UNIVERSIDAD NACIONAL DE INGENIERIA
FACULTAD DE INGENIERIA CIVIL

DISEÑO ESTRUCTURAL DE UN EDIFICIO DE CINCO PISOS DESTINADO PARA OFICINAS

INFORME DE INGENIERIA

Para optar el Título Profesional de:
INGENIERO CIVIL

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DEDICATORIA

Dedico el presente Informe de Ingeniería a mi hijo Piero, cuya existencia estimula mi superación personal.

AGRADECIMIENTO

Agradezco a mis padres por quienes logre tener una profesión, a mis hermanos por su comprensión y cariño, a mi esposa Ana por el amor y apoyo que me brinda en todo momento y gracias a quien logre terminar el presente Informe de Ingeniería, a mis suegros por su constante estimulación.

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INTRODUCCION

El presente Informe de Ingeniería cuyo tema es **"DISEÑO ESTRUCTURAL DE UN EDIFICIO DE CINCO PISOS DESTINADO PARA OFICINAS"** forma parte del Curso de Titulación por Actualización de Conocimientos, de la Facultad de Ingeniería Civil de la Universidad Nacional de Ingeniería.

El diseño sismo resistente en el Perú es de gran importancia ya que es una zona sísmica, en el que han ocurrido eventos sísmicos en los años pasados y cobrado numerosas víctimas humanas y perdidas materiales, estas experiencias nos llevan a tomar medidas preventivas con respecto a las normas de diseño y construcción de edificaciones ya que en ellas se albergan personas y con ello darles la seguridad de que si ocurriese un sismo puedan salir ilesas o con el menor daño posible, las nuevas normas de diseño sísmico E030 se caracteriza por tener desplazamientos laterales mas pequeños que la anterior, por lo que se obtiene un diseño mas rígido.

En el presente proyecto se realiza un análisis de diseño sismo resistente utilizando las nuevas normas de estructuras, se lleva a cabo un análisis estático por cargas equivalentes y un análisis modal espectral tomando las consideraciones que nos indican las normas.

Se emplean programas de computo **"SAP 2000"** y **" PCACOL"** para el análisis y diseño estructural, ya que estos programas especialmente el SAP 2000 es muy difundido y comercial a nivel internacional.

Espero que el presente proyecto sea de utilidad para quienes quieran consultar sobre el tema.

I.- GENERALIDADES

I.1 OBJETIVO

Presentar una manera de diseñar y estructurar un edificio de sistema dual (pórticos y placas) mediante criterios de análisis, utilizando las nuevas normas de diseño sismo-resistente .

I.2 DESCRIPCION DEL PROYECTO

I.2.1 Ubicación

El edificio se encuentra ubicado en la ciudad de Lima.

I.2.2 Finalidad

La finalidad de este informe de Ingeniería es el análisis y diseño estructural de un edificio de oficinas de 5 pisos de sistema dual (pórticos y placas).

I.2.3 Consideraciones iniciales

Uso	Categoría	s/c	
Oficina	C	250	(Kg/m2)

Tabiqueria : 180 Kg/m2
Acabados : 120 Kg/m2
S/C piso típico: 250 Kg/m2
S/C techo: 150 Kg/m2
Altura entrepiso : 3 m
f'c : 210 Kg/cm2

I.3 NORMAS USADAS

Las normas usadas en el presente informe de Ingeniería han sido objeto de importantes cambios y actualizaciones, en especial la de diseño sismorresistente , estas normas son las siguientes:

E.030 Diseño sismorresistente
E.060 Concreto Armado
Concreto Armado-Comentarios
E.050 Suelos y Cimentaciones

II.- PREDIMENSIONAMIENTO

II.1 PREDIMENSIONAMIENTO DE LOSA ALIGERADA

Según el nuevo Reglamento Peruano de Concreto Armado en su articulo 10.4.1 respecto a peraltes mínimos para no verificar deflexiones, el articulo 10.4.1.1 dice lo siguiente: En losas aligeradas continuas conformadas por viguetas de 10 cm de ancho, bloques de ladrillo de 30 cm de ancho y losa superior de 5 cm , con sobrecargas menores a 300 Kg/m2 y luces menores de 7.3 m, se debe cumplir que:

$$h \geq l/25$$

Siendo "h" el espesor de la losa y "l" la luz libre.

ESPESOR DE LOSA ALIGERADA (h):

L= 4.50m
h=L/25= 0.180
h= 0.2m
Peso de losa : 300 Kg/m2

II.2 PREDIMENSIONAMIENTO DE VIGAS

Según especifica el ACI, la altura (h) de vigas recomendable cuando es continua en 2 extremos : L/21
Asimismo en la practica se recomienda :
Altura de vigas L/12.
Ancho de vigas interiores B/20 y para vigas perimetrales B/20*1.2.

Eje	Viga	Luz libre (m)	h (m)	Ancho tributario	b (m)	Usar b (m)
	V-405-5	4.50	0.60	1.00	0.06	0.25
	V-405-5	4.50	0.60	1.00	0.06	0.25
	V-705-4	4.50	0.60	1.00	0.06	0.25
	V-706-4	4.50	0.60	1.00	0.06	0.25
	V-705-4	4.50	0.60	1.00	0.06	0.25
	V-705-3	4.50	0.60	1.00	0.06	0.25
A	V-706-3	4.50	0.60	1.00	0.06	0.25
	V-705-3	4.50	0.60	1.00	0.06	0.25
	V-705-2	4.50	0.60	1.00	0.06	0.25
	V-706-2	4.50	0.60	1.00	0.06	0.25
	V-705-2	4.50	0.60	1.00	0.06	0.25
	V-705-1	4.50	0.60	1.00	0.06	0.25
	V-706-1	4.50	0.60	1.00	0.06	0.25
	V-705-1	4.50	0.60	1.00	0.06	0.25
	V-408-5	4.50	0.60	1.00	0.05	0.25
	V-409-5	4.50	0.60	1.00	0.05	0.25
	V-408-5	4.50	0.60	1.00	0.05	0.25
	V-708-4	4.50	0.60	1.00	0.05	0.25
	V-709-4	4.50	0.60	1.00	0.05	0.25
	V-708-4	4.50	0.60	1.00	0.05	0.25
	V-708-3	4.50	0.60	1.00	0.05	0.25
B	V-709-3	4.50	0.60	1.00	0.05	0.25
	V-708-3	4.50	0.60	1.00	0.05	0.25
	V-708-2	4.50	0.60	1.00	0.05	0.25
	V-709-2	4.50	0.60	1.00	0.05	0.25
	V-708-2	4.50	0.60	1.00	0.05	0.25
	V-708-1	4.50	0.60	1.00	0.05	0.25
	V-709-1	4.50	0.60	1.00	0.05	0.25
	V-708-1	4.50	0.60	1.00	0.05	0.25

Eje	Viga	Luz libre (m)	h (m)	Ancho tributario	b (m)	Usar b (m)
	V-405-5	4.50	0.60	1.00	0.06	0.25
	V-405-5	4.50	0.60	1.00	0.06	0.25
	V-705-4	4.50	0.60	1.00	0.06	0.25
	V-706-4	4.50	0.60	1.00	0.06	0.25
	V-705-4	4.50	0.60	1.00	0.06	0.25
	V-705-3	4.50	0.60	1.00	0.06	0.25
C	V-706-3	4.50	0.60	1.00	0.06	0.25
	V-705-3	4.50	0.60	1.00	0.06	0.25
	V-705-2	4.50	0.60	1.00	0.06	0.25
	V-706-2	4.50	0.60	1.00	0.06	0.25
	V-705-2	4.50	0.60	1.00	0.06	0.25
	V-705-1	4.50	0.60	1.00	0.06	0.25
	V-706-1	4.50	0.60	1.00	0.06	0.25
	V-705-1	4.50	0.60	1.00	0.06	0.25
	V-401-5	7.00	0.60	2.25	0.14	0.30
	V-101-4	7.00	0.60	2.25	0.14	0.30
1	V-101-3	7.00	0.60	2.25	0.14	0.30
	V-101-2	7.00	0.60	2.25	0.14	0.30
	V-101-1	7.00	0.60	2.25	0.14	0.30
	V-402-5	7.00	0.60	2.25	0.14	0.30
	V-102-4	7.00	0.60	4.50	0.23	0.30
2	V-102-3	7.00	0.60	4.50	0.23	0.30
	V-102-2	7.00	0.60	4.50	0.23	0.30
	V-102-1	7.00	0.60	4.50	0.23	0.30
	V-403-5	7.00	0.60	2.25	0.14	0.30
	V-103-4	7.00	0.60	4.50	0.23	0.30
3	V-103-3	7.00	0.60	4.50	0.23	0.30
	V-103-2	7.00	0.60	4.50	0.23	0.30
	V-103-1	7.00	0.60	4.50	0.23	0.30
	V-404-5	7.00	0.60	2.25	0.14	0.30
	V-104-4	7.00	0.60	2.25	0.14	0.30
4	V-104-3	7.00	0.60	2.25	0.14	0.30
	V-104-2	7.00	0.60	2.25	0.14	0.30
	V-104-1	7.00	0.60	2.25	0.14	0.30

II.3 PREDIMENSIONAMIENTO DE COLUMNAS

Esquina: bxd=1.5PG/(0.2f'c)

Lateral bxd=1.5PG/(0.25f'c)

Central bxd=1.5PG/(0.30f'c)

Estimación de pesos y dimensiones

Columna esquina (C1)- nivel 5

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.28		1	300	2066.4
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Sobrecarga	2.4	3.58		1	150	1288.8

Peso total=PG=8235.36 kg

bxd=1.5PG/(0.2f'c) 294.12cm2 (30*30) cm2

Columna esquina (C1)-nivel 4

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.28		1	300	2066.4
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Columna	0.3	0.1	3	1	2400	216
Sobrecarga	2.4	3.58		1	250	2148

Peso total=PG=9310.56 kg

bxd=1.5PG/(0.2f'c) 626.64 cm2 (30*30) cm2

Columna esquina (C1)-nivel 3

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.28		1	300	2066.4
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Columna	0.3	0.2	3	1	2400	432
Sobrecarga	2.4	3.58		1	250	2148

Peso total=PG=9526.56 kg

bxd=1.5PG/(0.2f'c) 966.87cm2 (30*35) cm2

Columna esquina (C1)-nivel 2

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.28		1	300	2066.4
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Columna	0.3	0.35	3	1	2400	756
Sobrecarga	2.4	3.58		1	250	2148

Peso total=PG=9850.56 kg

bxd=1.5PG/(0.2f'c) 1318.68cm2 (30*45) cm2

Columna esquina (C1)-nivel 1

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.28		1	300	2066.4
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Columna	0.3	0.45	3	1	2400	972
Sobrecarga	2.4	3.58		1	250	2148

Peso total=PG=10066.56 kg

bxd=1.5PG/(0.2f'c) 1678.20cm2 (30*55) cm2

Uniformizo todas las columnas:
USARE 1° al 5° nivel (0.3x0.55)

Columna esquina (C1)-nivel 3

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.28		1	300	2066.4
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Columna	0.3	0.2	3	1	2400	432
Sobrecarga	2.4	3.58		1	250	2148

Peso total=PG=9526.56 kg

bxd=1.5PG/(0.2f'c) 966.87cm2 (30*35) cm2

Columna esquina (C1)-nivel 2

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.28		1	300	2066.4
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Columna	0.3	0.35	3	1	2400	756
Sobrecarga	2.4	3.58		1	250	2148

Peso total=PG=9850.56 kg

bxd=1.5PG/(0.2f'c) 1318.68cm2 (30*45) cm2

Columna esquina (C1)-nivel 1

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.28		1	300	2066.4
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Columna	0.3	0.45	3	1	2400	972
Sobrecarga	2.4	3.58		1	250	2148

Peso total=PG=10066.56 kg

bxd=1.5PG/(0.2f'c) 1678.20cm2 (30*55) cm2

Uniformizo todas las columnas:
USARE 1° al 5° nivel (0.3x0.55)

Columna esquina (C2)-nivel 5

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.28		1	300	2066.4
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Sobrecarga	2.4	3.58		1	150	1288.8

Peso total=PG=8235.36 kg

bxd=1.5PG/(0.2f'c) 294.12 cm2 (30*30) cm2

Columna lateral (C2)-nivel 4

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	3.28		1	300	4132.8
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	4.5	3.58		1	120	1933.2
Tabiqueria	4.5	3.58		1	180	2899.8
Columna	0.3	0.1	3	1	2400	216
Sobrecarga	4.5	3.58		1	250	4027.5

Peso total=PG=16267.86 kg

bxd=1.25PG/(0.25f'c) 583.41 cm2 (30*30) cm2

Columna lateral (C2)-nivel 3

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	3.28		1	300	4132.8
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	4.5	3.58		1	120	1933.2
Tabiqueria	4.5	3.58		1	180	2899.8
Columna	0.3	0.2	3	1	2400	432
Sobrecarga	4.5	3.58		1	250	4027.5

Peso total=PG=16483.86 kg

bxd=1.25PG/(0.25f'c) 975.88 cm2 (30*35) cm2

Columna lateral (C2)-nivel 2

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	3.28		1	300	4132.8
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	4.5	3.58		1	120	1933.2
Tabiqueria	4.5	3.58		1	180	2899.8
Columna	0.3	0.35	3	1	2400	756
Sobrecarga	4.5	3.58		1	250	4027.5

Peso total=PG=16807.86 kg

bxd=1.25PG/(0.25f'c) 1376.07 cm2 (30*45) cm2

Columna lateral (C2)-nivel 1

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	3.28		1	300	4132.8
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	4.5	3.58		1	120	1933.2
Tabiqueria	4.5	3.58		1	180	2899.8
Columna	0.3	0.45	3	1	2400	972
Sobrecarga	4.5	3.58		1	250	4027.5

Peso total=PG=17023.86 kg

bxd=1.25PG/(0.25f'c) 1781.40 cm2 (35*50) cm2

Uniformizo todas las columnas:

USARE 1° al 5° nivel (0.35x0.50)

Columna esquina (C3)-nivel 5

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	6.55		1	300	4126.5
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	2.4	6.7		1	120	1929.6
Tabiqueria	2.4	6.7		1	180	2894.4
Sobrecarga	2.4	6.7		1	150	2412

Peso total=PG=15012.9 kg

bxd=1.25PG/(0.25f'c) 357.45 cm2 (30*30) cm2

Columna lateral (C3)- nivel 4

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	6.55		1	300	4126.5
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	2.4	6.7		1	120	1929.6
Tabiqueria	2.4	6.7		1	180	2894.4
Columna	0.3	0.15	3	1	2400	324
Sobrecarga	2.4	6.7		1	250	4020

Peso total=PG=16944.9 kg

bxd=1.25PG/(0.25f'c) 760.9 cm2 (30*30) cm2

Columna lateral (C3)-nivel 3

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	6.55		1	300	4126.5
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	2.4	6.7		1	120	1929.6
Tabiqueria	2.4	6.7		1	180	2894.4
Columna	0.3	0.25	3	1	2400	540
Sobrecarga	2.4	6.7		1	250	4020

Peso total=PG=17160.9 kg

bxd=1.25PG/(0.25f'c) 1169.49 cm2 (30*40) cm2

Columna lateral (C3)-nivel 2

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	6.55		1	300	4126.5
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	2.4	6.7		1	120	1929.6
Tabiqueria	2.4	6.7		1	180	2894.4
Columna	0.3	0.4	3	1	2400	864
Sobrecarga	2.4	6.7		1	250	4020

Peso total=PG=17484.9 kg

bxd=1.25PG/(0.25f'c) 1585.80 cm2 (30*55) cm2

Columna lateral (C3)-nivel 1

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	6.55		1	300	4126.5
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	2.4	6.7		1	120	1929.6
Tabiqueria	2.4	6.7		1	180	2894.4
Columna	0.3	0.55	3	1	2400	1188
Sobrecarga	2.4	6.7		1	250	4020

Peso total=PG=17808.9 kg

bxd=1.25PG/(0.25f'c) 2009.82 cm2 (35*60) cm2

Uniformizo todas las columnas:

USARE 1° al 5° nivel (0.35x0.60)

Columna central (C4)-nivel 5

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	6.55		1	300	8253
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	4.5	6.7		1	120	3618
Tabiqueria	4.5	6.7		1	180	5427
Sobrecarga	4.5	6.7		1	150	4522.5

Peso total=PG=26226.9 kg

bxd=1.1PG/(0.30f'c) 457.93 cm2 (30*30) cm2

Columna central (C4)-nivel 4

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	6.55		1	300	8253
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	4.5	6.7		1	120	3618
Tabiqueria	4.5	6.7		1	180	5427
Columna	0.3	0.15	3	1	2400	324
Sobrecarga	4.5	6.7		1	250	7537.5

Peso total=PG=29565.9 kg

bxd=1.1PG/(0.30f'c) 974.16 cm2 (30*35) cm2

Columna central (C4)-nivel 3

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	3.28		1	300	4132.8
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	4.5	6.7		1	120	3618
Tabiqueria	4.5	6.7		1	180	5427
Columna	0.3	0.35	3	1	2400	756
Sobrecarga	4.5	6.7		1	250	7537.5

Peso total=PG=25877.7 kg

bxd=1.1PG/(0.30f'c) 1425.99 cm2 (30*50) cm2

Columna central (C4)-nivel 2

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	3.28		1	300	4132.8
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	4.5	6.7		1	120	3618
Tabiqueria	4.5	6.7		1	180	5427
Columna	0.3	0.5	3	1	2400	1080
Sobrecarga	4.5	6.7		1	250	7537.5

Peso total=PG=26201.7 kg

bxd=1.1PG/(0.30f'c) 1883.48 cm2 (30*65) cm2

Columna central (C4)-nivel 1

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	3.28		1	300	4132.8
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	4.5	6.7		1	120	3618
Tabiqueria	4.5	6.7		1	180	5427
Columna	0.3	0.65	3	1	2400	1404
Sobrecarga	4.5	6.7		1	250	7537.5

Peso total=PG=26525.7 kg

bxd=1.1PG/(0.30f'c) 2346.63 cm2 (35*70) cm2

Uniformizo todas las columnas:

USARE 1° al 5° nivel (0.35x0.70)

II.4.- PREDIMENSIONAMIENTO DE PLACAS

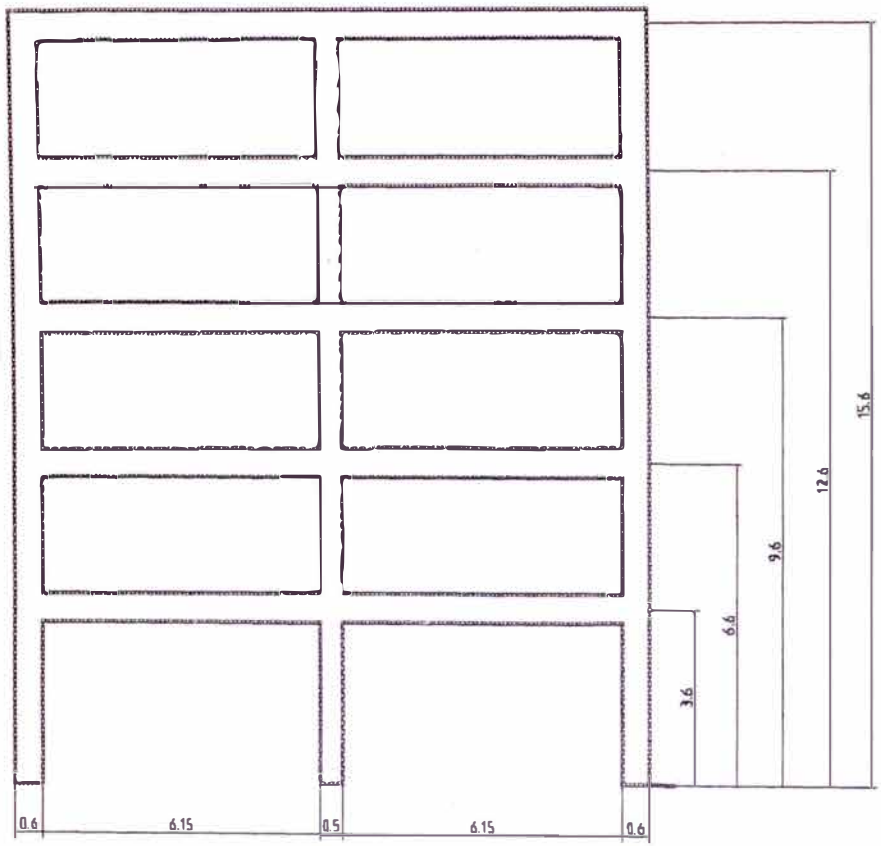
Es difícil fijar un dimensionamiento de placas puesto que su principal función es absorber fuerzas sísmicas, mientras mas abundantes e importantes sean tomaran un mayor porcentaje del cortante sísmico total, aliviando mas a los pórticos.
Referente al espesor, la norma indica que no deberá ser menor de 10 cm.
Finalmente se tomara como espesor de placa:

$$e=0.2 \text{ m}$$

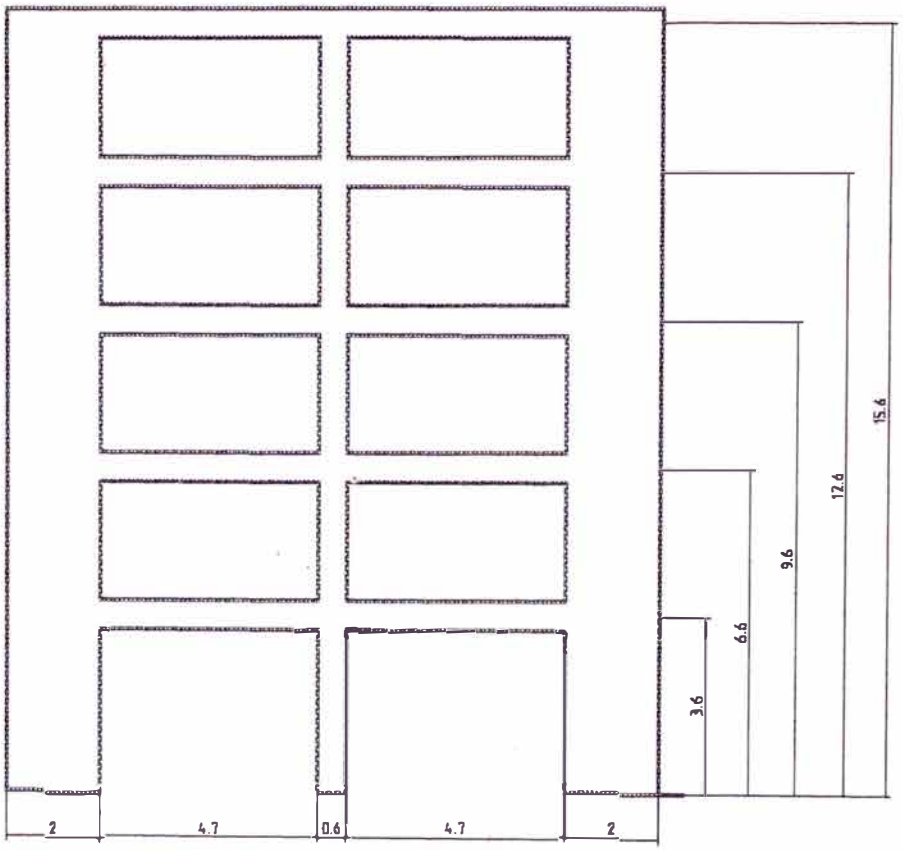
II.5 RESUMEN

II.5.1Losa aligerada
Espesor de losa aligerada: 0.20m
II.5.2 Vigas
Vigas principales (eje y):0.30x0.60
Vigas secundarias (eje x):0.25x0.60
II.5.3Columnas
Columnas C1: 1° al 5° nivel (0.30x0.55)
Columnas C2: 1° al 5° nivel (0.35x0.50)
Columnas C3: 1° al 5° nivel (0.35x0.60)
Columnas C4: 1° al 5° nivel (0.35x0.70)
II.5.3 Placas
Espesor de placa: 0.20m.
Las dimensiones aquí presentadas no son definitivas ya que podrán ser modificadas en el diseño sismoresistente o modificadas por resistencia.

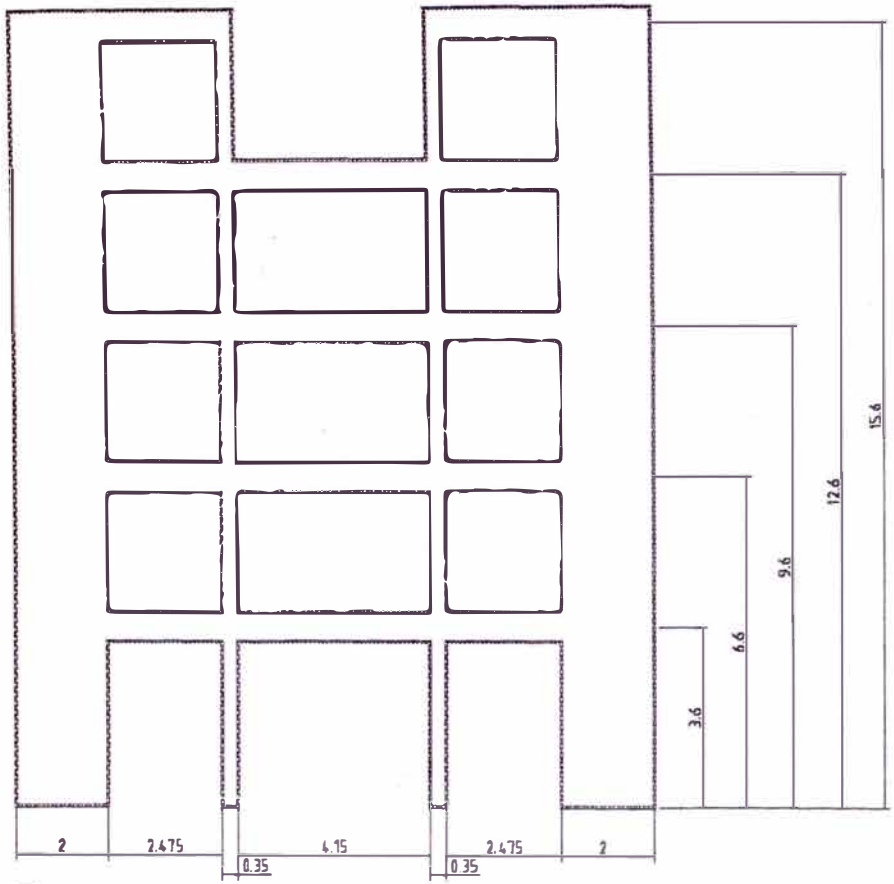
PORTICO 3 Y 2



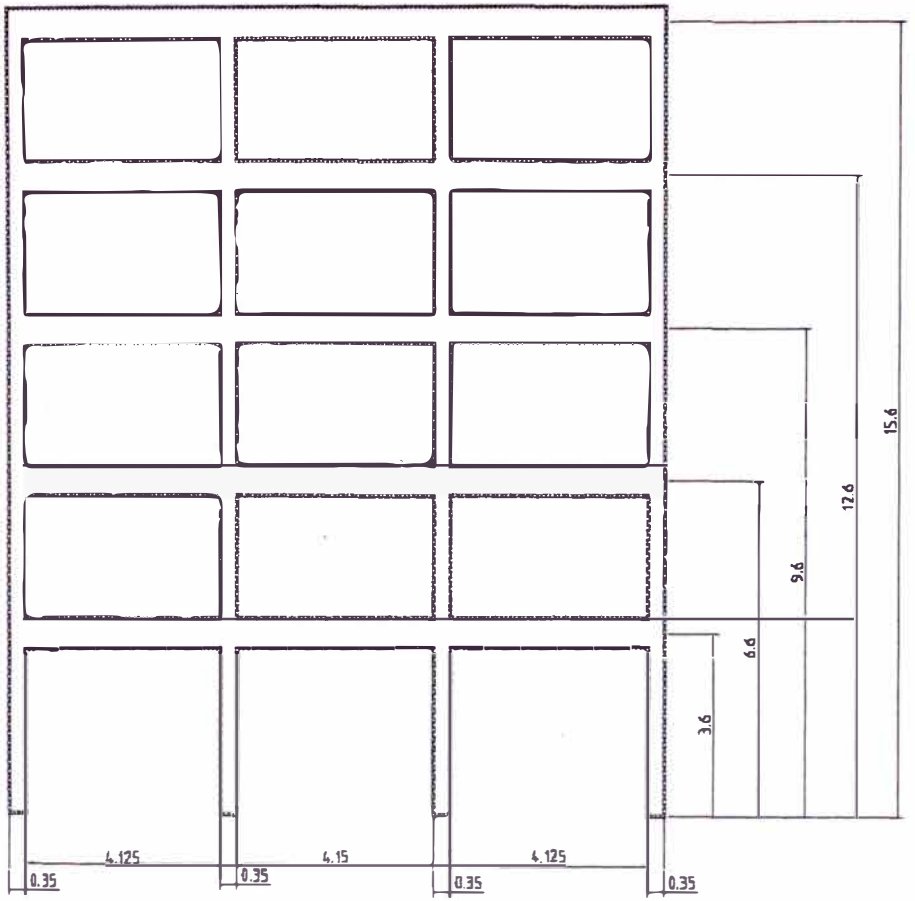
PORTICO 1 Y 4



PORTICOS A y C



PORTICO B



III.- METRADO DE CARGAS

III.1 METRADO DE CARGAS POR PISOS

Peso de la edificación P:

Según Norma E.030:
Como la edificación es de categoría C, se tomara el 25% de la carga viva
y en azoteas y techos en general se toma el 25% de la carga viva

Quinto nivel	Peso	Area	Longitud	
Peso de losa 5° nivel	300	138.18		41454
Peso de viga V-X	2400	1.05	4.2	10584
Peso de viga V-Y	2400	0.72	9.3	16070
Peso de columnas	2400	3.48	1.5	12528
Peso de acabados	120	163.8		19656
Peso de tabiqueria	180	163.8		29484
25% de sobrecarga	38	163.8		6224.4
		TOTAL		**136000.8 Kg**

Cuarto nivel	Peso	Area	Longitud	
Peso de losa 4° nivel	300	165.06		49518
Peso de viga V-X	2400	0.15	30.2	10872
Peso de viga V-Y	2400	0.72	9.3	16070
Peso de columnas	2400	3.48	3	25056
Peso de acabados	120	193.2		23184
Peso de tabiqueria	180	193.2		34776
25% de sobrecarga	63	193.2		12171.6
		TOTAL		**171648 Kg**

Tercer nivel	Peso	Area	Longitud	
Peso de losa 3° nivel	300	165.06		49518
Peso de viga V-X	2400	0.15	30.2	10872
Peso de viga V-Y	2400	0.72	9.3	16070
Peso de columnas	2400	3.48	3	25056
Peso de acabados	120	193.2		23184
Peso de tabiqueria	180	193.2		34776
25% de sobrecarga	63	193.2		12171.6
		TOTAL		**171648 Kg**

Segundo nivel	Peso	Area	Longitud	
Peso de losa 2° nivel	300	165.06		49518
Peso de viga V-X	2400	0.15	30.2	10872
Peso de viga V-Y	2400	0.72	9.3	16070
Peso de columnas	2400	3.48	3	25056
Peso de acabados	120	193.2		23184
Peso de tabiqueria	180	193.2		34776
25% de sobrecarga	63	193.2		12171.6
		TOTAL		**171648 Kg**

Primer nivel	Peso	Area	Longitud	
Peso de losa 1° nivel	300	165.06		49518
Peso de viga V-X	2400	0.15	30.2	10872
Peso de viga V-Y	2400	0.72	9.3	16070
Peso de columnas	2400	3.48	3	25056
Peso de acabados	120	193.2		23184
Peso de tabiqueria	180	193.2		34776
25% de sobrecarga	63	193.2		12171.6
		TOTAL		**171648 Kg**

Peso total=822592.8 Kg

Peso total=823 Tn

III.2 METRADO DE CARGAS POR PORTICOS

Cálculos de pesos de aportantes sin considerar el peso de vigas

WD= Carga muerta
WD= Losa+Tabiqueria+Acabados

WL= Carga viva
WL= S/C

Aportante	Tipo de carga	Piso tipico	Azotea	Ancho	Ancho	Ancho
		Kg/m2	Kg/m2	ejesA,B,C	ejes1,4	ejes2,3
Losa	D	300	300	1	2.25	4.5
Tabiqueria	D	180	0	1	2.25	4.5
Acabados	D	120	120	1	2.25	4.5
S/C	L	250	150	1	2.25	4.5
	WD	600	420			
	WL	250	150			

Cargas para vigas incluyendo su peso propio:

Ejes A,B,C:
WD=600x1+2400x0.25x0.6
WL=600x1
Ejes 1,4:
WD=600x2.25+2400x0.25x0.6
WL=600x2.25
Ejes 2,3:
WD=600x4.5+2400x0.25x0.6
WL=600x4.5

Aportante	Tipo de carga	Piso tipico	Azotea	Piso tipico	Azotea	Piso tipico	Azotea
ejes		A,B,C (Kg/m)	A,B,C (Kg/m)	1,4 (Kg/m)	1,4 (Kg/m)	2,3 (Kg/m)	2,3 (Kg/m)
Carga muerta	WD	960	780	1782	1377	3132	2322
Carga viva	WL	250	150	562.5	337.5	1125	675

IV ANALISIS ESTRUCTURAL

IV.1 INTRODUCCION

Todas las estructuras soportan cargas , siendo estas: cargas muertas, cargas vivas y cargas laterales

a) · Cargas muertas .- Son las cargas debidos al peso propio de la edificación , tanto la estructura resistente como los elementos no estructurales (tabiques y acabados).
b) Cargas vivas o sobrecargas de servicio.- Son las producidas por el peso de personas, muebles equipos, etc.
c) Cargas laterales.- Son las producidas por sismos, vientos, etc.

IV.2 ANALISIS SISMICO

Cualquier estructura puede ser diseñada usando los resultados de los análisis dinámicos, solo las estructuras regulares de no mas de 45m de altura podrán analizarse mediante el procedimiento de fuerzas estáticas equivalentes.

Análisis Estático.- Este método representa las solicitaciones sísmicas mediante un conjunto de fuerzas horizontales actuando en cada nivel de la edificación

Análisis dinámico.- Existen 2 métodos , el método tiempo historia y el método modal espectral

Método Tiempo-historia:

Este procedimiento incluye los siguientes pasos

1.-Se selecciona un registro sísmico como el representativo de un sismo esperado
2.-El registro es digitado como una serie de pequeños intervalos de tiempo de cerca de 1/40 a 1/25 de segundo con niveles dados de aceleración ocurrida para cada intervalo
3.-Se escoge un modelo matemático, usualmente es el modelo masa-resorte con amortiguamiento
4.-Las ecuaciones de movimiento se obtienen relacionando cada masa y su aceleración con las fuerzas que actúan sobre ella mediante los resortes elásticos
5.-Se pone el modelo matemático en la computadora y se le suministra el registro digitado como aceleración aplicada a la base de la estructura
6.-La computadora integra las ecuaciones de movimiento de cada masa que esta sujeta al incremento de elasticidad y fuerzas de amortiguamiento mediante los resortes, la computadora da como respuesta todo el registro de la aceleración, velocidad, y desplazamiento de cada masa

El procedimiento automáticamente incluye varios modos de vibración y combina sus efectos conforme ocurran, así elimina la incertidumbre de combinar los modos que son inherentes al análisis espectral.

Método Espectral:

En el análisis de estructuras de varios grados de libertad se observa que la respuesta dinámica puede obtenerse a través de la superposición de las respuestas de los modos normale de vibración , por lo tanto si disponemos de espectros de respuestas elásticas de sismos podemos conocer la respuesta máxima para cada modo de vibración y utilizando una combinación adecuada de ellos podemos estimar la respuesta máxima probable.

La repuesta máxima elástica esperada (r), correspondiente al efecto conjunto de los diferentes modos de vibración empleados (ri) podrá determinarse mediante la siguiente expresión:

$$r=0.25*\sum | ri | +0.75*\sqrt{\sum ri^2}$$

Alternativamente la respuesta máxima podrá estimarse mediante la combinación cuadrática completa de los valores calculados para cada modo

IV.2.1 ANALISIS SISMICO ESTATICO POR CARGAS EQUIVALENTES

Fuerza cortante en la base:

V=Z*U*C*S*P/R------(1)

IV.2.2 ANALISIS SISMICO ESTATICO PARA EL PROYECTO EN ESTUDIO

Siendo:

Z (zona 3)=	0.4
S=	1.0
Tp=	0.4
U (OFICINAS)=	1.0
C=	2.16
R=	10

Periodo fundamental:
T=hn/Ct
Siendo:
hn=15.6m (altura total del edificio)
Ct=35 (para edificios cuyos elementos resistentes son pórticos)
T=0.45

Factor de amplificación sísmica:
Este coeficiente se interpreta como el factor de amplificación de la respuesta estructural respecto a la aceleración en el suelo.

$$C=0.25x(Tp/T)^{1.25}=2.16$$

En (1):

V (Tn)=ZxUxCxSxP/R
V (Tn)=**71.07**

P1 (Tn)=171.65
P2 (Tn)=171.65
P3 (Tn)=171.65
P4 (Tn)=171.65
P5 (Tn)=136.00

$\sum Pixhi=7683.01$

$$Fi=\frac{(Pi*hi)*V}{\sum Pixhi}$$

F1 (Tn)=5.72
F2 (Tn)=10.48
F3 (Tn)=15.24
F4 (Tn)=20.01
F5 (Tn)=19.63

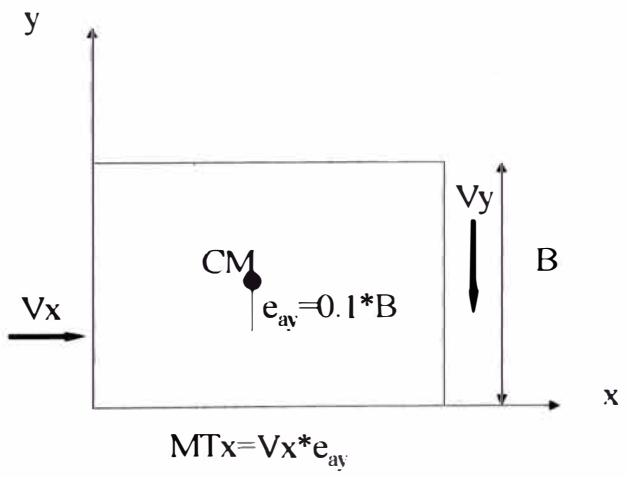
Efectos de torsión:

La fuerza en cada nivel Fi, se supondrá actuando en el centro de masas del nivel respectivo, debiendo considerarse además el efecto de excentricidades accidentales
La excentricidad accidental en cada nivel , se considerara como 0.10 veces la dimensión del edificio en la dirección perpendicular a la de la aplicación de las fuerzas
Siendo (ey), la excentricidad accidental para las fuerzas aplicadas en la dirección "X"
Siendo (ex), la excentricidad accidental para las fuerzas aplicadas en la dirección "Y"

ey=14.0/10=1.40

ex=13.8/10=1.38

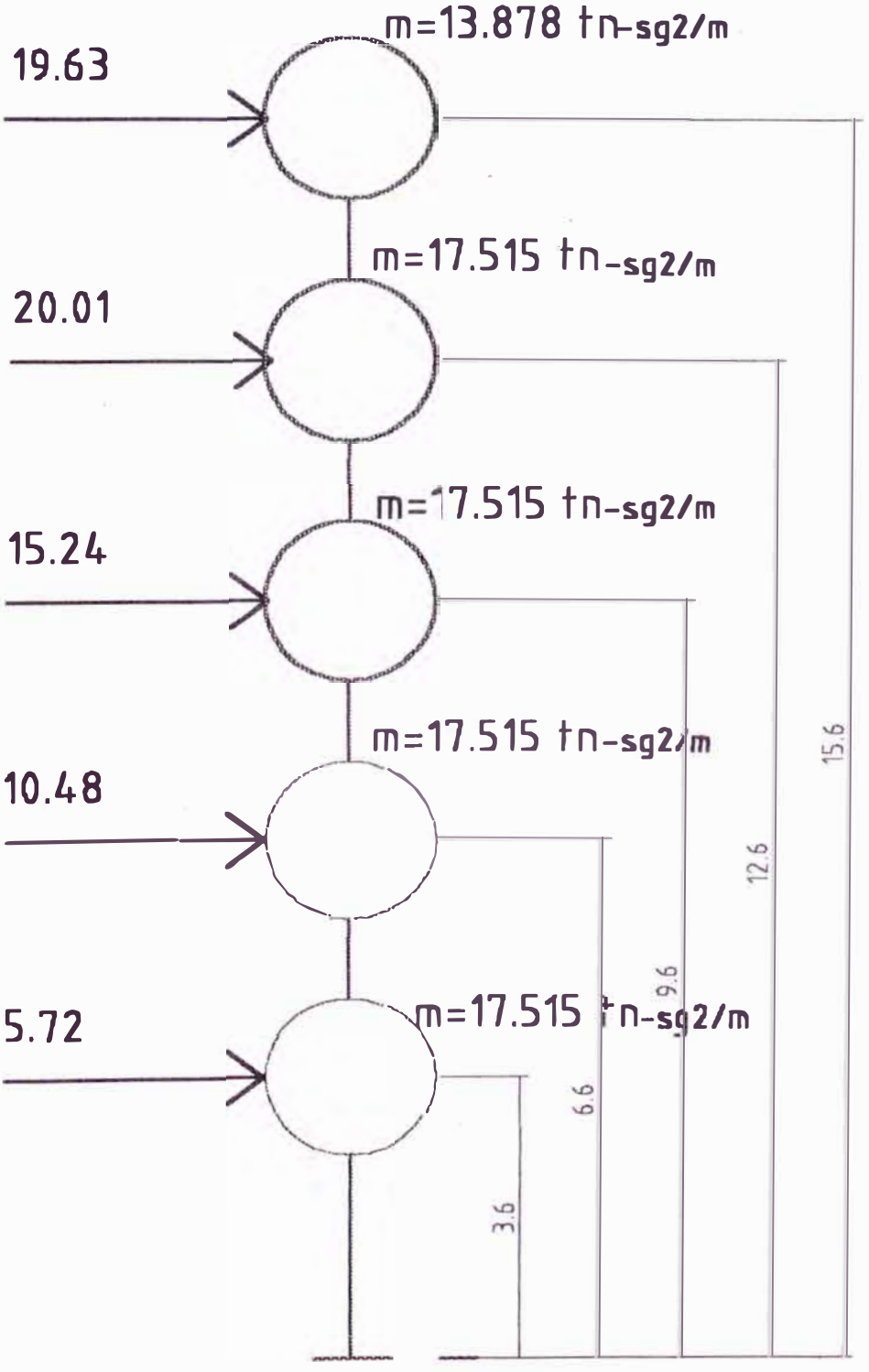
Efectos de torsión



$MTx=Vx*e_{ay}$

ANALISIS SISMICO ESTATICO

FUERZAS SISMICAS EN EJE X, Y (tn)

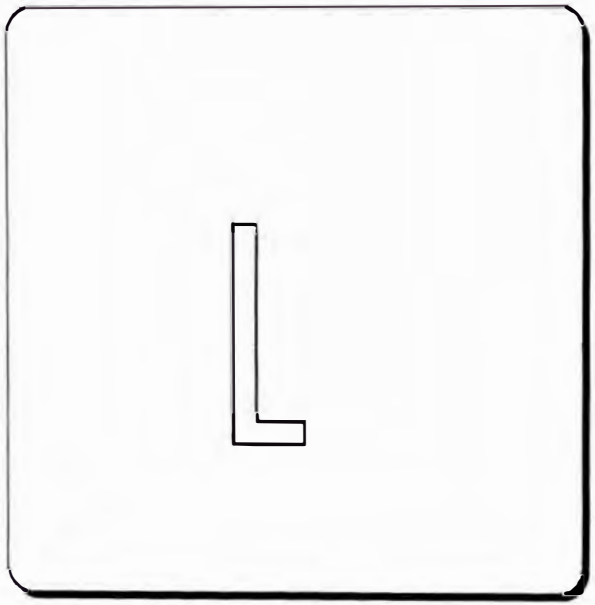


Propiedades de la Placa P1

HSF 1995

	Coordenadas de los Vértices	
	x	y
1	0.4	-0.200
2	0.4	0
3	0.000	0
4	0.000	1.8
5	-0.200	1.8
6	-0.200	-0.2
7	0.4	-0.2
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		

Círculos: agregar (R+) o descontar (R-)		
R	x	y



A = 0.480

Ejes Originales

y_{max} = 1.800

y_{min} = -0.200

Ix = 3.9040E-01

Iy = 9.6000E-03

Ixy = -3.3600E-02

J = -2.4000E-02

Ejes Baricéntricos

x = -0.050

y = 0.650

Ix = 1.8760E-01

Iy = 8.4000E-03

Ixy = -1.8000E-02

J = 1.9600E-01

i = 0.639

S_{top} = 1.6313E-01

S_{bot} = 2.2071E-01

Ejes Principales

ϕ = 5.68

Ix = 1.8939E-01

Iy = 6.6098E-03

Datos de entrada para el programa a3se

```
Análisis Sísmico Seudo-Tridimensional de Estructura Aporticada de 5 Pisos
5,7,4
3.60,3.00,3.00,3.00,3.00
6.75,7.00,19.63,19.63,1.38,1.40
6.75,7.00,20.01,20.01,1.38,1.40
6.75,7.00,15.24,15.24,1.38,1.40
6.75,7.00,10.48,10.48,1.38,1.40
6.75,7.00,5.72,5.72,1.38,1.40
2.2E6
1  1,13.5,0,90,2
2  2,9,0,90,2
3  2,4.5,0,90,2
4  1,0,0,90,2
A  3,0,0,0,1
B  4,0,7,0,1
C  3,0,14,0,1
2                          ejes 1,4
6.0,6.0
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.30,.60,.30,.60
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.30,.60,.30,.60
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2                          eje 3,2
6.70,6.70
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.30,.60,.30,.60
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3                          ejes A,C
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```

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.20,2.0,0.1876,.60,.35, ,.60,.35, ,.20,2.0,0.1876
3 eje B
4.475,4.50,4.475
.25,.60,.25,.60,.25,.60
.25,.60,.25,.60,.25,.60
.25,.60,.25,.60,.25,.60
.25,.60,.25,.60,.25,.60
.25,.60,.25,.60,.25,.60
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.60,.35, ,.50,.35, ,.50,.35, ,.60,.35, ,
.60,.35, ,.50,.35, ,.50,.35, ,.60,.35, ,
.60,.35, ,.50,.35, ,.50,.35, ,.60,.35, ,
.60,.35, ,.50,.35, ,.50,.35, ,.60,.35, ,

Resultados del programa a3se.

Análisis Sísmico Seudo-Tridimensional de Estructura Aporticada de 5 Pisos

{A3se} - versión 1a - H. Scaletti (1995)

15/02/2001 - 19:03

5 pisos
7 pórticos
4 tipo(s)

Alturas de los Entrepisos:

3.60 3.00 3.00 3.00 3.00

Fuerzas y Excentricidades en Cada Nivel:

nivel	xo	yo	Fx	Fy	ex	ey
5	6.75	7.00	19.63	19.63	1.38	1.40
4	6.75	7.00	20.01	20.01	1.38	1.40
3	6.75	7.00	15.24	15.24	1.38	1.40
2	6.75	7.00	10.48	10.48	1.38	1.40
1	6.75	7.00	5.72	5.72	1.38	1.40

E = 2.20E+06
G = 8.80E+05
Gm = 8.80E+05

Factor de reducción de rigideces en vigas: .70
Brazos rígidos reducidos en 1/4 de peralte de viga

Tipo y Ubicación de Cada Pórtico:

pórtico	tipo	x1	y1	alfa
1	1	13.50	.00	90.00
2	2	9.00	.00	90.00
3	2	4.50	.00	90.00
4	1	.00	.00	90.00
A	3	.00	.00	.00
B	4	.00	7.00	.00
C	3	.00	14.00	.00

Pórtico tipo 1

2 vano(s)
5 piso(s)

Luces de las Vigas:

6.00 6.00

Dimensiones de las Vigas:

.30	.60	.30	.60
.30	.60	.30	.60
.30	.60	.30	.60
.30	.60	.30	.60
.30	.60	.30	.60

Dimensiones de las Columnas:

.20	2.00	.35	.60	.20	2.00
.20	2.00	.35	.60	.20	2.00
.20	2.00	.35	.60	.20	2.00
.20	2.00	.35	.60	.20	2.00
.20	2.00	.35	.60	.20	2.00

Momentos de Inercia de Columnas y Placas:

1.876E-01	6.300E-03	1.876E-01
1.876E-01	6.300E-03	1.876E-01
1.876E-01	6.300E-03	1.876E-01
1.876E-01	6.300E-03	1.876E-01
1.876E-01	6.300E-03	1.876E-01

Pórtico tipo 2
2 vano(s)
5 piso(s)

Luces de las Vigas:
6.70 6.70

Dimensiones de las Vigas:

.30 .60 .30 .60
.30 .60 .30 .60
.30 .60 .30 .60
.30 .60 .30 .60
.30 .60 .30 .60

Dimensiones de las Columnas:

.35 .60 .35 .50 .35 .60
.35 .60 .35 .50 .35 .60
.35 .60 .35 .50 .35 .60
.35 .60 .35 .50 .35 .60
.35 .60 .35 .50 .35 .60

Pórtico tipo 3

3 vano(s)
5 piso(s)

Luces de las Vigas:

3.65 4.50 3.65

Dimensiones de las Vigas:

.25 .60 .00 .00 .25 .60
.25 .60 .25 .60 .25 .60
.25 .60 .25 .60 .25 .60
.25 .60 .25 .60 .25 .60
.25 .60 .25 .60 .25 .60

Dimensiones de las Columnas:

.20 2.00 .60 .35 .60 .35 .20 2.00
.20 2.00 .60 .35 .60 .35 .20 2.00
.20 2.00 .60 .35 .60 .35 .20 2.00
.20 2.00 .60 .35 .60 .35 .20 2.00
.20 2.00 .60 .35 .60 .35 .20 2.00

Momentos de Inercia de Columnas y Placas:

1.876E-01 2.144E-03 2.144E-03 1.876E-01
1.876E-01 2.144E-03 2.144E-03 1.876E-01
1.876E-01 2.144E-03 2.144E-03 1.876E-01
1.876E-01 2.144E-03 2.144E-03 1.876E-01
1.876E-01 2.144E-03 2.144E-03 1.876E-01

Pórtico tipo 4

3 vano(s)
5 piso(s)

Luces de las Vigas:

4.47 4.50 4.47

Dimensiones de las Vigas:

.25	.60	.25	.60	.25	.60
.25	.60	.25	.60	.25	.60
.25	.60	.25	.60	.25	.60
.25	.60	.25	.60	.25	.60
.25	.60	.25	.60	.25	.60

Dimensiones de las Columnas:

.60	.35	.50	.35	.50	.35	.60	.35
.60	.35	.50	.35	.50	.35	.60	.35
.60	.35	.50	.35	.50	.35	.60	.35
.60	.35	.50	.35	.50	.35	.60	.35
.60	.35	.50	.35	.50	.35	.60	.35

Efectos Globales - Sismo en la Dirección X

Desplazamientos de Cada Nivel

nivel	x	y	r
5	9.134E-03	4.681E-10	1.649E-04
4	7.345E-03	3.762E-10	1.309E-04
3	5.320E-03	2.722E-10	9.333E-05
2	3.180E-03	1.625E-10	5.477E-05
1	1.250E-03	6.379E-11	2.098E-05

Distorsiones de los Entrepisos

nivel	x	y	r
5	1.789E-03	9.194E-11	3.402E-05
4	2.026E-03	1.040E-10	3.753E-05
3	2.140E-03	1.097E-10	3.855E-05
2	1.930E-03	9.875E-11	3.379E-05
1	1.250E-03	6.379E-11	2.098E-05

Fuerzas Concentradas

nivel	x	y	r
5	1.963E+01	0.000E+00	2.748E+01
4	2.001E+01	0.000E+00	2.801E+01
3	1.524E+01	0.000E+00	2.134E+01
2	1.048E+01	0.000E+00	1.467E+01
1	5.720E+00	0.000E+00	8.008E+00

Cortantes Totales en Cada Nivel

nivel	x	y	r
5	1.963E+01	0.000E+00	2.748E+01
4	3.964E+01	0.000E+00	5.550E+01
3	5.488E+01	0.000E+00	7.683E+01
2	6.536E+01	0.000E+00	9.150E+01
1	7.108E+01	0.000E+00	9.951E+01

Efectos Globales - Sismo en la Dirección Y

Desplazamientos de Cada Nivel

nivel	x	y	r
5	3.993E-10	9.234E-03	1.625E-04
4	3.211E-10	7.433E-03	1.290E-04
3	2.325E-10	5.374E-03	9.199E-05
2	1.390E-10	3.197E-03	5.399E-05
1	5.466E-11	1.243E-03	2.068E-05

Distorsiones de los Entrepisos

nivel	x	y	r
5	7.821E-11	1.801E-03	3.354E-05
4	8.854E-11	2.059E-03	3.699E-05
3	9.352E-11	2.177E-03	3.800E-05
2	8.435E-11	1.954E-03	3.331E-05
1	5.466E-11	1.243E-03	2.068E-05

Fuerzas Concentradas

nivel	x	y	r
5	0.000E+00	1.963E+01	2.709E+01
4	0.000E+00	2.001E+01	2.761E+01
3	0.000E+00	1.524E+01	2.103E+01
2	0.000E+00	1.048E+01	1.446E+01
1	0.000E+00	5.720E+00	7.894E+00

Cortantes Totales en Cada Nivel

nivel	x	y	r
5	0.000E+00	1.963E+01	2.709E+01
4	0.000E+00	3.964E+01	5.470E+01
3	0.000E+00	5.488E+01	7.573E+01
2	0.000E+00	6.536E+01	9.020E+01
	0.000E+00	7.108E+01	9.809E+01

Efectos en el Pórtico del Eje 1

Sismo en la Dirección Y

Desplazamientos, Distorsiones, Fuerzas y Cortes en Cada Nivel

nivel	u	ë	F	V
5	.01033	.00203	4.931	4.931
4	.00830	.00231	11.354	16.162
3	.00599	.00243	7.556	23.635
2	.00356	.00218	6.039	29.635
	.00138	.00138	5.565	35.192

Momentos Flectores y Cortes en las Vigas

viga	niv	Mi	Mj	V
1	5	6.462	4.933	2.424
2	5	4.933	6.462	2.424
1	4	8.082	7.303	3.273
2	4	7.303	8.082	3.273
1	3	8.770	7.789	3.523
2	3	7.789	8.770	3.523
1	2	8.638	7.729	3.482
2	2	7.729	8.638	3.482
1	1	6.528	5.792	2.621
2	1	5.792	6.528	2.621

Fuerzas Axiales, Momentos y Cortes en las Columnas

col.	nivel	N	Mt	Mb	V
1	5	2.021	7.490	9.070	.824
1	4	4.751	17.863	2.476	5.867
1	3	7.689	11.529	17.268	9.249
1	2	10.592	7.293	43.721	12.374
1	1	12.778	36.089	94.935	16.395
2	5	.000	9.277	6.788	5.355
2	4	.000	6.945	6.850	4.598
2	3	.000	7.797	7.800	5.199
2	2	.000	6.735	7.966	4.900
2	1	.000	2.927	5.720	2.402
3	5	2.021	7.490	9.070	.824
3	4	4.751	17.863	2.476	5.867
3	3	7.689	11.529	17.268	9.249
3	2	10.592	7.293	43.721	12.374
3		12.778	36.089	94.935	16.395

Efectos en el Pórtico del Eje 4

Sismo en la Dirección Y

Desplazamientos, Distorsiones, Fuerzas y Cortes en Cada Nivel

nivel	u	ë	F	V
5	.01033	.00203	4.931	4.931
4	.00830	.00231	11.354	16.162
3	.00599	.00243	7.556	23.635
2	.00356	.00218	6.039	29.635
1	.00138	.00138	5.565	35.192

Momentos Flectores y Cortes en las Vigas

viga	niv	Mi	Mj	V
1	5	6.462	4.933	2.424
2	5	4.933	6.462	2.424
1	4	8.082	7.303	3.273
2	4	7.303	8.082	3.273
1	3	8.770	7.789	3.523
2	3	7.789	8.770	3.523
1	2	8.638	7.729	3.482
2	2	7.729	8.638	3.482
1	1	6.528	5.792	2.621
2	1	5.792	6.528	2.621

Fuerzas Axiales, Momentos y Cortes en las Columnas

col.	nivel	N	Mt	Mb	V
1	5	2.021	7.490	9.070	.824
1	4	4.751	17.863	2.476	5.867
1	3	7.689	11.529	17.268	9.249
1	2	10.592	7.293	43.721	12.374
1	1	12.778	36.089	94.935	16.395
2	5	.000	9.277	6.788	5.355
2	4	.000	6.945	6.850	4.598
2	3	.000	7.797	7.800	5.199
2	2	.000	6.735	7.966	4.900
2	1	.000	2.927	5.720	2.402
3	5	2.021	7.490	9.070	.824
3	4	4.751	17.863	2.476	5.867
3	3	7.689	11.529	17.268	9.249
3	2	10.592	7.293	43.721	12.374
3	1	12.778	36.089	94.935	16.395

Efectos en el Pórtico del Eje 2

Sismo en la Dirección Y

Desplazamientos, Distorsiones, Fuerzas y Cortes en Cada Nivel

nivel	u	ë	F	V
5	.00960	.00188	6.073	6.073
4	.00772	.00214	.417	5.682
3	.00558	.00226	.859	6.534
2	.00332	.00203	.307	6.260
1	.00129	.00129	2.371	3.903

Momentos Flectores y Cortes en las Vigas

viga	niv	Mi	Mj	V
1	5	3.181	2.571	.935
2	5	2.571	3.181	.935
1	4	4.549	4.124	1.410
2	4	4.124	4.549	1.410
1	3	4.934	4.418	1.521
2	3	4.418	4.934	1.521
1	2	4.913	4.410	1.516
2	2	4.410	4.913	1.516
1	1	3.784	3.322	1.155
2	1	3.322	3.784	1.155

Fuerzas Axiales, Momentos y Cortes en las Columnas

col.	nivel	N	Mt	Mb	V
1	5	.812	3.032	1.797	1.610
1	4	2.037	2.538	2.039	1.526
1	3	3.358	2.664	2.732	1.799
1	2	4.674	1.950	3.245	1.731
1	1	5.677	.364	4.224	1.274
2	5	.000	4.820	3.738	2.853
2	4	.000	4.000	3.892	2.631
2	3	.000	4.398	4.412	2.937
2	2	.000	3.862	4.530	2.797
2	1	.000	1.702	3.175	1.355
3	5	.812	3.032	1.797	1.610
3	4	2.037	2.538	2.039	1.526
3	3	3.358	2.664	2.732	1.799
3	2	4.674	1.950	3.245	1.731
3	1	5.677	.364	4.224	1.274

Efectos en el Pórtico del Eje 3

Sismo en la Dirección Y

Desplazamientos, Distorsiones, Fuerzas y Cortes en Cada Nivel

nivel	u	ë	F	V
5	.00960	.00188	6.073	6.073
4	.00772	.00214	.417	5.682
3	.00558	.00226	.859	6.534
2	.00332	.00203	.307	6.260
1	.00129	.00129	2.371	3.903

Momentos Flectores y Cortes en las Vigas

viga	niv	Mi	Mj	V
1	5	3.181	2.571	.935
2	5	2.571	3.181	.935
1	4	4.549	4.124	1.410
2	4	4.124	4.549	1.410
1	3	4.934	4.418	1.521
2	3	4.418	4.934	1.521
1	2	4.913	4.410	1.516
2	2	4.410	4.913	1.516
1	1	3.784	3.322	1.155
2	1	3.322	3.784	1.155

Fuerzas Axiales, Momentos y Cortes en las Columnas

col.	nivel	N	Mt	Mb	V
1	5	.812	3.032	1.797	1.610
1	4	2.037	2.538	2.039	1.526
1	3	3.358	2.664	2.732	1.799
1	2	4.674	1.950	3.245	1.731
1	1	5.677	.364	4.224	1.274
2	5	.000	4.820	3.738	2.853
2	4	.000	4.000	3.892	2.631
2	3	.000	4.398	4.412	2.937
2	2	.000	3.862	4.530	2.797
2	1	.000	1.702	3.175	1.355
3	5	.812	3.032	1.797	1.610
3	4	2.037	2.538	2.039	1.526
3	3	3.358	2.664	2.732	1.799
3	2	4.674	1.950	3.245	1.731
3	1	5.677	.364	4.224	1.274

Efectos en el Pórtico del Eje A

Sismo en la Dirección X

Desplazamientos, Distorsiones, Fuerzas y Cortes en Cada Nivel

nivel	u	ë	F	V
5	.01029	.00203	7.773	7.773
4	.00826	.00229	11.157	18.929
3	.00597	.00241	8.128	27.041
2	.00356	.00217	5.993	33.000
1	.00140	.00140	4.968	37.726

Momentos Flectores y Cortes en las Vigas

viga	niv	Mi	Mj	V
1	5	7.753	5.242	5.251
3	5	5.242	7.753	5.251
1	4	9.158	6.541	6.343
2	4	4.049	4.049	1.951
3	4	6.541	9.158	6.343
1	3	10.663	7.766	7.446
2	3	3.961	3.961	1.909
3	3	7.766	10.663	7.446
1	2	10.983	8.150	7.730
2	2	3.547	3.547	1.710
3	2	8.150	10.983	7.730
1	1	8.630	6.309	6.036
2	1	2.230	2.230	1.075
3	1	6.309	8.630	6.036

Fuerzas Axiales, Momentos y Cortes en las Columnas

col.	nivel	N	Mt	Mb	V
1	5	3.811	9.647	7.277	1.349
1	4	8.415	17.858	2.385	6.391
1	3	13.819	12.825	18.577	10.143
1	2	19.429	5.115	44.183	13.306
1	1	23.810	33.404	96.334	17.534
2	5	3.811	4.263	4.139	2.801
2	4	6.823	4.777	4.742	3.173
2	3	10.671	5.102	5.130	3.410
2	2	14.887	4.669	4.931	3.200
2	1	18.391	2.194	2.589	1.328
3	5	3.811	4.263	4.139	2.801
3	4	6.823	4.777	4.742	3.173
3	3	10.671	5.102	5.130	3.410

3	2	14.887	4.669	4.931	3.200
3	1	18.391	2.194	2.589	1.328
4	5	3.811	9.647	7.277	1.349
4	4	8.415	17.858	2.385	6.391
4	3	13.819	12.825	18.577	10.143
4	2	19.429	5.115	44.183	13.306
4	1	23.810	33.404	96.334	17.534

Efectos en el Pórtico del Eje C

Sismo en la Dirección X

Desplazamientos, Distorsiones, Fuerzas y Cortes en Cada Nivel

nivel	u	ë	F	V
5	.01029	.00203	7.773	7.773
4	.00826	.00229	11.157	18.929
3	.00597	.00241	8.128	27.041
2	.00356	.00217	5.993	33.000
1	.00140	.00140	4.968	37.726

Momentos Flectores y Cortes en las Vigas

viga	niv	Mi	Mj	V
1	5	7.753	5.242	5.251
3	5	5.242	7.753	5.251
1	4	9.158	6.541	6.343
2	4	4.049	4.049	1.951
3	4	6.541	9.158	6.343
1	3	10.663	7.766	7.446
2	3	3.961	3.961	1.909
3	3	7.766	10.663	7.446
1	2	10.983	8.150	7.730
2	2	3.547	3.547	1.710
3	2	8.150	10.983	7.730
1	1	8.630	6.309	6.036
2	1	2.230	2.230	1.075
3	1	6.309	8.630	6.036

Fuerzas Axiales, Momentos y Cortes en las Columnas

col.	nivel	N	Mt	Mb	V
1	5	3.811	9.647	7.277	1.349
1	4	8.415	17.858	2.385	6.391
1	3	13.819	12.825	18.577	10.143
1	2	19.429	5.115	44.183	13.306
1	1	23.810	33.404	96.334	17.534

2	5	3.811	4.263	4.139	2.801
2	4	6.823	4.777	4.742	3.173
2	3	10.671	5.102	5.130	3.410
2	2	14.887	4.669	4.931	3.200
2	1	18.391	2.194	2.589	1.328
3	5	3.811	4.263	4.139	2.801
3	4	6.823	4.777	4.742	3.173
3	3	10.671	5.102	5.130	3.410
3	2	14.887	4.669	4.931	3.200
3	1	18.391	2.194	2.589	1.328
4	5	3.811	9.647	7.277	1.349
4	4	8.415	17.858	2.385	6.391
4	3	13.819	12.825	18.577	10.143
4	2	19.429	5.115	44.183	13.306
4	1	23.810	33.404	96.334	17.534

Efectos en el Pórtico del Eje B

Sismo en la Dirección X

Desplazamientos, Distorsiones, Fuerzas y Cortes en Cada Nivel

nivel	u	ë	F	V
5	.00913	.00179	6.307	6.307
4	.00735	.00203	.101	6.206
3	.00532	.00214	.622	6.829
2	.00318	.00193	.370	6.458
	.00125	.00125	3.390	3.069

Momentos Flectores y Cortes en las Vigas

viga	niv	Mi	Mj	V
1	5	2.355	1.790	1.005
2	5	1.671	1.671	.805
3	5	1.790	2.355	1.005
1	4	3.880	3.272	1.734
2	4	3.078	3.078	1.483
3	4	3.272	3.880	1.734
1	3	4.186	3.537	1.872
2	3	3.245	3.245	1.564
3	3	3.537	4.186	1.872
1	2	4.210	3.563	1.884
2	2	3.181	3.181	1.533
3	2	3.563	4.210	1.884
1	1	3.196	2.658	1.419
2	1	2.268	2.268	1.093
3	1	2.658	3.196	1.419

Fuerzas Axiales, Momentos y Cortes en las Columnas

col.	nivel	N	Mt	Mb	V
1	5	.819	2.095	1.628	1.241
1	4	2.231	1.815	1.723	1.179
1	3	3.756	1.992	2.006	1.333
1	2	5.291	1.731	2.099	1.277
1	1	6.447	.739	1.717	.682
2	5	.162	3.046	2.691	1.912
2	4	.364	2.908	2.863	1.924
2	3	.614	3.117	3.128	2.082
2	2	.899	2.818	3.040	1.953
2	1	1.164	1.301	1.767	.852
3	5	.162	3.046	2.691	1.912
3	4	.364	2.908	2.863	1.924
3	3	.614	3.117	3.128	2.082
3	2	.899	2.818	3.040	1.953
3	1	1.164	1.301	1.767	.852
4	5	.819	2.095	1.628	1.241
4	4	2.231	1.815	1.723	1.179
4	3	3.756	1.992	2.006	1.333
4	2	5.291	1.731	2.099	1.277
4	1	6.447	.739	1.717	.682

IV.2.3 DESPLAZAMIENTOS EN LOS ENTREPISOS

Del análisis sísmico estático se obtuvieron los siguientes desplazamientos, en los cuales cumple con lo especificado en las Normas de Diseño Sismo Resistente 3.8.1 (tabla 8, limites para desplazamiento lateral de entrepiso), donde especifica que: si el material predominante es concreto armado entonces $Di/hei \leq 0.007$

Desplazamiento en el eje x:

Nivel	Desplazamiento	Desplazamiento*Rd/h
5	1.789E-03	0.0059
4	2.026E-03	0.00675
3	2.140E-03	0.0071
2	1.930E-03	0.0064
1	1.250E-03	0.00347

Desplazamiento en el eje y:

Nivel	Desplazamiento	Desplazamiento*Rd/h
5	0.001801	0.006
4	0.002059	0.00686
3	0.002177	0.00726
2	0.001954	0.0065
1	0.00243	0.00675

IV.2.4.-ANALISIS SÍSMICO DINÁMICO PARA EL PROYECTO EN ESTUDIO

Obtención de masas y calculo del Momento Polar de Inercia

De la hoja de las propiedades (figuras 1 y 2) de la planta de las estructura se tienen los Ix e Iy , asi como también las áreas por piso tal como se muestra en la tabla 1.
El momento polar de Inercia de la masa (Jm) se obtendrá de la siguiente manera:

$$Jm=(Ix+Iy)/A$$

Las masa las obtendremos de dividir el peso de la estructura (del metrado por pisos) y la aceleración de la gravedad (Peso/9.8 m/sg2).

TABLA 1:

Piso	Peso (Tn)	Masa (Tn-sg2/m)	Ix (m4)	Iy (m4)	A (m2)	Jm (Tn-m-sg2)
5	136.00	13.878	2315.3	3022.9	163.80	452.28
4	171.65	17.515	3155.6	3066.1	193.2	564.04
3	171.65	17.515	3155.6	3066.1	193.2	564.04
2	171.65	17.515	3155.6	3066.1	193.2	564.04
1	171.65	17.515	3155.6	3066.1	193.2	564.04

Determinación del espectro de aceleraciones

Para este calculo se procede ha hallar el factor de amplificación sísmica, pero no con un periodo predominante de vibración de la estructura dada, sino mas bien variable, de tal forma que este coeficiente sísmico este en el rango ≤ 2.5 tal como lo especifica el articulo 2.3 de la Norma de diseño Sismo Resistente del RNC. Dicho valor del factor de amplificación sísmica es usado luego para determinar la aceleración espectral como se muestra en la siguiente formula:

$$Sa = \frac{Z*U*Ci}{R} *g$$

Reemplazando diferentes valores de Ti en la formula anterior obtenemos el espectro de aceleraciones:

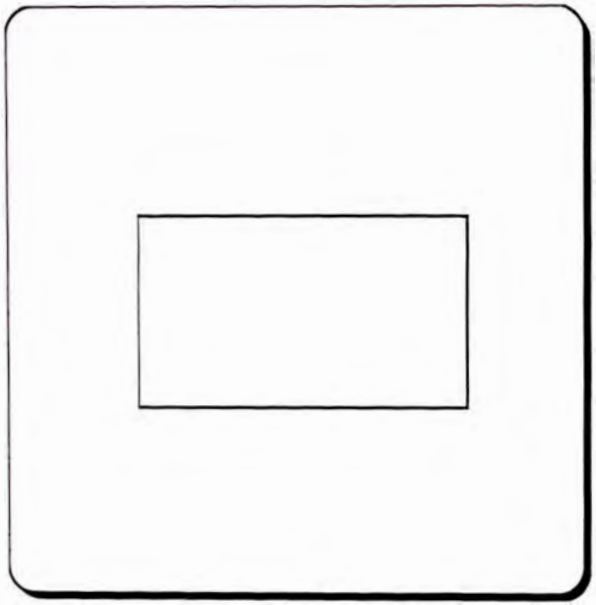
Ti	Ci	Sa
0.4	2.5	0.98
0.5	1.8915	0.741
0.6	1.506	0.59
0.7	1.242	0.487
0.8	1.051	0.412
0.9	0.907	0.356
1.0	0.795	0.312

Propiedades del área de piso tipico

HSF 1995

	Coordenadas de los Vértices	
	x	y
1	13.8	0.000
2	13.8	14
3	0.000	14
4	0.000	0
5	13.800	0
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		

Círculos: agregar (R+) o descontar (R-)		
R	x	y



A = 193.200

Ejes Originales

y_{max} = 14.000

y_{min} = 0.000

Ix = 1.2622E+04

Iy = 1.2264E+04

Ixy = 9.3316E+03

J = 2.1596E+04

Ejes Baricéntricos

x = 6.900

y = 7.000

Ix = 3.1556E+03

Iy = 3.0661E+03

Ixy = 0.0000E+00

J = 6.2217E+03

i = 5.675

S_{top} = 4.5080E+02

S_{bot} = 4.5080E+02

Ejes Principales

ϕ = 0.00

Ix = 3.1556E+03

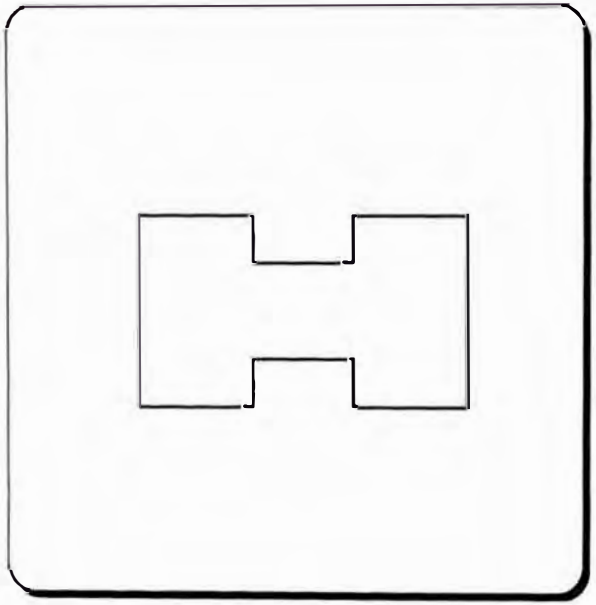
Iy = 3.0661E+03

Propiedades del área de azotea

HSF 1995

	Coordenadas de los Vértices	
	x	y
1	13.8	0.000
2	13.8	14
3	9.000	14
4	9.000	10.5
5	4.800	10.5
6	4.800	14
7	0	14
8	0	0
9	4.8	0.000
10	4.8	3.5
11	9	3.5
12	9	0
13	13.8	0
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

Círculos: agregar (R+) o descontar (R-)		
R	x	y



A = 163.800

Ejes Originales

y_{max} = 14.000

y_{min} = 0.000

Ix = 1.0341E+04

Iy = 1.0821E+04

Ixy = 7.9115E+03

J = 1.8733E+04

Ejes Baricéntricos

x = 6.900

y = 7.000

Ix = 2.3153E+03

Iy = 3.0229E+03

Ixy = 0.0000E+00

J = 5.3381E+03

i = 5.709

S_{top} = 3.3075E+02

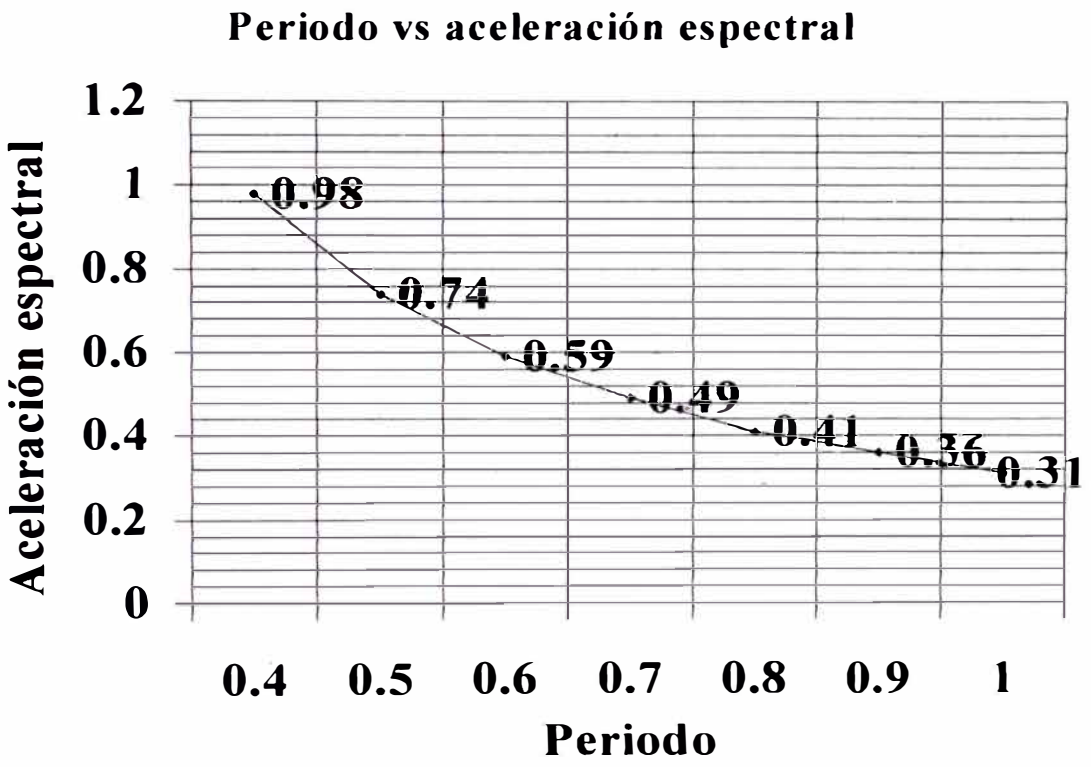
S_{bot} = 3.3075E+02

Ejes Principales

ϕ = 90.00

Ix = 3.0229E+03

Iy = 2.3153E+03



En la ejecución del programa a3s se estimo la respuesta máxima mediante la combinación cuadratica completa de los valores calculados para cada modo

Datos de entrada para el programa a3s.

```
Análisis Sísmico Seudo-Tridimensional de Estructura Aporticada de 5 Pisos
5,7,4
3.60,3.00,3.00,3.00,3.00
6.75,7.00,13.878,452.28
6.75,7.00,17.515,564.04
6.75,7.00,17.515,564.04
6.75,7.00,17.515,564.04
6.75,7.00,17.515,564.04
2.2E6, , , ,0.25
1   1,13.5,0,90,2
2   2,9,0,90,2
3   2,4.5,0,90,2
4   1,0,0,90,2
A   3,0,0,0,1
B   4,0,7,0,1
C   3,0,14,0,1
10,2,98
7,,                    Z=0.4  U=S=1.0  R=10
.4,.98
.5,.74
.6,.59
.7,.49
.8,.41
.9,.36
1.0,.31
2                              ejes 1,4
6.0,6.0
.30,.60,.30,.60
.30,.60,.30,.60
.30,.60,.30,.60
.30,.60,.30,.60
.30,.60,.30,.60
.20,2.0,0.1876,.35,.60, ,.20,2.0,0.1876
.20,2.0,0.1876,.35,.60, ,.20,2.0,0.1876
.20,2.0,0.1876,.35,.60, ,.20,2.0,0.1876
.20,2.0,0.1876,.35,.60, ,.20,2.0,0.1876
.20,2.0,0.1876,.35,.60, ,.20,2.0,0.1876
2                              eje 3,2
6.70,6.70
.30,.60,.30,.60
.30,.60,.30,.60
.30,.60,.30,.60
.30,.60,.30,.60
.30,.60,.30,.60
.35,.60, ,.35,.50,,.35,.60, ,
.35,.60, ,.35,.50,,.35,.60, ,
.35,.60, ,.35,.50,,.35,.60, ,
.35,.60, ,.35,.50,,.35,.60, ,
.35,.60, ,.35,.50,,.35,.60, ,
```

```
3                                   ejes A,C
3.65,4.50,3.65
.25,.60,.00,.00,.25,.60
.25,.60,.25,.60,.25,.60
.25,.60,.25,.60,.25,.60
.25,.60,.25,.60,.25,.60
.25,.60,.25,.60,.25,.60
.20,2.0,0.1876,.60,.35, ,.60,.35, ,.20,2.0,0.1876
.20,2.0,0.1876,.60,.35, ,.60,.35, ,.20,2.0,0.1876
.20,2.0,0.1876,.60,.35, ,.60,.35, ,.20,2.0,0.1876
.20,2.0,0.1876,.60,.35, ,.60,.35, ,.20,2.0,0.1876
.20,2.0,0.1876,.60,.35, ,.60,.35, ,.20,2.0,0.1876
3                                   eje B
4.475,4.50,4.475
.25,.60,.25,.60,.25,.60
.25,.60,.25,.60,.25,.60
.25,.60,.25,.60,.25,.60
.25,.60,.25,.60,.25,.60
.25,.60,.25,.60,.25,.60
.60,.35, ,.50,.35, ,.50,.35, ,.60,.35, ,
.60,.35, ,.50,.35, ,.50,.35, ,.60,.35, ,
.60,.35, ,.50,.35, ,.50,.35, ,.60,.35, ,
.60,.35, ,.50,.35, ,.50,.35, ,.60,.35, ,
.60,.35, ,.50,.35, ,.50,.35, ,.60,.35, ,
```

Resultados del programa a3s.

```
{A3s} - versión 1.4 - H. Scaletti (1991)

 Análisis Sísmico Seudo-Tridimensional de Estructura Aporticada de 5 Pisos

   5 pisos
   7 pórticos
   4 tipo(s)

 Alturas de los Entrepisos:
   3.60   3.00   3.00   3.00   3.00

 Inercias en Cada Nivel:
 nivel     xo     yo      masa       Jo

    5    6.75   7.00   1.39E+01   4.52E+02
    4    6.75   7.00   1.75E+01   5.64E+02
    3    6.75   7.00   1.75E+01   5.64E+02
    2    6.75   7.00   1.75E+01   5.64E+02
    1    6.75   7.00   1.75E+01   5.64E+02
  E =  2.20E+06
  G =  8.80E+05
 Gm =  8.80E+05
```

Factor de Reducción de Rigideces en Vigas: .70
Factor de Reducción de Brazos Rígidos: .25
Tipo y Ubicación de Cada Pórtico:

pórtico	tipo	xı	yı	alfa
1	1	13.50	.00	90.00
2	2	9.00	.00	90.00
3	2	4.50	.00	90.00
4	1	.00	.00	90.00
A	3	.00	.00	.00
B	4	.00	7.00	.00
C	3	.00	14.00	.00

Análisis Dinámico Modal (Espectral)
10 modos (SRSS)

f m x = 98.00 Hertz

Espectro de Pseudo Aceleraciones:

T	Sa
.40	.98
.50	.74
.60	.59
.70	.49
.80	.41
.90	.36
1.00	.31

(interpolación lineal)

Pórtico tipo

2 vano(s)
5 piso(s)

Luces de las Vigas:

6.00 6.00

Dimensiones de las Vigas:

.30	.60	.30	.60
.30	.60	.30	.60
.30	.60	.30	.60
.30	.60	.30	.60
.30	.60	.30	.60

Dimensiones de las Columnas:

.20 2.00	.35 .60	.20 2.00
.20 2.00	.35 .60	.20 2.00
:20 2.00	.35 .60	.20 2.00
.20 2.00	.35 .60	.20 2.00
.20 2.00	.35 .60	.20 2.00

Momentos de Inercia de Columnas y Placas:

1.876E-01	6.300E-03	1.876E-01
1.876E-01	6.300E-03	1.876E-01
1.876E-01	6.300E-03	1.876E-01
1.876E-01	6.300E-03	1.876E-01
1.876E-01	6.300E-03	1.876E-01

Pórtico tipo 2

2 vano(s)
5 piso(s)

Luces de las Vigas:

6.70 6.70

Dimensiones de las Vigas:

.30 .60	.30 .60
.30 .60	.30 .60
.30 .60	.30 .60
.30 .60	.30 .60
.30 .60	.30 .60

Dimensiones de las Columnas:

.35 .60	.35 .50	.35 .60
.35 .60	.35 .50	.35 .60
.35 .60	.35 .50	.35 .60
.35 .60	.35 .50	.35 .60
.35 .60	.35 .50	.35 .60

Pórtico tipo 3

3 vano(s)
5 piso(s)

Luces de las Vigas:

3.65 4.50 3.65

Dimensiones de las Vigas:

.25	.60	.00	.00	.25	.60
.25	.60	.25	.60	.25	.60
:25	.60	.25	.60	.25	.60
.25	.60	.25	.60	.25	.60
.25	.60	.25	.60	.25	.60

Dimensiones de las Columnas:

.20	2.00	.60	.35	.60	.35	.20	2.00
.20	2.00	.60	.35	.60	.35	.20	2.00
.20	2.00	.60	.35	.60	.35	.20	2.00
.20	2.00	.60	.35	.60	.35	.20	2.00
.20	2.00	.60	.35	.60	.35	.20	2.00

Momentos de Inercia de Columnas y Placas:

1.876E-01	2.144E-03	2.144E-03	1.876E-01
1.876E-01	2.144E-03	2.144E-03	1.876E-01
1.876E-01	2.144E-03	2.144E-03	1.876E-01
1.876E-01	2.144E-03	2.144E-03	1.876E-01
1.876E-01	2.144E-03	2.144E-03	1.876E-01

Pórtico tipo 4

3 vano(s)
5 piso(s)

Luces de las Vigas:

4.47	4.50	4.47

Dimensiones de las Vigas:

.25	.60	.25	.60	.25	.60
.25	.60	.25	.60	.25	.60
.25	.60	.25	.60	.25	.60
.25	.60	.25	.60	.25	.60
.25	.60	.25	.60	.25	.60

Dimensiones de las Columnas:

.60	.35	.50	.35	.50	.35	.60	.35
.60	.35	.50	.35	.50	.35	.60	.35
.60	.35	.50	.35	.50	.35	.60	.35
.60	.35	.50	.35	.50	.35	.60	.35
.60	.35	.50	.35	.50	.35	.60	.35

Modo 1
T = .5349 seg
f = 1.8693 Hertz
w = 11.745 rad/seg
Sa = 6.876E-01
Sv = 5.854E-02
Sd = 4.984E-03

Vector Característico:

u	v	é
.175276	.000000	.000000
.138688	.000000	.000000
.098577	.000000	.000000
.057598	.000000	.000000
.021962	.000000	.000000

Factores de Participación:

7.981669	.000022	.000000

Modo 2
T = .5306 seg
f = 1.8845 Hertz
w = 11.841 rad/seg
Sa = 6.940E-01
Sv = 5.861E-02
Sd = 4.950E-03

Vector Característico:

u	v	é
.000000	.175091	.000000
.000000	.138883	.000000
.000000	.098667	.000000
.000000	.057493	.000000
.000000	.021767	.000000

Factores de Participación:

-.000022	7.978847	.000002

Modo 3
T = .3476 seg
f = 2.8765 Hertz
w = 18.074 rad/seg
Sa = 9.800E-01
Sv = 5.422E-02
Sd = 3.000E-03

Vector Característico:

u	v	é
.000000	.000000	.031268
.000000	.000000	.024352
.000000	.000000	.016988
.000000	.000000	.009714
.000000	.000000	.003598

Factores de Participación:

.000000	.000000	44.968230

Modo 4
T = .1342 seg
f = 7.4519 Hertz
w = 46.822 rad/seg
Sa = 9.800E-01
Sv = 2.093E-02
Sd = 4.470E-04

Vector Característico:

u	v	é
-.150610	.000000	.000000
-.000761	.000000	.000000
.113140	.000000	.000000
.140266	.000000	.000000
.081518	.000000	.000000

Factores de Participación:

3.762684	.000004	.000000

Modo 5
T = .1316 seg
f = 7.6013 Hertz
w = 47.760 rad/seg
Sa = 9.800E-01
Sv = 2.052E-02
Sd = 4.296E-04

Vector Característico:

u	v	é
.000000	-.150517	.000000
.000000	-.001045	.000000
.000000	.113426	.000000
.000000	.140393	.000000
.000000	.081033	.000000

Factores de Participación:

-.000004	3.757740	.000001

Modo 6

T = .0822 seg
f = 12.1694 Hertz
w = 76.463 rad/seg
Sa = 9.800E-01
Sv = 1.282E-02
Sd = 1.676E-04

Vector Característico:

u	v	é
.000000	.000000	-.026078
.000000	.000000	.000645
.000000	.000000	.020455
.000000	.000000	.024706
.000000	.000000	.014086

Factores de Participación:

.000000	.000000	21.986140

Modo 7

T = .0595 seg
f = 16.7999 Hertz
w = 105.557 rad/seg
Sa = 9.800E-01
Sv = 9.284E-03
Sd = 8.795E-05

Vector Característico:

u	v	é
-.110377	.000000	.000000
.101641	.000000	.000000
.095224	.000000	.000000
-.087013	.000000	.000000
-.143076	.000000	.000000

Factores de Participación:

-2.113738	-.000002	.000000

Modo 8

T = .0580 seg
f = 17.2430 Hertz
w = 108.341 rad/seg
Sa = 9.800E-01
Sv = 9.045E-03
Sd = 8.349E-05

Vector Característico:

u	v	é
.000000	-.110549	.000000
.000000	.101478	.000000
.000000	.095166	.000000
.000000	-.087658	.000000
.000000	-.142732	.000000

Factores de Participación:

.000002	-2.125251	-.000001

Modo 9
T = .0364 seg
f = 27.4375 Hertz
w = 172.395 rad/seg
Sa = 9.800E-01
Sv = 5.685E-03
Sd = 3.297E-05

Vector Característico:

u	v	é
.072022	.000000	.000000
-.136381	.000000	.000000
.071703	.000000	.000000
.087934	.000000	.000000
-.146665	.000000	.000000

Factores de Participación:

-1.161977	-.000001	.000000

Modo 10
T = .0355 seg
f = 28.1868 Hertz
w = 177.103 rad/seg
Sa = 9.800E-01
Sv = 5.534E-03
Sd = 3.124E-05

Vector Característico:

u	v	é
.000000	.000000	-.019014
.000000	.000000	.018149
.000000	.000000	.016410
.000000	.000000	-.015784
.000000	.000000	-.025203

Factores de Participación:

.000000	.000000	-12.225780

Efectos Globales - Sismo en la Dirección X

Desplazamientos de Cada Nivel

nivel	x	y	r
5	6.977E-03	2.682E-08	2.154E-16
4	5.517E-03	2.127E-08	1.677E-16
3	3.926E-03	1.511E-08	1.170E-16
2	2.303E-03	8.813E-09	6.694E-17
1	8.848E-04	3.341E-09	2.482E-17

Distorsiones de los Entrepisos

nivel	x	y	r
5	1.478E-03	5.559E-09	4.770E-17
4	1.607E-03	6.167E-09	5.075E-17
3	1.631E-03	6.307E-09	5.011E-17
2	1.421E-03	5.474E-09	4.213E-17
1	8.848E-04	3.341E-09	2.482E-17

Fuerzas Concentradas

nivel	x	y	r
5	1.578E+01	5.328E-05	2.602E-11
4	1.410E+01	5.212E-05	2.546E-11
3	1.254E+01	3.883E-05	1.853E-11
2	1.121E+01	2.615E-05	1.213E-11
1	8.227E+00	1.333E-05	7.113E-12

Cortantes en Cada Nivel

nivel	x	y	r
5	1.578E+01	5.328E-05	2.602E-11
4	2.783E+01	1.043E-04	5.014E-11
3	3.638E+01	1.405E-04	6.754E-11
2	4.261E+01	1.624E-04	7.789E-11
1	4.618E+01	1.714E-04	8.243E-11

Efectos Globales - Sismo en la Dirección Y

Desplazamientos de Cada Nivel

nivel	x	y	r
5	2.684E-08	6.920E-03	7.884E-11
4	2.123E-08	5.486E-03	6.138E-11
3	1.510E-08	3.901E-03	4.286E-11
2	8.826E-09	2.282E-03	2.458E-11
1	3.369E-09	8.700E-04	9.152E-12

Distorsiones de los Entrepisos

nivel	x	y	r
5	5.616E-09	1.451E-03	1.759E-11
4	6.148E-09	1.599E-03	1.864E-11
3	6.275E-09	1.627E-03	1.834E-11
2	5.458E-09	1.414E-03	1.544E-11
1	3.369E-09	8.700E-04	9.152E-12

Fuerzas Concentradas

nivel	x	y	r
5	5.336E-05	1.583E+01	8.978E-06
4	5.195E-05	1.397E+01	6.765E-06
3	3.879E-05	1.254E+01	5.758E-06
2	2.616E-05	1.110E+01	4.544E-06
1	1.347E-05	7.674E+00	2.945E-06

Cortantes en Cada Nivel

nivel	x	y	r
5	5.336E-05	1.583E+01	8.978E-06
4	1.043E-04	2.803E+01	1.504E-05
3	1.404E-04	3.671E+01	1.956E-05
2	1.623E-04	4.295E+01	2.232E-05
1	1.715E-04	4.651E+01	2.327E-05

Efectos Locales en el Pórtico 1

Sismo en la Dirección Y

Desplazamientos

nivel	u
5	.006920
4	.005486
3	.003901
2	.002282
1	.000870

Distorsiones

nivel	ë
5	.001451
4	.001599
3	.001627
2	.001414
1	.000870

Fuerzas

nivel	F
5	3.889496
4	7.407176
3	5.583122
2	5.287585
1	4.442561

Cortantes

nivel	V
5	3.889496
4	9.914649
3	13.780430
2	17.247300
1	20.729700

Momentos Flectores y Cortes en las Vigas

viga	nivel	Mi	Mj	V
1	5	5.102	4.170	1.973
2	5	4.170	5.102	1.973
1	4	6.110	5.673	2.507
2	4	5.673	6.110	2.507
1	3	6.403	5.862	2.610
2	3	5.862	6.403	2.610
1	2	6.100	5.621	2.494
2	2	5.621	6.100	2.494
1	1	4.498	4.127	1.835
2	1	4.127	4.498	1.835

Fuerzas Axiales, Momentos y Cortes en las Columnas

col.	nivel	N	Mt	Mb	V
1	5	1.083	3.730	6.184	1.431
1	4	2.489	10.038	6.867	3.704
1	3	3.946	7.738	13.708	5.477
1	2	5.332	10.018	28.926	7.337

1	1	6.343	25.642	59.414	9.718
2	5	.000	5.537	3.968	3.168
2	4	.000	3.876	3.881	2.584
2	3	.000	4.211	4.328	2.844
2	2	.000	3.449	4.368	2.604
2	1	.000	1.339	3.358	1.303
3	5	1.083	3.730	6.184	1.431
3	4	2.489	10.038	6.867	3.704
3	3	3.946	7.738	13.708	5.477
3	2	5.332	10.018	28.926	7.337
3	1	6.343	25.642	59.414	9.718

Efectos Locales en el Pórtico 4

Sismo en la Dirección Y

Desplazamientos

nivel	u
5	.006920
4	.005486
3	.003901
2	.002282
1	.000870

Distorsiones

nivel	ë
5	.001451
4	.001599
3	.001627
2	.001414
1	.000870

Fuerzas

nivel	F
5	3.889494
4	7.407209
3	5.583098
2	5.287576
1	4.442560

Cortantes

nivel	V
5	3.889494
4	9.914678
3	13.780430
2	17.247290
1	20.729680

Momentos Flectores y Cortes en las Vigas

viga	nivel	Mi	Mj	V
1	5	5.102	4.170	1.973
2	5	4.170	5.102	1.973
1	4	6.110	5.673	2.507
2	4	5.673	6.110	2.507
1	3	6.403	5.862	2.610
2	3	5.862	6.403	2.610
1	2	6.100	5.621	2.494
2	2	5.621	6.100	2.494
1	1	4.498	4.127	1.835
2	1	4.127	4.498	1.835

Fuerzas Axiales, Momentos y Cortes en las Columnas

col.	nivel	N	Mt	Mb	V
1	5	1.083	3.730	6.184	1.431
1	4	2.489	10.038	6.867	3.704
1	3	3.946	7.738	13.708	5.477
1	2	5.332	10.018	28.926	7.337
1	1	6.343	25.642	59.414	9.718
2	5	.000	5.537	3.968	3.168
2	4	.000	3.876	3.881	2.584
2	3	.000	4.211	4.328	2.844
2	2	.000	3.449	4.368	2.604
2	1	.000	1.339	3.358	1.303
3	5	1.083	3.730	6.184	1.431
3	4	2.489	10.038	6.867	3.704
3	3	3.946	7.738	13.708	5.477
3	2	5.332	10.018	28.926	7.337
3	1	6.343	25.642	59.414	9.718

Efectos Locales en el Pórtico 2

Sismo en la Dirección Y

Desplazamientos

nivel	u
5	.006920
4	.005486
3	.003901
2	.002282
1	.000870

Distorsiones

nivel	ë
5	.001451
4	.001599
3	.001627
2	.001414
1	.000870

Fuerzas

nivel	F
5	4.687283
4	.616974
3	.692404
2	.652828
1	1.792567

Cortantes

nivel	V
5	4.687283
4	4.154879
3	4.591961
2	4.256542
1	2.534564

Momentos Flectores y Cortes en las Vigas

viga	nivel	Mi	Mj	V
1	5	2.554	2.079	.753
2	5	2.079	2.554	.753
1	4	3.558	3.239	1.105
2	4	3.239	3.558	1.105
1	3	3.707	3.334	1.145
2	3	3.334	3.707	1.145
1	2	3.568	3.216	1.103
2	2	3.216	3.568	1.103
1	1	2.664	2.353	.816
2	1	2.353	2.664	.816

Fuerzas Axiales, Momentos y Cortes en las Columnas

col.	nivel	N	Mt	Mb	V
1	5	.619	2.299	1.445	1.247
1	4	1.527	1.775	1.584	1.114
1	3	2.466	1.805	1.995	1.259
1	2	3.366	1.272	2.273	1.174
1	1	4.026	.260	2.804	.823
2	5	.000	3.694	2.889	2.194
2	4	.000	2.898	2.888	1.928

2	3	.000	3.077	3.146	2.074
2	2	.000	2.610	3.118	1.909
2	1	.000	1.091	2.113	.889
3	5	.619	2.299	1.445	1.247
3	4	1.527	1.775	1.584	1.114
3	3	2.466	1.805	1.995	1.259
3	2	3.366	1.272	2.273	1.174
3	1	4.026	.260	2.804	.823

Efectos Locales en el Pórtico 3

Sismo en la Dirección Y

Desplazamientos

nivel	u
5	.006920
4	.005486
3	.003901
2	.002282
1	.000870

Distorsiones

nivel	ë
5	.001451
4	.001599
3	.001627
2	.001414
1	.000870

Fuerzas

nivel	F
5	4.687286
4	.616980
3	.692410
2	.652830
1	1.792564

Cortantes

nivel	V
5	4.687286
4	4.154875
3	4.591965
2	4.256542
1	2.534567

Momentos Flectores y Cortes en las Vigas

viga	nivel	Mi	Mj	V
1	5	2.554	2.079	.753
2	5	2.079	2.554	.753
1	4	3.558	3.239	1.105
2	4	3.239	3.558	1.105
1	3	3.707	3.334	1.145
2	3	3.334	3.707	1.145
1	2	3.568	3.216	1.103
2	2	3.216	3.568	1.103
1	1	2.664	2.353	.816
2	1	2.353	2.664	.816

Fuerzas Axiales, Momentos y Cortes en las Columnas

col.	nivel	N	Mt	Mb	V
1	5	.619	2.299	1.445	1.247
1	4	1.527	1.775	1.584	1.114
1	3	2.466	1.805	1.995	1.259
1	2	3.366	1.272	2.273	1.174
1	1	4.026	.260	2.804	.823
2	5	.000	3.694	2.889	2.194
2	4	.000	2.898	2.888	1.928
2	3	.000	3.077	3.146	2.074
2	2	.000	2.610	3.118	1.909
2	1	.000	1.091	2.113	.889
3	5	.619	2.299	1.445	1.247
3	4	1.527	1.775	1.584	1.114
3	3	2.466	1.805	1.995	1.259
3	2	3.366	1.272	2.273	1.174
3	1	4.026	.260	2.804	.823

Efectos Locales en el Pórtico A

Sismo en la Dirección X

Desplazamientos

nivel	u
5	.006977
4	.005517
3	.003926
2	.002303
1	.000885

Distorsiones

nivel	ë
5	.001478
4	.001607
3	.001631
2	.001421
1	.000885

Fuerzas

nivel	F
5	5.471835
4	7.143043
3	5.978593
2	5.494300
1	4.603044

Cortantes

nivel	V
5	5.471835
4	11.411690
3	15.515250
2	18.880900
1	22.005920

Momentos Flectores y Cortes en las Vigas

viga	nivel	Mi	Mj	V
1	5	7.798	6.069	5.603
3	5	6.069	7.798	5.603
1	4	8.634	6.891	6.273
2	4	2.809	2.809	1.354
3	4	6.891	8.634	6.273
1	3	9.375	7.536	6.833
2	3	2.793	2.793	1.346
3	3	7.536	9.375	6.833
1	2	9.126	7.400	6.677
2	2	2.537	2.537	1.223
3	2	7.400	9.126	6.677
1	1	6.863	5.504	4.997
2	1	1.660	1.660	.800
3	1	5.504	6.863	4.997

Fuerzas Axiales, Momentos y Cortes en las Columnas

col.	nivel	N	Mt	Mb	V
1	5	2.037	4.564	5.509	1.529
1	4	4.340	9.556	7.188	3.728
1	3	6.847	8.051	14.094	5.673
1	2	9.290	9.801	29.012	7.567
1	1	11.095	25.031	60.571	10.240
2	5	2.037	2.869	2.786	1.885
2	4	3.214	3.076	3.053	2.043
2	3	4.603	3.133	3.165	2.099
2	2	6.032	2.748	2.945	1.898
2	1	7.178	1.223	1.557	.772
3	5	2.037	2.869	2.786	1.885
3	4	3.214	3.076	3.053	2.043
3	3	4.603	3.133	3.165	2.099
3	2	6.032	2.748	2.945	1.898
3	1	7.178	1.223	1.557	.772
4	5	2.037	4.564	5.509	1.529
4	4	4.340	9.556	7.188	3.728
4	3	6.847	8.051	14.094	5.673
4	2	9.290	9.801	29.012	7.567
4	1	11.095	25.031	60.571	10.240

Efectos Locales en el Pórtico C

Sismo en la Dirección X

Desplazamientos

nivel	u
5	.006977
4	.005517
3	.003926
2	.002303
1	.000885

Distorsiones

nivel	ë
5	.001478
4	.001607
3	.001631
2	.001421
1	.000885

Fuerzas

nivel	F
5	5.471835
4	7.143043
3	5.978593
2	5.494300
1	4.603044

Cortantes

nivel	V
5	5.471835
4	11.411690
3	15.515250
2	18.880900
	22.005920

Momentos Flectores y Cortes en las Vigas

viga	nivel	Mi	Mj	V
1	5	7.798	6.069	5.603
3	5	6.069	7.798	5.603
1	4	8.634	6.891	6.273
2	4	2.809	2.809	1.354
3	4	6.891	8.634	6.273
1	3	9.375	7.536	6.833
2	3	2.793	2.793	1.346
3	3	7.536	9.375	6.833
1	2	9.126	7.400	6.677
2	2	2.537	2.537	1.223
3	2	7.400	9.126	6.677
1	1	6.863	5.504	4.997
2	1	1.660	1.660	.800
3	1	5.504	6.863	4.997

Fuerzas Axiales, Momentos y Cortes en las Columnas

col.	nivel	N	Mt	Mb	V
1	5	2.037	4.564	5.509	1.529
1	4	4.340	9.556	7.188	3.728
1	3	6.847	8.051	14.094	5.673
1	2	9.290	9.801	29.012	7.567
1	1	11.095	25.031	60.571	10.240
2	5	2.037	2.869	2.786	1.885
2	4	3.214	3.076	3.053	2.043

2	3	4.603	3.133	3.165	2.099
2	2	6.032	2.748	2.945	1.898
2	1	7.178	1.223	1.557	.772
3	5	2.037	2.869	2.786	1.885
3	4	3.214	3.076	3.053	2.043
3	3	4.603	3.133	3.165	2.099
3	2	6.032	2.748	2.945	1.898
3	1	7.178	1.223	1.557	.772
4	5	2.037	4.564	5.509	1.529
4	4	4.340	9.556	7.188	3.728
4	3	6.847	8.051	14.094	5.673
4	2	9.290	9.801	29.012	7.567
4	1	11.095	25.031	60.571	10.240

Efectos Locales en el Pórtico B

Sismo en la Dirección X

Desplazamientos

nivel	u
5	.006977
4	.005517
3	.003926
2	.002303
1	.000885

Distorsiones

nivel	ë
5	.001478
4	.001607
3	.001631
2	.001421
1	.000885

Fuerzas

nivel	F
5	5.409318
4	.479405
3	.621101
2	.755448
1	2.737511

Cortantes

nivel	V
5	5.409318
4	5.092179
3	5.367214
2	4.889231
	2.181396

Momentos Flectores y Cortes en las Vigas

viga	nivel	Mi	Mj	V
1	5	1.975	1.499	.842
2	5	1.375	1.375	.663
3	5	1.499	1.975	.842
1	4	3.198	2.691	1.428
2	4	2.504	2.504	1.207
3	4	2.691	3.198	1.428
1	3	3.298	2.782	1.474
2	3	2.537	2.537	1.222
3	3	2.782	3.298	1.474
1	2	3.197	2.699	1.429
2	2	2.395	2.395	1.154
3	2	2.699	3.197	1.429
1	1	2.339	1.943	1.038
2	1	1.647	1.647	.794
3	1	1.943	2.339	1.038

Fuerzas Axiales, Momentos y Cortes en las Columnas

col.	nivel	N	Mt	Mb	V
1	5	.700	1.789	1.432	1.074
1	4	1.886	1.466	1.447	.971
1	3	3.107	1.549	1.602	1.050
1	2	4.285	1.304	1.604	.969
1	1	5.132	.523	1.213	.482
2	5	.149	2.583	2.310	1.631
2	4	.332	2.369	2.358	1.576
2	3	.538	2.437	2.466	1.634
2	2	.761	2.128	2.300	1.476
2	1	.958	.936	1.257	.609
3	5	.149	2.583	2.310	1.631
3	4	.332	2.369	2.358	1.576
3	3	.538	2.437	2.466	1.634
3	2	.761	2.128	2.300	1.476
3	1	.958	.936	1.257	.609
4	5	.700	1.789	1.432	1.074
4	4	1.886	1.466	1.447	.971
4	3	3.107	1.549	1.602	1.050
4	2	4.285	1.304	1.604	.969
4	1	5.132	.523	1.213	.482

IV.2.5.- COMPARACION DEL ANALISIS ESTATICO Y EL ANALISIS DINAMICO

Para el análisis sísmico se han utilizado los programas de computo desarrollados por el Dr. Hugo Scaletti Farina, profesor de la Universidad Nacional De Ingeniería, Facultad de Ingeniería Civil.
El análisis sísmico seudotridimensional estático equivalente se ha realizado con el programa A3SE versión 1-a 1995 y el análisis sísmico modal seudo tridimensional dinámico con el programa A3S versión 1.4 1991.

De los análisis obtenemos los cortantes en la dirección X e Y:

Cortante en la dirección "X":

nivel	Sismo estático	Sismo dinámico
5	19.63 tn	15.78 tn
4	39.64 tn	27.84 tn
3	54.88 tn	36.38 tn
2	65.36 tn	42.62 tn
1	71.08 tn	46.18 tn

80%Vestatico= 0.80x71.08=56.864 tn> Vdinamico=46.18 tn

las nuevas fuerzas , utilizadas para el análisis en conjunto de las fuerzas sísmicas y las fuerzas verticales para la obtención de las envolventes de diseño, se determinaran con la siguiente expresión:
Fi corregido = (80%Vestático/Vdinámico)xFi dinámico
Factor de multiplicación en eje "X" :Fm=80%Vestático/Vdinámico = 1.23

Cortante en la dirección "Y":

nivel	Sismo estático	Sismo dinámico
5	19.63 tn	15.83 tn
4	39.64 tn	28.03 tn
3	54.88 tn	36.72 tn
2	65.36 tn	42.96 tn
1	71.08 tn	46.52 tn

80%Vestatico=0.80x71.08=56.864
Factor de multiplicación en eje "Y" :Fm=80%Vestatico/Vdinamico= 1.22

Fuerzas corregidas en cada pórtico eje X:

Pórtico A y C:	Fi	Fm (eje x)	Fcorregida
5	5.472314	1.23	6.730946
4	7.14438	1.23	8.787587
3	5.979731	1.23	7.355069
2	5.49567	1.23	6.759674
1	4.604147	1.23	5.663101

pórtico B:	Fi	Fm (eje x)	Fcorregida
5	5.409847	1.23	6.654112
4	0.479453	1.23	0.589727
3	0.621253	1.23	0.764141
2	0.755576	1.23	0.929358
1	2.73783	1.23	3.367531

Fuerzas corregidas en cada pórtico eje Y:

pórtico 1y 4:	Fi	Fm (eje y)	Fcorregida
5	3.889944	1.22	4.745732
4	7.408448	1.22	9.038307
3	5.584259	1.22	6.812796
2	5.288846	1.22	6.452392
1	4.443557	1.22	5.42114

pórtico 2y 3:	Fi	Fm (eje y)	Fcorregida
5	4.687742	1.22	5.719045
4	0.617012	1.22	0.752755
3	0.692563	1.22	0.844927
2	0.652957	1.22	0.796608
1	1.792778	1.22	2.187189

IV.3.- ANALISIS PARA CARGAS VERTICALES

En este tipo de análisis estamos estudiando los efectos internos que pueden causar las cargas verticales como la carga muerta y la carga viva en la estructura.
Para poder ayudar a resolver este análisis estamos haciendo uso del programa de análisis estructural "SAP 2000".

IV.3.1.- CARGAS FACTORADAS

Al diseñar una estructura de concreto armado y sus respectivos elementos estructurales deberá garantizarse que en todas sus secciones la resistencia de diseño sean por lo menos iguales a la resistencia requerida que se calcularan para las cargas amplificadas en las combinaciones que estipula la Norma.
Según las normas Peruanas de Estructuras, articulo 10.2.1 la resistencia requerida (U), para cargas muertas (CM), vivas (CV) y de sismo (CS) deberá ser como mínimo:

U=1.5CM+1.8CV
U=1.25(CM+CV±CS
U=0.9CM±1.25CS

IV.3.2 ANALISIS CON CARGAS DE SERVICIO PARA EL PROYECTO EN ESTUDIO

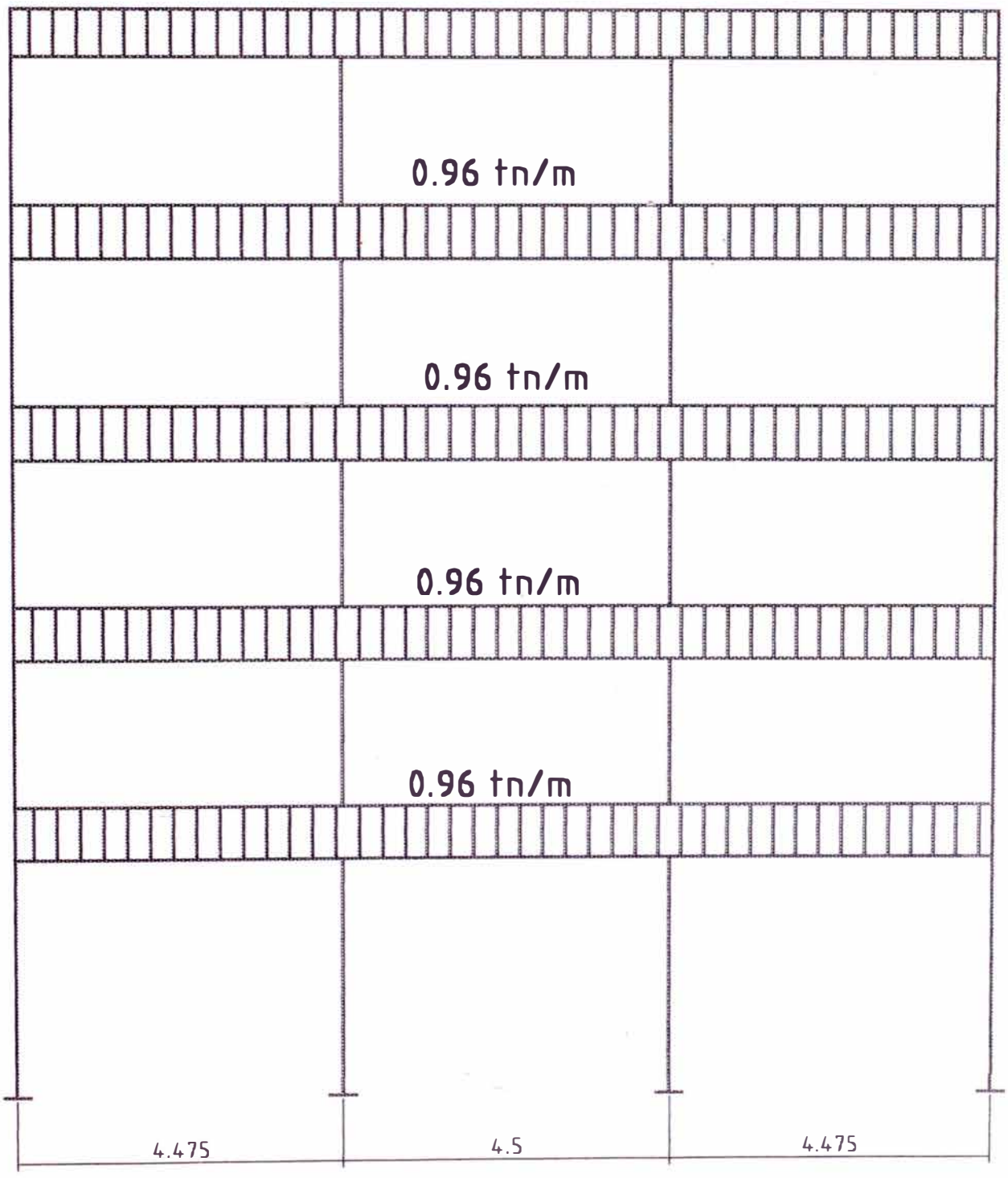
Para el presente Proyecto será:

U=1.5CM+1.8CV1
U=1.5CM+1.8CV2
U=1.25(CM+CV1+CS)
U=1.25(CM+CV1-CS)
U=1.25(CM+CV2+CS)
U=1.25(CM+CV2-CS)
U=0.9CM+1.25CS
U=0.9CM-1.25CS

Se analizara por pórtico aplicando cargas verticales (muerta y viva) y laterales (sismo); a continuación presentamos los cuatro tipos de pórticos sometidos a los diferentes tipos de cargas.
Mediante el programa SAP2000 hacemos las combinaciones de los momentos y cortantes hallados para cada estado de carga.

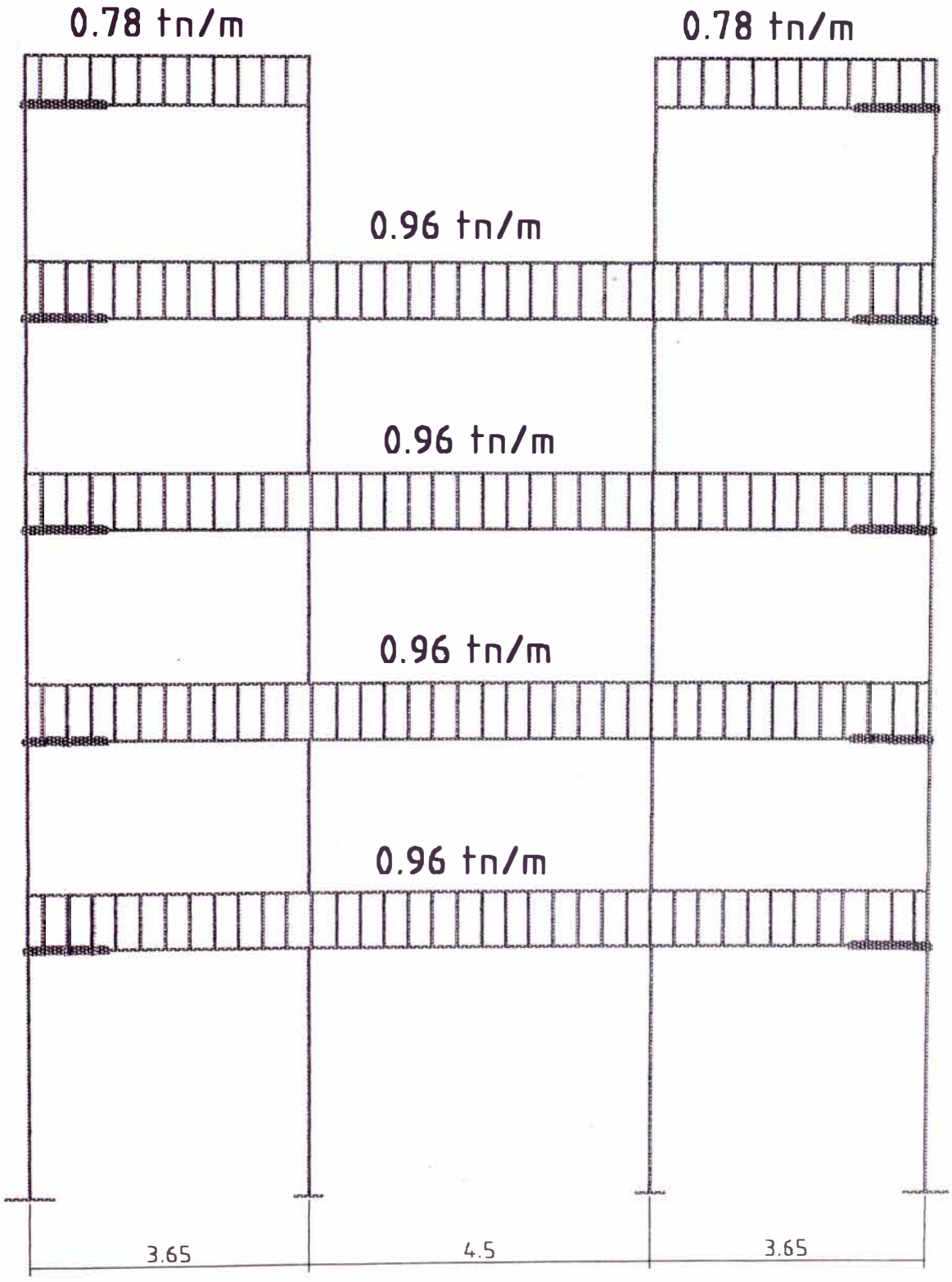
PORTICO B

CARGA MUERTA

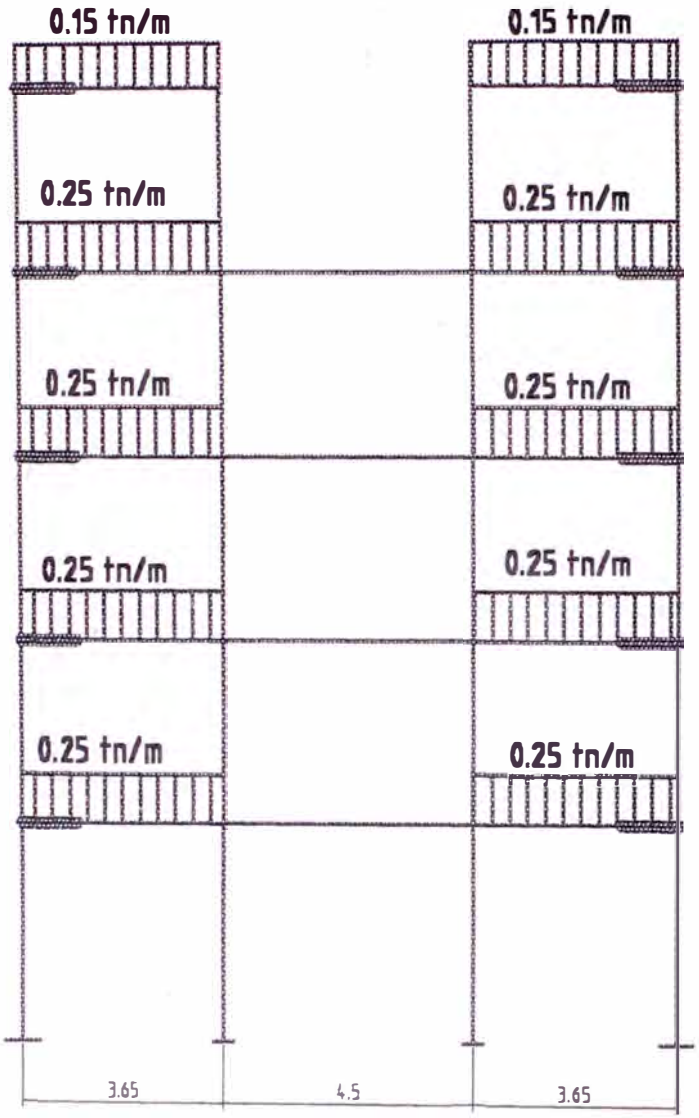


PORTICOS A y C

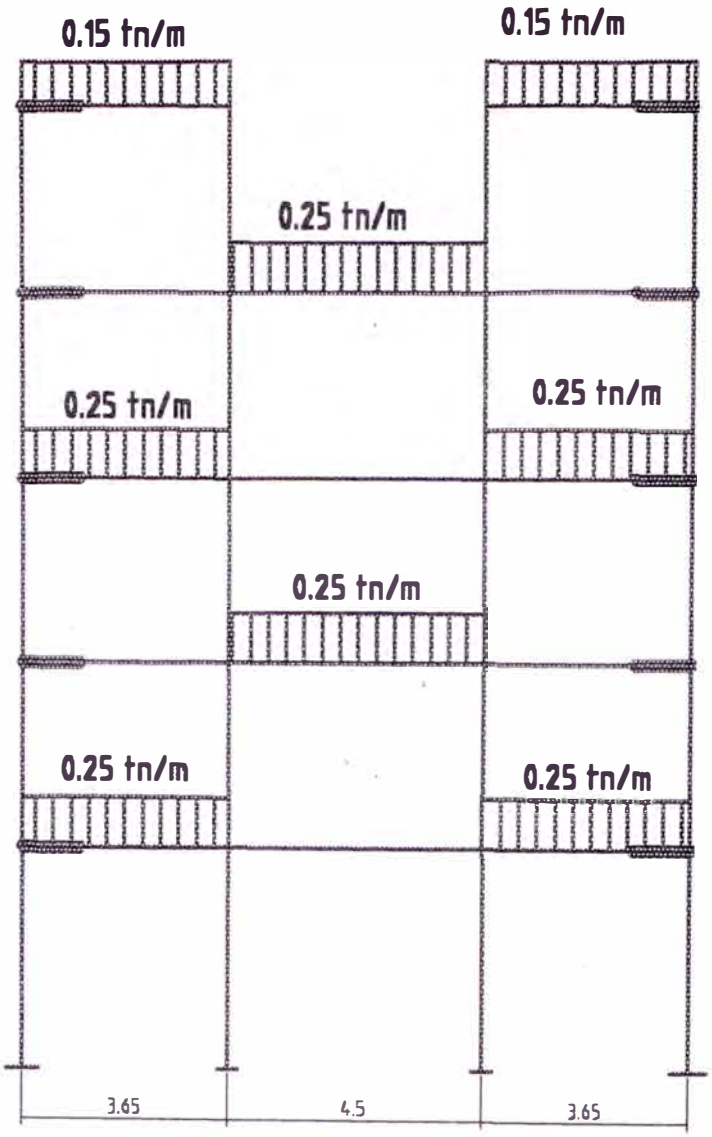
CARGA MUERTA



CARGA VIVA2

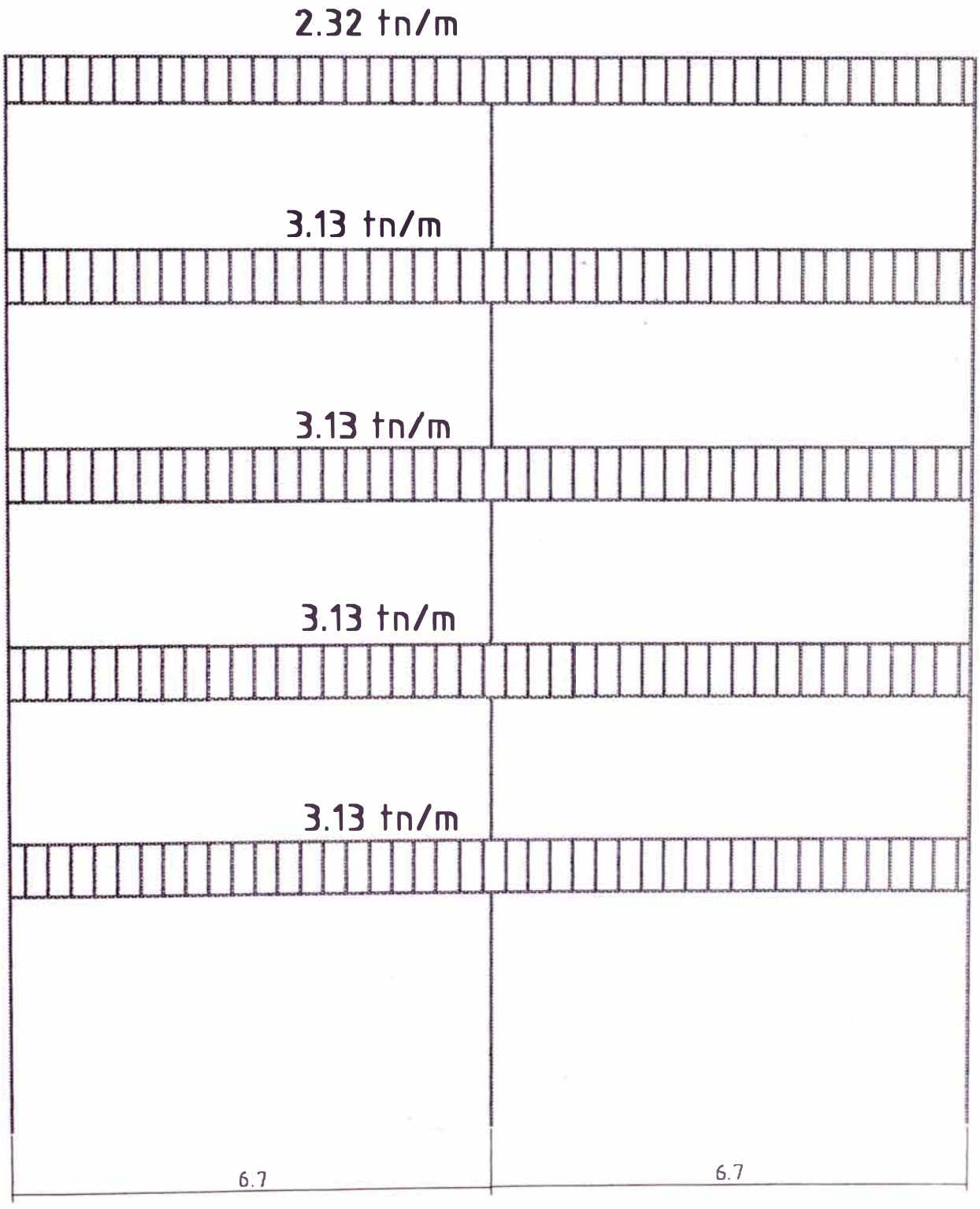


CARGA VIVA1

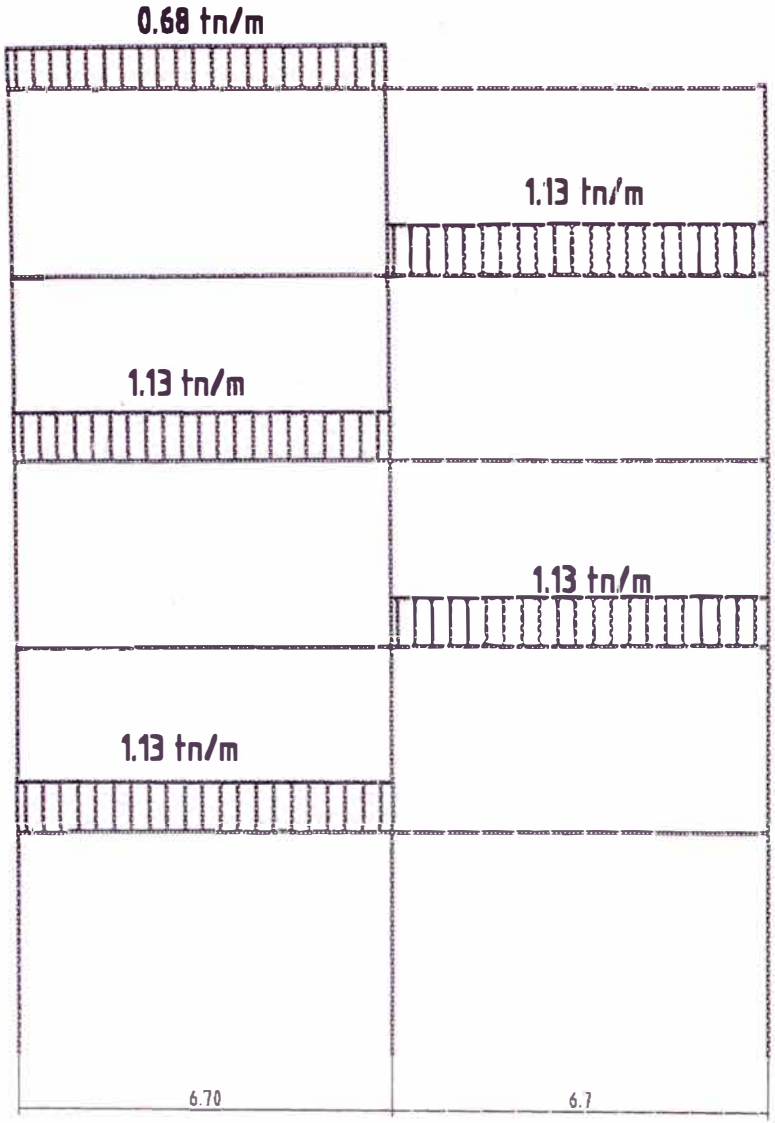


PORTICO 3 Y 2

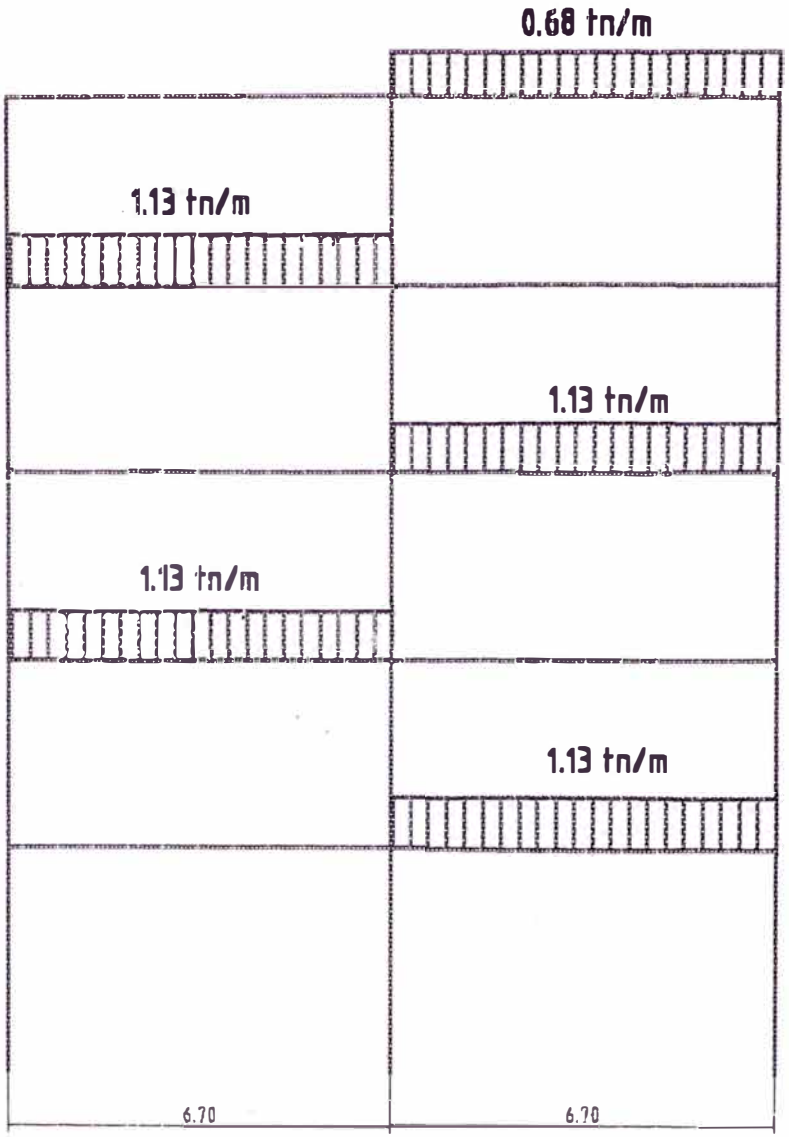
CARGA MUERTA



CARGA VIVA1



CARGA VIVA2



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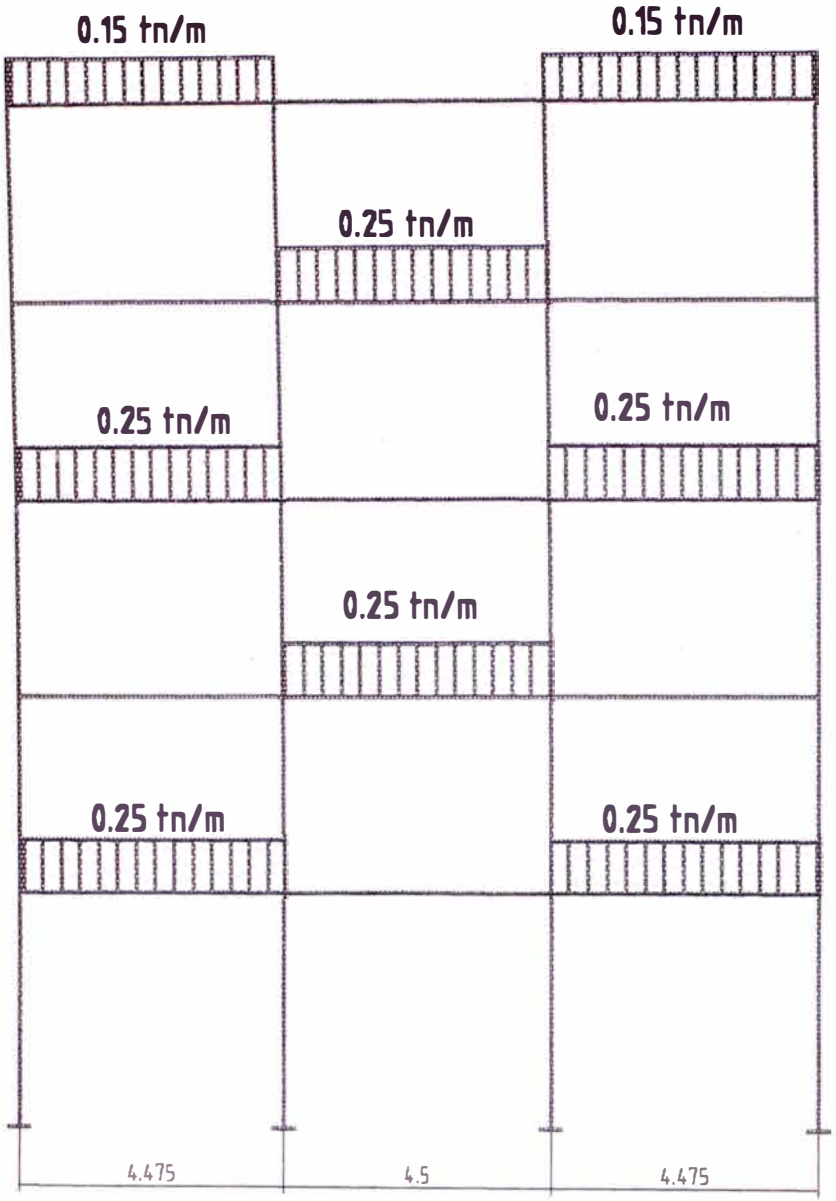

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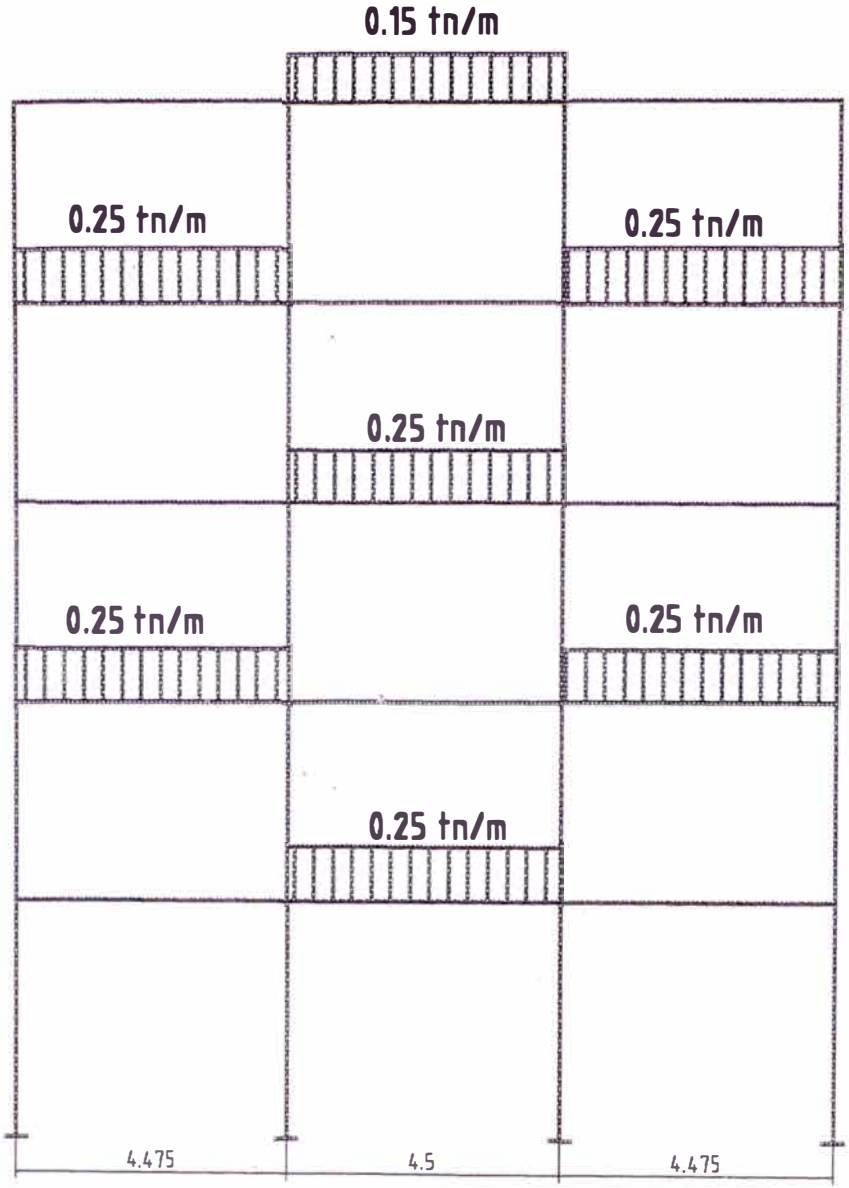
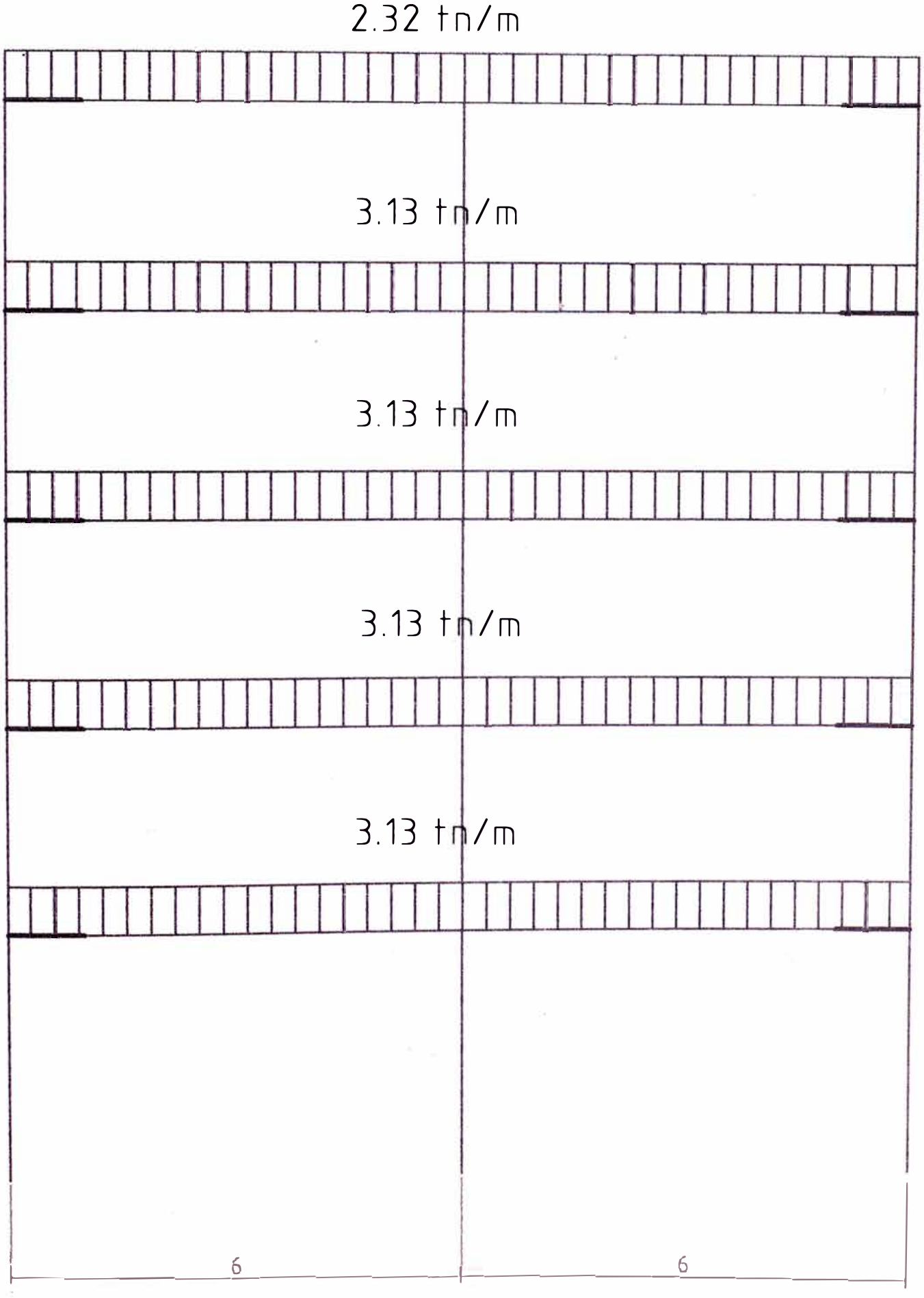


PORTICO 1 Y 4

CARGA MUERTA



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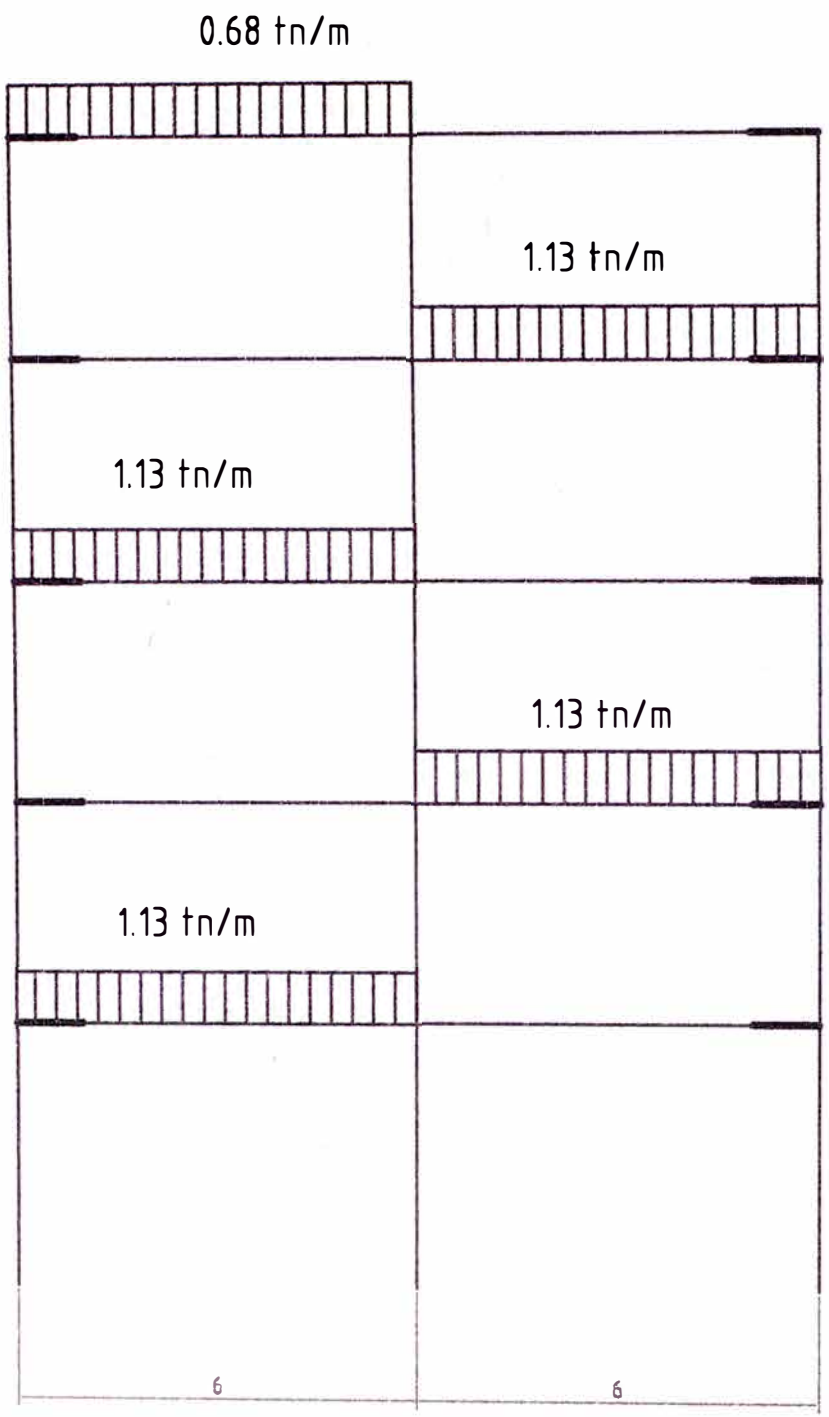

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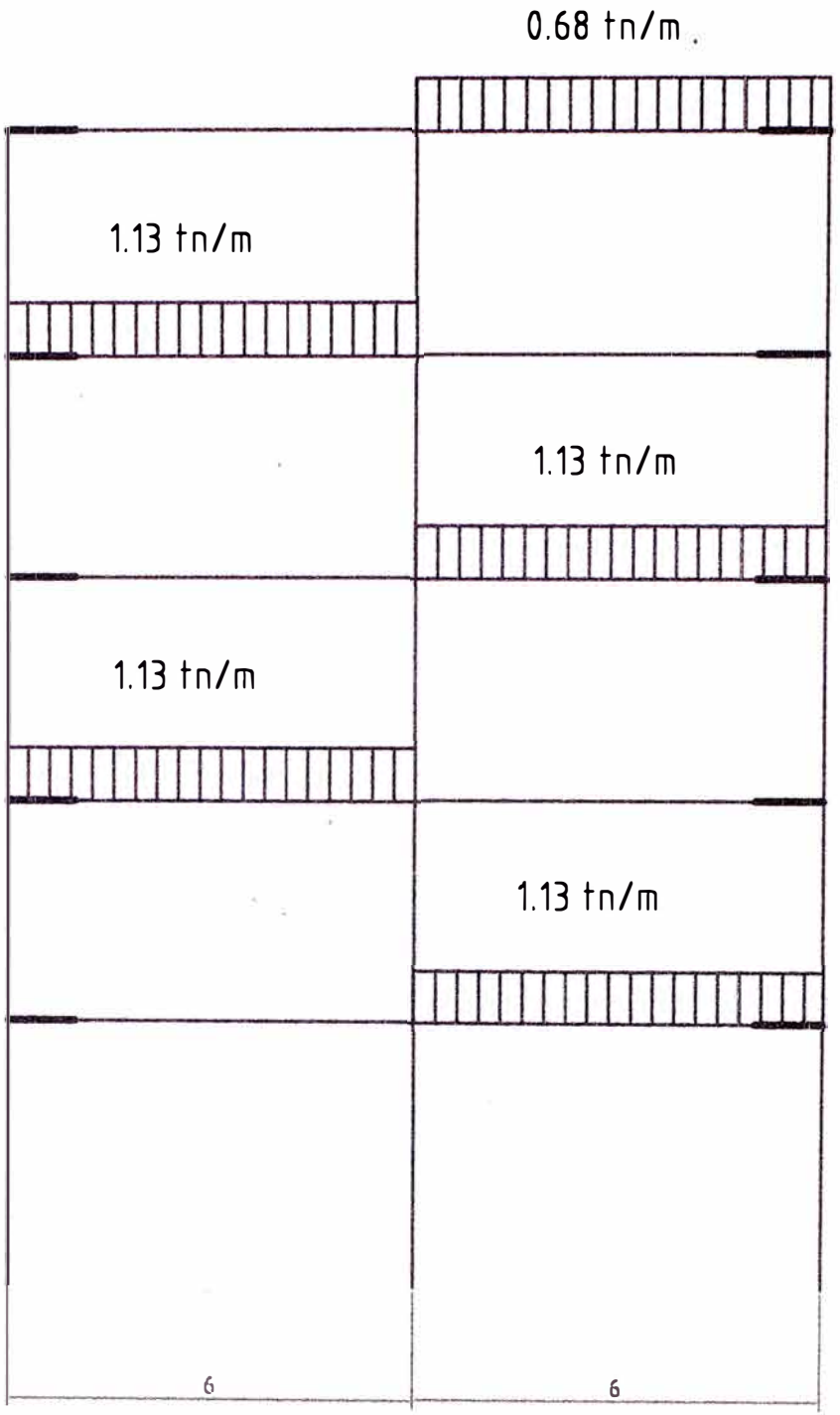


PORTICO 1 Y 4

Programa SAP2000 Versión 7.10

DISPLACEMENT DEGREES OF FREEDOM

(A) = Active DOF, equilibrium equation

(-) = Restrained DOF, reaction computed

(+) = Constrained DOF

( ) = Null DOF

JOINTS			UX	UY	UZ	RX	RY	RZ
1			-		-		-	
2	TO	6	A		A		A	
7			-		-		-	
8	TO	12	A		A		A	
13			-		-		-	
14	TO	18	A		A		A	

JOINT DISPLACEMENTS

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

COMB ENVE ---------- MAX

JOINT	UX	UZ	RY
1	.000000	.000000	.000000
2	0.001418	.000000	0.000603
3	0.003578	.000000	0.000749
4	0.005876	.000000	0.000743
5	0.007986	.000000	0.000661
6	0.009831	.000000	0.000624
7	.000000	.000000	.000000
8	0.001422	.000000	0.000332
9	0.003532	.000000	0.000442
10	0.005809	.000000	0.000432
11	0.007908	.000000	0.000413
12	0.009655	.000000	0.000155
13	.000000	.000000	.000000
14	0.001386	.000000	0.000543
15	0.003484	.000000	0.000696
16	0.005754	.000000	0.000689
17	0.007827	.000000	0.000603
18	0.009563	.000000	0.000527

COMB ENVE ---------- MIN

JOINT	UX	UZ	RY
1	.000000	.000000	.000000
2	-0.001459	-0.000225	-0.000562
3	-0.003603	-0.000372	-0.000707
4	-0.005895	-0.000483	-0.000694

5	-0.007975	-0.000550	-0.000597
6	-0.009667	-0.000581	-0.000513
7	.000000	.000000	.000000
8	-0.001422	-0.000544	-0.000332
9	-0.003532	-0.000897	-0.000442
10	-0.005809	-0.001154	-0.000432
11	-0.007908	-0.001317	-0.000413
12	-0.009655	-0.001386	-0.000155
13	.000000	.000000	.000000
14	-0.001345	-0.000225	-0.000583
15	-0.003459	-0.000372	-0.000738
16	-0.005735	-0.000483	-0.000738
17	-0.007838	-0.000550	-0.000667
18	-0.009727	-0.000582	-0.000639

APPLIED LOADS

FORCES AND MOMENTS ACTING ON JOINTS, IN GLOBAL COORDINATES

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
2	6.775000	.000000	18.696500
3	8.062500	.000000	18.696500
4	8.512500	.000000	18.696500
5	11.300000	.000000	18.696500
6	5.937500	.000000	13.633500
8	.000000	.000000	2.100000
9	.000000	.000000	2.100000
10	.000000	.000000	2.100000
11	.000000	.000000	2.100000
12	.000000	.000000	1.275000

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
2	-6.775000	-12.873000	.000000
3	-8.062500	-12.873000	.000000
4	-8.512500	-12.873000	.000000
5	-11.300000	-12.873000	.000000
6	-5.937500	-9.387000	.000000
8	.000000	-15.870000	-2.100000
9	.000000	-15.870000	-2.100000
10	.000000	-15.870000	-2.100000
11	.000000	-15.870000	-2.100000
12	.000000	-11.880000	-1.275000
14	.000000	-12.873000	-18.696500
15	.000000	-12.873000	-18.696500
16	.000000	-12.873000	-18.696500
17	.000000	-12.873000	-18.696500
18	.000000	-9.387000	-13.633500

RESTRAINTFORCES(REACTIONS)

FORCES AND MOMENTS ACTING ON JOINTS, IN GLOBAL COORDINATES

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
1	22.903193	61.732227	104.970853
7	3.140896	69.784740	6.660577
13	16.011824	61.676158	94.099536

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
1	-17.980397	.000000	-99.831703
7	-3.140896	.000000	-6.660577
13	-20.934620	.000000	-99.238686

GLOBAL FORCE BALANCE

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD CMUERTA ----------

	FX	FZ	MY
APPLIED	.000000	-102.000000	-1.07E-13
REACTNS	4.44E-16	102.000000	1.63E-13
TOTAL	4.44E-16	2.84E-14	5.68E-14

LOAD CVIVA1 ----------

	FX	FZ	MY
APPLIED	.000000	-15.480000	-6.120000
REACTNS	-5.27E-16	15.480000	6.120000
TOTAL	-5.27E-16	7.11E-15	1.42E-14

LOAD CVIVA2 ----------

	FX	FZ	MY
APPLIED	.000000	-15.480000	6.120000
REACTNS	7.77E-16	15.480000	-6.120000
TOTAL	7.77E-16	3.55E-15	3.91E-14

LOAD CSISMO ----------

	FX	FZ	MY
APPLIED	32.470000	.000000	315.462000
REACTNS	-32.470000	-7.11E-15	-315.462000
TOTAL	-9.95E-14	-7.11E-15	-2.67E-12

COMB COMB1 ---------- MAX

	FX	FZ	MY
APPLIED	.000000	-180.864000	-11.016000
REACTNS	-2.83E-16	180.864000	11.016000
TOTAL	-2.83E-16	5.54E-14	1.11E-13

COMB COMB1 ---------- MIN

	FX	FZ	MY
APPLIED	.000000	-180.864000	-11.016000
REACTNS	-2.83E-16	180.864000	11.016000
TOTAL	-2.83E-16	5.54E-14	1.11E-13

COMB COMB2 ---------- MAX

	FX	FZ	MY
APPLIED	.000000	-180.864000	11.016000
REACTNS	2.07E-15	180.864000	-11.016000
TOTAL	2.07E-15	4.90E-14	1.56E-13

COMB COMB2 ---------- MIN

	FX	FZ	MY
APPLIED	.000000	-180.864000	11.016000
REACTNS	2.07E-15	180.864000	-11.016000
TOTAL	2.07E-15	4.90E-14	1.56E-13

COMB COMB3 ---------- MAX

	FX	FZ	MY
APPLIED	40.587500	-146.850000	386.677500
REACTNS	-40.587500	146.850000	-386.677500
TOTAL	-1.24E-13	3.55E-14	-3.25E-12

COMB COMB3 ---------- MIN

	FX	FZ	MY
APPLIED	40.587500	-146.850000	386.677500
REACTNS	-40.587500	146.850000	-386.677500
TOTAL	-1.24E-13	3.55E-14	-3.25E-12

COMB COMB4 ---------- MAX

	FX	FZ	MY
APPLIED	40.587500	-146.850000	401.977500
REACTNS	-40.587500	146.850000	-401.977500
TOTAL	-1.23E-13	3.11E-14	-3.22E-12

COMB COMB4 ---------- MIN

	FX	FZ	MY
APPLIED	40.587500	-146.850000	401.977500
REACTNS	-40.587500	146.850000	-401.977500
TOTAL	-1.23E-13	3.11E-14	-3.22E-12

COMB COMB5 ---------- MAX

	FX	FZ	MY
APPLIED	-40.587500	-146.850000	-401.977500
REACTNS	40.587500	146.850000	401.977500
TOTAL	1.24E-13	5.33E-14	3.43E-12

COMB COMB5 ---------- MIN

	FX	FZ	MY
APPLIED	-40.587500	-146.850000	-401.977500
REACTNS	40.587500	146.850000	401.977500
TOTAL	1.24E-13	5.33E-14	3.43E-12

COMB COMB6 ---------- MAX

	FX	FZ	MY
APPLIED	-40.587500	-146.850000	-386.677500
REACTNS	40.587500	146.850000	386.677500
TOTAL	1.26E-13	4.88E-14	3.46E-12

COMB COMB6 ---------- MIN

	FX	FZ	MY
APPLIED	-40.587500	-146.850000	-386.677500
REACTNS	40.587500	146.850000	386.677500
TOTAL	1.26E-13	4.88E-14	3.46E-12

COMB COMB7 ---------- MAX

	FX	FZ	MY
APPLIED	40.587500	-91.800000	394.327500
REACTNS	-40.587500	91.800000	-394.327500
TOTAL	-1.24E-13	1.67E-14	-3.29E-12

COMB COMB7 ---------- MIN

	FX	FZ	MY
APPLIED	40.587500	-91.800000	394.327500
REACTNS	-40.587500	91.800000	-394.327500
TOTAL	-1.24E-13	1.67E-14	-3.29E-12

COMB COMB8 ---------- MAX

	FX	FZ	MY
APPLIED	-40.587500	-91.800000	-394.327500
REACTNS	40.587500	91.800000	394.327500
TOTAL	1.25E-13	3.45E-14	3.39E-12

COMB COMB8 ---------- MIN

	FX	FZ	MY
APPLIED	-40.587500	-91.800000	-394.327500
REACTNS	40.587500	91.800000	394.327500
TOTAL	1.25E-13	3.45E-14	3.39E-12

COMB ENVE ---------- MAX

	FX	FZ	MY
APPLIED	40.587500	.000000	401.977500
REACTNS	40.587500	180.864000	401.977500
TOTAL	1.26E-13	5.54E-14	3.46E-12

COMB ENVE ---------- MIN

	FX	FZ	MY
APPLIED	-40.587500	-180.864000	-401.977500
REACTNS	-40.587500	.000000	-401.977500
TOTAL	-1.24E-13	.000000	-3.29E-12

FRAME ELEMENT JOINT FORCES

FORCES AND MOMENTS ACTING ON ELEMENTS, IN GLOBAL COORDINATES

ELEM 1 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
1	22.903193	61.732227	104.970853
2	17.980397	.000000	38.936033

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
1	-17.980397	.000000	-99.831703
2	-22.903193	-61.732227	-25.410951

ELEM 2 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
2	18.337175	49.362506	48.318644
3	11.332679	.000000	10.048044

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
2	-11.332679	.000000	-37.504196
3	-18.337175	-49.362506	.000000

ELEM 3 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
3	14.978454	36.408463	21.640582

4	6.607398	.000000	25.312645

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
3	-6.607398	.000000	-8.430814
4	-14.978454	-36.408463	-11.391380

ELEM 4 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
4	12.105740	22.953551	10.667260
5	2.706786	.000000	32.966855

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
4	-2.706786	.000000	.000000
5	-12.105740	-22.953551	-15.232573

ELEM 5 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
5	6.645538	10.392528	15.646792
6	.000000	.000000	21.742950

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
5	.000000	.000000	-6.922251
6	-6.645538	-10.392528	-1.670108

ELEM 6 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
7	3.140896	69.784740	6.660577
8	3.140896	.000000	4.646649

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
7	-3.140896	.000000	-6.660577
8	-3.140896	-69.784740	-4.646649

ELEM 7 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
8	5.831360	54.459154	9.569304
9	5.831360	.000000	8.624130

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
8	-5.831360	.000000	-9.569304
9	-5.831360	-54.459154	-8.624130

ELEM 8 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
9	5.995001	39.582703	9.271192
10	5.995001	.000000	9.408770

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
9	-5.995001	.000000	-9.271192
10	-5.995001	-39.582703	-9.408770

ELEM 9 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
10	5.254906	25.037719	8.163794
11	5.254906	.000000	8.283687

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
10	-5.254906	.000000	-8.163794
11	-5.254906	-25.037719	-8.283687

ELEM 10 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
11	5.532647	10.594839	7.472340
12	5.532647	.000000	9.821128

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
11	-5.532647	.000000	-7.472340
12	-5.532647	-10.594839	-9.821128

ELEM 11 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
13	16.011824	61.676158	94.099536
14	20.934620	.000000	26.765646

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
13	-20.934620	.000000	-99.238686
14	-16.011824	-61.676158	-40.290728

ELEM 12 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
14	11.280996	49.378429	38.561559
15	18.285492	.000000	.000000

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
14	-18.285492	.000000	-49.376007
15	-11.280996	-49.378429	-10.048044

ELEM 13 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
15	6.748184	36.465040	9.475176
16	15.119241	.000000	10.769378

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
15	-15.119241	.000000	-22.684945
16	-6.748184	-36.465040	-24.690643

ELEM 14 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
16	2.074931	23.028563	.000000
17	11.473885	.000000	12.790898

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
16	-11.473885	.000000	-10.121150
17	-2.074931	-23.028563	-30.525179

ELEM 15 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
17	.000000	10.445672	4.389609
18	6.645538	.000000	1.890508

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
17	-6.645538	.000000	-13.114150
18	.000000	-10.445672	-21.963350

ELEM 16 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
2	0.127281	13.483529	2.401923
8	2.441402	9.973569	11.936267

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
2	-2.441402	.000000	-26.741453
8	-0.127281	.000000	-3.763247

ELEM 17 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
3	3.337219	14.507440	4.924653
9	4.707997	10.558249	13.282730

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
3	-4.707997	.000000	-30.415987
9	-3.337219	-0.005611	-5.961569

ELEM 18 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
4	4.611888	14.519033	4.279165
10	5.639786	10.350164	12.760415

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
4	-5.639786	.000000	-30.439121
10	-4.611888	.000000	-5.937426

ELEM 19 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
5	5.110350	14.173549	2.587730
11	4.519550	9.862670	11.681899

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
5	-4.519550	.000000	-29.046553
11	-5.110350	.000000	-5.141271

ELEM 20 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
6	11.593895	10.392528	1.670108
12	2.785741	7.074724	7.443657

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
6	-2.785741	.000000	-21.742950
12	-11.593895	.000000	-2.998180

ELEM 21 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
8	3.045947	9.901577	3.628630
14	5.360067	13.411537	26.444121

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
8	-5.360067	.000000	-11.801649
14	-3.045947	.000000	-2.104591

ELEM 22 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
9	3.485316	10.517595	5.885696
15	4.856093	14.466787	30.247938

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
9	-4.856093	.000000	-13.206857
15	-3.485316	.000000	-4.756604

ELEM 23 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
10	3.867009	10.331729	5.902710
16	4.894907	14.500599	30.363228

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
10	-4.894907	.000000	-12.725700
16	-3.867009	.000000	-4.203273

ELEM 24 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
11	5.406295	9.884538	5.181511
17	4.815495	14.195417	29.137519

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
11	-4.815495	.000000	-11.722139
17	-5.406295	.000000	-2.678697

ELEM 25 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
12	6.645538	7.127868	3.096643
18	.000000	10.445672	21.963350

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
12	.000000	.000000	-7.542121
18	-6.645538	.000000	-1.890508

FRAME ELEMENT INTERNAL FORCES

ELEM 1 == LENGTH = 3.60

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	17.980397	99.831703
0.50000	.000000	17.980397	69.075959
1.00000	.000000	17.980397	38.936033

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-61.732227	-22.903193	-104.970853
0.50000	-61.732227	-22.903193	-64.411909
1.00000	-61.732227	-22.903193	-25.410951

ELEM 2 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	11.332679	37.504196
0.50000	.000000	11.332679	21.723904
1.00000	.000000	11.332679	10.048044

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-49.362506	-18.337175	-48.318644
0.50000	-49.362506	-18.337175	-20.819208
1.00000	-49.362506	-18.337175	.000000

ELEM 3 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	6.607398	8.430814
0.50000	.000000	6.607398	2.844964
1.00000	.000000	6.607398	25.312645

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-36.408463	-14.978454	-21.640582
0.50000	-36.408463	-14.978454	-2.422054
1.00000	-36.408463	-14.978454	-11.391380

ELEM 4 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	2.706786	.000000
0.50000	.000000	2.706786	14.845064
1.00000	.000000	2.706786	32.966855

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-22.953551	-12.105740	-10.667260
0.50000	-22.953551	-12.105740	-11.467143
1.00000	-22.953551	-12.105740	-15.232573

ELEM 5 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	.000000	6.922251
0.50000	.000000	.000000	14.018087
1.00000	.000000	.000000	21.742950

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-10.392528	-6.645538	-15.646792
0.50000	-10.392528	-6.645538	-7.171712
1.00000	-10.392528	-6.645538	-1.670108

ELEM 6 == LENGTH = 3.60

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	3.140896	6.660577
0.50000	.000000	3.140896	1.280069
1.00000	.000000	3.140896	4.646649

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-69.784740	-3.140896	-6.660577
0.50000	-69.784740	-3.140896	-1.280069
1.00000	-69.784740	-3.140896	-4.646649

ELEM 7 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	5.831360	9.569304
0.50000	.000000	5.831360	0.834917
1.00000	.000000	5.831360	8.624130

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-54.459154	-5.831360	-9.569304
0.50000	-54.459154	-5.831360	-0.834917
1.00000	-54.459154	-5.831360	-8.624130

ELEM 8 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	5.995001	9.271192
0.50000	.000000	5.995001	0.543057
1.00000	.000000	5.995001	9.408770

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-39.582703	-5.995001	-9.271192
0.50000	-39.582703	-5.995001	-0.543057
1.00000	-39.582703	-5.995001	-9.408770

ELEM 9 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	5.254906	8.163794
0.50000	.000000	5.254906	0.544609
1.00000	.000000	5.254906	8.283687

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-25.037719	-5.254906	-8.163794
0.50000	-25.037719	-5.254906	-0.544609
1.00000	-25.037719	-5.254906	-8.283687

ELEM 10 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	5.532647	7.472340

0.50000	.000000	5.532647	1.522158
1.00000	.000000	5.532647	9.821128

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-10.594839	-5.532647	-7.472340
0.50000	-10.594839	-5.532647	-1.522158
1.00000	-10.594839	-5.532647	-9.821128

ELEM 11 == LENGTH = 3.60

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	20.934620	99.238686
0.50000	.000000	20.934620	62.223173
1.00000	.000000	20.934620	26.765646

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-61.676158	-16.011824	-94.099536
0.50000	-61.676158	-16.011824	-66.887223
1.00000	-61.676158	-16.011824	-40.290728

ELEM 12 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	18.285492	49.376007
0.50000	.000000	18.285492	21.954095
1.00000	.000000	18.285492	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-49.378429	-11.280996	-38.561559
0.50000	-49.378429	-11.280996	-22.858791
1.00000	-49.378429	-11.280996	-10.048044

ELEM 13 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	15.119241	22.684945
0.50000	.000000	15.119241	1.588872
1.00000	.000000	15.119241	10.769378

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-36.465040	-6.748184	-9.475176
0.50000	-36.465040	-6.748184	-2.011781
1.00000	-36.465040	-6.748184	-24.690643

ELEM 14 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	11.473885	10.121150
0.50000	.000000	11.473885	9.973251
1.00000	.000000	11.473885	12.790898

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-23.028563	-2.074931	.000000
0.50000	-23.028563	-2.074931	-13.351171
1.00000	-23.028563	-2.074931	-30.525179

ELEM 15 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	6.645538	13.114150
0.50000	.000000	6.645538	6.015591
1.00000	.000000	6.645538	1.890508

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-10.445672	.000000	-4.389609
0.50000	-10.445672	.000000	-12.861966
1.00000	-10.445672	.000000	-21.963350

ELEM 16 == LENGTH = 6.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.16667	2.441402	.000000	4.392813
0.37500	2.441402	0.812610	4.898210
0.58333	2.441402	2.815110	4.035655
0.79167	2.441402	6.317319	4.307652
1.00000	2.441402	9.973569	3.763247

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.16667	-0.127281	-10.558529	-14.720424
0.37500	-0.127281	-6.902279	-4.077017
0.58333	-0.127281	-3.246029	.000000
0.79167	-0.127281	-1.089487	-2.409164
1.00000	-0.127281	.000000	-11.936267

ELEM 17 == LENGTH = 6.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.16667	4.707997	.000000	6.225575
0.37500	4.707997	1.502578	5.744297
0.58333	4.707997	3.505078	4.051618
0.79167	4.707997	6.901999	5.496698
1.00000	4.707997	10.558249	5.961569

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.16667	-3.337219	-11.582440	-17.371047
0.37500	-3.337219	-7.926190	-5.323535
0.58333	-3.337219	-4.269940	.000000
0.79167	-3.337219	-2.008111	-3.163781
1.00000	-3.337219	-0.005611	-13.282730

ELEM 18 == LENGTH = 6.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.16667	5.639786	.000000	5.762960
0.37500	5.639786	1.319706	5.486293
0.58333	5.639786	3.322206	4.064944
0.79167	5.639786	6.693914	5.528631
1.00000	5.639786	10.350164	5.937426

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.16667	-4.611888	-11.594033	-17.382588
0.37500	-4.611888	-7.937783	-5.365845
0.58333	-4.611888	-4.281533	.000000
0.79167	-4.611888	-1.994491	-2.940624
1.00000	-4.611888	.000000	-12.760415

ELEM 19 == LENGTH = 6.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.16667	4.519550	.000000	4.513880

0.37	4.519550	0.877350	4.736709
0.5	4.519550	2.879850	4.089815
0.79167	4.519550	6.206420	5.280150
1.00000	4.519550	9.862670	5.141271

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.16667	-5.110350	-11.248549	-16.335503
0.37500	-5.110350	-7.592299	-4.661522
0.58333	-5.110350	-3.936049	.000000
0.79167	-5.110350	-1.603870	-2.530870
1.00000	-5.110350	.000000	-11.681899

ELEM 20 == LENGTH = 6.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.16667	2.785741	.000000	3.437140
0.37500	2.785741	0.406468	3.969369
0.58333	2.785741	1.958968	3.524402
0.79167	2.785741	4.387224	3.366872
1.00000	2.785741	7.074724	2.998180

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.16667	-11.593895	-8.242528	-12.425422
0.37500	-11.593895	-5.555028	-3.962405
0.58333	-11.593895	-2.867528	.000000
0.79167	-11.593895	-1.055784	-0.998050
1.00000	-11.593895	.000000	-7.443657

ELEM 21 == LENGTH = 6.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	5.360067	.000000	3.628630
0.20833	5.360067	1.017495	4.263024
0.41667	5.360067	3.174037	4.035655
0.62500	5.360067	6.830287	4.762859
0.83333	5.360067	10.486537	4.167472

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-3.045947	-9.901577	-11.801649
0.20833	-3.045947	-6.245327	-2.364536
0.41667	-3.045947	-2.743119	.000000
0.62500	-3.045947	-0.740619	-3.941666
0.83333	-3.045947	.000000	-14.495083

ELEM 22 == LENGTH = 6.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	4.856093	.000000	5.885696
0.20833	4.856093	1.967457	5.471642
0.41667	4.856093	4.229287	4.051618
0.62500	4.856093	7.885537	5.667719
0.83333	4.856093	11.541787	6.098180

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-3.485316	-10.517595	-13.206857
0.20833	-3.485316	-6.861345	-3.138725
0.41667	-3.485316	-3.464425	.000000
0.62500	-3.485316	-1.461925	-5.246957
0.83333	-3.485316	.000000	-17.243651

ELEM 23 == LENGTH = 6.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	4.894907	.000000	5.902710
0.20833	4.894907	1.976057	5.516959
0.41667	4.894907	4.263099	4.064944
0.62500	4.894907	7.919349	5.451878
0.83333	4.894907	11.575599	5.705502

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-3.867009	-10.331729	-12.725700
0.20833	-3.867009	-6.675479	-2.928952
0.41667	-3.867009	-3.303771	.000000
0.62500	-3.867009	-1.301271	-5.331430
0.83333	-3.867009	.000000	-17.325129

ELEM 24 == LENGTH = 6.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	4.815495	.000000	5.181511
0.20833	4.815495	1.625737	5.293056
0.41667	4.815495	3.957917	4.089815
0.62500	4.815495	7.614167	4.778473
0.83333	4.815495	11.270417	4.582979

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-5.406295	-9.884538	-11.722139
0.20833	-5.406295	-6.228288	-2.543776
0.41667	-5.406295	-2.901718	.000000
0.62500	-5.406295	-0.899218	-4.703286
0.83333	-5.406295	.000000	-16.404602

ELEM 25 == LENGTH = 6.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	.000000	3.096643
0.20833	.000000	1.108928	3.398905
0.41667	.000000	2.920672	3.558799
0.62500	.000000	5.608172	4.070196
0.83333	.000000	8.295672	3.604397

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-6.645538	-7.127868	-7.542121
0.20833	-6.645538	-4.440368	-1.030084
0.41667	-6.645538	-2.012111	.000000
0.62500	-6.645538	-0.459611	-4.063232
0.83333	-6.645538	.000000	-12.592678

PORTICO 2 Y 3

S A P 2 0 0 0 (R)

Educational Version 7.10

DISPLACEMENT DEGREES OF FREEDOM

(A) = Active DOF, equilibrium equation
(-) = Restrained DOF, reaction computed
(+) = Constrained DOF
( ) = Null DOF

JOINTS			UX	UY	UZ	RX	RY	RZ
1			-		-		-	
2	TO	6	A		A		A	
7			-		-		-	
8	TO	12	A		A		A	
13			-		-		-	
14	TO	18	A		A		A	

JOINT DISPLACEMENTS

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

COMB ENVE ---------- MAX

JOINT	UX	UZ	RY
1	.000000	.000000	.000000
2	3050.799	.000000	1462.550
3	6217.978	.000000	1311.461
4	9076.526	.000000	1253.973
5	11592.970	.000000	1132.308
6	13826.361	.000000	1213.034
7	.000000	.000000	.000000
8	3082.784	.000000	742.668213
9	6200.727	.000000	811.790076
10	9066.135	.000000	754.347549
11	11597.822	.000000	691.494127
12	13622.751	.000000	433.139298
13	.000000	.000000	.000000
14	3118.138	.000000	660.688490
15	6192.326	.000000	648.029476
16	9064.303	.000000	553.019594
17	11609.437	.000000	439.836290
18	13474.997	.000000	83.177984

COMB ENVE ---------- MIN

JOINT	UX	UZ	RY
1	.000000	.000000	.000000
2	-3160.587	-723.491969	-663.430946
3	-6211.606	-1181.084	-642.482060
4	-9079.881	-1537.563	-551.442732

5	-11629.709	-1744.237	-455.494227
6	-13593.094	-1847.702	-112.231834
7	.000000	.000000	.000000
8	-3082.784	-1678.545	-742.668213
9	-6200.727	-2773.694	-811.790076
10	-9066.135	-3572.175	-754.347549
11	-11597.822	-4076.781	-691.494127
12	-13622.751	-4289.958	-433.139298
13	.000000	.000000	.000000
14	-3008.350	-723.491969	-1459.808
15	-6198.698	-1181.084	-1317.008
16	-9060.949	-1537.563	-1255.550
17	-11572.698	-1744.237	-1116.650
18	-13708.263	-1847.702	-1183.980

APPLIED LOADS

FORCES AND MOMENTS ACTING ON JOINTS, IN GLOBAL COORDINATES

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
2	2.737500	.000000	25.172068
3	0.996250	.000000	25.172068
4	1.050000	.000000	25.172068
5	0.937500	.000000	25.172068
6	7.150000	.000000	17.596880
8	.000000	.000000	7.608855
9	.000000	.000000	7.608855
10	.000000	.000000	7.608855
11	.000000	.000000	7.608855
12	.000000	.000000	4.578780

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
2	-2.737500	-22.542150	.000000
3	-0.996250	-22.542150	.000000
4	-1.050000	-22.542150	.000000
5	-0.937500	-22.542150	.000000
6	-7.150000	-15.758400	.000000
8	.000000	-38.270400	-7.608855
9	.000000	-38.270400	-7.608855
10	.000000	-38.270400	-7.608855
11	.000000	-38.270400	-7.608855
12	.000000	-27.416400	-4.578780
14	.000000	-22.542150	-25.172067
15	.000000	-22.542150	-25.172067
16	.000000	-22.542150	-25.172067
17	.000000	-22.542150	-25.172067
18	.000000	-15.758400	-17.596880

RESTRAINT FORCES (REACTIONS)

FORCES AND MOMENTS ACTING ON JOINTS, IN GLOBAL COORDINATES

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
1	7.608575	92.848136	15.126962
7	4.929202	179.511050	9.566553
13	2.752442	92.848136	9.451972

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
1	-2.876262	.000000	-9.685408
7	-4.929202	.000000	-9.566553
13	-7.484754	.000000	-14.893526

GLOBAL FORCE BALANCE

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD CMUERTA ----------

	FX	FZ	MY
APPLIED	.000000	-198.856000	1.43E-13
REACTNS	6.66E-16	198.856000	-4.87E-13
TOTAL	6.66E-16	-1.99E-13	-3.44E-13

LOAD CVIVA1 ----------

	FX	FZ	MY
APPLIED	.000000	-34.840000	-15.262600
REACTNS	-2.48E-15	34.840000	15.262600
TOTAL	-2.48E-15	-2.84E-14	-1.17E-13

LOAD CVIVA2 ----------

	FX	FZ	MY
APPLIED	.000000	-34.840000	15.262600
REACTNS	3.44E-15	34.840000	-15.262600
TOTAL	3.44E-15	-1.42E-14	-2.31E-14

LOAD CSISMO ----------

	FX	FZ	MY
APPLIED	10.297000	.000000	119.890200
REACTNS	-10.297000	4.44E-15	-119.890200
TOTAL	-3.32E-13	4.44E-15	-3.89E-12

COMB COMB1 ---------- MAX

	FX	FZ	MY
APPLIED	.000000	-360.996000	-27.472680
REACTNS	-3.46E-15	360.996000	27.472680
TOTAL	-3.46E-15	-3.50E-13	-7.27E-13

COMB COMB1 ---------- MIN

	FX	FZ	MY
APPLIED	.000000	-360.996000	-27.472680
REACTNS	-3.46E-15	360.996000	27.472680
TOTAL	-3.46E-15	-3.50E-13	-7.27E-13

COMB COMB2 ---------- MAX

	FX	FZ	MY
APPLIED	.000000	-360.996000	27.472680
REACTNS	7.19E-15	360.996000	-27.472680
TOTAL	7.19E-15	-3.24E-13	-5.57E-13

COMB COMB2 ---------- MIN

	FX	FZ	MY
APPLIED	.000000	-360.996000	27.472680
REACTNS	7.19E-15	360.996000	-27.472680
TOTAL	7.19E-15	-3.24E-13	-5.57E-13

COMB COMB3 ---------- MAX

	FX	FZ	MY
APPLIED	12.871250	-292.120000	130.784500
REACTNS	-12.871250	292.120000	-130.784500
TOTAL	-4.17E-13	-2.79E-13	-5.44E-12

COMB COMB3 ---------- MIN

	FX	FZ	MY
APPLIED	12.871250	-292.120000	130.784500
REACTNS	-12.871250	292.120000	-130.784500
TOTAL	-4.17E-13	-2.79E-13	-5.44E-12

COMB COMB4 ---------- MAX

	FX	FZ	MY
APPLIED	12.871250	-292.120000	168.941000
REACTNS	-12.871250	292.120000	-168.941000
TOTAL	-4.10E-13	-2.61E-13	-5.33E-12

COMB COMB4 ---------- MIN

	FX	FZ	MY
APPLIED	12.871250	-292.120000	168.941000
REACTNS	-12.871250	292.120000	-168.941000
TOTAL	-4.10E-13	-2.61E-13	-5.33E-12

COMB COMB5 ---------- MAX

	FX	FZ	MY
APPLIED	-12.871250	-292.120000	-168.941000
REACTNS	12.871250	292.120000	168.941000
TOTAL	4.13E-13	-2.90E-13	4.29E-12

COMB COMB5 ---------- MIN

	FX	FZ	MY
APPLIED	-12.871250	-292.120000	-168.941000
REACTNS	12.871250	292.120000	168.941000
TOTAL	4.13E-13	-2.90E-13	4.29E-12

COMB COMB6 ---------- MAX

	FX	FZ	MY
APPLIED	-12.871250	-292.120000	-130.784500
REACTNS	12.871250	292.120000	130.784500
TOTAL	4.20E-13	-2.72E-13	4.41E-12

COMB COMB6 ---------- MIN

	FX	FZ	MY
APPLIED	-12.871250	-292.120000	-130.784500
REACTNS	12.871250	292.120000	130.784500
TOTAL	4.20E-13	-2.72E-13	4.41E-12

COMB COMB7 ---------- MAX

	FX	FZ	MY
APPLIED	12.871250	-178.970400	149.862750
REACTNS	-12.871250	178.970400	-149.862750
TOTAL	-4.15E-13	-1.74E-13	-5.18E-12

COMB COMB7 ---------- MIN

	FX	FZ	MY
APPLIED	12.871250	-178.970400	149.862750
REACTNS	-12.871250	178.970400	-149.862750
TOTAL	-4.15E-13	-1.74E-13	-5.18E-12

COMB COMB8 ---------- MAX

	FX	FZ	MY
APPLIED	-12.871250	-178.970400	-149.862750
REACTNS	12.871250	178.970400	149.862750
TOTAL	4.16E-13	-1.85E-13	4.56E-12

COMB COMB8 ---------- MIN

	FX	FZ	MY
APPLIED	-12.871250	-178.970400	-149.862750
REACTNS	12.871250	178.970400	149.862750
TOTAL	4.16E-13	-1.85E-13	4.56E-12

COMB ENVE ---------- MAX

	FX	FZ	MY
APPLIED	12.871250	.000000	168.941000
REACTNS	12.871250	360.996000	168.941000

TOTAL	4.20E-13	.000000	4.56E-12

COMB ENVE ---------- MIN

	FX	FZ	MY
APPLIED	-12.871250	-360.996000	-168.941000
REACTNS	-12.871250	.000000	-168.941000
TOTAL	-4.17E-13	-3.50E-13	-5.44E-12

FRAME ELEMENT JOINT FORCES

FORCES AND MOMENTS ACTING ON ELEMENTS, IN GLOBAL COORDINATES

ELEM 1 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
1	7.608575	92.848136	15.126962
2	2.876262	.000000	12.263908

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
1	-2.876262	.000000	-9.685408
2	-7.608575	-92.848136	-0.669136

ELEM 2 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
2	8.546465	73.441858	13.887474
3	.000000	.000000	14.015181

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
2	.000000	.000000	.000000
3	-8.546465	-73.441858	.000000

ELEM 3 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
3	8.212712	54.897721	13.119442
4	.000000	.000000	14.003477

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
3	.000000	.000000	.000000
4	-8.212712	-54.897721	.000000

ELEM 4 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
4	7.971378	34.788061	12.776097
5	.000000	.000000	13.611464

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
4	.000000	.000000	.000000
5	-7.971378	-34.788061	.000000

ELEM 5 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
5	8.902820	15.933661	13.317918
6	.000000	.000000	16.553942

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
5	.000000	.000000	.000000
6	-8.902820	-15.933661	.000000

ELEM 6 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
7	4.929202	179.511050	9.566553
8	4.929202	.000000	8.178574

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
7	-4.929202	.000000	-9.566553
8	-4.929202	-179.511050	-8.178574

ELEM 7 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
8	4.973628	140.544093	8.432751
9	4.973628	.000000	8.603512

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
8	-4.973628	.000000	-8.432751
9	-4.973628	-140.544093	-8.603512

ELEM 8 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
9	4.206989	102.471728	7.426342
10	4.206989	.000000	7.815755

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
9	-4.206989	.000000	-7.426342
10	-4.206989	-102.471728	-7.815755

ELEM 9 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
10	3.701061	64.757795	6.735238
11	3.701061	.000000	7.018024

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
10	-3.701061	.000000	-6.735238
11	-3.701061	-64.757795	-7.018024

ELEM 10 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
11	3.404451	27.357685	5.761423
12	3.404451	.000000	6.823076

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
11	-3.404451	.000000	-5.761423
12	-3.404451	-27.357685	-6.823076

ELEM 11 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
13	2.752442	92.848136	9.451972
14	7.484754	.000000	0.456817

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
13	-7.484754	.000000	-14.893526
14	-2.752442	-92.848136	-12.051589

ELEM 12 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
14	.000000	73.441858	.000000
15	8.651201	.000000	.000000

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
14	-8.651201	.000000	-14.082878
15	.000000	-73.441858	-14.133987

ELEM 13 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
15	.000000	54.897721	.000000
16	8.174139	.000000	.000000

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
15	-8.174139	.000000	-13.043238
16	.000000	-54.897721	-13.963961

ELEM 14 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
16	.000000	34.788061	.000000
17	8.062118	.000000	.000000

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
16	-8.062118	.000000	-12.832581
17	.000000	-34.788061	-13.827198

ELEM 15 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
17	.000000	.933661	.000000
18	8.732921	.000000	.000000

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
17	-8.732921	.000000	-13.317918
18	.000000	-15.933661	-16.360981

ELEM 16 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
2	.000000	22.378886	.000000
8	4.764397	22.705414	25.792267

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
2	-4.764397	.000000	-26.151382
8	.000000	.000000	.000000

ELEM 17 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
3	1.160888	22.896906	.000000
9	0.788221	22.187394	24.418558

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
3	-0.788221	.000000	-27.134623
9	-1.160888	.000000	.000000

ELEM 18 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY

4	0.657977	23.069977	.000000
10	0.812445	22.014323	23.169135

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
4	-0.812445	.000000	-26.779573
10	-0.657977	.000000	.000000

ELEM 19 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
5	0.031588	23.246608	.000000
11	1.884642	21.837692	21.905625

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
5	-1.884642	.000000	-26.309272
11	-0.031588	.000000	.000000

ELEM 20 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
6	12.085820	15.933661	.000000
12	0.894975	15.583139	14.792443

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
6	-0.894975	.000000	-16.553942
12	-12.085820	.000000	.000000

ELEM 21 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
8	.000000	22.705414	.000000
14	5.444268	22.378886	26.134467

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
8	-5.444268	.000000	-25.785078
14	.000000	.000000	.000000

ELEM 22 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
9	0.496542	22.187394	.000000
15	0.123874	22.896906	27.177225

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
9	-0.123874	.000000	-24.441487
15	-0.496542	.000000	.000000

ELEM 23 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
10	0.155828	22.014323	.000000
16	0.310296	23.069977	26.796542

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
10	-0.310296	.000000	-23.180512
16	-0.155828	.000000	.000000

ELEM 24 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
11	.000000	21.837692	.000000
17	1.552181	23.246608	26.208267

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
11	-1.552181	.000000	-21.860147
17	.000000	.000000	.000000

ELEM 25 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
12	8.732921	15.583139	.000000
18	.000000	15.933661	16.360981

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
12	.000000	.000000	-14.790108
18	-8.732921	.000000	.000000

FRAME ELEMENT INTERNAL FORCES

ELEM 1 ========== LENGTH = 3.60

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	2.876262	9.685408
0.50000	.000000	2.876262	5.630818
1.00000	.000000	2.876262	12.263908

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-92.848136	-7.608575	-15.126962
0.50000	-92.848136	-7.608575	-2.554209
1.00000	-92.848136	-7.608575	-0.669136

ELEM 2 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	.000000	.000000
0.50000	.000000	.000000	.295524
1.00000	.000000	.000000	.015181

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-73.441858	-8.546465	-13.887474
0.50000	-73.441858	-8.546465	-2.226599
1.00000	-73.441858	-8.546465	.000000

ELEM 3 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	.000000	.000000
0.50000	.000000	.000000	1.905660
1.00000	.000000	.000000	14.003477

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-54.897721	-8.212712	-13.119442
0.50000	-54.897721	-8.212712	-1.714502
1.00000	-54.897721	-8.212712	.000000

ELEM 4 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	.000000	.000000
0.50000	.000000	.000000	1.728362
1.00000	.000000	.000000	13.611464

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-34.788061	-7.971378	-12.776097
0.50000	-34.788061	-7.971378	-1.867283

1.00000	-34.788061	-7.971378	.000000

ELEM 5 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	.000000	.000000
0.50000	.000000	.000000	3.277038
1.00000	.000000	.000000	16.553942

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-15.933661	-8.902820	-13.317918
0.50000	-15.933661	-8.902820	-1.014493
1.00000	-15.933661	-8.902820	.000000

ELEM 6 ========== LENGTH = 3.60

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	4.929202	9.566553
0.50000	.000000	4.929202	1.654672
1.00000	.000000	4.929202	8.178574

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-179.511050	-4.929202	-9.566553
0.50000	-179.511050	-4.929202	-1.654672
1.00000	-179.511050	-4.929202	-8.178574

ELEM 7 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	4.973628	8.432751
0.50000	.000000	4.973628	1.786099
1.00000	.000000	4.973628	8.603512

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-140.544093	-4.973628	-8.432751
0.50000	-140.544093	-4.973628	-1.786099
1.00000	-140.544093	-4.973628	-8.603512

ELEM 8 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	4.206989	7.426342
0.50000	.000000	4.206989	1.929288
1.00000	.000000	4.206989	7.815755

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-102.471728	-4.206989	-7.426342
0.50000	-102.471728	-4.206989	-1.929288
1.00000	-102.471728	-4.206989	-7.815755

ELEM 9 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	3.701061	6.735238
0.50000	.000000	3.701061	1.941969
1.00000	.000000	3.701061	7.018024

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-64.757795	-3.701061	-6.735238
0.50000	-64.757795	-3.701061	-1.941969
1.00000	-64.757795	-3.701061	-7.018024

ELEM 10 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

DIST	P	V2	M3
0.00000	.000000	3.404451	5.761423
0.50000	.000000	3.404451	1.871053
1.00000	.000000	3.404451	6.823076

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-27.357685	-3.404451	-5.761423
0.50000	-27.357685	-3.404451	-1.871053
1.00000	-27.357685	-3.404451	-6.823076

ELEM 11 ========== LENGTH = 3.60

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	7.484754	14.893526
0.50000	.000000	7.484754	2.543651
1.00000	.000000	7.484754	0.456817

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-92.848136	-2.752442	-9.451972
0.50000	-92.848136	-2.752442	-5.620259
1.00000	-92.848136	-2.752442	-12.051589

ELEM 12 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	8.651201	14.082878
0.50000	.000000	8.651201	2.226599
1.00000	.000000	8.651201	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-73.441858	.000000	.000000
0.50000	-73.441858	.000000	-1.295524
1.00000	-73.441858	.000000	-14.133987

ELEM 13 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	8.174139	13.043238
0.50000	.000000	8.174139	1.714502
1.00000	.000000	8.174139	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-54.897721	.000000	.000000
0.50000	-54.897721	.000000	-1.905660
1.00000	-54.897721	.000000	-13.963961

ELEM 14 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	8.062118	12.832581
0.50000	.000000	8.062118	1.874886
1.00000	.000000	8.062118	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-34.788061	.000000	.000000
0.50000	-34.788061	.000000	-1.757571
1.00000	-34.788061	.000000	-13.827198

ELEM 15 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	8.732921	13.317918
0.50000	.000000	8.732921	1.076382
1.00000	.000000	8.732921	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-15.933661	.000000	.000000
0.50000	-15.933661	.000000	-3.338927
1.00000	-15.933661	.000000	-16.360981

ELEM 16 ========== LENGTH = 6.70

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	4.764397	.000000	.000000
0.25000	4.764397	.000000	8.487649
0.50000	4.764397	2.619152	14.379008
0.75000	4.764397	11.434339	6.592046
1.00000	4.764397	22.705414	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	.000000	-22.378886	-26.151382
0.25000	.000000	-11.107811	-2.339244
0.50000	.000000	-2.056418	.000000
0.75000	.000000	.000000	-1.740044
1.00000	.000000	.000000	-25.792267

ELEM 17 ========== LENGTH = 6.70

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.788221	.000000	.000000
0.25000	0.788221	.000000	7.389244
0.50000	0.788221	2.225416	14.298978
0.75000	0.788221	10.916319	7.267372
1.00000	0.788221	22.187394	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-1.160888	-22.896906	-27.134623
0.25000	-1.160888	-11.625831	-2.464282
0.50000	-1.160888	-2.386481	.000000
0.75000	-1.160888	.000000	-1.491905
1.00000	-1.160888	.000000	-24.418558

ELEM 18 ========== LENGTH = 6.70

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.812445	.000000	.000000
0.25000	0.812445	.000000	6.788107
0.50000	0.812445	1.848610	14.350796
0.75000	0.812445	10.743248	7.187041
1.00000	0.812445	22.014323	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-0.657977	-23.069977	-26.779573
0.25000	-0.657977	-11.798902	-2.189549
0.50000	-0.657977	-2.299838	.000000
0.75000	-0.657977	.000000	-0.866060
1.00000	-0.657977	.000000	-23.169135

ELEM 19 ========== LENGTH = 6.70

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	1.884642	.000000	.000000
0.25000	1.884642	.000000	5.993757
0.50000	1.884642	1.466473	14.312707
0.75000	1.884642	10.566617	7.023136
1.00000	1.884642	21.837692	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-0.031588	-23.246608	-26.309272
0.25000	-0.031588	-11.975533	-1.817662
0.50000	-0.031588	-2.173628	.000000
0.75000	-0.031588	.000000	-0.318503
1.00000	-0.031588	.000000	-21.905625

ELEM 20 ========== LENGTH = 6.70

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.894975	.000000	.000000
0.25000	0.894975	.000000	5.384135
0.50000	0.894975	1.077259	11.018088
0.75000	0.894975	7.703939	4.844395
1.00000	0.894975	15.583139	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-12.085820	-15.933661	-16.553942
0.25000	-12.085820	-8.054461	-0.513606
0.50000	-12.085820	-1.117751	.000000
0.75000	-12.085820	.000000	.000000
1.00000	-12.085820	.000000	-14.792443

ELEM 21 ========== LENGTH = 6.70

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	5.444268	.000000	.000000
0.25000	5.444268	.000000	6.590883
0.50000	5.444268	2.052820	14.379008
0.75000	5.444268	11.107811	8.476761
1.00000	5.444268	22.378886	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	.000000	-22.705414	-25.785078
0.25000	.000000	-11.434339	-1.738881
0.50000	.000000	-2.615554	.000000
0.75000	.000000	.000000	-2.328355
1.00000	.000000	.000000	-26.134467

ELEM 22 ========== LENGTH = 6.70

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.123874	.000000	.000000
0.25000	0.123874	.000000	7.273918
0.50000	0.123874	2.396261	14.298978
0.75000	0.123874	11.625831	7.415464
1.00000	0.123874	22.896906	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-0.496542	-22.187394	-24.441487
0.25000	-0.496542	-10.916319	-1.498452
0.50000	-0.496542	-2.235197	.000000
0.75000	-0.496542	.000000	-2.490501
1.00000	-0.496542	.000000	-27.177225

ELEM 23 ========== LENGTH = 6.70

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.310296	.000000	.000000
0.25000	0.310296	.000000	7.191331
0.50000	0.310296	2.304068	14.350796
0.75000	0.310296	11.798902	6.797989
1.00000	0.310296	23.069977	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-0.155828	-22.014323	-23.180512
0.25000	-0.155828	-10.743248	-0.870350
0.50000	-0.155828	-1.852841	.000000
0.75000	-0.155828	.000000	-2.199431
1.00000	-0.155828	.000000	-26.796542

ELEM 24 ========== LENGTH = 6.70

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	1.552181	.000000	.000000

0.25000	1.552181	.000000	7.014279
0.50000	1.552181	2.151765	14.312707
0.75000	1.552181	11.975533	5.929373
1.00000	1.552181	23.246608	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	.000000	-21.837692	-21.860147
0.25000	.000000	-10.566617	-0.309647
0.50000	.000000	-1.444610	.000000
0.75000	.000000	.000000	-1.753278
1.00000	.000000	.000000	-26.208267

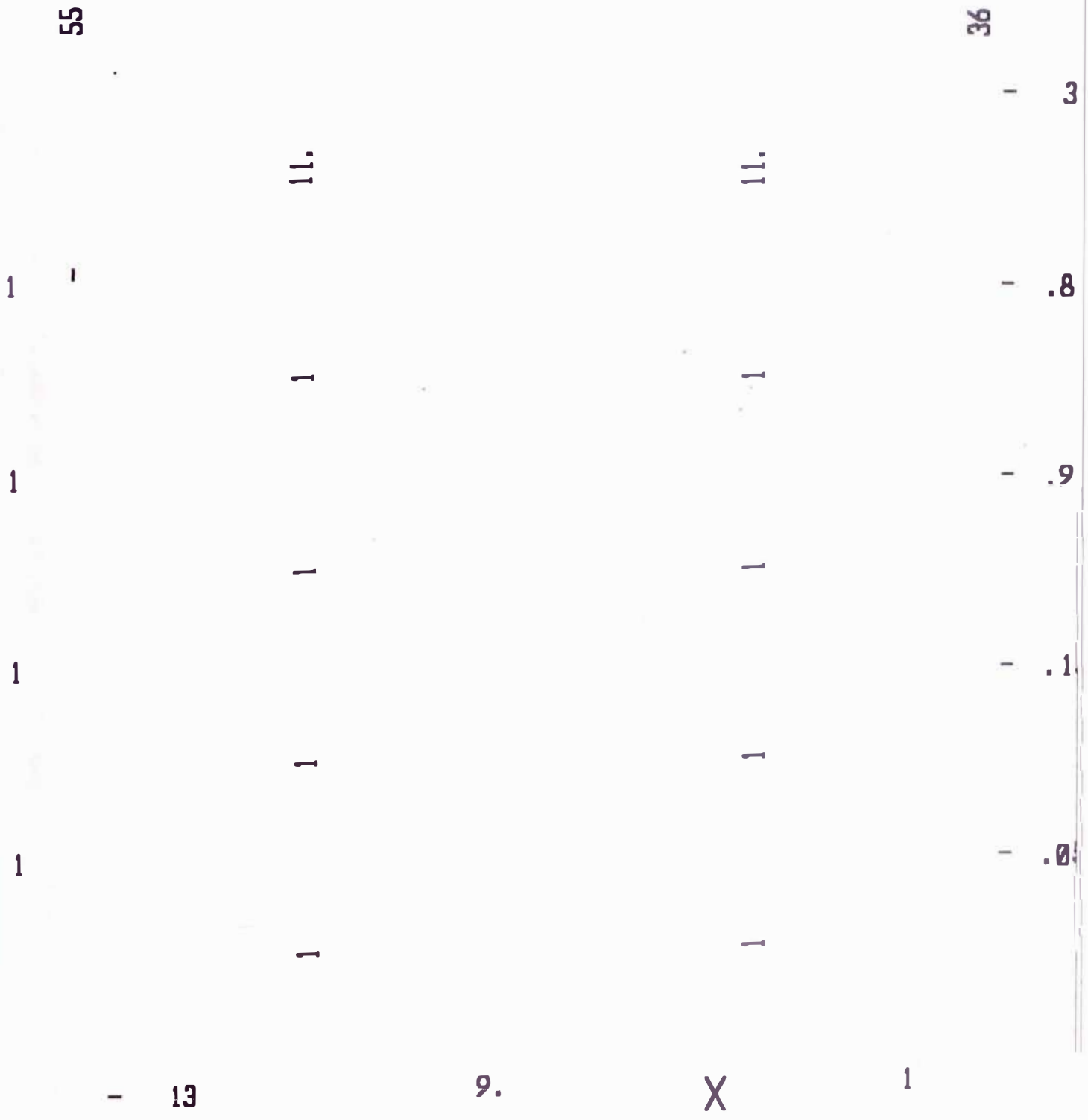
ELEM 25 ========== LENGTH = 6.70

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	.000000	.000000
0.25000	.000000	.000000	4.825190
0.50000	.000000	1.075528	11.018088
0.75000	.000000	8.054461	5.261896
1.00000	.000000	15.933661	.000000

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-8.732921	-15.583139	-14.790108
0.25000	-8.732921	-7.703939	.000000
0.50000	-8.732921	-1.035037	.000000
0.75000	-8.732921	.000000	-0.391368
1.00000	-8.732921	.000000	-16.360981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Structural Analysis Programs

Educational Version 7.10

DISPLACEMENT DEGREES OF FREEDOM

(A) = Active DOF, equilibrium equation
(-) = Restrained DOF, reaction computed
(+) = Constrained DOF
( ) = Null DOF

JOINTS			UX	UY	UZ	RX	RY	RZ
1			-		-		-	
2	TO	6	A		A		A	
7			-		-		-	
8	TO	12	A		A		A	
13			-		-		-	
14	TO	18	A		A		A	
19			-		-		-	
20	TO	24	A		A		A	

JOINT DISPLACEMENTS

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

COMB ENVE ---------- MAX

JOINT	UX	UZ	RY
1	.000000	.000000	.000000
2	0.001424	7.27E-05	0.000560
3	0.003497	0.000121	0.000696
4	0.005710	0.000155	0.000710
5	0.007865	0.000175	0.000699
6	0.010012	0.000185	0.000684
7	.000000	.000000	.000000
8	0.001425	9.12E-05	0.000123
9	0.003466	0.000153	0.000218
10	0.005656	0.000198	0.000202
11	0.007720	0.000230	0.000267
12	0.009977	0.000257	0.000180
13	.000000	.000000	.000000
14	0.001403	6.76E-05	2.50E-05
15	0.003428	0.000111	7.48E-05
16	0.005597	0.000135	8.18E-05
17	0.007542	0.000148	4.06E-05
18	0.008770	0.000164	0.000108
19	.000000	.000000	.000000
20	0.001363	6.17E-05	0.000533
21	0.003398	0.000101	0.000670
22	0.005552	0.000125	0.000644
23	0.007419	0.000137	0.000517
24	0.008792	0.000141	0.000417

COMB ENVE ---------- MIN

JOINT	UX	UZ	RY
1	.000000	.000000	.000000
2	-0.001440	-0.000174	-0.000552
3	-0.003517	-0.000290	-0.000684
4	-0.005719	-0.000373	-0.000684
5	-0.007793	-0.000425	-0.000636
6	-0.009693	-0.000449	-0.000582
7	.000000	.000000	.000000
8	-0.001433	-0.000347	-2.77E-05
9	-0.003474	-0.000572	-8.62E-05
10	-0.005660	-0.000728	-9.01E-05
11	-0.007689	-0.000827	-9.49E-05
12	-0.009657	-0.000867	-0.000152
13	.000000	.000000	.000000
14	-0.001396	-0.000323	-0.000120
15	-0.003421	-0.000529	-0.000207
16	-0.005593	-0.000666	-0.000194
17	-0.007572	-0.000745	-0.000213
18	-0.009089	-0.000774	-0.000136
19	.000000	.000000	.000000
20	-0.001346	-0.000163	-0.000541
21	-0.003378	-0.000270	-0.000682
22	-0.005543	-0.000344	-0.000670
23	-0.007491	-0.000387	-0.000581
24	-0.009111	-0.000405	-0.000519

APPLIED LOADS

FORCES AND MOMENTS ACTING ON JOINTS, IN GLOBAL COORDINATES

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
2	7.075000	.000000	4.555294
3	8.450000	.000000	4.555294
4	9.200000	.000000	4.555294
5	10.987500	.000000	4.555294
6	8.412500	.000000	3.470700
8	.000000	.000000	1.323956
9	.000000	.000000	2.346675
10	.000000	.000000	1.323956
11	.000000	.000000	2.346675
18	.000000	.000000	0.842700

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
2	-7.075000	-4.394250	.000000
3	-8.450000	-4.394250	.000000
4	-9.200000	-4.394250	.000000
5	-10.987500	-4.394250	.000000
6	-8.412500	-3.348000	.000000
8	.000000	-5.744250	.000000
9	.000000	-6.160500	.000000
10	.000000	-5.744250	.000000
11	.000000	-6.160500	.000000
12	.000000	-1.908000	-0.842700
14	.000000	-5.744250	-1.323956
15	.000000	-6.160500	-2.346675
16	.000000	-5.744250	-1.323956
17	.000000	-6.160500	-2.346675
18	.000000	-1.908000	.000000
20	.000000	-4.394250	-4.555294
21	.000000	-4.394250	-4.555294
22	.000000	-4.394250	-4.555294
23	.000000	-4.394250	-4.555294
24	.000000	-3.348000	-3.470700

RESTRAINT FORCES (REACTIONS)

FORCES AND MOMENTS ACTING ON JOINTS, IN GLOBAL COORDINATES

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
1	22.550559	47.738095	103.675036
7	1.655500	44.469048	3.002306
13	1.414687	41.440702	2.690214
19	18.916063	44.709749	95.785833

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
1	-21.082854	-19.924576	-101.856767
7	-1.443564	-11.701439	-2.745723
13	-1.626622	-8.673093	-2.946797
19	-20.383768	-16.896231	-97.604101

GLOBAL FORCE BALANCE

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD CMUERTA ----------

	FX	FZ	MY
APPLIED	.000000	-51.006000	-4.59E-14
REACTNS	-5.00E-15	51.006000	-9.85E-14
TOTAL	-5.00E-15	-7.11E-14	-1.44E-13

LOAD CVIVA1 ----------

	FX	FZ	MY
APPLIED	.000000	-6.995000	5.46E-16
REACTNS	-6.11E-16	6.995000	-1.54E-14
TOTAL	-6.11E-16	-9.77E-15	-1.48E-14

LOAD CVIVA2 ----------

	FX	FZ	MY
APPLIED	.000000	-8.395000	-7.45E-15
REACTNS	-6.11E-16	8.395000	-2.68E-14
TOTAL	-6.11E-16	-8.88E-15	-3.43E-14

LOAD CSISMO ----------

	FX	FZ	MY
APPLIED	35.300000	.000000	351.390000
REACTNS	-35.300000	3.55E-15	-351.390000
TOTAL	-2.84E-13	3.55E-15	-3.07E-12

COMB COMB1 ---------- MAX

	FX	FZ	MY
APPLIED	.000000	-89.100000	-6.79E-14
REACTNS	-8.59E-15	89.100000	-1.76E-13
TOTAL	-8.59E-15	-1.24E-13	-2.43E-13

COMB COMB1 ---------- MIN

	FX	FZ	MY
APPLIED	.000000	-89.100000	-6.79E-14
REACTNS	-8.59E-15	89.100000	-1.76E-13
TOTAL	-8.59E-15	-1.24E-13	-2.43E-13

COMB COMB2 ---------- MAX

	FX	FZ	MY
APPLIED	.000000	-91.620000	-8.23E-14

REACTNS	-8.59E-15	91.620000	-1.96E-13
TOTAL	-8.59E-15	-1.23E-13	-2.78E-13

COMB COMB2 ---------- MIN

	FX	FZ	MY
APPLIED	.000000	-91.620000	-8.23E-14
REACTNS	-8.59E-15	91.620000	-1.96E-13
TOTAL	-8.59E-15	-1.23E-13	-2.78E-13

COMB COMB3 ---------- MAX

	FX	FZ	MY
APPLIED	44.125000	-72.501250	439.237500
REACTNS	-44.125000	72.501250	-439.237500
TOTAL	-3.62E-13	-9.66E-14	-4.04E-12

COMB COMB3 ---------- MIN

	FX	FZ	MY
APPLIED	44.125000	-72.501250	439.237500
REACTNS	-44.125000	72.501250	-439.237500
TOTAL	-3.62E-13	-9.66E-14	-4.04E-12

COMB COMB4 ---------- MAX

	FX	FZ	MY
APPLIED	44.125000	-74.251250	439.237500
REACTNS	-44.125000	74.251250	-439.237500
TOTAL	-3.62E-13	-9.55E-14	-4.06E-12

COMB COMB4 ---------- MIN

	FX	FZ	MY
APPLIED	44.125000	-74.251250	439.237500
REACTNS	-44.125000	74.251250	-439.237500
TOTAL	-3.62E-13	-9.55E-14	-4.06E-12

COMB COMB5 ---------- MAX

	FX	FZ	MY
APPLIED	-44.125000	-72.501250	-439.237500
REACTNS	44.125000	72.501250	439.237500
TOTAL	3.48E-13	-1.05E-13	3.64E-12

COMB COMB5 ---------- MIN

	FX	FZ	MY
APPLIED	-44.125000	-72.501250	-439.237500
REACTNS	44.125000	72.501250	439.237500
TOTAL	3.48E-13	-1.05E-13	3.64E-12

COMB COMB6 ---------- MAX

	FX	FZ	MY
APPLIED	-44.125000	-74.251250	-439.237500
REACTNS	44.125000	74.251250	439.237500
TOTAL	3.48E-13	-1.04E-13	3.61E-12

COMB COMB6 ---------- MIN

	FX	FZ	MY
APPLIED	-44.125000	-74.251250	-439.237500
REACTNS	44.125000	74.251250	439.237500
TOTAL	3.48E-13	-1.04E-13	3.61E-12

COMB COMB7 ---------- MAX

	FX	FZ	MY
APPLIED	44.125000	-45.905400	439.237500

REACTNS	-44.125000	45.905400	-439.237500
TOTAL	-3.60E-13	-5.95E-14	-3.97E-12

COMB COMB7 ---------- MIN

	FX	FZ	MY
APPLIED	44.125000	-45.905400	439.237500
REACTNS	-44.125000	45.905400	-439.237500
TOTAL	-3.60E-13	-5.95E-14	-3.97E-12

COMB COMB8 ---------- MAX

	FX	FZ	MY
APPLIED	-44.125000	-45.905400	-439.237500
REACTNS	44.125000	45.905400	439.237500
TOTAL	3.51E-13	-6.84E-14	3.71E-12

COMB COMB8 ---------- MIN

	FX	FZ	MY
APPLIED	-44.125000	-45.905400	-439.237500
REACTNS	44.125000	45.905400	439.237500
TOTAL	3.51E-13	-6.84E-14	3.71E-12

COMB ENVE ---------- MAX

	FX	FZ	MY
APPLIED	44.125000	.000000	439.237500
REACTNS	44.125000	91.620000	439.237500
TOTAL	3.51E-13	.000000	3.71E-12

COMB ENVE ---------- MIN

	FX	FZ	MY
APPLIED	-44.125000	-91.620000	-439.237500
REACTNS	-44.125000	.000000	-439.237500
TOTAL	-3.62E-13	-1.24E-13	-4.06E-12

FRAME ELEMENT JOINT FORCES

FORCES AND MOMENTS ACTING ON ELEMENTS, IN GLOBAL COORDINATES

ELEM 1 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
1	22.550559	47.738095	103.675036
2	21.082854	19.924576	26.903153

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
1	-21.082854	-19.924576	-101.856767
2	-22.550559	-47.738095	-23.437683

ELEM 2 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
2	16.135443	38.161682	42.341229
3	13.902464	15.911608	6.186929

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
2	-13.902464	-15.911608	-39.539139
3	-16.135443	-38.161682	-2.168253

ELEM 3 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
3	11.562446	27.280729	16.851264
4	8.270965	10.982277	17.999975

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
3	-8.270965	-10.982277	-13.810630
4	-11.562446	-27.280729	-11.002265

ELEM 4 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
4	7.698809	17.002708	3.866839
5	3.915326	6.757302	19.319210

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
4	-3.915326	-6.757302	-3.335122
5	-7.698809	-17.002708	-8.410856

ELEM 5 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
5	5.254700	7.932742	0.406816
6	5.212160	3.127425	16.494014

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
5	-5.212160	-3.127425	-5.786316
6	-5.254700	-7.932742	-11.182055

ELEM 6 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
7	1.655500	44.469048	3.002306
8	1.443564	11.701439	2.957493

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
7	-1.443564	-11.701439	-2.745723
8	-1.655500	-44.469048	-2.451109

ELEM 7 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
8	3.926995	34.660164	5.932833
9	3.242896	9.595129	5.848152

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
8	-3.242896	-9.595129	-4.965217
9	-3.926995	-34.660164	-4.763469

ELEM 8 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
9	4.041391	24.162670	6.113022
10	3.315146	6.848626	6.011151

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY

9	-3.315146	-6.848626	-4.990392
10	-4.041391	-24.162670	-4.955045

ELEM 9 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
10	3.708381	15.123955	5.512091
11	2.922946	4.963295	5.613053

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
10	-2.922946	-4.963295	-4.430278
11	-3.708381	-15.123955	-4.338560

ELEM 10 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
11	3.252651	6.254943	5.041159
12	3.295190	4.172704	4.744442

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
11	-3.295190	-4.172704	-4.847791
12	-3.252651	-6.254943	-5.037781

ELEM 11 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
13	1.414687	41.440702	2.690214
14	1.626622	8.673093	2.402659

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
13	-1.626622	-8.673093	-2.946797
14	-1.414687	-41.440702	-2.909043

ELEM 12 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
14	3.253298	31.703791	4.967119
15	3.937397	6.638756	4.792774

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
14	-3.937397	-6.638756	-5.934734
15	-3.253298	-31.703791	-5.877456

ELEM 13 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
15	3.337759	21.125056	5.029124
16	4.064004	3.811011	4.984154

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
15	-4.064004	-3.811011	-6.151753
16	-3.337759	-21.125056	-6.040259

ELEM 14 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
16	2.943473	12.157931	4.388813
17	3.728909	1.997270	4.441607

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
16	-3.728909	-1.997270	-5.470627
17	-2.943473	-12.157931	-5.716100

ELEM 15 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
17	2.100961	4.551637	3.071872
18	2.058421	2.469397	3.231012

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
17	-2.058421	-2.469397	-3.265241
18	-2.100961	-4.551637	-2.937673

ELEM 16 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
19	18.916063	44.709749	95.785833
20	20.383768	16.896231	25.167195

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
19	-20.383768	-16.896231	-97.604101
20	-18.916063	-44.709749	-28.632666

ELEM 17 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
20	14.473469	35.205309	41.040645
21	16.706448	12.955235	2.379762

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
20	-16.706448	-12.955235	-43.842735
21	-14.473469	-35.205309	-6.398438

ELEM 18 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
21	10.635274	24.243115	13.777413
22	13.926755	7.944662	18.128410

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
21	-13.926755	-7.944662	-16.818047
22	-10.635274	-24.243115	-25.126120

ELEM 19 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
22	6.134549	14.036684	3.856061
23	9.918031	3.791278	22.480353

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
22	-9.918031	-3.791278	-4.387778
23	-6.134549	-14.036684	-33.388707

ELEM 20 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
23	2.058421	6.229436	18.258980
24	2.100961	1.424119	6.771757

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
23	-2.100961	-1.424119	-12.879480
24	-2.058421	-6.229436	-12.083716

ELEM 21 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
2	.000000	9.628620	13.580644
8	0.659885	7.987711	7.182434

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
2	-0.659885	-4.012968	-19.843984
8	.000000	-4.876931	-5.512813

ELEM 22 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
3	2.818501	10.880953	15.978883
9	3.877003	8.843915	8.110264

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
3	-3.877003	-4.929331	-23.038193
9	-2.818501	-6.121311	-6.887189

ELEM 23 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
4	4.844361	10.389815	14.337387
10	5.352488	8.126456	7.100716

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
4	-5.352488	-4.224975	-21.866814
10	-4.844361	-5.505278	-6.087972

ELEM 24 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
5	13.115110	9.152097	12.775890
11	9.389135	7.647122	6.666773

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
5	-9.389135	-3.629877	-18.788191
11	-13.115110	-4.495117	-4.947416

ELEM 25 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
6	3.295190	7.932742	11.182055
12	3.252651	6.254943	5.037781

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
6	-3.252651	-3.127425	-16.494014
12	-3.295190	-4.172704	-4.744442

ELEM 26 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
8	1.693941	3.526621	0.594316
14	2.855221	3.526621	3.649330

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
8	-2.855221	.000000	-3.661185
14	-1.693941	.000000	-0.582461

ELEM 27 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
9	2.890751	4.833933	1.985366
15	3.992176	4.833933	5.365549

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
9	-3.992176	.000000	-5.415753
15	-2.890751	.000000	-1.935162

ELEM 28 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
10	4.452161	4.375947	2.546233
16	5.019479	4.375947	5.505635

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
10	-5.019479	.000000	-5.542371
16	-4.452161	.000000	-2.509496

ELEM 29 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
11	13.566918	5.163651	2.891246
17	9.078022	5.163651	5.906121

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
11	-9.078022	.000000	-6.145089
17	-13.566918	.000000	-2.652278

ELEM 31 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
14	3.874469	7.915739	5.478119
20	4.639743	9.556647	19.615977

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
14	-4.639743	-4.804958	-7.147741
20	-3.874469	-3.940996	-13.352638

ELEM 32 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
15	3.009265	8.925156	7.005429
21	4.067767	10.962194	23.216485

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
15	-4.067767	-6.202553	-8.228504
21	-3.009265	-5.010573	-16.157175

ELEM 33 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
16	4.105415	8.054866	6.112352
22	4.613542	10.318225	21.581130

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
16	-4.613542	-5.433688	-7.125096
22	-4.105415	-4.153384	-14.051703

ELEM 34 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
17	11.896431	6.384404	3.513512
23	8.170456	7.889379	15.613174

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
17	-8.170456	-3.232399	-5.232868
23	-11.896431	-2.367159	-9.600874

ELEM 35 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
18	2.100961	4.551637	2.937673
24	2.058421	6.229436	12.083716

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
18	-2.058421	-2.469397	-3.231012
24	-2.100961	-1.424119	-6.771757

FRAME ELEMENT INTERNAL FORCES

ELEM 1 == LENGTH = 3.60

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	19.924576	21.082854	101.856767
0.50000	19.924576	21.082854	64.183301
1.00000	19.924576	21.082854	26.903153

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-47.738095	-22.550559	-103.675036
0.50000	-47.738095	-22.550559	-63.331397
1.00000	-47.738095	-22.550559	-23.437683

ELEM 2 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	15.911608	13.902464	39.539139
0.50000	15.911608	13.902464	18.823830
1.00000	15.911608	13.902464	6.186929

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-38.161682	-16.135443	-42.341229
0.50000	-38.161682	-16.135443	-18.281741
1.00000	-38.161682	-16.135443	-2.168253

ELEM 3 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	10.982277	8.270965	13.810630
0.50000	10.982277	8.270965	2.121376
1.00000	10.982277	8.270965	17.999975

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-27.280729	-11.562446	-16.851264
0.50000	-27.280729	-11.562446	.000000
1.00000	-27.280729	-11.562446	-11.002265

ELEM 4 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	6.757302	3.915326	3.335122
0.50000	6.757302	3.915326	7.770997
1.00000	6.757302	3.915326	19.319210

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-17.002708	-7.698809	-3.866839
0.50000	-17.002708	-7.698809	-2.537867
1.00000	-17.002708	-7.698809	-8.410856

ELEM 5 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	3.127425	5.212160	5.786316
0.50000	3.127425	5.212160	8.754240
1.00000	3.127425	5.212160	16.494014

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-7.932742	-5.254700	-0.406816
0.50000	-7.932742	-5.254700	-3.408511
1.00000	-7.932742	-5.254700	-11.182055

ELEM 6 == LENGTH = 3.60

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	11.701439	1.443564	2.745723
0.50000	11.701439	1.443564	0.161153
1.00000	11.701439	1.443564	2.957493

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-44.469048	-1.655500	-3.002306
0.50000	-44.469048	-1.655500	-0.036253
1.00000	-44.469048	-1.655500	-2.451109

ELEM 7 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	9.595129	3.242896	4.965217
0.50000	9.595129	3.242896	0.150509
1.00000	9.595129	3.242896	5.848152

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-34.660164	-3.926995	-5.932833
0.50000	-34.660164	-3.926995	-0.091975
1.00000	-34.660164	-3.926995	-4.763469

ELEM 8 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	6.848626	3.315146	4.990392
0.50000	6.848626	3.315146	0.019798
1.00000	6.848626	3.315146	6.011151

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-24.162670	-4.041391	-6.113022
0.50000	-24.162670	-4.041391	-0.058059
1.00000	-24.162670	-4.041391	-4.955045

ELEM 9 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	4.963295	2.922946	4.430278
0.50000	4.963295	2.922946	0.104772
1.00000	4.963295	2.922946	5.613053

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-15.123955	-3.708381	-5.512091
0.50000	-15.123955	-3.708381	-0.007561
1.00000	-15.123955	-3.708381	-4.338560

ELEM 10 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	4.172704	3.295190	4.847791
0.50000	4.172704	3.295190	.000000
1.00000	4.172704	3.295190	4.744442

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-6.254943	-3.252651	-5.041159
0.50000	-6.254943	-3.252651	-0.189323
1.00000	-6.254943	-3.252651	-5.037781

ELEM 11 == LENGTH = 3.60

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	8.673093	1.626622	2.946797
0.50000	8.673093	1.626622	0.032724
1.00000	8.673093	1.626622	2.402659

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-41.440702	-1.414687	-2.690214
0.50000	-41.440702	-1.414687	-0.157624
1.00000	-41.440702	-1.414687	-2.909043

ELEM 12 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	6.638756	3.937397	5.934734
0.50000	6.638756	3.937397	0.078274
1.00000	6.638756	3.937397	4.792774

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-31.703791	-3.253298	-4.967119
0.50000	-31.703791	-3.253298	-0.136807
1.00000	-31.703791	-3.253298	-5.877456

ELEM 13 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	3.811011	4.064004	6.151753
0.50000	3.811011	4.064004	0.058059
1.00000	3.811011	4.064004	4.984154

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-21.125056	-3.337759	-5.029124
0.50000	-21.125056	-3.337759	-0.024609
1.00000	-21.125056	-3.337759	-6.040259

ELEM 14 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	1.997270	3.728909	5.470627
0.50000	1.997270	3.728909	0.026397
1.00000	1.997270	3.728909	4.441607

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-12.157931	-2.943473	-4.388813
0.50000	-12.157931	-2.943473	-0.122737
1.00000	-12.157931	-2.943473	-5.716100

ELEM 15 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	2.469397	2.058421	3.265241
0.50000	2.469397	2.058421	0.189323
1.00000	2.469397	2.058421	3.231012

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-4.551637	-2.100961	-3.071872
0.50000	-4.551637	-2.100961	.000000
1.00000	-4.551637	-2.100961	-2.937673

ELEM 16 == LENGTH = 3.60

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	16.896231	20.383768	97.604101
0.50000	16.896231	20.383768	61.160686
1.00000	16.896231	20.383768	25.167195

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-44.709749	-18.916063	-95.785833
0.50000	-44.709749	-18.916063	-62.012590
1.00000	-44.709749	-18.916063	-28.632666

ELEM 17 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	12.955235	16.706448	43.842735
0.50000	12.955235	16.706448	18.926739
1.00000	12.955235	16.706448	2.379762

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-35.205309	-14.473469	-41.040645
0.50000	-35.205309	-14.473469	-19.468828
1.00000	-35.205309	-14.473469	-6.398438

ELEM 18 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	7.944662	13.926755	16.818047
0.50000	7.944662	13.926755	2.175498
1.00000	7.944662	13.926755	18.128410

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-24.243115	-10.635274	-13.777413
0.50000	-24.243115	-10.635274	-4.380208
1.00000	-24.243115	-10.635274	-25.126120

ELEM 19 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	3.791278	9.918031	4.387778
0.50000	3.791278	9.918031	13.278530
1.00000	3.791278	9.918031	22.480353

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-14.036684	-6.134549	-3.856061
0.50000	-14.036684	-6.134549	-18.511660
1.00000	-14.036684	-6.134549	-33.388707

ELEM 20 == LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	1.424119	2.100961	12.879480
0.50000	1.424119	2.100961	9.825618
1.00000	1.424119	2.100961	6.771757

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-6.229436	-2.058421	-18.258980
0.50000	-6.229436	-2.058421	-15.171348
1.00000	-6.229436	-2.058421	-12.083716

ELEM 21 == LENGTH = 3.65

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.27397	0.659885	4.876968	9.135676
0.45548	0.659885	5.449368	5.715077
0.63699	0.659885	6.021768	2.077366
0.81849	0.659885	6.985680	2.171868
1.00000	0.659885	7.987711	5.512813

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.27397	.000000	-8.116120	-10.971614
0.45548	.000000	-7.114088	-5.926608
0.63699	.000000	-6.112057	-1.707550
0.81849	.000000	-5.449331	-2.263766
1.00000	.000000	-4.876931	-7.182434

ELEM 22 == LENGTH = 3.65

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.27397	3.877003	5.793331	10.617552
0.45548	3.877003	6.365731	6.589863
0.63699	3.877003	6.938131	2.336954
0.81849	3.877003	7.841884	2.719003
1.00000	3.877003	8.843915	6.887189

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.27397	-2.818501	-9.368453	-12.913491
0.45548	-2.818501	-8.366421	-7.111816
0.63699	-2.818501	-7.364390	-2.032716
0.81849	-2.818501	-6.693711	-2.725678
1.00000	-2.818501	-6.121311	-8.110264

ELEM 23 == LENGTH = 3.65

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.27397	5.352488	5.088975	9.680412
0.45548	5.352488	5.661375	6.119359
0.63699	5.352488	6.233775	2.345544
0.81849	5.352488	7.124425	2.423110
1.00000	5.352488	8.126456	6.087972

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.27397	-4.844361	-8.877315	-12.233249
0.45548	-4.844361	-7.875284	-6.683950
0.63699	-4.844361	-6.873253	-1.964951
0.81849	-4.844361	-6.077678	-2.140393
1.00000	-4.844361	-5.505278	-7.100716

ELEM 24 == LENGTH = 3.65

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.27397	9.389135	4.493877	8.714013
0.45548	9.389135	5.066277	5.577277
0.63699	9.389135	5.718545	2.170672
0.81849	9.389135	6.645091	1.804050
1.00000	9.389135	7.647122	4.947416

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.27397	-13.115110	-7.639597	-10.392343
0.45548	-13.115110	-6.637566	-5.751443
0.63699	-13.115110	-5.639917	-1.804567
0.81849	-13.115110	-5.067517	-2.088205
1.00000	-13.115110	-4.495117	-6.666773

ELEM 25 == LENGTH = 3.65

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.27397	3.252651	3.829425	7.703630
0.45548	3.252651	4.294500	5.097891
0.63699	3.252651	4.759575	2.229562
0.81849	3.252651	5.484787	2.017307
1.00000	3.252651	6.254943	4.744442

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.27397	-3.295190	-6.770242	-9.142522
0.45548	-3.295190	-6.000086	-4.935311
0.63699	-3.295190	-5.229930	-1.400615
0.81849	-3.295190	-4.637779	-1.293858
1.00000	-3.295190	-4.172704	-5.037781

ELEM 26 == LENGTH = 4.50

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	2.855221	.000000	0.594316
0.25000	2.855221	.000000	1.421998
0.50000	2.855221	0.826621	1.488352
0.75000	2.855221	2.176621	1.410143
1.00000	2.855221	3.526621	0.582461

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-1.693941	-3.526621	-3.661185
0.25000	-1.693941	-2.176621	-0.567134
0.50000	-1.693941	-0.826621	.000000
0.75000	-1.693941	.000000	-0.555279
1.00000	-1.693941	.000000	-3.649330

ELEM 27 == LENGTH = 4.50

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	3.992176	.000000	1.985366
0.25000	3.992176	0.458808	2.334815
0.50000	3.992176	1.430808	2.077028
0.75000	3.992176	3.132371	2.284612
1.00000	3.992176	4.833933	1.935162

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-2.890751	-4.833933	-5.415753
0.25000	-2.890751	-3.132371	-1.253565
0.50000	-2.890751	-1.430808	.000000
0.75000	-2.890751	-0.458808	-1.203362
1.00000	-2.890751	.000000	-5.365549

ELEM 28 == LENGTH = 4.50

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	5.019479	.000000	2.546233
0.25000	5.019479	0.703947	2.433897
0.50000	5.019479	1.675947	1.542166
0.75000	5.019479	3.025947	2.397161
1.00000	5.019479	4.375947	2.509496

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-4.452161	-4.375947	-5.542371
0.25000	-4.452161	-3.025947	-1.506575
0.50000	-4.452161	-1.675947	.000000
0.75000	-4.452161	-0.703947	-1.469839
1.00000	-4.452161	.000000	-5.505635

ELEM 29 == LENGTH = 4.50

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	9.078022	.000000	2.891246
0.25000	9.078022	0.788526	2.907042
0.50000	9.078022	1.760526	2.207771
0.75000	9.078022	3.462089	2.668074
1.00000	9.078022	5.163651	2.652278

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-13.566918	-5.163651	-6.145089
0.25000	-13.566918	-3.462089	-1.649248
0.50000	-13.566918	-1.760526	.000000
0.75000	-13.566918	-0.788526	-1.410281
1.00000	-13.566918	.000000	-5.906121

ELEM 31 == LENGTH = 3.65

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	4.639743	4.804958	5.478119
0.18151	4.639743	5.377358	2.184856
0.36301	4.639743	6.040084	2.016696
0.54452	4.639743	7.042116	5.606725
0.72603	4.639743	8.044147	8.979642

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-3.874469	-7.915739	-7.147741
0.18151	-3.874469	-6.913707	-2.276754
0.36301	-3.874469	-5.949796	-1.646880
0.54452	-3.874469	-5.377396	-5.818256
0.72603	-3.874469	-4.804996	-10.815581

ELEM 32 == LENGTH = 3.65

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	4.067767	6.202553	7.005429
0.18151	4.067767	6.774953	2.783421
0.36301	4.067767	7.445632	2.326359
0.54452	4.067767	8.447663	6.633090
0.72603	4.067767	9.449694	10.714602

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-3.009265	-8.925156	-8.228504
0.18151	-3.009265	-7.923125	-2.790096
0.36301	-3.009265	-7.019373	-2.022121
0.54452	-3.009265	-6.446973	-7.155043
0.72603	-3.009265	-5.874573	-13.010541

ELEM 33 == LENGTH = 3.65

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	4.613542	5.433688	6.112352
0.18151	4.613542	6.006088	2.494918
0.36301	4.613542	6.801663	2.226308
0.54452	4.613542	7.803694	5.952694
0.72603	4.613542	8.805725	9.466318

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-4.105415	-8.054866	-7.125096
0.18151	-4.105415	-7.052835	-2.212201
0.36301	-4.105415	-6.162184	-1.845714
0.54452	-4.105415	-5.589784	-6.517285
0.72603	-4.105415	-5.017384	-12.019155

ELEM 34 == LENGTH = 3.65

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	8.170456	3.232399	3.513512
0.18151	8.170456	3.804799	1.206697
0.36301	8.170456	4.377199	1.931475
0.54452	8.170456	5.374848	4.501529
0.72603	8.170456	6.376879	6.801715

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-11.896431	-6.384404	-5.232868
0.18151	-11.896431	-5.382373	-1.490852
0.36301	-11.896431	-4.455827	-1.565370
0.54452	-11.896431	-3.803559	-4.675695
0.72603	-11.896431	-3.231159	-8.480045

ELEM 35 == LENGTH = 3.65

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	2.058421	2.469397	2.937673
0.18151	2.058421	2.934472	1.338978
0.36301	2.058421	3.526624	1.779450
0.54452	2.058421	4.296780	3.519338
0.72603	2.058421	5.066936	4.996637

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-2.100961	-4.551637	-3.231012
0.18151	-2.100961	-3.781481	-0.615529
0.36301	-2.100961	-3.056269	-0.950503
0.54452	-2.100961	-2.591194	-3.356759
0.72603	-2.100961	-2.126119	-6.435529

PORTICO B

programa SAP2000 Versión 7.10

DISPLACEMENT DEGREES OF FREEDOM

(A) = Active DOF, equilibrium equation
(-) = Restrained DOF, reaction computed
(+) = Constrained DOF
( ) = Null DOF

JOINTS			UX	UY	UZ	RX	RY	RZ
1			-		-		-	
2	TO	6	A		A		A	
7			-		-		-	
8	TO	12	A		A		A	
13			-		-		-	
14	TO	18	A		A		A	
19			-		-		-	
20	TO	24	A		A		A	

JOINT DISPLACEMENTS

TRANSLATIONS AND ROTATIONS, IN GLOBAL COORDINATES

COMB ENVE ---------- MAX

JOINT	UX	UZ	RY
1	.000000	.000000	.000000
2	0.004743	1.56E-05	0.000984
3	0.007949	1.87E-05	0.000761
4	0.010743	1.78E-05	0.000724
5	0.013279	1.49E-05	0.000679
6	0.015509	1.20E-05	0.000555
7	.000000	.000000	.000000
8	0.004713	.000000	0.000435
9	0.007934	.000000	0.000403
10	0.010734	.000000	0.000369
11	0.013270	.000000	0.000342
12	0.015408	.000000	0.000191
13	.000000	.000000	.000000
14	0.004691	.000000	0.000439
15	0.007926	.000000	0.000378
16	0.010729	.000000	0.000333
17	0.013265	.000000	0.000292
18	0.015342	.000000	0.000143
19	.000000	.000000	.000000
20	0.004676	1.49E-05	0.000759
21	0.007924	1.75E-05	0.000564
22	0.010727	1.58E-05	0.000504
23	0.013264	1.22E-05	0.000442
24	0.015313	6.78E-06	0.000215

COMB ENVE ---------- MIN

JOINT	UX	UZ	RY
1	.000000	.000000	.000000
2	-0.004757	-0.000202	-0.000761
3	-0.007950	-0.000328	-0.000555
4	-0.010745	-0.000419	-0.000502
5	-0.013284	-0.000474	-0.000460
6	-0.015479	-0.000498	-0.000242
7	.000000	.000000	.000000
8	-0.004718	-0.000335	-0.000439
9	-0.007935	-0.000554	-0.000378
10	-0.010735	-0.000716	-0.000334
11	-0.013272	-0.000819	-0.000294
12	-0.015398	-0.000865	-0.000144
13	.000000	.000000	.000000
14	-0.004686	-0.000335	-0.000435
15	-0.007925	-0.000554	-0.000404
16	-0.010728	-0.000716	-0.000368
17	-0.013263	-0.000819	-0.000340
18	-0.015353	-0.000865	-0.000190
19	.000000	.000000	.000000
20	-0.004661	-0.000202	-0.000982
21	-0.007923	-0.000327	-0.000770
22	-0.010725	-0.000417	-0.000726
23	-0.013260	-0.000471	-0.000661
24	-0.015343	-0.000495	-0.000528

APPLIED LOADS

FORCES AND MOMENTS ACTING ON JOINTS, IN GLOBAL COORDINATES

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
2	4.212500	.000000	3.154036
3	1.162500	.000000	3.154036
4	0.950000	.000000	3.154036
5	0.737500	.000000	3.154036
6	8.312500	.000000	2.403075
8	.000000	.000000	0.786300
9	.000000	.000000	0.786300
10	.000000	.000000	0.786300
11	.000000	.000000	0.786300
12	.000000	.000000	0.477502
14	.000000	.000000	0.724036
15	.000000	.000000	0.724036
16	.000000	.000000	0.724036
17	.000000	.000000	0.724036
18	.000000	.000000	0.428700

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
2	-4.212500	-4.228875	.000000
3	-1.162500	-4.228875	.000000
4	-0.950000	-4.228875	.000000
5	-0.737500	-4.228875	.000000
6	-8.312500	-3.222000	.000000
8	.000000	-7.474500	-0.724036
9	.000000	-7.474500	-0.724036
10	.000000	-7.474500	-0.724036
11	.000000	-7.474500	-0.724036
12	.000000	-5.857875	-0.428700
14	.000000	-7.474500	-0.786300
15	.000000	-7.474500	-0.786300

16	.000000	-7.474500	-0.786300
17	.000000	-7.474500	-0.786300
18	.000000	-5.857875	-0.477502
20	.000000	-4.228875	-3.154036
21	.000000	-4.228875	-3.154036
22	.000000	-4.228875	-3.154036
23	.000000	-4.228875	-3.154036
24	.000000	-3.222000	-2.403075

RESTRAINT FORCES (REACTIONS)

FORCES AND MOMENTS ACTING ON JOINTS, IN GLOBAL COORDINATES

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
1	4.142694	25.960895	8.365065
7	3.977775	35.819604	7.570078
13	3.953482	35.819604	7.521286
19	3.560573	25.873296	7.606854

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
1	-3.653233	-1.999463	-7.776009
7	-3.980148	.000000	-7.569277
13	-3.951109	.000000	-7.522087
19	-4.050034	-1.911864	-8.195910

GLOBAL FORCE BALANCE

TOTAL FORCE AND MOMENT AT THE ORIGIN, IN GLOBAL COORDINATES

LOAD CMUERTA ----------

	FX	FZ	MY
APPLIED	.000000	-62.139000	3.81E-14
REACTNS	8.33E-17	62.139000	-6.30E-14
TOTAL	8.33E-17	4.97E-14	-2.49E-14

LOAD CVIVA1 ----------

	FX	FZ	MY
APPLIED	.000000	-8.067500	3.73E-15
REACTNS	1.39E-17	8.067500	-2.48E-15
TOTAL	1.39E-17	5.33E-15	1.26E-15

LOAD CVIVA2 ----------

	FX	FZ	MY
APPLIED	.000000	-7.400000	2.24E-15
REACTNS	-4.68E-17	7.400000	-8.82E-15
TOTAL	-4.68E-17	7.99E-15	-6.58E-15

LOAD CSISMO ----------

	FX	FZ	MY
APPLIED	12.300000	.000000	136.740000
REACTNS	-12.300000	-3.55E-15	-136.740000
TOTAL	1.28E-13	-3.55E-15	-3.98E-12

COMB COMB1 ---------- MAX

	FX	FZ	MY
APPLIED	.000000	-107.730000	6.39E-14
REACTNS	1.50E-16	107.730000	-9.90E-14
TOTAL	1.50E-16	8.42E-14	-3.51E-14

COMB COMB1 ---------- MIN

	FX	FZ	MY
APPLIED	.000000	-107.730000	6.39E-14
REACTNS	1.50E-16	107.730000	-9.90E-14
TOTAL	1.50E-16	8.42E-14	-3.51E-14

COMB COMB2 ---------- MAX

	FX	FZ	MY
APPLIED	.000000	-106.528500	6.12E-14
REACTNS	4.06E-17	106.528500	-1.10E-13
TOTAL	4.06E-17	8.90E-14	-4.92E-14

COMB COMB2 ---------- MIN

	FX	FZ	MY
APPLIED	.000000	-106.528500	6.12E-14
REACTNS	4.06E-17	106.528500	-1.10E-13
TOTAL	4.06E-17	8.90E-14	-4.92E-14

COMB COMB3 ---------- MAX

	FX	FZ	MY
APPLIED	15.375000	-87.758125	170.925000
REACTNS	-15.375000	87.758125	-170.925000
TOTAL	1.60E-13	6.44E-14	-5.00E-12

COMB COMB3 ---------- MIN

	FX	FZ	MY
APPLIED	15.375000	-87.758125	170.925000
REACTNS	-15.375000	87.758125	-170.925000
TOTAL	1.60E-13	6.44E-14	-5.00E-12

COMB COMB4 ---------- MAX

	FX	FZ	MY
APPLIED	15.375000	-86.923750	170.925000
REACTNS	-15.375000	86.923750	-170.925000
TOTAL	1.60E-13	6.77E-14	-5.01E-12

COMB COMB4 ---------- MIN

	FX	FZ	MY
APPLIED	15.375000	-86.923750	170.925000
REACTNS	-15.375000	86.923750	-170.925000
TOTAL	1.60E-13	6.77E-14	-5.01E-12

COMB COMB5 ---------- MAX

	FX	FZ	MY
APPLIED	-15.375000	-87.758125	-170.925000
REACTNS	15.375000	87.758125	170.925000
TOTAL	-1.60E-13	7.33E-14	4.94E-12

COMB COMB5 ---------- MIN

	FX	FZ	MY
APPLIED	-15.375000	-87.758125	-170.925000
REACTNS	15.375000	87.758125	170.925000
TOTAL	-1.60E-13	7.33E-14	4.94E-12

COMB COMB6 ---------- MAX

	FX	FZ	MY
APPLIED	-15.375000	-86.923750	-170.925000
REACTNS	15.375000	86.923750	170.925000
TOTAL	-1.60E-13	7.66E-14	4.93E-12

COMB COMB6 ---------- MIN

	FX	FZ	MY
APPLIED	-15.375000	-86.923750	-170.925000
REACTNS	15.375000	86.923750	170.925000
TOTAL	-1.60E-13	7.66E-14	4.93E-12

COMB COMB7 ---------- MAX

	FX	FZ	MY
APPLIED	15.375000	-55.925100	170.925000
REACTNS	-15.375000	55.925100	-170.925000
TOTAL	1.60E-13	4.03E-14	-5.00E-12

COMB COMB7 ---------- MIN

	FX	FZ	MY
APPLIED	15.375000	-55.925100	170.925000
REACTNS	-15.375000	55.925100	-170.925000
TOTAL	1.60E-13	4.03E-14	-5.00E-12

COMB COMB8 ---------- MAX

	FX	FZ	MY
APPLIED	-15.375000	-55.925100	-170.925000
REACTNS	15.375000	55.925100	170.925000
TOTAL	-1.60E-13	4.92E-14	4.95E-12

COMB COMB8 ---------- MIN

	FX	FZ	MY
APPLIED	-15.375000	-55.925100	-170.925000
REACTNS	15.375000	55.925100	170.925000
TOTAL	-1.60E-13	4.92E-14	4.95E-12

COMB ENVE ---------- MAX

	FX	FZ	MY
APPLIED	15.375000	.000000	170.925000
REACTNS	15.375000	107.730000	170.925000
TOTAL	1.60E-13	8.90E-14	4.95E-12

COMB ENVE ---------- MIN

	FX	FZ	MY
APPLIED	-15.375000	-107.730000	-170.925000
REACTNS	-15.375000	.000000	-170.925000
TOTAL	-1.60E-13	.000000	-5.01E-12

FRAME ELEMENT JOINT FORCES

FORCES AND MOMENTS ACTING ON ELEMENTS, IN GLOBAL COORDINATES

ELEM 1 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
1	4.142694	25.960895	8.365065
2	3.653233	1.999463	6.548633

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
1	-3.653233	-1.999463	-7.776009
2	-4.142694	-25.960895	-5.375630

ELEM 2 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
2	2.720315	19.631656	3.819104
3	1.594355	0.479068	4.475477

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
2	-1.594355	-0.479068	-2.043426
3	-2.720315	-19.631656	-2.739639

ELEM 3 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
3	2.685939	14.121377	4.024426
4	1.553472	.000000	4.202050

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
3	-1.553472	.000000	-2.267057
4	-2.685939	-14.121377	-2.393359

ELEM 4 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
4	2.470520	8.725911	3.723209
5	1.290077	.000000	3.854826

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
4	-1.290077	.000000	-1.864720
5	-2.470520	-8.725911	-2.005512

ELEM 5 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
5	2.612536	3.658652	3.628073
6	1.212257	.000000	4.338116

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
5	-1.212257	.000000	-1.600986
6	-2.612536	-3.658652	-2.035784

ELEM 6 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
7	3.977775	35.819604	7.570078
8	3.980148	.000000	6.749910

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
7	-3.980148	.000000	-7.569277
8	-3.977775	-35.819604	-6.759255

ELEM 7 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
8	3.519624	28.193822	5.262756
9	3.477229	.000000	5.450384

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
8	-3.477229	.000000	-5.236913
9	-3.519624	-28.193822	-5.346282

ELEM 8 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
9	3.088295	20.698807	4.661047
10	2.962280	.000000	4.782218

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
9	-2.962280	.000000	-4.446213
10	-3.088295	-20.698807	-4.541733

ELEM 9 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
10	2.857355	13.286551	4.326310
11	2.681118	.000000	4.419241

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
10	-2.681118	.000000	-4.026995
11	-2.857355	-13.286551	-4.085807

ELEM 10 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
11	2.634405	5.920226	3.844043
12	2.443521	.000000	4.174863

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
11	-2.443521	.000000	-3.520633
12	-2.634405	-5.920226	-3.855958

ELEM 11 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
13	3.953482	35.819604	7.521286
14	3.951109	.000000	6.711250

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY

13	-3.951109	.000000	-7.522087
14	-3.953482	-35.819604	-6.701906

ELEM 12 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
14	3.506796	28.193822	5.281832
15	3.549191	.000000	5.390065

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
14	-3.549191	.000000	-5.307675
15	-3.506796	-28.193822	-5.494166

ELEM 13 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
15	2.966836	20.698807	4.451960
16	3.092851	.000000	4.549653

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
15	-3.092851	.000000	-4.666794
16	-2.966836	-20.698807	-4.790138

ELEM 14 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
16	2.687427	13.286551	4.033417
17	2.863664	.000000	4.098311

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
16	-2.863664	.000000	-4.332732
17	-2.687427	-13.286551	-4.431745

ELEM 15 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
17	2.372438	5.920226	3.415960
18	2.563321	.000000	3.747381

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
17	-2.563321	.000000	-3.739370
18	-2.372438	-5.920226	-4.066286

ELEM 16 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
19	3.560573	25.873296	7.606854
20	4.050034	1.911864	5.211209

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
19	-4.050034	-1.911864	-8.195910
20	-3.560573	-25.873296	-6.384212

ELEM 17 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY

20	1.685390	19.547241	2.196711
21	2.811351	0.394654	2.859460

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
20	-2.811351	-0.394654	-3.972389
21	-1.685390	-19.547241	-4.595298

ELEM 18 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
21	1.537521	14.007389	2.231982
22	2.669988	.000000	2.380581

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
21	-2.669988	.000000	-3.989351
22	-1.537521	-14.007389	-4.189273

ELEM 19 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
22	1.336434	8.602637	1.902996
23	2.516876	.000000	2.106305

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
22	-2.516876	.000000	-3.761486
23	-1.336434	-8.602637	-3.955619

ELEM 20 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
23	1.055924	3.586495	1.351691
24	2.456203	.000000	1.816082

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
23	-2.456203	.000000	-3.378778
24	-1.055924	-3.586495	-4.118413

ELEM 21 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
2	2.153622	6.638795	7.419056
8	2.888367	6.865745	8.958290

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
2	-2.888367	-1.520394	-10.367737
8	-2.153622	-1.349308	-5.119004

ELEM 22 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
3	1.127005	5.945210	5.006696
9	1.144498	5.921492	7.256810

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
3	-1.144498	-0.622062	-8.499903
9	-1.127005	-0.609803	-3.789242

ELEM 23 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
4	0.686605	5.700590	4.258079
10	0.734581	5.573232	6.480075

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
4	-0.734581	-0.290909	-7.925260
10	-0.686605	-0.348076	-3.225768

ELEM 24 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
5	0.659679	5.505645	3.606498
11	0.880683	5.281697	5.873669

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
5	-0.880683	-0.016810	-7.482899
11	-0.659679	-0.135695	-2.764356

ELEM 25 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
6	7.408408	3.658652	2.035784
12	6.008129	3.721829	3.519039

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
6	-6.008129	.000000	-4.338116
12	-7.408408	.000000	-0.937227

ELEM 26 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
8	1.707681	5.720217	3.749137
14	2.428516	5.720217	7.635694

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
8	-2.428516	-0.373092	-7.635666
14	-1.707681	-0.373092	-3.749165

ELEM 27 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
9	0.606668	5.473407	3.234906
15	0.710516	5.473407	7.003990

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
9	-0.710516	-0.126282	-7.002055
15	-0.606668	-0.126282	-3.236841

ELEM 28 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
10	0.405443	5.265364	2.782384
16	0.502535	5.265364	6.510232

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
10	-0.502535	.000000	-6.511947
16	-0.405443	.000000	-2.780670

ELEM 29 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
11	0.422083	5.090169	2.412478
17	0.642526	5.090169	6.086840

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
11	-0.642526	.000000	-6.098768
17	-0.422083	.000000	-2.400550

ELEM 30 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
12	5.000463	3.503353	0.879687
18	3.428362	3.503353	3.730829

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
12	-3.428362	.000000	-3.736202
18	-5.000463	.000000	-0.874314

ELEM 31 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
14	1.347585	6.862561	5.115890
20	2.082330	6.635611	10.356601

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
14	-2.082330	-1.346124	-8.955176
20	-1.347585	-1.517210	-7.407920

ELEM 32 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
15	0.141424	5.951065	3.836836
21	0.158917	5.974783	8.584649

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
15	-0.158917	-0.639376	-7.304404
21	-0.141424	-0.651635	-5.091442

ELEM 33 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
16	0.164968	5.582518	3.241825
22	0.212943	5.709876	7.950758

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
16	-0.212943	-0.357362	-6.496131
22	-0.164968	-0.300195	-4.283577

ELEM 34 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
17	0.106803	5.230581	2.684116
23	0.327807	5.454530	7.334397

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
17	-0.327807	-0.084579	-5.793428
23	-0.106803	.000000	-3.457996

ELEM 35 ==========

COMB ENVE ---------- MAX

JOINT	FX	FZ	MY
18	2.456203	3.649671	0.834023
24	1.055924	3.586495	4.118413

COMB ENVE ---------- MIN

JOINT	FX	FZ	MY
18	-1.055924	.000000	-3.415834
24	-2.456203	.000000	-1.816082

FRAME ELEMENT INTERNAL FORCES

ELEM 1 ========== LENGTH = 3.60

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	1.999463	3.653233	7.776009
0.50000	1.999463	3.653233	1.288822
1.00000	1.999463	3.653233	6.548633

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-25.960895	-4.142694	-8.365065
0.50000	-25.960895	-4.142694	-0.996848
1.00000	-25.960895	-4.142694	-5.375630

ELEM 2 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.479068	1.594355	2.043426
0.50000	0.479068	1.594355	0.395004
1.00000	0.479068	1.594355	4.475477

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-19.631656	-2.720315	-3.819104
0.50000	-19.631656	-2.720315	-0.434405
1.00000	-19.631656	-2.720315	-2.739639

ELEM 3 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	1.553472	2.267057
0.50000	.000000	1.553472	0.173142
1.00000	.000000	1.553472	4.202050

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-14.121377	-2.685939	-4.024426
0.50000	-14.121377	-2.685939	-0.142026
1.00000	-14.121377	-2.685939	-2.393359

ELEM 4 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	1.290077	1.864720
0.50000	.000000	1.290077	0.150797
1.00000	.000000	1.290077	3.854826

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-8.725911	-2.470520	-3.723209
0.50000	-8.725911	-2.470520	-0.154518
1.00000	-8.725911	-2.470520	-2.005512

ELEM 5 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	1.212257	1.600986
0.50000	.000000	1.212257	0.447903
1.00000	.000000	1.212257	4.338116

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-3.658652	-2.612536	-3.628073
0.50000	-3.658652	-2.612536	-0.268696
1.00000	-3.658652	-2.612536	-2.035784

ELEM 6 ========== LENGTH = 3.60

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	3.980148	7.569277
0.50000	.000000	3.980148	0.474655
1.00000	.000000	3.980148	6.749910

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-35.819604	-3.977775	-7.570078
0.50000	-35.819604	-3.977775	-0.479727
1.00000	-35.819604	-3.977775	-6.759255

ELEM 7 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	3.477229	5.236913
0.50000	.000000	3.477229	0.170948
1.00000	.000000	3.477229	5.450384

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-28.193822	-3.519624	-5.262756
0.50000	-28.193822	-3.519624	-0.131819
1.00000	-28.193822	-3.519624	-5.346282

ELEM 8 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	2.962280	4.446213
0.50000	.000000	2.962280	0.149775
1.00000	.000000	2.962280	4.782218

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-20.698807	-3.088295	-4.661047
0.50000	-20.698807	-3.088295	-0.136949

1.00000	-20.698807	-3.088295	-4.541733

ELEM 9 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	2.681118	4.026995
0.50000	.000000	2.681118	0.140740
1.00000	.000000	2.681118	4.419241

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-13.286551	-2.857355	-4.326310
0.50000	-13.286551	-2.857355	-0.123680
1.00000	-13.286551	-2.857355	-4.085807

ELEM 10 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	2.443521	3.520633
0.50000	.000000	2.443521	0.269640
1.00000	.000000	2.443521	4.174863

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-5.920226	-2.634405	-3.844043
0.50000	-5.920226	-2.634405	-0.271152
1.00000	-5.920226	-2.634405	-3.855958

ELEM 11 ========== LENGTH = 3.60

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	3.951109	7.522087
0.50000	.000000	3.951109	0.479734
1.00000	.000000	3.951109	6.711250

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-35.819604	-3.953482	-7.521286
0.50000	-35.819604	-3.953482	-0.474662
1.00000	-35.819604	-3.953482	-6.701906

ELEM 12 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	3.549191	5.307675
0.50000	.000000	3.549191	0.131251
1.00000	.000000	3.549191	5.390065

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-28.193822	-3.506796	-5.281832
0.50000	-28.193822	-3.506796	-0.170380
1.00000	-28.193822	-3.506796	-5.494166

ELEM 13 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	3.092851	4.666794
0.50000	.000000	3.092851	0.138036
1.00000	.000000	3.092851	4.549653

COMB ENVE ---------- MIN

REL DIST	P	V2	M3

0.00000	-20.698807	-2.966836	-4.451960
0.50000	-20.698807	-2.966836	-0.150862
1.00000	-20.698807	-2.966836	-4.790138

ELEM 14 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	2.863664	4.332732
0.50000	.000000	2.863664	0.126722
1.00000	.000000	2.863664	4.098311

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-13.286551	-2.687427	-4.033417
0.50000	-13.286551	-2.687427	-0.143781
1.00000	-13.286551	-2.687427	-4.431745

ELEM 15 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	2.563321	3.739370
0.50000	.000000	2.563321	0.269200
1.00000	.000000	2.563321	3.747381

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-5.920226	-2.372438	-3.415960
0.50000	-5.920226	-2.372438	-0.267688
1.00000	-5.920226	-2.372438	-4.066286

ELEM 16 ========== LENGTH = 3.60

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	1.911864	4.050034	8.195910
0.50000	1.911864	4.050034	0.994481
1.00000	1.911864	4.050034	5.211209

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-25.873296	-3.560573	-7.606854
0.50000	-25.873296	-3.560573	-1.286455
1.00000	-25.873296	-3.560573	-6.384212

ELEM 17 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.394654	2.811351	3.972389
0.50000	0.394654	2.811351	0.417674
1.00000	0.394654	2.811351	2.859460

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-19.547241	-1.685390	-2.196711
0.50000	-19.547241	-1.685390	-0.378272
1.00000	-19.547241	-1.685390	-4.595298

ELEM 18 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	2.669988	3.989351
0.50000	.000000	2.669988	0.153175
1.00000	.000000	2.669988	2.380581

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-14.007389	-1.537521	-2.231982
0.50000	-14.007389	-1.537521	-0.184291
1.00000	-14.007389	-1.537521	-4.189273

ELEM 19 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	2.516876	3.761486
0.50000	.000000	2.516876	0.185777
1.00000	.000000	2.516876	2.106305

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-8.602637	-1.336434	-1.902996
0.50000	-8.602637	-1.336434	-0.182055
1.00000	-8.602637	-1.336434	-3.955619

ELEM 20 ========== LENGTH = 3.0

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	.000000	2.456203	3.378778
0.50000	.000000	2.456203	0.283492
1.00000	.000000	2.456203	1.816082

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-3.586495	-1.055924	-1.351691
0.50000	-3.586495	-1.055924	-0.462700
1.00000	-3.586495	-1.055924	-4.118413

ELEM 21 ========== LENGTH = 4.475

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	2.888367	1.520394	7.419056
0.25000	2.888367	2.486994	5.566153
0.50000	2.888367	3.524341	2.617719
0.75000	2.888367	5.173636	3.395006
1.00000	2.888367	6.865745	5.119004

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-2.153622	-6.638795	-10.367737
0.25000	-2.153622	-4.946686	-4.275839
0.50000	-2.153622	-3.282508	-0.062841
0.75000	-2.153622	-2.315908	-2.582043
1.00000	-2.153622	-1.349308	-8.958290

ELEM 22 ========== LENGTH = 4.475

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	1.144498	0.622062	5.006696
0.25000	1.144498	1.588662	4.098484
0.50000	1.144498	2.582541	2.206434
0.75000	1.144498	4.229382	2.934995
1.00000	1.144498	5.921492	3.789242

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-1.127005	-5.945210	-8.499903
0.25000	-1.127005	-4.253101	-3.123635
0.50000	-1.127005	-2.560991	.000000
0.75000	-1.127005	-1.576403	-1.965866
1.00000	-1.127005	-0.609803	-7.256810

ELEM 23 ========== LENGTH = 4.475

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.734581	0.290909	4.258079
0.25000	0.734581	1.257509	3.706371
0.50000	0.734581	2.229849	2.203937
0.75000	0.734581	3.881122	2.688632
1.00000	0.734581	5.573232	3.225768

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-0.686605	-5.700590	-7.925260
0.25000	-0.686605	-4.008481	-2.808687
0.50000	-0.686605	-2.316371	.000000
0.75000	-0.686605	-1.314676	-1.584511
1.00000	-0.686605	-0.348076	-6.480075

ELEM 24 ========== LENGTH = 4.475

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.880683	0.016810	3.606498
0.25000	0.880683	0.983410	3.334314
0.50000	0.880683	1.950010	2.158034
0.75000	0.880683	3.589588	2.476709
1.00000	0.880683	5.281697	2.764356

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-0.659679	-5.505645	-7.482899
0.25000	-0.659679	-3.813536	-2.557297
0.50000	-0.659679	-2.121427	.000000
0.75000	-0.659679	-1.102295	-1.316147
1.00000	-0.659679	-0.135695	-5.873669

ELEM 25 ========== LENGTH = 4.475

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	6.008129	.000000	2.035784
0.25000	6.008129	0.334650	2.424909
0.50000	6.008129	1.139591	1.898580
0.75000	6.008129	2.421282	1.393796
1.00000	6.008129	3.721829	0.937227

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-7.408408	-3.658652	-4.338116
0.25000	-7.408408	-2.358106	-1.296694
0.50000	-7.408408	-1.058282	.000000
0.75000	-7.408408	-0.272919	-0.405321
1.00000	-7.408408	.000000	-3.519039

ELEM 26 ========== LENGTH = 4.50

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	2.428516	0.373092	3.749137
0.25000	2.428516	1.345092	3.055878
0.50000	2.428516	2.317092	1.784163
0.75000	2.428516	4.018654	3.055906
1.00000	2.428516	5.720217	3.749165

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-1.707681	-5.720217	-7.635666
0.25000	-1.707681	-4.018654	-2.504154
0.50000	-1.707681	-2.317092	.000000
0.75000	-1.707681	-1.345092	-2.504182

1.00000	-1.707681	-0.373092	-7.635694

ELEM 27 ========== LENGTH = 4.50

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.710516	0.126282	3.234906
0.25000	0.710516	1.098282	2.854600
0.50000	0.710516	2.070282	1.881513
0.75000	0.710516	3.771845	2.856535
1.00000	0.710516	5.473407	3.236841

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-0.606668	-5.473407	-7.002055
0.25000	-0.606668	-3.771845	-2.171458
0.50000	-0.606668	-2.070282	.000000
0.75000	-0.606668	-1.098282	-2.173393
1.00000	-0.606668	-0.126282	-7.003990

ELEM 28 ========== LENGTH = 4.50

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.502535	.000000	2.782384
0.25000	0.502535	0.890239	2.646211
0.50000	0.502535	1.862239	1.911252
0.75000	0.502535	3.563802	2.644497
1.00000	0.502535	5.265364	2.780670

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-0.405443	-5.265364	-6.511947
0.25000	-0.405443	-3.563802	-1.919993
0.50000	-0.405443	-1.862239	.000000
0.75000	-0.405443	-0.890239	-1.918278
1.00000	-0.405443	.000000	-6.510232

ELEM 29 ========== LENGTH = 4.50

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.642526	.000000	2.412478
0.25000	0.642526	0.715044	2.478321
0.50000	0.642526	1.687044	1.939560
0.75000	0.642526	3.388607	2.466393
1.00000	0.642526	5.090169	2.400550

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-0.422083	-5.090169	-6.098768
0.25000	-0.422083	-3.388607	-1.694806
0.50000	-0.422083	-1.687044	.000000
0.75000	-0.422083	-0.715044	-1.682877
1.00000	-0.422083	.000000	-6.086840

ELEM 30 ========== LENGTH = 4.50

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	3.428362	.000000	0.879687
0.25000	3.428362	0.097978	1.472188
0.50000	3.428362	0.887728	1.518441
0.75000	3.428362	2.195541	1.466815
1.00000	3.428362	3.503353	0.874314

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-5.000463	-3.503353	-3.736202
0.25000	-5.000463	-2.195541	-0.815040

0.50000	-5.000463	-0.887728	.000000
0.75000	-5.000463	-0.097978	-0.809668
1.00000	-5.000463	.000000	-3.730829

ELEM 31 ========== LENGTH = 4.475

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	2.082330	1.346124	5.115890
0.25000	2.082330	2.312724	3.395454
0.50000	2.082330	3.279324	2.613708
0.75000	2.082330	4.943501	5.558579
1.00000	2.082330	6.635611	7.407920

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-1.347585	-6.862561	-8.955176
0.25000	-1.347585	-5.170451	-2.582491
0.50000	-1.347585	-3.521156	-0.058830
0.75000	-1.347585	-2.483810	-4.268265
1.00000	-1.347585	-1.517210	-10.356601

ELEM 32 ========== LENGTH = 4.475

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.158917	0.639376	3.836836
0.25000	0.158917	1.605976	2.949505
0.50000	0.158917	2.590565	2.225009
0.75000	0.158917	4.282674	4.150145
1.00000	0.158917	5.974783	5.091442

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-0.141424	-5.951065	-7.304404
0.25000	-0.141424	-4.258956	-1.980376
0.50000	-0.141424	-2.612115	.000000
0.75000	-0.141424	-1.618235	-3.175295
1.00000	-0.141424	-0.651635	-8.584649

ELEM 33 ========== LENGTH = 4.475

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.212943	0.357362	3.241825
0.25000	0.212943	1.323962	2.694300
0.50000	0.212943	2.325657	2.208658
0.75000	0.212943	4.017767	3.721481
1.00000	0.212943	5.709876	4.283577

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-0.164968	-5.582518	-6.496131
0.25000	-0.164968	-3.890408	-1.590178
0.50000	-0.164968	-2.239135	.000000
0.75000	-0.164968	-1.266795	-2.823797
1.00000	-0.164968	-0.300195	-7.950758

ELEM 34 ========== LENGTH = 4.475

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	0.327807	0.084579	2.684116
0.25000	0.327807	1.051179	2.453655
0.50000	0.327807	2.070311	2.123903
0.75000	0.327807	3.762420	3.242998
1.00000	0.327807	5.454530	3.457996

COMB ENVE ---------- MIN

REL DIST	P	V2	M3

0.00000	-0.106803	-5.230581	-5.793428
0.25000	-0.106803	-3.538472	-1.293093
0.50000	-0.106803	-1.898894	.000000
0.75000	-0.106803	-0.932294	-2.465980
1.00000	-0.106803	.000000	-7.334397

ELEM 35 ========== LENGTH = 4.475

COMB ENVE ---------- MAX

REL DIST	P	V2	M3
0.00000	1.055924	.000000	0.834023
0.25000	1.055924	0.200761	1.371319
0.50000	1.055924	0.986124	1.840331
0.75000	1.055924	2.285948	2.285933
1.00000	1.055924	3.586495	1.816082

COMB ENVE ---------- MIN

REL DIST	P	V2	M3
0.00000	-2.456203	-3.649671	-3.415834
0.25000	-2.456203	-2.349124	-0.382843
0.50000	-2.456203	-1.067433	.000000
0.75000	-2.456203	-0.262492	-1.157718
1.00000	-2.456203	.000000	-4.118413

V.- DISEÑO

V.1 DISEÑO DE LOSA ALIGERADA

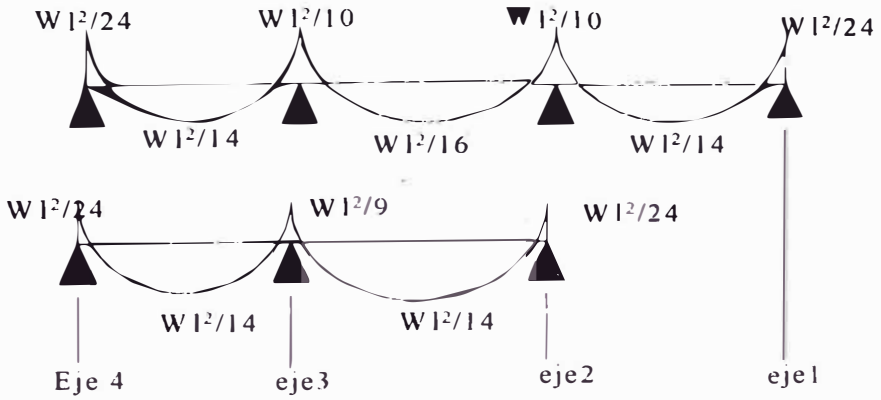
La losa aligerada es un sistema de construcción que consiste en una serie de nervaduras de concreto armado en una sola dirección llenadas entre unidades de relleno, generalmente se usan como aligerados ladrillos de arcilla con huecos estandarizados; la parte superior de las nervaduras podrá ser conectada mediante una losa de concreto que serán llenados monolíticamente constituyéndose un sistema estructural resistente a la flexión y corte como si se tratase de una serie de vigas T.

Calculo de momentos:

Piso típico

WD = 0.24 tn/m
WL = 0.1 tn/m
Wu = 0.54 tn/m
L = 4.2 m

Momentos en losa piso tipico



Momentos entre ejes 4-3-2-1

M(4)=0.54*4.2²/24= -0.397 tn-m
M(4-3)= 0.54*4.2²/14= 0.680 tn-m
M(3)= 0.54*4.2²/10= -0.953 tn-m
M(3-2)= 0.54*4.2²/16= 0.595 tn-m
M(2)= 0.54*4.2²/10= -0.953 tn-m
M(2-1)= 0.54*4.2²/14= 0.680 tn-m
M(1)= 0.54*4.2²/24= -0.397 tn-m

Momentos entre ejes 4-3-2

M(4)= 0.54*4.2^2/24= -0.397 tn-m
M(4-3)= 0.54*4.2^2/14= 0.680 tn-m
M(3)= 0.54*4.2^2/9= -1.058 tn-m
M(3-2)= 0.54*4.2^2/14= 0.680 tn-m
M(2)= 0.54*4.2^2/24= -0.397 tn-m

En el presente informe presento el calculo estructural de un eje, los otros ejes se presentan en una tabla de resumen.

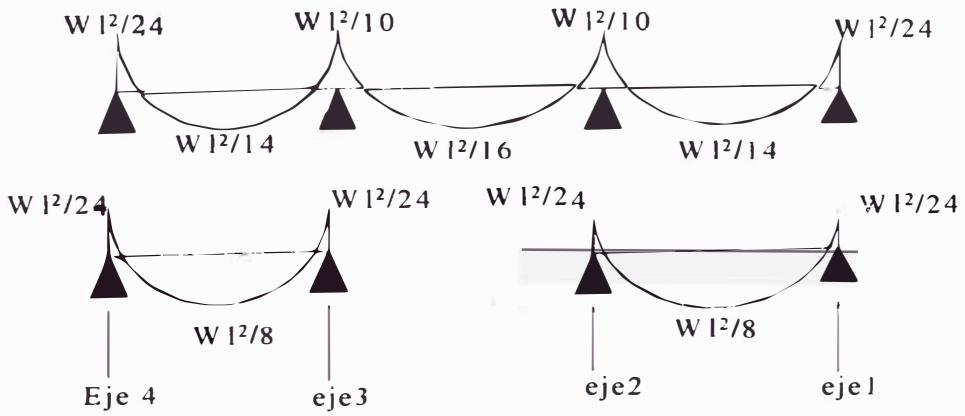
Piso típico ejes 4-3-2-1

Acero de refuerzo entre ejes 4-3 y 2-1:
b = 40 cm
c= 5
β1= 0.85
a=c*β1= 4.25
h = 20 cm
f´c = 210 Kg/cm2
Mu (+)= 0.680 tn-m
Ø = 0.9
d=20-3= 17 cm
Fy= 4200 Kg/cm2
As=0.680*100000/(0.9*4200*(17-4.25/2))=1.210084034 cm2
a=1.078966*4200/(0.85*210*40)=0.634685882
c=a/beta1=0.634686/0.85=0.746689273
As (cm2)=0.680*100000/(0.9*4200*(17-0.6346/2)=1.07896 cm2

Azotea

WD = 0.17 tn/m
WL = 0.06 tn/m
Wu = 0.36 tn/m
L = 4.2 m

Momentos en losa de azotea



Momentos entre ejes 4-3-2-1

M(4)=0.36*4.2^2/24= -0.265 tn-m
M(4-3)= 0.36*4.2^2/14= 0.454 tn-m
M(3)= 0.36*4.2^2/10= -0.635 tn-m
M(3-2)= 0.36*4.2^2/16= 0.397 tn-m
M(2)= 0.36*4.2^2/10= -0.635 tn-m
M(2-1)= 0.36*4.2^2/14= 0.454 tn-m
M(1)= 0.36*4.2^2/24= -0.265 tn-m

Momentos entre ejes 4-3 y 2-1

M(4)= 0.36*4.2^2/24= -0.265 tn-m
M(4-3)= 0.36*4.2^2/8= 0.794 tn-m
M(3)= 0.36*4.2^2/24= -0.265 tn-m

A continuación presento un resumen del calculo en los otros ejes de la losa aligerada del piso típico:

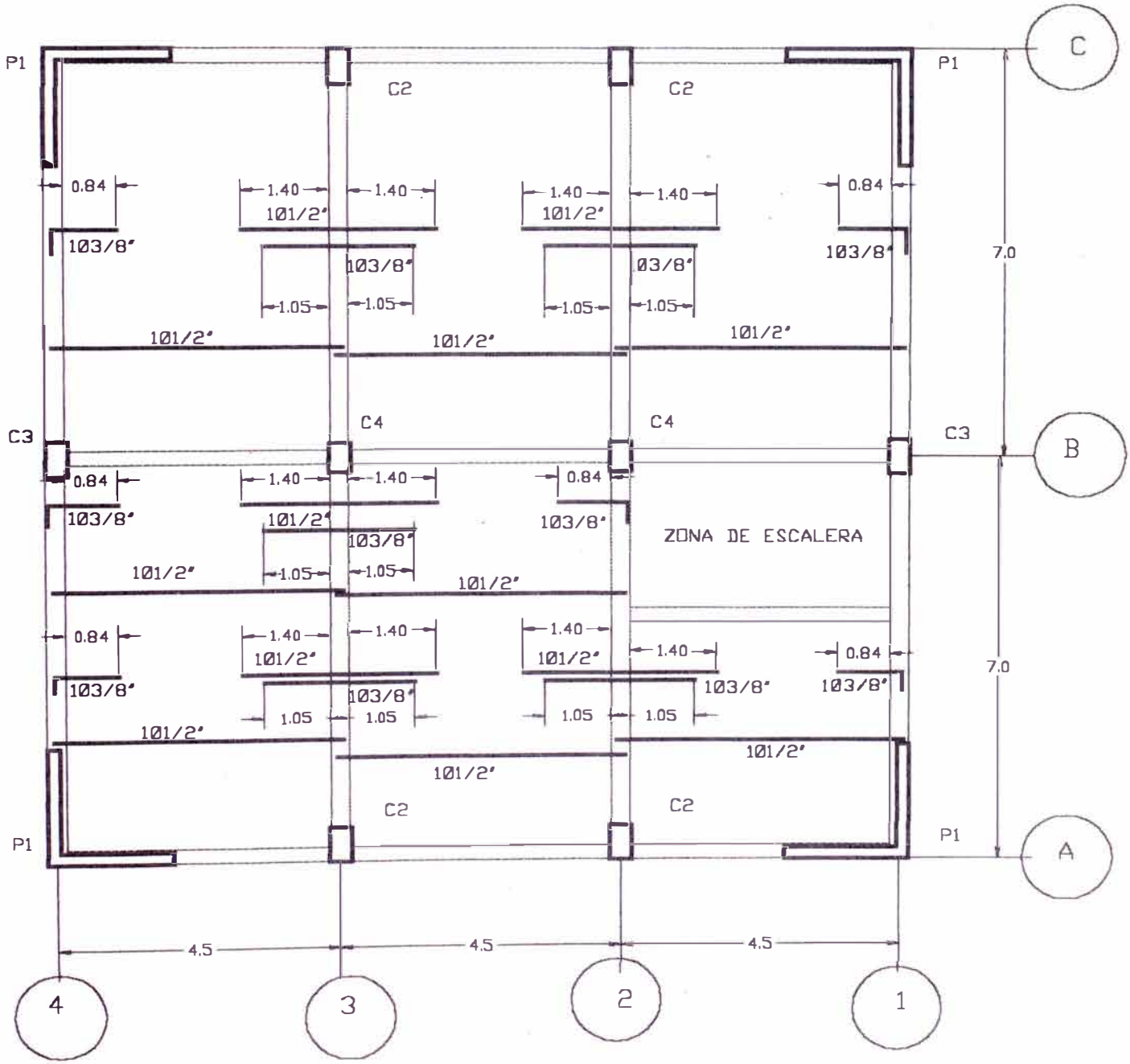
Tipo de seccion	ejes	b	c	β1	a= c*β1	h	Mu	Area acero	a	Area acero
Unidades		cm					tn-m	cm2		cm2
Piso típico ejes 4-3-2-1										
Suponiendo que el eje neutro esta en el ala	3-2	40	5	0.85	4.25	20	0.595	1.0588	0.5541	0.942
Piso típico ejes 4-3-2-1 y ejes 4-3-2										
Suponiendo que el eje neutro esta en el alma	4	10	5	0.85	4.25	20	-0.397	0.6863	1.5224	0.647
Piso típico ejes 4-3-2										
Suponiendo que el eje neutro esta en el alma	3	10	5	0.85	4.25	20	1.058	1.8301	4.4612	1.896
Suponiendo que el eje neutro esta en el ala	3-2	40	5	0.85	4.25	20	0.680	1.2101	0.6347	1.079
Piso típico ejes 4-3-2-1										
Suponiendo que el eje neutro esta en el alma	3	10	5	0.85	4.25	20	-0.953	1.6471	3.9459	1.677

Resumen del calculo en los otros ejes de la losa aligerada de la azotea:

Tipo de sección	ejes	b (cm)	c	β1	a= c*β1	h	Mu	Area acero	a	Area acero
Unidades		cm					tn-m	cm2		cm2
Piso azotea ejes 4-3-2-1										
Suponiendo que el eje neutro esta en el ala	4-3 y 2-1	40	5	0.85	4.25	20	0.454	0.8067	0.4206	0.715
Suponiendo que el eje neutro esta en el alma	4 y 1	10	5	0.85	4.25	20	0.265	0.4575	0.9976	0.424
Suponiendo que el eje neutro esta en el ala	3-2	40	5	0.85	4.25	20	0.397	0.7059	0.3671	0.624
Suponiendo que el eje neutro esta en el alma	3 y 2	10	5	0.85	4.25	20	0.635	1.098	2.5106	1.067
Piso azotea ejes 4-3 y 2-1										
Suponiendo que el eje neutro esta en el ala	4-3	40	5	0.85	4.25	20	0.794	1.4118	0.7429	1.263
Suponiendo que el eje neutro esta en el alma	4 y 3	10	5	0.85	4.25	20	0.265	0.4575	0.9976	0.424

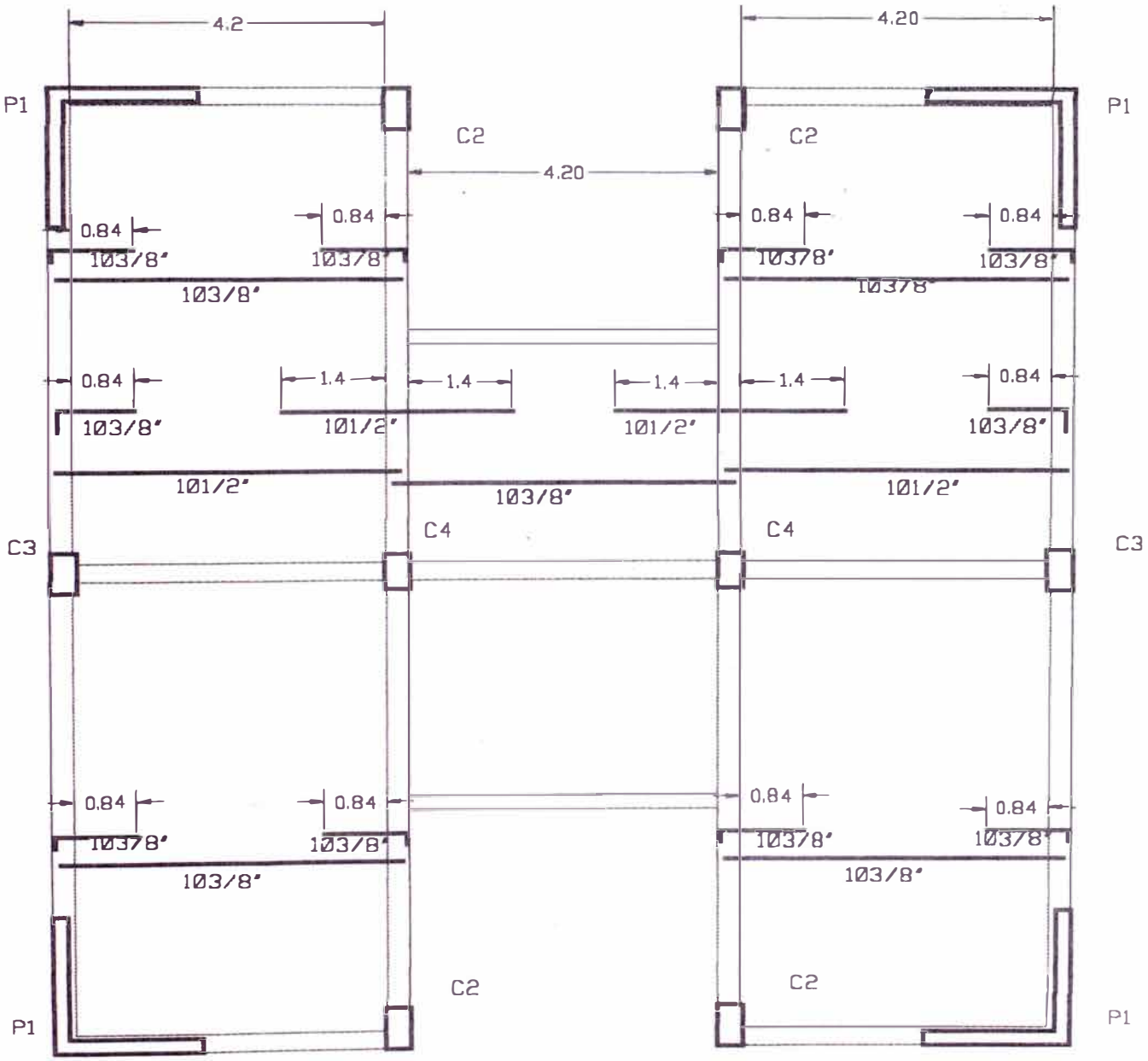
ALIGERADO

PISO TIPICO



ALIGERADO

AZOTEA



V.2.- DISEÑO DE ESCALERA

GENERALIDADES

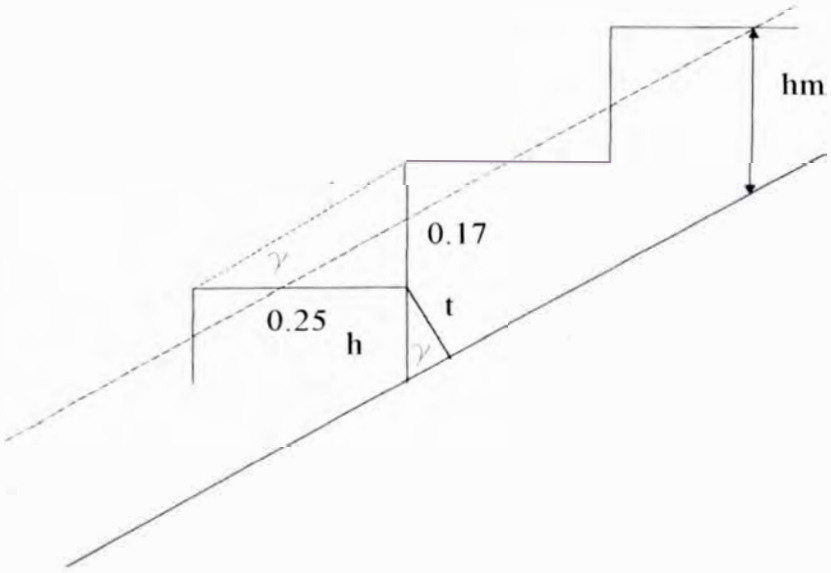
Se tiene una escalera típica, excepto en el primer tramo que esta anclado en la cimentación, el diseño consiste en transformar la escalera en una losa de espesor medio constante, lo cual nos lleva primero al calculo del peso propio y luego a la aplicación de los conceptos de vigas, para definir dimensiones y calcular armaduras.

ESPECIFICACIONES GENERALES

Concreto: f'c=210 Kg/cm2
Acero: Fy=4200 Kg/cm2
S/C=400 Kg/m2
Piso terminado: 100 Kg/m2

DISEÑO

DIMENSIONAMIENTO
# de contrapasos =18
hcp=3/18=0.167 m
t=lmayor/25
t=4.2/25=0.17 m



d=t-2.5=17-2.5=14.5 cm
1°Tramo
Parte inclinada
h= t/cosγ=0.17x √ (0.17²+0.25²)/0.25=0.20
hm=h+hcp/2=0.2+0.17/2
hm=0.29 m

METRADO DE CARGAS

Tramo inclinado

Carga muerta:

peso propio:0.29x1.0x1.0x2400=		696	kg/m2
Acabado =		100	kg/m2

	D=	796	kg/m2

Carga viva:

S/C	L=	400	kg/m2

Descanso

Carga muerta:

peso propio	0.17x1.0x1.0x2400=	408	kg/m2	
Acabado		100	kg/m2	

	D=	508	kg/m2	

Carga viva:

S/C	L=	400	kg/m2

Carga ultima de rotura (Wu):

Wu=1.5x CM+1.8x CV

tramo inclinado

Wu=(1.5x796+1.8x400)*1.2=2296.8 kg/m

wu= 2296.8kg/m

wu= 2.30 tn/m

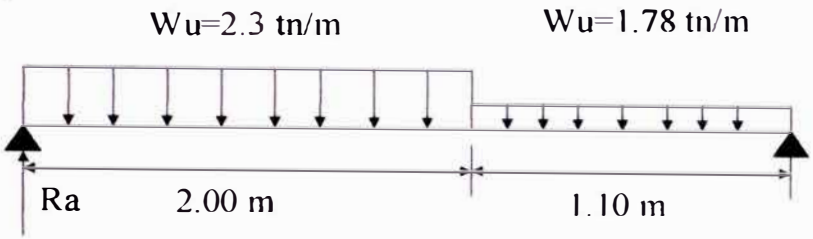
descanso

Wu=(1.5x508+1.8x400)*1.2=1778.4 kg/m

wu= 1778.4 kg/m

wu= 1.78 t/m2

Escalera, 1° tramo



Momento de flexión

Ra= 3.46 tn

x= 1.38 m (de Ra hacia la derecha)
Mu=Mx= 2.58 tn-m

momento resistente máximo del concreto

MC= 12398.02 Kg-m
(MC =12.39 tn-m)>(Mmax =2.58 tn-m)OK

Verificación por corte

Vu=Vmax= 3.46 tn
corte del concreto
vc=Øx(0.53x√f'c)
Vc=(vc)x(b)x(d)=0.85x(0.53x√210)x120x14.5

Vc= 11359.36 Kg
Vc= 11.36 tn

(Vu= 3.46 tn) < (VC=11.36 tn) OK

Diseño del acero

Mu=As*Fy*(d-a/2).....(1)
Donde:
a=As*Fy/(0.85*f'c*b)

de (1):

$2.58x10^5 = Asx4200(14.5 - \frac{Asx4200}{2x0.85x210x120})x0.9$

As(+)= 4.867 cm2/ancho

usando Ø1/2" tengo la siguiente distribución: s=1.27x120/4.867 = 31.31 cm
Entonces usare: Ø1/2" @ 0.30 m

As(-)=As(+)/3= 1.62 cm2/ancho
Asmin=0.0018x120x17= 3.67 cm2
comparado con Asmin, el As(-) es menor, por lo tanto usare Asmin.
As(-)= 3.67 cm2
usando Ø3/8" tengo la siguiente distribución : s=0.71*120/3.67 = 23.22
Entonces usare: Ø3/8" @ 0.20 m

Acero de temperatura

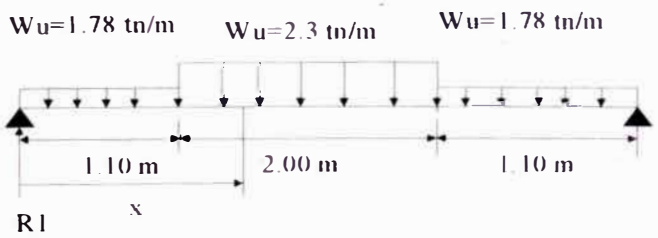
Astemp= 0.0018x100x17= 3.06 cm2/m

Entonces usare: Ø3/8" @ 0.20 m

Segundo tramo

R1= 4.26 tn

ESCALERA 2° TRAMO



$Mx=4.26x-1.78*1.10*(x-1.10/2)-2.3*((x-1.10)^2)/2$

$Vx=dm/dx=0$

dMx/dx=4.26-1.78*1.1-2.3*(x-1.1)=0
X= 2.1m

Mmax= 4.76 tn-m

(MC =12.39 tn-m)>(Mmax=4.76 tn-m) OK
(Vu=4.26 tn)<(Vc=11.36 tn) OK

$4.76x10^5 = Asx4200(14.5 - \frac{Asx4200}{2x0.85x210x120})x0.9$

As(+)= 9.2649 cm2

Usando Ø1/2" tengo la siguiente distribución: s=1.27*120/9.2649=16.45cm

usare Ø1/2" @ 0.15

As(-)=As(+)/3= 3.09 cm2.esto es menor que el acero mínimo, por lo tanto usare acero mínimo (3.67 cm2)
s=0.71*120/3.67=23.21 cm

usare Ø3/8" @ 0.20

Astemp=0.0018x100x17= 3.06 cm2/m
Usare Ø3/8" @ 0.20

V.3.- DISEÑO DE VIGAS

VIGAS SIMPLEMENTE REFORZADAS

Para abreviar presento el analisis de una viga, el calculo estructural de las otras vigas se presenta en forma de resumen.

Acero longitudinal

viga de pórtico 1-4 típico
elemento 16 y 21

DATOS
beta= 0.85
f'c= 210 Kg/cm2
Fy= 4200 Kg/cm2
h= 60 cm
b= 30 cm
d= 55 cm
$E=2x10^6$
Mmax(+)= 4.9 tn-m
Mmax(-)i= 14.72 tn-m
Mmax(-)j= 9.65 tn-m
Analizando centro de la viga
ρ balanceada=0.85*f'c*0.003*Es/(Fy*(0.003*Es+Fy))= 0.02125
ρ maxima=0.75*ρ balanceada = 0.015938
ρ minima=14/Fy= 0.003333
As= M/(Ø*Fy*(d-a/2)=4.9*10 ^{5}/(0.9*4200*(0.9*55)= 2.61878
a=As*Fy/(0.85*f'c*b)=2.61878*4200/(0.85*210*30)= 1.882353
As= M/(Ø*Fy*(d-a/2)= 2.40
ρ = 0.001453 <cuantía mínima
As=0.003333*30*55= 5.5 ⟹ 3Ø5/8"
Analizando extremo i
As en (i)
Mmax(-)i=14.72 tn-m
ρ balanceada = 0.02125
ρ máxima = 0.75*ρ balanceada = 0.015938
ρ mínima =14/Fy= 0.003333
As=14.72*10 ^{5}/(0.9*4200*(0.9*55)= 7.86703
a= As*Fy/(0.85*f'c*b)=7.48*4200/(0.85*210*30)= 5.866667
As== M/(Ø*Fy*(d-a/2)= 7.48 2Ø1/2"+3Ø5/8"
ρ = 0.004533 >cuantía mínima OK

Analizando extremo j
As en (j)
Mmax(-)j= 9.65 tn-m

As=9.65*10 ^{5}/(0.9*4200*(0.9*55)= 5.141361cm2
a=4.79*4200/(0.85*210*30)= 3.756863
As=9.65*10 ^{5}/(0.9*4200*(55-3.756/2)= 4.79 cm2

ρ=4.79/(30*55) =0.002904 <cuantía mínima

As=0.003333*30*55= 5.5 cm2 ⟶ 4Ø1/2"

longitud de desarrollo:

ld= As en (i)

34.61	cm		
40.07	cm	⟶	40.07*1.4=56 cm
30	cm		

ld= As en (j)

22.08	cm		
32.00	cm	⟶	32*1.4=45 cm
30	cm		

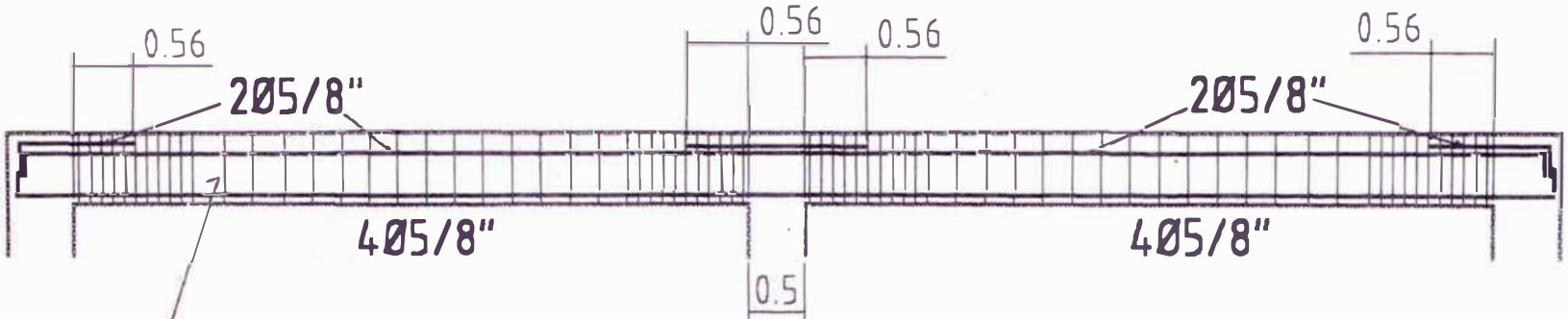
Resumen del calculo de vigas simplemente reforzadas

Viga de pórtico	**1-4 5° azotea**	**2-3 típico**	**2-3 azotea**	**B tipico**
elemento	20 y 25	16 y 21	20 y 25	21
h cm	60	60	60	60
b cm	30	30	30	25
d cm	55	55	55	55
Mmax(+) tn-m	3.97	14.38	11.02	2.62
Mmax(-)i tn-m	12.43	21.89	13.68	9.41
Mmax(-)j tn-m	4.35	22.92	12.98	7.96
Analizando centro de la viga				
ρ balanceada	0.02125	0.0213	0.0213	0.0213
ρ maxima	0.015938	0.0159	0.0159	0.0159
ρ minima	0.003333	0.0033	0.0033	0.0033
a	1.521569	6.0277	4.6193	1.3179
ρ	0.001174<cuantia minima	0.0041> cuantia minima	0.0034> cuantia minima	0.0009<cuantia minima
As (cm2)	5.5 (3Ø5/8")	7.32 (4Ø5/8")	5.53 (3Ø5/8")	4.58 (3Ø5/8")
Analizando extremo i				
a	4.909804	9.1757	5.7343	4.7333
As (cm2)	6.26 (2Ø1/2"+2Ø5/8")	11.49 (2Ø5/8"+3Ø3/4")	6.94 (4Ø5/8")	4.73 (3Ø5/8")
ρ	0.003793>cuantia minima	0.0064>cuantia minima	0.0042>cuantia minima	0.0034>cuantia minima
Analizando extremo j				
a	1.662745	9.6074	5.4409	4.0039
As (cm2)	5.5 (4Ø1/2")	12.08 (2Ø5/8"+3Ø3/4")	6.57 (4Ø5/8")	4.58 (3Ø5/8")
ρ	0.001288<cuantia minima	0.0067>cuantia minima	0.004>cuantia minima	0.0029<cuantia minima
longitud de desarrollo				
Ld en i	40.07*1.4=56 cm	49.91*1.4=70 cm	40.07*1.4=56 cm	40.07*1.4=56 cm
Ld en j	32*1.4=45 cm	49.91*1.4=70 cm	40.07*1.4=55 cm	40.07*1.4=55 cm

Viga de pórtico	B azotea	B tipico	Bazotea	A tipico
elemento	25	26	30	21
h cm	60	60	60	60
b cm	25	25	25	25
d cm	55	55	55	55
Mmax(+) tn-m	1.9	3.75	1.52	9.14
Mmax(-)i tn-m	3.86	6.84	3.28	10.97
Mmax(-)j tn-m	3.03	6.72	3.21	5.88
Analizando centro de la viga				
ρ balanceada	0.0213	0.0213	0.0213	0.0213
ρ maxima	0.0159	0.0159	0.0159	0.0159
ρ minima	0.0033	0.0033	0.0033	0.0033
a	0.8659	1.7224	0.6965	4.3106
ρ	0.0007<cuantia minima	0.0013<cuantia minima	0.0005<cuantia minima	0.0033 cuantia minima
As (cm2)	0.92 (3Ø5/8")	1.83 (4Ø1/2")	0.74 (4Ø1/2")	4.58 (4Ø1/2")
Analizando extremo i				
a	1.7788	3.1906	1.5059	5.2141
As (cm2)	1.89 (3Ø5/8")	3.39 (3Ø5/8")	4.58 (4Ø1/2")	5.54 (2Ø1/2"+2Ø5/8")
ρ	0.0014<cuantia minima	0.0025<cuantia minima	0.0012<cuantia minima	0.004> cuantia minima
Analizando extremo j				
a	1.3929	3.1153	1.4682	2.7294
As (cm2)	1.48 (3Ø5/8")	3.31 (4Ø1/2")	4.58 (4Ø1/2")	4.58 (4Ø1/2")
ρ	0.0011 <cuantia minima	0.0024<cuantia minima	0.0011<cuantia minima	0.0021<cuantia minima
longitud de desarrollo				
Ld en i	40.07*1.4=56 cm	40.07*1.4=56 cm	32*1.4=45 cm	40.07*1.4=56 cm
Ld en j	40.07*1.4=56 cm	32*1.4=45 cm	32*1.4=45 cm	32*1.4=45 cm

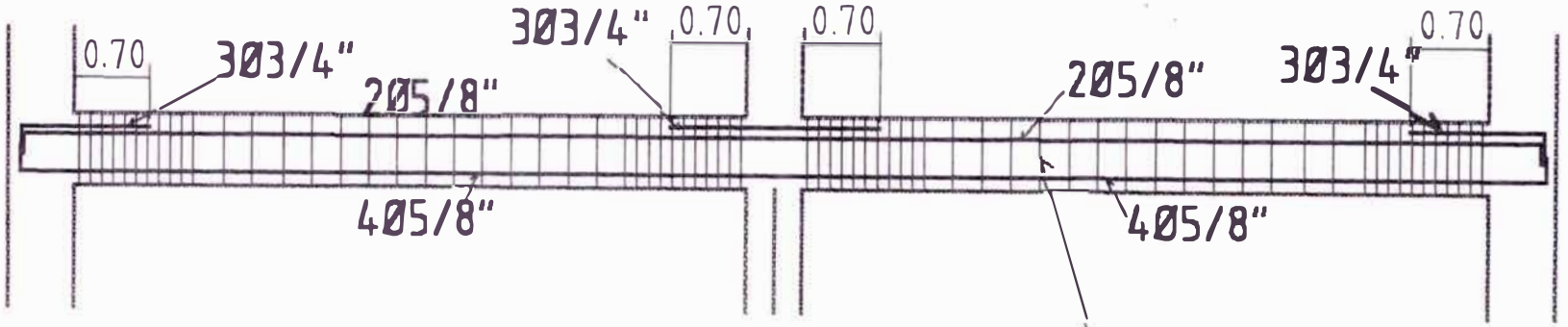
ACERO LONGITUDINAL DE VIGAS

PORTICOS 2 Y 3



ELEMENTO 20 Y 25

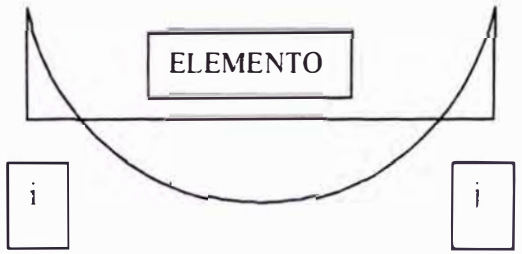
estribos Ø3/8":1@5,10@10.5,r@26



ELEMENTO 16 Y 21

estribos Ø3/8":1@5,10@10.5,r@26

Viga de pórtico	A azotea	A tipico
elemento	25	26
h cm	60	60
b cm	25	25
d cm	55	55
Mmax(+) tn-m	7.7	1.49
Mmax(-)i tn-m	9.14	3.18
Mmax(-)j tn-m	4.05	3.17
Analizando centro de la viga		
ρ balanceada	0.0213	0.0213
ρ maxima	0.0159	0.0159
ρ minima	0.0033	0.0033
a	2.5129	0.6776
ρ	0.0028<cuantia minima	0.0005<cuantia minima
As (cm2)	4.58 (4Ø1/2")	4.58 (4Ø1/2")
Analizando extremo i		
a	3.68	1.4588
As (cm2)	4.58 (4Ø1/2")	4.58 (4Ø1/2")
ρ	0.0033<cuantia minima	0.0011<cuantia minima
Analizando extremo j		
a	1.0165	1.4588
As (cm2)	4.58 (4Ø1/2")	4.58 (4Ø1/2")
ρ	0.0014<cuantia minima	0.0011<cuantia minima
longitud de desarrollo		
Ld en i	32*1.4=45 cm	32*1.4=45 cm
Ld en j	32*1.4=45 cm	32*1.4=45 cm



ESTRIBOS DE VIGAS

viga de pórtico 1-4 típico
elemento 16
wd=1.78 tn
wl=0.56 tn
d=0.55 m
w=3.68 tn/m
Vu=10.56 tn
Vc=(0.85*0.53*raiz(210))*30*55= 10.77 tn
Vc>Vu
Pero también Vu >0.5*Øvc
Av=3.5*bw*s/Fy
s=Av*Fy/(3.5*bw) = 57 cm
Según las Normas Peruanas de Estructuras:
S max=d/2 o´ 60 cm
Espaciamiento del refuerzo transversal en la zona de confinamiento
s<d/4, 8ØLmenor, 24Øestribo, 30 cm
24Øestribo (3/8") 22.86 cm
8ØLmenor (1/2") 10.16 cm
d/4 13.75 cm
s= 10.5 cm
2*d=2*55= 110 cm
Zona donde no requiere estribos de confinamiento:
s<d/2<27.5
(5m-0.3m-1.1m*2)/10=0.25 m
estribos1@5, 10@10.5, resto@25 cm

viga de pórtico 1-4 azotea
elemento 20
wd= 1.38 tn
wl= 0.34 tn
d= 0.55 m
w= 2.68 tn/m
Vu= 8.24 tn
Vc=(0.85*0.53*raiz(210))*30*55= 10.77 tn
Vc>Vu
distancia hasta donde se colocara estribos:
Pero tambien Vu >0.5*Øvc
Av=3.5*bw*s/Fy
s=Av*Fy/(3.5*bw) = 57 cm
Según las Normas Peruanas de Estructuras:
S max=d/2 o´ 60 cm
Espaciamiento del refuerzo transversal en la zona de confinamiento
s<d/4, 8ØLmenor, 24Øestribo, 30 cm
24Øestribo (3/8") 22.86 cm
8ØLmenor (1/2") 10.16 cm
d/4 13.75 cm
s= 10.5 cm
2*d=2*55= 110 cm

Zona donde no requiere estribos de confinamiento:
s<d/2<27.5
(5m-0.3m-1.1m*2)/10= 0.25 m
estribos1@5, 10@10.5, resto@25 cm

viga de pórtico 2-3 típico
elemento 16 y 21
wd= 3.13 tn
wl= 1.13 tn
d= 0.55 m
w= 6.73 tn/m
Vu= 21.02 tn
Vc=(0.85*0.53*raiz(210))*30*55= 10.77 tn
Vc<Vu
distancia hasta donde se colocara estribos:
xc=(Vu-Vc)/w
xc= 1.52 m
longitud estribada:x´=xc+d
x´= 2.07 m
Mínima separación de estribos
s=Ø*Av*Fy*d/(Vud-Vc)
Av=2*0.71= 1.42 cm2
Vud=Vu-wd= 17.32 tn
s=0.85*1.42*4200*55/((17.32-10.77)*1000)= 42.59 cm
La máxima separación de estribos
a).-con cuantía mínima:
Av=0.0015*bw*s
bw= 30 cm
1.42=0.0015*30*s ---------> s= 31.56 cm
b).-o´d/2= 27.50 cm <------ smax
Espaciamiento del refuerzo transversal en la zona de confinamiento
s<d/4, 8ØLmenor, 24Øestribo, 30 cm
24Øestribo (3/8")= 22.86 cm
8ØLmenor (5/8")= 12.72 cm
d/4= 13.75 cm
2*d=2*55= 110 cm
s= 10.5 cm
(6.7m-0.3m-0.25m-1.1m*2)/10= 0.26 m
estribos1@5, 10@10.5, resto@26 cm

viga de pórtico 2-3 5° piso
elemento 20 y 25
wd= 2.32 tn
wl= 0.68 tn
d= 0.55 m
w= 4.70 tn/m
Vu= 14.52 tn
Vc=(0.85*0.53*raiz(210))*30*55= 10.77 tn
Vc<Vu
distancia hasta donde se colocara estribos:
xc=(Vu-Vc)/w

xc= 0.80 m
longitud estribada:x´=xc+d
x´= 1.35 m
Mínima separación de estribos:
s=Ø*Av*Fy*d/(Vud-Vc)
Av=2*0.71= 1.42 cm2
Vud=Vu-wd= 11.93 tn
s=0.85*1.42*4200*55/((11.99-10.77)*1000) 240.15 cm
La máxima separación de estribos:
a).-con cuantía mínima:
Av=0.0015*bw*s
bw= 30 cm
1.42=0.0015*30*s ---------> s= 31.56 cm
b).-o´d/2= 27.50 cm <------ smax
27.50<42.59----->1@ 5 ,resto @27.50 cm
Espaciamiento del refuerzo transversal en la zona de confinamiento
s<d/4, 8ØLmenor, 24Øestribo, 30 cm

24Øestribo (3/8")= 22.86cm
8ØLmenor (5/8")= 12.72cm
d/4= 13.75cm
s= 10.5 cm
2*d=2*55= 110 cm

(6.7m-0.3m-0.25m-1.1m*2)/10= 0.26 m
estribos1@5, 10@10.5, resto@26 cm

viga de pórtico B típico
elemento 21
wd= 0.96 tn
wl= 0.25 tn
d= 0.55 m
w= 1.89 tn/m
Vu= 6.60 tn
Vc=(0.85*0.53*raiz(210))*25*55= 8.98 tn
Vc>Vu
distancia hasta donde se colocara estribos:
Pero también Vu >0.5*Øvc
Av=3.5*bw*s/Fy
s=Av*Fy/(3.5*bw) = 68 cm
Según las Normas Peruanas de Estructuras:
S max=d/2 o´ 60 cm
Según las Normas Peruanas de Estructuras:
S max=d/2 o´ 60 cm
Espaciamiento del refuerzo transversal en la zona de confinamiento
s<d/4, 8ØLmenor, 24Øestribo, 30 cm
Ø3/8" 1@ 0.05,27.5 cm
24Øestribo (3/8") 22.86cm
8ØLmenor (5/8") 12.72cm
d/4 13.75cm
s=(2*55-5)/9= 11.7 cm

2*d=2*55= 110 cm
(4.5m-0.175*2m-1.1m*2)/8= 0.24 m
estribos1@5, 9@11.7, resto@24 cm

viga de pórtico B típico
elemento 26
wd= 0.96 tn
wl= 0.25 tn
d= 0.55 m
w= 1.89 tn/m
Vu= 5.46 tn
Vc=(0.85*0.53*raiz(210))*25*55= 8.98 tn
Vc>Vu
distancia hasta donde se colocara estribos:
Pero tambien Vu >0.5*Øvc
Av=3.5*bw*s/Fy
s=Av*Fy/(3.5*bw) = 68 cm
Según las Normas Peruanas de Estructuras:
S max=d/2 o´ 60 cm
Espaciamiento del refuerzo transversal en la zona de confinamiento
s<d/4, 8ØLmenor, 24Øestribo, 30 cm
Ø3/8" 1@ 0.05,27.5 cm
24Øestribo (3/8") 22.86cm
8ØLmenor (1/2") 10.16cm
d/4 13.75cm
s=(2*55-5)/11= 9.5 cm
2*d=2*55= 110 cm
(4.5m-0.175*2m-1.1m*2)/8= 0.24 m
estribos1@5, 11@9.5, resto@24 cm

viga de pórtico B 5° piso
elemento 25
wd= 0.78 tn
wl= 0.15 tn
d= 0.55 m
w= 1.44 tn/m
Vu= 3.52 tn
Vc=(0.85*0.53*raiz(210))*25*55= 8.98 tn
Vc>Vu
Según las Normas Peruanas de Estructuras:
S max=d/2 o´ 60 cm
Espaciamiento del refuerzo transversal en la zona de confinamiento
s<d/4, 8ØLmenor, 24Øestribo, 30 cm
Ø3/8" 1@ 0.05,27.5 cm
24Øestribo (3/8") 22.86cm
8ØLmenor (5/8") 12.72cm
d/4 13.75cm
s=(2*55-5)/9= 11.7 cm
2*d=2*55= 110 cm
(4.475m-0.175*2m-1.1m*2)/8= 0.24 m
estribos1@5, 9@11.7, resto@24 cm

viga de pórtico B 5° piso
elemento 30
wd= 0.78 tn
wl=·0.15 tn
d= 0.55 m
w= 1.44 tn/m
Vu= 3.3 tn
Vc=(0.85*0.53*raiz(210))*25*55= 8.98 tn
Vc>Vu
Según las Normas Peruanas de Estructuras:
S max=d/2 o´ 60 cm
Espaciamiento del refuerzo transversal en la zona de confinamiento
s<d/4, 8ØLmenor, 24Øestribo, 30 cm
Ø3/8" 1@ 0.05,27.5 cm
24Øestribo (3/8") 22.86cm
8ØLmenor (1/2") 10.16cm
d/4 13.75cm
s=(2*55-5)/11= 9.5 cm
2*d=2*55= 110 cm
(4.5m-0.175*2m-1.1m*2)/8= 0.24 m
estribos1@5, 11@9.5, resto@24 cm

viga de pórtico A 1° piso
elemento 21
wd= 0.96 tn
wl= 0.25 tn
d= 0.55 m
w= 1.89 tn/m
Vu=7.72 tn
Vc=(0.85*0.53*raiz(210))*25*55= 8.98 tn
Vc>Vu
distancia hasta donde se colocara estribos:
Pero tambien Vu >0.5*Øvc
Av=3.5*bw*s/Fy
s=Av*Fy/(3.5*bw) = 68 cm
Según las Normas Peruanas de Estructuras:
S max=d/2 o´ 60 cm ----> 1Ø3/8" @ 27.5 cm
Según las Normas Peruanas de Estructuras:
S max=d/2 o´ 60 cm
Espaciamiento del refuerzo transversal en la zona de confinamiento
s<d/4, 8ØLmenor, 24Øestribo, 30 cm
Ø3/8" 1@ 0.05,27.5 cm
24Øestribo (3/8") 22.86cm
8ØLmenor (1/2") 10.16cm
d/4 13.75cm
s=(2*55-5)/11= 9.5 cm
2*d=2*55= 110 cm
(2.65m-0.175m-1.1m*2)/2= 0.14 m
estribos1@5, 11@9.5, 1@14 cm

viga de pórtico A 5° piso
elemento 25
wd= 0.78 tn
wl= 0.15 tn
d= 0.55 m
w= 1.44 tn/m
Vu=6.77 tn
Vc=(0.85*0.53*raiz(210))*25*55= 8.98 tn
Vc>Vu
distancia hasta donde se colocara estribos:
Pero tambien Vu >0.5*Øvc
Av=3.5*bw*s/Fy
s=Av*Fy/(3.5*bw) = 68 cm
Según las Normas Peruanas de Estructuras:
S max=d/2 o´ 60 cm
Espaciamiento del refuerzo transversal en la zona de confinamiento
s<d/4, 8ØLmenor, 24Øestribo, 30 cm
Ø3/8" 1@ 0.05,27.5 cm
24Øestribo (3/8") 22.86cm
8ØLmenor (1/2") 10.16cm
d/4 13.75cm
s=(2*55-5)/11= 9.5 cm
2*d=2*55= 110 cm
(4.5m-0.175*2m-1.1m*2)/8= 0.14 m
estribos1@5, 11@9.5, 1@14 cm

viga de pórtico A 1° piso
elemento 26
wd= 0.96 tn
wl= 0.25 tn
d= 0.55 m
w= 1.89 tn/m
Vu=3.32 tn
Vc=(0.85*0.53*raiz(210))*25*55= 8.98 tn
Vc>Vu
Según las Normas Peruanas de Estructuras:
S max=d/2 o´ 60 cm
Espaciamiento del refuerzo transversal en la zona de confinamiento
s<d/4, 8ØLmenor, 24Øestribo, 30 cm
Ø3/8" 1@ 0.05,27.5 cm
24Øestribo (3/8") 22.86cm
8ØLmenor (1/2") 10.16cm
d/4 13.75cm
s=(2*55-5)/11= 9.5 cm
2*d=2*55= 110 cm
(4.5m-0.175*2m-1.1m*2)/8= 0.24 m
estribos1@5, 11@9.5, resto@24 cm

V.4.- DISEÑO DE COLUMNAS

Verificando esbeltez en columnas:

Placa P1:

Portico 1,4

ln=3.30 m

Ig= 0.1876

Iv=0.5*0.3*0.6^3/12= 0.0027

Gb= 1

Ga=(Ig/3.6+Ig/3)/(Iv/6)= 254.77

Gm=(Gb+Ga)/2= 127.88

K= 0.88

ry=0.3*2.00= 0.6

K*ln/r= 4.81 < 22

Portico A

ln= 3.30 m

Ig= 0.1876

Iv= 0.00225

Gb= 1

Ga= 185.98

Gm= 93.49

K= 0.88

rx=0.3*2.00= 0.6

K*ln/r= 4.81 < 22

Resumen de la verificación de esbeltez en las columnas restantes:

	Columna C2:	Columna C3:	Columna C4:
	Pórtico 2,3	Pórtico 1,4	Pórtico 2,3
ln=	3.3m	3.3m	3.3m
Ig=	0.006	0.0063	0.0036
Iv=	0.003	0.0027	0.0027
Gb=	1.000	1	1
Ga=	9.554	3.56	2.76
Gm=	5.27>2	2.28>2	1.88<2
K=	2.255	1.63	0.84
ry=0.3*0.60	0.180	0.18	0.15
K*ln/r=	41.34>22	29.89>22	18 49<22
Portico A		Pórtico B	Pórtico B
ln=	3.3m	3.3m	3.3m
Ig=	0.002	0.0021	0.0018
Iv=	0.002	0.00225	0.00225
Gb=	1.000	1	1
Ga=	1.063	2.61	1.08
Gm=	1.03<2	1.8<2	1.04<2
K=	0.927	0.85	0.925
rx=0.3*0.35	0.105	0.105	0.105
K*ln/r=	29.12>22 corrección por esbeltez	26.69>22 corrección por esbeltez	29.09>22 corrección por esbeltez

El acero longitudinal de columnas se diseño utilizando el programa PCACOL

COLUMNA 2

PCACOL(tm)V2.30 Proprietary Software of Portland Cement ASSN

General Information:

```
File Name:  C:\PRELIM~1\COLUMNAS\C2P1EA-3.COL
Project:    EDIFICIO DE 5 PISOS      Code: ACI 318-89
Column:     COLUMNA C2               Units: SI Metric
Engineer:   VICTOR SOLANO            Date: 20/12/00
Run Option: Investigation            Slender column
Run Axis:   Biaxial                  Column Type: Structural
```

Material Properties:

```
f'c   = 21 MPa                       fy   = 420 MPa
Ec    = 22000 MPa                    Es   = 200000 MPa
fc    = 17.85 MPa                    erup = 0 mm/mm
eu    = 0.003 mm/mm
Stress Profile: Block                Beta1 = 0.85
```

Geometry:

```
Rectangular: Width = 350 mm          Depth = 600 mm

Gross section area, Ag =  210000 mm^2
Ix =  6.3e+009 mm^4                  Xo =  0 mm
Iy =  2.14375e+009 mm^4              Yo =  0 mm
```

Reinforcement:

```
Rebar Database: User-defined
Size     Diam    Area  Size     Diam    Area  Size     Diam    Area
-------------------------------------------------------------------
   3       10      71     4       13     127     5       16     200
   6       16     287     8       25     507    10       32     794
  12       38    1140
```

```
Confinement: Tied; phi(c) = 0.7,  phi(b) = 0.9,  a = 0.8
N-3 ties with N-4 bars, N-4 with larger bars.

Layout: Rectangular
Pattern: Sides Different  [Cover to longitudinal reinforcement]

Total steel area, As = 2400 mm^2 at 1.14%
```

	Top	Bottom	Left	Right
Bars	4 N- 5	4 N- 5	2 N- 5	2 N- 5
Cover(mm)	40	40	40	40

Slenderness:

Sway Criteria:

X-axis: Braced against sidesway -- Not hinged at either end.
Y-axis: Braced against sidesway -- Not hinged at either end.

Columns:

Col.	Axis	Height (m)	Width (mm)	Depth (mm)	I (mm^4)	f'c (MPa)	Ec (MPa)
Design	X	3.3	350	600	6.3e+009	21	22000
	Y	3.3			2.14375e+009		
Above	X	3	350	600	6.3e+009	21	22000
	Y	3			2.14375e+009		
Below	X	3.6	350	600	6.3e+009	21	22000
	Y	3.6			2.14375e+009		

Beams:

X-Beams Location	Length (m)	Width (mm)	Depth (mm)	I (mm^4)	f'c (MPa)	Ec (MPa)
Above Left	2.65	250	600	4.5e+009	21	22000
Above Right	4.5	250	600	4.5e+009	21	22000
Below Left	(NO BEAM SPECIFIED...)					
Below Right	(NO BEAM SPECIFIED...)					

Y-Beams Location	Length (m)	Width (mm)	Depth (mm)	I (mm^4)	f'c (MPa)	Ec (MPa)
Above Left	(NO BEAM SPECIFIED...)					
Above Right	6.7	300	600	5.4e+009	21	22000
Below Left	(NO BEAM SPECIFIED...)					
Below Right	(NO BEAM SPECIFIED...)					

Effective Length Factors:

Axis	Psi(top)	Psi(bot)	k(Braced)	k(Sway)	klu/r
X	1.486	0.000	0.774	N/A	14.8
Y	1.693	0.000	0.785	N/A	25.6

Moment Magnification Factors:

Beta(d) load case factors: Dead = 1.5, Live = 1.8
Strength reduction factor = 0.7

Load Comb	Pc (kN)	Betad	EI (kN-mm^2)	Cm	Delta	Pc (kN)	EI (kN-mm^2)	Delta
	---------- Braced (X-axis) ----------					---- Sway (X-axis)----		
1 U1	41130	0.807	2.72e+010	0.000	0.000	* * Not Applicable * *		
U2				0.000	0.000	* * Not Applicable * *		
U3				0.000	0.000	* * Not Applicable * *		
U4				0.000	0.000	* * Not Applicable * *		
	---------- Braced (Y-axis) ----------					---- Sway (Y-axis)----		
1 U1	12123	0.807	8.24e+009	0.000	0.000	* * Not Applicable * *		
U2				0.000	0.000	* * Not Applicable * *		
U3				0.000	0.000	* * Not Applicable * *		
U4				0.000	0.000	* * Not Applicable * *		

NOTE: A Delta of 0.00 denotes slenderness need not be considered.

Load Combinations:

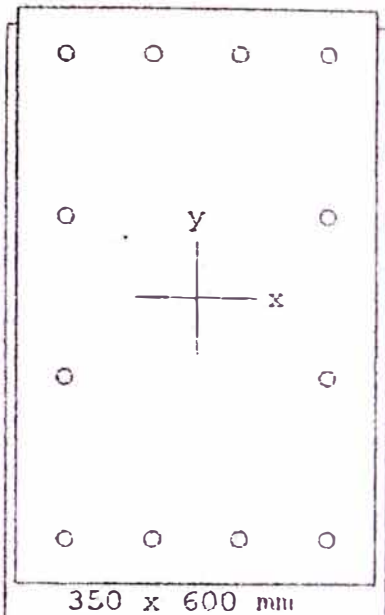
U1 = 1.400*Dead + 1.700*Live + 0.000*Lateral
U2 = 1.050*Dead + 1.275*Live + 1.275*Lateral
U3 = 1.050*Dead + 0.000*Live + 1.275*Lateral
U4 = 0.900*Dead + 0.000*Live + 1.300*Lateral

Service Loads:

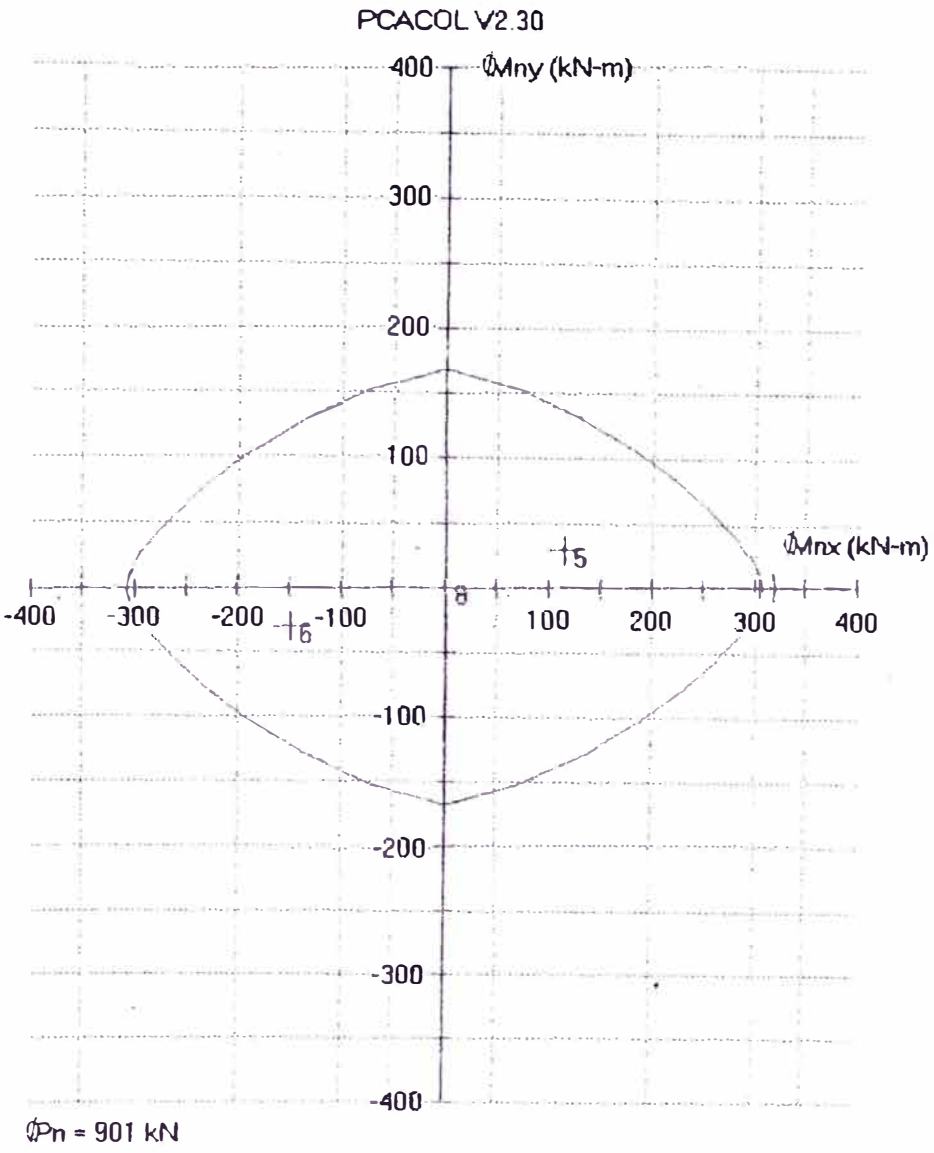
Load	Axial Load (kN)	Moments about X-axis @ Top (kN-m)	Moments about X-axis @ Bot (kN-m)	Moments about Y-axis @ Top (kN-m)	Moments about Y-axis @ Bot (kN-m)
1 Dead	499.8	43.2	21.5	2.5	1.3
Live	99.3	18.4	6.5	0.3	0.1
Latl	195.5	36.5	93	21.4	22.9

NOTE: Each loading combination includes the following cases:
First line - moment at column top.
Second line - moment at column bottom.
Third line - moment due to minimum X-Eccentricity.
Fourth line - moment due to minimum Y-Eccentricity.

		Applied Loads			Computed Strength			Computed/
Pt.	Load Comb	P (kN)	Mx (kN-m)	My (kN-m)	P (kN)	Mx (kN-m)	My (kN-m)	Applied Ray length
1	1 U1	869	92	4	2148	234	10	2.474
2			-41	-2	2640	-128	-6	3.040
3			0	0	2640	-0	-0	3.039
4			0	0	2640	-0	-0	3.039
5	1 U2	901	115	30	1756	234	62	1.951
6			-149	-31	1501	-259	-53	1.669
7			0	0	2640	-0	-0	2.931
8			0	0	2640	-0	-0	2.931
9	1 U3	774	92	30	1770	220	72	2.289
10			-141	-31	1418	-259	-56	1.832
11			0	0	2640	-0	-0	3.410
12			0	0	2640	-0	-0	3.410
13	1 U4	704	86	30	1728	218	76	2.456
14			-140	-31	1305	-261	-58	1.854
15			0	0	2640	-0	-0	3.750
16			0	0	2640	-0	-0	3.750



350 x 600 mm



f'c = 21 MPa

fy = 420 MPa

Confinement: Tied

clr cover = 40 mm

spacing = 69 mm

12 N-5 at 1.14%

As = 2400 mm^2

Ix = 6.300e+009 mm^4

Iy = 2.144e+009 mm^4

Xo = 0 mm

Yo = 0 mm

Licensed To: Licensee name not yet specified.

File name: C:\PRELIM~1\COLUMNAS\C2P1EA~3.COL

Project: EDIFICIO DE 5 PISOS

Column Id: COLUMNA C2

Engineer: VICTOR SOLANO

Date: 20/12/00 Time: 00:50:43

Code: ACI 318-89

Units: Metric

Material Properties:

Ec = 22000 MPa eu = 0.003 mm/mm

fc = 17.85 MPa Es = 200000 MPa

Beta1 = 0.85

Stress Profile: Block

phi(c) = 0.70, phi(b) = 0.90

X-axis slenderness is considered; k(b) = 0.77 k(s) = 1.27

Y-axis slenderness is considered; k(b) = 0.78 k(s) = 1.30

COLUMNA 3

PCACOL(tm)V2.30 Proprietary Software of Portland Cement ASSN.

General Information:

```
File Name:  C:\PRELIM~1\COLUMNAS\C3P1EA-B.COL
Project:    EDIFICIO DE 5 PISOS      Code: ACI 318-89
Column:     COLUMNA C3               Units: SI Metric
Engineer:   VICTOR SOLANO
Run Option: Investigation            Slender column
Run Axis:   Biaxial                  Column Type: Structural
```

Material Properties:

```
f'c   = 21 MPa                       fy   = 420 MPa
Ec    = 22000 MPa                    Es   = 200000 MPa
fc    = 17.85 MPa                    erup = 0 mm/mm
eu    = 0.003 mm/mm
Stress Profile: Block                Betal = 0.85
```

Geometry:

```
Rectangular: Width = 350 mm          Depth = 600 mm

Gross section area, Ag =  210000 mm^2
Ix =  6.3e+009 mm^4                  Xo =  0 mm
Iy =  2.14375e+009 mm^4              Yo =  0 mm
```

Reinforcement:

```
Rebar Database: User-defined
Size     Diam    Area  Size     Diam    Area  Size     Diam    Area
-------------------------------------------------------------------
   3       10      71     4       13     127     5       16     200
   6       16     287     8       25     507    10       32     794
  12       38    1140
```

```
Confinement: Tied; phi(c) = 0.7,  phi(b) = 0.9,  a = 0.8
N-3 ties with N-4 bars, N-4 with larger bars.

Layout: Rectangular
Pattern: Sides Different  [Cover to longitudinal reinforcement]

Total steel area, As = 2400 mm^2 at 1.14%
```

	Top	Bottom	Left	Right
Bars	4 N- 5	4 N- 5	2 N- 5	2 N- 5
Cover(mm)	40	40	40	40

Slenderness:

Sway Criteria:

X-axis: Braced against sidesway -- Not hinged at either end.
Y-axis: Braced against sidesway -- Not hinged at either end.

Columns:

Col.	Axis	Height (m)	Width (mm)	Depth (mm)	I (mm^4)	f'c (MPa)	Ec (MPa)
Design	X	3.3	350	600	6.3e+009	21	22000
	Y	3.3			2.14375e+009		
Above	X	3	350	600	6.3e+009	21	22000
	Y	3			2.14375e+009		
Below	X	3.6	350	600	6.3e+009	21	22000
	Y	3.6			2.14375e+009		

Beams:

X-Beams Location	Length (m)	Width (mm)	Depth (mm)	I (mm^4)	f'c (MPa)	Ec (MPa)
Above Left	4.475	250	600	4.5e+009	21	22000
Above Right	(NO BEAM SPECIFIED...)					
Below Left	(NO BEAM SPECIFIED...)					
Below Right	(NO BEAM SPECIFIED...)					

Y-Beams Location	Length (m)	Width (mm)	Depth (mm)	I (mm^4)	f'c (MPa)	Ec (MPa)
Above Left	5	300	600	5.4e+009	21	22000
Above Right	5	300	600	5.4e+009	21	22000
Below Left	(NO BEAM SPECIFIED...)					
Below Right	(NO BEAM SPECIFIED...)					

Effective Length Factors:

Axis	Psi(top)	Psi(bot)	k(Braced)	k(Sway)	klu/r
X	3.987	0.000	0.850	N/A	16.2
Y	0.632	0.000	0.732	N/A	23.9

Moment Magnification Factors:

Beta(d) load case factors: Dead = 1.5, Live = 1.8
Strength reduction factor = 0.7

Load Comb	Braced (X-axis) Pc (kN)	Betad	EI (kN-mm^2)	Cm	Delta	Sway (X-axis) Pc (kN)	EI (kN-mm^2)	Delta
1 U1	33422	0.846	2.66e+010	0.000	0.000	* * Not Applicable * *		
U2				0.000	0.000	* * Not Applicable * *		
U3				0.000	0.000	* * Not Applicable * *		
U4				0.000	0.000	* * Not Applicable * *		

Load Comb	Braced (Y-axis) Pc (kN)	Betad	EI (kN-mm^2)	Cm	Delta	Sway (Y-axis) Pc (kN)	EI (kN-mm^2)	Delta
1 U1	13656	0.846	8.06e+009	0.000	0.000	* * Not Applicable * *		
U2				0.000	0.000	* * Not Applicable * *		
U3				0.000	0.000	* * Not Applicable * *		
U4				0.000	0.000	* * Not Applicable * *		

NOTE: A Delta of 0.00 denotes slenderness need not be considered.

Load Combinations:

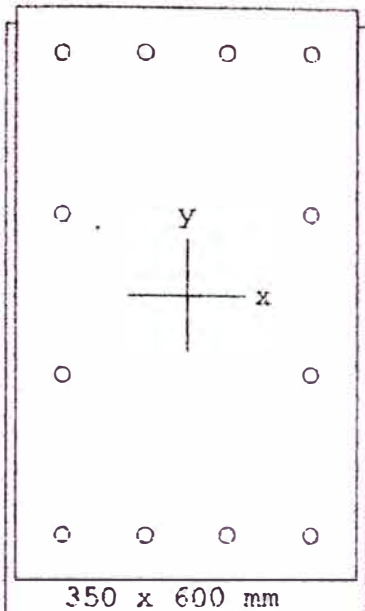
U1 = 1.400*Dead + 1.700*Live + 0.000*Lateral
U2 = 1.050*Dead + 1.275*Live + 1.275*Lateral
U3 = 1.050*Dead + 0.000*Live + 1.275*Lateral
U4 = 0.900*Dead + 0.000*Live + 1.300*Lateral

Service Loads:

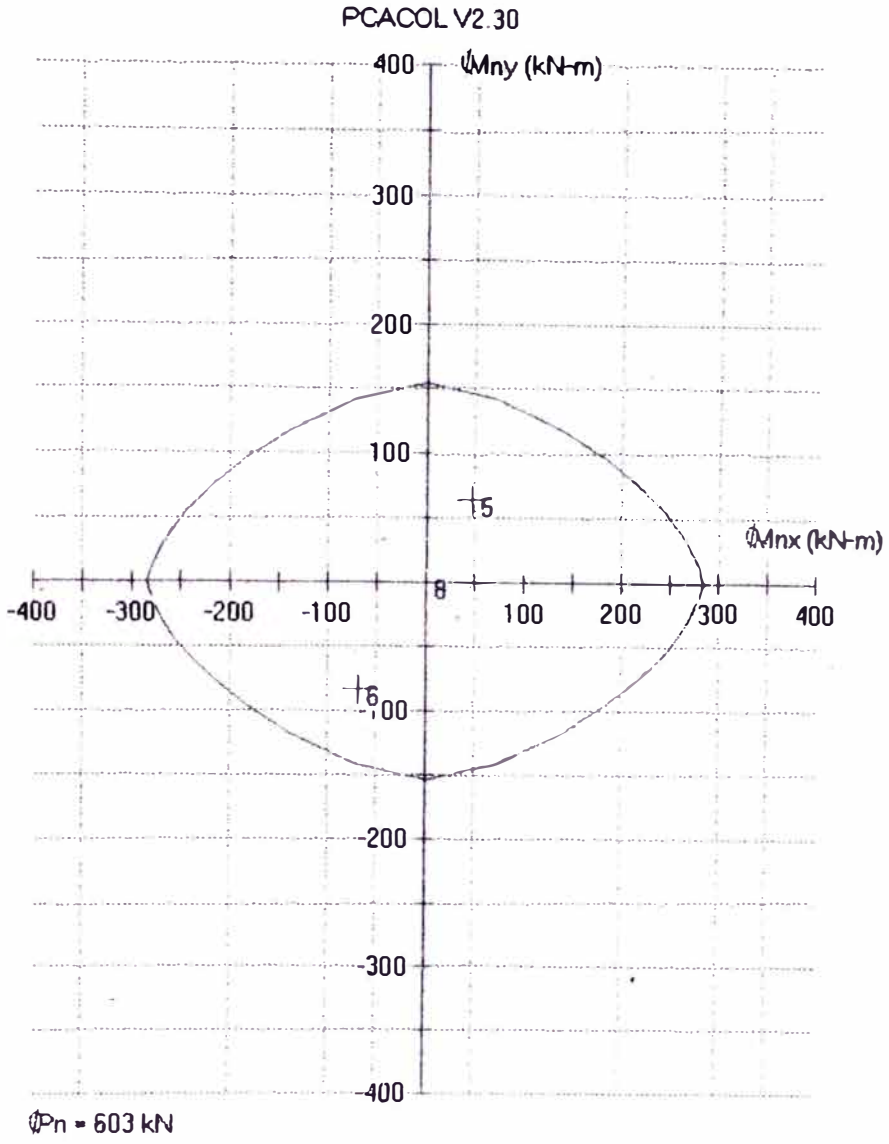
Load	Axial Load (kN)	Moments about X-axis @ Top (kN-m)	@ Bot (kN-m)	Moments about Y-axis @ Top (kN-m)	@ Bot (kN-m)
1 Dead	393.5	0	0	4.6	2.3
Live	59.8	4.4	2.3	1.5	0.8
Latl	89.4	32.7	51	45	62.5

NOTE: Each loading combination includes the following cases:
First line - moment at column top.
Second line - moment at column bottom.
Third line - moment due to minimum X-Eccentricity.
Fourth line - moment due to minimum Y-Eccentricity.

		Applied Loads			Computed Strength			Computed/
	Load	P	Mx	My	P	Mx	My	Applied
Pt.	Comb	(kN)	(kN-m)	(kN-m)	(kN)	(kN-m)	(kN-m)	Ray length
1	1 U1	653	7	9	2640	29	35	4.045
2			-4	-5	2640	-15	-18	4.045
3			0	0	2640	-0	-0	4.045
4			0	0	2640	-0	-0	4.045
5	1 U2	603	47	64	1330	104	142	2.204
6			-68	-83	1001	-114	-139	1.659
7			0	0	2640	-0	-0	4.375
8			0	0	2640	-0	-0	4.375
9	1 U3	527	42	62	1226	98	145	2.327
10			-65	-82	883	-110	-139	1.676
11			0	0	2640	-0	-0	5.007
12			0	0	2640	-0	-0	5.007
13	1 U4	470	43	63	1080	99	146	2.298
14			-66	-83	762	-109	-137	1.620
15			0	0	2640	-0	-0	5.612
16			0	0	2640	-0	-0	5.612



350 x 600 mm



f'c = 21 MPa

fy = 420 MPa

Confinement: Tied

clr cover = 40 mm

spacing = 69 mm

12 N-5 at 1.14%

As = 2400 mm^2

Ix = 6.300e+009 mm^4

Iy = 2.144e+009 mm^4

X● = 0 mm

Y● = 0 mm

Licensed To: Licensee name not yet specified.

File name: C:\PRELIM-1\COLUMNAS\C3P1EA-B.COL

Project: EDIFICIO DE 5 PISOS

Column Id: COLUMNA C3

Engineer: VICTOR SOLANO

Date: 20/01/01 Time: 00:50:43

Code: ACI 318-89

Units: Metric

Material Properties:

Ec = 22000 MPa eu = 0.003 mm/mm

fc = 17.85 MPa Es = 200000 MPa

Beta1 = 0.85

Stress Profile: Block

phi(c) = 0.70, phi(b) = 0.90

X-axis slenderness is considered; k(b) = 0.85 k(s) = 1.56

Y-axis slenderness is considered; k(b) = 0.73 k(s) = 1.13

COLUMNA 4

General Information:

```
File Name:  C:\PRELIM~1\COLUMNAS\C4ESBEL.COL
Project:    EDIFICIO DE 5 PISOS      Code: ACI 318-89
Column:     COLUMNA C4               Units: SI Metric
Engineer:   VICTOR SOLANO
Run Option: Investigation            Slender column
Run Axis:   Biaxial                  Column Type: Structural
```

Material Properties:

```
f'c   = 21 MPa                       fy   = 420 MPa
Ec    = 22000 MPa                    Es   = 200000 MPa
fc    = 17.85 MPa                    ɛrup = 0 mm/mm
eu    = 0.003 mm/mm
Stress Profile: Block                Betal. = 0.85
```

Geometry:

```
Rectangular: Width = 350 mm          Depth = 500 mm

Gross section area, Ag =  175000 mm^2
Ix =  3.64583e+009 mm^4              Xo =  0 mm
Iy =  1.78646e+009 mm^4              Yo =  0 mm
```

Reinforcement:

```
Rebar Database: User-defined
```

Size	Diam	Area	Size	Diam	Area	Size	Diam	Area
3	10	71	4	13	127	5	16	200
6	16	287	8	25	507	10	32	794
12	38	1140						

```
Confinement: Tied; phi(c) = 0.7,  phi(b) = 0.9,  a = 0.8
N-3 ties with N-4 bars, N-4 with larger bars.

Layout: Rectangular
Pattern: Sides Different  [Cover to longitudinal reinforcement]

Total steel area, As = 2400 mm^2 at 1.37%
```

	Top	Bottom	Left	Right
Bars	4 N- 5	4 N- 5	2 N- 5	2 N- 5
Cover(mm)	40	40	40	40

Slenderness:

Sway Criteria:

X-axis: Braced against sidesway -- Not hinged at either end.
Y-axis: Braced against sidesway -- Not hinged at either end.

Columns:

Col.	Axis	Height (m)	Width (mm)	Depth (mm)	I (mm^4)	f'c (MPa)	Ec (MPa)
Design	X	3.3	350	500	3.64583e+009	21	22000
	Y	3.3			1.78646e+009		
Above	X	3	350	500	3.64583e+009	21	22000
	Y	3			1.78646e+009		
Below	X	3.6	350	500	3.64583e+009	21	22000
	Y	3.6			1.78646e+009		

Beams:

X-Beams Location	Length (m)	Width (mm)	Depth (mm)	I (mm^4)	f'c (MPa)	Ec (MPa)
Above Left	4.475	2500	600	4.5e+010	21	22000
Above Right	4.5	2500	600	4.5e+010	21	22000
Below Left	(NO BEAM SPECIFIED...)					
Below Right	(NO BEAM SPECIFIED...)					

Y-Beams Location	Length (m)	Width (mm)	Depth (mm)	I (mm^4)	f'c (MPa)	Ec (MPa)
Above Left	6.7	300	600	5.4e+009	21	22000
Above Right	6.7	300	600	5.4e+009	21	22000
Below Left	(NO BEAM SPECIFIED...)					
Below Right	(NO BEAM SPECIFIED...)					

Effective Length Factors:

Axis	Psi(top)	Psi(bot)	k(Braced)	k(Sway)	klu/r
X	0.116	0.000	0.706	N/A	16.1
Y	0.705	0.000	0.735	N/A	24.0

Moment Magnification Factors:

Beta(d) load case factors: Dead = 1.5, Live = 1.8
Strength reduction factor = 0.7

Load Comb	Braced (X-axis) Pc (kN)	Betad	EI (kN-mm^2)	Cm	Delta	Sway (X-axis) Pc (kN)	EI (kN-mm^2)	Delta
1 U1	29718	0.826	1.63e+010	0.000	0.000	* * Not Applicable * *		
U2				0.000	0.000	* * Not Applicable * *		
U3				0.000	0.000	* * Not Applicable * *		
U4				0.000	0.000	* * Not Applicable * *		

Load Comb	Braced (Y-axis) Pc (kN)	Betad	EI (kN-mm^2)	Cm	Delta	Sway (Y-axis) Pc (kN)	EI (kN-mm^2)	Delta
1 U1	12220	0.826	7.29e+009	0.000	0.000	* * Not Applicable * *		
U2				0.000	0.000	* * Not Applicable * *		
U3				0.000	0.000	* * Not Applicable * *		
U4				0.000	0.000	* * Not Applicable * *		

NOTE: A Delta of 0.00 denotes slenderness need not be considered.

Load Combinations:

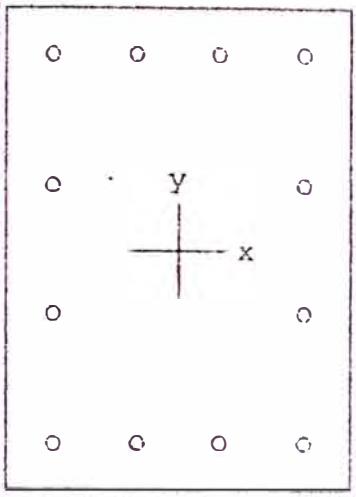
U1 = 1.400*Dead + 1.700*Live + 0.000*Lateral
U2 = 1.050*Dead + 1.275*Live + 1.275*Lateral
U3 = 1.050*Dead + 0.000*Live + 1.275*Lateral
U4 = 0.900*Dead + 0.000*Live + 1.300*Lateral

Service Loads:

Load	Axial Load (kN)	Moments about X-axis @ Top (kN-m)	Moments about X-axis @ Bot (kN-m)	Moments about Y-axis @ Top (kN-m)	Moments about Y-axis @ Bot (kN-m)
1 Dead	988.9	0	0	0.03	0.004
Live	173.2	17.1	9.5	1.1	0.5
Latl	19.6	48.3	67.1	52.9	60

NOTE: Each loading combination includes the following cases:
First line - moment at column top.
Second line - moment at column bottom.
Third line - moment due to minimum X-Eccentricity.
Fourth line - moment due to minimum Y-Eccentricity.

		Applied Loads			Computed Strength			Computed/
Pt.	Load Comb	P (kN)	Mx (kN-m)	My (kN-m)	P (kN)	Mx (kN-m)	My (kN-m)	Applied Ray length
1	1 U1	1679	29	2	2290	39	3	1.364
2			-16	-1	2290	-22	-1	1.364
3			0	0	2290	-0	-0	1.364
4			0	0	2290	-0	-0	1.364
5	1 U2	1284	83	69	1647	109	91	1.283
6			-98	-77	1501	-117	-93	1.169
7			0	0	2290	-0	-0	1.783
8			0	0	2290	-0	-0	1.783
9	1 U3	1063	62	67	1584	93	102	1.490
10			-86	-77	1381	-112	-100	1.299
11			0	0	2290	-0	-0	2.153
12			0	0	2290	-0	-0	2.153
13	1 U4	915	63	69	1419	98	107	1.550
14			-87	-78	1164	-116	-104	1.273
15			0	0	2290	-0	-0	2.501
16			0	0	2290	-0	-0	2.501



350 x 500 mm

f'c = 21 MPa

fy = 420 MPa

Confinement: Tied

clr cover = 40 mm

spacing = 69 mm

12 N-5 at 1.37%

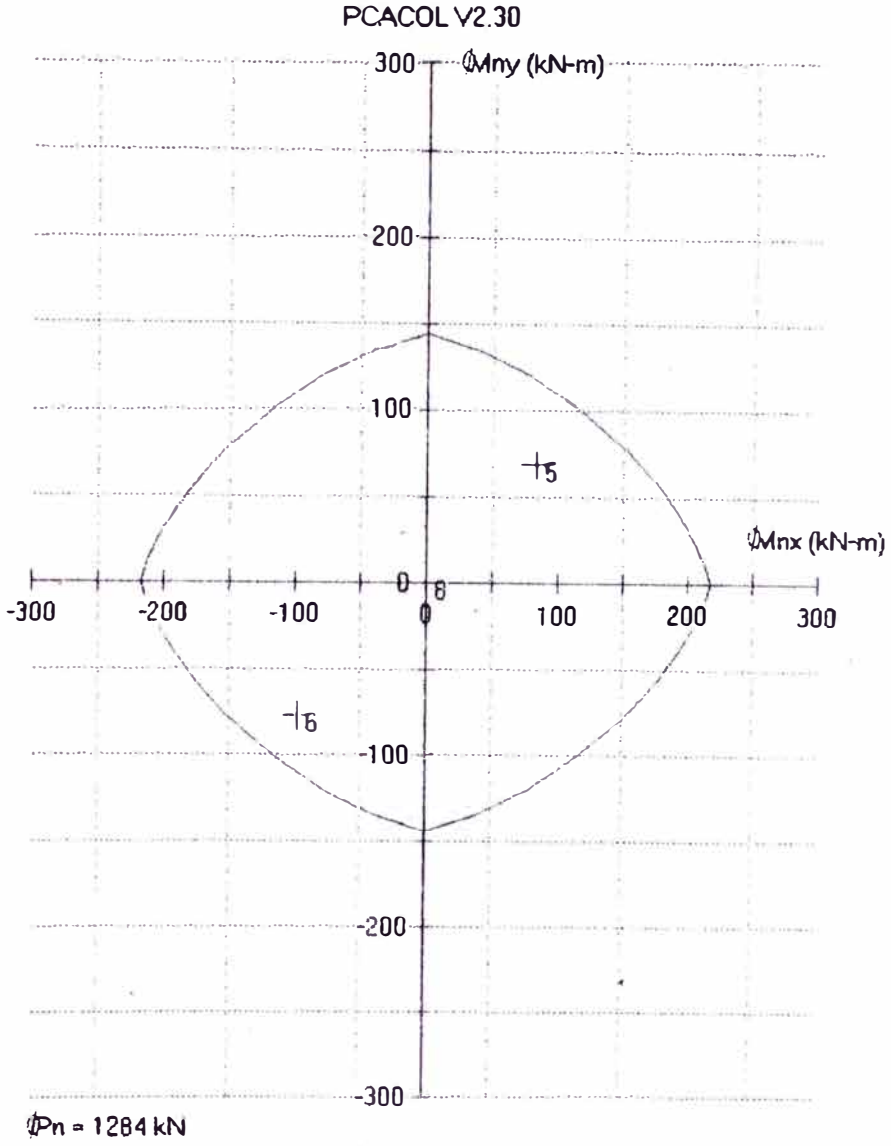
As = 2400 mm^2

Ix = 3.646e+009 mm^4

Iy = 1.786e+009 mm^4

Xo = 0 mm

Yo = 0 mm



Licensed To: Licensee name not yet specified.

File name: C:\PRELIM~1\COLUMNAS\C4ESBEL.COL

Project: EDIFICIO DE 5 PISOS

Column Id: COLUMNA C4

Engineer: VICTOR SOLANO

Date: 20/01/01 Time: 00:50:43

Code: ACI 318-89

Units: Metric

Material Properties:

Ec = 22000 MPa eu = 0.003 mm/mm

fc = 17.85 MPa Es = 200000 MPa

Beta1 = 0.85

Stress Profile: Block

phi(c) = 0.70, phi(b) = 0.90

X-axis slenderness is considered; k(b) = 0.71 k(s) = 1.03

Y-axis slenderness is considered; k(b) = 0.74 k(s) = 1.14

PLACA1

PCACOL(tm)V2.30 Proprietary Software of Portland Cement ASSN.

General Information:

```
File Name:  C:\PRELIM~1\COLUMNAS\P1P1E4-A.COL
Project:    INVESTIGACION          Code: ACI 318-89
Column:     PLACA1                 Units: SI Metric
Engineer:   VICTOR SOLANO
Run Option: Investigation          Short (nonslender) column
Run Axis:   X-axis                 Column Type: Structural
```

Material Properties:

```
f'c    = 21 MPa                    fy    = 420 MPa
Ec     = 22000 MPa                 Es    = 2*10^5 MPa
fc     = 17.85 MPa                 erup  = 0 mm/mm
eu     = 0.003 mm/mm
Stress Profile: Block              Beta1 = 0.85
```

Geometry:

```
Rectangular: Width = 200 mm        Depth = 2241.1 mm

Gross section area, Ag =  448220 mm^2
Ix =  1.876e+011 mm^4              Xo =  0 mm
Iy =  1.49407e+009 mm^4            Yo =  0 mm
```

Reinforcement:

```
Rebar Database: User-defined
```

Size	Diam	Area	Size	Diam	Area	Size	Diam	Area
3	10	71	4	13	127	15	16	200
20	20	300	25	25	500	30	30	700
35	36	1000	45	44	1500	55	56	2500

```
Confinement: Tied; phi(c) = 0.7,  phi(b) = 0.9,  a = 0.8
N-3 ties with N-4 bars, N-4 with larger bars.

Layout: Rectangular
Pattern: Equal Bar Spacing  [Cover to longitudinal reinforcement]

Total steel area, As = 4572 mm^2 at 1.02%

36N-4   Cover = 40 mm
```

Pt.	Applied Loads P (kN)	Applied Loads Mx (kN-m)	Computed Strength P (kN)	Computed Strength Mx (kN-m)	Computed/ Applied Ray length
1	617	1050	1088	1871	1.777

ESTRIBOS EN COLUMNAS

Columna C2

Pu= 92.848 tn
Ag (35x60)= 2100 cm2
Ac (51.04x26.04)= 1329.08 cm2
b= 0.35 m
t= 0.6 m
H= 3.3 m
Verificación por cortante:
Vc=0.53*(1+0.0071*Pu/Ag)*raiz(210)*b*d
d=60-4-1.59-0.96= 53.45
Vc= 14.82 tn
Vu= 3.14 tn
Vn=Vu/Ø= 3.69 tn
Vc>Vn por lo tanto el concreto toma todo el corte
0.1*f'c*Ag= 44.1 tn
Pu > 0.1*f'c*Ag
Diseño del refuerzo transversal:
hc=60-2*(4+0.96/2)= 51.04 cm
hc2=35-2*(4+0.96/2)= 26.04 cm
hx=hc/2= 25.52 cm
a)diseño por confinamiento:
Calculo de la longitud de confinamiento:

l0= { t= 0.6 m ; H/6=3.30/6= 0.55 m ; 0.45= 0.45 } m

Por lo tanto l0= 60 cm
Calculo del espaciamiento (s) dentro de la zona de confinamiento:

{ b/2= 0.18 m ; 0.1= 0.10 m }

Por lo tanto s= 10 cm
Refuerzo transversal en la columna:
Se requiere una cuantía que sea mayor entre las siguientes:
cuantía 0.013
0.006

Por lo tanto cuantía = 0.013

Ash = 0.71 cm2
hc=51.04/2= 26 cm
s=1.5*2*0.71/(26*0.013)= 6.30 cm
s=1.5*2*1.27/(26*0.013)= 11.27 cm
usar Ø 3/8" 1@ 0.05, 9 @ 0.06 en la zona de confinamiento
Espaciamiento fuera de la zona de confinamiento:

{ 16db= 25.44 cm ; b= 35 cm ; 30 cm= 30 cm }

Por lo tanto s= 23 cm
Espaciamiento dentro del nudo : 15 cm

usar estribos de Ø 3/8" 1@ 0.05, 9 @ 0.06, r @0.23

Columna C3
Pu= 69.784 tn
Ag (35x60)= 2100 cm2
Ac (51.04x26.04)= 1329.08 cm2
b= 0.35 m
t= 0.6 m
H= 3.3 m
Verificación por cortante:
Vc=0.53*(1+0.0071*Pu/Ag)*raiz(210)*b*d
d=60-4-1.59-0.96= 53.45
Vc= 14.71 tn
Vu= 7.61 tn
Vn=Vu/Ø= 8.95 tn
Vc>Vn por lo tanto el concreto toma todo el corte
0.1*f'c*Ag= 44.1 tn
Pu > 0.1*f'c*Ag
Diseño del refuerzo transversal:
hc=60-2*(4+0.96/2)= 51.04 cm
hc2=35-2*(4+0.96/2)= 26.04 cm
hx=hc/2= 25.52 cm
a)diseño por confinamiento:

Calculo de la longitud de confinamiento:

l0= { t= 0.6 m ; H/6=3.30/6= 0.55 m ; 0.45= 0.45 m }

Por lo tanto l0= 60 cm
Calculo del espaciamiento dentro de la zona de confinamiento:

{ b/2= 0.18 m ; 0.1= 0.10 m }

Por lo tanto s= 10 cm
Refuerzo transversal en la columna:
Se requiere una cuantía que sea mayor entre las siguientes:
cuantía { 0.013 ; 0.006 }

Por lo tanto cuantía = 0.013

Ash = 0.71 cm2
hc=51.04/2= 26 cm
s=1.5*2*0.71/(26*0.013)= 6.30 cm
s=1.5*2*1.27/(26*0.013)= 11.27 cm
usar Ø 3/8" 1@ 0.05, 9 @ 0.06 en la zona de confinamiento

Espaciamiento fuera de la zona de confinamiento:

{ 16db= 25.44 cm ; b= 35 cm ; 30 cm= 30 cm }

Por lo tanto s= 23 cm
Espaciamiento dentro del nudo : 15 cm

usar estribos de Ø 3/8" 1@ 0.05, 9 @ 0.06, r @0.23

Columna C4
Pu= 179.51 tn
Ag (35x50)= 1750 cm2
Ac (41.04x26.04)= 1068.68 cm2
b= 0.35 m
t= 0.5 m
H= 3.3 m
Verificación por cortante:
Vc=0.53*(1+0.0071*Pu/Ag)*raiz(210)*b*d
d=50-4-1.59-0.96= 43.45
Vc= 12.53 tn
Vu= 3.14 tn
Vn=Vu/Ø= 3.69 tn
Vc>Vn por lo tanto el concreto toma todo el corte
0.1*f'c*Ag= 36.75 tn
Pu > 0.1*f'c*Ag
Diseño del refuerzo transversal:
hc=50-2*(4+0.96/2)= 41.04 cm
hc2=35-2*(4+0.96/2)= 26.04 cm
hx=hc/2= 20.52 cm
a)diseño por confinamiento:
Calculo de la longitud de confinamiento:

lo= { t= 0.5 m ; H/6=3.30/6= 0.55 m ; 0.45= 0.45 m }

Por lo tanto lo= 55 cm
Calculo del espaciamiento dentro de la zona de confinamiento:

{ b/2= 0.18 m ; 0.1= 0.10 m }

Por lo tanto s= 10 cm
Refuerzo transversal en la columna:
Se requiere una cuantía que sea mayor entre las siguientes:

cuantia { 0.014 ; 0.006 }

Por lo tanto cuantía = 0.014

Ash = 0.71 cm2
hc=51.04/2= 21 cm
s=1.5*2*0.71/(21*0.013)= 7.98 cm
s=1.5*2*1.27/(21*0.013)= 14.28 cm
usar Ø 3/8" 1@ 0.05, 9 @ 0.07 en la zona de confinamiento
Espaciamiento fuera de la zona de confinamiento:

{ 16db= 25.44 cm ; b= 35 cm ; 30 cm= 30 cm }

Por lo tanto s= 23 cm
Espaciamiento dentro del nudo : 15 cm

usar estribos de Ø 3/8" 1@ 0.05, 9 @ 0.07, r @0.23

V.5.- DISEÑO DE PLACAS

Los muros de corte deben ser diseñados para la acción combinada de carga axial, momentos y corte; teniendo en cuenta las siguientes consideraciones generales:
1.- En el dimensionamiento se tendrá especial cuidado en los esfuerzos de compresión de los extremos y en su resistencia al pandeo.
2.- El espesor mínimo de los muros será de 10 cm y en caso que el muro sea coincidente con los muros del sótano el espesor será mayor a 20 cm.
Requerimientos de diseño
Será aplicada en el diseño los lineamientos generales establecidos por flexocompresión.
Muros esbeltos (h_w/l_w >2)

El comportamiento es semejante al de una viga en voladizo. Es necesario elementos de confinamiento en los extremos.
La presencia de momentos flectores grandes en la base del muro hace necesario considerar la formulación de una rotula plástica en la base; la dimensión de la rotula (lp) puede exceder la longitud del muro (valores típicos están en el intervalo de 0.5 a1.0 veces el peralte del elemento), y producirán fisuras de tracción diagonal por la acción de fuerzas cortantes muy apreciables. Algunos investigadores recomiendan diseñar para la fuerza cortante máxima en la base hasta un nivel de por lo menos 1.5 veces la longitud del muro con el fin de proveer mas resistencia por cortante en toda la longitud probable de la rotula plástica.

Determinación de los refuerzos de la placa P1:

Vu>0.53*raiz(f´c)*Acv o´si h>25 cm

Vu=22.9 tn< 30.72 tn
No necesita refuerzo en 2 capas

Refuerzo longitudinal y transversal en el muro

Refuerzo longitudinal
Espaciamiento máximo =45 cm o´3h (el menor)
Acv/m= 100*20= 2000 cm2/m
El area de acero en cada dirección por cada metro de muro

cuantia*Acv= 0.0025*2000= 5.0 cm2/m
Usando Ø1/2" ⟹ As=1.27cm2
s requerido = As/(As/m)= 0.25 m < 0.45 m CONFORME

Verificación por flexión:

Según las normas Peruanas de estructuras, los muros con esfuerzos de flexión debida a las fuerzas coplanares deberán diseñarse de acuerdo a lo siguiente:

Para muros esbeltos (Altura total /longitud: H/L >1),serán aplicables los lineamientos generales establecidos para flexocompresión : se investigara la resistencia en base a una relación de Carga axial –Momento, debiéndose concentrar mayor refuerzo en los extremos.

Por lo tanto se usara una doble malla de Ø1/2" @ 0.12

Refuerzo horizontal

Vn=Acv*(alfa*raiz(210)+cuantía n*Fy)
Vn= 1283.2
alfa=0.8 para hw/lw<1.5
alfa=0.53 para hw/lw>2
Acv=20*200= 4000 cm2
Vc=0.53*raiz(210)*Acv=30.72 tn
Vn=Vc+Vs
Vs=Vn-Vc= 22.9/0.6-30.72 = 7.45 tn
Vs=Av*Fy*d/s
s=Av*Fy*d/Vs= 2*0.71*4.2*0.8*200/7.45=128.14 cm
s=128 cm >45 cm
Espaciamiento máximo =45 cm o 3h (el menor)
Por lo tanto s=45 cm
Refuerzo mínimo horizontal
Para varillas menores o igual que N° 5 y Fy > 4200 Kg/cm2

Ah min =0.0020*b*h
Ah min =0.0020*20*100= 4cm2/m
Usando Ø3/8" As=2*0.71=1.42 cm2
s requerido=As/(Ah min)= 0.36m <0.45 m CONFORME

Por lo tanto se usara una doble malla de Ø3/8" @0.36

V.6.- DISEÑO DE CIMENTACION (ZAPATAS)

Estimación de pesos y dimensiones

Placa esquina (P1)-nivel 5

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.3125		1	300	2086.875
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Sobrecarga	2.4	3.58		1	150	1288.8

WD= 6967.035 Kg
WL= 1288.8 Kg

Placa esquina (P1)-nivel 4

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.3125		1	300	2086.875
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Columna	0.2	3.8	3	1	2400	5472
Sobrecarga	2.4	3.58		1	250	2148

WD= 12439.035 Kg
WL= 2148 Kg

Placa esquina (P1)-nivel 3

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.3125		1	300	2086.875
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Columna	0.2	3.8	3	1	2400	5472
Sobrecarga	2.4	3.58		1	250	2148

WD= 12439.035 Kg
WL= 2148 Kg

Placa esquina (P1)-nivel 2

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.3125		1	300	2086.875
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Columna	0.2	3.8	3	1	2400	5472
Sobrecarga	2.4	3.58		1	250	2148

WD= 12439.035 Kg
WL= 2148 Kg

Placa esquina (P1)-nivel 1

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.3125		1	300	2086.875
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Columna	0.2	3.8	3	1	2400	5472
Sobrecarga	2.4	3.58		1	250	2148

WD= 12439.035 Kg
WL= 2148 Kg

PD= 56723.175 Kg
PL= 9880.8 Kg

Columna esquina (C2)-nivel 5

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	3.3125		1	300	2086.875
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	2.4	3.58		1	120	1031.04
Tabiqueria	2.4	3.58		1	180	1546.56
Sobrecarga	2.4	3.58		1	150	1288.8

WD= 6967.035 Kg
WL= 1288.8 Kg

Columna lateral (C2)-nivel 4

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	3.3125		1	300	4173.75
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	4.5	3.58		1	120	1933.2
Tabiqueria	4.5	3.58		1	180	2899.8
Columna	0.35	0.6	3	1	2400	1512
Sobrecarga	4.5	3.58		1	250	4027.5

WD= 13577.31 Kg
WL= 4027.5 Kg

Columna lateral (C2)-nivel 3

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	3.3125		1	300	4173.75
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	4.5	3.58		1	120	1933.2
Tabiqueria	4.5	3.58		1	180	2899.8
Columna	0.35	0.6	3	1	2400	1512
Sobrecarga	4.5	3.58		1	250	4027.5

WD= 13577.31 Kg
WL= 4027.5 Kg

Columna lateral (C2)-nivel 2

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	3.3125		1	300	4173.75
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	4.5	3.58		1	120	1933.2
Tabiqueria	4.5	3.58		1	180	2899.8
Columna	0.35	0.6	3	1	2400	1512
Sobrecarga	4.5	3.58		1	250	4027.5

WD= 13577.31 Kg
WL= 4027.5 Kg

Columna lateral (C2)-nivel 1

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	3.3125		1	300	4173.75
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	3.58	0.3	0.6	1	2400	1546.56
Acabados	4.5	3.58		1	120	1933.2
Tabiqueria	4.5	3.58		1	180	2899.8
Columna	0.35	0.6	3	1	2400	1512
Sobrecarga	4.5	3.58		1	250	4027.5

WD= 13577.31 Kg
WL= 4027.5 Kg

PD= 61276.275 Kg
PL= 17398.8 Kg

Columna esquina (C3)-nivel 5

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	6.625		1	300	4173.75
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	2.4	6.7		1	120	1929.6
Tabiqueria	2.4	6.7		1	180	2894.4
Sobrecarga	2.4	6.7		1	150	2412

WD= 12648.15 Kg
WL= 2412 Kg

Columna lateral (C3)-nivel 4

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	6.625		1	300	4173.75
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	2.4	6.7		1	120	1929.6
Tabiqueria	2.4	6.7		1	180	2894.4
Columna	0.35	0.6	3	1	2400	1512
Sobrecarga	2.4	6.7		1	250	4020

WD= 14160.15 Kg
WL= 4020 Kg

Columna lateral (C3)-nivel 3

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	6.625		1	300	4173.75
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	2.4	6.7		1	120	1929.6
Tabiqueria	2.4	6.7		1	180	2894.4
Columna	0.35	0.6	3	1	2400	1512
Sobrecarga	2.4	6.7		1	250	4020

WD= 14160.15 Kg
WL= 4020 Kg

Columna lateral (C3)-nivel 2

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	6.625		1	300	4173.75
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	2.4	6.7		1	120	1929.6
Tabiqueria	2.4	6.7		1	180	2894.4
Columna	0.35	0.6	3	1	2400	1512
Sobrecarga	2.4	6.7		1	250	4020

WD= 14160.15 Kg
WL= 4020 Kg

Columna lateral (C3)-nivel 1

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	2.1	6.625		1	300	4173.75
Vigas-X	2.1	0.25	0.6	1	2400	756
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	2.4	6.7		1	120	1929.6
Tabiqueria	2.4	6.7		1	180	2894.4
Columna	0.35	0.6	3	1	2400	1512
Sobrecarga	2.4	6.7		1	250	4020

WD= 14160.15 Kg
WL= 4020 Kg

PD= 69288.75 Kg
PL= 18492 Kg

Columna central (C4)-nivel 5

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	6.625		1	300	8347.5
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	4.5	6.7		1	120	3618
Tabiqueria	4.5	6.7		1	180	5427
Sobrecarga	4.5	6.7		1	150	4522.5

WD= 21798.9 Kg
WL= 4522.5 Kg

Columna central (C4)-nivel 4

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	6.625		1	300	8347.5
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	4.5	6.7		1	120	3618
Tabiqueria	4.5	6.7		1	180	5427
Columna	0.35	0.5	3	1	2400	1260
Sobrecarga	4.5	6.7		1	250	7537.5

WD= 23058.9 Kg
WL= 7537.5 Kg

Columna central (C4)-nivel 3

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	6.625		1	300	8347.5
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	4.5	6.7		1	120	3618
Tabiqueria	4.5	6.7		1	180	5427
Columna	0.35	0.5	3	1	2400	1260
Sobrecarga	4.5	6.7		1	250	7537.5

WD= 23058.9 Kg
WL= 7537.5 Kg

Columna central (C4)-nivel 2

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	6.625		1	300	8347.5
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	4.5	6.7		1	120	3618
Tabiqueria	4.5	6.7		1	180	5427
Columna	0.35	0.5	3	1	2400	1260
Sobrecarga	4.5	6.7		1	250	7537.5

WD= 23058.9 Kg
WL= 7537.5 Kg

Columna central (C4)-nivel 1

Aportante	L(m)	B(m)	H(m)	N° VECES	W(Kg)	PESO(Kg)
Losa	4.2	6.625		1	300	8347.5
Vigas-X	4.2	0.25	0.6	1	2400	1512
Vigas-Y	6.7	0.3	0.6	1	2400	2894.4
Acabados	4.5	6.7		1	120	3618
Tabiqueria	4.5	6.7		1	180	5427
Columna	0.35	0.5	3	1	2400	1260
Sobrecarga	4.5	6.7		1	250	7537.5

WD= 23058.9 Kg
WL= 7537.5 Kg

Zapata de columna C2: (Z2)

PD= 61.276275 tn
PL= 17.3988 tn
Dr= 1.2 m
peso vol suelo= 2.26 tn/m3
f'c= 210 Kg/cm2
Fy= 4200 Kg/cm2
S/C piso= 500 Kg/cm2
σ Terreno= 4 Kg/cm2

σ neto del terreno = 36.11 tn/m2
Azap =(PD+PL+0.05*(PD+PL)/36.11= 2.29 m2 = 1.52x1.52 m2
Para cumplir lv1=lv2=> T= 1.645 y S=1.40
entonces S = 1.90 m y T=2.15 m

lv1=lv2 ⟹

USAR: 2.15x1.90 m2
lv1=0.78
lv2=0.78 CONFORME

Reacción neta del terreno
Pu= 1.5*PD+1.8*PL= 123.23 tn
Wnu=Pu/Az = 30.17 tn/m2

Dimensionamiento de la altura hz de la zapata

por punzonamiento

βc = 1.71 <2

b0=2*(0.6+d)+2*(0.35+d)=1.9+4*d

Resolviendo: d= 0.275 m
usar h=0.60 m
d prom= 51.71 cm
Ø5/8" , r=7.5 cm

verificación por cortante
Vdu= 14.79 tn
Vn=Vdu/Ø= 17.39 tn
Vc= 75.45 tn > Vn CONFORME
diseño por flexión

Mu= 17.21 tn-m

As= 9.79 cm2
a= 1.10 cm
As= 8.90 cm2
Verificación de área de acero mínima
As min= 17.68 cm2
Entonces usare As min= 17.68 cm2
USAR:As=>n= 9
s=(1.90-2r-Ø)/(n-1)= 0.22

usar: 9 Ø 5/8"@0.22

en dirección transversal

Ast=Asx2.15/1.90= 20.01 cm2 => n= 13
s=(2.15-2r-Ø)/(n-1)= 0.17

usar: 13 Ø 5/8"@0.17

longitud de desarrollo del refuerzo

longitud disponible para cada barra: ld=lv-r

ld=0.70m
como el espaciamiento es s=0.17>0.15
lde=0.8*ld
ld= 34.61 cm
ld= 38.06 cm
ld= 30 cm

lde= 30.45 cm < ldisp = 70.00 cm

Efectos de carga excentrica :

e= 0.16 m
Esf max=92.848/(1.65*1.4)+6*92.848*0.16/(1.4*1.65*1.65)=64.01 tn/m2
64.01 tn/m2> Esf net terreno*1.5=54.16 tn/m2
Esf min= 12.39 tn/m2
1° tanteo:
T=2 m
σ1*S=q1=P/T+6*P*e/T2= 68.71 tn/m
σ1=σ n entonces: S= 1.90 m
σ1,2=92.848/(2.15*1.9)+6*92.848*0.16/(1.9*2.15*2.15)= 32.88 tn/m2
32.88 tn/m2< σ net terreno*1.5=54.16 tn/m2

Zapata de columna C3: (Z3)

PD= 69.28875 tn
PL= 18.492 tn
Dr= 1.2 m
peso vol suelo= 2.26 tn/m3
f'c= 210 Kg/cm2
Fy= 4200 Kg/cm2
S/C piso= 500 Kg/cm2
σ Terreno= 4 Kg/cm2

σ neto del terreno = 36.11 tn/m2
Azap=(PD+PL+0.05*(PD+PL)/36.11=2.55 m2 = 1.60x1.60 m2
Para cumplir lv1=lv2=>T=1.725 entonces T =1.75m
S=1.475 entonces S =1.50m

USAR: 1.75x1.50 m2

lv1=lv2= lv1=0.58
lv2=0.58 CONFORME

Reacción neta del terreno
Pu= 137.22 tn
Wnu= 52.27 tn/m2

Dimensionamiento de la altura hz de la zapata

por punzonamiento

βc= 1.71 <2

b0=2*(0.6+d)+2*(0.35+d)=1.9+4*d

Resolviendo: d=0.275 m

usar h=0.60 m
d prom= 51.71 cm
Ø5/8" , r=7.5 cm

verificación por cortante
Vdu= 4.54 tn
Vn=Vdu/Ø= 5.35 tn
Vc= 59.57 tn>Vn CONFORME
diseño por flexión

Mu= 12.96 tn-m

As= 7.37 cm2
a= 1.05 cm
As= 6.70 cm2
Verificación de área de acero mínima
As min= 13.96 cm2
Entonces usare As min= 13.50 cm2

USAR: As=>n= 7
s=(1.50-2r-Ø)/(n-1)= 0.22
usar: 7 Ø 5/8"@0.22

en dirección transversal

Ast=Asx1.75/1.50= 15.75 cm2 => n= 10
s=(1.65-2r-Ø)/(n-1)= 0.18
usar: 10 Ø 5/8"@0.18
longitud de desarrollo del refuerzo

longitud disponible para cada barra: ld=lv-r

ld= 0.50 m
como el espaciamiento es s=0.17>0.15
lde=0.8*ld
ld= 34.61 cm
ld= 38.06 cm
ld= 30 cm

lde= 30.45 cm < ldisp= 50.00 cm

Efectos de carga excentrica:

e= 0.14
σ max=39.08tn/m2 < σ net terreno*1.5=54.165 tn/m2
σ min= 14.09 tn/m2

Zapata de columna C4: (Z4)

PD= 114.0345 tn Pu= 233.46225 tn
PL= 34.6725 tn
Dr= 1.2 m
peso vol suelo= 2.26 tn/m3
f'c= 210 Kg/cm2
Fy= 4200 Kg/cm2
S/C piso = 500 Kg/cm2
σ Terreno = 4 Kg/cm2

σ neto del terreno =36.11 tn/m2
Azap=(PD+PL+0.05*(PD+PL)/36.11= 4.32 m2 = 2.08x2.08 m2
Para cumplir lv1=lv2=>T=2.20 m
S= 2.05 m

USAR: 2.2x2.05 m2
lv1=0.85
lv2=0.85 CONFORME

lv1=lv2=

Reacción neta del terreno
Pu= 233.46 tn
Wnu= 51.77 tn/m2

Dimensionamiento de la altura hz de la zapata

por punzonamiento

beta c=0.5/0.35= 1.43 <2

b0=2*(0.5+d)+2*(0.35+d)=1.7+4*d

d=0.44 m

usar h=0.60 m
d prom=60-(7.5+1.59/2)= 51.71 cm
Ø5/8" , r=7.5 cm

verificación por cortante
Vdu= 35.33 tn
Vn=Vdu/Ø= 41.57 tn
Vc=79.42tn>Vn CONFORME
diseño por flexión

Mu=wu*S*lv2/2= 38.34 tn-m

As= 21.79 cm2
a= 2.30 cm
As= 20.06 cm2
Verificación de área de acero mínima

As min= 19.08 cm2 <20.06 CONFORME
USAR:As=>n= 10
s=(2.00-2r-Ø)/(n-1)= 0.21 m
usar: 10 Ø 5/8"@0.21

en dirección transversal

Ast=Asx2.20/2.05= 21.53 cm2 => n= 14
s=(2.15-2r-Ø)/(n-1)= 0.16 m
usar: 13 Ø 5/8"@0.16
longitud de desarrollo del refuerzo

longitud disponible para cada barra: ld=lv-r

ld= 0.78 m
como el espaciamiento es s=0.16>0.15
lde=0.8*ld
ld= 34.61 cm
ld= 38.06 cm
ld= 30 cm

lde= 30.45 cm < ldisp= 78 cm

Efectos de carga excentrica :

e= 0.05
σ max= 45.59tn/m2 < σ net terreno*1.5=54.17 tn/m2
σ min=34.02 tn/m2

Zapata de placa P1:(Z1)

PD= 56.72 TN
PL= 9.88 TN

PD=56.72/3.8= 14.93 TN/m
PL=9.88/3.8= 2.60 TN/m
Pu=1.5*PD+1.8*PL= 27.07
σ terreno= 4 Kg/cm2 ⟶ σ net terreno=36.11 tn/m2
f'c= 210 Kg/cm2
Fy= 4200 Kg/cm2

área de la zapata:
1.00*a=(Ps+ppzapata)/ σnet terreno=(56.72+9.88+0.05*(56.72+9.88))/36.11
a= 0.51 m ⟶ a=55 cm
vuelo =(55-20)/2=17.5 cm (17.5 cm no cumple cuando se verifica por ld, por lo tanto asumo 40 cm de vuelo.
Reacción neta:
w=Pu/Az= 49.22 tn/m2= 4.922 Kg/cm2
M=w*x2/2= 3.937615 tn-m= 393761.54 Kg-cm
M=w*x2/2= 3937.62 Kg-m
V= 19688.08 kg
Corte a la distancia d
Vd=V-w*d=19688.08-4.920*d
Altura de zapata
a) Por flexión
con p=0.18*f'c/Fy= 0.18*210/4200= 0.009
k de verificación
n=2*1000000/(15000*raiz(210))= 9.20
k= 0.33
j=1-k/3= 0.889
Momento del concreto:
Mc=0.5*f'c*k*j*b*d2= 1396.90*d^2
Mc=M
1396.90*d^2=393761.54
d= 17 cm
b)Por corte
Vd=(V-w*d)=Vc
Vc=0.29*raiz(210)*b*d en el estado elástico
4.92*b*(40-d)=0.29*raiz(210)*b*d
d= 21.6 cm

c)Por ld
ld= 29.45 cm

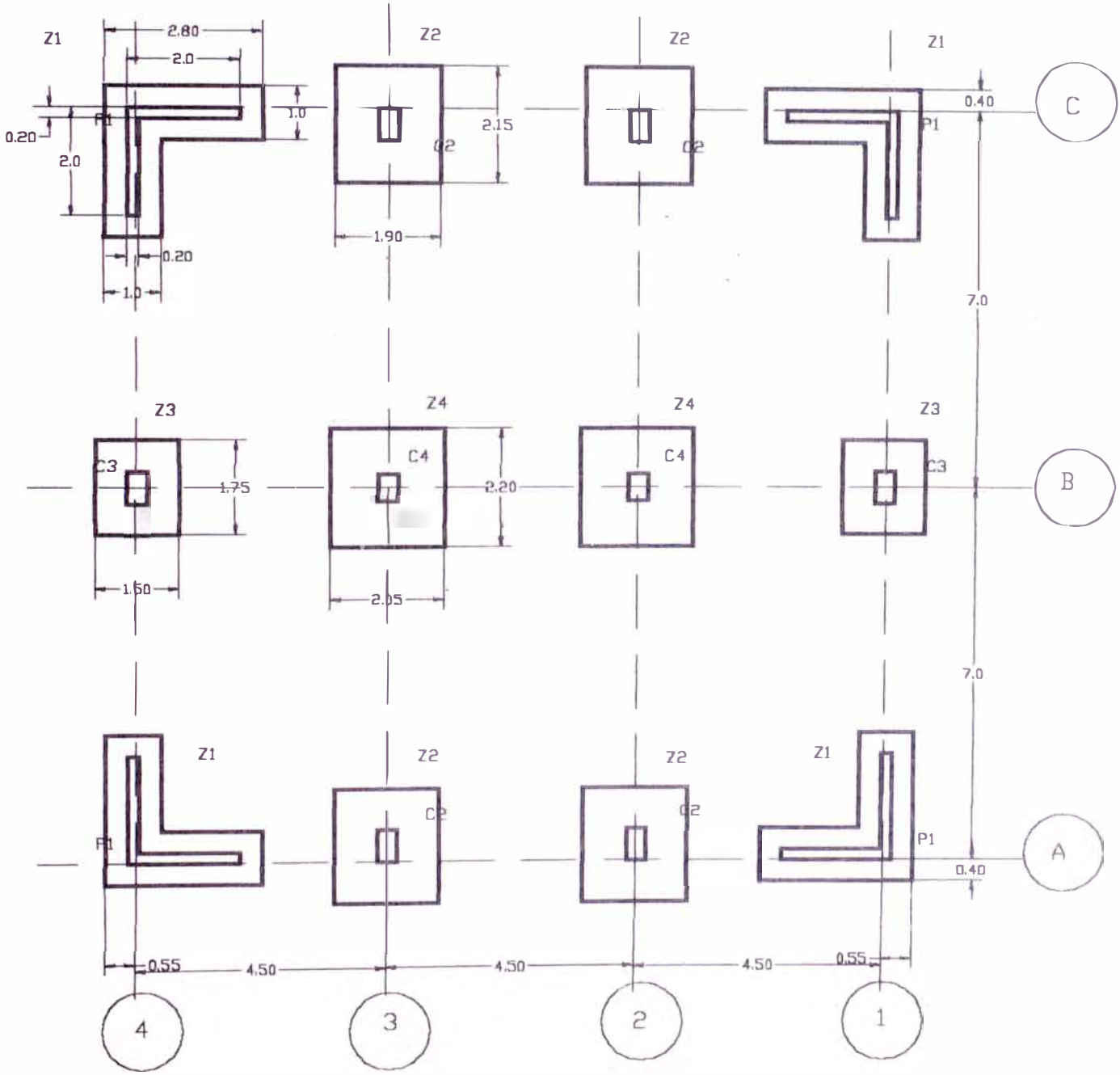
ld= 21.34 cm
h=ld+7.5+l= 37.95 cm
h=60 cm
d=60-7.5-l= 51.5 cm

Acero: As=M/(fs*j*d)= 4.09 cm2
Verificación de As min:
p=0.0018
As=0.0018*b*t=0.0018*100*60=10.8 cm2/m
n=As/AØ= 5
s=100/4= 0.25 cm
USAR 5Ø 5/8" @ 0.21

As repartición o´ temperatura:
p=0.0018
As=0.0018*b*t=0.0018*100*60=10.8 cm2/m
n=As/AØ= 5
s=(1.00-2*0.075-0.0159)/4= 0.21 m
USAR 5Ø 5/8" @ 0.25

Verificación por longitud de desarrollo:
ld=0.06*1.99*4200/raiz(210)= 34.61 cm
ld=0.006*1.59*4200= 40.07 cm
lde=0.8*ld= 32.05 cm
ldisponible=40.00-7.50= 32.5 cm > 32.05cm CONFORME

ZAPATAS


Z1
2.80
2.0
0.20
2.0
1.0
P1
0.20
1.0
Z2
2.15
C2
1.90
Z2
C2
Z1
0.40
P1
C
7.0
Z3
C3
1.75
1.50
Z4
C4
2.20
2.05
Z4
C4
Z3
C3
B
7.0
Z1
P1
Z2
C2
Z2
C2
Z1
P1
0.40
A
0.55
4.50
4.50
4.50
0.55
4
3
2
1

VI. CONCLUSIONES Y RECOMENDACIONES

VI.1 CONCLUSIONES

- En los diseños estructurales se tiene que tener en cuenta que la estructura en casos de sismos severos debe sufrir daños sin llegar a colapsar considerando el cuidado de las vidas humanas.
- Con el peralte obtenido del predimensionamiento del presente proyecto, todas las vigas son simplemente reforzadas ya que el momento ultimo debido a las cargas aplicadas es menor que el momento resistente del concreto.
- Las nuevas normas de diseño sismo resistente son más estrictas en el control de desplazamientos obteniéndose estructuras más rigidas que las obtenidas con las normas anteriores.
- Para el presente trabajo se efectuó el análisis por cargas laterales por el método sísmico estático de cargas equivalentes y por el método espectral, esto considerando que el edificio es de baja altura y además simétrico.
- La buena capacidad portante considerada para el terreno y la manera en que fue concebido el diseño de las zapatas evita el uso de vigas de cimentación; además σ max<1.5σ neto del terreno.
- Las dimensiones de vigas, placas y columnas obtenidas en el análisis sísmico no son definitivas ya que pueden ser afinadas considerando la capacidad resistente de cada una.
- De los análisis sísmicos realizados tanto en la dirección X como en la dirección Y, el cortante dinámico en la base es menor que el 80% del cortante estático, lo que motiva a realizar una corrección utilizando un factor de multiplicación "Fm" para cada eje y obtener de esta manera las fuerzas corregidas que serán las que se aplicaran a cada pórtico.

VI.2 RECOMENDACIONES

- Seria recomendable el obtener registros de sismos ocurridos en el Perú de manera de poder efectuar análisis dinámico tiempo historia ya que se veria un comportamiento más real de las estructuras.

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