UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Pertama
Sidang Akademik 1994/95

OKTOBER/NOVEMBER 1994

REG 462 - Rekabentuk Konkrit

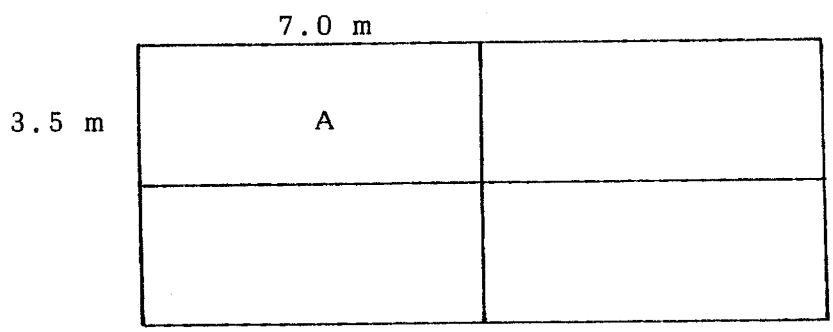
Masa : (3 jam)

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

Jawab SEMUA soalan.

1. (a) Dari sudut kejuruteraan, apakah perbezaan antara papak dua hala dengan papak sehala? Nyatakan juga kelebihan dan kekurangannya.

   (b) Dari Rajah 1, tentukan tebal papak konkrit untuk Panel A, supaya menepati keperluan pesongan. Tentukan tetulang yang diperlukan oleh panel ini jika beban kenaan ialah 4.5 kN/m^2 dan berat konkrit 24 kN/m^3.



Rajah 1 : Pelan lantai

(20 markah)

2. (a) Huraikan perbezaan antara tiang pendek dengan tiang lansing.

   (b) Jika tiang menara setinggi 6m menerima beban paksi yang diberikan oleh persamaan dalam BS 8110 seperti berikut:

...2/-

Nmuk = 0.4 fcuAc + 75 fyAsc
di mana;

Ac = luas keratan tiap konkrit
Asc = luas keratan tetulang
fcu = kekuatan konkrit
fy = kekuatan keluli

tentukan saiz tiang dan tetulang yang diperlukan untuk menanggung beban 1500 kN. Konkrit yang digunakan adalah gred 25, kekuatan keluli 460 N/mm^2 dan nisbah kelangsingan ialah 15.

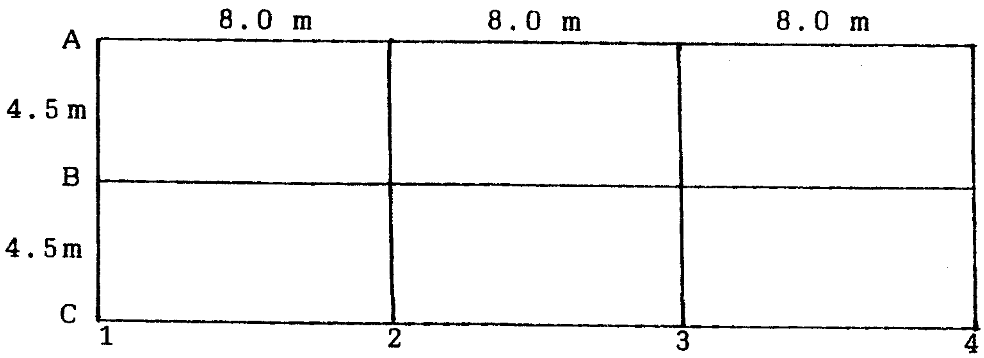
(c) Tentukan saiz rakap dan jarak maksimum

(20 markah)

3. (a) Kegagalan rasuk lazimnya berpunca daripada pesongan yang berlebihan. Terangkan apakah kriteria yang digunakan dalam mengawal pesongan rasuk dan peranan nisbah l/d;

di mana l = rentang dan d = kedalaman efektif.

(b) Dengan berpandukan Rajah 2, tentukan saiz rasuk dan tetulang untuk rasuk C/2-3, jika



Rajah 2

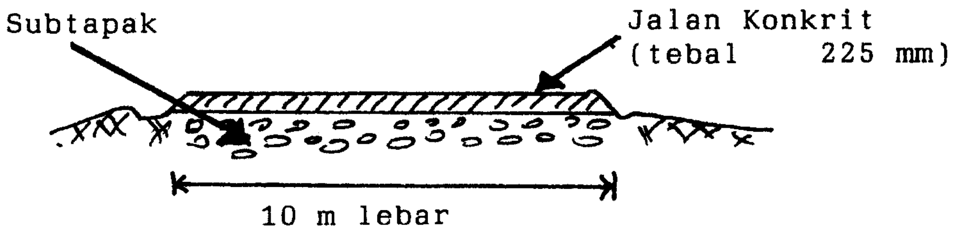
beban kenaan ialah 5.0 kN/m^2, berat konkrit 24 kN/m^3, tetulang fy = 460 N/mm^2 dan konkrit gred 30.

(20 markah)

...3/-

4. (a) Pembinaan jalan daripada struktur konkrit semakin popular pada masa ini walaupun kos permulaannya adalah lebih tinggi jika dibandingkan dengan jalan tar. Beri pendapat anda tentang perkara ini dengan tumpuan daripada sudut kejuruteraan.

(b) Sebatang lebuhraya (Rajah 3) selebar 10 m akan dibina daripada struktur konkrit gred 35. Jika beban statik kenderaan yang direkabentuk bernilai 10 kN/m lebar jalan, tentukan tetulang untuk lebuhraya tersebut jika tebal jalan konkrit tidak melebihi 225 mm. Guna tetulang fy = 250 N/mm^2.



Rajah 3

(20 markah)

5. (a) Bincang perbezaan antara rasuk tetulang tunggal dengan rasuk yang bertetulang ganda dan berikan contoh lakaran keratan berpandukan gambarajah momen lentur.

(b) Rasuk disokong mudah sepanjang 8 m memikul beban hidup 4.0 kN/m dan beban mati 6.0 kN/m.

Ukuran rasuk ialah 200 mm x 360 mm.

Dapatkan rekabentuk tetulang pada bahagian tengah rentang apabila gred konkrit 25 dan keluli lembut digunakan. Andaikan jarak tetulang atas ialah 37.5 mm di bawah permukaan rasuk.

(c) Semak pesongan dan cadangkan alternatif yang boleh diambil untuk menjadikan rasuk bertetulang tunggal.

(20 markah)

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Table 3.15 Bending moment coefficients for rectangular panels supported on four sides with provisio at corners

Type of panel and moments considered	Short span coefficients, β_{sx}							
	Values of l_y/l_x							
	1.0	1.1	1.2	1.3	1.4	1.5	1.75	2.0
Interior panels								
Negative moment at continuous edge	0.031	0.037	0.042	0.046	0.050	0.053	0.059	0.063
Positive moment at mid-span	0.024	0.028	0.032	0.035	0.037	0.040	0.044	0.048
One short edge discontinuous								
Negative moment at continuous edge	0.039	0.044	0.048	0.052	0.055	0.058	0.063	0.067
Positive moment at mid-span	0.029	0.033	0.036	0.039	0.041	0.043	0.047	0.050
One long edge discontinuous								
Negative moment at continuous edge	0.039	0.049	0.056	0.062	0.068	0.073	0.082	0.089
Positive moment at mid-span	0.030	0.036	0.042	0.047	0.051	0.055	0.062	0.067
Two adjacent edges discontinuous								
Negative moment at continuous edge	0.047	0.056	0.063	0.069	0.074	0.078	0.087	0.093
Positive moment at mid-span	0.036	0.042	0.047	0.051	0.055	0.059	0.065	0.070
Two short edges discontinuous								
Negative moment at continuous edge	0.046	0.050	0.054	0.057	0.060	0.062	0.067	0.070
Positive moment at mid-span	0.034	0.038	0.040	0.043	0.045	0.047	0.050	0.053
Two long edges discontinuous								
Negative moment at continuous edge	—	—	—	—	—	—	—	—
Positive moment at mid-span	0.034	0.046	0.056	0.065	0.072	0.078	0.091	0.100
Three edges discontinuous (one long edge continuous)								
Negative moment at continuous edge	0.057	0.065	0.071	0.076	0.081	0.084	0.092	0.098
Positive moment at mid-span	0.043	0.048	0.053	0.057	0.060	0.063	0.069	0.074
Three edges discontinuous (one short edge continuous)								
Negative moment at continuous edge	—	—	—	—	—	—	—	—
Positive moment at mid-span	0.042	0.054	0.063	0.071	0.078	0.084	0.096	0.105
Four edges discontinuous								
Positive moment at mid-span	0.055	0.065	0.074	0.081	0.087	0.092	0.103	0.111

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

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

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]

Fire resistance	Minimum beam width (b)	Rib width (b)	Minimum thickness of floors (h)	Column width (b)			Minimum wall thickness		
				Fully exposed	50 % exposed	One face exposed	$\rho < 0.4$ %	$0.4\% < \rho < 1\%$	$\rho > 1$ %
h	mm	mm	mm	mm	mm	mm	mm	mm	mm
0.5	200	125	75	150	125	100	150	100	75
1	200	125	95	200	160	120	150	120	75
1.5	200	125	110	250	200	140	175	140	100
2	200	125	125	300	200	160	–	160	100
3	240	150	150	400	300	200	–	200	150
4	280	175	170	450	350	240	–	240	180

NOTE 1. These minimum dimensions relate specifically to the covers given in tables 3.5 and 4.9.

NOTE 2. ρ is the area of steel relative to that of concrete.

Figure 3.2 Minimum dimensions of reinforced concrete members for fire resistance

Table 3.6 Design 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	$0.09Fl$	$-0.11Fl$	$0.07Fl$	$-0.08Fl$
Shear	$0.45F$	–	$0.6F$	–	$0.55F$

NOTE. l is the effective span;

F is the total design ultimate load ($1.4G_k + 1.60Q_k$).

No redistribution of the moments calculated from this table should be made.

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:

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

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 $5/8 f_y$.

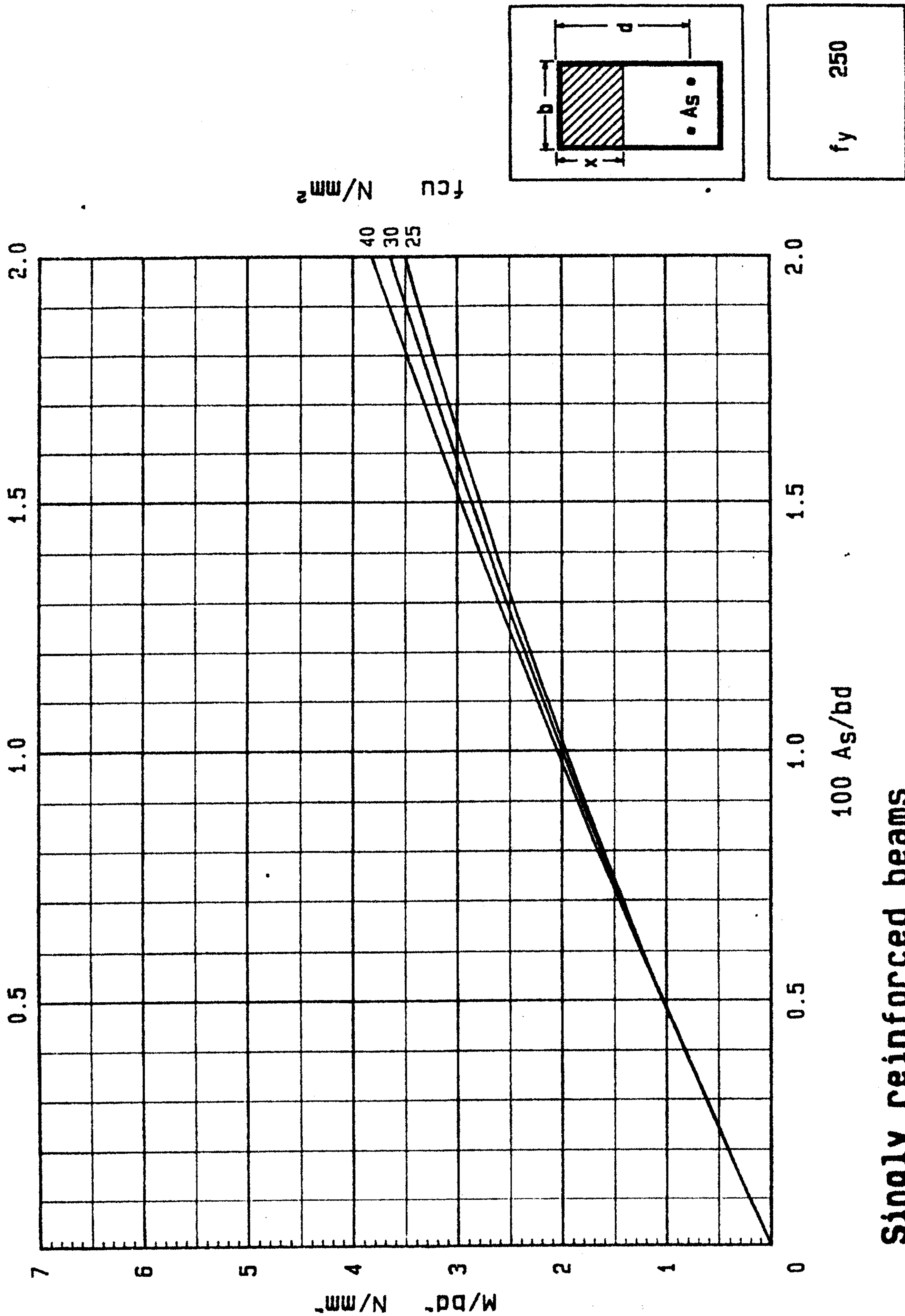
Table 3.14 Bending moment coefficients for slabs spanning in two directions at right-angles, simply-supported on four sides

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

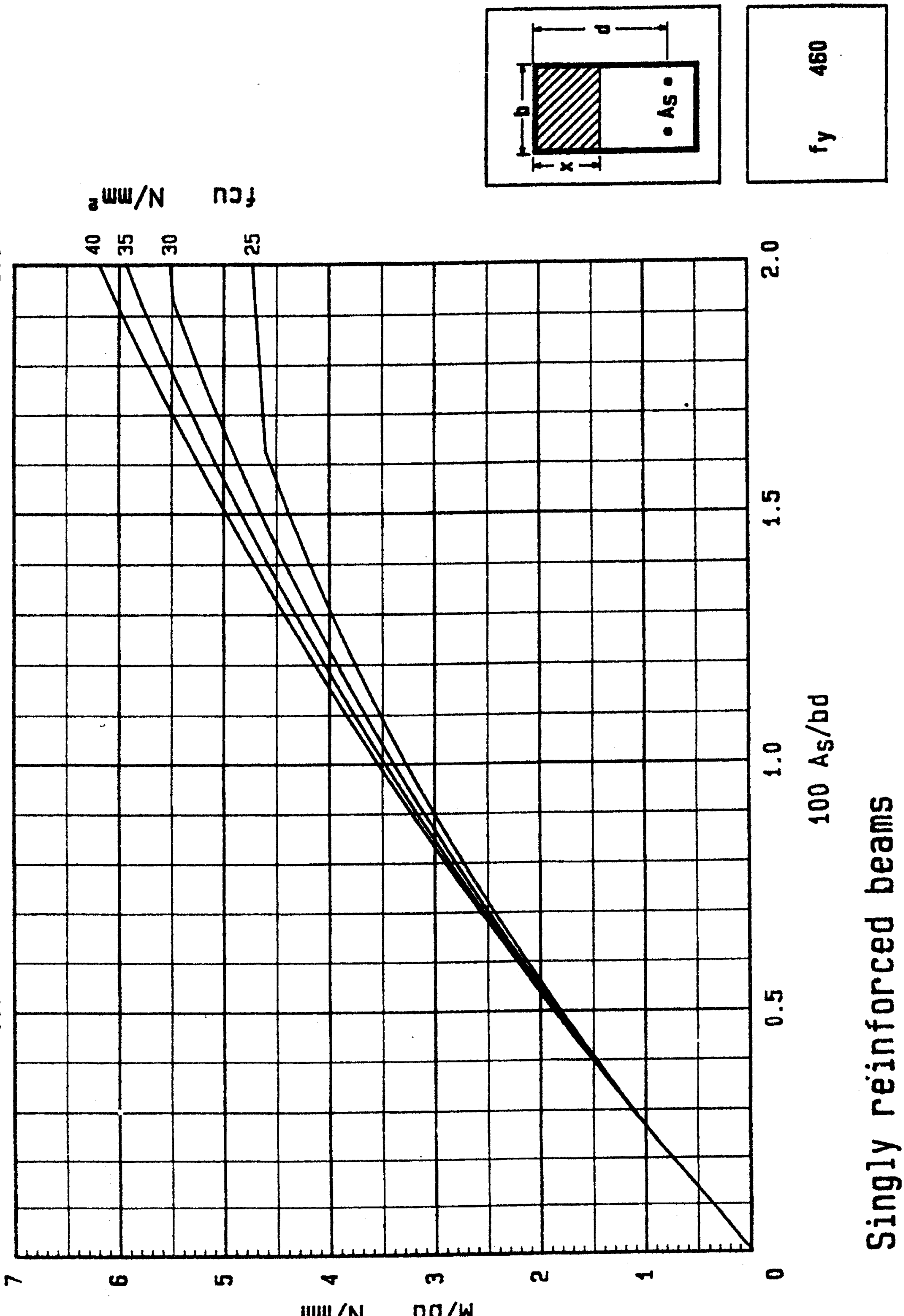
Table 3.13 Ultimate bending moment and shear forces in one-way spanning slabs

	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	$0.4F$	—	$0.6F$	—	$0.5F$

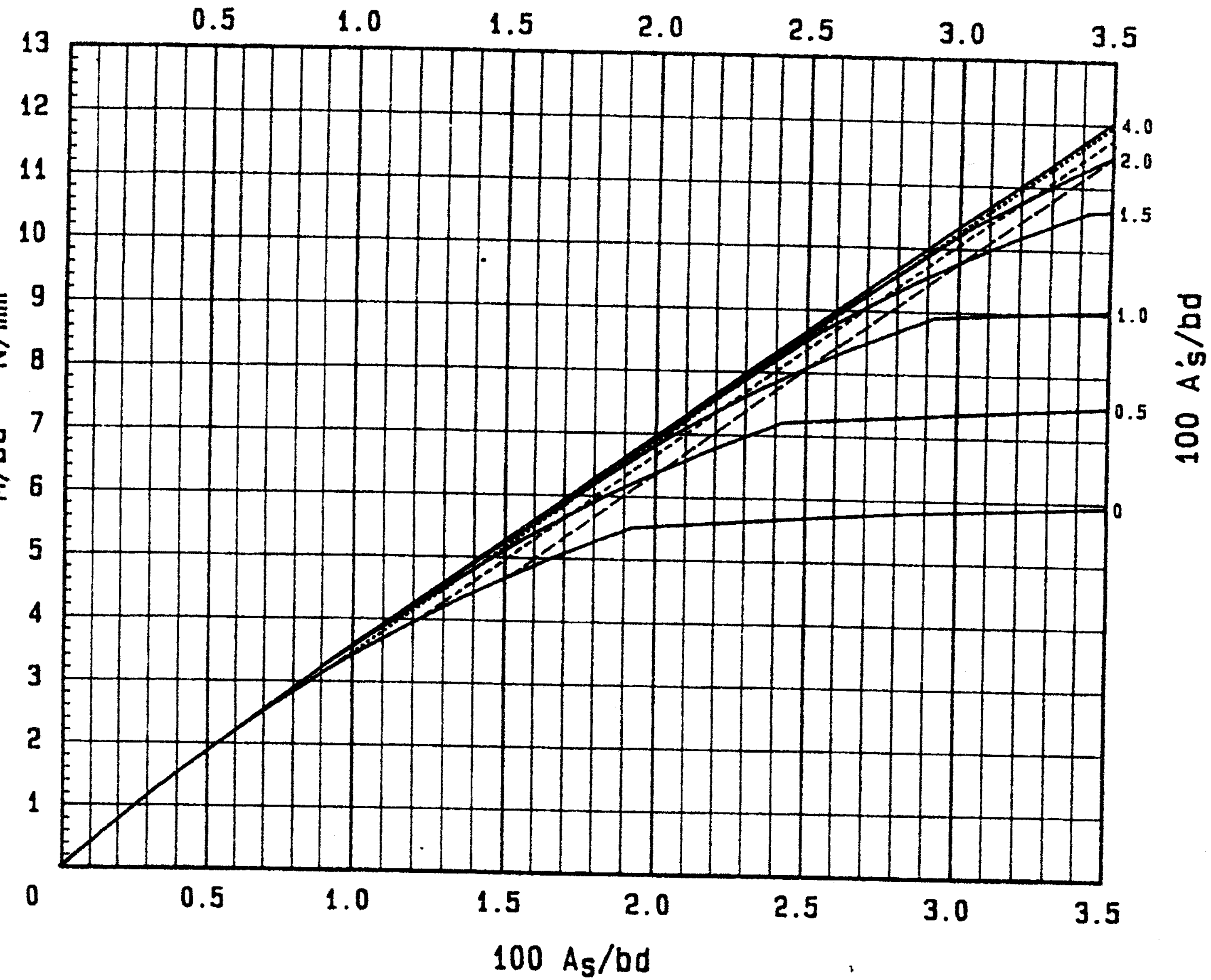
NOTE. F is the total design ultimate load $(1.4G_k + 1.6Q_k)$;
l is the effective span.



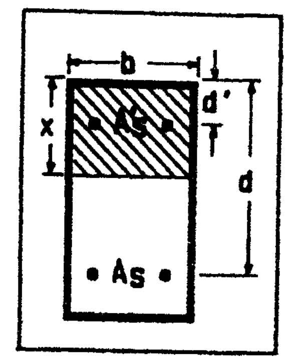
Singly reinforced beams



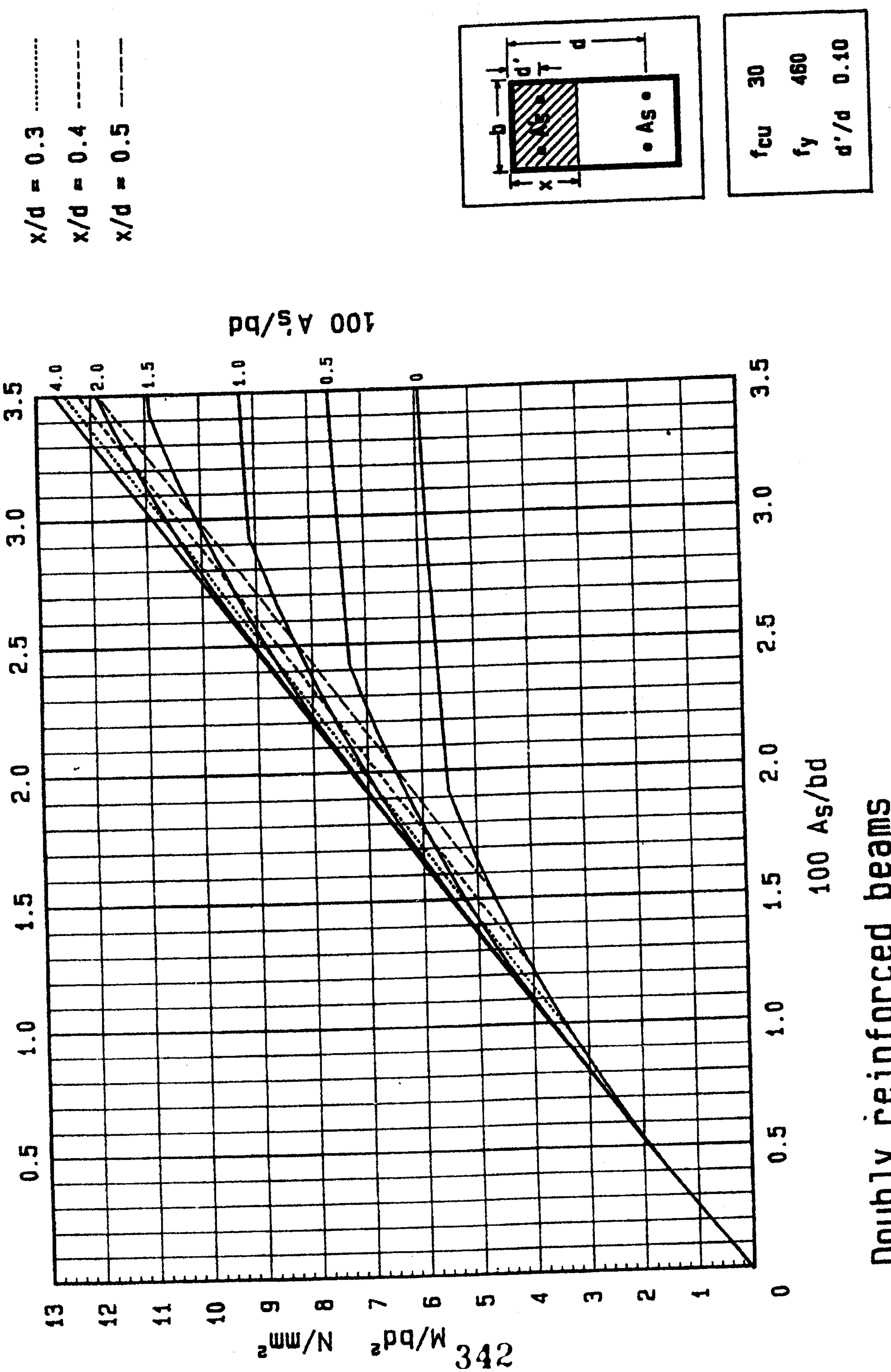
Singly reinforced beams



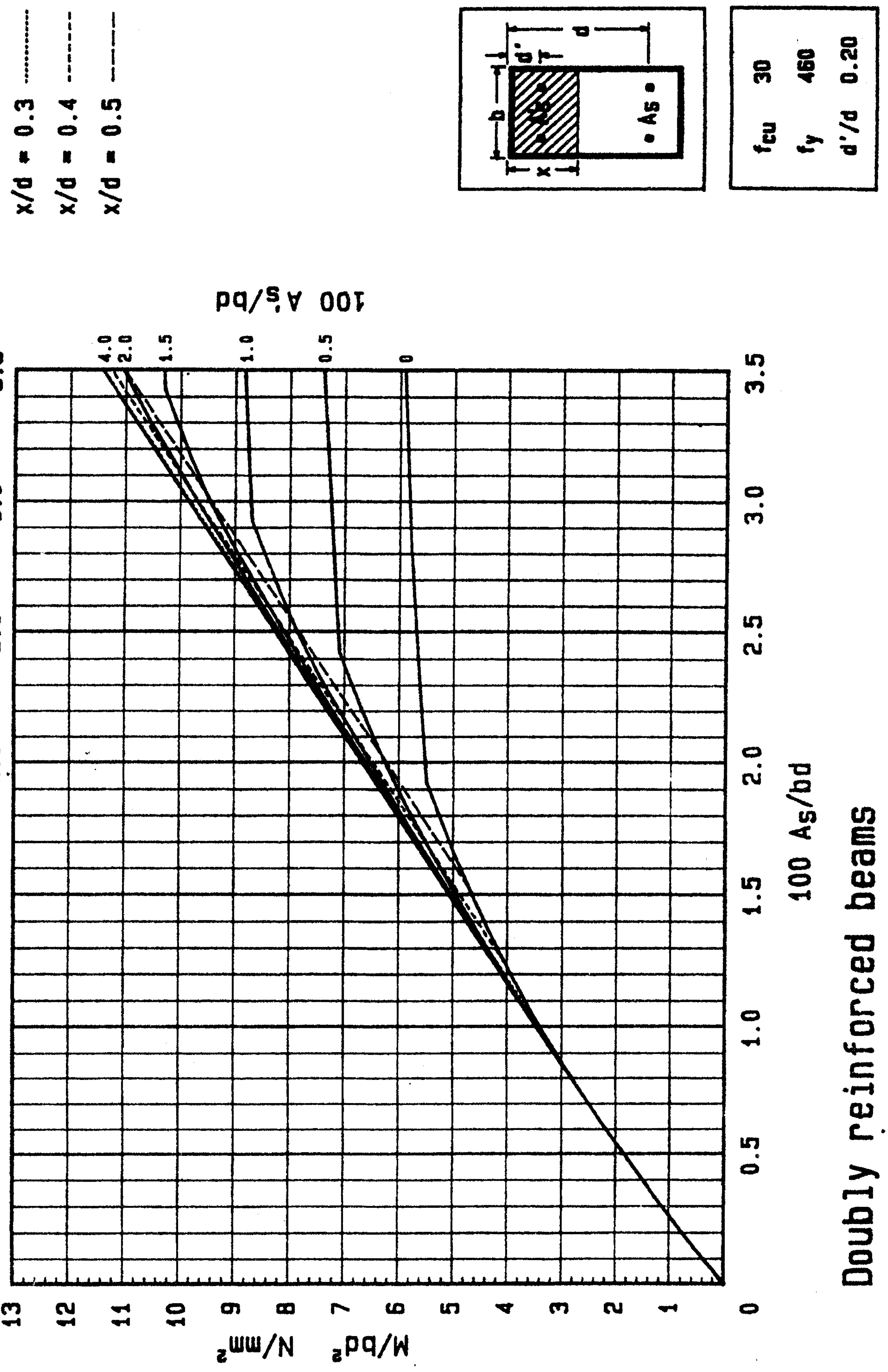
Doubly reinforced beams



f_{cu}	30
f_y	460
d'/d	0.15



Doubly reinforced beams


x/d = 0.3
x/d = 0.4
x/d = 0.5
b
d'
d
x
A's
As
fcu 30
fy 460
d'/d 0.20
100 A's/bd
4.0
2.0
1.5
1.0
0.5
0
M/bd² N/mm²
100 As/bd
0.5
1.0
1.5
2.0
2.5
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Doubly reinforced beams