

Structural use of concrete —

Part 3: Design charts for singly reinforced beams, doubly reinforced beams and rectangular columns

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- British Precast Concrete Federation Ltd.
- British Railways Board
- British Ready Mixed Concrete Association
- British Reinforcement Manufacturers' Association
- British Steel Industry
- Building Employers' Confederation
- Cement Admixtures Association
- Cement and Concrete Association
- Cement Makers' Federation
- Concrete Society
- Department of the Environment (Building Research Establishment)
- Department of the Environment (Housing and Construction Industries)
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- Sand and Gravel Association Limited

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f_y	Chart number
250	1
460	2
Doubly reinforced beams	
f_y f_{cu} d'/d	Chart number
460 25 0.10	3
	0.15 4
	0.20 5
460 30 0.10	6
	0.15 7
	0.20 8
460 35 0.10	9
	0.15 10
	0.20 11
460 40 0.10	12
	0.15 13
	0.20 14
460 45 0.10	15
	0.15 16
	0.20 17
460 50 0.10	18
	0.15 19
	0.20 20
Rectangular columns	
f_y f_{cu} d/h	Chart number
460 25 0.75	21
	0.80 22
	0.85 23
	0.90 24
	0.95 25
460 30 0.75	26
	0.80 27
	0.85 28
	0.90 29
	0.95 30
460 35 0.75	31

		0.80	32
		0.85	33
		0.90	34
		0.95	35
460	40	0.75	36
		0.80	37
		0.85	38
		0.90	39
		0.95	40
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		0.80	42
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Foreword

This Part of BS 8110 has been prepared under the direction of the Civil Engineering and Building Structures Standards Committee.

BS 8110 deals with the structural use of concrete. It is published in three Parts:

- *Part 1: Code of practice for design and construction;*
- *Part 2: Code of practice for special circumstances;*
- *Part 3: Design charts for singly reinforced beams, doubly reinforced beams and rectangular columns.*

The design charts in this Part of BS 8110 have been prepared in accordance with the assumptions laid down in Part 1, with the intention that they may be used as standard charts and so avoid duplication of effort by individual design offices.

This Part of BS 8110 reflects the change in the characteristic strength of available reinforcing steel and supersedes CP 110-2:1972 and CP 110-3:1972 which are both withdrawn.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 2 to 56, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 General

1.1 Scope

This part of BS 8110 covers design charts for singly reinforced beams, doubly reinforced beams and rectangular columns. These design charts cannot be used to obtain the complete detailed design of any member but they may be used as an aid when analysing the cross section of a member at the ultimate limit state. The charts have been based on the assumptions laid down in BS 8110-1, use being made of the parabolic-rectangular stress block throughout. Full details of the derivation of the charts are given in Appendix.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

1.2 Symbols

For the purposes of this Part of BS 8110 the definitions of the symbols given in BS 8110-1 and BS 8110-2 apply together with the following which are used in Appendix.

f_{sc}	Stress in reinforcement in compression at the ultimate limit state
f_{st}	Stress in reinforcement in tension at the ultimate limit state
ϵ_0	Strain at the point on the parabolic-rectangular stress-strain diagram where the parabolic section joins the linear section ($\epsilon_0 = 2.4 \times 10^{-4} \sqrt{f_{cu}/\gamma_m}$).

1.3 Use of charts

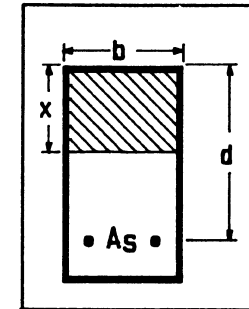
Design examples illustrating the use of the charts are given in Appendix B.

The values of K indicated on the column design charts are the additional moment reduction coefficients given by equation 33 of BS 8110-1:1985.

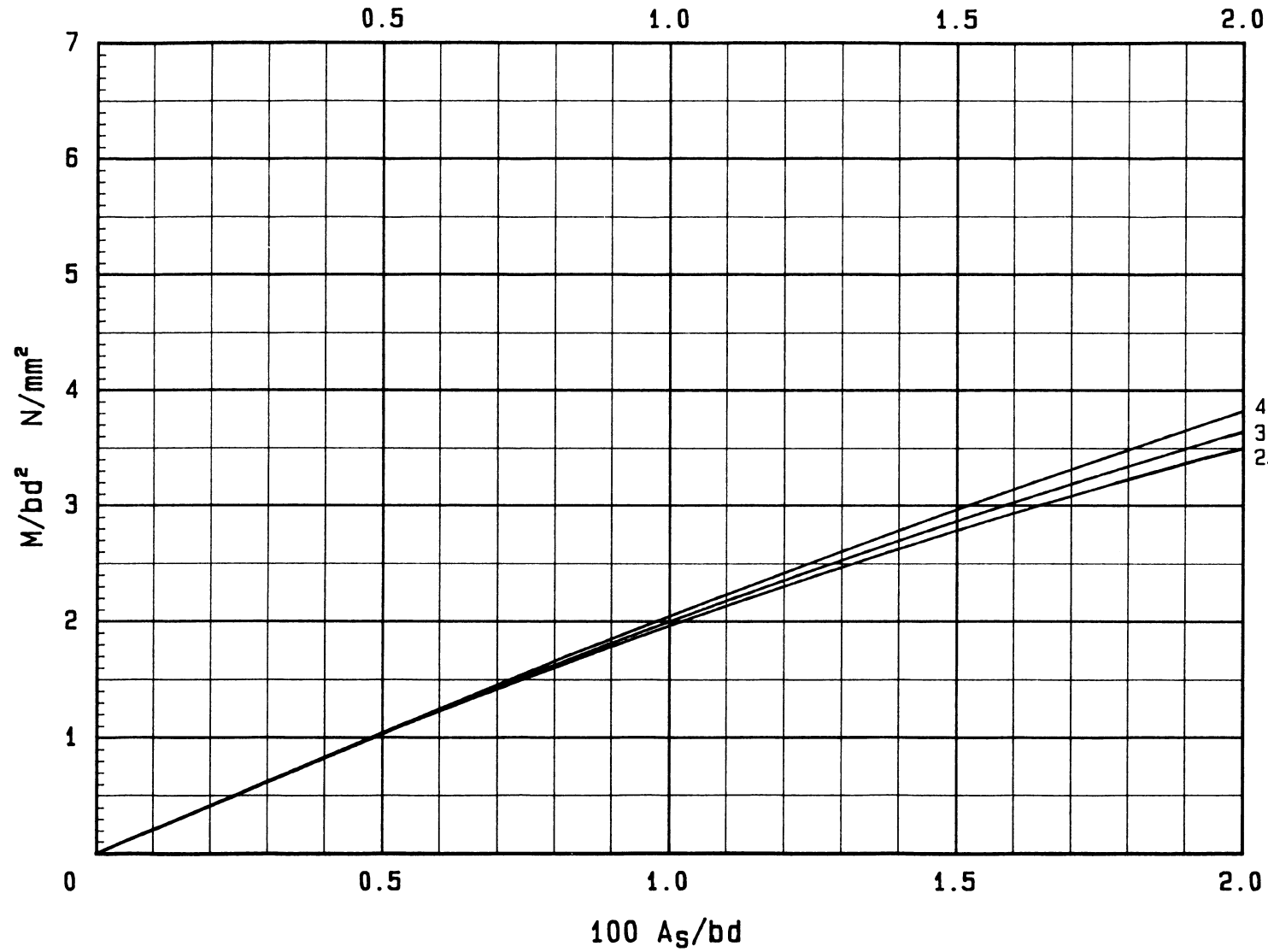
2 Design charts

Design charts Nos. 1 to 50 are given on the following pages.

f_{cu} N/mm²



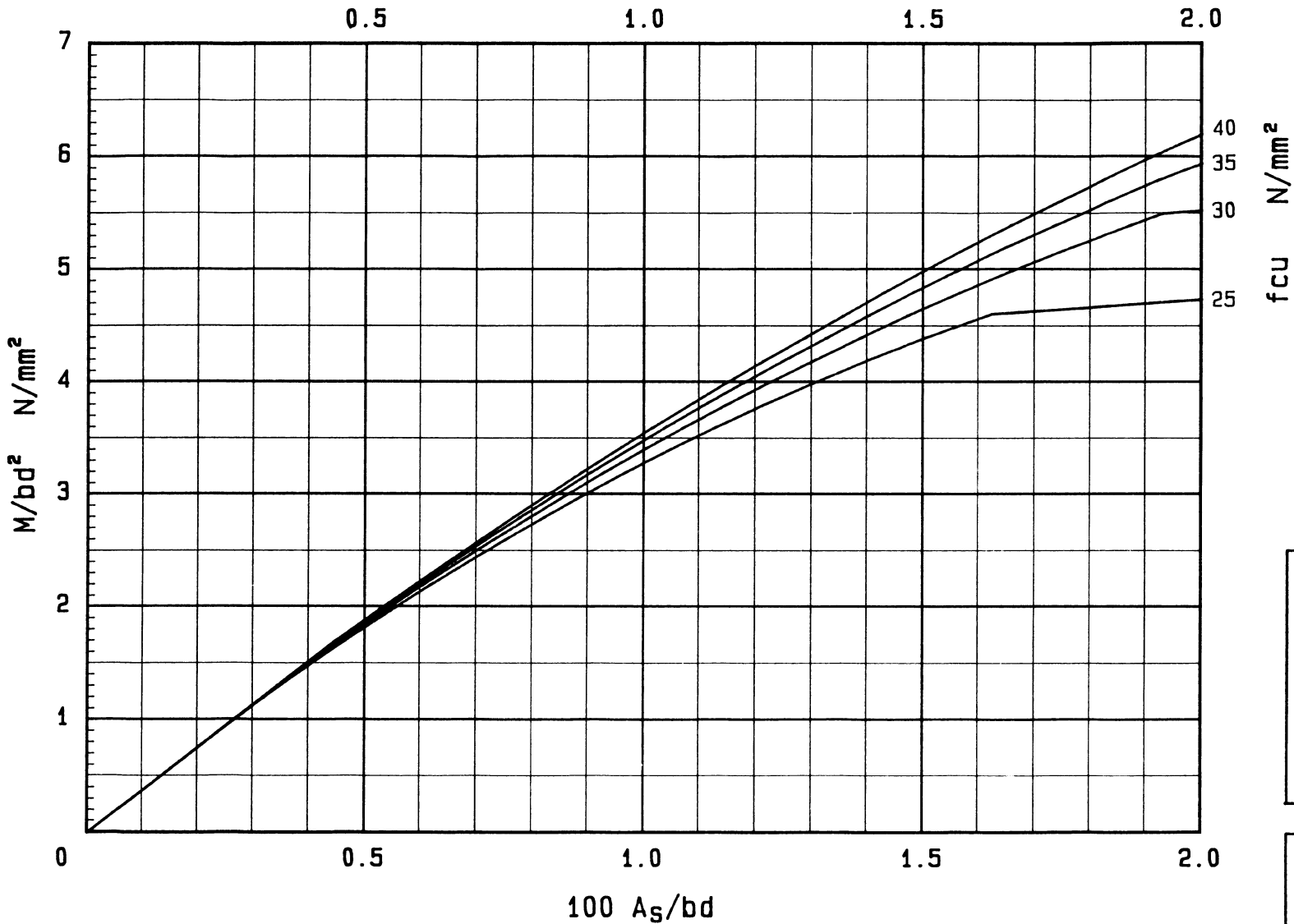
f_y 250



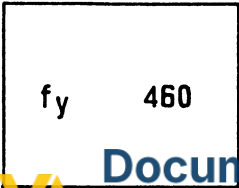
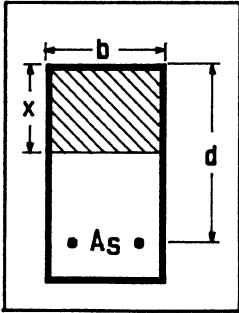
Singly reinforced beams

Chart No. 1

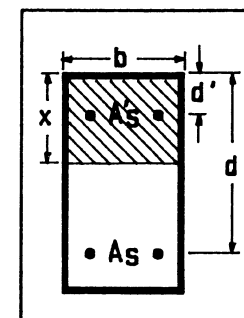
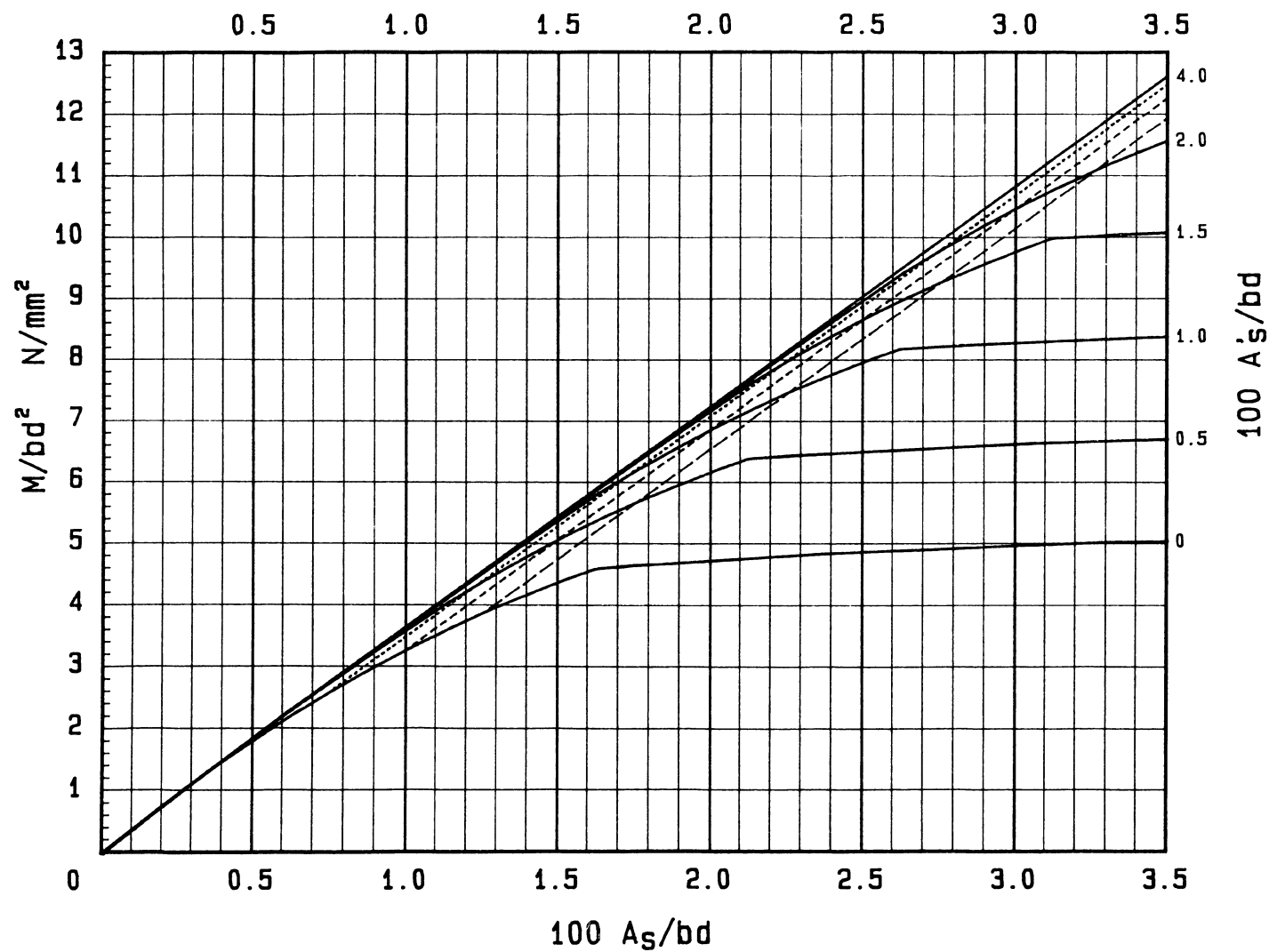
Chart No. 2



Singly reinforced beams



$x/d = 0.3$
 $x/d = 0.4$
 $x/d = 0.5$

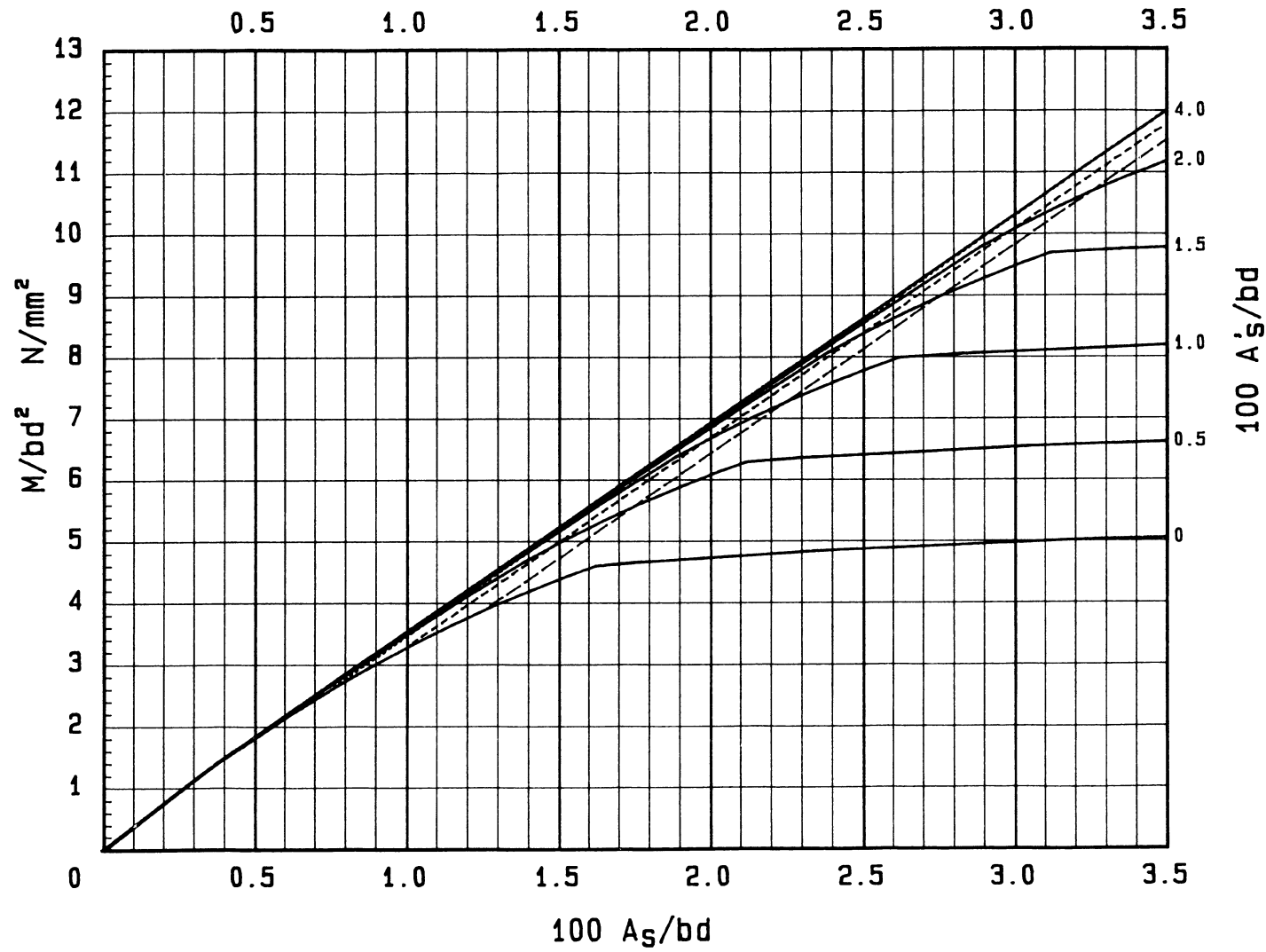


f_{cu}	25
f_y	460
d'/d	0.10

Doubly reinforced beams

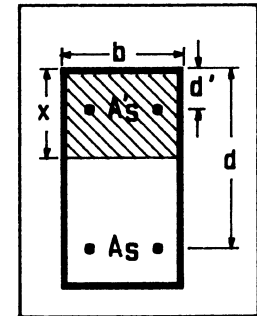
Chart No. 3

Chart No. 4



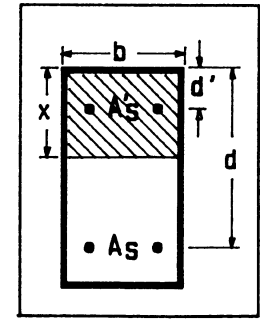
Doubly reinforced beams

$x/d = 0.3$
 $x/d = 0.4$
 $x/d = 0.5$

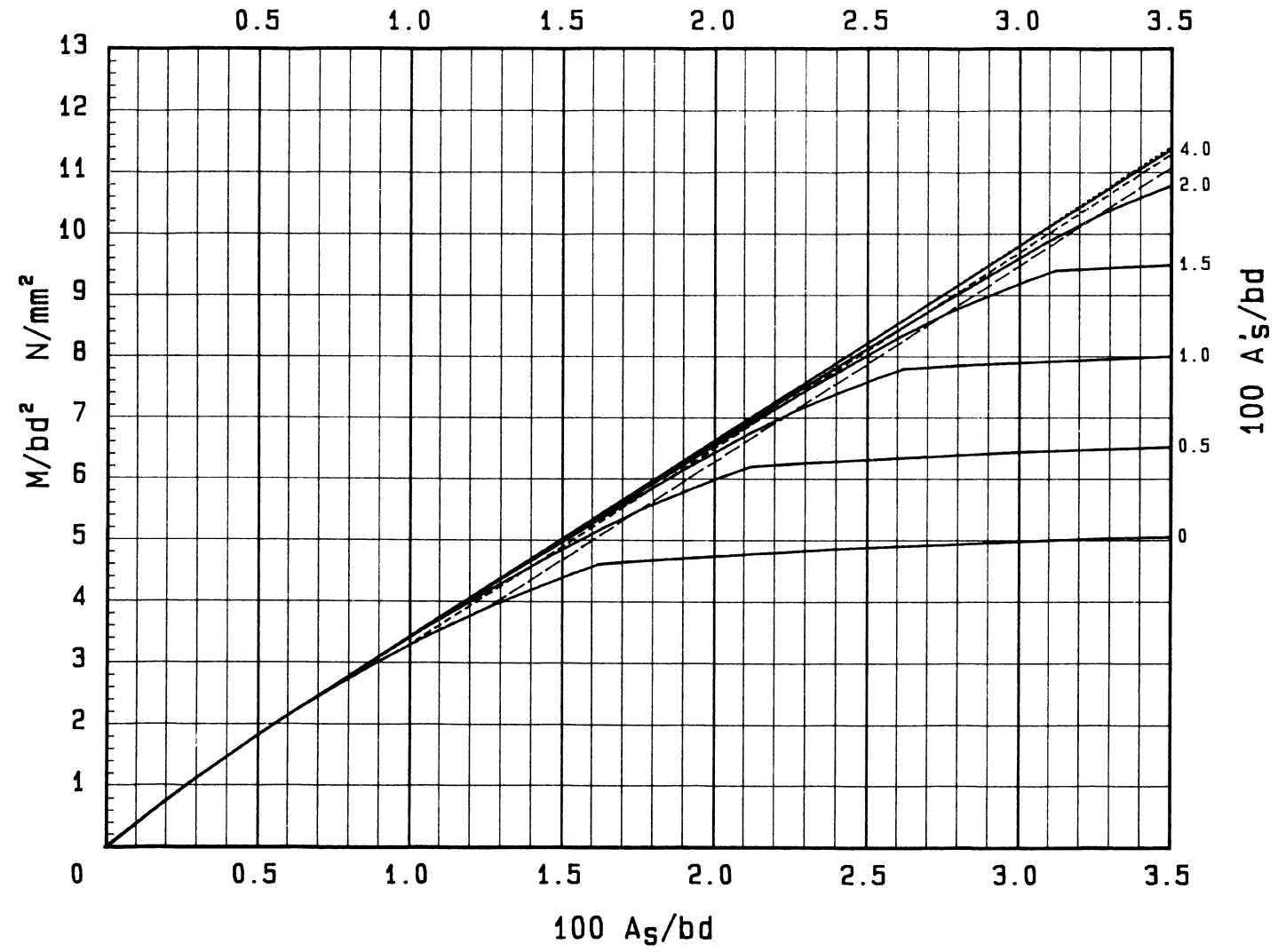


f_{cu}	25
f_y	460
d'/d	0.15

$x/d = 0.3$
 $x/d = 0.4$
 $x/d = 0.5$



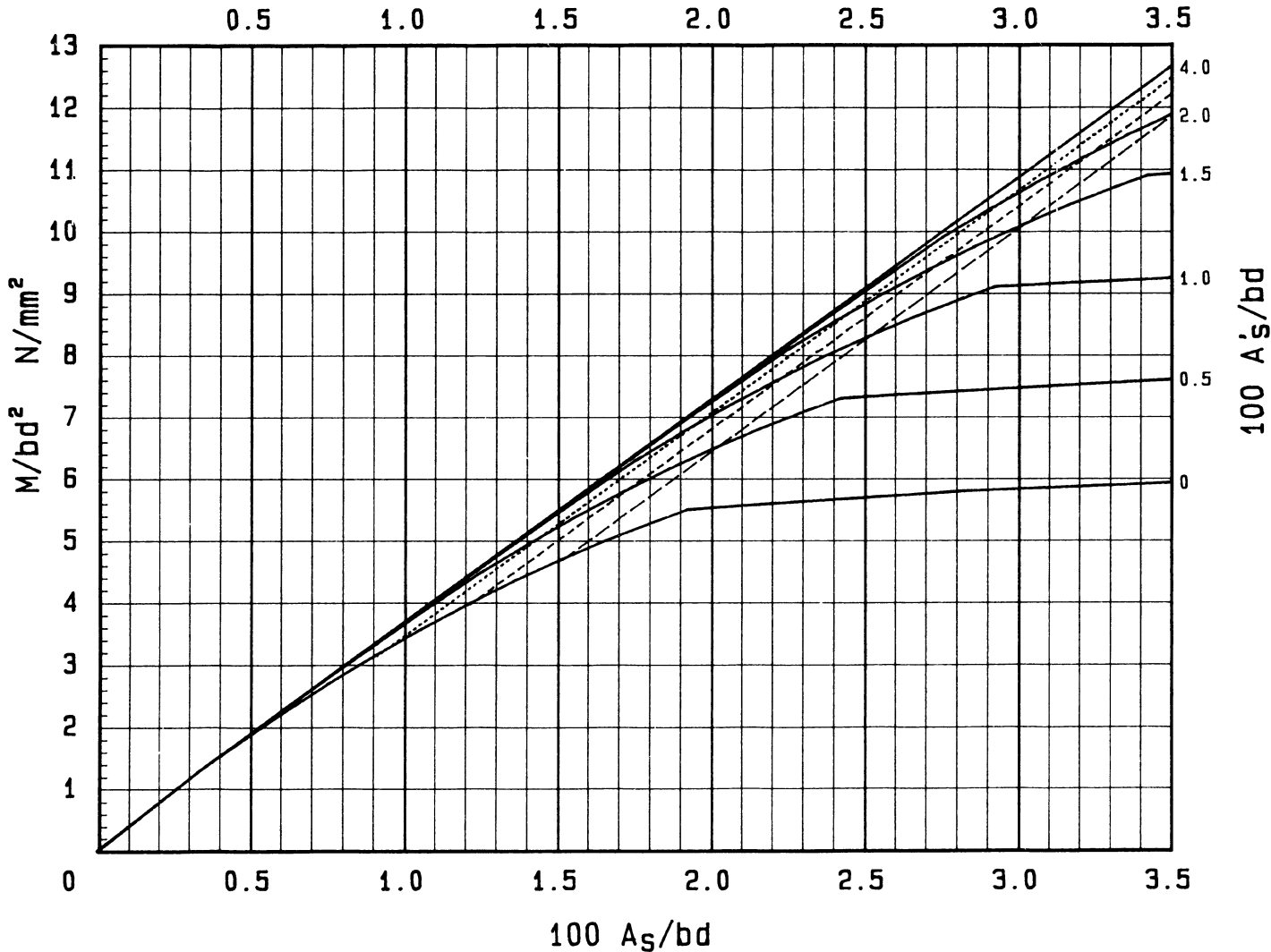
f_{cu}	25
f_y	460
d'/d	0.20



Doubly reinforced beams

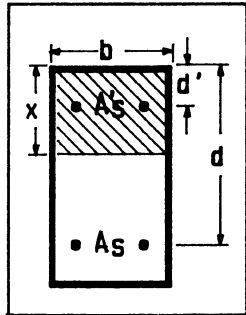
Chart No. 5

Chart No. 6



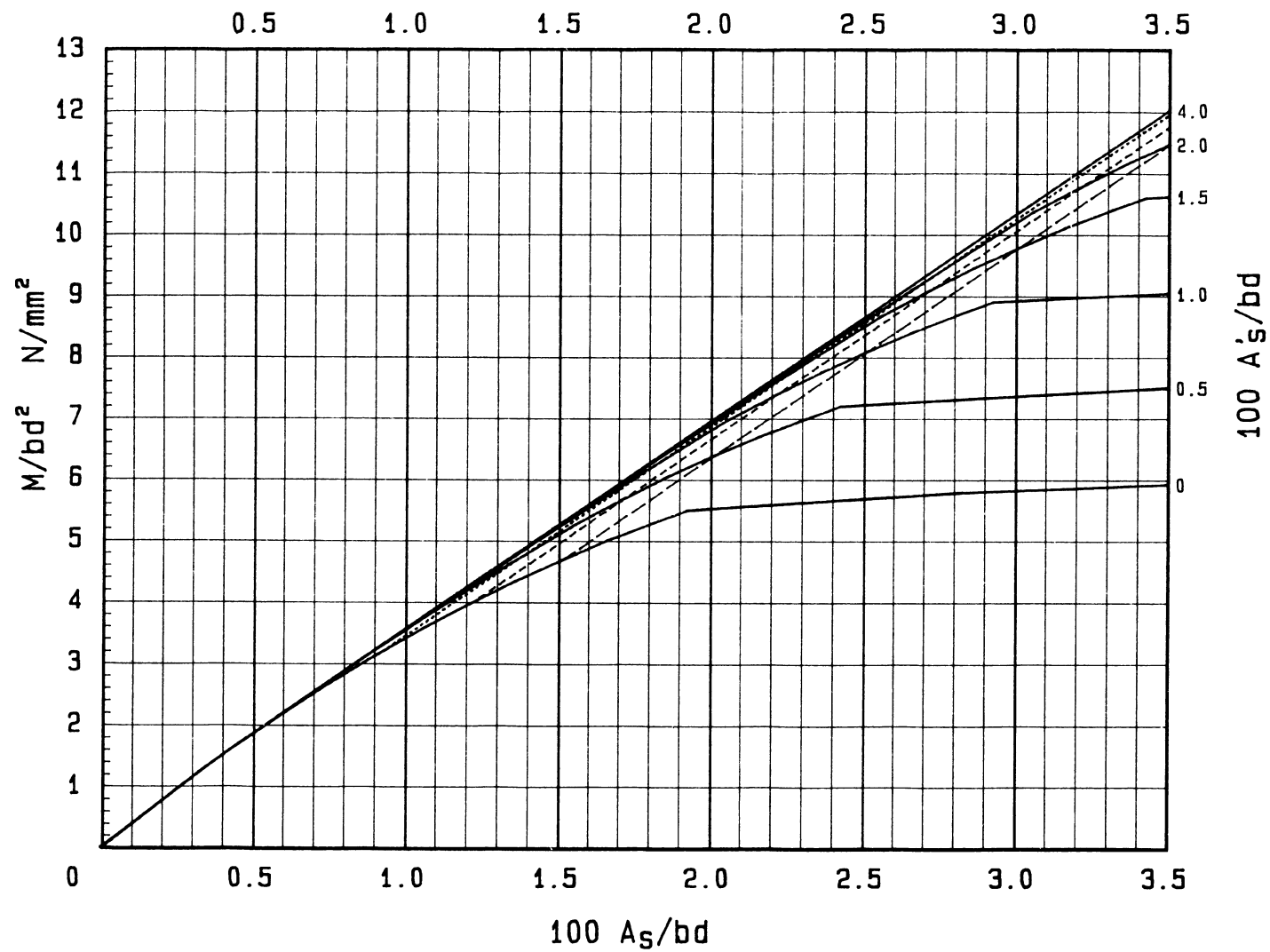
Doubly reinforced beams

$x/d = 0.3$
 $x/d = 0.4$
 $x/d = 0.5$



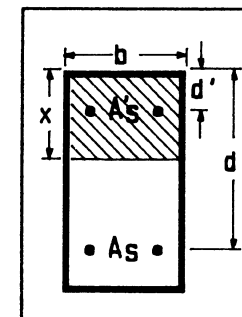
f_{cu}	30
f_y	460
d'/d	0.10

Chart No. 7



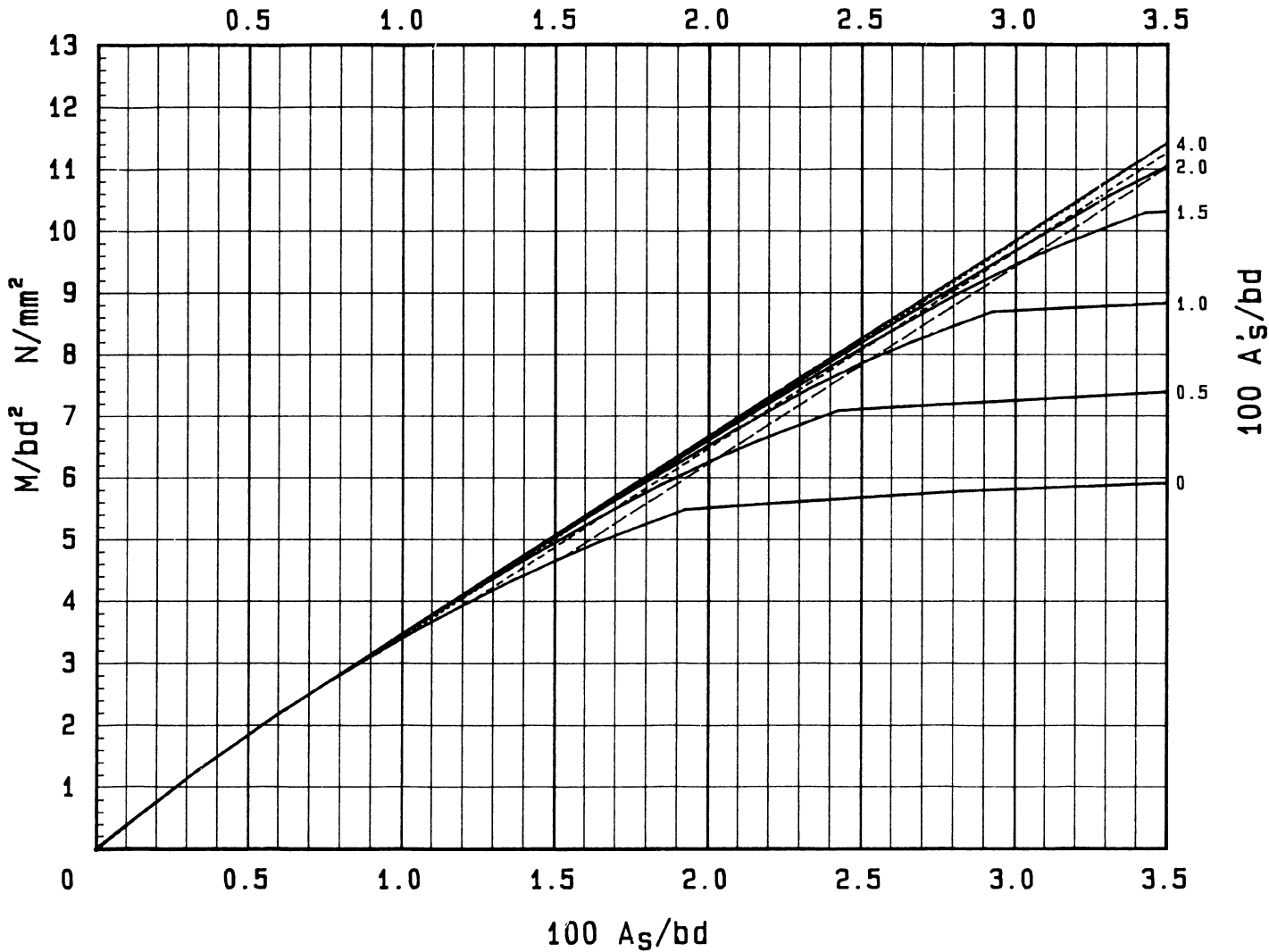
Doubly reinforced beams

$x/d = 0.3$
 $x/d = 0.4$
 $x/d = 0.5$



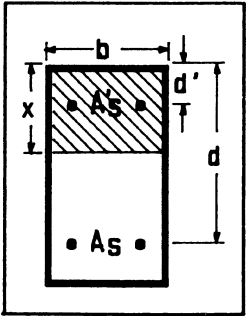
f_{cu}	30
f_y	460
d'/d	0.15

Chart No. 8



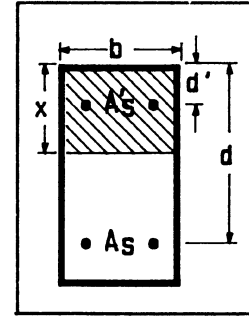
Doubly reinforced beams

$x/d = 0.3$
 $x/d = 0.4$
 $x/d = 0.5$

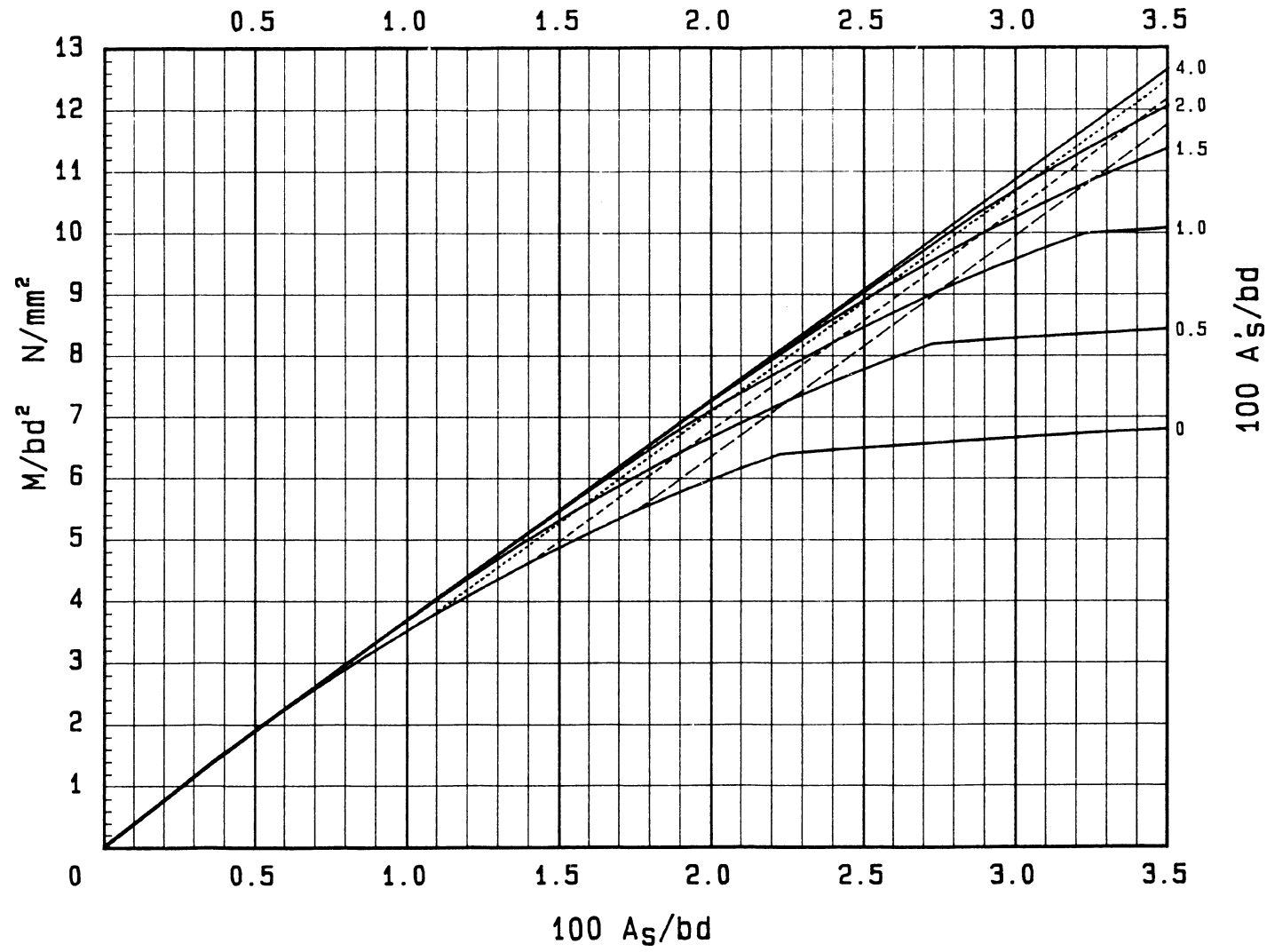


f_{cu}	30
f_y	460
d'/d	0.20

$x/d = 0.3$
 $x/d = 0.4$
 $x/d = 0.5$



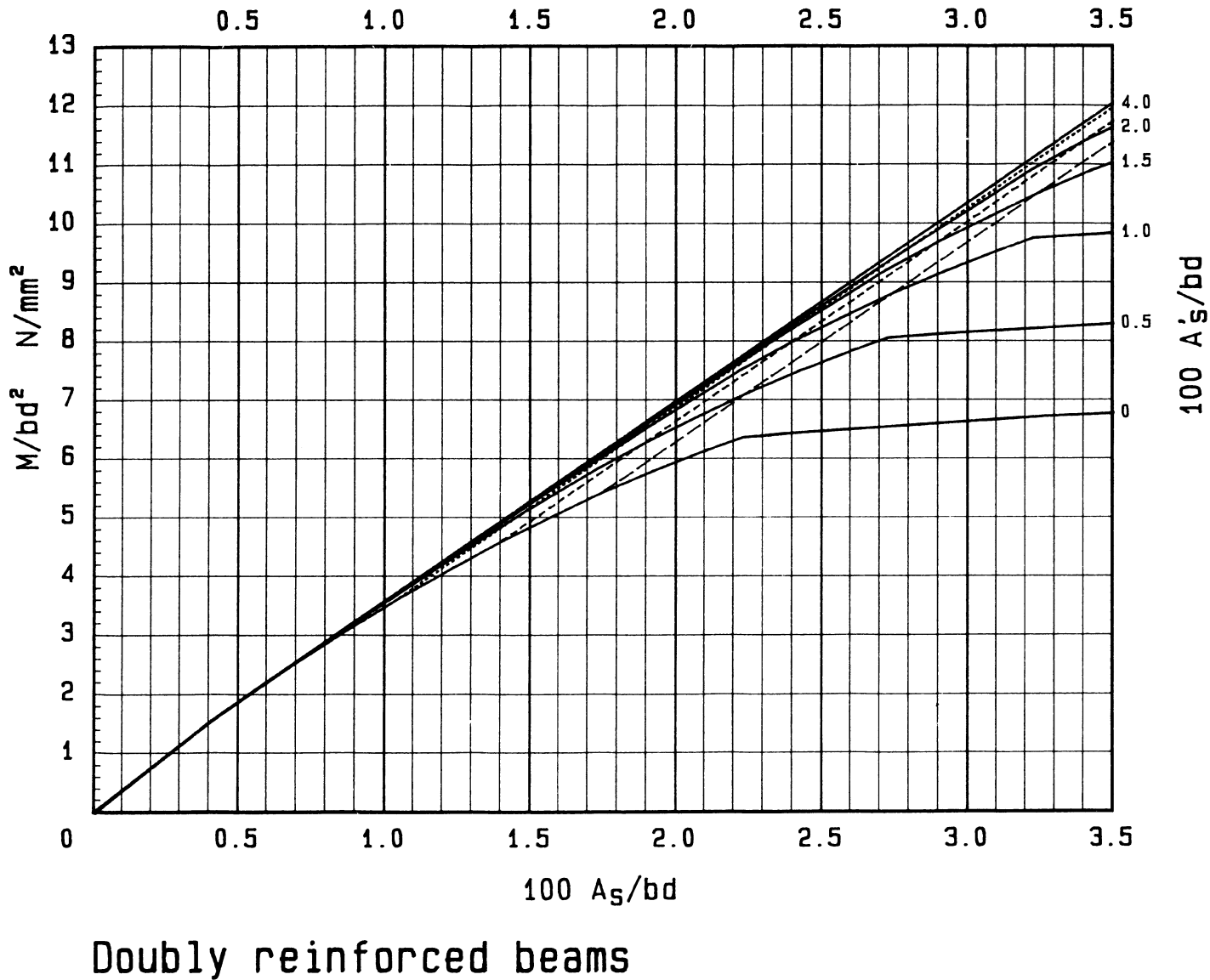
f_{cu}	35
f_y	460
d'/d	0.10



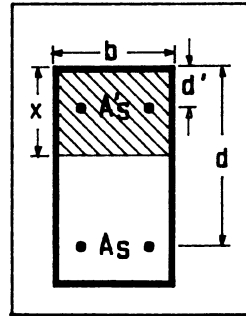
Doubly reinforced beams

Chart No. 9

Chart No. 10

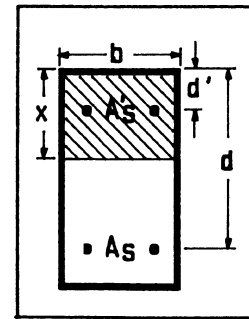


$x/d = 0.3$
 $x/d = 0.4$
 $x/d = 0.5$

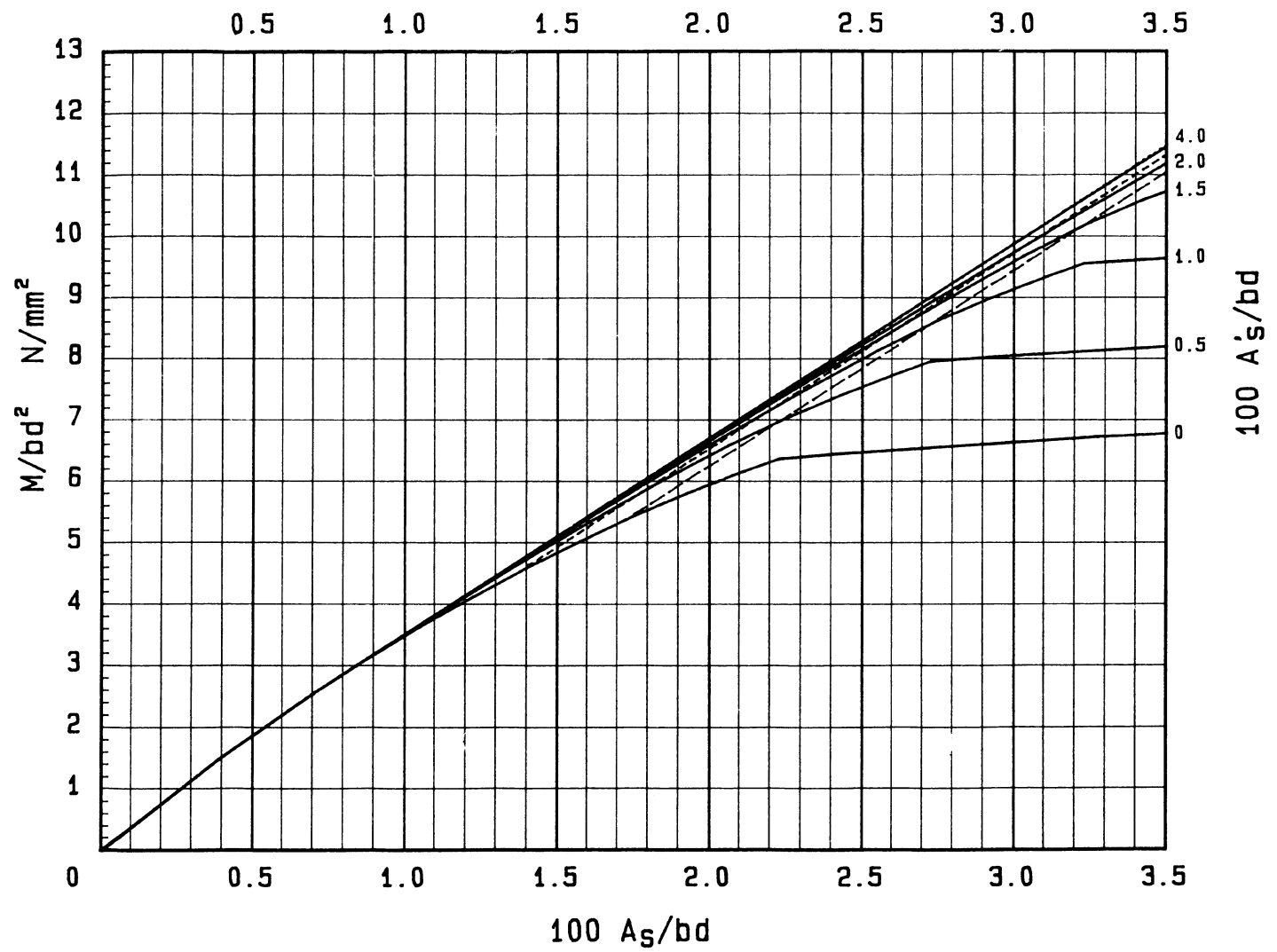


f_{cu}	35
f_y	460
d'/d	0.15

$x/d = 0.3$
 $x/d = 0.4$
 $x/d = 0.5$ ----



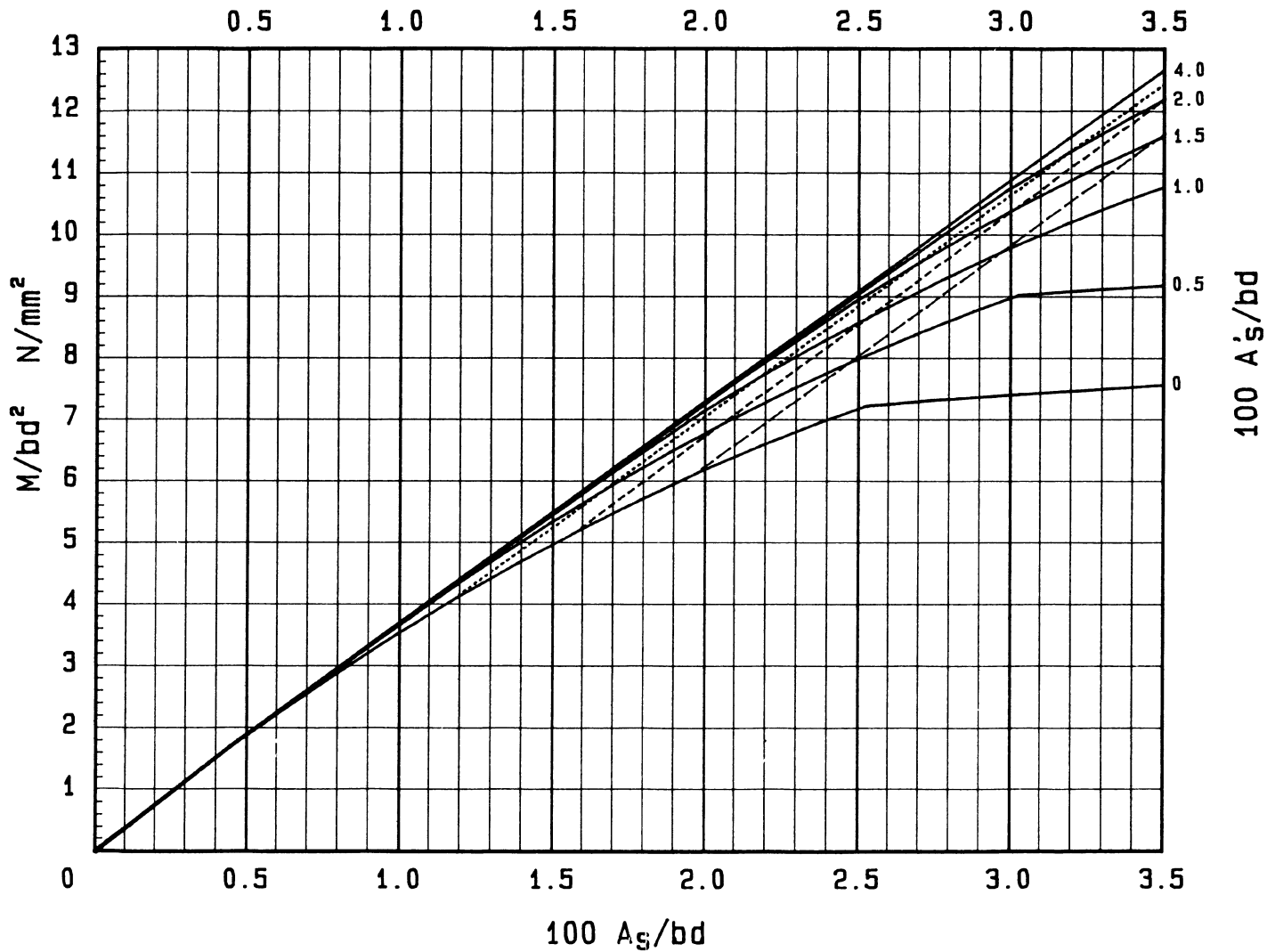
f_{cu}	35
f_y	460
d'/d	0.20



Doubly reinforced beams

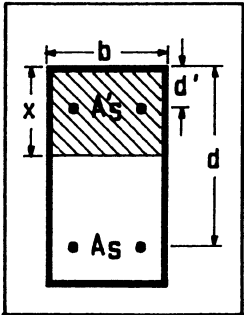
Chart No. 11

Chart No. 12



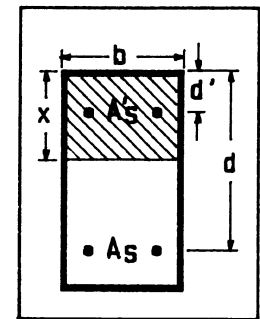
Doubly reinforced beams

$x/d = 0.3$
 $x/d = 0.4$
 $x/d = 0.5$

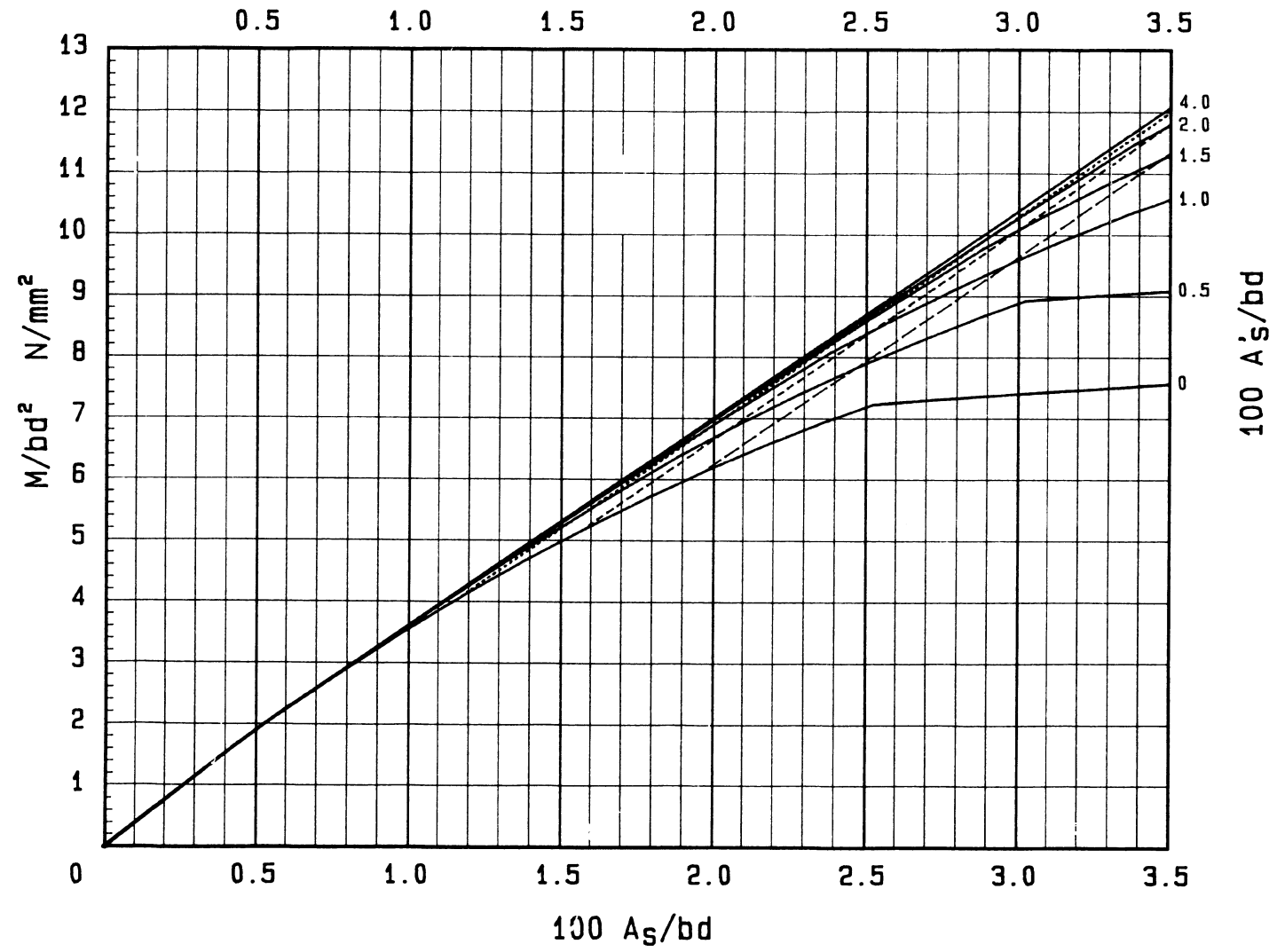


f_{cu}	40
f_y	460
d'/d	0.10

$x/d = 0.3$
 $x/d = 0.4$
 $x/d = 0.5$



f_{cu}	40
f_y	460
d'/d	0.15



Doubly reinforced beams

Chart No. 13