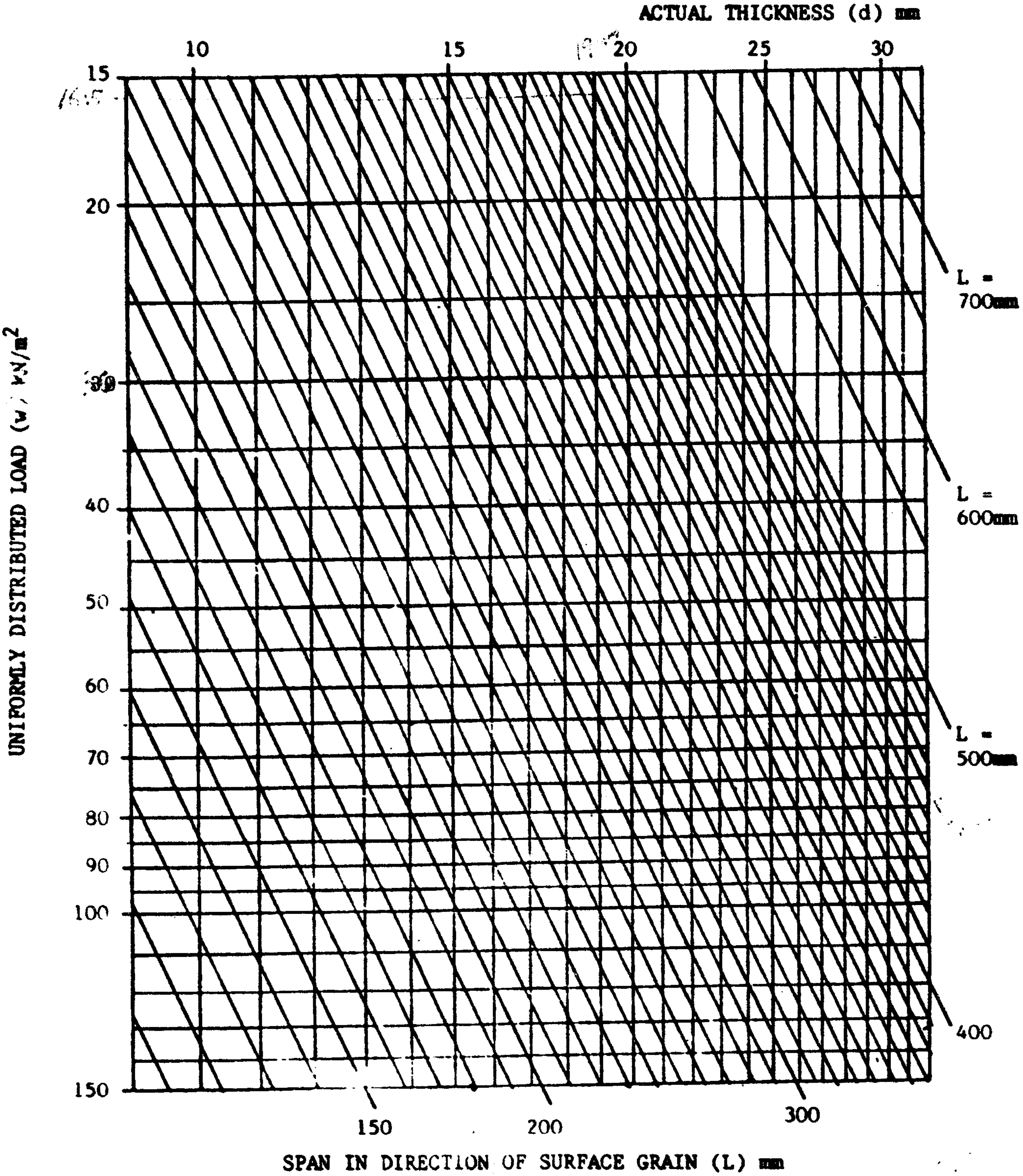


Rajah 3.2 : Penentuan Saiz Kayu Lapis

SAFE LOAD GRAPHS FOR SATURATED PLYWOODS

$$\text{Deflexion} = \frac{3 \times L}{1000} = \frac{12 \times w \times L^4}{185 \times 1000 \times Ed^3}$$

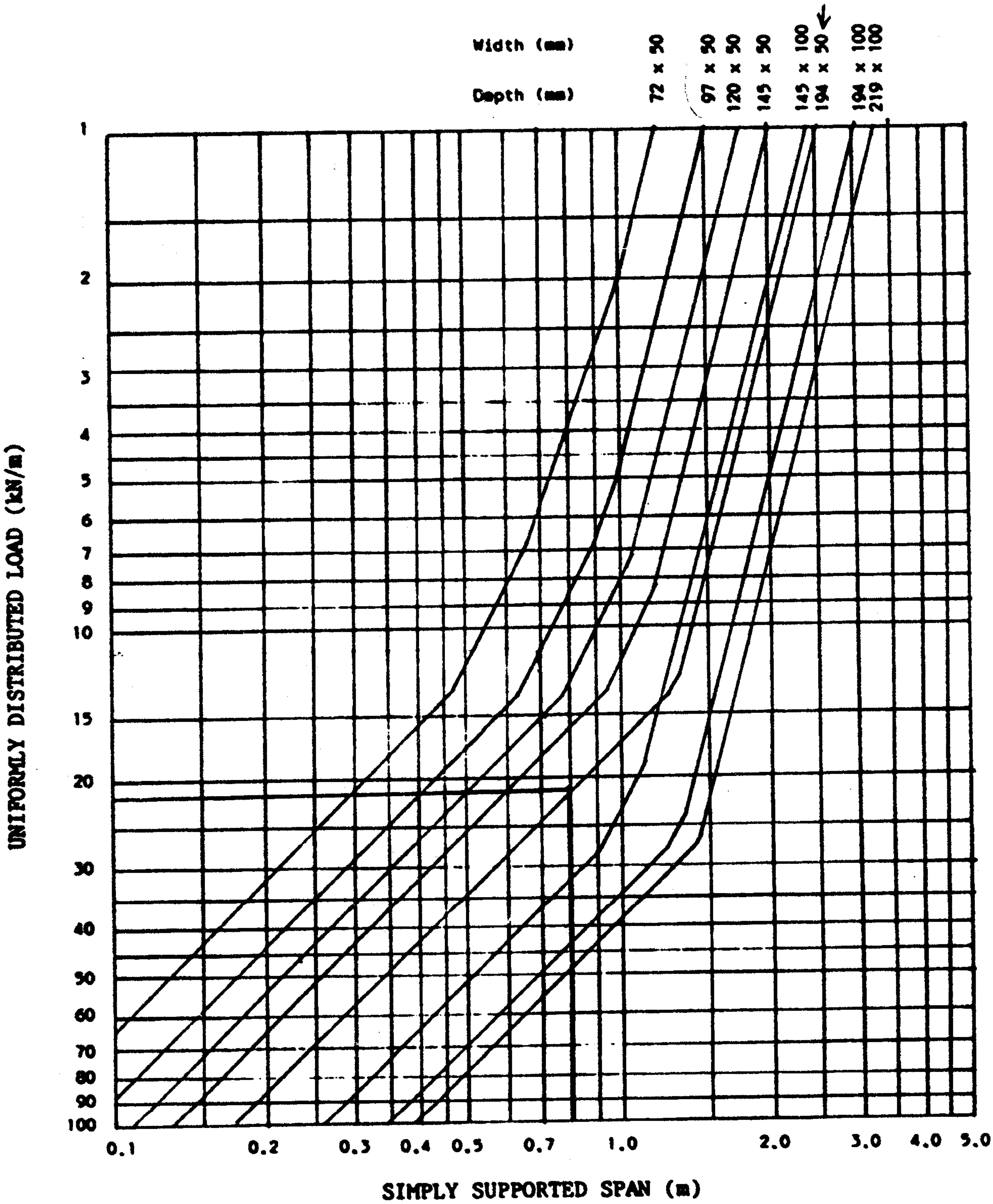
If $E = 5000\ N/mm^2$, $w = 231\ 250\ \frac{d^3}{L^3}\ kN/m^2$



Rajah 3.3 (a)

SAFE LOAD GRAPHS FOR REGULARIZED SC4 TIMBER TO BS 5975:1982

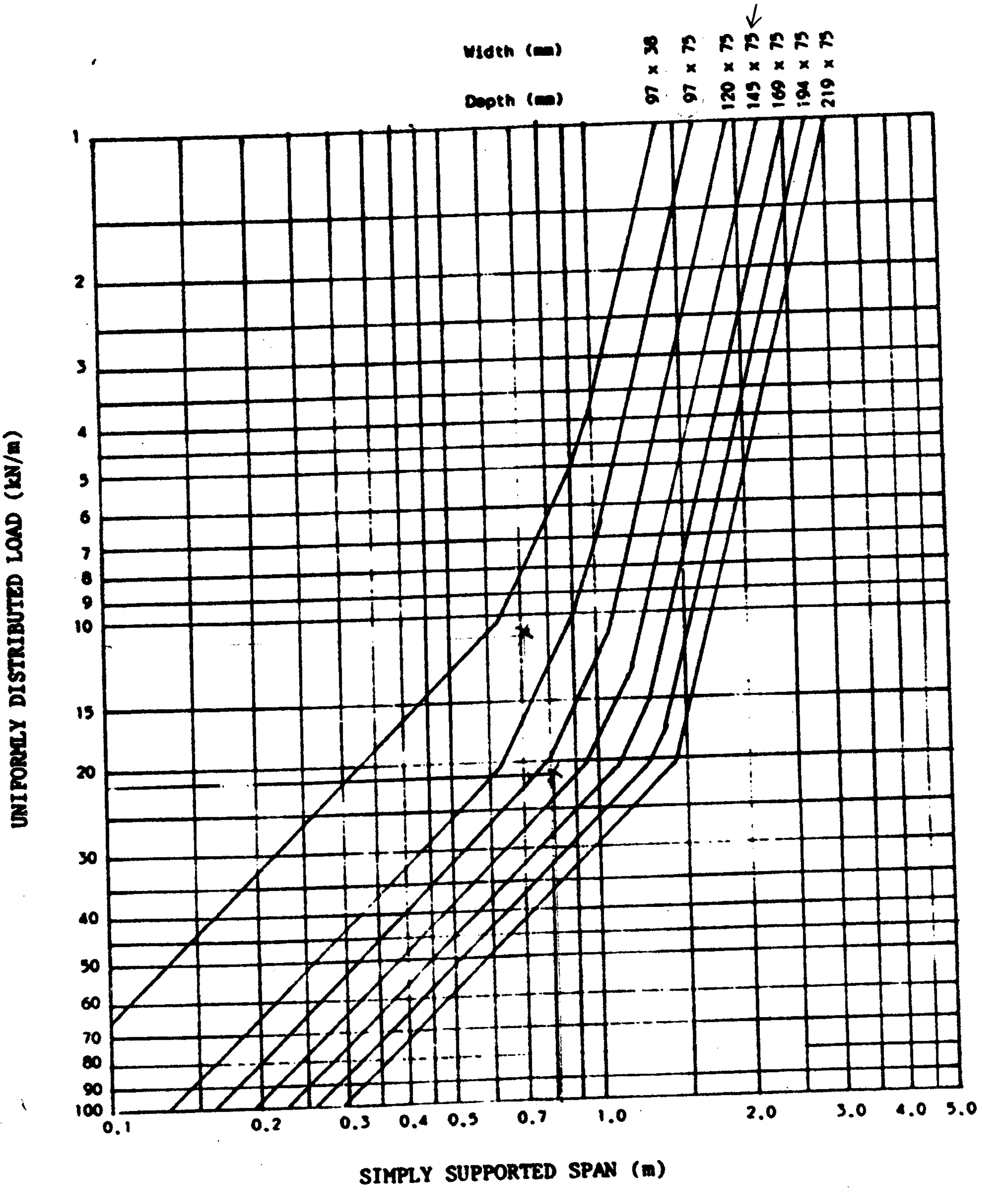
Deflection limited to 3mm and 0.003 of the span
modulus of elasticity 5616 N/mm^2 bending stress 8.67 N/mm^2
shear stress 1.34 N/mm^2 bearing stress 2.87 N/mm^2



Rajah 3.3 (b)

SAFE LOAD GRAPHS FOR RE@ULARIZED SC4 TIMBER TO BS 5975:1982

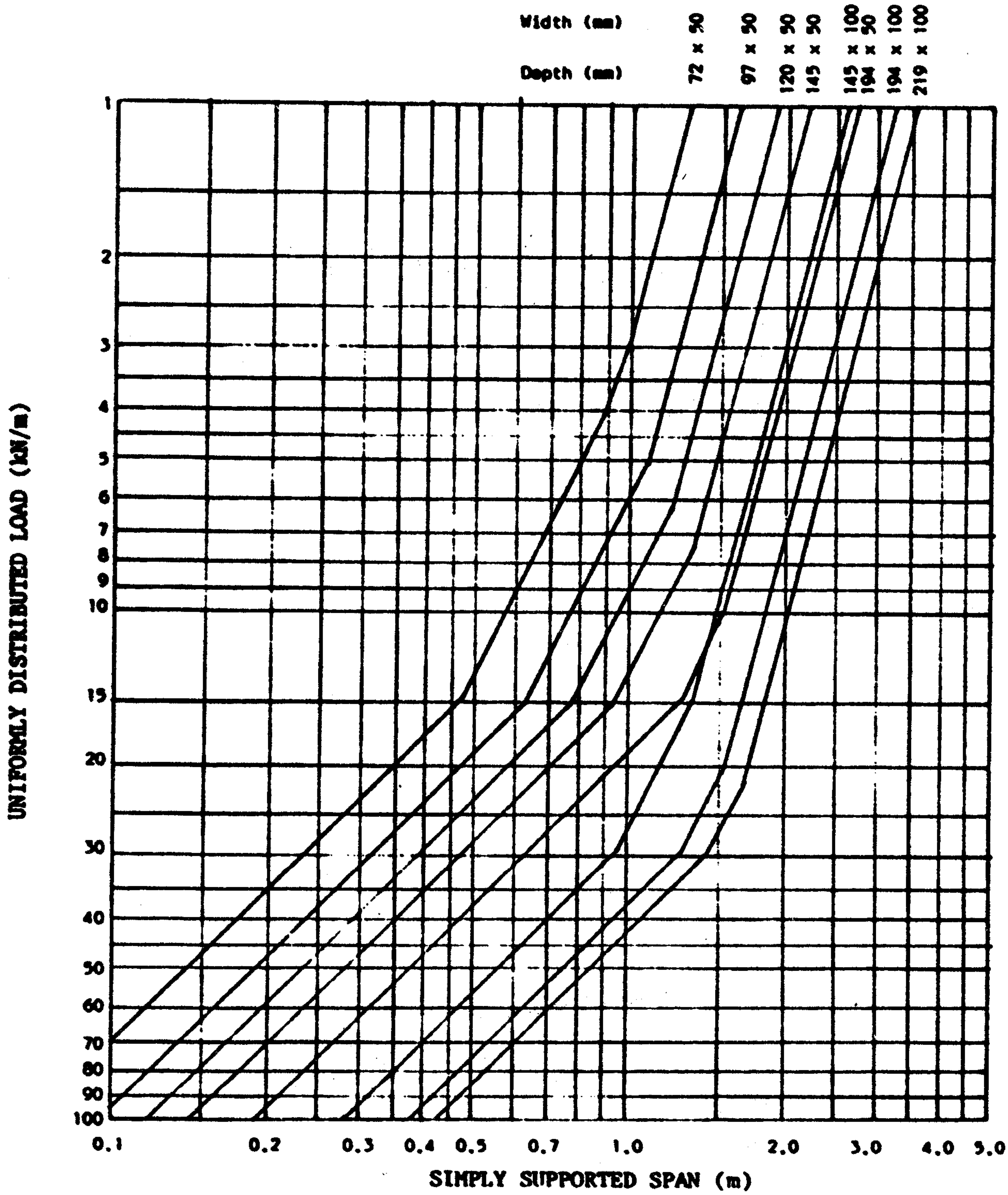
Deflection limited to 3mm and 0,003 of the span
modulus of elasticity 5616 N/mm^2 bending stress 8.67 N/mm^2
shear stress 1.34 N/mm^2 bearing stress 2.87 N/mm^2



Rajah 3.3 (c)

SAFE LOAD GRAPHS FOR REGULARIZED SC4 TIMBER TO BS 5975:1982 WHERE LOAD SHARING IS POSSIBLE AND SPACING IS NOT MORE THAN 600mm.

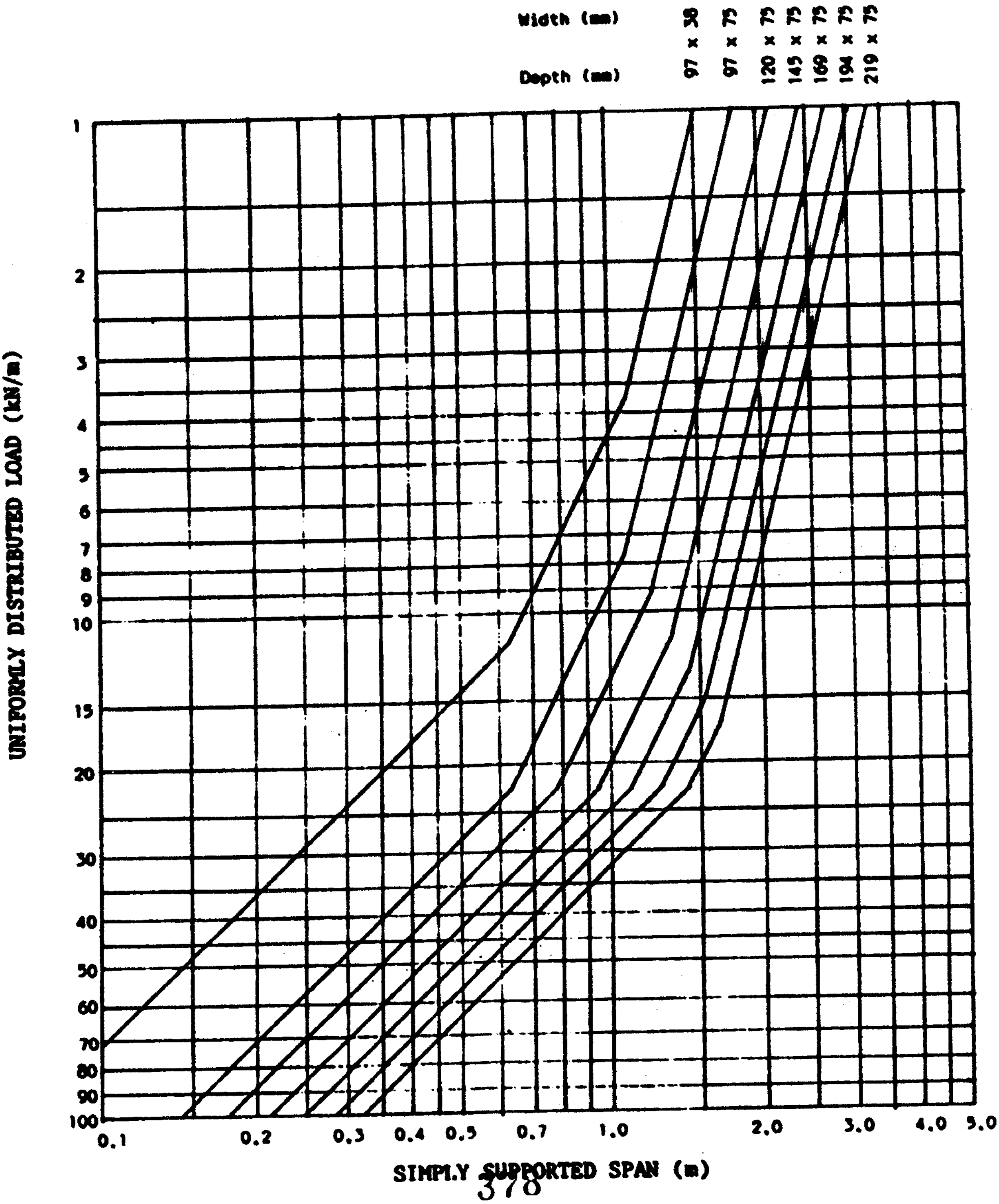
Deflection limited to 3mm and 0.003 of the span
modulus of elasticity 8035 N/mm^2 bending stress 9.54 N/mm^2
shear stress 1.47 N/mm^2 bearing stress 3.16 N/mm^2

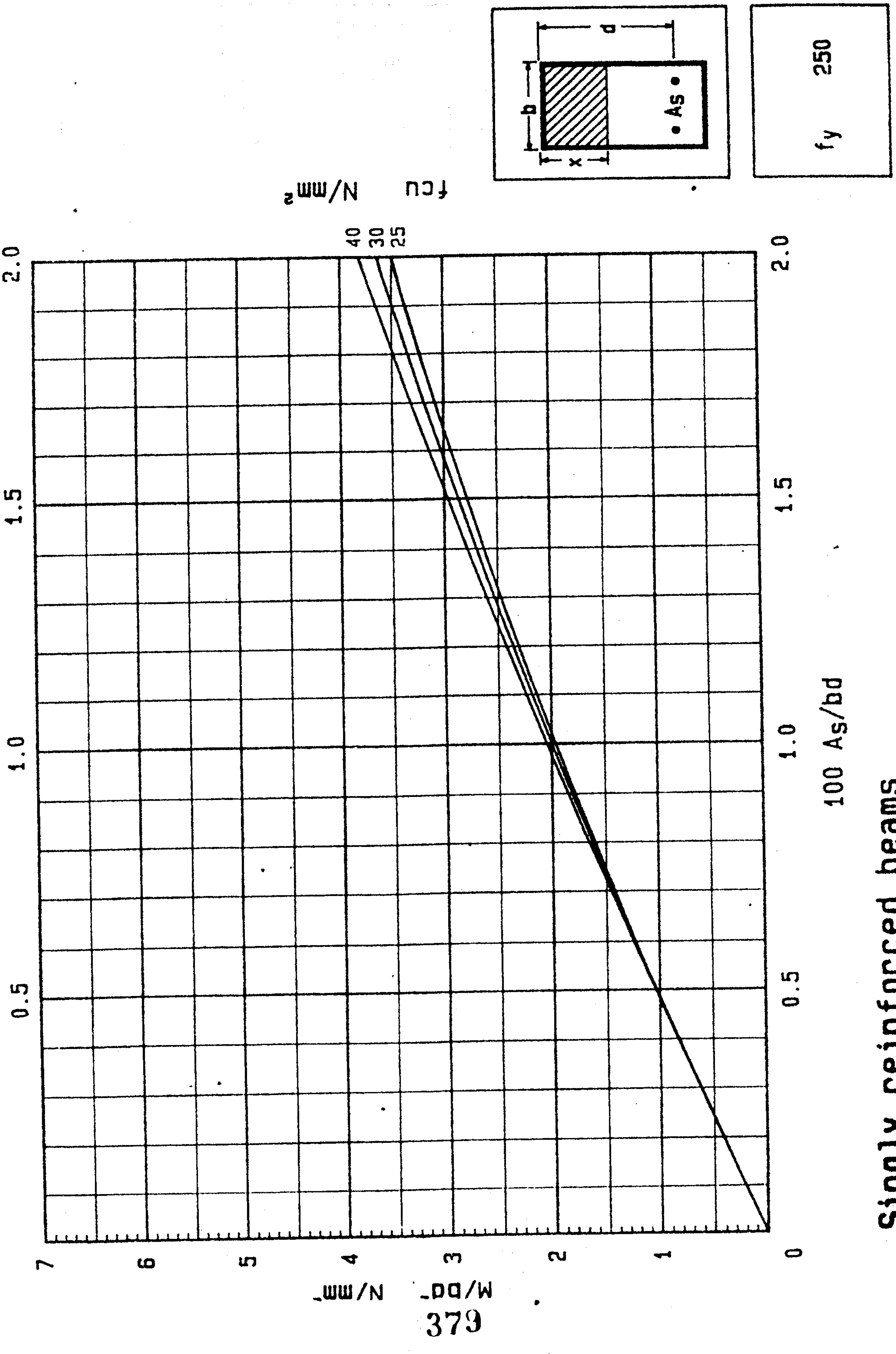


Rajah 3.3 (d)

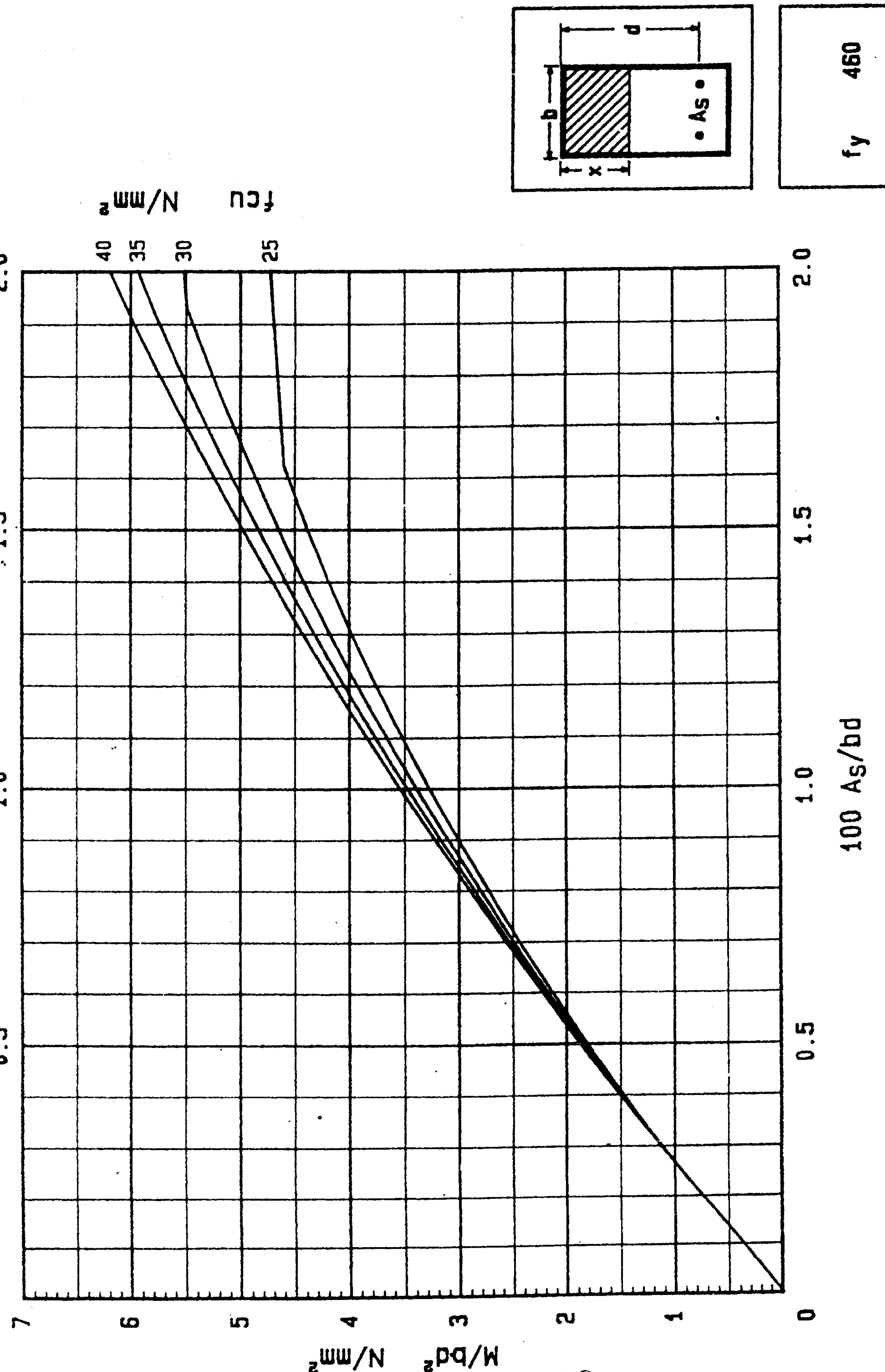
SAFE LOAD GRAPHS FOR REGULARIZED SC4 TIMBER TO BS 5975:1982 WHERE LOAD SHARING IS POSSIBLE AND SPACING IS NOT MORE THAN 600mm.

Deflection limited to 3mm and 0.003 of the span
modulus of elasticity 8035 N/mm^2 bending stress 9.54 N/mm^2
shear stress 1.47 N/mm^2 bearing stress 3.16 N/mm^2



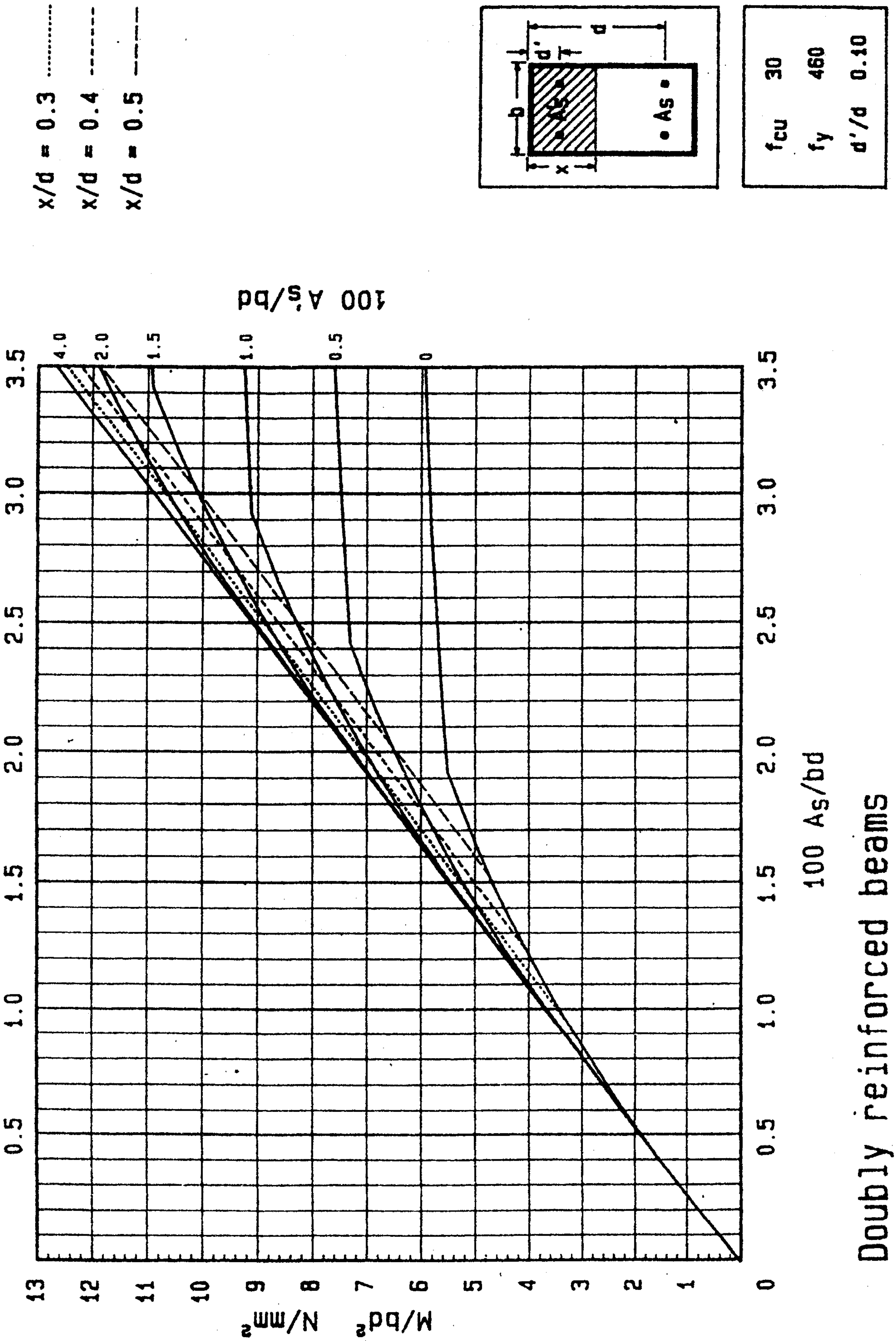


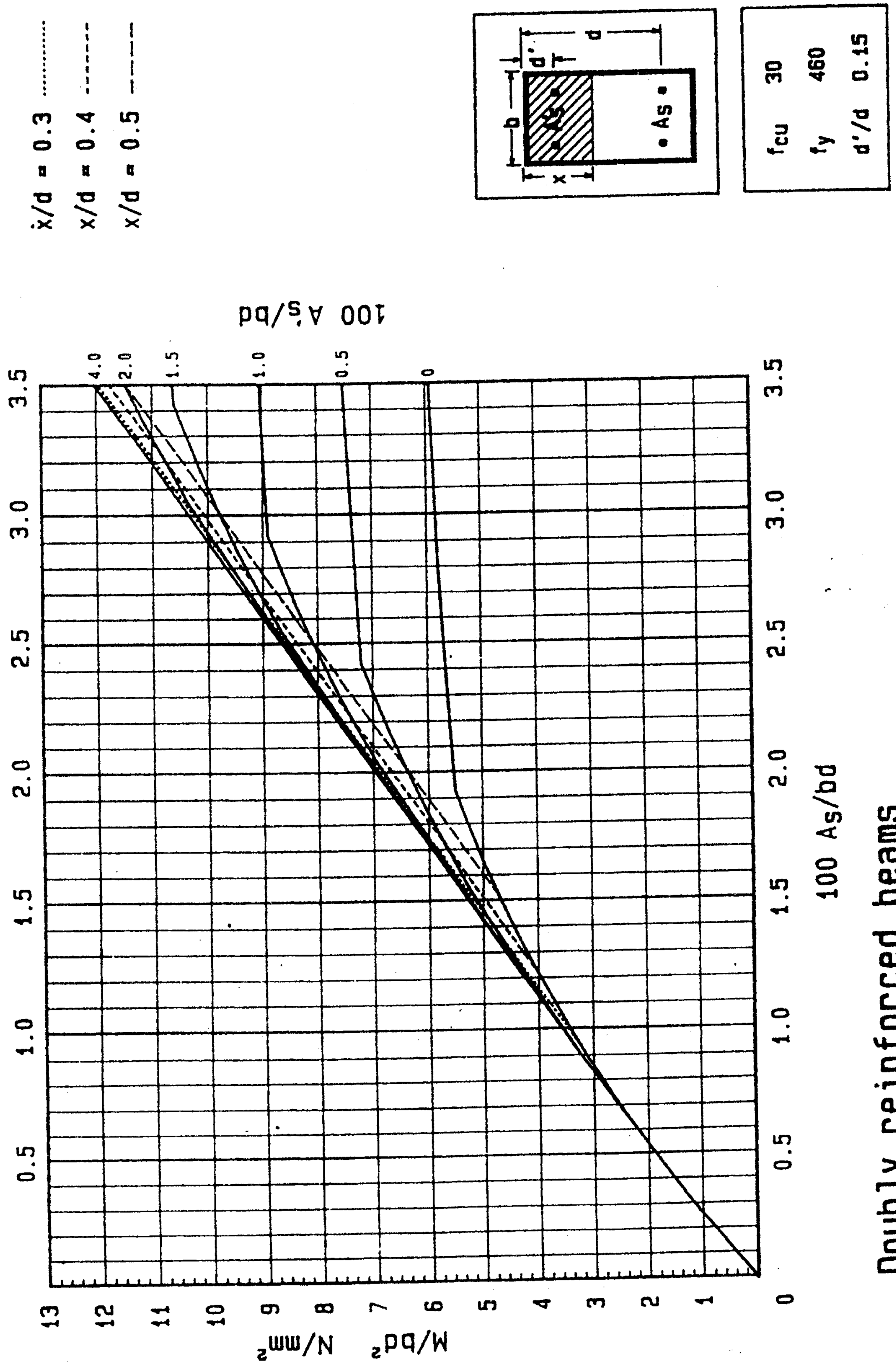
Singly reinforced beams



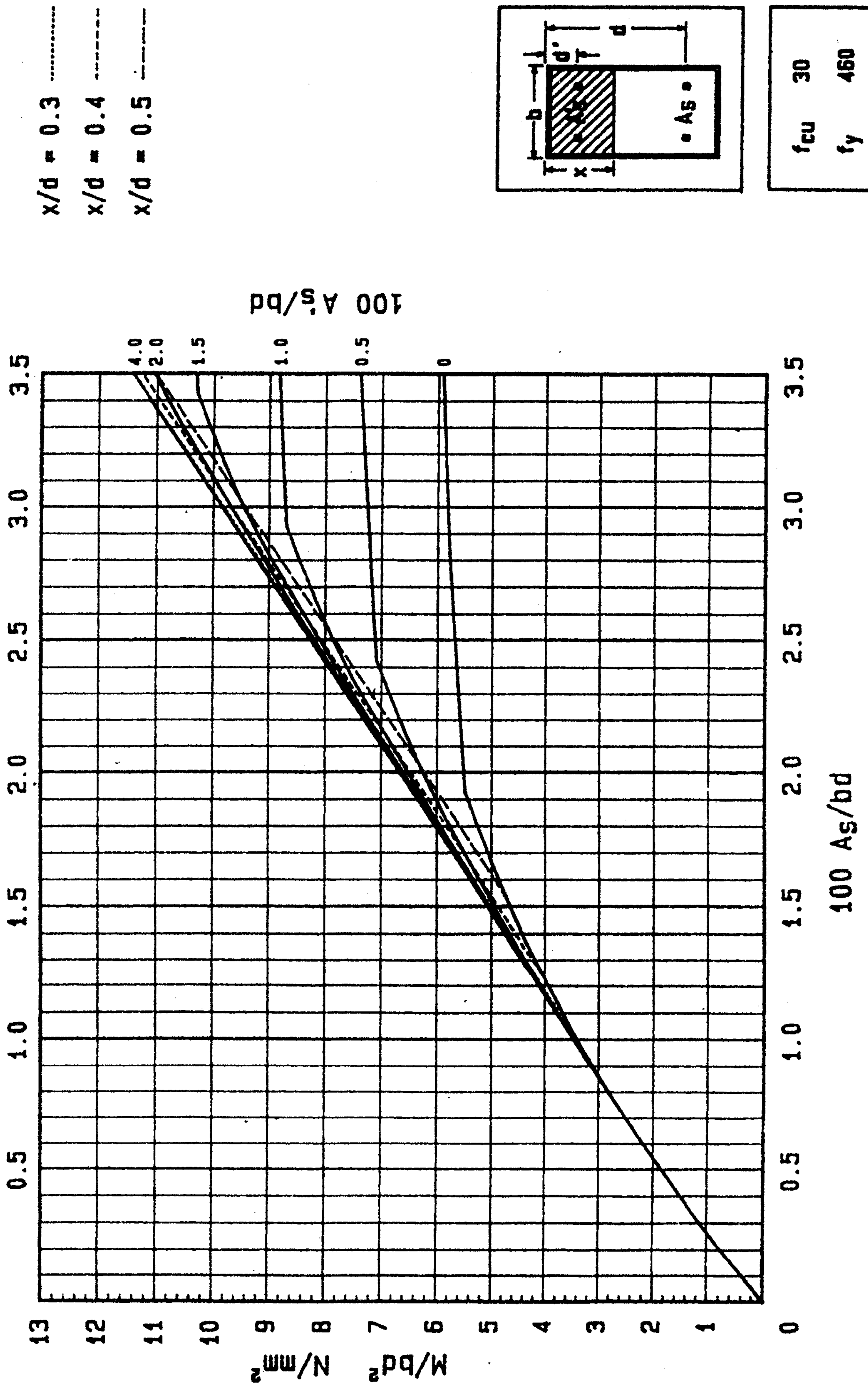
Singly reinforced beams

BS 8110 : Part 3 : 1985





Doubly reinforced beams



Doubly reinforced beams

Table 3.11 Modification factor for tension reinforcement

Service stress		M/bd^2 0.50	0.75	1.00	1.50	2.00	3.00	4.00	5.00	6.00
	100	2.00	2.00	2.00	1.86	1.63	1.36	1.19	1.08	1.01
	150	2.00	2.00	1.98	1.69	1.49	1.25	1.11	1.01	0.94
(f_y = 250)	156	2.00	2.00	1.96	1.66	1.47	1.24	1.10	1.00	0.94
	200	2.00	1.95	1.76	1.51	1.35	1.14	1.02	0.94	0.88
	250	1.90	1.70	1.55	1.34	1.20	1.04	0.94	0.87	0.82
(f_y = 460)	288	1.68	1.50	1.38	1.21	1.09	0.95	0.87	0.82	0.78
	300	1.60	1.44	1.33	1.16	1.06	0.93	0.85	0.80	0.76

NOTE 1. The values in the table derive from the equation:

$$\text{Modification factor} = 0.55 + \frac{(477 - f_s)}{120\left(0.9 + \frac{M}{bd^2}\right)} < 2.0 \qquad \text{equation 7}$$

where

M is the design ultimate moment at the centre of the span or, for a cantilever, at the support.

NOTE 2. The design service stress in the tension reinforcement in a member may be estimated from the equation:

$$f_s = \frac{5 f_y A_{s,\,req}}{8 A_{s,\,prov}} \times \frac{1}{\beta_b} \qquad \text{equation 8}$$

NOTE 3. For a continuous beam, if the percentage of redistribution is not known but the design ultimate moment at mid-span is obviously the same as or greater than the elastic ultimate moment, the stress, f_s, in this table may be taken as $5/8 f_y$.

Table 3.14 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
α_{sx}	0.062	0.074	0.084	0.093	0.099	0.104	0.113	0.118
α_{sy}	0.062	0.061	0.059	0.055	0.051	0.046	0.037	0.029

Table 3.13 Ultimate bending moment and shear forces in one-way spanning slabs

	At outer support	Near middle of end span	At first interior support	Middle of interior spans	Interior supports
Moment	0	$0.086Fl$	$-0.086Fl$	$0.063Fl$	$-0.063Fl$
Shear	$0.4F$	—	$0.6F$	—	$0.5F$

NOTE. F is the total design ultimate load ($1.4G_k + 1.6Q_k$);
l is the effective span.

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

Bar weights based on a density of 7850 kg/m³

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	30
8	1.183	1.118	1.006	0.805	0.671	0.575	0.503	0.447	0.402	0.366	0.
10	1.847	1.744	1.57	1.256	1.047	0.897	0.785	0.698	0.628	0.571	0.
12	2.659	2.511	2.26	1.808	1.507	1.291	1.13	1.004	0.904	0.822	0.
16	4.729	4.467	4.02	3.216	2.68	2.297	2.01	1.787	1.608	1.462	1.