UNIVERSIDAD NACIONAL DE INGENIERIA

FACULTAD DE INGENIERIA CIVIL

TESIS DE GRADO

ESTRUCTURA DE CONCRETO ARMADO CON DISEÑO SISMICO

EDIFICIO DE 11 PISOS TIPO "L" BLOCK "E"
CONJUNTO RESIDENCIAL SAN FELIPE

TOMO I

RAFAEL ORLANDO ZAPATA ASCENCIO

PROMOCION 1966

LIMA - PERU

1969

A LA MEMORIA DE MIS PADRES

A LA MEMORIA DE MI TIA TARCILA ZAPATA V.,QUIEN DEDICO LOS ULTIMOS 20 AÑOS DE SU VIDA A MI CRIANZA, CUIDADO Y FORMACION.

A MIS HERMANOS

MI ESPECIAL Y ETERNO AGRADECIMIENTO A LOS SIGUIENTES PROFESIONALES:

SRTA. ROGELIA PINATTE G.

Asistente Social de Kilates

de fina y exquisita sensibilidad

social.

ING° FERNAN PACHECO-GAMBOA FLORES

Profesional Probo y mejor amigo.

ARQUITECTO ALVARO CASTRO REVILLA

Hombre Cabal, recto y justo.

Quienes desde sus diferentes puestos en la Ex-Junta Nacional de la Vivienda hicieron posible la continuación de mis estudios y la feliz culminación de ellos.

Il·JDICE

ESTRUCTURACION

Primer e importante paso en el diseño de un edificio anti sismico de concreto armado.

Observando detenidamente el plano arquitectónico,del edificio a diseñar se puede apreciar que en el sentido paralelo a los pórticos es sismicamente favorable, no así en el sentido perpendicular a ellos que he tenido que adicionarle una placa, la misma que - junto con la caja del ascensor tomaran el sismo en esa dirección. Incluyendo por tanto una modificación arquitectónica, que por estar ubicada en la luz central, no modifica substancialmente el proyecto,en cambio estructuralmente, la placa, como se verá más adelante, contribuye grandemente atomar la fuerza de sismo en esa dirección.

NOMENCLATURA

Pórticos:

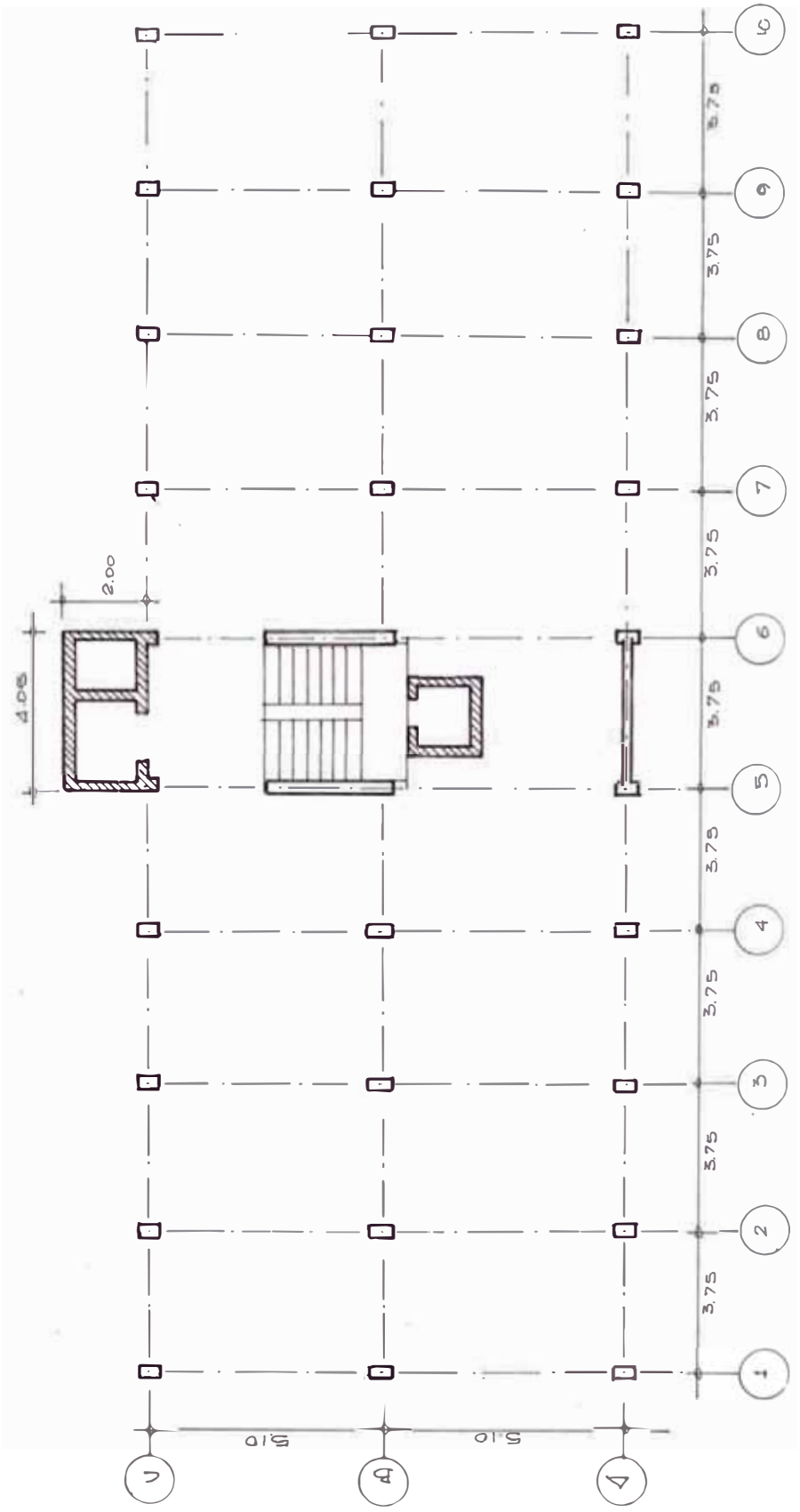
Principales. - Los llamaremos 1,2,3.... 10

De arriostre.- Nominados letras: "A"-"B" y "C"

Los pórticos principales tendran en este caso 2 crujías nominadas como Tramo AB y tramo B-C;

Los pórticos de arriostre son simétricos y sus crujías se reconocerán como tramo 1-2, 2-3 ...9-10 etc.

Así mismo el edificio consta de un sótano (ver arquitectura) y 11ªpisos, denominando cada entrepiso como sigue:1er piso,2ª piso, 3er piso. 11ª piso; de modo tal que el primer piso acaba en el primer techo,y así sucesivamente y el 11ª acaba en el último techo, llamándole también a este techo, azotea; sobre todo para los efectos del metrado de cargas pues este techo será el menos sobrecargado.


10
9
8
7
6
5
4
3
2
1
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3.75
3.75
3.75
3.75
3.75
3.75
A
B
C
5.10
5.10
2.00
4.05

Vigas: Principales.- Se nominaran como sigue:

1ª Letra V que significa viga

2ª Número del pórtico, seguido de un guión

3ª Número del piso.

Ejemplo: V3-5

El 3 significa que es el pórtico 3

V significa viga

5 significa 5ª piso,

∴ Será viga del pórtico 3 y del 5ª piso.

Arriostre.- Se nomina como sigue:

1ª Letra "V" que significa viga

2ª Letra que nomina el pórtico de arriostre.

3ª Número del piso.

Ejemplo: VA-5

Será viga del pórtico A y del 5ª Piso

Columnas.-

Se nominaran en cada piso como sigue:

1ª Letra "C" que significa columna.

2ª Un número que da dirección del pórtico principal

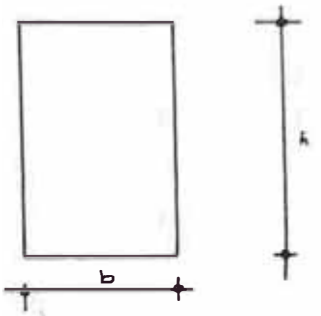
3ª Una letra que da la dirección del pórtico de arriostre

Ejemplo: En el 5ª Piso

C 4 - A

Columna del pórtico 4ª Interceptado con el Eje "A"

Dimensionamiento prévio



h = Altura de la sección

b = Ancho de la sección

El Peralte se calcula según el siguiente cuadro:

SOBRECARGA	250	500	1,000
h	L'/11	L'/10	L'/8

Ancho: $b = \frac{B}{20}$

En la azotea: $h = \frac{L'}{15}$ y el ancho $b = \frac{B}{20}$

Donde:

L' = Luz libre

B = Ancho de Influencia.

A veces por razones arquitectónicas requiere aumentar o disminuir algunas de las dimensiones de la sección, para lo cual se usa la siguiente relación.

$$bh^2 = b_o h_o^2$$

En vigas exteriores el ancho se puede calcular tomando el 70% delancho tributario.

La tabla anterior ha sido calculada para obtener una cuantía del 1% y con acero $f_y = 2{,}800\ Kg/cm^2$.

Cuando se trata de diseñar para cargas laterales este método da resultados hasta para 9 pisos; para más pisos basta con aumentar ligeramente el peralte.

DIMENSIONAMIENTO DE VIGAS PRINCIPALES

1.- Vigas del 11ª Piso o azotea:

Vigas interiores: Pórticos 2-3,4

$h = \frac{4.35}{15} = 28$..... digamos h = 30 cm.

$b = \frac{3.75}{20} = 18.8 \cong 20$ .. usamos b = 25 cm. por razones de acomodo de fierro y la altura "h" por tratarse de edificio mayor de 9 pisos adopto h = 35.

Luego:

$h = 35$

$b = 25$

2.- Vigas de pisos 1º al 10º

Observando la arquitectura, todos los pórticos tienen luces iguales, además estan igualmente separados; de manera que para los efectos del dimensionamiento previo asumimos que tienen el mismo an cho tributario. Luego.

Vigas de pórticos 2º al 9º en los pisos 1º al 10º

$h = \frac{4.35}{11} = 39.5 \equiv 40$ ..... $h = 40$

$b = \frac{3.75}{20} = 18.8 \equiv 20$ .....Por acomodo de fierro b=25

Vigas de Arriostre

1.- Piso 11º ó Azotea.-

Vigas exteriores.- pórticos de arriostre "A" y "C"

$h = \frac{3.45}{15} = 23$

$b = \frac{5.10}{20} \times 0.7 = 18$

Pero por razones arquitectónicas h = 40, en este caso uso la relación.

$b_o h_o^2 = b h^2 \rightarrow\rightarrow\rightarrow b = \frac{b_o h_o^2}{h^2}$

Reemplazando tenemos:

$b = \frac{18 \times 23^2}{40^2} = 5.95$

Pero por acomodo de fierro asumo b = 20

Luego:

$h = 40$ cm.

$b = 20$ cm.

Viga interior- pórtico de arriostre "B"

$h = \frac{345}{15} = 23.$ cm.

$b = \frac{5.10}{20} = 25.5$

Pero por razones arquitectónicas .... h = 20

Luego:

$$b = \frac{23^2 \times 25.5}{20^2} = 33.6 \text{ ..... Asumo } b = 40$$

Luego:

h = 20

b = 40

2.- Vigas de Pisos 1ª al 10ª

Vigas exteriores. - Pórticos de arriostre "A" y "C"

$$h = \frac{3.45}{11} = 31.4$$

$$b = \frac{5.10}{20} \times 0.70 = 18$$

Por arquitectura h = 40

$$b = \frac{18 \times 31.4^2}{40^2} = 11.1 \text{ ..... Asumo } b = 20$$

Luego:

h = 40

b = 20

Vigas Interior.- Pórtico de arriostre "B"

$$h = \frac{3.45}{11} = 31.4$$

$$b = \frac{5.10}{20} = 25.5$$

Por arquitectura h = 20

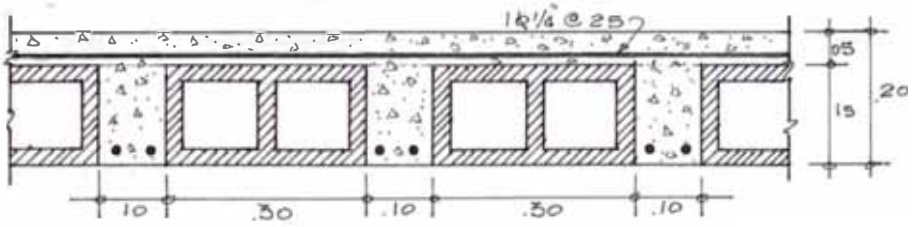
$$b = \frac{31.4^2 \times 25.5}{20^2} = 63 - 70$$

Luego:

h = 20

b = 70

METRADO DE CARGAS EN ALIGERADO



Peso propio del aligerado.

Peso de losa 0.05 x 1.00 x 2,400 ..-.. = 120 kg/m^2

Peso de viguetas = 90 kg/m^2

Peso de ladrillos (blocks de concreto) 0.25x0.30x15

"Comprex" de 8.4 kg/ c/u. ... total 10 m^2 8.4x10 = 84 kg/m^2

294 kg/m^2

Digamos: 300 kg/m^2

ALIGERADO AZOTEA Ó PISO 11ª

1.- Cargas muertas.

Peso propio	300 kg/m^2
Peso piso acabado y yeso en cielo raso	100 kg/m^2
Total cargas muertas (servicio)	400 kg/m^2

2.- Sobrecargas (servicio) ..... 100 kg/m^2

Aligerado pisos 1ª al 10ª

1.- Cargas muertas

Peso propio del aligerado	300 kg/m^2
Peso piso acabado y yeso en cielo raso	100 kg/m^2
peso tabiquería móvil perpendicular a lass viguetas	100 kg/m^2
Total cargas muertas (servicio)	500 kg/m^2

2.- Sobrecargas (servicio) 250 kg/m^2

Nota: En el metrado de cargas de vigas, se considerará como "peso aligerado" = 400 kg/m^2, al peso propio de este, más peso de piso acabado.

METRADO DE CARGAS SOBRE LAS VIGAS

PORTICOS 1ª-10ª

Piso 11ª ó azotea

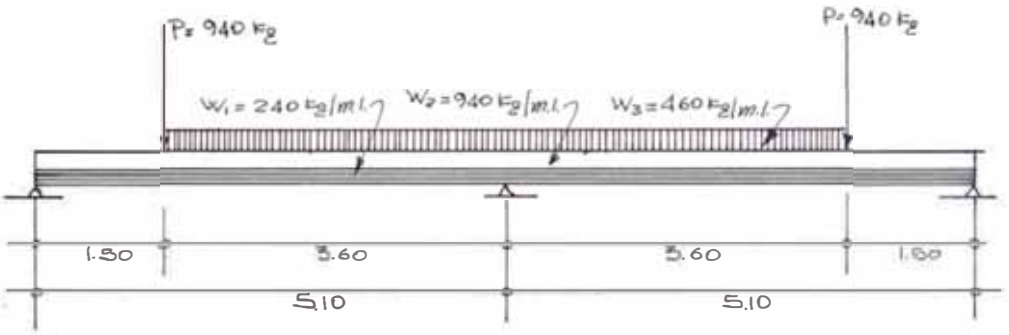
Ancho de influencia $\frac{3.75}{2}$

1ª Cargas muertas (servicio)

a.- peso del aligerado: 400 x $\frac{3.75}{2}$	750 kg/m^2
b.- Peso propio de la viga:0.25x0.35x2400	210 kg/m^2
c.- Peso de muro de ladrillo pandereta soga	90 kg/m^2
	1050 kg/m^2

2ª Sobrecargas (Servicio) 100 x $\frac{3.75}{2}$ ..... 188 kg/m^2

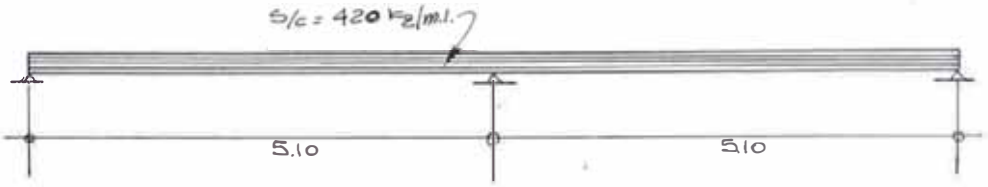
Pisos 1ª=3ª=5ª=7ª=9ª (Techo 1ª,3ª,2ª,5ª) (Planta primer piso Duplex



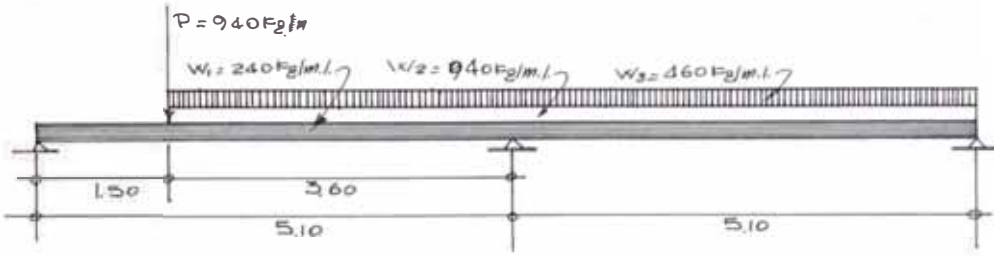
1.- Cargas muertas (Servicio)

a.- Peso propio de la viga:w_1=0.25x0.40x2400	= 240kg/m.
b.- peso del aligerado: w_2 = 500x3.75/2	= 940 kg/m.
c.- Peso del tabique de ladrillo pandereta,soga:	
w_3 = 2.30x200x1.00	= 460 kg/m.
d.- carga concentrada: P=2.5x3.75/2x200	= 940 kg/m.

2.- Sobrecargas (Servicio).- 225 x 3.75/2 = 420 kg/m.



Pisos 2ª, 4ª,6ª,8ª,10ª



Cargas Muertas (Servicio)

a.- peso propio de la viga w_1 =0.25x0.40x2400 = 240 kg/m.l.

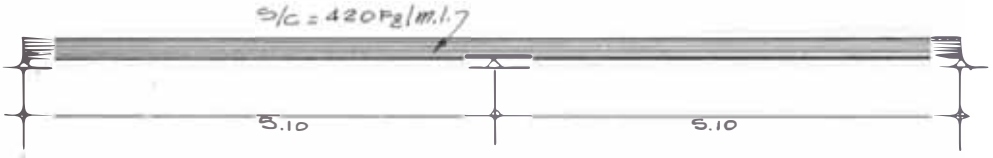
b.- peso del aligerado:w_2=500 x 3.75/2 ... = 940 kg/m.l.

c.- peso del tabique de aldrillo pandereta soga

w_3 = 2.30x1.00 x 200 = 460 kg/m.l.

d.- Carga concentrada P= 2.5x3.75/2 x 200 = 940 kg/m.l.

2.- Sobrecargas.

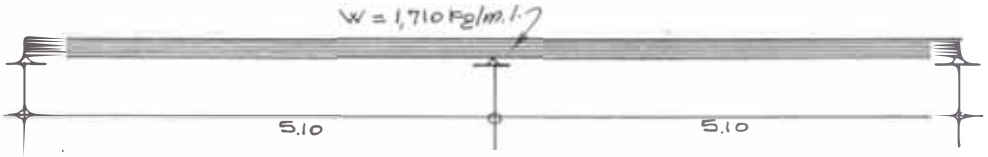


s/c = 225 x 3.75/2 ..... 420 kg/m.l.

CARGAS SOBRE LAS VIGAS DE PORTICOS 2-4-7-9

Piso 11ª Azotea

1.- Cargas muertas.

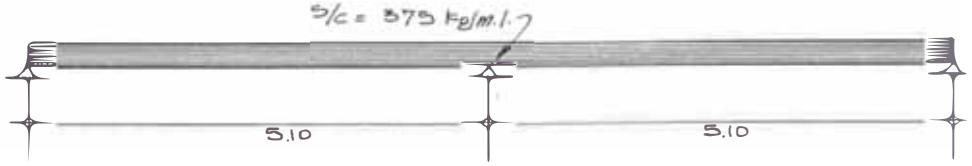


a.- Peso propio de la viga: w_1 = 0.25x0.35 x 2400 .....= 210 kg/m.l.

b.- peso del aligerado:400 x 3.75 ..... 1500 kg/m.l.

total cargas muertas = 1710 kg/m.l.

2.- Sobrecargas



s/c = 100 x 3.75 ..... = 375 kg/m.l.

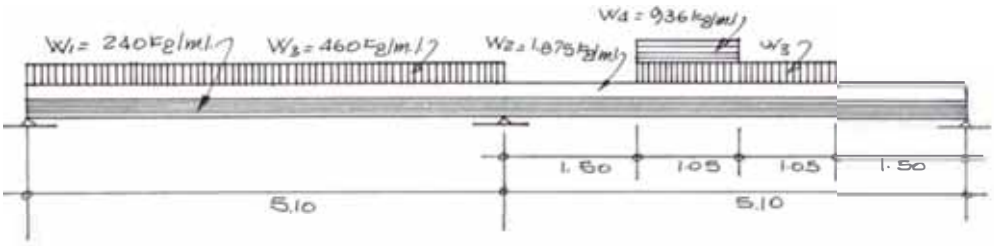
Metrado de cargas de la escalera (Servicio)

1.- Cargas muertas :asumo ..... 500 kg/m^2 (proyecc.horizontal)

2.- Sobrecargas ..... 400 kg/m^2 (Proyecc.horizontal)

Pisos 1ª,3ª,5ª,7ª y 9ª (Planta primer piso Duplex)

1.- Cargas muertas .- (Servicio)



a.- Peso propio de la viga: w_1 = 0.25 x 0.40 x 2,400 = 240 kg/m.l.

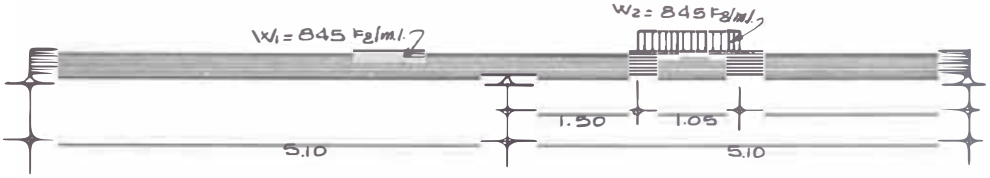
b.- peso del aligerado: w_2 = 500 x 3.75 ..... =1875 kg/m.l

c.- Peso del tabique de ladrillo pandereta soga:

w_3 = 230 x 200 x 1.00 ..... = 460 kg/m.l

d.- Peso de escalera: w_4 = 500 x 3.75/2 ..... = 936 kg/m.l

2.- Sobrecargas.

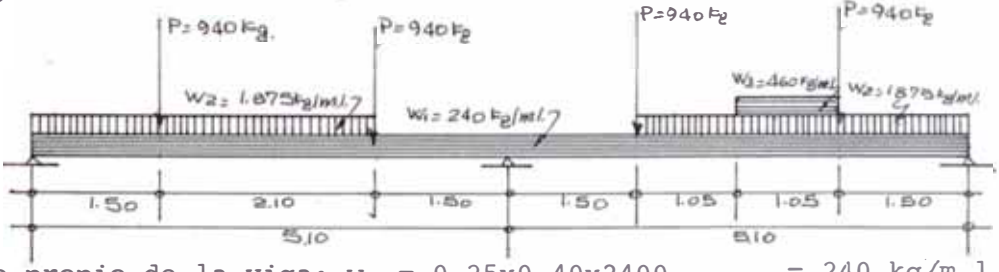


a.- Sobrecarga transmitida por el aligerado: w_1 =225x3.75 = 845

b.- Sobrecarga transmitida por la escalera: w_2 =450x3.75/2 = 845

Pisos: 2ª,4ª,6ª y 10 (Planta segundo piso Duplex)

1.- Cargas muertas (Servicio)



a.- Peso propio de la viga: w_1 = 0.25x0.40x2400 = 240 kg/m.l.

b.- Peso del aligerado .... w_2 = 500 x 3.75 =1875 kg/m.l.

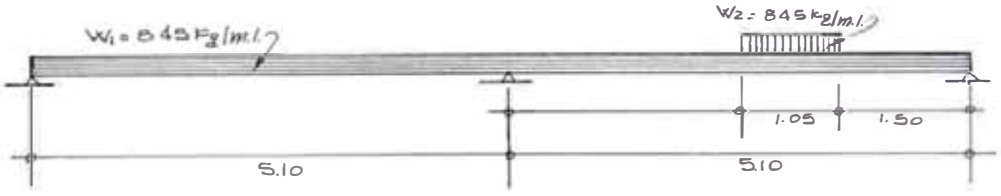
c.- Peso del tabique de ladrillo

pandereta soga .....w_3 = 2.30 x 200 x 1.00 = 460 kg/m.l.

d.- Cargas concentradas P = 2.50 x 3.75/2 x 200 = 940 Kg/m.l.

e.- Peso de la escalera: w_4 = 500 x 3.75/2 .... = 936 kg/m.l.

2.- Sobrecargas.



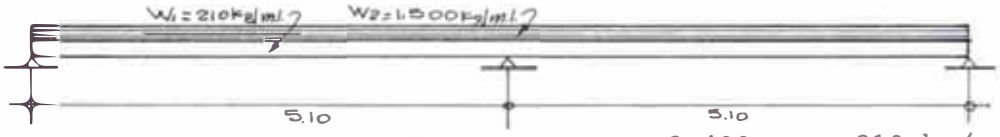
a.- Sobrecarga transmitida por el aligerado: w_1 = 225 x 3.75 = 845kg/m

b.- Sobrecarga transmitida por la escalera: w_2 =450x3.75/2 = 845kg/m.

Cargas sobre las vigas de los pórticos 3º y 8º

PISO 11º AZOTEA

1.- Cargas muertas.

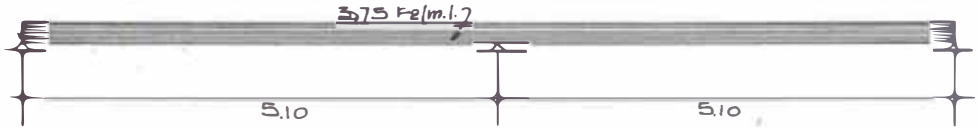


a.- Peso propio de la viga: w_1 = 0.25 x 0.35 x 2,400 = 210 kg/m.l.

b.- Peso del aligerado: w_2 = 400 x 3.75 =1500 kg/m.l.

1,710 kg/m.l.

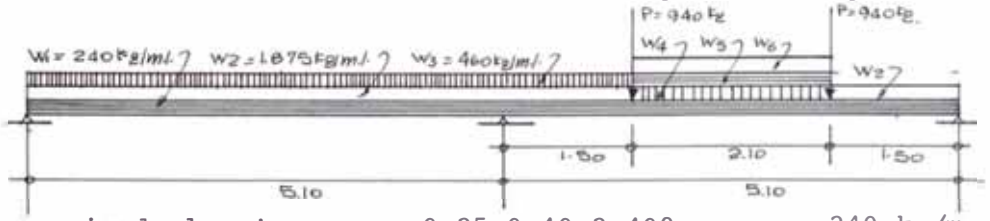
2.- Sobrecargas.



s/c ..... = 100 x 3.75 ..... = 375 kg/m.l.

Pisos 1º, 3º,5º,7º y 9º (Primer piso Duplex)

1.- Cargas muertas. (Se extiende en toda la long. de la viga)



a.- Peso propio de la viga: w_1 = 0.25x0.40x2,400 = 240 kg/m.

b.- peso del aligerado: w_2 = 500 x 3.75 =1875 kg/m.

c.- peso del tabique de ladrillo pandereta

soga : 230 x 1.00 x 200 = w_3 = 460 kg/m.

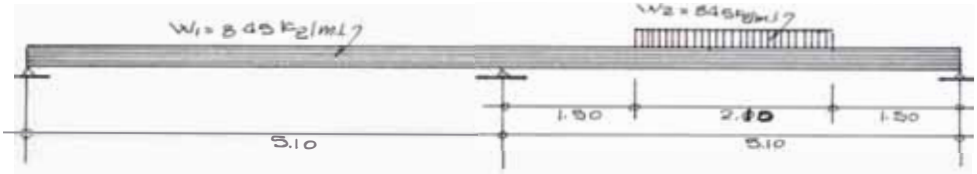
d.- Peso del muro de concreto donde se apoya
la escalera: w_4 = 0.25 x 1.45 x 2,400 = 870 kg/m.

e.- Peso del muro lad.pandereta cabeza que
va del descanzo de la escalera hasta el
fondo de la viga del piso superior:
w_5 = 1.00 x 100 x 360 = 390 kg/m.

f.- Cargas concentradas: P = 2.5 x 2.5 x 200 = 1,250 kg/m.

g.- peso de la escalera: W_6 = 500 x 3.75/2 ... = 940 kg/m.

2.- Sobrecargas (Servicio)

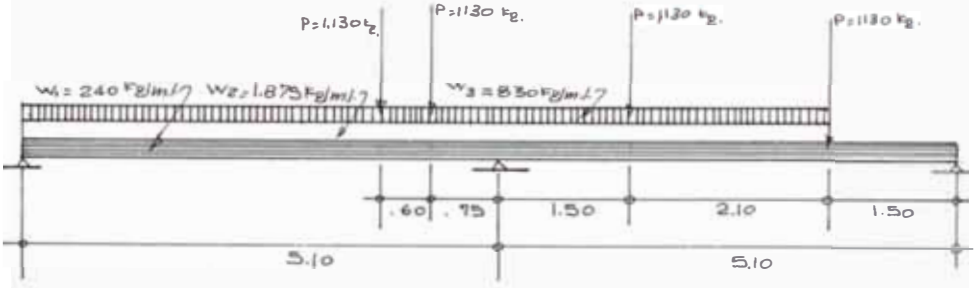


a.- Sobrecarga transmitida por el aligerado: w_1 = 225x3.75 = 845kg/m.

b.- sobrecarga de la escalera: w_2 = 450 x 3.75/2 = 845 kg/m.

Pisos: 2º,4º,6º,8º y 10º (Segundo piso Duplex)

1.- Cargas muertas (Servicio)



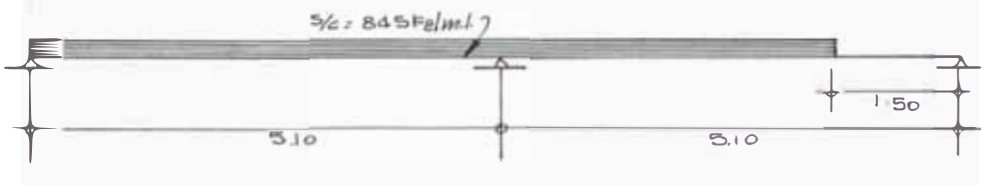
a.- peso propio de la viga: w_1 = 0.25 x 0.40 x 2400 = 240 kg/m.l.

b.- peso del aligerado: w_2= 500 x 3.75 =1875 kg/m.l.

c.- Peso del tabique de ladrillo pandereta
cabeza: 2.30 x 1.00 x 3.60 = 830 kg/m.l.

d.- Cargas concentradas P = 2.30 x 2.45 x 200 =1130 kg/m.l.

2.- Sobrecargas (Servicio)

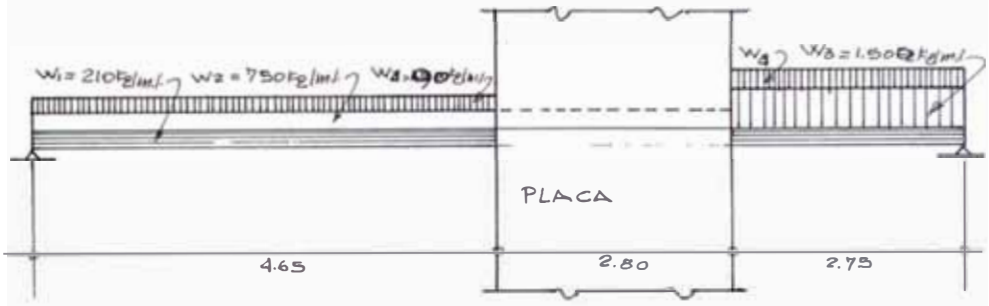


s/c = 225 x 3.75 = 845 kg/m.l.

CARGAS SOBRE LAS VIGAS DE LOS PORTICOS 5 y 6

Piso 11ª ó Azotea

1.- Cargas muertas (Servicio)



a.- Peso propio de la viga: w_1 = 0.25 x 0.35 x 2400 = 210 kg/m.l.

b.- Peso de aligerado (B=3.75/2): w_2 =400x3.75/2 = 750 kg/m.l.

c.- Peso de aligerado(B=3.75): w_3 = 400 x 3.75 =1500 kg/m.l.

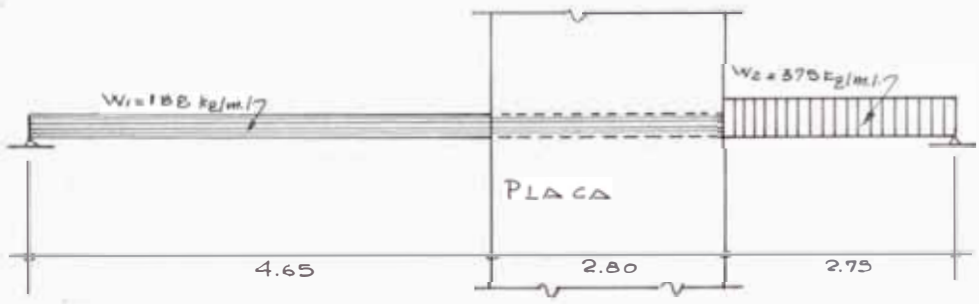
d.- Peso del parapeto de lado pandereta soga

w_4 = 0.45 x 1.00 x 200 = 90 kg/m.l.

e.- Peso del muro de ladrillo pandereta cabeza:

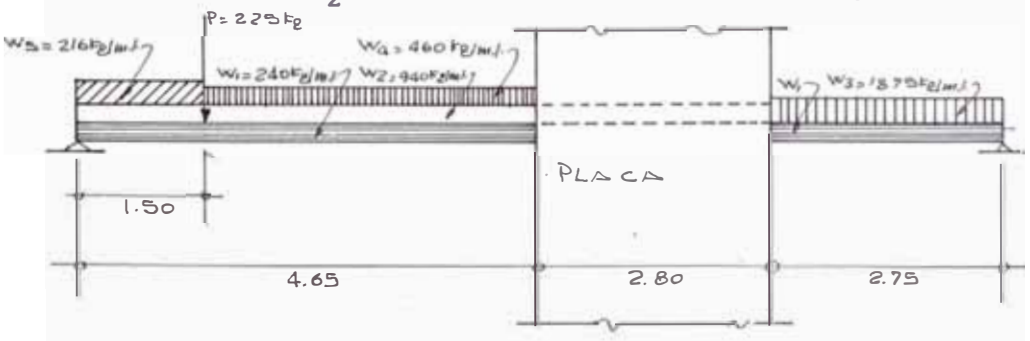
w_5 = 2.10 x 1.00 x 360 = 756 kh/m.l.

2.- Sobrecargas (Servicio)



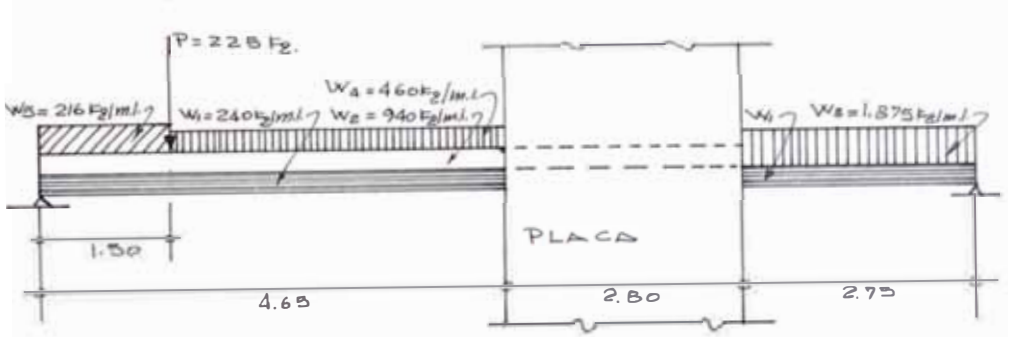
a) s/c para B = 3.75/2: w_1 = 100 x 3.75/2 ..... = 188 kg/m.l.

b) s/c para B = 3.75: w_2 = 100 x 3.75 ..... = 375 kg/m.l.



Pisos: 1º,3º,5º,7º y 9º (Primer piso Duplex)

1.- Cargas muertas (Servicio)



a.- Peso propio de la viga:w_1 = 0.25x0.40x2400 = 240 kg/m.l.

b.- peso del aligerado....:w_2 = 500 x 3.75/2 = 940 kg/m.l.

c.- Peso del aligerado ...:w_3 = 500 x 3.75 =1875 kg/m.l.

d.- Peso del tabique de la

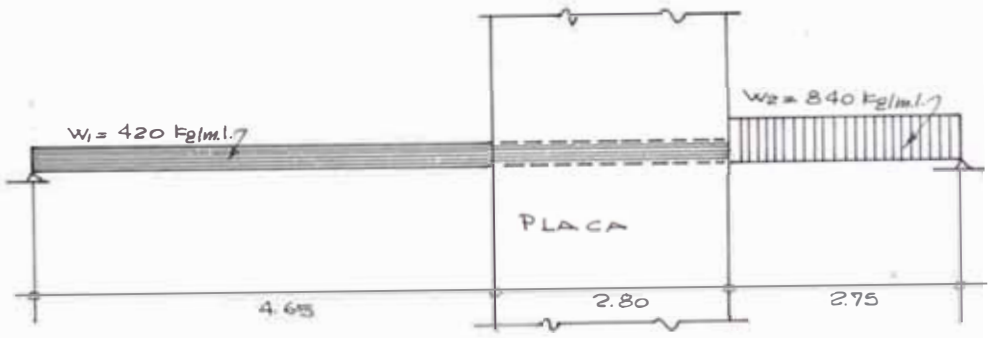
drillo pandereta soga.:w_4 = 1.00 x 2.30 x 200 = 460 kg/m.l.

e.- Peso de la baranda de

concreto expuesto ....:w_5 = 0.90 x 0.1 x 2,400 = 216 kg/m.l.

f'- Peso de la pilastra...:P = 0.15x0.25x2.25x2400 = 225kg/m.l.

2.- Sobrecargas (Servicio)

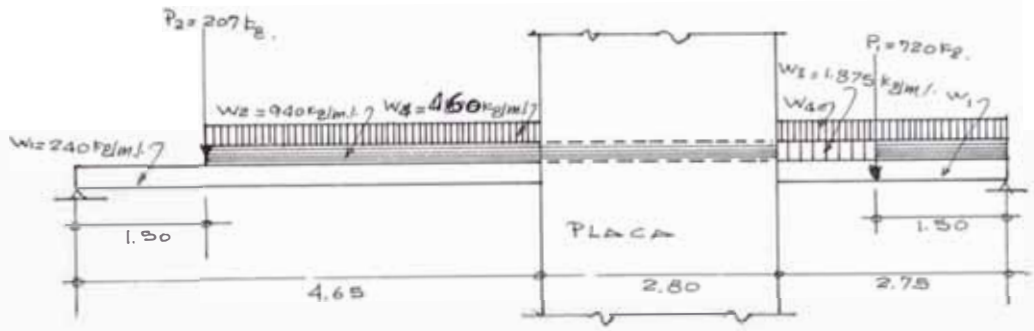


a) s/c para B = 3.72/2: w_1 = 225 x 3.75/2 ..... = 420 kg/m.l.

b) s/c para B = 3.75 : w_2 = 225 x 3.75 ..... = 840 kg/m.l.

Pisos 2º,4º,6º,8º y 10º (Planta 2º Piso Duplex)

1.- Cargas muertas (Servicio)



a.- Peso propio de la viga: w_1 = 0.25x0.40x2,400 = 240 kg/m.l.

b.- Peso del aligerado (B=3.75/2):w_2=500x3.75/2 = 940 kg/m.l.

c.- Peso del aligerado(B=3.75):w_3 = 500 x .375 = 1875 kg/m.l.

d.- Peso del muro de ladrillo pandereta soga:

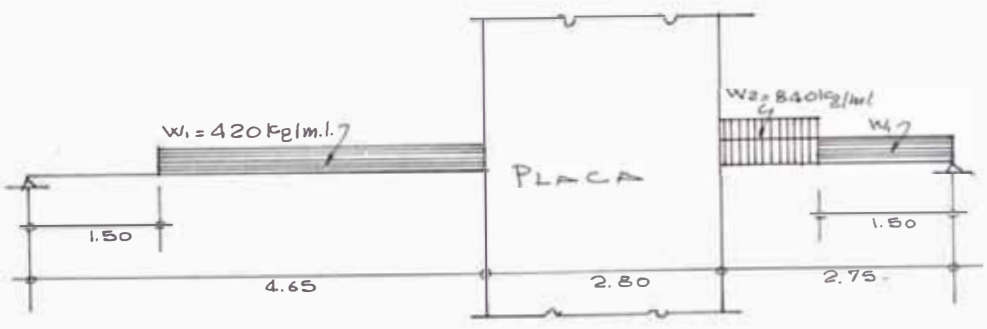
w_4 = 2.30 x 200 = 460

e.- Peso del parapeto de conc.:P_1=0.10x1.6x3.75/2x

x 2400 = 720 kg/m.l.

f.- Peso de la pilastra: P_2 =0.25x0.15x2.30x2400 = 207 kg/m.l.

2.- Sobrecargas (Servicio)



a) s/c para B = 3.75/2: w_1 = 225 x 3.75/2 ..... = 420 kg/m.l.

b) s/c para descanso escalera: 450 x 3.75/2 ... = 840 kg/m.l.

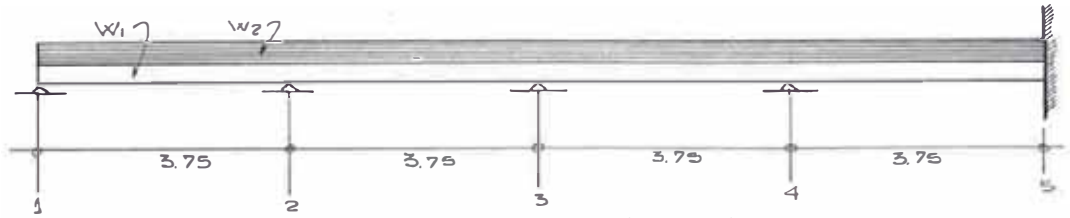
Metrado de cargas sobre las vigas de Arriostre

Pórtico de arriostre "A"

Igual A.pórtico de arriostre "C" (Ejes del 1ºal 5º igual A ejes del 10º al 6º dos simetría.ver arquitectura)

Piso 11º ó azotea

1.- Cargas muertas (Servicio)



a.- Peso propio de la viga: w_1 = 0.20 x 0.40 x 2400 = 232kg/m.l.

b.- peso del muro de ladrillo pandereta

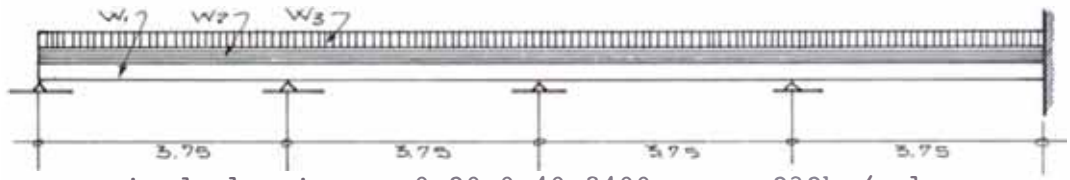
soga: w_2 = 0.45 x 200 x 100 = 90 kg/m.l

W_T = 322kg/m.l.

2.- Sobrecargas :No hay.

Pisos : 1º, 3º,5º,7º y 9º (Planta primer piso Duplex)

1.- Cargas muertas (Servicio)



a.- Peso propio de la viga:w_1=0.20x0.40x2400 = 232kg/m.l.

b.- peso de la baranda de concreto:w_2-0.80x1.15x2400 =220kg/m.l.

c.- peso de los blocks de concreto vibrado

de 0.20x0.20x0.08 á 2.4 kg c/u.

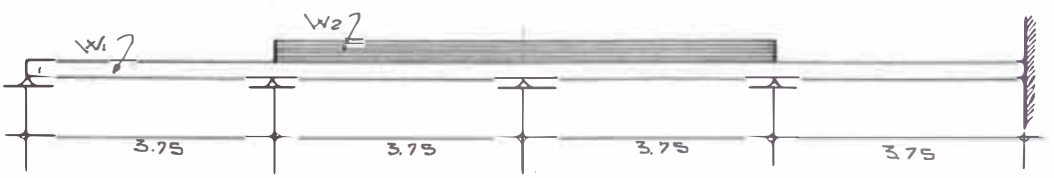
a razón de 25 blocks /m^2:w_3=25 x 2.30 = 138 kg/m.l.

590 kg/m.l.

2.- Sobrecargas :No hay

pisos: 2º,4º,6º,8º y 10º (Planta segundo piso Duplex)

1.- Cargas muertas (Servicio)



a.- Peso propio de la viga:w_1 = 0.20x0.40x2400 = 232kg/m.l.

b.- peso del muro de ladrillo

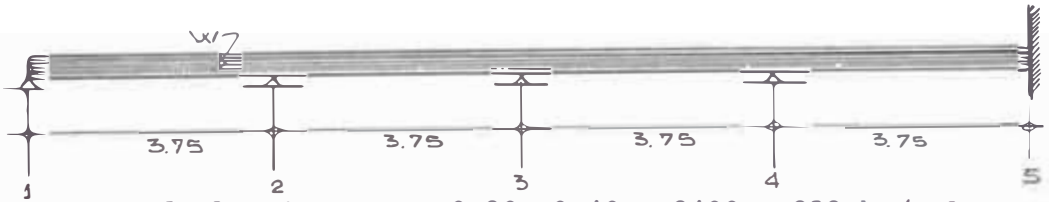
chico caravista soga: w_2 =2.30x220 = 510 kg/m.l.

2.- Sobrecargas :No hay

Pórtico de Arriostre "B"

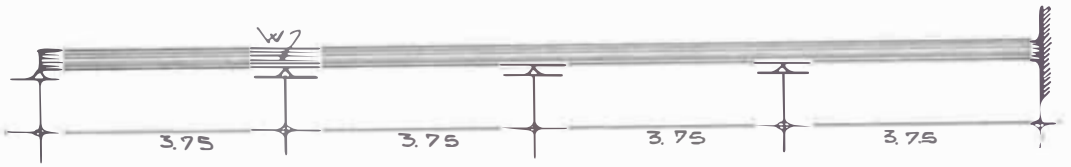
Piso 11ª ó Azotea

1.- Cargas muertas.



a.- Peso propio de la viga: w_1 = 0.20 x0.40 x 2400 = 232 kg/m.l.

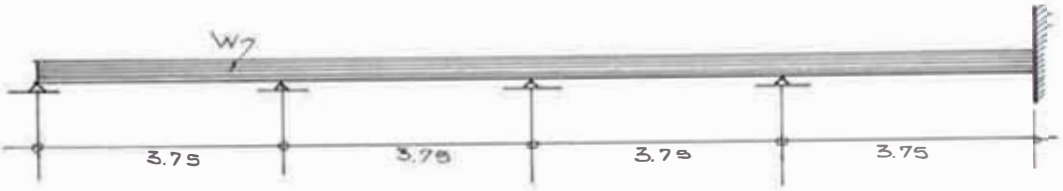
2.- sobrecargas (Servicio)



s/c .... 0.40 x 1.00 x 100 = 40 kg/m.l

Resto de pisos.

1.- Cargas muertas (Servicio)



a.- Peso propio de la viga: w = 0.20x0.70x2400 = 336 kg/m.l.

2.- Sobrecargas (Servicio)

a.- s/c .... 0.70 x 225 ..... 157 kg/m.l.

METRADO DE CARGAS SOBRE LAS COLUMNAS

Para los efectos del dimensionamiento previo,se considera que: las cargas verticales que actúan sobre las columnas serán las reacciones isostáticas de las vigas principales y secundarias que actuan sobre las columnas.

CALCULO DE LAS REACCIONES ISOSTATICAS DE LAS VIGAS

Piso 11ª ó azotea

A.- Pórticos 1ª y 10ª VI-II V10-11

1.- Cargas muertas (Servicio)

Del gráfico de cargas

RA = 1,050 x 2.55 = 2,680 Kg.

RB = 1,050 x 5.10 = 5,360 Kg.

RC = 1,050 x 2.55 = 2,680 Kg.

2.- Sobrecargas (Servicio)

RA = 188 x 2.55 = 480 Kg.

RB = 188 x 5.10 = 960 Kg.

RC = 188 x 2.55 = 480 Kg.

B.- Pórticos 2ª=4ª=7ª=9ª V2-11=V4-11 = V7-11=V9-11

1.- Cargas muertas (Servicio)

Del gráfico de cargas.

RA = 1,710 x 2.55 = 4,360 Kg.

RB = 1,710 x 5.10 = 8,720 Kg.

RC = 1,710 x 2.55 = 4,360 Kg.

2.- Sobrecargas(Servicio)

RA = 375 x 2.55 = 960 Kg.

RB 375 x 5.10 = 1,920 Kg.

RC = 375 x 2.55 = 960 Kg.

C.- Pórticos 3ª= 8ª: V3-11 = V8-11

1.- Cargas muertas (Servicio)

Del gráfico:

RA = 1,710 x 2.55 = 4,360 kg.

RB = 1,710 x 5.10 = 8,720 kg.

RC = 1,710 x 2.55 = 4,360 kg.

2.- Sobrecargas (Servicio)

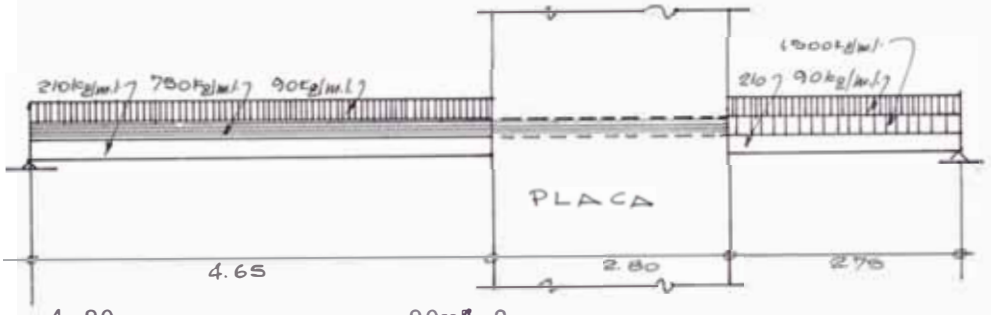
RA = 3.75 x 2.55 = 960 kg.

RB = 3.75 x 5.10 = 1,920 kg.

RC = 3.75 x 2.55 = 960 kg.

D.- Pórticos 5ª = 6ª

1.- Cargas muertas (Servicio)



RA + 210 x $\frac{4.80}{2}$ + 750 x 4.8/2+$\frac{90x4.8}{2}$ = 490 + 1,800 + 216 = 2,506

RC = 210 x 2.75/2+1,500x2.75/2+ $\frac{90x2.75}{2}$ = 124+2,060+290=2,474

Sobre la placa.

V'_p = RA = 2,506

V'_p = RC = 2,474 a esto le sumamos lo que gravita directamente

= 750 x $\frac{4.63}{2}$ = 1725

6,705 kg.

Resumen:

RA = 2,506 kg.

RC = 2,474 kg.

Vp = 6,705 kg.

2.- Sobrecargas (Servicio)

$$RA = 188 \times \frac{4.8}{2} = 450 \text{ Kg.}$$

$$RC = 375 \times \frac{2.75}{2} = 515 \text{ Kg.}$$

Sobre la placa.

V'_p = 450

V'_p = 515 Además lo que gravita directamente sobre la placa

188x2.3 = 432

1,397 Kg.

Resumen:

RA = 450 Kg.

V_p = 1,399 Kg.

Rc = 515 Kg.

Cargas transmitidas por las vigas de arriostre.

E.- Pórtico de arriostre "A" = "C"

1.- Cargas muertas (Servicio)

$$R_1 = 322 \times \frac{3.75}{2} = 600 \text{ Kg.}$$

R_2 = 322 x 3.75 =1,200 Kg.

R_3 = 322 x 3.75 = 1,200Kg.

R_4 = 322 x 3.75 = 1,200Kg.

R_5 = 322 x3.75/2 = 600 Kg.

2.- Sobrecargas (No hay)

F.- Pórtico de arriostre "B"

1.- Cargas muertas (Servicio)

R_1 = 232 x 3.75/2 = 435 Kg.

R_2 = 232 x 3.75 = 870 Kg.

R_3 = 232 x 3.75 = 870 Kg.

R_4 = 232 x 3.75/2 = 435 Kg.

2.0 Sobrecargas.

R_1 = 40 x 3.75/2 = 75 kg.

R_2 = 40 x 3.75 = 150 kg.

R_3 = 40 x 3.75 = 150 kg.

R_4 = 40 x 3.75 = 150 kg.

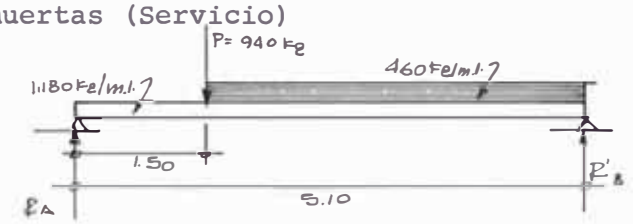
R_5 = 40 x 3.75/2 = 75 kg.

CALCULO DE LAS REACCIONES ISOSTATICAS DE LAS VIGAS

En los pisos 1ª,3ª,5°,7ª,9ª Planta primer piso Duplex.

A.- Pórticos 1ª=10ª

1.- Cargas muertas (Servicio)



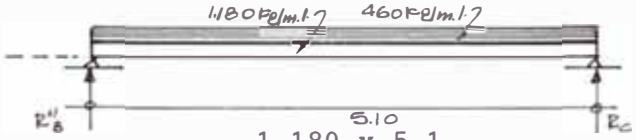
5.1 RA = 1,180 x 5.1/2 + 460 x 3.62/2 + 3.6 x 940

5.1 RA = 15,350 + 2,980 + 3,280

$$RA = \frac{21,610}{5.10} = 4,250$$

RA = 4,250 kg.

R'_B = 4,340 kg.



$$R'_B = R_C = 460 \times 5.1/2 + \frac{1,180 \times 5.1}{2} = 1,170 + 3,000$$

$R''_B = R_C$ = 4,170 kg.

$R_B = R'_B + R''_B$ = 8,510 kg.

Resumen:

R_A = 4,250 kg.

R_B = 8,510 kg.

R_C = 4,170 kg.

2.- Sobrecargas.

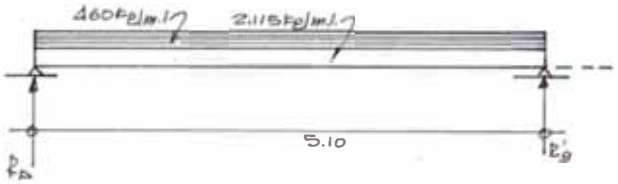
$$R_A = 420 \times \frac{5.10}{2} = 1{,}070 \text{ kg.}$$

$$R_B = 420 \times 5.10 = 2{,}140 \text{ kg.}$$

$$R_C = 420 \times 5.10/2 = 1{,}070 \text{ kg.}$$

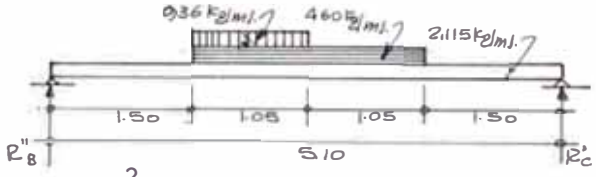
B.- Pórticos 2ª=4ª=7ª=9ª

1.- Cargas muertas (Servicio)



$R_A = R'_B = 460 \times 5.1/2 + 2{,}115 \times 5.1/2 = 1{,}170+5{,}400 = 6{,}570$

$R_A = R''_B = 6{,}570$ kg.



$5.10R''_B = 2{,}115 \times 5.1^2/2 + 460x2.10(1.50+1.05)+936x1.05(1.50+1.05+1.02)$

$5.10R''_B = 2{,}115 \times \frac{5.1^2}{2} + 460 \times 2.10 \times 2.55 + 936 \times 1.05 \times 3.57$

$5.1\ R'_B = 27{,}500 + 2{,}460 + 3{,}750$

$$R''_B = \frac{33{,}710}{5.1} = 6{,}600 \text{ kg.}$$

$R_B = R'_B + R''_B = 6{,}570 + 6{,}600 = 13{,}170$ kg.

$R_B = 13{,}170$ kg.

$R_C = 2{,}115 \times 5.1 + 460 \times 2.10 + 936 \times 1.05 = 6{,}600$

$R_C = 10{,}600 + 966 + 984 - 6{,}600$

$R_C = 5{,}950$ kg.

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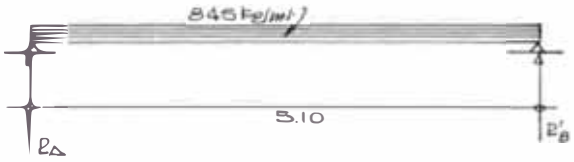
Resumen:

R_A = 6,570 kg.

R_B = 13,170 kg.

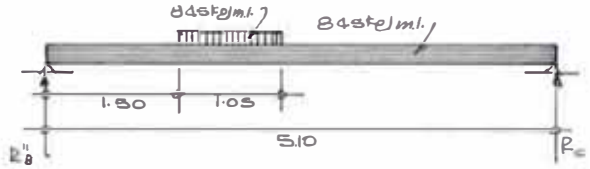
R_C = 5,950 kg.

2.- Sobrecargas (Servicio)



$R_A = R_B = 845 \times 5.1/2 = 2,150$ kg.

$R_A = R'_B = 2,150$ kg.



$5.1R''_B = 845 \times 5.1/2 + 845 \times 1.00 \times (2.55 + 0.52)$

$5.1R''_B = 845 \times 5.1/2 + 845 \times 1.00 \times 3.07$

$5.1\ R''_B = 11,000 + 3,160$

$R''_B = \frac{14,160}{5.10} = 2,780$

$R''_B + 2,780$

$R_C = 845 \times 5.10 + 845 \times 1.05 - 2,780 =$

$R_C = 4,300 + 886 - 2.78 = 2,406$

$R_C = 2,406$ kg.

$R_B = R'_B + R''_B = 2,150 + 2,780 = 4,930$

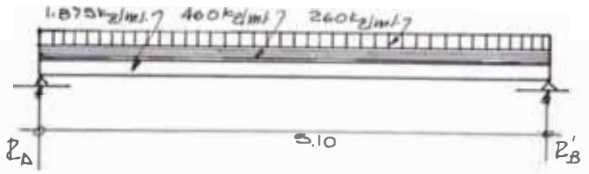
Resumen:

R_A = 2,150 kg.

R_B = 4,930 kg.

R_C = 2,406 kg.

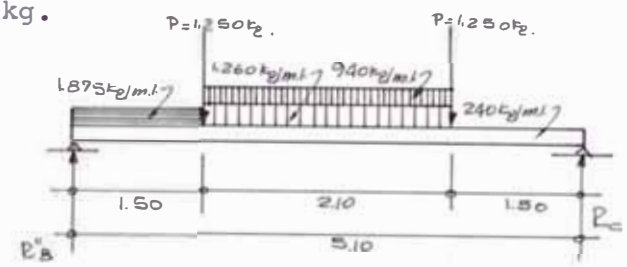
C.- Pórticos 3º=8º



$$R_A = R'_B = 1{,}875 \times 5.1/2 + \frac{240 \times 5.1}{2} + \frac{460 \times 5.1}{2}$$

$$R_A = R'_B = 3{,}780 + 612 + 1{,}172 = 5{,}564 \text{ kg.}$$

$$R_A = R'_B = 5{,}560 \text{ kg.}$$



$$5.1R''_B = 1{,}875 + 1.5/2(5.1-0.75)+1{,}250\times3.60+1{,}260\times2.1(1.05+1.50)$$
$$+240\times5.1/2+1.250\times1.5+940\times2.1(1.05\times1.50)$$

$$5.1R''_B = 1{,}875\times1.5\times4.35+1{,}250\times3.60+1{,}260\times2.10\times2.55+120\times5.1^2+940\times2.1\times2.55$$

$$5.1R''_B = 12{,}500 + 4{,}500 + 6{,}720 + 3{,}740$$

$$5.1R''_B = 32{,}500 \text{ kg.}$$

$$R_B = \frac{32{,}500}{5.1} = 6{,}380 \text{ kg.}$$

$$R_B = R'_B + R''_B = 5{,}564 + 6{,}380 = 11{,}940 \qquad R_B = 11{,}940 \text{ kg.}$$

$$R_C = 240 \times 5.1 + 1.875 \times 1.5 + 1{,}250 \times 2 + 940 \times 2.1 + 1{,}260 \times 2.1 - 6{,}380$$

$$R_C = 1.225 + 2{,}815 + 2{,}500 + 1{,}970 + 2{,}640 = 6{,}380$$

$$R_C = 4{,}770 \text{ kg.}$$

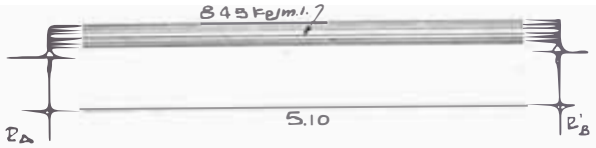
Resumen:

$R_A = 5{,}564$ kg.

$R_B = 11{,}940$ kg.

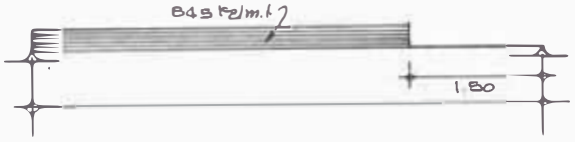
$R_C = 4{,}770$ kg.

2.- Sobrecargas (Servicio)



$R_A = R'_B = 845 \times 5.1/2 \times = 2{,}150$ kg.

$R_A = R'_B = 2{,}150$ kg.



$5.1\ R''_B = 845 \times 3.60 \left(\frac{3.6}{2} + 1.50 \right) =$

$5.1\ R''_B = 845 \times 3.60 \times 2.3\ 0 = 7{,}000$

$R''_B = \frac{7{,}000}{5.1} = 1{,}370$ kg.

$R''_B = 1{,}370$ kg.

$R_C = 845 \times 3.60 - 1{,}370$

$R_C = 3{,}200 - 1{,}370$

$R_C = 1{,}830$

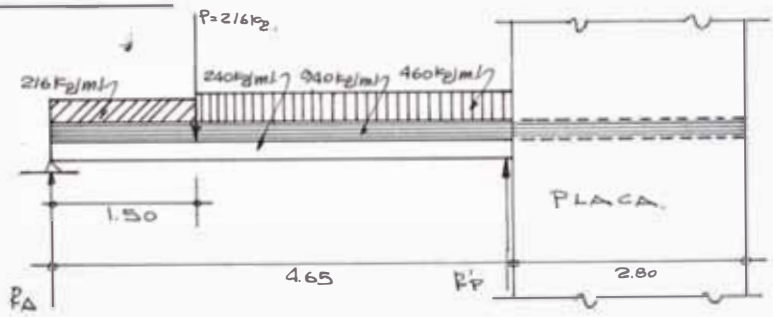
Resumen:

$R_A = 2{,}150$ kg.

$R_B = 3{,}520$ kg.

$R_C = 1{,}830$ kg.

D.- <u>Pórticos 5ª=6ª</u>



$4.65\ R_A = 240 \times \frac{4.65^2}{2} + 940 \times \frac{4.65^2}{2} + 460 \times \frac{3.15^2}{2} + 216 \times 1.50$

$(3.15 + 0.75) + 225 \times 3.15 =$

$4.65 R_A = 240 \times \frac{4.65^2}{2} + 900 \times \frac{4.65^2}{2} + 460 \times \frac{3.15^2}{2} + 216 \times 1.5 \times 3.9 + 225 \times 3.15$

$4.65R_A = 2,600 + 10,150 + 2,120 + 1,260 + 710$

$4.65R_A = 16,840$

$R_A = \frac{16,840}{4.65} = 2,980$ kg.

$R_A = 2,980$ kg.

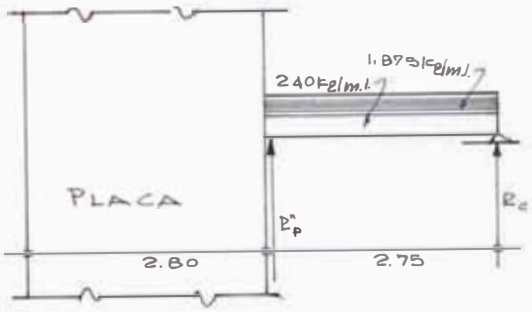
Cargas sobre la placa.

$R'_p = 240 \times 4.65 + 940 + 460 \times 3.15 + 2.16 \times 1.50 + 2.25 \times 4.65 = 2,980$

$R'_p = 1,115 + 4,370 + 1,450 + 324 - 2,980$

$R'_p = 7,484 - 2,980 = 4,504$

$R'_p = 4,504$ kg.



$R''_p = R_c = 1/2 \times 1,875 \times 2.75 + 1/2 \times 240 \times 2.75 =$

$R''_p = R_C = 2,580 + 330 = 2,910$

$R''_p = R_C = 2,910$

Sobre la placa.

$R_p = R'_p + R''_p + 940 \times 2.80 = 4,504 + 2,910 + 2,636$

$R_p = 10,050$

Resumen:

$R_A = 2,980$ kg.

$R_p = 10,050$ kg.

$R_C = 2,910$ kg.

2.- Sobrecargas (Servicio)

$R_A = R'_p = 420 \times \frac{4.65}{2} = 976$ kg.

$R'_p = R_C = 840 \times \frac{2.75}{2} = 1155$ kg.

Sobre la placa:

$R_p = R'_p + R''_p + 420 \times 2.80 = 9.76 + 1,155 + 1,176$

$R_p = 3,300$

Resumen:

$R_A = 976$

$R_p = 3,300$

$R_C = 1,155$

Cargas transmitidas por las vigas de Arriostre.

E.- Pórtico de Arriostre "A" = "C"

1.- Cargas Muertas (Servicio)

$R_1 = 590 \times 3.75/2 = 1,100$ Kg.

$R_2 = 590 \times 3.75 = 2,200$ Kg.

$R_3 = 590 \times 3.75 = 2,200$ Kg.

$R_4 = 590 \times 3.75 = 2,200$ Kg.

$R_5 = 590 \times 3.75/2 = 1,100$ Kg.

2.- Sobrecargas (No hay)

F.- Pórtico de arriostre "B"

1.- Cargas muertas (Servicio)

$R_1 = 336 \times 3.75/2 = 630$ Kg.

$R_2 = 336 \times 3.75 = 1,260$ Kg.

$R_3 = 336 \times 3.75 = 1,260$ Kg.

$R_4 = 336 \times 3.75 = 1,260$ Kg.

$R_5 = 336 \times 3.75/2 = 630$ Kg.

2.- Sobrecargas (Servicio)

$R_1 = 157 \times 3.75/2 = 295$

$R_2 = 157 \times 3.75 = 590$

$R3 = 157 \times 3.75 = 590$

$R_4 = 157 \times 3.75 = 590$

$R_5 = 157 \times 3.75/2 = 295$

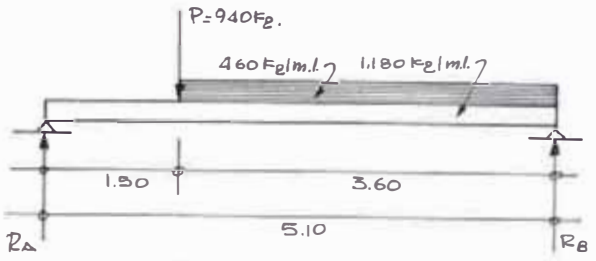
CALCULO DE LAS REACCIONES ISOSTATICAS DE LAS VIGAS

En los pisos 2ª=4ª=6ª=8ª=10ª

Planta segundo piso Duplex.

A.- Pórtico 1ª 10ª

1-- Cargas muertas (Servicio)



$$5.1R_A = 1{,}180 \times \frac{5.1^2}{2} + 460 \times \frac{3.6^2}{2} + 940 \times 3.6$$

$$5.1R_A = 15{,}350 + 2{,}980 + 2{,}380$$

$$5.1R_A = 20{,}710$$

$$R_A = \frac{20{,}710}{5.10} = 4{,}060$$

$R_A = 4{,}060$ kg.

$R'_B = 1{,}180 \times 5.1 + 460 \times 3.60 + 940 - 4{,}060$

$R'_B = 4{,}550$ kg.

Por simetría.

$R'_B = R''_B$ Luego $R_B = 2 \times 4{,}550 = 9{,}400$

$R_A = R_C = 4{,}060$

Resumen:

$R_A = 4{,}060$ kg.

$R_B = 9{,}100$ kg.

$R_C = 4{,}060$ kg.

2.- Sobrecargas.

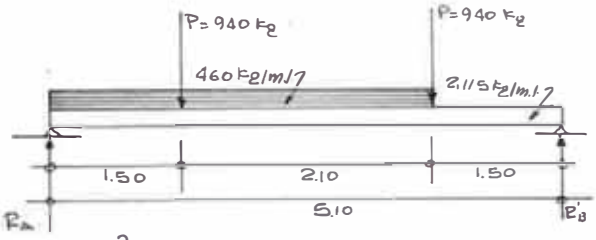
$R_A = 420 \times 5.1/2 = 1{,}070$ kg.

$R_B = 420 \times 5.1 = 2{,}140$ kg.

$R_C = 420 \times 5.1/2 = 1{,}070$ kg.

B.-Pórticos 2ª=4ª=7ª=8ª

1.- Cargas muertas .(Servicio)



$5.1\ R_A = 2{,}115 \times \frac{5.1^2}{2} + 460x3.60(1.80+1.50)+940x3.60x940x1.50$

$5.1R_A = 27{,}500+460x3.6x3.30+940x3.6+940x1.50$

$5.1R_A = 27{,}500 + 8{,}280 + 3{,}480 + 1{,}410$

$5.1R_A = 37{,}070$

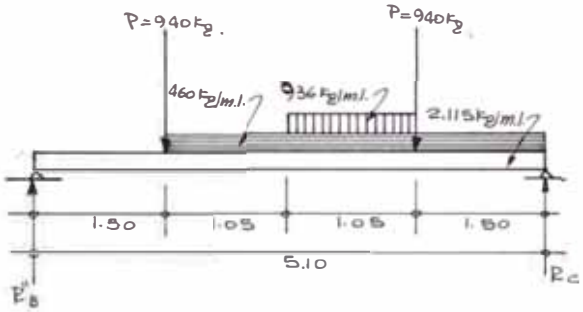
$$R_A = \frac{37{,}070}{5.1} = 7{,}200$$

$$R_A = 7{,}200 \text{ kg.}$$

$R'_B = 2{,}115 \times 5.1 + 460 \times 3.60 + 2 \times 940 - 7{,}200$

$R'_B = 10{,}800 + 1{,}650 + 1{,}880 = 7{,}200$

$R'_B = 7{,}180$ kg.



$5.1R''_B = 2{,}115 \times \frac{5.1^2}{2} + 460x\frac{3.6^2}{2} + 936x1.05x200x940x3.60+940x1.5$

$5.1R''_B = 27{,}500 + 2{,}980 + 1{,}960 + 3{,}290 + 1{,}420$

$5.1R''_B = 37{,}140$

$$R = \frac{37{,}140}{5.1} = 7{,}260$$

$$R''_B = 7{,}260 \text{ kg.}$$

$R_C = 2{,}115 \times 5.1 + 460 \times 3.60 + 936 \times 1.05 + 940 \times 2 - 7.260$

$R_C = 10{,}800 + 1{,}650 + 985 + 1{,}880 - 7{,}260$

$R_C = 8{,}055$ kg.

$R_B = R'_B + R''_B = 7{,}200 + 7{,}260 = 14{,}460$ kg.

Resumen:

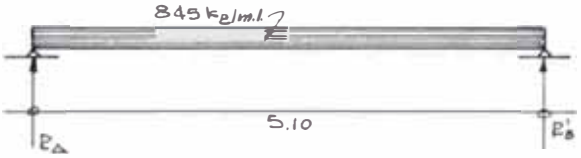
R_A = 7,200 kg.

R_B =14,460 kg.

R_C = 8,055 kg.

2.- Sobrecargas.

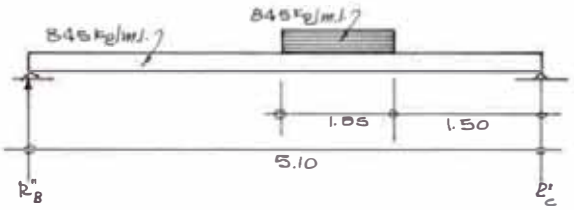
Tramo A-B



$R_A = R'_B = 845 \times 5.1/2 = 2,150$

$R_A = R'_B = 2,150$ kg.

TRAMO B-C



$5.1R'_B = 845 \times \frac{5.1^2}{2} \times 845 \times 1.05(1.50+0.50)$

$5.1\ R'_B = 11,000 + 1,770$

$R'_B = \frac{12,770}{5.1}$

$R'_B = 2,500$

$R_C = 845 \times 5.1 + 845 \times 1.05 = 2,500$

$R_C = 4,300 + 800 - 2,500$

$R_C = 2,660$

$R_B = R'_B + R''_B = 2,150 + 2,600 = 4,650$

Resumen:

R_A = 2,150 kg.

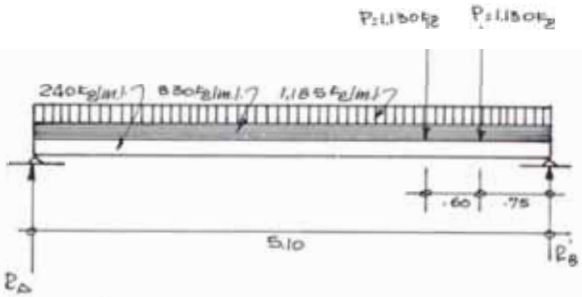
R_B = 4,650 kg.

R_C = 2,660 kg.

C.-Pórticos 3ª = 8ª

1.- Cargas muertas (Servicio)

Tramo A-B



$$5.1R_A = 1{,}875 \times \frac{5.1^2}{2} + \frac{240 \times 5.1^2}{2} + 830 \times \frac{5.1^2}{2} + 1{,}130 \times 1.35 + 1{,}130 \times 0.75$$

$$5.1R_A = 24{,}400 + 3{,}120 + 10{,}800 + 1{,}525 + 845$$

$$R_A = \frac{40{,}690}{5.1}$$

$$R_A = 8{,}000$$

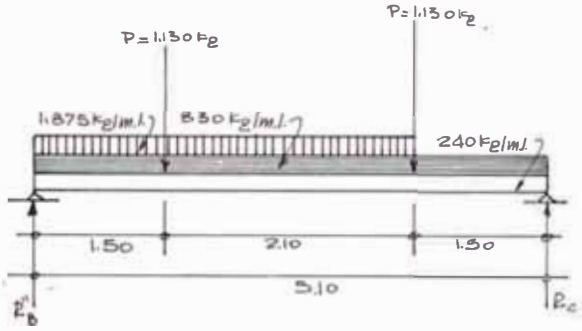
$$R'_B = 1{,}875 \times 5.1 + 240 \times 5.1 + 830 \times 5.1 + 1{,}130 \times 2 = 8{,}000$$

$$R'_B = 9{,}560 + 1{,}220 + 4{,}230 + 2{,}260 - 8{,}000$$

$$R'_B = 17{,}276 - 8{,}000$$

$$R'_B = 9{,}276 \text{ kg.}$$

Tramo B-C



$$5.1R''_B = 1{,}875 \times \frac{5.1^2}{2} + 240 \times \frac{5.1^2}{2} + 830 \times 360(1.05+1.50) + 1{,}130 \times 3.6 + 1{,}130 \times 1.50$$

$$5.1R''_B = 24{,}400 + 1{,}220 + 7{,}600 + 4{,}060 + 1{,}700$$

$$5.1R''_B = 38{,}980$$

$$R''_B = \frac{38{,}980}{5.1} = 7{,}640$$

$$R'_B = 7{,}640 \text{ kg.}$$

$R_C = 1,875x5.1+240x5.1+830x3.60+2x1,130 -7,640$

$R_C = 9,560 + 1,220 + 2,980 + 2,260 - 7,640$

$R_C = 22,890 - 7,640$

$R_C = 8,380$

$R_C = 8,380$ kg-m.

$R_B = R'_C + R''_C = 9,276 + 7,640$

$R_B = 16,916$ kg.

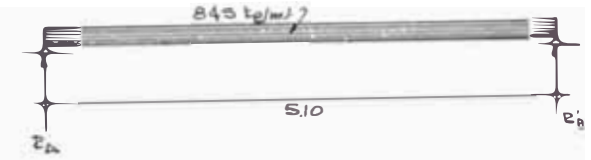
Resumen:

$R_A = 8,000$ kg.

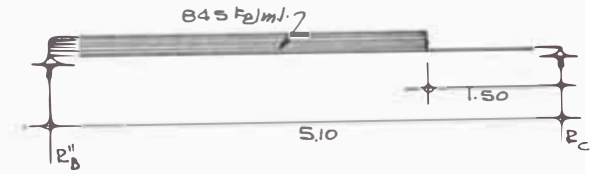
$R_B = 16,916$ kg.

$R_C = 8,380$ kg.

2.- Sobrecargas.



$R'_A = R'_B = 845 \times 5.1/2 = 2,150$ kg.



$5.1R''_B = 845 \times 3.6 \times 3.3$

$5.1\ R''_B = 1,000$

$R''_B = \frac{1,000}{5.10} = 1,960$

$R_B = 1,960$

$R_C = 3,040 - 1,960$

$R_C = 2,080$

Resumen:

$R_A = 2,150$ kg.

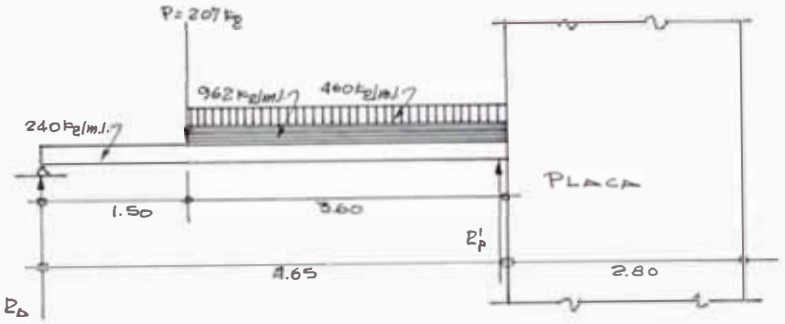
$R_B = 4,120$ kg.

$R_C = 2,080$ kg.

D.- Pórticos 5ª = 6ª

1.- Cargas muertas (Servicio)

Tramo A-B



$$4.65\ R_A = 240 \times \frac{4.65^2}{2} + 926 \times \frac{3.15^2}{2} + 460 \times \frac{3.15}{2} + 207 \times 3.15$$

$$4.65\ R_A = 2{,}590 + 4{,}600 + 2{,}280 + 650$$

$$4.65\ R_A = 10{,}120$$

$$R_A = \frac{10{,}120}{4.65}$$

$$R_A = 2{,}180 \text{ kg.}$$

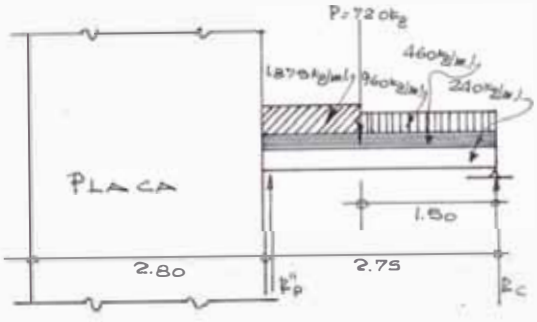
$$R'_p = 240 \times 4.65 + 207 + 962 \times 3.15 + 460 \times 3.15 - 2{,}180$$

$$R'_p = 1{,}130 + 207 + 3{,}030 + 1{,}450 - 2{,}180$$

$$R'_p = 5{,}817 - 2{,}180 = 3{,}637$$

$$R'_p = 3{,}637 \text{ kg.}$$

Tramo B-C



$$2.75\ R''_p = 240 \times \frac{2.75^2}{2} + 460 \times \frac{2.75}{2} + 960 \times \frac{1.5^2}{2} + 240 \times 1.25(0.62+1.5)$$

$$2.75\ R''_p = 910 + 1{,}740 + 1{,}080 + 635 + 1{,}080$$

$$2.75\ R''_p = 5{,}445$$

$$R''_p = \frac{5{,}445}{2.75}$$

$$R''_p = 1{,}980$$

R_C = 240x2.75+460x2.75+960x1.50+1,875x1.25+720-1,980

R_C = 640 + 1,260+1,440 + 2,220 + 720 - 1,980

R_C = 6,280 - 1,980

R_C = 4,300 kg.

$R_p = R'_p + R''_p + 940 \times 2.80$

R_p = 3,637 + 1,980 + 2,630

R_p = 8,247 kg.

R_p = 8,247 kg.

Resumen:

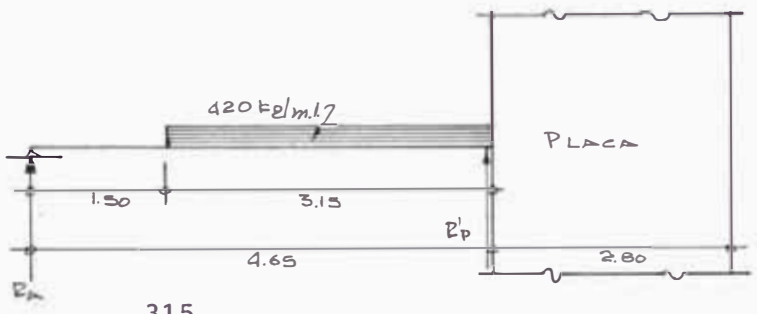
R_A = 2,180 kg.

R_B = 8,247 kg.

R_C = 4,300 kg.

2.- Sobrecargas.

Tramo A-Placa



4.65 $R_A = 420 \times \frac{3.15}{2}$

$R_A = \frac{2,080}{4.65}$

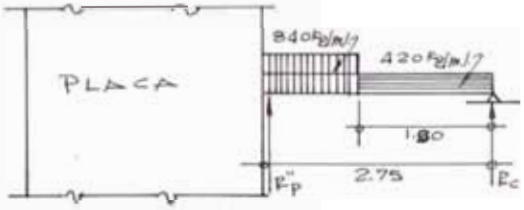
R_A = 450 =

R'_p = 420 x 3.15 - 450

R'_p = 1,320 - 450

R'_p = 870 kg.

Tramo Placa -A



2.75 $R''_p = 840 \times 1.25(0.62 + 1.50) + 420 \times \frac{1.50^2}{2}$

2.75 R''_p = 2,240 + 472

$2.75\ R''_p = 2{,}692$

$$R''_p = \frac{2{,}692}{2.75}$$

$$R''_p = 980 \text{ Kg.}$$

$$R_p = R''_p + R'_p + 420 \times 2.80$$

$$R_p = 870 + 980 + 1{,}175$$

$$R_p = 3{,}025 \text{ Kg.}$$

$$R_c = 840 \times 1.25 + 420 + 420 \times 1.50 - 980$$

$$R_c = 1{,}050 + 630 - 980$$

$$R_C = 700 \text{ Kg.}$$

Resumen:

$R_A =$ 450 Kg.

$R_P =$ 3,025 Kg.

$R_C =$ 700 Kg.

CARGAS TRANSMITIDAS POR LAS VIGAS DE ARRIOSTRE

E.- Pórticos de arriostre "A" = "C"

1.- Cargas Muertas (Servicio)

$R_1 = 232 \times \frac{3.75}{2} = 435$ = 435 Kg.

$R_2 = 232x3.75+500x3.75/2=870+955$ = 1,825 Kg.

$R_3 = 232x3.75+510x3.75=870+1{,}910$ = 2,780 Kg.

$R_4 = 232x3.75+510x3.75/2=870+955=$ = 1,825 Kg.

$R_s = 232 + \frac{3.75}{2}$ = 435 Kg.

2.- Sobrecargas: No hay.

F.- Pórticos de arriostre "B"

1.- Cargas muertas (Servicio)

$R_1 = 336 \times 3.75/2$ = 630 Kg.

$R_2 = 336 \times 3.75$ =1,260 Kg.

$R_3 = 336 \times 3.75$ =1,260 Kg.

$R_4 = 336 \times 3.75$ =1,260 Kg.

$R_5 = 336 \times 3.75/2$ = 630 Kg.

2.- Sobrecargas.

R_1 = 157 x 3.75/2 = 295

R_2 = 157 x 3.75 = 590

R_3 = 157 x 3.75 = 590

R_4 = 157 x 3.75 = 590

R_5 = 155 x 3.75/2 = 295

METRADO DE CARGAS SOBRE LAS COLUMNAS COMO EL EDIFICIO ES

SIMETRICO,TRABAJO CON MEDIO EDIFICIO

NIVEL AZOTEA ó PISO 11

CARGAS MUERTAS

	Colum.	C1-A	C2-A	C3-A	C4-A	C5-A	C1-B	C2-B	C3-B	C4-B	C5-B	C1-C	C2-C	C3-C	C4-C	C5-C
Vigas	VA-1	2680					5360					2680				
Prin-	VA-2		4360					8720					4360			
cipa-	VA-3			4300					8720					4360		
les	VA-4				4300					8720					4360	
	VA-5					2016					6705					2474
Vigas	VA-A	600	1200	1200	1200	600										
de a-	VA-B						435	870	870	870	435					
rrios tre	VA-C											600	1200	1200	1200	
Total		3280	5560	5560	5560	2616	5795	9590	9590	9590	7130	3280	5560	5560	5560	600

ΣPiso=87,807

Cargas vigas

Vigas	VA-1	480					960					480				
Prin-	VA-2		960					1920					960			
cipa-	VA-3			960					1920					960		
les	VA-4				960					1920					960	
	VA-5					450					1397					515
Vigas	VA-A															
de a-	VA-B						975	150	150	150	75					
rrios tre	VA-C															
		480	960	960	960	450	1035	2070	2070	2070	1472	480	960	960	960	515

Σ = 16,402

CARGAS TRANSMITIDAS POR EL PRIMER PISO DUPLEX A LAS

COLUMNAS DEL 1º NIVEL (Igual a:3º,5º,7ºy9º)

	COL.	C1-A	C2-A	C3-A	C4-A	C5-A	C1-B	C2-B	C3-B	C4-B	C5-B	C1-C	C2-C	C3-C	C4-C	C5-C
Vig. Prin.	V1-1	4250					4510					4170				
	V1-2		6570					13170					5950			
	V1-3			5564					11940					4770		
	V1-4				6570					13170					5950	
	V1-5					2980					10050					2910
Vig. de a rrios.	V1-A	1100	2200	2200	2200	1100										
	V1-B						630	1260	1260	1260	630					
	V1-C											1100	2200	2200	2200	1100
TOTAL		5350	8770	7764	8770	4080	9140	14430	13200	14430	10680	5270	8150	6970	8150	4010

Vig. Prin.	V1-1	1070					2140					1070				
	V1-2		2150					4930					2406			
	V1-3			2150					3520					1830		
	V1-4				2150					4930					2406	
	V1-5					976					3300					1155
Vig.de arrios tre	V1-A															
	V1-B						295	590	590	590	295					
	V1-C															
TOTAL		1070	2150	2150	2150	976	2215	5520	4110	5520	3595	1070	2406	1830	2406	1155

Σ=38,543

CARGAS TRANSMITIDAS POR LAS VIGAS DEL SEGUNDO PISO DURBEX A LAS COLUMNAS

DEL 2º NIVEL (Igual a :4º,6º,8º y 10º) CARGAS MUERTAS EN(Kg.)

COLUMNAS		C1-A	C2-A	C3-A	C4-A	C5-A	C1-B	C2-B	C3-B	C4-B	C5-B	C1-C	C2-C	C3-C	C4-C	C5-C
Vigas	V2-1	4060					9100					4060				
prin.	V2-2		7200					14460					8055			
	V2-3			8000					16916					8380		
	V2-4				7200					14460					8055	
	V2-5					2180					8247					4300
Vig.de	V2-A	435	1825	2780	1825	435										
arrios	V2-B						630	1260	1260	1260	630					
tre	V2-C															
TOTAL		4495	9025	10780	9025	2615	9730	15720	18276	15720	8877	4060	8055	8380	8055	4300

TOTAL DEL PISO PARA EL ANALISIS SISMICO 135,143

Vigas.	V2-1	1070					2140					1070				
Prin.	V2-2		2150					4650					2660			
	V2-3			2150					4120					2080		
	V2-4				2150					4650					2660	
	V2-5					450					3025					700
Vig.de	V2-A															
arrios	V2-B						295	590	590	590	295					
tre	V2-C											435	1825	2780	1825	435
TOTAL		1070	2150	2150	2150	450	2435	5240	4710	5240	3320	1505	4485	4860	4485	1135

Σ= 45,385

DIMENSIONAMIENTO DE COLUMNAS

Se dimensionarán las columnas para resistir una carga de rotura de:

$$P_u = 1.65\ (D + 0.56)$$

y para una cuantía del 1% .

La excentricidad es función de la altura de los niveles, cuando actúá el sismo la excentricidad se toma de acuerdo a la expresión

$e = 0.025h$ ..... h = altura de piso a piso

Sólo hasta la mitad de la altura total del edificio y desde la mitad hasta el último nivel se considerará:

$e = 0.03h$.

El dimensionamiento se hara para la Columna Exterior e Interior más cargada; para las demás columnas se adoptaran las - mismas dimensiones, por razones arquitectónicas y de economía, toda vez que se reduce considerablemente el gasto en encofrado.

Así mismo usaré concreto de alta resistencia en los 3 primeros pisos y cambiar el concreto en los pisos superiores, de tal manera que se pueda conservar las mismas dimensiones de la columna en toda su altura.

Observando los cuadros de cargas sobre las columnas ve mos que las más cargadas son:

Columna exterior .....-.. C3-A

Columna interior C3-B

C3-A Carga muertas : 5,560 +5 x 7.764 +5x10,780 =

5,560 + 38,820 + 53,900 = 98,280 Kg.

Sobrecargas: 960 +5x2,150 +5x2,150 = 22,460 Kg.

C3-B Cargas muertas: 9,590 + 5x13,200 + 5 x 18,176 =

9,590 + 66,000 + 90,880 = 166,400 Kg.

SOBRECARGAS: 2,070 + 5x4,110 + 5x4,710 =

2,070 + 20,550 + 23,550 = 46,170 Kg.

RESUMEN:

C3-A: Cargas muertas: 98,280 Kg.

Sobrecargas: 22,460 Kg.

C3-B: Cargas muertas: 166,400 Kg.

Sobrecargas: 46,170 Kg.

DIMENSIONAMIENTO DE LA COLUMNA INTERIOR MAS DESFAVORABLE

C3-B

Considerando un peso propio de la columna igual A: 650 Kg/m.l.

Peso propio = 30.6 x 650 = 19,500 Kg.

Pu = 1.65(D + 0.5L)

Pu = 1.65(166,400 + 19,900 + 0.5 x 46,170)

Pu = 1.65 x (186,300 + 23,085)

Pu = 1.65 x 209,385

Pu = 345,000 Kg.

Por sismo el factor de carga es: 1.2

$$S = \frac{345,000}{1.2} = 288,000 \text{ Kg.}$$

S = 288,000 Kg.

Cálculo de b x t = $\frac{P_u}{0.6\, f'_c}$

$$b \times t = \frac{345,000}{0.6 \times 2.80} = 2,050 \text{ cm}^2$$ (Considerando $f'_c = 280$ Kg/cm^2)

Tomamos una sección de: 03 x 0.80 = 2400 cm^2

Cuando actúa el sismo la excentricidad se toma de acuerdo a la siguiente expresión:

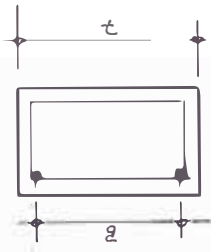
e = 0.025h

Luego:

e = 0.025 x 360 = 9.00 cm. lo que ocurrira cuando la excentricidad se haga máxima.

$$\frac{e}{t} = \frac{9.00}{80} = 0.1120$$

Cálculo de K_1



$$K = \frac{S}{f'_c\, bd}$$

$$K = \frac{288{,}000}{280 \times 2400} = 0.43$$

g = t80 -2(5 + 1.2 + 1.3)/80 = (80-15)/80

Considerando:

Recubrimiento = 5a

ø 1 = 1"

Estribos = 1/2"

g = 65/80 = 0.81

g = 0.810

Como no hay gráfico para g = 0.81 tomo

El gráfico para g = 0.80

y con los datos obtenidos de K y e entro al gráfico.

K. e/t = 0.43 x 0.112 = 0.0482

K. e/t = 0.0482

y encuentro:

ptm = 0.15

$$m = \frac{f_y}{0.85\, f'_c} = \frac{2{,}800}{0.85 \times 280} = 0.118 = 11.8$$

Luego:

$$pt = \frac{0.15}{0.118} = 0.0127$$

pt = 0.0127

Cuantía que puede acomodarse fácilmente en la sección en este caso la condición de cargas verticales es mayor la de sismo.

De la columna exterior más cargada C3-A

Peso propio: Considerando un peso propio de columnas=520kg/m.l. tenemos:

P.P. = 30.6 x 520 = 16,900 kg/m.l.

Pu = 1.65(98,280 + 16,000 + 0.5 x 22,460)

Pu = 1.65 (98,280 + 16,000 + 11,230)

Pu = 1.65 x 125,510

Pu = 207,000 Kg.

Por el sismo de el factor de carga es: 1.2, luego:

$$S = \frac{207,000}{1.2} = 172,500 \text{ Kg.}$$

$$\boxed{S = 172,500}$$

Usando $f'_c = 280 \text{ Kg/cm}^2$

$$b \times t = \frac{207,000}{0.6 \times 280} = 1,230 \text{ Kg.}$$

Asumiendo $b \times t = 30 \times 50 = 1,500 \text{ cm}^2$

Cuando actúa en el sismo la columna interior el momento será: la carga por excentricidad, luego el momento dividido entre la carga de la columna exterior para la excentricidad de esta columna.

$$e = \frac{288,000 \times 9}{172,500} = 15.0 \text{ cm.}$$

e = 15.0 cm.

$$e/t = \frac{15.0}{50} = 0.30$$

$$R = \frac{172,500}{280 \times 1,500} = 0.41$$

Cálculo de g.

g =(50 -2(5 + 1.3 + 1.2))/50 = 50-15)/50 35/50

g = 0.7

K = e/t = 0.41 x 0.30 = 0.123

K = e/t = 0.123

Encuentro : ptm = 0.48

m = 11.8

Luego:

$$pt = \frac{0.38}{11.8} = 0.0322$$

$$\boxed{pt = 0.0322}$$

cuantía muy grande que es necesario bajar.

b x t = 30 x 55 = 1,650

$\frac{e}{t} = \frac{150}{55} = 0.273$

$R = \frac{172,500}{280x1650} = 0.374$

R = 0.374

g (55-2(5+1.3+1.2))/55 = (55-15)/55

g = 40/55 = 0.727

R x e/t = 0.374 x 0.273 = 0.1020

R x e/t = 0.1020

Conservadoramente voy al gráfico para g = 0.7 y encuentro

ptm = 0.25

m = 11.8

$pt = \frac{0.25}{11.8} = 0.0212$

pt = 0.0212 cuantía fácilmente acomodable.

Pero puede disminuirse más aún la cuantía y aumentar las dimentsiones de la sección:

b x t = 30 x 60 = 1,800 cm^2

$e/t = \frac{15.0}{60} = 0.250$

$R = \frac{172,500}{280x1,800} = 0.342$

R = 0.342

g(60-2(5 + 1.3 + 1.2)/60 = (60-15)/60

g = 45/60 = 0.75

K x e/t = 0.0855

Como no hay abaco para 0.75, uso el de

g = 0.70 conservadoramente:

Luego encuentro

ptm = 0.10

m = 11.8 $pt = \frac{0.10}{11.8} = 0.085$

cuantía < 0.01 mínima.

Si comparamos la segunda situación con esta última apreciamos que mientras la anterior tiene una cuantía de 0.0212, ésta última com sólo aumentar t de 55cm. a 60cm. la cuantía disminuye a 0.085 luego es fácil suponer que el "t" nos da una cuantía de 0.01 estará entre 55 y 60, razón por lo que asumo como dimensiones 30 x 60

Resumen:

Columnas exteriores: b = 30
t = 60

Columnas Interiores: b = 30
t = 80

ANALISIS SISMICO

Este se hara de acuerdo a las "Normas Peruanas" de diseño antisismico" y para distribuir los cortantes entre los elementos resistentes usaremos el método del Dr. Kiyoshi Muto, llamando comunmente como "El Método de Muto"

Como se anotará en la estructuración inicial,al edificio se le adicionó una placa ubicada en el eje en el sentido de la fachada y entre los ejes 5 y 6 perpendiculares a la misma,con la finalidad de hacer más resistente a la acción del sismo en esa dirección; pués al colocar dicha placa se buscaba acercar lo más posible los centros de gravedad y rigidez del edificio; para de esa forma evitar la torsión sísmica en los entrepisos, que ocasiona un considerable aumento del cortante sobre los elementos más flexibles.

Dirección de la fuerza sísmica.- Para los efectos de éste análisis consideré solamente la acción horizontal de la fuerza sísmica,en ambas direcciones del edificio, despreciando la acción vertical.

Hago notar que la Fuerza sísmica actúa separadamente en ambas direcciones.

Acción de la Fuerza Sísimica.- Se considera que la fuerza horizontalactúa en el nivel de la losa a no ser que haya una fuerza horizontal a la mitad del entre piso, fuerza que habrá de tomarse en cuenta.

Desplazamiento.- Se considera que las estructuras de los pisos,son suficientemente rigidas en su dirección horizontal, de acuerdo a esto se asume que todos los elementos resistentes en cualquier piso tendrán el mismo desplazamiento horizontal relativo.

Deformaciones.- La distribución del corte y el análisis de esfuerzos de los elementos resistentes, se harán de acuerdo a la teoría elástica.

Distribución del corte en un piso cualquiera entre todos los elementos resistentes. De piso.- Esta se hace proporcionalmente a los valores "D" de todos los elementos

VALOR "D".- Es la fuerza que toma un elemento cuando el desplazamiento relativo de un entrepiso es unitario.

$$D = \frac{V}{\delta}$$

METRADO DE CARGAS

Las cargas que intervienen en el análisis sísmico de un edificio consta de:

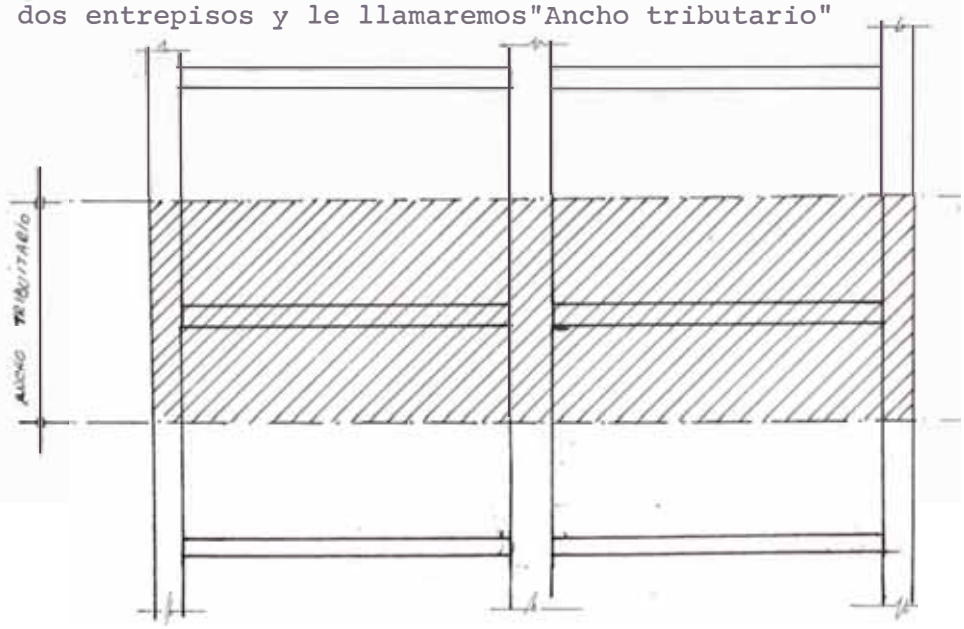
a.- Por la carga permanente total que recibe cada columna.

b.- Por el peso propio de las mismas

c.- Por el 25% de la carga viva.

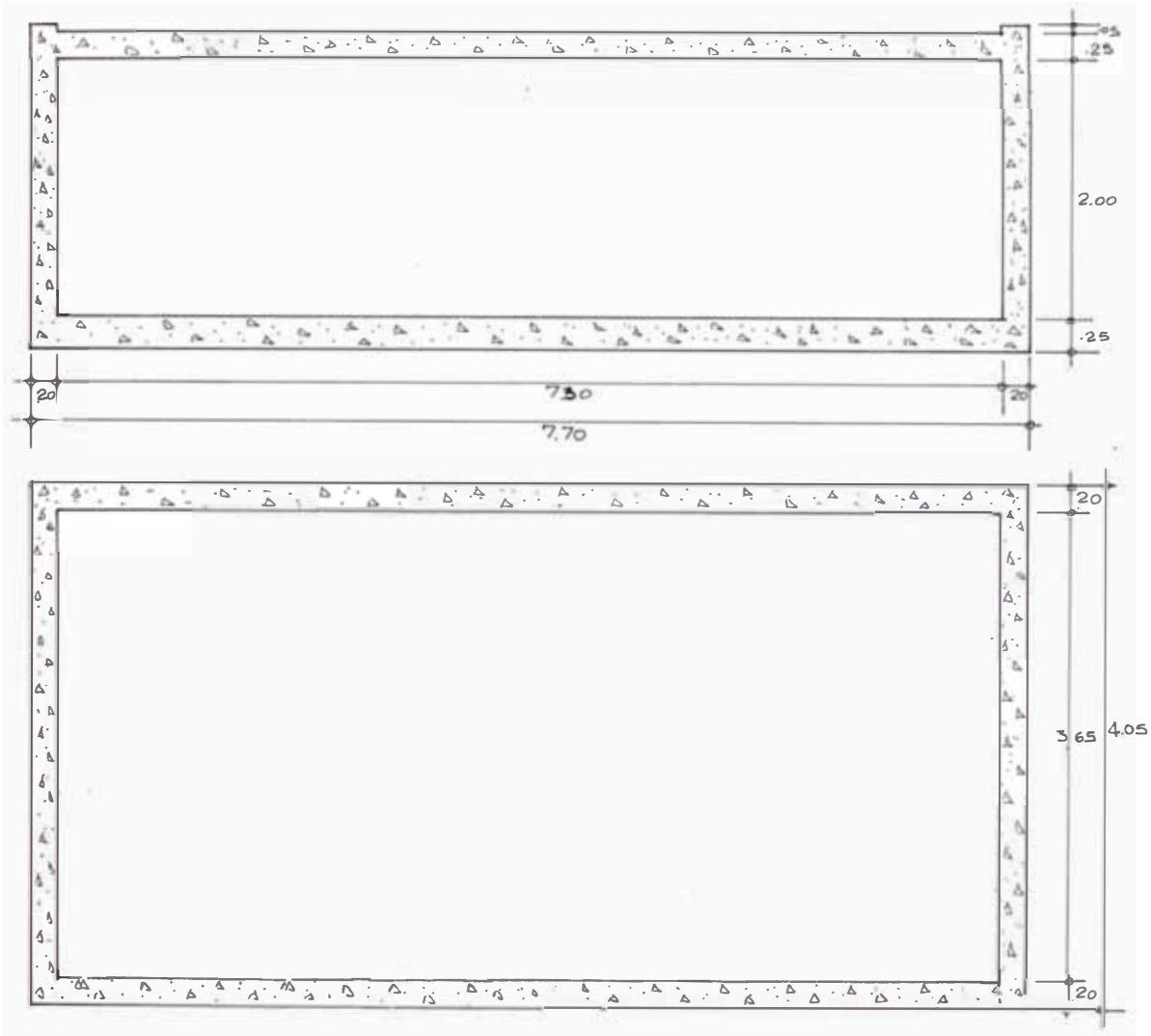
Es necesario hacer notar que del metrado de cargas. En el nivel azotea, que comprende el tanque elevado y la casa de máquinas, se tomara el 12% para el esfuerzo cortante a todo lo alto del edificio.

El metrado de cargas por piso para el análisis sísmico se ha tomado en cuenta todas las cargas comprendidas hasta la mitad de dos entrepisos y le llamaremos"Ancho tributario"



METRADO DE CARGAS AL NIVEL AZOTEA

METRADO DEL TANQUE ELEVADO



1.- Cargas muertas:

a.- Peso de la tapa = 0.25 x 4.05 x 7.70 x 2,400 = 18,700 kg.

b.- Peso del acabado = 100kg/m^2 x 4.05 x 7.70 = 3,120 kg.

c.- Peso de la losa de fondo:0.25x4.05x7.7x2400 = 18,700 kg.

d.- Peso de las paredes del tanque:

2x(2x4.05+2x7.30)x0.20x2400

(8.10+14.60)x0.20x2400x=22.7x0.2x2400x2 = 21,800 kg.

e.- Peso del agua = 1,000 x 7.30x3.65 x 2 = 53,500 kg.

= 115,800 kg.

METRADO DE LA SALA DE MAQUINAS DEL ASCENSOR.

1.- Losa de techo: Es losa de fondo del tanque

2.- Peso losa de fondo: 4.40 x 4.05 x 0.20 x 2400 = 8,560.00

3.- Peso de los muros de concreto armado:

=(2.20x3 +3.65)x0.20x2.10x2,400+

+0.60x0.30x2.40x2400x2

10.35 x 0.2 x 2.10 x 2,400 + 2,070

10,430 + 2,070 = 12,500.00

4.- Peso los tabiques:

(2.6 + 1.9 + 1.10 + 1.20)x240x200

6.80 x 2.40 x 200 = 3,260.00

5.- Peso de la máquina: Supongo 10,000.00

34,320

Como para el análisis antisismico se toma sólo el 12% de los pesos del tanque elevado y casa de máquinas tengo:

W =(115,800 + 34,320)0.12 = 150,120 x 0.12 = 18,300

W = 18,300 Kg.

Metrado de la caja de ascensor.

NOTA: No se metraran las cargas que transmiten las vigas,porque para los efectos del peso total del edificio, estos ya se tienen en los cuadros del metrado general de cargas.

Peso propio: (6.00 + 8.10) x 0.2 x30.60x2,400+

+2 x 0.30 x 30.60 x 2,400 =

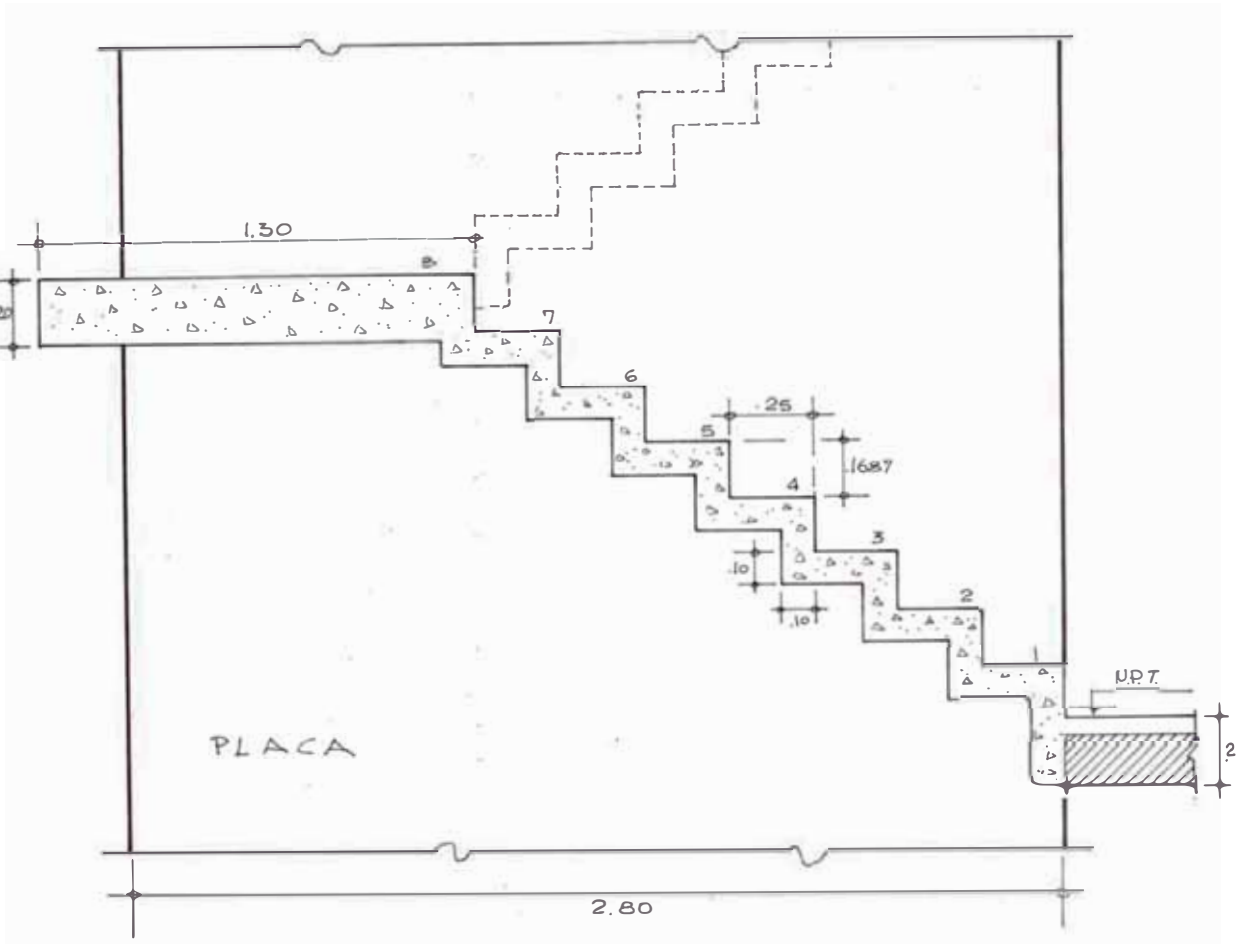
= 14.10 x 0.2 x 30.60 x 2,400 + 26,400

= 207,000 + 26,400 = 233,400.00Kg.

METRADO DE LAS PLACAS

Placas paralelas centrales y simétricas, en las cuales se em potra cada uno de los tramos de la escalera principal (placas Nº1)

METRADO DE LA ESCALERA.



Peso por m. de paso

p.p. = 0.25 x 0.105 x 1.00 x 2,400 + 0.1687^5 x 0.1x1,000x2,400

= 63 + 40.5 = 103.5

Acabado = 100 kg/m^2 x 0.25 = 25.0

128.5

Kg/m.l.de paso.

Sobrecarga.- 450 kg/m.l. x 0.25

Como cada paso tiene 1.70 y son 7 pasos tenemos

- Carga muerta... 7 x 1.7 x 128.50 = 1,530 kg.

  Sobrecarga 7 x 1.7 x 112.50 = 1,340 kg.

Descanso:

Peso propio: 0.20 x 1.30 x 3.45/2 x 2,400 = 1.075Kg.

Acabado: 1.30 x 3.45/2 x 1.00 = 225 Kg

1,300 Kg.

Sobrecarga: 450 x 1.30 x 3.45/2 = 1,000 Kg.

Por tramo de Escalera:

Total cargas muertas: 1,530 + 1,300 = 2,830 Kg.

Total sobrecargas + 1,340 + 1,000 = 2,340 Kg.

Como cada placa tiene empotrada 11 tramos de escalera, la carga que recibe será:

Cargas muertas: 11 x 2,830 = = 31,400 Kg.

Sobrecargas: 11 x 2,340 = 25,700 Kg.

Peso propio de cada placa :0.30x2.80x30.6x2400 = 61,600 Kg.

Cada placa tendrá:

Cargas muertas: 31,400 + 61,600 = 93,000 Kg.

Sobrecargas = 25,700 Kg.

Y Como son 2 placas iguales e igualmente cargada tendremos:

Cargas muertas = 2 x 93,000 = 186,000 Kg.

Sobrecargas = 2 x 25,700 = 51,400 Kg.

Metrado de la placa exterior: Plac. Nº 2

Peso propio = 0.30 x 3.45 x 30.60 x 2,400 +2x0.30x0.60x30.6

x2400 = 76,000 + 26,400 = 102,400 Kg.

RESUMEN:

Carga muertas = 186,000 + 102,400 = 288,400 Kg.

Sobrecargas : = 51,400 Kg.

PESO PROPIO DE LAS COLUMNAS:

Σpp = 16x0.30x0.60x30.60x2,400+8x0.3x0.8x30.6x2,400

Σpp = 211,000 + 141,000 = 352,000 Kg.

Σpp = 352,000 Kg.

El peso total del edificio para el análisis sísmico

$$P = C_p + 0.25\ C_v.$$

Luego tenemos:

1.- Cargas permanentes.

Cp = 2(87,807 +5x129.164+5x135,143)+233,400+288,400+352,000

Cp = 2(87,807 + 645,820 + 665,715) + 873,800

Cp = 2 x 1'399,342 + 873,800

Cp = 2'798,684 + 873,800 = 3'672,484

Cp = 3'672,484 Kg.

Sobrecargas.

s/c = 2(16,402+5x38,543+5x45,385)+51,400

s/c = 2(16,402+192,715+226,925)+51,400

s/c = 2 x 436,040 + 51,400 = 872,084 + 51,400

s/c = 923,484 Kg.

P = 3'672,484 + 0.25 x 923,484

P = 3'672,484 + 231,000

P = 3'903,584 Kg.

P = 3'903,584 Kg.

P = 3,903.6 Tn.

CALCULO DEL CORTANTE EN LA BASE DEL EDIFICIO

Para el efecto se aplica la fórmula:

H = UKCP Obtenida de las Normas Peruanas para Diseño antisísmico.

Donde:

H = Cortante en la base, del edificio

U = Depende de la región sísmica y del tipo de edificación

*K = Depende del tipo de estructuración

---

* Factor que toma en cuenta la respuesta de una estructura que se origina a una exitación sísmica de acuerdo a su grado de amortiguamiento, flexibilidad, ductibilidad y coeficiente de absorción de energía.

C = Coeficiente de amortiguamiento

P = Peso total del edificio.

1.- Determinación de "U"

El edificio analizado construido en Lima, Entonces será región 2 y es edificio de departamentos, luego: Tipo "B"

Si es región 2 y tipo "B"

U = 0.8

2.-Determinación de "K"

Las placas tomaran la fuerza horizontal, luego

K = 1.00

3.- Determinación de "C"

Fórmula:

$$C = \frac{0.05}{\sqrt[3]{T}}$$

Donde:

T = Periodo de vibración, valor que se calcula mediante una fórmula adecuada a la rigidez del edificio.

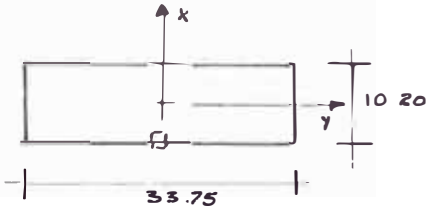
En este caso pro ser un edificio que además de la caja de ascensor tiene otras placas, algunos ventanales y muros de relleno uso:

$$T = \frac{0.07\ h}{\sqrt{D}}$$

Donde:

h = Altura total del edificio h = 30.60

D = Dimensión del edificio en la dirección de la fuerza considerada.



Reemplazandd valores tenemos:

Dirección "X"

$$T = \frac{0.07 \times 30.60}{\sqrt{10.20}} = \frac{0.07 \times 30.60}{3.19} = 0.67$$

Dirección "Y"

$$T = \frac{0.07 \times 30.6}{\sqrt{33.75}} = \frac{0.07 \times 30.60}{5.8} = 0.37$$

$$\underline{T_y = 0.37}$$

Encontrado T, paso a encontrar "C"

$$C_x = \frac{0.05}{\sqrt[3]{0.67}} = \frac{0.05}{0.874} = 0.0573$$

$$C_x = 0.0573$$

$$C_y = \frac{0.05}{\sqrt[3]{0.37}} = \frac{0.05}{0.718} = 0.0704$$

$$\underline{C_y = 0.0700}$$

Cálculo de "H" en la dirección "X"

$$H = 0.8 \times 1.00 \times 0.573 \times 3{,}903.6 =$$

$$\underline{H_x = 179 \text{ Tn.}} = H_x = 179 \text{ Tn.}$$

Cálculo de H en la dirección "Y"

$$H_y = 0.8 \times 1.00 \times 0.0704 \times 3{,}903.6 = 255 \text{ Tn.}$$

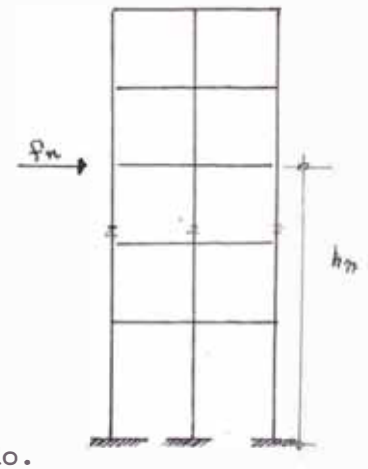
$$\underline{H_y = 258 \text{ Tn.}}$$

Determinación del cortante en cada nivel.

$$f_n = H \frac{W_n h_n}{\Sigma W_n h_n}$$

En la dirección "X" será:

$$f_{nx} = \left(\frac{H_x}{\Sigma W_n h_n} \right) W_n h_n \quad \ldots\ldots H_x = 179 \text{Tn.}$$



En la dirección Y será:

$$f_{ny} = \left(\frac{H_y}{\Sigma W_n h_n} \right) W_n h_n \ldots\ldots H = 258 \text{ Tn.}$$

Fórmula donde:

h_n = Altura total del nivel cero al nivel considerado.

W_n = Peso en el nivel considerado.

Cálculo del peso de cada nivel

Nivel Azotea ó piso 11ª

Nivel Azotea

1.- Cargas permanentes.

$$C_p = 87,807 + 1/2(460x7.20+2x940+2(460x7.20+4x940) +460x6.60+2x1,250+460x5.90+200)(510x7.50)x2)$$

$$C_p = 87,807 + 1/2(3,310+1,880+2(3,310+3,760)+3,040 +2,500+2,715+200(510x7.50)2$$

$$C_p = 87,807 + 1/2(5,190+2(7,070)+8,455 + 7,650$$

$$C_p = 87,807 + 1/2(13,645 + 14,140 + 7,650)$$

$$C_p = 87,807 + 1/2(35,455)$$

$$C_p = 87,807 + 17,727 = 105,582 \text{ kg.}$$

$$C_p = 105,582 \text{ kg.}$$

2.- Sobrecargas:

$$s/c = 16,402 \text{ kg.}$$

Se podrá apreciar que del 2ª al 11ª piso, estan alternados:Primer piso Duplex, Segundo piso Duplex. Primer piso Duplex, luego se podra sumar entre si la mitad de los pesos totales de cada piso y en contrar la concentración de pesos en los niveles.

Peso del primer piso Duplex.- Segundo piso Duplex.

$$C_p = \frac{129,164}{2} + \frac{135,143}{2} = 64,582 + 67,572$$

$$C_p = 132,154 \text{ kg.}$$

La combinación segundo pido Duplex. - Primer piso Duplex será igual

Si observamos la elevación del edificio,vemos claramente que hay 9 niveles igualmente cargados así tenemos:

$$P = 9 \times 132,154 = 1'189,386$$

Si a este peso le aumentamos el hallado para azotea dará un peso parcial que restado del total en contrado del metrado general, nos da el peso del primer piso.

P = 1'189,386 + 105,582 = 1,294,968 Kg.

P = 1'294,968 Kg.

Cargas permanentes de primer piso serán:

Cp = 1'399,342 - 1'294,968 = 104,374 Kg.

Cp = 104,374 Kg.

Las sobrecargas son las encontradas en el metrado general para cada piso.

Peso de columnas.

Piso 11 ó nivel azotea.

Pp. = 0.60 x 0.30 x 2.7/2x2,400 x 16..	=	9,350 Kg.
+0.30 x 0.80 x 2.7/2 x 2,400 x 8.	=	6,230
		15,580

Niveles: 2ª,3ª,4ª,5ª6ª,7ª,8ª,9ª y 10ª

Pp. = 0.60 x 0.30 x 2.7/2 x 2,400 x 16.	=	18,700 Kg.
+0.30 x 0.80 x 2.7 x 2,400 x 8.	=	12,460 Kg
		31,160 Kg.

Primer piso

Pp. = 0.30 x 0.60(2.7/2+3.6/2)x2,400x16 =		
+0.30x0.80 x(2.7/2 +3.6/2)x2,400x8 =		
= 0.30x0.60 x(1.35 + 1.80) x 2,400 x 16	=	21,800
+0.30 x 0.80 x 3.15 x 2,400 x 16	=	29,000
		50,000

Peso de las placas por niveles.

Placas centrales.

Piso 11 ó nivel azotea.

Carga de la Escalera:	=	2,830
pp. de la placa = 0.30x2.80x2.7/2x2,400	=	2,720
		5,550 Kg.
Sobrecargas.		2,340 Kg.

Niveles: 3°= 4°=5°= 6°= 7°= 8°= 9°= 10°=11°

1.- Cargas muertas.

Peso de la escalera: 2 x 2,830	= 5,660
Pp. de la placa:0.30x2.8x2.7x2,400	= 5,440
	11,100 Kg.

2.- Sobrecargas: 2 x 2,340 Kg.

Primer piso

1.- Cargas muertas.

Peso de la escalera : 2 x 2,830	= 5,660 Kg.
Peso de la placa:0.30x2.8x3.15x2,400	= 6,350 kg.
	12,010 Kg.
2.- Sobrecarga: 2 x 2,340 Kg.	4,680 kg.

Metrado de la placa exterior por niveles.

Piso 11ª

Nivel Azotea:

1.- Cargas permanentes:

pp. = 0.30 x 3.45 x 2.7/2 x 2,400	= 3,350
+ 2 x 0.30 x 0.60 x 2.7/2 x 2,400	= 1,165
	4,515 Kg.

2.- s/c no hay

Niveles: 2ª,3ª,4ª,5ª,6ª,7ª,8ª,9ª y 10ª

1.- Cargas permanentes:

Pp. = 0.30 x 3.45 x 2.7 x 2,400	= 6,700
+ 2 x 0.30 x 0.65 x 2.7 x 2,400	= 2,330
TOTAL	9,030 Kg

s/c no hay

Primer nivel

1.- Cargas permanentes.

Pp:0.30 x 3.45 x 3.15 x 2,400	= 7,820
+2 x 0.30 x 0.60 x 3.15 x 2,400	= 2,730
TOTAL	10,540

2.- S/c no hay

Metrado de la caja de ascensor por niveles.

Nivel Azotea.

1.- Cargas permanentes.

pp = 14.1 x 0.20 x 2.7/2 x 2,400 = 9,140

+2 x 0.30 x 0.60 x 2.7/2 x 2,400 = 1,165

TOTAL = 10,305

2.- s/c no hay

Niveles 3ª,4ª,5ª,6ª,7ª,8ª,9ª y 10ª -11ª

1.- Cargas permanentes:

Pp = 14.10 x 0.20 x 2.7 x 2,400 = 18,240

+ 2 x 0.30 x 0.65 x 2.7 x 2,400 = 2,330

TOTAL = 20,570

2.- s/ cargas : no hay

Primer nivel.

1.- Cargas Permanentes

Pp = 14.10 x 0.20 x3.15 x 2,400 = 21,300

+2 x 0.30 x 0.60 x 3.15 x 2,400 = 2,720

TOTAL = 24,020

2.- Sobrecargas : no hay

SUMATORIA DE CARGAS POR NIVELES.

Piso 11 ó nivel azotea.

1.- Cargas permanentes.

Cp = 2x105,582+15,580+2x5,550+4,515+10,305

Cp = 211,164+15,580+11,100+4,515+10,305=252,500

Cp = 252,500 Kg.

2.- Sobrecargas.

s/c = 2x16.402+2x2,340

s/c = 32,804 + 4,680 = 37,484

s/c = 37,484 Kg.

w_{11} = 252,500 + 0.25 x 37,484

W = 252,500 + 9,371 = 261,871

W = 261,871 Kg.

Pisos 2º,4º,6º,8º y 10º

1.- Cargas Permanentes.

Cp = 2x132,154+31,160+2x11,100+29,030+20,570

Cp = 264,308 +31,160 +22,200 + 18,060 + 20,570

Cp = 352,298 Kg.

2.- Sobrecargas.

s/c = 2x45.385 + 2,4680

= 90,770 + 9,360 = 100,130

s/c = 100,130 Kg.

W = 352,298 + 0.25 x 100,130

W = 352,298 + 20.042

W = 372,340 Kg.

Pisos 3º,5º,7º y 9º

1.- Cargas Permanentes

Igual que los anteriores, es decir.

Cp = 352,298

2.- Sobrecargas.

s/c = 2 x 38,542 + 2x4,680

= 77,084 + 9,360 = 86,444

s/c = 86,444 Kg.

W = 352,298 + 0.25 x 86,444

W = 352,298 + 21,611

W = 373,909 Kg.

Primer piso

1.- Cargas Permanentes.

Cp =104x374 x2+50,800+2x12,010+10,540+24,020

Cp = 208,748+50,800+24,020+10,540+24,020

Cp = 318,128 Kg.

2.- Sobrecargas.

s/c = 2 x 38,543 + 2 x 4,680 =

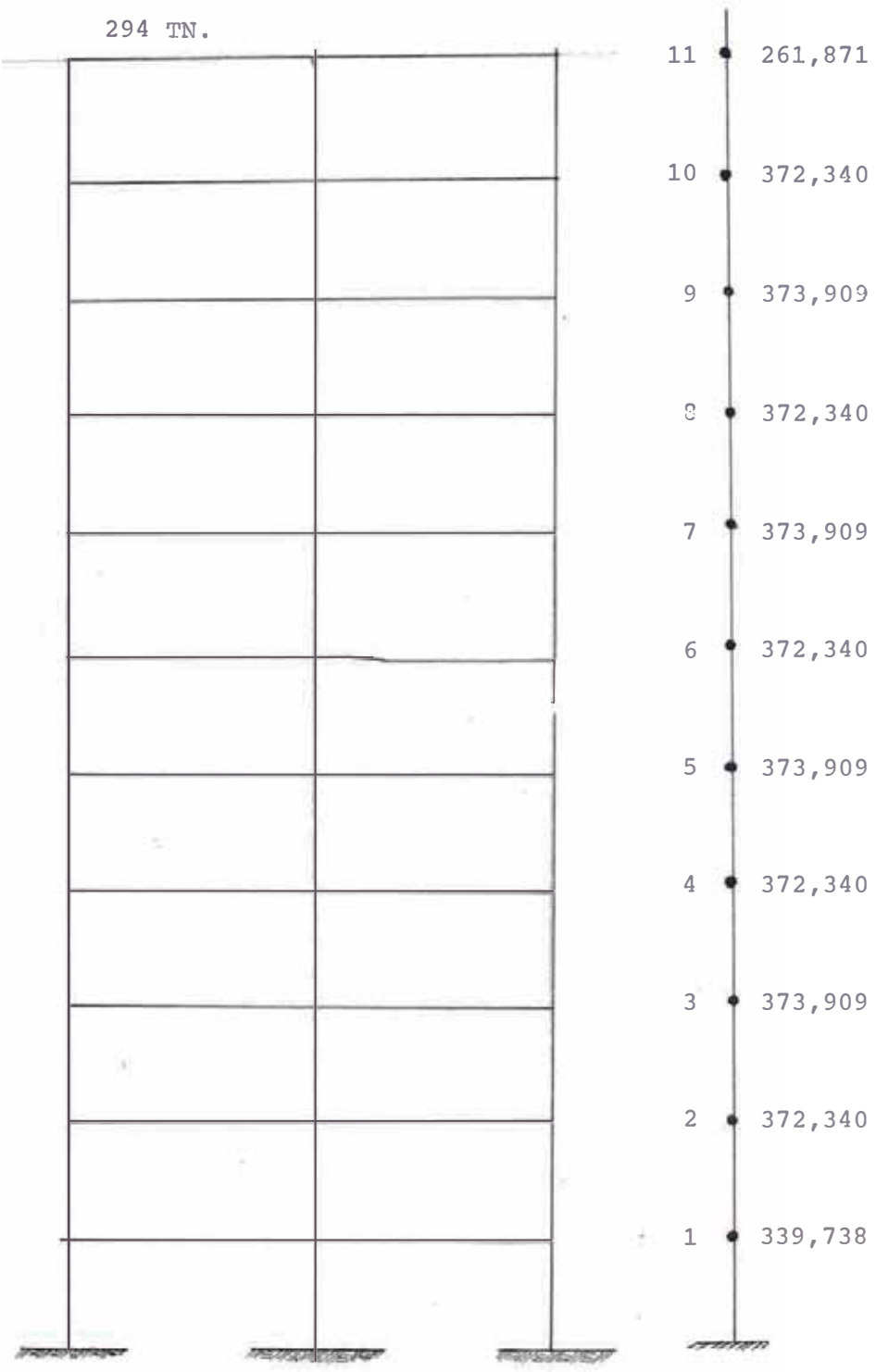
s/c = 77,086 + 9,360 = 86,446

s/c = 86,446

W = 318,128 + 0.25 x 86,446

W = 318,128 + 21,611 =

W = 339,738 Kg.



$$f_n = H \frac{W_n h_n}{\Sigma W_n h_n}$$

n	h_n	Wn(Tn)	Wnh_n	H_x	H_y	$f_n(x)$Tn	$f_n(y)$Tn	Vn(x)Tn	$V_n(y)$Tn.
11	30.60	261.87	8013.22	179	358	21.54	31.04	21.54	31.04
10	27.90	372.34	10388.28	179	258	27.92	40.25	49.46	71.29
9	25.20	373.91	9422.53	179	258	25.32	36.50	74.78	107.79
8	22.50	372.34	8377.65	179	258	22.52	32.45	97.38	140.24
7	19.80	373.91	7403.42	179	258	19.90	28.68	117.2	168.92
6	17.10	372.34	6317.01	179	258	16.98	24.47	134.18	193.39
5	14.40	373.91	5384.30	179	258	14.47	20.85	148.65	214.24
4	11.70	372.34	4356.38	179	258	11.70	16.87	160.35	231.11
3	9.00	373.91	3365.19	179	258	9.04	13.03	169.39	244.14
2	6.30	372.34	2345.74	179	258	6.30	9.08	175.69	253.22
1	3.60	339.74	1223.05	179	258	3.28	4.73	178.97	257.95

Σ = 66,596.78

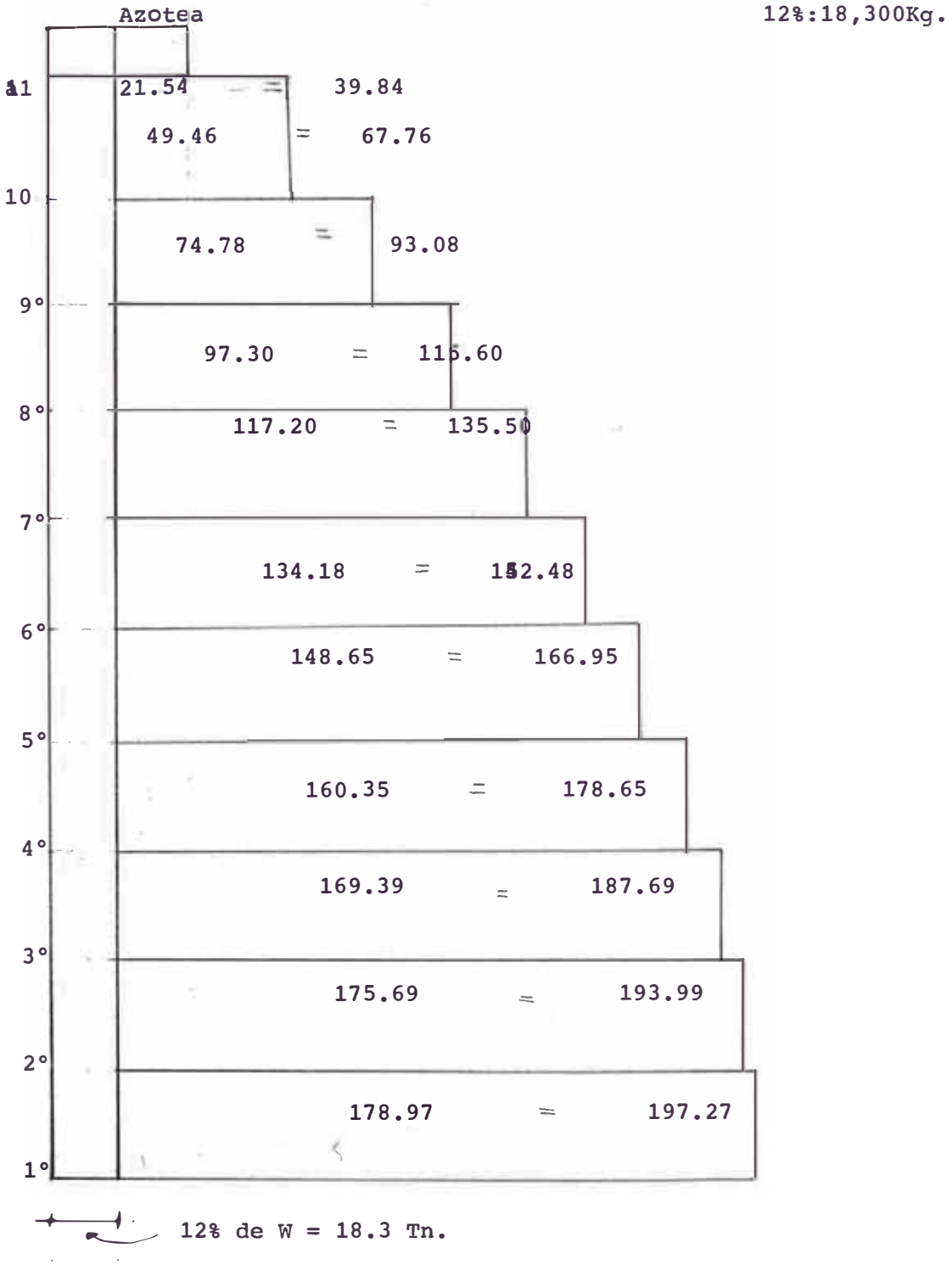
Es necesario hacer recordar que en cada nivel se tendrá que aumentar el 12% de las cargas de tanque y caja de máquinas.

CORTANTE EN CADA NIVEL

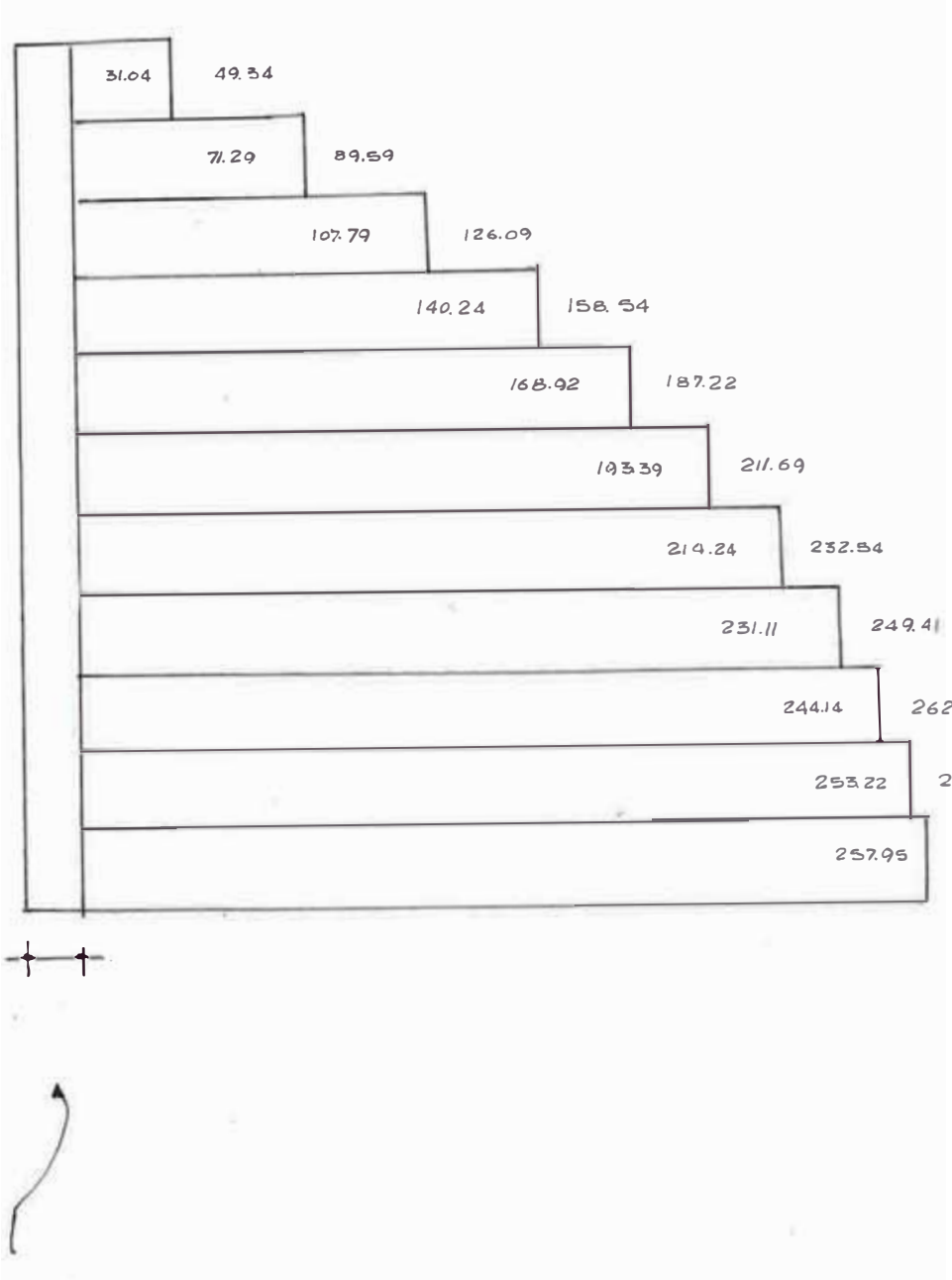
SENTIDO EL EJE "X" (Ver dibujo)

CORTANTE EN CADA NIVEL

SENTIDO DEL EJE "X"



SENTIDO DEL EJE "Y"



12% de W = 18.3 Tn.

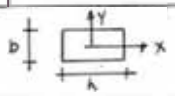
CALCULO DE LAS RIGIDECES DE VIGAS Y COLUMNAS

1.- VIGAS

$K = I/L =$ $I = 1/12\ bh^3$ (Sección rectangular)

Pórtico	Nivel	b x t	I cm^4	Lcm.	K
Pórticos	Azotea	25x35	89,400	510	175
principa	Resto de				
les	niveles	25x40	133,000	510	262
Arriostre	Todos los				
A = C	niveles	20x40	106,800	375	284
Arriostre	Azotea	40x20	26,600	375	71
"B"	resto de				
	niveles	70x40	46,700	375	125

2.- COLUMNAS



Nivel	Columna	b x t	$I_y cm^4$	$I_x cm^4$	h(cm)	K_y	K_x
1ª	Exterior	30x60	540,000	135,000	360	1500	375
	Interior	30x80	1280,000	180,000	360	2560	500
Resto de	Exterior	30x60	540,000	135,000	270	2700	500
niveles	Interior	30x80	1280,000	180,000	270	4570	667

CALCULO DE LOS VALORES "D" EN COLUMNAS

Fórmula:

$$D = a\,K_c \left(\frac{12\,EK_o}{h^2} \right)$$

Donde:

$\left(\frac{12EK_o}{h^2}\right)$ unidad común.

Luego:

$D = aK_c$ donde K_c = K de la columna.

a = constante que depende de $\bar{K}$

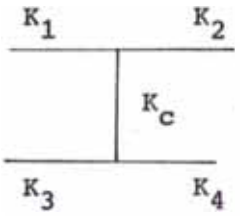
K = I/h = coeficiente de rigidez absoluta.

$K/K_o = K_c$ = Coeficiente de rigidez relativa.

Determinación del valor "a"

C_{as}

Caso 1.- Caso general.



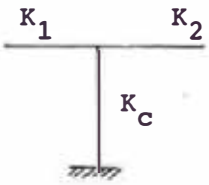
$$\bar{K} = \frac{\Sigma K_v}{2K_c}$$

$$\bar{K} = \frac{K_1 + K_2 + K_3 + K_4}{2K_c}$$

Para columna exterior será: $\bar{K} = \frac{K_2 + K_4}{2K_c}$

$$a = \frac{\bar{K}}{2+\bar{K}}$$

Caso 2.- Un extremo empotrado.



$$\bar{K} = \frac{K_1 + K_2}{F_c}$$

$$a = \frac{0.5 + \bar{K}}{F_c}$$

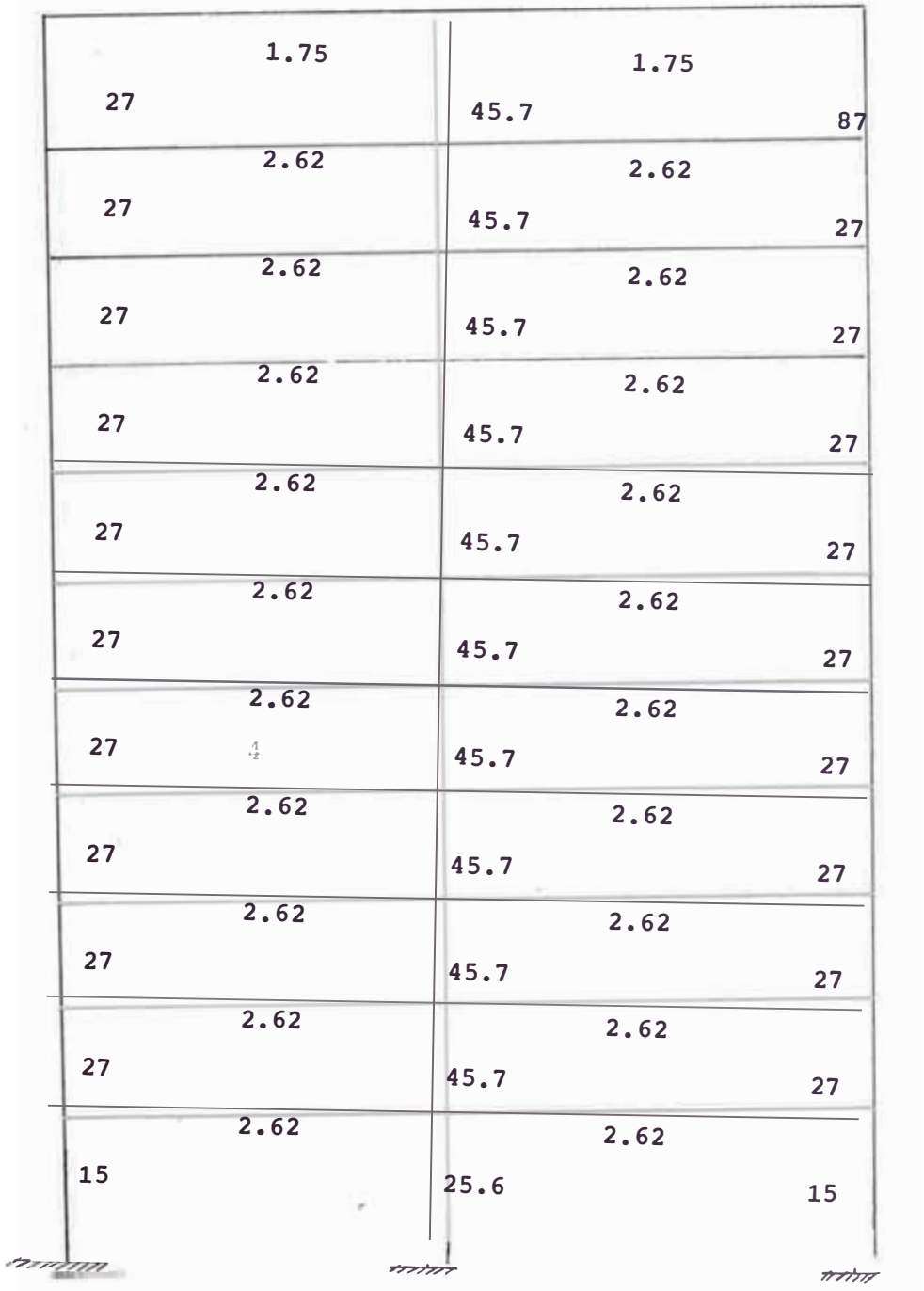
Para: $K = \alpha$ $\quad a = 1$

$K = 0$ $\quad a = 0.25$

Valores de "D" en el eje "X"

Los pórticos a,2,3,4,7,8,9, y 10 tienen características geométricas iguales, consecuentemente los mismos valores de "D"

PORTICO CON LOS VALORES K RELATIVOS EN EL SENTIDO EN EL SENTIDO DEL EJE X



VALORES DE "D" EN EL SENTIDO DEL EJE X

PORTICOS PRINCIPALES (TODOS IGUALES GEOMETRICAMENTE)

Piso	Columna	K_1	K_2	K_3	K_4	K_c	ΣK_v	$2K_c$	$\bar{K}$	$2+\bar{K}$	a	D
11	Exterior	---	1.75	---	2.62	2.7	4.37	5.4	0.081	2.081	0.038	1.02
	Interior	1.75	1.75	2.62	2.62	45.7	8.74	91.4	0.095	2.095	0.045	2.06
10	Exterior	---	2.62	---	2.62	2.7	5.24	5.4	0.097	2.07	0.046	1.24
	Interior	2.62	2.62	2.62	2.62	45.7	10.48	91.4	0.115	2.115	0.054	2.47
9°	Exterior	---	2.62	---	2.62	2.7	5.24	5.4	0.097	2.097	0.046	1.24
	Interior	2.62	2.62	2.62	2.62	45.7	10.48	91.4	0.115	2.115	0.054	2.47
8°	Exterior	---	2.62	---	2.62	2.7	5.24	5.4	0.097	2.097	0.046	1.24
	Interior	2.62	2.62	2.62	2.62	45.7	10.48	91.4	0.115	2.115	0.054	2.47
7°	Exterior	---	2.62	---	2.62	2.7	5.24	5.4	0.097	2.097	0.046	1.24
	Interior	2.62	2.62	2.62	2.62	45.7	10.48	91.4	0.115	2.115	0.054	2.47
6°	Exterior	---	2.62	---	2.62	2.7	5.24	5.4	0.097	2.097	0.046	1.24
	Interior	2.62	2.62	2.62	2.62	45.7	10.48	91.4	0.115	2.115	0.054	2.47
5°	Exterior	---	2.62	---	2.62	2.7	5.24	5.4	0.097	2.097	0.046	1.24
	Interior	2.62	2.62	2.62	2.62	45.7	10.48	91.4	0.115	2.115	0.054	2.47
4°	Exterior	---	2.62	---	2.62	2.7	5.24	5.4	0.097	2.097	0.046	1.24
	Interior	2.62	2.62	2.62	2.62	45.7	10.48	91.4	0.115	2.115	0.054	2.47
3°	Exterior	---	2.62	---	2.62	2.7	5.24	5.4	0.097	2.097	0.046	1.24
	Interior	2.62	2.62	2.62	2.62	45.7	10.48	91.4	0.115	2.115	0.054	2.47
2ª	Exterior	---	2.62	---	2.62	2.7	5.24	5.4	0.097	2.097	0.046	1.24
	Interior	2.62	2.62	2.62	2.62	45.7	10.48	91.4	0.115	2.115	0.054	2.47
1ª	Exterior	---	2.62	---	---	1.5	2.62	15.	0.175	2.175	0.310	4.66
	Interior	2.62	2.62	---	---	25.6	5.24	25.6	0.204	2.204	0.314	8.15

Primer piso: Exterior : $0.5 + \bar{K} = 0.675$

Interior : $0.5 + \bar{K} = 0.704$

NOTA: Es necesario hacer incapie en que por razones de tabulación se ha colocado $2K_c$, en el cálculo de $\bar{K}$ pero que éste término, no rige para el primer piso, que como se desprende de la fórmula,el denominador para columna con un extremo empotrado,es sólo K_c, pués así se ha considerado.
Por la misma razón en el cálculo de "O" se ha generalizado $\bar{K}$,pero para encontrar se le ha sumado 0.5 aplicándo la fórmula: $a = \frac{0.5+\bar{K}}{2+\bar{K}}$

PORTICO PRINCIPAL CON LOS VALORES "D"

1.02	2.06	1.02	4.10x8 = 32.80
1.24	2.47	1.24	4.95x8 = 39.6
1.24	2.47	1.24	4.95x8 = 39.6
1.24	2.47	1.24	4.95x8 = 39.6
1.24	2.47	1.24	4.95x8 = 39.6
1.24	2.47	1.24	4.95x8 = 39.6
1.24	2.47	1.24	4.95x8 = 39.6
1.24	2.47	1.24	4.95x8 = 39.6
1.24	2.47	1.24	4.95x8 = 39.6
1.24	2.47	1.24	4.95x8 = 39.6
4.66	8.05	4.66	17.37x8 = 138.96

VALORES DE "D" EN EL SENTIDO DEL EJE "Y"

PORTICO DE ARRIOSTRE "A" (Igual a pórtico "C")

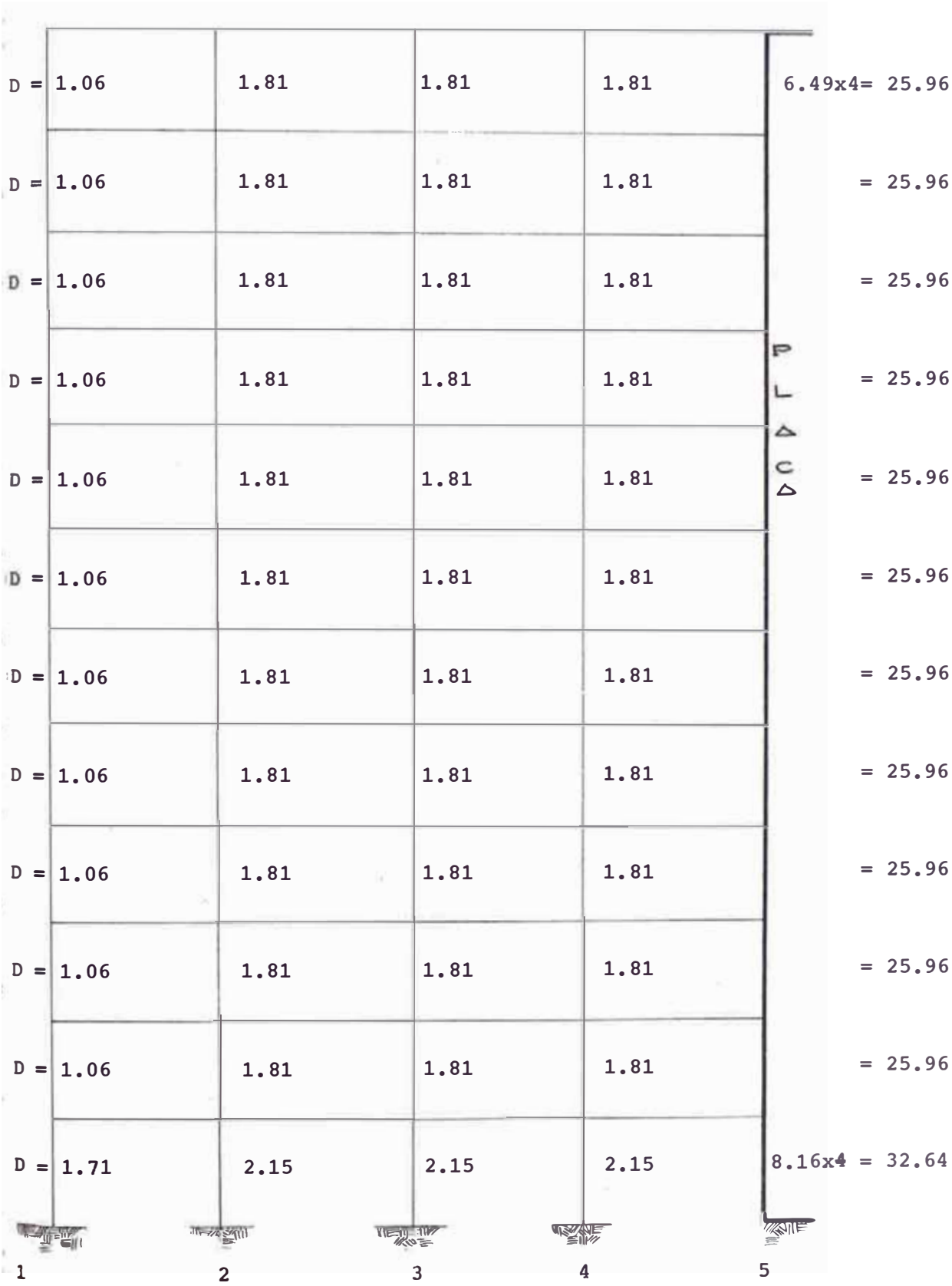
Columna	K_1	K_2	K_3	K_4	K_c	ΣK_v	$2K_c$	$\bar{K}$	$2+\bar{K}$	"a"	"D"
Exterior	---	2.84	---	2.84	5.00	5.68	10.00	0.568	2.568	0.212	1.06
Interior	2.84	2.84	2.84	2.84	5.00	11.36	10.00	1.136	3.136	0.362	1.81
Exterior	---	2.84	---	2.84	5.00	5.68	10.00	0.568	2.568	0.212	1.06
Interior	2.84	2.84	2.84	2.84	5.00	11.36	10.00	1.136	3.136	0.362	1.81
Exterior	---	2.84	---	2.84	5.00	5.68	10.00	0.568	2.568	0.212	1.06
Interior	2.84	2.84	2.84	2.84	5.00	11.36	10.00	1.136	3.136	0.362	1.81
Exterior	---	2.84	---	2.84	5.00	5.68	10.00	0.568	2.568	0.212	1.06
Interior	2.84	2.84	2.84	2.84	5.00	11.36	10.00	1.136	3.136	0.362	1.81
Exterior	---	2.84	---	2.84	5.00	5.68	10.00	0.568	2.568	0.212	1.06
Interior	2.84	2.84	2.84	2.84	5.00	11.36	10.00	1.136	3.136	0.362	1.81
Exterior	---	2.84	---	2.84	5.00	5.68	10.00	0.568	2.568	0.212	1.06
Interior	2.84	2.84	2.84	2.84	5.00	11.36	10.00	1.136	3.136	0.362	1.81
Exterior	---	2.84	---	2.84	5.00	5.68	10.00	0.568	2.568	0.212	1.06
Interior	2.84	2.84	2.84	2.84	5.00	11.36	10.00	1.136	3.136	0.362	1.81
Exterior	---	2.84	---	2.84	5.00	5.68	10.00	0.568	2.568	0.212	1.06
Interior	2.84	2.84	2.84	2.84	5.00	11.36	10.00	1.136	3.136	0.362	1.81
Exterior	---	2.84	---	2.84	5.00	5.68	10.00	0.568	2.568	0.212	1.06
Interior	2.84	2.84	2.84	2.84	5.00	11.36	10.00	1.136	3.136	0.362	1.81
Exterior	---	2.84	---	2.84	5.00	5.68	10.00	0.568	2.568	0.212	1.02
Interior	2.84	2.84	2.84	2.84	5.00	11.36	10.00	1.136	3.136	0.362	1.81
Exterior	---	2.84	---	---	3.75	2.84	3.75	0.758	2.758	0.457	1.71
Interior	2.84	2.84	---	---	3.75	5.68	3.75	1.516	3.516	0.573	2.15

Primer Piso: Exteriores: 0.5 + K = 0.5 + 0.758 = 1.258

Interiores: 0.5 + K = 0.5 + 1.516 = 2.016

PORTICO DE ARRIOSTRE "A" CON LOS VALORES "D"

EN SUS COLUMNAS (Igual pórtico "C")



VALORES DE K EN EL SENTIDO DEL EJE "Y"

PORTICO DE ARRIOSTRE B

K=0.71 K = 6.67	0.71 K=6.67	0.71 6.67	0.71 6.67	
K=1.25 K=6.67	1.25 6.67	1.25 6.67	1.25 6.67	
K=1.25 K=6.67	1.25 6.67	1.25 6.67	1.25 6.67	
K=1.25 K=6.67	1.25 6.67	1.25 6.67	1.25 6.67	
K=1.25 K=6.67	1.25 6.67	1.25 6.67	1.25 6.67	PLACA
K=1.25 K=6.67	1.25 6.67	1.25 6.67	1.25 6.67	
K=1.25 K=6.67	1.25 6.67	1.25 6.67	1.25 6.67	
K=1.25 K=6.67	1.25 6.67	1. 1.25 6.67	1.25 6.67	
K=1.25 K=6.67	1.25 6.67	1.25 6.67	1.25 6.67	
K=1.25 K=6.67	1.25 6.67	1.25 6.67	1.25 6.67	
K=1.25 K=5.00	1.25 5.00	1.25 5.00	1.25 5.00	

VALORES "D" EN EL SENTIDO DEL EJE "Y"

PORTICO DE ARRIOSTRE "B"

COLUMNA	K_1	K_2	K_3	K_4	K_c	ΣK_v	$2K_c$	$\bar{K}$	$2+\bar{K}$	"a"	"D"
Exterior	---	0.71	---	1.25	6.67	1.96	13.34	0.147	2.147	0.0685	0.456
Interior	0.71	0.71	1.25	1.25	6.67	3.92	13.34	0.294	2.294	0.128	0.856
Exterior	---	1.25	---	1.25	6.67	2.50	13.34	0.187	2.187	0.0856	0.570
Interior	1.25	1.25	1.25	1.25	6.67	5.00	13.34	0.374	2.374	0.158	1.050
Exterior	---	1.25	---	1.25	6.67	2.50	13.34	0.187	2.187	0.0856	0.570
Interior	1.25	1.25	1.25	1.25	6.67	5.00	13.34	0.374	2.374	0.158	1.050
Exterior	---	1.25	---	1.25	6.67	2.50	13.34	0.187	2.187	0.0857	0.570
Interior	1.25	1.25	1.25	1.25	6.67	5.00	13.34	0.374	2.374	0.158	1.050
Exterior	---	1.25	---	1.25	6.67	2.50	13.34	0.187	2.187	0.0857	0.570
Interior	1.25	1.25	1.25	1.25	6.67	5.00	13.34	0.374	2.374	0.158	1.050
Exterior	---	1.25	---	1.25	6.67	2.50	13.34	0.187	2.187	0.0857	0.570
Interior	1.25	1.25	1.25	1.25	6.67	5.00	13.34	0.374	2.374	0.158	1.050
Exterior	---	1.25	---	1.25	6.67	2.50	13.34	0.187	2.187	0.0857	0.570
Interior	1.25	1.25	1.25	1.25	6.67	5.00	13.34	0.374	2.374	0.158	1.050
Exterior	---	1.25	---	1.25	6.67	2.50	13.34	0.187	2.187	0.0857	0.57
Interior	1.25	1.25	1.25	1.25	6.67	5.00	13.34	0.374	2.374	0.158	1.050
Exterior	---	1.25	---	1.25	6.67	2.50	13.34	0.187	2.187	0.0857	0.57
Interior	1.25	1.25	1.25	1.25	6.67	5.00	13.34	0.374	2.374	0.158	1.05
Exterior	---	1.25	---	1.25	6.67	2.50	13.34	0.187	2.187	0.0857	0.57
Interior	1.25	1.25	1.25	1.25	6.67	5.00	13.34	0.374	2.374	0.158	1.05
							K_c				
Exterior	---	1.25	---	---	5.00	1.25	5.00	0.25	2.25	0.332	1.66
Interior	1.25	1.25	---	---	5.00	2.50	5.00	0.50	2.50	0.40	2.00

Primer piso: Exterior: $0.5 + \bar{K} = 0.5 + 0.25 = 0.75$

Interior: $0.5 + \bar{K} = 0.5 + 0.5 = 1.00$

VALORES "D" EN EL SENTIDO DEL EJE "Y"

PORTICO DE ARRIOSTRE "B"

				ΣD_P ΣD_T
D = 0.456	0.856	0.856	0.856	3.023x2=6.048
D = 0.57	1.05	1.05	1.05	3.72x2=7.44
D = 0.570	1.05	1.05	1.05	=7.44
D = 0.570	1.05	1.05	1.05	=7.44
D = 0.57	1.05	1.05	1.05	=7.44
D = 0.57	1.05	1.05	1.05	=7.44
D = 0.57	1.05	1.05	1.05	=7.44
D = 0.57	1.05	1.05	1.05	=7.44
D = 0.57	1.05	1.05	1.05	=7.44
D = 0.57	1.05	1.05	1.05	=7.44
D = 1.66	2.00	2.00	2.00	7.66x2=15.32

PLACA

1) (2) (3) (4)

CALCULO DEL VALOR "D" DE LAS PLACAS CONSIDERADAS LIBRES Y EL CORTANTE QUE TOMAN

Fórmula:

$$D_{wn} = \frac{V_n}{\delta_{wn}}$$

Donde:

V_n = Cortante que toma la placa

δ_{wn} = Deflexión total

Fórmula de la deformación total.

$$\delta_{wn} = \delta_{sn} + \delta_{Bn} + \delta_{Rn}$$

Donde:

1.- δ_{sn} = Deformación por corte: $\delta_{sn} = A_{sn} \times \beta \frac{27.6}{h_n} K_o$

$$A_{sn} = \frac{KV_n}{A_{wn}} \quad , \quad B = 1 \quad \text{Deformación elástica.}$$

K = Coeficiente del ángulo cortante = 1.2

A_{wn} = Area de la sección de la placa en el piso considerado:"n"

h_n = Altura del piso

V_n = Cortante que toma la placa.

2.- Deformación por flexión = δ_{Bn}

$$\delta_{Bn} = 4\Delta\beta n \frac{3}{h_n}$$

Donde:

$$\Delta\beta n = \sum_{i=1}^{i=n-1} \frac{M_i}{Kwi} + \frac{1}{2} \frac{M_n}{Kwn}$$

$$Ki = I_i/h_i = 1/K_o$$

Nota: En el cálculo de la deformación por flexión, no entra el factor de deformación plástico: B por que generalmente en los pisos superiores el corte V_n,Va ha ser pequeño, de manera que cuando se calcula el esfuerzo $f = V/A\ K < f$ Admisible.

Obtención de "D"

Procedimiento.

1.- Para encontrar D, es necesario tener el valor del corte que toma la placa, pero como este no lo tenemos:asumimos una distribución de corte.

2.- Se calcula las deformaciones δ_B δ_S δ_R

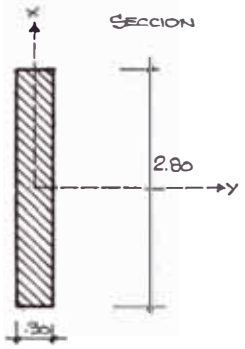
3.- Se obtiene $\delta_{wn} = \delta_{sn} + \delta_{Bn} + \delta_{Rn}$.

4.- Se calcula el valor "D" en cada nivel.

5.- Con el valor "D" se encuentra la distribución de corte, si esta coincide con la distribución asumida, el valor "D" será el verdadero, de lo contrario se hara otro tanteo, con la distribución de corte hallada, y se continua con el paso 2.

Valor "D" para las placas que siguen el sentido del eje X:Placa 1

Placas donde se empotra la escalera: Nº 2.



Primer piso h = 3.60

Resto de piso h = 2.70

I_y = 1/12x289 =5'486,000cm^4

I = 54'800,000 cm^4

VALORDE K ABSOLUTO Y RELATIVO

1.- K Absoluto primer piso

$$K = \frac{I}{h} = \frac{54'800,000}{360} = 152,000 \text{ cm}^3$$

Resto de Piso

$$K = \frac{I}{h} = \frac{54'800,000}{270} = 203,000 \text{ cm}^3$$

2.- K relativo;

$$\text{Primer piso} = \frac{152{,}000}{100} = 1{,}520 \text{ cm}^3 \qquad K = 1{,}520 \text{ cm}^3$$

$$\text{Resto de pisos} = \frac{203{,}000}{100} = 2030 \qquad K = 2{,}030 \text{ cm}^3$$

$$A_{wn} = 280 \times 30 = 8{,}400 \text{ cm}^2$$

$$A_{wn} = 8.4 \times 10^3$$

DEFORMACIÓN POR FLEXION δ_{Bn} (Primer tanteo)

n	V_n Asumido	h_n	$V_n h_n$	M'_n	$2M_n$	K_{wn}	$\frac{2Mn}{Kwn}$	4ABn	3/hn	δ_{Bn}
11	3	270	8.1×10^2	8.1×10^2	8.1×10^2	2030	0.40	542.08	3/270=1/90	6.02
10	8	270	21.6×10^2	29.7×10^2	37.8×10^2	2030	1.86	539.82	1/90	5.99
9	12	270	32.4×10^2	62.1×10^2	91.8×10^2	2030	4.52	533.44	1/90	5.93
8	16	270	43.2×10^2	105.3×10^2	167.4×10^2	2030	8.24	520.68	1/90	5.78
7	20	270	54.0×10^2	159.3×10^2	264.6×10^2	2030	13.03	499.41	1/90	5.55
6	23	270	62.1×10^2	221.4×10^2	380.7×10^2	2030	18.75	467.63	1/90	5.20
5	26	270	70.2×10^2	291.6×10^2	513.0×10^2	2030	25.27	423.61	1/90	4.70
4	28	270	75.6×10^2	367.2×10^2	658.8×10^2	2030	32.45	365.89	1/90	4.06
3	30	270	81.0×10^2	448.2×10^2	815.4×10^2	2030	40.16	293.28	1/90	3.26
2	32	270	86.4×10^2	534.6×10^2	982.8×10^2	2030	48.41	204.71	1/90	2.27
1	33	360	118.8×10^2	653.4×10^2	1180.0×10^2	1520	78.15	78.15	3/360=1/120	0.65

DEFORMACION POR CORTE

$$\delta_{sn} = \frac{27.6\ K_o\ \beta}{h_n} \times A_{sn} \qquad B = 1$$

Donde:

$$A_{sn} = \frac{K\ V_n}{A_{wn}}$$

Siendo:

$A_{wn} = 8.4 \times 10^3$ cm^2 (área de la placa)

K = 1.2 = (Factor de forma para sec. rectangulares)

$$\gamma_{11} = \frac{1.2 \times 3}{8.4 \times 10^{3}} = 0.43 \times 10^{-3} \qquad \delta_{sn} = \frac{27.6 \times 10^{2}}{2.7 \times 10^{2}} \times 0.43 \times 10^{-3} = 0.43 \times 10^{-3} \times 10.2 = 43.86 \times 10^{-3}$$

$$\gamma_{10} = \frac{1.2 \times 8}{8.4 \times 10^{3}} = 1.14 \times 10^{-3} \qquad \delta_{s10} = 1.14 \times 10^{-3} \times 10.2 = 11.68 \times 10^{-3}$$

$$\gamma_{9} = \frac{1.2 \times 12}{8.4 \times 10^{3}} = 1.71 \times 10^{-3} \qquad \delta_{s9} = 1.71 \times 10^{-3} \times 10.2 = 17.44 \times 10^{-3}$$

$$\gamma_{8} = \frac{1.2 \times 16}{8.4 \times 10^{3}} = 2.28 \times 10^{-3} \qquad \delta_{s8} = 2.28 \times 10^{-3} \times 10.2 = 23.25 \times 10^{-3}$$

$$\gamma_{7} = \frac{1.2 \times 20}{8.4 \times 10^{3}} = 3.28 \times 10^{-3} \qquad \delta_{s7} = 2.85 \times 10^{-3} \times 10.2 = 29,07 \times 10^{-3}$$

$$\gamma_{6} = \frac{1.2 \times 23}{8.4 \times 10^{3}} = 3.28 \times 10^{-3} \qquad \delta_{s6} = 3.28 \times 10^{-3} \times 10.2 = 33.46 \times 10^{-3}$$

$$\gamma_{5} = \frac{1.2 \times 26}{8.4 \times 10^{3}} = 3.71 \times 10^{-3} \qquad \delta_{s5} = 3.71 \times 10^{-3} \times 10.2 = 37,84 \times 10^{-3}$$

$$\gamma_{4} = \frac{1.2 \times 28}{8.4 \times 10^{3}} = 4.00 \times 10^{-3} \qquad \delta_{s4} = 4.00 \times 10^{-3} \times 10.2 = 40.80 \times 10^{-3}$$

$$\gamma_{s3} = \frac{1.2 \times 30}{8.4 \times 10^{3}} = 4.28 \times 10^{-3} \qquad \delta_{s3} = 4.28 \times 10^{-3} \times 10.2 = 43.65 \times 10^{-3}$$

$$\gamma_{s2} = \frac{1.2 \times 32}{8.4 \times 10^{3}} = 4.57 \times 10^{-3} \qquad \delta_{s2} = 4.57 \times 10^{-3} \times 10.2 = 46.61 \times 10^{-3}$$

$$\gamma_{s1} = \frac{1.2 \times 32}{8.4 \times 10^{3}} = 4.71 \times 10^{-3} \qquad \delta_{s1} = 4.71 \times 10^{-3} \times \frac{27.6 \times 10^{2}}{3.6 \times 10^{-3}} = 4.71 \times 10^{-3} \times 7.66 = 36.2 \times 10^{-3}$$

eformación por rotación lo consideramos cero, por suponer el terreno e buena calidad.

$$\delta_{Rn} = 0$$

VALOR D $\qquad D_n = \frac{V_n}{\delta_{Tn}}$

n	V_n	δ_{Bn}	δ_{Sn}	δ_t	D_{w1n}
11	3	6.02	0.04386	6.0638	0.495
10	8	5.99	0.01162	6.0016	1.332
9	12	5.93	0.01744	5.9474	2.017
8	16	5.78	0.02325	5.8032	2.757
7	20	5.55	0.02907	5.5790	3.584
6	23	5.20	0.03346	5.2334	4.394
5	26	4.70	0.03784	4.7378	5.487
4	28	4.06	0.04080	4.1008	6.827
3	30	3.26	0.04365	3.3036	9.081
2	32	2.27	0.04661	2.3166	13.813
1	33	0.65	0.03620	0.6862	48.090

CALCULO DEL VALOR "D" DE LAS PLACAS DEL ASCENSOR.

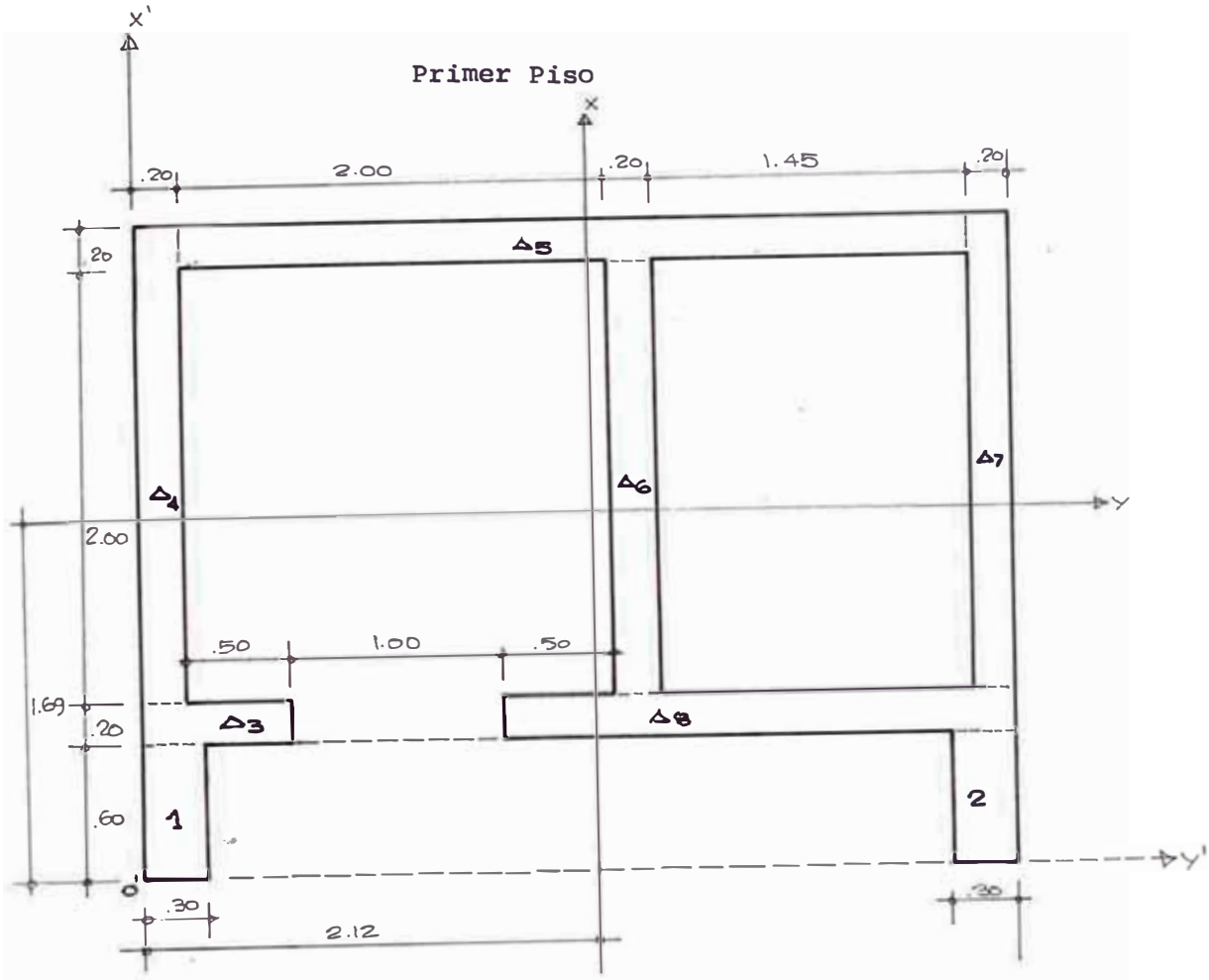
Como las placas del ascensor tienen aberturas, será necesario determinar si estas son grandes o pequeñas, para lo cual utilizamos la siguiente fórmula:

$$p = \sqrt{\frac{\text{Area de la abertura}}{\text{Area total de la pared}}}$$

Si:

$p \leq 0.4$ es una pared con aberturas pequeñas

$p > 0.4$ es una pared con aberturas pequeñas grandes.



CALCULO DEL CENTRO DE GRAVEDAD,

$$X = \frac{\Sigma\ Ap\ xP}{\Sigma\ Ap} \qquad y = \frac{\Sigma\ Ap\ x\ Yp}{\Sigma\ Ap}$$

$Ap(cm^2)$	Xp (cm)	Yp(cm)	$Ap\ xp(cm^3)$	$Ap\ Yp\ (cm^3)$
A_1 = 1,800	30	15	54,000	27,000
A_2 = 1,800	30	390	54,000	702,000
A_3 = 1,400	70	35	98,000	49,000
A_4 = 4,400	190	10	836,000	44,000
A_5 = 7,300	290	202.5	2117,000	1478,250
A_6 = 4,000	180	230	720,000	920,000
A_7 = 4,400	190	395	836,000	1738,000
A_8 = 4,700	70	287.5	329,000	1351,250
Σ =29,800			5044,000	6309,500

$$\bar{X} = \frac{5'044,000}{29,800} = 169 \text{ cm.} \qquad \bar{X} = 169 \text{ cm.}$$

$$\bar{Y} = \frac{6'309,500}{29,800} = 212 \text{ cm} \qquad \bar{Y} = 212 \text{ cm.}$$

Cálculo del momento de inercia de la sección.

$$I_y = I_{Gy} + A\bar{x}^2$$

$$I_x = I_{Gx} + A\bar{y}^2$$

Sec.	b cm.	h cm.	Area(cm^2)	$\bar{X}$	$\bar{X}^2$	$A\bar{x}^2$	$I_{Gy}=\frac{1}{12}bh^3$	$I_y=I_{Gy}+A\bar{x}^2$
1	30	60	1,800	-139	19,321	34'777,800	540,000	35'317,800
2	30	60	1,800	-139	19,321	34'777,800	540,000	35'317,800
3	70	20	1,400	- 99	9,801	13'721,400	46,667	13'768,067
4	20	200	4,400	21	441	1'940,400	17'675,680	19,616,080
5	365	20	7,300	121	14,641	106'879,300	243,280	107,122,580
6	20	200	4,000	11	121	484,000	13'280,000	13'764,000
7	20	220	4,400	21	441	1'940,400	17'675,680	19'616,080
8	235	20	4,700	-99	9,801	72'527,400	156,664	72'684,064
Σ			29,800			267'048,500	50'157,971	317'206,471

$$I_{yy} = 317'206,471 \text{ cm}^4 \text{ digamos } I_{yy} = 317.2 \times 10^6 \text{ cm}^4$$

$$K = \frac{317.2 \times 10^6}{360} = 882 \times 10^3$$

$$K_{w2} = \frac{K}{K_o} = \frac{882 \times 10^3}{10^2} = 8,820$$

$$K_{w2} = 8,820$$

Area de la sección = 29,800 cm^2

Cálculo de p

$$p = \sqrt{\frac{\text{Area de la abertura}}{\text{Area total de la pared}}}$$

Area de la abertura = 100 x 360

Area total de la pared = (2 x 405 + 2 x 300 + 2 x 60)x360 =

= (810 + 600 + 120)360 = 1,530 x 360

$$p = \sqrt{\frac{100 \times 360}{1,530 \times 360}} = \sqrt{\frac{100}{1,530}} = \sqrt{0.0654} = 0.256$$

$$p = 0.256 < 0.4$$

Luego sera pared con aberturas pequeñas tratándose de pared con aberturas pequeñas se modificara la deformación por corte δ_s: A' la que llamaremos deformación por marco en la siguiente forma.

$$\delta_f = \frac{1}{r} \delta_s$$

Donde:

$r = (1.0 - 1.25\ p)$

δ_f = deformación cpor corte considerando el hueco la deformación total será

$$\delta_{tm} = \delta_{fn} + \delta_{Bn} + \delta_{Rn}$$

(Para calcular δ_B se considera la función de la sección como una sección intermedia. entre la sección sin hueco y la sección con hueco.)

<u>El cálculo se hara para paredes sólidas o sin huecos</u>

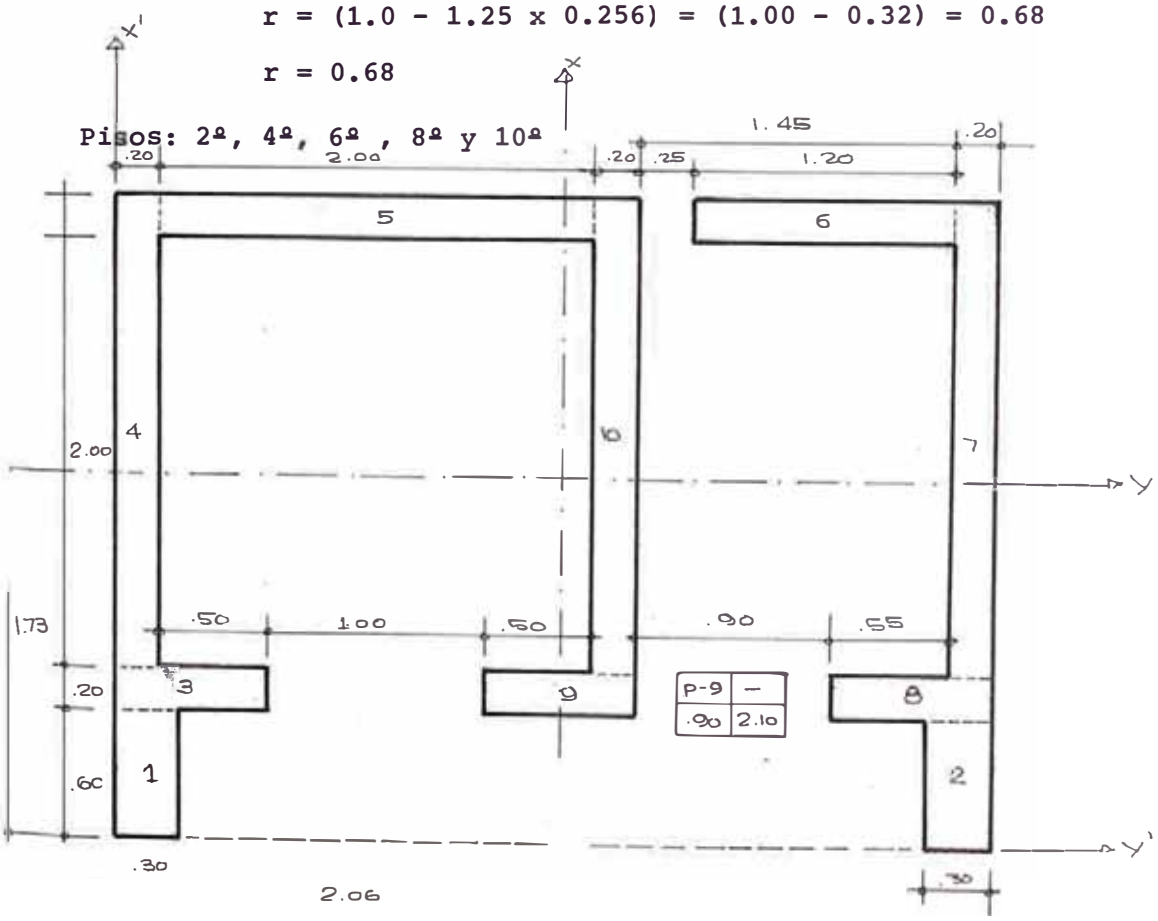
Cálculo de r:

$r = (1.0 - 1.25p)$

$r = (1.0 - 1.25 \times 0.256) = (1.00 - 0.32) = 0.68$

$r = 0.68$

Pisos: 2ª, 4ª, 6ª , 8ª y 10ª



CALCULO DEL CENTRO DE GRAVEDAD

Ap(cm^2)	Xp(cm.)	Yp(cm.)	Ap Xp(cm^3)	Ap Yp(cm^3)
A_1 = 1,800	30	15	54,000	27,000
A_2 = 1,800	30	390	54,000	702,000
A_3 = 1,400	70	35	98,000	49,000
A_4 = 4,400	190	10	836,000	44,000
A_5 = 4,000	290	120	1'160,000	480,000
A_6 = 2,400	290	325	696,000	780,000
A_7 = 4,400	190	395	836,000	1'738,000
A_8 = 1,500	70	367.5	105,000	551,250
A_9 = 1,400	70	205	98,000	287,000
A_{10}= 4,400	190	230	836,000	1'012,000
Σ = 27,500			4'773,000	5'670,250

$$\bar{X} = \frac{4'773,000}{27,500} = 173 \text{ cm.}$$

$$\bar{Y} = \frac{5'670,250}{27,500} = 206 \text{ cm.}$$

Area de la sección 27,500 cm^2

CALCULO DEL MOMENTO DE INERCIA DE LA SECCION

$I_y = I_{Gy} + A\bar{x}^2$

Sec.	b	h	Area	$\bar{X}$	$\bar{X}^2$	A X^2	$I_{Gy}=\frac{1}{12}bh^3$	$I_y=I_{Gy}+A\bar{x}^2$
1	30	60	1,800	-143	20,449	36'808,200	540,000	37'348,200
2	30	60	1,800	-143	20,449	36'808,200	540,000	37'348,200
3	70	20	1,400	-103	10,609	14'852,600	46,667	14'899,267
4	20	220	4,400	17	289	1'271,600	17'675,680	18.947,280
5	200	20	4,000	117	13,689	54.756,000	133,328	54'889,328
6	120	20	2,400	117	13,689	32.753,600	80,000	33.653,600
7	20	220	4,400	17	289	1,271,600	17'675,680	18'947,280
8	75	20	1,500	-103	10,609	15'913,500	50,000	15.963,500
9	70	20	1,400	-103	10,609	14.852,600	46,667	14'899,261
10	20	220	4,400	17	289	1'271,600	17'675,680	18'947,280
Σ			27,500					265'843,202

$I = 265'843,202\ cm^4$

Digamos:

$I = 265.8 \times 10^6\ cm^4$

$K = \frac{265.8 \times 10^6}{270} = 99 \times 10^4 \qquad K = 99 \times 10^4$

$K_{w2} = \frac{99 \times 10^4}{10^2} = 9,900$

$K_{w2} = 9,900$

Cálculo de p

p Area de la abertura = 100 x 270 + 25 x 270 + 90 x 210

= 125 x 270 + 90 x 210 = 125 x 270+90x30x70

= 125 x 270 + 70 x 270

= 195 x 270

Area total de la pared= (810 + 600 + 120) x 270 =

= 1,530 x 270

$p \sqrt{\frac{195 \times 270}{1530 \times 270}} = \sqrt{\frac{195}{1530}} = \sqrt{0.127} = 0.356$

$p = 0.358 < 0.4$

Luego sera pared con aberturas pequeñas, como en el caso anterior se hara corrección por marco.

$\delta_f = \frac{1}{r}\ \delta_s$

Cálculo de r

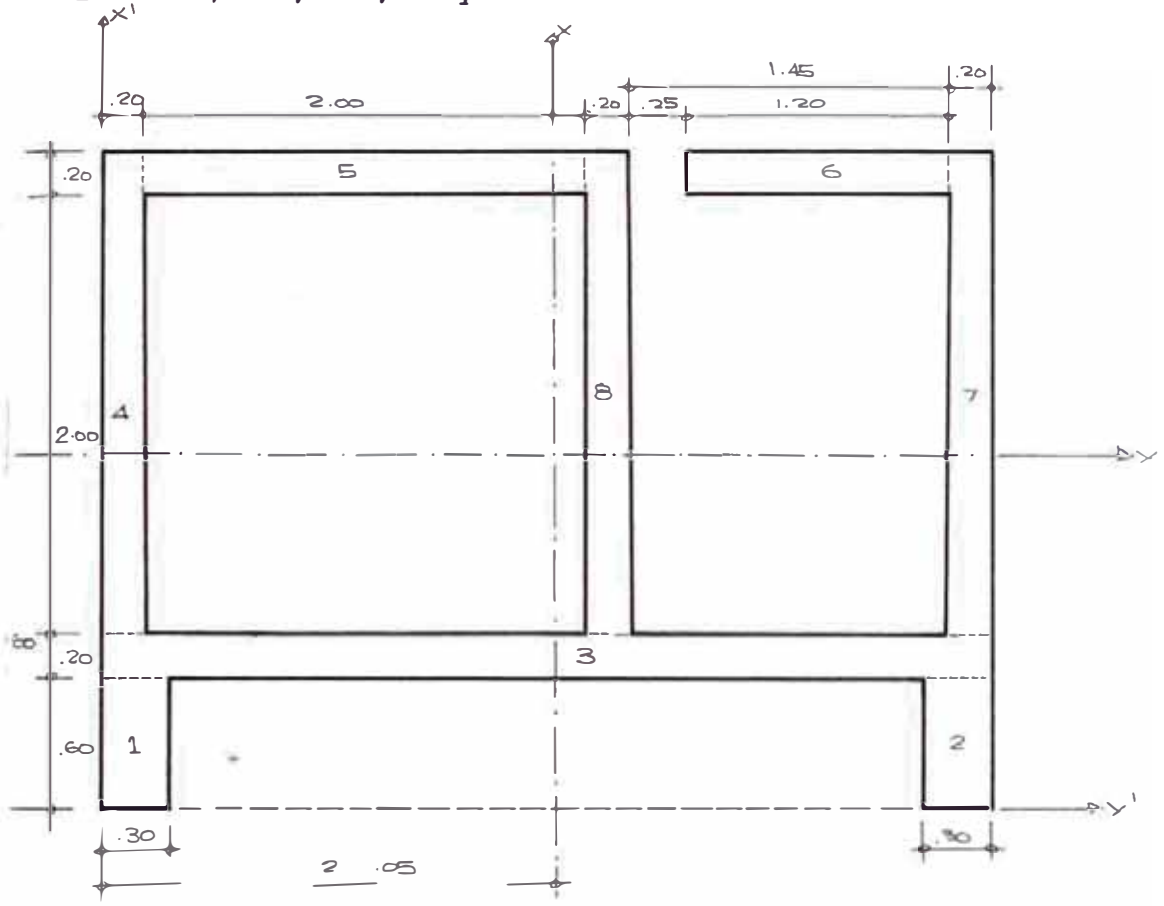
$r = (1.00 - 1.25p)$

$r = (1.00 - 1.25 \times 0.356)$

$r = 1.00 - 0.445 = 0.555$

$r = 0.555$

Pisos 3ª , 5ª , 7ª , 9ª y 11ª



CALCULO DEL CENTRO DE GRAVEDAD

$Ap(cm^2)$	Xp(cm)	Yp(cm.)	$Ap(cm^3)$	$Ap\ Yp(cm^3)$
A_1 = 1,800	30	15	54,000	27,000
A_2 = 1,800	30	390	54,000	702,000
A_3 = 8,100	70	202.5	567,000	1'640,250
A_4 = 4,400	190	10	836,000	44,000
A_5 = 4,000	290	120	1'160,000	480,000
A_6 = 2,400	290	325	696,000	780,000
A_7 = 4,400	190	395	836,000	1'738,000
A_8 = 4,400	190	230	836,000	1'012,000
Σ =31,300			5'039,000	6'423,250

$$\bar{x} = \frac{5'039,000}{31,300} = 160$$

$$\bar{y} = \frac{6'423,250}{31,300} = 205$$

Area de la sección = 31,300 cm^2

CALCULO DEL MOMENTO DE INERCIA DE LA SECCION:

$$I_y = I_{Gy} + A\bar{x}^2$$

sec.	b	h	Area	$\bar{x}$	$\bar{x}^2$	$A\bar{x}^2$	$I_{Gy} = \frac{1}{12}bh^3$	$I_{Gy}=I_{Gy}+A\bar{x}^2$
1	30	60	1,800	-130	16,900	30'420,000	540,000	30'960,000
2	30	60	1,800	-130	16,900	30'420,000	540,000	30'960,000
3	405	20	8,100	- 90	8,100	65'610.000	270,000	65'880,000
4	20	220	4,400	30	900	3'960,000	17'675,680	21.635,680
5	200	20	4,000	130	16,900	67'600,000	133,328	67'733,328
7	20	220	4,400	30	900	3'960,000	17'675,680	21'635,680
8	20	220	4,400	30	900	3'960,000	17'675,680	21'635,680
								301'080,368

$$I = 301'080,368 \text{ cm}^4$$

Digamos:

$$I = 301.1 \times 10^6 \text{ cm}^4$$

$$K = \frac{301.1 \times 10^6}{270} = 1.11 \times 10^6 \text{ cm}^3$$

$$K = 1.11 \times 10^6 \text{ cm}^3$$

$$K_{w2} = \frac{1.11 \times 10^6}{10^2} = 11,100$$

$$K_{w2} = 11,100$$

Cálculo de p

Area de la abertura = 25 x 270

Area total de la pared = 1,530 x 270

$$p = \sqrt{\frac{25 \times 270}{1530 \times 270}} \quad \sqrt{\frac{25}{1,530}} \quad \sqrt{0.0160} = 0.127$$

$$p = 0.127 < 0.4$$

Luego será pared con aberturas pequeñas.

Corrección por marco

$$\delta_f = \frac{1}{r}\ \delta_s$$

Cálculo de r:

$$r(1.00-1.25p) = 1.00 \times 1.25 \times 0.127 = 1.00 - 0.16$$

$$r = 0.84$$

DEFORMACION POR FLEXION DE LA CAJA DEL ASCENSOR δ_{Bn} (Primer tanteo)

n	Vn	hn	Vnhn $\times 10^2$	M'n $\times 10^2$	2Mn $\times 10^2$	Kwn	$\frac{2Mn}{Kwn}$	$4\Delta Bn$	3/hn	δ_{Bn}
11	6	270	16.2	16.2	16.2	11100	0.1459	154.9967	$3/270=\frac{1}{90}$	1.722
10	12	270	32.4	48.6	64.8	9900	0.6545	154.1963	1/90	1.713
9	18	270	48.0	96.6	145.2	11100	1.3081	152.2337	1/90	1.691
8	24	270	64.8	161.4	258.0	9900	2.6060	148.3196	1/90	1.647
7	29	270	78.3	239.7	401.1	11100	3.6135	142.1001	1/90	1.578
6	34	270	91.8	331.5	571.2	9900	5.7697	132.7170	1/90	1.474
5	39	270	105.3	436.8	768.3	11100	6.9216	120.0258	1/90	1.333
4	43	270	116.1	552.9	989.7	9900	9.9968	103.1074	1/90	1.145
3	47	270	126.9	679.8	1232.7	11100	11.1054	82.9052	1/90	0.9111
2	50	270	135.0	814.8	1494.6	9900	15.0969	55.7029	1/90	0.618
1	52	310	161.2	976.0	1790.8	8820	20.303	20.303	$3/360=\frac{1}{120}$	0.169

DEFORMACION POR CORTE

$$A_{sn} = \frac{K\ V_n}{A_{wn}} \qquad \delta_{sn} = \frac{27.6 \times K_o\ B}{h_n} \times A_{sn}$$

$$A_{s11} = \frac{1.2 \times 6}{31.3\times10^3} = 0.23 \times 10^{-3} \qquad \delta_{s11} = 10.2\times0.23\times10^{3} = 2.346\times10^{-3}$$

$$A_{s10} = \frac{1.2 \times 12}{27.5\times10^3} = 0.523\times10^{-3} \qquad \delta_{s10} = 10.2\times0.523\times10^{-3} = 5.3346\times10^{-3}$$

$$A_{s9} = \frac{1.2 \times 18}{31.3\times10^3} = 0.690\times10^{-3} \qquad \delta_{s9} = 10.2\times0.690\times10^{-3} = 7.038\times10^{-3}$$

$$A_{s8} = \frac{1.2 \times 28}{27.5\times10^3} = 1.047\times10^{-3} \qquad \delta_{s8} = 10.2\times1.047\times10^{-3} = 10.67\times10^{-3}$$

$$A_{s7} = \frac{1.2 \times 29}{31.3\times10^3} = 1.11\times10^{-3} \qquad \delta_{s7} = 10.2\times1.111\times10^{-3} = 11.33\times10^{-3}$$

$$A_{s6} = \frac{1.2 \times 34}{27.5\times10^{3}} = 1.483\times10^{-3} \qquad \delta_{s6} = 10.2 \times 1.483\times10^{-3} = 15.126\times10^{-3}$$

$$A_{s5} = \frac{1.2 \times 39}{31.3\times10^{3}} = 1.495\times10^{-3} \qquad \delta_{s5} = 10.2\times1.495\times10^{-3} = 15.249\times10^{-3}$$

$$A_{s4} = \frac{1.2 \times 43}{27.5\times10^{3}} = 1.876\times10^{-3} \qquad \delta_{s4} = 10.2\times1.876\times10^{-3} = 19.135\times10^{-3}$$

$$A_{s3} = \frac{1.2 \times 47}{31.3\times10^{3}} = 1.80\times10^{-3} \qquad \delta_{s3} = 10.2\times1.801\times10^{-3} = 18.370\times10^{-3}$$

$$A_{s2} = \frac{1.2 \times 50}{27.5\times10^{3}} = 2.181\times10^{-3} \qquad \delta_{s2} = 10.2\times2.181\times10^{-3} = 22.246\times10^{-3}$$

$$A_{s1} = \frac{1.2 \times 52}{29.8\times10^{3}} = 2.093\times10^{-3} \qquad \delta_{s1} = \frac{27.6\times10^{2}}{3.6\times10^{2}} = 2.093\times10^{-3} =$$

$$= 7.66\times2.93\times10^{-3} = 22.443\times10^{-3}$$

DEFORMACION POR MARCO.

$$\delta_f = \frac{1}{r}\,\delta_s$$

Primer piso .... r = 0.68

2ª,4ª,6ª,8ª y 10ª r = 0.555

3ª,5ª,7ª,9ª y 11ªpi. r = 0.84

$$\delta_{f11} = \frac{1}{0.84}\ 2.346 \times 10^{-3} = 2.79 \times 10^{-3}$$

$$\delta_{f10} = \frac{1}{0.555} \times 5.3346 \times 10^{-3} = 9.61 \times 10^{-3}$$

$$\delta_{f9} = \frac{1}{0.84} \times 7.038 \times 10^{-3} = 8.36 \times 10^{-3}$$

$$\delta_{f8} = \frac{1}{0.555} \times 10.67 \times 10^{-3} = 19.22 \times 10^{-3}$$

$$\delta_{f7} = \frac{1}{0.84} \times 11.33 \times 10^{-3} = 13.50 \times 10^{-3}$$

$$\delta_{f6} = \frac{1}{0.555} \times 15.12 \times 10^{-3} = 27.20 \times 10^{-3}$$

$$\delta_{f5} = \frac{1}{0.84} \times 15.149 \times 10^{-3} = 18.05 \times 10^{-3}$$

$$\delta_{f4} = \frac{1}{0.555} \times 19.135 \times 10^{-3} = 34.30 \times 10^{-3}$$

$$\delta_{f3} = \frac{1}{0.84} \times 18{,}37 \times 10^{-3} = 21.86 \times 10^{-3}$$

$$\delta_{f2} = \frac{1}{0.555} \times 22.246 \times 10^{-3} = 40.00 \times 10^{-3}$$

$$\delta_{f1} = \frac{1}{0.680} \times 22.443 \times 10^{-3} = 33.00 \times 10^{-3}$$

VALOR "D"

$$D = \frac{V_n}{\delta_{tn}}$$

n	V_n	δ_{Bn}	δ_{fn}	δ_t	D_{w2n}
11	6	1.722	0.00379	1.7249	3.34
10	12	1.713	0.00961	1.7226	6.96
9	18	1.691	0.00836	1.6993	10.60
8	24	1.647	0.01922	1.6662	14.40
7	29	1.578	0.01350	1.5915	18.40
6	34	1.474	0.0272	1.5012	22.61
5	39	1.333	0.01805	1.3510	28.84
4	43	1.145	0.03430	1.1793	36.50
3	47	0.9111	0.02186	0.9324	50.40
2	50	0.618	0.04000	0.658	75.80

DISTRIBUCION DEL CORTE (EN LAS PLACAS)

$$V_{wn} = V_n \frac{D_w}{\Sigma D}$$

n	Vn	ΣD_c	D_{w1}	$2D_{w1}$	D_{w2}	$\Sigma D=\Sigma D_c+2D_{w1}+D_{w2}$	V_{w1}	V_{w2}
11	39.84	32.80	0.495	0.990	3.34	37.130	0.53	3.59
10	67.76	39.60	1.332	2.664	6.96	49.224	1.83	9.58
9	93.08	39.60	2.017	4.034	10.60	54.234	3.55	18.20
8	115.60	39.60	2.757	5.514	14.40	59.514	5.33	27.90
7	135.50	39.60	3.584	7.168	18.40	65.168	7.46	38.30
6	152.48	39.60	4.394	8.788	22.61	70.998	9.45	48.60
5	166.95	39.60	5.487	10.974	28.84	79.414	11.52	60.60
4	178.65	39.60	6.827	13.654	36.50	89.754	13.58	72.60
3	187.69	39.60	9.081	18.162	50.40	108,162	15.74	87.40
2	193.99	39.60	13.813	27.626	75.80	143.026	18.70	102.80
1	197.27	138.96	48.090	96.180	253.8	488.94	19.40	103.00

DEFORMACION POR FLEXION EN LAS PLACAS δ_{Bn}

(Segundo Tanteo)

n	Vn	hN	Vnhn $x10^2$	M'n $x10^2$	2M'n $x10^2$	K_{wn}	$\frac{2Mn}{K_{wn}}$	$4\Delta Bn$	3/hn	δ_{Bn}
11	0.5	270	1.35	1.35	1.35	2,030	0.066	218.716	1/90	2.43
10	2.0	270	5.4	6.75	8.10	2,030	0.399	218.251	1/90	2.42
9	3.5	270	9.45	16.20	22.95	2,030	1.130	216.722	1/90	2.40
8	5.5	270	14.85	31.05	47.25	2,030	2.327	213.265	1/90	2.37
7	7.5	270	20.25	51.30	82.35	2,030	4.056	206.882	1/90	2.30
6	9.5	270	25.65	76.95	128.25	2,030	6.317	196.509	1/90	2.18
5	11.5	270	31.05	108.0	184.95	2.030	9.110	181.082	1/90	2.01
4	13.5	270	36.45	144.45	252.45	2,030	12.436	159.536	1/90	1.77
3	16	270	43.2	187.65	332.10	2,030	16.359	130.741	1/90	1.45
2	19	270	51.3	238.95	426.60	2,030	21.014	93.368	1/90	1.03
1	20	360	72.0	310.95	549.90	1,520	36.177	36.177	1/120	0.40

DEFORMACION POR CORTE.

$$A_{sn} = \frac{K\,V_n}{}$$

$$\delta_{sn} = \frac{27.6\,K_o B}{h} \times A_{sn} \ldots \beta=1$$

$$A_{s11} = \frac{1.2 \times 0.5}{8.4 \times 10^3} = 0.07 \times 10^{-3} \qquad \delta_{s11} = 10.2 \times 0.07 \times 10^{-3} = 0.71 \times 10^{-3}$$

$$A_{s10} = \frac{1.2 \times 2.0}{8.4 \times 10^3} = 0.285 \times 10^{-3} \qquad \delta_{s10} = 10.2 \times 0.285 \times 10^{-3} = 2.90 \times 10^{-3}$$

$$A_{s9} = \frac{1.2 \times 3.5}{8.4 \times 10^3} = 0.5 \times 10^{-3} \qquad \delta_{s9} = 10.2 \times 0.5 \times 10^{-3} = 5.10 \times 10^{-3}$$

$$A_{s8} = \frac{1.2 \times 5.5}{8.4 \times 10^3} = 0.78 \times 10^{-3} \qquad \delta_{s8} = 10.2 \times 0.78 \times 10^{-3} = 7.95 \times 10^{-3}$$

$$A_{s7} = \frac{1.2 \times 7.5}{8.4 \times 10^3} = 1.07 \times 10^{-3} \qquad \delta_{s7} = 10.2 \times 1.07 \times 10^{-3} = 10.94 \times 10^{-3}$$

$$A_{s6} = \frac{1.2 \times 9.5}{8.4 \times 10^3} = 1.36 \times 10^{-3} \qquad \delta_{s6} = 10.2 \times 1.36 \times 10^{-3} = 13.87 \times 10^{-3}$$

$$A_{s5} = \frac{1.2 \times 11.5}{8.4 \times 10^3} = 1.64 \times 10^{-3} \qquad \delta_{s5} = 10.2 \times 1.64 \times 10^{-3} = 16.72 \times 10^{-3}$$

$$A_{s4} = \frac{1.2 \times 13.5}{8.4 \times 10^3} = 1.92 \times 10^{-3} \qquad \delta_{s4} = 10.2 \times 2.28 \times 10^{-3} = 19.58 \times 10^{-3}$$

$$A_{s3} = \frac{1.2 \times 16}{8.4 \times 10^3} = 2.28 \times 10^{-3} \qquad \delta_{s3} = 10.2 \times 2.28 \times 10^{-3} = 23.25 \times 10^{-3}$$

$$A_{s2} = \frac{1.2 \times 19}{8.4 \times 10^3} = 2.71 \times 10^{-3} \quad \left| \quad \delta_{s2} = 10.2 \times 2.71 \times 10^{-3} = 27.64 \times 10^{-3} \right.$$

$$A_{s1} = \frac{1.2 \times 20}{8.4 \times 10^3} = 2.85 \times 10^{-3} \quad \left| \quad \delta_{s1} = 7.66 \times 2.85 \times 10^{-3} = 7.81 \times 10^{-3} \right.$$

Considerando igualmente cero la deformación por rotación

$$\delta_{Rn} = 0$$

Valor "D"

$$D_n = \frac{V_h}{\delta_{tn}}$$

n	Vn	δ_{Bn}	δ_{sn}	δ_t	D_{w1n}
11	0.5	2.43	0.00071	2.4307	0.20
10	2.0	2.42	0.0029	2.4229	0.80
9	3.5	2.40	0.051	2.4051	1.45
8	5.50	2.37	0.0079	2.3779	2.31
7	7.50	2.30	0.0100	2.3100	3.24
6	9.50	2.18	0.0138	2.1938	4.32
5	11.50	2.01	0.0167	2.0267	5.69
4	13.50	1.77	0.0195	1.7895	7.54
3	16.00	1.45	0.0232	1.4732	10.80
2	19.00	1.03	0.02764	1.0576	18.00
1	20.00	0.40	0.0078	0.4078	50.00

DEFORMACION POR FLEXION DE LA CAJA DEL ASCENSOR δ_{Bn}

(Segundo Tanteo)

n	Vn	hn	Vnhn	M'_n	2Mn	K_{wn}	$\frac{2Mn}{K_{wn}}$	$4\Delta Bn$	3/hn	δ_{Bn}
			$x10^2$	$x10^2$	$x10^2$					
11	3.5	270	9.45	9.45	9.45	11,100	0.085	226.86	1/90	2.52
10	9.5	270	25.65	35.10	44.55	9,900	0.45	226.33	1/90	2.51
9	18	270	48.60	83.70	118.80	11,100	1.07	224.81	1/90	2.49
8	28	270	75.60	159.30	243.00	9,900	2.45	221.29	1/90	2.46
7	38	270	102.60	261.90	421.20	11,100	3.79	215.05	1/90	2.39
6	48	270	129.60	391.50	653.40	9,900	6.60	204.66	1/90	2.27
5	60	270	162.00	553.50	945.00	11,100	8.51	189.55	1/90	2.10
4	72	270	194.40	747.90	1301.40	9,900	13.14	167.9	1/90	1.86
3	87	270	234.90	982.80	1730.70	11,100	15.59	139.17	1/90	1.54
2	102	270	275.40	1258.20	2541.00	9,900	25.66	97.92	1/90	1.08
1	103	360	370.80	1629.00	3187.20	8,800	36.13	36.13	1/120	0.30

DEFORMACION POR CORTE.

$$A_{sn} = \frac{K\ Vn}{A_{wn}} \qquad \delta_{sn} = \frac{27.6\ K_o B}{hn}\ A_{sn}$$

$$A_{s11} = \frac{1.2 \times 3.5}{31.3x10^3} = 0.134x10^{-3} \qquad \delta_{s11} = 10.2x0.134x10^{-3} = 1.37x10^{-3}$$

$$A_{s10} = \frac{1.2 \times 9.5}{27.5x10^3} = 0.415x10^{-3} \qquad \delta_{s10} = 10.2x0.415x10^{-3} = 4.22x10^{-3}$$

$$A_{s9} = \frac{1.2 \times 18}{31.3x10^3} = 0.69x10^{-3} \qquad \delta_{s9} = 10.2x0.69x10^{-3} = 7.04x10^{-3}$$

$$A_{s8} = \frac{1.2 \times 28}{37.5x10^3} = 1.22x10^{-3} \qquad \delta_{s8} = 10.2\ x1.22x10^{-3} = 12.45x10^{-3}$$

$$A_{s7} = \frac{1.2 \times 38}{31.3x10^3} = 1.455x10^{-3} \qquad \delta_{s7} = 10.2x1.455x10^{-3} = 14.85x10^{-3}$$

$$A_{s6} = \frac{1.2 \times 48}{27.5x10^3} = 2.09x10^{-3} \qquad \delta_{s6} = 10.2x2.09x10^{-3} = 21.35x10^{-3}$$

$$A_{s5} = \frac{1.2 \times 60}{31.3x10^3} = 2.3 \times 10^{-3} \qquad \delta_{s5} = 10.2x2.30x10^{-3} = 23.40x10^{-3}$$

$$A_{s4} = \frac{1.2 \times 72}{27.5x10^3} = 3.14x10^{-3} \qquad \delta_{s4} = 10.2x3.14x10^{-3} = 32.0x10^{-3}$$

$$A_{s3} = \frac{1.2 \times 87}{31.3x10^3} = 3.34x10^{-3} \qquad \delta_{s3} = 10.2x3.34x10^{-3} = 34.0x10^{-3}$$

$$A_{s2} = \frac{1.2 \times 102}{27.5 \times 10^{3}} = 4.45 \times 10^{-3} \qquad \delta_{s2} = 10.2 \times 4.45 \times 10^{-3} = 32.0 \times 10^{-3}$$

$$A_{s1} = \frac{1.2 \times 103}{29.8 \times 10^{3}} = 4.15 \times 10^{-3} \qquad \delta_{s1} = 7.66 \times 4.15 \times 10^{-3} = 31.8 \times 10^{-3}$$

DEFORMACION POR CORTE:

$\delta_f = \frac{1}{r}\delta_s$

Primer piso	r = 0.68
2ª,4ª,6ª,8ª y 10ª piso	r = 0.555
3ª,5ª,7ª,9ª y 11ª piso	r = 0.840

$\delta_{f11} = 1/0.84 \times 1.37 \times 10^{-3} = 1.63 \times 10^{-3}$

$\delta_{f10} = 1/0.555 \times 4.22 \times 10^{-3} = 7.66 \times 10^{-3}$

$\delta_{f9} = 1/0.84 \times 7.04 \times 10^{-3} = 8.36 \times 10^{-3}$

$\delta_{f8} = 1/0.555 \times 12.45 \times 10^{-3} = 22.6 \times 10^{-3}$

$\delta_{f7} = 1/0.84 \times 14.85 \times 10^{-3} = 17.70 \times 10^{-3}$

$\delta_{f6} = 1/0.555 \times 21.35 \times 10^{-3} = 38.80 \times 10^{-3}$

$\delta_{f5} = 1/0.84 \times 23.40 \times 10^{-3} = 27.82 \times 10^{-3}$

$\delta_{f4} = 1/0.555 \times 32.0 \times 10^{-3} = 58.2 \times 10^{-3}$

$\delta_{f3} = 1/0.840 \times 34.0 \times 10^{-3} = 40.5 \times 10^{-3}$

$\delta_{f2} = 1/0.555 \times 45.4 \times 10^{-3} = 82.6 \times 10^{-3}$

$\delta_{f1} = 1/0.68 \times 31.8 \times 10^{-3} = 46.7 \times 10^{-3}$

VALOR "D"

$$D = \frac{V_n}{\delta_{tn}}$$

n	V_n	δ_{Bn}	δ_{fn}	δ_{tn}	D_{w2n}
11	3.5	2.52	0.0016	2.5216	1.395
10	9.5	2.51	0.0076	2.5176	3.780
9	18	2.49	0.0083	2.4983	7.20
8	28	2.46	0.0226	2.4826	11.30
7	38	2.39	0.0177	2.4077	15.85
6	48	2.27	0.0388	2.3088	20.82
5	60	2.10	0.0278	2.1278	28.30
4	72	1.86	0.0582	1.9182	37.55
3	87	1.54	0.0405	1.5805	55.00
2	102	1.08	0.0826	1.1626	87.60
1	103	0.30	0.0467	0.3467	303.0

DISTRIBUCION DEL CORTE (En las placas)

$$V_{wn} = V_n \frac{D_w}{\Sigma D}$$

n	Vn	ΣD_x	D_{w1}	$2D_{w1}$	D_{w2}	$\Sigma D = \Sigma D_c + D_{w1} + D_{w2}$	V_{w1}	V_{w2}
11	39.84	32.80	0.20	0.40	1.39	34.57	0.232	1.61
10	67.76	39.60	0.80	1.60	3.78	44.98	1.39	6.57
9	93.08	39.60	1.45	2.90	7.20	49.70	2.72	13.50
8	115.60	39.60	2.31	4.62	11.30	55.52	4.81	23.50
7	135.50	39.60	3.24	6.48	15.85	61.93	7.10	34.70
6	152.48	39.60	4.32	8.64	20.82	69.06	9.55	46.10
5	166.95	39.60	5.69	11.38	28.30	70.28	12.00	59.60
4	178.65	39.60	7.54	15.08	37.55	92.23	14.60	72.60
3	187.69	39.60	10.80	21.60	55.00	116.20	16.80	88.80
2	193.99	39.60	18.00	36.00	87.60	163.20	21.20	108.00
1	197.27	138.96	50.00	100.0	303.0	541.96	18.20	110.00

TERCER TANTEO

DEFORMACION POR FLEXION EN LAS PLACAS δ_{Bn}

n	Vn	hn	Vnhn $x10^2$	M'_n $x10^2$	$2M'_n$ $x10^2$	K_{wn}	$\frac{2Mn}{K_{wn}}$	$4\Delta Bn$	3/hn	δ_{Bn}
11	0.2	270	0.54	0.54	0.54	2,030	0.0266	203.432	1/90	2.260
10	1.0	270	2.70	3.24	3.78	2,030	0.186	203.220	1/90	2.258
9	2.5	270	6.75	9.99	13.23	2,030	0.650	202.382	1/90	2.248
8	4.5	270	12.15	22.14	32.13	2,030	1.582	200.148	1/90	2.223
7	7.0	270	18.9	41.04	63.18	2,030	3.112	195.454	1/90	2.171
6	9.5	270	25.65	66.69	107.73	2,030	5.030	187.041	1/90	2.078
5	12	270	32.4	99.09	165.78	2,030	8.166	173.574	1/90	1.928
4	14	270	37.8	136.89	235.98	2.030	11.624	153.784	1/90	1.708
3	16	270	43.2	180.09	316.98	2.030	15.614	126.546	1/90	1.406
2	20	270	54.0	234.09	414.18	2,030	20.402	90.503	1/90	1.005
1	18	360	64.8	298.89	532.98	1,520	35.064	35.064	1/120	0.292

DEFORMACION POR CORTE

$$A_{sn} = \frac{K\,V_n}{A_{wn}} \qquad \delta_{sn} = \frac{27.6K_o B}{h} \times A_s \quad \ldots \beta = 1$$

$$A_{s11} = \frac{1.2 \times 0.2}{8.4 \times 10^3} = 0.0286 \times 10^{-3} \qquad \delta_{s11} = 10.2x0.0286x10^{-3} = 0.291x10^{-3}$$

$$A_{s10} = \frac{1.2 \times 1.0}{8.4 \times 10^3} = 0.142x10^{-3} \qquad \delta_{s10} = 10.2x0.142x10^{-3} = 1.448x10^{-3}$$

$$A_{s9} = \frac{1.2 \times 2.5}{8.4 \times 10^3} = 0.350x10^{-3} \qquad \delta_{s9} = 10.2x0.35x10^{-3} = 3.57x10^{-3}$$

$$A_{s8} = \frac{1.2 \times 4.5}{8.4x\ 10^3} = 0.642x10^{-3} \qquad \delta_{s8} = 10.2x0.642x10^{-3} = 6.548x10^{-3}$$

$$A_{s7} = \frac{1.2 \times 7}{8.4 \times 10^3} = 1.00 \times 10^{-3} \qquad \delta_{s7} = 10.2x1.0x10^{-3} = 10.2x10^{-3}$$

$$A_{s6} = \frac{1.2 \times 9.5}{8.4 \times 10^3} = 1.357x10^{-3} \qquad \delta_{s6} = 10.2x1.357x10^{-3} = 13.841x10^{-3}$$

$$A_{s5} = \frac{1.2 \times 12}{8.4 \times 10^3} = 1.714x10^{-3} \qquad \sigma_{s5} = 10.2x1.714x10^{-3} = 17.482x10^{-3}$$

$$A_{s4} = \frac{1.2 \times 14}{8.4 \times 10^3} = 2.00 \times 10^{-3} \qquad \sigma_{s4} = 10.2x2.00x10^{-3} = 20.3x10^{-3}$$

$$A_{s3} = \frac{1.2 \times 16}{8.4 \times 10^3} = 2.333x10^{-3} \qquad \sigma_{s3} = 10.2x2.333x10^{-3} = 27.796x10^{-3}$$

$$A_{s2} = \frac{1.2 \times 20}{8.4 \times 10^3} = 2.85 \times 10^{-3} \quad | \quad \delta_{s2} = 10.2 \times 2.85 \times 10^{-3} = 29.07 \times 10^{-3}$$

$$A_{s1} = \frac{1.2 \times 18}{8.4 \times 10^3} = 2.571 \times 10^{-3} \quad | \quad \delta_{s1} = 7.66 \times 2.571 \times 10^{-3} = 26.224 \times 10^{-3}$$

Considerando igualmente la deformación por rotación:

$$\delta R_n = 0$$

Valor "D" $\qquad D_n = \frac{V_n}{\delta_{tn}}$

n	V_n	δ_{Bn}	δ_{Sn}	δ_t	D_{w1n}
11	0.2	2.260	0.0002	2.260	0.0884
10	1.0	2.258	0.0014	2.259	0.440
9	2.5	2.248	0.0035	2.251	1.110
8	4.5	2.223	0.0065	2.229	2.018
7	7.0	2.171	0.0102	2.181	3.200
6	9.5	2.078	0.0138	2.091	4.545
5	12	1.928	0.0174	1.945	6.160
4	14	1.708	0.0204	1.728	8.092
3	16	1.406	0.0237	1.429	11.188
2	20	1.005	0.0290	1.034	19.340
1	18	0.292	0.0262	0.318	56.603

DEFORMACION POR FLEXION DE LA CAJA DEL ASCENSOR δ_{Bn}

n	Vn	hn	Vnhn x10²	M'n x10²	2Mn x10²	K_{wn}	$\frac{2Mn}{K_{wn}}$	$4\Delta Bn$	3/hn	δ_{Bn}
11	1.5	270	4.05	4.05	4.05	11,100	0.0364	196.770	1/90	2.186
10	6.5	270	17.55	21.60	25.65	9,900	0.2590	196.475	1/90	2.183
9	13	270	35.10	56.7	78.30	11,100	0.705	195.511	1/90	2.172
8	23.0	270	62.10	118.80	175.50	9,900	1.7727	193.034	1/90	2.144
7	34	270	91.80	210.60	329.40	11,100	2.9675	188.295	1/90	2.092
6	46	270	124.20	334.80	545.40	9,900	5.5090	179.819	1/90	1.997
5	58	270	156.60	491.40	826.20	11,100	7.4432	166.867	1/90	1.854
4	72	270	194.40	685.80	1172.2	9,900	11.840	147.584	1/90	1.642
3	88	270	237.60	923.40	1,609.	11,100	14.497	121.247	1/90	1.347
2	105	270	283.50	1206.9	21130.	9,900	21.518	85.232	1/90	0.947
1	110	360	396.00	1602.9	2809.8	8,820	31.857	31.857	1/120	0.265

DEFORMACION POR CORTE

$$A_{sn} = \frac{K_{vn}}{A_{wn}} \qquad \delta_{sn} = \frac{27.6\ K_o B}{h_n} \quad ..B=1$$

$A_{s11} = \frac{1.2 \times 1.5}{31.3 \times 10^3} = 0.0575\times10^{-3}$ | $\delta_{s11} = 10.2\times0.0575\times10^{-3} = 0.586\times10^{-3}$

$A_{s10} = \frac{1.2 \times 6.5}{27.5 \times 10^3} = 0.284\times10^{-3}$ | $\delta_{s10} = 10.2\times0.284\times10^{-3} = 2.9\times10^{-3}$

$A_{s9} = \frac{1.2 \times 13}{31.3 \times 10^3} = 0.498\times10^{-3}$ | $\delta_{s9} = 10.2\times0.498\times10^{-3} = 5.09\times10^{-3}$

$A_{s8} = \frac{1.2 \times 23}{27.5\times10^3} = 1.000\times10^{-3}$ | $\delta_{s8} = 10.2\times1.00\times10^{-3} = 10.2\times10^{-3}$

$A_{s7} = \frac{1.2 \times 34}{31.3\times10^3} = 1.30\times10^{-3}$ | $\delta_{s7} = 10.2\times1.30\times10^{-3} = 13.25\times10^{-3}$

$A_{s6} = \frac{1.2 \times 46}{27.5\times10^3} = 2.00\times10^{-3}$ | $\delta_{s6} = 10.2\times2.00\times10^{-3} = 20.4\times10^{-3}$

$A_{s5} = \frac{1.2 \times 58}{31.3\times10^3} = 2.22\times10^{-3}$ | $\delta_{s5} = 10.2\times2.22\times10^{-3} = 21.6\times10^{-3}$

$A_{s4} = \frac{1.2 \times 72}{27.5\times10^3} = 3.14\times10^{-3}$ | $\delta_{s4} = 10.2\times3.14\times10.3 = 32.0\times10^{-3}$

$A_{s3} = \frac{1.2 \times 88}{31.3\times10^3} = 3.38\times10^{-3}$ | $\delta_{s3} = 10.2\times3.38\times10^{-3} = 34.5\times10^{-3}$

$A_{s2} = \frac{1.2 \times 105}{27.5\times10^3} = 4.58\times10^{-3}$ | $\delta_{s2} = 10.2\times4.58\times10^{-3} = 46.8\times10^{-3}$

$A_{s1} = \frac{1.2 \times 110}{29.8\times10^3} = 4.44\times10^{-3}$ | $\delta_{s1} = 7.66\times4.44\times10^{-3} = 45.3\times10^{-3}$

CORRECCION POR MARCO.

$$\delta_f = \frac{1}{r}\delta_s$$

Primer piso ..... r = 0.68

2ª,4ª,6ª,8ª y 10ª..... r = 0.555

3ª,5ª,7ª,9ª y 11ª .... r = 0.840

$\delta_{f11} = 1/0.840 \times 0.586 \times 10^{-3} = 0.7 \times 10^{-3}$

$\delta_{f10} = 1/0.555 \times 2.90 \times 10^{-3} = 5.22 \times 10^{-3}$

$\delta_{f9} = 1/840 \times 5.09 \times 10^{-3} = 6.05 \times 10^{-3}$

$\delta_{f8} = 1/0.555 \times 10.2 \times 10^{-3} = 18.40 \times 10^{-3}$

$\delta_{f7} = 1/0.840 \times 13.25 \times 10^{-3} = 15.78 \times 10^{-3}$

$\delta_{f6} = 1/0.555 \times 20.4 \times 10^{-3} = 36.80 \times 10^{-3}$

$\delta_{f5} = 1/0.840 \times 21.60 \times 10^{-3} = 25.75 \times 10^{-3}$

$\delta_{f4} = 1/0.555 \times 32.0 \times 10^{-3} = 57.6 \times 10^{-3}$

δ

$\delta_{f3} = 1/0.840 \times 34.5 \times 10^{-3} = 41.00 \times 10^{-3}$

$\delta_{f2} = 1/0.555 \times 46.8 \times 10^{-3} = 84.4 \times 10^{-3}$

$\delta_{f1} = 1/0.68 \times 45.3 \times 10^{-3} = 66.6 \times 10^{-3}$

Valor "D"

$$D = \frac{V_n}{\delta_{tn}}$$

n	V_n	δ_{Bn}	δ_{fn}	δ_{tn}	D_{w2n}
11	1.5	2.186	0.0007	2.186	0.686
10	6.5	2.183	0.0052	2.188	2.961
9ª	13	2.172	0.0060	2.178	5.970
8ª	23	2.144	0.0184	2.162	10.610
7ª	34	2.092	0.0157	2.107	16.220
6ª	46	1.997	0.0368	2.033	22.610
5ª	58	1.854	0.0257	1.879	30.90
4ª	72	1.642	0.0576	1.699	42.40
3ª	88	1.347	0.0410	1.388	63.50
2ª	105	0.947	0.0844	1.031	102.0
1ª	110	0.265	0.0666	0.331	332.0

DISTRIBUCION DEL CORTE

$$V_{wn} = \frac{Dwn}{\Sigma Dn}$$

n	V_n	ΣD_c	D_{w1}	RD_{w1}	B_{w2}	$\Sigma D = \Sigma D_c + D_{w1} + D_{w2}$	V_{w1}	V_{w2}
11	39.84	32.80	0.088	0.176	0.686	33.662	0.104	0.814
10	67.76	39.60	0.440	0.880	2.961	44.441	0.690	4.530
9ª	93.08	39.60	1.110	2.220	5.97	47.790	2.16	11.62
8ª	115.60	39.60	2.018	4.036	10.61	54.246	4.35	22.60
7ª	135.50	39.60	3.200	6.400	16.22	62.220	6.96	35.10
6ª	152.48	39.60	4.545	9.090	22.61	71.300	9.75	48.60
5ª	166.95	39.60	6.160	12.320	30.90	82.82	12.40	62.40
4ª	178.65	39.60	8.092	16.184	42.40	98.184	14.70	77.20
3ª	187.69	39.60	11.188	22.376	63.50	125.476	16.58	94.80
2ª	193.99	39.60	19.340	38.680	102.0	180.28	20.50	108.0
1ª	197.27	138.9	56.603	113.206	332.0	584.166	19.10	112.0

DEFORMACION POR FLEXION EN LAS PLACAS

n	Vn	hn	Vnhn $x10^2$	M'_{n_2} $x10^2$	$2M'_{n_2}$ $x10^2$	Kwn	$\frac{2Mn}{K_{wn}}$	$4\Delta Bn$	3/hn	δBn
11	0.15	270	0.405	0.405	0.405	2030	0.0199	193.34	1/90	2.148
10	0.8	270	2.16	2.565	2.970	2030	0.1463	190.184	1/90	2.113
9ª	2.0	270	5.40	7.965	10.53	2030	0.5187	189.520	1/90	2.105
8ª	4.0	270	10.8	18.765	26.730	2030	1.316	187.686	1/90	2.085
7ª	6.5	270	17.55	36.315	55.08	2030	2.7133	183.657	1/90	2.040
6ª	9.0	270	24.3	60.615	96.930	2030	4.7748	176.169	1/90	1.957
5ª	12	270	32.4	93.015	153.63	2030	7.579	163.826	1/90	1.820
4ª	13.5	270	36.45	129.465	222.48	2030	10.9590	145.299	1/90	1.614
3ª	15.5	270	41.85	171.315	300.78	2030	14.816	119.524	1/90	1.328
2ª	20	270	54.0	225.315	369.63	2030	18.208	86.500	1/90	0.961
1ª	19	360	68.4	293.715	519.03	1520	34.146	34.146	1/120	0.284

DEFORMACION POR CORTE.

$$A_{sn} = \frac{K_{vn}}{A_{wn}} \qquad \delta_{sn} = \frac{27.6\ K_o B}{h} \quad '''B = 1$$

$A_{s11} = \frac{1.2 \times 0.15}{8.4x10^3} = 0.0214x10^{-3}$ $\quad \delta_{s11} = 10.2x0.0214x10^{-3} = 0.218x10^{-3}$

$A_{s10} = \frac{1.2x\ 0.8}{8.4x10^3} = 0.1142x10^{-3}$ $\quad \delta_{s10} = 10.2x0.1142x10^{-3} = 1.164x10^{-3}$

$A_{s9} = \frac{1.2 \times 2}{8.4x10^3} = 0.286x10^{-3}$ $\quad \delta_{s9} = 10.2x0.286x10^{-3} = 2.918x10^{-3}$

$A_{s8} = \frac{1.2 \times 4}{8.4x10^3} = 0.572x10^{-3}$ $\quad \delta_{s8} = 10.2x0.572x10^{-3} = 5.83x10^{-3}$

$A_{s7} = \frac{1.2x6.5}{8.4x10^3} = 0.923x10^{-3}$ $\quad \delta_{s7} = 10.2x0.923x10^{-3} = 9.41x10^{-3}$

$A_{s6} = \frac{1.2x9}{8.4x10^3} = 1.285x10^{-3}$ $\quad \delta_{s6} = 10.2x1.285x10^{-3} = 13.107x10^{-3}$

$A_{s5} = \frac{1.2x12}{8.4x10^3} = 1.704x10^{-3}$ $\quad \delta_{s5} = 10.2x1.704x10^{-3} = 17.38x10^{-3}$

$A_{s4} = \frac{1.2x13.5}{8.4x10^3} = 1.928x10^{-3}$ $\quad \delta_{s4} = 10.2x1.928x10^{-3} = 19.665x10^{-3}$

$A_{s3} = \frac{1.2 \times 15.5}{8.4x10^3} = 2.214x10^{-3}$ $\quad \delta_{s3} = 10.2x2.214x10^{-3} = 22.582x10^{-3}$

$$A_{s2} = \frac{1.2 \times 20}{8.4 \times 10^3} = 2.714 \times 10^{-3} \qquad \delta_{s2} = 10.2 \times 2.840 \times 10^{-3} = 28.96 \times 10^{-3}$$

$$A_{s1} = \frac{1.2 \times 19}{8.4 \times 10^3} = 2.714 \times 10^{-3} \qquad \delta_{s1} = 7.66 \times 2.714 \times 10^{-3} = 20.789 \times 10^{-3}$$

Considerando igualmente la deformación por rotación $\delta_{RA} = 0$

Valor "D"

$$D = \frac{V_n}{\delta_{tn}}$$

n	V_n	δ_{Bn}	δ_{sn}	δ_{tn}	D_{wn}
11	0.15	2.148	0.0002	2.148	0.060
10	0.80	2.113	0.0016	2.114	0.378
9	2.00	2.105	0.0029	2.107	0.940
8	4.00	2.085	0.0058	2.090	1.913
7	6.50	2.040	0.0094	2.049	3.172
6	9.0	1.957	0.0130	1.970	4.568
5	12.0	1.820	0.0173	1.837	6.530
4	13.5	1.614	0.0196	1.633	8.266
3	15.5	1.328	0.0225	1.350	11.481
2	20.0	0.961	0.0289	0.989	20.820
1	19.0	0.2841	0.0207	0.304	62.500

DEFORMACION POR FLEXION DE LA CAJA DEL ASCENSOR

n	V_n	h_n	$V_n h_n$ $x10^2$	M'_n $x10^2$	$2M_n$ $x10^2$	K_{wn}	$\frac{2Mn}{K_{wn}}$	$4\Delta_{Bn}$	3/hn	δ_{Bn}
11	1.2	270	3.24	3.24	3.24	11100	0.0291	200.097	1/90	2.223
10	5.5	270	14.85	18.09	24.33	9900	0.2154	199.853	1/90	2.220
9	12	270	32.40	50.49	68.58	11100	0.6178	199.020	1/90	2.211
8	23	270	62.10	112.59	163.08	9900	1.6470	196.755	1/90	2.186
7	35	270	94.5	207.09	319.68	11100	2.8800	192.228	1/90	2.135
6	48	270	129.60	336.69	543.78	9900	5.4920	183.856	1/90	2.042
5	60	270	162.00	498.69	835.38	11100	7.5250	170.839	1/90	1.898
4	75	270	202.50	701.19	1199.88	9900	12.120	151.194	1/90	1.679
3	92	270	248.40	949.59	1650.78	11100	14.870	124.204	1/90	1.380
2	106	270	286.20	1235.20	1285.79	9900	22.074	87.260	1/90	0.969
1	112	360	403.20	1638.99	2874.78	8800	32.593	32.593	1/120	0.271

DEFORMACION POR CORTE

$$A_{sn} = \frac{K\,V_n}{A_{wn}}$$

$A_{s11} = \frac{1.2x1.2}{31.3x10^3} = 0.0459x10^{-3}$ | $\delta_{s11} = 10.2x0.0459x10^{-3} = 0.468x10^{-3}$

$A_{s10} = \frac{1.2x5.5}{27.5x10^3} = 0.239x10^{-3}$ | $\delta_{s10} = 10.2x0.239\text{-}x10^{-3} = 2.437x10^{-3}$

$A_{s9} = \frac{1.2x12}{31.3x10^3} = 0.450x10^{-3}$ | $\delta_{s9} = 10.2x0.459x10^{-3} = 4.680x10^{-3}$

$A_{s8} = \frac{1.2x23}{27.5x10^3} = 1.002x10^{-3}$ | $\delta_{s8} = 10.2x1.002x10^{-3} = 10.220x10^{-3}$

$A_{s7} = \frac{1.2x35}{31.3x10^3} = 1.340x10^{-3}$ | $\delta_{s7} = 10.2x1.340x10^{-3} = 13.668x10^{-3}$

$A_{s6} = \frac{1.2x48}{27.5x01^3} = 2.092x10^{-3}$ | $\delta_{s6} = 10.2x2.092x10^{-3} = 21.338x10^{-3}$

$A_{s5} = \frac{1.2x60}{31.3x10^3} = 2.298x10^{-3}$ | $\delta_{s5} = 10.2x2.298x10^{-3} = 23.439x10^{-3}$

$A_{s4} = \frac{1.2x75}{27.5x10^3} = 3.27x10^{-3}$ | $\delta_{s4} = 10.2x3.27x10^{-3} = 33.354x10^{-3}$

$A_{s3} = \frac{1.2x92}{3.13x10^3} = 3.523x10^{-3}$ | $\delta_{s3} = 10.2x3.523x10^{-3} = 35.934x10^{-3}$

$$A_{s2} = \frac{1.2x106}{27.5x10^3} = 4.621 \times 10^{-3} \qquad \delta_{s2} = 10.2x4.621x10^{-3} = 47.134x10^{-3}$$

$$A_{s1} = \frac{1.2x112}{29.8x10^3} = 4.502x10^{-3} \qquad \delta_{s1} = 7.66x4.502x10^{-3} = 34.485x10^{-3}$$

CORRECCION POR MARCO

$$\delta_f = \frac{1}{r}\,\delta_s$$

Primer piso..... r = 0.68

2ª,4ª,6ª,8ª y 10ª r = 0.555

3ª,5ª,7ª,9ª y 11ª r = 0.84

$\delta_{f11} = 1/0.840 \times 0.468 \times 10^{-3} = 0.556 \times 10^{-3}$

$\delta_{f10} = 1/0.555 \times 2.437 \times 10^{-3} = 4.435 \times 10^{-3}$

$\delta_{f9} = 1/0.840 \times 4.680 \times 10^{-3} = 5.560 \times 10^{-3}$

$\delta_{f8} = 1/0.555 \times 10.22 \times 10^{-3} = 18.600 \times 10^{-3}$

$\delta_{f7} = 1/0.840 \times 13.668 \times 10^{-3} = 16.265 \times 10^{-3}$

$\delta_{f6} = 1/0.555 \times 21.338 \times 10^{-3} = 38.835 \times 10^{-3}$

$\delta_{f5} = 1/0.840 \times 23.338 \times 10^{-3} = 27.892 \times 10^{-3}$

$\delta_{f4} = 1/0.555 \times 33.354 \times 10^{-3} = 60.704 \times 10^{-3}$

$\delta_{f3} = 1/0.840 \times 35.934 \times 10^{-3} = 42.761 \times 10^{-3}$

$\delta_{f2} = 1/0.555 \times 47.134 \times 10^{-3} = 85.783 \times 10^{-3}$

$\delta_{f1} = 1/0.840 \times 34.485 \times 10^{-3} = 50.692 \times 10^{-3}$

VALOR "D" $\qquad D = \frac{V_n}{\delta_{tn}}$

n	V_n	δ_{Bn}	δ_{fn}	δ_{tn}	D_{w2n}
11	1.2	2.223	0.0005	2.23	0.593
10	5.5	2.220	0.043	2.224	2.473
9	12	2.211	0.0055	2.216	5.415
8	23	2.186	0.0186	2.204	10.435
7	35	2.135	0.0162	2.151	16.271
6	48	2.042	0.0388	2.080	23.000
5	60	1.898	0.0278	1.925	31.100
4	75	1.679	0.0607	1.739	43.128
3	92	1.380	0.0427	1.422	64.697
2	106	0.969	0.0857	1.054	100.569
1	112	0.271	0.0506	0.321	348.909

DISTRIBUCION DEL CORTE

$$V_{wn} = V_n \times \frac{D_{wn}}{\Sigma D_n}$$

n	V_n	ΣD_c	D_{w1}	$2D_{w1}$	$2D_{w2}$	$\Sigma D=\Sigma D_c+2D_{w1}+D_{w2}$	V_{w1}	V_{w2}
11	39.84	32.80	0.060	0.12	0.593	33.513	0.0712	0.704
10	67.76	39.60	0.378	0.75	2.473	42.829	0.597	3.912
9°	93.08	39.60	0.940	1.880	5.415	46.895	1.864	10.743
8°	115.60	39.60	1.913	3.826	10.435	53.861	4.105	22.393
7°	135.50	39.60	3.172	6.340	16.271	62.215	6.905	35.421
6°	152.48	39.60	4.568	9.136	23.000	71.736	9.707	48.87
5°	166.95	39.60	6.530	13.060	31.100	83.760	13.014	61.98
4°	178.65	39.60	8.266	16.532	43.128	99.260	14.870	77.58
3°	187.69	39.60	11.481	22.962	64.697	128.259	16.922	95.363
2°	193.99	39.60	20.820	41.64	100.569	181.809	22.214	107.307
1°	197.27	138.96	62.500	125.00	348.909	612.286	20.120	112.348

DEFORMACION POR FLEXION EN LAS PLACAS

n	V_n	h_n	$V_n h_n$ x10^2	M'_n x10^2	$2M'_n$ x10^2	K_{wn}	$\frac{2Mn}{K_{wn}}$	$4W_{Bn}$	3/hn	δ_{Bn}
11	0.1	270	0.27	0.27	0.27	2,030	0.0133	205.319	1/90	2.281
10	0.6	270	1.62	1.89	2.16	2,030	0.106	205.200	1/90	2.280
9°	2.0	270	5.4	7.29	9.18	2,030	0.452	204.642	1/90	2.273
8°	4.0	270	10.8	18.04	25.38	2,030	1.250	202.940	1/90	2.254
7°	7.0	270	18.9	36.99	55.08	2,030	2.713	198.977	1/90	2.210
6°	10	270	27.0	63.99	100.98	2,030	4.974	191.290	1/90	2.125
5°	13	270	35.1	99.09	163.08	2,030	8.033	178.283	1/90	1.980
4°	15	270	40.5	139.59	238.68	2,030	11.757	158.493	1/90	1.761
3°	16	270	43.2	182.79	322.38	2,030	15.880	130.856	1/90	1.453
2°	22	270	59.4	242.18	424.98	2,030	20.885	94.091	1/90	1.045
1ª	20	360	72.0	314.19	556.38	1,520	36.603	36.603	1/120	0.305

DEFORMACION POR CORTE:

$$A_{sn} = \frac{K_{vn}}{A_{wn}} \qquad \delta_{sn} = \frac{27.6\ K_o B}{h} \times A_s \ldots\ B=1$$

$A_{s11} = \frac{1.2x0.1}{8.4x10^3} = 0.0143x10^{-3}$ | $\delta_{s11} = 10.2x0.0143x10^{-3} = 0.146x10^{-3}$

$A_{s10} = \frac{1.2x0.6}{8.4x10^3} = 0.085x10^{-3}$ | $\delta s10 = 10.2x0.085x10^{-3} = 0.875x10^{-3}$

$A_{s9} = \frac{1.2x2}{8.4x10^3} = 0.286x10^{-3}$ | $\delta s9 = 10.2x0.286x10^{-3} = 2.918x10^{-3}$

$A_{s8} = \frac{1.2x4.0}{8.4x10^3} = 0.572x10^{-3}$ | $\delta s8 = 10.2x0.572x10^{-3} = 5.830x10^{-3}$

$A_{s7} = \frac{1.2x7.0}{8.4x10^3} = 1.000x10^{-3}$ | $\delta s7 = 10.2x1.000x10^{-3} = 10.2x10^{-3}$

$A_{s6} = \frac{1.2x10}{8.4x10^3} = 1.43x10^{-3}$ | $\delta s6 = 10.2x1.43x10^{-3} = 14.3x10^{-3}$

$A_{s5} = \frac{1.2x13}{8.4x10^3} = 1.859x10^{-3}$ | $\delta s5 = 10.2x1.859x10^{-3} = 18.92x10^{-3}$

$A_{s4} = \frac{1.2x15}{8.4x10^3} = 2.142x10^{-3}$ | $\delta s4 = 10.2x2.142x10^{-3} = 21.82x10^{-3}$

$A_{s3} = \frac{1.2x16}{8.4x10^3} = 2.284x10^{-3}$ | $\delta s3 = 10.2x2.284x10^{-3} = 23.35x10^{-3}$

$A_{s2} = \frac{1.2x22}{8.4x10^3} = 3.14x10^{-3}$ | $\delta s2 = 10.2x3.141x10^{-3} = 32.10x10^{-3}$

$A_{s1} = \frac{1.2x20}{8.4x10^3} = 2.86x10^{-3}$ | $\delta_{s1} = 10.2x2.86x10^{-3} = 29.18x10^{-3}$

Considerando igualmente la deformación por rotación $\delta_{Rn} = 0$

Valor "D" $\qquad D = \frac{V_n}{\delta_{tn}}$

n	V_n	δ_{Bn}	δ_{sn}	δ_{tn}	D_{w1n}
11	0.1	2.281	0.0001	2.281	0.043
10	0.6	2.280	0.008	2.280	0.263
9°	2.0	2.273	0.0029	2.275	0.879
8°	4.0	2.254	0.0058	2.259	1.770
7°	7.0	2.210	0.0102	2.220	3.153
6°	10	2.125	0.0140	2.139	4.675
5°	13	1.980	0.018	1.998	6.506
4°	15	1.761	0.021	1.782	8.417
3°	16	1.453	0.023	1.476	10.840
2°	22	1.045	0.032	1.077	20.427
1°	20	0.305	0.029	0.334	59.880

DEFORMACION POR FLEXION EN LA CAJA DEL ASCENSOR

n	V_n	h_n	$V_n h_n$ x10^2	M'_n x10^2	$2M'_n$ x10^2	K_{wn}	$\frac{2Mn}{K_{wn}}$	$4\Delta_{Bn}$	3/hn	δ_{Bn}
11	1.0	270	2.7	2.7	2.7	11,100	0.0243	200.030	1/90	2.222
10	4.0	270	10.8	13.5	16.2	9,900	0.163	199.843	1/90	2.220
9°	11	270	29.7	43.2	56.7	11,100	0.510	199.170	1/90	2.213
8°	22	270	59.4	102.6	145.8	9,900	1.472	197.188	1/90	2.190
7°	35	270	94.5	197.1	299.7	11,100	2.700	193.016	1/90	2.144
6°	49	270	132.3	329.4	526.5	9,900	5.318	184.998	1/90	2.055
5°	62	270	167.4	496.8	826.2	11,100	7.443	172.237	1/90	1.913
4°	77	270	207.9	704.7	1201.5	9,900	12.136	152.658	1/90	1.696
3°	95	270	256.5	961.2	1665.9	11,100	15.008	125.514	1/90	1.394
2°	107	270	288.9	1250.1	2211.3	9,900	22.336	88.170	1/90	0.979
1°	112	360	403.2	1653.2	2903.3	8,820	32.917	32.917	1/120	0.273

DEFORMACION POR CORTE:

$$A_{sn} = \frac{K_{vn}}{A_{wn}}$$

$$A_{s11} = \frac{1.2x1}{31.3x10^3} = 0.0383x10^{-3} \qquad \delta_{s11} = 10.2x0.0383x10^{-3} = 0.391x10^{-3}$$

$$A_{s10} = \frac{1.2x4}{27.5x10^3} = 0.175x10^{-3} \qquad \delta_{s10} = 10.2x0.175x10^{-3} = 1.78x10^{-3}$$

$$A_{s9} = \frac{1.2x11}{31.3x10^3} = 0.422x10^{-3} \qquad \delta_{s9} = 10.2x0.422x10^{-3} = 4.300x10^{-3}$$

$$A_{s8} = \frac{1.2x22}{27.5x10^3} = 0.960x10^{-3} \qquad \delta_{s8} = 10.2x0.960x10^{-3} = 9.800x10^{-3}$$

$$A_{s7} = \frac{1.2x35}{31.3x10^3} = 1.34x10^{-3} \qquad \delta_{s7} = 10.2x1.340x10^{-3} = 1.370x10^{-3}$$

$$A_{s6} = \frac{1.2x49}{27.5x10^3} = 2.14x10^{-3} \qquad \delta_{s6} = 10.2x2.140x10^{-3} = 21.8x10^{-3}$$

$$A_{s5} = \frac{1.2x62}{31.3x10^3} = 2.37x10^{-3} \qquad \delta_{s5} = 10.2x2.370x10^{-3} = 23.7x10^{-3}$$

$$A_{s4} = \frac{1.2x77}{27.5x10^3} = 3.36x10^{-3} \qquad \delta_{s4} = 10.2x3.36x10^{-3} = 34.21x10^{-3}$$

$$A_{s3} = \frac{1.2x95}{31.3x10^3} = 3.64x10^{-3} \qquad \delta_{s3} = 10.2x3.64x10^{-3} = 37.20x10^{-3}$$

$$A_{s2} = \frac{1.2x107}{27.5x10^3} = 4.67x10^{-3} \qquad \delta_{s2} = 10.2x4.67x10^{-3} = 47.60x10^{-3}$$

$$A_{s1} \quad \frac{1.2x112}{29.8x10^3} = 4.52x10^{-3} \qquad \delta_{s1} = 10.2x4.52x10^{-3} = 46.10x10^{-3}$$

CORRECCION POR MARCO

$$\delta_f = \frac{1}{r}\,\delta_s$$

Primer piso ..... r = 0.68

2ª,4ª,6ª,8ª y 10ª..... r = 0.555

3ª,5ª,7ª,9ª y 11ª..... r = 0.840

$\delta_{f11} = 1/0.840x0.391x10^{-3} = 0.466x10^{-3}$

$\delta_{f10} = 1/0.555x1.780x10^{-3} = 3.210x10^{-3}$

$\delta_{f9} = 1/0.840x4.30x10^{-3} = 5.22x10^{-3}$

$\delta_{f8} = 1/0.555x9.80x10^{-3} = 17.65x10^{-3}$

$\delta_{f7} = 1/0.840x13.70x10^{-3} = 16.30x10^{-3}$

$\delta_{f6} = 1/0.555x21.80x10^{-3} = 39.30x10^{-3}$

$\delta_{f5} = 1/0.84x23.7x10^{-3} = 28.21x10^{-3}$

$\delta_{f4} = 1/0.555x34.22x10^{-3} = 62.20x10^{-3}$

$\delta_{f3} = 1/0.840x37.2x10^{-3} = 44.30x10^{-3}$

$\delta_{f2} = 1/0.555x47.60x10^{-3} = 85.8x10^{-3}$

$\delta_{f1} = 1/0.640x46.10x10^{-3} = 72.10x10^{-3}$

VALOR "D" $\quad D = \frac{V_n}{\delta_{tn}}$

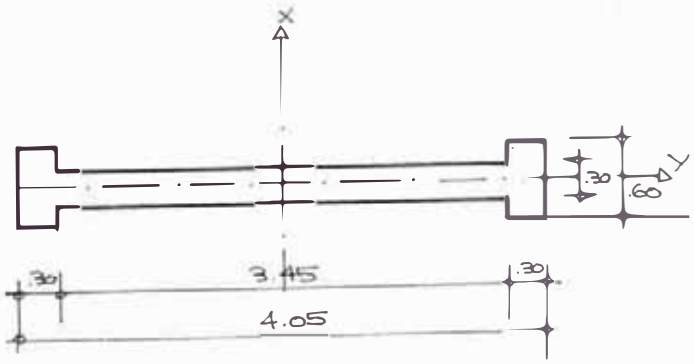
n	V_n	δ_{Bn}	δ_{fn}	δ_{tn}	D_{w2n}
11	1	2.222	0.0004	2.222	0.450
10	4	2.220	0.003	2.223	1.799
9°	11	2.213	0.005	2.218	4.959
8°	22	2.190	0.017	2.207	9.968
7°	35	2.144	0.016	2.160	16.203
6°	49	2.055	0.039	2.094	23.400
5°	62	1.913	0.028	1.941	31.942
4°	77	1.696	0.062	1.758	43.799
3°	95	1.394	0.044	1.438	66.063
2°	107	0.979	0.085	1.064	100.563
1°	112	0.273	0.072	0.345	324.637

DISTRIBUCION DEL CORTE:

$$V_{wn} = \frac{D_{wn}}{\Sigma D_n} \; V_n$$

ı	V_n	ΣD_c	D_{w1}	$2D_{w1}$	D_{w2}	$\Sigma D=\Sigma D_c+D_{w1}+D_{w2}$	V_{w1}	V_{w2}
L1	39.84	32.80	0.043	0.086	0.450	33.336	0.0513	0.537
L0	67.76	39.60	0.263	0.526	1.799	41.925	0.425	2.907
9	93.08	39.60	0.879	1.758	4.959	46.317	1.758	9.918
8	115.60	39.60	1.770	3.540	9.968	53.108	3.851	21.690
7	135.50	39.60	3.153	6.306	16.203	62!109	6.873	35.322
6	152.48	39.60	4.675	9.350	23.400	72,350	9.850	51.012
5	166.95	39.60	6.505	13.016	31.942	84.558	12.842	63.053
4	178.65	39.60	8.417	16.834	43.799	100.233	14.999	78.049
3	187.69	39.60	10.840	21.680	66.063	127.343	15.967	97.310
2	193.99	39.60	20.427	40.854	100.563	181.017	21.877	107.70
1	197.27	138.96	59.880	119.760	324.637	583.357	20.600	111.00

Valor "D" para las placas que siguen el sentido del eje "y"



Primer piso h = 3.60

Resto pisos h = 2.70

Cálculo del momento de inercia respecto del eje "x"

$$I_{xx} = 1/12 \times 30 \times 345^3 + s(30x60x187.5^2 + 1/12 \times 60 \times 30^3)$$

$$I_{xx} = 102'659,000 + 2 \times 63'179,200$$

$$I_{xx} = 102'659,000 + 126'358,400$$

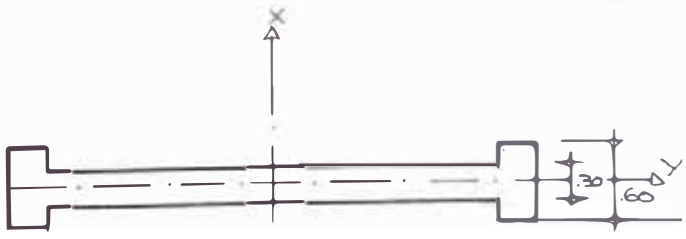
$$I_{xx} = 229'017,400 \text{ cm}^4$$

DISTRIBUCION DEL CORTE:

$$V_{wn} = \frac{D_{wn}}{\Sigma D_n} \; V_n$$

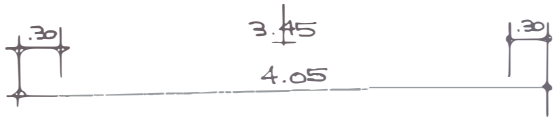
n	V_n	ΣD_c	D_{w1}	$2D_{w1}$	D_{w2}	$\Sigma D=\Sigma D_c+D_{w1}+D_{w2}$	V_{w1}	V_{w2}
11	39.84	32.80	0.043	0.086	0.450	33.336	0.0513	0.537
10	67.76	39.60	0.263	0.526	1.799	41.925	0.425	2.907
9	93.08	39.60	0.879	1.758	4.959	46.317	1.758	9.918
8	115.60	39.60	1.770	3.540	9.968	53.108	3.851	21.690
7	135.50	39.60	3.153	6.306	16.203	62!109	6.873	35.322
6	152.48	39.60	4.675	9.350	23.400	72,350	9.850	51.012
5	166.95	39.60	6.505	13.016	31.942	84.558	12.842	63.053
4	178.65	39.60	8.417	16.834	43.799	100.233	14.999	78.049
3	187.69	39.60	10.840	21.680	66.063	127.343	15.967	97.310
2	193.99	39.60	20.427	40.854	100.563	181.017	21.877	107.70
1	197.27	138.96	59.880	119.760	324.637	583.357	20.600	111.00

Valor "D" para las placas que siguen el sentido del eje "y"



Primer piso h = 3.60

Resto pisos h = 2.70



Cálculo del momento de inercia respecto del eje "x"

$$I_{xx} = 1/12 \times 30 \times 345^3 + s(30x60x187.5^2 + 1/12 \times 60 \times 30^3)$$

$$I_{xx} = 102'659,000 + 2 \times 63'179,200$$

$$I_{xx} = 102'659,000 + 126'358,400$$

$$I_{xx} = 229'017,400 \text{ cm}^4$$

1.- VALORES DE "K" ABSOLUTO

Primer piso $K = I/h = \frac{229'017,400}{360} = 636,000$

Resto piso $K = I/h = \frac{229'017,400}{270} = 848,000$

2.- VALORES DE "K" RELATIVO

Primer piso $\frac{636,000}{100} = 6,360$ $K = 6,360$

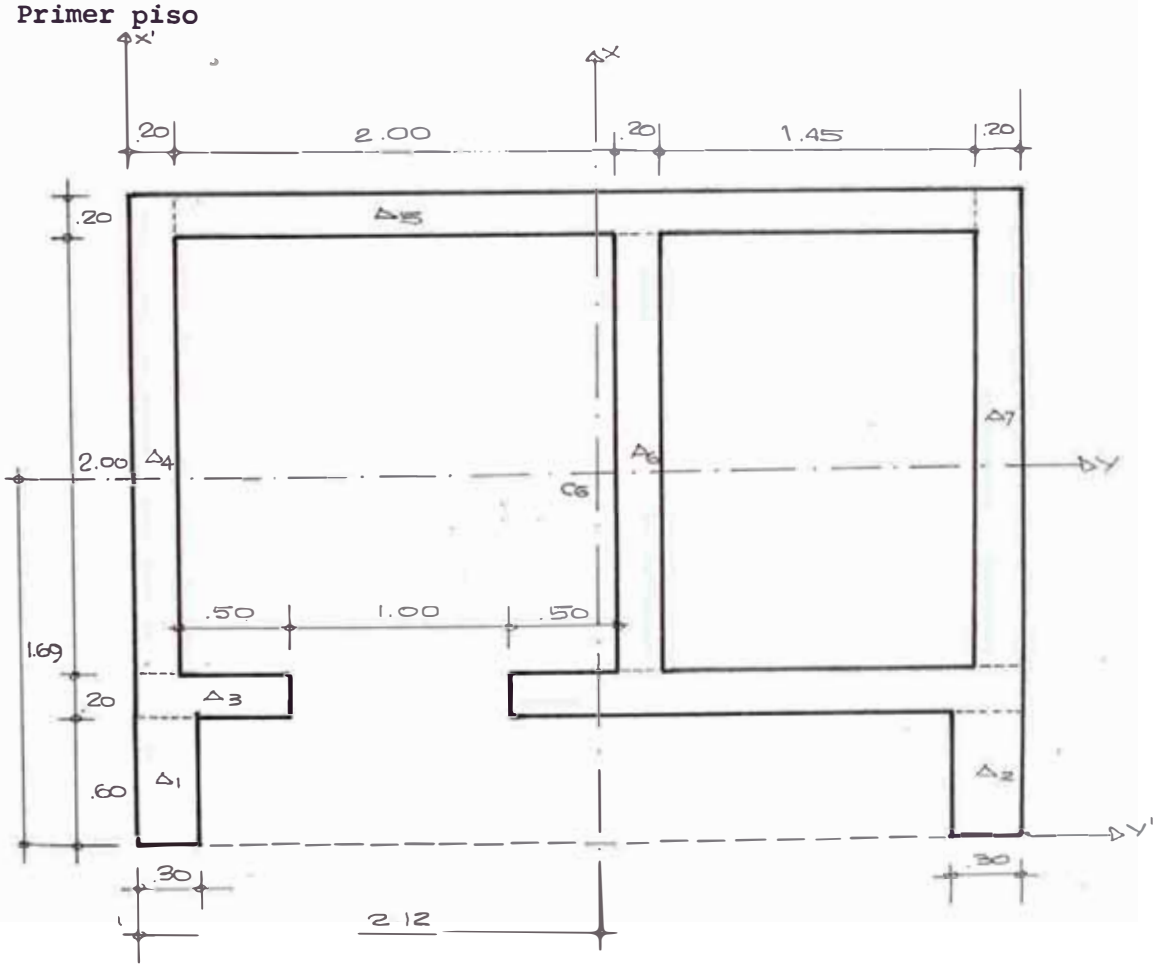
Resto piso $\frac{848,000}{100} = 8,480$ $K = 8,480$

$A_{wn} = 345 \times 30 + 2 \times 30 \times 60 = 10,350 + 3,600 = 13,950$

$A_{wn} = 13,950\ cm^2$

CALCULO DEL VALOR "D" DE LAS PLACAS DEL ASCENSOR.

Primer piso



CALCULO DEL MOMENTO DE INERCIA DE LA SECCION RESPECTO DEL EJE X

$$I_{xx} = I_{Gx} + A\bar{y}^2$$

Sec.	b cm.	h cm.	Area cm^2	$\bar{y}$	$\bar{y}^2$	$A\bar{y}^2$	$I_{Gx}=\frac{1}{12}bh^3$	$I_x=I_{Gx}+A\bar{y}^2$
1	60	30	1,800	-197	38,809	69'856,200	135,000	69'991,200
2	60	30	1,800	178	31,684	57'031,200	135,000	57'166,200
3	20	70	1,400	-187	34,969	48'956,600	571,666	49'528,266
4	220	20	4,400	-202	40,804	179'537,600	146,664	179'684,264
5	20	365	7,300	-9.5	90	657,000	81'040,765	81'697,765
6	200	20	4,000	18	324	1'296,000	133,328	1'429,328
7	220	20	4,400	183	33,489	147'351,600	146,664	147'498,264
8	20	235	4,700	75.5	5,700	430,350	21'600,000	22'030,350
			29,800					609'025,637

I_{xx} = 609'025,637 cm^4 digamos I_{xx} = 609.026,000

$$K = \frac{609'026,000}{360} = \frac{1'699,200}{}$$ K =1'699,200

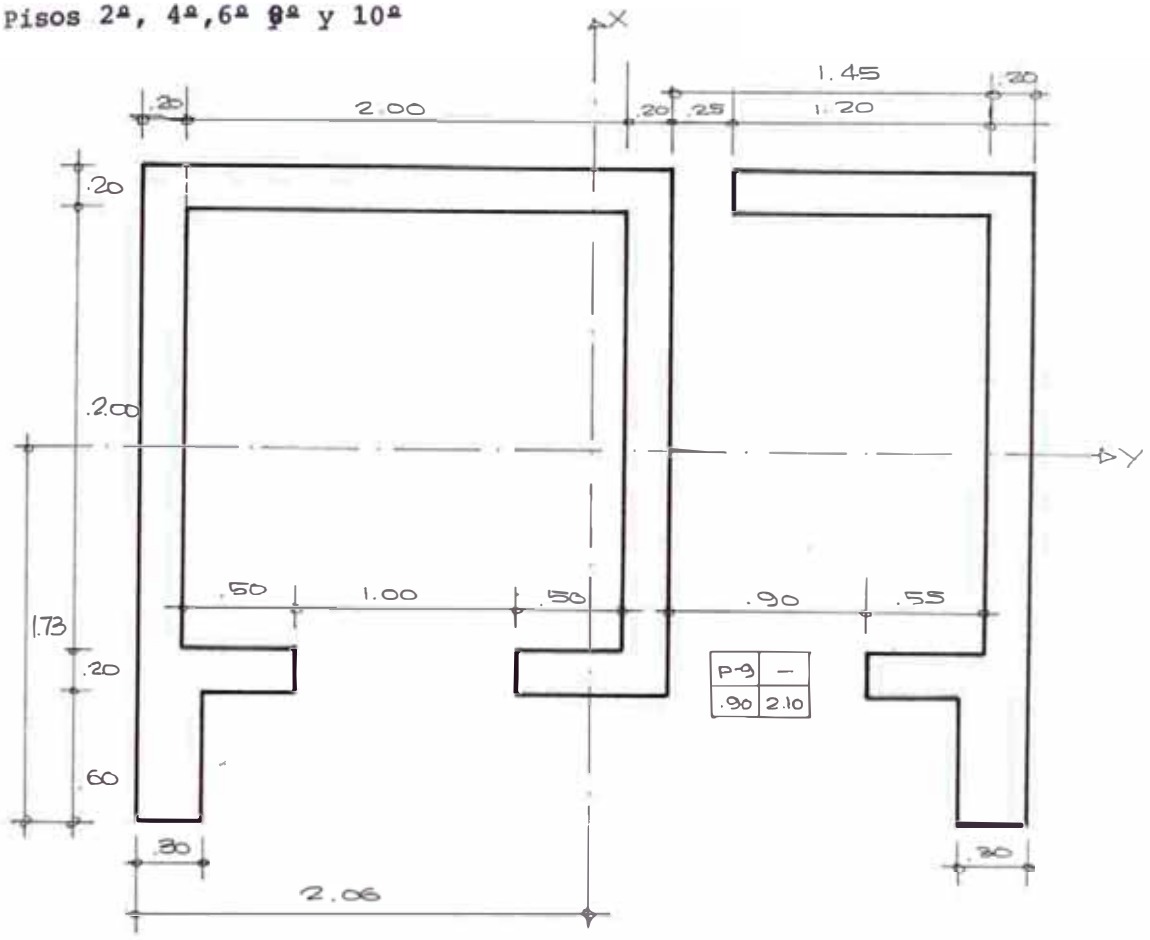
Rigidez relativa:

$$K_{w2} = \frac{1'699,200}{100} = 16.992$$ K_{w1} = 16,992

Area de la sección = 29,800 cm^2

r = 0.68 (encontrado anteriormente)

Pisos 2ª, 4ª, 6ª 8ª y 10ª



CALCULO DEL MOMENTO DE INERCIA DE LA SECCION RESPECTO DEL EJE X

Sec.	b cm.	h cm.	Area cm2	$\bar{y}$	$\bar{y}^2$	$A\bar{y}^2$	$I_{Gx}=\frac{1}{12}bh^3$	$I_{xx}=I_{Gx}+A\bar{y}^2$
1	60	30	1,800	-191	36,481	65'665,800	135,000	65'800,800
2	60	30	1,800	+184	33,856	60'940,800	135,000	61'075,800
3	20	70	1,400	-171	29,241	40,937,400	571,600	41'509,000
4	220	20	4,400	-196	38,416	169'030,400	146,664	169'177.064
5	20	200	4,000	- 86	7,396	29'584,000	13333,328	42'917,328
6	20	120	2,400	+119	14,161	33'986,400	2'880,000	36'866,400
7	220	20	4,400	+189	35,721	157'172,400	146,664	157'319,064
8	20	75	1,500	161.5	26,082	39'123,000	703,125	39'826,125
9	20	70	1,400	-1	1	1,400	571,438	572,838
10	220	20	4,400	+24	576	2'534,400	146,664	2'681,064
			27,500					617'745,483
								≅ 617'745,500

I_{xx} = 617,745,400

$K = \frac{617'745,500}{270}$ = 2'282,000 K = 2'282,000

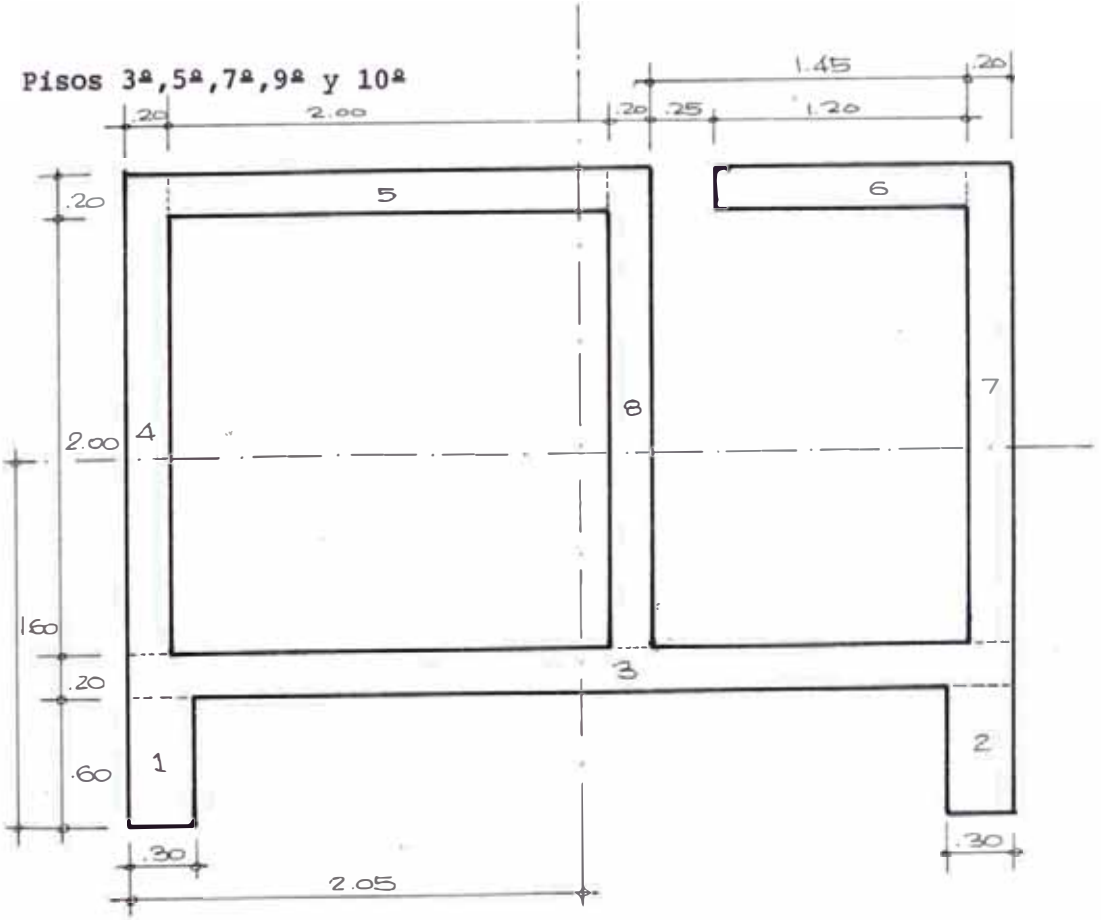
Rigidez relativa:

$K_1 = \frac{2'282,000}{100}$ = 22,820 K_{2-4} = 22,820

Area de la sección = 27,500 cm^2

r = 0.555

Pisos 3ª,5ª,7ª,9ª y 10ª



CALCULO DEL MOMENTO DE INERCIA DE LA SECCION RESPECTO DEL EJE "X"

Sec.	b cm.	h cm.	Area cm2.	$\bar{y}$	$\bar{y}^2$	$A\bar{y}^2$	$I_{Gx}=\frac{1}{12}nh^3$	$I_{xx}=I_{Gx}+A\bar{y}^2$
1	60	30	1,800	-190	36,100	64'980,000	135,000	65'085,000
2	60	30	1,800	+185	34,225	61'605,000	135,000	61'740,000
3	20	405	8,100	-2.5	6.25	50,625	110'716.875	110'767,500
4	220	20	4,400	-195	38,025	167'310,000	146,664	167'464,664
5	20	200	4,000	-85	7,225	28'900,000	13'333,328	42'233,328
6	20	120	2,400	120	14,400	34'560,000	2'880,000	37'440,000
7	220	20	4,400	190	36,100	158,840,000	146,664	158'986,664
8	220	20	4,400	25	625	2'750,000	146,664	2'896,664
			31,300					646'605,820

$$K = \frac{646'605,820}{270} = 2'395,000$$

Rigidez relativa

$$K = \frac{2'395,000}{100} = 23,950 \qquad K = 23,950$$

$A_w = 31,300\ cm^2$ $\qquad r = 0.84$

Primer Tanteo

Placa de sección I

Deformación por flexión δ_B

ℓ	V_n As.	h_n	$V_n h_n$ $x10^2$	M'_n $x10^2$	$2M'_n$ $x10^2$	K_{wn}	$\frac{2Mn}{K_{wn}}$	$4\Delta_{Bn}$	3/hn	δ_{Bn}
1	1	270	$2.7x10^2$	2.7	2.7	8480	0.0328	94,398	1/90	1.048
0	3	270	8.1	10.8	13.5	8,480	0.159	94.207	1/90	1.046
	6	270	16.2	27.0	37.8	8,480	0.445	93.603	1/90	1.040
	10	270	27.0	54.0	81.0	8,480	0.955	92,203	1/90	1.024
	14	270	37.8	91.8	145.8	8,480	1.719	89.529	1/90	0.994
	16	270	43.2	135.	226.8	8,480	2.674	85.136	1/90	0.946
	20	270	54.0	189.0	324.0	8,480	3.821	78.641	1/90	0.873
	25	270	67.5	256.5	445.5	8,480	5.253	69.567	1/90	0.772
	30	270	81.0	337.5	594.0	8,480	7.003	57.310	1/90	0.592
	36	270	97.2	434.7	772.2	8,480	9.106	41.200	1/90	0.457
	42	360	151.2	585.9	1020.6	8,480	16.0471	16.047	1/120	0.134

eformación por Corte

$s_W = \frac{KVn}{A_{wn}} = K = 1$ (Factor de forma para sección I $\qquad \delta_{sn} = \frac{27.6x\ Ko\ B}{h_n} xA_{sn}$... B=1

$s11 = \frac{1x1.00}{13.95x10^3} = 0.0717x10^{-3}$ $\qquad \delta_{s11} = 10.2x0.0717x10^{-3} = 0.731x10^{-3}$

$s10 = \frac{1x3.-0}{13.95x10^3} = 0.215x10^{-3}$ $\qquad \delta_{s10} = 10.2x0.215x10^{-3} = 2.20x10^{-3}$

$s9 = \frac{1 \times 6.00}{13.95x10^3} = 0.43x10^{-3}$ $\qquad \delta_{s9} = 10.2x0.43x10^{-3} = 4.39x10^{-3}$

$s8 = \frac{1 \times 10}{13.95x10^3} = 0.717x10^{-3}$ $\qquad \delta_{s8} = 10.2x0.717x10^{-3} = 7.31x10^{-3}$

$s7 = \frac{1 \times 14}{13.95x10^3} = 1.000x10^{-3}$ $\qquad \delta_{s7} = 10.2x1.00x10^{-3} = 10.25x10^{-3}$

$A_{s6} = \frac{1 \times 16}{13.95x10^3} = 1.148x10^{-3}$ | $\delta_{s6} = 10.2x1.148x10^{-3} = 11.70x10^{-3}$

$A_{s5} = \frac{1 \times 20}{13.95x10^3} = 1.432x10^{-3}$ | $\delta_{s5} = 10.2x1.432x10^{-3} = 14.32x10^{-3}$

$A_{s4} = \frac{1 \times 25}{13.95x10^3} = 1.791x10^{-3}$ | $\delta_{s4} = 10.2x1.791x10^{-3} = 18.30x10^{-3}$

$A_{s3} = \frac{1 \times 30}{13.95x10^3} = 2.15x10^{-3}$ | $\delta_{s3} = 10.2x2.15x10^{-3} = 21.95x10^{-3}$

$A_{s2} = \frac{1 \times 36}{13.95x10^3} = 2.58x10^{-3}$ | $\delta_{s2} = 10.2x2.88x10^{-3} = 26.30x10^{-3}$

$A_{s1} = \frac{1 \times 42}{13.95x10^3} = 3.01x10^{-3}$ | $\delta_{s1} = 7.66x3.01x10^{-3} = 23.00x10^{-3}$

Considerando la deformación por rotación $\delta_{Bn} = 0$

VALOR "D" $D = \frac{V_n}{\delta tn}$

n	V_n	δ_{Bn}	δ_{sn}	δ_{tn}	D_{wn}
11	1.00	1.048	0.0007	1.048	0.954
10	3.00	1.046	0.002	1.048	2.862
9	6.00	1.040	0.004	1.044	5.747
8	10.00	1.024	0.007	1.031	9.699
7	14.00	0.994	0.010	1.000	14.000
6	16.00	0.946	0.011	0.959	16.718
5	20.00	0.875	0.014	0.851	23.501
4	25.00	0.772	0.018	0.790	31.645
3	30.00	0.592	0.021	0.613	48.939
2	36.00	0.452	0.026	0.478	75.313
1	42.00	0.134	0.023	0.157	267.515

DEFORMACION POR FLEXION DE LA CAJA DEL ASCENSOR.

Nº	V	hn	$V_n h_n$ $x10^2$	M'_n $x10^2$	$2M'_n$ $x10^2$	K_{wn}	$\frac{2Mn}{K_{wn}}$	$4\Delta Bn$	3/hn	δ_{Bn}
11	2.	270	5.4	5.4	5.4	23950	0.022	107.384	1/90	1.193
10	6.0	270	16.2	21.6	27.0	22850	0.118	107.244	1/90	1.191
9	15	270	40.5	62.1	83.7	23950	0.349	106.777	1/90	1.186
8	26	270	70.2	132.3	194.4	22850	0.850	105.568	1/90	1.172
7	38	270	102.6	234.9	367.2	23950	1.533	103.185	1/90	1.146
6	50	270	135.0	369.9	604.8	22850	2.641	99.006	1/90	1.100
5	75	270	202.5	572.4	942.3	23950	3.934	92,426	1/90	1.026
4	92	270	248.4	820.8	1393.2	22850	6.097	82.395	1/90	0.915
3	106	270	286.2	1107.0	1927.8	23950	8.049	68.249	1/90	0.758
2	112	270	302.4	1409.4	2516.4	22850	11.012	40.188	1/90	0.546
1	118	360	424.8	1834.2	3243.6	16992	19.088	19.088	1/120	0.159

DEFORMACION POR CORTE

$$A_{sw} = \frac{K\ V_n}{A_{wn}} \qquad K = 1.2 \qquad \delta_{sn} = \frac{27.6\ K_o B}{h_n} \times A_{sn}$$

$\delta_f = 1/r \times \delta_s$

Primer piso $r = 0.68$

2ª,4ª,6ª,8ª y 10ª $r = 0.555$

3ª,5ª,7ª,9ª y 11ª $r = 0.84$

$\delta_{f11} = 1/0.84 \times 0.782 \times 10^{-3} = 0.930 \times 10^{-3}$

$\delta_{f10} = 1/0.555 \times 2.67 \times 10^{-3} = 4.86 \times 10^{-3}$

$\delta_{f9} = 1/0.84 \times 5.86 \times 10^{-3} = 6.96 \times 10^{-3}$

$\delta_{f8} = 1/0.555 \times 11.58 \times 10^{-3} = 21.50 \times 10^{-3}$

$\delta_{f7} = 1/0.84 \times 14.85 \times 10^{-3} = 17.68 \times 10^{-3}$

$\delta_{f6} = 1/0.555 \times 22.22 \times 10^{-3} = 40.50 \times 10^{-3}$

$\delta_{f5} = 1/0.84 \times 28.80 \times 10^{-3} = 34.30 \times 10^{-3}$

$\delta_{f4} = 1/0.555 \times 41.00 \times 10^{-3} = 74.60 \times 10^{-3}$

$\delta_{f3} = 1/0.84 \times 41.4 \times 10^{-3} = 49.5 \times 10^{-3}$

$\delta_{f2} = 1/0.555 \times 5.00 \times 10^{-3} = 91.00 \times 10^{-3}$

$\delta_{f1} = 1/0.68 \times 36.4 \times 10^{-3} = 53.5 \times 10^{-3}$

VALOR "D"

$$D = \frac{V_n}{\delta_{tn}}$$

n	V_n	δ_{Bn}	δ_{sn}	δ_{tn}	D_{w2}
11	2.00	1.193	0.001	1.194	1.675
10	6.00	1.191	0.004	1.195	5.020
9	15.00	1.186	0.007	1.193	12.57
8	26.00	1.172	0.021	1.193	21.79
7	38.00	1.146	0.017	1.161	32.73
6	50.00	1.100	0.040	1.140	43.85
5	75.00	1.026	0.034	1.060	70.75
4	92.00	0.915	0.074	0.989	93.02
3	106.00	0.758	0.044	0.807	131.35
2	112.00	0.546	0.091	0.637	175.82
1	118.00	0.159	0.053	0.212	556.603

DISTRIBUCION DEL CORTE.

$$V_w = V_n \times \frac{D_{wn}}{\Sigma Dw}$$

n	V_n	ΣD_c	D_{w1}	D_{w2}	$\Sigma D_{Tot.}$	V_{w1}	V_{w2}
11	49.34	32.01	0.95	1.67	34.63	1.352	2.378
10	89.59	33.40	2.86	5.02	41.28	6.20	10.894
9	126.09	33.40	5.74	12.57	51.71	13.994	30.645
8	158.54	38.40	9.70	21.79	64.89	14.41	29.917
7	187.22	33.40	14.00	32.73	80.13	32.704	76.457
6	211.69	33.40	16.72	43.85	93.97	37.653	98.750
5	232.54	33.40	23.50	70.75	127.65	42.793	128.83
4	249.41	33.40	31.64	93.02	158.06	49.263	144.832
3	262.44	33.40	48.94	131.35	213.69	60.098	161.297
2	271.52	33.40	75.31	175.82	284.53	71.845	166.149
1	276.25	47.96	267.515	556.603	872.078	82.92	270.34

Segundo Tanteo

Placa de sección I

Deformación por flexión δ_B

nº	V_n	h_n	$V_n h_n$ $x10^2$	M'n $x10^2$	2M'n $x10^2$	K_{wn}	$\frac{2Mn}{K_{wn}}$	$4\Delta Bn$	3/hn	δ_{Bn}
11	1.5	270	4.05	4.05	4.05	8,480	0.047	205.267	1/90	2.280
10	6.0	270	16.2	20.25	24.3	8,480	0.286	204.934	1/90	2.277
9	14	270	37.8	58.05	78.3	8,480	0.923	203.725	1/90	2.363
8	24	270	64.3	122.85	180.9	8,480	2.133	200.699	1/90	2.229
7	33	270	98.1	211.95	334.8	8,480	3.948	194.588	1/90	2.162
6	38	270	102.6	314.55	526.5	8,480	6.208	184.432	1/90	2.049
5	43	270	116.1	430.65	745.2	8,480	8.787	169.437	1/90	1.882
4	50	270	135.0	565.75	996.4	8,480	11.750	148,900	1/90	1.654
3	60	270	162.0	727.75	1293.5	8,480	15.253	121.897	1/90	1.354
2	72	270	194.4	922.15	1649.9	8,480	19.456	87.188	1/90	0.968
1	86	360	309.6	1231.75	2153.9	6.360	33.866	33.866	1/120	0.282

DEFORMACION POR CORTE

$$A_{sw} = \frac{K\ V_n}{A_{wn}} \qquad \delta_{sn} = \frac{27.6\ K_o\ B}{h_n}\ A_{sn} \qquad B = 1$$

$$A_{s11} = \frac{1.0 \times 1.5}{13.95x10^3} = 0.108 \times 10^{-3} \qquad \delta_{s11} = 10.2x0.108x10^{-3} = 1.10x10^{-3}$$

$$A_{s10} = \frac{1.0 \times 6.}{13.95x10^3} = 0.430 \times 10^{-3} \qquad \delta_{s10} = 10.2x0.430x10^{-3} = 4.40x10^{-3}$$

$$A_{s9} = \frac{1.0 \times 14}{13.95x10^3} = 1.000x10^{-3} \qquad \delta_{s9} = 10.2x1.00x10^{-3} = 10.2x10^{-3}$$

$$A_{s8} = \frac{1.0 \times 24}{13.95x10^3} = 1.72x10^{-3} \qquad \delta_{s8} = 10.2x1.72x10^{-3} = 17.50x10^{-3}$$

$$A_{s7} = \frac{1.0 \times 33}{13.95x10^3} = 2.36x10^{-3} \qquad \delta_{s7} = 10.2x2.36x10^{-3} = 24.08x10^{-3}$$

$$A_{s6} = \frac{1.0 \times 38}{13.95x10^3} = 2.72x10^{-3} \qquad \delta_{s6} = 10.2x2.72x10^{-3} = 27.80x10^{-3}$$

$$A_{s5} = \frac{1.0 \times 43}{13.95x10^3} = 3.08 \times 10^{-3} \qquad \delta_{s5} = 10.2x3.08x10^{-3} = 31.40x10^{-3}$$

$$A_{s4} = \frac{1.0 \times 50}{13.95x10^3} = 3.58x10^{-3} \qquad \delta_{s4} = 10.2x3.58x10^{-3} = 36.6x10^{-3}$$

$$A_{s3} = \frac{1.0 \times 60}{13.95x10^{3}} = 4.30x10^{-3} \qquad \delta_{s3} = 10.2x4.30x10^{-3} = 43.8x10^{-3}$$

$$A_{s2} = \frac{1.0 \times 86}{13.95x10^{3}} = 5.16x10^{-3} \qquad \delta_{s2} = 10.2x5.16x10^{-3} = 52.60\ x10^{-3}$$

$$A_{s1} = \frac{1.0 \times 86}{13.95x10^{3}} = 6.16x10^{-3} \qquad \delta_{s1} = 76.6x6.16x10^{-3} = 47.20x10^{-3}$$

CONSIDERANDO IGUALMENTE LA DEFORMACION POR ROTACION $\delta_{Rn}=0$

VALOR "D" $\quad D = \frac{V_n}{\delta_{tn}}$

n	V_n	δ_{Bn}	δ_{sn}	δ_{tn}	D_{w1}
11	1.5	2.280	0.001	2.281	0.657
10	6.0	2.277	0.004	2.281	2.630
9	14.0	2.363	0.010	2.373	5.899
8	24.0	2.229	0.017	2.246	10.685
7	33.0	2.162	0.024	2.186	15.096
6	38.0	2.049	0.027	2.076	18.304
5	43.0	1.882	0.031	1.913	22.477
4	50.0	1.654	0.036	1.660	30.120
3	60.0	1.354	0.043	1.397	42.949
2	72.0	0.968	0.052	1.020	70.588
1	86.0	0.282	0.047	0.329	261.398

DEFORMACION POR FLEXION DE LA CAJA DEL ASCENSOR: δ_{Bn}

N	V_n	h_n	$V_n h_n$ $x10^2$	M'n $x10^2$	2M'n $x10^2$	K_{wn}	$\frac{2Mn}{K_{wn}}$	$4\Delta_{Bn}$	3/hn	δ_{Bn}
11	2.0	270	5.4	5.4	5.4	23,950	0.0225	182,034	1/902	2.022
10	10	270	27.0	32.4	37.8	22,850	0.165	181,847	1/900	2.020
9	30	270	81.0	113.4	145.8	23,950	0.608	181,074	1/90	2.011
8	53	270	143.1	256.5	369.9	22,850	1.618	178,848	1/90	1.987
7	76	270	205.2	461.7	718.2	23,950	2.998	174.232	1/90	1.935
6	98	270	264.6	726.3	1188.0	22,850	5.199	166,035	1/90	1.844
5	128	270	345.6	1071.9	1798.2	23,950	7.508	153.328	1/90	1.703
4	146	270	394.2	1466.1	2538.0	22,850	11.107	134.713	1/90	1.496
3	161	270	343.7	1809.8	3275.9	23,950	13.678	109.928	1/90	1.221
2	168	270	453.6	2263.4	4073.2	22,850	17.825	78.425	1/90	0.871
1	173	360	622.8	2886.2	5149.6	16,992	30.300	30.300	1/120	0.252

Deformación por corte.

$$\gamma_{sw} = \frac{K\ V_n}{A_{wn}}$$

$\gamma_{s11} = \frac{1.2 \times 2.0}{31.3 \times 10^3} = 0.0767 \times 10^{-3}$	$\delta_{s11} = 10.2 \times 0.0767 \times 10^{-3} = 0.782 \times 10^{-3}$
$\gamma_{s10} = \frac{1.2 \times 10}{27.5 \times 10^3} = 0.436 \times 10^{-3}$	$\delta_{s10} = 10.2 \times 0.436 \times 10^{-3} = 4.45 \times 10^{-3}$
$\gamma_{s9} = \frac{1.2 \times 30}{31.3 \times 10^3} = 1.15 \times 10^{-3}$	$\delta_{s9} = 10.2 \times 1.15 \times 10^{-3} = 11.72 \times 10^{-3}$
$\gamma_{s8} = \frac{1.2 \times 53}{27.5 \times 10^3} = 2.31 \times 10^{-3}$	$\delta_{s8} = 10.2 \times 2.31 \times 10^{-3} = 23.40 \times 10^{-3}$
$\gamma_{s7} = \frac{1.2 \times 76}{31.3 \times 10^3} = 2.91 \times 10^{-3}$	$\delta_{s7} = 10.2 \times 2.91 \times 10^{-3} = 29.70 \times 10^{-3}$
$\gamma_{s6} = \frac{1.2 \times 98}{27.5 \times 10^3} = 4.28 \times 10^{-3}$	$\delta_{s6} = 10.2 \times 4.28 \times 10^{-3} = 43.60 \times 10^{-3}$
$\gamma_{s5} = \frac{1.2 \times 128}{31.3 \times 10^3} = 4.92 \times 10^{-3}$	$\delta_{s5} = 10.2 \times 4.92 \times 10^{-3} = 50.10 \times 10^{-3}$
$\gamma_{s4} = \frac{1.2 \times 146}{27.5 \times 10^3} = 6.38 \times 10^{-3}$	$\delta_{s4} = 10.2 \times 6.38 \times 10^{-3} = 65.0 \times 10^{-3}$
$\gamma_{s3} = \frac{1.2 \times 161}{31.3 \times 10^3} = 6.18 \times 10^{-3}$	$\delta_{s3} = 10.2 \times 6.18 \times 10^{-3} = 63.0 \times 10^{-3}$
$\gamma_{s2} = \frac{1.2 \times 168}{27.5 \times 10^3} = 7.34 \times 10^{-3}$	$\delta_{s2} = 10.2 \times 7.34 \times 10^{-3} = 74.90 \times 10^{-3}$
$\gamma_{s1} = \frac{1.2 \times 173}{29.8 \times 10^3} = 6.97 \times 10^{-3}$	$\delta_{s1} = 7.66 \times 6.97 \times 10^{-3} = 53.40 \times 10^{-3}$

Corrección por Marco.

$\delta_f = 1/r \quad \delta_s$

Primer piso r = 0.68

2ª,4ª,6ª,8ª y 10ª r = 0.555

3ª,5ª,7ª,9ª y 11ª r = 0.84

$\delta_{f11} = 1/0.84 \times 0.782 \times 10^{-3} = 0.930 \times 10^{-3}$

$\delta_{f10} = 1/0.555 \times 4.45 \times 10^{-3} = 8.01 \times 10^{-3}$

$\delta_{f9} = 1/0.84 \times 11.72 \times 10^{-3} = 14.00 \times 10^{-3}$

$\delta_{f8} = 1/0.555 \times 23.40 \times 10^{-3} = 42.20 \times 10^{-3}$

$\delta_{f7} = 1/0.84 \times 29.70 \times 10^{-3} = 35.4 \times 10^{-3}$

$\delta_{f6} = 1/0.555 \times 43.60 \times 10^{-3} = 78.5 \times 10^{-3}$

$\delta_{f5} = 1/0.84 \times 50.10 \times 10^{-3} = 59.6 \times 10^{-3}$

$\delta_{f4} = 1/0.555 \times 65.0 \times 10^{-3} = 117.00 \times 10^{-3}$

$\delta_{f3} = 1/0.84 \times 63.00 \times 10^{-3} = 75.00 \times 10^{-3}$

$\delta_{f2} = 1/0.555 \times 74.9 \times 10^{-3} = 135.00 \times 10^{-3}$

$\delta_{f1} = 1/0.62 \times 71.10 \times 10^{-3} = 78.6 \times 10^{-3}$

Valor "D"

$$D_n = \frac{V_n}{\delta tn}$$

n	V_n	δ_{Bn}	δ_{sn}	δ_{tn}	D_{w2}
11	2.00	2.022	0.001	2.023	1.746
10	10.00	2.020	0.008	2.028	4.930
9	30.00	2.011	0.014	2.025	14.810
8	53.00	1.987	0.042	2.029	26.121
7	76.00	1.935	0.035	1.970	38.578
6	98.0	1.844	0.078	1.922	50.988
5	128.00	1.703	0.059	1.762	72.644
4	146.00	1.496	0.017	1.613	90.514
3	161.00	1.221	0.075	1.296	124.228
2	168.00	0.871	0.135	1.006	166.998
1	173.00	0.252	0.078	0.330	524.242

DISTRIBUCION DEL CORTE

$$V_{wn} = \frac{D_{wn}}{\Sigma D_w} \quad V_n$$

n	V_n	ΣD_c	D_{w1}	D_{w2}	$\Sigma D = \Sigma D_c + D_{w1} + D_{w2}$	V_{w1}	V_{w2}
11	49.34	32.01	0.657	1.746	34.413	0.939	2.496
10	89.59	33.40	2.630	4.930	40.960	5.751	10.781
9	126.09	33.40	5.899	14.810	54.109	13.744	34.507
8	158.54	33.40	10.685	26.121	70.206	24.041	58.772
7	187.22	33.40	15.096	38.578	87.074	32.456	82.942
6	211.69	33.40	18.304	50.988	102.692	37.706	105.035
5	232.54	33.40	22.477	72.644	128.521	40.458	130.759
4	249.41	33.40	33.120	90.514	154.034	53.323	145.727
3	262.44	33.40	42.949	124.228	200.577	55.833	161.574
2	271.52	33.40	70.588	166.998	270.986	70.588	166.998
1	276.25	47.96	261.398	524.242	833.600	86.522	173.524

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laca de sección I.- Deformación por flexión: δ_B

ª	V_n	h_n	$V_n h_n$ x10^2	M'n x10^2	2M'n x10^2	K_{wn}	$\frac{2Mn}{K_{wn}}$	$4\Delta_{Bn}$	3/hn	δ_{Bn}
11	1.	270	2.7	2.7	2.7	8,480	0.032	198.004	1/90	2.200
10	6.	270	16.2	18.9	21.6	8,480	0.254	197.718	1/90	2.196
9	14	270	37.8	56.7	75.6	8,480	0.891	196.573	1/90	2.184
8	24	270	64.8	121.5	178.2	8,480	2.104	103.578	1/90	2.150
7	32	270	86.4	207.9	329.4	8,480	3.884	187.590	1/90	2.084
6	38	270	102.6	310.5	518.4	8,480	6.113	177.593	1/90	1.973
5	40	270	108.0	418.5	729.0	8,480	8.596	162.884	1/90	1.809
4	48.	270	129.6	548.1	966.6	8,480	11.398	142.890	1/90	1.583
3	56	270	151.2	699.3	1247.4	8,480	14.709	116.783	1/90	1.297
2	70	270	189.0	883.0	1582.3	8,480	18.659	83.415	1/90	0.926
1	80	360	288.0	1176.30	2059.3	6,360	32.378	32.378	1/120	0.269

DEFORMACION POR CORTE

$$A_{sw} = \frac{K\ V_n}{A_{wn}}$$

$$A_{s11} = \frac{1 \times 1.00}{13.95x10^3} = 0.0716x10^{-3} \qquad \delta_{s11} = 10.2x0.074x10^{-3} = 0.732x10^{-3}$$

$$A_{s10} = \frac{1 \times 6.0}{13.95x10^3} = 0.43 \times 10^{-3} \qquad \delta_{s10} = 10.2x0.43x10^{-3} = 4.38 \times 10^{-3}$$

$$A_{s9} = \frac{1 \times 14}{13.95x10^3} = 1.00x10^{-3} \qquad \delta_{s9} = 10.2x1.00x10^{-3} = 10.2x10^{-3}$$

$$A_{s8} = \frac{1 \times 24}{13.95x10^3} = 1.72x10^{-3} \qquad \delta_{s8} = 10.2x1.72x10^{-3} = 17.55x10^{-3}$$

$$A_{s7} = \frac{1 \times 32}{13.95x10^3} = 2.95x10^{-3} \qquad \delta_{s7} = 10.2x2.95x10^{-3} = 23.40x10^{-3}$$

$$A_{s6} = \frac{1 \times 38}{13.95x10^3} = 2.73x10^{-3} \qquad \delta_{s6} = 10.2x2.73x10^{-3} = 27.80x10^{-3}$$

$$A_{s5} = \frac{1 \times 40}{13.95x10^3} = 2.86x10^{-3} \qquad \delta_{s5} = 10.2x2.86x10^{-3} = 29.21x10^{-3}$$

$$A_{s4} = \frac{1 \times 48}{13.95x10^3} = 3.44x10^{-3} \qquad \delta_{s4} = 10.2x3.44x10^{-3} = 35.5x10^{-3}$$

$$A_{s3} = \frac{1 \times 56}{13.95x10^3} = 4.02x10^{-3} \qquad \delta_{s3} = 10.2x4.02x10^{-3} = 41.00x10^{-3}$$

A_{s2}

$$A_{s2} = \frac{4 \times 70}{13.95x10^{3}} = 5.02x10^{-3} \quad | \quad \delta_{s2} = 10.2 \times 5.02x10^{-3} = 51.2x10^{-3}$$

$$A_{s1} = \frac{1 \times 80}{13.95x10^{3}} = 5.74x10^{-3} \quad | \quad \delta_{s1} = 76.6x5.74x10^{-3} = 44.0x10^{-3}$$

Considerando igualmente la deformación por rotación $\delta_{Rn} = 0$

Valor "D"

$$D = \frac{V}{\delta tn}$$

n	V_n	δ_{Bn}	δ_{sn}	δ_t	D_{wn}
11	1.00	2.200	0.0007	2.200	0.454
10	6.00	2.196	0.004	2.200	2.727
9	14.00	2.184	0.010	2.194	6.380
8	24.00	2.150	0.017	2.167	11.075
7	32.00	2.084	0.023	2.107	15.187
6	38.00	1.973	0.027	2.000	19.000
5	40.00	1.809	0.029	1.838	21.760
4	48.00	1.583	0.035	1.618	29.666
3	56.00	1.297	0.041	1.338	41.853
2	70.00	0.926	0.051	0.977	71.648
1	80.00	0.269	0.044	0.313	255.591

DEFORMACION POR FLEXION DE LA CAJA DEL ASCENSOR: δ_{Bn} =

Nº	V_n	h_n	$V_n h_n$ x10^2	M'n x10^2	2M'n x10^2	K_{wn}	$\frac{2Mn}{K_{wn}}$	$4\Delta Bn$	3/hn	δ_{Bn}
11	2.5	270	6.75	6.75	6.75	23,950	0.0281	195.140	1/90	2.168
10	11	270	29.7	36.45	43.20	22,850	0.189	194.923	1/90	2.165
9	34	270	91.80	128.25	164.70	23,950	0.687	194.047	1/90	2.156
8	59	270	159.3	287.55	415.8	22,850	1.819	191.541	1/90	2.128
7	83	270	244.1	511.65	799.8	23,950	3.255	186.467	1/90	2.071
6	105	270	283.5	795.15	1306.8	22,850	5.719	177.493	1/90	1.972
5	130	270	351.0	1146.15	1941.3	23,950	8.105	163.669	1/90	1.818
4	145	270	391.5	1537.65	2683.8	22,850	11.745	143.819	1/90	1.597
3	162	270	437.4	1975.05	3512.7	23,850	14.666	117.408	1/90	1.304
2	166	270	448.2	2423.25	4398.3	22,850	19.248	83.494	1/90	0.927
1	170	360	612.0	3035.25	5458.5	16,992	32.123	32.123	1/120	0.267

Deformación por corte

$$A_{sw} = \frac{K\ V_n}{A_{wb}}$$

$$A_{s11} = \frac{1.2 \times 2.5}{31.3x10^3} = 0.0959x10^{-3} \qquad \delta_{s11} = 10.2x0.0959x10^{-3} = 0.980x10^{-3}$$

$$A_{s10} = \frac{1.2 \times 11}{27.5x10^3} = 0.48x10^{-3} \qquad \delta_{s10} = 10.2x0.48x10^{-3} = 4.90x10^{-3}$$

$$A_{s9} = \frac{1.2 \times 34}{31.3x10^3} = 1.305x10^{-3} \qquad \delta_{s9} = 10.2x1.305x10^{-3} = 13.30x10^{-3}$$

$$A_{s8} = \frac{1.2 \times 59}{27.5x10^3} = 2.576 \times 10^{-3} \qquad \delta_{s8} = 10.2x2.576x10^{-3} = 26.30x10^{-3}$$

$$A_{s7} = \frac{1.2 \times 83}{31.3x10^3} = 3.18x10^{-3} \qquad \delta_{s7} = 10.2x3.18x10^{-3} = 32.50x10^{-3}$$

$$A_{s6} = \frac{1.2 \times 105}{27.5x10^3} = 4.58x10^{-3} \qquad \delta_{s6} = 10.2x4.58x10^{-3} = 46.80x10^{-3}$$

$$A_{s5} = \frac{1.2 \times 130}{31.3x10^3} = 5.40x10^{-3} \qquad \delta_{s5} = 10.2x5.40x10^{-3} = 55.01x10^{-3}$$

$$A_{s4} = \frac{1.2 \times 145}{27.5x10^3} = 6.33x10^{-3} \qquad \delta_{s4} = 10.2x6.33x10^{-3} = 64.6x10^{-3}$$

$$A_{s3} = \frac{1.2 \times 162}{31.3x10^3} = 6.22 \times 10^{-3} \qquad \delta_{s3} = 10.2x6.22x10^{-3} = 63.40x10^{-3}$$

$$A_{s2} = \frac{1.2 \times 166}{27.5x10^3} = 7.24 \times 10^{-3} \qquad \delta_{s2} = 10.2x7.24x10^{-3} = 73.8x10^{-3}$$

$$A_{s1} = \frac{1.2 \times 170}{29.8x10^3} = 6.85x10^{-3} \qquad \delta_{s1} = 7.66x6.85x10^{-3} = 52.5x10^{-3}$$

CORRECCION POR MARCO

$\delta_f = 1/r \ \delta_s$

Primer piso	r = 0.68
2ª,4ª,6ª,8ª, y 10ª	r = 0.555
3ª,5ª,7ª,9ª, y 11ª	r = 0.84

$\delta_{f11} = 1/0.84 \times 0.980 \times 10^{-3} = 1.17 \times 10^{-3}$

$\delta_{f10} = 1/0.555 \times 4.90 \times 10^{-3} = 8.72 \times 10^{-3}$

$\delta_{f9} = 1/0.84 \times 13.30 \times 10^{-3} = 15.80 \times 10^{-3}$

$\delta_{f8} = 1/0.555 \times 26.30 \times 10^{-3} = 47.40 \times 10^{-3}$

$\delta_{f7} = 1/0.84 \times 32.50 \times 10^{-3} = 38.70 \times 10^{-3}$

$\delta_{f6} = 1/0.555 \times 46.80 \times 10^{-3} = 83.50 \times 10^{-3}$

$\delta_{f5} = 1/0.84 \times 55.01 \times 10^{-3} = 65.5 \times 10^{-3}$

$\delta_{f4} = 1/0.555 \times 64.60 \times 10^{-3} = 116.50 \times 10^{-3}$

$\delta_{f3} = 1/0.84 \times 63.40 \times 10^{-3} = 75.60 \times 10^{-3}$

$\delta_{f2} = 1/0.555 \times 73.80 \times 10^{-3} = 133.00 \times 10^{-3}$

$\delta_{f1} = 1/0.68 \times 52.50 \times 10^{-3} = 72.00 \times 10^{-3}$

VALOR "D"

$$D_n = \frac{V_n}{\delta_{tn}}$$

N	V_n	δ_{Bn}	δ_{rn}	δ_{tn}	D_{w2}
11	2.50	2.168	0.001	2.169	1.152
10	11.00	2.165	0.008	2.173	5.062
9°	34.00	2.156	0.015	2.171	15.660
8°	59.00	2.128	0.047	2.175	27.126
7°	83.00	2.071	0.038	2.109	39.355
6ª	105.00	1.972	0.083	2.055	51.094
5°	130.00	1.818	0.065	1.883	69.038
4°	145.00	1.597	0.116	1.713	84.646
3°	162.00	1.304	0.075	1.379	117.476
2°	166.00	0.927	0.133	1.060	156.603
1ª	170.00	0.267	0.072	0.339	501.474

DISTRIBUCION DEL CORTE.

n	V_n	ΣD_c	D_{w1}	D_{w2}	ΣD	V_{w1}	V_{w2}
11	49.34	32.01	0.454	1.152	33.616	0.666	1.689
10	89.59	33.40	2.727	5.062	41.189	5.928	11.004
9	126.09	33.40	6.380	15.660	55.440	14.501	35.595
8	158.54	33.40	11.075	27.126	71.601	24.089	60.029
7	187.22	33.40	15.187	39.355	89.942	30.604	81.898
6	211.69	33.40	19.000	51.094	103.494	38.855	104.487
5	232.54	33.40	21.760	69.038	124.198	50.734	129.239
4	249.41	33.40	29.666	84.646	147.712	50.076	142.882
3	262.44	33.40	41.853	117.476	192.729	56.961	159.884
2	271.52	33.40	71.648	156.603	261.451	74.298	162.397
1	276.25	47.96	255.591	501.474	805.025	87.667	172.005

VALOR "D"

$$D_n = \frac{V_n}{\delta_{tn}}$$

n	V_n	δ_{Bn}	δ_{rn}	δ_{tn}	D_{w2}
11	2.5	2.168	0.001	2.169	1.152
10	11.00	2.165	0.008	2.173	5.062
9	34.00	2.156	0.015	2.171	15.660
8	59.00	2.128	0.047	2.175	27.126
7	83.000	2.071	0.038	2.109	39.355
6	105.00	1.972	0.083	2.055	51.094
5	130.00	1.818	0.065	1.883	69.038
4	145.00	1.591	0.116	1.713	84.646
3	162.00	1.304	0.075	1.379	117.476
2	166.00	0.924	0.133	1.060	156.603
1	170.00	0.267	0.072	0.339	501.474

DISTRIBUCION DEL CORTE $\quad V_{wn} = \frac{D_{wn}}{\Sigma D_n} V_n$

n	V_n	ΣD_c	D_{w1}	D_{w2}	ΣD	V_{w1}	V_{w2}
11	49.43	32.01	0.454	1.152	33.616	0.653	1.658
10	89.59	33.40	2.727	5.062	41.189	5.917	10.984
9	126.09	33.40	6.380	15.660	55.400	14.482	35.548
8	158.54	33.40	11.075	27.601	71.601	24.475	59.948
7	187.22	33.40	15.187	39.355	89.942	31.588	81.858
6	211.69	33.40	19.000	51.994	103.494	38.760	104.231
5	232.54	33.40	21.760	69.038	124.198	40.691	129.101
4	249.41	33.40	29.666	84.646	147.712	49.838	142.205
3	262.44	33.40	41.853	117.476	192.729	56.920	159.767
2	271.52	33.40	71.648	156.603	261.451	73.834	161.301
1	276.25	47.96	255.591	501.474	805.025	87.667	276.123

Doy por terminado los tanteos.

RESUMEN:

VALORES "D" EN EL SENTIDO DEL EJE "X"

Nº	PORTICO TIPICO(B)				ΣD_c	D_{w1}	$2D_{w1}$	D_{w2}	ΣD Tot.
	1°Ext	Int.	Ext.	ΣD_c					
11	1,02	2.06	1.02	4.10	32.80	0.043	0.086	0.450	33.336
10	1.24	2.47	1.24	4.95	39.60	0.263	0.526	1.799	41.925
9	1.24	2.47	1.24	4.95	39.60	0.870	1.758	4.959	46.317
8	1.24	2.47	1.24	4.95	39.60	1.770	3.540	9.968	53.108
7	1.24	2.47	1.24	4.95	39.60	3.153	6.306	16.202	62.109
6	1.24	2.47	1.24	4.95	39.60	4.675	9.350	23.400	72.350
5	1.24	2.47	1.24	4.95	39.60	6.560	13.016	31.940	84.558
4	1.24	2.47	1.24	4.95	39.60	8.417	16.834	43.799	100.233
3	1.24	2.47	1.24	4.95	39.60	10.840	21.680	66.063	127.343
2	1.24	2.47	1.24	4.95	39.60	20.427	40.854	100.563	181.017
1	4.66	8.05	4.66	17.37	138.96	59.880	119.760	324.637	583.357

Nª	PORTICO A(2)=PORTICO" C" (2)				ΣD	ΣD	PORTICO B(2)					$ΣD_B$	D_{w1}	D_{w2}	ΣD
	Ext	1°Int	2°Int	3°Int	ΣD	AyC	Ext	1°In	2°In.	3°Int	ΣD				
11	1.06	1.81	1.81	1.81	6.49	25.96	0.456	0.856	0.856	0.856	3.024	6.048	0.454	1.152	33.616
10	1.06	1.81	1.81	1.81	6.49	25.96	0.57	1.05	1.05	1.05	3.72	7.44	2.727	5.062	41.189
9	1.06	1.81	1.81	1.81	6.49	25.96	0.57	1.05	1.05	1.05	3.72	7.44	6.380	15.660	55.440
8	1.06	1.81	1.81	1.81	6.49	25.96	0.57	1.05	1.05	1.05	3.72	7.44	11.075	27.126	71.601
7	1.06	1.81	1.81	1.81	6.49	25.96	0.57	1.05	1.05	1.05	3.72	7.44	15.187	39.355	89.942
6	1.06	1.81	1.81	1.81	6.49	25.96	0.57	1.05	1.05	1.05	3.72	7.44	19.00	51.094	103.494
5	1.06	1.81	1.81	1.81	6.49	25.96	0.57	1.05	1.05	1.05	3.72	7.44	21.760	69.038	124.198
4	1.06	1.81	1.81	1.81	6.49	25.96	0.57	1.05	1.05	1.05	3.72	7.44	29.660	84.646	147.712
3	1.06	1.81	1.81	1.81	6.44	25.96	0.57	1.05	1.05	1.05	3.72	7.44	41.853	117.476	192.729
2	1.06	1.81	1.81	1.81	6.44	25.96	0.57	1.05	1.05	1.05	3.72	7.44	71.648	156.60	261.451
1	1.71	2.15	2.15	2.15	8.16	32.64	1.66	2.0	2.0	2.0	7.66	15.32	255.59	501.47	805.025

DISTRIBUCION DE LOS ESFUERZOS CORTANTES EN COLUMNAS Y PLACAS

Esta fuerza se obtendra repartiendo la fuerza cortante actuante n el piso, proporcionalmente a los valores "D"

$$F_G = \frac{F_n}{\Sigma D} \times D_n$$

La distribución de lafuerza cortante en las diferentes columnas y placas, se encuentran tubuladas en los cuadros siguientes.

FUERZAS CORTANTES EN LAS COLUMNAS PLACAS Y CAJA DE ASCENSOR EN EL ASCENSOR EN EL SENTIDO DEL EJE "X"

Nº	F_n Tn.	Fn:COL.PORTICO TIP.(Tn)			PLACAS Tn.	ASCENSOR Tn.
		EXTERIOR	INTER.	EXTER.		
11	39.84	1.22	2.46	1.22	0.0513	0.537
10	67.76	2.02	3.96	2.02	0.425	2.907
9	93.08	2.46	4.97	2.46	1.758	9.918
8	115.60	2.70	5.38	2.70	3.851	21.690
7	135.50	2.71	5.40	2.71	6.873	35.322
6	152.48	2.62	5.22	2.62	9.850	51.012
5	166.95	2.44	4.86	2.44	12.842	63.053
4	178.65	2.21	4.40	2.21	14.992	78.049
3	187.69	1.83	3.64	1.83	15.967	97.310
2	193.99	1.33	2.64	1.33	21.877	107.700
1	197.27	1.57	2.72	1.57	20.600	111.000

FUERZAS CORTANTES DE LAS COLUMNAS PLACA Y ASCENSOR EN EL SENTIDO DEL EJE "Y"

Nº	F_n Tn.	COLUM.PORTICO A=C(Tn)				COL.PORTICO B (Tn)				PLACA	ASCENSOR
		EXT.	1°INT.	2°INT.	3° INT.	EXT.	1°INT.	2°INT.	3°INT.		
11	49.34	1.55	2.66	2.66	2.66	0.67	1.25	1.25	1.25	0.653	1.658
10	89.59	2.31	3.94	3.94	3.94	1.24	2.29	2.29	2.29	5.919	10.984
9º	125.09	4.12	4.12	4.12	4.12	1.30	2.39	2.39	2.39	14.482	35.548
8º	158.54	4.06	4.06	4.06	4.06	1.28	2.35	2.35	2.35	24.475	59.948
7º	187.22	2.21	3.77	3.77	3.77	1.19	2.18	2.18	2.18	31.588	81.858
6º	211.69	2.17	3.71	3.71	3.71	1.17	2.15	2.15	2.15	38.760	104.231
5º	232.54	1.99	3.49	3.49	3.49	1.25	1.97	1.97	1.97	40.691	129.101
4º	249.41	1,79	3.06	3.06	3.06	0.96	1.77	1.77	1.77	49.838	142.205
3º	262.44	1.44	2.46	2.46	2.46	0.78	1.43	1.43	1.43	56.920	159.767
2º	271.52	1.10	1.88	1.88	1.88	0.59	1.09	1.09	1.09	73.834	161.301
1º	276.25	0.37	0.74	0.74	0.74	0.40	0.69	0.69	0.69	87.667	276.123

DETERMINACION DE LOS PUNTOS DE INFLEXION EN COLUMNAS

Los puntos de inflexión en columnas, las obtendremos de las tablas dadas por el Dr. Kiyoshi Muto.

En este caso usare la tabla correspondiente a fuerzas sismicas distribuidas triangularmente. (Tabla 1-A)

Fórmula: $Y = Y_o + Y_1 + Y_2 + Y_3$

Donde:

Y_o = Porcentaje inicial de la altura que se determina con el valor K y la ubicación del piso "n" en un edificio de n pisos.

Y_1 = Término de corrección, debido a la variación entre rigideces de las vigas superiores e inferiores.

Y_2 = Corrección debido a la variación de altura del piso superior.

Y_3 = Corrección debido a la variación de altura del piso inferior.

En este caso y por mejor ordenamiento del trabajo hare la aplicación en el piso 11, mostrar el modus operandi, pero los valores en si, los dare en una tabla, como veremos a continuación.

Aplicación.... Piso 11 Sentido del eje X.- Col. Exterior

Y_o Tabla 1

$\bar{K} = 0.081 \approx 0.1$ $\quad Y_o = -0.25$

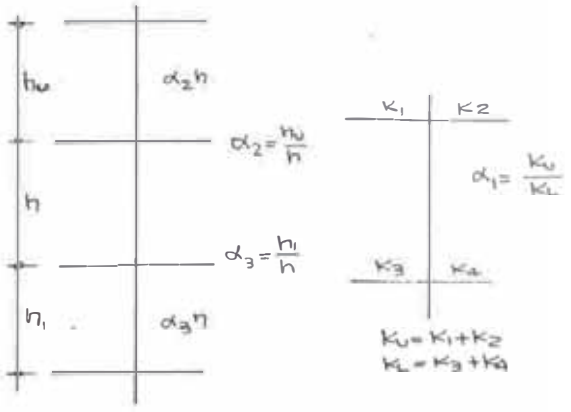
Tabla 2

Y_1 $\quad \alpha_1 = \frac{1.75}{2.62} = 0.62$ $\quad Y_1 = 0.30$

$\bar{K} = 0.1$

Tabla 3

Y_3 $\quad \alpha_3 = \frac{h_1}{h} = \frac{2.7}{2.7} = 1$ $\quad Y_3 = 0$



CALCULO DE LOS PUNTOS DE INFLEXION DE COLUMNAS EN EL SENTIDO DEL EJE "X"

PORTICO PRINCIPAL (TIPICO

NOTA: Los valores de K C 0.1 ,se han aproximado a $\bar{K}$ = 0.1 y para valores mayores de 0.1 y menores que 0.2 se ha interpolado.

Piso	COLUMNA	$\bar{K}$	K_v	K	h_u	h	h_1	α_1	α_2	α_3	Y_o Tabl. 1-A	$Y_1^{(t-2)}$	Y_2^{t-3}	Y_3^{t-3}	Y	Yh
11º	Exter.	0.081	1.75	2.62	0.00	2.70	2.70	0.62	0.00	1.00	-0.25	0.30			0.05	0.135
	Inter.	0.095	3.50	5.24				0.67	0.00		-0.25	0.20	0	--	0.05	-.135
10º	Exter.	0.097	2.62	2.62	2.70	2.70	2.70	1.00	1.00	1.00	-0.05	0.00	---	---	-.05	-.135
	Inter.	0.115	5.24	5.24				1.00			-0.01	0.00	---	---	-.01	-.027
9º	Exter.	0.097	2.62	2.62	2.70	2.70	2.70	1.00	1.00	1.00	0.10	0.00	---	---	0.10	0.270
	Inter.	0.115	5.24	5.24				1.00			0.13	0.00	---	---	0.13	0.350
8º	Exter.	0.097	2.62	2.62	2.70	2.70	2.70	1.00	1.00	1.00	0.20	0.00	---	---	0.20	0.540
	Inter.	0.115	5.24	5.24				1.00			0.22	0.00	---	---	0.22	0.595
7º	Exter.	0.097	2.62	2.62	2.70	2.70	2.70	1.00	1.00	1.00	0.25	0.00	---	---	0.25	0.675
	Inter.	0.115	5.24	5.24				1.00			0.27	0.00	---	---	0.27	0.730
6º	Exter.	0.097	2.62	2.62	2.70	2.70	2.70	1.00	1.00	1.00	0.35	0.00	---	---	0.35	0.945
	Inter.	0.115	5.24	5.24				1.00			0.36	0.00	---	---	0.36	0.972
5º	Exter.	0.097	2.62	2.62	2.70	2.70	2.70	1.00	1.00	1.00	0.40	0.00	---	---	0.40	1.080
	Inter.	0.115	5.24	5.24				1.00			0.40	0.00	---	---	0.40	1.080
4º	Exter.	0.097	2.62	2.62	2.70	2.70	2.70	1.00	1.00	1.00	0.50	0.00	---	---	0.50	1.350
	Inter.	0.115	5.24	5.24				1.00			0.50	0.00	---	---	0.50	1.450
3º	Exter.	0.097	2.62	2.62	2.70	2.70	2.70	1.00	1.00	1.00	0.65	0.00	---	---	0.65	1.750
	Inter.	0.115	5.24	5.24				1.00			0.64	0.00	---	---	0.64	1.730
2º	Exter.	0.097	2.62	2.62	2.70	2.70	2.70	1.00	1.00	1.33	0.85	0.00	---	-.08	0.77	2.080
	Inter.	0.115	5.24	5.24				1.00			0.82	0.00	---	-.08	0.74	2.00
1º	Exter.	0.175	2.62	0.00	2.70	3.60	0.00	---	0.75	0.00	1.12	0.000	-.05	---	1.07	3.85
	Inter.	0.204	5.24	0.00				---			1.05	0.00	-.05	---	1.00	3.60

CALCULO DEL PUNTO DE INFLEXION DE LAS COLUMNAS DE [illegible]

PORTICO "A" - IGUAL AL PORTICO "C"

Piso	Columna	$\bar{K}$	K_u	K_r	h_u	h	h_1	α_1	α_2	α_3	Y_o t-1.A	Y_1 T-2	Y_2 T-3	Y_3 T-3	Y	Yh
11°	Exter.	0.568	2.84	2.84	0.00	2.70	2.70	1.00	0.00	1.00	0.285	---	---	---	0.285	0.77
	Inter.	1.136	5.68	5.68				1.00	0.00	1.00	0.360	---	---	---	0.360	0.97
10°	Exter.	0.568	2.84	2.84	2.70	2.70	2.70	1.00	1.00	1.00	0.385	---	---	---	0.385	1.04
	Inter.	1.136	5.68	5.68				1.00	1.00	1.00	0.460	---	---	---	0.460	1.24
9°	Exter.	0.568	2.84	2.84	2.70	2.70	2.70	1.00	1.00	1.00	0.40	---	---	---	0.40	1.08
	Inter.	1.136	5.68	5.68				1.00	1.00	1.00	0.45	---	---	---	0.45	1.21
8ª	Exter.	0.568	2.84	2.84	2.70	2.70	2.70	1.00	1.00	1.00	0.45	---	---	---	0.45	1.21
	Interp	1.136	5.68	5.68				1.00	1.00	1.00	0.45	---	---	---	0.45	1.21
7ª	Exter.	0.568	2.84	2.84	2.70	2.70	2.70	1.00	1.00	1.00	0.45	---	---	---	0.45	1.21
	Inter.	1.136	5.68	5.68				1.00	1.00	1.00	0.50	---	---	---	0.45	1.21
6ª	Exter.	0.568	2.84	2.84	2.70	2.70	2.70	1.00	1.00	1.00	0.45	---	---	---	0.50	1.35
	Inter.	1.136	5.68	5.68				1.00	1.00	1.00	0.50	---	---	---	0.45	1.21
5ª	Exter.	0.568	2.84	2.84	2.70	2.70	2.70	1.00	1.00	1.00	0.485	---	---	---	0.50	1.35
	Inter.	1.136	5.68	5.58			1.00	1.00	1.00	1.00	0.50	---	---	0.0	0.485	1.31
4ª	Exter.	0.568	2.84	2.84	2.70	2.70	2.70	1.00	1.00	1.00	0.50	---	---	---	0.50	1.35
	Inter.	1.136	5.68	5.68				1.00	1.00	1.00	0.50	0--	---	---	0.50	1.35
3ª	Exter.	0.568	2.84	2.84	2.70	2.70	2.70	1.00	1.00	1.00	0.50	---	---	---	0.50	1.35
	Inter.	1.136	5.68	5.68				1.00	1.00	1.00	0.50	---	---	---	0.50	1.35
2ª	Exter.	0.568	2.84	2.84	2.70	2.70	3.60	1.00	1.00	1.00	0.55	---	---	-0.02	0.53	1.43
	Inter.	1.136	5.68	5.68				1.00	1.00	1.33	0.50	---	---	0.0	0.5	1.35
1ª	Exter.	0.758	2.84	2.84	2.70	3.60	0.00	---	0.75	---	0.75	---	---	---	0.75	2.70
	Inter.	1.516	5.68	0.00				---	0.75	---	0.63	---	---	---	0.63	2.33

CALCULO DEL PUNTO DE INFLEXION DE LAS COLUMNAS ...

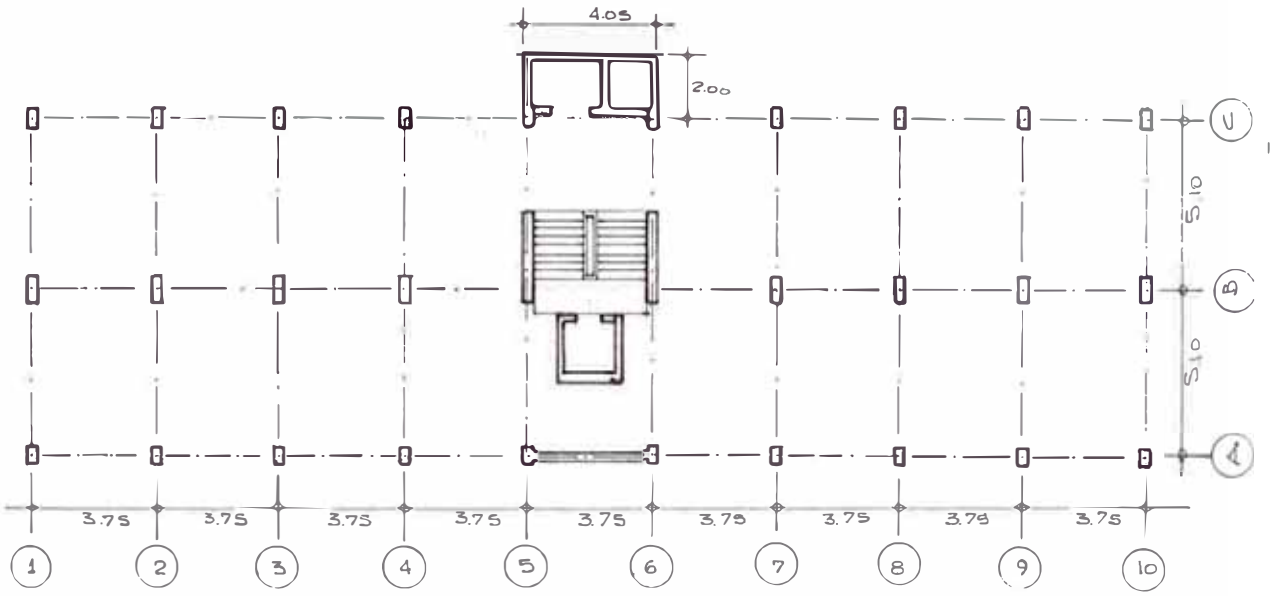
PORTICO DE ARRIOSTRE "B"

Piso	Columnas	$\bar{K}$	K_u	K_L	h_u	h	h_1	α_1	α_2	α_3	Y_{T-1-A}	Y_{T-2}	Y_{T-3}	Y_{T-3}	Y	Yh
11°	Exter.	0.147	0.71	1.25	0.00	2.70	2.70	0.566	1.00	1.00	-.13	0.31	-----	----	0.18	0.486
	Interior	0.294	1.42	2.50				0.566	---	1.00	0.15	0.17	---	---	0.32	0.865
10°	Exterior	0.187	1.25	1.25	2.70	2.70	2.70	1.00	1.00	1.00	0.17	---	---	---	0.17	0.460
	Interior	0.374	2.50	2.50				1.00	1.00	1.00	0.29	---	---	---	0.29	0.783
9°	Exterior	0.187	1.25	1.25	2.70	2.70	2.70	1.00	1.00	1.00	0.27	---	---	---	0.29	0.730
	Interior	0.374	2.50	2.50				1.00	1.00	1.00	0.39	---	---	---	0.39	1.050
8°	Exterior	0.187	1.25	1.25	2.70	2.70	2.70	1.00	1.00	1.00	0.33	---	---	---	0.33	0.890
	Interior	0.374	2.50	2.50				1.00	1.00	1.00	0.40	---	---	---	0.40	1.080
7º	Exterior	0.187	1.25	1.25	2.70	2.70	2.70	1.00	1.00	1.00	0.38	---	---	---	0.38	1.025
	Interior	0.374	2.50	2.50				1.00	1.00	1.00	0.44	---	---	---	0.44	1.190
6º	Exterior	0.187	1.25	1.25	2.70	2.70	2.70	1.00	1.00	1.00	0.40	---	---	---	0.44	1.190
	Interior	0.374	2.50	2.50				1.00	1.00	1.00	0.45	---	---	---	0.45	1.210
5º	Exterior	0.187	1.25	1.25	2.70	2.70	2.70	1.00	1.00	1.00	0.44	---	---	---	0.44	1.190
	Interior	0.374	2.50	2.50				1.00	1.00	1.00	0.45	---	---	---	0.45	1.210
4º	Exterior	0.187	1.25	1.25	2.70	2.70	2.70	1.00	1.00	1.00	0.50	---	---	---	0.50	1.350
	Interior	0.374	2.50	2.50				1.00	1.00	1.00	0.50	---	---	---	0.50	1.350
3º	Exterior	0.187	1.25	1.25	2.70	2.70	2.70	1.00	1.00	1.00	0.56	---	---	---	0.56	1.510
	Interior	0.374	2.50	2.50				1.00	1.00	1.00	0.50	---	---	---	0.50	1.350
2º	Exterior	0.187	1.25	1.25	2.70	2.70	3.60	1.00	1.00	1.33	0.67	---	---	-.05	0.62	1.670
	Interior	0.374	2.50	2.50				1.00	1.00	1.33	0.56	---	-.05	-.01	0.55	1.485
1º	Exterior	0.250	1.25	0.00	2.70	3.60	0.00	---	0.75	---	0.97	---	-.05	---	0.92	3.30
	Interior	0.500	2.50	0.00				---	0.75	---	0.75	---	-.05	---	0.72	2.50

DETERMINACION DEL CENTRO DE MASA

CALCULO DEL CENTRO DE GRAVEDAD

El centro de gravedad de todos los niveles van ha coincidir toda vez que todos tienen las mismas dimensiones y formas geométricas Luego el centro de masa coincide con el centro de gravedad en todos los pisos.



Nº	Areas	A_P	X_P	Y_P	A_PX_P	A_PY_P
1	15x10.2	153	5.10	7.50	780	1,148
2	15x10.2	153	5.10	26.25	780	4,020
3	3.75x5.1	19.1	7.65	16.875	146	322
4	4.05x2.0	8.1	11.20	16.875	91	137
		333.2			1797	5,627

$$\bar{X} = \frac{1,797}{333.2} = 540 \qquad \bar{Y} = \frac{5,627}{333.2} = 16.985$$

DETERMINACION DEL CENTRO DE RIGIDEZ

El centro de rigidez es el centro de gravedad de los valores "D" de las placas y columnas y caja de ascensor.

Fórmulas:

$$Y_{GR} = \frac{\Sigma D_x Y}{\Sigma D_x} \quad \ldots\ldots\ldots (1)$$

$$X_{GR} = \frac{\Sigma D_x X}{\Sigma D_y} \quad \ldots\ldots\ldots (2)$$

Donde:

D_x = suma de rigideces en el sentido del eje "X"

D_y = Suma rigideces en el sentido del eje "Y"

Obtendremos asimismo los valores de las inversas de rigideces por piso

Los momentos de Inercia serán:

1) $I_x = \Sigma (D x Y^2)$

2) $I_y = \Sigma D_y X^2$

Cuando se toman respecto de los ejes que pasan por el centro de gravedad Y

1.A) $I_x = \Sigma D_x Y^2 - Y_{CR}^2 \Sigma D_x$

2.A) $I_y = \Sigma D_y X^2 - X_{CR}^2 \Sigma D_y$

Una consecuencia de la anterior, o sea aplicando Steigner.

CENTRO DE RIGIDECES POR PISO

Piso	Eje	D_x	Y	Y^2	D_xY	D_xY^2	I_x
	1	+17.37	-16.875	285.00	-394.20	4980.00	
	2	+17.37	-13.125	172.50	-228.00	3000.00	
	3	+17.37	- 9.375	88.00	-162.80	1530.00	
	4	+17.37	- 5.625	31.60	- 97.50	550.00	
	5	59.88	- 1.875	3.52	-122.20	210.00	
1ª	5'	324.627	0.000	0.00	0.00	0.00	
	6	59.880	1.875	3.52	112.20	210.00	
	7	17.37	5.625	31.60	97.50	550.00	
	8	17.37	9.375	88.00	162.80	1530.00	
	9	17.37	13.125	172.50	228.00	3000.00	
	10	17.37	16.875	285.00	394.20	4980.00	
	Σ	583.36			0.00		20,520
	1	4.95	-16.875	285.00	-84.00	1410.00	
	2	4.95	-13.125	172.50	-65.00	854.00	
	3	4.95	- 9.375	88.00	-46.40	435.00	
	4	4.95	- 5.625	31.60	-27.80	156.20	
	5	20.425	- 1.875	3.52	-38.30	72.00	
2ª	5'	100.563	0.00	0.00	0.00	0.00	
	6	20.425	1.875	3.52	38.30	72.00	
	7	4.95	5.625	31.60	27.80	156.20	
	8	4.95	9.375	88.00	46.40	435.00	
	9	4.95	13.125	172.50	65.00	854.00	
	10	4.95	16.875	285.00	84.00	1410.00	
	Σ	181.013			0.00	5854.40	5,854.40
	1	4.95	-16.875	285.00	-84.00	1410.00	
	2	4.95	-13.125	175.50	-65.00	854.00	
	3	4.95	- 9.375	88.00	-46.40	435.00	
	4	4.95	- 5.625	31.60	-27.80	156.20	
	5	10.84	- 1.875	3.52	-20.30	38.20	
3ª	5'	66.063	0.000	0.00	0.00	0.00	
	6	10.84	1.875	3.52	20.30	38.20	
	7	4.95	5.625	31.60	27.80	156.20	
	8	4.95	9.375	88.00	46.40	435.00	
	9	4.95	13.125	175.50	65.00	854.00	
	10	4.95	16.875	285.00	84.00	1410.00	
	Σ	127.343			0.00	5786.80	5,786.80

Piso	Eje	D_x	Y	Y^2	D_xY	D_xY^2	I_x
	1	4.95	-16.875	285.00	-84.00	1410.00	
	2	4.95	-13.125	175.50	-65.00	854.00	
	3	4.95	- 9.375	88.00	-46.40	435.00	
	4	4.95	- 5.625	31.60	-27.80	156.20	
	5	8.417	- 1.875	3.52	-15.80	29.60	
4ª	5'	43.799	0.000	0.00	0.00	0.00	
	6	8.417	1.875	3.52	15.80	29.60	
	7	4.95	5.625	31.60	27.80	156.20	
	8	4.95	9.375	88.00	46.40	435.00	
	9	4.95	13.125	175.50	65.00	854.00	
	10	4.95	16.875	285.00	84.00	1410.00	
	Σ	100.033				5769.60	5,769.60
	1	4.95	-16.875	285.00	-84.00	1410.00	
	2	4.95	-13.125	172.50	-65.00	854.00	
	3	4.95	- 9.375	88.00	-46.40	435.00	
	4	4.95	- 5.625	31.60	-27.80	156.20	
	5	6.56	- 1.875	3.52	12.30	23.10	
5ª	5'	31.94	0.00	0.00	0.00	0.00	
	6	6.56	1.875	3.52	12.30	23.10	
	7	4.95	5.625	31.60	27.80	156.20	
	8	4.95	9.375	88.00	46.40	435.00	
	9	4.95	13.125	172.50	65.00	854.00	
	10	4.95	16.875	285.00	84.00	1410.00	
	Σ	84.66			0.00	5756.60	5,756.60
	1	4.95	-16.875	285.00	-84.00	1410.00	
	2	4.95	-13.125	172.50	-65.00	854.00	
	3	4.95	- 9.375	88.00	-46.40	435.00	
	4	4.95	- 5.625	31.60	-27.80	156.20	
	5	4.675	- 1.875	3.52	- 8.76	16.90	
6ª	5'	23.400	0.000	0.00	0.00	0.00	
	6	4.675	1.875	3.52	8.76	16.90	
	7	4.95	5.625	31.60	27.80	156.20	
	8	4.95	9.375	88.00	46.40	435.00	
	9	4.95	13.125	172.50	65.00	854.00	
	10	4.95	16.875	285.00	84.00	1410.00	
	Σ	72.35			0.00	5744.20	5,744.20

Piso	Eje	D_x	Y	Y^2	D_xY	D_xY^2	I_x
	1	4.95	-16.875	285.00	-84.00	1410.00	
	2	4.95	-13.125	172.50	-65.00	854.00	
	3	4.95	- 9.375	88.00	-46.40	435.00	
	4	4.95	- 5.625	31.60	-27.80	156.20	
	5	3.153	- 1.875	3.52	- 5.90	11.10	
7ª	5'	16.202	0.000	0.00	0.00	0.00	
	6	3.153	1.875	3.52	5.90	11.10	
	7	4.95	5.625	31.60	27.80	156.20	
	8	4.95	9.375	88.00	46.40	435.00	
	9	4.95	13.375	172.50	65.00	854.00	
	10	4.95	16.875	285.00	84.00	1410.00	
	Σ	62.108			0.00	5732.60	5,73260
	1	4.95	-16.875	285.00	-84.00	1410.00	
	2	4.95	-13.125	172.50	-65.00	854.00	
	3	4.95	- 9.375	88.00	-46.40	435.00	
	4	4.95	- 5.625	31.60	-27.80	156.20	
	5	1.77	- 1.875	3.52	- 3.32	6.23	
8ª	5'	9.968	0.000	0.000	0.00	0.00	
	6	1.77	1.875	3.52	3.32	6.23	
	7	4.95	5.625	31.60	27.80	156.20	
	8	4.95	9.375	88.00	46.40	435.00	
	9	4.95	13.125	172.50	65.00	854.00	
	10	4.95	16.875	285.00	84.00	1410.00	
	Σ	53.108				5722.86	5,722.86
	1	4.95	-16.875	285.00	-84.00	1410.00	
	2	4.95	-13.125	172.50	-65.00	854.00	
	3	4.95	- 9.375	88.00	-46.40	435.00	
	4	4.95	- 5.625	31.60	-27.80	156.20	
	5	0.879	- 1.875	3.52	- 1.65	3.10	
9ª	5'	4.959	0.000	0.00	0.00	0.00	
	6	0.879	1.875	3.52	1.65	3.10	
	7	4.95	5.625	31.60	27.80	156.20	
	8	4.95	9.375	88.00	46.40	435.00	
	9	4.95	13.125	172.50	65.00	854.00	
	10	4.95	16.875	285.00	84.00	1410.00	
	Σ	46.317			0.00	5716.60	5,716.60

Piso	Eje	D_x	Y	Y^2	D_xY	D_xY^2	I_x
	1	4.95	-16.875	285.00	-84.00	1410.00	
	2	4.95	-13.125	172.50	-65.00	854.00	
	3	4.95	- 9.375	88.00	-46.40	435.00	
	4	4.95	- 5.625	31.60	-27.80	156.20	
	5	0.263	- 1.875	3.52	-0.49	0.92	
10°	5'	1.799	0.000	0.00	0.00	0.00	
	6	0.263	1.875	3.52	0.49	0.92	
	7	4.95	5.625	31.60	27.80	156.20	
	8	4.95	9.375	88.00	46.40	435.00	
	9	4.95	13.125	172.50	65.00	854.00	
	10	4.95	16.875	285.00	84.00	1410.00	
	Σ	41.925			0.00	5712.24	5,712.24
	1	4.10	-16.875	285.00	-69.20	1168.00	
	2	4.10	-13.125	172.50	-53.80	707.00	
	3	4.10	- 9.375	88.00	-38.40	361.00	
	4	4.10	- 5.625	31.60	-23.10	129.50	
	5	0.043	- 1.875	3.52	- 0.08	0.15	
11ª	5'	0.45	0.000	0.00	0.00	0.00	
	6	0.043	1.875	3.52	0.08	0.15	
	7	4.10	5.625	31.60	23.10	129.50	
	8	4.10	9.375	88.00	38.40	361.00	
	9	4.10	13.125	172.50	53.80	707.00	
	10	4.10	16.875	285.00	69.20	1168.00	
	Σ	33.336			0.00	5710.70	5,710.70

COMO HEMOS VISTO POR HABER SIMETRIA EN EL SENTIDO DE EJE "Y" NO HABRA EXCENTRICIDAD EN ESE SENTIDO

Piso	Eje	D_y	X	X^2	D_yX^2	$I_x = D_yX^2$	X_{CR}
	A	271,91	-5.40	29.20	-1,475	7930.00	
	B	15.32	-0.30	0.09	-1.5	1.4	
1ª	C	16.32	+4.80	23.00	+78.40	376.00	
	C'	501.47	+5.80	33.60	+2,920.00	16900.00	
	Σ	805.02			+1512.90	28607.40	1.88
	A	84.63	-5.40	29.20	- 4.56	2470.00	
	B	7.44	-0.30	0.09	- 2.24	0.67	
2ª	C	12.98	+4.80	23.00	+ 62.40	299.00	
	C'	156.60	+5.80	33.60	+ 910.00	5260.00	
	Σ	261.65			+ 514.16	8029.67	1.96
	A	54.83	-5.40	29.20	- 2.96	1600.00	
	B	7.44	-0.30	0.09	- 2.24	0.67	
3ª	C	12.98	+4.80	23.00	+ 62.40	299.00	
	C!	117.48	+5.80	33.60	+ 680.00	3940.00	
	Σ	192.93			+ 444.16	5839.00	2.30
	A	42.64	-5.40	29.20	- 231.00	1290.00	
	B	7.44	-0.30	0.09	- 2.24	0.67	
4ª	C	12.98	+4.80	23.00	+ 62.40	299.00	
	C'	84.65	+5.80	33.60	+ 491.00	2850.00	
	Σ	147.71			+ 320.16	4439.67	2.18
	A	34.74	-5.40	29.20	- 182.00	1010.00	
	B	7.44	-0.30	0.09	- 224.00	0.67	
5ª	C	12.98	+4.80	23.00	+ 62.40	299.00	
	C'	69.04	+5.80	33.60	+ 401.00	2330.00	
	Σ	124.20			+ 279.16	3639.67	2.14
	A	31.98	-5.40	29.20	- 172.00	931.00	
	B	7.44	-0.30	0.09	- 224.00	0.67	
6ª	C	12.98	+4.80	23.00	+ 62.40	299.00	
	C'	51.09	+5.80	33.60	+ 297.00	1720.00	
	Σ	103.49			+ 185.16	2950.67	1.80
	A	28.17	-5.40	29.20	- 152.00	820.00	
	B	7.44	-0.30	0.09	- 2.24	0.67	
7ª	C	12.98	+4.80	23.00	+ 62.40	299.00	
	C'	39.36	+5.80	33.60	+ 228.00	1320.00	
	Σ	87.95			+ 136.16	2439.67	1.55

Piso	Eje	D_y	X	X^2	D_yX^2	$I_y = D_yx^2$	X_{CR}
	A	24.05	-5.40	29.20	-130.00	703.00	
	B	7.44	-0.30	0.09	-224.00	0.67	
8ª	C	12.98	+4.80	23.00	+62.40	299.00	
	C'	27.13	+5.80	33.60	+157.00	910.00	
	Σ	71.61			87.16	1912.67	1.22
	A	19.36	-5.00	29.20	-104.50	565.00	
	B	7.44	-0.30	0.09	- 2.24	0.67	
9ª	C	12.98	+4.80	23.00	+ 62.40	299.00	
	C'	15.66	+5.80	33.60	91.00	526.00	
	Σ	55.44			+46.66	1390.67	0.84
	A	15.25	-5.40	29.20	-82.50	456.00	
	B	7.44	-0.30	0.09	- 2.24	0.67	
10ª	C	12.98	+4.80	23.00	+62.40	299.00	
	C!	5.06	+5.80	33.60	+29.40	170.00	
	Σ	40.74			+17.06	925.67	0.42
	A	13.43	-5.40	29.20	-72.50	392.00	
	B	6.05	-0.30	0.09	1.80	0.54	
11ª	C	12.98	+4.80	23.00	+62.40	299.00	
	C'	1.15	+5.80	33.60	+ 6.60	38.60	
	Σ	33.61			-5.00	730.14	-0.16

CALCULO DEL MOMENTO DE TORSION

Se utiliza la siguiente fórmula:

$$M_T \; V_n \; (1.5e + 0.005b)$$

Donde:

e = distancia entre el centro de gravedad (centro de corte y el centro de rigidez)

V_n= Cortante en el piso en tn.

b = dimensión perpendicular a la dirección que se estudia

Torsión en el sentido del eje "X"

No hay excentricidad respecto del eje "X" (Y_{CR}), luego el momento de torsión $M_T = 0$

SENTIDO DEL EJE Y

PISO	V_n	e	b_x	1.5e	$0.05b_x$	$1.5e+0.05b_x$	M_T	I_X	I_Y	I_x+I_y	M_T/I_x+I_y
11ª	49.34	0.17	12.20	0.255	0.610	0.865	42.60	5710.70	730.80	6441.50	0.0066
10°	89.59	0.475	12.20	0.713	0.610	2.320	118.50	5712.24	923.00	6635.25	0.0179
9ª	126.09	1.14	12.20	1.710	0.610	2.320	292.00	5716.60	1424.50	7136.74	0.0410
8ª	158.54	1.515	12.20	2.275	0.610	2.885	457.00	5722.86	1964.00	7686.86	0.0597
7ª	187.22	1.85	12.20	2.775	0.610	3.385	635.00	5732.60	2535.00	8267.60	0.0768
6ª	211.69	2.16	12.20	3.240	0.610	3.850	814.00	5744.20	3044.00	8788.20	0.0926
5ª	232.54	2.52	12.20	3.780	0.610	4.390	1040.00	5756.60	3822.00	9578.60	0.1068
4ª	249.41	2.48	12.20	3.720	0.610	4.330	1080.00	5769.60	4584.00	10353.60	0.1040
3ª	262.44	2.60	12.20	3.900	0.610	4.510	1185.00	5786.80	6133.00	11919.80	0.0995
2ª	271.52	2.25	12.20	3.375	0.610	3.985	1080.00	5854.40	8348.00	14202.40	0.0760
1ª	276.25	2.17	12.20	3.260	0.610	3.870	1070.00	20520.00	26085.00	46605.00	0.0230

CORTANTE FINAL CORREGIDO POR TORSION SISMICA.

$$V_{fx} = \frac{V_n \times D_x}{\Sigma D_x} \pm \frac{M_T}{I_x+I_y}(D_x).Y \qquad \text{sentido del eje "X"}$$

$$V_{fy} = \frac{V_{ny} D_y}{\Sigma D_y} \pm \frac{M_T}{I_x+I_y}(D_y).X \qquad \text{sentido del eje "Y"}$$

Donde:

V_f = Cortante final en cada piso

V_n = Cortante que actúa en el piso considerado

D = Factor de distribución de cada eje , igual a la ΣD de los elemen tos resistentes en cada eje.

ΣD = Suma de los factores de distribución de todos los ejes. del piso.

M_T = Momento de torsión.

$\frac{M_T}{I_x+I_y}$ = Factor encontrado en el cuadro anterior.

X = Absisa del eje con respecto a los ejes coordenados que pasan por el centro de rigidez.

Y = Ordenadas del eje con respecto a los ejes coordenados que pasan por el centro de rigidez.

En el cálculo de V_f, se tomara en cuenta el cortante por torsión sólo cuando se suma, no así cuando se resta.

Cálculo de los V_f en cada eje: Corregido por torsión

1.- Sentido del eje "X" : No hay corrección por torsión

2.- Sentido del eje "Y"

Ubicación del centro de rigidez en cada piso

Piso	V_n	Eje	D_y	X	$\frac{V_n}{\Sigma D_y} D_y$	$D_y x$	$\frac{M_T}{I_x+I_y}$	$\frac{M_T}{I_x+I_y}$	V_{fy}
		A	271.91	-6.98	93.40	---	---	---	93.40
		B	15.32	-1.88	5.21	---	---	---	5.26
1ª	276.25	C	16.32	+3.22	5.60	52.6	0.023	1.21	6.81
		C'	501.474	+4.22	172.00	2120	---	48.70	220.70
		Σ	805.024						
		A	84.628	-7.06	88.00	---			88.00
		B	7.44	-1.96	7.72	---	0.076	---	7.72
2ª	271.52	C	12.98	+3.14	13.50	40.8	---	3.10	16.60
		C'	156.603	+4.14	162.30	646.0		99.10	212.40
		Σ	261.651						
		A	54.833	-7.40	74.60	---			74.60
		B	7.44	-2.30	10.15	---	0.0995		10.15
3ª	262.44	C	12.98	+3.40	17.68	44.10		4.40	22.08
		C'	117.476	+4.40	160.00	518.		51.50	211.50
		Σ	192.729						
		A	42.64	-7.28	72.10	---			72.10
		B	7.44	-2.18	12.55	---	0.104		12.55
4ª	249.41	C	12.98	+2.98	21.90	38.7		40.3	25.93
		C'	84.646	+3.98	143.00	337.		35.0	178.00
		Σ	147.706						
		A	34.74	-7.24	65.20	---			65.20
		B	7.44	-2.14	13.95	---	0.1068		13.95
5ª	232.54	C	12.08	+2.96	24.40	38.4		4.10	28.50
		C'	69.038	+3.96	129.50	274.0		29.20	158.70
		Σ	124.198						
		A	31.98	-6.90	65.40	---			65.40
		B	7.44	-1.80	15.20	---	0.0926		15.20
6ª	211.69	C	12.98	+3.30	26.50	42.9		3.97	30.49
		C'	51.094	+4.30	104.59	220.		20.40	124.99
		Σ	103.494						
		A	28.167	-6.65	60.00	---			60.00
		B	7.44	-1.55	15.85	---	0.0768		15.85
7ª	187.22	C	12.98	+3.55	27.70	46		3.54	31.24
		C'	39.355	+4.55	83.87	179		13.70	97.57
		Σ	87.942						

Piso	V_n	Eje	D_y	X	$\frac{V_n}{\Sigma D_y} D_y$	$D_y X$	$\frac{M_T}{I_x+I_y}$	$\frac{M_T}{I_x+I_y} D_y x$	V_{f_y}
		A	24.055	-6.32	53.30	---			53.30
		B	7.44	-1.22	16.48	---	0.0597		16.48
3ª	158.54	C	12.98	+2.38	28.76	50.5		3.09	31.76
		C'	27.126	+4.88	60.00	133.		7.95	67.95
		Σ	71.601						
		A	19.36	-5.94	44.10	---			44.10
		B	7.44	-0.84	16.95	---	0.041		16.95
9ª	126.09	C	12.98	+4.26	27.60	55.5		2.27	29.87
		C'	15.66	+5.26	35.65	82.5		3.38	37.03
		Σ	55.44						
		A	15.257	-5.52	33.60	---			33.60
		B	7.44	-0.42	16.40	---	0.0179		16.40
10°	89.59	C	12.98	+4.68	28.60	60.80		1.09	29.69
		C'	5.062	+5.68	11.25	28.80		0.51	11.76
		Σ	40.739						
		A	13.434	-4.94	19.30	---		---	19.30
		B	6.048	+0.16	8.62	1.05	.0066	0.00	8.62
11ª	49.34	C	12.98	+5.26	18.50	68.40		0.45	18.95
		C'	1.152	+6.26	1.64	7.22		0.05	1.69
		Σ	33.614						

En el sentido del eje "X" no hay corrección de corte por torsión. Luego solamente encontraré los cortantes V_f. en cada eje según la fórmula.

$$V_f = \frac{V_n \times D_x}{\Sigma D_x}$$

Piso	Eje	V_n	D_x	$V_{fx}=\frac{V_n}{\Sigma D_x}D_x$
	1	197.27	17.37	5.86
	2		17.37	5.86
	3		17.37	5.86
	4		17.37	5.86
	5		59.00	20.20
1°	5'		324.627	110.00
	6		59.88	20.20
	7		17.37	5.86
	8		17.37	5.86
	9		17.37	5.86
	10		17.37	5.86
	Σ		583.36	
	1	193.99	4.95	5.25
	2		4.95	5.25
	3		4.95	5.25
	4		4.95	5.25
	5		20.425	21.90
2ª	5'		100.563	107.00
	6		20.425	21.90
	7		4.95	5.25
	8		4.95	5.25
	9		4.95	5.25
	10		4.95	5.25
	Σ		181.013	
	1	187.69	4.95	7.29
	2		4.95	7.29
	3		4.95	7.29
	4		4.95	7.29
	5		10.84	15.95
3ª	5'		66.063	97.29
	6		10.84	15.95
	7		4.95	7.29
	8		4.95	7.29
	9		4.95	7.29
	10		4.95	7.29
	Σ		127.342	

Piso	Eje	V_n	D_x	$V_f = \frac{V_n}{\Sigma D_y}$
4º	1	178.65	4.95	8.83
	2		4.95	8.83
	3		4.95	8.83
	4		4.95	8.83
	5		8.417	15.00
	5'		43.799	78.10
	61		4.417	15.00
	7		4.95	8.83
	8		4.95	8.83
	9		4.95	8.83
	10		4.95	8.83
	Σ		100.33	
5º	1	166.95	4.95	9.76
	2		4.95	9.76
	3		4.95	9.76
	4		4.95	9.76
	5		6.56	12.92
	5'		31.94	62.90
	6		6.56	12.92
	7		4.95	9.76
	8		4.95	9.76
	9		4.95	9.76
	10		4.95	9.76
	Σ		84.66	
6º	1	152.48	4.95	10.45
	2		4.95	10.45
	3		4.95	10.45
	4		4.95	10.45
	5		4.675	9.88
	5'		23.400	48.40
	6		4.675	9.88
	7		4.95	10.45
	8		4.95	10.45
	9		4.95	10.45
	10		4.95	10.45
	Σ		72.35	

Piso	Eje	V_n	D_x	$V_f = \frac{V_n}{\Sigma D_x} D_x$
7ª	1	135.50	4.95	10.80
	2		4.95	10.80
	3		4.95	10.80
	4		4.95	10.80
	5		3.153	6.86
	5'		16.202	35.40
	6		3.153	6.86
	7		4.95	10.80
	8		4.95	10.80
	9		4.95	10.80
	10		4.95	10.80
	Σ		62.108	
8ª	1	115.60	4.95	10.80
	2		4.95	10.80
	3		4.95	10.80
	4		4.95	10.80
	5		1.77	3.86
	5'		9.968	21.75
	6		1.77	3.86
	7		4.95	10.80
	8		4.95	10.80
	9		4.95	10.80
	10		4.95	10.80
	Σ		53.108	
9ª	1	93.08	4.95	9.95
	2		4.95	9.95
	3		4.95	9.95
	4		4.95	9.95
	5		0.879	1.77
	5'		4.959	10.00
	6		0.879	1.77
	7		4.95	9.95
	8		4.95	9.95
	9		4.95	9.95
	10		4.95	9.95
	Σ		46.317	

Piso	Eje	V_n	D_x	$V_f = \frac{V_n}{\Sigma D_x} D_x$
	1	67.76	4.95	8.00
	2		4.95	8.00
	3		4.95	8.00
	4		4.95	8.00
	5		0.263	0.426
10ª	5'		1.799	2.91
	6		0.263	0.426
	7		4.95	8.00
	8		4.95	8.00
	9		4.95	8.00
	10		4.95	8.00
	Σ		41.925	
	1	39.84	4.10	4.90
	2		4.10	4.90
	3		4.10	4.90
	4		4.10	4.90
	5		0.043	0.05
11°	5'		0.045	0.54
	6		0.043	0.05
	7		4.10	4.90
	8		4.10	4.90
	9		4.10	4.90
	10		4.10	4.90
	Σ		33.336	4.90

ALCULO DE LOS V_f EN CADA ELEMENTO RESISTENTE O COLUMNAS Y PLACAS

ENTIDO DEL EJE X

iso	Eje	Elem. col.ó placa	V_f eje	D_{eje}	$D_{elem.}$	$\frac{D_{elem}}{D_{eje}}$	$V_{f\ elem.} = V_{f\ eje} \frac{D_{elem}}{D_{eje}}$
	1=10	C1-A	5.86	17.37	4.66	0.268	1.57
		C1-B			8.05	0.464	2.72
		C1-C			4.66	0.268	1.57
	2=9	C2-A	5.86	17.37	4.66	0.268	1.57
		C2-B			8.05	0.464	2.72
		C2-C			4.66	0.268	1.57
	3=8	C3-A	5.86	17.37	4.66	0.268	1.57
		C3-B			8.05	0.464	2.72
		C3-C			4.66	0.268	1.57
1º	4=7	C4-A	5.86	17.37	4.66	0.268	1.57
		C4-B			8.05	0.464	2.72
		C4-C			4.66	0.268	1.57
	5=6	Placa	20.2	59.88	59.88	1.00	20.20
	5'	Ascensor	110	324.627	324.627	1.00	110.00
	1=10	C1-A	5.25	4.95	1.24	0.256	1.31
		C1-B			2.47	0.50	2.62
		C1-C			1.24	2.50	1.31
	2=9	C2-A	5.25	4.95	1.24	0.250	1.31
		C2-B			2.47	0.50	2.62
		C2-C			1.24	0.250	1.31
2ª	3=8	C3-A	5.25	4.95	1.24	0.250	1.31
		C3-B			2.47	0.50	2.62
		C3-C			1.24	0.250	1.31
	4=7	C4-A	5.25	4.95	1.24	0.250	1.31
		C4-B			2.47	0.50	2.62
		C4-C			1.24	0.250	1.31
	5=6	Placa	21.90	20.425	20.425	1.00	21.90
	5'	Ascensor	107	100.563	100.563	1.00	107.00

Piso	Eje	Elem.	$V_{f\ eje}$	D_{eje}	$D_{elem.}$	$\frac{D_{elem.}}{D_{eje}}$	$V_{f\ elem.} = V_{f\ eje} \frac{D_{elem}}{D_{eje}}$
3ª	1=10	C1-A	7.29	4.95	1.24	0.25	1.83
		C1-B			2.47	0.50	3.64
		C1-C			1.24	0.25	1.83
	2=9	C2-A	7.29	4.95	1.24	0.25	1.83
		C2-B			2.47	0.50	3.64
		C2-C			1.24	0.25	1.83
	3=8	C3-A	7.29	4.95	1.24	0.25	1.83
		C3-B			2.47	0.50	3.64
		C3-C			1.24	0.25	1.83
	4=7	C4-A	7.29	4.95	1.24	0.25	1.83
		C4-B			2.47	0.50	3.64
		C4-C			1.24	0.25	1.83
	5=6	Placa	15.95	10.84	10.81	1.00	15.95
	5'	Ascensor	97.20	66.063	66.63	1.00	97.20
4ª	1=10	C1-A	8.83	4.95	1.24	0.25	2.20
		C1-B			2.47	0.50	4.42
		C1-C			1.24	0.25	2.20
	2=9	C2-A	8.83	4.95	1.24	0.25	2.20
		C2-B			2.47	0.50	4.42
		C2-C			1.24	0.25	2.20
	3=8	C3-A	8.83	4.95	1.24	0.25	2.20
		C3-B			2.47	0.5	4.42
		C3-C			1.24	0.25	2.20
	4=7	C4-A	8.83	4.95	1.24	0.25	2.20
		C4-B			2.47	0.50	4.42
		C4-C			1.24	0.25	2.20
	5=6	Placa	15.0	8.417	8.417	1.00	15.00
	5'	Ascensor	78.10	43.799	43.799	1.00	43.799

Piso	Eje	Elem.	$V_{f\ eje}$	D_{eje}	$D_{elem.}$	$\frac{D_{elem.}}{D_{eje}}$	$V_{f_{elem.}} = V_{f_{eje}} \frac{D_{elem}}{D_{eje}}$
	1=10	C1-A	9.76	4.95	1.24	0.25	2.44
		C1-B			2.47	0.50	4.88
		C1-C			1.24	0.25	2.44
	3=9	C2-A	9.76	4.95	1.24	0.25	2.44
		C2-B			2.47	0.50	4.88
		C2-C			1.24	0.25	2.44
	3=8	C3-A	9.76	4.95	1.24	0.25	2.44
		C3-B			2.47	0.50	4.88
		C3-C			1.24	0.25	2.44
	4=7	C4-A	9.76	4.95	1.24	0.25	2.44
		C4-B			2.47	0.50	4.88
		C4-C			1.24	0.25	2.44
	5=6	Placa	12.92	6.56	6.56	1.00	12.92
	5'	Ascensor	62.90	31.94	31.94	1.00	62.90
	1=10	C1-A	10.45	4.95	1.24	0.25	2.64
		C1-B			2.47	0.50	5.22
		C1-C			1.24	0.25	2.64
	2=9	C2-A	10.45	4.95	1.24	0.25	2.64
		C2-B			2.47	0.50	5.22
		C2-C			1.24	0.25	2.64
	3=8	C3-A	10.45	4.95	1.24	0.25	2.64
		C3-B			2.47	0.50	5.22
		C3-C			1.24	0.25	2.64
	4=7	C4-A	10.45	4.95	1.24	0.25	2.64
		C4-B			2.47	0.50	5.22
		C4-C			1.24	0.25	2.64
	5=6	Placa	9.88	4.675	4.675	1.00	9.88
	5'	Ascensor	48.40	23.40	23.40	1.00	48.40

Eje	Elem.	$V_{f\ eje}$	D_{eje}	$D_{elem.}$	$\frac{D_{elem.}}{D_{eje}}$	$V_{f_{elem.}} = V_{f_{eje}} \frac{D_{elem.}}{D_{eje.}}$
1=10	C1-A	10.8	4.95	1.24	0.25	2.70
	C1-B			2.47	0.50	5.40
	C1-C			1.24	0.25	2.70
2=9	C2-A	10.8	4.95	1.24	0.25	2.70
	C2-B			2.47	0.50	5.40
	C2-C			1.24	0.25	2.70
3=8	C3-A	10.8	4.95	1.24	0.25	2.70
	C3-B			2.47	0.50	5.40
	C3-C			1.24	0.25	2.70
4=7	C4-A	10.8	4.95	1.24	0.25	2.70
	C4-B			2.47	0.50	5.40
	C4-C	10		1.24	0.25	2.70
5=6	Placa	6.86	3.153	3.153	1.00	6.86
5'	Ascensor	35.40	16.202	16.202	1.00	35.40
1=10	C1-A	10.8	4.95	1.24	0.25	2.70
	C1-B			2.47	0.50	5.40
	C1-C			1.24	0.25	2.70
2=9	C2-A	10.8	4.95	1.24	0.25	2.70
	C2-B			2.47	0.50	5.40
	C2-C			1.24	0.25	2.70
3=8	C3-A	10.8	4.95	1.24	0.25	2.70
	C3-B			2.47	0.50	5.40
	C3-C			1.24	0.25	2.70
4=7	C4-A	10.8	4.95	1.24	0.25	2.70
	C4-B			2.47	0.50	5.40
	C4-C			1.24	0.25	2.70
5=6	Placa	3.86	1.77	1.77	1.00	3.86
5'	Ascensor	21.75	9.968	9.968	1.00	21.75

›iso	Eje	Elem.	$V_{f\ eje}$	D_{eje}	$D_{elem.}$	$\frac{D_{elem.}}{D_{eje.}}$	$V_{f_{elem.}} = V_{f_{eje}} \frac{D_{elem}}{D_{eje}}$
	1=10	C1-A C1-B C1-C	9.95	4.95	1.24 2.47 1.24	0.25 0.50 0.25	2.49 4.98 2.49
	2=9	C2-A C2-B C2-C	9.95	4.95	1.24 2.47 1.24	0.25 0.50 0.25	2.49 4.98 2.49
)2	3=8	C3-A C3-B C3-C	9.95	4.95	1.24 2.47 1.24	0.25 0.50 0.25	2.49 4.98 2.49
	4=7	C4-A C4-B C4-C	9.95	4.95	1.24 2.47 1.24	0.25 0.50 0.25	2.49 4.98 2.49
	5=6	Placa	1.77	0.879	0.879	1.00	1.77
	5'	Ascen spr —	10.0	4.959	4.959	1.00	10.-0
	1=10	C1-A C1-B C1-C	8.00	4.95	1.34 2.47 1.24	0.25 0.50 0.25	2.00 4.00 2.00
	2=9	C2-A C2-B C2-C	8.00	4.95	1.24 2.47 1.24	0.25 0.50 0.25	2.00 4.00 2.00
10°	3=8	C3-A C3-B C3-C	8.00	4.95	1.24 2.47 1.24	0.25 0.50 0.25	2.00 4.00 2.00
	4=T	C4-A C4-B C4-C	8.00	4.95	1.24 2.47 1.24	0.25 0.50 0.25	2.00 4.00 2.00
	5=6	Placa	0.426	0.263	0.263	1.00	0.426
	5'	Ascen sor —	2.91	1.799	1.799	1.00	2.91

Piso	Eje	Elem.	$V_{f\ eje}$	D_{eje}	$D_{elem.}$	$\frac{D_{elem}}{D_{eje}}$	$V_{f_{elem.}} = V_{f_{eje}} \frac{D_{elem}}{D_{eje}}$
		C1-A			1.02	0.249	1.22
	1=10	C1-B	4.90	4.10	2.06	0.502	2.06
		C1-B			1.02	0.249	1.22
		C2-A			1.02	0.249	1.22
	2=9	C2-B	4.90	4.10	2.06	0.502	2.06
		C2-C			1.02	0.249	1.22
		C3-A			1.02	0.249	1.22
11ª	3=8	C3-B	4.90	4.10	2.06	0.502	2.02
		C3-C			1.02	0.249	1.22
		C4-A			1.02	0.249	1.22
	4=9	C4-B	4.90	4.10	2.06	0.502	2.06
		C4-C			1.02	0.249	1.22
	5=6	Placa	0.05	0.043	0.043	1.00	0.05
	5'	Ascensor	0.54	0.45	0.45	1.00	0.54

CALCULO DE LOS V_f EN CADA ELEMENTO RESISTENTE:COLUMNAS Y PLACAS.-

SENTIDO DEL EJE "Y": PORTICOS DE ARRIOSTRE

Piso	Eje	Elem. col.ó placa	$V_{f_y eje}$	$D_y eje$	$D_{elem.}$	$\frac{D_{elem.}}{D_{eje}}$	$V_{f_{elem.}} = V_{f_{eje}} \frac{D_{elem}}{D_{eje}}$
		C1-A			1.71	0.0063	0.59
		C2-A			2.15	0.0079	0.74
		C3-A			2.15	0.0079	0.74
	A	C4-A			2.15	0.0079	0.74
1ª		Pla.2	93.4	271.91	255.591	0.94	87.60
		C7-A			2.15	0.0079	0.74
		C8-A			2.15	0.0079	0.74
		C9-A			2.15	0.0079	0.74
		C10-A			1.71	0.0063	0.59

iso	Eje	Elem.	$V_{f_{eje}}$	D_y eje	$D_{elem.}$	$\frac{D_{elem}}{D_{eje}}$	$V_{f_{elem.}} = V_{f_{eje}} \frac{D_{elem}}{D_{eje}}$
		C1-B			1.66	0.108	0.57
		C2-B			2.00	0.131	0.686
		C3-B			2.00	0.131	0.686
2ª	B	C4-B	5.26	15.32	2.00	0.131	0.686
		C7-B			2.00	0.131	0.686
		C8-B			2.00	0.131	0.686
		C9-B			2.00	0.131	0.686
		c10-B			1.66	0.108	0.570
		C1-C			1.71	0.105	0.71
		C2-C			2.15	0.132	0.90
		C3-C			2.15	0.132	0.90
	C	C4-C	6.81	16.32	2.15	0.132	0.90
		C7-C			2.15	0.132	0.90
		C8-C			2.15	0.132	0.90
		C9-C			2.15	0.132	0.90
		C10-C			1.71	0.105	0.71
	C'	Asc.	220.7	501.474	501.4	1.000	220.70
		C1-A			1.06	0.0125	1.10
		C2-A			1.81	0.0214	1.88
		C3-A			1.81	0.0214	1.88
		C4-A			1.81	0.0214	1.88
	A	Pl.2	88.00	84.628	71.648	0.836	74.40
		C7-A			1.81	0.0214	1.88
		C8-A			1.81	0.0214	1.88
		C9-A			1.81	0.0214	1.88
		C10-A			1.06	0.0125	1.10
2ª		C1-B			0.57	0.0766	0.59
		C2-B			1.05	0.141	1.09
		C3-B			1.05	0.141	1.09
	B	C4-B	7.72	7.44	1.05	0.141	1.09
		C7-B			1.05	0.141	1.09
		C8-B			1.05	0.141	1.09
		C9-B			1.05	0.141	1.09
		C10-B			0.54	0.0766	0.59

iso	Eje	Elem. col. placa	V_f eje	D_{eje}	D_{elem}	$\frac{D_{elem}}{D_{eje}}$	$V_{f_{ele}} = V_{f_{eje}} \frac{D_{elem}}{D_{eje}}$
		C1-C			1.06	0.0816	1.36
		C2-C			1.81	0.14	2.32
		C3-C			1.81	0.14	2.32
a	C	C4-C			1.81	0.14	2.32
		C7-C	16.6	12.98	1.81	0.14	2.32
		C8-C			1.81	0.14	2.32
		C9-C			1.81	0.14	2.32
		C10-C			1.06	0.0816	1.36
	C'	Asce.	212.4	156.6	156.603	1	212.40
		C1-A			1.06	0.0193	1.44
		C2-A			1.81	0.033	2.47
		C3-A			1.81	0.033	2.47
		C4-A			1.81	0.033	2.47
	A	Pl.2	74.6	54.83	41.853	76.40	57.00
		C7-A			1.81	0.033	2.47
		C8-A			1.81	0.033	2.47
		C9-A			1.81	0.033	2.47
		C10-A			1.06	0.0193	1.44
3a		C1-B			0.57	0.0766	0.776
		C2-B			1.05	0.141	1.482
		C3-B			1.05	0.141	1.482
	B	C4-B	10.15	7.44	1.05	0.141	1.482
		C7-B			1.05	0.141	1.482
		C8-B			1.05	0.141	1.482
		C9-B			1.05	0.141	1.482
		C10-B			0.57	0.0766	0.776
		C1-C			1.06	0.0817	1.80
		C2-C			1.81	0.14	3.09
		C3-C			1.81	0.14	3.09
4a	C	C4-C			1.81	0.14	3.09
		C7-C	22.08	12.98	1.81	0.14	3.09
		C8-C			1.81	0.14	3.09
		C9-C			1.81	0.14	3.09
		C10-C			1.06	0.0817	1.80
	C'	Asc.	211.5	117.476	117.476	1.00	211.50

iso	Eje	Elem. col.ó placa	$V_f$eje	D_{eje}	$D_{elem.}$	$\frac{D_{elem}}{D_{eje}}$	$V_f elem. = V_{f_{eje}} \frac{D_{elem}}{D_{eje}}$
		C1-A			1.06	0.0248	1.79
		C2-A			1.81	0.0425	3.03
		C3-A			1.81	0.0425	3.03
1ª	A	C4-A			1.81	0.0425	3.03
		Pl.2	72.1	42.64	29.66	0.699	50.30
		C7-A			1.81	0.0425	3.03
		C8-A			1.81	0.0425	3.03
		C9-A			1.81	0.0425	3.03
		C10-A			1.06	0.0248	1.79
		C1-B			0.57	0.0766	0.93
		C2-B			1.05	0.141	1.77
		C3-B			1.05	0.141	1.77
	B	C4-B	12.55	7.44	1.05	0.141	1.77
		C7-B			1.05	0.141	1.77
		C8-B			1.05	0.141	1.77
		C9-B			1.05	0.141	1.77
		C10-B			0.57	0.0766	0.93
		C1-C			1.06	0.0817	2.12
		C2-C			1.81	0.14	3.63
		C3-C			1.81	0.14	3.63
	C	C4-C	25.93	12.98	1.81	0.14	3.63
		C7-C			1.81	0.14	3.63
		C8-C			1.81	0.14	3.63
		C9-C			1.81	0.14	3.63
		C10-C			1.06	0.0817	2.12
	C'	Asc.	178	84.646	84.646	1.00	178.00
		C1-A			1.06	0.0303	1.99
		C2-A			1.81	0.052	3.40
		C3-A			1.81	0.052	3.40
	A	C4-A			1.81	0.052	3.40
		Pl.2	65.2	34.74	21.76	0.626	40.80
5º		C7-A			1.81	0.052	3.40
		C8-A			1.81	0.052	3.40
		C9-A			1.81	0.052	3.40
		C10-A			1.06	0.0303	1.99

iso	Eje	Elem. col6 placa	$V_{f_{eje}}$	D_{eje}	D_{elem}	$\frac{D_{elem}}{D_{eje}}$	$V_{f_{elem}} = V_{f_{eje}} \frac{D_{elem}}{D_{eje}}$
		C1-B			0.57	0.0766	1.07
		C2-B			1.05	0.141	1.97
		C3-B			1.05	0.141	1.97
	B	C4-B	13.95	7.44	1.05	0.141	1.97
		C7-B			1.05	0.141	1.97
		C8-B			1.05	0.141	1.97
		C9-B			1.05	0.141	1.97
°		C10-B			0.57	0.0766	1.07
		C1-C			1.06	0.0817	2.33
		C2-C			1.81	0.14	3.98
		C3-C			1.81	0.14	3.98
	C	C4-C	28.5	12.98	1.81	0.14	3.98
		C7-C			1.81	0.14	3.98
		C8-C			1.81	0.14	3.98
		C9-C			1.81	0.14	3.98
		C10-C			1.06	0.0817	2.33
	C'	As.	158.7	69.038	69.038	1.00	158.70
		C1-A			1.06	0.0332	2.17
		C2-A			1.81	0.0566	3.71
		C3-A			1.81	0.0566	3.71
		C4-A			1.81	0.0566	3.71
	A	P1.2	65.4	31.98	19.0	0.594	38.80
		C7-A			1.81	0.0566	3.71
		C8-A			1.81	0.0566	3.71
		C9-A			1.81	0.0566	3.71
		C10-A			1.06	0.0332	2.17
6ª		C1-B			0.57	0.0766	1.17
		C2-B			1.05	0.141	2.15
		C3-B			1.05	0.141	2.15
	B	C4-B	15.2	7.44	1.05	0.141	2.15
		C7-B			1.05	0.141	2.15
		C8-B			1.05	0.141	2.15
		C9-B			1.05	0.141	2.15
		C10-B			0.57	0.0766	1.17

Piso	Eje	Elem. col.ó placa	$V_{f_{eje}}$	D_{eje}	D_{elem}	$\frac{D_{elem}}{D_{eje}}$	$V_{f_{elem.}} = V_{f_{eje}} \frac{D_{elem}}{D_{eje}}$
		C1-C			1.06	0.0817	2.49
		C2-C			1.81	0.14	4.26
		C3-C	30.49	12.98	1.81	0.14	4.26
	C	C4-C			1.81	0.14	4.26
		C7-C			1.81	0.14	4.26
		C8-C			1.81	0.14	4.26
		C9-C			1.81	0.14	4.26
		C10-C			1.06	0.0817	2.49
	C'	As.	124.99	51.094	51.094	1.00	124.99
		C1-A			1.06	0.0374	2.24
		C2-A			1.81	0.0639	3.83
		C3-A			1.81	0.0639	3.83
		C4-A			1.81	0.0639	3.83
	A	Pl.2	60.0	28.167	15.187	0.540	32.40
		C7-A			1.81	0.0639	3.83
		C8-A			1.81	0.0639	3.83
		C9-A			1.81	0.0639	3.83
		C10-A			1.06	0.0374	2.24
		C1-B			0.57	0.0766	1.21
		C2-B			1.05	0.141	2.24
		C3-B			1.05	0.141	2.24
7ª	B	C4-B	15.85	7.44	1.05	0.141	2.24
		C7-B			1.05	0.141	2.24
		C8-B			1.05	0.141	2.24
		C9-B			1.05	0.141	2.24
		C10-B			0.57	0.0766	1.21
		C1-C			1.06	0.0817	2.56
		C2-C			1.81	0.14	4.38
		C3-C			1.81	0.14	4.38
	C	C4-C	31.24	12.98	1.81	0.14	4.38
		C7-C			1.81	0.14	4.38
		C8-C			1.81	0.14	4.38
		C9-C			1.81	0.14	4.38
		C10-C			1.06	0.0817	2.56
	C'	Asc.	97.57	39.355	39.355	1.00	97.57

Piso	Eje	Elem. col.ó placa	$V_{f_{eje}}$	D_{eje}	D_{elem}	$\frac{D_{elem}}{D_{eje}}$	$V_{f_{ele}} = V_{f_{eje}} \frac{D_{elem}}{D_{eje}}$
		C1-A			1.06	0.044	2.35
		C2-A			1.81	0.075	4.01
		C3-A			1.81	0.075	4.01
		C4-A			1.81	0.075	4.01
	A	Plc.2	53.3	24.055	11.075	0.45	24.00
		C7-A			1.81	0.075	4.01
		C8-A			1.81	0.075	4.01
		C9-A			1.81	0.075	4.01
		C10-A			1.06	0.044	2.35
		C1-B			0.57	0.0766	1.26
8ª		C2-B			1.05	0.141	2.33
		C3-B			1.05	0.141	2.33
	B	C4-B	16.48	7.44	1.05	0.141	2.33
		C7-B			1.05	0.141	2.33
		C8-B			1.05	0.141	2.33
		C9-B			1.05	0.141	2.33
		C10-B			0.57	0.0766	1.26
		C1-C			1.06	0.087	2.76
		C2-C			1.81	0.147	4.45
		C3-C			1.81	0.14	4.45
	C	C4-C	31.76	12.98	1.81	0.14	4.45
		C7-C			1.81	0.14	4.45
		C8-C			1.81	0.14	4.45
		C9-C			1.81	0.14	4.45
		C10-C			1.06	0.087	2.76
	C'	Asc.	67.95	27.126	27.126	1.00	67.95
		C1-A			1.06	0.0546	2.41
		C2-A			1.81	0.0934	4.12
		C3-A			1.81	0.0934	4.12
		C4-A			1.81	0.0934	4.12
	A	Pl.2	44.10	19.36	6.38	0.33	14.50
9ª		C7-A			1.81	0.0934	4.12
		C8-A			1.81	0.0934	4.12
		C9-A			1.81	0.0934	4.12
		C10-A			1.06	0.0546	2.41

Piso	Eje	Elem. col.ó placa	$V_{f_{eje}}$	D_{eje}	$D_{elem.}$	$\frac{D_{elem}}{D_{eje}}$	$V_{f_{elem.}} = V_{f_{eje}} \frac{D_{elem}}{D_{eje}}$
9ª	B	C1-B			0.57	0.0766	1.30
		C2-B			1.05	0.141	2.50
		C3-B			1.05	0.141	2.50
		C4-B			1.05	0.141	2.50
		C7-B			1.05	0.141	2.50
		C8-B			1.05	0.141	2.50
		C9-B			1.05	0.141	2.50
		C10=B			0.57	0.0766	1.30
	C	C1-C	29.87	12.98	1.06	0.0817	2.44
		C2-C			1.81	0.14	4.19
		C3-C			1.81	0.14	4.19
		C4-C			1.81	0.14	4.19
		C7-C			1.81	0.14	4.19
		C8-C			1.81	0.14	4.19
		C9-C			1.81	0.14	4.19
		C10-C			1.06	0.0817	2.44
	C'	Asc.	37.03	15.66	15.66	1.00	37.03
10ª	A	C1-A	33.6	15.25	1.06	0.0695	2.33
		C2-A			1.81	0.1185	3.98
		C3-A			1.81	0.1185	3.98
		C4-A			1.81	0.1185	3.98
		P1.2			2.727	0.179	6.00
		C7-A			1.81	0.1185	3.98
		C8-A			1.81	0.1185	3.98
		C9-A			1.81	0.1185	3.98
		C10-A			1.06	0.0695	2.33
	B	C1-B	16.4	7.44	0.57	0.0766	1.26
		C2-B			1.05	0.141	2.32
		C3-B			1.05	0.141	2.32
		C4-B			1.05	0.141	2.32
		C7-B			1.05	0.141	2.32
		C8-B			1.05	0.141	2.32
		C9-B			1.05	0.141	2.32
		C10-B			0.57	0.0766	1.26

›iso	Eje	Elem. col.ó placa	$V_{f_{eje}}$	D_{eje}	D_{elem}	$\frac{D_{elem}}{D_{eje}}$	$V_{f_{ele}} = V_{f_{eje}} \frac{D_{elem}}{D_{eje}}$
		C1-C			1.06	0.0877	2.42
		C2-C			1.81	0.14	4.14
		C3-C			1.81	0.14	4.14
10°	C	C4-C	29.69	12.98	1.81	0.14	4.14
		C7-C			1.81	0.14	4.14
		C8-C			1.81	0.14	4.14
		C9-C			1.81	0.14	4.14
		C10=C			1.06	0.0877	2.42
	C'	Asc.	11.76	5.062	5.062	1.00	11.76
		C1-A			1.06	0.079	1.52
		C2-A			1.81	0.135	2.60
		C3-A			1.81	0.135	2.60
		C4-A			1.81	0.135	2.60
	A	Pl.2	19.30	13.434	0.454	0.0338	0.65
		C7-A			1.81	0.135	2.60
		C8-A			1.81	0.135	2.60
		C9-A			1.81	0.135	2.60
		C10-A			1.81	0.135	2.60
		C1-B			0.57	0.0944	0.81
		C2-B			1.05	0.174	1.50
		C3-B			1.05	0.174	1.50
	B	C4-B	8.62	6.048	1.05	0.174	1.50
		C7-B			1.05	0.174	1.50
		C8-B			1.05	0.174	1.50
		C9-B			1.05	0.174	1.50
		C10-B			0.57	0.0944	0.81
11ª		C1-C			1.06	0.0817	1.55
		C2_C			1.81	0.14	2.64
		C3-C			1.81	0.14	2.64
	C	C4-C	18.95	12.98	1.81	0.14	2.64
		C7-C			1.81	0.14	2.64
		C8-C			1.81	0.14	2.64
		C9-C			1.81	0.14	2.64
		C10-C			1.06	0.0817	1.55
	C'	Asc.	1.69	1.152	1.152.	1.00	1.69

MOMENTOS EN COLUMNAS Y VIGAS

Como se tienen los puntos de inflexión en las columnas y se ha obtenido el cortante que toma cada una de ellas, se pueden hallar los momentos en la cabeza y base de la columna como sigue:

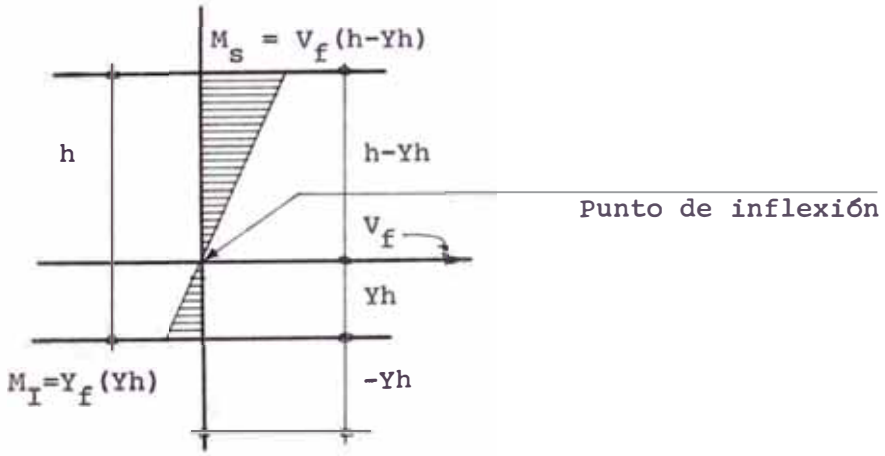
a.- Momentos en la cabeza y base de la columna :Se multiplica el cortante, por la distancia que hay de la cabeza - al punto de inflexión.

b.- Momentos en la base la columna: Se multiplica el cortante por la distancia de la base al punto de inflexión.

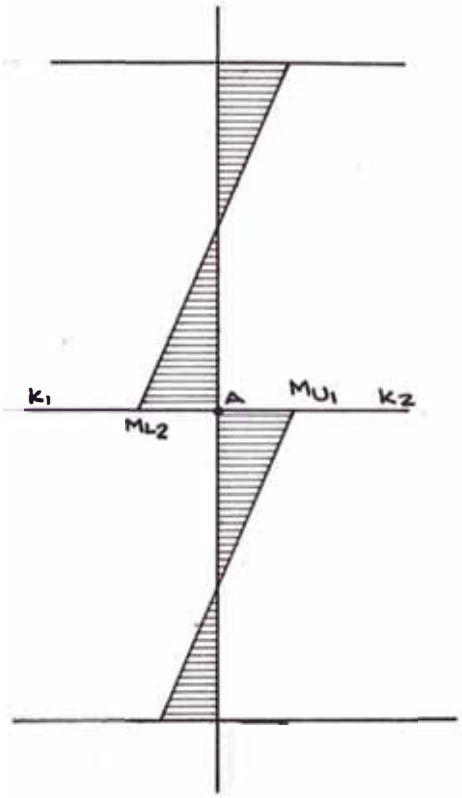
Lo que se puede resumir en las siguientes fórmulas:

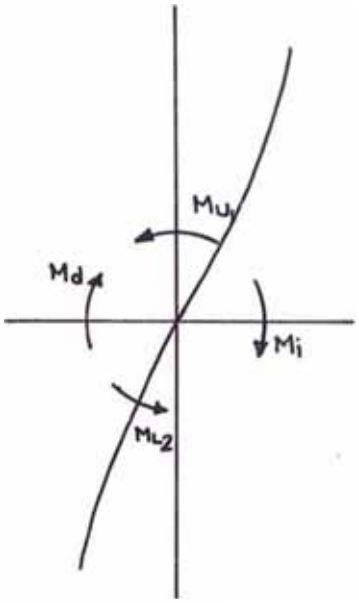
$M_s = V_f(h-Yh)$ ..... Momento en la cabeza

$M_I = V_f\ Yh$ ..... Momento en la base



Para encontrar los momentos en las vigas, se suman los momentos de las columnas y se reparten proporcionalmente a las rigideces de las vigas que concurren al nudo. Tal como:



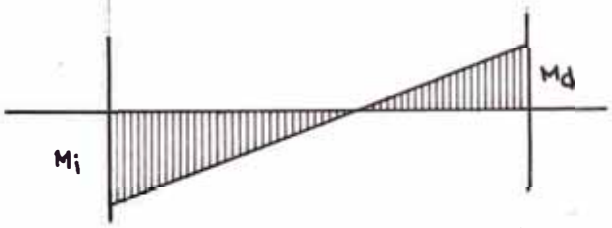


Nótese que los momentos de las vigas son de signo contrario a los momentos de columnas. Luego si los momentos de las columnas son(-),los de las vigas son (+).

$$M_d = \frac{(M_{u1} + M_{L2})R_1}{R_1 + R_2} \qquad M_{u1}+M_{L2} \qquad \text{..... (1)}$$

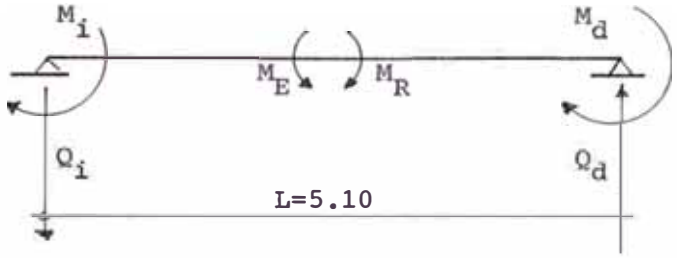
$$M_i = \frac{(M_{u1} + M_{L2})R_2}{R_1 + R_2} \qquad M_{u1}+M_{L2} \qquad \text{..... (2)}$$

El diagrama de momentos de las vigas es como sigue:



Querra decir que el cortante es uniforme,luego:

$$Q_1 = \frac{(M_d) + (M_i)}{L} \qquad Q_d = \frac{(M_d) + (M_i)}{L}$$



SENTIDO DEL EJE "X"

Dado que los pórticos 1=(2-3-4-7-8-9 y 10) tienen el mismo γ_y los mismos V_f, en sus elementos resistentes correspondientes,tendran los mismos momentos en columnas y vigas.

MOMENTOS EN COLUMNAS PORTICOS: 1=(2-3-4-7-8-9 y 10)

Piso	Colum.	V_f(Tn)	h(mts.)	Yh	h-Yh	M_I(tn-m)	M_s(tn-m)
	C1-A	1.22		0.135	2.565	0.165	3.130
11°	C1-B	2.06	2.70	-0.135	2.835	-0.287	5.840.00
	C1-C	1.22		0.135	2.565	0.165	3.130
	C1-A	2.00		-0.135	2.835	-0.270	5.660
10°	C1-B	4.00	2.70	-0.027	2.727	-0.108	10.900
	C1-C	2.00		-0.135	2.835	-0.270	5.660
	C1-A	2.49		0.270	2.430	0.672	6.050
9ª	C1-B	4.98	2.70	0.350	2.350	1.740	11.70
	C1-C	2.49		0.270	2.430	0.672	6.050
	C1-A	2.70		0.540	2.160	1.460	5.840
8ª	C1-B	5.40		0.595	2.105	3.210	11.350
	C1-C	2.70		0.540	2.160	1.460	5.840
	C1-A	2.70		0.675	2.025	1.820	5.460
7ª	C1-B	5.40	2.70	0.730	1.970	2.940	10.640
	C1-C	2.70		0.675	2.025	1.820	5.460
	C1-A	2.64		0.945	1.755	2.490	4.640
6	C1-B	5.22	2.70	0.972	1.728	5.060	9.00
	C1-C	2.64		0.945	1.755	2.490	4.640

Piso	Col.	V_f(tn)	h(mt.)	Yh	h-Yh	M_I(tn-m)	M_s(Tn-m)
	C1-A	2.44		1.080	1.620	2.640	3.960
5ª	C1-B	4.88	2.70	1.080	1.620	5.260	7.900
	C1-C	2.44		1.080	1.620	2.640	3.960
	C1-A	2.20		1.350	1.350	2.970	2.970
4ª	C1-B	4.42	2.70	1.350	1.35	2.97	2.970
	C1-C	2.20		1.350	1.350	2.970	2.970
	C1-A	1.83		1.750	0.950	3.200	1.740
3ª	C1-B	3.64	2.70	1.730	0.970	6.300	3.530
	C1-C	1.83		1.750	0.950	3.200	1.740
	C1-A	1.31		2.080	0.620	2.720	0.810
2ª	C1-B	2.62	2.70	2.00	0.700	5.240	0.830
	C1-C	1.31		2.080	0.620	2.720	0.810
	C1-A	1.57		3.850	-0.250	6.050	-0.393
1ª	C1-B	2.72	3.60	3.600	0.00	9.800	0.000
	C1-C	1.57		3.850	-0.25	6.050	-0.393

NOTA.- En este cuadro los momentos de columnas estan en valor absoluto: Los signos negativos significan que esos momentos son de signo contrario que los demás en el cuadro siguiente aparece la convención de signos adoptado.

MOMENTOS EN VIGAS

COMO LAS RIGIDECES DE LAS VIGAS SON IGUALES EN EL NUDO INTERMEDIO SE DIVIDE ENTRE "2"

Piso	MOMENTOS EN COLUMNAS						MOMENTOS EN VIGAS			
	NUDO A		NUDO B		NUDO C		TRAMO A-B		TRAMO B-C	
	M_{L2}	M_{V1}	M_{L2}	M_{V1}	M_{L2}	M_{V1}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	--	3.13	---	5.84	--	3.130	+3.130	+2.92	+2.92	+3.130
10	0.165	5.666	-.287	10.900	0.163	5.600	+5.831	+4.306	+4.306	+5.831
9	-.270	6.050	-.108	11.70	-.270	6.050	+5.780	+5.796	+5.796	+5.780
8	0.672	5.840	3.20	11.350	0.672	5.840	+6.512	+7.275	+7.275	+6.312
7	1.460	5.40	3.21	10.64	1.460	5.460	+6.92	+6.925	+6.925	+6.92
6	1.820	4.60	2.94	9.00	1.820	4.600	+6.420	+5.97	+5.97	+6.420
5	2.490	3.96	5.06	7.960	2.49	3.96	+6.450	+6.51	+6.51	+6.450
4	2.640	2.970	5.26	2.97	2.64	2.97	+5.610	+4.125	+4.125	+5.61
3	2.97	1.74	2.97	3.53	2.97	1.74	+4.71	+3.25	+3.25	+4.710
2	3.20	6.81	6.30	1.830	3.20	0.81	+4.00	+4.065	+4.063	+4.000
1	2.72	-.393	5.240	0.00	2.72	-.393	-2.327	+2.620	+2.620	+2.327

Observese que en este cuadro según la convención de signos adoptada, aparecen la columna cons signo cambiado para que los momentos de las vigas nos defrente positivos.

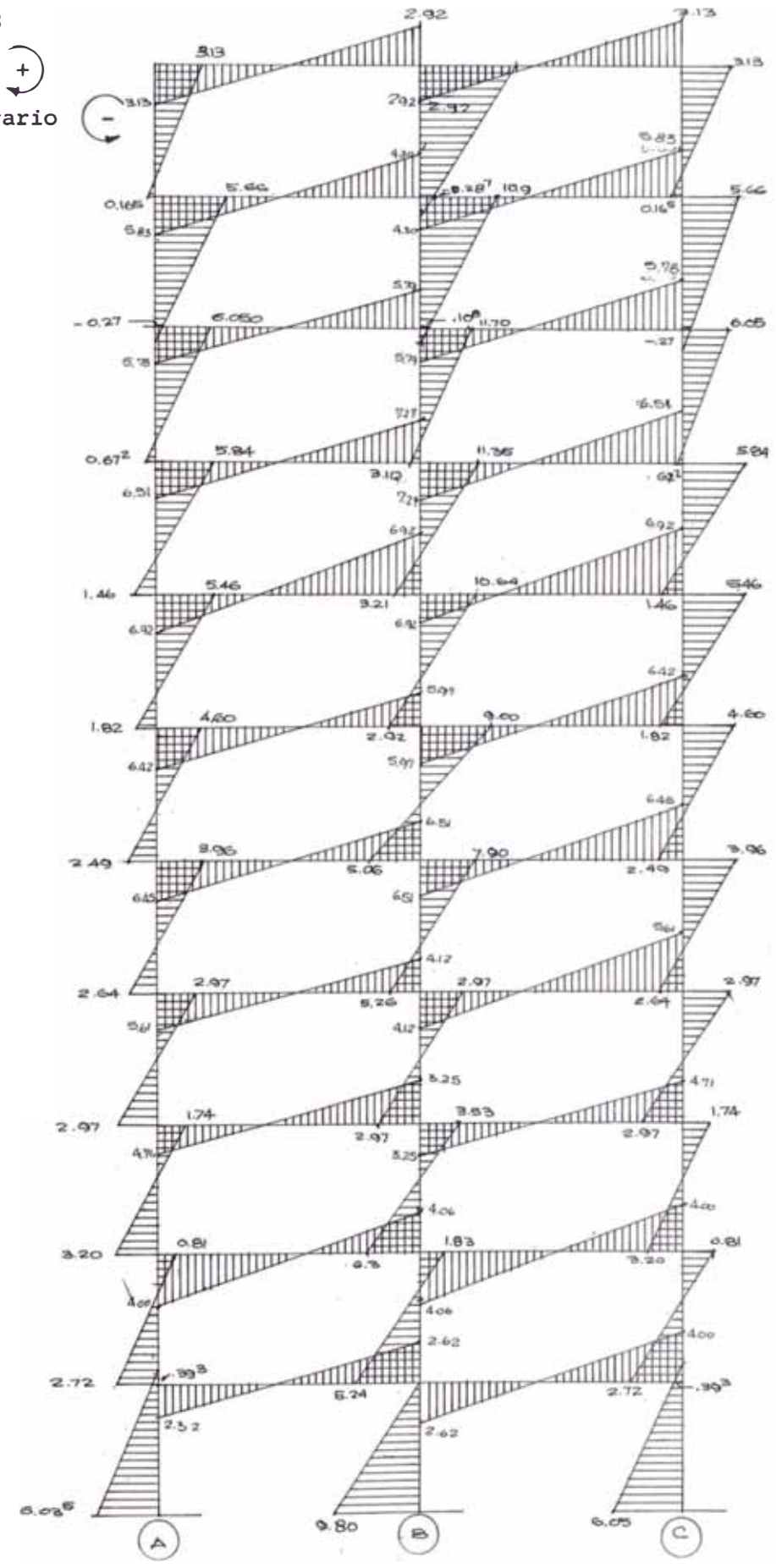
Pi-	MOMENTOS EN VIGAS				CORTANTES EN VIGAS			
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	Q_{AB}	Q_{BA}	Q_{BC}	Q_{CB}
11	+3.130	+2.920	+2.92	+3.130	+1.185	+1.185	-1.185	+1.185
10	+5.831	+4.306	+4.306	+5.831	-2.04	+2.04	-2.04	+2.04
9	+5.780	+5.796	+5.796	+5.780	+2.27	+2.27	-2.27	+2.27
8	+6.512	+7.275	+7.275	+6.512	-2.70	+2.70	-2.70	+2.70
7	+6.920	+6.925	+6.925	+6.920	-2.74	+2.74	-2.74	+2.74
6	+6.42	+5.970	+5.970	+6.420	-2.43	+2.43	-2.430	+2.43
5	+6.450	+6.51	+6.51	+6.45	-2.54	+2.54	-2.540	+2.54
4	+5.61	+4.125	+4.125	+5.61	-1.910	+1.910	-1.910	+1.91
3	+5.71	+3.25	+3.25	+5.71	-1.76	+1.76	-1,76	+1.76
2	+5.00	+4.065	+4.065	+5.00	-1.78	+1.780	-1.78	1.78
1	+2.327	+2.620	+2.620	+2.327	-0.97	+0.97	-0.97	+0.97

CONVENCION DE SIGNOS

(+) Sentido horario

(-) Sentido anti-horario

Sentido del sismo



SENTIDO DEL EJE "Y": Analizare sólo el pórtico por diseñar las columnas del pórtico "A" son simétricos, por lo que bastara con hallar los momentos para la primera mitad del pórtico

MOMENTOS EN COLUMNAS - PORTICO "A"

Piso	COL.	V_f(Tn)	h cm	V_h	h Yh	M_I(Tn-m)	M_s(Tn-m)
	C1-A	1.52		0.77	1.93	1.170	2.935
11°	C2-A	2.60	2.70	0.97	1.73	2.52	4.500
	C3-A	2.60		0.97	1.73	2.52	4.500
	C4-A	2.600		0.97	1.73	2.52	4.500
	C1-A	2.33		1.04	1.66	2.52	3.870
10°	C2-A	3.98	2.70	1.24	1.24	4.98	5.81
	C3-A	3.98		1.24	1.46	4.94	5.81
	C4-A	3.98		1.24	1.46	4.94	5.81
	C1-A	2.410		1.08	1.62	2.60	3.80
9°	C2-A	4.12	2.70	1.21	1.49	4.98	6.14
	C3-A	4.12		1.21	1.49	4.98	6.14
	C4-A	4.12		1.21	1.49	4.98	6.16
	C1-A	2.35		1.21	1.49	2.84	3.50
8°	C2-A	4.01	2.70	1.21	1.49	4.85	5.98
	C3-A	4.01		1.21	1.49	4.85	5.98
	C4-A	4.01		1.21	1.49	4.85	5.98
	C1-A	2.24		1.21	1.49	2.71	3.34
7ª	C2-A	3.83	2.70	1.21	1.49	4.64	5.70
	C3-A	3.83		1.21	1.49	4.64	5.70
	C4-A	3.83		1.21	1.49	4.64	5.70
	C1-A	2.17		1.35	1.35	2.93	2.93
6ª	C2-A	3.71	2.70	1.21	1.49	4.49	5.53
	C3-A	3.71		1.21	1.49	4.49	5.53
	C4-A	3.71		1.21	1.49	4.49	5.53

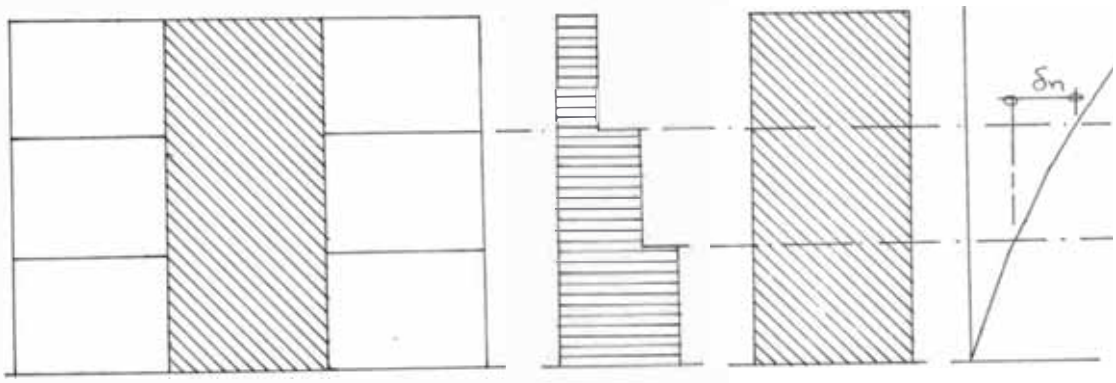
Piso	Col.	V_f(tn)	h cm	Yh	h Yh	M_I(Tn-m)	M_s(tn-m)
	C1-A	1.999		1.35	1.35	2.70	2.70
5ª	C2-A	3.40	2.70	1.31	1.39	4.46	4.72
	C3-A	3.40		1.31	1.39	4.46	4.72
	C4-A	3.40		1.31	1.39	4.46	4.72
	C1-A	1.79		1.35	1.35	2.42	2.42
4ª	C2-A	3.03	2.70	1.35	1.35	4.09	4.09
	C3-A	3.03		1.35	1.35	4.09	4.09
	C4-A	3.03		1.35	1.35	4.09	4.09
	C1-A	1.440		1.35	1.35	1.945	1.945
3ª	C2-A	2.47	2.70	1.35	1.35	3.34	3.34
	C3-A	2.47		1.35	1.35	3.34	3.34
	C4-A	2.47		1.35	1.35	3.34	3.34
	C1-A	1.10		1.43	1.27	1.57	1.40
2ª	C2-A	1.88	2.70	1.35	1.35	2.54	2.54
	C3-A	1.88		1.35	1.35	2.54	2.54
	C4-A	1.88		1.35	1.35	2.54	2.54
	C1-A	0.59		2.70	0.90	2.59	0.53
1ª	C2-A	0.74	3.60	2.33	1.27	1.725	1.28
	C3-A	0.74		2.33	1.27	1.725	1.28
	C4-A	0.74		2.33	1.27	1.725	1.28

INTERACCION ENTRE MUROS Y MARCOS (EFECTO DE LIMITE)

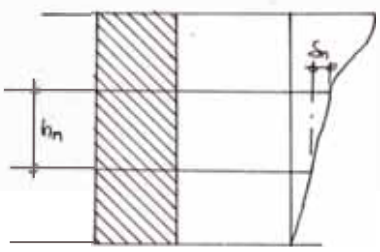
En el caso de edificios altos la deformación por flexión tiene gran importancia y las rotaciones de los muros producen fuerzas cortantes y momentos flexionantes de gran importancia en las vigas que descansan sobre ellos.

METODO APROXIMADO A SEGUIR:

1º Asumir una distribución de fuerza cortante(en este caso, el cortante que toma la placa encontrado en el cálculo de D), y calcular la deformación del muro considerándolo aislado).



2.- Asumir que los miembros colindantes mantienen una deformación continua con el muro de acuerdo a esto calcularemos la deformación en la forma siguiente.



$$R_n = \frac{\delta_n}{D_{wn}} \quad \text{.....} \quad (1)$$

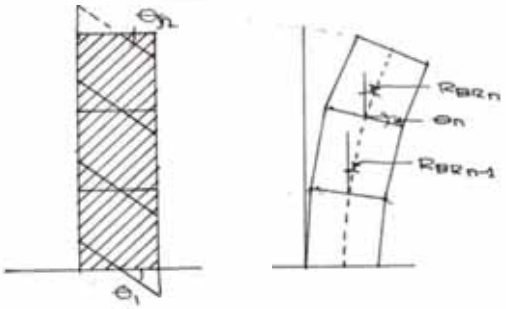
Pero:

$$\delta_n = \frac{V_n}{B_{wn}} \quad \text{....Unidad} \quad \frac{h_n^2}{12EK_o} \quad \text{...(2)}$$

$$\therefore \quad R_n = \frac{V_n}{D_{wn}} \times \frac{h_n^2}{12EK_o} \times \frac{1}{h_n} \quad \ldots\ldots\ldots \quad (3)$$

$$R_n = \frac{V_n}{D_{wn}} \times \frac{h_n}{2} \quad \ldots\ldots \text{ unid.}\left(\frac{1}{GEK_o}\right) \quad \ldots(4)$$

ROTACION DE LA PARED



Abajo: El valor de θ_1 que corresponde a la rotación de la fundación.

Piso intermedio: θ_n se calcula como el valor promedio de los valores R_{BRn} de los pisos adyacentes superior e inferior.

$$\theta_n = \frac{R_{BRn} - R_{BRn-1}}{2} \quad \ldots\ldots\ldots\ldots\ldots (5)$$

Ultimo piso.

$$\theta_u = R_{BRu} = 1 \quad \ldots\ldots\ldots\ldots\ldots (6)$$

La rotación se calcula:

$$R_{BRn} = R_n - R_{sn} \quad \ldots\ldots\ldots\ldots\ldots (7)$$

Donde:

R_n = Rotación total considerando la deformación total

R_{sn} = Rotación debido a la deformación por corte

R_{BRn} = Rotación debido a la flexión y rotación de la fundación.

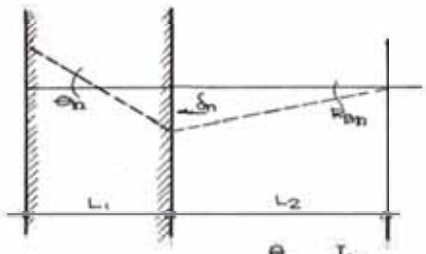
Todas las rotaciones estan expresadas en la unidad $\left(\frac{1}{GEK_o}\right)$

La rotación R_{sn} = lo calculamos de la siguiente manera:

$$R_{sn} = \frac{\delta_{Bn}}{hn} \quad \ldots\ldots\ldots \left(\frac{h_n^2}{12EK_o}\right)$$

$$R_{sn} = \delta_{sn} \frac{h_n}{2} \quad \ldots\ldots \left(\frac{1}{6EK_o}\right) \quad \ldots\ldots\ldots (8)$$

ACION DE LA VIGA : R_{Bn}



$$R_{Bn} = \frac{-\delta_n}{L_2} \quad \text{.....(9)}$$

$$\delta_n = \theta_n \frac{L_1}{2} \quad \text{.....(10)}$$

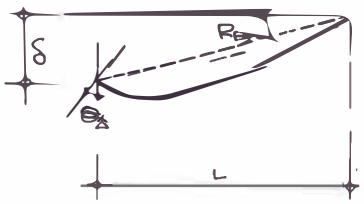
$$R_{Bn} = -\frac{\theta_n}{2}\frac{L_1}{L_2} \quad \text{.....(11)}$$

3.- Cálculo de los momentos en los extremos, debido a las deformaciones anteriores.

$$M_{AB} = \frac{2EI}{p}\left(2\theta_A + \theta_B - 3\frac{\delta}{L}\right) \quad \text{.....(12)}$$

$$M_{BA} = \frac{2EI}{p}\left(\theta_A + 2\theta_B - 3\frac{\delta}{L}\right) \quad \text{.....(13)}$$

VIGAS



θ_A = rotación de la pared

R_{Bn} = Rotación de la viga

θ_B = 0

Las rotaciones calculadas tienen como unidad $1/GEK_o$

Por lo tanto:

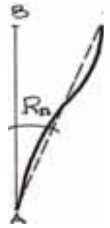
$$M_{AB} = \frac{2EK}{6EK_o}(2\theta_A - 3R_B) \quad \text{.....(14)}$$

$$M_{BA} = \frac{2EK}{6EK_o}(\theta_A - 3R_B) \quad \text{.....(15)}$$

$$M_{AB} = \frac{R_B}{3}(2\theta_A - 3R_B)$$

$$M_{BA} = \frac{R_B}{3}(\theta_A - 3R_B) \quad \text{.....(16)}$$

EN LAS COLUMNAS



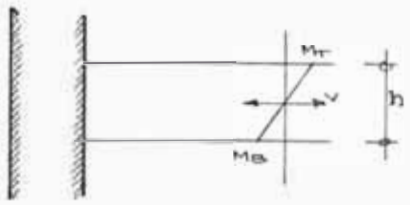
$\theta_A = \theta_B$ 0 ; R=Rotación de columnas.

$$M_{AB} = M_{BA} = \frac{2EK}{6EK_o}(-3R)$$

$$M_{AB} = M_{BA} = -K_c R \quad \text{.....(17)}$$

4.- Debido a que se trata sólo de un método aproximado, se realisará sólo un ciclo de distribución de momentos.

5.- Se halla el valor "D" de las columnas adyacentes.



$$V = \frac{M_B + M_T}{h} \quad .....(18)$$

$$\frac{V}{\delta} = \frac{M_B + M_T}{h\delta} \cdot \frac{\frac{M_B + M_T}{h^2}}{R} = \frac{M_B + M_T}{h^2 R \frac{1}{6EK_o}}$$

$$\frac{V}{\delta} = \frac{M_B + M_T}{2R} \left(\frac{12EK_o}{h^2} \right) \quad .....(19)$$

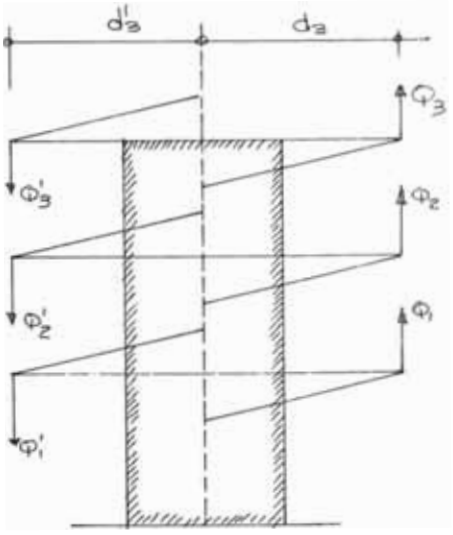
$$\therefore \quad D_n = \frac{M_B + M_T}{2R_n} \quad ..... (20)$$

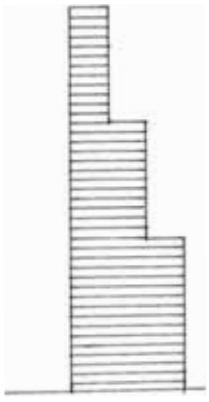
6.- Se determina la reacción de la viga en la pared y se calcula el momento adicional causado por el efecto de límite.

$$M_3 = Q_3 d_3 + Q_3' d_3'$$

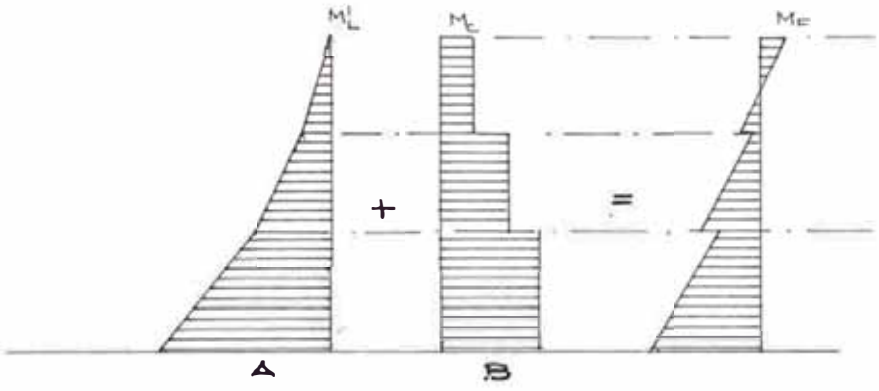
$$M_2 = M_3 + Q_2 d_2 + Q_2' d_2'$$

$$M_1 = M_2 + Q_1 d_1 + Q_1' d_1'$$





7.- Corrección de los momentos de flexión en la pared.

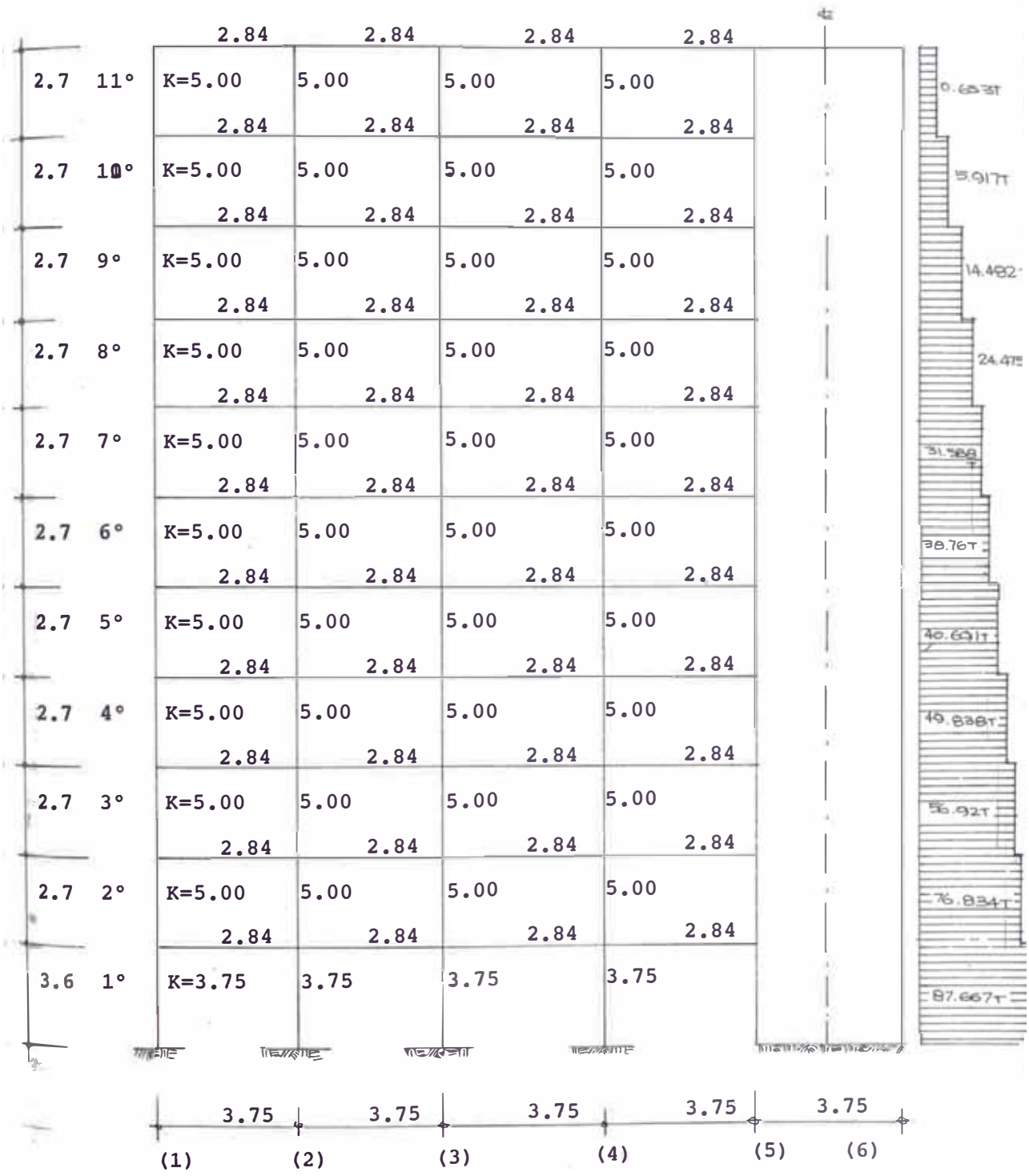


8.- Rechequeo de los valores D

La deformación final por flexión, δ_{Bn}, son obtenidos como la suma de los obtenido con los diagramas "A" y "B" delitem anterior A esta deformación se le suma las deformaciones iniciales por corte y por rotación si la hay y se determina finalmente el valor "D"

9.- Se comparan los valores "B" iniciales y finales y si la diferencia es muy grande, se repite el procedimiento.

INTERACCION ENTRE MUROS Y MARCO-PORTICO DE ARRIOSTRE "A"



EN PRIMER LUGAR CONSIDERAREMOS LA PARED SOLA ACTUANDO SOBRE ELLA LA DISTRIBUCION TOTAL DE FUERZA CORTANTE

CALCULO DE LAS DEFORMACIONES

(1) V_n T_n	(2) $\frac{1}{D_{wn}}$	(3) $\frac{h_n}{2}$	(5)= 1,2, 3 R_n	(4) δ_{sn}	(6)= 3,4 R_{Sn}	(5)-6 R_{BRn}	θ_n	R_{Bn}
							194.86	-97.43
0.653	1/0.454	135	195	0.001	0.135	194.86	243.16	-121.58
5.917	1/2.727	135	292	0.004	0.540	291.46	298.05	-149.02
14.482	1/6.380	135	306	0.010	1.350	304.65	301.17	-150.58
24.475	1/11.075	135	300	0.010	2.30	297.7	288.19	-144.09
31.588	1/15.187	135	281	0.023	2.31	278.69	275.52	-137.76
38.760	1/1900	135	276	0.027	3.64	272.36	260.72	-130.36
40.691	1/21.760	135	253	0.029	3.92	249.08	235.17	-117.58
49.838	1/29.666	135	226	0.035	4.73	221.27	199.86	- 99.98
56.920	1/418.53	135	183	0.041	5.54	177.46	154.18	- 77.09
73.834	1/71.648	135	139	0.051	6.90	133.90	94.00	- 47.00
87.667	1/255.59	180	62	0.044	7.90	54.10	32.97	- 16.48

$R_{Bn} = -\theta_n \frac{L_1}{L_2}$ Donde: L_2 = distancia de la placa al pórtico

B_1 = ancho de la placa

en nuestro caso $L_1 = L_2 = 3.75$

Luego tenemos:

$$R_{Bn} = \theta_n \times 1/2$$

CONSIDERANDO R_n = 306 COMO UNIDAD STANDARD

R_n	R_{Bn}	Θ_n
195	-97.43	194.86
(0.636)	(0.318)	(0.636)
292	-121.58	243.16
(0.955)	(0.394)	(0.795)
306	-149.02	298.05
(1.00)	(0.486)	(0.975)
300	-150.58	301.17
(0.98)	(0.49)	(0.985)
281	-144.09	288.19
(0.918)	(0.47)	(0.942)
276	-137.76	275.52
(0.90)	(0.45)	(0.90)
253	-130.36	260.72
(0.826)	(0.428)	(0.85)
226	-117.58	235.17
(0.74)	(0.384)	(0.766)
183	-79.98	199.86
(0.600)	-(0.326)	(0.85)
139	-77.09	154.18
(0.455)	(0.25)	(0.504)
62	-17.00	94.00
(0.202)	(0.154)	(0.308)
	-16.48	32.97
	(0.054)	(0.107)

Momentos de empotramiento perfecto

En Vigas: $M_{AB} = \frac{R_B}{3}(2\theta + 3R_B)$

$M_{BA} = \frac{R_B}{3}(\theta + 3R_B)$

Donde:

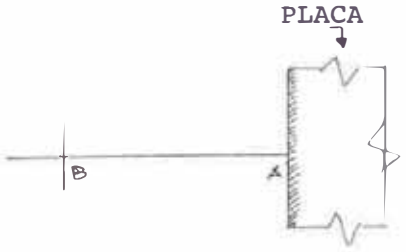
$R_B = \frac{284}{100} = 2.84$; $\frac{R_B}{3} = 0.946$

Viga	$R_B/3$	θ	2θ	$3R_B$	$2\theta+3R_B$	$\theta+3RB$	M_{AB}	M_{BA}
11	0.946	0.636	1.272	0.954	2.226	1.590	2.10	1.50
10	0.946	0.795	1.590	1.092	2.682	1.887	2.54	1.78
9	0.946	0.975	1.950	1.458	3.408	2.433	3.22	2.30
8	0.946	0.985	1.970	1.470	3.440	2.455	3.25	2.32
7	0.946	0.942	1.884	1.410	3.294	2.352	3.11	2.22
6	0.946	0.90	1.80	1.350	3.150	2.250	2.98	2.13
5	0.946	0.85	1.70	1.284	2.984	2.134	2.82	2.02
4	0.946	0.766	1.532	1.152	2.684	1.918	2.54	1.81
3	0.946	0.85	1.70	0.978	2.678	1.828	2.53	1.73
2	0.946	0.504	1.-08	0.750	1.758	1.254	1.66	1.18
1	0.946	0.308	0.616	0.412	1.078	0.770	1.02	0.73

EN COLUMNAS

$M_{AB} = M_{BA} = K_c K_n$

PISO	K_c	K_n	$M_{AB}=M_{BA}$
11	5.00	0.636	3.18
10	5.00	0.955	4.78
9	5.00	1.00	5.00
8	5.00	0.98	4.60
7	5.00	0.918	4.60
6	5.00	0.90	4.50
5	5.00	0.826	4.14
4	5.00	0.74	3.70
3	5.00	0.60	3.00
2	5.00	0.425	2.28
1	3.75	0.202	0.76



DISTRIBUCION DE MOMENTOS

Coeficientes de partición sólo para columnas inmediata a la placa.

PRIMER PISO

NUDO A

$\Sigma K = 5.68+3.75+5.00$

$\Sigma K = 14.43$

$C_{AA'} = \frac{2.84}{14.43} = 0.196$

$C_{AB} = \frac{5.00}{14.48} = 0.346$

$C_{AD} = \frac{3.75}{14.43} = 0.262$

PISOS 2°AL 1°

NUDO B(igual A: C,D,E,F,H,I,J)

$\Sigma K = 5.68+10.00$

$\Sigma K = 15.68$

$C_{BB} = C_{BB'} = \frac{2.84}{15.68} = 0.180$

$C_{BA} = C_{BC} = \frac{5.00}{15.68} = 0.32$

PISO 11

NUDO "K"

$\Sigma K = 5.68+5.00$

$\Sigma K = 10.68$

$C_{KK'} = \frac{2.84}{10.68} = 0.266 = C_{kk'}$

$C_{KJ} = \frac{5.00}{10.68} = 0.468$

El diagrama de Cross aparece en hoja aparte.

Asi mismo el diagrama de momentos.

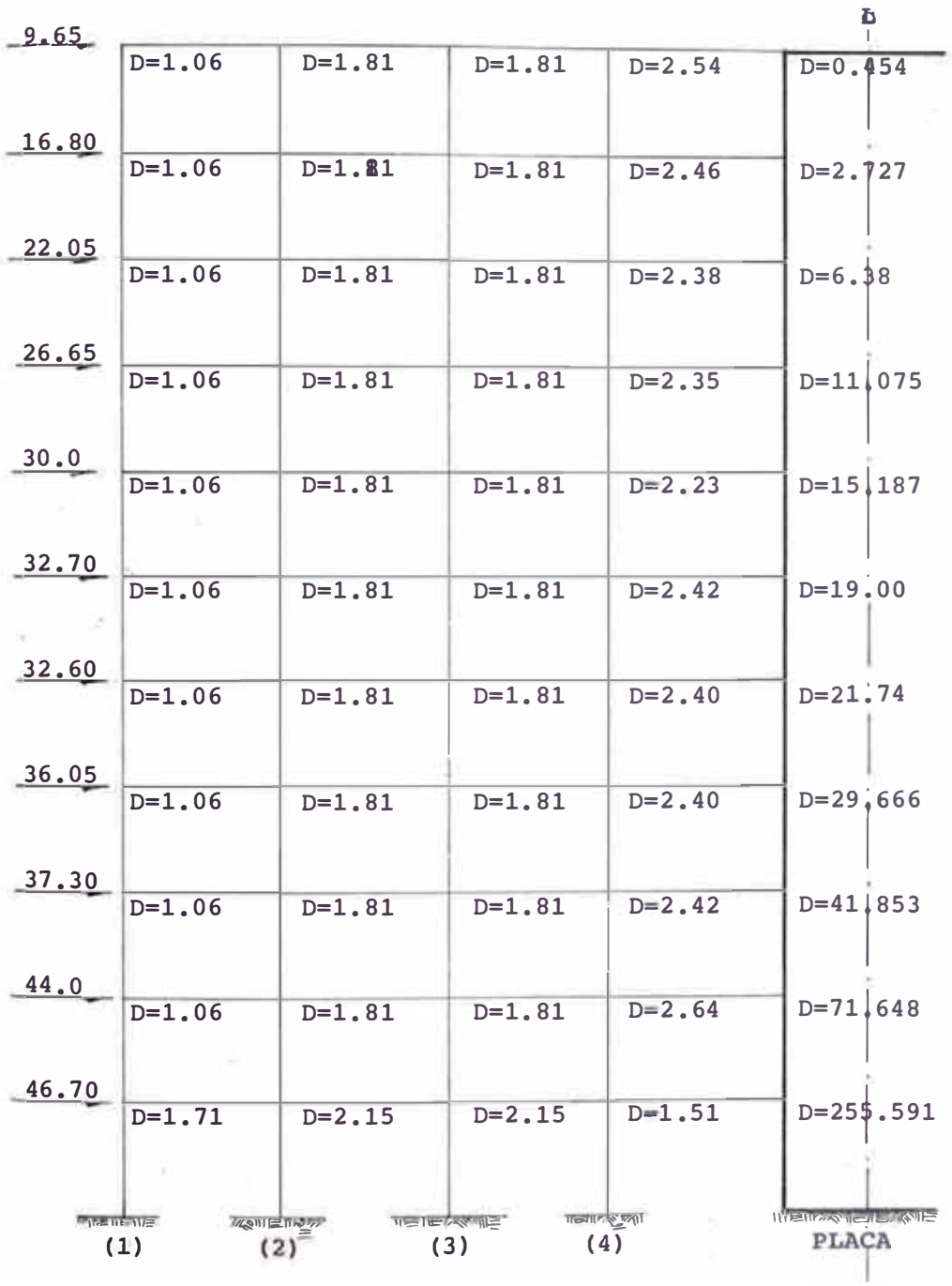
CALCULO DE LOS VALORES "D" PARA LAS COLUMNAS ADYACENTES A LA PLACA

$$D = \frac{M_u + M_D}{2R_n}$$

Piso	M_u	M_D	M_u+M_D	R_n	$2R_n$	D
11	2.39	0.94	3.33	0.636	1.272	2.54
10	2.93	1.76	4.69	0.955	1.910	2.46
9	2.90	1.87	4.77	1.00	2.00	2.38
8	2.77	1.83	4.60	0.980	1.960	2.35
7	2.62	1.70	4.32	0.918	1.936	2.23
6	2.59	1.77	4.36	0.900	1.800	2.42
5	2.36	1.61	3.97	0.826	1.652	2.40
4	2.06	1.49	3.55	0.740	1.480	2.40
3	1.67	1.24	2.91	0.600	1.200	2.42
2	1.18	1.12	2.30	0.455	0.910	2.64
1	0.15	0.46	0.61	0.202	0.404	1.51

DIAGRAMA DE PORTICO "A" MOSTRANDO LOS VALES "D" Y LOS V_f EN CADA NIVEL.

Por ser el pórtico simétrico y estar trabajando con la mitad del portico, los V_n será $\frac{V_f}{2}$ y en cada piso.



DISTRIBUCION DELCORTE:

Como ha variado el valor "D" de las columnas adyacentes a la placa y el valor de corte que toman columnas y placas es proporcio-nal a los valores "D" habra que hacer una nueva distribución del cor te según la fórmula:

$$V_{f(elemento)} = \frac{V_{f(eje)}}{\Sigma\ D}\ D_n$$

Piso	V_f(eje) (Tn)	Elemento	$D_{Elemento}$ (Tn)	V_f Elemento (Tn)
11°	9.65	C1-A	1.06	1.33
		C2-A	1.81	2.28
		C3-A	1.81	2.28
		C4-A	2.54	3.20
		Placa 2	0.454	0.57
			Σ=7.674	
10°	16.80	C1-A	1.06	1.81
		C2-A	1.81	3.08
		C3-A	1.81	3.08
		C4-A	2.46	4.20
		Placa 2	2.727	4.64
			Σ=9.867	
9°	22.05	C1-A	1.06	1.74
		C2-A	1.81	2.96
		C3-A	1.81	2.96
		C4-A	2.38	3.90
		Placa 2	6.38	10.40
			Σ=13.44	
8°	26.65	C1-A	1.06	1.56
		C2-A	1.81	2.67
		C3-A	1.81	2.67
		C4-A	2.35	3.46
		Placa 2	11.075	16.30
			Σ=22.997	

Piso	$V_{f(eje)}$ (tn)	Elemento	$D_{elemento}$ (tn)	$V_{f(elem.)}$ (tn)
7ª	30.00	C1-A	1.06	1.44
		C2-A	1.81	2.46
		C3-A	1.81	2.46
		C4-A	2.23	3.02
		Placa 2	15.187	20.60
			Σ=22.997	
6ª	32.70	C1-A	1.06	1.33
		C2-A	1.81	2.26
		C3-A	1.81	2.26
		C4-A	2.42	3.12
		Placa 2	19.00	23.80
			Σ=26.10	
5ª	32.60	C1-A	1.06	1.20
		C2-A	1.81	2.04
		C3-A	1.81	2.04
		C4-A	2.40	2.71
		Placa 2	21.76	24.50
			Σ=28.84	
4ª	36.05	C1-A	1.06	1.05
		C2-A	1.81	1.78
		C3-A	1.81	1.78
		C4-A	2.40	2.36
		Placa 2	29.666	29.20
			Σ=36.746	
3ª	37.30	C1-A	1.06	0.81
		C2-A	1.81	1.38
		C3-A	1.81	1.38
		C4-A	2.42	1.85
		Placa 2	41.853	32.00
			Σ=48.953	

Piso	$V_{f(eje)}$ (tn)	Elemento	$D_{elemento}$ (Tn)	$V_{f(elem.)}$ (Tn)
2°	44.00	C1-A	1.06	0.59
		C2-A	1.81	1.01
		C3-A	1.81	1.01
		C4-A	2.64	1.47
		Placa 2	71.648	40.00
			Σ=78.968	
1ª	46.7	C1-A	1.71	0.34
		C2-A	2.15	0.38
		C3-A	2.15	0.38
		C4-A	1.51	0.27
		Placa 2	255.591	45.40
			Σ=263.111	

Los momentos en las columnas variaran según el siguiente oeficiente:

$$\frac{V \times h}{M_s + M_i}$$

onde:

M_s = momento en la cabeza de la columna

M_i = momento en la base de la columna ambos hayados anteriormente.

Coeficiente que sirve para obtener los momentos finales se ún las fórmulas:

$M'_s = \frac{V \times h}{M_s + M_i} \times M_s$ ..... Momento final en la cabeza de la columna.

$M'_i = \frac{V \times h}{M_s + M_i} \times M_I$ ..... Momento final en la base de la co lumna.

MOMENTOS FINALES EN LAS COLUMNAS ADYACENTES A LA PLACA:

COLUMNA C4-A

Piso	V	h	Vxh	M_s	M_I	M_s+M_i	$\frac{V \times h}{M_s+M_i}$	M'_s	M'_I
11	3.20	2.70	8.64	4.50	2.52	7.02	2.270	5.71	3.20
10	4.20	2.70	11.35	5.81	4.94	10.75	1.055	6.14	5.22
9	3.90	2.70	10.50	6.16	4.98	11.14	0.940	5.80	4.56
8	3.46	2.70	9.35	5.98	4.85	10.83	0.862	5.16	4.18
7	3.02	2.70	8.16	5.70	4.64	10.34	0.790	4.50	3.67
6	3.12	2.70	8.44	5.53	4.49	10.02	0.800	3.76	3.56
5	2.71	2.70	7.32	4.72	4.46	9.18	0.786	3.22	3.22
4	2.36	2.70	6.38	4.09	4.09	8.18	0.786	3.221	3.22
3	1.85	2.70	5.00	3.34	3.34	6.68	0.750	2.50	2.50
2	1.47	2.70	3.97	2.54	2.54	5.08	0.780	1.98	1.98
1	0.27	3.60	0.97	1.28	1.72	3.00	0.324	0.41	0.56

Una vez hallados los momentos en las columnas adyacentes a la placa o sea columnas C4-A, en todos los pisos, y como han variado los cortantes que toma cada elemento resistente, columna y placas, habra que encontrar los nuevos momentos en las columnas: C1-P, C2-P,C3-P

En todos los pisos, según las fórmulas:

$M_s = V_f(h-Yh)$ ..... Momento superior

$M_I = V_f\ Yh$ ..... Momento Inferior.

Momentos en columnas: Pórtico A

Piso	Columna	V_f(Tn)	hcm.	Yh	h-Yh	M_I	M_S
	C1-A	1.33		0.77	1.93	1.02	2.56
11°	C2-A	2.28	2.70	0.97	1.73	2.22	3.94
	C3-A	2.28		0.97	1.73	2.22	3.94
	C1-A	1.81		1.04	1.66	1.88	3.00
10°	C2-A	3.08	2.70	1.24	1.46	3.76	4.50
	C3-A	3.08		1.24	1.46	3.76	4.50
	C1-A	1.74		1.08	1.62	1.88	2.82
9°	C2-A	2.96	2.70	1.21	1.49	3.58	4.42
	C3-A	2.96		1.21	1.49	3.58	4.42
	C1-A	1.56		1.21	1.49	1.89	2.32
8ª	C2-A	2.67	2.70	1.21	1.49	3.22	3.98
	C3-A	2.67		1.21	1.49	3.22	3.98
	C1-A	1.44		1.21	1.49	1.74	2.14
7ª	C2-A	2.46	2.70	1.21	1.49	2.98	3.66
	C3-A	2.46		1.21	1.49	2.98	3.66
	C1-A	1.33		1.35	1.35	1.80	1.80
6°	C2-A	2.26	2.70	1.21	1.49	3.74	3.36
	C3-A	2.26		1.21	1.49	2.74	3.36
	C1-A	1.20		1.35	1.35	1.62	1.62
5ª	C2-A	2.04	2.70	1.21	1.39	2.44	2.81
	C3-A	2.04		1.21	1.39	2.44	2.81

Piso	Columna	V_f(tn)	h cm.	Yh	h-Yh	M_I	M_S
	C1-A	1.08		1.35	1.35	1.42	1.42
4º	C2-A	1.78	2.70	1.35	1.35	2.40	2.40
	C3-A	1.78		1.35	1.35	2.40	2.40
	C1-A	0.81		1.35	1.35	1.09	1.09
3º	C2-A	1.38	2.70	1.35	1.35	1.86	1.86
	C3-A	1.38		1.35	1.35	1.86	1.86
	C1-A	0.59		1.43	1.27	0.84	0.75
2º	C2-A	1.01	2.70	1.35	1.35	1.36	1.36
	C3-A	1.01		1.35	1.35	1.36	1.36
	C1-A	0.34		2.70	0.90	0.91	0.30
1º	C2-A	0.38	3.60	2.33	1.27	0.88	0.48
	C3-A	0.38		2.33	1.27	0.88	0.48

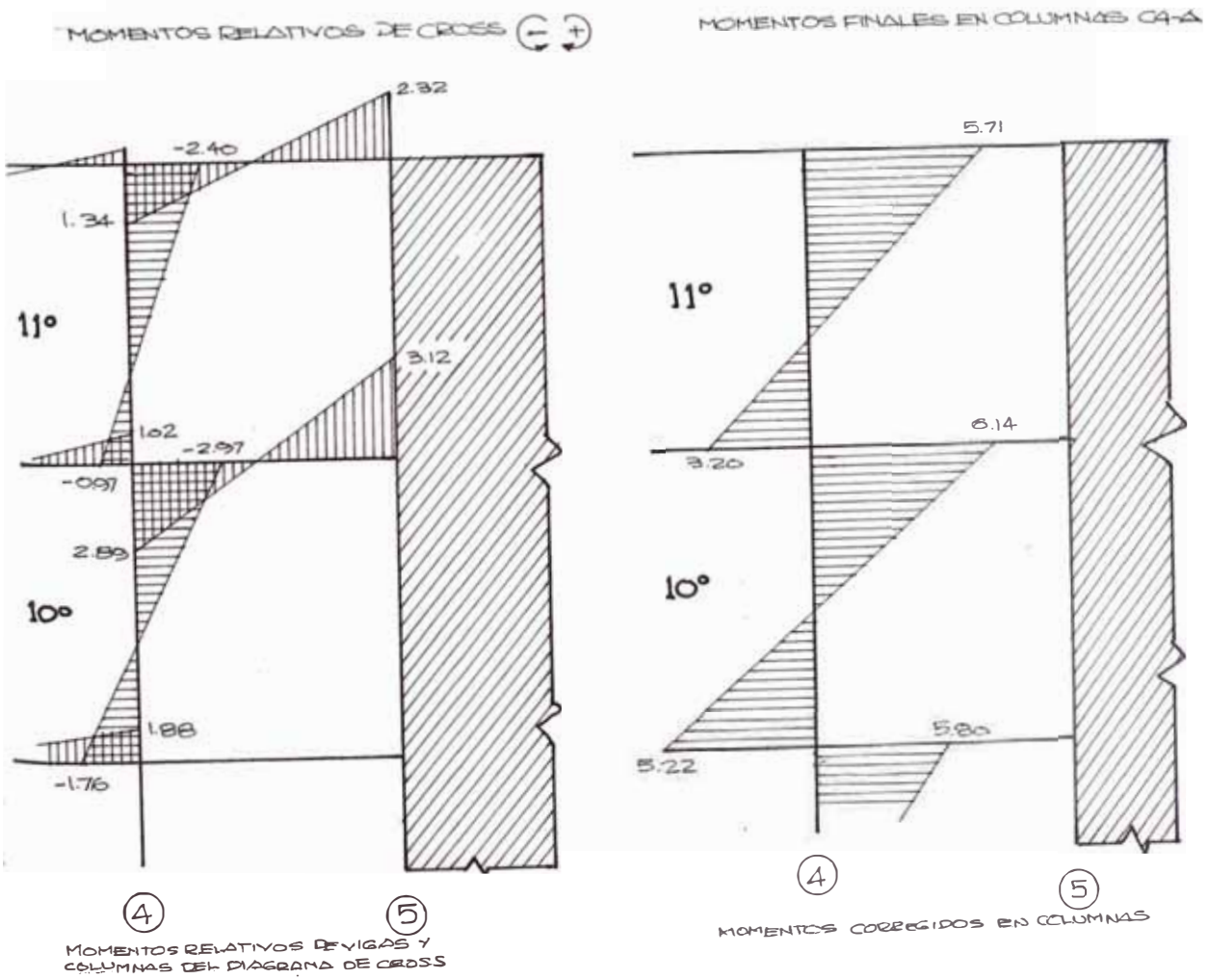
MOMENTOS EN LAS VIGAS

Los momentos de las vigas situadas entre la placa y la columna adyacente (C4-A) se encuentran:

Equilibrando el nudo (en nuestro caso nudo 4). Tal equilibrio se consigue repartiendo los momentos corregidos de las columnas que concurren en el nudo proporcionalmente a los momentos relativos de las vigas que concurren en dicho nudo,encontrados anteriormente en el diagrama de cross.

El momento en el tramo de viga que entra a la plca (M5-4), será proporcional a la relación de suma de momentos corregidos de columnas entre suma de momentos relativos de vigas que concurren en el nudo ($\frac{\Sigma MC4}{\Sigma MV4}$), y el momento relativo de la viga en el punto considerado.

Ejemplo de aplicación



Fórmulas:

$$M'_{4-3} = \frac{\Sigma M_{C4}}{\Sigma M_{V4}} \times M_{4-3}$$

$$M'_{4-5} = \frac{\Sigma M_{C4}}{\Sigma M_{V4}} \times M_{4-5}$$

$$M'_{5-4} = \frac{\Sigma M_{C4}}{\Sigma M_{V4}} \times M_{5-4}$$

Donde:

M'_{4-3} = Momento final de viga tramo 4-3

M'_{4-5} = Momento final de viga tramo 4-5

M'_{5-4} = Momento final de viga tramo 5-4

M_{4-3} = Momento relativo de viga tramo 4-3 encontrado por Cross.

M_{4-5} = Momento relativo de viga tramo 4-5 encontrado por Cross.

M_{5-4} = Momento relativo de viga tramo 5-4 encontrado por Cross.

ΣM_{C4} = Sumatoria de momentos de columnas en el nudo 4

ΣM_{V4} = Sumatoria de momentos relativos de vigas en el nudo 4

APLICACION PARA EL PISO 11- VIGA:4-5

$M_{4-3} = 0.45$ $\qquad M_{5-4} = 2.32$

$M_{4-5} = \frac{1.95}{2.40}$

$\Sigma M_{V4} = 2.40$

$M_d = -5.71$

$M_i = \underline{0.00}$

$\Sigma M_{C4} = -5.71$

$M'_{4-3} = \frac{\Sigma M_{C4}}{\Sigma M_{V4}} \times M_{4-3}$ $\qquad M'_{4-3} = \frac{5.71}{2.40} \times 0.45 = 1.07$

$M'_{4-5} = \frac{\Sigma M_{C4}}{M_{V4}} \times M_{4-5}$ $\qquad M_{4-5} = \frac{5.71}{2.40} \times 1.95 = 4.64$

$M_{5-4} = \frac{\Sigma M_{C4}}{M_{V4}} \times M_{5-4}$ $\qquad M_{5-4} = \frac{5.71}{2.40} \times 2.32 = 5.51$

A continuación se presenta en un cuadro, los momentos finales de las vigas que concurren en el nudo 4, concretamente de V_{4-5}.

MOMENTOS FINALES EN LAS VIGAS V_{4-5} DE TODOS LOS PISOS

Piso	MOMENTOS EN VIGAS				MOMENTOS EN COL.				MOMENTOS FINALES EN VIGAS		
	(1) M_{4-3}	(2) M_{4-5}	(3)=(1),(2) $\Sigma M_{V4} = M_{4-3}+M_{4-5}$	(4) M_{5-4}	M_d	M_i	(5) $\Sigma M_{C4} = M_d+M_i$	(6) $\frac{\Sigma M_{C4}}{\Sigma M_{V4}}$	$M_{4-3}=(6)(1)$	$M_{4-5}=(6)(2)$	$M_{5-4}=(6)(4)$
11	0.45	1.95	2.40	2.32	-5.71	---	-5.71	2.38	1.07	4.64	5.51
10	1.04	2.82	3.86	3.06	-6.14	-3.2	-9.34	2.42	2.52	6.83	7.40
9ª	1.18	3.48	4.66	3.81	-5.80	-5.22	-11.02	2.36	2.79	8.23	9.00
8ª	1.17	3.49	4.66	3.83	-5.16	-4.56	-9.72	2.08	2.44	7.28	7.98
7ª	1.11	3.33	4.44	3.66	-4.50	-4.18	-8.68	1.95	2.17	6.50	7.15
6ª	1.08	3.21	4.41	3.52	-4.65	-3.67	-8.32	1.88	2.04	6.06	6.64
5ª	1.00	3.02	4.02	3.32	-3.76	-3.78	-7.54	1.87	1.87	5.66	6.24
4ª	0.93	2.74	3.67	3.01	-3.22	-3.56	-6.78	1.85	1.72	5.06	5.56
3ª	0.75	2.48	3.23	2.90	-2.50	-3.22	-5.72	1.77	1.33	4.39	5.13
2ª	0.62	1.80	2.42	1.98	-1.98	-2.50	-4.48	1.85	1.15	3.33	3.66
1ª	0.34	1.07	1.41	1.19	-0.41	-1.98	-2.39	1.70	0.58	1.81	2.02

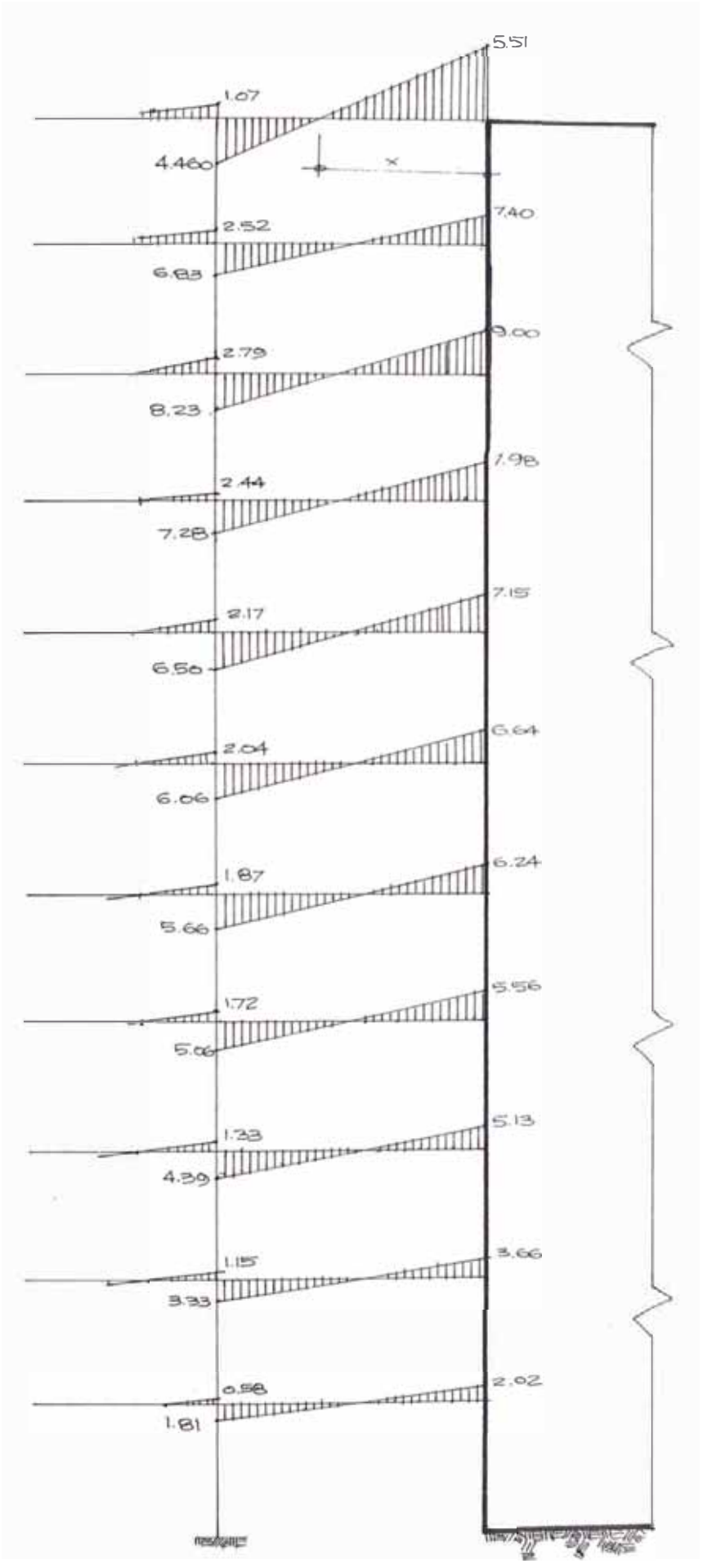
MOMENTOS FINALES EN EL RESTO DE VIGAS: V_{1-2}, V_{2-3}, V_{3-4}

Para el efecto se usarán las fórmulas deducidas anteriormente (sentido eje X)

Como las rigideces R son iguales en los nudos 2 y 3, se repartiran la mitad para cada lado.

Piso	MOMENTOS DE COLUMNAS						MOMENTOS DE VIGAS					
	NUDO 1		NUDO 2		NUDO 3		TRAM.1-2		TRAM.2-3		TRAM.3-4	
	M_{L2}	M_{ui}	M_{L2}	M_{ui}	M_{L2}	M_{ui}	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}	M_{3-4}	M_{4-3}
11°	0.00	2.56	0.00	3.94	0.00	3.94	2.56	1.92	1.92	1.92	1.92	
10°	1.02	3.00	2.22	4.50	2.22	4.50	4.02	3.36	3.36	3.36	3.36	
9ª	1.88	2.82	3.76	4.42	3.76	4.42	4.70	4.09	4.09	4.09	4.09	
8ª	1.88	2.32	3.58	3.98	3.58	3.98	4.20	3.78	3.78	3.78	3.78	
7ª	1.89	2.14	3.22	3.16	3.22	3.16	4.03	3.19	3.19	3.19	3.19	
6ª	1.74	1.80	2.98	3.36	2.98	3.36	3.54	3.17	3.17	3.17	3.17	
5ª	1.80	1.62	2.74	2.81	2.74	2.81	3.42	2.77	2.77	2.77	2.77	
4ª	1.62	1.42	2.44	2.40	2.44	2.40	3.04	2.41	2.41	2.41	2.41	
3ª	1.42	1.09	2.40	1.86	2.40	1.86	2.51	2.13	2.13	2.13	2.13	
2ª	1.09	0.75	1.86	1.36	1.86	1.36	1.84	1.61	1.61	1.61	1.61	
1ª	0.84	0.30	1.36	0.48	1.36	0.48	1.14	0.92	0.92	0.92	0.92	

NOTA: El momento M_{4-3} no aparece, por haber sido encontrado en el cuadro anterior.


5.51
1.07
4.460
x
7.40
2.52
6.83
9.00
2.79
8.23
7.98
2.44
7.28
7.15
2.17
6.56
6.64
2.04
6.06
6.24
1.87
5.66
5.56
1.72
5.06
5.13
1.38
4.39
3.66
1.15
3.33
2.02
0.58
1.81

Deducida la fórmula, encontrare los valores X en la fórmula siguiente.

Punto de inflexión de la viga V_{4-5} en todos los pisos y distancia del punto de inflexión al eje de la placa.

Piso	M_d	M_i	M_d+M_i	L	X	L'/2=3.75/2	X'=X+L/2
11°	4.46	5.51	9.97	3.75	1.68	1.87	3.55
10°	6.83	7.40	14.13	3.75	1.81	1.87	3.68
9ª	8.23	9.00	17.23	3.75	1.79	1.87	3.66
8ª	7.28	7.98	15.26	3.75	1.79	1.87	3.66
7ª	6.50	7.15	13.65	3.75	1.78	1.87	3.65
6ª	6.06	6.64	12.70	3.75	1.79	1.87	3.66
5ª	5.66	6.24	11.90	3.75	1.75	1.87	3.62
4ª	5.06	5.56	10.62	3.75	1.78	1.87	3.65
3ª	4.39	5.13	9.52	3.75	1.73	1.87	3.50
2ª	3.33	3.66	6.99	3.75	1.79	1.87	3.66
1°	1.81	2.02	3.83	3.75	1.77	1.87	3.64

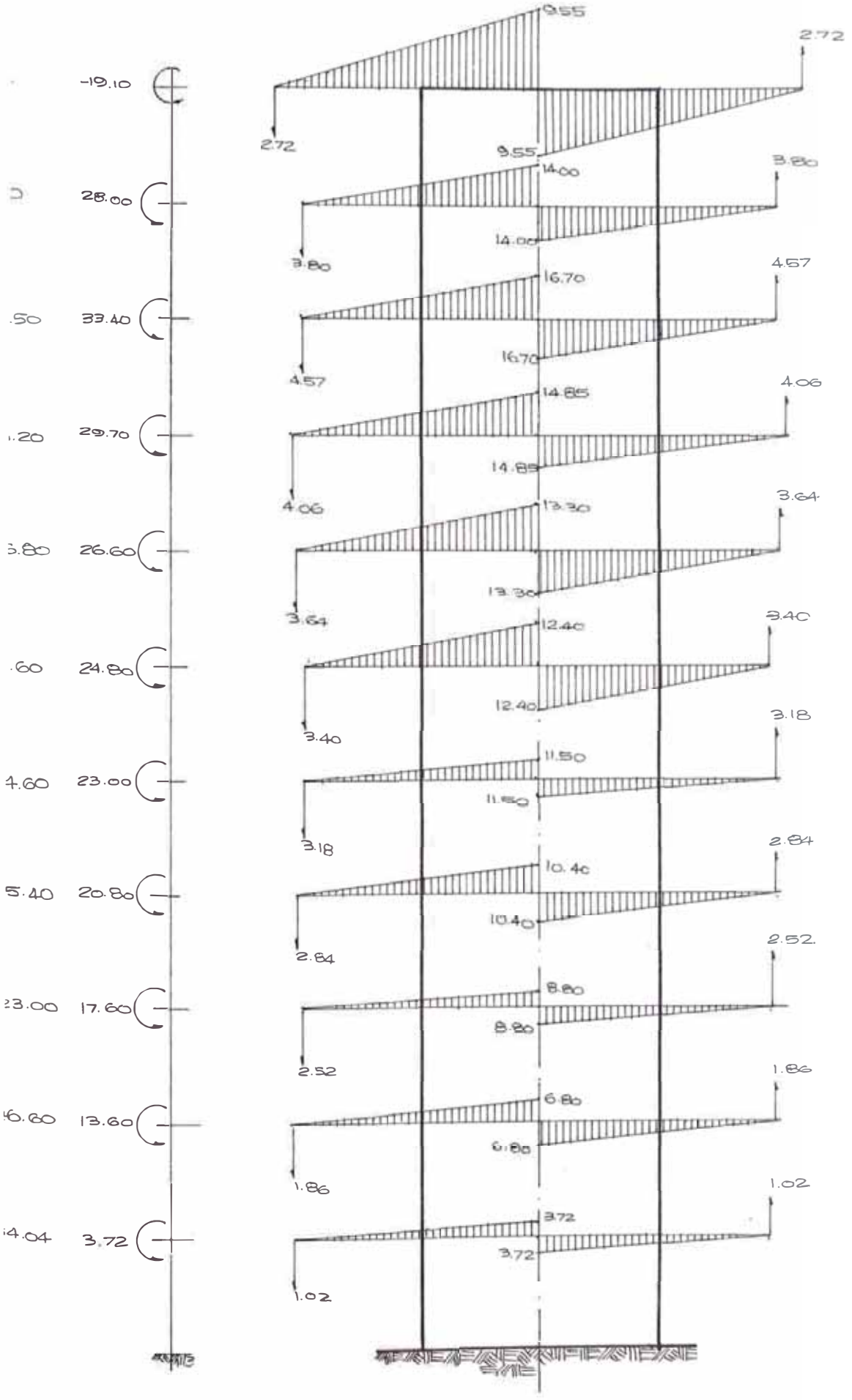
Donde L' = Ancho de la placa.

X' = Distancia del punto de inflexión al eje de la placa.

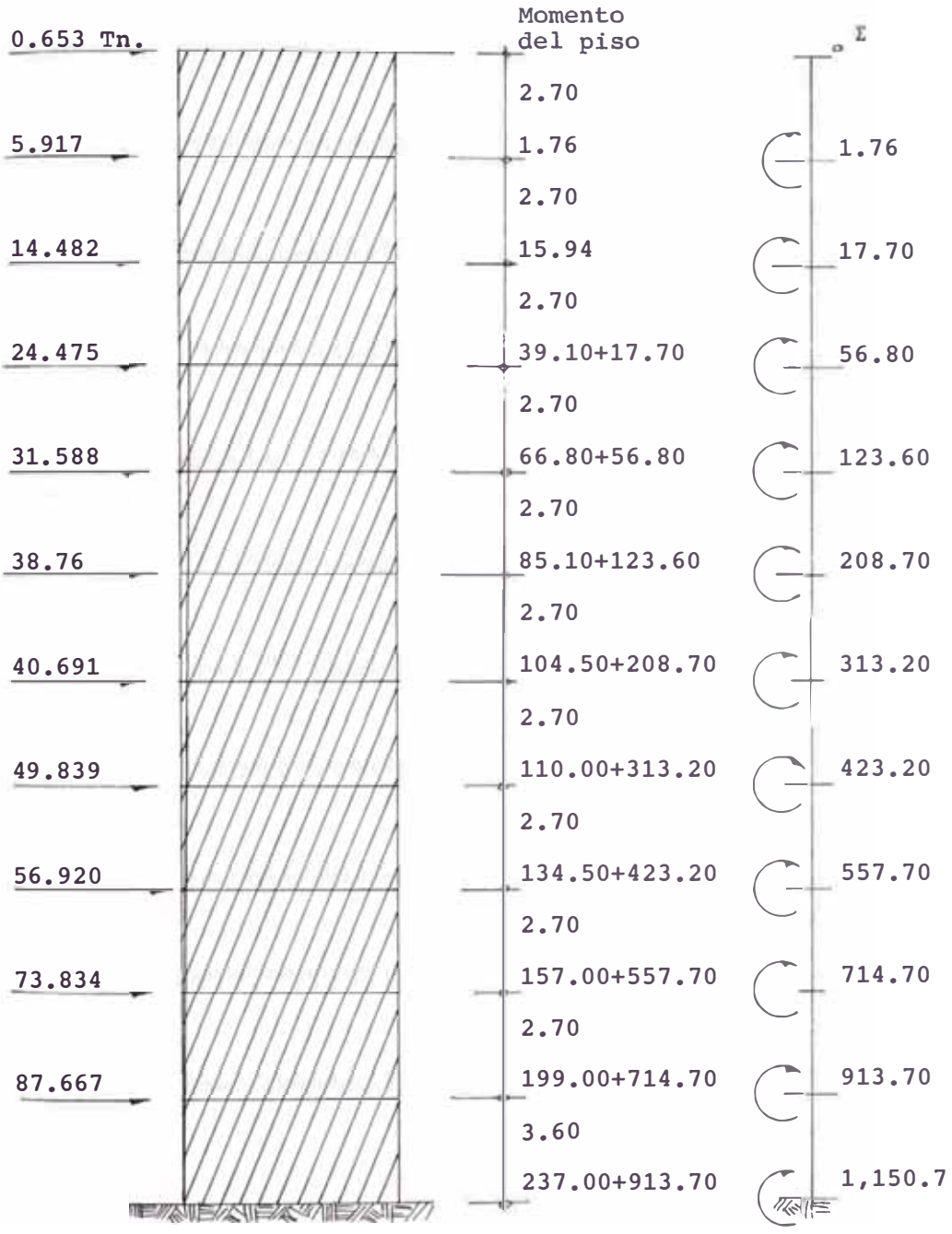
EFECTO LIMITE DEL PORTICO SOBRE LA PLACA.

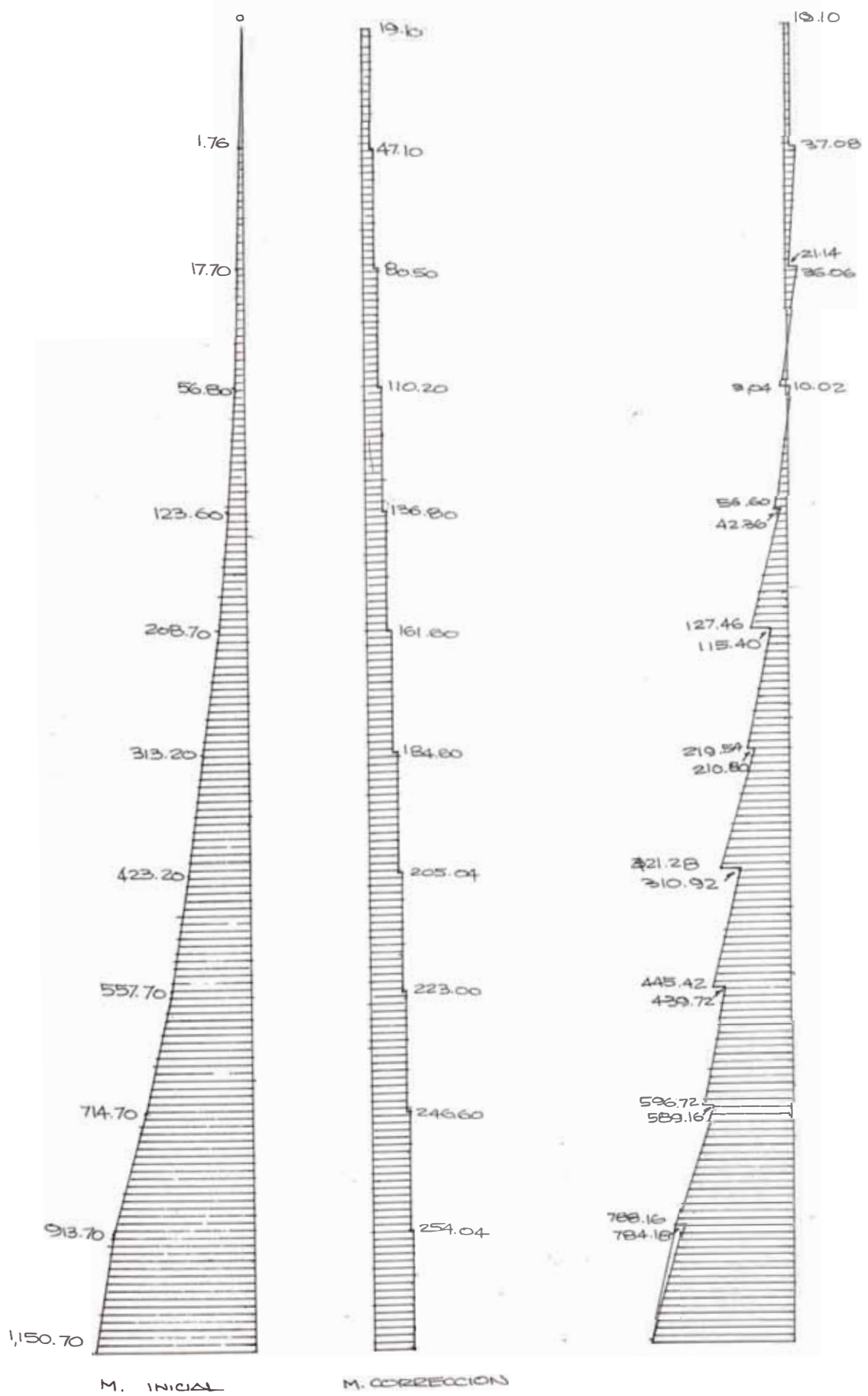
Piso	Q	X	M	ΣM	Σ
11ª	2.72	3.55	9.55	19.10	19.10
10ª	3.80	3.68	14.00	28.00	47.10
9ª	4.57	3.66	16.70	33.40	80.50
8ª	4.06	3.66	14.85	29.70	110.20
7ª	3.64	3.65	13.30	26.60	136.80
6ª	3.40	3.66	12.40	24.80	161.60
5ª	3.18	3.62	11.50	23.00	184.60
4ª	2.84	3.65	10.40	20.80	205.40
3ª	2.52	3.50	8.80	17.60	223.00
2ª	1.86	3.66	6.80	13.60	246.60
1ª	1.02	3.64	3.72	7.44	254.04

:TO LIMITE DEL PORTICO SOBRE LA PLACA



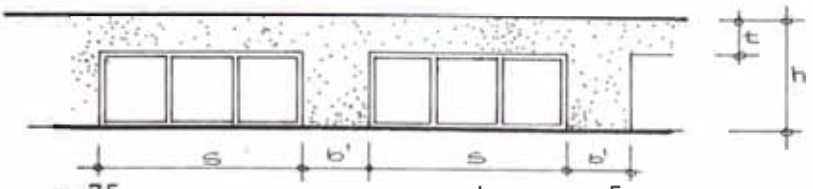
MOMENTOS DE LA PLACA CONSIDERADA COMO LIBRE VOLADIZO




0
1.76
17.70
56.80
123.60
208.70
313.20
423.20
557.70
714.70
913.70
1,150.70
M. INICIAL
19.10
47.10
80.50
110.20
136.80
161.60
184.60
205.04
223.00
246.60
254.04
M. CORRECCION
19.10
37.08
21.14
36.06
3.64
10.02
56.60
42.36
127.46
115.40
219.54
210.80
321.28
310.92
445.42
439.72
596.72
589.16
788.16
784.16

ALIGERADOS

ESPECIFICACIONES.



$S_{máx.}$ = 75 $t_{mín.}$ = 5 cm.

$b_{mín.}$ = 10 h = 36 cm.

NOMENCLATURA.

PISO	DENOMINACION	TIPOS
Techo azotea	A.A.	1 - 2 - 3
Techo 1erPiso Duplex	A.P.P.D.	1 - 2 - 3 - 4
Techo 2ªPiso Duplex	A.S.P.D.	1 - 2 - 3
Techo Primer Piso	A.P.P.	1 - 2 - 3

Características del aligerado por diseñar.

h = 20 cm.

t = 5 cm.

s = 30 cm.

b' = 10 cm.

Recubrimiento: r = 2 cm.

d = 20 - 3 = 17 cm.

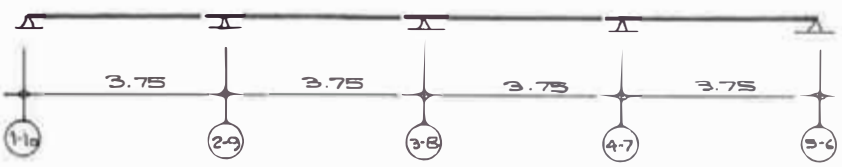
f_y= 2,800 Kg/mm^2

f'_c = 210 Kg/cm^2

El análisis estructural de los aligerados será por el método de Hardy Cross.

Análisis estructural de aligerados de azotea:

Aligerado tipo (1) A.A.A



1.- Rigides

$K = I/L$

I = constante.

L = constante

Luego: K = constante.

No obstante esto, para la simplificación de Cross tendremos:

$$K'_{1-2} = K \times 3/4 = 0.75\ K$$

$$K_{2-3} = K_{3-4} = K$$

$$K'_{4-5} = K \times 3/4 = 0.75K$$

2.- Cálculo de los coeficientes de distribución.

$$C = \frac{K}{\Sigma K}$$

Nudo (1):

$C_{1-2} = 0$ Simplificación de Cross

NUDO (2) $\Sigma K = 475K$

$$C_{2-1} = \frac{0.75K}{1.75k} = 0.43 \qquad C_{2-1} = 0.43$$

$$C_{2-3} = \frac{K}{1.75K} = 0.57 \qquad C_{2-3} = 0.57$$

NUDO (3) $\Sigma K = 2K$

$$C_{3-2} = \frac{K}{2K} = 0.5 \quad \ldots\ldots \quad C_{3-2} = 0.5$$

$$C_{3-4} = \frac{K}{2K} = 0.5 \quad \ldots\ldots \quad C_{3-4} = 0.5$$

NUDO (4) $\Sigma K = 1.75K$

$$C_{4-3} = \frac{K}{1.75K} = 0.57 \quad \ldots\ldots \quad C_{4-3} = 0.57$$

$$C_{4-5} = \frac{0,75K}{1.75K} = 0.43 \quad \ldots\ldots \quad C_{4-5} = 0.53$$

NUDO (5) $C_{5-4} = 0$ simplificación de Cross.

CARGAS SOBRE EL ALIGERADO

1.- CARGAS MUERTAS

a.- Peso propio.... = 300 Kg/m^2

b.- Peso piso acabado+cielo raso = 100 Kg/m^2

Total C.M. = 400 Kg/m^2 (servicio

C.M. Rotura = W_o=1.5x400=600 Kg/m^2

Por vigueta:

$$W_o = \frac{600}{2.5} = 240 \text{ Kg/m.l.}$$

2.- CARGA VIVA..... 100 Kg/m^2 (Servicio)

C.V. = Rotura = 1.8 x 100 = 180 Kg/m^2

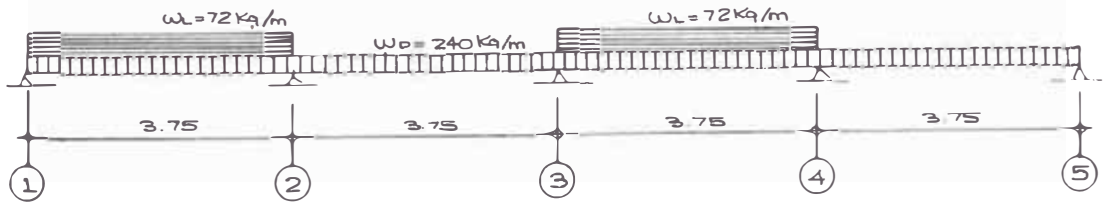
Por vigueta = $\frac{180}{2.5}$ = 72 Kg/m.l.

RESUMEN:

C.M.	240 Kg/m.l.
C.V.	72 Kg/m.l.
TOTAL	312 Kg/m.l.

PRIMERA COMBINACION DE CARGAS:

Para momentos máximos positivos en los tramos:1-2 y 3-4



CALCULO DE LOS MOMENTOS DE EMPOTRAMIENTO PERFECTO.

M_1 = 1/24x312x3.75^2 =-183 Kg-m (Tomando del A.C.I.aligerado apoyado en vigas se considerará en diagrama de momentos).

$M_{1-2} = -M_{2-1}$=-1/12x312x3.75^2=-366 Kg-m.

M'_{2-1} = -M +366 + $\frac{366}{2}$ = 366 + 183 = +549 Kg-m (Simplificación)

$M_{2-3} = -M_{3-2}$ = -1/12 x 240 x 3.75^2 = -282 Kg-m.

$M_{3-4} = -M_{4-3}$ = -1/12 x 312 x 3.75^2 = -366 Kg-m.

$M_{4-5} = -M_{5-4} = -1/12 \times 240 \times 3.75^2 = -282$ Kg-m

$M'_{5-4} = -282 - 141 = 423$ Kg-m. (Simplificación)

$M_5 = +1/24 \times 240 \times 3.75^2 = +141$ (Se considerara sólo en diagramas)

CALCULO DE LOS MOMENTOS ISOSTATICOS

$M_{1-2} = 1/8 \times 312 \times 3.75^2 = 548$ Kg-m.

$M_{2-3} = 1/8 \times 240 \times 3.75^2 = 422$ Kg-m.

$M_{3-4} = 1/8 \times 312 \times 3.75^2 = 548$ Kg-m.

$M_{4-5} = 1/8 \times 240 \times 3.75^2 = 422$ Kg-m.

CALCULO DE LAS REACCIONES ISOSTATICAS

TRAMO 1-2

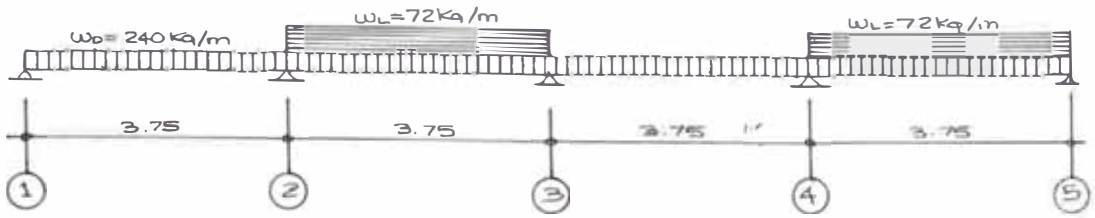
$$R_{1-2} = R_{2-1} = \frac{312 \times 3.75}{2} = 585 \text{ Kg} = R_{3-4} = R_{4-3}$$

$$R_{2-3} = R_{3-2} = \frac{240 \times 3.75}{2} = 450 \text{ Kg} = R_{4-5} = R_{5-4}$$

DISTRIBUCION DE MOMENTOS

(1)	(2)		(3)		(4)		(5)
0.00	0.43	0.57	0.50	0.50	0.57	0.43	0.00
0.000	+549	-282	+282	-366	+366	-423	
	-115	-152	- 76				
		+ 40	+ 80	+ 80	+ 40		
	- 17	- 23	- 12	+ 5	+ 10	+ 7	
			- 3	+ 3			
	+417	-417	+278	-278	+416	-416	
-183							+141
R.I.	+585	+585	+450	+450	585	585	450	450
R"H.	-62.5	+62.5	- 37	+ 37	- 37	+ 37	73.5	-73.5
R.C.	+522.5	+647.5	+413	+487	+548	+622	523.5	376.5

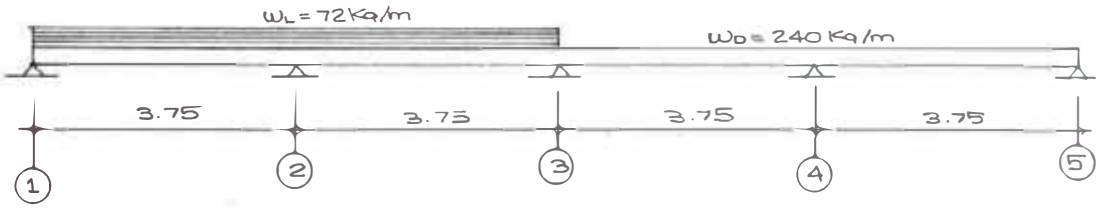
SEGUNDA COMBINACION DE CARGAS.



Como se puede observar que por ser todas las luces iguales . Esta segunda comvinación de cargas es similar a la primera, pero invertida, de manera que los momentos finales y reacciones serán las que se muestran en el cuadro.

M.F.	141	+416	-416	+278	-278	+417	-417	183
R.I.	450	450	585	585	450	450	585	585
R.H.	-73.	73	- 37	- 37	37	- 37	+62	-62
R.C.	37	52	622	548	487	413	647	523.5

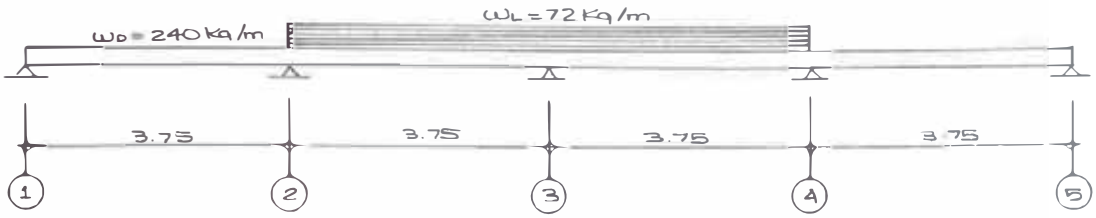
TERCERO COMBINACION DE CARGAS.



DISTRIBUCION DE MOMENTOS

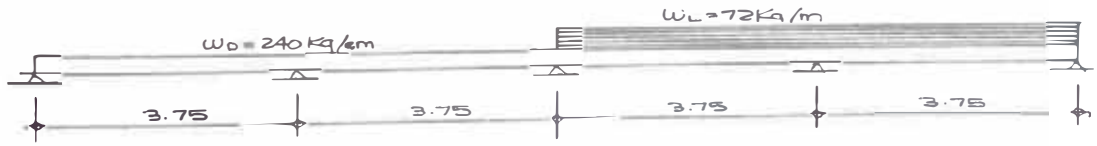
0.000	0.43	0.57	0.50	0.50	0.57	0.43	0.000
0.000	+549	-366	+366	-282	+282	-423	
	- 79	-104 ←	- 52	+ 40 ←	+ 80	+ 61	
		- 18 ←	- 36	- 36 →	- 18		
	+ 8	+ 10 →	+ 5	+ 5 ←	+ 10	+ 8	
			- 5	- 5			
	+478	-478	+278	-278	+354	-354	
-183							+141
RI	+585	+585	+585	+585	+450	+450	+450	+450
RH	-74.6	74.6	53	-53.	-20	+20	+57	-57
RC	+511	+659	532	532	430	470	507	393

CUARTA COMBINACION DE CARGAS



	0.00	0.43	0.57	0.50	0.50	0.57	0.43	0.00
	0.00	+423	-336	+336	-336	+336	-423	0.00
		- 37	- 50	- 25	+ 25	+ 50	+ 37	
	-141	+386	-386	+311	-311	+386	-386	+141
RI	+450	+450	+585	+585	+585	+585	+450	+450
RH	- 65	+ 65	+ 20	- 20	- 20	+ 20	+ 65	- 65
RC	+385	+515	+605	+565	+565	+605	+515	+385

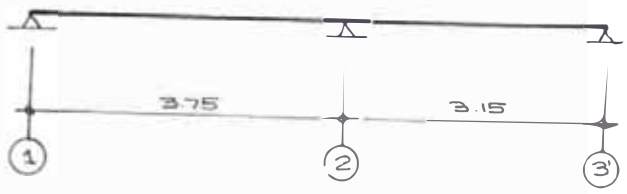
CUARTA COMBINACION DE CARGAS



Observamos facilmente que esta quinta y última combinación de cargas es igual a la tercera pero invertida de manera que los mo - mentos finales y reacciones corregidas, son las que se muestran en el cuadro siguiente.

M.F.	-141	+354	-350	+278	-278	+478	-478	+183
R.I.	+450	+450	+450	+450	+585	+585	+585	+585
R.H.	- 57	+ 57	+20.2	-20.2	-53.4	+53.4	+73.6	-73.6
R.C	+393	+507	+470.2	+429.8	531.6	532.4	+658.6	511.4

ALIGERADO TIPO 2 - AA-2



RIGIDECES

I = Cte., luego:

$K'_1 = \frac{1}{3.75} \times \frac{3}{4} = 0.2$ (Simplificación de Cross)

$K'_2 = \frac{1}{3.15} \times \frac{3}{4} = 0.231$ (Simplificación de Cross)

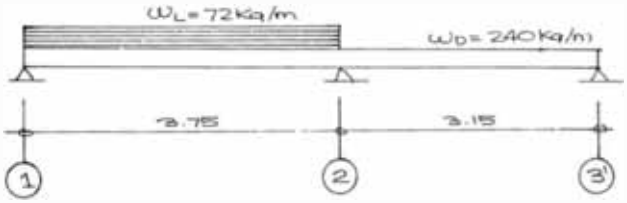
COEFICIENTES DE REPARTICION

Nudo 1..... $C_{1-2} = 0$ (Simplificación de Cross)

Nudo 2 $\quad C_{2-1} = \frac{0.2}{0.431} = 0.464$

ΣK=0.431 $\quad C_{2-3} = \frac{0.231}{0.431} = 0.536$

PRIMERA COMBINACION DE CARGAS



CALCULO DE LOS MOMENTOS

$M_1 = 181$

$M_{1-2} = -1/12 \times 312 \times 3.75^2 = -366$ Kg-m.

$M_{2-1} = 1/12 \times 312 \times 3.75^2 = 366$ Kg-m.

$M'_{2-1} = 366 + 366/2 = 366 + 183 = 549$ Kg-m. (Simplificación de Cross)

$M_{2-3} = M_{3-2} = -1/12 \times 240 \times 3.15^2 = -198$ Kg-m.

$M'_{3-2} = -198 + 198/2 = 198 + 99 = 297$ Kg-m. (simplificación de Cross)

$M_{3'} = 1/24 \times 3.15^2 = +99$ Kg-m.

CALCULO DE LOS MOMENTOS ISOSTATICOS

$$M_{1-2} = 1/8 \times 312 \times 3.75^2 = 548 \text{ Kg-m.}$$

$$M_{2-3'} = 1/8 \times 240 \times 3.15^2 = 298 \text{ Kg.}$$

CALCULO DE LAS REACCIONES ISOSTATICAS

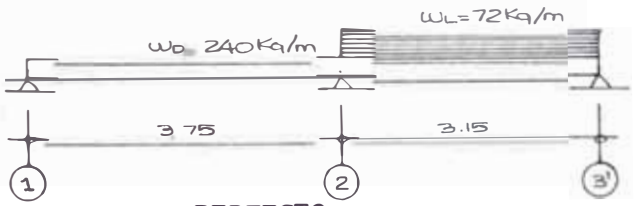
$$R_{1-2} = R_{2-1} = 312 \times \frac{3.75}{2} = 585 \text{ Kg.}$$

$$R'_{2-3} = R'_{3-2} = \frac{240}{2} \times 3.15 = 376 \text{ Kg.}$$

DISTRIBUCION DE MOMENTOS

	0.00	0.464	0.536	0.000
	0.00	+549	-297	0.000
		-117	-135	
		+432	-432	
	-183			+ 99
R.I.	+585	+585	+376	+376
R.H.	- 66	+ 66	+106	-106
R.C.	+519	+651	+482	+270

SEGUNDA COMBINACION DE CARGAS



MOMENTO DE EMPOTRAMIENTO PERFECTO

$M_1 = 1/24 \times 240 \times 3.75^2 = 141$ Kg-m. (Para el primer apoyo:Coef.A.C.I.)

$M_{1-2} = -M_{2-1} = -1/12 \times 240 \times 3.75^2 = -282$

$M_{2-1} = +282 + 141 = 423$ Kg-m.

$M_{2-3'} = -M_{3'-2} = 1/12 \times 312 \times 3.15^2 = -258$ Kg-m.

$M'_{2-3'} = -258 - 129 = -387$ Kg-m.

$M_3 = 1/24 \times 3.15^2 = 129$ Kg-m.

MOMENTOS ISOSTATICOS

$$M_{1-2} = 1/8 \times 240 \times 3.75^2 = 422 \text{ Kg-m.}$$

$$M_{2-3'} = 1/8 \times 312 \times 3.15^2 = 386 \text{ Kg-m.}$$

REACCIONES ISOSTATICAS.

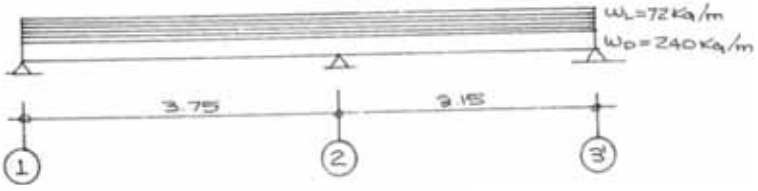
$$R_{1-2} = R_{2-1} = \frac{240 \times 3.75}{2} = 450 \text{ Kg.}$$

$$R_{2-3'} = R'_{3-2} = \frac{312 \times 3.15}{2} = 491 \text{ Kg.}$$

DISTRIBUCION DE MOMENTOS

	0.000	0.464	0.534	0.000
	0.000	+422	-386	
		- 17	- 19	
		+405	-405	
	-141			+129
R.I.	+450	+450	+491	+491.0
R.H.	-70.	+ 70	+87	-87.
R.C.	+380	+520	+578	+404

TERCERA COMBINACION DE CARGAS.



MOMENTOS DE EMPOTRAMIENTO PERFECTO

$M_1 = 1/24 \times 312 \times 3.75^2 = -183$ Kg/m.1. (Coef. A.C.I.)

$M_{1-2} = -M_{2-3'} = 1/12 \times 312 \times 3.75^2 = -3.66$ Kg-m.

$M'_{2-1} = 366 + 183 = 549$ Kg-m. (Simplificación de Cross)

$M_{2-3'} = -M_{3-2'} = 1/12 \times 312 \times 3.15^2 = -258$ Kg-m.

$M'_{2-3'} = -258 - 129 = -387$ Kg-m. (Simplificación de Cross)

$M_{3'} = 1/24 \times 312 \times 3.15^2 = 129$ Kg-m. (Coef. A.C.I.)

MOMENTOS ISOSTATICOS

$$M_{1-2} = 1/8 \times 312 \times 3.75^2 = 548 \text{ Kg-m.}$$

$$M_{2-3} = 1/8 \times 312 \times 3.15^2 = 386 \text{ Kg-m.}$$

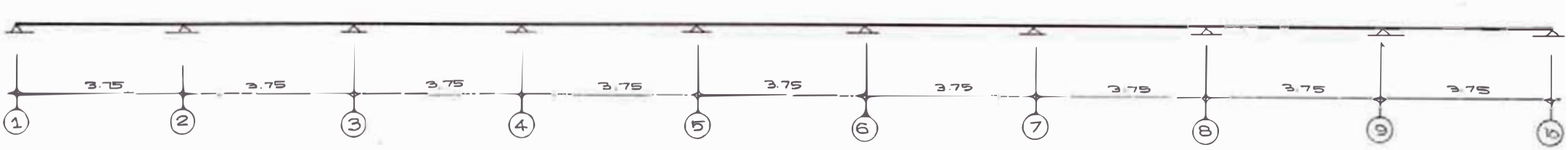
REACCIONES ISOSTATICAS

$$R_{1-2} = R_{2-3'} = \frac{312 \times 3.75^2}{2} = 585 \text{ Kg.}$$

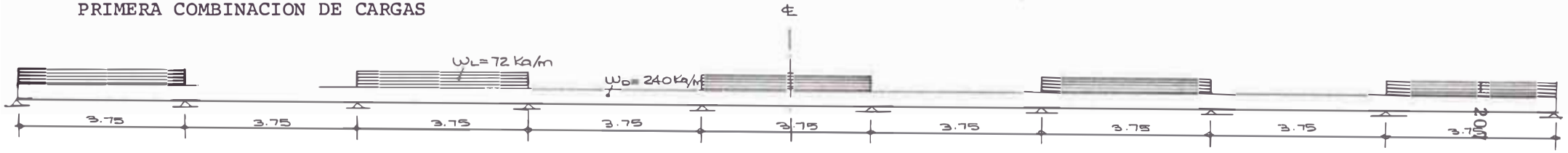
$$R_{2-3'} = R_{3'2} = \frac{312 \times 315}{2} = 491 \text{ Kg.}$$

DISTRIBUCION DE MOMENTOS

	0.00	0.464	0.536	0.00
	0.00	+548	-386	0.00
		- 75	- 87	
		+473	-473	
	-183			+129
R.I.	+585	+585	+491	+491
R.H.	- 77	+ 77	+109	-109
R.C.	+508	+662	+600	+382



PRIMERA COMBINACION DE CARGAS



COEFICIENTES DE REPARTO

$C_{1-2} = 0$

Nudo 2
- $C_{2-1} = 0.43$ (Cross simplificado encontrado anteriormente)
- $C_{2-3} = 0.57$

Nudo 3
- $C_{3-2} = 0.5$
- $C_{3-4} = 0.5$

Nudo 4
- $C_{4-3} = 0.5$
- $C_{4-5} = 0.5$

Nudo 5

Aplicando la simplificación de Cross para viga simétrica y simetricamente cargada. por tener luces e inercia iguales.

$K_{4-5} = 1$

$K_{5-4} = 1$

$K'_{5-4} = 1/2 = 0.5$

$\Sigma K = 1.5$

- $C_{5-4} = 1/1.5 = 0.67$
- $C_{5-8} = 0.5/1.5 = 0.33$

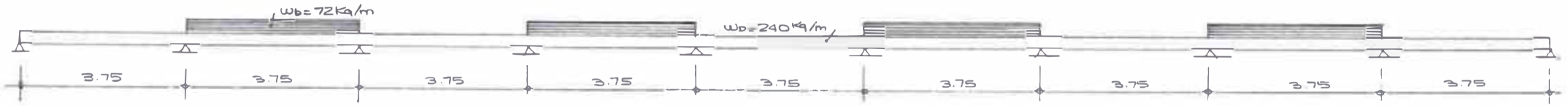
SE TOMARAN LOS COEFICIENTES DE EMPOTRAMIENTO DE LOS CASOS ANTERIORES POR TRATARSE DE LAS MISMAS LUCES Y CARGAS EN CADA CASO.

DIAGRAMA DE CROSS:

0.00	0.43	0.57	0.5	0.5	0.5	0.5	0.67	0.33	0.00
	+549	-282	+282	-366	+366	-282	+282	-366	
	-115	-152	- 76			- 28	- 56	- 28	
		+ 40	+ 80	+ 80	+ 40				
	- 17	- 23	- 12	- 24	- 48	- 48	- 24		
		+ 9	+ 18	+ 18	+ 9	+ 8	+ 15	+ 8	
	- 4	+ 9			- 9	- 9			
-183	+413	-413	+292	-292	+359	-359	+208	-208	

R.I.	+585	+585	+450	+450	+450	+450	+450	+450	+585	
R.H.	- 61	+ 61	+ 32	- 32	- 19	+ 19	+ 41	- 41	0.00	0.00
R.C.	+424	+646	+482	+418	+431	+469	+491	+409	+450	

SEGUNDA COMBINACION DE CARGAS

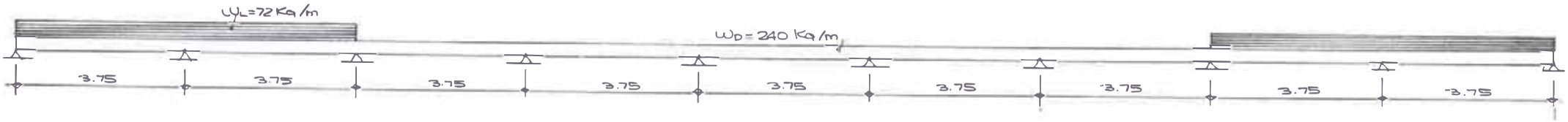


Simétrico y simetricamente cargado, luego los coeficientes de reparto seran los mismos que el caso anterior.

	0.00	0.43	0.57	0.50	0.50	0.50	0.50	0.67	0.33	0.00
		+423	-366	+366	-282	+282	-366	+366	-282	0.00
		- 25	- 32	- 16			- 28	- 56	- 28	
				- 34	- 34	- 17				
					+ 32	+ 64	+ 64	+ 32		
			- 8	- 16	- 16		- 10	- 21	- 11	
		+ 4	+ 4			+ 5	+ 5			
	-141	+402	-402	+300	-300	+334	-334	+321	-321	
R.I.	+450	+450	+585	+585	+450	+450	+585	+585	+450	
R.H.	- 70	+ 70	+ 27	- 27	-32.5	+32	+ 3	- 3	0.00	
R.C.	+380	+520	+612	+558	+418.5	+482	+588	+582	+450	

TERCERA COMBINACIONDE CARGAS

PARA MAXIMO NEGATIVO EN APOYO 2 y 9

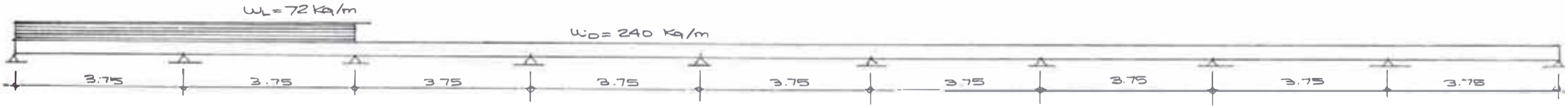


Como es simétrico y simetricamente cargado tomamos los mismos coeficientes.

0.00	0.43	0.57	0.5	0.5	0.5	0.5	0.67	0.33	0.00
	+549	-366	+366	-282	+282	-282	+282	-282	
	- 79	-104	- 52						
			- 16	- 16	- 8				
					+ 4	+ 4			
-183	+470	-470	+298	-298	+278	-278	+282	-282	
R.I	+585	+585	+585	+585	+450	+450	+450	+450	+450
R.H	- 77	+ 77	+ 46	- 46	+ 5	- 5	-1	+ 1	0.00
R.C	+508	+662	+631	+539	+455	-445	+449	+451	+450

CUARTA COMBINACION DE CARGAS

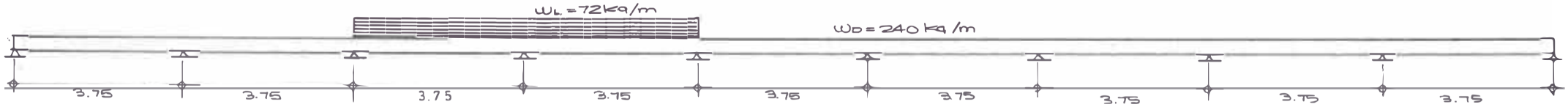
MOMENTO MAXIMO NEGATIVO PARA EL APOYO 3



	0.43	0.57	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.57	0.43	0.0
	+423	-366	+366	-366	+366	-282	+282	-282	+282	-282	+282	-282	+282	-282	+282	-423	
	+ 25	+ 32	+ 16											+ 40	+ 80	+ 61	
		- 4	- 8	- 8	- 4							- 10	- 20	- 20	- 10		
	+ 2	+ 2		+ 20	+ 10	+ 40	+ 20				+ 5	+ 5			+ 6	+ 4	
			- 10	- 10			- 10	- 10									
	-141	+450	-334	+364	-364	+402	-402	+292	-292	282	-282	+287	-287	262	-262	+358	-358	+141
R.I	+450	+450	+585	+585	+585	+585	+450	+450	+450	+450	+450	+450	+450	+450	+450	+450	+450	+450
R.H	-82.5	+82.5	- 8	+ 8	- 10	+ 10	+ 27	- 27	+ 3	- 3	0.0	0.0	+ 7	- 7	-2.5	+ 25	+ 58	- 58
R.C	+367.5	+532.5	+577	+593	+575	+595	+477	+423	+453	+447	+450	+450	+457	-443	+425	+475	+508	+392

QUINTA COMBINACION DE CARGAS

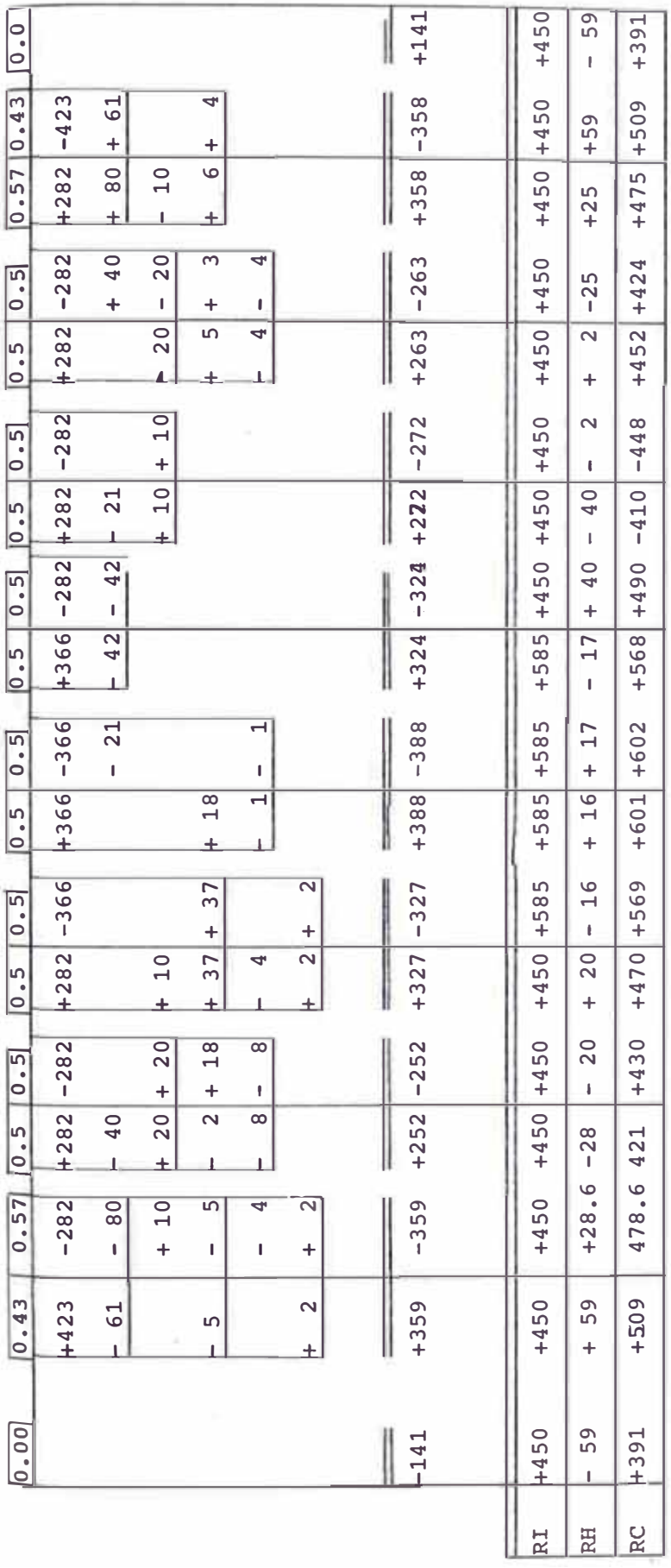
MAXIMO NEGATIVO EN EL APOYO "4"



	0.00	0.43	0.57	0.50	0.50	0.50	0.5	0.50	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.57	0.43	0.00
		+423	-282	+282	366	+366	-366	+366	-282	+282	-282	+282	-282	+282	-282	+282	-423	
		- 61	- 80	- 40											- 40	+ 80	+ 61	
			+ 31	+ 62	+ 62	+ 31							- 10	- 20	- 20			
		- 13	- 18	- 9	- 8	- 18	- 15	- 8				+ 5	+ 5					
		+ 13	+ 18	+ 18	+ 8		- 19	- 38	- 38	- 19								
						+ 10	+ 10			+ 10	+ 10							
	-141	+362	-362	+304	-304	+390	-390	+320	-320	+272	-272	+287	-287	+262	-262	+362	-362	+141
RI	+450	+450	+450	+450	+450	+585	+585	+585	+585	+450	+450	+450	+450	+450	+450	+450	+450	+450
RH	- 59	+ 59	+ 16	- 16	- 23	+ 23	+ 18	- 18	+ 12	- 12	- 4	+ 4	+ 7	- 7	- 26	+ 26	+ 59	- 59
RC	+391	+509	+466	-434	+562	+608	+603	+567	+462	+438	+446	+454	+457	+443	+423	+476	+509	-391

SEXTA COMBINACION DE CARGA

MAXIMO MOMENTO NEGATIVO EN EL APOYO 5


0.00
0.43
0.57
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.5
0.57
0.43
0.0
RI
RH
RC

ALIGERADOS DEL PRIMER PISO

Iguales a los del segundo piso Duplex.

ALIGERADO TIPO 1 APP-1 = ASPED - 1 = APPT - 1

Las coeficientes de repartición , son los mismos que los de la azotea, por tener luces y secciones iguales.

De manera que:

$C_{1-2} = 0$

$C_{2-1} = 0.43$

$C_{2-3} = 0.57$

$C_{3-2} = 0.5$

$C_{3-4} = 0.5$

$C_{4-3} = 0.57$

$C_{4-5} = 0.43$

CARGAS SOBRE EL ALIGERADO

1.- Cargas Muertas:

a.- Peso propio	300 Kg/m^2
b.- Peso piso acabado más cielo raso	100 Kg/m^2
c.- Peso de tabiquería movil perpendicular a las viguetas	100 Kg/m^2
TOTAL C.M.(Servicio)	500 Kg/m^2

C.M. Rotura = 1.5 x 500 = 750 Kg/m^2

2.- Cargas Vivas.

s/c = 225 Kg/m^2 (Servicio)

Rotura: 1.8 x 225 = 405 Kg/m^2

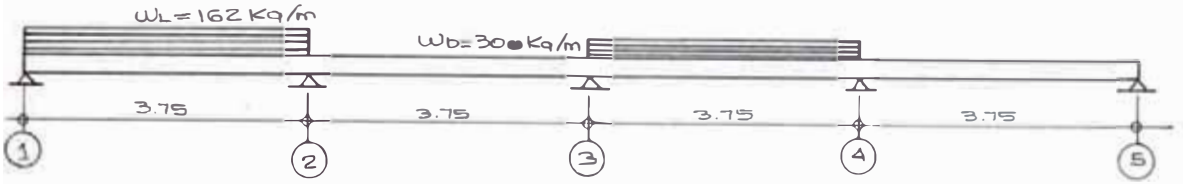
Por vigueta = $\frac{405}{2.5}$ = 162 Kg/m.l.

RESUMEN.

CM.	300 Kg/m.l.
CV.	162 Kg/m.l.
TOTAL	462 Kg/m.l.

PRIMERA COMBINACION DE CARGAS

Para momentos máximos positivos en los tramos 1-2 y 3-4



Cálculo de los momentos de empotramiento perfecto

$$M_1 = 1/24 \times 462 \times 3.75^2 = -270 \text{ (Tomando del A.C.I.)}$$

Este momento se considerará en el diagrama de momentos.

$$M_{1-2} = -M_{2-1} = -1/12 \times 462 \times 3.75^2 = -540 \text{ Kg-m}$$

$$M'_{2-1} = + 540 + \frac{450}{2} = 540 + 270 = 810 \text{ Kg-m (Simplifcación)}$$

$$M_{2-3} = -M_{3-2} = -1/12 \times 300 \times 3.75^2 = -352 \text{ Kg-m.}$$

$$M_{3-4} = -M_{4-3} = -540 \text{ Kg-m.}$$

$$M_{-45} = -M_{5-4} - 1/2 \times 300 \times 3.75^2 = -352 \text{ Kg-m.}$$

$$M'_{4-5} = -352 \times \frac{352}{2} = - 352 - 176 = - 528 \text{ Kg-m. (Simplificación)}$$

$$M_{5-4} = 1/24 \times 300 \times 3.75^2 = + 176 \text{ (Del A.C.I., considerar en el diagrama de momentos)}$$

CALCULO DE LOS MOMENTOS ISOSTATICOS

Tramo Cargado con 1.5CM + 1.8CV

$$M = 1/8 \times 462 \times 3.75^2 = 810 \text{ Kg-m.}$$

Tramo cargado con: 1.5CM.M.

$$M = 1/8 \times 300 \times 3.75^2 = 528 \text{ Kg-m.}$$

CALCULO DE LAS REACCIONES ISOSTATICAS

1.- Primer tramo y todos los cargados con 1.5CM+1.8CV

$$R_{1-2} = R_{2-1} = 462 \times \frac{3.75}{2} = 846 \text{ Kg.}$$

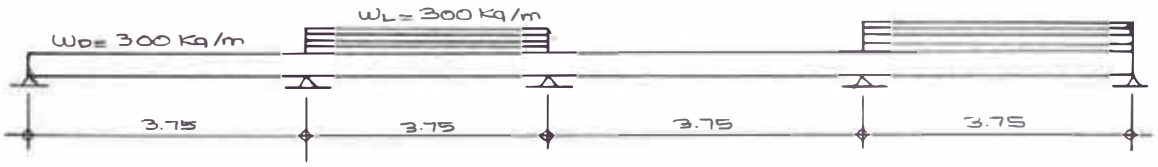
2.- Segundo tramo y todos los cargados con 15C.M.

$$R_{2-3} = R_{3-2} = 300 \times \frac{3.75}{2} = 562 \text{ Kg.}$$

DISTRIBUCION DE MOMENTOS.

0.00	0.43	0.57	0.50	0.50	0.57	0.43	0.00
	+810	-352	+352	-540	+540	-528	
	-197	-261	-130	+ 3	+ 7	+ 5	
		+ 78	+152	+157	+ 78		
	- 34	- 44	- 22	- 22	- 44	- 34	
		+ 11	+ 22	+ 22	+ 11		
	- 5	- 6	- 3	- 3	- 6	- 5	
			+ 3	+ 3			
-270	+574	-574	+380	380	+562	-562	+176
RI	+846	+846	+562	+562	+846	+846	+562	+562
RH	- 81	+ 81	+ 52	- 52	- 48	+ 48	+103	-103
RC	+765	+927	+614	+510	+798	+894	+665	+159

SEGUNDA COMBINACION DE CARGAS.

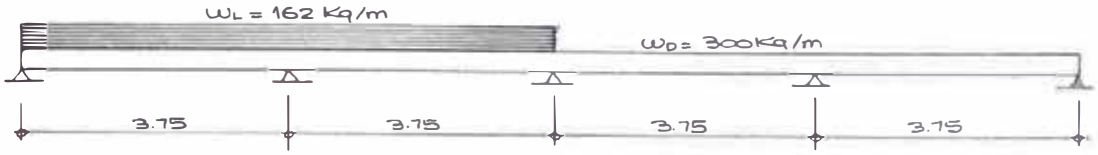


Como se puede apreciar: Por ser todas las luces iguales esta combinación es similar a la 1ra pero invertida. Luego los momentos finales y reacciones de apoyo seran los que se muestran en el c cuadro siguiente.

M.F.	-176	+562	-562	+380	-380	+574	-574	+270
R.I.	+562	+562	+846	+846	+562	+562	+846	+846
R.H.	-103	+103	+ 48	- 48	- 52	+ 52	+ 81	- 81
R.C.	+459	+665	+894	+798	+510	+614	+927	+765

TERCERA COMBINACION DE CARGAS

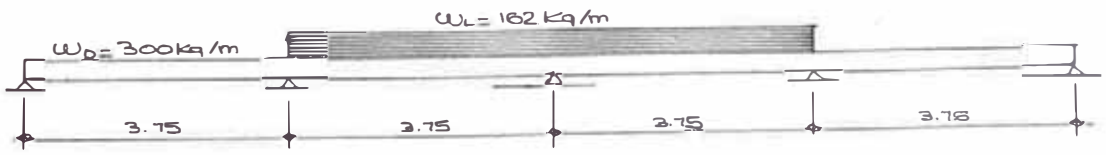
Máximo momento negativo en el apoyo 2:



DISTRIBUCION DE MOMENTOS:

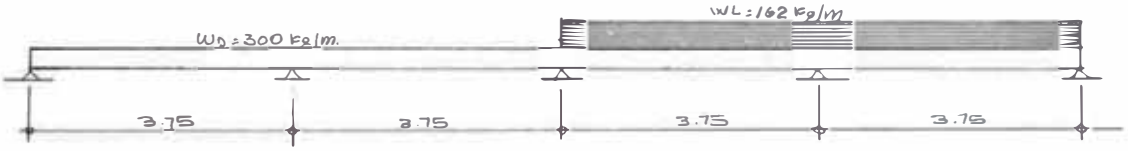
	(1)	(2)		(3)		(4)		(5)
	0.00	0.43	0.57	0.50	0.50	0.57	0.43	0.00
		+810	-540	+540	-352	+352	-528	
		-116	-154	- 77	+ 50	+100	+ 76	
			- 40	- 80	- 80	- 40		
		+ 17	+ 23	+ 12	+ 12	+ 23	+ 17	
			- 6	- 12	- 12	- 6		
		+ 3	+ 3			+ 3	+ 3	
	-270	+714	-714	+383	-383	+432	-432	+176
R.I.	+846	+846	+846	+846	+562	+562	+562	+562
R.H.	-252	+252	+ 88	- 88	- 13	+ 13	+ 68	- 68
R.C.	+594	+1092	+934	+758	+549	+595	+630	+494

CUARTA COMBINACION DE CARGAS.



	0.00	0.43	0.57	0.50	0.50	0.57	0.43	0.00
		+582	-540	+540	-540	+540	-582	
		- 18	- 24	- 12	+ 12	+ 24	+ 18	
	-176	+564	-564	+528	-528	+564	-564	+176
R.I.	+562	+562	+846	+846	+846	+846	+562	+562
R.H.	-103	+103	+ 10	- 10	- 10	+ 10	+103	-103
R.C	+459	+665	+856	+836	+836	+856	+665	+459

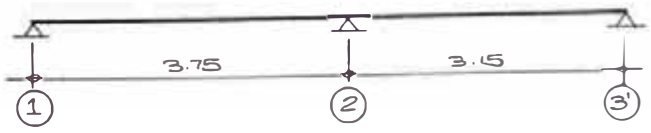
QUINTO COMBINACION DE CARGAS:



Observamos facilmente que esta y última combinación de cargas es igual a la 3ra pero invertida, de manera que los mo - mentos finales y reacciones corregidas, son las que se muestran en el cuadro siguiente.

M.F.	-176	+432	-432	+383	-383	+714	-714	+270
R.I.	+562	+562	+562	+562	+846	+846	+846	+846
R.H.	- 68	+ 68	+ 13	- 13	- 88	+ 88	+252	-252
R.C.	+494	+630	+573	+549	+758	+934	+1098	+594

ALIGERADO TIPO 2 APP-2 = APPT - 2



CALCULO DE RIGIDECES:

$K'_1 = \frac{1}{375} \times 3/4 = 0.2$ (Simplificación de cRoss)

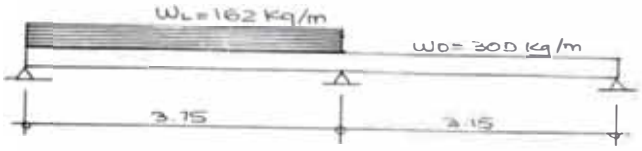
$K''_2 = \frac{1}{3.15} \times 3/4 = 0.231$ (Simplificación de Cross)

COEFICIENTES DE REPARTICIÓN

Nudo 2 $\quad C_{2-1} = \frac{0.200}{0.431} = 0.464$

$\Sigma K = 0.431 \quad C_{2-3} = \frac{0.231}{0.431} = 0.536$

PRIMERA COMBINACIÓN DE CARGAS



CALCULO DE LOS MOMENTOS

$M_1 = 1/24 \times 462 \times 3.75^2 = -270$ Kg-m.

$M_{2-1} = +810$ Kg-m

$M_{2-3'} = -M_{3'-2} = -1/12 \times 300 \times 3.15^2 = 248$ Kg-m.

$+M'_{2-3} = -248 \times 124 = -372$ Kg-m

$-M'_{2-3} = -372$ Kg-m (Simplficación de Cross)

$M'_3 = 1/24 \times 300 \times 3.15^2 = 124$ Kg-m.

CALCULO DE LOS MOMENTOS ISOSTATICOS

$M_{1-2} = 1/8 \times 462 \times 3.75^2 = 810$ Kg-m.

$M_{2-3} = 1/8 \times 300 \times 3.75^2 = 372$Kg-m.

CALCULO DE LAS REACCIONES ISOSTATICAS

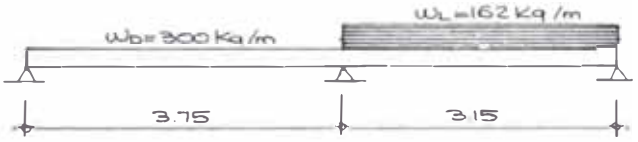
$R_{1-2} = R_{21} = 462 \times \frac{3.75}{2} = 864$ Kg.

$R_{2-3} = R_{3-2} = 300 \times \frac{3.15}{2} = 472$ Kg.

DISTRIBUCION DE MOMENTOS:

0.00	0.464	0.536	0.00
	+810	-372	
	-204	-234	
	+606	-606	
-270	+606	-606	124
R.I. +864	+864	+472	+472
R.H. - 90	+ 90	+185	-185
R.C. +774	+954	+657	+287

SEGUNDA COMBINACION DE CARGAS:



MOMENTOS DE EMPOTRAMIENTO PERFECTO.

$$M_1 = -1/24 \times 300 \times 3.75^2 = -176$$

$$M_{1-2} = -M'_{2-1} = -1/12 \times 300 \times 3.75^2 = -352 \text{ Kg-m.}$$

$$M'_{2-1} = 352 + 176 = 528 \text{ Kg-m.}$$

$$M_{2-3} = - M_{3-2} = - 1/12 \times 462 \times 3.15^2 = -382$$

$$M'_{2-3} = -382 + 191 = -573 \text{ Kg-m.}$$

REACCIONES ISOSTATICAS.

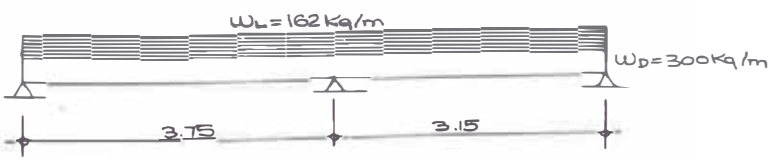
$$R_{1-2} = R_{2-1} = 300 \times 3.75/2 = 562$$

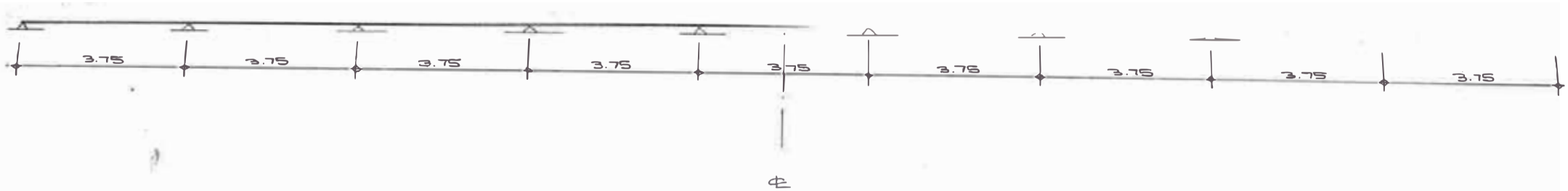
$$R_{2-3} = E_{3-2} = 462 \times \frac{3.15}{2} = 726 \text{ Kg.}$$

	0.00	0.464	0.536	0.00
		+528	-573	
		+ 21	+ 24	
	-176	+549	-549	+191
R.I.	-562	+562	+726	+726
R.H.	-100	+100	+ 95	- 95
R.C.	+462	+662	+821	+631

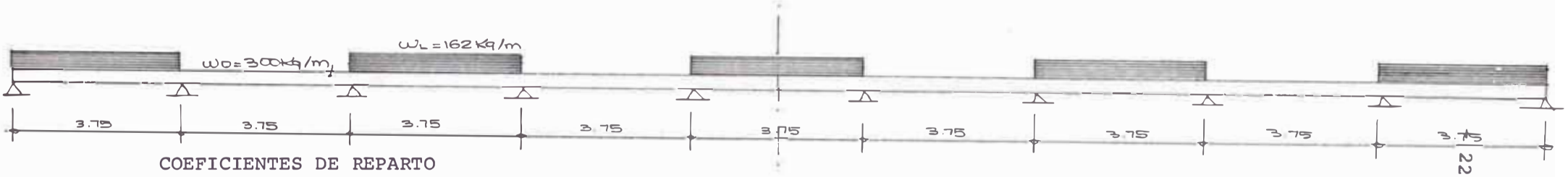
TERCERA COMBINACION DE CARGAS.

	0.00	0.464	0.536	0.00
		+810	-537	
		-127	-146	
	-270	+683	-683	+191
R.I.	+864	+864	726	+726
R.H.	-111	+111	+156	-156
R.C.	+753	+975	+882	+570





PRIMERA COMBINACION DE CARGAS



COEFICIENTES DE REPARTO

Por ser las luces y secciones iguales a las del aligerado 3 de la azotea, tomare los mismos coeficientes de reparto de la azotea.

$C_{1-2} = 0$

$C_{2-1} = 0.43$

$C_{2-3} = 0.57$

$C_{3-4} = 0.5$

$C_{4-3} = 0.5$

$C_{4-5} = 0.5$

$C_{5-4} = 0.67$ Simplificación de Cross.

$C_{5-5'} = 0.33$

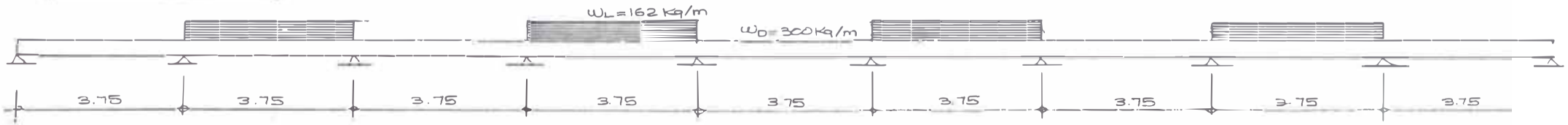
MOMENTOS DE CROSS.

Se tomaran los mismos momentos del aligerado tipo 1. Según se trate de tramo totalmente cargado, tramo cargado sólo con carga muerta o en Fn se trate de tramo exterior con cual quier tipo de carga y su respectiva simplflicación.

0.00	0.43	0.57	0.50	0.50	0.50	0.50	0.67	0.33
	+810	-352	+352	-540	+540	-352	+352	-540
	-192	-262 →	-131			+ 63 ←	+126	+ 62
		+ 79 ←	+159	+159 →	+ 79			
	- 34	- 45 →	- 22	- 84 ←	-165	-165 →	- 84	
		+ 26 ←	+ 53	+ 53 →	+ 26	+ 28 ←	+ 56	+ 28
	- 11	- 15 →	- 8	- 13 ←	- 27	- 27 →	- 13	
		+ 5 ←	+ 10	+ 10 →	+ 5	+ 5 ←	+ 9	+ 4
	+ 2	3			- 5	- 5		
-270	+573	-573	+413	-413	+452	-453	+446	-446

R.I.	+846	+846	+562	+562	+846	+846	+562	+562	+846
R.H.	- 81	+ 81	+ 43	- 43	- 10	+ 10	+ 2	- 2	0.00
R.C.	+765	+927	+605	+519	+836	+856	+564	+560	+846

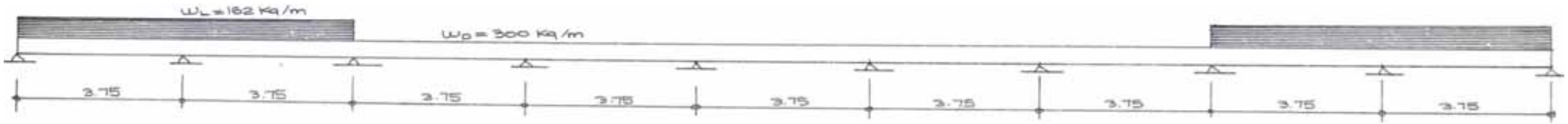
SEGUNDA COMBINACION



	0.00	0.43	0.57	0.50	0.50	0.50	0.50	0.67	0.33
		+528	+540	+540	+352	+352	-540	+540	-352
		+ 5	+ 7 →	+ 3			- 63 →	-126	- 62
			- 48 ←	- 95	- 95 →	- 48			
		+ 21	+ 27 →	+ 13	+ 79 →	+149	+149 →	+ 79	
			- 23 ←	- 46	- 46 →	- 23	- 26 ←	- 53	- 26
		+ 10	+ 13 →	+ 6	+ 12 ←	+ 24	+ 24 →	+ 12	
			- 5 ←	- 9	- 9 →	- 5	-4 ←	- 8	- 4
		+ 2	+ 3	+412	-412	+ 4	+4		
	-176	+566	=566	+412	=412	+438	-438	+444	+444
R.I.	+562	+562	+846	+846	+562	562	+846	+846	+562
R.H.	-167	+167	+ 41	- 41	- 7	+ 7	- 2	+ 2	0.00
R.C.	+395	+729	+887	+805	+555	+569	+844	+949	+562

TERCERA COMBINACION

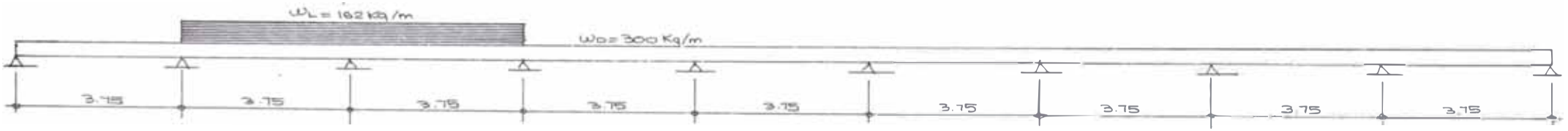
PARA MAXIMO MOMENTO NEGATIVO APOYOS 2 y 9



	0.00	0.43	0.57	0.50	0.50	0.50	0.50	0.67	0.33	0.00
		+810	-540	+540	-352	+352	-352	+352	-352	
		-116	-154	- 77						
			- 28	56	- 56	- 28				
		+ 12	+ 16	+ 8	+ 7	+ 14	+ 14	+ 7		
				- 8	- 8			- 5	- 2	
	-270	+706	-706	+407	-407	+338	-338	+354	-354	
R.I.	+846	+846	+846	+846	+562	+562	+562	+562	+562	
R.H.	-116	+116	+ 80	- 80	+ 18	- 18	- 4	+ 4	0.00	
R.C.	+730	+962	+926	+776	+580	+544	+558	+566	+562	

CUARTA COMBINACION DE CARGAS

MOMENTO MAXIMO NEGATIVO PARA EL APOYO 3

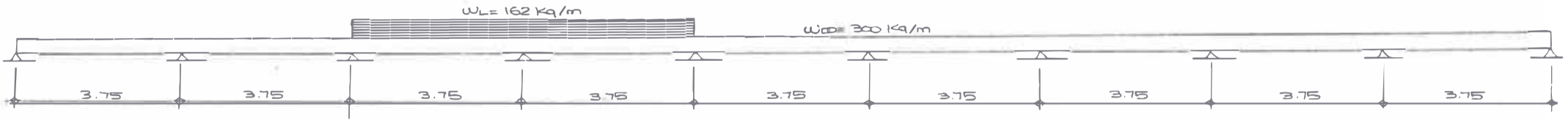


0.0	0.43	0.57	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.00
	+528	-540	+540	-540	+540	-352	+352	-352	+352	-352	+352	-352	+352	-352	+352	-528	
	+ 5	+ 7 →	+ 3	- 47 ←	- 94	- 94 →	- 47							+ 50 ←	+100	+ 76	
		+ 11 ←	+ 22	+ 22 →	+ 11	+ 11 ←	+ 23	+ 23	+ 11			- 12 ←	- 25	- 25 →	- 12		
	- 5	6			- 11	- 11			- 5	- 5	+ 6	+ 6			+ 7	- 5	
-176	+528	-528	+565	-565	+446	-446	+329	-329	+357	-357	+358	-358	+327	+327	+457	-457	+176

R.I	+562	+562	+846	+846	+846	+846	+562	+562	+562	+562	+562	+562	+562	+562	+562	+562	+562	+562
R.H	-136	+136	- 10	+ 10	+ 32	- 32	+ 31	- 31	+ 8	- 8	0.0	0.0	+ 8	- 8	+ 35	+ 35	+ 75	-75
R.C	+426	+698	+836	+856	+878	+814	+593	+531	+554	+570	+562	+562	+570	+554	+527	+597	+631	+487

QUINTA COMBINACION DE CARGAS

MAXIMO MOMENTO NEGATIVO EN EL APOYO "4"



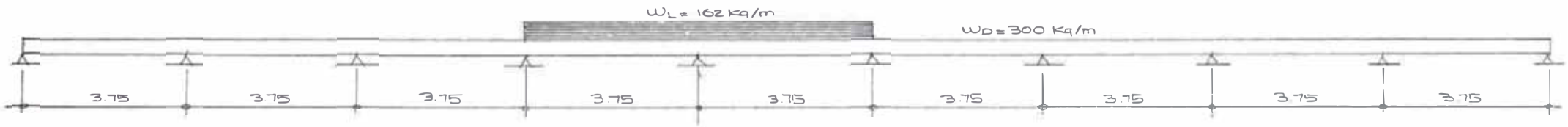
REARTICION DE MOMENTOS

0.00	0.43	0.57	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.57	0.43	0.00
	+528	-352	+352	-540	+540	-540	+540	-352	+352	-352	+352	-352	+352	-352	+352	-528	
	- 76	-100→	- 50											+ 50←	+100	+ 76	
		+ 59←	+119	+119→	+ 59							- 12←	- 25	- 25→	- 12		
	- 25	- 34→	- 17	- 19←	- 29	- 29→	- 19			+ 3←	+ 6	+ 6→	+ 3	+ 3←	+ 7	+ 5	
		+ 9←	+ 18	+ 18→	+ 9	- 42←	- 84	- 84→	- 42								
	- 4	- 5→	- 2	+ 8←	+ 16	+ 16→	+ 8	+ 9←	+ 19	+ 19→	+ 9						
			- 3	- 3			- 8	- 8→	- 4	- 2←	- 4	- 4→	- 2				
									+ 3	+ 3			+ 1	+ 1			
-176	+423	-423	+417	-417	+595	-595	+437	-437	+328	-328	+362	-362	+329	-329	+457	447	+176

R.I.	+562	+562	+562	+562	+846	+846	+846	+846	+562	+562	+562	+562	+562	+562	+562	+562	+562	+562
R.H.	- 66	+ 66	+ 2	2	- 48	+ 48	+ 42	- 42	+ 29	- 29	- 9	+ 9	+ 9	- 9	- 34	+ 34	+ 72	- 72
R.C.	+496	+628	+564	+560	+798	+894	+888	+804	+591	+533	+553	-571	+571	-553	+528	+596	+634	+490

SEXTA COMBINACION DE CARGAS

MAXIMO NEGATIVO EN EL APOYO 5



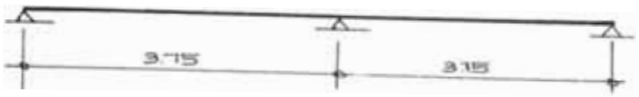
0.00	0.43	0.57	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	\0.57	0:431	u.uu
	+528	-352	+352	-352	+352	-540	+540	540	+540	-352	+352	-352	+352	-352	+352	-528		
	- 76	100	+ 50	+ 47	+ 94	+ 94	+ 47	+ 47	- 94	- 94	- 47			+ 50	+100	+ 76		
			+ 1	+ 1								12	- 25	- 25	- 121			
										+ 15	+ 30	+ 30	+ 15	+ 3	+ 7	+ 5		
									- 8	- 8			- 9	- 9				
-176	+452	-452	+401	-401	+446	-446	+587	-587	+437	-437	+334	-334	+333	-333	+447	-447	+176	
R.I.	+562	+562	+562	+562	+562	+562	+846	+846	+846	+846	+562	+562	+562	+562	+562	+562	+562	+562
R.H.	- 74	+ 74	+ 14	- 14	- 12	+ 12	- 38	+ 38	+ 40	- 40	+ 27	- 27	0	0	- 30	+ 301	+ 72	- 72
R.C.	+488	+636	+576	+548	+550	+574	+808	+884	+886	+806	+589	+535	+562	+562	+532	+592	+634	+490

ALIGERADOS DEL PRIMER PISO DUPLEX

ALIGERADO TIPO 1:

Igual al tipo (1) del primer piso y del segundo piso Duplex analizado anteriormente.

ALIGERADO TIPO 2 APPD - 2



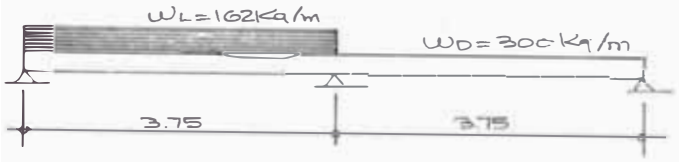
COEFICIENTES DE REPARTO

$K'_{3-2} = K'_{3-2} = 1/2 \times 3/4 = 0.75K$ (Simplificación de Cross)

Nudo (3) $C_{3-2} = \frac{0.75K}{2x0.75K} = 0.5$

$\Sigma K = 2 \times 0.75K \quad C_{3-2} = \frac{0.75K}{2x0.75K} = 0.5$

PRIMERA COMBINACION DE CARGAS.



MOMENTOS DE EMPOTRAMIENTO PERFECTO

$M_{2-3} = -1/24 \times 462 \times 3.75^2 = -270$ Kg-m (A.C.I.)

$M_{2-3} = -M_{3-2} = -1/12 \times 462 \times 3.75^2 = -540$ Kg-m.

$M'_{3-2} = +540 + 270 = +810$ Kg-m. (Simplificación de Cross)

$M_{3-4} = -M_{4-3} = -1/12 \times 300 \times 3.75^2 = -352$ Kg-m.

$M_{3-4} = -352 \times 176 = -528$ Kg-m.

$M_4 = 1/24 \times 300 \times 3.75^2 = 176$

CALCULO DE LOS MOMENTOS ISOSTATICOS

$M_{2-3} = 1/8 \times 462 \times 3.75^2 = 810$ Kg-m.

$M_{3-4} = 1/8 \times 300 \times 3.75^2 = 528$ Kg-m.

CALCULO DE LAS REACCIONES DE APOYO

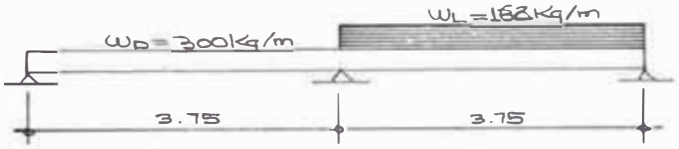
$$R_{3-2} = 462 \times \frac{3.75}{2} = 846 \text{ Kg.}$$

$$R_{3-4} = R_{4-3} = 300 \times \frac{3.75}{2} = 562 \text{ Kg.}$$

DISTRIBUCION DE MOMENTOS

	0.0	0.50	0.50	0.0
		+810	-528	
		-141	-141	
	-270	+669	-669	+176
R.I.	+846	+846	+562	+562
R.H.	-106	+106	+131	-131
R.C.	+740	+952	+693	+431

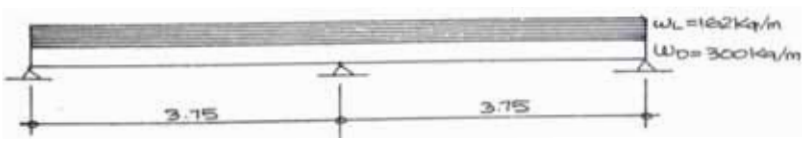
SEGUNDA COMBINACION DE CARGAS:



Observese que es igual al caso anterior, sólo que este es invertido, luego los momentos finales y reacciones de apoyo serán.

M.F.	-176	+669	-669	+270
R.I.	+562	+562	+846	+846
R.H.	-131	+131	+106	-106
R.C.	+431	+693	+952	+740

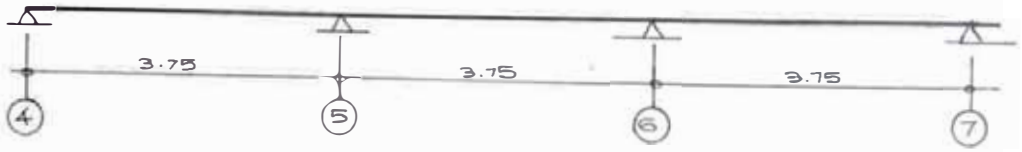
TERCERA COMBINACION DE CARGAS



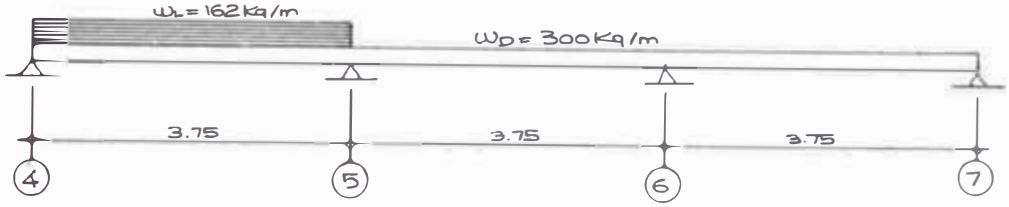
Simétrico y simetricamente cargado, además dos tramos, luego tendremos:

M.F.	-270	+810	-810	+270
R.I.	+846	+846	+846	+846
R.H.	-144	+144	+144	-144
R.C.	+702	+990	+990	+702

ALIGERADO TIPO :3 AP.P.D - 3



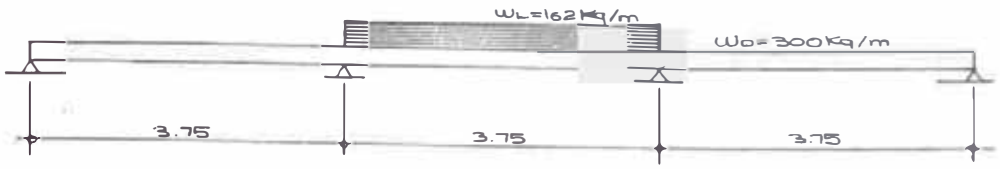
PRIMERA COMBINACION DE CARGAS:



Por ser luces iguales a secciones iguales a los casos anteriores usaré los mismos coeficientes de reparto así mismo por tener tramos cargados y tramos descargados usaré los momentos anteriores en cada caso.

	0.00	0.43	0.57		0.57	0.43	0.00
		+810	-532		+532	-529	
		-120	-158	⟶	- 79		
			+ 21	⟵	+ 43	+ 32	
		- 9	- 12	⟶	- 6		
					+ 3	+ 3	
	-270	+681	-681		+493	-493	+176
R.I	+846	+846	+562		+562	+562	+562
R.H.	-110	+110	+ 50		- 50	+ 85	- 85
R.C.	+736	+956	+612		+512	+647	+477

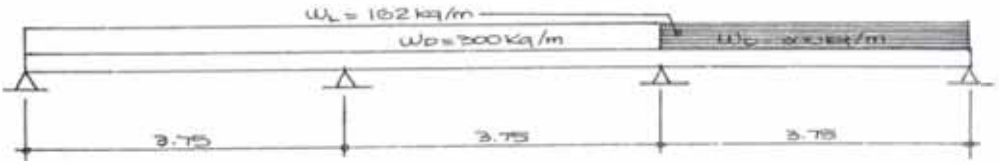
SEGUNDA COMBINACIQN DE CARGAS.



Simétrico y simétricamente cargado, pero lo hare todo completo por ser muy sencillo.

	0.00	0.43	0.57	0.57	0.43	0.00
		+528	-540	+540	528	
		+ 5	+ 7	- 7	- 5	
			- 3	+ 3		
		+ 1	+ 2	- 2	+ 1	
	-176	+534	-534	+534	-534	+ 76
R.I	+562	+562	+846	+846	+562	+562
R.M.	- 96	+ 96	0.00	0.00	+ 96	- 96
R.C.	+466	+658	+846	+846	+658	+466

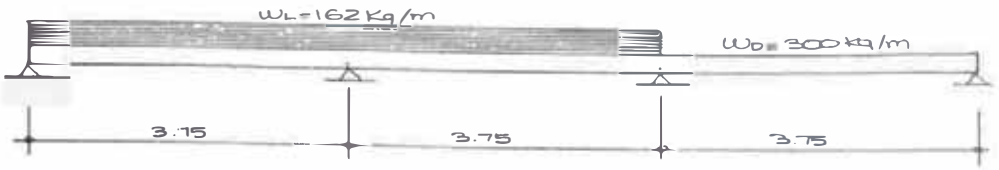
TERCERA COMBINACION DE CARGAS.



Observemos que es igual, pero invertida a la primera combinación, luego los momentos y reacciones de apoyo serán:

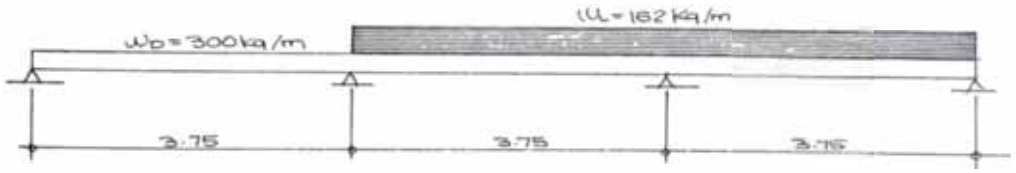
M.F.	-176	+493	-493	+681	-681	+270
R.H.	+562	+562	+562	+562	+846	+846
R.H.	- 85	+ 55	- 50	+ 50	+110	-110
R.C.	+477	+647	+512	+612	+956	+736

CUARTA COMBINACION DE CARGAS



	0.00	0.	0.43	0.57		0.57	0.43	0.00
			+810	-540		+540	-528	
			-116	-154		- 77		
				++ 18		+ 37	+ 28	
			- 8	- 10		- 5		
						+ 3	+ 2	
	-270		+686	-686		+498	-498	+176
RI.	+846		+846	+846		+846	+562	+562
RH	-111		+111	+ 50		- 50	+ 86	- 86
RC	+735		+957	+896		+796	+648	+476

QUINTA COMBINACION DE CARGAS.



Observamos que esta combinación es igual e invertida de la cuarta combinación de cargas. Luego los momentos finales y reacciones de apoyo serán.

M.F.	-176	+498	-498	+686	-686	+270
R.I.	+562	+562	+846	+846	+846	+846
R.H.	- 86	+ 86	- 50	+ 50	+111	-111
R.C.	+476	+648	+796	+896	+957	735

DE LAS ENVOLVENTES DE FLEXION TOMO LOS MOMENTOS DE DISEÑO

Ubicación	Tipo	Tramo	$M_{izq.}$ Kg-m	$M_{(+)máx.}$ Kg-m.	$M_{der.}$ (Kg-m)
		1-2	120	280	390
	AA-1	2-3	390	220	240
		3-4	22-	22-	390
		4-5	390	280	120
		1-2	120	260	380
Azotea	AA-2	2-3	380	180	80
		1-2	120	260	380
		2-3	400	200	000
	AA-3	3-4	300	220	320
		4-5	330	220	320
		5-6	320	330	320
	APP-1=	1-2	160	400	590
	APPT=1	2-3	580	330	420
Primer	ASPT-1	3-4	420	340	600
Piso=		4-5	560	400	180
Segundo	APP-2	1-2	170	380	560
Piso	ASPT-2	2-3'	570	170	130
Típico		1-2	170	390	570
	APP-3	2-3	570	330	470
	ASPT-3	3-4	450	400	460
		4-5	490	380	460
		5-6	460	370	460
Primer	APPT-2	2-3	180	340	680
Piso		3-4	680	340	180
típico		4-5	180	340	510
	APPT-3	5-6	600	-60	600
		6-7	580	340	180
	APPT-4	1-2	180	540	180

DISEÑO POR FLEXION

Uso las mismas fórmulas del diseño de vigas rectangulares.

$$a = \frac{A_s f_y}{0.85 f'_c b} \quad \ldots\ldots\ldots\ldots \text{(I)}$$

$$M_u = \phi\, A_s f_y (d - a/2) \quad \ldots\ldots\ldots \text{(II)}$$

Donde:

$\phi = 0.90$ para flexión según el A.C.I.

Cuantía

$$Pb = 0.85\, K \frac{f'c}{f_y} \times \frac{6{,}000}{6{,}000 + f_y}$$

$$Pb \text{ máx.} = 0.75\, Pb.$$

$$P \text{ mín.} = \frac{14}{f_y} = \frac{14}{2{,}800} = 0.005$$

$$Pb \text{ mín.} = 0.005$$

Momento máximo resistente

$M_u = 0.258\, f'cbd^2$, reemplazando valores tenemos:

$d = 20-(2+1)=17$

$M_u = 0.258 \times 210 \times 10 \times 17^2 = 156{,}000$ Kg-m.

$M_u = 1{,}560$ Kg-m Todos los M_u actuantes (Ver cuadro de momentos de diseños)

Luego no habra ensanche por compresión por flexión acero mínimo.

$A_s = 0.005 \times 10 \times 17 = 0.85\ cm^2$

(0.31 1 ø 1/4" < 0.85 > 1 ø 3/8"(0.71)

Tomo como A_s mínimo 1ø3/8", teniendo en cuenta que el A.C.I. recomienda que cuando es mucha la diferencia entre el A_s teórico y el A_s mínimo , usar el A_s teórico aumentado en 1/3 de este.

Para 1ø 3/8" $A_s = 0.71$

$$a = \frac{0.71 \times 2{,}800}{0.85 \times 210 \times 10} = 1.10$$

$a = 1.10$, $a/2 = 0.55$, $d-a/2 = 17-0.55 = 16.45$

$M_u = 0.90 \times 0.71 \times 2{,}800 \times 16.45 = 29{,}500$ Kg-m.

Mu = 295 Kg-m.

Luego para A_s mín = 1ø 3/8"

M_u = 295 Kg-m.

CALCULO DE LAS AREAS DE ACERO

ALIGERADOS DE AZOTEA O PISO 11:

Aligerado tipo 1: AA-1

1.- Tramo 1-2

a.- Apoyo izquierdo

$M_u(-)$ = 120 Kg-m.

$$A_s = \frac{Mu(Kg-m)x100}{0.90f_y(D-a/2)} = \frac{Mu \times 100}{0.9x2,800(d-a/2)}$$

$$A_s = \frac{Mu(Kg-m)}{25.2(d-a/2)} \quad .....(II')$$

$$a = A_s \times \frac{2,800}{25.2x210x10} = 1.57\ A_s$$

$$a = 1.57\ A_s \quad .....(I')$$

Suponiendo a = 2, a/2 = 1, d-a/2 = 17-1 = 16

$$A_s = \frac{120}{25.2x16} = 0.30$$

Verificando: a = 1.57 x 0.30 = 0.47

Tomo A_s mín. = 1 ø 3/8"

b.- PARA EL MAXIMO MOMENTO POSITIVO

Mu(+) = 280 Kg-m.

Asumo a = 2, a/2 = 1, d -a/2 = 17-1 = 16

$$A_s = \frac{280}{25.2x16} = 0.70$$

Verificando:

a = 1.57 x 0.70 = 1.09

Tomo ahora a = 14, a/2 = 0.7 , d-a/2 = 17-0.7 = 16.3

$$A_s = \frac{280}{25.2x16.3} \times 0.68$$

Verificando:

a = 1.57 x 0.68 = 1.07 O.K.

Pero A_s = 0.60 < A_s mín. luego

A_s mín. = 1ø3/8"

C.- Apoyo Derecho

$M_{u(-)} = 390$ Kg-m.

Asumo $a = 1.2 \times a/2 = 0.60$, $d-a/2 = 17-0.6 = 16.4$

$$A_s = \frac{390}{25.2 \times 16.4} = 0.94$$

Verificando:

$a = 1.57 \times 0.94 = 1.48$

Asumo ahora

$a = 1.52 \times a/2 = 0.76$, $d-a/2 = 17.00-0.76 = 16.24$

$$A_s = \frac{390}{25.2 \times 16.24} = 0.96$$

Verficando

$a = 1.57 \times 0.96 = 1.50$ O.K.

$A_s = 0.96\ cm^2$

2.- TRAMO 2-3

a.- APOYO IZQUIERDO

$Mu(-) = 390$ Kg-m.

$A_s = 0.96\ cm^2$

b.- Para TOMAR EL MAXIMO MOMENTO POSITIVO

$Mu(+) = 220$ Kg-m < 280 A_s mín.

$A_s = 1ø3/8"$

C.- APOYO DERECHO

$Mu(-) = 240$ Kg-m < 295 Kg-m.

A_s mín. $= 1$ ø3/8"

3.- TRAMO 3-4

a.- APOYO IZQUIERDO

$Mu(-) = 220$ Kg-m < 295 Kg-m.

$A_s = 1ø$ 3/8"

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

$Mu(+) = 220$ Kg-m.

A_s mínimo $= 1ø$ 3/8"

C.- APOYO DERECHO

Mu = 390 Kg-m

A_s = 0.96 cm^2 (encontrado anteriormente)

4.- TRAMOS 4-5

a.- APOYO IZQUIERDO

Mu(-) = 390 Kg-m

A_s = 0.96 cm^2 (encontrado anteriormente)

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 260 Kg-m. < 295 Kg-m.

A_s = 1 ø 3/8"

c.- APOYO DERECHO

Mu(-) = 120 Kg-m < 295 Kg-m.

A_s = 1 ø 3/8"

ALIGERADO TIPO 2: AA-2

1.- TRAMO 1-2

a.- APOYO IZQUIERDO

Mu(-) = 120 Kg-m. < 295 Kg-m.

A_s mín. = 1ø 3/8"

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 260 Kg-m. < 295 Kg-m.

A_s mín. = 1ø 3/8"

c.- APOYO DERECHO

Mu(-) = 380 Kg-m.

Suponiendo:

a = 1.5, a/2 = 0.75, d-a/2=17.00-0.75=16.25

$$A_s = \frac{380}{25.2 \times 16.25} = 0.93$$

Verificando: a = 1.57 x 0.93 = 1.46 ≈ 1.5 O.K.

!.- TRAMO 2-3'

a.- APOYO IZQUIERDA:

Mu(-) = 380 Kg-m.

A_S = 0.93 cm^2

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 180 Kg-m. < 295 Kg-m.

A_s mín. = 1ø 3/8"

c.- APOYO DERECHO

Mu(-) = 80 Kg-m. < 295 Kg-m.

A_s = 1ø 3/8"

ALIGERADO TIPO 3: AA-3

1.- TRAMO 1-2

a.- APOYO IZQUIERDO

Mu(-) = 120 Kg-m. < 295 Kg-m. . A_s mín.

A_s = 1 ø 3/8"

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 260 Kg-m. < 295 Kg-m. . A_s mín.

A_s = 1ø 3/8"

c.- APOYO DERECHO

Mu(-) = 380 Kg-m.

A_S = 0.93 cm^2 (encontrado anteriormente)

2.- TRAMO 2-3

a.- APOYO IZQUIERDO

Mu(-) = 400 Kg-m.

Suponiendo a = 1.52, a/2= 0.76, d-a/2=17-0.76=16.24

$$A_s = \frac{400}{25.2 \times 16.24} = 0.98 \text{ cm}^2$$

Verificando: a = 1.57 x 0.98 = 1.53 O.K.

A_s = 0.98 cm^2

b.PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 200 Kg-m < 295 Kg-m.=. . A_s mínimo

A_S = 1 ø 3/8"

c.- APOYO DERECHO

Mu(-) = 300 Kg-m.

Suponiendo a= 1.2 , a/2 = 0.6, d-a/2=17.06=16.4

$$A_s = \frac{300}{25.2 \times 16.4} = 0.73$$

Verificando : a = 1.57 x 0.73 = 1.13 O.K.

$A_S = 0.73\ cm^2$

3.- TRAMO 3-4

a.- APOYO IZQUIERDO

Mu(-) = 300 Kg-m.

$A_s = 0.73\ cm^2$

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 220 Kg-m < 295 Kg-m. ∴ A_s mínimo

A_s = 1 ø/ 3/8"

c.- APOYO DERECHO

Mu(-) = 320 Kg-m.

Asumo: a = 1.2, a/2= 0.6, d-a/2=17.-0.6 = 16.4

$$A_s = \frac{320}{25.2 \times 16.4} = 0.78$$

Verificando: a = 1.57 x 0.78 = 1.21 O.K.

$A_s = 0.78\ cm^2$

4'- TRAMO 4-5

a.- APOYO IZQUIERDO

Mu(-) = 330 Kg-m.

Suponiendo a = 1.30 , a/2 = 0.65, d-a/2=17-0.65=16.35

$$A_s = \frac{330}{25 \times 16.35} = 0.80$$

Verificando: a = 1.57 x 0.80 = 1.26 ≅ 1.30 O.K.

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 220 Kg-m. < 295 Kg-m. A_s mínimo.

A_s = 1 ø 3/8"

c.- APOYO DERECHO

Mu(-) = 320 Kg-m.

$A_S = 0.78\ cm^2$

5.- TRAMO 5-6

a.- APOYO IZQUIERDO

Mu(-) = 320 Kg-m

$A_s = 0.78\ cm^2$

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 330 Kg-m.

$A_S = 0.80\ cm^2$

c.- APOYO DERECHO

Mu(-) =320 Kg-m.

$A_s = 0.78\ cm^2$

ALIGERADOS DEL PRIMER PISO - IGUALES A LOS DEL SEGUNDO PISO TIPICO

1.- TRAMO 1-2

a.- APOYO IZQUIERDO

Mu(-) = 160 Kg-m. < 295 Kg-m. ∴ A_s mínimo.

$A_s = 1\ \phi\ 3/8"$

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 400 Kg-m.

$A_s = 0.98\ cm^2$ (encontrado anteriormente)

c.- APOYO DERECHO

Mu(-) = 590 Kg-m.

Asumo: a=2, a/2 = 1, d-a/2 = 17-1 = 16

$$A_s = \frac{590}{25.2 \times 16} = 1.46\ cm^2$$

Verificando: a = 1.57 x 1.46 = 2.3

Asumo ahora: a = 2.4,a/2, = 1.2d-a/2=17-1.2=15.8

$$A_s = \frac{590}{25.2 \times 15.8} = 1.48\ cm^2$$

Verificando: a = 1.57x1.48 = 2.32 - 2.4 O.K.

$A_s = 1.48\ cm^2$

2.- TRAMO 2-3

a.- APOYO IZQUIERDO

Mu(-) = 580 Kg-m.

Asumo: A = 2.3, a/2 = 1.15 ,d-a/2=17.00-1.15=15.85

$$A_S = \frac{580}{25.2 \times 15.85} = 1.45 \text{ cm}^2$$

Verificando: a=1.57x1.45= 2.28 ≅ 2.3 O.K.

$$A_S = 1.45 \text{ cm}^2$$

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 330 Kg-m.

$A_S = 0.8 \text{ cm}^2$ (Encontrado anteriormente)

c.- APOYO DERECHO

Mu(-) = 420 Kg-m.

Asumo: a =1.60 , a/2 = 0.80 , d-a/2=17.00-0.80=16.20

$$A_s = \frac{420}{25.2 \times 16.20} = 1.03 \text{ cm}^2$$

Verificando: a = 15.7 x1.03 = 1.61 O.K.

$$A_S = 1.03 \text{ cm}^2$$

3. TRAMO 3-4

a.- APOYO IZQUIERDO

Mu(-) = 420 Kg-m.

$A_s = 1.03 \text{ cm}^2$

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 340 Kg-m

Asumo: a = 1.30, a/2 = 0.65, d-a/2=17.00-0.65= 16.35

$$A_S = \frac{340}{25.2 \times 16.35} = 0.83$$

Verificando: a = 1.57 x 0.83 = 1.3 O.K.

$A_S = 0.83 \text{ cm}^2$

c.- APOYO DERECHO

Mu(-) = 600 Kg-m.

Asumo: a=2.4, a/2=1.2, d-a/2=17.00-1.2 = 15.80

$$A_S = \frac{600}{25.2 \times 15.8} = 1.50$$

Verificando: 1= 1.57x1.50 = 2.36 O.K.

$A_S = 1.50\ cm^2$

4.- TRAMO 4-5

A.- APOYO IZQUIERDO

Mu(-) = 560 Kg-m.

Asumo: a=2.2, a/2 = 1.1, d-a/2= 17.00-1.1 = 15.9

$$A_s = \frac{560}{25.2 \times 15.9} = 1.40 cm^2$$

Verificando: a = 1.57x1.40=2.2 O.K.

$A_S = 1.40\ cm^2$

b.- PARA TOMAR EL MOMENTO POSITIVO

Mu(+) = 400 Kg-m.

A_S = 0.98 (Encontrado anteriormente)

c.- APOYO DERECHO

Mu = 180 Kg-m. < 295 ∴ A_S mínimo.

A_S = 1 ø 3/8"

ALIGERADO TIPO 2: APP-2=ASPT-2

1.- TRAMO 1-2

a.- APOYO IZQUIERDO

Mu(-) = 170 Kg-m. < 295 Kg-m ∴ A_S mín.

A_S = 1 ø 3/8"

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 380 Kg-m.

$A_S = 0.93\ cm^2$ (encontrado anteriormente)

c.- APOYO DERECHO

Mu(-) = 560 Kg-m.

$A_S = 1.40\ cm^2$ (encontrado anteriormente)

2.- TRAMO 2-3'

a.- APOYO IZQUIERDO

Mu(-) = 570 Kg-m.

Asumo: a =2.30, a/2 = 1.65,d-a/2=17.00-1.65=15.35

$$A_S = \frac{570}{25.2 \times 15.35} = 1.47 \text{ cm}^2$$

Verificando: a = 1.57 x 1.47 = 2.3 O.K.

$A_s = 1.47 \text{ cm}^2$

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 170 Kg-m. < 295 Kg-m ∴ A_s mín.

A_s = 1 ø 3/8"

c.- APOYO DERECHO

Mu(-) = 130 Kg-m. < 295 Kg-m ∴ A_s mínimo

A_s = 1ø3/8"

ALIGERADO TIPO 3: APP-3 = ASPT-3

1.- TRAMO 1-2

a.- APOYO IZQUIERDO

Mu(-) = 170 Kg-m. < 295 Kg-m ∴ A_s mínimo

A_s = 1 ø 3/8"

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 390 Kg-m.

$A_S = 0.96 \text{ cm}^2$ (encontrado anteriormente)

c.- APOYO DERECHO

Mu(-) = 570 Kg-m.

$A_s = 1.47 \text{ cm}^2$ (encontrado anteriormente)

2.- TRAMO 2-3

a.- APOYO IZQUIERDO

Mu(-) = 570 Kg-m.

$As = 1.47 \text{ cm}^2$ (encontrado anteriormente)

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 330 Kg-m

As = 0.80 cm2 (encontrado anteriormente)

c.- APOYO DERECHO

Mu(-) = 470 Kg-m.

Asumo : a = 2; a/2 = 1, d-a/2 = 17-1 = 16

$$A_S = \frac{470}{25.2 \times 16} = 1.17$$

Verificando: a = 1.57 x 1.17 = 1.83

Asumo: a =1.82, a/2 = 0.91, d-a/2=17.00-0.91 = 16.09

$$A_s = \frac{470}{25.2 \times 16.09} = 1.16$$

Verificando: a = 1.57 x 1.16 = 1.82 O.K.

$A_S = 1.16\ cm^2$ O.K.

3.- TRAMO 3-4

a.- APOYO IZQUIERDO

Mu(-) = 450 Kg-m.

Asumo a = 1.70, a/2 = 0.85 , d-a/2 =17.00-0.85 = 16.15

$$A_S = \frac{450}{25.2 \times 16.15} = 1.10$$

Verificando: a = 1.57 x 1.10 = 1.73 O.K.

$A_s = 1.10\ cm^2$

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 400 Kg-m.

As = $0.98 cm^2$ (encontrado anteriormente)

c.- APOYO DERECHO

Mu(+) = 460 Kg-m.

Asumo: a = 1.76, a/2 = 0.88, d-a/2 = 17.00-0.88=16.12

$$A_S = \frac{460}{25.2 \times 16.12} = 1.13$$

Verificación: a = 1.57 x 1.13 = 1.77 O.K.

$A_s = 1.13\ cm^2$

4.- TRAMO 4-5

a.- APOYO IZQUIERDO:

Mu(-) = 490 Kg-m.

Asumo: a = 2.00;a/2=1.00;d-a/2=17-1 = 16

$$A_s = \frac{490}{25.2 \times 16} = 1.21$$

Verificando: a = 1.57 x 1.21 = 1.90

Asumo ahora: a =1.90, a/2=0.95, d-a/2=17-0.95=16.05

$$A_s = \frac{490}{25.2 \times 16.05} = 1.21$$

Verificando: a= 1.57 x 1.21 = 1.90

$A_S = 1.21\ cm^2$

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 380 Kg-m.

As = 0.93 cm^2 (encontrado anteriormente)

c.- APOYO DERECHO

Mu(-) = 460 Kg-m.

$A_s = 1.13\ cm^2$ (encontrado anteriormente)

5.- TRAMO 5-6

a.- APOYO IZQUIERDO

Mu(-) = 460 Kg-m.

$A_s = 1.13\ cm^2$

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 370 Kg-m.

Asumo: a =1.40 , a/2 = 0.70, d-a/2= 17-0.7 = 16.30

$$A_S = \frac{370}{25.2 \times 16.3} = 0.9$$

Verificando: a = 1.57 x 0.9 = 1.41 O.K.

$A_s = 0.90\ cm^2$

c.- APOYO DERECHO

Mu(-) = 460 Kg-m.

As = 1.13 cm^2 (encontrado anteriormente)

ALIGERADOS DE PRIMER PISO TIPICO

ALIGERADO TIPO 1 = ALIGERADO TIPO DEL PRIMER PISO Y DEL SEGUNDO PISO TIPICO.

A.P.T-1=APP-1 = ASPT-1

ALIGERADO TIPO 2: APPT-2

1.-TRAMO 2-3

A.- APOYO IZQUIERDO

Mu(-) = 180 Kg-m. < 295 Kg-m. ∴ A_s mínimo

A_S = 1 ø 3/8"

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 340 Kg-m.

A_S = 0.83 cm^2 (encontrado anteriormente)

c.- APOYO DERECHO.

Mu(-) = 680 Kg-m.

Asumo: a = 2.60, a/2=1.3 , d-a/2=17-1.3 = 15.7

$$A_s = \frac{680}{25.2 \times 15.7} = 1.72$$

Asumo ahora: a = 2.70, a/2=1.35, d-a/2=15.65

$$A_s = \frac{680}{25.2 \times 15.65} = 1.72$$

a = 1.57 cm x 15.72 = 2.70 O.K.

A_S = 1.72 cm^2

2.- TRAMO 3-4

a.- APOYO IZQUIERDO

Mu(-) = 680

A_s = 1.72 cm^2

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 340 Kg-m.

A_S = 0.83 cm^2 (encontrado anteriormente)

c- APOYO DERECHO

Mu(-) = 180 Kg-m < 295 Kg-m. ∴ A_s mínimo

A_S = 1 ø 3/8"

ALIGERADO TIPO 3: APPT-3

1.- TRAMO 4-5

a.- APOYO IZQUIERDO

Mu(-) = 180 Kg-m. < 295 Kg-m $\therefore$ A_S mín.

A_S = 1 ø 3/8"

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

Mu(+) = 340 Kg-m.

As = 0.83 cm^2 (encontrado anteriormente)

c.- APOYO DERECHO

Mu(-) = 510 Kg-m.

Asumo: a = 2, a/2= 1.00, d-a/2 = 17-1 = 16

$$A_S = \frac{510}{25.2 \times 16} = 1.26$$

Verificando: 1.57 x 1.26 = 1.99 O.K.

A_S = 1.26 cm^2

2.- TRAMO 5-6

a.- APOYO IZQUIERDO

Mu(-) = 600 Kg-m.

A_S = 1.50cm^2 (encontrado anteriormente)

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

En este caso no hay momento positivo,porque se levanta la parábola sobre el eje neutro luego tomoa A_S mínimo.

A_S (+) = 1 ø 3/8"

Y en la parte superior también hago pasar acero tal como 1 ø 3/8"

c.-APOYO DERECHO

Mu(-) = 600 Kg-m.

A_S = 1.50 cm^2

3.- TRAMO 6-7

a.- APOYO IZQUIERDO

Mu(-) = 580 Kg-m.

A_S - 1.45 cm^2 (encontrado anteriormente)

b.- PARA TOMAR EL MAXIMO MOMENTO POSITIVO

$Mu(+) = 340$ Kg-m.

$A_s = 0.83\ cm^2$ (encontrado anteriormente)

c.- APOYO DERECHO

$Mu(-) = 180$ Kg-m. < 2.95 Kg-m $\therefore$ A_s mínimo.

$A_S = 1\ \phi\ 3/8"$

ALIGERADO TIPO - 4

(De un sólo tramo)

a.- APOYOS

$Mu(-) = 180$ Kg-m < 295 Kg-m. $\therefore$ A_s mínimo.

$A_s = 1\ \phi\ 3/8"$

b.-PARA TOMAR EL MAXIMO MOMENTO POSITIVO

$Mu(+) = 540$ Kg/m.

Asumo: a = 2.1, a/2 = 1.05, d-a/2 = 17.00-1.05 = 15.95

$$A_S = \frac{540}{25.2 \times 15.95} = 1.34$$

Verificando: a = 1.57 x 1.34 = 2.1 O.K.

$A_s = 1.34\ cm^2$

COMPROBACION POR CORTE:

CORTE QUE TOMA EL CONCRETO

$V_c = v_c \times bt$

$v_c = 0.53 \times 0.85 \sqrt{210} = 6.55\ Kg/cm^2$

$V_c = 6.55 \times 10 \times 20 = 1{,}310$ Kg.

De las envolventes de corte vemos que:

V_u actuante máximo es: $V_{u\ act.} = 1{,}040$ Kg.

Luego:

$V_c = 1{,}310$ K> $M_{u\ act.} = 1{,}040$

De manera que: no necesita ensanche por corte:

CUADRO RESUMEN DE LAS AREAS DE ACERO Y ø EN VARILLAS

Ubicación	Tipo	Tramo	Momento	A_s cm^2	ø:Varillas
Azotea	AA-1	1-2	$M_{izq.}$ = 120	mínimo	1ø3/8"
			M(+) =280	Mínimo	1ø3/8"
			M_{der} = 390	0.96	1ø1/2"
		2-3	$M_{izq.}$ = 390	0.96	1ø1/2"
			M(+) = 220	mínimo	1ø3/8"
			$M_{der.}$ = 240	mínimo	1ø3/8"
		3-4	$M_{izq.}$ = 220	mínimo	1ø3/8"
			M(+) = 220	mínimo	1ø3/8"
			$M_{der.}$ = 390	0.96	1ø1/2"
		4-5	$M_{izq.}$ = 390	0.96	1ø1/2"
			M(+) = 280	mínimo	1ø3/8"
			M_{der} = 120	mínimo	1ø3/8"
	AA-2	1-2	$M_{izq.}$ = 120	mínimo	1ø3/8"
			M(+) = 260	mínimo	1ø3/8"
			$M_{der.}$ = 380	0.93	1ø1/2"
		2-3'	$M_{izq.}$ = 380	0.93	1ø1/2"
			M(+) = 180	mínimo	1ø3/8"
			$M_{der.}$ = 80	mínimo	1ø3/8"
	AA-3	1-2	$M_{izq.}$ = 120	mínimo	1ø3/8"
			M(+) = 260	mínimo	1ø3/8"
			$M_{der.}$ = 380	0.93	1ø1/2"
		2-3	$M_{izq.}$ = 400	0.98	1ø1/2.
			M(+) = 200	mínimo	1ø3/8"
			$M_{der.}$ = 300	0.73	1ø1/2"
		3-4	$M_{izq.}$ = 300	0.73	1ø1/2"
			M(+) = 220	mínimo	1ø3/8"
			$M_{der.}$ = 320	0.78	1ø1/2"
		4-5	$M_{izq.}$ = 330	0.80	1ø1/2"
			M(+) = 220	mínimo	1ø3/8"
			$M_{der.}$ = 320	0.78	1ø1/2"

(Continuación)

Ubicación	Tipo	Tramo	Momento Kg-m	$A_s cm^2$	ø:Varillas
Azotea	AA-3	5-6	$M_{izq.}$ = 320	0.78	1ø1/2"
			M(+) = 330	0.80	1ø1/2"
			$M_{der.}$ = 320	0.78	1ø1/2"
PRIMER Piso-Segundo Piso Duplex.	AAP-1= APPT-1 ASPT-1	1-2	$M_{izq.}$ = 160	mínimo	1ø3/8"
			M(+) = 400	0.98	1ø1/2"
			M_{der} = 590	1.48	1ø3/8"+1ø1/2.
		2-3	$M_{izq.}$ = 580	1.45	1ø3/8"+1ø1/2"
			M(+) = 330	0.80	1ø1/2"
			$M_{der.}$ = 420	1.03	1ø1/2"
		3-4	$M_{izq.}$ = 420	1.03	1ø1/2"
			M(+) = 340	0.83	1ø1/2"
			M_{der} = 600	1.50	1ø3/8"+1ø1/2"
		4-5	$M_{izq.}$ = 560	1.40	2ø3/8"
			M(+) = 400	0.98	1ø1/2"
			M_{der} = 180	mínimo	1ø3/8"
	APP-2= ASPT-2	1-2	$M_{izq.}$ = 170	mínimo	1ø3/8"
			M(+) = 380	0.93	1ø3/8"+1ø1/4"
			M_{der} = 560	1.40	1ø3/8"
		2-3	M_{izq} = 570	1.47	2ø3/8"
			M(+) = 170	mínimo	1ø3/8"
			$M_{der.}$ = 130	mínimo	1ø3/8"
	APP-3= ASPT-3	1-2	$M_{izq.}$ = 170	mínimo	1ø3/8"
			M(+) = 390	0.96	1ø1/2"+
			M_{der} = 570	1.47	1ø3/8"+1ø1/2"
		2-3	$M_{izq.}$ = 570	1.47	1ø3/8"+1ø1/2"
			M(+) = 330	0.80	1ø1/2"
			M_{der} = 470	1.16	1ø1/2"
		3-4	$M_{izq.}$ = 450	1.10	1ø1/2"
			M(+) = 400	0.98	1ø1/2"
			M_{der} = 460	1.13	1ø1/2"

Ubicación	Tipo	Tramo	Momento Kg-m	$A_s cm^2$	ø:Varillas
Primer piso=segundo piso típico	APP-3= ASPT-3	4-5	$M_{izq.}$= 490	1.21	1ø1/2"
			M(+)= 380	0.93	1ø1/2"
			M_{der}= 460	1.13	1ø1/2"
		5-6	$M_{izq.}$= 460	1.13	1ø1/2"
			M(+) = 370	0.90	1ø1/2"
			M_{der} = 460	0.93	1ø1/2.
	APPT-2	2-3	$M_{izq.}$= 180	mínimo	1ø3/8"
			M(+) = 340	0.83	1ø1/2"
			M_{der}= 680	1.72	1ø1/2"+1ø3/8"
		3-4	$M_{izq.}$= 680	1.72	1ø1/2"+1ø3/8"
			M(+) = 340	0.83	1ø1/2"
			$M_{der.}$= 180	mínimo	1ø3/8"
PRIMER PISO TIPICO	APPT-3	4-5	$M_{izq.}$= 180	mínimo	1ø3/8"
			M(+) = 340	0.83	1ø1/2"
			M_{der} = 510	1.26	1ø1/2"
		5-6	$M_{izq.}$ = 600	1.50	1ø1/2"+1ø3/8"
			M(+) = 60	mínimo	1ø3/8"
			$M_{der.}$= 600	1.50	1ø1/2"+1ø3/8"
		6-7	$M_{izq.}$= 580	1.45	1ø1/2"+1ø3/8"
			M(+) = 340	0.83	1ø1/2"+1ø1/4"
			$M_{der.}$= 180	mínimo	1ø3/8"
	APPT-4	1-2	$M_{izq.}$= 180	mínimo	1ø3/8"
			M(+) = 540	1.34	2ø3/8"
			$M_{der.}$= 180	mínimo	1ø3/8"

ADHERENCIA Y LONGITUD DE ANCLAJE

$$V_{máx.} = \phi\ I_p\ \epsilon_o Jd$$

$$L = \frac{Df_y}{\phi 4Up}$$

Cálculo de los valores de Up.

Para varillas superirores $U_p = \frac{4.5\ \sqrt{f'c}}{D}$ < 39 Kg/mm^2

Para varillas interiores: $U_p = \frac{6.4\ \sqrt{f'c}}{D}$ ≤ 56 Kg/cm^2

D	Varillas sup.	Varillas Inf.
3/8	39	56
1/2	39	56

Como el armado es hecho con ø 3/8" y 1/2", encontraré el corte máximo para cada diámetro, a partir de su "U_p", compararé este V máx. con las envolventes , para ver si cumple por adherencia,si esto se cumple, encontraré la longitud de anclaje máxima para cada diámetro.

1.- ACERO DE CAPA SUPERIOR.

a.- Para ø 3/8"

$V_{máx.} = 0.85 \times 39 \times 3 \times 0.876 \times 17 = 1,480$ Kg.

$V_{máx.\ derm.} > V_{act.} = 830$ Kg.

b.- Para ø 1/2"

$V_{máx.} = 0.85 \times 39 \times 3.97 \times 0.876 \times 17 = 1,960$

$V_{máx.\ per.} > V_{act.} = 1,040$

Resulta moroso hacer más verificaciones, toda vez que los V máx. permisibles, son muchos mayores que los V actuantes.

LONGITUD DE ANCLAJE:

Para ø 3/8"

$$L = \frac{1.00 \times 2,800}{4 \times 0.85 \times 39} = 21$$

Para ø1/2"

$$L = \frac{1.20 \times 2,800}{4 \times 0.85 \times 39} = 25$$

ANALISIS DE PORTICOS POR CARGAS VERTICALES

PORTICOS POR ANALIZAR:

Pórtico principal 4

Pórtico de Arriostre A

Utilizando el método de KANI encontraré los momentos finales y esfuerzos cortantes, debidos al peso propio y a las diferentes hipótesis de sobrecargas.

Después de obtener los momentos y cortantes, por cargas y sobrecargas, estos resultados los combinaremos con los efectos de sismo, combinaciones que nos daran las envolventes de flexión y corte, combinaciones que se haran como lo indica el reglamento A.C.I.

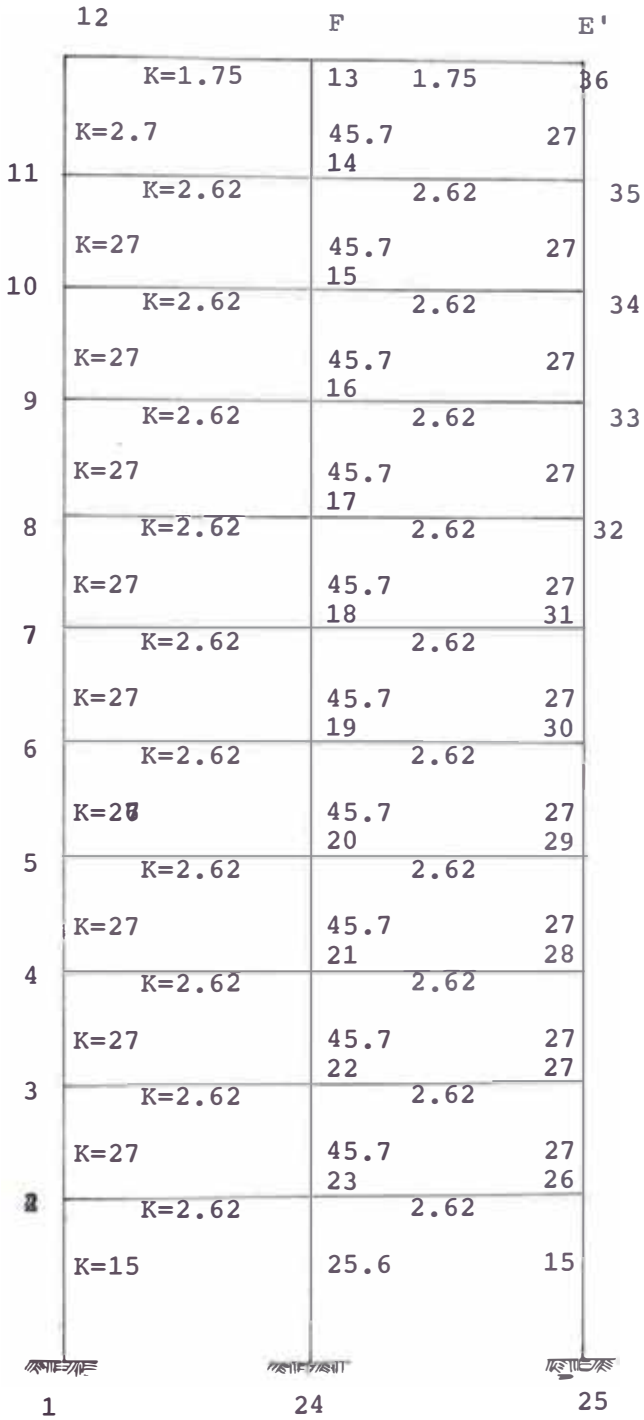
1.- $U = 1.5D + 1.8L$

2.- $U = 1.25(D + L + S)$

3.- $U = 0.9D + 1.1S$

Teniendo en cuenta en cada caso las diferentes hipótesis de sobrecargas y ambos sentidos del efecto de sismo.

PORTICO 4 CON LOS VALORES K RELATIVOS.



CALCULO DE LOS FACTORES DE GIRO O DE REPARTICION (N)

Los factores de giro en el método de Kani, se obtienen repartiendo en cada nudo el valor (-1/2) proporcionalmente a las rigideces de los elementos que concurren en los nudos.

Nudos: 1, 2, 4 y 2-5 coeficiente ≠ 0 por empotramiento perfecto

Nudo 2 = 26

$\Sigma K = 27+15+2.62$

$\Sigma K = 44.62$

$N_{2-3} = -1/2 \times \frac{27}{44.62} = -0.30$

$N_{2-1} = -1/2 \times \frac{15}{44.62} = -0.168$

$N_{2-23} = -1/2 \times \frac{2.62}{44.62} = -0.032$

Nudo 23

$\Sigma K = 2.62+2.62+45.7+25.6$

$\Sigma K = 76.54$

$N_{23-2} = N_{23-26} = -1/2 \times \frac{2.62}{76.54} = -0.017$

$N_{23-22} = -1/2 \times \frac{45.7}{76.54} = -0.298$

$N_{23-24} = -1/2 \times \frac{25.6}{76.54} = -0.168$

Nudo (3)=4=5=6 =7=8=9=10= =11 y simétricas.

$\Sigma K = 27+27+2.62$

$\Sigma K = 56.62$

$N_{3-2} = -1/2 \times \frac{27}{56.62} = -0.238$

$N_{3-22} = -1/2 \times \frac{2.62}{56.62} = -0.024$

$N_{3-4} = -1/2 \times \frac{27}{56.62} = -0.238$

Nudo (22)=21=20=19=18=17=16=15= =14

$\Sigma K = 45.7+45.7+2.62+2.62$

$\Sigma K = 96.64$

$N_{22-21} = N_{22-23} = -1/2 \times \frac{45.7}{96.64} = -0.236$

$N_{22-3} = N_{22-27} = -1/2 \times \frac{2.62}{96.64} = 0.0114$

Nudo (12) = 36

$\Sigma K = 1.75+27$

$\Sigma K = 28.75$

$N_{12-11} = -1/2 \times \frac{27}{28.75} = -0.47$

$N_{12-13} = -1/2 \times \frac{1.75}{28.75} = -0.03$

Nudo (13)

$\Sigma K = 1.75+1.75+45.7$

$\Sigma K = 49.20$

$N_{13-12} = -1/2 \times \frac{1.75}{49.20} = -0.018$

$N_{13-36} = -1/2 \times \frac{1.75}{49.20} = -0.018$

$N_{13-14} = -1/2 \times \frac{45.70}{49.20} = -0.464$

CALCULO DEL FACTOR DE CORRIMIENTO

Los factores de corrimiento se encuentran repartiendo el valor -3/2 proporcionalmente a las rigideces K de las columnas en un piso determinado.

Primer Piso

$\Sigma K = 15 + 25.6 + 15$

$\Sigma K = 55.6$

C extrema $\gamma = -3/2 \times \frac{15}{55.6} = -0.405$

C central $\gamma = -3/2 \times \frac{25.6}{55.6} = -0.690$

Resto de Pisos

$\Sigma K = 27+45.7+27$

$\Sigma K = 99.7$

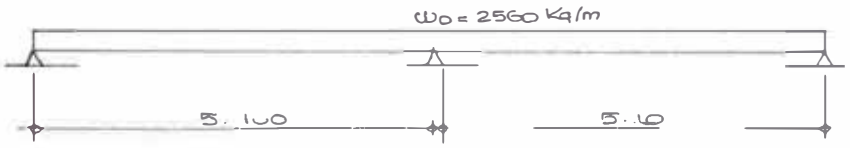
C extrema $\gamma = -3/2 \times \frac{27.0}{99.7} = -0.406$

C central $\gamma = -3/2 \times \frac{45.7}{99.7} = -0.688$

CALCULO DE MOMENTOS EN LAS VIGAS

Piso 11 ó Azotea.

1.- Cargas Muertas: 1.5 x 1,710 = 2,560 Kg/m.l.



a.- Momentos de empotramiento perfecto

$M_{AB} = -M_{BA} = 1/12 \times 2,560 \times 5.1^2 = -5,540$

$M_{BC} = -M_{cc} = -5,540$ Kg-m.

b.- Momentos isostáticos

$M_{AB} = M_{BC} = 1/8 \times 2,560 \times 5.1^2 = 8,320$ Kg-m.

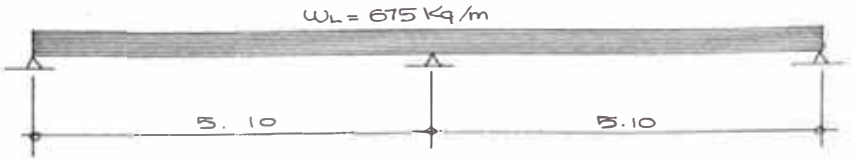
c.- Reacciones Isostáticas: $R_{AB} = R_{BA} = R_{BC} = R_{CB} = \frac{2,560 \times 5.1}{2} = 6,530.00$

2.- Sobrecargas.

L = 1.8 x 375 = 675 Kg-m.

L = 675 Kg/m.l.

a.-



a.-Momentos de empotramiento perfecto

$$M_{AB} = -M_{BA} = -1/12 \times 675 \times 5.1^2 = -1,460 \text{ Kg-m.}$$

$$M_{BC} = -M_{CB} = -1/2 \times 675 \times 5.1^2 = 1,460 \text{ Kg-m.}$$

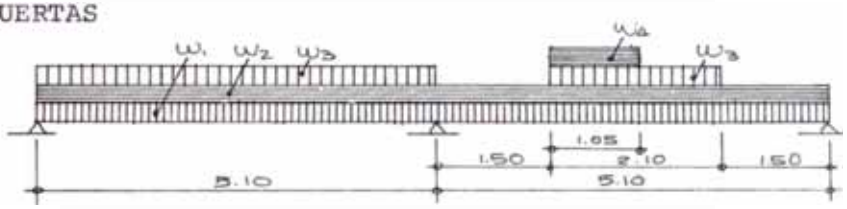
b.- Momentos isostáticos.

$$M_{AB} = M_{BA} = 1/8 \times 675 \times 5.1^2 = 2,200 \text{ Kg-m.}$$

c.- Reacciones Isostáticas: $R_{AB} = R_{BA} = R_{BC} = R_{CB} = \frac{675 \times 5.1}{2} = 1,720$

Pisos 1ª=3ª=5ª=7ª=9ª

CARGAS MUERTAS



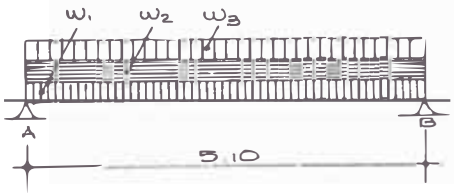
w_1 = 240 Kg/m.l. x 1.5 = 360 Kg/m.l.

w_2 = 1,875 Kg/m.l. x 1.5 = 2,815 Kg/m.l.

w_3 = 460 Kg/m.l. x 1.5 = 690 Kg/m.l.

w_4 = 936 Kg/m.l. x 1.5 = 1,400 Kg/m.l.

TRAMO A-B



w_1 = 360

w_2 =2,815

w_3 = 690

Σ =3,865

a.- Momentos de empotramiento perfecto

$$M_{AB} = -M_{BA} = -1/K \times 3,865 \times 5.1^2 = 8,360 \text{ Kg-m.}$$

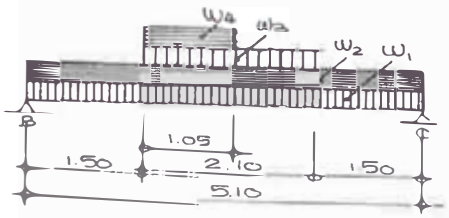
$$M_{AB} = -M_{BA} = 8,360 \text{ Kg-m.}$$

b.-Momentos isostáticos.

$$M_{AB} = 1/8 \times 3,865 \times 5.1^2 = 12,600$$

$$M_{AB} = 12,600 \text{ Kg-m.}$$

TRAMO B-C



w_1 = 360 Kg/m.l.

w_2 = 2,815 Kg/m.l.

w_3 = 690 Kg/m.l.

w_4 = 1,400

a.- Momentos de empotramiento perfecto.

$$M_{BC1} = -M_{BA1} = -1/12 \times 360 \times 5.1^2 = -780 \text{ Kg-m.}$$

$$M_{BC2} = -M_{BA2} = -1/12 \times 2{,}815 \times 5.1^2 = -6{,}100 \text{ Kg-m.}$$

$$M_{BC3} = -M_{BA3} = -\frac{690}{12 \times 5.1^2}\{6 \times 5.1^2 |(1.5+2.10)^2 - 1.50^2)| \}$$

$$-8.51\ |(1.50+2.10)^3 - 1.50^3)|$$

$$+3|(1.50+2.10)^4 - 1.50^4|\}$$

$$M_{BC3} = -M_{BA3} = -\frac{690}{12 \times 5.1^2}\{156|(3.60)^2 - 1.5^2| -$$

$$-8.51|(3.60)^3 - 1.5^3) + 3|(3.6)^4 - 1.5^4|\}$$

$$M_{BC3} = -M_{BA3} = -\frac{690}{12 \times 5.1^2}\{156(12.95-2.25) - 8 \times 5.1|46.6-3.38) + 3$$

$$(168-5.00)\}$$

$$M_{BC3} = -M_{BA3} = -\frac{690}{12 \times 5.1^2}|156(10.70) - 8 \times 5.1(43.22) + 3(163)|$$

$$M_{BC3} = -M_{BA3} = -\frac{690}{12 \times 5.1^2}(1{,}670 - 1{,}760 + 489)$$

$$M_{BC3} = -M_{BA3} = -\frac{690}{12 \times 5.1^2}(399) =$$

$$M_{BC3} = -M_{BA3} = -884 \text{ Kg-m.}$$

$$M_{BC4} = -\frac{1{,}400}{12 \times 5.1^2}\{6 \times 5.1^2 |(1.5+1.05)^2 - 1.5^2| - 8 \times 5.1|(1.5+1.05)^3 -$$

$$-1.5^3| + 3\ |(1.5+1.05)^4 - 1.50^4|\}$$

$$M_{BC4} = -\frac{1{,}400}{12 \times 5.1^2}\{156(2.55^2 - 1.5^2) - 8 \times 5.1|(2.55^3 - 1.5^3)| +$$

$$+3|2.55^4 - 1.5^4|$$

$$M_{BC4} = -\frac{1{,}400}{12 \times 5.1^2}\{156(6.50-2.25) - 8 \times 5.1(16.6-3.38) + 3(42.3-5.06)$$

$$M_{BC4} = -\frac{1{,}400}{12 \times 5.1^2}\{156(4.25) - 8 \times 5.1 \times 13.22 + 3 \times 39.30)$$

$$M_{BC4} = -\frac{1{,}400}{12 \times 5.1^2}(664 - 540 + 112)$$

$M_{Bc4} = -1,060$ Kg-m.

$$M_{CB4} = \frac{1,400}{5.1^2 x12} \{4x5.1|(1.50+1.05)^3-1.5^3|-3|(1.5+1.05)^4-1.5^4|$$

$$M_{CB4} = \frac{1,400}{5.1^2 x12} \{4x5.1(2.55^3-1.5^3)-3(2.55^4-1.5^4)$$

$$M_{CB4} = \frac{1,400}{5.1^2 x12} \{4x5.1(16.6-3.38)-3(42.3-5.00)$$

$$M_{CB4} = \frac{1,400}{5.1^2 x12} (4x5.1x13.22-3x37.30)$$

$$M_{CB4} = \frac{1,400}{5.1^2 x12} (270-112)$$

$$M_{CB4} = \frac{1,400}{5.1^2 x12} x158 = 710 \text{ Kg-m.}$$

$M_{CB4} = -710$ Kg-m.

$M_{BC} = M_{BC1} + M_{BC2} + M_{BC3} + M_{BC4} =$

$M_{BC} = -780 - 6,100 - 884 - 1,060$

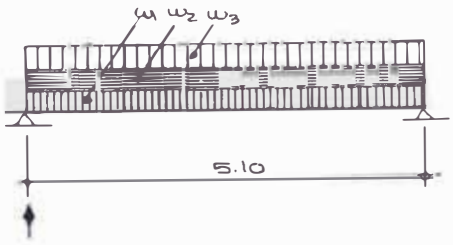
$M_{BC} = -8,824$ Kg-m.

$M_{CB} = +780 + 6,100 + 884 + 710 =$

$M_{CB} = + 8,474$ Kg-m.

MOMENTOS ISOSTATICOS

TRAMO AB



$w_1 = 360$

$w_2 = 2,815$

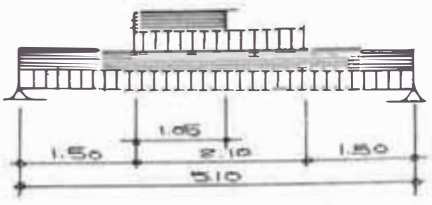
$w_3 = 690$

$3,865$

$R_A = R'_B = 3,865 \times \frac{5.1}{2} = 9,860$ Kg-m.

$M_{AB} = 1/8 \times 3,865 \times 5.1^2 = 12,600$ Kg-m.

TRAMO BC



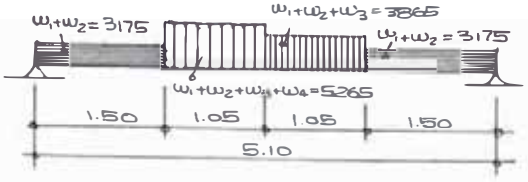
$w_1 = 360$ Kg/ml.

$w_2 = 2,815$Kg/ml.

$w_3 = 690$Kg/ml.

$w_4 = 1,400$Kg/ml.

La viga se puede cargar por tramos, con la suma de sus cargas como sigue:



$w_1 + w_2 = 360 + 2{,}815 = 3{,}175$

$w_1 + w_2 + w_3 = 360 + 2{,}815 + 690 = 3{,}865$

$w_1 + w_2 + w_3 + w_4 = 360 + 2{,}815 + 690 + 1{,}400 = 5{,}265$

CALCULO DE LAS REACCIONES DE APOYO

$\Sigma Mc = 0$

$5.1R''_B = 3{,}175x1.50(5.10-0.75)+5{,}265x1.05(2.55+0.52)$
$+ 3{,}865x1.05x(1.50+0.52)+3{,}175x1.50x0.75$

$5.1R''_B = 3{,}175x1.50 \times 4.35 + 5{,}265 \times 1.05x3.17+3{,}865x1.05x2.02$
$+ 3{,}175x1.50x0.75$

$5.1R''_B = 20{,}700 + 17{,}500 + 8{,}200 + 3{,}580$

$5.1R''_B = 49{,}980$ Kg-m.

$R''_B = \frac{49{,}980}{5.1}$

$R''_B = 9{,}800$ Kg.

$R_C = 3{,}175x1.50+5{,}265x1.05+3{,}865x1.05+3{,}175x1.5=9{,}800$

$R_C = 19{,}120 - 9980$

$R_C = 9{,}320$ Kg.

CALCULO DE LOS MOMENTOS ISOSTATICOS

TRAMO I $\quad 0 \leq X \leq 1.50$

$M_I = 9{,}800\ X \times 3.175\ \frac{X^2}{2}$

Cuando $X = 0 \quad M_I = 0$

$X = 0.50 \quad M_I = 4{,}900 - 397$

$M_I = 4{,}603$ Kg-m.

$X = 1.00$ $\quad M_I = 9,800 - 1,587$

$M_I = 8,213$ Kg-m.

$X = 1.50$ $\quad M_I = 14,700 - 3,570$ Kg-m

$M_I = 11,130$ Kg-m.

TRAMO II

$1.50 \leq X \leq 2.55$

$$M_{II} = 9,800X - 3,175x\ 1.50(X-0.75) - \frac{5,265(X-1.50)^2}{2}$$

Cuando:

$X = 1.50$ $\quad M_{II} = 14,700 - 3,570 - 0$

$M_{II} = 11,130$ Kg-m.

$X = 2.00$ $\quad M_{II} = 19,600 - 660$

$M_{II} = 12,880$ Kg-m.

$X = 2.55$ $\quad M_{II} = 25,00 - 8,560 - 2,900$

$M_{II} = 13,540$ Kg-m.

TRAMO III

$2.5 \leq X \leq 3.60$

$$M_{III} = 9,800X - 3,175x1.50(X-0.75) - 5,265x1.05(X-2.02) - 3,865\left(\frac{X-2.55}{2}\right)^2$$

Cuando: $X = 2.55$ $\quad M_{III} = 25,000 - 8,560 - 2,900$

$M_{III} = 13,540$ Kg-m.

$X = 3.00$ $\quad M_{III} = 29,400 - 10,700 - 5,420 - 380$

$M_{III} = 12,900$ Kg

$X = 3.60$ $\quad M_{III} = 35,300 - 13,580 - 8,740 = 2,130$

$M_{III} = 10,530$ Kg.

TRAMO IV: Comenzando por el apoyo derecho.

$$M_{IV} = 9,320 - \frac{3,175\ X^2}{2}$$

Cuando $X = 0$ $\quad M_{IV} = 0$

$X = 0.50$ $\quad M_{IV} = 4m660 - 397$

$M_{IV} = 4,263$

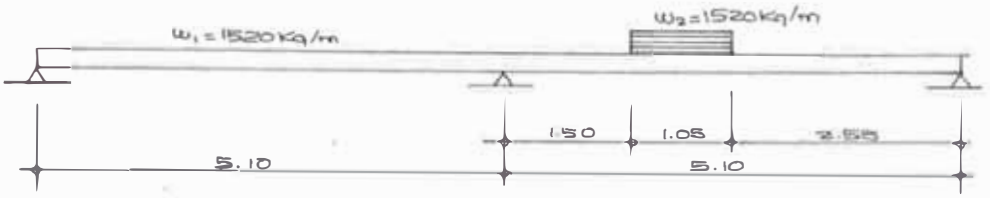
X = 1.00 $\quad M_{IV} = 9,320 - 1,587$

$M_{IV} = 7,733$

X = 1.50 $\quad M_{IV} = 14,100 - 3,570$

$M_{IV} = 10,530$ Kg.-m.

2.- SOBRECARGAS.

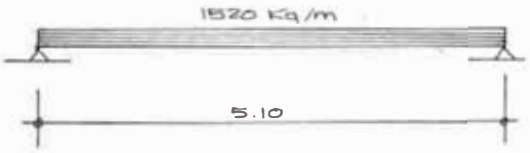


$W_1 = 845 \times 1.8 = 1,520$ Kg.

$W_2 = 845 \times 1.8 = 1,520$ Kg.

.1- MOMENTOS DE EMPOTRAMIENTO PERFECTO

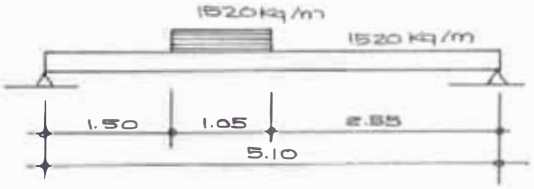
TRAMO A-B



$M_{AB} = -M_{BA} = -1/12 \times 1520 \times 5.1^2$

$M_{AB} = -M_{BA} = 3,300$Kg.

TRAMO BC



$M'_{BC} = M_{BA} = 1/12 \times 1,270 \times 5.1^2 = 2,770$ Kg-m.

$$M''_{BC2} = -\frac{1,520}{12x1.5^2}\{6x5.1^2|(1.50+1.05)^2-1.5^2|-8x5.1|(1.5+1.05)^3-1.5^3| +3|(1.5+1.05)^4-1.05^4|\}$$

$$M''_{BC} = -\frac{1,520}{12x1.5^2}\{6x5.1^2(2.55^2-1.5^2)-8x5.1(2.55^3-1.5^3)+3(2.55^4-1.5^4)\}$$

$$M''_{BC} = -\frac{1,520}{12x5.1^2}\{156(6.50-2.25)-8x5.1(16.6-3.38)+3(42.3-5.0)\}$$

$$M''_{BC} = -\frac{1,520}{12x5.1^2}(156x4.25x8x5.1x13.22+3x37.30)$$

$$M''_{BC} = -\frac{1,520}{12x5.1^2}(664 - 540 + 112)$$

$$M''_{BC} = -\frac{1,520}{12x5.1^2} \times 236 =$$

$$M''_{CB} = \frac{1,520}{12x5.1^2}\{4x5.1\ |(1.50+1.05)^3-1.5^3|-3|(1.5+1.05)^4-1.5^4|$$

$$M''_{CB} = \frac{1,520}{12x5.1^2}\{4x5.1\ [16.6-3.38)-3(42.3x5.00)\}$$

$$M''_{CB} = \frac{1,520}{12x5.1^2}(4 \times 5.1 \times 13.22 - 3 \times 37.30)$$

$$M''_{CB} = \frac{1,520}{12x5.1^2}(270-112)$$

$$M''_{CB} = \frac{1,520}{12x5.1^2} \times 158 =$$

$$M''_{CB} = 770 \text{ Kg-m.}$$

RESUMEN:

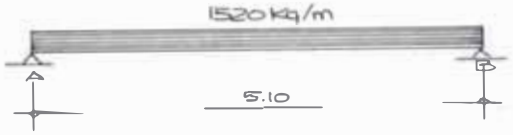
$$M_{BC} = M'_{BC} + M''_{CB} = -2,770 - 1,380 = 4,150$$

$$M_{BC} = 4,150 \text{ Kg-m.}$$

$$M_{CB} = 2,770 + 770 = 3,540$$

$$M_{CB} = 3,540 \text{ Kg-m.}$$

MOMENTOS ISOSTATICOS

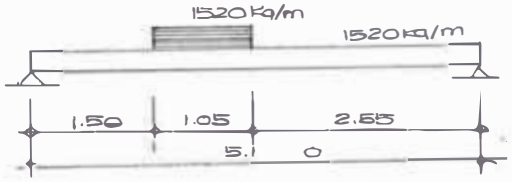


TRAMO A-B

$$M_{AB} = 1/8 \times 1,520 \times 5.1^2 = 4,940 \text{ Kg-m.}$$

$$R_{AB} = R_{BA} = 1,520 \times \frac{5.1}{2} = 3,880 \text{ Kg.}$$

TRAMO B-C



$$R_{BC} = 1,520 \times \frac{5.1^2}{2} + 1,520 \times 1.05 \times 3.025$$

$$R_{BC} = 19,800 + 4,870$$

$$R_{BC} = 24,670$$

$$R_{BC} = \frac{24,670}{5.1} = 4,840 \text{ Kg.}$$

$$R_{BC} = 4,840 \text{ Kg.}$$

$$R_{CB} = 1,520 \times 5.1 + 1,520 \times 1.05 = 4,840$$

$$R_{CB} = 7,750 + 1,600 - 4,840$$

$$R_{CB} = 9,350 - 4,840 \qquad R_{CB} = 4,510$$

$$R_{CB} = 4,510$$

MOMENTOS

TRAMO I

$$0 \leq X \leq 1.5$$

$$M_I = 4,840\ X - 1,520\ \frac{X^2}{2}$$

Cuando:

X = 0	$M_I = 0$
X = 0.5	$M_I = 2,420 - 190 = 2,230$
X = 1.00	$M_I = 4,840 - 760 = 4,080$
X = 1.5	$M_I = 1,260 - 1780 = 5,480$

TRAMO II

$$1.5 \leq X \leq 2.55$$

$$M_{II} = 4,840X - 1.520\ \frac{X^2}{2} = 1,520\ \frac{(X-1.5)^2}{2}$$

$$M_{II} = 4,840X - 1.520\ \frac{X^2}{2} = \frac{1,520}{2}\ (X-1.5)^2$$

Cuando:

X = 1.5	$M_{II} = 5,480$
X = 2.00	$M_{II} = 9,680 - 3.00 - 190$
	$M_{II} = 7,070$
X = 2.55	$M_{II} = 12,350 - 4.950 - 840$
	$M_{II} = 6,560$

TRAMO III

Comentando por la derecha $0 \leq x \leq 2.55$

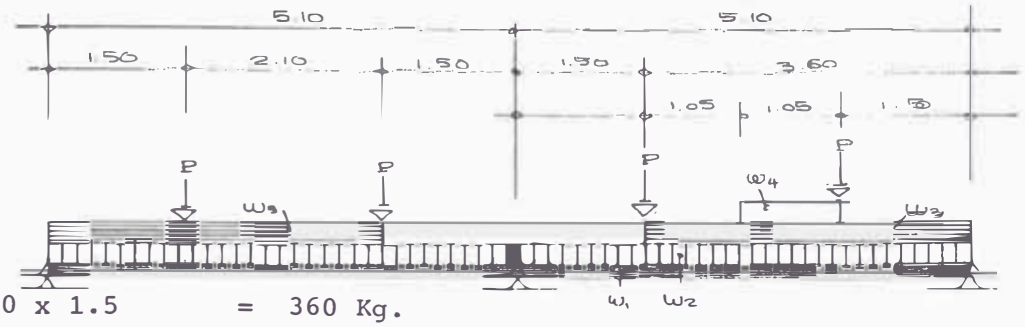
$$M_{III} = 4,510X - 1,520\ \frac{X^2}{2}$$

Cuando:

X = 0	$M_{III} = 0$
X = 0.5	$M_{III} = 2,255 - 190 = 2,365$
X = 1.00	$M_{III} = 4,510 - 760 = 3,750$
X = 1.50	$M_{III} = 6,760 - 1,780 = 4,980$
X = 2.00	$M_{III} = 9,020 - 3,040 = 5,980$
X = 2.55	$M_{III} = 11,500 - 4,940 = 6,560$

PISOS 2ª=4ª=6ª=8ª=10ª

1.- CARGAS MUERTAS.



W_1 = 240 x 1.5 = 360 Kg.

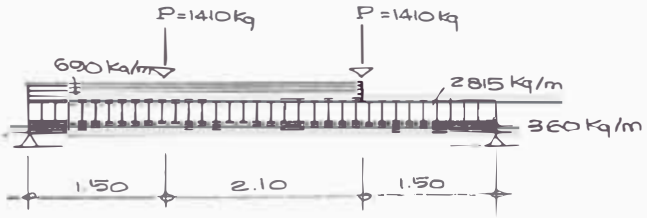
W_2 = 1,875 x 1.5 =2,815 Kg.

W_3 = 460 x 1.5 = 690 Kg.

W_4 = 936 x 1.5 =1,400 Kg.

W_5 = 940 x 1.5 =1,410 Kg.

TRAMO A-B



a.-Momentos de empotramiento perfecto

$$M'_{AB} = -M''_{BA} = 1/12 \times 360 \times 5.1^2 = -780 \text{ Kg-m.}$$

$$M''_{AB} = -M''_{BA} = -1/12 \times 2{,}815 \times 5.1^2 = -6{,}100 \text{ Kg-m.}$$

$$M'''_{AB} = -\frac{1{,}410 \times 1.5 \times 3.6^2}{5.1^2} = -1{,}050 \text{ Kg-m.}$$

$$M^{IV}_{AB} = +\frac{1{,}410 \times 1.5^2 \times 3.6}{5.1^2} = +\ 440 \text{ Kg-m.}$$

$$M^{IV}_{AB} = -\frac{1{,}410 \times 1.52 \times 3.6}{5.1^2} = -\ 440 \text{ Kg-m.}$$

$$M^{IV}_{BA} = +\frac{1{,}410 \times 1.5^2 \times 3.6}{5.1^2} = +1{,}050 \text{ Kg-m.}$$

$$M^{V}_{AB} = -\frac{690 \times 3.6^2}{12 \times 5.1^2} \quad (6 \times 5.1^2 - 8 \times 3.6 \times 5.1 + 3 \times 3.6^2)$$

$$M^{V}_{AB} = -\frac{690 \times 3.6^2}{12 \times 5.1^2} \quad (156-147+39)$$

$$M^{V}_{AB} = - \frac{690 \times 3.6^2}{12 \times 5.1^2} \times 48 = - 1{,}375 \text{ Kg-m.}$$

$$M^{V}_{BA} = \frac{690 \times 3.6^3}{12 \times 5.1^2} (4 \times 5.1 - 3 \times 3.6)$$

$$M^{V}_{BA} = \frac{690 \times 3.6^3}{12 \times 5.1^2} (20.4 - 10.8)$$

$$M^{V}_{BA} = \frac{690 \times 3.6^3}{12 \times 5.1^2} \times 9.6 = 990$$

$$M^{V}_{BA} = 990 \text{ Kg-m.}$$

$$M_{AB} = M'_{AB} + M''_{AB} + M'''_{AB} + M^{IV}_{AB} + M^{V}_{AB}$$

$$M_{BA} = M'_{BA} + M''_{BA} + M'''_{BA} + M^{IV}_{BA} + M^{V}_{BA}$$

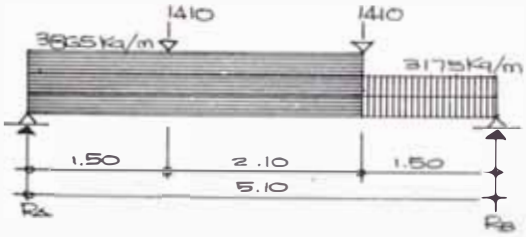
$\therefore$

$$M_{AB} = - 780 - 6{,}100 - 1{,}050 - 440 - 1{,}375 = 9{,}745 \text{ Kg-m.}$$

$$M_{BA} = +780 + 6{,}100 + 440 + 1{,}050 + 990 = 9{,}360 \text{ Kg-m.}$$

b.- MOMENTOS ISOSTATICOS

Para el efecto sumaremos las cargas por tramos.



$$w_1 + w_2 = 360 + 2{,}815 = 3{,}175$$

$$w_1 + w_2 + w_3 = 360 + 2{,}815 + 690 = 3{,}865$$

CALCULO DE LAS REACCIONES DE APOYO

$$5.1 R_A = 3{,}865 \times 3.6 (5.1 - 1.8) + 1{,}410 \times 3.6 + 1{,}410 \times 1.5 \times 3{,}175 \times 1.5 \times 0.75$$

$$5.1 R_A = 3{,}865 \times 3.6 \times 3.3 + 1{,}410 \times 3.6 + 1{,}410 \times 1.5 + 3{,}175 \times 1.50 \times 0.75$$

$$5.1 R_A = 46{,}000 + 5{,}040 + 2{,}100 + 3{,}570$$

$$5.1 R_A = 56{,}710 \text{ Kg.}$$

$$R_A = 11{,}100 \text{ Kg.}$$

$$R_B = 3{,}865 \times 3.6 + 3{,}175 \times 1.5 + 2{,}820 - 11{,}100$$

$$R'_B = 13{,}900 + 4760 + 2{,}820 - 11{,}100$$

$$R'_B = 10{,}380 \text{ Kg.}$$

MOMENTOS ISOSTATICOS

TRAMO I

$$0 \leq X \leq 1.50$$

$$M_I = 11{,}100X - 3{,}865\frac{X^2}{2}$$

Cuando:

$X = 0$ $\quad M_I = 0$

$X = 0.50$ $\quad M_I = 5{,}550\text{-}480$

$M_I = 5{,}070$ Kg-m.

$X = 4.00$ $\quad M_I = 11{,}100 - 1{,}930$

$M_I = 9{,}170$ Kg-m.

$X = 1.50$ $\quad M_I = 16{,}650 - 4{,}350$

$M_I = 12{,}300$ Kg-m.

TRAMO II

$$1.5 \leq X \leq 3.6$$

$$M_{II} = 11{,}100X - 3{,}865\frac{X^2}{2} - 1{,}410(X-1.50)$$

Cuando: $X = 1.5$ $\quad M_{II} = 16{,}650 - 4{,}350$

$M_{II} = 12{,}300$ Kg-m.

$X = 2.00$ $\quad M_{II} = 22{,}200 - 7{,}730 - 705$

$M_{II} = 13{,}765$ Kg.

$X = 2.50$ $\quad M_{III} = 27{,}750 - 12{,}100\text{-}1{,}410$

$M_{III} = 14{,}240$ Kg-m.

$X = 3.00$ $\quad M_{III} = 33{,}300 - 17{,}400 - 2{,}120$

$M_{III} = 13{,}780$ Kg-m.

$X = 3.60$ $\quad M_{III} = 40{,}000\text{-}25{,}000\text{-}\ 2{,}960$

$M_{III} = 12{,}040$ Kg.

TRAMO IV (Comenzando por el apoyo derecho)

$0 \leq X \leq 1.5$

$$M_{IV} = 10,380X - 3,175 \times \frac{X^2}{2}$$

Cuando: X = 0 $M_{IV} = 0$

X = 0.5 $M_{IV} = 5,190 - 400$

$M_{IV} = 4,790$ Kg-m.

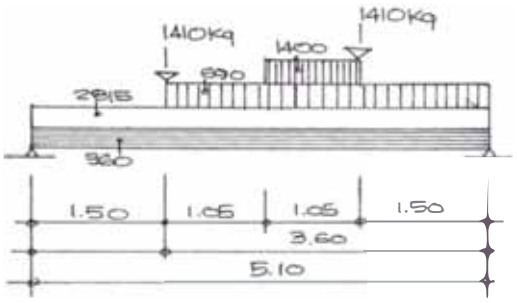
X=1.00 $M_{IV} = 10,380 - 1,587$

$M_{IV} = 8,790$ Kg-m.

X=1.50 $M_{IV} = 15,580 - 3,540$

$M_{IV} = 12,040$ Kg-m.

TRAMO BC



MOMENTOS DE EMPOTRAMIENTO PERFECTO

$M'_{BC} = -M'_{CB} = 1/12 \times 360 \times 5.1^2 = -780$ Kg-m.

$M''_{BC} = -M''_{CB} = 1/12 \times 2,815 \times 5.1^2 = -6,100$ Kg-m.

$$M'''_{BC} = -\frac{1,410 \times 1.5 \times 3.6^2}{5.1^2} = -1,050 \text{ Kg-m.}$$

$$M'''_{CB} = +\frac{1,410 \times 1.5^2 \times 3.6}{5.1^2} = +440 \text{ Kg-m.}$$

$$M^{IV}_{CC} = -\frac{1,410 \times 1.5^2 \times 3.6}{5.1^2} = -440 \text{ Kg-m.}$$

$$M^{IV}_{CB} = +\frac{1,410 \times 3.6^2 \times 1.5}{5.1^2} = 1,050 \text{ Kg-m.}$$

$$M^{V}_{BC} = -\frac{690 \times 3.6^2}{12 \times 5.1^2} \quad (4 \times 5.1x = 3 \times 3.6)$$

$$M^{V}_{CC} = -\frac{690 \times 3.6^2}{12 \times 5.1^2} \quad (20.4 - 10.8)$$

TRAMO IV (Comenzando por el apoyo derecho)

$0 \leq X \leq 1.5$

$M_{IV} = 10,380X - 3,175 \times \frac{X^2}{2}$

Cuando: X = 0 $M_{IV} = 0$

X = 0.5 $M_{IV} = 5,190 - 400$

$M_{IV} = 4,790$ Kg-m.

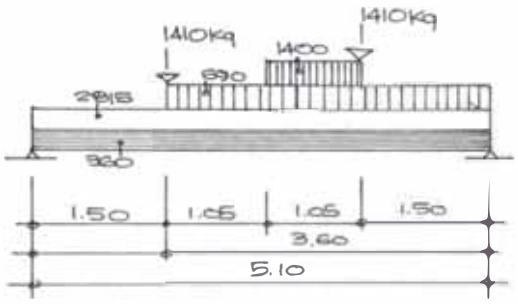
X=1.00 $M_{IV} = 10,380 - 1,587$

$M_{IV} = 8,790$ Kg-m.

X=1.50 $M_{IV} = 15,580 - 3,540$

$M_{IV} = 12,040$ Kg-m.

TRAMO BC



MOMENTOS DE EMPOTRAMIENTO PERFECTO

$M'_{BC} = -M'_{CB} = 1/12 \times 360 \times 5.1^2 = -780$ Kg-m.

$M''_{BC} = -M''_{CB} = 1/12 \times 2,815 \times 5.1^2 = -6,100$ Kg-m.

$M'''_{BC} = -\frac{1,410 \times 1.5 \times 3.6^2}{5.1^2} = -1,050$ Kg-m.

$M'''_{CB} = +\frac{1,410 \times 1.5^2 \times 3.6}{5.1^2} = +440$ Kg-m.

$M^{IV}_{CC} = -\frac{1,410 \times 1.5^2 \times 3.6}{5.1^2} = -440$ Kg-m.

$M^{IV}_{CB} = +\frac{1,410 \times 3.6^2 \times 1.5}{5.1^2} = 1,050$ Kg-m.

$M^{V}_{BC} = -\frac{690 \times 3.6^2}{12 \times 5.1^2}$ (4x5.1x=3x3.6)

$M^{V}_{CC} = -\frac{690 \times 3.6^2}{12 \times 5.1^2}$ (20.4-10.8)

$$M^{V}_{BC} = - \frac{690 \times 3.6^2}{12 \times 5.1^2} \times 9.6$$

$$M^{V}_{BC} = 990 \text{ Kg-m.}$$

$$M^{V}_{CB} = - \frac{690 \times 3.6^2}{12 \times 5.1^2} (6 \times 5.1^2 - 8 \times 3.6 \times 5.1 + 3 \times 3.6^2)$$

$$M'_{CB} = - \frac{690 \times 3.6^2}{12 \times 5.1^2} (156 \times 147 - 39)$$

$$M'_{CB} = - \frac{690 \times 3.6^2}{12 \times 5.1^2} \times 48$$

$$M'_{CB} = -1.375 \text{ Kg-m.}$$

$$M^{VI} = - \frac{1,400}{12 \times 5.1^2} \{6 \times 5.1^2 | (2.55+1.05)^2 \times 2.55^2 | - 8 \times 5.1 | (2.55+1.05)^3 - 2.55^3 | + 3 | (2.55+1.05)^4 - 2.55^4 |$$

$$M^{VI}_{BC} = - \frac{1,440}{12 \times 5.1^2} \{156 | (3.60)^2 - 2.55^2 | - 8 \times 5.1 | (3.60)^3 - 2.55^3 | + 3 | (3.60)^4 - 2.55^4 |$$

$$M^{VI}_{BC} = - \frac{1,400}{12 \times 5.1^2} \{156(12.95-6.50) - 8 \times 5.1(46.6-16.6) + 3(168-42.4)\}$$

$$M^{VI}_{BC} = - \frac{1,400}{12 \times 5.1^2} \{156(6.45) - 8 \times 5.1 \times 30.00 + 3 \times 125.6 |$$

$$M^{IV}_{BC} = - \frac{1,400}{12 \times 5.1^2} (1,000 - 1,225 + 377)$$

$$M^{V}_{BC} = - \frac{1,400}{12 \times 5.1^2} \times 152 = 680$$

$$M^{V}_{BC} = 680 \text{ Kg-m.}$$

$$M_{CB} = - \frac{1,400}{12 \times 5.1^2} \{4 \times 5.1 | (2.55+1.05)^3 - 1.05^3 | - 3 | (2.55+1.05)^4 - 1.05^4 |$$

$$M_{CB} = - \frac{1,400}{12 \times 5.1^2} \{4 \times 5.1 | (3.60)^3 - 1.05^3 | - 3 | (3.60)^4 - 1.05^4 |$$

$$M_{CB} = - \frac{1,400}{12 \times 5.1^2} \{4 \times 5.1(46.6-16.6) - 3(168-42.4)\}$$

$$M_{CB} = - \frac{1,400}{12 \times 5.1^2} (4 \times 5.1 \times 30 - 3 \times 125.6)$$

$$M_{CB} = - \frac{1,400}{12 \times 5.1^2} (612 - 377)$$

$$M_{CB} = - \frac{1,400}{12 \times 5.1^2} \times 235 = 1,050$$

M_{CB} = 1,050 Kg-m.

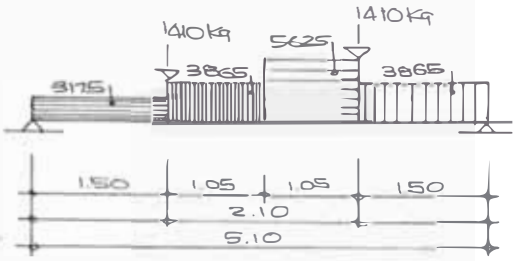
M_{BC} = -760 - 6,100 - 1,050 - 440 - 990 - 680 =

M_{BC} = 10,020 Kg-m.

M_{CB} = 760 + 6,100 + 440 + 1,050

M_{CB} = 10,775 Kg-m.

b.- Momentos Isostáticos.



W_1+W_2 = 360+ 2,815 = 3,175 Kg.

$W_1+W_2+W_3$ = 360+2,815+690 = 3,865 Kg.

$W_1+W_2+W_3+W_4$ = 360+2,815+690+1,400 = 5,265 Kg.

CALCULO DE LAS REACCIONES DE APOYO

$5.1R''_B$ = 3,175x1.5(5.10-0.75)+1,410x3.60+3,865x1.05(3.60x0.52)+5,265x
1.05 (2.55-0.52)+1,410x1.5+3,865x1.5x0.75

$5.1R''_B$ = 3,175x1.5x4.35+1,410x3.60+3,865x1.05x3.08+5,265x1.05x2.03+
+ 1,410x1.5+3,865x1.5x0.75

$5.1R''_B$ = 20,700+5,070+12,500+11,230+2,120+4,350

$5.1R''_B$ = 55,970

R''_B = 10,950 Kg.

R_C = 3,175x1.5+2,820+3,865x1.05+5,265x1.05+3,865x1.5-10,950

R_C = 4,760+2,820+4,060+5,540+4,060-10,950

R_C = 21,240-10,950

R_C = 10,290 Kg.

CALCULO DE MOMENTOS

TRAMO I

$$0 \leq X \leq 1.50$$

$$M_I = 10,950X - 3,175 \frac{X^2}{2}$$

Cuando $X = 0$ $\quad M_I = 0$

$X = 0.5$ $\quad M_I = 5,475 - 396$

$M_I = 5,079$ Kg-m.

$X = 1.00$ $\quad M_I = 10,950 - 1,587$

$M_I = 9,363$ Kg-m.

$X = 1.5$ $\quad M_I = 16,425 - 3,570$

$M_I = 12,855$ Kg-m.

TRAMO II

$$1.5 \leq X \leq 2.55$$

$$M_{II} = 10,950\ X - 3,175x1.5(X-0.75) - 1,410(X-1.5) - \frac{3,865}{2}(X-1.5)^2$$

Cuando: $X = 1.5$ $\quad M_{II} = 16,425 - 3,570$

$M_{II} = 12,855$ Kg-m.

$X = 2.00$ $\quad M_{II} = 21,900 - 5,960 - 705 - 485$

$M_{II} = 14,750$ Kg-m.

$X = 2.55$ $\quad M_{II} = 27,950 - 8,560 - 1,480 - 2,130$

$M_{II} = 15,780$

TRAMO III

$$2.55 \leq X \leq 3.60$$

$$M_{III} = 10,950\ X - 3,175x1.5(X-0.75) - 1,410(X-1.5) - 3,865x1.05($$
$$(X-2.02) - 5,265\left(\frac{X-2.55}{2}\right)^2$$

Cuando $X = 2.55$ $\quad M_{III} = 27,950 - 8,560 - 1,480 - 2,130$

$M_{III} = 15,780$

$X = 3.00$ $\quad M_{III} = 32,850 - 10,700 - 2,120 - 3,980 - 530$

$M_{III} = 15,520$ Kg-m.

X = 3.60 M_{III} = 39,450 - 13,580= 2,960-9,160-2,900

M_{III} = 11,050 Kg-m.

TRAMO IV (Comenzando del apoyo derecho)

$0 \leq X \leq 1.5$

$$M_{IV} = 10,290X - \frac{3,865X^2}{2}$$

Cuando: X = 0 M_{IV} =0

X = 0.5 M_{IV} = 5,145 - 435

M_{IV} = 4,710 Kg-m.

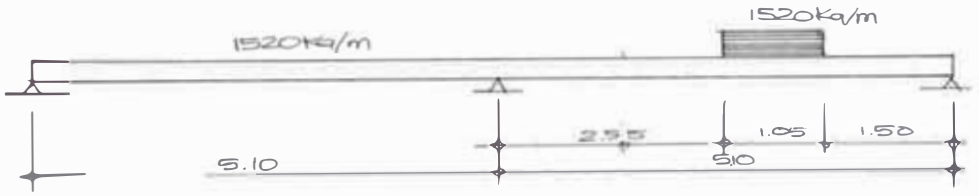
X=1.00 M_{IV} = 10,290-1,932

M_{IV} = 8,353 Kg-m.

X=1.5 M_{IV} = 15,400 - 4,350

M_{IV} = 11,050 Kg-m.

2.- SOBRECARGAS

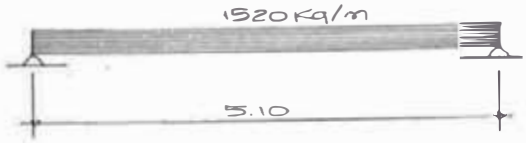


W_1 = 845 x 1.8 = 1,520 Kg.

W_2 = 845 x 1.8 = 1,520 Kg.

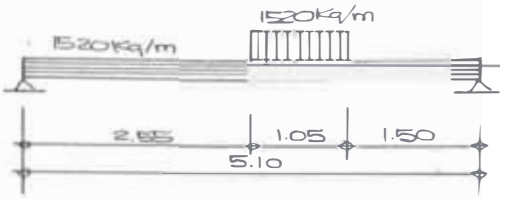
MOMENTOS DE EMPOTRAMIENTO PERFECTO

TRAMO A-B



$M_{AB} = -M_{BA}$ = 1/12 x 1,520 x 5.1^2 = 3,300 Kg-m.

TRAMO BC



$M'_{BC} = -M'_{CB} = 1/12 \times 1{,}520 \times 5.1^2 = 3{,}300$ Kg-m.

$$M''_{BC} = -\frac{1{,}520}{12x5.1^2}\{6x5.1^2|(2.55+1.05)^2-2.55^2|-8x5.1|(2.55+1.05)^3-2.55^3|\}$$

$$M''_{BC} = -\frac{1{,}520}{12x5.1^2}\{156\ |3.60^2-2.55^2|-8x5.1|3.60^3-2.55^3|+3|3.6^4-2.55^4|\}$$

$$M''_{BC} = -\frac{1{,}520}{12x5.1^2}\{156(12.95-6.50)-8x5.1(46.6-16.6)+3(168-42.4)\}$$

$$M''_{BC} = -\frac{1{,}520}{12x5.1^2}\{156(6.45)-8x5.1(30.00)+3(125.6)\}$$

$$M''_{BC} = -\frac{1{,}520}{12x5.1^2}(1{,}000-1{,}225+377)$$

$$M''_{BC} = -\frac{1{,}520}{12x5.1^2}x152$$

$M''_{BC} = -740$

$$M''_{CB} = \frac{1{,}520}{12x5.1^2}\{4x5.1\ |(2.55+1.05)^3-1.05^3|-3|(2.55+1.05)^4-1.05^4|\}$$

$$M''_{CB} = \frac{1.520}{12x5.1^2}|4x5.1(46.6-16.6)-3(168-42.2)|$$

$$M''_{CB} = \frac{1{,}520}{12x5.1^2}(4x5.1x30-3x125.6)$$

$$M''_{CB} = \frac{1{,}520}{12x5.1^2}x\ 235$$

$M''_{CB} = 1{,}150$ Kg-m.

$M''_{BC} = -3{,}300 - 740 = -4{,}040$ Kg-m.

$M_{CB} = -3{,}300-1{,}150 = 4{,}450$ Kg-m.

MOMENTOS ISOSTATICOS

TRAMO A-B

$R_A = R'_B = 1,520 \times \frac{5.1}{2} = 3,880$ Kg.

$M_{AB} = 1/8 \times 1,520 \times 5.1^2 = 4,940$ Kg-m.

Para los efectos de las envolventes haré los momentos isostáticos por secciones, en tantas, cuantas se ha tomado para los momentos por cargas muertas.

$$M = 3,880X - 1,520 \frac{X^2}{2}$$

Cuando: X = 0 M = 0

X = 0.50 M = 1,940 - 190

M = 1,750 Kg-m.

X = 1.00 M = 3,880 - 760

M = 3,120 Kg-m.

X = 1.50 M = 5,820 - 1710

M = 4,110 Kg-m.

X = 2.00 M = 7,760 - 3,040

M = 4,720 Kg-m.

X = 2.50 M = 9,900 - 4,950

M = 4,950 Kg-m.

X = 3.00 M = 11,640 - 6,840

M = 4,800 Kg-m.

X = 3.60 M = 4,110 Kg-m(por simetría)

X = 4.10 M = 3.12 Kg-m.

X = 4.60 M = 1,750 Kg-m.

X = 5.10 M = 0.00 Kg-m.

TRAMO BC

$$5.1R''_B = 1,520 \times \frac{5.1^2}{2} + 1,520 \times 1.05 \times 2.02$$

$$5.1R''_B = 19,800 + 3,220$$

$$5.1R''_B = 23,020$$

$$R''_B = 4,520 \text{ Kg.}$$

$$R_C = 1,520 \times 5.1 + 1,520 \times 1.05 \times 4,520$$

$$R_C = 7,750 + 1,950 - 4,520$$

$$R_C = 5,180 \text{ Kg.}$$

MOMENTOS ISOSTATICOS

TRAMO I

$$0 \leq X \leq 1.50$$

$$M_I = 4,520X - 1,520 \frac{X^2}{2}$$

Cuando: $X = 0$ $M_I = 0$

$X = 0.5$ $M_I = 2,260 - 190$

$M_I = 2,070$ Kg-m.

$X = 1.00$ $M_I = 4,520 - 760$

$M_I = 3,760$ Kg.-m

$X = 1.50$ $M_I = 6,780 - 1,710$

$M_I = 5,070$ Kg-m.

$X = 2.00$ $M_I = 9,040 - 3,040$

$M_I = 6,000$ Kg.-m.

$X = 2.55$ $M_I = 11,500 - 4,940$

$M_I = 6,560$ Kg-m.

TRAMO II

$$2.55 \leq X \leq 3.60$$

$$M_{II} = 4,520X - \frac{1,520X^2}{2} = 1,520 \frac{(X-2.55)^2}{2}$$

Cuando $X = 2.55$ $M_{II} = 11,500 - 4,940$

$M_{II} = 6,560$ Kg-m.

$X = 3.00$ $M_{II} = 13,550 - 6,840 - 154$

$M_{II} = 6,556$ Kg-m.

$X = 3.6$ $M_{II} = 16,250 - 9,850 - 835$

$M_{II} = 6,065$ Kg-m.

TRAMO IV (Comenzando del apoyo derecho)

$$M_{IV} = 5{,}180X - 1{,}520 \frac{X^2}{2}$$

Cuando: $X = 0$ $\quad M_{IV} = 0$

$X = 0.5$ $\quad M_{IV} = 2{,}590 - 190$

$M_{IV} = 2{,}400$

$X = 1.00$ $\quad M_{IV} = 5{,}180 - 760$

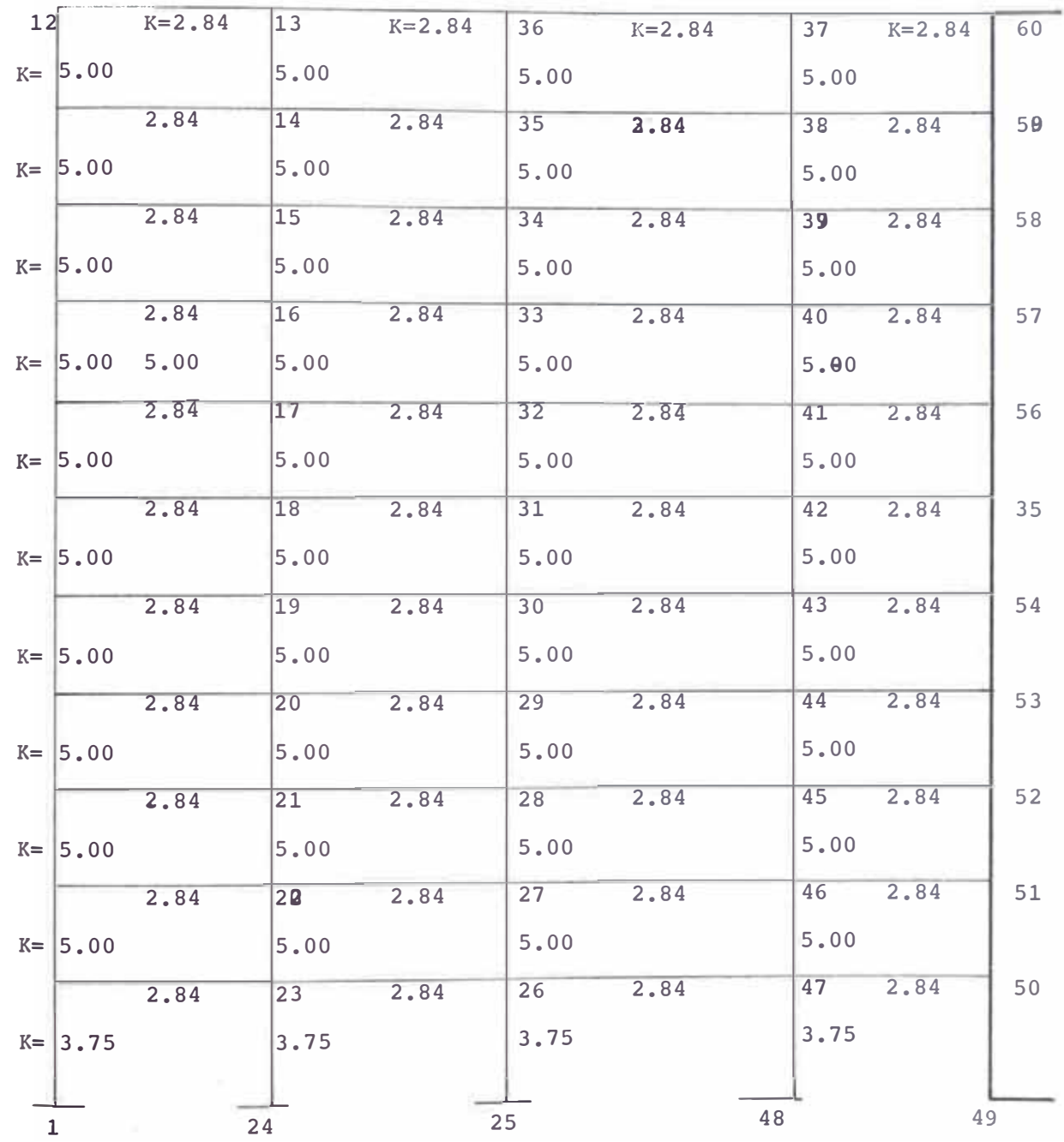
$M_{IV} = 4{,}420$

$X = 1.5$ $\quad M_{IV} = 7{,}775 - 1{,}710$

$M_{IV} = 6{,}065$ Kg-m.

PORTICO DE ARRIOSTRE :A

VALORES "K" RELATIVOS EN EL PORTICO DE ARRIOSTRE



CALCULO DE LOS FACTORES DE GIRO O DE REPARTICION (μ)

Nudos 1,24,25,48 y 49; coeficientes = 0 (empotramiento)

Nudo (2)

$\Sigma K = 5,72.84+3.75$

$\Sigma K = 11.59$

$\mu_{2-3} = -1/2 \times \frac{5.00}{11.59} = -0.216$

$\mu_{2-23} = -1/2 \times \frac{2.84}{11.59} = 0.122$

$\mu_{2-1} = -1/2 \times \frac{3.75}{11.59} = 0.162$

Nudo:3=4=5=6=7=8=
=9=10=11

$\Sigma K=5.00+5.00+2.84$

$\Sigma K =12,84$

$\mu_{3-2} = -1/2 \times \frac{5}{12.84} = -0.195$

$\mu_{3-32} = -1/2 \times \frac{2.84}{12.84} = 0.110$

$\mu_{3-5} = -1/2 \times \frac{5}{12.84} = 0.195$

Nudo(12

$\Sigma K=5.00+2.84$

$\Sigma K=7.84$

$\mu_{12-11} = -1/2x \frac{5}{17.84} = 0.32$

$\mu_{12-13} = -1/2x \frac{2.84}{17.84} = 0.18$

Nudo (13)=36=37

$\Sigma K=2.84+2.84+5.00$

$\Sigma K=10.68$

$\mu_{13-12} = -1/2 \times \frac{2.84}{10.68} = -0.133$

$\mu_{13-36} = -1/2 \times \frac{2.84}{10.68} = -0.133$

$\mu_{13-14} = -1/2 \times \frac{5}{10.68} = -0.234$

Nudo(23)=26=47

$\Sigma K=2.84+5.00+2.84+3.75$

$\Sigma K = 14.43$

$\mu_{23-2} = -1/2 \times \frac{2.84}{14.43} = -0.098$

$\mu_{23-26} = -1/2 \times \frac{2.84}{14.43} = -0.098$

$\mu_{23-22} = -1/2 \times \frac{5}{14.43} = -0.174$

$\mu_{23-24} = -1/2x \frac{3.75}{14.43} = -0.130$

Nudos Interiores:14=
15=....22
35=....27
38=....46

$\Sigma K=2.84+5.00+2.84+5.0$

$\Sigma K=15.68$

$\mu_{14-11} = -1/2 \times \frac{2.84}{15.68} = -0.090$

$\mu_{14-13} = -1/2 \times \frac{5}{15.68} = -0.160$

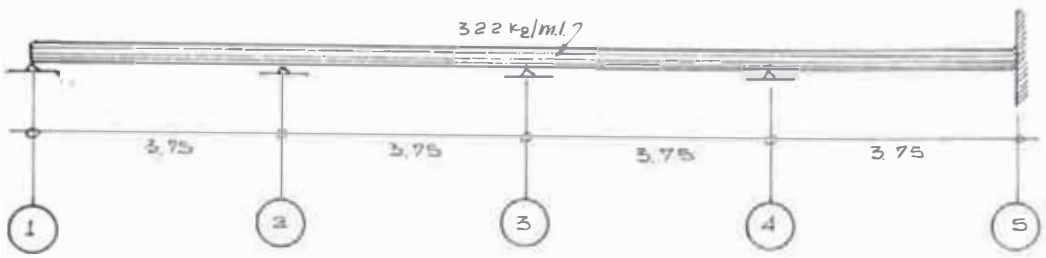
$\mu_{14-35} = -1/2 \times \frac{2.84}{15.68} = -0.090$

$\mu_{14-15} = -1/2 \times \frac{5}{15.68} = -0.160$

Nudos:50=51=....-60Coeficiente μ=0 empotramiento

CALCULO DE LOS MOMENTOS DE EMPOTRAMIENTO PERFECTO

Piso 11ª ó Azotea



Como todos los tramos son iguales hallo: Sólo para el tramo 1-2

$M_{1-2} = -M_{2-1} = 1/12 \times 322 \times 3.75^2 = 377$ Kg-m.

Luego:

$M_{1-2} = -377$ Kg-m. $\qquad M_{2-1} = +377$ Kg-m

$M_{2-3} = -377$ Kg-m $\qquad M_{3-2} = +377$ Kg-m

$M_{3-4} = -377$ Kg-m $\qquad M_{4-3} = +377$ Kg-m.

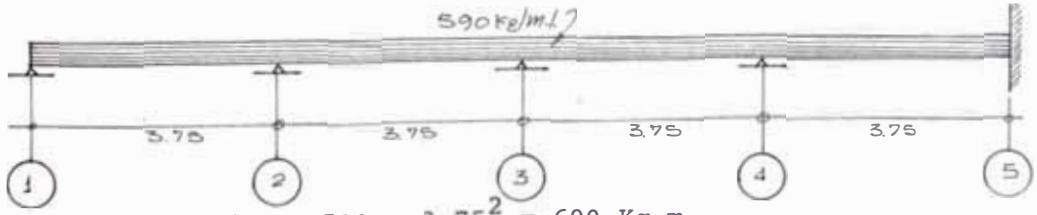
$M_{4-5} = -377$ Kg-m. $\qquad M_{5-4} = +377$ Kg-m.

$R_{1-2}=R_{2-1}=R_{2-3}=R_{3-2}=R_{3-4}=R_{4-3}=R_{4-5}=R_{5-4} = 322 \times \frac{3.75}{2} = 604$Kg.

Como todos los tramos tienen la misma luz y estan igualmente cargados, el momento isostático será:

$M = 1/8 \times wL^2 = 1/8 \times 3.75^2 \times 322 = 566$ Kg-m.

Pisos 1ª,3ª,5ª, y 9ª



$M_{12} = -M_{2-1} = -1/12 \times 590 \times 3.75^2 = 690$ Kg-m.

$M_{1-2}=-690$ Kg-m. $\qquad M_{2-1} = +690$ Kg-m

$M_{2-3}=-690$Kg-m $\qquad M_{3-2} = +690$Kg-m.

$M_{3-4} = -690$Kg-m $\qquad M_{4-3} = +690$ Kg-m.

$M_{4-5} = -690$ Kg-m. $\qquad M_{5-4} = +690$ Kg-m.

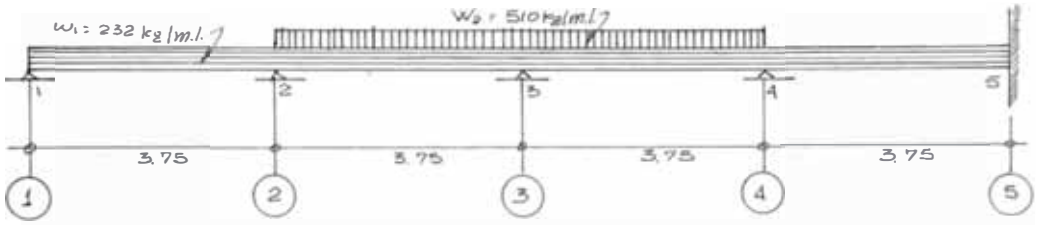
MOMENTOS ISOSTATICOS

$R_{1-2}=R_{2-1}=R_{2-3}=R_{3-2}=R_{3-4}=R_{4-3}=R_{4-5}=R_{5-4}=\frac{590x3.75}{2}=1,010Kg.$

Como todos los tramos tienen la misma luz y estan igualmente cargados, con carga uniformente repartida, el momento isostático en todos los tramos será:

$M = 1/8\ wL^2 = 1/8x590x3.75^2 = 1,040$ Kg-m.

Pisos 2ª,4ª,6ª,8ª y 10ª



$M_{1-2}=-M_{2-1} = -1/12 \times 232 \times 3.75^2 = -272$

$M_{1-2} = -272$ Kg-m $\qquad M_{2-1} = +272$Kg-m.

$M_{3-2} = -M_{2-3} = -1/12 \times 742x3.75^2 = -820$Kg-m.

$M_{3-2} = -820$ Kg-m $\qquad M_{2-3} = +820$ Kg-m.

$M_{3-4} = -820$ Kg-m. $\qquad M_{4-3} = +820$ Kg-m.

$M_{4-5} = -272$ Kg-m $\qquad M_{5-4} = +272$ Kg-m.

MOMENTOS ISOSTATICOS

$R_{1-2}=R_{2-1}=\frac{232x3.75^2}{2} = 435$ Kg.

$R_{2-3}=R_{3-4}=R_{4-3}=\frac{510x3.75}{2} =$

$R_{4-5}=R_{5-4} = \frac{232x3.75}{2} = 435$

MOMENTOS ISOSTATICOS

TRAMO 1-2

$M = 1/8 \times 232 \times 3.75^2 =$

M = 407 Kg-m.

TRAMO 2-3

$M = 1/8 \times 742x3.75^2 =$

M = 1,300 Kg-m.

TRAMO 3-4

$$M = 1/8 \times 742 \times 3.75^2$$

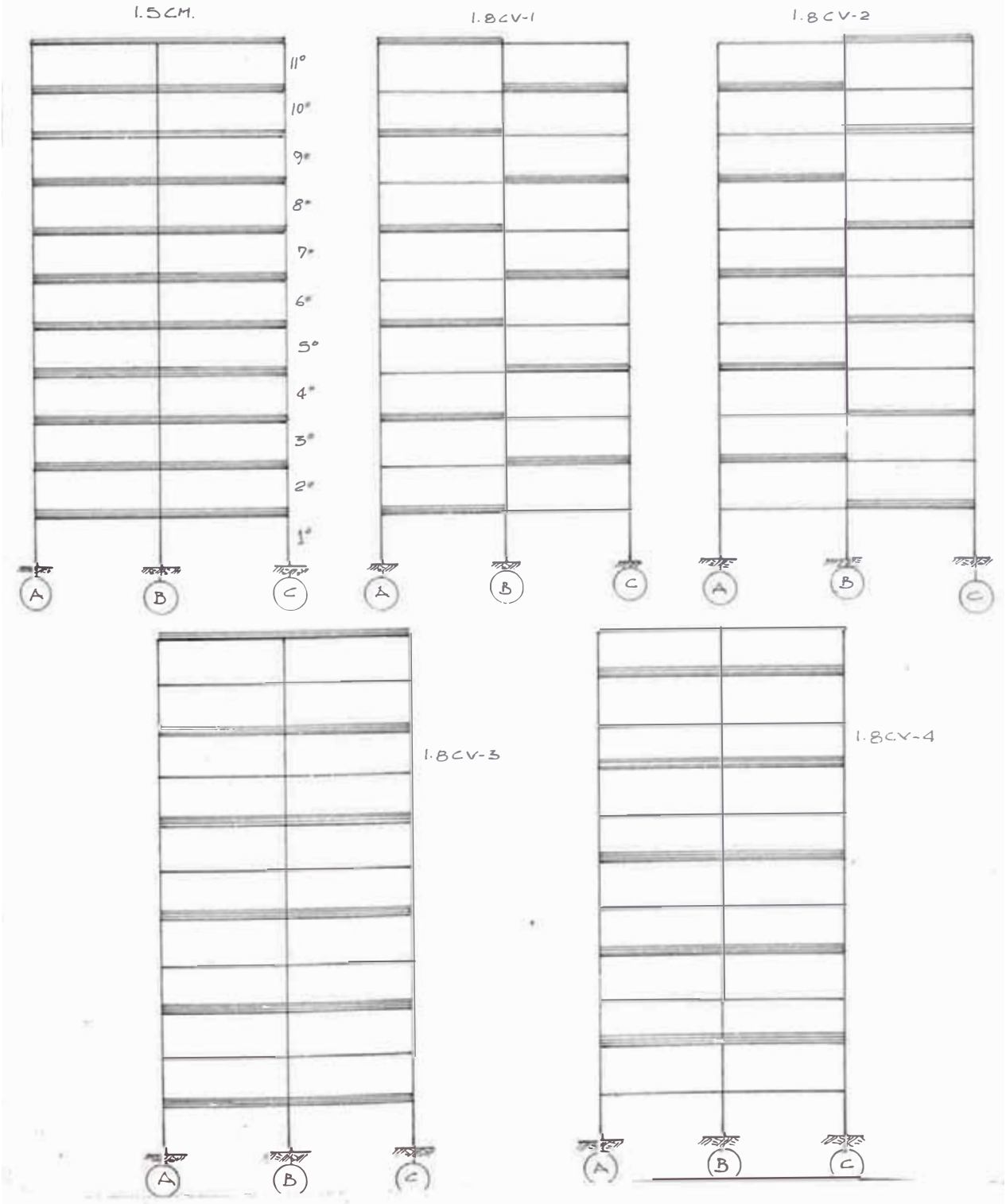
$$M = 1{,}300 \text{ Kg-m.}$$

TRAMO 4-5

$$M = 1/8 \times 232 \times 3.75^2 =$$

$$M = 407 \text{ Kg-m.}$$

ESQUEMA DE COMBINACIONES DE CARGAS Y SOBRECARGAS



ENVOLVENTES DE MOMENTOS: VIGAS

A continuación se presentan los cuadros de momentos resultantes obtenidos por el método de KANI para las diferentes combinaciones de cargas:

COMBINACION DE SIGNOS: GRNTHER

\- +

MOMENTOS EN VIGAS- PORTICO PRINCIPAL 4

CARGAS MUERTAS: 1.5C.M.

NIVEL	TRAMO A-B		TRAMO B-C	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-5.31	+5.64	-5.67	+5.31
10	-9.41	+9.54	-10.19	+10.41
9	-8.12	+8.48	-8.93	+8.25
8	-9.38	+9.56	-10.21	+10.37
7	-8.12	+8.48	-8.93	+8.25
6	-9.38	+9.56	-10.21	+10.37
5	-8.12	+8.48	-8.93	+8.25
4	-9.38	+9.56	-10.21	+10.37
3	-8.12	+8.48	-8.95	+8.25
2	-9.42	+9.45	-10.19	+10.41
1	-7.91	+8.60	-9.03	+8.06

CARGAS VIVAS (1.8CV)

CV-1: 1.8CV-1

NIVEL	TRAMO A-B		TRAMO B-C	
	M_{A-B}	M_{B-A}	M_{BC}	M_{CB}
11	-1.43	+1.37	-0.10	+0.01
10	-0.03	+0.12	-4.01	+4.24
9	-3.21	+3.18	-0.16	+0.01
8	-0.05	+0.11	-4.02	+4.22
7	-3.21	+3.18	-0.16	+0.01
6	-0.05	+0.11	-4.02	+4.22
5	-3.21	+3.18	-0.16	+0.01
4	-0.05	+0.11	-4.01	+4.24
3	-3.21	+3.18	-0.16	+0.01
2	-0.05	+0.11	-4.01	+4.24
1	-3.16	+3.22	-0.16	-0.02

V-2: 1.8CV-2

Nivel	TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	0.00	+0.09	-1.42	+1.39
10	-3.15	+3.24	-0.12	+0.03
9	+0.04	+0.20	-4.01	+3.46
8	-3.14	+3.26	-0.09	+0.06
7	+0.04	+0.20	-4.01	+3.46
6	-3.14	+3.26	-0.09	+0.06
5	+0.04	+0.20	-4.01	+3.46
4	-3.14	+3.26	-0.09	+0.06
3	+0.06	+0.21	-4.01	-3.46
2	-3.14	+3.26	-0.08	+0.08
1	+0.08	+0.22	-4.03	+3.42

CV-3: 1.8 CV-3

Nivel	TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-1.33	+1.54	-1.49	+1.37
10	-0.05	-0.01	+0.08	+0.13
9	-3.03	+3.48	-4.18	+3.39
8	-0.05	-0.01	+0.09	+0.15
7	-3.03	+3.48	-4.18	+3.39
6	-0.05	-0.01	+0.09	+0.15
5	-3.03	+3.48	-4.18	+3.39
4	-0.05	-0.01	+0.09	+0.15
3	-3.03	+3.48	-4.18	+3.39
2	-0.05	-0.01	+0.09	+0.15
1	-2.99	+3.50	-4.20	+3.35

CV-4

Nivel	TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-0.09	-0.06	+0.02	+0.07
10	-3.12	+3.39	-4.18	+4.15
9	-0.14	-0.10	+0.02	+0.10
8	-3.11	+3.41	-4.17	+4.16
7	-0.14	-0.10	+0.02	+0.10
6	-3.11	+3.41	-4.17	+4.16
5	-0.14	-0.10	+0.02	+0.10
4	-3.12	+3.39	-4.19	+4.15
3	-0.14	-0.10	+0.02	+0.10
2	-3.12	+3.39	-4.18	+4.17
1	-0.09	-0.06	+0.02	+0.07

Como se podra apreciar en los cuadros anteriores los momentos resultantes de KANI estan afectados de los coeficientes de rotura: 1.5 para CM y 1.8 para CV.

Ahora presento cuadros con los momentos sin los coeficientes, porque más adelante habra que necesitarse así:

CARGAS MUERTAS

Nivel	TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-3.54	+3.76	-3.78	+3.54
10	-6.27	+6.36	-6.79	+6.95
9	-5.41	+5.66	-5.95	+5.50
8	-6.25	+6.38	-6.80	+6.92
7	-5.41	+5.66	-5.95	+5.50
6	-6.25	+6.38	-6.80	+6.92
5	-5.41	+5.66	-5.95	+5.50
4	-6.25	+6.38	-6.80	+6.92
3	-5.41	+5.66	-5.97	+5.50
2	-6.27	+6.36	-6.79	+6.95
1	-5.28	+5.73	-6.02	+5.38

CV-1

NIVEL	TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-0.80	+0.76	-0.05	+0.00
10	-0.02	+0.07	-2.23	+2.36
9	-1.78	+1.77	-0.09	+0.00
8	-0.03	+0.06	-2.23	+2.34
7	-1.78	+1.77	-0.09	+0.00
6	-0.03	+0.06	-2.23	+2.34
5	-1.78	+1.77	-0.09	+0.00
4	-0.03	+0.06	-2.23	+2.36
3	-1.78	+1.77	-0.09	0.00
2	-0.03	+0.06	-2.23	+2.36
1	-1.76	+1.80	-0.09	-0.01

CV-2

NIVEL	TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	0.00	+0.05	-0.79	+0.77
10	-1.75	+1.80	-0.07	+0.02
9	+0.02	+0.11	-2.23	+1.92
8	-1.74	+1.82	-0.05	+0.03
7	+0.02	+0.11	-2.23	+1.92
6	-1.74	+1.82	-0.05	+0.03
5	+0.02	+0.11	-2.23	+1.92
4	-1.74	+1.82	-0.05	+0.03
3	+0.03	+0.12	-2.23	+1.92
2	-1.74	+1.82	-0.05	+0.04
1	+0.04	+0.12	-2.24	+1.90

CV-3

NIVEL	TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-0.74	+0.86	-0.84	+0.76
10	-0.03	0.00	+0.05	+0.07
9	-1.68	+1.93	-2.32	+1.88
8	-0.03	0.00	+0.05	+0.08
7	-1.68	+1.93	-2.32	+1.88
6	-0.03	0.00	+0.05	+0.08
5	-1.68	+1.93	-2.32	+1.88
4	-0.05	0.00	+0.05	+0.08
3	-1.68	+1.93	-2.32	+1.88
2	-0.03	0.00	+0.05	+0.08
1	-1.66	+1.95	-2.34	+1.86

CV-4

NIVEL	TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-0.05	-0.03	+0.01	+0.04
10	-1.73	+1.88	-2.32	+2.30
9	-0.08	-0.06	+0.01	+0.06
8	-2.73	+1.88	-2.32	+2.31
7	-0.08	-0.06	+0.01	+0.06
6	-1.73	+1.88	-2.32	+2.31
5	-0.08	-0.06	+0.01	+0.06
4	-1.73	+1.88	-2.32	+2.31
3	-0.08	-0.06	+0.01	+0.06
2	-1.73	+1.88	-2.32	+2.32
1	-0.05	-0.03	+0.01	+0.04

SENTIDO					SENTIDO				
Nivel	TRAMO AB		TRAMO BC		NIVEL	TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}		M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	+3.13	+2.92	+2.92	+3.13	11	-3.13	-2.92	-2.92	3.13
10	+5.83	+4.31	+4.31	+5.83	10	-5.83	-4.31	-4.31	-5.83
9	+5.78	+5.80	+5.80	+5.78	9	-5.78	-5.80	-5.80	-5.78
8	+6.51	+7.28	+7.28	+6.51	8	-6.51	-7.28	-7.28	-6.51
7	+6.92	+6.93	+6.93	+6.92	7	-6.92	-6.93	-6.93	-6.92
6	+6.42	+5.97	+5.97	+6.42	6	-6.42	-5.97	-5.97	-6.42
5	+6.45	+6.51	+6.51	+6.45	5	-6.45	-6.51	-6.51	-4.45
4	+5.61	+4.13	+4.13	+5.61	4	-5.61	-4.13	-4.13	-5.61
3	+4.71	+3.25	+3.25	+4.71	3	-4.71	-3.25	-3.25	-4.71
2	+4.00	+4.07	+4.07	+4.00	2	-4.00	-4.07	-4.07	-4.00
1	+2.33	+2.62	+2.62	+2.33	1	-2.33	-2.62	-2.62	-2.33

ENVOLVENTES DE MOMENTOS

Según el A.C.I. se usan las siguientes combinaciones

1.- 1.5CM + 1.8CV

2.- 0.9CM + 1.1 SISMO

3.- 1.25CM + CV + S

PRIMERA COMBINACION

Nivel	1.5 CM				1.8CV-1				ENVOLVENTES:1.5CM+1.8CV			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-5.31	+5.64	-5.67	+5.31	-1.43	+1.37	-0.10	+0.01	-6.74	+7.01	-5.87	5.32
10	-9.41	+9.54	-10.19	+10.41	-0.03	+0.12	-4.01	+4.24	-9.44	+9.66	-14.2	+14.65
9	-8.12	+8.48	-8.93	+8.25	-3.21	+3.18	-0.16	+0.01	-11.33	+11.6	-9.09	+8.26
8	-9.38	+9.56	-10.21	+10.37	-0.05	+0.11	-4.02	+4.22	-9.43	+9.67	-14.23	+14.59
7	-8.12	+8.48	-8.93	+8.25	-3.21	+3.18	-0.16	+0.01	-11.33	+11.66	-9.09	+8.26
6	-9.38	+9.56	-10.21	+10.37	-0.05	+0.11	-4.02	+4.22	-9.43	+9.67	-14.23	+14.59
5	-8.12	+8.48	-8.93	+8.25	-3.21	+3.18	-0.16	+0.01	-11.33	+11.06	-9.09	+8.26
4	-9.38	+9.56	-10.21	+10.37	-0.05	+0.11	-4.01	+4.24	-9.43	+9.67	-14.23	+14.61
3	-8.12	+8.48	-8.95	+8.25	-3.21	+3.18	-0.16	+0.01	-11.33	+11.66	-9.11	+8.26
2	-9.42	+9.45	-10.19	+10.41	-0.05	+0.11	-4.01	+4.24	-9.47	+9.55	-14.20	+14.65
1	-7.91	+8.60	-9.03	+8.06	-3.16	+3.22	-0.16	-0.02	-11.07	+11.82	-9.16	+8.04

Nivel	1.5CM				1.8CV-2				ENVOLVENTES 1.5CM+1.8CV			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{CB}	M_{BC}
11	-5.31	+5.64	-5.67	+5.31	0.00	+0.09	-1.42	+1.39	-5.31	+5.73	-7.09	+6.90
10	-9.41	+9.54	-10.19	+10.41	-3.15	+3.24	-0.12	+0.03	-12.56	+12.78	-10.31	+10.44
9	-8.12	+8.48	-8.93	+8.25	+0.04	+0.20	-4.01	+3.46	-8.08	+8.68	-12.94	+11.71
8	-9.38	+9.56	-10.21	+10.37	-3.14	+3.26	-0.09	+0.06	-12.52	+12.82	-10.30	+10.41
7	-8.12	+8.48	-8.93	+8.25	+0.04	+0.20	-4.01	+3.46	-8.08	+8.68	-12.94	+11.71
6	-9.38	+9.56	-10.21	+10.37	-3.14	+3.26	-0.09	+0.06	-12.52	+12.82	-10.30	+10.43
5	-8.12	+8.48	-8.93	+8.29	+0.04	+0.20	-4.01	+3.46	-8.08	+8.68	-12.94	+11.71
4	-9.38	+9.56	-10.21	+10.37	-3.14	+3.26	-0.09	+0.06	-12.52	+12.82	-10.30	+10.43
3	-8.12	+8.48	-8.95	+8.25	+0.06	+0.21	-4.01	+3.46	-8.06	+8.69	-12.96	+11.71
2	-9.42	+9.54	-10.19	+10.41	-3.14	+3.26	-0.08	+0.08	-12.56	+12.80	-10.27	+10.49
1	-7.91	+8.60	-9.03	+8.06	+0.08	+0.22	-4.03	+3.42	-7.83	+8.82	+13.06	+11.48

NIVEL	1.5CM				1.8CV-3				ENVOLVENTES 1.5CM+1.8CV			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-5.31	+5.64	- 5.67	+5.31	-1.33	+1.54	-1.49	+1.37	-6.64	+7.18	-7.16	+6.68
10	-9.41	+9.54	-10.19	+10.41	-0.05	-0.01	+0.08	+0.13	-9.46	+9.53	-10.11	+10.54
9	-8.12	+8.48	-8.93	+8.25	-3.03	+3.48	-4.18	+3.39	-11.15	+11.96	-13.11	+11.64
8	-9.38	+9.56	-10.21	+10.37	-0.05	-0.01	+0.09	+0.15	-9.43	+9.55	-10.12	+10.52
7	-8.12	+8.48	-8.93	+8.25	-3.03	+3.48	-4.18	+3.39	-11.15	+11.96	-13.11	+11.64
6	-9.38	+9.56	- 10.21	+10.37	-0.05	-0.01	+0.09	+0.15	-9.43	+9.55	-10.12	+10.52
5	-8.12	+8.48	-8.93	+8.25	-3.03	+3.48	-4.18	+3.39	-11.15	+11.96	-13.11	+11.64
4	-9.38	+9.56	-10.21	+10.37	-0.05	-0.01	+0.09	+0.15	-9.43	+9.55	-10.12	+10.52
2	-9.42	+9.54	-10.19	+10.41	-0.05	-0.01	+0.09	+0.15	-9.47	+9.53	-10.10	+10.56
1	-7.91	+8.60	-9.03	+8.06	-2.99	+3.50	-4.20	+3.35	-10.90	+12.10	-13.23	+11.41

Ni	1.5CM				1.8CV-4				ENVOLVENTES 1.5CM+1.8CV			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
Vel	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-5.31	+5.64	-5.67	+5.31	-0.09	-0.06	+0.02	+0.07	-5.40	+5.58	-5.65	+5.38
10	-9.41	+9.54	-10.19	+10.41	-3.12	+3.39	-4.18	+4.15	-12.52	+12.93	-14.37	+14.56
9	-8.12	+8.48	-8.93	+8.25	-0.14	-0.10	+0.02	+0.10	-8.26	+8.38	-8.91	+8.35
8	-9.38	+9.56	-10.21	+10.37	-3.11	+3.41	-4.17	+4.16	-12.49	+12.97	-14.38	+14.53
7	-8.12	+8.48	-8.93	+8.25	-0.14	-0.10	+0.02	+0.10	-8.26	+8.38	-8.91	+8.35
6	-9.38	+9.56	-10.21	+10.37	-3.11	+3.41	-4.17	+4.16	-12.49	+12.97	-14.38	+14.53
5	-8.12	+8.48	-8.93	+8.25	-0.14	-0.10	+0.02	+0.10	-8.26	+8.38	-8.91	+8.35
4	-9.38	+9.56	-10.21	+10.37	-3.12	+3.39	-4.19	+4.15	-12.49	+12.95	-14.40	+14.52
3	-8.12	+8.48	-8.95	+8.25	-0.14	-0.10	+0.02	+0.10	-8.26	+8.38	-8.93	+8.35
2	-9.42	+9.54	-10.19	+10.41	-3.12	+3.39	-4.18	+4.17	-12.54	+12.93	-14.37	+14.58
1	-7.91	+8.60	-9.03	+8.06	-0.09	-0.06	+0.02	+0.07	-8.00	+8.54	-9.01	+8.13

SEGUNDA COMBINACION : 0.9CM + 1.1 SISMO

N.	C.M.				SISMO →				0.9CM				1.1 SISMO →				0.9CM+1.1S →			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-3.54	+3.76	-3.78	+3.54	+3.13	+2.92	+2.92	+3.13	-3.18	+3.38	-3.40	+3.18	+3.44	+3.21	+3.21	+3.44	+0.26	+ 6.59	-0.19	+6.62
10	-6.27	+6.36	-6.79	+6.95	+5.83	+4.31	+4.31	+5.83	-5.65	+5.74	-6.10	+6.25	+6.41	+4.75	+4.75	+6.41	+0.76	+10.49	-1.35	+12.66
9	-5.41	+5.66	-5.95	+5.50	+5.78	+5.80	+5.80	+5.78	-4.88	+5.10	-5.35	+4.95	+6.35	+6.38	+6.38	+6.35	+1.47	+11.48	+1.03	+11.30
8	-6.25	+6.38	-6.80	+6.92	+6.51	+7.28	+7.28	+6.51	-5.64	+5.75	-6.12	+6.23	+7.16	+8.00	+8.00	+7.16	+1.52	+13.75	+1.88	+13.39
7	-5.41	+5.66	-5.95	+5.50	+6.92	+6.93	+6.93	+6.92	-4.88	+5.10	-5.35	+4.95	+7.60	+7.61	+7.61	+7.60	+2.72	+12.71	+2.26	+12.55
6	-6.25	+6.38	-6.80	+6.92	+6.42	+5.97	+5.97	+6.42	-5.64	+5.75	-6.12	+6.23	+7.05	+6.56	+6.56	+7.05	+1.41	+12.31	+0.44	+13.28
5	-5.41	+5.66	-5.95	+5.50	+6.45	+6.51	+6.51	+6.45	-4.88	+5.10	-5.35	+4.95	+7.10	+7.16	+7.16	+7.10	+2.22	+12.26	+1.81	+12.05
4	-6.29	+6.38	-6.80	+6.92	+5.61	+4.13	+4.13	+5.61	-5.64	+5.75	-6.12	+6.23	+6.16	+4.54	+4.54	+6.16	+0.52	+10.29	-1.58	+12.39
3	-5.41	+5.66	-5.97	+5.50	+4.71	+3.25	+3.25	+4.71	-4.88	+5.10	+5.10	+4.95	+5.18	+3.57	+3.57	+5.18	+0.30	+8.85	-1.80	+10.13
2	-6.27	+6.36	-6.79	+6.95	+4.00	+4.07	+4.07	+4.00	-5.65	+5.74	-6.10	+6.25	+4.30	+4.48	+4.48	+4.30	-1.35	+10.22	-1.62	+10.55
1	-5.28	+5.73	-6.02	+5.38	+2.33	+2.62	+2.62	+2.33	-4.75	+5.16	-5.41	+4.85	+2.45	+2.88	+2.88	+2.45	-2.30	+8.04	-2.53	+7.30

0.9CM + 1.1 SISMO ←

N	CM				SISMO ←				0.9CM.				1.1 SISMO ←				0.9CM+1.1 SISMO←			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-3.54	+3.76	-3.78	+3.54	-3.13	-2.92	-2.92	-3.13	-3.18	+3.38	-3.40	+3.18	-3.44	-3.21	-3.21	-3.44	-6.62	+0.17	-6.61	-0.26
10	-6.27	+6.36	-6.79	+6.95	-5.83	-4.31	-4.31	-3.83	-5.65	+5.74	-6.10	+6.25	-6.41	-4.75	-4.75	-6.41	-11.96	+0.99	-10.85	-0.16
9	-5.41	+5.66	-5.95	+5.50	-5.78	-5.80	-5.80	-5.78	-4.88	+5.10	-5.35	+4.95	-6.35	-6.38	-6.38	-6.35	-11.23	-1.24	-11.73	-1.40
8	-6.25	+6.38	-6.80	+6.92	-6.51	-7.28	-7.28	-6.51	-5.64	+5.75	-6.12	+6.23	+7.16	-8.00	-8.00	-7.16	-12.80	-2.25	-14.12	-0.93
7	-5.41	+5.66	-5.95	+5.50	-6.92	-6.93	-6.93	-6.92	-4.88	+5.10	-5.35	+4.95	-7.60	-7.61	-7.61	-7.60	-12.48	-2.51	-12.96	-2.65
6	-6.25	+6.38	-6.80	+6.92	-6.42	-5.97	-5.97	-6.42	-5.64	+5.75	-6.12	+6.23	-7.05	-6.56	-6.56	-7.05	-12.69	-0.81	-12.68	-0.82
5	-5.41	+5.66	-5.95	+5.50	-6.45	-6.51	-6.51	-6.45	-4.88	+5.10	-5.35	+4.95	-7.10	-7.16	-7.16	-7.10	-11.98	-2.06	-12.51	-2.15
4	-6.25	+6.38	-6.80	+6.92	-5.61	-4.13	-4.13	-5.61	-5.64	+5.75	-6.12	+6.23	-6.16	-4.54	-4.54	-6.16	-11.80	+1.21	-10.66	+0.07
3	-5.41	+5.66	-5.97	+5.50	-4.71	-3.25	-3.25	-4.71	-4.88	+5.10	-5.37	+4.95	-5.18	-3.57	-3.57	-5.18	-10.06	+1.53	-8.92	-0.23
2	-6.27	+6.36	-6.79	+6.95	-4.00	-4.07	-4.07	-4.00	-5.65	+5.74	-6.10	+6.25	-4.30	-4.48	-4.48	-4.30	-9.95	+1.26	-10.58	+1.95
1	-5.28	+5.73	-6.02	+5.38	-2.33	-2.62	-2.62	-2.33	-4.75	+5.16	-5.41	+4.85	-2.45	-2.88	-2.88	-2.45	-7.20	+2.28	-8.29	+2.40

TERCERA COMBINACION: 1.25 (CM+CV+$\overleftarrow{S}$)

N	C.M.				CV-1				$\overrightarrow{S}$				Σ=CM+CV-1+$\overrightarrow{S}$				1.25(CM+CV-1+$\overrightarrow{S}$)			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-3.54	+3.76	-3.78	+3.54	-0.80	+0.76	-0.06	+0.00	+3.13	+2.92	+2.92	+3.13	-1.21	+7.44	-0.92	+6.67	-1.51	+9.3	-1.15	+8.33
10	-6.27	+6.36	-6.79	+6.95	-0.02	+0.07	-2.23	+2.36	+5.85	+4.31	+4.31	+5.83	-0.46	+10.7	-4.71	+15.14	-0.58	+13.9	-5.90	+18.90
9	-5.41	+5.66	-5.95	+5.50	-1.78	+1.77	-0.09	+0.00	+5.78	+5.80	+5.80	+5.78	-1.41	+13.23	-0.24	+11.3	-1.76	+16.5	-0.30	+14.10
8	-6.25	+6.38	-6.80	+6.92	-0.03	+0.06	-2.23	+2.34	+6.51	+7.28	+7.28	+6.51	+0.23	+13.72	-1.75	+15.8	-0.29	+17.2	-2.18	+19.70
7	-5.41	+5.66	-5.95	+5.50	-1.78	+1.77	-0.09	+0.00	+6.92	+6.93	+6.93	+6.92	-0.27	+14.4	+0.89	+12.4	-0.34	+17.9	+1.11	+15.52
6	-6.25	+6.38	-6.80	+6.92	-0.03	+0.06	-2.23	+2.34	+6.42	+5.97	+5.97	+6.42	+0.14	+12.4	-3.06	+15.7	+0.18	+15.5	-3.82	+19.6
5	-5.41	+5.66	-5.95	+5.50	-1.78	+1.77	-0.09	+0.00	+6.45	+6.51	+6.51	+6.45	-0.74	+13.9	+0.47	+11.9	-0.92	+17.4	+0.59	+14.90
4	-6.25	+6.38	-6.80	+6.92	-0.03	+0.06	-2.23	+2.36	+5.61	+4.13	+4.13	+5.61	-0.67	+10.5	-4.90	+14.9	-0.84	+13.2	-6.12	+18.60
3	-5.41	+5.66	-5.97	+5.50	-1.78	+1.77	-0.09	+0.00	+4.71	+3.25	+3.25	+4.71	+2.48	+10.7	-2.81	+10.2	-3.10	+13.3	-3.52	+12.75
2	-6.27	+6.36	-6.79	+6.95	-0.03	+0.06	-2.23	+2.36	+4.00	+4.07	+4.05	+4.00	-2.30	+10.5	-4.97	+13.3	-2.88	+13.1	-6.2	+16.65
1	-5.28	+5.73	-6.02	+5.38	-1.76	+1.80	-0.09	-0.01	+2.33	+2.62	+2.62	+2.33	-4.71	+10.1	-3.49	+7.70	-5.90	+12.7	-4.36	+ 9.62

1.25 (CM+CV-1+S)

N	CM				CV-1				SISMO ←				(CM+CV-1+S←)				1.25(CM+CV+1+S)			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-3.54	+3.76	-3.78	+3.54	-0.80	+0.76	-0.06	+0.00	-3.13	-2.92	-2.92	-3.13	-7.47	+1.60	-6.76	+0.41	-9.35	+2.00	-8.45	+0.51
10	-6.27	+6.36	-6.79	+6.95	-0.02	+0.07	-2.23	+2.36	+5.83	+4.31	+4.31	+5.83	-0.46	+10.7	-4.71	+15.1	-0.58	+13.9	-5.90	+18.9
9	-5.41	+5.66	-5.95	+5.50	-1.78	+1.77	-0.09	+0.00	+5.78	+5.80	+5.80	+5.78	-1.41	+13.2	-0.24	+11.2	-1.76	+16.5	-0.30	+14.1
8	-6.25	+6.38	-6.80	+6.92	-0.03	+0.06	-2.23	+2.34	+6.51	+7.28	+7.28	+6.51	+0.23	+13.7	-1.75	+15.7	-0.29	+17.2	-2.18	+19.7
7	-5.41	+5.66	-5.95	+5.50	-1.78	+1.77	-0.09	+0.00	+6.92	+6.93	+6.93	+6.92	-0.27	+14.3	+0.89	+12.4	-0.34	+17.9	+1.1	+15.5
6	-6.25	+6.38	-6.80	+6.92	-0.03	+0.06	-2.23	+2.34	+6.42	+5.97	+5.99	+6.42	+0.14	+12.4	-3.06	+15.6	+0.18	+15.5	-3.82	+19.6
5	-5.41	+5.66	-5.95	+5.50	-1.78	+1.77	-0.09	+0.00	+6.45	+6.51	+6.51	+6.45	-0.74	+13.9	+0.47	+11.9	-0.92	+17.4	+0.59	+14.9
4	-6.25	+6.38	-6.80	+6.92	-0.03	-0.06	-2.23	+2.36	+5.61	+4.13	+4.13	+5.61	-0.67	+10.5	-4.90	+14.8	-0.84	+13.2	-6.12	+18.6
3	-5.41	+5.66	-5.97	+5.50	-1.78	+1.77	-0.09	+0.00	+4.71	+3.25	+3.25	+4.71	-2.88	+10.6	-2.81	+10.2	-3.10	+13.3	-3.52	+12.7
2	-6.27	+6.36	-6.79	+6.95	-0.03	+0.06	-2.23	+2.36	+4.00	+4.07	+4.05	+4.00	-2.30	+10.4	-4.97	+13.3	-2.88	+13.1	-6.20	+16.6
1	-5.28	+5.73	-6.02	+5.38	-1.76	+1.80	-0.09	-0.01	+2.33	+2.62	+2.62	+2.33	-4.71	+10.1	-3.49	+ 7.7	-5.90	+12.7	-4.36	+9.62

$1.25(CM + CV - 1 + S)$

N	CM				CV-1				SISMO ←				Σ(CM+CV-1+S ←)				1.25(CM+CV-1+S) ←			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-3.54	+3.76	-3.78	+3.54	-0.80	+0.76	-0.06	+0.00	-3.13	-2.92	-2.92	-3.13	-7.47	+1.60	-6.76	+0.41	-9.35	+2.00	-8.45	+0.51
10	-6.27	+6.36	-6.79	+6.95	-0.02	+0.07	-2.23	+2.36	-5.83	-4.31	-4.31	-5.83	-12.12	+2.12	-133	+3.48	-15.1	+2.65	-16.7	+4.35
9	-5.41	+5.66	-5.95	+5.50	-1.78	+1.77	-0.09	+0.00	-5.78	-5.80	-5.80	-5.78	-12.9	+1.63	-11.8	-0.28	-16.2	+2.04	-14.8	-0.35
8	-6.35	+6.38	-6.80	+6.92	-0.03	+0.06	-2.23	+2.34	-6.51	-7.28	-7.28	-6.51	-12.8	-0.84	-16.3	+2.75	-16.0	-0.10	-20.4	-3.44
7	-5.41	+5.66	-5.95	+5.50	-1.78	+1.77	-0.09	+0.00	-6.92	-6.93	-6.93	-6.92	-14.1	+0.50	-12.9	-1.42	-17.6	+0.62	-16.2	-1.77
6	-6.25	+6.38	-6.80	+6.92	-0.03	+0.06	-2.23	+2.34	-6.42	-5.97	-5.97	-6.42	-12.7	+0.45	-15.0	+2.84	-15.9	+0.56	-18.8	+3.55
5	-5.41	+5.66	-5.95	+5.50	-1.78	+1.77	-0.09	+0.00	-6.45	-6.51	-6.51	-6.45	-13.64	+0.92	-12.5	-0.95	-17.1	+1.15	-15.7	-1.19
4	-6.25	+6.38	-6.80	+6.92	-0.03	+0.06	-2.23	+2.36	-5.61	-4.13	-4.13	-5.61	-11.8	+2.31	-13.1	+3.67	-14.8	+2.89	-16.4	+4.59
3	-5.41	+5.66	-5.97	+5.50	-1.78	+1.77	-0.09	+0.00	-4.71	-3.25	-3.25	-4.71	-11.9	+4.18	-9.31	+0.79	-14.9	+5.2	-11.6	+0.99
2	-6.27	+6.38	-6.79	+6.95	-0.03	+0.06	-2.23	+2.36	-4.00	-4.07	-5.05	-4.00	-10.3	+2.37	-13.1	+5.31	-12.9	+2.96	-16.3	+6.65
1	-5.28	+5.73	-6.02	+5.38	-1.76	+1.80	-0.09	-0.01	-2.33	-2.62	-2.62	-2.33	-9.27	+4.91	-8.34	+2.04	-11.6	+6.15	-10.4	+2.55

N	CM				CV-2				SISMO ←				(CM+CV-2+S←)				1.25(CM+CV+S←)			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-3.54	+3.76	-3.78	+3.54	0.00	+0.05	-0.79	+0.77	-3.13	-2.92	-2.92	-3.13	-6.67	+0.89	-7.49	+1.18	-8.34	+1.11	-9.35	+1.47
10	-6.27	+6.36	-6.79	+6.95	-1.75	+1.80	-0.07	+0.02	-5.83	-4.31	-4.31	-5.83	-13.8	+3.85	-11.2	+1.14	-17.3	+4.81	-13.9	+1.42
9	-5.41	+5.66	-5.95	+5.50	+0.02	+0.11	-2.23	+1.92	-5.78	-5.80	-5.80	-5.78	-11.2	-0.03	-13.9	+1.64	-13.9	-0.04	-17.9	+2.04
8	-6.25	+6.38	-6.80	+6.92	-1.74	+1.82	-0.05	+0.03	-6.51	-7.28	-7.28	-6.51	-14.5	+0.92	-14.1	+0.44	-18.1	+1.15	-17.6	+0.55
7	-5.41	+5.66	-5.95	+5.50	+0.02	+0.11	-2.23	+1.92	-6.92	-6.93	-6.93	-6.92	-12.3	-1.16	-15.1	+0.50	-15.4	-1.45	-18.9	+0.62
6	-6.25	+6.38	-6.90	+6.92	-1.74	+1.82	-0.05	+0.03	-6.42	-5.97	-5.97	-6.42	-14.4	+2.23	-12.8	+0.53	-17.9	+2.79	-16.0	+0.66
5	-5.41	+5.66	-5.95	+5.50	+0.02	+0.11	-2.23	+1.92	-6.45	-6.51	-6.51	-6.45	-11.8	-0.74	-14.7	+0.97	-14.8	-0.93	-18.3	+1.21
4	-6.25	+6.38	-6.80	+6.92	-1.74	+1.82	-0.05	+0.03	-5.61	-4.13	-4.13	-5.61	-13.6	+4.07	-10.9	+1.34	-17.0	+5.09	-13.7	+1.67
3	-5.41	+5.66	-5.97	+5.50	+0.03	+0.12	-2.23	+1.92	-4.71	-3.25	-3.25	-4.71	-10.0	+2.53	-11.4	+2.71	-12.5	+3.16	-14.3	+3.38
2	-6.27	+6.36	-6.79	+6.95	-1.74	+1.82	-0.05	+0.04	-4.00	-4.07	-4.07	-4.00	-12.0	+4.11	-10.9	+2.99	-15.0	+5.14	-13.6	+3.73
1	-5.28	+5.73	-6.02	+5.38	+0.04	+0.12	-2.24	+1.90	-2.33	-2.62	-2.62	-2.33	-7.57	+3.23	-10.8	+4.95	-9.46	+4.04	-13.6	+6.18

N	CM				CV-3				SISMO →				Σ (CM+CV-3+S→)				1.25 (CM+CV-3+S→)			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-3.54	+3.76	-3.78	+3.54	-0.73	+0.86	-0.84	+0.76	-3.13	+2.92	+2.92	+3.13	-1.14	+7.54	-1.70	+7.43	-1.43	+9.42	-2.12	+9.27
10	-6.27	+6.36	-6.79	+6.95	-0.03	+0.00	+0.05	+0.07	+5.83	+4.31	+4.31	+5.83	-0.47	+10.7	-2.43	+12.8	-0.59	+13.3	-3.04	+16.1
9	-5.41	+5.66	-5.95	+5.50	-1.68	+1.93	-2.32	+1.88	+5.78	+5.80	+5.80	+5.78	-1.31	+13.4	-2.47	+13.2	-1.64	+16.7	-3.08	+16.45
8	-6.25	+6.38	-6.80	+6.92	-0.03	+0.00	+0.05	+0.08	+6.51	+7.28	+7.28	+6.51	+0.23	+13.6	+0.53	+13.5	+0.29	+17.1	+0.66	+16.9
7	-5.41	+5.66	-5.95	+5.50	-1.68	+1.93	-2.32	+1.88	+6.92	+6.93	+6.93	+6.92	-0.17	+14.5	-1.84	+14.3	-0.21	+18.2	-1.68	+17.90
6	-6.25	+6.38	-6.80	+6.92	-0.03	+0.00	+0.05	+0.08	+6.42	+5.97	+5.97	+6.42	+0.14	+12.35	-0.78	+13.4	+0.18	+15.4	-0.93	+16.8
5	-5.41	+5.66	-5.95	+5.50	-1.68	+1.93	-2.32	+1.88	+6.45	+6.51	+6.51	+6.45	-0.64	+14.1	-1.76	+13.8	-0.80	+17.6	-2.20	+17.3
4	-6.25	+6.38	-6.80	+6.92	-0.03	+0.00	+0.05	+0.08	+5.61	+4.13	+4.13	+5.61	-0.67	+10.5	-2.62	+12.6	-0.84	+13.2	-3.28	+15.8
2	-5.41	+5.66	-5.95	-0.03	+0.00	+0.05	+0.08	+4.00	+4.07	+4.07	+4.00	-2.30	+10.4	-2.67	+11.0	-2.88	+13.0	-3.34	+13.8	+13.80
1	-5.28	+5.73	-6.02	+5.30	-1.66	+1.95	-2.34	+1.86	+2.33	+2.62	+2.62	+2.33	-4.16	+10.3	-5.74	+9.49	-5.20	+12.9	-7.16	+11.85

N	CM.				CV-3				SISMO ←				Σ(CM+CV-3+S←)				1.25(CM+CV-3+S←)			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-3.54	+3.76	-3.78	+3.54	-0.73	+0.86	-0.84	+0.76	-3.13	-2.92	-2.92	-3.13	-7.40	+1.70	-7.54	+1.17	-9.25	+2.12	-9.40	+1.46
10	-6.27	+6.36	-6.79	+6.95	-0.03	+0.00	+0.05	+0.07	-5.83	-4.31	-4.31	-5.83	-12.1	+2.05	-11.0	+1.19	-15.1	+2.56	-13.8	+1.48
9	-5.41	+5.66	-5.95	+5.50	-1.68	+1.93	-2.32	+1.88	-5.78	-5.80	-5.80	-5.78	-12.8	+1.79	-14.0	+1.60	-16.1	+2.24	-17.5	+2.0
8	-6.25	+6.38	-6.80	+6.92	-0.03	+0.-0	+0.05	+0.08	-6.51	-7.28	-7.28	-6.51	-12.9	-0.90	-14.0	+0.49	-16.2	+1.12	-17.5	+0.61
7	-5.41	+5.66	-5.95	+5.50	-1.68	+1.93	-2.32	+1.88	-6.92	-6.93	-6.93	-6.92	-14.0	+0.66	-15.2	+0.46	-17.5	+0.82	-19.0	+0.57
6	-6.25	+6.38	-6.80	+6.92	-0.03	+0.00	+0.05	+0.08	-6.42	-5.97	-5.97	-6.42	-12.7	+0.41	-12.7	+0.57	-15.9	+0.51	-15.9	+0.71
5	-5.41	+5.66	-5.95	+5.50	-1.68	+1.93	-2.32	+1.88	-6.45	-6.51	-6.51	-6.45	-13.5	+1.08	-14.7	+0.93	-16.9	+1.35	-18.4	+1.16
4	-6.25	+6.38	-6.80	+6.92	-0.03	+0.00	+0.05	+0.88	-5.61	-4.13	-4.13	-5.61	-11.8	+2.25	-10.8	+1.39	-14.8	+2.82	-13.6	+1.73
3	-5.41	+5.66	-5.95	+5.50	-1.68	+1.93	-2.32	+1.88	-4.71	-3.25	-3.25	-4.71	-11.8	+4.34	-11.5	+2.67	-14.7	+5.32	-14.4	+3.34
2	-6.27	+6.36	-6.79	+6.95	-0.03	+0.00	+0.05	+0.88	-4.00	-4.07	-4.07	-4.00	-10.3	+2.29	-10.8	+3.03	-12.9	+2.86	-13.5	+3.78
1	-5.28	+5.73	-6.02	+5.38	-1,66	+1.95	-2.34	+1.86	-2.33	-2.62	-2.62	-2.33	-9.27	+5.06	-10.9	+4.91	-11.6	+6.33	-13.7	+6.14

N	CM				CV-4				SISMO →				(CM+CV-4+S→)				1.25(CM+CV-4+S→)			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BC}	M_{BC}	M_{CB}
11	-3~54	+3.76	-3.78	+3.54	-0.05	-0.03	+0.01	+0.04	+3.13	+2.92	+2.92	+3.13	-0.46	+6.65	-0.85	+6.71	-0.58	+8.30	-1.06	+8.40
10	-6~27	+6.36	-6.79	+6.95	-1.73	+1.88	-2.32	+2.30	+5.83	+4.31	+4.31	+5.83	-2.17	+12.55	-4.80	+15.0	-2.72	+15.7	-6.00	+18.8
9	-5~41	+5.66	-5.95	+5.50	-0.08	-0.06	+0.01	+0.06	+5.78	+5.80	+5.80	+5.78	+0.29	+11.40	-0.14	+11.3	+0.36	+14.2	-1.18	+14.2
8	-6.25	+6.38	-6.80	+6.92	-1.73	+1.88	-2.32	+2.31	+6.51	+7.28	+7.28	+6.51	-1.47	+15.5	-1.84	+15.7	-1.84	+19.4	-2.30	+19.7
7	-5.41	+5.66	-5.95	+5.50	-0.08	-0.06	+0.01	+0.06	+6.92	+6.93	+6.93	+6.92	+1.43	+12.5	+0.99	+12.4	+1.79	+15.7	+1.24	+15.6
6	-6.25	+6.38	-6.80	+6.92	-1.73	+1.88	-2.32	+2.31	+6.42	+5.97	+5.97	+6.42	-1.56	+14.2	-3.15	+15.7	-1.95	+17.3	-3.94	+19.5
5	-5.41	+5.66	-5.95	+5.50	-0.08	-0.06	+0.01	+0.06	+6.45	+6.51	+6.51	+6.45	+0.96	+12.1	+0.57	+12.4	+1.20	+15.1	+0.71	+15.0
4	-6.27	+6.38	-6.8	+6.92	-1.73	+1.88	-2.32	+2.31	+5.61	+4.13	+4.13	+5.61	-2.37	+12.3	-4.99	+14.6	-2.96	+15.5	-6.24	+18.5
3	-.541	+5.66	-5.95	+5.50	-0.08	-0.06	+0.01	+0.06	+4.71	+4.35	+4.35	+4.71	-0.78	+8.85	-2.71	+10.2	-0.98	+11.0	-3.49	+12.8
2	-.627	+6.36	-6.8	+6.95	-1.73	+1.88	-2.32	+2.32	+4.00	+4.07	+4.07	+4.00	-4.00	+12.3	-5.04	+13.2	-5.0	+15.4	-6.30	+16.6
1	-5.28	+5.73	-6.02	+5.38	-0.05	-0.03	+0.01	+0.04	+2.33	+2.62	+2.62	+2.33	-3.00	+8.32	-3.39	+7.75	-3.75	+10.4	-4.24	+9.70

N	CM				CV-4				SISMO←				CM+CV-4+S ←				1.25(CM+CV-4+S←)			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-3.54	+3.76	-3.78	+3.54	-0.05	-0.03	+0.01	+0.04	-3.13	-2.92	-2.92	-3.13	-6.72	+0.81	-6.69	+0.45	-7.85	+0.10	-8.35	+0.56
10	-6.27	+6.36	-6.79	+6.95	-1.73	+1.88	-2.32	+2.30	-5.83	-4.31	-4.31	-5.83	-13.8	+3.93	-13.4	+3.43	-17.3	+4.91	-16.8	+4.29
9	-5.41	+5.66	-5.95	+5.50	-0.08	-0.06	+0.01	+0.06	-5.78	-5.80	-5.80	-5.78	-11.2	-0.20	-11.8	-0.22	-14.1	-0.25	-14.8	-0.28
8	-6.25	+6.38	-6.80	+6.92	-1.73	+1.88	-2.32	+2.31	-6.51	-7.28	-7.80	-6.51	-14.4	+0.98	-16.4	+2.72	-18.1	+1.22	-20.5	+3.40
7	-5.41	+5.66	-5.95	+5.50	-0.08	-0.06	+0.01	+0.06	-6.92	-6.93	-6.93	-6.92	-12.4	1.21	-12.8	-1.36	-15.5	-1.51	-16.1	-1.70
6	-6.25	+6.38	-6.80	+6.92	-1.73	+1.88	-2.32	+2.31	-6.42	-5.97	-5.97	-6.42	-14.4	+2.29	-15.0	+2.81	-18.0	+2.86	-18.8	+3.52
5	-5.41	+5.66	-5.95	+5.50	-0.08	-0.06	+0.01	+0.06	-6.45	-6.51	-6.51	-6.45	-11.9	-0.91	-13.4	-0.89	-14.9	-1.14	-16.8	-1.11
4	-6.25	+6.38	-6.80	+6.92	-1.73	+1.88	-2.32	+2.31	-5.61	-4.13	-4.13	-5.61	-13.5	+4.13	-13.2	+3.62	-17.0	+5.16	-16.6	+4.52
3	-5.41	+5.66	-5.97	+5.50	-0.08	-0.06	+0.01	+0.06	-4.71	-3.25	-3.25	-4.71	-10.2	+2.47	-9.21	+0.85	-12.7	+3.09	-11.5	+1.06
2	-6.27	+6.36	-6.79	+6.95	-1.73	+1.88	-2.32	+2.32	-4.00	-4.07	-4.07	-4.00	-12.0	+4.17	-13.1	+5.27	-15.0	+5.20	-16.4	+6.59
1	-5.28	+5.73	-6.02	+5.38	-0.05	-0.03	+0.01	+0.04	-2.33	-2.62	-2.62	-2.33	-7.6	+3.08	-8.63	+3.09	-9.56	3.85	-10.8	+3.86

PORTICO DE ARRIOSTRE :(A)

MOMENTOS EN VIGAS DE DIAGRAMA DE KANI:

1.5CM.

Piso	TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5	
	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}	M_{3-4}	M_{4-3}	M_{4-5}	M_{5-4}
11	-0.25	+0.41	-0.42	+0.36	-0.37	+0.40	-0.36	+0.39
10	-0.23	+0.38	-0.70	+0.88	-0.88	+0.72	-0.39	+0.22
9	-0.56	+0.71	-0.75	+0.66	-0.67	+0.73	-0.65	+0.71
8	-0.23	+0.38	-0.70	+0.88	-0.87	+0.72	-0.37	+0.22
7	-0.56	+0.71	-0.75	-0.66	-0.67	+0.73	-0.65	+0.71
6	-0.23	+0.38	-0.70	+0.88	-0.87	+0.72	-0.37	+0.22
5	-0.56	+0.71	-0.75	+0.66	-0.67	+0.73	-0.65	+0.71
4	-0.23	+0.38	-0.70	+0.88	-0.87	+0.72	-0.37	+0.22
3	-0.56	+0.71	-0.75	+0.66	-0.67	+0.73	-0.65	+0.71
2	-0.23	+0.38	+0.70	+0.88	-0.87	+0.72	-0.37	+0.22
1	-0.53	+0.74	-0.73	+0.68	-0.68	+0.71	-0.65	+0.68

Luego haré un cuadro de los momentos por C.M. pero sin afectarlo por el coeficiente 1.5, tenemos así:

CM.

Piso	TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5	
	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}	M_{3-4}	M_{4-3}	M_{4-5}	M_{5-4}
11	-0.17	+0.27	-0.28	+0.24	-0.25	+0.37	-0.25	+0.26
10	-0.15	+0.25	-0.47	+0.59	-0.59	+0.48	-0.26	+0.15
9	-0.37	+0.47	-0.50	+0.44	-0.45	+0.49	-0.43	+0.47
8	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15
7	-0.37	+0.47	-0.50	+0.44	-0.45	+0.49	-0.43	+0.47
6	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15
5	-0.37	+0.47	-0.50	+0.44	-0.45	+0.49	-0.43	+0.47
4	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15
3	-0.37	+0.47	-0.50	+0.44	-0.45	+0.41	-0.43	+0.47
2	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15
1	-0.35	+0.49	-0.49	+0.45	-0.45	+0.47	-0.43	+0.45

SISMO →

Piso	TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5	
	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}	M_{3-4}	M_{4-3}	M_{4-5}	M_{5-4}
11	+2.56	+1.92	+1.92	+1.92	+1.92	+1.07	+4.64	+5.51
10	+4.02	+3.36	+3.36	+3.36	+3.36	+2.52	+6.83	+7.40
9	+4.70	+4.09	+4.09	+4.09	+4.09	+2.79	+8.23	+9.00
8	+4.20	+3.78	+3.78	+3.78	+3.78	+2.44	+7.28	+7.98
7	+4.03	+3.19	+3.19	+3.19	+3.19	+2.17	+6.50	+7.15
6	+3.54	+3.17	+3.17	+3.17	+3.17	+2.04	+6.06	+6.64
5	+3.42	+2.77	+2.77	+2.77	+2.77	+1.87	+5.66	+6.24
4	+3.04	+2.41	+2.41	+2.41	+2.41	+1.72	+5.06	+5.56
3	+2.51	+2.13	+2.13	+2.13	+2.13	+1.33	+4.39	+5.13
2	+1.84	+1.61	+1.61	+1.61	+1.61	+1.15	+3.33	+3.66
1	+1.14	+0.92	+0.92	+0.92	+0.92	+0.58	+1.81	+2.02

SISMO ←

Piso	TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5	
	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}	M_{3-4}	M_{4-3}	M_{4-5}	M_{5-4}
11	-2.56	-1.92	-1.92	-1.92	-1.92	-1.07	-4.64	-5.51
10	-4.02	-3.36	-3.36	-3.36	-3.36	-2.52	-6.83	-7.40
9	-4.70	-4.09	-4.09	-4.09	-4.09	-2.79	-8.23	-9.00
8	-4.20	-3.78	-3.78	-3.78	-3.78	-2.44	-7.28	-7.98
7	-4.03	-3.19	-3.19	-3.19	-3.19	-2.17	-6.50	-7.15
6	-3.54	-3.17	-3.17	-3.17	-3.17	-2.04	-6.06	-6.64
5	-3.42	-2.77	-2.77	-2.77	-2.77	-1.87	-5.66	-6.24
4	-3.04	-2.41	-2.41	-2.41	-2.41	-1.72	-5.06	-5.56
3	-2.51	-2.13	-2.13	-2.13	-2.13	-1.33	-4.39	-5.13
2	-1.84	-1.61	-1.61	-1.61	-1.61	-1.15	-3.33	-3.66
1	-1.14	-0.92	-0.92	-0.92	-0.92	-0.58	-1.81	-2.02

ENVOLVENTES DE MOMENTOS.- Como no hay cargas vivas, se utilizaran sólo las siguientes combinaciones. 1.- 0.9CM+1.1 SISMO ⇄
2.- 1.25(CM+SISMO) ⇄

PRIMERA COMBINACION :0.9 CM + 1.1 SISMO →

Piso	0.9 CM								1.1 SISMO →			
	TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3	
	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}	M_{3-4}	M_{4-3}	M_{4-5}	M_{5-4}	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}
11	-0.15	+0.25	-0.25	+0.22	+0.22	+0.24	+0.22	+2.82	+2.02	+2.02	+2.02	+2.02
10	-0.14	+0.23	-0.42	+0.53	-0.53	+0.43	+0.13	+4.42	+3.70	+3.70	+3.07	+3.07
9	-0.34	+0.43	-0.45	+0.40	-0.40	+0.44	+0.43	+5.18	+4.50	+4.50	+4.50	+4.50
8	-0.14	+0.23	-0.42	+0.53	-0.52	+0.43	+0.13	+4.62	+4.16	+4.16	+4.16	+4.16
7	-0.34	+0.43	-0.45	+0.40	-0.40	+0.44	+0.43	+4.44	+3.40	+3.40	+3.40	+3.40
6	-0.14	+0.23	-0.42	+0.53	-0.52	+0.43	+0.13	+3.90	+3.50	+3.50	+3.50	+3.50
5	-0.34	+0.43	-0.45	+0.40	-0.40	+0.44	+0.43	+3.76	+3.05	+3.05	+3.05	+3.05
4	-0.14	+0.23	-0.42	+0.53	-0.52	+0.43	+0.13	+3.34	+2.65	+2.65	+2.65	+2.65
3	-0.34	+0.43	-0.45	+0.40	-0.40	+0.44	+0.43	+3.76	+2.34	+2.34	+2.34	+2.34
2	-0.14	+0.23	-0.42	+0.53	-0.52	+0.43	+0.13	+2.02	+1.77	+1.77	+1.77	+1.77
1	-0.32	+0.44	0.44	+0.41	-0.41	+0.44	+0.41	+1.25	+1.01	+1.01	+1.01	+1.01

PRIMERA COMBINACION: 0.9 CM + 1.1 SISMO →

Piso	1.1 SISMO →				0.9 CM + 1.1 SISMO →							
	TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5	
	M_{3-4}	M_{4-3}	M_{4-5}	M_{5-4}	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}	M_{3-4}	M_{4-3}	M_{4-5}	M_{5-4}
11	+2.02	+1.18	+5.10	+6.06	+2.67	+2.77	+1.77	+2.24	+1.80	+1.42	+4.88	+6.28
10	+3.70	+2.78	+7.50	+8.15	+4.28	+3.93	+3.28	+4.23	+3.17	+3.27	+7.27	+8.28
9	+4.50	+3.07	+9.05	+9.90	+4.84	+4.93	+4.05	+4.90	+4.10	+3.51	+8.66	+10.33
8	+4.16	+2.68	+8.00	+8.80	+4.48	+4.39	+3.74	+4.69	+3.64	+3.11	+7.78	+8.93
7	+3.40+	+2.39	+7.15	+7.86	+4.10	+3.83	+2.95	+3.80	+3.00	+2.89	+6.76	+8.29
6	+3.50	+2.24	+6.66	+7.30	+3.76	+3.73	+3.08	+4.03	+2.98	+2.67	+6.44	+7.43
5	+3.05	+2.06	+6.24	+6.86	+3.42	+3.48	+2.60	+3.45	+2.65	+2.50	+5.85	+6.29
4	+2.65	+1.89	+5.56	+6.12	+3.20	+2.88	+2.23	+3.18	+2.13	+2.32	+5.34	+6.25
3	+2.34	+1.46	+4.83	+5.65	+3.42	+2.77	+1.89	+2.74	+1.94	+1.90	+4.44	+6.08
2	+1.77	+1.26	+3.66	+4.03	+1.88	+2.00	+1.35	+2.30	+1.25	+1.69	+3.44	+4.16
1	+1.01	+0.64	+1.99	+1.99	+0.93	+1.45	+0.57	+1.42	+0.60	+1.07	+1.60	+2.40

PRIMERA COMBINACION: 0.9 CM + 1.1 SISMO ←

Piso	0.9 CM								1.1 SISMO →			
	TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3	
	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}	M_{3-4}	M_{43}	M_{5-4}	M_{4-5}	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}
11	-0.15	+0.25	-0.25	+0.22	-0.22	+0.24	+0.22	-0.22	-2.82	-2.02	-2.02	-2.02
10	-0.14	+0.23	-0.42	+0.53	-0.53	+0.43	+0.13	-0.23	-4.42	-3.70	-3.70	-3.70
9	-0.34	+0.43	-0.45	+0.40	-0.40	+0.44	+0.43	-0.39	-5.18	-4.50	-4.50	-4.50
8	-0.14	+0.23	-0.42	+0.53	-0.53	+0.43	+0.13	-0.22	-4.62	-4.16	-4.16	-4.16
7	-0.34	+0.43	-0.45	+0.40	-0.40	+0.44	+0.43	-0.39	-4.44	-3.40	-3.40	-3.40
6	-0.14	+0.23	-0.42	+0.53	-0.53	+0.43	+0.13	-0.22	-3.90	-3.50	-3.50	-3.50
5	-0.34	+0.43	-0.45	+0.40	-0.40	+0.44	+0.43	-0.39	-3.76	-3.05	-3.05	-3.05
4	-0.14	+0.23	-0.42	+0.53	-0.52	+0.43	+0.13	-0.22	-3.34	-2.65	-2.65	-2.65
3	-0.34	+0.43	-0.45	+0.40	-0.40	+0.44	+0.43	-0.39	-3.76	-2.34	-2.34	-2.34
2	-0.14	+0.23	-0.42	0.53	-0.52	+0.43	+0.13	-0.22	-2.02	-1.77	-1.77	-1.77
1	-0.32	+0.44	-0.44	+0.41	-0.41	+0.44	+0.41	-0.39	-1.25	-1.01	-1.01	-1.01

PRIMERA COMBINACION: 0.9 CM + 1.1 SISMO ←

PISO	1.1 SISMO →				0.9CM + 1.1 SISMO ←							
	TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5	
	M_{3-4}	M_{4-3}	M_{4-5}	M_{5-4}	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}	M_{3-4}	M_{4-3}	M_{4-5}	M_{5-4}
11	-2.02	-1.18	-5.10	-6.06	-2.97	-1.77	-2.30	-1.80	-2.24	-0.94	-5.32	-5.84
10	-3.70	-2.78	-7.50	-8.15	-4.56	-3.47	-4.12	-3.17	-4.23	-2.53	-7.73	-8.02
9	-4.50	-3.07	-9.05	-9.90	-5.56	-4.07	-4.95	-4.10	-4.90	-2.63	-9.44	-9.47
8	-4.16	-2.68	-8.00	-8.80	-4.76	-3.93	-4.58	-3.63	-4.68	-2.25	-8.22	-8.67
7	-3.40	-2.39	-7.15	-7.86	-4.78	-2.97	-3.85	-3.00	-3.80	-1.95	-7.54	-7.43
6	-3.50	-2.24	-6.66	-7.30	-4.04	-3.27	-3.92	-2.97	-4.02	-1.81	-6.88	-7.17
5	-3.05	-2.06	-6.24	-6.86	-4.10	-2.62	-3.50	-2.65	-3.45	-1.62	-6.63	-6.43
4	-2.65	-1.89	-5.56	-6.12	-3.48	-2.42	-3.07	-2.12	-3.17	-1.46	-5.78	-5.99
3	-2.34	-1.46	-4.83	-5.65	-4.10	-1.91	-2.97	-1.94	-2.74	-1.02	-.522	-5.22
2	-1.77	-1.26	-3.66	-4.03	-2.16	-1.54	-2.19	-1.24	-2.29	-0.83	-3.88	-3.90
1	-1.01	-0.64	-1.99	-1.99	-1.57	-0.57	-1.45	-0.60	-1.42	-0.21	-2.38	-1.58

-4.03

SEGUNDA COMBINACION: 1.25(CM+SISMO →)

PISO	CM								→ SISMO →			
	TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3	
	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}	M_{3-4}	M_{4-3}	M_{4-5}	M_{5-4}	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}
11	-0.17	+0.27	-0.28	+0.24	-0.25	+0.37	-0.25	+0.26	+2.56	+1.92	+1.92	+1.92
10	-0.15	+0.25	-0.47	+0.59	-0.59	+0.48	-0.26	+0.15	+4.02	+3.36	+3.36	+3.36
9	-0.37	+0.47	-.50	+0.44	-0.45	+0.49	-0.43	+0.47	+4.70	+4.09	+4.09	+4.09
8	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15	+4.20	+3.78	+3.78	+3.78
7	-0.37	+0.47	-0.50	+0.44	-0.45	+0.49	-0.43	+0.47	+4.03	+3.19	+3.19	+3.19
6	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15	+3.54	+3.17	+3.17	+3.17
5	-0.37	+0.47	-0.50	+0.44	-0.45	+0.49	-0.43	+0.47	+3.42	+2.77	+2.77	+2.77
4	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15	+3.04	+2.41	+2.41	+2.41
3	-0.37	+0.47	-0.50	+0.44	-0.45	+0.49	-0.43	+0.47	+2.51	+2.13	+2.13	+2.13
2	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15	+1.84	+1.61	+1.61	+1.61
1	-0.35	+0.49	-0.49	+0.45	-0.45	+0.47	-0.43	+0.45	+1.14	+0.92	+0.92	+0.92

SEGUNDA COMBINACION: 1.25 (CM+ SISMO →)

Piso	SISMO →				1.25(CM+SISMO→)							
	TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5	
	M_{3-4}	M_{4-3}	M_{4-5}	M_{5-4}	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}	M_{3-4}	M_{4-5}	M_{4-5}	M_{5-4}
11	+1.92	+1.07	+4.64	+5.51	+2.98	+2.74	+2.05	+2.70	+2.09	+1.80	+5.49	+6.96
10	+3.36	+2.52	+6.83	+7.40	+4.84	+4.51	+3.62	+4.94	+3.46	+3.75	+8.21	+9.44
9	+4.09	+2.79	+8.23	+9.00	+5.31	+5.70	+4.48	+5.66	+4.55	+4.10	+9.75	+11.82
8	+3.78	+2.44	+7.28	+7.98	+5.06	+5.04	+4.14	+5.46	+4.00	+3.65	+8.80	+10.15
7	+3.19	+2.17	+6.50	+7.15	+4.58	+4.58	+3.36	+4.54	+3.42	+3.32	+7.58	+9.51
6	+3.17	+2.04	+6.06	+6.64	+5.49	+4.27	+3.38	+4.70	+3.24	+3.15	+7.26	+8.49
5	+2.77	+1.87	+5.66	+6.24	+3.81	+5.05	+2.84	+4.01	+2.90	+2.95	+6.55	+8.40
4	+2.41	+1.72	+5.06	+5.56	+3.62	+3.32	+2.42	+3.75	+2.29	+2.75	+6.01	+7.15
3	+2.13	+1.33	+4.39	+5.13	+2.58	+3.25	+2.04	+3.21	+2.10	+2.28	+4.95	+7.00
2	+1.61	+1.15	+3.33	+3.66	+2.11	+2.32	+1.42	+2.75	+1.29	+2.04	+3.55	+4.39
1	+0.92	+0.58	+1.81	+2.02	+0.99	+1.76	+0.54	+1.71	+0.59	+1.31	+1.72	+3.08

SEGUNDA COMBINACION: 1.25CM + SISMO ←)

Piso	C.M.								SISMO ←			
	TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3	
	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}	M_{3-4}	M_{4-3}	M_{4-5}	M_{5-4}	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}
11	-0.17	+0.27	-0.28	+0.26	-0.25	+0.37	-0.25	+0.26	-2.50	-1.92	-1.92	-1.92
10	-0.15	+0.23	-0.47	+0.59	-0.59	+0.48	-0.26	+0.15	-4.02	-3.36	-3.36	-3.36
9	-0.37	+0.47	-0.50	+0.44	-0.45	+0.49	-0.43	+0.47	-4.70	-4.09	-4.09	-4.09
8	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15	-4.20	-3.78	-3.78	-3.78
76	-0.37	+0.47	-0.50	+0.44	-0.45	+0.49	-0.43	+0.47	-4.03	-3.19	-3.19	-3.19
6	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15	-3.54	-3.17	-3.17	-3.17
5	-0.37	+0.47	-0.50	+0.44	-0.45	+0.49	-0.43	+0.47	-3.42	-2.77	-2.77	-2.77
4	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15	-3.04	-2.41	-2.41	-2.41
3	-0.37	+0.47	-0.50	+0.44	-0.45	+0.49	-0.43	+0.47	-3.51	-2.13	-2.13	-2.13
2	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15	-1.84	-1.61	-1.61	-1.61
1	-0.35	+0.49	-0.49	+0.45	-0.45	+0.47	-0.43	+0.45	-1.14	-0.92	-0.92	-0.92

SEGUNDA COMBINACION: 1.25(CM + SISMO ←)

Piso	SISMO ←				1.25(CM + SISMO ←)							
	TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5	
	M_{3-4}	M_{4-3}	M_{4-5}	M_{5-4}	M_{1-2}	M_{2-1}	M_{2-3}	M_{3-2}	M_{3-4}	M_{4-3}	M_{4-5}	M_{5-4}
11	-1.92	-1.07	-4.64	-5.51	-3.41	-2.06	-2.75	-2.10	-2.71	-0.87	-6.11	-6.56
10	-3.36	-2.52	-6.83	-7.40	-5.21	-3.88	-4.79	-3.46	-4.94	-2.55	-8.30	-9.06
9	-4.09	-2.79	-8.23	-9.00	-6.30	-4.52	-5.74	-4.56	-5.67	-2.88	-10.8	-10.65
8	-3.78	-2.44	-7.28	-7.15	-5.44	-4.41	-5.30	-3.98	-5.45	-2.45	-9.18	-9.78
7	-3.19	-2.17	-6.50	-6.64	-5.50	-3.40	-4.61	-3.44	-4.55	-2.10	-8.65	-8.35
6	-3.17	-2.04	-6.06	-6.24	-4.61	-3.65	-4.55	-3.10	-4.68	-1.95	-7.88	-8.60
5	-2.77	-1.87	-5.66	-5.56	-4.86	-2.88	-4.08	-2.79	-4.02	-1.82	-7.60	-7.21
4	-2.41	-1.72	-5.06	-5.13	-3.99	-2.70	-3.60	-2.28	-3.74	-1.55	-6.64	-6.76
3	-2.13	-1.33	-4.39	-3.66	-3.66	-2.07	-3.28	-2.11	-3.22	-1.05	-6.01	-5.31
2	-1.61	-1.15	-3.33	-2.02	-2.48	-1.70	-2.60	-1.27	-2.74	-0.84	-4.46	-4.39
1	-0.92	-0.58	-1.81	-2.02	-1.86	-0.54	-1.76	-0.58	-1.71	-0.14	-2.80	-1.96

MOMENTOS ISOSTATICOS

Anteriormente se han encontrado los momentos isostáticos de las vigas, pero considerando las cargas muertas afectadas con el coeficiente 1.5 y las cargas vivas afectadas por 1.8, sin embargo para dibujar las envolventes, se necesitan hacer combinaciones considerando las cargas sin los coeficientes citados, combinaciones que aparecen en el detalle en los cuadros siguientes:

MOMENTOS ISOSTATICOS EN LAS VIGAS DE AZOTEA.

TRAMO	X	1.5CM Tn-m	1.8CV Tn-m	CM Tn-m	CV Tn-m	0.9CM Tn-m.
A-B	ƀ	8.32	2.20	5.55	1.22	5.00
B-C	ƀ	8.32	2.20	5.55	1.22	5.00

COMBINACIONES:

1.5CM + 1.8CV

1.25(CM+CV+S) sismo no da momento isostáticos

PRIMERA COMBINACION:

1.5CM + 1.8CV

TRAMO	X	1.5CM	1.8CV-1	1.8CV-2	1.8CV-3	1.8CV-4	1.5CM +1.8 CV-1	1.5CM +1.8 CV-2	1.5CM +1.8 CV-3	1.5CM +1.8 CV-4
A-B	ƀ	8.32	2.20	--	2.20	---	10.52	8.32	10.52	8.32
B-C	ƀ	8.32	--	2.20	2.20	---	8.32	10.52	10.52	8.32

SEGUNDA COMBINACION: 1.25 (CM+CV)

TRAMO	X	CM	CV-1	CV-2	CV-3	CV-4	1.25(CM+ CV-1)	1.25(CM+ CV-2)	1.25(CM+ CV-3)	1.25(CM+ CV-4)
A-B	ƀ	5.55	1.22	---	1.22	---	6.77	5.55	6.77	5.55
B-C	ƀ	5.55	---	1.22	1.22	---	5.55	6.77	6.77	5.55

)MENTOS ISOSTATICOS PARA LAS VIGAS DE LOS PISOS:

1º,3º,5º,7º y 9º

TRAMO	X	1.5CM	1.8CV	CM	CV	0.9CM
A-B		1.26	4.94	8.40	2.74	7.56
	0	0.00	0.00	0.00	0.00	0.00
	0.5	4.60	2.23	3.06	1.24	2.76
	1.0	8.21	4.08	5.47	2.27	4.93
	1.5	11.13	5.48	7.43	3.05	6.68
B-C	2.0	12.88	6.45	8.61	3.54	7.78
	2.5	13.54	6.56	9.04	3.75	8.14
	3.0	12.90	6.13	8.60	3.41	7.23
3.	3.6	10.53	4.98	7.03	2.77	6.32
	4.1	7.73	3.75	5.15	2.08	4.64
	4.6	4.26	2.37	2.84	1.32	2.56
	5.1	0.00	0.00	0.00	0.00	0.00

COMBINACIONES:

1.5CM + 1.8CV

1.25(CM + CV+S)

0.9CM + 1.1S

Como el sismo no da momentos isostáticos, la 2º combinación no tendrá el término S y la 3º se reducira sólo a 0.9CM , lo que se representa en el cuadro presente.

PRIMERA COMBINACION: 1.5CM + 1.8CV

TRAMO	X	1.5CM	1.8CV-1	1.8CV-2	1.8CV-3	1.8CV-4	1.5CM+ 1.8CV-1	1.5CM+ 1.8CV-2	1.5CM+ 1.8CV-3	1.5CM+ 1.8CV-4
A-B	b	12.60	4.94	---	4.94	---	17.54	12.60	17.54	12.60
B-C	0	0.00	----	0.00	0.00	---	0.00	0.00	0.00	0.00
	0.50	4.60	---	2.23	2.23	---	4.60	6.83	6.83	4.60
	1.00	8.21	---	4.08	4.08	---	8.21	12.29	12.29	8.21
	1.50	11.13	---	5.48	5.48	---	11.13	16.61	16.61	11.13
	2.00	12.88	---	6.45	6.45	---	12.88	19.33	19.33	12.88
	2.55	13.54	---	6.56	6.56	---	13.54	20.10	20.10	13.54
	3.00	12.90	- —	6.13	6.13	---	12.90	19.03	19.03	12.90
	3.60	10.53	---	4.98	4.98	---	10.53	15.51	15.51	10.53
	4.10	7.73	---	3.75	3.75	---	7.73	11.48	11.48	7.73
	4.60	4.26	---	2.37	2.37	---	4.26	6.63	6.63	4.26
	5.10	0.00	---	0.00	0.00	---	0.00	0.00	0.00	0.00

SEGUNDA COMBINACION: 1.25(CM+CV)

TRAMO	X	CM	CV-1	CV-2	CV-3	CV-4	1.25(CM+ CV-1)	1.25(CM+ CV-2)	1.25(CM+ CV-3)	1.25(CM+ CV-4)
A-B	0	8.40	2.74	---	2.74	---	13.90	10.50	13.90	10.50
B-C	0.00	0.00	---	0.00	0.00	---	0.00	0.00	0.00	0.00
	0.50	3.06	---	1.24	1.24	---	3.82	5.38	5.38	3.82
	1.00	5.47	---	2.27	2.27	---	6.85	9.66	9.66	6.85
	1.50	7.43	--	3.05	3.05	---	9.30	13.10	13.10	9.30
	2.00	8.61	---	3.54	3.54	---	10.80	15.20	15.20	10.80
	2.50	9.04	---	3.75	3.75	---	11.30	16.00	16.00	11.30
	3.00	8.60	---	3.41	3.41	--	10.75	15.01	15.01	10.75
	3.60	7.03	---	2.77	2.77	---	8.78	12.25	12.25	8.78
	4.10	5.15	--	2.08	2.08	---	6.44	9.04	9.04	6.44
	4.60	2.84	---	1.32	1.32	---	3.55	5.20	5.20	3.55
	5.10	0.00	---	0.00	0.00	---	0.00	0.00	0.00	0.00

MOMENTOS ISOSTATICOS PARA LAS VIGAS DE LOS PISOS:

2ª,4ª,6ª,8ª y 10ª

TRAMO	X	1.5CM	1.8CV	CM	CV	0.9CM
	0	0.00	0.00	0.00	0.00	0.00
	0.50	5.07	1.75	3.38	0.97	3.04
	1.00	9.17	3.12	6.12	1.73	5.50
	1.50	12.30	4.11	8.20	2.28	7.38
A-B	2.00	13.77	4.72	9.18	2.62	8.26
	2.50	14.24	4.95	9.50	2.75	8.59
	3.00	13.78	4.80	9.18	2.66	8.26
	3.60	12.04	4.11	8.04	2.28	7.22
	4.10	8.79	3.12	5.86	1.73	5.27
	4.60	4.79	1.75	3.19	0.97	2.88
	5.10	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
	0.50	5.08	2.07	3.38	1.15	3.04
	1.00	9.36	3.76	6.25	2.09	5.22
B-C	1.50	12.86	5.07	8.56	2.82	7.71
	2.00	14.75	6.00	9.84	3.34	8.85
	2.55	15.78	6.56	10.50	3.65	9.45
	3.00	15.52	6.55	10.35	3.55	9.32
	3.60	11.05	6.06	7.36	3.37	6.64
	4.10	8.35	4.42	5.56	2.45	5.00
	4.60	4.71	2.40	3.14	1.33	2.83
	5.10	0.00	0.00	0.00	0.00	0.00

COMBINACIONES:

1.5CM + 1.8CV

1.25(CM+CV+S)

0.9CM+1.1S

PRIMERA COMBINACION: 1.5CM + 1.8CV

TRAMO	X	1.5CM	1.8CV-1	1.8CV-2	1.8CV-3	1.8CV-4	1.5CM+ 1.8CV-1	1.5CM+ 1.8CV-2	1.5CM+ 1.8CV-3	1.5CM+ 1.8CV-4
	0.00	0.00	---	0.00	---	0.00	0.00	0.00	0.00	0.00
	0.50	5.07	---	1.75	---	1.75	5.07	6.82	5.07	6.82
	1.00	9.17	---	3.12	---	3.12	9.17	12.29	9.17	12.29
	1.50	12.30	---	4.11	---	4.11	12.30	16.41	12.30	16.41
	2.00	13.77	---	4.72	---	4.72	13.77	18.49	13.77	18.49
A-B	2.50	14.24	---	4.95	---	4.95	14.24	19.19	14.24	19.19
	3.00	13.78	---	4.80	---	4.80	13.78	18.58	13.78	18.58
	3.60	12.04	---	4.11	---	4.11	12.04	16.15	12.04	16.15
	4.10	8.79	---	3.12	---	3.12	8.79	11.91	8.79	11.91
	4.60	4.79	---	1.75	---	1.75	4.79	6.54	4.79	6.54
	5.10	0.00	---	0.00	---	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	---	---	0.00	0.00	0.00	0.00	0.00
	0.50	5.08	2.07	---	---	2.07	7.15	5.08	5.08	7.15
	1.00	9.36	3.76	---	---	3.76	13.12	9.36	9.36	13.12
	1.50	12.86	5.50	---	---	5.07	17.93	12.86	12.86	17.93
	2.00	14.75	6.00	---	---	6.00	20.75	14.75	14.75	20.75
B-C	2.55	15.78	6.56	---	---	6.56	22.34	15.78	15.78	22.34
	3.00	15.52	6.55	---	---	6.55	22.07	15.52	15.52	22.07
	3.60	10.05	6.06	---	---	6.00	16.11	10.05	10.05	16.11
	4.10	8.35	4.42	---	---	4.42	12.77	8.35	8.35	12.77
	4.60	4.71	2.40	---	---	2.40	7.11	4.71	4.71	7.11
	5.10	0.00	0.00	---	---	0.00	0.00	0.00	0.00	0.00

SEGUNDA COMBINACION: 1.25 (CM + CV)

TRAMO	X	CM	CV-1	CV-2	CV-3	CV-4	1.25(CM+ +CV-1	1.25(CM+ CV-2	1.25(CM+ CV-3	1.25(CM+ CV-4
A-B	0.00	0.00	---	0.00	---	0.00	0.00	0.00	0.00	0.00
	0.50	3.38	---	0.97	---	0.97	4.22	5.44	4.22	5.44
	1.00	6.12	---	1.73	---	1.73	7.65	9.81	7.65	9.81
	1.50	8.20	---	2.28	---	2.28	10.25	13.10	10.25	13.10
	2.00	9.18	---	2.62	---	2.62	11.50	14.75	11.50	14.75
	2.50	9.50	---	2.75	---	2.75	11.90	15.30	11.90	15.30
	3.00	9.18	---	2.66	---	2.66	11.50	14.80	11.50	14.80
	3.60	8.04	---	2.28	---	2.88	10.00	12.90	10.00	12.90
	4.10	5.86	---	1.73	---	1.73	7.32	9.50	7.32	9.50
	4.60	3.19	---	0.97	---	0.97	3.99	5.20	3.99	5.20
	5.10	0.00	---	0.00	---	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	---	---	0.00	0.00	0.00	0.00	0.00
	0.50	3.38	1.15	---	---	1.15	5.66	4.22	4.22	5.66
	1.00	6.25	2.09	---	---	2.09	10.80	7.80	7.80	10.80
	1.50	8.56	2.82	---	---	2.82	14.20	10.70	10.70	14.20
	2.00	9.84	3.34	---	---	3.34	16.48	12.30	12.30	16.48
	2.55	10.50	3.65	---	---	3.65	17.70	13.10	13.10	17.70
	3.00	10.35	3.65	---	---	3.65	17.50	12.90	12.90	17.50
	3.60	7.36	3.37	---	---	3.37	13.40	9.20	9.20	13.40
	4.10	5.56	2.45	---	---	2.45	10.00	6.95	6.95	5.58
	4.60	3.14	1.33	---	---	1.33	5.58	3.92	3.92	5.58
	5.10	0.00	0.00	---	---	0.00	0.00	0.00	0.00	0.00

MOMENTOS ISOSTATICOS EN EL PORTICO DE ARRIOSTRE

Como sólo actúan cargas muertas y estas son uniformemente repartidas, daré sólo el momento en la línea de centros de cada tramo que estará dado por $1/8\ wL^2$.

1.5CM

PISO	X	TRAMO			
		1-2	2-3	3-4	4-5
11ºó azotea	D	0.57	0.57	0.57	0.57
1º=3º=5º=7º=9º	Lc	1.04	1.04	1.04	1.04
2º=4º=6º=8º=10º	D	0.41	1.3	1.3	0.41

CM.

Piso	X	TRAMO			
		1-2	2-3	3-4	4-5
11º ó azotea	D	0.38	0.38	0.38	0.38
1º=3º=5º=7º=9º	D	0.69	0.69	0.69	0.69
2º=4º=6º=8º=10º	D	0.27	0.87	0.87	0.27

0.9CM

Piso	X	TRAMO			
		1-2	2-3	-3-4	45
11ºóazotea	D	0.34	0.34	0.34	0.34
1º,3º,5º,7º,9º	D	0.62	0.62	0.62	0.62
2º,4º,6º,8º10º	D	0.24	0.78	0.78	0.24

ENVOLVENTES DE CORTE PARA VIGAS

Para la obtención de los cortantes en los extremos de las vigas empleo la siguiente fórmula.

$$V_{1-2} = V_{\text{isostático}} - \frac{M_1 + M_2}{L}$$

$$V_{2-1} = V_{\text{isostático}} + \frac{M_1 + M_2}{L}$$

COMBINACIONES DE CARGA A USAR.

1.- $V_u = 1.5D + 1.8L$

2.- $1.25(D+L+S \overrightarrow{\leftarrow})$

3.- $0.9D+1.1S \overrightarrow{\leftarrow}$

Por razones de espacio presento primer las reacciones por sismo en ambas direcciones.

En el cuadro siguiente presento las reacciones isostáticas de las vigas; afectadas por el coeficiente 1.5 y 1.8 para CM y CV respectivamente, y en el mismo cuadro, las reacciones sin los coeficientes.

PISO	SISMO →				SISMO ←			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{AB}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	-1.185	+1.185	-1.185	+1.185	+1.185	-1.185	+1.185	-1.185
10	-2.04	+2.04	-2.04	+2.04	+2.04	-2.04	+2.04	-2.04
9	-2.27	+2.27	-2.27	+2.27	+2.27	-2.27	+2.27	-2.27
8	-2.70	+2.70	-2.70	+2.70	+2.70	-2.70	+2.70	-2.70
7	-2.74	+2.74	-2.74	+2.74	+2.74	-2.74	+2.74	-2.74
6	-2.43	+2.43	-2.43	+2.43	+2.43	-2.43	+2.43	-2.43
5	-2.54	+2.54	-2.54	+2.54	+2.54	-2.54	+2.54	-2.54
4	-1.91	+1.91	-1.91	+1.91	+1.91	-1.91	+1.91	-1.91
3	-1.76	+1.76	-1.76	+1.76	+1.76	-1.76	+1.76	-1.76
2	-1.78	+1.78	-1.78	+1.78	+1.78	-1.78	+1.78	-1.78
1	-0.97	+0.97	-0.97	+0.97	+0.97	-0.97	+0.97	-0.97

PORTICO PRINCIPAL: 4

REACCIONES ISOSTATICAS: V(Tn.)

Piso	1.5CM				$1.8CV_1$				$1.8CV_2$				1.8CV-3				1.8CV-4			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	6.53	6.53	6.53	6.53	1.72	1.72	----	---	---	---	1.72	1.72	1.72	1.72	1.72	1.72	---	---	---	---
10	11.10	10.38	10.95	10.29	---	---	4.52	5.18	3.88	3.88	---	---	---	---	---	---	3.88	3.88	4.52	5.18
9	9.85	9.85	9.80	9.32	3.88	3.88	---	---	---	---	4.55	4.51	3.88	3.88	4.85	4.51	---	---	---	---
8	11.10	10.38	10.95	10.29	---	---	4.52	5.18	3.88	3.88	---	---	---	---	---	---	3.88	3.88	4.52	5.18
7	9.86	9.86	9.80	9.32	3.88	3.88	---	---	---	--	4.85	4.51	3.88	3.88	4.85	4.51	---	---	---	---
6	11.10	10.38	10.95	10.29	---	---	4.52	5.18	3.88	3.88	---	---	---	---	---	---	3.88	3.88	4.52	5.18
5	9.85	9.86	9.80	9.32	3.88	3.88	---	---	---	---	4.85	4.51	3.88	3.88	4.85	4.51	---	---	---	---
4	11.10	10.38	10.95	10.29	---	---	4.52	5.18	3.88	3.88	---	---	---	---	---	---	3.88	3.88	4.52	5.18
3	9.86	9.86	9.80	9.32	3.88	3.88	---	---	---	---	4.85	4.51	3.88	3.88	4.85	4.51	---	---	---	---
2	11.10	10.38	10.95	10.29	---	---	4.52	5.18	3.88	3.88	---	---	---	---	---	---	3.88	3.88	4.52	5.18
1	9.85	9.85	9.80	9.32	3.88	3.88	---	---	---	---	4.85	4.51	3.88	3.88	4.85	4.51	---	---	---	---

Piso	CM				CV-1				CV-2				CV-3				CV-4			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	4.35	4.35	4.35	4.35	0.96	0.96	---	---	---	---	0.96	0.96	0.96	0.96	0.96	0.96	---	---	---	---
10	7.40	6.91	7.30	6.85	---	---	2.51	2.88	2.16	2.16	---	---	---	---	---	---	2.16	2.16	2.51	2.88
9	6.58	6.58	6.54	6.21	2.16	2.16	---	---	---	---	2.70	2.51	2.16	2.16	2.70	2.51	---	---	---	---
8	7.40	6.91	7.30	6.85	---	---	2.51	2.88	2.16	2.16	---	---	---	---	---	---	2.16	2.16	2.51	2.88
7	6.58	6.58	6.54	6.21	2.16	2.16	---	---	---	---	2.70	2.51	2.16	2.16	2.70	2.51	---	---	---	---
6	7.40	6.91	7.30	6.85	---	---	2.51	2.88	2.16	2.16	---	---	---	---	---	---	2.16	2.16	2.51	2.88
5	6.58	6.58	6.54	6.21	2.16	2.16	---	---	---	---	2.70	2.51	2.16	2.16	2.70	2.51	---	---	---	---
4	7.40	6.91	7.30	6.85	---	---	2.51	2.88	2.16	2.16	---	---	---	---	---	---	2.16	2.16	2.51	2.88
3	6.58	6.58	6.54	6.21	2.16	2.16	---	---	---	---	2.70	2.51	2.16	2.16	2.70	2.51	---	---	---	---
2	7.40	6.91	7.30	6.85	---	---	2.51	2.88	2.16	2.16	---	---	---	---	---	---	2.16	2.16	2.51	2.88
1	6.58	6.58	6.54	6.21	2.16	2.16	---	---	---	---	2.70	2.51	2.16	2.16	2.70	2.51	---	---	---	---

PRIMERA COMBINACION: 1.5 CM + 1.8CV-1

L = 5.10

PISO	REACCIONES ISOSTATICAS				MOMENTOS HIPERSTATICOS							
	1.5CM+1.8CV1				1.5CM				1.8CV-1			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	+ 8.25	+ 8.25	+ 6.53	+6.53	-5.31	+5.64	-5.67	+ 5.31	-1.43	+1.37	-0.10	+0.01
10	+11.10	+10.38	+15.47	+15.47	-9.41	+9.54	-10.19	+10.41	-0.03	+0.12	-4.01	+4.24
9	+13.74	+13.74	+ 9.80	+ 9.32	-8.12	+8.48	- 8.93	+ 8.25	-3.21	+3.18	-0.16	+0.01
8	+11.10	+10.38	+15.47	+15.47	-9.38	+9.56	-10.21	+10.37	-0.05	+0.11	-4.02	+4.24
7	+13.74	+13.74	+ 9.80	+ 9.32	-8.12	+8.48	- 8.93	+ 8.25	-3.21	+3.18	-0.16	+0.01
6	+11.10	+10.38	+15.47	+15.47	-9.38	+9.56	-10.21	+10.37	-0.05	+0.11	-4.02	+4.24
5	+13.74	+13.74	+ 9.80	+ 9.32	-8.12	+8.48	- 8.93	+ 8.25	-3.22	+3.18	-0.16	+0.01
4	+11.10	+10.38	+15.47	+15.47	-9.38	+9.56	-10.21	+10.37	-0.05	+0.11	-4.01	+4.24
3	+13.74	+13.74	+ 9.80	+ 9.32	-8.12	+8.48	- 8.93	+ 8.25	-3.21	+3.18	-0.16	+0.01
2	+11.10	+10.38	+15.47	+15.47	-9.38	+9.56	-10.19	+10.41	-0.05	+0.11	-4.01	+4.24
1	+13.74	+13.74	+ 9.80	+ 9.32	-7.91	+8.60	- 9.03	+ 8.06	-3.16	+3.22	-0.16	+0.02

PRIMERA COMBINACION: 1.5CM + 1.8 CV-1

L = 5.10

PISO	CORRECCION POR MOMENTOS								REACCIONES CORREGIDAS			
	1.5CM				1.8CV-1				1.5CM+1.8CV-1			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	-0.06	+0.06	+0.07	-0.07	+0.01	-0.01	0.00	0.00	8.20	8.30	6.60	6.46
10	-0.03	+0.03	-0.04	+0.04	-0.02	+0.02	-0.05	+0.05	11.05	10.43	15.38	15.56
9	-0.07	+0.07	+0.13	-0.13	+0.01	-0.01	+0.03	-0.03	13.68	13.80	9.96	9.16
8	-0.04	+0.04	-0.03	+0.03	-0.01	+0.01	-0.04	+0.04	11.50	10.43	15.40	15.54
7	-0.07	+0.07	+0.13	-0.13	+0.01	-0.01	+0.03	-0.03	13.68	13.80	9.96	9.16
6	-0.04	+0.04	-0.03	+0.03	+0.01	+0.01	-0.04	+0.04	11.05	10.43	15.40	15.54
5	-0.07	+0.07	+0.13	-0.13	+0.01	-0.01	+0.03	-0.03	13.68	13.80	9.96	9.16
4	-0.04	+0.04	-0.03	+0.03	-0.01	+0.01	-0.05	+0.05	11.05	10.43	15.40	15.54
3	-0.07	+0.07	+0.13	-0.13	+0.01	+0.01	+0.03	-0.03	13.68	13.80	9.96	9.15
2	-0.03	+0.03	-0.03	+0.04	-0.01	+0.01	-0.05	+0.05	11.06	10.42	15.38	15.56
1	-0.14	+0.14	+0.19	-0.19	+0.01	+0.01	+0.04	-0.04	13.59	13.89	10.03	9.09

1.5CM + 1.8 CV-2

L = 5.10

PISO	REACCIONES ISOSTATICAS				MOMENTOS HIPERSTATICOS							
	1.5CM+1.8CV-2				1.5CM				1.8CV-2			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	6.53	6.53	8.25	8.25	-5.31	+5.64	-5.67	+5.31	0.00	+0.09	-1.42	+1.39
10	14.48	13.76	10.95	10.29	-9.41	+9.54	-10.19	+10.41	-3.15	+3.24	-0.12	+0.03
9	9.86	9.86	14.65	13.83	-8.12	+8.48	- 8.93	± 8.25	+0.04	+0.20	-4.01	+3.46
8	14.48	13.76	10.95	10.29	-9.38	+9.56	-10.21	+10.37	-3.14	+3.26	-0.09	+0.06
7	9.86	9.86	14.65	13.83	-8.12	+8.48	- 8.93	+ 8.25	+0.04	+0.20	-4.01	+3.46
6	14.48	13.76	10.95	10.29	-9.38	+9.56	-10.21	+10.37	-3.14	+0.36	-0.09	+0.06
5	9.86	9.86	14.65	13.83	-8.12	+8.48	- 8.93	+ 8.25	+0.04	+0.20	-4.01	+3.46
4	14.48	13.76	10.95	10.29	-9.38	+9.56	-10.21	+10.37	-3.14	+0.36	-0.09	+0.06
3	9.86	9.86	14.65	13.83	-8.12	+8.48	- 8.95	+ 8.25	+0.06	+0.21	-4.01	+3.46
2	14.48	13.76	10.95	10.29	-9.42	+9.54	-10.19	+10.41	-3.14	+3.36	-0.09	+0.08
1	9.86	9.86	14.65	13.83	-7.91	+8.60	- 9.03	+ 8.06	+0.08	+0.22	-4.03	+3.42

13.76

1.5CM + 1.8CV-2

L = 5.10

PISO	CORRECCION POR MOMENTOS								REACCIONES CORREGIDAS			
	1.5CM				1.8CV-2				1.5CM + 1.8CV-2			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	-0.06	+0.06	+0.07	-0.07	-0.02	+0.02	+0.01	-0.01	6.45	6.61	8.33	8.17
10	-0.03	+0.03	-0.04	+0.04	-0.02	+0.02	+0.02	-0.02	14.43	13.81	10.93	10.31
9	-0.07	+0.07	+0.13	-0.13	-0.05	+0.05	+0.11	-0.11	9.74	9.98	14.89	13.59
8	-0.04	+0.04	-0.03	+0.03	-0.02	+0.02	+0.01	-0.01	14.42	13.82	10.93	10.31
7	-0.07	+0.07	+0.13	-0.13	-0.05	+0.05	+0.11	-0.11	9.74	9.98	14.89	13.59
6	-0.04	+0.04	-0.03	+0.03	-0.02	+0.02	+0.01	-0.01	14.42	13.82	10.93	10.31
5	-0.07	+0.07	+0.13	-0.13	-0.05	+0.05	+0.11	-0.11	9.74	9.98	14.89	13.59
4	-0.04	+0.04	-0.03	+0.03	-0.02	+0.02	+0.01	-0.01	14.42	13.82	10.93	10.31
3	-0.07	+0.07	+0.14	-0.14	-0.05	+0.05	+0.11	-0.11	9.74	9.98	14.89	13.88
2	-0.03	+0.03	-0.04	+0.04	-0.02	+0.02	+0.01	-0.01	14.43	13.81	10.91	10.33
1	-0.14	+0.14	+0.19	-0.19	-0.06	+0.06	+0.12	-0.12	9.66	10.06	14.96	13.52

1.5CM + 1.8 CV-3

L = 5.10

PISO	REACCIONES ISOSTATICAS				MOMENTOS HIPERSTATICOS							
	1.5CM+1.8CV-3				1.5CM				1.8CV-3			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	8.25	8.25	8.25	8.25	-5.31	+5.64	-5.67	5.31	-1.33	+1.54	-1.49	+1.37
10	11.10	10.38	10.95	10.29	-9.41	+9.54	-10.19	10.41	-0.05	-0.01	+0.08	+0.13
9	13.74	13.74	14.65	13.83	-8.12	+8.48	- 8.93	8.25	-3.03	+3.48	-4.18	+3.39
8	11.10	10.38	10.95	10.95	-9.38	+9.56	-10.21	10.37	-0.05	-0.01	+0.09	+0.15
7	13.74	13.74	14.65	13.83	-8.12	+8.48	- 8.93	8.25	-3.03	+3.48	-4.18	+3.39
6	11.10	10.38	10.95	10.95	-9.38	+9.56	-10.21	10.37	-0.05	-0.01	+0.09	+0.15
5	13.74	13.74	14.65	13.83	-8.12	+8.48	- 8.93	8.25	-3.03	+3.48	-4.18	+3.39
4	11.10	10.38	10.95	10.95	-9.38	+9.56	-10.21	10.37	-0.05	-0.01	+0.09	+0.15
3	13.74	13.74	14.65	13.83	-8.12	+8.48	- 8.95	8.25	-3.03	+3.48	-4.18	+3.39
2	11.10	10.38	10.95	10.95	-9.42	+9.54	-10.19	10.41	-0.05	-0.01	+0.09	+0.15
1	13.74	13.74	14.65	13.83	-7.91	+8.60	- 9.03	8.06	-2.99	+3.50	-4.20	+3.35

1.5CM + 1.8CV-3

L = 5.10

PISO	CORRECCION POR MOMENTOS								REACCIONES CORREGIDAS			
	1.5CM				1.8CV-3				1.5CM+1.8CV-3			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	-0.06	+0.06	+0.07	-0.07	-0.04	+0.04	+0.02	-0.02	8.15	8.35	8.34	8.16
10	-0.03	+0.03	-0.04	+0.04	+0.01	-0.01	-0.04	+0.04	11.06	10.40	10.87	10.37
9	-0.07	+0.07	+0.13	-0.13	-0.09	+0.09	+0.16	-0.16	13.58	13.90	14.94	13.54
8	-0.04	+0.04	-0.03	+0.03	+0.01	-0.01	-0.05	+0.05	11.07	10.41	10.87	11.03
7	-0.07	+0.07	+0.13	-0.13	-0.09	+0.09	+0.16	-0.09	13.58	13.90	14.94	13.54
6	-0.04	+0.04	-0.03	+0.03	+0.01	-0.01	-0.05	+0.05	11.07	10.41	10.87	11.03
5	-0.07	+0.07	+0.13	-0.13	-0.09	+0.09	+0.16	-0.16	13.58	13.90	14.94	13.54
4	-0.04	+0.04	-0.03	+0.03	+0.01	-0.01	-0.05	+0.05	11.07	10.41	10.87	11.03
3	-0.07	+0.07	+0.14	-0.14	-0.09	+0.09	+0.16	-0.16	13.58	13.90	14.95	13.54
2	-0.03	+0.03	-0.04	+0.04	+0.01	-0.01	-0.05	+0.05	11.08	10.40	10.88	11.04
1	-0.14	+0.14	+0.19	-0.19	-0.10	+0.10	+0.17	-0.17	13.50	13.98	15.01	13.47

1.5CM + 1.8CV-4

L = 5.10

PISO	REACCIONES ISOSTATICAS				MOMENTOS HIPERSTATICOS							
	1.5CM+1.8CV-4				1.5CM				1.8CV-4			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BCTR	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{BC}
11	6.53	6.53	6.53	6.53	-5.31	+5.64	-5.67	+ 5.31	-0.09	-0.06	+0.02	+0.07
10	14.48	13.78	15.47	15.47	-9.41	+9.54	-10.19	+10.41	-3.12	+3.39	-4.18	+4.15
9	9.86	9.86	9.80	9.32	-8.12	+8.48	- 8.93	+ 8.25	-0.14	-0.10	+0.02	+0.10
8	14.48	13.78	15.47	15.47	-9.38	+9.56	-10.21	+10.37	-3.11	+3.41	-4.18	+4.16
7	9.86	9.86	9.80	9.32	-8.12	+8.48	- 8.93	+ 8.25	-0.14	-0.10	+0.02	+0.10
6	14.48	13.78	15.47	15.47	-9.38	+9.56	-10.21	+10.37	-3.11	+3.41	-4.17	+4.16
5	9.86	9.86	9.80	9.32	-8.12	+8.48	- 8.93	+ 8.25	-0.14	-0.10	+0.02	+0.10
4	14.48	13.78	15.47	15.47	-9.38	+9.56	-10.21	+10.37	-3.11	+3.39	-4.19	+4.15
3	9.86	9.86	9.80	9.32	-8.12	+8.48	- 8.93	+ 8.25	-0.14	-0.10	+0.02	+0.10
2	14.48	13.78	15.47	15.47	-9.42	+9.56	-10.19	+10.41	-3.12	+3.39	-4.18	+4.17
1	9.86	9.86	9.80	9.32	-8.91	+8.60	- 9.03	+ 8.06	-0.09	-0.06	+0.02	+0.07

1.5CM +1.8CV-4

L = 5.10

PISO	CORRECCION POR MOMENTOS								REACCIONES CORREGIDAS			
	1.5CM				1.8CV-4				1.5CM+1.8CV-4			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	-0.06	+0.06	+0.07	-0.07	+0.03	-0.03	-0.02	+0.02	6.50	6.56	6.58	6.48
10	-0.03	+0.03	-0.04	+0.04	-0.05	+0.05	+0.01	-0.01	14.40	13.86	15.44	15.50
9	-0.07	+0.07	+0.13	-0.13	+0.05	-0.05	-0.02	+0.02	9.84	9.88	9.91	9.21
8	-0.04	+0.04	-0.03	+0.03	-0.06	+0.06	+0.01	-0.01	14.38	13.88	15.45	15.50
7	-0.07	+0.07	+0.13	-0.13	+0.05	-0.05	-0.02	+0.02	9.84	9.88	9.91	9.21
6	-0.04	+0.04	-0.03	+0.03	-0.06	+0.06	0.00	-0.01	14.38	13.88	15.44	15.50
5	-0.07	+0.07	+0.13	-0.13	+0.05	-0.05	-0.02	+0.02	9.84	9.88	9.91	9.21
4	-0.04	+0.04	-0.03	+0.03	-0.06	+0.06	+0.01	-0.01	14.38	13.88	15.45	15.49
3	-0.07	+0.07	+0.14	-0.14	+0.05	-0.05	-0.02	+0.02	9.84	9.88	9.92	9.22
2	-0.03	+0.03	-0.04	+0.04	-0.06	+0.06	0.00	0.00	14.39	13.87	15.43	15.51
1	-0.14	+0.14	+0.19	-0.19	+0.03	-0.03	-0.02	+0.02	9.75	9.97	9.97	9.15

SEGUNDA COMBINACION: 125(CMCV+SISMO)

Previamente haré la corrección por momentos para luego entrar a los cuadros finales.

CM + CV-1

PISO	MOMENTOS HIPERSTATICOS								CORRECCION POR MOMENTOS							
	CM				CV-1				CM				CV-1			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{BC}
11	-3.54	+3.76	-3.78	+3.54	-0.80	+0.76	-0.06	+0.0	-0.04	+0.04	+0.05	-0.05	+0.01	-0.01	+0.01	-0.01
10	-6.27	+6.36	-6.79	+6.95	-0.02	+0.07	-2.33	2.36	-0.02	+0.02	-0.03	+0.03	-0.01	+0.01	-0.03	+0.03
9	-5.41	+5.66	-5.95	+5.50	-1.78	+1.77	-0.09	0.00	-0.05	+0.05	+0.09	-0.09	0.00	0.00	+0.02	-0.02
8	-6.25	+6.38	-6.80	+6.92	-0.03	+0.06	-2.23	2.34	-0.03	+0.03	-0.02	+0.02	+0.01	+0.01	-0.02	+0.02
7	-5.41	+5.66	-5.95	+5.50	-1.78	+1.77	-0.09	0.00	-0.05	+0.05	+0.09	-0.09	0.00	0.00	+0.02	-0.02
6	-6.25	+6.38	-6.80	+6.92	-0.03	+0.06	-2.23	2.34	-0.03	+0.03	-0.02	+0.02	-0.01	+0.01	-0.02	+0.02
5	-5.41	+5.66	-5.95	+5.50	-1.78	+1.77	-0.09	0.00	-0.05	+0.05	+0.09	-0.09	0.00	0.00	+0.02	-0.02
4	-6.25	+6.38	-6.80	+6.92	-0.03	+0.06	-2.23	2.36	-0.03	+0.03	-0.02	+0.02	-0.01	+0.01	-0.03	+0.03
3	-5.41	+5.66	-5.97	+5.50	-1.78	+1.77	-0.09	0.00	-0.05	+0.05	+0.09	-0.09	0.00	0.00	+0.02	-0.02
2	-6.27	+6.36	-6.79	+6.95	-0.03	+0.06	-2.23	2.36	-0.02	+0.05	-0.03	+0.03	-0.01	+0.01	-0.03	+0.03
1	-5.28	+5.73	-6.02	+5.38	-1.76	+1.80	-0.09	0.00	-0.09	+0.09	+0.13	-0.13	-0.01	+0.01	+0.02	-0.02

CM + CV-2

PISO	MOMENTOS HIPERSTATICOS								CORRECCION POR MOMENTOS							
	CM.				CV-2				CM.				CV-2			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-3.54	+3.76	-3.78	+3.54	0.00	+0.05	-0.79	+0.77	-.04	+0.04	+0.05	-0.05	-0.01	+0.02	0.00	0.00
10	-6.27	+6.36	-6.79	+6.95	-1.75	+1.80	-0.07	+0.02	-0.02	+0.02	-0.03	+0.03	-0.01	+0.01	+0.01	-0.01
9	-5.41	+5.66	-5.95	+5.50	+0.02	+0.11	-2.23	+1.92	-.05	+0.05	+0.09	-0.09	-0.03	+0.03	+0.06	-0.06
8	-6.25	+6.38	-6.80	+6.92	-1.74	+1.82	-0.05	+0.03	-.03	+0.03	-0.02	+0.02	-0.02	+0.02	0.00	0.00
7	-5.41	+5.66	-5.95	+5.50	+0.02	+0.11	-2.23	+1.92	-.05	+0.05	+0.09	-0.09	-0.03	+0.03	+0.06	-0.06
6	-6.25	+6.38	-6.80	+6.92	-1.74	+1.82	-0.05	+0.03	-0.03	+0.03	-0.02	+0.02	-0.02	+0.02	0.00	0.00
5	-5.41	+5.66	-5.95	+5.50	+0.02	+0.11	-2.23	+1.92	-.05	+0.05	+0.09	-0.09	-0.03	+0.03	+0.06	-0.06
4	-6.25	+6.38	-6.80	+6.92	-1.74	+1.82	-0.05	+0.03	-.03	+0.03	-0.02	+0.02	-0.02	+0.02	0.00	0.00
3	-5.41	+5.66	-5.95	+5.50	+0.02	+0.12	-2.23	+1.92	-.05	+0.05	+0.09	-0.09	-0.03	+0.03	+0.06	-0.06
2	-6.27	+6.36	-6.79	+6.95	-1.74	+1.82	-0.05	0.04	-.02	+0.02	-0.03	+0.03	-0.02	+0.02	0.00	0.00
1	-5.28	+5.73	-6.02	+5.38	+0.04	+0.12	-2.23	1.90	-.09	+0.09	+0.13	-0.13	-0.03	+0.03	+0.07	-0.07

CM y CV-3

PISO	MOMENTOS HIPERESTATICOS								CORRECCION POR MOMENTOS							
	CM				CV-3				CM				CV-3			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-3.54	+3.76	-3.78	+3.54	-0.74	+0.86	-0.84	+0.76	-0.04	+0.04	+0.05	-0.05	-0.02	+0.02	+0.02	-0.02
10	-6.27	+6.36	-6.76	+6.95	-0.03	+0.00	+0.05	+0.07	-0.02	+0.02	-0.03	+0.03	+0.01	-0.01	-0.02	+0.02
9	-5.41	+5.66	-5.95	+5.50	-1.68	+1.93	-2.32	+1.88	-0.05	+0.05	+0.09	-0.09	-0.05	+0.05	+0.09	-0.09
8	-6.25	+6.38	-6.80	+6.92	-0.03	+0.00	+0.05	+0.08	-0.03	+0.03	-0.02	+0.09	+0.01	-0.01	-0.03	+0.03
7	-5.41	+5.66	-5.95	+5.50	-1.68	+1.93	-2.32	+1.88	-0.05	+0.05	+0.09	-0.09	-0.05	+0.05	+0.09	-0.09
6	-6.25	+6.38	-6.80	+6.92	-0.03	+0.00	+0.05	+0.08	-0.03	+0.03	-0.02	+0.02	+0.01	-0.01	-0.03	+0.03
5	-5.41	+5.66	-5.95	+5.50	-1.68	+1.93	-2.32	+1.88	-0.05	+0.05	+0.09	-0.09	-0.05	+0.05	+0.09	-0.09
4	-6.25	+6.38	-6.80	+6.92	-0.03	+0.00	+0.05	+0.08	-0.03	+0.03	-0.02	+0.02	+0.01	-0.01	-0.03	+0.03
3	-5.41	+5.66	-5.95	+5.50	-1.68	+1.93	-2.32	+1.88	-0.05	+0.05	+0.09	-0.09	-0.05	+0.05	+0.09	-0.09
2	-6.27	+6.36	-6.79	+6.93	-0.03	+0.00	+0.05	+0.08	-0.02	+0.02	-0.03	+0.03	+0.01	-0.01	-0.03	+0.03
1	-5.28	+5.73	-6.02	+5.38	-1.66	+1.95	-2.38	+1.86	-0.09	+0.09	+0.13	-0.13	-0.06	+0.06	+0.09	-0.09

CM y CV-4

PISO	MOMENTOS HIPERESTATICOS								CORRECCION POR MOMENTOS							
	CM				CV-4				CM				CV-4			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	M_{AB}	M_{BA}	M_{BC}	M_{BC}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}	M_{AB}	M_{BA}	M_{BC}	M_{CB}
11	-3.54	+3.76	-3.78	+3.54	-0.05	-0.03	+0.01	+0.04	-0.04	+0.04	+0.05	-0.05	+0.02	-0.02	-0.01	+0.01
10	-6.27	+6.36	-6.79	+6.95	-1.73	+1.88	-2.32	+2.30	-0.02	+0.02	-0.03	+0.03	-0.03	+0.03	0.00	0.00
9	-5.41	+5.66	-5.95	+5.50	-0.08	-0.06	+0.01	+0.06	-0.05	+0.05	+0.09	-0.09	+0.03	-0.03	-0.01	+0.01
8	-6.25	+5.38	-6.80	+6.92	-1.73	+1.88	-2.32	+2.31	-0.03	0.03	-0.02	+0.02	-0.03	+0.03	0.00	0.00
7	-5.41	+5.66	-5.95	+5.50	-0.08	-0.06	+0.01	+0.06	-0.05	+0.05	+0.09	-0.09	+0.03	-0.03	-0.01	+0.01
6	-6.25	+6.38	-6.80	+6.92	-1.73	+1.88	-2.32	+2.31	-0.03	+0.03	-0.02	+0.02	-0.03	+0.03	0.00	0.00
5	-5.41	+5.66	-5.95	+5.50	-0.08	-0.06	+0.01	+0.06	-0.05	+0.05	+0.09	-0.09	+0.03	-0.03	-0.01	+0.01
4	-6.25	+6.38	-6.80	+6.92	-1.73	+1.88	-2.32	+2.31	-0.03	+0.03	-0.02	+0.02	-0.03	+0.03	0.00	0.00
3	-5.41	+5.66	-5.95	+5.50	-0.08	-0.06	+0.01	+0.06	-0.05	+0.05	+0.09	-0.09	+0.03	-0.03	-0.01	+0.01
2	-6.27	+6.36	-6.79	+6.95	-1.73	+1.88	-2.32	+2.31	-0.02	+0.02	-0.03	+0.02	-0.03	+0.03	0.00	0.00
1	-5.28	+5.73	-6.02	+5.38	-0.05	-0.03	+0.01	+0.04	-0.09	+0.09	+0.13	-0.13	+0.02	-0.02	-0.01	+0.01

SEGUNDA COMBINACION: $1.25(CM+CV-1+\overrightarrow{S})$

Piso	REACCIONES ISOSTAT. CM+CV-1				CORREGIDO POR MOM. CM+CV-1				SISMO $\overrightarrow{S}$				Σ REACCIONES CM+CV+SISMO				REACCIONES FINALES 1.25(CM+CV+$\overrightarrow{S}$)			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	+5.31	+5.31	+4.35	+4.35	-0.03	+0.03	+0.06	-0.06	-1.19	+1.19	-1.19	+1.19	+4.09	6.53	+3.22	5.48	+5.10	8.16	+4.02	6.85
10	+7.40	+6.91	+9.81	+9.73	-0.03	+0.03	-0.06	+0.06	-2.04	+2.04	-2.04	+2.04	+5.33	8.98	+7.71	11.83	+6.64	11.40	+9.65	14.80
9	+8.74	+8.74	+6.54	+6.21	-0.05	+0.05	+0.11	-0.11	-2.27	+2.27	-2.27	+2.27	+6.42	11.06	+4.38	8.37	+8.00	13.80	+4.49	10.45
8	+7.40	+6.91	+9.81	+9.73	-0.04	+0.04	-0.04	+0.04	-2.70	+2.70	-2.70	+2.70	+4.66	9.65	+7.07	12.47	+5.82	12.05	+8.85	15.60
7	+8.74	+8.74	+6.54	+6.21	-0.05	+0.05	+0.11	-0.11	-2.74	+2.74	-2.74	+2.74	+5.95	11.53	+3.91	8.84	+7.44	14.40	+4.89	11.05
6	+7.40	+6.91	+9.81	+9.73	-0.04	+0.04	-0.04	+0.04	-2.43	+2.43	-2.43	+2.43	+4.93	9.38	+7.34	12.11	+6.66	11.70	+9.16	15.15
5	+8.74	+8.74	+6.54	+6.21	-0.05	+0.05	+0.11	-0.11	-2.54	+2.54	-2.54	+2.54	+6.15	11.33	+4.11	8.64	+7.68	14.15	+5.13	10.80
4	+7.40	+6.91	+9.81	+9.73	-0.04	+0.04	-0.05	+0.05	-1.91	+1.91	-1.91	+1.91	+5.45	8.86	+7.85	11.69	+6.80	11.10	+9.80	14.60
3	+8.74	+8.74	+6.54	+6.21	-0.05	+0.05	+0.11	-0.11	-1.76	+1.76	-1.76	+1.76	+6.93	10.55	+4.89	7.86	+8.65	13.15	+6.10	9.84
2	+7.40	+6.91	+9.81	+9.73	-0.03	+0.03	-0.06	+0.06	-1.78	+1.78	-1.78	+1.78	+5.89	8.72	+7.97	11.57	+6.85	10.90	+9.95	14.45
1	+8.74	+8.74	+6.54	+6.21	-0.10	+0.10	+0.15	-0.15	-0.97	+0.97	-0.97	+.097	+7.67	9.81	+5.72	7.03	+9.57	12.25	+7.15	8.80

1.25 (CM +CV1+S)

PISO	CORRECIONES ISOSTATICAS CM+CV-1				CORRECCION POR MOMENTO CM+CV-1				SISMO ←				Σ DE REACCIONES CM+CV1+S				REACCIONES FINALES 1.25(CM+CV+S)			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	+5.31	+5.31	+4.35	+4.35	-0.03	+0.03	+0.06	-0.06	+1.19	-1.19	+1.19	-1.19	6.47	+4.15	5.60	+3.10	8.10	+5.08	7.00	3.88
10	+7.40	+6.91	+9.81	+9.73	-0.03	+0.03	-0.06	+0.06	+2.04	-2.04	+2.04	-2.04	9.41	+4.90	11.79	+7.75	11.78	+6.12	14.71	9.68
9	+8.74	+8.74	+6.54	+6.21	-0.05	+0.05	+0.11	-0.11	+2.27	-2.27	+2.27	-2.27	10.96	+6.52	8.92	+3.83	13.70	+8.15	11.15	4.79
8	+7.40	+6.91	+9.81	+9.73	-0.04	+0.04	-0.04	+0.04	+2.70	-2.70	+2.70	-2.70	10.06	+4.25	12.47	+7.07	12.60	+5.31	15.60	8.85
7	+8.74	+8.74	+6.54	+6.21	-0.05	+0.05	+0.11	-0.11	+2.74	-2.74	+2.74	-2.74	11.43	+6.05	9.39	+3.36	14.30	+7.56	11.72	4.20
6	+7.40	+6.91	+9.81	+9.73	-0.04	+0.04	-0.04	+0.04	+2.43	-2.43	+2.43	-2.43	9.79	+4.52	12.20	+7.34	12.22	+5.65	15.25	9.17
5	+8.74	+8.74	+6.54	+6.21	-0.05	+0.05	+0.11	-0.11	+2.54	-2.54	+2.54	-2.54	11.23	+6.05	9.19	+3.56	14.05	+7.56	11.35	4.45
4	+7.40	+6.91	+9.81	+9.73	-0.04	+0.04	-0.05	+0.05	+1.91	-1.91	+1.91	-1.91	9.27	+5.04	11.67	+7.87	11.60	+6.30	14.60	9.85
3	+8.74	+8.74	+6.54	+6.21	-0.05	+0.05	+0.11	-0.11	+1.76	-1.76	+1.76	-1.76	10.45	+7.03	8.41	+4.34	13.05	+8.30	10.50	5.43
2	+7.40	+6.91	+9.81	+9.73	-0.03	+0.03	-0.06	+0.06	+1.78	-1.78	+1.78	-1.78	9.15	+5.01	11.53	+8.01	11.42	+6.26	14.40	10.00
1	+8.74	+8.74	+9.54	+6.21	-0.10	+0.10	+0.15	-0.15	+0.97	-0.97	+0.97	-0.97	9.61	+7.87	7.66	+5.09	12.00	+9.84	9.57	6.36

$$1.25(CM + CV\text{-}2 + \overset{+}{S})$$

PISO	REACCIONES ISOSTATICAS				CORRECCION POR MOMENTO				SISMO				ΣDE REACCIONES				REACCIONES FINALES			
	CM+CV-2				CM+CV-2				→				CM+CV2+S ←				1.25(CM+CV-2+S←)			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{CB}	V_{BC}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	+4.35	+4.35	+5.31	+5.31	-0.05	+0.05	+0.05	-0.05	-1.19	+1.19	-1.19	+1.19	+3.11	5.59	+4.17	6.45	+3.88	7.00	+5.21	8.06
10	+9.56	+9.07	+7.30	+6.85	-0.03	+0.03	+0.02	+0.02	-2.04	+2.04	-2.04	+2.04	+7.49	11.14	+5.24	8.91	+9.35	13.90	+6.55	11.10
9	+6.58	+6.58	+9.24	+8.72	-0.08	+0.08	+0.15	-0.15	-2.27	+2.27	-2.27	+2.27	+4.23	8.93	+7.12	10.84	+5.28	11.15	+8.80	13.55
8	+9.56	+9.07	+7.30	+6.85	-0.05	+0.05	-0.02	+0.02	-2.70	+2.70	-2.70	+2.70	+6.81	11.82	+4.58	9.57	+8.50	14.80	+5.72	11.95
7	+6.58	+6.58	+9.24	+8.72	-0.08	+0.08	+0.15	-0.15	-2.74	+2.74	-2.74	+2.74	+3.76	9.40	+6.65	11.31	+4.70	11.75	+8.30	14.15
6	+9.56	+9.07	+7.30	+6.85	-0.05	+0.05	-0.02	+0.02	-2.43	+2.43	-2.43	+2.43	+7.08	11.55	+4.85	9.30	+8.85	14.40	+6.06	11.60
5	+6.58	+6.58	+9.24	+8.72	-0.08	+0.08	+0.15	-0.15	-2.54	+2.54	-2.54	+2.54	+3.96	9.20	+6.85	11.11	+4.95	11.50	+8.65	13.90
4	+9.56	+9.07	+7.30	+6.85	-0.05	+0.05	-0.02	+0.02	-1.91	+1.91	-1.91	+1.91	+3.96	11.03	+5.37	8.78	+9.50	13.80	+6.73	10.95
3	+6.58	+6.58	+9.24	+8.72	-0.08	+0.08	+0.15	-0.15	-1.76	+1.76	-1.76	+1.76	+7.60	8.42	+7.63	10.33	+5.93	10.50	+9.54	12.90
2	+9.56	+9.07	+7.30	+6.85	-0.04	+0.04	-0.03	+0.03	-1.78	1.78	-1.78	+1.78	+4.74	10.89	+5.49	8.66	+9.66	13.60	+6.86	10.80
1	+6.58	+6.88	+9.24	+8.72	-0.12	+0.12	+0.20	-0.20	-0.97	+0.97	-0.97	+0.97	+7.74	7.67	+8.47	9.49	+6.86	9.58	10.6	11.85

.1.25(CM+CV-2+$\widetilde{S}$)

Piso	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	+4.35	+4.35	+5.31	+5.31	-0.05	+0.05	+0.05	-0.05	+1.19	-1.19	+1.19	-1.19	5.47	+3.21	6.55	+4.07	6.85	+4.00	8.18	5.08
10	+9.56	+9.07	+7.30	+6.85	-0.03	+0.03	-0.02	+0.02	+2.04	-2.04	+2.04	-2.04	11.57	+7.06	9.32	+4.83	14.50	+8.83	11.65	6.04
9	+6.58	+6.58	+9.24	+8.72	-0.08	+0.08	+0.15	-0.15	+2.27	-2.27	+2.27	-2.27	8.77	+4.39	11.66	+6.30	10.96	+5.50	14.45	7.86
8	+9.56	+9.07	+7.30	+6.85	-0.05	+0.05	-0.02	+0.02	+2.70	-2.70	+2.70	-2.70	12.21	+6.42	9.98	+4.17	15.30	+8.02	12.49	5.21
7	+6.58	+6.58	+9.24	+8.72	-0.08	+0.08	+0.15	-0.15	+2.74	-2.74	+2.74	-2.74	9.24	+3.92	12.13	+5.83	11.54	+4.90	15.18	7.29
6	+9.56	+9.07	+7.30	+6.85	-0.05	+0.05	-0.02	+0.02	+2.43	-2.43	+2.43	-2.43	11.94	+6.69	9.71	+4.44	14.95	+8.36	12.14	5.55
5	+6.58	+6.58	+9.24	+8.72	-0.08	+0.08	+0.15	-0.15	+2.54	-2.54	+2.54	-2.54	9.04	+4.12	11.93	+6.03	11.30	+5.15	14.90	7.54
4	+9.56	+9.07	+7.30	+6.85	-0.05	+0.05	-0.02	+0.02	+1.91	-1.91	+1.91	-1.91	11.94	+7.21	9.19	+4.96	14.30	+9.01	10.19	6.20
3	+6.58	+6.58	+9.24	+8.72	-0.08	+0.08	+0.15	-0.15	+1.76	-1.76	+1.76	-1.76	9.04	+4.90	8.15	+6.81	10.32	+6.13	11.31	8.5
2	+9.56	+9.07	+7.30	+6.85	-0.05	+0.04	-0.03	-0.03	+1.78	-1.78	+1.78	-1.78	11.30	+7.33	9.05	+5.10	14.11	+9.16	10.59	6.37
1	+6.58	+6.58	+9.24	+8.72	-0.12	+0.12	+0.20	-0.20	+0.97	-0.97	+0.97	-0.97	7.43	+5.73	9.47	+7.55	9.30	+7.16		9.44

1.25(CM+CV-3+S)

Piso	REACCIONES ISOSTATICAS CM+CV-3				CORRECCION POR MOM CM+CV-3				SISMO				Σ DE REACCIONES (CM+CV3+S)				REACCIONES FINALES 1.25(CM+CV3+S)			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	+5.31	+5.31	+5.31	+5.31	-0.06	+0.06	+0.07	-0.07	-1.19	+1.19	-1.19	+1.19	+4.06	6.56	+4.19	6.43	+5.07	8.21	+5.24	8.05
10	+7.40	+6.91	+7.30	+6.85	-0.01	+0.01	+0.05	+0.05	-2.04	+2.04	-2.04	+2.04	+5.35	8.96	+5.21	8.94	+6.68	11.20	+6.51	11.18
9	+8.74	+8.74	+9.24	+8.72	-0.10	+0.10	+0.18	-0.18	-2.27	+2.27	-2.27	+2.27	+6.37	11.11	+7.15	10.81	+7.96	13.90	+8.94	13.51
8	+7.40	+6.91	+7.30	+6.85	-0.02	+0.02	-0.05	+0.05	-2.70	+2.70	-2.70	+2.70	+4.68	9.63	+4.55	9.60	+5.86	12.02	+5.69	12.00
7	+8.74	+8.74	+9.24	+8.72	-0.10	+0.10	+0.18	-0.18	-2.74	+2.74	-2.74	+2.74	+5.90	11.58	+6.68	11.28	+7.38	14.48	+8.22	14.10
6	+7.40	+6.91	+7.30	+6.85	-0.02	+0.02	-0.05	+0.05	-2.43	+2.43	-2.43	+2.43	+4.95	9.36	+4.82	9.33	+6.19	11.71	+6.05	14.19
5	+8.74	+8.74	+9.24	+8.72	-0.10	+0.10	+0.18	-0.18	-2.54	+2.54	-2.54	+2.54	+6.10	11.38	+6.88	11.08	+7.63	14.20	+8.62	13.85
4	+7.40	+6.91	+7.30	+6.85	-0.02	+0.02	-0.05	+0.05	-1.91	+1.91	-1.91	+1.91	+5.47	8.84	+5.34	8.81	+6.84	11.04	+6.66	11.00
3	+8.74	+8.74	+9.24	+8.72	-0.10	+0.10	+0.18	-0.18	-1.76	+1.76	-1.76	+1.76	+6.88	10.60	+7.66	10.30	+8.60	13.25	+9.58	12.89
2	+7.40	+6.91	+7.30	+6.85	-0.01	+0.01	-0.05	+0.05	-1.78	+1.78	-1.78	+1.78	+5.61	8.70	+5.46	8.69	+7.01	10.88	+6.82	10.85
1	+8.74	+8.74	+9.24	+8.72	-0.15	+0.15	+0.22	-0.22	-0.97	+0.97	-0.97	+0.97	+7.62	9.86	+8.49	9.47	+9.52	12.31	10.60	11.82

$1.25(CM + CV\text{-}3 \pm S)$

Piso	REACCIONES ISOSTATICAS CM+AV-3				CORRECCION POR MOMEN. CM+CV-3				SISMO ±				Σ DE REACCIONES CM+CV-3+S				REACCIONES FINALES 1.25(CM+CV-3+S)			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	+5.31	+5.31	+5.31	+5.31	-0.06	+0.06	+0.07	-0.07	+1.19	-1.19	+1.19	-1.19	6.44	+4.18	6.57	+4.05	8.05	+5.22	8.21	5.06
10	+7.40	+6.91	+7.30	+6.85	-0.01	+0.01	-0.05	+0.05	+2.04	-2.04	+2.04	-2.04	9.43	+1.88	9.29	+4.86	11.80	+6.10	11.60	6.07
9	+8.74	+8.74	+9.24	+8.72	-0.10	+0.10	+0.18	-0.18	+2.27	-2.27	+2.27	-2.27	10.91	+6.27	11.69	+6.27	13.64	+8.20	14.60	7.84
8	+7.40	+6.91	+7.30	+6.85	-0.02	+0.02	-0.05	+0.05	+2.70	-2.70	+2.70	-2.70	10.08	+4.23	9.95	+4.20	12.60	+5.29	12.44	5.25
7	+8.74	+8.74	+9.24	+8.72	-0.10	+0.10	+0.18	-0.18	+2.74	-2.74	+2.74	-2.74	11.38	+6.10	12.16	+5.80	14.20	+7.65	15.20	7.25
6	+7.40	+6.91	+7.30	+6.85	-0.02	+0.02	-0.05	+0.05	+2.43	-2.43	+2.43	-2.43	9.81	+4.50	9.68	+4.47	12.28	+5.63	12.10	5.60
5	+8.74	+8.74	+9.24	+8.72	-0.10	+0.10	+0.18	-0.18	+2.54	-2.54	+2.54	-2.54	11.18	+6.30	11.96	+6.00	13.90	+7.86	14.92	7.50
4	+7.40	+6.91	+7.30	+6.85	-0.02	+0.02	-0.05	+0.05	+1.91	-1.91	+1.91	-1.91	9.29	+5.02	9.15	+4.99	11.60	+6.27	11.45	5.61
3	+8.74	+8.74	+9.24	+8.72	-0.10	+0.10	+0.18	-0.18	+1.76	-1.76	+1.76	-1.76	10.40	+7.08	11.18	+6.78	13.00	+8.86	13.98	8.46
2	+7.40	+6.91	+7.30	+6.85	-0.01	+0.01	-0.05	+0.05	+1.78	-1.78	+1.78	-1.78	9.17	+5.14	9.02	+5.13	11.45	+6.44	11.29	6.44
1	+8.74	+8.74	+9.24	+8.72	-0.15	+0.15	+0.22	-.22	+0.97	-0.97	+0.97	-0.97	9.56	+7.92	10.43	+.753	11.95	+9.90	13.05	9.40

$1.25(CM+ CV-4+S)$

Piso	REACCIONES ISOSTATICAS CM+CV-4				CORRECCION POR MOMEN. CM+CV-4				SISMO →				Σ DE REACCIONES CM+CV-4+S →				REACCIONES FINALES. 1.25(CM+CV4-S)			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	+4.35	+4.35	+4,35	+4.35	-0.02	+0.02	+0.04	-0.04	-1.19	+1.19	-1.19	+1.19	+3.14	5.56	+3.20	5.50	+3.92	6.95	+4.00	6.87
10	+9.52	+9.07	+9.81	+9.73	-0.05	+0.05	-0.03	+0.03	-2.04	+2.04	-2.04	+2.04	+7.43	11.16	+7.74	11.80	+9.33	13.95	+9.66	14.75
9	+6.58	+6.58	+6.54	+6.21	-0.06	+0. 2	+0.08	-0.08	-2.27	+2.27	-2.27	+2.27	+4.29	8.87	+4.35	8.40	+5.35	11.10	+5.44	10.50
8	+9.52	+9.07	+9.81	+9.73	- 0.02	+0.06	-0.02	+0.02	-2.70	+2.70	-2.70	+2.70	+6.76	11.83	+7.09	12.45	+8.45	14.80	+8.86	15.55
7	+6.58	+6.58	+6.54	+6.21	-0.0 6	+0.02	+0.08	-0.08	-2.74	+2.74	-2.74	+2.74	+3.82	9.34	+3.88	9.87	+4.77	11.68	+4.85	11.10
6	+9.52	+9.07	+9.81	+9.73	-0.02	+0.06	-0.02	+0.02	-2.43	+2.43	-2.43	+2.43	+7.03	11.56	+7.36	8.67	+8.78	14.45	+9.20	9.14
5	+6.58	+6.58	+6.54	+6.21	-0.05	+0.02	+0.08	-0.08	-2.54	+2.54	-2.54	+2.54	+4.02	9.14	+3.92	11.66	+5.04	11.41	+4.90	10.85
4	+9.52	+9.07	+9.81	+9.73	-0.02	+0.06	-0.02	+0.02	-1.91	+1.91	-1.91	+1.91	+7.55	11.04	+7.86	7.89	+9.44	13.80	+9.86	14.58
3	+6.58	+6.58	+6.54	+6.21	-0.02	+0.02	+0.08	-0.08	-1.76	+1.76	-1.76	+1.76	+4.80	8.36	+4.86	11.54	+6.00	10.45	+6.07	9.86
2	+9.52	+9.07	+9.81	+9.73	-0.05	+0.05	-0.03	+0.03	-1.78	+1.78	-1.78	+1.78	+7.69	10.90	+7.10	11.54	+9.60	13.60	+8.86	14.41
1	+6.58	+6.58	+6.54	+6.21	-0.07	+0.07	+0.12	-0.12	-0.97	+0.97	-0.97	+0.97	+5.54	7.62	+5.69	7.06	+6.92	9.53	+7.11	8.83

$$1.25\ (CM + CV\text{-}4 + \overleftarrow{S})$$

Piso	REACCIONES ISOSTATICAS				CORRECCION POR MOMEM.				SISMO				ΣDE REACCIONES				REACCIONES FINALES			
	CM+CV-4				CM+CV-4				←				CM+CV-4+S				1.25(CM+CV-4+S)			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CBC}
11	+4.35	+4.35	+4.35	+4.35	-0.02	+0.02	+0.04	-0.04	+1.19	-1.19	+1.19	-1.19	5.52	+3.18	5.58	+3.12	6.90	+3.97	6.96	3.90
10	+9.52	+9.07	+9.81	+9.73	-0.05	+0.05	0.03	+0.03	+2.04	-2.04	+2.04	-2.04	11.51	+7.08	11.82	+7.72	14.40	+8.86	14.80	9.65
9	+6.58	+6.58	+6.54	+6.21	-0.02	+0.02	+0.07	-0.08	+2.27	-2.27	2.27	-2.27	8.83	+4.33	8.89	+8.86	11.03	+5.42	11.10	4.82
8	+9.52	+9.07	+9.81	+9.73	-0.06	+0.06	-0.02	+0.02	+2.70	-2.70	+2.70	-2.70	12.16	+6.43	12.49	+7.05	15.20	+8.04	15.60	8.81
7	+6.58	+6.58	+6.54	+6.21	-0.02	+0.02	+0.08	-0.08	+2.74	-2.74	+2.74	-2.74	9.30	+3.86	9.36	+3.39	11.62	+4.83	11.70	4.24
6	+9.52	+9.07	+9.81	+9.73	-0.06	+0.06	-0.02	+0.02	+2.43	-2.43	+2.43	-2.43	11.89	+6.70	12.22	+7.32	14.84	+8.36	15.30	9.15
5	+6.58	+6.58	+6.54	+6.21	-0.02	+0.02	+0.08	-0.08	+2.54	-2.54	+2.54	-2.54	9.10	+4.06	9.16	+3.59	11.38	+5.07	11.45	4.49
4	+9.52	+9.07	+9.81	+9.73	-0.06	+0.06	-0.02	+0.02	+1.91	-1.91	+1.91	-1.91	11.37	+7.22	11.70	+7.84	14.20	+9.05	14.62	9.80
3	+6.58	+6.58	+6.54	+6.21	-0.02	+0.02	+0.08	0.07	+1.76	-1.76	+1.76	-1.76	8.32	+4.84	8.38	+4.35	10.40	+6.05	10.48	5.44
2	+9.52	+9.07	+9.81	+9.73	-0.05	+0.05	-0.08	+0.08	+1.78	-1.78	+1.78	-1.78	11.25	+7.34	11.56	+7.98	14.08	+9.16	14.45	9.98
1	+6.58	+6.58	+6.54	+6.21	-0.07	+0.07	+0.12	-0.12	+0.97	-0.97	+0.97	-0.97	7.38	+5.68	7.63	+5.12	9.35	+7.10	9.54	6.40

TERCERA COMBINACION: 0.9 CM + 1.1 SISMO

L = 5.10

Piso	REACCIONES ISOSTATICAS 0.9 CM				MOMENTOS HIPERESTATI. 0.9 CM				CORRECCION POR MOMEN. 0.9 CM				SISMO 1.1 SISMO				REACCIONES FINALES 0.9CM+1.1S			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	+3.92	+3.92	+3.92	+3.92	-3.18	+3.38	-3.40	+3.18	-0.04	+0.04	+0.04	-0.04	-1.30	+1.30	-1.30	+1.30	+2.58	+5.26	+2.66	+5.18
10	+6.66	+6.22	+6.57	+6.16	-5.65	+5.73	-6.10	+6.25	-0.02	+0.02	-0.03	+0.03	-2.24	+2.24	-2.24	+2.24	+4.40	+8.48	+4.30	+8.43
9	+5.92	+5.92	+5.90	+5.60	-4.86	+5.10	-5.35	+4.95	-0.05	+0.05	+0.08	-0.08	-2.50	+2.50	-2.50	+2.50	+3.37	+8.47	+3.48	+8.02
8	+6.66	+6.22	+6.57	+6.16	-5.62	+5.75	-6.12	+6.25	-0.03	+0.03	-0.03	+0.03	-2.97	+2.97	-2.97	+2.97	+3.66	+9.22	+3.57	+9.16
7	+5.92	+5.92	+5.90	+5.60	-4.86	+5.10	-5.35	+4.95	-0.05	+0.05	+0.08	-0.08	-3.02	+3.02	-3.02	+3.02	+2.85	+8.99	+2.96	+8.54
6	+6.66	+6.22	+6.57	+6.16	-5.62	+5.75	-6.12	+6.25	-0.03	+0.03	-0.03	+0.03	-2.68	+2.68	-2.68	+2.68	+3.95	+8.93	+3.86	+8.87
5	+5.92	+5.92	+5.90	+5.60	-4.86	+5.10	-5.36	+4.95	-0.05	+0.05	+0.08	-0.08	-2.80	+2.80	-2.80	+2.80	+3.07	+8.77	+3.18	+8.32
4	+6.66	+6.22	+6.57	+6.16	-5.62	+5.75	-6.10	+6.25	-0.03	+0.03	-.03	+0.03	-2.10	+2.10	-2.10	+2.10	+4.53	+8.35	+4.44	+8.29
3	+5.92	+5.92	+5.90	+5.60	-4.86	+5.10	-5.36	+4.95	-0.05	+0.05	+0.08	-0.08	-1.94	+1.94	-1.94	+1.94	+3.93	+7.91	+4.04	+7.46
2	+6.66	+6.22	+6.57	+6.16	-5.65	+5.75	-6.10	+6.25	-0.03	+0.03	-0.03	+0.03	-1.96	+1.96	-1.96	+1.96	+4.67	+8.21	+4.58	+8.15
1	+5.92	+5.92	+5.40	+5.60	-4.76	+5.16	-5.42	+4.85	-0.08	+0.08	+0.08	0.08	-1.07	+1.07	-1.07	+1.07	+4.77	+7.07	+4.91	+6.59

+6.66

TERCERA COMBINACION: 0.9CM + 1.1 S ←

L' = 5.10

Piso	REACCIONES ISOSTAT. 0.9CM				MOMENT.HIPERESTAT. 0.9CM				CORRECCION POR MOMEN. 0.9CM				SISMO ← 1.1 SISMO				REACCIONES FINALES 0.9CM+1.1 S ←			
	TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC		TRAMO AB		TRAMO BC	
	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}	V_{AB}	V_{BA}	V_{BC}	V_{CB}
11	+3.92	+3.92	+3.92	+3.92	-3.18	+3.38	-3.40	+3.18	-0.04	+0.04	+0.04	-0.04	+1.30	-1.30	+1.30	-1.30	+5.18	+2.66	+5.26	+2.58
10	+6.66	+6.22	+6.57	+6.16	-5.65	+5.73	-6.10	+6.25	-0.02	+0.02	-0.03	-0.03	+2.24	-2.24	+2.24	-2.24	+8.88	+4.00	+8.78	+3.95
9	+5.92	+5.92	+5.90	+6.16	-4.86	+5.10	-5.35	+4.95	-0.05	+0.05	+0.08	-0.08	+2.50	-2.50	+2.50	-2.50	+8.37	+3.47	+8.48	+3.02
8	+6.66	+6.22	+6.57	+5.60	-5.62	+5.75	-6.12	+6.25	-0.03	+0.03	-0.03	+0.03	+2.97	-2.97	+2.97	-2.97	+9.60	+3.28	+9.51	+3.22
7	+5.92	+5.92	+5.90	+6.16	-4.86	+5.10	-5.35	+4.95	-0.05	+0.05	+0.08	-0.08	+3.02	-3.02	+3.02	-3.02	+8.89	+2.95	+9.00	+2.50
6	+6.66	+6.22	+6.57	+5.60	-5.62	+5.75	-6.12	+6.25	-0.03	+0.03	-0.03	+0.03	+2.68	-2.68	+2.68	-2.68	+9.31	+3.57	+9.22	+3.51
5	+5.92	+5.92	+5.90	+6.16	-4.86	+5.10	-5.35	+4.95	-0.05	+0.05	+0.08	-0.08	+2.80	-2.80	+2.80	-2.80	+8.67	+3.17	+8.78	+2.72
4	+6.66	+6.66	+6.57	+5.60	-5.62	+5.75	-6.12	+6.25	-0.03	+0.03	-0.03	+0.03	+2.10	-2.10	+2.10	-21.0	8.73	+4.15	+8.64	+4.09
3	+5.92	+5.92	+5.90	+6.16	-4.86	+5.10	-5.35	+4.95	-0.05	+0.05	+0.08	-0.08	+1.94	-1.94	+1.94	-1.94	+7.81	+4.03	+7.92	+3.58
2	+6.66	+6.22	+6.57	+5.60	-5.65	+5.73	-6.10	+6.25	-0.03	+0.03	-0.03	+0.03	+1.96	-1.96	+1.96	-1.96	+8.59	+4.29	+8.50	+4.23
1	+5.92	+5.92	+5.90	+5.60	-4.76	+5.16	-5.42	+4.85	-0.08	+0.08	+0-08	-0.08	+1.07	-1.07	+1.07	-1.07	+6.91	+4.93	+7.05	+4.45

PORTICO DE ARRIOSTRE "A"

COMBINACIONES: 1.25(CM + SISMO)

0.9CM + 1.1 SISMO

PRIMERO HARÉ LAS CORRECCION HIPERESTATICA

L = 3.75

Piso	MOMENTOS HIPERESTATICOS C.M.								CORRECCION POR MOMENTOS C.M.							
	TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5	
	V_{1-2}	V_{2-1}	V_{2-3}	V_{3-2}	V_{3-4}	V_{4-3}	V_{4-5}	V_{5-4}	V_{1-2}	V_{2-1}	V_{2-3}	V_{3-2}	V_{3-4}	V_{4-3}	V_{4-5}	V_{5-4}
11	-0.17	-0.27	-0.28	+0.24	-0.25	+0.37	-0.25	+0.26	-0.03	+0.03	+0.01	-0.01	-0.03	+0.03	0.00	0.00
10	-0.15	+0.25	-0.47	+0.59	-0.59	+0.48	-0.26	+0.15	-0.03	+0.03	-0.03	+0.03	+0.03	-0.03	+0.03	-0.03
9	-0.37	+0.47	-0.50	+0.44	-0.45	+0.49	-0.43	+0.47	-0.03	+0.03	+0.02	-0.02	-0.01	+0.01	-0.01	+0.01
8	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15	-0.03	+0.03	-0.03	+0.03	+0.03	-0.03	+0.03	-0.03
7	-0.37	+0.47	-0.50	+0.44	-0.45	+0.49	-0.43	+0.47	-0.03	+0.03	+0.02	-0.02	-0.01	+0.01	-0.01	+0.01
6	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15	-0.03	+0.03	-0.03	+0.03	+0.03	-0.03	+0.03	-0.03
5	-0.37	+0.47	-0.50	+0.44	-0.45	+0.49	-0.43	+0.47	-0.03	+0.03	+0.02	-0.02	-0.01	+0.01	-0.01	+0.01
4	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15	-0.03	+0.03	-0.03	+0.03	+0.03	-0.03	+0.03	-0.03
3	-0.37	+0.47	-0.50	+0.44	-0.45	+0.49	-0.43	+0.47	-0.03	+0.03	+0.02	-0.02	-0.01	+0.01	-0.01	+0.01
2	-0.15	+0.25	-0.47	+0.59	-0.58	+0.48	-0.25	+0.15	-0.03	+0.03	-0.03	+0.03	+0.03	-0.03	+0.03	-0.03
1	-0.35	+0.49	-0.49	+0.45	-0.45	+0.47	-0.43	+0.45	-0.04	+0.04	+0.01	-0.01	-0.01	+0.01	-0.01	+0.01

1.25(CM + SISMO)

Piso	REACCIONES ISOSTATICAS								SISMO			
	CM+ CORRECCION								→			
	TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3	
	V_{1-2}	V_{2-1}	V_{2-3}	V_{3-2}	V_{3-4}	V_{4-3}	V_{4-5}	V_{5-4}	V_{1-2}	V_{2-1}	V_{2-3}	V_{3-2}
11	+0.57	+0.63	+0.61	+0.59	+0.57	+0.63	+0.60	+0.60	-1.19	+1.19	-1.02	+1.02
10	+0.41	+0.47	+0.93	+0.99	+0.99	+0.93	+0.44	+0.41	-1.96	+1.96	-1.79	+1.79
9	+0.98	+1.04	+1.03	+0.99	+1.00	+1.02	+1.00	+1.02	-2.34	+2.34	-2.18	+2.18
8	+0.41	+0.47	+0.93	+0.99	+0.99	+0.93	+0.44	+0.41	-2.13	+2.13	-2.02	+2.02
7	+0.98	+1.04	+1.03	+0.99	+1.00	+1.02	+1.00	+1.02	-1.92	+1.92	-1.70	+1.70
6	+0.41	+0.47	+0.93	+0.99	+0.99	+0.93	+0.44	+0.41	-1.79	+1.79	-1.69	+1.69
5	+0.98	+1.04	+1.03	+0.99	+1.00	+1.02	+1.00	+1.02	-1.65	+1.65	-1.47	+1.47
4	+0.41	+0.47	+0.93	+0.99	+0.99	+0.93	+0.44	+0.41	-1.45	+1.45	-1.28	+1.28
3	+0.98	+1.04	+1.03	+0.99	+1.00	+1.02	+1.00	+1.02	-1.24	+1.24	-1.14	+1.14
2	+0.41	+0.47	+0.93	+0.99	+0.99	+0.93	+0.44	+0.41	-0.92	+0.92	-0.86	+0.86
1	+0.97	+1.05	+1.02	+1.00	+1.00	+1.02	+1.00	+1.02	-0.55	+0.55	-0.49	+0.49

1.25 (CM+SISMO)

Piso	SISMO				REACCIONES FINALES							
	→				1.25(CM+S)							
	TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5	
	V_{3-4}	V_{4-3}	V_{4-5}	V_{5-4}	V_{1-2}	V_{2-1}	V_{2-3}	V_{3-2}	V_{3-4}	V_{4-3}	V_{4-5}	V_{5-4}
11	-0.80	+0.80	-2.72	+2.72	-0.775	+2.28	-0.51	+2.02	-0.29	+1.79	-2.65	+4.15
10	-1.64	+1.64	-3.80	+3.80	-1.94	+3.40	-1.07	+3.48	-0.81	+3.21	-4.20	+5.26
9	-1.81	+1.81	-4.57	+4.57	-1.70	+4.22	-1.44	+3.96	-1.00	+3.50	-4.46	+7.00
8	-1.66	+1.66	-4.06	+4.06	-2.15	+3.25	-1.36	+3.76	-0.84	+3.24	-4.52	+5.60
7	-1.43	+1.43	-3.64	+3.64	-1.17	+3.70	-0.84	+3.36	-0.54	+3.06	-3.30	+5.81
6	-1.39	+1.39	-3.40	+3.40	-1.72	+2.82	-0.95	+3.35	-0.50	+2.80	-3.70	+4.76
5	-1.24	+1.24	-3.18	+3.18	-0.83	+3.36	-0.55	+3.08	-0.30	+2.82	-2.72	+5.25
4	-1.10	+1.10	-2.84	+2.84	-1.30	+2.40	-0.44	+2.84	-0.14	+2.54	-3.00	+4.40
3	-0.92	+0.92	-2.52	+2.52	-0.32	+2.85	-0.14	+2.64	-0.10	+2.42	-1.90	+4.42
2	-0.74	+0.74	-1.86	+1.86	-0.64	+1.34	+0.09	+2.31	+0.31	+2.08	-1.77	+2.84
1	-0.40	+0.40	-1.02	+1.02	-0.53	+2.00	+0.66	+1.86	+0.75	+1.77	-0.83	+2.55

1.25 (CM + SISMO)

Piso	REACCIONES ISOSTATICAS								SISMO			
	CM											
	TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3	
	V_{1-2}	V_{2-1}	V_{2-3}	V_{3-2}	V_{3-4}	V_{4-3}	V_{4-5}	V_{5-4}	V_{1-2}	V_{2-1}	V_{2-3}	V_{3-2}
11	+0.57	+0.63	+0.61	+0.59	+0.57	+0.63	+0.60	+0.60	+1.19	-1.19	+1.02	-1.02
10	+0.41	+0.47	+0.93	+0.99	+0.99	+0.93	+0.44	+0.41	+1.96	-1.96	+1.79	-1.79
9	+0.98	+1.04	+1.03	+0.99	+1.00	+1.02	+1.00	+1.02	+2.34	-2.34	+2.18	-2.18
8	+0.41	+0.47	+0.93	+0.99	+0.99	+0.93	+0.44	+0.41	+2.13	-2.13	+2.02	-2.02
7	+0.98	+1.04	+1.03	+0.99	+1.00	+1.02	+1.00	+1.02	+1.92	-1.92	+1.70	-1.70
6	+0.41	+0.47	+0.93	+0.99	+0.99	+0.93	+0.44	+0.41	+1.79	-1.79	+1.69	-1.69
5	+0.98	+1.04	+1.03	+0.99	+1.00	+1.02	+1.00	+1.02	+1.65	-1.65	+1.47	-1.47
4	+0.41	+0.47	+0.93	+0.99	+0.99	+0.93	+0.44	+0.41	+1.45	-1.45	+1.28	-1.28
3	+0.98	+1.04	+1.03	+0.99	+1.00	+1.02	+1.00	+1.02	+1.24	-1.24	+1.14	-1.14
2	+0.41	+0.47	+0.93	+0.99	+0.99	+0.93	+0.44	+1.02	+0.92	-0.92	+0.86	-0.86
1	+0.97	+1.05	+1.02	+1.00	+1.00	+1.02	+1.00	+1.02	+0.53	-0.53	+0.49	-0.49

1.25 (CM + SISMO←)

Piso	SISMO ←				REACCIONES FINALES 1.25(CM + SISMO←)							
	TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5	
	V_{3-4}	V_{4-3}	V_{4-5}	V_{5-4}	V_{1-2}	V_{2-1}	V_{2-3}	V_{3-2}	V_{3-4}	V_{4-3}	V_{4-5}	V_{5-4}
11	+0.80	-0.80	+2.72	-2.72	+2.20	-0.70	+2.05	-0.54	+1.71	-0.21	+4.15	-2.65
10	+1.64	-1.64	+3.80	-3.80	+2.96	-1.86	+3.40	-1.00	+3.28	-0.90	+5.30	-4.24
9	+1.81	-1.81	+4.57	-4.57	+4.15	-1.62	+4.21	-1.49	+3.51	-0.99	+7.00	-4.46
8	+1.66	-1.66	+4.06	-4.06	+3.19	-2.07	+3.68	-1.29	+3.32	-0.91	+5.60	-4.56
7	+1.43	-1.43	+3.64	-3.64	+3.62	-1.10	+3.41	-0.89	+3.04	-0.51	+5.80	-3.28
6	+1.39	-1.39	+3.40	-3.40	+2.75	-1.65	+3.27	-0.88	+2.98	-0.58	+4.80	-3.74
5	+1.24	-1.24	+3.18	-3.18	+3.29	-0.76	+3.12	-0.48	+2.80	-0.28	+5.24	-2.70
4	+1.10	-1.10	±2.84	-2.84	+2.32	-1.25	+2.76	-0.36	+2.62	-0.21	+4.10	-3.20
3	+0.92	-0.92	±2.52	-2.52	+2.78	-0.25	+2.71	-0.19	+2.40	-0.12	+4.40	-1.88
2	+0.74	-0.74	±1.86	-1.86	+1.66	-0.56	+2.24	+0.16	+2.16	-0.24	+2.88	-1.81
1	+0.40	-0.40	±1.02	-1.02	+1.90	-0.65	+1.89	+0.64	+1.75	-0.77	+2.52	+0.00

SEGUNDA COMBINACION: 0.9CM + 1.1 SISMO →

Piso	REACCIONES ISOSTATICAS 0.9CM + 0.9 CORRECCION								1.1 SISMO →			
	TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3	
	V_{1-2}	V_{2-1}	V_{2-3}	V_{3-2}	V_{3-4}	V_{4-3}	V_{4-5}	V_{5-4}	V_{1-2}	V_{2-1}	V_{2-3}	V_{3-2}
11	+0.51	+0.57	+0.55	+0.53	+0.51	+0.57	+0.54	+0.54	-1.31	+1.31	-1.12	+1.12
10	+0.37	+0.42	+0.84	+0.89	+0.89	+0.84	+0.40	+0.37	-2.16	+2.16	-1.97	+1.97
9	+0.88	+0.94	+0.93	+0.89	+0.90	+0.92	+0.90	+0.92	-2.56	+2.58	-2.40	+2.40
8	+0.37	+0.42	+0.84	+0.89	+0.89	+0.84	+0.40	+0.37	-2.34	+2.34	-2.22	+2.22
7	+0.88	+0.94	+0.93	+0.89	+0.90	+0.92	+0.90	+0.92	-2.12	+2.12	-1.87	+1.87
6	+0.37	+0.42	+0.84	+0.89	+0.89	+0.84	+0.40	+0.37	-1.97	+1.97	-1.86	+1.86
5	+0.88	+0.94	+0.93	+0.89	+0.90	+0.92	+0.90	+0.92	-1.81	+1.81	-1.62	+1.62
4	+0.37	+0.42	+0.84	+0.89	+0.89	+0.84	+0.40	+0.37	-1.60	+1.60	-1.41	+1.41
3	+0.88	+0.94	+0.93	+0.89	+0.90	+0.92	+0.90	+0.92	-1.36	+1.36	-1.25	+1.25
2	+0.37	+0.42	+0.84	+0.89	+0.89	+0.84	+0.40	+0.37	-1.01	+1.01	-0.95	+0.95
1	+0.87	+0.95	+0.92	+0.90	+0.90	+0.92	+0.90	+0.92	-0.61	+0.61	-0.54	+0.54

SEGUNDA COMBINACION: 0.9 CM + 1.1 SISMO →

Piso	SISMO →				REACCIONES FINALES							
					0.9CM + 1.1 SISMO							
	TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5	
	V_{3-4}	V_{4-3}	V_{4-5}	V_{5-4}	V_{1-2}	V_{2-1}	V_{2-3}	V_{3-2}	V_{3-4}	V_{4-3}	V_{4-5}	V_{5-4}
11	-0.88	+0.88	-3.00	+3.00	-0.80	+1.88	-0.57	+1.65	-0.37	+1.45	-2.46	+3.54
10	-1.80	+1.80	-4.18	+4.18	-1.79	+2.58	-1.13	+2.86	-0.91	+2.64	-3.78	+4.55
9	-1.99	+1.99	-5.02	+5.02	-1.70	+3.52	-1.47	+3.38	-1.09	+2.91	-4.12	+5.94
8	-1.83	+1.83	-4.47	+4.47	-1.97	+2.76	-1.38	+3.11	-0.94	+2.67	-4.07	+4.84
7	-1.57	+1.57	-4.00	+4.00	-1.24	+3.06	-0.94	+2.76	-0.67	+2.49	-3.08	+4.92
6	-1.53	+1.53	-3.74	+3.74	-1.60	+2.39	-1.02	+2.75	-0.64	+2.37	-3.34	+4.11
5	-1.36	+1.36	-3.50	+3.50	-0.93	+2.75	-0.69	+2.51	-0.46	+2.28	-2.60	+4.42
4	-1.21	+1.21	-3.12	+3.12	-1.23	+2.02	-0.57	+2.30	-0.32	+2.05	-2.72	+3.49
3	-1.01	+1.01	-2.78	+2.78	-0.48	+2.30	-0.32	+2.14	-0.11	+1.93	-1.88	+3.70
2	-0.83	+0.83	-2.04	+2.04	-0.64	+1.43	-0.11	+1.84	+0.08	+1.65	-1.64	+2.41
1	-0.44	+0.44	-1.12	+1.12	+0.26	+1.56	-0.38	+1.44	+0.46	+1.36	-0.22	+2.04

SEGUNDA COMBINACION : 0.9 CM + 1.1 SISMO

Piso	REACCIONES ISOSTATICAS 0.9 + 0.9 CORRECCION								1.1 SISMO ←			
	TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3	
	V_{1-2}	V_{2-1}	V_{2-3}	V_{3-2}	V_{3-4}	V_{4-3}	V_{4-5}	V_{5-4}	V_{1-2}	V_{2-1}	V_{2-3}	V_{3-2}
11	+0.51	+0.57	+0.55	+0.53	+0.51	+0.57	+0.54	+0.54	+1.31	-1.31	+1.12	-1.12
10	+0.37	+0.42	+0.84	+0.89	+0.89	+0.84	+0.40	+0.37	+2.16	-2.16	+1.97	-1.97
9	+0.88	+0.94	+0.93	+0.89	+0.90	+0.92	+0.90	+0.92	+2.58	-2.58	+2.40	-2.40
8	+0.37	+0.42	+0.84	+0.89	+0.89	+0.84	+0.40	+0.37	+2.34	-2.34	+2.22	-2.22
7	+0.88	+0.94	+0.93	+0.89	+0.90	+0.92	+0.90	+0.92	+2.12	-2.12	+1.87	-1.87
6	+0.37	+0.42	+0.84	+0.89	+0.89	+0.84	+0.40	+0.37	+1.97	-1.97	+1.86	-1.86
5	+0.88	+0.94	+0.93	+0.89	+0.90	+0.92	+0.90	+0.92	+1.81	-1.81	+1.62	-1.62
4	+0.37	+0.42	+0.84	+0.89	+0.89	+0.84	+0.40	+0.37	+1.60	-1.60	+1.41	-1.41
3	+0.88	+0.94	+0.93	+0.89	+0.90	+0.92	+0.90	+0.92	+1.36	-1.36	+1.25	-1.25
2	+0.37	+0.42	+0.84	+0.89	+0.89	+0.84	+0.40	+0.37	+1.01	-1.01	+0.95	-0.95
1	+0.87	+0.94	+0.92	+0.90	+0.90	+0.92	+0.90	+0.92	+0.61	-0.61	+0.54	-0.54

SEGUNDA COMBINACION: 0.9CM +1.1 SISMO

Piso	SISMO ←				REACCIONES FINALES 0.9CM + 1.1 SISMO ←							
	TRAMO 3-4		TRAMO 4-5		TRAMO 1-2		TRAMO 2-3		TRAMO 3-4		TRAMO 4-5	
	V_{3-4}	V_{4-3}	V_{4-5}	V_{5-4}	V_{1-2}	V_{2-1}	V_{2-3}	V_{3-2}	V_{3-4}	V_{4-3}	V_{4-5}	V_{5-4}
11	+0.88	-0.88	+3.00	-3.00	+1.82	-0.74	+1.67	-0.59	+1.39	-0.31	+3.54	-2.46
10	+1.80	-1.80	+4.18	-4.18	+2.53	-1.74	+2.81	-1.08	+2.69	-0.96	+4.58	-3.81
9	+1.99	-1.99	+5.02	-5.02	+3.46	-1.64	+3.33	-1.51	+2.89	-1.07	+5.92	-4.10
8	+1.83	-1.83	+4.47	-4.47	+2.71	-1.92	+3.06	-1.33	+2.72	-0.99	+4.87	-4.10
7	+1.57	-1.57	+4.00	-4.00	+3.00	-1.18	+2.80	-0.98	+2.47	-0.65	+4.90	-3.08
6	+1.53	-1.53	+3.74	-3.74	+2.34	-1.55	+2.70	-0.97	+2.42	-0.69	+4.14	-3.37
5	+1.36	-1.36	+3.50	-3.50	+2.69	-0.87	+2.55	-0.73	+2.26	-0.44	+4.40	-2.58
4	+1.21	-1.21	+3.12	-3.12	+1.97	-1.18	+2.25	-0.52	+2.10	-0.37	+3.52	-2.75
3	+1.01	-1.01	+2.78	-2.78	+2.24	-0.42	+2.18	-0.36	+1.91	-0.09	+3.68	-1.86
2	+0.81	-0.81	+2.04	-2.04	+1.38	-0.59	+1.79	-0.06	+1.70	+0.03	+2.44	-1.67
1	+0.44	-0.44	+1.12	-1.12	+1.48	+0.34	+1.46	+0.36	+1.34	+0.48	+2.02	-0.20

CORTES ISOSTATICOS

Para los efectos de dibujar cada una de las combinaciones de corte, es necesario tener cada una de las combinaciones isostáticas de corte, lo que presento a continuación en gráficos.

Combinaciones:

1.5 CM + 1.8CV

0.9CM + 1.1 SISMO ⇄

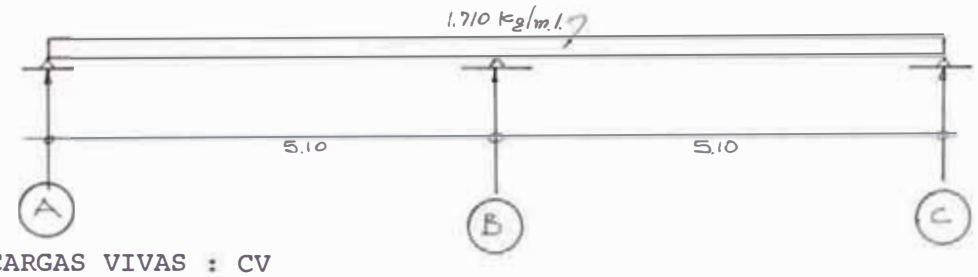
1.25(CM + CV + SISMO ⇄)

NOTA: El sismo no da corte isostático.

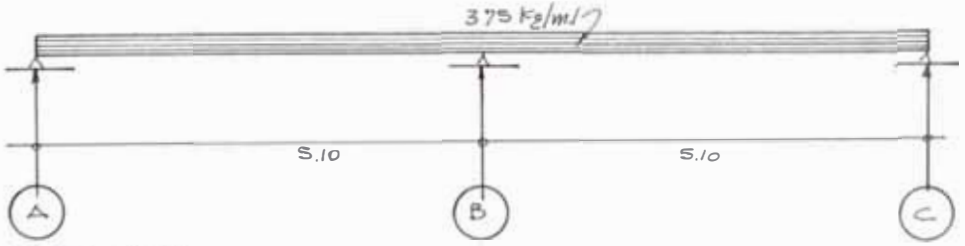
Primero presento las vigas cargadas.

NIVEL AZOTEA

CARGAS MUERTAS : CM

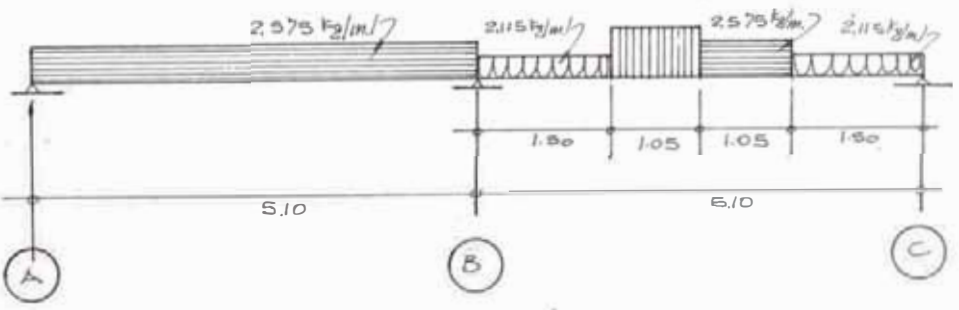


CARGAS VIVAS : CV

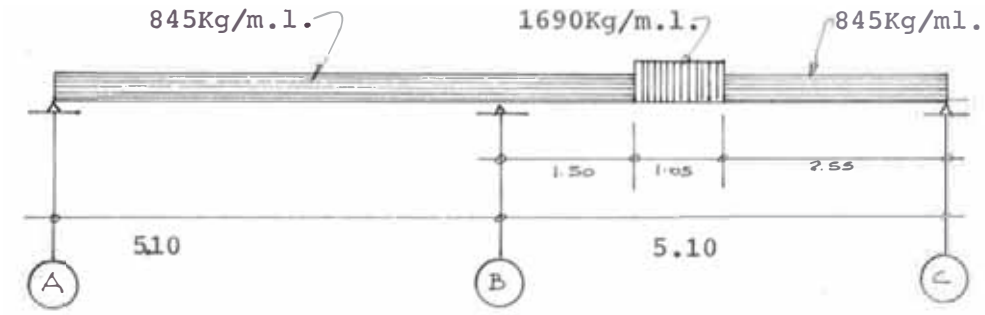


PISOS : 1ª=3ª=5ª=7ª=9ª

CARGAS MUERTAS : CM

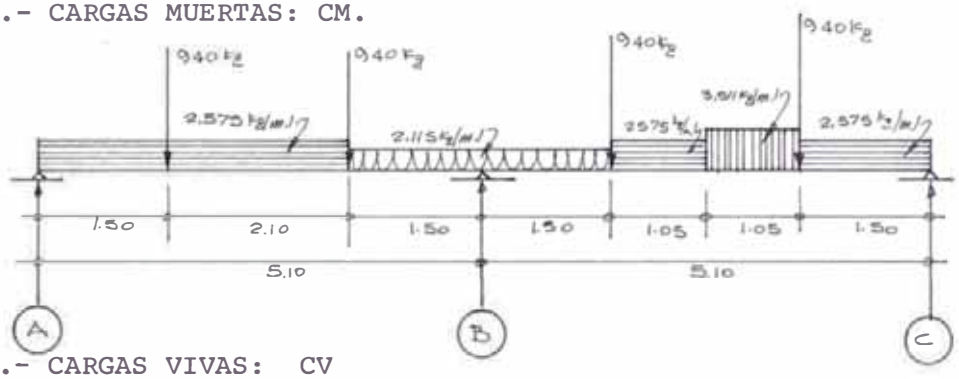


CARGAS VIVAS: CV

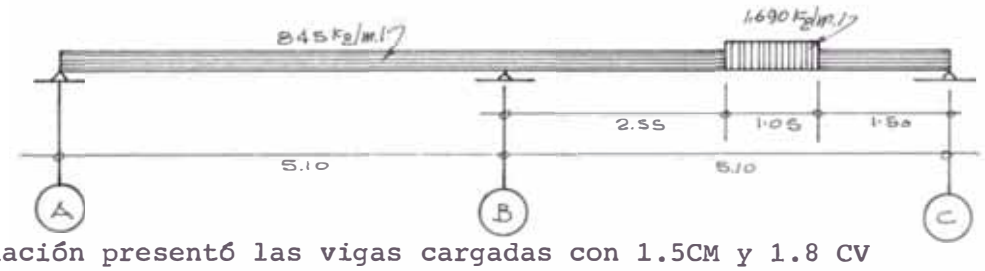


PISOS :2ª=4ª=6ª=8ª=10ª

1.- CARGAS MUERTAS: CM.



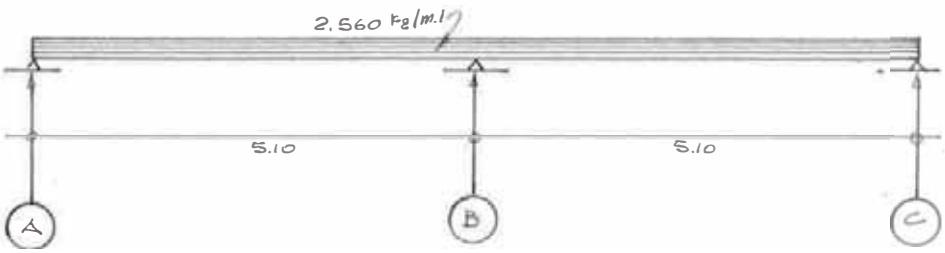
2.- CARGAS VIVAS: CV



A Continuación presentó las vigas cargadas con 1.5CM y 1.8 CV

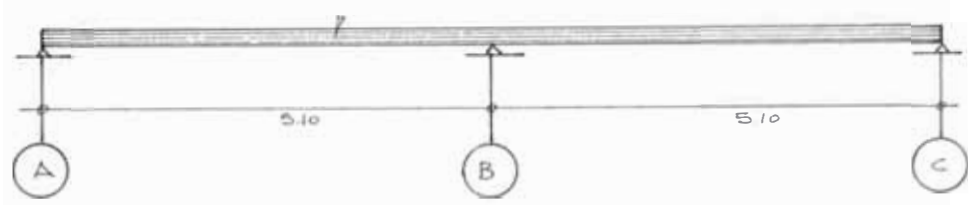
NIVEL AZOTEA:

CARGAS MUERTAS: 1.5CM



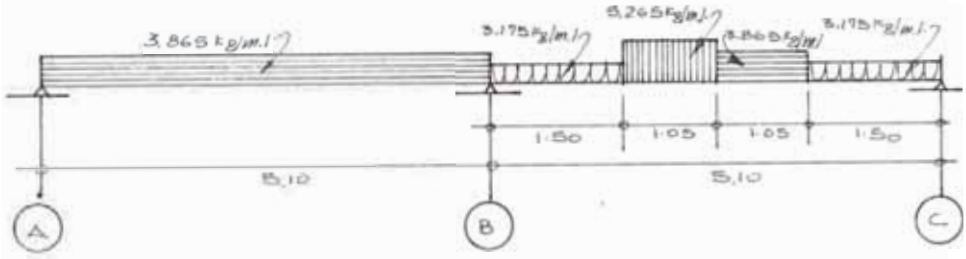
CARGAS VIVAS: 1.8CV

675 Kg/m.l.

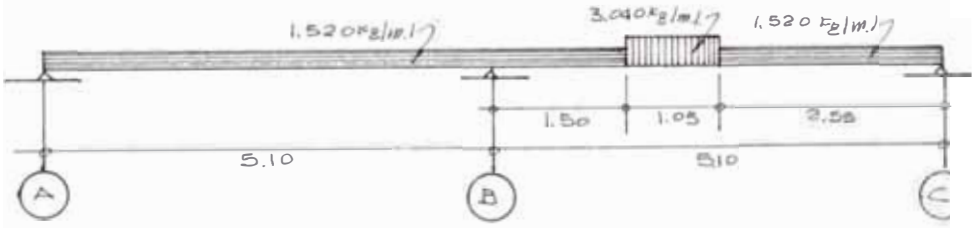


Pisos: 1º=3º=5º=7º y 9º

CARGAS MUERTAS: 1.5CM

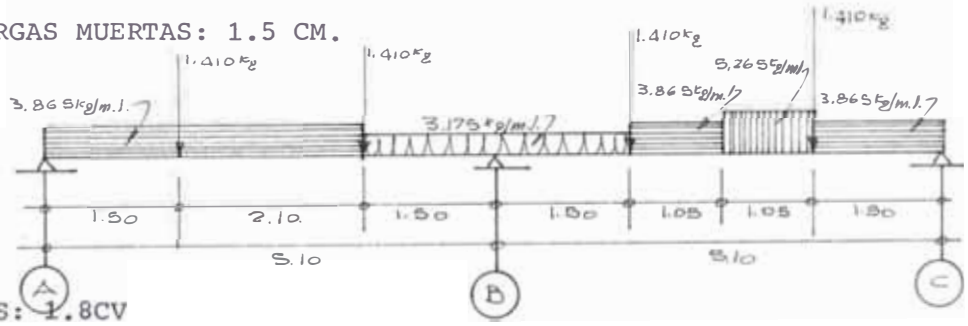


CARGAS VIVAS: 1.8CV

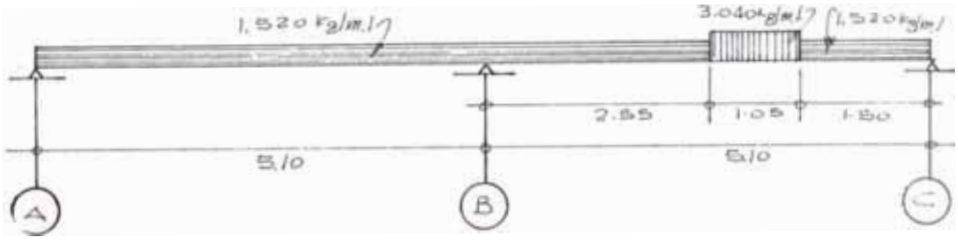


Pisos: 2º,4º,6º,8º,y10º

CARGAS MUERTAS: 1.5 CM.



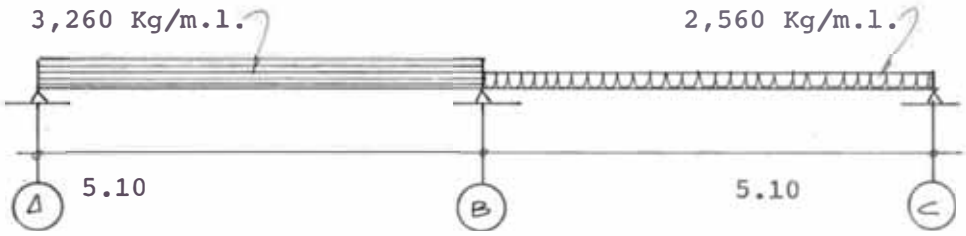
CARGAS VIVAS: 1.8CV



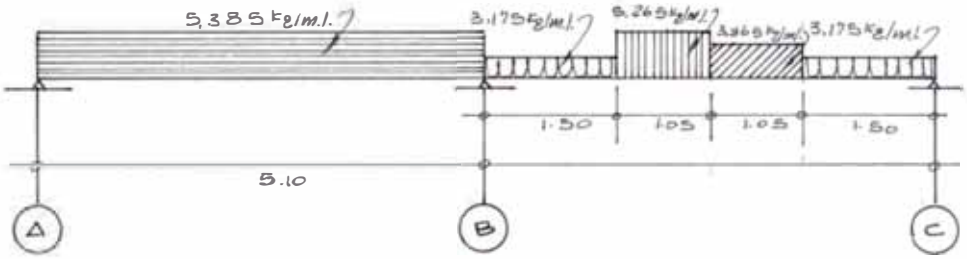
PRIMERA COMBINACION: 1.5CM+ 1.8CV

1.5CM + 1.8CV-1

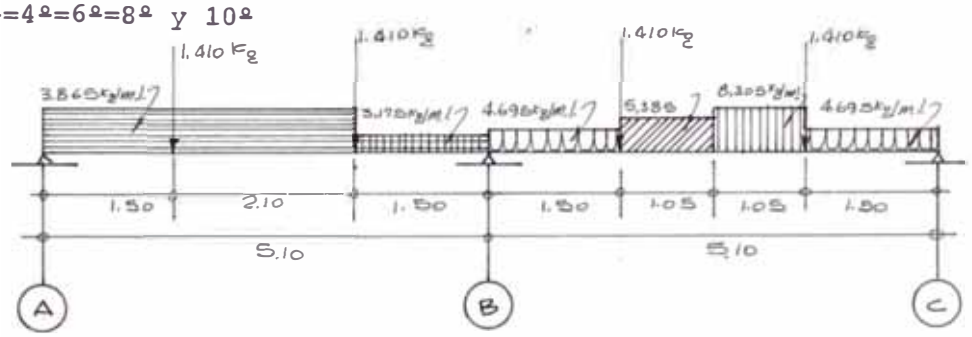
NIVEL AZOTEA:



PISOS: 1ª=3ª=5ª=7ª=9ª

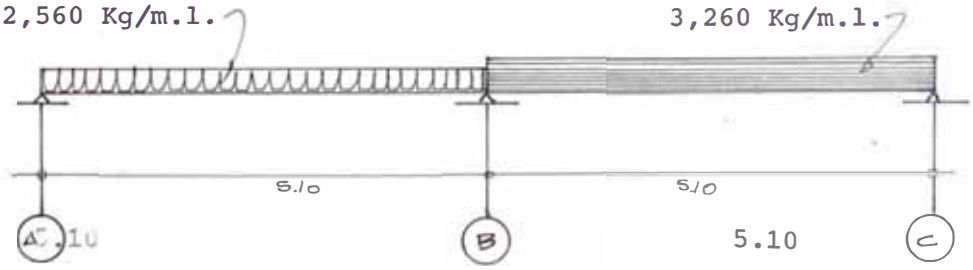


PISOS: 2ª=4ª=6ª=8ª y 10ª

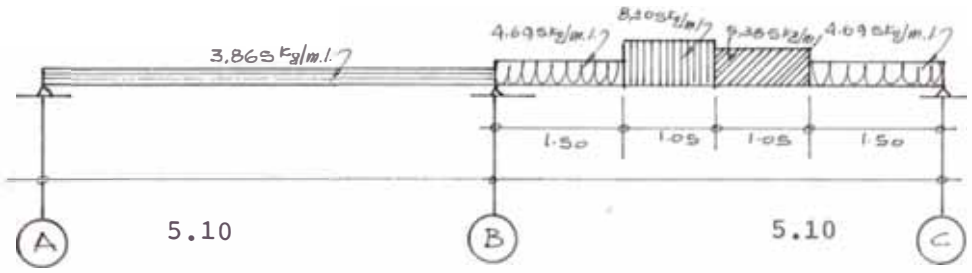


1.5CM + 1.8CV-2

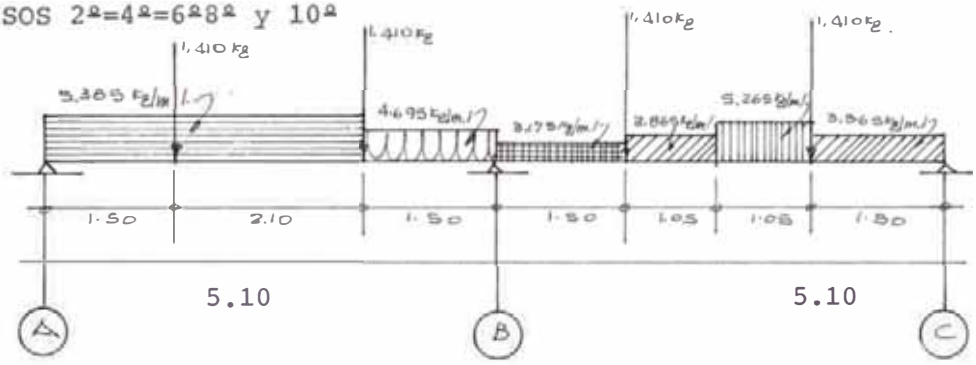
NIVEL AZOTEA : ó Piso 11



PISOS: 1ª=3ª=5ª=7ª= y 9ª

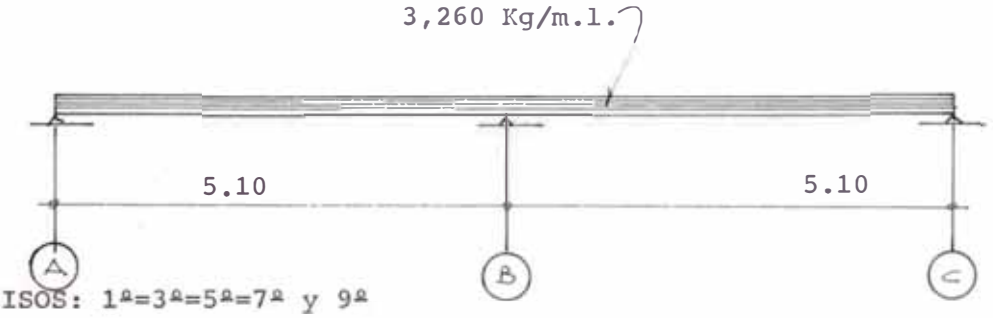


PISOS 2ª=4ª=6ª8ª y 10ª

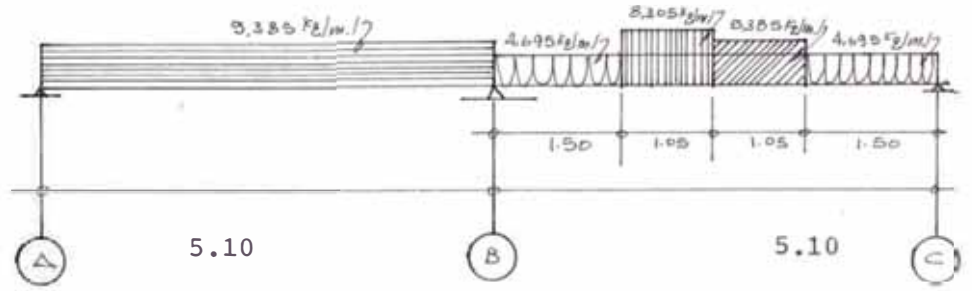


1.5CM + 1.8 CV-3

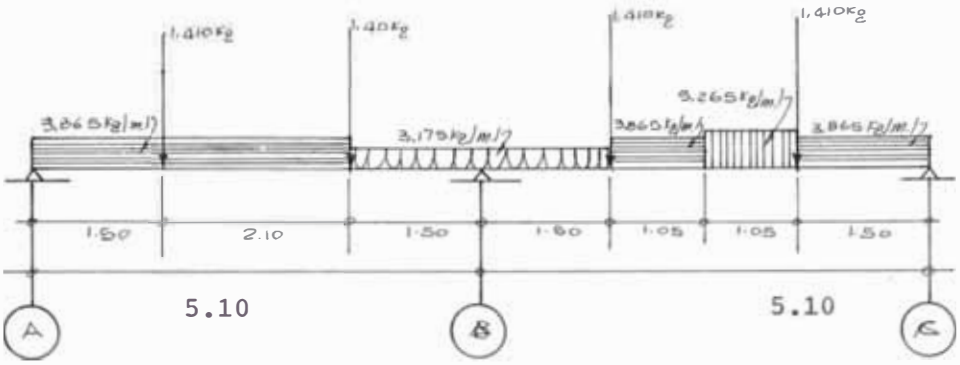
NIVEL AZOTEA ó Piso 11



PISOS: 1ª=3ª=5ª=7ª y 9ª

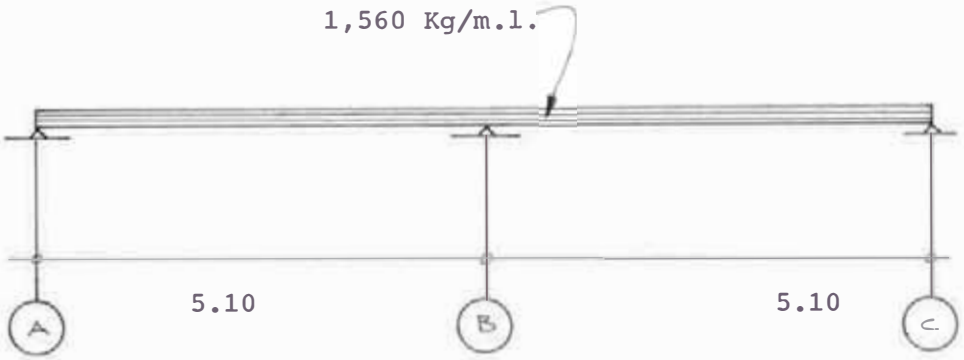


Pisos: 2ª=4ª=6ª=8ª y 10ª

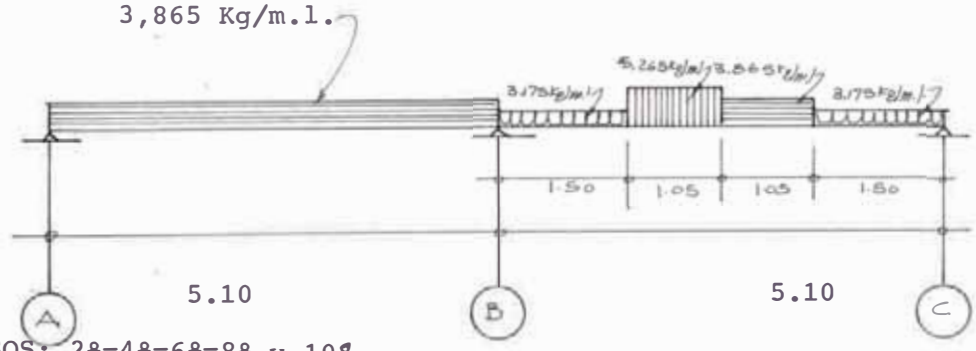


1.5CM + 1.8CV-4

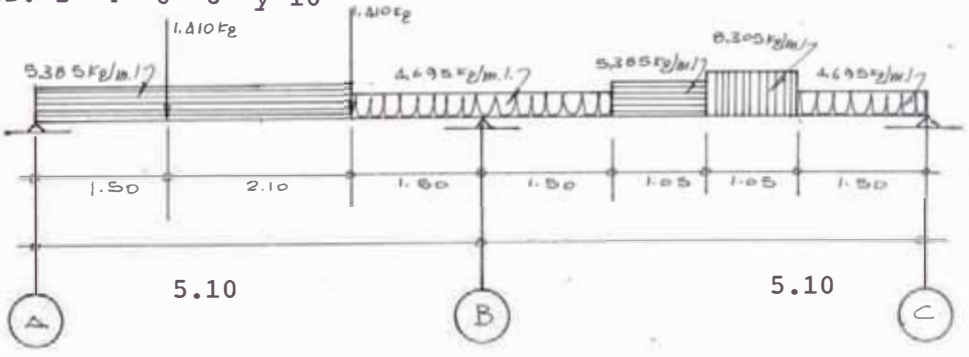
NIVEL AZOTEA ó piso 11



PISO 1ª=3ª=5ª=7ª= y 9ª

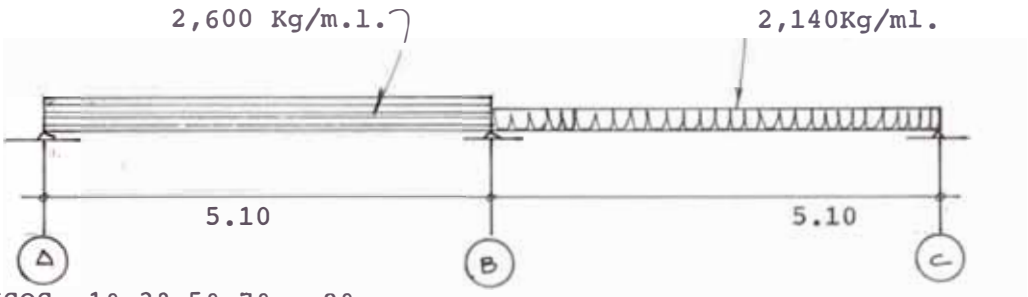


PISOS: 2ª=4ª=6ª=8ª y 10ª

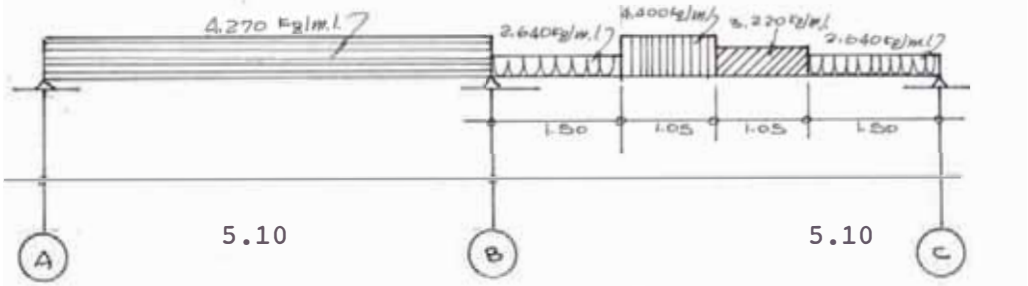


3ra COMBINACION 1.25 (CM+CV+SISMO)

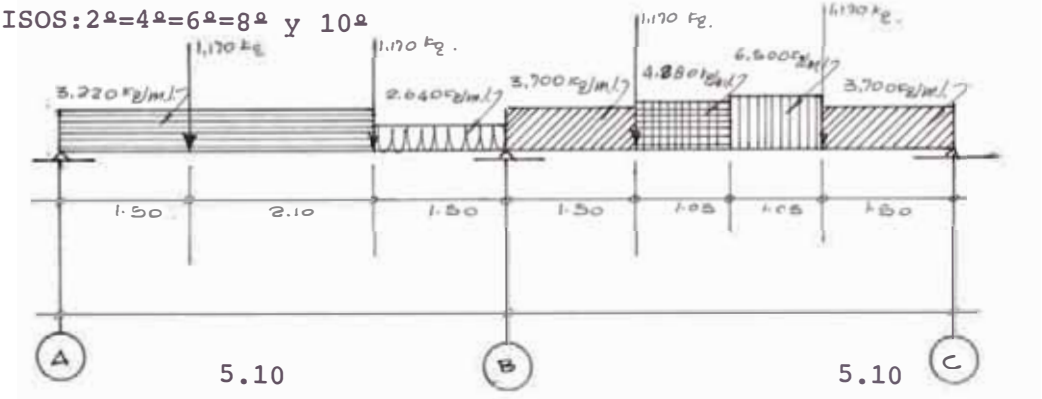
1.25(CM+CV-1)



PISOS: 1ª=3°=5ª=7ª y 9ª

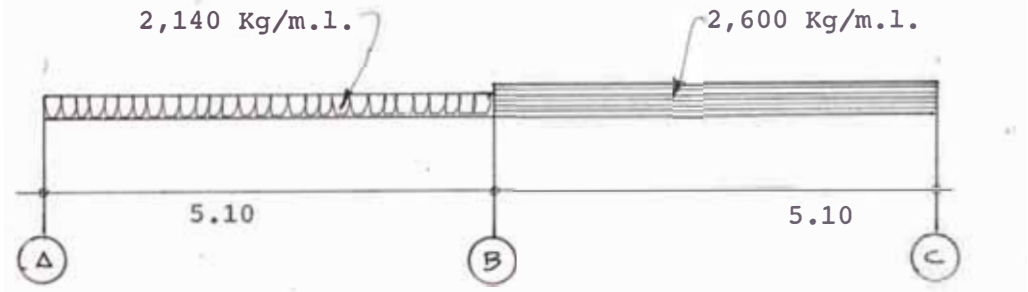


PISOS:2ª=4ª=6ª=8ª y 10ª

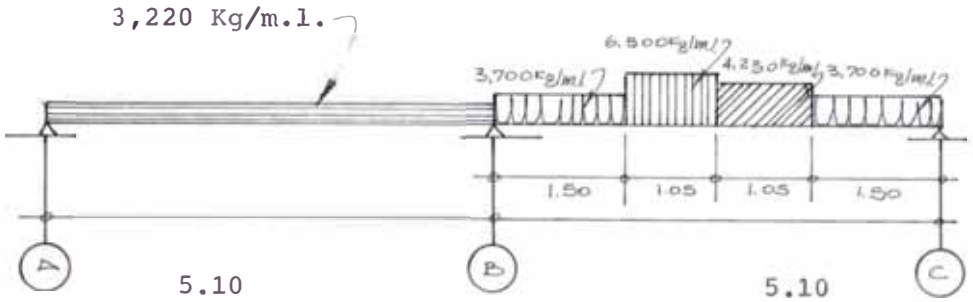


1.25(CM+CV-2)

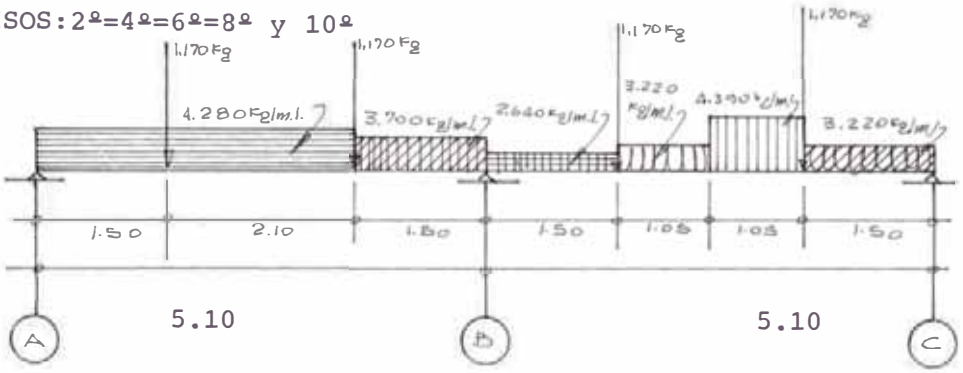
NIVEL AZOTEA ó Piso 11ª



PISOS: 1º=3º=5º=7º y 9º

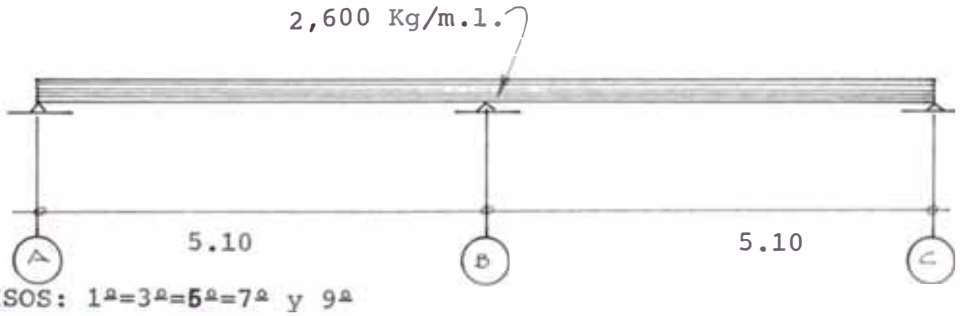


PISOS: 2º=4º=6º=8º y 10º

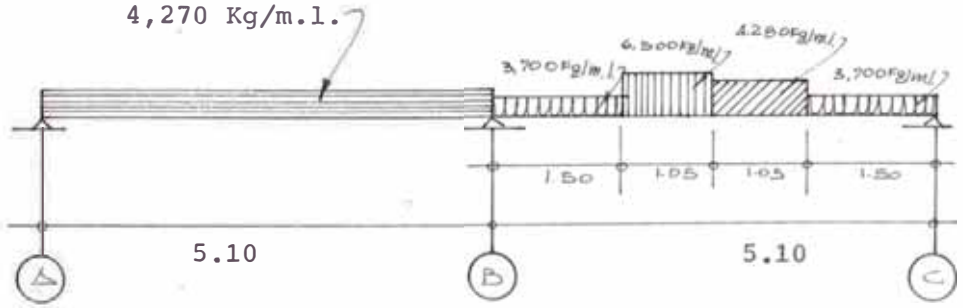


1.25(CM+CV-3)

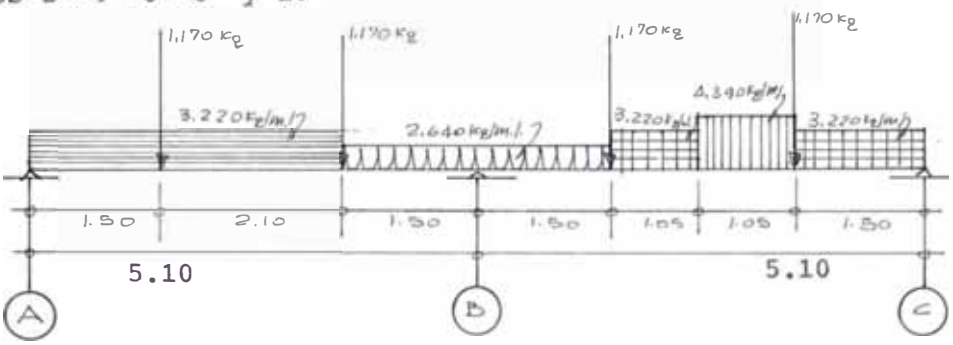
NIVEL AZOTEA ó piso 11



PISOS: 1º=3º=5º=7º y 9º



PISOS 2ª=4ª=6ª=8ª y 10ª



MOMENTOS EN COLUMNAS

PORTICO PRINCIPAL

Los momentos de las columnas que presento en los siguientes cuadros, son los obtenidos en los diagramas de KANI, además en el análisis sísmico, con los que haré las siguientes combinaciones de cargas.

1ª: 1.5D + 1.8L

2ª: 1.25(D+L+S)

$\pm$

La hipótesis 0.9D $\pm$ 1.1 SISMO, no la uso, por no ser crítica.

MOMENTOS EN COLUMNAS POR CARGAS MUERTAS

PISO	COL.	1.5 CM		CM	
		M_s(tn-m)	M_I(Tn-m)	M_s(Tn-m)	M_I(Tn-m)
11	C4-A	+5.32	+5.07	+3.54	+3.54
	C4-B	+0.03	+0.31	+0.02	+0.21
	C4-C	-5.31	-5.49	-3.54	-3.66
10	C4-A	+4.37	+3.98	+2.92	+2.65
	C4-B	+0.35	+0.23	+0.23	+0.15
	C4-C	-4.90	-4.06	-3.26	-2.70
9ª	C4-A	+4.14	+4.72	+2.76	+3.15
	C4-B	+0.20	+0.33	+0.13	+0.22
	C4-C	-4.33	-5.19	-2.81	-3.46
8ª	C4-A	+4.68	+4.07	+3.12	+2.71
	C4-B	+0.33	+0.22	+0.22	+0.15
	C4-C	-5.15	-4.13	-3.44	-2.75
7ª	C4-A	+4.09	+4.71	+2.72	+3.14
	C4-B	+0.23	+0.34	+0.15	+2.27
	C4-C	-4.14	-5.18	-2.76	-3.46
6ª	C4-A	+4.70	+4.07	+3.14	+2.71
	C4-B	+0.35	+0.24	+0.23	+0.16
	C4-C	-5.18	-4.14	-3.46	-2.76
5ª	C4-A	+4.08	+4.69	+2.72	+3.13
	C4-B	+0.23	+0.33	+0.15	+0.22
	C4-C	-4.12	-5.15	-3.44	-2.75
4ª	C4-A	+4.72	+5.16	+3.15	+2.78
	C4-B	+0.34	+0.24	+0.23	+0.26
	C4-C	-5.21	-4.24	-3.48	-2.83
3ª	C4-A	+3.95	+4.31	+2.64	+2.88
	C4-B	+0.22	+0.32	+0.15	+0.21
	C4-C	-4.02	-4.76	-2.68	-3.18

PISO	COL.	1.5CM		CM.	
		M_S (Tn-m)	M_I (Tn-m)	M_S (Tn-m)	M_I (Tn-m)
2º	C4-A	+5.14	+5.65	+3.43	+3.77
	C4-B	+0.36	+0.37	+0.24	+0.25
	C4-C	-5.67	-5.80	-3.78	-3.87
1º	C4-A	+2.25	+1.10	+1.50	+0.73
	C4-B	+0.08	+0.00	+0.05	+0.00
	C4-C	-2.27	-0.16	-1.51	-0.11

MOMENTOS EN COLUMNAS POR CARGAS VIVAS

PRIMERA COMBINACION DE SOBRECARGAS

PISO	COL.	1.8CM-1		CV-1	
		M_S (Tn-m)	M_I (tn-M	M_S (Tn-m)	M_I (Tn-m)
11º	C4-A	+1.43	-0.05	+0.80	-0.03
	C4-B	-1.28	+2.00	-0.71	+1.11
	C4-C	-0.01	-2.13	0.00	-1.18
10º	C4-A	+0.07	+0.04	+0.91	
	C4-B	+1.91	-1.51	+1.06	-0.84
	C4-C	-2.11	0.00	-1.17	0.00
9º	C4-A	+1.61	+0.02	+0.90	+0.01
	C4-B	-1.48	+1.05	-0.82	+0.58
	C4-C	+0.01	-2.10	+0.00	-1.17
8º	C4-A	+0.02	+1.61	+0.01	+0.90
	C4-B	+1.94	-1.51	+1.08	-0.84
	C4-C	-2.11	-0.01	-1.17	0.00
7º	C4-A	+1.61	+0.02	+0.90	+0.01
	C4-B	-1.50	+1.96	-0.83	+1.09
	C4-C	-0.01	-2.11	0.00	-1.17
6º	C4-A	+0.02	+1.61	+0.01	+0.90
	C4-B	+1.96	-1.49	+1.09	-0.83
	C4-C	-2.11	-0.01	-1.17	-0.00
5º	C4-A	+1.61	+0.02	+0.90	+0.00
	C4-B	-1.50	+1.94	-0.83	+1.08
	C4-C	-0.01	-2.11	0.00	-1.17
4º	C4-A	+0.03	+1.63	+0.02	+0.91
	C4-B	+1.95	-1.48	+1.08	-0.82
	C4-C	-2.11	-0.01	-1.17	0.00
3º	C4-A	+1.58	-0.04	+0.88	-0.02
	C4-B	-1.51	+1.93	-0.84	+1.07
	C4-C	+0.03	-2.00	+0.02	-1.11
2º	C4-A	+0.08	+1.87	+0.04	+1.07
	C4-B	+2.01	-1.25	+1.12	-0.70
	C4-C	-2.26	-0.44	-1.26	-0.02
1º	C4-A	+1.31	+0.68	+0.73	+0.38
	C4-B	-1.80	-0.86	-1.00	-0.48
	C4-C	+0.45	+0.25	+0.25	+0.14

SEGUNDA COMBINACION DE SOBRECARGAS

PISO	COL.	1.8CV-2		CV-2	
		M_S (Tn-m)	M_I (Tn-m)	M_S (Tn-m)	M_I (Tn-m)
11º	C4-A	-0.01	+1.63	-0.00	+0.91
	C4-B	+1.81	-1.64	+0.73	-0.92
	C4-C	-1.41	+0.12	-0.78	+0.67
10º	C4-A	+1.51	-0.03	+0.84	-0.02
	C4-B	-1.51	+1.94	-0.84	+1.08
	C4-C	-0.16	-1.75	-0.09	-0.97
9º	C4-A	+1.57	-0.02	+0.87	
	C4-B	+1.89	-1.61	+1.05	-0.89
	C4-C	-1.71	-0.02	-0.95	-0.01
8º	C4-A	+1.56	-0.03	+0.87	-0.02
	C4-B	-1.59	+1.90	-0.88	+1.06
	C4-C	-0.04	-1.73	-0.02	-0.96
7º	C4-A	-0.03	+1.57	-0.02	+0.87
	C4-B	+1.89	-1.59	+1.05	-0.88
	C4-C	-1.73	-0.03	-0.96	-0.02
6º	C4-A	+1.56	-0.03	+0.87	-0.02
	C4-B	-1.61	+1.88	-0.89	+1.04
	C4-C	-0.04	-1.73	-0.02	-0.96
5º	C4-A	-0.04	+1.55	-0.02	+0.86
	C4-B	+1.88	-1.60	+1.04	-0.89
	C4-C	-1.73	-0.03	-0.96	-0.02
4º	C4-A	+1.56	-0.03	+0.87	-0.02
	C4-B	-1.60	+1.88	-0.89	+1.04
	C4-C	-0.05	-1.74	-0.03	-0.97
3º	C4-A	-0.06	+1.47	+0.03	+0.82
	C4-B	+1.88	-1.58	+1.04	-0.88
	C4-C	-1.73	+0.02	-0.96	+0.01
2º	C4-A	+1.65	+2.90	+0.92	+1.61
	C4-B	-1.62	+1.80	+1.00	+1.00
	C4-C	-0.11	-2.00	-0.06	-1.11
1º	C4-A	-0.37	-0.27	-0.21	-0.15
	C4-B	+2.01	+0.86	+1.12	+0.48
	C4-C	-1.43	-0.80	-0.79	-0.44

TERCERA COMBINACION DE SOBRECARGAS

PISO	COL.	1.8CV-3		CV3	
		M_S (Ton-m)	M_I (Ton-m)	M_S (Ton-m)	M_I (Ton-m)
11º	C4-A	+1.33	-0.03	+0.74	-0.02
	C4-B	-0.03	-0.06	-0.02	-0.06
	C4-C	-1.36	+0.08	-1.76	+0.04
10º	C4-A	+0.02	+1.53	+0.01	+1.85
	C4-B	-0.04	+0.38	-0.02	+0.21
	C4-C	-0.20	-1.70	-0.11	-0.95
9º	C4-A	+1.49	+0.03	+0.83	+0.02
	C4-B	-0.303	+0.04	-0.17	-0.02
	C4-C	-1.68	-0.07	-0.93	-0.04
8º	C4-A	+0.02	-1.51	+0.01	-0.84
	C4-B	-0.05	+0.34	-0.03	+0.19
	C4-C	-0.10	-1.70	+0.00	-0.95
7º	C4-A	+1.50	+0.01	+0.83	0.00
	C4-B	+0.33	-0.05	+0.18	-0.03
	C4-C	-1.69	-0.07	-0.94	-0.04
6º	C4-A	-0.01	+1.51	0.00	+0.84
	C4-B	-0.04	+0.38	-0.03	+0.21
	C4-C	-0.08	-1.70	-0.04	-0.95
5º	C4-A	+1.52	+0.02	+0.84	+0.01
	C4-B	+0.34	-0.06	+0.19	-0.03
	C4-C	-1.69	-0.07	-0.94	-0.04
4º	C4-A	+0.02	+1.52	+0.01	+1.85
	C4-B	-0.05	+0.35	-0.03	+0.19
	C4-C	-0.08	-1.71	-0.04	-0.95
3º	C4-A	+1.49	-0.05	+0.83	-0.03
	C4-B	+0.35	-0.07	+0.19	-0.04
	C4-C	-1.68	-0.03	-0.93	-0.02
2º	C4-A	+0.08	+1.71	+0.04	+0.95
	C4-B	-0.03	+0.35	-0.02	+0.19
	C4-C	-0.15	-1.96	-0.08	-1.09
1º	C4-A	+1.28	+0.55	+0.71	+0.31
	C4-B	+0.33	-0.01	+0.18	-0.00
	C4-C	-1.38	-0.78	-0.77	-0.43

CUARTA COMBINACION DE SOBRECARGAS

PISO	COL	1.8CV-4		CV-4	
		M_S (ton-m)	M_I (Tn-m)	M_S (Ton-m)	M_I (Ton-m)
11°	C4-A	+0.09	+1.56	+0.05	+0.87
	C4-B	+0.06	+0.40	+0.03	+0.22
	C4-C	-0.05	-2.08	-0.03	-1.15
10ª	C4-A	+1.56	+0.08	+0.87	+0.04
	C4-B	-0.40	+0.05	-0.22	+0.03
	C4-C	-2.07	-0.04	-1.15	-0.02
9ª	C4-A	+0.07	+1.55	+0.04	+0.86
	C4-B	+0.04	+0.39	+0.02	+0.22
	C4-C	-0.05	-2.08	-0.03	-1.15
8ª	C4-A	+1.55	+0.07	+0.86	+0.04
	C4-B	+0.40	+0.04	+0.22	+0.02
	C4-C	-2.07	-0.05	-1.15	-0.03
7ª	C4-A	+0.08	+1.57	+0.04	+0.87
	C4-B	+0.04	+0.39	+0.02	+0.22
	C4-C	-0.05	-2.08	-0.03	-1.15
6ª	C4-A	+1.55	+0.07	+1.86	+0.04
	C4-B	+0.40	+0.04	+0.22	+0.02
	C4-C	-2.08	-0.05	-1.15	-0.03
5ª	C4-A	+0.07	+1.55	+0.04	+0.86
	C4-B	+0.04	+0.40	+0.02	+0.22
	C4-C	-0.05	-2.08	-0.03	-1.15
4ª	C4-A	+1.56	+0.09	+0.87	+0.05
	C4-B	+0.40	+0.04	+0.22	+0.02
	C4-C	-2.09	-0.07	-1.16	-0.04
3ª	C4-A	+0.05	+1.48	+0.03	+0.82
	C4-B	+0.03	+0.37	+0.02	+0.21
	C4-C	+0.00	-1.95	0.00	-1.08
2ª	C4-A	+1.66	+0.44	+0.87	+0.24
	C4-B	+0.40	+0.15	+0.22	+0.08
	C4-C	-2.19	-0.45	-1.22	-0.25
1ª	C4-A	-0.35	+0.16	-0.19	+0.09
	C4-B	-0.11	-0.03	-0.06	-0.02
	C4-C	+0.38	+0.22	+0.21	+0.12

MOMENTOS EN COLUMNAS: POR SISMO

CONVENCION DE SIGNOS - +

PISO	COL.	SISMO →		SISMO ←	
		M_S (Tn-m)	M_I (Tn-m)	M_S (Tn-m)	M_I (Tn-m)
11º	C4-A	-3.13	-0.17	+3.13	+0.17
	C4-B	-5.84	+0.29	+5.84	-0.29
	C4-C	-3.13	-0.17	+3.13	+0.17
10º	C4-A	-5.66	+0.27	+5.66	-0.27
	C4-B	-10.90	+0.11	10.90	-0.11
	C4-C	-5.66	+0.27	+5.66	-0.27
9º	C4-A	-6.05	-0.67	+6.05	+0.67
	C4-B	-11.70	-1.74	11.70	+1.74
	C4-C	-6.05	-0.67	+6.05	+0.67
8º	C4-A	-5.84	-1.46	+5.84	+1.46
	C4-B	-13.50	-3.21	13.50	+3.21
	C4-C	-5.84	-1.46	+5.84	+1.46
7º	C4-A	-5.46	-1.82	+5.46	+1.82
	C4-B	-10.64	-2.94	10.64	+2.94
	C4-C	-5.46	-1.82	+5.46	+1.82
6º	C4-A	-4.64	-2.49	+4.64	+2.49
	C4-B	-9.00	-5.06	+9.00	+5.06
	C4-C	-4.64	-2.49	+4.64	+2.49
5º	C4-A	-3.96	-2.64	+3.96	+2.64
	C4-B	-7.90	-5.26	+7.90	+5.26
	C4-C	-3.96	-2.64	+3.96	+2.64
4º	C4-A	-2.97	-2.97	+2.97	+2.97
	C4-B	-2.97	-2.97	+2.97	+2.97
	C4-C	-2.97	-2.97	+2.97	+2.97
3º	C4-A	-1.74	-3.20	+1.74	+3.20
	C4-B	-3.53	-6.30	+3.54	+6.30
	C4-C	-1.74	-3.20	+1.74	+3.20
2º	C4-A	-0.81	-2.72	+0.81	+2.72
	C4-B	-1.83	-5.24	+1.83	+5.24
	C4-C	-0.81	-2.72	+0.81	+2.72
1º	C4-A	-6.05	+0.39	+6.05	-0.39
	C4-B	-9.80	0.00	+9.80	0.00
	C4-C	-6.05	+0.39	+6.05	-0.39

PRIMERA COMBINACION 1.5CM + 1.8L

PISO	COL.	1.5CM		1.8CV-1		1.5CM+1.8CV-1	
		M_S(T-n)	M_I(T-n)	M_S(T-n)	M_I(T-n)	M_S(T-n)	M_I(T-n)
11º	C4-A	+5.32	+5.07	+1.43	-0.05	+6.75	+6.50
	C4-B	+0.03	+0.31	-1.28	+2.00	-1.25	+2.31
	C4-C	-5.31	-5.49	-0.01	-2.13	-5.32	-7.62
10º	C4-A	+4.37	+3.98	+0.07	+1.63	+4.44	+5.61
	C4-B	+0.35	+0.23	+1.91	-1.51	+2.26	-1.28
	C4-C	-4.90	-4.06	-2.11	0.00	-7.01	-4.06
9º	C4-A	+4.14	4.72	+1.61	+0.02	+5.75	+4.74
	C4-B	+0.35	+0.33	-1.48	+1.05	-1.13	+1.38
	C4-C	-4.22	-5.19	+0.01	-2.10	-4.21	-7.20
8º	C4-A	+4.68	+4.07	+0.02	+1.61	+4.70	+5.68
	C4-B	+0.33	+0.22	+1.94	-1.51	+2.27	-1.29
	C4-C	-5.15	-4.13	-2.11	-0.01	-7.26	-4.14
7º	C4-A	+4.09	+4.71	+1.61	+0.02	+5.70	+4.73
	C4-B	+0.23	+0.34	-1.50	+1.96	-1.27	+2.30
	C4-C	-4.14	-5.18	-0.01	-2.11	-4.15	-7.29
6º	C4-A	+4.70	+4.07	+0.02	+1.61	+4.72	+5.68
	C4-B	+0.35	+0.24	+1.96	-1.49	+2.31	-1.25
	C4-C	-5.18	-4.14	-2.11	-0.01	-9.29	-4.15
5º	C4-A	+4.08	4.69	+1.61	+0.02	+5.69	+4.71
	C4-B	+0.23	+0.33	-1.50	+1.94	-1.27	+2.27
	C4-C	-4.12	-5.15	-0.01	-2.11	-4.13	-7.26
4º	C4-A	+4.72	+4.16	+0.03	+1.63	+4.75	+5.79
	C4-B	+0.34	+0.24	+1.95	-1.48	+2.29	-1.24
	C4-C	-5.21	-4.24	-2.11	-0.01	-7.32	-4.25
3º	C4-A	+3.95	-4.31	+1.58	-0.04	+5.43	-4.35
	C4-B	+0.22	+0.32	-1.51	+1.93	-1.29	+2.25
	C4-C	-1.02	-4.76	+0.03	-2.00	-4.05	-6.76
2º	C4-A	+5.14	+5.65	+0.08	+1.87	+5.22	+7.52
	C4-B	+0.36	+0.37	+2.01	-1.25	+2.37	-0.88
	C4-C	-5.67	-5.80	-2.26	-0.44	-7.93	-6.24
1º	C4-A	+2.25	+1.10	+1.31	+0.68	+3.56	+1.78
	C4-B	+0.08	+0.00	-1.80	-0.86	-1.72	-0.86
	C4-C	-2.27	-0.16	+0.45	+0.25	-1.82	+0.09

Piso	Col.	1.5 CM		1.8CV-2		1.5CM+1.8CV-2	
		M_S(tn)	M_I(tn)	M_S(Tn)	M_I(tn)	M_S(tn)	M_I(tn)
11º	C4-A	+5.32	+5.07	-0.01	+1.63	+5.31	+6.70
	C4-B	+0.03	+0.31	+1.31	-1.64	+1.34	-1.33
	C4-C	-5.31	-5.49	-1.41	+0.12	-6.72	-5.37
10º	C4-A	+4.37	+3.98	+1.51	-0.03	+5.88	+4.01
	C4-B	+0.35	+0.23	-1.51	+1.94	-1.16	+2.17
	C4-C	-4.90	-4.06	-0.16	-1.75	-5.06	-5.81
9º	C4-A	+4.14	+4.72	-0.03	+1.57	+4.17	+6.29
	C4-B	+0.20	+0.33	+1.89	-1.61	+2.09	-1.28
	C4-C	-4.22	-5.19	-1.71	-0.02	-5.93	-5.21
8º	C4-A	+4.68	+4.07	+1.56	-0.03	+6.24	+4.04
	C4-B	+0.33	+0.22	-1.59	+1.90	-1.26	+2.12
	C4-C	-5.15	-4.13	-0.04	-1.73	-5.11	-5.86
7º	C4-A	+4.09	+4.71	-0.03	+1.57	+4.06	+6.28
	C4-B	+0.23	+0.34	+1.89	-1.59	+2.12	+1.25
	C4-C	-4.14	-5.18	-1.73	-0.03	-5.87	-5.21
6º	C4-A	+4.70	+4.70	+1.56	-0.03	+6.26	+4.04
	C4-B	+0.35	+0.24	-1.61	+1.88	-1.26	+2.12
	C4-C	-5.18	-4.14	-0.04	-1.73	-5.14	-4.87
5º	C4-A	+4.08	+4.69	-0.04	+1.55	+4.12	+6.24
	C4-B	+0.23	+0.33	+1.88	-1.60	+2.11	-1.27
	C4-C	-4.12	-5.15	-1.73	-0.03	-5.85	-5.18
4º	C4-A	+4.72	+4.16	+1.56	-0.03	+6.28	+4.12
	C4-B	+0.34	+0.24	-1.60	+1.88	-1.26	+2.12
	C4-C	-5.21	-4.24	-0.05	-1.74	-5.26	-5.98
3º	C4-A	+3.95	+4.31	-0.06	+1.47	+3.89	+5.78
	C4-B	+0.22	+0.32	+1.88	-1.58	+2.10	-1.26
	C4-C	-4.02	-4.76	-1.73	+0.02	-5.75	-4.78
2º	C4-A	+5.14	+5.65	+1.65	+2.90	+6.79	+8.55
	C4-B	+0.36	+0.37	-1.62	+1.80	-1.26	+2.17
	C4-C	-5.67	-5.80	-0.11	-2.00	-5.78	-7.80
1º	C4-A	+2.25	+1.10	-0.37	-0.27	+1.88	+0.83
	C4-B	+0.08	+0.00	+2.01	+0.86	+2.09	+0.86
	C4-C	-2.27	-0.16	-1.43	-0.80	-3.67	-0.96

Piso	Col.	1.5 CM		1.8CV-3		1.5CM+1.8CV-3	
		M_S(Tn)	M_I(Tn)	M_S(T-n)	M_I(T-n)	M_S(T-n)	M_I(T-n)
11º	C4-A	+5.32	+5.07	+1.33	-0.03	+6.65	+5.04
	C4-B	+0.03	+0.31	-0.03	-0.06	0.00	+0.25
	C4-C	-5.31	-5.49	-1.36	+0.08	-6.67	-5.41
10º	C4-A	+4.37	+3.98	+0.02	+1.53	+4.39	+5.51
	C4-B	+0.35	+0.23	-0.04	+0.38	+0.31	+0.61
	C4-C	-4.90	-4.06	-0.20	-1.70	-5.10	-5.76
9º	C4-A	+4.14	+4.72	+1.49	+0.03	+5.63	+4.75
	C4-B	+0.20	+0.33	+0.30	-0.01	-0.50	+0.83
	C4-C	-4.22	-5.19	-1.68	-0.07	-5.90	-5.26
8º	C4-A	+4.68	+4.07	+0.02	-1.51	+4.70	+2.56
	C4-B	+0.33	+0.22	-0.05	+0.34	+0.27	+0.49
	C4-C	-5.15	-4.13	-0.10	-1.70	-5.25	-5.87
7º	C4-A	+4.09	+4.71	+1.50	+0.01	+5.59	+4.72
	C4-B	+0.23	+0.34	+0.33	-0.05	-0.56	-0.39
	C4-C	-4.14	-5.18	-1.69	-0.07	-5.83	-5.25
6º	C4-A	+4.70	+4.07	-0.01	+1.51	+4.69	+5.58
	C4-B	+0.35	+0.24	-0.04	+0.38	+0.31	+0.62
	C4-C	-5.18	-4.14	-0.08	-1.70	-5.26	-5.84
5º	C4-A	+4.08	+4.69	+1.52	+0.02	+5.60	+4.71
	C4-B	+0.23	+0.23	+0.34	-0.06	+0.57	+0.17
	C4-C	-4.12	-5.15	-1.69	-0.07	-5.80	-5.22
4º	C4-A	+4.72	+4.16	+0.02	+1.52	+4.74	+5.68
	C4-B	+0.34	+0.24	-0.05	+0.35	+0.29	+0.19
	C4-C	-5.21	-4.24	-0.08	-1.71	-5.13	-5.95
3º	C4-A	+3.95	+4.31	+1.49	-0.05	+5.44	+4.26
	C4-B	+0.22	+0.32	+0.35	-0.07	+0.57	+0.25
	C4-C	-4.02	-4.76	-1.68	-0.03	-5.70	-4.79
2º	C4-A	+5.14	+5.65	+0.08	+1.71	+5.22	+7.36
	C4-B	+0.36	+0.37	-0.03	+0.35	+0.33	+0.72
	C4-C	-5.67	-5.80	-0.15	-1.96	-5.82	-7.76
1º	C4-A	+2.25	+1.10	+1.28	+0.55	+3.53	+1.65
	C4-B	+0.08	+0.00	+0.33	-0.01	+0.41	+0.41
	C4-C	-2.27	-0.16	-1.38	-0.78	-3.65	-0.94

Piso	COL.	1.5CM.		1.8CV-4		1.5CM+1.8CV-4	
		M_S (T-n)	M_I (T-n)	M_S (T-m)	M_I (T-m)	M_S (T-n)	M_I (T-m)
11º	C4-A	+5.32	+5.07	+0.09	+1.56	+5.41	+6.63
	C4-B	+0.03	+0.31	+0.06	+0.40	+0.09	+0.71
	C4-C	-5.31	-5.49	-0.05	-2.09	-5.36	-7.56
10º	C4-A	+4.37	+3.98	+1.56	+0.08	+5.93	+4.06
	C4-B	+0.35	+0.23	-0.40	+0.05	-0.05	+0.28
	C4-C	-4.90	-4.06	-2.07	-0.04	-6.97	-4.10
9º	C4-A	+4.14	+4.72	+0.07	+1.55	+4.21	+6.27
	C4-C	-4.22	-5.19	-0.05	-2.08	-4.27	-7.27
	C4-B	+0.20	+0.33	+0.04	+0.39	+0.24	+0.72
8º	C4-A	+4.68	+4.07	+1.55	+0.07	+6.23	+4.14
	C4-B	+0.33	+0.22	+0.40	+0.04	+0.73	+0.26
	C4-C	-5.15	-4.13	-2.07	-0.05	-7.22	-4.18
7º	C4-A	+4.09	+4.71	+0.08	+1.57	+4.17	+6.28
	C4-B	+0.23	+0.34	+0.04	+0.39	+0.27	+0.73
	C4-C	-4.14	-5.18	-0.05	-2.08	-4.19	-7.26
6º	C4-A	+4.70	+4.07	+1.55	+0.07	+6.25	+4.14
	C4-B	+0.35	+0.24	+0.40	+0.04	+0.75	+0.28
	C4-C	-5.18	-4.14	-2.08	-0.05	-7.26	-4.19
5º	C4-A	+4.08	+4.69	+0.07	+1.55	+4.15	+6.24
	C4-B	+0.23	+0.33	+0.04	+0.40	+0.27	+0.73
	C4-C	-4.12	-5.15	-0.05	-2.08	-4.17	-7.23
4º	C4-A	+4.72	+4.16	+1.56	+0.09	+6.28	+4.25
	C4-B	+0.34	+0.24	+0.40	+0.04	+0.74	+0.28
	C4-C	-5.21	-4.24	-2.09	-0.07	-7.30	-4.31
3º	C4-A	+3.95	+4.31	+0.05	+1.48	+4.00	+5.97
	C4-B	+0.22	+0.32	+0.03	+0.37	+0.25	+0.69
	C4-C	-4.02	-4.76	+0.00	-1.95	-4.02	-6.71
2º	C4-A	+5.14	+5.65	+1.66	+0.44	+6.80	+6.09
	C4-B	+0.36	+0.37	+0.40	+0.15	+0.76	+0.52
	C4-C	-5.67	-5.80	-2.19	-0.45	-7.86	-6.25
1º	C4-A	+2.25	+1.10	-0.35	+0.16	+2.90	+1.26
	C4-B	+0.08	+0.00	-0.11	-0.03	-0.03	-0.03
	C4-C	-2.27	-0.16	+0.38	+0.22	-1.89	+0.06

SEGUNDA COMBINACION

1.25 (CM + CV + S)

Como CM + S $\overrightarrow{\leftarrow}$ son constantes y varía sólo, haré previamente CM + S$\overrightarrow{\leftarrow}$

PISO	COLUMNA	CM		SISMO →		SISMO ←		CM + S →		CM + S ←	
		M_S(Tn)	M_I(Tn)	M_S(Tn)	M_I(tn)	M_S(Tn)	M_I(Tn)	M_S(Tn-m)	M_I(Tn-m)	M_S(Tn-m)	M_I(Tn-m)
11º	C4-A	+3.54	+3.54	-3.13	-0.17	+3.13	+0.17	+0.41	+3.37	+6.67	+3.71
	C4-B	+0.02	+0.21	-5.84	+0.29	+5.94	-0.29	-5.82	+0.50	+5.86	-0.08
	C4-C	-3.54	-3.66	-3.13	-0.17	+3.13	+0.17	-6.67	-3.83	-0.41	-3.49
10º	C4-A	+2.92	+2.65	-5.66	+0.27	+5.66	-0.27	-2.74	+2.92	+8.58	+2.44
	C4-B	+0.23	+0.15	-10.90	+0.11	+10.90	-0.11	-10.67	+0.26	+11.13	+0.04
	C4-C	-3.26	-2.70	-5.66	+0.27	+5.66	-0.27	-8.92	-2.43	+2.43	-2.97
9º	C4-A	+2.76	+3.15	-6.05	-0.67	+6.05	+0.67	-3.29	+2.85	+8.81	+3.82
	C4-C	-2.81	-3.46	-6.05	-0.67	+6.05	+0.67	-8.86	-4.13	+3.14	-2.79
8º	C4-A	+3.12	+2.71	-5.84	-1.46	+5.84	+1.46	-2.72	+1.25	+8.96	+4.17
	C4-B	+0.22	+0.15	-1.35	-3.21	-13.5	+3.21	-13.28	-3.06	+13.72	+3.36
	C4-C	-3.44	-2.75	-5.84	-1.46	+5.84	+1.46	-9.28	-4.21	+2.40	-1.29
7º	C4-A	+2.72	+3.14	-5.46	-1.82	+5.46	+1.82	-2.74	-1.23	+8.18	+4.96
	C4-B	+0.15	+2.27	-10.64	-2.94	+10.64	+2.94	-10.49	-0.67	+10.79	+5.21
	C4-C	-2.76	-3.46	-5.46	-1.82	+5.46	+1.82	-8.22	-5.28	+2.70	-1.64

(Continuación)

Piso	Columna	CM		SISMO →		SISMO ←		CM+S→		CM+S ←	
		M_S(Tn)	M_I(Tn)	M_S(Tn)	M_I(Tn)	M_S(Tn)	M_I(Tn)	M_S(Tn-m)	M_I(Tn-m)	M_S(Tn-m)	M_I(Tn-m)
6º	C4-A	+3.14	+2.71	-4.64	-2.49	+4.64	+2.49	-1.50	-0.27	+7.78	+5.20
	C4-B	+0.23	+0.16	-9.00	-5.06	+9.00	+5.06	-8.77	-4.90	+9.23	+5.22
	C4-C	-3.46	-2.76	-4.64	-2.49	+4.64	+2.49	-8.10	-5.25	+1.18	-0.27
5º	C4-A	+2.72	+3.13	-3.96	-2.64	+3.96	2.64	-1.24	+0.49	+6.68	+5.77
	C4-B	+0.15	+0.22	-7.90	-5.26	+7.90	+5.26	-7.75	-5.04	+8.05	+5.48
	C4-C	-3.44	-2.75	-3.96	-2.64	+3.96	+2.64	-7.40	-5.39	+0.52	-0.11
4º	C4-A	+3.15	+2.78	-2.97	-2.97	+2.97	+2.97	+0.18	-0.19	+6.12	+5.75
	C4-B	+0.23	+0.26	-2.97	-2.97	+2.97	+2.97	-2.74	-2.71	+3.20	+5.23
	C4-C	-3.48	-2.86	-2.97	-2.97	+2.97	+2.97	-6.81	-5.80	-0.51	+0.14
3º	C4-A	+2.64	+2.88	-1.74	-3.20	+1.74	+3.20	+0.90	-0.32	+4.38	+6.08
	C4-B	+0.15	+0.21	-3.54	-6.30	+3.54	+6.30	-3.39	-6.09	+3.69	+6.51
	C4-C	-2.68	-3.18	-1.74	-3.20	+1.74	+3.20	-4.42	-6.38	-0.94	+0.02
2º	C4-A	+3.48	+3.77	-0.81	-2.72	0.81	+2.72	+2.67	+1.05	+4.29	+6.49
	C4-B	+0.24	+0.25	-1.83	-5.24	+1.83	+5.24	-1.59	-3.99	+2.07	+5.49
	C4-C	-3.78	-3.87	-0.81	-2.72	+0.81	+2.72	-4.59	-6.59	-2.97	-1.15
1º	C4-A	+1.50	+0.73	-6.05	+0.39	+6.05	-0.39	-4.55	+1.12	+7.55	+0.34
	C4-B	+0.05	+0.00	-9.80	0.00	+9.80	0.00	-9.75	0.00	+0.85	0.00
	C4-C	-1.51	-0.11	-6,05	+0.39	+6.05	-0.39	-7.66	+0.28	+4.54	-0.50

Piso	Col.	CM + S		CV-1		CM+S+CV-1		1.25(CM+CV-1+S)	
		M_S(T-m)	M_I(T-m)	M_S(T-m)	M_I(T-m)	M_S(T-m)	M_I(T-m)	M_S(T-m)	M_I(T-m)
11	C4-A	+0.41	+3.37	+0.80	-0.03	+1.21	+3.34	+1.510	+4.17
	C4-B	-5.82	+0.50	-0.71	+1.11	-6.53	+1.61	-8.16	+2.02
	C4-C	-6.67	-3.83	0.00	-1.18	-6.67	-5.01	-8.34	-6.26
10	C4-A	-2.74	+2.92	+0.40	+0.91	+2.34	+3.83	+2.82	+4.80
	C4-B	-10.67	+0.26	+1.06	-0.84	-9.61	-0.58	-12.0	-0.72
	C4-C	-8.92	-2.43	-1.17	0.00	-10.09	-2.43	-12.6	-3.04
9	C4-A	-3.29	+2.84	+0.90	+0.01	-2.39	+2.85	-2.99	+3.56
	C4-B	-11.57	-1.52	-0.82	+0.589	-12.39	-0.940	-15.50	-1.17
	C4-C	-8.86	-4.13	0.00	-1.17	-8.86	-5.30	-11.10	-6.64
8º	C4-A	-2.72	+1.25	+0.01	+0.90	-2.71	+2.15	-3.39	+2.69
	C4-B	-131.2	-2.97	+10.8	-0.84	-12.2	-3.81	-15.2	-4.76
	C4-C	-9.28	-4.21	-1.17	0.00	-10.45	-4.21	-13.10	-5.26
7º	C4-A	-2.74	-1.23	+0.90	+0.01	-1.84	-1.22	-2.30	-1.53
	C4-B	-10.49	-0.67	-0.83	+1.09	-11.32	-0.42	+14.20	-0.52
	C4-C	-8.22	-5.28	0.00	-1.17	-8.28	-6.45	-10.35	-8.065
6º	C4-A	-1.50	-0.22	+0.01	+0.90	-1.49	+0.68	-1.86	+0.85
	C4-B	-8.77	-4.90	+1.09	-0.83	-7.68	-5.73	-9.60	-7.16
	C4-C	-8.10	-5.25	-1.17	0.00	-9.27	-5.25	-11.60	-6.56
5º	C4-A	-1.24	+0.49	+0.90	0.00	-0.34	+0.49	-0.42	+0.61
	C4-B	-7.75	-5.04	-0.83	+1.08	-8.58	-4.96	-10.70	-6.70
	C4-C	-7.40	-5.39	-0.00	-1.17	-7.40	-6.26	-9.26	-7.85
4º	C4-A	+0.18	-0.19	+0.02	+0.91	+0.20	+0.72	+0.25	+0.90
	C4-B	-2.74	-2.71	+1.08	-0.82	-1.66	-3.53	-2.08	-4.42
	C4-C	-6.81	-5.80	-1.17	0.00	-7.98	-5.80	-10.0	-7.25
3º	C4-A	+0.90	-0.32	+0.88	-0.02	+1.78	-0.34	+2.23	-0.42
	C4-B	-3.39	-6.09	-0.84	+1.07	-4.23	-5.02	-5.30	-6.28
	C4-C	-4.42	-6.38	+0.02	-1.11	-4.40	-7.49	-5.50	-9.36
2º	C4-A	+2.69	+1.05	+0.04	+1.07	+2.71	+2.12	+3.40	+2.66
	C4-B	-1.59	-4.99	+1.22	-0.70	-0.47	-5.69	-0.59	-7.12
	C4-C	-4.59	-6.59	-1.26	-0.02	-5.85	-6.61	-7.32	-8.26
1º	C4-A	-4.55	+1.22	+0.73	+0.38	-3.82	+1.50	-4.78	+1.88
	C4-B	-9.75	0.00	-1.00	-0.48	-10.75	-1.00	-13.45	-1.25
	C4-C	-7.66	+0.28	+0.25	+0.14	-7.41	+0.42	-9.30	+0.52

Col.	CM + S +		CV		CM+CV-1+S		1.25(CM+CV1+S	
	M_S(T-n)	M_I(Tn-m)	M_S(Tn-m)	M_I(T-n)	M_S(T-m)	M_I(T-m)	M_S(T-n)	M_I(T-m)
C4-A	+6.67	+3.71	+0.08	-0.03	+6.75	+3.68	+8.44	+4.10
C4-B	+5.86	-0.08	-0.71	+1.11	+5.15	+1.03	+6.44	+1.28
C4-C	-0.41	-3.49	0.00	-1.18	-0.41	-4.67	-0.51	-5.34
C4-A	+8.58	+2.44	+0.04	+0.91	+8.62	+3.35	+10.8	+4.18
C4-B	+11.13	+0.04	+1.06	-0.84	+12.69	-0.80	+15.20	-1.00
C4-C	+2.43	-2.97	-1.17	0.00	+1.26	-2.97	+1.57	-3.70
C4-A	+8.81	+3.82	+0.90	+0.01	+9.71	+3.83	+11.22	+4.80
C4-B	+11.83	+1.96	-0.82	+0.58	+11.01	+2.54	+13.75	+3.18
C4-C	+3.24	-2.79	0.00	-1.17	+3.24	-3.96	+4.05	-4.95
C4-A	+8.96	+4.17	+0.01	+0.90	+8.97	+5.04	+11.15	+6.30
C4-B	+13.62	+3.36	+1.08	-0.84	+14.70	+2.52	+18.40	+3.12
C4-C	+2.40	-1.29	-1.17	0.00	+1.23	-1.29	+1.54	-1.61
C4-A	+8.18	+4.96	+0.90	+0.01	+9.08	+4.97	+11.40	+6.20
C4-B	+10.79	+5.21	-0.83	+1.09	+9.96	+6.30	+12.40	+7.86
C4-C	+2.70	-1.64	0.00	-1.17	+2.70	-2.81	+3.38	-3.51
C4-A	+7.78	+5.20	+0.01	+0.90	+7.79	+6.10	+9.24	+7.61
C4-B	+9.28	+5.22	+1.09	-0.83	+10.32	+4.39	+12.90	+5.50
C4-C	+1.18	-0.27	-1.17	-0.00	+0.01	-0.27	+0.01	-0.33
C4-A	+6.68	+5.77	+0.90	+0.00	+7.58	+5.77	+9.50	+7.20
C4-B	+8.05	+5.48	-0.83	+1.08	+7.22	+6.56	+9.00	+8.20
C4-C	+0.52	-0.11	0.00	-1.17	+0.52	-1.28	+0.65	-1.60
C4-A	+6.12	+5.75	+0.02	+0.91	+6.14	+6.66	+7.66	+8.32
C4-B	+3.20	+5.23	+1.08	-0.82	+4.28	+4.41	+5.35	+5.50
C4-C	-0.51	+0.14	-1.17	0.00	-1.68	-1.54	-2.10	-1.93
C4-A	+4.38	+6.08	+0.88	-0.02	+5.26	+6.06	+6.56	+7.56
C4-B	+3.69	+6.51	-0.84	+1.07	+2.85	+7.58	+3.56	+9.80
C4-C	-0.94	+0.02	+0.02	-1.11	-0.92	-1.09	-1.14	-1.36
C4-A	+4.29	+6.49	+0.04	+1.07	+4.31	+7.56	+5.19	+9.45
C4-B	+2.07	+5.49	+1.12	-0.70	+3.19	+4.79	+4.98	+6.00
C4-C	-2.97	-1.15	-1.26	-0.02	-4.23	-1.17	-5.18	-1.46
C4-A	+7.55	+0.34	+0.73	+0.38	+8.48	+0.72	+10.6	+0.90
C4-B	+9.85	0.00	-1.00	-0.48	+8.85	-0.48	+11.08	-0.60
C4-C	+4.54	-0.50	+0.25	+0.14	+4.79	-0.36	+6.00	-0.45

i	COL.	CM+S		CV-2		CM+$\vec{S}$+CV-2		1.25(CM+$\vec{S}$+CV-2)	
		M_S	M_I	M_S	M_I	M_S	M_I	M_S	M_I
1	C4-A	+0.41	+3.37	0.00	+0.91	+0.41	+4.28	+0.51	+5.36
	C4-B	-5.82	+0.50	+0.73	-0.92	-5.09	-0.42	-6.36	-0.52
	C4-C	-6.67	-3.83	-0.78	+0.67	+7.45	-3.16	-9.30	-4.95
0	C4-A	-2.74	+2.92	+0.84	-0.02	-1.90	+2.90	-2.38	+3.62
	C4-B	-10.67	+0.26	-0.84	+1.08	-11.49	+1.34	-14.35	+1.68
	C4-C	-8.92	-2.43	-0.09	-0.97	-9.01	-3.40	-11.30	-4.25
	C4-A	-3.29	+2.84	-0.02	+0.87	-3.31	+3.74	-4.14	+4.66
	C4-B	-11.59	-1.52	+1.05	-0.89	-10.54	-2.41	-13.20	-3.02
	C4-C	-8.86	-4.13	-0.95	-0.01	-9.81	-4.14	-12.30	-5.18
	C4-A	-2.72	+1.25	+0.87	-0.02	-1.85	+1.23	-2.31	+1.54
	C4-B	-13.28	-2.97	-0.88	+1.06	-14.16	-1.91	-17.70	-2.49
	C4-C	-9.28	-4.21	-0.02	-0.96	-9.30	-5.17	-11.60	-6.46
	C4-A	-2.74	-1.23	-0.02	+0.87	-2.76	-0.36	-3.45	-0.45
	C4-B	-10.49	-0.67	+1.05	-0.88	-9.44	-1.55	-11.80	-1.23
	C4-C	-8.22	-5.28	-0.96	-0.02	-9.18	-5.30	-11.50	-6.62
	C4-A	-1.50	-0.22	+0.87	-0.02	-0.63	-0.24	-0.79	-0.30
	C4-B	-8.71	-4.90	-0.89	+1.04	-9.66	-3.86	-12.1	-4.82
	C4-C	-8.10	-5.25	-0.02	-0.96	-8.12	-6.21	-10.15	-7.76
	C4-A	-1.24	+0.49	-0.02	+0.86	-1.26	+1.35	-1.57	+1.69
	C4-B	-7.75	-5.04	+1.04	-0.89	-6.71	+4.15	-8.40	-7.40
	C4-C	-7.40	-5.39	-0.96	-0.02	-8.36	-5.41	-10.45	-6.76
	C4-A	+0.18	-0.19	0.87	-0.02	+1.05	-0.21	+1.31	-0.26
	C4-B	-2.74	-2.71	-0.89	+1.04	-3.62	-1.67	-4.52	-2.08
	C4-C	-6.81	-5.80	-0.03	-0.97	-6.84	-6.77	-8.10	-8.36
	C4-A	+0.90	-0.32	-0.03	+0.82	+0.87	+0.50	+0.80	+0.62
	C4-B	-3.39	-6.09	+1.04	-0.88	-2.35	-6.97	-2.84	-8.70
	C4-C	-4.42	-6.38	-0.96	+0.01	-5.38	-6.87	-6.72	-7.96
	C4-A	+2.67	+1.05	+0.92	+1.61	+3.59	+2.06	+4.50	+2.58
	C4-B	-1.59	-4.99	+1.00	+1.00	-0.59	-3.99	-0.74	-4.00
	C4-C	-4.59	-6.59	-0.06	-1.16	-4.65	-7.70	-5.80	-9.60
	C4-A	-4.55	+1.12	-0.21	-0.15	-4.76	+0.97	-5.96	+1.21
	C4-B	-9.75	0.00	+1.12	+0.48	-8.63	+0.48	-10.80	+0.60
	C4-C	-7.66	+0.28	-0.79	-0.44	-8.45	+0.16	-0.20	+2.00

iso	COL.	CM+$\tilde{S}$		CV-2		CM+$\tilde{S}$+CV-2		1.25(CM+$\tilde{S}$+CV-2)	
		M_S Tn-m	M_I Tn-m	M_S Tn-m	M_I Tn-m	M_S Tn-m	M_I Tn-m	M_S Tn-m	M_I Tn-m
	C4-A	+6.67	+3.71	-0.00	+0.21	+6.67	+3.92	+8.35	+4.90
1	C4-B	+5.80	-0.08	+0.73	-0.92	+6.59	-1.00	+8.24	-1.25
	C4-C	-0.41	-3.49	-0.78	+0.67	-1.19	-2.82	-1.49	-3.52
	C4-A	+5.85	+2.44	+0.84	-0.02	+9.42	+2.42	+11.5	+3.02
0	C4-B	+11.13	+0.04	-0.84	+1.08	=10.29	+1.12	+12.85	-1.39
	C4-C	+2.43	-2.97	-0.09	-0.97	-2.34	-3.94	-2.82	-4.93
	C4-A	+8.81	+3.82	-0.02	+0.87	+8.79	+4.69	+11.0	+5.86
	C4-B	+11.83	+1.96	+1.05	-0.88	+12.88	+1.00	+16.10	+1.35
	C4-C	+3.24	-2.79	-0.95	-0.01	+2.29	-2.80	+2.86	-3.50
	C4-A	+8.96	+4.17	+0.87	-0.02	+9.83	+4.15	+12.30	+5.20
	C4-B	+13.62	+3.36	-0.88	+1.06	+12.94	+4.42	+15.90	+5.50
	C4-C	+2.40	-1.29	-0.02	-0.96	+2.38	-2.25	-2.98	-2.80
	C4-A	+8.18	+4.96	-0.02	+0.87	+8.16	+5.83	+10.2	+7.30
	C4-B	+10.79	+5.21	+1.05	-0.88	+11.84	+4.33	+14.80	+5.41
	C4-C	+2.70	-1.64	-0.96	-0.02	+1.74	-1.66	+2.18	-2.08
	C4-A	+7.78	+5.20	+0.87	-0.02	+8.65	+5.18	+10.80	+6.50
	C4-B	+9.23	+5.22	-0.89	+1.04	+8.34	+6.26	+10.40	+7.84
	C4-C	+1.18	-0.27	-0.02	-0.96	+1.16	-1.23	+1.45	+1.54
	C4-A	+6.68	+5.77	-0.02	+0.86	+6.66	+6.63	+8.34	+8.30
	C4-B	+8.05	+5.48	+1.04	-0.89	+9.09	+4.59	+11.35	+5.75
	C4-C	+0.52	-0.11	-0.96	-0.02	-0.44	-0.13	-0.55	-0.16
	C4-A	+6.12	+5.75	+0.87	-0.02	+6.99	-5.73	+8.95	-7.16
	C4-B	+3.20	+5.23	-0.89	+1.04	+2.32	+6.27	+2.90	+7.85
	C4-C	-0.51	+0.14	-0.03	-0.97	-0.54	-0.83	-0.67	-1.04
	C4-A	+4.38	+6.08	+0.03	+0.82	+4.41	+6.90	+5.50	+8.64
	C4-B	+3.69	+6.51	+1.04	-0.88	+4.73	+5.63	+4.92	+7.05
	C4-C	-0.94	+0.02	-0.96	+0.01	-1.90	+0.03	-2.38	+0.04
	C4-A	+4.29	+6.49	+0.92	+1.61	+5.21	+8.10	+6.5	+10.10
	C4-B	+2.07	+5.49	+1.00	+1.00	+3.07	+6.49	+3.84	+8.12
	C4-C	-2.97	-1.15	-0.06	-1.11	-3.03	-2.26	-3.79	-2.82
	C4-A	+7.55	+0.34	-0.21	-0.15	+3.34	+0.19	+4.18	+0.24
	C4-B	+9.85	0.00	+1.12	+0.48	+10.97	+0.48	+13.70	+0.06
	C4-C	+4.54	-0.50	-0.79	-0.44	+3.75	-0.94	+4.68	-14.70

Piso	Col.	CM+$\vec{S}$		CV-3		CM+$\vec{S}$+CV-3		1.25(CM+$\vec{S}$CV-3)	
		M_S	M_I	M_S	M_I	M_S	M_I	M_S	M_I
		Tn-m	Tn-m	Tn-m	Tn-m	Tn-m	Tn-m	Tn-m	Tn-m
11	C4-A	+0.41	+3.37	+0.74	-0.02	+1.15	+3.35	+1.44	+4.20
	C4-B	-5.82	+0.50	-0.02	-0.06	-5.84	+0.46	-7.30	+0.57
	C4-C	-6.67	-3.83	-1.76	+0.04	-8.43	-3.79	-10.50	-4.74
10	C4-A	-2.74	+2.92	+0.01	+1.85	-2.73	+4.77	-3.42	+5.96
	C4-B	-10.67	+0.26	-0.02	+0.21	-10.69	+0.47	-13.35	+0.59
	C4-C	-8.92	-2.43	-0.11	-0.95	-9.03	-3.38	-11.30	-4.22
9	C4-A	-3.29	+2.84	+0.83	+0.02	-2.46	+2.86	-3.08	+3.58
	C4-B	-11.57	-1.52	+0.17	-0.02	-11.40	-1.54	-14.25	-1.92
	C4-C	-8.86	-4.13	-0.93	-0.04	-9.76	-4.17	-12.20	-5.22
8	C4-A	-2.72	+1.25	+0.01	-0.84	-2.71	+0.41	-3.39	+0.51
	C4-B	-13.28	-2.97	-0.03	+0.19	-13.31	-2.78	-16.60	-3.49
	C4-C	-9.28	-4.21	+0.00	-0.95	-9.28	-5.16	-11.60	-6.45
7	C4-A	-2.74	-1.23	+0.83	0.00	-1.91	-1.23	-2.48	-1.54
	C4-B	-10.49	-0.67	+0.18	-0.03	-10.31	-0.70	-12.90	-0.87
	C4-C	-8.22	-5.28	-0.94	-0.04	-9.16	-5.32	-11.45	-6.65
6	C4-A	-1.50	-0.22	0.-0	+0.84	-1.50	+0.62	-18.70	+0.77
	C4-B	-8.77	-4.90	-0.03	+0.21	-8.80	-4.69	-11.00	-5.86
	C4-C	-8.10	-5.25	-0.04	-0.95	-8.14	-6.20	-10.20	-7.75
5	C4-A	-1.24	+0.49	+0.84	+0.01	-0.40	+0.50	-0.50	+0.62
	C4-B	-7.75	-5.04	+0.19	-0.03	-2.71	-5.07	-3.39	-6.35
	C4-C	-7.40	-5.39	-0.94	-0.04	-8.34	-5.43	-10.40	-6.80
4	C4-A	+0.18	-0.19	+0.01	+1.85	+0.19	+1.66	+0.24	+2.08
	C4-B	-2.78	-2.71	-0.03	+0.19	-2.81	-2.52	-2.52	-3.15
	C4-C	-6.81	-5.80	-0.04	-0.95	-6.85	-6.75	-8.56	-8.44
3	C4-A	+0.90	-0.32	+0.83	-0.03	+0.58	-0.35	+0.72	-0.44
	C4-B	-3.39	-6.09	+0.19	-0.04	-3.20	-6.13	-4.00	-7.66
	C4-C	-4.42	-6.38	-0.93	-0.02	-5.35	-6.40	-6.70	-8.00
2	C4-A	+2.67	+1.05	+0.04	+0.95	+2.71	+2.00	+3.39	+2.50
	C4-B	-1.59	-4.99	-0.02	+0.19	-1.61	-4.801	-2.02	-6.00
	C4-C	-4.59	-6.59	-0.08	-1.09	-4.67	-7.61	-5.35	-9.50
1	C4-A	-4.55	+1.19	+0.71	+0.31	-3.84	+1.50	-4.80	+1.87
	C4-B	-9.75	0.00	+0.18	0.00	-9.57	0.00	-12.0	0.00
	C4-C	-7.66	+0.28	-0.77	-0.43	-8.43	-0.15	-10.55	-0.18

Piso	Col.	CM + $\overleftarrow{S}$		CV-3		CM+$\overleftarrow{S}$+CV-3		1.25(CM+$\overleftarrow{S}$+CV-3)	
		M_S Tn-m	M_I Tn-m	M_S Tn-m	M_I Tn-m	M_S Tn-m	M_I Tn-m	M_S Tn-m	M_I Tn-m
11	C4-A	+6.67	+3.71	+0.74	-0.02	+7.41	+3.69	+9.26	+4.10
	C4-B	+5.86	-0.08	-0.02	-0.06	+5.84	-0.14	+7.30	-0.17
	C4-C	-0.41	-3.49	-1.76	+0.04	-2.17	-3.45	-2.72	-4.30
10	C4-A	+8.58	±2.44	+0.01	+1.85	+8.59	+4.29	+10.70	+5.35
	C4-B	+11.13	+0.04	-0.02	+0.21	+11.11	+0.25	+13.90	+0.31
	C4-C	+2.43	-2.97	-0.11	-0.95	+2.32	-3.92	+2.88	-4.90
9	C4-A	+8.81	+3.82	+0.83	+0.02	+9.64	+3.90	+12.01	+4.86
	C4-B	+11.83	+1.96	+0.17	-0.02	+12.00	+1.94	+15.00	+2.42
	C4-C	+3.24	-2.79	-0.93	-0.04	+2.31	-0.48	-2.89	-0.60
8	C4-A	+8.96	+4.17	+0.01	-0.84	+8.97	+3.33	+11.20	+4.16
	C4-B	+13.62	+3.36	-0.03	+0.19	+13.59	+3.55	+17.00	+4.46
	C4-C	+2.40	-1.29	±0.00	-0.95	±2.40	-2.24	+3.00	-2.80
7	C4-A	+8.18	+4.96	+0.83	0.00	+9.01	+4.96	+11.25	+6.20
	C4-B	+10.79	+5.21	+0.18	-0.03	+10.97	+5.18	+13.70	+6.50
	C4-C	+2.70	-1.64	-0.94	-0.04	+1.76	-1.68	+2.20	-2.10
6	C4-A	+7.78	+5.20	0.00	+0.84	+7.78	+6.04	+9.72	+7.55
	C4-B	+9.23	+5.22	-0.03	+0.21	+9.20	+5.43	+11.50	+6.28
	C4-C	+1.18	-0.27	-0.04	-0.95	+1.14	-1.22	+1.42	-1.52
5	C4-A	+6.68	+5.77	+0.84	+0.01	+7.52	+5.78	+9.40	+7.22
	C4-B	+8.05	+5.48	+0.19	-0.03	+8.24	+5.45	+10.30	+6.80
	C4-C	+0.52	-0.11	-0.94	-0.04	-0.42	-0.15	-0.52	-0.18
4	C4-A	+6.12	+5.75	+0.01	+1.85	+6.13	+7.60	+7.66	+9.50
	C4-B	+3.20	+5.23	-0.03	+0.19	+3.17	+5.42	+4.96	+6.76
	C4-C	-0.51	+0.14	-0.04	-0.95	-0.55	-0.81	-0.69	-1.01
3	C4-A	+4.38	+6.08	+0.83	-0.03	+5.21	+6.05	+6.50	+7.56
	C4-B	+3.69	+6.51	+0.19	-0.04	+3.88	+6.47	+4.85	+8.10
	C4-C	-0.94	+0.02	-0.93	-0.02	-1.87	0.00	-2.34	0.00
2	C4-A	+4.29	+6.49	+0.04	+0.95	+4.33	+7.44	+5.42	+9.30
	C4-B	+2.07	+5.49	-0.02	+0.19	+2.05	+5.68	+2.56	+7.10
	C4-C	-2.97	-1.15	-0.08	-1.09	-2.89	-2.24	-3.60	-2.80
1	C4-A	+7.55	+0.34	+0.71	+0.31	+1.83	+0.65	+2.28	+0.81
	C4-B	+9.85	0.00	+0.18	0.00	+10.03	0.00	+12.90	0.00
	C4-C	+4.54	-0.50	-0.77	-0.43	-0.49	-0.93	-0.61	-1.16

Piso	Col.	CM+$\vec{S}$		CV-4		CM+$\vec{S}$+CV-4		1.25(CM+$\vec{S}$+CV-4)	
		M_S	M_I	M_S	M_I	M_S	M_I	M_S	M_I
11	C4-A	+0.41	+3.37	+0.05	+0.87	+0.45	+4.24	+0.56	+5.30
	C4-B	-5.82	+0.50	+0.03	+0.22	-5.79	+0.72	-7.24	+0.90
	C4-C	-6.67	-.3.83	-0.03	-1.15	-6.70	-4.98	-8.36	-6.23
10	C4-A	-2.74	+2.92	+0.87	+0.04	-1.87	+2.96	-2.34	+3.70
	C4-B	-10.67	+0.26	-0.22	+0.02	-10.89	0.29	-13.60	+0.36
	C4-C	-8.92	-2.43	-1.15	-0.02	-10.07	-2.45	-12.60	-3.06
9	C4-A	-3.29	+2.84	+0.04	+0.86	+3.25	+3.70	+4.06	+4.62
	C4-B	-11.57	-1.52	+0.02	+0.22	-11.55	-1.30	-14.40	-1.62
	C4-C	-8.86	-4.13	-0.03	-1.15	-8.89	-5.28	-11.10	-6.60
8	C4-A	-2.72	+1.25	+0.86	+0.04	-12.20	+1.79	-16.50	+1.61
	C4-B	-13.28	-2.97	+0.22	+0.02	-0.91	-2.95	-1.13	-3.69
	C4-C	-9.28	-4.21	-1.15	-0.03	-10.43	-4.18	-13.05	-5.22
7	C4-A	-2.74	-1.23	+0.04	+0.87	-2.78	-0.36	-3.48	-0.45
	C4-B	-10.49	-0.67	+0.02	+0.22	-10.47	-0.45	-13.10	-0.55
	C4-C	-8.22	-5.28	-0.03	-1.15	-8.25	-6.43	-10.30	-8.04
6	C4-A	-1.50	-0.22	+1.86	+0.04	+0.36	-0.18	+0.45	-0.22
	C4-B	-8.77	-4.90	+0.22	+0.02	-8.55	-4.88	-10.70	-6.10
	C4-C	-8.10	-5.25	-1.15	-0.03	-9.25	-5.28	-11.55	-6.60
5	C4-A	-1.24	+0.49	+0.04	+0.86	-1.20	+1.35	-1.50	+1.69
	C4-B	-7.75	-5.04	+0.02	+0.02	-7.73	-4.82	-9.66	-6.80
	C4-C	-7.40	-5.39	-0.03	-1.15	-7.37	-6.54	-9.20	-8.16
4	C4A	+0.18	-0.19	+0.87	+0.05	+1.05	-0.14	+1.31	-0.17
	C4-B	-2.74	-2.71	+0.22	+0.02	-2.52	-2.69	-3.15	-3.36
	C4-C	-6.81	-5.80	-1.16	-0.06	-7.97	-5.84	-9.95	-7.30
3	C4-A	+0.90	-0.32	+0.03	+0.82	+0.93	+0.50	+1.16	+0.62
	C4-B	-3.34	-6.09	+0.02	+0.21	-3.32	-5.88	-4.15	-7.35
	C4-C	-4.42	-6.38	0.00	-1.08	-4.42	-7.46	-5.52	-9.32
2	C4-A	+2.67	+1.05	+0.87	+0.24	+3.54	+1.29	+4.42	+1.61
	C4-B	-1.59	-4.99	+0.22	+0.08	-1.37	-4.91	-1.71	-6.15
	C4-C	-4.59	-6.59	-1.22	-0.25	-3.37	-6.84	-4.20	-0.55
1	C4-A	-4.55	+1.12	-0.19	+0.09	+4.74	+0.93	+5.82	+1.16
	C4-B	-9.75	0.00	-0.06	-0.02	-9.81	-0.02	-12.30	-0.02
	C4-C	-7.66	+0.28	+0.21	+0.12	-7.45	+0.40	-9.30	+0.50

Piso	Col.	CM + S		CV-4		CM+S+CV-4		1.25(CM+S+CV-4)	
		M_S tn-m	M_I Tn-m	M_S Tn-m	M_I Tn-m	M_S Tn-m	M_I Tn-m	M_S Tn-m	M_I Tn-m
11	C4-A	+6.67	+3.71	+0.05	+0.87	+6.72	+4.58	+8.40	+5.72
	C4-B	+5.80	-0.08	+0.03	+0.22	+5.89	+0.14	+7.36	+0.17
	C4-C	-0.41	-3.49	-0.03	-1.15	-0.44	-4.64	-0.55	-5.80
10	C4-A	+8.58	±2.44	±0.87	±0.04	±9.45	+2.48	+11.80	+3.98
	C4-B	+11.13	+0.04	-0.22	+0.03	+10.91	+0.07	+13.60	+0.09
	C4-C	+2.43	-2.97	-1.15	-0.02	+1.28	-2.99	+1.60	-3.74
9	C4-A	+8.81	+3.82	+0.04	+0.86	+8.85	+4.68	+11.10	+5.85
	C4-B	+11.83	+1.96	+0.02	+0.22	+11.85	+2.18	+14.80	+2.72
	C4-C	+3.24	-2.79	-0.03	-1.15	+3.27	-3.94	+4.09	-4.82
8	C4-A	+8.96	+4.17	+0.86	+0.04	+9.82	+4.21	+12.30	+5.26
	C4-B	+13.62	+3.36	+0.22	+0.02	+13.84	+3.38	+17.30	+4.22
	C4-C	+2.40	-1.29	∓1.15	∓0.03	+1.25	-1.32	+1.56	-1.65
7	C4-A	+8.18	+4.96	+0.04	+0.87	+8.22	+5.83	+10.25	+7.30
	C4-B	+10.79	+5.21	+0.02	+0.22	+10.81	+5.43	+13.50	+6.80
	C4-C	+2.70	∓1.64	∓0.03	-1.15	+2.67	-2.79	+3.34	-3.50
6	C4-A	+7.78	+5.20	+1.86	+0.04	+9.64	+5.24	+12.10	+6.55
	C4-B	+9.23	+5.22	+0.22	+0.02	+9.45	+5.24	+11.80	+6.55
	C4-C	+1.18	-0.27	-1.15	-0.03	+0.03	+0.30	-0.04	-0.04
5	C4-A	+6.68	+5.77	+0.04	+0.86	+6.72	+6.63	+8.40	+8.30
	C4-B	+8.05	+5.48	+0.02	+0.82	+8.07	+5.70	+10.10	+7.12
	C4-C	+0.52	-0.11	-0.03	-1.15	+0.49	+0.38	+0.61	+0.47
4	C4-A	+6.12	+5.75	-0.87	+0.05	+5.25	+5.80	+6.56	+7.25
	C4-B	+3.20	+5.23	+0.22	+0.02	+3.42	+5.25	+4.28	+6.56
	C4-C	-0.51	+0.14	-1.16	-0.04	-1.67	+0.10	-2.09	+0.12
3	C4-A	+4.38	+6.08	+0.02	+0.82	+4.41	+6.90	+5.50	+8.61
	C4-B	+3.69	+6.51	+0.02	+0.21	+3.71	+6.72	+4.64	+8.40
	C4-C	-0.94	+0.02	0.00	-1.08	-0.94	-1.06	-1.17	-1.32
2	C4-A	+4.29	+6.49	+0.87	+0.24	+5.16	+6.73	+6.45	+8.32
	C4-B	+2.07	+5.49	+0.22	+0.08	+2.29	+5.57	+2.86	+6.96
	C4-C	-2.97	-1.15	-1.22	-0.25	-4.19	-1.40	-5.24	-1.75
1	C4-A	+7.55	+0.34	-0.19	+0.09	+7.36	+0.43	+9.20	+0.54
	C4-B	+9.85	0.00	-0.06	-0.02	+9.79	-0.02	+12.20	-0.02
	C4-C	+4.54	-0.50	+0.21	+0.12	+4.75	-0.38	+5.94	-0.47

MOMENTOS EN COLUMNAS DEL PORTICO DE ARRIOSTRE

A continuación presento los momentos en columnas del diagrama de Kani, así como los momentos obtenidos del análisis sísmico y la combinación de cargas a efectuar será:

$$1.25\ (CM + SISMO \pm)$$

Por ser la más desfavorable.

Piso	Columna	1.5CM		CM.	
		M_S Tn-m	M_I Tn-m	M_S Tn-m	M_I Tn-m
11	C4-A	+0.25	+0.11	+0.17	+0.07
	CA-2	+0.02	+0.16	+0.01	+0.11
	CA-3	+0.02	+0.01	+0.01	+0.00
	CA-4	-0.05	-0.16	-0.03	-0.11
10	CA-1	+0.13	+0.29	+0.09	+0.19
	CA-2	+0.15	+0.02	+0.10	+0.01
	CA-3	0.00	0.00	0.00	0.00
	CA-4	-0.17	-0.04	-0.11	-0.03
9	CA-1	+0.28	-0.11	+0.19	-0.07
	CA-2	+0.02	+0.17	+0.01	+0.11
	CA-3	0.00	0.00	0.00	0.00
	CA-4	-0.04	-0.17	-0.03	-0.11
8	CA-1	+0.11	+0.28	+0.07	+0.19
	CA-2	+0.15	+0.02	+0.10	+0.01
	CA-3	0.00	0.00	0.00	0.00
	CA-4	-0.17	-0.04	-0.11	-0.03
7	CA-1	+0.28	-0.17	+0.19	-0.11
	CA-2	0.02	+0.16	+0.01	+0.11
	CA-3	+0.00	0.00	0.00	0.00
	CA-4	-0.04	-0.17	-0.03	-0.11
6	CA-1	+0.11	+0.28	+0.07	-0.19
	CA-2	+0.16	+0.02	+0.11	+0.01
	CA-3	0.00	0.00	0.00	0.00
	CA-4	-0.17	-0.04	-0.11	-0.03
5	CA-1	+0.28	+0.11	+0.19	+0.07
	CA-2	+0.02	+0.16	+0.01	+0.11
	CA-3	0.00	0.00	0.00	0.00
	CA4-	-0.04	-0.17	-0.03	-0.11
4	CA-1	+0.11	+0.28	+0.07	+0.19
	CA-2	+0.16	+0.02	+0.11	+0.01
	CA-3	0.00	0.00	0.00	0.00
	CA-4	-0.17	-0.04	-0.11	-0.03
3	CA-1	+0.28	+0.11	+0.19	+0.07
	CA-2	+0.02	+0.16	+0.01	+0.11
	CA-3	0.00	0.00	0.00	0.00
	CA-4	-0.03	-0.15	-0.02	-0.10
2	CA-1	+0.12	+0.30	+0.08	+0.20
	CA-2	+0.17	+0.04	+0.19	+0.03
	CA-3	0.00	0.00	0.00	0.00
	CA-4	-0.17	-0.07	-0.11	-0.05
1	CA-1	+0.24	+0.12	+0.16	+0.08
	CA-2	-0.06	-0.03	-0.11	-0.02
	CA-3	0.00	0.00	0.00	0.00
	CA-4	+0.02	+0.01	+0.01	0.00

MOMENTOS EN COLUMNAS POR SISMO

Piso	Columna	SISMO →		SISMO←	
		M_S	M_I	M_S	M_I
11	CA-1	+1.02	+2.56	-1.02	-2.56
	CA-2	+2.22	+3.94	-2.22	-3.94
	CA-3	+2.22	+3.94	-2.22	-3.94
	CA-4	+5.71	+3.20	-5.71	-3.20
10	CA-1	+1.88	+3.00	-1.88	-3.00
	CA-2	+3.76	+4.50	-3.76	-4.50
	CA-3	+3.76	+4.50	-3.76	-4.50
	CA-4	+6.14	+5.22	-6.14	-5.22
9	CA=1	+1.88	+2.82	-1.88	-2.82
	CA-2	+3.58	+4.42	-3.58	-4.42
	CA-3	+3.58	+4.42	-3.58	-4.42
	CA-4	+5.88	+4.56	-3.88	-4.56
8	CA-1	+1.89	+2.32	-1.89	-2.32
	CA-2	+3.22	+3.98	-3.22	-3.98
	CA-3	+3.22	+3.98	-3.22	-3.98
	CA-4	+5.16	+4.18	-5.16	-4.18
7	CA-1	+1.74	+2.14	-1.74	-2.14
	CA-2	+2.98	+3.66	-2.98	-3.66
	CA-3	+2.98	+3.66	-2.98	-3.66
	CA-4	+4.50	+3.67	-4.50	-3.67
6	CA-1	+1.80	+1.80	-1.80	-1.80
	CA-2	+2.74	+3.36	-2.74	-3.36
	CA-3	+2.74	+3.36	-2.74	-3.36
	CA-4	+4.65	+3.78	-4.65	-3.78
5	CA-1	+1.62	+1.62	-1.62	-1.62
	CA-2	+2.44	+2.81	-2.44	-2.81
	CA-3	+2.44	+2.81	-2.44	-2.81
	CA-4	+3.76	+3.56	-3.76	-3.56
4	CA-1	+1.42	+1.42	-1.42	-1.42
	CA-2	+2.40	+2.40	-2.40	-2.40
	CA-3	+2.40	+2.40	-2.40	-2.40
	CA-4	+3.22	+3.22	-3.22	-3.22
3	CA-1	+1.09	+1.09	-1.09	-1.09
	CA-2	+1.86	+1.09	-1.86	-1.09
	CA-3	+1.86	+1.86	-1.86	-1.86
	CA-4	+2.50	+2.50	-2.50	-2.50
2	CA-1	+0.84	+0.75	-0.88	-0.75
	CA-2	+1.36	+1.36	-1.36	-1.36
	CA-3	+1.36	+1.36	-1.36	-1.36
	CA-4	+1.98	+1.98	-1.98	-1.98
1	CA-1	+0.91	+0.30	-0.91	-0.30
	CA-2	+0.88	0.48	-0.88	-0.48
	CA-3	+0.88	+0.48	-0.88	-0.48
	CA-4	+0.41	+0.56	-0.41	-0.56

ENVOLVENTES DE MOMENTOS EN PORTICO DE ARRIOSTRE

$1.25\ (CM + SISM\overleftrightarrow{O})$

Piso	Columna	$CM+\overleftrightarrow{S}$		$1.25(CM+\overleftrightarrow{S})$	
		M_S	M_I	M_S	M_I
11	CA-1	+1.19	+2.61	+1.49	+3.26
	CA-2	+2.23	+4.05	+2.88	+5.05
	CA-3	+2.23	+3.94	+2.88	+4.92
	CA-4	+5.68	+3.09	+7.10	+3.86
10	CA-1	+1.97	+3.19	+2.46	+3.98
	CA-2	+3.86	+4.51	+4.95	+5.64
	CA-3	+3.76	+4.50	+4.70	+5.63
	CA-4	+6.03	+5.19	+7'54	+6.50
9	CA-1	+2.07	+2.75	+2.58	+2.84
	CA-2	+3.59	+4.53	+4.48	+5.66
	CA-3	+3.58	+4.42	+4.46	+5.52
	CA-4	+5.85	+4.45	+7.30	+5.56
8	CA-11	+1.96	+2.51	+2.46	+3.14
	CA-2	+3.32	+3.99	+4.15	+5.00
	CA-3	+3.22	+3.98	+4.02	+4.96
	CA-4	+5.05	+4.21	+6.30	+5.26
7	CA-1	+1.93	+2.03	+2.41	+2.54
	CA-2	+2.99	+3.77	+3.74	+4.70
	CA-3	+2.98	+3.66	+3.72	+4.56
	CA-4	+4.47	+3.56	+5.58	+4.45
6	CA-1	+1.87	+1.61	+2.34	+2.03
	CA-2	+2.85	+3.37	+3.56	+4.20
	CA-3	+2.74	+3.36	+3.42	+4.20
	CA-4	+4.44	+3.75	+5.55	+4.68
5	CA-1	+1.81	+1.70	+2.26	+2.12
	CA-2	+2.45	+2.92	+3.06	+3.64
	CA-3	+2.44	+3.86	+3.05	+3.70
	CA-4	+3.73	+3.45	+4.66	+4.30
4	CA-1	+1.49	+1.61	+1.86	+2.02
	CA-2	+2.51	+2.41	+2.14	+3.02
	CA-3	+2.40	+2.40	+3.00	+3.00
	CA-4	+3.11	+3.19	+3.99	+4.00
3	CA-1	+1.28	+1.16	+1.60	+1.45
	CA-2	+1.87	+1.20	+2.34	+1.50
	CA-3	+1.86	+1.86	+2.32	+2.32
	CA-4	+2.48	+2.40	+3.10	+3.00
2	CA-1	+0.92	+0.95	+1.15	+1.19
	CA-2	+1.55	+1.39	+1.94	+1'73
	CA-3	+1.36	+1.36	+1.70	+1.70
	CA-4	+1.87	+1.53	+2.34	+1.91
1	CA-1	+1.07	+0.38	+1.34	+0.47
	CA-2	+0.77	+0.46	+0.96	+0.57
	CA-3	+0.88	+0.48	+1.10	+0.60
	CA-4	+0.42	+0.56	+0.52	+0.70

Piso	Columna	CM+$\overleftarrow{S}$		1.25(CM+$\overleftarrow{S}$)	
		M_S Tn-m	M_I Tn-m	M_S Tn-m	M_I Tn-m
11	CA-1	-0.85	-2.63	-1.06	-3.28
	CA-2	-2.21	-3.83	-2.76	-4.78
	CA-3	-2.21	-3.94	-2.76	-4.92
	CA-4	-5.74	-3.31	-7.18	-4.14
10	CA-1	-1.79	-2.81	-2.24	-3.52
	CA-2	-3.66	-4.49	-4.57	-5.62
	CA-3	-3.76	-4.50	-4.70	-5.64
	CA-4	-6.25	-5.25	-7.30	-6.56
9	CA-1	-1.69	-2.89	-2.12	-3.62
	CA-2	-3.57	-4.31	-4.46	-5.40
	CA-3	-3.58	-4.42	-4.48	-5.52
	CA-4	-3.91	-4.67	-4.90	-5.84
8	CA-1	-1.82	-2.13	-2.28	-2.66
	CA-2	-3.12	-3.97	-3.90	-4.96
	CA-3	-3.22	-3.98	-4.03	-4.98
	CA-4	-5.27	-4.21	-6.60	-5.26
7	CA-1	-1.55	-2.25	-1.94	-2.81
	CA-2	-2.97	-3.55	-3.71	-4.44
	CA-3	-2.98	-3.66	-3.72	-4.57
	CA-4	-4.53	-3.78	-5.66	-4.72
6	CA-1	-1.72	-1.99	-2.15	-2.48
	CA-2	-2.63	-3.37	-3.28	-4.21
	CA-3	-2.74	-3.36	-3.42	-4.20
	CA-4	-4.76	-3.78	-5.95	-4.72
5	CA-1	-1.43	-1.55	-1.79	-1.94
	CA-2	-2.43	-2.70	-3.20	-3.38
	CA-3	-2.44	-2.81	-3.05	-3.51
	CA-4	-3.79	-3.67	-4.74	-4.58
4	CA-1	-1.35	-1.23	-1.69	-1.54
	CA-2	-2.51	-2.39	-3.14	-3.00
	CA-3	-2.40	-2.40	-3.00	-3.00
	CA-4	-3.33	-3.35	-4.16	-4.18
3	CA-1	-0.90	-1.02	-1.12	-1.27
	CA-2	-1.85	-0.98	-2.31	-1.22
	CA-3	-1.86	-1.86	-2.32	-2.32
	CA-4	-2.52	-2.60	-3.15	-3.25
2	CA-1	-0.80	-0.55	-1.00	-0.69
	CA-2	-1.17	-1.33	-1.46	-1.66
	CA-3	-1.36	-1.36	-1.70	-1.70
	CA-4	-2.09	-2.03	-2.61	-2.54
1	CA-1	+0.75	-0.22	-0.94	-0.27
	CA-2	-0.99	-0.50	-1.24	-0.62
	CA-3	-0.88	-0.48	-1.10	-0.60
	CA-4	-0.40	-0.56	-0.50	-0.70