ECOLE POLYTECHNIQUE
DE THIES
Département de
GENIE CIVIL

PROJET DE FIN
D ETUDES

Titre: Analyse structurale et dimensionnement en béton armé

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JUIN 1988

REMERCIEMENTS

Sur cette page, je tiens tout d'abord à remercier vivement mon directeur de projet Monsieur Thomas Aquin ingénieur Mc. A, professeur à l'école polytechnique de Thies pour son dévouement et sa disponibilité.
Mes remerciements vont aussi à tous ceux qui, de prés ou de loin, m'ont aidé à faire ce projet en particulier mon dessinateur et ami P. Faly Sané.

SOMMAIRE

Dans ce projet de fin d'étude, il est question d'une étude de bâtiment en particulier d'une analyse structurale et d'un dimensionnement en béton armé des élèments structuraux du bâtiment.
Pour ce faire j'ai créé un bâtiment du type commercial avec comme forme structurale de plancher des dalles planes avec poutres aux extrémités et portant dans deux directions.
il ne sera pas fait l'analyse de toutes la structure du batiment mais de quelques cadres longitudinaux et transversaux représentatifs et de dimensionner quelques élèments structuraux comme les dalles, les poutres, les poteaux et les semelles.
L'étude se divise en quatre parties:

- L'étude des plans architectes
- La mise en charge
- L'analyse structurale et
- Le dimensionnement des élèments structuraux.

TABLE DES MATIERES

PARTIE I

Etude de plans architectes

L'ossature d'un bâtiment.

La charpente d'un bâtiment peut être divisée en quatre (4) parties:

1) Les planchers et toits.

Ils se composent de la partie portante, la dalle avec des poutres ou poutrelles, de la chape et du plafond.

2) Les éléments verticaux.

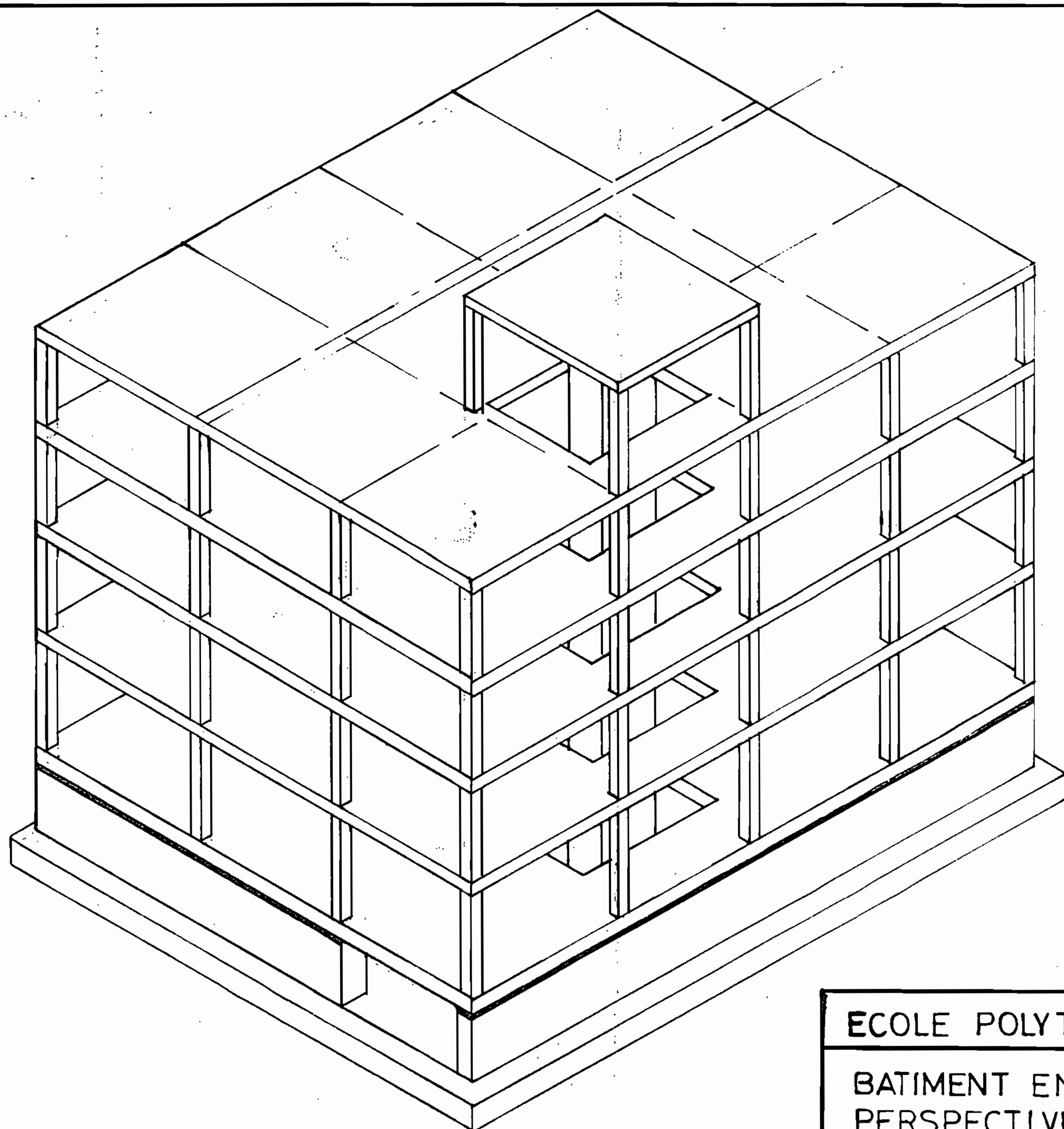
Ils transmettent les charges des planchers aux fondations. On distingue les murs structuraux et les poteaux.

3) Les fondations

Ils prennent appuis au sol, transmettent et répartissent sur ou dans le sol les charges. On a les semelles, les radiers, les murs de fondation, les piliers ou pilastres et les dalles sur le sol (dallages).

4) Les escaliers.

Ils relient les planchers. Ses principales parties sont: les paliers, les volées et les limons.



PERSPECTIVE

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Prédimensionnement.

Le batiment d'étude est un batiment commercial constitué d'un sous-sol, d'un rez de chaussée et de trois (3) étages (voir les plans architectes en annexe)
Les planchers du bâtiment sont des dalles avec poutres dans les deux sens. Cette forme structural est avantageuse surtout lorsque les charges sur les planchers sont élevées ou lorsque l'espacement entre les poteaux est grand.
Dans notre cas, on fixe cette espace, la distance axe à axe des poteaux à 6 m dans les deux sens.

1) Dimensions dalles

Les dalles sont carrées (6 × 6 m) et bidirectionnelles avec des appuis rigides (poutres) sur les quatres (4) cotés.

- Epaisseur minimale : $h \geq 100$ mm

- Dalle discontinue sur une ou plusieurs rives : $h \geqslant \frac{\text{périmètre}}{140} = \frac{4 \times l}{140} = \frac{4 \times 6000}{140} = 170\,mm$
- Dalle continue sur deux (2) rives

$$h \geqslant \frac{\text{périmètre}}{160} = \frac{4 \times l}{160} = \frac{4 \times 6000}{160} = 150\,mm$$

On prend $h = 170$ mm

2) Dimensions poutres.

Poutres unidimensionnelles

- Epaisseur minimale au dessous de laquelle on doit calculer les fleches (h)

Poutres continues à une extrémité.

$$h = \frac{l}{18,5} = \frac{6000}{18,5} = 324 \text{ mm}$$

Poutres continues aux deux extrémité

$$h = \frac{l}{21} = \frac{6000}{21} = 286 \text{ mm}$$

On prend $h = 400$ mm

- Largeur (b)

$$1,5 \leq \frac{h}{b} \leq 2 \Longleftrightarrow \frac{h}{2} \leq b \leq \frac{h}{1,5}$$

$h = 400$ mm $\Longrightarrow$ 200 mm $\leq b \leq$ 267 mm

$b = 250$ mm poutres intérieures

$b = 300$ mm poutres extérieures (torsion)

3) Dimensions poteaux.

Béton $w_c = 2400 \text{ kg/m}^3 \Rightarrow \gamma_c = 24 \text{ kN/m}^3$

- Charges permanentes

Dalle poids propre $0,17 \times 24 = 4,08 \text{ kN/m}^2$

Surcharge permanente $1,30 \text{ kN/m}^2$

$w_d = 5,38 \text{ kN/m}^2$

$$w_{df} = 5,38 \times 1,25 = 6,73 \text{ kN/m}^2$$

- Surcharges

Toit : $w_\ell = 2,4\ kN/m^2 \Rightarrow w_{\ell f} = 1,5 \times 2,4 = 3,60\ kN/m^2$

Planchers : $w_\ell = 4,8\ kN/m^2 \Rightarrow w_{\ell f} = 1,5 \times 4,8 = 7,20\ kN/m^2$

- Charges pondérées

$w_f = w_{df} + w_{\ell f}$

		kN/m^2
Toit	4	$6,73 + 3,6 = 10,33$
Plancher	3	$7,20 + 6,73 = 13,93$
Plancher	2	$7,20 + 6,73 = 13,93$
Plancher	1	$7,20 + 6,73 = 13,93$
Plancher	R-C	$7,20 + 6,73 = 13,93$

Poteaux Sous-sol $w_f = 66,05\ kN/m^2$

- Surface tributaire poteaux

$6 \times 6 = 36\ m^2$

- Charges axiales aux poteaux de :
- Rez de chaussée : $52,12 \times 36 = 1876,32\ kN$
- Sous-sol : $66,05 \times 36 = 2377,80\ kN$

$f'_c = 25\ MPa$ $f_y = 400\ MPa$ $\rho = 1\%$

(voir fig. 1 dimensionnement poteaux)

Sections poteaux $400 \times 400\ mm$

(première approximation)

[redacted] Axial Load Limit $P_{r(max)}$ for Tied Columns, $f'_c = 25$ MPa

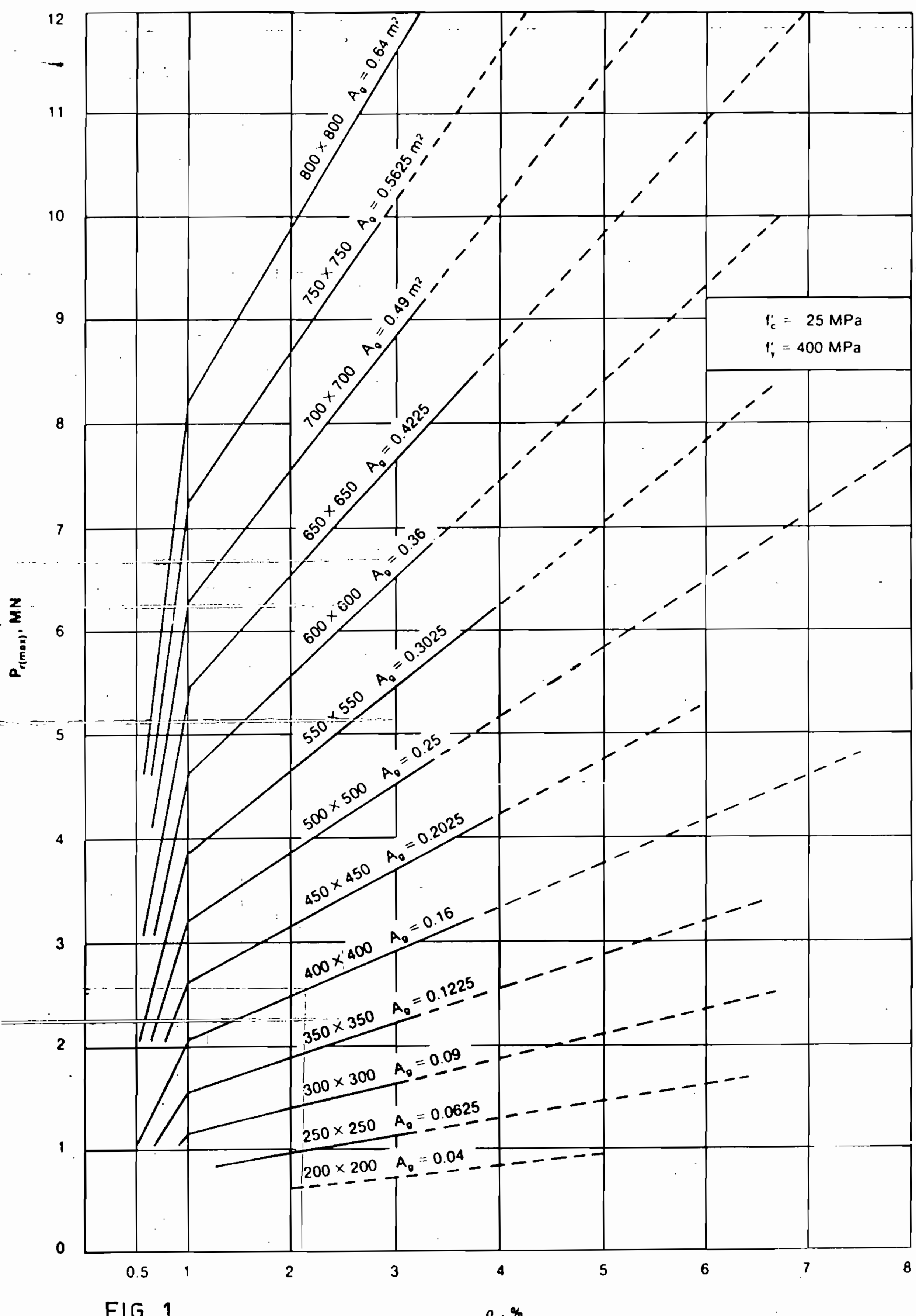
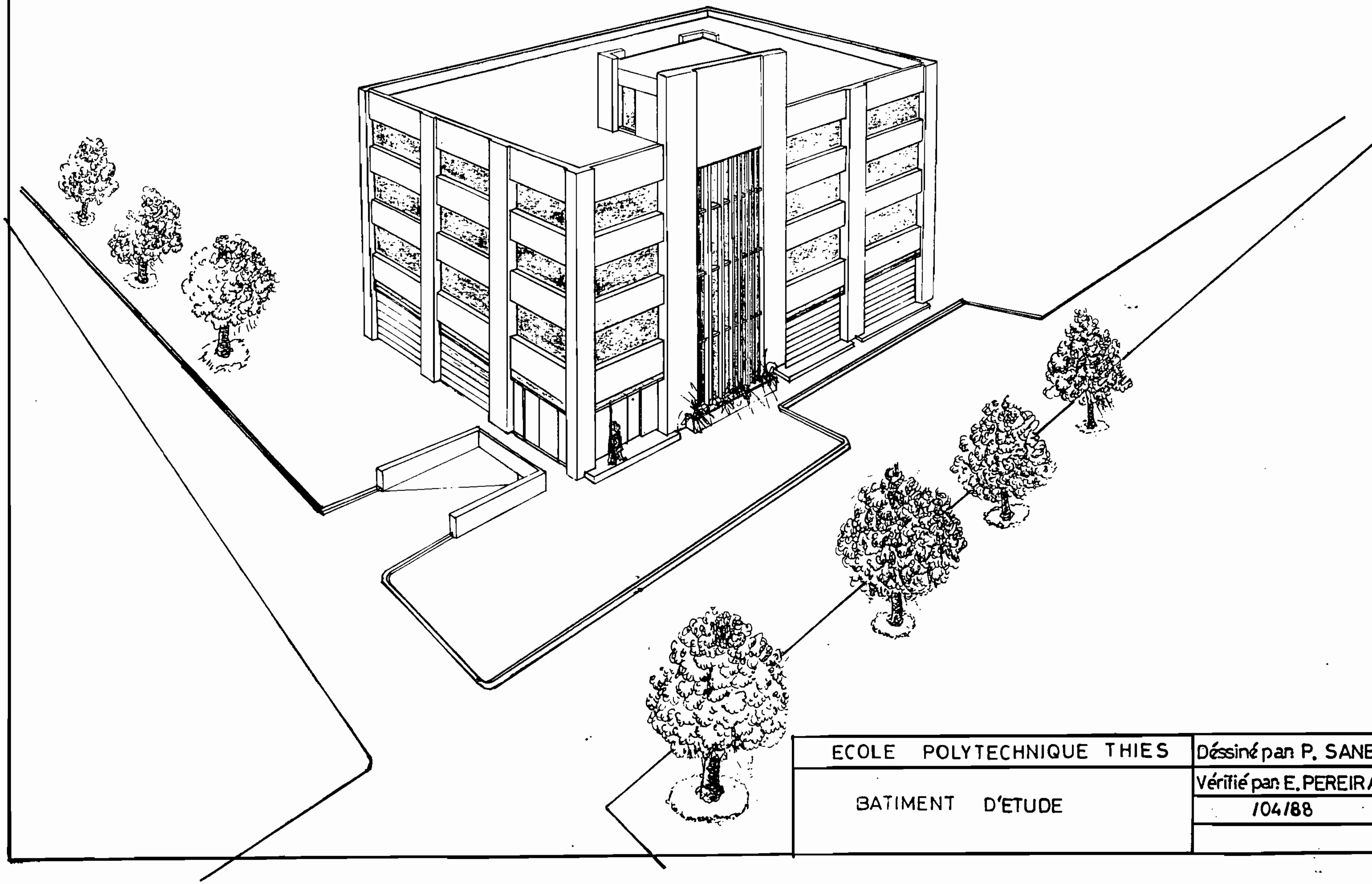


FIG 1



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PARTIE II

Mise en charge

Mise en charge.

Charges sur la structure.

Un bâtiment est conçu pour supporter toutes les charges prévues et leurs assemblages qui donnent les forces internes maximales.

1) Classes et types de charges.

On a deux (2) classes de charges:
- Les charges permanentes et
- Les surcharges (controlées et non controlées)

On distingue trois types de charges:
- Les charges concentrées (KN)
- Les charges linéaires (KN/m) et
- Les charges réparties (KN/m² ou KPa)

2) Charges prévues.

Les charges, les surcharges et les effets appliqués au bâtiment sont,

a) Les charges permanentes (D):
Poids propres des éléments, des matériaux
Surcharges permanentes, etc...

b) Les surcharges dues à l'usage (L)
Charges appliquées sur les surfaces de

de planchers ou de toits selon l'usage du bâtiment.

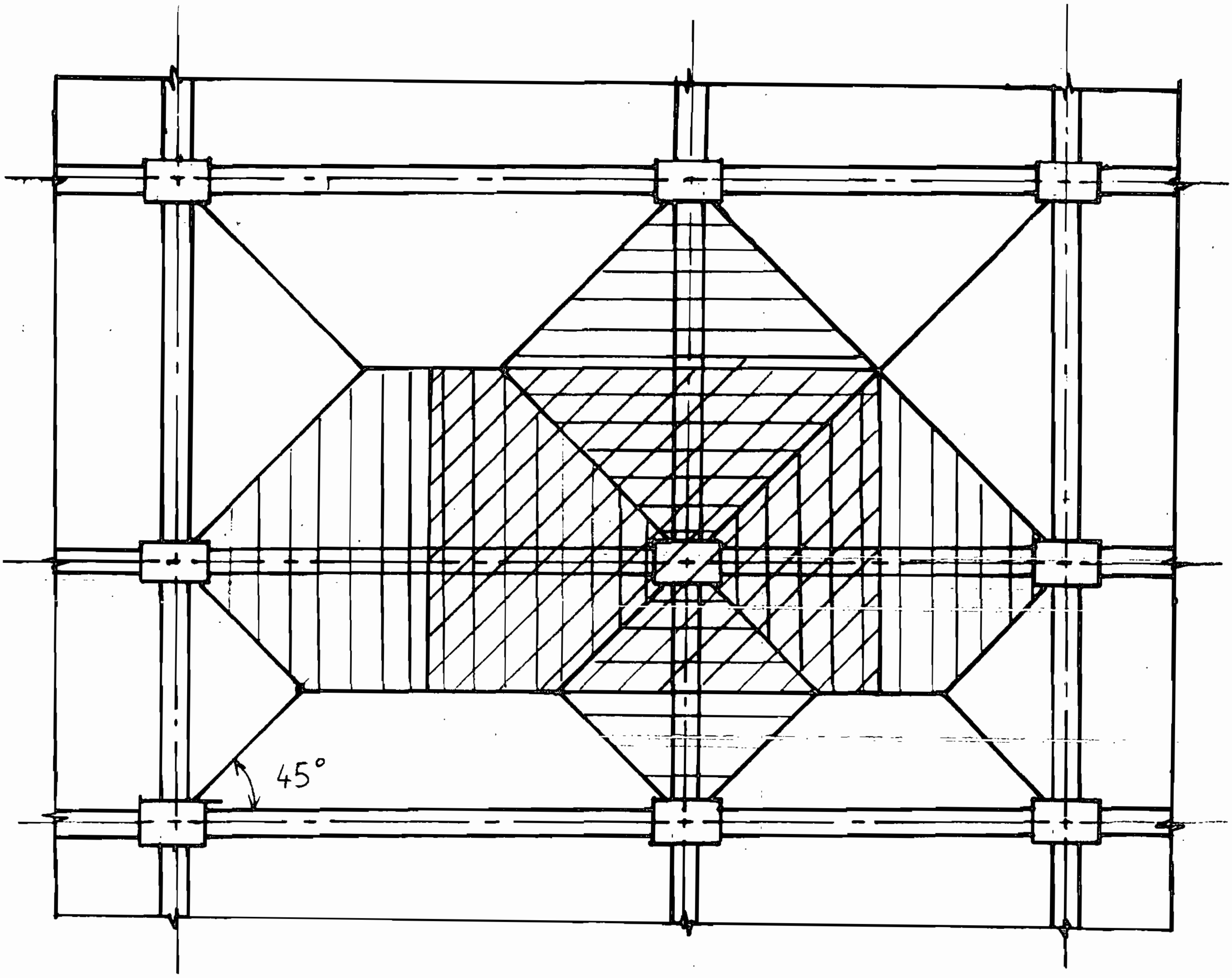
c) Les surcharges dûes à la pluies (dans nos pays), à la neige et à la glace (dans les pays tempérés)

d) Les surcharges dûes aux vents (Q) ou aux séismes.

e) Autres :
Poussées des terres. Pressions hydrostatiques. Efforts statiques ou d'inertie
- Efforts dûs aux dilatations et contraction (T) provoqués par des variations de températures, le retrait et...

Surface tributaire

Cette notion définit la surface supportée par un élément et délimitée par des lignes de cisaillement nul. Elle permet de déterminer les charges que supportent les poutres et les poteaux.
La norme recommande une réduction de la surcharge en fonction de la surface tributaire.



SURFACES TRIBUTAIRES DES DALLES ARMEES
DANS LES 2 SENS SUR POUTRES

Combinaisons des charges

Elles dépendent des méthodes de calcul.

1) Calcul aux contraintes admissibles
Son principe est que les contraintes des actions des charges de service demeurent dans le domaine élastique et sont inférieures aux contraintes admissibles.
Les combinaisons sont les suivantes:
D ; D + L ; D + Q ; D + T ($\psi = 1,0$)
D + L + Q ; D + L + T ; D + Q + T ($\psi = 0,75$) et
D + L + Q + T ($\psi = 0,66$)
ψ = coéfficient de simultanéité de charges.
Cette méthode dépassé fait place à nos jours à celle des états limites.

2) Calcul aux états limites
Il tient compte du comportement inélastique du béton. L'état limite est le point où la structure cesse de remplir sa fonction. On distingue l'état limite de service ou d'utilisation et l'état limite ultime ou de rupture.
Les charges sont pondérées

$\alpha_D = 1,25$; $\alpha_L = 1,50$

$\alpha_Q = 1,50$ et $\alpha_T = 1,25$

La combinaison des charges est:

$$\alpha_D D + \gamma \psi (\alpha_L L + \alpha_Q Q + \alpha_T T)$$

γ = coéfficient de risque $\gamma \geq 0,8$ ($\gamma = 1,0$)
ψ = coéfficient de simultanéité de charge
$\psi = 1,00$, $\psi = 0,70$ ou $\psi = 0,60$

Le calcul du bâtiment se fait telque
$\phi R \geq S$
ϕR = résistance d'un élément en fonction des sollicitations (flexion, éfforts tranchants, charges axiales et torsion)
S = effets des charges pondérées.

La combinaison $D + \psi (L + Q + T)$
permet la vérification de la tenu en service.

PARTIE III

Analyse structurale
Réactions
Efforts internes
Déformations

Analyse structurale.

Cette analyse se fait à l'aide du programme P-FRAME. Ce programme très performant permet de déterminer les efforts internes dans les éléments linéaires (poutres et poteaux) des cadres rigides.
Il donne les efforts axiaux (compression ou traction), les efforts transversaux (cisaillement) et les moments de flexion aux noeuds de ces éléments assemblés selon les cas de chargement et leurs combinaisons.
Il permet également de trouver les déformations aux noeuds (déplacements dans les deux (2) sens et rotation) et les réactions aux appuis.
Les valeurs trouvées sont utilisées dans les calculs de dimensionnement des poutres et des poteaux.
Il est stocké sur disquettes, l'analyse et les résultats numériques.

1) Propriétés du béton.

Densité : $\gamma_c = 2400\ kg/m^3$

Résistance à la compression : $f'_c = 20\ MPa$

Coéfficient de poisson : $\mu = 0,18$

Module d'élasticité ou module de Young E_c :

$E_c = 0,43\ \gamma_c^{1,5} \sqrt{f'_c}$ $\quad 1500 < \gamma_c < 2500\ kg/m^3$

Béton de densité normale

$\gamma_c = 2400\ kg/m^3 \Longrightarrow E_c = 5000\sqrt{f'_c}$

$f'_c = 20\ MPa \Longrightarrow E_c = 5000\sqrt{20} = 22361$

$$E_c = 22\,400\ MPa$$

Module de cisaillement ou module de Coulomb :

$$G = \frac{E_c}{2(1+\mu)} = \frac{22\,400}{2(1+0,18)} = 9\,492$$

$$G = 9500\ MPa.$$

2) Propriétés des sections des membrures

Aire section A (mm^2)
Moment d'inertie I (mm^4)

Section du type 1
Section des colonnes 400 × 400

$A = 400 \times 400 = 160\,000 \Rightarrow A = 160\,000\ mm^2$

$I = \frac{(400)^4}{12} = 2133,33 \cdot 10^6 \Rightarrow I = 2133,33 \cdot 10^6\ mm^4$

Section du type 2
Section des poutres internes 250 × 400

$A = 250 \times 400 = 100\,000 \Rightarrow A = 100\,000\ mm^2$

$I = \frac{250 \times (400)^3}{12} = 1333,33 \cdot 10^6 \Rightarrow I = 1333,33 \cdot 10^6\ mm^4$

Section du type 3
Section des poutres externes 300 × 400

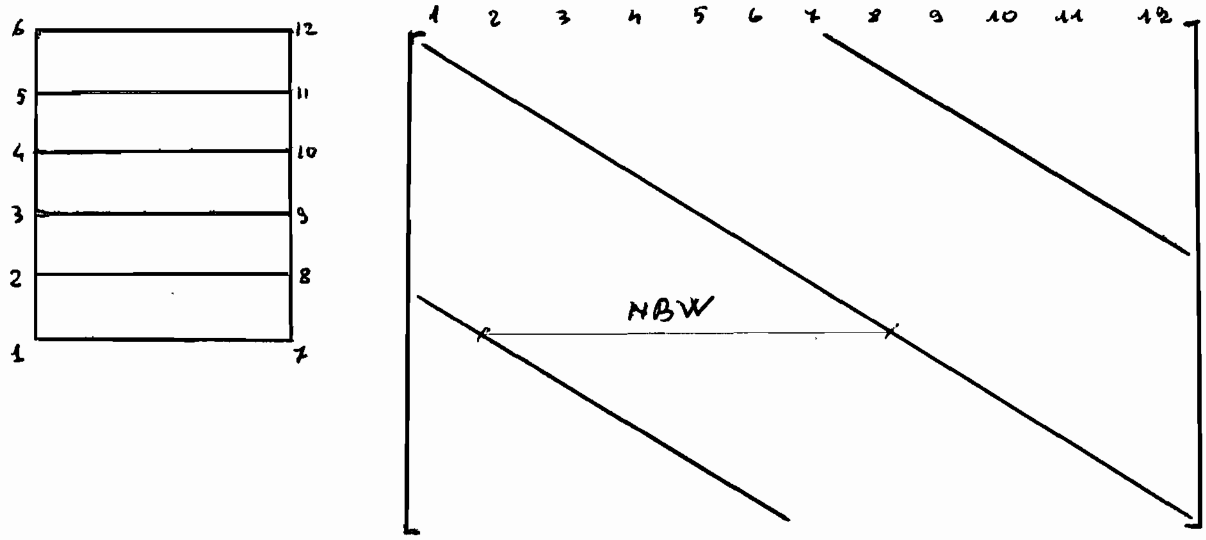
$A = 300 \times 400 = 120\,000 \Rightarrow A = 120\,000\ mm^2$

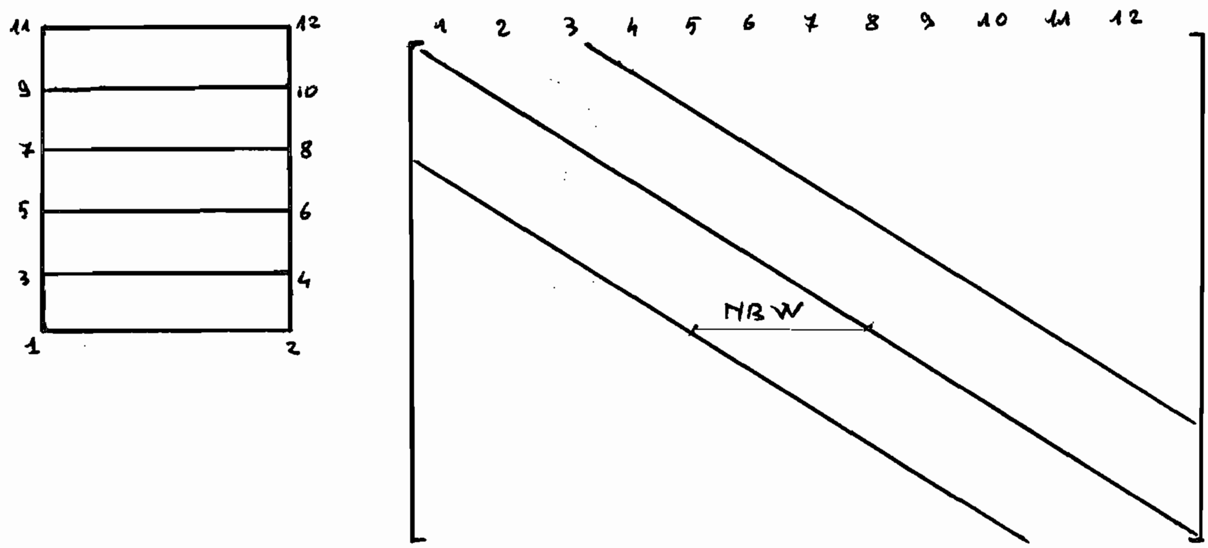
$I = \frac{300 \times (400)^3}{12} = 1600 \cdot 10^6 \Rightarrow I = 1600 \cdot 10^6\ mm^4$

3) Principe de numérotation des noeuds

La matrice de rigidité global d'un cadre rigide est une matrice bandeé. La numérotation des noeuds se fait intelligeamment pour que les coéfficients de la matrice se rapprochent le plus possible de la diagonale principale. On optimise ainsi la largeur de la bande.

<u>Exemples:</u>





NBW = largeur de la bande.

4) Cas de chargement.

Cadre rigide global.

Calcul des déformations, des efforts aux noeuds et des réactions.

On a quatre (4) types de cadre global:

- Cadre rigide longitudinal interne.
- Cadre rigide longitudinal externe.
- Cadre rigide transversal interne.
- Cadre rigide transversal externe.

a) Charges permanentes (D)

Beton $\gamma_c = 2400\ kg/m^3 = 24\ kN/m^3$

i) Charges concentrées (kN)

- Poids des poteaux au dessus des noeuds aux étages 1, 2 et 3:

$0,40 \times 0,40 \times 3,50 \times 24 = 13,44\ kN$

- Poids des poteaux au dessus des noeuds au rez de chaussée:

$0,40 \times 0,40 \times 4,00 \times 24 = 15,36\ kN$

- Rétombées poutres transversales:

$0,40 - 0,17 = 0,23\ m$

Cadres internes

$0,23 \times 0,25 \times (6,00 - 0,40) \times 24 = 7,73\ kN$

$0,23 \times 0,30 \times (6,00 - 0,40) \times 24 = 9,27\ kN$

Cadres externes

$0,23 \times 0,25 \times (3,00 - 0,40/2) \times 24 = 3,86\ kN$

$0,23 \times 0,30 \times (3,00 - 0,40/2) \times 24 = 4,64\ kN$

Charges aux noeuds des cadres internes

13,44 + 7,73 = 21,17 kN
15,36 + 7,73 = 23,09 kN
13,44 + 9,27 = 22,71 kN
15,36 + 9,27 = 24,63 kN

Charges aux noeuds des cadres externes

13,44 + 3,86 = 17,3 kN
15,36 + 3,86 = 19,22 kN
13,44 + 4,64 = 18,08 kN
15,36 + 4,64 = 20,00 kN

ii) Charges uniformes (kN/m)

Cadres internes

- Poids dalle 0,17 × 6,00 × 24 = 24,48
- Retombées poutres 0,23 × 0,25 × 24 = 1,38
- Surcharge permanente 1,30 × 6,00 = 7,80

33,66

33,66 kN/m sur toutes les poutres

Cadres externes

- Poids dalle 0,17 × (3,00 − 0,30/2) × 24 = 11,63
- Poids poutres 0,40 × 0,30 × 24 = 2,88
- Surcharge permanente 1,3 × (3,00 − 0,30/2) = 3,71
- Murs extérieurs 10

18,22
10,00
28,22

28,22 kN/m sur toutes les poutres

b) Surcharge (L)

Surcharge toit terrasse 2,4 kN/m²

Surcharge plancher étage 4,8 kN/m²

Surcharge uniforme (kN/m)

Cadres internes

$2,4 \times 6,00 = 14,40$

14,40 kN/m sur toutes les poutres du toit

$4,8 \times 6,00 = 28,80$

28,80 kN/m sur toutes les poutres de tous les planchers étages.

Cadres externes

$2,4 \times 2,85 = 6,84$ kN/m poutres toit

$4,8 \times 2,85 = 13,68$ kN/m poutres planchers

c) Charges dues aux vents (Q)

- Pression dynamique de référence q

Vent correspondant à une probabilité de dépassement de 1/30

$V = 22$ m/s $\Rightarrow q = 0,30$ kPa

(voir tableau ci après)

- Pression ou succion exercée par le vent

$p = q\, C_e\, C_g\, C_p$

Coefficient de pression au vent = 0,8

Coefficient de pression sous le vent = −0,5

$C_p = 0,8 - (-0,5) = 1,3$.

VITESSE Maximale instantanee du vent en m/s

	J	F	M	A	M	J	J	A	S	O	N	D
1951	15	18	16	15	16	17	21	18	18	14	12	12
1952	16	12	14	14	14	24	20	18	21	23	16	16
1953	14	14	15	12	14	13	20	16	19	12	—	11
1954	15	13	16	13	12	16	14	20	17	16	13	16
1955	14	14	15	13	13	14	18	20	21	16	15	18
1956	20	19	21	20	16	17	26	23	23	15	18	22
1957	21	16	22	21	19	19	24	20	29	27	16	16
1958	13	12	14	14	13	15	20	25	23	25	16	13
1959	20	13	16	16	14	12	23	14	26	15	14	13
1960	16	16	15	20	13	12	21	23	23	24	12	15
1961	15	14	12	12	13	25	25	21	16	13	11	13
1962	11	12	14	14	12	20	31	40	30	29	18	24
1963	25	24	17	16	14	15	30	23	24	14	9	12
1964	9	11	10	10	8	11	19	13	16	13	9	13
1965	13	10	9	11	9	10	15	19	16	20	9	11
1966	10	10	10	9	10	16	9	29	17	12	11	12
1967	12	14	12	12	11	16	26	22	12	18	9	11
1968	11	9	9	10	11	12	18	13	21	12	11	9
1969	10	9	11	13	11	9	20	31	12	9	12	13
1970	14	10	12	11	11	15	12	26	20	12	11	13
1971	11	13	12	14	12	13	22	18	18	18	11	13
1972	12	12	12	11	12	21	8	19	16	14	9	10
1973	9	11	11	13	10	11	16	14	17	10	10	11
1974	12	13	13	13	11	10	13	17	18	21	12	15
1975	12	10	13	15	11	11	13	12	19	14	12	11
1976	13	12	13	12	14	13	16	17	17	16	10	12
1977	11	13	11	11	12	14	14	15	18	10	9	10
1978	11	11	10	10	10	12	14	15	14	15	11	13
1979	12	10	11	25	23	19	18	10	11	12	10	11
1980	11	13	14	12	12	10	10	19	21	12	11	13
1981	13	11	11	10	10	15	25	17	24	14	10	11
1982	12	10	13	12	11	9	17	15	18	13	12	14

21,25

moyenne annuelle maximale = 21,25

$\Rightarrow V \leq 22$ m/s. $\Rightarrow V = 22$ m/s

$C_g = 2,0$

h (m)	étage (ordre)	$p = q\,C_e\,C_g\,C_p$ (KN/m²)
4,17	1er	$0,30 \times 0,9 \times 2,0 \times 1,3 = 0,702$
7,84	2ème	$0,30 \times 1,0 \times 2,0 \times 1,3 = 0,78$
11,51	3ème	$0,30 \times 1,0 \times 2,0 \times 1,3 = 0,78$
15,18	4ème (toit)	$0,30 \times 1,1 \times 2,0 \times 1,3 = 0,86$

- Charges latérales du vent s'exerçant sur les cadres (charges concentrées

$F = p \cdot S$ $\qquad$ S = surface tributaire (m²)

Cadres internes

Etages	F = p. S (KN)
1er	$F_1 = 0,702 \times 6,00 \times \left(\frac{3,5+4,0}{2} + 0,17\right) = 16,51$
2ème	$F_2 = 0,78 \times 6,00 \times (3,50 + 0,17) = 17,18$
3ème	$F_3 = 0,78 \times 6,00 \times (3,50 + 0,17) = 17,18$
4ème toit	$F_4 = 0,86 \times 6,00 \times \left(\frac{3,67}{2} + 1,20\right) = 15,66$

Cadres externes

Etages	F (KN)
1er	$F_1 = 0,702 \times 3,00 \times 3,92 = 8,25$
2ème	$F_2 = 0,78 \times 3,00 \times 3,67 = 8,59$
3ème	$F_3 = 0,78 \times 3,00 \times 3,67 = 8,59$
4ème	$F_4 = 0,86 \times 3,00 \times 3,04 = 7,83$

d) Combinaison des charges.

On considère ici trois (3) cas de combinaison de charges

1er Cas

D + L

Charges non pondéreés sur la structure

2eme Cas

1,25D + 1,50 L

3ème Cas

1,25D + 0,7 (1,50L + 1,5Q)

1,25D + 1,05 L + 1,05Q

Des deux derniers cas, celui qui donne les les efforts internes les plus grands est le cas le plus considéré et le seul pris en compte dans le calcul de dimentionnement.

Cadres rigides partiels

Calcul des déformations et des efforts internes aux poutres.

On distingue les cadres rigides partiels longitudinaux et transversaux avec sept (7) types chaque :

- Cadre partiel interne plancher terrasse
- Cadre partiel externe plancher terrasse
- Cadre partiel interne plancher étages 2 et 3
- Cadre partiel externe plancher étages 2 et 3
- Cadre partiel interne plancher 1er étage
- Cadre partiel externe plancher 1er étage
- Cadre partiel interne rez de chaussée.

a) Charges permanentes (D)

Charges uniformes (kN/m)

Cadres internes

- Poids dalle $0,17 \times 24 = 4,08$
- Surcharge permanente $1,30$

$w = 5,38\ kN/m^2$

Dalle $\Rightarrow l_a = 6,00\ m \Rightarrow 2\dfrac{w l_a}{3} = 2 \times \dfrac{5,38 \times 6,00}{3}$

$= 21,52\ kN/m$

Retombées poutre $0,23 \times 0,25 \times 24 = 1,38$

Cloison ou mur de séparation $6,00$

$28,90$

28,90 kN/m sur toutes les poutres.

Cadres exterieurs

- Poids dalle $0,17 \times 24 = 4,08$
- Surcharge permanente $1,30$

$w = 5,38 \text{ kN/m}^2$

Dalle $\Rightarrow l_a = 3,00 - 0,15 = 2,85 \text{ m}$

$$\frac{w l_a}{3} = \frac{5,38 \times 2,85}{3} = 5,11 \text{ kN/m}$$

		5,11
Poids poutres	$0,40 \times 0,30 \times 24 =$	2,88
Murs extérieurs		10,00
		17,99

17,99 kN/m sur toutes les poutres.

b) Surcharge (L)

Surcharge uniforme (kN/m)

* Toit $2,4 \text{ kN/m}^2$

Cadres internes

$$2 \times \frac{w l_a}{3} = 2 \times \frac{2,4 \times 6,00}{3} = 9,60 \text{ kN/m}$$

Cadres extérieurs

$$\frac{w l_a}{3} = \frac{2,4 \times 2,85}{3} = 2,28 \text{ kN/m}$$

* Plancher étage $4,8 \text{ kN/m}^2$

Cadres internes

$$2 \times \frac{w l_a}{3} = 2 \times \frac{4,8 \times 6,00}{3} = 19,20 \text{ kN/m}$$

Cadres exterieurs

$$\frac{w l_a}{3} = \frac{4,8 \times 2,85}{3} = 4,56 \text{ kN/m.}$$

c) Combinaison des charges.

D (KN/m) charge permanente
L (KN/m) surcharge

Charges pondérées
$w_D = 1,25\ D$ (KN/m)
$w_L = 1,50\ L$ (KN/m)

La répartition des charges se restreint à l'une des deux combinaisons suivantes :
- Charge permanente pondérée sur toutes les travées, la surcharge pondérée répartie à toutes les deux travées pour avoir le moment positif maximum au milieu de la travée de la poutre ainsi chargée. Et
- Charge permanente pondérée sur toutes les travées et la surcharge pondérée repartie sur deux travées adjacentes pour avoir le moment négatif aux supports ou appuis.

PARTIE IV

Dimensionnement des éléments structuraux

Dalles avec poutres
Cisaillement poutres
Torsion poutres
Poteaux
Semelles isolées

Dimensionnement de dalles avec poutres

Hypothèses:

Dalle:

$f'_c = 20\ MPa$ $\quad$ $f_y = 400\ MPa$

$\ell = 6\,000\ mm$

Poutres:

internes 250×400

externe 300×400

Poteaux

400×400

Etapes:

1) Epaisseur de la dalle.

$$\ell_{n\,max} = 6000 - 2 \times \frac{250}{2} = 5750$$

$$\ell_{n\,max} = 5750\ mm$$

Dalle carrée

$\beta = 1$

Epaisseur minimale.

$$h_{min} = \frac{\ell_n\,(800 + f_y/1{,}5)}{36\,000 + 5000\beta(1 + \beta_s)}$$

$f_y = 400\ MPa$

$\beta_s = 1$

$$h_{min} = \frac{5750(800 + 400/1{,}5)}{36000 + 5000 \times 1 \times (1+1)} = 133{,}33$$

$$h_{min} = 135\ mm.$$

Epaisseur maximum.

$$h_{max} = \frac{l_n\,(800 + f_y/1,5)}{36\,000}$$

$$h_{max} = \frac{5750\,(800 + 400/1,5)}{36\,000} = 170,4$$

$$h_{max} = 170 \text{ mm}$$

On prend $h = 170$ mm

Epaisseur requise.

$$h_{requis} = \frac{l_n\,(800 + f_y/1,5)}{36\,000 + 5000\beta[\alpha_m - 0,5(1-\beta_s)(1 + 1/\beta)]}$$

Valeur de α_m:

- Poutres de rives

$a = 400$ mm

$b = 300$ mm

$h = 170$ mm

$a/h = 400/170 = 2,35 \approx 2,4$

$b/h = 300/170 = 1,76 \approx 1,8$

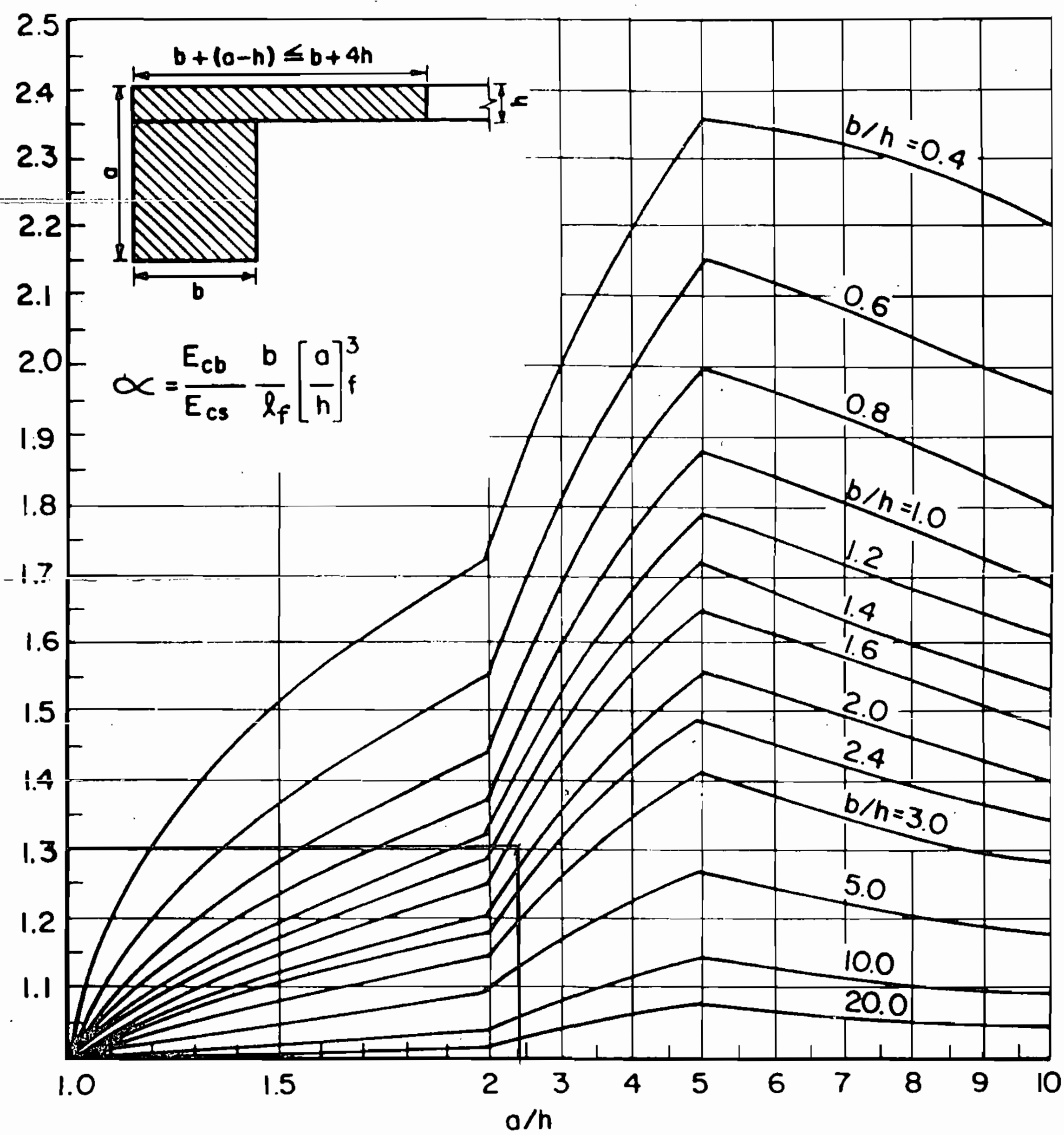
Table 1 $\Longrightarrow$ $f = 1,3$

$$l = 3000 + \frac{300}{2} = 3150 \text{ mm}$$

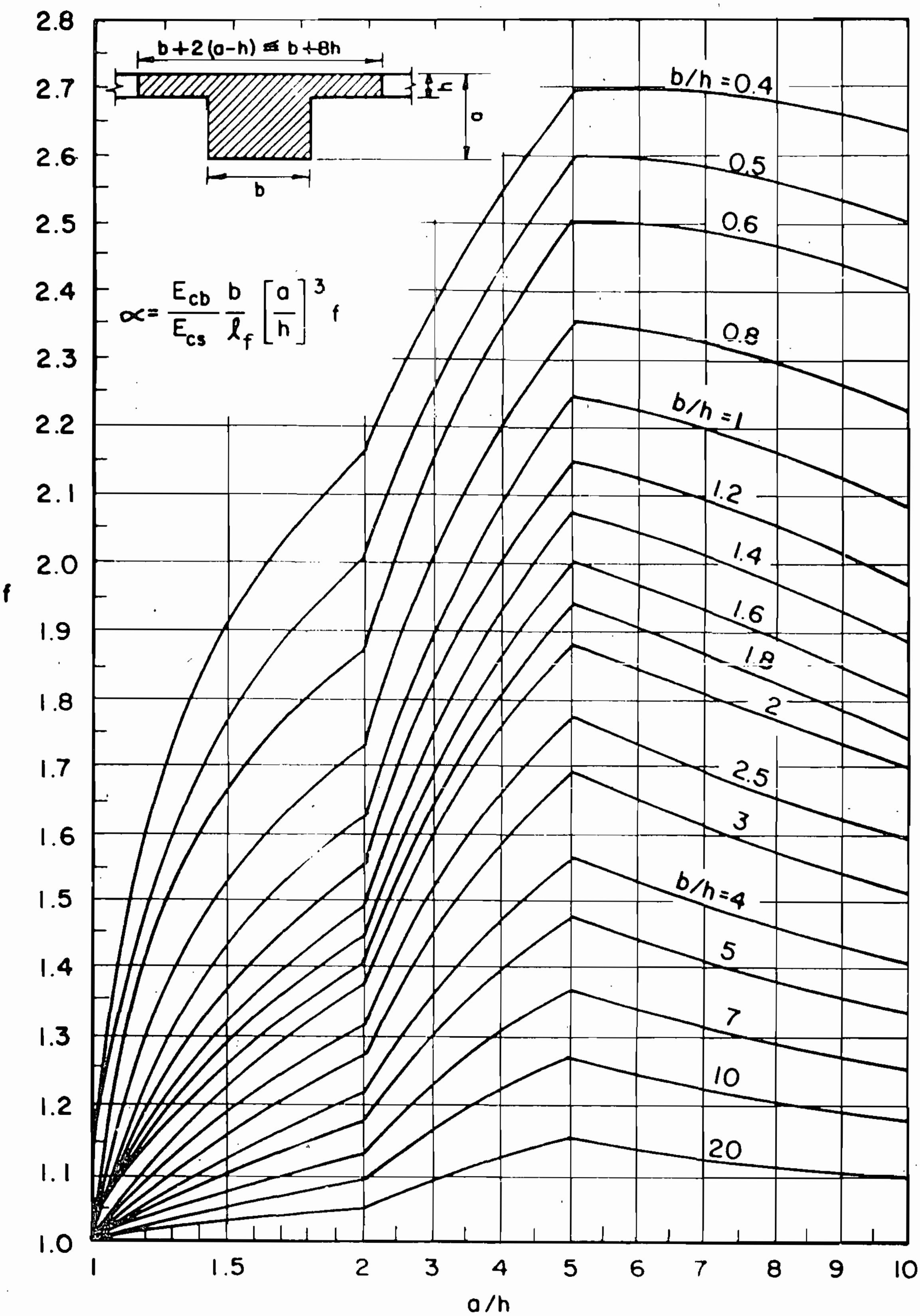
$$\alpha_1 = \frac{E_{cb}}{E_{cs}} \times \frac{b}{l} \times \left[\frac{a}{h}\right]^3 \times f \qquad E_{cb} = E_{cs}$$

$$\alpha_1 = \frac{300}{3150}\,(2,35)^3 \times 1,3 = 1,61$$

$$\alpha_1 = \alpha_m = 1,61 > 0,8 \quad \text{ok}$$



1 RIGIDITE RELATIVE DE POUTRES DE RIVE



2 RIGIDITE RELATIVE DE POUTRES INTERIEURES

- Poutres intérieures

$a = 400$ mm

$b = 250$ mm

$h = 170$ mm

$a/h = 400/170 = 2,35 \approx 2,4$

$b/h = 250/170 = 1,47 \approx 1,5$

Table 2 $\qquad \delta = 1,57$

$l = 6000$ mm

$$\alpha_2 = \frac{E_{cb}}{E_{cs}} \times \frac{b}{l} \times \left[\frac{a}{h}\right]^3 \times \delta \qquad E_{cb} = E_{cs}$$

$$\alpha_2 = \frac{250}{6000} \times (2,35)^3 \times 1,57 = 0,85$$

$$\alpha_2 = \alpha_3 = \alpha_B = \alpha_c = 0,85 > 0,8 \quad \text{ok}$$

Panneau de coin S1

$l_{nl} = 6000 - 300/2 - 250/2 = 5725$ mm

$l_{nl} = l_{ns} = 5725$ mm

$$\beta = \frac{l_{nl}}{l_{ns}} = \frac{5725}{5725} = 1 \quad ; \quad \beta_s = \frac{2 \times 6000}{4 \times 6000} = 0,50$$

$$\alpha_m = (\alpha_1 + \alpha_A + \alpha_2 + \alpha_B)/4$$

$$= \frac{1,61 \times 2 + 0,85 \times 2}{4} = 1,23$$

$\alpha_m = 1,23$

$$h_{req} = \frac{5725\,(800 + 400/1,5)}{36\,000 + 5000 \times 1 \times [1,23 - 0,5(1-0,5)(1 + \frac{1}{1})]}$$

$= 154$

$h_{req} = 155$ mm

- Panneau de rives (de côtés) S2 et S3

$l_{nl} = 6000 - 2\times 250/2 = 5750$ mm

$l_{ns} = 6000 - 300/2 - 250/2 = 5725$ mm

$\beta = \dfrac{l_{nl}}{l_{ns}} = \dfrac{5750}{5725} = 1{,}00$; $\beta_s = \dfrac{3\times 6000}{4\times 6000} = 0{,}75$

$\alpha_m = (\alpha_1 + \alpha_2 + \alpha_B + \alpha_c)/4 = (1{,}61 + 3\times 0{,}85)/4$
$= 1{,}04$

$$h_{requise} = \frac{5750(800 + 400/1{,}5)}{36\,000 + 5000\times 1\times\left[1{,}04 - 0{,}5\times(1-0{,}75)\left(1+\frac{1}{1{,}00}\right)\right]}$$
$= 153{,}5$

$h_{requise} = 155$ mm

- Panneau intérieur S4

$l_{nl} = 6000 - 2\times 250/2 = 5750 \text{ mm} = l_{ns}$

$\beta = \dfrac{l_{nl}}{l_{ns}} = \dfrac{5750}{5750} = 1$; $\beta_s = \dfrac{4\times 6000}{4\times 6000} = 1$

$\alpha_m = (\alpha_2 + \alpha_3 + \alpha_B + \alpha_c)/4 = (0{,}85\times 4)/4 = 0{,}85$

$$h_{requise} = \frac{5750(800 + 400/1{,}5)}{36\,000 + 5000\times 1\times\left[0{,}85 - 0{,}5(1-1)\left(1+\frac{1}{1}\right)\right]}$$
$= 152{,}4$ mm

$h_{requise} = 155$ mm

Pour tous les panneaux (ou dalles)

$h_{min} < h_{requise} < h_{max}$

On prend $h = 160$ mm.

2) Moments de dimensionnement.

- Chargement.

Poids propre de la dalle

$0,160 \times 24 \times 1,25 = 4,80$ kN/m²

Surcharge permanente

$1,30 \times 1,25 = 1,63$ kN/m²

$w_{df} = 6,43$ kN/m²

Surcharges et charges pondérées:

Toit: $2,4 \times 1,5 = 3,60$ kN/m² $= w_{lf}$

$w_f = w_{df} + w_{lf} = 6,43 + 3,60$

$w_f = 10,03$ kN/m²

Plancher étage: $4,8 \times 1,5 = 7,20$ kN/m³ $= w_{lf}$

$w_f = w_{df} + w_{lf} = 6,43 + 7,20$

$w_f = 13,63$ kN/m²

- Calcul des moments

Méthode de calcul direct (DDM) (§ 13 6)

Vérification des restrictions ou limitations géométriques et de chargement

(§ 13 6 1 et 13 6 10)

$$\beta_a = \frac{w_d}{w_l}$$

Toit :

$$\beta_a = \frac{0,16 \times 24 + 1,3}{2,4} = 2,14 > 2,0$$

Effets du rapport de la charge permanente et la surcharge negligeables.

Plancher

$$\beta_a = \frac{0,16 \times 24 + 1,3}{4,8} = 1,07 < 2,0$$

On doit considerer les effets du rapport charge permanente / surcharge.

- Moments aux sections critiques.

Toit $w_f = 10,03$ kN/m²

$$M_o = \frac{(w_f \cdot 10^{-3})\, l_2\, l_n^2}{8}$$

$l_2 = 6000$ mm

Entre A et B

$l_n = 6000 - 300/2 - 250/2 = 5725$

$= 5725$ mm

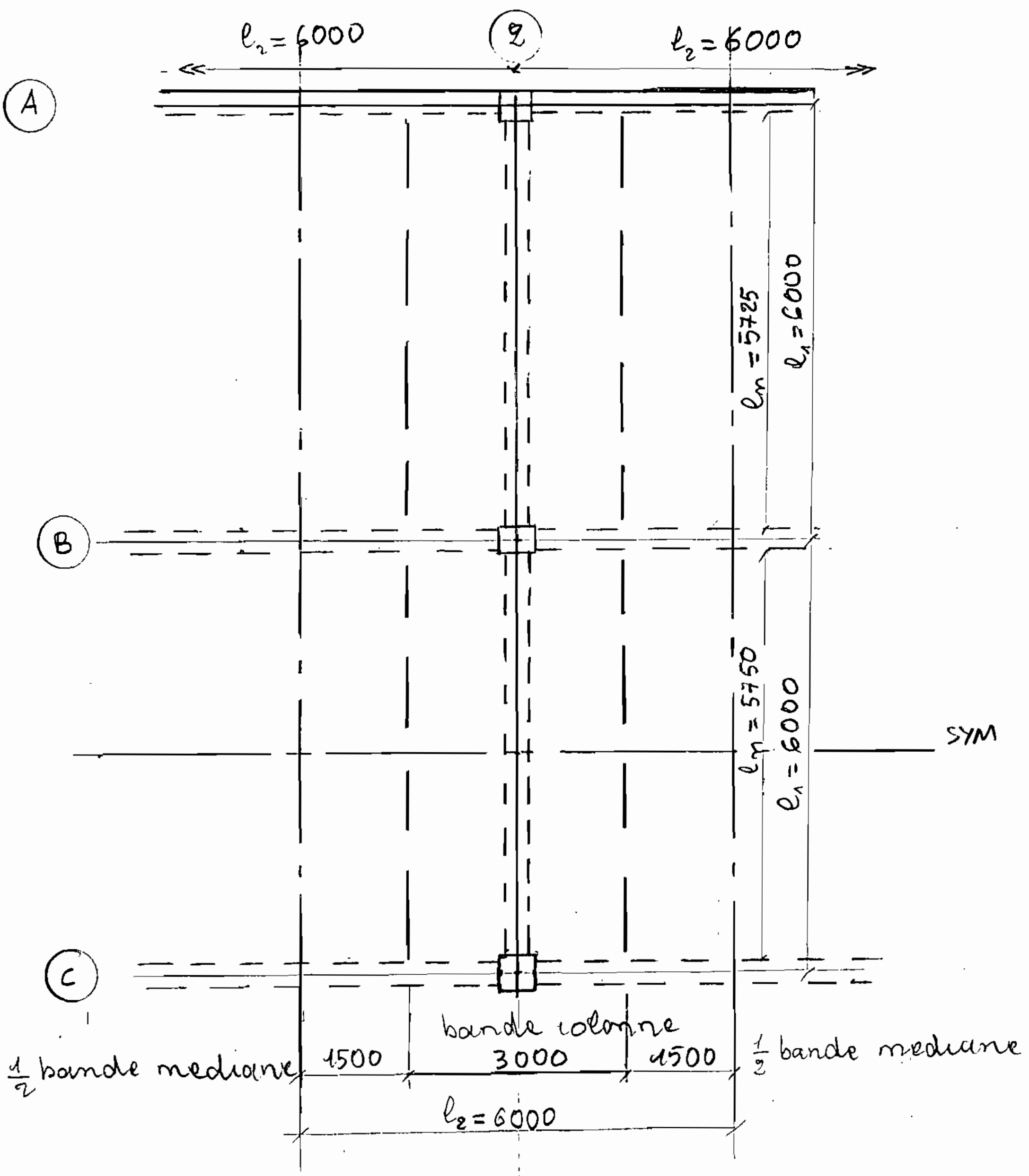
$$M_o = \frac{10,03 \cdot 10^{-3} \times 6000 \times (5725)^2}{8} = 246,6 \cdot 10^6 \text{ N·mm}$$

Entre B et C

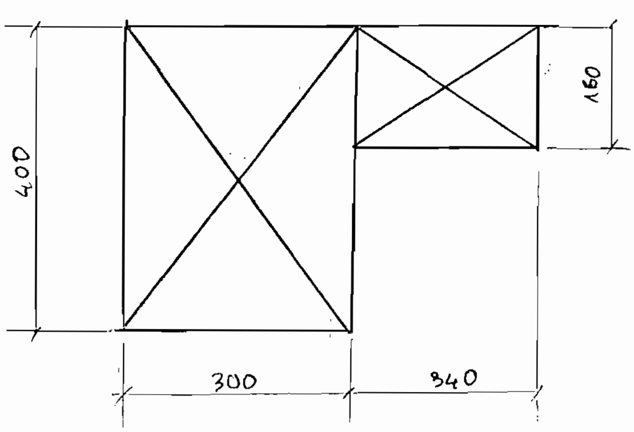
$l_n = 6000 - 2 \times 250/2 = 5750$ mm

$= 5750$ mm

$$M_o = \frac{10,03 \cdot 10^{-3} \times 6000 \times (5750)^2}{8} = 248,7 \cdot 10^6 \text{ N·mm}$$



$$C = \sum \left(1 - 0,63\,\frac{x}{y}\right)\frac{x^3 y}{3}$$



- Distribution des moments aux bandes de poteaux, aux bandes medianes et aux poutres.

$$C = \sum \left(1 - 0,63 \frac{x}{y}\right) \frac{x^3 y}{3}$$

$$C = \left(1 - 0,63 \times \frac{300}{400}\right) \times \frac{(300)^3 \times 400}{3} + \left(1 - 0,63 \times \frac{160}{240}\right) \times \frac{(160)^3 \times 240}{3}$$

$$C = 2,089 \cdot 10^9 \ mm^4$$

$$I_s = \frac{l_2 h^3}{12} = \frac{6000 \times (160)^3}{12}$$

$$I_s = 2,048 \cdot 10^9 \ mm^4$$

$$\beta_t = \frac{E_{cb} C}{2 E_{cs} I_s} \qquad E_{cb} = E_{cs}$$

$$\beta_t = \frac{2,089 \cdot 10^9}{2 \times 2,048 \cdot 10^9}$$

$$\beta_t = 0,51$$

% Moments pondérés des bandes de poteaux

Traveé d'estremité ligne colonne 2

$$l_2 / l_1 = 6000/5725 = 1,05$$

$$\alpha_1 = 0,85 \Rightarrow \alpha_1 \, l_2/l_1 = 0,85 \times 1,05 = 0,89$$

Support extérieur (moment négatif externe)

Tableau 2 $\quad \ell_2/\ell_1 = 1{,}05 \approx 1{,}0$

$\alpha_1 \, \ell_2/\ell_1$	β_t	%
0	0	100
0,89	0,51	x ?
$\geq 1{,}0$	$\geq 2{,}5$	75

$$\frac{0{,}51-0}{2{,}5-0} = \frac{X-100}{75-100} \Rightarrow X = \frac{0{,}51}{2{,}5}(-25)+100$$

$$X = 94{,}9\,\%$$

A mi porté (moment positif)

Tableau 3 $\quad \ell_2/\ell_1 = 1{,}0$

$\alpha_1 \, \ell_2/\ell_1$	%
0	60
0,89	x ?
1,0	75

$$\frac{0{,}89-0}{1{,}0-0} = \frac{X-60}{75-60} \Rightarrow X = \frac{0{,}89}{1{,}0}(15)+60$$

$$X = 73{,}35\,\%$$

Support intérieur (moment negatif intérieur)

Tableau 1 $\quad \ell_2/\ell_1 = 1{,}0 \Rightarrow X = 75\,\%$

[redacted] **Design Moments for Column Strips, Middle Strips and Beams**

1

DESIGN MOMENTS FOR COLUMN STRIPS			
Percentage of Interior Negative Design Moment			
ℓ_2/ℓ_1	0.5	1.0	2.0
$(\alpha_1 \ell_2/\ell_1) = 0$	75	75	75
$(\alpha_1 \ell_2/\ell_1) \geqslant 1.0$	90	75	45

2

Percentage of Exterior Negative Design Moment				
ℓ_2/ℓ_1		0.5	1.0	2.0
$(\alpha_1 \ell_2/\ell_1) = 0$	$\beta_t = 0$	100	100	100
	$\beta_t \geqslant 2.5$	75	75	75
$(\alpha_1 \ell_2/\ell_1) \geqslant 1.0$	$\beta_t = 0$	100	100	100
	$\beta_t \geqslant 2.5$	90	75	45

3

Percentage of Positive Design Moment			
ℓ_2/ℓ_1	0.5	1.0	2.0
$(\alpha_1 \ell_2/\ell_1) = 0$	60	60	60
$(\alpha_1 \ell_2/\ell_1) \geqslant 1.0$	90	75	45

4

DESIGN MOMENTS FOR BEAMS	
Percentage of Column Strip Moment	
$(\alpha_1 \ell_2/\ell_1) = 0.0$	0
$(\alpha_1 \ell_2/\ell_1) \geqslant 1.0$	85

Notes: That portion of the design moment not resisted by the column strip will be assigned to middle strips.
Linear interpolation shall be made for in-between values.

% MOMENTS PONDERES DE BANDES POTEAUX DE BANDES MEDIANES ET DES POUTRES

Travée intérieur ligne colonne 2

$l_2/l_1 = 6000/5750 = 1,04$

$\alpha_1 = 0,85 \Rightarrow \alpha_1 \, l_2/l_1 = 0,85 \times 1,04 = 0,89$

Tableaux

3 à mi portee $\Rightarrow$ 73,35 %

1 aux supports $\Rightarrow$ 75 %

% Moments ponderés des bandes médianes

Travee exterieur

Moment negatif externe : 100 - 94,9 = 5,1
5,1 % (2,55 % par moitier).

Moment positif : 100 - 73,35 = 26,65
26,65 % (13,33 % par moitier)

Moment negatif interne : 100 - 75 = 25
25 % (12,5 % par moitier).

Travée intérieur

Moments negatifs : 100 - 75 = 25
25 %

Moment positif : 100 - 73,35 = 26,65
26,65 %

% Moments des bandes de poteaux aux poutres table 4

$\alpha_1 \, l_2/l_1$	%
0	0
0,89	x ?
1,0	85

$$\frac{0,89-0}{1,0-0} = \frac{x-0}{85-0} \Rightarrow x = \frac{0,89}{1,0} \times 85$$

$$x = 75,65$$

Tableaux resumés des moments

	A	(travée AB)	B (gauche)	B (droite)	(travée BC)	C
l_n (mm)		5725			5750	
M_o (10^6 N·mm)		246,6			248,7	
Repartition du moment statique pondéré	0,16	0,59	0,70	0,65	0,35	0,65
M (10^6 N·mm)	-39,5	+145,5	-172,6	-161,7	+87,0	-161,7
% M des bandes de poteaux	94,9	73,35	75	75	73,35	75
M_{BP} (10^6 N·mm)	-37,5	+106,7	-129,5	-121,3	+63,8	-121,3
% M des bandes medianes	5,1	26,65	25	25	26,65	25
M_{BM} (10^6 N·mm)	-2,0	+ 38,8	-43,1	-40,4	+23,2	-40,4

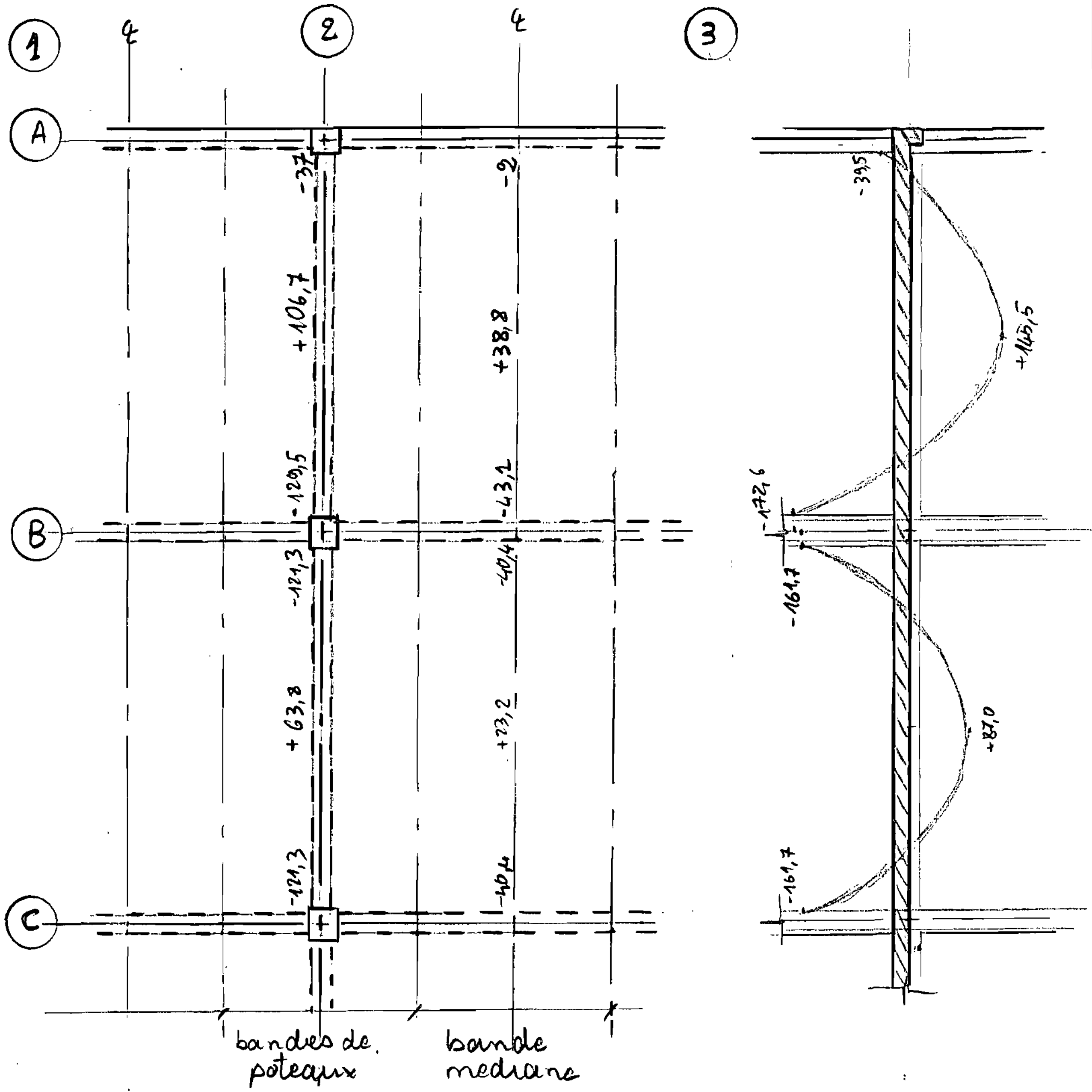


Diagramme des moments

<table>
<tr><th rowspan="2"></th><th rowspan="2">1/2 bande mediane entre 1 et 2</th><th colspan="2">bande de poteaux</th><th rowspan="2">1/2 bande mediane entre 2 et 3</th><th rowspan="2">Total</th></tr>
<tr><th>Dalle</th><th>poutre</th></tr>
<tr><td>Extérieur Support A</td><td>-1,0</td><td>-7,7</td><td>-29,8</td><td>-1,0</td><td>-38,5</td></tr>
<tr><td>mi portée</td><td>+19,4</td><td colspan="2">+106,7</td><td>+19,4</td><td>+145,5</td></tr>
<tr><td>Sup. colonne ligne B</td><td>-20,2</td><td colspan="2">-121,3</td><td>-20,2</td><td>-161,7</td></tr>
<tr><td>mi portée</td><td>+11,6</td><td colspan="2">+63,8</td><td>+11,6</td><td>+87,0</td></tr>
<tr><td>Sup. colonne ligne C</td><td>-20,2</td><td colspan="2">-121,3</td><td>-20,2</td><td>-161,7</td></tr>
</table>

3) Choix des armatures des dalles et des poutres

- **Armatures des dalles**

$\rho_{min} = 0,002$

$\rho_{max} = 0,36 \beta_1 \dfrac{f'_c}{f_y} = 0,36 \times 0,85 \times \dfrac{20}{400}$

$\rho_{max} = 0,015$

Armatures supérieures pour reprendre les moments negatifs

$d = h - \text{enrob.} - \phi_{\#20}$

$= 160 - 20 - 19,5 = 120,5$

$d = 120 \text{ mm}$

1 m de largeur de dalle $\Rightarrow b = 1000 \text{ mm}$

$$k_z = \frac{M_z \cdot 10^6}{bd^2} = \rho \phi f_y \left[1 - \rho \frac{\phi_s f_y}{1,7 \phi_c f'_c}\right] \Rightarrow$$

$$\frac{M_z \cdot 10^6}{1000 \times (120)^2} = \rho \times 0,85 \times 400 \left[1 - \rho \frac{0,85 \times 400}{1,70 \times 0,60 \times 20}\right] \Rightarrow$$

$$0,069 M_z = 340 \rho [1 - 16,67 \rho] \Rightarrow$$

$$5666,67 \rho^2 - 340 \rho + 0,069 M_z = 0$$

M_z en kN·m

$0,002 = \rho_{min} < \rho < \rho_{max} = 0,015$

$$\rho = \frac{A_s}{bd} \Rightarrow A_s = \rho bd = \rho \cdot 1000 \times 120$$

$$A_s = 120\,000\,\rho$$

$M_2(-)$ (kNm)	$\rho \geq \rho_{min}$ 0,002	A_s (mm^2)	A_s (mm^2)	espacement s (mm)
9	0,00041 0,002	240	$3\phi10 \Rightarrow 300$	300
7,7	0,0016 0,002	240	$3\phi10 \Rightarrow 300$	300
43,1	0,011	1276	$7\phi15 \Rightarrow 1400$	140
40,4	0,098	1176	$6\phi15 \Rightarrow 1200$	170

- Armatures inférieures pour reprendre les moments positifs

$$d = h - \text{enrobage} - \phi_{barre\ N^o 20} - \frac{\phi_{barre\ N^o 20}}{2}$$

$$d = 160 - 20 - 19{,}5 - 19{,}5/2$$

$$d = 110 \text{ mm}$$

1 m de largeur de dalle $\Rightarrow b = 1000$ mm

$$K_2 = \frac{M_2 \cdot 10^6}{bd^2} = \rho \phi_s f_y \left[1 - \rho \frac{\phi_s f_y}{1{,}7 \phi_c f_c'}\right] \Rightarrow$$

$$\frac{M_2 \cdot 10^6}{1000 \times (110)^2} = 340\rho\left[1 - 16{,}67\rho\right] \Rightarrow$$

$$0{,}083\, M_2 = 340\rho - 5666{,}67\rho^2 \Rightarrow$$

$$5666{,}67\rho^2 - 340\rho + 0{,}083\, M_2 = 0$$

M_2 en kN.m $\qquad \rho_{min} \leq \rho \leq \rho_{max}$

$$\rho = \frac{A_s}{bd} \Rightarrow A_s = \rho bd = \rho \times 1000 \times 110$$
$$A_s = 110\,000 \rho$$

M_2 (+)	$\rho \geq \rho_{min}$ 0,002	A_s (mm²)	A_s(mm)	s(mm)
38,8	0,012	1297	7Ø15 ⇒ 1400	140
23,2	0,006	697	7Ø10 ⇒ 700	140

NB : _ Les moments de dimensionnements (2) et le choix des armatures des dalles ont été fait pour le toit ($w = 10{,}03$ kN/m²).
Pour les planchers ($w = 13{,}63$ kN/m²), on peut supposer les armatures calculées pour le toit sont requises approximativement.

- Tout ce qui a été fait ici suivant la ligne colonne transversal 2 est similaire aux lignes 3 et 4 et les résultats seront les mêmes suivant la ligne colonne longitudinal B.

_ Armatures des poutres (longitudinales)

$$\rho_{min} = \frac{1{,}4}{f_y} = \frac{1{,}4}{400} = 0{,}0035 \qquad \rho_{max} = 0{,}015$$

1) Dimensions :

Dalle $h_f = 160$ mm   Poutres $h = 400$ mm

$$d = h - 40 - \phi_{\#10} - \phi_{\#25}/2 = 400 - 40 - 11 - 25{,}2/2$$
$$d = 336 \text{ mm.}$$

$$h_f/d = 160/336 = 0{,}48 > 0{,}20 \Rightarrow h_f/d = 0{,}2$$

$h_f/d = 0{,}48 > 0{,}20 \Rightarrow$ Poutres en T

Poutres internes $b_w = 250$ mm

$b_f \leq 0{,}25\, l = 0{,}25 \times 6000 = 1500$ mm

$b_f \leq 2 \times 6h + b_w = 12 \times 160 + 250 = 2170$ mm

$b_f \leq 4\, b_w = 4 \times 250 = 1000$ mm

$b_f = 1000$ mm $\Rightarrow b_f/b_w = 4{,}0$

Poutres externes $b_w = 300$ mm

$b_f \leq l/12 = 6000/12 = 500$ mm

$b_f \leq 6h + b_w = 6 \times 160 + 300 = 1260$ mm

$b_f = 500$ mm $\Rightarrow b_f/b_w = 1{,}66\ (\approx 2{,}0)$

* Table Armatures.

$M_r = K_2\, b d^2 \cdot 10^{-6} \Rightarrow K_2 = M_r \cdot 10^6 / b d^2$

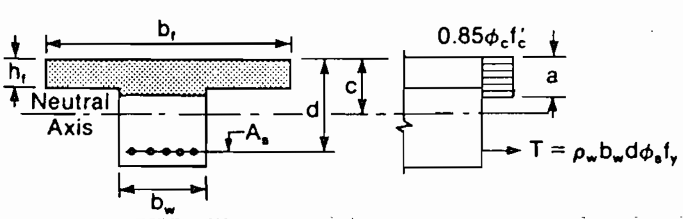
$\rho_w = A_s / bd \Rightarrow A_s = \rho_w\, b d$

Poutres intérieures (250×400) b = 250 mm
Toit et planchers d = 336 mm

		$M_r = M_f$	K_2	ρ_w %	A_s	
Toit (Str 05)	TE	-114,22	4,0	1,24	1042	3Ø25
	TE	+90,68	3,2	0,98	823	2Ø25
	TI	-169,14	6,0	1,92	1613	2Ø30 et 1Ø20
	TI	+77,73	2,8	0,85	714	2Ø25
Plancher (Str 07)	TE	-29	1,0	0,36	302	2Ø15
	TE	+114,50	4,0	1,24	1042	3Ø15
	TI	-211,35	7,5	2,46	2066	3Ø30
	TI	+100	3,5	1,08	907	2Ø25
		kN·m	Moments résultats analyse par P-Frame			

T-Beams
Reinforcement Ratio ρ_w (%) Based on Web Width, for Resistance Factors K_r (MPa)
Reinforcement f_y = 400 MPa Concrete f'_c = 20 MPa

h_f/d	0.10					0.15					0.20				
b_f/b_w / K_r	2.0	3.0	4.0	5.0	6.0	2.0	2.5	3.0	4.0	5.0	1.5	2.0	3.0	4.0	5.0
1.2	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.37	0.36	0.36	0.36	0.36
1.4	0.43	0.42	0.42	0.42	0.42	0.43	0.42	0.42	0.42	0.42	0.43	0.43	0.42	0.42	0.42
1.6	0.49	0.48	0.48	0.48	0.48	0.49	0.49	0.48	0.48	0.48	0.50	0.49	0.48	0.48	0.48
1.8	0.56	0.55	0.54	0.54	0.54	0.56	0.55	0.55	0.54	0.54	0.56	0.56	0.55	0.54	0.54
2.0	0.62	0.61	0.60	0.60	0.60	0.62	0.61	0.61	0.60	0.60	0.63	0.62	0.61	0.60	0.60
2.2	0.69	0.67	0.67	0.66	0.66	0.69	0.68	0.67	0.67	0.66	0.70	0.69	0.67	0.67	0.66
2.4	0.76	0.74	0.73	0.72	0.72	0.75	0.74	0.74	0.73	0.72	0.77	0.75	0.74	0.73	0.72
2.6	0.83	0.80	0.79	0.79	0.78	0.82	0.81	0.80	0.79	0.79	0.84	0.82	0.80	0.79	0.79
2.8	0.90	0.87	0.85	0.85	0.84	0.89	0.87	0.87	0.85	0.85	0.92	0.89	0.87	0.85	0.85
3.0	0.97	0.93	0.92	0.91	0.91	0.96	0.94	0.93	0.92	0.91	0.99	0.96	0.93	0.92	0.91
3.2	1.05	1.00	0.98	0.97	0.97	1.03	1.01	1.00	0.98	0.97	1.07	1.03	1.00	0.98	0.97
3.4	1.13	1.07	1.05	1.04	1.03	1.11	1.08	1.06	1.05	1.04	1.15	1.10	1.06	1.05	1.04
3.6	1.21	1.14	1.11	1.10	1.09	1.18	1.15	1.13	1.11	1.10	1.23	1.17	1.13	1.11	1.10
3.8	1.30	1.21	1.18	1.16	1.15	1.26	1.22	1.20	1.18	1.16	1.32	1.25	1.20	1.18	1.16
4.0	1.39	1.28	1.24	1.23	1.22	1.34	1.29	1.27	1.24	1.23	1.41	1.32	1.27	1.24	1.23
4.2	1.48	1.36	1.31	1.29	1.28	1.43	1.37	1.33	1.31	1.29	1.51	1.40	1.33	1.31	1.29
4.4	1.58	1.44	1.38	1.36	1.34	1.52	1.44	1.40	1.37	1.36	1.61	1.48	1.40	1.37	1.36
4.6	1.69	1.53	1.45	1.42	1.41	1.61	1.52	1.48	1.44	1.42	1.72	1.57	1.47	1.44	1.42
4.8	1.80	1.61	1.52	1.49	1.47	1.71	1.61	1.55	1.51	1.49		1.66	1.54	1.51	1.49
5.0		1.70	1.60	1.55	1.54	1.81	1.69	1.63	1.57	1.55		1.75	1.62	1.57	1.55
5.2		1.80	1.67	1.62	1.60	1.93	1.79	1.70	1.64	1.62		1.85	1.69	1.64	1.62
5.4		1.90	1.76	1.69	1.67		1.88	1.79	1.71	1.68		1.95	1.76	1.71	1.68
5.6		2.01	1.84	1.76	1.73		1.98	1.87	1.78	1.75		2.06	1.83	1.78	1.75
5.8		2.12	1.93	1.83	1.80		2.09	1.96	1.85	1.82			1.91	1.85	1.82
6.0			2.02	1.91	1.86			2.05	1.92	1.88			1.99	1.92	1.88
6.2			2.11	1.99	1.93			2.15	1.99	1.95			2.07	1.99	1.95
6.4			2.22	2.07	2.00			2.26	2.07	2.02			2.15	2.06	2.02
6.6			2.32	2.15	2.07			2.37	2.15	2.09			2.24	2.13	2.09
6.8				2.24	2.14				2.23	2.15			2.33	2.20	2.15
7.0				2.33	2.22				2.32	2.22			2.43	2.27	2.22
7.2				2.43	2.30				2.40	2.29			2.53	2.35	2.29
7.4				2.53	2.38				2.50	2.36			2.64	2.42	2.36
7.6				2.64	2.47				2.59	2.44				2.50	2.43
7.8					2.55				2.70	2.51				2.57	2.50
8.0					2.65				2.81	2.59				2.65	2.57
8.2					2.75					2.67				2.74	2.64
8.4					2.85					2.76				2.83	2.72
8.6					2.96					2.85				2.92	2.79
8.8										2.94				3.01	2.86
9.0										3.04				3.12	2.93
9.2										3.14				3.22	3.01
9.4										3.25					3.08
9.6															3.16
9.8															3.24



Values below solid line indicate T-beam behavior ($a > h_f$, shown at left)

$\rho_w = \frac{A_s}{b_w d}$ $M_r = K_r b d^2 \, 10^{-6}$

$K_r = \rho_w \phi_s f_y \left[1 - \frac{\rho_w \phi_s f_y}{1.7\phi_c f'_c} \frac{b_w}{b_f}\right]$ ABOVE SOLID LINE

$K_r = 0.85\,\phi_c f'_c \times \left[\left(\frac{b_f}{b_w} - 1\right)\frac{h_f}{d}\left(1 - \frac{h_f}{2d}\right) + \frac{a}{d}\left(1 - \frac{a}{2d}\right)\right]$ BELOW SOLID LINE

ρ_w(%) D'ACIER DE POUTRES EN T

Poutres extérieures (300×400) $b = 300\,mm$
$d = 336\,mm$

Toit et plancher

		$M_u = M_f$	K_u	$\rho\ \%$	A_s	
Toit (Str 06)	TE	-54,55	1,6	0,49	494	2Ø20
		+46,93	1,4	0,43	433	2Ø20
	TI	-87,52	2,6	0,82	826	2Ø25
		-38,98	1,2	0,36	363	2Ø15
Plancher (Str08)	TE	-18,00	0,5	$0,35 = \rho_{min}\%$	353	2Ø15
		+49,52	1,5	0,46	464	2Ø20
	TI	-94,99	2,8	0,89	897	2Ø30
		+44,58	1,3	0,40	403	2Ø20

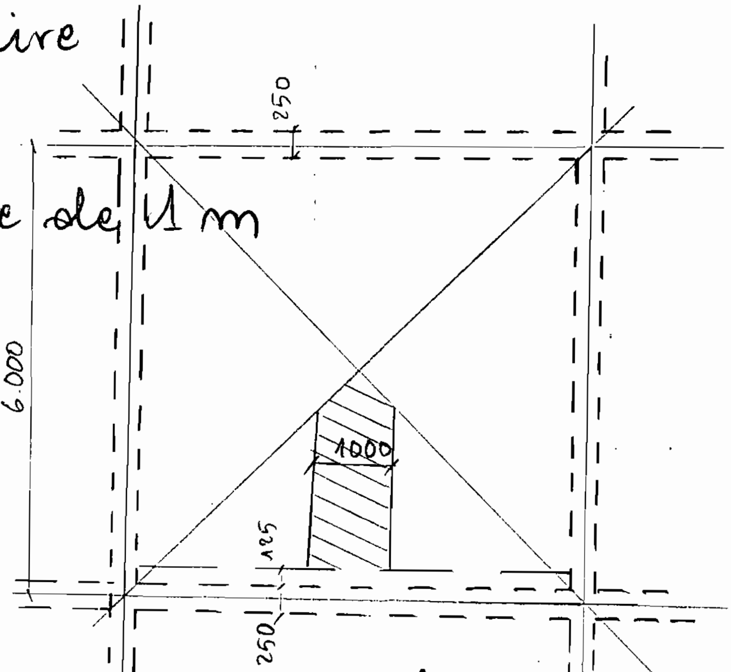
TE = travee extérieure
TI = traveé intérieure

Ces resultats trouvees pour les poutres longitudinales peuvent être retenus pour les poutres transversales.

4) Vérification du cisaillement (Dalle)

Panneau intérieur S4

Surface tributaire des poutres



Largeur de dalle de 1 m
$b = 1000\ mm$

$h = 160\ mm$

$d = h - 25 - 10$
$= 160 - 35$
$d = 125\ mm$

Capacité de cisaillement de la dalle.

$V_f = w_f\ (6000/2 - 250/2 - 125) \times 1000$

$V_f = w_f \times (2750) \cdot 10^3$

Toit : $w_f = 10{,}03\ kN/m^2$

$V_f = 10{,}03 \cdot 10^{-6} \times 2750 \cdot 10^3 = 27{,}58$

$V_f = 27{,}60\ kN$

Plancher : $w_f = 13,63\ kN/m^2$

$$V_f = 13,63 \cdot 10^{-6} \times 2750 \cdot 10^3 = 37,48$$

$$V_f = 37,50\ kN$$

$$V_2 = 0,2\ \lambda\ \phi_c \sqrt{f'_c}\ b\ d$$

$$V_2 = 0,2 \times 1,0 \times 0,60 \times \sqrt{20} \times 1000 \times 125 \cdot 10^{-3} = 67,08$$

$$V_2 = 67,10\ kN$$

$V_2 > V_f$ dans les deux 2 cas.

Dimensionnement en cisaillement des poutres interieures.

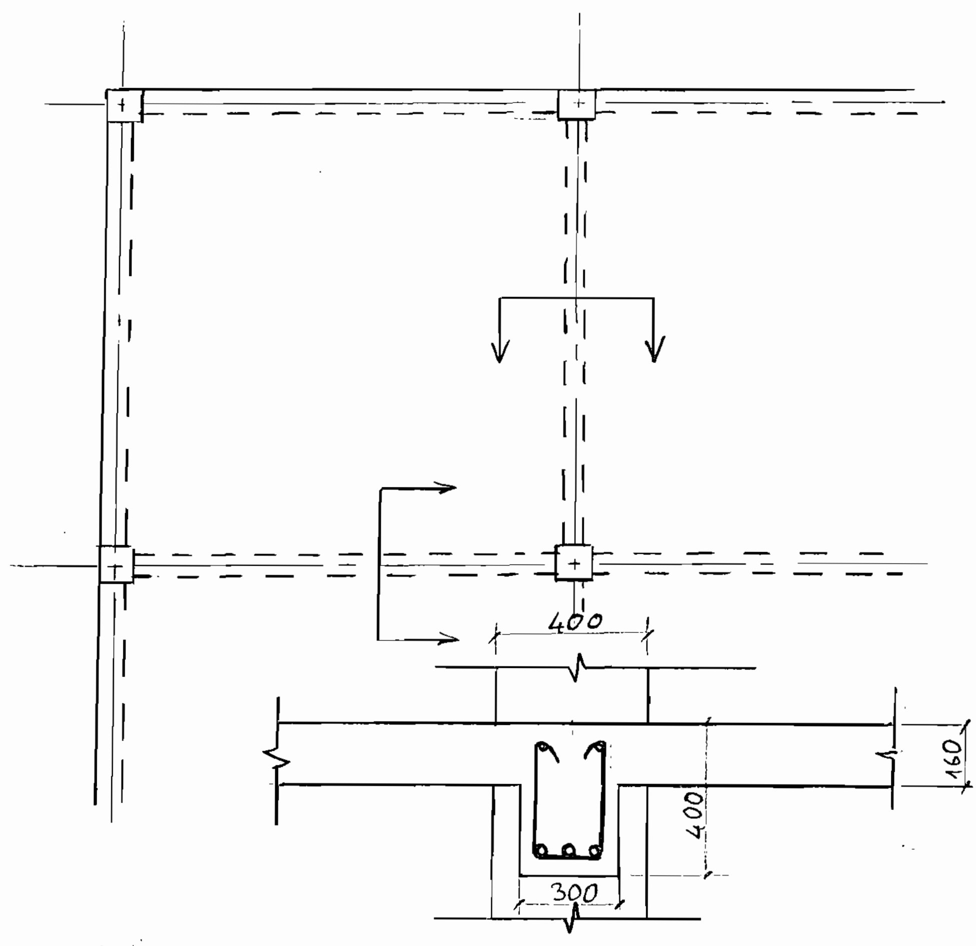
Hypothèses

Dalle 6000 × 6000 × 160

$f'_c = 20$ MPa $\qquad f_y = 400$ MPa

Poutres internes 250 × 400

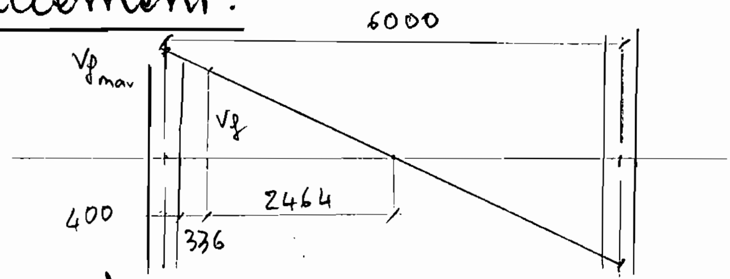
Poteau 400 × 400



Methode simplifiée

1) Effort de cisaillement.

Diagramme des efforts tranchant V (KN)



$V_{f\,max}$ à l'axe des poteaux

V_f à $d = 336$ mm de la face des poteaux

$V_f = 0$ kN à 3000 mm

$$336 + \frac{400}{2} = 536 \text{ mm} \Rightarrow 3000 - 536 = 2464 \text{ mm}$$

$$\frac{V_f}{V_{f\,max}} = \frac{2464}{3000} \Rightarrow V_f = 0{,}82\, V_{f\,max} \quad (\text{kN})$$

$$v_f = \frac{V_f \cdot 10^3}{b_w\, d} = \frac{V_f \cdot 10^3}{250 \times 336} = 0{,}011905\, V_f \quad (\text{MPa})$$

	Toit (Str 05)	Plancher (Str 07)
$V_{f\,max}$ (kN) V_f (kN) v_f (MPa)	154,83 127,17 1,51	198,37 162,93 1,94

2) Calcul des étriers pres des supports

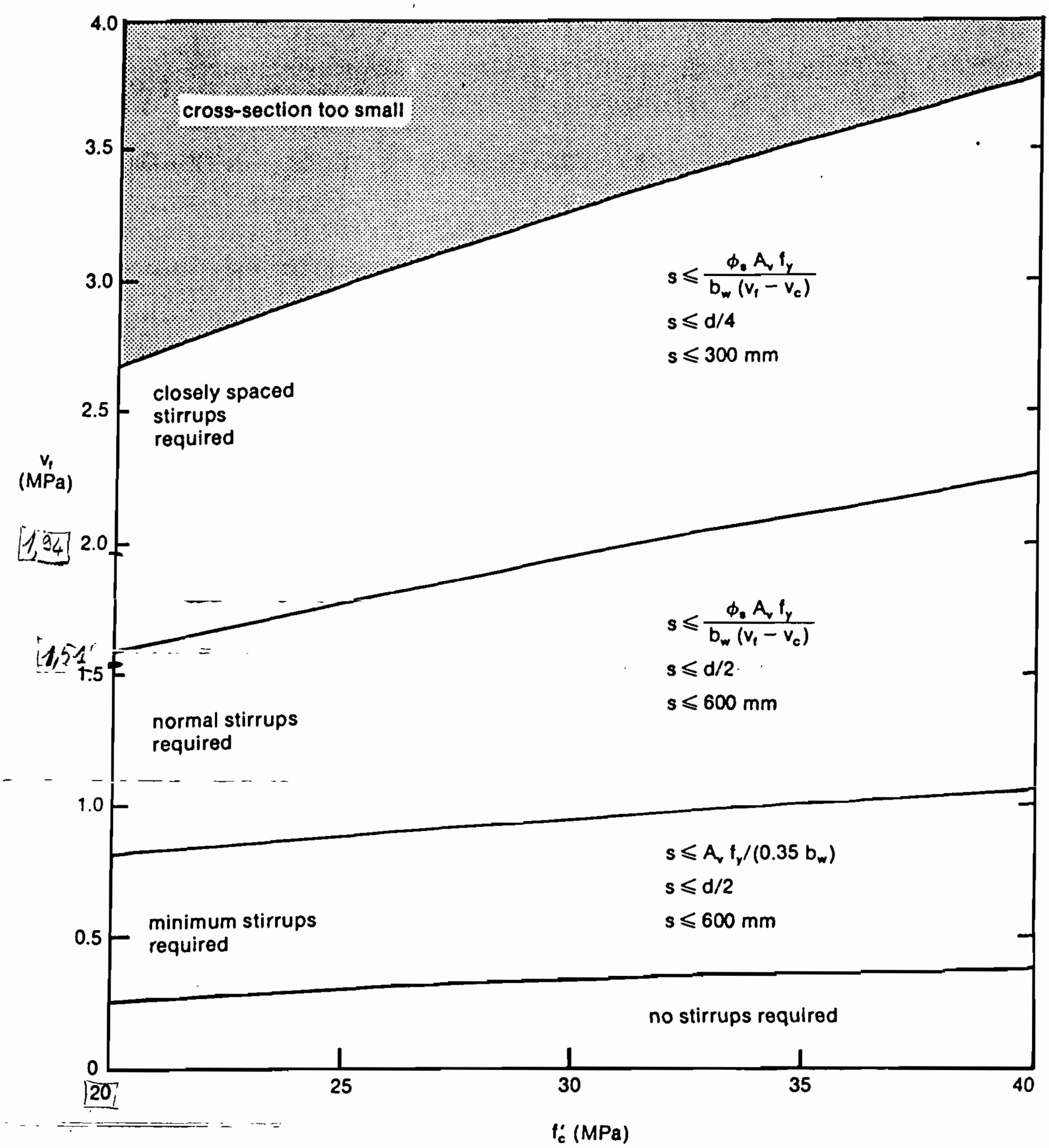
Resistance du beton

$$v_c = 0{,}2\lambda\, \phi_c \sqrt{f'_c} = 0{,}2 \times 1{,}0 \times 0{,}60 \times \sqrt{20}$$

$v_c = 0{,}54$ MPa $\qquad v_c/2 = 0{,}27$ MPa

$v_f > v_c/2$ étriers nécessaires

Etriers barre N° 10 en forme de U avec crochet de 135°



[redacted] **Stirrup Design Requirements of Clause 11.3 for Non-Prestressed Beams with Vertical Stirrups, Zero Axial Load and Zero Torsion. Values are for normal density concrete.**

1 ETRIERS PRES DES SUPPORTS

$v_c = 0{,}54$

$\phi_s A_v f_y = 0{,}85 \times 200 \times 400 \cdot 10^{-3} = 68\,kN.$

Table 1	Toit (Str 05)	Plancher (Str 07)
v_f (MPa)	1,51	1,94
$v_f - v_c$ (MPa)	0,97	1,40
$s \leq \dfrac{\phi_s A_v f_y}{b_w (v_f - v_c)}$	280 mm	194 mm
	$s \leq d/2 = 336/2 = 168$ mm	$s \leq d/4 = 336/4 = 84$ mm
	$s \leq 600$ mm	$s \leq 300$ mm

$s = 165$ (Toit) $\qquad s = 80$ (Plancher)

3) Calcul des étriers aux autres parties de la poutre.

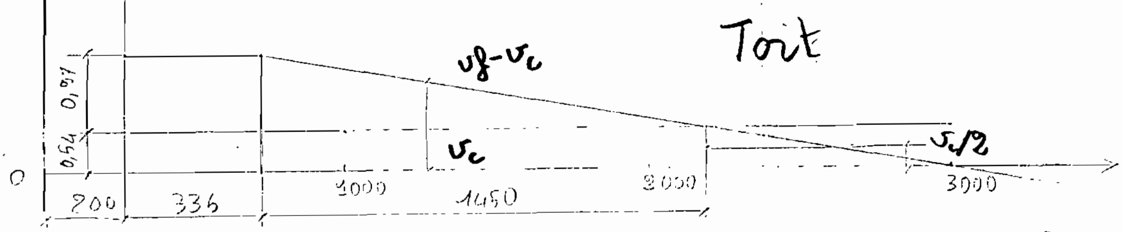
Les étriers sont necessaire quand

$v_f > v_c/2 = 0{,}54/2 = 0{,}27$ MPa

$s \leq \dfrac{d}{2} = \dfrac{336}{2} = 168$ mm espacement maximum.

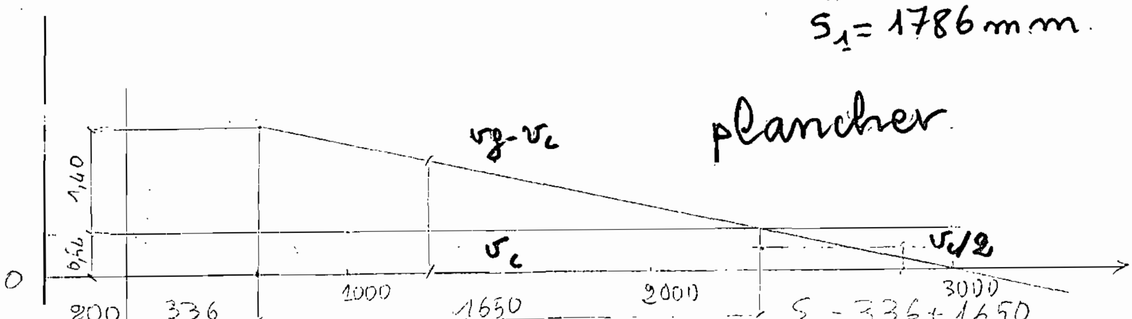
$$\frac{1}{s} = \frac{b_w (v_f - v_c)}{\phi_s A_v f_y} = \frac{250}{68000}(v_f - v_c)$$

$$\frac{1}{s} = 0{,}003676\,(v_f - v_c)$$



$s_1 = 336 + 1450$

$s_1 = 1786$ mm.



$s_1 = 336 + 1650$

$s_1 = 1986$ mm

$$\frac{(v_f - v_c)\, b_w}{\phi_s A_v f_y} = \frac{1}{s}$$

Notes:

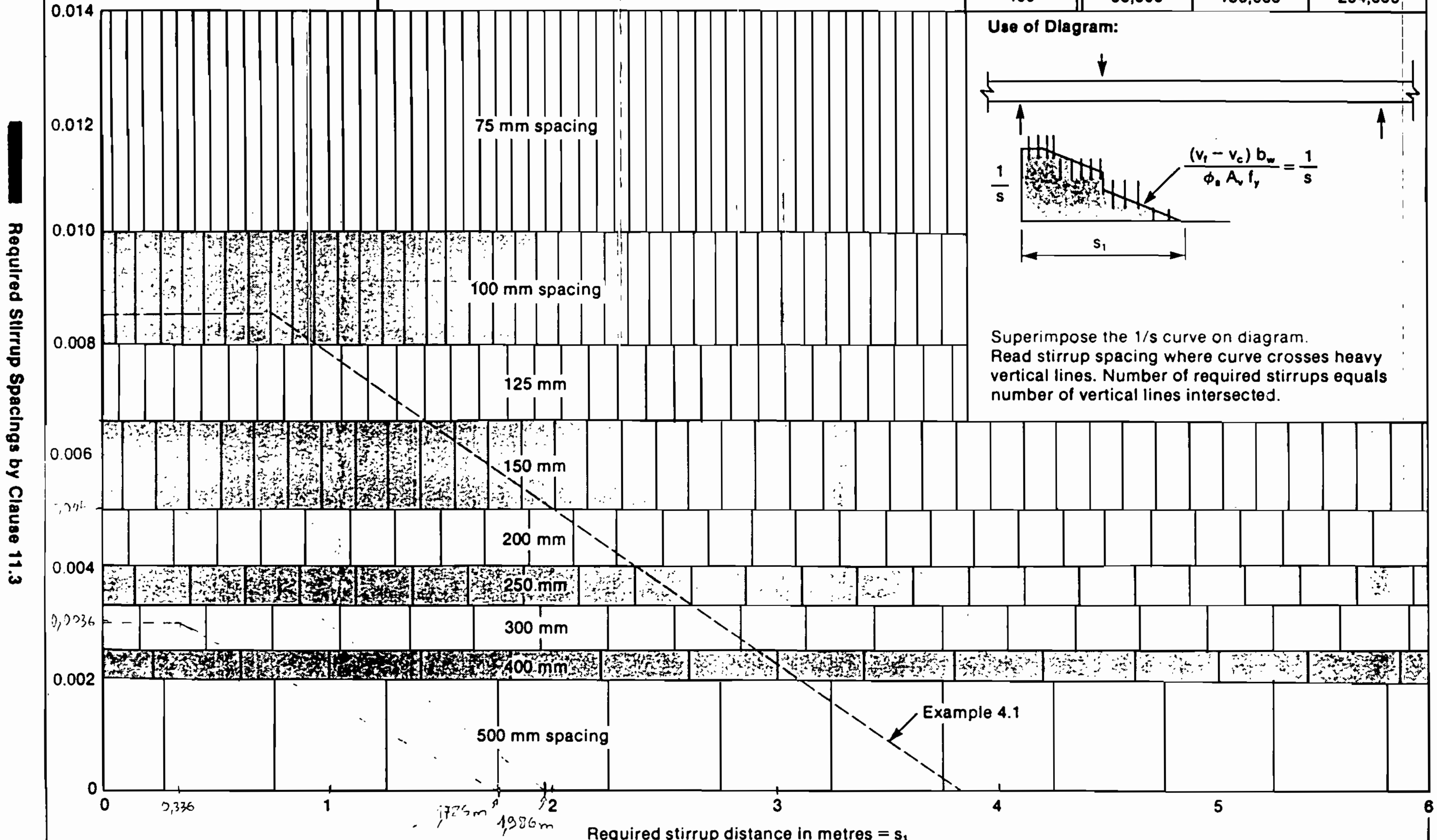
1. If $v_f \leqslant \lambda \phi_c \sqrt{f'_c}$
2. $s \leqslant d/2$
   $\leqslant 600$ mm
3. If $v_f > 0.6\, \lambda \phi_c \sqrt{f'_c}$
   then $s \leqslant d/4$
   and $s \leqslant 300$ mm
4. $s \leqslant A_v f_y / (0.35\, b_w)$

Values of $\phi_s A_v f_y$ for U stirrups

f_y (MPa)	No. 10	No. 15	No. 20
300	51,000	102,000	153,000
400	68,000	136,000	204,000

Use of Diagram:

Superimpose the 1/s curve on diagram.
Read stirrup spacing where curve crosses heavy vertical lines. Number of required stirrups equals number of vertical lines intersected.



2 ETRIERS AUX AUTRES PARTIES DE LA POUTRE

$$S \leq \frac{A_v f_y}{0{,}35\, b_w} = \frac{200 \times 400}{0{,}35 \times 250} = 914\ mm$$

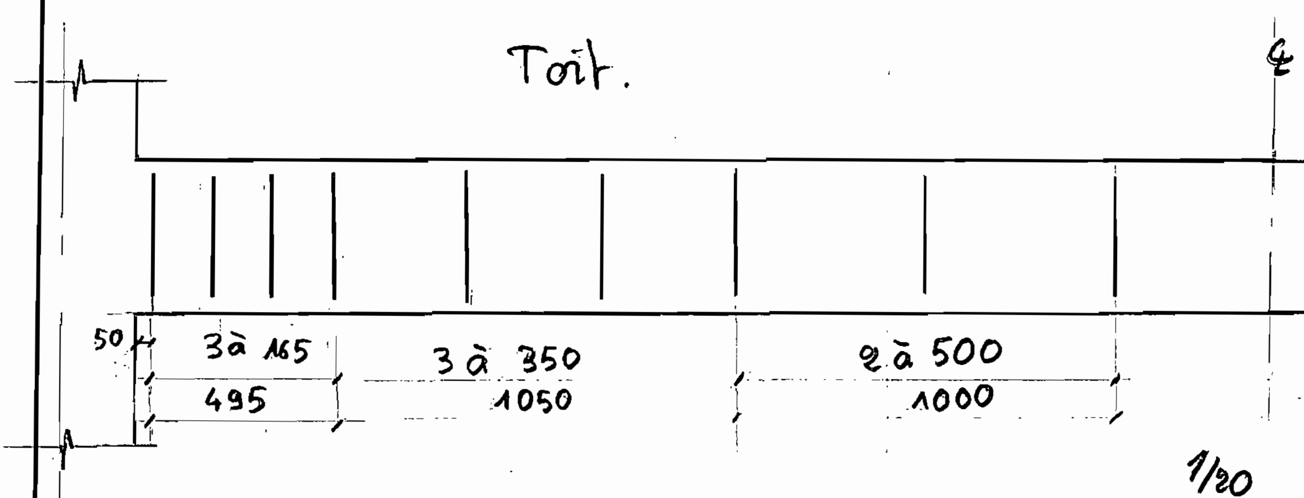
$$S \leq \frac{\phi_s A_v f_y}{b_w (v_g - v_c)} \qquad \frac{1}{S} = \frac{b_w (v_g - v_c)}{\phi_s A_v f_y} = \frac{250\,(v_g - v_c)}{0{,}85 \times 200 \times 400}$$

$$\frac{1}{S} = \frac{v_g - v_c}{272}$$

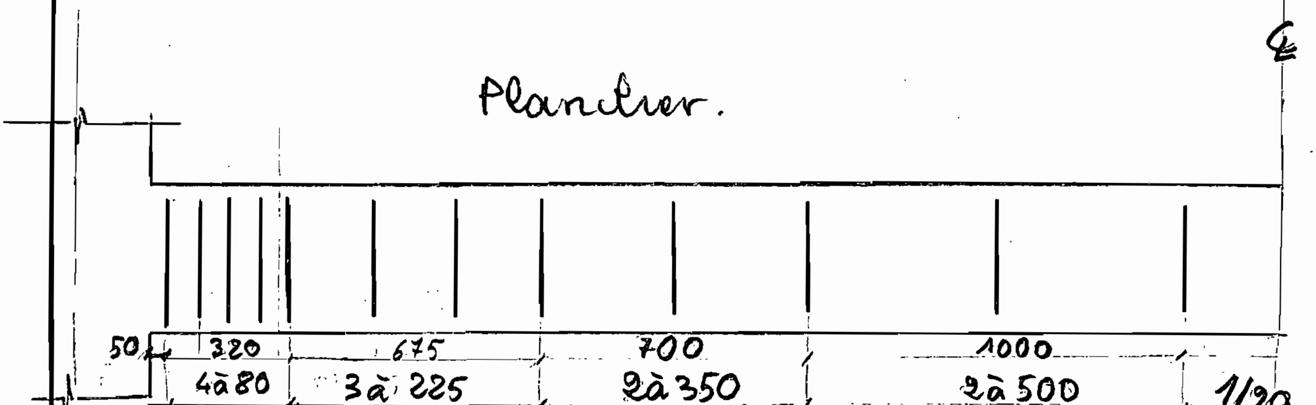
fig 2	Toit (Str 05)	Plancher (Str 07)
$v_g - v_c$	0,97	1,40
$\frac{1}{S}$	0,0036	0,0051
S_1	1786	1986

Resumé

Toit.



Plancher.



Dimensionnement en torsion des poutres de rive (extérieures)
(Torsion de compatibilité)

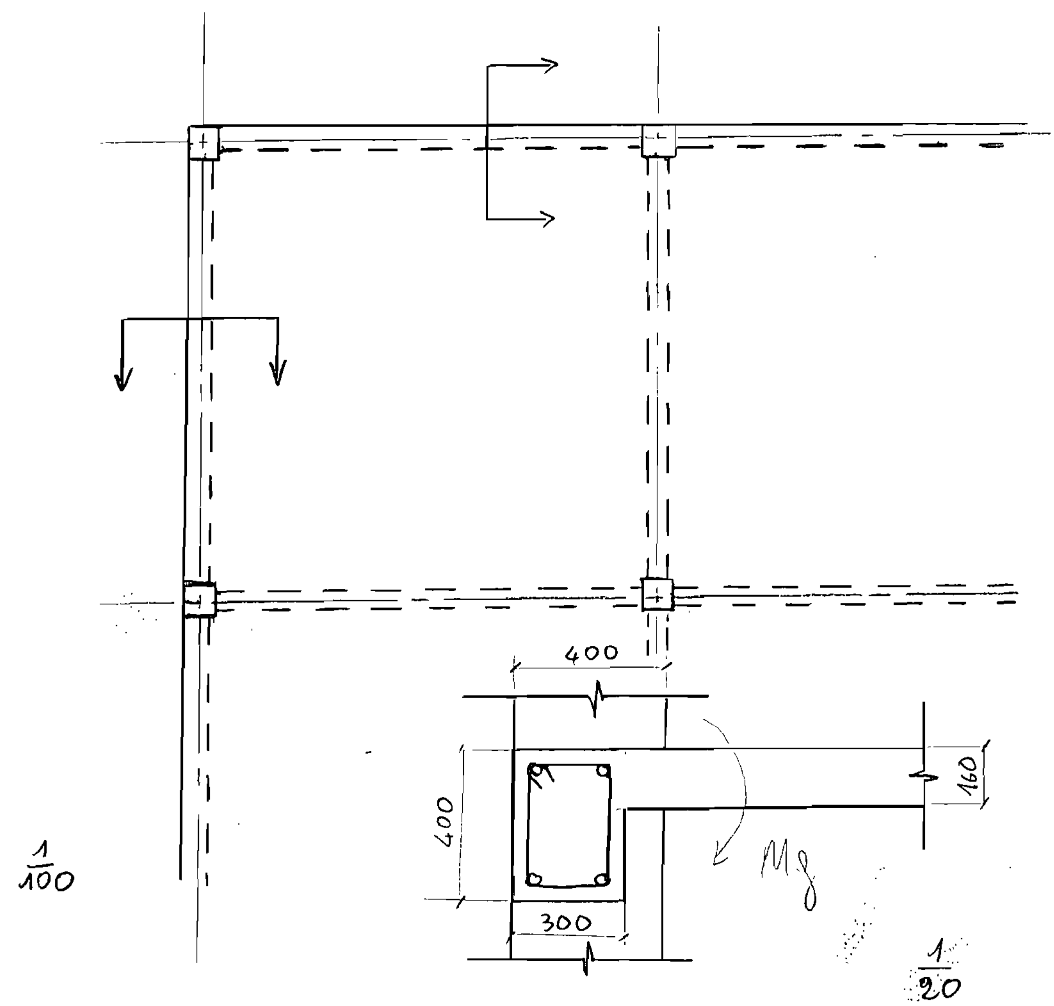
Hypothèses :

Dalle 6000 × 6000 × 160

$f'_c = 20$ MPa $\quad f_y = 400$ MPa

Poutres externes 300 × 400

Poteaux 400 × 400



1) Moment de torsion sollicitant.

- Charges permanentes

Poids dalles : $24 \times 0,160 = 3,84$ kN/m²

Surcharge permanente $1,30$ kN/m

$w_d = 5,14$ kN/m

$$w_{df} = 1,25 \times 5,14 = 6,43 \text{ kN/m}^2$$

- Surcharges et charges pondérées

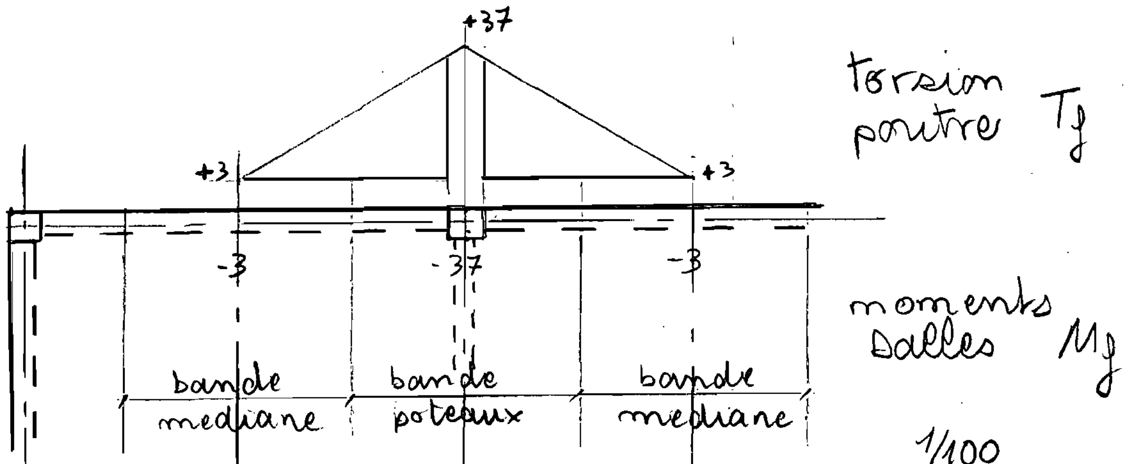
Toit : $w_{ef} = 1,5 \times 2,4 = 3,60$ kN/m²

$$w_f = w_{df} + w_{ef} = 6,43 + 3,60 = 10,03 \text{ kN/m}^2$$

Plancher : $w_{ef} = 1,5 \times 4,8 = 7,20$ kN/m²

$$w_f = w_{df} + w_{ef} = 6,43 + 7,20 = 13,63 \text{ kN/m}$$

La dalle en fléchissant entraine la poutre de rive et la tord. Les moments de flexion de la dalle sont les moments de torsion de la poutre (torsion de compatibilité).



A la face de la colonne

$$\frac{37-3}{X-3} = \frac{3000-0}{2800-0} \Longrightarrow X = 34 \times \left(\frac{2800}{3000}\right)$$

$$X = T_f = 31{,}73 \text{ kN}\cdot\text{m}$$

2) Moment de résistance à la torsion de la poutre avant la fissuration

$$T_{cr} = \frac{A_c^2}{P_c} \times 0{,}4\,\lambda\,\phi_c\,\sqrt{f'_c}$$

$A_c = 300 \times 400 = 120\,000 \text{ mm}^2$

$P_c = 2(300+400) = 1400 \text{ mm}$

$$T_{cr} = \frac{(120\,000)^2}{1400} \times 0{,}4 \times 1{,}0 \times 0{,}60 \times \sqrt{20} \cdot 10^{-6}$$

$$T_{cr} = 11{,}04 \text{ kN}\cdot\text{m}$$

$0{,}25\,T_{cr} = 2{,}76 \text{ kN}\cdot\text{m}$

$0{,}67\,T_{cr} = 7{,}40 \text{ kN}\cdot\text{m}$

$T_f > 0{,}25\,T_{cr} \Longrightarrow$ On doit tenir compte des effets de la torsion.

On doit calculer les armature de torsion.

$T_{f\,max} \geqslant 0{,}67\,T_{cr}$.

3) Dimensionnement à la torsion (Méthode simplifiée)

a) Armature de torsion

$A_o = 0{,}85\, A_{oh}$ $\quad$ $A_{oh} = (400-40-11)(300-40-11)$

$= 349 \times 249$

$A_{oh} = 85\,901 \text{ mm}^2$

$A_o = 0{,}85 \times 85\,901$

$A_o = 73\,866 \text{ mm}^2$

$$\frac{A_t}{s} = \frac{T}{2A_o \phi_s f_y} = \frac{31{,}73 \cdot 10^6}{2 \times 73\,866 \times 0{,}85 \times 400}$$

$$\frac{A_t}{s} = 0{,}632$$

$A_l = \frac{A_t}{s} P_h$ $\quad$ $P_h = 2(349 + 249)$

$P_h = 1196 \text{ mm}$

$A_l = 0{,}632 \times 1196$

$A_l = 756 \text{ mm}^2$

b) Armature de flexion.

$M_f = \frac{w l_n^2}{10}$ à la face de la colonne

$l_n = 6{,}00 - 0{,}40 = 5{,}60 \text{ mm}$

Toit: $\quad w = \frac{10{,}03 \times 6{,}00}{3} = 20{,}06 \text{ kN/m}$

$$M_f = \frac{20{,}06 \times (5{,}6)^2}{10} = 69{,}91 \text{ kN}\cdot\text{m}.$$

Plancher: $\quad w = \frac{13{,}63 \times 6{,}00}{3} = 27{,}26 \text{ kN/m}$

$$M_f = \frac{27{,}06 \times (5{,}6)^2}{10} = 85{,}49 \text{ kN}\cdot\text{m}$$

$$K_r = \frac{M_r \cdot 10^6}{b d^2} = \rho \phi_s f_y \left[1 - \rho \frac{\phi_s f_y}{1{,}7 \phi_c f'_c} \right]$$

$b = 300 \text{ mm}$; $d = 336 \text{ mm}$

$$0,030\,M_r = 340\rho - 5666,67\rho^2 \Rightarrow$$
$$5666,67\rho^2 - 340\rho + 0,030\,M_r = 0$$

$M_r = M_f$ (kNm)	ρ	A_s (mm^2)
69,91	0,007	$2\phi25 \Rightarrow 1000$
85,49	0,009	$2\phi25 \Rightarrow 1000$

A_s requise $= 1000\,mm^2$

c) Armature de cisaillement transversal

$V_f = 1,15\,\dfrac{w l_n}{2}$ à la face de la colonne

Toit : $V_f = 1,15 \times \dfrac{20,06 \times 5,6}{2} = 64,60$ kN

Plancher: $V_f = 1,15 \times \dfrac{27,26 \times 5,6}{2} = 87,78$ kN

cisaillement dans le beton

$V_c = 0,2\,\lambda\,\phi_c\sqrt{f'_c}\;bd$

$= 0,2 \times 1,0 \times 0,60\sqrt{20} \times 300 \times 336 \cdot 10^{-3}$

$V_c = 54$ kN $\qquad V_c/2 = 27$ kN

$V_f > V_c/2 \Rightarrow$ des étriers sont necessaires pour reprendre le cisaillement

Minimum $\dfrac{A_v}{s} = \dfrac{0,35\,b}{f_y} = \dfrac{0,35 \times 300}{400} = 0,263\,\dfrac{mm^2}{mm}$

d) Armature necessaire pour la torsion, la flexion et le cisaillement.

Etriers fermés barre N°10

$A_t = 100\,mm^2 \qquad A_v = 200\,mm^2$

$$\frac{A_t}{s} + 0,5\frac{A_r}{s} = 0,632 + 0,5 \times 0,263$$
$$= 0,764 \Rightarrow s = 130 \text{ mm}$$

Espacement minimum

$$s_{max} \leq \frac{d}{2} = \frac{336}{2} = 168 \text{ mm}$$

$$s_{max} \leq \frac{P_h}{8} = \frac{1196}{8} = 150 \text{ mm}$$

$$s = 130 < s_{max} = 150 \text{ mm} \quad \text{ok}$$

Acier d'armature superieure

$$A_{s\,req} = 1000 + \frac{A_l}{2} = 1000 + \frac{756}{2} = 1378 \text{ mm}^2$$

$$3\phi 25 \Rightarrow A_s = 1400 \text{ mm}^2$$

Acier d'armature inferieur

$$A_{s\,req} = \frac{A_l}{2} - \frac{M_f}{0,9 d f_y} = \frac{756}{2} - \frac{M_f \cdot 10^6}{0,9 \times 336 \times 400}$$

Toit $M_f = 69,91$ kN·m $\Rightarrow A_{s\,req} = -199,96 \text{ mm}^2$

Plancher $M_f = 85,49$ kN·m $\Rightarrow A_{s\,req} = -329 \text{ mm}^2$

$$2\phi 10 \Rightarrow A_s = 200 \text{ mm}^2 \text{ minimum.}$$

Dimensionnement des poteaux intérieurs

Hypothèses :

$f'_c = 30$ MPa $\qquad f_y = 400$ MPa

Poteaux encastrés aux deux extrémités
$k = 0,9$

Poteaux	Section (mm)	Etage	l_u (mm)
poteau	350×350	3em	3500
poteau	350×350	2em	3500
poteau	400×400	1er	3500
poteau	400×400	R.C	4000
pilier	400×400	S.S	4000

Recouvrement 50 mm
On suppose $M_2 \leq 100$ kN·m dans tous les poteaux

1) Elancement

$k = 0,9 \qquad r = 0,3\,h$

l_u	h	r	$k l_u / r$
3500	350	105	30,00
3500	400	120	26,25
4000	400	120	30,00

A tous les poteaux
$M_1 / M_2 \leq 0,5$

Tous les poteaux ou colonnes sont des colonnes courtes.
On neglige l'effet d'elancement.

2) Armatures des poteaux

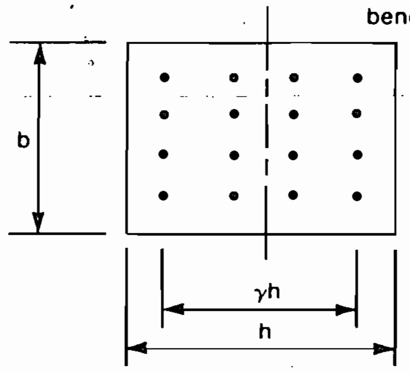
Table 1
$h = 350$ mm $\phi 15$ $\gamma = 0,60$
$h = 400$ mm $\phi 15$ $\gamma = 0,65$
$\phi 20$ $\gamma = 0,60$

fig. 2 Diagrammes d'interaction.

h (mm)	400	400	400	350	350
$P_2 = P_g \cdot 10^3$ N	2538	2002	1461	923	386
P_2 / A_g	15,9	12,5	9,1	7,5	3,2
$M_2 / A_g h$	1,56	1,56	1,56	2,33	2,33
ρ	0,015	0,01	0,01	0,01	0,012
A_s	2400	1600	1600	1225	1475
	8ϕ20	8ϕ15	8ϕ15	8ϕ15	8ϕ15

Espacement cadre $\phi 10$
$s \leq 16\ \phi_{barre}$
$s \leq 48\ \phi_{\#10}$
$s \leq h$.

[redacted] **Values of Gamma for Columns**

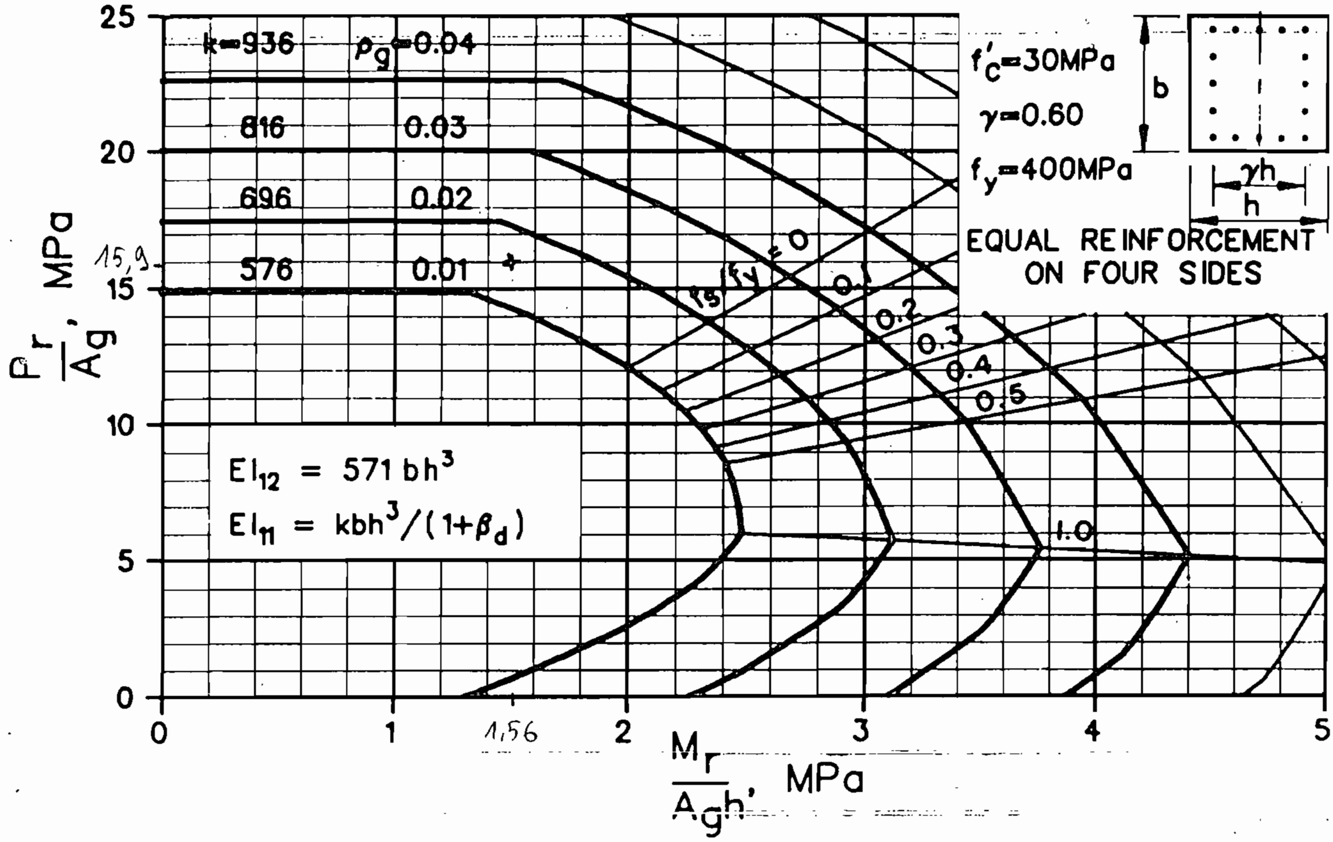


h mm	15	20	25	30	35	45	55
40 mm cover to No. 10 ties							
200	0.41	0.39	0.36				
250	0.53	0.51	0.49	0.47	0.45		
300	0.60	0.59	0.57	0.56	0.54	0.51	0.47
350	0.66	0.65	0.63	0.62	0.60	0.58	0.55
400	0.70	0.69	0.68	0.67	0.65	0.63	0.60
450	0.74	0.73	0.72	0.71	0.69	0.67	0.65
500	0.76	0.76	0.74	0.74	0.72	0.71	0.68
550	0.78	0.78	0.77	0.76	0.75	0.73	0.71
600	0.80	0.80	0.79	0.78	0.77	0.76	0.74
650	0.82	0.81	0.80	0.80	0.79	0.77	0.76
700	0.83	0.83	0.82	0.81	0.80	0.79	0.77
750	0.84	0.84	0.83	0.82	0.82	0.80	0.79
800	0.85	0.85	0.84	0.83	0.83	0.82	0.80
850	0.86	0.86	0.85	0.84	0.84	0.83	0.81
900	0.87	0.86	0.86	0.85	0.85	0.84	0.82
1000	0.88	0.88	0.87	0.87	0.86	0.85	0.84
1100	0.89	0.89	0.88	0.88	0.87	0.87	0.86
1200	0.90	0.90	0.89	0.89	0.88	0.88	0.87
1300	0.91	0.91	0.90	0.90	0.89	0.89	0.88
1400	0.92	0.91	0.91	0.91	0.90	0.90	0.89
50 mm cover to No. 10 ties							
300	0.53	0.52	0.50	0.48	0.46	0.44	
350	0.60	0.59	0.57	0.56	0.54	0.52	0.48
400	0.65	0.64	0.62	0.61	0.60	0.58	0.55
450	0.69	0.68	0.67	0.66	0.64	0.63	0.60
500	0.72	0.71	0.70	0.69	0.68	0.66	0.64
550	0.74	0.74	0.73	0.72	0.71	0.69	0.67
600	0.77	0.76	0.75	0.74	0.73	0.72	0.70
650	0.78	0.78	0.77	0.76	0.75	0.74	0.72
700	0.80	0.79	0.79	0.78	0.77	0.76	0.74
750	0.81	0.81	0.80	0.79	0.79	0.78	0.76
800	0.82	0.82	0.81	0.81	0.80	0.79	0.77
850	0.83	0.83	0.82	0.82	0.81	0.80	0.79
900	0.84	0.84	0.83	0.83	0.82	0.81	0.80
1000	0.86	0.86	0.85	0.85	0.84	0.83	0.82
1100	0.87	0.87	0.86	0.86	0.85	0.85	0.84
1200	0.88	0.88	0.87	0.87	0.87	0.86	0.85
1300	0.89	0.89	0.88	0.88	0.88	0.87	0.86
1400	0.90	0.90	0.89	0.89	0.89	0.88	0.87

Note: Gamma, γ, is the ratio of the centre to centre distance between the outermost reinforcing bars (measured perpendicular to the axis of bending) to the column size.

TABLE 1 VALEURS DE γ

[redacted] Interaction Diagrams for Axial Load and Moment Resistance for Rectangular Column with an Equal Number of Bars on all Four Faces.



[redacted] Interaction Diagrams for Axial Load and Moment Resistance for Rectangular Column with an Equal Number of Bars on all Four Faces.

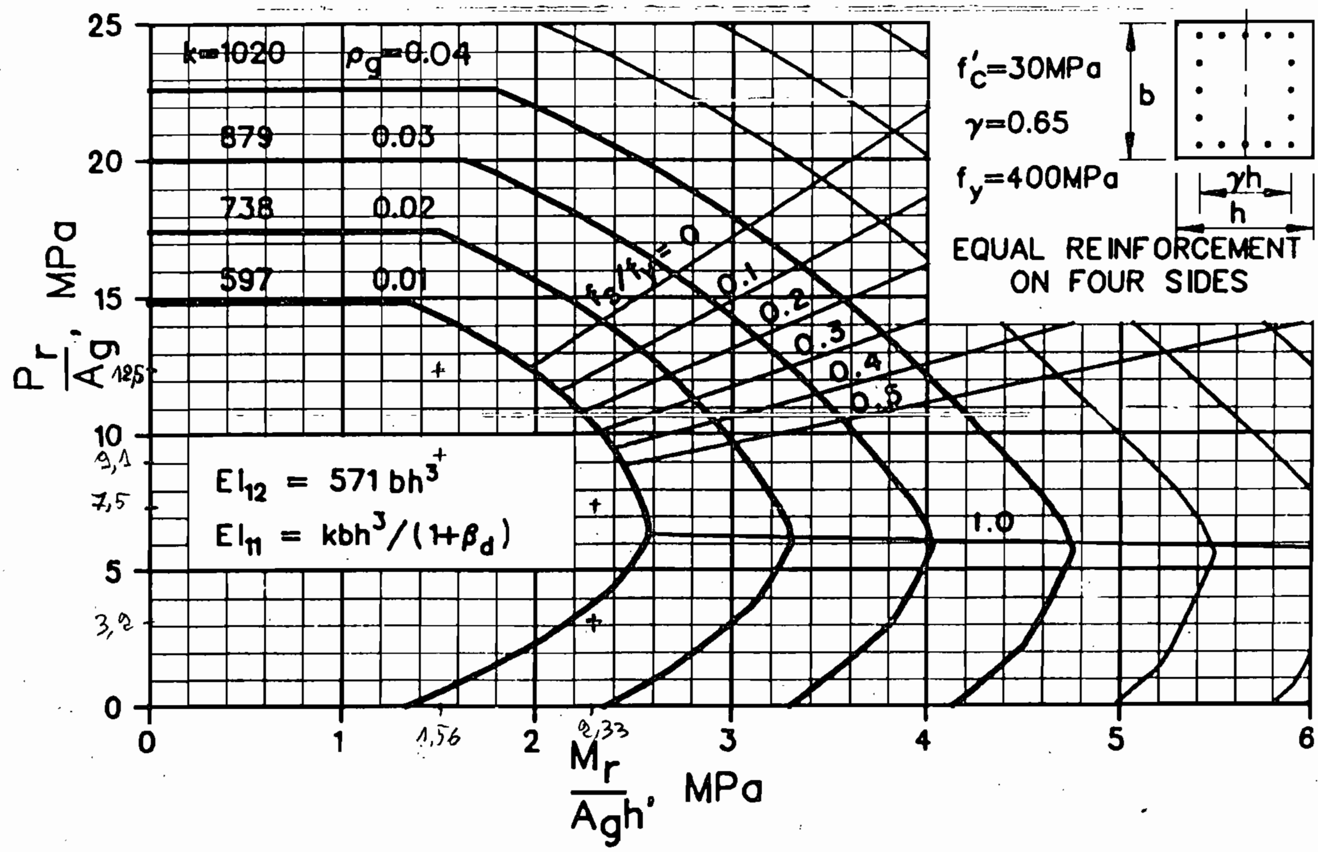


FIGURE 2 DIAGRAMMES D'INTERACTION

Dimentionnement de semelles isolées.

Hypothèses

Colonnes

$c_1 = c_2 = 400$ mm

$f'_c = 20$ MPa

$f_y = 400$ MPa

Semelles

$f'_c = 20$ MPa

$f_y = 400$ MPa

Béton.

Poids spécifique $\gamma_c = 24$ kN/m^3

Sol

Capacité portante du sol à 5 m de profondeur

$q_s = 200$ kN/m^2

Poids spécifique du sol

$\gamma_s = 16$ kN/m^3

Surcharges permanentes 1,3 kN/m^2

Surcharges

Plancher terrasse 2,4 kN/m^2 (toit)

Plancher étages 4,8 kN/m^2

1) Charges au niveau des semelles

* Semelles isolées internes (F4)

- Charges permanentes.

Dalle plancher 6000 × 6000 × 170 sur 5 niveaux

$\Rightarrow 5 \times 0,17 \times 6,00 \times 6,00 \times 24 = 734,40 kN$

Surcharges permanentes 1,3 kN/m²

$\Rightarrow 5 \times 6,00 \times 6,00 \times 1,3 = 234,00 kN$

Retombées poutres

$\Rightarrow 4 \times 5 \times (0,40 - 0,17) \times 5,60 \times 0,25 \times 24 = 154,56 kN$

Poteaux 400 × 400 × 3500, 3 unites

$\Rightarrow 3 \times 0,40 \times 0,40 \times 3,50 \times 24 = 40,32 kN$

Poteaux 400 × 400 × 4000, 2 unites

$\Rightarrow 2 \times 0,40 \times 0,40 \times 4,00 \times 24 = 30,72 kN$

$$P_D = 734,40 + 234,00 + 154,56 + 40,32 + 30,72$$

$$P_D = 1194,00 kN$$

- Surcharges.

Plancher étages et Rez de chaussée 4,8 kN/m²

Surface tributaire = 6,00 × 6,00 = 36,00 m²

Sur 4 niveaux $\Rightarrow 4 \times 36,00 = 144 m^2$

$B = 144,00 m^2 > 80 m^2$

Facteur de réduction de surcharges

$0,50 + \sqrt{20/144} = 0,87$

$\Rightarrow 4,8 \times 0,87 = 4,20 kN/m^2$

$$P_L = 4 \times 36,00 \times 4,20 = 604,8$$

$$P_L = 604,80 kN.$$

- Charges non ponderées

$$P = P_D + P_L = 1194,00 + 604,80 = 1798,80 \text{ kN}$$

$$P = 1798,80 \text{ kN.}$$

- Charges ponderées

$$P_f = 1,25\, P_D + 1,5\, P_L = 1,25 \times 1194,00 + 1,5 \times 604,80$$

$$P_f = 2399,70 \text{ kN.}$$

2) <u>Dimensions semelle.</u>

$$q_s = \frac{P}{A} \Rightarrow A = \frac{P}{q_s} = \frac{1798,80}{200} = 8,994$$

$$A = 9,00 \text{ m}^2$$

Semelle carrée $\Rightarrow A = b^2$

$$\Rightarrow b = \sqrt{A} = \sqrt{9,00} = 3,00 \text{ m.}$$

$$b = 3,00 \text{ m} = 3000 \text{ mm.}$$

3) <u>Epaisseur minimale de la semelle.</u>

$$q_{sf} = \frac{P_f}{A_f} = \frac{2399,70}{9,00} = 266,63 \text{ kN/m}^2$$

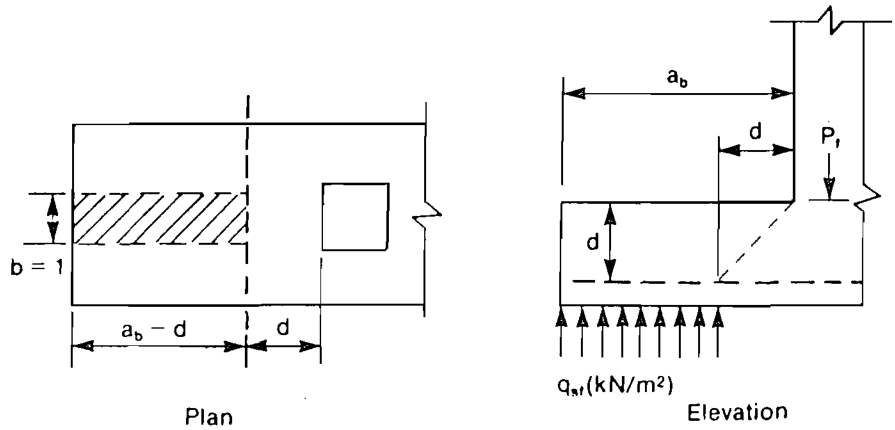
$$q_{sf} = 266,63 \text{ kN/m}^2$$

- Cisaillement unidimentionnel.

$$a_b = \frac{b_f - c}{2} = \frac{3000 - 400}{2} = 1300$$

$$a_b = 1300 \text{ mm} = 1,30 \text{ m.}$$

$$d = a_b \left(\frac{q_{sf}}{q_{sf} + 0,2\lambda \phi_c \sqrt{f'_c} \times 1000} \right) \text{ avec}$$



Values of effective depth d in mm

q_{sf} (kN/m²)	a_b (m)															d/a_b
	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00	
100	150	150	150	150	157	188	219	251	282	314	345	376	408	439	471	157
150	150	150	150	174	218	262	305	349	393	436	480	524	567	611	655	218
200	150	150	162	217	271	325	380	434	488	542	597	651	705	760	814	271
250	150	150	190	254	317	381	444	508	572	635	699	762	826	889	953	317
300	150	150	215	286	358	430	501	573	645	717	788	860	932	1003	1075	358
350	150	157	236	315	394	473	552	631	710	789	868	947	1026	1105	1184	394
400	150	170	256	341	427	512	597	683	768	854	939	1024	1110	1195	1281	427
450	150	182	273	364	456	547	638	729	820	912	1003	1094	1185	1277	1368	456
500	150	192	289	385	482	578	675	771	868	964	1061	1157	1254	1350	1446	482
550	150	202	303	404	506	607	708	809	911	1012	1113	1214	1315	1417	1518	506
600	150	211	316	422	527	633	739	844	950	1055	1161	1266	1372	1478	1583	527
650	150	219	328	438	547	657	766	876	985	1095	1205	1314	1424	1533	1643	547
700	150	226	339	452	566	679	792	905	1018	1132	1245	1358	1471	1584	1698	566
750	150	233	349	466	582	699	816	932	1049	1165	1282	1398	1515	1632	1748	582
800	150	239	359	478	598	718	837	957	1077	1197	1316	1436	1556	1675	1795	598
850	150	245	367	490	612	735	858	980	1103	1225	1348	1471	1593	1716	1838	612
900	150	250	375	501	626	751	877	1002	1127	1252	1378	1503	1628	1754	1879	626
950	150	255	383	511	639	766	894	1022	1150	1278	1405	1533	1661	1789	1917	639
1000	150	260	390	520	650	780	911	1041	1171	1301	1431	1561	1691	1822	1952	650
1100	150	268	403	537	672	806	940	1075	1209	1344	1478	1613	1747	1881	2016	672
1200	150	276	414	552	690	829	967	1105	1243	1381	1520	1658	1796	1934	2072	690
1300	150	283	424	566	707	849	990	1132	1274	1415	1557	1698	1840	1981	2123	707
1400	150	289	433	578	722	867	1012	1156	1301	1445	1590	1734	1879	2024	2168	722
1500	150	294	441	589	736	883	1031	1178	1325	1473	1620	1767	1914	2062	2209	736

Note:
Capacity reduction factor φ_c = 0.60 has been included in table values.
Minimum effective depths have been determined according to:
1) one way shear requirements (CSA Standard A23.3, Clauses 11.2.5.2, 11.10.1.1, 15.5.2)
2) minimum depth requirements (CSA Standard A23.3, Clause 15.7)

1 CISAILLEMENT UNIDIMENTIONNEL

ϕ_c = coéfficient de résistance du béton $\phi_c = 0{,}60$
λ = coéfficient pour tenir compte du béton leger
Pour le béton de densité normale
$\lambda = 1{,}00$

$$\Rightarrow \quad d = a_b \left(\frac{q_{sf}}{q_{sf} + 120\sqrt{f'_c}} \right)$$

$$d = 1300 \left(\frac{266{,}63}{266{,}63 + 120\sqrt{20}} \right) = 432$$

$$d = 432 \text{ mm.}$$

La valeur de d peut aussi être trouveé à l'aide de la table 1

- Cisaillement bidirectionnel

$$\frac{d}{h} = \frac{-(2q_{sf} + m) + \sqrt{m^2 + 4(q_{sf} + m)(^{1{,}48}/_{A_c})q_{sf}}}{2(q_{sf} + m)}$$

avec $m = 4 \times 1000 \times 0{,}4 \times \lambda \times \phi_c \sqrt{f'_c}$ $\qquad h = c = 400$ mm
Béton de densité normale $\qquad m = 960\sqrt{f'_c}$
$m = 960\sqrt{20} = 4293{,}25 \qquad m = 4293{,}25$

$$\frac{d}{400} = \frac{-(2 \times 266{,}63 + 4293{,}25) + \sqrt{(4293{,}25)^2 + 4(266{,}63 + 4293{,}25)\left(\frac{9{,}00}{0{,}16}\right)266{,}63}}{2(266{,}63 + 4293{,}25)}$$

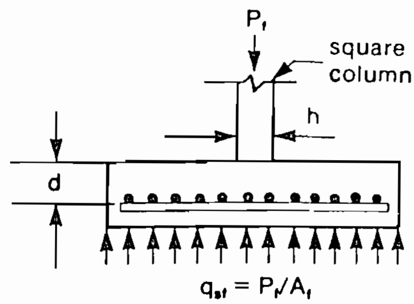
$= 1{,}345$

$$d = 538 \text{ mm.}$$

$f'_c = 20$ **MPa**

A_f = area of footing, m²
A_c = area of column, m²

For circular, polygonal, or rectangular columns with aspect ratios not exceeding 2.0, use $h = \sqrt{A_c}$.



Values of footing to column area ratio, A_f/A_c

q_{sf} (kN/m²)	d/h															
	0.5	**0.6**	**0.7**	**0.8**	**0.9**	**1.0**	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**	**1.6**	**1.7**	**1.8**	**1.9**	**2.0**
100	34	43	53	65	77	89	103	118	133	150	167	185	204	224	244	266
150	23	30	36	44	52	61	70	80	90	101	113	125	138	152	166	180
200	18	23	28	34	40	46	53	61	69	77	86	96	105	116	126	137
250	15	19	23	27	32	38	44	50	56	63	70	78	86	94	103	112
300	12	16	19	23	28	32	37	42	48	53	59	66	72	79	87	94
350	11	14	17	20	24	28	32	37	41	46	52	57	63	69	75	82
400	10	12	15	18	21	25	29	33	37	41	46	51	56	61	67	73
450	9	11	14	16	19	23	26	30	33	37	42	46	51	55	60	66
500	8	10	13	15	18	21	24	27	30	34	38	42	46	51	55	60
550	8	10	12	14	16	19	22	25	28	31	35	39	43	47	51	55
600	7	9	11	13	15	18	20	23	26	29	33	36	40	43	47	51
650	7	8	10	12	14	17	19	22	25	27	31	34	37	41	44	48
700	6	8	10	12	14	16	18	21	23	26	29	32	35	38	42	45
750	6	8	9	11	13	15	17	19	22	24	27	30	33	36	39	43
800	6	7	9	10	12	14	16	19	21	23	26	29	31	34	37	41
850	6	7	8	10	12	14	16	18	20	22	25	27	30	33	36	39
900	5	7	8	10	11	13	15	17	19	21	24	26	29	31	34	37
950	5	6	8	9	11	13	14	16	18	20	23	25	28	30	33	36
1000	5	6	7	9	10	12	14	16	18	20	22	24	26	29	32	34
1100	5	6	7	8	10	11	13	15	16	18	20	22	25	27	29	32
1200	4	5	7	8	9	11	12	14	15	17	19	21	23	25	28	30
1300	4	5	6	7	9	10	12	13	15	16	18	20	22	24	26	28
1400	4	5	6	7	8	10	11	12	14	16	17	19	21	23	25	27
1500	4	5	6	7	8	9	11	12	13	15	16	18	20	22	24	26

Note:
Capacity reduction factor $\varphi_c = 0.60$ has been included in table values. Columns with aspect ratios greater than 2.0 must be considered on an individual basis. Also minimum depth requirements of Clause 15.7 must be checked.

2 CISAILLEMENT BIDIMENTIONNEL

La table 2 peut aussi nous donner la valeur de d.

Le cisaillement bidirectionnel gouverne
$d = 538$ mm.

4) Armature minimum de cisaillement.
Flexion et cisaillement de la semelle.
Poinçonnement

$$V_f = q_{sf}\left(b^2 - (c+d)^2\right)$$

$$= 266,63\left((3000)^2 - (400+538)^2\right)10^{-6}$$

$$V_f = 2165 \text{ kN}$$

$$V_c = \left(1 + \frac{2}{\beta_c}\right) \times 0,2\,\lambda\,\phi_c\sqrt{f'_c}\;b_o\,d$$

$$\beta_c = \frac{3000}{3000} = 1 \qquad b_o = 4(c+d) = 4(400+538)$$
$$b_o = 3752 \text{ mm.}$$

$$V_c = \left(1 + \frac{2}{1}\right) \times 0,2 \times 1,00 \times 0,60 \times \sqrt{20} \times 3752 \times 538 \cdot 10^{-3}$$

$$V_c = 3249,84 \text{ kN}$$

$$V_c > 0,4\,\lambda\,\phi_c\sqrt{f'_c}\;b_o d = 0,4 \times 1,00 \times 0,60 \times \sqrt{20} \times 3752 \times 538 \cdot 10^{-3}$$

$$V_c = 3249,84 \text{ kN} > 2166,56 \text{ kN. ok.}$$

$V_f = 2165{,}00\ kN < V_c = 3249{,}84\ kN$ ok

5) Longueur de scellement ou ancrage de base

- Diamètre maximum des barres

$$d_{b\,max} = 12{,}94\sqrt{(\alpha_1 - 0{,}075)\sqrt{f'_c}}$$
$$= 12{,}94\sqrt{(1{,}3 - 0{,}075)\sqrt{20}} = 30{,}28$$

$$d_{b\,max} = 30\ mm.$$

$d_b < 30\ mm$

Les barres que l'on doit utiliser dans le ferraillage des semelles ne doivent pas être plus grandes que les barres N° 30 ($d_b = 29{,}9\ mm$)

- Longueur de scellement.

Compression

$$\ell_{bd} = 0{,}24\ d_b f_y / \sqrt{f'_c}$$

barres N°	$d_{b(mm)}$	ℓ_{bd} (mm)	$> 0{,}044\, d_b f_y$	
25	25,2	540	> 445	ok
20	19,5	420	> 345	ok
15	16	345	> 280	ok
10	11,3	245	> 200	ok.

Voir les tableaux

Quelles que soient les barres choisies

$\ell_{bd} < d = 538 \simeq 540\ mm.$ ok

- Épaisseur semelle. $d_{b\,max} = 25{,}2$ (barre N° 25)

$h = d + d_{b\,max} + recouvr. = 540 + 25 + 75$

$$h = 640\ mm.$$

On prend

$$h = 650\ mm \quad et \quad d = 550\ mm$$

- Longueur disponible.

$$\ell_d = \left(\frac{b-c}{2}\right) - 75 = \frac{3000-400}{2} - 75 = 1225$$

$$\ell_d = 1225\ mm$$

Cette longueur est suffisante pour transferer par frottement les contraintes de l'acier vers le béton.

6) Flexion

Pour une semelle isolée, le moment pondéré maximal est calculé à la face du poteaux

$$q_{sf}\, a_b^2 = 266{,}63 \times (1{,}3)^2 = 450{,}60\ kN$$

. Armature de la semelle

Pour une largeur de 1 m de semelle

$$A_s = 1{,}5 f'_c\, d - \sqrt{(1{,}5 f'_c\, d)^2 - 4412 f'_c (q_{sf}\, a_b^2)}$$

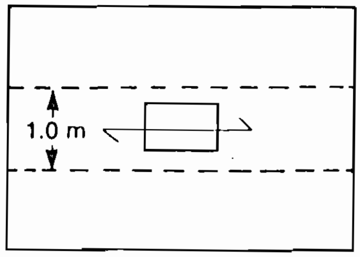
$$A_s = 1{,}5 \times 20 \times 550 - \sqrt{(1{,}5 \times 20 \times 550)^2 - 4412 \times 20 \times 450{,}60}$$

$$A_s = 1252{,}41\ mm^2/m$$

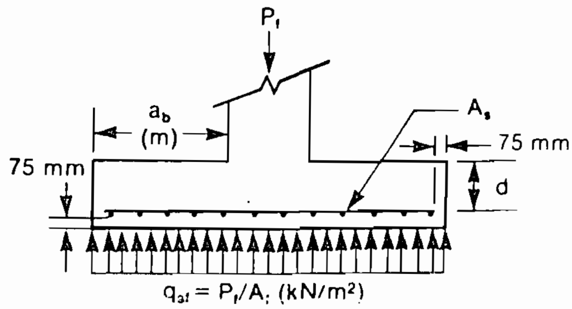
$$A_s \geq 2{,}0 \times (d+100) = 2 \times (550+100)$$
$$\geq 1300\ mm^2/m.$$

$$A_s \leq 0{,}765 f'_c\, d = 0{,}765 \times 20 \times 550$$
$$\leq 8415\ mm^2/m$$

$f'_c = 20$ MPa
$f_y = 400$ MPa
Max. $d_b = 27.4\sqrt{a_b - 0.075}$
$\leq 43.1\,(a_b - 0.075)$



Plan



Elevation

Values of A_s (mm²) required in a 1 m width of footing

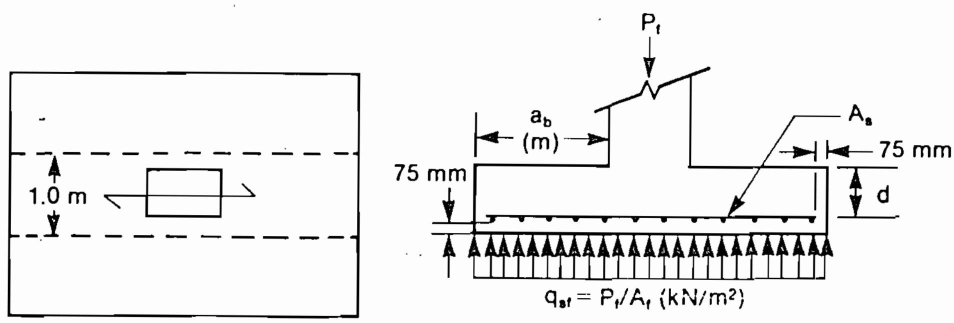
$q_{sf}\,a_b^2$ (kN)	d (mm)															
	150	**175**	**200**	**225**	**250**	**275**	**300**	**325**	**350**	**375**	**400**	**425**	**450**	**475**	**500**	**525**
50	520	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250
60	632	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250
70	748	625	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250
80	868	721	620	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250
90	991	820	702	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250
100	1119	921	786	688	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250
120	1391	1130	959	836	742	750	800	850	900	950	1000	1050	1100	1150	1200	1250
140	1689	1350	1137	987	874	786	800	850	900	950	1000	1050	1100	1150	1200	1250
160	2023	1583	1322	1142	1009	905	821	850	900	950	1000	1050	1100	1150	1200	1250
180		1832	1514	1302	1146	1026	930	851	900	950	1000	1050	1100	1150	1200	1250
200		2101	1716	1466	1286	1149	1040	951	900	950	1000	1050	1100	1150	1200	1250
250			2266	1902	1652	1467	1322	1205	1109	1027	1000	1050	1100	1150	1200	1250
300			2913	2380	2043	1800	1615	1468	1346	1245	1158	1084	1100	1150	1200	1250
350				2918	2463	2152	1920	1738	1591	1468	1364	1274	1196	1150	1200	1250
400					2922	2525	2239	2019	1842	1696	1573	1468	1377	1297	1226	1250
450					3432	2925	2574	2309	2101	1930	1787	1666	1560	1468	1387	1315
500						3356	2927	2612	2367	2170	2006	1866	1747	1642	1550	1469
600							3703	3260	2929	2669	2457	2280	2128	1997	1882	1781
700								3979	3537	3200	2931	2710	2523	2363	2223	2101
800								4803	4202	3768	3432	3159	2933	2740	2573	2428
900									4947	4383	3963	3631	3359	3130	2934	2763
1000										5059	4532	4128	3804	3534	3305	3107
1200											5826	5221	4761	4392	4086	3826
1400													5837	5332	4927	4590
1600														6383	5844	5411
1800															6865	6303
2000																7289

Note:
Steel areas shown are based on flexural and minimum reinforcement (Clause 7.8.1) requirements. Where numerical values are not shown, required steel area is in excess of that specified in Clause 10.3.3 and effective depth d must be increased.

Continued

3 ARMATURES DE FLEXION POUR 1M DE SEMELLE

f'_c = 20 MPa
f_y = 400 MPa
Max. $d_b = 27.4\sqrt{a_b - 0.075}$
$\leq 43.1\,(a_b - 0.075)$



Plan

Elevation

Values of A_s (mm²) required in a 1 m width of footing

$q_{sf}\,a_b^2$ (kN)	d (mm)															
	550	**575**	**600**	**625**	**650**	**675**	**700**	**725**	**750**	**775**	**800**	**825**	**850**	**900**	**950**	**1000**
400	1300	1350	1400	1450	1500	1550	1600	1650	1700	1750	1800	1850	1900	2000	2100	2200
500	1396	1350	1400	1450	1500	1550	1600	1650	1700	1750	1800	1850	1900	2000	2100	2200
600	1691	1609	1536	1469	1500	1550	1600	1650	1700	1750	1800	1850	1900	2000	2100	2200
700	1992	1894	1806	1726	1653	1587	1600	1650	1700	1750	1800	1850	1900	2000	2100	2200
800	2299	2184	2081	1987	1902	1825	1754	1688	1700	1750	1800	1850	1900	2000	2100	2200
900	2613	2480	2360	2253	2155	2066	1984	1909	1840	1775	1800	1850	1900	2000	2100	2200
1000	2934	2782	2645	2522	2411	2310	2218	2133	2054	1982	1914	1851	1900	2000	2100	2200
1200	3601	3405	3231	3075	2936	2809	2693	2588	2490	2401	2317	2240	2168	2037	2100	2200
1400	4305	4058	3841	3649	3477	3322	3182	3054	2936	2828	2728	2636	2549	2393	2256	2200
1600	5051	4744	4479	4245	4038	3852	3684	3532	3393	3265	3147	3038	2937	2755	2595	2453
1800	5850	5471	5148	4867	4619	4399	4202	4023	3860	3712	3575	3449	3332	3121	2937	2775
2000	6713	6246	5854	5518	5225	4966	4735	4528	4340	4169	4012	3867	3733	3494	3285	3101
2200	7661	7079	6603	6202	5857	5555	5287	5048	4833	4637	4458	4294	4142	3872	3637	3431
2400		7987	7406	6926	6520	6168	5859	5585	5339	5117	4915	4730	4560	4257	3995	3765
2600			8274	7698	7218	6809	6454	6141	5861	5610	5383	5176	4985	4648	4358	4104
2800				8527	7959	7483	7074	6717	6400	6118	5863	5632	5420	5047	4726	4447
3000				9431	8751	8194	7722	7315	6958	6641	6356	6099	5865	5452	5100	4795
3500						10189	9503	8935	8449	8027	7654	7322	7022	6502	6063	5686
4000								10790	10118	9553	9065	8637	8257	7608	7068	6611
4500										11271	10623	10070	9588	8781	8124	7574
5000												11659	11041	10035	9237	8580
5500													12657	11389	10418	9636
6000														12873	11683	10750
6500															13050	11932
7000																13197
7500																14566

Note:
Steel areas shown are based on flexural and minimum reinforcement (Clause 7.8.1) requirements. Where numerical values are not shown, required steel area is in excess of that specified in Clause 10.3.3 and effective depth d must be increased.

3 (SUITE)

$$A_s = 1300 mm^2/m$$

On aurait pu obtenir la valeur de A_s' à partir du tableau 3

Semelle largeur $b = 3,00$ m.

$\Rightarrow A_s = 3,00 \times 1300$

$$A_s = 3900 mm^2$$

Barres N°	A_{sb} (mm^2)	Nombre (N)	A_s (mm^2)	e (mm)
25 (25,2)	500	8	4000	365
20 (19,5)	300	13	3900	225 ×
15 (16,0)	200	20	4000	145

e espacement. $e = \dfrac{b - 75 - d_b/2}{N}$

On peut porter notre choix sur
13 ∅ 20 e = 225 mm ou
20 ∅ 15 e = 145 mm dans chaque sens.

7) Transmission des contraintes à la surface de contact.

- Resistance ou contrainte maximale à la surface de contact de la semelle.

$$f_b = \frac{P_f}{A_c} = \frac{2399{,}70}{(0{,}40)^2} = 14\,998{,}125 \text{ kPa} \simeq 15 \cdot 10^3 \text{ kPa}$$

$$f_b = 15 \text{ MPa.}$$

$$f_{b\,adm} = 0{,}85\, \phi_c f'_c \sqrt{A_1/A_2}$$

$$\sqrt{A_1/A_2} = \sqrt{9{,}00/0{,}16} = 7{,}5 \geq 2 \Rightarrow \sqrt{A_1/A_2} = 2$$

$$f_{b\,adm} = 0{,}85 \times 0{,}60 \times 20 \times 2 = 20{,}4 \text{ MPa}$$

$$f_{b\,adm} = 20{,}4 \text{ MPa} > f_b = 15 \text{ MPa}$$

OK

- Force pondérée des charges aux appuis

$$P_f = 2399{,}70 \text{ kN}$$

$$0{,}85\, \phi_c f'_c A_c = 0{,}85 \times 0{,}60 \times 20 \times (0{,}40)^2 \cdot 10^3$$
$$= 1632 \text{ kN} < P_f = 2399{,}70 \text{ kN}$$

$$\Rightarrow 2399{,}70 - 1632 = 767{,}70 \text{ kN}$$

Armature pour reprendre cette effort

$$A_{sd} = \frac{767{,}70 \cdot 10^3}{\phi_s f_y} = \frac{767{,}70 \cdot 10^3}{0{,}85 \times 400} = 2258 \text{ mm}^2$$

$$A_{sd} > 0{,}005\ A_c = 0{,}005 \times (400)^2 = 800\ mm^2 \quad ok.$$

$$A_{sd} = 2258\ mm^2$$

Barre N°	$A_{s(b)}$ (mm^2)	Nombre	A_s (mm^2)
20	300	8	2400

CONCLUSION

C'est là une étude plus ou moins complète du bâtiment qui est fait. Elle va de l'établissement de plans architectes à celui de plans de béton armé (coffrage et ferraillage).
Les plans de béton armé sont la représentation des calculs de dimensionnement de ces quelques éléments structuraux parmis les plus importants du batiment.
L'étude pourrait se poursuivre et s'étendre à d'autres éléments comme les escaliers, le noyau ou la gaine de l'ascenseur, les murs de fondations, les dallages etc...
Par ce travail, c'est une esquisse de procédure de conception (calculs et dessins) qui est fait. Il peut etre améliorer et/ou perfectionner.

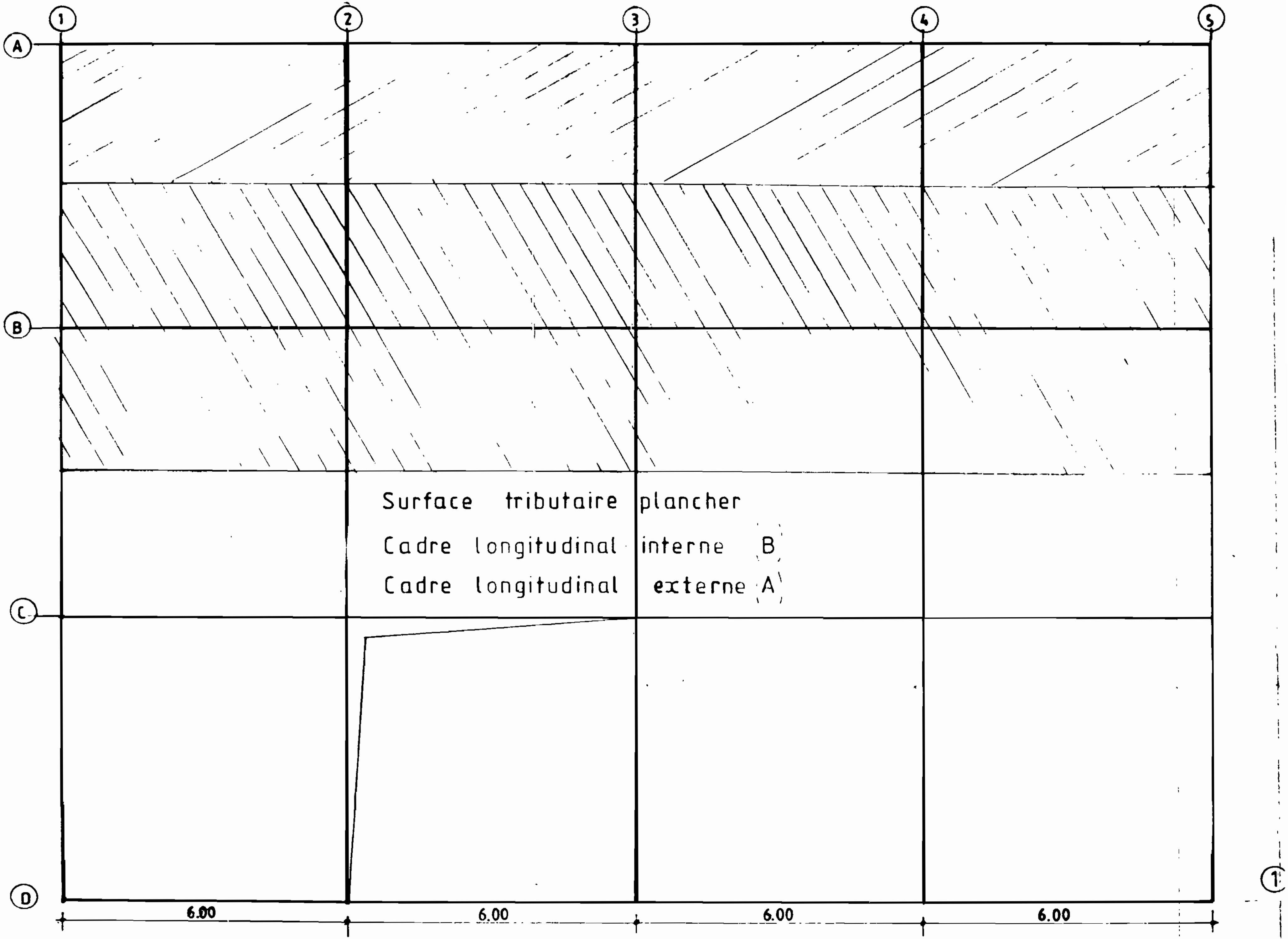
BIBIOGRAPHIE

- Code National du Batiment du Canada 1985
  puplie par le comité associé du code national du batiment, le conseil national de recherches Candda Ottawa.

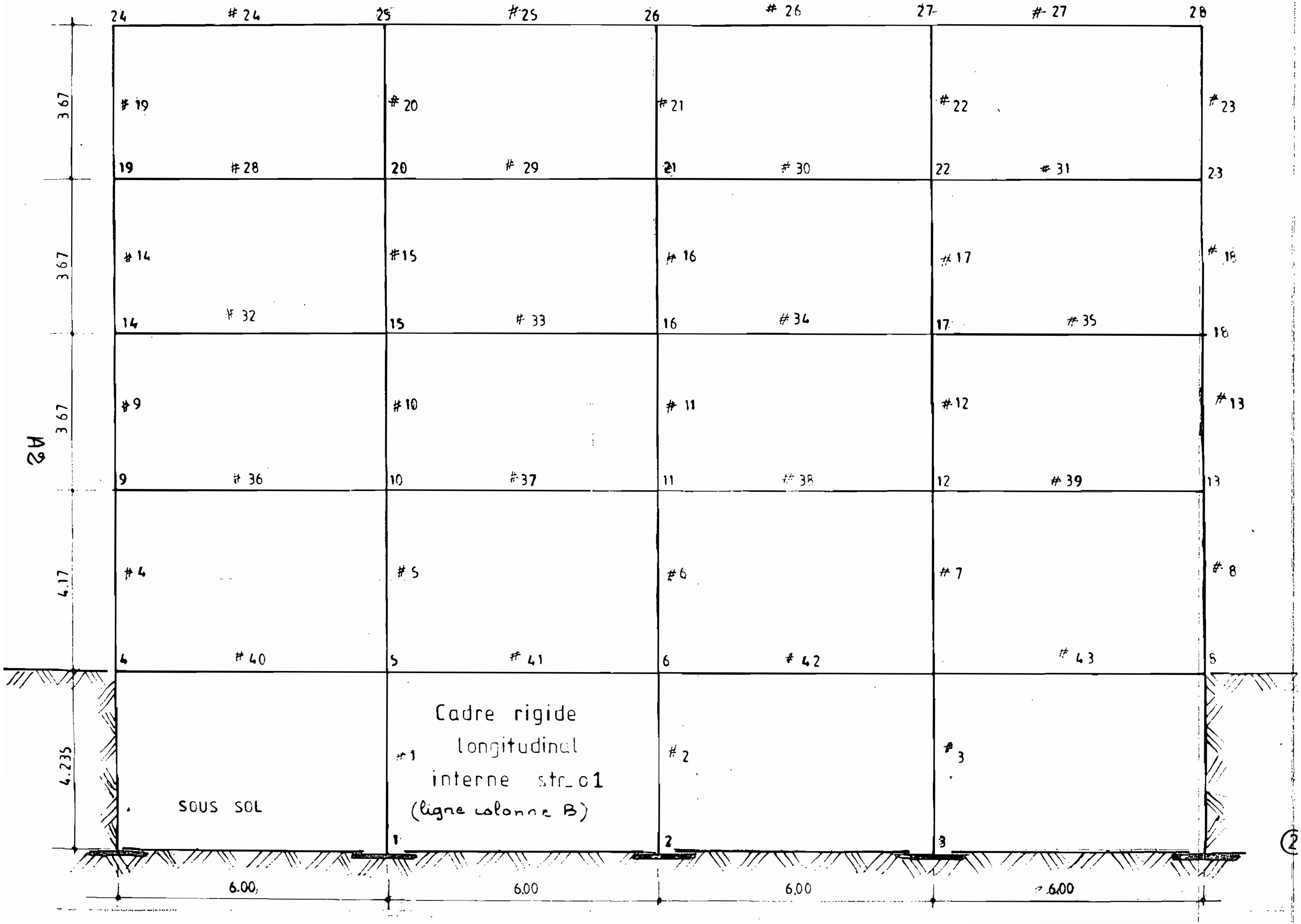
- Calcul des ouvrages en beton dans les batiments
  préparée par l Association canadienne de normalisation et approuvée par le Conseil canadien des normes.

- " Concrete Design Handbook"
  de l association canadienne de Ciment Portland (ACCP/CPCA)

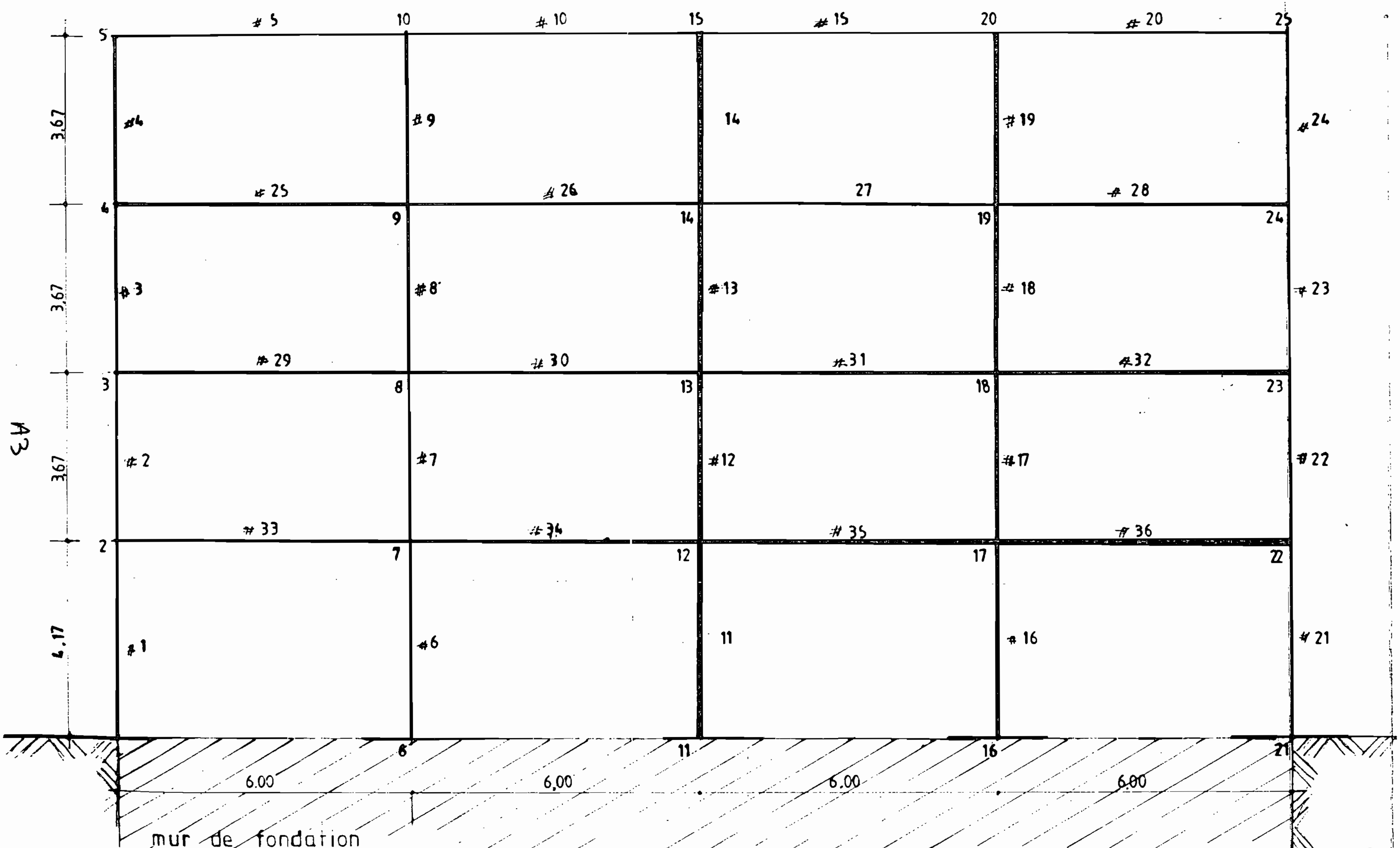
ANNEXES


1
2
3
4
5
A
B
C
D
Surface tributaire plancher
Cadre longitudinal interne B
Cadre longitudinal externe A
6.00
6.00
6.00
6.00

A1



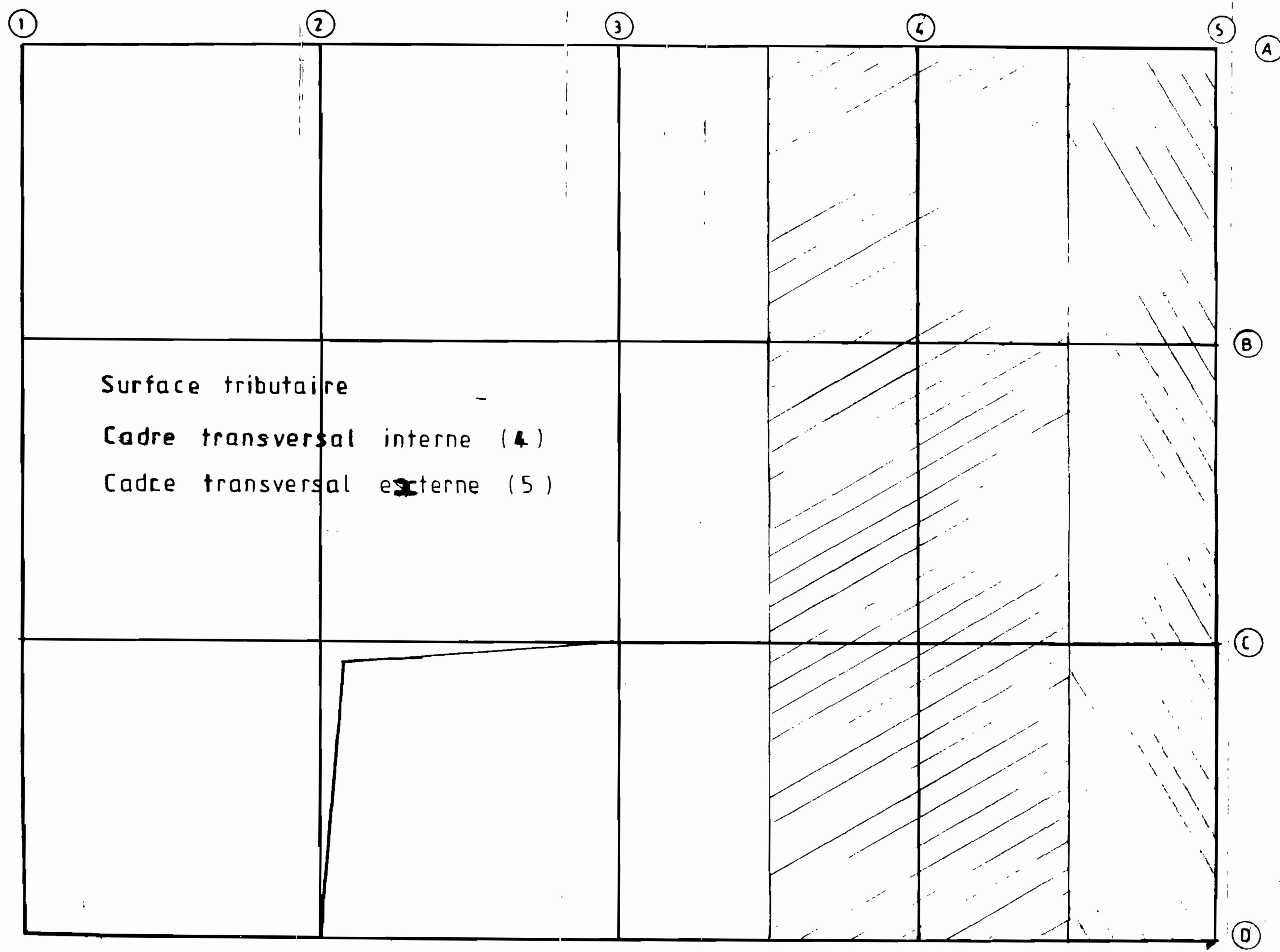
Cadre rigide
longitudinal
interne str_c1
(ligne colonne B)
SOUS SOL
3.67
3.67
3.67
4.17
4.235
6.00
6.00
6.00
6.00
A2

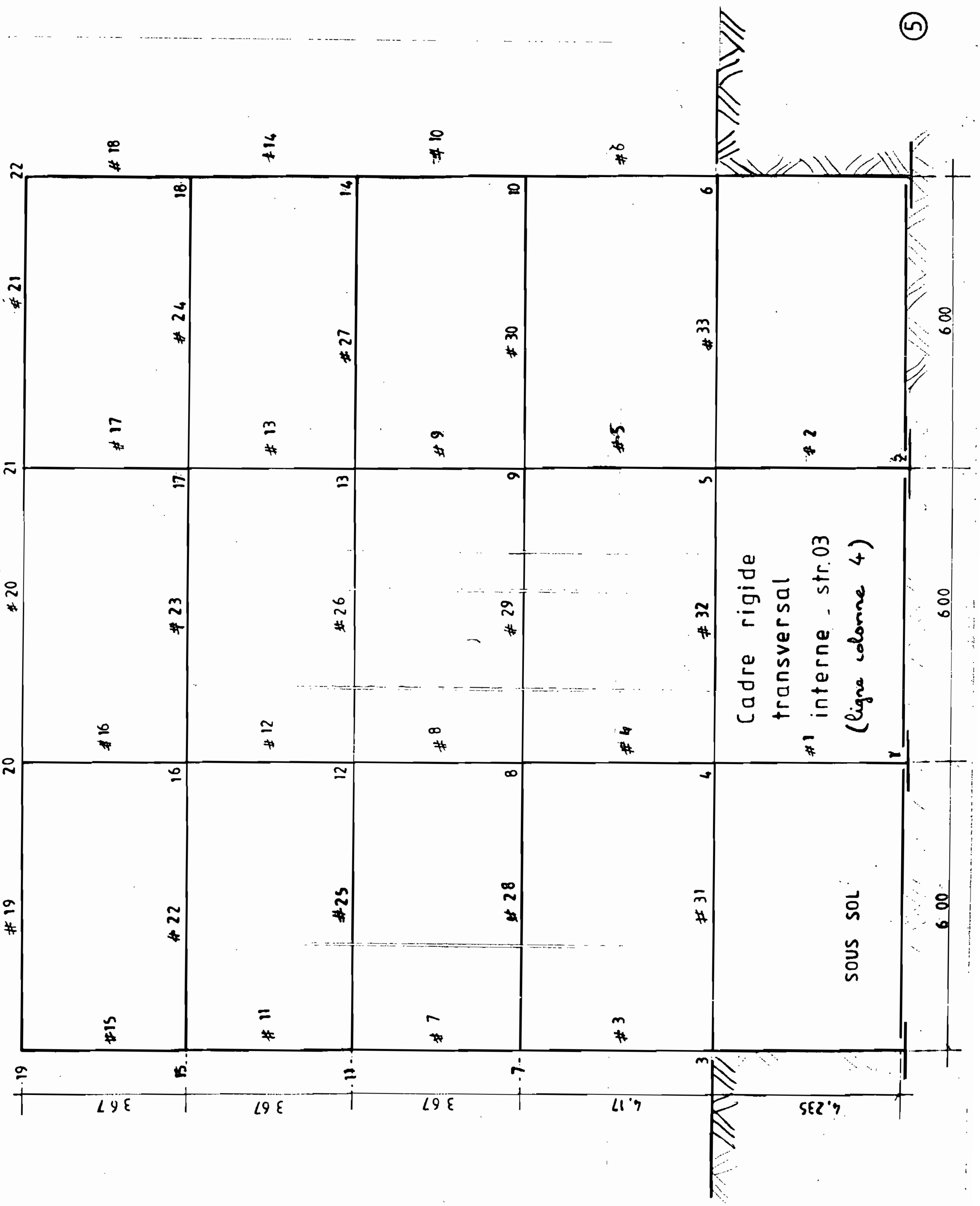


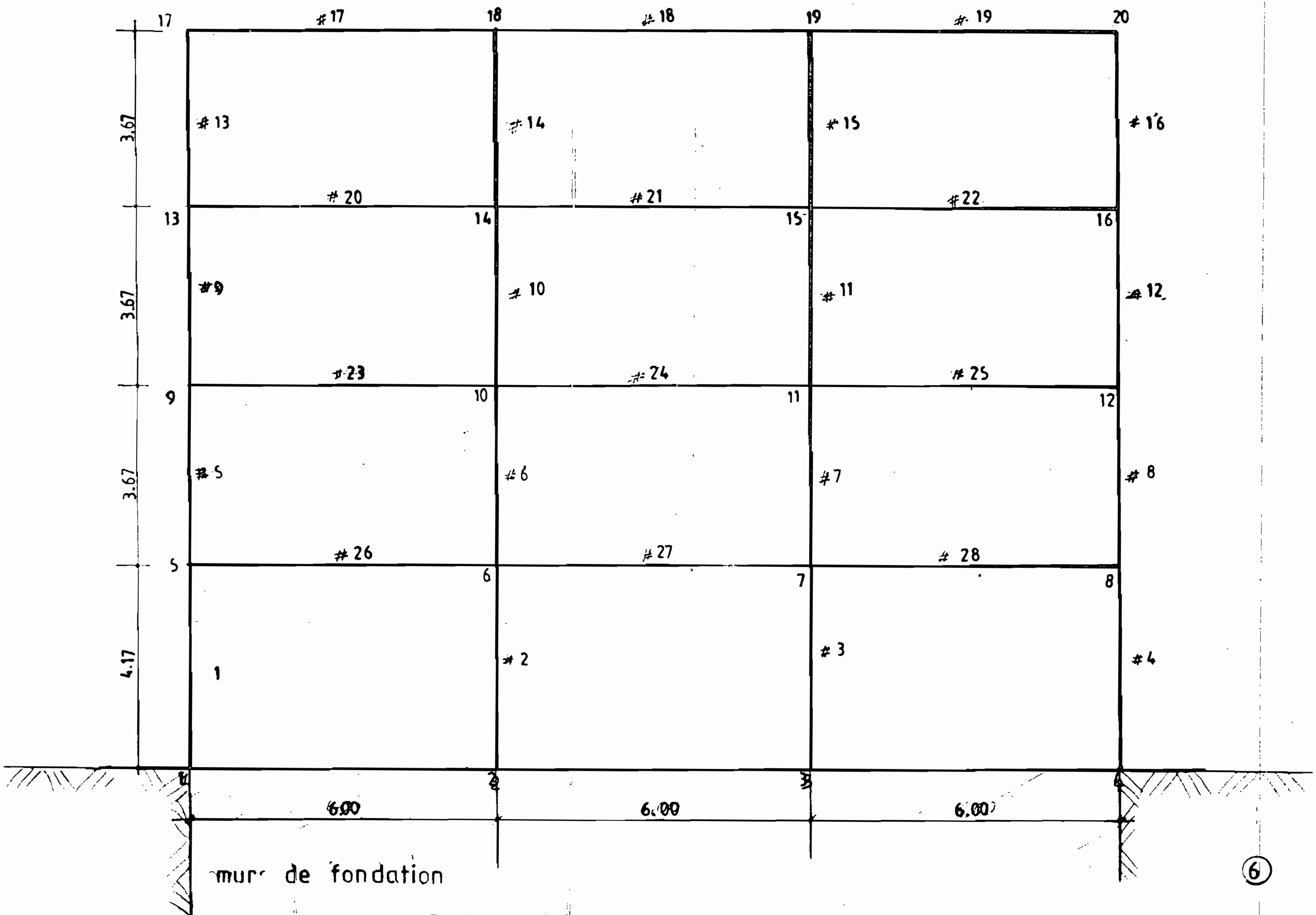
Cadre rigide longitudinal externe: str: 02
(ligne colonne A)

(3)

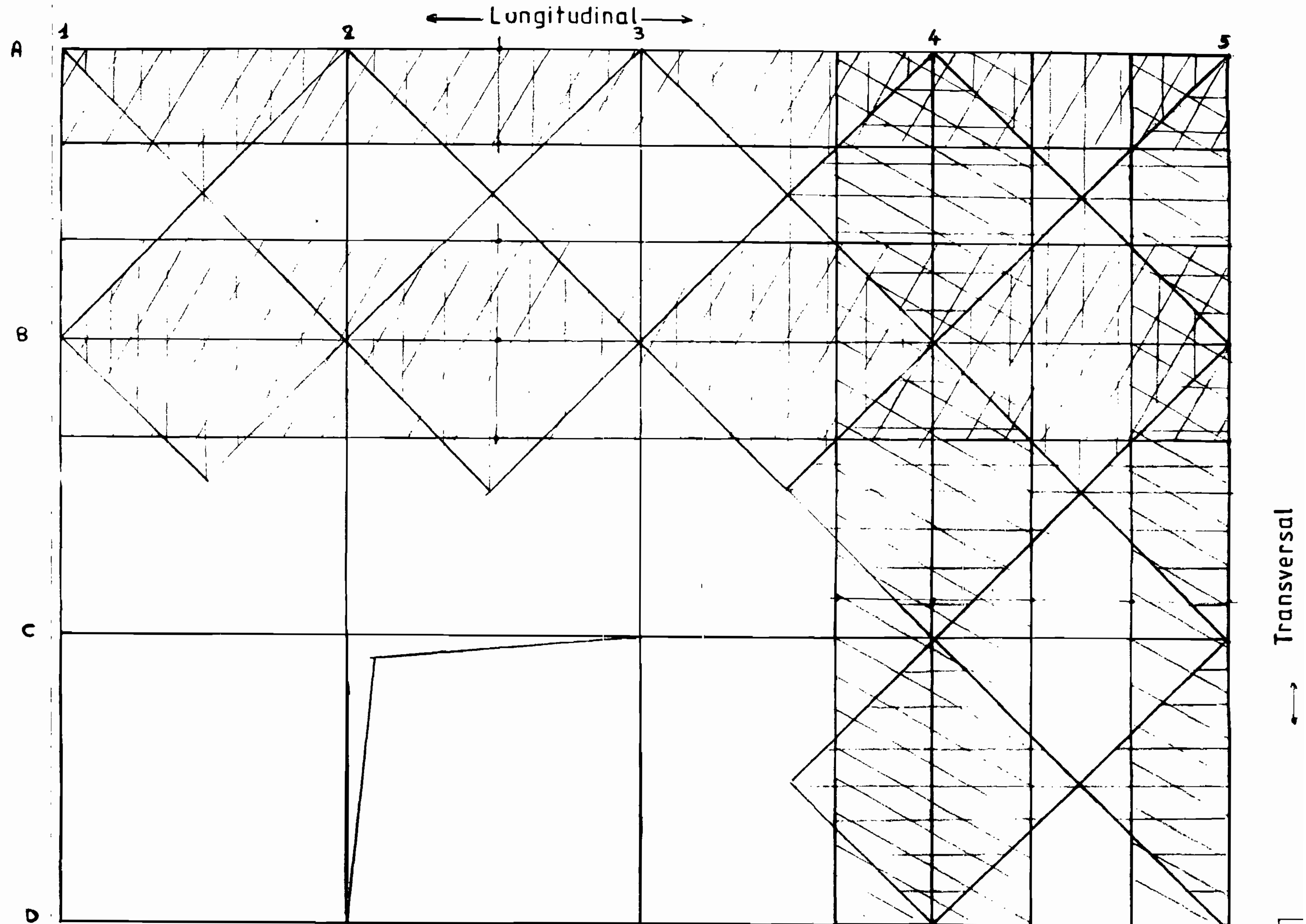
A3


1
2
3
4
5
A
B
C
D
Surface tributaire
Cadre transversal interne (4)
Cadre transversal e?terne (5)


⑤
Cadre rigide transversal interne _ str.03
(ligne colonne 4)
SOUS SOL
6.00
6.00
6.00
3.67
3.67
3.67
4.17
4.235



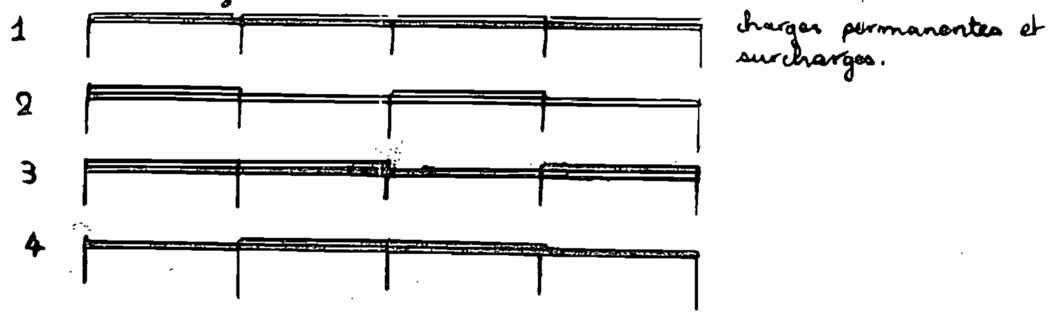
Cadre rigide transversal externe: str: 0.4
(ligne colonne 5)

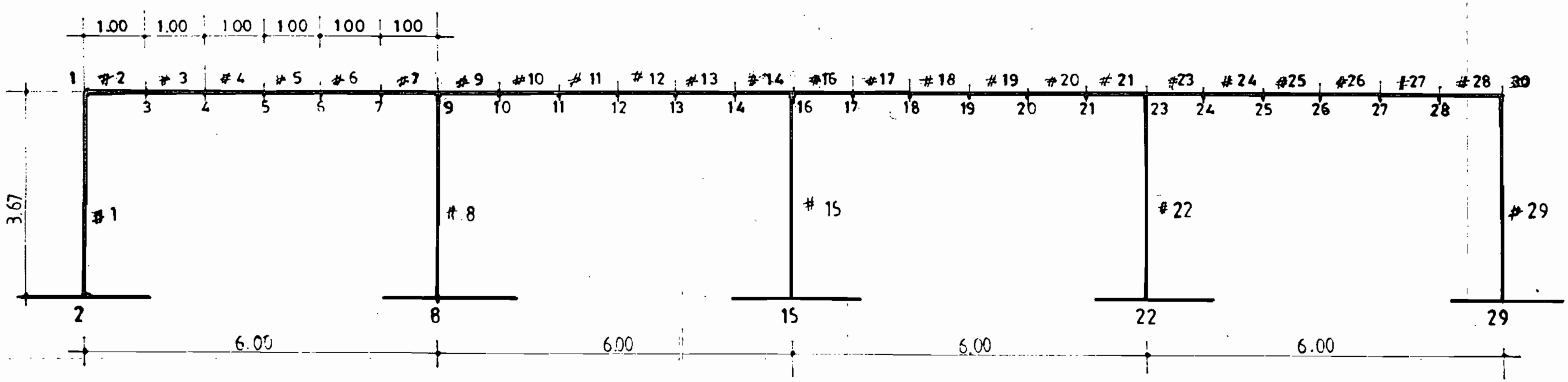


Surfaces tributaires poutres : Cadre partiel longitudinal et transversal

7

Cas de chargement



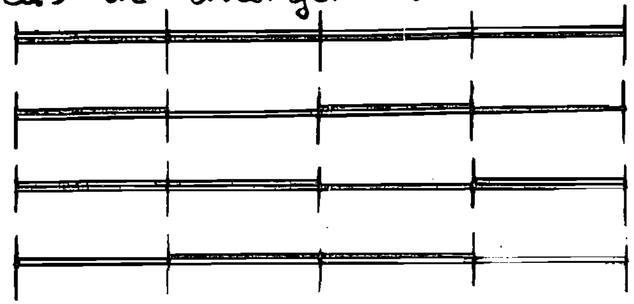


Cadre partiel interne et externe: str: 0.5 et str: 0.6

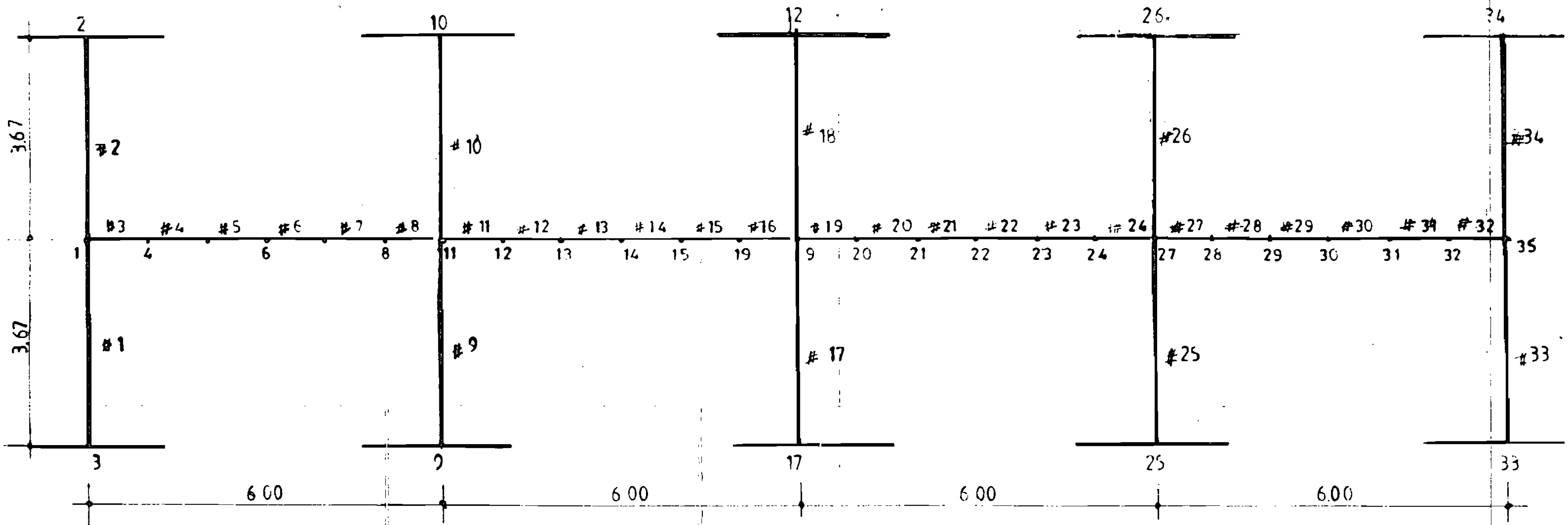
(lignes colonnes B et A respectivement)

⑧

Cas de chargement

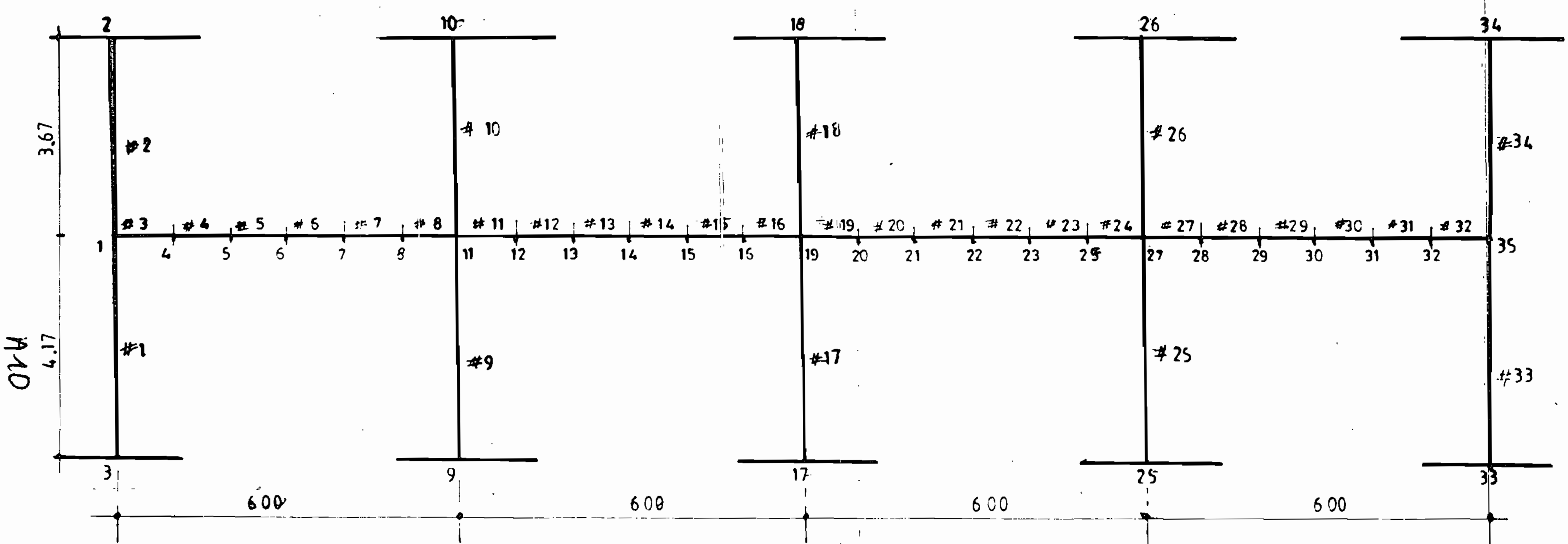


charges permanentes et surcharges.



Cadre partiel interne et externe

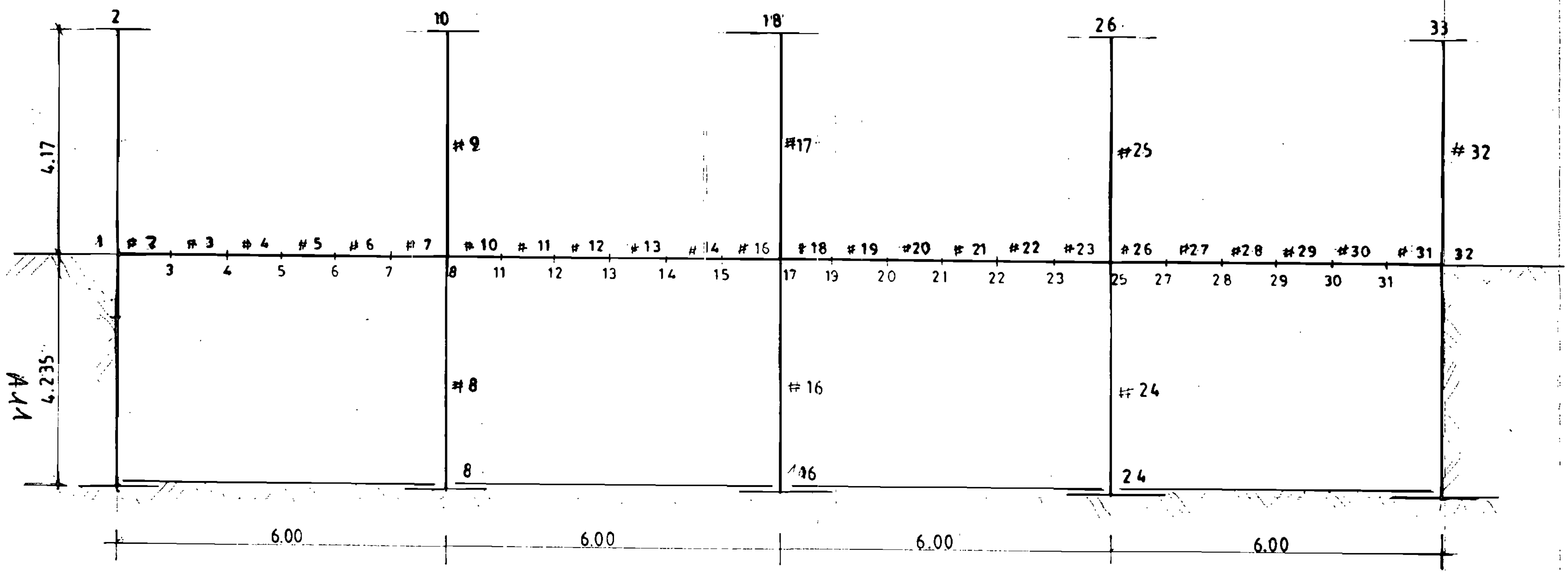
plancher étages 2 et 3 str. 07 et str. 08



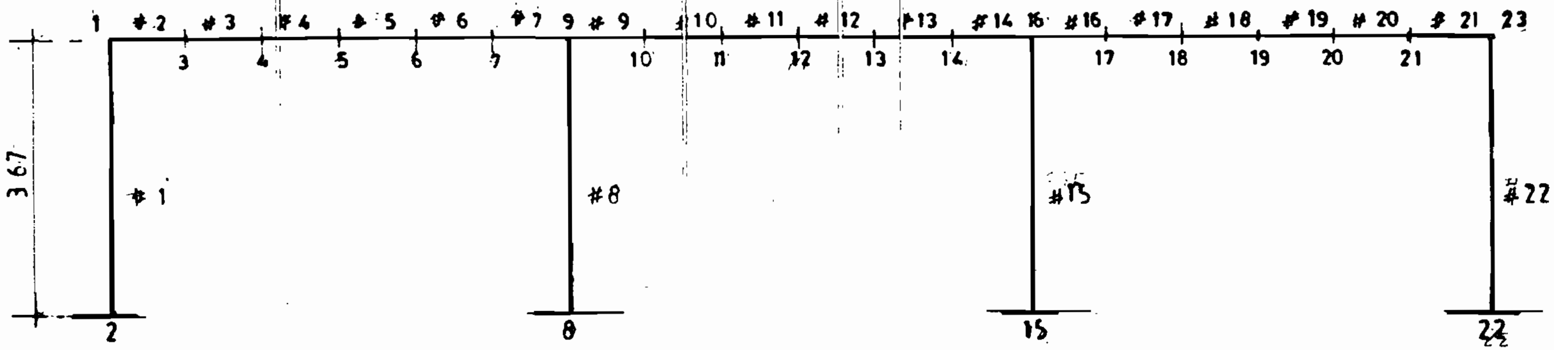
Cadre partiel interne et e(x)cterne

plancher Etage 1 str 09 et str 10

(10)

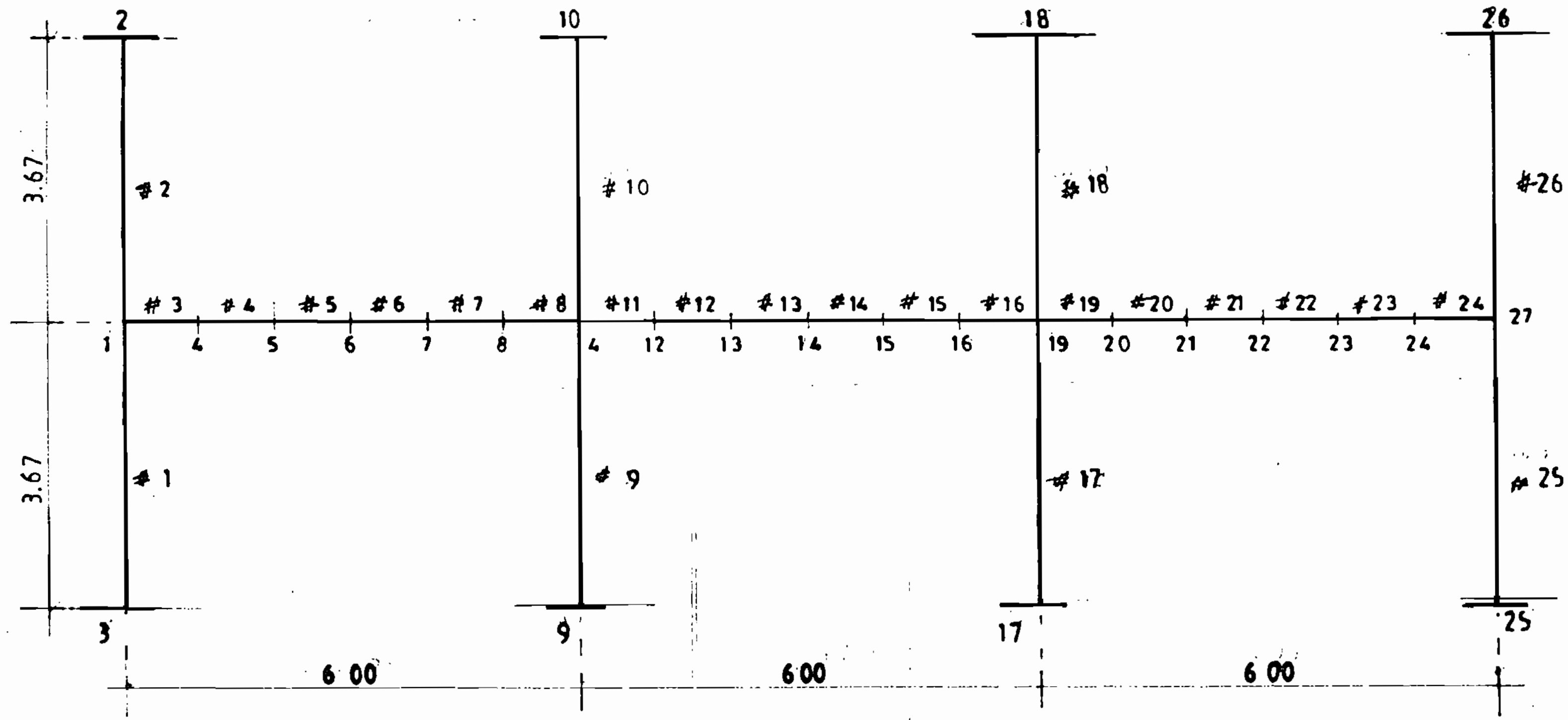


Cadre partiel interne plancher rez de chaussée: **str 11**



Cadre partiel interne et externe

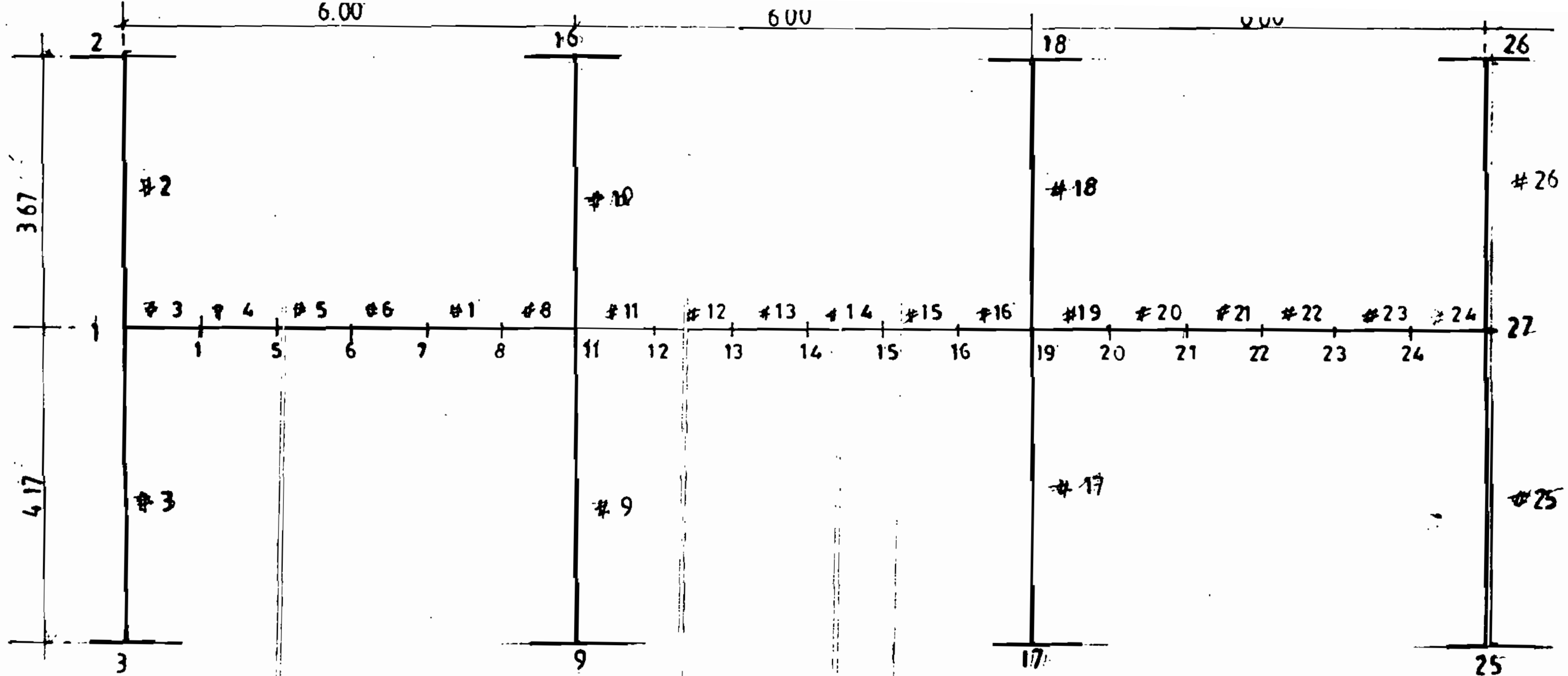
plancher terrasse str. 12 et 13



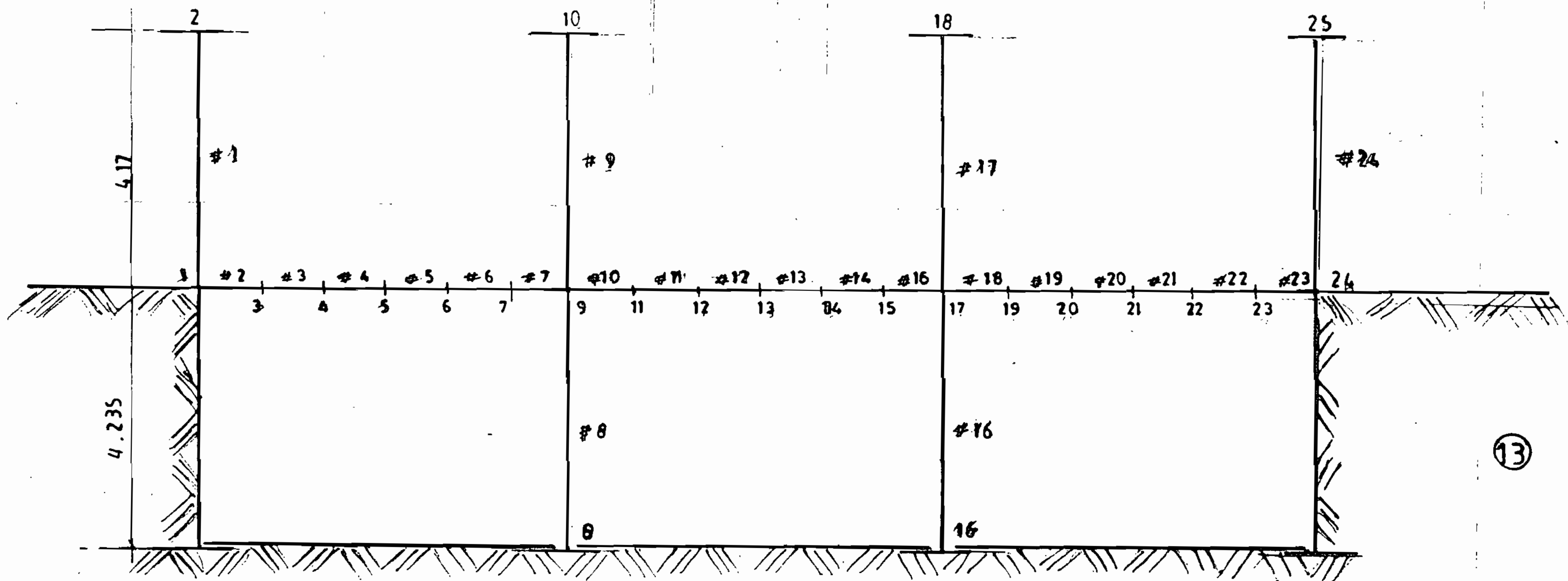
Cadre partiel interne et externe

plancher Etages 2 et 3 str 14 et 15

A13



Cadre partiel intrene et externe plancher Etage 1 str 16 et str 17



Cadre partiel plancher rez de chaussée str. 18

STR. 01 MEMBER END ACTIONS DRIVE A

MEM NO.	LD. CMB	AXIAL (KN) LOWER JT.	SHEAR (KN) LOWER JT.	BM (KN-M) LOWER JT.	AXIAL (KN) UPPER JT.	SHEAR (KN) UPPER JT.	BM (KN-M) UPPER JT.
1	1	+1874.916	-1.232	-1.723	-1874.916	+1.232	-3.495
	2	+2538.055	-1.670	-2.336	-2538.055	+1.670	-4.737
	3	+2188.563	-6.526	-8.731	-2188.563	+6.526	-18.907
2	1	+1876.014	+0.000	+0.000	-1876.014	-0.000	+0.000
	2	+2539.654	+0.000	+0.000	-2539.654	-0.000	+0.000
	3	+2189.347	-4.352	-5.568	-2189.347	+4.352	-12.865
3	1	+1874.916	+1.232	+1.723	-1874.916	-1.232	+3.495
	2	+2538.055	+1.670	+2.336	-2538.055	-1.670	+4.737
	3	+2187.717	-3.581	-4.613	-2187.717	+3.581	-10.551
4	1	+769.276	-25.438	-35.770	-769.276	+25.438	-70.306
	2	+1036.730	-34.717	-48.817	-1036.730	+34.717	-95.954
	3	+880.112	-14.148	+2.261	-880.112	+14.148	-61.257
5	1	+1480.702	-1.560	-4.324	-1480.702	+1.560	-2.179
	2	+2002.464	-2.098	-5.842	-2002.464	+2.098	-2.905
	3	+1731.648	+11.497	+27.148	-1731.648	-11.497	+20.796
6	1	+1477.395	-0.000	-0.000	-1477.395	+0.000	-0.000
	2	+1998.099	-0.000	-0.000	-1998.099	+0.000	-0.000
	3	+1725.674	+13.230	+32.644	-1725.674	-13.230	+22.527
7	1	+1480.702	+1.560	+4.324	-1480.702	-1.560	+2.179
	2	+2002.464	+2.098	+5.842	-2002.464	-2.098	+2.905
	3	+1727.613	+14.964	+36.861	-1727.613	-14.964	+25.541
8	1	+769.276	+25.438	+35.770	-769.276	-25.438	+70.306
	2	+1036.730	+34.717	+48.817	-1036.730	-34.717	+95.954
	3	+922.800	+44.312	+83.992	-922.800	-44.312	+100.788
9	1	+561.538	-53.385	-102.443	-561.538	+53.385	-93.479
	2	+755.772	-72.807	-139.762	-755.772	+72.807	-127.440
	3	+646.145	-55.800	-111.421	-646.145	+55.800	-93.366
10	1	+1082.350	+0.358	+1.373	-1082.350	-0.358	-0.059
	2	+1460.995	+0.496	+1.910	-1460.995	-0.496	-0.089
	3	+1267.294	+13.975	+25.038	-1267.294	-13.975	+26.249
11	1	+1081.605	-0.000	-0.000	-1081.605	+0.000	-0.000
	2	+1460.191	-0.000	-0.000	-1460.191	+0.000	-0.000
	3	+1265.453	+13.057	+22.275	-1265.453	-13.057	+25.644
12	1	+1082.350	-0.358	-1.373	-1082.350	+0.358	+0.059
	2	+1460.995	-0.496	-1.910	-1460.995	+0.496	+0.089
	3	+1265.666	+13.191	+22.029	-1265.666	-13.191	+26.381
13	1	+561.538	+53.385	+102.443	-561.538	-53.385	+93.479
	2	+755.772	+72.807	+139.762	-755.772	-72.807	+127.440
	3	+671.566	+68.099	+126.445	-671.566	-68.099	+123.479
14	1	+351.499	-47.483	-88.158	-351.499	+47.483	-86.104

	2	+471.676	-65.022	-120.428	-471.676	+65.022	-118.203
	3	+407.489	-49.955	-96.598	-407.489	+49.955	-86.735
15	1	+686.570	-2.724	-4.571	-686.570	+2.724	-5.425
	2	+923.044	-3.586	-6.065	-923.044	+3.586	-7.096
	3	+806.766	+5.016	+6.560	-806.766	-5.016	+11.850
16	1	+685.271	-0.000	-0.000	-685.271	+0.000	-0.000
	2	+921.523	-0.000	-0.000	-921.523	+0.000	-0.000
	3	+804.636	+8.235	+11.961	-804.636	-8.235	+18.260
17	1	+686.570	+2.724	+4.571	-686.570	-2.724	+5.425
	2	+923.044	+3.586	+6.065	-923.044	-3.586	+7.096
	3	+805.917	+11.534	+17.431	-805.917	-11.534	+24.898
18	1	+351.499	+47.483	+88.158	-351.499	-47.483	+86.104
	2	+471.676	+65.022	+120.428	-471.676	-65.022	+118.203
	3	+419.595	+59.652	+107.364	-419.595	-59.652	+111.558
19	1	+140.670	-60.498	-98.461	-140.670	+60.498	-123.569
	2	+186.594	-81.127	-133.242	-186.594	+81.127	-164.494
	3	+165.296	-69.496	-114.715	-165.296	+69.496	-140.337
20	1	+291.745	+0.155	-0.367	-291.745	-0.155	+0.936
	2	+386.276	+0.071	-0.601	-386.276	-0.071	+0.860
	3	+347.587	+4.643	+4.847	-347.587	-4.643	+12.193
21	1	+288.609	-0.000	-0.000	-288.609	+0.000	-0.000
	2	+382.460	-0.000	-0.000	-382.460	+0.000	-0.000
	3	+343.400	+4.241	+4.991	-343.400	-4.241	+10.575
22	1	+291.745	-0.155	+0.367	-291.745	+0.155	-0.936
	2	+386.276	-0.071	+0.601	-386.276	+0.071	-0.860
	3	+347.217	+4.080	+5.575	-347.217	-4.080	+9.399
23	1	+140.670	+60.498	+98.461	-140.670	-60.498	+123.569
	2	+186.594	+81.127	+133.242	-186.594	-81.127	+164.494
	3	+169.181	+72.975	+115.241	-169.181	-72.975	+152.576
24	1	+60.498	+140.670	+123.569	-60.498	+147.690	-144.629
	2	+81.127	+186.594	+164.494	-81.127	+195.456	-191.078
	3	+85.939	+165.296	+140.337	-85.939	+177.874	-178.074
25	1	+60.343	+144.055	+143.693	-60.343	+144.305	-144.441
	2	+81.056	+190.820	+190.218	-81.056	+191.230	-191.449
	3	+81.296	+169.712	+165.881	-81.296	+173.458	-177.118
26	1	+60.343	+144.305	+144.441	-60.343	+144.055	-143.693
	2	+81.056	+191.230	+191.449	-81.056	+190.820	-190.218
	3	+77.055	+169.942	+166.543	-77.055	+173.228	-176.400
27	1	+60.498	+147.690	+144.629	-60.498	+140.670	-123.569
	2	+81.127	+195.456	+191.078	-81.127	+186.594	-164.494
	3	+72.975	+173.989	+167.001	-72.975	+169.181	-152.576
28	1	-13.016	+188.119	+184.564	+13.016	+186.641	-180.130
	2	-16.105	+256.694	+251.445	+16.105	+254.956	-246.232
	3	-1.503	+213.806	+201.451	+1.503	+220.084	-220.284
29	1	-10.137	+187.014	+185.921	+10.137	+187.746	-188.115

	2	-12.448	+255.350	+253.929	+12.448	+256.300	-256.779
	3	-1.876	+212.633	+203.587	+1.876	+221.257	-229.459
30	1	-10.137	+187.746	+188.115	+10.137	+187.014	-185.921
	2	-12.448	+256.300	+256.779	+12.448	+255.350	-253.929
	3	-5.869	+213.516	+206.208	+5.869	+220.374	-226.782
31	1	-13.016	+186.641	+180.130	+13.016	+188.119	-184.564
	2	-16.105	+254.956	+246.232	+16.105	+256.694	-251.445
	3	-13.323	+211.863	+196.308	+13.323	+222.027	-226.799
32	1	+5.902	+187.329	+181.637	-5.902	+187.431	-181.945
	2	+7.785	+255.709	+247.868	-7.785	+255.941	-248.565
	3	+23.885	+210.268	+189.964	-23.885	+223.622	-230.023
33	1	+2.821	+187.178	+186.575	-2.821	+187.582	-187.787
	2	+3.703	+255.547	+254.719	-3.703	+256.103	-256.384
	3	+14.926	+210.444	+197.214	-14.926	+223.446	-236.217
34	1	+2.821	+187.582	+187.787	-2.821	+187.178	-186.575
	2	+3.703	+256.103	+256.384	-3.703	+255.547	-254.719
	3	+10.104	+210.910	+198.612	-10.104	+222.980	-234.824
35	1	+5.902	+187.431	+181.945	-5.902	+187.329	-181.637
	2	+7.785	+255.941	+248.565	-7.785	+255.709	-247.868
	3	+8.447	+210.307	+191.013	-8.447	+223.583	-230.843
36	1	-27.947	+185.028	+172.749	+27.947	+189.732	-186.859
	2	-38.090	+252.570	+235.715	+38.090	+259.080	-255.243
	3	-24.317	+205.580	+172.678	+24.317	+228.310	-240.870
37	1	-26.029	+187.450	+187.665	+26.029	+187.310	-187.245
	2	-35.496	+255.927	+256.239	+35.496	+255.723	-255.628
	3	-21.840	+209.581	+195.036	+21.840	+224.309	-239.220
38	1	-26.029	+187.310	+187.245	+26.029	+187.450	-187.665
	2	-35.496	+255.723	+255.628	+35.496	+255.927	-256.239
	3	-22.013	+209.449	+194.418	+22.013	+224.441	-239.394
39	1	-27.947	+189.732	+186.859	+27.947	+185.028	-172.749
	2	-38.090	+259.080	+255.243	+38.090	+252.570	-235.715
	3	-23.787	+211.044	+191.824	+23.787	+222.846	-227.233
40	1	+0.164	+190.631	+197.524	-0.164	+184.129	-178.017
	2	+0.214	+260.225	+269.556	-0.214	+251.425	-243.153
	3	-26.945	+218.970	+225.265	+26.945	+214.920	-213.114
41	1	-0.164	+186.995	+185.836	+0.164	+187.765	-188.143
	2	-0.214	+255.304	+253.732	+0.214	+256.346	-256.858
	3	-8.922	+213.132	+204.872	+8.922	+220.758	-227.748
42	1	-0.164	+187.765	+188.143	+0.164	+186.995	-185.836
	2	-0.214	+256.346	+256.858	+0.214	+255.304	-253.732
	3	+8.661	+214.053	+207.969	-8.661	+219.837	-225.322
43	1	+0.164	+184.129	+178.017	-0.164	+190.631	-197.524
	2	+0.214	+251.425	+243.153	-0.214	+260.225	-269.556
	3	+27.206	+211.404	+199.012	-27.206	+222.486	-232.258

STR. 01 SUPPORT REACTIONS DRIVE A

JOINT NUMBER	LOAD CMB	X-REACTION (KNTS)	Y-REACTION (KNTS)	Z-REACTION (KNTS-M)
1	1	+1.232	+1898.006	-1.723
	2	+1.670	+2566.918	-2.336
	3	+6.526	+2217.425	-8.731
2	1	-0.000	+1899.104	+0.000
	2	-0.000	+2568.516	+0.000
	3	+4.352	+2218.209	-5.568
3	1	-1.232	+1898.006	+1.723
	2	-1.670	+2566.918	+2.336
	3	+3.581	+2216.579	-4.613
4	1	+25.602	+984.537	+161.755
	2	+34.931	+1327.743	+220.740
	3	-12.798	+1129.870	+227.526
8	1	-25.602	+984.537	-161.755
	2	-34.931	+1327.743	-220.740
	3	-71.518	+1176.074	-148.266

STR. 02 MEMBER END ACTIONS DRIVE A

MEM NO.	LD. CMB	AXIAL (KN) LOWER JT.	SHEAR (KN) LOWER JT.	BM (KN-M) LOWER JT.	AXIAL (KN) UPPER JT.	SHEAR (KN) UPPER JT.	BM (KN-M) UPPER JT.
1	1	+523.451	-15.683	-21.987	-523.451	+15.683	-43.412
	2	+689.326	-20.885	-29.279	-689.326	+20.885	-57.812
	3	+615.699	-12.353	-8.360	-615.699	+12.353	-43.150
2	1	+383.746	-33.560	-64.186	-383.746	+33.560	-58.980
	2	+504.775	-44.660	-85.443	-504.775	+44.660	-78.460
	3	+453.271	-36.326	-70.973	-453.271	+36.326	-62.343
3	1	+242.321	-29.580	-55.188	-242.321	+29.580	-53.372
	2	+317.935	-39.514	-73.559	-317.935	+39.514	-71.457
	3	+287.895	-32.562	-62.525	-287.895	+32.562	-56.978
4	1	+100.181	-39.564	-63.550	-100.181	+39.564	-81.650
	2	+130.203	-51.865	-83.954	-130.203	+51.865	-106.389
	3	+120.316	-46.615	-75.421	-120.316	+46.615	-95.656
5	1	+39.564	+100.181	+81.650	-39.564	+110.179	-111.643
	2	+51.865	+130.203	+106.389	-51.865	+143.007	-144.803
	3	+54.836	+120.316	+95.656	-54.836	+134.426	-137.984
6	1	+1029.955	+0.504	+0.489	-1029.955	-0.504	+1.612
	2	+1360.181	+0.676	+0.658	-1360.181	-0.676	+2.161
	3	+1230.242	+8.246	+20.149	-1230.242	-8.246	+14.236
7	1	+756.923	+1.743	+3.672	-756.923	-1.743	+2.724
	2	+998.008	+2.313	+4.887	-998.008	-2.313	+3.602
	3	+905.163	+8.556	+15.531	-905.163	-8.556	+15.871
8	1	+485.844	-0.370	-0.265	-485.844	+0.370	-1.092
	2	+638.440	-0.431	-0.280	-638.440	+0.431	-1.303
	3	+582.627	+3.698	+6.016	-582.627	-3.698	+7.554
9	1	+215.684	+2.148	+2.804	-215.684	-2.148	+5.080
	2	+280.015	+2.761	+3.653	-280.015	-2.761	+6.478
	3	+261.372	+4.765	+6.119	-261.372	-4.765	+11.370
10	1	+37.416	+105.505	+106.563	-37.416	+104.855	-104.612
	2	+49.104	+137.008	+138.324	-49.104	+136.202	-135.907
	3	+50.071	+126.946	+126.615	-50.071	+127.796	-129.165
11	1	+1015.609	-0.000	-0.000	-1015.609	+0.000	-0.000
	2	+1341.291	-0.000	-0.000	-1341.291	+0.000	-0.000
	3	+1212.097	+7.475	+19.273	-1212.097	-7.475	+11.898
12	1	+747.423	-0.000	-0.000	-747.423	+0.000	-0.000
	2	+985.585	-0.000	-0.000	-985.585	+0.000	-0.000
	3	+893.232	+6.295	+10.779	-893.232	-6.295	+12.325
13	1	+478.768	-0.000	-0.000	-478.768	+0.000	-0.000
	2	+629.245	-0.000	-0.000	-629.245	+0.000	-0.000
	3	+573.830	+4.121	+6.259	-573.830	-4.121	+8.864
14	1	+209.710	-0.000	-0.000	-209.710	+0.000	-0.000

	2	+272.404	-0.000	-0.000	-272.404	+0.000	-0.000
	3	+253.922	+2.092	+2.650	-253.922	-2.092	+5.028
15	1	+37.416	+104.855	+104.612	-37.416	+105.505	-106.563
	2	+49.104	+136.202	+135.907	-49.104	+137.008	-138.324
	3	+47.979	+126.126	+124.137	-47.979	+128.616	-131.607
16	1	+1029.955	-0.504	-0.489	-1029.955	+0.504	-1.612
	2	+1360.181	-0.676	-0.658	-1360.181	+0.676	-2.161
	3	+1228.287	+6.948	+18.747	-1228.287	-6.948	+10.226
17	1	+756.923	-1.743	-3.672	-756.923	+1.743	-2.724
	2	+998.008	-2.313	-4.887	-998.008	+2.313	-3.602
	3	+904.167	+4.432	+6.882	-904.167	-4.432	+9.385
18	1	+485.844	+0.370	+0.265	-485.844	-0.370	+1.092
	2	+638.440	+0.431	+0.280	-638.440	-0.431	+1.303
	3	+582.162	+4.670	+6.762	-582.162	-4.670	+10.379
19	1	+215.684	-2.148	-2.804	-215.684	+2.148	-5.080
	2	+280.015	-2.761	-3.653	-280.015	+2.761	-6.478
	3	+261.178	-0.475	-0.636	-261.178	+0.475	-1.107
20	1	+39.564	+110.179	+111.643	-39.564	+100.181	-81.650
	2	+51.865	+143.007	+144.803	-51.865	+130.203	-106.389
	3	+48.454	+132.562	+132.713	-48.454	+122.180	-101.568
21	1	+523.451	+15.683	+21.987	-523.451	-15.683	+43.412
	2	+689.326	+20.885	+29.279	-689.326	-20.885	+57.812
	3	+636.875	+24.607	+43.256	-636.875	-24.607	+59.355
22	1	+383.746	+33.560	+64.186	-383.746	-33.560	+58.980
	2	+504.775	+44.660	+85.443	-504.775	-44.660	+78.460
	3	+465.957	+43.302	+81.350	-465.957	-43.302	+77.570
23	1	+242.321	+29.580	+55.188	-242.321	-29.580	+53.372
	2	+317.935	+39.514	+73.559	-317.935	-39.514	+71.457
	3	+293.864	+37.314	+68.099	-293.864	-37.314	+68.844
24	1	+100.181	+39.564	+63.550	-100.181	-39.564	+81.650
	2	+130.203	+51.865	+83.954	-130.203	-51.865	+106.389
	3	+122.180	+48.454	+76.258	-122.180	-48.454	+101.568
25	1	-9.984	+124.060	+116.921	+9.984	+127.340	-126.760
	2	-12.351	+165.132	+155.411	+12.351	+169.638	-168.929
	3	-5.033	+144.979	+132.398	+5.033	+152.855	-156.025
26	1	-7.466	+125.521	+125.048	+7.466	+125.879	-126.124
	2	-9.159	+167.162	+166.579	+9.159	+167.608	-167.916
	3	-3.966	+146.775	+142.352	+3.966	+151.059	-155.201
27	1	-7.466	+125.879	+126.124	+7.466	+125.521	-125.048
	2	-9.159	+167.608	+167.916	+9.159	+167.162	-166.579
	3	-5.994	+147.225	+143.687	+5.994	+150.609	-153.842
28	1	-9.984	+127.340	+126.760	+9.984	+124.060	-116.921
	2	-12.351	+169.638	+168.929	+12.351	+165.132	-155.411
	3	-11.140	+148.750	+144.099	+11.140	+149.084	-145.102
29	1	+3.980	+123.344	+114.168	-3.980	+128.056	-128.302

	2	+5.146	+164.240	+152.019	-5.146	+170.530	-170.888
	3	+12.783	+142.776	+124.869	-12.783	+155.058	-161.716
30	1	+1.867	+125.723	+125.843	-1.867	+125.677	-125.708
	2	+2.402	+167.413	+167.565	-2.402	+167.357	-167.399
	3	+7.925	+145.853	+139.828	-7.925	+151.981	-158.215
31	1	+1.867	+125.677	+125.708	-1.867	+125.723	-125.843
	2	+2.402	+167.357	+167.399	-2.402	+167.413	-167.565
	3	+5.750	+145.795	+139.631	-5.750	+152.039	-158.361
32	1	+3.980	+128.056	+128.302	-3.980	+123.344	-114.168
	2	+5.146	+170.530	+170.888	-5.146	+164.240	-152.019
	3	+5.988	+148.341	+142.215	-5.988	+149.493	-145.669
33	1	-17.877	+121.625	+107.598	+17.877	+129.775	-132.048
	2	-23.775	+161.951	+143.256	+23.775	+172.819	-175.858
	3	-15.311	+139.828	+114.123	+15.311	+158.006	-168.658
34	1	-16.638	+125.957	+126.764	+16.638	+125.443	-125.222
	2	-22.138	+167.729	+168.810	+22.138	+167.041	-166.744
	3	-15.000	+145.448	+138.892	+15.000	+152.386	-159.704
35	1	-16.638	+125.443	+125.222	+16.638	+125.957	-126.764
	2	-22.138	+167.041	+166.744	+22.138	+167.729	-168.810
	3	-16.180	+144.854	+137.027	+16.180	+152.980	-161.404
36	1	-17.877	+129.775	+132.048	+17.877	+121.625	-107.598
	2	-23.775	+172.819	+175.858	+23.775	+161.951	-143.256
	3	-18.696	+149.516	+144.296	+18.696	+148.318	-140.705

STR. 02 SUPPORT REACTIONS DRIVE A

JOINT NUMBER	LOAD CMB	X-REACTION (KNTS)	Y-REACTION (KNTS)	Z-REACTION (KNTS-M)
1	1	+15.683	+543.451	-21.987
	2	+20.885	+714.326	-29.279
	3	+12.353	+640.699	-8.360
6	1	-0.504	+1049.175	+0.489
	2	-0.676	+1384.206	+0.658
	3	-8.246	+1254.267	+20.149
11	1	+0.000	+1034.829	-0.000
	2	+0.000	+1365.316	-0.000
	3	-7.475	+1236.122	+19.273
16	1	+0.504	+1049.175	-0.489
	2	+0.676	+1384.206	-0.658
	3	-6.948	+1252.312	+18.747
21	1	-15.683	+543.451	+21.987
	2	-20.885	+714.326	+29.279
	3	-24.607	+661.875	+43.256

STR. 03 MEMBER END ACTIONS DRIVE A

MEM NO.	LD. CMB	AXIAL (KN) LOWER JT.	SHEAR (KN) LOWER JT.	BM (KN-M) LOWER JT.	AXIAL (KN) UPPER JT.	SHEAR (KN) UPPER JT.	BM (KN-M) UPPER JT.
1	1	+1875.704	-1.415	-1.977	-1875.704	+1.415	-4.016
	2	+2539.141	-1.919	-2.680	-2539.141	+1.919	-5.446
	3	+2189.594	-8.090	-10.973	-2189.594	+8.090	-23.287
2	1	+1875.704	+1.415	+1.977	-1875.704	-1.415	+4.016
	2	+2539.141	+1.919	+2.680	-2539.141	-1.919	+5.446
	3	+2188.501	-4.751	-6.310	-2188.501	+4.751	-13.810
3	1	+769.552	-25.184	-35.244	-769.552	+25.184	-69.771
	2	+1037.098	-34.371	-48.102	-1037.098	+34.371	-95.227
	3	+874.010	-10.513	+12.972	-874.010	+10.513	-56.809
4	1	+1481.048	-1.415	-4.216	-1481.048	+1.415	-1.684
	2	+2002.952	-1.899	-5.692	-2002.952	+1.899	-2.227
	3	+1732.729	+14.836	+35.365	-1732.729	-14.836	+26.502
5	1	+1481.048	+1.415	+4.216	-1481.048	-1.415	+1.684
	2	+2002.952	+1.899	+5.692	-2002.952	-1.899	+2.227
	3	+1727.305	+18.067	+45.035	-1727.305	-18.067	+30.304
6	1	+769.552	+25.184	+35.244	-769.552	-25.184	+69.771
	2	+1037.098	+34.371	+48.102	-1037.098	-34.371	+95.227
	3	+929.576	+47.466	+93.752	-929.576	-47.466	+104.181
7	1	+561.785	-53.699	-103.041	-561.785	+53.699	-94.035
	2	+756.102	-73.230	-140.573	-756.102	+73.230	-128.182
	3	+642.379	-53.894	-108.515	-642.379	+53.894	-89.278
8	1	+1082.795	+0.031	+0.855	-1082.795	-0.031	-0.743
	2	+1461.623	+0.055	+1.212	-1461.623	-0.055	-1.010
	3	+1268.083	+17.867	+32.104	-1268.083	-17.867	+33.470
9	1	+1082.795	-0.031	-0.855	-1082.795	+0.031	+0.743
	2	+1461.623	-0.055	-1.212	-1461.623	+0.055	+1.010
	3	+1265.876	+17.835	+30.251	-1265.876	-17.835	+35.204
10	1	+561.785	+53.699	+103.041	-561.785	-53.699	+94.035
	2	+756.102	+73.230	+140.573	-756.102	-73.230	+128.182
	3	+675.911	+70.713	+130.643	-675.911	-70.713	+128.873
11	1	+351.741	-47.154	-87.636	-351.741	+47.154	-85.418
	2	+471.995	-64.591	-119.740	-471.995	+64.591	-117.307
	3	+405.800	-48.069	-94.311	-405.800	+48.069	-82.104
12	1	+686.819	-2.535	-4.281	-686.819	+2.535	-5.021
	2	+923.405	-3.337	-5.691	-923.405	+3.337	-6.558
	3	+807.195	+7.869	+10.814	-807.195	-7.869	+18.065
13	1	+686.819	+2.535	+4.281	-686.819	-2.535	+5.021
	2	+923.405	+3.337	+5.691	-923.405	-3.337	+6.558
	3	+806.029	+13.934	+20.975	-806.029	-13.934	+30.162
14	1	+351.741	+47.154	+87.636	-351.741	-47.154	+85.418

	2	+471.995	+64.591	+119.740	-471.995	-64.591	+117.307
	3	+421.856	+60.749	+108.405	-421.856	-60.749	+114.542
15	1	+140.854	-60.895	-99.346	-140.854	+60.895	-124.140
	2	+186.834	-81.650	-134.411	-186.834	+81.650	-165.244
	3	+164.864	-69.335	-115.498	-164.864	+69.335	-138.960
16	1	+291.686	-0.465	-1.682	-291.686	+0.465	-0.025
	2	+386.241	-0.764	-2.346	-386.241	+0.764	-0.459
	3	+347.555	+5.408	+5.147	-347.555	-5.408	+14.701
17	1	+291.686	+0.465	+1.682	-291.686	-0.465	+0.025
	2	+386.241	+0.764	+2.346	-386.241	-0.764	+0.459
	3	+347.036	+6.290	+8.984	-347.036	-6.290	+14.100
18	1	+140.854	+60.895	+99.346	-140.854	-60.895	+124.140
	2	+186.834	+81.650	+134.411	-186.834	-81.650	+165.244
	3	+170.054	+74.080	+116.561	-170.054	-74.080	+155.312
19	1	+60.895	+140.854	+124.140	-60.895	+147.506	-144.095
	2	+81.650	+186.834	+165.244	-81.650	+195.216	-190.391
	3	+85.778	+164.864	+138.960	-85.778	+178.306	-179.285
20	1	+61.361	+144.180	+144.120	-61.361	+144.180	-144.120
	2	+82.414	+191.025	+190.850	-82.414	+191.025	-190.850
	3	+80.370	+169.249	+164.584	-80.370	+173.921	-178.597
21	1	+60.895	+147.506	+144.095	-60.895	+140.854	-124.140
	2	+81.650	+195.216	+190.391	-81.650	+186.834	-165.244
	3	+74.080	+173.116	+164.498	-74.080	+170.054	-155.312
22	1	-13.742	+188.177	+184.764	+13.742	+186.583	-179.983
	2	-17.059	+256.774	+251.719	+17.059	+254.876	-246.025
	3	-3.226	+212.548	+197.602	+3.226	+221.342	-223.985
23	1	-11.672	+187.380	+186.686	+11.672	+187.380	-186.686
	2	-14.486	+255.825	+254.929	+14.486	+255.825	-254.929
	3	-5.687	+211.835	+200.773	+5.687	+222.055	-231.431
24	1	-13.742	+186.583	+179.983	+13.742	+188.177	-184.764
	2	-17.059	+254.876	+246.025	+17.059	+256.774	-251.719
	3	-13.331	+210.475	+192.286	+13.331	+223.415	-231.103
25	1	+6.546	+187.334	+181.671	-6.546	+187.426	-181.946
	2	+8.639	+255.719	+247.922	-8.639	+255.931	-248.559
	3	+23.864	+208.192	+183.588	-23.864	+225.698	-236.105
26	1	+3.980	+187.380	+186.969	-3.980	+187.380	-186.969
	2	+5.247	+255.825	+255.260	-5.247	+255.825	-255.260
	3	+13.866	+208.728	+191.821	-13.866	+225.162	-241.124
27	1	+6.546	+187.426	+181.946	-6.546	+187.334	-181.671
	2	+8.639	+255.931	+248.559	-8.639	+255.719	-247.922
	3	+9.964	+206.223	+184.945	-9.964	+225.667	-237.278
28	1	-28.516	+185.057	+172.812	+28.516	+189.703	-186.751
	2	-38.859	+252.609	+235.800	+38.859	+259.041	-255.095
	3	-26.046	+203.243	+165.324	+26.046	+230.647	-247.537
29	1	-27.070	+187.380	+187.580	+27.070	+187.380	-187.580

	2	-36.905	+255.825	+256.110	+36.905	+255.825	-256.110
	3	-23.015	+207.536	+188.931	+23.015	+226.354	-245.384
30	1	-28.516	+189.703	+186.751	+28.516	+185.057	-172.812
	2	-38.859	+259.041	+255.095	+38.859	+252.609	-235.800
	3	-23.247	+208.613	+184.829	+23.247	+225.277	-234.824
31	1	-0.000	+190.574	+197.413	+0.000	+184.186	-178.247
	2	-0.007	+260.148	+269.404	+0.007	+251.502	-243.466
	3	-22.890	+218.506	+224.343	+22.890	+215.384	-214.979
32	1	+0.000	+187.380	+186.480	-0.000	+187.380	-186.480
	2	+0.013	+255.825	+254.605	-0.013	+255.825	-254.605
	3	+0.036	+212.618	+202.902	-0.036	+221.272	-228.865
33	1	-0.000	+184.186	+178.247	+0.000	+190.574	-197.413
	2	-0.007	+251.502	+243.466	+0.007	+260.148	-269.404
	3	+22.854	+211.061	+197.640	-22.854	+222.829	-232.941

STR. 03 SUPPORT REACTIONS DRIVE A

JOINT NUMBER	LOAD CMB	X-REACTION (KNTS)	Y-REACTION (KNTS)	Z-REACTION (KNTS-M)
1	1	+1.415	+1898.794	-1.977
	2	+1.919	+2568.004	-2.680
	3	+8.090	+2218.456	-10.973
2	1	-1.415	+1898.794	+1.977
	2	-1.919	+2568.004	+2.680
	3	+4.751	+2217.364	-6.310
3	1	+25.184	+984.756	+162.168
	2	+34.365	+1328.034	+221.302
	3	-12.377	+1123.303	+237.315
6	1	-25.184	+984.756	-162.168
	2	-34.365	+1328.034	-221.302
	3	-70.320	+1183.192	-139.189

STR. 04 MEMBER END ACTIONS DRIVE A

MEM NO.	LD. CMB	AXIAL (KN) LOWER JT.	SHEAR (KN) LOWER JT.	BM (KN-M) LOWER JT.	AXIAL (KN) UPPER JT.	SHEAR (KN) UPPER JT.	BM (KN-M) UPPER JT.
1	1	+523.653	-15.547	-21.705	-523.653	+15.547	-43.125
	2	+689.590	-20.704	-28.905	-689.590	+20.704	-57.432
	3	+612.689	-10.558	-3.267	-612.689	+10.558	-40.762
2	1	+1029.327	+0.712	+0.873	-1029.327	-0.712	+2.096
	2	+1359.365	+0.954	+1.170	-1359.365	-0.954	+2.806
	3	+1229.845	+10.547	+25.949	-1229.845	-10.547	+18.031
3	1	+1029.327	-0.712	-0.873	-1029.327	+0.712	-2.096
	2	+1359.365	-0.954	-1.170	-1359.365	+0.954	-2.806
	3	+1227.164	+8.810	+23.762	-1227.164	-8.810	+12.977
4	1	+523.653	+15.547	+21.705	-523.653	-15.547	+43.125
	2	+689.590	+20.704	+28.905	-689.590	-20.704	+57.432
	3	+640.384	+26.124	+47.794	-640.384	-26.124	+61.144
5	1	+383.923	-33.740	-64.523	-383.923	+33.740	-59.304
	2	+505.006	-44.897	-85.890	-505.006	+44.897	-78.883
	3	+451.470	-35.406	-69.553	-451.470	+35.406	-60.387
6	1	+756.577	+1.632	+3.515	-756.577	-1.632	+2.476
	2	+997.569	+2.168	+4.681	-997.569	-2.168	+3.275
	3	+904.918	+10.446	+18.899	-904.918	-10.446	+19.437
7	1	+756.577	-1.632	-3.515	-756.577	+1.632	-2.476
	2	+997.569	-2.168	-4.681	-997.569	+2.168	-3.275
	3	+903.559	+6.578	+10.601	-903.559	-6.578	+13.542
8	1	+383.923	+33.740	+64.523	-383.923	-33.740	+59.304
	2	+505.006	+44.897	+85.890	-505.006	-44.897	+78.883
	3	+468.183	+44.642	+83.534	-468.183	-44.642	+80.303
9	1	+242.492	-29.385	-54.882	-242.492	+29.385	-52.959
	2	+318.156	-39.262	-73.165	-318.156	+39.262	-70.928
	3	+287.133	-31.580	-61.259	-287.133	+31.580	-54.640
10	1	+485.528	-0.266	-0.055	-485.528	+0.266	-0.923
	2	+638.039	-0.297	-0.010	-638.039	+0.297	-1.079
	3	+582.322	+5.139	+8.308	-582.322	-5.139	+10.552
11	1	+485.528	+0.266	+0.055	-485.528	-0.266	+0.923
	2	+638.039	+0.297	+0.010	-638.039	-0.297	+1.079
	3	+581.685	+5.863	+8.541	-581.685	-5.863	+12.975
12	1	+242.492	+29.385	+54.882	-242.492	-29.385	+52.959
	2	+318.156	+39.262	+73.165	-318.156	-39.262	+70.928
	3	+295.038	+37.819	+68.623	-295.038	-37.819	+70.174
13	1	+100.331	-39.811	-64.057	-100.331	+39.811	-82.051
	2	+130.395	-52.184	-84.610	-130.395	+52.184	-106.905
	3	+120.189	-46.591	-75.832	-120.189	+46.591	-95.157
14	1	+215.209	+1.943	+2.192	-215.209	-1.943	+4.939

	2	+279.420	+2.489	+2.861	-279.420	-2.489	+6.275
	3	+260.818	+5.245	+6.333	-260.818	-5.245	+12.917
15	1	+215.209	-1.943	-2.192	-215.209	+1.943	-4.939
	2	+279.420	-2.489	-2.861	-279.420	+2.489	-6.275
	3	+260.545	+0.490	+1.057	-260.545	-0.490	+0.742
16	1	+100.331	+39.811	+64.057	-100.331	-39.811	+82.051
	2	+130.395	+52.184	+84.610	-130.395	-52.184	+106.905
	3	+122.674	+49.077	+77.073	-122.674	-49.077	+103.039
17	1	+39.811	+100.331	+82.051	-39.811	+110.029	-111.142
	2	+52.184	+130.395	+106.905	-52.184	+142.815	-144.164
	3	+54.813	+120.189	+95.157	-54.813	+134.553	-138.247
18	1	+37.868	+105.180	+106.203	-37.868	+105.180	-106.203
	2	+49.695	+136.605	+137.889	-49.695	+136.605	-137.889
	3	+49.567	+126.265	+125.329	-49.567	+128.477	-131.964
19	1	+39.811	+110.029	+111.142	-39.811	+100.331	-82.051
	2	+52.184	+142.815	+144.164	-52.184	+130.395	-106.905
	3	+49.077	+132.068	+131.221	-49.077	+122.674	-103.039
20	1	-10.427	+124.081	+117.016	+10.427	+127.319	-126.732
	2	-12.921	+165.161	+155.538	+12.921	+169.609	-168.885
	3	-5.992	+144.344	+130.472	+5.992	+153.490	-157.911
21	1	-8.217	+125.700	+125.463	+8.217	+125.700	-125.463
	2	-10.135	+167.385	+167.103	+10.135	+167.385	-167.103
	3	-5.885	+146.389	+141.025	+5.885	+151.445	-156.195
22	1	-10.427	+127.319	+126.732	+10.427	+124.081	-117.016
	2	-12.921	+169.609	+168.885	+12.921	+165.161	-155.538
	3	-11.257	+148.070	+142.162	+11.257	+149.764	-147.247
23	1	+4.356	+123.351	+114.186	-4.356	+128.049	-128.282
	2	+5.635	+164.250	+152.048	-5.635	+170.520	-170.858
	3	+12.846	+141.736	+121.646	-12.846	+156.098	-164.729
24	1	+2.457	+125.700	+125.861	-2.457	+125.700	-125.861
	2	+3.170	+167.385	+167.593	-3.170	+167.385	-167.593
	3	+7.539	+144.874	+136.984	-7.539	+152.960	-161.242
25	1	+4.356	+128.049	+128.282	-4.356	+123.351	-114.186
	2	+5.635	+170.520	+170.858	-5.635	+164.250	-152.048
	3	+6.823	+147.289	+139.159	-6.823	+150.545	-148.926
26	1	-18.194	+121.650	+107.648	+18.194	+129.750	-131.949
	2	-24.193	+161.985	+143.322	+24.193	+172.785	-175.725
	3	-16.185	+138.619	+110.314	+16.185	+159.215	-172.103
27	1	-17.273	+125.700	+126.338	+17.273	+125.700	-126.338
	2	-22.979	+167.385	+168.238	+22.979	+167.385	-168.238
	3	-16.286	+144.087	+135.174	+16.286	+153.747	-164.154
28	1	-18.194	+129.750	+131.949	+18.194	+121.650	-107.648
	2	-24.193	+172.785	+175.725	+24.193	+161.985	-143.322
	3	-18.518	+148.233	+140.576	+18.518	+149.601	-144.678

STR. 04 SUPPORT REACTIONS DRIVE A

JOINT NUMBER	LOAD CMB	X-REACTION (KNTS)	Y-REACTION (KNTS)	Z-REACTION (KNTS-M)
1	1	+15.547	+543.653	-21.705
	2	+20.704	+714.590	-28.905
	3	+10.558	+637.689	-3.267
2	1	-0.712	+1048.547	+0.873
	2	-0.954	+1383.390	+1.170
	3	-10.547	+1253.870	+25.949
3	1	+0.712	+1048.547	-0.873
	2	+0.954	+1383.390	-1.170
	3	-8.810	+1251.189	+23.762
4	1	-15.547	+543.653	+21.705
	2	-20.704	+714.590	+28.905
	3	-26.124	+665.384	+47.794

STR. 07 MEMBER END ACTIONS DRIVE A

MEM NO.	LD. CMB	AXIAL (KN) LOWER JT.	SHEAR (KN) LOWER JT.	BM (KN-M) LOWER JT.	AXIAL (KN) UPPER JT.	SHEAR (KN) UPPER JT.	BM (KN-M) UPPER JT.
1	1	+93.004	-29.268	-79.064	-93.004	+29.268	-28.350
	2	+94.389	-29.870	-81.334	-94.389	+29.870	-28.290
	3	+92.963	-29.513	-79.130	-92.963	+29.513	-29.181
	4	+50.354	-15.131	-41.427	-50.354	+15.131	-14.105
2	1	+93.004	-29.268	-79.064	-93.004	+29.268	-28.350
	2	+94.389	-29.870	-81.334	-94.389	+29.870	-28.290
	3	+92.963	-29.513	-79.130	-92.963	+29.513	-29.181
	4	+50.354	-15.131	-41.427	-50.354	+15.131	-14.105
3	1	+58.536	+186.009	+158.128	-58.536	-121.084	-4.582
	2	+59.741	+188.778	+162.669	-59.741	-123.853	-6.353
	3	+59.025	+185.927	+158.260	-59.025	-121.002	-4.796
	4	+30.263	+100.709	+82.854	-30.263	-64.584	-0.208
4	1	+58.536	+121.084	+4.582	-58.536	-56.159	+84.040
	2	+59.741	+123.853	+6.353	-59.741	-58.928	+85.038
	3	+59.025	+121.002	+4.796	-59.025	-56.077	+83.744
	4	+30.263	+64.584	+0.208	-30.263	-28.459	+46.313
5	1	+58.536	+56.159	-84.040	-58.536	+8.766	+107.736
	2	+59.741	+58.928	-85.038	-59.741	+5.997	+111.504
	3	+59.025	+56.077	-83.744	-59.025	+8.848	+107.358
	4	+30.263	+28.459	-46.313	-30.263	+7.666	+56.709
6	1	+58.536	-8.766	-107.736	-58.536	+73.691	+66.507
	2	+59.741	-5.997	-111.504	-59.741	+70.922	+73.044
	3	+59.025	-8.848	-107.358	-59.025	+73.773	+66.047
	4	+30.263	-7.666	-56.709	-30.263	+43.791	+30.981
7	1	+58.536	-73.691	-66.507	-58.536	+138.616	-39.646
	2	+59.741	-70.922	-73.044	-59.741	+135.847	-30.340
	3	+59.025	-73.773	-66.047	-59.025	+138.698	-40.188
	4	+30.263	-43.791	-30.981	-30.263	+79.916	-30.873
8	1	+58.536	-138.616	+39.646	-58.536	+203.541	-210.725
	2	+59.741	-135.847	+30.340	-59.741	+200.772	-198.649
	3	+59.025	-138.698	+40.188	-59.025	+203.623	-211.349
	4	+30.263	-79.916	+30.873	-30.263	+116.041	-128.852
9	1	+199.467	+12.012	+20.330	-199.467	-12.012	+23.755
	2	+154.775	+27.047	+39.228	-154.775	-27.047	+60.034
	3	+200.994	+10.181	+17.575	-200.994	-10.181	+19.788
	4	+154.091	-5.555	-3.129	-154.091	+5.555	-17.257
10	1	-199.467	-6.565	-13.759	+199.467	+6.565	-10.334
	2	-154.775	+6.041	+0.683	+154.775	-6.041	+21.489
	3	-200.994	-6.661	-13.329	+200.994	+6.661	-11.116
	4	-154.091	-16.913	-23.972	+154.091	+16.913	-38.099
11	1	+39.959	+195.392	+197.304	-39.959	-130.467	-34.374
	2	+38.736	+108.779	+117.127	-38.736	-72.654	-26.410
	3	+42.184	+198.365	+202.677	-42.184	-133.440	-36.774

	4	+18.904	+192.141	+184.208	-18.904	-127.216	-24.529
12	1	+39.959	+130.467	+34.374	-39.959	-65.542	+63.631
	2	+38.736	+72.654	+26.410	-38.736	-36.529	+28.181
	3	+42.184	+133.440	+36.774	-42.184	-68.515	+64.204
	4	+18.904	+127.216	+24.529	-18.904	-62.291	+70.224
13	1	+39.959	+65.542	-63.631	-39.959	-0.617	+96.710
	2	+38.736	+36.529	-28.181	-38.736	-0.404	+46.647
	3	+42.184	+68.515	-64.204	-42.184	-3.590	[illegible]
	4	+18.904	+62.291	-70.224	-18.904	+2.634	+100.053
14	1	+39.959	+0.617	-96.710	-39.959	+64.308	+64.865
	2	+38.736	+0.404	-46.647	-38.736	+35.721	+28.989
	3	+42.184	+3.590	-100.257	-42.184	+61.335	+71.385
	4	+18.904	-2.634	-100.053	-18.904	+67.559	+64.957
15	1	+39.959	-64.308	-64.865	-39.959	+129.233	-31.905
	2	+38.736	-35.721	-28.989	-38.736	+71.846	-24.795
	3	+42.184	-61.335	-71.385	-42.184	+126.260	-22.412
	4	+18.904	-67.559	-64.957	-18.904	+132.484	+35.065
16	1	+39.959	-129.233	+31.905	-39.959	+194.158	-193.600
	2	+38.736	-71.846	+24.795	-38.736	+107.971	-114.704
	3	+42.184	-126.260	+22.412	-42.184	+191.185	-181.134
	4	+18.904	-132.484	+35.065	-18.904	+197.409	-200.011
17	1	+194.295	+7.988	+14.716	-194.295	-7.988	+14.600
	2	+151.395	-5.491	-0.755	-151.395	+5.491	-19.396
	3	+149.446	+20.843	+29.634	-149.446	-20.843	+46.859
	4	+197.624	+4.962	+9.197	-197.624	-4.962	+9.014
18	1	-194.295	-8.173	-14.940	+194.295	+8.173	-15.056
	2	-151.395	-24.155	-35.003	+151.395	+24.155	-53.644
	3	-149.446	+6.552	+3.410	+149.446	-6.552	+20.635
	4	-197.624	-5.253	-9.548	+197.624	+5.253	-9.731
19	1	+23.798	+194.433	+194.057	-23.798	-129.508	-32.087
	2	+20.072	+194.820	+187.744	-20.072	-129.895	-25.387
	3	+27.893	+107.707	+113.639	-27.893	-71.582	-23.995
	4	+8.689	+197.840	+200.728	-8.689	-132.915	-35.350
20	1	+23.798	+129.508	+32.087	-23.798	-64.583	+64.959
	2	+20.072	+129.895	+25.387	-20.072	-64.970	+72.045
	3	+27.893	+71.582	+23.995	-27.893	-35.457	+29.525
	4	+8.689	+132.915	+35.350	-8.689	-67.990	+65.102
21	1	+23.798	+64.583	-64.959	-23.798	+0.342	+97.079
	2	+20.072	+64.970	-72.045	-20.072	-0.045	+104.552
	3	+27.893	+35.457	-29.525	-27.893	+0.668	+46.920
	4	+8.689	+67.990	-65.102	-8.689	-3.065	+100.629
22	1	+23.798	-0.342	-97.079	-23.798	+65.267	+64.274
	2	+20.072	+0.045	-104.552	-20.072	+64.880	+72.134
	3	+27.893	-0.668	-46.920	-27.893	+36.793	+28.189
	4	+8.689	+3.065	-100.629	-8.689	+61.860	+71.231
23	1	+23.798	-65.267	-64.274	-23.798	+130.192	-33.456
	2	+20.072	-64.880	-72.134	-20.072	+129.805	-25.208
	3	+27.893	-36.793	-28.189	-27.893	+72.918	-26.666

	4	+8.689	-61.860	-71.231	-8.689	+126.785	-23.091
24	1	+23.798	-130.192	+33.456	-23.798	+195.117	-196.111
	2	+20.072	-129.805	+25.208	-20.072	+194.730	-187.476
	3	+27.893	-72.918	+26.666	-27.893	+109.043	-117.646
	4	+8.689	-126.785	+23.091	-8.689	+191.710	-182.339
25	1	+198.657	+1.176	+0.000	-198.657	-1.176	+4.314
	2	+155.306	+9.874	+0.000	-155.306	-9.874	+36.239
	3	+153.996	-6.832	-0.000	-153.996	+6.832	-25.075
	4	+153.617	+8.045	+0.000	-153.617	-8.045	+29.527
26	1	-198.657	-8.739	-15.170	+198.657	+8.739	-16.902
	2	-155.306	+6.258	+2.062	+155.306	-6.258	+20.904
	3	-153.996	-22.839	-31.511	+153.996	+22.839	-52.308
	4	-153.617	+8.494	+7.199	+153.617	-8.494	+23.975
27	1	+13.883	+202.196	+208.699	-13.883	-137.271	-38.965
	2	+16.455	+115.881	+130.333	-16.455	-79.756	-32.515
	3	+11.886	+198.949	+195.029	-11.886	-134.024	-28.543
	4	+9.138	+115.524	+128.837	-9.138	-79.399	-31.375
28	1	+13.883	+137.271	+38.965	-13.883	-72.346	+65.843
	2	+16.455	+79.756	+32.515	-16.455	-43.631	+29.179
	3	+11.886	+134.024	+28.543	-11.886	-69.099	+73.019
	4	+9.138	+79.399	+31.375	-9.138	-43.274	+29.962
29	1	+13.883	+72.346	-65.843	-13.883	-7.421	+105.727
	2	+16.455	+43.631	-29.179	-16.455	-7.506	+54.747
	3	+11.886	+69.099	-73.019	-11.886	-4.174	+109.655
	4	+9.138	+43.274	-29.962	-9.138	-7.149	+55.173
30	1	+13.883	+7.421	-105.727	-13.883	+57.504	+80.686
	2	+16.455	+7.506	-54.747	-16.455	+28.619	+44.190
	3	+11.886	+4.174	-109.655	-11.886	+60.751	+81.366
	4	+9.138	+7.149	-55.173	-9.138	+28.976	+44.260
31	1	+13.883	-57.504	-80.686	-13.883	+122.429	-9.280
	2	+16.455	-28.619	-44.190	-16.455	+64.744	-2.491
	3	+11.886	-60.751	-81.366	-11.886	+125.676	-11.847
	4	+9.138	-28.976	-44.260	-9.138	+65.101	-2.778
32	1	+13.883	-122.429	+9.280	-13.883	+187.354	-164.171
	2	+16.455	-64.744	+2.491	-16.455	+100.869	-85.298
	3	+11.886	-125.676	+11.847	-11.886	+190.601	-169.986
	4	+9.138	-65.101	+2.778	-9.138	+101.226	-85.941
33	1	+93.677	+40.258	+52.924	-93.677	-40.258	+94.823
	2	+50.435	+25.538	+35.977	-50.435	-25.538	+57.747
	3	+95.301	+40.440	+52.516	-95.301	-40.440	+95.899
	4	+50.613	+22.010	+29.421	-50.613	-22.010	+51.355
34	1	-93.677	+26.375	+27.448	+93.677	-26.375	+69.347
	2	-50.435	+9.083	+5.782	+50.435	-9.083	+27.551
	3	-95.301	+28.554	+30.704	+95.301	-28.554	+74.087
	4	-50.613	+12.872	+12.653	+50.613	-12.872	+34.587

STR. 08 MEMBER END ACTIONS DRIVE A

MEM NO.	LD. CMB	AXIAL (KN) LOWER JT.	SHEAR (KN) LOWER JT.	BM (KN-M) LOWER JT.	AXIAL (KN) UPPER JT.	SHEAR (KN) UPPER JT.	BM (KN-M) UPPER JT.
1	1	+42.109	-14.641	-36.072	-42.109	+14.641	-17.660
	2	+42.505	-14.923	-36.768	-42.505	+14.923	-18.000
	3	+42.078	-14.619	-36.018	-42.078	+14.619	-17.633
	4	+31.924	-10.967	-27.021	-31.924	+10.967	-13.229
2	1	-42.109	-14.641	-36.072	+42.109	+14.641	-17.660
	2	-42.505	-14.923	-36.768	+42.505	+14.923	-18.000
	3	-42.078	-14.619	-36.018	+42.078	+14.619	-17.633
	4	-31.924	-10.967	-27.021	+31.924	+10.967	-13.229
3	1	+0.000	+84.218	+72.143	+0.000	-54.890	-2.589
	2	+0.000	+85.011	+73.535	+0.000	-55.683	-3.189
	3	+0.000	+84.157	+72.036	+0.000	-54.829	-2.543
	4	+0.000	+63.848	+54.041	+0.000	-41.361	-1.437
4	1	+0.000	+54.890	+2.589	+0.000	-25.563	+37.637
	2	+0.000	+55.683	+3.189	+0.000	-26.356	+37.831
	3	+0.000	+54.829	+2.543	+0.000	-25.502	+37.623
	4	+0.000	+41.361	+1.437	+0.000	-18.873	+28.680
5	1	+0.000	+25.563	-37.637	+0.000	+3.765	+48.536
	2	+0.000	+26.356	-37.831	+0.000	+2.972	+49.523
	3	+0.000	+25.502	-37.623	+0.000	+3.826	+48.461
	4	+0.000	+18.873	-28.680	+0.000	+3.614	+36.310
6	1	+0.000	-3.765	-48.536	+0.000	+33.092	+30.107
	2	+0.000	-2.972	-49.523	+0.000	+32.299	+31.887
	3	+0.000	-3.826	-48.461	+0.000	+33.153	+29.972
	4	+0.000	-3.614	-36.310	+0.000	+26.102	+21.452
7	1	+0.000	-33.092	-30.107	+0.000	+62.420	-17.649
	2	+0.000	-32.299	-31.887	+0.000	+61.627	-15.076
	3	+0.000	-33.153	-29.972	+0.000	+62.481	-17.845
	4	+0.000	-26.102	-21.452	+0.000	+48.589	-15.893
8	1	+0.000	-62.420	+17.649	+0.000	+91.747	-94.732
	2	+0.000	-61.627	+15.076	+0.000	+90.954	-91.367
	3	+0.000	-62.481	+17.845	+0.000	+91.808	-94.95[illegible]
	4	+0.000	-48.589	+15.893	+0.000	+71.077	-75.726
9	1	+90.022	+1.114	+1.344	-90.022	-1.114	+2.744
	2	+79.334	+4.252	+5.129	-79.334	-4.252	+10.477
	3	+90.452	+0.876	+1.056	-90.452	-0.876	+2.158
	4	+79.250	-2.028	-2.446	-79.250	+2.028	-4.996
10	1	-90.022	+1.114	+1.344	+90.022	-1.114	+2.744
	2	-79.334	+4.252	+5.129	+79.334	-4.252	+10.477
	3	-90.452	+0.876	+1.056	+90.452	-0.876	+2.158
	4	-79.250	-2.028	-2.446	+79.250	+2.028	-4.996
11	1	+0.000	+88.296	+89.244	+0.000	-58.968	-15.612
	2	+0.000	+67.714	+70.412	+0.000	-45.227	-13.942
	3	+0.000	+89.095	+90.674	+0.000	-59.768	-16.243

	4	+0.000	+87.422	+85.717	+0.000	-58.095	-12.959
12	1	+0.000	+58.968	+15.612	+0.000	-29.641	+28.693
	2	+0.000	+45.227	+13.942	+0.000	-22.739	+20.041
	3	+0.000	+59.768	+16.243	+0.000	-30.440	+28.861
	4	+0.000	+58.095	+12.959	+0.000	-28.767	+30.472
13	1	+0.000	+29.641	-28.693	+0.000	-0.313	+43.670
	2	+0.000	+22.739	-20.041	+0.000	-0.252	+31.536
	3	+0.000	+30.440	-28.861	+0.000	-1.113	+44.638
	4	+0.000	+28.767	-30.472	+0.000	+0.560	+44.576
14	1	+0.000	+0.313	-43.670	+0.000	+29.014	+29.319
	2	+0.000	+0.252	-31.536	+0.000	+22.236	+20.544
	3	+0.000	+1.113	-44.638	+0.000	+28.215	+31.087
	4	+0.000	-0.560	-44.576	+0.000	+29.888	+29.352
15	1	+0.000	-29.014	-29.319	+0.000	+58.342	-14.359
	2	+0.000	-22.236	-20.544	+0.000	+44.723	-12.936
	3	+0.000	-28.215	-31.087	+0.000	+57.542	-11.792
	4	+0.000	-29.888	-29.352	+0.000	+59.215	-15.199
16	1	+0.000	-58.342	+14.359	+0.000	+87.669	-87.364
	2	+0.000	-44.723	+12.936	+0.000	+67.211	-68.903
	3	+0.000	-57.542	+11.792	+0.000	+86.870	-83.998
	4	+0.000	-59.215	+15.199	+0.000	+88.543	-89.078
17	1	+87.669	+0.000	+0.000	-87.669	-0.000	+0.000
	2	+77.446	-3.358	-4.050	-77.446	+3.358	-8.273
	3	+77.009	+3.117	+3.759	-77.009	-3.117	+7.679
	4	+88.543	+0.000	+0.000	-88.543	-0.000	+0.000
18	1	-87.669	+0.000	+0.000	+87.669	-0.000	+0.000
	2	-77.446	-3.358	-4.050	+77.446	+3.358	-8.273
	3	-77.009	+3.117	+3.759	+77.009	-3.117	+7.679
	4	-88.543	+0.000	+0.000	+88.543	-0.000	+0.000
19	1	+0.000	+87.669	+87.364	+0.000	-58.342	-14.359
	2	+0.000	+87.681	+85.449	+0.000	-58.353	-12.432
	3	+0.000	+67.148	+68.640	+0.000	-44.661	-12.736
	4	+0.000	+88.543	+89.078	+0.000	-59.215	-15.199
20	1	+0.000	+58.342	+14.359	+0.000	-29.014	+29.319
	2	+0.000	+58.353	+12.432	+0.000	-29.026	+31.257
	3	+0.000	+44.661	+12.736	+0.000	-22.173	+20.681
	4	+0.000	+59.215	+15.199	+0.000	-29.888	+29.352
21	1	+0.000	+29.014	-29.319	+0.000	+0.313	+43.670
	2	+0.000	+29.026	-31.257	+0.000	+0.302	+45.619
	3	+0.000	+22.173	-20.681	+0.000	+0.314	+31.611
	4	+0.000	+29.888	-29.352	+0.000	-0.560	+44.576
22	1	+0.000	-0.313	-43.670	+0.000	+29.641	+28.693
	2	+0.000	-0.302	-45.619	+0.000	+29.629	+30.653
	3	+0.000	-0.314	-31.611	+0.000	+22.802	+20.053
	4	+0.000	+0.560	-44.576	+0.000	+28.767	+30.472
23	1	+0.000	-29.641	-28.693	+0.000	+58.968	-15.612
	2	+0.000	-29.629	-30.653	+0.000	+58.957	-13.640
	3	+0.000	-22.802	-20.053	+0.000	+45.289	-13.992

	4	+0.000	-28.767	-30.472	+0.000	+58.095	-12.959
24	1	+0.000	-58.968	+15.612	+0.000	+88.296	-89.244
	2	+0.000	-58.957	+13.640	+0.000	+88.284	-87.261
	3	+0.000	-45.289	+13.992	+0.000	+67.777	-70.525
	4	+0.000	-58.095	+12.959	+0.000	+87.422	-85.717
25	1	+90.022	-1.114	-1.344	-90.022	+1.114	-2.744
	2	+79.713	+2.284	+2.755	-79.713	-2.284	+5.628
	3	+79.368	-4.234	-5.107	-79.368	+4.234	-10.431
	4	+79.250	+2.028	+2.446	-79.250	-2.028	+4.996
26	1	-90.022	-1.114	-1.344	+90.022	+1.114	-2.744
	2	-79.713	+2.284	+2.755	+79.713	-2.284	+5.628
	3	-79.368	-4.234	-5.107	+79.368	+4.234	-10.431
	4	-79.250	+2.028	+2.446	+79.250	-2.028	+4.996
27	1	+0.000	+91.747	+94.732	+0.000	-62.420	-17.649
	2	+0.000	+71.142	+76.004	+0.000	-48.655	-16.105
	3	+0.000	+90.959	+91.387	+0.000	-61.632	-15.092
	4	+0.000	+71.077	+75.726	+0.000	-48.589	-15.893
28	1	+0.000	+62.420	+17.649	+0.000	-33.092	+30.107
	2	+0.000	+48.655	+16.105	+0.000	-26.167	+21.306
	3	+0.000	+61.632	+15.092	+0.000	-32.304	+31.876
	4	+0.000	+48.589	+15.893	+0.000	-26.102	+21.452
29	1	+0.000	+33.092	-30.107	+0.000	-3.765	+48.536
	2	+0.000	+26.167	-21.306	+0.000	-3.680	+36.229
	3	+0.000	+32.304	-31.876	+0.000	-2.977	+49.517
	4	+0.000	+26.102	-21.452	+0.000	-3.614	+36.310
30	1	+0.000	+3.765	-48.536	+0.000	+25.563	+37.637
	2	+0.000	+3.680	-36.229	+0.000	+18.808	+28.665
	3	+0.000	+2.977	-49.517	+0.000	+26.351	+37.830
	4	+0.000	+3.614	-36.310	+0.000	+18.873	+28.680
31	1	+0.000	-25.563	-37.637	+0.000	+54.890	-2.589
	2	+0.000	-18.808	-28.665	+0.000	+41.295	-1.386
	3	+0.000	-26.351	-37.830	+0.000	+55.678	-3.185
	4	+0.000	-18.873	-28.680	+0.000	+41.361	-1.437
32	1	+0.000	-54.890	+2.589	+0.000	+84.218	-72.143
	2	+0.000	-41.295	+1.384	+0.000	+63.783	-53.926
	3	+0.000	-55.678	+3.185	+0.000	+85.006	-73.527
	4	+0.000	-41.361	+1.437	+0.000	+63.848	-54.041
33	1	+42.109	+14.641	+17.660	-42.109	-14.641	+36.072
	2	+31.891	+10.944	+13.200	-31.891	-10.944	+26.963
	3	+42.503	+14.921	+17.998	-42.503	-14.921	+36.763
	4	+31.924	+10.967	+13.229	-31.924	-10.967	+27.021
34	1	-42.109	+14.641	+17.660	+42.109	-14.641	+36.072
	2	-31.891	+10.944	+13.200	+31.891	-10.944	+26.963
	3	-42.503	+14.921	+17.998	+42.503	-14.921	+36.763
	4	-31.924	+10.967	+13.229	+31.924	-10.967	+27.021

STR. 05 MEMBER END ACTIONS DRIVE A

MEM NO.	LD. CMB	AXIAL (KN) LOWER JT.	SHEAR (KN) LOWER JT.	BM (KN-M) LOWER JT.	AXIAL (KN) UPPER JT.	SHEAR (KN) UPPER JT.	BM (KN-M) UPPER JT.
1	1	+142.063	-46.519	-51.615	-142.063	+46.519	-111.203
	2	+144.086	-47.506	-52.055	-144.086	+47.506	-114.215
	3	+141.880	-46.486	-51.729	-141.880	+46.486	-110.971
	4	+99.546	-31.743	-35.001	-99.546	+31.743	-76.097
2	1	+46.519	+142.063	+111.203	-46.519	-91.538	+5.597
	2	+47.506	+144.086	+114.215	-47.506	-93.561	+4.609
	3	+46.486	+141.880	+110.971	-46.486	-91.355	+5.647
	4	+31.743	+99.546	+76.097	-31.743	-63.421	+5.386
3	1	+46.519	+91.538	-5.597	-46.519	-41.013	+71.872
	2	+47.506	+93.561	-4.609	-47.506	-43.036	+72.908
	3	+46.486	+91.355	-5.647	-46.486	-40.830	+71.740
	4	+31.743	+63.421	-5.386	-31.743	-27.296	+50.744
4	1	+46.519	+41.013	-71.872	-46.519	+9.512	+87.622
	2	+47.506	+43.036	-72.908	-47.506	+7.489	+90.682
	3	+46.486	+40.830	-71.740	-46.486	+9.695	+87.307
	4	+31.743	+27.296	-50.744	-31.743	+8.829	+59.977
5	1	+46.519	-9.512	-87.622	-46.519	+60.037	+52.847
	2	+47.506	-7.489	-90.682	-47.506	+58.014	+57.931
	3	+46.486	-9.695	-87.307	-46.486	+60.220	+52.350
	4	+31.743	-8.829	-59.977	-31.743	+44.954	+33.085
6	1	+46.519	-60.037	-52.847	-46.519	+110.562	-32.453
	2	+47.506	-58.014	-57.931	-47.506	+108.539	-25.345
	3	+46.486	-60.220	-52.350	-46.486	+110.745	-33.133
	4	+31.743	-44.954	-33.085	-31.743	+81.079	-29.932
7	1	+46.519	-110.562	+32.453	-46.519	+161.087	-168.277
	2	+47.506	-108.539	+25.345	-47.506	+159.064	-159.146
	3	+46.486	-110.745	+33.133	-46.486	+161.270	-169.140
	4	+31.743	-81.079	+29.932	-31.743	+117.204	-129.074
8	1	+313.605	+5.849	+7.569	-313.605	-5.849	+12.903
	2	+267.946	+18.786	+23.102	-267.946	-18.786	+42.650
	3	+316.095	+4.446	+5.805	-316.095	-4.446	+9.757
	4	+267.158	-6.437	-6.597	-267.158	+6.437	-15.934
9	1	+40.670	+152.517	+155.375	-40.670	-101.992	-28.120
	2	+28.719	+108.883	+116.496	-28.719	-72.758	-25.676
	3	+42.039	+154.825	+159.384	-42.039	-104.300	-29.821
	4	+38.180	+149.953	+145.008	-38.180	-99.428	-20.317
10	1	+40.670	+101.992	+28.120	-40.670	-51.467	+48.610
	2	+28.719	+72.758	+25.676	-28.719	-36.633	+29.019
	3	+42.039	+104.300	+29.821	-42.039	-53.775	+49.216
	4	+38.180	+99.428	+20.317	-38.180	-48.903	+53.849
11	1	+40.670	+51.467	-48.610	-40.670	-0.942	+74.815
	2	+28.719	+36.633	-29.019	-28.719	-0.508	+47.589
	3	+42.039	+53.775	-49.216	-42.039	-3.250	+77.728

	4	+38.180	+48.903	-53.849	-38.180	+1.622	+77.490
12	1	+40.670	+0.942	-74.815	-40.670	+49.583	+50.495
	2	+28.719	+0.508	-47.589	-28.719	+35.617	+30.034
	3	+42.039	+3.250	-77.728	-42.039	+47.275	+55.716
	4	+38.180	-1.622	-77.490	-38.180	+52.147	+50.606
13	1	+40.670	-49.583	-50.495	-40.670	+100.108	-24.350
	2	+28.719	-35.617	-30.034	-28.719	+71.742	-23.646
	3	+42.039	-47.275	-55.716	-42.039	+97.800	-16.822
	4	+38.180	-52.147	-50.606	-38.180	+102.672	-26.803
14	1	+40.670	-100.108	+24.350	-40.670	+150.633	-149.720
	2	+28.719	-71.742	+23.646	-28.719	+107.867	-113.450
	3	+42.039	-97.800	+16.822	-42.039	+148.325	-139.884
	4	+38.180	-102.672	+26.803	-38.180	+153.197	-154.738
15	1	+301.265	-0.000	-0.000	-301.265	+0.000	-0.000
	2	+258.334	-12.311	-13.219	-258.334	+12.311	-29.868
	3	+255.770	+11.839	+13.418	-255.770	-11.839	+28.018
	4	+306.393	-0.000	-0.000	-306.393	+0.000	-0.000
16	1	+40.670	+150.633	+149.720	-40.670	-100.108	-24.350
	2	+41.030	+150.466	+143.318	-41.030	-99.941	-18.114
	3	+30.200	+107.445	+111.867	-30.200	-71.320	-22.485
	4	+38.180	+153.197	+154.738	-38.180	-102.672	-26.803
17	1	+40.670	+100.108	+24.350	-40.670	-49.583	+50.495
	2	+41.030	+99.941	+18.114	-41.030	-49.416	+56.564
	3	+30.200	+71.320	+22.485	-30.200	-35.195	+30.772
	4	+38.180	+102.672	+26.803	-38.180	-52.147	+50.606
18	1	+40.670	+49.583	-50.495	-40.670	+0.942	+74.815
	2	+41.030	+49.416	-56.564	-41.030	+1.109	+80.718
	3	+30.200	+35.195	-30.772	-30.200	+0.930	+47.904
	4	+38.180	+52.147	-50.606	-38.180	-1.622	+77.490
19	1	+40.670	-0.942	-74.815	-40.670	+51.467	+48.610
	2	+41.030	-1.109	-80.718	-41.030	+51.634	+54.347
	3	+30.200	-0.930	-47.904	-30.200	+37.055	+28.911
	4	+38.180	+1.622	-77.490	-38.180	+48.903	+53.849
20	1	+40.670	-51.467	-48.610	-40.670	+101.992	-28.120
	2	+41.030	-51.634	-54.347	-41.030	+102.159	-22.549
	3	+30.200	-37.055	-28.911	-30.200	+73.180	-26.207
	4	+38.180	-48.903	-53.849	-38.180	+99.428	-20.317
21	1	+40.670	-101.992	+28.120	-40.670	+152.517	-155.375
	2	+41.030	-102.159	+22.549	-41.030	+152.684	-149.970
	3	+30.200	-73.180	+26.207	-30.200	+109.305	-117.450
	4	+38.180	-99.428	+20.317	-38.180	+149.953	-145.008
22	1	+313.605	-5.849	-7.569	-313.605	+5.849	-12.903
	2	+269.884	+8.755	+10.122	-269.884	-8.755	+20.522
	3	+268.182	-17.871	-21.341	-268.182	+17.871	-41.208
	4	+267.158	+6.437	+6.597	-267.158	-6.437	+15.934
23	1	+46.519	+161.087	+168.277	-46.519	-110.562	-32.453
	2	+32.275	+117.200	+129.449	-32.275	-81.075	-30.311
	3	+48.072	+158.877	+158.658	-48.072	-108.352	-25.044

	4	+31.743	+117.204	+129.074	-31.743	-81.079	-29.932
24	1	+46.519	+110.562	+32.453	-46.519	-60.037	+52.847
	2	+32.275	+81.075	+30.311	-32.275	-44.950	+32.702
	3	+48.072	+108.352	+25.044	-48.072	-57.827	+58.046
	4	+31.743	+81.079	+29.932	-31.743	-44.954	+33.085
25	1	+46.519	+60.037	-52.847	-46.519	-9.512	+87.622
	2	+32.275	+44.950	-32.702	-32.275	-8.825	+59.589
	3	+48.072	+57.827	-58.046	-48.072	-7.302	+90.610
	4	+31.743	+44.954	-33.085	-31.743	-8.829	+59.977
26	1	+46.519	+9.512	-87.622	-46.519	+41.013	+71.872
	2	+32.275	+8.825	-59.589	-32.275	+27.300	+50.352
	3	+48.072	+7.302	-90.610	-48.072	+43.223	+72.649
	4	+31.743	+8.829	-59.977	-31.743	+27.296	+50.744
27	1	+46.519	-41.013	-71.872	-46.519	+91.538	+5.597
	2	+32.275	-27.300	-50.352	-32.275	+63.425	+4.990
	3	+48.072	-43.223	-72.649	-48.072	+93.748	+4.163
	4	+31.743	-27.296	-50.744	-31.743	+63.421	+5.386
28	1	+46.519	-91.538	-5.597	-46.519	+142.063	-111.203
	2	+32.275	-63.425	-4.990	-32.275	+99.550	-76.498
	3	+48.072	-93.748	-4.163	-48.072	+144.273	-114.847
	4	+31.743	-63.421	-5.386	-31.743	+99.546	-76.097
29	1	+142.063	+46.519	+51.615	-142.063	-46.519	+111.203
	2	+99.550	+32.275	+36.464	-99.550	-32.275	+76.498
	3	+144.273	+48.072	+53.403	-144.273	-48.072	+114.847
	4	+99.546	+31.743	+35.001	-99.546	-31.743	+76.097

STR. 06 MEMBER END ACTIONS DRIVE A

MEM NO.	LD. CMB	AXIAL (KN) LOWER JT.	SHEAR (KN) LOWER JT.	BM (KN-M) LOWER JT.	AXIAL (KN) UPPER JT.	SHEAR (KN) UPPER JT.	BM (KN-M) UPPER JT.
1	1	+72.145	-21.569	-25.379	-72.145	+21.569	-53.780
	2	+72.681	-21.800	-25.479	-72.681	+21.800	-54.527
	3	+72.087	-21.553	-25.393	-72.087	+21.553	-53.707
	4	+62.093	-18.368	-21.579	-62.093	+18.368	-45.833
2	1	+21.569	+72.145	+53.780	-21.569	-46.237	+5.412
	2	+21.800	+72.681	+54.527	-21.800	-46.774	+5.201
	3	+21.553	+72.087	+53.707	-21.553	-46.180	+5.427
	4	+18.368	+62.093	+45.833	-18.368	-39.605	+5.016
3	1	+21.569	+46.237	-5.412	-21.569	-20.330	+38.695
	2	+21.800	+46.774	-5.201	-21.800	-20.866	+39.021
	3	+21.553	+46.180	-5.427	-21.553	-20.272	+38.653
	4	+18.368	+39.605	-5.016	-18.368	-17.118	+33.378
4	1	+21.569	+20.330	-38.695	-21.569	+5.578	+46.071
	2	+21.800	+20.866	-39.021	-21.800	+5.041	+46.934
	3	+21.553	+20.272	-38.653	-21.553	+5.635	+45.972
	4	+18.368	+17.118	-33.378	-18.368	+5.370	+39.252
5	1	+21.569	-5.578	-46.071	-21.569	+31.485	+27.540
	2	+21.800	-5.041	-46.934	-21.800	+30.949	+28.939
	3	+21.553	-5.635	-45.972	-21.553	+31.543	+27.383
	4	+18.368	-5.370	-39.252	-18.368	+27.857	+22.638
6	1	+21.569	-31.485	-27.540	-21.569	+57.393	-16.899
	2	+21.800	-30.949	-28.939	-21.800	+56.856	-14.963
	3	+21.553	-31.543	-27.383	-21.553	+57.450	-17.114
	4	+18.368	-27.857	-22.638	-18.368	+50.345	-16.463
7	1	+21.569	-57.393	+16.899	-21.569	+83.300	-87.245
	2	+21.800	-56.856	+14.963	-21.800	+82.764	-84.773
	3	+21.553	-57.450	+17.114	-21.553	+83.358	-87.517
	4	+18.368	-50.345	+16.463	-18.368	+72.832	-78.051
8	1	+161.696	+2.883	+3.773	-161.696	-2.883	+6.807
	2	+150.774	+5.636	+7.269	-150.774	-5.636	+13.415
	3	+162.374	+2.553	+3.342	-162.374	-2.553	+6.028
	4	+150.522	+0.306	+0.656	-150.522	-0.306	+0.469
9	1	+18.686	+78.396	+80.438	-18.686	-52.488	-14.996
	2	+16.164	+68.010	+71.358	-16.164	-45.523	-14.591
	3	+19.000	+79.016	+81.489	-19.000	-53.108	-15.427
	4	+18.062	+77.690	+77.582	-18.062	-51.783	-12.846
10	1	+18.686	+52.488	+14.996	-18.686	-26.581	+24.538
	2	+16.164	+45.523	+14.591	-16.164	-23.035	+19.688
	3	+19.000	+53.108	+15.427	-19.000	-27.201	+24.728
	4	+18.062	+51.783	+12.846	-18.062	-25.875	+25.983
11	1	+18.686	+26.581	-24.538	-18.686	-0.673	+38.165
	2	+16.164	+23.035	-19.688	-16.164	-0.548	+31.479
	3	+19.000	+27.201	-24.728	-19.000	-1.293	+38.975

	4	+18.062	+25.875	-25.983	-18.062	+0.032	+38.904
12	1	+18.686	+0.673	-38.165	-18.686	+25.234	+25.885
	2	+16.164	+0.548	-31.479	-16.164	+21.940	+20.783
	3	+19.000	+1.293	-38.975	-19.000	+24.614	+27.315
	4	+18.062	-0.032	-38.904	-18.062	+25.940	+25.918
13	1	+18.686	-25.234	-25.885	-18.686	+51.142	-12.303
	2	+16.164	-21.940	-20.783	-16.164	+44.427	-12.401
	3	+19.000	-24.614	-27.315	-19.000	+50.522	-10.253
	4	+18.062	-25.940	-25.918	-18.062	+51.847	-12.976
14	1	+18.686	-51.142	+12.303	-18.686	+77.049	-76.399
	2	+16.164	-44.427	+12.401	-16.164	+66.915	-68.072
	3	+19.000	-50.522	+10.253	-19.000	+76.429	-73.728
	4	+18.062	-51.847	+12.976	-18.062	+77.755	-77.777
15	1	+154.098	-0.000	-0.000	-154.098	+0.000	-0.000
	2	+143.927	-2.579	-2.895	-143.927	+2.579	-6.568
	3	+143.222	+2.470	+2.940	-143.222	-2.470	+6.123
	4	+155.510	-0.000	-0.000	-155.510	+0.000	-0.000
16	1	+18.686	+77.049	+76.399	-18.686	-51.142	-12.303
	2	+18.742	+77.012	+74.640	-18.742	-51.105	-10.581
	3	+16.530	+66.793	+67.605	-16.530	-44.305	-12.056
	4	+18.062	+77.755	+77.777	-18.062	-51.847	-12.976
17	1	+18.686	+51.142	+12.303	-18.686	-25.234	+25.885
	2	+18.742	+51.105	+10.581	-18.742	-25.197	+27.570
	3	+16.530	+44.305	+12.056	-16.530	-21.818	+21.005
	4	+18.062	+51.847	+12.976	-18.062	-25.940	+25.918
18	1	+18.686	+25.234	-25.885	-18.686	+0.673	+38.165
	2	+18.742	+25.197	-27.570	-18.742	+0.710	+39.814
	3	+16.530	+21.818	-21.005	-16.530	+0.670	+31.579
	4	+18.062	+25.940	-25.918	-18.062	-0.032	+38.904
19	1	+18.686	-0.673	-38.165	-18.686	+26.581	+24.538
	2	+18.742	-0.710	-39.814	-18.742	+26.618	+26.150
	3	+16.530	-0.670	-31.579	-16.530	+23.157	+19.665
	4	+18.062	+0.032	-38.904	-18.062	+25.875	+25.983
20	1	+18.686	-26.581	-24.538	-18.686	+52.488	-14.996
	2	+18.742	-26.618	-26.150	-18.742	+52.525	-13.421
	3	+16.530	-23.157	-19.665	-16.530	+45.645	-14.736
	4	+18.062	-25.875	-25.983	-18.062	+51.783	-12.846
21	1	+18.686	-52.488	+14.996	-18.686	+78.396	-80.438
	2	+18.742	-52.525	+13.421	-18.742	+78.433	-78.900
	3	+16.530	-45.645	+14.736	-16.530	+68.132	-71.624
	4	+18.062	-51.783	+12.846	-18.062	+77.690	-77.582
22	1	+161.696	-2.883	-3.773	-161.696	+2.883	-6.807
	2	+151.273	+0.251	+0.221	-151.273	-0.251	+0.700
	3	+150.846	-5.408	-6.824	-150.846	+5.408	-13.025
	4	+150.522	-0.306	-0.656	-150.522	+0.306	-0.469
23	1	+21.569	+83.300	+87.245	-21.569	-57.393	-16.899
	2	+18.491	+72.840	+78.200	-18.491	-50.353	-16.603
	3	+21.939	+82.714	+84.649	-21.939	-56.807	-14.889

	4	+18.368	+72.832	+78.051	-18.368	-50.345	-16.463
24	1	+21.569	+57.393	+16.899	-21.569	-31.485	+27.540
	2	+18.491	+50.353	+16.603	-18.491	-27.865	+22.506
	3	+21.939	+56.807	+14.889	-21.939	-30.899	+28.964
	4	+18.368	+50.345	+16.463	-18.368	-27.857	+22.638
25	1	+21.569	+31.485	-27.540	-21.569	-5.578	+46.071
	2	+18.491	+27.865	-22.506	-18.491	-5.378	+39.127
	3	+21.939	+30.899	-28.964	-21.939	-4.992	+46.909
	4	+18.368	+27.857	-22.638	-18.368	-5.370	+39.252
26	1	+21.569	+5.578	-46.071	-21.569	+20.330	+38.695
	2	+18.491	+5.378	-39.127	-18.491	+17.110	+33.261
	3	+21.939	+4.992	-46.909	-21.939	+20.916	+38.947
	4	+18.368	+5.370	-39.252	-18.368	+17.118	+33.378
27	1	+21.569	-20.330	-38.695	-21.569	+46.237	+5.412
	2	+18.491	-17.110	-33.261	-18.491	+39.597	+4.908
	3	+21.939	-20.916	-38.947	-21.939	+46.823	+5.077
	4	+18.368	-17.118	-33.378	-18.368	+39.605	+5.016
28	1	+21.569	-46.237	-5.412	-21.569	+72.145	-53.780
	2	+18.491	-39.597	-4.908	-18.491	+62.085	-45.933
	3	+21.939	-46.823	-5.077	-21.939	+72.731	-54.700
	4	+18.368	-39.605	-5.016	-18.368	+62.093	-45.833
29	1	+72.145	+21.569	+25.379	-72.145	-21.569	+53.780
	2	+62.085	+18.491	+21.929	-62.085	-18.491	+45.933
	3	+72.731	+21.939	+25.815	-72.731	-21.939	+54.700
	4	+62.093	+18.368	+21.579	-62.093	-18.368	+45.833