ISOLATED FOOTINGS AND DEEP WELLS

1

1.1 INTRODUCTION

In this manual, two cases for the isolated footings are studied :

* Footings made of reinforced concrete only and have no plain concrete bases.
* Footings made of reinforced concrete resting on plain concrete bases.

The following parameters are used in the calculations :

a) The column load at the ground surface (P) has the value between 25 and 450 tons. (250 KN and 4500 KN approximately).

b) The allowable gross soil pressure (p_s) has the values between 0.25 and 3.00 kgf/cm^2 . (25 KN/m^2 and 300 KN/m^2 approximately).

c) Gross working compressive stress on column, f_{gross} equals 50, 60 and 70 kgf/cm^2 . (5000, 6000 and 7000 KN/m^2 approximately).

d) Allowable working shear stress (q_s) in reinforced concrete footing equals to $f_{gross}/10$.

e) Allowable working punching stress (q_p) in reinforced concrete equals to 1.5 q_s , i.e. $q_p = f_{gross}/6.6$

f) The columns considered are those of rectangular sections with their small dimension (a_c) having the values of 25, 30, 35, 40, 50 and 60 cm.

g) For economical reasons the dimensions of the footings are calculated such that the cantilever arms of the footings are equal in all directions around the columns.

Knowing the column load, the allowable soil pressure, the type of concrete and the breadth of column section, then the curves give the length of the cross section of the column, the length, the breadth and the depth of the footings together with the cross-sectional area of the necessary reinforcement. The curves present also the quantity of concrete of the footings and the weight of steel reinforcement.

1.2 KEY FOR CURVES

The curves are numbered by three notations as shown below :

1.2.1 Roman letters

They represent the grade of the concrete used.

This means that I , II and III correspond respectively to a gross stress in the column (f_{gross}) equals to 50, 60 and 70 kg/cm^2 .

1.2.2 Numbers

The numbers from 1 to 6 correspond respectively to the chosen values of the column breadth which are equal to 0.25, 0.30, 0.35, 0.40, 0.50 and 0.60 m.

1.2.3 Letters

Each letter represents one of the seeked design parameters :

* Letters from (a) to (i) correspond to footings made of reinforced and plain concrete.

* Letters from (j) to (n) refer to reinforced concrete footings resting directly on the soil.

a) Plain concrete thickness .

b) Length and breadth of the plain concrete footing or reinforced concrete footing when resting directly on soil .

c) Dimensions of reinforced concrete .

d) Depth of reinforced concrete .

e) Bending moment/m' .

f) Area of reinforcement bars (cm^2/m') . (f_s = 1400 kg/cm^2)

g) Total weight of reinforcement bars in the footing .

h) Volume of plain concrete footing.

i) Volume of reinforced concrete footing.

j) Depth of reinforced concrete footing.

k) Bending moment/m' .

l) Area of reinforcement bars (cm^2/m') . (f_s = 1400 kg/cm^2)

m) Total weight of reinforced bars in the footing.

n) Volume of reinforced concrete footing.

The curves numbered I , II and III only, give the missing dimension of the column.

For example, Curve No. I-4-j gives the depth of the reinforced concrete for reinforced concrete footing resting directly on the soil supporting a column of breadth 0.40 m and subjected to f_{gross} equal to 50 Kg/cm^2 .

1.3) REINFORCED CONCRETE FOOTING RESTING DIRECTLY ON SOIL

Given in Figure (1.1)

a) Column load P in tons at ground surface.

b) Allowable gross soil pressure p_s in t/m^2.

c) Breadth of column cross-section a_c in meters.

d) Gross compressive stress on column f_{gross} in kg/cm^2.

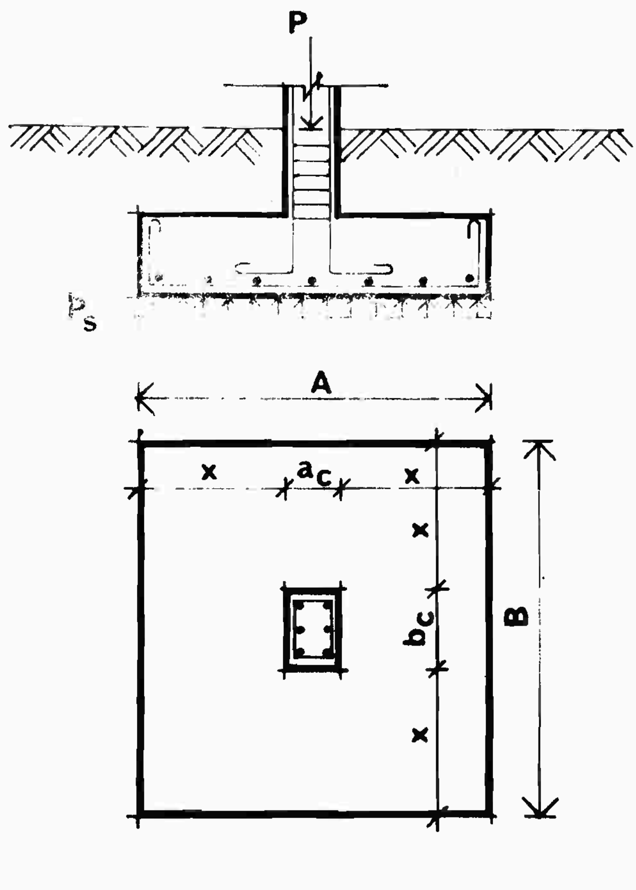


Fig. 1.1

1.3.1) Dimensioning of column

$b_c = P / (f_{gross} \times a_c)$ (1.1)

1.3.2) Dimensioning of footing

1.3.2.1) Area of footing (A x B)

Area $= (1.08\ P) / p_s$ (1.2)

Area $= A \times B$

$= (a_c + 2X) (b_c + 2X)$

$= (1.08\ P / p_s$

$= a_c\ b_c + 2X (a_c + b_c) + 4X^2$

$X = \{ -2 (a_c + b_c) + [4 (a_c + b_c)^2 - 16 (a_c\ b_c - 1.08\ P/p_s)]^{1/2} \}/8$ (1.3)

1.3.2.2) Depth of footing (d)

$d = \text{max. of} (d_m , d_s , d_p)$

where

d_m = depth needed to resist bending moment.

d_s = depth needed to resist shear.

d_p = depth needed to resist punching.

The net pressure on soil p_n is equal to :

$p_n = P / (A \times B) = p_s / 1.08$.

1.3.2.3) Bending moment in t.m/m'

$B.M./m' = 0.85\ p_n X^2/2 = 0.394\ p_s\ X^2$ (1.4)

$d_m = (k_1/100) (0.394\ p_s\ X^2 \times 1000)^{1/2}$ meters

$d_m = 0.198\ k_1 X (p_s)^{1/2}$ meters (1.5)

1.3.2.4) Shear

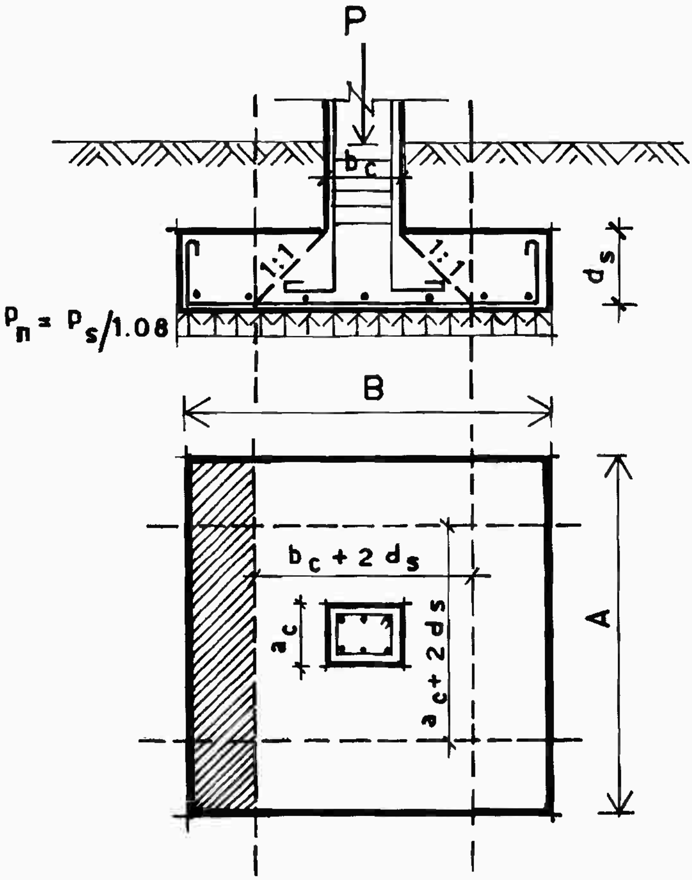


Fig. 1.2

$$Q_s = p_s\ /1.08\ [A\ (B - b_c - 2d_s)/2]$$

$$q_s = \frac{p_s\ /1.08\ [A\ (B - b_c - 2d_s)]}{2\ A\ d_s}$$

$$= \frac{0.463p_s\ (B - b_c - 2d_s)}{d_s}$$

From the above equation, we get :

$$q_s d_s = 0.463p_s\ (B - b_c) - 0.926\ p_s d_s$$

Hence the depth required to resist the shearing force can be obtained from the following expression :

$$d_s = \frac{0.463 p_s (B - b_c)}{q_s + 0.926\, p_s} \qquad (1.6)$$

1.3.2.5) Punching

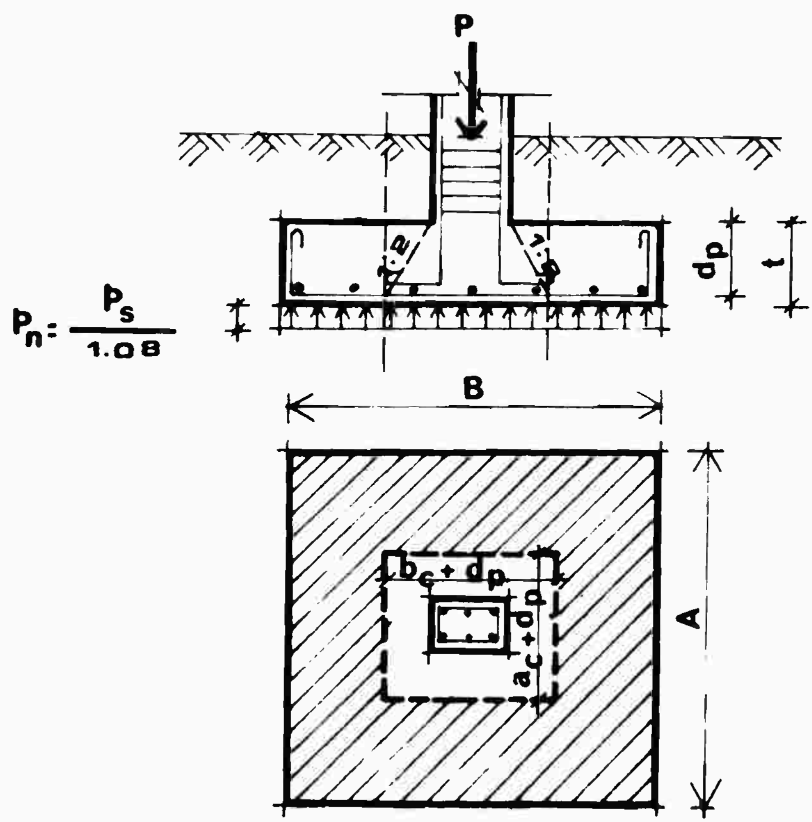


Fig. 1.3

$$Q_p = P - (p_s/1.08)(a_c + d_p)(b_c + d_p)$$

$$q_p = \frac{P - (p_s / 1.08)[a_c b_c + d_p (a_c + b_c) + d_p^2]}{2(a_c + b_c + 2 d_p) d_p}$$

From the above equation, we get :

$$(4q_p + p_s/1.08) d_p^2 + (2q_p + p_s / 1.08)(a_c + b_c) d_p + (p_s/1.08) a_c b_c - P = 0 .$$

Hence the depth required to resist the punching force can be obtained from the following expression :

$$d_p = 1/[2(4q_p + p_s/1.08)] \times \{-[(2q_p + p_s/1.08)(a_c + b_c)] + ([(2q_p + p_s/1.08)(a_c + b_c)]^2 - 4[4q_p + (p_s/1.08)][p_s/1.08(a_c b_c) - P]\}^{1/2}\} \qquad (1.7)$$

1.3.2.6) Reinforcement

$$A_s = M/(k_2 \times 100 d) \text{ cm}^2/\text{m}' \qquad (1.8)$$

where M is in Kg. cm/m'

$$W_s = 0.78 \ A_s [(A + 0.8 D) B + (B + 0.8 D) A] \qquad (1.9)$$

where

W_s = Total weight of steel in kilograms.

A , B & d = Breadth , length and depth of footing in meters.

D = Diameter of reinforcing bars in centimeters.

(It is calculated such that the distance between bars ranges between 10 cm and 20 cm) .

It must be noticed that the given weights of steel correspond exactly to the theoretical required area. In practice if the area of steel is increased, the given weights of steel must be proportionally majorated.

The curves (d) & (p) and (j) & (l) , give the exact needed reinforced concrete depths and reinforcement areas. If other footing's depths were chosen, the chart (A) can be used to evaluate the required corresponding reinforcement areas after determining the bending moments from the curves (e) & (k) .

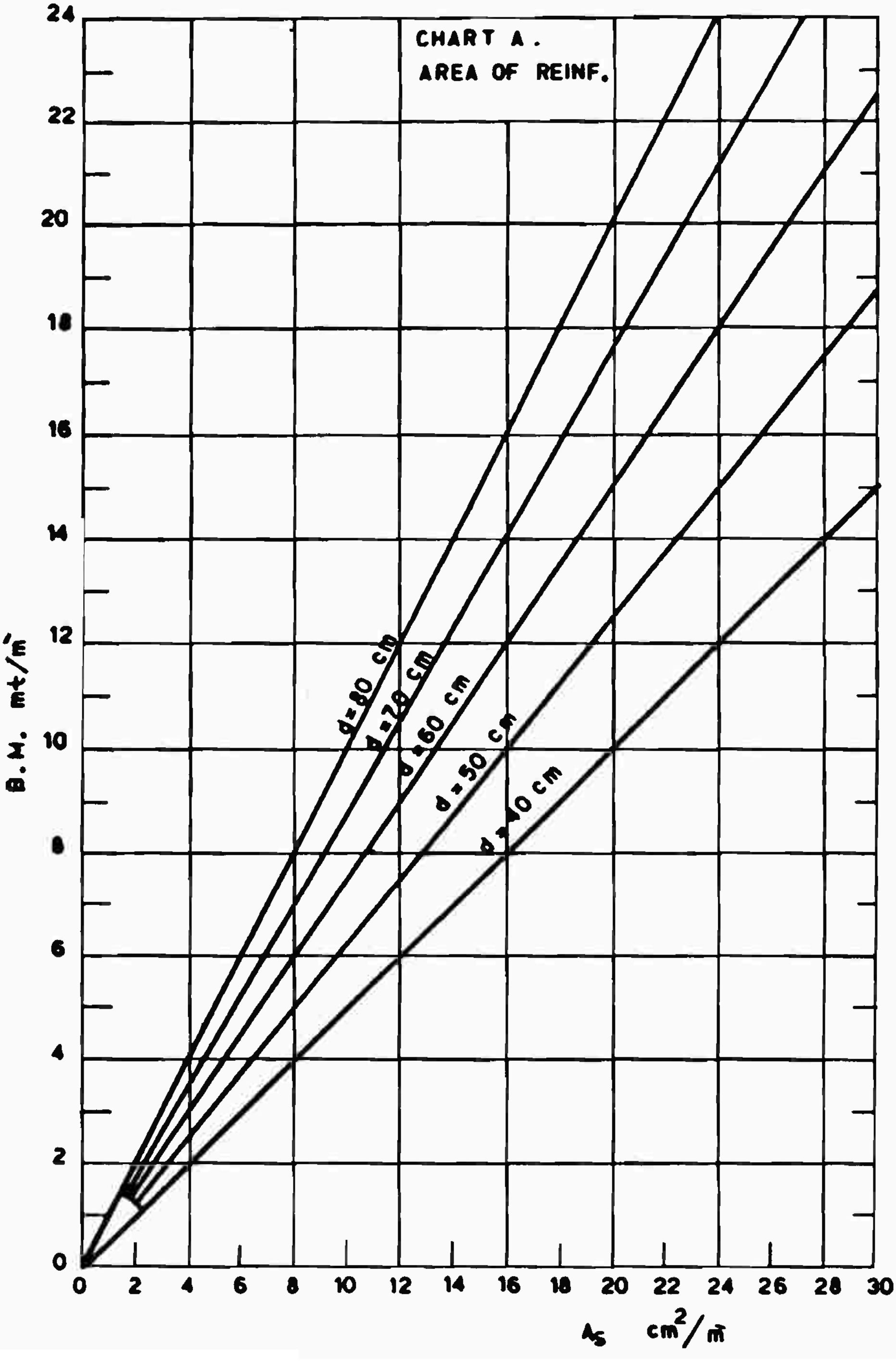


CHART A.
AREA OF REINF.
d=80 cm
d=70 cm
d=60 cm
d=50 cm
d=40 cm
B.M. mt/m'
As cm²/m'
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30

1.4) REINFORCED CONCRETE FOOTING RESTING ON PLAIN CONCRETE BASE

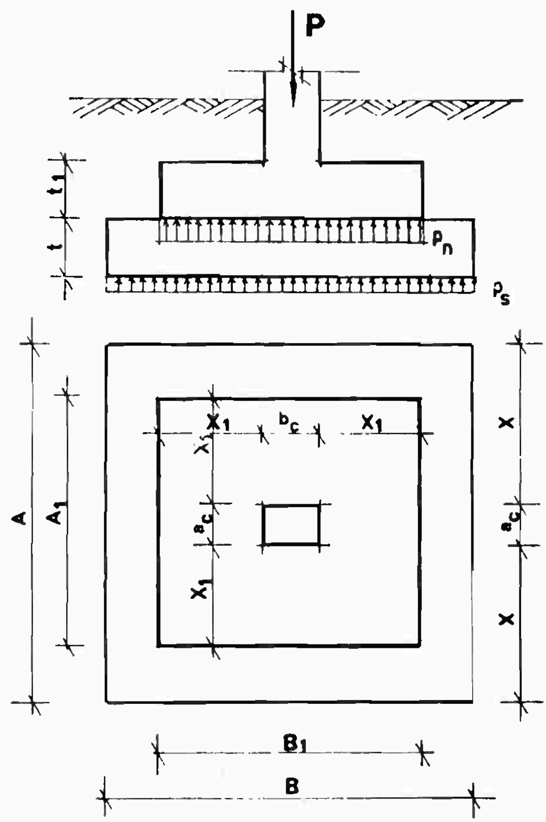


Fig. 1.4

The length of the cross-section of the column is to be calculated by formula (1.1)

1.4.1) Dimensioning of the plain concrete footing :

The distance (X) calculated by formula (1.3) and hence we will have

$$A = a_c + 2X$$

$$B = b_c + 2X$$

For soil pressure up to 2.00 kg/cm^2, it was found that the best thickness of plain concrete footing is calculated as a function of the column load from the expression :

$$t = (P / 300) + 0.2 \qquad (1.10)$$

where t in meters and P in tons

For soil pressures of 2.5 and 3.0 kg/cm^2 the proposed thickness of the plain concrete footing is obtained from the expression :

$$t = (X - X_1) \qquad (1.10a)$$

With X_1 having the minimum practical value of 0.25 m. The cantilever arm of the plain concrete ($X - X_1$) will be taken equal to the maximun distance producing bending tensile stresses in the plain concrete not exceeding 40 t/m^2 , and hence :

$$X' = t\,(40 / 3p_s)^{1/2} \quad (\text{where } X' = X - X_1) \qquad (1.11)$$

The ratio X'/t for different values of (p_s) is given in table (1.1) below :

p_s (t/m^2)	2.5	5	10	15	20	30
X'/t	2.3	1.6	1.15	0.94	0.82	0.67

Table (1.1)

For simplicity, the cantilever arm of the plain concrete (X') may be taken here equal to (t) .

The cantilever arm (X_1) of the reinforced concrete footing is taken equal to :

$$X_1 = (X - t) \geq 0.25 \qquad (1.12)$$

The calculations of (M) , (d_m) , (d_s) , (d_p) , (A_s) and (W_s) are calculated using the same formulea 1.4 , 1.5 , 1.6 , 1.7 , 1.8 and 1.9 after making the substitution :

$$p_s = [\,P / (A_1 B_1) \times 1.08\,] \; (t / m^2) \qquad (1.13)$$

Although the check of punching has been taken into consideration in the proposed design curves we think that punching is unlikely to occur in reinforced concrete footings resting on plain concrete bases, but further laboratory and field investigations are required to clarify this subject in the future.

1.5) General remarks

In this manual, the local maximum bond stress check, as carried out by conventional calculations is neglected ; the average bond stresses in footings being always safe. Due to this, the depth of reinforced concrete footing is relatively small, the volume of reinforced concrete is relatively small and hence the ratio, (weight of steel/volume of concrete) is relatively high. Nevertheless, the absolute weight of steel reinforcement is less than that calculated for a safe maximum bond stress of about 10 kg/cm^2 as will be seen in solved examples.

The reason for this is that the exact actual mechanical behaviour of steel bars in the footings is still not clear. The steel reinforcement in footings is subjected not only to bending tensile stresses but also to normal circumferential stresses spreading downward from the column itself. Many foundation engineers believe that the ckeck of failure due to local bond at the section of maximum bending, as carried out by the conventional calculation given in some codes of parctice, is very far from reality. We believe that these calculations lead to exaggerated depth of footing or exaggerated amount of reinforcements without true need for it. Model tests carried out in the Faculty of Engineering Cairo University confirmed this idea. They showed that allowable bond stresses of at least three times as high as those found in the present Egyptian Code of Practice would still provide sufficient safety against bond failure. However, the average bond stress should not exceed the allowable working code values which can be obtained, as proposed in our procedure, by extending the reinforcing bars vertically at the edge of the footings by a distance equal to forty times the bars' diameter.

The example given below shows the economy in concrete and reinforcement which can be realised when the check of local bond is disregarded.

Example :

Compare between proposed procedure and classical calculations in design of footings for the following allowable stresses on soil :

a) $p_s = 0.5 \ kg/cm^2$

b) $p_s = 1.5 \ kg/cm^2$

c) $p_s = 3.0 \ kg/cm^2$

Given a column load of 120 t and dimensions of column :

$a_c = 0.25 \quad b_c = 0.80$ m ($f_{gross} = 60 \ kg/cm^2$) .

In the following table, column (1) gives the values obtained from our proposed design curves.

Columns (2) and (3) show classical values which give a bond stress in the footings in the range of 10 kg/cm^2 ; bond stress is reduced by increasing the reinforcement as shown in col. (2) or increasing the depth of footing as shown in col. (3) .

It can be noticed that for very low allowable stresses on the soil the design is very close to conventional figures, in the other cases bond is governing .

Case (1) :

p_s = 0.5 kg/cm^2 , P = 120 t

	col. 1	col. 2	col. 3
t (m)	0.6	0.6	0.6
A (m)	4.8	4.8	4.8
B (m)	5.35	5.35	5.35
A_1 (m)	3.6	3.6	3.6
B_1 (m)	4.15	4.15	4.15
d (m)	0.4	0.4	0.4
B. M. (tm/m')	9.57	9.57	9.57
A_s (cm^2/m')	6ϕ22	6ϕ22	6ϕ22
V (P. C.) (m^3)	15.4	15.4	15.4
V (R. C.) (m^3)	6.72	6.72	6.72
W_s (kg)	770	770	770
q_b (kg/cm^2)	9.32	9.32	9.32

where q_b is the bond stress

Case (2) :

p_s = 1.5 kg/cm^2 , P = 120 t

	col. 1	col. 2	col. 3
t (m)	0.6	0.6	0.6
A (m)	2.7	2.7	2.7
B (m)	3.25	3.25	3.25
A_1 (m)	1.5	1.5	1.5
B_1 (m)	2.05	2.05	2.05
d (m)	0.35	0.35	0.75
B. M. (tm/m')	6.5	6.5	6.5
A_s (cm^2/m')	6ϕ19	10ϕ22	6ϕ19
V (P. C.) (m^3)	5.26	5.26	5.26
V (R. C.) (m^3)	1.08	1.08	**2.31**
W_s (kg)	150	**365**	150
q_b (kg/cm^2)	22.35	10.2	10.44

where q_b is the bond stress

Case (3) :

p_s = 3.0 kg/cm^2 , P = 120t

	col. 1	col. 2	col. 3
t (m)	0.55	0.55	0.55
A (m)	1.8	1.8	1.8
B (m)	2.35	2.35	2.35
A_1 (m)	0.75	0.75	0.75
B_1 (m)	1.3	1.3	1.3
d (m)	0.25	0.25	1
B. M. (tm/m')	2.6	2.6	2.6
A_s (cm^2/m')	7φ16	11φ38	7φ16
V (P. C.) (m^3)	2.33	2.33	2.33
V (R. C.) (m^3)	0.24	0.24	**0.96**
W_s (kg)	50	**790**	50
q_b (kg/cm^2)	40.2	10.8	10.1

1.6) APPROXIMATE DESIGN AND CHECK OF STRESSES

For an approximate and rapid dimensioning or check of stresses of footing the two charts given in Figures No. : (1.7) and No: (1.8) may be used. In the following, different necessary mathematical derivations are presented.

1.6.1) Plain Concrete Dimensions

The distance (X) is calculated by Formula (1.3) after carrying out some simplifications, and hence the plain concrete dimensions can be obtained from the following simple expressions :

$$A = a_c + 2X$$

$$B = b_c + 2X$$

Equation (1.3) can be simplified as follows :

$$X = \frac{-2\,(a_c + b_c) + [\,4\,(a_c + b_c)^2 - 16\,(a_c\,b_c - 1.08\,P/p_s)\,]^{1/2}}{8}$$

The term [$a_c\,b_c$] can be neglected, compared with the other terms in the equation and hence we have :

$$X = \frac{-2\,(a_c + b_c) + [\,4\,(a_c + b_c)^2 + 16\,(1.08\,P/ps)\,]^{1/2}}{8}$$

This expression, once more, can be simplified (within practical values) to have the following form :

$$X = 0.27\,[\,2\,(P/p_s)^{1/2} - (a_c + b_c)\,] \qquad (1.13)$$

1.6.2) Reinforced Concrete Dimensions

Depending on the plain concrete thickness the cantilever arm of the reinforced concrete is obtained from the following expression :

$$X_1 = X - t \qquad (1.14)$$

and hence the reinforced concrete footing will have the following dimensions :

$A_1 = a_c + 2X_1$

$B_1 = b_c + 2X_1$

The bending moment per meter run in the footing is calculated from the following equation :

$$M = 0.85\ p_n \frac{X_1^2}{2} \qquad (1.15)$$

where p_n is the net pressure under the reinforced concrete and is calculated as follows :

$$p_n = \frac{P}{(2X_1)^2}\left[\frac{1}{\left(\frac{a_c}{2X_1}+1\right)\left(\frac{b_c}{2X_1}+1\right)}\right] \qquad (1.16)$$

In practice [$2X_1$] is usually big compared to the column dimensions and hence one can notice that the pressure [p_n] is inversely proportional to [X_1^2] and consequently from [1.15] & [1.16] the bending moment in footing is practically independent from the plain concrete thickness.

As mentioned before in (1.3.2.2) the depth of the reinforced concrete footing is calculated as follows :

$d = \text{Max. of}\ (d_m, d_s, d_p)$

From numerical calculations covering wide ranges of practical values of loads, gross stresses in columns and column dimensions, it was noticed that [d] ranges between 1.35 to 1.5 times the value of the required depth to resist the bending moment (d_m) . Hence the depth of the reinforced concrete footing can be calculated as follows :

$$d = 1.5\ k_1 \left(M \times \frac{10^5}{100}\right)^{1/2} \qquad (1.17)$$

[M in (mt) and d in (cm)]

If k_1 is approximated to 0.3 , equation (1.17) will take the following form :

$$d = 14 (M)^{1/2} \qquad (1.18)$$

It is noticed here that the increase in the needed depth (for some cases) when the previous equation is used will lead to corresponding reduction in the required steel reinforcement .

The area of steel reinforcement per meter run is calculated as follows :

$$A_s = \frac{M \times 10^5}{k_2 \times 14 (M)^{1/2}}$$

which for k_2 equals 1250 can be reduced to :

$$A_s = 5.7 (M)^{1/2} \qquad (1.19)$$

[M is in (m.t) and A_s in cm^2 / m']

A comparison between the exact and the approximate solution is presented in table (1.2) below from which it can be noticed that, in general, for small loads and medium to low bearing capacity, the approximate solution leads to footing dimensions almost identical to the exact solution, with a slight increase in reinforced concrete depth and reinforcement. For high loads and high bearing capacity, the approximate solution underestimates the required footing area by ≅ 10% and over estimates the reinforced concrete depths and reinforcement.

P = 40 t	p_s = 2.5 t/m^2		f_{gross} = 50 kg/cm^2	a_c = 25 cm
	A (m)	B (m)	d (cm)	A_s (cm^2/m)
Approx.	4.15	4.22	27	11.6
Exact	4.15	4.22	26.5	11
P = 80 t	p_s = 2.5 t/m^2		f_{gross} = 50 kg/cm^2	a_c = 25 cm
	A (m)	B (m)	d (cm)	A_s (cm^2/m)
Approx.	5.79	6.18	38.5	16.2
Exact	5.71	6.1	36.5	15.9
P = 80 t	p_s = 30. t/m^2		f_{gross} = 50 kg/cm^2	a_c = 25 cm
	A (m)	B (m)	d (cm)	A_s (cm^2/m)
Approx.	1.55	1.94	25.5	11.
Exact	1.51	1.9	21.5	9.4
P = 160 t	p_s = 15. t/m^2		f_{gross} = 60 kg/cm^2	a_c = 35 cm
	A (m)	B (m)	d (cm)	A_s (cm^2/m)
Approx.	3.15	3.6	45.5	19.2
Exact	3.2	3.6	37.	19.5
P = 280 t	p_s = 5.0 t/m^2		f_{gross} = 70 kg/cm^2	a_c = 40 cm
	A (m)	B (m)	d (cm)	A_s (cm^2/m)
Approx.	7.28	7.88	67.5	27.8
Exact	7.5	8.1	56.4	22.8
P = 280 t	p_s = 30. t/m^2		f_{gross} = 80 kg/cm^2	a_c = 40 cm
	A (m)	B (m)	d (cm)	A_s (cm^2/m)
Approx.	2.7	3.3	51.	21.2
Exact	2.9	3.5	26.6	17.8

Table (1.2) Comparison between approx. & exact solutions.

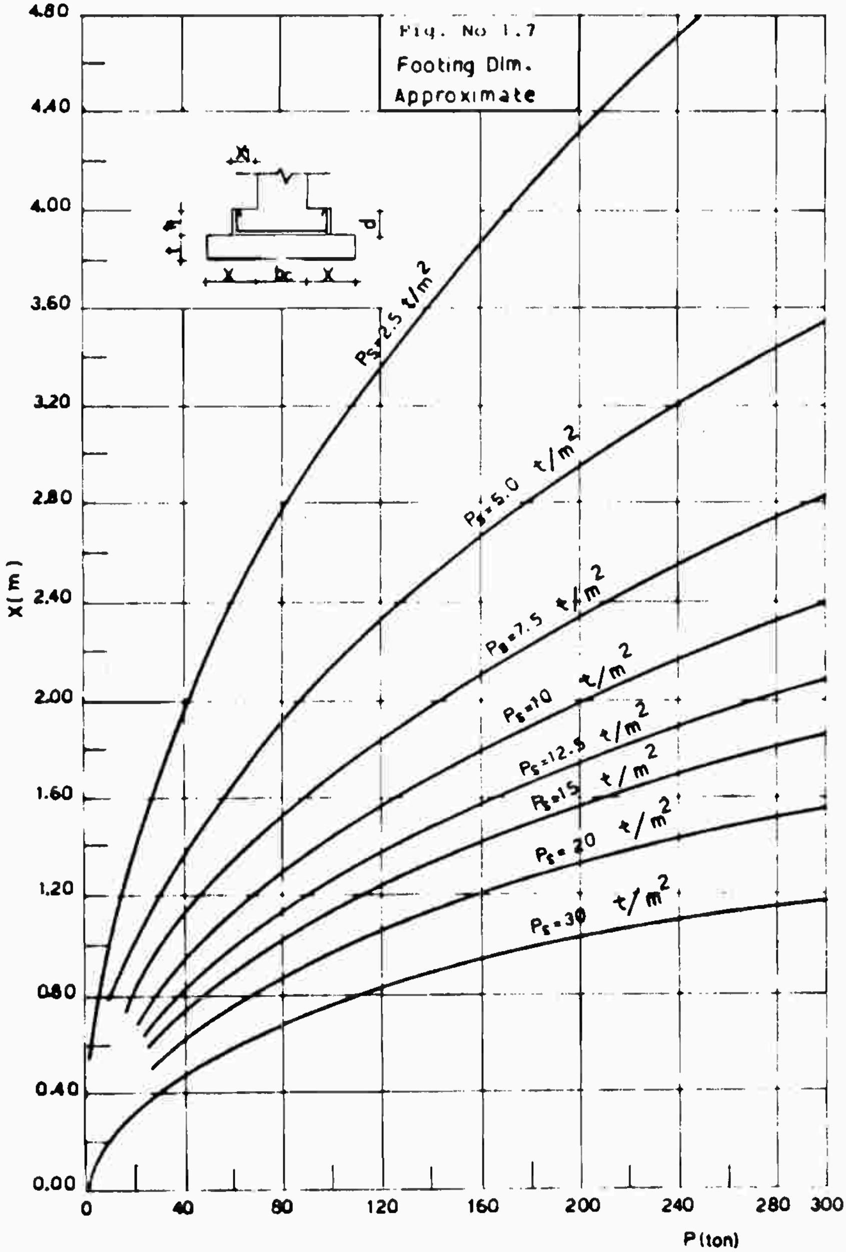


Fig. No 1.7
Footing Dim.
Approximate
X
d
bc
X
X
P_s=2.5 t/m²
P_s=5.0 t/m²
P_s=7.5 t/m²
P_s=10 t/m²
P_s=12.5 t/m²
P_s=15 t/m²
P_s=20 t/m²
P_s=30 t/m²
X(m)
4.80
4.40
4.00
3.60
3.20
2.80
2.40
2.00
1.60
1.20
0.80
0.40
0.00
0
40
80
120
160
200
240
280
300
P (ton)

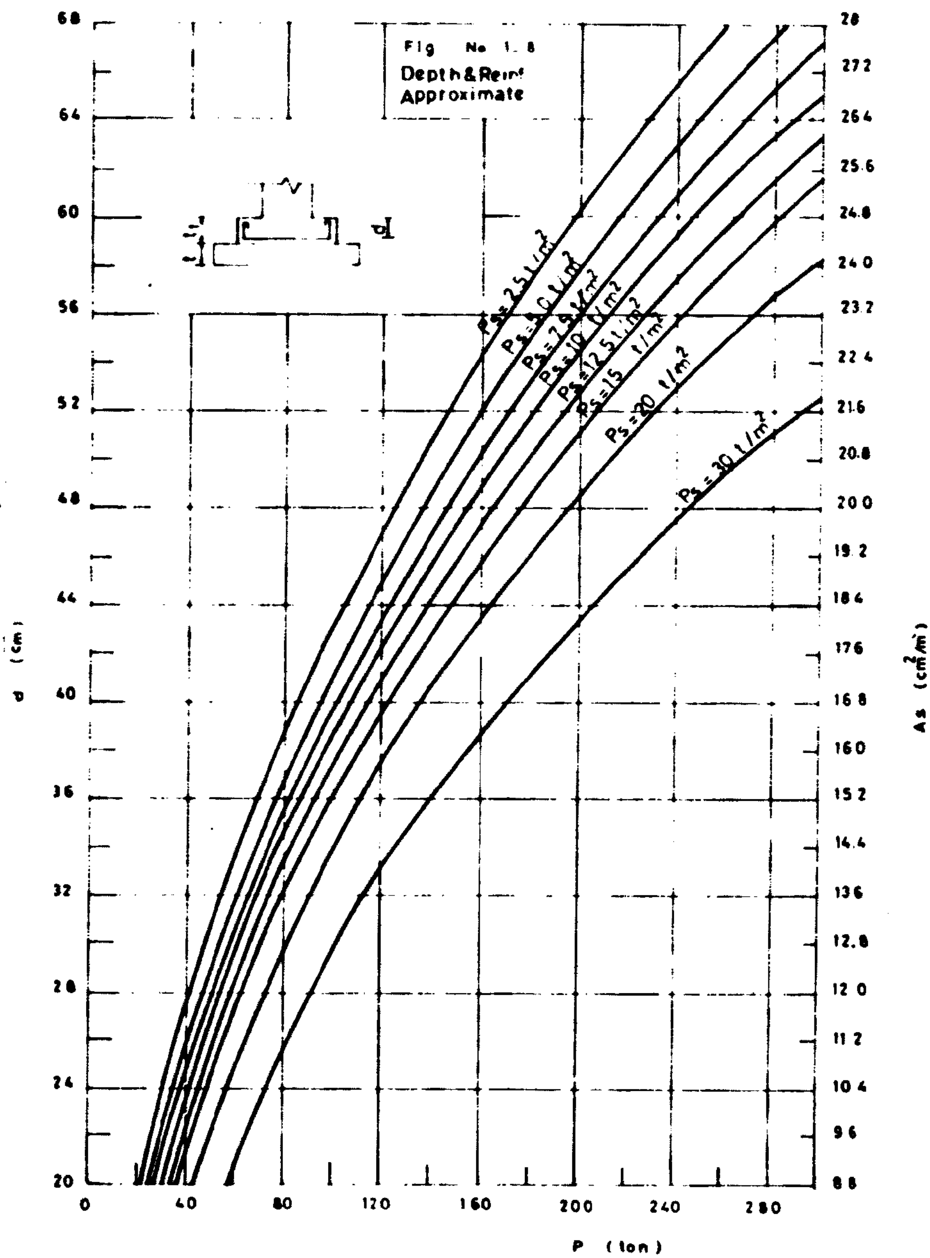


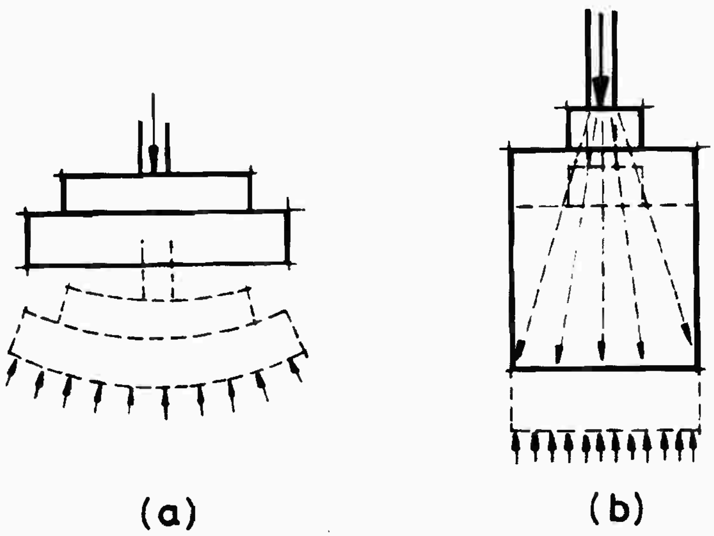
Fig No 1.8
Depth & Reinf Approximate
Ps=2.5 t/m²
Ps=5.0 t/m²
Ps=7.5 t/m²
Ps=10 t/m²
Ps=12.5 t/m²
Ps=15 t/m²
Ps=20 t/m²
Ps=30 t/m²
d (cm)
As (cm²/m')
P (ton)
0 40 80 120 160 200 240 280
20 24 28 32 36 40 44 48 52 56 60 64 68
8.8 9.6 10.4 11.2 12.0 12.8 13.6 14.4 15.2 16.0 16.8 17.6 18.4 19.2 20.0 20.8 21.6 22.4 23.2 24.0 24.8 25.6 26.4 27.2 28

1.7) DEEP WELLS (ALEXANDRIAN WELLS)

In dry, consistent or cemented formation, and when the foundation level is located at big depths below ground level it is usually recommeded to use deep wells foundation, known in Egypt as Alexandrian wells. They are made of plain concrete casted in an open excavation, on the top of which reinforced concrete isolated footings are based.

1.7.1) Design Criteria

In spite of the resemblance between deep wells and isolated footing systems the load transfer through the two systems differs considerably (Fig. 1.5) . We can notice that the behaviour of isolated footings could be considered as a loaded thin plate resting on elastic material while deep wells transfer the load by dispersion of compressive trajectories through the well mass.



a) Isolated Footings **b) Deep Wells**

Fig. (1.5) load transfer through isolated foundations

The behaviour of isolated footings (figure 1.5.a) could be considered as loaded plate resting on an elastic material ; the footing after loading is deformed inducing bending moment and shearing forces in the footing.

In case of deep wells (figure 1.5.b) the foundation undergoes pure rigid body motion ; and due to the big depth of the foundation, the loads are transfered to the soil by inclined compressive trajectories through the well. The vertical component of these trajectories induces pure compressive normal stresses and their horizontal component (spliting forces) induces horizontal tensile stresses.

1.7.2) Modes Of Failure

When a small part of a concrete block is loaded, the parts of the block situated outside the loaded zone play the predominent part in the resistance of the block ; once cracks are initiated and the block being divided by these cracks into several portions the behaviour of the block can no more be considered as a continuum media and its behaviour follows the fracture mechanics laws, Figure (1.6) shows the different modes of failure of partially loaded concrete blocks.

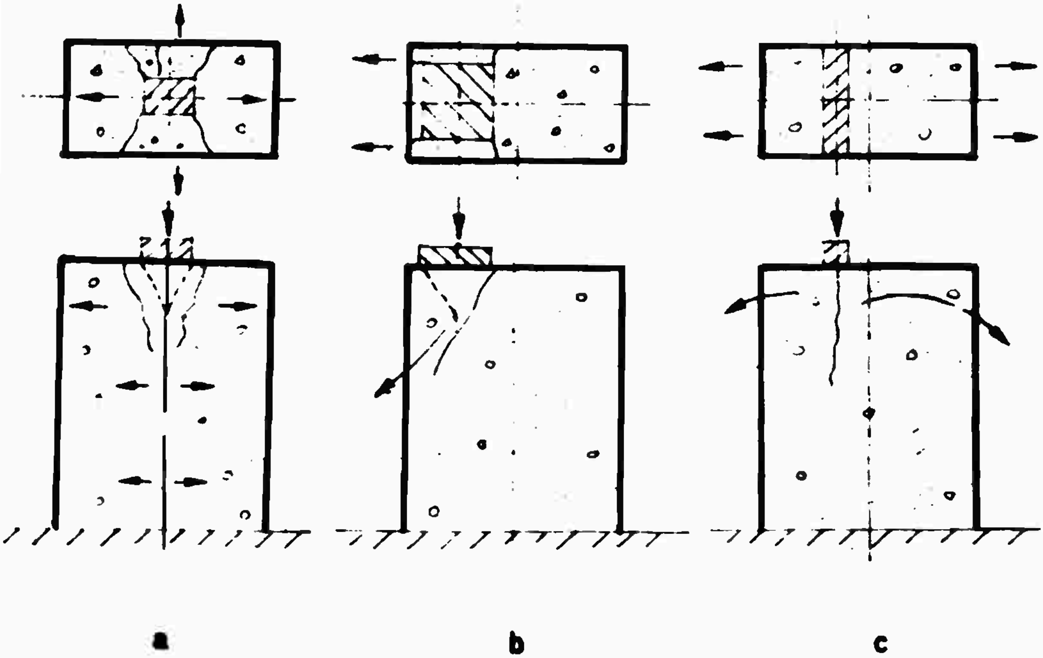


Fig. (1.6)

The bearing resistance of a partially loaded plain concrete block usually exceeds its cube strength. This bearing resistance can be obtained from the following expression :

$$p_{uc} = K f_c \qquad (1.20)$$

where

p_{uc} = the ultimate bearing stress.

f_c = the cube concrete strength of the plain concrete pier.

K = a factor depending on the dimensions of the foundation block and loaded area.

$$K = 1 + (3 - C_1 - C_2)[(1 - C_1)(1 - C_2)]^{1/2}$$

where (C_1) and (C_2) are the ratios between the sides of the loaded area to the sides of the foundation block, ($1 < K < 3.3$) .

If C_1 is taken equal to C_2 the Factor (K) can be calculated by the following formula :

$$K = 1 + (3 - 2C)(1 - C) \qquad (K < 3.3) \qquad (1.21)$$

where $C = C_1 = C_2$

Values of [K] for different values of (C) are given in the table below :

C	1	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1
K	1.0	1.52	1.84	2.14	2.44	2.73	3.02	3.3	3.3	3.3

Table (1.3)

For the design purpose the allowable working bearing stresses (p_c) are recommended to be taken equal to m = $f_c/6$ to $f_c/8$ which corresponds to a factor of safety ranging between 6 and 8 and reaching about 20 when (C) is equal to 0.6 .

1.7.3) Deep Well Dimensioning

The dimensions of the rectangular sides of the deep wells could be obtained from the figures [I , II , III , (1 - 6)] . If the well cross-section is not rectangular, the area of the cross-section must satisfy the following relation :

$$A_w = \frac{P + \gamma_c h}{p_s} \qquad (1.22)$$

where A_w = The cross-section area of well

P = The column load

h = Total height of well ≅ Depth of foundation level below ground surface

p_s = The allowable gross soil pressure

The area of the reinforced concrete footing can be obtained from the following equation :

$$A_f = \frac{P}{p_c} \qquad (1.23)$$

where

A_f = The area of the reinforced concrete footing .

P = The column load

p_c = The contact stress between reinforced concrete footing and pier

The thickness of the reinforced concrete footing can be taken equal to twice the cantilever arm of footing. It is recommended to be taken not less than 30 cm. The reinforcement formed of 2 meshs (lower and upper) having an area of steel not less than 0.25 % of the concrete cross-section of the reinforced concrete footing in each direction.

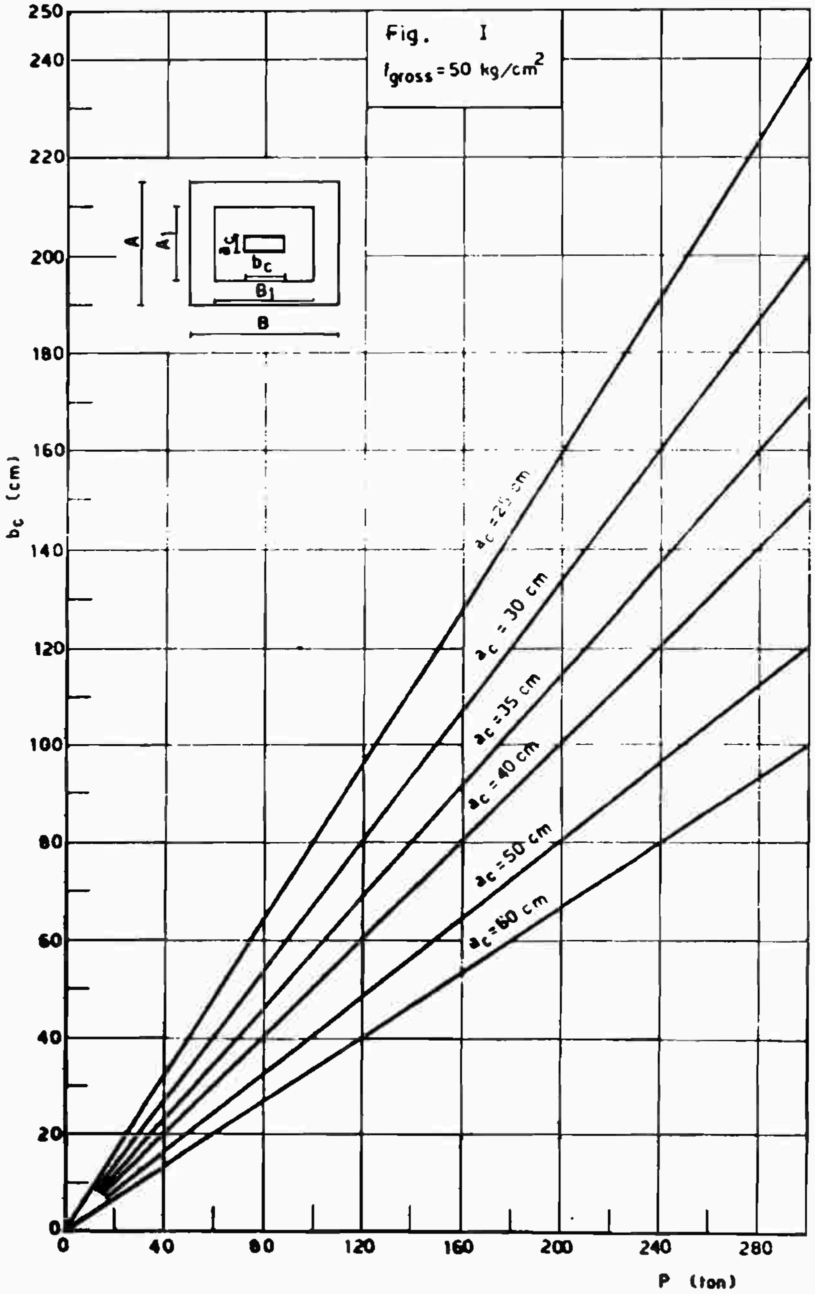


Fig. I
f_{gross} = 50 kg/cm²
A
A_1
a_c
b_c
B_1
B
b_c (cm)
P (ton)
a_c = 25 cm
a_c = 30 cm
a_c = 35 cm
a_c = 40 cm
a_c = 50 cm
a_c = 60 cm
0
20
40
60
80
100
120
140
160
180
200
220
240
250
0
40
80
120
160
200
240
280

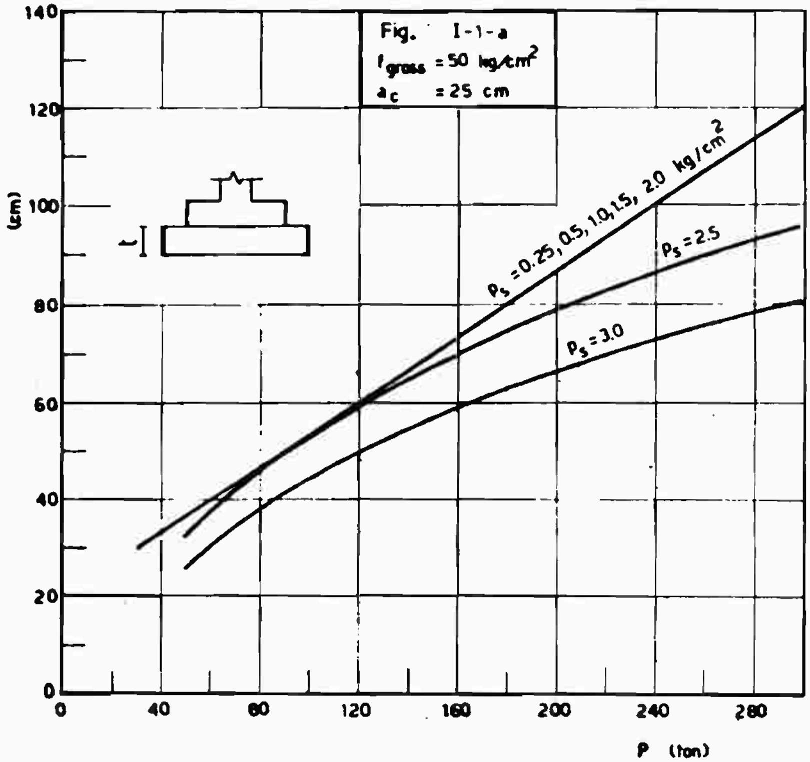


Fig. I-1-a
f_{gross} = 50 kg/cm²
a_c = 25 cm
P_s = 0.25, 0.5, 1.0, 1.5, 2.0 kg/cm²
P_s = 2.5
P_s = 3.0
(cm)
P (ton)
0
20
40
60
80
100
120
140
160
200
240
280

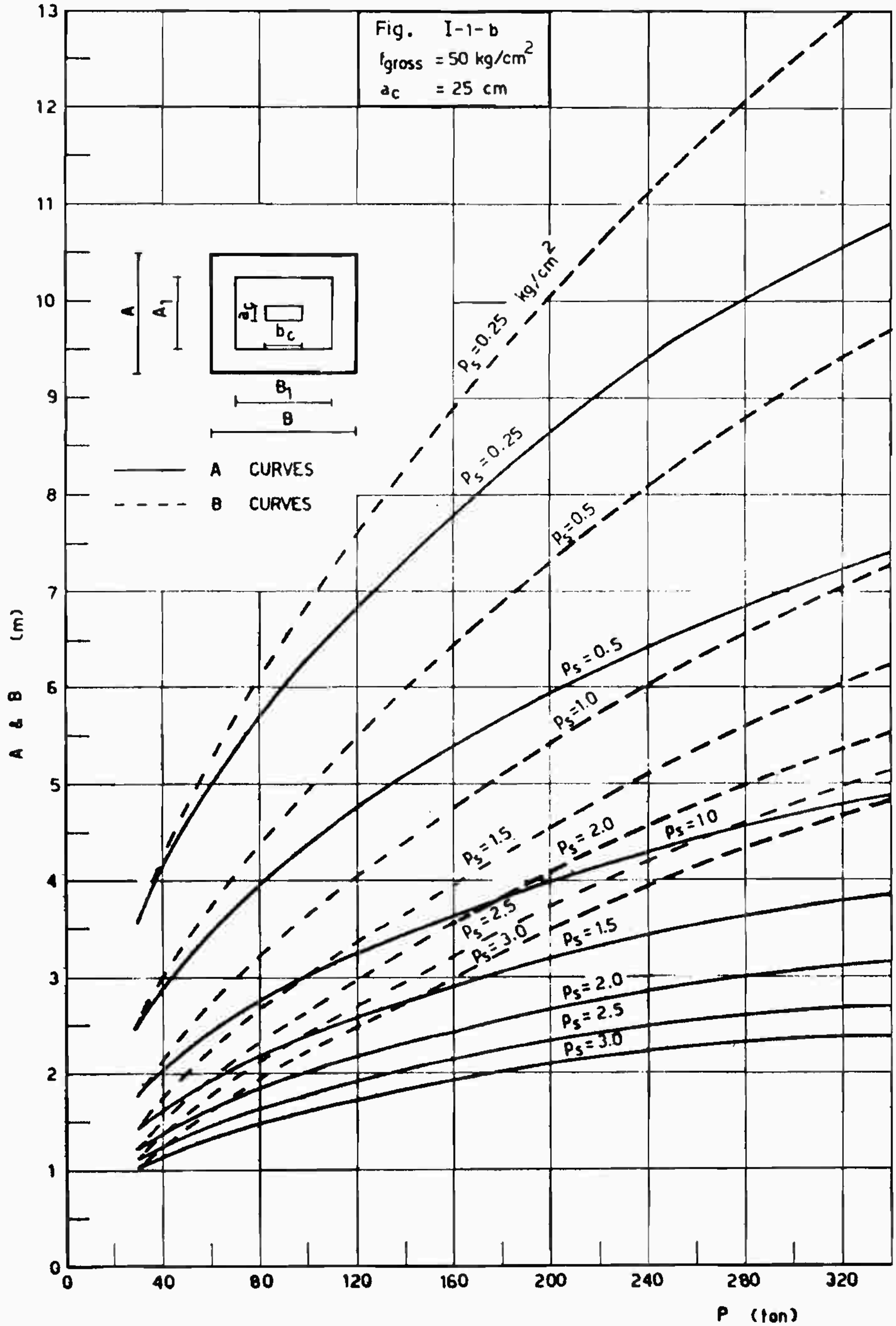


Fig. I-1-b
f gross = 50 kg/cm2
ac = 25 cm
A
A1
ac
bc
B1
B
A CURVES
B CURVES
Ps=0.25 kg/cm2
Ps=0.25
Ps=0.5
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=1.0
Ps=2.5
Ps=3.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
A & B (m)
P (ton)
0 40 80 120 160 200 240 280 320
0 1 2 3 4 5 6 7 8 9 10 11 12 13

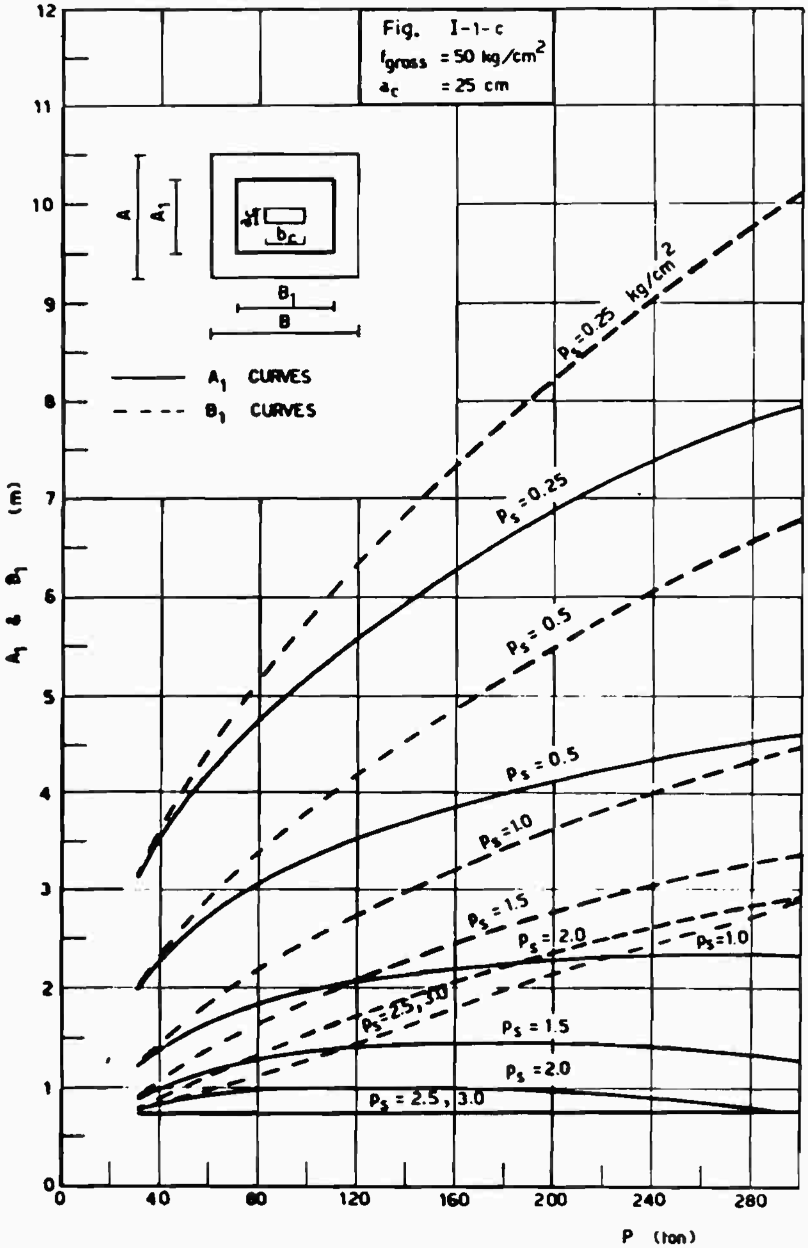


Fig. I-1-c
f_{gross} = 50 kg/cm^2
a_c = 25 cm
A
A_1
a_c
b_c
B_1
B
A_1 CURVES
B_1 CURVES
P_s = 0.25 kg/cm^2
P_s = 0.25
P_s = 0.5
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 1.0
P_s = 2.5, 3.0
P_s = 1.5
P_s = 2.0
P_s = 2.5, 3.0
A_1 & B_1 (m)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
40
80
120
160
200
240
280

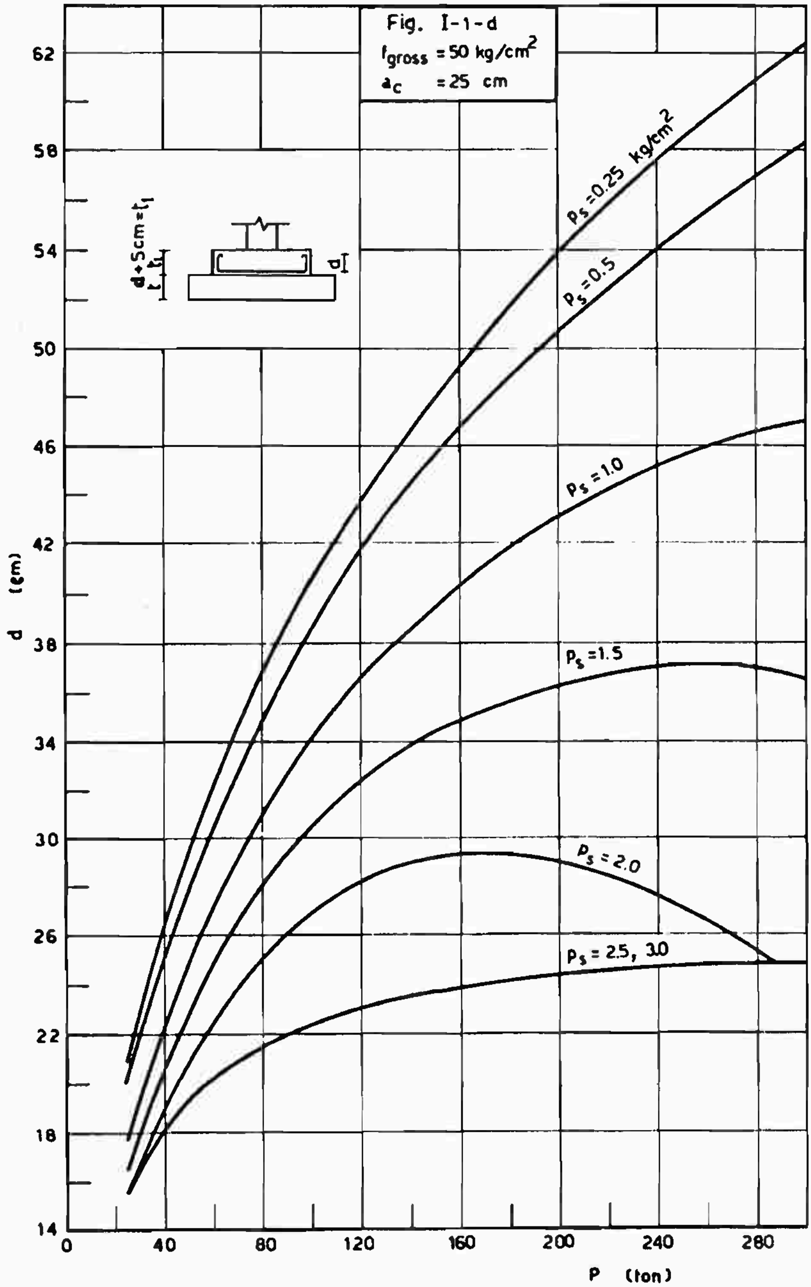


Fig. I-1-d
f gross = 50 kg/cm²
a c = 25 cm
d+5cm=t₁
d
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5, 3.0
d (cm)
P (ton)
14
18
22
26
30
34
38
42
46
50
54
58
62
0
40
80
120
160
200
240
280

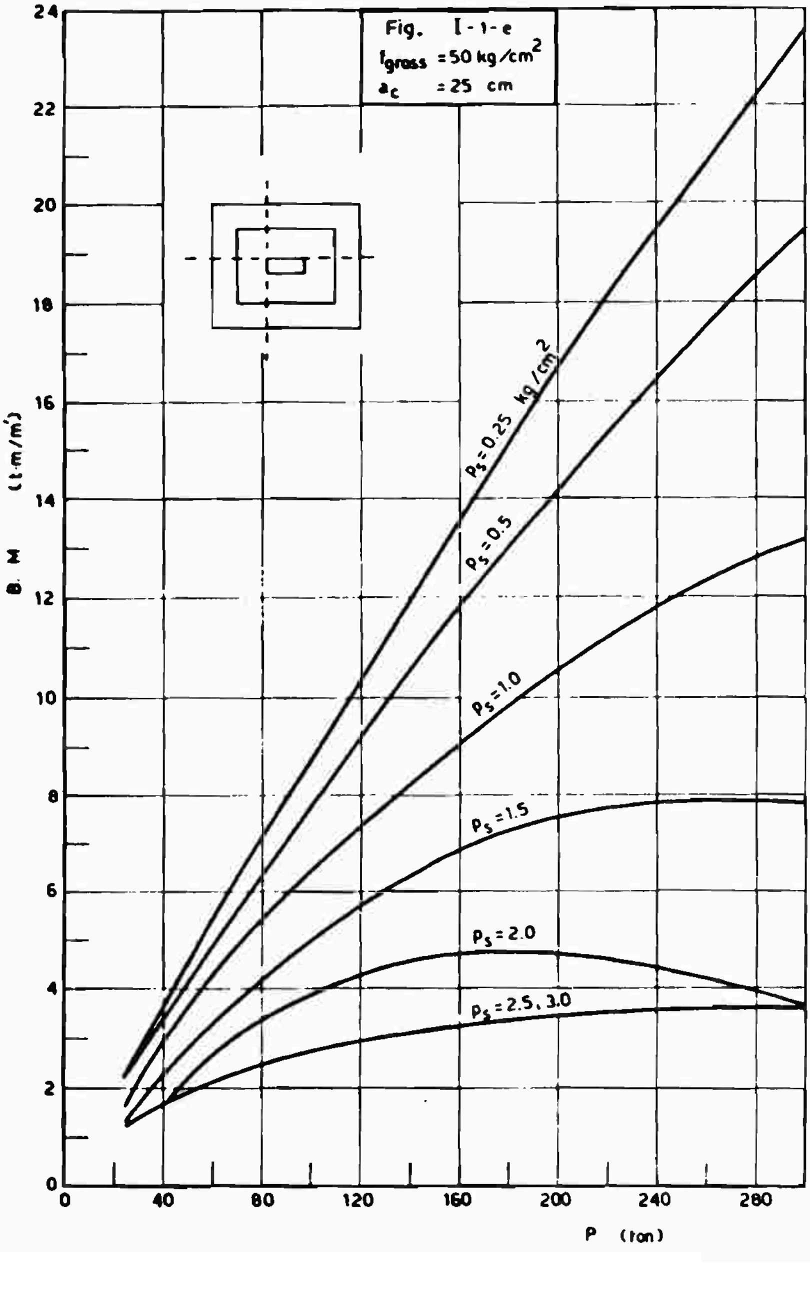


Fig. I-1-e
f_{gross} = 50 kg/cm²
a_c = 25 cm
B. M (t·m/m')
P (ton)
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5, 3.0
0
2
4
6
8
10
12
14
16
18
20
22
24
40
80
120
160
200
240
280

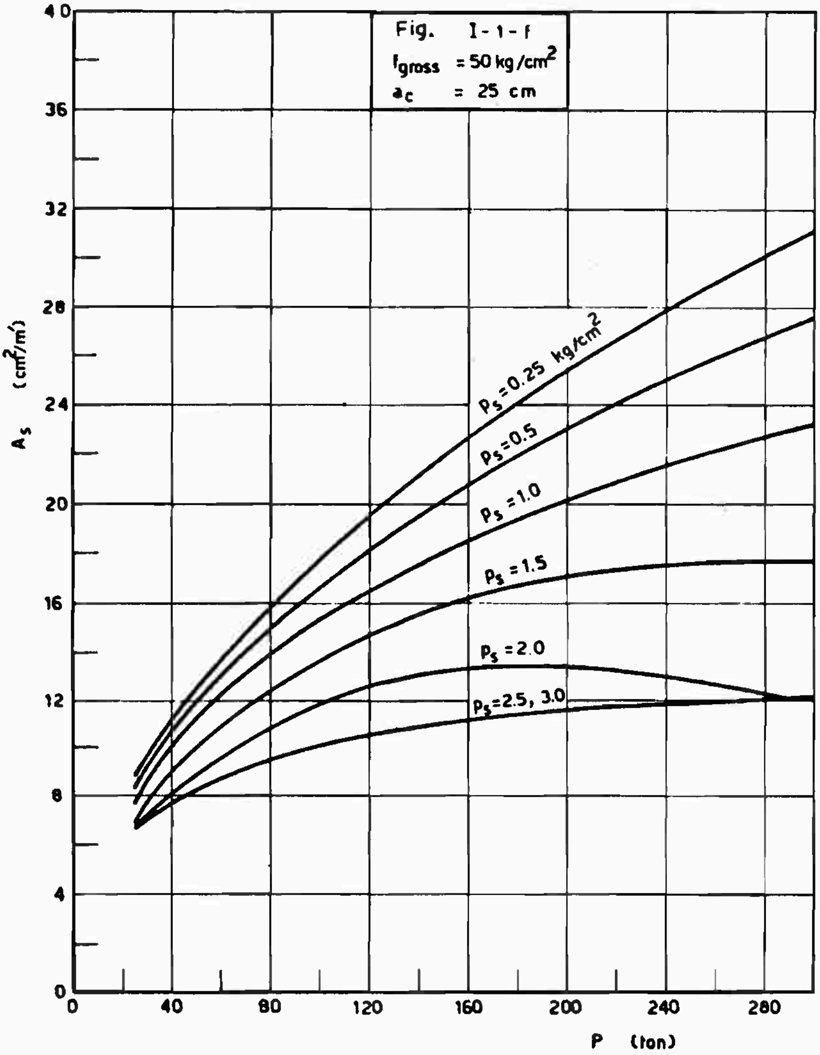


Fig. I-1-f
f_{gross} = 50 kg/cm²
a_c = 25 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5, 3.0
A_s (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280

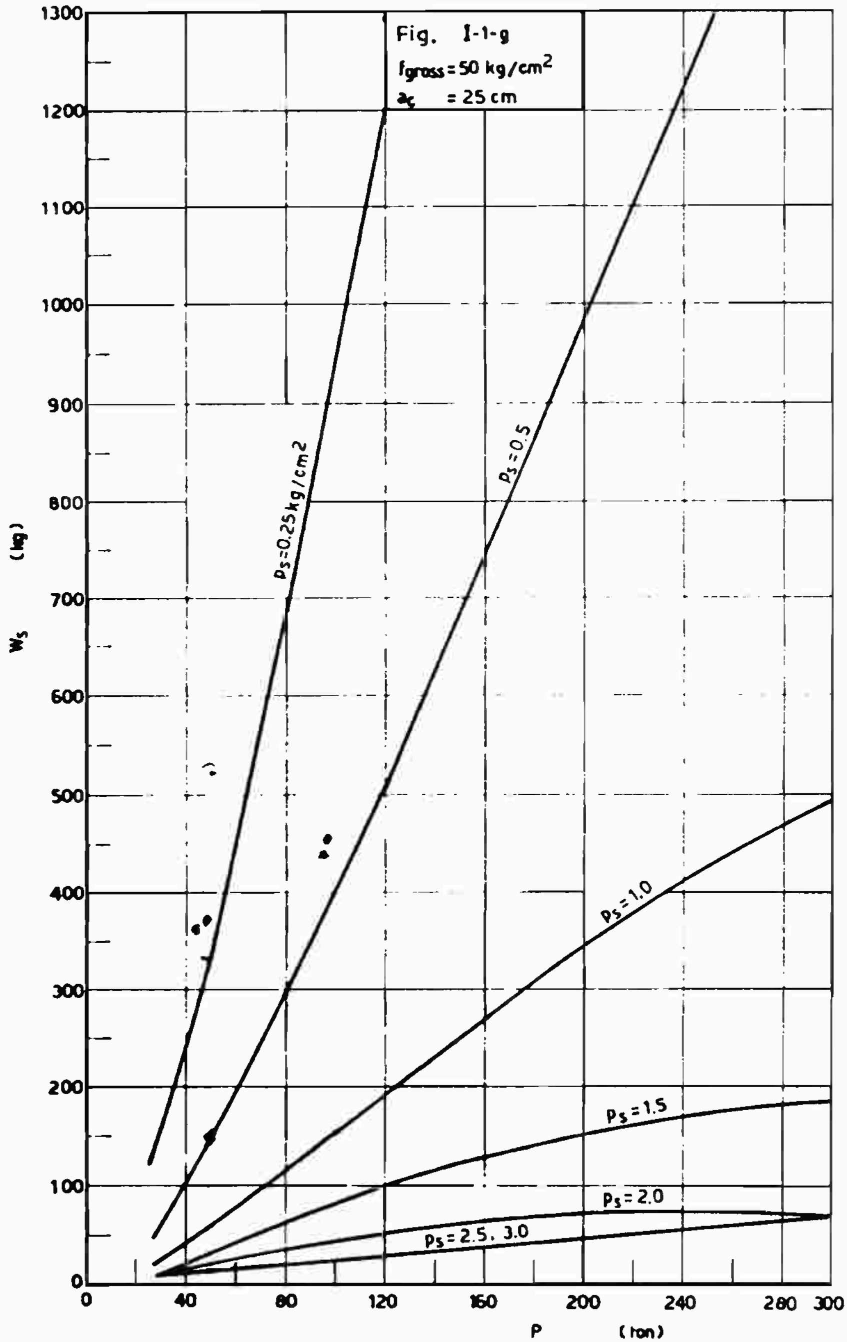


Fig. I-1-g
fgross = 50 kg/cm2
ac = 25 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5, 3.0
Ws (kg)
P (ton)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
40
80
120
160
200
240
280
300

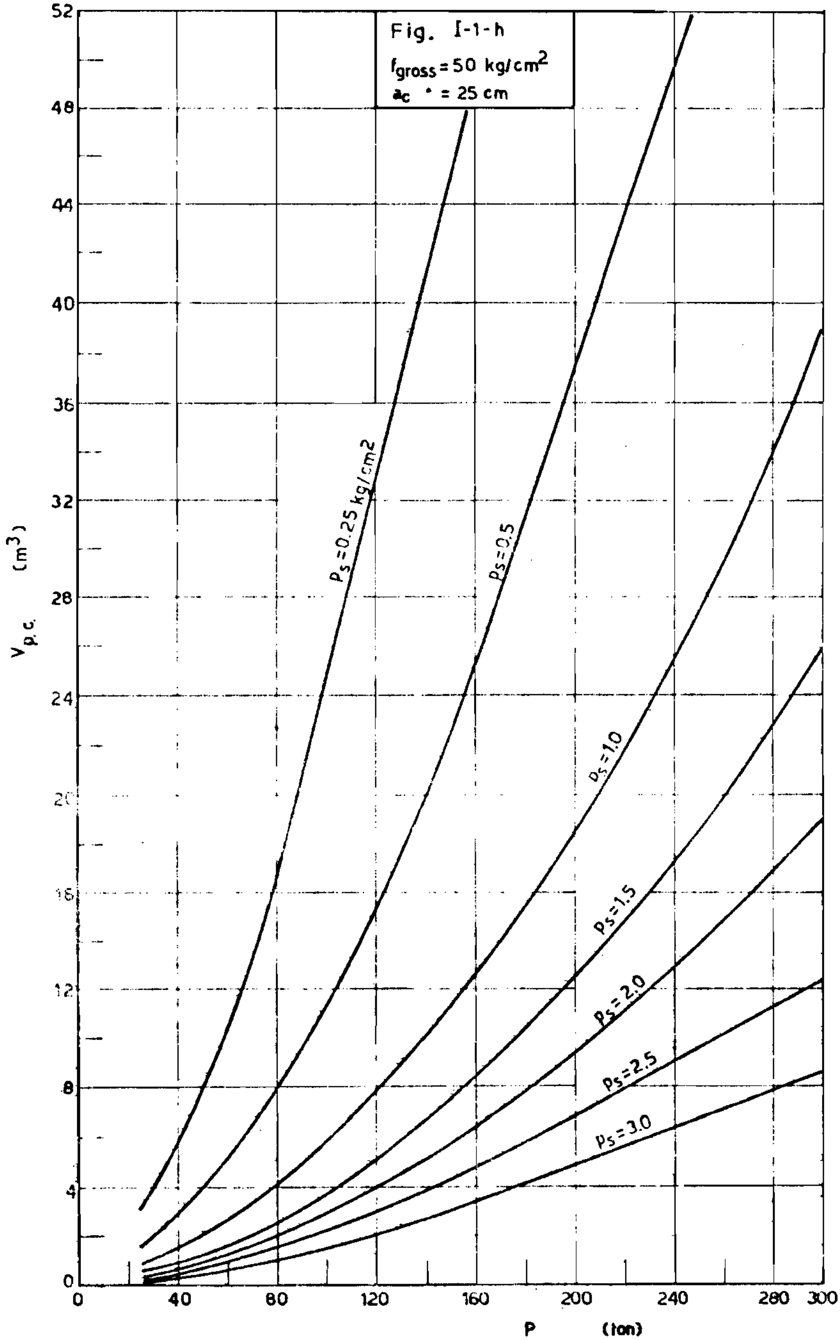


Fig. I-1-h
f_{gross} = 50 kg/cm^2
a_c * = 25 cm
P_s=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
$V_{p.c.}$ (m^3)
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
48
52
0
40
80
120
160
200
240
280
300

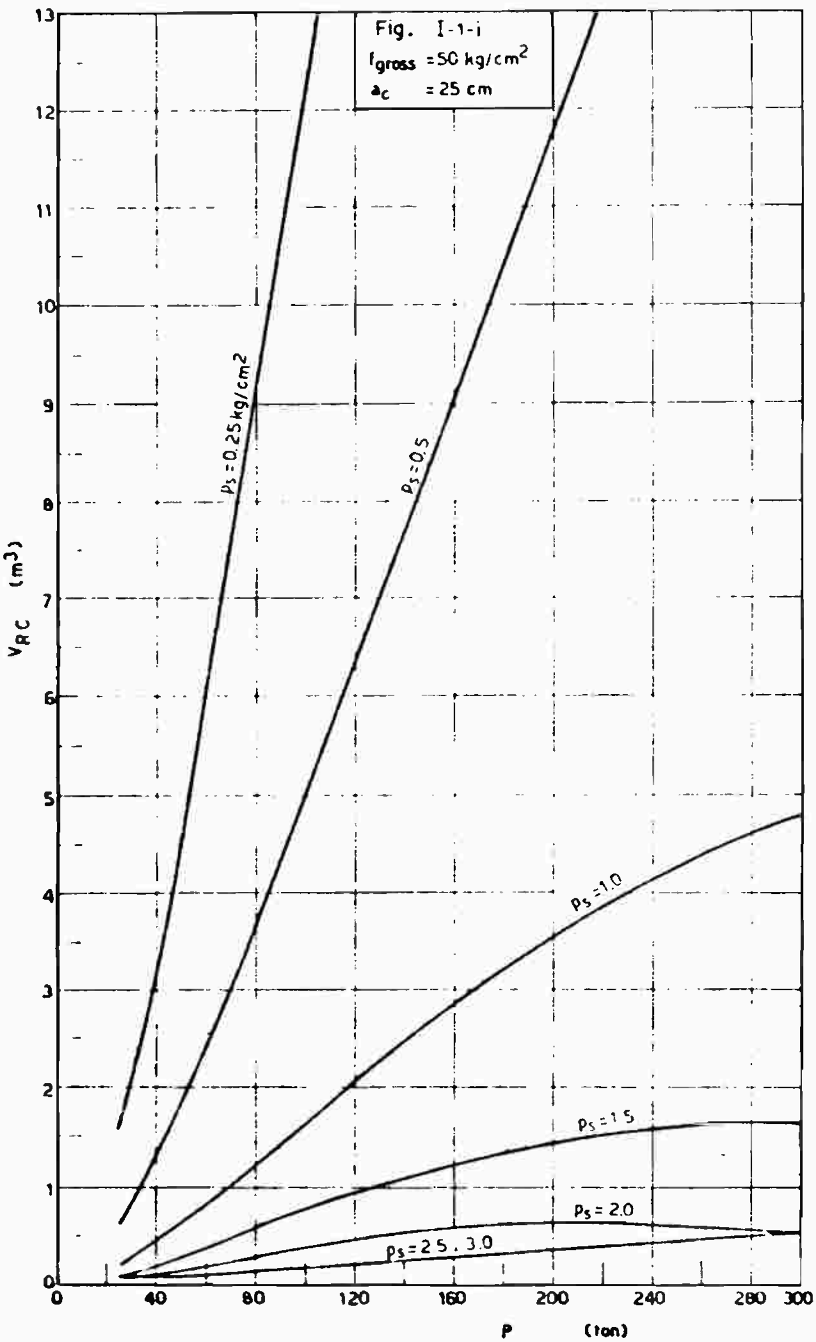


Fig. I-1-i
f_{gross} = 50 kg/cm²
a_c = 25 cm
p_s = 0.25 kg/cm2
p_s = 0.5
p_s = 1.0
p_s = 1.5
p_s = 2.0
p_s = 2.5 , 3.0
V_{RC} (m³)
P (ton)
0
40
80
120
160
200
240
280
300
1
2
3
4
5
6
7
8
9
10
11
12
13

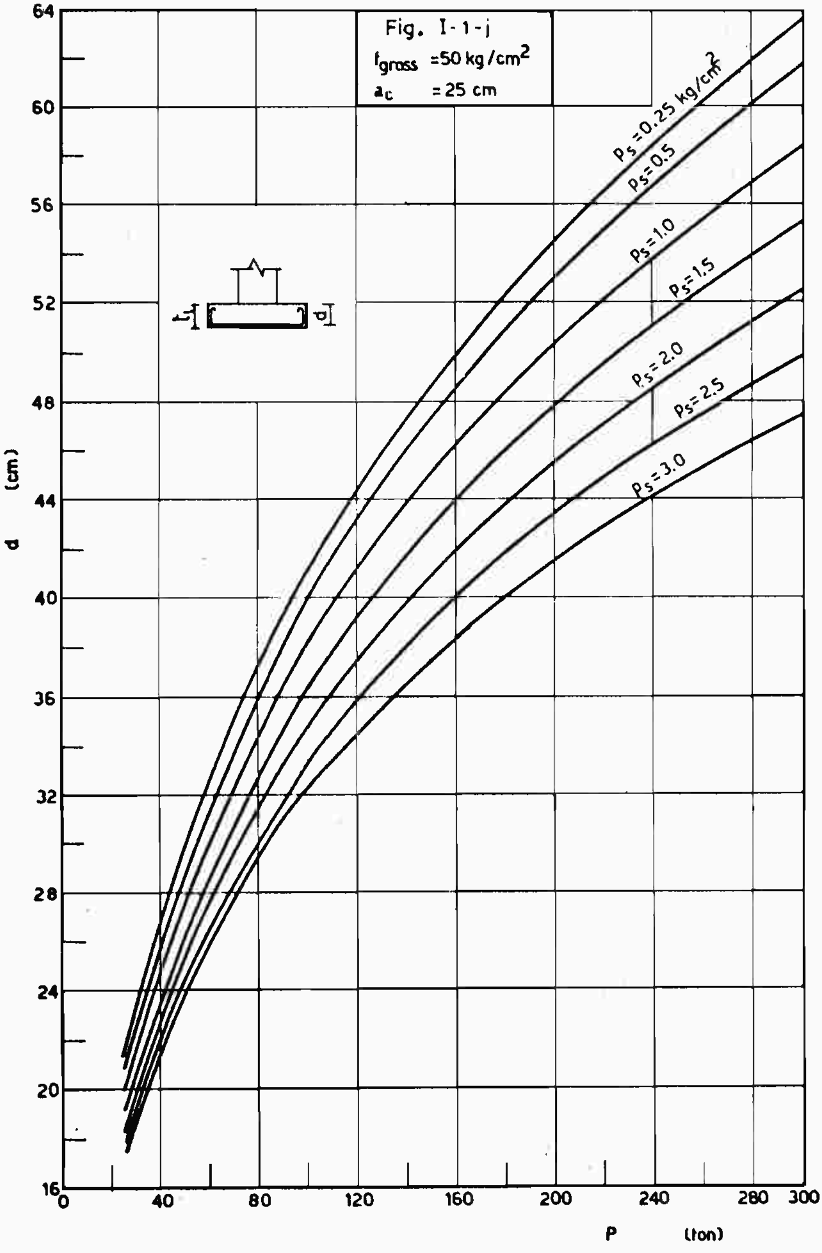


Fig. I-1-j
f_{gross} = 50 kg/cm²
a_c = 25 cm
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
d (cm)
P (ton)
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300

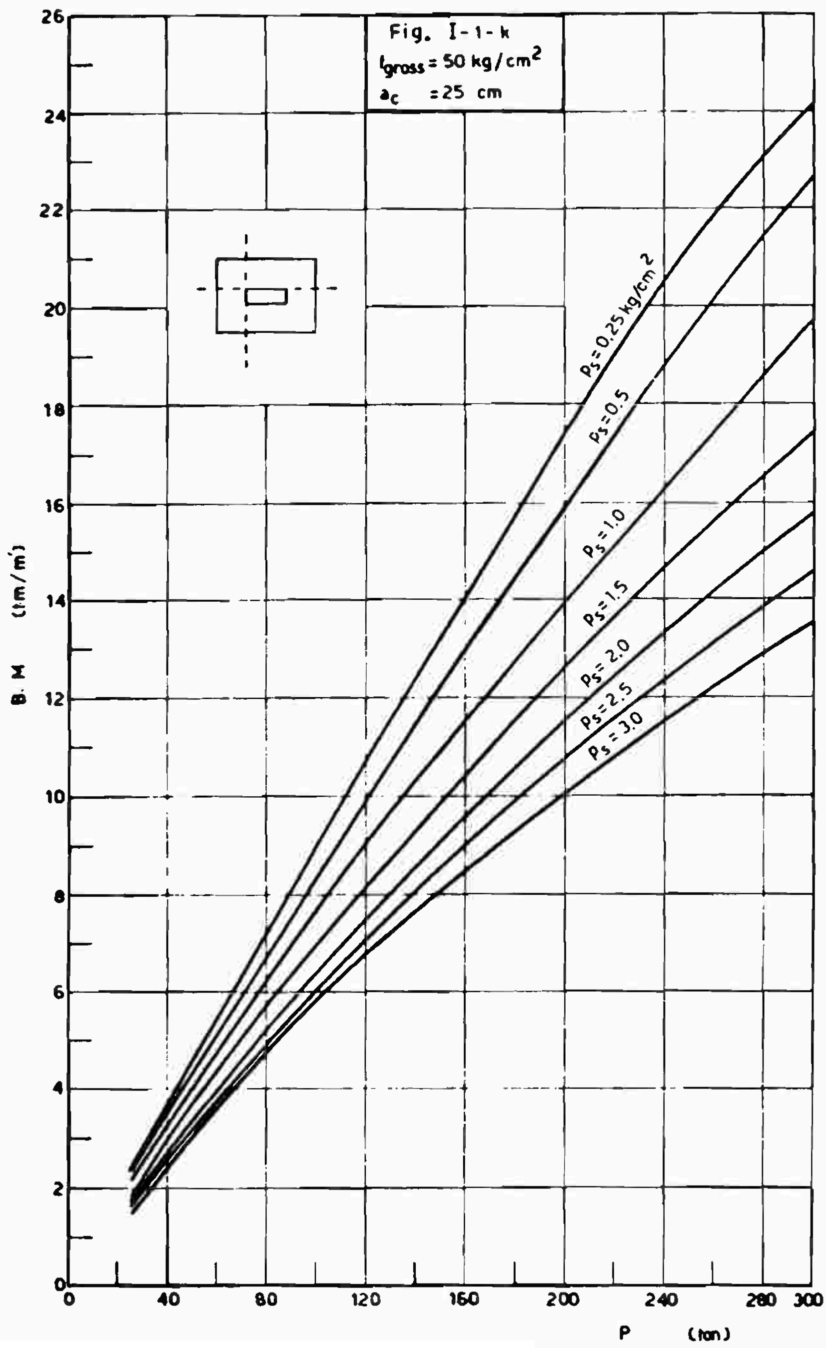


Fig. I-1-k
f_{gross} = 50 kg/cm²
a_c = 25 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
B.M (t.m/m')
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
40
80
120
160
200
240
280
300

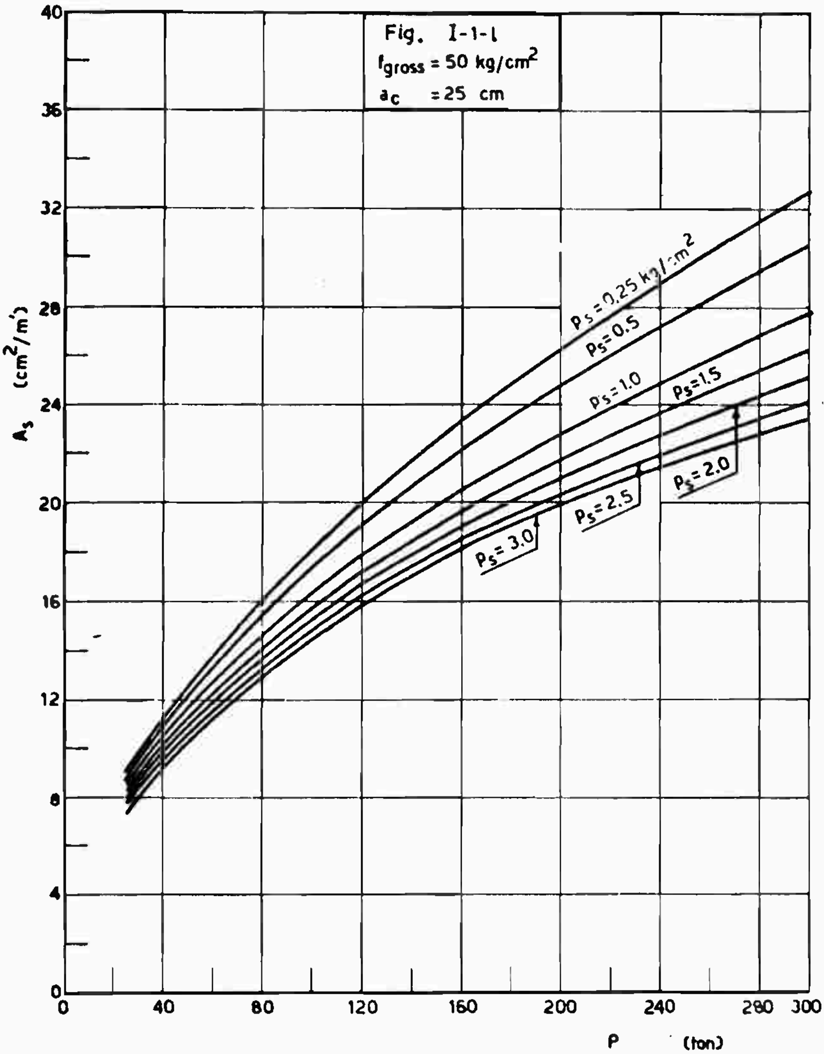


Fig. I-1-1
f_{gross} = 50 kg/cm²
a_c = 25 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
A_s (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300

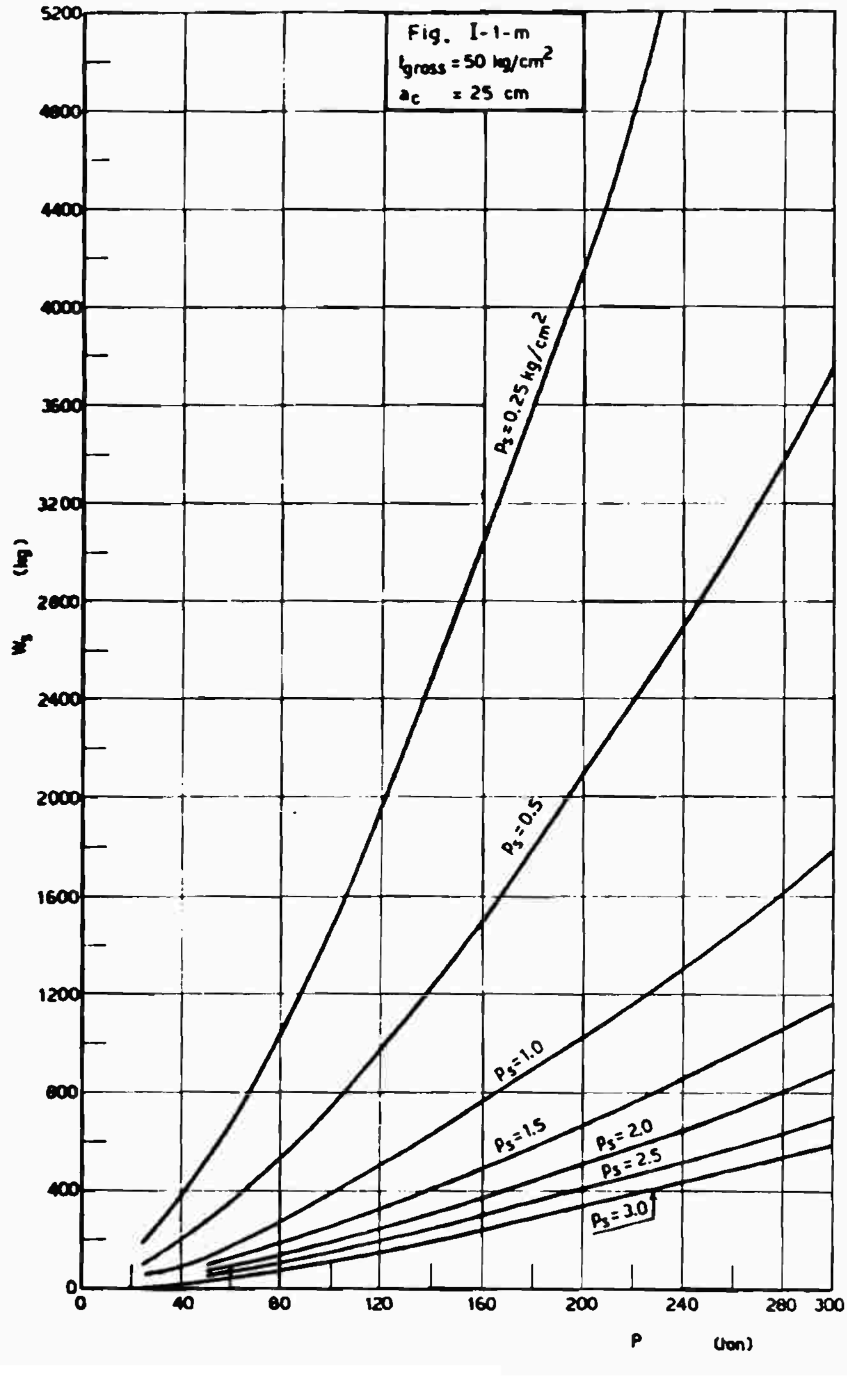


Fig. I-1-m
f_{gross} = 50 kg/cm²
a_c = 25 cm
W_s (kg)
P (ton)
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200
40
80
120
160
200
240
280
300

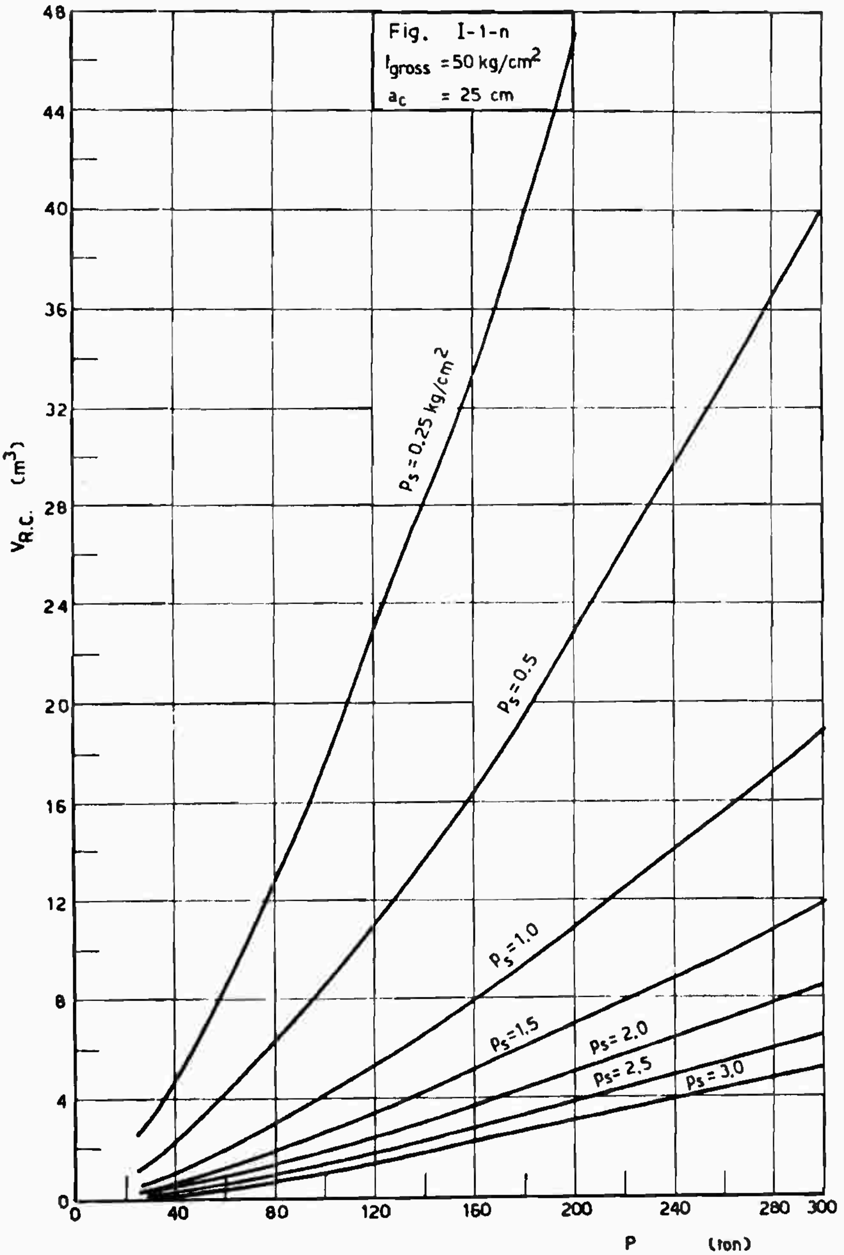


Fig. I-1-n
f_{gross} = 50 kg/cm²
a_c = 25 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
$V_{R.C.}$ (m³)
P (ton)
0 4 8 12 16 20 24 28 32 36 40 44 48
0 40 80 120 160 200 240 280 300

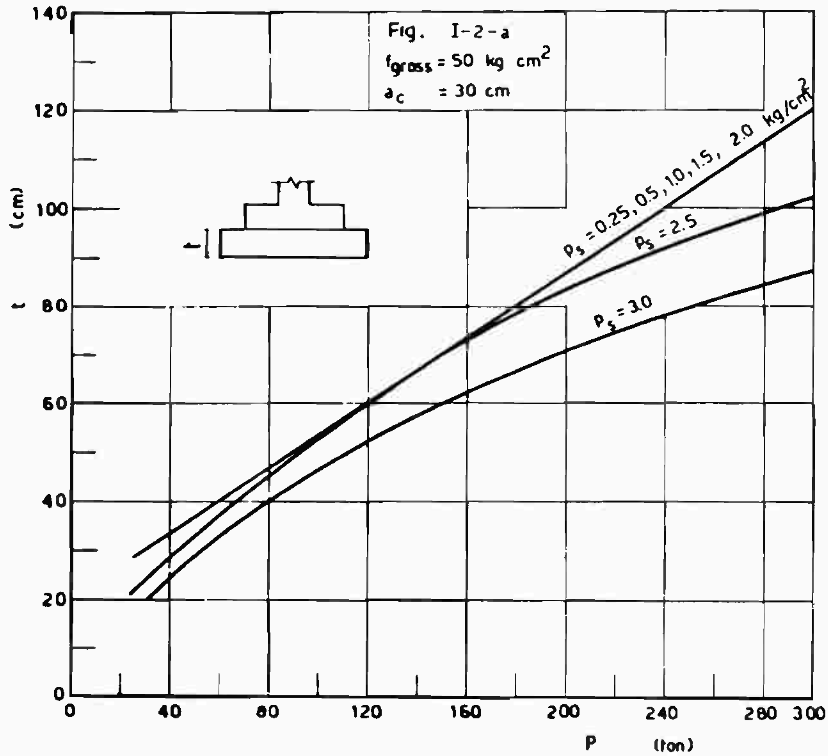


Fig. I-2-a
f_{gross} = 50 kg cm^2
a_c = 30 cm
P_s = 0.25, 0.5, 1.0, 1.5, 2.0 kg/cm^2
P_s = 2.5
P_s = 3.0
t (cm)
0
20
40
60
80
100
120
140
0
40
80
120
160
200
240
280
300
P (ton)

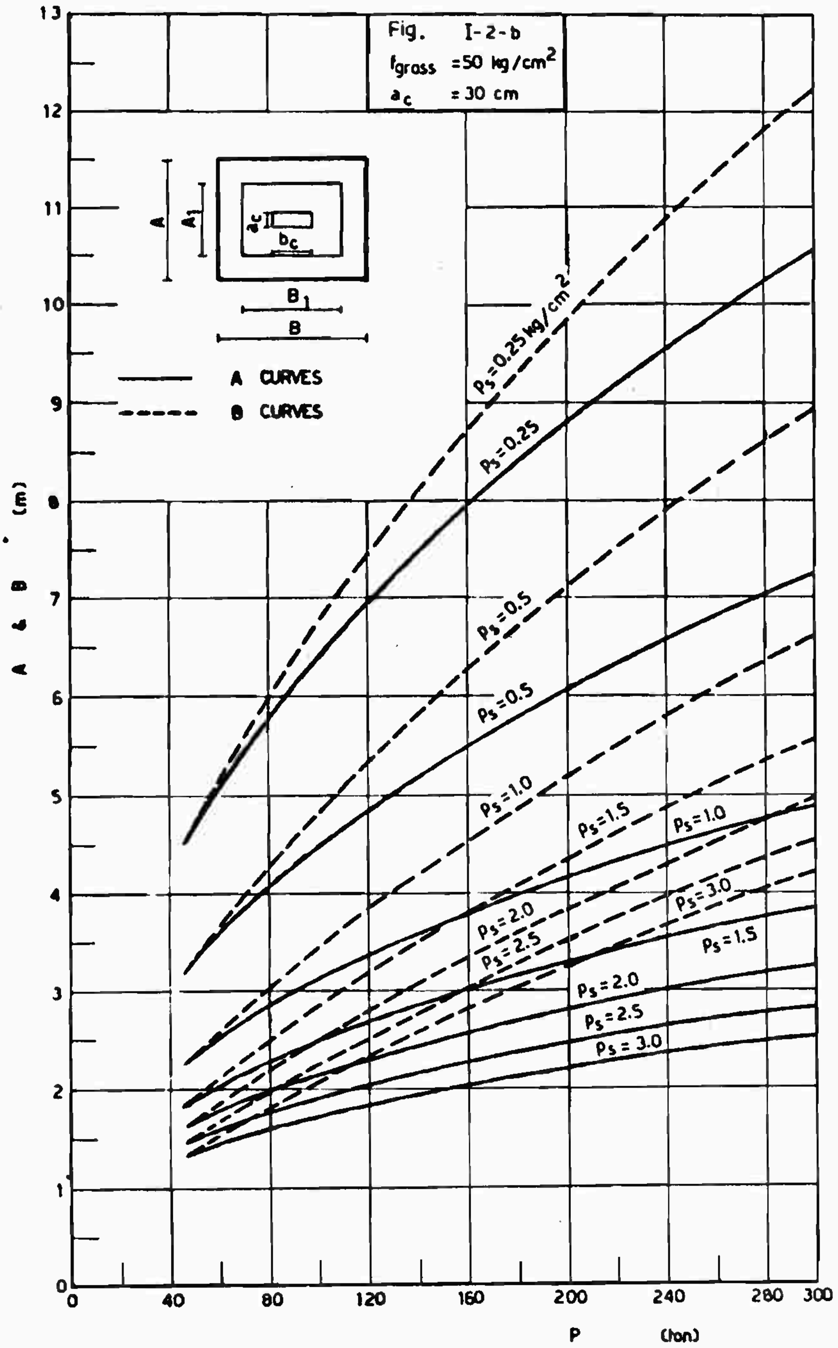


Fig. I-2-b
f_{gross} = 50 kg/cm²
a_c = 30 cm
A
A1
ac
bc
B1
B
A CURVES
B CURVES
Ps = 0.25 kg/cm²
Ps = 0.25
Ps = 0.5
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 1.0
Ps = 2.0
Ps = 2.5
Ps = 3.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
A & B (m)
P (ton)
0 40 80 120 160 200 240 280 300
0 1 2 3 4 5 6 7 8 9 10 11 12 13

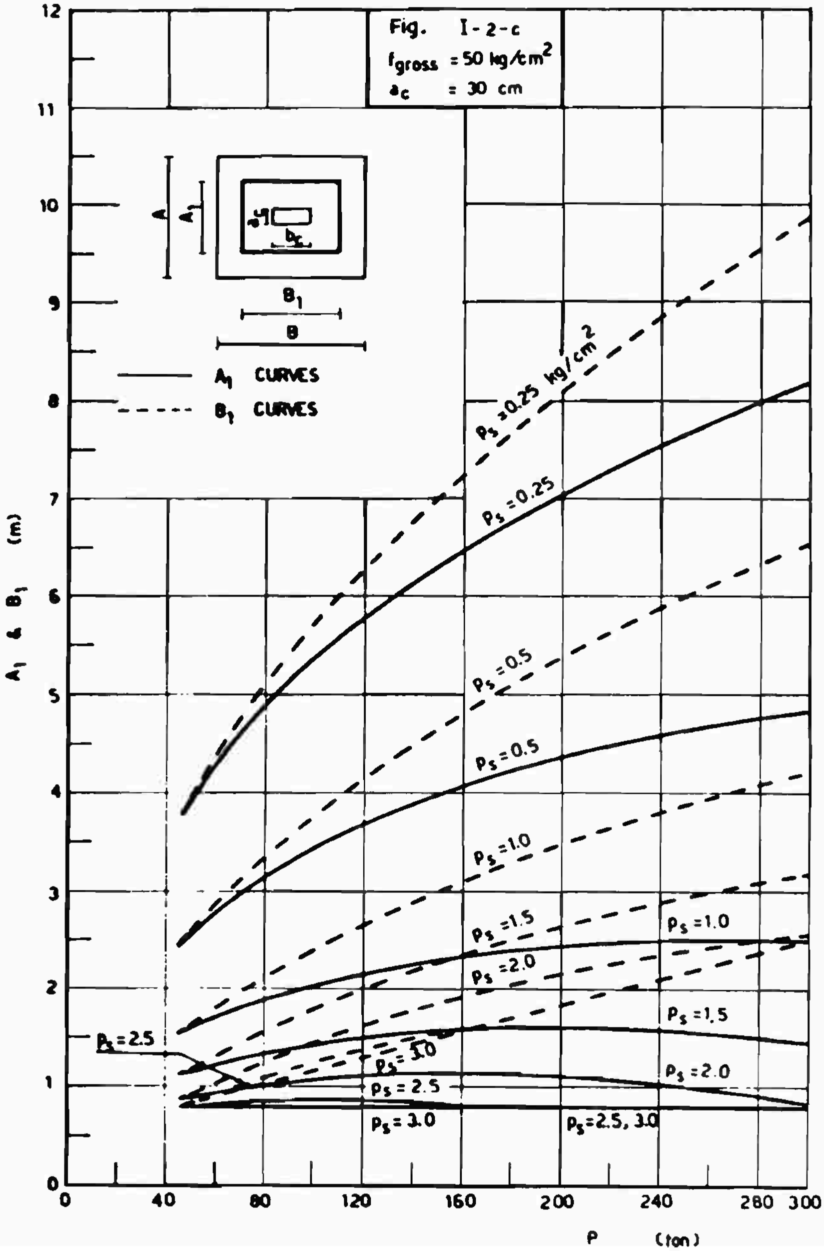


Fig. I-2-c
f_{gross} = 50 kg/cm^2
a_c = 30 cm
A_1 CURVES
B_1 CURVES
p_s = 0.25 kg/cm^2
p_s = 0.25
p_s = 0.5
p_s = 0.5
p_s = 1.0
p_s = 1.5
p_s = 2.0
p_s = 1.0
p_s = 1.5
p_s = 2.0
p_s = 2.5
p_s = 3.0
p_s = 2.5
p_s = 3.0
p_s = 2.5, 3.0
A_1 & B_1 (m)
P (ton)

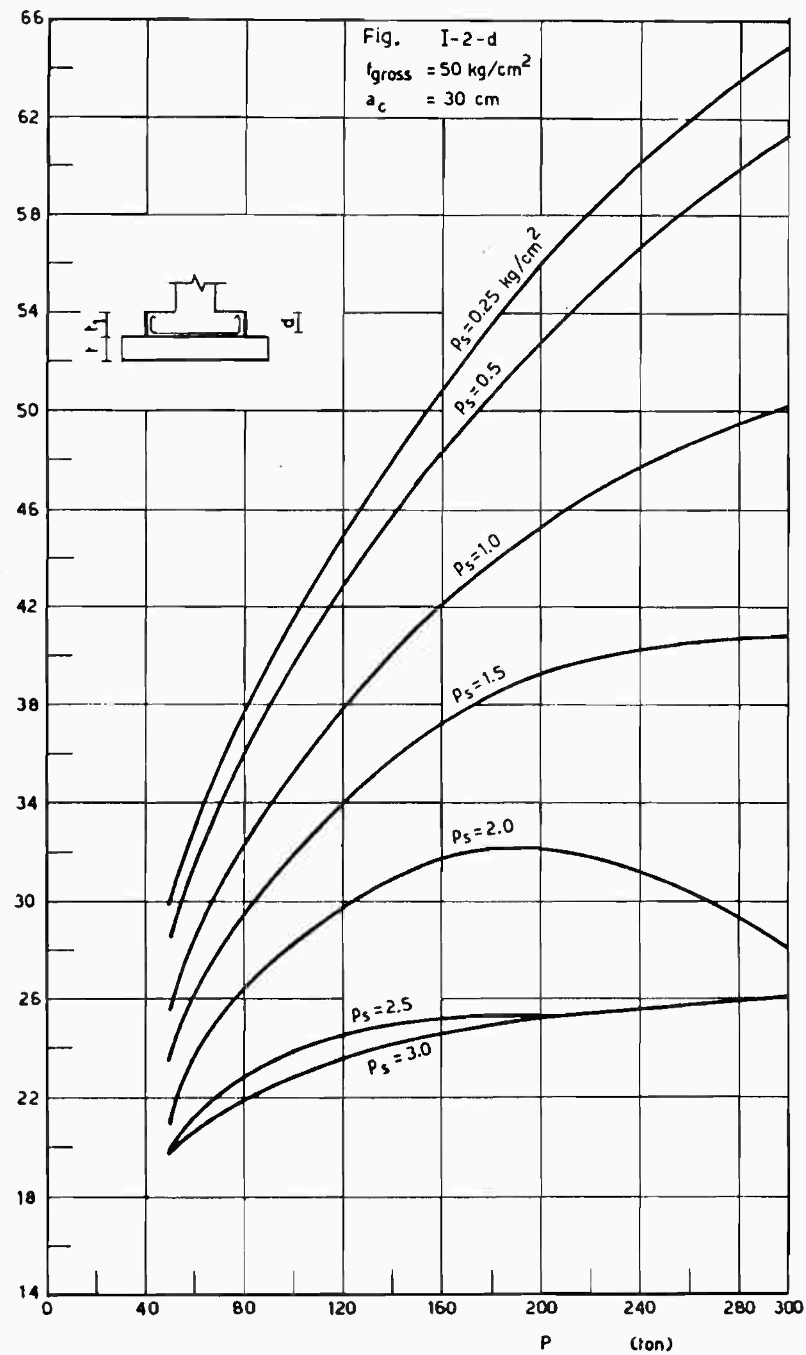


Fig. I-2-d
f_{gross} = 50 kg/cm²
a_c = 30 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d (cm)
P (ton)
66
62
58
54
50
46
42
38
34
30
26
22
18
14
0
40
80
120
160
200
240
280
300

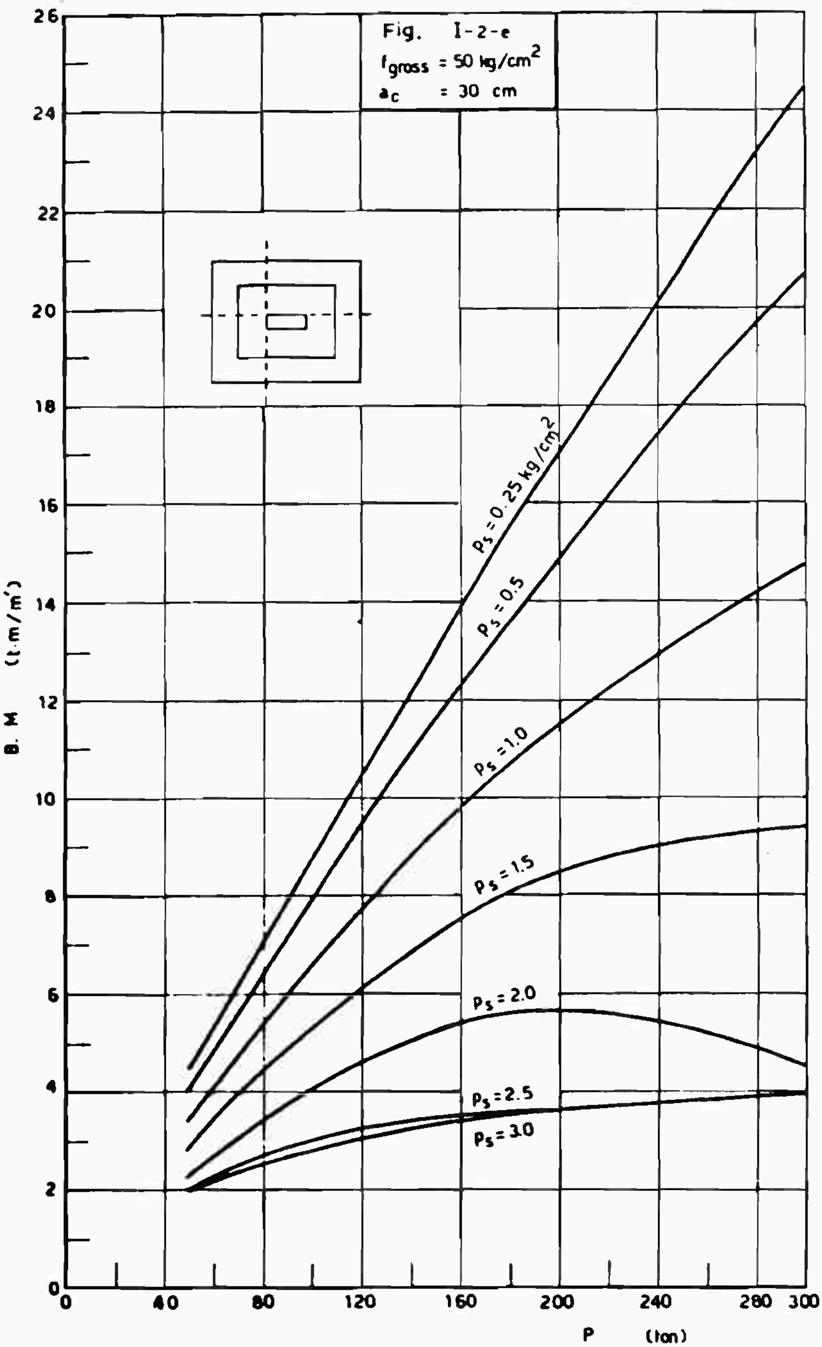


Fig. I-2-e
f_{gross} = 50 kg/cm²
a_c = 30 cm
B. M (t.m/m')
P (ton)
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
0
40
80
120
160
200
240
280
300

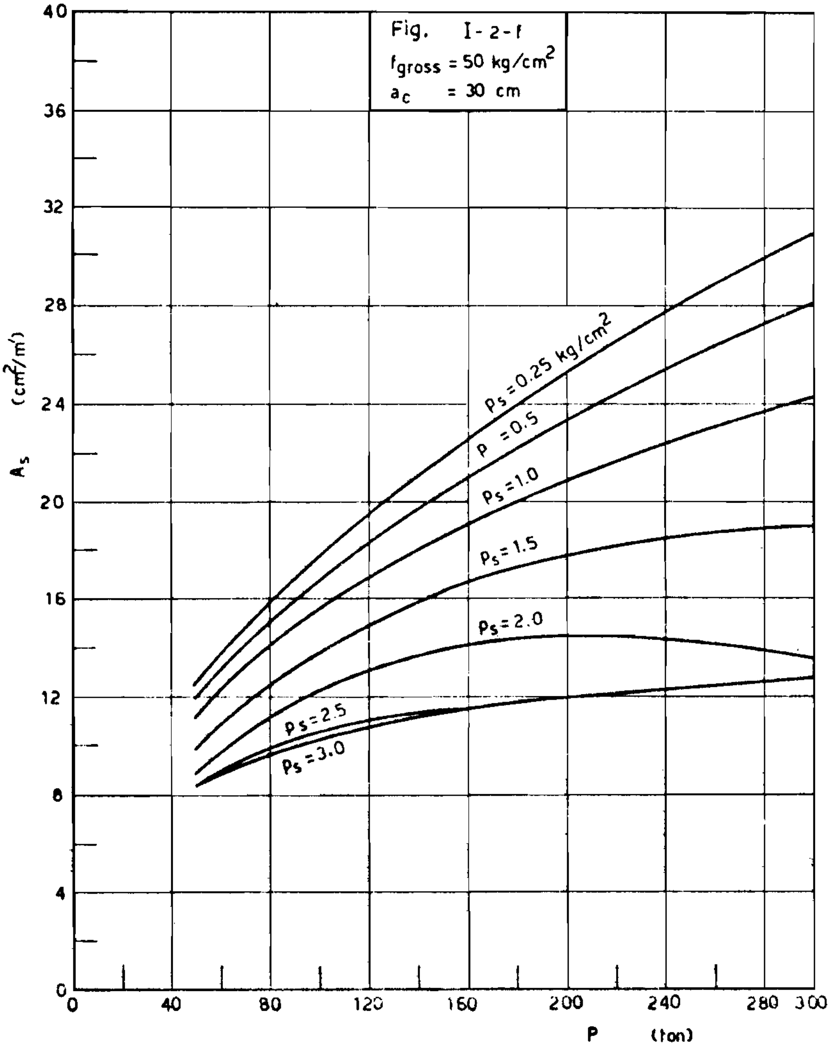


Fig. I-2-f
f_{gross} = 50 kg/cm²
a_c = 30 cm
P_s=0.25 kg/cm²
P =0.5
P_s=1.0
P_s= 1.5
P_s= 2.0
P_s=2.5
P_s=3.0
A_s (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300

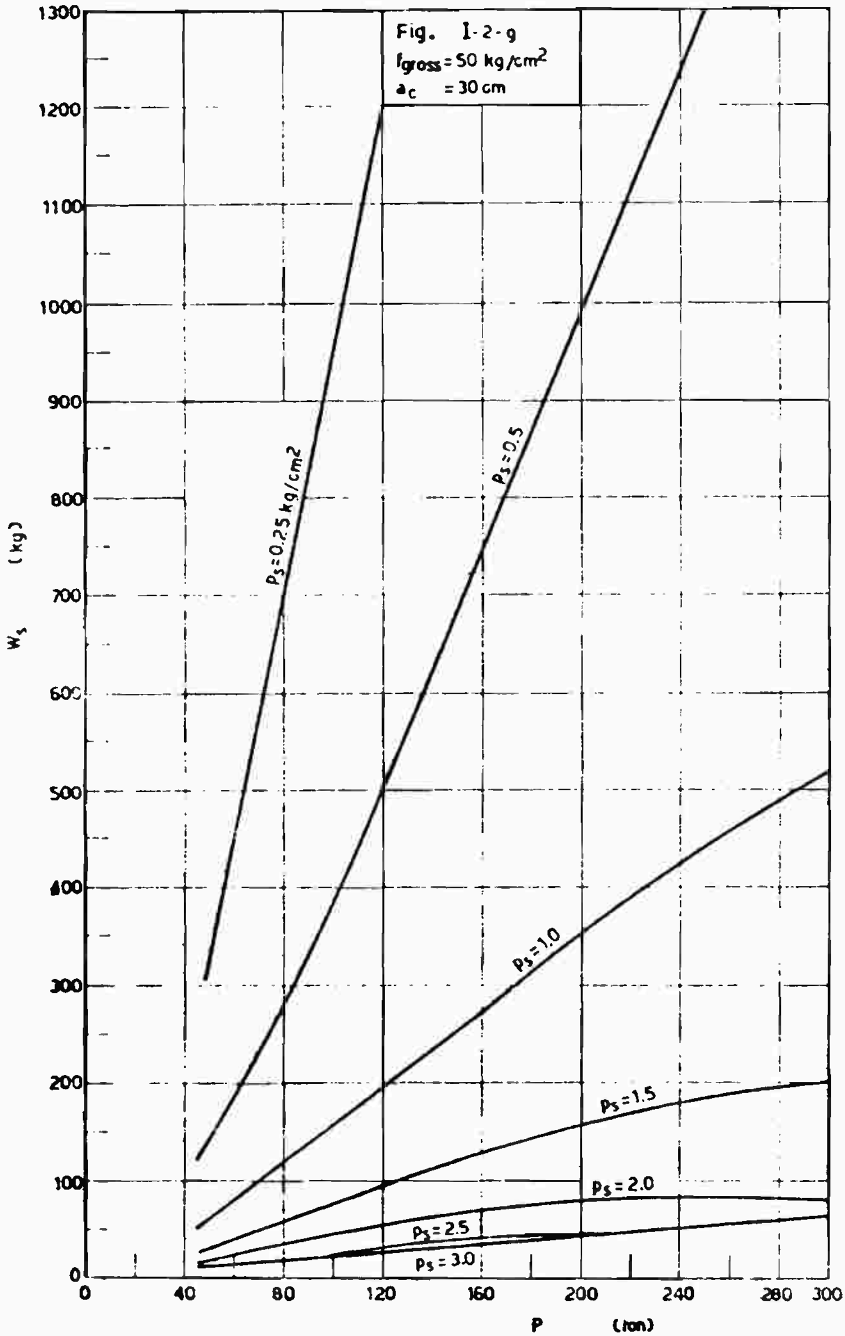


Fig. I-2-g
f_{gross} = 50 kg/cm²
a_c = 30 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
W_s (kg)
P (ton)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
0
40
80
120
160
200
240
280
300

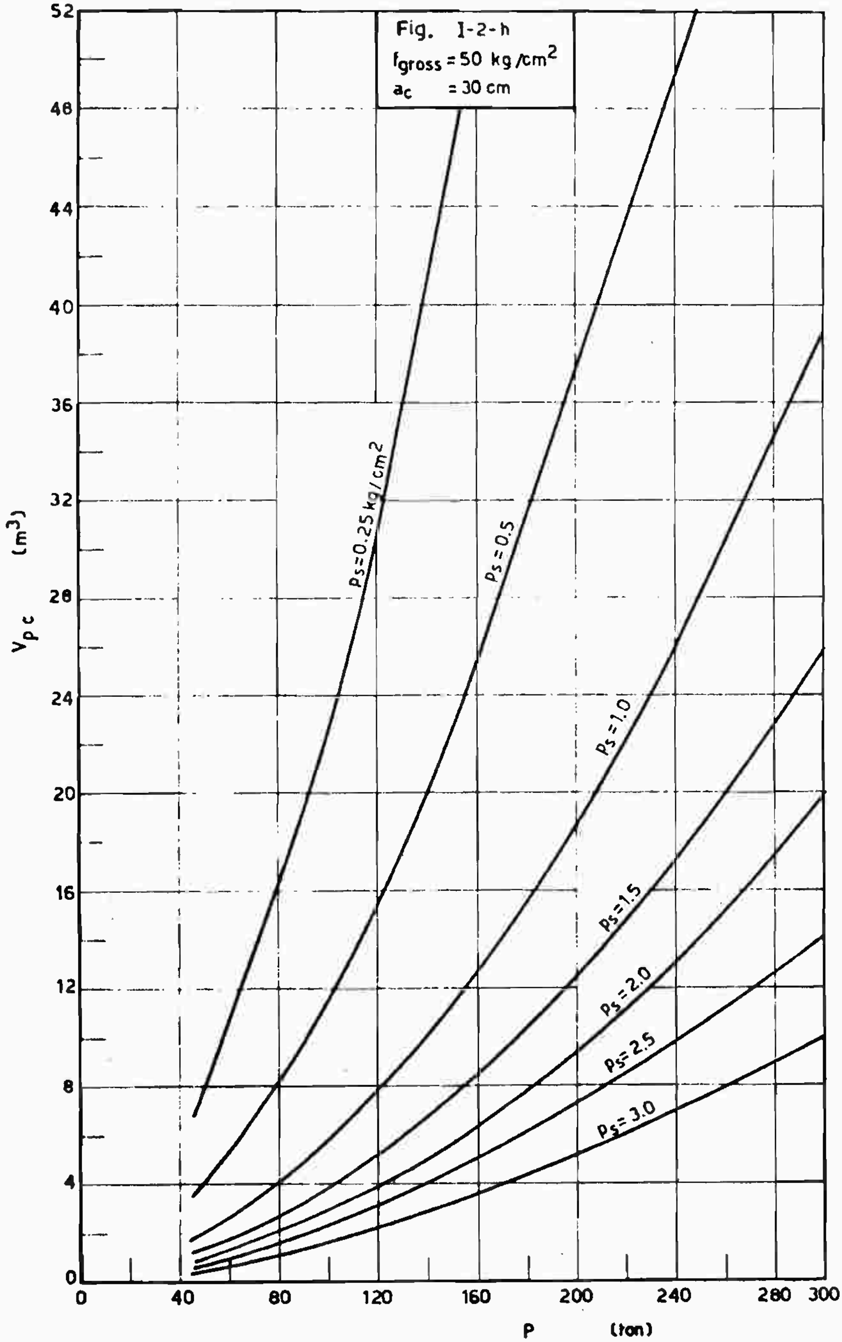


Fig. I-2-h
f_{gross} = 50 kg/cm²
a_c = 30 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
V_{pc} (m³)
P (ton)
0 4 8 12 16 20 24 28 32 36 40 44 48 52
0 40 80 120 160 200 240 280 300

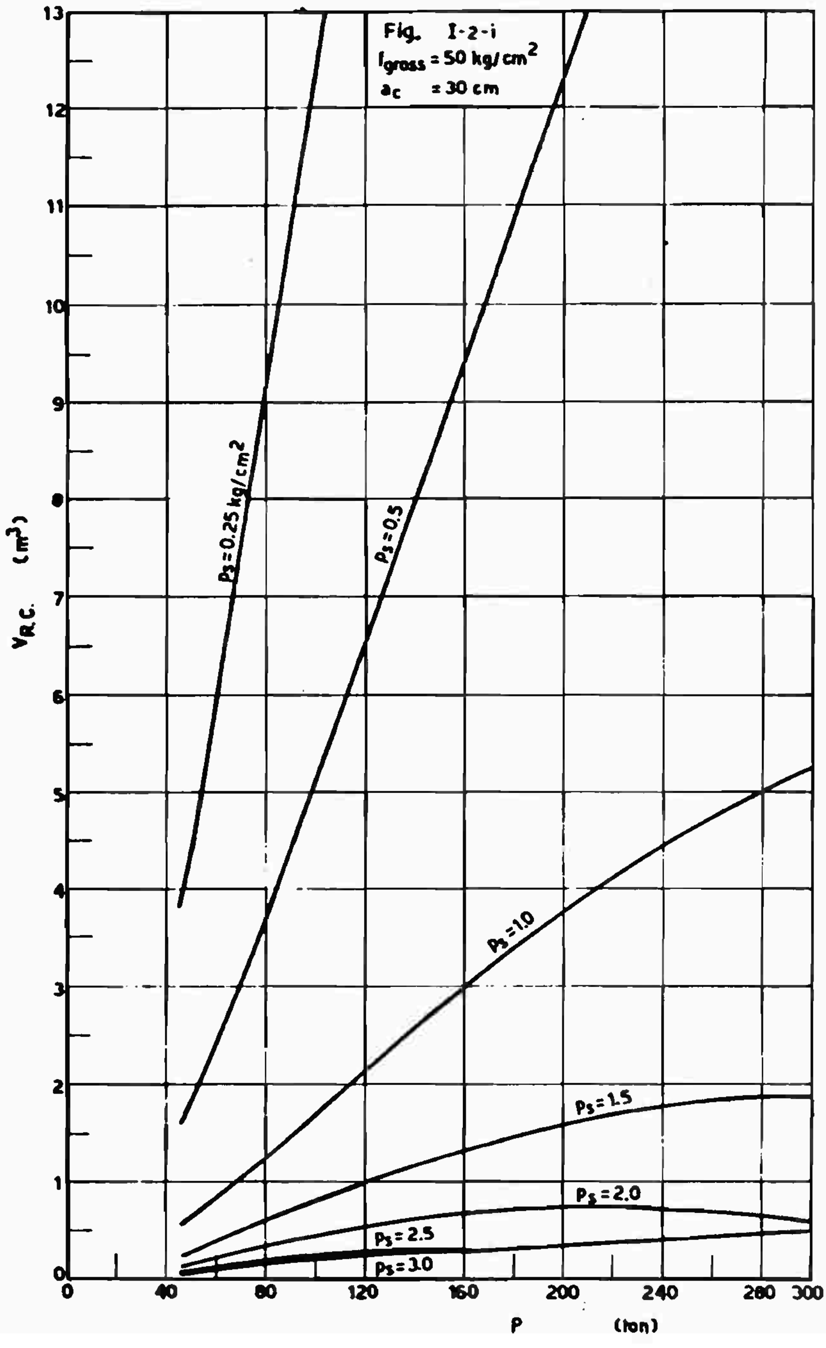


Fig. I-2-i
f_{gross} = 50 kg/cm²
a_c = 30 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
$V_{R.C.}$ (m³)
P (ton)
0
40
80
120
160
200
240
280
300
1
2
3
4
5
6
7
8
9
10
11
12
13

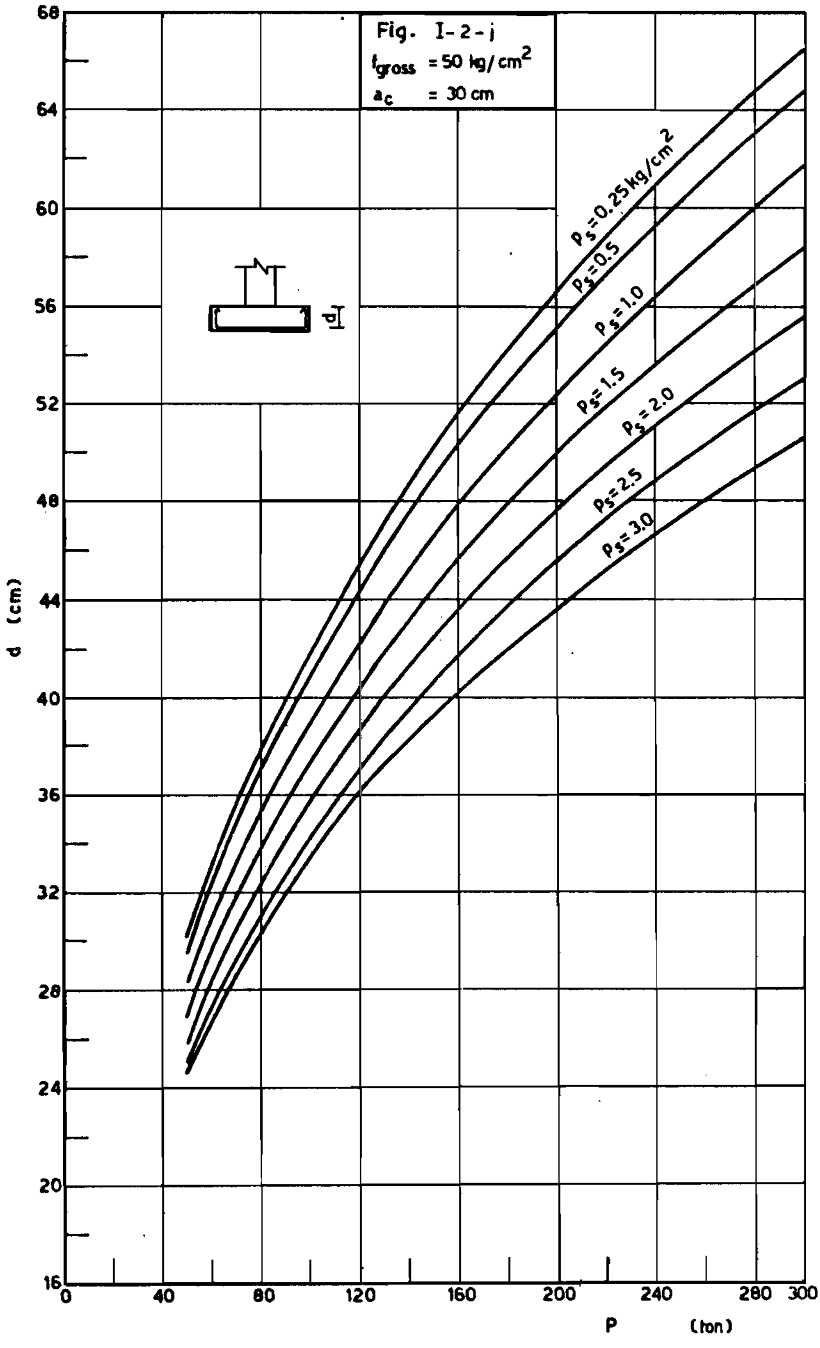


Fig. I-2-j
f_{gross} = 50 kg/cm²
a_c = 30 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
d
d (cm)
68
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300
P (ton)

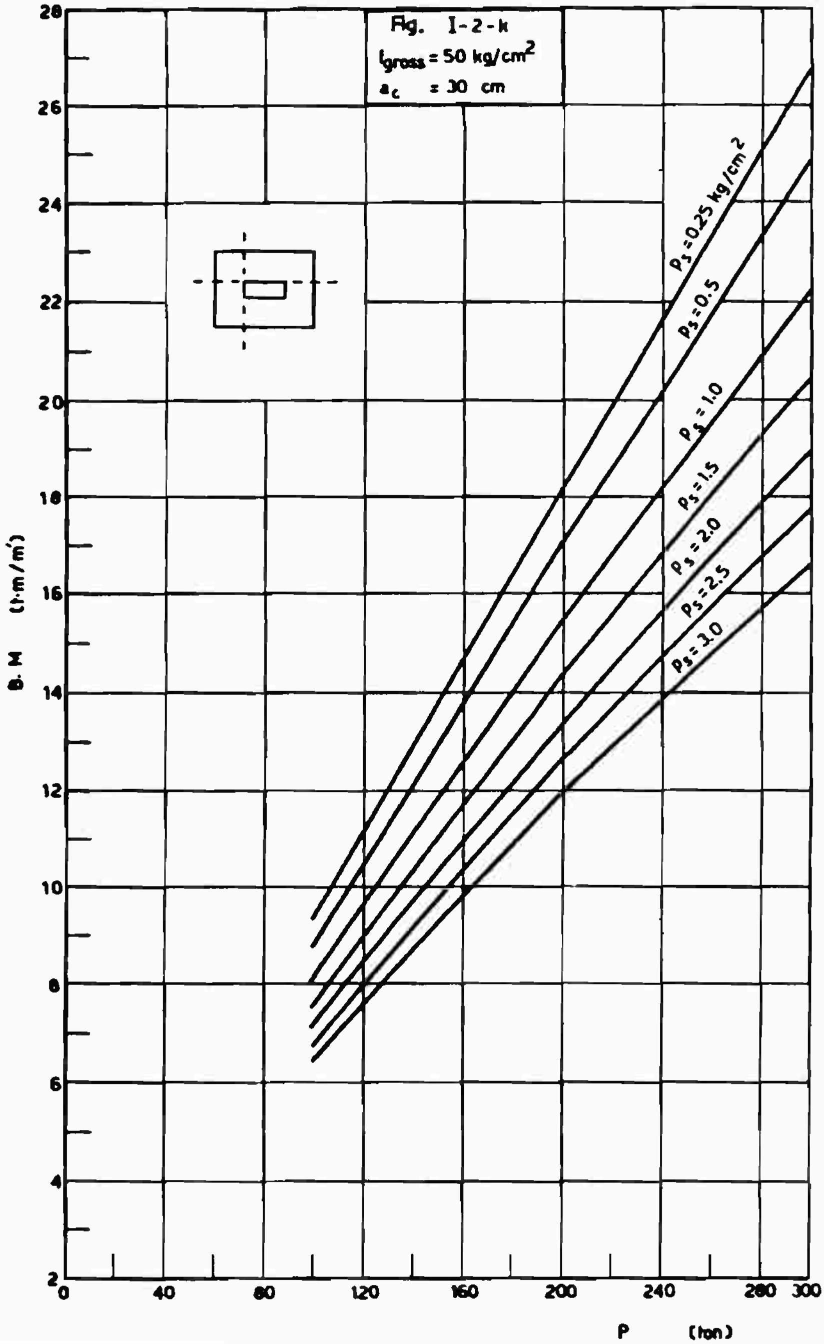


Fig. I-2-k
f_{gross} = 50 kg/cm²
a_c = 30 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
B. M (t·m/m')
P (ton)
2 4 6 8 10 12 14 16 18 20 22 24 26 28
0 40 80 120 160 200 240 280 300

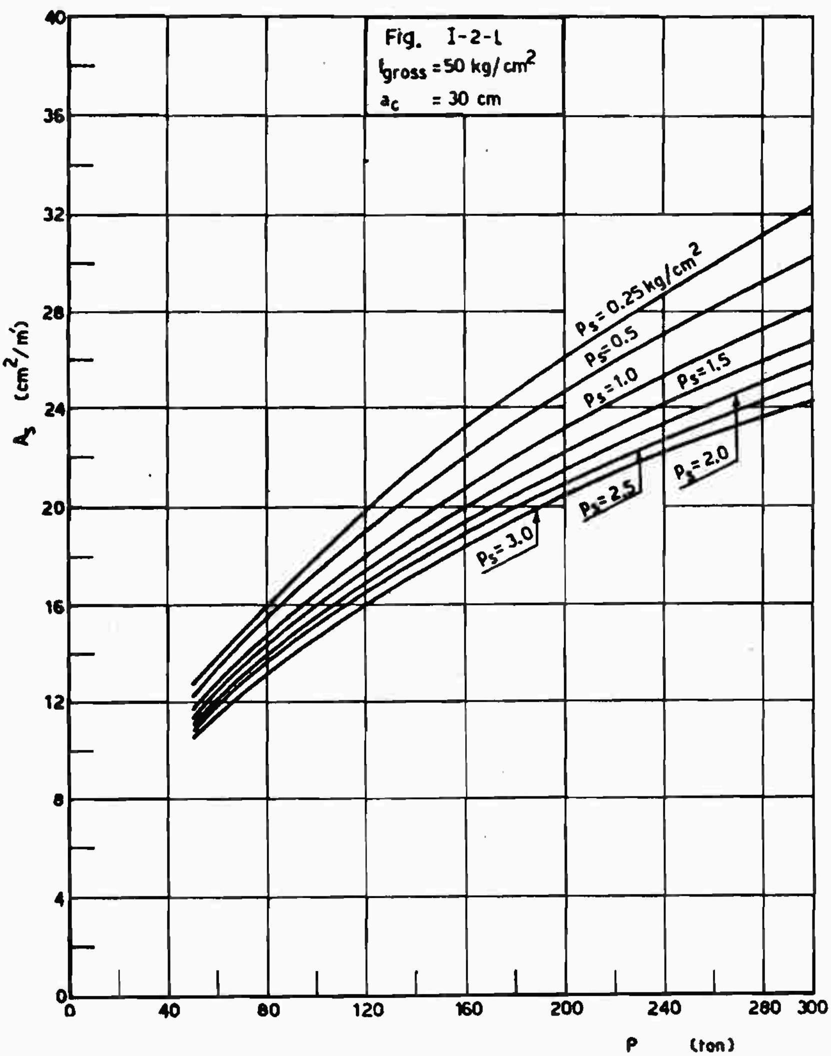


Fig. I-2-L
f gross = 50 kg/cm2
ac = 30 cm
Ps = 0.25 kg/cm2
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
As (cm2/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
40
80
120
160
200
240
280
300

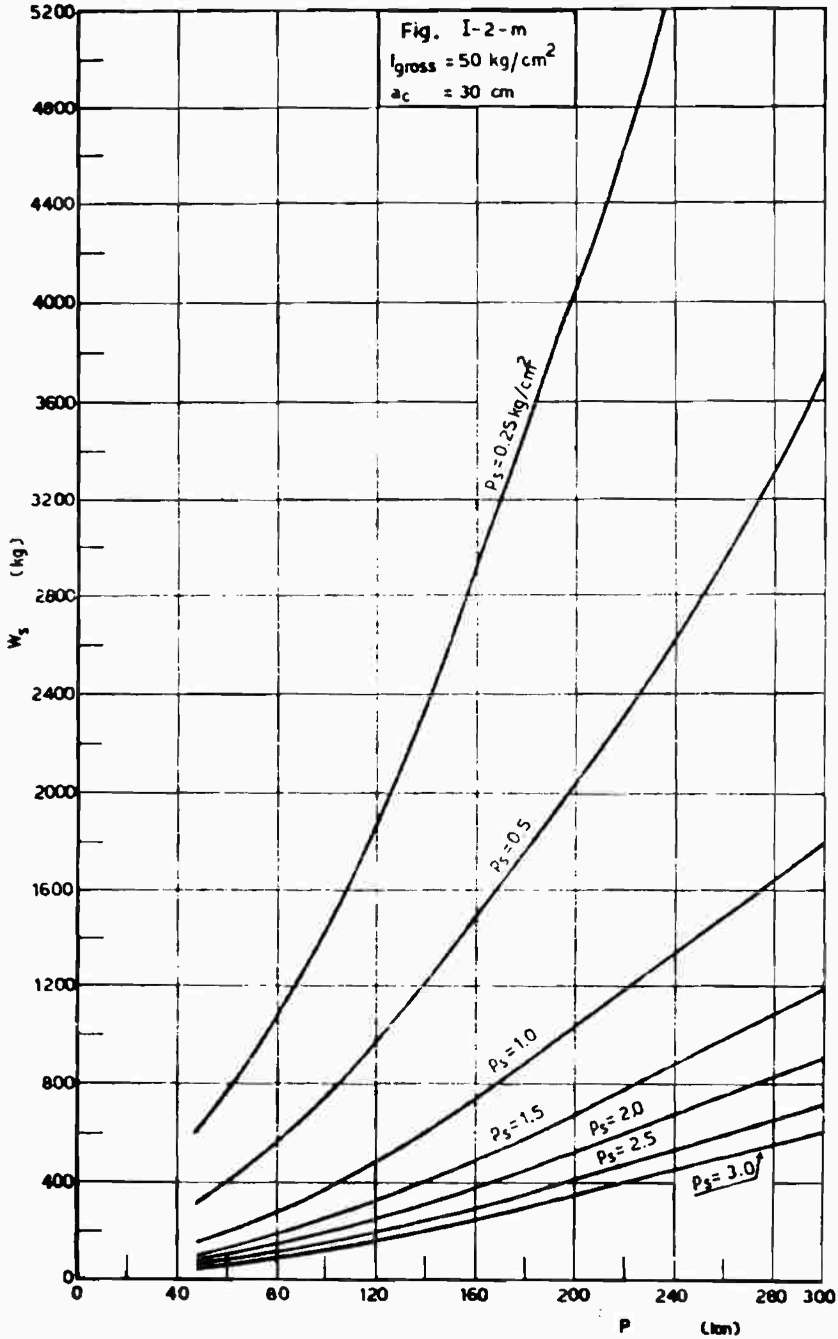


Fig. I-2-m
I_{gross} = 50 kg/cm^2
a_c = 30 cm
P_s=0.25 kg/cm^2
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
W_s (kg)
P (ton)
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200
40
80
120
160
200
240
280
300

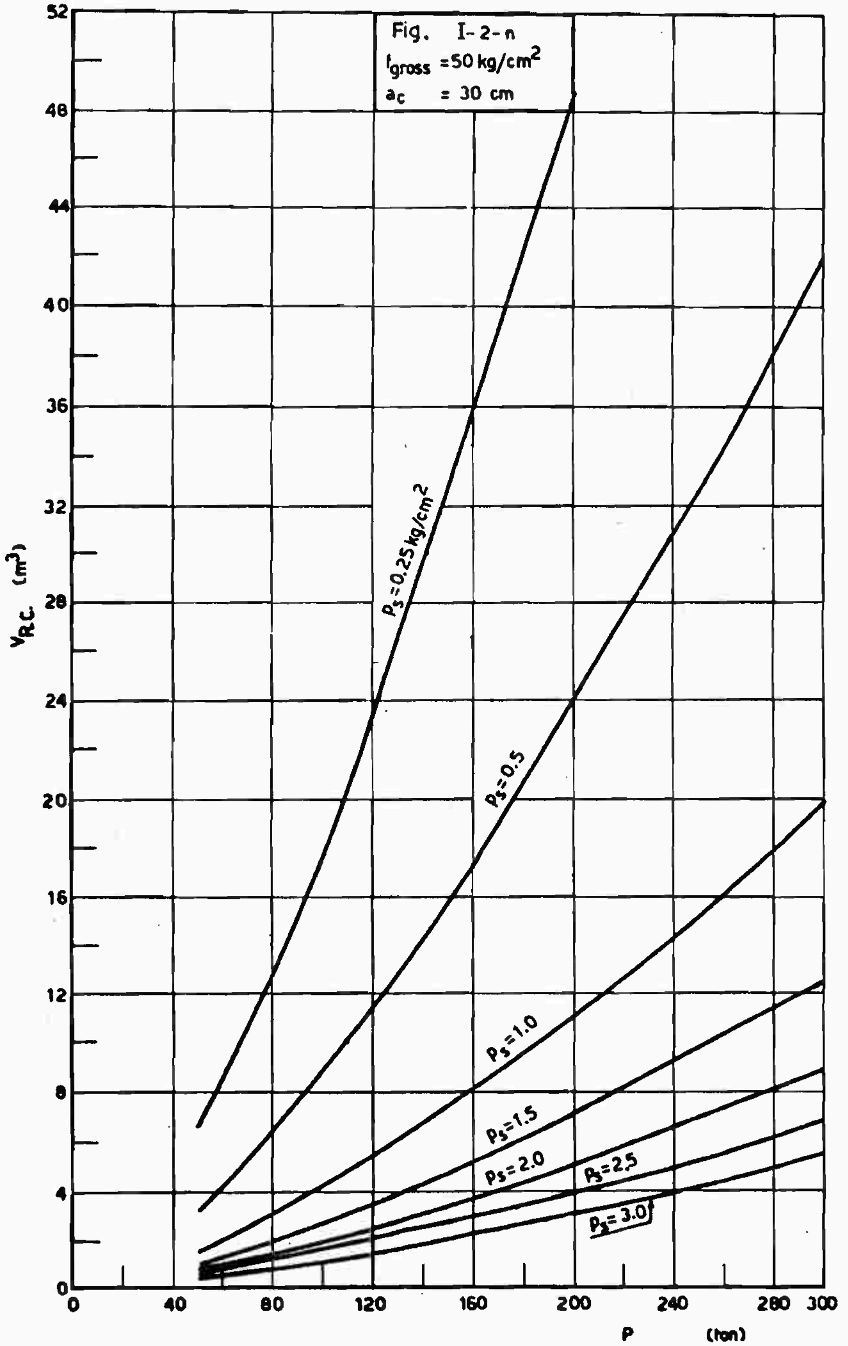


Fig. I-2-n
f_{gross} = 50 kg/cm²
a_c = 30 cm
p_s=0.25 kg/cm²
p_s=0.5
p_s=1.0
p_s=1.5
p_s=2.0
p_s=2.5
p_s=3.0
$V_{R.C.}$ (m³)
P (ton)
0 4 8 12 16 20 24 28 32 36 40 44 48 52
0 40 80 120 160 200 240 280 300

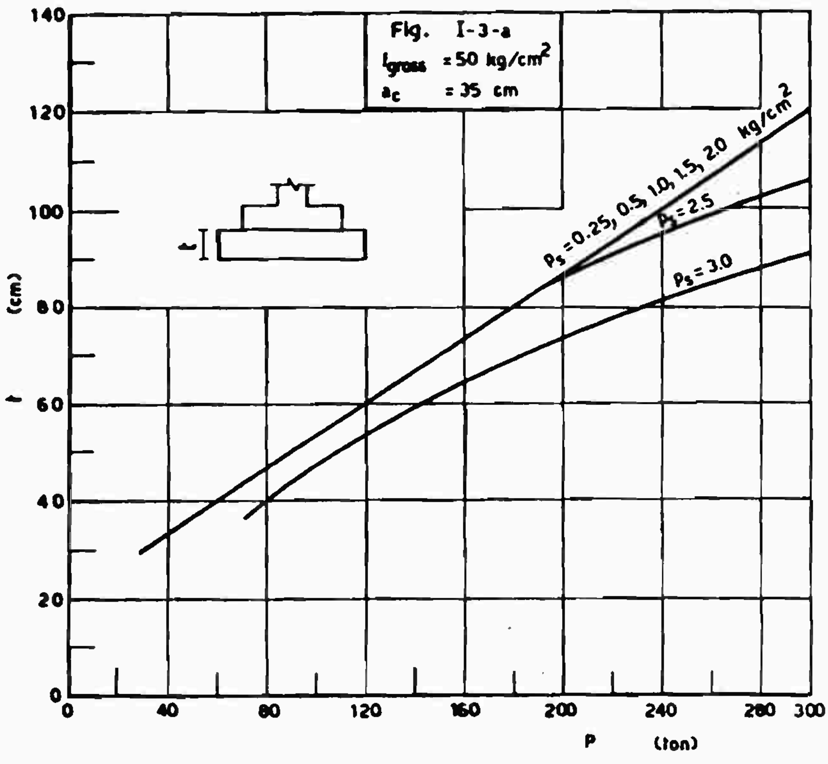


Fig. I-3-a
f_{gross} = 50 kg/cm^2
a_c = 35 cm
P_s = 0.25, 0.5, 1.0, 1.5, 2.0 kg/cm^2
P_s = 2.5
P_s = 3.0
t (cm)
P (ton)
0
20
40
60
80
100
120
140
0
40
80
120
160
200
240
280
300

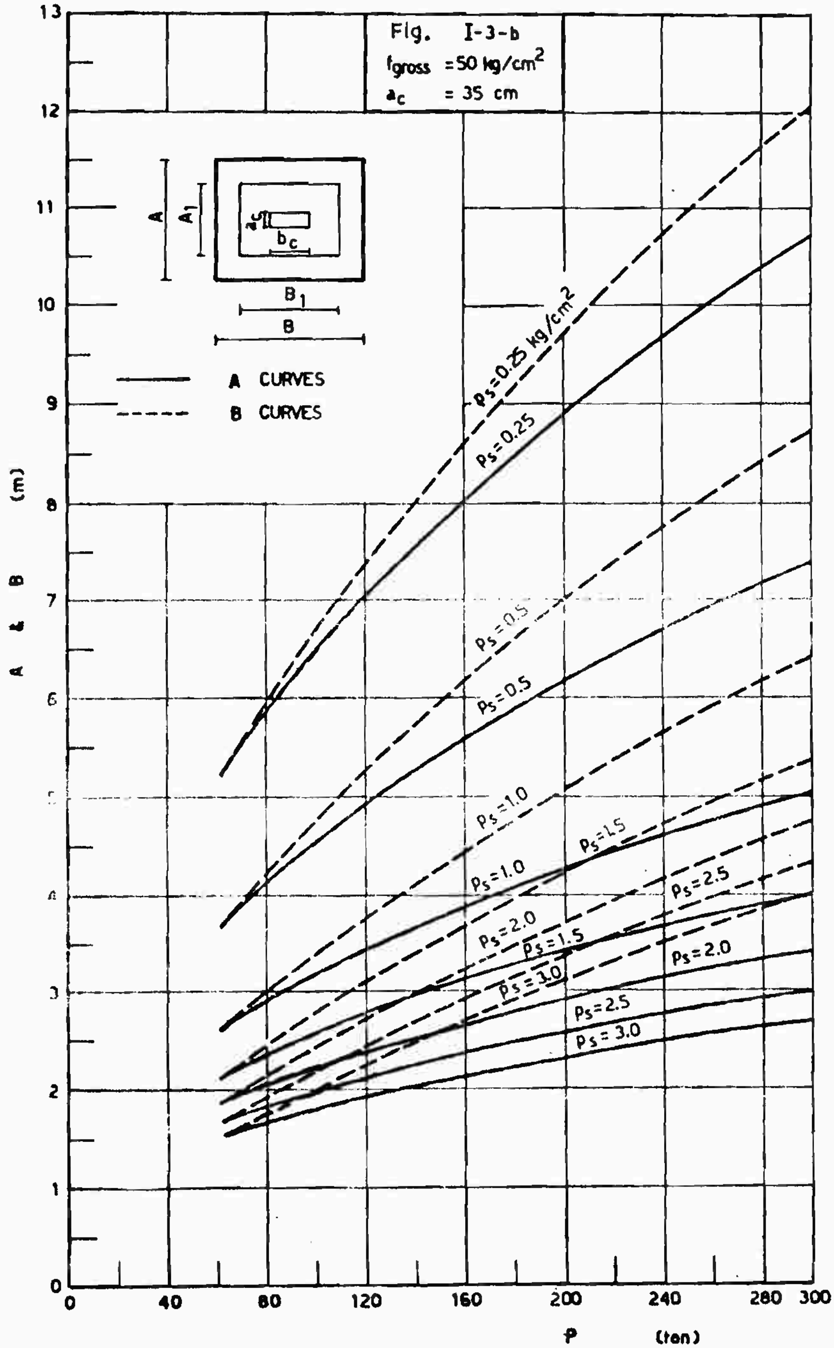


Fig. I-3-b
f_{gross} = 50 kg/cm²
a_c = 35 cm
A
A_1
a_c
b_c
B_1
B
A CURVES
B CURVES
Ps=0.25 kg/cm²
Ps=0.25
Ps=0.5
Ps=0.5
Ps=1.0
Ps=1.5
Ps=1.0
Ps=2.5
Ps=2.0
Ps=1.5
Ps=3.0
Ps=2.0
Ps=2.5
Ps=3.0
A & B (m)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
0
40
80
120
160
200
240
280
300

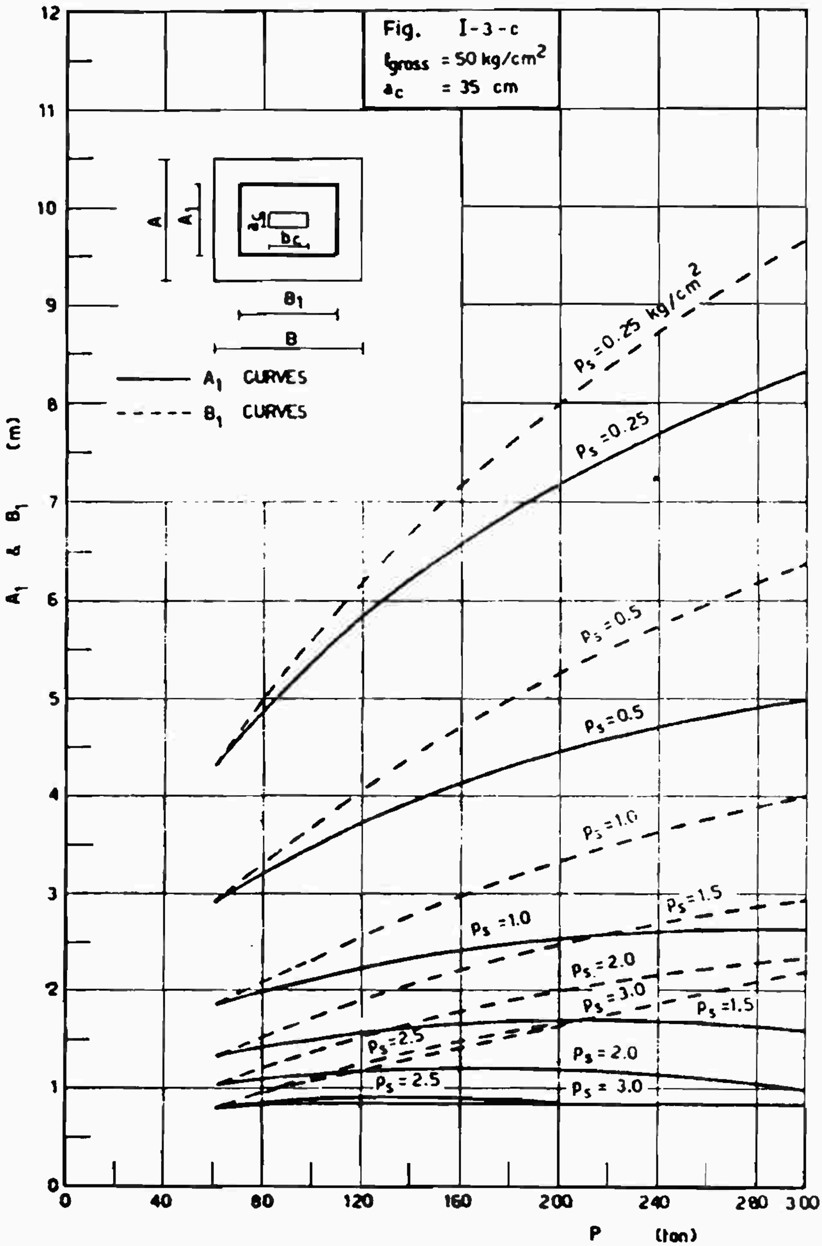


Fig. I-3-c
f_{gross} = 50 kg/cm²
a_c = 35 cm
A
A_1
a_c
b_c
B_1
B
A_1 CURVES
B_1 CURVES
P_s = 0.25 kg/cm²
P_s = 0.25
P_s = 0.5
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 1.0
P_s = 2.0
P_s = 3.0
P_s = 1.5
P_s = 2.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
A_1 & B_1 (m)
P (ton)
0 40 80 120 160 200 240 280 300
0 1 2 3 4 5 6 7 8 9 10 11 12

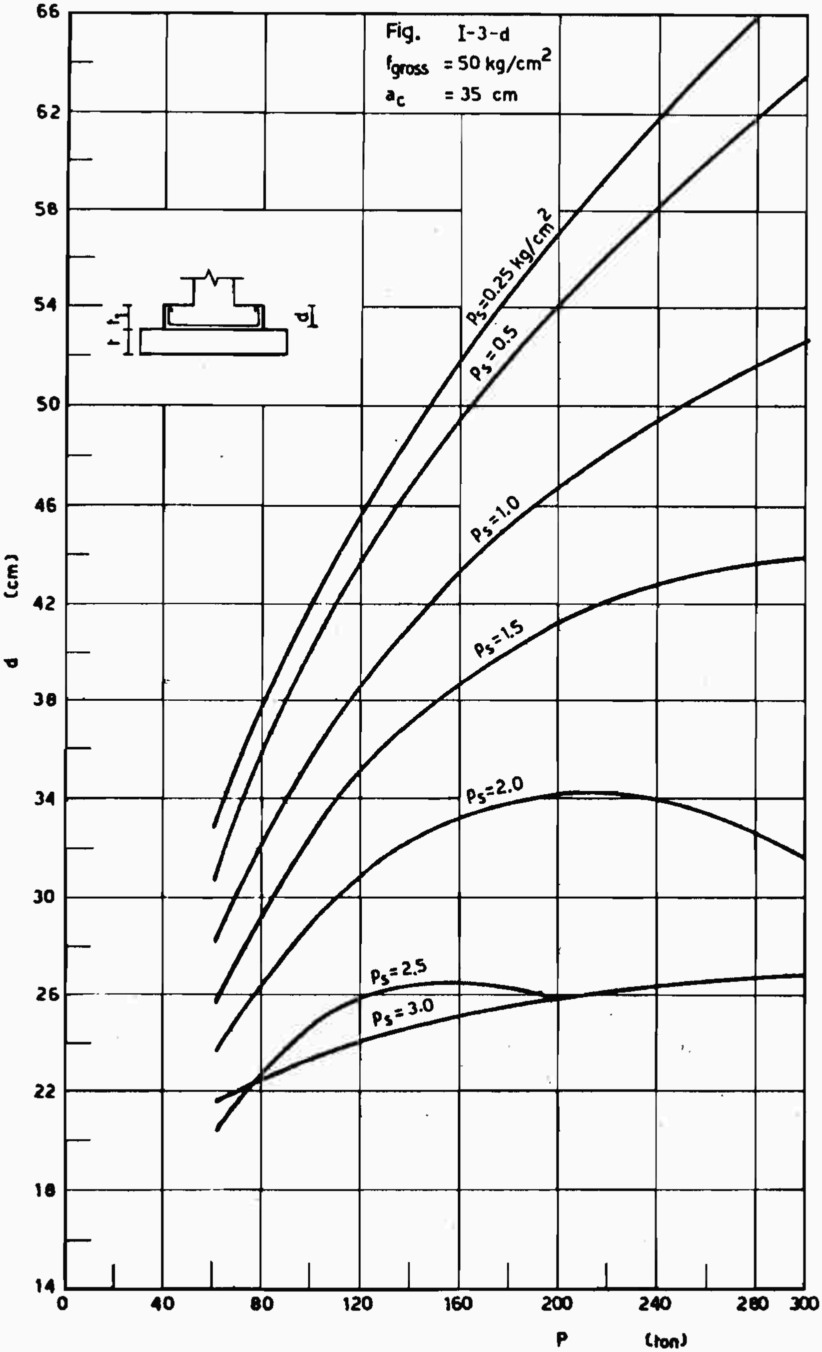


Fig. I-3-d
f_{gross} = 50 kg/cm²
a_c = 35 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
d (cm)
P (ton)
66
62
58
54
50
46
42
38
34
30
26
22
18
14
0
40
80
120
160
200
240
280
300

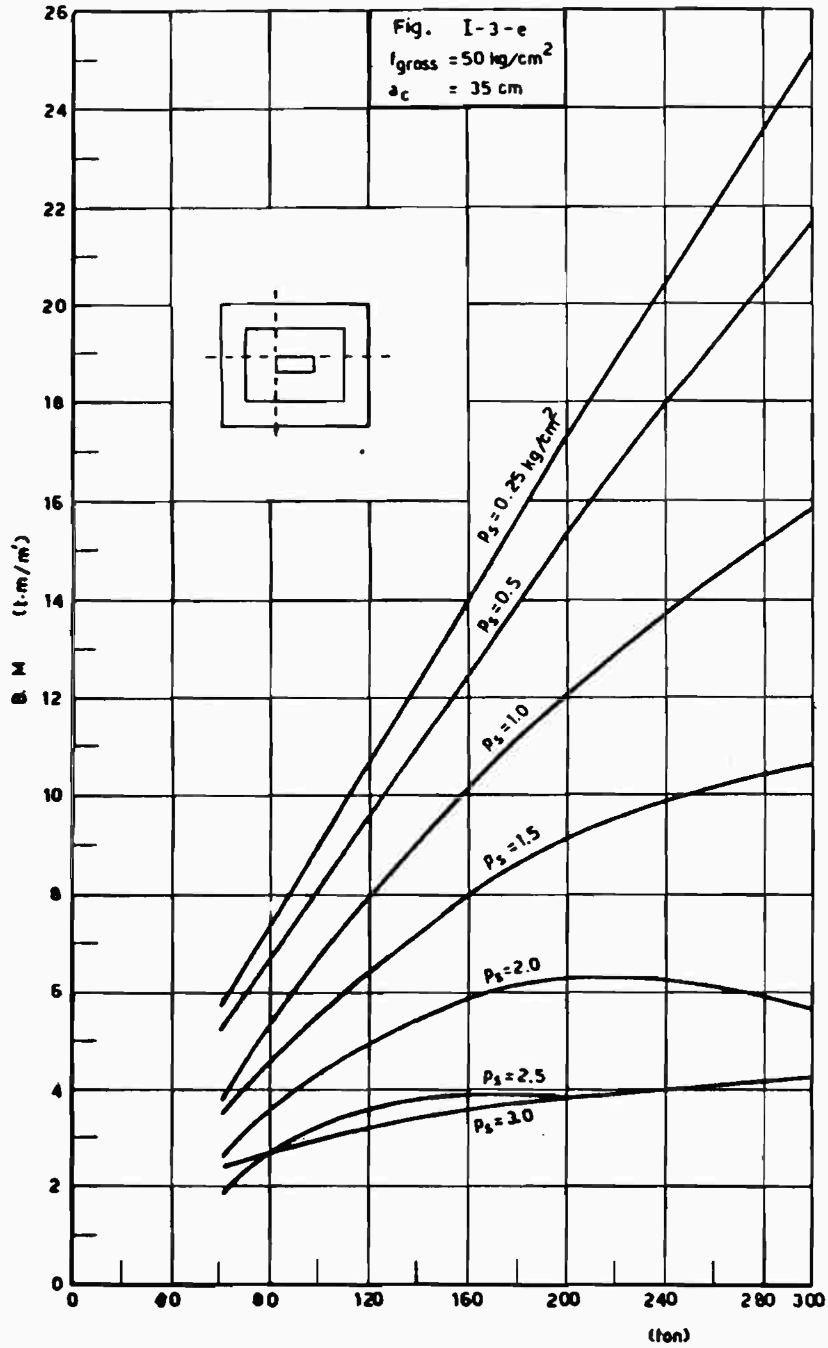


Fig. I-3-e
f_{gross} = 50 kg/cm²
a_c = 35 cm
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
B. M (t.m/m')
(ton)
0 2 4 6 8 10 12 14 16 18 20 22 24 26
0 40 80 120 160 200 240 280 300

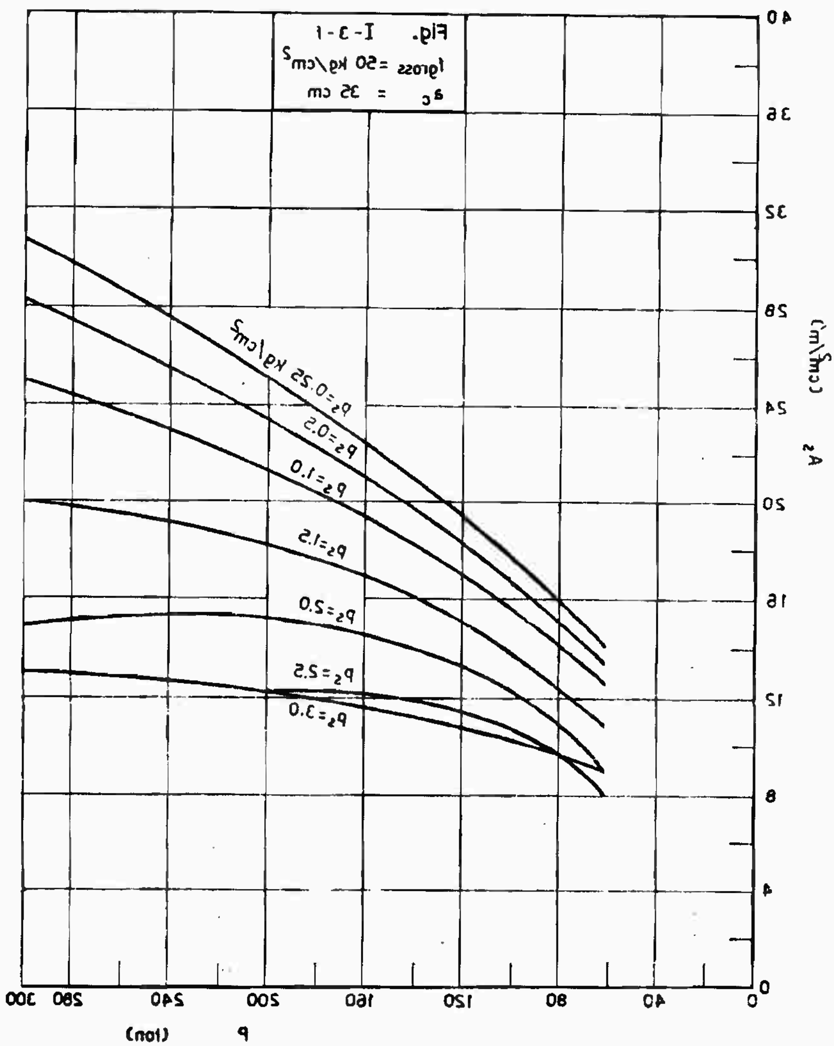


Fig. I-3-1
fgross =50 kg/cm2
ac = 35 cm
ps=0.25 kg/cm2
ps=0.5
ps=1.0
ps=1.5
ps=2.0
ps=2.5
ps=3.0
As (cm2/m)
P (ton)
0
4
8
12
16
20
24
28
32
36
40
40
80
120
160
200
240
280
300

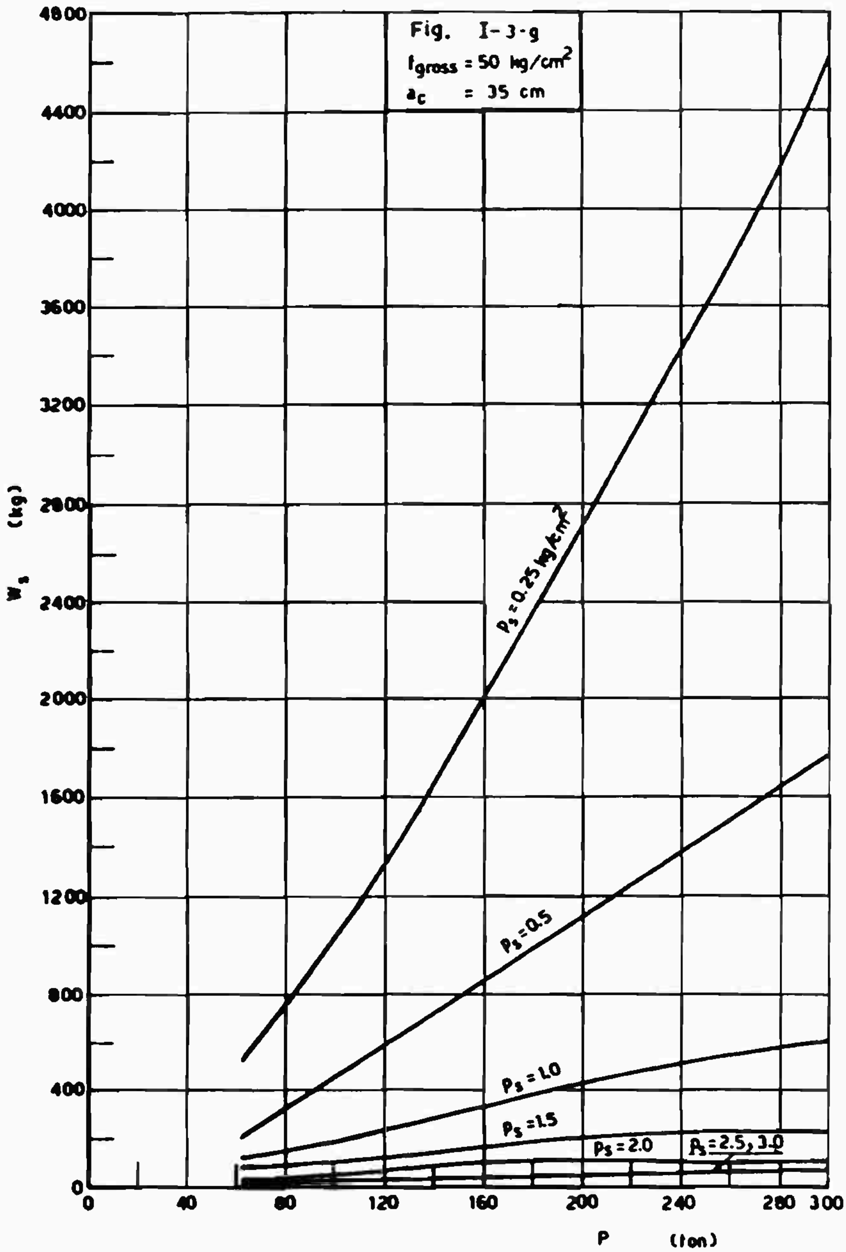


Fig. I-3-g
f_{gross} = 50 kg/cm²
a_c = 35 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5, 3.0
W_s (kg)
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
0
40
80
120
160
200
240
280
300
P (ton)

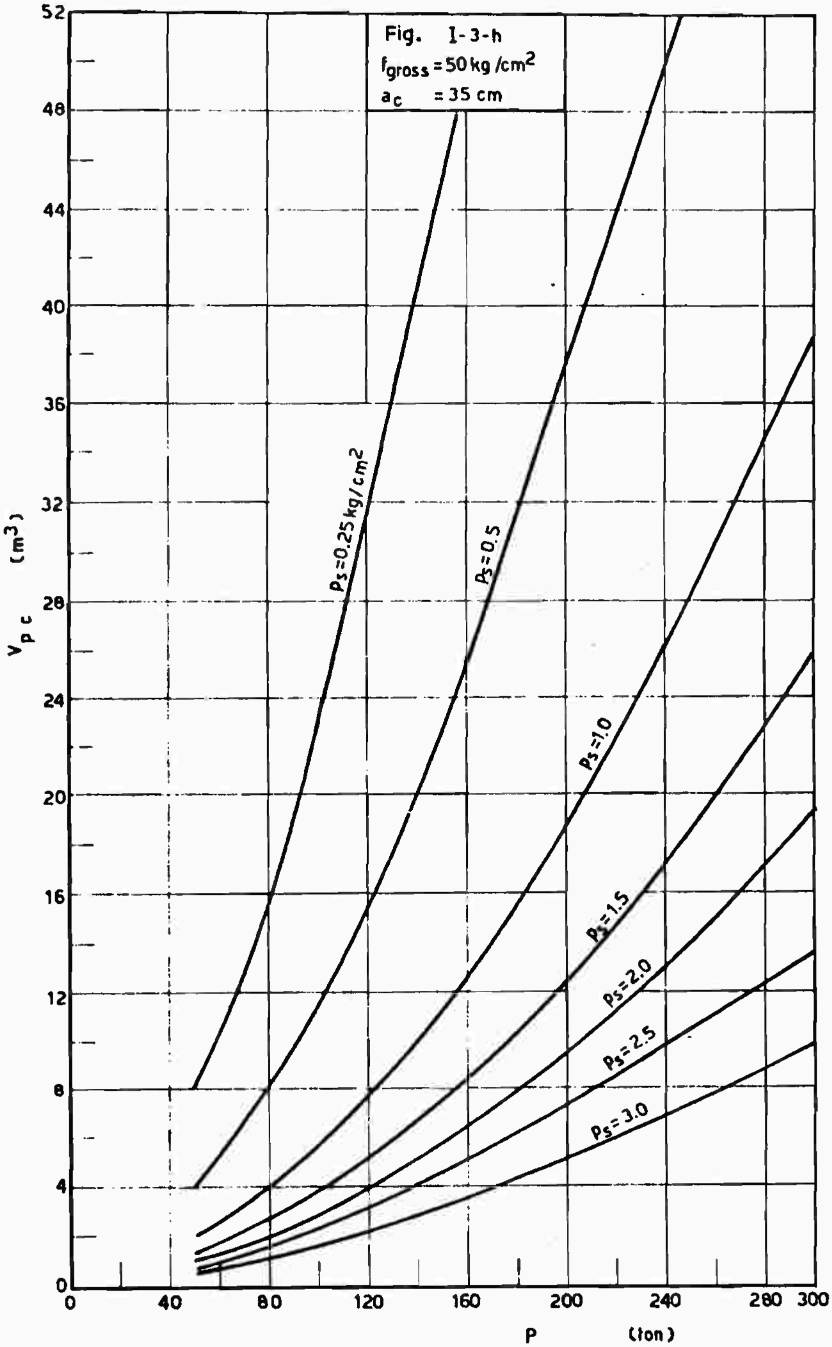


Fig. I-3-h
f gross = 50 kg/cm2
a c = 35 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
V p c (m3)
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
48
52
40
80
120
160
200
240
280
300

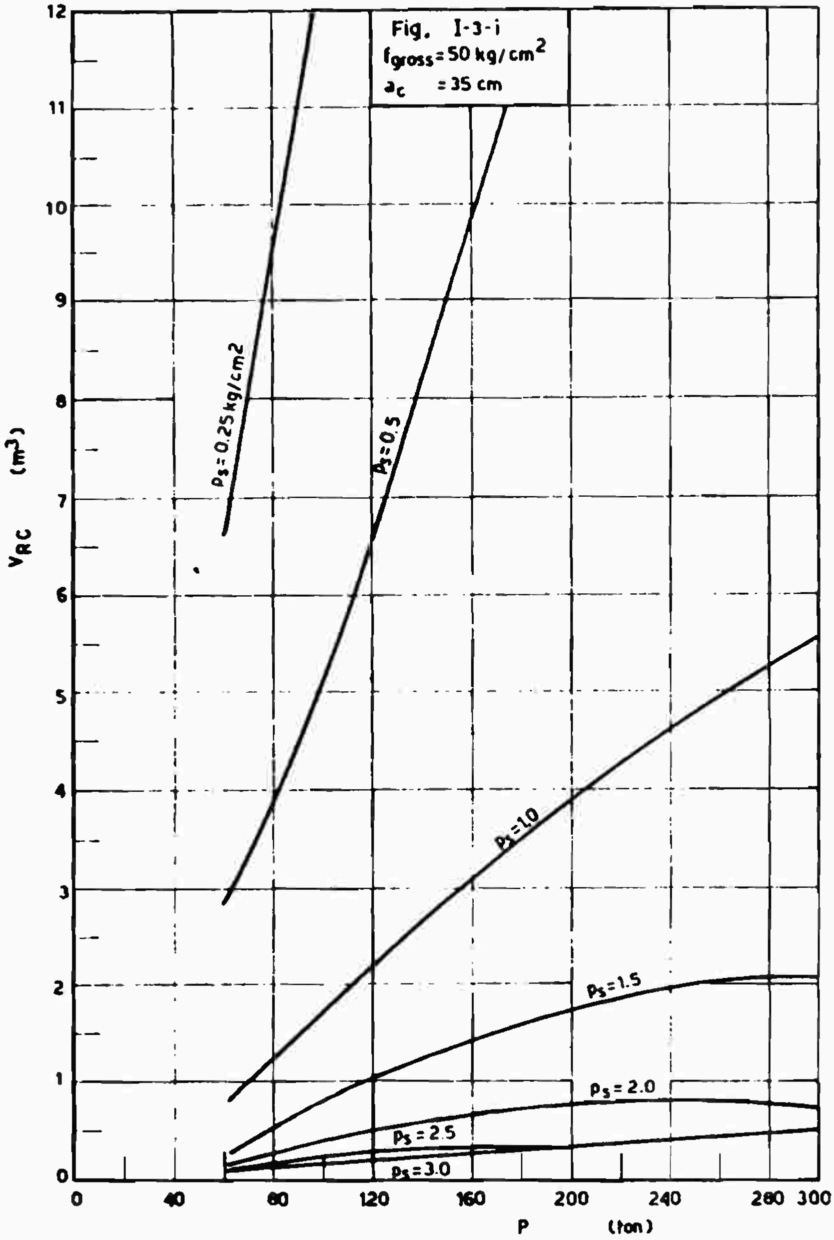


Fig. I-3-i
f_{gross} = 50 kg/cm²
a_c = 35 cm
p_s = 0.25 kg/cm2
p_s = 0.5
p_s = 1.0
p_s = 1.5
p_s = 2.0
p_s = 2.5
p_s = 3.0
V_{RC} (m³)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
280
300

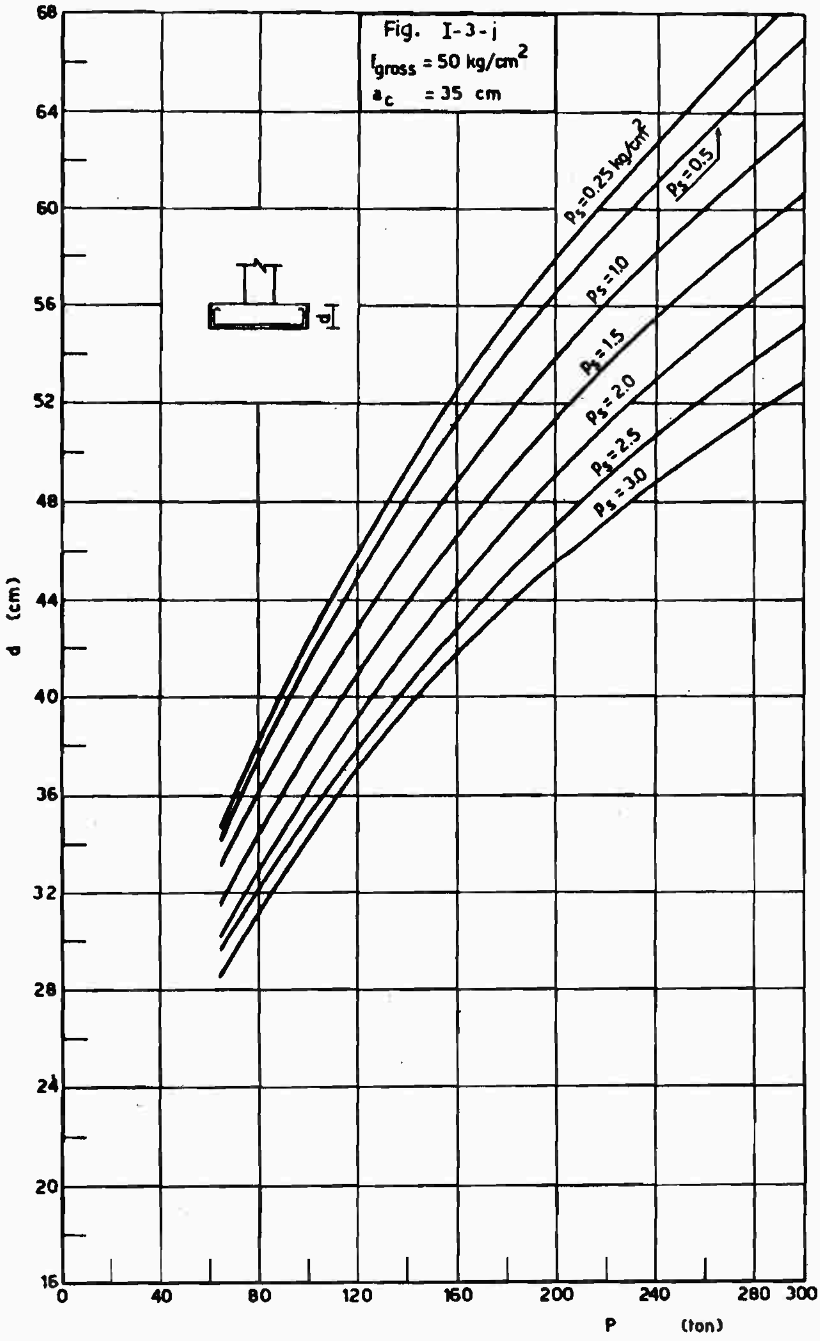


Fig. I-3-j
f_{gross} = 50 kg/cm^2
a_c = 35 cm
Ps=0.25 kg/cm^2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d
d (cm)
68
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300
P (ton)

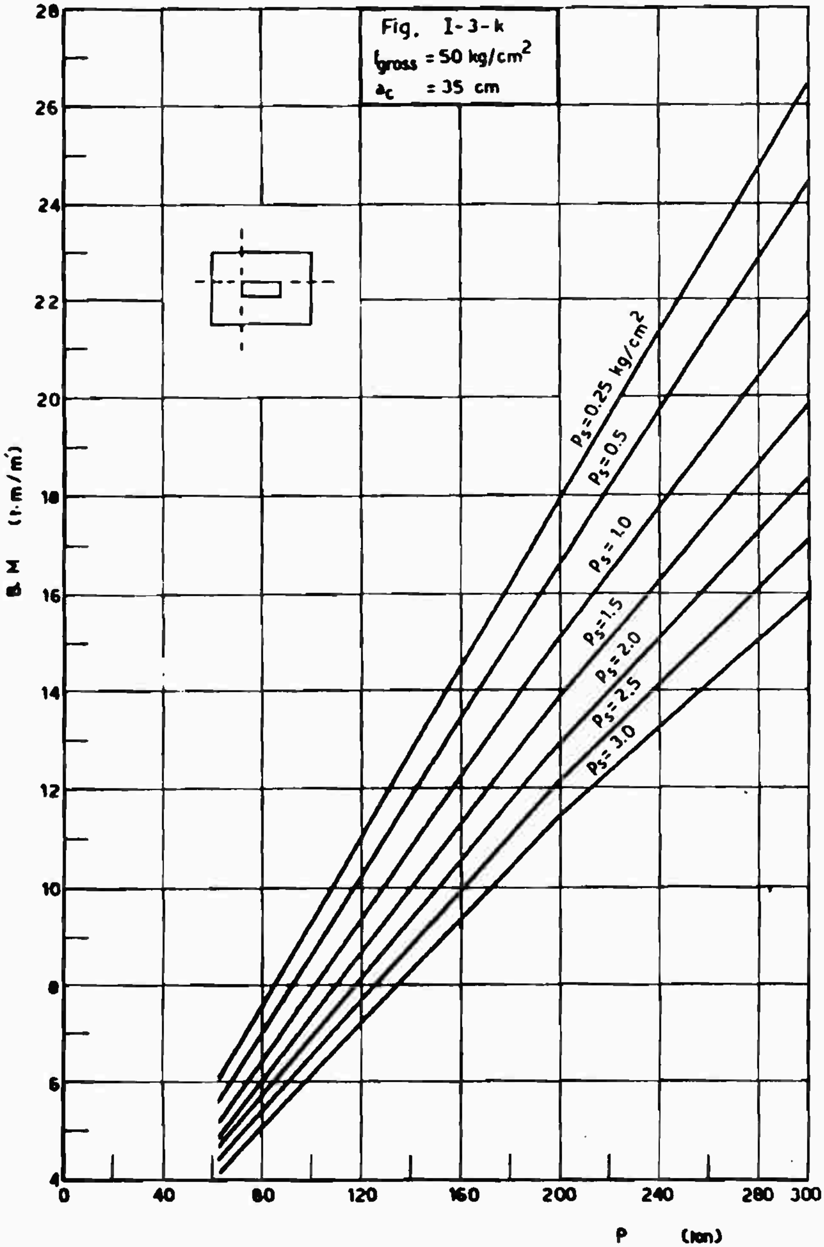


Fig. I-3-k
f_{gross} = 50 kg/cm²
a_c = 35 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
B.M (t.m/m')
P (ton)
4
6
8
10
12
14
16
18
20
22
24
26
28
0
40
80
120
160
200
240
280
300

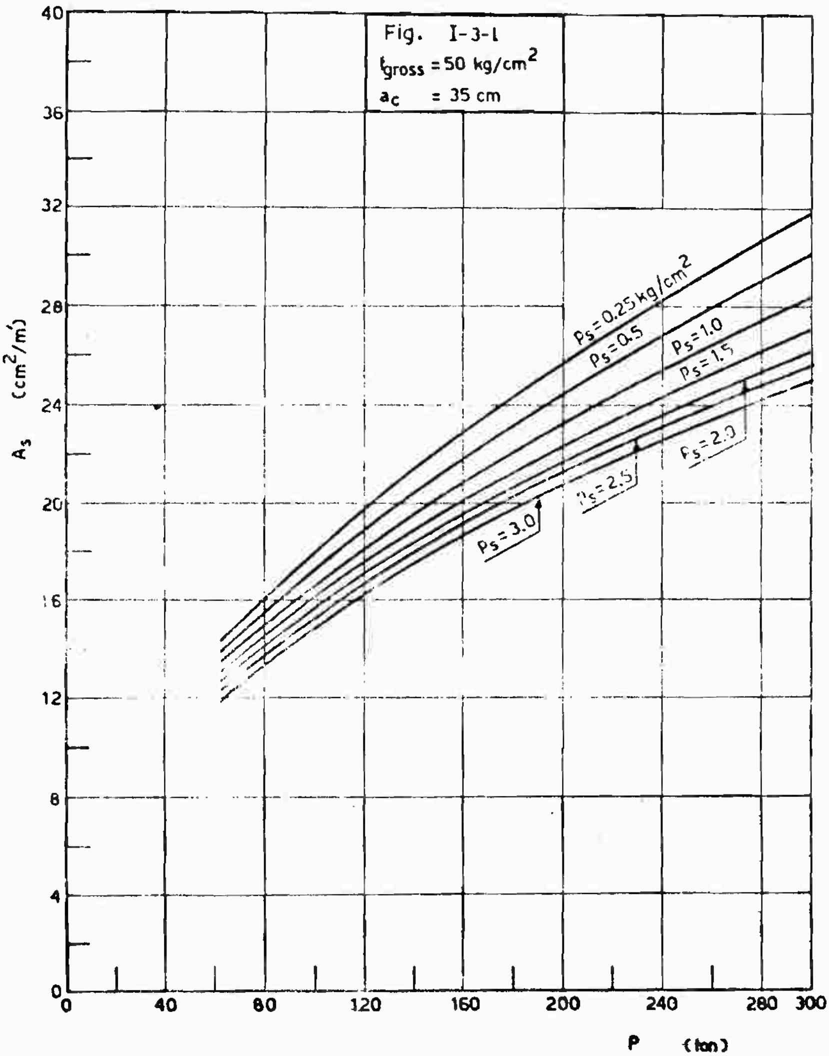


Fig. I-3-1
f_{gross} = 50 kg/cm²
a_c = 35 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
As (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
40
80
120
160
200
240
280
300

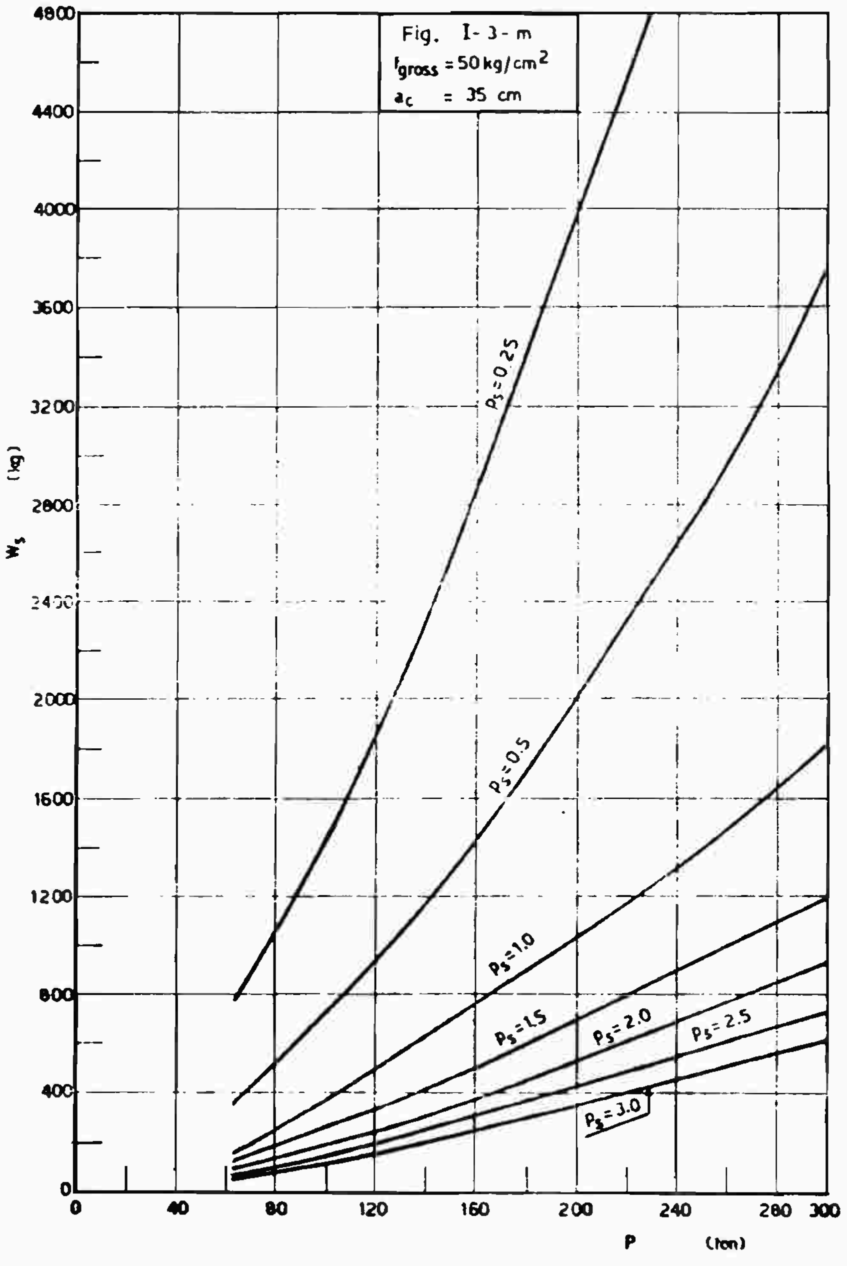


Fig. I-3-m
f_{gross} = 50 kg/cm^2
a_c = 35 cm
P_s=0.25
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
W_s (kg)
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
0
40
80
120
160
200
240
280
300
P (ton)

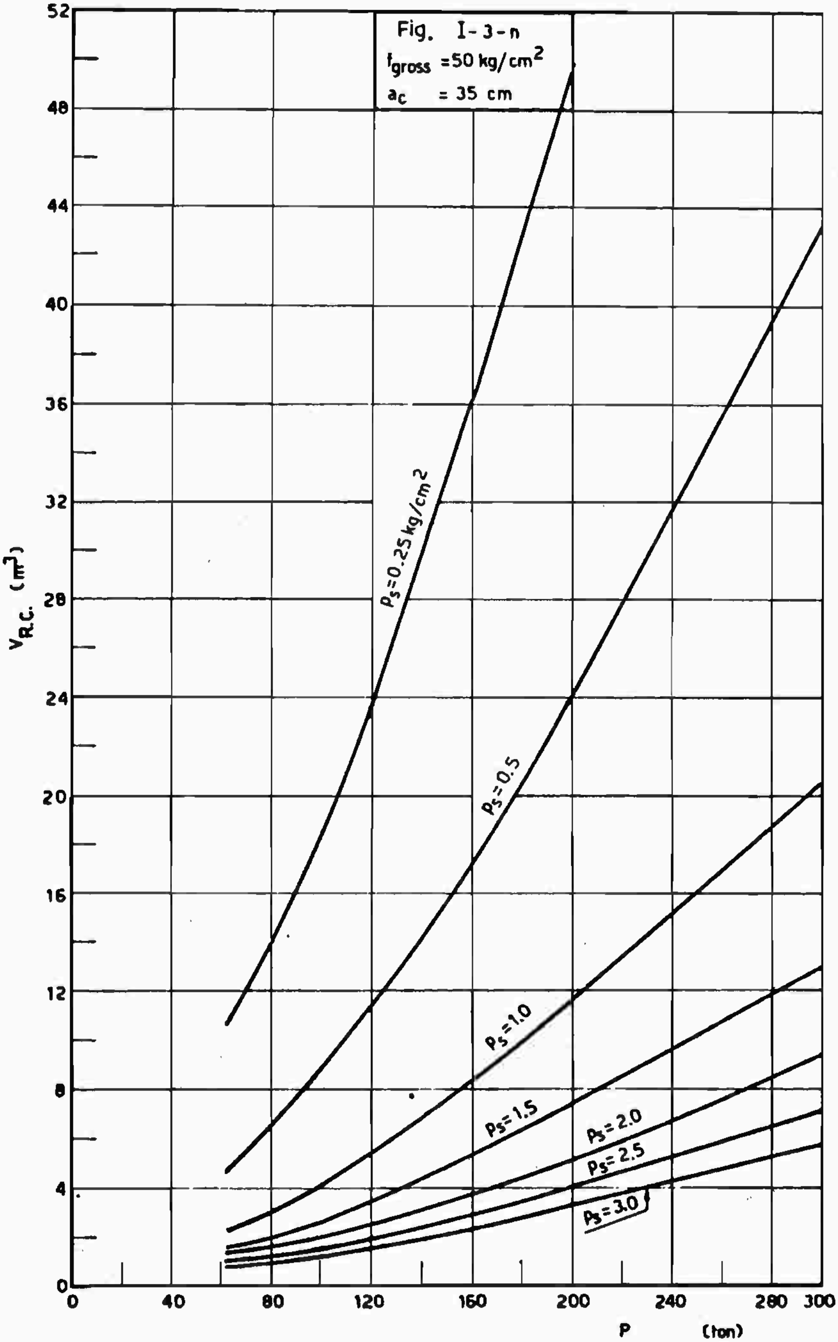


Fig. I-3-n
f gross = 50 kg/cm2
a c = 35 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
V R.C. (m3)
0
4
8
12
16
20
24
28
32
36
40
44
48
52
0
40
80
120
160
200
240
280
300
P (ton)

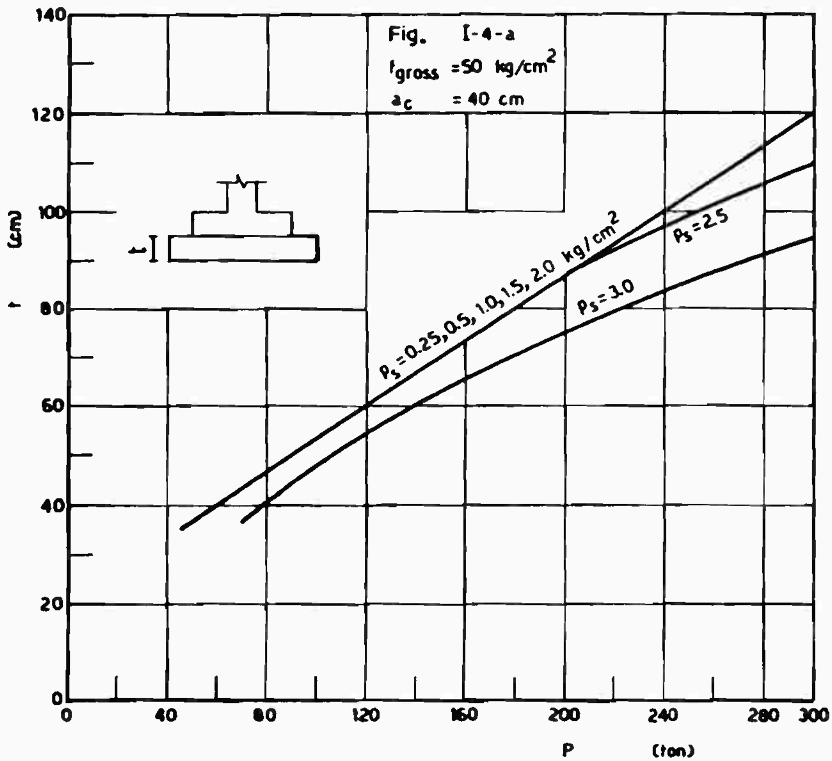


Fig. I-4-a
f_{gross} = 50 kg/cm^2
a_c = 40 cm
P_s=0.25, 0.5, 1.0, 1.5, 2.0 kg/cm^2
P_s=2.5
P_s=3.0
t (cm)
P (ton)
0
20
40
60
80
100
120
140
160
200
240
280
300

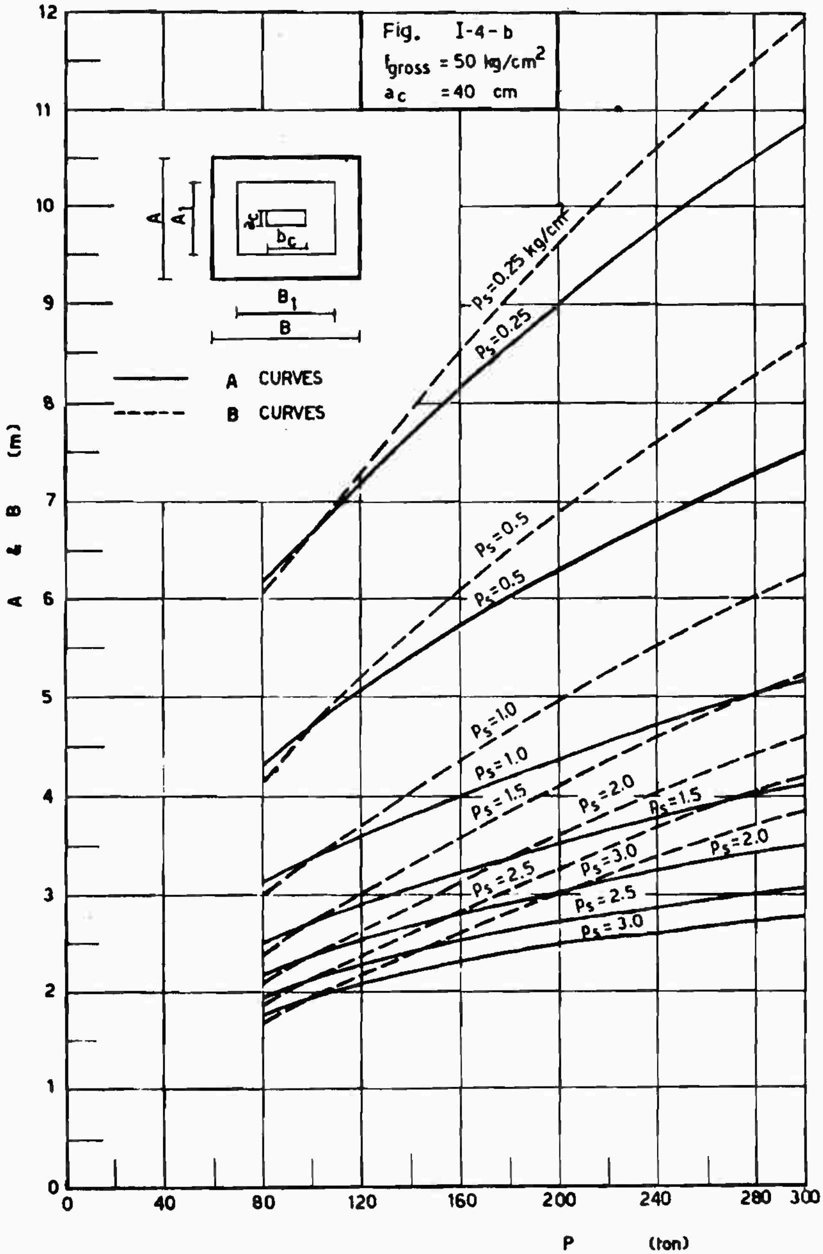


Fig. I-4-b
f_{gross} = 50 kg/cm^2
a_c = 40 cm
A
A_1
a_c
b_c
B_1
B
A CURVES
B CURVES
P_s=0.25 kg/cm^2
P_s=0.25
P_s=0.5
P_s=0.5
P_s=1.0
P_s=1.0
P_s=1.5
P_s=2.0
P_s=1.5
P_s=3.0
P_s=2.0
P_s=2.5
P_s=2.5
P_s=3.0
A & B (m)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
280
300
P (ton)

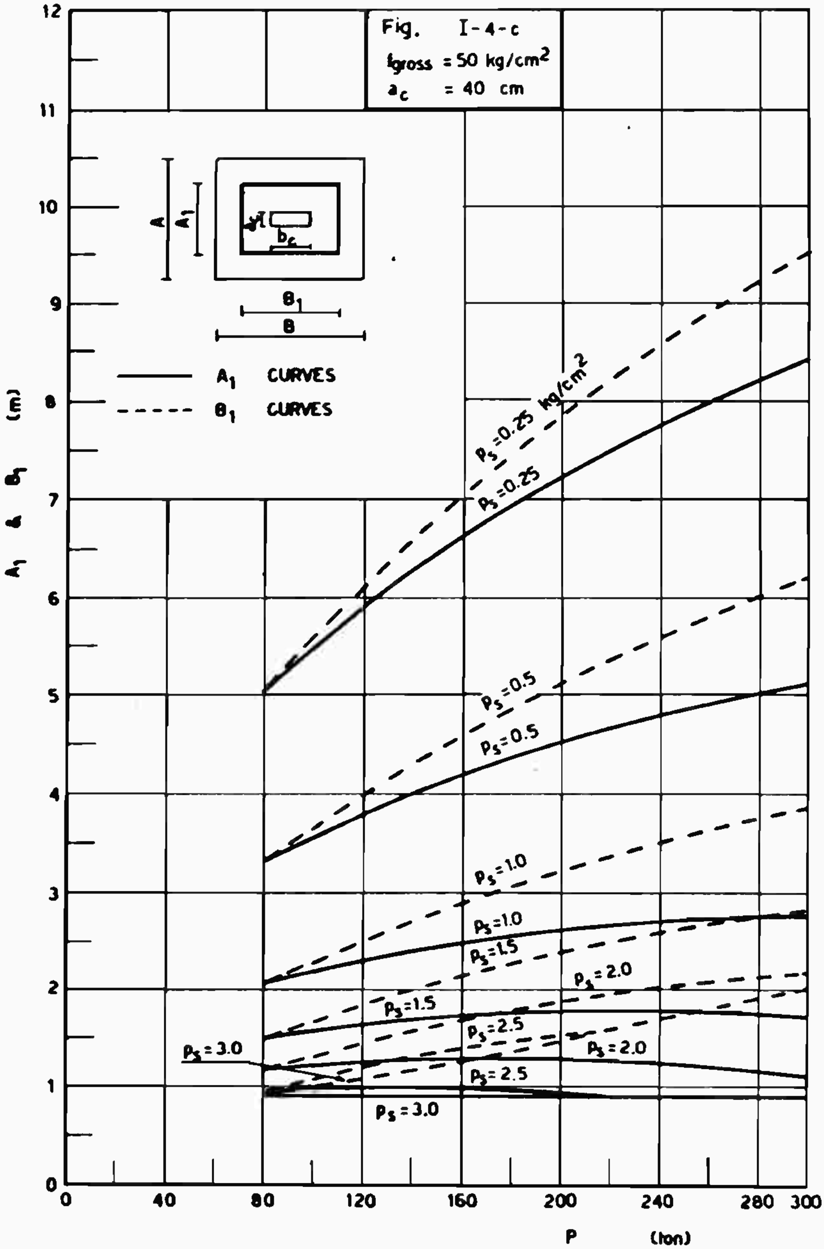


Fig. I-4-c
f_{gross} = 50 kg/cm²
a_c = 40 cm
A
A_1
b_c
B_1
B
A_1 CURVES
B_1 CURVES
P_s=0.25 kg/cm²
P_s=0.25
P_s=0.5
P_s=0.5
P_s=1.0
P_s=1.0
P_s=1.5
P_s=2.0
P_s=1.5
P_s=2.5
P_s=3.0
P_s=2.0
P_s=2.5
P_s=3.0
A_1 & B_1 (m)
P (ton)

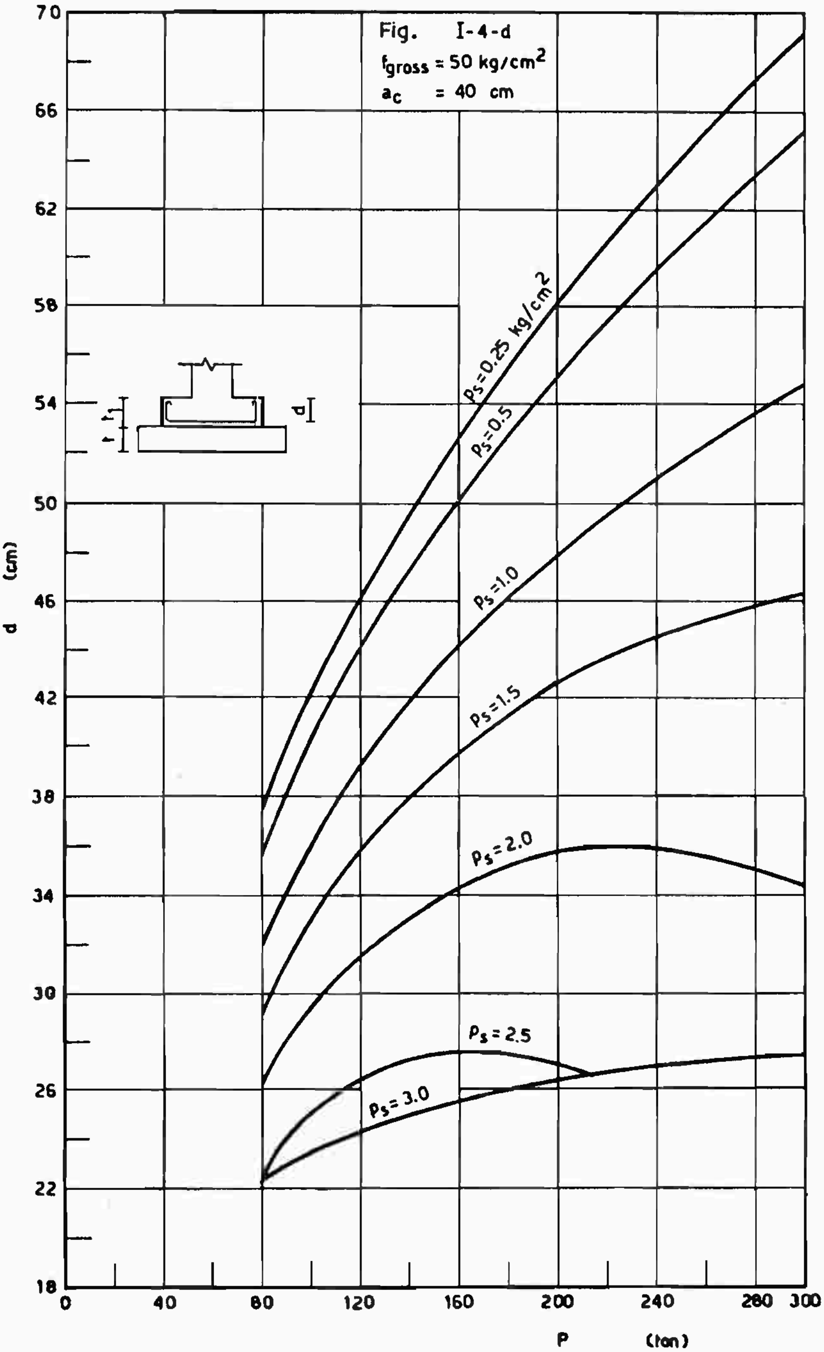


Fig. I-4-d
f_{gross} = 50 kg/cm²
a_c = 40 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d (cm)
P (ton)
70
66
62
58
54
50
46
42
38
34
30
26
22
18
0
40
80
120
160
200
240
280
300

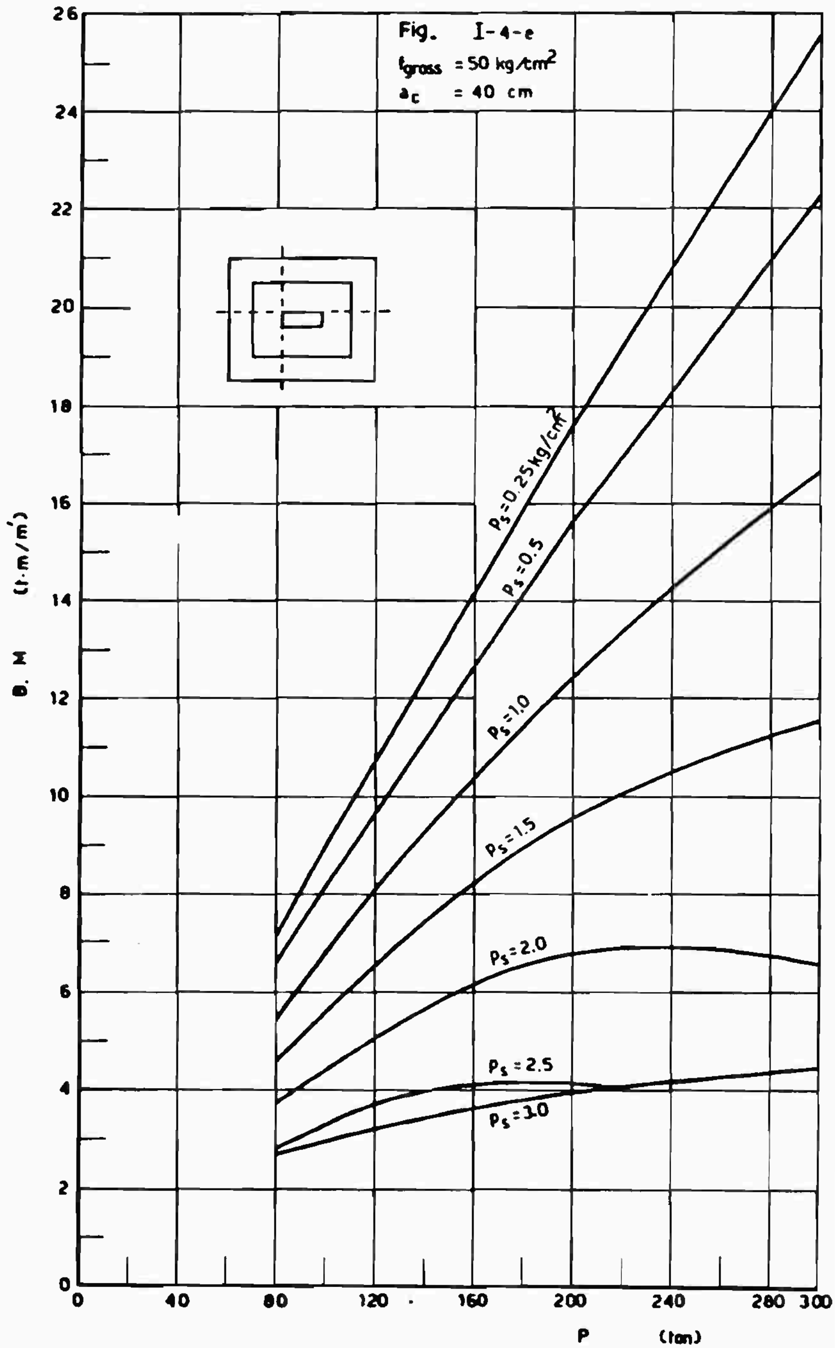


Fig. I-4-e
f_{gross} = 50 kg/cm²
a_c = 40 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
B. M (t.m/m')
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
0
40
80
120
160
200
240
280
300

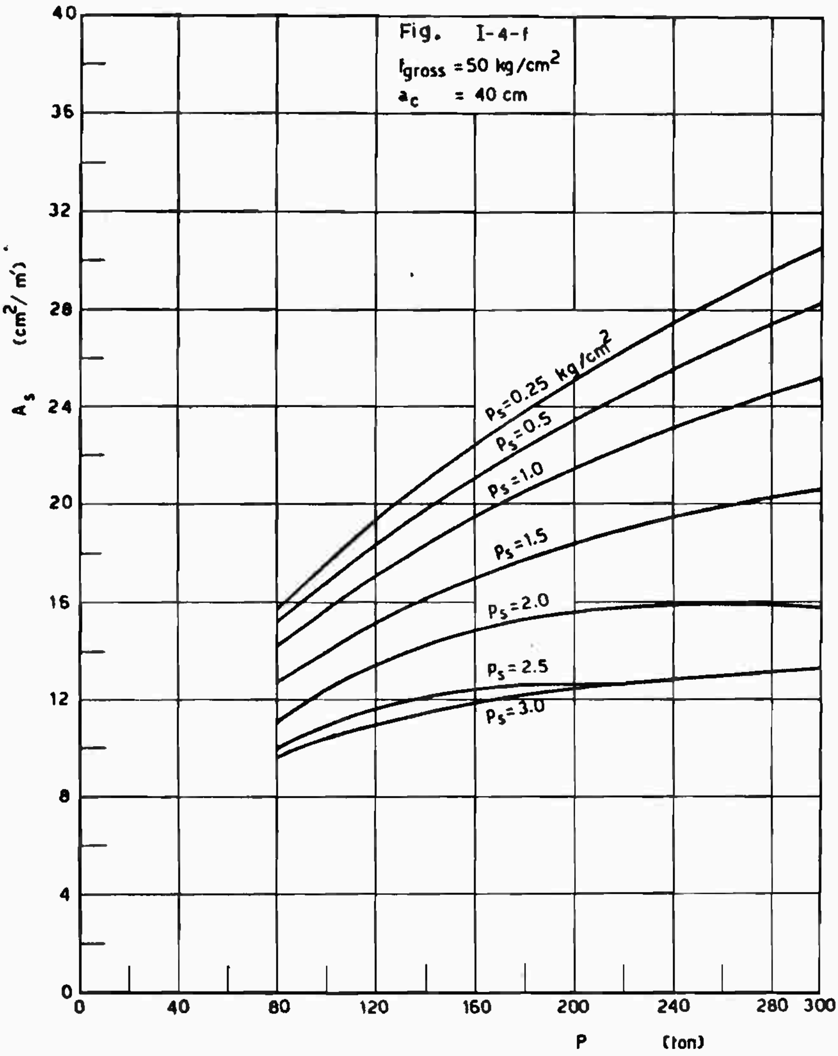


Fig. I-4-f
f_{gross} = 50 kg/cm²
a_c = 40 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_s (cm²/ m')
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300
P (ton)

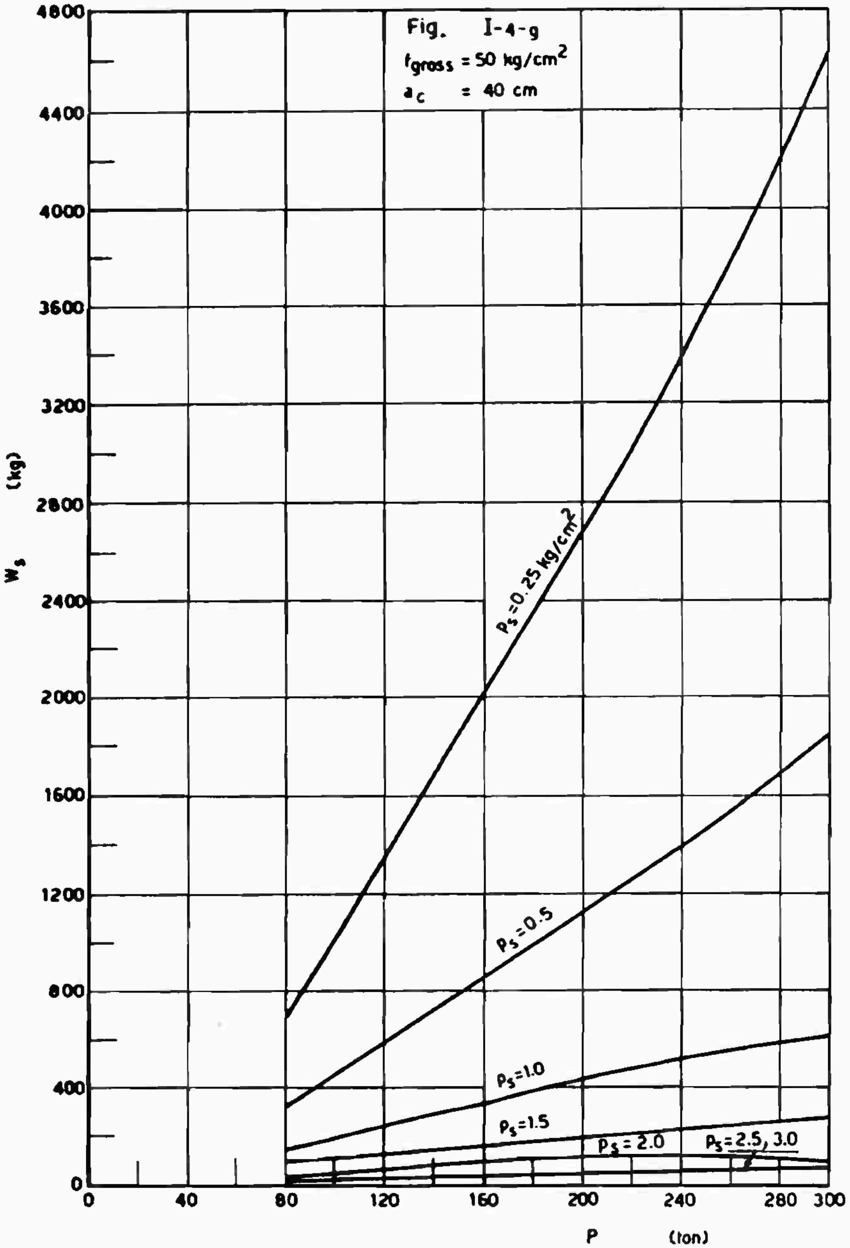


Fig. I-4-g
f_{gross} = 50 kg/cm^2
a_c = 40 cm
W_s (kg)
P (ton)
P_s=0.25 kg/cm^2
P_s=0.5
P_s=1.0
P_s=1.5
P_s = 2.0
P_s=2.5, 3.0
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
0
40
80
120
160
200
240
280
300

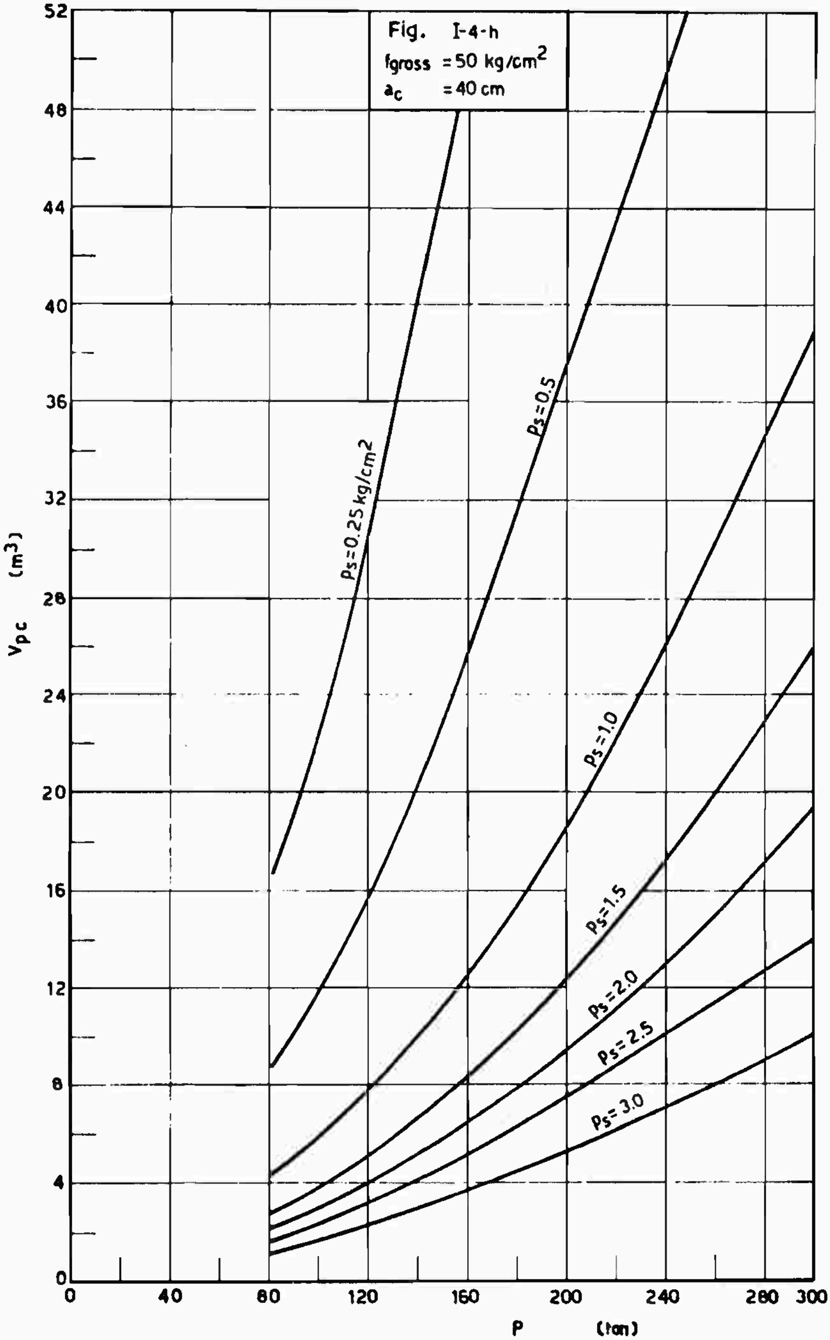


Fig. I-4-h
fgross = 50 kg/cm2
ac = 40 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
Vpc (m3)
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
48
52
0
40
80
120
160
200
240
280
300

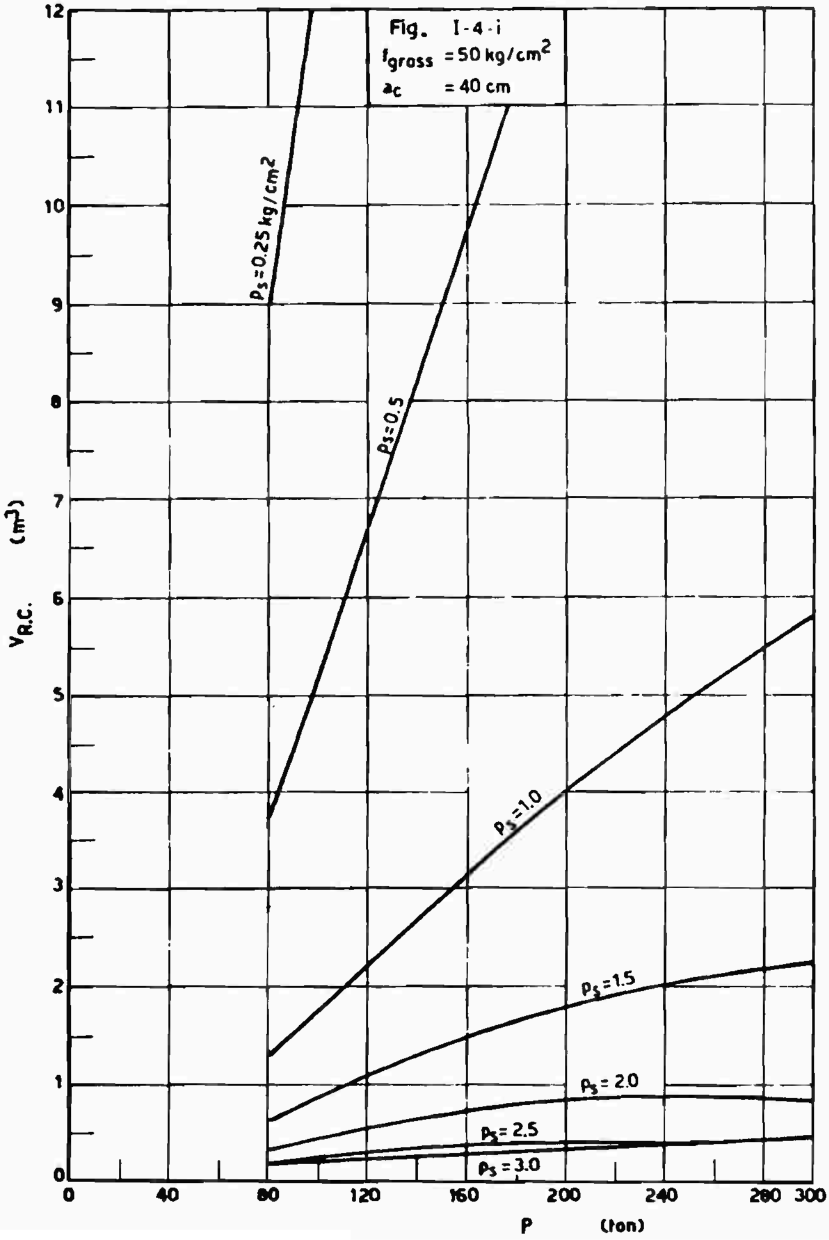


Fig. I-4-i
f_{gross} = 50 kg/cm²
a_c = 40 cm
p_s=0.25 kg/cm²
p_s=0.5
p_s=1.0
p_s=1.5
p_s= 2.0
p_s= 2.5
p_s = 3.0
$V_{R.C.}$ (m³)
P (ton)
0
40
80
120
160
200
240
280
300
1
2
3
4
5
6
7
8
9
10
11
12

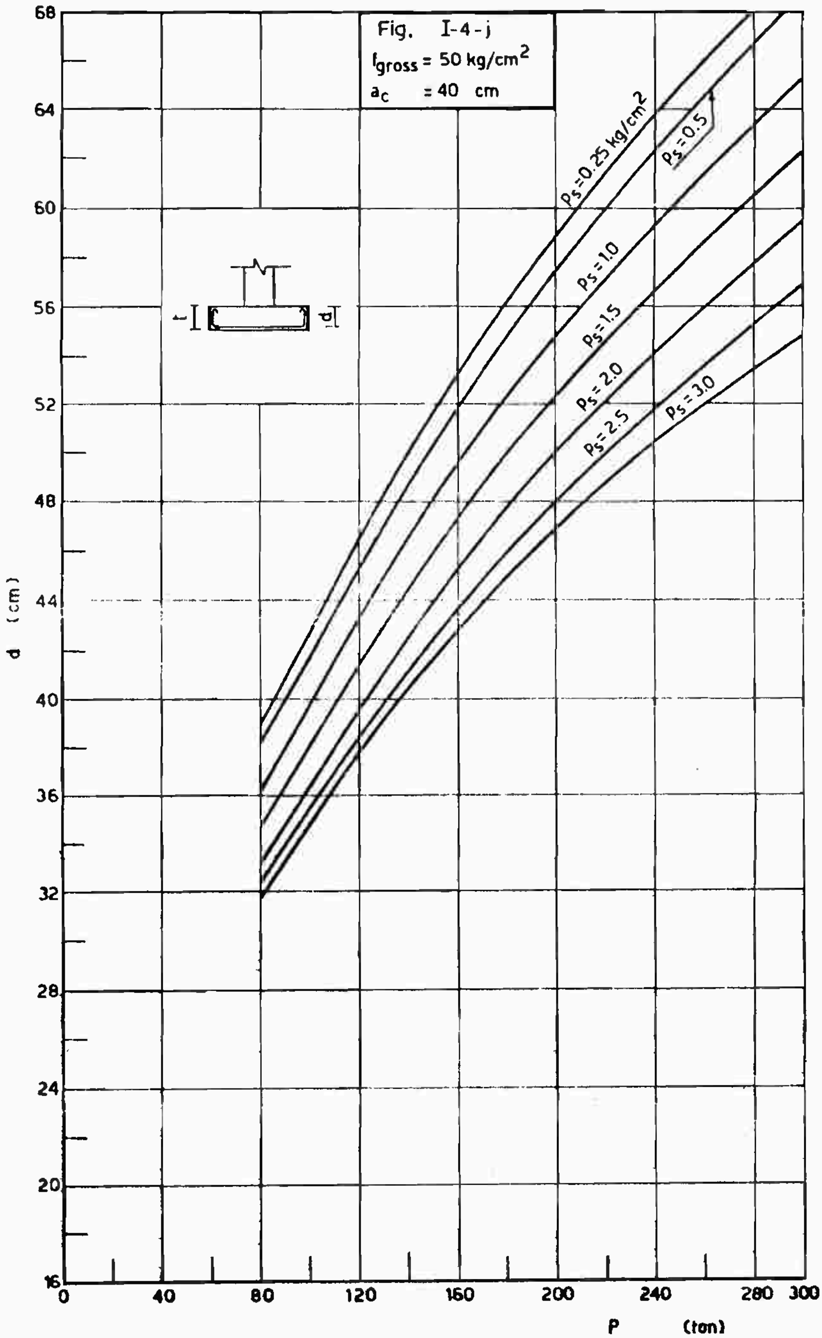


Fig. I-4-j
f_{gross} = 50 kg/cm^2
a_c = 40 cm
Ps=0.25 kg/cm^2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d (cm)
P (ton)
68
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300

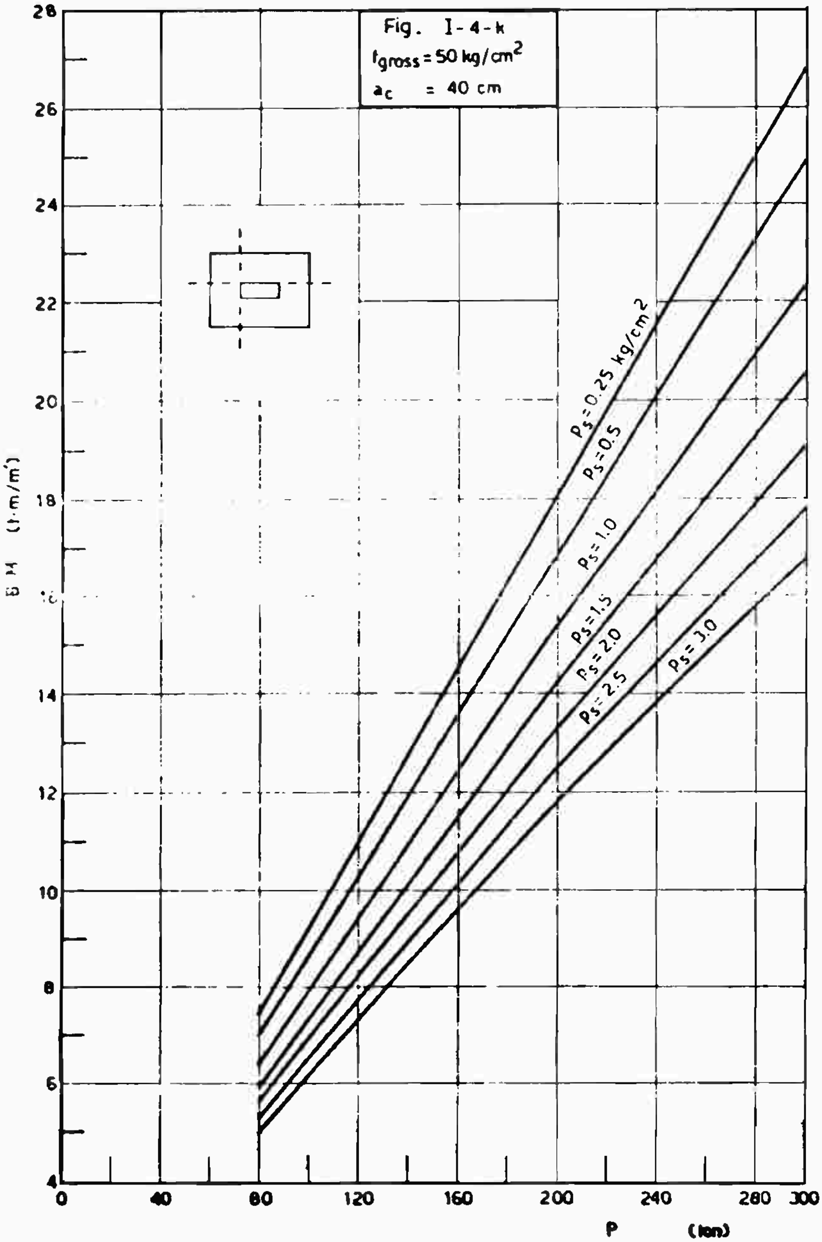


Fig. I-4-k
f_{gross} = 50 kg/cm²
a_c = 40 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
B.M (t.m/m')
P (ton)
28
26
24
22
20
18
14
12
10
8
6
4
0
40
80
120
160
200
240
280
300

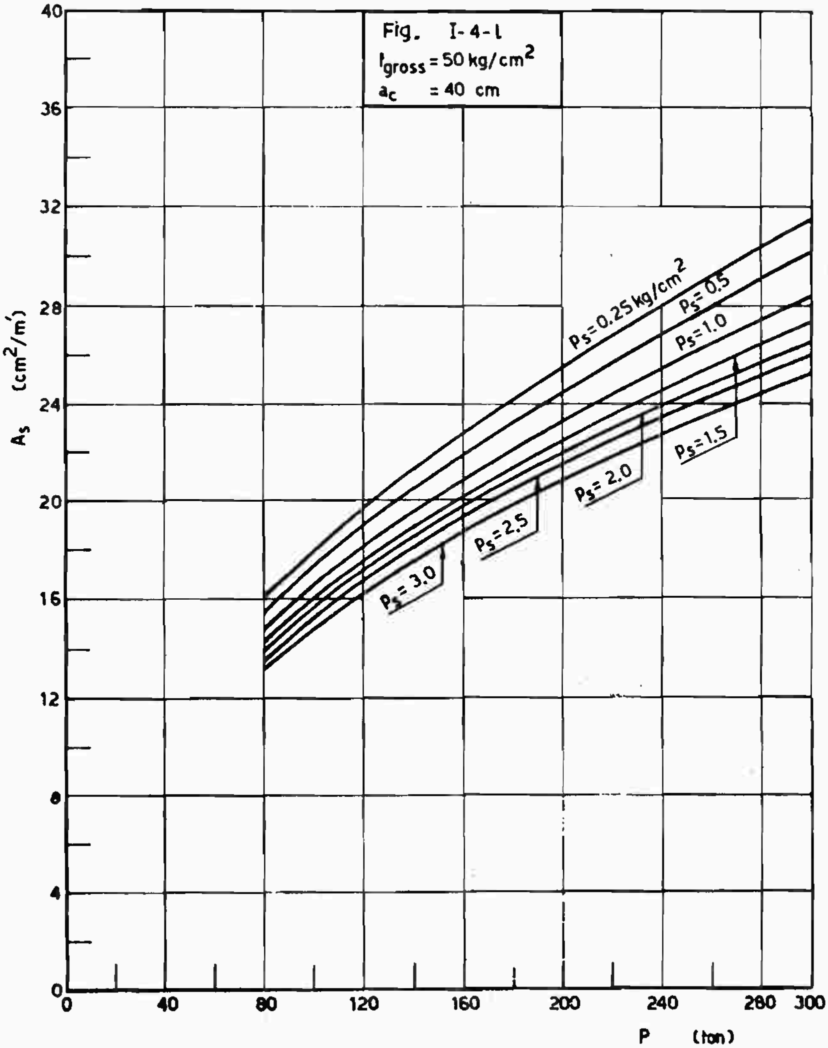


Fig. I-4-1
f_{gross} = 50 kg/cm²
a_c = 40 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_s (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300

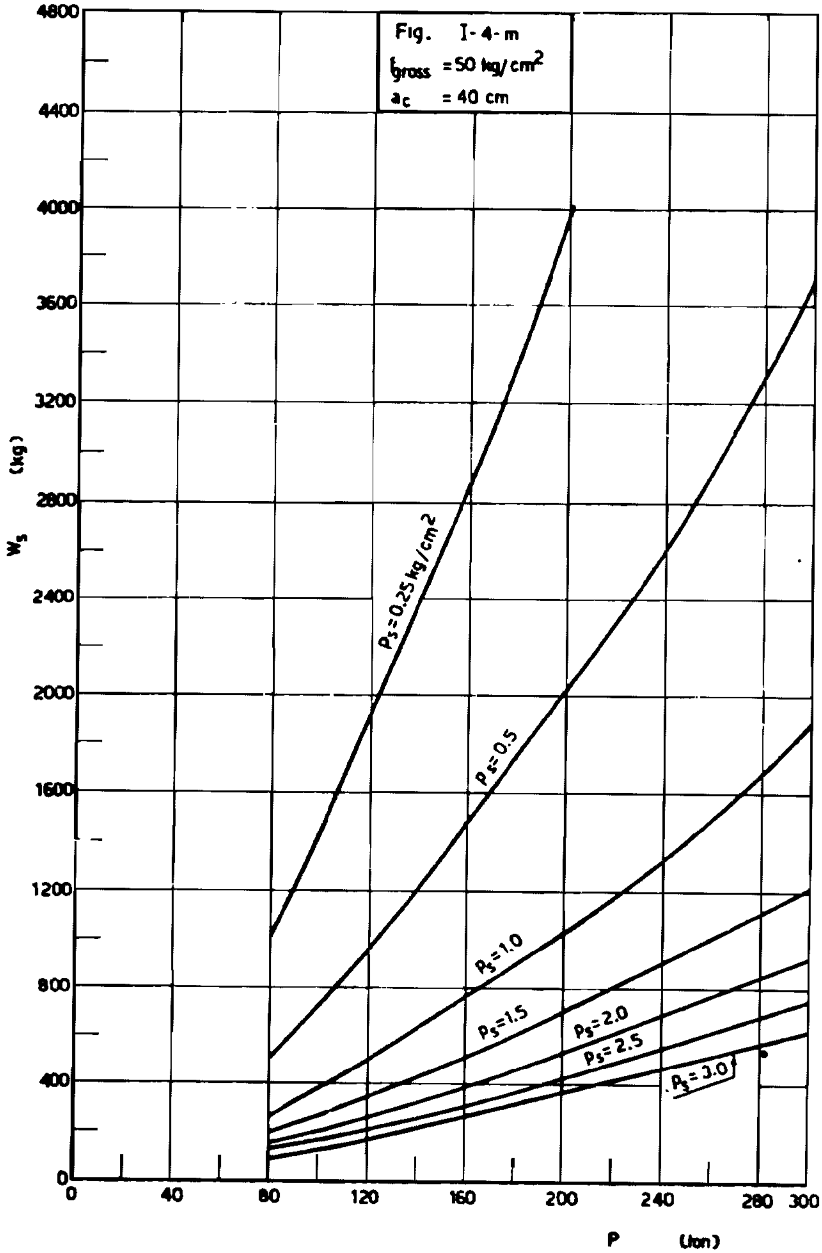


Fig. I-4-m
f_{gross} = 50 kg/cm²
a_c = 40 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
W_s (kg)
P (ton)
0
40
80
120
160
200
240
280
300
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800

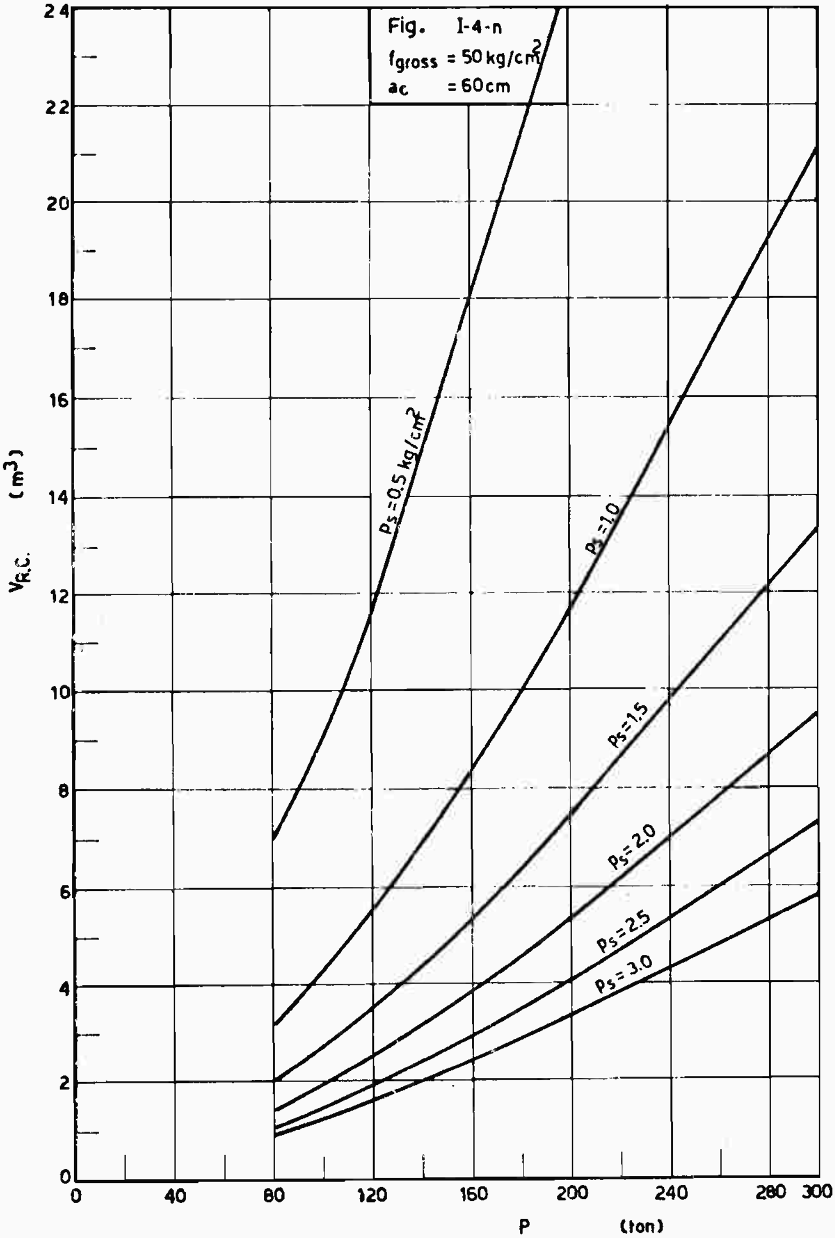


Fig. I-4-n
fgross = 50 kg/cm2
ac = 60cm
Ps = 0.5 kg/cm2
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
VR.C. (m3)
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
0
40
80
120
160
200
240
280
300

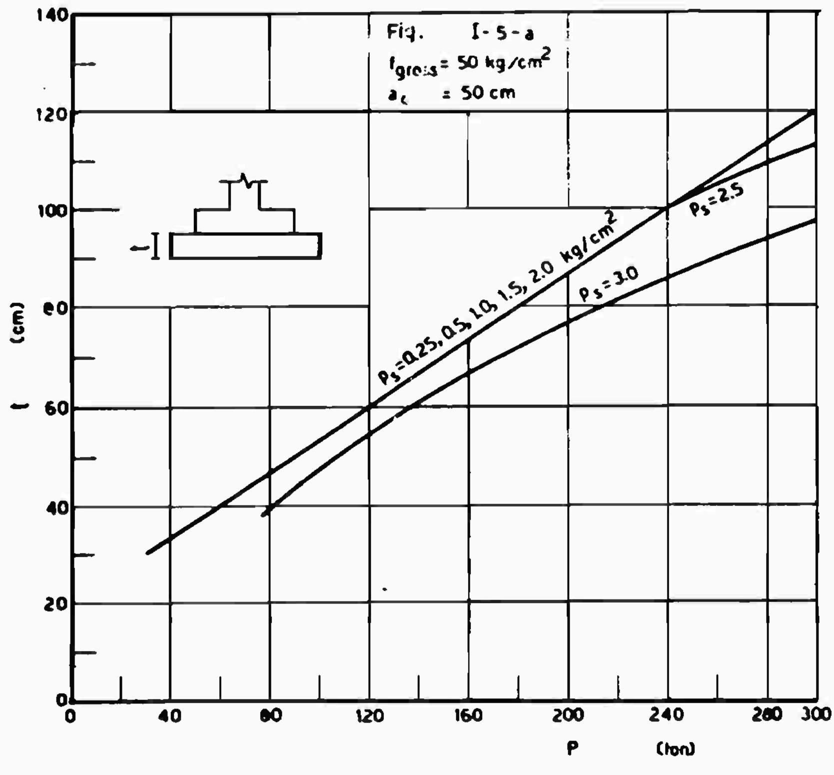


Fig. I-5-a
f_{gross} = 50 kg/cm²
a_c = 50 cm
P_s=0.25, 0.5, 1.0, 1.5, 2.0 kg/cm²
P_s=2.5
P_s=3.0
t (cm)
P (ton)
0
20
40
60
80
100
120
140
0
40
80
120
160
200
240
280
300

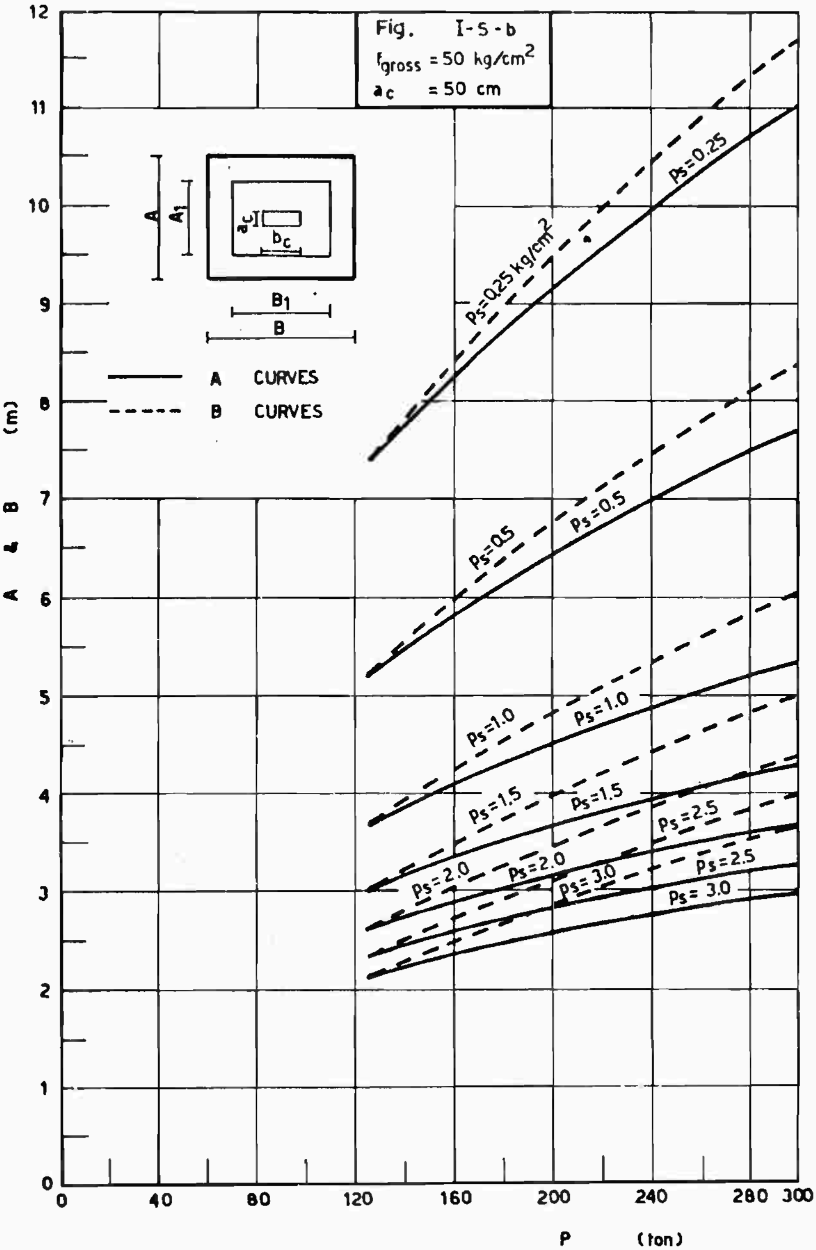


Fig. I-5-b
f_{gross} = 50 kg/cm²
a_c = 50 cm
A
A_1
a_c
b_c
B_1
B
A CURVES
B CURVES
Ps=0.25 kg/cm²
Ps=0.25
Ps=0.5
Ps=0.5
Ps=1.0
Ps=1.0
Ps=1.5
Ps=1.5
Ps=2.0
Ps=2.0
Ps=2.5
Ps=2.5
Ps=3.0
Ps=3.0
A & B (m)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
280
300

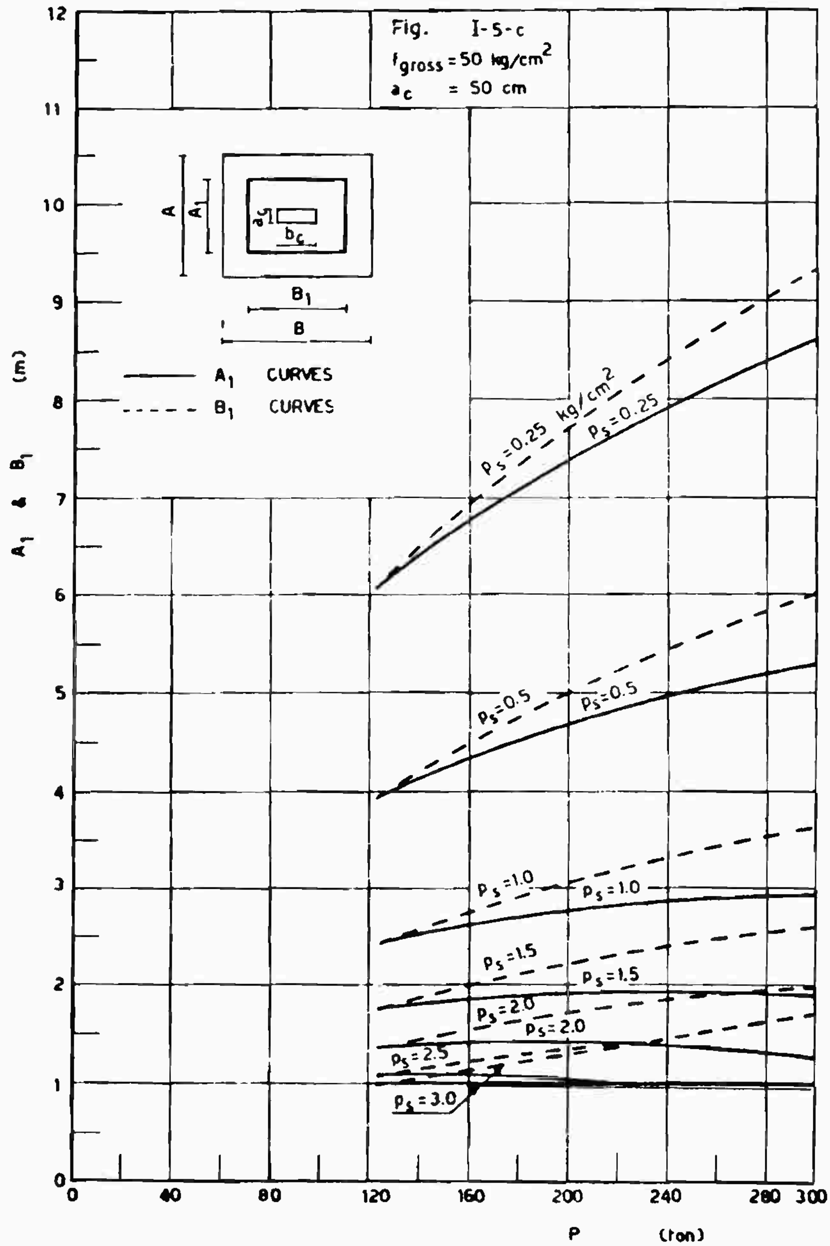


Fig. I-5-c
f_{gross} = 50 kg/cm²
a_c = 50 cm
A
A_1
a_c
b_c
B_1
B
A_1 CURVES
B_1 CURVES
p_s=0.25 kg/cm²
p_s=0.25
p_s=0.5
p_s=0.5
p_s=1.0
p_s=1.0
p_s=1.5
p_s=1.5
p_s=2.0
p_s=2.0
p_s=2.5
p_s=3.0
A_1 & B_1 (m)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
280
300

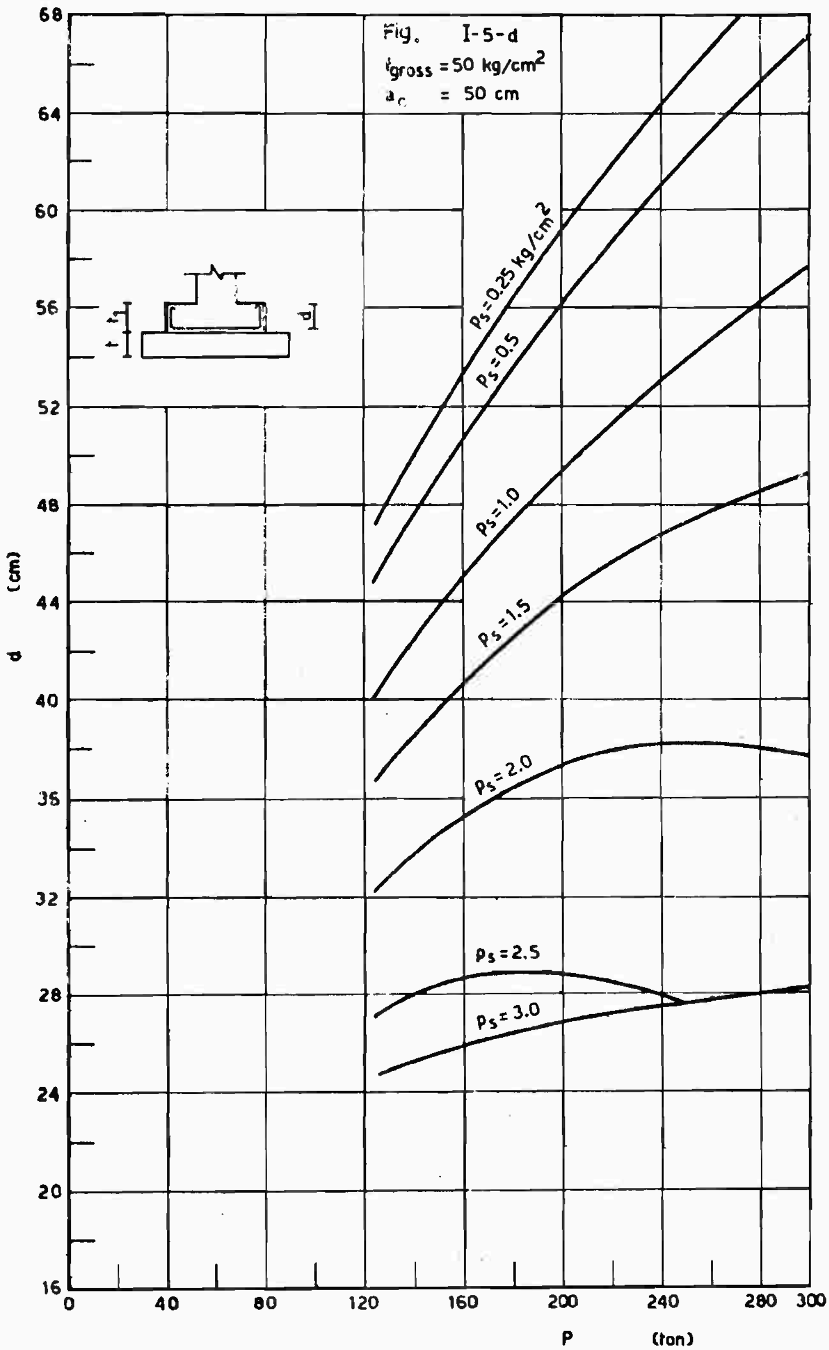


Fig. I-5-d
f_{gross} = 50 kg/cm²
a_c = 50 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d (cm)
P (ton)
68
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300

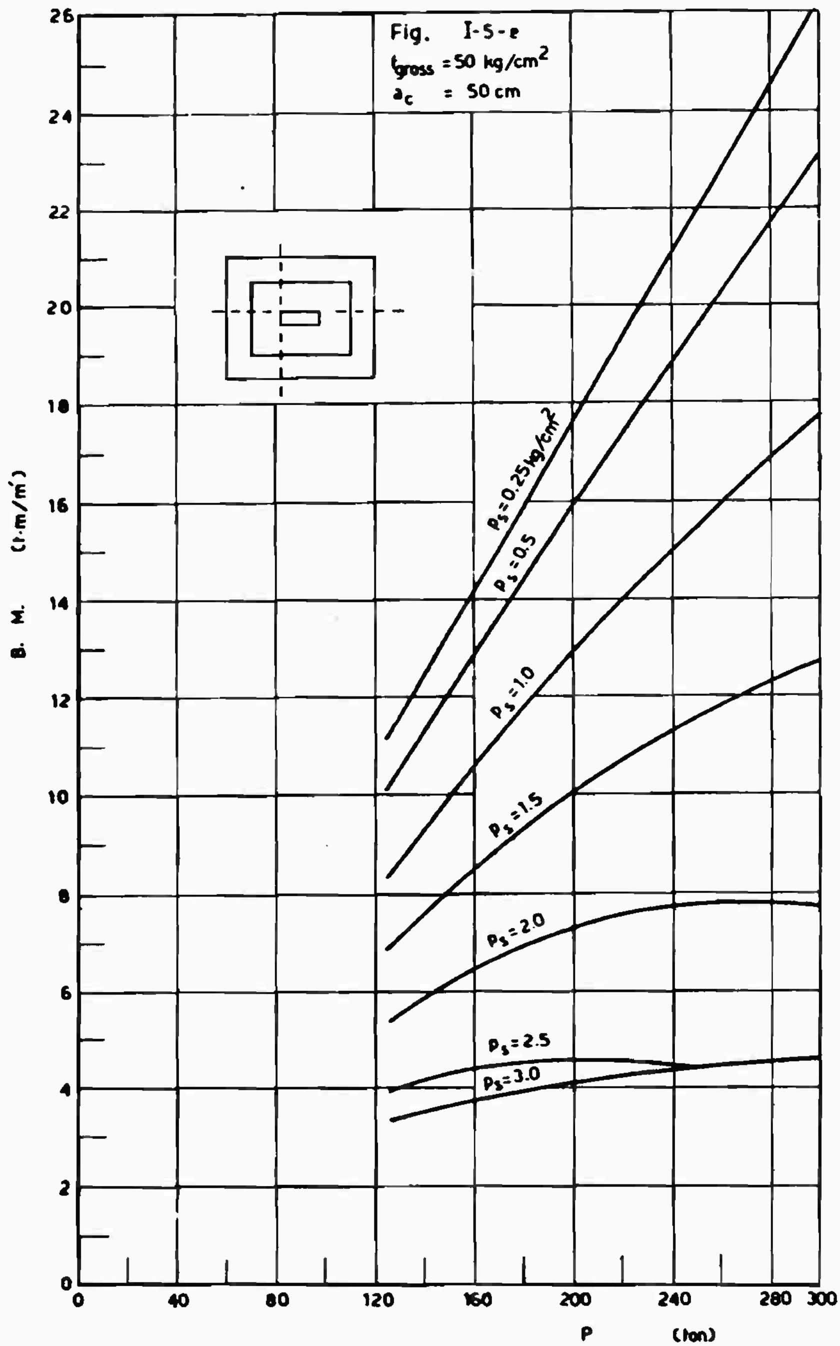


Fig. I-5-e
f_{gross} = 50 kg/cm^2
a_c = 50 cm
P_s=0.25 kg/cm^2
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
B. M. (t·m/m')
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
40
80
120
160
200
240
280
300

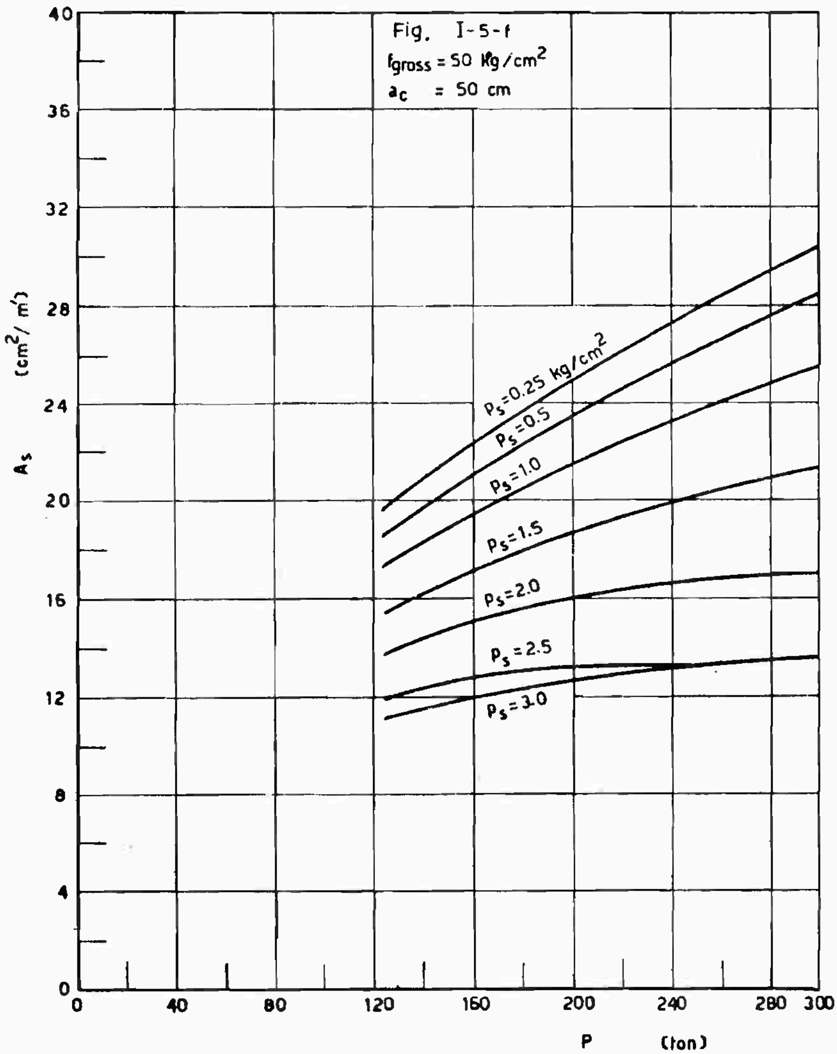


Fig. I-5-f
fgross = 50 Kg/cm2
ac = 50 cm
Ps=0.25 Kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
As (cm2/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300

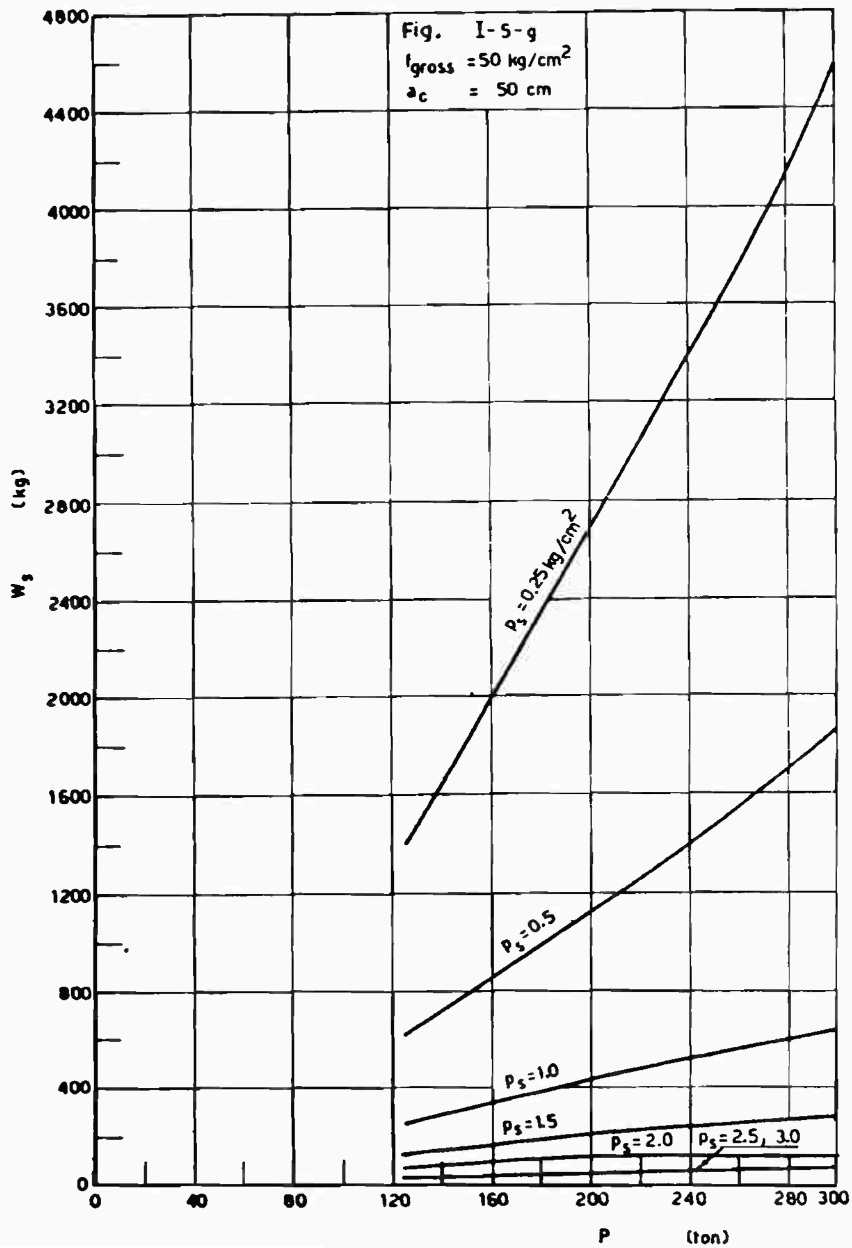


Fig. I-5-g
f_{gross} = 50 kg/cm²
a_c = 50 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5, 3.0
W_s (kg)
P (ton)
0
40
80
120
160
200
240
280
300
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800

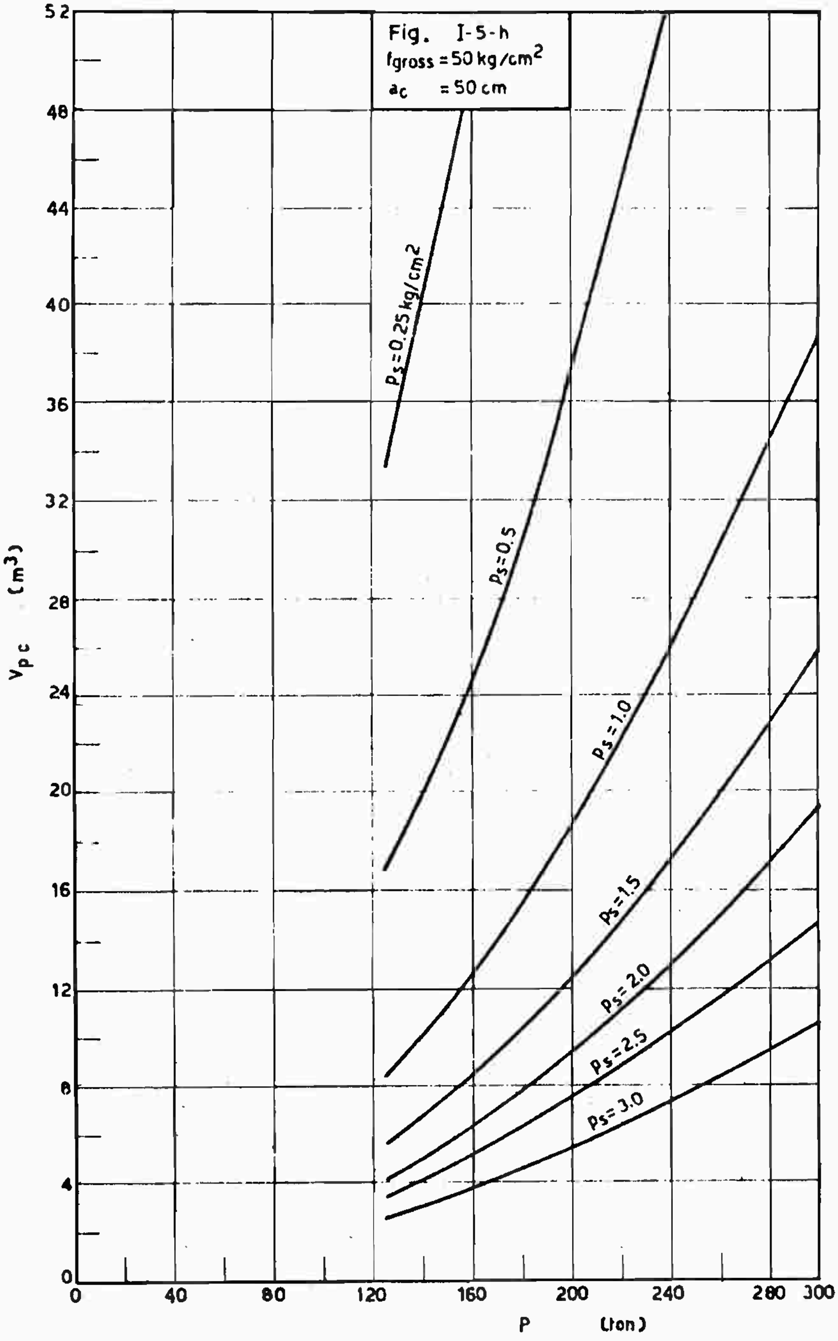


Fig. I-5-h
fgross = 50 kg/cm²
ac = 50 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
Vpc (m³)
P (ton)
0
40
80
120
160
200
240
280
300
4
8
12
16
20
24
28
32
36
40
44
48
52

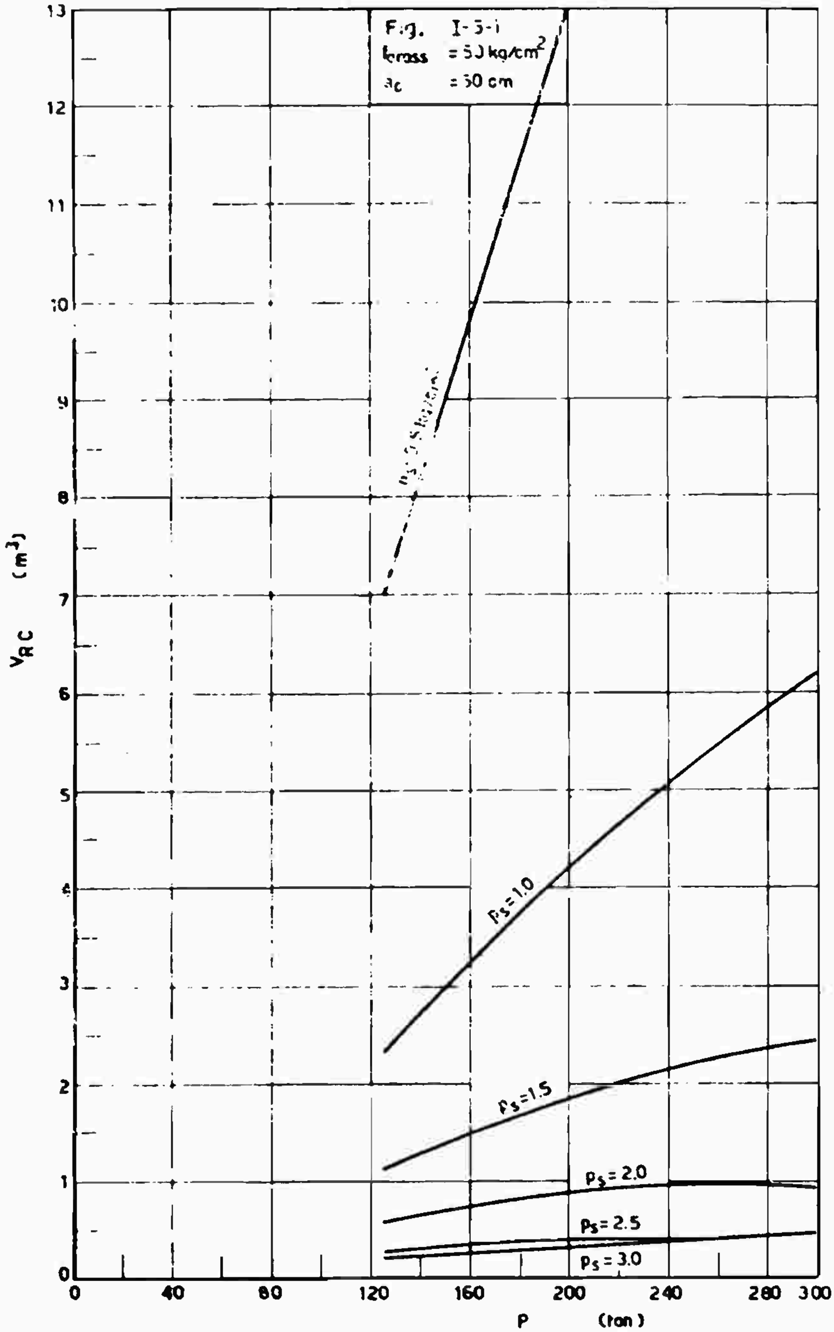


Fig. I-5-1
V_{RC} (m^3)
P (ton)
0
40
80
120
160
200
240
280
300
1
2
3
4
5
6
7
8
9
10
11
12
13
Ps=1.0
Ps=1.5
Ps= 2.0
Ps= 2.5
Ps = 3.0

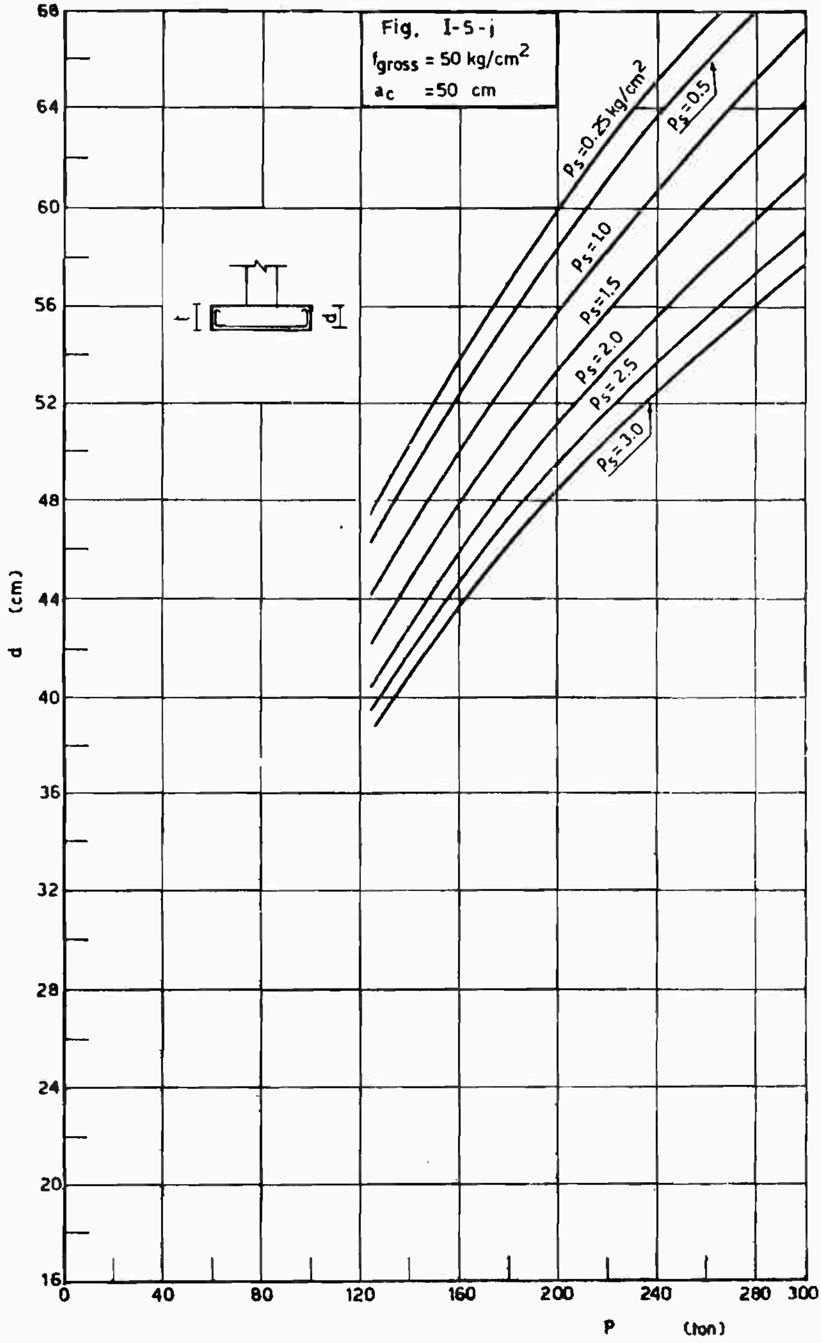


Fig. I-5-j
f_{gross} = 50 kg/cm²
a_c = 50 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d (cm)
P (ton)
t
d
68
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300

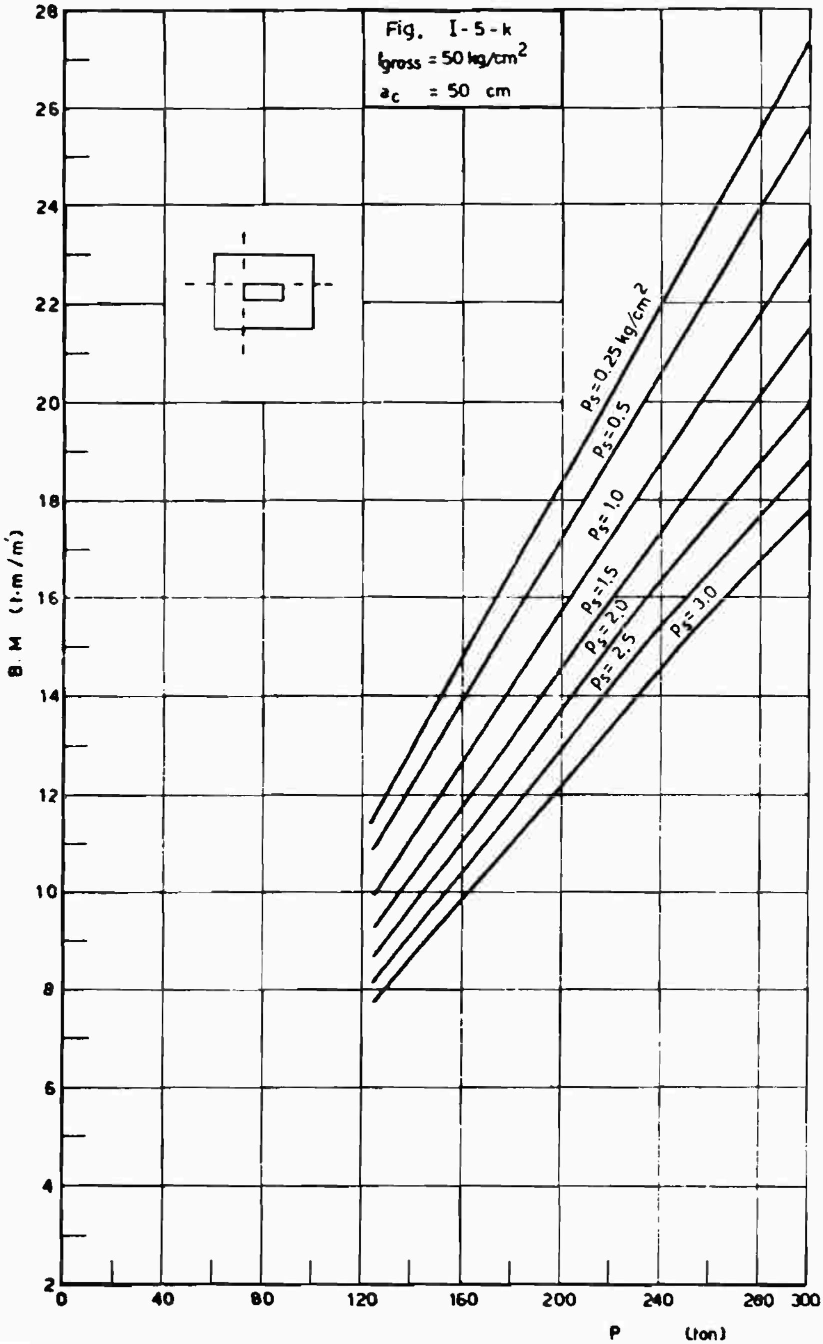


Fig. I-5-k
f gross = 50 kg/cm2
ac = 50 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
B.M (t·m/m')
P (ton)
0
40
80
120
160
200
240
280
300
2
4
6
8
10
12
14
16
18
20
22
24
26
28

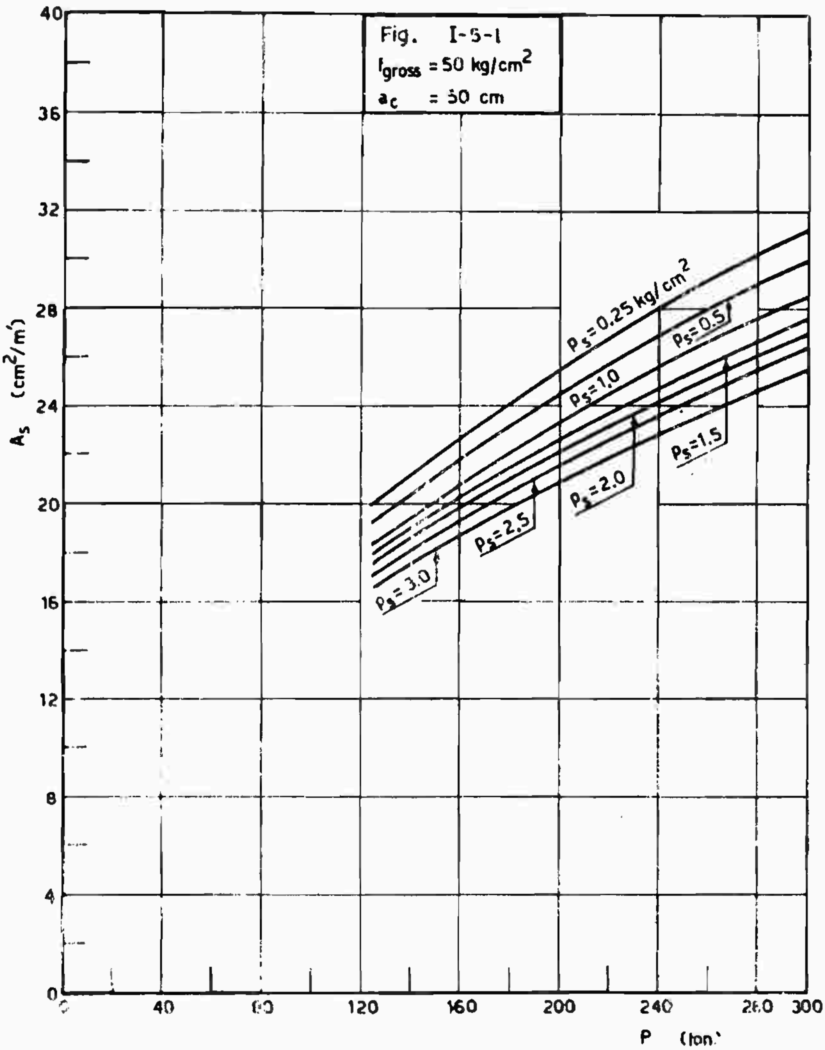


Fig. I-5-1
f_{gross} = 50 kg/cm²
a_c = 50 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_s (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
40
80
120
160
200
240
280
300

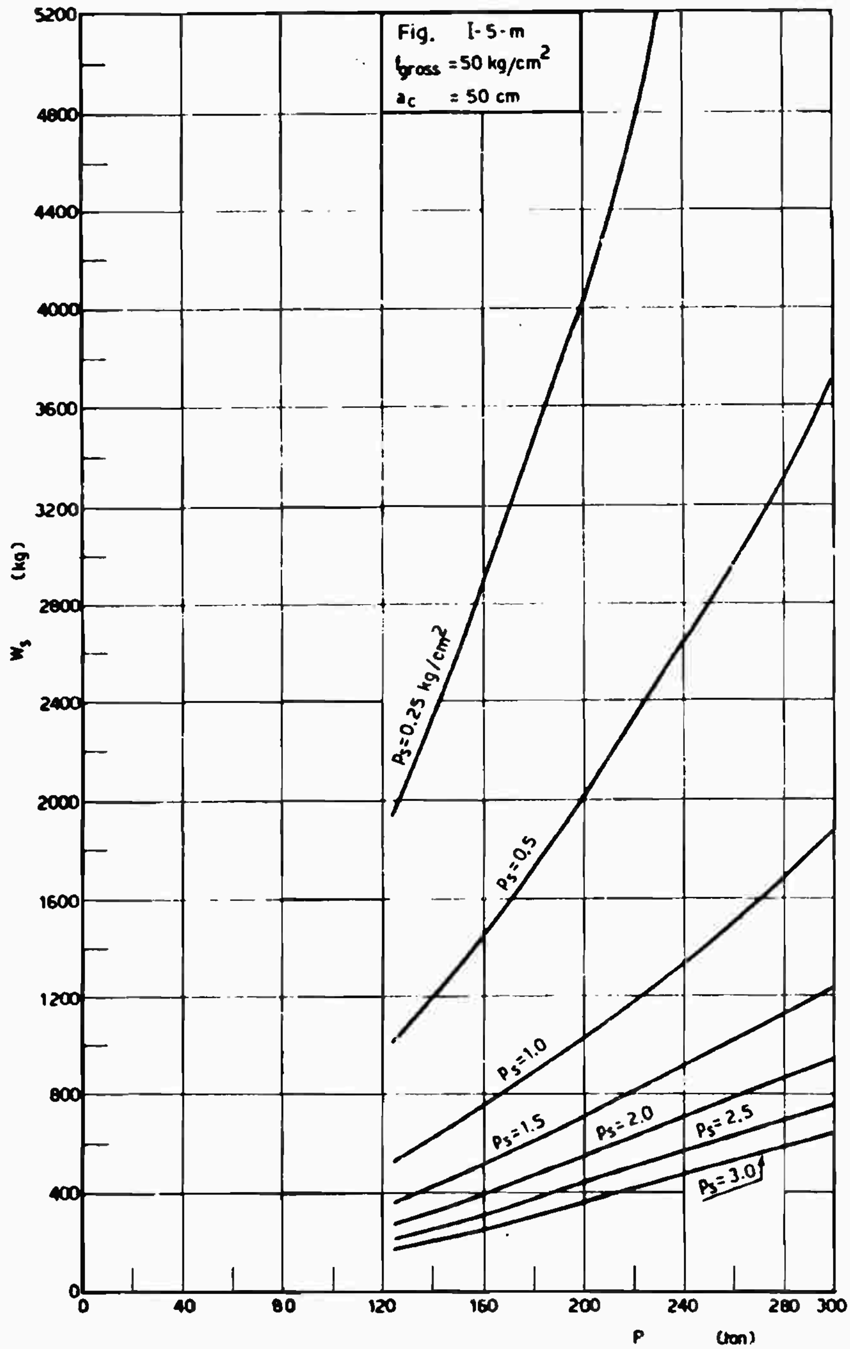


Fig. I-5-m
f_{gross} = 50 kg/cm²
a_c = 50 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
W_s (kg)
P (ton)
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200
0
40
80
120
160
200
240
280
300

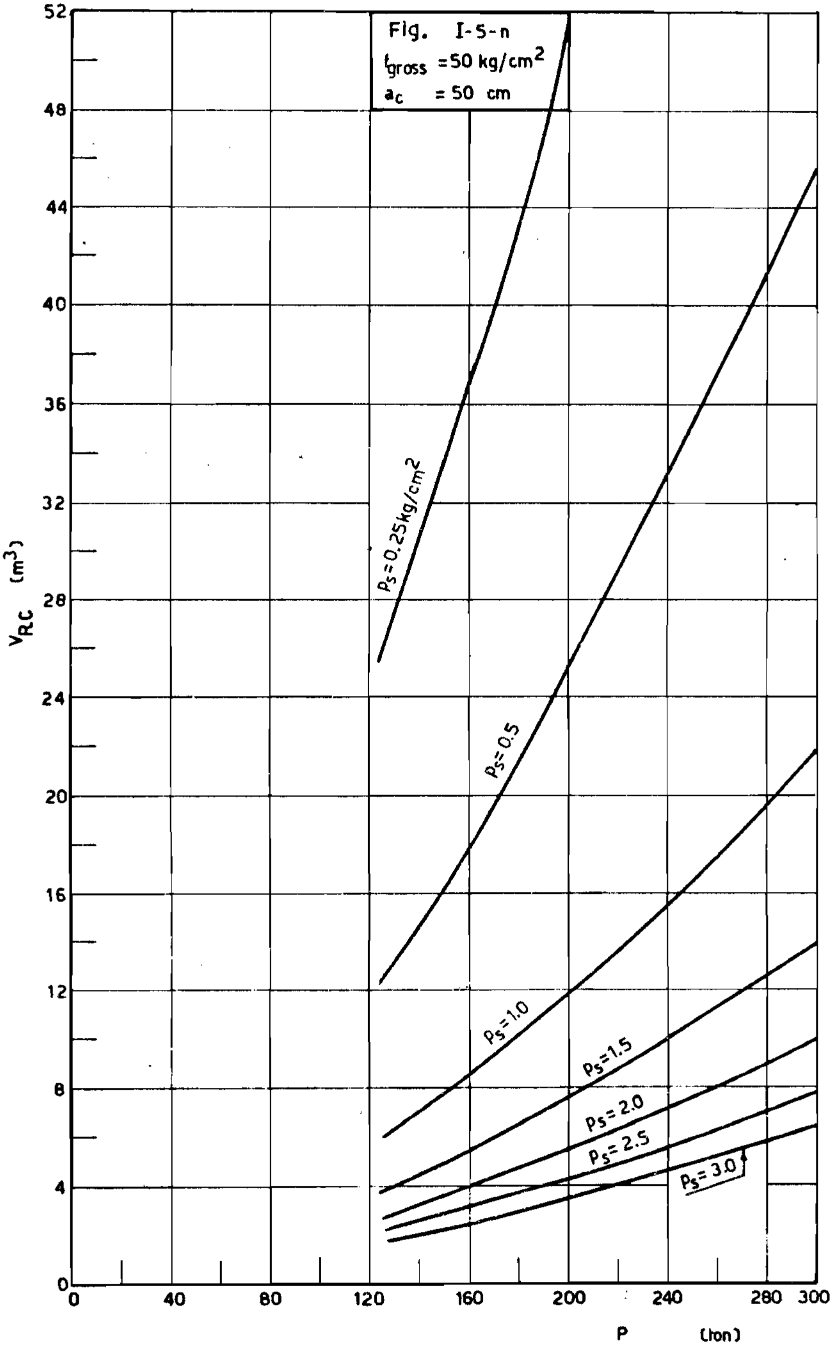


Fig. I-5-n
f_{gross} = 50 kg/cm²
a_c = 50 cm
P_s=0.25kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
V_{RC} (m³)
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
48
52
40
80
120
160
200
240
280
300

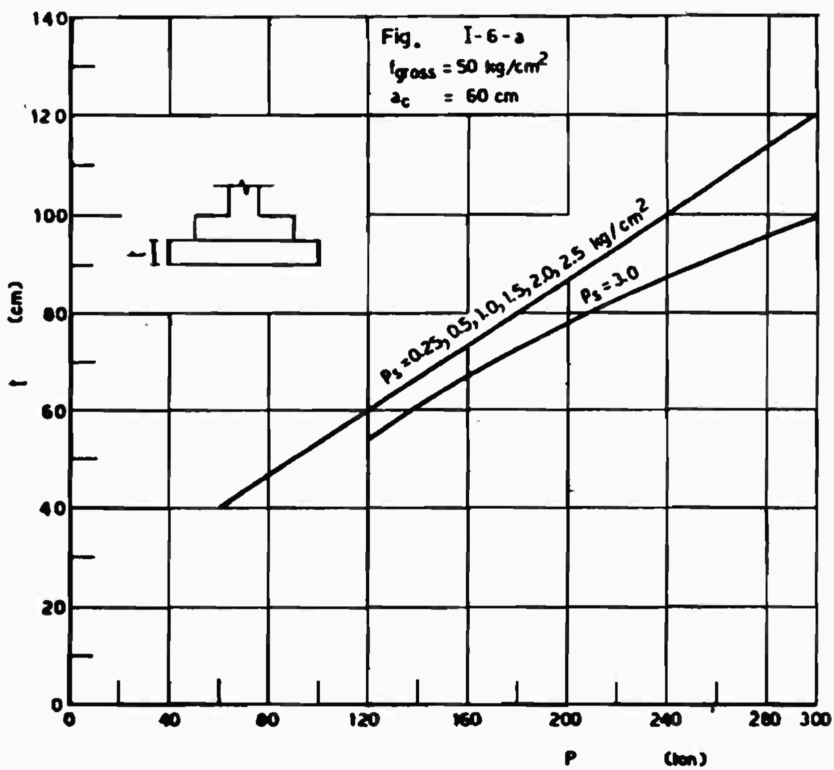


Fig. I-6-a
f_{gross} = 50 kg/cm²
a_c = 60 cm
P_s = 0.25, 0.5, 1.0, 1.5, 2.0, 2.5 kg/cm²
P_s = 3.0
t (cm)
P (ton)
0
20
40
60
80
100
120
140
0
40
80
120
160
200
240
280
300

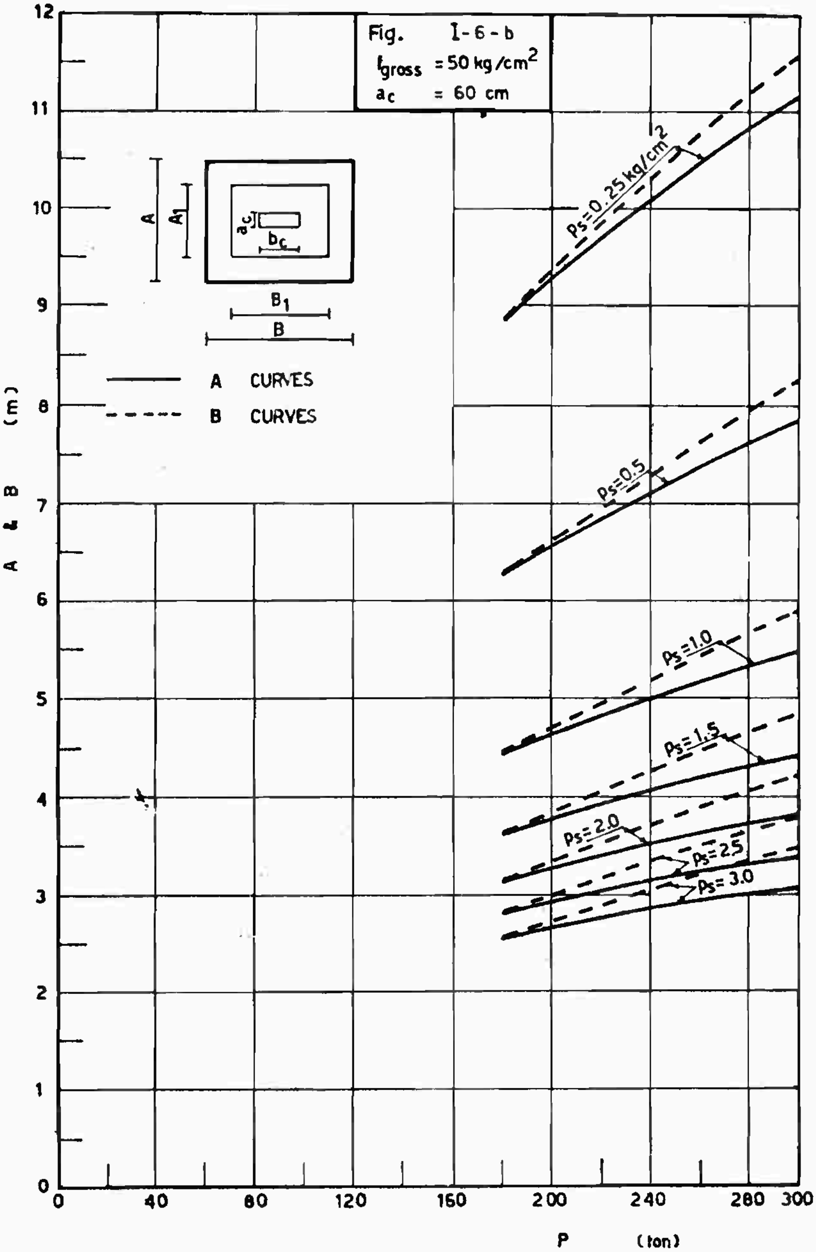


Fig. I-6-b
f gross = 50 kg/cm2
ac = 60 cm
A
A1
ac
bc
B1
B
A CURVES
B CURVES
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
A & B (m)
P (ton)
0 1 2 3 4 5 6 7 8 9 10 11 12
0 40 80 120 160 200 240 280 300

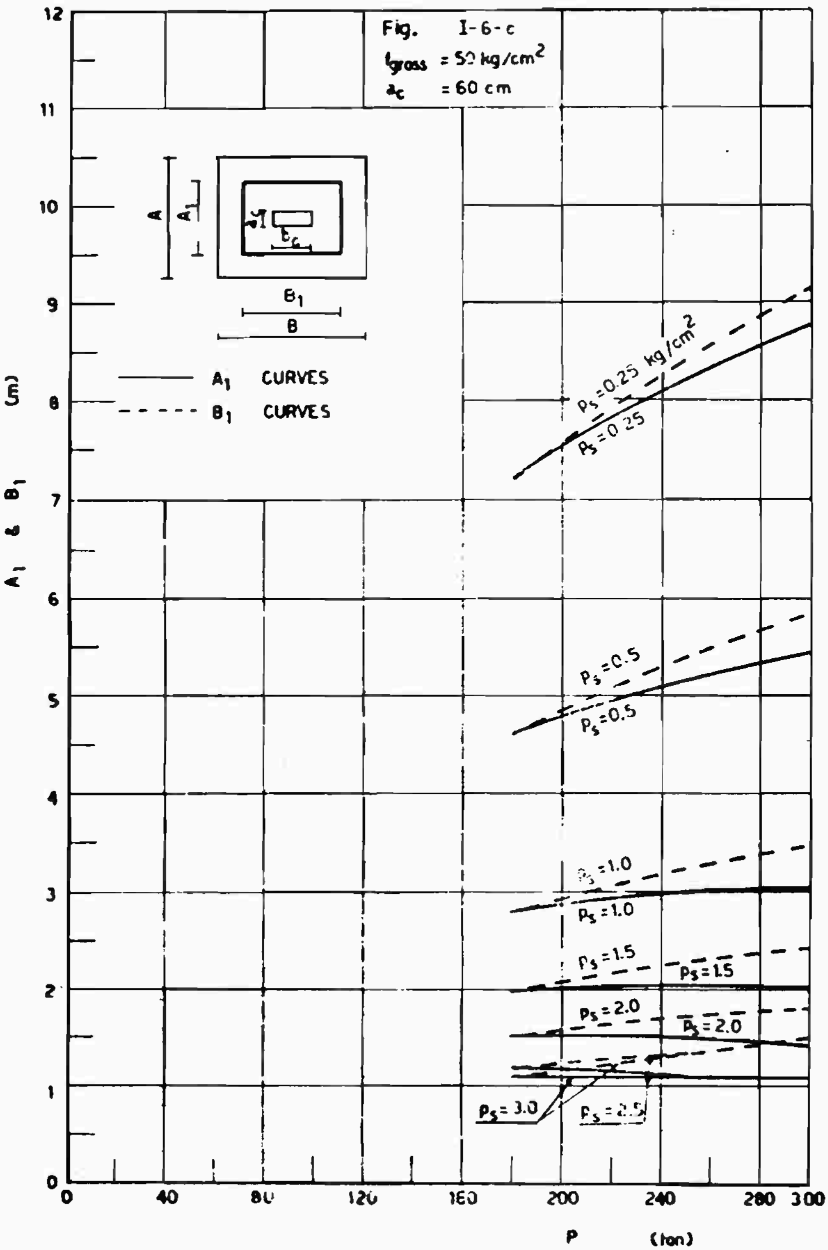


Fig. I-6-c
f_{gross} = 50 kg/cm²
a_c = 60 cm
A
A_1
b_c
B_1
B
A_1 CURVES
B_1 CURVES
A_1 & B_1 (m)
P_s = 0.25 kg/cm²
P_s = 0.25
P_s = 0.5
P_s = 0.5
P_s = 1.0
P_s = 1.0
P_s = 1.5
P_s = 1.5
P_s = 2.0
P_s = 2.0
P_s = 3.0
P_s = 2.5
P (ton)

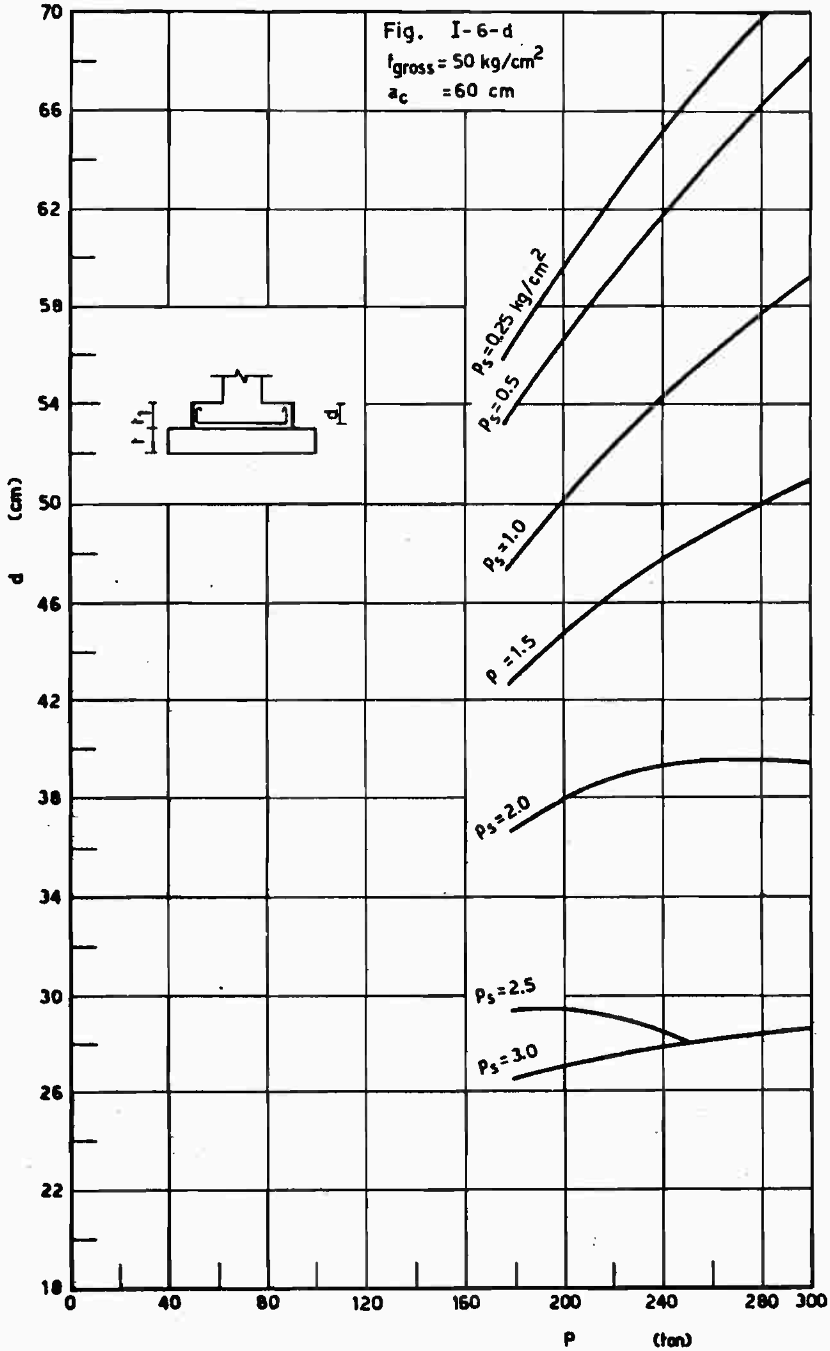


Fig. I-6-d
f_{gross} = 50 kg/cm²
a_c = 60 cm
p_s=0.25 kg/cm²
p_s=0.5
p_s=1.0
p =1.5
p_s=2.0
p_s=2.5
p_s=3.0
d (cm)
70
66
62
58
54
50
46
42
38
34
30
26
22
18
0
40
80
120
160
200
240
280
300
P (ton)

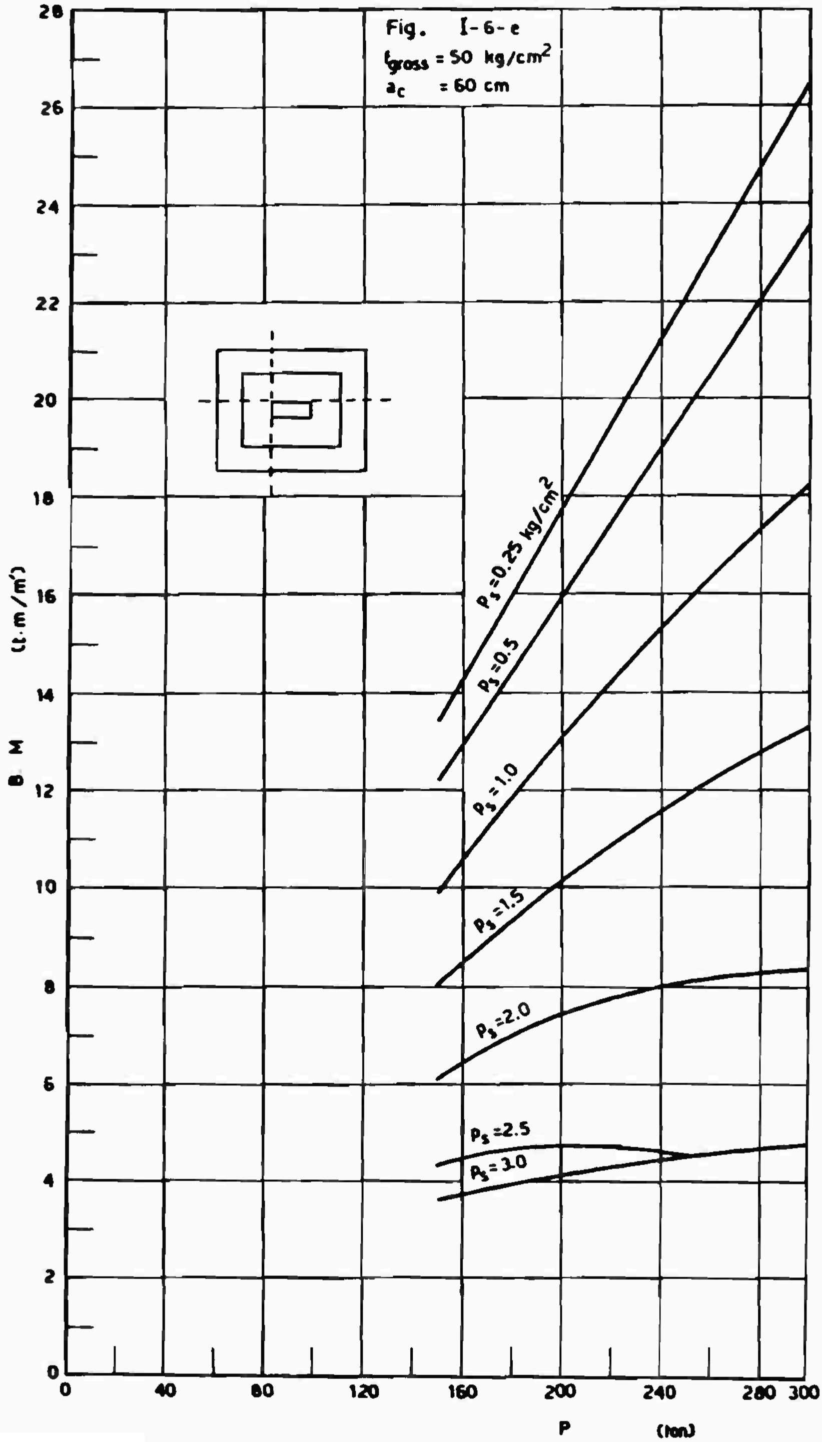


Fig. I-6-e
f_{gross} = 50 kg/cm²
a_c = 60 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
B M (t·m/m')
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
40
80
120
160
200
240
280
300

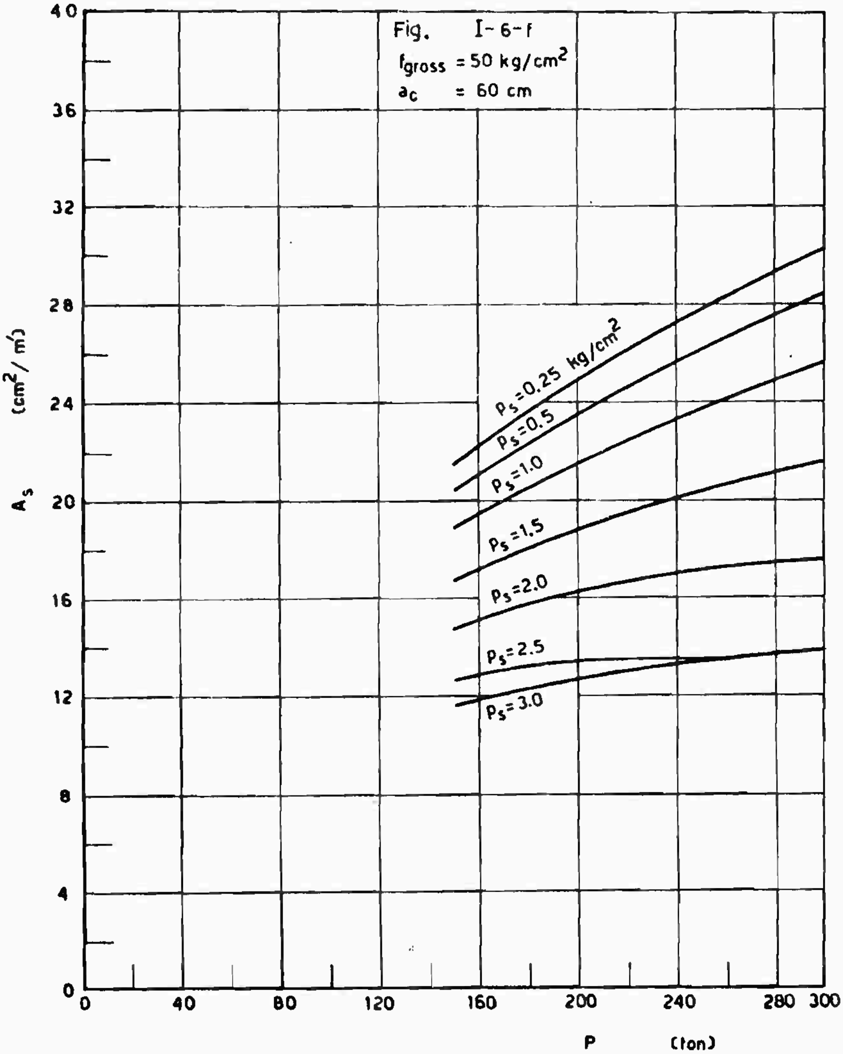


Fig. I-6-f
f_{gross} = 50 kg/cm²
a_c = 60 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_s (cm²/ m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300

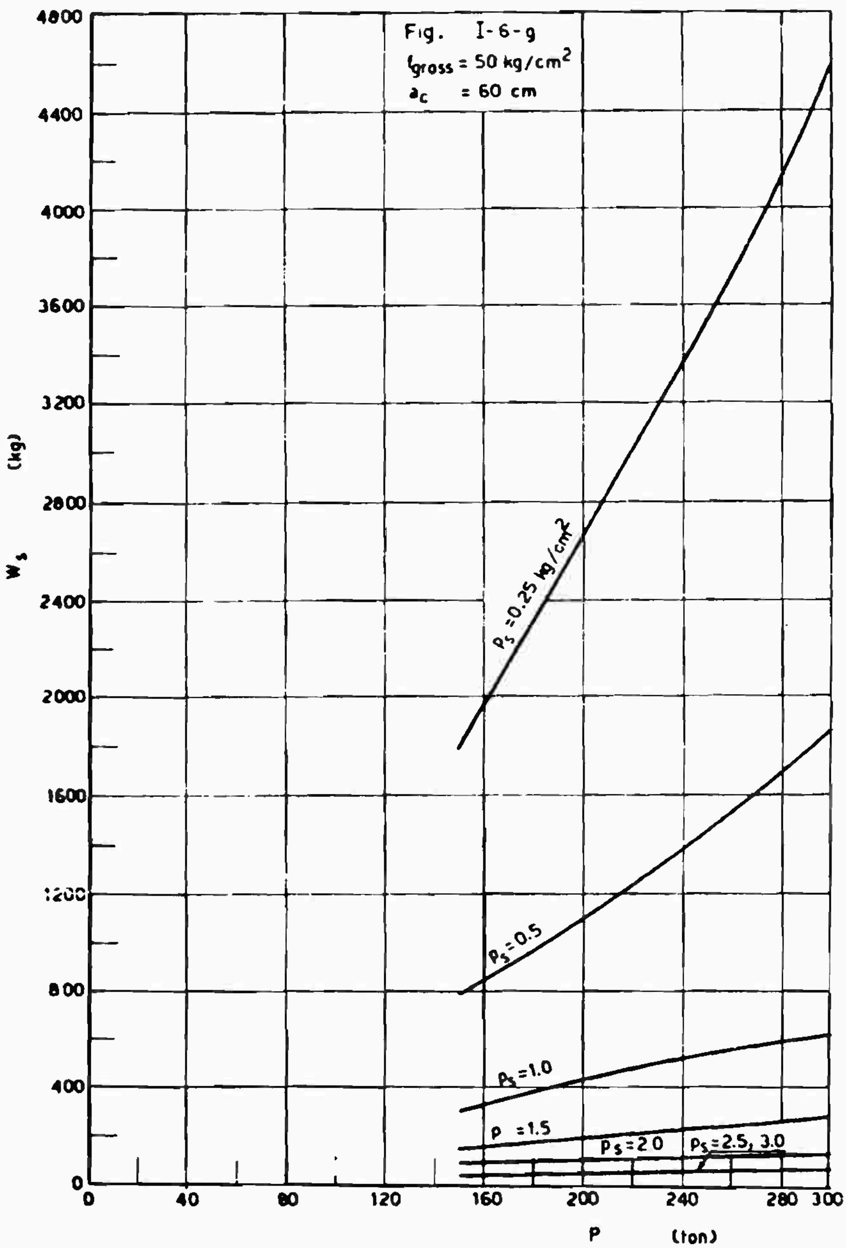


Fig. I-6-g
f_{gross} = 50 kg/cm²
a_c = 60 cm
p_s = 0.25 kg/cm²
p_s = 0.5
p_s = 1.0
p = 1.5
p_s = 2.0
p_s = 2.5, 3.0
W_s (kg)
P (ton)
0
40
80
120
160
200
240
280
300
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800

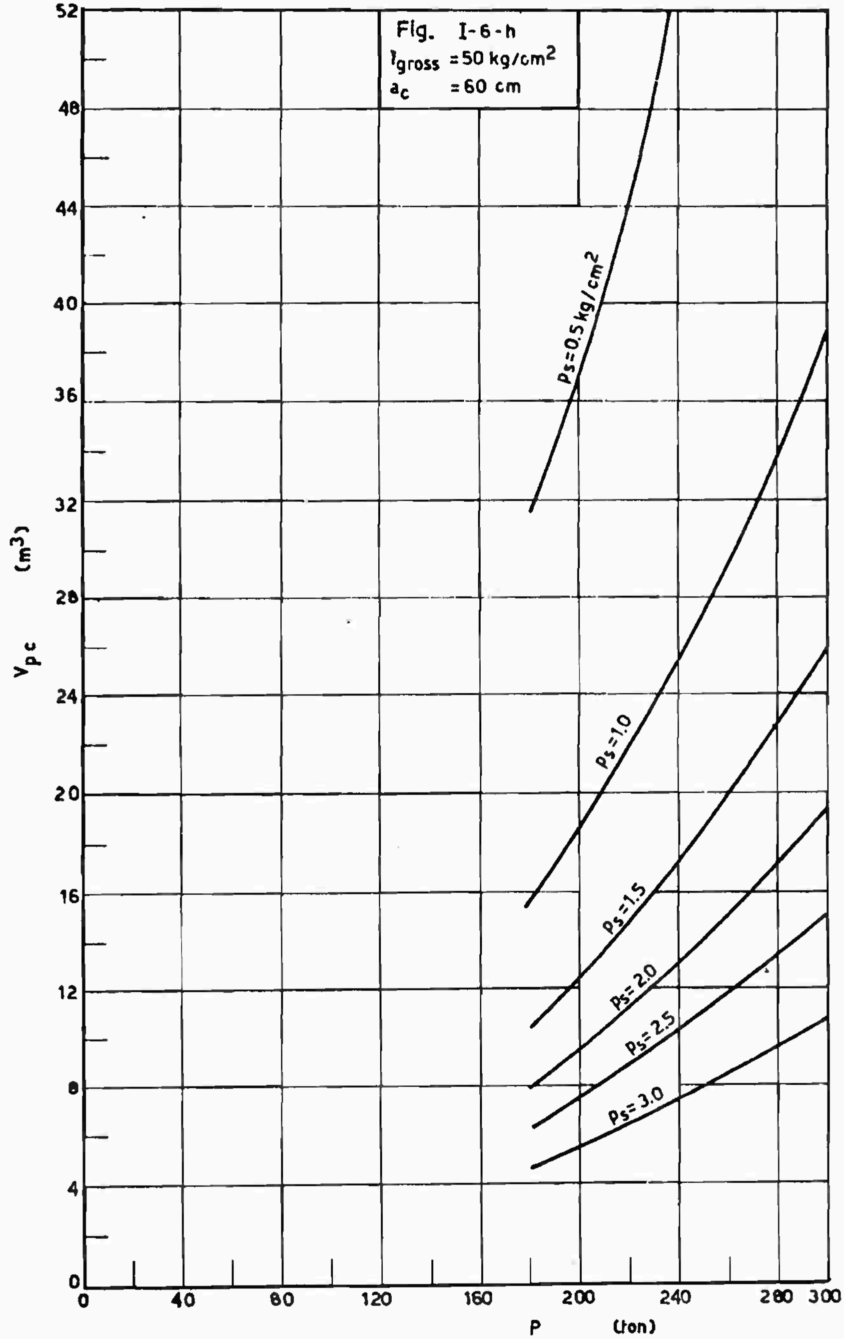


Fig. I-6-h
γ_{gross} = 50 kg/cm²
a_c = 60 cm
Ps=0.5 kg/cm²
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
V_{pc} (m³)
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
48
52
0
40
80
120
160
200
240
280
300

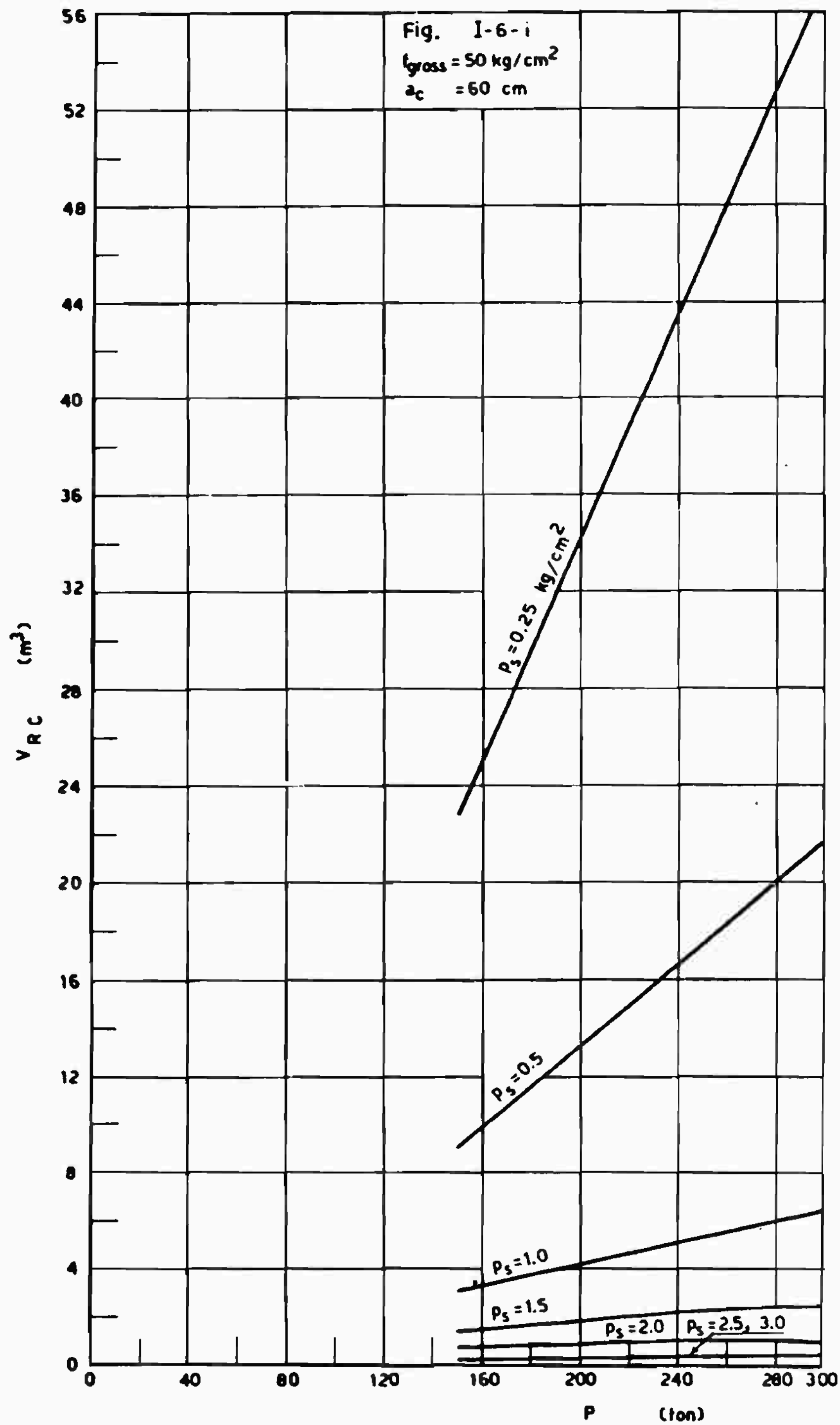


Fig. I-6-i
f_{gross} = 50 kg/cm²
a_c = 60 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5, 3.0
V_{RC} (m³)
P (ton)
0
40
80
120
160
200
240
280
300
4
8
12
16
20
24
28
32
36
40
44
48
52
56

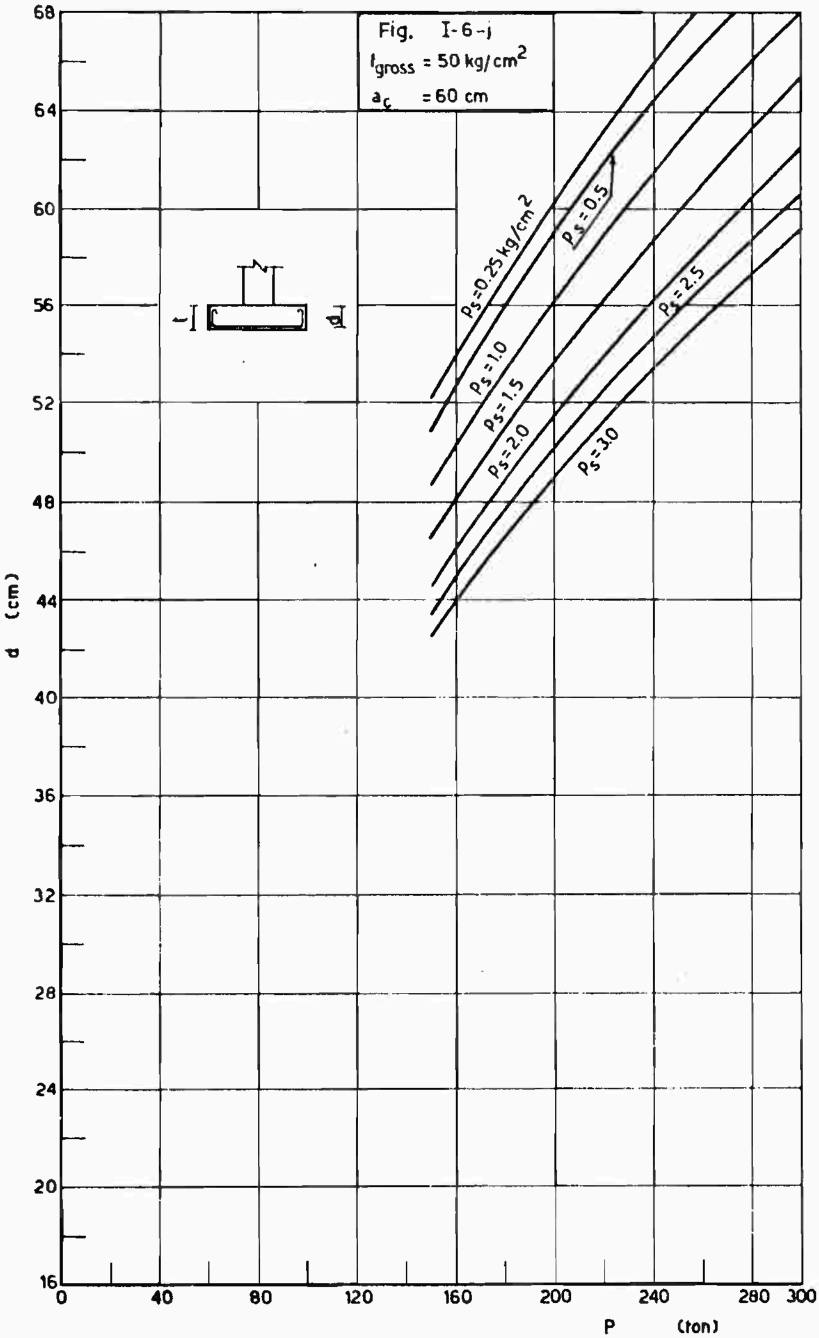


Fig. I-6-j
f_{gross} = 50 kg/cm²
a_c = 60 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d (cm)
P (ton)
68
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300

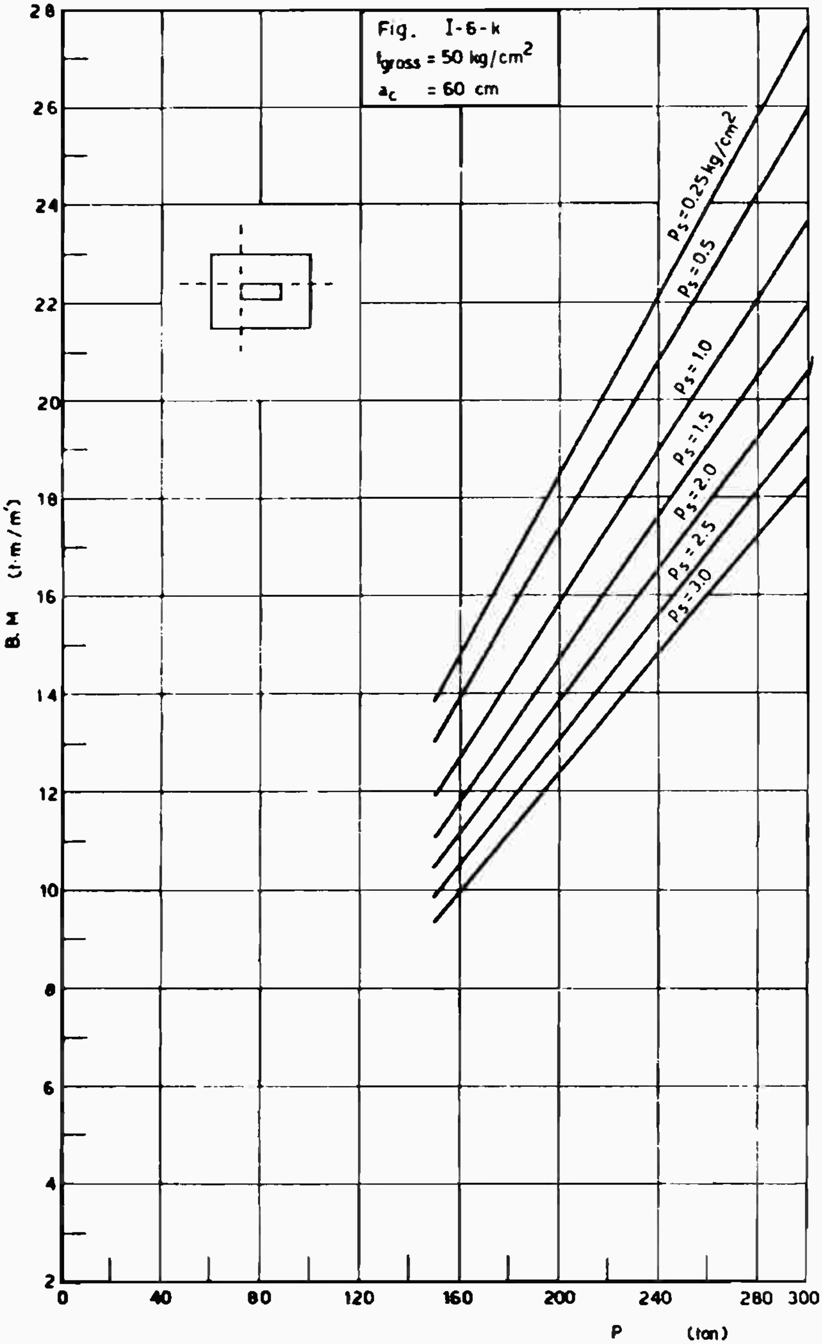


Fig. I-6-k
f_{gross} = 50 kg/cm^2
a_c = 60 cm
Ps=0.25 kg/cm^2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
B.M (t.m/m')
P (ton)
2
4
6
8
10
12
14
16
18
20
22
24
26
28
0
40
80
120
160
200
240
280
300

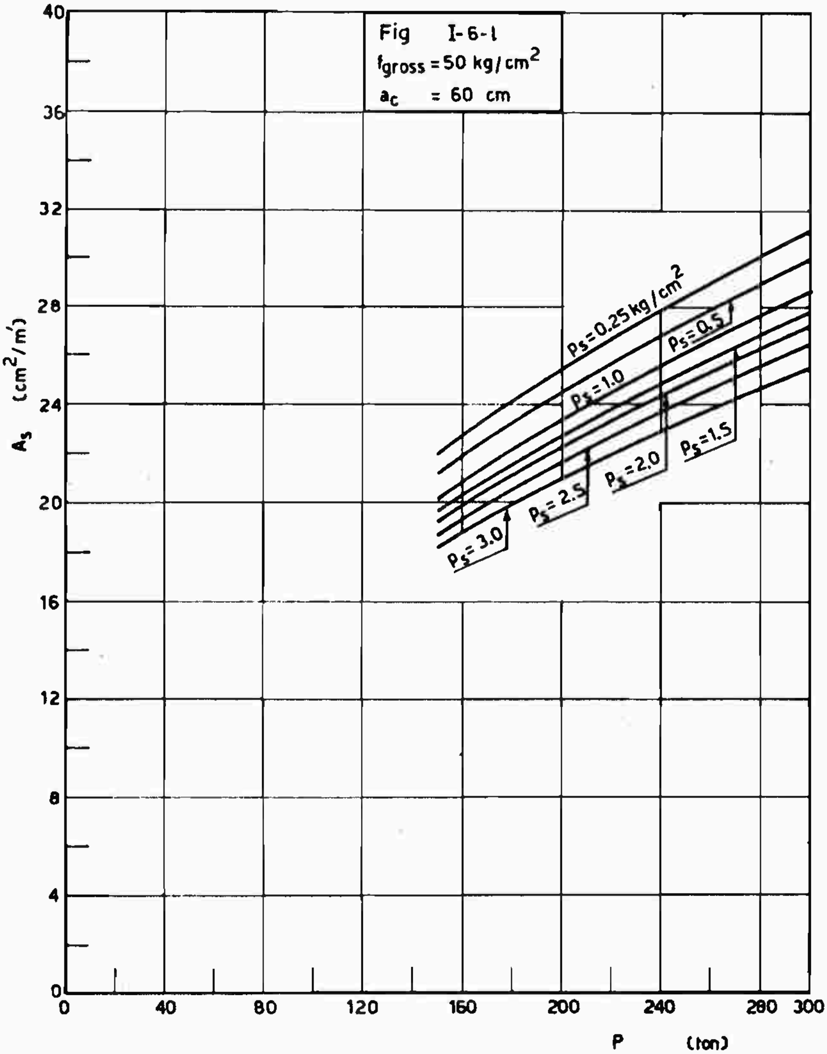


Fig I-6-1
$f_{gross} = 50\ kg/cm^2$
$a_c = 60\ cm$
$P_s = 0.25\ kg/cm^2$
$P_s = 0.5$
$P_s = 1.0$
$P_s = 1.5$
$P_s = 2.0$
$P_s = 2.5$
$P_s = 3.0$
$A_s\ (cm^2/m')$
P (ton)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300

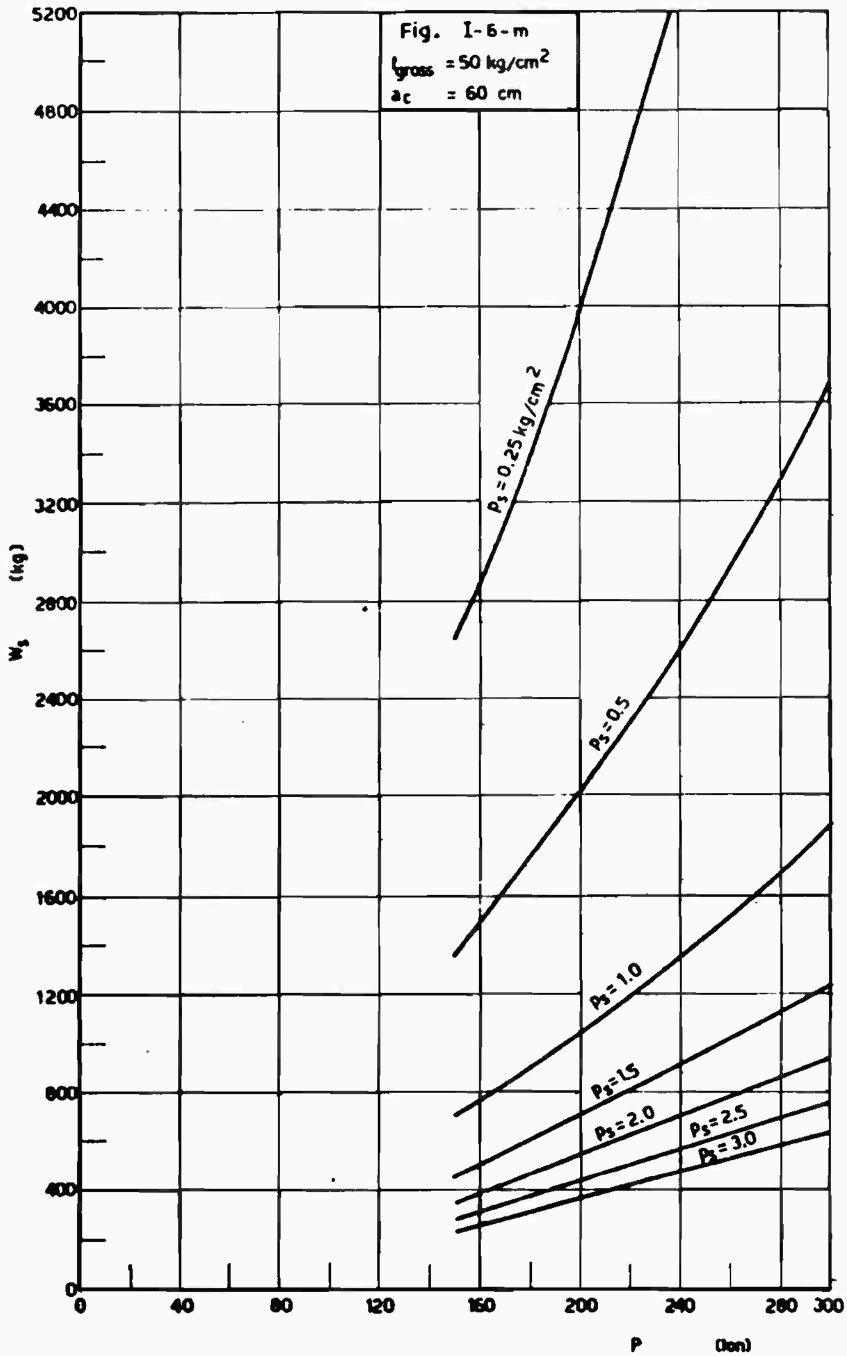


Fig. I-6-m
f_{gross} = 50 kg/cm²
a_c = 60 cm
W_s (kg)
P (ton)
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200
0
40
80
120
160
200
240
280
300

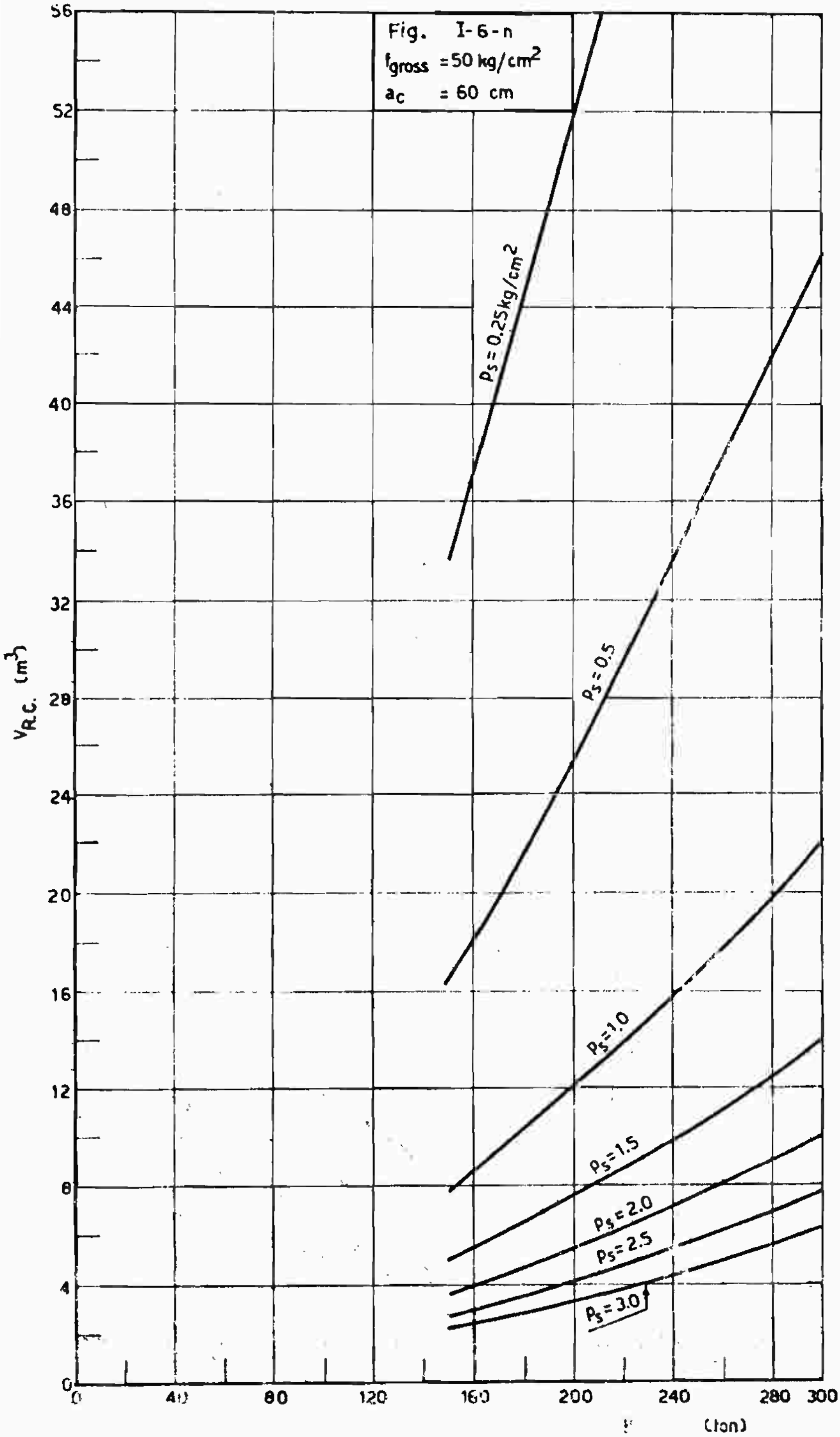


Fig. I-6-n
f_{gross} = 50 kg/cm²
a_c = 60 cm
p_s = 0.25 kg/cm²
p_s = 0.5
p_s = 1.0
p_s = 1.5
p_s = 2.0
p_s = 2.5
p_s = 3.0
$V_{R.C.}$ (m³)
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
0
40
80
120
160
200
240
280
300
(ton)

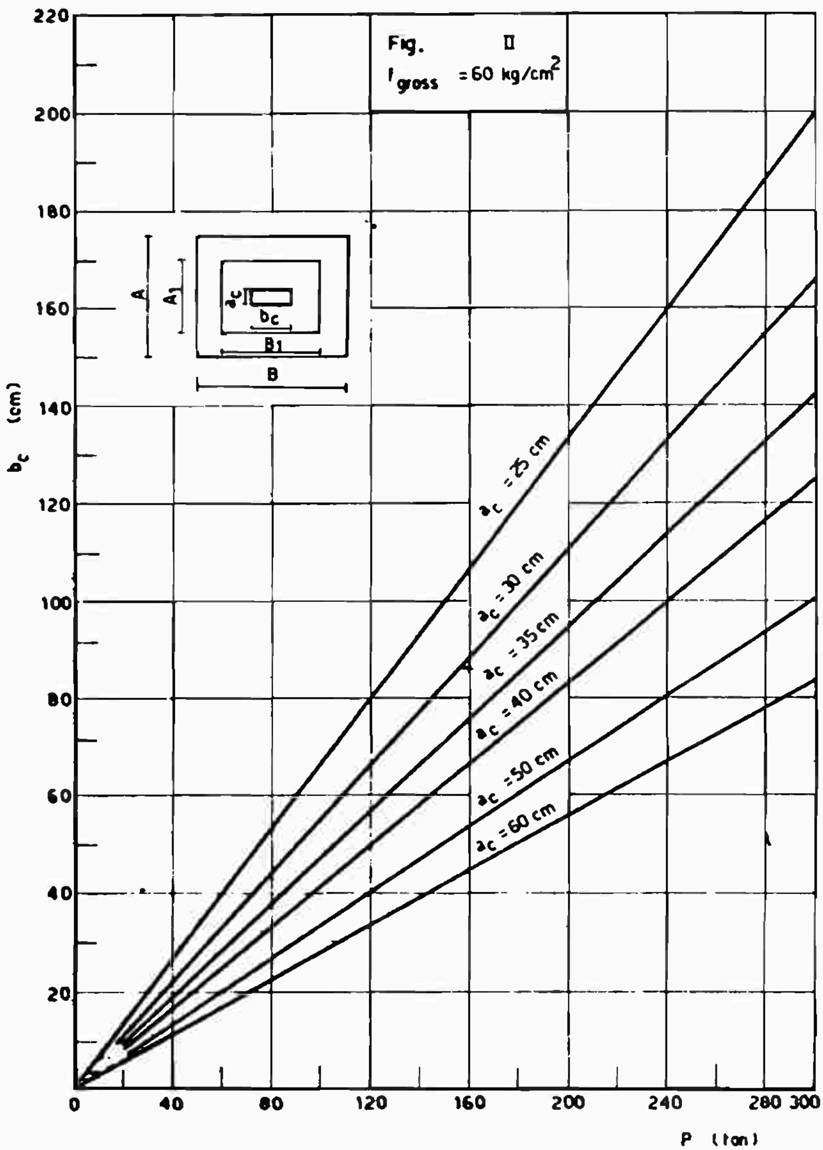


Fig. II
f_{gross} = 60 kg/cm²
A
A_1
a_c
b_c
B_1
B
a_c = 25 cm
a_c = 30 cm
a_c = 35 cm
a_c = 40 cm
a_c = 50 cm
a_c = 60 cm
b_c (cm)
P (ton)
0
20
40
60
80
100
120
140
160
180
200
220
240
280
300

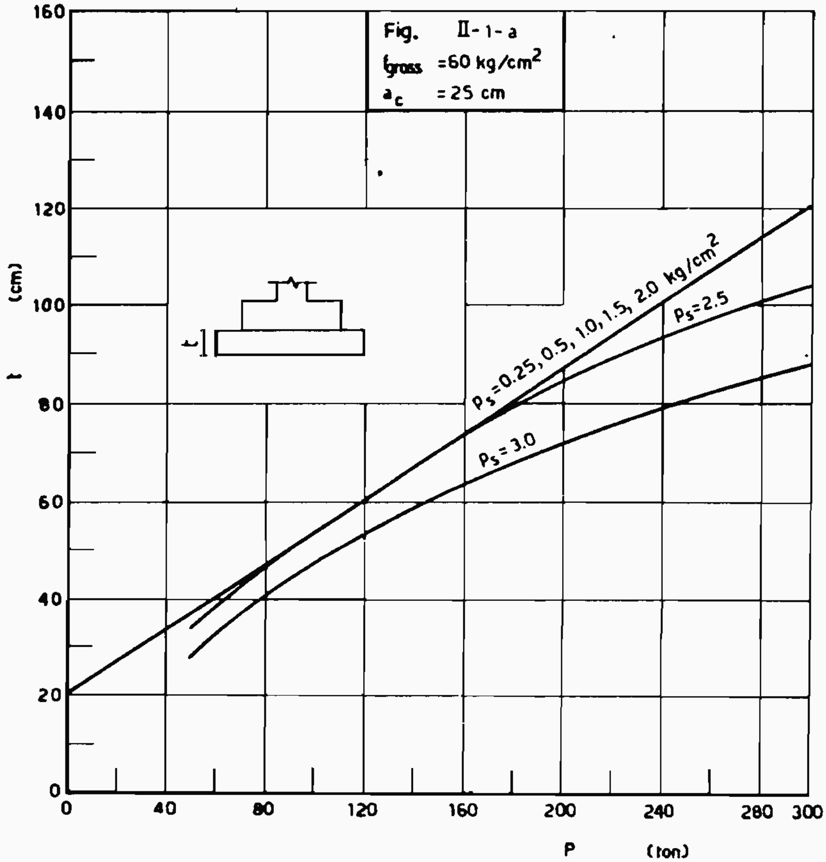


Fig. II-1-a
f_{gross} = 60 kg/cm^2
a_c = 25 cm
t (cm)
P (ton)
P_s=0.25, 0.5, 1.0, 1.5, 2.0 kg/cm^2
P_s=2.5
P_s=3.0
0
20
40
60
80
100
120
140
160
0
40
80
120
160
200
240
280
300

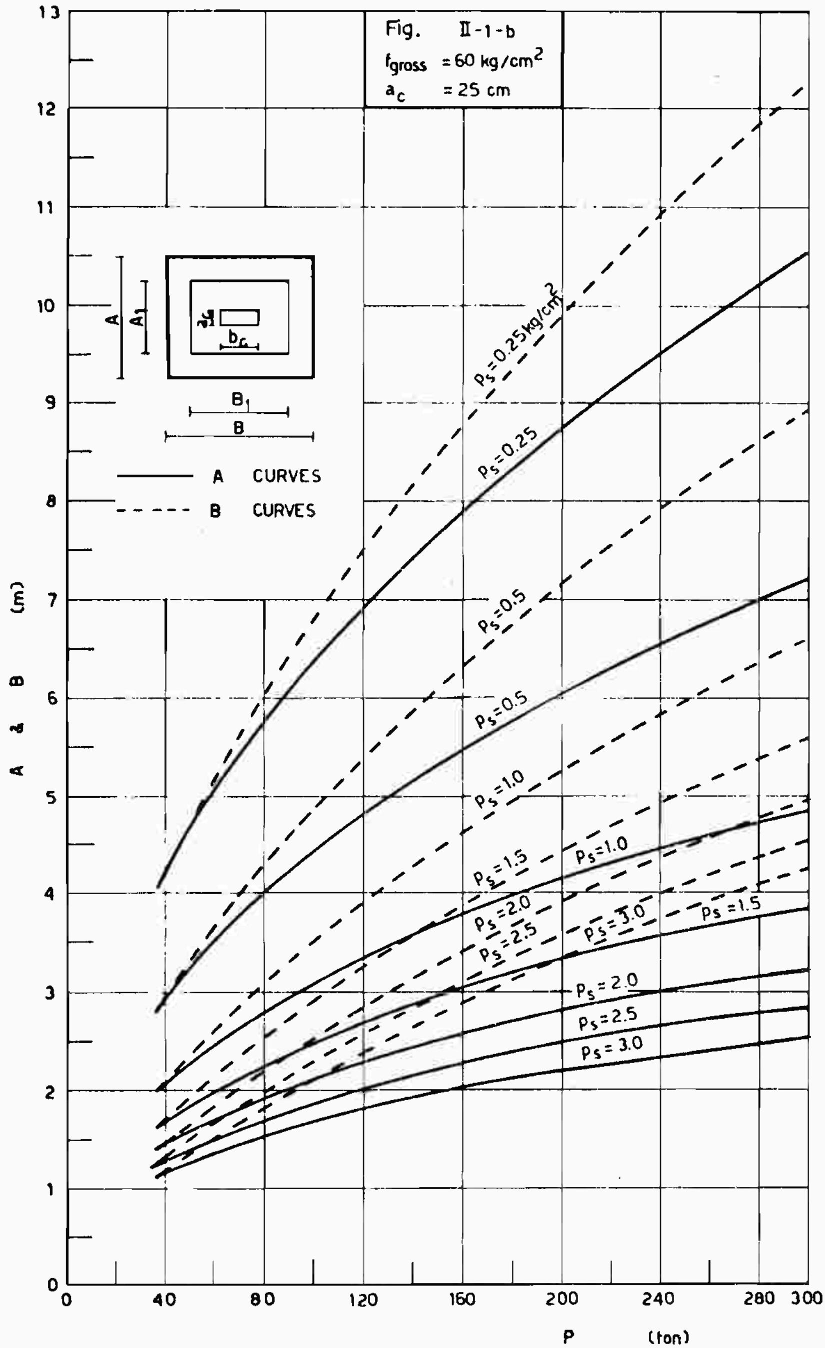


Fig. II-1-b
f_gross = 60 kg/cm²
a_c = 25 cm
A
A1
a_c
b_c
B1
B
A CURVES
B CURVES
Ps=0.25 kg/cm²
Ps=0.25
Ps=0.5
Ps=0.5
Ps=1.0
Ps=1.0
Ps=1.5
Ps=1.5
Ps=2.0
Ps=2.0
Ps=2.5
Ps=2.5
Ps=3.0
Ps=3.0
A & B (m)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
0
40
80
120
160
200
240
280
300

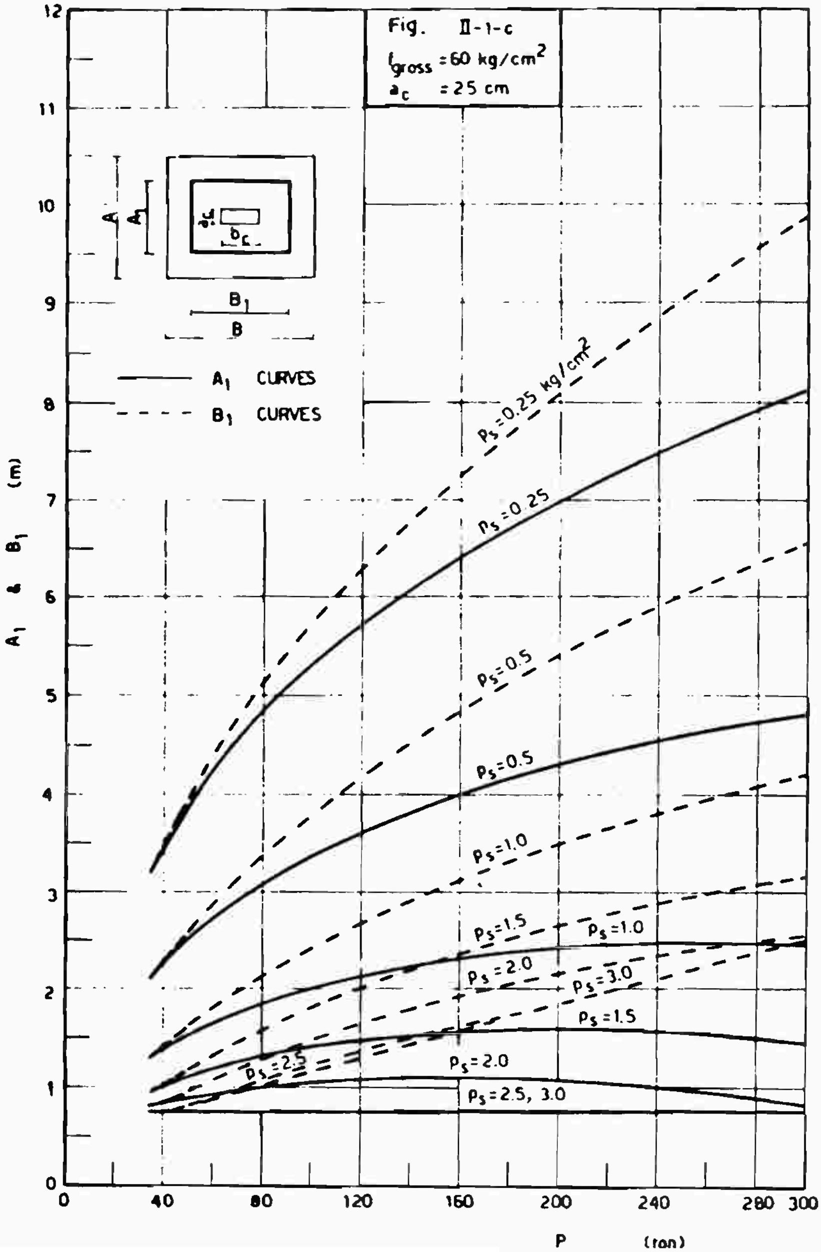


Fig. II-1-c
f_{gross} = 60 kg/cm²
a_c = 25 cm
A
A_1
a_c
b_c
B_1
B
A_1 CURVES
B_1 CURVES
A_1 & B_1 (m)
P (ton)
P_s = 0.25 kg/cm²
P_s = 0.25
P_s = 0.5
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 1.0
P_s = 2.0
P_s = 3.0
P_s = 1.5
P_s = 2.5
P_s = 2.0
P_s = 2.5, 3.0

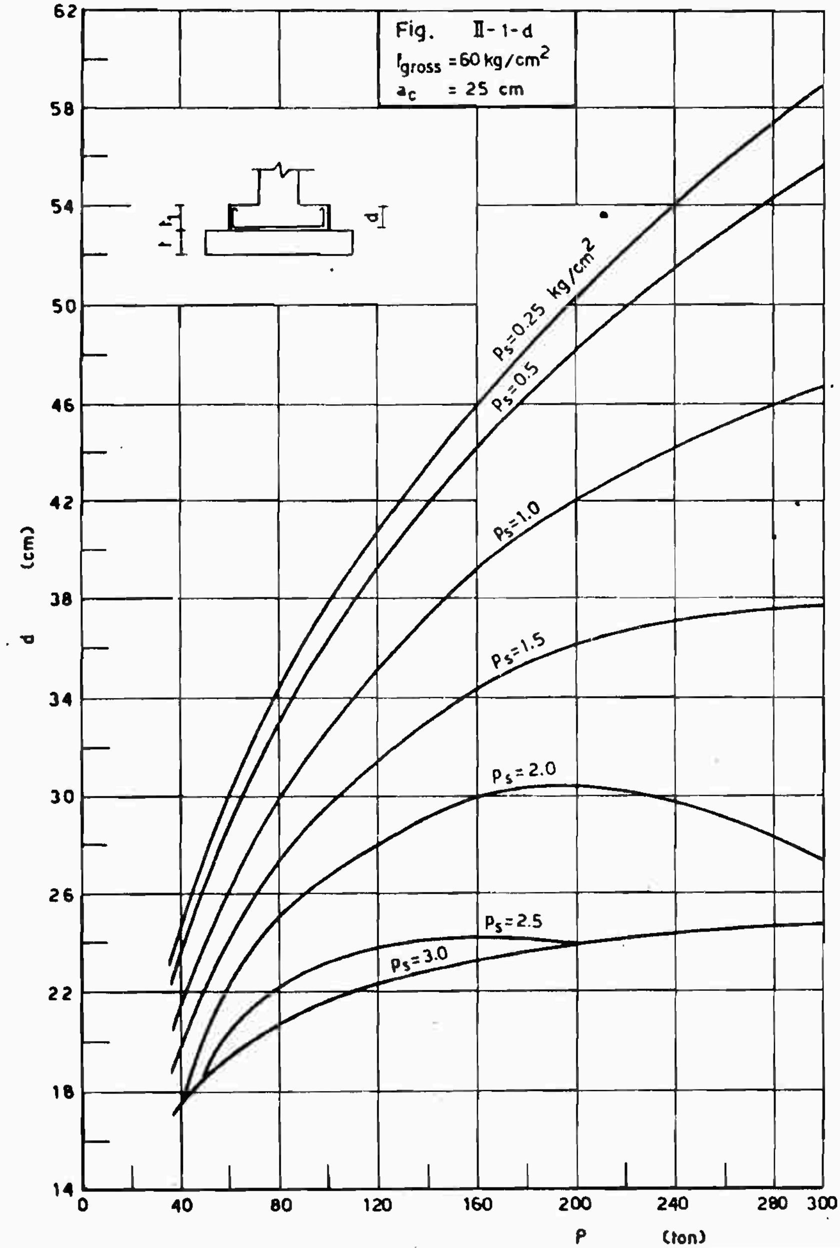


Fig. II-1-d
f_{gross} = 60 kg/cm²
a_c = 25 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d (cm)
P (ton)
62
58
54
50
46
42
38
34
30
26
22
18
14
0
40
80
120
160
200
240
280
300

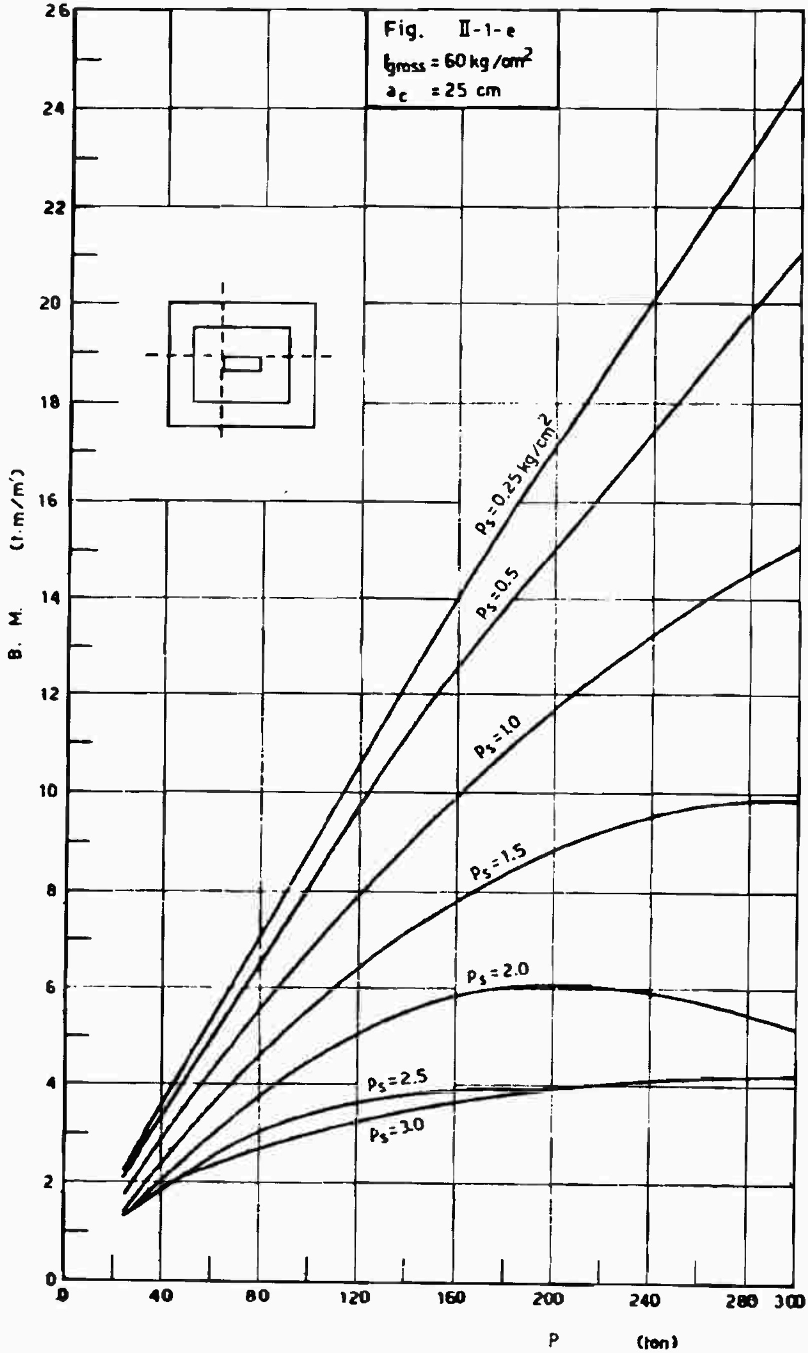


Fig. II-1-e
f_{gross} = 60 kg/cm²
a_c = 25 cm
B. M. (t.m/m')
P (ton)
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
40
80
120
160
200
240
280
300

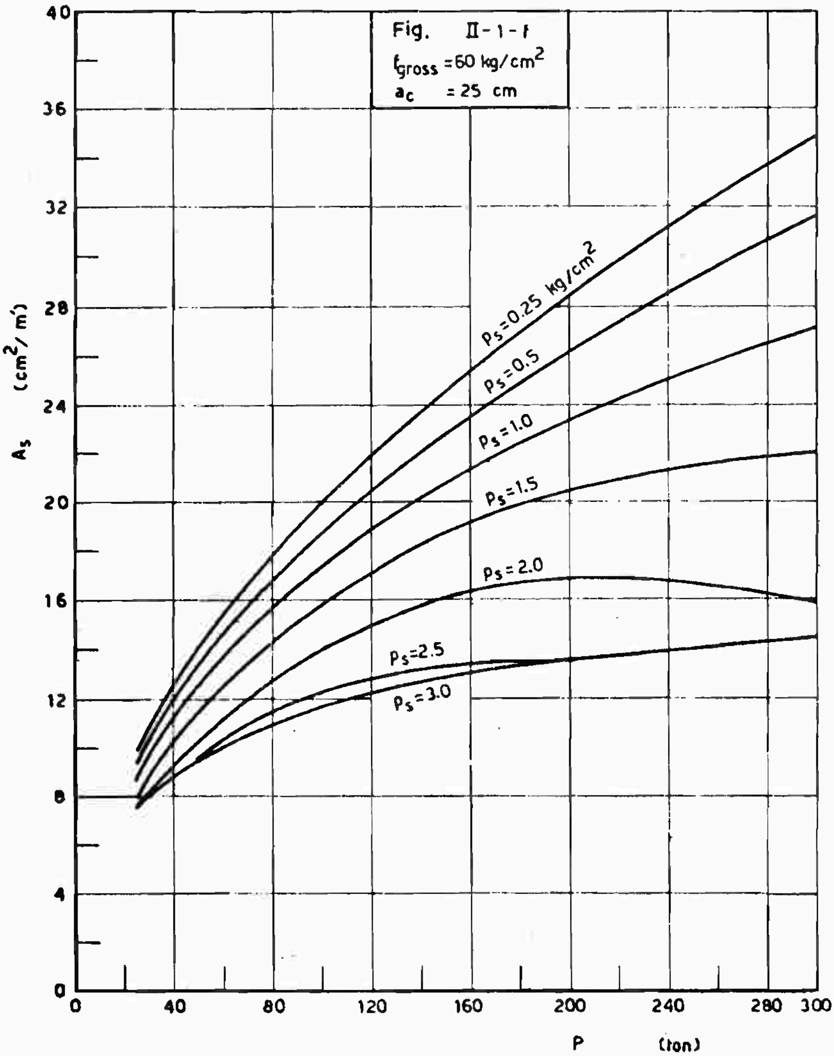


Fig. II-1-f
f_{gross} = 60 kg/cm²
a_c = 25 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_s (cm²/ m')
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300
P (ton)

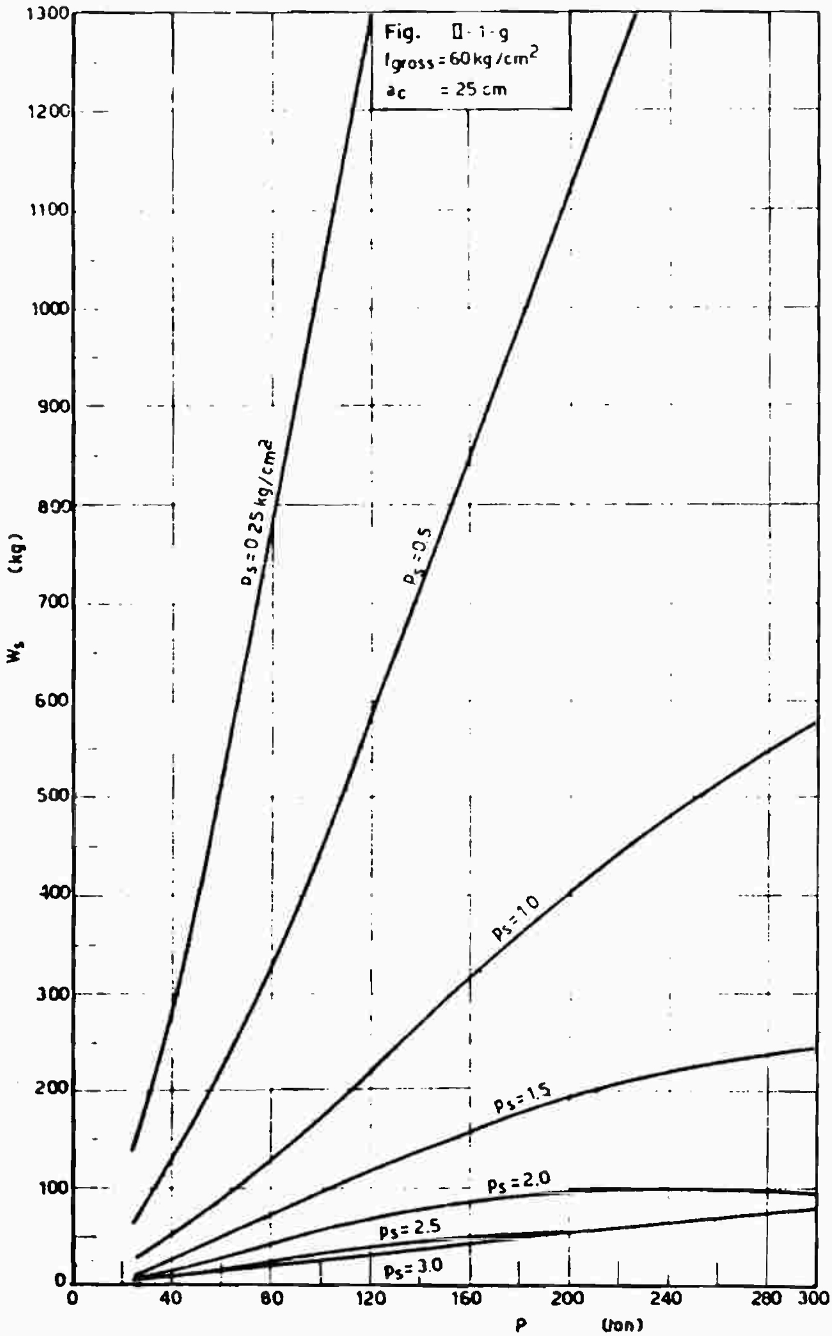


Fig. II-1-g
f_{gross} = 60 kg/cm²
a_c = 25 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
W_s (kg)
P (ton)
0
40
80
120
160
200
240
280
300
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300

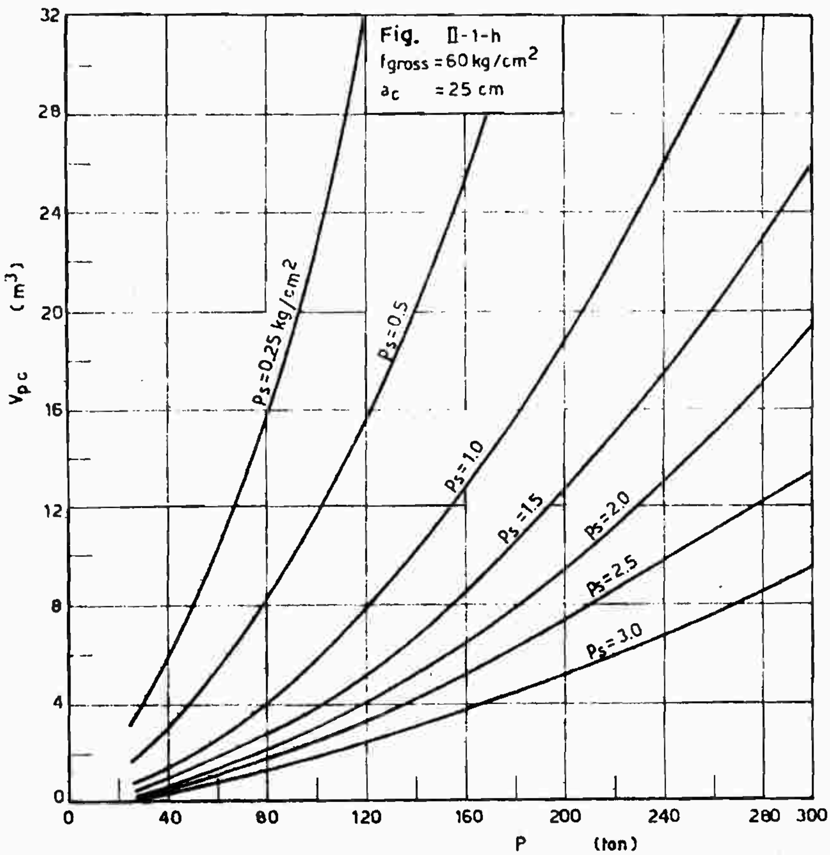


Fig. II-1-h
fgross = 60 kg/cm2
ac = 25 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
Vpc (m3)
P (ton)
0
4
8
12
16
20
24
28
32
40
80
120
160
200
240
280
300

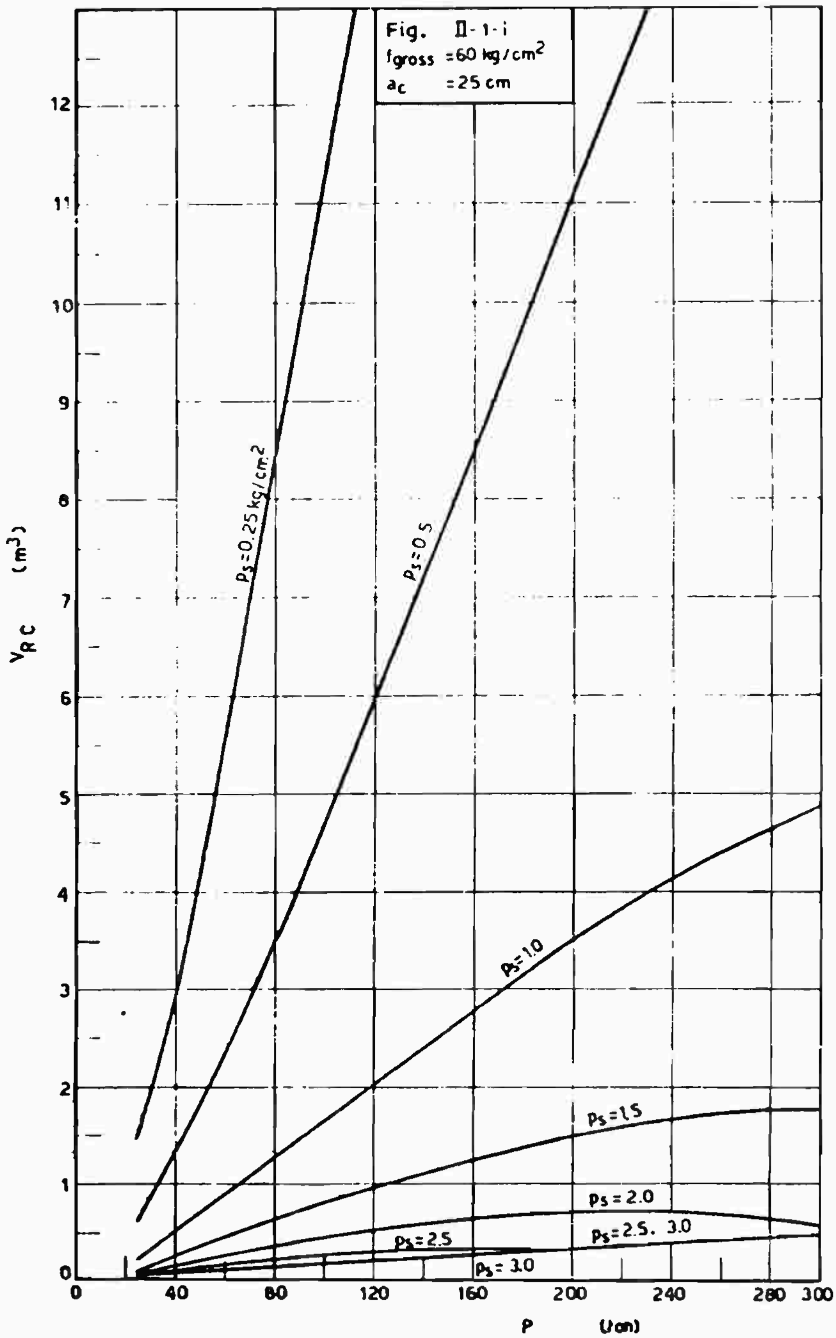


Fig. II-1-i
fgross =60 kg/cm2
ac =25 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=2.5, 3.0
Ps=3.0
VRC (m3)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
40
80
120
160
200
240
280
300

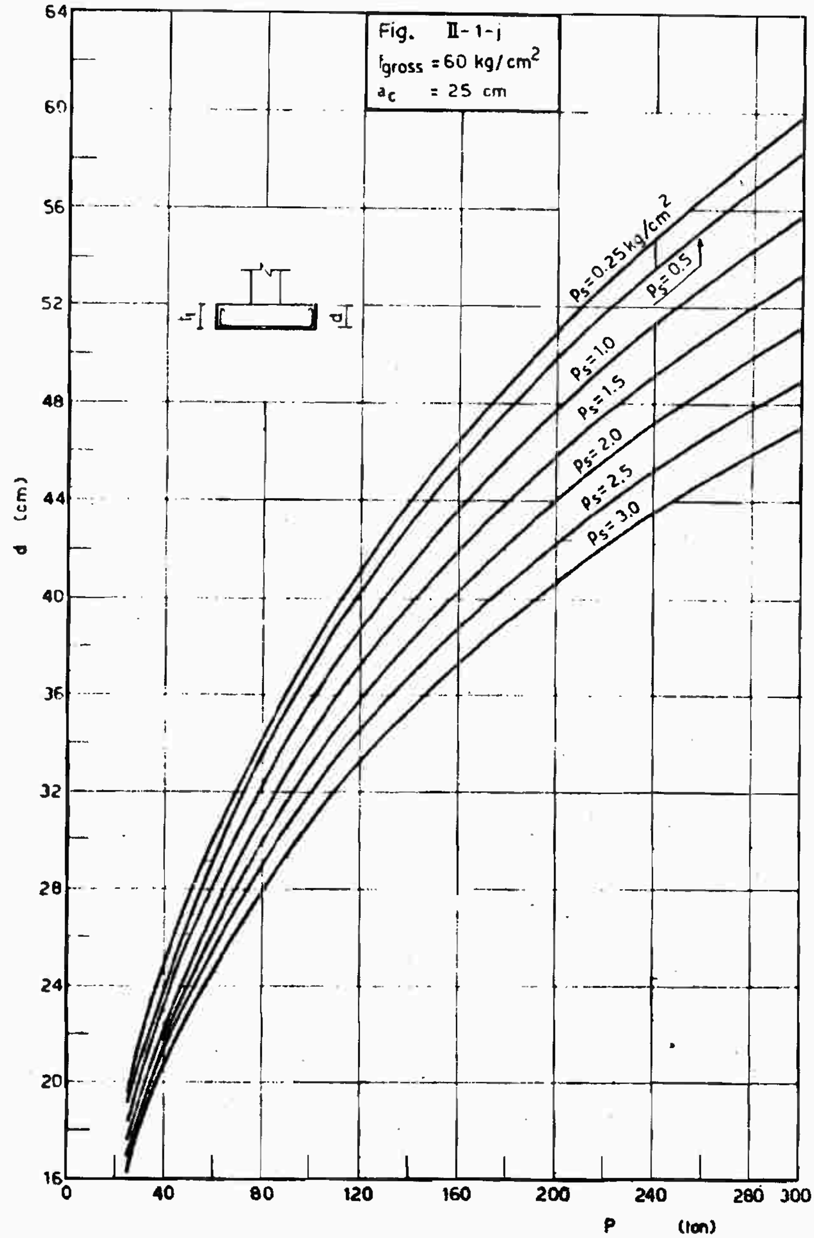


Fig. II-1-j
f gross = 60 kg/cm²
a c = 25 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d
d (cm)
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300
P (ton)

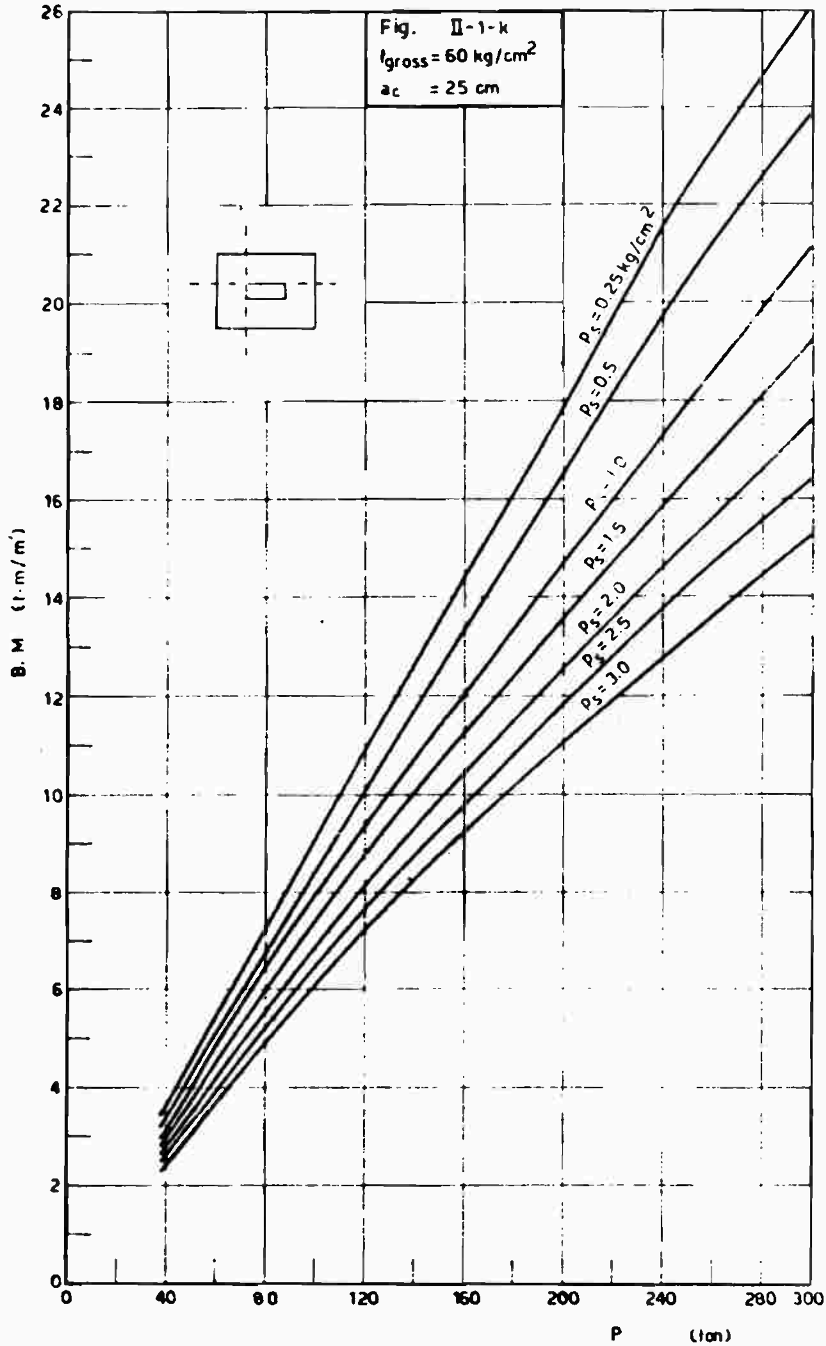


Fig. II-1-k
f_{gross} = 60 kg/cm²
a_c = 25 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
B. M (t·m/m')
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
0
40
80
120
160
200
240
280
300

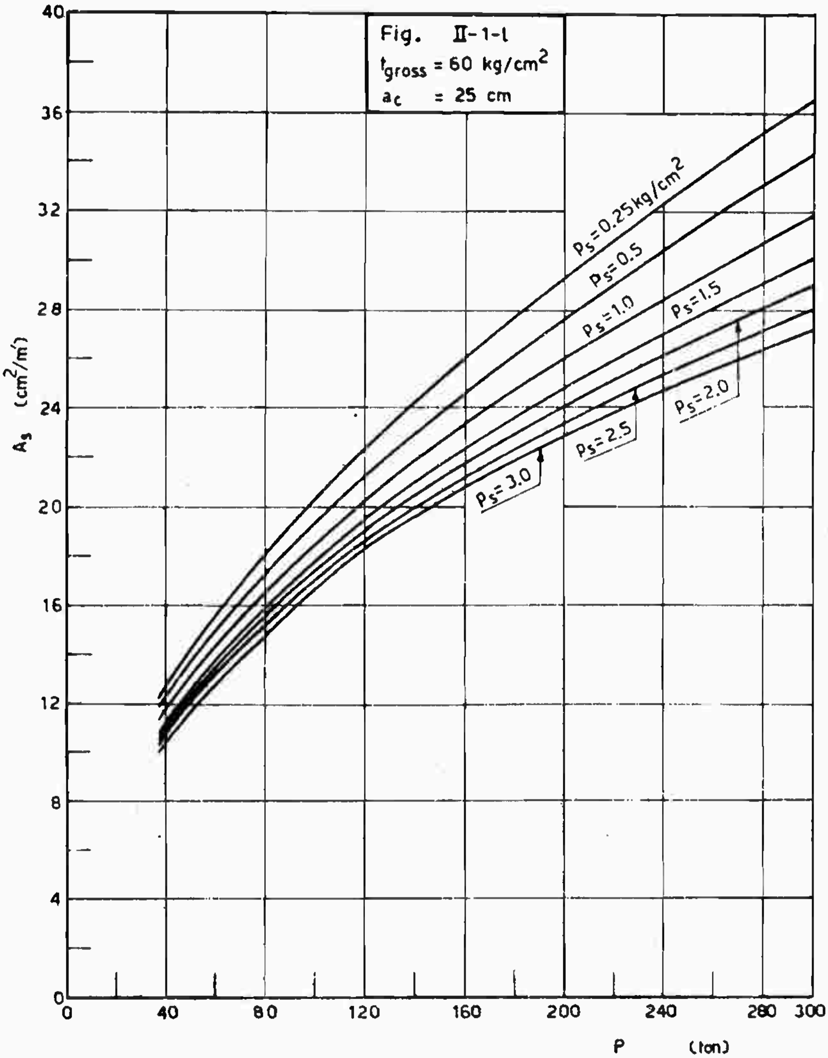


Fig. II-1-l
t_{gross} = 60 kg/cm²
a_c = 25 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
As (cm²/m)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300
P (ton)

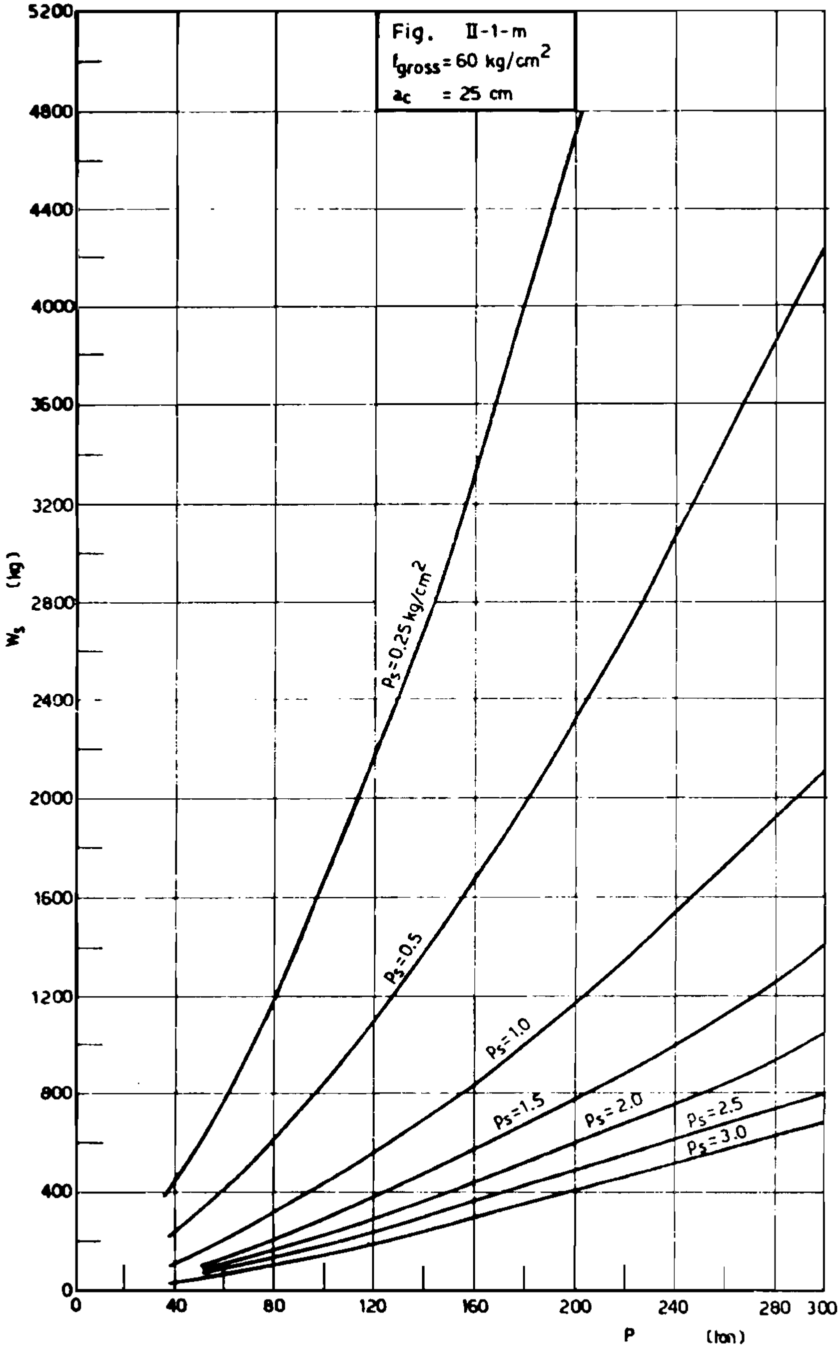


Fig. II-1-m
f_{gross} = 60 kg/cm²
a_c = 25 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
W_s (kg)
5200
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
0
40
80
120
160
200
240
280
300
P (ton)

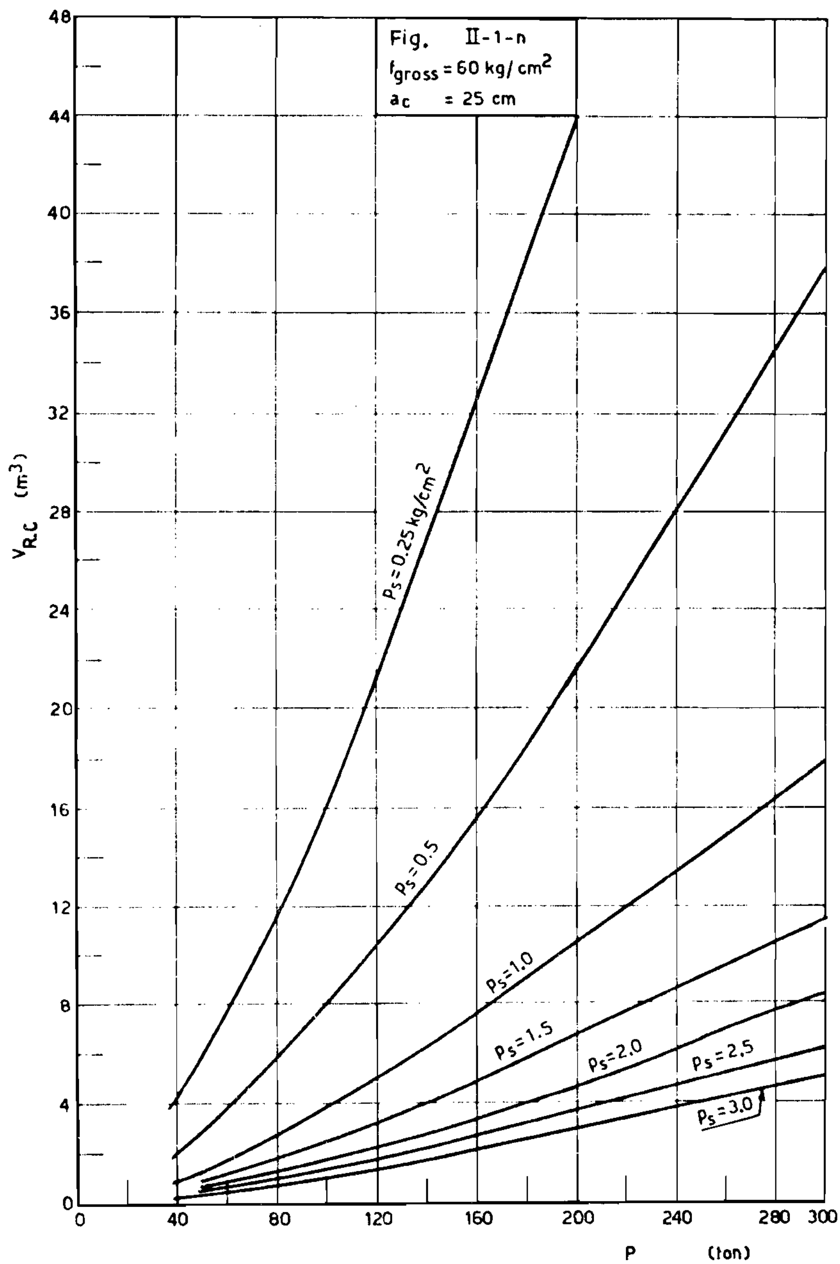


Fig. II-1-n
f_{gross} = 60 kg/cm²
a_c = 25 cm
$V_{R.C}$ (m³)
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
P (ton)
0 40 80 120 160 200 240 280 300
0 4 8 12 16 20 24 28 32 36 40 44 48

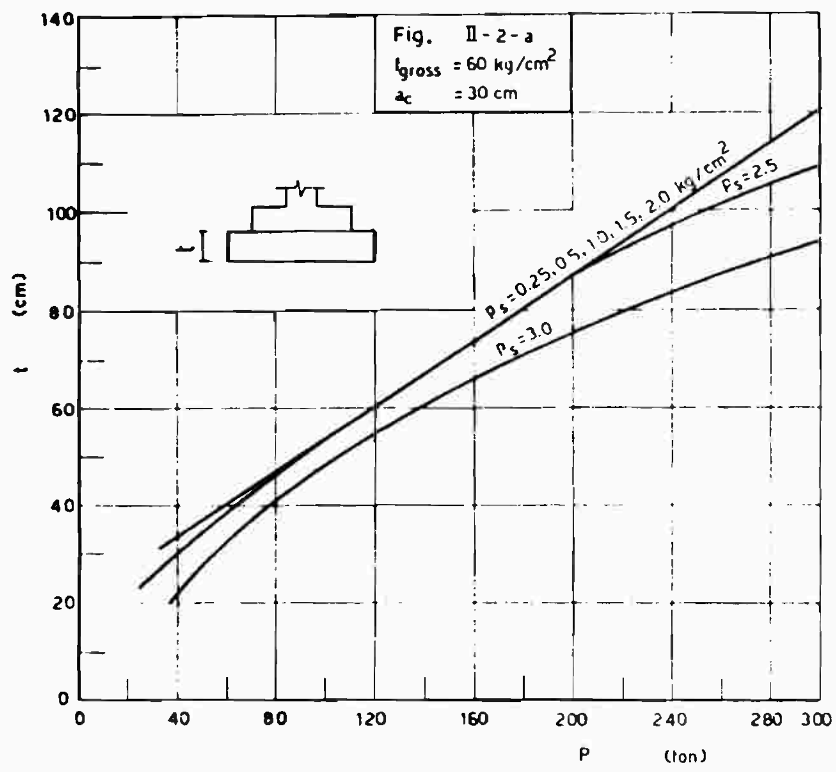


Fig. II - 2 - a
f_{gross} = 60 kg/cm^2
a_c = 30 cm
p_s=0.25, 0.5, 1.0, 1.5, 2.0 kg/cm^2
p_s=2.5
p_s=3.0
t (cm)
P (ton)
0
20
40
60
80
100
120
140
0
40
80
120
160
200
240
280
300

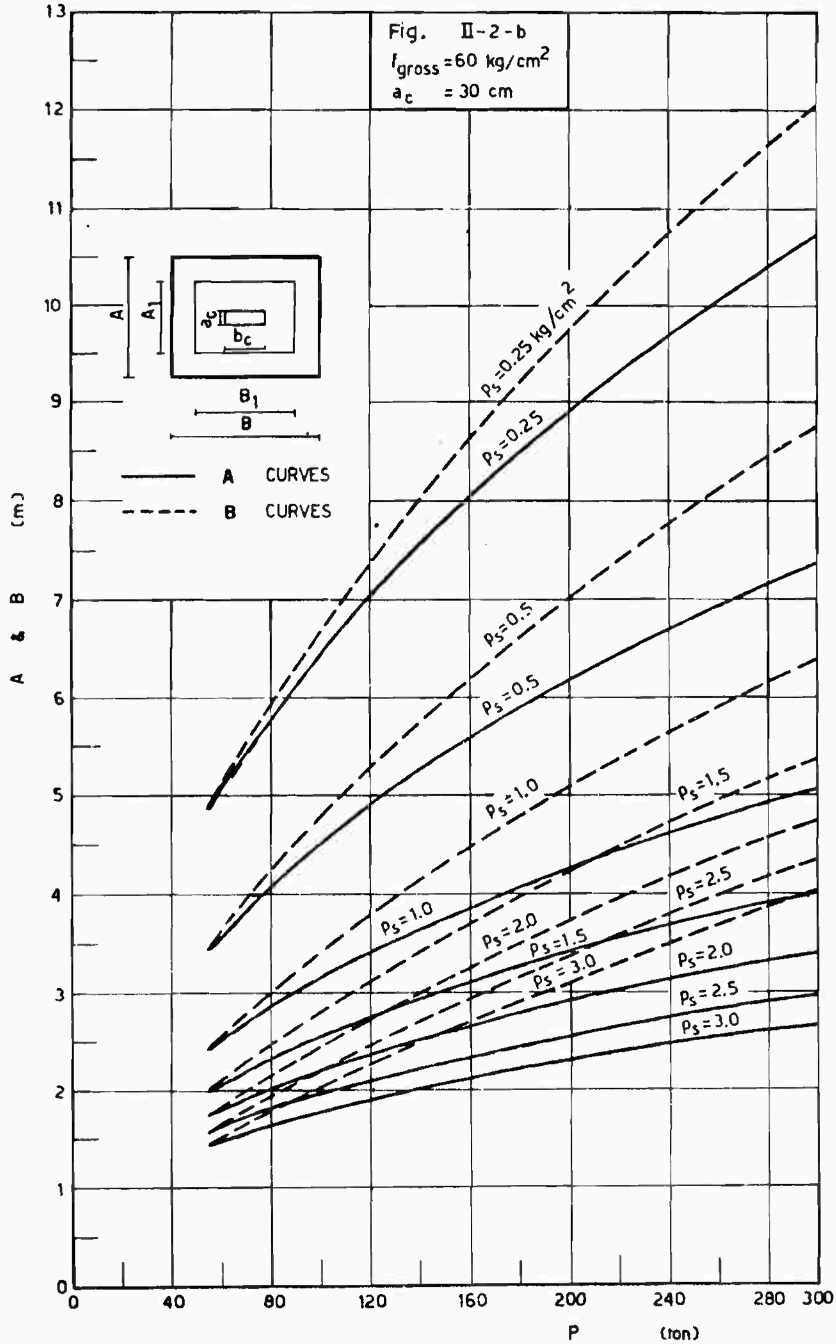


Fig. II-2-b
f_{gross} = 60 kg/cm²
a_c = 30 cm
A
A_1
a_c
b_c
B_1
B
A CURVES
B CURVES
P_s=0.25 kg/cm²
P_s=0.25
P_s=0.5
P_s=0.5
P_s=1.0
P_s=1.5
P_s=1.0
P_s=2.5
P_s=2.0
P_s=1.5
P_s=3.0
P_s=2.0
P_s=2.5
P_s=3.0
A & B (m)
P (ton)
0
40
80
120
160
200
240
280
300
1
2
3
4
5
6
7
8
9
10
11
12
13

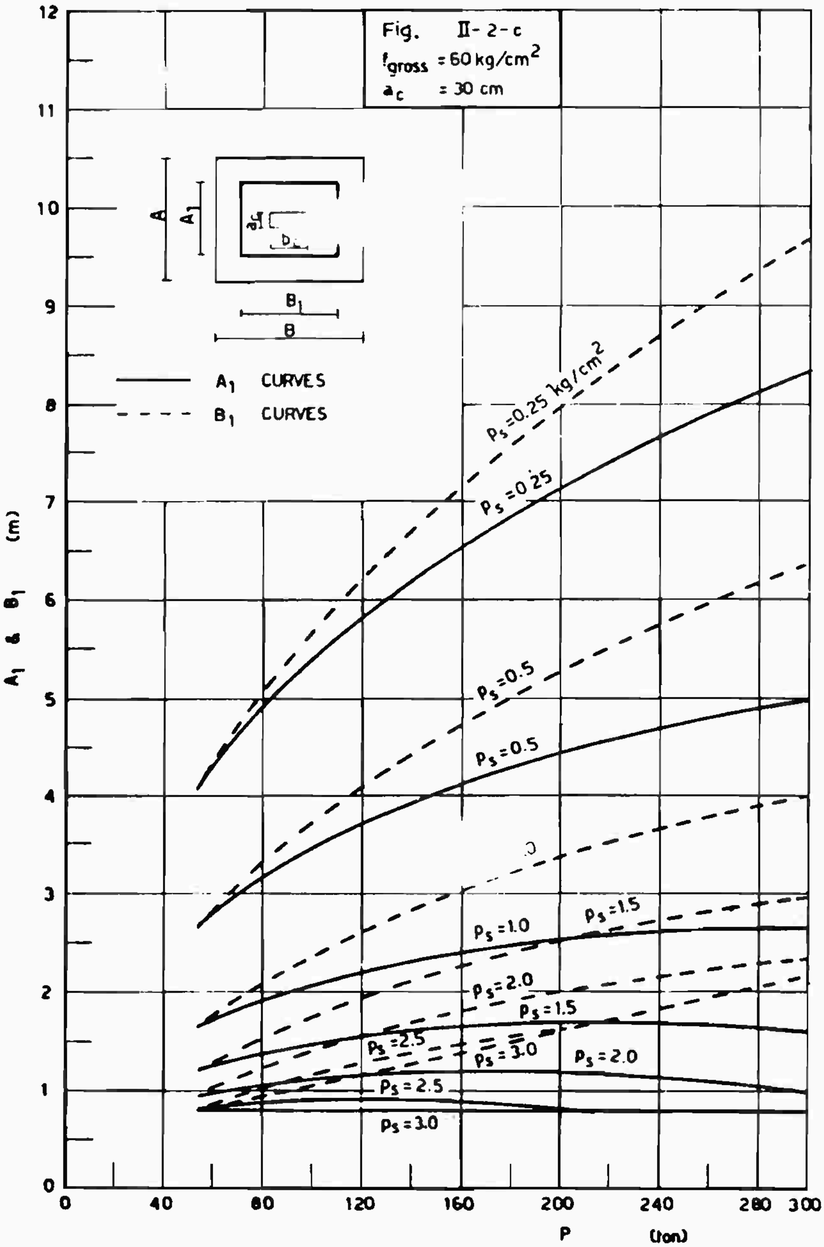


Fig. II- 2- c
f_{gross} = 60 kg/cm²
a_c = 30 cm
A
A_1
B_1
B
A_1 CURVES
B_1 CURVES
P_s=0.25 kg/cm²
P_s=0.25
P_s=0.5
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=1.5
P_s=2.5
P_s=3.0
P_s=2.0
P_s=2.5
P_s=3.0
A_1 & B_1 (m)
P (ton)
0
40
80
120
160
200
240
280
300
1
2
3
4
5
6
7
8
9
10
11
12

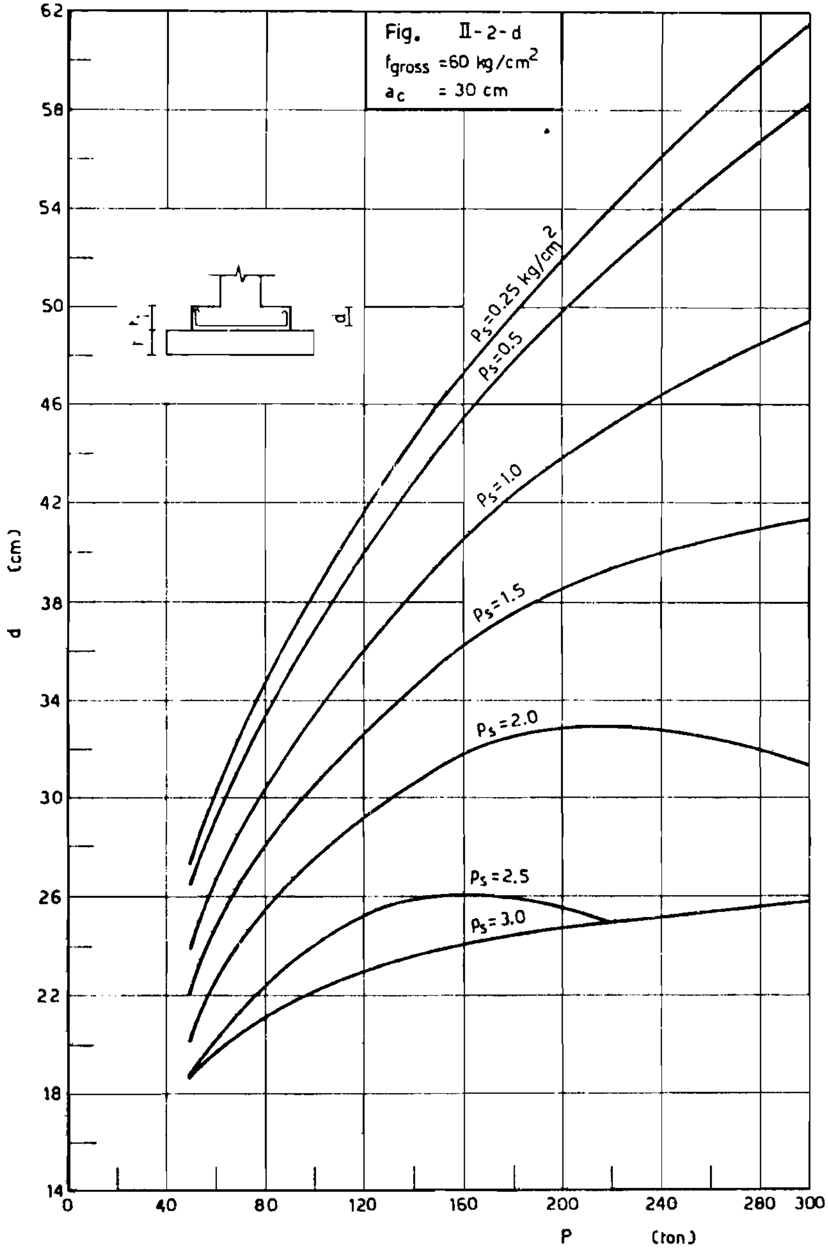


Fig. II-2-d
f_gross = 60 kg/cm2
a_c = 30 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d
d (cm)
P (ton)
62
58
54
50
46
42
38
34
30
26
22
18
14
0
40
80
120
160
200
240
280
300

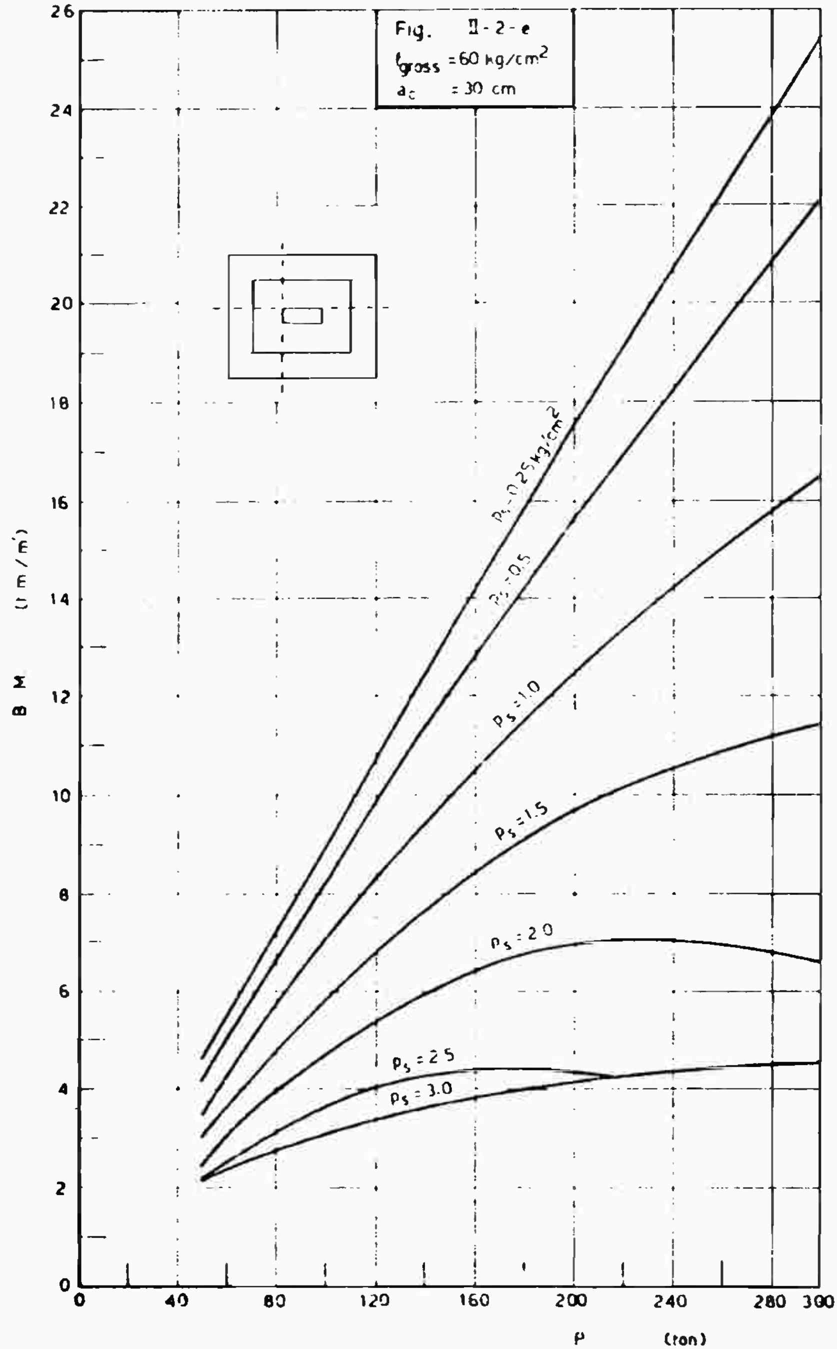


Fig. II-2-e
f_{gross} = 60 kg/cm²
a_c = 30 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
B M (t m / m')
P (ton)
0 40 80 120 160 200 240 280 300
0 2 4 6 8 10 12 14 16 18 20 22 24 26

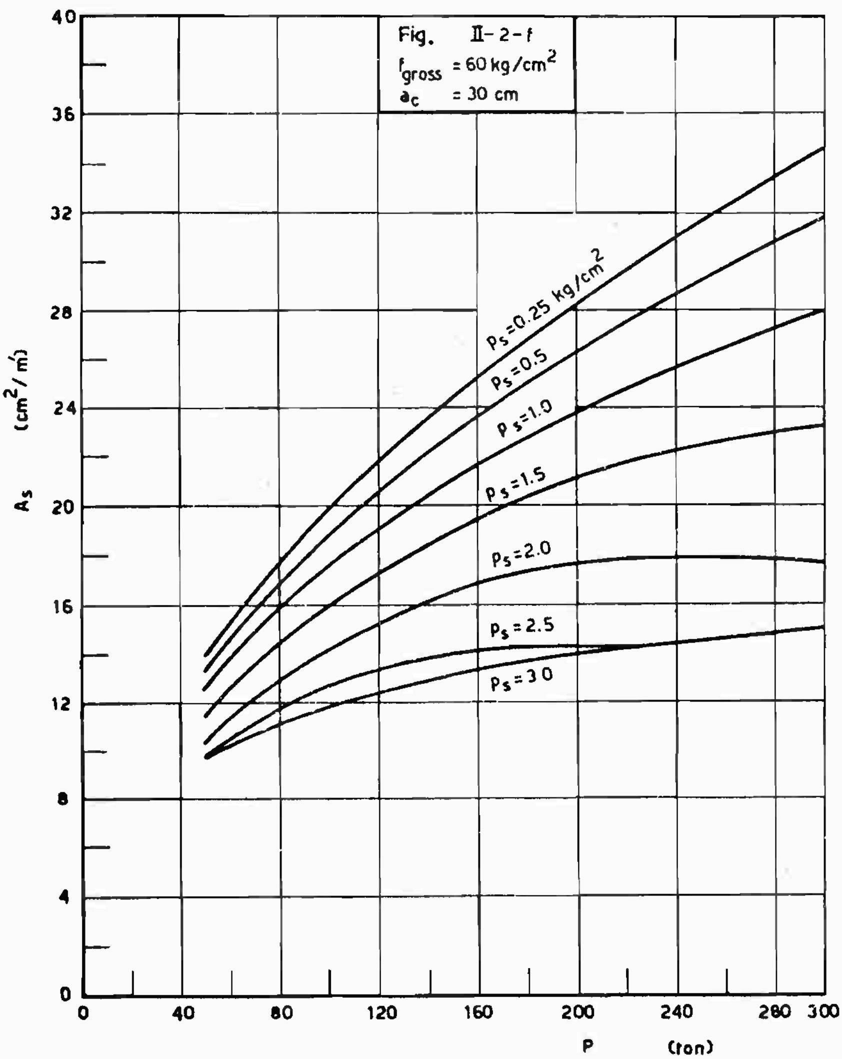


Fig. II-2-f
f_{gross} = 60 kg/cm²
a_c = 30 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_s (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300

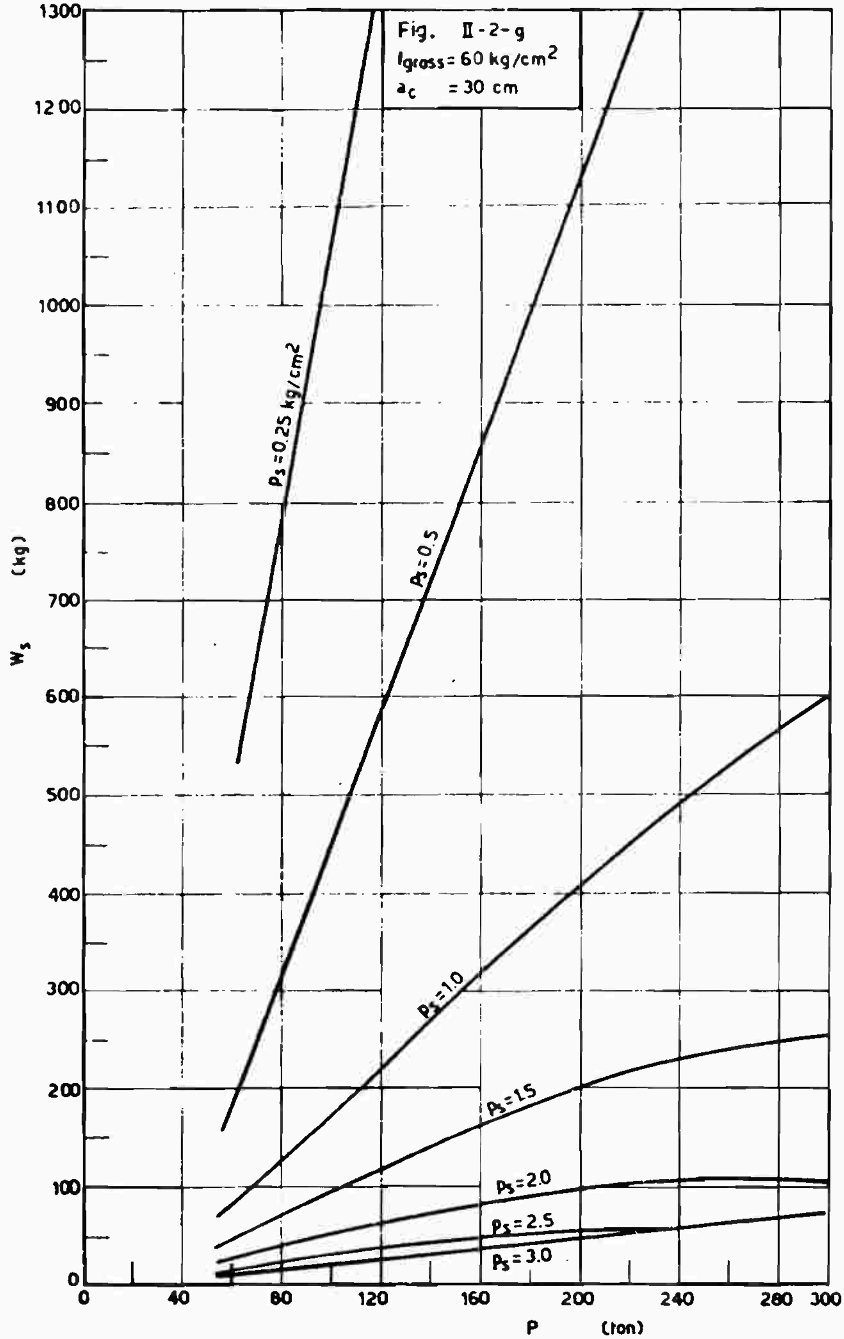


Fig. II-2-g
f_{gross} = 60 kg/cm^2
a_c = 30 cm
p_s = 0.25 kg/cm^2
p_s = 0.5
p_s = 1.0
p_s = 1.5
p_s = 2.0
p_s = 2.5
p_s = 3.0
W_s (kg)
P (ton)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
40
80
120
160
200
240
280
300

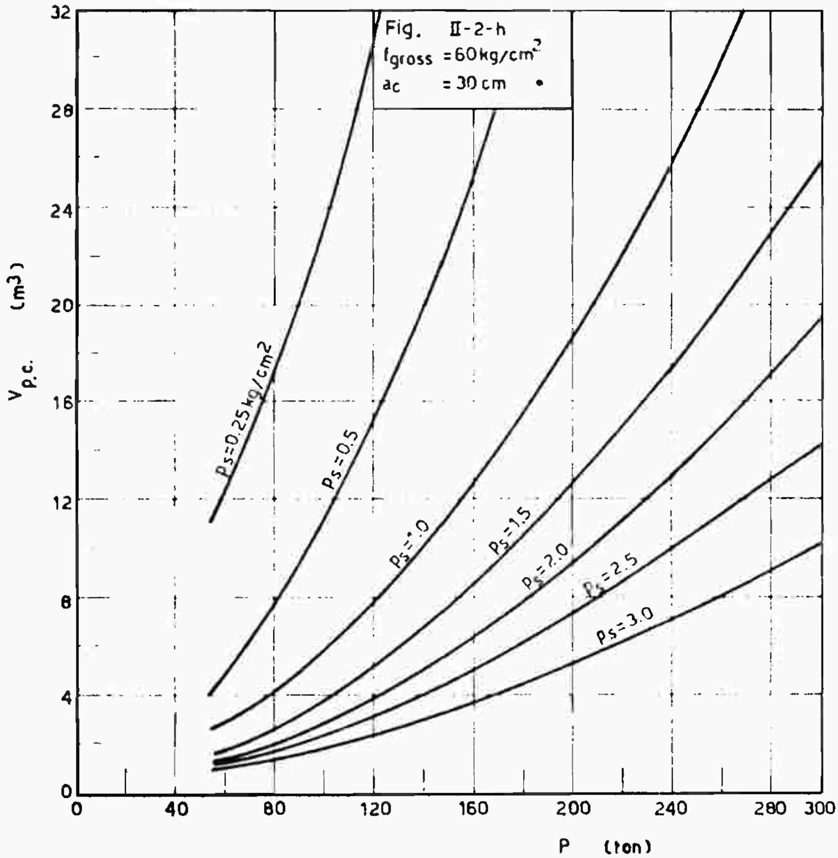


Fig. II-2-h
f_{gross} = 60 kg/cm²
ac = 30 cm
$V_{p.c.}$ (m³)
P (ton)
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
0
4
8
12
16
20
24
28
32
0
40
80
120
160
200
240
280
300

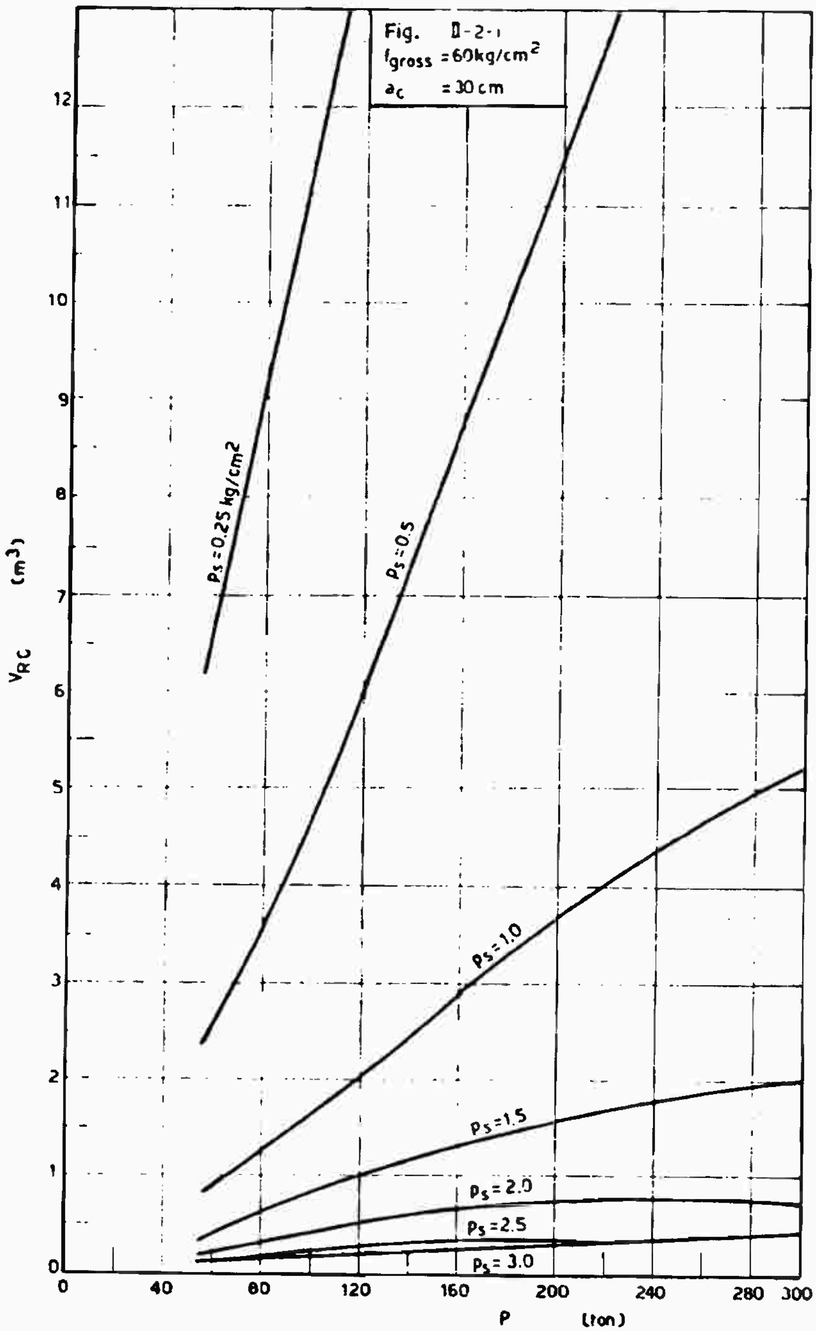


Fig. II-2-1
f_{gross} = 60kg/cm²
a_c = 30 cm
V_{RC} (m³)
P (ton)
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
0
40
80
120
160
200
240
280
300
1
2
3
4
5
6
7
8
9
10
11
12

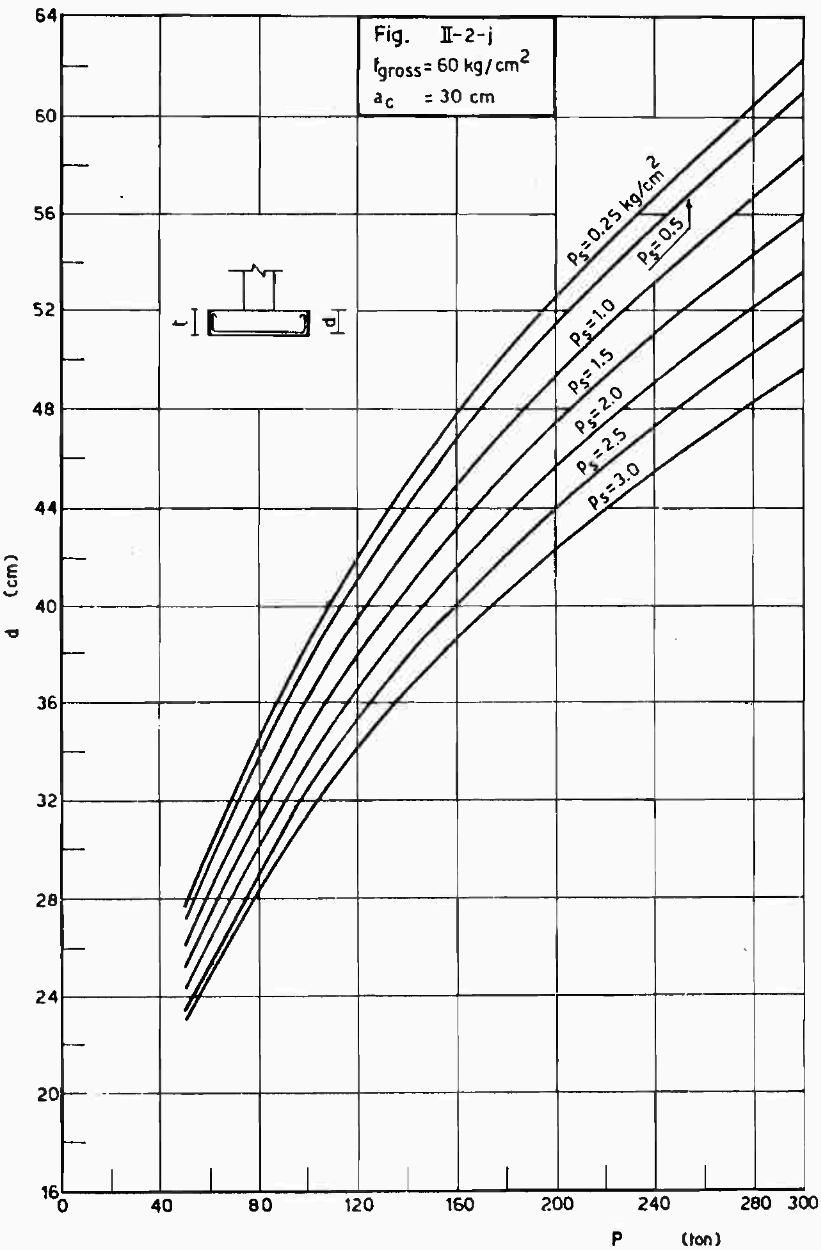


Fig. II-2-j
f_{gross} = 60 kg/cm²
a_c = 30 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d (cm)
P (ton)
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300

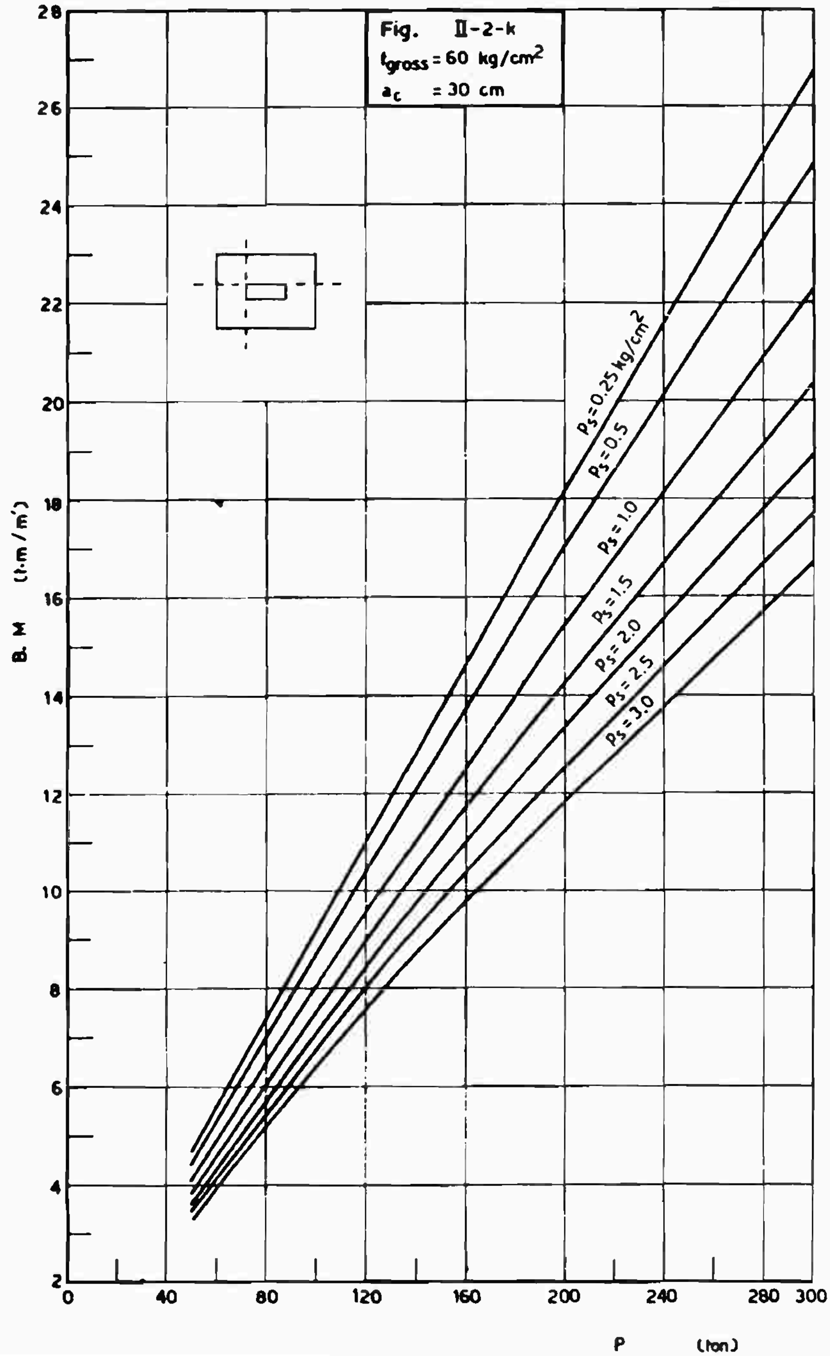


Fig. II-2-k
f_{gross} = 60 kg/cm^2
a_c = 30 cm
Ps=0.25 kg/cm^2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
B. M (t·m / m')
P (ton)
2
4
6
8
10
12
14
16
18
20
22
24
26
28
0
40
80
120
160
200
240
280
300

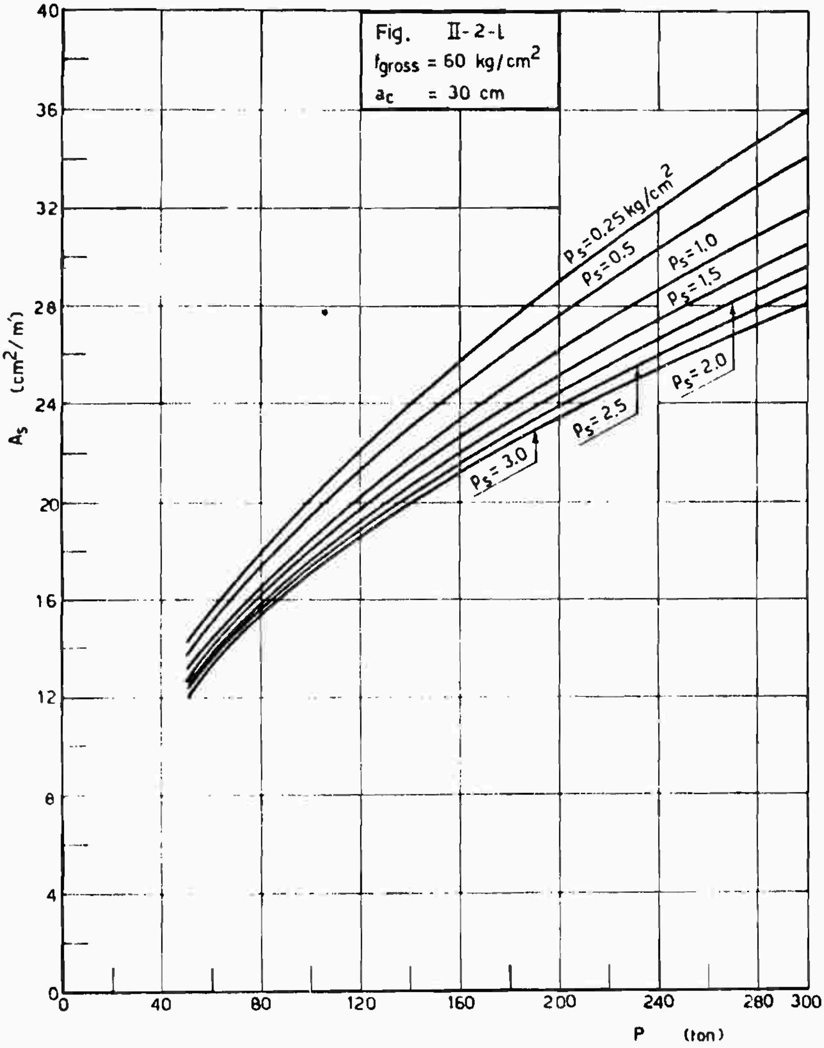


Fig. II-2-L
f_{gross} = 60 kg/cm²
a_c = 30 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_s (cm²/m')
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300
P (ton)

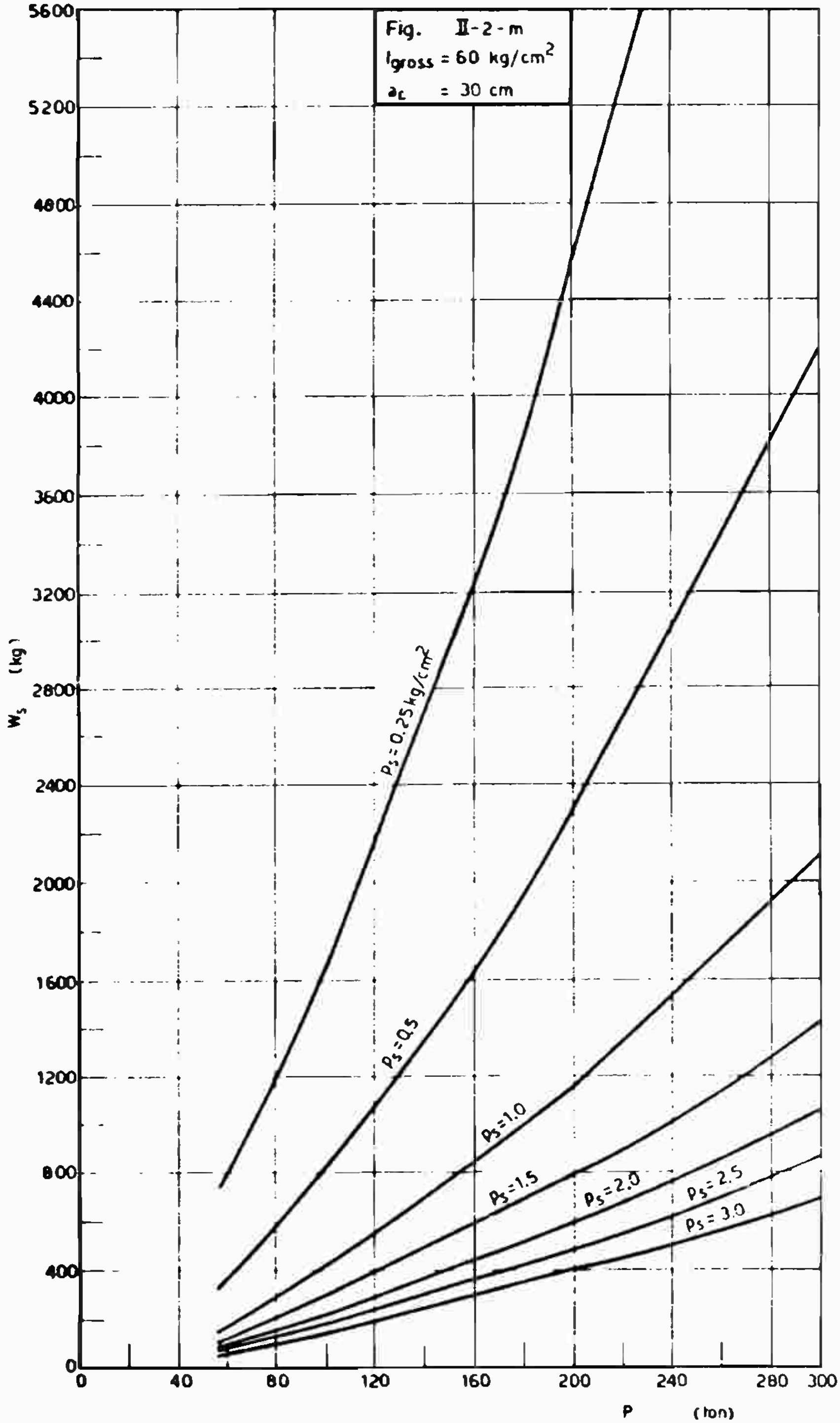


Fig. II-2-m
I_{gross} = 60 kg/cm²
a_c = 30 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
W_s (kg)
P (ton)
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200
5600
40
80
120
160
200
240
280
300

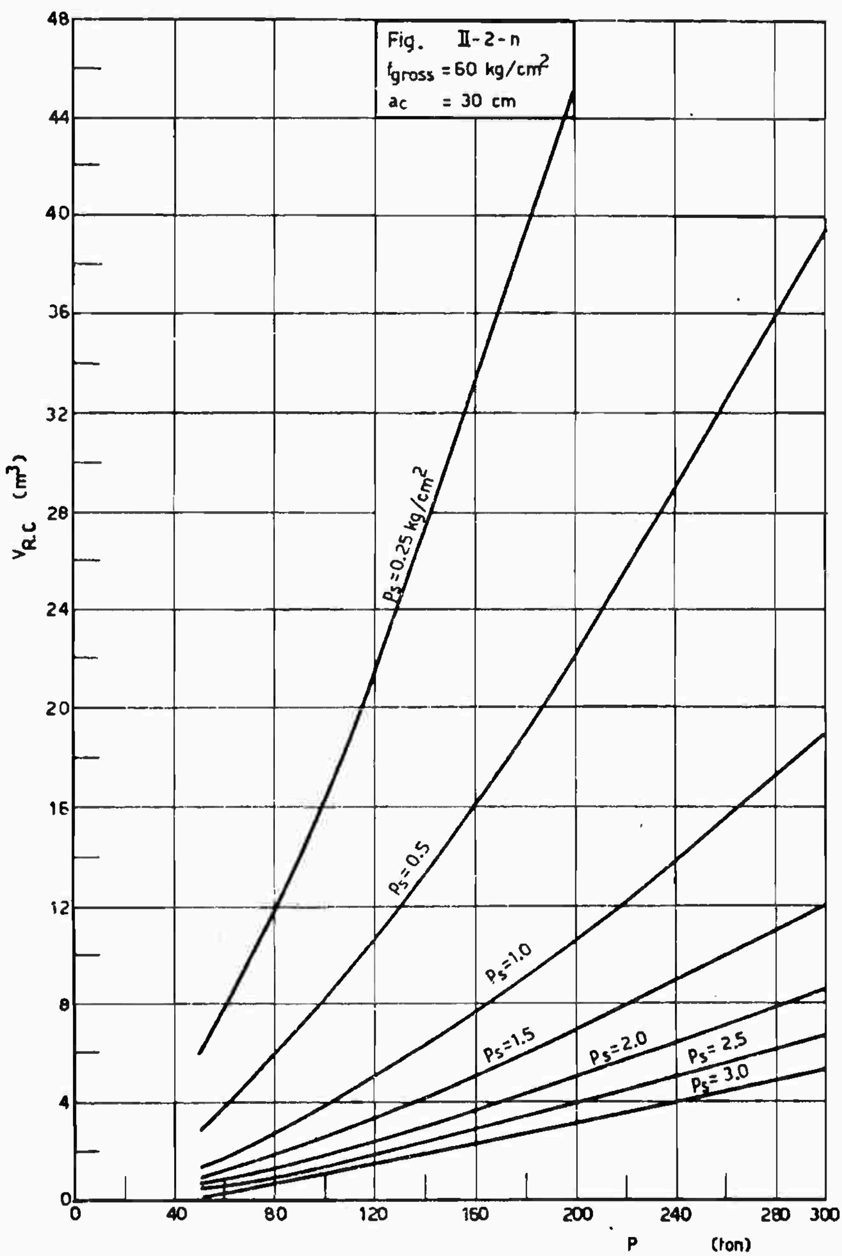


Fig. II-2-n
f_{gross} = 60 kg/cm²
a_c = 30 cm
$V_{R.C}$ (m³)
P (ton)
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
0
4
8
12
16
20
24
28
32
36
40
44
48
0
40
80
120
160
200
240
280
300

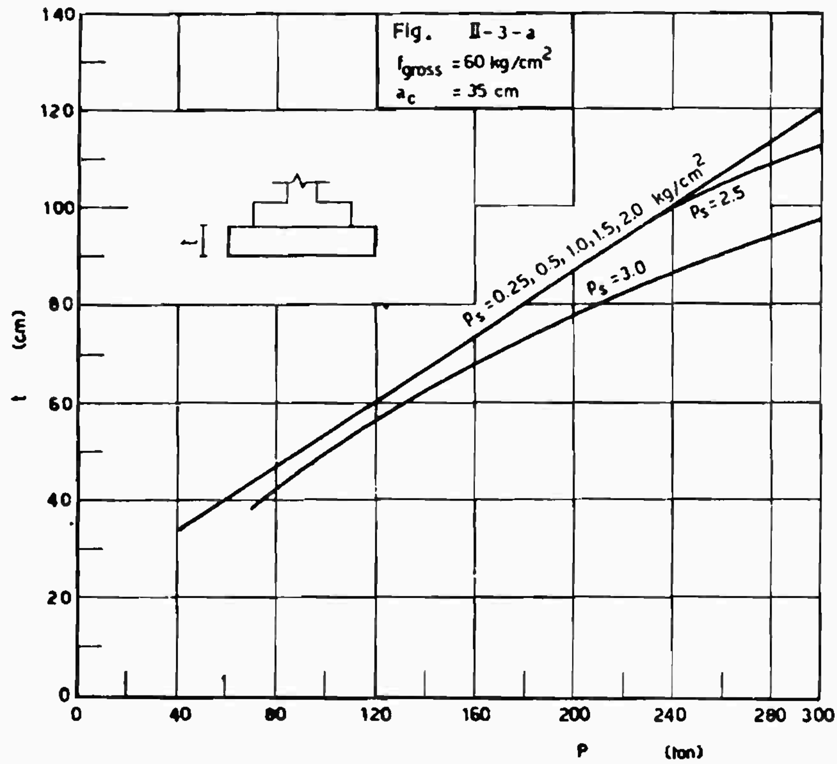


Fig. II-3-a
f gross = 60 kg/cm2
a c = 35 cm
Ps = 0.25, 0.5, 1.0, 1.5, 2.0 kg/cm2
Ps = 2.5
Ps = 3.0
t (cm)
P (ton)
0
20
40
60
80
100
120
140
0
40
80
120
160
200
240
280
300

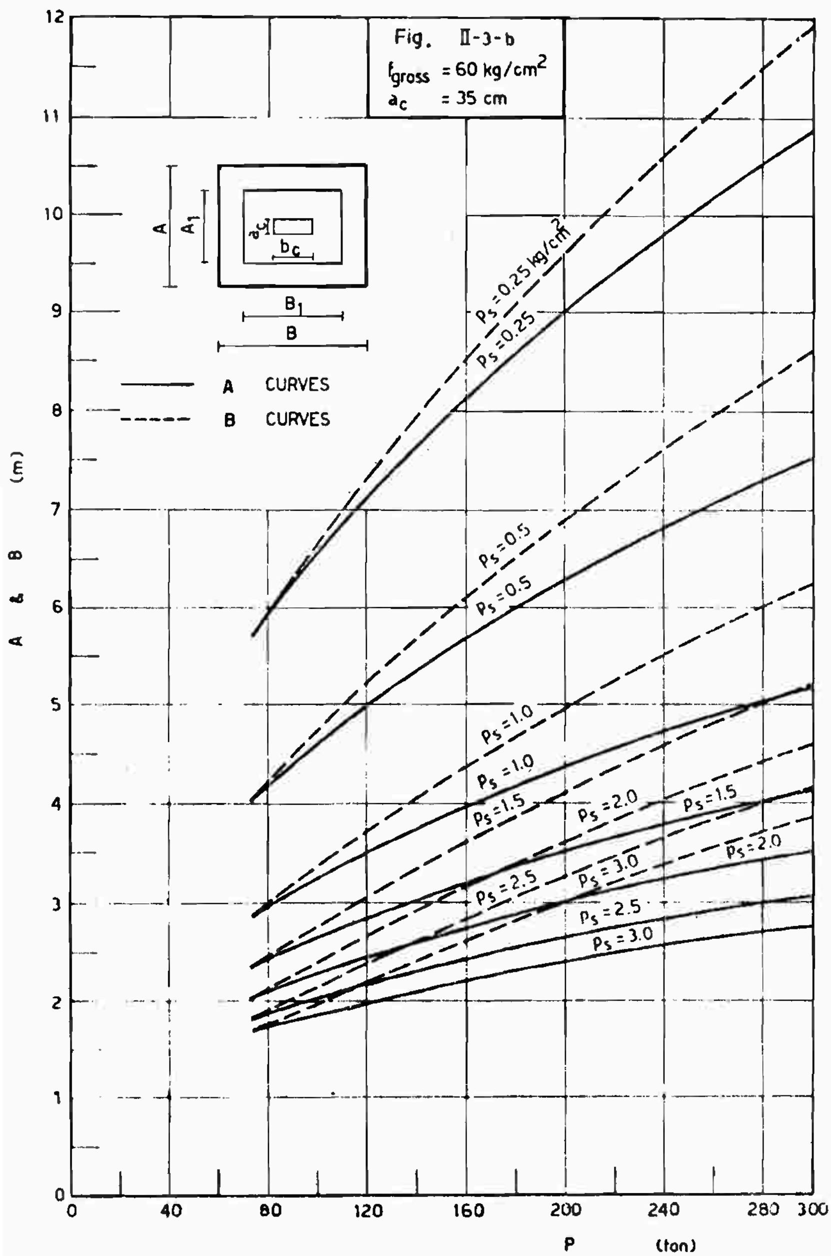


Fig. II-3-b
f_{gross} = 60 kg/cm²
a_c = 35 cm
A
A_1
a_c
b_c
B_1
B
A CURVES
B CURVES
Ps = 0.25 kg/cm²
Ps = 0.25
Ps = 0.5
Ps = 0.5
Ps = 1.0
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 1.5
Ps = 2.5
Ps = 3.0
Ps = 2.0
Ps = 2.5
Ps = 3.0
A & B (m)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
280
300

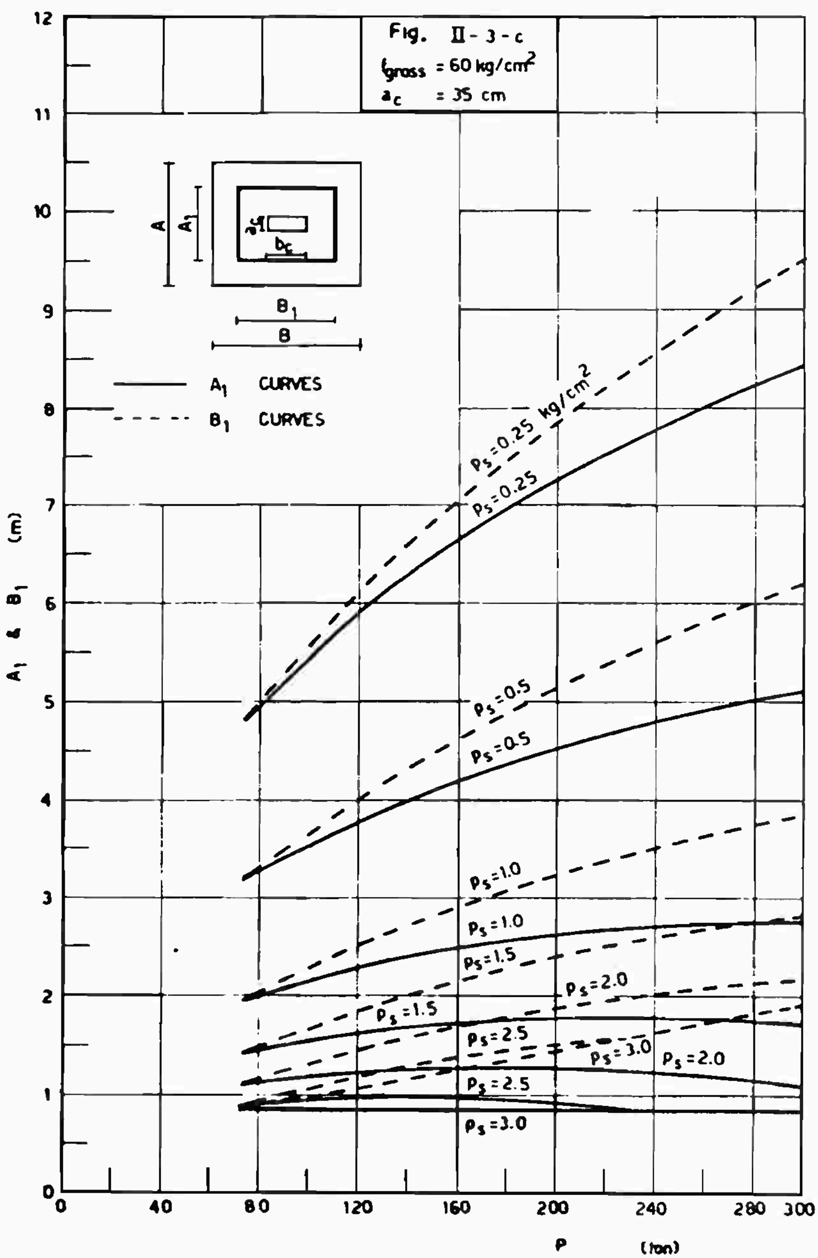


Fig. II - 3 - c
f_{gross} = 60 kg/cm²
a_c = 35 cm
A
A_1
a_c
b_c
B_1
B
A_1 CURVES
B_1 CURVES
p_s=0.25 kg/cm²
p_s=0.25
p_s=0.5
p_s=0.5
p_s=1.0
p_s=1.0
p_s=1.5
p_s=1.5
p_s=2.0
p_s=2.0
p_s=2.5
p_s=2.5
p_s=3.0
p_s=3.0
A_1 & B_1 (m)
P (ton)
0
40
80
120
160
200
240
280
300
1
2
3
4
5
6
7
8
9
10
11
12

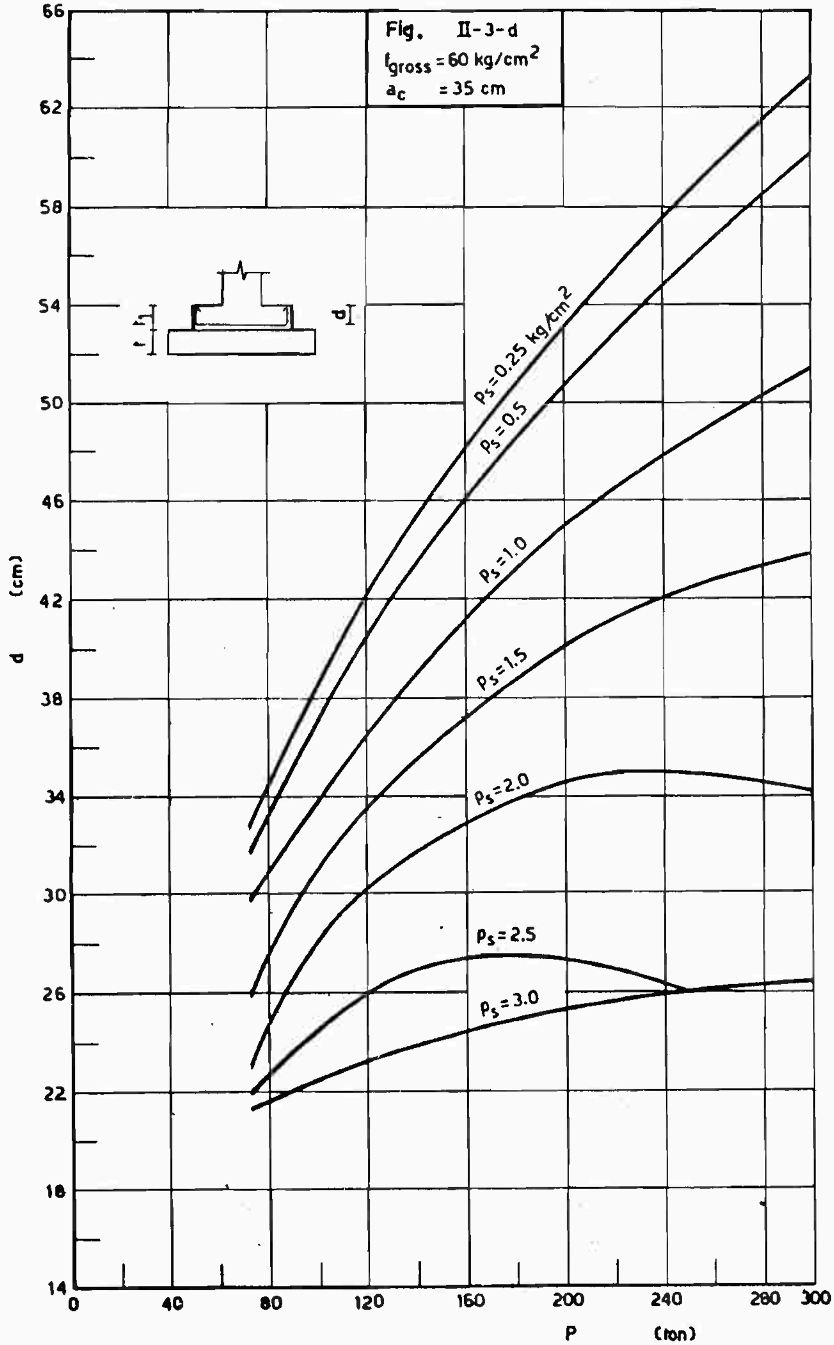


Fig. II-3-d
f_{gross} = 60 kg/cm²
a_c = 35 cm
d
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
66
62
58
54
50
46
42
38
34
30
26
22
18
14
d (cm)
0
40
80
120
160
200
240
280
300
P (ton)

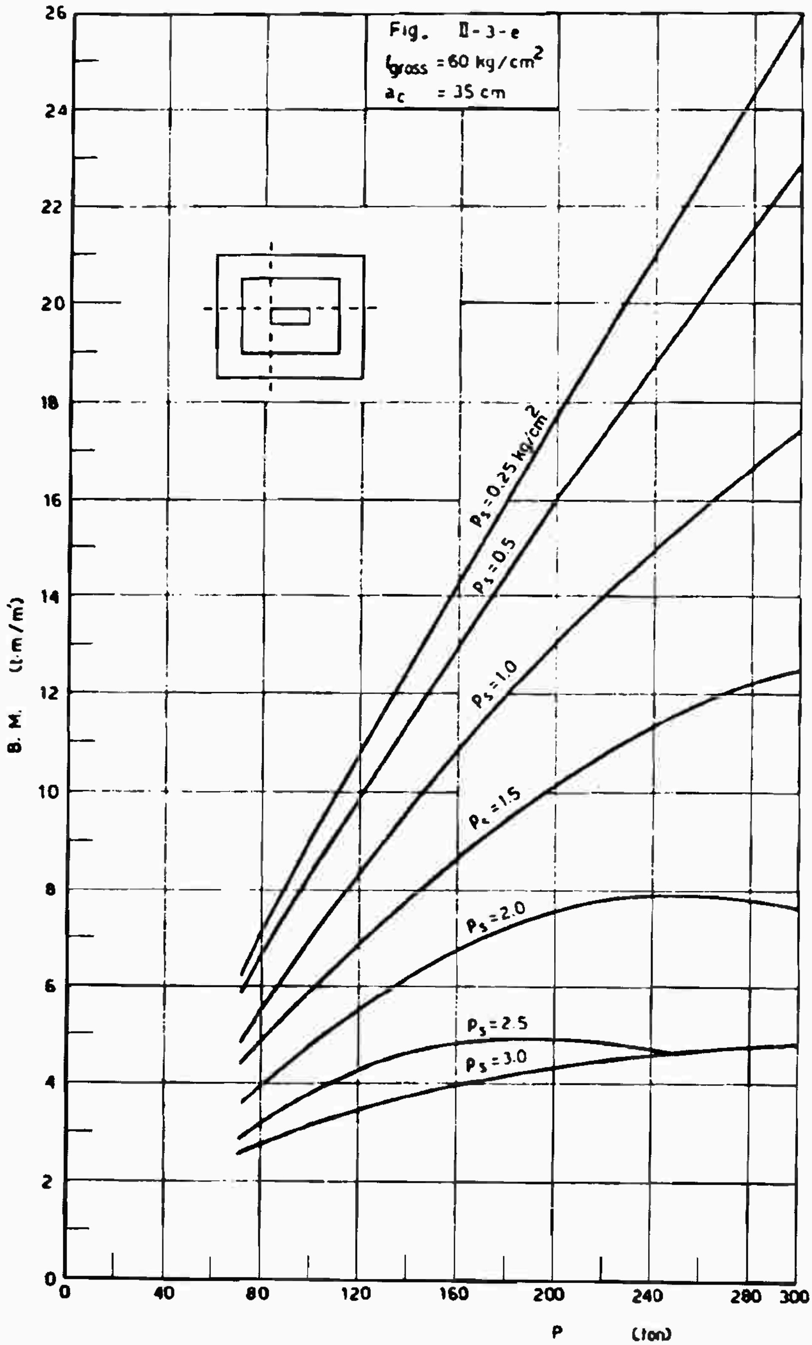


Fig. II-3-e
f_{gross} = 60 kg/cm²
a_c = 35 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
B. M. (t.m/m')
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
0
40
80
120
160
200
240
280
300

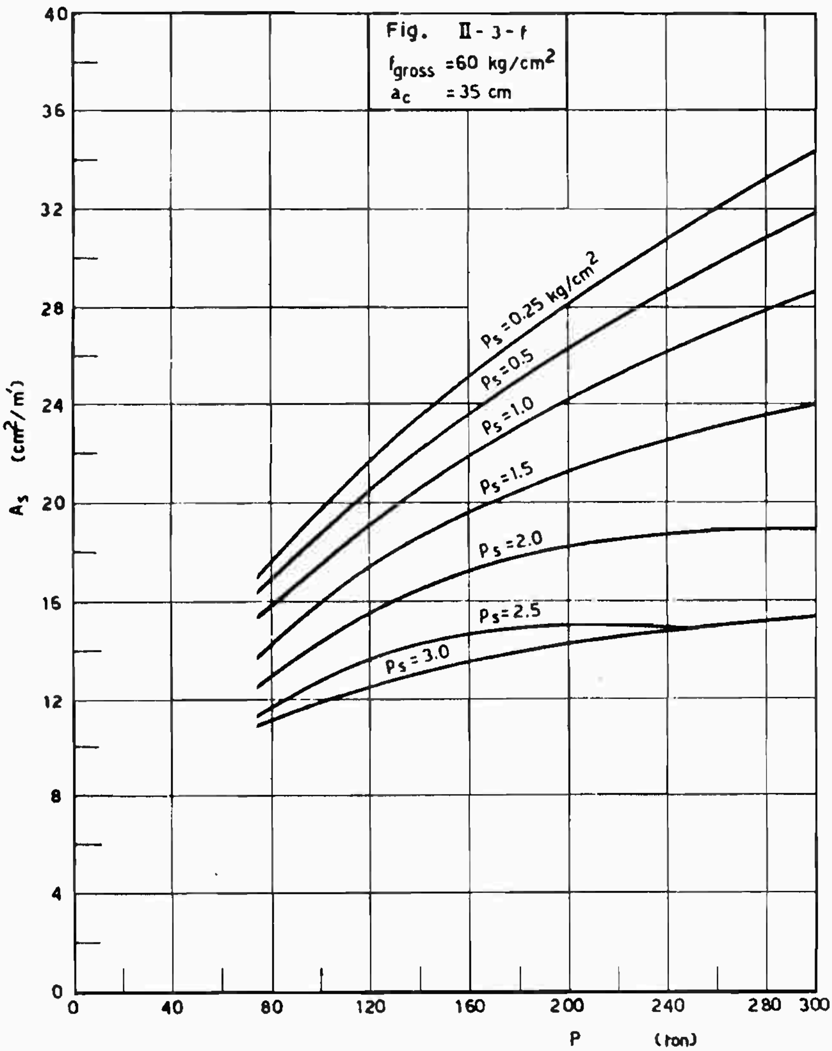


Fig. II - 3 - f
f_{gross} = 60 kg/cm²
a_c = 35 cm
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
A_s (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300

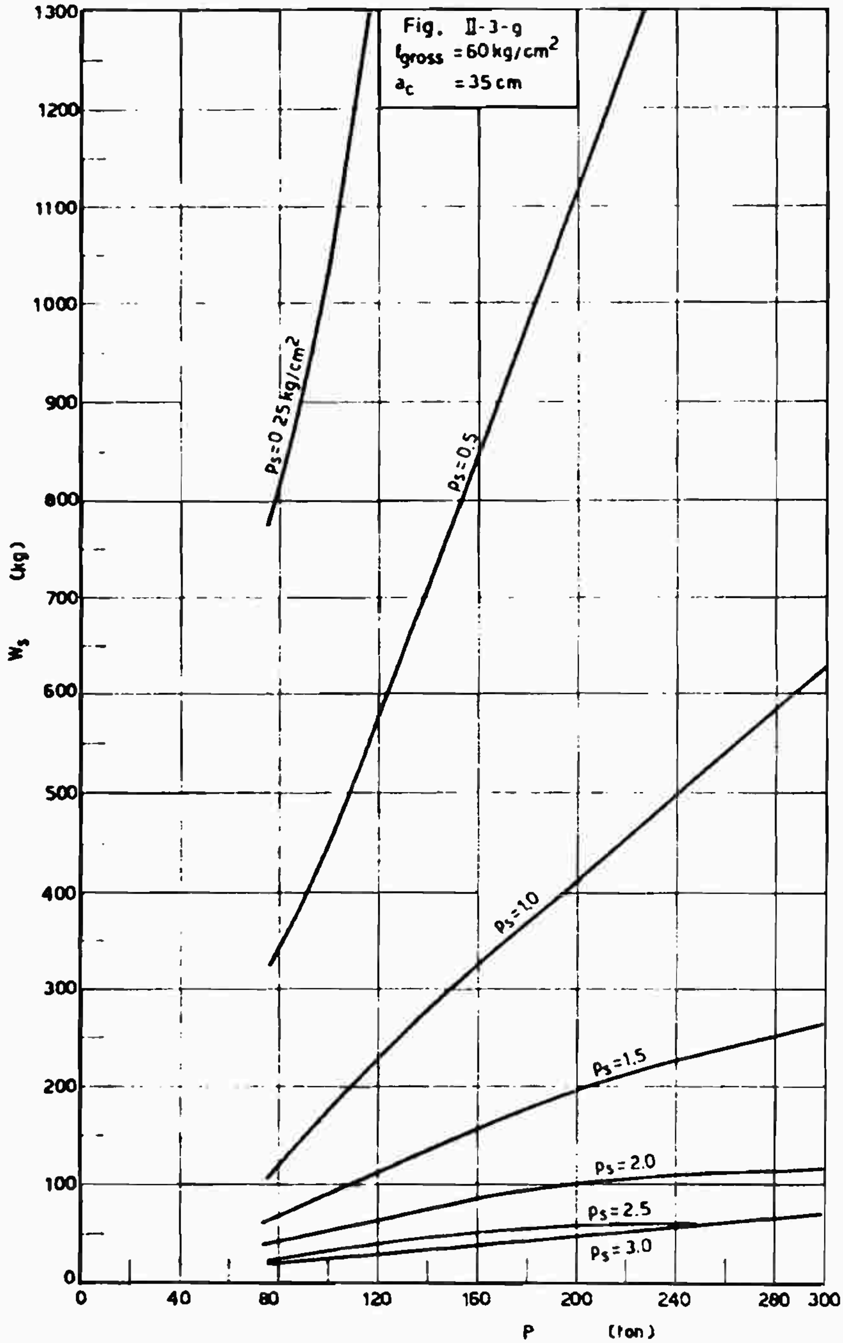


Fig. II-3-g
f_{gross} = 60 kg/cm^2
a_c = 35 cm
p_s = 0.25 kg/cm^2
p_s = 0.5
p_s = 1.0
p_s = 1.5
p_s = 2.0
p_s = 2.5
p_s = 3.0
W_s (kg)
P (ton)
0
40
80
120
160
200
240
280
300
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300

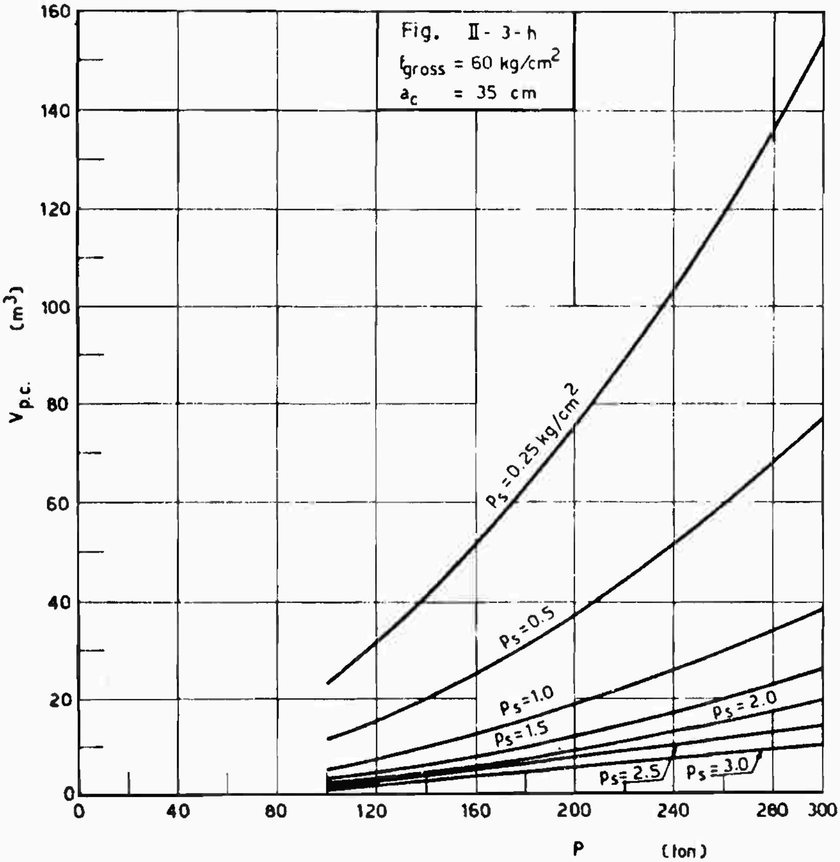


Fig. II - 3 - h
f_{gross} = 60 kg/cm^2
a_c = 35 cm
$V_{p.c.}$ (m^3)
P (ton)
Ps = 0.25 kg/cm^2
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
0
20
40
60
80
100
120
140
160
0
40
80
120
160
200
240
280
300

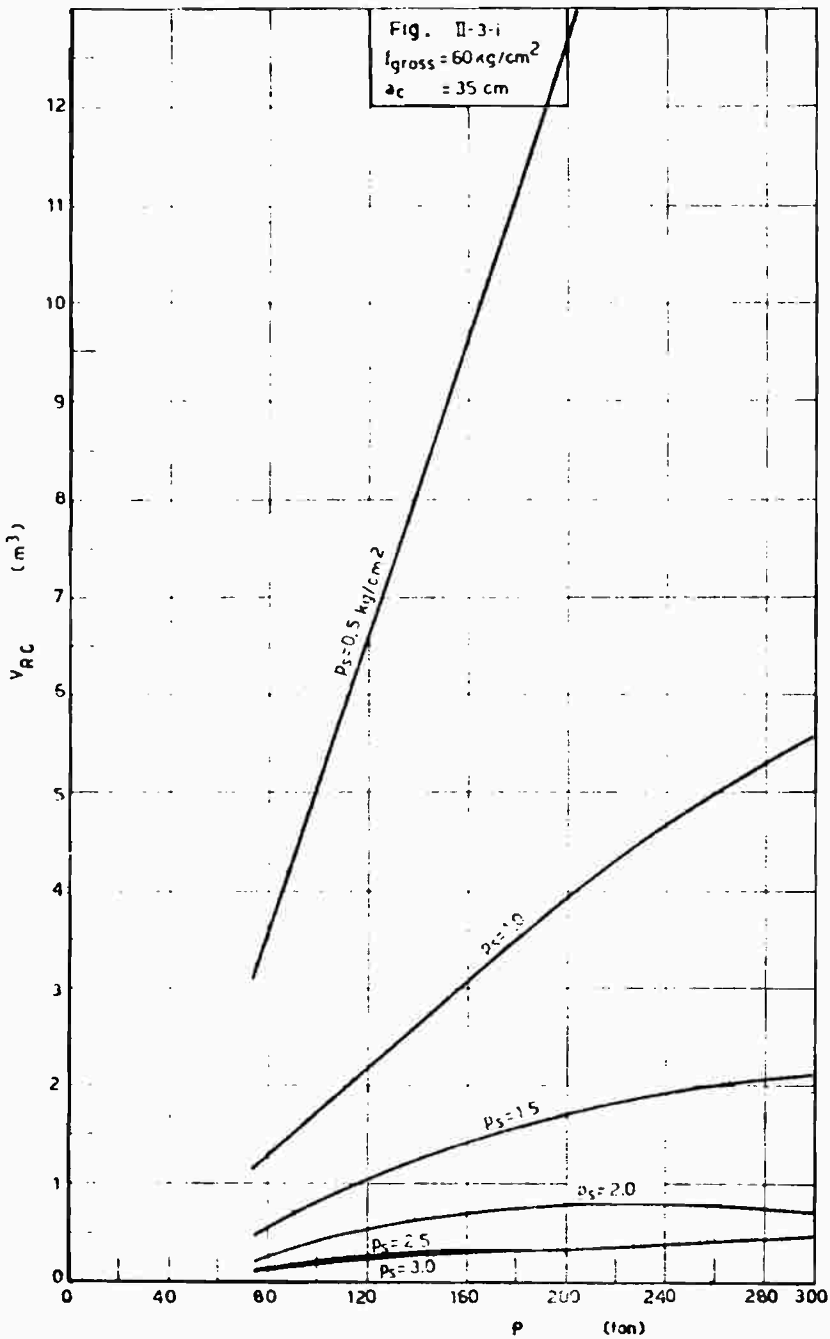


Fig. II-3-i
f_{gross} = 60 kg/cm²
a_c = 35 cm
p_s=0.5 kg/cm2
p_s=1.0
p_s=1.5
p_s=2.0
p_s=2.5
p_s=3.0
V_{RC} (m³)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
280
300
P (ton)

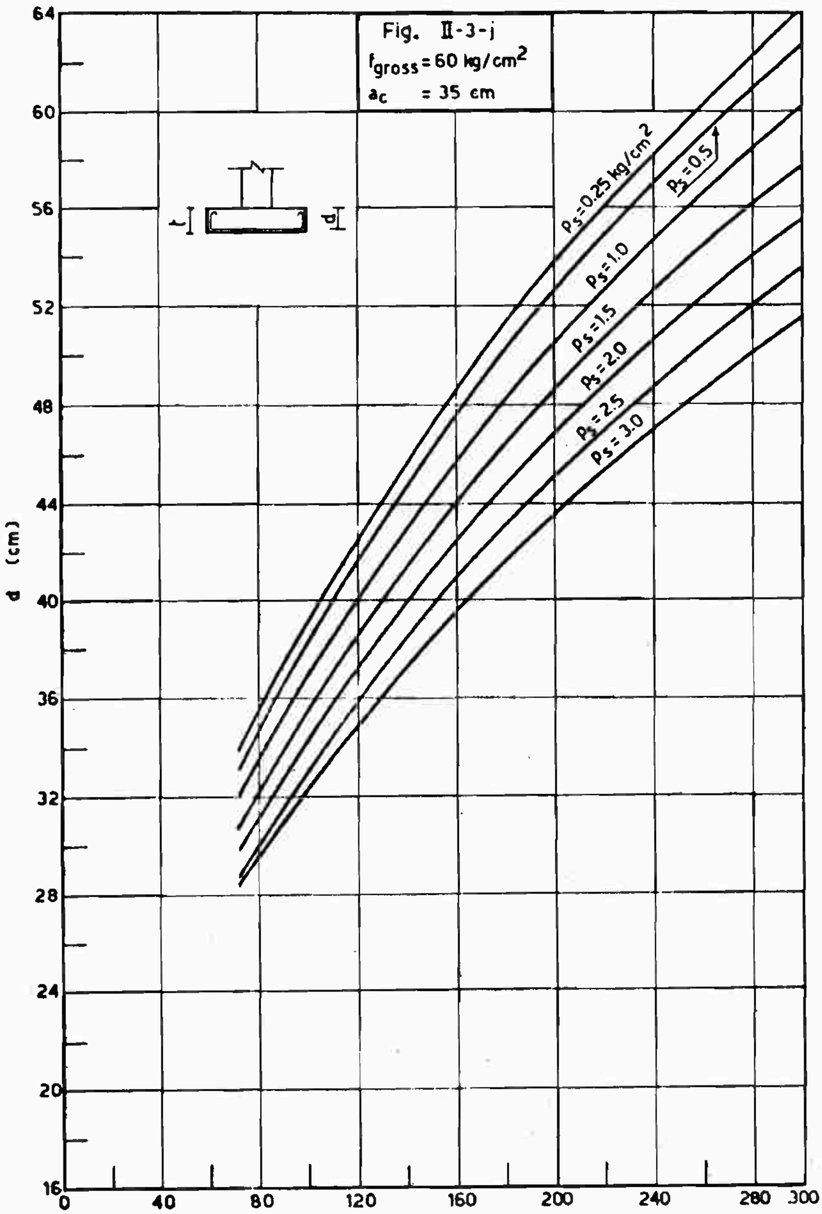


Fig. II-3-j
f gross = 60 kg/cm2
ac = 35 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d
d (cm)
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300

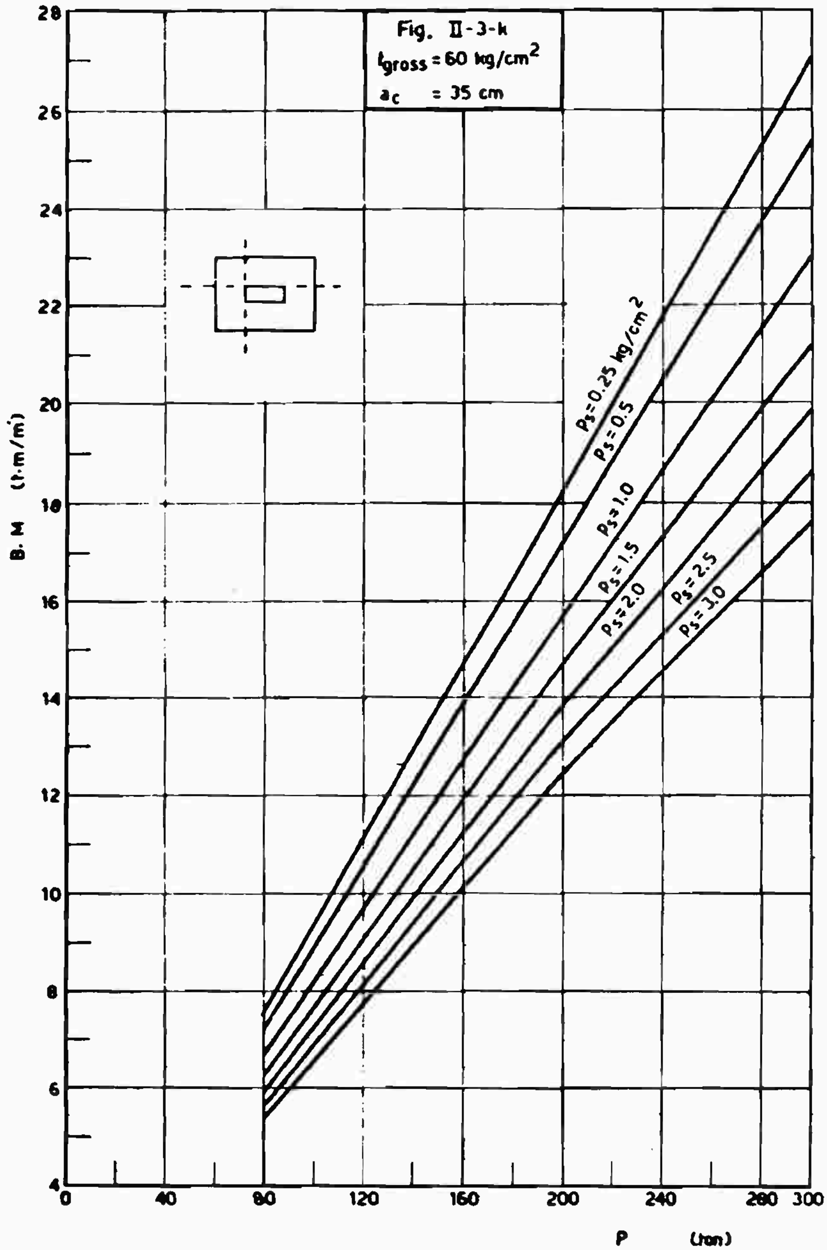


Fig. II-3-k
f_{gross} = 60 kg/cm²
a_c = 35 cm
B. M (t.m/m')
P (ton)
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
28
26
24
22
20
18
16
14
12
10
8
6
4
0
40
80
120
160
200
240
280
300

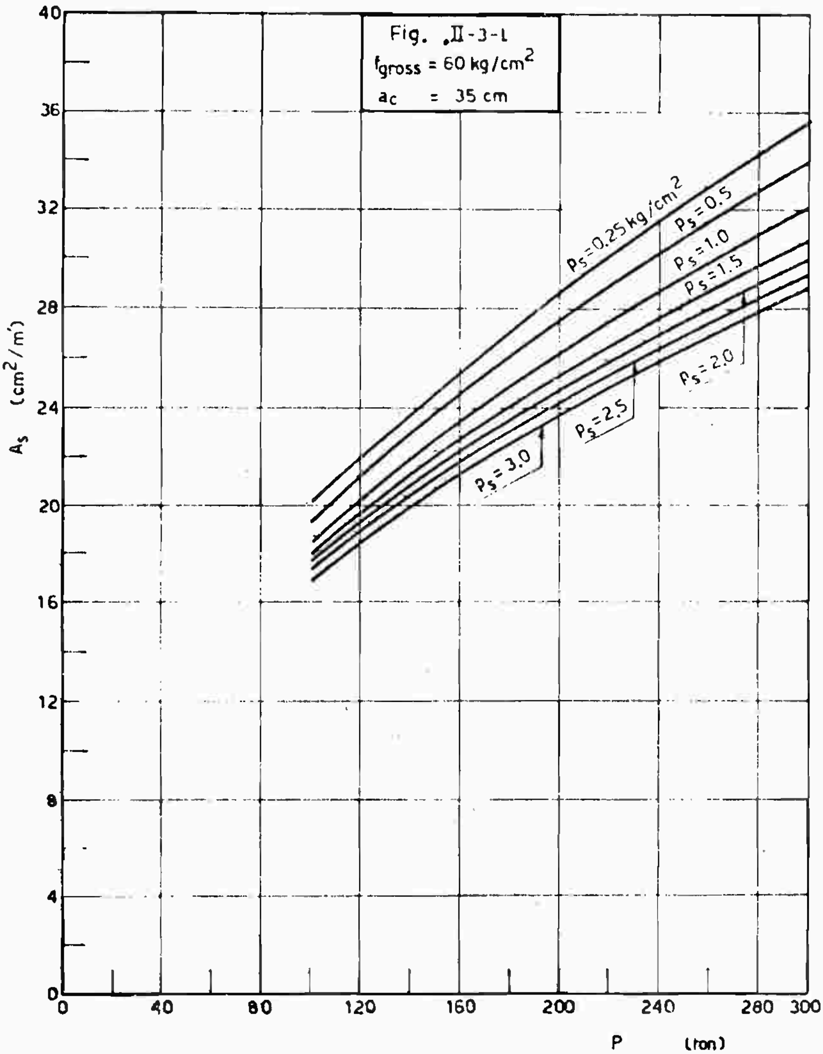


Fig. II-3-1
f_{gross} = 60 kg/cm^2
a_c = 35 cm
P_s=0.25 kg/cm^2
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_s (cm^2/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
40
80
120
160
200
240
280
300

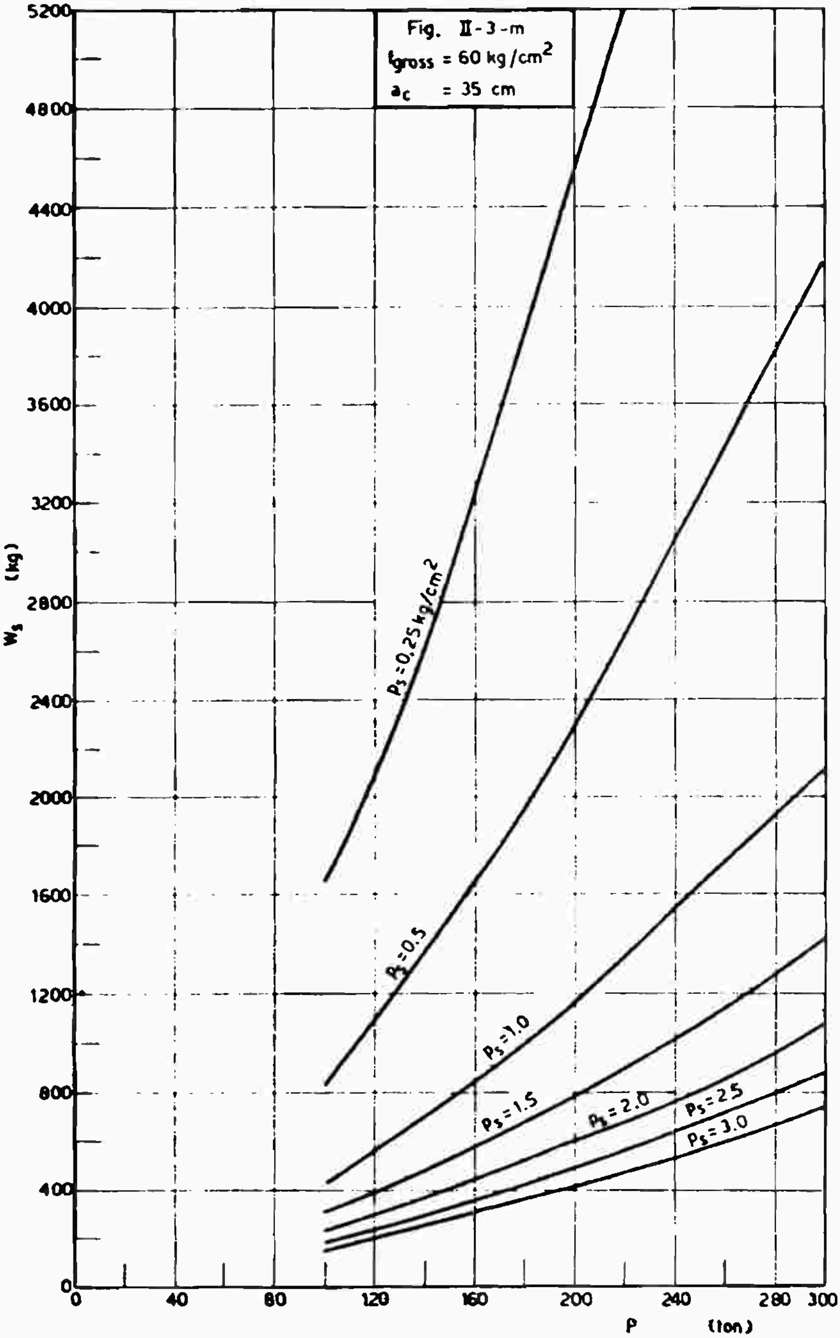


Fig. II-3-m
f_{gross} = 60 kg/cm²
a_c = 35 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
W_s (kg)
P (ton)
0
40
80
120
160
200
240
280
300
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200

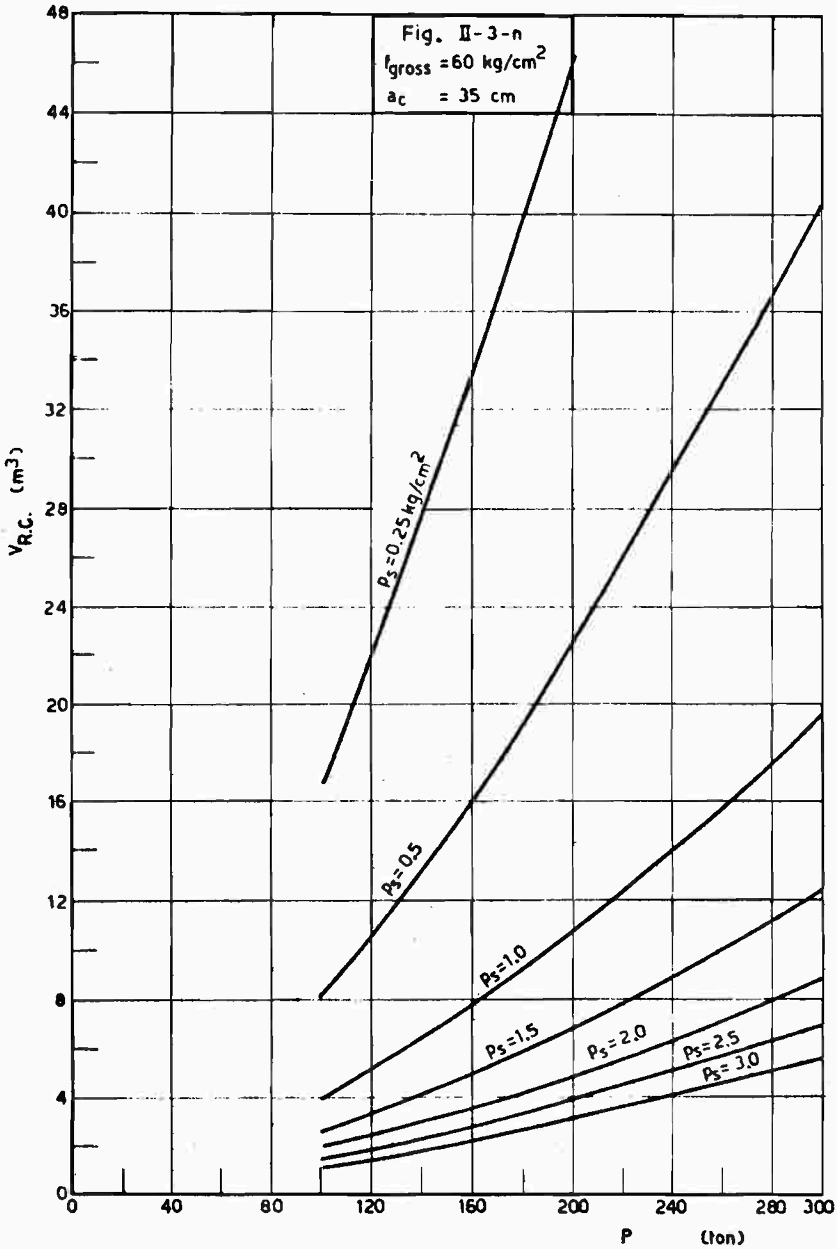


Fig. II-3-n
f_{gross} = 60 kg/cm^2
a_c = 35 cm
P_s=0.25 kg/cm^2
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
$V_{R.C.}$ (m^3)
0
4
8
12
16
20
24
28
32
36
40
44
48
0
40
80
120
160
200
240
280
300
P (ton)

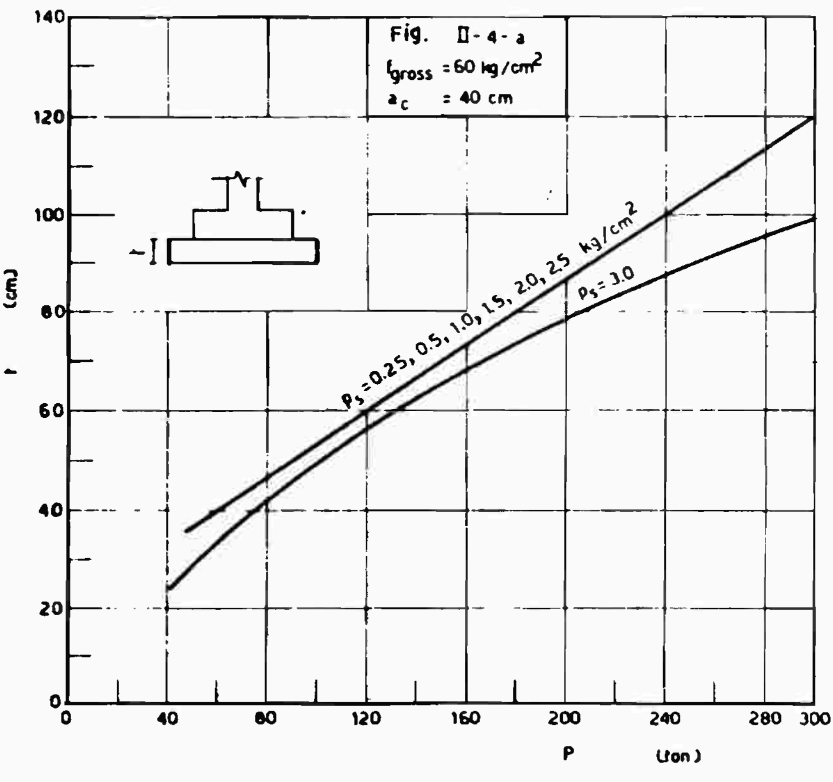


Fig. II - 4 - a
f_{gross} = 60 kg/cm²
a_c = 40 cm
p_s = 0.25, 0.5, 1.0, 1.5, 2.0, 2.5 kg/cm²
p_s = 3.0
t (cm)
P (ton)
0
20
40
60
80
100
120
140
160
200
240
280
300

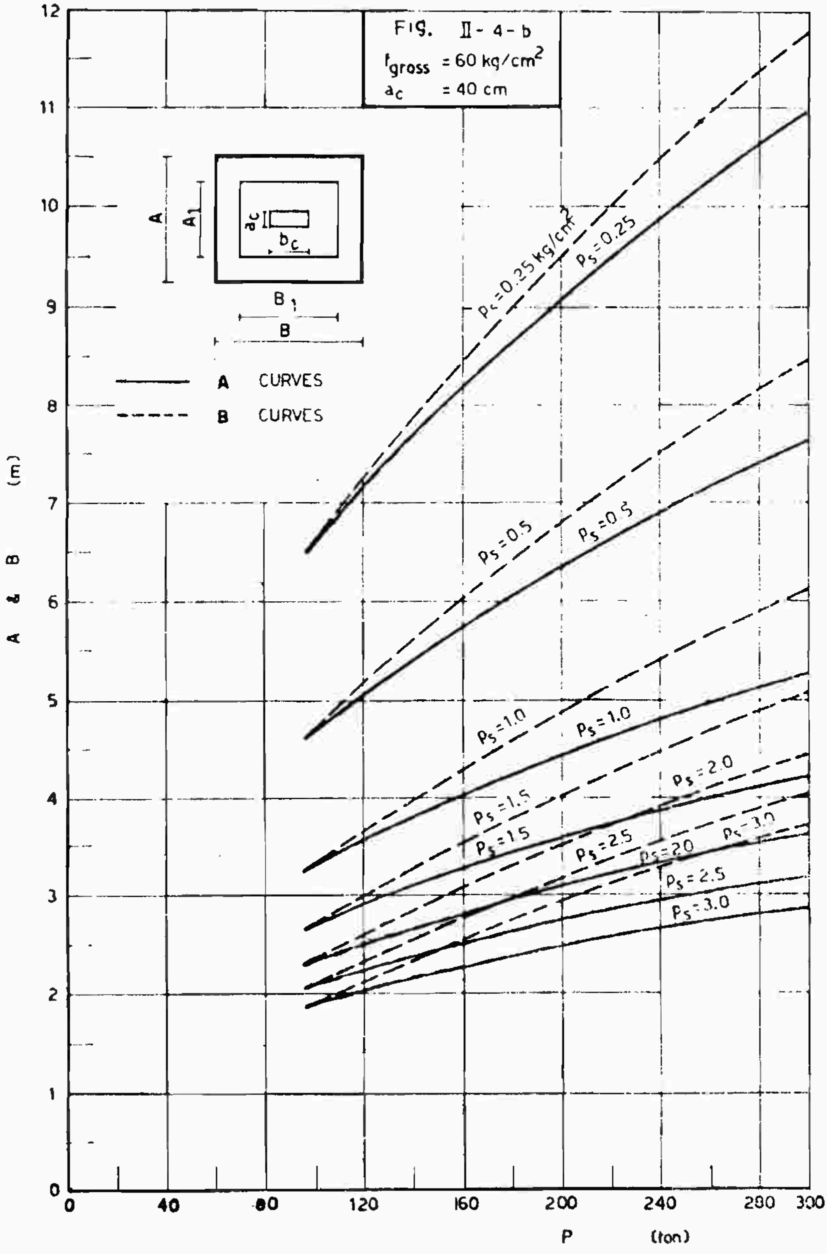


Fig. II - 4 - b
f_{gross} = 60 kg/cm²
a_c = 40 cm
A
A_1
a_c
b_c
B_1
B
A CURVES
B CURVES
P_s = 0.25 kg/cm²
P_s = 0.25
P_s = 0.5
P_s = 0.5
P_s = 1.0
P_s = 1.0
P_s = 1.5
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 2.0
P_s = 3.0
P_s = 2.5
P_s = 3.0
A & B (m)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
280
300
P (ton)

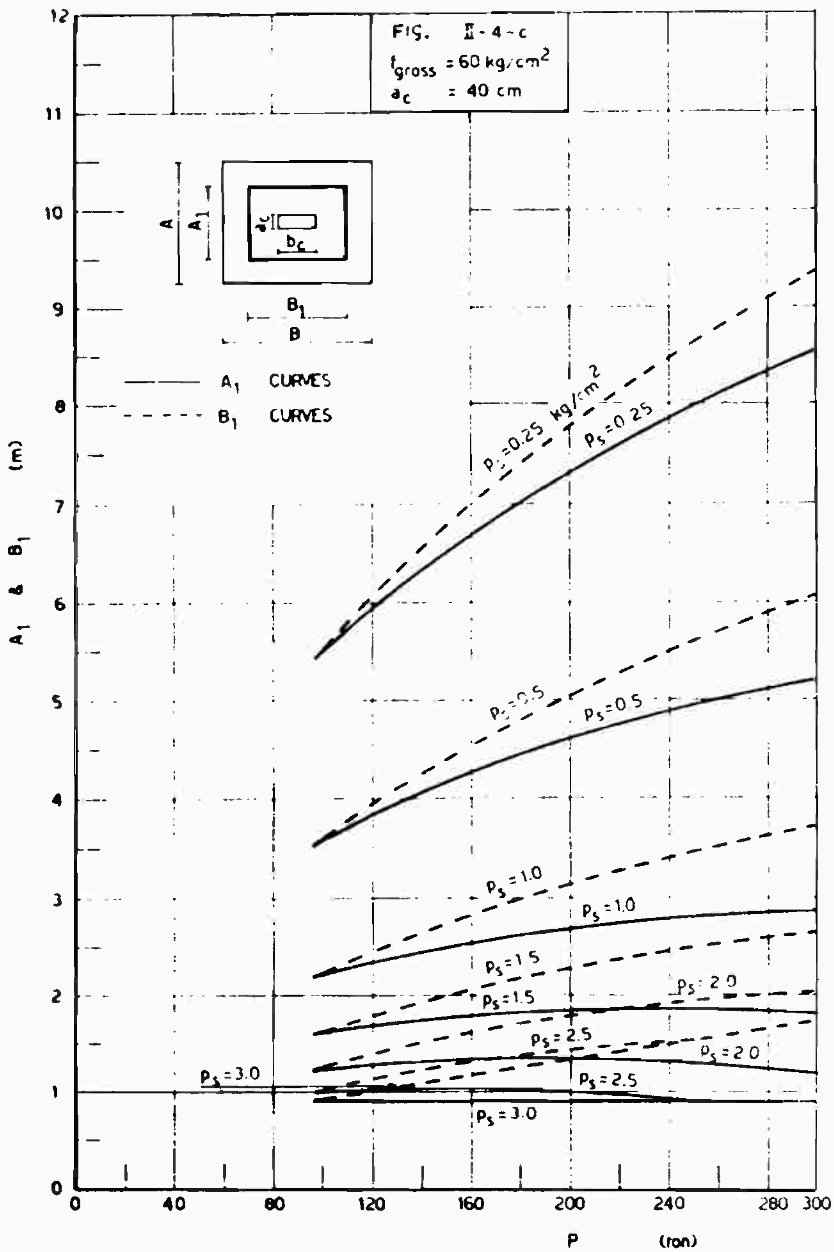


FIG. II-4-c
f_{gross} = 60 kg/cm²
a_c = 40 cm
A
A_1
a_c
b_c
B_1
B
A_1 CURVES
B_1 CURVES
P_s = 0.25 kg/cm²
P_s = 0.25
P_s = 0.5
P_s = 0.5
P_s = 1.0
P_s = 1.0
P_s = 1.5
P_s = 1.5
P_s = 2.0
P_s = 2.0
P_s = 2.5
P_s = 2.5
P_s = 3.0
P_s = 3.0
A_1 & B_1 (m)
P (ton)
0 1 2 3 4 5 6 7 8 9 10 11 12
0 40 80 120 160 200 240 280 300

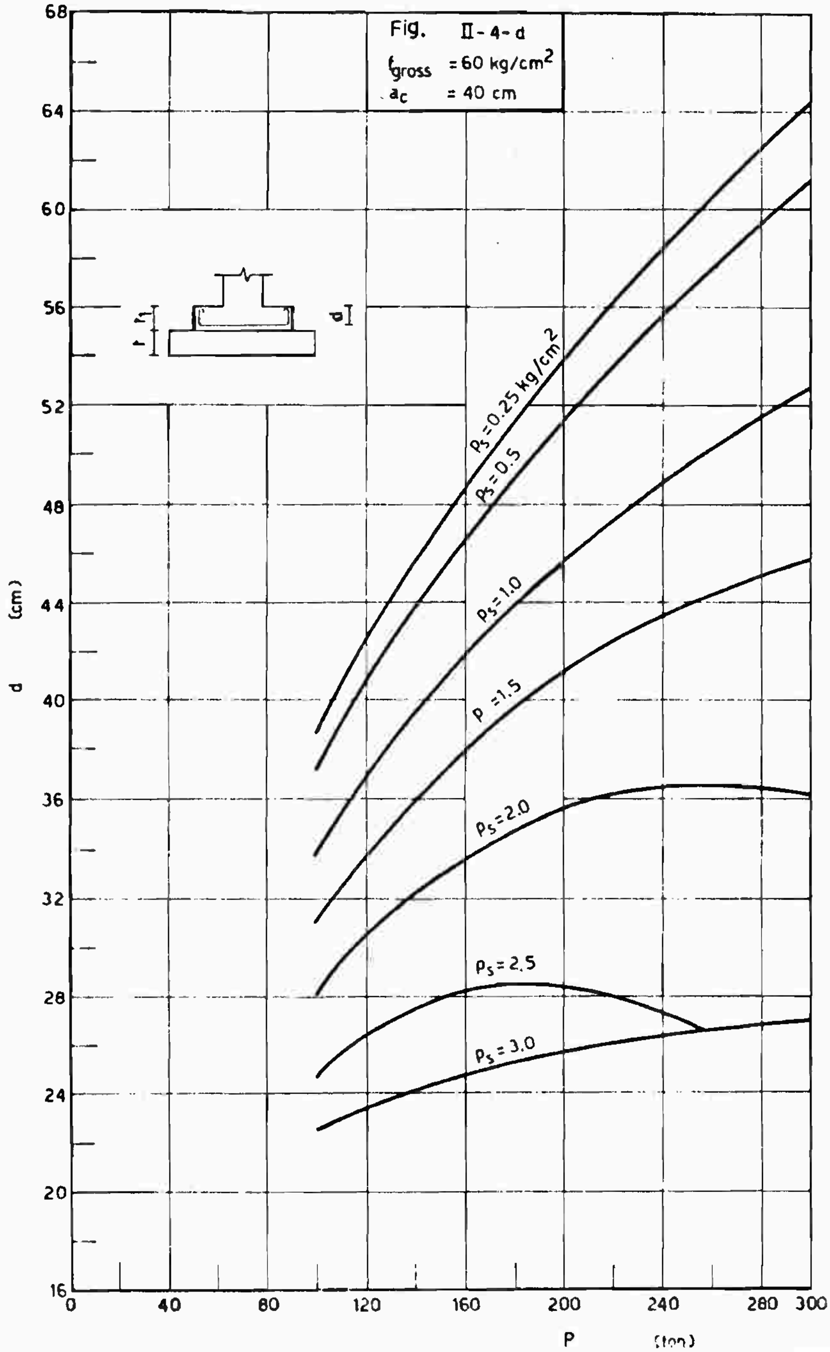


Fig. II-4-d
f gross = 60 kg/cm2
ac = 40 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
P =1.5
Ps=2.0
Ps=2.5
Ps=3.0
d (cm)
P (ton)
68
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300

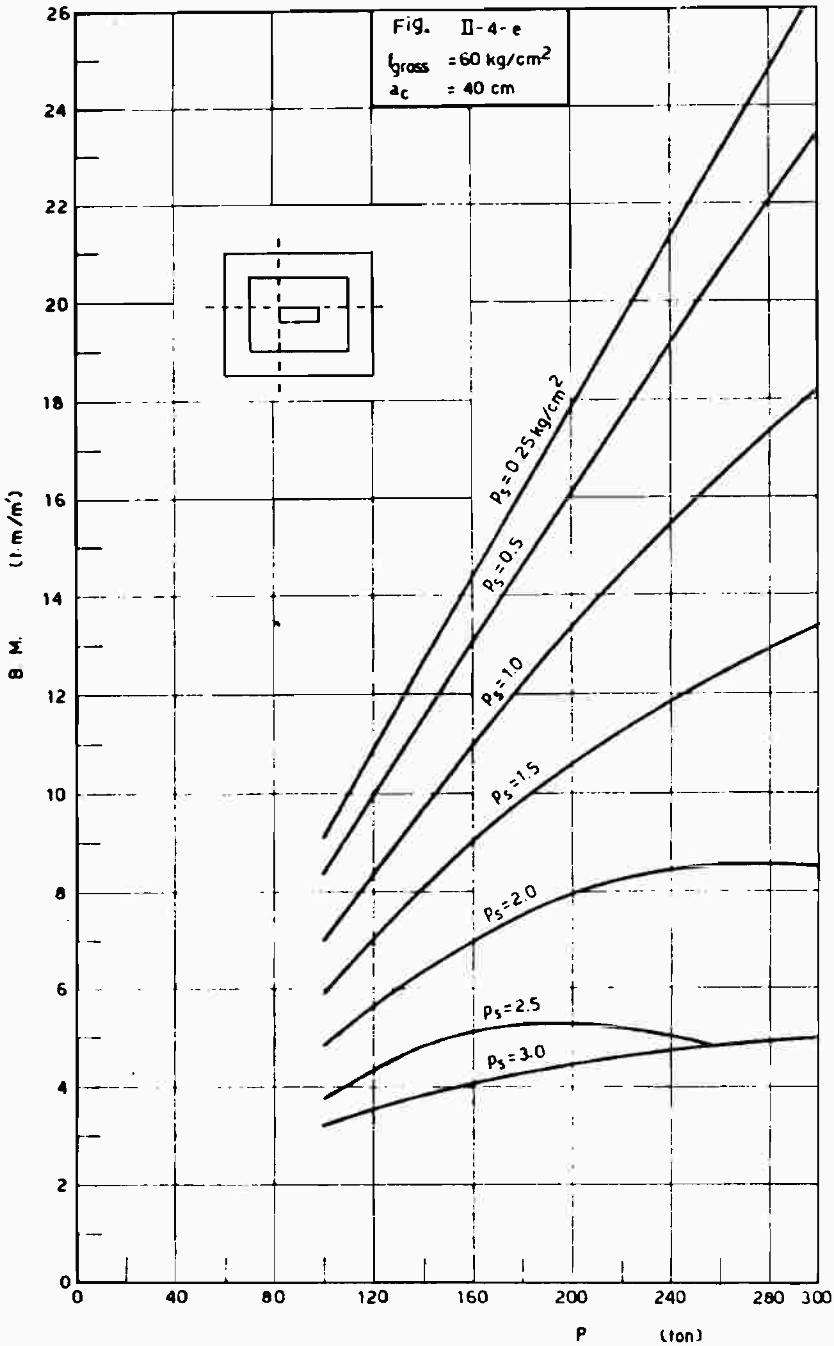


Fig. II-4-e
f_{gross} = 60 kg/cm²
a_c = 40 cm
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
B. M. (t.m/m')
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
0
40
80
120
160
200
240
280
300

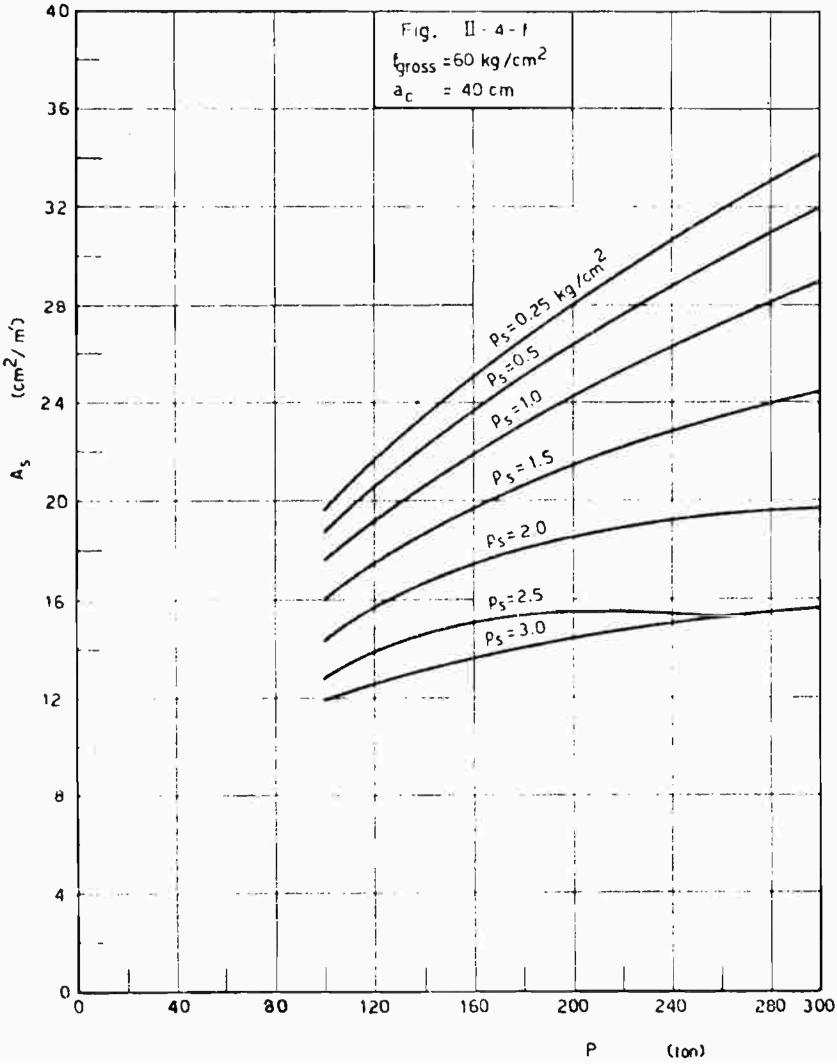


Fig. II - 4 - f
f gross = 60 kg/cm2
ac = 40 cm
Ps = 0.25 kg/cm2
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
As (cm2/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300

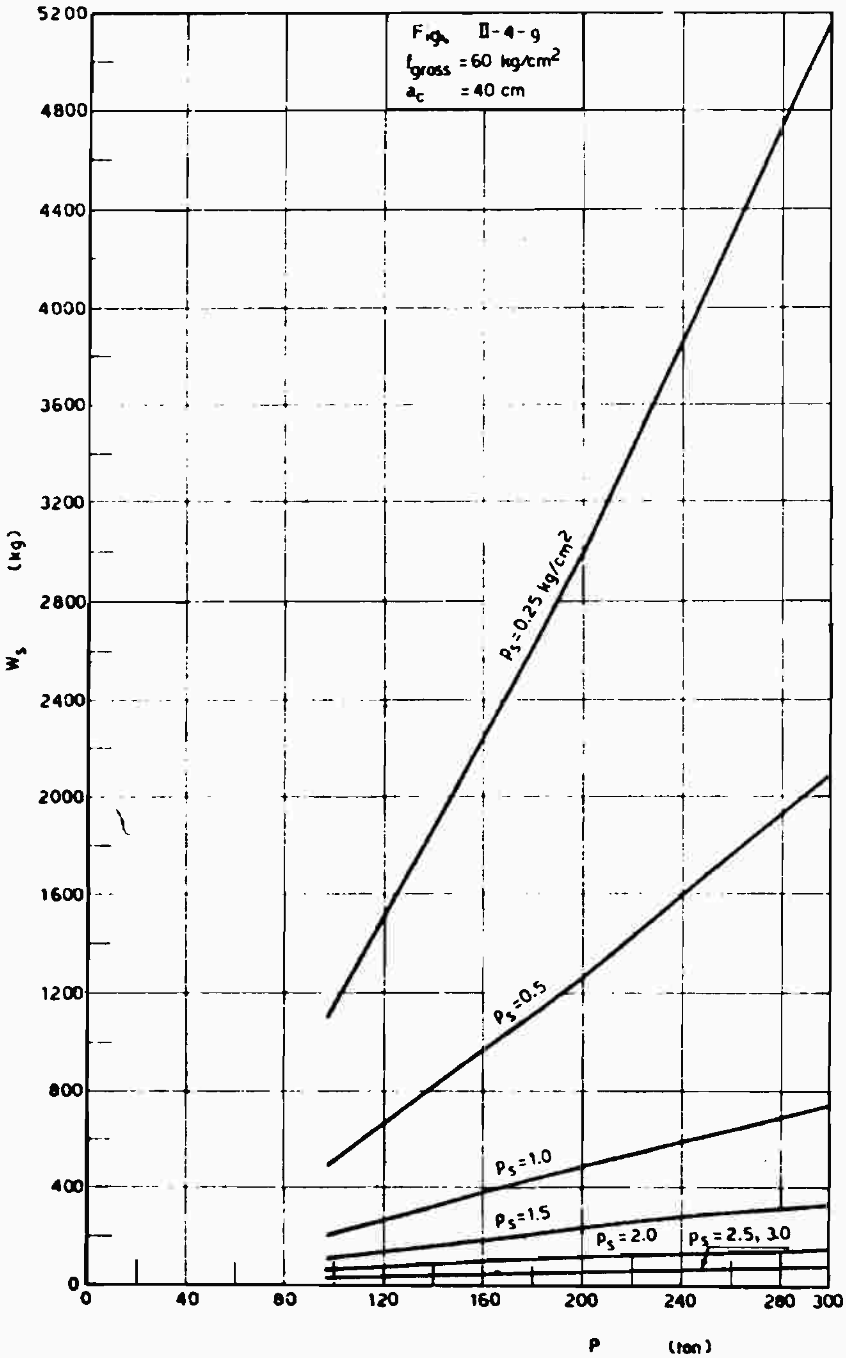


Fig. II-4-g
f_{gross} = 60 kg/cm²
a_c = 40 cm
W_s (kg)
P (ton)
p_s = 0.25 kg/cm²
p_s = 0.5
p_s = 1.0
p_s = 1.5
p_s = 2.0
p_s = 2.5, 3.0
0
40
80
120
160
200
240
280
300
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200

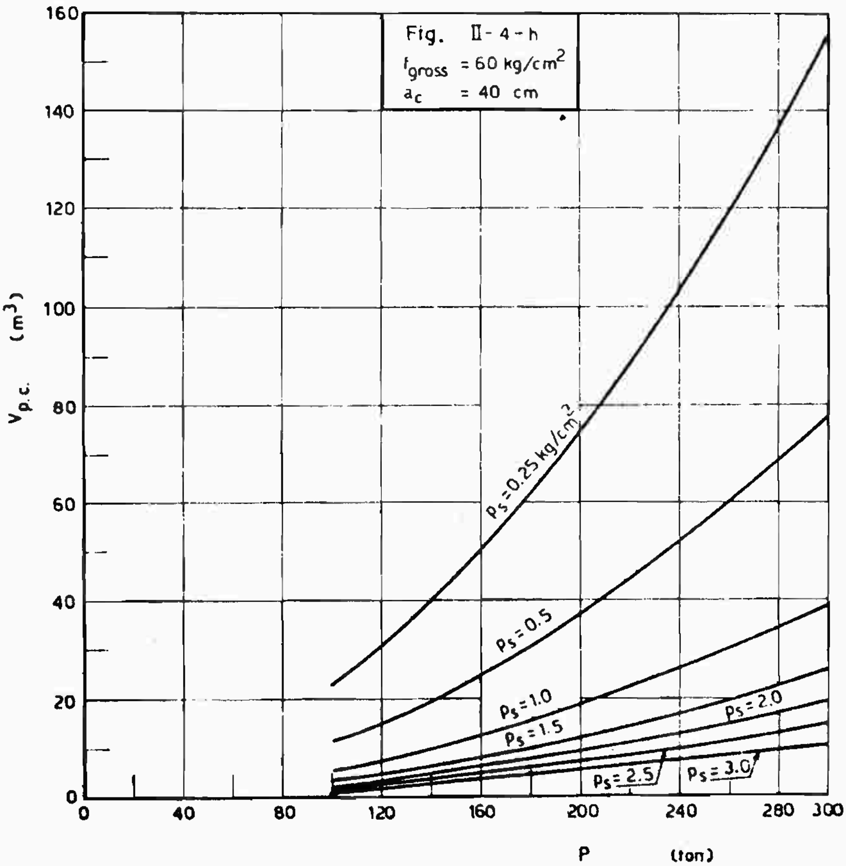


Fig. II - 4 - h
f gross = 60 kg/cm2
ac = 40 cm
Ps = 0.25 kg/cm2
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
V p.c. (m3)
P (ton)
0
20
40
60
80
100
120
140
160
0
40
80
120
160
200
240
280
300

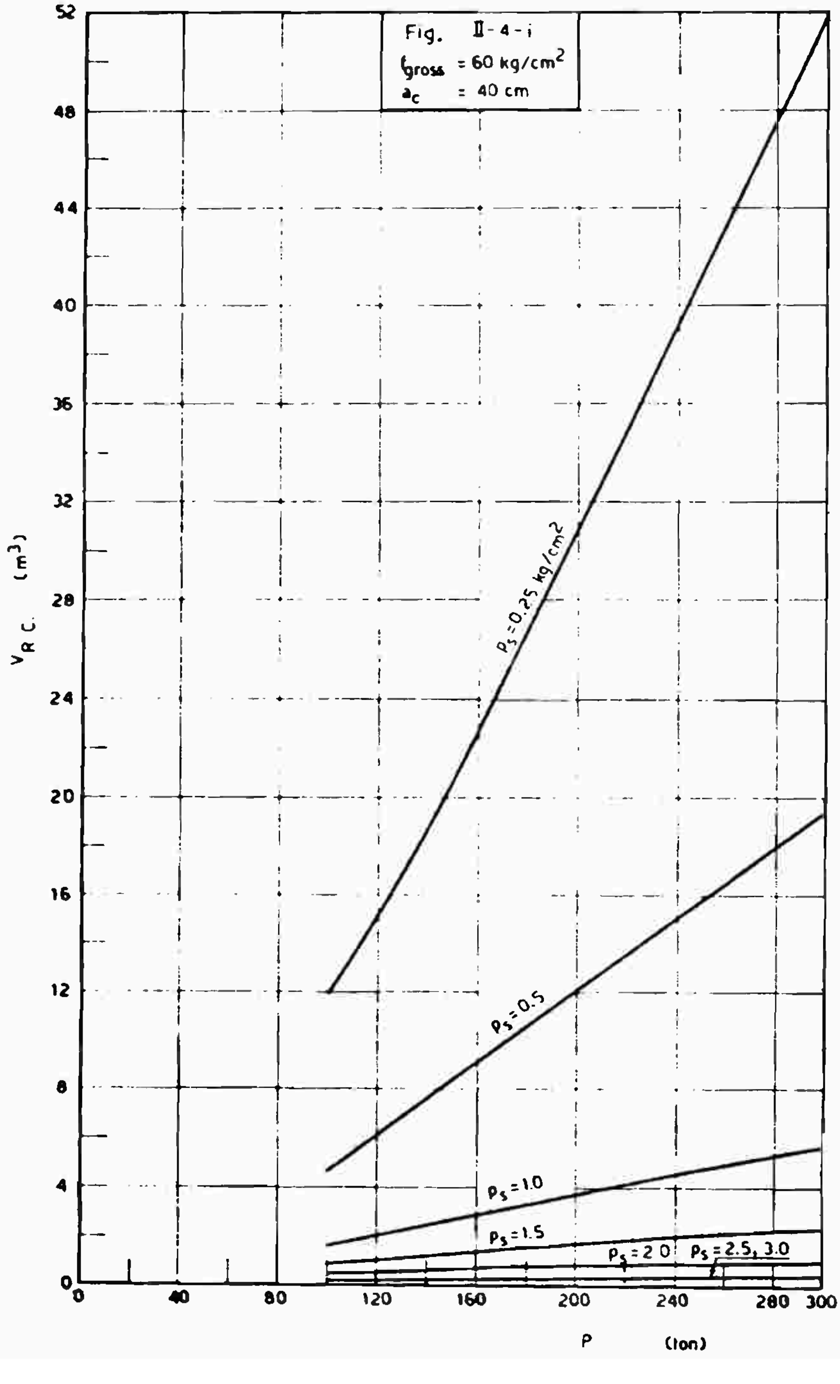


Fig. II-4-i
f_gross = 60 kg/cm²
a_c = 40 cm
V_R.C. (m³)
P (ton)
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5, 3.0
0
4
8
12
16
20
24
28
32
36
40
44
48
52
0
40
80
120
160
200
240
280
300

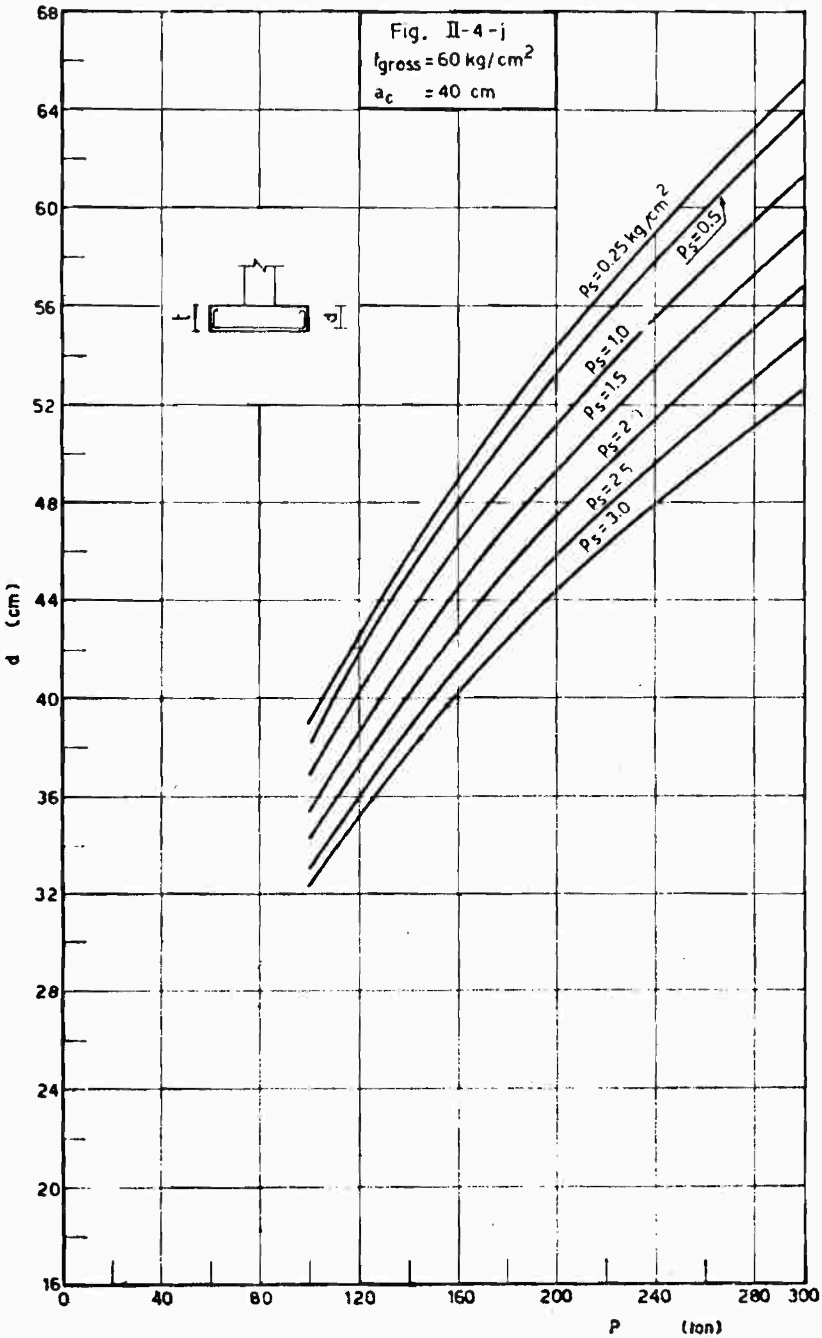


Fig. II-4-j
f_{gross} = 60 kg/cm²
a_c = 40 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d (cm)
P (ton)
68
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300

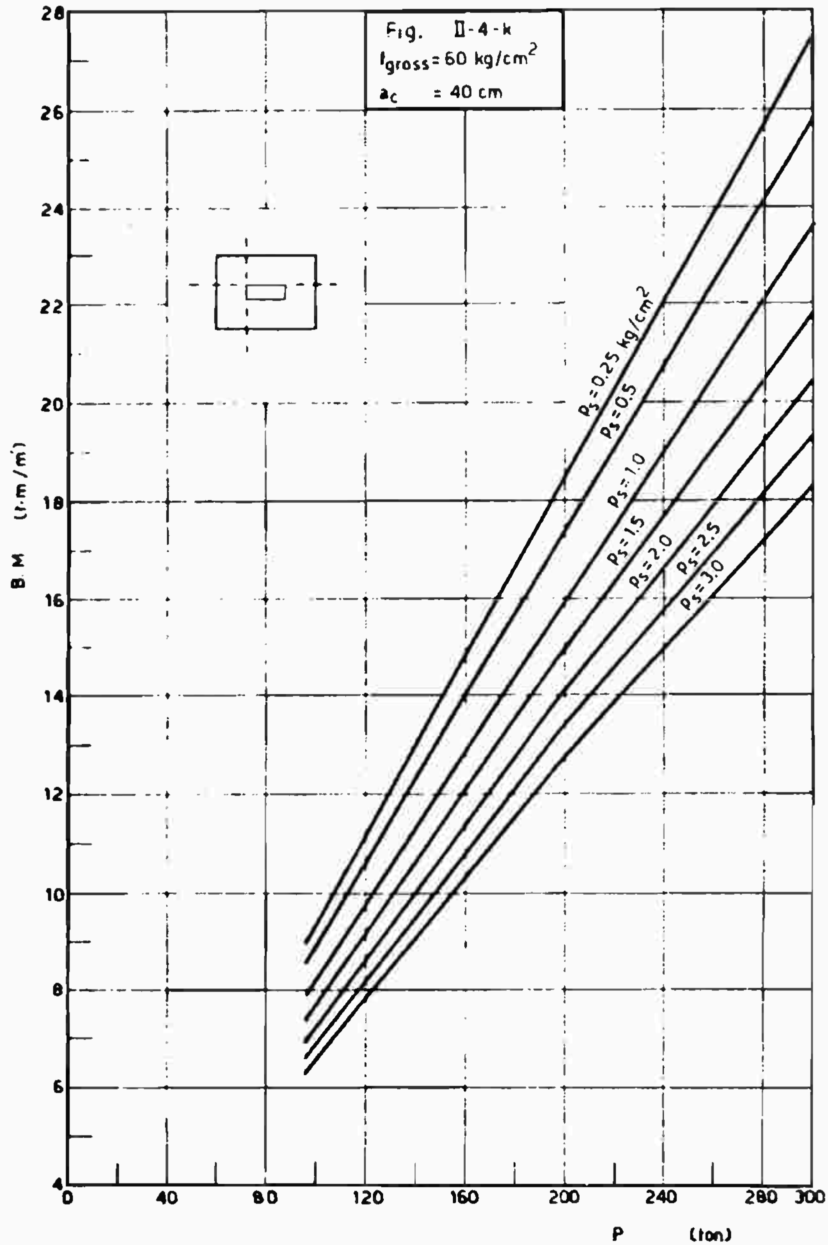


Fig. II-4-k
f_{gross} = 60 kg/cm²
a_c = 40 cm
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
B.M (t.m/m')
P (ton)
0 40 80 120 160 200 240 280 300
4 6 8 10 12 14 16 18 20 22 24 26 28

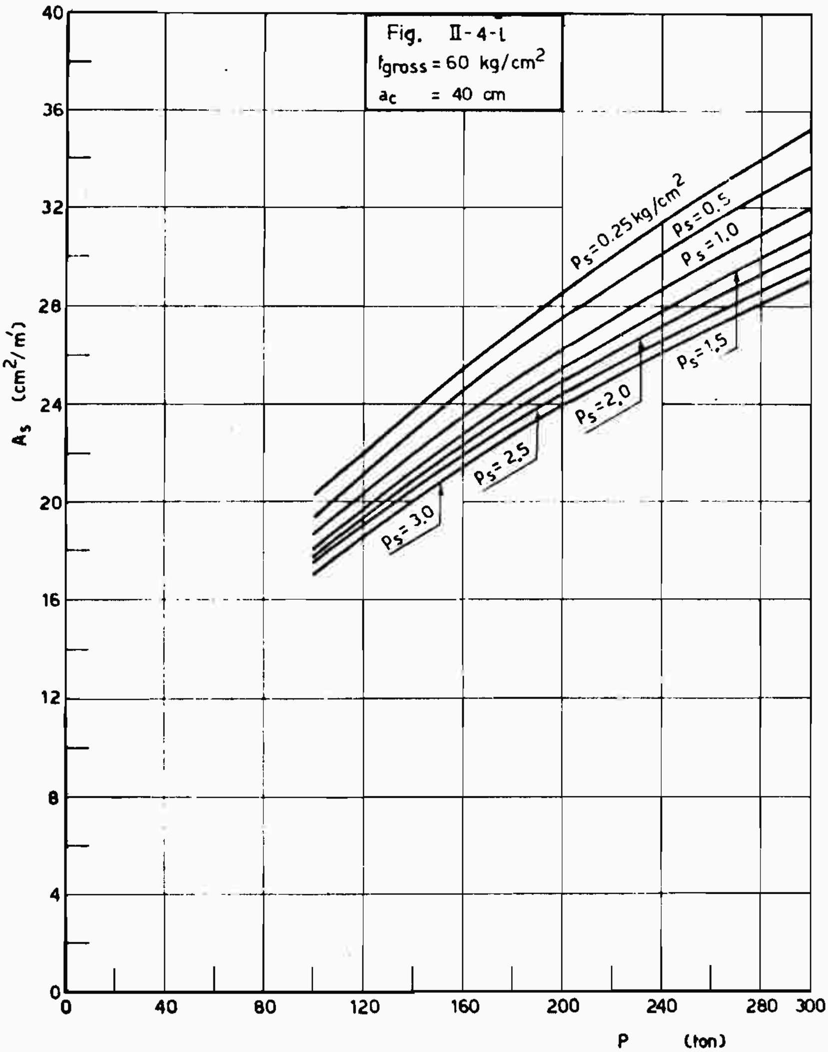


Fig. II-4-L
f_{gross} = 60 kg/cm^2
a_c = 40 cm
P_s=0.25 kg/cm^2
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_s (cm^2/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300

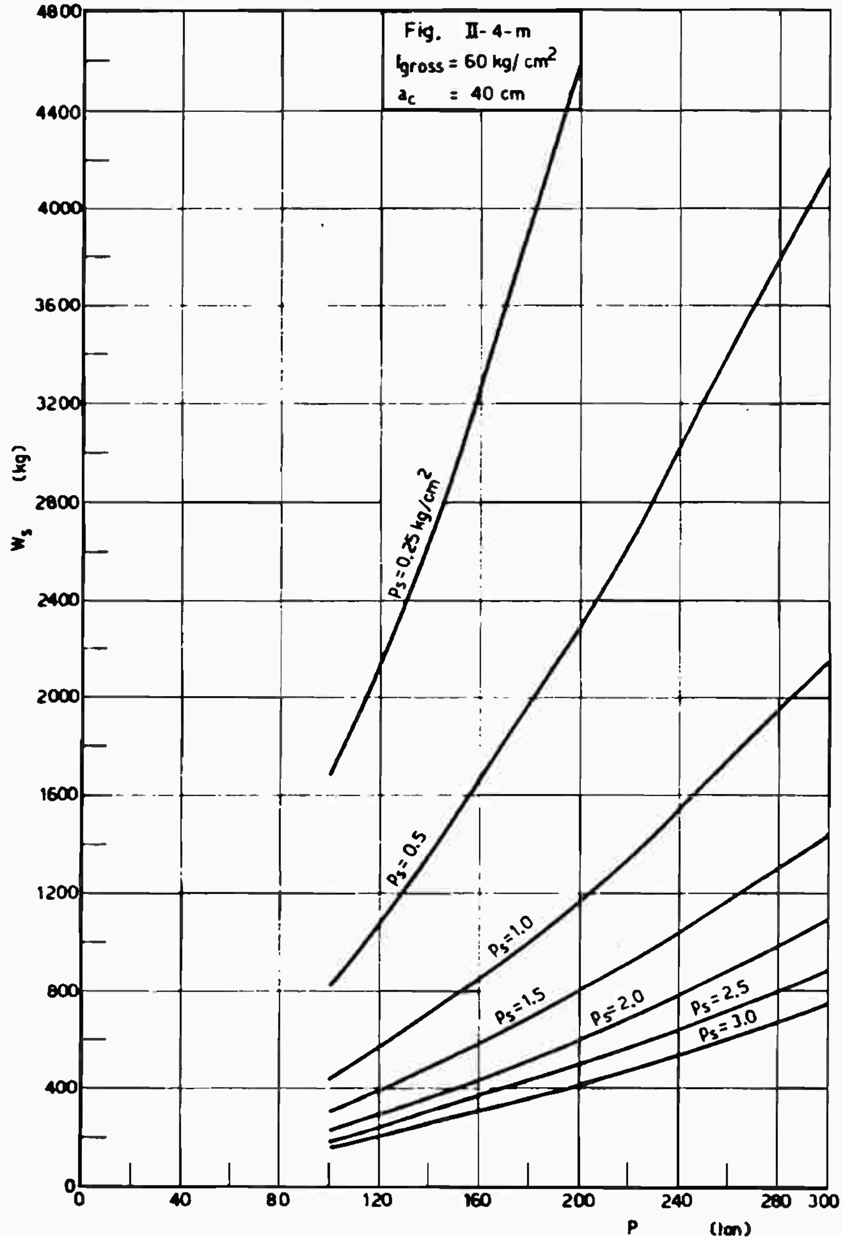


Fig. II- 4- m
f_{gross} = 60 kg/cm²
a_c = 40 cm
W_s (kg)
P (ton)
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
0
40
80
120
160
200
240
280
300

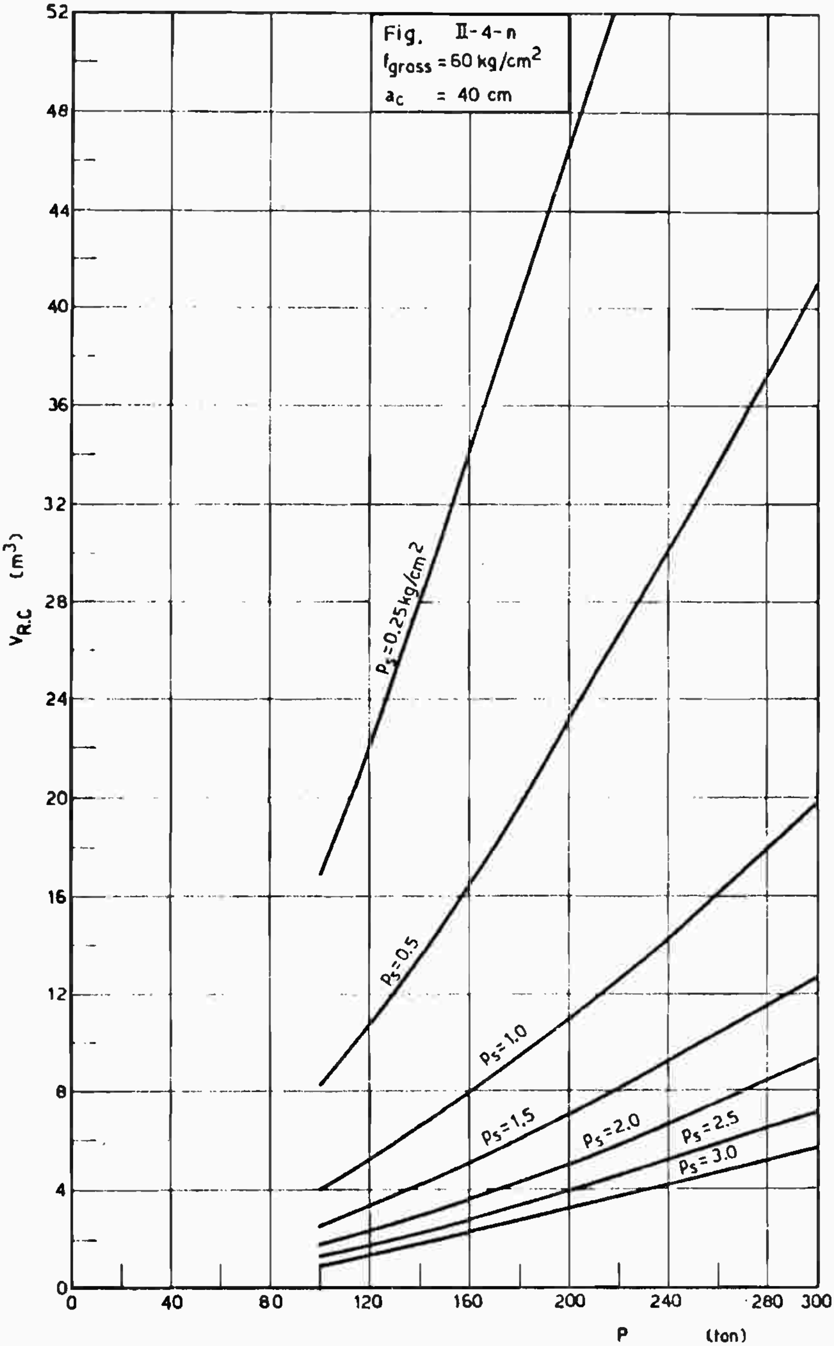


Fig. II-4-n
f gross = 60 kg/cm2
ac = 40 cm
VR.C (m3)
P (ton)
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
0
4
8
12
16
20
24
28
32
36
40
44
48
52
0
40
80
120
160
200
240
280
300

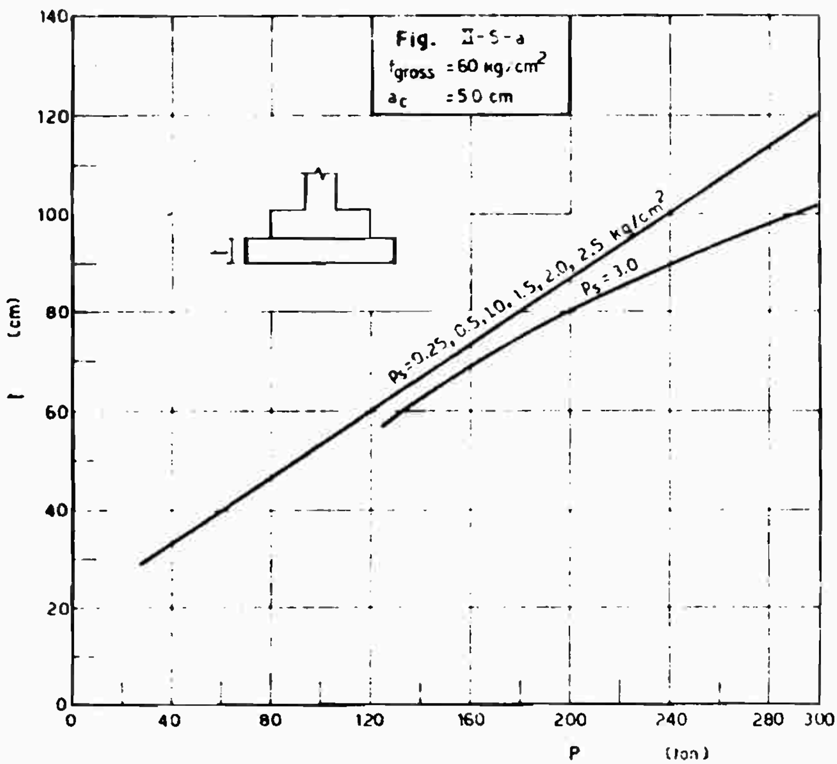


Fig. II-5-a
f_{gross} = 60 kg/cm²
a_c = 50 cm
Ps = 0.25, 0.5, 1.0, 1.5, 2.0, 2.5 kg/cm²
Ps = 3.0
t (cm)
P (ton)
0
20
40
60
80
100
120
140
0
40
80
120
160
200
240
280
300

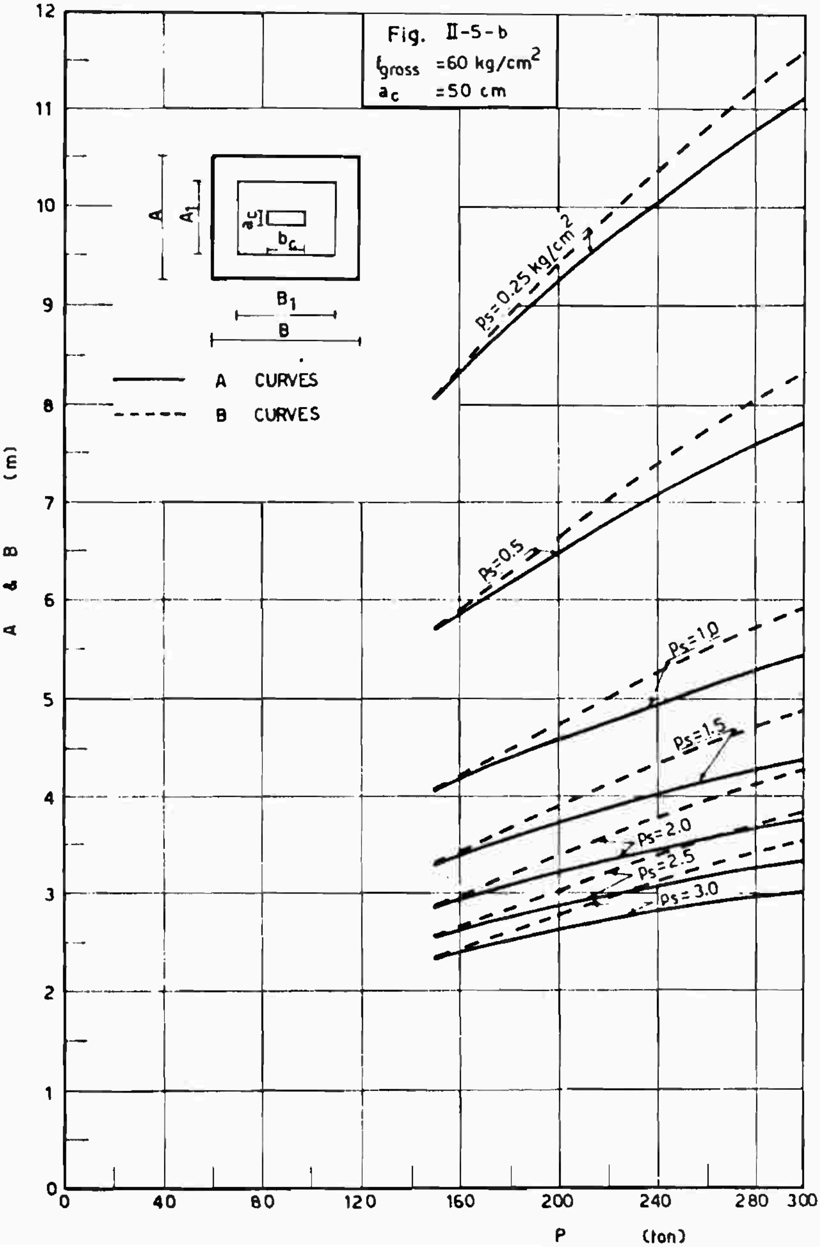


Fig. II-5-b
f gross = 60 kg/cm2
ac = 50 cm
A
A1
ac
bc
B1
B
A CURVES
B CURVES
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
A & B (m)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
280
300

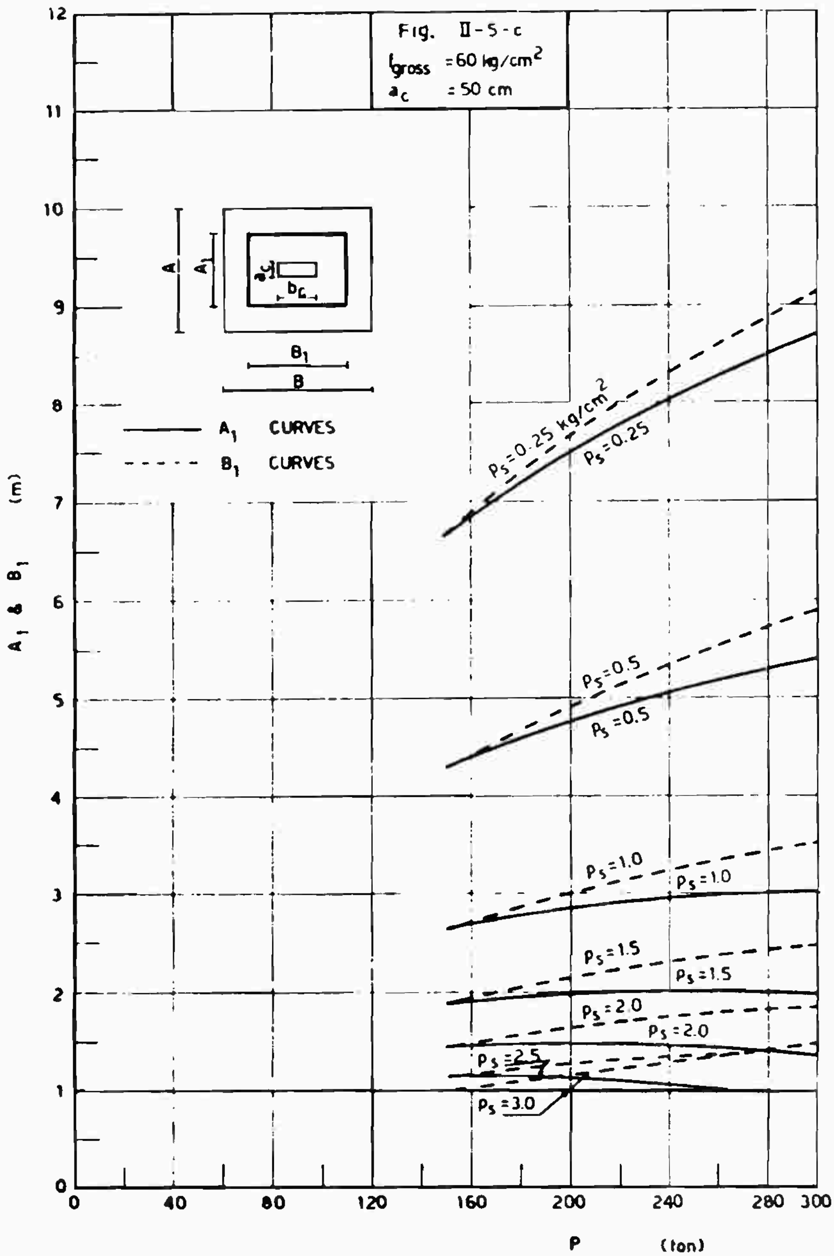


Fig. II-5-c
f_{gross} = 60 kg/cm²
a_c = 50 cm
A
A_1
a_c
b_c
B_1
B
A_1 CURVES
B_1 CURVES
P_s=0.25 kg/cm²
P_s=0.25
P_s=0.5
P_s=0.5
P_s=1.0
P_s=1.0
P_s=1.5
P_s=1.5
P_s=2.0
P_s=2.0
P_s=2.5
P_s=3.0
A_1 & B_1 (m)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
280
300

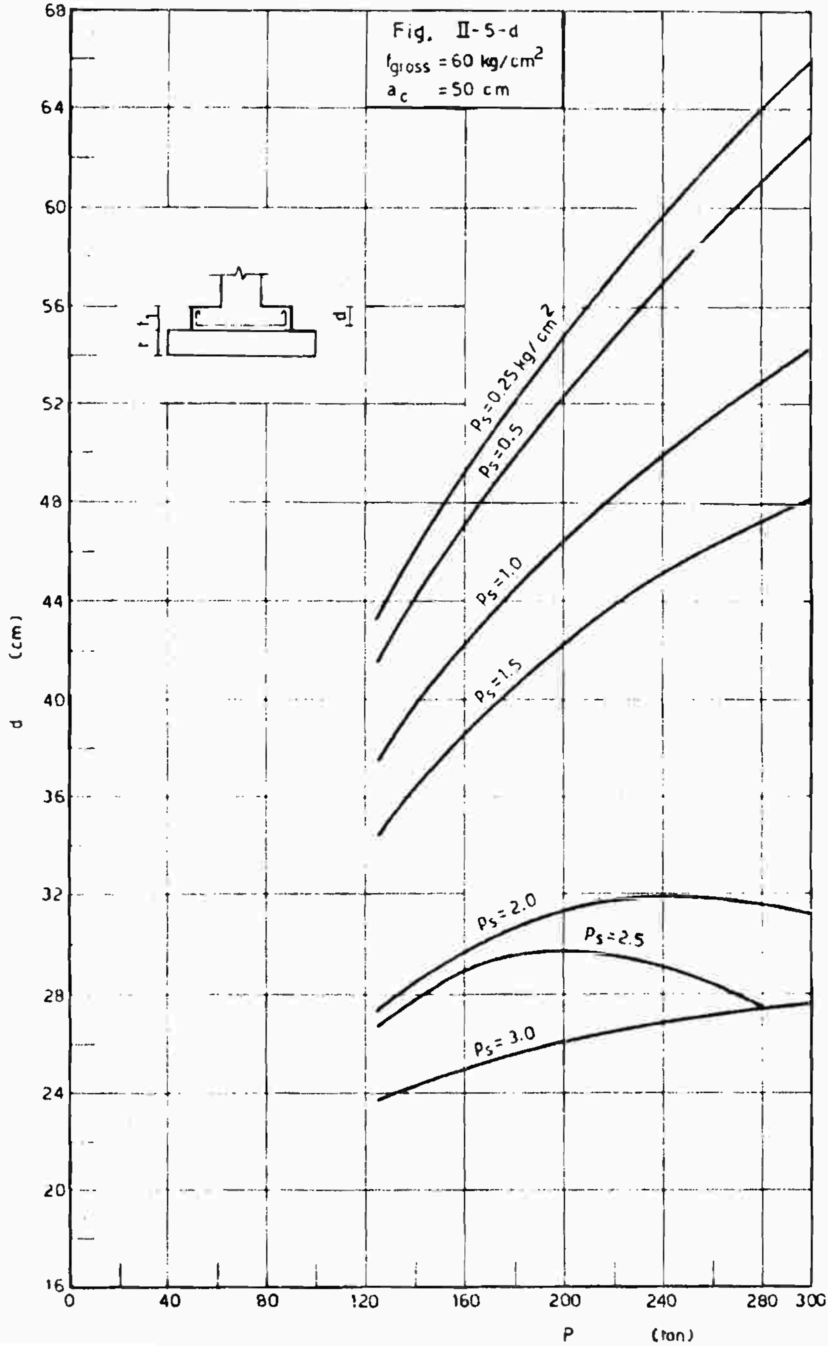


Fig. II-5-d
f_{gross} = 60 kg/cm²
a_c = 50 cm
d
t
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
d (cm)
16 20 24 28 32 36 40 44 48 52 56 60 64 68
0 40 80 120 160 200 240 280 300
P (ton)

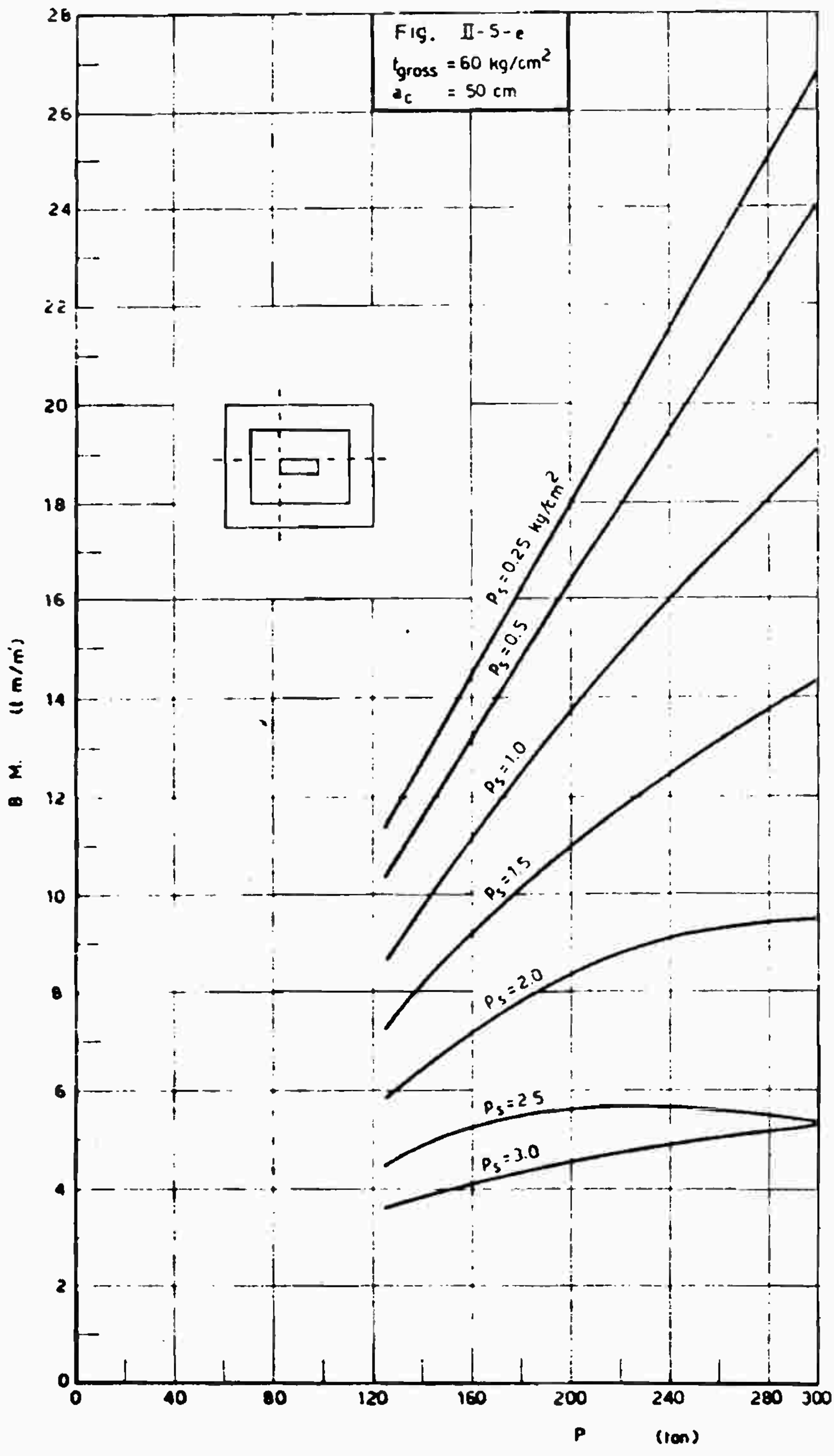


Fig. II-5-e
t_{gross} = 60 kg/cm²
a_c = 50 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
B.M. (t m/m')
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
0
40
80
120
160
200
240
280
300

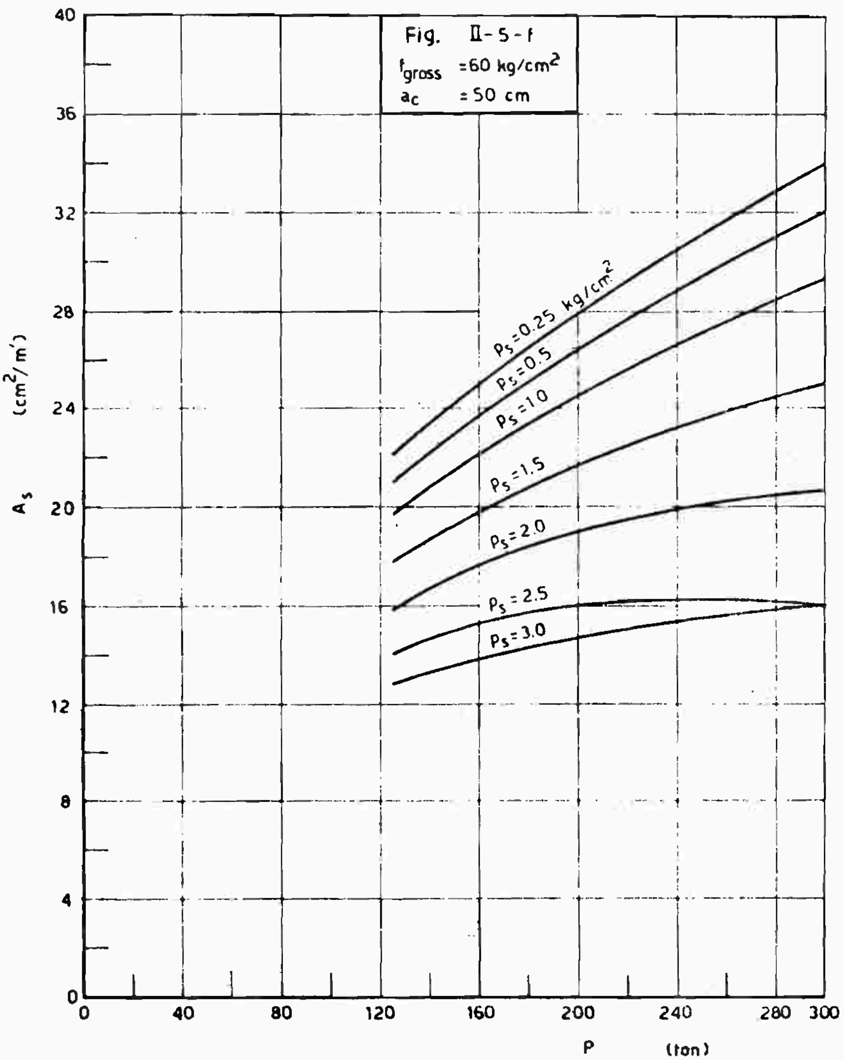


Fig. II-5-f
f_gross =60 kg/cm²
a_c =50 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
A_s (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
40
80
120
160
200
240
280
300

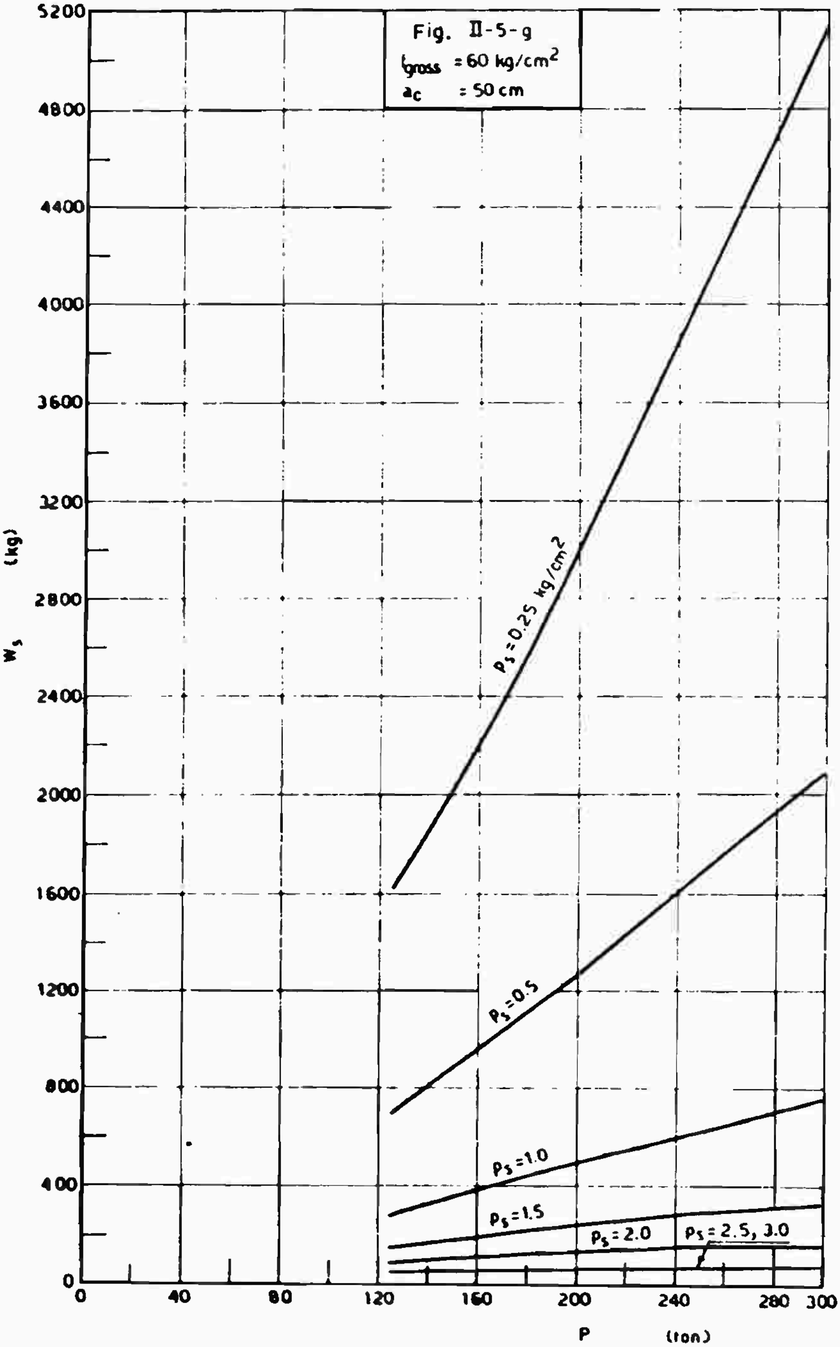


Fig. II-5-g
f_{gross} = 60 kg/cm²
a_c = 50 cm
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5, 3.0
Ws (kg)
P (ton)
0
40
80
120
160
200
240
280
300
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200

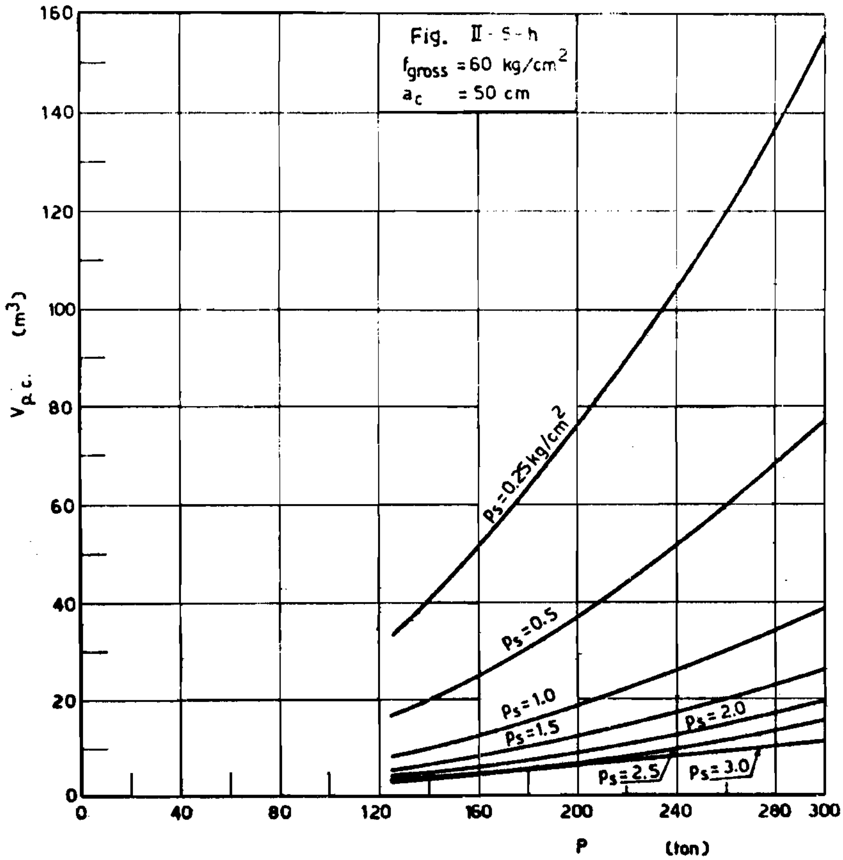


Fig. II - 5 - h
f_{gross} = 60 kg/cm²
a_c = 50 cm
$V_{p.c.}$ (m³)
P (ton)
0
40
80
120
160
200
240
280
300
20
60
100
140
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0

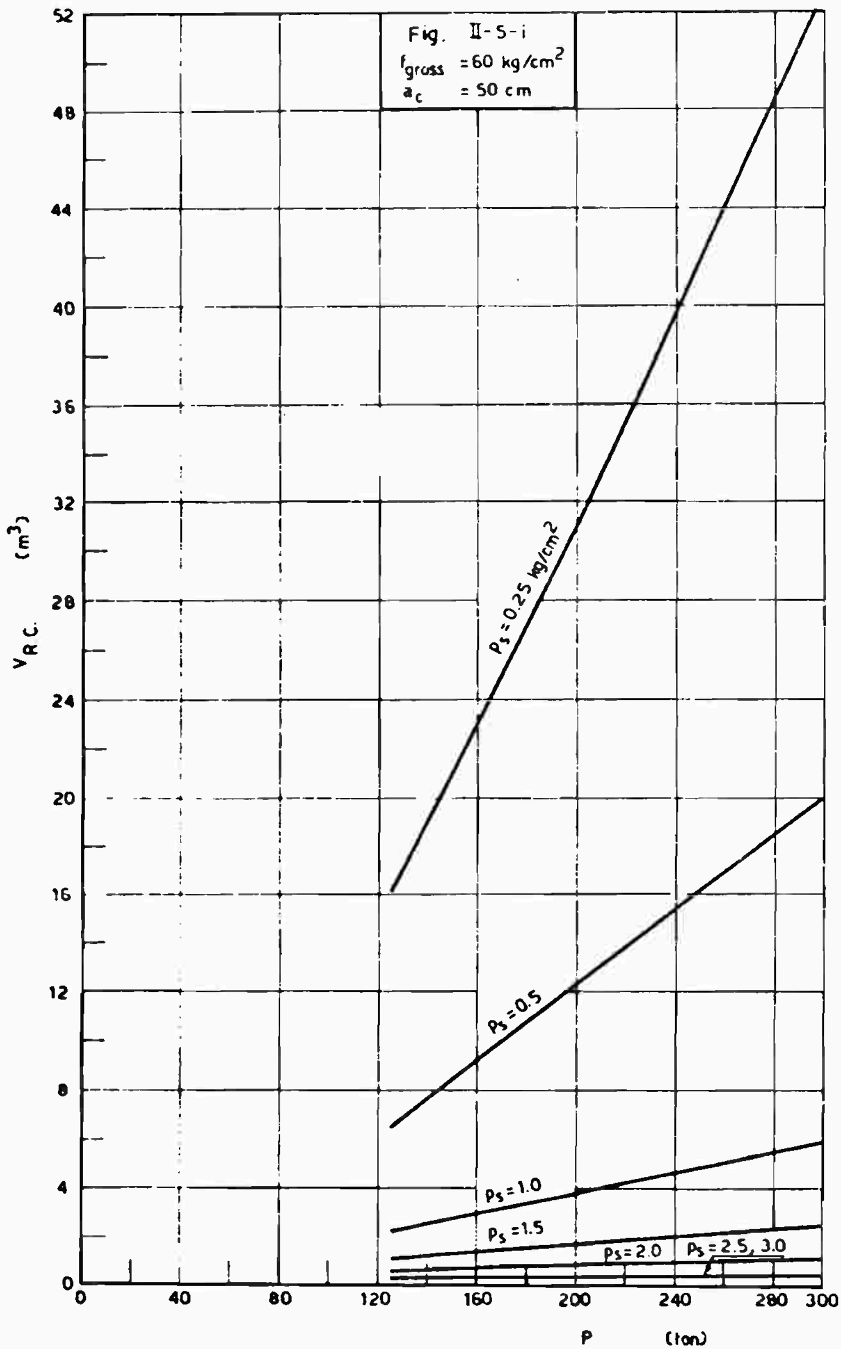


Fig. II-5-i
f_{gross} = 60 kg/cm²
a_c = 50 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5, 3.0
$V_{R.C.}$ (m³)
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
48
52
40
80
120
160
200
240
280
300

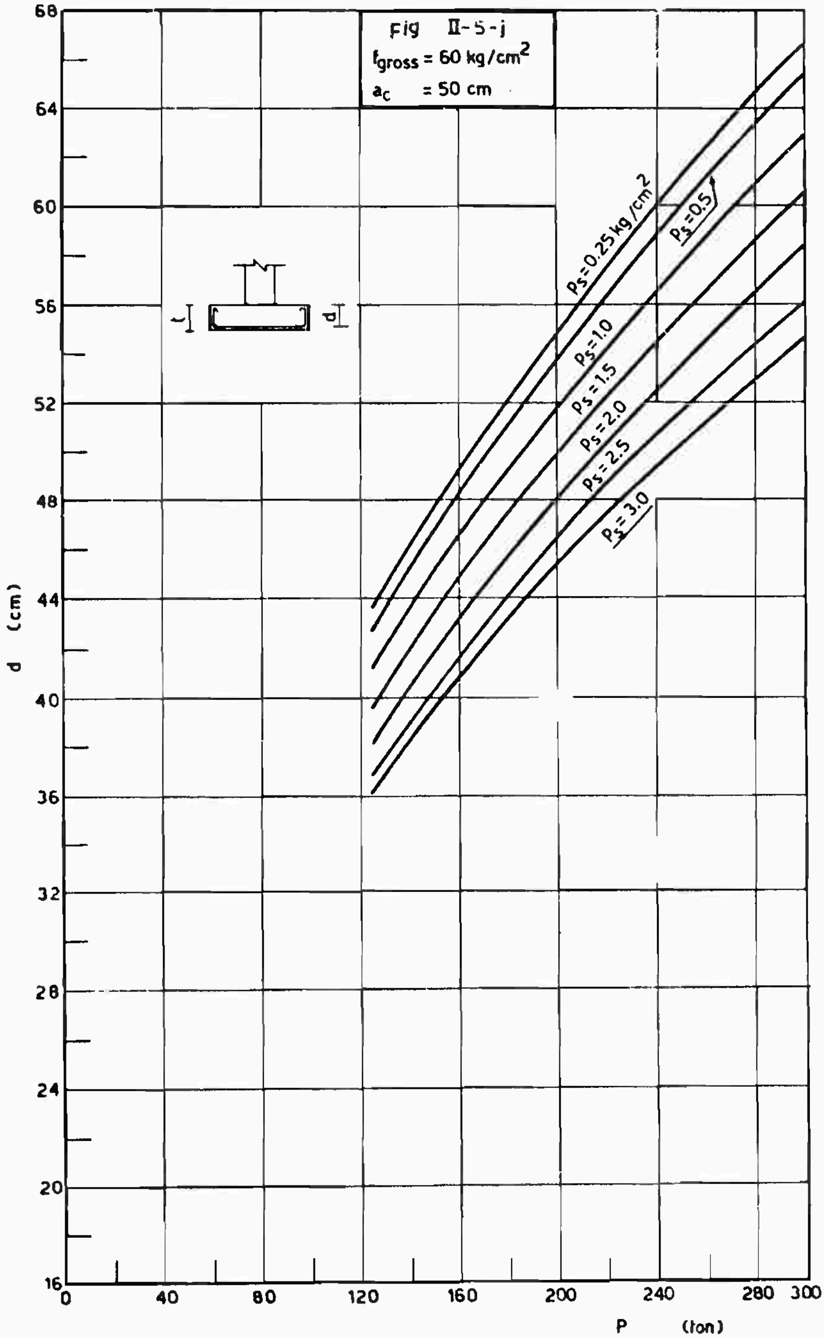


Fig II-5-j
f_{gross} = 60 kg/cm²
a_c = 50 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
t
d
d (cm)
P (ton)
16
20
24
28
32
36
40
44
48
52
56
60
64
68
0
40
80
120
160
200
240
280
300

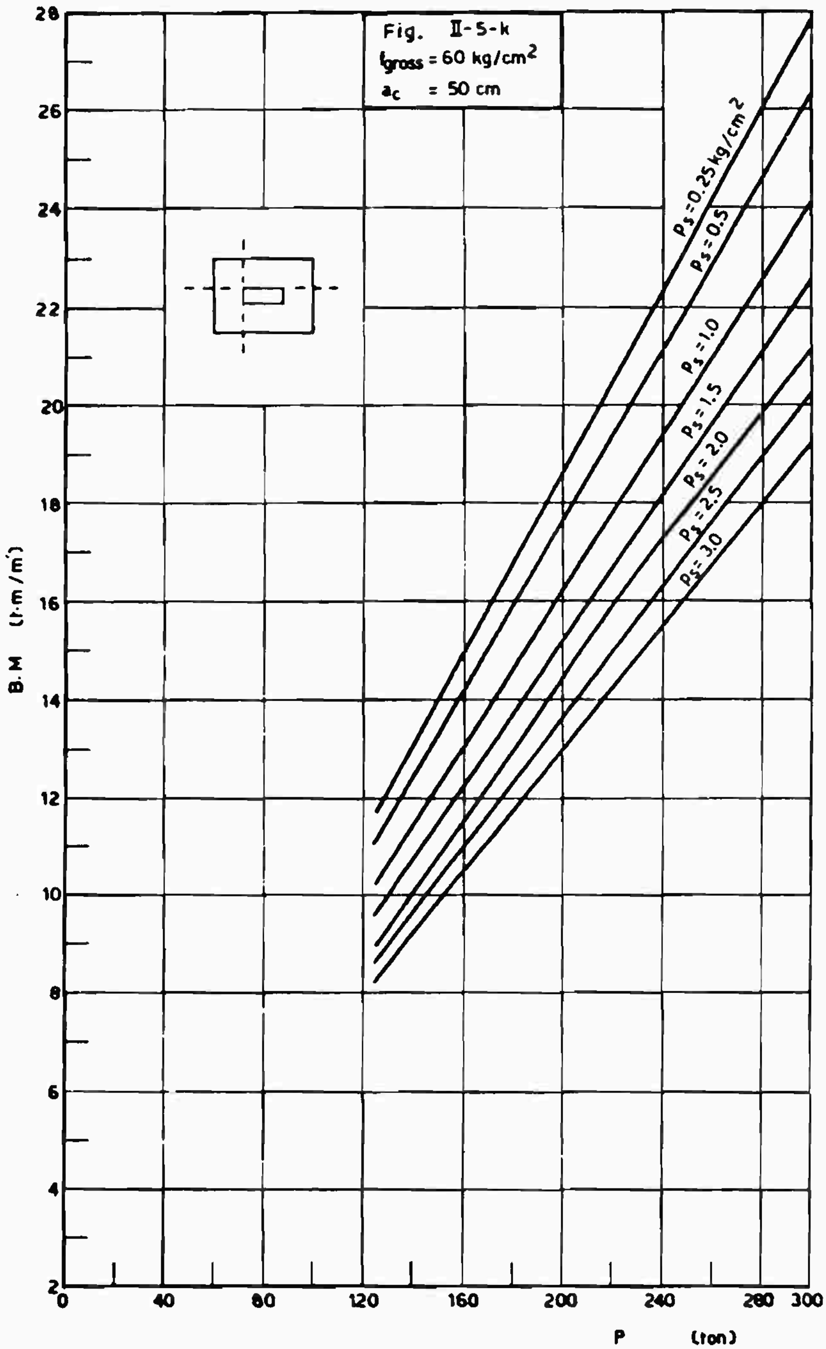


Fig. II-5-k
f_{gross} = 60 kg/cm²
a_c = 50 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
B.M (t·m/m')
P (ton)
0 40 80 120 160 200 240 280 300
2 4 6 8 10 12 14 16 18 20 22 24 26 28

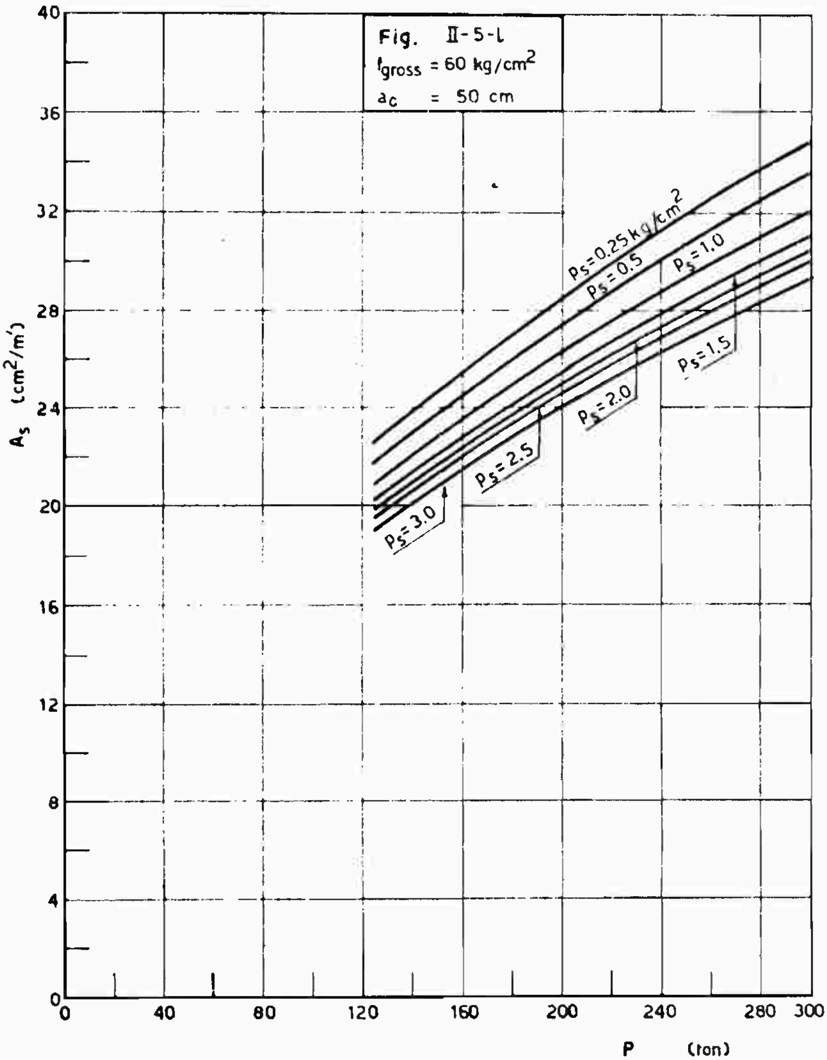


Fig. II-5-l
f_{gross} = 60 kg/cm²
a_c = 50 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_s (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300

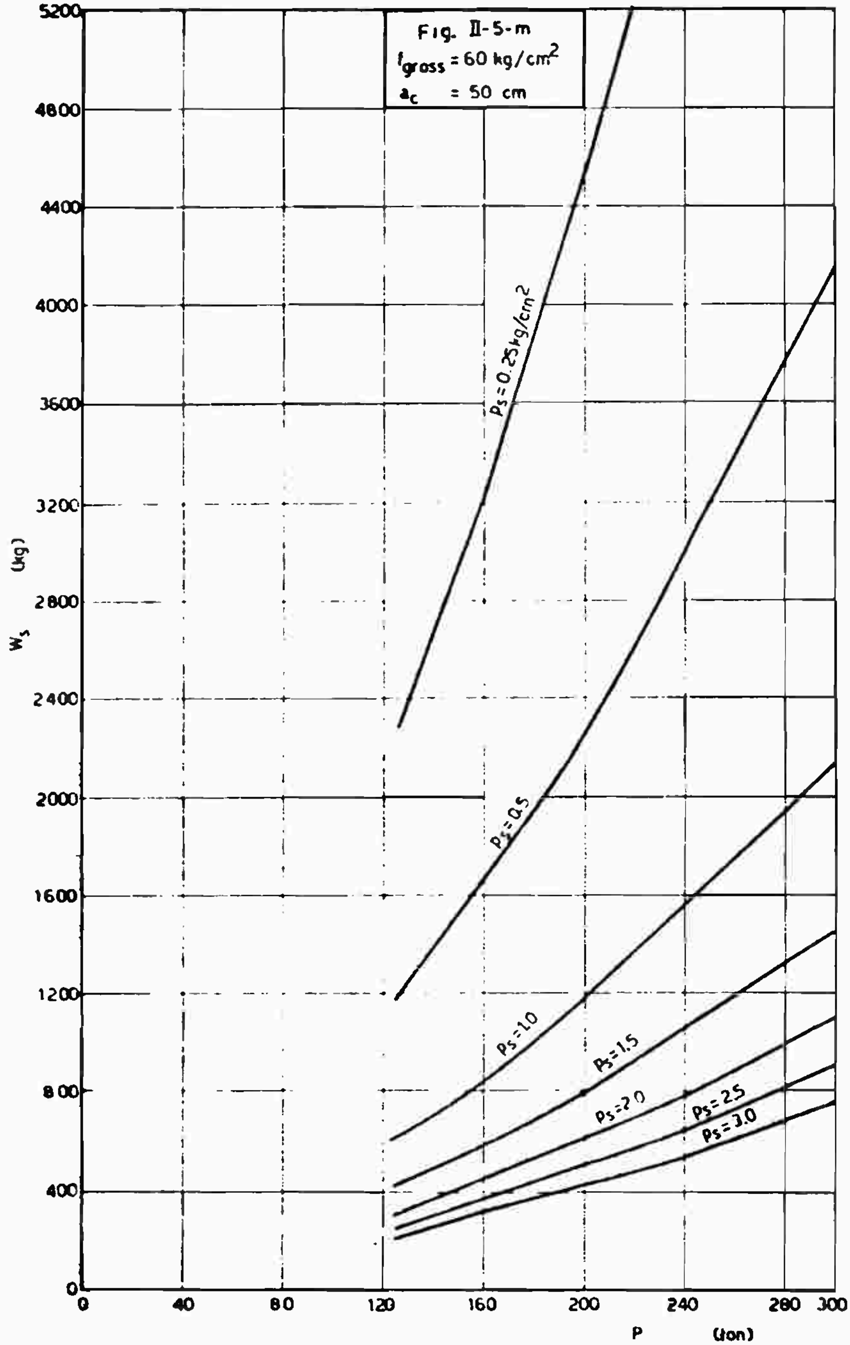


Fig. II-5-m
f_{gross} = 60 kg/cm²
a_c = 50 cm
Ps=0.25kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
W_s (kg)
P (ton)
0
40
80
120
160
200
240
280
300
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200

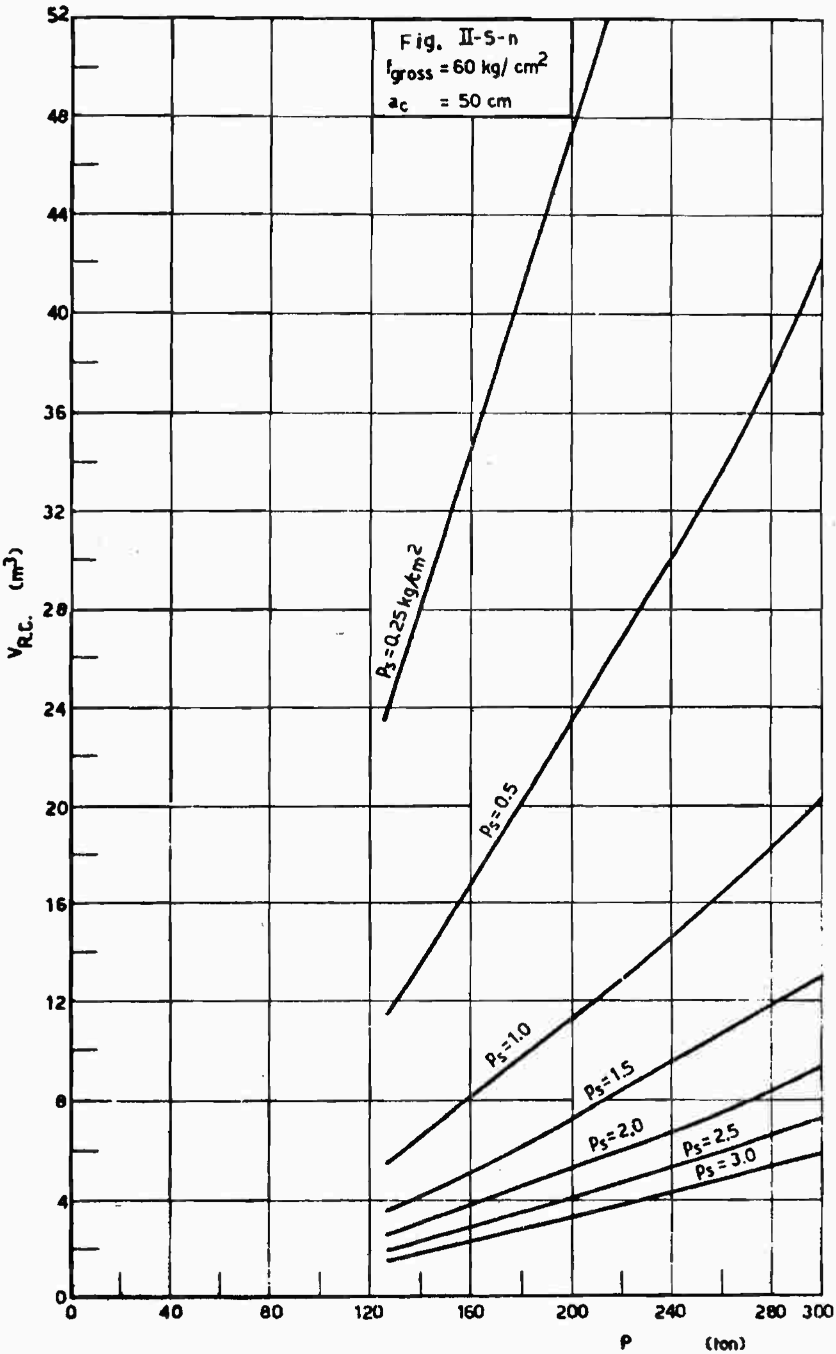


Fig. II-5-n
f_{gross} = 60 kg/ cm²
a_c = 50 cm
$V_{R.C.}$ (m³)
P (ton)
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
0 40 80 120 160 200 240 280 300
0 4 8 12 16 20 24 28 32 36 40 44 48 52

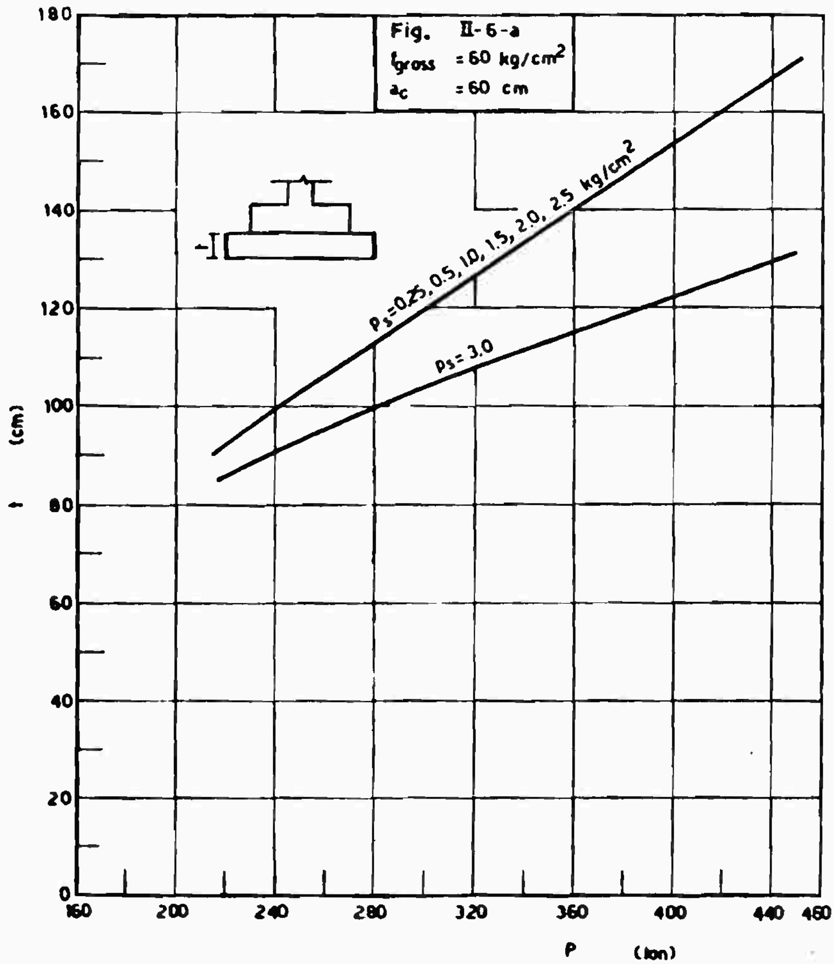


Fig. II-6-a
f_{gross} = 60 kg/cm²
a_c = 60 cm
P_s=0.25, 0.5, 1.0, 1.5, 2.0, 2.5 kg/cm²
P_s= 3.0
t (cm)
P (ton)
0
20
40
60
80
100
120
140
160
180
160
200
240
280
320
360
400
440
460

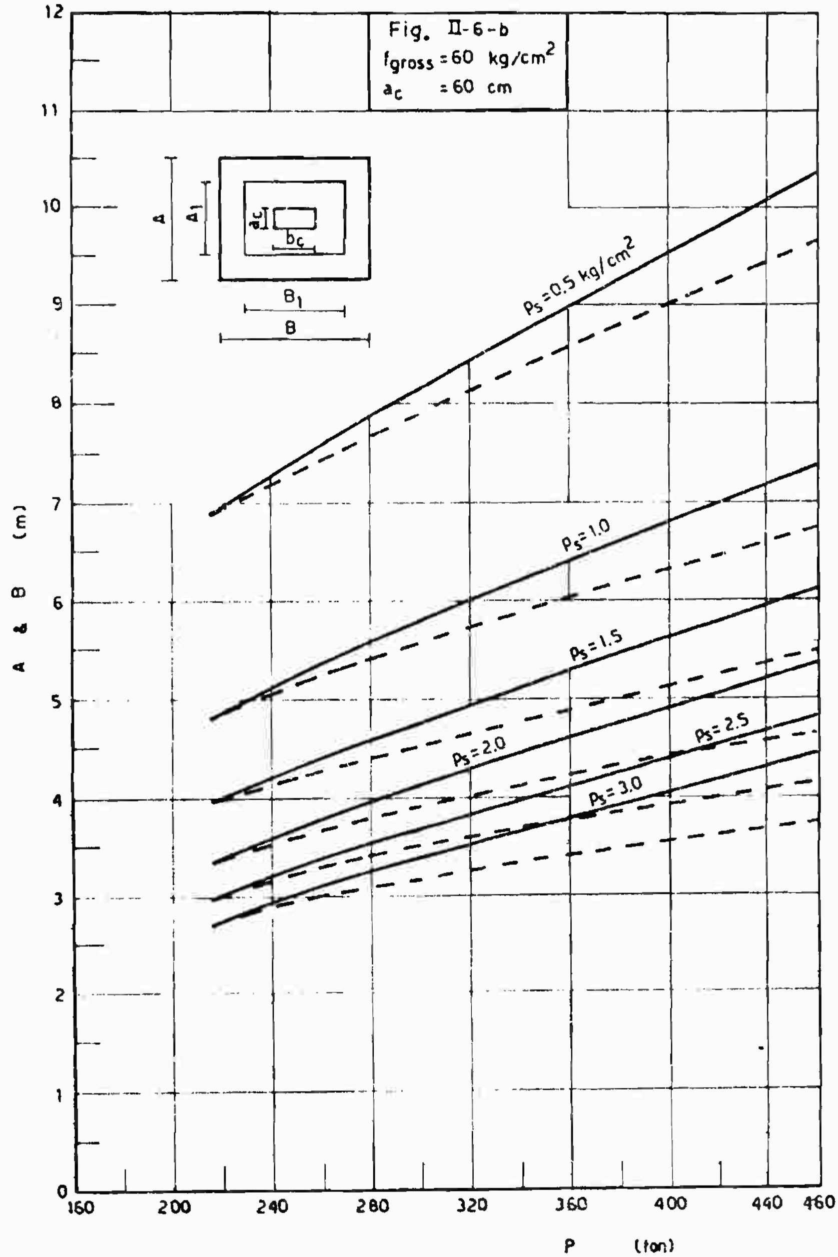


Fig. II-6-b
f_{gross} = 60 kg/cm²
a_c = 60 cm
A
A_1
a_c
b_c
B_1
B
P_s = 0.5 kg/cm²
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
A & B (m)
P (ton)
0 1 2 3 4 5 6 7 8 9 10 11 12
160 200 240 280 320 360 400 440 460

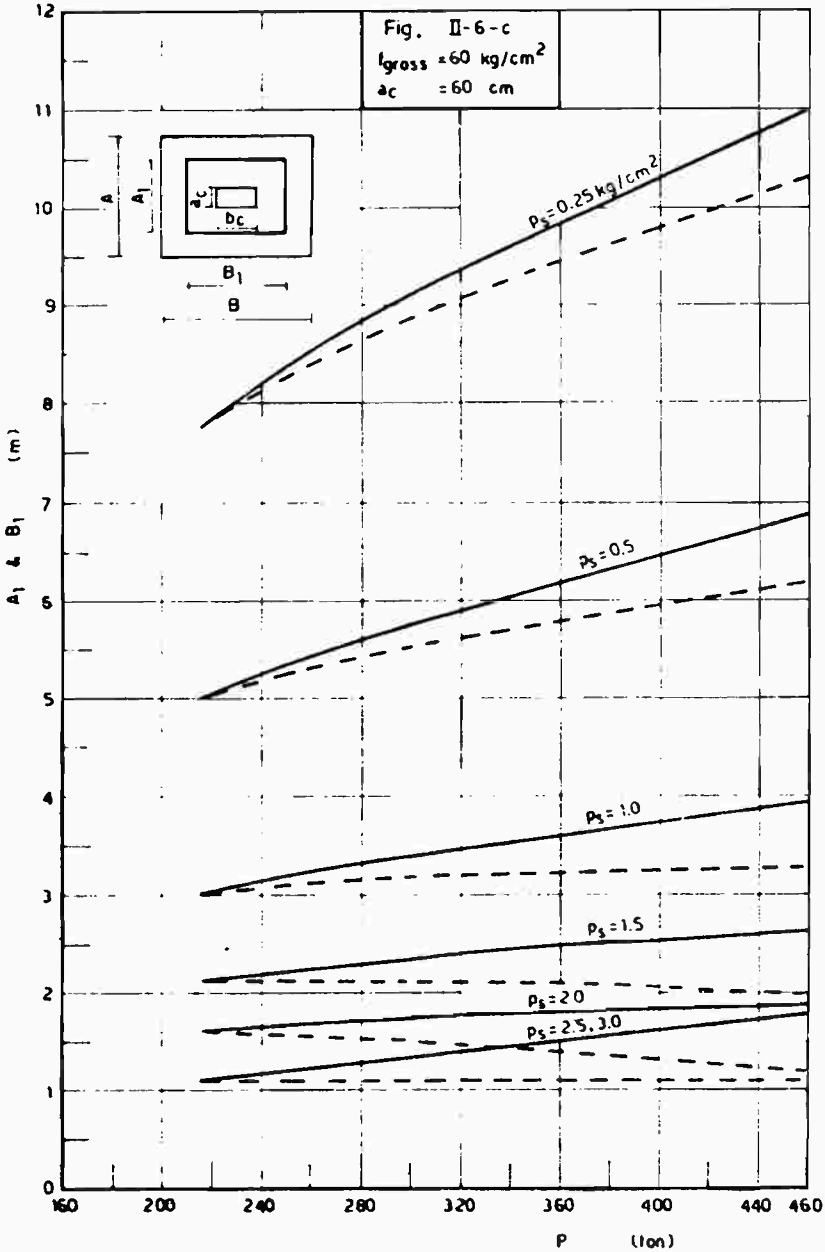


Fig. II-6-c
f_{gross} = 60 kg/cm²
a_c = 60 cm
A
A_1
a_c
b_c
B_1
B
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5, 3.0
A_1 & B_1 (m)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
160
200
240
280
320
360
400
440
460

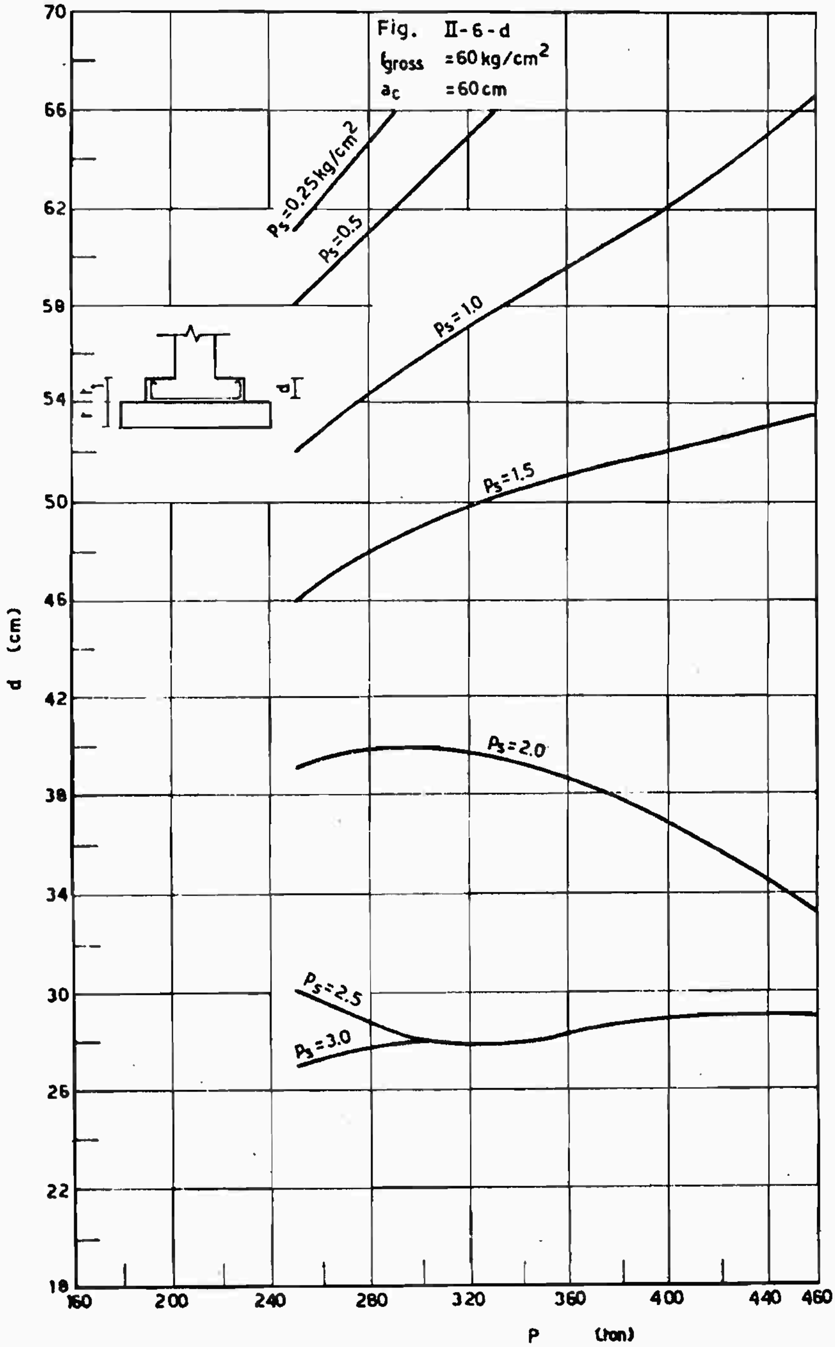


Fig. II-6-d
f gross =60 kg/cm2
ac =60 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d
d (cm)
70
66
62
58
54
50
46
42
38
34
30
26
22
18
160
200
240
280
320
360
400
440
460
P (ton)

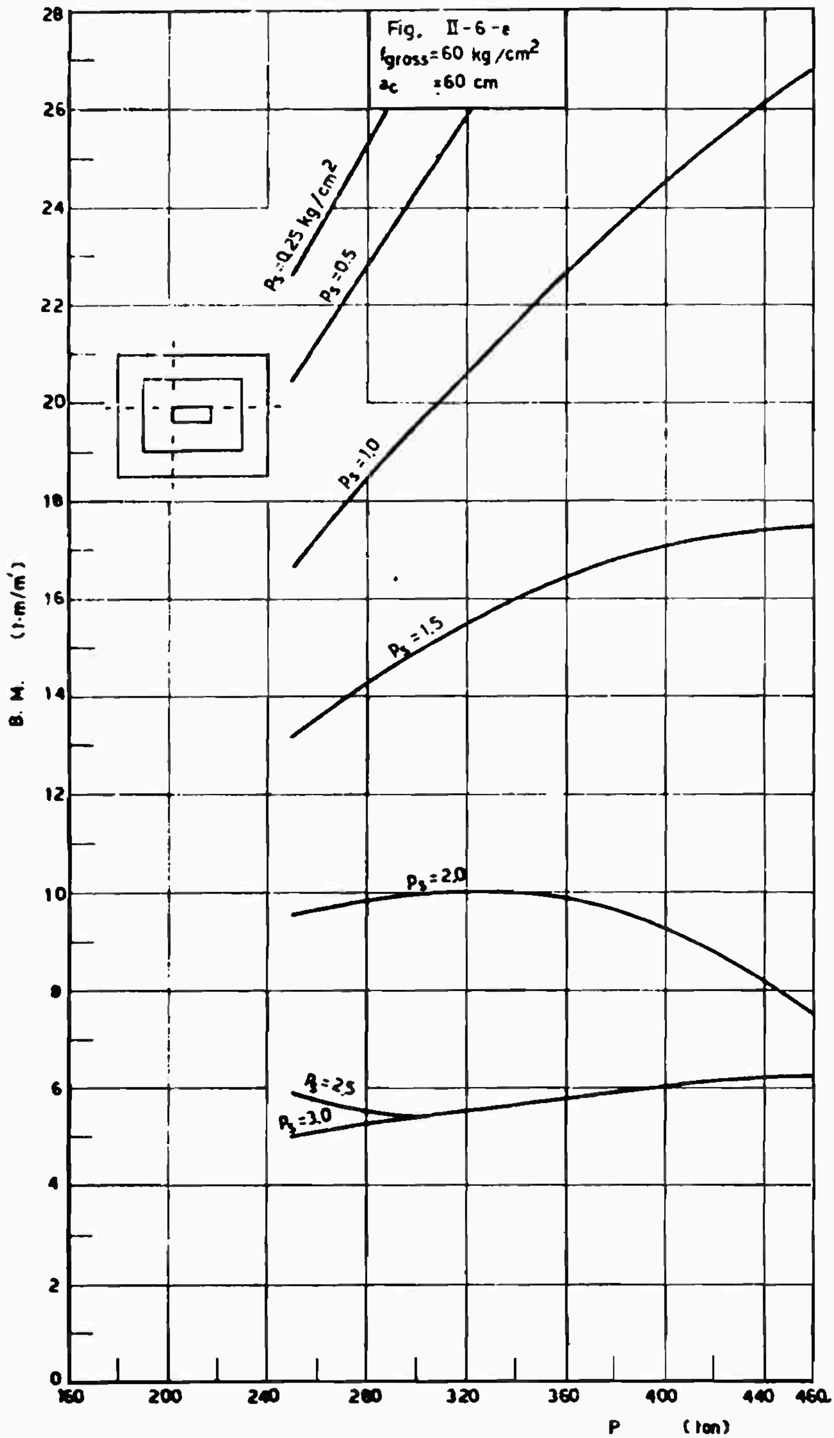


Fig. II-6-e
f_{gross} = 60 kg/cm²
a_c = 60 cm
P_s = 0.25 kg/cm2
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
B. M. (t.m/m')
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
160
200
240
280
320
360
400
440
460

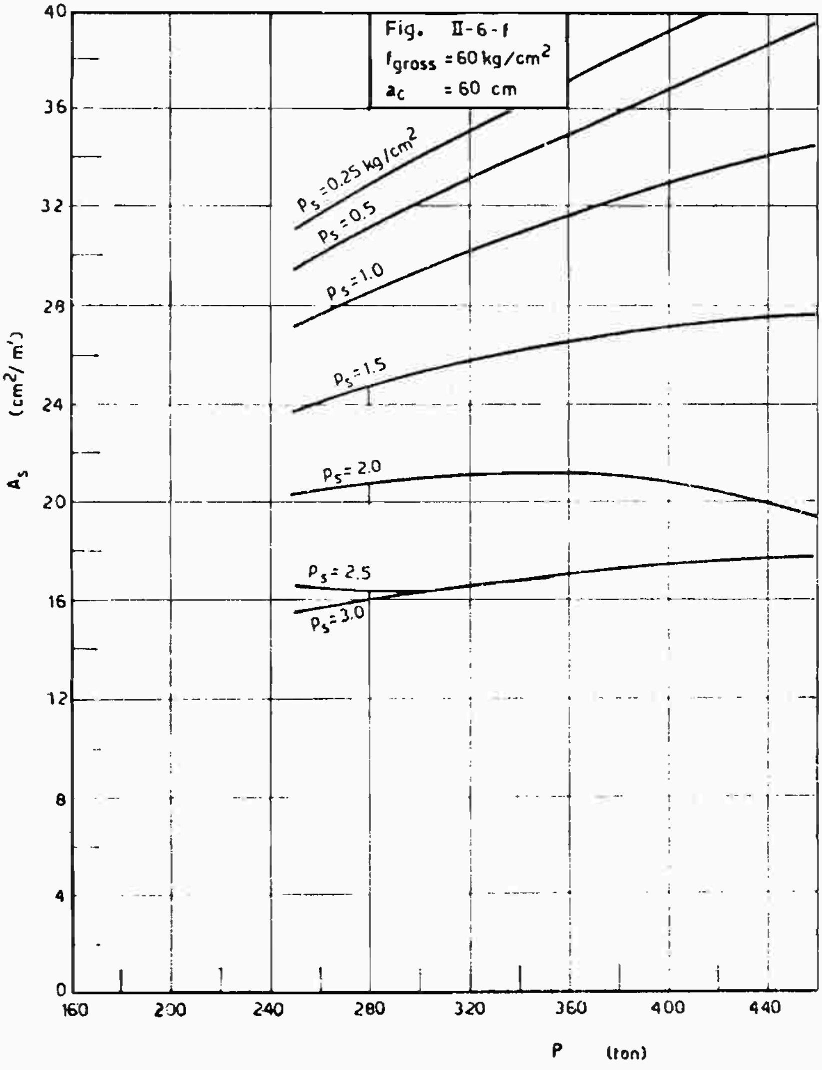


Fig. II-6-f
f gross = 60 kg/cm2
ac = 60 cm
Ps = 0.25 kg/cm2
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
As (cm2/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
160
200
240
280
320
360
400
440

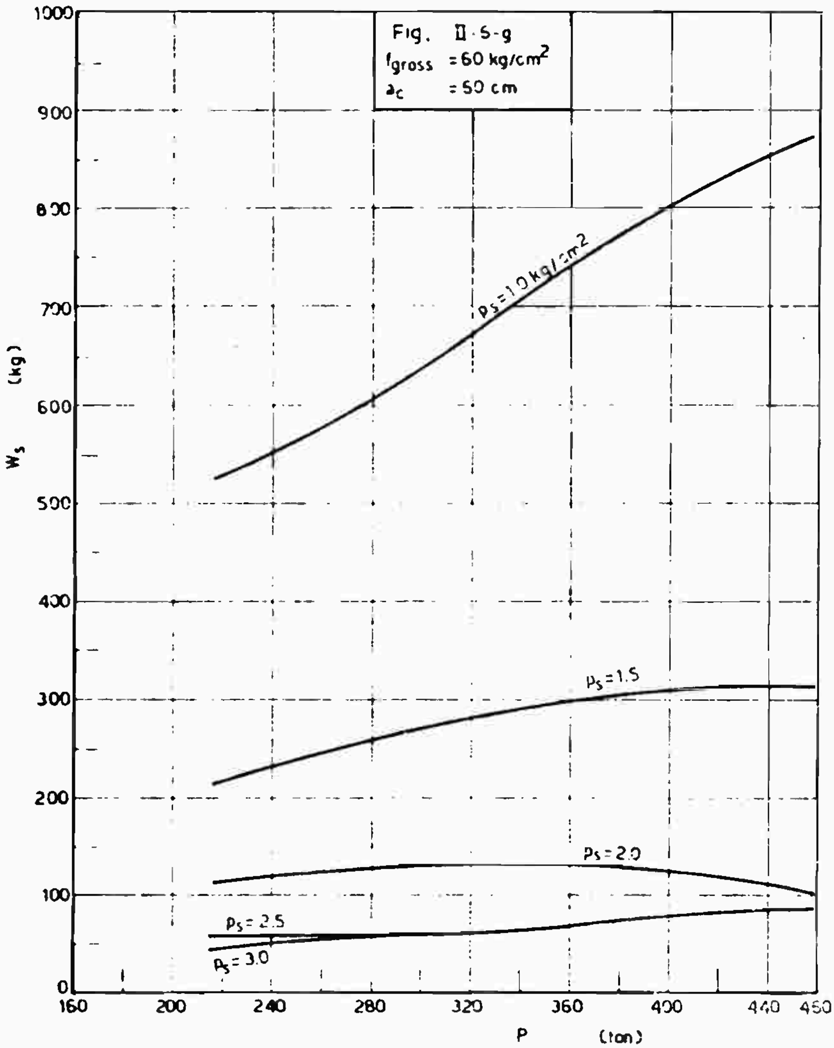


Fig. II-5-g
f_{gross} = 60 kg/cm²
a_c = 50 cm
p_s = 1.0 kg/cm²
p_s = 1.5
p_s = 2.0
p_s = 2.5
p_s = 3.0
W_s (kg)
P (ton)
0
100
200
300
400
500
600
700
800
900
1000
160
200
240
280
320
360
400
440
460

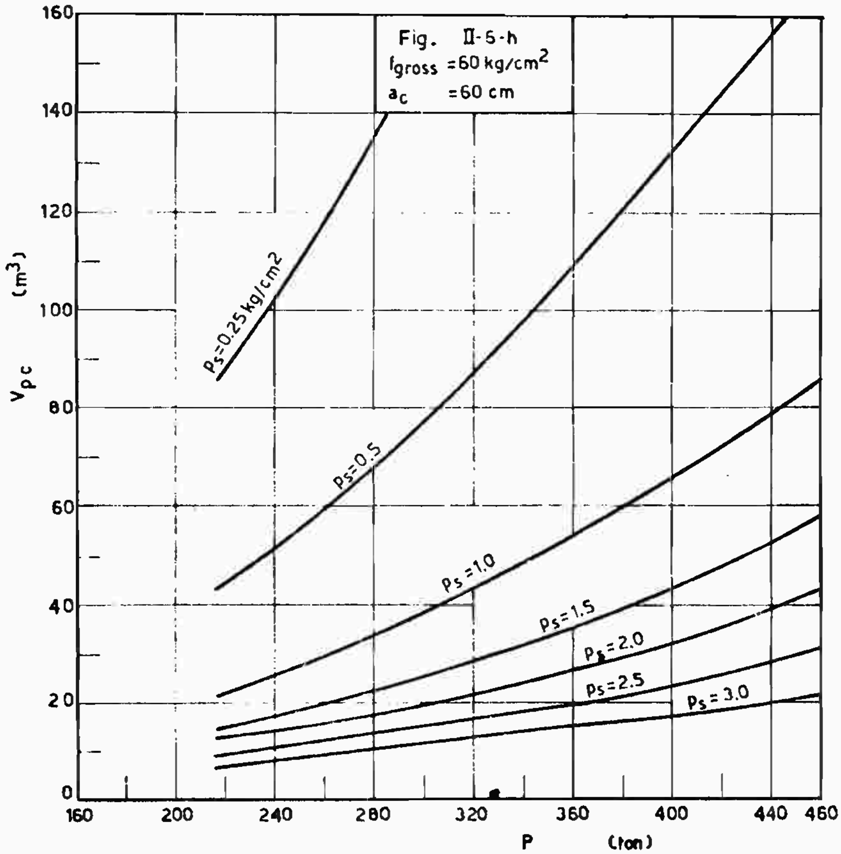


Fig. II-5-h
f_{gross} = 60 kg/cm²
a_c = 60 cm
V_{pc} (m³)
P (ton)
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
0
20
40
60
80
100
120
140
160
160
200
240
280
320
360
400
440
460

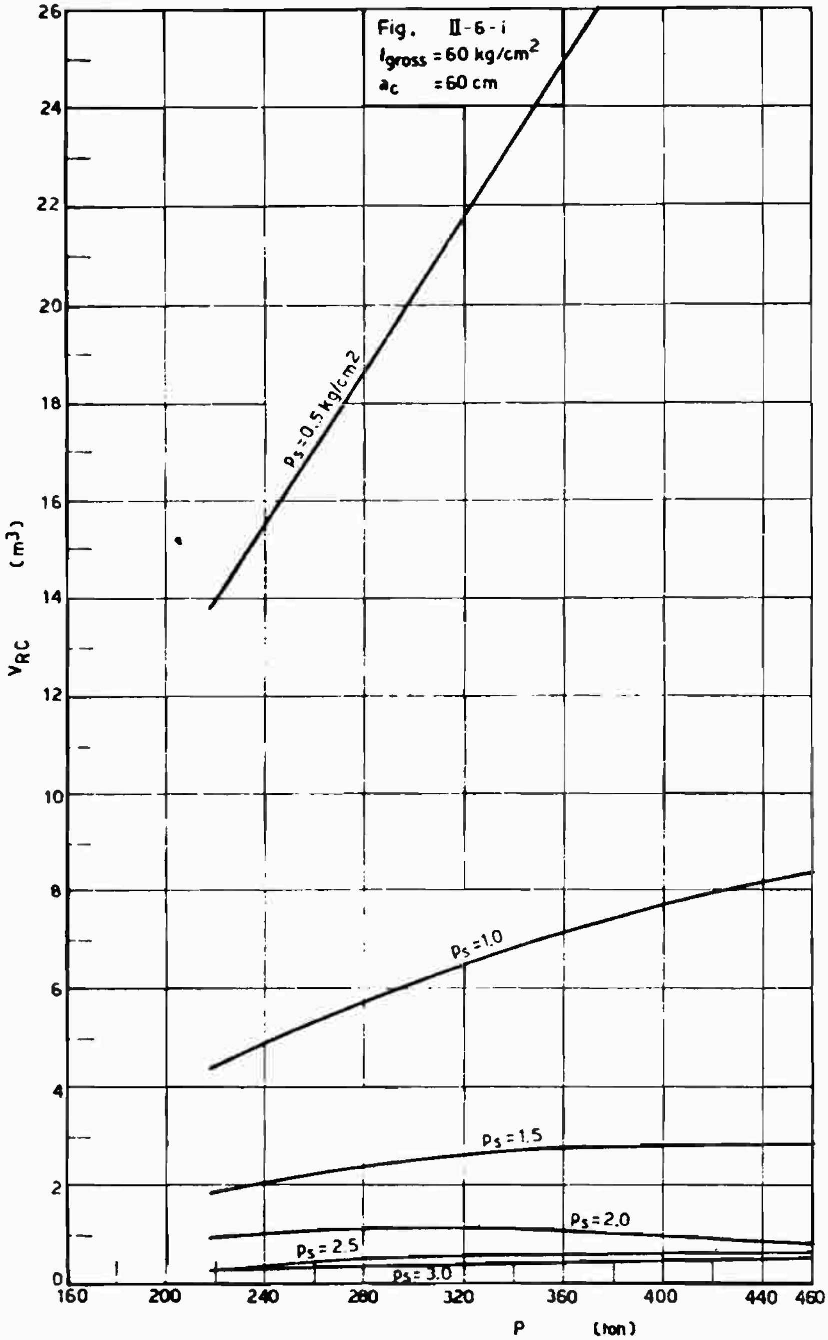


Fig. II-6-i
f_{gross} = 60 kg/cm²
a_c = 60 cm
p_s = 0.5 kg/cm2
p_s = 1.0
p_s = 1.5
p_s = 2.0
p_s = 2.5
p_s = 3.0
V_{RC} (m³)
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
160
200
240
280
320
360
400
440
460

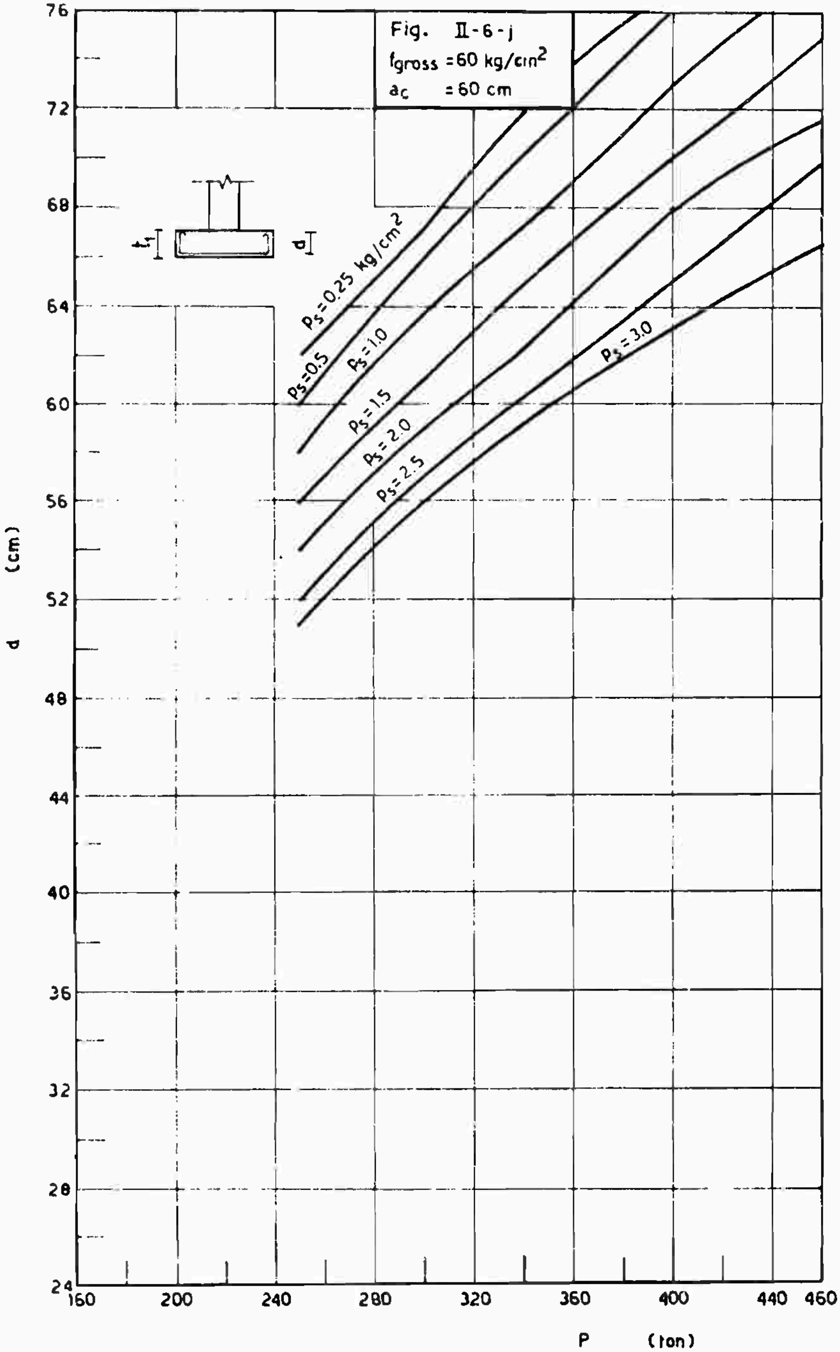


Fig. II-6-j
f_{gross} = 60 kg/cm^2
a_c = 60 cm
P_s=0.25 kg/cm^2
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
d (cm)
P (ton)
76
72
68
64
60
56
52
48
44
40
36
32
28
24
160
200
240
280
320
360
400
440
460

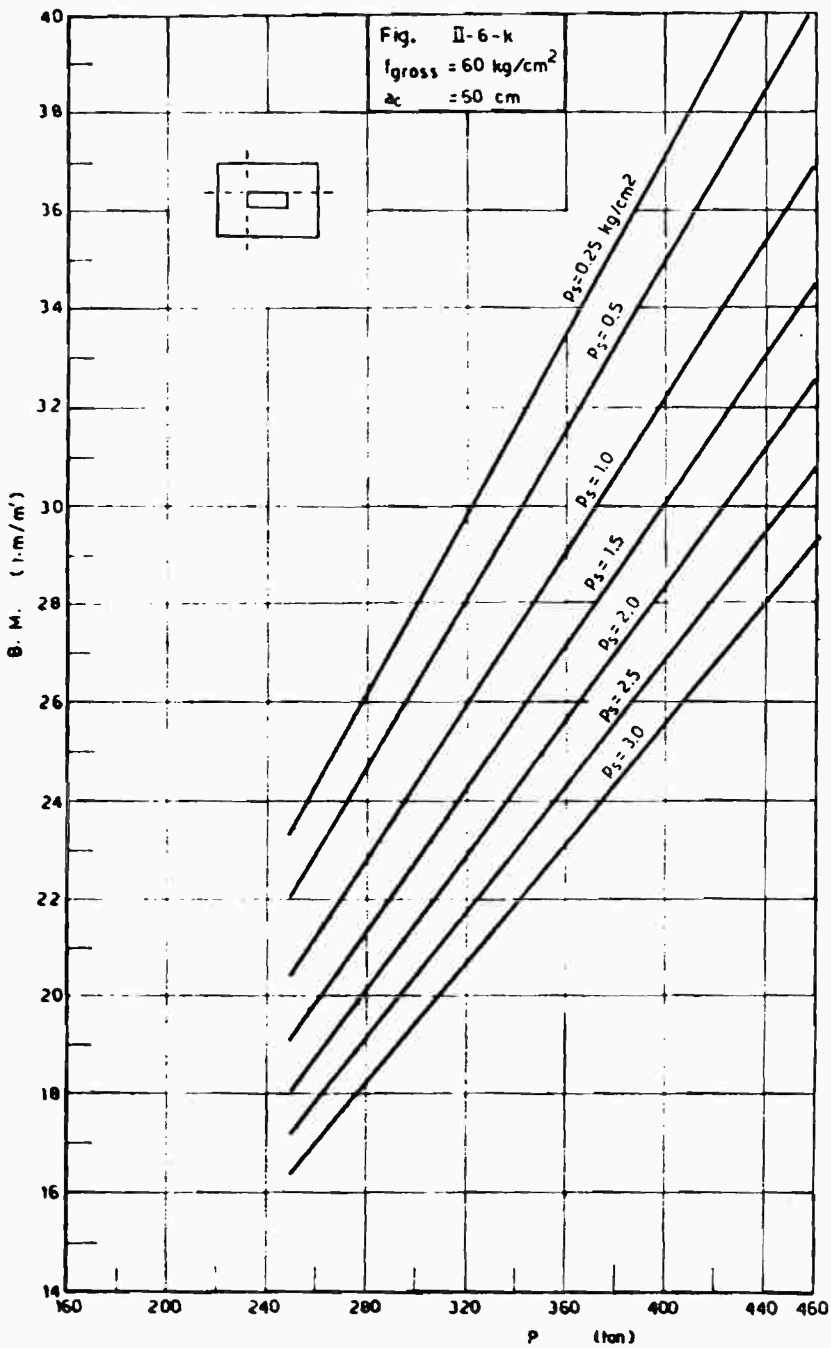


Fig. II-6-k
f_{gross} = 60 kg/cm²
a_c = 50 cm
P_s=0.25 kg/cm2
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
B. M. (t.m/m')
P (ton)
14
16
18
20
22
24
26
28
30
32
34
36
38
40
160
200
240
280
320
360
400
440
460

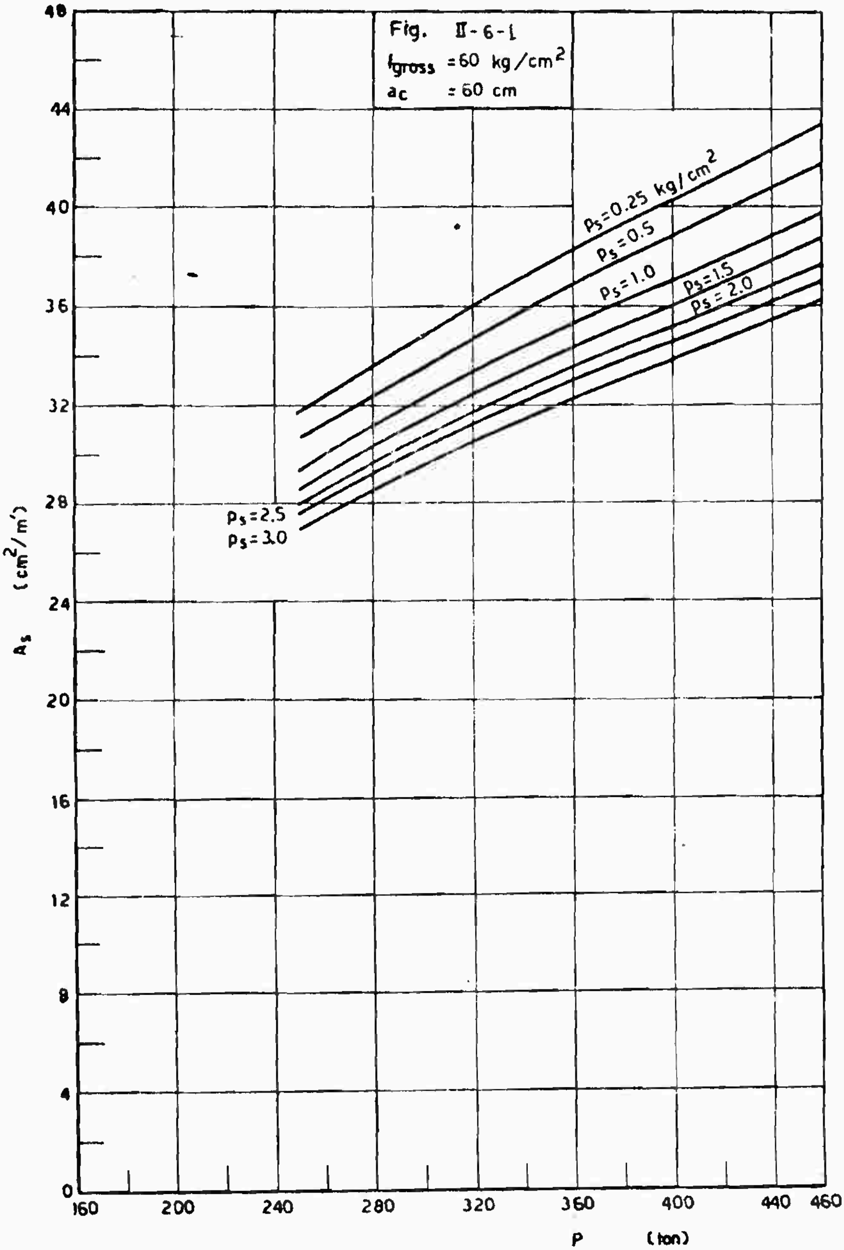


Fig. II-6-1
fgross = 60 kg/cm2
ac = 60 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
As (cm2/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
48
160
200
240
280
320
360
400
440
460

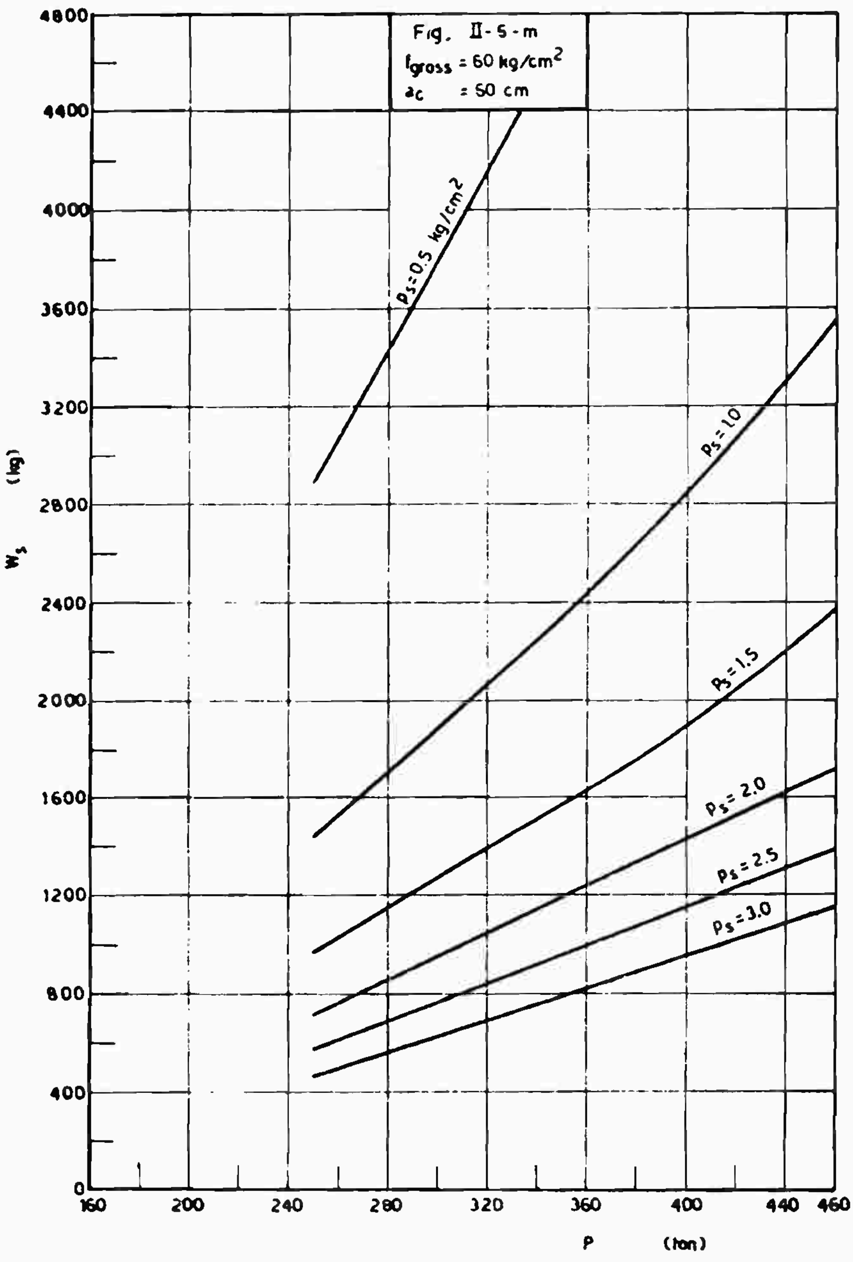


Fig. II-5-m
f_{gross} = 60 kg/cm²
a_c = 50 cm
Ps=0.5 kg/cm²
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
Ws (kg)
160
200
240
280
320
360
400
440
460
P (ton)

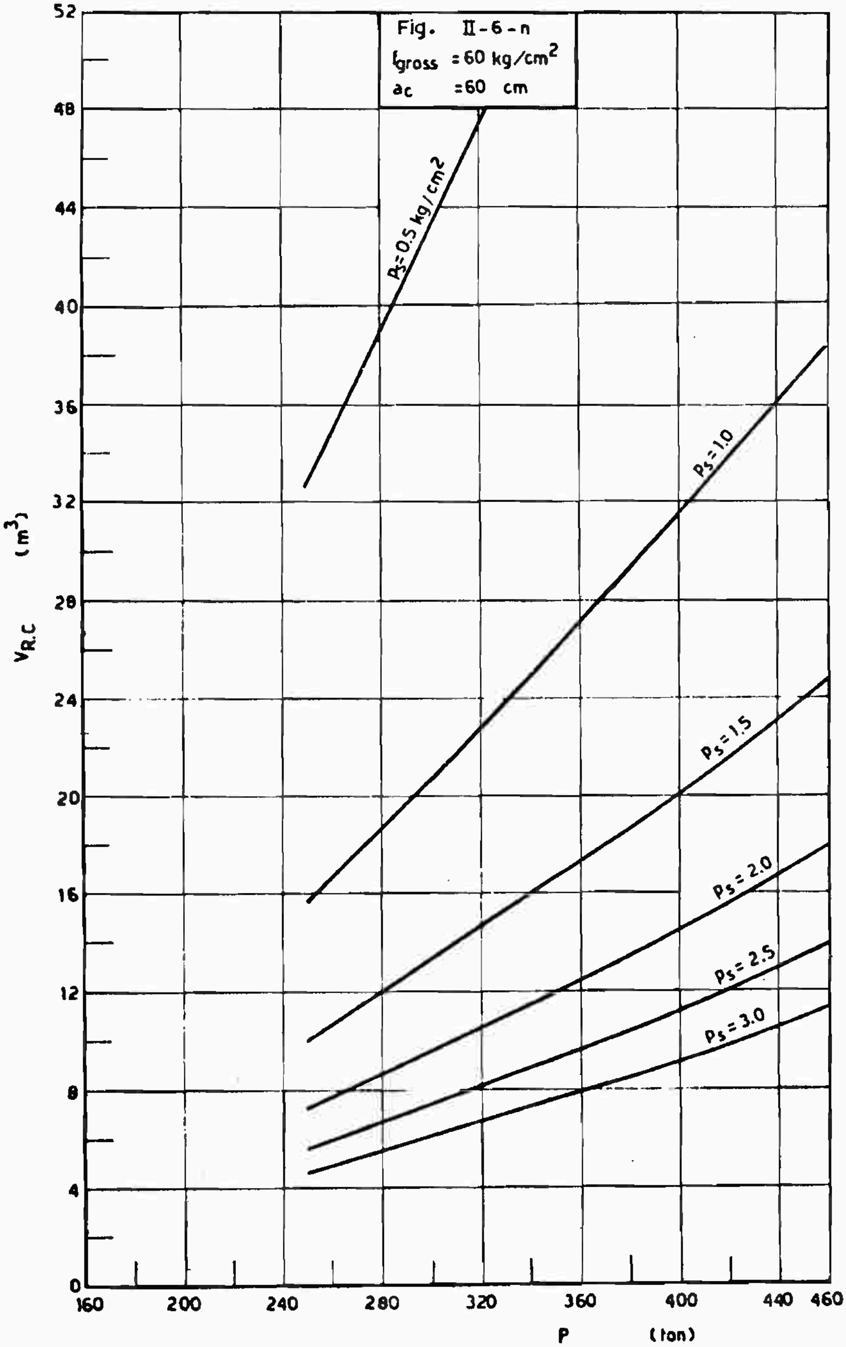


Fig. II-6-n
f_{gross} = 60 kg/cm^2
a_c = 60 cm
Ps=0.5 kg/cm2
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
$V_{R.C}$ (m^3)
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
48
52
160
200
240
280
320
360
400
440
460

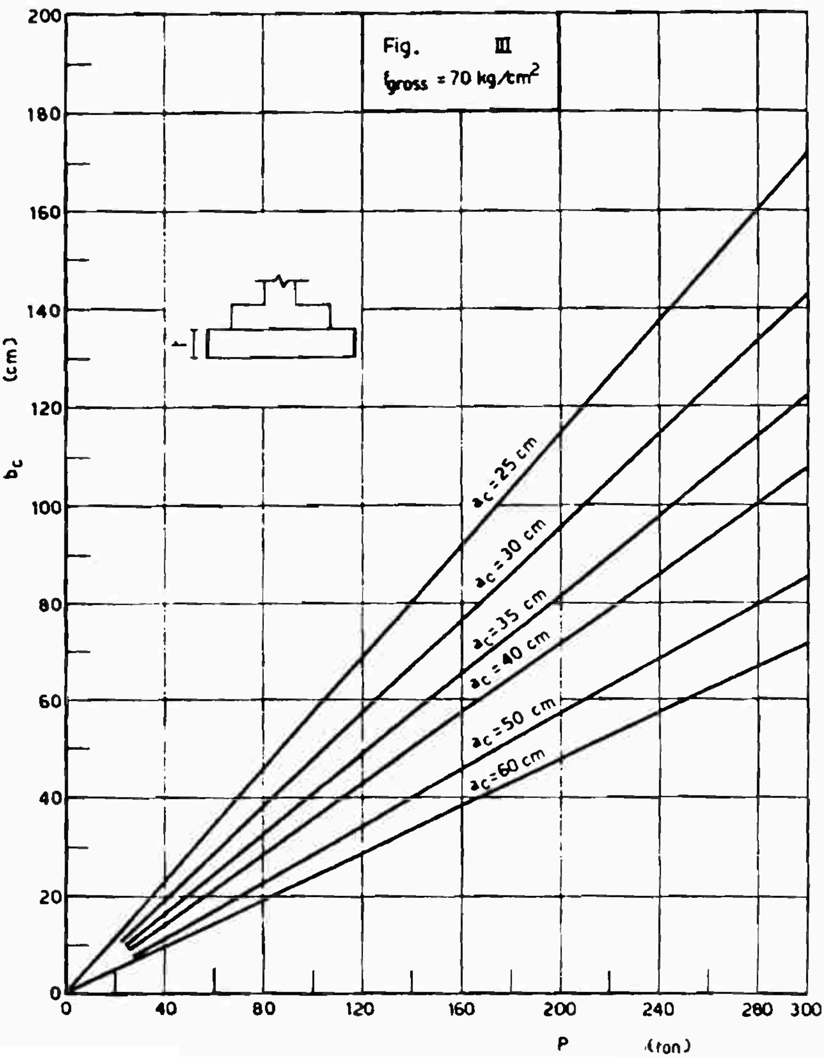


Fig. III
f_{gross} = 70 kg/cm^2
b_c (cm)
P (ton)
a_c=25 cm
a_c=30 cm
a_c=35 cm
a_c=40 cm
a_c=50 cm
a_c=60 cm
0
20
40
60
80
100
120
140
160
180
200
240
280
300

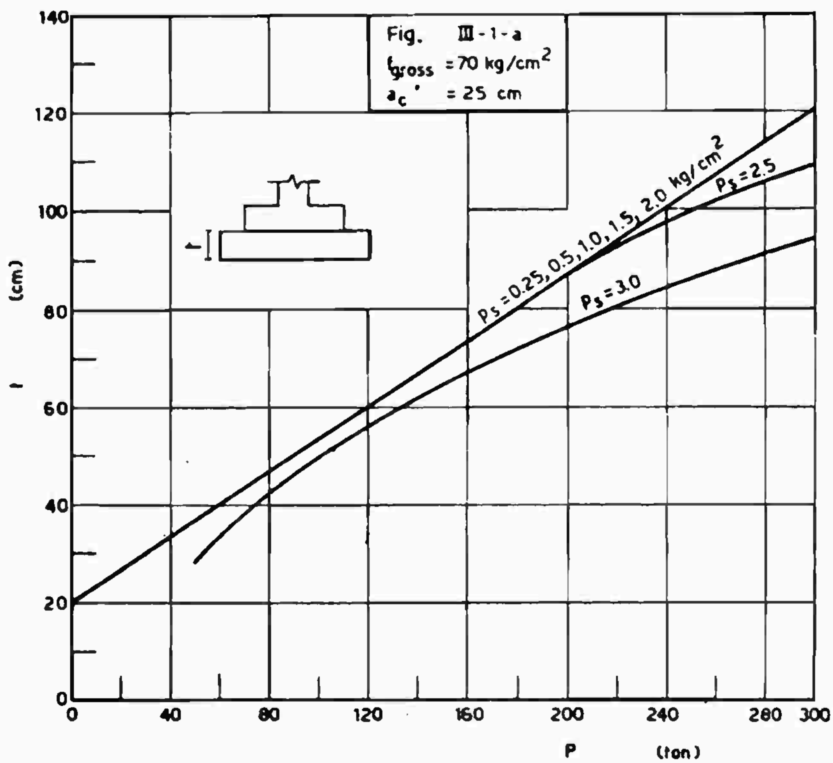


Fig. III-1-a
f_{gross} = 70 kg/cm²
a_c' = 25 cm
Ps=0.25, 0.5, 1.0, 1.5, 2.0 kg/cm²
Ps=2.5
Ps=3.0
t (cm)
P (ton)
0
20
40
60
80
100
120
140
160
200
240
280
300

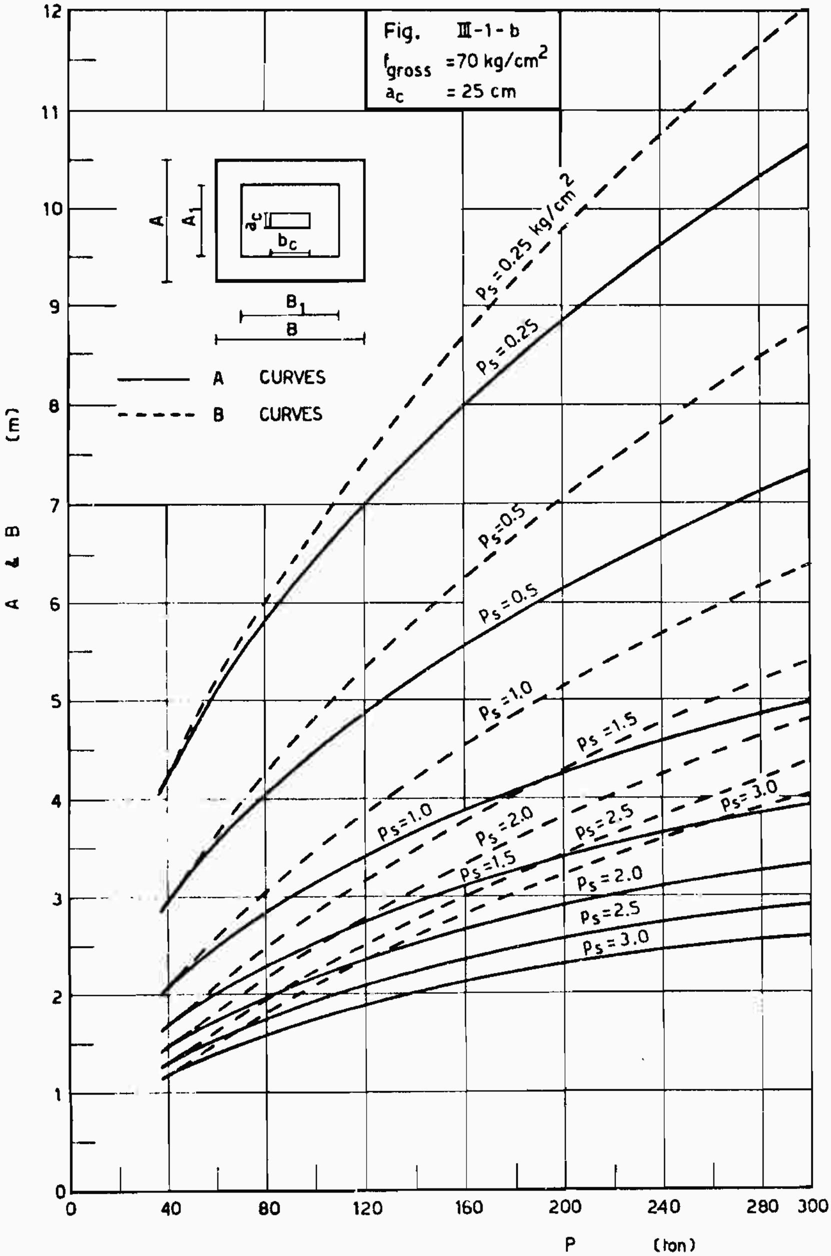


Fig. III-1-b
f_{gross} = 70 kg/cm²
a_c = 25 cm
A
A_1
a_c
b_c
B_1
B
A CURVES
B CURVES
A & B (m)
P (ton)
Ps = 0.25 kg/cm²
Ps = 0.25
Ps = 0.5
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 1.0
Ps = 2.0
Ps = 2.5
Ps = 3.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0

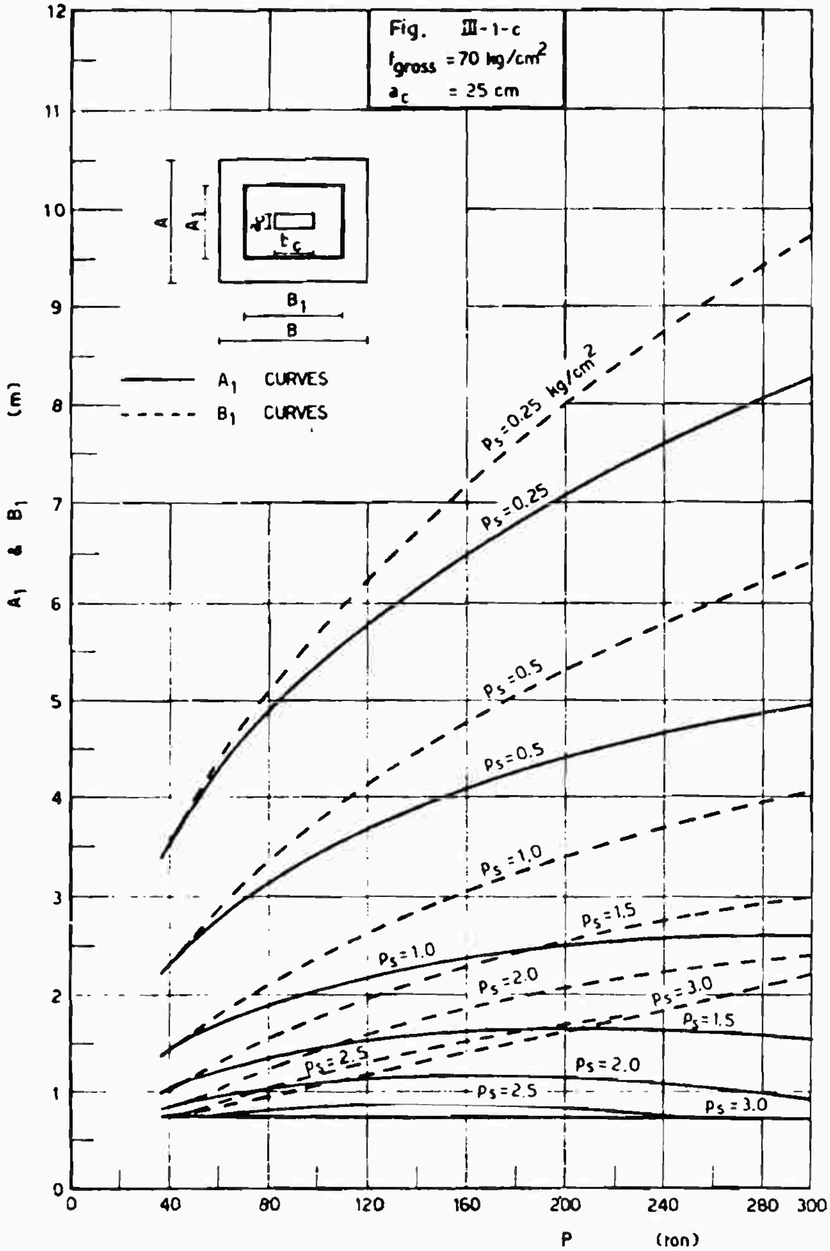


Fig. III-1-c
f_{gross} = 70 kg/cm²
a_c = 25 cm
A
A_1
t_c
B_1
B
A_1 CURVES
B_1 CURVES
p_s = 0.25 kg/cm²
p_s = 0.25
p_s = 0.5
p_s = 0.5
p_s = 1.0
p_s = 1.5
p_s = 1.0
p_s = 2.0
p_s = 3.0
p_s = 1.5
p_s = 2.5
p_s = 2.0
p_s = 2.5
p_s = 3.0
A_1 & B_1 (m)
P (ton)

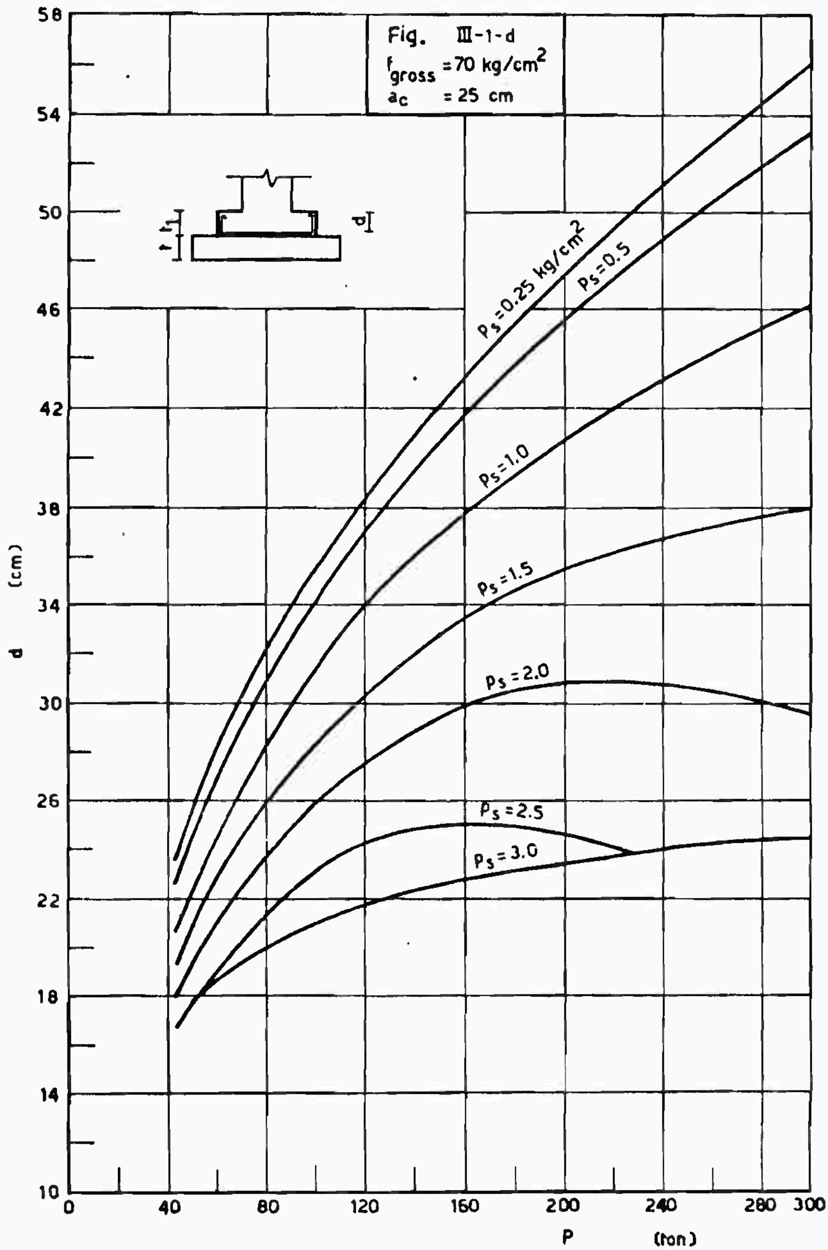


Fig. III-1-d
f_{gross} = 70 kg/cm²
a_c = 25 cm
d
P_s=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
P_s=2.5
P_s=3.0
d (cm)
P (ton)
58
54
50
46
42
38
34
30
26
22
18
14
10
0
40
80
120
160
200
240
280
300

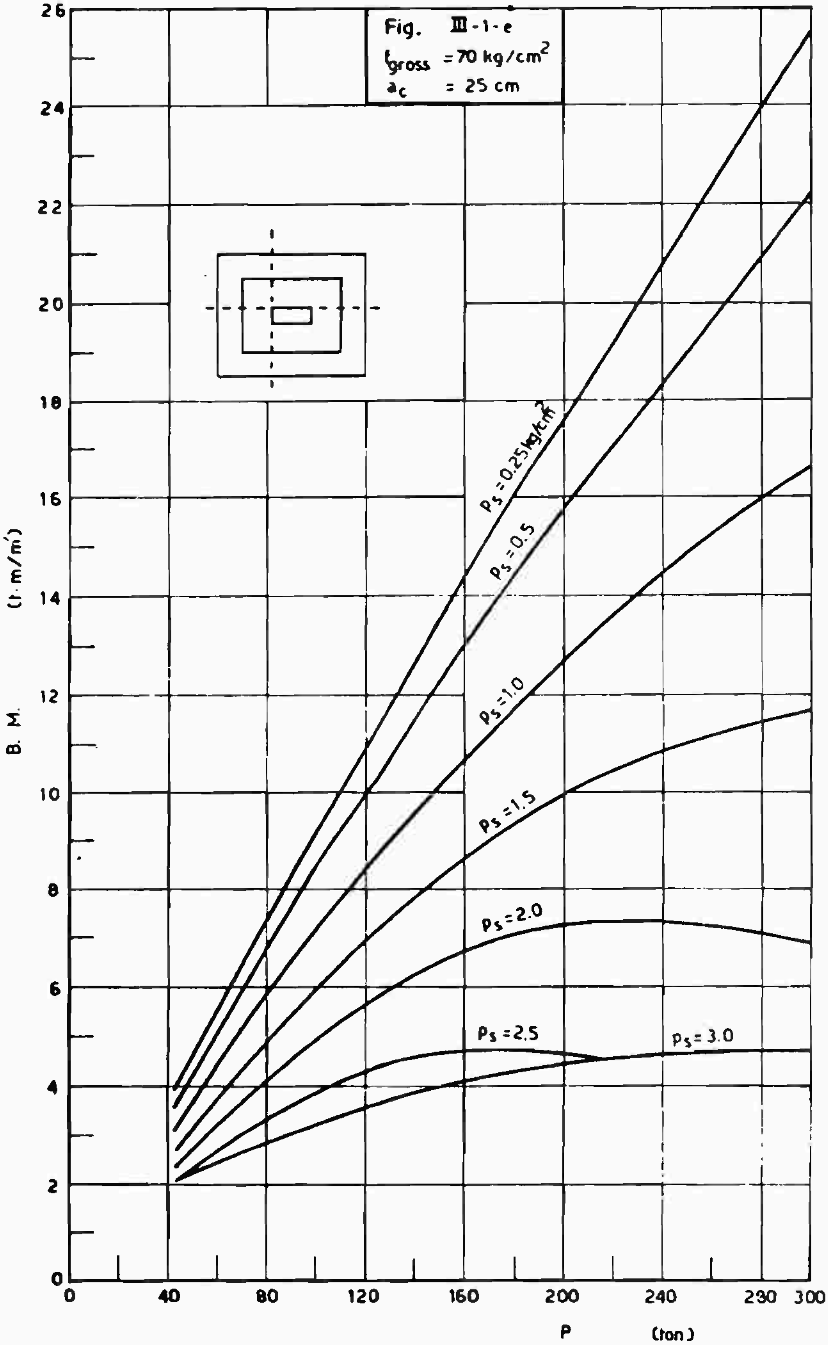


Fig. III-1-e
f_{gross} = 70 kg/cm²
a_c = 25 cm
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
B. M. (t·m/m')
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
40
80
120
160
200
240
280
300

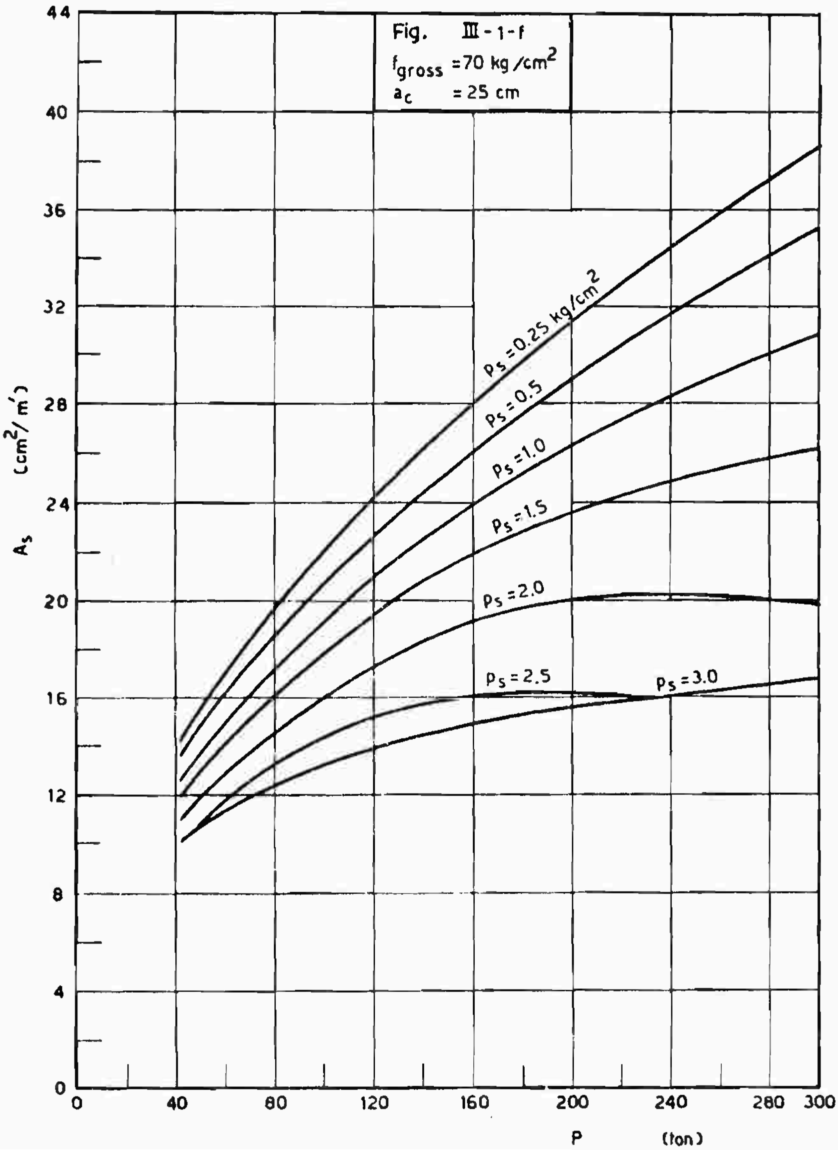


Fig. III-1-f
f_{gross} = 70 kg/cm^2
a_c = 25 cm
P_s = 0.25 kg/cm^2
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
A_s (cm^2/m')
P (ton)
0 4 8 12 16 20 24 28 32 36 40 44
0 40 80 120 160 200 240 280 300

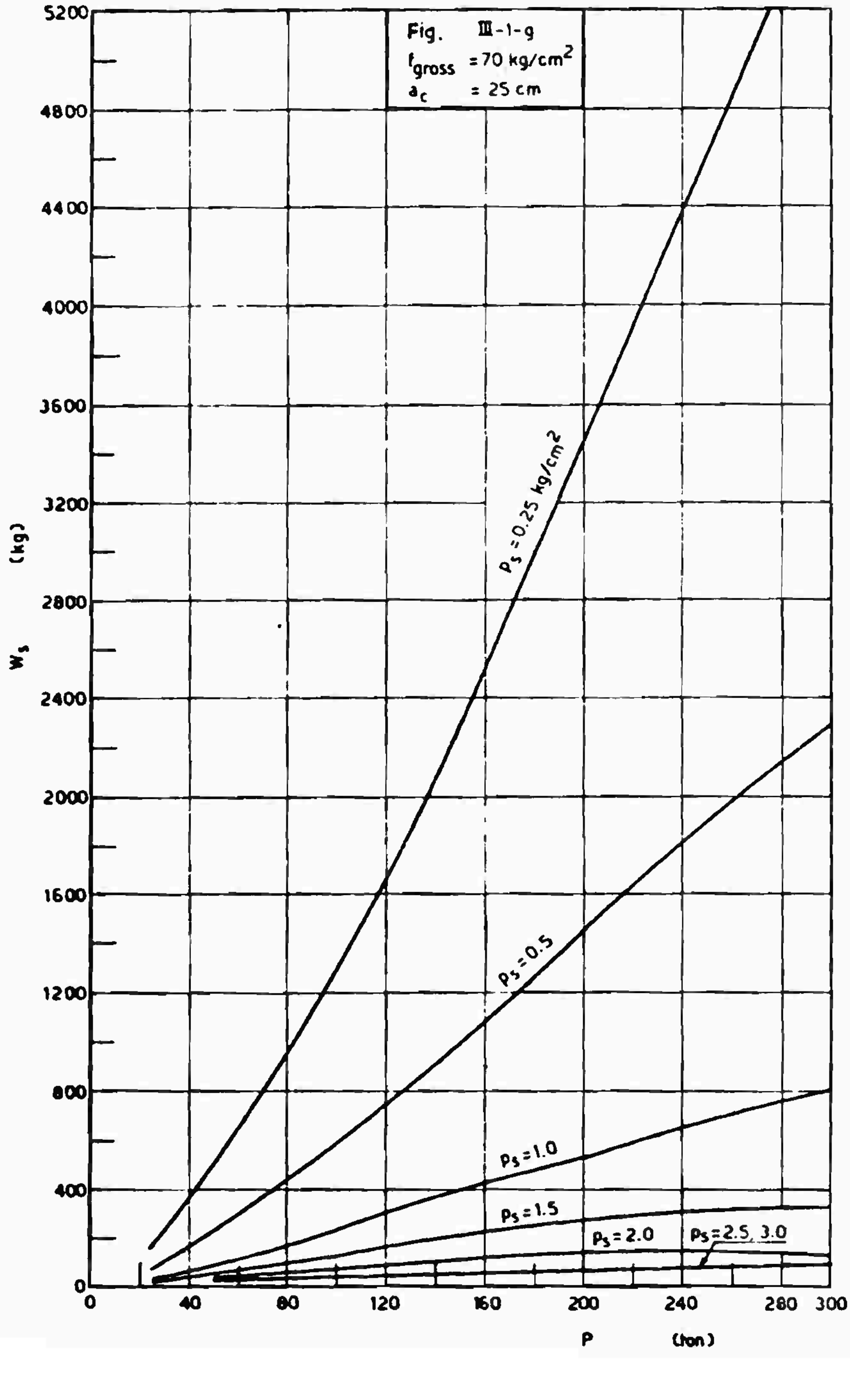


Fig. III-1-g
f_{gross} = 70 kg/cm²
a_c = 25 cm
p_s = 0.25 kg/cm²
p_s = 0.5
p_s = 1.0
p_s = 1.5
p_s = 2.0
p_s = 2.5, 3.0
W_s (kg)
P (ton)
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200
40
80
120
160
200
240
280
300

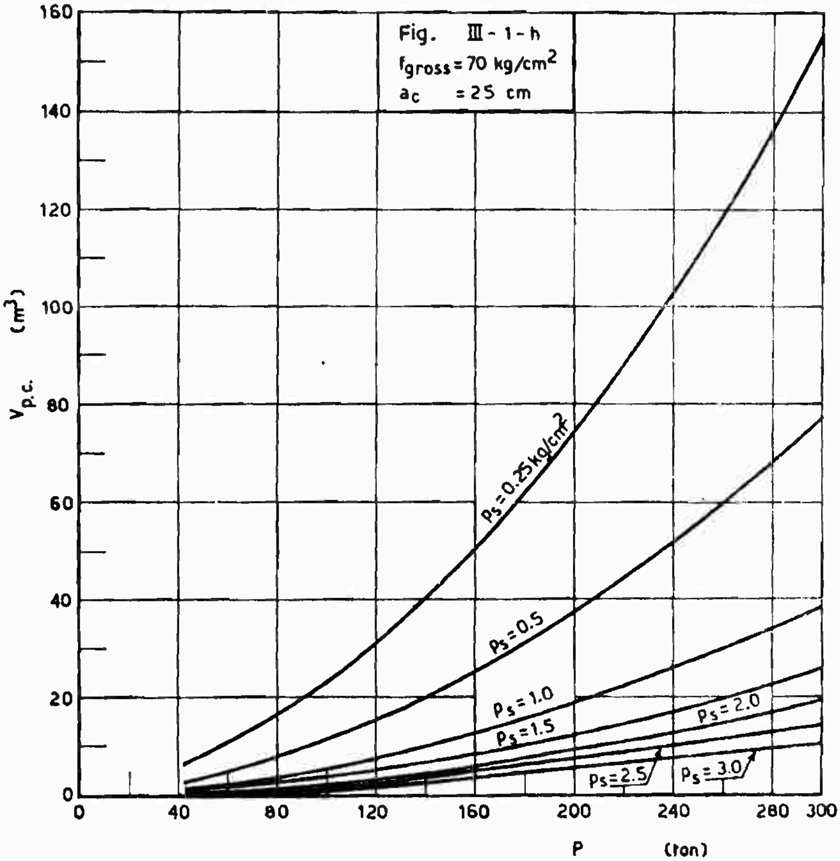


Fig. III - 1 - h
f gross = 70 kg/cm2
a c = 25 cm
Ps = 0.25 kg/cm2
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
V p.c. (m3)
P (ton)
0
20
40
60
80
100
120
140
160
0
40
80
120
160
200
240
280
300

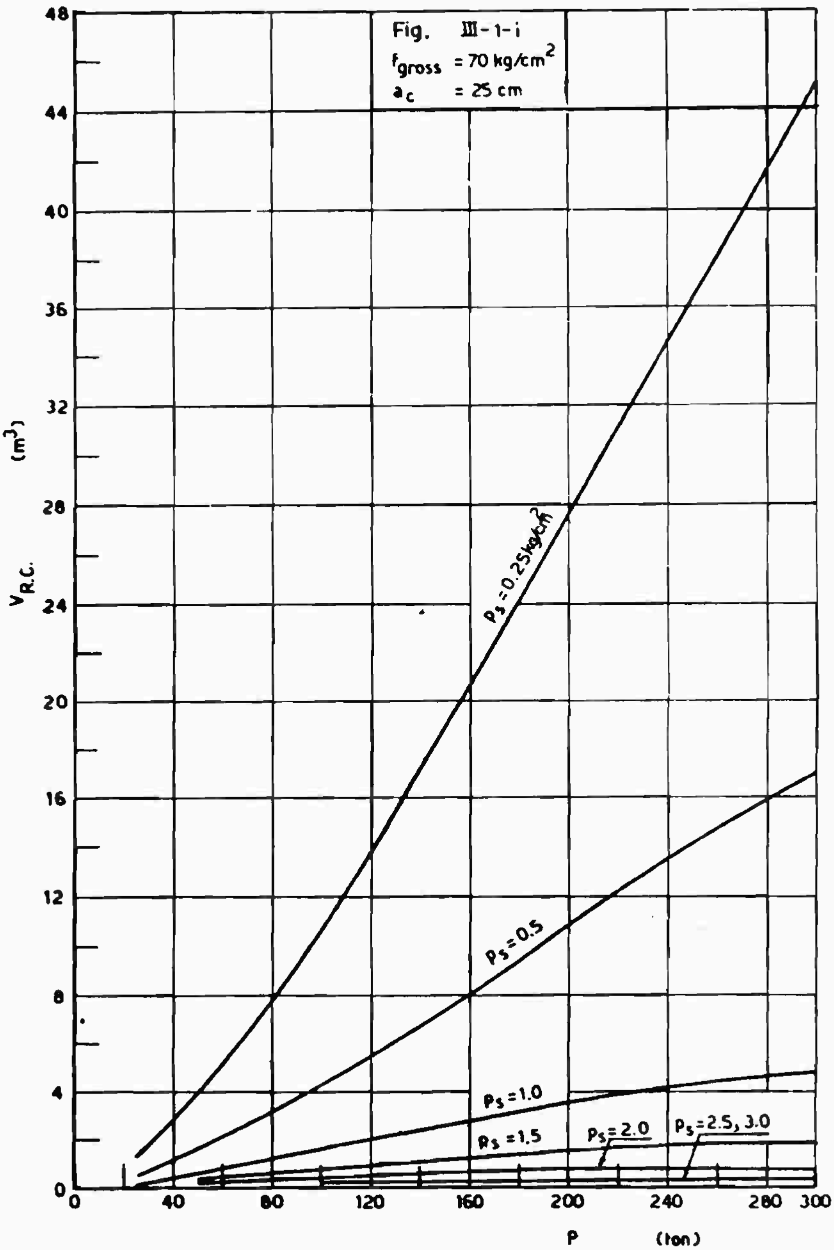


Fig. III-1-i
f_{gross} = 70 kg/cm²
a_c = 25 cm
$V_{R.C.}$ (m³)
P (ton)
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5, 3.0
0
4
8
12
16
20
24
28
32
36
40
44
48
40
80
120
160
200
240
280
300

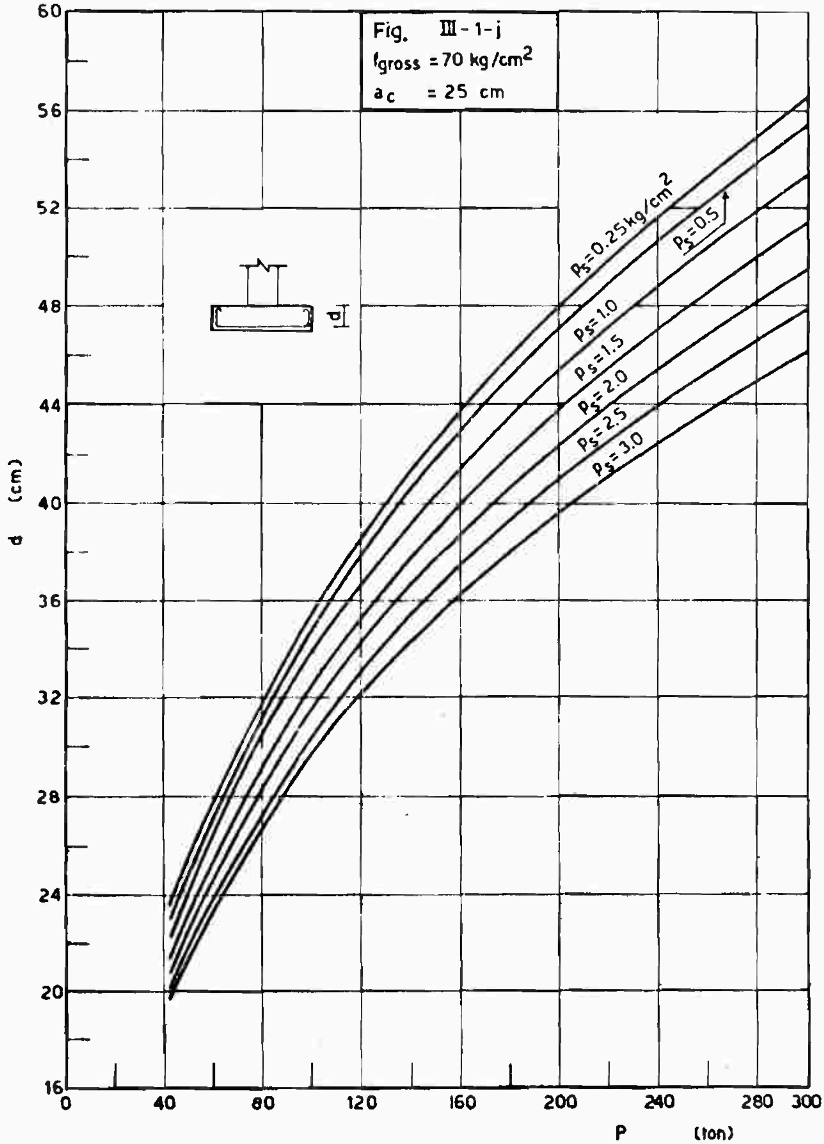


Fig. III - 1 - j
f_{gross} = 70 kg/cm²
a_c = 25 cm
d
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
d (cm)
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300
P (ton)

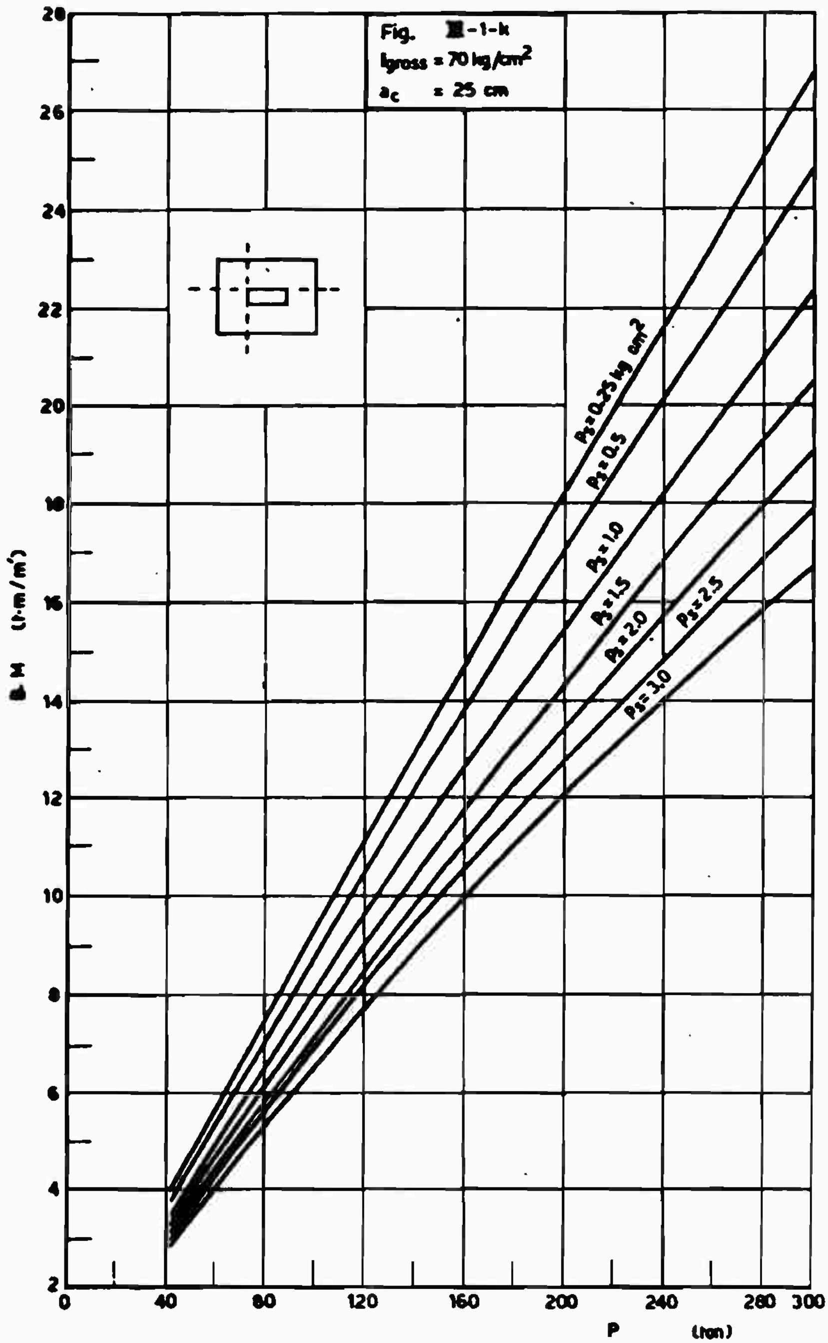


Fig. III-1-k
fgross = 70 kg/cm²
ac = 25 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
M (t·m/m')
P (ton)
0
40
80
120
160
200
240
280
300
2
4
6
8
10
12
14
16
18
20
22
24
26
28

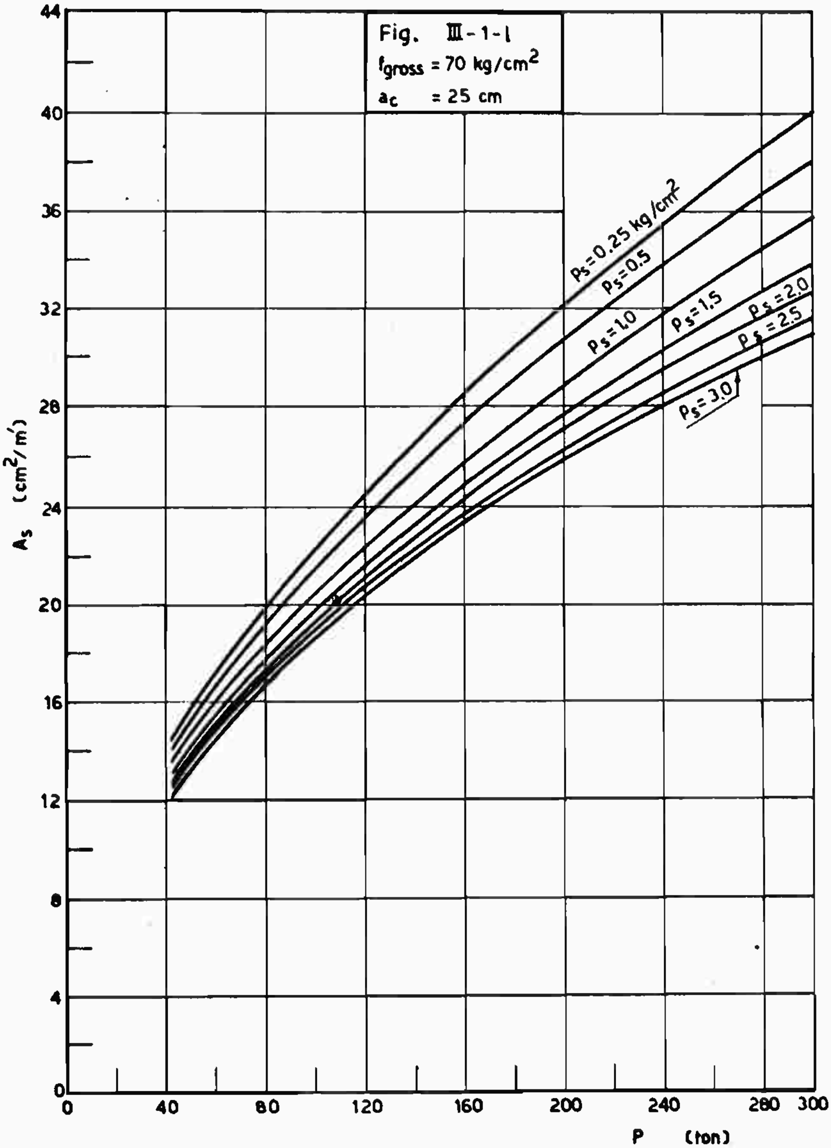


Fig. III-1-1
fgross = 70 kg/cm2
ac = 25 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
As (cm2/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
40
80
120
160
200
240
280
300

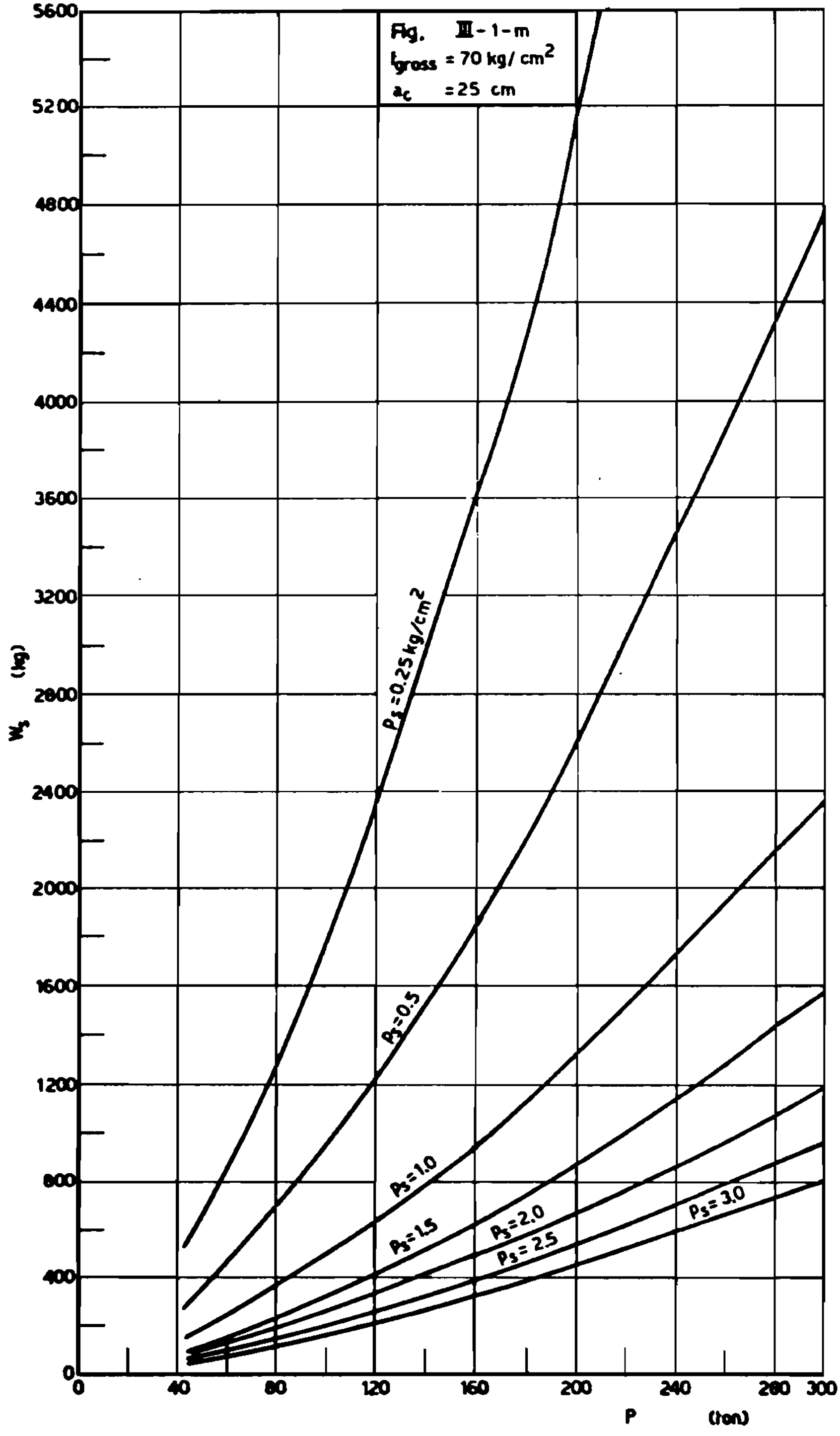


Fig. III-1-m
f_{gross} = 70 kg/cm²
a_c = 25 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
W_s (kg)
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200
5600
0
40
80
120
160
200
240
280
300
P (ton)

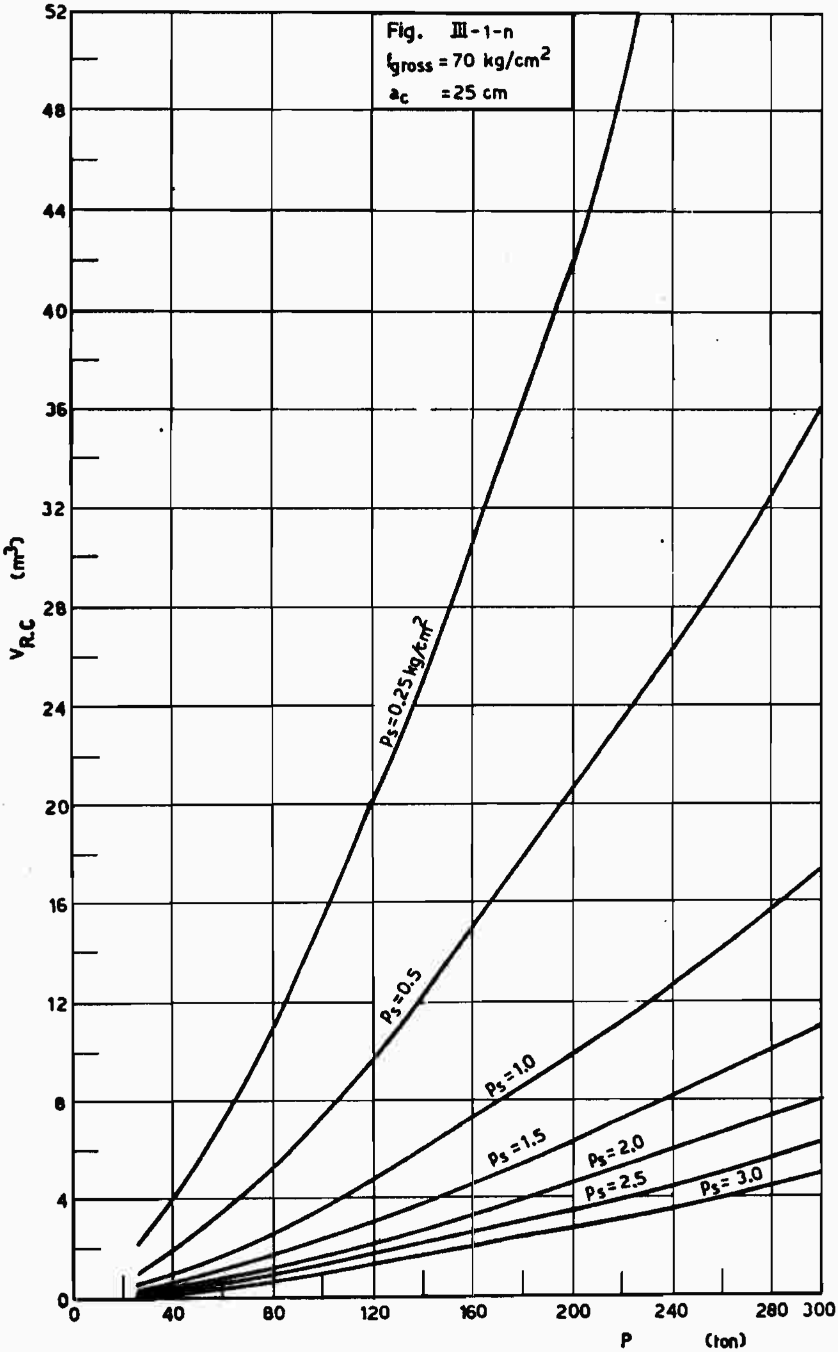


Fig. III-1-n
fgross = 70 kg/cm2
ac = 25 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
VR.C (m3)
0
4
8
12
16
20
24
28
32
36
40
44
48
52
0
40
80
120
160
200
240
280
300
P (ton)

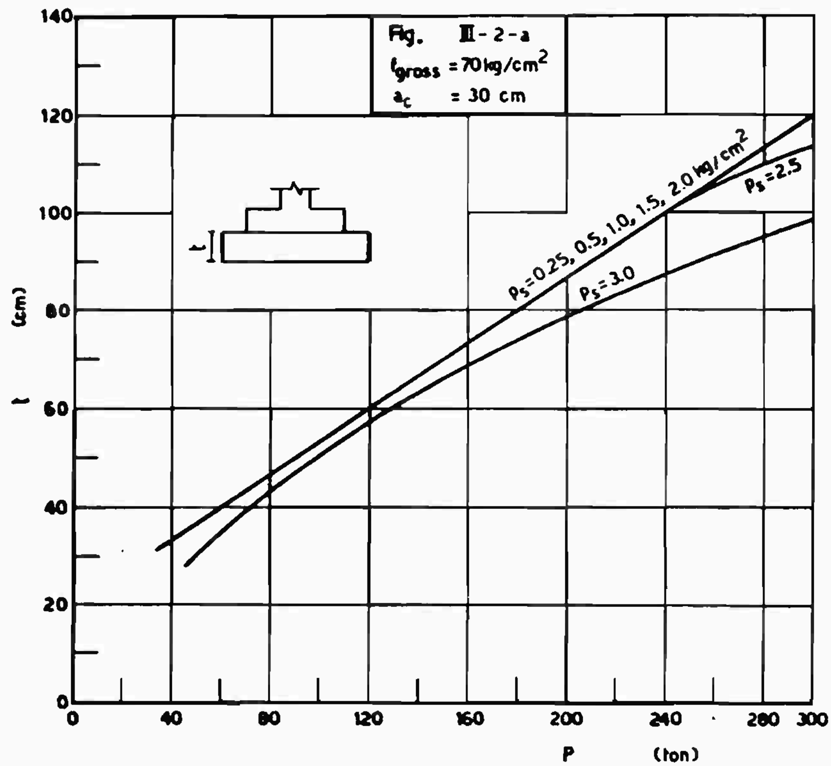


Fig. III-2-a
f_{gross} = 70 kg/cm^2
a_c = 30 cm
P_s = 0.25, 0.5, 1.0, 1.5, 2.0 kg/cm^2
P_s = 2.5
P_s = 3.0
t (cm)
P (ton)
0
20
40
60
80
100
120
140
160
200
240
280
300
t

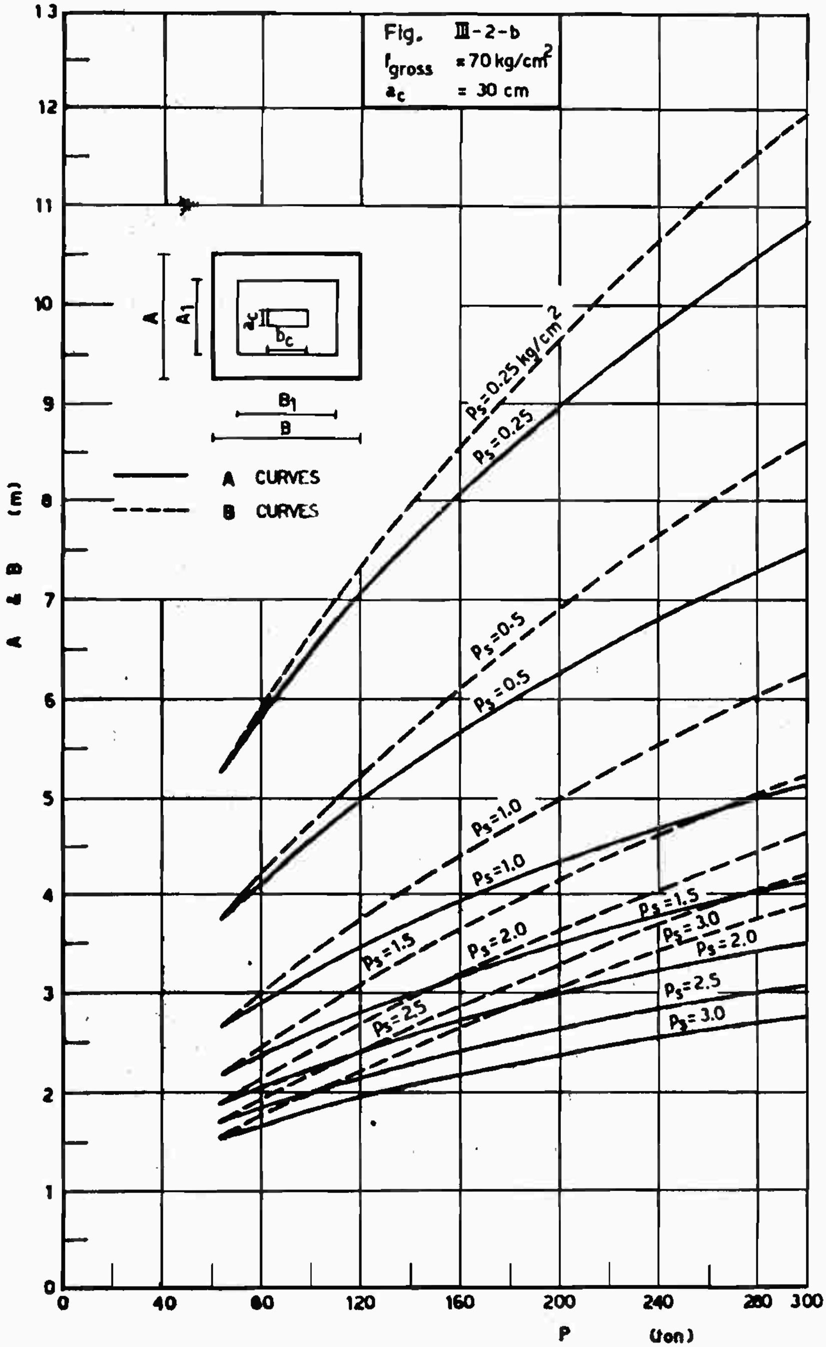


Fig. III-2-b
f gross = 70 kg/cm2
a c = 30 cm
A
A1
ac
bc
B1
B
A CURVES
B CURVES
Ps=0.25 kg/cm2
Ps=0.25
Ps=0.5
Ps=0.5
Ps=1.0
Ps=1.0
Ps=1.5
Ps=1.5
Ps=2.0
Ps=2.0
Ps=2.5
Ps=2.5
Ps=3.0
Ps=3.0
A & B (m)
P (ton)
0 1 2 3 4 5 6 7 8 9 10 11 12 13
0 40 80 120 160 200 240 280 300

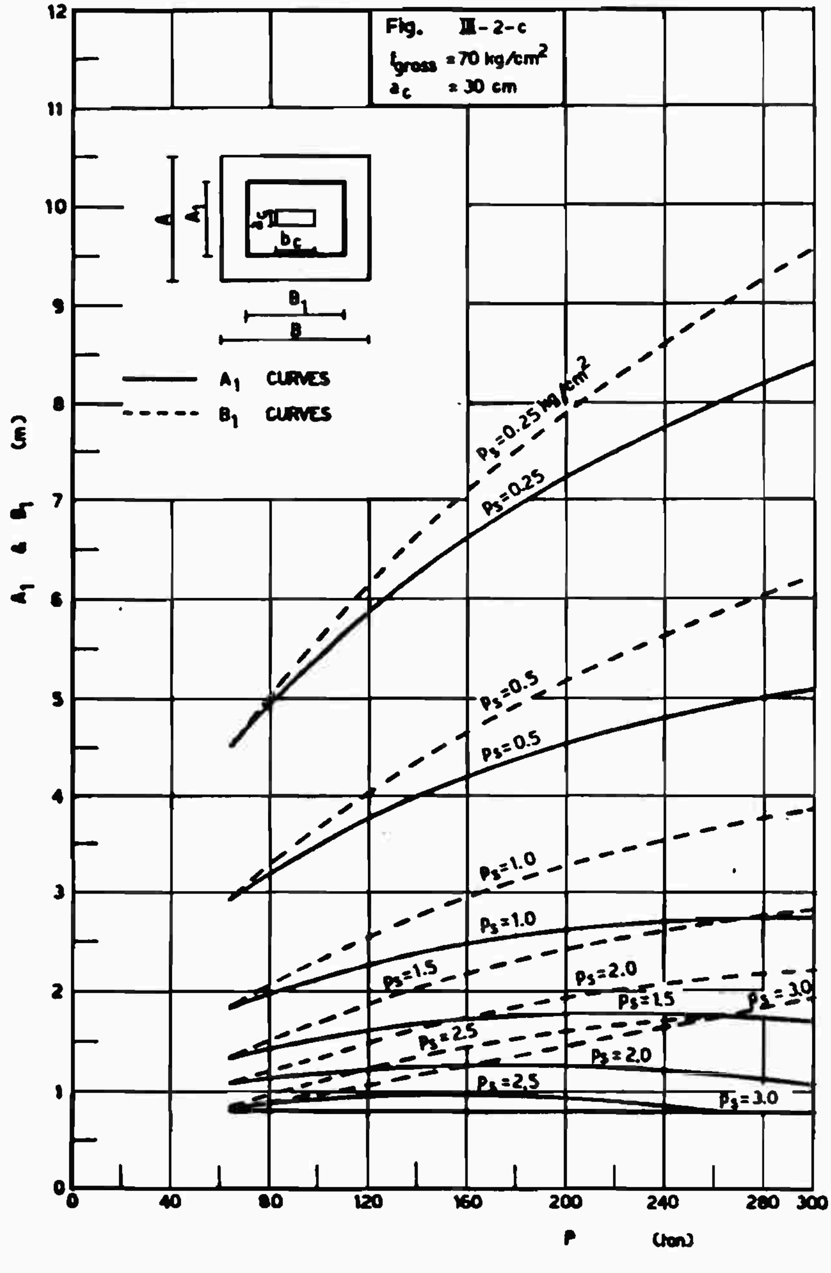


Fig. III-2-c
f_{gross} = 70 kg/cm²
a_c = 30 cm
A
A_1
a_c
b_c
B_1
B
A_1 CURVES
B_1 CURVES
P_s=0.25 kg/cm²
P_s=0.25
P_s=0.5
P_s=0.5
P_s=1.0
P_s=1.0
P_s=1.5
P_s=2.0
P_s=1.5
P_s=3.0
P_s=2.5
P_s=2.0
P_s=2.5
P_s=3.0
A_1 & B_1 (m.)
P (ton)
0 1 2 3 4 5 6 7 8 9 10 11 12
0 40 80 120 160 200 240 280 300

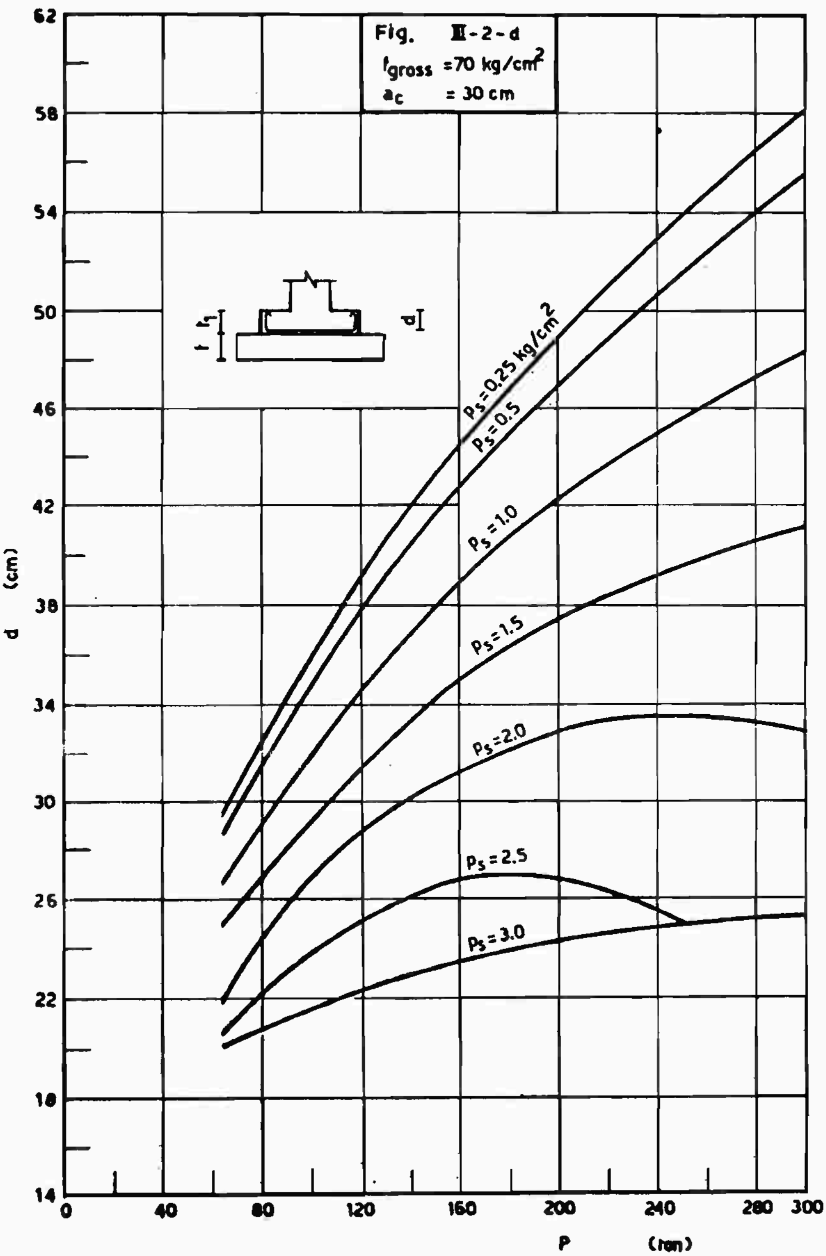


Fig. III-2-d
f_{gross} = 70 kg/cm^2
a_c = 30 cm
P_s=0.25 kg/cm^2
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
d (cm)
P (ton)
62
58
54
50
46
42
38
34
30
26
22
18
14
0
40
80
120
160
200
240
280
300

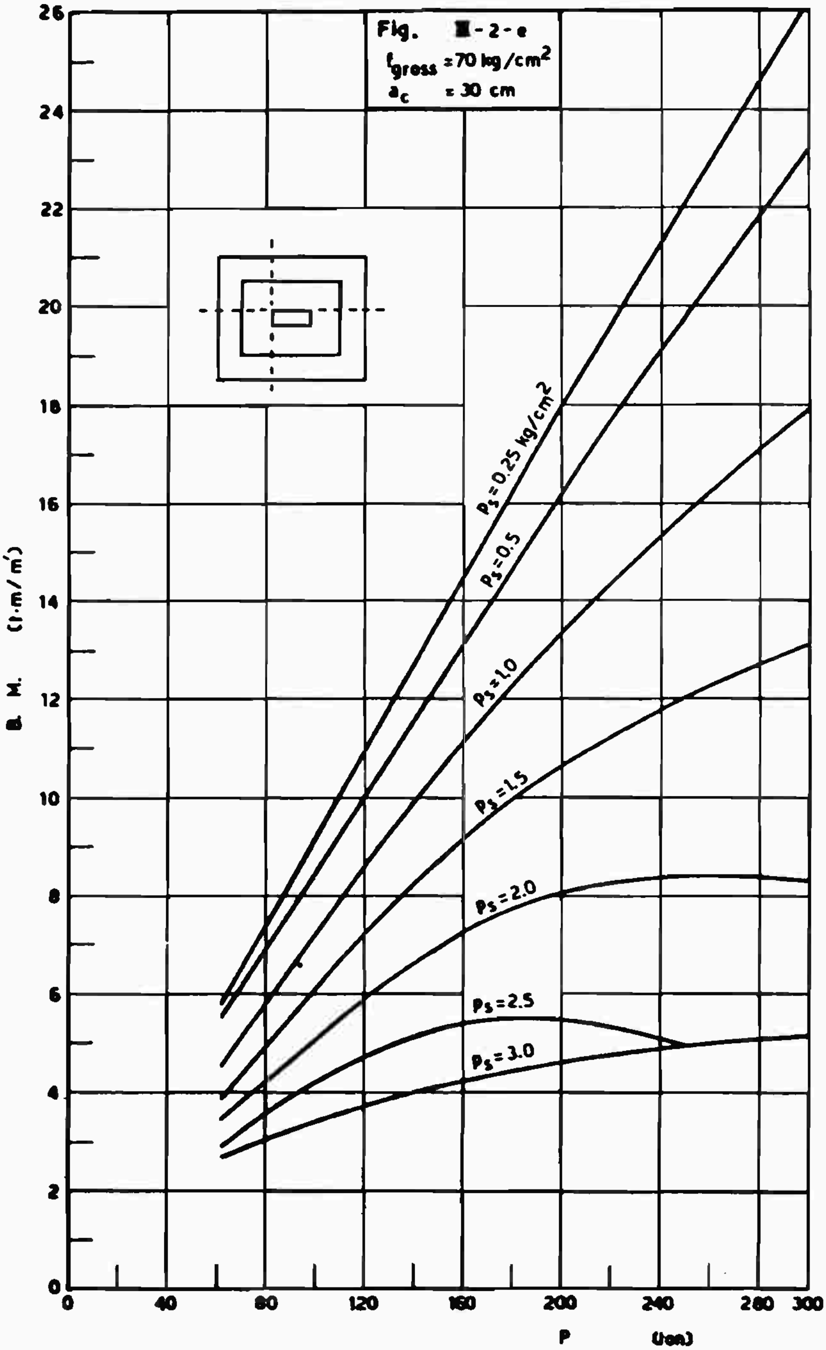


Fig. III - 2 - e
f_{gross} = 70 kg/cm²
a_c = 30 cm
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
B. M. (t.m/m')
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
40
80
120
160
200
240
280
300

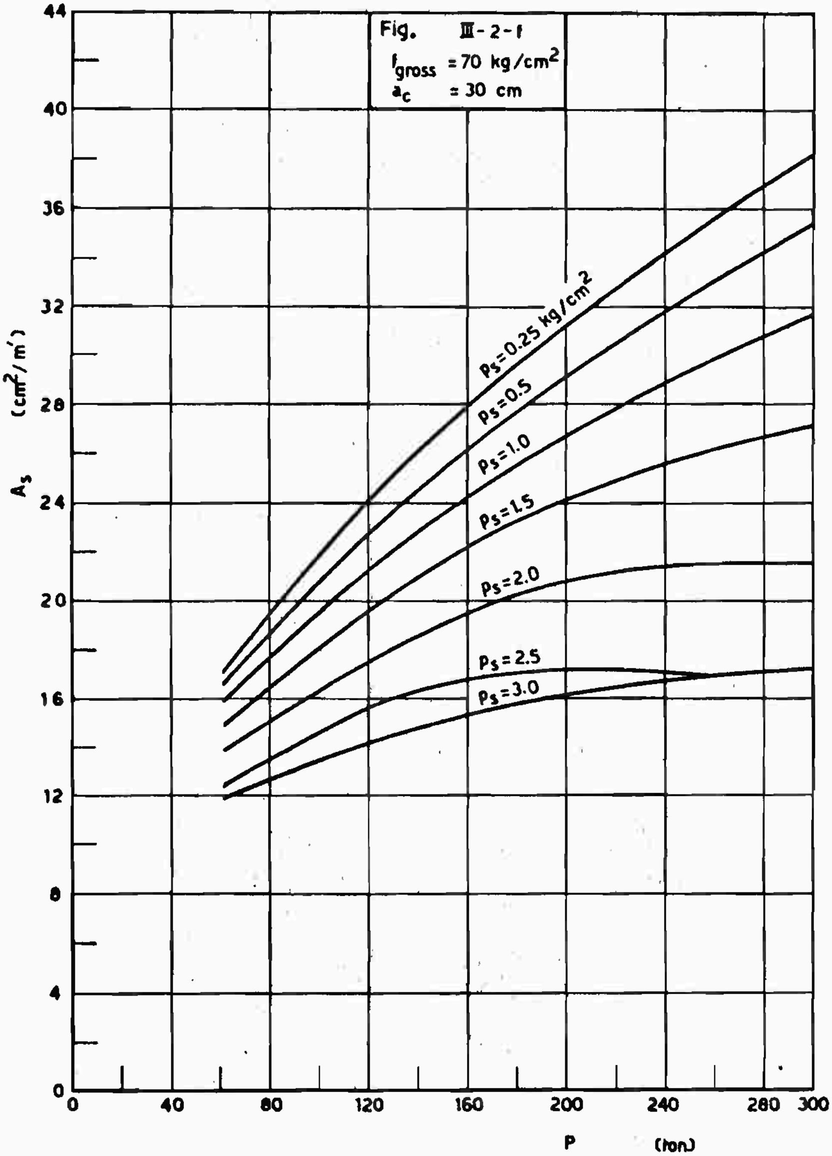


Fig. III-2-f
f_{gross} = 70 kg/cm²
a_c = 30 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
A_s (cm²/m')
44
40
36
32
28
24
20
16
12
8
4
0
0
40
80
120
160
200
240
280
300
P (ton)

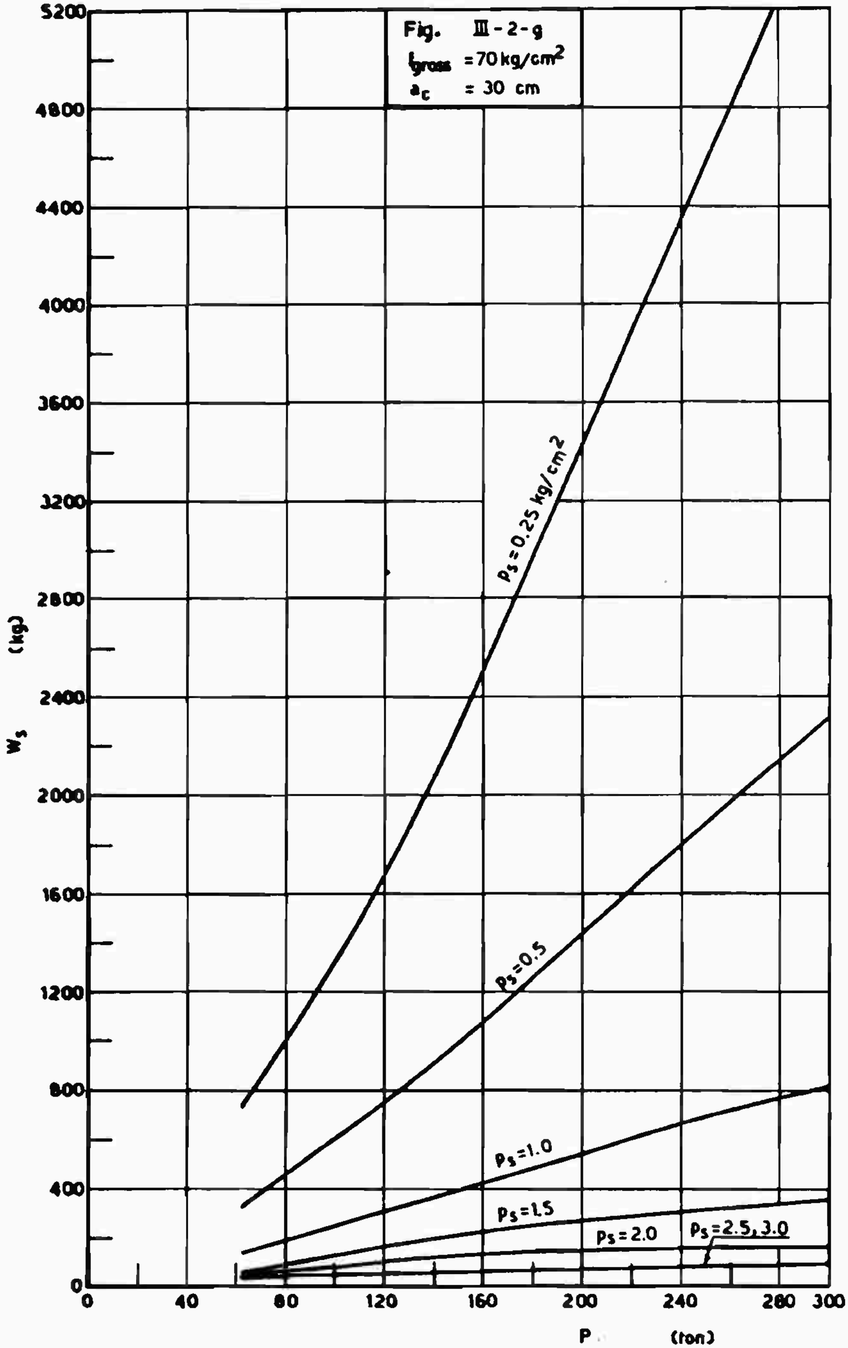


Fig. III - 2 - g
f_{gross} = 70 kg/cm²
a_c = 30 cm
p_s = 0.25 kg/cm²
p_s=0.5
p_s=1.0
p_s=1.5
p_s = 2.0
p_s = 2.5, 3.0
W_s (kg)
P (ton)
0
40
80
120
160
200
240
280
300
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200

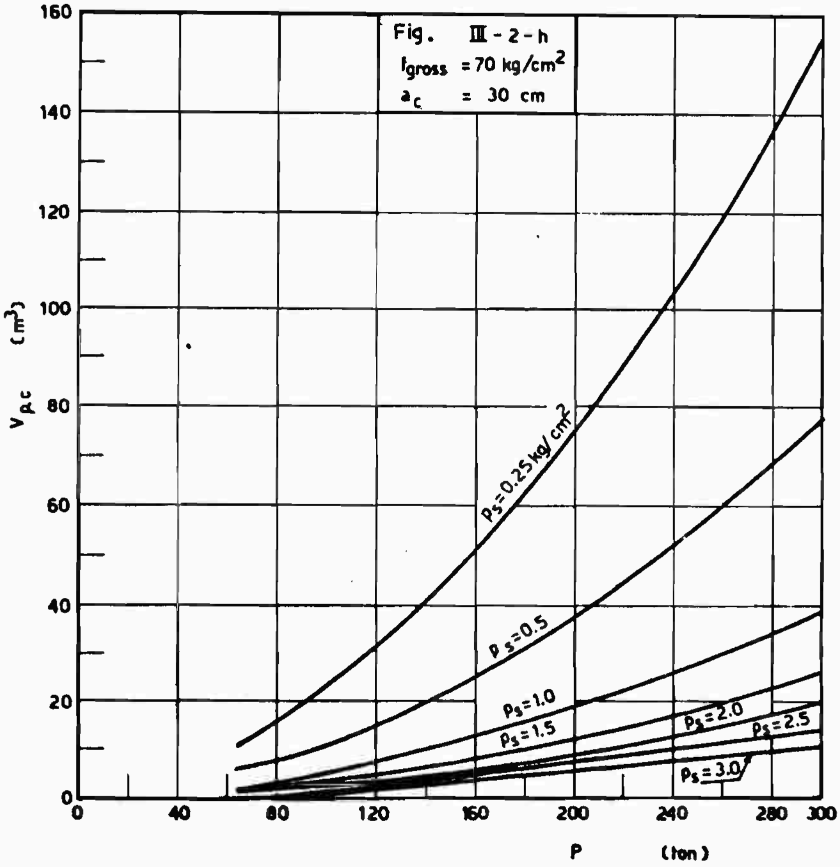


Fig. III - 2 - h
f gross = 70 kg/cm2
a c = 30 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
V p.c (m3)
P (ton)
0
20
40
60
80
100
120
140
160
200
240
280
300

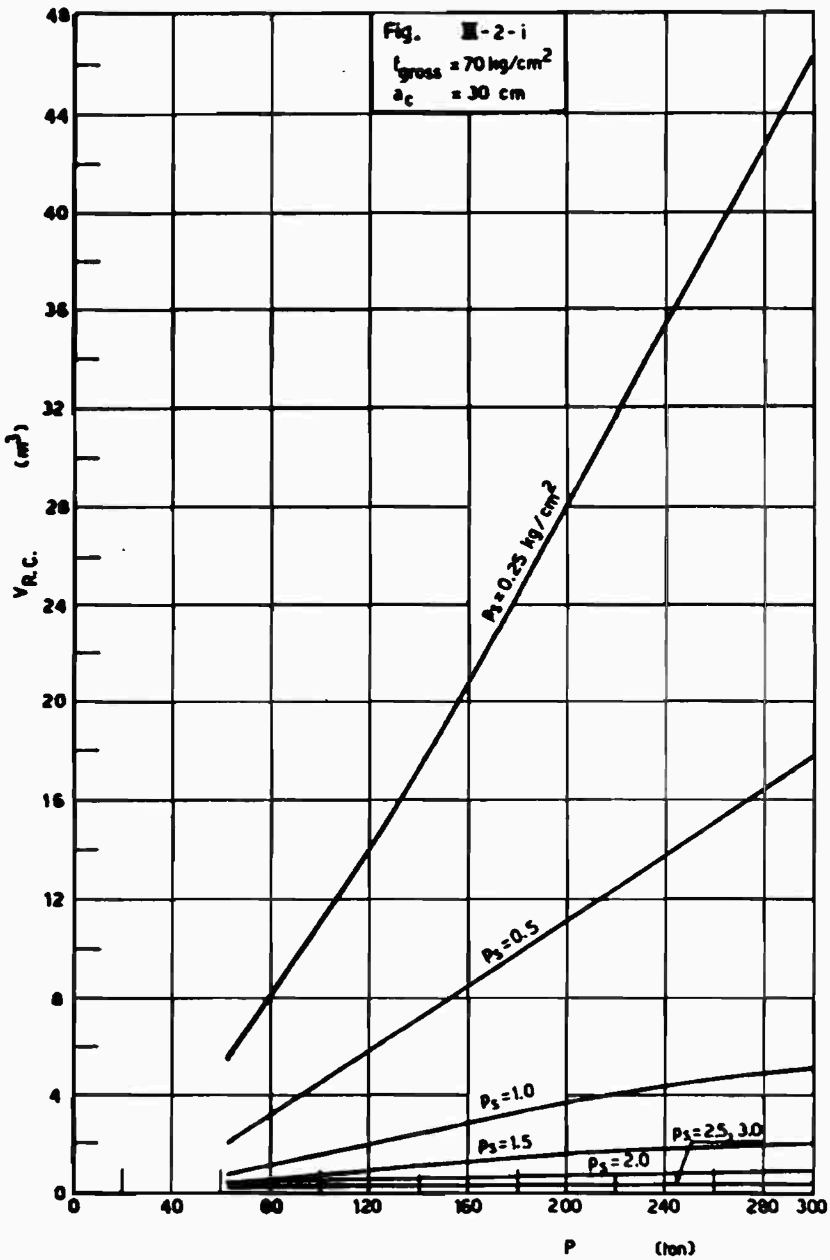


Fig. III-2-i
f_{gross} = 70 kg/cm^2
a_c = 30 cm
p_s = 0.25 kg/cm^2
p_s = 0.5
p_s = 1.0
p_s = 1.5
p_s = 2.0
p_s = 2.5, 3.0
$V_{R.C.}$ (m^3)
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
48
0
40
80
120
160
200
240
280
300

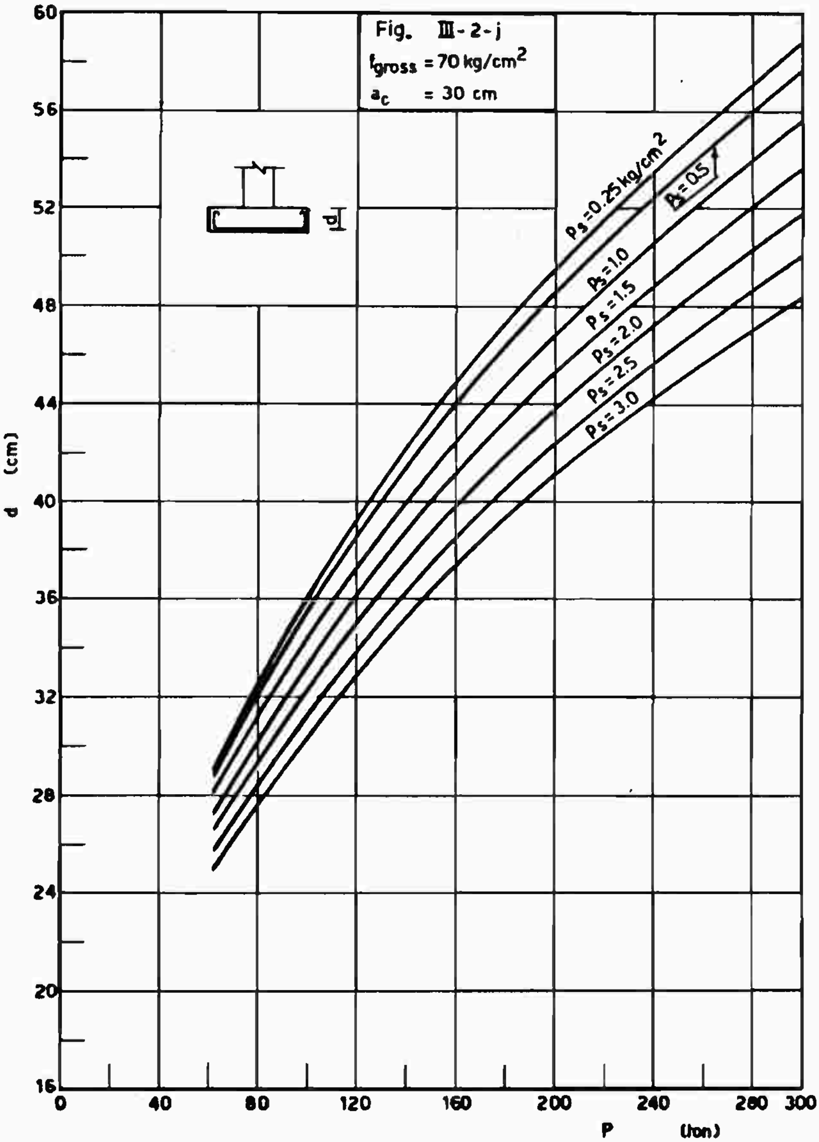


Fig. III-2-j
f_{gross} = 70 kg/cm^2
a_c = 30 cm
d
Ps=0.25 kg/cm^2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
60
56
52
48
44
40
36
32
28
24
20
16
d (cm)
0
40
80
120
160
200
240
280
300
P (ton)

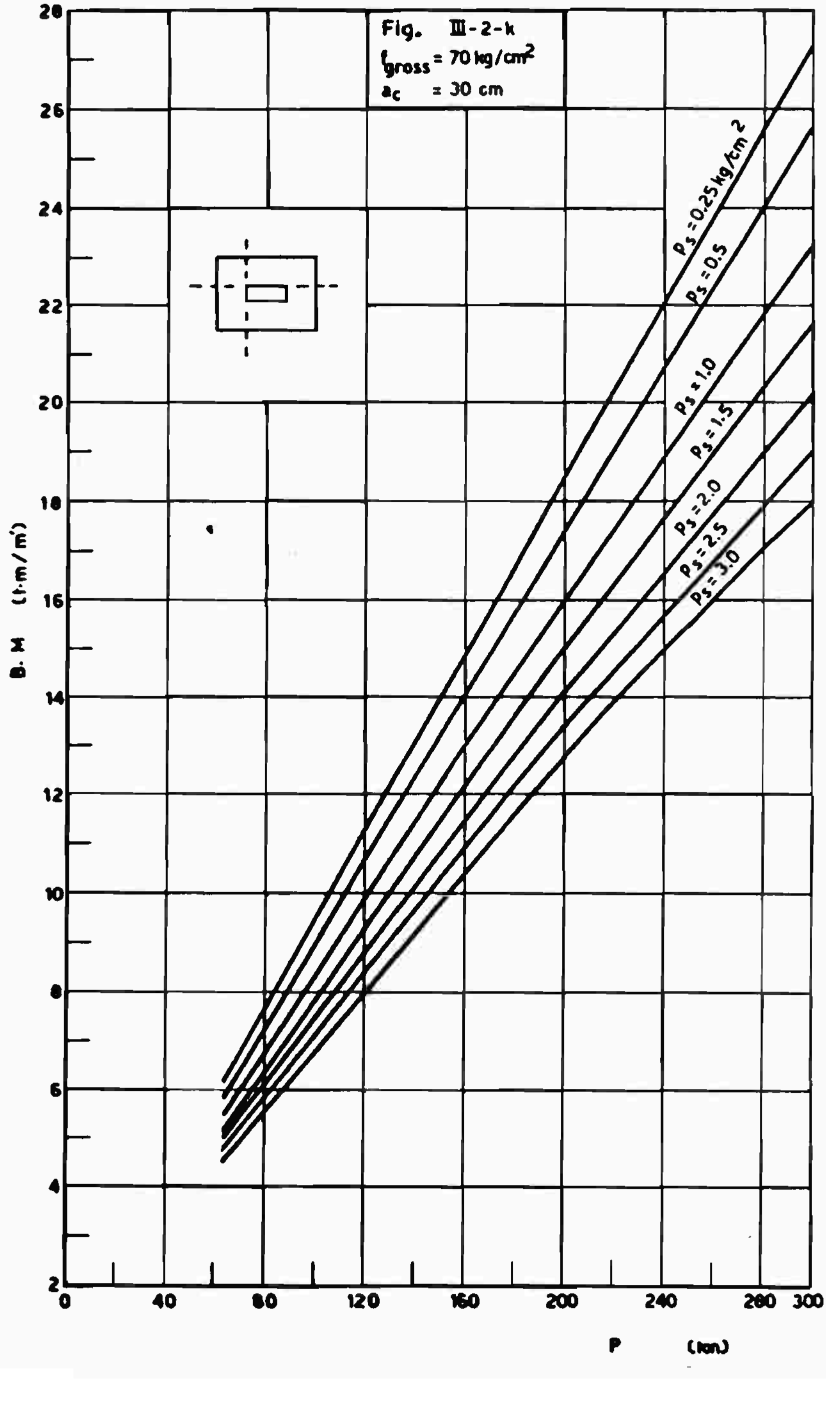


Fig. III-2-k
f_{gross} = 70 kg/cm²
a_c = 30 cm
Ps = 0.25 kg/cm 2
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
B. M (t·m/m')
P (ton.)
0
40
80
120
160
200
240
280
300
2
4
6
8
10
12
14
16
18
20
22
24
26
28

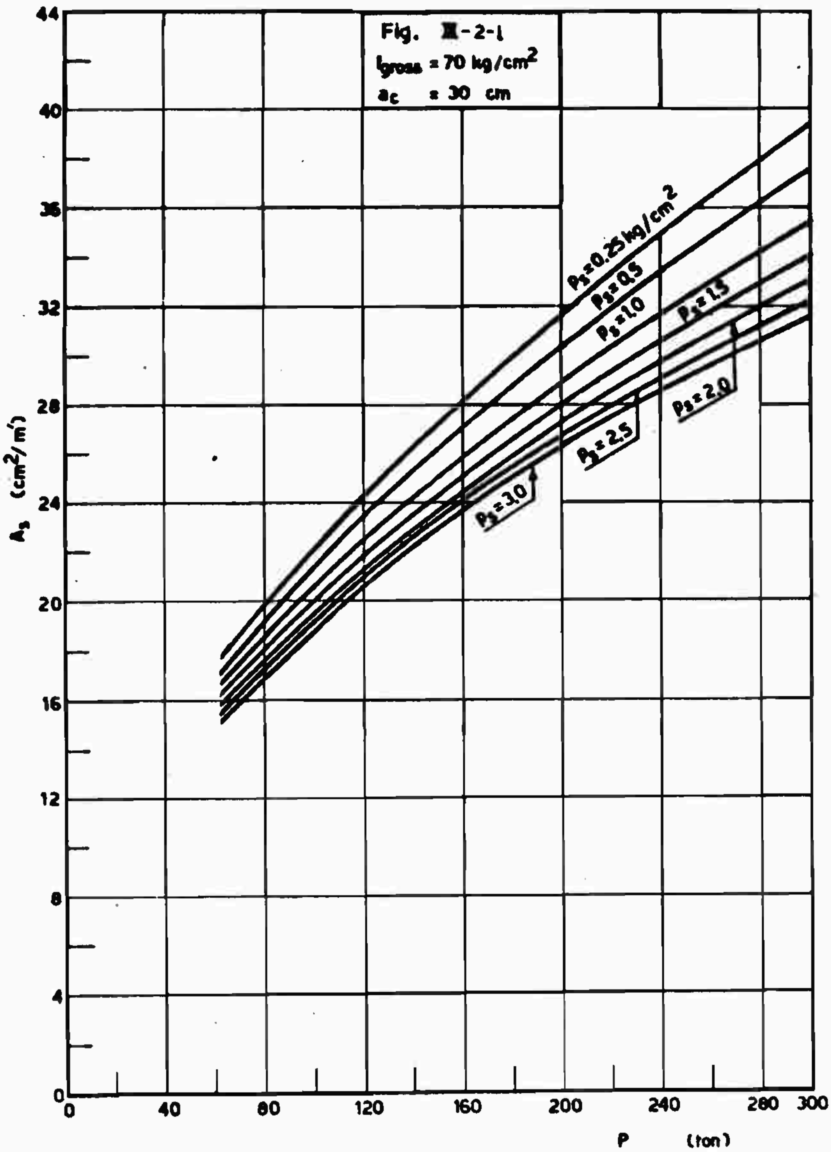


Fig. III-2-1
f_{gross} = 70 kg/cm²
a_c = 30 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
A_s (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
0
40
80
120
160
200
240
280
300

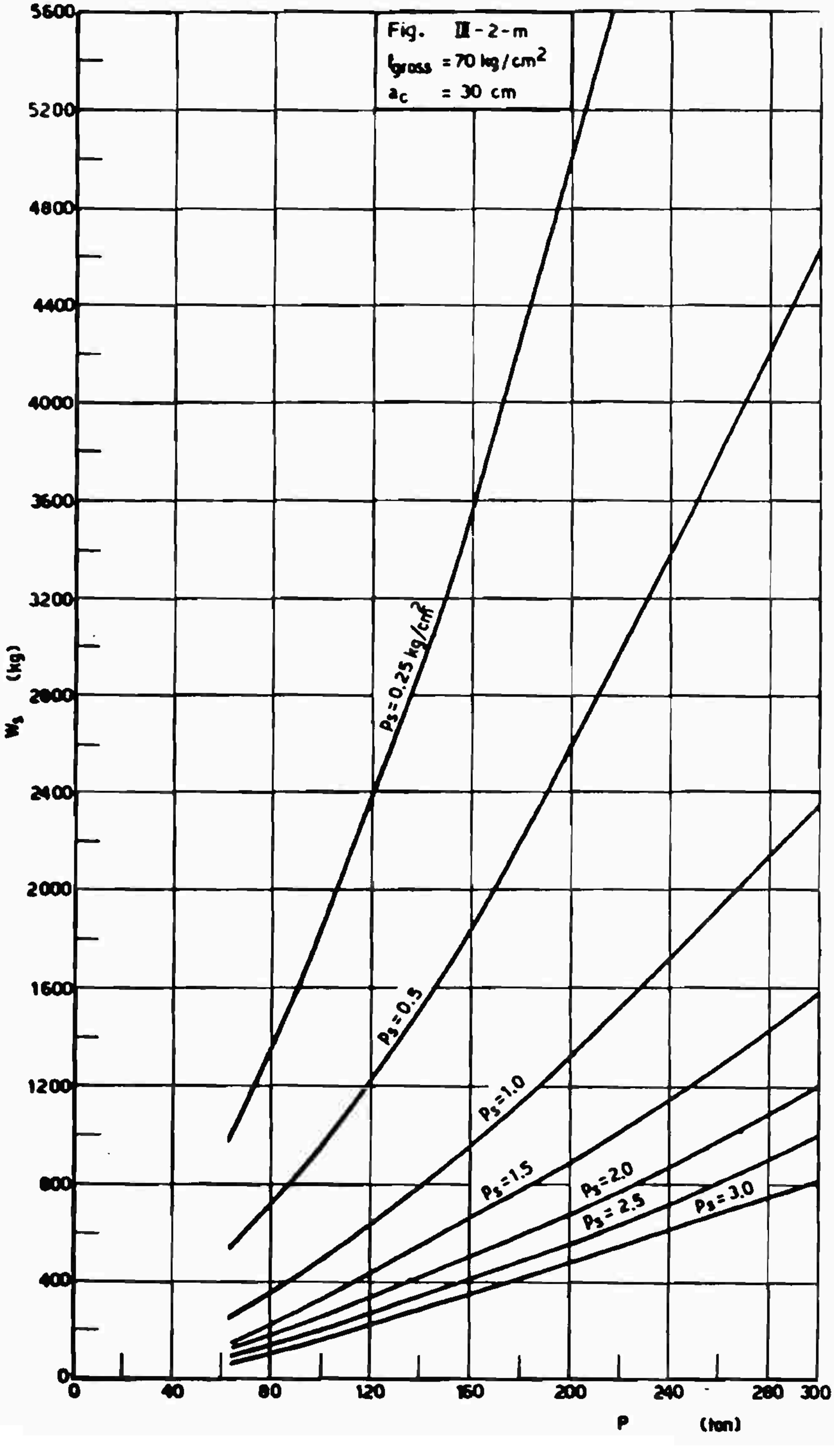


Fig. II-2-m
f_{gross} = 70 kg/cm²
a_c = 30 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
Ws (kg)
P (ton)
0
40
80
120
160
200
240
280
300
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200
5600

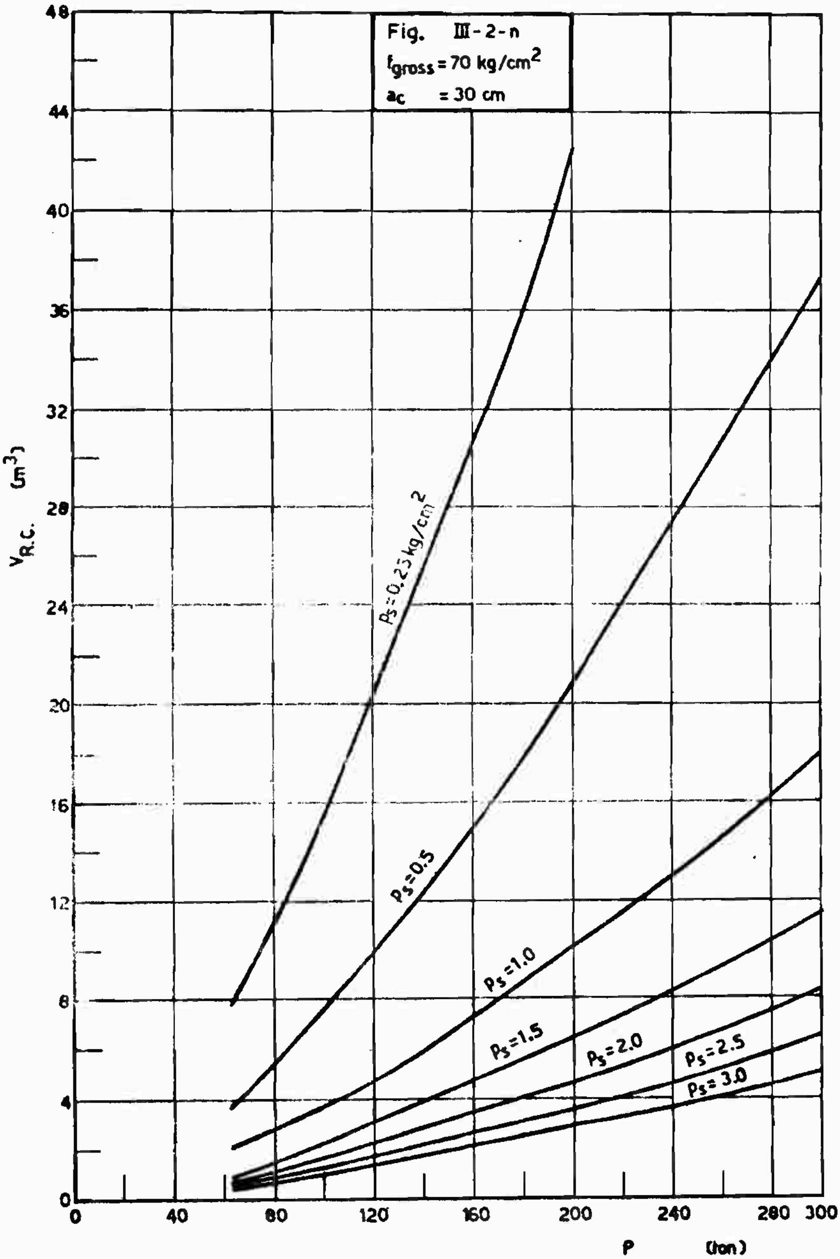


Fig. III-2-n
f_{gross} = 70 kg/cm²
a_c = 30 cm
$V_{R.C.}$ (m³)
0
4
8
12
16
20
24
28
32
36
40
44
48
0
40
80
120
160
200
240
280
300
P (ton)
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0

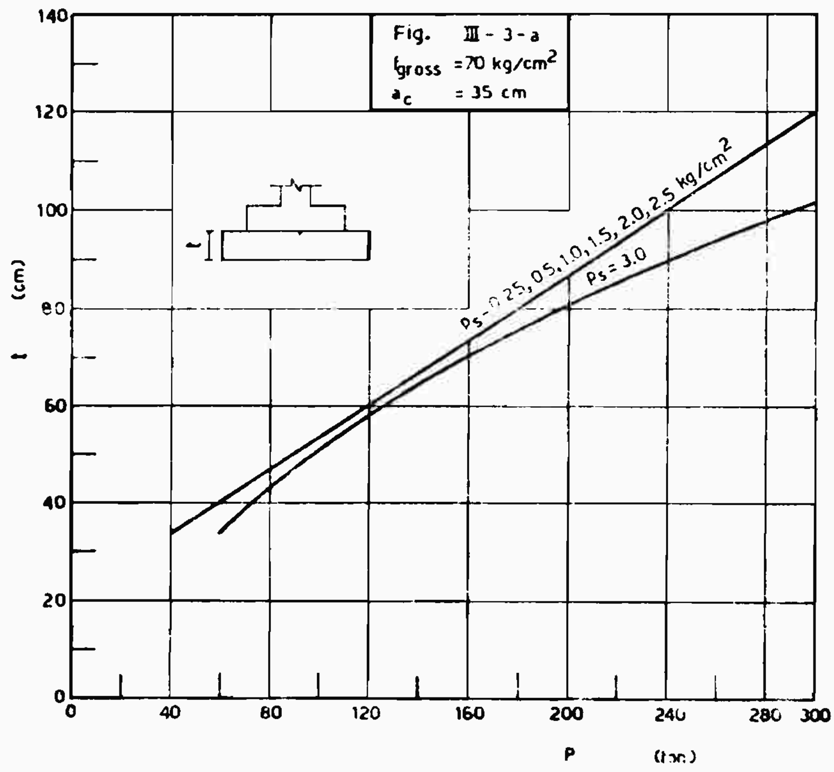


Fig. III - 3 - a
f_{gross} =70 kg/cm²
a_c = 35 cm
Ps=0.25, 0.5, 1.0, 1.5, 2.0, 2.5 kg/cm²
Ps= 3.0
t (cm)
P (ton)

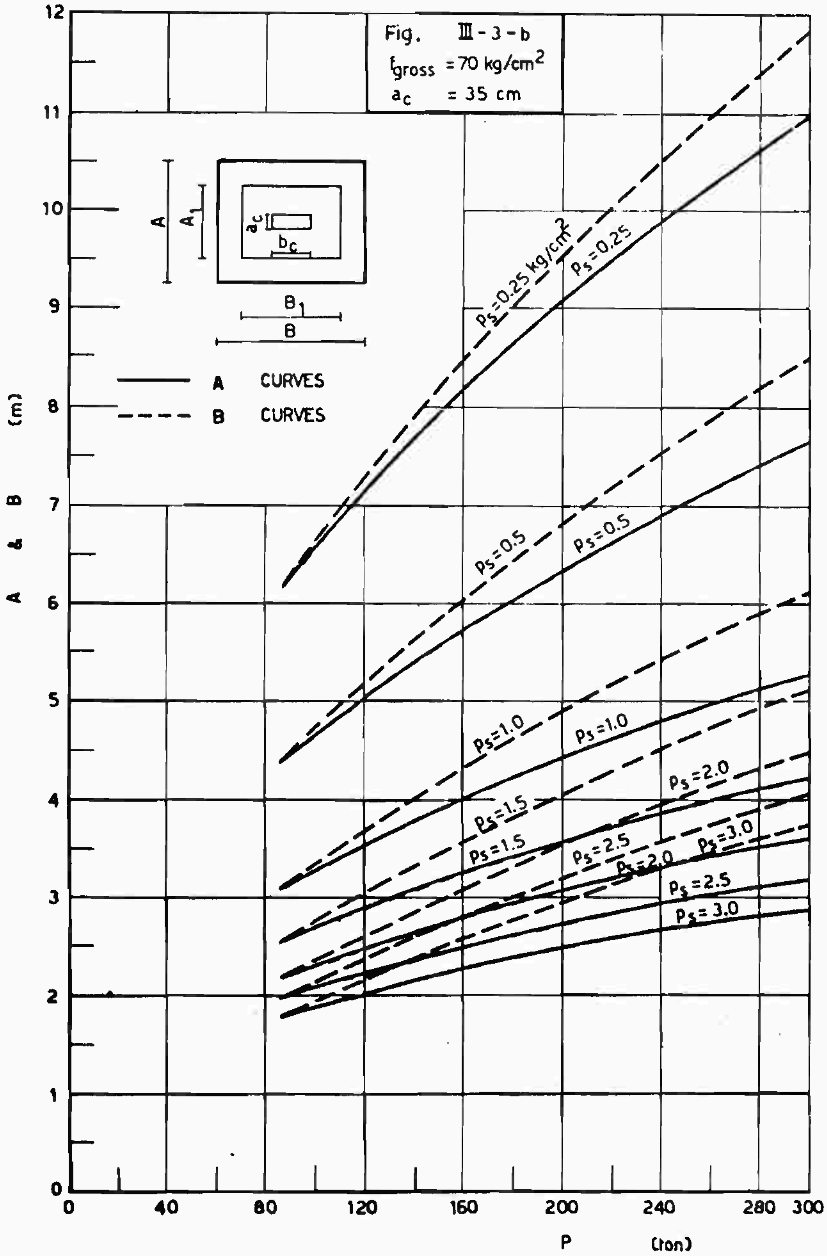


Fig. III - 3 - b
f_{gross} = 70 kg/cm²
a_c = 35 cm
A
A_1
a_c
b_c
B_1
B
A CURVES
B CURVES
Ps=0.25 kg/cm²
Ps=0.25
Ps=0.5
Ps=0.5
Ps=1.0
Ps=1.0
Ps=1.5
Ps=1.5
Ps=2.0
Ps=2.5
Ps=2.0
Ps=3.0
Ps=2.5
Ps=3.0
A & B (m)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
280
300

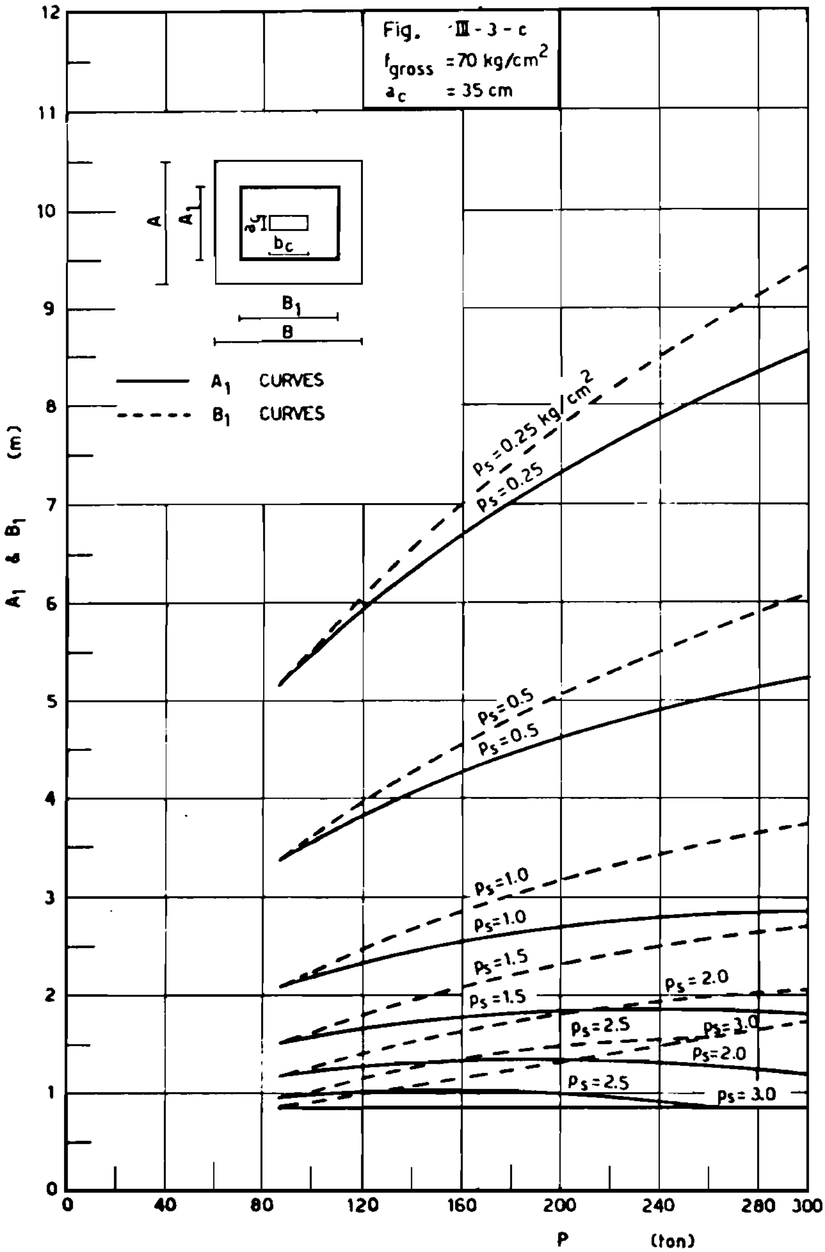


Fig. III - 3 - c
f_{gross} = 70 kg/cm²
a_c = 35 cm
A
A_1
a_c
b_c
B_1
B
A_1 CURVES
B_1 CURVES
p_s = 0.25 kg/cm²
p_s = 0.25
p_s = 0.5
p_s = 0.5
p_s = 1.0
p_s = 1.0
p_s = 1.5
p_s = 1.5
p_s = 2.0
p_s = 2.5
p_s = 3.0
p_s = 2.0
p_s = 2.5
p_s = 3.0
A_1 & B_1 (m)
P (ton)
0
40
80
120
160
200
240
280
300
1
2
3
4
5
6
7
8
9
10
11
12

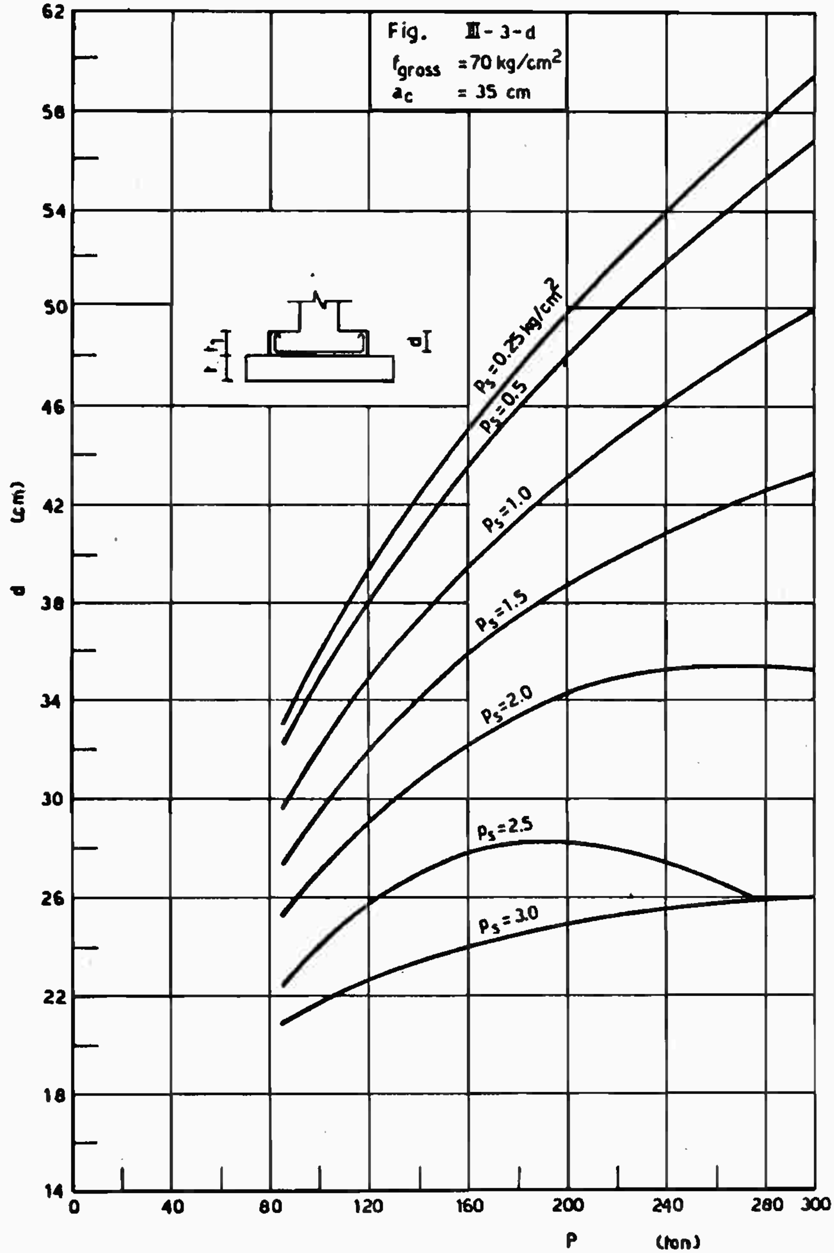


Fig. III - 3 - d
f_{gross} = 70 kg/cm²
a_c = 35 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
d
t
d (cm)
62
58
54
50
46
42
38
34
30
26
22
18
14
0
40
80
120
160
200
240
280
300
P (ton)

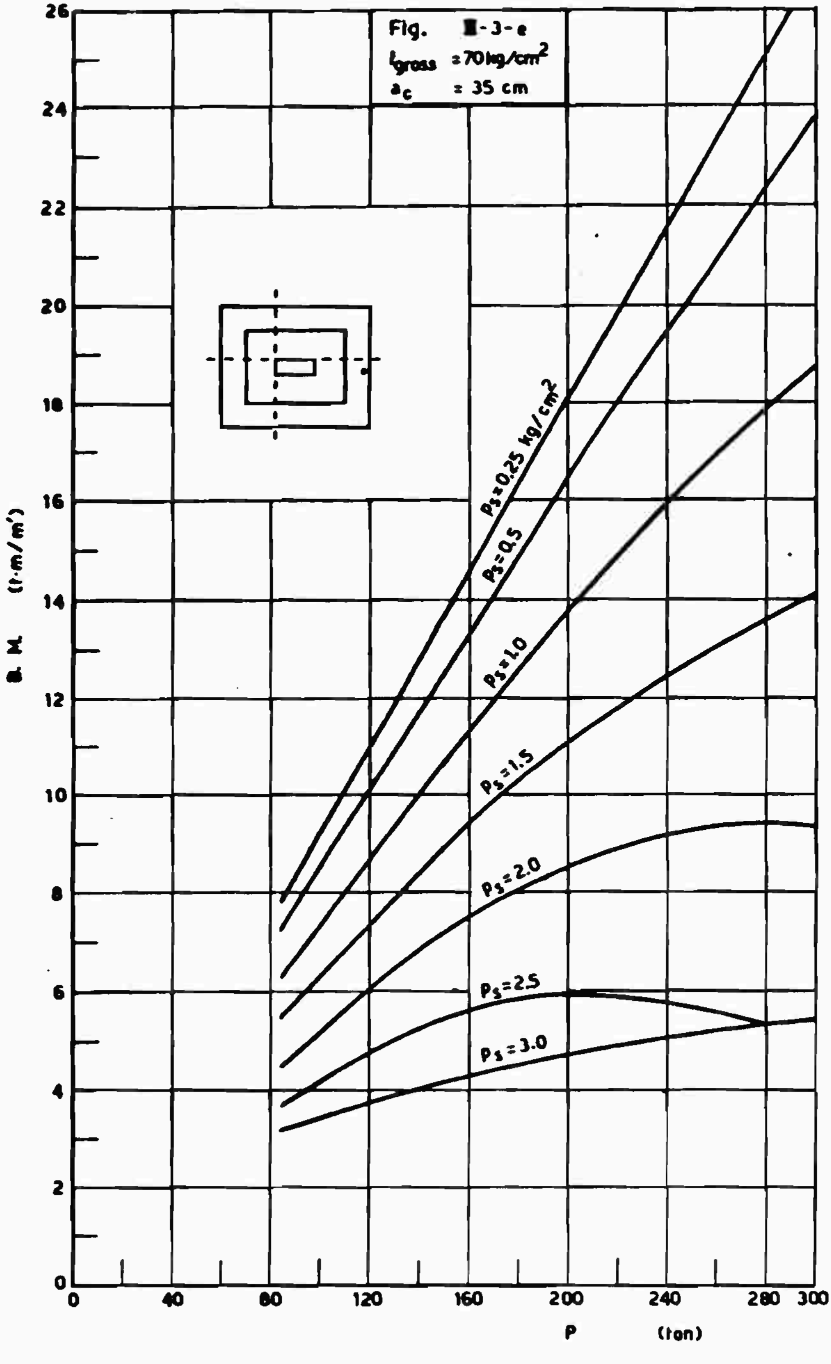


Fig. Ⅲ-3-e
f_{gross} = 70 kg/cm²
a_c = 35 cm
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
B. M. (t·m/m')
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
40
80
120
160
200
240
280
300

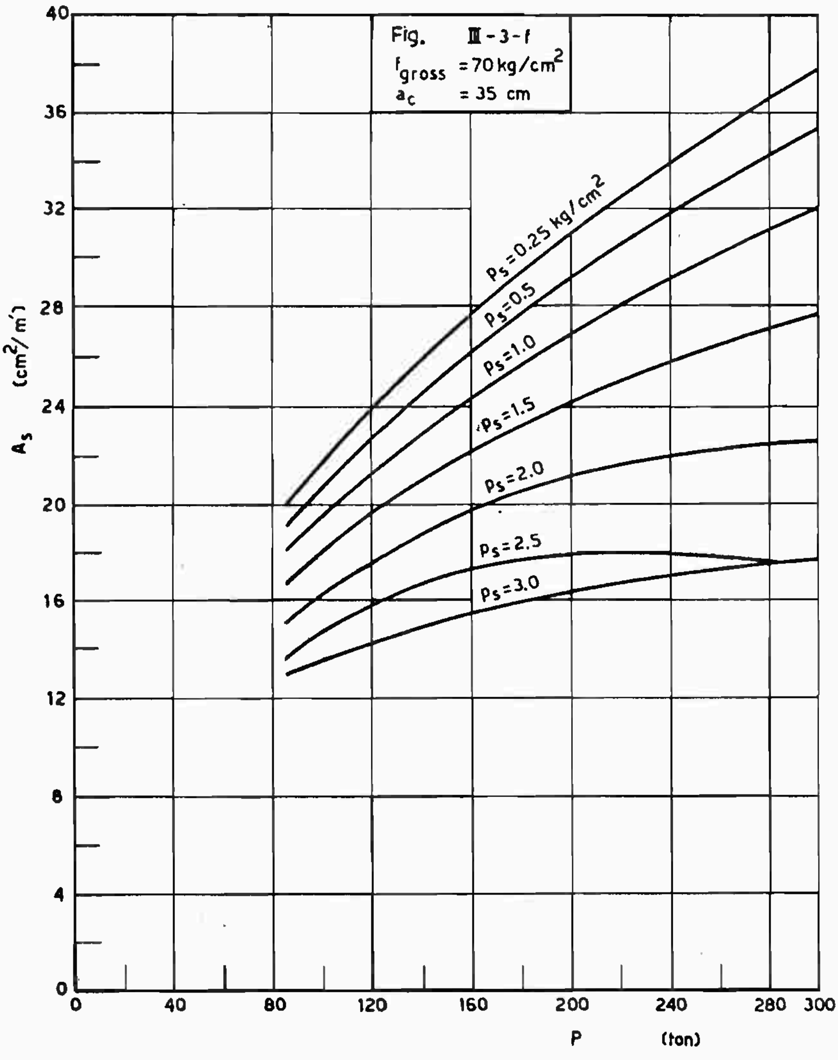


Fig. III-3-f
f gross = 70 kg/cm2
a c = 35 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
As (cm2/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300

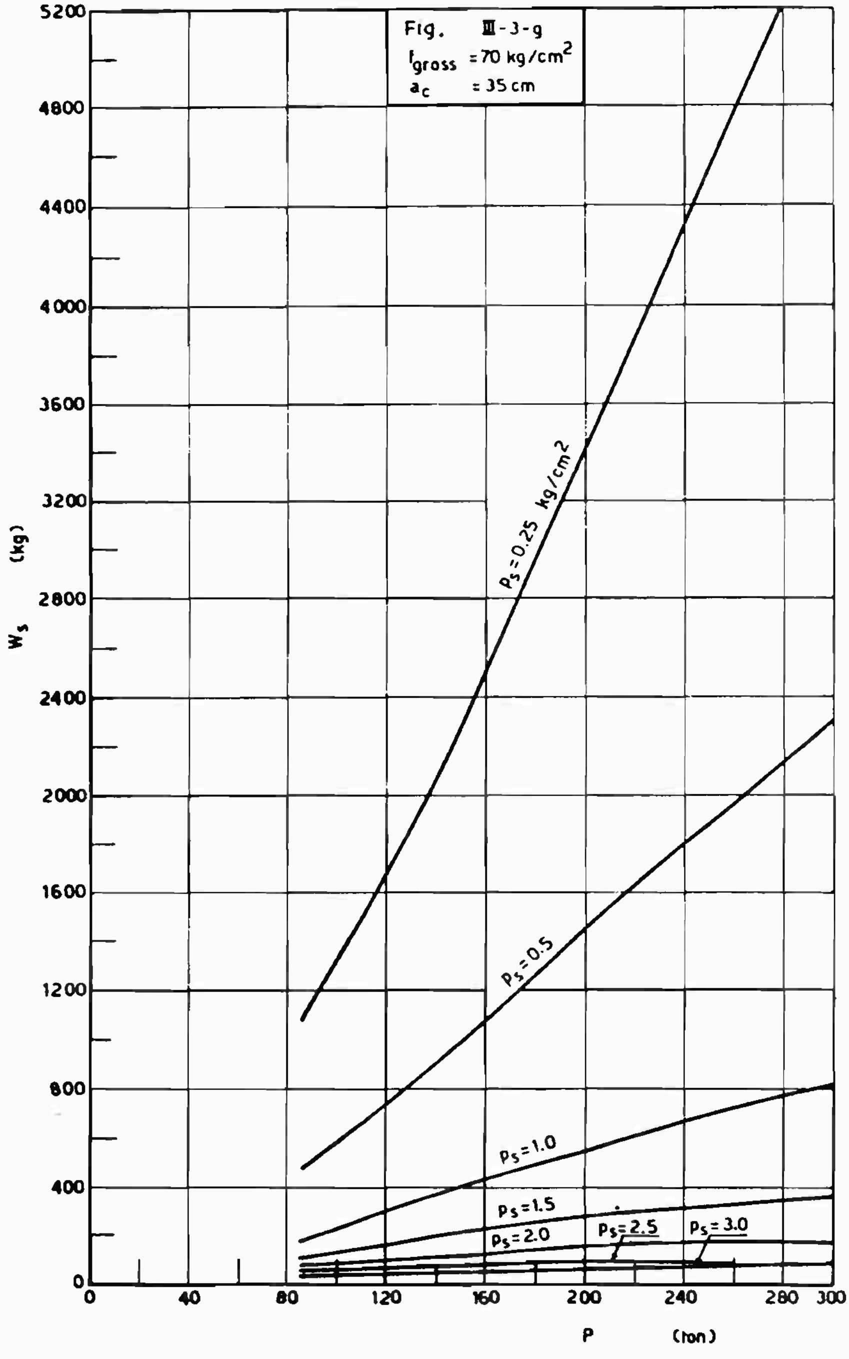


Fig. III-3-g
f_{gross} = 70 kg/cm²
a_c = 35 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
W_s (kg)
P (ton)
0
40
80
120
160
200
240
280
300
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200

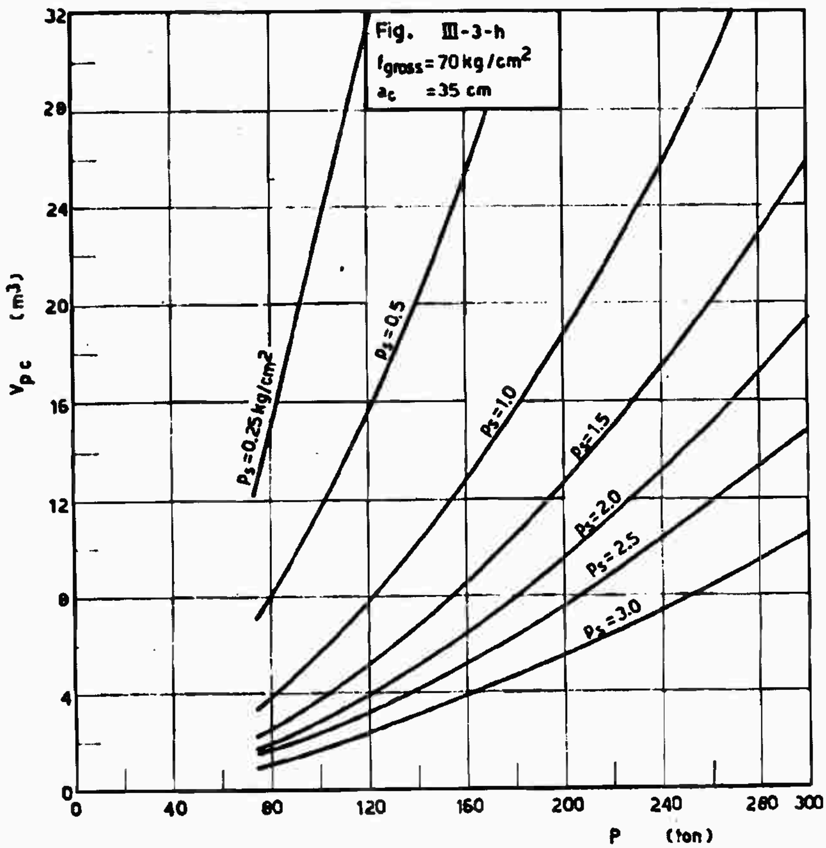


Fig. III-3-h
fgross = 70 kg/cm2
ac = 35 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
Vpc (m3)
P (ton)
0
4
8
12
16
20
24
28
32
0
40
80
120
160
200
240
280
300

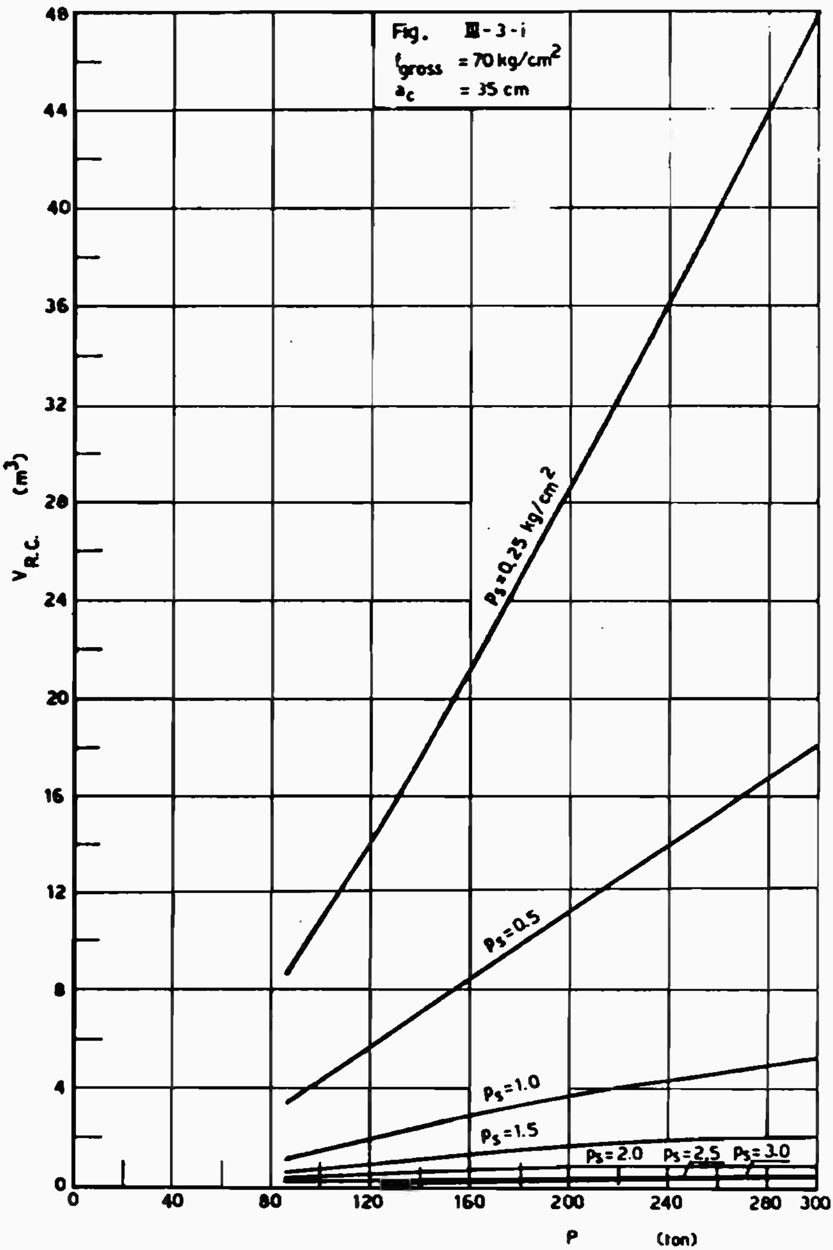


Fig. III-3-i
f_{gross} = 70 kg/cm²
a_c = 35 cm
$V_{R.C.}$ (m³)
P (ton)
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
0
4
8
12
16
20
24
28
32
36
40
44
48
0
40
80
120
160
200
240
280
300

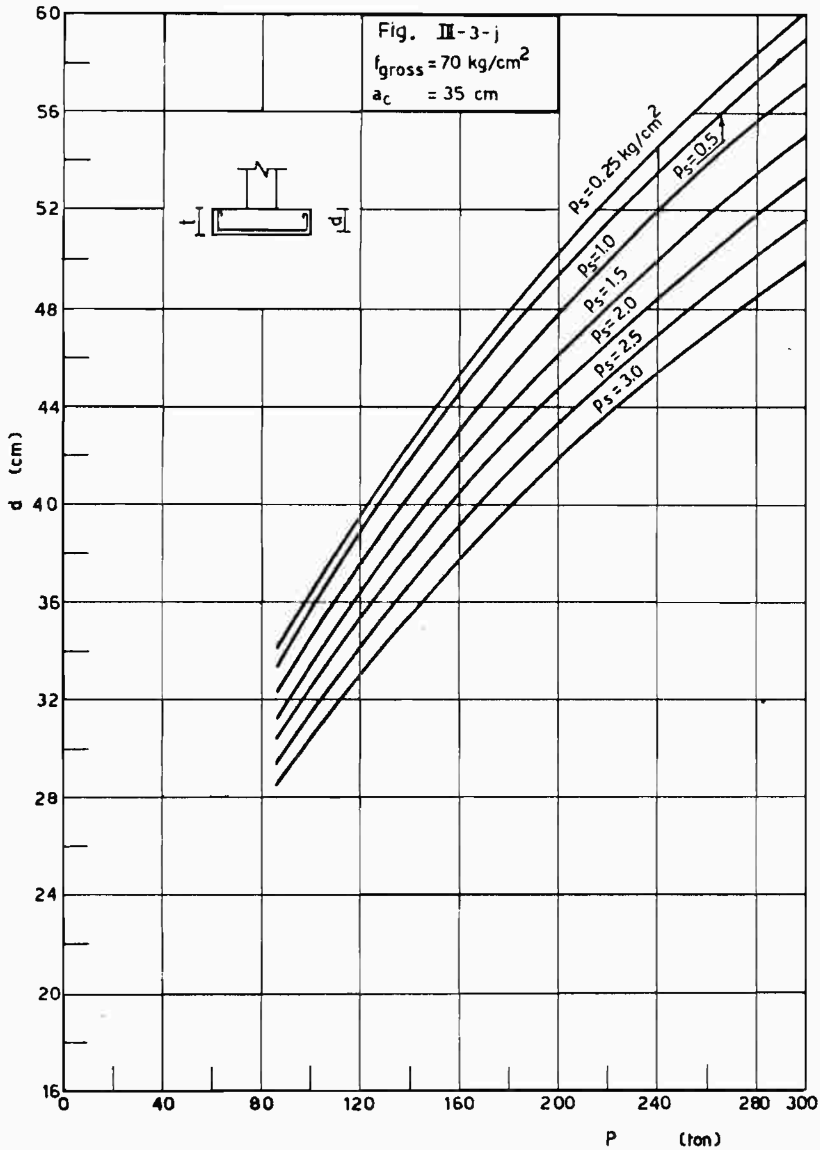


Fig. III-3-j
f_{gross} = 70 kg/cm²
a_c = 35 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d (cm)
P (ton)
16
20
24
28
32
36
40
44
48
52
56
60
0
40
80
120
160
200
240
280
300

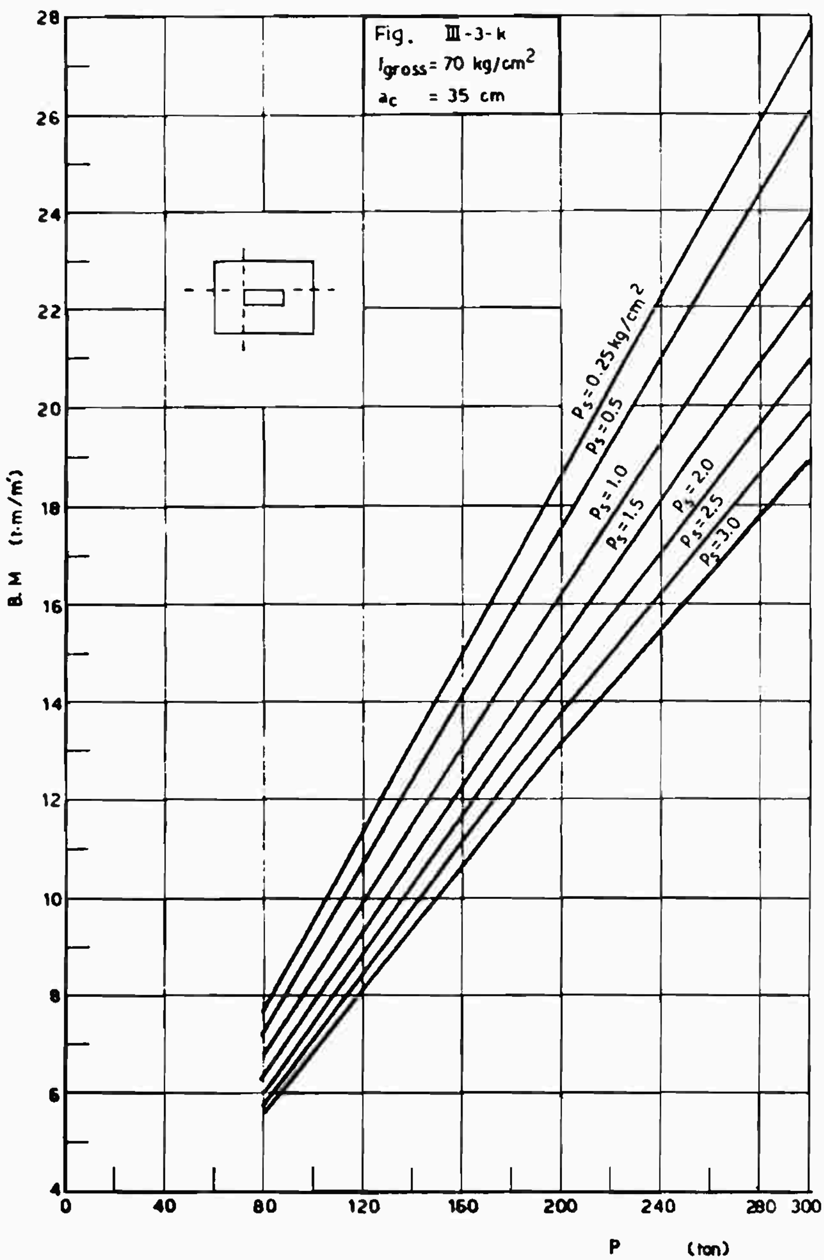


Fig. III-3-k
f_{gross} = 70 kg/cm^2
a_c = 35 cm
B.M (t.m/m')
P (ton)
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
0 40 80 120 160 200 240 280 300
4 6 8 10 12 14 16 18 20 22 24 26 28

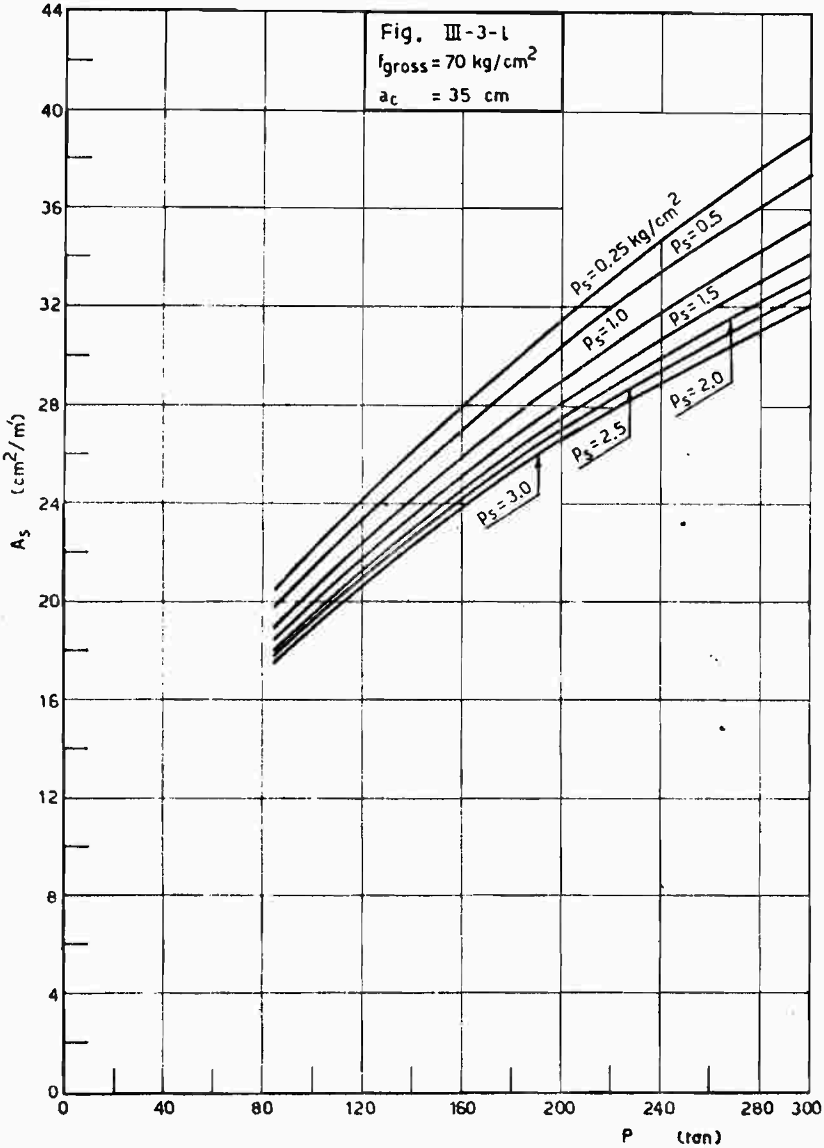


Fig. III-3-L
f gross = 70 kg/cm2
ac = 35 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
As (cm2/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
0
40
80
120
160
200
240
280
300

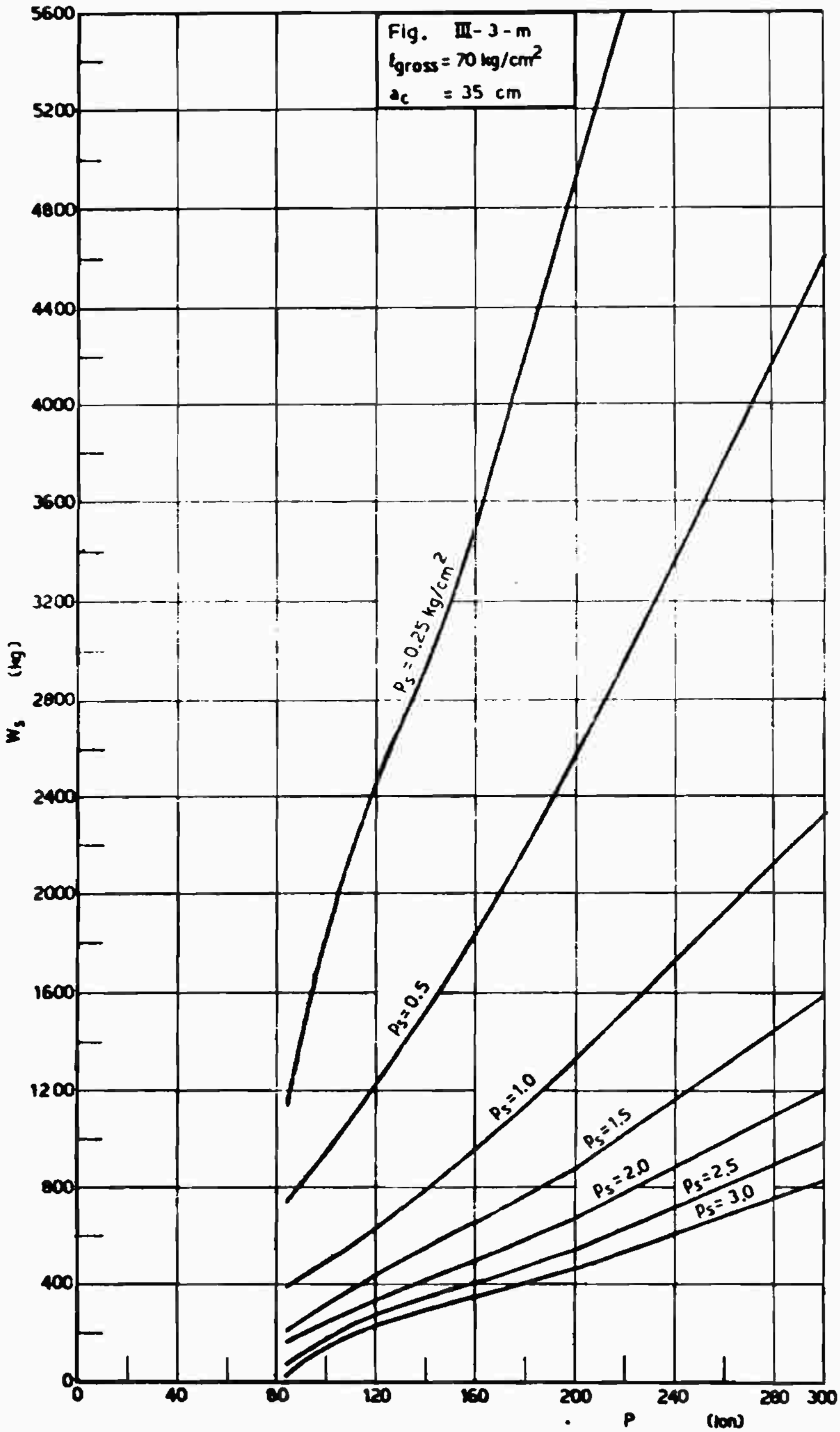


Fig. III- 3 - m
f_{gross} = 70 kg/cm²
a_c = 35 cm
P_s = 0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s= 3.0
W_s (kg)
P (ton)
0
40
80
120
160
200
240
280
300
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200
5600

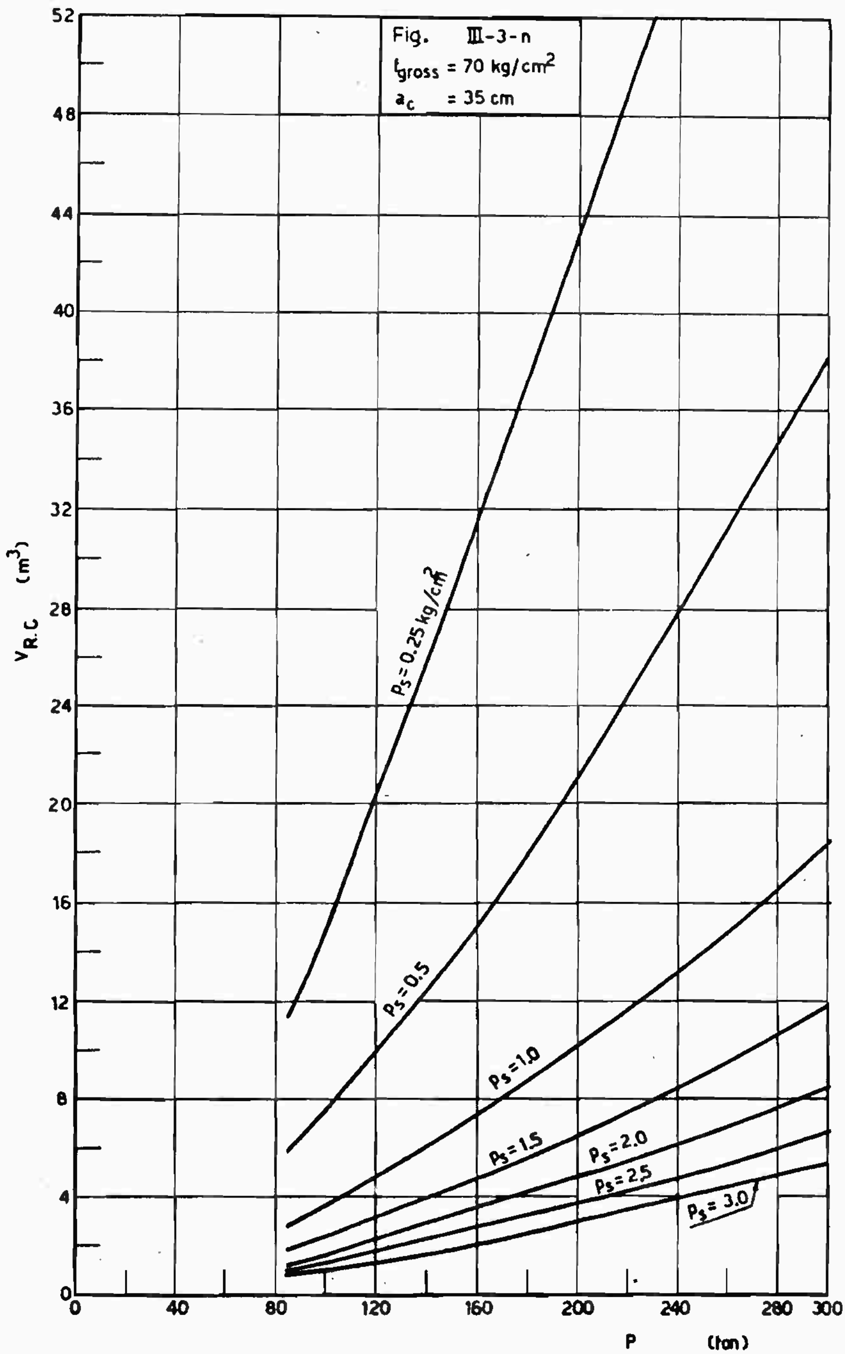


Fig. III-3-n
f_{gross} = 70 kg/cm²
a_c = 35 cm
$V_{R.C}$ (m³)
P (ton)
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
0 4 8 12 16 20 24 28 32 36 40 44 48 52
0 40 80 120 160 200 240 280 300

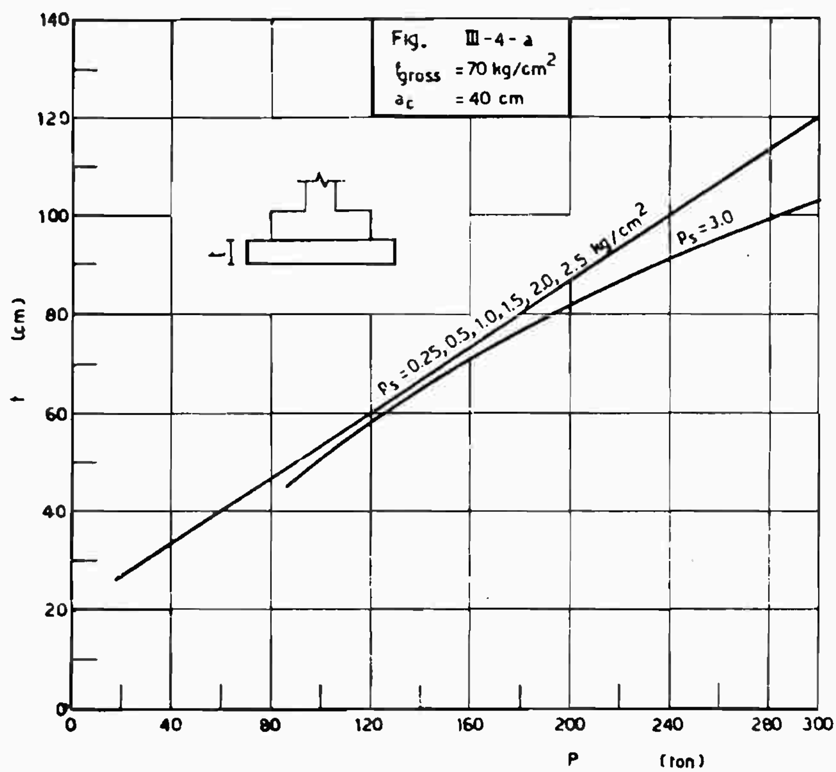


Fig. III-4-a
f_{gross} = 70 kg/cm^2
a_c = 40 cm
P_s = 0.25, 0.5, 1.0, 1.5, 2.0, 2.5 kg/cm^2
P_s = 3.0
t (cm)
P (ton)
0
20
40
60
80
100
120
140
0
40
80
120
160
200
240
280
300

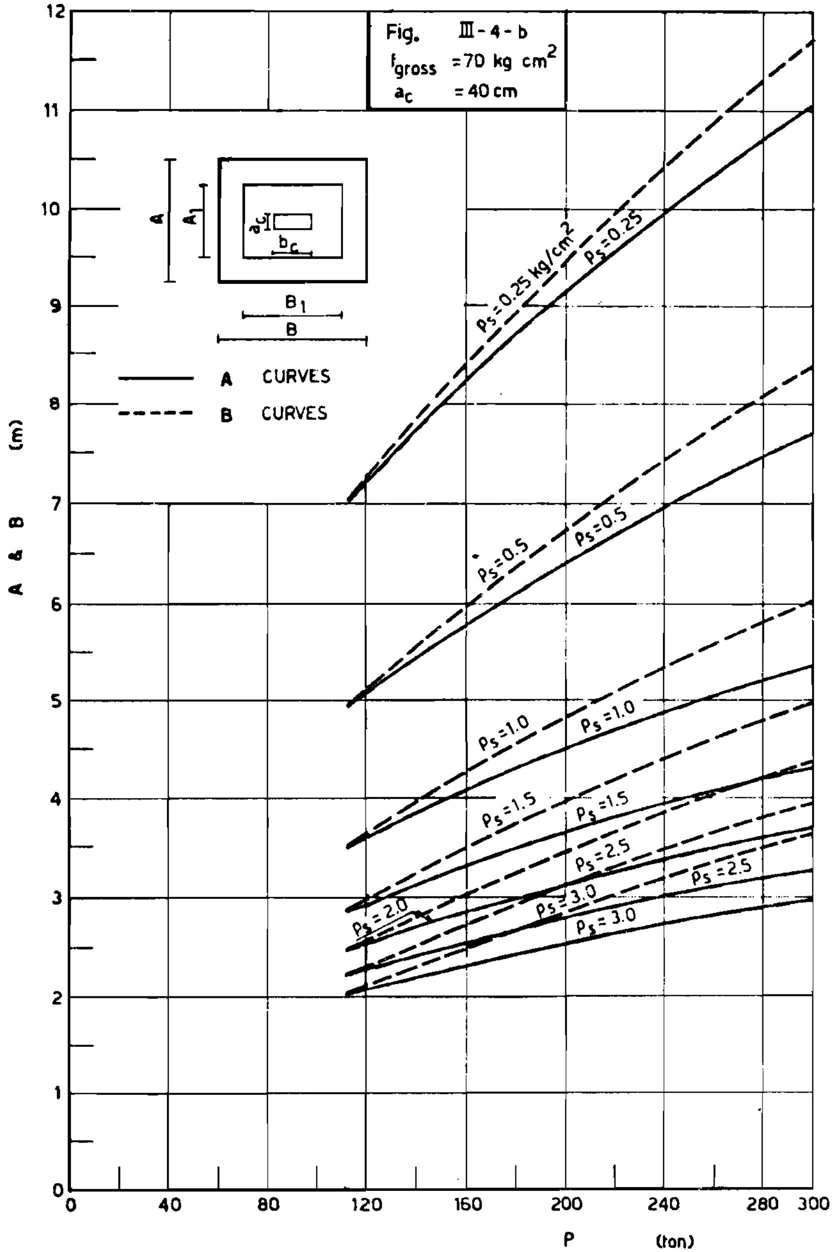


Fig. III - 4 - b
f_{gross} = 70 kg cm^2
a_c = 40 cm
A
A_1
a_c
b_c
B_1
B
A CURVES
B CURVES
A & B (m)
P (ton)
Ps = 0.25 kg/cm^2
Ps = 0.25
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
0
1
2
3
4
5
6
7
8
9
10
11
12
40
80
120
160
200
240
280
300

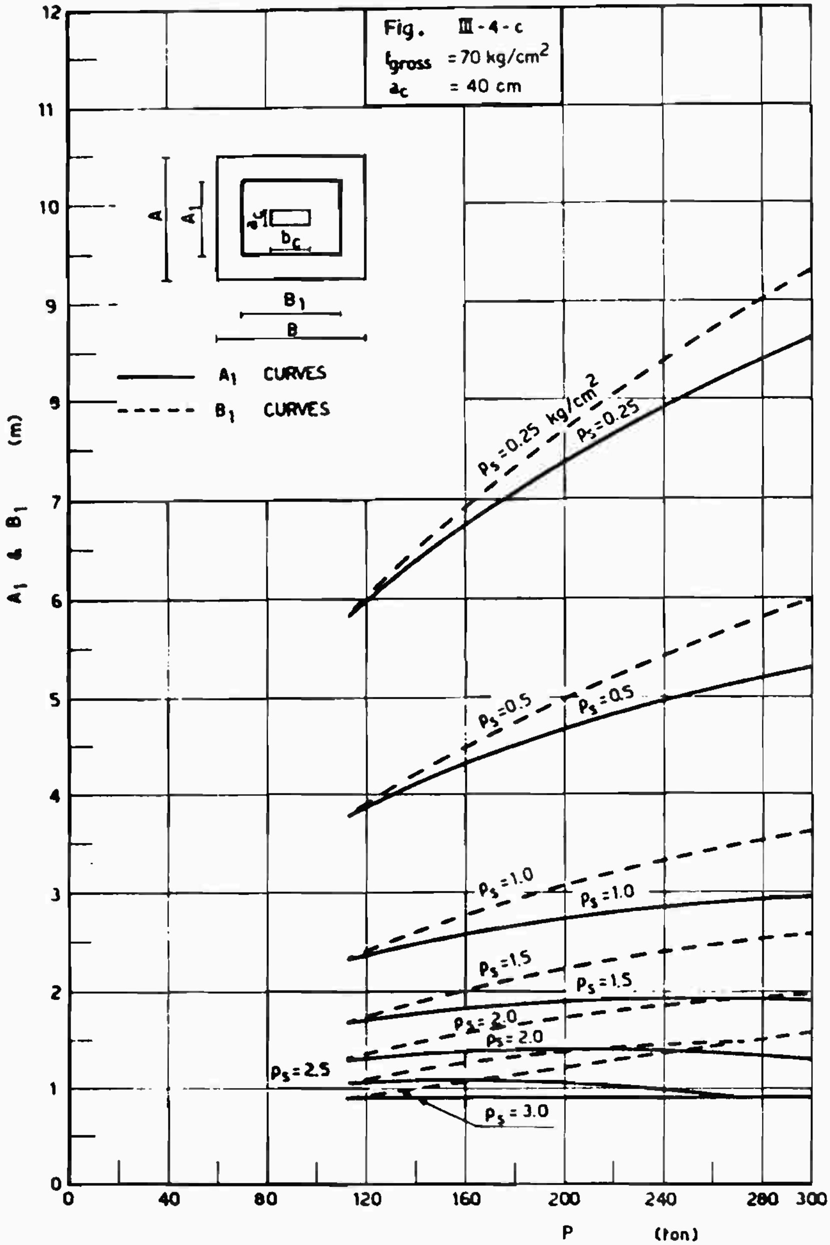


Fig. III-4-c
f_{gross} = 70 kg/cm^2
a_c = 40 cm
A
A_1
a_c
b_c
B_1
B
A_1 CURVES
B_1 CURVES
A_1 & B_1 (m)
P (ton)
P_s = 0.25 kg/cm^2
P_s = 0.25
P_s = 0.5
P_s = 0.5
P_s = 1.0
P_s = 1.0
P_s = 1.5
P_s = 1.5
P_s = 2.0
P_s = 2.0
P_s = 2.5
P_s = 3.0
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
280
300

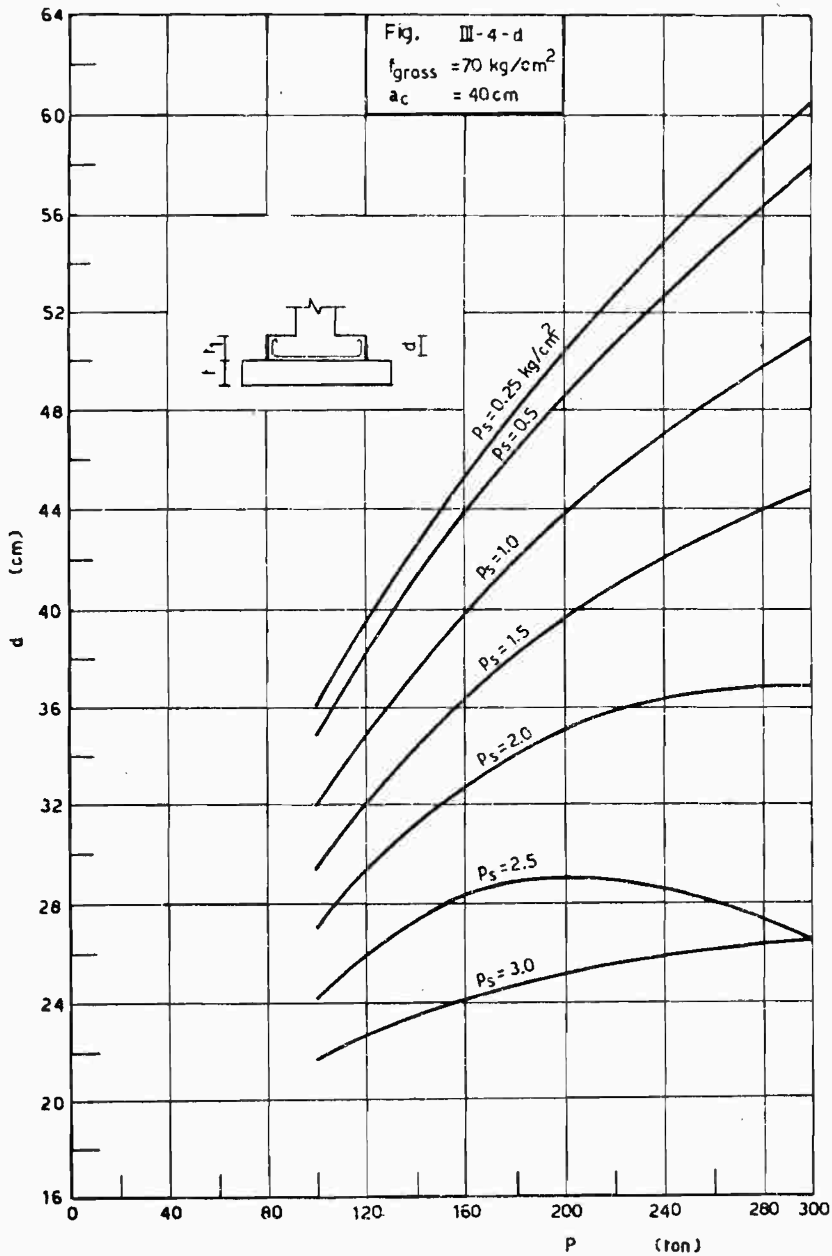


Fig. III-4-d
f_{gross} = 70 kg/cm²
a_c = 40 cm
d (cm)
P (ton)
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300

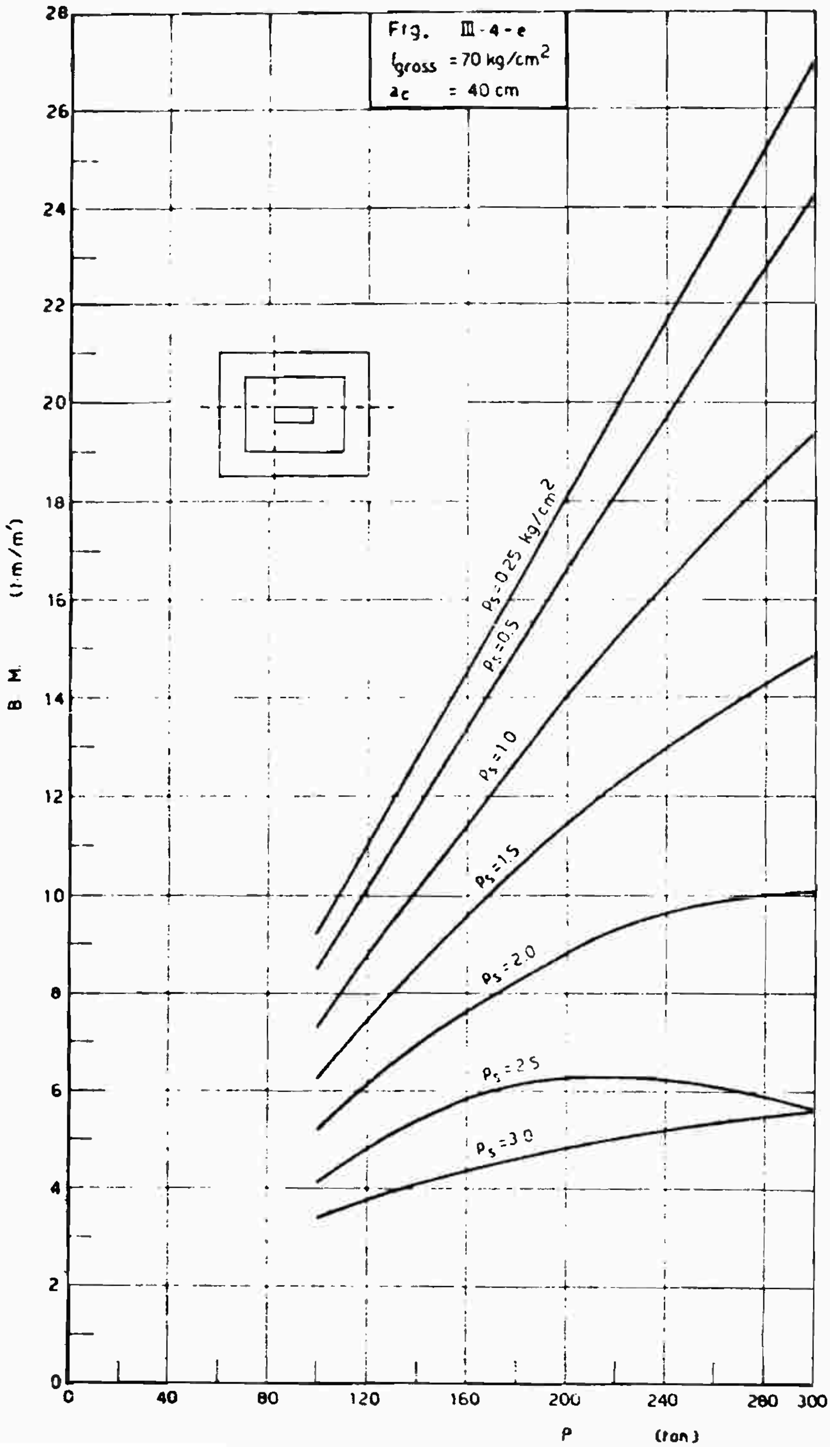


Fig. III-4-e
f_{gross} = 70 kg/cm²
a_c = 40 cm
B.M. (t.m/m')
P (ton)
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
0 40 80 120 160 200 240 280 300

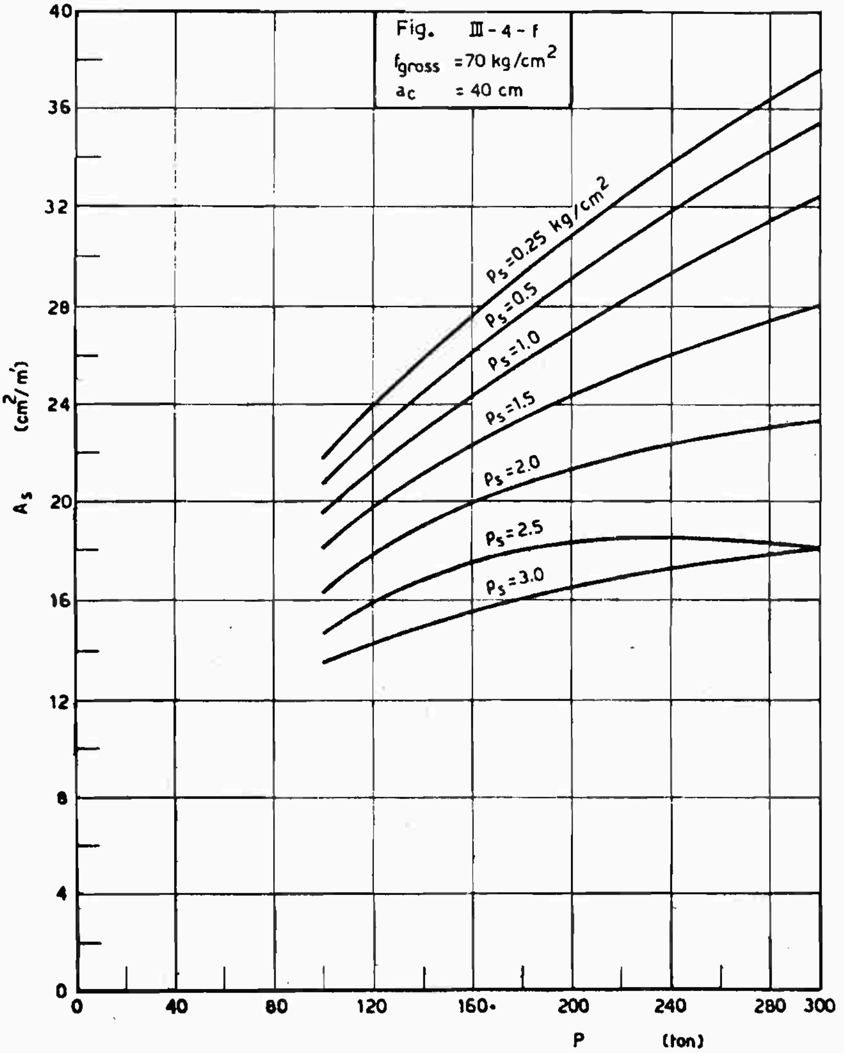


Fig. III - 4 - f
f_{gross} = 70 kg/cm^2
a_c = 40 cm
P_s=0.25 kg/cm^2
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_s (cm^2/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
40
80
120
160
200
240
280
300

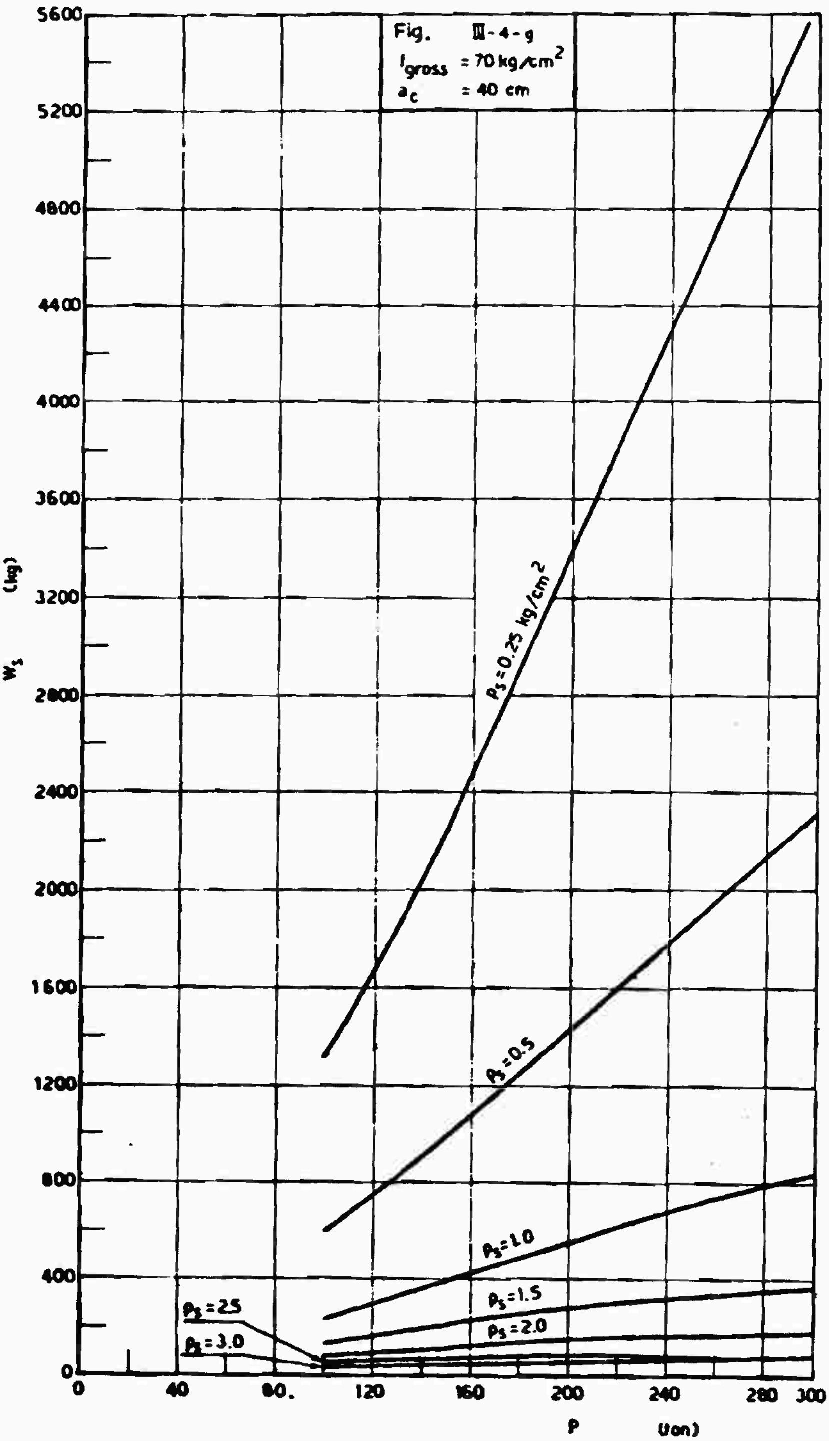


Fig. III-4-g
f_{gross} = 70 kg/cm^2
a_c = 40 cm
P_s = 0.25 kg/cm^2
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
W_s (kg)
P (ton)
0
40
80.
120
160
200
240
280
300
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200
5600

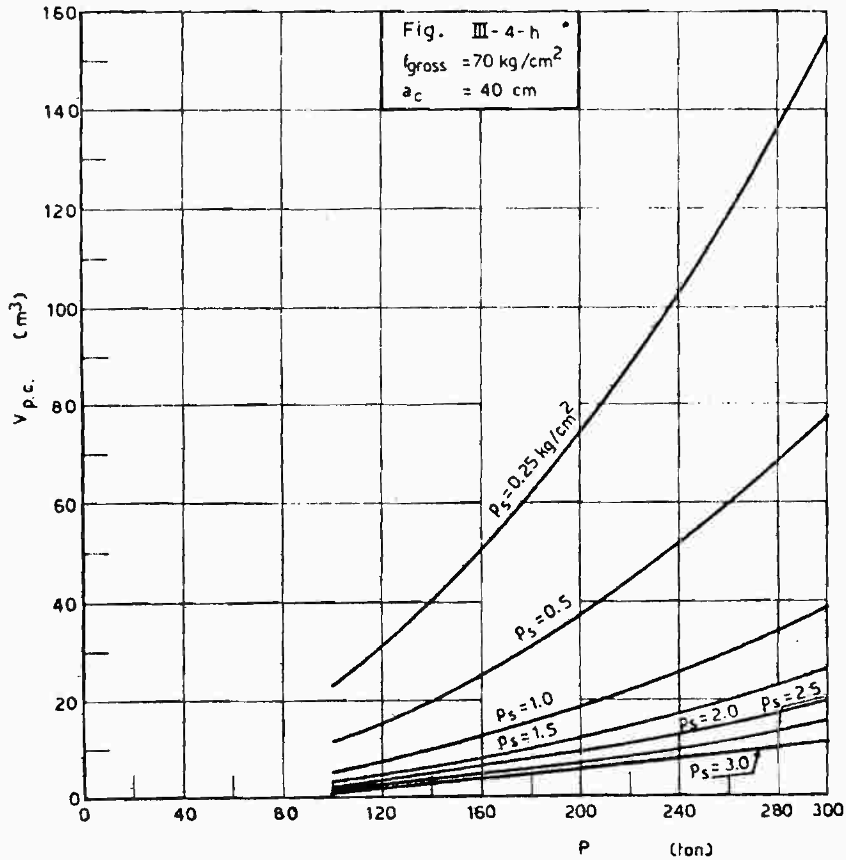


Fig. III-4-h
f_{gross} = 70 kg/cm²
a_c = 40 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
$V_{p.c.}$ (m³)
P (ton)
0
20
40
60
80
100
120
140
160
0
40
80
120
160
200
240
280
300

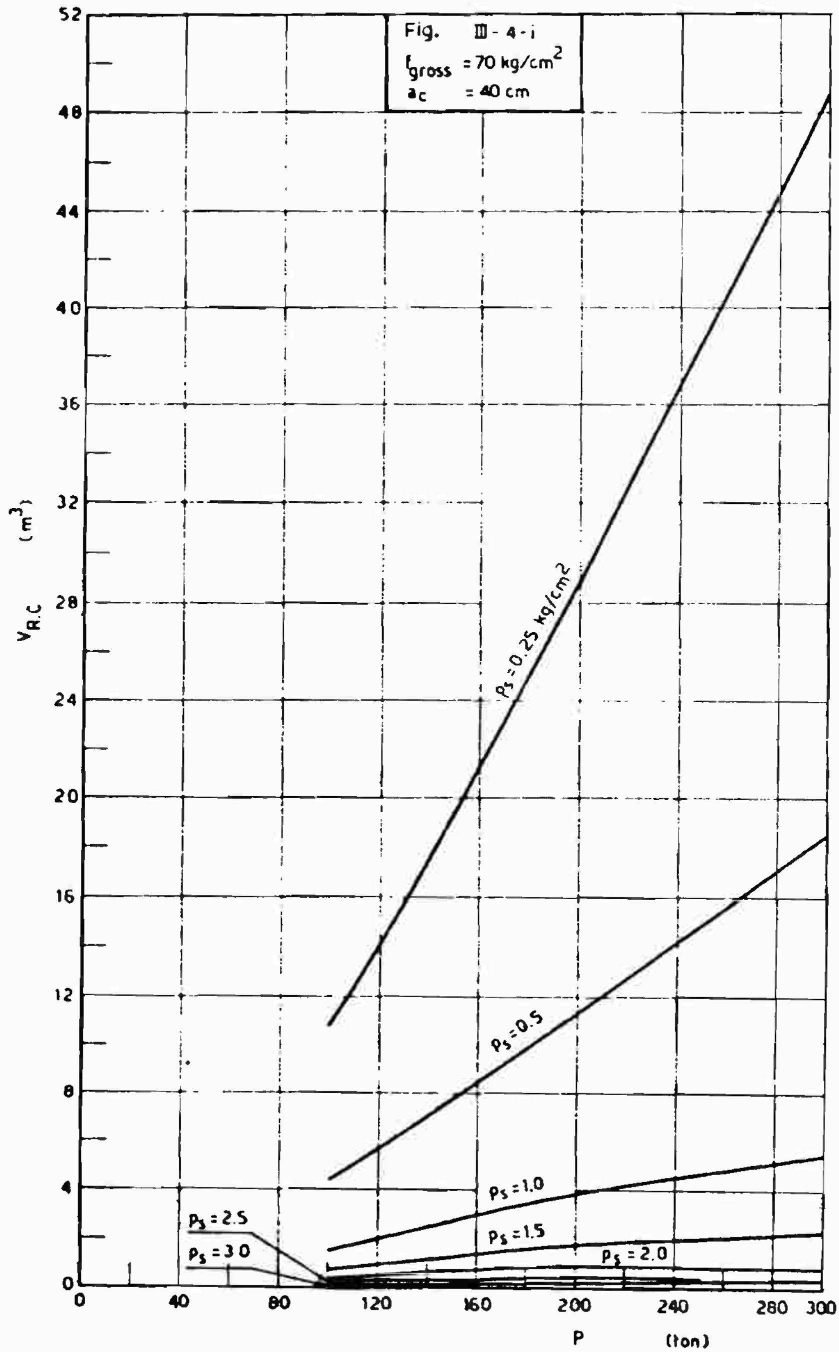


Fig. III - 4 - i
f_{gross} = 70 kg/cm²
a_c = 40 cm
$V_{R.C}$ (m³)
P (ton)
p_s = 0.25 kg/cm²
p_s = 0.5
p_s = 1.0
p_s = 1.5
p_s = 2.0
p_s = 2.5
p_s = 3.0
0
4
8
12
16
20
24
28
32
36
40
44
48
52
0
40
80
120
160
200
240
280
300

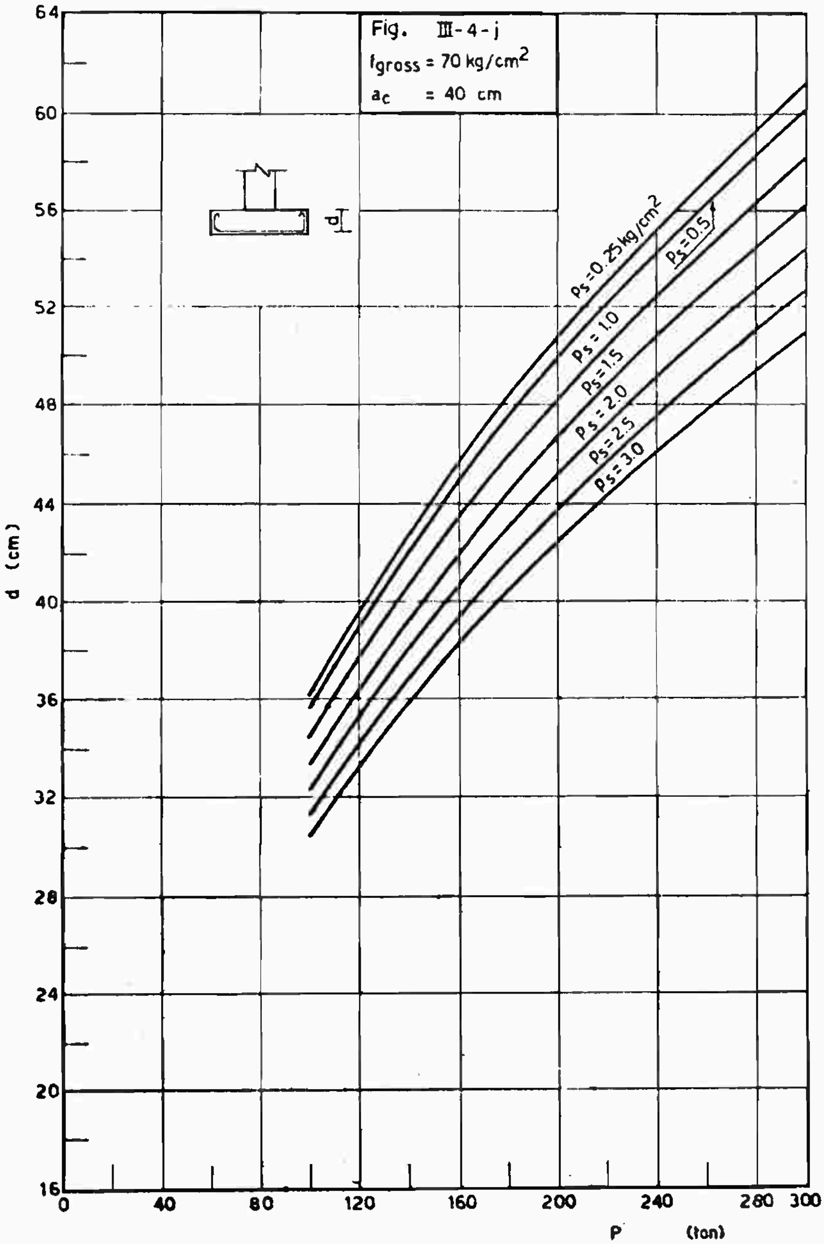


Fig. III-4-j
f_{gross} = 70 kg/cm^2
a_c = 40 cm
d
Ps=0.25kg/cm^2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d (cm)
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300
P (ton)

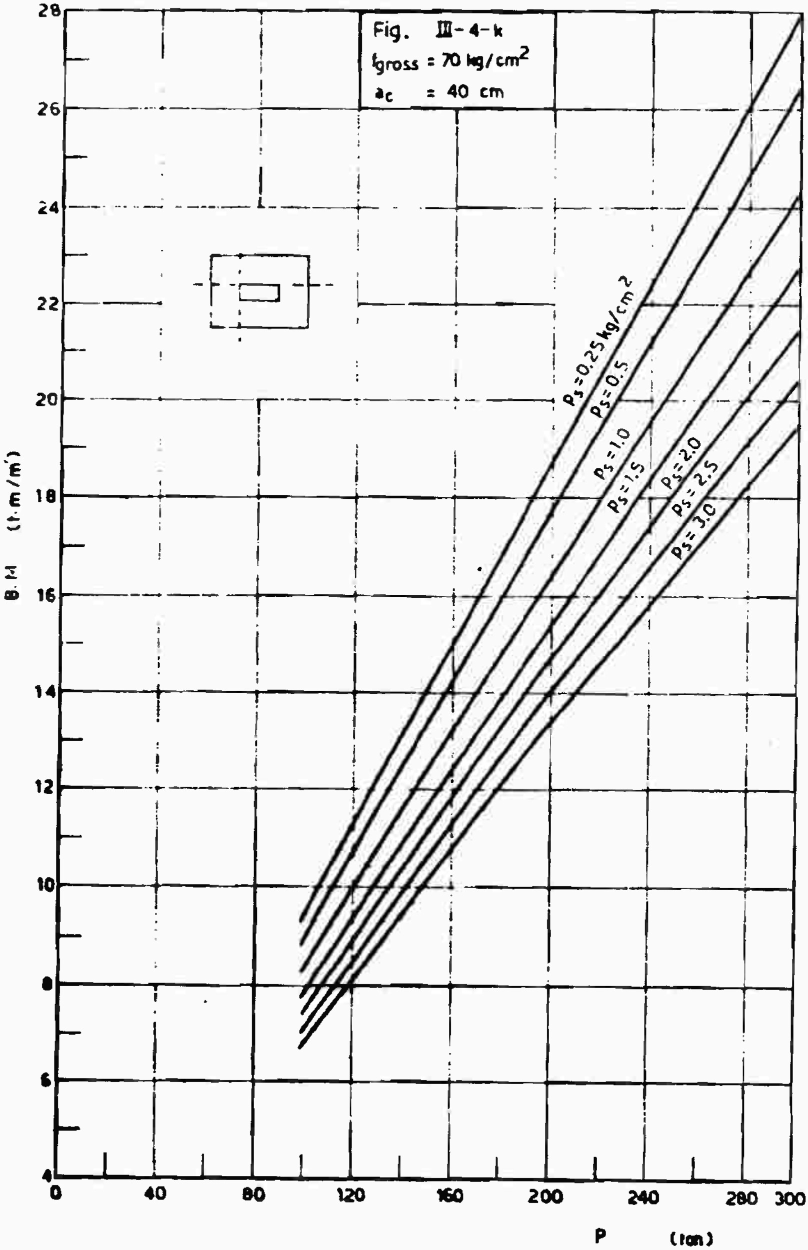


Fig. III-4-k
fgross = 70 kg/cm2
ac = 40 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
B.M (t.m/m')
P (ton)
28
26
24
22
20
18
16
14
12
10
8
6
4
0
40
80
120
160
200
240
280
300

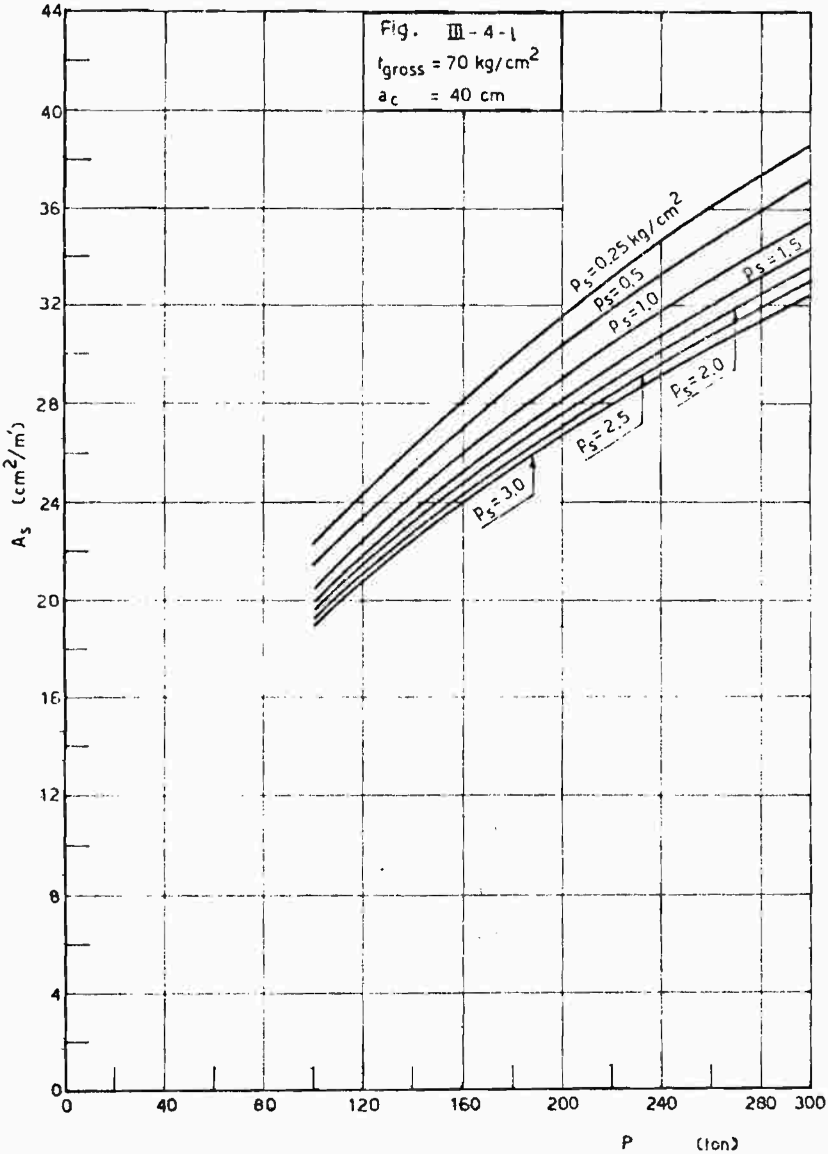


Fig. III - 4 - 1
f_{gross} = 70 kg/cm^2
a_c = 40 cm
P_s=0.25 kg/cm^2
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_s (cm^2/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
0
40
80
120
160
200
240
280
300

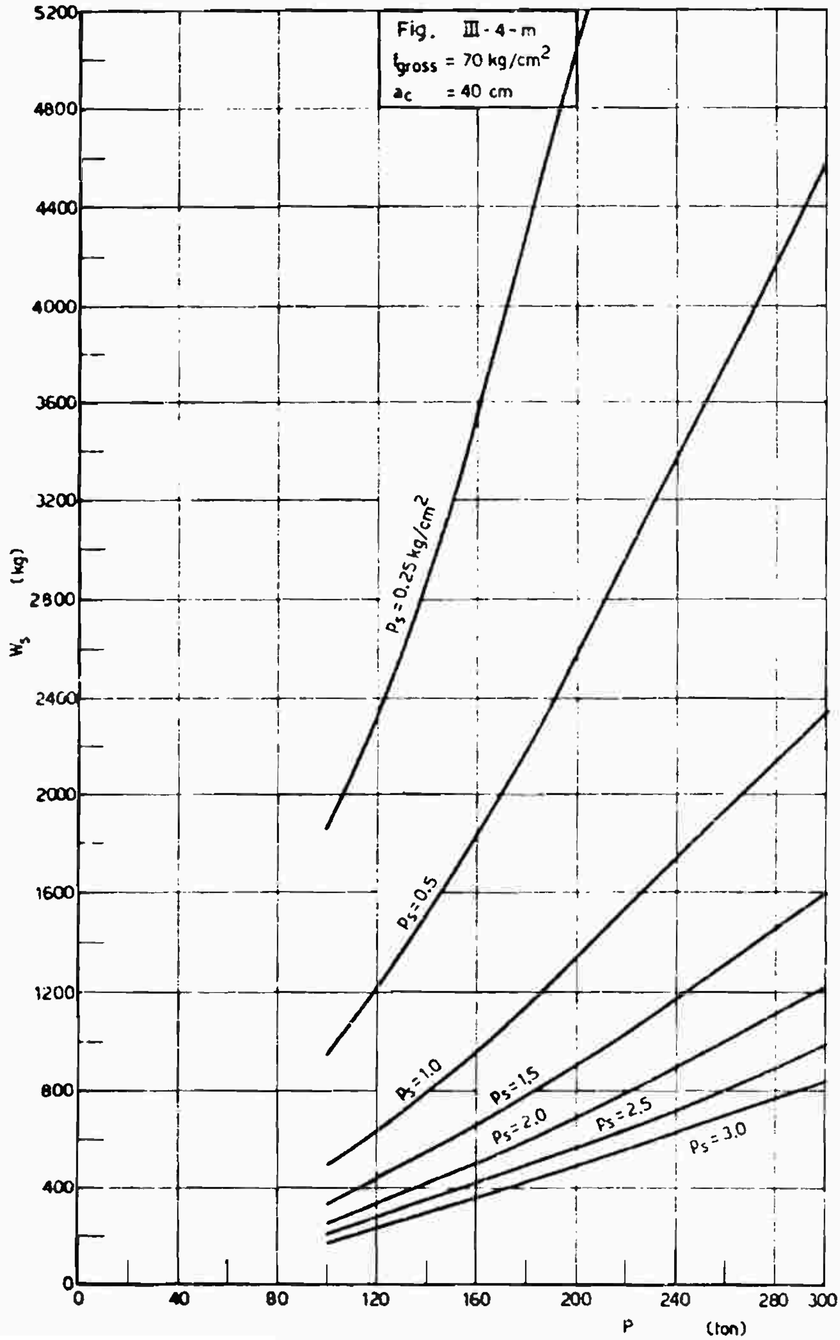


Fig. III-4-m
f_{gross} = 70 kg/cm²
a_c = 40 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
W_s (kg)
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200
0
40
80
120
160
200
240
280
300
P (ton)

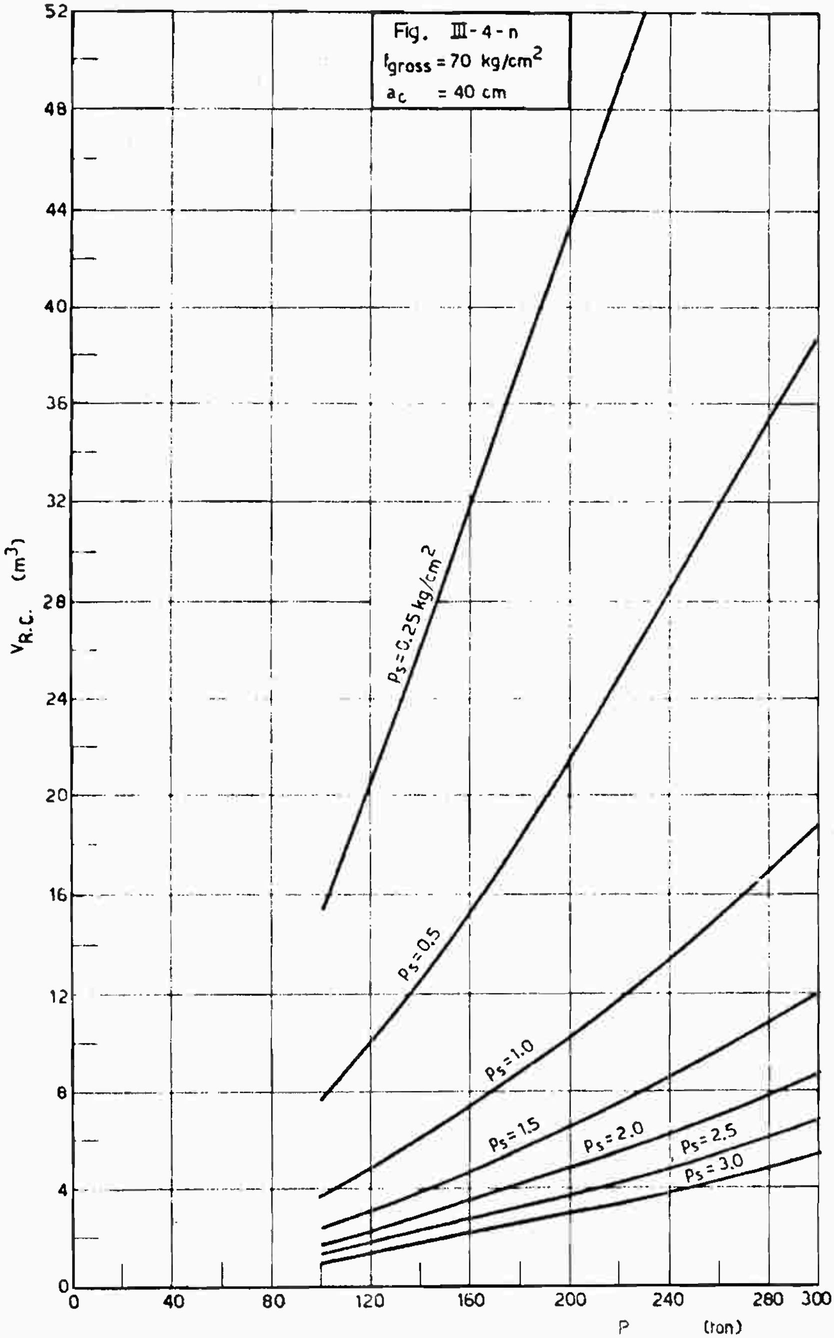


Fig. III-4-n
f_{gross} = 70 kg/cm^2
a_c = 40 cm
$V_{R.C.}$ (m^3)
P (ton)
Ps=0.25 kg/cm^2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
0
4
8
12
16
20
24
28
32
36
40
44
48
52
0
40
80
120
160
200
240
280
300

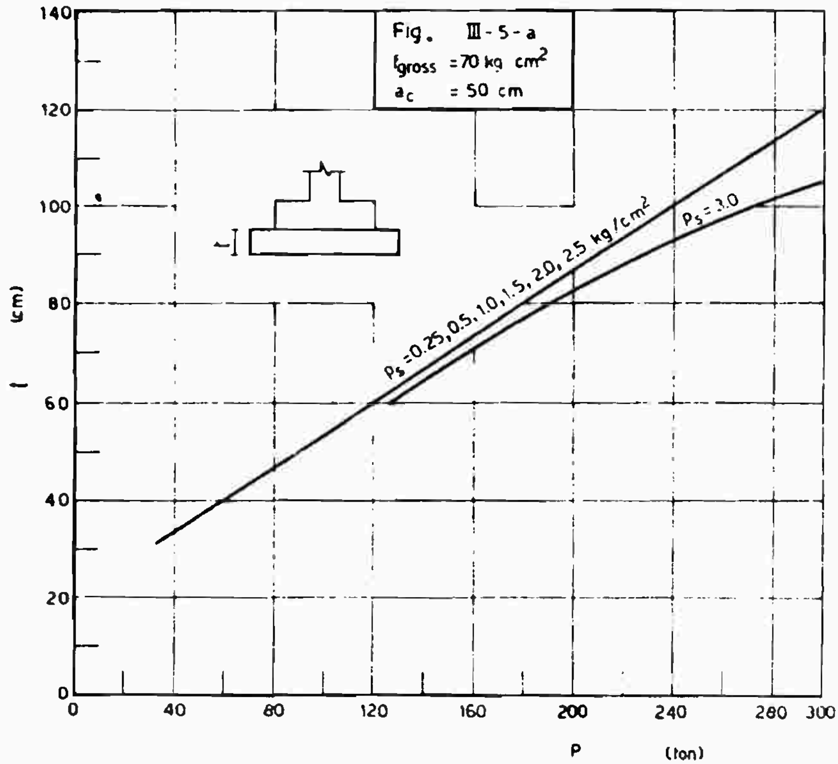


Fig. III - 5 - a
f_{gross} = 70 kg cm²
a_c = 50 cm
P_s = 0.25, 0.5, 1.0, 1.5, 2.0, 2.5 kg/cm²
P_s = 3.0
t (cm)
P (ton)
0
20
40
60
80
100
120
140
160
200
240
280
300

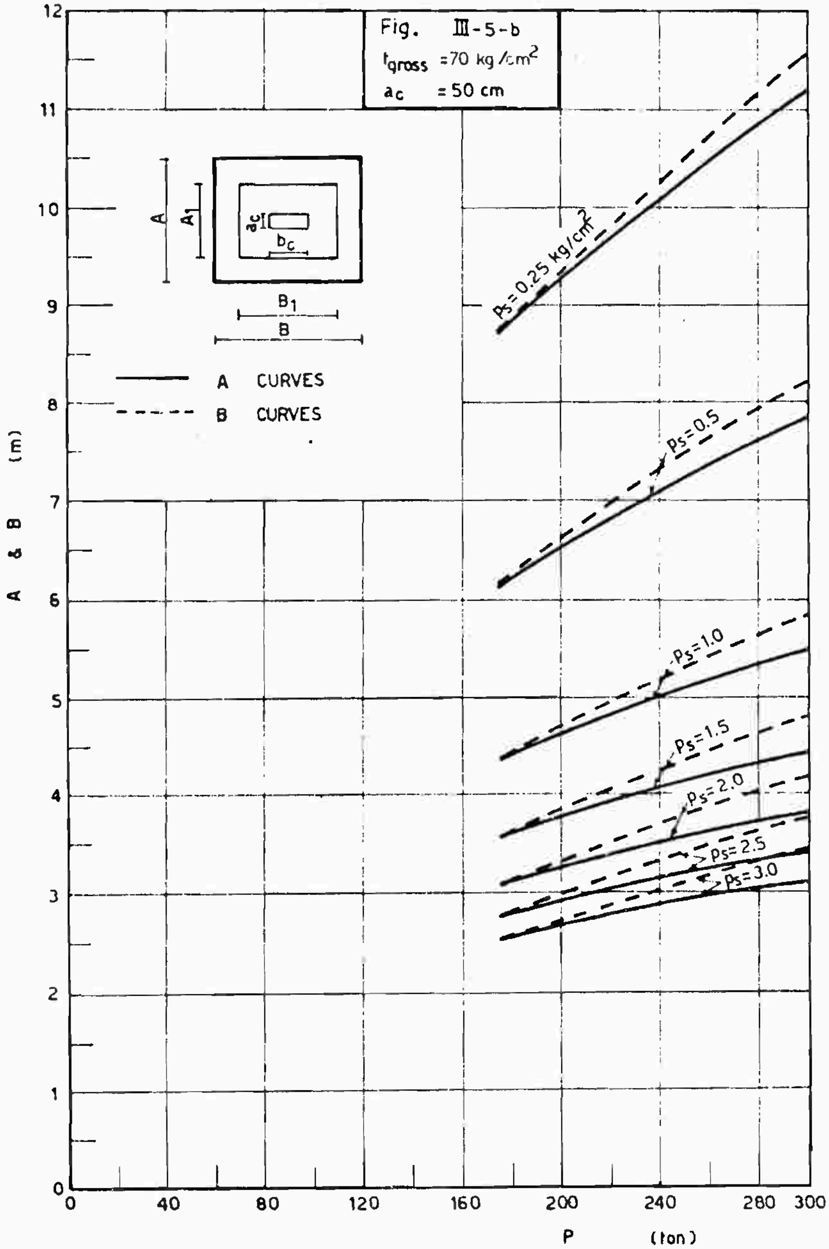


Fig. III-5-b
t_{gross} = 70 kg/cm²
a_c = 50 cm
A
A_1
a_c
b_c
B_1
B
A CURVES
B CURVES
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
A & B (m)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
280
300

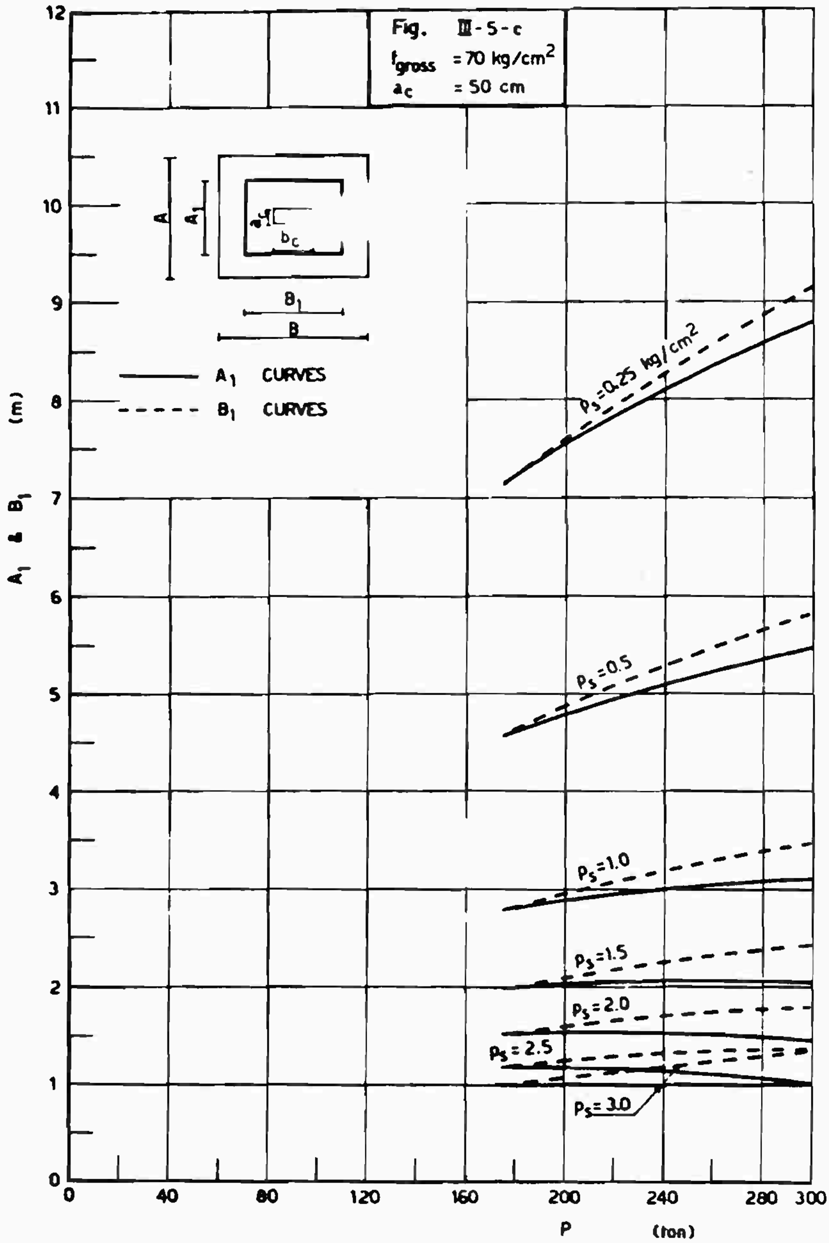


Fig. III-5-c
f_{gross} = 70 kg/cm²
a_c = 50 cm
A
A_1
a_c
b_c
B_1
B
A_1 CURVES
B_1 CURVES
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_1 & B_1 (m)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
280
300

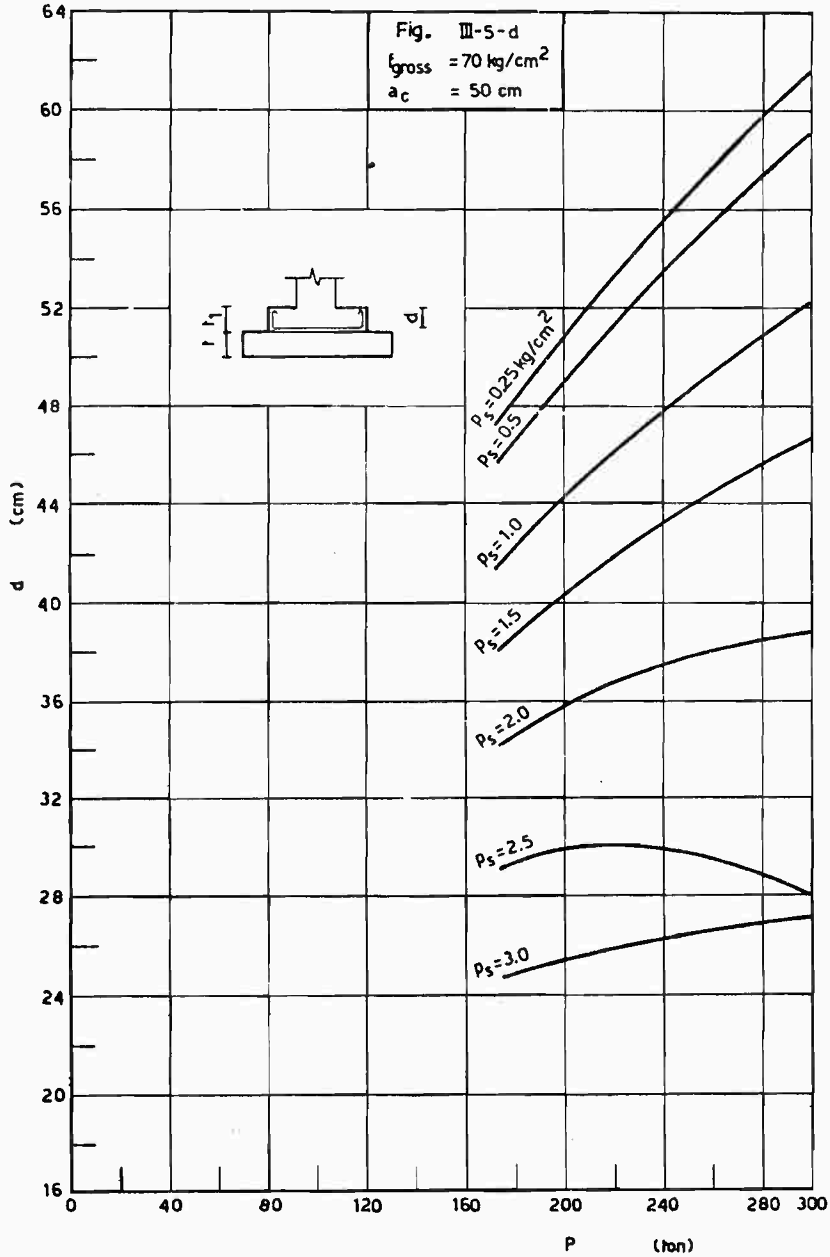


Fig. III-5-d
f_{gross} = 70 kg/cm²
a_c = 50 cm
d (cm)
P (ton)
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300

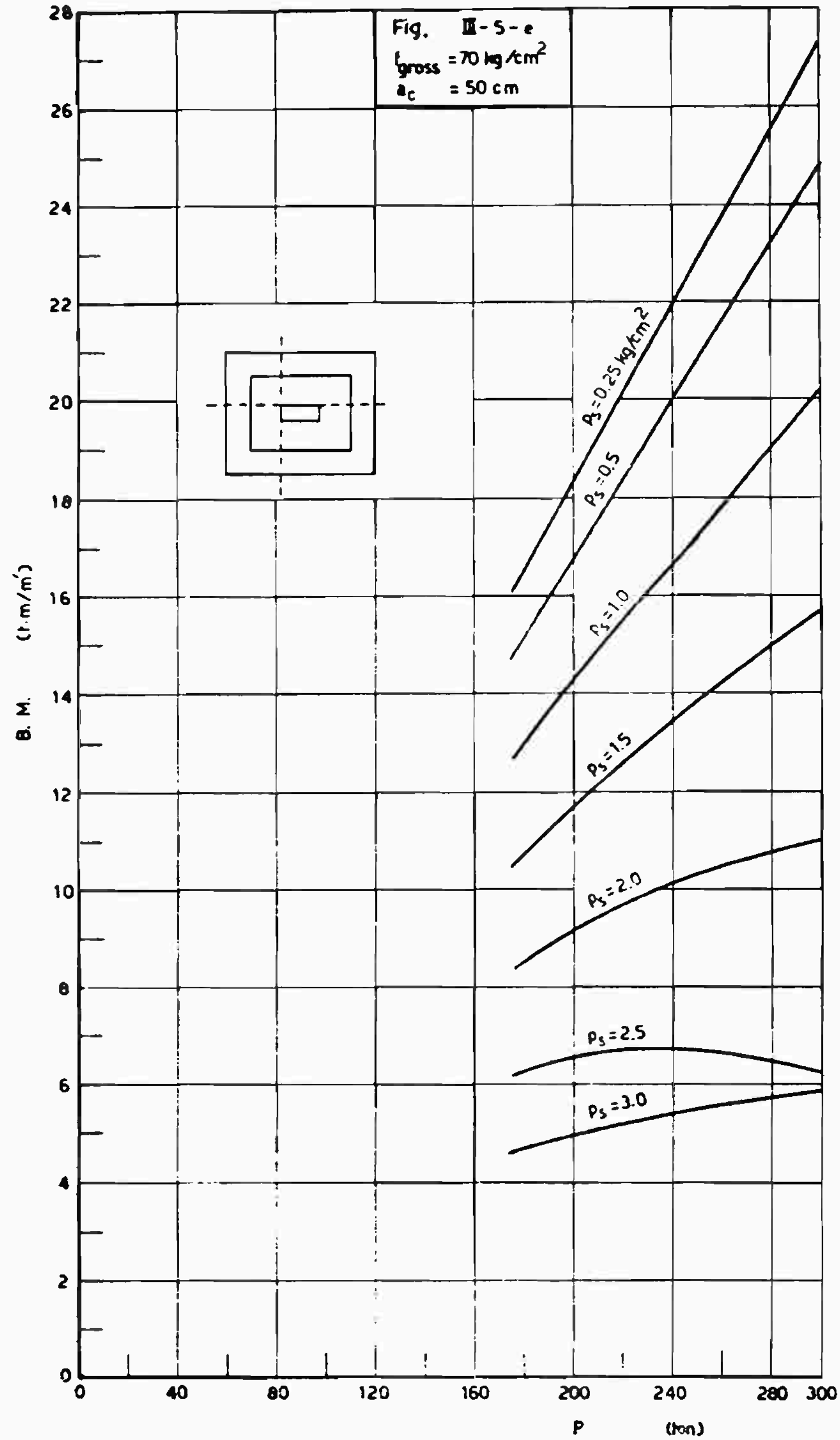


Fig. III-5-e
f_{gross} = 70 kg/cm²
a_c = 50 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
B. M. (t.m/m')
P (ton)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
40
80
120
160
200
240
280
300

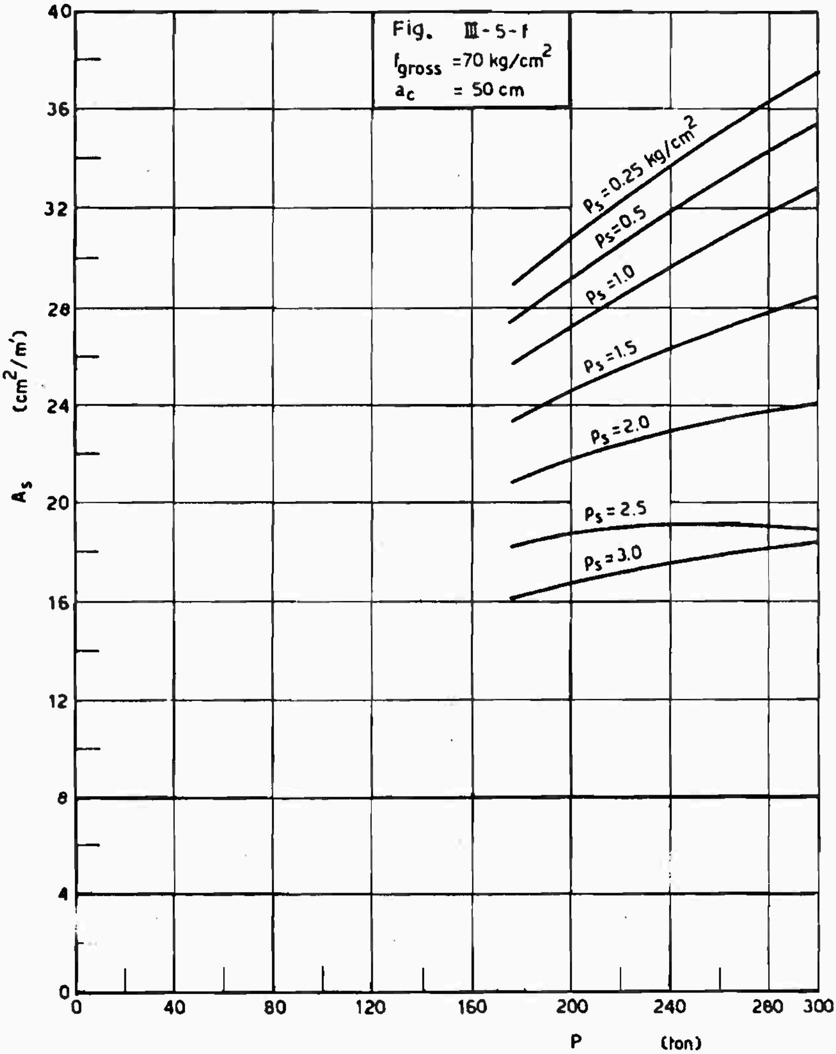


Fig. III-5-f
f_{gross} = 70 kg/cm²
a_c = 50 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
A_s (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
300

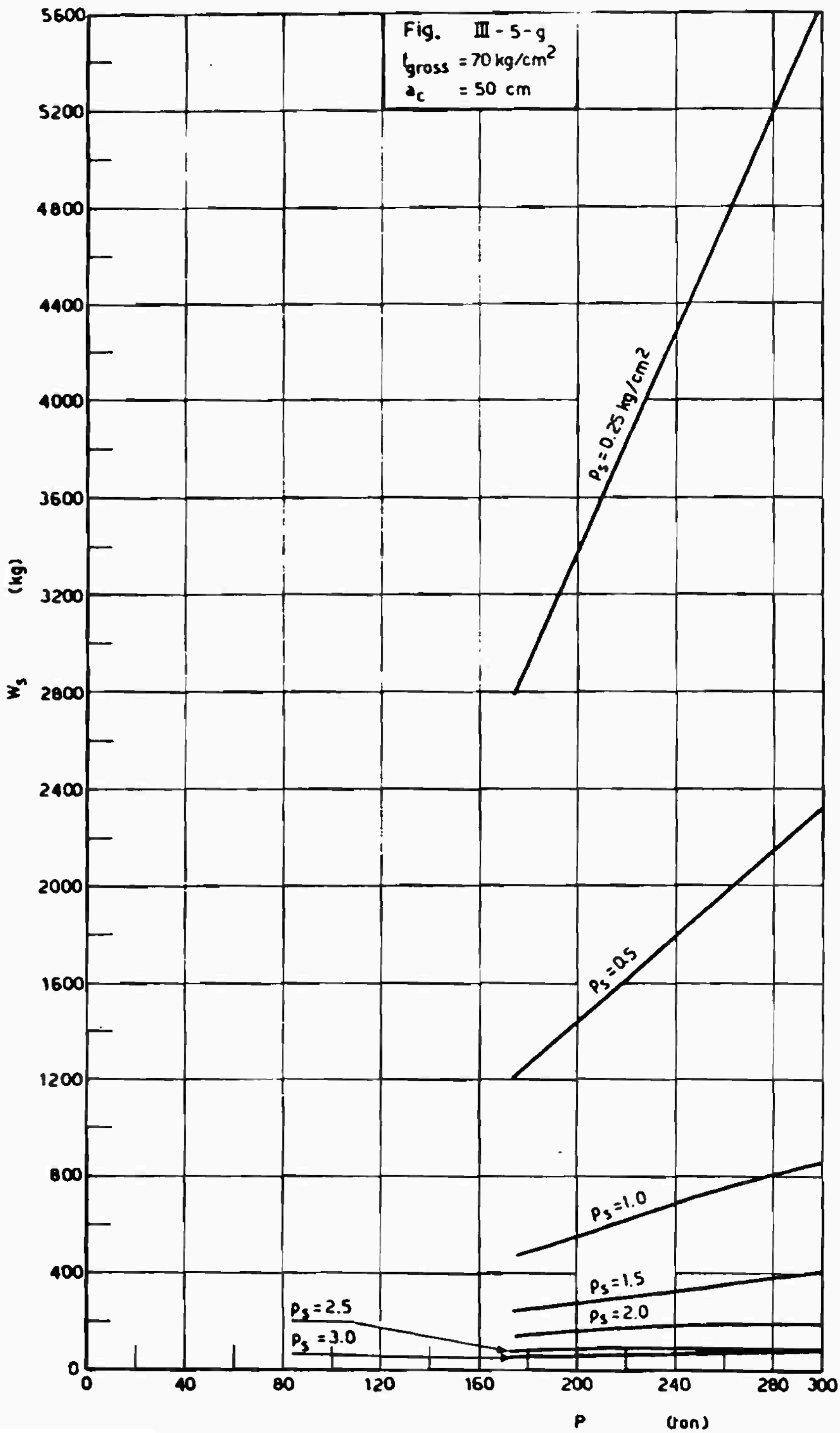


Fig. III - 5 - g
f_{gross} = 70 kg/cm²
a_c = 50 cm
5600
5200
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
W_s (kg)
0
40
80
120
160
200
240
280
300
P (ton)
P_s = 0.25 kg/cm2
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0

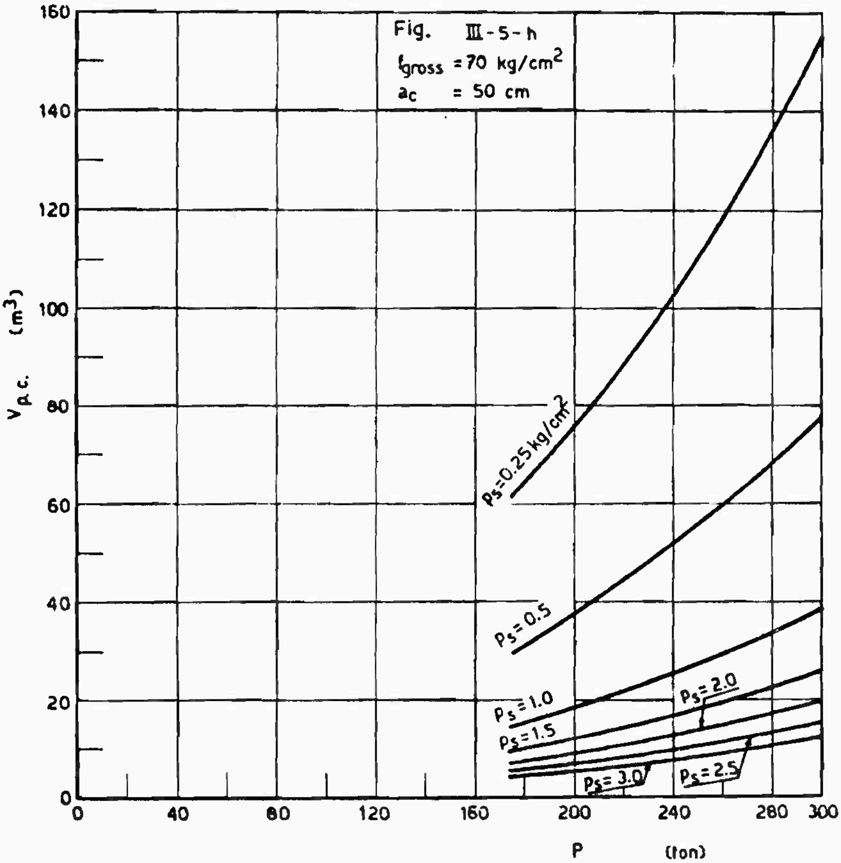


Fig. III-5-h
f_{gross} = 70 kg/cm²
a_c = 50 cm
Ps=0.25 kg/cm²
Ps= 0.5
Ps= 1.0
Ps= 1.5
Ps= 2.0
Ps= 2.5
Ps= 3.0
$V_{p.c.}$ (m³)
P (ton)
0
20
40
60
80
100
120
140
160
0
40
80
120
160
200
240
280
300

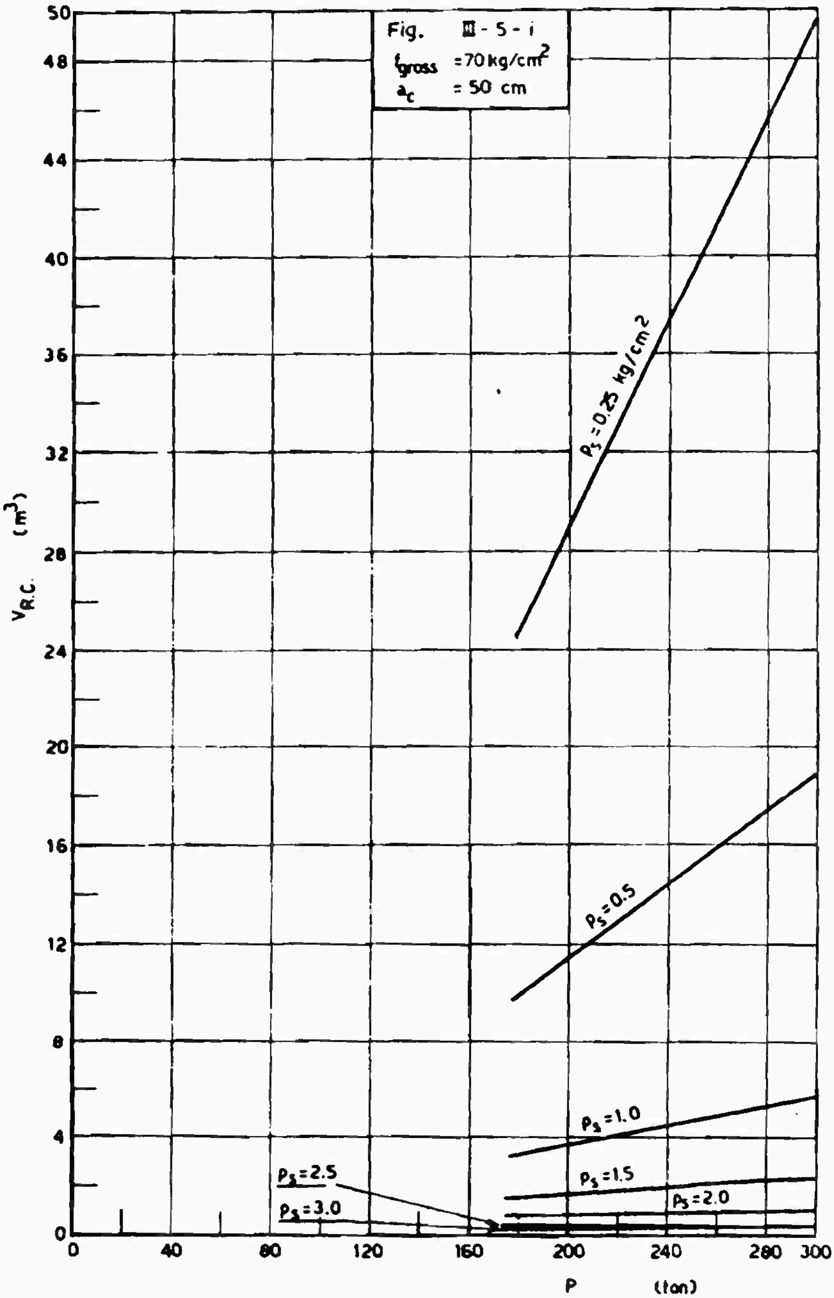


Fig. III - 5 - i
f_{gross} = 70 kg/cm²
a_c = 50 cm
P_s = 0.25 kg/cm2
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
$V_{R.C.}$ (m³)
P (ton)
0 4 8 12 16 20 24 28 32 36 40 44 48 50
0 40 80 120 160 200 240 280 300

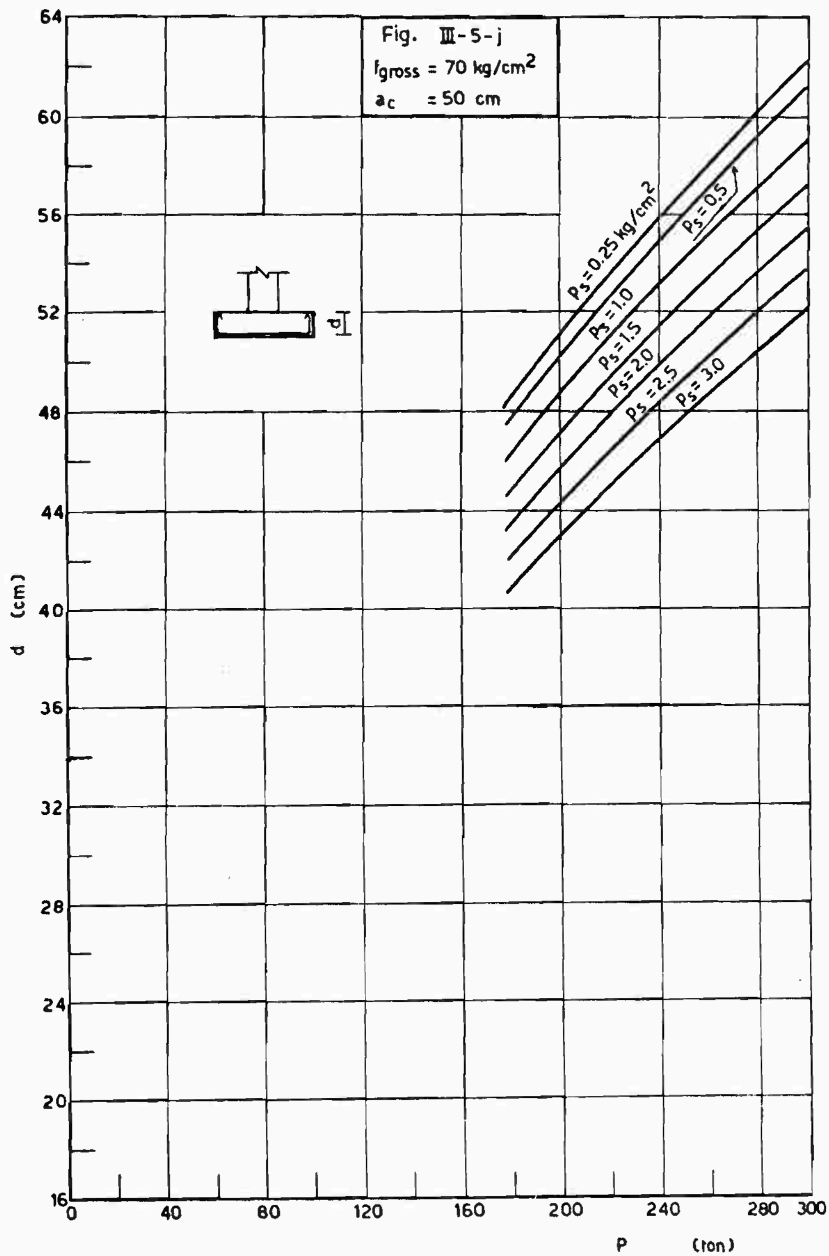


Fig. III-5-j
f_{gross} = 70 kg/cm²
a_c = 50 cm
Ps=0.25 kg/cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
d
d (cm)
64
60
56
52
48
44
40
36
32
28
24
20
16
0
40
80
120
160
200
240
280
300
P (ton)

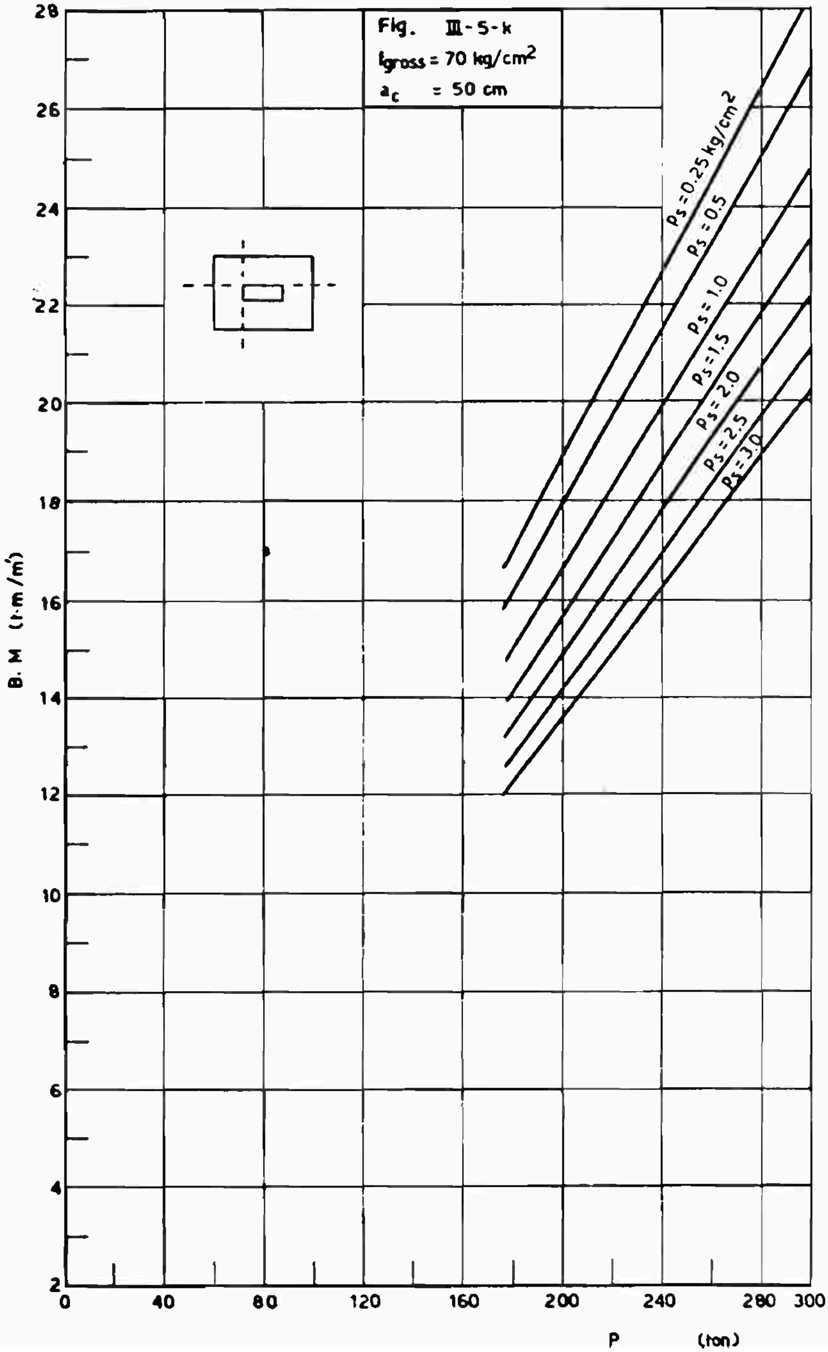


Fig. III-5-k
f_{gross} = 70 kg/cm^2
a_c = 50 cm
Ps = 0.25 kg/cm^2
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
B.M (t·m/m')
P (ton)
2
4
6
8
10
12
14
16
18
20
22
24
26
28
0
40
80
120
160
200
240
280
300

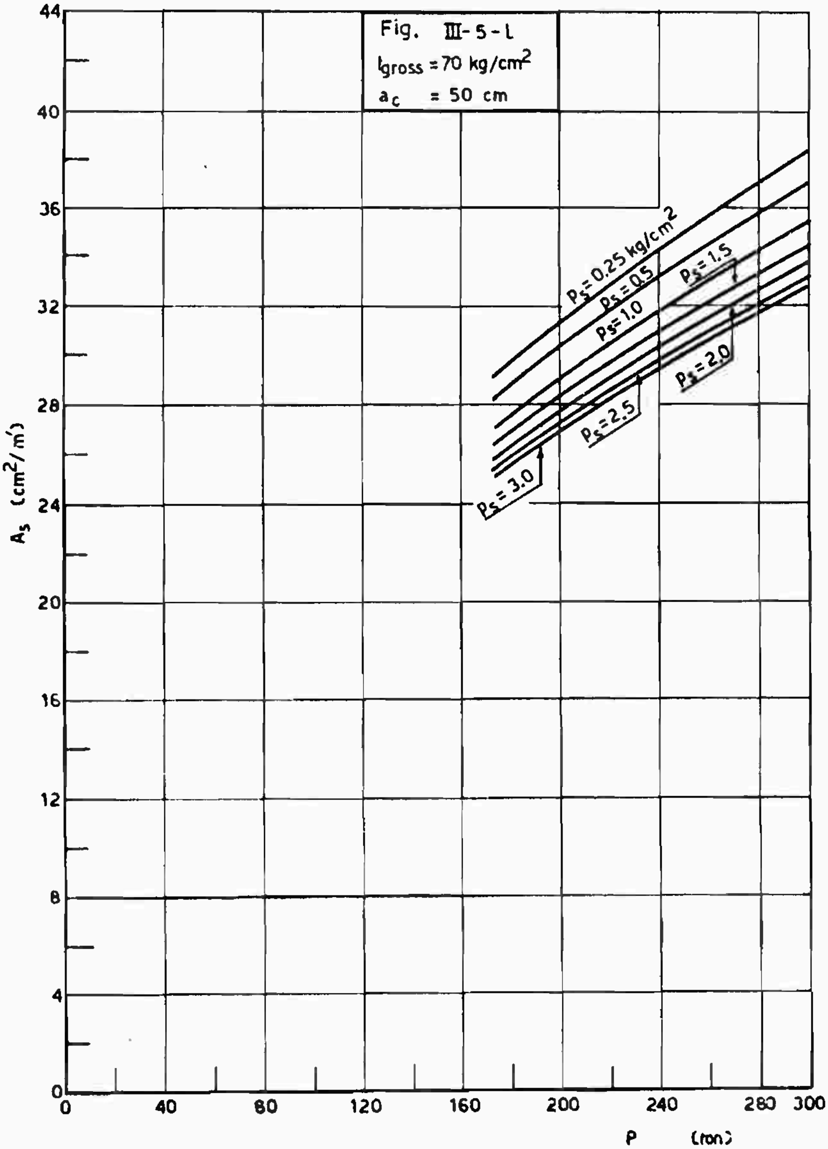


Fig. III-5-L
t_{gross} = 70 kg/cm²
a_c = 50 cm
P_s= 0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_s (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
0
40
80
120
160
200
240
280
300

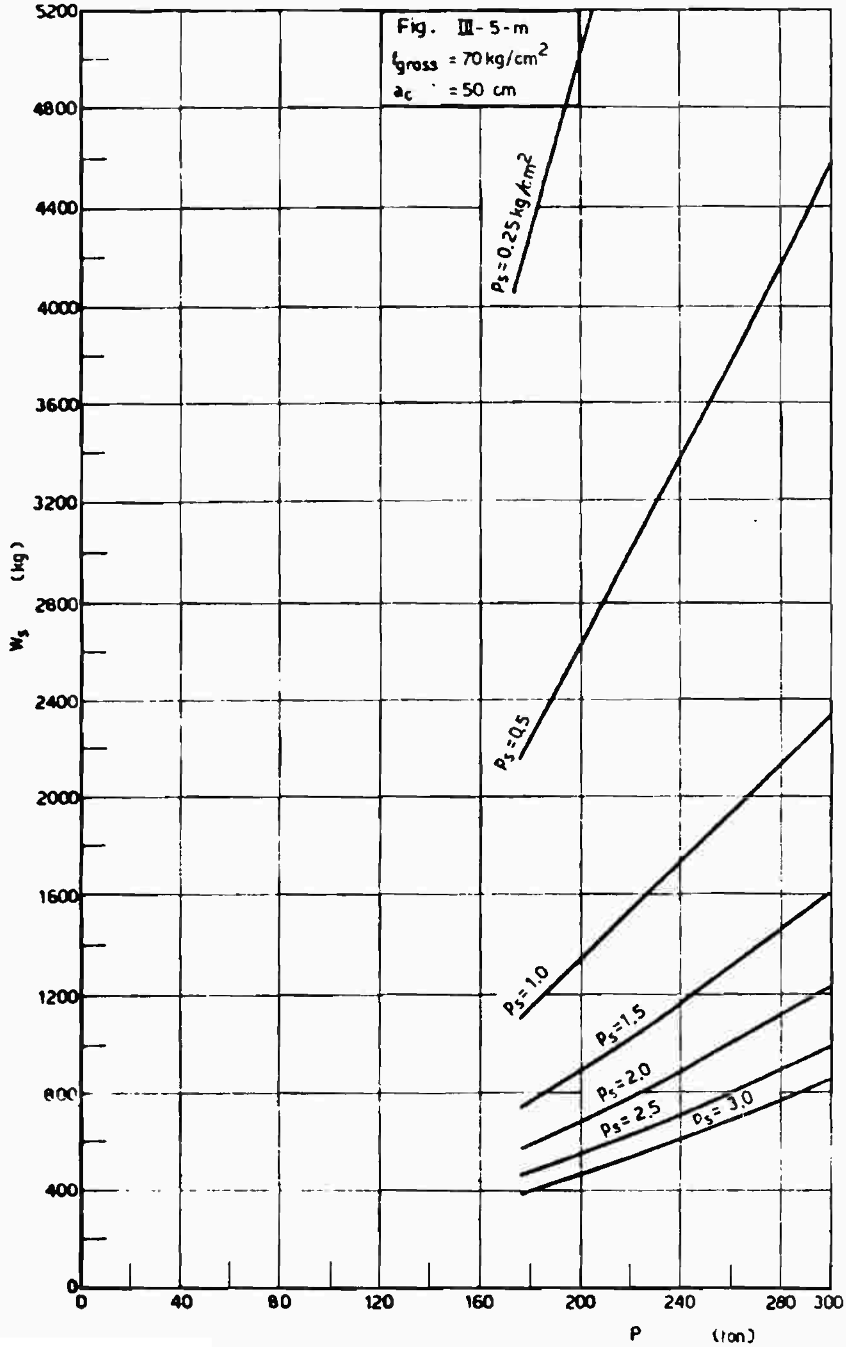


Fig. III-5-m
f_{gross} = 70 kg/cm^2
a_c = 50 cm
P_s = 0.25 kg/cm^2
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
W_s (kg)
P (ton)
0
40
80
120
160
200
240
280
300
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
5200

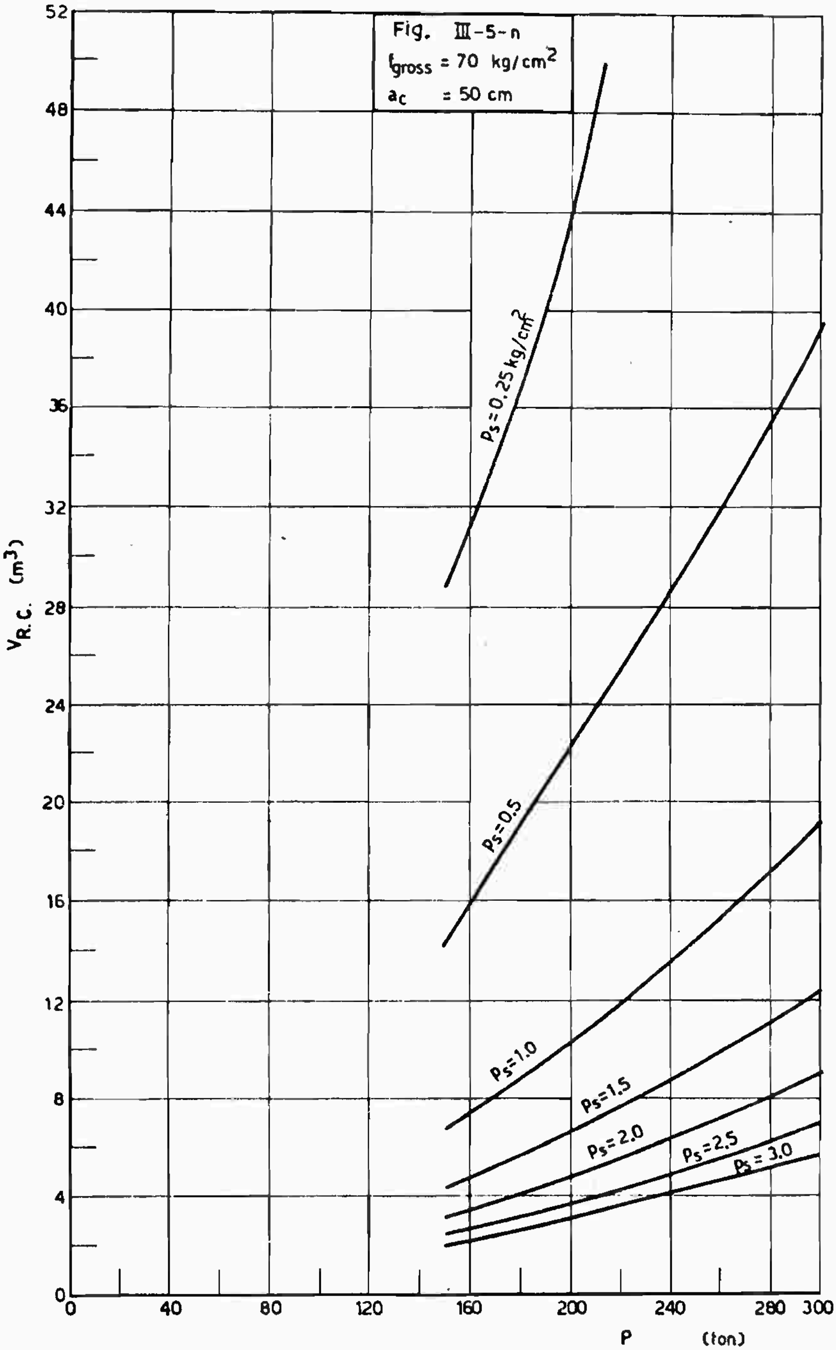


Fig. III-5-n
f gross = 70 kg/cm2
ac = 50 cm
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
VR.C. (m3)
P (ton)
0
40
80
120
160
200
240
280
300
4
8
12
16
20
24
28
32
36
40
44
48
52

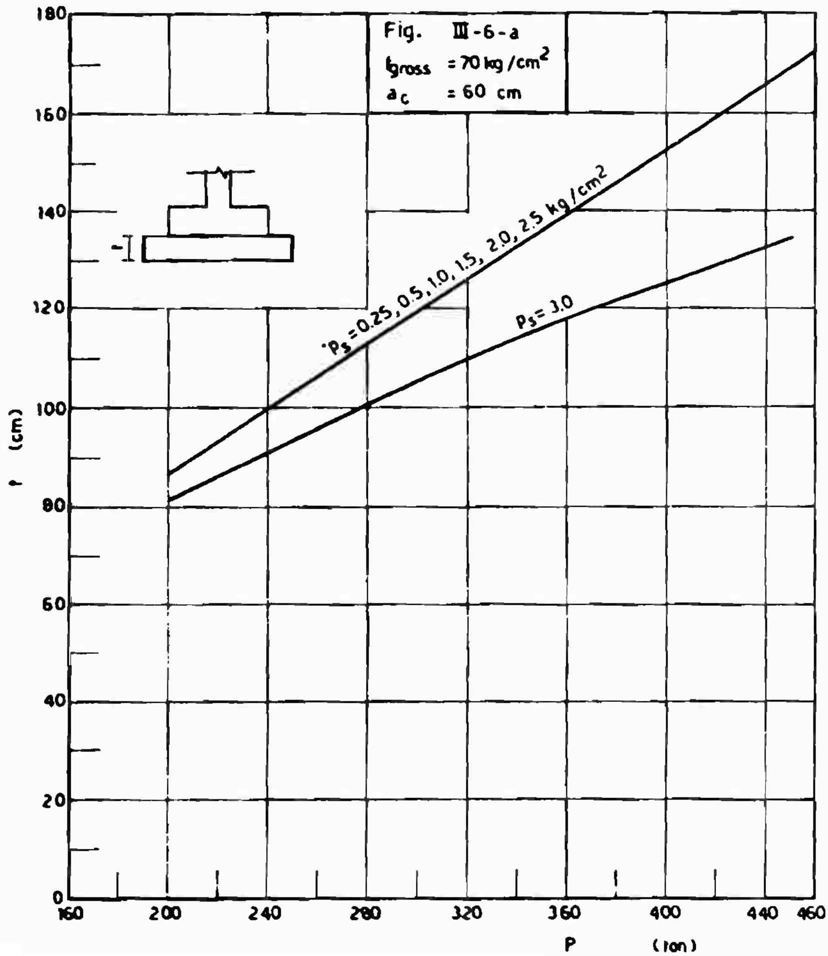


Fig. III-6-a
f gross = 70 kg/cm2
a c = 60 cm
Ps=0.25, 0.5, 1.0, 1.5, 2.0, 2.5 kg/cm2
Ps= 3.0
t (cm)
0
20
40
60
80
100
120
140
160
180
160
200
240
280
320
360
400
440
460
P (ton)

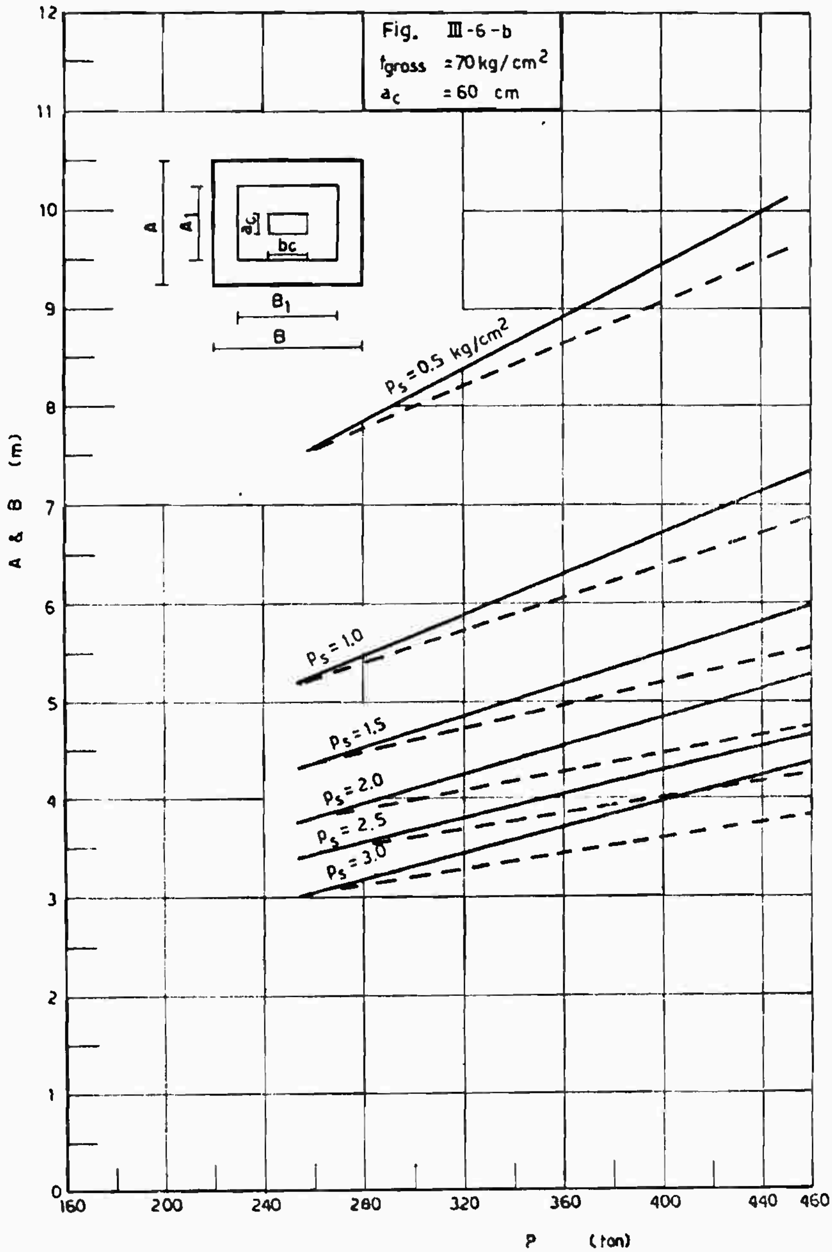


Fig. III-6-b
f_{gross} = 70 kg/cm²
a_c = 60 cm
A
A_1
a_c
bc
B_1
B
P_s = 0.5 kg/cm²
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
A & B (m)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
160
200
240
280
320
360
400
440
460

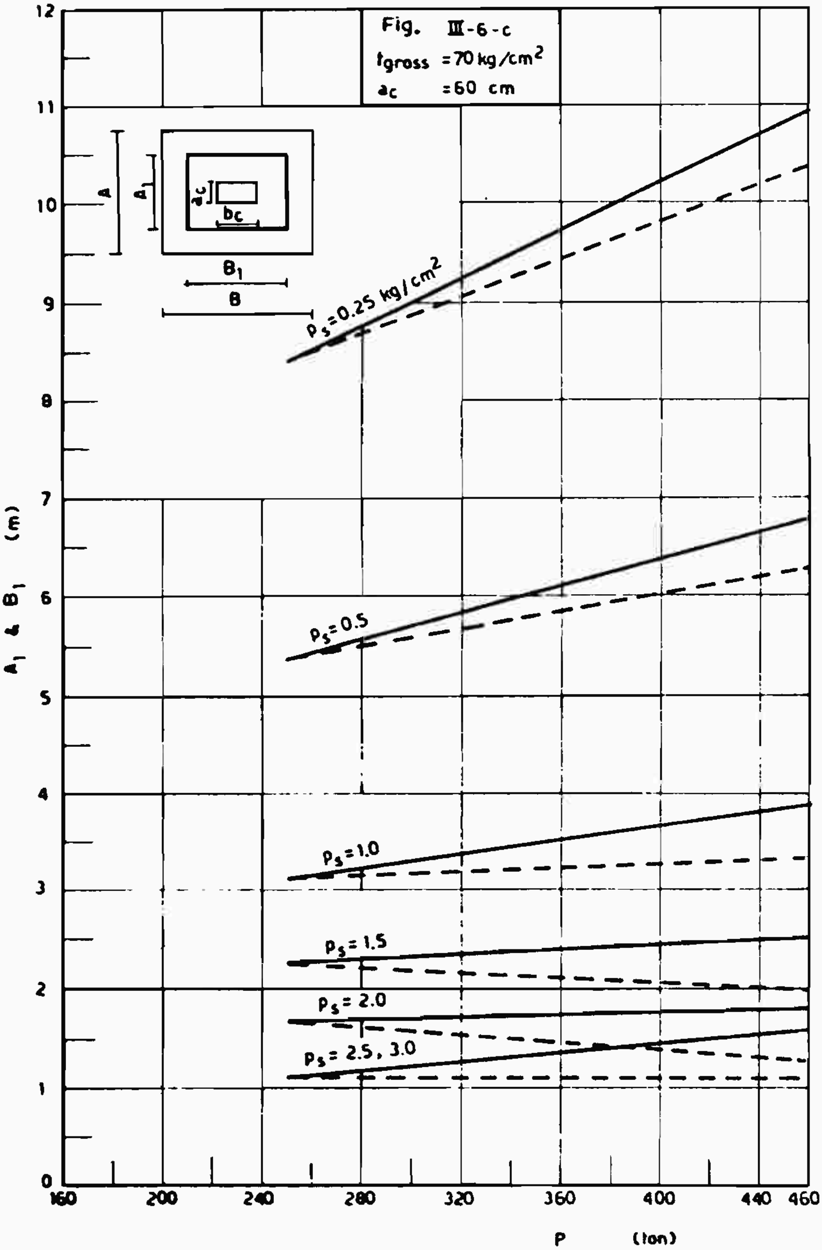


Fig. III-6-c
fgross = 70 kg/cm2
ac = 60 cm
A
A1
ac
bc
B1
B
Ps=0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5, 3.0
A1 & B1 (m)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
11
12
160
200
240
280
320
360
400
440
460

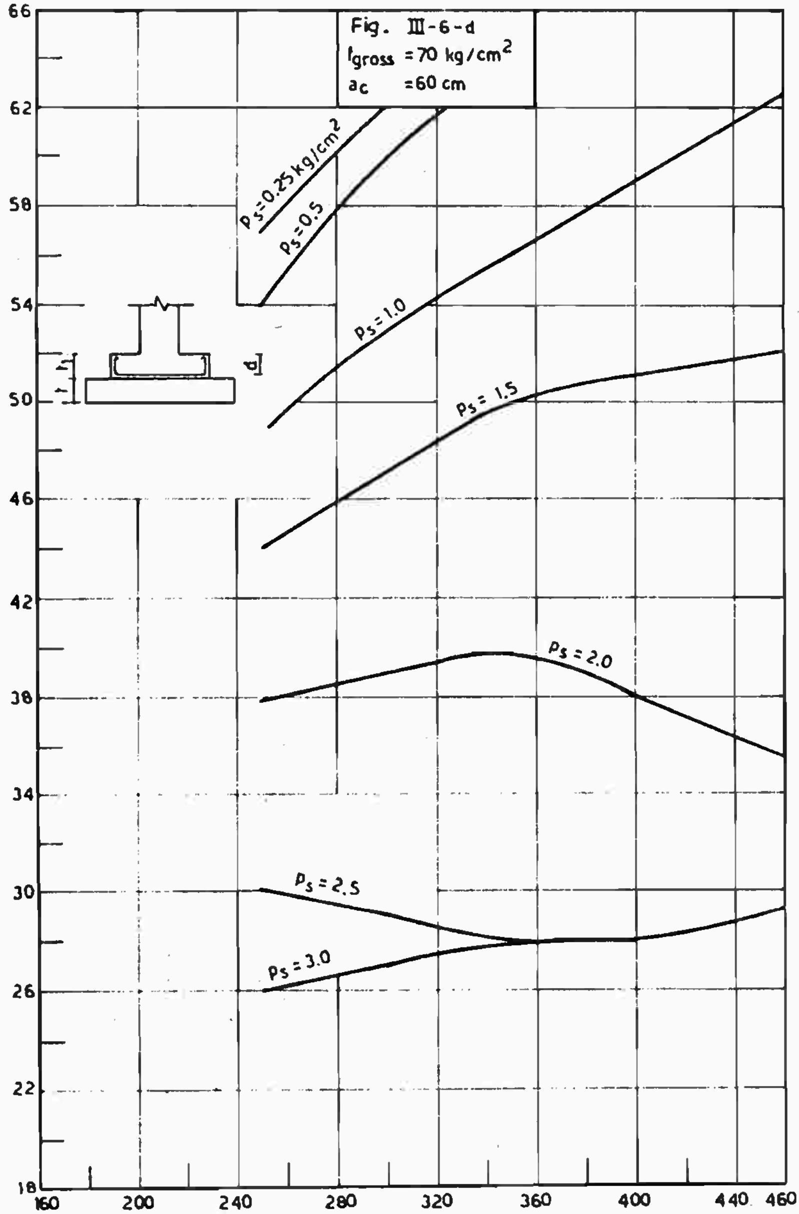


Fig. III-6-d
f_{gross} = 70 kg/cm²
a_c = 60 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s= 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
d
66
62
58
54
50
46
42
38
34
30
26
22
18
160
200
240
280
320
360
400
440
460

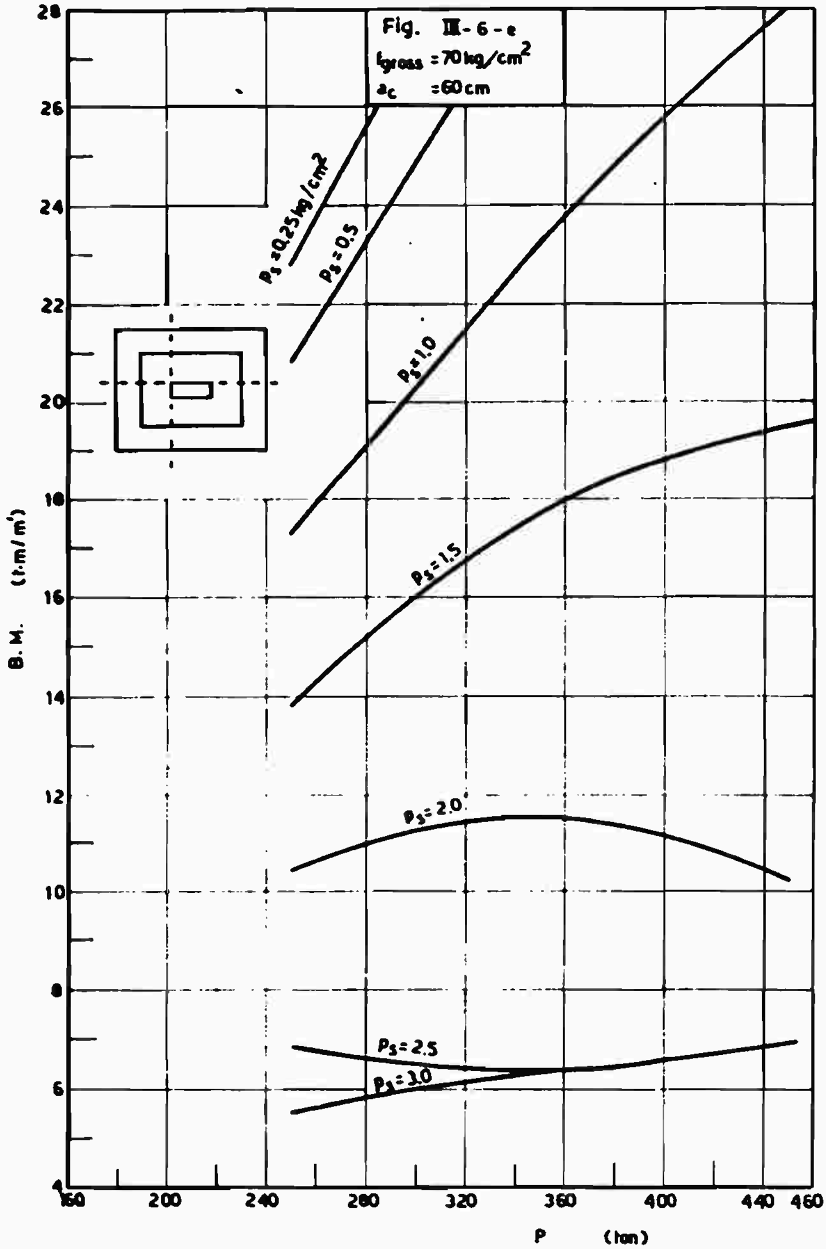


Fig. III - 6 - e
f_{gross} = 70 kg/cm²
a_c = 60 cm
P_s = 0.25 kg/cm²
P_s = 0.5
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
B. M. (t.m/m')
P (ton)
4
6
8
10
12
14
16
18
20
22
24
26
28
160
200
240
280
320
360
400
440
460

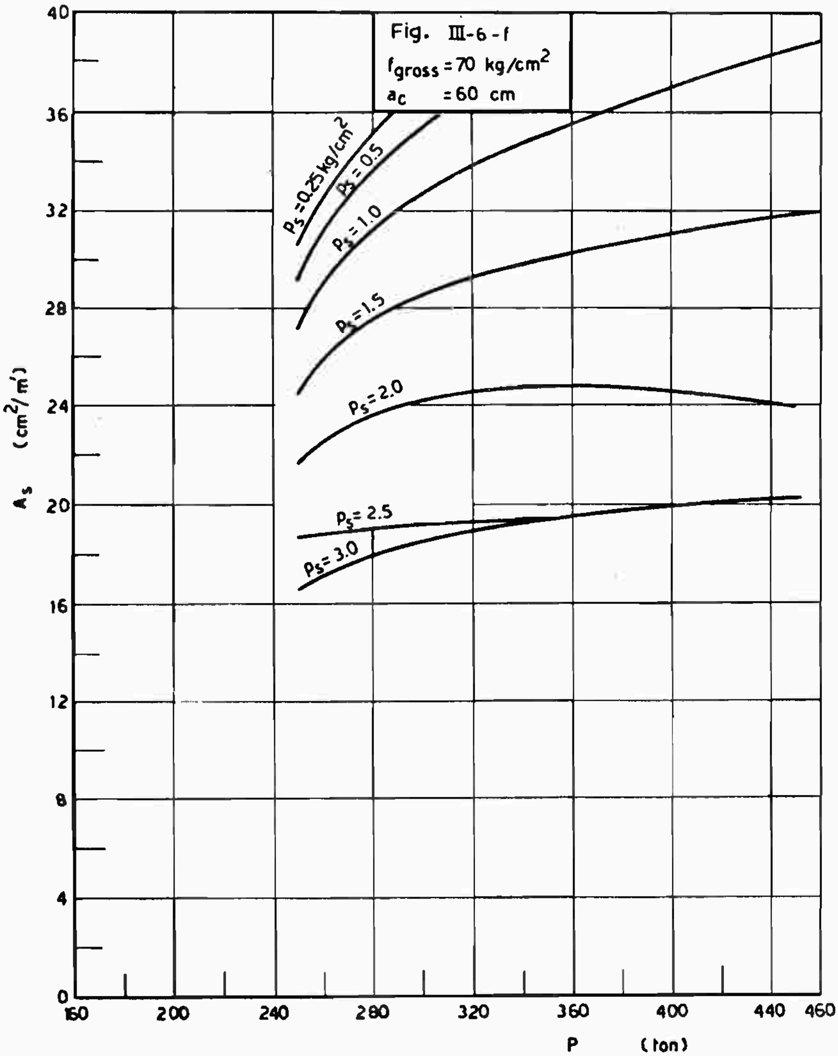


Fig. III-6-f
f_gross = 70 kg/cm²
a_c = 60 cm
Ps = 0.25 kg/cm²
Ps = 0.5
Ps = 1.0
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
As (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
160
200
240
280
320
360
400
440
460

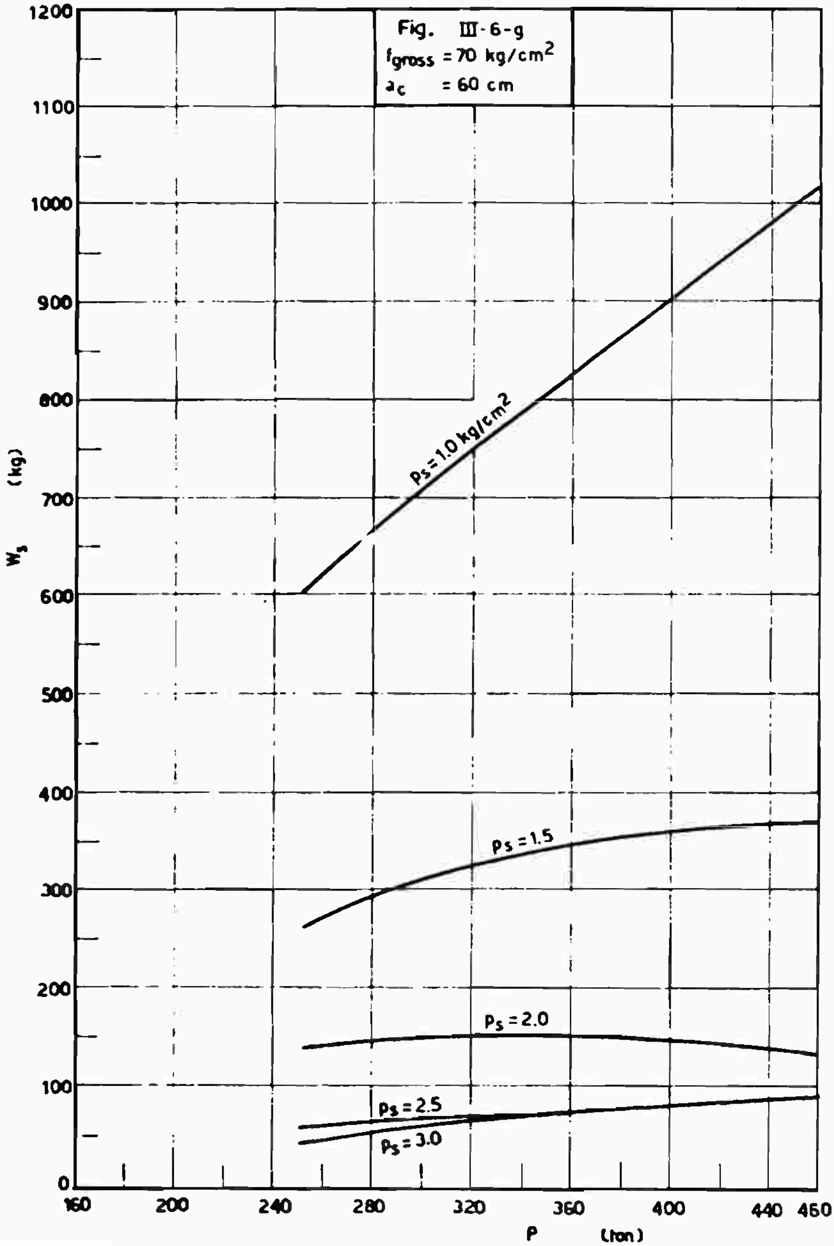


Fig. III-6-g
f_{gross} = 70 kg/cm^2
a_c = 60 cm
Ps=1.0 kg/cm^2
Ps = 1.5
Ps = 2.0
Ps = 2.5
Ps = 3.0
W_s (kg)
P (ton)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
160
200
240
280
320
360
400
440
460

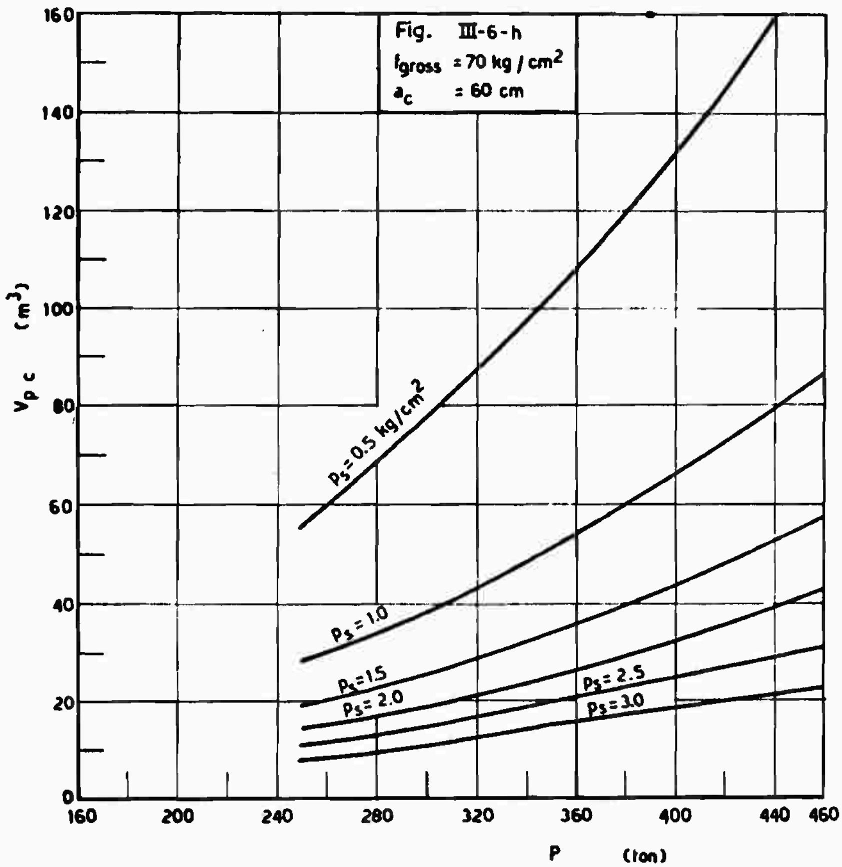


Fig. III-6-h
f_{gross} = 70 kg / cm^2
a_c = 60 cm
160
140
120
100
80
60
40
20
0
V_{pc} (m^3)
P_s = 0.5 kg/cm^2
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
160
200
240
280
320
360
400
440
460
P (ton)

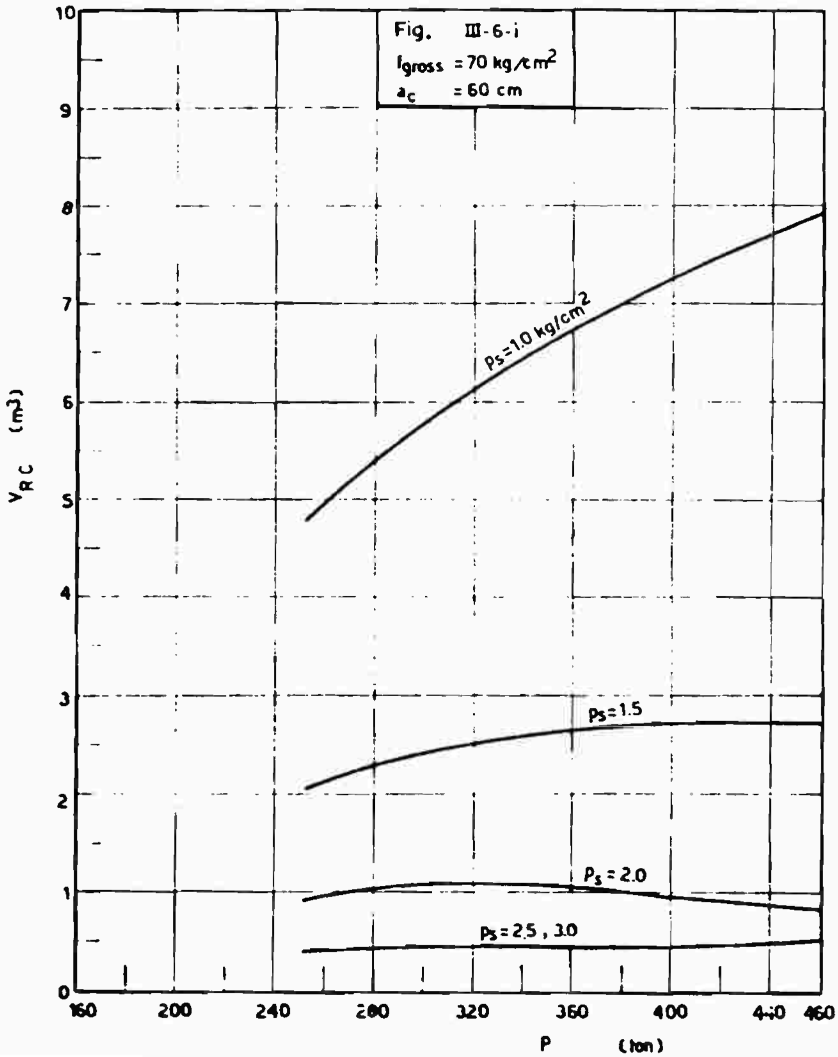


Fig. III-6-i
f_{gross} = 70 kg/cm²
a_c = 60 cm
Ps=1.0 kg/cm²
Ps=1.5
Ps = 2.0
Ps = 2.5 , 3.0
V_{RC} (m³)
P (ton)
0
1
2
3
4
5
6
7
8
9
10
160
200
240
280
320
360
400
440
460

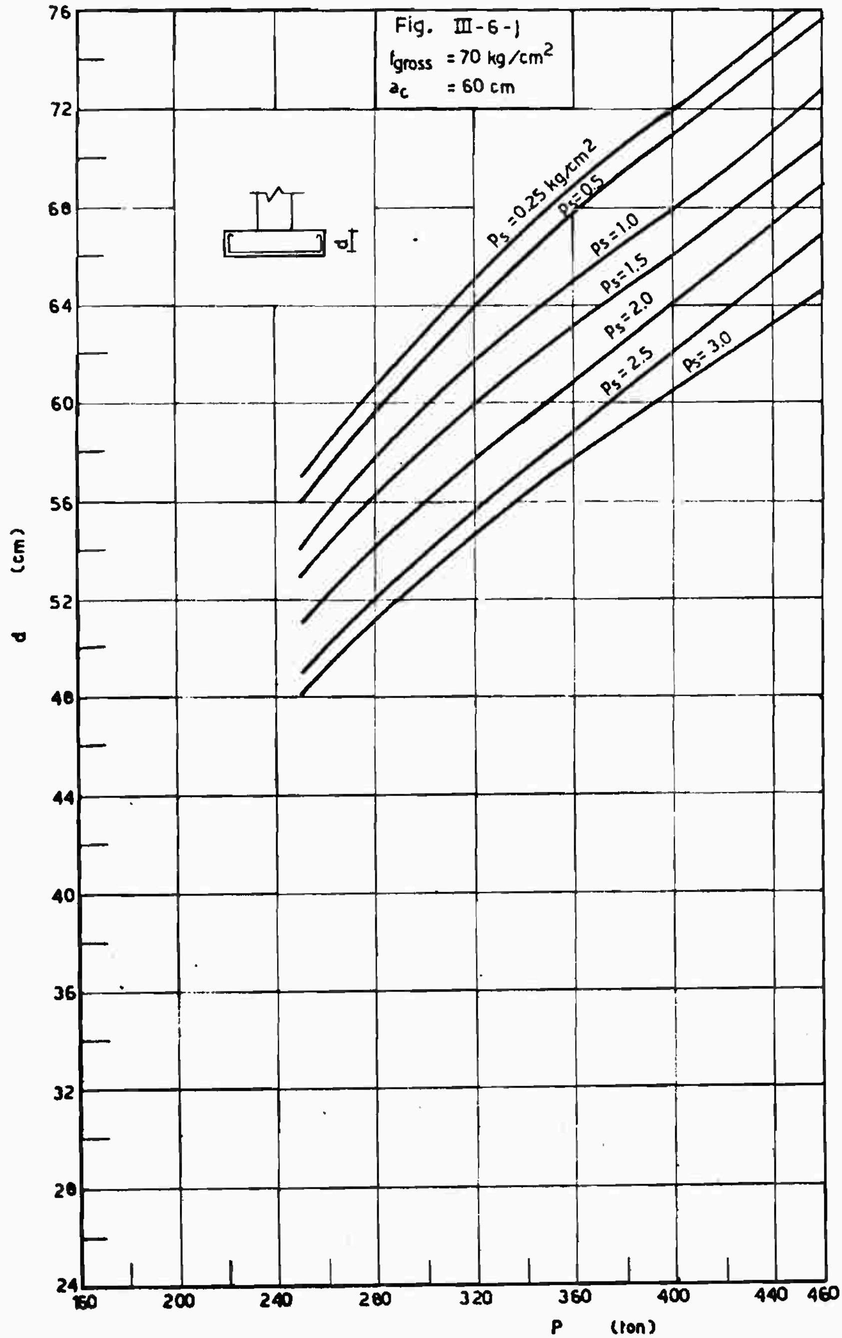


Fig. III-6-j
fgross = 70 kg/cm2
ac = 60 cm
d
Ps = 0.25 kg/cm2
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
76
72
68
64
60
56
52
48
44
40
36
32
28
24
d (cm)
160
200
240
280
320
360
400
440
460
P (ton)

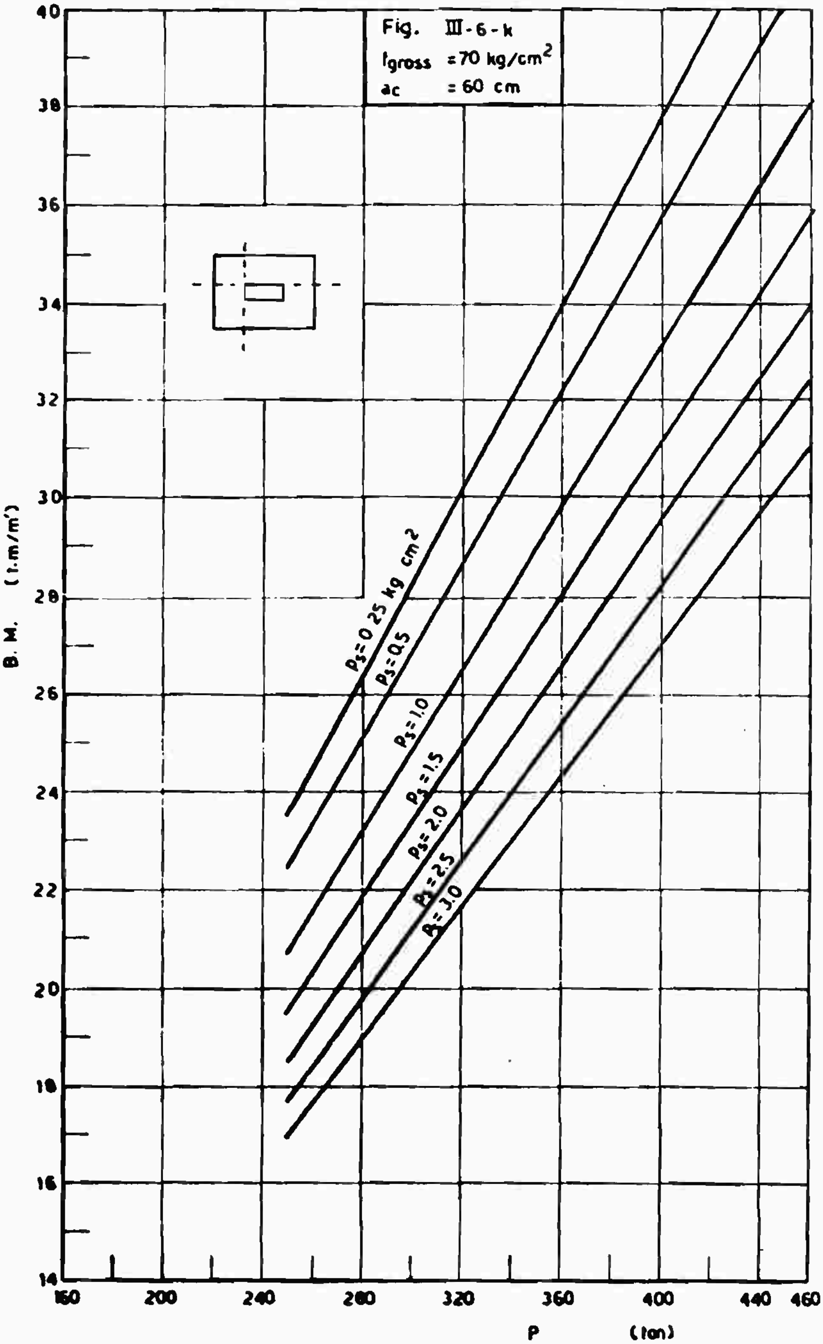


Fig. III-6-k
f_{gross} = 70 kg/cm²
ac = 60 cm
B. M. (t.m/m')
P (ton)
Ps=0.25 kg cm²
Ps=0.5
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
40
38
36
34
32
30
28
26
24
22
20
18
16
14
160
200
240
280
320
360
400
440
460

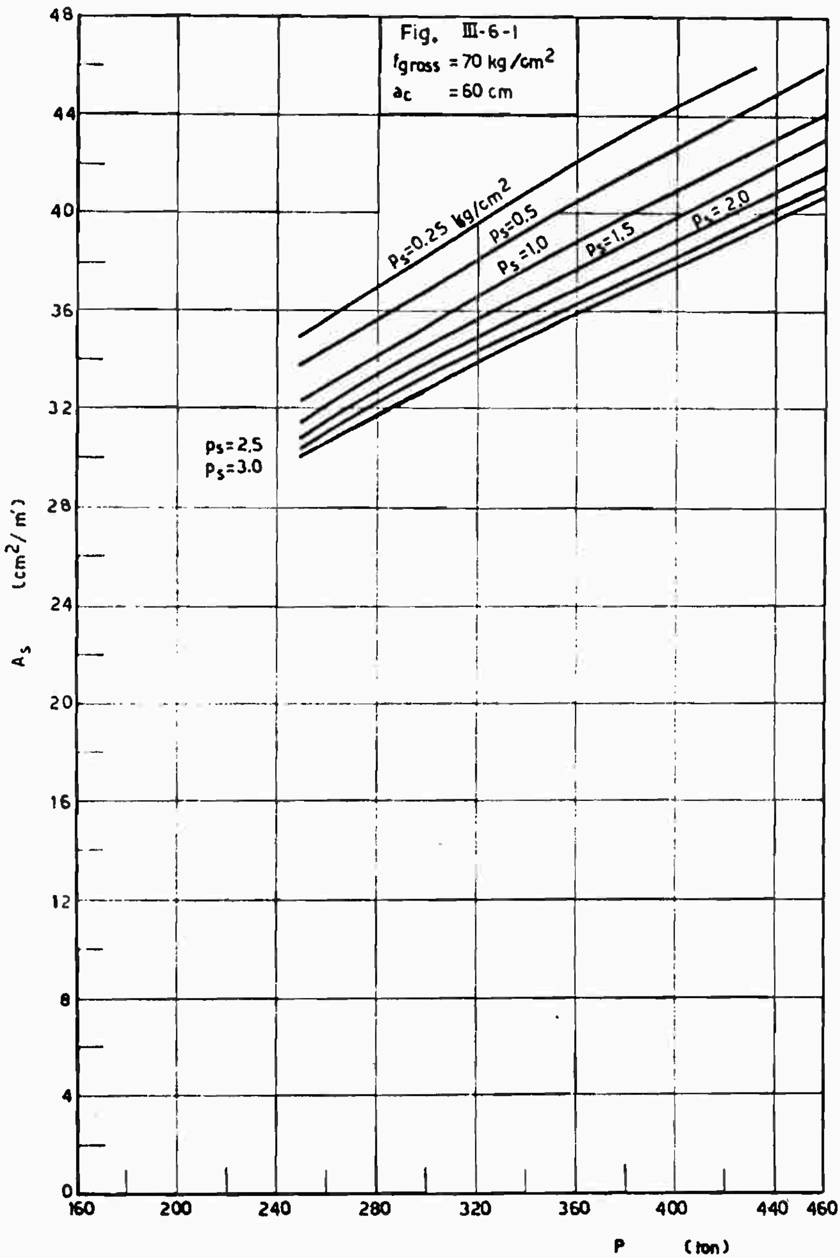


Fig. III-6-1
f_{gross} = 70 kg/cm²
a_c = 60 cm
P_s=0.25 kg/cm²
P_s=0.5
P_s=1.0
P_s=1.5
P_s=2.0
P_s=2.5
P_s=3.0
A_s (cm²/m')
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
48
160
200
240
280
320
360
400
440
460

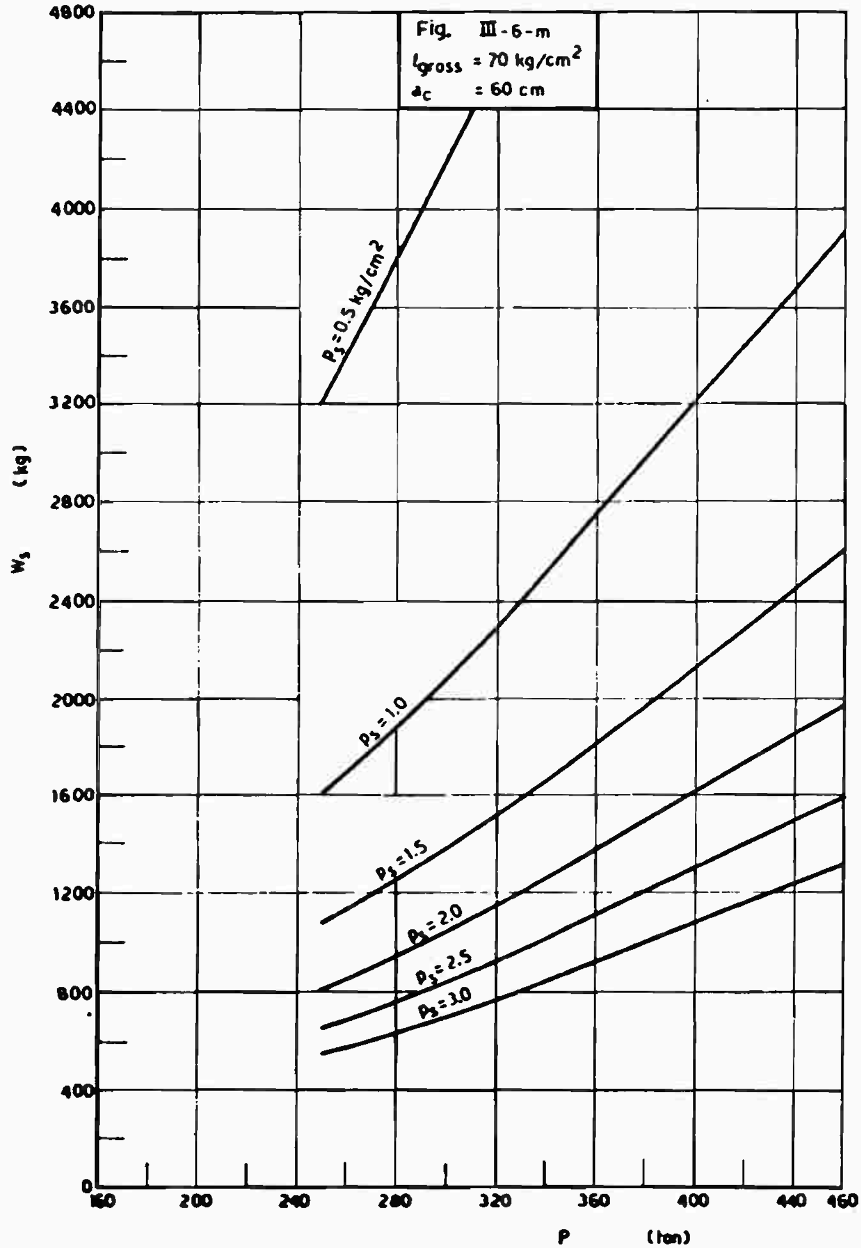


Fig. III-6-m
f_{gross} = 70 kg/cm²
a_c = 60 cm
P_s = 0.5 kg/cm²
P_s = 1.0
P_s = 1.5
P_s = 2.0
P_s = 2.5
P_s = 3.0
W_s (kg)
P (ton)
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
4800
160
200
240
280
320
360
400
440
460

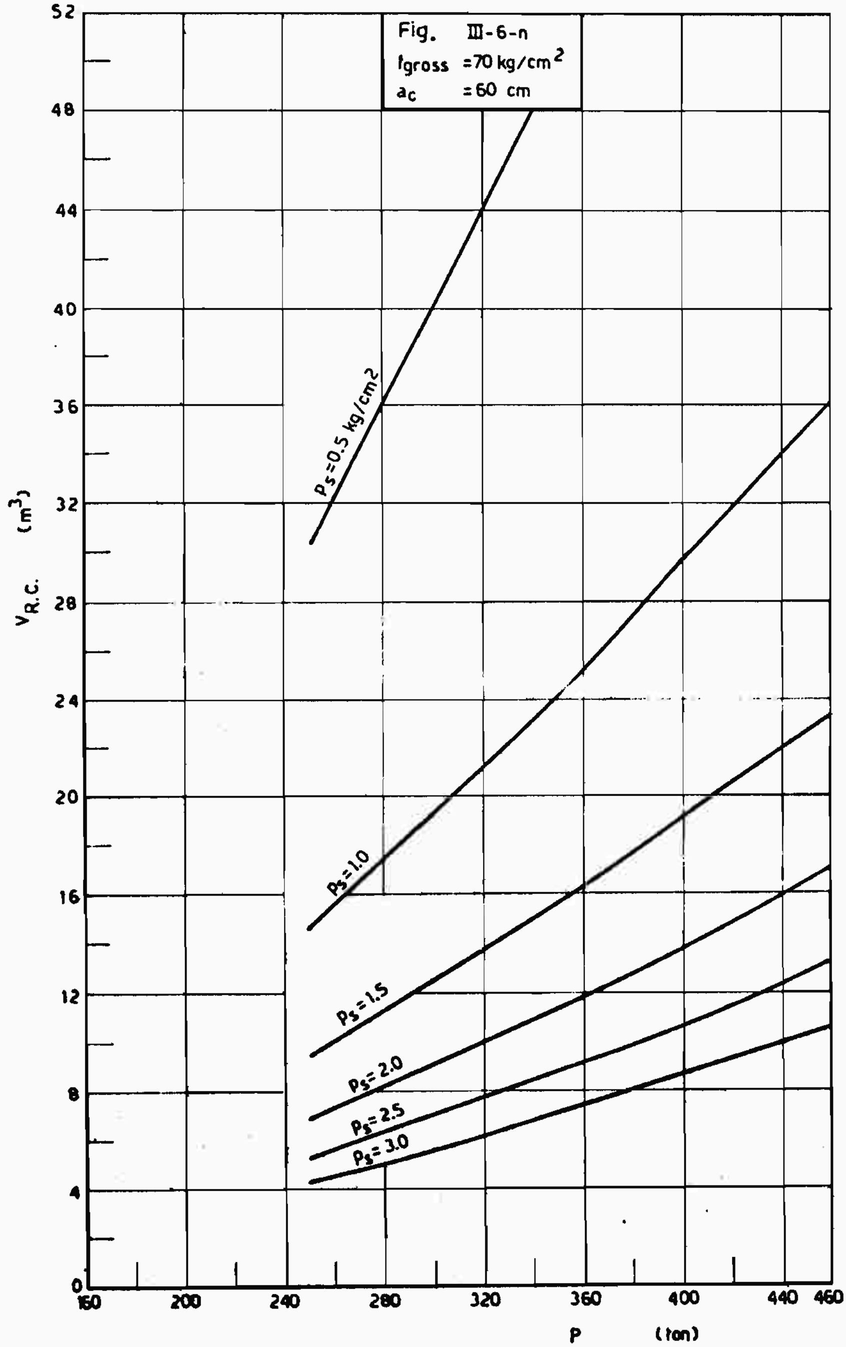


Fig. III-6-n
fgross =70 kg/cm2
ac =60 cm
Ps=0.5 kg/cm2
Ps=1.0
Ps=1.5
Ps=2.0
Ps=2.5
Ps=3.0
VR.C. (m3)
P (ton)
0
4
8
12
16
20
24
28
32
36
40
44
48
52
160
200
240
280
320
360
400
440
460