ELABORACIÓN DE DIAGNÓSTICOS, ESTUDIOS TÉCNICOS, AJUSTES A DISEÑOS O DISEÑOS INTEGRALES, CONSTRUCCIÓN Y PUESTA EN FUNCIONAMIENTO DE LAS OBRAS DE INFRAESTRUCTURA EDUCATIVA – UBICADAS EN EL DEPARTAMENTO DE VALLE DEL CAUCA – GRUPO 02

Contrato No. PAF-JU02-G02DC-2015

INFORME CÁLCULO Y ANALISIS ESTRUCTURAL INSTITUCIÓN EDUCATIVA MERCEDES ABREGO

BOGOTÁ
2017

CONTROL DE REVISIONES

REVISIÓN	FECHA	OBSERVACIONES
1	30/12/16	Primera Redacción

Elaborado por: Edgar Rolando Barrera Firma:	**Revisado por**: Javier José Carrillo Ortega Fecha: febrero 2017 Firma:	**Aprobado por:** Director de Interventoría Fecha: Firma:

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1 INTRODUCCIÓN

El presente documento contiene las memorias de análisis y diseño estructural correspondiente al proyecto de la “INSTITUCIÓN EDUCATIVA MERCEDES ABREGO” ubicado en la ciudad de Cali en el departamento de VALLE DEL CAUCA de acuerdo al contrato No. PAF-JU02-G02DC-2015 realizando el estudio de acuerdo a la Norma Colombiana de Diseño y Construcción Sismo Resistente Ley 400 de 1997 (Modificada Ley 1229 de 2008) y Decreto 926 de Marzo de 2010, Decreto 092 del 17 de Enero de 2011, Decreto 0340 del 13 de Febrero de 2012 y en el Reglamento para Concreto Estructural ACI 318S-08.

Para la evaluación de la edificación se ha seguido un proceso normativo que incluye las etapas de inspección, evaluación, pruebas y ensayos, revisión analítica, propuesta de intervención y soluciones constructivas, que tomen en cuenta los aspectos de resistencia, ductilidad, comportamiento y estabilidad de la estructura.

2 DESCRIPCIÓN DEL TRABAJO DE OFICINA

De acuerdo a los planos arquitectónicos y visitas realizadas en campo se procedió al desarrollo del estudio y análisis estructural con la ayuda de diferentes programas tales como ETABS v9.7.4, el cual tiene en cuenta los efectos de segundo orden. Por otro lado, se siguieron las recomendaciones descritas en el respectivo estudio de suelos

3 DESCRIPCIÓN DE LOS CRITERIOS BÁSICOS DE DISEÑO

El proyecto se soluciona mediante el diseño de una estructura aporticada, utilizando para el entrepiso del nivel N:-2.09 m Y N:-0.05 m placa maciza de espesor e= 0.10 m en N:+3.45 m placa maciza en dos direcciones de espesor e=0.15 m para soportar la carga del tanque. La cubierta liviana se compone de perfiles y correas en el nivel N:+6.95 m. Se manejan luces entre 5.00 m y 7.00 m en los dos sentidos de la estructura.

4 NORMAS Y CÓDIGOS A LOS CUALES SE CIÑEN LOS DISEÑOS

El diseño de todas las estructuras se realizó basado en la Norma Colombiana de Diseño y Construcción Sismo Resistente Ley 400 de 1997 (Modificada Ley 1229 de 2008) y

Decreto 926 de Marzo de 2010, Decreto 092 del 17 de Enero de 2011, Decreto 0340 del 13 de Febrero de 2012 y en el Reglamento para Concreto Estructural ACI 318S-08.

5 DESCRIPCIÓN DE LA METODOLOGÍA DE DISEÑO EMPLEADA.

El proyecto se soluciona mediante el diseño de una estructura aporticada, utilizando para el entrepiso del nivel N:-2.09 m Y N:-0.05 m placa maciza de espesor e= 0.10 m en N:+3.45 m placa maciza en dos direcciones de espesor e=0.15 m para soportar la carga del tanque. La cubierta liviana se compone de perfiles y correas en el nivel N:+6.95 m. Se manejan luces entre 5.00 m y 7.00 m en los dos sentidos de la estructura.

Las cargas horizontales fueron distribuidas entre los diferentes pórticos en proporción a su rigidez y teniendo en cuenta los efectos de torsión.

El dimensionamiento dado a todos los elementos que intervienen en las estructuras satisfacen los requerimientos de solicitación ocasionados por las derivas presentes. Las cargas vivas de diseño son: **2.00 kN/ m²** para salones de clase, **5.00 kN/ m²** para tanques y corredores, y **0.35 kN/ m²** para cubiertas.

Para la cimentación se siguieron las recomendaciones descritas en el respectivo estudio de suelos, que recomienda apoyar la estructura a **-1.00 m** del nivel de la placa aérea de cimentación, apoyando las zapatas a **-1.00 m**, según lo indicado en los planos estructurales. La capacidad portante de seguridad admisible del suelo es **0.092 MPa** y el tipo de suelo es **E**.

6 DESCRIPCIÓN Y ANÁLISIS DE LAS CONDICIONES EXISTENTES

El sitio donde se procederá a la construcción de la estructura se encuentra ubicado una edificación existente, como se evidencia en las fotos mostradas a continuación.

1. **Fotografía Estructura existente**

Fuente: Propia

2. **Fotografía Estructura existente**

Fuente: Propia

3. Fotografía Estructura existente

Fuente: Propia

4. Fotografía Estructura existente

Fuente: Propia

MEMORIAL DE RESPONSABILIDAD

JAMUNDÍ (VALLE DEL CAUCA). Enero de 2017.

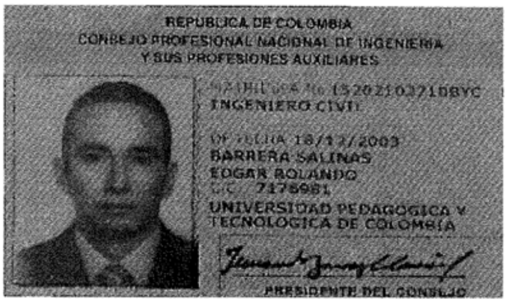
Señores
PLANEACIÓN MUNICIPAL
La Ciudad

Yo, **EDGAR ROLANDO BARRERA,** ingeniero civil con Matrícula Profesional Nº **15202-102710** de **BOYACÁ,** debidamente registrado en el consejo profesional de Ingeniería y Arquitectura de Cundinamarca, presento los Cálculos y Diseños Estructurales elaborados de acuerdo a los requerimientos de la **NORMA COLOMBIANA DE DISEÑO Y CONSTRUCCIÓN SISMO RESISTENTE LEY 400 DE 1997 (MODIFICADA LEY 1229 DE 2008) Y DECRETO 926 DE MARZO DE 2010**, para el proyecto INSTITUCIÓN EDUCATIVA MERCEDES ABREGO, ubicado en municipio de Jamundí en el departamento de Valle Del Cauca, declaro que asumo la responsabilidad por los perjuicios que causa de ellos puedan deducirse, exonerando a esta PLANEACIÓN MUNICIPAL de cualquier responsabilidad.

Acepto y reconozco que la revisión efectuada por PLANEACIÓN MUNICIPAL no constituye una aprobación al Diseño Estructural, sino una verificación del cumplimiento de la **NORMA COLOMBIANA DE DISEÑO Y CONSTRUCCIÓN SISMO RESISTENTE.**

Atentamente,

EDGAR ROLANDO BARRERA
ING. ESTRUCTURAL
T.P. 15202-102710 BYC



REPUBLICA DE COLOMBIA
CONSEJO PROFESIONAL NACIONAL DE INGENIERIA
Y SUS PROFESIONES AUXILIARES

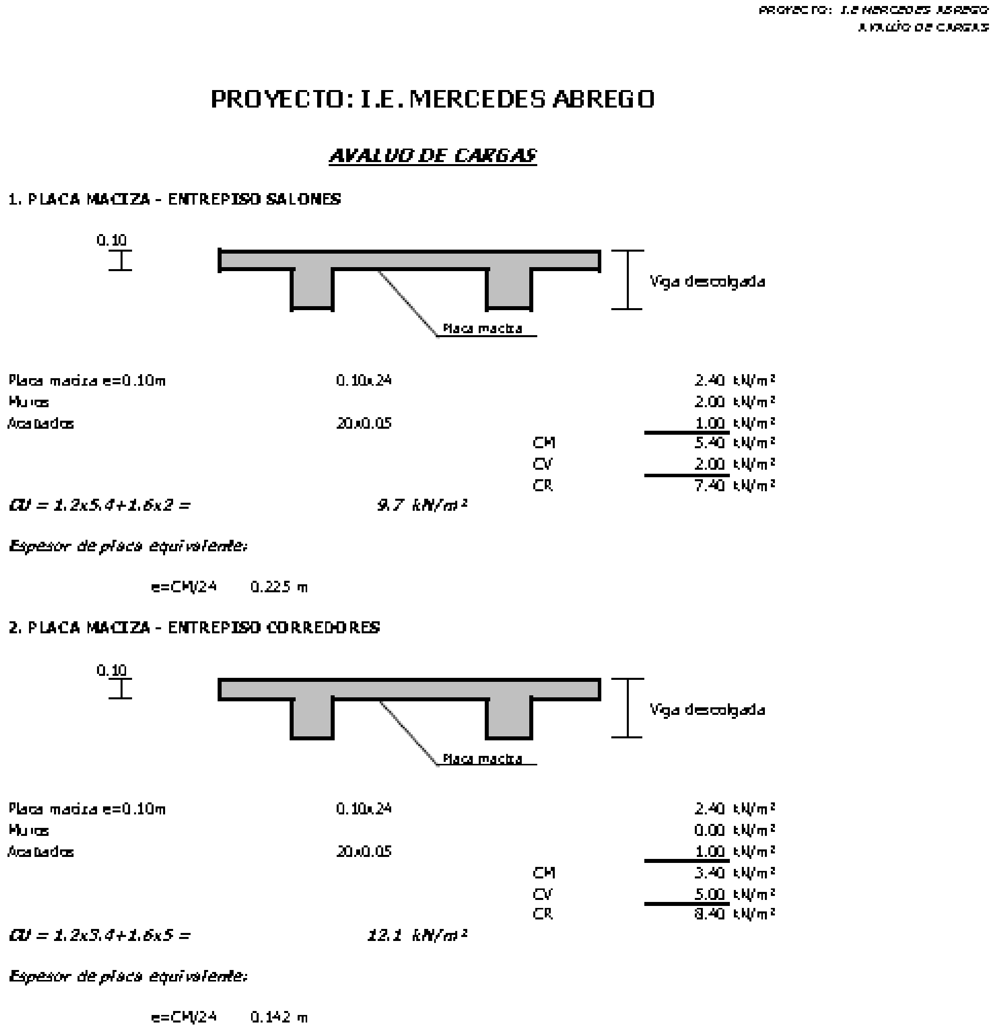
MATRICULA No. 15202103710BYC
INGENIERO CIVIL

DE FECHA 18/12/2003
BARRERA SALINAS
EDGAR ROLANDO
C.C. 7176981
UNIVERSIDAD PEDAGOGICA Y
TECNOLOGICA DE COLOMBIA

PRESIDENTE DEL CONSEJO

7 MEMORIA DE CÁLCULO

7.1 AVALUO DE CARGAS



PROYECTO: I.E MERCEDES ABREGO
AVALÚO DE CARGAS

PROYECTO: I.E. MERCEDES ABREGO

AVALUO DE CARGAS

1. PLACA MACIZA - ENTREPISO SALONES

0.10
Viga descolgada
Placa maciza

Placa maciza e=0.10m	0.10x24		2.40 kN/m²
Muros			2.00 kN/m²
Acabados	20x0.05		1.00 kN/m²
		CM	5.40 kN/m²
		CV	2.00 kN/m²
		CR	7.40 kN/m²

CU = 1.2x5.4+1.6x2 = ***9.7 kN/m²***

Espesor de placa equivalente:

e=CM/24 0.225 m

2. PLACA MACIZA - ENTREPISO CORREDORES

0.10
Viga descolgada
Placa maciza

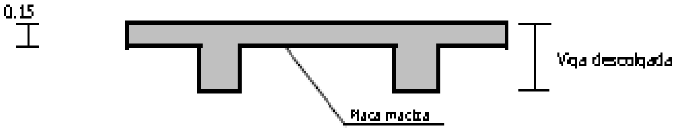
Placa maciza e=0.10m	0.10x24		2.40 kN/m²
Muros			0.00 kN/m²
Acabados	20x0.05		1.00 kN/m²
		CM	3.40 kN/m²
		CV	5.00 kN/m²
		CR	8.40 kN/m²

CU = 1.2x3.4+1.6x5 = ***12.1 kN/m²***

Espesor de placa equivalente:

e=CM/24 0.142 m

3. PLACA MACIZA - CUBIERTA



Placa maciza e=0.15m	0.15x24		3.60 kN/m²
Acabados	22x0.05		1.10 kN/m²
		CM	4.70 kN/m²
		CV	5.00 kN/m²
		CR	9.70 kN/m²

CU = 1.2x4.7+1.6x5 = ***15.6 kN/m²***

Espesor de placa equivalente:

e=CM/24 0.196 m

4. CUBIERTA LIVIANA

Teja termo-acústica			0.10 kN/m²
Correas metálicas			0.10 kN/m²
Acabados e iluminacion			0.10 kN/m²
		CM	0.30 kN/m²
	Tabla 4.2.1-2 de NSR-10 (Tipo de cubierta F)	CV	0.35 kN/m²
		CR	0.65 kN/m²

CU = 1.2x0.3+1.6x0.35 = ***0.92 kN/m²***

Espesor de placa equivalente:

e=CM/24 0.013 m

Pendiente de Cubierta α(°) = 17.00 ⟶ Equivale a 30.6%
Altitud de al cabecera municipal (m.s.n.m.) 1000
B.4.8.3 de NSR-10 (Carga de granizo) CG 0.00 kN/m²

Según la tabla B.4.2.1-2 - En cubiertas inclinadas con más de 15° de pendiente en estructura metálica o de madera la carga viva asumida puede ser 0.35 kN/m².
Según B.4.8.3.1 - Las cargas de granizo deben tenerse en cuenta en las regiones del país con más de 2.000 metros de altura sobre el nivel del mar o en lugares de menor altura donde la autoridad municipal o distrital así lo exija.
Según B.4.8.3.2 - Para cubiertas con inclinación mayor a 15% el valor de la carga viva para granizo puede reducirse a 0.50 kN/m².

7.1.1 AVALÚO DE CARGAS DE VIENTO ANÁLISIS SIMPLIFICADO (sprfv)

Para que le análisis se pueda realizar mediante el método de diseño simplificado se requiere que se cumpla con lo establecido por la NSR-10 titulo B.6.4.1.1. y B.6.4.1.2.

a - El edificio sea de diafragma simple como se define en la sección B.6.2.
b - El edificio sea bajo de acuerdo con lo establecido con la sección B.6.2.
c - El edificio sea cerrado como se define en la sección B.6.2. y cumpla las provisiones de zonas propensas a huracanes de acuerdo con la sección B.6.5.9.3.
d - El edificio sea de forma regular como se define en la sección B.6.2.
e - El edificio no sea clasificado como flexible como se define en la sección B.6.2.
f - Las características de respuesta del edificio sean tales que el mismo no esté sujeto a las cargas por viento a travéz de él, a generación de vórtices, a inestabilidad por golpeteo o aleteo, y no esté ubicado en un sitio en el que se puedan presentar efectos de canalización o sacudimiento por la estela de obstrucciones en barlovento, que obliguen a concideraciones especiales.
g - El edificio tenga una sección transversal aproximadamente simétrica en cada dirección y tenga una cubierta plana o cubierta a dos o cuatro aguas con ángulo de inclinación $\emptyset \leq 45°$
h - El edificio esta eximido de los casos de carga torsional indicados en la nota 5 de la figura B.6.5.7. o estos casos no conctrolan el diseño de ninguno de los elementos del SPRFV del edificio.

De los anteriores parametros se observa que la edificación cumple con lo estipulado, por lo tanto:

Tipo de análisis permitido: ANÁLISIS SIMPLIFICADO

Entonces: $\boxed{Ps = \lambda K z t I P s_{10}}$

Donde:

λ= Factor de ajuste por altura y exposición, figura B.6.4.2.
K_{zt}= Factor topográfico comose define en la sección B.6.5.7. evaluado a la altura promedio de la cubierta, **h**, B.6.5.1.
I= Factor de importancia como se define en la sección B.6.5.5.
P_{s10}= Presión de viento de diseño simplificado para la categoria de exposición **B**, con **h=10** m de la figura B.6.4.2.

	CIUDAD	ZONA	VELOCIDAD DEL VIENTO
Zona de amenza eólica=	CALI	3	100 Km/h

Luego:

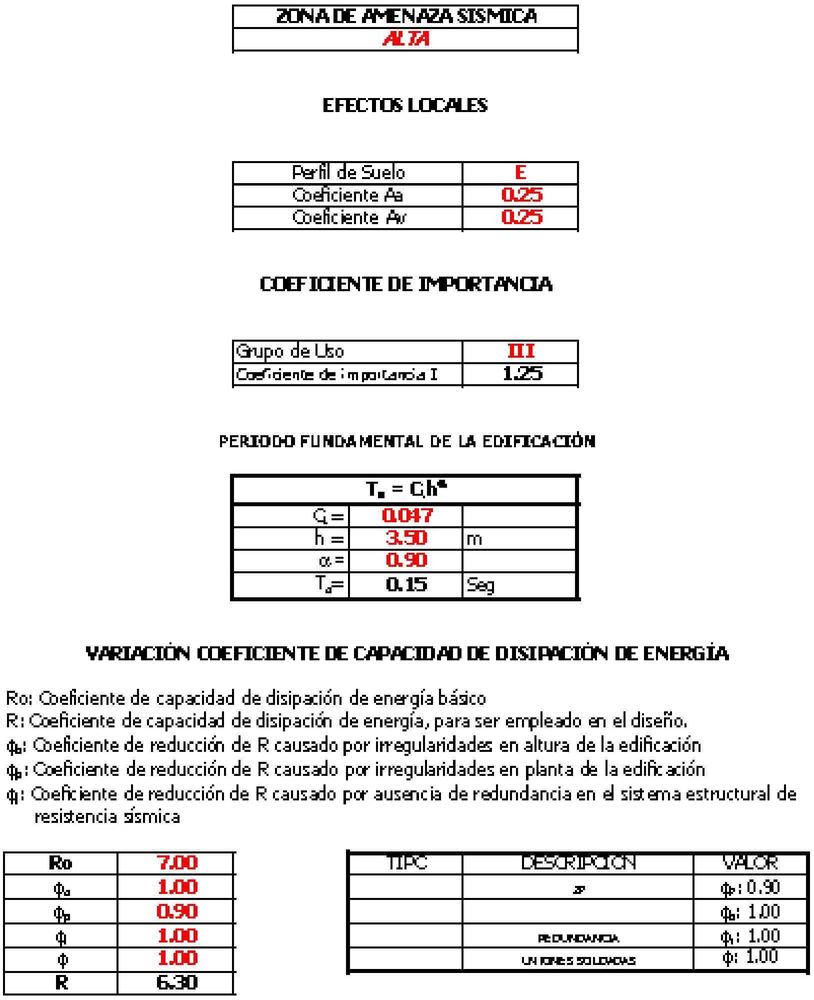
λ=	1.0
K_{zt}=	1.0
I=	1.25
P_{s10}=	**0.23**

Según B.6.4.2.1.1. Presiones mínimas: Los efectos de carga de las presiones de viento de diseño de la sección B.6.4.2.1. no serán menores que el caso de carga mínima de la sección B.6.1.3.1. suponiendo presiones Ps, de +0.40 kN/m^2 para las zonas de A, B, C y D y de 0.00 kN/m^2 paras las zonas E, F, G y H.

Por lo tanto la carga de viento a emplear es: **0.40** kN/m^2

7.2 ANALISIS SISMICO

7.2.1 ESPECTRO DE DISEÑO NSR10



ZONA DE AMENAZA SISMICA
ALTA

EFECTOS LOCALES

Perfil de Suelo	E
Coeficiente Aa	0.25
Coeficiente Av	0.25

COEFICIENTE DE IMPORTANCIA

Grupo de Uso	III
Coeficiente de importancia I	1.25

PERIODO FUNDAMENTAL DE LA EDIFICACIÓN

$T_a = C_t h^{\alpha}$		
C_t =	0.047	
h =	3.50	m
α =	0.90	
T_a=	0.15	Seg

VARIACIÓN COEFICIENTE DE CAPACIDAD DE DISIPACIÓN DE ENERGÍA

Ro: Coeficiente de capacidad de disipación de energía básico
R: Coeficiente de capacidad de disipación de energía, para ser empleado en el diseño.
ϕ_a: Coeficiente de reducción de R causado por irregularidades en altura de la edificación
ϕ_p: Coeficiente de reducción de R causado por irregularidades en planta de la edificación
ϕ_r: Coeficiente de reducción de R causado por ausencia de redundancia en el sistema estructural de resistencia sísmica

Ro	7.00
ϕ_a	1.00
ϕ_p	0.90
ϕ_r	1.00
ϕ	1.00
R	6.30

TIPO	DESCRIPCION	VALOR
	2P	ϕ_p: 0.90
		ϕ_a: 1.00
	REDUNDANCIA	ϕ_r: 1.00
	UNIONES SOLDADAS	ϕ: 1.00

ESPECTRO DE DISENO (AMORTIGUAMIENTO ξ=5% DEL CRITICO)

Fa: Factor de ampliación de la aceleración.
Fv: Factor de ampliación de la aceleración en el rango de velocidades constantes.
Sa: Valor del espectro de aceleraciones de diseño para un periodo de vibración dado.
Aa: Coeficiente que representa la aceleración horizontal pico efectiva para diseño.
Av: Coeficiente que representa la velocidad horizontal pico efectiva para diseño.
T: Periodo de vibración del sistema elástico, en segundos.
T_C: Periodo de vibración, en segundos, correspondiente a la transición entre la zona de aceleración constante del espectro de diseño, para periodos cortos, y la parte descendiente del mismo.
T_L: Periodo de vibración, en segundos, correspondiente al inicio de la zona de desplazamiento aproximadamente constante del espectro de diseño para periodos largos.

ZONA DE AMENAZA ALTA

T_o:	0.21	Seg
T_C:	0.99	Seg
T_L:	7.20	Seg
Aa:	0.25	
Av:	0.25	
Fa:	1.45	
Fv:	3.00	

T	Sa	Sa/$R_{adoptado}$
(Seg)	(%g)	(%g)
0.00	1.133	0.180
0.05	1.133	0.180
0.10	1.133	0.180
0.16	1.133	0.180
0.21	1.133	0.180
0.40	1.133	0.180
0.60	1.133	0.180
0.80	1.133	0.180
0.99	1.133	0.180
1.34	0.841	0.133
1.68	0.669	0.106
2.03	0.555	0.088
2.37	0.474	0.075
2.72	0.414	0.066
3.06	0.367	0.058
3.41	0.330	0.052
3.75	0.300	0.048
4.10	0.275	0.044
4.44	0.253	0.040
4.79	0.235	0.037
5.13	0.219	0.035
5.48	0.205	0.033
5.82	0.193	0.031
6.17	0.182	0.029
6.51	0.173	0.027
6.86	0.164	0.026
7.20	0.156	0.025
8.20	0.120	0.019
9.20	0.096	0.015

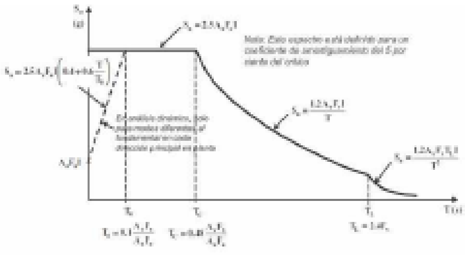
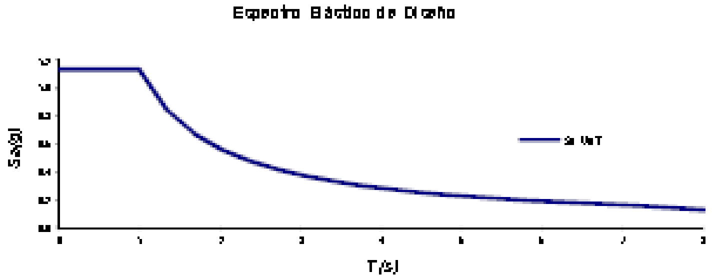
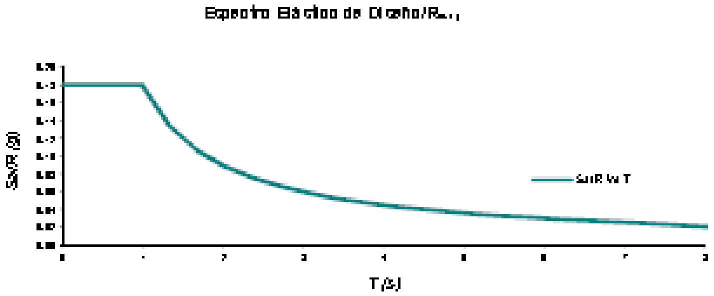


Figura A.2.6-1 — Espectro Elástico de Aceleraciones de Diseño como fracción de g





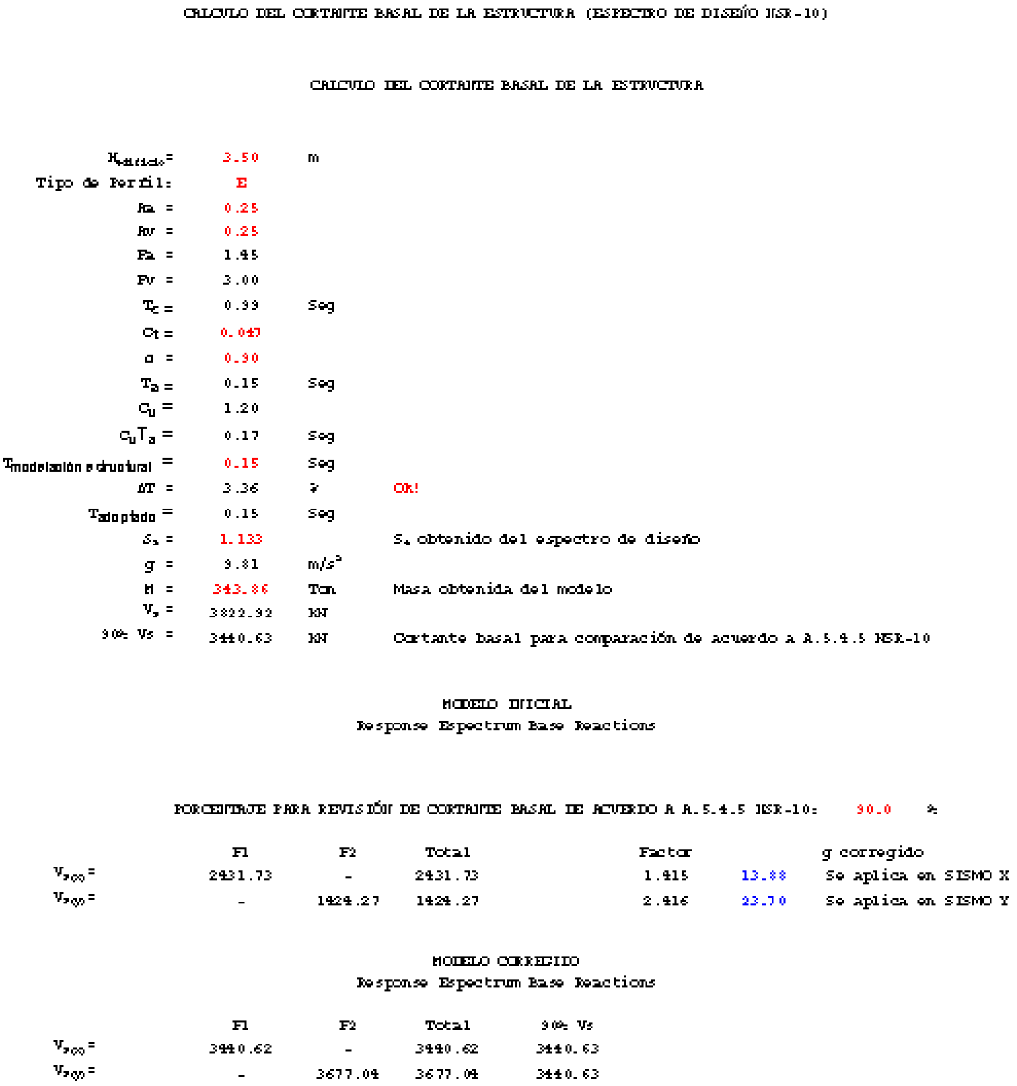
Sistema de resistencia Sísmica: Pórticos resistentes a momentos con Capacidad Especial de Disipación de Energía (DES).

Nota: El sistema de pórtico es un sistema estructural compuesto por un pórtico espacial, resistente a momentos, esencialmente completo, sin diagonales, que resiste todas las cargas verticales y las fuerzas horizontales.

MODELO MATEMÁTICO

Modelo Tridimensional con Diafragma Rígido: En este modelo los entrepisos se consideran diafragmas infinitamente rígidos en su propio plano. La masa de cada diafragma se considera concentrada en su centro de masa. Los efectos torsionales accidentales son incluidos haciendo ajustes en la localización de los centros de masa de los diafragmas.
Los efectos direccionales son tomados en cuenta a través de las componentes de los desplazamientos de los grados de libertad horizontales ortogonales del diafragma.

7.2.2 CALCULO DEL CORTANTE BASAL DE LA ESTRUCTURA (ESPECTRO DE DISEÑO NSR-10)



CALCULO DEL CORTANTE BASAL DE LA ESTRUCTURA (ESPECTRO DE DISEÑO NSR-10)

CALCULO DEL CORTANTE BASAL DE LA ESTRUCTURA

$H_{edificio}$ =	3.50	m	
Tipo de Perfil:	E		
Aa =	0.25		
Av =	0.25		
Fa =	1.45		
Fv =	3.00		
T_C =	0.99	Seg	
C_t =	0.047		
α =	0.90		
T_a =	0.15	Seg	
C_u =	1.20		
$C_u T_a$ =	0.17	Seg	
$T_{modelación\ estructural}$ =	0.15	Seg	
ΔT =	3.36	%	OK!
$T_{adoptado}$ =	0.15	Seg	
S_a =	1.133		S_a obtenido del espectro de diseño
g =	9.81	m/s^2	
M =	343.86	Ton	Masa obtenida del modelo
V_s =	3822.92	KN	
90% Vs =	3440.63	KN	Cortante basal para comparación de acuerdo a A.5.4.5 NSR-10

MODELO INICIAL

Response Espectrum Base Reactions

PORCENTAJE PARA REVISIÓN DE CORTANTE BASAL DE ACUERDO A A.5.4.5 NSR-10: 90.0 %

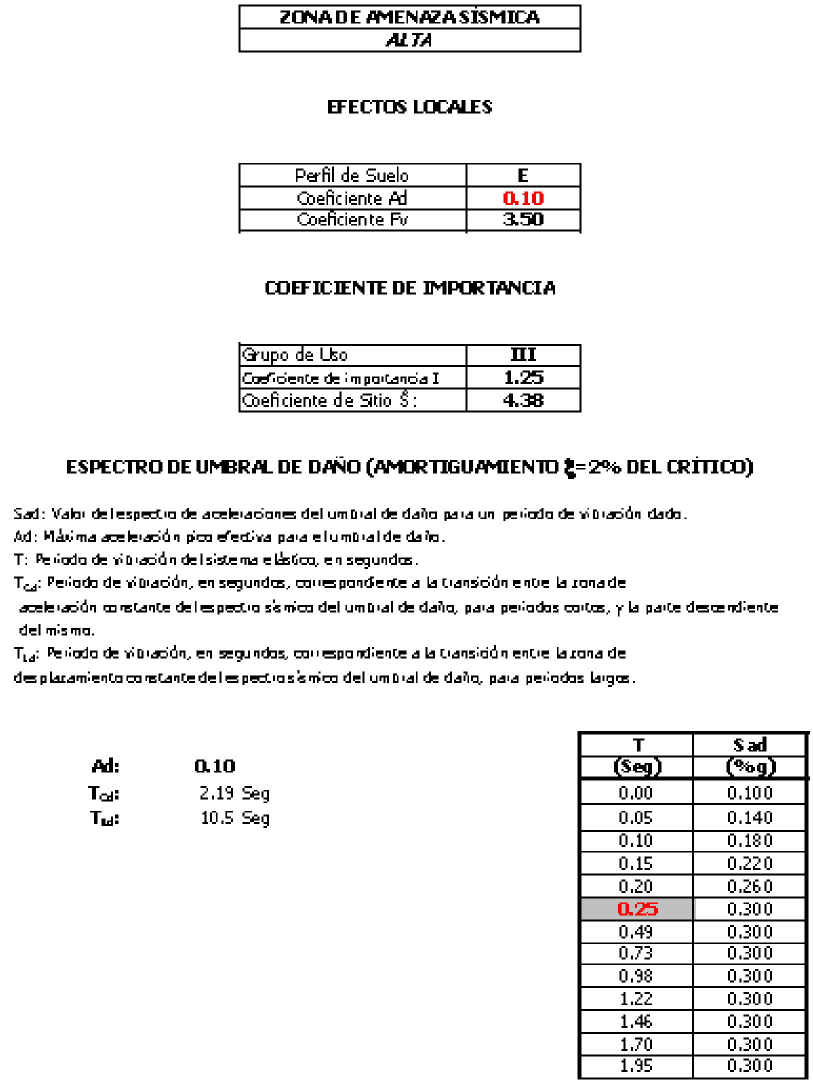
	F1	F2	Total	Factor		g corregido
$V_{s(X)}$ =	2431.73	-	2431.73	1.415	13.88	Se aplica en SISMO X
$V_{s(Y)}$ =	-	1424.27	1424.27	2.416	23.70	Se aplica en SISMO Y

MODELO CORREGIDO

Response Espectrum Base Reactions

	F1	F2	Total	90% Vs
$V_{s(X)}$ =	3440.62	-	3440.62	3440.63
$V_{s(Y)}$ =	-	3677.04	3677.04	3440.63

7.2.3 ANÁLISIS SÍSMICO (ESPECTRO DE UMBRAL DE DAÑO NSR-10)



ZONA DE AMENAZA SÍSMICA
ALTA

EFECTOS LOCALES

Perfil de Suelo	E
Coeficiente Ad	0.10
Coeficiente Fv	3.50

COEFICIENTE DE IMPORTANCIA

Grupo de Uso	III
Coeficiente de importancia I	1.25
Coeficiente de Sitio Ŝ :	4.38

ESPECTRO DE UMBRAL DE DAÑO (AMORTIGUAMIENTO ξ=2% DEL CRÍTICO)

Sad: Valor del espectro de aceleraciones del umbral de daño para un periodo de vibración dado.

Ad: Máxima aceleración pico efectiva para el umbral de daño.

T: Periodo de vibración del sistema elástico, en segundos.

T_{Cd}: Periodo de vibración, en segundos, correspondiente a la transición entre la zona de aceleración constante del espectro sísmico del umbral de daño, para periodos cortos, y la parte descendiente del mismo.

T_{Ld}: Periodo de vibración, en segundos, correspondiente a la transición entre la zona de desplazamiento constante del espectro sísmico del umbral de daño, para periodos largos.

Ad: **0.10**
T_{Cd}: 2.19 Seg
T_{Ld}: 10.5 Seg

T (Seg)	Sad (%g)
0.00	0.100
0.05	0.140
0.10	0.180
0.15	0.220
0.20	0.260
0.25	0.300
0.49	0.300
0.73	0.300
0.98	0.300
1.22	0.300
1.46	0.300
1.70	0.300
1.95	0.300

[illegible]

2.19	0.300
2.78	0.236
3.38	0.194
3.97	0.165
4.56	0.144
5.16	0.127
5.75	0.114
6.34	0.103
6.94	0.095
7.53	0.087
8.13	0.081
8.72	0.075
9.31	0.070
9.91	0.066
10.50	0.063
11.50	0.052
12.50	0.044

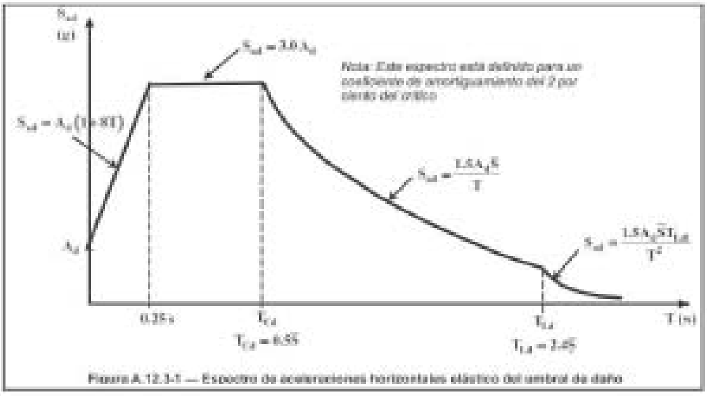
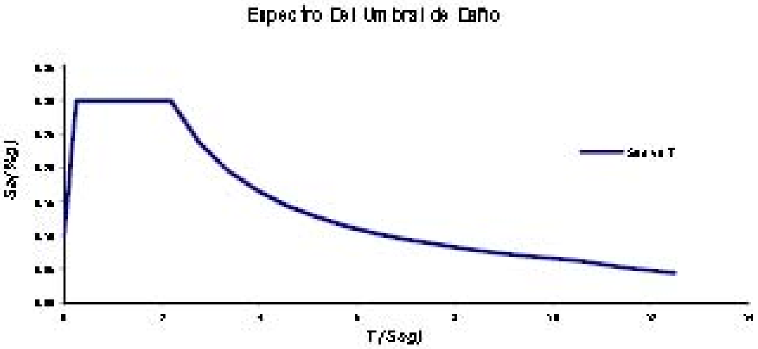

S_{ad} (g)
$S_{ad} = 3.0\,A_d$
Nota: Este espectro está definido para un coeficiente de amortiguamiento del 2 por ciento del crítico
$S_{ad} = A_d(1+8T)$
$S_{ad} = \frac{1.5A_dS}{T}$
$S_{ad} = \frac{1.5A_dST_{Ld}}{T^2}$
A_d
0.25 s
T_{Cd}
$T_{Cd} = 0.5S$
T_{Ld}
$T_{Ld} = 3.0S$
T (s)

Figura A.12.3-1 — Espectro de aceleraciones horizontales elástico del umbral de daño



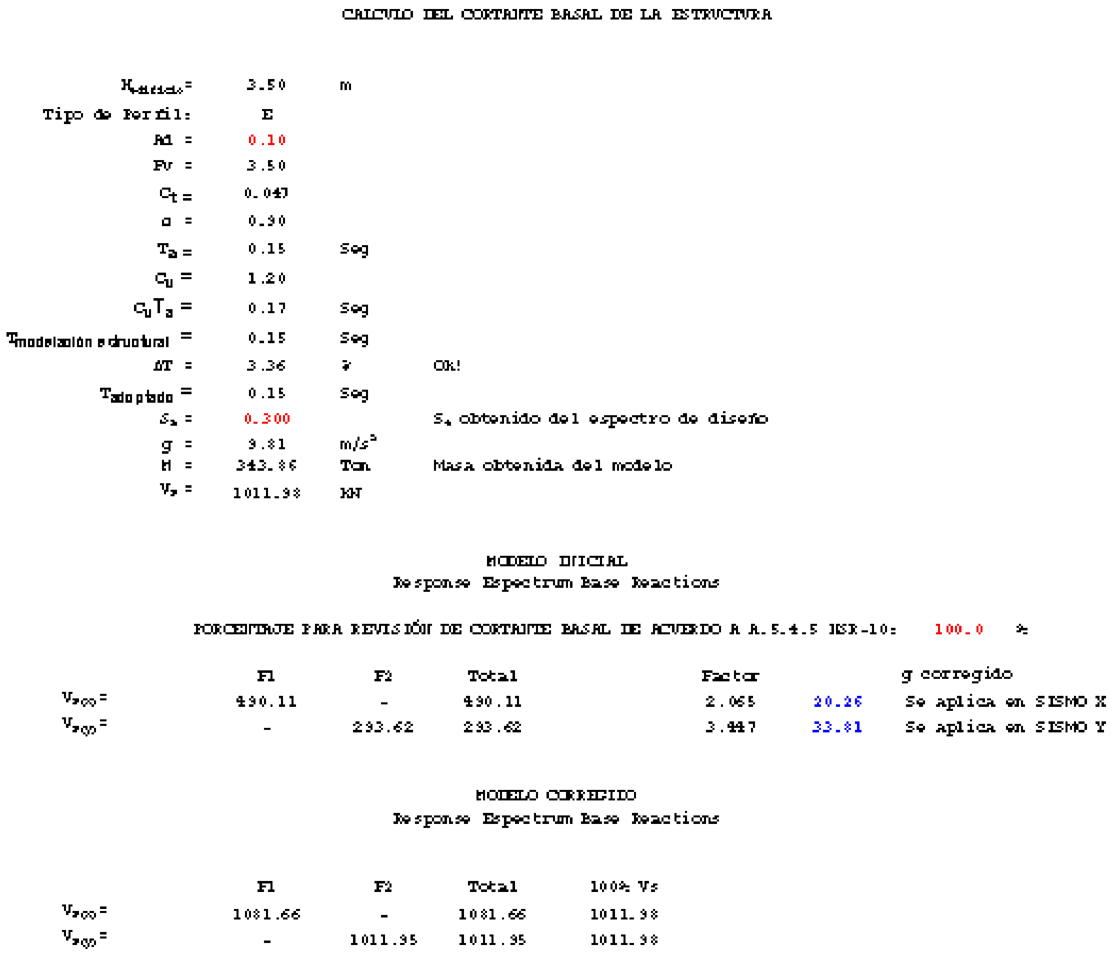
Sistema de resistencia Sísmica: Pórticos resistentes a momentos con Capacidad Especial de Disipación de Energía (DES).

Nota: El sistema de pórtico es un sistema estructural compuesto por un pórtico espacial, resistente a momentos, esencialmente completo, sin diagonales, que resiste todas las cargas verticales y las fuerzas horizontales.

MODELO MATEMÁTICO

Modelo Tridimensional con Diafragma Rígido: En este modelo los entrepisos se consideran diafragmas infinitamente rígidos en su propio plano. La masa de cada diafragma se considera concentrada en su centro de masa. Los efectos torsionales accidentales son incluidos haciendo ajustes en la localización de los centros de masa de los diafragmas.
Los efectos direccionales son tomados en cuenta a través de las componentes de los desplazamientos de los grados de libertad horizontales ortogonales del diafragma.

7.2.4 CALCULO DEL CORTANTE BASAL DE LA ESTRUCTURA (ESPECTRO DE UMBRAL DE DAÑO NSR-10)



CALCULO DEL CORTANTE BASAL DE LA ESTRUCTURA

$H_{edificio}$ =	3.50	m	
Tipo de Perfil:	E		
Aa =	0.10		
Fv =	3.50		
C_t =	0.047		
α =	0.90		
T_a =	0.15	Seg	
C_u =	1.20		
C_uT_a =	0.17	Seg	
$T_{modelación\ estructural}$ =	0.15	Seg	
ΔT =	3.36	%	OK!
$T_{adoptado}$ =	0.15	Seg	
S_a =	0.300		S_a obtenido del espectro de diseño
g =	9.81	m/s^2	
M =	343.86	Ton	Masa obtenida del modelo
V_s =	1011.98	KN	

MODELO INICIAL
Response Spectrum Base Reactions

PORCENTAJE PARA REVISIÓN DE CORTANTE BASAL DE ACUERDO A A.5.4.5 NSR-10: 100.0 %

	F1	F2	Total	Factor	g corregido	
$V_{s(x)}$ =	490.11	-	490.11	2.065	20.26	Se aplica en SISMO X
$V_{s(y)}$ =	-	293.62	293.62	3.447	33.81	Se aplica en SISMO Y

MODELO CORREGIDO
Response Spectrum Base Reactions

	F1	F2	Total	100% Vs
$V_{s(x)}$ =	1081.66	-	1081.66	1011.98
$V_{s(y)}$ =	-	1011.95	1011.95	1011.98

7.2.5 CÁLCULO DE DERIVAS MÁXIMAS

ALTURA DE N+3.45	3.50	m
ALTURA DE N+0.00	2.09	m

Deriva Máxima Permitida	1.00	%

Nivel	Punto	COMBINACIÓN DE CARGA	DESPLAZAMIENTOS FUERZA SÍSMICA		Deriva Δ	Deriva Δ	Observación
			Desplazamiento X	Desplazamiento Y	m	%	
N+3.45	1	COMDER1 MAX	0.0143	0.0052	0.01231	0.35	OK
N+3.45	1	COMDER1 MIN	-0.0143	-0.0052	0.01231	0.35	OK
N+3.45	1	COMDER2 MAX	0.0102	0.014	0.01571	0.45	OK
N+3.45	1	COMDER2 MIN	-0.0102	-0.014	0.01571	0.45	OK
N+0.00	1	COMDER1 MAX	0.0035	0.0003	0.00351	0.17	OK
N+0.00	1	COMDER1 MIN	-0.0035	-0.0003	0.00351	0.17	OK
N+0.00	1	COMDER2 MAX	0.0027	0.0002	0.00271	0.13	OK
N+0.00	1	COMDER2 MIN	-0.0027	-0.0002	0.00271	0.13	OK
BASE	1	COMDER1 MAX	0	0	–	–	–
BASE	1	COMDER1 MIN	0	0	–	–	–
BASE	1	COMDER2 MAX	0	0	–	–	–
BASE	1	COMDER2 MIN	0	0	–	–	–
N+3.45	2	COMDER1 MAX	0.0143	0.004	0.01485	0.42	OK
N+3.45	2	COMDER1 MIN	-0.0143	-0.004	0.01485	0.42	OK
N+3.45	2	COMDER2 MAX	0.0102	0.0089	0.01354	0.39	OK
N+3.45	2	COMDER2 MIN	-0.0102	-0.0089	0.01354	0.39	OK
N+0.00	2	COMDER1 MAX	0	0	–	–	–
N+0.00	2	COMDER1 MIN	0	0	–	–	–
N+0.00	2	COMDER2 MAX	0	0	–	–	–
N+0.00	2	COMDER2 MIN	0	0	–	–	–
N+3.45	3	COMDER1 MAX	0.0143	0.0033	0.01468	0.42	OK
N+3.45	3	COMDER1 MIN	-0.0143	-0.0033	0.01468	0.42	OK
N+3.45	3	COMDER2 MAX	0.0102	0.0082	0.01309	0.37	OK
N+3.45	3	COMDER2 MIN	-0.0102	-0.0082	0.01309	0.37	OK
N+0.00	3	COMDER1 MAX	0	0	–	–	–
N+0.00	3	COMDER1 MIN	0	0	–	–	–
N+0.00	3	COMDER2 MAX	0	0	–	–	–
N+0.00	3	COMDER2 MIN	0	0	–	–	–
N+3.45	4	COMDER1 MAX	0.0143	0.0043	0.01493	0.43	OK
N+3.45	4	COMDER1 MIN	-0.0143	-0.0043	0.01493	0.43	OK
N+3.45	4	COMDER2 MAX	0.0102	0.0112	0.01515	0.43	OK
N+3.45	4	COMDER2 MIN	-0.0102	-0.0112	0.01515	0.43	OK
N+0.00	4	COMDER1 MAX	0	0	–	–	–
N+0.00	4	COMDER1 MIN	0	0	–	–	–
N+0.00	4	COMDER2 MAX	0	0	–	–	–
N+0.00	4	COMDER2 MIN	0	0	–	–	–
N+3.45	5	COMDER1 MAX	0.0143	0.0069	0.01588	0.45	OK
N+3.45	5	COMDER1 MIN	-0.0143	-0.0069	0.01588	0.45	OK
N+3.45	5	COMDER2 MAX	0.0102	0.018	0.02069	0.59	OK
N+3.45	5	COMDER2 MIN	-0.0102	-0.018	0.02069	0.59	OK
N+0.00	5	COMDER1 MAX	0	0	–	–	–
N+0.00	5	COMDER1 MIN	0	0	–	–	–
N+0.00	5	COMDER2 MAX	0	0	–	–	–
N+0.00	5	COMDER2 MIN	0	0	–	–	–
N+3.45	6	COMDER1 MAX	0.0143	0.01	0.01745	0.50	OK
N+3.45	6	COMDER1 MIN	-0.0143	-0.01	0.01745	0.50	OK
N+3.45	6	COMDER2 MAX	0.0102	0.0257	0.02765	0.79	OK
N+3.45	6	COMDER2 MIN	-0.0102	-0.0257	0.02765	0.79	OK
N+0.00	6	COMDER1 MAX	0	0	–	–	–
N+0.00	6	COMDER1 MIN	0	0	–	–	–
N+0.00	6	COMDER2 MAX	0	0	–	–	–
N+0.00	6	COMDER2 MIN	0	0	–	–	–
N+3.45	7	COMDER1 MAX	0.0125	0.0062	0.01338	0.38	OK
N+3.45	7	COMDER1 MIN	-0.0125	-0.0062	0.01338	0.38	OK
N+3.45	7	COMDER2 MAX	0.0057	0.014	0.01412	0.40	OK
N+3.45	7	COMDER2 MIN	-0.0057	-0.014	0.01412	0.40	OK
N+0.00	7	COMDER1 MAX	0.0003	0.0007	0.00076	0.04	OK
N+0.00	7	COMDER1 MIN	-0.0003	-0.0007	0.00076	0.04	OK
N+0.00	7	COMDER2 MAX	0.0002	0.001	0.00102	0.05	OK
N+0.00	7	COMDER2 MIN	-0.0002	-0.001	0.00102	0.05	OK
BASE	7	COMDER1 MAX	0	0	–	–	–
BASE	7	COMDER1 MIN	0	0	–	–	–
BASE	7	COMDER2 MAX	0	0	–	–	–
BASE	7	COMDER2 MIN	0	0	–	–	–

ALTURA DE N+3.45	3.50	m	Deriva Máxima Permitida	1.00 %
ALTURA DE N+0.00	2.09	m		

Nivel	Punto	COMBINACIÓN DE CARGA	DESPLAZAMIENTOS FUERZA SÍSMICA		Deriva Δ m	Deriva Δ %	Observación
			Desplazamiento X	Desplazamiento Y			
N+3.45	8	COMDER1 MAX	0.0125	0.004	0.01278	0.37	OK
N+3.45	8	COMDER1 MIN	-0.0125	-0.004	0.01278	0.37	OK
N+3.45	8	COMDER2 MAX	0.0057	0.0089	0.01035	0.30	OK
N+3.45	8	COMDER2 MIN	-0.0057	-0.0089	0.01035	0.30	OK
N+0.00	8	COMDER1 MAX	0.0003	0.0002	0.00036	0.02	OK
N+0.00	8	COMDER1 MIN	-0.0003	-0.0002	0.00036	0.02	OK
N+0.00	8	COMDER2 MAX	0.0001	0.0002	0.00022	0.01	OK
N+0.00	8	COMDER2 MIN	-0.0001	-0.0002	0.00022	0.01	OK
BASE	8	COMDER1 MAX	0	0	—	—	—
BASE	8	COMDER1 MIN	0	0	—	—	—
BASE	8	COMDER2 MAX	0	0	—	—	—
BASE	8	COMDER2 MIN	0	0	—	—	—
N+3.45	9	COMDER1 MAX	0.0125	0.0033	0.01293	0.37	OK
N+3.45	9	COMDER1 MIN	-0.0125	-0.0033	0.01293	0.37	OK
N+3.45	9	COMDER2 MAX	0.0057	0.0082	0.00999	0.29	OK
N+3.45	9	COMDER2 MIN	-0.0057	-0.0082	0.00999	0.29	OK
N+0.00	9	COMDER1 MAX	0	0	—	—	—
N+0.00	9	COMDER1 MIN	0	0	—	—	—
N+0.00	9	COMDER2 MAX	0	0	—	—	—
N+0.00	9	COMDER2 MIN	0	0	—	—	—
N+3.45	10	COMDER1 MAX	0.0125	0.0043	0.01322	0.38	OK
N+3.45	10	COMDER1 MIN	-0.0125	-0.0043	0.01322	0.38	OK
N+3.45	10	COMDER2 MAX	0.0057	0.0112	0.01257	0.36	OK
N+3.45	10	COMDER2 MIN	-0.0057	-0.0112	0.01257	0.36	OK
N+0.00	10	COMDER1 MAX	0	0	—	—	—
N+0.00	10	COMDER1 MIN	0	0	—	—	—
N+0.00	10	COMDER2 MAX	0	0	—	—	—
N+0.00	10	COMDER2 MIN	0	0	—	—	—
N+3.45	11	COMDER1 MAX	0.0125	0.0069	0.01428	0.41	OK
N+3.45	11	COMDER1 MIN	-0.0125	-0.0069	0.01428	0.41	OK
N+3.45	11	COMDER2 MAX	0.0057	0.018	0.01888	0.54	OK
N+3.45	11	COMDER2 MIN	-0.0057	-0.018	0.01888	0.54	OK
N+0.00	11	COMDER1 MAX	0	0	—	—	—
N+0.00	11	COMDER1 MIN	0	0	—	—	—
N+0.00	11	COMDER2 MAX	0	0	—	—	—
N+0.00	11	COMDER2 MIN	0	0	—	—	—
N+3.45	12	COMDER1 MAX	0.0125	0.01	0.01601	0.46	OK
N+3.45	12	COMDER1 MIN	-0.0125	-0.01	0.01601	0.46	OK
N+3.45	12	COMDER2 MAX	0.0057	0.0257	0.02632	0.75	OK
N+3.45	12	COMDER2 MIN	-0.0057	-0.0257	0.02632	0.75	OK
N+0.00	12	COMDER1 MAX	0	0	—	—	—
N+0.00	12	COMDER1 MIN	0	0	—	—	—
N+0.00	12	COMDER2 MAX	0	0	—	—	—
N+0.00	12	COMDER2 MIN	0	0	—	—	—
N+3.45	13	COMDER1 MAX	0.0129	0.0062	0.01321	0.38	OK
N+3.45	13	COMDER1 MIN	-0.0129	-0.0062	0.01321	0.38	OK
N+3.45	13	COMDER2 MAX	0.0071	0.014	0.01427	0.41	OK
N+3.45	13	COMDER2 MIN	-0.0071	-0.014	0.01427	0.41	OK
N+0.00	13	COMDER1 MAX	0.0008	0.0009	0.00120	0.06	OK
N+0.00	13	COMDER1 MIN	-0.0008	-0.0009	0.00120	0.06	OK
N+0.00	13	COMDER2 MAX	0.0006	0.0013	0.00143	0.07	OK
N+0.00	13	COMDER2 MIN	-0.0006	-0.0013	0.00143	0.07	OK
BASE	13	COMDER1 MAX	0	0	—	—	—
BASE	13	COMDER1 MIN	0	0	—	—	—
BASE	13	COMDER2 MAX	0	0	—	—	—
BASE	13	COMDER2 MIN	0	0	—	—	—
N+3.45	14	COMDER1 MAX	0.0129	0.004	0.01271	0.36	OK
N+3.45	14	COMDER1 MIN	-0.0129	-0.004	0.01271	0.36	OK
N+3.45	14	COMDER2 MAX	0.0071	0.0089	0.01096	0.31	OK
N+3.45	14	COMDER2 MIN	-0.0071	-0.0089	0.01096	0.31	OK

ALTURA DE N+3.45 3.50 m
ALTURA DE N+0.00 2.09 m

Deriva Máxima Permitida 1.00 %

Nivel	Punto	COMBINACIÓN DE CARGA	DESPLAZAMIENTOS FUERZA SÍSMICA		Deriva Δ	Deriva Δ	Observación
			Desplazamiento X	Desplazamiento Y	m	%	
N+0.00	14	COMDER1 MAX	0.0008	0.0001	0.00081	0.04	OK
N+0.00	14	COMDER1 MIN	-0.0008	-0.0001	0.00081	0.04	OK
N+0.00	14	COMDER2 MAX	0.0006	0.0002	0.00063	0.03	OK
N+0.00	14	COMDER2 MIN	-0.0006	-0.0002	0.00063	0.03	OK
BASE	14	COMDER1 MAX	0	0	–	–	–
BASE	14	COMDER1 MIN	0	0	–	–	–
BASE	14	COMDER2 MAX	0	0	–	–	–
BASE	14	COMDER2 MIN	0	0	–	–	–
N+3.45	15	COMDER1 MAX	0.0129	0.0033	0.01332	0.38	OK
N+3.45	15	COMDER1 MIN	-0.0129	-0.0033	0.01332	0.38	OK
N+3.45	15	COMDER2 MAX	0.0071	0.0082	0.01085	0.31	OK
N+3.45	15	COMDER2 MIN	-0.0071	-0.0082	0.01085	0.31	OK
N+0.00	15	COMDER1 MAX	0	0	–	–	–
N+0.00	15	COMDER1 MIN	0	0	–	–	–
N+0.00	15	COMDER2 MAX	0	0	–	–	–
N+0.00	15	COMDER2 MIN	0	0	–	–	–
N+3.45	16	COMDER1 MAX	0.0129	0.0043	0.01360	0.39	OK
N+3.45	16	COMDER1 MIN	-0.0129	-0.0043	0.01360	0.39	OK
N+3.45	16	COMDER2 MAX	0.0071	0.0112	0.01326	0.38	OK
N+3.45	16	COMDER2 MIN	-0.0071	-0.0112	0.01326	0.38	OK
N+0.00	16	COMDER1 MAX	0	0	–	–	–
N+0.00	16	COMDER1 MIN	0	0	–	–	–
N+0.00	16	COMDER2 MAX	0	0	–	–	–
N+0.00	16	COMDER2 MIN	0	0	–	–	–
N+3.45	227	COMDER1 MAX	0.0146	0.0052	0.01382	0.39	OK
N+3.45	227	COMDER1 MIN	-0.0146	-0.0052	0.01382	0.39	OK
N+3.45	227	COMDER2 MAX	0.0126	0.014	0.01652	0.47	OK
N+3.45	227	COMDER2 MIN	-0.0126	-0.014	0.01652	0.47	OK
N+0.00	227	COMDER1 MAX	0.0018	0.001	0.00206	0.10	OK
N+0.00	227	COMDER1 MIN	-0.0018	-0.001	0.00206	0.10	OK
N+0.00	227	COMDER2 MAX	0.0018	0.0015	0.00234	0.11	OK
N+0.00	227	COMDER2 MIN	-0.0018	-0.0015	0.00234	0.11	OK
BASE	227	COMDER1 MAX	0	0	–	–	–
BASE	227	COMDER1 MIN	0	0	–	–	–
BASE	227	COMDER2 MAX	0	0	–	–	–
BASE	227	COMDER2 MIN	0	0	–	–	–
N+3.45	228	COMDER1 MAX	0.0146	0.004	0.01338	0.38	OK
N+3.45	228	COMDER1 MIN	-0.0146	-0.004	0.01338	0.38	OK
N+3.45	228	COMDER2 MAX	0.0126	0.0089	0.01387	0.40	OK
N+3.45	228	COMDER2 MIN	-0.0126	-0.0089	0.01387	0.40	OK
N+0.00	228	COMDER1 MAX	0.0018	0.0001	0.00180	0.09	OK
N+0.00	228	COMDER1 MIN	-0.0018	-0.0001	0.00180	0.09	OK
N+0.00	228	COMDER2 MAX	0.0018	0.0002	0.00181	0.09	OK
N+0.00	228	COMDER2 MIN	-0.0018	-0.0002	0.00181	0.09	OK
BASE	228	COMDER1 MAX	0	0	–	–	–
BASE	228	COMDER1 MIN	0	0	–	–	–
BASE	228	COMDER2 MAX	0	0	–	–	–
BASE	228	COMDER2 MIN	0	0	–	–	–
N+3.45	229	COMDER1 MAX	0.0146	0.0033	0.01497	0.43	OK
N+3.45	229	COMDER1 MIN	-0.0146	-0.0033	0.01497	0.43	OK
N+3.45	229	COMDER2 MAX	0.0126	0.0082	0.01503	0.43	OK
N+3.45	229	COMDER2 MIN	-0.0126	-0.0082	0.01503	0.43	OK
N+0.00	229	COMDER1 MAX	0	0	–	–	–
N+0.00	229	COMDER1 MIN	0	0	–	–	–
N+0.00	229	COMDER2 MAX	0	0	–	–	–
N+0.00	229	COMDER2 MIN	0	0	–	–	–
N+3.45	230	COMDER1 MAX	0.0146	0.0043	0.01522	0.43	OK
N+3.45	230	COMDER1 MIN	-0.0146	-0.0043	0.01522	0.43	OK
N+3.45	230	COMDER2 MAX	0.0126	0.0112	0.01695	0.48	OK
N+3.45	230	COMDER2 MIN	-0.0126	-0.0112	0.01695	0.48	OK
N+0.00	230	COMDER1 MAX	0	0	–	–	–
N+0.00	230	COMDER1 MIN	0	0	–	–	–
N+0.00	230	COMDER2 MAX	0	0	–	–	–
N+0.00	230	COMDER2 MIN	0	0	–	–	–

CÁLCULO DE DERIVAS MÁXIMAS (ESPECTRO DE UMBRAL DE DAÑO)

ALTURA DE N+3.45	**3.50**	m	Deriva Máxima Permitida	**0.40** %
ALTURA DE N+0.00	**2.09**	m		

Nivel	**Punto**	**COMBINACIÓN DE CARGA**	**DESPLAZAMIENTOS FUERZA SÍSMICA** **Desplazamiento X**	**Desplazamiento Y**	**Deriva Δ m**	**Deriva Δ %**	**Observación**
N+3.45	1	COMDERUMBE MAX	0.00450	0.00170	0.00376	0.11	OK
N+3.45	1	COMDERUMBE MIN	-0.00450	-0.00170	0.00376	0.11	OK
N+3.45	1	COMDERUMB2 MAX	0.00310	0.00380	0.00436	0.12	OK
N+3.45	1	COMDERUMB2 MIN	-0.00310	-0.00380	0.00436	0.12	OK
N+0.00	1	COMDERUMBE MAX	0.00110	0.00010	0.00110	0.05	OK
N+0.00	1	COMDERUMBE MIN	-0.00110	-0.00010	0.00110	0.05	OK
N+0.00	1	COMDERUMB2 MAX	0.00080	0.00010	0.00081	0.04	OK
N+0.00	1	COMDERUMB2 MIN	-0.00080	-0.00010	0.00081	0.04	OK
BASE	1	COMDERUMBE MAX	0.00000	0.00000	–	–	–
BASE	1	COMDERUMBE MIN	0.00000	0.00000	–	–	–
BASE	1	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
BASE	1	COMDERUMB2 MIN	0.00000	0.00000	–	–	–
N+3.45	2	COMDERUMBE MAX	0.00450	0.00110	0.00463	0.13	OK
N+3.45	2	COMDERUMBE MIN	-0.00450	-0.00110	0.00463	0.13	OK
N+3.45	2	COMDERUMB2 MAX	0.00310	0.00230	0.00386	0.11	OK
N+3.45	2	COMDERUMB2 MIN	-0.00310	-0.00230	0.00386	0.11	OK
N+0.00	2	COMDERUMBE MAX	0.00000	0.00000	–	–	–
N+0.00	2	COMDERUMBE MIN	0.00000	0.00000	–	–	–
N+0.00	2	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
N+0.00	2	COMDERUMB2 MIN	0.00000	0.00000	–	–	–
N+3.45	3	COMDERUMBE MAX	0.00450	0.00090	0.00459	0.13	OK
N+3.45	3	COMDERUMBE MIN	-0.00450	-0.00090	0.00459	0.13	OK
N+3.45	3	COMDERUMB2 MAX	0.00310	0.00230	0.00386	0.11	OK
N+3.45	3	COMDERUMB2 MIN	-0.00310	-0.00230	0.00386	0.11	OK
N+0.00	3	COMDERUMBE MAX	0.00000	0.00000	–	–	–
N+0.00	3	COMDERUMBE MIN	0.00000	0.00000	–	–	–
N+0.00	3	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
N+0.00	3	COMDERUMB2 MIN	0.00000	0.00000	–	–	–
N+3.45	4	COMDERUMBE MAX	0.00450	0.00130	0.00468	0.13	OK
N+3.45	4	COMDERUMBE MIN	-0.00450	-0.00130	0.00468	0.13	OK
N+3.45	4	COMDERUMB2 MAX	0.00310	0.00330	0.00453	0.13	OK
N+3.45	4	COMDERUMB2 MIN	-0.00310	-0.00330	0.00453	0.13	OK
N+0.00	4	COMDERUMBE MAX	0.00000	0.00000	–	–	–
N+0.00	4	COMDERUMBE MIN	0.00000	0.00000	–	–	–
N+0.00	4	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
N+0.00	4	COMDERUMB2 MIN	0.00000	0.00000	–	–	–
N+3.45	5	COMDERUMBE MAX	0.00450	0.00210	0.00497	0.14	OK
N+3.45	5	COMDERUMBE MIN	-0.00450	-0.00210	0.00497	0.14	OK
N+3.45	5	COMDERUMB2 MAX	0.00310	0.00550	0.00631	0.18	OK
N+3.45	5	COMDERUMB2 MIN	-0.00310	-0.00550	0.00631	0.18	OK
N+0.00	5	COMDERUMBE MAX	0.00000	0.00000	–	–	–
N+0.00	5	COMDERUMBE MIN	0.00000	0.00000	–	–	–
N+0.00	5	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
N+0.00	5	COMDERUMB2 MIN	0.00000	0.00000	–	–	–
N+3.45	6	COMDERUMBE MAX	0.00450	0.00300	0.00541	0.15	OK
N+3.45	6	COMDERUMBE MIN	-0.00450	-0.00300	0.00541	0.15	OK
N+3.45	6	COMDERUMB2 MAX	0.00310	0.00780	0.00839	0.24	OK
N+3.45	6	COMDERUMB2 MIN	-0.00310	-0.00780	0.00839	0.24	OK
N+0.00	6	COMDERUMBE MAX	0.00000	0.00000	–	–	–
N+0.00	6	COMDERUMBE MIN	0.00000	0.00000	–	–	–
N+0.00	6	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
N+0.00	6	COMDERUMB2 MIN	0.00000	0.00000	–	–	–
N+3.45	7	COMDERUMBE MAX	0.00390	0.00170	0.00409	0.12	OK
N+3.45	7	COMDERUMBE MIN	-0.00390	-0.00170	0.00409	0.12	OK
N+3.45	7	COMDERUMB2 MAX	0.00170	0.00380	0.00389	0.11	OK
N+3.45	7	COMDERUMB2 MIN	-0.00170	-0.00380	0.00389	0.11	OK
N+0.00	7	COMDERUMBE MAX	0.00010	0.00020	0.00022	0.01	OK
N+0.00	7	COMDERUMBE MIN	-0.00010	-0.00020	0.00022	0.01	OK
N+0.00	7	COMDERUMB2 MAX	0.00000	0.00030	0.00030	0.01	OK
N+0.00	7	COMDERUMB2 MIN	0.00000	-0.00030	0.00030	0.01	OK
BASE	7	COMDERUMBE MAX	0.00000	0.00000	–	–	–
BASE	7	COMDERUMBE MIN	0.00000	0.00000	–	–	–
BASE	7	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
BASE	7	COMDERUMB2 MIN	0.00000	0.00000	–	–	–

ALTURA DE N+3.45 **3.50** m
ALTURA DE N+0.00 **2.09** m

Deriva Máxima Permitida **0.40** %

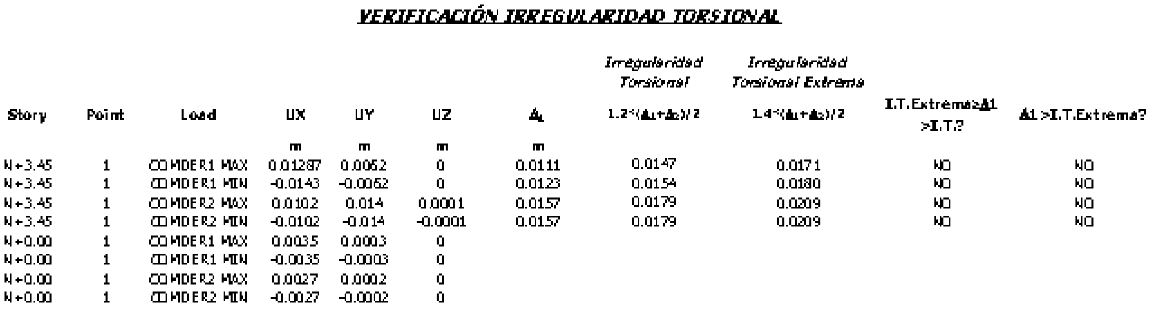
Nivel	Punto	COMBINACIÓN DE CARGA	DESPLAZAMIENTOS FUERZA SÍSMICA		Deriva Δ m	Deriva Δ %	Observación
			Desplazamiento X	Desplazamiento Y			
N+3.45	8	COMDERUMBE MAX	0.00390	0.00110	0.00396	0.11	OK
N+3.45	8	COMDERUMBE MIN	-0.00390	-0.00110	0.00396	0.11	OK
N+3.45	8	COMDERUMB2 MAX	0.00170	0.00230	0.00278	0.08	OK
N+3.45	8	COMDERUMB2 MIN	-0.00170	-0.00230	0.00278	0.08	OK
N+0.00	8	COMDERUMBE MAX	0.00010	0.00000	0.00010	0.00	OK
N+0.00	8	COMDERUMBE MIN	-0.00010	0.00000	0.00010	0.00	OK
N+0.00	8	COMDERUMB2 MAX	0.00000	0.00010	0.00010	0.00	OK
N+0.00	8	COMDERUMB2 MIN	0.00000	-0.00010	0.00010	0.00	OK
BASE	8	COMDERUMBE MAX	0.00000	0.00000	–	–	–
BASE	8	COMDERUMBE MIN	0.00000	0.00000	–	–	–
BASE	8	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
BASE	8	COMDERUMB2 MIN	0.00000	0.00000	–	–	–
N+3.45	9	COMDERUMBE MAX	0.00390	0.00090	0.00400	0.11	OK
N+3.45	9	COMDERUMBE MIN	-0.00390	-0.00090	0.00400	0.11	OK
N+3.45	9	COMDERUMB2 MAX	0.00170	0.00230	0.00286	0.08	OK
N+3.45	9	COMDERUMB2 MIN	-0.00170	-0.00230	0.00286	0.08	OK
N+0.00	9	COMDERUMBE MAX	0.00000	0.00000	–	–	–
N+0.00	9	COMDERUMBE MIN	0.00000	0.00000	–	–	–
N+0.00	9	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
N+0.00	9	COMDERUMB2 MIN	0.00000	0.00000	–	–	–
N+3.45	10	COMDERUMBE MAX	0.00390	0.00130	0.00411	0.12	OK
N+3.45	10	COMDERUMBE MIN	-0.00390	-0.00130	0.00411	0.12	OK
N+3.45	10	COMDERUMB2 MAX	0.00170	0.00330	0.00371	0.11	OK
N+3.45	10	COMDERUMB2 MIN	-0.00170	-0.00330	0.00371	0.11	OK
N+0.00	10	COMDERUMBE MAX	0.00000	0.00000	–	–	–
N+0.00	10	COMDERUMBE MIN	0.00000	0.00000	–	–	–
N+0.00	10	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
N+0.00	10	COMDERUMB2 MIN	0.00000	0.00000	–	–	–
N+3.45	11	COMDERUMBE MAX	0.00390	0.00210	0.00443	0.13	OK
N+3.45	11	COMDERUMBE MIN	-0.00390	-0.00210	0.00443	0.13	OK
N+3.45	11	COMDERUMB2 MAX	0.00170	0.00550	0.00576	0.16	OK
N+3.45	11	COMDERUMB2 MIN	-0.00170	-0.00550	0.00576	0.16	OK
N+0.00	11	COMDERUMBE MAX	0.00000	0.00000	–	–	–
N+0.00	11	COMDERUMBE MIN	0.00000	0.00000	–	–	–
N+0.00	11	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
N+0.00	11	COMDERUMB2 MIN	0.00000	0.00000	–	–	–
N+3.45	12	COMDERUMBE MAX	0.00390	0.00300	0.00492	0.14	OK
N+3.45	12	COMDERUMBE MIN	-0.00390	-0.00300	0.00492	0.14	OK
N+3.45	12	COMDERUMB2 MAX	0.00170	0.00780	0.00798	0.23	OK
N+3.45	12	COMDERUMB2 MIN	-0.00170	-0.00780	0.00798	0.23	OK
N+0.00	12	COMDERUMBE MAX	0.00000	0.00000	–	–	–
N+0.00	12	COMDERUMBE MIN	0.00000	0.00000	–	–	–
N+0.00	12	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
N+0.00	12	COMDERUMB2 MIN	0.00000	0.00000	–	–	–
N+3.45	13	COMDERUMBE MAX	0.00410	0.00170	0.00418	0.12	OK
N+3.45	13	COMDERUMBE MIN	-0.00410	-0.00170	0.00418	0.12	OK
N+3.45	13	COMDERUMB2 MAX	0.00220	0.00380	0.00403	0.12	OK
N+3.45	13	COMDERUMB2 MIN	-0.00220	-0.00380	0.00403	0.12	OK
N+0.00	13	COMDERUMBE MAX	0.00020	0.00020	0.00028	0.01	OK
N+0.00	13	COMDERUMBE MIN	-0.00020	-0.00020	0.00028	0.01	OK
N+0.00	13	COMDERUMB2 MAX	0.00020	0.00030	0.00036	0.02	OK
N+0.00	13	COMDERUMB2 MIN	-0.00020	-0.00030	0.00036	0.02	OK
BASE	13	COMDERUMBE MAX	0.00000	0.00000	–	–	–
BASE	13	COMDERUMBE MIN	0.00000	0.00000	–	–	–
BASE	13	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
BASE	13	COMDERUMB2 MIN	0.00000	0.00000	–	–	–
N+3.45	14	COMDERUMBE MAX	0.00410	0.00110	0.00405	0.12	OK
N+3.45	14	COMDERUMBE MIN	-0.00410	-0.00110	0.00405	0.12	OK
N+3.45	14	COMDERUMB2 MAX	0.00220	0.00230	0.00297	0.08	OK
N+3.45	14	COMDERUMB2 MIN	-0.00220	-0.00230	0.00297	0.08	OK

ALTURA DE N+3.45 **3.50** m
ALTURA DE N+0.00 **2.09** m

Deriva Máxima Permitida **0.40** %

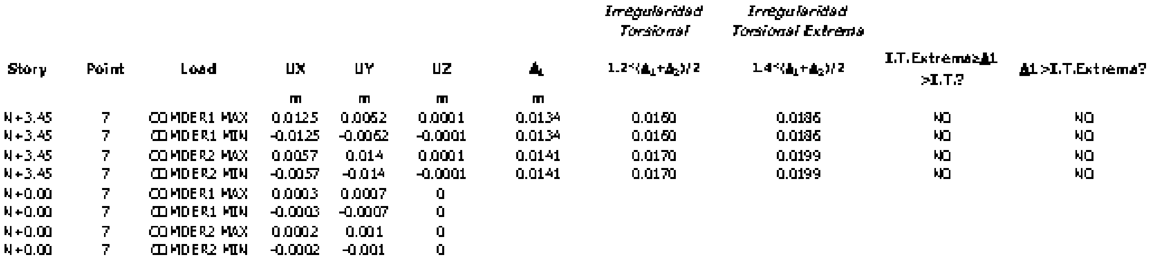
Nivel	**Punto**	**COMBINACIÓN DE CARGA**	**DESPLAZAMIENTOS FUERZA SÍSMICA**		**Deriva Δ m**	**Deriva Δ %**	**Observación**
			Desplazamiento X	**Desplazamiento Y**			
N+0.00	14	COMDERUMBE MAX	0.00020	0.00000	0.00020	0.01	OK
N+0.00	14	COMDERUMBE MIN	-0.00020	0.00000	0.00020	0.01	OK
N+0.00	14	COMDERUMB2 MAX	0.00020	0.00010	0.00022	0.01	OK
N+0.00	14	COMDERUMB2 MIN	-0.00020	-0.00010	0.00022	0.01	OK
BASE	14	COMDERUMBE MAX	0.00000	0.00000	–	–	–
BASE	14	COMDERUMBE MIN	0.00000	0.00000	–	–	–
BASE	14	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
BASE	14	COMDERUMB2 MIN	0.00000	0.00000	–	–	–
N+3.45	15	COMDERUMBE MAX	0.00410	0.00090	0.00420	0.12	OK
N+3.45	15	COMDERUMBE MIN	-0.00410	-0.00090	0.00420	0.12	OK
N+3.45	15	COMDERUMB2 MAX	0.00220	0.00230	0.00318	0.09	OK
N+3.45	15	COMDERUMB2 MIN	-0.00220	-0.00230	0.00318	0.09	OK
N+0.00	15	COMDERUMBE MAX	0.00000	0.00000	–	–	–
N+0.00	15	COMDERUMBE MIN	0.00000	0.00000	–	–	–
N+0.00	15	COMDERUMB2 MAX	0.00000	0.00000	–	–	–
N+0.00	15	COMDERUMB2 MIN	0.00000	0.00000	–	–	–
N+3.45	16	COMDERUMBE MAX	0.00410	0.00130	0.00430	0.12	OK
N+3.45	16	COMDERUMBE MIN	-0.00410	-0.00130	0.00430	0.12	OK
N+3.45	16	COMDERUMB2 MAX	0.00220	0.00330	0.00397	0.11	OK
N+3.45	16	COMDERUMB2 MIN	-0.00220	-0.00330	0.00397	0.11	OK

7.2.6 VERIFICACION DE IRREGULARIDAD TORSIONAL

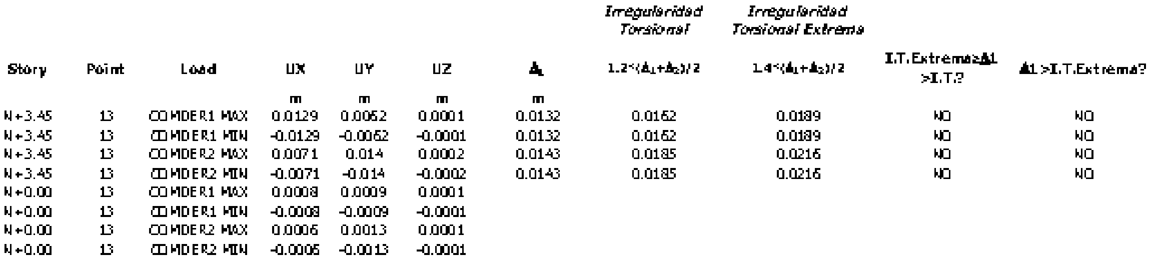


VERIFICACIÓN IRREGULARIDAD TORSIONAL

Story	Point	Load	UX	UY	UZ	Δ_1	*Irregularidad Torsional* $1.2*(\Delta_1+\Delta_2)/2$	*Irregularidad Torsional Extrema* $1.4*(\Delta_1+\Delta_2)/2$	I.T. Extrema≥Δ1 >I.T.?	Δ1 >I.T.Extrema?
			m	m	m	m				
N+3.45	1	COMDER1 MAX	0.01287	0.0062	0	0.0111	0.0147	0.0171	NO	NO
N+3.45	1	COMDER1 MIN	-0.0143	-0.0062	0	0.0123	0.0154	0.0180	NO	NO
N+3.45	1	COMDER2 MAX	0.0102	0.014	0.0001	0.0157	0.0179	0.0209	NO	NO
N+3.45	1	COMDER2 MIN	-0.0102	-0.014	-0.0001	0.0157	0.0179	0.0209	NO	NO
N+0.00	1	COMDER1 MAX	0.0035	0.0003	0					
N+0.00	1	COMDER1 MIN	-0.0035	-0.0003	0					
N+0.00	1	COMDER2 MAX	0.0027	0.0002	0					
N+0.00	1	COMDER2 MIN	-0.0027	-0.0002	0					



Story	Point	Load	UX	UY	UZ	Δ_1	*Irregularidad Torsional* $1.2*(\Delta_1+\Delta_2)/2$	*Irregularidad Torsional Extrema* $1.4*(\Delta_1+\Delta_2)/2$	I.T. Extrema≥Δ1 >I.T.?	Δ1 >I.T.Extrema?
			m	m	m	m				
N+3.45	7	COMDER1 MAX	0.0125	0.0062	0.0001	0.0134	0.0160	0.0186	NO	NO
N+3.45	7	COMDER1 MIN	-0.0125	-0.0062	-0.0001	0.0134	0.0160	0.0186	NO	NO
N+3.45	7	COMDER2 MAX	0.0057	0.014	0.0001	0.0141	0.0170	0.0199	NO	NO
N+3.45	7	COMDER2 MIN	-0.0057	-0.014	-0.0001	0.0141	0.0170	0.0199	NO	NO
N+0.00	7	COMDER1 MAX	0.0003	0.0007	0					
N+0.00	7	COMDER1 MIN	-0.0003	-0.0007	0					
N+0.00	7	COMDER2 MAX	0.0002	0.001	0					
N+0.00	7	COMDER2 MIN	-0.0002	-0.001	0					



Story	Point	Load	UX	UY	UZ	Δ_1	*Irregularidad Torsional* $1.2*(\Delta_1+\Delta_2)/2$	*Irregularidad Torsional Extrema* $1.4*(\Delta_1+\Delta_2)/2$	I.T. Extrema≥Δ1 >I.T.?	Δ1 >I.T.Extrema?
			m	m	m	m				
N+3.45	13	COMDER1 MAX	0.0129	0.0062	0.0001	0.0132	0.0162	0.0189	NO	NO
N+3.45	13	COMDER1 MIN	-0.0129	-0.0062	-0.0001	0.0132	0.0162	0.0189	NO	NO
N+3.45	13	COMDER2 MAX	0.0071	0.014	0.0002	0.0143	0.0185	0.0216	NO	NO
N+3.45	13	COMDER2 MIN	-0.0071	-0.014	-0.0002	0.0143	0.0185	0.0216	NO	NO
N+0.00	13	COMDER1 MAX	0.0008	0.0009	0.0001					
N+0.00	13	COMDER1 MIN	-0.0008	-0.0009	-0.0001					
N+0.00	13	COMDER2 MAX	0.0006	0.0013	0.0001					
N+0.00	13	COMDER2 MIN	-0.0006	-0.0013	-0.0001					

Story	Point	Load	UX	UY	UZ	Δ_1	*Irregularidad Torsional* $1.2*(\Delta_1+\Delta_2)/2$	*Irregularidad Torsional Extrema* $1.4*(\Delta_1+\Delta_2)/2$	I.T.Extrema≥Δ1 >I.T.?	Δ1 >I.T.Extrema?
			m	m	m	m				
N+3.45	227	COMDER1 MAX	0.0146	0.0062	0.0001	0.0138	0.0163	0.0190	NO	NO
N+3.45	227	COMDER1 MIN	-0.0146	-0.0062	-0.0001	0.0138	0.0163	0.0190	NO	NO
N+3.45	227	COMDER2 MAX	0.0126	0.014	0.0001	0.0165	0.0182	0.0213	NO	NO
N+3.45	227	COMDER2 MIN	-0.0126	-0.014	-0.0001	0.0165	0.0182	0.0213	NO	NO
N+0.00	227	COMDER1 MAX	0.0018	0.001	0					
N+0.00	227	COMDER1 MIN	-0.0018	-0.001	0					
N+0.00	227	COMDER2 MAX	0.0018	0.0015	0					
N+0.00	227	COMDER2 MIN	-0.0018	-0.0015	0					

Story	Point	Load	UX	UY	UZ	Δ_1	*Irregularidad Torsional* $1.2*(\Delta_1+\Delta_2)/2$	*Irregularidad Torsional Extrema* $1.4*(\Delta_1+\Delta_2)/2$	I.T.Extrema≥Δ1 >I.T.?	Δ1 >I.T.Extrema?
			m	m	m	m				
N+3.45	228	COMDER1 MAX	0.0146	0.004	0	0.0134	0.0170	0.0198	NO	NO
N+3.45	228	COMDER1 MIN	-0.0146	-0.004	0	0.0134	0.0170	0.0198	NO	NO
N+3.45	228	COMDER2 MAX	0.0126	0.0089	0.0001	0.0139	0.0173	0.0202	NO	NO
N+3.45	228	COMDER2 MIN	-0.0126	-0.0089	-0.0001	0.0139	0.0173	0.0202	NO	NO
N+0.00	228	COMDER1 MAX	0.0018	0.0001	0					
N+0.00	228	COMDER1 MIN	-0.0018	-0.0001	0					
N+0.00	228	COMDER2 MAX	0.0018	0.0002	0					
N+0.00	228	COMDER2 MIN	-0.0018	-0.0002	0					

Story	Point	Load	UX	UY	UZ	Δ_1	*Irregularidad Torsional* $1.2*(\Delta_1+\Delta_2)/2$	*Irregularidad Torsional Extrema* $1.4*(\Delta_1+\Delta_2)/2$	I.T.Extrema≥Δ1 >I.T.?	Δ1 >I.T.Extrema?
			m	m	m	m				
N+3.45	229	COMDER1 MAX	0.0146	0.0033	0	0.0150	0.0181	0.0211	NO	NO
N+3.45	229	COMDER1 MIN	-0.0146	-0.0033	0	0.0150	0.0181	0.0211	NO	NO
N+3.45	229	COMDER2 MAX	0.0126	0.0082	0.0001	0.0150	0.0191	0.0223	NO	NO
N+3.45	229	COMDER2 MIN	-0.0126	-0.0082	-0.0001	0.0150	0.0191	0.0223	NO	NO
N+0.00	229	COMDER1 MAX	0	0	0					
N+0.00	229	COMDER1 MIN	0	0	0					
N+0.00	229	COMDER2 MAX	0	0	0					
N+0.00	229	COMDER2 MIN	0	0	0					

							Irregularidad Torsional	*Irregularidad Torsional Extrema*		
Story	**Point**	**Load**	UX	UY	UZ	Δ_1	$1.2*(\Delta_1+\Delta_2)/2$	$1.4*(\Delta_1+\Delta_2)/2$	I.T.Extrema≥Δ1 >I.T.?	Δ1 >I.T.Extrema?
			m	m	m	m				
N+3.45	230	COMDER1 MAX	0.0146	0.0043	0.0001	0.0152	0.0173	0.0202	NO	NO
N+3.45	230	COMDER1 MIN	-0.0146	-0.0043	-0.0001	0.0152	0.0173	0.0202	NO	NO
N+3.45	230	COMDER2 MAX	0.0126	0.0112	0	0.0169	0.0181	0.0211	NO	NO
N+3.45	230	COMDER2 MIN	-0.0126	-0.0112	0	0.0169	0.0181	0.0211	NO	NO
N+0.00	230	COMDER1 MAX	0	0	0					
N+0.00	230	COMDER1 MIN	0	0	0					
N+0.00	230	COMDER2 MAX	0	0	0					
N+0.00	230	COMDER2 MIN	0	0	0					

							Irregularidad Torsional	*Irregularidad Torsional Extrema*		
Story	**Point**	**Load**	UX	UY	UZ	Δ_1	$1.2*(\Delta_1+\Delta_2)/2$	$1.4*(\Delta_1+\Delta_2)/2$	I.T.Extrema≥Δ1 >I.T.?	Δ1 >I.T.Extrema?
			m	m	m	m				
N+3.45	16	COMDER1 MAX	0.0129	0.0043	0.0001	0.0136	0.0161	0.0188	NO	NO
N+3.45	16	COMDER1 MIN	-0.0129	-0.0043	-0.0001	0.0136	0.0161	0.0188	NO	NO
N+3.45	16	COMDER2 MAX	0.0071	0.0112	0.0001	0.0133	0.0155	0.0181	NO	NO
N+3.45	16	COMDER2 MIN	-0.0071	-0.0112	-0.0001	0.0133	0.0155	0.0181	NO	NO
N+0.00	16	COMDER1 MAX	0	0	0					
N+0.00	16	COMDER1 MIN	0	0	0					
N+0.00	16	COMDER2 MAX	0	0	0					
N+0.00	16	COMDER2 MIN	0	0	0					

							Irregularidad Torsional	*Irregularidad Torsional Extrema*		
Story	**Point**	**Load**	UX	UY	UZ	Δ_1	$1.2*(\Delta_1+\Delta_2)/2$	$1.4*(\Delta_1+\Delta_2)/2$	I.T.Extrema≥Δ1 >I.T.?	Δ1 >I.T.Extrema?
			m	m	m	m				
N+3.45	10	COMDER1 MAX	0.0125	0.0043	0.0001	0.0132	0.0165	0.0192	NO	NO
N+3.45	10	COMDER1 MIN	-0.0125	-0.0043	-0.0001	0.0132	0.0165	0.0192	NO	NO
N+3.45	10	COMDER2 MAX	0.0057	0.0112	0.0001	0.0126	0.0189	0.0220	NO	NO
N+3.45	10	COMDER2 MIN	-0.0057	-0.0112	-0.0001	0.0126	0.0189	0.0220	NO	NO
N+0.00	10	COMDER1 MAX	0	0	0					
N+0.00	10	COMDER1 MIN	0	0	0					
N+0.00	10	COMDER2 MAX	0	0	0					
N+0.00	10	COMDER2 MIN	0	0	0					

							Irregularidad Torsional	*Irregularidad Torsional Extrema*		
Story	**Point**	**Load**	UX	UY	UZ	Δ_1	$1.2*(\Delta_1+\Delta_2)/2$	$1.4*(\Delta_1+\Delta_2)/2$	I.T.Extrema≥Δ1 >I.T.?	Δ1 >I.T.Extrema?
			m	m	m	m				
N+3.45	11	COMDER1 MAX	0.0125	0.0069	0	0.0143	0.0182	0.0212	NO	NO
N+3.45	11	COMDER1 MIN	-0.0125	-0.0069	0	0.0143	0.0182	0.0212	NO	NO
N+3.45	11	COMDER2 MAX	0.0057	0.018	0.0001	0.0189	0.0271	0.0316	NO	NO
N+3.45	11	COMDER2 MIN	-0.0057	-0.018	-0.0001	0.0189	0.0271	0.0316	NO	NO
N+0.00	11	COMDER1 MAX	0	0	0					
N+0.00	11	COMDER1 MIN	0	0	0					
N+0.00	11	COMDER2 MAX	0	0	0					
N+0.00	11	COMDER2 MIN	0	0	0					

							Irregularidad Torsional	*Irregularidad Torsional Extrema*		
Story	**Point**	**Load**	UX	UY	UZ	Δ_1	$1.2*(\Delta_1+\Delta_2)/2$	$1.4*(\Delta_1+\Delta_2)/2$	I.T.Extrema≥Δ1 >I.T.?	Δ1 >I.T.Extrema?
			m	m	m	m				
N+3.45	12	COMDER1 MAX	0.0125	0.01	0.0001	0.0160	0.0201	0.0234	NO	NO
N+3.45	12	COMDER1 MIN	-0.0125	-0.01	-0.0001	0.0160	0.0201	0.0234	NO	NO
N+3.45	12	COMDER2 MAX	0.0057	0.0257	0.0001	0.0263	0.0324	0.0378	NO	NO
N+3.45	12	COMDER2 MIN	-0.0057	-0.0257	-0.0001	0.0263	0.0324	0.0378	NO	NO
N+0.00	12	COMDER1 MAX	0	0	0					
N+0.00	12	COMDER1 MIN	0	0	0					
N+0.00	12	COMDER2 MAX	0	0	0					
N+0.00	12	COMDER2 MIN	0	0	0					

							Irregularidad Torsional	*Irregularidad Torsional Extrema*		
Story	**Point**	**Load**	UX	UY	UZ	Δ_1	$1.2*(\Delta_1+\Delta_2)/2$	$1.4*(\Delta_1+\Delta_2)/2$	I.T.Extrema≥Δ1 >I.T.?	Δ1 >I.T.Extrema?
			m	m	m	m				
N+3.45	6	COMDER1 MAX	0.0143	0.01	0	0.0174	0.0200	0.0233	NO	NO
N+3.45	6	COMDER1 MIN	-0.0143	-0.01	0	0.0174	0.0200	0.0233	NO	NO
N+3.45	6	COMDER2 MAX	0.0102	0.0257	0.0001	0.0277	0.0290	0.0338	NO	NO
N+3.45	6	COMDER2 MIN	-0.0102	-0.0257	-0.0001	0.0277	0.0290	0.0338	NO	NO
N+0.00	6	COMDER1 MAX	0	0	0					
N+0.00	6	COMDER1 MIN	0	0	0					
N+0.00	6	COMDER2 MAX	0	0	0					
N+0.00	6	COMDER2 MIN	0	0	0					

							Irregularidad Torsional	*Irregularidad Torsional Extrema*		
Story	**Point**	**Load**	UX	UY	UZ	Δ_1	$1.2*(\Delta_1+\Delta_2)/2$	$1.4*(\Delta_1+\Delta_2)/2$	I.T.Extrema≥Δ1 >I.T.?	Δ1 >I.T.Extrema?
			m	m	m	m				
N+3.45	5	COMDER1 MAX	0.0143	0.0069	0	0.0159	0.0185	0.0216	NO	NO
N+3.45	5	COMDER1 MIN	-0.0143	-0.0069	0	0.0159	0.0185	0.0216	NO	NO
N+3.45	5	COMDER2 MAX	0.0102	0.018	0.0001	0.0207	0.0215	0.0251	NO	NO
N+3.45	5	COMDER2 MIN	-0.0102	-0.018	-0.0001	0.0207	0.0215	0.0251	NO	NO
N+0.00	5	COMDER1 MAX	0	0	0					
N+0.00	5	COMDER1 MIN	0	0	0					
N+0.00	5	COMDER2 MAX	0	0	0					
N+0.00	5	COMDER2 MIN	0	0	0					

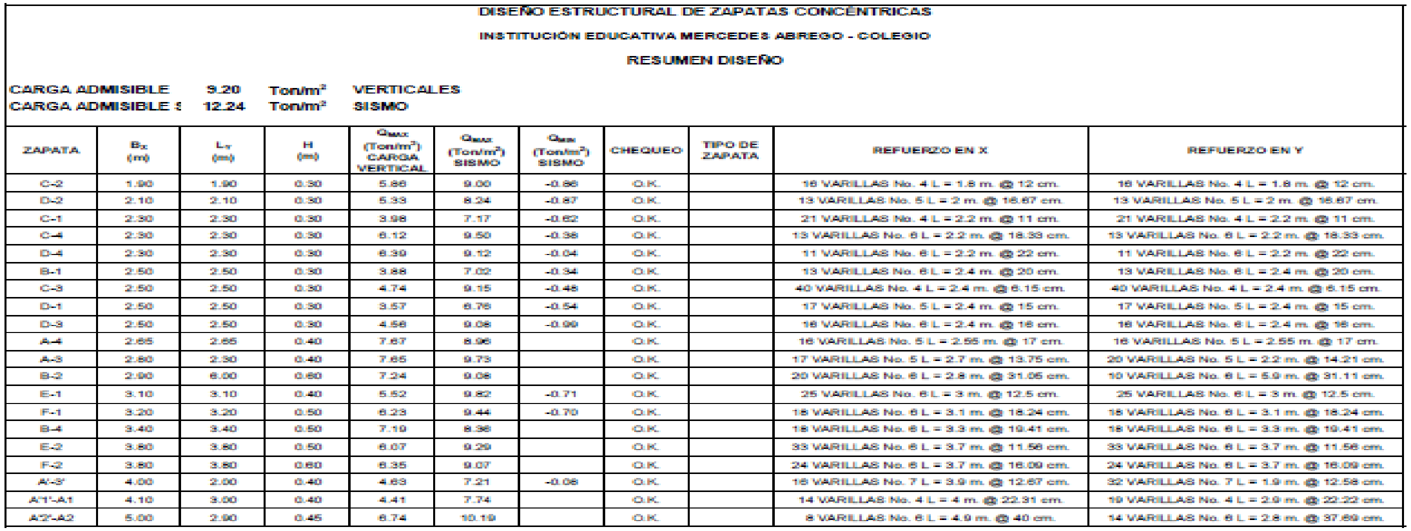
							Irregularidad Torsional	*Irregularidad Torsional Extrema*		
Story	**Point**	**Load**	**UX**	**UY**	**UZ**	Δ_1	$1.2*(\Delta_1+\Delta_2)/2$	$1.4*(\Delta_1+\Delta_2)/2$	**I.T. Extrema≥Δ1 >I.T.?**	**Δ1 >I.T.Extrema?**
			m	m	m	m				
N+3.45	4	COMDER1 MAX	0.0143	0.0043	0	0.0149	0.0178	0.0207	NO	NO
N+3.45	4	COMDER1 MIN	-0.0143	-0.0043	0	0.0149	0.0178	0.0207	NO	NO
N+3.45	4	COMDER2 MAX	0.0102	0.0112	0	0.0151	0.0169	0.0198	NO	NO
N+3.45	4	COMDER2 MIN	-0.0102	-0.0112	0	0.0151	0.0169	0.0198	NO	NO
N+0.00	4	COMDER1 MAX	0	0	0					
N+0.00	4	COMDER1 MIN	0	0	0					
N+0.00	4	COMDER2 MAX	0	0	0					
N+0.00	4	COMDER2 MIN	0	0	0					

							Irregularidad Torsional	*Irregularidad Torsional Extrema*		
Story	**Point**	**Load**	**UX**	**UY**	**UZ**	Δ_1	$1.2*(\Delta_1+\Delta_2)/2$	$1.4*(\Delta_1+\Delta_2)/2$	**I.T. Extrema≥Δ1 >I.T.?**	**Δ1 >I.T.Extrema?**
			m	m	m	m				
N+3.45	3	COMDER1 MAX	0.0143	0.0033	0	0.0147	0.0177	0.0207	NO	NO
N+3.45	3	COMDER1 MIN	-0.0143	-0.0033	0	0.0147	0.0177	0.0207	NO	NO
N+3.45	3	COMDER2 MAX	0.0102	0.0082	0	0.0131	0.0160	0.0186	NO	NO
N+3.45	3	COMDER2 MIN	-0.0102	-0.0082	0	0.0131	0.0160	0.0186	NO	NO
N+0.00	3	COMDER1 MAX	0	0	0					
N+0.00	3	COMDER1 MIN	0	0	0					
N+0.00	3	COMDER2 MAX	0	0	0					
N+0.00	3	COMDER2 MIN	0	0	0					

							Irregularidad Torsional	*Irregularidad Torsional Extrema*		
Story	**Point**	**Load**	**UX**	**UY**	**UZ**	Δ_1	$1.2*(\Delta_1+\Delta_2)/2$	$1.4*(\Delta_1+\Delta_2)/2$	**I.T. Extrema≥Δ1 >I.T.?**	**Δ1 >I.T.Extrema?**
			m	m	m	m				
N+3.45	2	COMDER1 MAX	0.0143	0.004	0	0.0148	0.0156	0.0181	NO	NO
N+3.45	2	COMDER1 MIN	-0.0143	-0.004	0	0.0148	0.0156	0.0190	NO	NO
N+3.45	2	COMDER2 MAX	0.0102	0.0089	0	0.0135	0.0155	0.0205	NO	NO
N+3.45	2	COMDER2 MIN	-0.0102	-0.0089	0	0.0135	0.0175	0.0205	NO	NO
N+0.00	2	COMDER1 MAX	0	0	0					
N+0.00	2	COMDER1 MIN	0	0	0					
N+0.00	2	COMDER2 MAX	0	0	0					
N+0.00	2	COMDER2 MIN	0	0	0					

7.3 DISEÑO DE CIMENTACIÓN

7.3.1 ELECCIÓN DE CARGAS PARA DISEÑO DE CIMENTACIÓN



DISEÑO ESTRUCTURAL DE ZAPATAS CONCÉNTRICAS

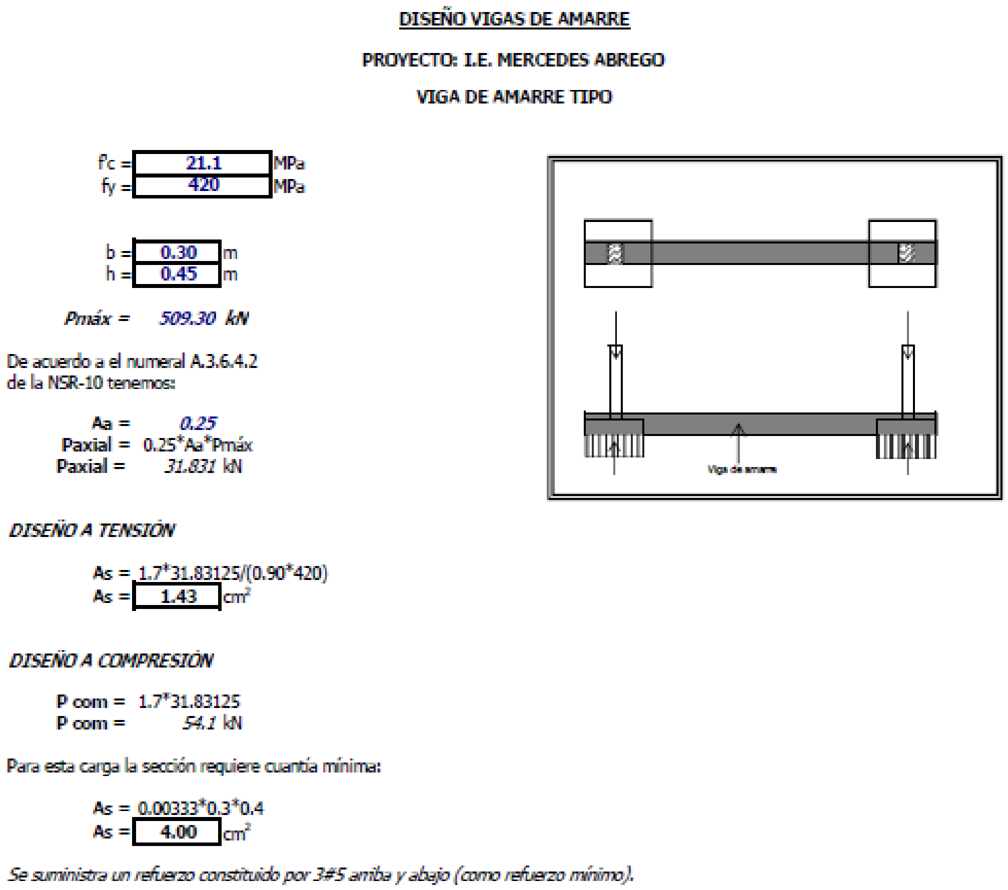
INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

RESUMEN DISEÑO

CARGA ADMISIBLE	9.20	Ton/m²	VERTICALES
CARGA ADMISIBLE S	12.24	Ton/m²	SISMO

ZAPATA	B_X (m)	L_Y (m)	H (m)	Q_{MAX} (Ton/m²) CARGA VERTICAL	Q_{MAX} (Ton/m²) SISMO	Q_{MIN} (Ton/m²) SISMO	CHEQUEO	TIPO DE ZAPATA	REFUERZO EN X	REFUERZO EN Y
C-2	1.90	1.90	0.30	5.86	9.00	-0.66	O.K.		16 VARILLAS No. 4 L = 1.8 m. @ 12 cm.	16 VARILLAS No. 4 L = 1.8 m. @ 12 cm.
D-2	2.10	2.10	0.30	5.33	8.24	-0.87	O.K.		13 VARILLAS No. 5 L = 2 m. @ 16.67 cm.	13 VARILLAS No. 5 L = 2 m. @ 16.67 cm.
C-1	2.30	2.30	0.30	3.98	7.17	-0.62	O.K.		21 VARILLAS No. 4 L = 2.2 m. @ 11 cm.	21 VARILLAS No. 4 L = 2.2 m. @ 11 cm.
C-4	2.30	2.30	0.30	6.12	9.50	-0.38	O.K.		13 VARILLAS No. 6 L = 2.2 m. @ 18.33 cm.	13 VARILLAS No. 6 L = 2.2 m. @ 18.33 cm.
D-4	2.30	2.30	0.30	6.39	9.12	-0.04	O.K.		11 VARILLAS No. 6 L = 2.2 m. @ 22 cm.	11 VARILLAS No. 6 L = 2.2 m. @ 22 cm.
B-1	2.50	2.50	0.30	3.88	7.02	-0.34	O.K.		13 VARILLAS No. 6 L = 2.4 m. @ 20 cm.	13 VARILLAS No. 6 L = 2.4 m. @ 20 cm.
C-3	2.50	2.50	0.30	4.74	9.15	-0.48	O.K.		40 VARILLAS No. 4 L = 2.4 m. @ 6.15 cm.	40 VARILLAS No. 4 L = 2.4 m. @ 6.15 cm.
D-1	2.50	2.50	0.30	3.57	6.76	-0.54	O.K.		17 VARILLAS No. 5 L = 2.4 m. @ 15 cm.	17 VARILLAS No. 5 L = 2.4 m. @ 15 cm.
D-3	2.50	2.50	0.30	4.56	9.08	-0.99	O.K.		16 VARILLAS No. 6 L = 2.4 m. @ 16 cm.	16 VARILLAS No. 6 L = 2.4 m. @ 16 cm.
A-4	2.65	2.65	0.40	7.67	8.96		O.K.		16 VARILLAS No. 5 L = 2.55 m. @ 17 cm.	16 VARILLAS No. 5 L = 2.55 m. @ 17 cm.
A-3	2.80	2.30	0.40	7.65	9.73		O.K.		17 VARILLAS No. 5 L = 2.7 m. @ 13.75 cm.	20 VARILLAS No. 5 L = 2.2 m. @ 14.21 cm.
B-2	2.90	6.00	0.60	7.24	9.08		O.K.		20 VARILLAS No. 6 L = 2.8 m. @ 31.05 cm.	10 VARILLAS No. 6 L = 5.9 m. @ 31.11 cm.
E-1	3.10	3.10	0.40	5.52	9.82	-0.71	O.K.		25 VARILLAS No. 6 L = 3 m. @ 12.5 cm.	25 VARILLAS No. 6 L = 3 m. @ 12.5 cm.
F-1	3.20	3.20	0.50	6.23	9.44	-0.70	O.K.		18 VARILLAS No. 6 L = 3.1 m. @ 18.24 cm.	18 VARILLAS No. 6 L = 3.1 m. @ 18.24 cm.
B-4	3.40	3.40	0.50	7.19	8.38		O.K.		18 VARILLAS No. 6 L = 3.3 m. @ 19.41 cm.	18 VARILLAS No. 6 L = 3.3 m. @ 19.41 cm.
E-2	3.80	3.80	0.50	6.07	9.29		O.K.		33 VARILLAS No. 6 L = 3.7 m. @ 11.56 cm.	33 VARILLAS No. 6 L = 3.7 m. @ 11.56 cm.
F-2	3.80	3.80	0.60	6.35	9.07		O.K.		24 VARILLAS No. 6 L = 3.7 m. @ 16.09 cm.	24 VARILLAS No. 6 L = 3.7 m. @ 16.09 cm.
A'-3'	4.00	2.00	0.40	4.63	7.21	-0.08	O.K.		16 VARILLAS No. 7 L = 3.9 m. @ 12.67 cm.	32 VARILLAS No. 7 L = 1.9 m. @ 12.58 cm.
A'1'-A1	4.10	3.00	0.40	4.41	7.74		O.K.		14 VARILLAS No. 4 L = 4 m. @ 22.31 cm.	19 VARILLAS No. 4 L = 2.9 m. @ 22.22 cm.
A'2'-A2	5.00	2.90	0.45	6.74	10.19		O.K.		8 VARILLAS No. 6 L = 4.9 m. @ 40 cm.	14 VARILLAS No. 6 L = 2.8 m. @ 37.69 cm.

7.3.2 DISEÑO VIGAS DE AMARRE



DISEÑO VIGAS DE AMARRE

PROYECTO: I.E. MERCEDES ABREGO

VIGA DE AMARRE TIPO

f'c = 21.1 MPa
fy = 420 MPa

b = 0.30 m
h = 0.45 m

Pmáx = 509.30 kN

De acuerdo a el numeral A.3.6.4.2
de la NSR-10 tenemos:

Aa = *0.25*
Paxial = 0.25*Aa*Pmáx
Paxial = *31.831* kN

DISEÑO A TENSIÓN

As = 1.7*31.83125/(0.90*420)
As = 1.43 cm^2

DISEÑO A COMPRESIÓN

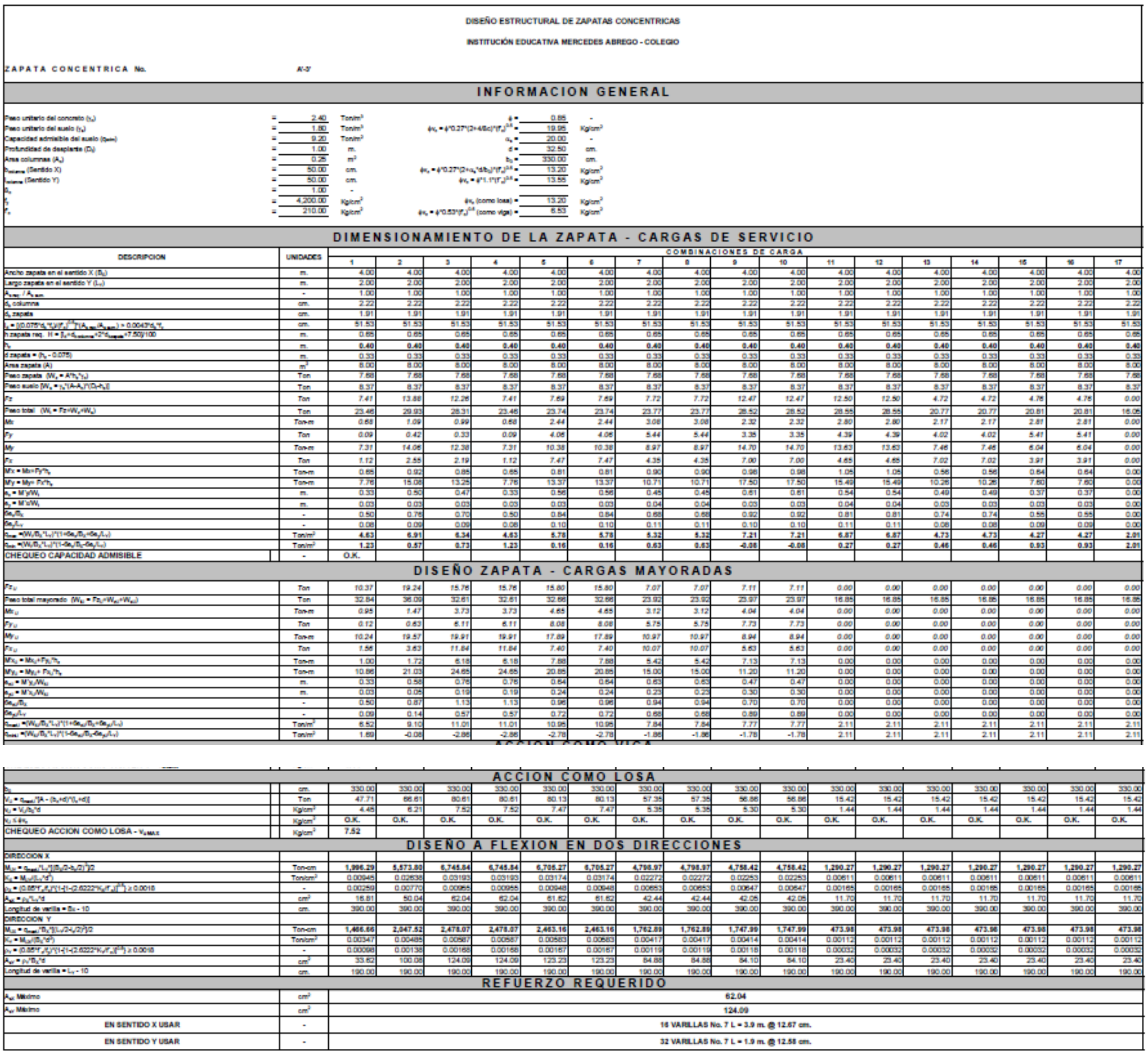
P com = 1.7*31.83125
P com = *54.1* kN

Para esta carga la sección requiere cuantía mínima:

As = 0.00333*0.3*0.4
As = 4.00 cm^2

Se suministra un refuerzo constituido por 3#5 arriba y abajo (como refuerzo mínimo).

7.3.3 DISEÑO DE ZAPATAS



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. A'-3'

INFORMACION GENERAL

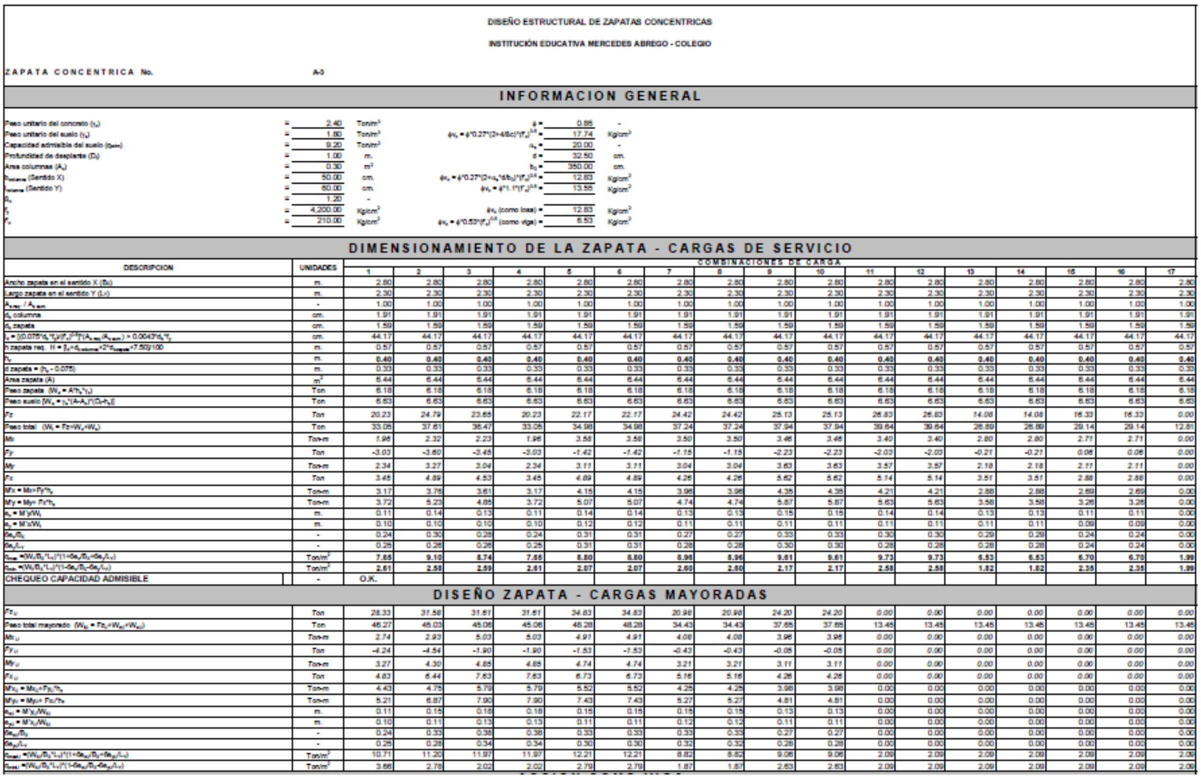
Peso unitario del concreto (γ_c)	= 2.40	Ton/m³	ϕ =	0.85	-
Peso unitario del suelo (γ_s)	= 1.80	Ton/m³	ϕv_c = ϕ*0.27*(2+4/Bc)*(f'c)^{0.5} =	19.95	Kg/cm²
Capacidad admisible del suelo (q_{adm})	= 9.20	Ton/m²	α_s =	20.00	-
Profundidad de desplante (D_f)	= 1.00	m.	d =	32.50	cm.
Area columnas (A_c)	= 0.25	m²	b_o =	330.00	cm.
$b_{columna}$ (Sentido X)	= 50.00	cm.	ϕv_c = ϕ*0.27*(2+α_s*d/b_o)*(f'c)^{0.5} =	13.20	Kg/cm²
$l_{columna}$ (Sentido Y)	= 50.00	cm.	ϕv_c = ϕ*1.1*(f'c)^{0.5} =	13.55	Kg/cm²
β_c	= 1.00	-			
f_y	= 4,200.00	Kg/cm²	ϕv_c (como losa) =	13.20	Kg/cm²
f'_c	= 210.00	Kg/cm²	ϕv_c = ϕ*0.53*(f'c)^{0.5} (como viga) =	6.53	Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Largo zapata en el sentido Y (L_Y)	m.	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
$A_{s,req}$ / $A_{s,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22
d_b zapata	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*($A_{s,req}$/$A_{s,sum}$) > 0.0043*d_b*f_y	cm.	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53
h zapata req. H = [l_d+$d_{b,columna}$+2*$d_{b,zapata}$+7.50]/100	m.	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
h_z	m.	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**
d zapata = (h_z - 0.075)	m.	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Area zapata (A)	m²	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Peso zapata (W_z = A*h_z*γ_c)	Ton	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68
Peso suelo [W_s = γ_s*(A-A_c)*(D_f-h_z)]	Ton	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37
Fz	Ton	*7.41*	*13.88*	*12.26*	*7.41*	*7.69*	*7.69*	*7.72*	*7.72*	*12.47*	*12.47*	*12.50*	*12.50*	*4.72*	*4.72*	*4.76*	*4.76*	*0.00*
Peso total (W_t = Fz+W_z+W_s)	Ton	23.46	29.93	28.31	23.46	23.74	23.74	23.77	23.77	28.52	28.52	28.55	28.55	20.77	20.77	20.81	20.81	16.05
Mx	Ton-m	*0.68*	*1.09*	*0.99*	*0.68*	*2.44*	*2.44*	*3.08*	*3.08*	*2.32*	*2.32*	*2.80*	*2.80*	*2.17*	*2.17*	*2.81*	*2.81*	*0.00*
Fy	Ton	*0.09*	*0.42*	*0.33*	*0.09*	*4.06*	*4.06*	*5.44*	*5.44*	*3.35*	*3.35*	*4.39*	*4.39*	*4.02*	*4.02*	*5.41*	*5.41*	*0.00*
My	Ton-m	*7.31*	*14.06*	*12.38*	*7.31*	*10.38*	*10.38*	*8.97*	*8.97*	*14.70*	*14.70*	*13.63*	*13.63*	*7.46*	*7.46*	*6.04*	*6.04*	*0.00*
Fx	Ton	*1.12*	*2.55*	*2.19*	*1.12*	*7.47*	*7.47*	*4.35*	*4.35*	*7.00*	*7.00*	*4.65*	*4.65*	*7.02*	*7.02*	*3.91*	*3.91*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	0.65	0.92	0.85	0.65	0.81	0.81	0.90	0.90	0.98	0.98	1.05	1.05	0.56	0.56	0.64	0.64	0.00
M'y = My+ Fx*h_z	Ton-m	7.76	15.08	13.25	7.76	13.37	13.37	10.71	10.71	17.50	17.50	15.49	15.49	10.26	10.26	7.60	7.60	0.00
e_x = M'y/W_t	m.	0.33	0.50	0.47	0.33	0.56	0.56	0.45	0.45	0.61	0.61	0.54	0.54	0.49	0.49	0.37	0.37	0.00
e_y = M'x/W_t	m.	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.03	0.04	0.04	0.03	0.03	0.03	0.03	0.00
6e_x/B_X	-	0.50	0.76	0.70	0.50	0.84	0.84	0.68	0.68	0.92	0.92	0.81	0.81	0.74	0.74	0.55	0.55	0.00
6e_y/L_Y	-	0.08	0.09	0.09	0.08	0.10	0.10	0.11	0.11	0.10	0.10	0.11	0.11	0.08	0.08	0.09	0.09	0.00
q_{max} =(W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)	Ton/m²	**4.63**	**6.91**	**6.34**	**4.63**	**5.78**	**5.78**	**5.32**	**5.32**	**7.21**	**7.21**	**6.87**	**6.87**	**4.73**	**4.73**	**4.27**	**4.27**	**2.01**
q_{min} =(W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)	Ton/m²	**1.23**	**0.57**	**0.73**	**1.23**	**0.16**	**0.16**	**0.63**	**0.63**	**-0.08**	**-0.08**	**0.27**	**0.27**	**0.46**	**0.46**	**0.93**	**0.93**	**2.01**
CHEQUEO CAPACIDAD ADMISIBLE	-	**O.K.**																
DISEÑO ZAPATA - CARGAS MAYORADAS																		
Fz_U	Ton	*10.37*	*19.24*	*15.76*	*15.76*	*15.80*	*15.80*	*7.07*	*7.07*	*7.11*	*7.11*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado (W_U = Fz_U+W_{zU}+W_{sU})	Ton	32.84	36.09	32.61	32.61	32.66	32.66	23.92	23.92	23.97	23.97	16.85	16.85	16.85	16.85	16.85	16.85	16.85
Mx_U	Ton-m	*0.95*	*1.47*	*3.73*	*3.73*	*4.65*	*4.65*	*3.12*	*3.12*	*4.04*	*4.04*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*0.12*	*0.63*	*6.11*	*6.11*	*8.08*	*8.08*	*5.75*	*5.75*	*7.73*	*7.73*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*10.24*	*19.57*	*19.91*	*19.91*	*17.89*	*17.89*	*10.97*	*10.97*	*8.94*	*8.94*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*1.56*	*3.63*	*11.84*	*11.84*	*7.40*	*7.40*	*10.07*	*10.07*	*5.63*	*5.63*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U$ = Mx_U+Fy_U*h_z	Ton-m	1.00	1.72	6.18	6.18	7.88	7.88	5.42	5.42	7.13	7.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U$ = My_U+ Fx_U*h_z	Ton-m	10.86	21.03	24.65	24.65	20.85	20.85	15.00	15.00	11.20	11.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e_{xU} = $M'y_U$/W_U	m.	0.33	0.58	0.76	0.76	0.64	0.64	0.63	0.63	0.47	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e_{yU} = $M'x_U$/W_U	m.	0.03	0.05	0.19	0.19	0.24	0.24	0.23	0.23	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6e_{xU}/B_X	-	0.50	0.87	1.13	1.13	0.96	0.96	0.94	0.94	0.70	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6e_{yU}/L_Y	-	0.09	0.14	0.57	0.57	0.72	0.72	0.68	0.68	0.89	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00
q_{maxU} =(W_U/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)	Ton/m²	6.52	9.10	11.01	11.01	10.95	10.95	7.84	7.84	7.77	7.77	2.11	2.11	2.11	2.11	2.11	2.11	2.11
q_{minU} =(W_U/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)	Ton/m²	1.69	-0.08	-2.86	-2.86	-2.78	-2.78	-1.86	-1.86	-1.78	-1.78	2.11	2.11	2.11	2.11	2.11	2.11	2.11
ACCION COMO LOSA																		
b_o	cm.	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00
V_U = q_{maxU}*[A - (b_x+d)*(l_y+d)]	Ton	47.71	66.61	80.61	80.61	80.13	80.13	57.35	57.35	56.86	56.86	15.42	15.42	15.42	15.42	15.42	15.42	15.42
v_U = V_U/b_o*d	Kg/cm²	4.45	6.21	7.52	7.52	7.47	7.47	5.35	5.35	5.30	5.30	1.44	1.44	1.44	1.44	1.44	1.44	1.44
v_U ≤ ϕv_c	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{uMAX}	Kg/cm²	**7.52**																
DISEÑO A FLEXION EN DOS DIRECCIONES																		
DIRECCION X																		
M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_x/2)²]/2	Ton-cm	**1,996.29**	**5,573.80**	**6,745.84**	**6,745.84**	**6,705.27**	**6,705.27**	**4,798.97**	**4,798.97**	**4,758.42**	**4,758.42**	**1,290.27**	**1,290.27**	**1,290.27**	**1,290.27**	**1,290.27**	**1,290.27**	**1,290.27**
K_X = M_{UX}/(L_Y*d²)	Ton/cm²	0.00945	0.02638	0.03193	0.03193	0.03174	0.03174	0.02272	0.02272	0.02253	0.02253	0.00611	0.00611	0.00611	0.00611	0.00611	0.00611	0.00611
ρ_X = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_X/f'_c)]^{0.5}) ≥ 0.0018	-	0.00259	0.00770	0.00955	0.00955	0.00948	0.00948	0.00653	0.00653	0.00647	0.00647	0.00165	0.00165	0.00165	0.00165	0.00165	0.00165	0.00165
A_{sX} = ρ_X*L_Y*d	cm²	16.81	50.04	62.04	62.04	61.62	61.62	42.44	42.44	42.05	42.05	11.70	11.70	11.70	11.70	11.70	11.70	11.70
Longitud de varilla = Bx - 10	cm.	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00
DIRECCION Y																		
M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_y/2)²]/2	Ton-cm	**1,466.66**	**2,047.52**	**2,478.07**	**2,478.07**	**2,463.16**	**2,463.16**	**1,762.89**	**1,762.89**	**1,747.99**	**1,747.99**	**473.98**	**473.98**	**473.98**	**473.98**	**473.98**	**473.98**	**473.98**
K_Y = M_{UY}/(B_X*d²)	Ton/cm²	0.00347	0.00485	0.00587	0.00587	0.00583	0.00583	0.00417	0.00417	0.00414	0.00414	0.00112	0.00112	0.00112	0.00112	0.00112	0.00112	0.00112
ρ_Y = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_Y/f'_c)]^{0.5}) ≥ 0.0018	-	0.00098	0.00138	0.00168	0.00168	0.00167	0.00167	0.00119	0.00119	0.00118	0.00118	0.00032	0.00032	0.00032	0.00032	0.00032	0.00032	0.00032
A_{sY} = ρ_Y*B_X*d	cm²	33.62	100.08	124.09	124.09	123.23	123.23	84.88	84.88	84.10	84.10	23.40	23.40	23.40	23.40	23.40	23.40	23.40
Longitud de varilla = L_Y - 10	cm.	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	**62.04**
A_{sY} Máximo	cm²	**124.09**
EN SENTIDO X USAR	-	**16 VARILLAS No. 7 L = 3.9 m. @ 12.67 cm.**
EN SENTIDO Y USAR	-	**32 VARILLAS No. 7 L = 1.9 m. @ 12.58 cm.**



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. A-3

INFORMACION GENERAL

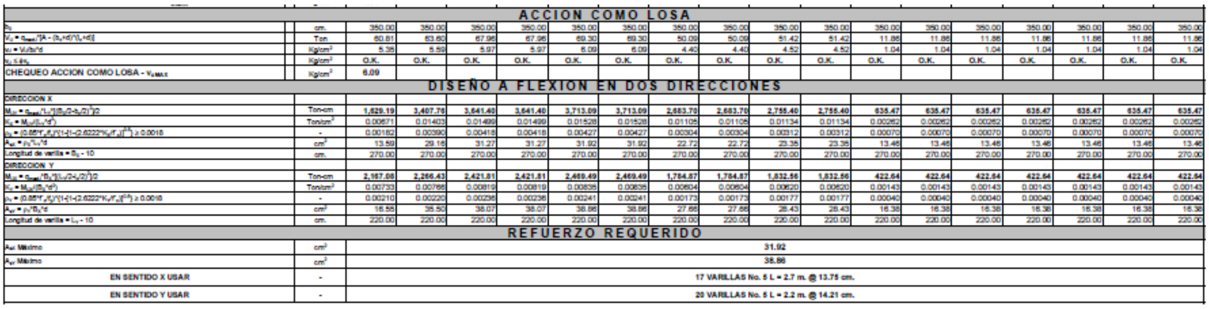
Peso unitario del concreto (γ_c)	=	2.40	Ton/m³	ϕ =	0.85	-
Peso unitario del suelo (γ_s)	=	1.80	Ton/m³	$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ =	17.74	Kg/cm²
Capacidad admisible del suelo (q_{adm})	=	9.20	Ton/m²	α_s =	20.00	-
Profundidad de desplante (D_f)	=	1.00	m.	d =	32.50	cm.
Area columnas (A_c)	=	0.30	m²	b_0 =	350.00	cm.
$b_{columna}$ (Sentido X)	=	50.00	cm.	$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ =	12.83	Kg/cm²
$l_{columna}$ (Sentido Y)	=	60.00	cm.	$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ =	13.55	Kg/cm²
β_c	=	1.20	-			
f_y	=	4,200.00	Kg/cm²	ϕv_c (como losa) =	12.83	Kg/cm²
f'_c	=	210.00	Kg/cm²	$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) =	6.53	Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80
Largo zapata en el sentido Y (L_Y)	m.	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
$A_{s\,req} / A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
d_b zapata	cm.	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
$l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*(A_{s\,req}/A_{s\,sum}) > 0.0043*d_b*f_y$	cm.	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17
h zapata req. $H = [l_d+d_{b\,columna}+2*d_{b\,zapata}+7.50]/100$	m.	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
h_z	m.	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**
d zapata = (h_z - 0.075)	m.	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Area zapata (A)	m²	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	6.18	6.18	6.18	6.18	6.18	6.18	6.18	6.18	6.18	6.18	6.18	6.18	6.18	6.18	6.18	6.18	6.18
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	6.63	6.63	6.63	6.63	6.63	6.63	6.63	6.63	6.63	6.63	6.63	6.63	6.63	6.63	6.63	6.63	6.63
Fz	*Ton*	*20.23*	*24.79*	*23.65*	*20.23*	*22.17*	*22.17*	*24.42*	*24.42*	*25.13*	*25.13*	*26.83*	*26.83*	*14.08*	*14.08*	*16.33*	*16.33*	*0.00*
Peso total ($W_t = Fz+W_z+W_s$)	Ton	33.05	37.61	36.47	33.05	34.98	34.98	37.24	37.24	37.94	37.94	39.64	39.64	26.89	26.89	29.14	29.14	12.81
Mx	*Ton-m*	*1.96*	*2.32*	*2.23*	*1.96*	*3.58*	*3.58*	*3.50*	*3.50*	*3.46*	*3.46*	*3.40*	*3.40*	*2.80*	*2.80*	*2.71*	*2.71*	*0.00*
Fy	*Ton*	*-3.03*	*-3.60*	*-3.45*	*-3.03*	*-1.42*	*-1.42*	*-1.15*	*-1.15*	*-2.23*	*-2.23*	*-2.03*	*-2.03*	*-0.21*	*-0.21*	*0.06*	*0.06*	*0.00*
My	*Ton-m*	*2.34*	*3.27*	*3.04*	*2.34*	*3.11*	*3.11*	*3.04*	*3.04*	*3.63*	*3.63*	*3.57*	*3.57*	*2.18*	*2.18*	*2.11*	*2.11*	*0.00*
Fx	*Ton*	*3.45*	*4.89*	*4.53*	*3.45*	*4.89*	*4.89*	*4.26*	*4.26*	*5.62*	*5.62*	*5.14*	*5.14*	*3.51*	*3.51*	*2.88*	*2.88*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	3.17	3.76	3.61	3.17	4.15	4.15	3.96	3.96	4.35	4.35	4.21	4.21	2.88	2.88	2.69	2.69	0.00
M'y = My+ Fx*h_z	Ton-m	3.72	5.23	4.85	3.72	5.07	5.07	4.74	4.74	5.87	5.87	5.63	5.63	3.58	3.58	3.26	3.26	0.00
$e_x = M'y/W_t$	m.	0.11	0.14	0.13	0.11	0.14	0.14	0.13	0.13	0.15	0.15	0.14	0.14	0.13	0.13	0.11	0.11	0.00
$e_y = M'x/W_t$	m.	0.10	0.10	0.10	0.10	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.09	0.09	0.00
$6e_x/B_X$	-	0.24	0.30	0.28	0.24	0.31	0.31	0.27	0.27	0.33	0.33	0.30	0.30	0.29	0.29	0.24	0.24	0.00
$6e_y/L_Y$	-	0.25	0.26	0.26	0.25	0.31	0.31	0.28	0.28	0.30	0.30	0.28	0.28	0.28	0.28	0.24	0.24	0.00
$q_{max} = (W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)$	Ton/m²	**7.65**	**9.10**	**8.74**	**7.65**	**8.80**	**8.80**	**8.96**	**8.96**	**9.61**	**9.61**	**9.73**	**9.73**	**6.53**	**6.53**	**6.70**	**6.70**	**1.99**
$q_{min} = (W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)$	Ton/m²	**2.61**	**2.58**	**2.59**	**2.61**	**2.07**	**2.07**	**2.60**	**2.60**	**2.17**	**2.17**	**2.58**	**2.58**	**1.82**	**1.82**	**2.35**	**2.35**	**1.99**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fz_U	Ton	*28.33*	*31.58*	*31.61*	*31.61*	*34.83*	*34.83*	*20.98*	*20.98*	*24.20*	*24.20*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado ($W_U = Fz_U+W_{zU}+W_{sU}$)	Ton	46.27	45.03	45.06	45.06	48.28	48.28	34.43	34.43	37.65	37.65	13.45	13.45	13.45	13.45	13.45	13.45	13.45
Mx_U	Ton-m	*2.74*	*2.93*	*5.03*	*5.03*	*4.91*	*4.91*	*4.08*	*4.08*	*3.96*	*3.96*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*-4.24*	*-4.54*	*-1.90*	*-1.90*	*-1.53*	*-1.53*	*-0.43*	*-0.43*	*-0.05*	*-0.05*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*3.27*	*4.30*	*4.85*	*4.85*	*4.74*	*4.74*	*3.21*	*3.21*	*3.11*	*3.11*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*4.83*	*6.44*	*7.63*	*7.63*	*6.73*	*6.73*	*5.16*	*5.16*	*4.26*	*4.26*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U = Mx_U+Fy_U*h_z$	Ton-m	4.43	4.75	5.79	5.79	5.52	5.52	4.25	4.25	3.98	3.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U+ Fx_U*h_z$	Ton-m	5.21	6.87	7.90	7.90	7.43	7.43	5.27	5.27	4.81	4.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_U$	m.	0.11	0.15	0.18	0.18	0.15	0.15	0.15	0.15	0.13	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_U$	m.	0.10	0.11	0.13	0.13	0.11	0.11	0.12	0.12	0.11	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.24	0.33	0.38	0.38	0.33	0.33	0.33	0.33	0.27	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.25	0.28	0.34	0.34	0.30	0.30	0.32	0.32	0.28	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_U/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m²	10.71	11.20	11.97	11.97	12.21	12.21	8.82	8.82	9.06	9.06	2.09	2.09	2.09	2.09	2.09	2.09	2.09
$q_{minU} = (W_U/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m²	3.66	2.78	2.02	2.02	2.79	2.79	1.87	1.87	2.63	2.63	2.09	2.09	2.09	2.09	2.09	2.09	2.09



ACCION COMO LOSA

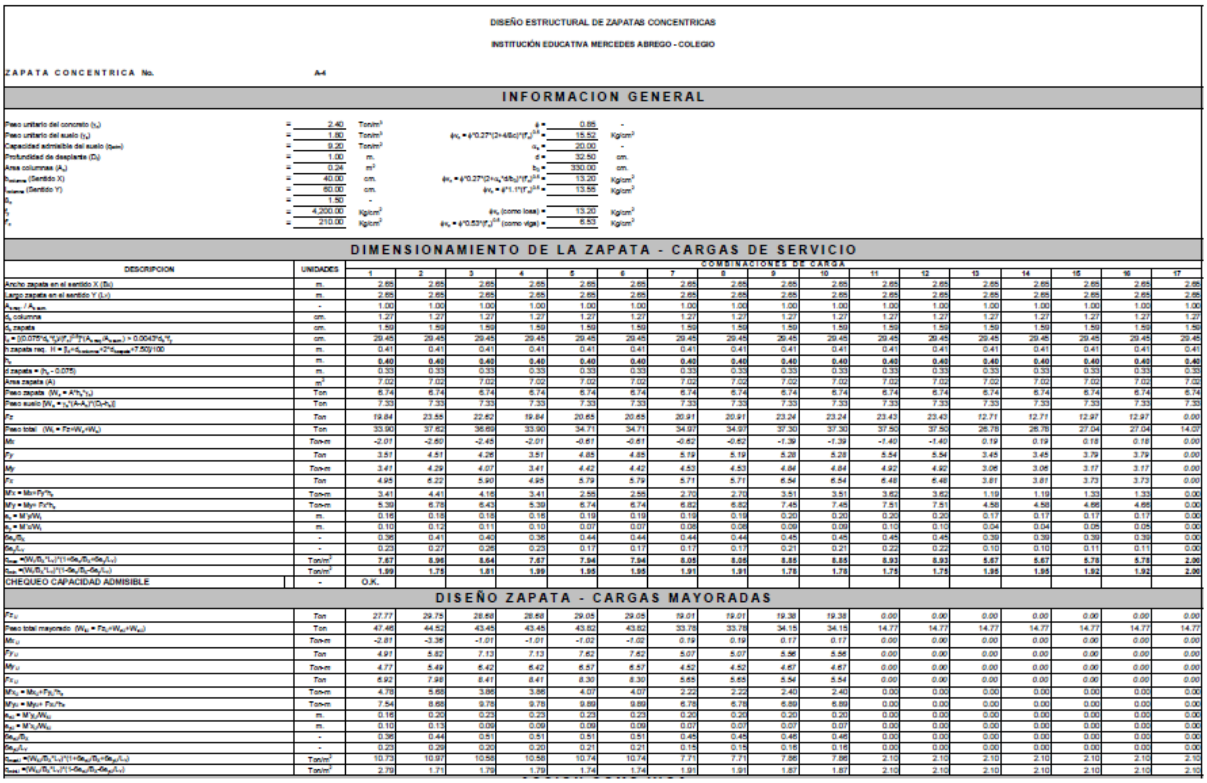
DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
b_0	cm.	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00
$V_U = q_{maxU}*[A-(b_c+d)*(l_c+d)]$	Ton	60.81	63.60	67.96	67.96	69.30	69.30	50.09	50.09	51.42	51.42	11.86	11.86	11.86	11.86	11.86	11.86	11.86
$v_U = V_U/b_0*d$	Kg/cm²	5.35	5.59	5.97	5.97	6.09	6.09	4.40	4.40	4.52	4.52	1.04	1.04	1.04	1.04	1.04	1.04	1.04
$v_U \le \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - $v_{u\,MAX}$	Kg/cm²	6.09																

DISEÑO A FLEXION EN DOS DIRECCIONES

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_c/2)^2]/2$	Ton-cm	**1,629.19**	**3,407.76**	**3,641.40**	**3,641.40**	**3,713.09**	**3,713.09**	**2,683.70**	**2,683.70**	**2,755.40**	**2,755.40**	**635.47**	**635.47**	**635.47**	**635.47**	**635.47**	**635.47**	**635.47**
$K_X = M_{UX}/(L_Y*d^2)$	Ton/cm²	0.00671	0.01403	0.01499	0.01499	0.01528	0.01528	0.01105	0.01105	0.01134	0.01134	0.00262	0.00262	0.00262	0.00262	0.00262	0.00262	0.00262
$\rho_X = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_X/f'_c)]^{0.5}) \ge 0.0018$	-	0.00162	0.00390	0.00418	0.00418	0.00427	0.00427	0.00304	0.00304	0.00312	0.00312	0.00070	0.00070	0.00070	0.00070	0.00070	0.00070	0.00070
$A_{sX} = \rho_X*L_Y*d$	cm²	13.59	29.16	31.27	31.27	31.92	31.92	22.72	22.72	23.35	23.35	13.46	13.46	13.46	13.46	13.46	13.46	13.46
Longitud de varilla = B_X - 10	cm.	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_c/2)^2]/2$	Ton-cm	**2,167.08**	**2,266.43**	**2,421.81**	**2,421.81**	**2,469.49**	**2,469.49**	**1,784.87**	**1,784.87**	**1,832.56**	**1,832.56**	**422.64**	**422.64**	**422.64**	**422.64**	**422.64**	**422.64**	**422.64**
$K_Y = M_{UY}/(B_X*d^2)$	Ton/cm²	0.00733	0.00766	0.00819	0.00819	0.00835	0.00835	0.00604	0.00604	0.00620	0.00620	0.00143	0.00143	0.00143	0.00143	0.00143	0.00143	0.00143
$\rho_Y = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_Y/f'_c)]^{0.5}) \ge 0.0018$	-	0.00210	0.00220	0.00236	0.00236	0.00241	0.00241	0.00173	0.00173	0.00177	0.00177	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040
$A_{sY} = \rho_Y*B_X*d$	cm²	16.55	35.50	38.07	38.07	38.86	38.86	27.68	27.68	28.43	28.43	16.38	16.38	16.38	16.38	16.38	16.38	16.38
Longitud de varilla = L_Y - 10	cm.	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	**31.92**
A_{sY} Máximo	cm²	**38.86**
EN SENTIDO X USAR	-	**17 VARILLAS No. 5 L = 2.7 m. @ 13.75 cm.**
EN SENTIDO Y USAR	-	**20 VARILLAS No. 5 L = 2.2 m. @ 14.21 cm.**



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. A-4

INFORMACION GENERAL

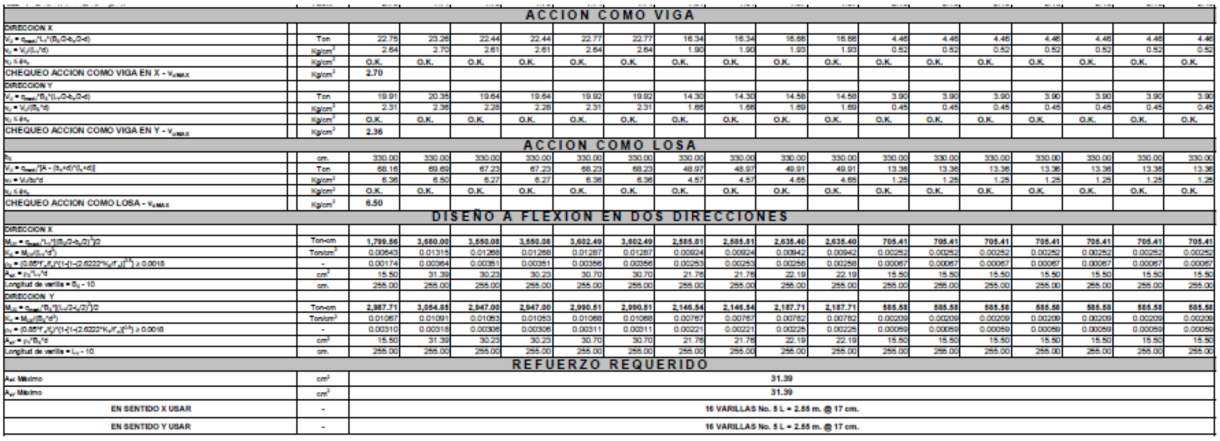
Peso unitario del concreto (γ_c)	=	2.40	Ton/m³	ϕ =	0.85	-
Peso unitario del suelo (γ_s)	=	1.80	Ton/m³	$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ =	15.52	Kg/cm²
Capacidad admisible del suelo (q_{adm})	=	9.20	Ton/m²	α_s =	20.00	-
Profundidad de desplante (D_f)	=	1.00	m.	d =	32.50	cm.
Area columnas (A_c)	=	0.24	m²	b_0 =	330.00	cm.
$b_{columna}$ (Sentido X)	=	40.00	cm.	$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ =	13.20	Kg/cm²
$l_{columna}$ (Sentido Y)	=	60.00	cm.	$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ =	13.55	Kg/cm²
β_c	=	1.50	-			
f_y	=	4,200.00	Kg/cm²	ϕv_c (como losa) =	13.20	Kg/cm²
f'_c	=	210.00	Kg/cm²	$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) =	6.53	Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65
Largo zapata en el sentido Y (L_Y)	m.	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65
$A_{s\,req}$ / $A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
d_b zapata	cm.	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
$l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*(A_{s\,req}/A_{s\,sum}) > 0.0043*d_b*f_y$	cm.	29.45	29.45	29.45	29.45	29.45	29.45	29.45	29.45	29.45	29.45	29.45	29.45	29.45	29.45	29.45	29.45	29.45
h zapata req. $H = [l_d+d_{b\,columna}+2*d_{b\,zapata}+7.50]/100$	m.	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
h_z	m.	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**
d zapata = (h_z - 0.075)	m.	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Area zapata (A)	m²	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02	7.02
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	6.74	6.74	6.74	6.74	6.74	6.74	6.74	6.74	6.74	6.74	6.74	6.74	6.74	6.74	6.74	6.74	6.74
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33	7.33
Fz	*Ton*	*19.84*	*23.55*	*22.62*	*19.84*	*20.65*	*20.65*	*20.91*	*20.91*	*23.24*	*23.24*	*23.43*	*23.43*	*12.71*	*12.71*	*12.97*	*12.97*	*0.00*
Peso total (W_t = Fz+W_z+W_s)	Ton	33.90	37.62	36.69	33.90	34.71	34.71	34.97	34.97	37.30	37.30	37.50	37.50	26.78	26.78	27.04	27.04	14.07
Mx	*Ton-m*	*-2.01*	*-2.60*	*-2.45*	*-2.01*	*-0.61*	*-0.61*	*-0.62*	*-0.62*	*-1.39*	*-1.39*	*-1.40*	*-1.40*	*0.19*	*0.19*	*0.18*	*0.18*	*0.00*
Fy	*Ton*	*3.51*	*4.51*	*4.26*	*3.51*	*4.85*	*4.85*	*5.19*	*5.19*	*5.28*	*5.28*	*5.54*	*5.54*	*3.45*	*3.45*	*3.79*	*3.79*	*0.00*
My	*Ton-m*	*3.41*	*4.29*	*4.07*	*3.41*	*4.42*	*4.42*	*4.53*	*4.53*	*4.84*	*4.84*	*4.92*	*4.92*	*3.06*	*3.06*	*3.17*	*3.17*	*0.00*
Fx	*Ton*	*4.95*	*6.22*	*5.90*	*4.95*	*5.79*	*5.79*	*5.71*	*5.71*	*6.54*	*6.54*	*6.48*	*6.48*	*3.81*	*3.81*	*3.73*	*3.73*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	3.41	4.41	4.16	3.41	2.55	2.55	2.70	2.70	3.51	3.51	3.62	3.62	1.19	1.19	1.33	1.33	0.00
M'y = My+ Fx*h_z	Ton-m	5.39	6.78	6.43	5.39	6.74	6.74	6.82	6.82	7.45	7.45	7.51	7.51	4.58	4.58	4.66	4.66	0.00
e_x = M'y/W_t	m.	0.16	0.18	0.18	0.16	0.19	0.19	0.19	0.19	0.20	0.20	0.20	0.20	0.17	0.17	0.17	0.17	0.00
e_y = M'x/W_t	m.	0.10	0.12	0.11	0.10	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.04	0.04	0.05	0.05	0.00
$6e_x/B_X$	-	0.36	0.41	0.40	0.36	0.44	0.44	0.44	0.44	0.45	0.45	0.45	0.45	0.39	0.39	0.39	0.39	0.00
$6e_y/L_Y$	-	0.23	0.27	0.26	0.23	0.17	0.17	0.17	0.17	0.21	0.21	0.22	0.22	0.10	0.10	0.11	0.11	0.00
$q_{max} = (W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)$	Ton/m²	**7.67**	**8.96**	**8.64**	**7.67**	**7.94**	**7.94**	**8.05**	**8.05**	**8.85**	**8.85**	**8.93**	**8.93**	**5.67**	**5.67**	**5.78**	**5.78**	**2.00**
$q_{min} = (W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)$	Ton/m²	**1.99**	**1.75**	**1.81**	**1.99**	**1.95**	**1.95**	**1.91**	**1.91**	**1.78**	**1.78**	**1.75**	**1.75**	**1.95**	**1.95**	**1.92**	**1.92**	**2.00**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fz_U	*Ton*	*27.77*	*29.75*	*28.68*	*28.68*	*29.05*	*29.05*	*19.01*	*19.01*	*19.38*	*19.38*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado (W_U = Fz_U+W_{zU}+W_{sU})	Ton	47.46	44.52	43.45	43.45	43.82	43.82	33.78	33.78	34.15	34.15	14.77	14.77	14.77	14.77	14.77	14.77	14.77
Mx_U	*Ton-m*	*-2.81*	*-3.36*	*-1.01*	*-1.01*	*-1.02*	*-1.02*	*0.19*	*0.19*	*0.17*	*0.17*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	*Ton*	*4.91*	*5.82*	*7.13*	*7.13*	*7.62*	*7.62*	*5.07*	*5.07*	*5.56*	*5.56*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	*Ton-m*	*4.77*	*5.49*	*6.42*	*6.42*	*6.57*	*6.57*	*4.52*	*4.52*	*4.67*	*4.67*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	*Ton*	*6.92*	*7.98*	*8.41*	*8.41*	*8.30*	*8.30*	*5.65*	*5.65*	*5.54*	*5.54*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U$ = Mx_U+Fy_U*h_z	Ton-m	4.78	5.68	3.86	3.86	4.07	4.07	2.22	2.22	2.40	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U$ = My_U+ Fx_U*h_z	Ton-m	7.54	8.68	9.78	9.78	9.89	9.89	6.78	6.78	6.89	6.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e_{xU} = $M'y_U/W_U$	m.	0.16	0.20	0.23	0.23	0.23	0.23	0.20	0.20	0.20	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e_{yU} = $M'x_U/W_U$	m.	0.10	0.13	0.09	0.09	0.09	0.09	0.07	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.36	0.44	0.51	0.51	0.51	0.51	0.45	0.45	0.46	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.23	0.29	0.20	0.20	0.21	0.21	0.15	0.15	0.16	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_U/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m²	10.73	10.97	10.58	10.58	10.74	10.74	7.71	7.71	7.86	7.86	2.10	2.10	2.10	2.10	2.10	2.10	2.10
$q_{minU} = (W_U/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m²	2.79	1.71	1.79	1.79	1.74	1.74	1.91	1.91	1.87	1.87	2.10	2.10	2.10	2.10	2.10	2.10	2.10



ACCION COMO VIGA

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$V_U = q_{maxU}*L_Y*(B_X/2-b_c/2-d)$	Ton	22.75	23.26	22.44	22.44	22.77	22.77	16.34	16.34	16.66	16.66	4.46	4.46	4.46	4.46	4.46	4.46	4.46
$v_U = V_U/(L_Y*d)$	Kg/cm²	2.64	2.70	2.61	2.61	2.64	2.64	1.90	1.90	1.93	1.93	0.52	0.52	0.52	0.52	0.52	0.52	0.52
$v_U \le \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{uMAX}	Kg/cm²	2.70																
DIRECCION Y																		
$V_U = q_{maxU}*B_X*(L_Y/2-l_c/2-d)$	Ton	19.91	20.35	19.64	19.64	19.92	19.92	14.30	14.30	14.58	14.58	3.90	3.90	3.90	3.90	3.90	3.90	3.90
$v_U = V_U/(B_X*d)$	Kg/cm²	2.31	2.38	2.28	2.28	2.31	2.31	1.68	1.68	1.69	1.69	0.45	0.45	0.45	0.45	0.45	0.45	0.45
$v_U \le \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{uMAX}	Kg/cm²	2.38																

ACCION COMO LOSA

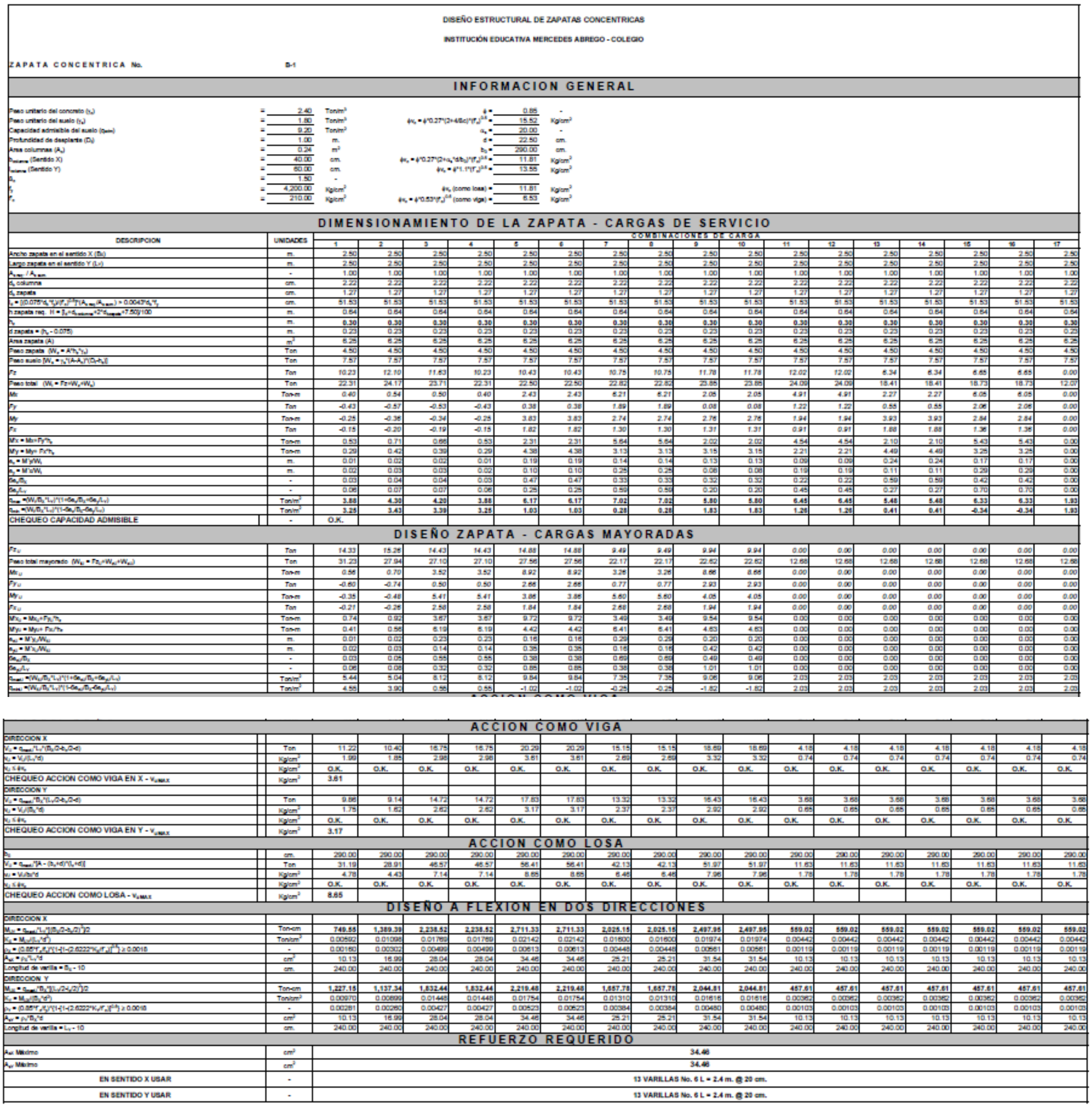
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
b_0	cm.	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00
$V_U = q_{maxU}*[A - (b_c+d)*(l_c+d)]$	Ton	68.16	69.69	67.23	67.23	68.23	68.23	48.97	48.97	49.91	49.91	13.36	13.36	13.36	13.36	13.36	13.36	13.36
$v_U = V_U/b_0*d$	Kg/cm²	6.36	6.50	6.27	6.27	6.36	6.36	4.57	4.57	4.65	4.65	1.25	1.25	1.25	1.25	1.25	1.25	1.25
$v_U \le \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{uMAX}	Kg/cm²	6.50																

DISEÑO A FLEXION EN DOS DIRECCIONES

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_c/2)^2]/2$	Ton-cm	**1,799.56**	**3,680.00**	**3,550.08**	**3,550.08**	**3,602.49**	**3,602.49**	**2,585.81**	**2,585.81**	**2,635.40**	**2,635.40**	**705.41**	**705.41**	**705.41**	**705.41**	**705.41**	**705.41**	**705.41**
$K_X = M_{UX}/(L_Y*d^2)$	Ton/cm²	0.00643	0.01315	0.01268	0.01268	0.01287	0.01287	0.00924	0.00924	0.00942	0.00942	0.00252	0.00252	0.00252	0.00252	0.00252	0.00252	0.00252
$\rho_X = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_X/f'_c)]^{0.5}) \ge 0.0018$	-	0.00174	0.00364	0.00351	0.00351	0.00356	0.00356	0.00253	0.00253	0.00258	0.00258	0.00067	0.00067	0.00067	0.00067	0.00067	0.00067	0.00067
$A_{sX} = \rho_X*L_Y*d$	cm²	15.50	31.39	30.23	30.23	30.70	30.70	21.78	21.78	22.19	22.19	15.50	15.50	15.50	15.50	15.50	15.50	15.50
Longitud de varilla = B_X - 10	cm.	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_c/2)^2]/2$	Ton-cm	**2,987.71**	**3,054.85**	**2,947.00**	**2,947.00**	**2,990.51**	**2,990.51**	**2,146.54**	**2,146.54**	**2,187.71**	**2,187.71**	**585.58**	**585.58**	**585.58**	**585.58**	**585.58**	**585.58**	**585.58**
$K_Y = M_{UY}/(B_X*d^2)$	Ton/cm²	0.01067	0.01091	0.01053	0.01053	0.01068	0.01068	0.00767	0.00767	0.00782	0.00782	0.00209	0.00209	0.00209	0.00209	0.00209	0.00209	0.00209
$\rho_Y = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_Y/f'_c)]^{0.5}) \ge 0.0018$	-	0.00310	0.00318	0.00306	0.00306	0.00311	0.00311	0.00221	0.00221	0.00225	0.00225	0.00059	0.00059	0.00059	0.00059	0.00059	0.00059	0.00059
$A_{sY} = \rho_Y*B_X*d$	cm²	15.50	31.39	30.23	30.23	30.70	30.70	21.78	21.78	22.19	22.19	15.50	15.50	15.50	15.50	15.50	15.50	15.50
Longitud de varilla = L_Y - 10	cm.	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00	255.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	31.39
A_{sY} Máximo	cm²	31.39
EN SENTIDO X USAR	-	16 VARILLAS No. 5 L = 2.55 m. @ 17 cm.
EN SENTIDO Y USAR	-	16 VARILLAS No. 5 L = 2.55 m. @ 17 cm.



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. B-1

INFORMACION GENERAL

Peso unitario del concreto (γ_c) = 2.40 Ton/m³
Peso unitario del suelo (γ_s) = 1.80 Ton/m³
Capacidad admisible del suelo (q_{adm}) = 9.20 Ton/m²
Profundidad de desplante (D_f) = 1.00 m.
Area columnas (A_c) = 0.24 m²
$b_{columna}$ (Sentido X) = 40.00 cm.
$l_{columna}$ (Sentido Y) = 60.00 cm.
β_c = 1.50 -
f_y = 4,200.00 Kg/cm²
f'_c = 210.00 Kg/cm²

ϕ = 0.85 -
$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ = 15.52 Kg/cm²
α_s = 20.00 -
d = 22.50 cm.
b_0 = 290.00 cm.
$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ = 11.81 Kg/cm²
$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ = 13.55 Kg/cm²
ϕv_c (como losa) = 11.81 Kg/cm²
$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) = 6.53 Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Largo zapata en el sentido Y (L_Y)	m.	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
$A_{s\,req}$ / $A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22
d_b zapata	cm.	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
$l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*(A_{s\,req}/A_{s\,sum}) > 0.0043*d_b*f_y$	cm.	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53
h zapata req. $H = [l_d+d_{columna}+2*d_{zapata}+7.50]/100$	m.	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
h_z	m.	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**
d zapata = (h_z - 0.075)	m.	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Area zapata (A)	m²	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57
Fz	Ton	*10.23*	*12.10*	*11.63*	*10.23*	*10.43*	*10.43*	*10.75*	*10.75*	*11.78*	*11.78*	*12.02*	*12.02*	*6.34*	*6.34*	*6.65*	*6.65*	*0.00*
Peso total (W_t = Fz+W_z+W_s)	Ton	22.31	24.17	23.71	22.31	22.50	22.50	22.82	22.82	23.85	23.85	24.09	24.09	18.41	18.41	18.73	18.73	12.07
Mx	Ton-m	*0.40*	*0.54*	*0.50*	*0.40*	*2.43*	*2.43*	*6.21*	*6.21*	*2.05*	*2.05*	*4.91*	*4.91*	*2.27*	*2.27*	*6.05*	*6.05*	*0.00*
Fy	Ton	*-0.43*	*-0.57*	*-0.53*	*-0.43*	*0.38*	*0.38*	*1.89*	*1.89*	*0.08*	*0.08*	*1.22*	*1.22*	*0.55*	*0.55*	*2.06*	*2.06*	*0.00*
My	Ton-m	*-0.25*	*-0.36*	*-0.34*	*-0.25*	*3.83*	*3.83*	*2.74*	*2.74*	*2.76*	*2.76*	*1.94*	*1.94*	*3.93*	*3.93*	*2.84*	*2.84*	*0.00*
Fx	Ton	*-0.15*	*-0.20*	*-0.19*	*-0.15*	*1.82*	*1.82*	*1.30*	*1.30*	*1.31*	*1.31*	*0.91*	*0.91*	*1.88*	*1.88*	*1.36*	*1.36*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	0.53	0.71	0.66	0.53	2.31	2.31	5.64	5.64	2.02	2.02	4.54	4.54	2.10	2.10	5.43	5.43	0.00
M'y = My+ Fx*h_z	Ton-m	0.29	0.42	0.39	0.29	4.38	4.38	3.13	3.13	3.15	3.15	2.21	2.21	4.49	4.49	3.25	3.25	0.00
e_x = M'y/W_t	m.	0.01	0.02	0.02	0.01	0.19	0.19	0.14	0.14	0.13	0.13	0.09	0.09	0.24	0.24	0.17	0.17	0.00
e_y = M'x/W_t	m.	0.02	0.03	0.03	0.02	0.10	0.10	0.25	0.25	0.08	0.08	0.19	0.19	0.11	0.11	0.29	0.29	0.00
$6e_x/B_X$	-	0.03	0.04	0.04	0.03	0.47	0.47	0.33	0.33	0.32	0.32	0.22	0.22	0.59	0.59	0.42	0.42	0.00
$6e_y/L_Y$	-	0.06	0.07	0.07	0.06	0.25	0.25	0.59	0.59	0.20	0.20	0.45	0.45	0.27	0.27	0.70	0.70	0.00
$q_{max} = (W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)$	Ton/m²	**3.88**	**4.30**	**4.20**	**3.88**	**6.17**	**6.17**	**7.02**	**7.02**	**5.80**	**5.80**	**6.45**	**6.45**	**5.48**	**5.48**	**6.33**	**6.33**	**1.93**
$q_{min} = (W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)$	Ton/m²	**3.25**	**3.43**	**3.39**	**3.25**	**1.03**	**1.03**	**0.28**	**0.28**	**1.83**	**1.83**	**1.26**	**1.26**	**0.41**	**0.41**	**-0.34**	**-0.34**	**1.93**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fz_U	Ton	*14.33*	*15.26*	*14.43*	*14.43*	*14.88*	*14.88*	*9.49*	*9.49*	*9.94*	*9.94*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado ($W_U = Fz_U+W_{zU}+W_{sU}$)	Ton	31.23	27.94	27.10	27.10	27.56	27.56	22.17	22.17	22.62	22.62	12.68	12.68	12.68	12.68	12.68	12.68	12.68
Mx_U	Ton-m	*0.56*	*0.70*	*3.52*	*3.52*	*8.92*	*8.92*	*3.26*	*3.26*	*8.66*	*8.66*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*-0.60*	*-0.74*	*0.50*	*0.50*	*2.66*	*2.66*	*0.77*	*0.77*	*2.93*	*2.93*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*-0.35*	*-0.48*	*5.41*	*5.41*	*3.86*	*3.86*	*5.60*	*5.60*	*4.05*	*4.05*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*-0.21*	*-0.26*	*2.58*	*2.58*	*1.84*	*1.84*	*2.68*	*2.68*	*1.94*	*1.94*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U = Mx_U+Fy_U*h_z$	Ton-m	0.74	0.92	3.67	3.67	9.72	9.72	3.49	3.49	9.54	9.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U+ Fx_U*h_z$	Ton-m	0.41	0.56	6.19	6.19	4.42	4.42	6.41	6.41	4.63	4.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_U$	m.	0.01	0.02	0.23	0.23	0.16	0.16	0.29	0.29	0.20	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_U$	m.	0.02	0.03	0.14	0.14	0.35	0.35	0.16	0.16	0.42	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.03	0.05	0.55	0.55	0.38	0.38	0.69	0.69	0.49	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.06	0.08	0.32	0.32	0.85	0.85	0.38	0.38	1.01	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_U/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m²	5.44	5.04	8.12	8.12	9.84	9.84	7.35	7.35	9.06	9.06	2.03	2.03	2.03	2.03	2.03	2.03	2.03
$q_{minU} = (W_U/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m²	4.55	3.90	0.56	0.56	-1.02	-1.02	-0.25	-0.25	-1.82	-1.82	2.03	2.03	2.03	2.03	2.03	2.03	2.03

ACCION COMO VIGA

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$V_U = q_{maxU}*L_Y*(B_X/2-b_c/2-d)$	Ton	11.22	10.40	16.75	16.75	20.29	20.29	15.15	15.15	18.69	18.69	4.18	4.18	4.18	4.18	4.18	4.18	4.18
$v_U = V_U/(L_Y*d)$	Kg/cm²	1.99	1.85	2.98	2.98	3.61	3.61	2.69	2.69	3.32	3.32	0.74	0.74	0.74	0.74	0.74	0.74	0.74
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - $v_{u\,MAX}$	Kg/cm²	3.61																
DIRECCION Y																		
$V_U = q_{maxU}*B_X*(L_Y/2-l_c/2-d)$	Ton	9.86	9.14	14.72	14.72	17.83	17.83	13.32	13.32	16.43	16.43	3.68	3.68	3.68	3.68	3.68	3.68	3.68
$v_U = V_U/(B_X*d)$	Kg/cm²	1.75	1.62	2.62	2.62	3.17	3.17	2.37	2.37	2.92	2.92	0.65	0.65	0.65	0.65	0.65	0.65	0.65
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - $v_{u\,MAX}$	Kg/cm²	3.17																

ACCION COMO LOSA

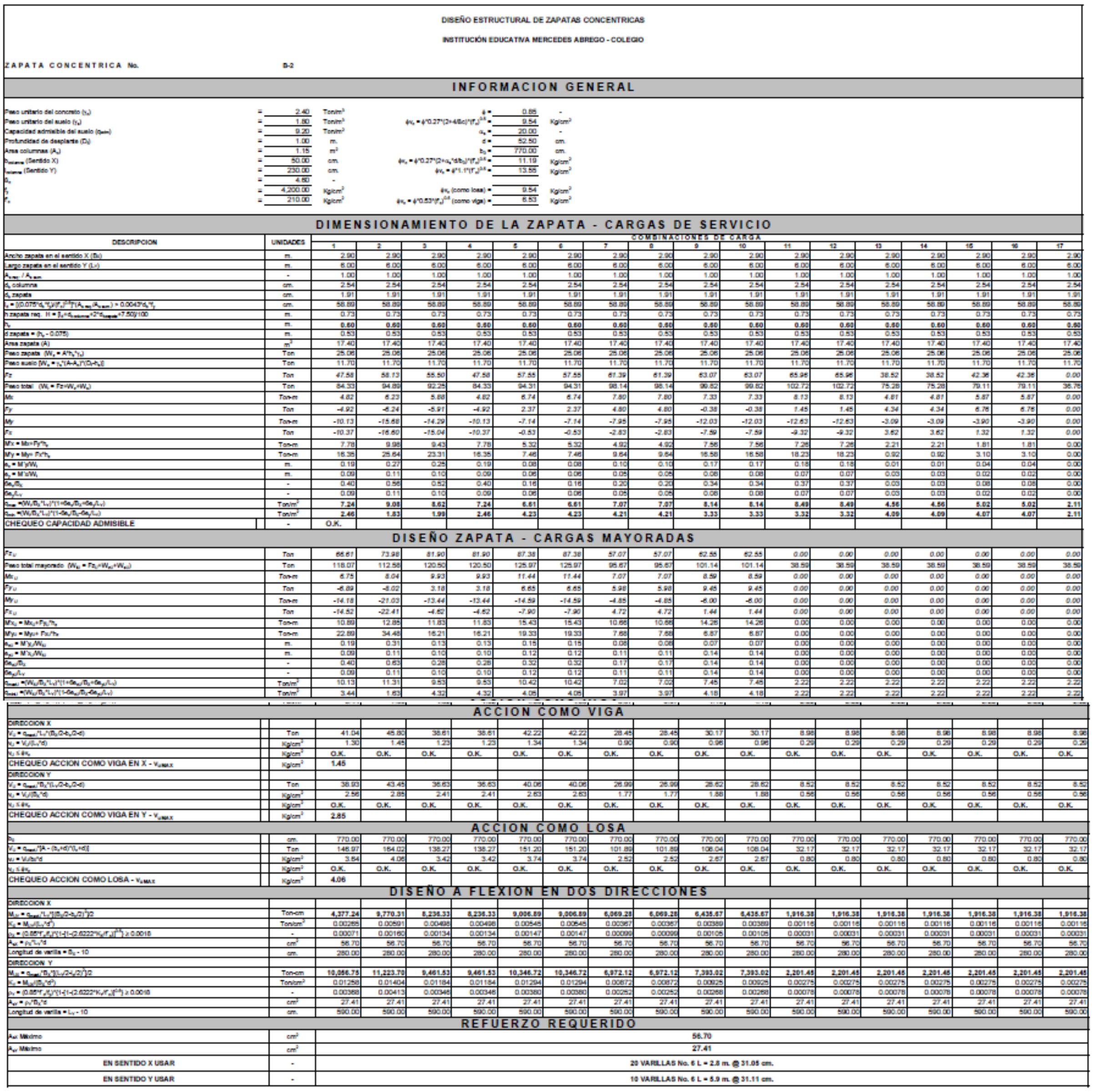
DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
b_0	cm.	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00
$V_U = q_{maxU}*[A - (b_c+d)*(l_c+d)]$	Ton	31.19	28.91	46.57	46.57	56.41	56.41	42.13	42.13	51.97	51.97	11.63	11.63	11.63	11.63	11.63	11.63	11.63
$v_U = V_U/b_0*d$	Kg/cm²	4.78	4.43	7.14	7.14	8.65	8.65	6.46	6.46	7.96	7.96	1.78	1.78	1.78	1.78	1.78	1.78	1.78
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - $v_{u\,MAX}$	Kg/cm²	8.65																

DISEÑO A FLEXION EN DOS DIRECCIONES

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_c/2)^2]/2$	Ton-cm	**749.55**	**1,389.39**	**2,238.52**	**2,238.52**	**2,711.33**	**2,711.33**	**2,025.15**	**2,025.15**	**2,497.95**	**2,497.95**	**559.02**	**559.02**	**559.02**	**559.02**	**559.02**	**559.02**	**559.02**
$K_X = M_{UX}/(L_Y*d^2)$	Ton/cm²	0.00592	0.01098	0.01769	0.01769	0.02142	0.02142	0.01600	0.01600	0.01974	0.01974	0.00442	0.00442	0.00442	0.00442	0.00442	0.00442	0.00442
$\rho_X = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_X/f'_c)]^{0.5}) \geq 0.0018$	-	0.00160	0.00302	0.00499	0.00499	0.00613	0.00613	0.00448	0.00448	0.00561	0.00561	0.00119	0.00119	0.00119	0.00119	0.00119	0.00119	0.00119
$A_{sX} = \rho_X*L_Y*d$	cm²	10.13	16.99	28.04	28.04	34.46	34.46	25.21	25.21	31.54	31.54	10.13	10.13	10.13	10.13	10.13	10.13	10.13
Longitud de varilla = B_X - 10	cm.	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_c/2)^2]/2$	Ton-cm	**1,227.15**	**1,137.34**	**1,832.44**	**1,832.44**	**2,219.48**	**2,219.48**	**1,657.78**	**1,657.78**	**2,044.81**	**2,044.81**	**457.61**	**457.61**	**457.61**	**457.61**	**457.61**	**457.61**	**457.61**
$K_Y = M_{UY}/(B_X*d^2)$	Ton/cm²	0.00970	0.00899	0.01448	0.01448	0.01754	0.01754	0.01310	0.01310	0.01616	0.01616	0.00362	0.00362	0.00362	0.00362	0.00362	0.00362	0.00362
$\rho_Y = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_Y/f'_c)]^{0.5}) \geq 0.0018$	-	0.00281	0.00260	0.00427	0.00427	0.00523	0.00523	0.00384	0.00384	0.00480	0.00480	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103
$A_{sY} = \rho_Y*B_X*d$	cm²	10.13	16.99	28.04	28.04	34.46	34.46	25.21	25.21	31.54	31.54	10.13	10.13	10.13	10.13	10.13	10.13	10.13
Longitud de varilla = L_Y - 10	cm.	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00

REFUERZO REQUERIDO

DESCRIPCION	UNIDADES	
A_{sX} Máximo	cm²	34.46
A_{sY} Máximo	cm²	34.46
EN SENTIDO X USAR	-	13 VARILLAS No. 6 L = 2.4 m. @ 20 cm.
EN SENTIDO Y USAR	-	13 VARILLAS No. 6 L = 2.4 m. @ 20 cm.



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. B-2

INFORMACION GENERAL

Peso unitario del concreto (γ_c)	=	2.40	Ton/m³	ϕ =	0.85	-
Peso unitario del suelo (γ_s)	=	1.80	Ton/m³	$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ =	9.54	Kg/cm²
Capacidad admisible del suelo (q_{adm})	=	9.20	Ton/m²	α_s =	20.00	-
Profundidad de desplante (D_f)	=	1.00	m.	d =	52.50	cm.
Area columnas (A_c)	=	1.15	m²	b_0 =	770.00	cm.
$b_{columna}$ (Sentido X)	=	50.00	cm.	$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ =	11.19	Kg/cm²
$l_{columna}$ (Sentido Y)	=	230.00	cm.	$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ =	13.55	Kg/cm²
β_c	=	4.60	-			
f_y	=	4,200.00	Kg/cm²	ϕv_c (como losa) =	9.54	Kg/cm²
f'_c	=	210.00	Kg/cm²	$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) =	6.53	Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Largo zapata en el sentido Y (L_Y)	m.	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
$A_{s,req} / A_{s,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54
d_b zapata	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
$l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*(A_{s,req}/A_{s,sum}) > 0.0043*d_b*f_y$	cm.	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89
h zapata req. $H = [l_d+d_{columna}+2*d_{zapata}+7.50]/100$	m.	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
h_z	m.	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**
d zapata = (h_z - 0.075)	m.	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
Area zapata (A)	m²	17.40	17.40	17.40	17.40	17.40	17.40	17.40	17.40	17.40	17.40	17.40	17.40	17.40	17.40	17.40	17.40	17.40
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	25.06	25.06	25.06	25.06	25.06	25.06	25.06	25.06	25.06	25.06	25.06	25.06	25.06	25.06	25.06	25.06	25.06
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	11.70	11.70	11.70	11.70	11.70	11.70	11.70	11.70	11.70	11.70	11.70	11.70	11.70	11.70	11.70	11.70	11.70
Fz	Ton	*47.58*	*58.13*	*55.50*	*47.58*	*57.55*	*57.55*	*61.39*	*61.39*	*63.07*	*63.07*	*65.96*	*65.96*	*38.52*	*38.52*	*42.36*	*42.36*	*0.00*
Peso total (W_t = Fz+W_z+W_s)	Ton	84.33	94.89	92.25	84.33	94.31	94.31	98.14	98.14	99.82	99.82	102.72	102.72	75.28	75.28	79.11	79.11	36.76
Mx	Ton-m	*4.82*	*6.23*	*5.88*	*4.82*	*6.74*	*6.74*	*7.80*	*7.80*	*7.33*	*7.33*	*8.13*	*8.13*	*4.81*	*4.81*	*5.87*	*5.87*	*0.00*
Fy	Ton	*-4.92*	*-6.24*	*-5.91*	*-4.92*	*2.37*	*2.37*	*4.80*	*4.80*	*-0.38*	*-0.38*	*1.45*	*1.45*	*4.34*	*4.34*	*6.76*	*6.76*	*0.00*
My	Ton-m	*-10.13*	*-15.68*	*-14.29*	*-10.13*	*-7.14*	*-7.14*	*-7.95*	*-7.95*	*-12.03*	*-12.03*	*-12.63*	*-12.63*	*-3.09*	*-3.09*	*-3.90*	*-3.90*	*0.00*
Fx	Ton	*-10.37*	*-16.60*	*-15.04*	*-10.37*	*-0.53*	*-0.53*	*-2.83*	*-2.83*	*-7.59*	*-7.59*	*-9.32*	*-9.32*	*3.62*	*3.62*	*1.32*	*1.32*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	7.78	9.98	9.43	7.78	5.32	5.32	4.92	4.92	7.56	7.56	7.26	7.26	2.21	2.21	1.81	1.81	0.00
M'y = My+ Fx*h_z	Ton-m	16.35	25.64	23.31	16.35	7.46	7.46	9.64	9.64	16.58	16.58	18.23	18.23	0.92	0.92	3.10	3.10	0.00
e_x = M'y/W_t	m.	0.19	0.27	0.25	0.19	0.08	0.08	0.10	0.10	0.17	0.17	0.18	0.18	0.01	0.01	0.04	0.04	0.00
e_y = M'x/W_t	m.	0.09	0.11	0.10	0.09	0.06	0.06	0.05	0.05	0.08	0.08	0.07	0.07	0.03	0.03	0.02	0.02	0.00
$6e_x/B_X$	-	0.40	0.56	0.52	0.40	0.16	0.16	0.20	0.20	0.34	0.34	0.37	0.37	0.03	0.03	0.08	0.08	0.00
$6e_y/L_Y$	-	0.09	0.11	0.10	0.09	0.06	0.06	0.05	0.05	0.08	0.08	0.07	0.07	0.03	0.03	0.02	0.02	0.00
$q_{max} = (W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)$	Ton/m²	**7.24**	**9.08**	**8.62**	**7.24**	**6.61**	**6.61**	**7.07**	**7.07**	**8.14**	**8.14**	**8.49**	**8.49**	**4.56**	**4.56**	**5.02**	**5.02**	**2.11**
$q_{min} = (W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)$	Ton/m²	**2.46**	**1.83**	**1.99**	**2.46**	**4.23**	**4.23**	**4.21**	**4.21**	**3.33**	**3.33**	**3.32**	**3.32**	**4.09**	**4.09**	**4.07**	**4.07**	**2.11**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fz_U	Ton	*66.61*	*73.98*	*81.90*	*81.90*	*87.38*	*87.38*	*57.07*	*57.07*	*62.55*	*62.55*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado (W_U = Fz_U+W_{zU}+W_{sU})	Ton	118.07	112.58	120.50	120.50	125.97	125.97	95.67	95.67	101.14	101.14	38.59	38.59	38.59	38.59	38.59	38.59	38.59
Mx_U	Ton-m	*6.75*	*8.04*	*9.93*	*9.93*	*11.44*	*11.44*	*7.07*	*7.07*	*8.59*	*8.59*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*-6.89*	*-8.02*	*3.18*	*3.18*	*6.65*	*6.65*	*5.98*	*5.98*	*9.45*	*9.45*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*-14.18*	*-21.03*	*-13.44*	*-13.44*	*-14.59*	*-14.59*	*-4.85*	*-4.85*	*-6.00*	*-6.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*-14.52*	*-22.41*	*-4.62*	*-4.62*	*-7.90*	*-7.90*	*4.72*	*4.72*	*1.44*	*1.44*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U$ = Mx_U+Fy_U*h_z	Ton-m	10.89	12.85	11.83	11.83	15.43	15.43	10.66	10.66	14.26	14.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U$ = My_U+ Fx_U*h_z	Ton-m	22.89	34.48	16.21	16.21	19.33	19.33	7.68	7.68	6.87	6.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e_{xU} = $M'y_U/W_U$	m.	0.19	0.31	0.13	0.13	0.15	0.15	0.08	0.08	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e_{yU} = $M'x_U/W_U$	m.	0.09	0.11	0.10	0.10	0.12	0.12	0.11	0.11	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.40	0.63	0.28	0.28	0.32	0.32	0.17	0.17	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.09	0.11	0.10	0.10	0.12	0.12	0.11	0.11	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_U/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m²	10.13	11.31	9.53	9.53	10.42	10.42	7.02	7.02	7.45	7.45	2.22	2.22	2.22	2.22	2.22	2.22	2.22
$q_{minU} = (W_U/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m²	3.44	1.63	4.32	4.32	4.05	4.05	3.97	3.97	4.18	4.18	2.22	2.22	2.22	2.22	2.22	2.22	2.22

ACCION COMO VIGA

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$V_U = q_{maxU}*L_Y*(B_X/2-b_c/2-d)$	Ton	41.04	45.80	38.61	38.61	42.22	42.22	28.45	28.45	30.17	30.17	8.98	8.98	8.98	8.98	8.98	8.98	8.98
$v_U = V_U/(L_Y*d)$	Kg/cm²	1.30	1.45	1.23	1.23	1.34	1.34	0.90	0.90	0.96	0.96	0.29	0.29	0.29	0.29	0.29	0.29	0.29
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{uMAX}	Kg/cm²	**1.45**																
DIRECCION Y																		
$V_U = q_{maxU}*B_X*(L_Y/2-l_c/2-d)$	Ton	38.93	43.45	36.63	36.63	40.06	40.06	26.99	26.99	28.62	28.62	8.52	8.52	8.52	8.52	8.52	8.52	8.52
$v_U = V_U/(B_X*d)$	Kg/cm²	2.56	2.85	2.41	2.41	2.63	2.63	1.77	1.77	1.88	1.88	0.56	0.56	0.56	0.56	0.56	0.56	0.56
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{uMAX}	Kg/cm²	**2.85**																

ACCION COMO LOSA

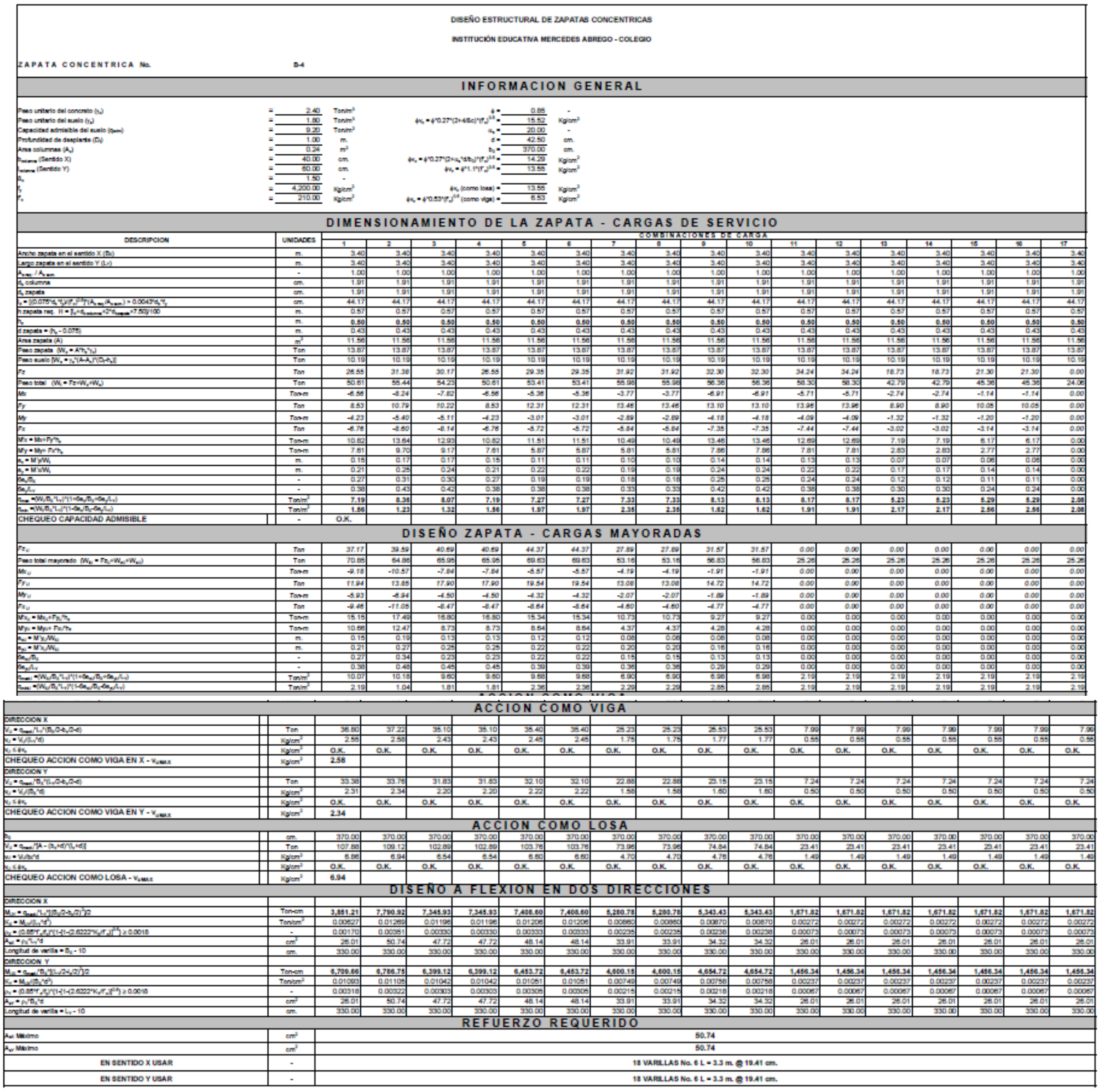
DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
b_0	cm.	770.00	770.00	770.00	770.00	770.00	770.00	770.00	770.00	770.00	770.00	770.00	770.00	770.00	770.00	770.00	770.00	770.00
$V_U = q_{maxU}*[A-(b_c+d)*(l_c+d)]$	Ton	146.97	164.02	138.27	138.27	151.20	151.20	101.89	101.89	108.04	108.04	32.17	32.17	32.17	32.17	32.17	32.17	32.17
$v_U = V_U/b_0*d$	Kg/cm²	3.64	4.06	3.42	3.42	3.74	3.74	2.52	2.52	2.67	2.67	0.80	0.80	0.80	0.80	0.80	0.80	0.80
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{uMAX}	Kg/cm²	**4.06**																

DISEÑO A FLEXION EN DOS DIRECCIONES

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_c/2)^2]/2$	Ton-cm	**4,377.24**	**9,770.31**	**8,236.33**	**8,236.33**	**9,006.89**	**9,006.89**	**6,069.28**	**6,069.28**	**6,435.67**	**6,435.67**	**1,916.38**	**1,916.38**	**1,916.38**	**1,916.38**	**1,916.38**	**1,916.38**	**1,916.38**
$K_X = M_{UX}/(L_Y*d^2)$	Ton/cm²	0.00265	0.00591	0.00498	0.00498	0.00545	0.00545	0.00367	0.00367	0.00389	0.00389	0.00116	0.00116	0.00116	0.00116	0.00116	0.00116	0.00116
$\rho_X = (0.85*f'_c/f_y)*\{1-[1-(2.6222*K_X/f'_c)]^{0.5}\} \geq 0.0018$	-	0.00071	0.00160	0.00134	0.00134	0.00147	0.00147	0.00099	0.00099	0.00105	0.00105	0.00031	0.00031	0.00031	0.00031	0.00031	0.00031	0.00031
$A_{sX} = \rho_X*L_Y*d$	cm²	56.70	56.70	56.70	56.70	56.70	56.70	56.70	56.70	56.70	56.70	56.70	56.70	56.70	56.70	56.70	56.70	56.70
Longitud de varilla = B_X - 10	cm.	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_c/2)^2]/2$	Ton-cm	**10,056.75**	**11,223.70**	**9,461.53**	**9,461.53**	**10,346.72**	**10,346.72**	**6,972.12**	**6,972.12**	**7,393.02**	**7,393.02**	**2,201.45**	**2,201.45**	**2,201.45**	**2,201.45**	**2,201.45**	**2,201.45**	**2,201.45**
$K_Y = M_{UY}/(B_X*d^2)$	Ton/cm²	0.01258	0.01404	0.01184	0.01184	0.01294	0.01294	0.00872	0.00872	0.00925	0.00925	0.00275	0.00275	0.00275	0.00275	0.00275	0.00275	0.00275
$\rho_Y = (0.85*f'_c/f_y)*\{1-[1-(2.6222*K_Y/f'_c)]^{0.5}\} \geq 0.0018$	-	0.00368	0.00413	0.00346	0.00346	0.00380	0.00380	0.00252	0.00252	0.00268	0.00268	0.00078	0.00078	0.00078	0.00078	0.00078	0.00078	0.00078
$A_{sY} = \rho_Y*B_X*d$	cm²	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41	27.41
Longitud de varilla = L_Y - 10	cm.	590.00	590.00	590.00	590.00	590.00	590.00	590.00	590.00	590.00	590.00	590.00	590.00	590.00	590.00	590.00	590.00	590.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	**56.70**
A_{sY} Máximo	cm²	**27.41**
EN SENTIDO X USAR	-	**20 VARILLAS No. 6 L = 2.8 m. @ 31.05 cm.**
EN SENTIDO Y USAR	-	**10 VARILLAS No. 6 L = 5.9 m. @ 31.11 cm.**



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. B-4

INFORMACION GENERAL

Peso unitario del concreto (γ_c)	=	2.40	Ton/m³	ϕ =	0.85	-
Peso unitario del suelo (γ_s)	=	1.80	Ton/m³	$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ =	15.52	Kg/cm²
Capacidad admisible del suelo (q_{adm})	=	9.20	Ton/m²	α_s =	20.00	-
Profundidad de desplante (D_f)	=	1.00	m.	d =	42.50	cm.
Area columnas (A_c)	=	0.24	m²	b_0 =	370.00	cm.
$b_{columna}$ (Sentido X)	=	40.00	cm.	$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ =	14.29	Kg/cm²
$l_{columna}$ (Sentido Y)	=	60.00	cm.	$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ =	13.55	Kg/cm²
β_c	=	1.50	-			
f_y	=	4,200.00	Kg/cm²	ϕv_c (como losa) =	13.55	Kg/cm²
f'_c	=	210.00	Kg/cm²	$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) =	6.53	Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40
Largo zapata en el sentido Y (L_Y)	m.	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40
$A_{s\,req} / A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
d_b zapata	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
$l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*(A_{s\,req}/A_{s\,sum}) > 0.0043*d_b*f_y$	cm.	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17
h zapata req. $H = [l_d+d_{b\,columna}+2*d_{b\,zapata}+7.50]/100$	m.	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
h_z	m.	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**
d zapata = (h_z - 0.075)	m.	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Area zapata (A)	m²	11.56	11.56	11.56	11.56	11.56	11.56	11.56	11.56	11.56	11.56	11.56	11.56	11.56	11.56	11.56	11.56	11.56
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	13.87	13.87	13.87	13.87	13.87	13.87	13.87	13.87	13.87	13.87	13.87	13.87	13.87	13.87	13.87	13.87	13.87
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	10.19	10.19	10.19	10.19	10.19	10.19	10.19	10.19	10.19	10.19	10.19	10.19	10.19	10.19	10.19	10.19	10.19
Fz	Ton	*26.55*	*31.38*	*30.17*	*26.55*	*29.35*	*29.35*	*31.92*	*31.92*	*32.30*	*32.30*	*34.24*	*34.24*	*18.73*	*18.73*	*21.30*	*21.30*	*0.00*
Peso total (W_t = Fz+W_z+W_s)	Ton	50.61	55.44	54.23	50.61	53.41	53.41	55.98	55.98	56.36	56.36	58.30	58.30	42.79	42.79	45.36	45.36	24.06
Mx	Ton-m	*-6.56*	*-8.24*	*-7.82*	*-6.56*	*-5.36*	*-5.36*	*-3.77*	*-3.77*	*-6.91*	*-6.91*	*-5.71*	*-5.71*	*-2.74*	*-2.74*	*-1.14*	*-1.14*	*0.00*
Fy	Ton	*8.53*	*10.79*	*10.22*	*8.53*	*12.31*	*12.31*	*13.46*	*13.46*	*13.10*	*13.10*	*13.96*	*13.96*	*8.90*	*8.90*	*10.05*	*10.05*	*0.00*
My	Ton-m	*-4.23*	*-5.40*	*-5.11*	*-4.23*	*-3.01*	*-3.01*	*-2.89*	*-2.89*	*-4.18*	*-4.18*	*-4.09*	*-4.09*	*-1.32*	*-1.32*	*-1.20*	*-1.20*	*0.00*
Fx	Ton	*-6.76*	*-8.60*	*-8.14*	*-6.76*	*-5.72*	*-5.72*	*-5.84*	*-5.84*	*-7.35*	*-7.35*	*-7.44*	*-7.44*	*-3.02*	*-3.02*	*-3.14*	*-3.14*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	10.82	13.64	12.93	10.82	11.51	11.51	10.49	10.49	13.46	13.46	12.69	12.69	7.19	7.19	6.17	6.17	0.00
M'y = My+ Fx*h_z	Ton-m	7.61	9.70	9.17	7.61	5.87	5.87	5.81	5.81	7.86	7.86	7.81	7.81	2.83	2.83	2.77	2.77	0.00
e_x = M'y/W_t	m.	0.15	0.17	0.17	0.15	0.11	0.11	0.10	0.10	0.14	0.14	0.13	0.13	0.07	0.07	0.06	0.06	0.00
e_y = M'x/W_t	m.	0.21	0.25	0.24	0.21	0.22	0.22	0.19	0.19	0.24	0.24	0.22	0.22	0.17	0.17	0.14	0.14	0.00
$6e_x/B_X$	-	0.27	0.31	0.30	0.27	0.19	0.19	0.18	0.18	0.25	0.25	0.24	0.24	0.12	0.12	0.11	0.11	0.00
$6e_y/L_Y$	-	0.38	0.43	0.42	0.38	0.38	0.38	0.33	0.33	0.42	0.42	0.38	0.38	0.30	0.30	0.24	0.24	0.00
$q_{max} = (W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)$	Ton/m²	**7.19**	**8.36**	**8.07**	**7.19**	**7.27**	**7.27**	**7.33**	**7.33**	**8.13**	**8.13**	**8.17**	**8.17**	**5.23**	**5.23**	**5.29**	**5.29**	**2.08**
$q_{min} = (W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)$	Ton/m²	**1.56**	**1.23**	**1.32**	**1.56**	**1.97**	**1.97**	**2.35**	**2.35**	**1.62**	**1.62**	**1.91**	**1.91**	**2.17**	**2.17**	**2.56**	**2.56**	**2.08**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

Fz_U	Ton	*37.17*	*39.59*	*40.69*	*40.69*	*44.37*	*44.37*	*27.89*	*27.89*	*31.57*	*31.57*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado ($W_U = Fz_U+W_{zU}+W_{sU}$)	Ton	70.85	64.86	65.95	65.95	69.63	69.63	53.16	53.16	56.83	56.83	25.26	25.26	25.26	25.26	25.26	25.26	25.26
Mx_U	Ton-m	*-9.18*	*-10.57*	*-7.84*	*-7.84*	*-5.57*	*-5.57*	*-4.19*	*-4.19*	*-1.91*	*-1.91*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*11.94*	*13.85*	*17.90*	*17.90*	*19.54*	*19.54*	*13.08*	*13.08*	*14.72*	*14.72*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*-5.93*	*-6.94*	*-4.50*	*-4.50*	*-4.32*	*-4.32*	*-2.07*	*-2.07*	*-1.89*	*-1.89*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*-9.46*	*-11.05*	*-8.47*	*-8.47*	*-8.64*	*-8.64*	*-4.60*	*-4.60*	*-4.77*	*-4.77*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U = Mx_U+Fy_U*h_z$	Ton-m	15.15	17.49	16.80	16.80	15.34	15.34	10.73	10.73	9.27	9.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U+ Fx_U*h_z$	Ton-m	10.66	12.47	8.73	8.73	8.64	8.64	4.37	4.37	4.28	4.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_U$	m.	0.15	0.19	0.13	0.13	0.12	0.12	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_U$	m.	0.21	0.27	0.25	0.25	0.22	0.22	0.20	0.20	0.16	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.27	0.34	0.23	0.23	0.22	0.22	0.15	0.15	0.13	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.38	0.48	0.45	0.45	0.39	0.39	0.36	0.36	0.29	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_U/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m²	10.07	10.18	9.60	9.60	9.68	9.68	6.90	6.90	6.98	6.98	2.19	2.19	2.19	2.19	2.19	2.19	2.19
$q_{minU} = (W_U/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m²	2.19	1.04	1.81	1.81	2.36	2.36	2.29	2.29	2.85	2.85	2.19	2.19	2.19	2.19	2.19	2.19	2.19

ACCION COMO VIGA

DIRECCION X																		
$V_U = q_{maxU}*L_Y*(B_X/2-b_c/2-d)$	Ton	36.80	37.22	35.10	35.10	35.40	35.40	25.23	25.23	25.53	25.53	7.99	7.99	7.99	7.99	7.99	7.99	7.99
$v_U = V_U/(L_Y*d)$	Kg/cm²	2.55	2.58	2.43	2.43	2.45	2.45	1.75	1.75	1.77	1.77	0.55	0.55	0.55	0.55	0.55	0.55	0.55
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{uMAX}	Kg/cm²	2.58																
DIRECCION Y																		
$V_U = q_{maxU}*B_X*(L_Y/2-l_c/2-d)$	Ton	33.38	33.76	31.83	31.83	32.10	32.10	22.88	22.88	23.15	23.15	7.24	7.24	7.24	7.24	7.24	7.24	7.24
$v_U = V_U/(B_X*d)$	Kg/cm²	2.31	2.34	2.20	2.20	2.22	2.22	1.58	1.58	1.60	1.60	0.50	0.50	0.50	0.50	0.50	0.50	0.50
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{uMAX}	Kg/cm²	2.34																

ACCION COMO LOSA

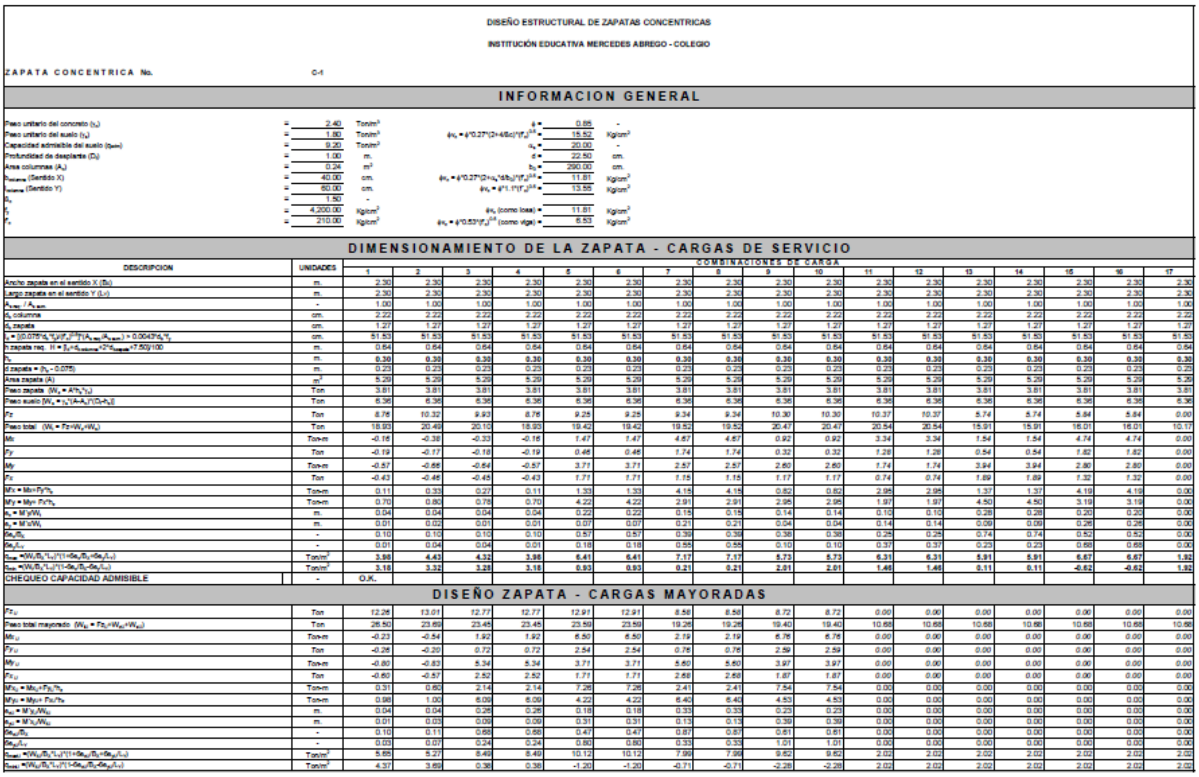
b_0	cm.	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00
$V_U = q_{maxU}*[A-(b_c+d)*(l_c+d)]$	Ton	107.88	109.12	102.89	102.89	103.76	103.76	73.96	73.96	74.84	74.84	23.41	23.41	23.41	23.41	23.41	23.41	23.41
$v_U = V_U/b_0*d$	Kg/cm²	6.86	6.94	6.54	6.54	6.60	6.60	4.70	4.70	4.76	4.76	1.49	1.49	1.49	1.49	1.49	1.49	1.49
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{uMAX}	Kg/cm²	6.94																

DISEÑO A FLEXION EN DOS DIRECCIONES

DIRECCION X																		
$M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_c/2)^2]/2$	Ton-cm	**3,851.21**	**7,790.92**	**7,345.93**	**7,345.93**	**7,408.60**	**7,408.60**	**5,280.78**	**5,280.78**	**5,343.43**	**5,343.43**	**1,671.82**	**1,671.82**	**1,671.82**	**1,671.82**	**1,671.82**	**1,671.82**	**1,671.82**
$K_X = M_{UX}/(L_Y*d^2)$	Ton/cm²	0.00627	0.01269	0.01196	0.01196	0.01206	0.01206	0.00860	0.00860	0.00870	0.00870	0.00272	0.00272	0.00272	0.00272	0.00272	0.00272	0.00272
$\rho_X = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_X/f'_c)]^{0.5}) \geq 0.0018$	-	0.00170	0.00351	0.00330	0.00330	0.00333	0.00333	0.00235	0.00235	0.00238	0.00238	0.00073	0.00073	0.00073	0.00073	0.00073	0.00073	0.00073
$A_{sX} = \rho_X*L_Y*d$	cm²	26.01	50.74	47.72	47.72	48.14	48.14	33.91	33.91	34.32	34.32	26.01	26.01	26.01	26.01	26.01	26.01	26.01
Longitud de varilla = B_X - 10	cm.	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_c/2)^2]/2$	Ton-cm	**6,709.66**	**6,786.75**	**6,399.12**	**6,399.12**	**6,453.72**	**6,453.72**	**4,600.15**	**4,600.15**	**4,654.72**	**4,654.72**	**1,456.34**	**1,456.34**	**1,456.34**	**1,456.34**	**1,456.34**	**1,456.34**	**1,456.34**
$K_Y = M_{UY}/(B_X*d^2)$	Ton/cm²	0.01093	0.01105	0.01042	0.01042	0.01051	0.01051	0.00749	0.00749	0.00758	0.00758	0.00237	0.00237	0.00237	0.00237	0.00237	0.00237	0.00237
$\rho_Y = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_Y/f'_c)]^{0.5}) \geq 0.0018$	-	0.00318	0.00322	0.00303	0.00303	0.00305	0.00305	0.00215	0.00215	0.00218	0.00218	0.00067	0.00067	0.00067	0.00067	0.00067	0.00067	0.00067
$A_{sY} = \rho_Y*B_X*d$	cm²	26.01	50.74	47.72	47.72	48.14	48.14	33.91	33.91	34.32	34.32	26.01	26.01	26.01	26.01	26.01	26.01	26.01
Longitud de varilla = L_Y - 10	cm.	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	50.74
A_{sY} Máximo	cm²	50.74
EN SENTIDO X USAR	-	18 VARILLAS No. 6 L = 3.3 m. @ 19.41 cm.
EN SENTIDO Y USAR	-	18 VARILLAS No. 6 L = 3.3 m. @ 19.41 cm.



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. C-1

INFORMACION GENERAL

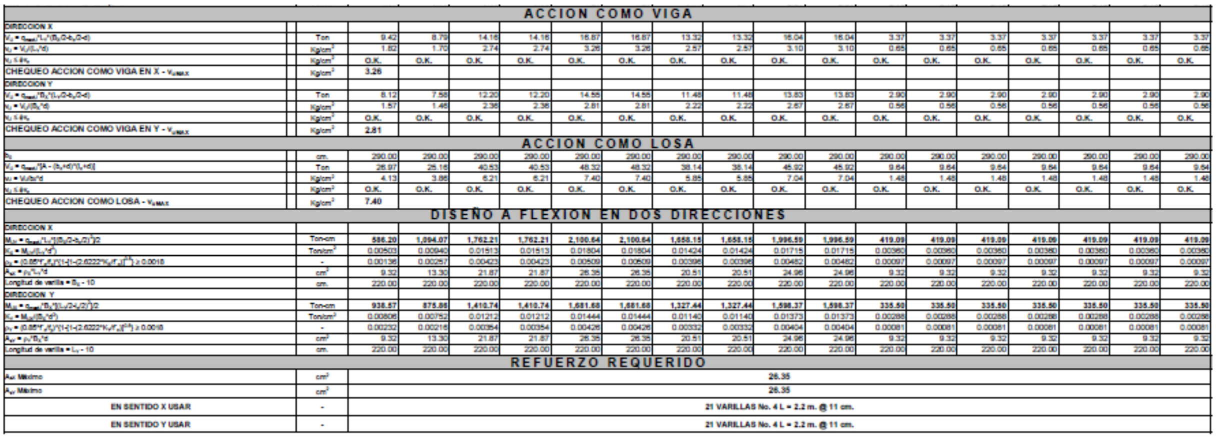
Peso unitario del concreto (γ_c)	= 2.40	Ton/m³		ϕ =	0.85	-
Peso unitario del suelo (γ_s)	= 1.80	Ton/m³		$\phi v_c = \phi \cdot 0.27 \cdot (2+4/\beta c) \cdot (f'_c)^{0.5}$ =	15.52	Kg/cm²
Capacidad admisible del suelo (q_{adm})	= 9.20	Ton/m²		α_s =	20.00	-
Profundidad de desplante (D_f)	= 1.00	m.		d =	22.50	cm.
Area columnas (A_c)	= 0.24	m²		b_0 =	290.00	cm.
$b_{columna}$ (Sentido X)	= 40.00	cm.		$\phi v_c = \phi \cdot 0.27 \cdot (2+\alpha_s \cdot d/b_0) \cdot (f'_c)^{0.5}$ =	11.81	Kg/cm²
$l_{columna}$ (Sentido Y)	= 60.00	cm.		$\phi v_c = \phi \cdot 1.1 \cdot (f'_c)^{0.5}$ =	13.55	Kg/cm²
β_c	= 1.50	-				
f_y	= 4,200.00	Kg/cm²		ϕv_c (como losa) =	11.81	Kg/cm²
f'_c	= 210.00	Kg/cm²		$\phi v_c = \phi \cdot 0.53 \cdot (f'_c)^{0.5}$ (como viga) =	6.53	Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (Bx)	m.	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Largo zapata en el sentido Y (Ly)	m.	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
$A_{s\,req} / A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22
d_b zapata	cm.	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
$l_d = [(0.075 \cdot d_b \cdot f_y)/(f'_c)^{0.5}] \cdot (A_{s\,req}/A_{s\,sum}) > 0.0043 \cdot d_b \cdot f_y$	cm.	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53
h zapata req. $H = [l_d + d_{columna} + 2 \cdot d_{zapata} + 7.50]/100$	m.	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
h_z	m.	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**
d zapata = (h_z - 0.075)	m.	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Area zapata (A)	m²	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29
Peso zapata ($W_z = A \cdot h_z \cdot \gamma_c$)	Ton	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81
Peso suelo [$W_s = \gamma_s \cdot (A-A_c) \cdot (D_f-h_z)$]	Ton	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36
Fz	Ton	8.76	10.32	9.93	8.76	9.25	9.25	9.34	9.34	10.30	10.30	10.37	10.37	5.74	5.74	5.84	5.84	0.00
Peso total ($W_t = Fz + W_z + W_s$)	Ton	18.93	20.49	20.10	18.93	19.42	19.42	19.52	19.52	20.47	20.47	20.54	20.54	15.91	15.91	16.01	16.01	10.17
Mx	Ton-m	-0.16	-0.38	-0.33	-0.16	1.47	1.47	4.67	4.67	0.92	0.92	3.34	3.34	1.54	1.54	4.74	4.74	0.00
Fy	Ton	-0.19	-0.17	-0.18	-0.19	0.46	0.46	1.74	1.74	0.32	0.32	1.28	1.28	0.54	0.54	1.82	1.82	0.00
My	Ton-m	-0.57	-0.66	-0.64	-0.57	3.71	3.71	2.57	2.57	2.60	2.60	1.74	1.74	3.94	3.94	2.80	2.80	0.00
Fx	Ton	-0.43	-0.46	-0.45	-0.43	1.71	1.71	1.15	1.15	1.17	1.17	0.74	0.74	1.89	1.89	1.32	1.32	0.00
M'x = Mx+Fy·h_z	Ton-m	0.11	0.33	0.27	0.11	1.33	1.33	4.15	4.15	0.82	0.82	2.95	2.95	1.37	1.37	4.19	4.19	0.00
M'y = My+ Fx·h_z	Ton-m	0.70	0.80	0.78	0.70	4.22	4.22	2.91	2.91	2.95	2.95	1.97	1.97	4.50	4.50	3.19	3.19	0.00
e_x = M'y/W_t	m.	0.04	0.04	0.04	0.04	0.22	0.22	0.15	0.15	0.14	0.14	0.10	0.10	0.28	0.28	0.20	0.20	0.00
e_y = M'x/W_t	m.	0.01	0.02	0.01	0.01	0.07	0.07	0.21	0.21	0.04	0.04	0.14	0.14	0.09	0.09	0.26	0.26	0.00
$6e_x/B_x$	-	0.10	0.10	0.10	0.10	0.57	0.57	0.39	0.39	0.38	0.38	0.25	0.25	0.74	0.74	0.52	0.52	0.00
$6e_y/L_y$	-	0.01	0.04	0.04	0.01	0.18	0.18	0.55	0.55	0.10	0.10	0.37	0.37	0.23	0.23	0.68	0.68	0.00
$q_{max} = (W_t/B_x \cdot L_y) \cdot (1+6e_x/B_x+6e_y/L_y)$	Ton/m²	**3.98**	**4.43**	**4.32**	**3.98**	**6.41**	**6.41**	**7.17**	**7.17**	**5.73**	**5.73**	**6.31**	**6.31**	**5.91**	**5.91**	**6.67**	**6.67**	**1.92**
$q_{min} = (W_t/B_x \cdot L_y) \cdot (1-6e_x/B_x-6e_y/L_y)$	Ton/m²	**3.18**	**3.32**	**3.28**	**3.18**	**0.93**	**0.93**	**0.21**	**0.21**	**2.01**	**2.01**	**1.46**	**1.46**	**0.11**	**0.11**	**-0.62**	**-0.62**	**1.92**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fz_U	Ton	12.26	13.01	12.77	12.77	12.91	12.91	8.58	8.58	8.72	8.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Peso total mayorado ($W_U = Fz_U + W_{zU} + W_{sU}$)	Ton	26.50	23.69	23.45	23.45	23.59	23.59	19.26	19.26	19.40	19.40	10.68	10.68	10.68	10.68	10.68	10.68	10.68
Mx_U	Ton-m	-0.23	-0.54	1.92	1.92	6.50	6.50	2.19	2.19	6.76	6.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fy_U	Ton	-0.26	-0.20	0.72	0.72	2.54	2.54	0.76	0.76	2.59	2.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00
My_U	Ton-m	-0.80	-0.83	5.34	5.34	3.71	3.71	5.60	5.60	3.97	3.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fx_U	Ton	-0.60	-0.57	2.52	2.52	1.71	1.71	2.68	2.68	1.87	1.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'x_U = Mx_U + Fy_U \cdot h_z$	Ton-m	0.31	0.60	2.14	2.14	7.26	7.26	2.41	2.41	7.54	7.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U + Fx_U \cdot h_z$	Ton-m	0.98	1.00	6.09	6.09	4.22	4.22	6.40	6.40	4.53	4.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_U$	m.	0.04	0.04	0.26	0.26	0.18	0.18	0.33	0.33	0.23	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_U$	m.	0.01	0.03	0.09	0.09	0.31	0.31	0.13	0.13	0.39	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_x$	-	0.10	0.11	0.68	0.68	0.47	0.47	0.87	0.87	0.61	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_y$	-	0.03	0.07	0.24	0.24	0.80	0.80	0.33	0.33	1.01	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_U/B_x \cdot L_y) \cdot (1+6e_{xU}/B_x+6e_{yU}/L_y)$	Ton/m²	5.65	5.27	8.49	8.49	10.12	10.12	7.99	7.99	9.62	9.62	2.02	2.02	2.02	2.02	2.02	2.02	2.02
$q_{minU} = (W_U/B_x \cdot L_y) \cdot (1-6e_{xU}/B_x-6e_{yU}/L_y)$	Ton/m²	4.37	3.69	0.38	0.38	-1.20	-1.20	-0.71	-0.71	-2.28	-2.28	2.02	2.02	2.02	2.02	2.02	2.02	2.02



ACCION COMO VIGA

DIRECCION X																		
$V_U = q_{maxU} \cdot L_y \cdot (B_x/2-b_c/2-d)$	Ton	9.42	8.79	14.16	14.16	16.87	16.87	13.32	13.32	16.04	16.04	3.37	3.37	3.37	3.37	3.37	3.37	3.37
$v_U = V_U/(L_y \cdot d)$	Kg/cm²	1.82	1.70	2.74	2.74	3.26	3.26	2.57	2.57	3.10	3.10	0.65	0.65	0.65	0.65	0.65	0.65	0.65
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{uMAX}	Kg/cm²	3.26																
DIRECCION Y																		
$V_U = q_{maxU} \cdot B_x \cdot (L_y/2-l_c/2-d)$	Ton	8.12	7.58	12.20	12.20	14.55	14.55	11.48	11.48	13.83	13.83	2.90	2.90	2.90	2.90	2.90	2.90	2.90
$v_U = V_U/(B_x \cdot d)$	Kg/cm²	1.57	1.46	2.36	2.36	2.81	2.81	2.22	2.22	2.67	2.67	0.56	0.56	0.56	0.56	0.56	0.56	0.56
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{uMAX}	Kg/cm²	2.81																

ACCION COMO LOSA

b_0	cm.	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00
$V_U = q_{maxU} \cdot [A - (b_c+d) \cdot (l_c+d)]$	Ton	26.97	25.16	40.53	40.53	48.32	48.32	38.14	38.14	45.92	45.92	9.64	9.64	9.64	9.64	9.64	9.64	9.64
$v_U = V_U/b_0 \cdot d$	Kg/cm²	4.13	3.86	6.21	6.21	7.40	7.40	5.85	5.85	7.04	7.04	1.48	1.48	1.48	1.48	1.48	1.48	1.48
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{uMAX}	Kg/cm²	7.40																

DISEÑO A FLEXION EN DOS DIRECCIONES

DIRECCION X																		
$M_{UX} = q_{maxU} \cdot L_y \cdot [(B_x/2-b_c/2)^2]/2$	Ton-cm	**586.20**	**1,094.07**	**1,762.21**	**1,762.21**	**2,100.64**	**2,100.64**	**1,658.15**	**1,658.15**	**1,996.59**	**1,996.59**	**419.09**	**419.09**	**419.09**	**419.09**	**419.09**	**419.09**	**419.09**
$K_X = M_{UX}/(L_y \cdot d^2)$	Ton/cm²	0.00503	0.00940	0.01513	0.01513	0.01804	0.01804	0.01424	0.01424	0.01715	0.01715	0.00360	0.00360	0.00360	0.00360	0.00360	0.00360	0.00360
$\rho_X = (0.85 \cdot f'_c/f_y) \cdot \{1-[1-(2.6222 \cdot K_X/f'_c)]^{0.5}\} \geq 0.0018$	-	0.00136	0.00257	0.00423	0.00423	0.00509	0.00509	0.00396	0.00396	0.00482	0.00482	0.00097	0.00097	0.00097	0.00097	0.00097	0.00097	0.00097
$A_{sX} = \rho_X \cdot L_y \cdot d$	cm²	9.32	13.30	21.87	21.87	26.35	26.35	20.51	20.51	24.96	24.96	9.32	9.32	9.32	9.32	9.32	9.32	9.32
Longitud de varilla = B_X - 10	cm.	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00
DIRECCION Y																		
$M_{UY} = q_{maxU} \cdot B_x \cdot [(L_y/2-l_c/2)^2]/2$	Ton-cm	**938.57**	**875.86**	**1,410.74**	**1,410.74**	**1,681.68**	**1,681.68**	**1,327.44**	**1,327.44**	**1,598.37**	**1,598.37**	**335.50**	**335.50**	**335.50**	**335.50**	**335.50**	**335.50**	**335.50**
$K_Y = M_{UY}/(B_x \cdot d^2)$	Ton/cm²	0.00806	0.00752	0.01212	0.01212	0.01444	0.01444	0.01140	0.01140	0.01373	0.01373	0.00288	0.00288	0.00288	0.00288	0.00288	0.00288	0.00288
$\rho_Y = (0.85 \cdot f'_c/f_y) \cdot \{1-[1-(2.6222 \cdot K_Y/f'_c)]^{0.5}\} \geq 0.0018$	-	0.00232	0.00216	0.00354	0.00354	0.00426	0.00426	0.00332	0.00332	0.00404	0.00404	0.00081	0.00081	0.00081	0.00081	0.00081	0.00081	0.00081
$A_{sY} = \rho_Y \cdot B_X \cdot d$	cm²	9.32	13.30	21.87	21.87	26.35	26.35	20.51	20.51	24.96	24.96	9.32	9.32	9.32	9.32	9.32	9.32	9.32
Longitud de varilla = L_Y - 10	cm.	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	26.35
A_{sY} Máximo	cm²	26.35
EN SENTIDO X USAR	-	21 VARILLAS No. 4 L = 2.2 m. @ 11 cm.
EN SENTIDO Y USAR	-	21 VARILLAS No. 4 L = 2.2 m. @ 11 cm.

DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. C-2

INFORMACION GENERAL

Peso unitario del concreto (γ_c)	=	2.40	Ton/m³	ϕ =	0.85	-
Peso unitario del suelo (γ_s)	=	1.80	Ton/m³	$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ =	15.52	Kg/cm²
Capacidad admisible del suelo (q_{adm})	=	9.20	Ton/m²	α_s =	20.00	-
Profundidad de desplante (D_f)	=	1.00	m.	d =	22.50	cm.
Area columnas (A_c)	=	0.24	m²	b_0 =	290.00	cm.
$b_{columna}$ (Sentido X)	=	40.00	cm.	$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ =	11.81	Kg/cm²
$l_{columna}$ (Sentido Y)	=	60.00	cm.	$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ =	13.55	Kg/cm²
β_c	=	1.50	-			
f_y	=	4,200.00	Kg/cm²	ϕv_c (como losa) =	11.81	Kg/cm²
f'_c	=	210.00	Kg/cm²	$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) =	6.53	Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90
Largo zapata en el sentido Y (L_Y)	m.	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90
$A_{s\,req}$ / $A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22
d_b zapata	cm.	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
$l_d = [(0.075*d_b*f_y)/(f'_c)^{1/2}]*(A_{s\,req}/A_{s\,sum}) > 0.0043*d_b*f_y$	cm.	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53
h zapata req. $H = [l_d+d_{b\,columna}+2*d_{b\,zapata}+7.50]/100$	m.	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
h_z	m.	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**
d zapata = (h_z - 0.075)	m.	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Area zapata (A)	m²	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61	3.61
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25
Fz	Ton	*8.75*	*9.92*	*9.62*	*8.75*	*9.73*	*9.73*	*10.71*	*10.71*	*10.37*	*10.37*	*11.11*	*11.11*	*6.23*	*6.23*	*7.21*	*7.21*	*0.00*
Peso total (W_t = Fz+W_z+W_s)	Ton	15.59	16.76	16.47	15.59	16.57	16.57	17.55	17.55	17.21	17.21	17.96	17.96	13.07	13.07	14.06	14.06	6.85
Mx	Ton-m	*-1.23*	*-1.82*	*-1.67*	*-1.23*	*0.72*	*0.72*	*4.57*	*4.57*	*-0.18*	*-0.18*	*2.73*	*2.73*	*1.22*	*1.22*	*5.07*	*5.07*	*0.00*
Fy	Ton	*0.77*	*1.11*	*1.03*	*0.77*	*1.71*	*1.71*	*3.57*	*3.57*	*1.75*	*1.75*	*3.15*	*3.15*	*1.40*	*1.40*	*3.26*	*3.26*	*0.00*
My	Ton-m	*-0.23*	*-0.14*	*-0.16*	*-0.23*	*3.37*	*3.37*	*1.10*	*1.10*	*2.57*	*2.57*	*0.85*	*0.85*	*3.46*	*3.46*	*1.19*	*1.19*	*0.00*
Fx	Ton	*-0.23*	*-0.18*	*-0.19*	*-0.23*	*1.56*	*1.56*	*0.42*	*0.42*	*1.16*	*1.16*	*0.31*	*0.31*	*1.65*	*1.65*	*0.52*	*0.52*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	1.47	2.15	1.98	1.47	0.21	0.21	3.50	3.50	0.70	0.70	1.78	1.78	0.80	0.80	4.09	4.09	0.00
M'y = My+ Fx*h_z	Ton-m	0.30	0.19	0.22	0.30	3.84	3.84	1.23	1.23	2.92	2.92	0.94	0.94	3.96	3.96	1.35	1.35	0.00
e_x = M'y/W_t	m.	0.02	0.01	0.01	0.02	0.23	0.23	0.07	0.07	0.17	0.17	0.05	0.05	0.30	0.30	0.10	0.10	0.00
e_y = M'x/W_t	m.	0.09	0.13	0.12	0.09	0.01	0.01	0.20	0.20	0.04	0.04	0.10	0.10	0.06	0.06	0.29	0.29	0.00
$6e_x/B_X$	-	0.06	0.04	0.04	0.06	0.73	0.73	0.22	0.22	0.53	0.53	0.17	0.17	0.96	0.96	0.30	0.30	0.00
$6e_y/L_Y$	-	0.30	0.41	0.38	0.30	0.04	0.04	0.63	0.63	0.13	0.13	0.31	0.31	0.19	0.19	0.92	0.92	0.00
$q_{max} = (W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)$	Ton/m²	**5.86**	**6.69**	**6.48**	**5.86**	**8.13**	**8.13**	**9.00**	**9.00**	**7.93**	**7.93**	**7.36**	**7.36**	**7.78**	**7.78**	**8.65**	**8.65**	**1.90**
$q_{min} = (W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)$	Ton/m²	**2.78**	**2.59**	**2.64**	**2.78**	**1.05**	**1.05**	**0.72**	**0.72**	**1.60**	**1.60**	**2.59**	**2.59**	**-0.54**	**-0.54**	**-0.86**	**-0.86**	**1.90**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

Fz_U	Ton	*12.24*	*12.37*	*13.07*	*13.07*	*14.47*	*14.47*	*9.27*	*9.27*	*10.67*	*10.67*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado ($W_{tU} = Fz_U+W_{zU}+W_{sU}$)	Ton	21.83	19.56	20.25	20.25	21.66	21.66	16.46	16.46	17.86	17.86	7.19	7.19	7.19	7.19	7.19	7.19	7.19
Mx_U	Ton-m	*-1.73*	*-2.41*	*0.73*	*0.73*	*6.23*	*6.23*	*1.69*	*1.69*	*7.19*	*7.19*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*1.08*	*1.47*	*2.61*	*2.61*	*5.27*	*5.27*	*2.04*	*2.04*	*4.69*	*4.69*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*-0.32*	*-0.13*	*4.96*	*4.96*	*1.71*	*1.71*	*4.94*	*4.94*	*1.69*	*1.69*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*-0.33*	*-0.19*	*2.33*	*2.33*	*0.72*	*0.72*	*2.35*	*2.35*	*0.73*	*0.73*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U = Mx_U+Fy_U*h_z$	Ton-m	2.05	2.86	1.52	1.52	7.81	7.81	2.30	2.30	8.60	8.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U+Fx_U*h_z$	Ton-m	0.41	0.19	5.66	5.66	1.93	1.93	5.64	5.64	1.91	1.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_{tU}$	m.	0.02	0.01	0.28	0.28	0.09	0.09	0.34	0.34	0.11	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_{tU}$	m.	0.09	0.15	0.07	0.07	0.36	0.36	0.14	0.14	0.48	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.06	0.03	0.88	0.88	0.28	0.28	1.08	1.08	0.34	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.30	0.46	0.24	0.24	1.14	1.14	0.44	0.44	1.52	1.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_{tU}/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m²	8.20	8.08	11.89	11.89	14.52	14.52	11.51	11.51	14.14	14.14	1.99	1.99	1.99	1.99	1.99	1.99	1.99
$q_{minU} = (W_{tU}/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m²	3.89	2.75	-0.67	-0.67	-2.52	-2.52	-2.39	-2.39	-4.24	-4.24	1.99	1.99	1.99	1.99	1.99	1.99	1.99

ACCION COMO LOSA

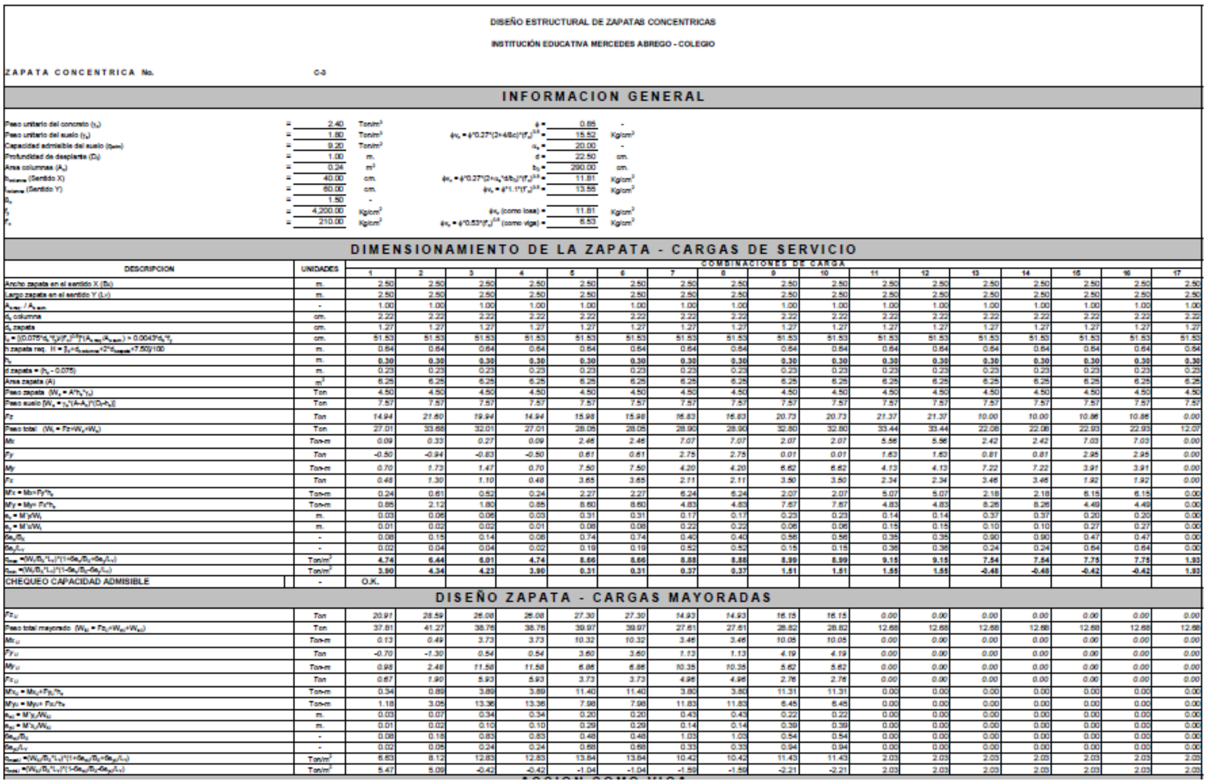
b_0	cm.	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00
$V_u = q_{maxU}*[A-(b_c+d)*(l_c+d)]$	Ton	25.38	25.00	36.79	36.79	44.93	44.93	35.61	35.61	43.75	43.75	6.16	6.16	6.16	6.16	6.16	6.16	6.16
$v_u = V_u/b_0*d$	Kg/cm²	3.89	3.83	5.64	5.64	6.89	6.89	5.46	5.46	6.71	6.71	0.94	0.94	0.94	0.94	0.94	0.94	0.94
$v_u \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - $v_{u\,MAX}$	Kg/cm²	**6.89**																

DISEÑO A FLEXION EN DOS DIRECCIONES

DIRECCION X																		
$M_{uX} = q_{maxU}*L_Y*[(B_X/2-b_c/2)^2]/2$	Ton-cm	**438.36**	**863.59**	**1,270.55**	**1,270.55**	**1,551.80**	**1,551.80**	**1,229.84**	**1,229.84**	**1,511.08**	**1,511.08**	**212.79**	**212.79**	**212.79**	**212.79**	**212.79**	**212.79**	**212.79**
$K_X = M_{uX}/(L_Y*d^2)$	Ton/cm²	0.00456	0.00898	0.01321	0.01321	0.01613	0.01613	0.01279	0.01279	0.01571	0.01571	0.00221	0.00221	0.00221	0.00221	0.00221	0.00221	0.00221
$\rho_X = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_X/f'_c)]^{0.5}) \geq 0.0018$	-	0.00123	0.00245	0.00366	0.00366	0.00452	0.00452	0.00354	0.00354	0.00440	0.00440	0.00059	0.00059	0.00059	0.00059	0.00059	0.00059	0.00059
$A_{sX} = \rho_X*L_Y*d$	cm²	7.70	10.49	15.66	15.66	19.33	19.33	15.13	15.13	18.79	18.79	7.70	7.70	7.70	7.70	7.70	7.70	7.70
Longitud de varilla = B_X - 10	cm.	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00
DIRECCION Y																		
$M_{uY} = q_{maxU}*B_X*[(L_Y/2-l_c/2)^2]/2$	Ton-cm	**658.52**	**648.65**	**954.33**	**954.33**	**1,165.57**	**1,165.57**	**923.75**	**923.75**	**1,134.99**	**1,134.99**	**159.83**	**159.83**	**159.83**	**159.83**	**159.83**	**159.83**	**159.83**
$K_Y = M_{uY}/(B_X*d^2)$	Ton/cm²	0.00685	0.00674	0.00992	0.00992	0.01212	0.01212	0.00960	0.00960	0.01180	0.01180	0.00166	0.00166	0.00166	0.00166	0.00166	0.00166	0.00166
$\rho_Y = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_Y/f'_c)]^{0.5}) \geq 0.0018$	-	0.00196	0.00193	0.00288	0.00288	0.00354	0.00354	0.00278	0.00278	0.00344	0.00344	0.00047	0.00047	0.00047	0.00047	0.00047	0.00047	0.00047
$A_{sY} = \rho_Y*B_X*d$	cm²	7.70	10.49	15.66	15.66	19.33	19.33	15.13	15.13	18.79	18.79	7.70	7.70	7.70	7.70	7.70	7.70	7.70
Longitud de varilla = L_Y - 10	cm.	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	**19.33**
A_{sY} Máximo	cm²	**19.33**
EN SENTIDO X USAR	-	**16 VARILLAS No. 4 L = 1.8 m. @ 12 cm.**
EN SENTIDO Y USAR	-	**16 VARILLAS No. 4 L = 1.8 m. @ 12 cm.**



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. C-3

INFORMACION GENERAL

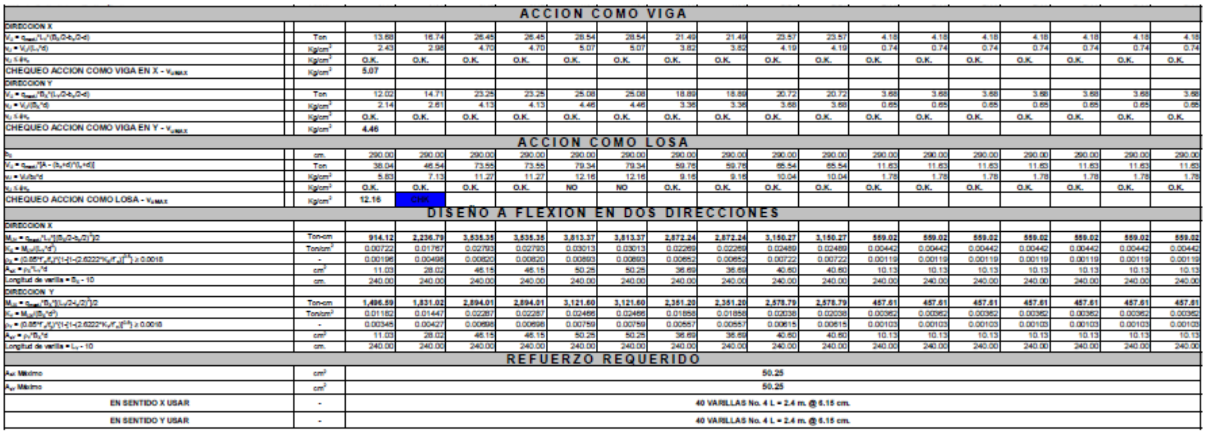
Peso unitario del concreto (γ_c)	=	2.40	Ton/m³	ϕ =	0.85	-
Peso unitario del suelo (γ_s)	=	1.80	Ton/m³	$\phi v_c = \phi \cdot 0.27 \cdot (2+4/\beta c) \cdot (f'_c)^{0.5}$ =	15.52	Kg/cm²
Capacidad admisible del suelo (q_{adm})	=	9.20	Ton/m²	α_s =	20.00	-
Profundidad de desplante (D_f)	=	1.00	m.	d =	22.50	cm.
Area columnas (A_c)	=	0.24	m²	b_0 =	290.00	cm.
$b_{columna}$ (Sentido X)	=	40.00	cm.	$\phi v_c = \phi \cdot 0.27 \cdot (2+\alpha_s \cdot d/b_0) \cdot (f'_c)^{0.5}$ =	11.81	Kg/cm²
$l_{columna}$ (Sentido Y)	=	60.00	cm.	$\phi v_c = \phi \cdot 1.1 \cdot (f'_c)^{0.5}$ =	13.55	Kg/cm²
β_c	=	1.50	-			
f_y	=	4,200.00	Kg/cm²	ϕv_c (como losa) =	11.81	Kg/cm²
f'_c	=	210.00	Kg/cm²	$\phi v_c = \phi \cdot 0.53 \cdot (f'_c)^{0.5}$ (como viga) =	6.53	Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Largo zapata en el sentido Y (L_Y)	m.	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
$A_{s\,req} / A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22
d_b zapata	cm.	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
$l_d = [(0.075 \cdot d_b \cdot f_y)/(f'_c)^{0.5}] \cdot (A_{s\,req}/A_{s\,sum}) > 0.0043 \cdot d_b \cdot f_y$	cm.	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53
h zapata req. $H = [l_d + d_{b\,columna} + 2 \cdot d_{b\,zapata} + 7.50]/100$	m.	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
h_z	m.	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**
d zapata = (h_z - 0.075)	m.	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Area zapata (A)	m²	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25
Peso zapata ($W_z = A \cdot h_z \cdot \gamma_c$)	Ton	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Peso suelo [$W_s = \gamma_s \cdot (A-A_c) \cdot (D_f-h_z)$]	Ton	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57
Fz	*Ton*	*14.94*	*21.60*	*19.94*	*14.94*	*15.98*	*15.98*	*16.83*	*16.83*	*20.73*	*20.73*	*21.37*	*21.37*	*10.00*	*10.00*	*10.86*	*10.86*	*0.00*
Peso total ($W_t = Fz + W_z + W_s$)	Ton	27.01	33.68	32.01	27.01	28.05	28.05	28.90	28.90	32.80	32.80	33.44	33.44	22.08	22.08	22.93	22.93	12.07
Mx	*Ton-m*	*0.09*	*0.33*	*0.27*	*0.09*	*2.46*	*2.46*	*7.07*	*7.07*	*2.07*	*2.07*	*5.56*	*5.56*	*2.42*	*2.42*	*7.03*	*7.03*	*0.00*
Fy	*Ton*	*-0.50*	*-0.94*	*-0.83*	*-0.50*	*0.61*	*0.61*	*2.75*	*2.75*	*0.01*	*0.01*	*1.63*	*1.63*	*0.81*	*0.81*	*2.95*	*2.95*	*0.00*
My	*Ton-m*	*0.70*	*1.73*	*1.47*	*0.70*	*7.50*	*7.50*	*4.20*	*4.20*	*6.62*	*6.62*	*4.13*	*4.13*	*7.22*	*7.22*	*3.91*	*3.91*	*0.00*
Fx	*Ton*	*0.48*	*1.30*	*1.10*	*0.48*	*3.65*	*3.65*	*2.11*	*2.11*	*3.50*	*3.50*	*2.34*	*2.34*	*3.46*	*3.46*	*1.92*	*1.92*	*0.00*
$M'x = Mx + Fy \cdot h_z$	Ton-m	0.24	0.61	0.52	0.24	2.27	2.27	6.24	6.24	2.07	2.07	5.07	5.07	2.18	2.18	6.15	6.15	0.00
$M'y = My + Fx \cdot h_z$	Ton-m	0.85	2.12	1.80	0.85	8.60	8.60	4.83	4.83	7.67	7.67	4.83	4.83	8.26	8.26	4.49	4.49	0.00
$e_x = M'y/W_t$	m.	0.03	0.06	0.06	0.03	0.31	0.31	0.17	0.17	0.23	0.23	0.14	0.14	0.37	0.37	0.20	0.20	0.00
$e_y = M'x/W_t$	m.	0.01	0.02	0.02	0.01	0.08	0.08	0.22	0.22	0.06	0.06	0.15	0.15	0.10	0.10	0.27	0.27	0.00
$6e_x/B_X$	-	0.08	0.15	0.14	0.08	0.74	0.74	0.40	0.40	0.56	0.56	0.35	0.35	0.90	0.90	0.47	0.47	0.00
$6e_y/L_Y$	-	0.02	0.04	0.04	0.02	0.19	0.19	0.52	0.52	0.15	0.15	0.36	0.36	0.24	0.24	0.64	0.64	0.00
$q_{max} = (W_t/B_X \cdot L_Y) \cdot (1 + 6e_x/B_X + 6e_y/L_Y)$	Ton/m²	**4.74**	**6.44**	**6.01**	**4.74**	**8.66**	**8.66**	**8.88**	**8.88**	**8.99**	**8.99**	**9.15**	**9.15**	**7.54**	**7.54**	**7.75**	**7.75**	**1.93**
$q_{min} = (W_t/B_X \cdot L_Y) \cdot (1 - 6e_x/B_X - 6e_y/L_Y)$	Ton/m²	**3.90**	**4.34**	**4.23**	**3.90**	**0.31**	**0.31**	**0.37**	**0.37**	**1.51**	**1.51**	**1.55**	**1.55**	**-0.48**	**-0.48**	**-0.42**	**-0.42**	**1.93**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fz_U	*Ton*	*20.91*	*28.59*	*26.08*	*26.08*	*27.30*	*27.30*	*14.93*	*14.93*	*16.15*	*16.15*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado ($W_U = Fz_U + W_{zU} + W_{sU}$)	Ton	37.81	41.27	38.76	38.76	39.97	39.97	27.61	27.61	28.82	28.82	12.68	12.68	12.68	12.68	12.68	12.68	12.68
Mx_U	*Ton-m*	*0.13*	*0.49*	*3.73*	*3.73*	*10.32*	*10.32*	*3.46*	*3.46*	*10.05*	*10.05*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	*Ton*	*-0.70*	*-1.30*	*0.54*	*0.54*	*3.60*	*3.60*	*1.13*	*1.13*	*4.19*	*4.19*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	*Ton-m*	*0.98*	*2.48*	*11.58*	*11.58*	*6.86*	*6.86*	*10.35*	*10.35*	*5.62*	*5.62*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	*Ton*	*0.67*	*1.90*	*5.93*	*5.93*	*3.73*	*3.73*	*4.96*	*4.96*	*2.76*	*2.76*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U = Mx_U + Fy_U \cdot h_z$	Ton-m	0.34	0.89	3.89	3.89	11.40	11.40	3.80	3.80	11.31	11.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U + Fx_U \cdot h_z$	Ton-m	1.18	3.05	13.36	13.36	7.98	7.98	11.83	11.83	6.45	6.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_U$	m.	0.03	0.07	0.34	0.34	0.20	0.20	0.43	0.43	0.22	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_U$	m.	0.01	0.02	0.10	0.10	0.29	0.29	0.14	0.14	0.39	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.08	0.18	0.83	0.83	0.48	0.48	1.03	1.03	0.54	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.02	0.05	0.24	0.24	0.68	0.68	0.33	0.33	0.94	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_U/B_X \cdot L_Y) \cdot (1 + 6e_{xU}/B_X + 6e_{yU}/L_Y)$	Ton/m²	6.63	8.12	12.83	12.83	13.84	13.84	10.42	10.42	11.43	11.43	2.03	2.03	2.03	2.03	2.03	2.03	2.03
$q_{minU} = (W_U/B_X \cdot L_Y) \cdot (1 - 6e_{xU}/B_X - 6e_{yU}/L_Y)$	Ton/m²	5.47	5.09	-0.42	-0.42	-1.04	-1.04	-1.59	-1.59	-2.21	-2.21	2.03	2.03	2.03	2.03	2.03	2.03	2.03



ACCION COMO VIGA

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$V_U = q_{maxU} \cdot L_Y \cdot (B_X/2 - b_c/2 - d)$	Ton	13.68	16.74	26.45	26.45	28.54	28.54	21.49	21.49	23.57	23.57	4.18	4.18	4.18	4.18	4.18	4.18	4.18
$v_U = V_U/(L_Y \cdot d)$	Kg/cm²	2.43	2.98	4.70	4.70	5.07	5.07	3.82	3.82	4.19	4.19	0.74	0.74	0.74	0.74	0.74	0.74	0.74
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{uMAX}	Kg/cm²	**5.07**																
DIRECCION Y																		
$V_U = q_{maxU} \cdot B_X \cdot (L_Y/2 - b_y/2 - d)$	Ton	12.02	14.71	23.25	23.25	25.08	25.08	18.89	18.89	20.72	20.72	3.68	3.68	3.68	3.68	3.68	3.68	3.68
$v_U = V_U/(B_X \cdot d)$	Kg/cm²	2.14	2.61	4.13	4.13	4.46	4.46	3.36	3.36	3.68	3.68	0.65	0.65	0.65	0.65	0.65	0.65	0.65
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{uMAX}	Kg/cm²	**4.46**																

ACCION COMO LOSA

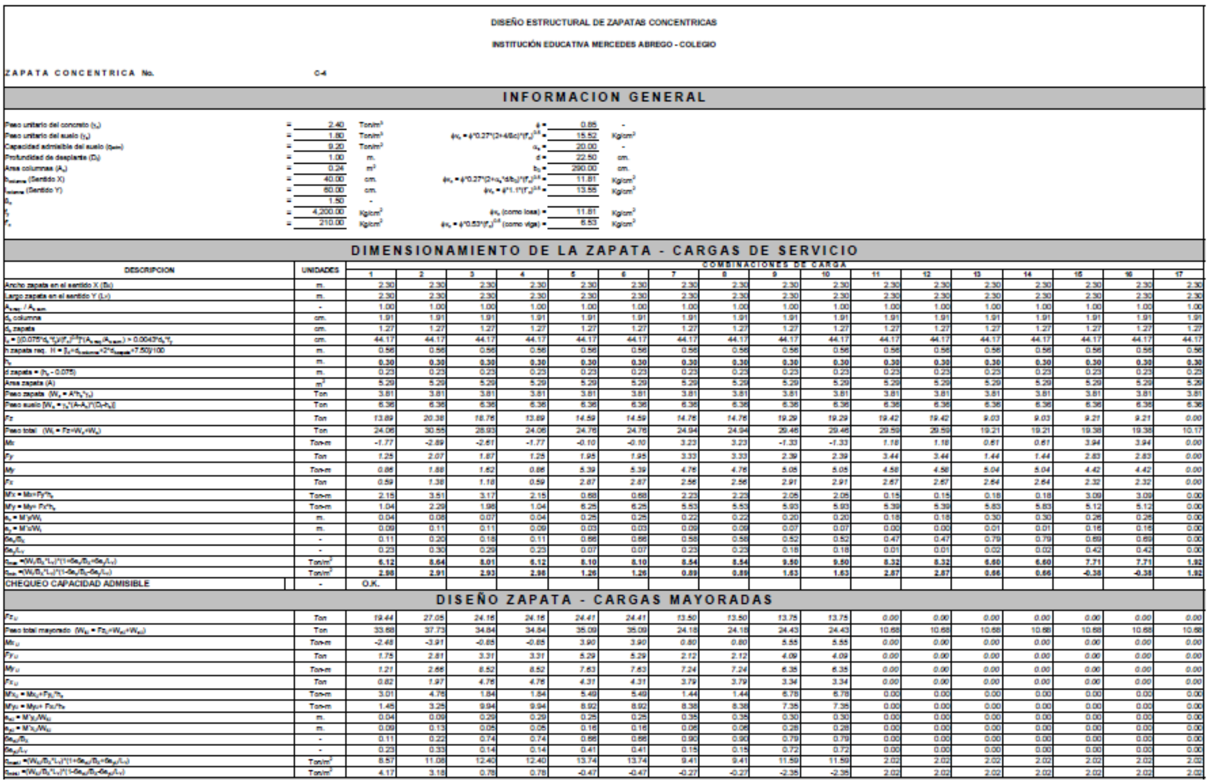
DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
b_0	cm.	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00
$V_U = q_{maxU} \cdot [A - (b_c+d) \cdot (l_c+d)]$	Ton	38.04	46.54	73.55	73.55	79.34	79.34	59.76	59.76	65.54	65.54	11.63	11.63	11.63	11.63	11.63	11.63	11.63
$v_U = V_U/b_0 \cdot d$	Kg/cm²	5.83	7.13	11.27	11.27	12.16	12.16	9.16	9.16	10.04	10.04	1.78	1.78	1.78	1.78	1.78	1.78	1.78
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	NO	NO	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{uMAX}	Kg/cm²	**12.16**	CHK															

DISEÑO A FLEXION EN DOS DIRECCIONES

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$M_{UX} = q_{maxU} \cdot L_Y \cdot [(B_X/2 - b_c/2)^2]/2$	Ton-cm	**914.12**	**2,236.79**	**3,535.35**	**3,535.35**	**3,813.37**	**3,813.37**	**2,872.24**	**2,872.24**	**3,150.27**	**3,150.27**	**559.02**	**559.02**	**559.02**	**559.02**	**559.02**	**559.02**	**559.02**
$K_X = M_{UX}/(L_Y \cdot d^2)$	Ton/cm²	0.00722	0.01767	0.02793	0.02793	0.03013	0.03013	0.02269	0.02269	0.02489	0.02489	0.00442	0.00442	0.00442	0.00442	0.00442	0.00442	0.00442
$\rho_X = (0.85 \cdot f'_c/f_y) \cdot (1 - \{1 - (2.6222 \cdot K_X/f'_c)\}^{0.5}) \geq 0.0018$	-	0.00196	0.00498	0.00820	0.00820	0.00893	0.00893	0.00652	0.00652	0.00722	0.00722	0.00119	0.00119	0.00119	0.00119	0.00119	0.00119	0.00119
$A_{sX} = \rho_X \cdot L_Y \cdot d$	cm²	11.03	28.02	46.15	46.15	50.25	50.25	36.69	36.69	40.60	40.60	10.13	10.13	10.13	10.13	10.13	10.13	10.13
Longitud de varilla = B_X - 10	cm.	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00
DIRECCION Y																		
$M_{UY} = q_{maxU} \cdot B_X \cdot [(L_Y/2 - l_c/2)^2]/2$	Ton-cm	**1,496.59**	**1,831.02**	**2,894.01**	**2,894.01**	**3,121.60**	**3,121.60**	**2,351.20**	**2,351.20**	**2,578.79**	**2,578.79**	**457.61**	**457.61**	**457.61**	**457.61**	**457.61**	**457.61**	**457.61**
$K_Y = M_{UY}/(B_X \cdot d^2)$	Ton/cm²	0.01182	0.01447	0.02287	0.02287	0.02466	0.02466	0.01858	0.01858	0.02038	0.02038	0.00362	0.00362	0.00362	0.00362	0.00362	0.00362	0.00362
$\rho_Y = (0.85 \cdot f'_c/f_y) \cdot (1 - \{1 - (2.6222 \cdot K_Y/f'_c)\}^{0.5}) \geq 0.0018$	-	0.00346	0.00427	0.00698	0.00698	0.00759	0.00759	0.00557	0.00557	0.00615	0.00615	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103
$A_{sY} = \rho_Y \cdot B_X \cdot d$	cm²	11.03	28.02	46.15	46.15	50.25	50.25	36.69	36.69	40.60	40.60	10.13	10.13	10.13	10.13	10.13	10.13	10.13
Longitud de varilla = L_Y - 10	cm.	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	**50.25**
A_{sY} Máximo	cm²	**50.25**
EN SENTIDO X USAR	-	**40 VARILLAS No. 4 L = 2.4 m. @ 6.15 cm.**
EN SENTIDO Y USAR	-	**40 VARILLAS No. 4 L = 2.4 m. @ 6.15 cm.**



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. C-4

INFORMACION GENERAL

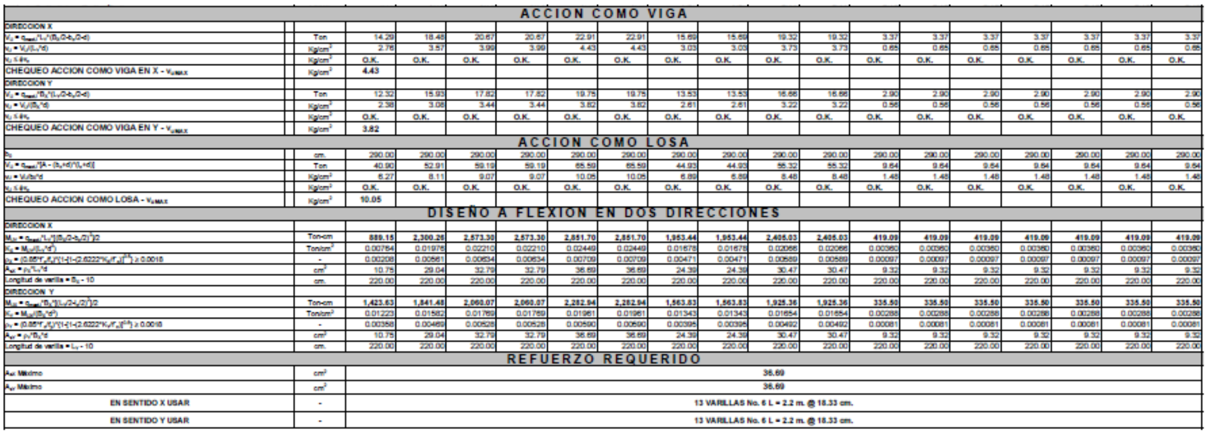
Peso unitario del concreto (γ_c)	=	2.40	Ton/m^3	ϕ =	0.85	-
Peso unitario del suelo (γ_s)	=	1.80	Ton/m^3	$\phi v_c = \phi \cdot 0.27 \cdot (2+4/\beta c) \cdot (f'_c)^{0.5}$ =	15.52	Kg/cm^2
Capacidad admisible del suelo (q_{adm})	=	9.20	Ton/m^2	α_s =	20.00	-
Profundidad de desplante (D_f)	=	1.00	m.	d =	22.50	cm.
Area columnas (A_c)	=	0.24	m^2	b_0 =	290.00	cm.
$h_{columna}$ (Sentido X)	=	40.00	cm.	$\phi v_c = \phi \cdot 0.27 \cdot (2+\alpha_s \cdot d/b_0) \cdot (f'_c)^{0.5}$ =	11.81	Kg/cm^2
$l_{columna}$ (Sentido Y)	=	60.00	cm.	$\phi v_c = \phi \cdot 1.1 \cdot (f'_c)^{0.5}$ =	13.55	Kg/cm^2
β_c	=	1.50	-			
f_y	=	4,200.00	Kg/cm^2	ϕv_c (como losa) =	11.81	Kg/cm^2
f'_c	=	210.00	Kg/cm^2	$\phi v_c = \phi \cdot 0.53 \cdot (f'_c)^{0.5}$ (como viga) =	6.53	Kg/cm^2

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (Bx)	m.	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Largo zapata en el sentido Y (Ly)	m.	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
$A_{s\,req} / A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
d_b zapata	cm.	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
$l_d = [(0.075 \cdot d_b \cdot f_y)/(f'_c)^{0.5}] \cdot (A_{s\,req}/A_{s\,sum}) > 0.0043 \cdot d_b \cdot f_y$	cm.	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17
h zapata req. $H = [l_d + d_{b\,columna} + 2 \cdot d_{b\,zapata} + 7.50]/100$	m.	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
h_z	m.	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**
d zapata = (h_z - 0.075)	m.	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Area zapata (A)	m^2	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29
Peso zapata ($W_z = A \cdot h_z \cdot \gamma_c$)	Ton	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81
Peso suelo [$W_s = \gamma_s \cdot (A-A_c) \cdot (D_f-h_z)$]	Ton	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36
Fz	Ton	*13.89*	*20.38*	*18.76*	*13.89*	*14.59*	*14.59*	*14.76*	*14.76*	*19.29*	*19.29*	*19.42*	*19.42*	*9.03*	*9.03*	*9.21*	*9.21*	*0.00*
Peso total (W_t = Fz+W_z+W_s)	Ton	24.06	30.55	28.93	24.06	24.76	24.76	24.94	24.94	29.46	29.46	29.59	29.59	19.21	19.21	19.38	19.38	10.17
Mx	Ton-m	*-1.77*	*-2.89*	*-2.61*	*-1.77*	*-0.10*	*-0.10*	*3.23*	*3.23*	*-1.33*	*-1.33*	*1.18*	*1.18*	*0.61*	*0.61*	*3.94*	*3.94*	*0.00*
Fy	Ton	*1.25*	*2.07*	*1.87*	*1.25*	*1.95*	*1.95*	*3.33*	*3.33*	*2.39*	*2.39*	*3.44*	*3.44*	*1.44*	*1.44*	*2.83*	*2.83*	*0.00*
My	Ton-m	*0.86*	*1.88*	*1.62*	*0.86*	*5.39*	*5.39*	*4.76*	*4.76*	*5.05*	*5.05*	*4.58*	*4.58*	*5.04*	*5.04*	*4.42*	*4.42*	*0.00*
Fx	Ton	*0.59*	*1.38*	*1.18*	*0.59*	*2.87*	*2.87*	*2.56*	*2.56*	*2.91*	*2.91*	*2.67*	*2.67*	*2.64*	*2.64*	*2.32*	*2.32*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	2.15	3.51	3.17	2.15	0.68	0.68	2.23	2.23	2.05	2.05	0.15	0.15	0.18	0.18	3.09	3.09	0.00
M'y = My+ Fx*h_z	Ton-m	1.04	2.29	1.98	1.04	6.25	6.25	5.53	5.53	5.93	5.93	5.39	5.39	5.83	5.83	5.12	5.12	0.00
e_x = M'y/W_t	m.	0.04	0.08	0.07	0.04	0.25	0.25	0.22	0.22	0.20	0.20	0.18	0.18	0.30	0.30	0.26	0.26	0.00
e_y = M'x/W_t	m.	0.09	0.11	0.11	0.09	0.03	0.03	0.09	0.09	0.07	0.07	0.00	0.00	0.01	0.01	0.16	0.16	0.00
$6e_x/B_X$	-	0.11	0.20	0.18	0.11	0.66	0.66	0.58	0.58	0.52	0.52	0.47	0.47	0.79	0.79	0.69	0.69	0.00
$6e_y/L_Y$	-	0.23	0.30	0.29	0.23	0.07	0.07	0.23	0.23	0.18	0.18	0.01	0.01	0.02	0.02	0.42	0.42	0.00
$q_{max} = (W_t/B_X \cdot L_Y) \cdot (1+6e_x/B_X+6e_y/L_Y)$	Ton/m^2	**6.12**	**8.64**	**8.01**	**6.12**	**8.10**	**8.10**	**8.54**	**8.54**	**9.50**	**9.50**	**8.32**	**8.32**	**6.60**	**6.60**	**7.71**	**7.71**	**1.92**
$q_{min} = (W_t/B_X \cdot L_Y) \cdot (1-6e_x/B_X-6e_y/L_Y)$	Ton/m^2	**2.98**	**2.91**	**2.93**	**2.98**	**1.26**	**1.26**	**0.89**	**0.89**	**1.63**	**1.63**	**2.87**	**2.87**	**0.66**	**0.66**	**-0.38**	**-0.38**	**1.92**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fz_U	Ton	*19.44*	*27.05*	*24.16*	*24.16*	*24.41*	*24.41*	*13.50*	*13.50*	*13.75*	*13.75*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado ($W_{tU} = Fz_U+W_{zU}+W_{sU}$)	Ton	33.68	37.73	34.84	34.84	35.09	35.09	24.18	24.18	24.43	24.43	10.68	10.68	10.68	10.68	10.68	10.68	10.68
Mx_U	Ton-m	*-2.48*	*-3.91*	*-0.85*	*-0.85*	*3.90*	*3.90*	*0.80*	*0.80*	*5.55*	*5.55*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*1.75*	*2.81*	*3.31*	*3.31*	*5.29*	*5.29*	*2.12*	*2.12*	*4.09*	*4.09*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*1.21*	*2.66*	*8.52*	*8.52*	*7.63*	*7.63*	*7.24*	*7.24*	*6.35*	*6.35*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*0.82*	*1.97*	*4.76*	*4.76*	*4.31*	*4.31*	*3.79*	*3.79*	*3.34*	*3.34*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U = Mx_U+Fy_U \cdot h_z$	Ton-m	3.01	4.76	1.84	1.84	5.49	5.49	1.44	1.44	6.78	6.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U+ Fx_U \cdot h_z$	Ton-m	1.45	3.25	9.94	9.94	8.92	8.92	8.38	8.38	7.35	7.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_{tU}$	m.	0.04	0.09	0.29	0.29	0.25	0.25	0.35	0.35	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_{tU}$	m.	0.09	0.13	0.05	0.05	0.16	0.16	0.06	0.06	0.28	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.11	0.22	0.74	0.74	0.66	0.66	0.90	0.90	0.79	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.23	0.33	0.14	0.14	0.41	0.41	0.15	0.15	0.72	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_{tU}/B_X \cdot L_Y) \cdot (1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m^2	8.57	11.08	12.40	12.40	13.74	13.74	9.41	9.41	11.59	11.59	2.02	2.02	2.02	2.02	2.02	2.02	2.02
$q_{minU} = (W_{tU}/B_X \cdot L_Y) \cdot (1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m^2	4.17	3.18	0.78	0.78	-0.47	-0.47	-0.27	-0.27	-2.35	-2.35	2.02	2.02	2.02	2.02	2.02	2.02	2.02



ACCION COMO VIGA

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$V_U = q_{maxU} \cdot L_Y \cdot (B_X/2-b_x/2-d)$	Ton	14.29	18.48	20.67	20.67	22.91	22.91	15.69	15.69	19.32	19.32	3.37	3.37	3.37	3.37	3.37	3.37	3.37
$v_U = V_U/(L_Y \cdot d)$	Kg/cm^2	2.76	3.57	3.99	3.99	4.43	4.43	3.03	3.03	3.73	3.73	0.65	0.65	0.65	0.65	0.65	0.65	0.65
$v_U \le \phi v_c$	Kg/cm^2	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{uMAX}	Kg/cm^2	**4.43**																
DIRECCION Y																		
$V_U = q_{maxU} \cdot B_X \cdot (L_Y/2-b_y/2-d)$	Ton	12.32	15.93	17.82	17.82	19.75	19.75	13.53	13.53	16.66	16.66	2.90	2.90	2.90	2.90	2.90	2.90	2.90
$v_U = V_U/(B_X \cdot d)$	Kg/cm^2	2.38	3.08	3.44	3.44	3.82	3.82	2.61	2.61	3.22	3.22	0.56	0.56	0.56	0.56	0.56	0.56	0.56
$v_U \le \phi v_c$	Kg/cm^2	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{uMAX}	Kg/cm^2	**3.82**																

ACCION COMO LOSA

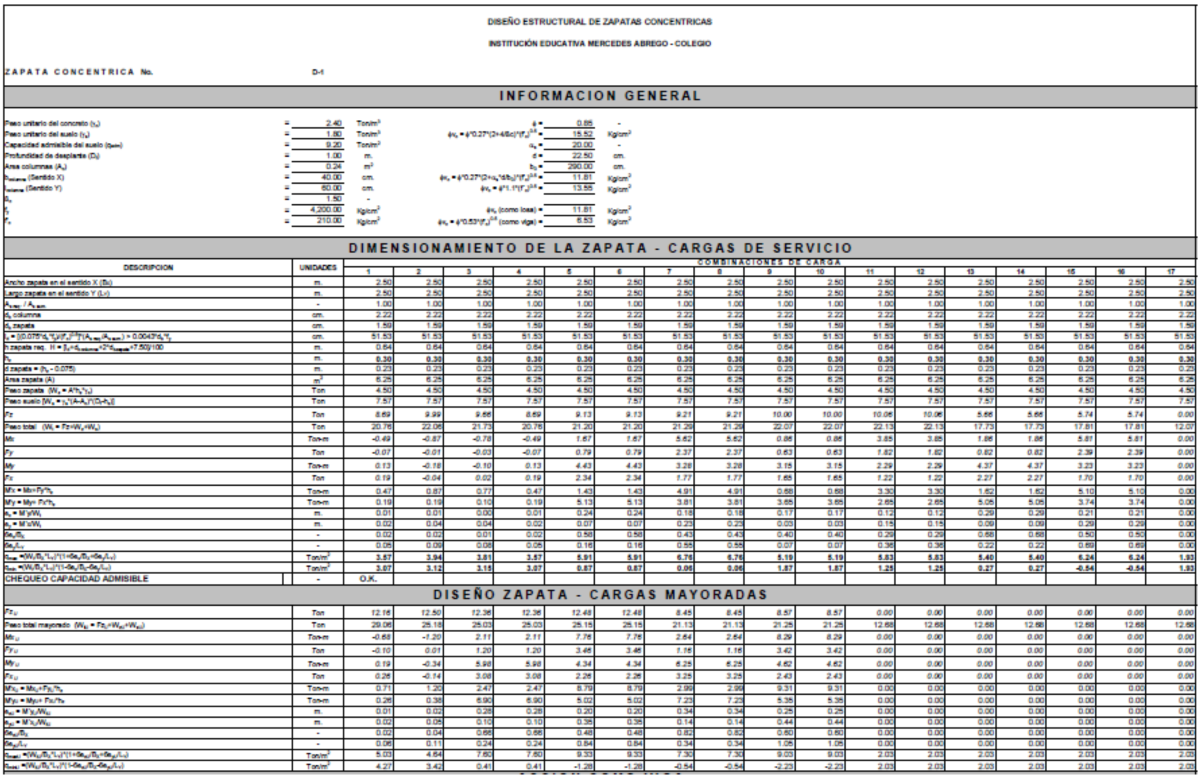
DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
b_0	cm.	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00
$V_U = q_{maxU} \cdot [A - (b_x+d) \cdot (l_x+d)]$	Ton	40.90	52.91	59.19	59.19	65.59	65.59	44.93	44.93	55.32	55.32	9.64	9.64	9.64	9.64	9.64	9.64	9.64
$v_U = V_U/b_0 \cdot d$	Kg/cm^2	6.27	8.11	9.07	9.07	10.05	10.05	6.89	6.89	8.48	8.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48
$v_U \le \phi v_c$	Kg/cm^2	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{uMAX}	Kg/cm^2	**10.05**																

DISEÑO A FLEXION EN DOS DIRECCIONES

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$M_{UX} = q_{maxU} \cdot L_Y \cdot [(B_X/2-b_x/2)^2]/2$	Ton-cm	**889.15**	**2,300.26**	**2,573.30**	**2,573.30**	**2,851.70**	**2,851.70**	**1,953.44**	**1,953.44**	**2,405.03**	**2,405.03**	**419.09**	**419.09**	**419.09**	**419.09**	**419.09**	**419.09**	**419.09**
$K_X = M_{UX}/(L_Y \cdot d^2)$	Ton/cm^2	0.00764	0.01976	0.02210	0.02210	0.02449	0.02449	0.01678	0.01678	0.02066	0.02066	0.00360	0.00360	0.00360	0.00360	0.00360	0.00360	0.00360
$\rho_X = (0.85 \cdot f'_c/f_y) \cdot \{1-[1-(2.6222 \cdot K_X/f'_c)]^{0.5}\} \ge 0.0018$	-	0.00208	0.00561	0.00634	0.00634	0.00709	0.00709	0.00471	0.00471	0.00589	0.00589	0.00097	0.00097	0.00097	0.00097	0.00097	0.00097	0.00097
$A_{sX} = \rho_X \cdot L_Y \cdot d$	cm^2	10.75	29.04	32.79	32.79	36.69	36.69	24.39	24.39	30.47	30.47	9.32	9.32	9.32	9.32	9.32	9.32	9.32
Longitud de varilla = B_X - 10	cm.	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00
DIRECCION Y																		
$M_{UY} = q_{maxU} \cdot B_X \cdot [(L_Y/2-l_x/2)^2]/2$	Ton-cm	**1,423.63**	**1,841.48**	**2,060.07**	**2,060.07**	**2,282.94**	**2,282.94**	**1,563.83**	**1,563.83**	**1,925.36**	**1,925.36**	**335.50**	**335.50**	**335.50**	**335.50**	**335.50**	**335.50**	**335.50**
$K_Y = M_{UY}/(B_X \cdot d^2)$	Ton/cm^2	0.01223	0.01582	0.01769	0.01769	0.01961	0.01961	0.01343	0.01343	0.01654	0.01654	0.00288	0.00288	0.00288	0.00288	0.00288	0.00288	0.00288
$\rho_Y = (0.85 \cdot f'_c/f_y) \cdot \{1-[1-(2.6222 \cdot K_Y/f'_c)]^{0.5}\} \ge 0.0018$	-	0.00358	0.00469	0.00528	0.00528	0.00590	0.00590	0.00395	0.00395	0.00492	0.00492	0.00081	0.00081	0.00081	0.00081	0.00081	0.00081	0.00081
$A_{sY} = \rho_Y \cdot B_X \cdot d$	cm^2	10.75	29.04	32.79	32.79	36.69	36.69	24.39	24.39	30.47	30.47	9.32	9.32	9.32	9.32	9.32	9.32	9.32
Longitud de varilla = L_Y - 10	cm.	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm^2	**36.69**
A_{sY} Máximo	cm^2	**36.69**
EN SENTIDO X USAR	-	**13 VARILLAS No. 6 L = 2.2 m. @ 18.33 cm.**
EN SENTIDO Y USAR	-	**13 VARILLAS No. 6 L = 2.2 m. @ 18.33 cm.**



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. D-1

INFORMACION GENERAL

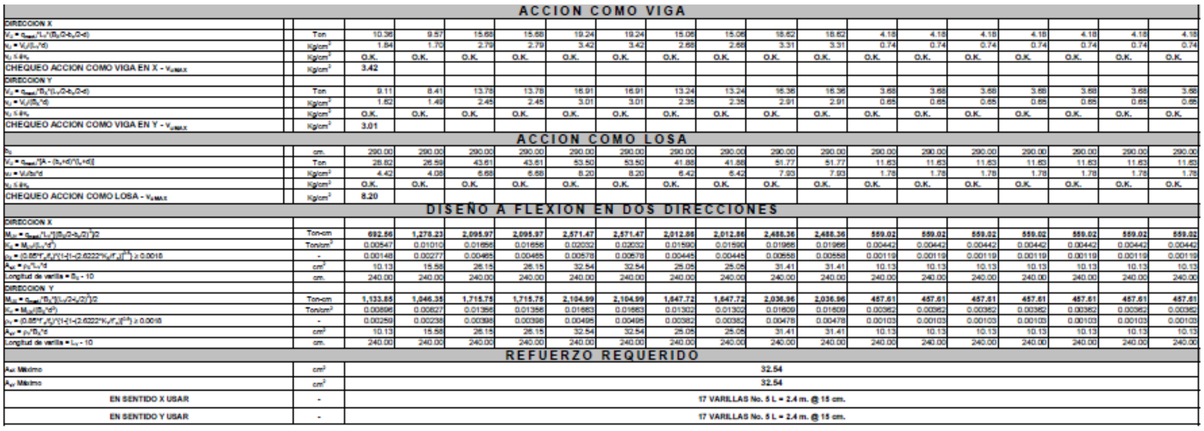
Peso unitario del concreto (γ_c)	=	2.40	Ton/m³	ϕ =	0.85	-
Peso unitario del suelo (γ_s)	=	1.80	Ton/m³	$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ =	15.52	Kg/cm²
Capacidad admisible del suelo (q_{adm})	=	9.20	Ton/m²	α_s =	20.00	-
Profundidad de desplante (D_f)	=	1.00	m.	d =	22.50	cm.
Area columnas (A_c)	=	0.24	m²	b_0 =	290.00	cm.
$b_{columna}$ (Sentido X)	=	40.00	cm.	$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ =	11.81	Kg/cm²
$l_{columna}$ (Sentido Y)	=	60.00	cm.	$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ =	13.55	Kg/cm²
β_c	=	1.50	-			
f_y	=	4,200.00	Kg/cm²	ϕv_c (como losa) =	11.81	Kg/cm²
f'_c	=	210.00	Kg/cm²	$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) =	6.53	Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Largo zapata en el sentido Y (L_Y)	m.	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
$A_{s\,req}/A_{s\,asum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22
d_b zapata	cm.	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
$l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*(A_{s\,req}/A_{s\,asum}) > 0.0043*d_b*f_y$	cm.	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53
h zapata req. $H = [l_d+d_{b\,columna}+2*d_{b\,zapata}+7.50]/100$	m.	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
h_z	m.	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**
d zapata = (h_z - 0.075)	m.	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Area zapata (A)	m²	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57	7.57
Fz	*Ton*	*8.69*	*9.99*	*9.66*	*8.69*	*9.13*	*9.13*	*9.21*	*9.21*	*10.00*	*10.00*	*10.06*	*10.06*	*5.66*	*5.66*	*5.74*	*5.74*	*0.00*
Peso total ($W_t = Fz+W_z+W_s$)	Ton	20.76	22.06	21.73	20.76	21.20	21.20	21.29	21.29	22.07	22.07	22.13	22.13	17.73	17.73	17.81	17.81	12.07
Mx	*Ton-m*	*-0.49*	*-0.87*	*-0.78*	*-0.49*	*1.67*	*1.67*	*5.62*	*5.62*	*0.86*	*0.86*	*3.85*	*3.85*	*1.86*	*1.86*	*5.81*	*5.81*	*0.00*
Fy	*Ton*	*-0.07*	*-0.01*	*-0.03*	*-0.07*	*0.79*	*0.79*	*2.37*	*2.37*	*0.63*	*0.63*	*1.82*	*1.82*	*0.82*	*0.82*	*2.39*	*2.39*	*0.00*
My	*Ton-m*	*0.13*	*-0.18*	*-0.10*	*0.13*	*4.43*	*4.43*	*3.28*	*3.28*	*3.15*	*3.15*	*2.29*	*2.29*	*4.37*	*4.37*	*3.23*	*3.23*	*0.00*
Fx	*Ton*	*0.19*	*-0.04*	*0.02*	*0.19*	*2.34*	*2.34*	*1.77*	*1.77*	*1.65*	*1.65*	*1.22*	*1.22*	*2.27*	*2.27*	*1.70*	*1.70*	*0.00*
$M'x = Mx+Fy*h_z$	Ton-m	0.47	0.87	0.77	0.47	1.43	1.43	4.91	4.91	0.68	0.68	3.30	3.30	1.62	1.62	5.10	5.10	0.00
$M'y = My+ Fx*h_z$	Ton-m	0.19	0.19	0.10	0.19	5.13	5.13	3.81	3.81	3.65	3.65	2.65	2.65	5.05	5.05	3.74	3.74	0.00
$e_x = M'y/W_t$	m.	0.01	0.01	0.00	0.01	0.24	0.24	0.18	0.18	0.17	0.17	0.12	0.12	0.29	0.29	0.21	0.21	0.00
$e_y = M'x/W_t$	m.	0.02	0.04	0.04	0.02	0.07	0.07	0.23	0.23	0.03	0.03	0.15	0.15	0.09	0.09	0.29	0.29	0.00
$6e_x/B_X$	-	0.02	0.02	0.01	0.02	0.58	0.58	0.43	0.43	0.40	0.40	0.29	0.29	0.68	0.68	0.50	0.50	0.00
$6e_y/L_Y$	-	0.05	0.09	0.08	0.05	0.16	0.16	0.55	0.55	0.07	0.07	0.36	0.36	0.22	0.22	0.69	0.69	0.00
$q_{max} = (W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)$	Ton/m²	**3.57**	**3.94**	**3.81**	**3.57**	**5.91**	**5.91**	**6.76**	**6.76**	**5.19**	**5.19**	**5.83**	**5.83**	**5.40**	**5.40**	**6.24**	**6.24**	**1.93**
$q_{min} = (W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)$	Ton/m²	**3.07**	**3.12**	**3.15**	**3.07**	**0.87**	**0.87**	**0.06**	**0.06**	**1.87**	**1.87**	**1.25**	**1.25**	**0.27**	**0.27**	**-0.54**	**-0.54**	**1.93**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

Fz_U	*Ton*	*12.16*	*12.50*	*12.36*	*12.36*	*12.48*	*12.48*	*8.45*	*8.45*	*8.57*	*8.57*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado ($W_U = Fz_U+W_{zU}+W_{sU}$)	Ton	29.06	25.18	25.03	25.03	25.15	25.15	21.13	21.13	21.25	21.25	12.68	12.68	12.68	12.68	12.68	12.68	12.68
Mx_U	*Ton-m*	*-0.68*	*-1.20*	*2.11*	*2.11*	*7.76*	*7.76*	*2.64*	*2.64*	*8.29*	*8.29*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	*Ton*	*-0.10*	*0.01*	*1.20*	*1.20*	*3.46*	*3.46*	*1.16*	*1.16*	*3.42*	*3.42*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	*Ton-m*	*0.19*	*-0.34*	*5.98*	*5.98*	*4.34*	*4.34*	*6.25*	*6.25*	*4.62*	*4.62*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	*Ton*	*0.26*	*-0.14*	*3.08*	*3.08*	*2.26*	*2.26*	*3.25*	*3.25*	*2.43*	*2.43*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U = Mx_U+Fy_U*h_z$	Ton-m	0.71	1.20	2.47	2.47	8.79	8.79	2.99	2.99	9.31	9.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U+ Fx_U*h_z$	Ton-m	0.26	0.38	6.90	6.90	5.02	5.02	7.23	7.23	5.35	5.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_U$	m.	0.01	0.02	0.28	0.28	0.20	0.20	0.34	0.34	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_U$	m.	0.02	0.05	0.10	0.10	0.35	0.35	0.14	0.14	0.44	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.02	0.04	0.66	0.66	0.48	0.48	0.82	0.82	0.60	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.06	0.11	0.24	0.24	0.84	0.84	0.34	0.34	1.05	1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_U/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m²	5.03	4.64	7.60	7.60	9.33	9.33	7.30	7.30	9.03	9.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03
$q_{minU} = (W_U/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m²	4.27	3.42	0.41	0.41	-1.28	-1.28	-0.54	-0.54	-2.23	-2.23	2.03	2.03	2.03	2.03	2.03	2.03	2.03



ACCION COMO VIGA

DIRECCION X																		
$V_U = q_{maxU}*L_Y*(B_X/2-b_c/2-d)$	Ton	10.36	9.57	15.68	15.68	19.24	19.24	15.06	15.06	18.62	18.62	4.18	4.18	4.18	4.18	4.18	4.18	4.18
$v_U = V_U/(L_Y*d)$	Kg/cm²	1.84	1.70	2.79	2.79	3.42	3.42	2.68	2.68	3.31	3.31	0.74	0.74	0.74	0.74	0.74	0.74	0.74
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{UMAX}	Kg/cm²	**3.42**																
DIRECCION Y																		
$V_U = q_{maxU}*B_X*(L_Y/2-b_y/2-d)$	Ton	9.11	8.41	13.78	13.78	16.91	16.91	13.24	13.24	16.36	16.36	3.68	3.68	3.68	3.68	3.68	3.68	3.68
$v_U = V_U/(B_X*d)$	Kg/cm²	1.62	1.49	2.45	2.45	3.01	3.01	2.35	2.35	2.91	2.91	0.65	0.65	0.65	0.65	0.65	0.65	0.65
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{UMAX}	Kg/cm²	**3.01**																

ACCION COMO LOSA

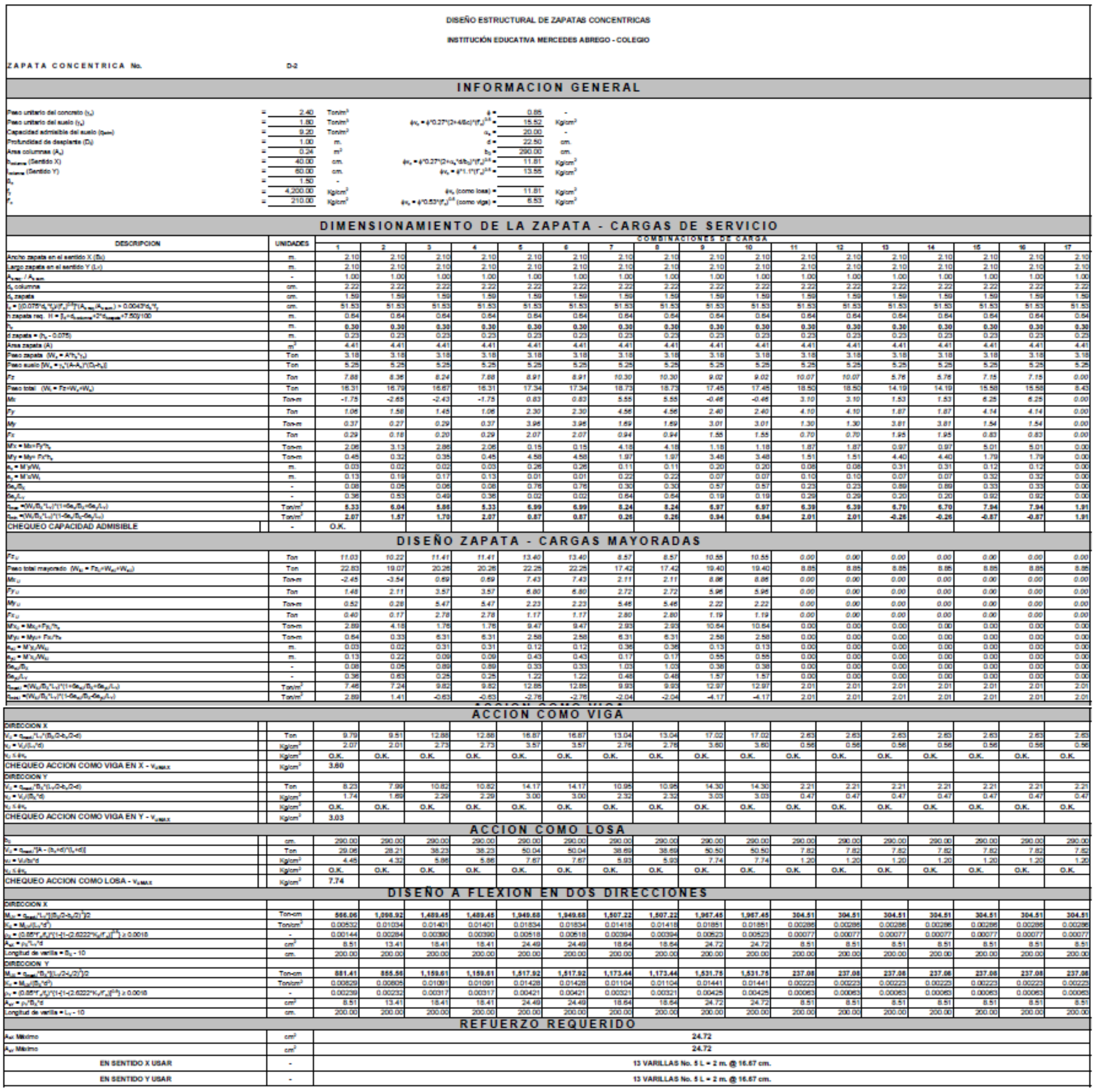
b_0	cm.	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00
$V_U = q_{maxU}*[A - (b_c+d)*(l_c+d)]$	Ton	28.82	26.59	43.61	43.61	53.50	53.50	41.88	41.88	51.77	51.77	11.63	11.63	11.63	11.63	11.63	11.63	11.63
$v_U = V_U/b_0*d$	Kg/cm²	4.42	4.08	6.68	6.68	8.20	8.20	6.42	6.42	7.93	7.93	1.78	1.78	1.78	1.78	1.78	1.78	1.78
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{UMAX}	Kg/cm²	**8.20**																

DISEÑO A FLEXION EN DOS DIRECCIONES

DIRECCION X																		
$M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_c/2)^2]/2$	Ton-cm	**692.56**	**1,278.23**	**2,095.97**	**2,095.97**	**2,571.47**	**2,571.47**	**2,012.86**	**2,012.86**	**2,488.36**	**2,488.36**	**559.02**	**559.02**	**559.02**	**559.02**	**559.02**	**559.02**	**559.02**
$K_X = M_{UX}/(L_Y*d^2)$	Ton/cm²	0.00547	0.01010	0.01656	0.01656	0.02032	0.02032	0.01590	0.01590	0.01966	0.01966	0.00442	0.00442	0.00442	0.00442	0.00442	0.00442	0.00442
$\rho_X = (0.85*f'_c/f_y)*\{1-[1-(2.6222*K_X/f'_c)]^{0.5}\} \geq 0.0018$	-	0.00148	0.00277	0.00465	0.00465	0.00578	0.00578	0.00445	0.00445	0.00558	0.00558	0.00119	0.00119	0.00119	0.00119	0.00119	0.00119	0.00119
$A_{sX} = \rho_X*L_Y*d$	cm²	10.13	15.58	26.15	26.15	32.54	32.54	25.05	25.05	31.41	31.41	10.13	10.13	10.13	10.13	10.13	10.13	10.13
Longitud de varilla = B_X - 10	cm.	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_c/2)^2]/2$	Ton-cm	**1,133.85**	**1,046.35**	**1,715.75**	**1,715.75**	**2,104.99**	**2,104.99**	**1,647.72**	**1,647.72**	**2,036.96**	**2,036.96**	**457.61**	**457.61**	**457.61**	**457.61**	**457.61**	**457.61**	**457.61**
$K_Y = M_{UY}/(B_X*d^2)$	Ton/cm²	0.00896	0.00827	0.01356	0.01356	0.01663	0.01663	0.01302	0.01302	0.01609	0.01609	0.00362	0.00362	0.00362	0.00362	0.00362	0.00362	0.00362
$\rho_Y = (0.85*f'_c/f_y)*\{1-[1-(2.6222*K_Y/f'_c)]^{0.5}\} \geq 0.0018$	-	0.00259	0.00238	0.00398	0.00398	0.00495	0.00495	0.00382	0.00382	0.00478	0.00478	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103
$A_{sY} = \rho_Y*B_X*d$	cm²	10.13	15.58	26.15	26.15	32.54	32.54	25.05	25.05	31.41	31.41	10.13	10.13	10.13	10.13	10.13	10.13	10.13
Longitud de varilla = L_Y - 10	cm.	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	**32.54**
A_{sY} Máximo	cm²	**32.54**
EN SENTIDO X USAR	-	**17 VARILLAS No. 5 L = 2.4 m. @ 15 cm.**
EN SENTIDO Y USAR	-	**17 VARILLAS No. 5 L = 2.4 m. @ 15 cm.**



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. D-2

INFORMACION GENERAL

Peso unitario del concreto (γ_c) = 2.40 Ton/m³
Peso unitario del suelo (γ_s) = 1.80 Ton/m³
Capacidad admisible del suelo (q_{adm}) = 9.20 Ton/m²
Profundidad de desplante (D_f) = 1.00 m.
Area columnas (A_c) = 0.24 m²
$b_{columna}$ (Sentido X) = 40.00 cm.
$l_{columna}$ (Sentido Y) = 60.00 cm.
β_c = 1.50 -
f_y = 4,200.00 Kg/cm²
f'_c = 210.00 Kg/cm²

ϕ = 0.85 -
$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ = 15.52 Kg/cm²
α_s = 20.00 -
d = 22.50 cm.
b_0 = 290.00 cm.
$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ = 11.81 Kg/cm²
$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ = 13.55 Kg/cm²
ϕv_c (como losa) = 11.81 Kg/cm²
$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) = 6.53 Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10
Largo zapata en el sentido Y (L_Y)	m.	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10
$A_{s\,req} / A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22
d_b zapata	cm.	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
$l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*(A_{s\,req}/A_{s\,sum}) > 0.0043*d_b*f_y$	cm.	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53
h zapata req. $H = [l_d+d_{b\,columna}+2*d_{b\,zapata}+7.50]/100$	m.	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
h_z	m.	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**
d zapata = (h_z - 0.075)	m.	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Area zapata (A)	m²	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25
Fz	*Ton*	*7.88*	*8.36*	*8.24*	*7.88*	*8.91*	*8.91*	*10.30*	*10.30*	*9.02*	*9.02*	*10.07*	*10.07*	*5.76*	*5.76*	*7.15*	*7.15*	*0.00*
Peso total (W_t = Fz+W_z+W_s)	Ton	16.31	16.79	16.67	16.31	17.34	17.34	18.73	18.73	17.45	17.45	18.50	18.50	14.19	14.19	15.58	15.58	8.43
Mx	*Ton-m*	*-1.75*	*-2.65*	*-2.43*	*-1.75*	*0.83*	*0.83*	*5.55*	*5.55*	*-0.46*	*-0.46*	*3.10*	*3.10*	*1.53*	*1.53*	*6.25*	*6.25*	*0.00*
Fy	*Ton*	*1.06*	*1.58*	*1.45*	*1.06*	*2.30*	*2.30*	*4.56*	*4.56*	*2.40*	*2.40*	*4.10*	*4.10*	*1.87*	*1.87*	*4.14*	*4.14*	*0.00*
My	*Ton-m*	*0.37*	*0.27*	*0.29*	*0.37*	*3.96*	*3.96*	*1.69*	*1.69*	*3.01*	*3.01*	*1.30*	*1.30*	*3.81*	*3.81*	*1.54*	*1.54*	*0.00*
Fx	*Ton*	*0.29*	*0.18*	*0.20*	*0.29*	*2.07*	*2.07*	*0.94*	*0.94*	*1.55*	*1.55*	*0.70*	*0.70*	*1.95*	*1.95*	*0.83*	*0.83*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	2.06	3.13	2.86	2.06	0.15	0.15	4.18	4.18	1.18	1.18	1.87	1.87	0.97	0.97	5.01	5.01	0.00
M'y = My+ Fx*h_z	Ton-m	0.45	0.32	0.35	0.45	4.58	4.58	1.97	1.97	3.48	3.48	1.51	1.51	4.40	4.40	1.79	1.79	0.00
e_x = M'y/W_t	m.	0.03	0.02	0.02	0.03	0.26	0.26	0.11	0.11	0.20	0.20	0.08	0.08	0.31	0.31	0.12	0.12	0.00
e_y = M'x/W_t	m.	0.13	0.19	0.17	0.13	0.01	0.01	0.22	0.22	0.07	0.07	0.10	0.10	0.07	0.07	0.32	0.32	0.00
$6e_x/B_x$	-	0.08	0.05	0.06	0.08	0.76	0.76	0.30	0.30	0.57	0.57	0.23	0.23	0.89	0.89	0.33	0.33	0.00
$6e_y/L_y$	-	0.36	0.53	0.49	0.36	0.02	0.02	0.64	0.64	0.19	0.19	0.29	0.29	0.20	0.20	0.92	0.92	0.00
$q_{max} = (W_t/B_x*L_y)*(1+6e_x/B_x+6e_y/L_y)$	Ton/m²	**5.33**	**6.04**	**5.86**	**5.33**	**6.99**	**6.99**	**8.24**	**8.24**	**6.97**	**6.97**	**6.39**	**6.39**	**6.70**	**6.70**	**7.94**	**7.94**	**1.91**
$q_{min} = (W_t/B_x*L_y)*(1-6e_x/B_x-6e_y/L_y)$	Ton/m²	**2.07**	**1.57**	**1.70**	**2.07**	**0.87**	**0.87**	**0.26**	**0.26**	**0.94**	**0.94**	**2.01**	**2.01**	**-0.26**	**-0.26**	**-0.87**	**-0.87**	**1.91**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

Fz_U	Ton	*11.03*	*10.22*	*11.41*	*11.41*	*13.40*	*13.40*	*8.57*	*8.57*	*10.55*	*10.55*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado ($W_{tU} = Fz_U+W_{zU}+W_{sU}$)	Ton	22.83	19.07	20.26	20.26	22.25	22.25	17.42	17.42	19.40	19.40	8.85	8.85	8.85	8.85	8.85	8.85	8.85
Mx_U	Ton-m	*-2.45*	*-3.54*	*0.69*	*0.69*	*7.43*	*7.43*	*2.11*	*2.11*	*8.86*	*8.86*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*1.48*	*2.11*	*3.57*	*3.57*	*6.80*	*6.80*	*2.72*	*2.72*	*5.96*	*5.96*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*0.52*	*0.28*	*5.47*	*5.47*	*2.23*	*2.23*	*5.46*	*5.46*	*2.22*	*2.22*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*0.40*	*0.17*	*2.78*	*2.78*	*1.17*	*1.17*	*2.80*	*2.80*	*1.19*	*1.19*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U = Mx_U+Fy_U*h_z$	Ton-m	2.89	4.18	1.76	1.76	9.47	9.47	2.93	2.93	10.64	10.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U+ Fx_U*h_z$	Ton-m	0.64	0.33	6.31	6.31	2.58	2.58	6.31	6.31	2.58	2.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_{tU}$	m.	0.03	0.02	0.31	0.31	0.12	0.12	0.36	0.36	0.13	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_{tU}$	m.	0.13	0.22	0.09	0.09	0.43	0.43	0.17	0.17	0.55	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_x$	-	0.08	0.05	0.89	0.89	0.33	0.33	1.03	1.03	0.38	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_y$	-	0.36	0.63	0.25	0.25	1.22	1.22	0.48	0.48	1.57	1.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_{tU}/B_x*L_y)*(1+6e_{xU}/B_x+6e_{yU}/L_y)$	Ton/m²	7.46	7.24	9.82	9.82	12.85	12.85	9.93	9.93	12.97	12.97	2.01	2.01	2.01	2.01	2.01	2.01	2.01
$q_{minU} = (W_{tU}/B_x*L_y)*(1-6e_{xU}/B_x-6e_{yU}/L_y)$	Ton/m²	2.89	1.41	-0.63	-0.63	-2.76	-2.76	-2.04	-2.04	-4.17	-4.17	2.01	2.01	2.01	2.01	2.01	2.01	2.01

ACCION COMO VIGA

DIRECCION X																		
$V_U = q_{maxU}*L_Y*(B_X/2-b_x/2-d)$	Ton	9.79	9.51	12.88	12.88	16.87	16.87	13.04	13.04	17.02	17.02	2.63	2.63	2.63	2.63	2.63	2.63	2.63
$v_U = V_U/(L_Y*d)$	Kg/cm²	2.07	2.01	2.73	2.73	3.57	3.57	2.76	2.76	3.60	3.60	0.56	0.56	0.56	0.56	0.56	0.56	0.56
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{uMAX}	Kg/cm²	3.60																
DIRECCION Y																		
$V_U = q_{maxU}*B_X*(L_Y/2-b_y/2-d)$	Ton	8.23	7.99	10.82	10.82	14.17	14.17	10.95	10.95	14.30	14.30	2.21	2.21	2.21	2.21	2.21	2.21	2.21
$v_U = V_U/(B_X*d)$	Kg/cm²	1.74	1.69	2.29	2.29	3.00	3.00	2.32	2.32	3.03	3.03	0.47	0.47	0.47	0.47	0.47	0.47	0.47
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{uMAX}	Kg/cm²	3.03																

ACCION COMO LOSA

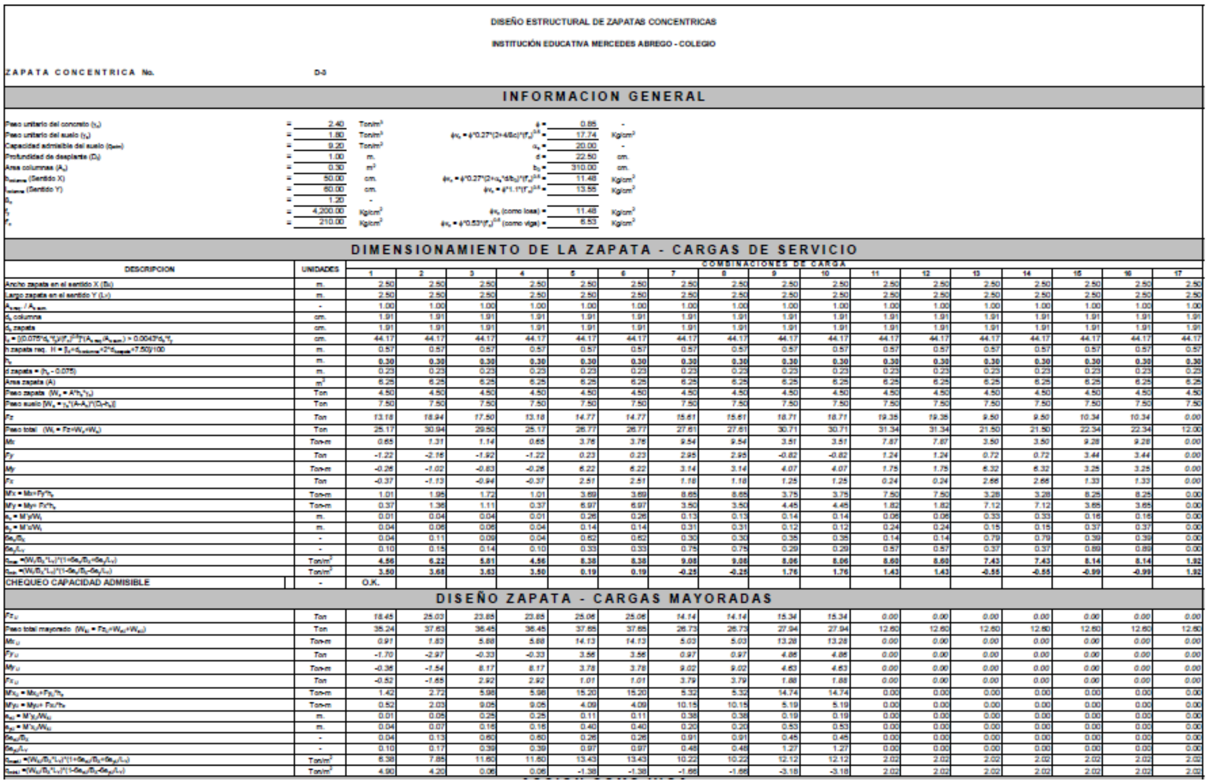
b_0	cm.	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00
$V_U = q_{maxU}*[A - (b_x+d)*(l_y+d)]$	Ton	29.06	28.21	38.23	38.23	50.04	50.04	38.69	38.69	50.50	50.50	7.82	7.82	7.82	7.82	7.82	7.82	7.82
$v_U = V_U/b_0*d$	Kg/cm²	4.45	4.32	5.86	5.86	7.67	7.67	5.93	5.93	7.74	7.74	1.20	1.20	1.20	1.20	1.20	1.20	1.20
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{uMAX}	Kg/cm²	7.74																

DISEÑO A FLEXION EN DOS DIRECCIONES

DIRECCION X																		
$M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_x/2)^2]/2$	Ton-cm	**566.06**	**1,098.92**	**1,489.45**	**1,489.45**	**1,949.68**	**1,949.68**	**1,507.22**	**1,507.22**	**1,967.45**	**1,967.45**	**304.51**	**304.51**	**304.51**	**304.51**	**304.51**	**304.51**	**304.51**
$K_x = M_{UX}/(L_Y*d^2)$	Ton/cm²	0.00532	0.01034	0.01401	0.01401	0.01834	0.01834	0.01418	0.01418	0.01851	0.01851	0.00286	0.00286	0.00286	0.00286	0.00286	0.00286	0.00286
$\rho_x = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_x/f'_c)]^{0.5}) \geq 0.0018$	-	0.00144	0.00284	0.00390	0.00390	0.00518	0.00518	0.00394	0.00394	0.00523	0.00523	0.00077	0.00077	0.00077	0.00077	0.00077	0.00077	0.00077
$A_{sx} = \rho_x*L_Y*d$	cm²	8.51	13.41	18.41	18.41	24.49	24.49	18.64	18.64	24.72	24.72	8.51	8.51	8.51	8.51	8.51	8.51	8.51
Longitud de varilla = B_X - 10	cm.	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_y/2)^2]/2$	Ton-cm	**881.41**	**855.56**	**1,159.61**	**1,159.61**	**1,517.92**	**1,517.92**	**1,173.44**	**1,173.44**	**1,531.75**	**1,531.75**	**237.08**	**237.08**	**237.08**	**237.08**	**237.08**	**237.08**	**237.08**
$K_y = M_{UY}/(B_X*d^2)$	Ton/cm²	0.00829	0.00805	0.01091	0.01091	0.01428	0.01428	0.01104	0.01104	0.01441	0.01441	0.00223	0.00223	0.00223	0.00223	0.00223	0.00223	0.00223
$\rho_y = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_y/f'_c)]^{0.5}) \geq 0.0018$	-	0.00239	0.00232	0.00317	0.00317	0.00421	0.00421	0.00321	0.00321	0.00425	0.00425	0.00063	0.00063	0.00063	0.00063	0.00063	0.00063	0.00063
$A_{sy} = \rho_y*B_X*d$	cm²	8.51	13.41	18.41	18.41	24.49	24.49	18.64	18.64	24.72	24.72	8.51	8.51	8.51	8.51	8.51	8.51	8.51
Longitud de varilla = L_Y - 10	cm.	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	24.72
A_{sY} Máximo	cm²	24.72
EN SENTIDO X USAR	-	13 VARILLAS No. 5 L = 2 m. @ 16.67 cm.
EN SENTIDO Y USAR	-	13 VARILLAS No. 5 L = 2 m. @ 16.67 cm.



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. D-3

INFORMACION GENERAL

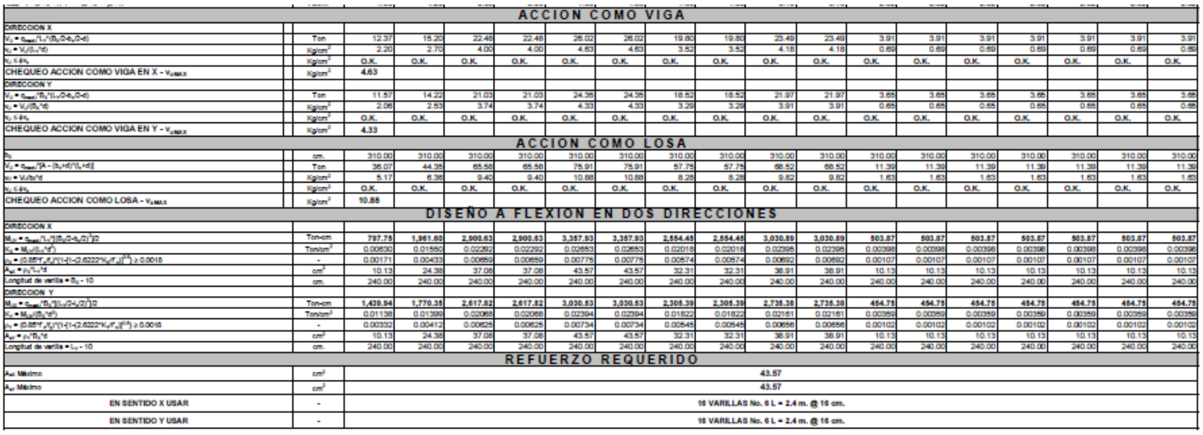
Peso unitario del concreto (γ_c) = 2.40 Ton/m³ — ϕ = 0.85 -
Peso unitario del suelo (γ_s) = 1.80 Ton/m³ — $\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ = 17.74 Kg/cm²
Capacidad admisible del suelo (q_{adm}) = 9.20 Ton/m² — α_s = 20.00 -
Profundidad de desplante (D_f) = 1.00 m. — d = 22.50 cm.
Area columnas (A_c) = 0.30 m² — b_0 = 310.00 cm.
$b_{columna}$ (Sentido X) = 50.00 cm. — $\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ = 11.48 Kg/cm²
$l_{columna}$ (Sentido Y) = 60.00 cm. — $\phi v_c = \phi*1.1*(f'_c)^{0.5}$ = 13.55 Kg/cm²
β_c = 1.20 -
f_y = 4,200.00 Kg/cm² — ϕv_c (como losa) = 11.48 Kg/cm²
f'_c = 210.00 Kg/cm² — $\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) = 6.53 Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (Bx)	m.	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Largo zapata en el sentido Y (Ly)	m.	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
$A_{s\,req}/A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
d_b zapata	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
$l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*(A_{s\,req}/A_{s\,sum}) > 0.0043*d_b*f_y$	cm.	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17
h zapata req. $H = [l_d+d_{b\,columna}+2*d_{b\,zapata}+7.50]/100$	m.	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
h_z	m.	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**
d zapata = (h_z - 0.075)	m.	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Area zapata (A)	m²	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
Fz	Ton	*13.18*	*18.94*	*17.50*	*13.18*	*14.77*	*14.77*	*15.61*	*15.61*	*18.71*	*18.71*	*19.35*	*19.35*	*9.50*	*9.50*	*10.34*	*10.34*	*0.00*
Peso total (W_t = Fz+W_z+W_s)	Ton	25.17	30.94	29.50	25.17	26.77	26.77	27.61	27.61	30.71	30.71	31.34	31.34	21.50	21.50	22.34	22.34	12.00
Mx	Ton-m	*0.65*	*1.31*	*1.14*	*0.65*	*3.76*	*3.76*	*9.54*	*9.54*	*3.51*	*3.51*	*7.87*	*7.87*	*3.50*	*3.50*	*9.28*	*9.28*	*0.00*
Fy	Ton	*-1.22*	*-2.16*	*-1.92*	*-1.22*	*0.23*	*0.23*	*2.95*	*2.95*	*-0.82*	*-0.82*	*1.24*	*1.24*	*0.72*	*0.72*	*3.44*	*3.44*	*0.00*
My	Ton-m	*-0.26*	*-1.02*	*-0.83*	*-0.26*	*6.22*	*6.22*	*3.14*	*3.14*	*4.07*	*4.07*	*1.75*	*1.75*	*6.32*	*6.32*	*3.25*	*3.25*	*0.00*
Fx	Ton	*-0.37*	*-1.13*	*-0.94*	*-0.37*	*2.51*	*2.51*	*1.18*	*1.18*	*1.25*	*1.25*	*0.24*	*0.24*	*2.66*	*2.66*	*1.33*	*1.33*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	1.01	1.95	1.72	1.01	3.69	3.69	8.65	8.65	3.75	3.75	7.50	7.50	3.28	3.28	8.25	8.25	0.00
M'y = My+ Fx*h_z	Ton-m	0.37	1.38	1.11	0.37	6.97	6.97	3.50	3.50	4.45	4.45	1.82	1.82	7.12	7.12	3.65	3.65	0.00
e_x = M'y/W_t	m.	0.01	0.04	0.04	0.01	0.26	0.26	0.13	0.13	0.14	0.14	0.06	0.06	0.33	0.33	0.16	0.16	0.00
e_y = M'x/W_t	m.	0.04	0.06	0.06	0.04	0.14	0.14	0.31	0.31	0.12	0.12	0.24	0.24	0.15	0.15	0.37	0.37	0.00
$6e_x/B_X$	-	0.04	0.11	0.09	0.04	0.62	0.62	0.30	0.30	0.35	0.35	0.14	0.14	0.79	0.79	0.39	0.39	0.00
$6e_y/L_Y$	-	0.10	0.15	0.14	0.10	0.33	0.33	0.75	0.75	0.29	0.29	0.57	0.57	0.37	0.37	0.89	0.89	0.00
$q_{max} = (W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)$	Ton/m²	**4.56**	**6.22**	**5.81**	**4.56**	**8.38**	**8.38**	**9.08**	**9.08**	**8.06**	**8.06**	**8.60**	**8.60**	**7.43**	**7.43**	**8.14**	**8.14**	**1.92**
$q_{min} = (W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)$	Ton/m²	**3.50**	**3.68**	**3.63**	**3.50**	**0.19**	**0.19**	**-0.25**	**-0.25**	**1.76**	**1.76**	**1.43**	**1.43**	**-0.55**	**-0.55**	**-0.99**	**-0.99**	**1.92**
CHEQUEO CAPACIDAD ADMISIBLE	-	**O.K.**																

DISEÑO ZAPATA - CARGAS MAYORADAS

Fz_U	Ton	*18.45*	*25.03*	*23.85*	*23.85*	*25.06*	*25.06*	*14.14*	*14.14*	*15.34*	*15.34*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado (W_U = Fz_U+W_{zU}+W_{sU})	Ton	35.24	37.63	36.45	36.45	37.66	37.66	26.73	26.73	27.94	27.94	12.60	12.60	12.60	12.60	12.60	12.60	12.60
Mx_U	Ton-m	*0.91*	*1.83*	*5.88*	*5.88*	*14.13*	*14.13*	*5.03*	*5.03*	*13.28*	*13.28*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*-1.70*	*-2.97*	*-0.33*	*-0.33*	*3.56*	*3.56*	*0.97*	*0.97*	*4.86*	*4.86*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*-0.36*	*-1.54*	*8.17*	*8.17*	*3.78*	*3.78*	*9.02*	*9.02*	*4.63*	*4.63*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*-0.52*	*-1.65*	*2.92*	*2.92*	*1.01*	*1.01*	*3.79*	*3.79*	*1.88*	*1.88*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U = Mx_U+Fy_U*h_z$	Ton-m	1.42	2.72	5.98	5.98	15.20	15.20	5.32	5.32	14.74	14.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U+ Fx_U*h_z$	Ton-m	0.52	2.03	9.05	9.05	4.09	4.09	10.15	10.15	5.19	5.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_U$	m.	0.01	0.05	0.25	0.25	0.11	0.11	0.38	0.38	0.19	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_U$	m.	0.04	0.07	0.16	0.16	0.40	0.40	0.20	0.20	0.53	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.04	0.13	0.60	0.60	0.26	0.26	0.91	0.91	0.45	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.10	0.17	0.39	0.39	0.97	0.97	0.48	0.48	1.27	1.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_U/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m²	6.38	7.85	11.60	11.60	13.43	13.43	10.22	10.22	12.12	12.12	2.02	2.02	2.02	2.02	2.02	2.02	2.02
$q_{minU} = (W_U/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m²	4.90	4.20	0.06	0.06	-1.38	-1.38	-1.66	-1.66	-3.18	-3.18	2.02	2.02	2.02	2.02	2.02	2.02	2.02



ACCION COMO VIGA

DIRECCION X																		
$V_U = q_{maxU}*L_Y*(B_X/2-b_x/2-d)$	Ton	12.37	15.20	22.48	22.48	26.02	26.02	19.80	19.80	23.49	23.49	3.91	3.91	3.91	3.91	3.91	3.91	3.91
$v_U = V_U/(L_Y*d)$	Kg/cm²	2.20	2.70	4.00	4.00	4.63	4.63	3.52	3.52	4.18	4.18	0.69	0.69	0.69	0.69	0.69	0.69	0.69
$v_U \le \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{UMAX}	Kg/cm²	**4.63**																
DIRECCION Y																		
$V_U = q_{maxU}*B_X*(L_Y/2-b_y/2-d)$	Ton	11.57	14.22	21.03	21.03	24.35	24.35	18.52	18.52	21.97	21.97	3.65	3.65	3.65	3.65	3.65	3.65	3.65
$v_U = V_U/(B_X*d)$	Kg/cm²	2.06	2.53	3.74	3.74	4.33	4.33	3.29	3.29	3.91	3.91	0.65	0.65	0.65	0.65	0.65	0.65	0.65
$v_U \le \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{UMAX}	Kg/cm²	**4.33**																

ACCION COMO LOSA

b_0	cm.	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00
$V_U = q_{maxU}*[A - (b_x+d)*(l_y+d)]$	Ton	36.07	44.35	65.58	65.58	75.91	75.91	57.75	57.75	68.52	68.52	11.39	11.39	11.39	11.39	11.39	11.39	11.39
$v_U = V_U/b_0*d$	Kg/cm²	5.17	6.36	9.40	9.40	10.88	10.88	8.28	8.28	9.82	9.82	1.63	1.63	1.63	1.63	1.63	1.63	1.63
$v_U \le \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{UMAX}	Kg/cm²	**10.88**																

DISEÑO A FLEXION EN DOS DIRECCIONES

DIRECCION X																		
$M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_x/2)^2]/2$	Ton-cm	**797.75**	**1,961.60**	**2,900.63**	**2,900.63**	**3,357.93**	**3,357.93**	**2,554.45**	**2,554.45**	**3,030.89**	**3,030.89**	**503.87**	**503.87**	**503.87**	**503.87**	**503.87**	**503.87**	**503.87**
$K_X = M_{UX}/(L_Y*d^2)$	Ton/cm²	0.00630	0.01550	0.02292	0.02292	0.02653	0.02653	0.02018	0.02018	0.02395	0.02395	0.00398	0.00398	0.00398	0.00398	0.00398	0.00398	0.00398
$\rho_X = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_X/f'_c)]^{0.5}) \ge 0.0018$	-	0.00171	0.00433	0.00659	0.00659	0.00775	0.00775	0.00574	0.00574	0.00692	0.00692	0.00107	0.00107	0.00107	0.00107	0.00107	0.00107	0.00107
$A_{sX} = \rho_X*L_Y*d$	cm²	10.13	24.38	37.08	37.08	43.57	43.57	32.31	32.31	38.91	38.91	10.13	10.13	10.13	10.13	10.13	10.13	10.13
Longitud de varilla = B_X - 10	cm.	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_y/2)^2]/2$	Ton-cm	**1,439.94**	**1,770.35**	**2,617.82**	**2,617.82**	**3,030.53**	**3,030.53**	**2,305.39**	**2,305.39**	**2,735.38**	**2,735.38**	**454.75**	**454.75**	**454.75**	**454.75**	**454.75**	**454.75**	**454.75**
$K_Y = M_{UY}/(B_X*d^2)$	Ton/cm²	0.01138	0.01399	0.02068	0.02068	0.02394	0.02394	0.01822	0.01822	0.02161	0.02161	0.00359	0.00359	0.00359	0.00359	0.00359	0.00359	0.00359
$\rho_Y = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_Y/f'_c)]^{0.5}) \ge 0.0018$	-	0.00332	0.00412	0.00625	0.00625	0.00734	0.00734	0.00545	0.00545	0.00656	0.00656	0.00102	0.00102	0.00102	0.00102	0.00102	0.00102	0.00102
$A_{sY} = \rho_Y*B_X*d$	cm²	10.13	24.38	37.08	37.08	43.57	43.57	32.31	32.31	38.91	38.91	10.13	10.13	10.13	10.13	10.13	10.13	10.13
Longitud de varilla = L_Y - 10	cm.	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	**43.57**
A_{sY} Máximo	cm²	**43.57**
EN SENTIDO X USAR	-	**16 VARILLAS No. 6 L = 2.4 m. @ 16 cm.**
EN SENTIDO Y USAR	-	**16 VARILLAS No. 6 L = 2.4 m. @ 16 cm.**

DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. D-4

INFORMACION GENERAL

Peso unitario del concreto (γ_c)	=	2.40	Ton/m³	ϕ =	0.85	-
Peso unitario del suelo (γ_s)	=	1.80	Ton/m³	$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ =	15.52	Kg/cm²
Capacidad admisible del suelo (q_{adm})	=	9.20	Ton/m²	α_s =	20.00	-
Profundidad de desplante (D_f)	=	1.00	m.	d =	22.50	cm.
Area columnas (A_c)	=	0.24	m²	b_0 =	290.00	cm.
$b_{columna}$ (Sentido X)	=	40.00	cm.	$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ =	11.81	Kg/cm²
$l_{columna}$ (Sentido Y)	=	60.00	cm.	$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ =	13.56	Kg/cm²
β_c	=	1.50	-			
f_y	=	4,200.00	Kg/cm²	ϕv_c (como losa) =	11.81	Kg/cm²
f'_c	=	210.00	Kg/cm²	$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) =	6.53	Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

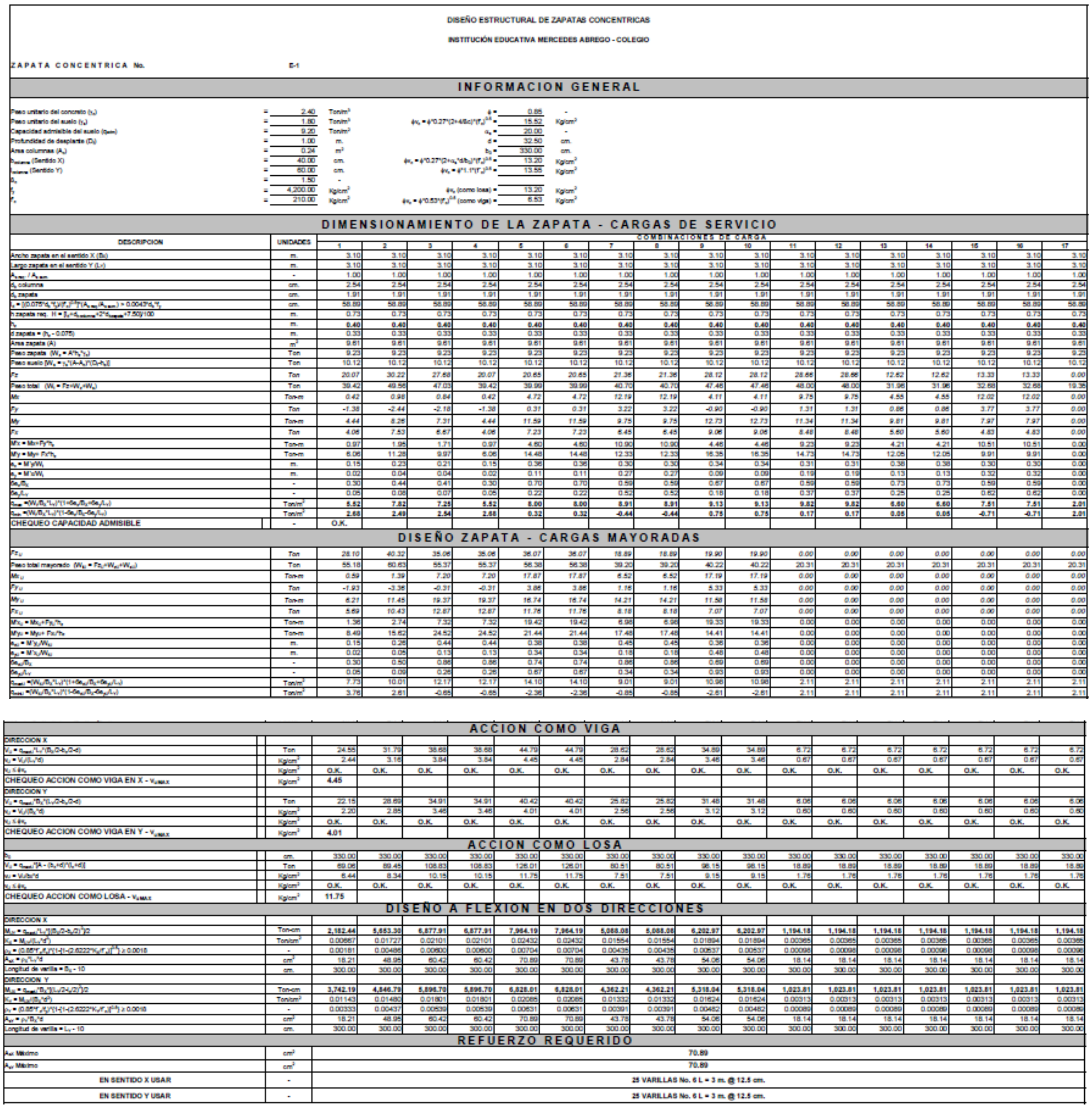
DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Largo zapata en el sentido Y (L_Y)	m.	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
$A_{s\,req}$ / $A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
d_b zapata	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
$l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*(A_{s\,req}/A_{s\,sum}) > 0.0043*d_b*f_y$	cm.	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17
h zapata req. $H = [l_d+d_{b\,columna}+2*d_{b\,zapata}+7.50]/100$	m.	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
h_z	m.	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**
d zapata = (h_z - 0.075)	m.	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Area zapata (A)	m²	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29	5.29
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.81
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36
Fz	Ton	*9.27*	*13.87*	*12.72*	*9.27*	*10.19*	*10.19*	*10.01*	*10.01*	*13.41*	*13.41*	*13.28*	*13.28*	*6.48*	*6.48*	*6.30*	*6.30*	*0.00*
Peso total (W_t = Fz+W_z+W_s)	Ton	19.44	24.04	22.89	19.44	20.36	20.36	20.18	20.18	23.58	23.58	23.45	23.45	16.65	16.65	16.47	16.47	10.17
Mx	Ton-m	*-3.66*	*-6.02*	*-5.43*	*-3.66*	*-1.49*	*-1.49*	*2.37*	*2.37*	*-3.77*	*-3.77*	*-0.86*	*-0.86*	*-0.02*	*-0.02*	*3.84*	*3.84*	*0.00*
Fy	Ton	*2.77*	*4.59*	*4.14*	*2.77*	*3.65*	*3.65*	*5.14*	*5.14*	*4.81*	*4.81*	*5.94*	*5.94*	*2.54*	*2.54*	*4.04*	*4.04*	*0.00*
My	Ton-m	*-0.75*	*-1.44*	*-1.27*	*-0.75*	*3.37*	*3.37*	*2.81*	*2.81*	*1.86*	*1.86*	*1.44*	*1.44*	*3.68*	*3.68*	*3.11*	*3.11*	*0.00*
Fx	Ton	*-0.83*	*-1.52*	*-1.35*	*-0.83*	*1.11*	*1.11*	*0.85*	*0.85*	*0.12*	*0.12*	*-0.07*	*-0.07*	*1.44*	*1.44*	*1.18*	*1.18*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	4.49	7.39	6.67	4.49	2.58	2.58	0.83	0.83	5.21	5.21	2.64	2.64	0.79	0.79	2.63	2.63	0.00
M'y = My+ Fx*h_z	Ton-m	1.00	1.89	1.67	1.00	3.71	3.71	3.07	3.07	1.90	1.90	1.42	1.42	4.11	4.11	3.47	3.47	0.00
e_x = M'y/W_t	m.	0.05	0.08	0.07	0.05	0.18	0.18	0.15	0.15	0.08	0.08	0.06	0.06	0.25	0.25	0.21	0.21	0.00
e_y = M'x/W_t	m.	0.23	0.31	0.29	0.23	0.13	0.13	0.04	0.04	0.22	0.22	0.11	0.11	0.05	0.05	0.16	0.16	0.00
$6e_x/B_X$	-	0.13	0.21	0.19	0.13	0.48	0.48	0.40	0.40	0.21	0.21	0.16	0.16	0.64	0.64	0.55	0.55	0.00
$6e_y/L_Y$	-	0.60	0.80	0.76	0.60	0.33	0.33	0.11	0.11	0.58	0.58	0.29	0.29	0.12	0.12	0.42	0.42	0.00
$q_{max} = (W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)$	Ton/m²	**6.39**	**9.12**	**8.44**	**6.39**	**6.95**	**6.95**	**5.74**	**5.74**	**7.97**	**7.97**	**6.43**	**6.43**	**5.56**	**5.56**	**6.12**	**6.12**	**1.92**
$q_{min} = (W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)$	Ton/m²	**0.96**	**-0.04**	**0.21**	**0.96**	**0.75**	**0.75**	**1.89**	**1.89**	**0.95**	**0.95**	**2.43**	**2.43**	**0.73**	**0.73**	**0.11**	**0.11**	**1.92**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																
DISEÑO ZAPATA - CARGAS MAYORADAS																		
Fz_U	Ton	*12.98*	*18.48*	*17.03*	*17.03*	*16.77*	*16.77*	*9.66*	*9.66*	*9.40*	*9.40*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado (W_{tU} = Fz_U+W_{zU}+W_{sU})	Ton	27.22	29.16	27.71	27.71	27.45	27.45	20.34	20.34	20.08	20.08	10.68	10.68	10.68	10.68	10.68	10.68	10.68
Mx_U	Ton-m	*-5.13*	*-8.16*	*-3.64*	*-3.64*	*1.88*	*1.88*	*-0.19*	*-0.19*	*5.33*	*5.33*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*3.88*	*6.24*	*6.40*	*6.40*	*8.54*	*8.54*	*3.75*	*3.75*	*5.88*	*5.88*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*-1.06*	*-2.00*	*4.31*	*4.31*	*3.51*	*3.51*	*5.22*	*5.22*	*4.42*	*4.42*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*-1.16*	*-2.10*	*1.09*	*1.09*	*0.71*	*0.71*	*2.03*	*2.03*	*1.65*	*1.65*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U$ = Mx_U+Fy_U*h_z	Ton-m	6.29	10.03	5.56	5.56	4.44	4.44	1.31	1.31	7.09	7.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U$ = My_U+ Fx_U*h_z	Ton-m	1.40	2.63	4.64	4.64	3.72	3.72	5.83	5.83	4.91	4.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e_{xU} = $M'y_U/W_{tU}$	m.	0.05	0.09	0.17	0.17	0.14	0.14	0.29	0.29	0.24	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e_{yU} = $M'x_U/W_{tU}$	m.	0.23	0.34	0.20	0.20	0.16	0.16	0.06	0.06	0.35	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.13	0.24	0.44	0.44	0.36	0.36	0.75	0.75	0.64	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.60	0.90	0.52	0.52	0.42	0.42	0.17	0.17	0.92	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_{tU}/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m²	8.94	11.75	10.27	10.27	9.21	9.21	7.37	7.37	9.71	9.71	2.02	2.02	2.02	2.02	2.02	2.02	2.02
$q_{minU} = (W_{tU}/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m²	1.36	-0.73	0.21	0.21	1.17	1.17	0.32	0.32	-2.12	-2.12	2.02	2.02	2.02	2.02	2.02	2.02	2.02

ACCION COMO VIGA

DIRECCION X																		
$V_U = q_{maxU}*L_Y*(B_X/2-b_c/2-d)$	Ton	14.91	19.60	17.12	17.12	15.36	15.36	12.28	12.28	16.20	16.20	3.37	3.37	3.37	3.37	3.37	3.37	3.37
$v_U = V_U/(L_Y*d)$	Kg/cm²	2.88	3.79	3.31	3.31	2.97	2.97	2.37	2.37	3.13	3.13	0.65	0.65	0.65	0.65	0.65	0.65	0.65
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{uMAX}	Kg/cm²	**3.79**																
DIRECCION Y																		
$V_U = q_{maxU}*B_X*(L_Y/2-l_c/2-d)$	Ton	12.86	16.90	14.76	14.76	13.24	13.24	10.59	10.59	13.97	13.97	2.90	2.90	2.90	2.90	2.90	2.90	2.90
$v_U = V_U/(B_X*d)$	Kg/cm²	2.48	3.27	2.85	2.85	2.56	2.56	2.05	2.05	2.70	2.70	0.56	0.56	0.56	0.56	0.56	0.56	0.56
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{uMAX}	Kg/cm²	**3.27**																
ACCION COMO LOSA																		
b_0	cm.	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00
$V_U = q_{maxU}*[A-(b_c+d)*(l_c+d)]$	Ton	42.68	56.12	49.02	49.02	43.98	43.98	35.17	35.17	46.38	46.38	9.64	9.64	9.64	9.64	9.64	9.64	9.64
$v_U = V_U/b_0*d$	Kg/cm²	6.54	8.60	7.51	7.51	6.74	6.74	5.39	5.39	7.11	7.11	1.48	1.48	1.48	1.48	1.48	1.48	1.48
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{uMAX}	Kg/cm²	**8.60**																
DISEÑO A FLEXION EN DOS DIRECCIONES																		
DIRECCION X																		
$M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_c/2)^2]/2$	Ton-cm	**927.90**	**2,439.98**	**2,131.24**	**2,131.24**	**1,912.28**	**1,912.28**	**1,528.94**	**1,528.94**	**2,016.55**	**2,016.55**	**419.09**	**419.09**	**419.09**	**419.09**	**419.09**	**419.09**	**419.09**
$K_X = M_{UX}/(L_Y*d^2)$	Ton/cm²	0.00797	0.02096	0.01830	0.01830	0.01642	0.01642	0.01313	0.01313	0.01732	0.01732	0.00360	0.00360	0.00360	0.00360	0.00360	0.00360	0.00360
$\rho_X = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_X/f'_c)]^{0.5}) \geq 0.0018$	-	0.00217	0.00598	0.00517	0.00517	0.00461	0.00461	0.00364	0.00364	0.00488	0.00488	0.00097	0.00097	0.00097	0.00097	0.00097	0.00097	0.00097
$A_{sX} = \rho_X*L_Y*d$	cm²	11.23	30.95	26.76	26.76	23.84	23.84	18.84	18.84	25.23	25.23	9.32	9.32	9.32	9.32	9.32	9.32	9.32
Longitud de varilla = B_X - 10	cm.	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_c/2)^2]/2$	Ton-cm	**1,485.68**	**1,953.34**	**1,706.17**	**1,706.17**	**1,530.88**	**1,530.88**	**1,224.00**	**1,224.00**	**1,614.35**	**1,614.35**	**335.50**	**335.50**	**335.50**	**335.50**	**335.50**	**335.50**	**335.50**
$K_Y = M_{UY}/(B_X*d^2)$	Ton/cm²	0.01276	0.01678	0.01465	0.01465	0.01315	0.01315	0.01051	0.01051	0.01386	0.01386	0.00288	0.00288	0.00288	0.00288	0.00288	0.00288	0.00288
$\rho_Y = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_Y/f'_c)]^{0.5}) \geq 0.0018$	-	0.00374	0.00499	0.00432	0.00432	0.00386	0.00386	0.00305	0.00305	0.00408	0.00408	0.00081	0.00081	0.00081	0.00081	0.00081	0.00081	0.00081
$A_{sY} = \rho_Y*B_X*d$	cm²	11.23	30.95	26.76	26.76	23.84	23.84	18.84	18.84	25.23	25.23	9.32	9.32	9.32	9.32	9.32	9.32	9.32
Longitud de varilla = L_Y - 10	cm.	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	30.95
A_{sY} Máximo	cm²	30.95
EN SENTIDO X USAR	-	**11 VARILLAS No. 6 L = 2.2 m. @ 22 cm.**
EN SENTIDO Y USAR	-	**11 VARILLAS No. 6 L = 2.2 m. @ 22 cm.**



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. E-1

INFORMACION GENERAL

Peso unitario del concreto (γ_c) = 2.40 Ton/m³
Peso unitario del suelo (γ_s) = 1.80 Ton/m³
Capacidad admisible del suelo (q_{adm}) = 9.20 Ton/m²
Profundidad de desplante (D_f) = 1.00 m.
Area columnas (A_c) = 0.24 m²
$b_{columna}$ (Sentido X) = 40.00 cm.
$l_{columna}$ (Sentido Y) = 60.00 cm.
β_c = 1.50 -
f_y = 4,200.00 Kg/cm²
f'_c = 210.00 Kg/cm²

ϕ = 0.85 -
$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ = 15.52 Kg/cm²
α_s = 20.00 -
d = 32.50 cm.
b_0 = 330.00 cm.
$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ = 13.20 Kg/cm²
$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ = 13.55 Kg/cm²
ϕv_c (como losa) = 13.20 Kg/cm²
$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) = 6.53 Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10
Largo zapata en el sentido Y (L_Y)	m.	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10
$A_{s\,req}$ / $A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54
d_b zapata	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
$l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*(A_{s\,req}/A_{s\,sum}) > 0.0043*d_b*f_y$	cm.	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89
h zapata req. $H = [l_d+d_{b\,columna}+2*d_{b\,zapata}+7.50]/100$	m.	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
h_z	m.	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**
d zapata = (h_z - 0.075)	m.	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Area zapata (A)	m²	9.61	9.61	9.61	9.61	9.61	9.61	9.61	9.61	9.61	9.61	9.61	9.61	9.61	9.61	9.61	9.61	9.61
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	9.23	9.23	9.23	9.23	9.23	9.23	9.23	9.23	9.23	9.23	9.23	9.23	9.23	9.23	9.23	9.23	9.23
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	10.12	10.12	10.12	10.12	10.12	10.12	10.12	10.12	10.12	10.12	10.12	10.12	10.12	10.12	10.12	10.12	10.12
Fz	Ton	*20.07*	*30.22*	*27.68*	*20.07*	*20.65*	*20.65*	*21.36*	*21.36*	*28.12*	*28.12*	*28.66*	*28.66*	*12.62*	*12.62*	*13.33*	*13.33*	*0.00*
Peso total ($W_t = Fz+W_z+W_s$)	Ton	39.42	49.56	47.03	39.42	39.99	39.99	40.70	40.70	47.46	47.46	48.00	48.00	31.96	31.96	32.68	32.68	19.35
Mx	Ton-m	*0.42*	*0.98*	*0.84*	*0.42*	*4.72*	*4.72*	*12.19*	*12.19*	*4.11*	*4.11*	*9.75*	*9.75*	*4.55*	*4.55*	*12.02*	*12.02*	*0.00*
Fy	Ton	*-1.38*	*-2.44*	*-2.18*	*-1.38*	*0.31*	*0.31*	*3.22*	*3.22*	*-0.90*	*-0.90*	*1.31*	*1.31*	*0.86*	*0.86*	*3.77*	*3.77*	*0.00*
My	Ton-m	*4.44*	*8.26*	*7.31*	*4.44*	*11.59*	*11.59*	*9.75*	*9.75*	*12.73*	*12.73*	*11.34*	*11.34*	*9.81*	*9.81*	*7.97*	*7.97*	*0.00*
Fx	Ton	*4.06*	*7.53*	*6.67*	*4.06*	*7.23*	*7.23*	*6.45*	*6.45*	*9.06*	*9.06*	*8.48*	*8.48*	*5.60*	*5.60*	*4.83*	*4.83*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	0.97	1.95	1.71	0.97	4.60	4.60	10.90	10.90	4.46	4.46	9.23	9.23	4.21	4.21	10.51	10.51	0.00
M'y = My+ Fx*h_z	Ton-m	6.06	11.28	9.97	6.06	14.48	14.48	12.33	12.33	16.35	16.35	14.73	14.73	12.05	12.05	9.91	9.91	0.00
e_x = M'y/W_t	m.	0.15	0.23	0.21	0.15	0.36	0.36	0.30	0.30	0.34	0.34	0.31	0.31	0.38	0.38	0.30	0.30	0.00
e_y = M'x/W_t	m.	0.02	0.04	0.04	0.02	0.11	0.11	0.27	0.27	0.09	0.09	0.19	0.19	0.13	0.13	0.32	0.32	0.00
$6e_x/B_X$	-	0.30	0.44	0.41	0.30	0.70	0.70	0.59	0.59	0.67	0.67	0.59	0.59	0.73	0.73	0.59	0.59	0.00
$6e_y/L_Y$	-	0.05	0.08	0.07	0.05	0.22	0.22	0.52	0.52	0.18	0.18	0.37	0.37	0.25	0.25	0.62	0.62	0.00
$q_{max} = (W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)$	Ton/m²	**5.52**	**7.82**	**7.25**	**5.52**	**8.00**	**8.00**	**8.91**	**8.91**	**9.13**	**9.13**	**9.82**	**9.82**	**6.60**	**6.60**	**7.51**	**7.51**	**2.01**
$q_{min} = (W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)$	Ton/m²	**2.68**	**2.49**	**2.54**	**2.68**	**0.32**	**0.32**	**-0.44**	**-0.44**	**0.75**	**0.75**	**0.17**	**0.17**	**0.05**	**0.05**	**-0.71**	**-0.71**	**2.01**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

Fz_U	Ton	*28.10*	*40.32*	*35.06*	*35.06*	*36.07*	*36.07*	*18.89*	*18.89*	*19.90*	*19.90*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado ($W_U = Fz_U+W_{zU}+W_{sU}$)	Ton	55.18	60.63	55.37	55.37	56.38	56.38	39.20	39.20	40.22	40.22	20.31	20.31	20.31	20.31	20.31	20.31	20.31
Mx_U	Ton-m	*0.59*	*1.39*	*7.20*	*7.20*	*17.87*	*17.87*	*6.52*	*6.52*	*17.19*	*17.19*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*-1.93*	*-3.36*	*-0.31*	*-0.31*	*3.86*	*3.86*	*1.16*	*1.16*	*5.33*	*5.33*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*6.21*	*11.45*	*19.37*	*19.37*	*16.74*	*16.74*	*14.21*	*14.21*	*11.58*	*11.58*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*5.69*	*10.43*	*12.87*	*12.87*	*11.76*	*11.76*	*8.18*	*8.18*	*7.07*	*7.07*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U = Mx_U+Fy_U*h_z$	Ton-m	1.36	2.74	7.32	7.32	19.42	19.42	6.98	6.98	19.33	19.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U+ Fx_U*h_z$	Ton-m	8.49	15.62	24.52	24.52	21.44	21.44	17.48	17.48	14.41	14.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_U$	m.	0.15	0.26	0.44	0.44	0.38	0.38	0.45	0.45	0.36	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_U$	m.	0.02	0.05	0.13	0.13	0.34	0.34	0.18	0.18	0.48	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.30	0.50	0.86	0.86	0.74	0.74	0.86	0.86	0.69	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.05	0.09	0.26	0.26	0.67	0.67	0.34	0.34	0.93	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_U/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m²	7.73	10.01	12.17	12.17	14.10	14.10	9.01	9.01	10.98	10.98	2.11	2.11	2.11	2.11	2.11	2.11	2.11
$q_{minU} = (W_U/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m²	3.76	2.61	-0.65	-0.65	-2.36	-2.36	-0.85	-0.85	-2.61	-2.61	2.11	2.11	2.11	2.11	2.11	2.11	2.11

ACCION COMO VIGA

DIRECCION X																		
$V_U = q_{maxU}*L_Y*(B_X/2-b_c/2-d)$	Ton	24.55	31.79	38.68	38.68	44.79	44.79	28.62	28.62	34.89	34.89	6.72	6.72	6.72	6.72	6.72	6.72	6.72
$v_U = V_U/(L_Y*d)$	Kg/cm²	2.44	3.16	3.84	3.84	4.45	4.45	2.84	2.84	3.46	3.46	0.67	0.67	0.67	0.67	0.67	0.67	0.67
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{uMAX}	Kg/cm²	**4.45**																
DIRECCION Y																		
$V_U = q_{maxU}*B_X*(L_Y/2-l_c/2-d)$	Ton	22.15	28.69	34.91	34.91	40.42	40.42	25.82	25.82	31.48	31.48	6.06	6.06	6.06	6.06	6.06	6.06	6.06
$v_U = V_U/(B_X*d)$	Kg/cm²	2.20	2.85	3.46	3.46	4.01	4.01	2.56	2.56	3.12	3.12	0.60	0.60	0.60	0.60	0.60	0.60	0.60
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{uMAX}	Kg/cm²	**4.01**																

ACCION COMO LOSA

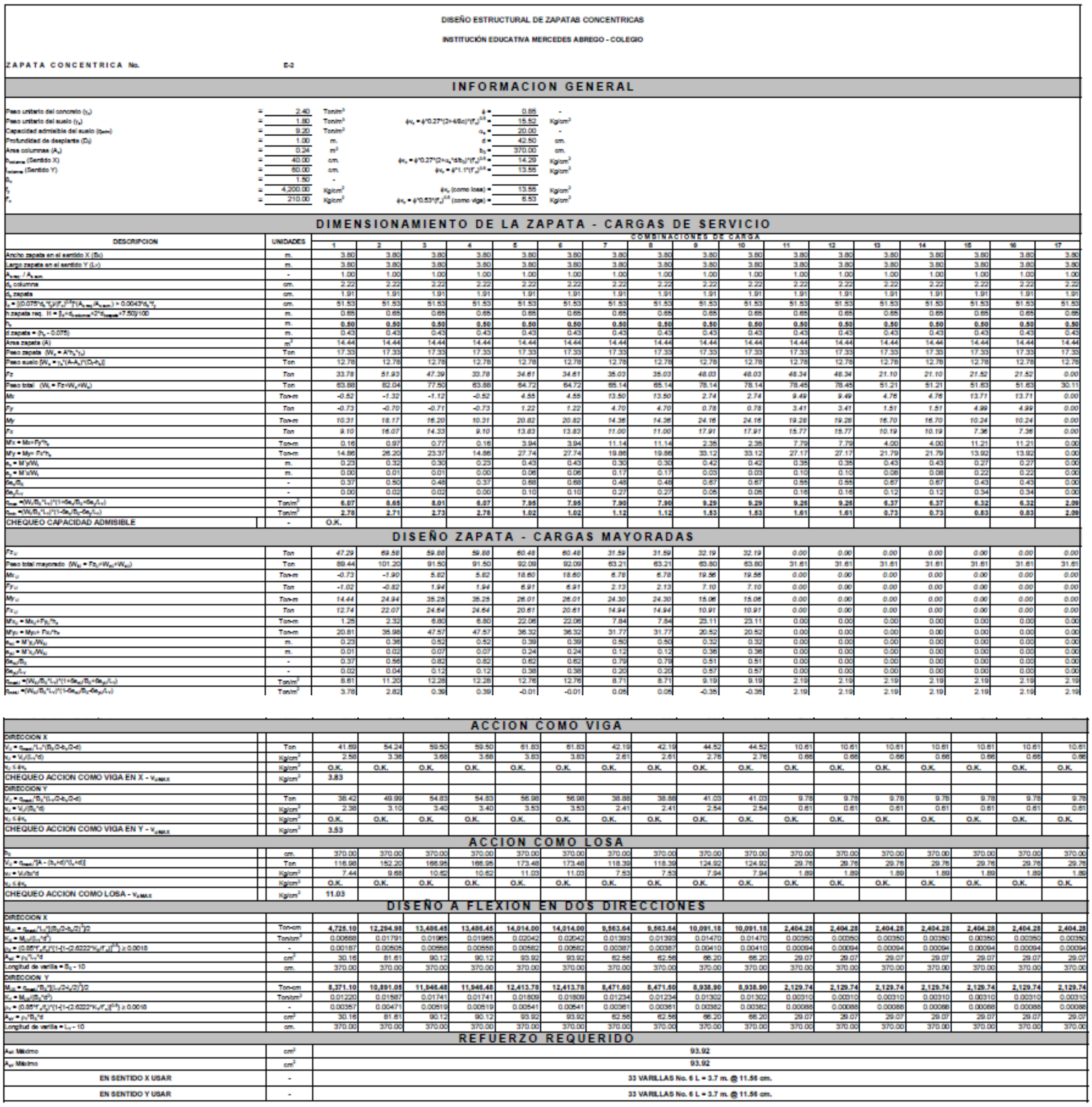
b_0	cm.	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00
$V_U = q_{maxU}*[A - (b_c+d)*(l_c+d)]$	Ton	69.06	89.45	108.83	108.83	126.01	126.01	80.51	80.51	98.15	98.15	18.89	18.89	18.89	18.89	18.89	18.89	18.89
$v_U = V_U/b_0*d$	Kg/cm²	6.44	8.34	10.15	10.15	11.75	11.75	7.51	7.51	9.15	9.15	1.76	1.76	1.76	1.76	1.76	1.76	1.76
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{uMAX}	Kg/cm²	**11.75**																

DISEÑO A FLEXION EN DOS DIRECCIONES

DIRECCION X																		
$M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_c/2)^2]/2$	Ton-cm	**2,182.44**	**5,653.30**	**6,877.91**	**6,877.91**	**7,964.19**	**7,964.19**	**5,088.08**	**5,088.08**	**6,202.97**	**6,202.97**	**1,194.18**	**1,194.18**	**1,194.18**	**1,194.18**	**1,194.18**	**1,194.18**	**1,194.18**
$K_X = M_{UX}/(L_Y*d^2)$	Ton/cm²	0.00667	0.01727	0.02101	0.02101	0.02432	0.02432	0.01554	0.01554	0.01894	0.01894	0.00365	0.00365	0.00365	0.00365	0.00365	0.00365	0.00365
$\rho_X = (0.85*f'_c/f_y)*\{1-[1-(2.6222*K_X/f'_c)]^{0.5}\} \geq 0.0018$	-	0.00181	0.00486	0.00600	0.00600	0.00704	0.00704	0.00435	0.00435	0.00537	0.00537	0.00098	0.00098	0.00098	0.00098	0.00098	0.00098	0.00098
$A_{sX} = \rho_X*L_Y*d$	cm²	18.21	48.95	60.42	60.42	70.89	70.89	43.78	43.78	54.06	54.06	18.14	18.14	18.14	18.14	18.14	18.14	18.14
Longitud de varilla = B_X - 10	cm.	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_c/2)^2]/2$	Ton-cm	**3,742.19**	**4,846.79**	**5,896.70**	**5,896.70**	**6,828.01**	**6,828.01**	**4,362.21**	**4,362.21**	**5,318.04**	**5,318.04**	**1,023.81**	**1,023.81**	**1,023.81**	**1,023.81**	**1,023.81**	**1,023.81**	**1,023.81**
$K_Y = M_{UY}/(B_X*d^2)$	Ton/cm²	0.01143	0.01480	0.01801	0.01801	0.02085	0.02085	0.01332	0.01332	0.01624	0.01624	0.00313	0.00313	0.00313	0.00313	0.00313	0.00313	0.00313
$\rho_Y = (0.85*f'_c/f_y)*\{1-[1-(2.6222*K_Y/f'_c)]^{0.5}\} \geq 0.0018$	-	0.00333	0.00437	0.00539	0.00539	0.00631	0.00631	0.00391	0.00391	0.00482	0.00482	0.00089	0.00089	0.00089	0.00089	0.00089	0.00089	0.00089
$A_{sY} = \rho_Y*B_X*d$	cm²	18.21	48.95	60.42	60.42	70.89	70.89	43.78	43.78	54.06	54.06	18.14	18.14	18.14	18.14	18.14	18.14	18.14
Longitud de varilla = L_Y - 10	cm.	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	70.89
A_{sY} Máximo	cm²	70.89
EN SENTIDO X USAR	-	**25 VARILLAS No. 6 L = 3 m. @ 12.5 cm.**
EN SENTIDO Y USAR	-	**25 VARILLAS No. 6 L = 3 m. @ 12.5 cm.**



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. E-2

INFORMACION GENERAL

Peso unitario del concreto (γ_c)	=	2.40	Ton/m³	ϕ =	0.85	-
Peso unitario del suelo (γ_s)	=	1.80	Ton/m³	$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ =	15.52	Kg/cm²
Capacidad admisible del suelo (q_{adm})	=	9.20	Ton/m²	α_s =	20.00	-
Profundidad de desplante (D_f)	=	1.00	m.	d =	42.50	cm.
Area columnas (A_c)	=	0.24	m²	b_0 =	370.00	cm.
$b_{columna}$ (Sentido X)	=	40.00	cm.	$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ =	14.29	Kg/cm²
$l_{columna}$ (Sentido Y)	=	60.00	cm.	$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ =	13.55	Kg/cm²
β_c	=	1.50	-			
f_y	=	4,200.00	Kg/cm²	ϕv_c (como losa) =	13.55	Kg/cm²
f'_c	=	210.00	Kg/cm²	$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) =	6.53	Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80
Largo zapata en el sentido Y (L_Y)	m.	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80
$A_{s\,req} / A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22
d_b zapata	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
$l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*(A_{s\,req}/A_{s\,sum}) > 0.0043*d_b*f_y$	cm.	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53
h zapata req. $H = [l_d + d_{b\,columna} + 2*d_{b\,zapata} + 7.50]/100$	m.	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
h_z	m.	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**
d zapata = (h_z - 0.075)	m.	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Area zapata (A)	m²	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33	17.33
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	12.78	12.78	12.78	12.78	12.78	12.78	12.78	12.78	12.78	12.78	12.78	12.78	12.78	12.78	12.78	12.78	12.78
Fz	*Ton*	*33.78*	*51.93*	*47.39*	*33.78*	*34.61*	*34.61*	*35.03*	*35.03*	*48.03*	*48.03*	*48.34*	*48.34*	*21.10*	*21.10*	*21.52*	*21.52*	*0.00*
Peso total ($W_t = Fz+W_z+W_s$)	Ton	63.88	82.04	77.50	63.88	64.72	64.72	65.14	65.14	78.14	78.14	78.45	78.45	51.21	51.21	51.63	51.63	30.11
Mx	*Ton-m*	*-0.52*	*-1.32*	*-1.12*	*-0.52*	*4.55*	*4.55*	*13.50*	*13.50*	*2.74*	*2.74*	*9.49*	*9.49*	*4.76*	*4.76*	*13.71*	*13.71*	*0.00*
Fy	*Ton*	*-0.73*	*-0.70*	*-0.71*	*-0.73*	*1.22*	*1.22*	*4.70*	*4.70*	*0.78*	*0.78*	*3.41*	*3.41*	*1.51*	*1.51*	*4.99*	*4.99*	*0.00*
My	*Ton-m*	*10.31*	*18.17*	*16.20*	*10.31*	*20.82*	*20.82*	*14.36*	*14.36*	*24.16*	*24.16*	*19.28*	*19.28*	*16.70*	*16.70*	*10.24*	*10.24*	*0.00*
Fx	*Ton*	*9.10*	*16.07*	*14.33*	*9.10*	*13.83*	*13.83*	*11.00*	*11.00*	*17.91*	*17.91*	*15.77*	*15.77*	*10.19*	*10.19*	*7.36*	*7.36*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	0.16	0.97	0.77	0.16	3.94	3.94	11.14	11.14	2.35	2.35	7.79	7.79	4.00	4.00	11.21	11.21	0.00
M'y = My+ Fx*h_z	Ton-m	14.86	26.20	23.37	14.86	27.74	27.74	19.86	19.86	33.12	33.12	27.17	27.17	21.79	21.79	13.92	13.92	0.00
e_x = M'y/W_t	m.	0.23	0.32	0.30	0.23	0.43	0.43	0.30	0.30	0.42	0.42	0.35	0.35	0.43	0.43	0.27	0.27	0.00
e_y = M'x/W_t	m.	0.00	0.01	0.01	0.00	0.06	0.06	0.17	0.17	0.03	0.03	0.10	0.10	0.08	0.08	0.22	0.22	0.00
$6e_x/B_X$	-	0.37	0.50	0.48	0.37	0.68	0.68	0.48	0.48	0.67	0.67	0.55	0.55	0.67	0.67	0.43	0.43	0.00
$6e_y/L_Y$	-	0.00	0.02	0.02	0.00	0.10	0.10	0.27	0.27	0.05	0.05	0.16	0.16	0.12	0.12	0.34	0.34	0.00
$q_{max} = (W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)$	Ton/m²	**6.07**	**8.65**	**8.01**	**6.07**	**7.95**	**7.95**	**7.90**	**7.90**	**9.29**	**9.29**	**9.26**	**9.26**	**6.37**	**6.37**	**6.32**	**6.32**	**2.09**
$q_{min} = (W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)$	Ton/m²	**2.78**	**2.71**	**2.73**	**2.78**	**1.02**	**1.02**	**1.12**	**1.12**	**1.53**	**1.53**	**1.61**	**1.61**	**0.73**	**0.73**	**0.83**	**0.83**	**2.09**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

Fz_U	Ton	*47.29*	*69.58*	*59.88*	*59.88*	*60.48*	*60.48*	*31.59*	*31.59*	*32.19*	*32.19*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado ($W_U = Fz_U+W_{zU}+W_{sU}$)	Ton	89.44	101.20	91.50	91.50	92.09	92.09	63.21	63.21	63.80	63.80	31.61	31.61	31.61	31.61	31.61	31.61	31.61
Mx_U	*Ton-m*	*-0.73*	*-1.90*	*5.82*	*5.82*	*18.60*	*18.60*	*6.78*	*6.78*	*19.56*	*19.56*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	*Ton*	*-1.02*	*-0.82*	*1.94*	*1.94*	*6.91*	*6.91*	*2.13*	*2.13*	*7.10*	*7.10*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	*Ton-m*	*14.44*	*24.94*	*35.25*	*35.25*	*26.01*	*26.01*	*24.30*	*24.30*	*15.06*	*15.06*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	*Ton*	*12.74*	*22.07*	*24.64*	*24.64*	*20.61*	*20.61*	*14.94*	*14.94*	*10.91*	*10.91*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U = Mx_U+Fy_U*h_z$	Ton-m	1.25	2.32	6.80	6.80	22.06	22.06	7.84	7.84	23.11	23.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U+ Fx_U*h_z$	Ton-m	20.81	35.98	47.57	47.57	38.32	38.32	31.77	31.77	20.52	20.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_U$	m.	0.23	0.36	0.52	0.52	0.39	0.39	0.50	0.50	0.32	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_U$	m.	0.01	0.02	0.07	0.07	0.24	0.24	0.12	0.12	0.36	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.37	0.56	0.82	0.82	0.62	0.62	0.79	0.79	0.51	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.02	0.04	0.12	0.12	0.38	0.38	0.20	0.20	0.57	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_U/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m²	8.61	11.20	12.28	12.28	12.76	12.76	8.71	8.71	9.19	9.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19
$q_{minU} = (W_U/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m²	3.78	2.82	0.39	0.39	-0.01	-0.01	0.05	0.05	-0.35	-0.35	2.19	2.19	2.19	2.19	2.19	2.19	2.19

ACCION COMO VIGA

DIRECCION X																		
$V_U = q_{maxU}*L_Y*(B_X/2-b_c/2-d)$	Ton	41.69	54.24	59.50	59.50	61.83	61.83	42.19	42.19	44.52	44.52	10.61	10.61	10.61	10.61	10.61	10.61	10.61
$v_U = V_U/(L_Y*d)$	Kg/cm²	2.58	3.36	3.68	3.68	3.83	3.83	2.61	2.61	2.76	2.76	0.66	0.66	0.66	0.66	0.66	0.66	0.66
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{uMAX}	Kg/cm²	**3.83**																
DIRECCION Y																		
$V_U = q_{maxU}*B_X*(L_Y/2-l_c/2-d)$	Ton	38.42	49.99	54.83	54.83	56.98	56.98	38.88	38.88	41.03	41.03	9.78	9.78	9.78	9.78	9.78	9.78	9.78
$v_U = V_U/(B_X*d)$	Kg/cm²	2.38	3.10	3.40	3.40	3.53	3.53	2.41	2.41	2.54	2.54	0.61	0.61	0.61	0.61	0.61	0.61	0.61
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{uMAX}	Kg/cm²	**3.53**																

ACCION COMO LOSA

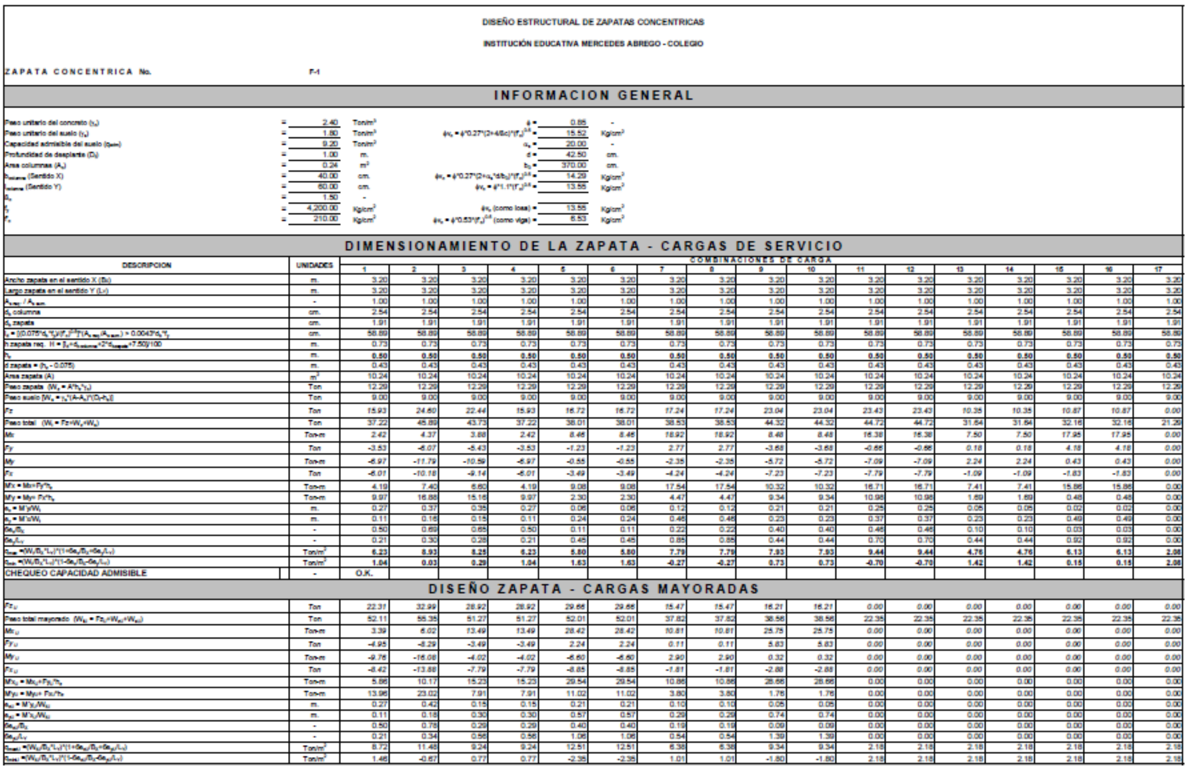
b_0	cm.	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00
$V_U = q_{maxU}*[A - (b_c+d)*(l_c+d)]$	Ton	116.98	152.20	166.95	166.95	173.48	173.48	118.39	118.39	124.92	124.92	29.76	29.76	29.76	29.76	29.76	29.76	29.76
$v_U = V_U/b_0*d$	Kg/cm²	7.44	9.68	10.62	10.62	11.03	11.03	7.53	7.53	7.94	7.94	1.89	1.89	1.89	1.89	1.89	1.89	1.89
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{uMAX}	Kg/cm²	**11.03**																

DISEÑO A FLEXION EN DOS DIRECCIONES

DIRECCION X																		
$M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_c/2)^2]/2$	Ton-cm	**4,725.10**	**12,294.98**	**13,486.45**	**13,486.45**	**14,014.00**	**14,014.00**	**9,563.64**	**9,563.64**	**10,091.18**	**10,091.18**	**2,404.28**	**2,404.28**	**2,404.28**	**2,404.28**	**2,404.28**	**2,404.28**	**2,404.28**
$K_X = M_{UX}/(L_Y*d^2)$	Ton/cm²	0.00688	0.01791	0.01965	0.01965	0.02042	0.02042	0.01393	0.01393	0.01470	0.01470	0.00350	0.00350	0.00350	0.00350	0.00350	0.00350	0.00350
$\rho_X = (0.85*f'_c/f_y)*\{1-[1-(2.6222*K_X/f'_c)]^{0.5}\} \geq 0.0018$	-	0.00187	0.00505	0.00558	0.00558	0.00582	0.00582	0.00387	0.00387	0.00410	0.00410	0.00094	0.00094	0.00094	0.00094	0.00094	0.00094	0.00094
$A_{sX} = \rho_X*L_Y*d$	cm²	30.16	81.61	90.12	90.12	93.92	93.92	62.58	62.58	66.20	66.20	29.07	29.07	29.07	29.07	29.07	29.07	29.07
Longitud de varilla = B_X - 10	cm.	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_c/2)^2]/2$	Ton-cm	**8,371.10**	**10,891.05**	**11,946.48**	**11,946.48**	**12,413.78**	**12,413.78**	**8,471.60**	**8,471.60**	**8,938.90**	**8,938.90**	**2,129.74**	**2,129.74**	**2,129.74**	**2,129.74**	**2,129.74**	**2,129.74**	**2,129.74**
$K_Y = M_{UY}/(B_X*d^2)$	Ton/cm²	0.01220	0.01587	0.01741	0.01741	0.01809	0.01809	0.01234	0.01234	0.01302	0.01302	0.00310	0.00310	0.00310	0.00310	0.00310	0.00310	0.00310
$\rho_Y = (0.85*f'_c/f_y)*\{1-[1-(2.6222*K_Y/f'_c)]^{0.5}\} \geq 0.0018$	-	0.00357	0.00471	0.00519	0.00519	0.00541	0.00541	0.00361	0.00361	0.00382	0.00382	0.00088	0.00088	0.00088	0.00088	0.00088	0.00088	0.00088
$A_{sY} = \rho_Y*B_X*d$	cm²	30.16	81.61	90.12	90.12	93.92	93.92	62.58	62.58	66.20	66.20	29.07	29.07	29.07	29.07	29.07	29.07	29.07
Longitud de varilla = L_Y - 10	cm.	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	93.92
A_{sY} Máximo	cm²	93.92
EN SENTIDO X USAR	-	**33 VARILLAS No. 6 L = 3.7 m. @ 11.56 cm.**
EN SENTIDO Y USAR	-	**33 VARILLAS No. 6 L = 3.7 m. @ 11.56 cm.**



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. F-1

INFORMACION GENERAL

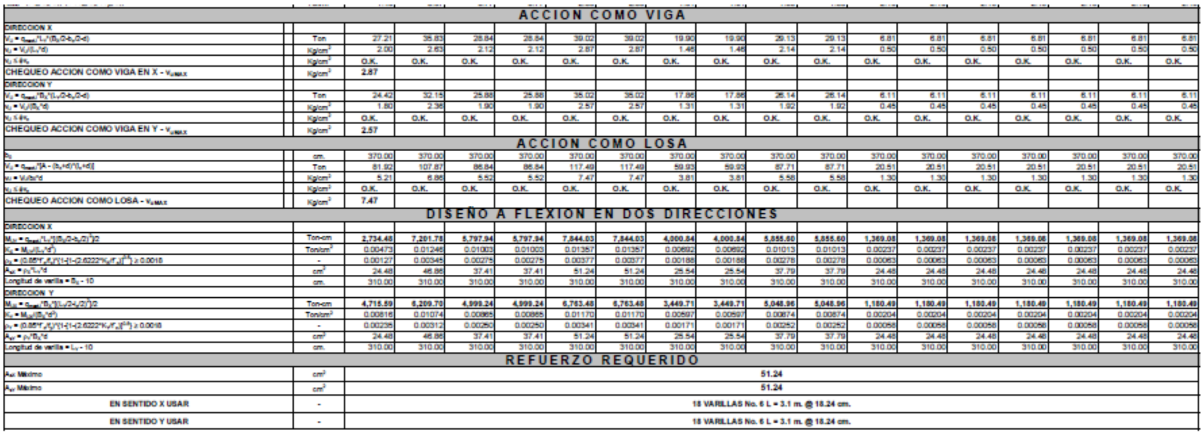
Peso unitario del concreto (γ_c)	=	2.40	Ton/m³	ϕ =	0.85	-
Peso unitario del suelo (γ_s)	=	1.80	Ton/m³	$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ =	15.52	Kg/cm²
Capacidad admisible del suelo (q_{adm})	=	9.20	Ton/m²	α_s =	20.00	-
Profundidad de desplante (D_f)	=	1.00	m.	d =	42.50	cm.
Area columnas (A_c)	=	0.24	m²	b_0 =	370.00	cm.
$b_{columna}$ (Sentido X)	=	40.00	cm.	$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ =	14.29	Kg/cm²
$l_{columna}$ (Sentido Y)	=	60.00	cm.	$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ =	13.55	Kg/cm²
β_c	=	1.50	-			
f_y	=	4,200.00	Kg/cm²	ϕv_c (como losa) =	13.55	Kg/cm²
f'_c	=	210.00	Kg/cm²	$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) =	6.53	Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
Largo zapata en el sentido Y (L_Y)	m.	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
$A_{s\,req}$ / $A_{s\,asum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54
d_b zapata	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
$l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*(A_{s\,req}/A_{s\,asum}) > 0.0043*d_b*f_y$	cm.	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89
h zapata req. $H = [l_d+d_{columna}+2*d_{zapata}+7.50]/100$	m.	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
h_z	m.	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**
d zapata = (h_z - 0.075)	m.	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Area zapata (A)	m²	10.24	10.24	10.24	10.24	10.24	10.24	10.24	10.24	10.24	10.24	10.24	10.24	10.24	10.24	10.24	10.24	10.24
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	12.29	12.29	12.29	12.29	12.29	12.29	12.29	12.29	12.29	12.29	12.29	12.29	12.29	12.29	12.29	12.29	12.29
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Fz	Ton	*15.93*	*24.60*	*22.44*	*15.93*	*16.72*	*16.72*	*17.24*	*17.24*	*23.04*	*23.04*	*23.43*	*23.43*	*10.35*	*10.35*	*10.87*	*10.87*	*0.00*
Peso total (W_t = Fz+W_z+W_s)	Ton	37.22	45.89	43.73	37.22	38.01	38.01	38.53	38.53	44.32	44.32	44.72	44.72	31.64	31.64	32.16	32.16	21.29
Mx	Ton-m	*2.42*	*4.37*	*3.88*	*2.42*	*8.46*	*8.46*	*18.92*	*18.92*	*8.48*	*8.48*	*16.38*	*16.38*	*7.50*	*7.50*	*17.95*	*17.95*	*0.00*
Fy	Ton	*-3.53*	*-6.07*	*-5.43*	*-3.53*	*-1.23*	*-1.23*	*2.77*	*2.77*	*-3.68*	*-3.68*	*-0.66*	*-0.66*	*0.18*	*0.18*	*4.18*	*4.18*	*0.00*
My	Ton-m	*-6.97*	*-11.79*	*-10.59*	*-6.97*	*-0.55*	*-0.55*	*-2.35*	*-2.35*	*-5.72*	*-5.72*	*-7.09*	*-7.09*	*2.24*	*2.24*	*0.43*	*0.43*	*0.00*
Fx	Ton	*-6.01*	*-10.18*	*-9.14*	*-6.01*	*-3.49*	*-3.49*	*-4.24*	*-4.24*	*-7.23*	*-7.23*	*-7.79*	*-7.79*	*-1.09*	*-1.09*	*-1.83*	*-1.83*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	4.19	7.40	6.60	4.19	9.08	9.08	17.54	17.54	10.32	10.32	16.71	16.71	7.41	7.41	15.86	15.86	0.00
M'y = My+ Fx*h_z	Ton-m	9.97	16.88	15.16	9.97	2.30	2.30	4.47	4.47	9.34	9.34	10.98	10.98	1.69	1.69	0.48	0.48	0.00
e_x = M'y/W_t	m.	0.27	0.37	0.35	0.27	0.06	0.06	0.12	0.12	0.21	0.21	0.25	0.25	0.05	0.05	0.02	0.02	0.00
e_y = M'x/W_t	m.	0.11	0.16	0.15	0.11	0.24	0.24	0.46	0.46	0.23	0.23	0.37	0.37	0.23	0.23	0.49	0.49	0.00
$6e_x/B_X$	-	0.50	0.69	0.65	0.50	0.11	0.11	0.22	0.22	0.40	0.40	0.46	0.46	0.10	0.10	0.03	0.03	0.00
$6e_y/L_Y$	-	0.21	0.30	0.28	0.21	0.45	0.45	0.85	0.85	0.44	0.44	0.70	0.70	0.44	0.44	0.92	0.92	0.00
$q_{max} = (W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)$	Ton/m²	**6.23**	**8.93**	**8.25**	**6.23**	**5.80**	**5.80**	**7.79**	**7.79**	**7.93**	**7.93**	**9.44**	**9.44**	**4.76**	**4.76**	**6.13**	**6.13**	**2.08**
$q_{min} = (W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)$	Ton/m²	**1.04**	**0.03**	**0.29**	**1.04**	**1.63**	**1.63**	**-0.27**	**-0.27**	**0.73**	**0.73**	**-0.70**	**-0.70**	**1.42**	**1.42**	**0.15**	**0.15**	**2.08**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fz_U	Ton	*22.31*	*32.99*	*28.92*	*28.92*	*29.66*	*29.66*	*15.47*	*15.47*	*16.21*	*16.21*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado ($W_{tU} = Fz_U+W_{zU}+W_{sU}$)	Ton	52.11	55.35	51.27	51.27	52.01	52.01	37.82	37.82	38.56	38.56	22.35	22.35	22.35	22.35	22.35	22.35	22.35
Mx_U	Ton-m	3.39	*6.02*	*13.49*	*13.49*	*28.42*	*28.42*	*10.81*	*10.81*	*25.75*	*25.75*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*-4.95*	*-8.29*	*-3.49*	*-3.49*	*2.24*	*2.24*	*0.11*	*0.11*	*5.83*	*5.83*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*-9.76*	*-16.08*	*-4.02*	*-4.02*	*-6.60*	*-6.60*	*2.90*	*2.90*	*0.32*	*0.32*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*-8.42*	*-13.88*	*-7.79*	*-7.79*	*-8.85*	*-8.85*	*-1.81*	*-1.81*	*-2.88*	*-2.88*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U = Mx_U+Fy_U*h_z$	Ton-m	5.86	10.17	15.23	15.23	29.54	29.54	10.86	10.86	28.66	28.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U+ Fx_U*h_z$	Ton-m	13.96	23.02	7.91	7.91	11.02	11.02	3.80	3.80	1.76	1.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_{tU}$	m.	0.27	0.42	0.15	0.15	0.21	0.21	0.10	0.10	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_{tU}$	m.	0.11	0.18	0.30	0.30	0.57	0.57	0.29	0.29	0.74	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.50	0.78	0.29	0.29	0.40	0.40	0.19	0.19	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.21	0.34	0.56	0.56	1.06	1.06	0.54	0.54	1.39	1.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_{tU}/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m²	8.72	11.48	9.24	9.24	12.51	12.51	6.38	6.38	9.34	9.34	2.18	2.18	2.18	2.18	2.18	2.18	2.18
$q_{minU} = (W_{tU}/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m²	1.46	-0.67	0.77	0.77	-2.36	-2.36	1.01	1.01	-1.80	-1.80	2.18	2.18	2.18	2.18	2.18	2.18	2.18



ACCION COMO VIGA

DIRECCION X																		
$V_U = q_{maxU}*L_Y*(B_X/2-b_c/2-d)$	Ton	27.21	35.83	28.84	28.84	39.02	39.02	19.90	19.90	29.13	29.13	6.81	6.81	6.81	6.81	6.81	6.81	6.81
$v_U = V_U/(L_Y*d)$	Kg/cm²	2.00	2.63	2.12	2.12	2.87	2.87	1.46	1.46	2.14	2.14	0.50	0.50	0.50	0.50	0.50	0.50	0.50
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{uMAX}	Kg/cm²	2.87																
DIRECCION Y																		
$V_U = q_{maxU}*B_X*(L_Y/2-l_c/2-d)$	Ton	24.42	32.15	25.88	25.88	35.02	35.02	17.86	17.86	26.14	26.14	6.11	6.11	6.11	6.11	6.11	6.11	6.11
$v_U = V_U/(B_X*d)$	Kg/cm²	1.80	2.36	1.90	1.90	2.57	2.57	1.31	1.31	1.92	1.92	0.45	0.45	0.45	0.45	0.45	0.45	0.45
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{uMAX}	Kg/cm²	2.57																

ACCION COMO LOSA

b_0	cm.	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00
$V_U = q_{maxU}*[A - (b_c+d)*(l_c+d)]$	Ton	81.92	107.87	86.84	86.84	117.49	117.49	59.93	59.93	87.71	87.71	20.51	20.51	20.51	20.51	20.51	20.51	20.51
$v_U = V_U/b_0*d$	Kg/cm²	5.21	6.86	5.52	5.52	7.47	7.47	3.81	3.81	5.58	5.58	1.30	1.30	1.30	1.30	1.30	1.30	1.30
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{uMAX}	Kg/cm²	7.47																

DISEÑO A FLEXION EN DOS DIRECCIONES

DIRECCION X																		
$M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_c/2)^2]/2$	Ton-cm	**2,734.48**	**7,201.78**	**5,797.94**	**5,797.94**	**7,844.03**	**7,844.03**	**4,000.84**	**4,000.84**	**5,855.60**	**5,855.60**	**1,369.08**	**1,369.08**	**1,369.08**	**1,369.08**	**1,369.08**	**1,369.08**	**1,369.08**
$K_X = M_{UX}/(L_Y*d^2)$	Ton/cm²	0.00473	0.01248	0.01003	0.01003	0.01357	0.01357	0.00692	0.00692	0.01013	0.01013	0.00237	0.00237	0.00237	0.00237	0.00237	0.00237	0.00237
$\rho_X = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_X/f'_c)]^{0.5}) \geq 0.0018$	-	0.00127	0.00345	0.00275	0.00275	0.00377	0.00377	0.00188	0.00188	0.00278	0.00278	0.00063	0.00063	0.00063	0.00063	0.00063	0.00063	0.00063
$A_{sX} = \rho_X*L_Y*d$	cm²	24.48	46.86	37.41	37.41	51.24	51.24	25.54	25.54	37.79	37.79	24.48	24.48	24.48	24.48	24.48	24.48	24.48
Longitud de varilla = B_X - 10	cm.	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_c/2)^2]/2$	Ton-cm	**4,715.59**	**6,209.70**	**4,999.24**	**4,999.24**	**6,763.48**	**6,763.48**	**3,449.71**	**3,449.71**	**5,048.96**	**5,048.96**	**1,180.49**	**1,180.49**	**1,180.49**	**1,180.49**	**1,180.49**	**1,180.49**	**1,180.49**
$K_Y = M_{UY}/(B_X*d^2)$	Ton/cm²	0.00816	0.01074	0.00865	0.00865	0.01170	0.01170	0.00597	0.00597	0.00874	0.00874	0.00204	0.00204	0.00204	0.00204	0.00204	0.00204	0.00204
$\rho_Y = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_Y/f'_c)]^{0.5}) \geq 0.0018$	-	0.00236	0.00312	0.00250	0.00250	0.00341	0.00341	0.00171	0.00171	0.00252	0.00252	0.00058	0.00058	0.00058	0.00058	0.00058	0.00058	0.00058
$A_{sY} = \rho_Y*B_X*d$	cm²	24.48	46.86	37.41	37.41	51.24	51.24	25.54	25.54	37.79	37.79	24.48	24.48	24.48	24.48	24.48	24.48	24.48
Longitud de varilla = L_Y - 10	cm.	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00	310.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	**51.24**
A_{sY} Máximo	cm²	**51.24**
EN SENTIDO X USAR	-	**18 VARILLAS No. 6 L = 3.1 m. @ 18.24 cm.**
EN SENTIDO Y USAR	-	**18 VARILLAS No. 6 L = 3.1 m. @ 18.24 cm.**

DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. F-2

INFORMACION GENERAL

Peso unitario del concreto (γ_c) = 2.40 Ton/m^3
Peso unitario del suelo (γ_s) = 1.80 Ton/m^3
Capacidad admisible del suelo (q_{adm}) = 9.20 Ton/m^2
Profundidad de desplante (D_f) = 1.00 m.
Area columnas (A_c) = 0.24 m^2
$b_{columna}$ (Sentido X) = 40.00 cm.
$l_{columna}$ (Sentido Y) = 60.00 cm.
β_c = 1.50 -
f_y = 4,200.00 Kg/cm^2
f'_c = 210.00 Kg/cm^2

ϕ = 0.85 -
$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ = 15.52 Kg/cm^2
α_s = 20.00 -
d = 52.50 cm.
b_0 = 410.00 cm.
$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ = 15.17 Kg/cm^2
$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ = 13.55 Kg/cm^2
ϕv_c (como losa) = 13.55 Kg/cm^2
$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) = 6.53 Kg/cm^2

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (Bx)	m.	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80
Largo zapata en el sentido Y (Ly)	m.	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80
$A_{s\,req}$ / $A_{s\,asum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54
d_b zapata	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
$l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*(A_{s\,req}/A_{s\,asum}) > 0.0043*d_b*f_y$	cm.	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89	58.89
h zapata req. $H = [l_d+d_{b\,columna}+2*d_{b\,zapata}+7.50]/100$	m.	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
h_z	m.	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**
d zapata = (h_z - 0.075)	m.	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
Area zapata (A)	m^2	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44	14.44
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	10.22	10.22	10.22	10.22	10.22	10.22	10.22	10.22	10.22	10.22	10.22	10.22	10.22	10.22	10.22	10.22	10.22
Fz	Ton	*26.44*	*41.89*	*38.02*	*26.44*	*27.80*	*27.80*	*28.08*	*28.08*	*39.05*	*39.05*	*39.27*	*39.27*	*17.22*	*17.22*	*17.50*	*17.50*	*0.00*
Peso total (W_t = Fz+W_z+W_s)	Ton	57.46	72.90	69.04	57.46	58.81	58.81	59.10	59.10	70.07	70.07	70.29	70.29	48.24	48.24	48.52	48.52	31.02
Mx	Ton-m	*-4.62*	*-7.71*	*-6.94*	*-4.62*	*1.52*	*1.52*	*12.09*	*12.09*	*-2.27*	*-2.27*	*5.71*	*5.71*	*3.37*	*3.37*	*13.94*	*13.94*	*0.00*
Fy	Ton	*2.76*	*4.75*	*4.25*	*2.76*	*5.15*	*5.15*	*9.26*	*9.26*	*6.07*	*6.07*	*9.17*	*9.17*	*4.04*	*4.04*	*8.15*	*8.15*	*0.00*
My	Ton-m	*-10.03*	*-17.08*	*-15.32*	*-10.03*	*-3.65*	*-3.65*	*-7.75*	*-7.75*	*-10.49*	*-10.49*	*-13.58*	*-13.58*	*0.36*	*0.36*	*-3.74*	*-3.74*	*0.00*
Fx	Ton	*-8.93*	*-15.20*	*-13.63*	*-8.93*	*-5.97*	*-5.97*	*-7.89*	*-7.89*	*-11.39*	*-11.39*	*-12.84*	*-12.84*	*-2.40*	*-2.40*	*-4.32*	*-4.32*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	6.27	10.56	9.49	6.27	1.57	1.57	6.54	6.54	5.91	5.91	0.21	0.21	0.94	0.94	9.05	9.05	0.00
M'y = My+ Fx*h_z	Ton-m	15.39	26.20	23.50	15.39	7.24	7.24	12.48	12.48	17.33	17.33	21.29	21.29	1.08	1.08	6.33	6.33	0.00
e_x = M'y/W_t	m.	0.27	0.36	0.34	0.27	0.12	0.12	0.21	0.21	0.25	0.25	0.30	0.30	0.02	0.02	0.13	0.13	0.00
e_y = M'x/W_t	m.	0.11	0.14	0.14	0.11	0.03	0.03	0.11	0.11	0.08	0.08	0.00	0.00	0.02	0.02	0.19	0.19	0.00
$6e_x/B_X$	-	0.42	0.57	0.54	0.42	0.19	0.19	0.33	0.33	0.39	0.39	0.48	0.48	0.04	0.04	0.21	0.21	0.00
$6e_y/L_Y$	-	0.17	0.23	0.22	0.17	0.04	0.04	0.17	0.17	0.13	0.13	0.00	0.00	0.03	0.03	0.29	0.29	0.00
$q_{max} = (W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)$	Ton/m^2	**6.35**	**9.07**	**8.39**	**6.35**	**5.04**	**5.04**	**6.17**	**6.17**	**7.39**	**7.39**	**7.22**	**7.22**	**3.56**	**3.56**	**5.04**	**5.04**	**2.15**
$q_{min} = (W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)$	Ton/m^2	**1.61**	**1.03**	**1.17**	**1.61**	**3.11**	**3.11**	**2.01**	**2.01**	**2.31**	**2.31**	**2.52**	**2.52**	**3.12**	**3.12**	**1.68**	**1.68**	**2.15**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fz_U	Ton	*37.01*	*56.44*	*49.11*	*49.11*	*49.52*	*49.52*	*25.74*	*25.74*	*26.14*	*26.14*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado (W_{tU} = Fz_U+W_{zU}+W_{sU})	Ton	80.44	89.01	81.68	81.68	82.09	82.09	58.30	58.30	58.71	58.71	32.57	32.57	32.57	32.57	32.57	32.57	32.57
Mx_U	Ton-m	*-6.46*	*-10.50*	*0.13*	*0.13*	*15.23*	*15.23*	*4.61*	*4.61*	*19.72*	*19.72*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*3.87*	*6.49*	*8.71*	*8.71*	*14.58*	*14.58*	*5.89*	*5.89*	*11.76*	*11.76*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*-14.04*	*-23.32*	*-9.98*	*-9.98*	*-15.83*	*-15.83*	*0.08*	*0.08*	*-5.77*	*-5.77*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*-12.50*	*-20.74*	*-12.75*	*-12.75*	*-15.49*	*-15.49*	*-3.81*	*-3.81*	*-6.55*	*-6.55*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U$ = Mx_U+Fy_U*h_z	Ton-m	8.78	14.39	5.35	5.35	23.98	23.98	8.15	8.15	26.77	26.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U$ = My_U+ Fx_U*h_z	Ton-m	21.54	35.77	17.63	17.63	25.13	25.13	2.37	2.37	9.70	9.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e_{xU} = $M'y_U/W_{tU}$	m.	0.27	0.40	0.22	0.22	0.31	0.31	0.04	0.04	0.17	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e_{yU} = $M'x_U/W_{tU}$	m.	0.11	0.16	0.07	0.07	0.29	0.29	0.14	0.14	0.46	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.42	0.63	0.34	0.34	0.48	0.48	0.06	0.06	0.26	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.17	0.26	0.10	0.10	0.46	0.46	0.22	0.22	0.72	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_{tU}/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m^2	8.89	11.65	8.17	8.17	11.06	11.06	5.19	5.19	8.05	8.05	2.26	2.26	2.26	2.26	2.26	2.26	2.26
$q_{minU} = (W_{tU}/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m^2	2.25	0.68	3.14	3.14	0.32	0.32	2.89	2.89	0.08	0.08	2.26	2.26	2.26	2.26	2.26	2.26	2.26

ACCION COMO VIGA

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$V_U = q_{maxU}*L_Y*(B_X/2-b_c/2-d)$	Ton	39.68	52.01	36.48	36.48	49.36	49.36	23.16	23.16	35.96	35.96	10.07	10.07	10.07	10.07	10.07	10.07	10.07
$v_U = V_U/(L_Y*d)$	Kg/cm^2	1.99	2.61	1.83	1.83	2.47	2.47	1.16	1.16	1.80	1.80	0.50	0.50	0.50	0.50	0.50	0.50	0.50
$v_U \leq \phi v_c$	Kg/cm^2	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - $v_{u\,MAX}$	Kg/cm^2	**2.61**																
DIRECCION Y																		
$V_U = q_{maxU}*B_X*(L_Y/2-l_c/2-d)$	Ton	38.30	47.59	33.37	33.37	45.16	45.16	21.19	21.19	32.90	32.90	9.21	9.21	9.21	9.21	9.21	9.21	9.21
$v_U = V_U/(B_X*d)$	Kg/cm^2	1.82	2.39	1.67	1.67	2.26	2.26	1.06	1.06	1.65	1.65	0.46	0.46	0.46	0.46	0.46	0.46	0.46
$v_U \leq \phi v_c$	Kg/cm^2	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - $v_{u\,MAX}$	Kg/cm^2	**2.39**																

ACCION COMO LOSA

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
b_0	cm.	410.00	410.00	410.00	410.00	410.00	410.00	410.00	410.00	410.00	410.00	410.00	410.00	410.00	410.00	410.00	410.00	410.00
$V_U = q_{maxU}*[A-(b_c+d)*(l_c+d)]$	Ton	119.08	156.09	109.47	109.47	148.12	148.12	69.50	69.50	107.91	107.91	30.22	30.22	30.22	30.22	30.22	30.22	30.22
$v_U = V_U/b_0*d$	Kg/cm^2	5.53	7.25	5.09	5.09	6.88	6.88	3.23	3.23	5.01	5.01	1.40	1.40	1.40	1.40	1.40	1.40	1.40
$v_U \leq \phi v_c$	Kg/cm^2	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - $v_{u\,MAX}$	Kg/cm^2	**7.25**																

DISEÑO A FLEXION EN DOS DIRECCIONES

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_c/2)^2]/2$	Ton-cm	**4,879.64**	**12,792.92**	**8,972.41**	**8,972.41**	**12,139.80**	**12,139.80**	**5,696.42**	**5,696.42**	**8,844.47**	**8,844.47**	**2,476.92**	**2,476.92**	**2,476.92**	**2,476.92**	**2,476.92**	**2,476.92**	**2,476.92**
$K_X = M_{UX}/(L_Y*d^2)$	Ton/cm^2	0.00466	0.01221	0.00857	0.00857	0.01159	0.01159	0.00544	0.00544	0.00844	0.00844	0.00236	0.00236	0.00236	0.00236	0.00236	0.00236	0.00236
$\rho_X = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_X/f'_c)]^{0.5}) \geq 0.0018$	-	0.00125	0.00337	0.00234	0.00234	0.00320	0.00320	0.00147	0.00147	0.00230	0.00230	0.00063	0.00063	0.00063	0.00063	0.00063	0.00063	0.00063
$A_{sX} = \rho_X*L_Y*d$	cm^2	35.91	67.33	46.63	46.63	63.75	63.75	35.91	35.91	45.95	45.95	35.91	35.91	35.91	35.91	35.91	35.91	35.91
Longitud de varilla = B_X - 10	cm.	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_c/2)^2]/2$	Ton-cm	**8,644.90**	**11,332.14**	**7,947.88**	**7,947.88**	**10,753.59**	**10,753.59**	**5,045.97**	**5,045.97**	**7,834.55**	**7,834.55**	**2,194.09**	**2,194.09**	**2,194.09**	**2,194.09**	**2,194.09**	**2,194.09**	**2,194.09**
$K_Y = M_{UY}/(B_X*d^2)$	Ton/cm^2	0.00825	0.01082	0.00759	0.00759	0.01027	0.01027	0.00482	0.00482	0.00748	0.00748	0.00209	0.00209	0.00209	0.00209	0.00209	0.00209	0.00209
$\rho_Y = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_Y/f'_c)]^{0.5}) \geq 0.0018$	-	0.00238	0.00315	0.00218	0.00218	0.00298	0.00298	0.00137	0.00137	0.00215	0.00215	0.00059	0.00059	0.00059	0.00059	0.00059	0.00059	0.00059
$A_{sY} = \rho_Y*B_X*d$	cm^2	35.91	67.33	46.63	46.63	63.75	63.75	35.91	35.91	45.95	45.95	35.91	35.91	35.91	35.91	35.91	35.91	35.91
Longitud de varilla = L_Y - 10	cm.	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00	370.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm^2	**67.33**
A_{sY} Máximo	cm^2	**67.33**
EN SENTIDO X USAR	-	**24 VARILLAS No. 6 L = 3.7 m. @ 16.09 cm.**
EN SENTIDO Y USAR	-	**24 VARILLAS No. 6 L = 3.7 m. @ 16.09 cm.**

7.4 DISEÑO DE VIGAS Y COLUMNAS

7.4.1 VIGAS

V-101 / N+ 0.00

B= 0.40 H= 0.45 L= 8.00		
Mu=-35.60 As=5.23		Mu=-34.67 As=5.23
	Mu=18.21 As=5.23	
Vu=-25.51	Vu=-0.52	Vu=25.29

V-102 / N+ 0.00

B= 0.40 H= 0.45 L= 7.90		
Mu=-150.18 As=10.92		Mu=-143.26 As=10.37
	Mu=115.69 As=8.23	
Vu=-94.80	Vu=-31.81	Vu=91.91

V-103 / N+ 0.00

B= 0.30 H= 0.45 L= 8.10		
Mu=-57.63 As=4.01		Mu=-169.66 As=13.01
	Mu=83.72 As=5.94	
Vu=-80.08	Vu=18.68	Vu=109.78

V-104 / N+ 0.00

B= 0.40 H= 0.45 L= 8.00		
Mu=-147.11 As=10.67		Mu=-135.31 As=9.74
	Mu=122.03 As=8.72	
Vu=-95.58	Vu=-32.59	Vu=91.24

V-105 / N+ 0.00

B= 0.40 H= 0.45 L= 6.24			B= 0.40 H= 0.45 L= 1.98		
Mu=-115.05 As=8.18		Mu=-119.29 As=8.51	Mu=-34.57 As=5.23		Mu=-13.60 As=5.23
	Mu=99.72 As=7.03			Mu=8.64 As=5.23	
Vu=-85.81	Vu=-39.78	Vu=86.34	Vu=-25.46	Vu=-18.77	Vu=-12.08

V-106 / N+ 0.00

B=0.30 H=0.45 L=3.66	B=0.30 H=0.45 L=3.66	B=0.30 H=0.45 L=2.28
Mu=-32.89 Mu=-14.98 As=3.92 As=3.92	Mu=-29.00 Mu=-116.01 As=3.92 As=8.46	Mu=-29.00 Mu=-116.01 As=3.92 As=8.46
Mu=56.52 As=4.09	Mu=29.00 As=3.92	Mu=29.00 As=3.92
Vu=-60.84 Vu=-25.89 Vu=22.43	Vu=22.43 Vu=63.20 Vu=86.63	Vu=22.43 Vu=63.20 Vu=86.63

V-107 / N+ 0.00

B=0.40 H=0.45 L=6.24	B=0.40 H=0.45 L=1.98
Mu=-16.17 Mu=-16.90 As=5.23 As=5.23	Mu=-13.09 Mu=-4.25 As=5.23 As=5.23
Mu=9.80 As=5.23	Mu=3.27 As=5.23
Vu=-24.83 Vu=21.21 Vu=25.06	Vu=-13.21 Vu=-6.52 Vu=5.59

V-201 / N+ 3.45

B=0.40 H=0.45 L=8.00	B=0.40 H=0.45 L=8.00	B=0.40 H=0.45 L=5.06
Mu=-30.74 Mu=-50.82 As=5.23 As=5.23	Mu=-46.90 Mu=-41.72 As=5.23 As=5.23	Mu=-35.68 Mu=-33.83 As=5.23 As=5.23
Mu=21.44 As=5.23	Mu=18.72 As=5.23	Mu=8.92 As=5.23
Vu=-22.95 Vu=5.39 Vu=27.86	Vu=-26.16 Vu=-3.98 Vu=24.74	Vu=-21.77 Vu=-7.62 Vu=21.12

B=0.40 H=0.45 L=8.69	B=0.40 H=0.45 L=8.76
Mu=-30.29 Mu=-94.10 As=5.23 As=6.61	Mu=-279.41 Mu=-268.96 As=22.39 As=21.36
Mu=23.52 As=5.23	Mu=239.19 As=18.53
Vu=-22.51 Vu=10.30 Vu=33.99	Vu=-159.81 Vu=-64.21 Vu=158.66

V-202 / N+ 3.45

B=0.40 H=0.45 L=4.50	B=0.40 H=0.45 L=4.48
Mu=-123.94 Mu=-44.85 As=8.86 As=5.23	Mu=-45.36 Mu=-92.11 As=5.23 As=6.46
Mu=144.29 As=12.27	Mu=155.98 As=12.90
Vu=-146.17 Vu=-62.58 Vu=21.02	Vu=-29.72 Vu=53.88 Vu=137.47

V-203/ N+3.45

B=0.40 H=0.45 L=8.00	B=0.40 H=0.45 L=8.00	B=0.40 H=0.45 L=5.06
Mu=-44.31 Mu=-55.18 As=5.23 As=5.23	Mu=-50.52 Mu=-45.21 As=5.23 As=5.23	Mu=-39.37 Mu=-32.27 As=5.23 As=5.23
Mu=21.87 As=5.23	Mu=20.58 As=5.23	Mu=9.84 As=5.23
Vu=-27.43 Vu=5.39 Vu=30.49	Vu=-28.81 Vu=-3.71 Vu=27.59	Vu=-24.48 Vu=-8.38 Vu=21.86

B=0.40 H=0.45 L=8.64	B=0.45 H=0.60 L=8.71
Mu=-32.75 Mu=-104.49 As=5.23 As=7.39	Mu=-552.97 Mu=-416.67 As=31.56 As=22.64
Mu=26.12 As=5.23	Mu=535.28 As=30.34
Vu=-24.10 Vu=10.80 Vu=38.16	Vu=-318.24 Vu=-151.85 Vu=288.99

V-204/ N+3.45

B=0.40 H=0.45 L=7.90	B=0.40 H=0.45 L=7.90	B=0.40 H=0.45 L=4.96
Mu=-52.48 Mu=-57.99 As=5.23 As=5.23	Mu=-45.29 Mu=-59.49 As=5.23 As=5.23	Mu=-77.65 Mu=-72.35 As=5.40 As=5.23
Mu=18.57 As=5.23	Mu=20.13 As=5.23	Mu=42.05 As=5.23
Vu=-28.63 Vu=5.24 Vu=30.33	Vu=-27.36 Vu=5.58 Vu=30.67	Vu=-61.80 Vu=-11.22 Vu=59.06

B=0.20 H=0.45 L=8.69	B=0.20 H=0.45 L=8.86
Mu=-36.68 Mu=-42.86 As=2.61 As=3.00	Mu=-53.83 Mu=-25.63 As=3.81 As=2.61
Mu=10.72 As=2.61	Mu=43.02 As=3.52
Vu=-16.09 Vu=1.99 Vu=17.80	Vu=-53.32 Vu=17.47 Vu=47.75

V-205/ N+3.45

B=0.30 H=0.45 L=5.06
Mu=-65.17 Mu=-47.65 As=4.56 As=3.92
Mu=109.23 As=7.92
Vu=-101.32 Vu=-4.85 Vu=94.90

V-206/ N+3.45

B=0.40 H=0.45 L=8.00			B=0.40 H=0.45 L=8.00			B=0.40 H=0.45 L=5.06		
Mu=-46.11		Mu=-49.72	Mu=-33.60		Mu=-55.38	Mu=-73.91		Mu=-51.96
As=5.23		As=5.23	As=5.23		As=5.23	As=5.23		As=5.23
	Mu=16.57			Mu=18.15			Mu=48.75	
	As=5.23			As=5.23			As=5.23	
Vu=-24.84	Vu=4.50	Vu=26.55	Vu=-23.70	Vu=5.64	Vu=27.41	Vu=-62.95	Vu=-13.38	Vu=52.85

V-207/ N+3.45

B=0.40 H=0.45 L=6.24			B=0.40 H=0.45 L=1.98			B=0.40 H=0.45 L=7.32		
Mu=-39.80		Mu=-36.09	Mu=-25.21		Mu=-42.12	Mu=-35.01		Mu=-43.66
As=5.23		As=5.23	As=5.23		As=5.23	As=5.23		As=5.23
	Mu=12.75			Mu=10.53			Mu=14.18	
	As=5.23			As=5.23			As=5.23	
Vu=-25.44	Vu=5.03	Vu=22.76	Vu=22.72	Vu=30.01	Vu=37.30	Vu=-22.41	Vu=4.34	Vu=24.87

V-208/ N+3.45

B=0.40 H=0.45 L=6.24			B=0.40 H=0.45 L=1.98			B=0.40 H=0.45 L=7.32		
Mu=-42.34		Mu=-35.28	Mu=-26.40		Mu=-27.93	Mu=-39.53		Mu=-41.17
As=5.23		As=5.23	As=5.23		As=5.23	As=5.23		As=5.23
	Mu=18.87			Mu=6.98			Mu=22.59	
	As=5.23			As=5.23			As=5.23	
Vu=-28.40	Vu=6.17	Vu=23.90	Vu=-23.05	Vu=17.31	Vu=25.20	Vu=-25.59	Vu=5.19	Vu=25.72

V-209/ N+3.45

B=0.40 H=0.45 L=6.24			B=0.40 H=0.45 L=1.98			B=0.40 H=0.45 L=7.32		
Mu=-97.33		Mu=-104.92	Mu=-43.33		Mu=-18.58	Mu=-37.79		Mu=-33.53
As=6.85		As=7.42	As=5.23		As=5.23	As=5.23		As=5.23
	Mu=84.27			Mu=10.83			Mu=18.60	
	As=5.89			As=5.23			As=5.23	
Vu=-74.42	Vu=-74.98	Vu=83.97	Vu=-32.76	Vu=-24.87	Vu=-16.98	Vu=-24.32	Vu=-3.79	Vu=22.92

V-210/ N+3.45

B=0.40 H=0.45 L=6.24			B=0.40 H=0.45 L=1.98			B=0.40 H=0.45 L=7.32		
Mu=-137.49		Mu=-138.70	Mu=-71.15		Mu=-18.75	Mu=-41.02		Mu=-34.83
As=9.92		As=10.01	As=5.23		As=5.23	As=5.23		As=5.23
	Mu=122.46			Mu=17.79			Mu=18.81	
	As=8.75			As=5.23			As=5.23	
Vu=-104.82	Vu=-47.19	Vu=106.34	Vu=-49.86	Vu=-41.97	Vu=-34.08	Vu=-25.29	Vu=-4.76	Vu=23.38

V-211/ N+ 3.45

B= 0.40 H= 0.45 L= 2.18			B= 0.40 H= 0.45 L= 7.32		
Mu=-0.00		Mu=-224.98	Mu=-180.41		Mu=-118.57
As=5.23		As=17.24	As=13.38		As=8.45
	Mu=0.00			Mu=93.29	
	As=5.23			As=6.55	
Vu=-71.12	Vu=-89.94	Vu=-108.75	Vu=-107.19	Vu=-33.49	Vu=89.91

V-212/ N+ 3.45

B= 0.40 H= 0.45 L= 2.43			B= 0.40 H= 0.45 L= 7.77		
Mu=-4.86		Mu=-180.90	Mu=-262.53		Mu=-72.30
As=5.23		As=13.42	As=20.73		As=5.23
	Mu=0.00			Mu=191.82	
	As=5.23			As=14.34	
Vu=-40.51	Vu=-68.23	Vu=-95.96	Vu=-178.49	Vu=-50.98	Vu=127.28

V-213/ N+ 3.45

B= 0.40 H= 0.45 L= 2.18			B= 0.40 H= 0.45 L= 7.32		
Mu=-0.00		Mu=-168.68	Mu=-255.32		Mu=-193.57
As=5.23		As=12.41	As=20.04		As=14.49
	Mu=0.00			Mu=191.35	
	As=5.23			As=14.30	
Vu=47.75	Vu=65.79	Vu=83.83	Vu=-149.81	Vu=-75.79	Vu=135.71

7.4.2 COLUMNAS

Columna A-1

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45	5.14	.45 1.00	.60	.40	29.56 4.15	-6.19 4.25	-83.76	10.26	31.65	16#5 #4 (1.1%) 16#5 #4 (1.1%)	0.17 0.28	1.43	2.26

Columna A-2

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45	3.05	.45	.60	.40	40.56 -44.92	18.57 -24.09	-89.64	24.42	26.63	16#5 (1.3%) 16#5 (1.3%)	0.19 0.22	1.26	1.57
N+0.00	1.64	.45 1.00	.60	.40	4.09 -0.46	4.99 13.60	-28.59	3.48	6.94	16#5 (1.3%) 16#5 (1.3%)	0.03 0.05	4.87	4.71

Columna B-2

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45	3.05	.45	.60	.40	26.45 38.02	23.66 11.75	-131.59	18.71	24.43	16#7 (2.6%) 16#7 (2.6%)	0.09 0.12	1.36	2.75
N+0.00	1.64	.45 1.00	.60	.40	-1.67 -0.94	8.54 -5.08	-35.56	2.69	6.19	16#7 (2.6%) 16#7 (2.6%)	0.02 0.01	8.49	8.09

Columna A-3

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45	3.05	.45	.60	.50	30.15 -113.47	-68.29 33.12	-103.19	48.67	50.50	18#6 #5 (1.5%) 18#6 #5 (1.5%)	0.19 0.34	2.59	2.16
N+0.00	1.64	.45 1.00	.60	.50	138.31 -55.85	-61.71 40.91	-331.73	94.76	70.66	18#6 #5 (1.5%) 18#6 #5 (1.5%)	0.41 0.19	4.60	3.87

Columna B-3

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45					-48.33	-27.68				18#6 #5 (1.5%)	0.15	1.53	2.20
	3.05	.45	.60	.50			-135.83	46.82	32.76				
					115.57	39.44				18#6 #5 (1.5%)	0.34		
N+0.00					-153.41	-28.51				18#6 #5 (1.5%)	0.44	4.52	4.16
	1.64	.45	.60	.50			-140.10	102.64	19.63				
		1.00			62.01	12.83				18#6 #5 (1.5%)	0.18		

Columna A-4

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45					47.42	23.91				16#4 #5 (1.1%)	0.26	1.43	2.25
	3.05	.45	.60	.40			-80.25	38.35	32.12				
					-86.84	-59.63				16#4 #5 (1.1%)	0.48		
N+0.00					110.37	89.59				16#4 #5 (1.1%)	0.59	2.23	4.25
	1.64	.45	.60	.40			-257.48	77.48	63.73				
		1.00			-54.20	-39.28				16#4 #5 (1.1%)	0.28		

Columna B-4

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45					-42.06	8.09				16#6 (1.9%)	0.16	1.39	3.64
	3.05	.45	.60	.40			-128.85	37.14	24.70				
					87.95	-7.13				16#6 (1.9%)	0.33		
N+0.00					-121.86	24.56				16#6 (1.9%)	0.46	3.46	6.54
	1.64	.45	.60	.40			-115.29	82.78	22.66				
		1.00			53.87	-9.63				16#6 (1.9%)	0.20		

Columna B-1

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45					-34.88	-20.62				16#7 #6 (2.2%)	0.13	1.59	4.14
	3.05	.45	.60	.40			-136.28	23.80	20.57				
N+0.00		1.00			48.41	19.32				16#7 #6 (2.2%)	0.17		

Columnas C-1, D-1, D-4

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45					-46.67	-14.90				16#6 (1.9%)	0.18	1.38	3.63
	3.05	.45	.60	.40			-120.26	28.80	14.37				
N+0.00		1.00			54.14	6.85				16#6 (1.9%)	0.20		

Columna E-1

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45					251.40	-101.00				18#7 #8 (2.6%)	0.54	1.28	5.28
	3.05	.45	.60	.50			-394.23	117.15	57.46				
N+0.00		1.00			-137.60	-68.77				18#7 #8 (2.6%)	0.31		

Columna F-1

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45					-321.10	-226.59				18#7 #8 (2.6%)	0.79	2.61	3.52
	3.05	.45	.60	.50			-324.61	139.59	109.32				
N+0.00		1.00			171.45	159.16				18#7 #8 (2.6%)	0.46		

Columnas C-2, D-2

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45					-38.02	13.00				16#6 #7 (2.2%)	0.14	1.21	2.45
	3.05	.45	.60	.40			-117.88	23.48	30.18				
N+0.00		1.00			44.15	-6.24				16#6 #7 (2.2%)	0.15		

Columna E-2

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45					522.62	-48.76				20#7 (2.2%)	0.69	1.23	2.47
	2.90	.60	.60	.60			-677.04	231.18	45.62				
N+0.00		1.00			-319.77	-53.59				20#7 (2.2%)	0.44		

Columna F-2

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45					-482.27	121.16				18#7 #8 (2.6%)	0.95	1.32	1.90
	2.90	.60	.60	.50			-552.87	203.22	96.03				
N+0.00		1.00			229.01	-103.44				18#7 #8 (2.6%)	0.51		

Columnas C-3, D-3

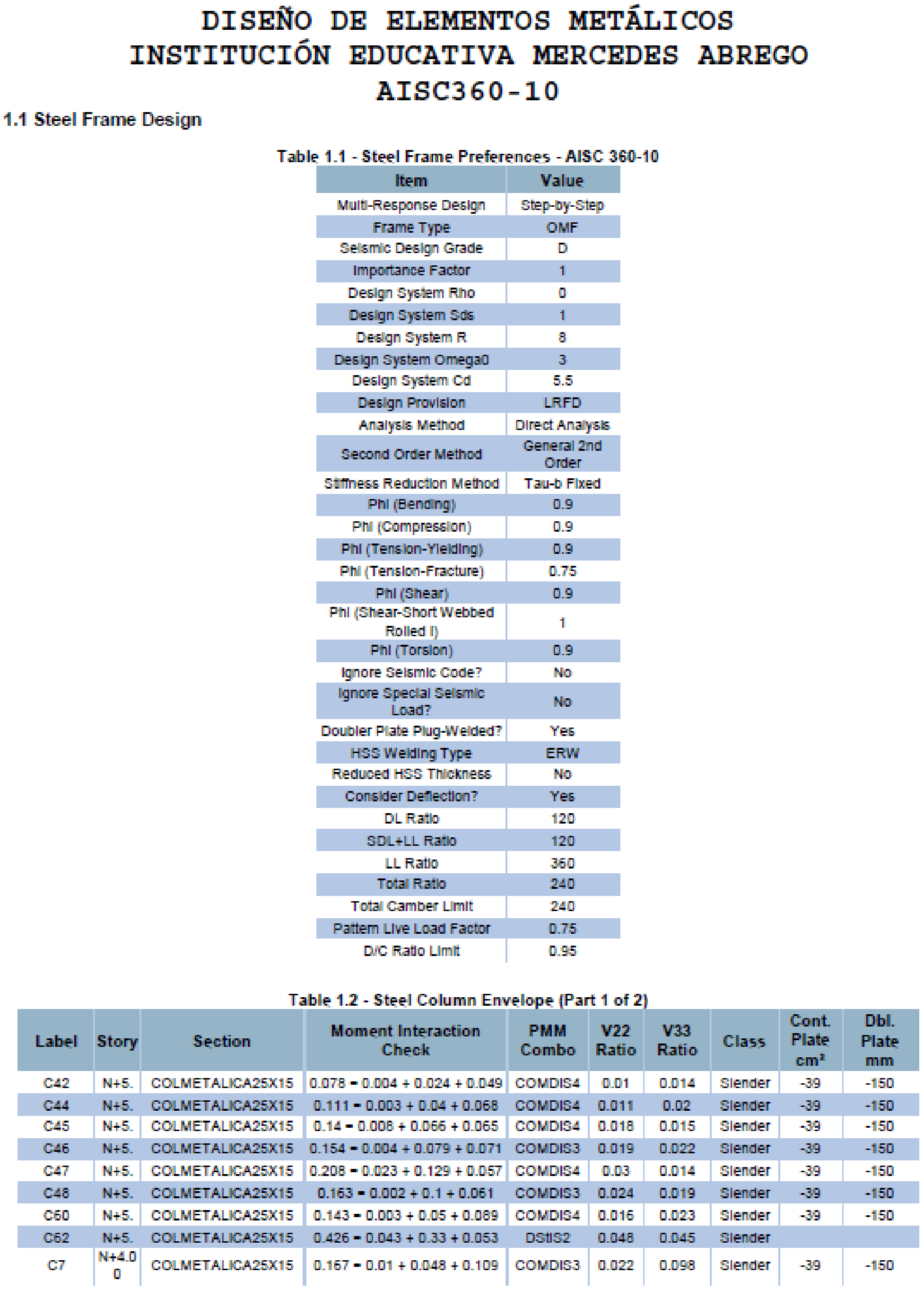
Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45					78.39	-21.82				18#6 #7 (2.0%)	0.19	2.15	2.84
	3.05	.45	.60	.50			-227.98	49.21	31.10				
N+0.00		1.00			-93.86	-12.54				18#6 #7 (2.0%)	0.21		

Columna C-4

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+3.45					70.34	52.49				16#6 #5 (1.6%)	0.31	1.24	3.23
	3.05	.45	.60	.40			-217.22	39.93	35.93				
N+0.00		1.00			-69.40	-42.82				16#6 #5 (1.6%)	0.30		

7.5 DISEÑO DE ELEMENTOS COMPLEMENTARIOS

7.5.1 DISEÑO DE ELEMENTOS METÁLICOS AISC360-2010



DISEÑO DE ELEMENTOS METÁLICOS
INSTITUCIÓN EDUCATIVA MERCEDES ABREGO
AISC360-10

1.1 Steel Frame Design

Table 1.1 - Steel Frame Preferences - AISC 360-10

Item	Value
Multi-Response Design	Step-by-Step
Frame Type	OMF
Seismic Design Grade	D
Importance Factor	1
Design System Rho	0
Design System Sds	1
Design System R	8
Design System Omega0	3
Design System Cd	5.5
Design Provision	LRFD
Analysis Method	Direct Analysis
Second Order Method	General 2nd Order
Stiffness Reduction Method	Tau-b Fixed
Phi (Bending)	0.9
Phi (Compression)	0.9
Phi (Tension-Yielding)	0.9
Phi (Tension-Fracture)	0.75
Phi (Shear)	0.9
Phi (Shear-Short Webbed Rolled I)	1
Phi (Torsion)	0.9
Ignore Seismic Code?	No
Ignore Special Seismic Load?	No
Doubler Plate Plug-Welded?	Yes
HSS Welding Type	ERW
Reduced HSS Thickness	No
Consider Deflection?	Yes
DL Ratio	120
SDL+LL Ratio	120
LL Ratio	360
Total Ratio	240
Total Camber Limit	240
Pattern Live Load Factor	0.75
D/C Ratio Limit	0.95

Table 1.2 - Steel Column Envelope (Part 1 of 2)

Label	Story	Section	Moment Interaction Check	PMM Combo	V22 Ratio	V33 Ratio	Class	Cont. Plate cm^2	Dbl. Plate mm
C42	N+5.	COLMETALICA25X15	0.078 = 0.004 + 0.024 + 0.049	COMDIS4	0.01	0.014	Slender	-39	-150
C44	N+5.	COLMETALICA25X15	0.111 = 0.003 + 0.04 + 0.068	COMDIS4	0.011	0.02	Slender	-39	-150
C45	N+5.	COLMETALICA25X15	0.14 = 0.008 + 0.066 + 0.065	COMDIS4	0.018	0.015	Slender	-39	-150
C46	N+5.	COLMETALICA25X15	0.154 = 0.004 + 0.079 + 0.071	COMDIS3	0.019	0.022	Slender	-39	-150
C47	N+5.	COLMETALICA25X15	0.208 = 0.023 + 0.129 + 0.057	COMDIS4	0.03	0.014	Slender	-39	-150
C48	N+5.	COLMETALICA25X15	0.163 = 0.002 + 0.1 + 0.061	COMDIS3	0.024	0.019	Slender	-39	-150
C60	N+5.	COLMETALICA25X15	0.143 = 0.003 + 0.05 + 0.089	COMDIS4	0.016	0.023	Slender	-39	-150
C62	N+5.	COLMETALICA25X15	0.426 = 0.043 + 0.33 + 0.053	DStlS2	0.048	0.045	Slender		
C7	N+4.00	COLMETALICA25X15	0.167 = 0.01 + 0.048 + 0.109	COMDIS3	0.022	0.098	Slender	-39	-150

Label	Story	Section	Moment Interaction Check	PMM Combo	V22 Ratio	V33 Ratio	Class	Cont. Plate cm²	Dbl. Plate mm
C8	N+4.00	COLMETALICA25X15	0.202 = 0.018 + 0.024 + 0.16	DStlS8	0.026	0.137	Slender		
C9	N+4.00	COLMETALICA25X15	0.234 = 0.015 + 0.078 + 0.14	DStlS8	0.057	0.119	Slender		
C10	N+4.00	COLMETALICA25X15	0.266 = 0.017 + 0.096 + 0.152	DStlS2	0.053	0.128	Slender		
C11	N+4.00	COLMETALICA25X15	0.899 = 0.036 + 0.294 + 0.569	DStlS2	0.098	0.398	Slender		
C13	N+4.00	COLMETALICA25X15	0.139 = 0.009 + 0.041 + 0.089	COMDIS4	0.012	0.066	Slender	-39	-150
C14	N+4.00	COLMETALICA25X15	0.172 = 0.014 + 0.051 + 0.106	COMDIS3	0.015	0.102	Slender	-39	-150
C15	N+4.00	COLMETALICA25X15	0.465 = 0.028 + 0.028 + 0.409	DStlS2	0.014	0.28	Slender		
C34	N+4.00	COLMETALICA25X15	0.141 = 0.01 + 0.032 + 0.098	COMDIS4	0.008	0.055	Slender	-39	-150
C35	N+4.00	COLMETALICA25X15	0.164 = 0.018 + 0.01 + 0.136	COMDIS4	0.004	0.09	Slender	-39	-150
C36	N+4.00	COLMETALICA25X15	0.326 = 0.031 + 0.012 + 0.284	DStlS2	0.003	0.198	Slender		
C1-1	N+4.00	COLMETALICA25X15	0.133 = 0.012 + 0.01 + 0.111	COMDIS4	0.003	0.083	Slender	-39	-150
C2-1	N+4.00	COLMETALICA25X15	0.161 = 0.02 + 0.015 + 0.126	COMDIS4	0.004	0.126	Slender	-39	-150
C3-1	N+4.00	COLMETALICA25X15	0.143 = 0.017 + 0.014 + 0.112	COMDIS4	0.004	0.109	Slender	-39	-150
C4-1	N+4.00	COLMETALICA25X15	0.16 = 0.018 + 0.017 + 0.125	COMDIS4	0.004	0.114	Slender	-39	-150
C5-1	N+4.00	COLMETALICA25X15	0.445 = 0.032 + 0.05 + 0.362	DStlS2	0.007	0.305	Slender		
C42	N+4.00	COLMETALICA25X15	0.121 = 0.005 + 0.06 + 0.057	COMDIS4	0.011	0.014	Slender	-39	-150
C44	N+4.00	COLMETALICA25X15	0.114 = 0.004 + 0.036 + 0.074	COMDIS6	0.011	0.02	Slender	-39	-150
C45	N+4.00	COLMETALICA25X15	0.124 = 0.009 + 0.066 + 0.049	COMDIS4	0.018	0.015	Slender	-39	-150
C46	N+4.00	COLMETALICA25X15	0.144 = 0.005 + 0.064 + 0.075	COMDIS4	0.019	0.022	Slender	-39	-150
C47	N+4.00	COLMETALICA25X15	0.303 = 0.023 + 0.194 + 0.086	COMDIS4	0.03	0.014	Slender	-39	-150
C48	N+4.00	COLMETALICA25X15	0.154 = 0.003 + 0.082 + 0.069	COMDIS4	0.024	0.019	Slender	-39	-150
C60	N+4.00	COLMETALICA25X15	0.146 = 0.003 + 0.058 + 0.085	COMDIS4	0.017	0.024	Slender	-39	-150
C62	N+4.00	COLMETALICA25X15	0.612 = 0.036 + 0.385 + 0.191	COMDIS4	0.048	0.045	Slender	-39	-150
C3-2	N+4.00	PERFILMETALICO25X15	3.687E-04 = 0 + 0 + 2.547E-04	COMDIS4	0.0002001	0.0004118	Non-Compact	-39	-250

Table 1.2 - Steel Column Envelope (Part 2 of 2)

Label	Story	B/C Ratio Major	B/C Ratio Minor
C42	N+5.	0	0
C44	N+5.	0	0
C45	N+5.	0	0
C46	N+5.	0	0
C47	N+5.	0	0
C48	N+5.	0	0
C60	N+5.	0	0
C62	N+5.		
C7	N+4.00	0	0
C8	N+4.00		
C9	N+4.00		
C10	N+4.00		

Label	Story	B/C Ratio Major	B/C Ratio Minor
C11	N+4.00		
C13	N+4.00	0	0
C14	N+4.00	0	0
C15	N+4.00		
C34	N+4.00	0	0
C35	N+4.00	0	0
C36	N+4.00		
C1-1	N+4.00	0	0
C2-1	N+4.00	0	0
C3-1	N+4.00	0	0
C4-1	N+4.00	0	0
C5-1	N+4.00		
C42	N+4.00	0	0
C44	N+4.00	0	0
C45	N+4.00	0	0
C46	N+4.00	0	0
C47	N+4.00	0	0
C48	N+4.00	0	0
C60	N+4.00	0	0
C62	N+4.00	0	0
C3-2	N+4.00	0	0

Table 1.3 - Steel Beam Envelope

Label	Story	Section	Moment Interaction Check	PMM Combo	V22 Ratio	V33 Ratio	Class	Conn. V I-End kN	Conn. V J-End kN
B146	N+5.85	PERFILMETALICO25X15	0.053 = 2.735E-04 + 0.035 + 0.018	COMDIS3	0.005	0.001	Non-Compact	-1.933	2.6057
B147	N+5.85	PERFILMETALICO25X15	0.046 = 0.001 + 0.025 + 0.02	COMDIS3	0.004	0.001	Non-Compact	-2.1294	2.0921
B148	N+5.85	PERFILMETALICO25X15	0.071 = 0.003 + 0.036 + 0.033	COMDIS3	0.004	0.003	Non-Compact	-1.3691	0
B149	N+5.85	PERFILMETALICO25X15	0.071 = 0.004 + 0.006 + 0.061	DStlS2	0.006	0.002	Non-Compact	-2.9097	2.1453
B150	N+5.85	PERFILMETALICO25X15	0.048 = 0.001 + 0.035 + 0.012	COMDIS3	0.005	0.001	Non-Compact	-1.9742	2.6454
B151	N+5.85	PERFILMETALICO25X15	0.046 = 0.001 + 0.034 + 0.011	COMDIS3	0.005	0.001	Non-Compact	-2.6742	0
B138	N+5.	PERFILMETALICO25X15	0.061 = 0.001 + 0.054 + 0.006	COMDIS3	0.006	0.000345	Non-Compact	-2.9751	3.7882
B139	N+5.	PERFILMETALICO25X15	0.05 = 0.002 + 0.043 + 0.005	COMDIS3	0.005	0.0002396	Non-Compact	-3.6658	3.275
B140	N+5.	PERFILMETALICO25X15	0.061 = 0.002 + 0.05 + 0.009	COMDIS3	0.005	0.0004226	Non-Compact	-2.8701	3.543
B141	N+5.	PERFILMETALICO25X15	0.057 = 0.002 + 0.043 + 0.012	COMDIS3	0.005	0.001	Non-Compact	-2.7313	3.0924
B142	N+5.	PERFILMETALICO25X15	0.062 = 0.001 + 0.046 + 0.015	COMDIS3	0.005	0.001	Non-Compact	-3.6938	4.4525
B6	N+4.00	PERFILMETALICO25X15	0.05 = 0.009 + 0.039 + 0.002	COMDIS3	0.005	0	Non-Compact	-2.3372	2.7683
B7	N+4.00	PERFILMETALICO25X15	0.036 = 0.001 + 0.032 + 0.002	COMDIS3	0.004	0.0001225	Non-Compact	-2.3253	2.4129
B8	N+4.00	PERFILMETALICO25X15	0.042 = 0.005 + 0.034 + 0.003	COMDIS3	0.004	0.0001842	Non-Compact	-2.1433	2.8159
B9	N+4.00	PERFILMETALICO25X15	0.074 = 0.01 + 0.053 + 0.011	COMDIS3	0.006	0.0003652	Non-Compact	-2.3614	2.8907
B11	N+4.00	PERFILMETALICO25X15	0.048 = 0.005 + 0.04 + 0.003	COMDIS3	0.005	0.0001374	Non-Compact	-2.5959	2.9731
B12	N+4.00	PERFILMETALICO25X15	0.039 = 0.003 + 0.033 + 0.003	COMDIS3	0.004	0.0001287	Non-Compact	-2.8075	2.7269
B14	N+3.45	PERFILMETALICO25X15	0.036 = 0 + 0.036 + 0	COMDIS3	0.005	0	Non-Compact	0	0

Label	Story	Section	Moment Interaction Check	PMM Combo	V22 Ratio	V33 Ratio	Class	Conn. V I-End kN	Conn. V J-End kN
B15	N+3.45	PERFILMETALICO25X15	0.029 = 0 + 0.029 + 0	COMDIS3	0.005	0	Non-Compact	0	0
B94	N+3.45	PERFILMETALICO25X15	0.063 = 0 + 0.063 + 0	COMDIS4	0.016	0	Non-Compact	-13.6645	0
B95	N+3.45	PERFILMETALICO25X15	0.078 = 0 + 0.078 + 0	COMDIS4	0.02	0	Non-Compact	-12.7867	0
B96	N+3.45	PERFILMETALICO25X15	0.067 = 0 + 0.067 + 0	COMDIS4	0.017	0	Non-Compact	-10.8282	0
B97	N+3.45	PERFILMETALICO25X15	0.074 = 0 + 0.074 + 0	COMDIS4	0.019	0	Non-Compact	-12.895	0
B98	N+3.45	PERFILMETALICO25X15	0.192 = 0 + 0.192 + 0	DStlS2	0.047	0	Non-Compact	-24.8196	0
B107	N+3.45	PERFILMETALICO25X15	0.063 = 0 + 0.063 + 0	COMDIS4	0.017	0	Non-Compact	-14.3672	0
B112	N+3.45	PERFILMETALICO25X15	0.166 = 0 + 0.166 + 0	DStlS2	0.041	0	Non-Compact	0	23.0391
B113	N+3.45	PERFILMETALICO25X15	0.088 = 0 + 0.088 + 0	COMDIS4	0.023	0	Non-Compact	0	15.8622
B115	N+3.45	PERFILMETALICO25X15	0.037 = 0 + 0.037 + 0	COMDIS3	0.005	0	Non-Compact	0	0
B116	N+3.45	PERFILMETALICO25X15	0.033 = 0 + 0.033 + 0	COMDIS3	0.005	0	Non-Compact	0	0
B117	N+3.45	PERFILMETALICO25X15	0.021 = 0 + 0.021 + 0	COMDIS3	0.003	0	Non-Compact	0	0
B118	N+3.45	PERFILMETALICO25X15	0.054 = 0 + 0.054 + 0	COMDIS3	0.005	0	Non-Compact	0	0

Table 1.4 - Steel Brace Envelope

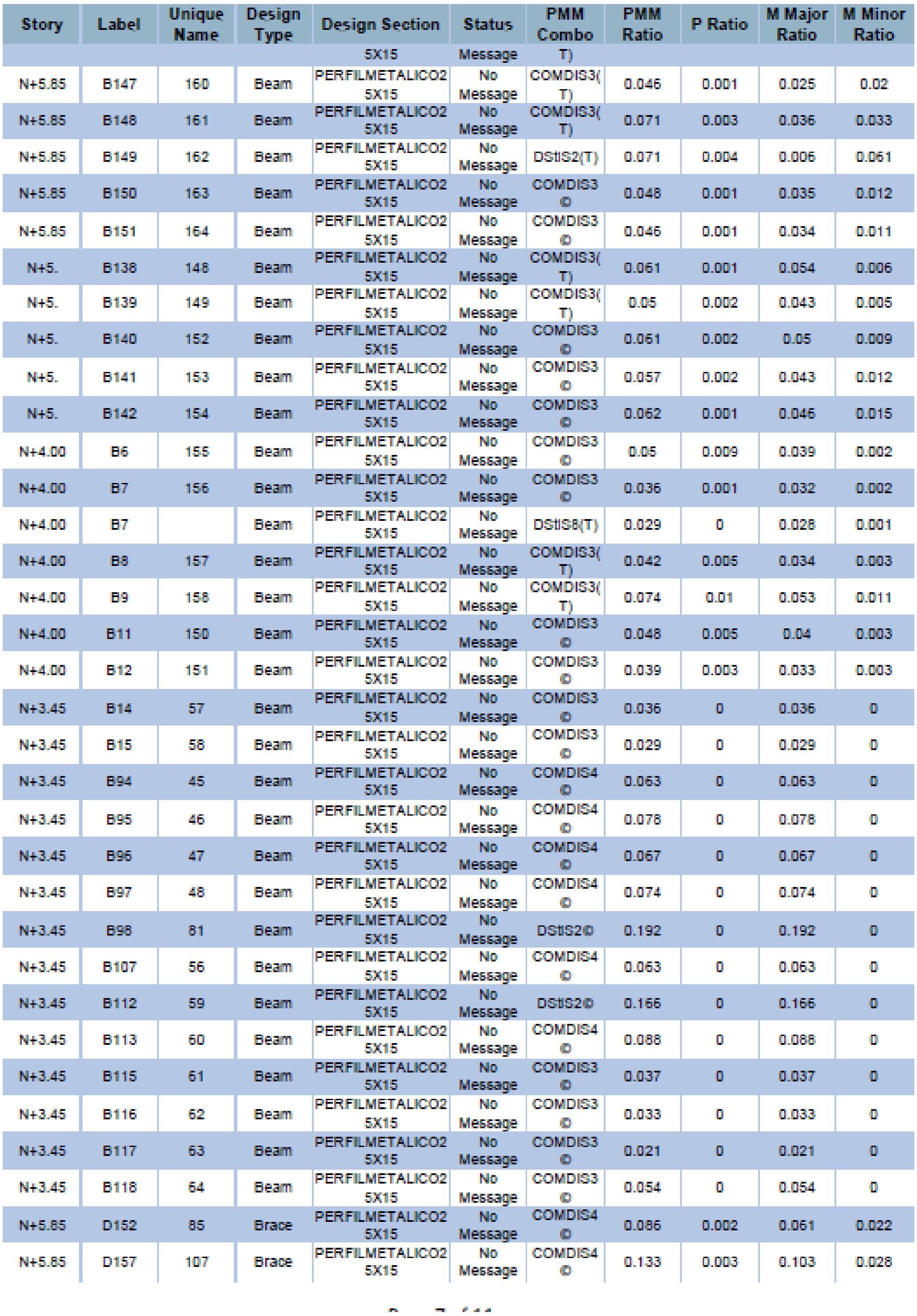
Label	Story	Section	Moment Interaction Check	PMM Combo	V22 Ratio	V33 Ratio	Class	Conn. P I-End kN	Conn. P J-End kN
D152	N+5.85	PERFILMETALICO25X15	0.086 = 0.002 + 0.061 + 0.022	COMDIS4	0.016	0.006	Non-Compact	-3.7234	-1.4512
D157	N+5.85	PERFILMETALICO25X15	0.133 = 0.003 + 0.103 + 0.028	COMDIS4	0.028	0.006	Non-Compact	-5.0769	-1.1652
D158	N+5.85	PERFILMETALICO25X15	0.158 = 0.003 + 0.101 + 0.054	DStlS2	0.026	0.019	Non-Compact	-5.1929	-1.5989
D159	N+5.85	PERFILMETALICO25X15	0.106 = 0.002 + 0.078 + 0.025	COMDIS4	0.019	0.006	Non-Compact	-4.0052	-1.7329
D160	N+5.85	PERFILMETALICO25X15	0.156 = 0.004 + 0.114 + 0.038	DStlS2	0.03	0.01	Non-Compact	-7.3181	-3.0597
D161	N+5.85	PERFILMETALICO25X15	0.265 = 0.002 + 0.07 + 0.194	DStlS2	0.018	0.036	Non-Compact	-3.3631	-0.9569
D168	N+5.85	PERFILMETALICO25X15	0.172 = 0.004 + 0.127 + 0.041	DStlS2	0.034	0.014	Non-Compact	-7.2803	-2.9477
D169	N+5.85	PERFILMETALICO25X15	0.212 = 0.005 + 0.177 + 0.029	COMDIS4	0.039	0.007	Non-Compact	-10.3868	-6.0542
D119	N+5.	PERFILMETALICO25X15	0.117 = 0.019 + 0.088 + 0.01	COMDIS4	0.021	0.001	Non-Compact	-29.2784	-25.2018
D120	N+5.	PERFILMETALICO25X15	0.13 = 0.028 + 0.098 + 0.005	COMDIS4	0.022	0.001	Non-Compact	-42.9842	-38.9076
D121	N+5.	PERFILMETALICO25X15	0.169 = 0.03 + 0.125 + 0.014	COMDIS4	0.039	0.001	Non-Compact	-46.2229	-38.4496
D122	N+5.	PERFILMETALICO25X15	0.184 = 0.039 + 0.136 + 0.008	COMDIS4	0.041	0.001	Non-Compact	-63.9479	-54.0226
D123	N+5.	PERFILMETALICO25X15	0.286 = 0.082 + 0.192 + 0.013	DStlS2	0.042	0.002	Non-Compact	-124.8744	-116.6683
D124	N+5.	PERFILMETALICO25X15	0.16 = 0.033 + 0.117 + 0.009	COMDIS4	0.034	0.001	Non-Compact	-55.1899	-46.9837
D125	N+5.	PERFILMETALICO25X15	0.17 = 0.036 + 0.128 + 0.006	COMDIS4	0.036	0.001	Non-Compact	-59.3872	-50.7648

Label	Story	Section	Moment Interaction Check	PMM Combo	V22 Ratio	V33 Ratio	Class	Conn. P I-End kN	Conn. P J-End kN
D130	N+5.	PERFILMETALICO25X15	0.554 = 0.23 + 0.254 + 0.07	DStlS2	0.044	0.011	Non-Compact	-175.8079	-170.1735
D151	N+5.	PERFILMETALICO25X15	0.114 = 0.03 + 0.079 + 0.005	COMDIS4	0.02	0.001	Non-Compact	-48.2779	-44.2012
D176	N+5.	PERFILMETALICO25X15	0.13 = 0.019 + 0.091 + 0.02	COMDIS4	0.021	0.002	Non-Compact	-32.927	-28.8503
D185	N+5.	PERFILMETALICO25X15	0.183 = 0.03 + 0.133 + 0.02	COMDIS4	0.039	0.004	Non-Compact	-52.0061	-43.4485
D186	N+5.	PERFILMETALICO25X15	0.153 = 0.041 + 0.099 + 0.013	COMDIS4	0.038	0.002	Non-Compact	-70.8572	-60.9319
D190	N+5.	PERFILMETALICO25X15	0.292 = 0.075 + 0.202 + 0.014	DStlS2	0.045	0.004	Non-Compact	-128.9776	-120.7717
D191	N+5.	PERFILMETALICO25X15	0.131 = 0.036 + 0.079 + 0.016	COMDIS4	0.031	0.003	Non-Compact	-61.8045	-53.597
D194	N+5.	PERFILMETALICO25X15	0.135 = 0.039 + 0.085 + 0.011	COMDIS4	0.032	0.002	Non-Compact	-65.3004	-56.6781
D197	N+5.	PERFILMETALICO25X15	0.362 = 0.238 + 0.111 + 0.013	DStlS2	0.031	0.001	Non-Compact	-190.0737	-184.4379
D170	N+4.00	PERFILMETALICO25X15	0.052 = 0.005 + 0.044 + 0.003	COMDIS4	0.014	0.002	Non-Compact	-10.9075	-9.676
D171	N+4.00	PERFILMETALICO25X15	0.151 = 0.027 + 0.116 + 0.008	COMDIS4	0.024	0.002	Non-Compact	-48.3373	-47.8981
D175	N+4.00	PERFILMETALICO25X15	0.052 = 0.003 + 0.037 + 0.013	COMDIS4	0.012	0.006	Non-Compact	-6.8603	-5.1896
D184	N+4.00	PERFILMETALICO25X15	0.065 = 0.002 + 0.052 + 0.01	COMDIS4	0.018	0.002	Non-Compact	-7.9352	-4.7495
D187	N+4.00	PERFILMETALICO25X15	0.077 = 0.004 + 0.064 + 0.008	COMDIS4	0.023	0.003	Non-Compact	-10.8978	-8.5495
D188	N+4.00	PERFILMETALICO25X15	0.216 = 0.041 + 0.162 + 0.013	DStlS2	0.045	0.003	Non-Compact	-71.9264	-70.8572
D189	N+4.00	PERFILMETALICO25X15	0.085 = 0.014 + 0.059 + 0.011	COMDIS4	0.016	0.004	Non-Compact	-34.2028	-30.8397
D192	N+4.00	PERFILMETALICO25X15	0.066 = 0.005 + 0.051 + 0.01	COMDIS4	0.018	0.003	Non-Compact	-10.5539	-8.61
D193	N+4.00	PERFILMETALICO25X15	0.185 = 0.033 + 0.13 + 0.022	COMDIS4	0.037	0.004	Non-Compact	-62.6887	-61.8045
D195	N+4.00	PERFILMETALICO25X15	0.067 = 0.005 + 0.055 + 0.008	COMDIS4	0.019	0.004	Non-Compact	-11.8692	-9.8282
D196	N+4.00	PERFILMETALICO25X15	0.19 = 0.035 + 0.139 + 0.015	COMDIS4	0.039	0.003	Non-Compact	-66.2293	-65.3004
D198	N+4.00	PERFILMETALICO25X15	0.099 = 0.023 + 0.029 + 0.047	COMDIS4	0.016	0.009	Non-Compact	-53.945	-52.2429
D199	N+4.00	PERFILMETALICO25X15	0.395 = 0.217 + 0.163 + 0.015	DStlS2	0.036	0.002	Non-Compact	-190.6808	-190.0737

Table 1.5 - Steel Frame Summary - AISC 360-10 (Part 1 of 2)

Story	Label	Unique Name	Design Type	Design Section	Status	PMM Combo	PMM Ratio	P Ratio	M Major Ratio	M Minor Ratio
N+5.	C42	87	Column	COLMETALICA25X15	No Message	COMDIS4©	0.078	0.004	0.024	0.049
N+5.	C42		Column	COLMETALICA25X15	No Message	COMDIS6(T)	0.075	0.002	0.031	0.042
N+5.	C44	131	Column	COLMETALICA25X15	No Message	DStlS2©	0.007	0.0001003	0.006	0.0004491
N+5.	C44		Column	COLMETALICA25X15	No Message	COMDIS4(T)	0.111	0.003	0.04	0.068
N+5.	C45	100	Column	COLMETALICA25X15	No Message	COMDIS4©	0.14	0.008	0.066	0.065
N+5.	C46	133	Column	COLMETALICA25X15	No Message	COMDIS3©	0.154	0.004	0.079	0.071
N+5.	C46		Column	COLMETALICA25X15	No Message	COMDIS5(T)	0.108	0.001	0.064	0.043
N+5.	C47	112	Column	COLMETALICA25X15	No Message	COMDIS4(T)	0.208	0.023	0.129	0.057
N+5.	C48	135	Column	COLMETALICA25X15	No Message	COMDIS3©	0.163	0.002	0.1	0.061
N+5.	C48		Column	COLMETALICA25X	No	COMDIS5(	0.118	0.001	0.08	0.036

Story	Label	Unique Name	Design Type	Design Section	Status	PMM Combo	PMM Ratio	P Ratio	M Major Ratio	M Minor Ratio
				15	Message	T)				
N+5.	C60	137	Column	COLMETALICA25X15	No Message	COMDIS4©	0.143	0.003	0.05	0.089
N+5.	C60		Column	COLMETALICA25X15	No Message	COMDIS6(T)	0.101	0.002	0.038	0.061
N+5.	C62	139	Column	COLMETALICA25X15	No Message	DStlS2(T)	0.426	0.043	0.33	0.053
N+4.00	C7	91	Column	COLMETALICA25X15	No Message	COMDIS3©	0.167	0.01	0.048	0.109
N+4.00	C8	104	Column	COLMETALICA25X15	No Message	DStlS8©	0.202	0.018	0.024	0.16
N+4.00	C9	116	Column	COLMETALICA25X15	No Message	DStlS8©	0.234	0.015	0.078	0.14
N+4.00	C10	121	Column	COLMETALICA25X15	No Message	DStlS2©	0.266	0.017	0.096	0.152
N+4.00	C11	126	Column	COLMETALICA25X15	No Message	DStlS2©	0.899	0.036	0.294	0.569
N+4.00	C13	89	Column	COLMETALICA25X15	No Message	COMDIS4©	0.139	0.009	0.041	0.089
N+4.00	C14	102	Column	COLMETALICA25X15	No Message	COMDIS3©	0.172	0.014	0.051	0.106
N+4.00	C15	114	Column	COLMETALICA25X15	No Message	DStlS2©	0.465	0.028	0.028	0.409
N+4.00	C34	88	Column	COLMETALICA25X15	No Message	COMDIS4©	0.141	0.01	0.032	0.098
N+4.00	C35	101	Column	COLMETALICA25X15	No Message	COMDIS4©	0.164	0.018	0.01	0.136
N+4.00	C36	113	Column	COLMETALICA25X15	No Message	DStlS2©	0.326	0.031	0.012	0.284
N+4.00	C1-1	94	Column	COLMETALICA25X15	No Message	COMDIS4©	0.133	0.012	0.01	0.111
N+4.00	C2-1	106	Column	COLMETALICA25X15	No Message	COMDIS4©	0.161	0.02	0.015	0.126
N+4.00	C3-1	119	Column	COLMETALICA25X15	No Message	COMDIS4©	0.143	0.017	0.014	0.112
N+4.00	C4-1	124	Column	COLMETALICA25X15	No Message	COMDIS4©	0.16	0.018	0.017	0.125
N+4.00	C5-1	129	Column	COLMETALICA25X15	No Message	DStlS2©	0.445	0.032	0.05	0.362
N+4.00	C42	86	Column	COLMETALICA25X15	No Message	COMDIS4©	0.121	0.005	0.06	0.057
N+4.00	C42		Column	COLMETALICA25X15	No Message	COMDIS5(T)	0.046	0.001	0.026	0.019
N+4.00	C44	130	Column	COLMETALICA25X15	No Message	DStlS2©	0.019	0.0001951	0.003	0.015
N+4.00	C44		Column	COLMETALICA25X15	No Message	COMDIS6(T)	0.114	0.004	0.036	0.074
N+4.00	C45	99	Column	COLMETALICA25X15	No Message	COMDIS4©	0.124	0.009	0.066	0.049
N+4.00	C46	132	Column	COLMETALICA25X15	No Message	COMDIS4©	0.144	0.005	0.064	0.075
N+4.00	C47	111	Column	COLMETALICA25X15	No Message	COMDIS4(T)	0.303	0.023	0.194	0.086
N+4.00	C48	134	Column	COLMETALICA25X15	No Message	COMDIS4©	0.154	0.003	0.082	0.069
N+4.00	C48		Column	COLMETALICA25X15	No Message	COMDIS6(T)	0.116	0.002	0.059	0.055
N+4.00	C60	136	Column	COLMETALICA25X15	No Message	COMDIS4©	0.146	0.003	0.058	0.085
N+4.00	C60		Column	COLMETALICA25X15	No Message	COMDIS6(T)	0.108	0.002	0.038	0.068
N+4.00	C62	138	Column	COLMETALICA25X15	No Message	COMDIS4(T)	0.612	0.036	0.385	0.191
N+4.00	C3-2	170	Column	PERFILMETALICO25X15	No Message	COMDIS4©	0.0003687	0	0	0.0002547
N+4.00	C3-2		Column	PERFILMETALICO25X15	No Message	DStlS14(T)	0	0	0	0
N+5.85	B146	159	Beam	PERFILMETALICO2	No	COMDIS3(	0.053	0.0002735	0.035	0.018



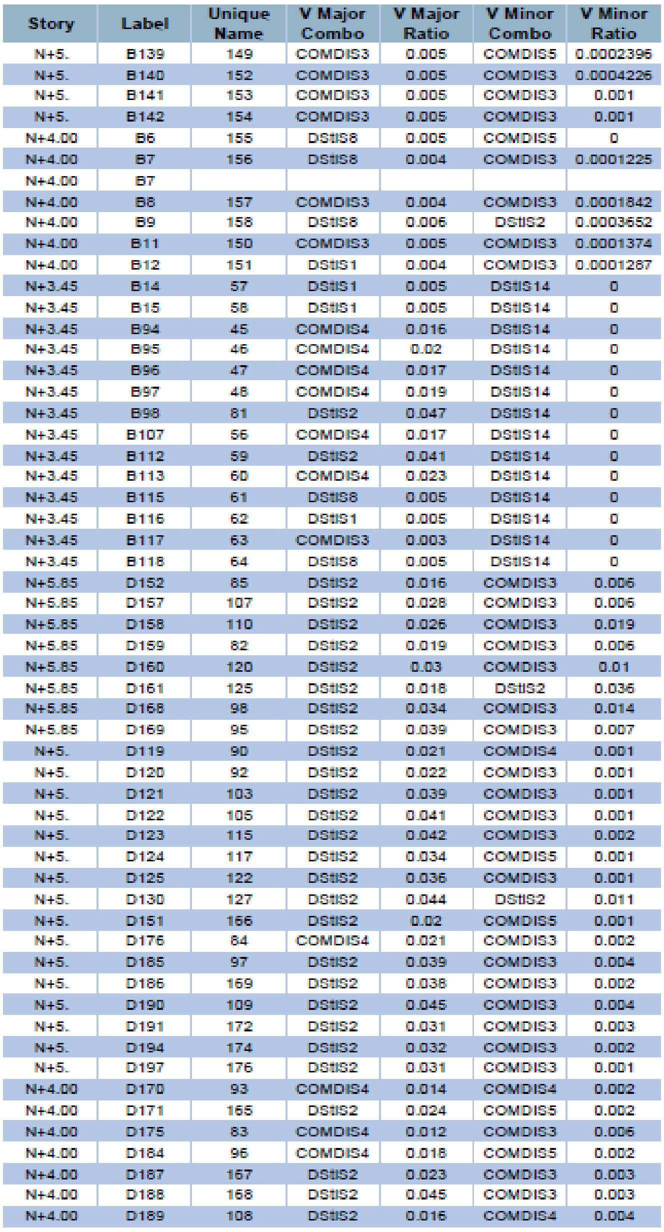
Story	Label	Unique Name	Design Type	Design Section	Status	PMM Combo	PMM Ratio	P Ratio	M Major Ratio	M Minor Ratio
				5X15	Message	T)				
N+5.85	B147	160	Beam	PERFILMETALICO25X15	No Message	COMDIS3(T)	0.046	0.001	0.025	0.02
N+5.85	B148	161	Beam	PERFILMETALICO25X15	No Message	COMDIS3(T)	0.071	0.003	0.036	0.033
N+5.85	B149	162	Beam	PERFILMETALICO25X15	No Message	DStlS2(T)	0.071	0.004	0.006	0.061
N+5.85	B150	163	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.048	0.001	0.035	0.012
N+5.85	B151	164	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.046	0.001	0.034	0.011
N+5.	B138	148	Beam	PERFILMETALICO25X15	No Message	COMDIS3(T)	0.061	0.001	0.054	0.006
N+5.	B139	149	Beam	PERFILMETALICO25X15	No Message	COMDIS3(T)	0.05	0.002	0.043	0.005
N+5.	B140	152	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.061	0.002	0.05	0.009
N+5.	B141	153	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.057	0.002	0.043	0.012
N+5.	B142	154	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.062	0.001	0.046	0.015
N+4.00	B6	155	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.05	0.009	0.039	0.002
N+4.00	B7	156	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.036	0.001	0.032	0.002
N+4.00	B7		Beam	PERFILMETALICO25X15	No Message	DStlS8(T)	0.029	0	0.028	0.001
N+4.00	B8	157	Beam	PERFILMETALICO25X15	No Message	COMDIS3(T)	0.042	0.005	0.034	0.003
N+4.00	B9	158	Beam	PERFILMETALICO25X15	No Message	COMDIS3(T)	0.074	0.01	0.053	0.011
N+4.00	B11	150	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.048	0.005	0.04	0.003
N+4.00	B12	151	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.039	0.003	0.033	0.003
N+3.45	B14	57	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.036	0	0.036	0
N+3.45	B15	58	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.029	0	0.029	0
N+3.45	B94	45	Beam	PERFILMETALICO25X15	No Message	COMDIS4©	0.063	0	0.063	0
N+3.45	B95	46	Beam	PERFILMETALICO25X15	No Message	COMDIS4©	0.078	0	0.078	0
N+3.45	B96	47	Beam	PERFILMETALICO25X15	No Message	COMDIS4©	0.067	0	0.067	0
N+3.45	B97	48	Beam	PERFILMETALICO25X15	No Message	COMDIS4©	0.074	0	0.074	0
N+3.45	B98	81	Beam	PERFILMETALICO25X15	No Message	DStlS2©	0.192	0	0.192	0
N+3.45	B107	56	Beam	PERFILMETALICO25X15	No Message	COMDIS4©	0.063	0	0.063	0
N+3.45	B112	59	Beam	PERFILMETALICO25X15	No Message	DStlS2©	0.166	0	0.166	0
N+3.45	B113	60	Beam	PERFILMETALICO25X15	No Message	COMDIS4©	0.088	0	0.088	0
N+3.45	B115	61	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.037	0	0.037	0
N+3.45	B116	62	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.033	0	0.033	0
N+3.45	B117	63	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.021	0	0.021	0
N+3.45	B118	64	Beam	PERFILMETALICO25X15	No Message	COMDIS3©	0.054	0	0.054	0
N+5.85	D152	85	Brace	PERFILMETALICO25X15	No Message	COMDIS4©	0.086	0.002	0.061	0.022
N+5.85	D157	107	Brace	PERFILMETALICO25X15	No Message	COMDIS4©	0.133	0.003	0.103	0.028

Story	Label	Unique Name	Design Type	Design Section	Status	PMM Combo	PMM Ratio	P Ratio	M Major Ratio	M Minor Ratio
N+5.85	D158	110	Brace	PERFILMETALICO2 5X15	No Message	DStlS2©	0.158	0.003	0.101	0.054
N+5.85	D159	82	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.106	0.002	0.078	0.025
N+5.85	D160	120	Brace	PERFILMETALICO2 5X15	No Message	DStlS2©	0.156	0.004	0.114	0.038
N+5.85	D161	125	Brace	PERFILMETALICO2 5X15	No Message	DStlS2©	0.265	0.002	0.07	0.194
N+5.85	D168	98	Brace	PERFILMETALICO2 5X15	No Message	DStlS2©	0.172	0.004	0.127	0.041
N+5.85	D169	95	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.212	0.005	0.177	0.029
N+5.	D119	90	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.117	0.019	0.088	0.01
N+5.	D120	92	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.13	0.028	0.098	0.005
N+5.	D121	103	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.169	0.03	0.125	0.014
N+5.	D122	105	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.184	0.039	0.136	0.008
N+5.	D123	115	Brace	PERFILMETALICO2 5X15	No Message	DStlS2©	0.286	0.082	0.192	0.013
N+5.	D124	117	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.16	0.033	0.117	0.009
N+5.	D125	122	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.17	0.036	0.128	0.006
N+5.	D130	127	Brace	PERFILMETALICO2 5X15	No Message	DStlS2©	0.554	0.23	0.254	0.07
N+5.	D151	166	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.114	0.03	0.079	0.005
N+5.	D176	84	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.13	0.019	0.091	0.02
N+5.	D185	97	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.183	0.03	0.133	0.02
N+5.	D186	169	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.153	0.041	0.099	0.013
N+5.	D190	109	Brace	PERFILMETALICO2 5X15	No Message	DStlS2©	0.292	0.075	0.202	0.014
N+5.	D191	172	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.131	0.036	0.079	0.016
N+5.	D194	174	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.135	0.039	0.085	0.011
N+5.	D197	176	Brace	PERFILMETALICO2 5X15	No Message	DStlS2©	0.362	0.238	0.111	0.013
N+4.00	D170	93	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.052	0.005	0.044	0.003
N+4.00	D171	165	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.151	0.027	0.116	0.008
N+4.00	D175	83	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.052	0.003	0.037	0.013
N+4.00	D184	96	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.065	0.002	0.052	0.01
N+4.00	D187	167	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.077	0.004	0.064	0.008
N+4.00	D188	168	Brace	PERFILMETALICO2 5X15	No Message	DStlS2©	0.216	0.041	0.162	0.013
N+4.00	D189	108	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.085	0.014	0.059	0.011
N+4.00	D192	118	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.066	0.005	0.051	0.01
N+4.00	D193	171	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.185	0.033	0.13	0.022
N+4.00	D195	123	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.067	0.005	0.055	0.008
N+4.00	D196	173	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.19	0.035	0.139	0.015
N+4.00	D198	128	Brace	PERFILMETALICO2 5X15	No Message	COMDIS4©	0.099	0.023	0.029	0.047

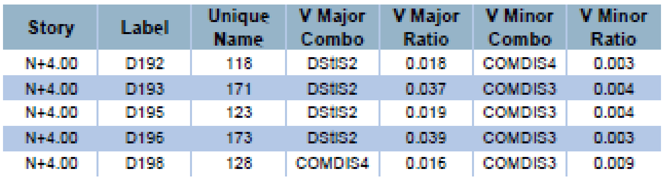
Story	Label	Unique Name	Design Type	Design Section	Status	PMM Combo	PMM Ratio	P Ratio	M Major Ratio	M Minor Ratio
N+4.00	D199	175	Brace	PERFILMETALICO2 5X15	No Message	DStlS2©	0.395	0.217	0.163	0.015

Table 1.5 - Steel Frame Summary - AISC 360-10 (Part 2 of 2)

Story	Label	Unique Name	V Major Combo	V Major Ratio	V Minor Combo	V Minor Ratio
N+5.	C42	87	COMDIS3	0.01	COMDIS4	0.014
N+5.	C42					
N+5.	C44	131	COMDIS5	0.011	COMDIS4	0.02
N+5.	C44					
N+5.	C45	100	COMDIS3	0.018	COMDIS4	0.015
N+5.	C46	133	COMDIS3	0.019	COMDIS4	0.022
N+5.	C46					
N+5.	C47	112	COMDIS3	0.03	COMDIS4	0.014
N+5.	C48	135	COMDIS3	0.024	COMDIS4	0.019
N+5.	C48					
N+5.	C60	137	COMDIS3	0.016	COMDIS4	0.023
N+5.	C60					
N+5.	C62	139	DStlS2	0.048	COMDIS4	0.045
N+4.00	C7	91	COMDIS3	0.022	COMDIS4	0.098
N+4.00	C8	104	COMDIS3	0.026	DStlS2	0.137
N+4.00	C9	116	COMDIS3	0.057	DStlS2	0.119
N+4.00	C10	121	DStlS2	0.053	DStlS2	0.128
N+4.00	C11	126	DStlS2	0.098	DStlS2	0.398
N+4.00	C13	89	COMDIS5	0.012	COMDIS4	0.066
N+4.00	C14	102	COMDIS3	0.015	COMDIS4	0.102
N+4.00	C15	114	DStlS1	0.014	DStlS2	0.28
N+4.00	C34	88	COMDIS4	0.008	COMDIS4	0.055
N+4.00	C35	101	COMDIS4	0.004	DStlS2	0.09
N+4.00	C36	113	COMDIS3	0.003	DStlS2	0.198
N+4.00	C1-1	94	COMDIS3	0.003	COMDIS4	0.083
N+4.00	C2-1	106	COMDIS4	0.004	DStlS2	0.126
N+4.00	C3-1	119	COMDIS3	0.004	DStlS2	0.109
N+4.00	C4-1	124	COMDIS4	0.004	DStlS2	0.114
N+4.00	C5-1	129	COMDIS4	0.007	DStlS2	0.305
N+4.00	C42	86	COMDIS3	0.011	COMDIS4	0.014
N+4.00	C42					
N+4.00	C44	130	COMDIS5	0.011	COMDIS4	0.02
N+4.00	C44					
N+4.00	C45	99	COMDIS3	0.018	COMDIS4	0.015
N+4.00	C46	132	COMDIS3	0.019	COMDIS4	0.022
N+4.00	C47	111	COMDIS3	0.03	COMDIS4	0.014
N+4.00	C48	134	COMDIS3	0.024	COMDIS4	0.019
N+4.00	C48					
N+4.00	C60	136	COMDIS3	0.017	COMDIS4	0.024
N+4.00	C60					
N+4.00	C62	138	DStlS2	0.048	COMDIS4	0.045
N+4.00	C3-2	170	COMDIS3	0.0002001	COMDIS6	0.0004118
N+4.00	C3-2					
N+5.85	B146	159	DStlS8	0.005	COMDIS3	0.001
N+5.85	B147	160	DStlS1	0.004	COMDIS3	0.001
N+5.85	B148	161	DStlS8	0.004	COMDIS3	0.003
N+5.85	B149	162	DStlS8	0.006	DStlS2	0.002
N+5.85	B150	163	DStlS8	0.005	COMDIS3	0.001
N+5.85	B151	164	DStlS8	0.005	COMDIS5	0.001
N+5.	B138	148	COMDIS3	0.006	COMDIS3	0.000345

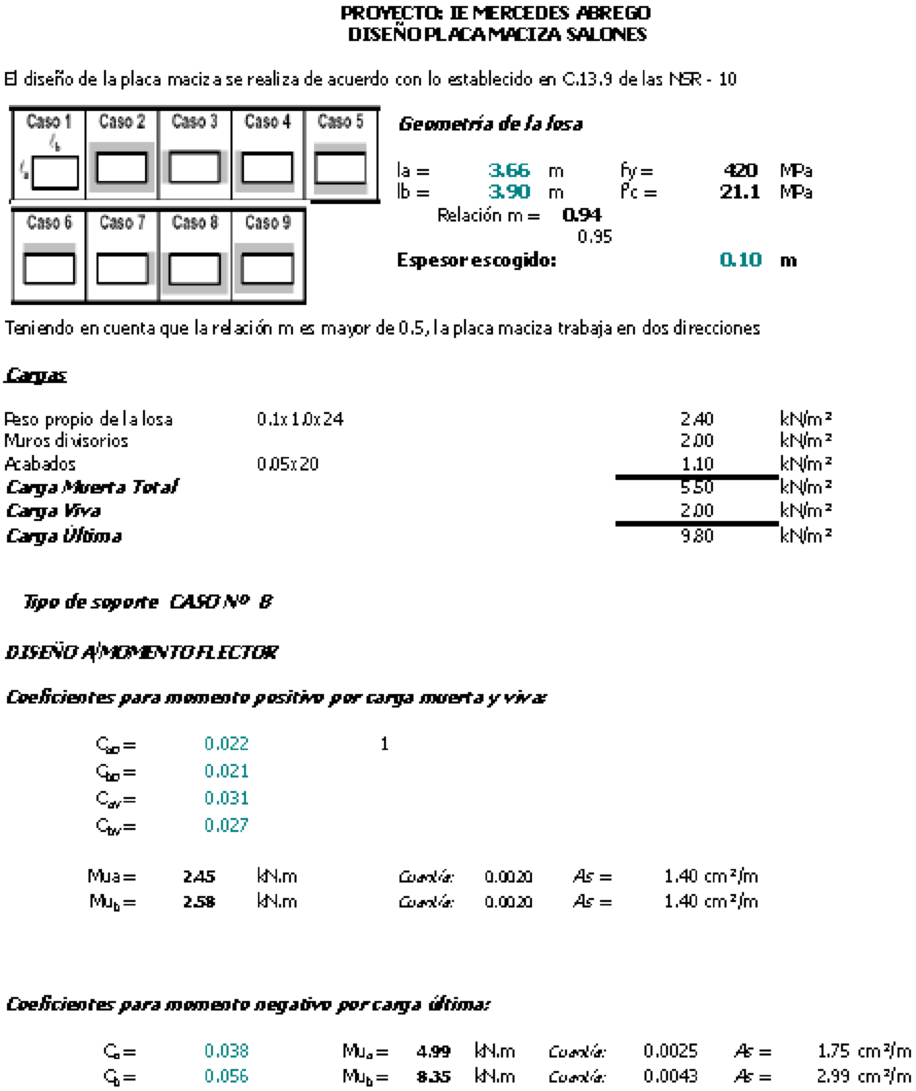


Story	Label	Unique Name	V Major Combo	V Major Ratio	V Minor Combo	V Minor Ratio
N+5.	B139	149	COMDIS3	0.005	COMDIS5	0.0002396
N+5.	B140	152	COMDIS3	0.005	COMDIS3	0.0004226
N+5.	B141	153	COMDIS3	0.005	COMDIS3	0.001
N+5.	B142	154	COMDIS3	0.005	COMDIS3	0.001
N+4.00	B6	155	DStlS8	0.005	COMDIS5	0
N+4.00	B7	156	DStlS8	0.004	COMDIS3	0.0001225
N+4.00	B7					
N+4.00	B8	157	COMDIS3	0.004	COMDIS3	0.0001842
N+4.00	B9	158	DStlS8	0.006	DStlS2	0.0003652
N+4.00	B11	150	COMDIS3	0.005	COMDIS3	0.0001374
N+4.00	B12	151	DStlS1	0.004	COMDIS3	0.0001287
N+3.45	B14	57	DStlS1	0.005	DStlS14	0
N+3.45	B15	58	DStlS1	0.005	DStlS14	0
N+3.45	B94	45	COMDIS4	0.016	DStlS14	0
N+3.45	B95	46	COMDIS4	0.02	DStlS14	0
N+3.45	B96	47	COMDIS4	0.017	DStlS14	0
N+3.45	B97	48	COMDIS4	0.019	DStlS14	0
N+3.45	B98	81	DStlS2	0.047	DStlS14	0
N+3.45	B107	56	COMDIS4	0.017	DStlS14	0
N+3.45	B112	59	DStlS2	0.041	DStlS14	0
N+3.45	B113	60	COMDIS4	0.023	DStlS14	0
N+3.45	B115	61	DStlS8	0.005	DStlS14	0
N+3.45	B116	62	DStlS1	0.005	DStlS14	0
N+3.45	B117	63	COMDIS3	0.003	DStlS14	0
N+3.45	B118	64	DStlS8	0.005	DStlS14	0
N+5.85	D152	85	DStlS2	0.016	COMDIS3	0.006
N+5.85	D157	107	DStlS2	0.028	COMDIS3	0.006
N+5.85	D158	110	DStlS2	0.026	COMDIS3	0.019
N+5.85	D159	82	DStlS2	0.019	COMDIS3	0.006
N+5.85	D160	120	DStlS2	0.03	COMDIS3	0.01
N+5.85	D161	125	DStlS2	0.018	DStlS2	0.036
N+5.85	D168	98	DStlS2	0.034	COMDIS3	0.014
N+5.85	D169	95	DStlS2	0.039	COMDIS3	0.007
N+5.	D119	90	DStlS2	0.021	COMDIS4	0.001
N+5.	D120	92	DStlS2	0.022	COMDIS3	0.001
N+5.	D121	103	DStlS2	0.039	COMDIS3	0.001
N+5.	D122	105	DStlS2	0.041	COMDIS3	0.001
N+5.	D123	115	DStlS2	0.042	COMDIS3	0.002
N+5.	D124	117	DStlS2	0.034	COMDIS5	0.001
N+5.	D125	122	DStlS2	0.036	COMDIS3	0.001
N+5.	D130	127	DStlS2	0.044	DStlS2	0.011
N+5.	D151	166	DStlS2	0.02	COMDIS5	0.001
N+5.	D176	84	COMDIS4	0.021	COMDIS3	0.002
N+5.	D185	97	DStlS2	0.039	COMDIS3	0.004
N+5.	D186	169	DStlS2	0.038	COMDIS3	0.002
N+5.	D190	109	DStlS2	0.045	COMDIS3	0.004
N+5.	D191	172	DStlS2	0.031	COMDIS3	0.003
N+5.	D194	174	DStlS2	0.032	COMDIS3	0.002
N+5.	D197	176	DStlS2	0.031	COMDIS3	0.001
N+4.00	D170	93	COMDIS4	0.014	COMDIS4	0.002
N+4.00	D171	165	DStlS2	0.024	COMDIS5	0.002
N+4.00	D175	83	COMDIS4	0.012	COMDIS3	0.006
N+4.00	D184	96	COMDIS4	0.018	COMDIS5	0.002
N+4.00	D187	167	DStlS2	0.023	COMDIS3	0.003
N+4.00	D188	168	DStlS2	0.045	COMDIS3	0.003
N+4.00	D189	108	DStlS2	0.016	COMDIS4	0.004



Story	Label	Unique Name	V Major Combo	V Major Ratio	V Minor Combo	V Minor Ratio
N+4.00	D192	118	DStlS2	0.018	COMDIS4	0.003
N+4.00	D193	171	DStlS2	0.037	COMDIS3	0.004
N+4.00	D195	123	DStlS2	0.019	COMDIS3	0.004
N+4.00	D196	173	DStlS2	0.039	COMDIS3	0.003
N+4.00	D198	128	COMDIS4	0.016	COMDIS3	0.009

7.5.2 DISEÑO DE PLACA MACIZAS



PROYECTO: IE MERCEDES ABREGO
DISEÑO PLACA MACIZA SALONES

El diseño de la placa maciza se realiza de acuerdo con lo establecido en C.13.9 de las NSR - 10

Caso 1
ℓ_b
ℓ_a
Caso 2
Caso 3
Caso 4
Caso 5
Caso 6
Caso 7
Caso 8
Caso 9

Geometría de la losa

la =	3.66	m	fy =	420	MPa
lb =	3.90	m	f'c =	21.1	MPa

Relación m = **0.94**
0.95

Espesor escogido: **0.10** **m**

Teniendo en cuenta que la relación m es mayor de 0.5, la placa maciza trabaja en dos direcciones

Cargas

Peso propio de la losa	0.1x1.0x24	2.40	kN/m²
Muros divisorios		2.00	kN/m²
Acabados	0.05x20	1.10	kN/m²
Carga Muerta Total		5.50	kN/m²
Carga Viva		2.00	kN/m²
Carga Última		9.80	kN/m²

Tipo de soporte CASO Nº 8

DISEÑO A MOMENTO FLECTOR

Coeficientes para momento positivo por carga muerta y viva:

C_{ad} = 0.022 1
C_{bd} = 0.021
C_{av} = 0.031
C_{bv} = 0.027

Mua =	**2.45**	kN.m	*Cuantía:*	0.0020	*As =*	1.40 cm²/m
Mu_b =	**2.58**	kN.m	*Cuantía:*	0.0020	*As =*	1.40 cm²/m

Coeficientes para momento negativo por carga última:

C_a =	0.038	Mu_a =	**4.99**	kN.m	*Cuantía:*	0.0025	*As =*	1.75 cm²/m
C_b =	0.056	Mu_b =	**8.35**	kN.m	*Cuantía:*	0.0043	*As =*	2.99 cm²/m

Distribución de refuerzo inferior:

Sentido La *1#3c/0.2*

Sentido Lb *1#3c/0.2*

Distribución de refuerzo superior:

Sentido La *1#3c/0.2*

Sentido Lb *1#3c/0.2*

REVISIÓN A CORTANTE

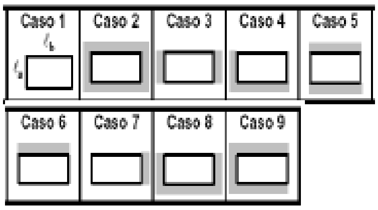
Coeficientes de relación de carga en las dos direcciones para cortante:

$W_a =$ 0.61
$W_b =$ 0.39

$\phi vc =$ **0.574 MPa**
$\phi vu_a =$ **0.117 MPa** **OK**
$\phi vu_b =$ **0.070 MPa** **OK**

PROYECTO: IE MERCEDES ABREGO
DISEÑO PLACA MACIZA CUBIERTA

El diseño de la placa maciza se realiza de acuerdo con lo establecido en C.13.9 de las NSR - 10



Geometría de la losa

la = **3.66** m fy = **420** MPa
lb = **4.28** m f'c = **21.1** MPa
Relación m = **0.86**
0.85

Espesor escogido: . **0.15** **m**

Teniendo en cuenta que la relación m es mayor de 0.5, la placa maciza trabaja en dos direcciones

Cargas

Peso propio de la losa	0.15x1.0x24	3.60	kN/m²
Muros divisorios		0.00	kN/m²
Acabados	0.05x20	1.10	kN/m²
Carga Muerta Total		4.70	kN/m²
Carga Viva		5.00	kN/m²
Carga Última		13.64	kN/m²

Tipo de soporte CASO Nº 3

DISEÑO A MOMENTO FLECTOR

Coeficientes para momento positivo por carga muerta y viva:

C_{aD} = 0.029
C_{bD} = 0.022
C_{aV} = 0.040
C_{bV} = 0.024

Mua =	**4.50**	kN.m	*Cuantía:*	0.0020	*As =*	2.40	cm²/m
Mu_b =	**4.09**	kN.m	*Cuantía:*	0.0020	*As =*	2.40	cm²/m

Coeficientes para momento negativo por carga última:

C_a =	0.000	Mu_a =	**0.00**	kN.m	*Cuantía:*	0.0020	*As =*	2.40	cm²/m
C_b =	0.065	Mu_b =	**16.24**	kN.m	*Cuantía:*	0.0028	*As =*	3.33	cm²/m

Distribución de refuerzo inferior:

Sentido La *1#4c/0.2*

Sentido Lb *1#4c/0.2*

Distribución de refuerzo superior:

Sentido La *1#4c/0.2*

Sentido Lb *1#4c/0.2*

REVISIÓN A CORTANTE

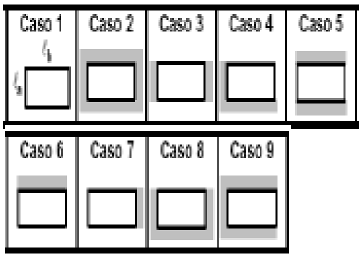
Coeficientes de relación de carga en las dos direcciones para cortante:

$W_a =$ 0.39
$W_b =$ 0.61

$\phi vc =$ **0.574** **MPa**
$\phi vu_a =$ **0.076** **MPa** **OK**
$\phi vu_b =$ **0.102** **MPa** **OK**

PROYECTO I.E. MERCEDES ABREGO
DISEÑO PLACA MACIZA PASILLOS

El diseño de la placa maciza se realiza de acuerdo con lo establecido en C.13.9 de las NSR - 10



Geometría de la losa

la = **2.28** m Fy = **420** MPa
lb = **8.10** m F'c = **21.1** MPa
Relación m = **0.3**

h = l/20 (0.4+Fy/700) = 0.11 m

Espesor escogido: 0.10 m

Teniendo en cuenta que la relación m es menor de 0.5, la placa maciza trabaja en una dirección

Cargas

Peso propio de la losa	0.1x1.0x24	2.40	kN/m²
Muros divisorios		0.00	kN/m²
Acabados	0.05x20	1.10	kN/m²
Carga Muerta Total		3.50	kN/m²
Carga Viva		5.00	kN/m²
Carga Última		12.20	kN/m²

DISEÑO A MOMENTO FLECTOR

Mu_a =	7.93	kNm	Cuantía:	0.0040	As =	2.83	cm²/m	***Transversal***
			Cuantía:	0.0018	As =	1.26	cm²/m	***Longitudinal***

Distribución de refuerzo:

1#3 c/ 0.2 Transversal
1#3 c/ 0.2 Longitudinal

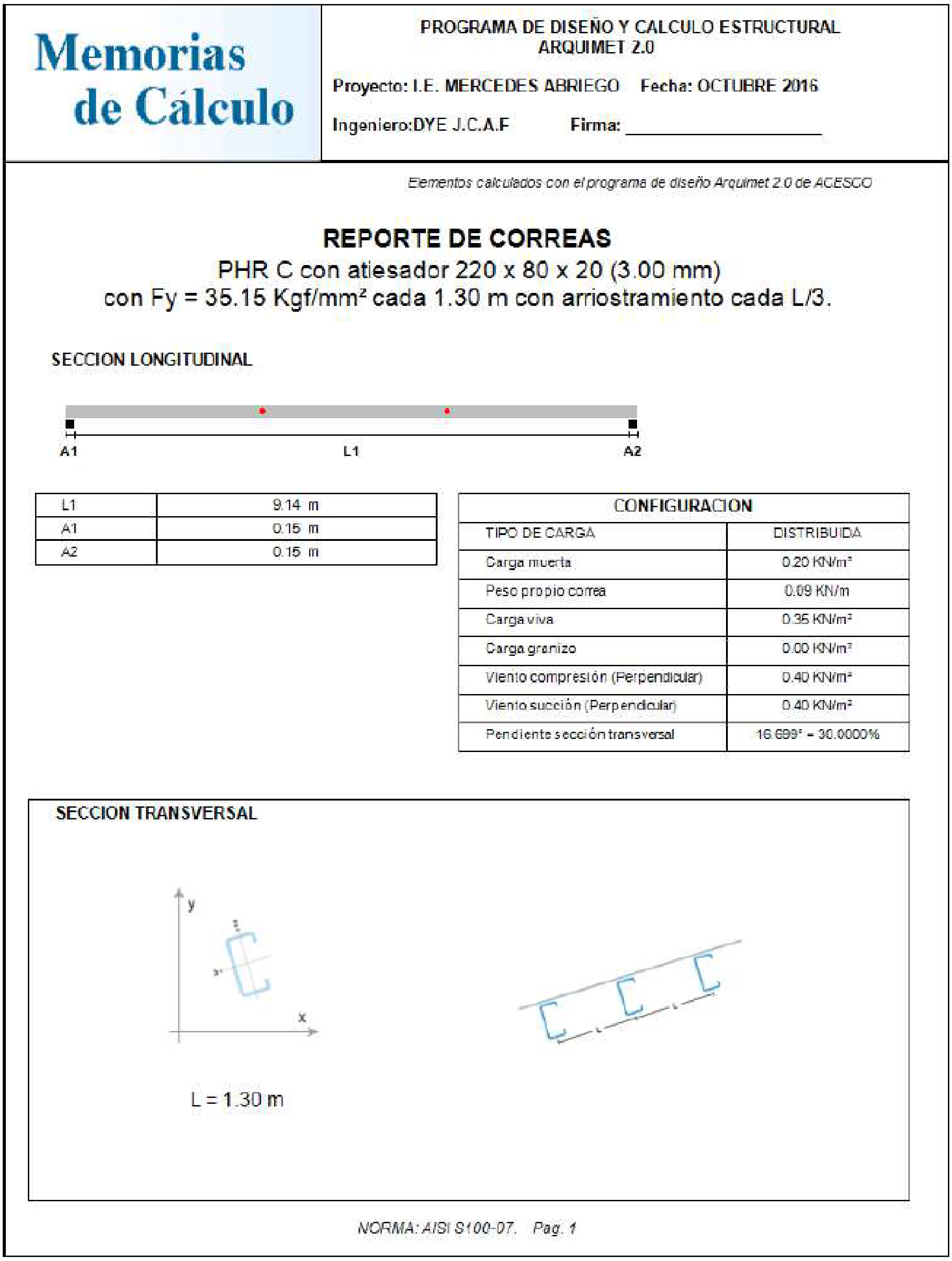
REVISIÓN A CORTANTE

Coeficientes de relación de carga en las dos direcciones para cortante:

R= 13.91 **kN**

ϕvc = **0.574 MPa**
ϕvu = **0.199 MPa** **OK**

7.5.3 DISEÑO CORREAS



Memorias de Cálculo

PROGRAMA DE DISEÑO Y CALCULO ESTRUCTURAL
ARQUIMET 2.0

Proyecto: I.E. MERCEDES ABRIEGO **Fecha:** OCTUBRE 2016

Ingeniero:DYE J.C.A.F **Firma:** ____________________

Elementos calculados con el programa de diseño Arquimet 2.0 de ACESCO

REPORTE DE CORREAS

PHR C con atiesador 220 x 80 x 20 (3.00 mm)
con Fy = 35.15 Kgf/mm² cada 1.30 m con arriostramiento cada L/3.

SECCION LONGITUDINAL

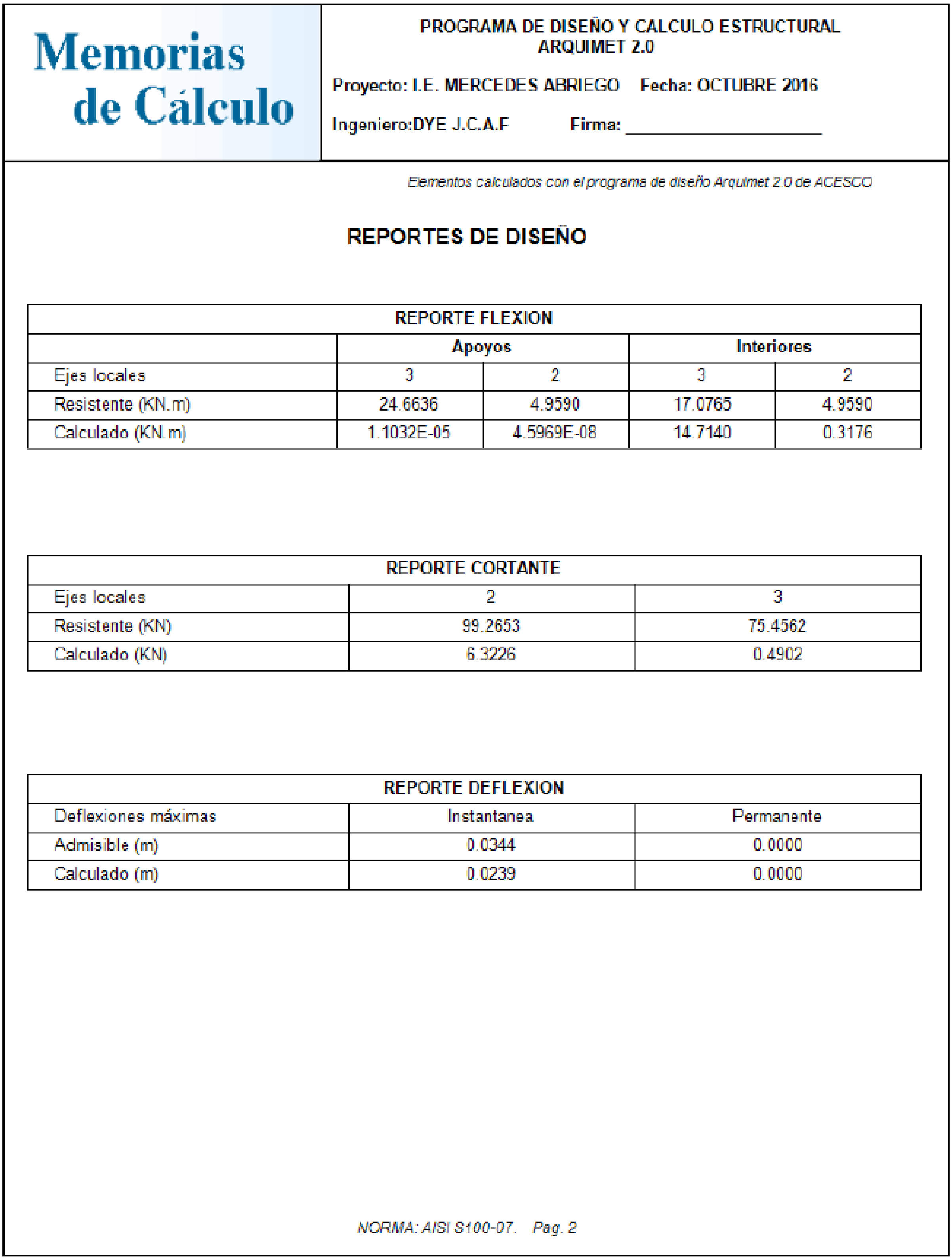
L1	9.14 m
A1	0.15 m
A2	0.15 m

CONFIGURACION	
TIPO DE CARGA	DISTRIBUIDA
Carga muerta	0.20 KN/m²
Peso propio correa	0.09 KN/m
Carga viva	0.35 KN/m²
Carga granizo	0.00 KN/m²
Viento compresión (Perpendicular)	0.40 KN/m²
Viento succión (Perpendicular)	0.40 KN/m²
Pendiente sección transversal	16.699° = 30.0000%

SECCION TRANSVERSAL

L = 1.30 m

NORMA: AISI S100-07. Pag. 1



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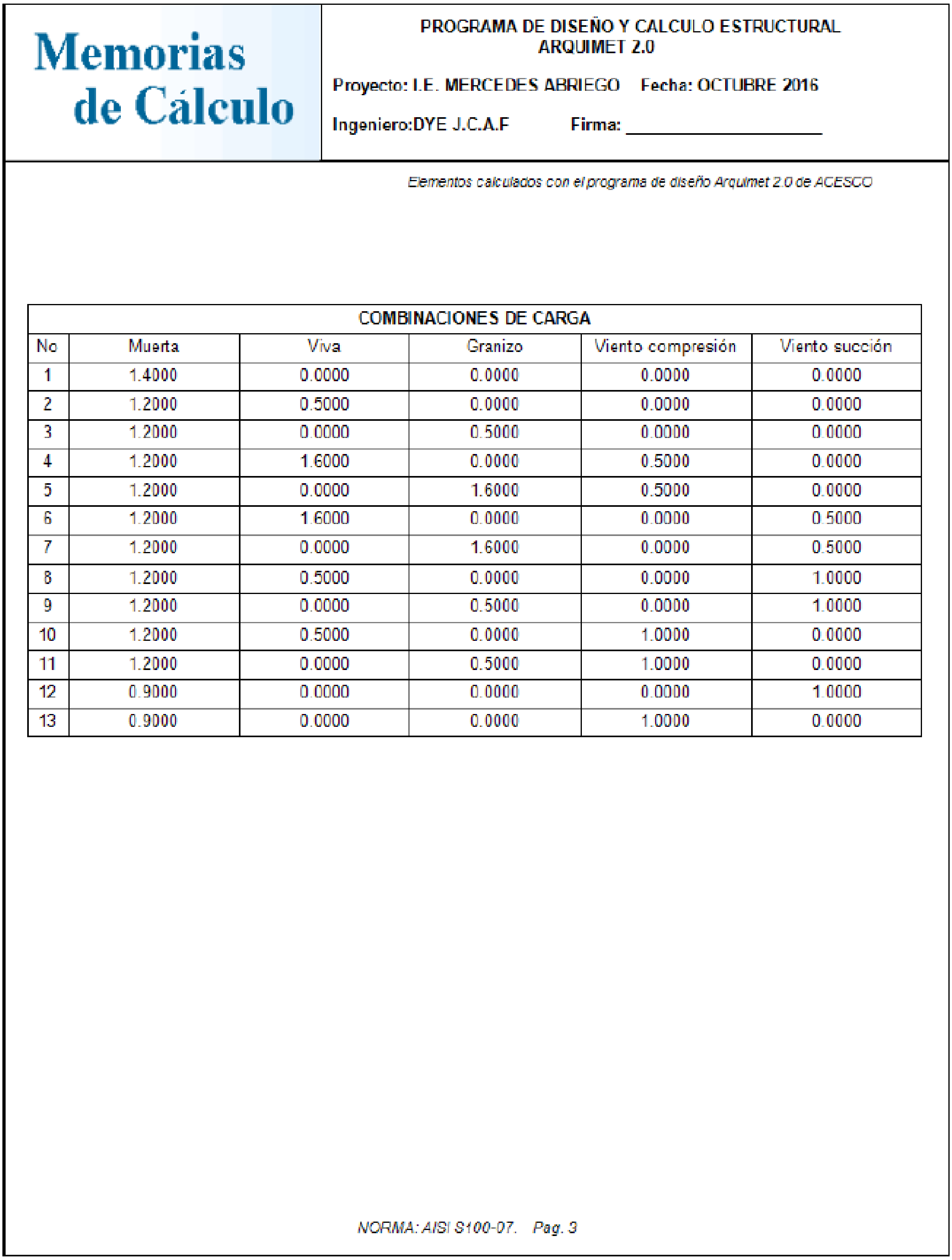
REPORTES DE DISEÑO

REPORTE FLEXION				
	Apoyos		**Interiores**	
Ejes locales	3	2	3	2
Resistente (KN.m)	24.6636	4.9590	17.0765	4.9590
Calculado (KN.m)	1.1032E-05	4.5969E-08	14.7140	0.3176

REPORTE CORTANTE		
Ejes locales	2	3
Resistente (KN)	99.2653	75.4562
Calculado (KN)	6.3226	0.4902

REPORTE DEFLEXION		
Deflexiones máximas	Instantanea	Permanente
Admisible (m)	0.0344	0.0000
Calculado (m)	0.0239	0.0000

NORMA: AISI S100-07. Pag. 2



Memorias de Cálculo

PROGRAMA DE DISEÑO Y CALCULO ESTRUCTURAL ARQUIMET 2.0

Proyecto: I.E. MERCEDES ABRIEGO **Fecha:** OCTUBRE 2016

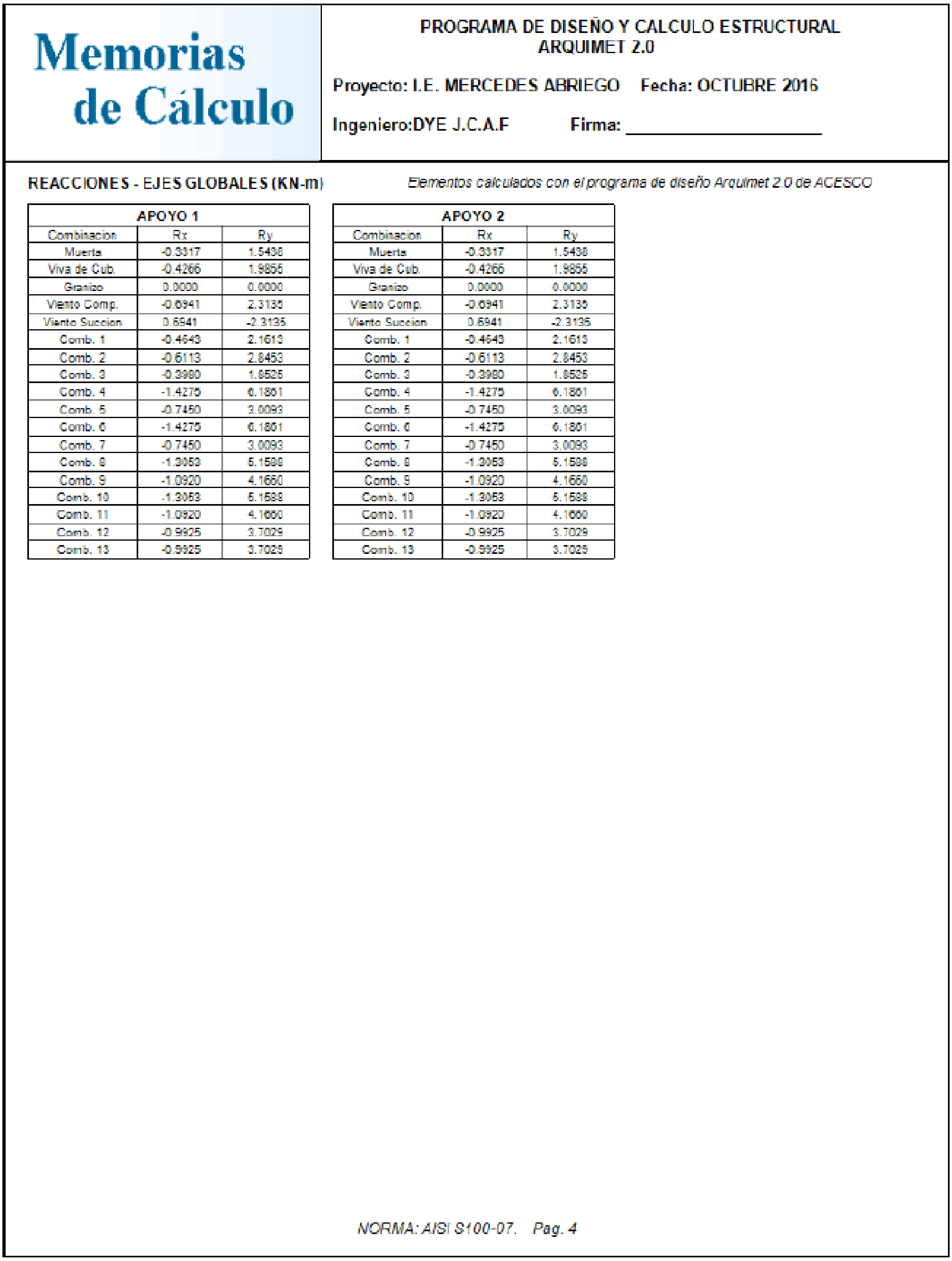
Ingeniero:DYE J.C.A.F **Firma:** ____________________

Elementos calculados con el programa de diseño Arquimet 2.0 de ACESCO

COMBINACIONES DE CARGA

No	Muerta	Viva	Granizo	Viento compresión	Viento succión
1	1.4000	0.0000	0.0000	0.0000	0.0000
2	1.2000	0.5000	0.0000	0.0000	0.0000
3	1.2000	0.0000	0.5000	0.0000	0.0000
4	1.2000	1.6000	0.0000	0.5000	0.0000
5	1.2000	0.0000	1.6000	0.5000	0.0000
6	1.2000	1.6000	0.0000	0.0000	0.5000
7	1.2000	0.0000	1.6000	0.0000	0.5000
8	1.2000	0.5000	0.0000	0.0000	1.0000
9	1.2000	0.0000	0.5000	0.0000	1.0000
10	1.2000	0.5000	0.0000	1.0000	0.0000
11	1.2000	0.0000	0.5000	1.0000	0.0000
12	0.9000	0.0000	0.0000	0.0000	1.0000
13	0.9000	0.0000	0.0000	1.0000	0.0000

NORMA: AISI S100-07. Pag. 3



Memorias de Cálculo

PROGRAMA DE DISEÑO Y CALCULO ESTRUCTURAL
ARQUIMET 2.0

Proyecto: I.E. MERCEDES ABRIEGO **Fecha:** OCTUBRE 2016

Ingeniero:DYE J.C.A.F **Firma:** ____________________

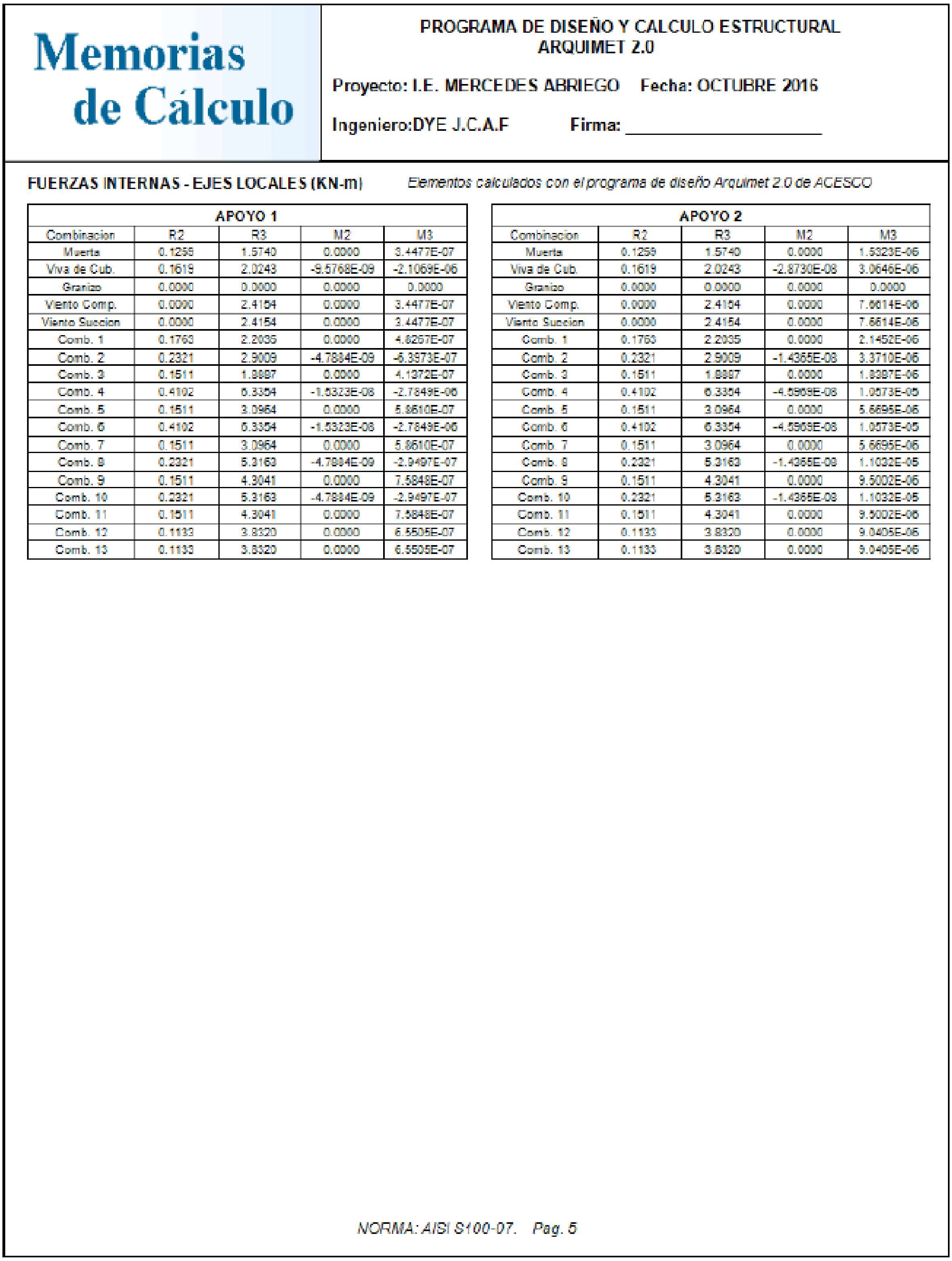
REACCIONES - EJES GLOBALES (KN-m)

Elementos calculados con el programa de diseño Arquimet 2.0 de ACESCO

APOYO 1		
Combinacion	Rx	Ry
Muerta	-0.3317	1.5436
Viva de Cub.	-0.4266	1.9856
Granizo	0.0000	0.0000
Viento Comp.	-0.6941	2.3135
Viento Succion	0.6941	-2.3135
Comb. 1	-0.4643	2.1613
Comb. 2	-0.6113	2.8453
Comb. 3	-0.3980	1.8526
Comb. 4	-1.4275	6.1861
Comb. 5	-0.7450	3.0093
Comb. 6	-1.4275	6.1861
Comb. 7	-0.7450	3.0093
Comb. 8	-1.3053	5.1588
Comb. 9	-1.0920	4.1660
Comb. 10	-1.3053	5.1588
Comb. 11	-1.0920	4.1660
Comb. 12	-0.9925	3.7029
Comb. 13	-0.9925	3.7029

APOYO 2		
Combinacion	Rx	Ry
Muerta	-0.3317	1.5436
Viva de Cub.	-0.4266	1.9856
Granizo	0.0000	0.0000
Viento Comp.	-0.6941	2.3135
Viento Succion	0.6941	-2.3135
Comb. 1	-0.4643	2.1613
Comb. 2	-0.6113	2.8453
Comb. 3	-0.3980	1.8526
Comb. 4	-1.4275	6.1861
Comb. 5	-0.7450	3.0093
Comb. 6	-1.4275	6.1861
Comb. 7	-0.7450	3.0093
Comb. 8	-1.3053	5.1588
Comb. 9	-1.0920	4.1660
Comb. 10	-1.3053	5.1588
Comb. 11	-1.0920	4.1660
Comb. 12	-0.9925	3.7029
Comb. 13	-0.9925	3.7029

NORMA: AISI S100-07. Pag. 4



Memorias de Cálculo

PROGRAMA DE DISEÑO Y CALCULO ESTRUCTURAL
ARQUIMET 2.0

Proyecto: I.E. MERCEDES ABRIEGO **Fecha:** OCTUBRE 2016

Ingeniero:DYE J.C.A.F **Firma:** ____________________

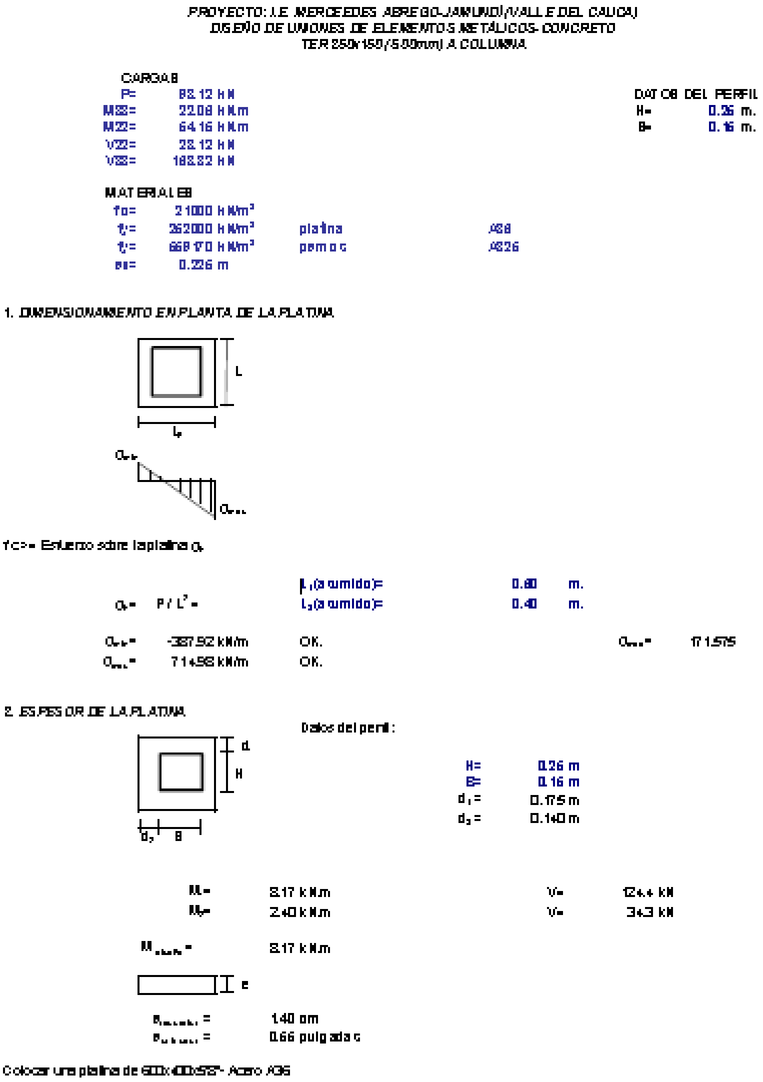
FUERZAS INTERNAS - EJES LOCALES (KN-m) *Elementos calculados con el programa de diseño Arquimet 2.0 de ACESCO*

APOYO 1				
Combinacion	R2	R3	M2	M3
Muerta	0.1259	1.5740	0.0000	3.4477E-07
Viva de Cub.	0.1619	2.0243	-9.5768E-09	-2.1069E-06
Granizo	0.0000	0.0000	0.0000	0.0000
Viento Comp.	0.0000	2.4154	0.0000	3.4477E-07
Viento Succion	0.0000	2.4154	0.0000	3.4477E-07
Comb. 1	0.1763	2.2035	0.0000	4.8267E-07
Comb. 2	0.2321	2.9009	-4.7884E-09	-6.3973E-07
Comb. 3	0.1511	1.8887	0.0000	4.1372E-07
Comb. 4	0.4102	6.3354	-1.5323E-08	-2.7849E-06
Comb. 5	0.1511	3.0964	0.0000	5.8610E-07
Comb. 6	0.4102	6.3354	-1.5323E-08	-2.7849E-06
Comb. 7	0.1511	3.0964	0.0000	5.8610E-07
Comb. 8	0.2321	5.3163	-4.7884E-09	-2.9497E-07
Comb. 9	0.1511	4.3041	0.0000	7.5848E-07
Comb. 10	0.2321	5.3163	-4.7884E-09	-2.9497E-07
Comb. 11	0.1511	4.3041	0.0000	7.5848E-07
Comb. 12	0.1133	3.8320	0.0000	6.5505E-07
Comb. 13	0.1133	3.8320	0.0000	6.5505E-07

APOYO 2				
Combinacion	R2	R3	M2	M3
Muerta	0.1259	1.5740	0.0000	1.5323E-06
Viva de Cub.	0.1619	2.0243	-2.8730E-08	3.0646E-06
Granizo	0.0000	0.0000	0.0000	0.0000
Viento Comp.	0.0000	2.4154	0.0000	7.6614E-06
Viento Succion	0.0000	2.4154	0.0000	7.6614E-06
Comb. 1	0.1763	2.2035	0.0000	2.1452E-06
Comb. 2	0.2321	2.9009	-1.4365E-08	3.3710E-06
Comb. 3	0.1511	1.8887	0.0000	1.8387E-06
Comb. 4	0.4102	6.3354	-4.5969E-08	1.0573E-05
Comb. 5	0.1511	3.0964	0.0000	5.6695E-06
Comb. 6	0.4102	6.3354	-4.5969E-08	1.0573E-05
Comb. 7	0.1511	3.0964	0.0000	5.6695E-06
Comb. 8	0.2321	5.3163	-1.4365E-08	1.1032E-05
Comb. 9	0.1511	4.3041	0.0000	9.5002E-06
Comb. 10	0.2321	5.3163	-1.4365E-08	1.1032E-05
Comb. 11	0.1511	4.3041	0.0000	9.5002E-06
Comb. 12	0.1133	3.8320	0.0000	9.0405E-06
Comb. 13	0.1133	3.8320	0.0000	9.0405E-06

NORMA: AISI S100-07. Pag. 5

7.5.4 DISEÑO PLATINAS



PROYECTO: I.E. MERCEDES ABREGO-JAMUNDÍ (VALLE DEL CAUCA)
DISEÑO DE UNIONES DE ELEMENTOS METÁLICOS- CONCRETO
TER 250x150 (5.00mm) A COLUMNA

CARGAS

P=	82.12	kN
M33=	22.08	kN.m
M22=	64.16	kN.m
V22=	28.12	kN
V33=	182.82	kN

DATOS DEL PERFIL

H=	0.26	m.
B=	0.16	m.

MATERIALES

f'c=	21000 kN/m²		
fy=	252000 kN/m²	platina	A36
fy=	668170 kN/m²	pernos	A325
e=	0.226 m		

1. DIMENSIONAMIENTO EN PLANTA DE LA PLATINA

L
L2
qmin
qmax

f'c>= Esfuerzo sobre la platina q

		L1(asumido)=	0.60	m.
q =	P / L² =	L2(asumido)=	0.40	m.

qmin=	-387.92 kN/m	OK.	qadm=	171.575
qmax=	714.98 kN/m	OK.		

2. ESPESOR DE LA PLATINA

Datos del perfil:

H=	0.26 m
B=	0.16 m
d_1 =	0.175 m
d_2 =	0.140 m

Mx=	8.17 kN.m	V=	124.4 kN
My=	2.40 kN.m	V=	34.3 kN

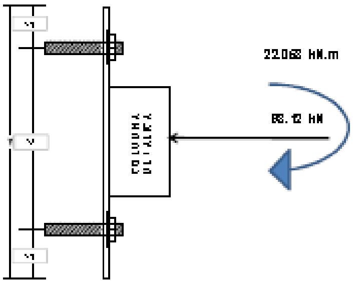
$M_{diseño}$ = 8.17 kN.m

$e_{requerido}$ = 1.40 cm
$e_{requerido}$ = 0.55 pulgadas

Colocar una platina de 600x400x5/8" - Acero A36

3. DISEÑO DE PERNOS

3.1 DISEÑO DE PERNOS EN SENTIDO LONGITUDINAL:



Y1= 0.070 m

Y2= 0.480 m

Y1= 0.070 m

Y= 0.60 m

Número total de anclajes: 4 Und.

CARGA POR CORTANTE:

VR = 164.95 kN

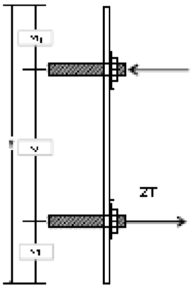
$V_{actuante}$ = VR / # total de anclajes = 41.24 kN

$V_{resistente}$ = 178.12 kN

CARGA POR COMPRESIÓN:

$P_{actuante}$ = Pu / # total de anclajes = 24.63 kN

CARGA POR MOMENTO:



Y1= 0.070 m

Y2= 0.480 m

Y1= 0.070 m

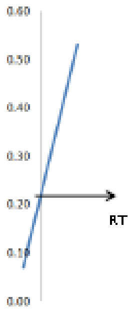
Y= 0.60 m

σ_{max} = 3228.08 kN/m

e = 0.22 m

X= 0.22 m

σ_{min} = -1636.28 kN/m



1 fila de pernos de anclaje trabajan en tensión.

RT_u = 80.78 KN

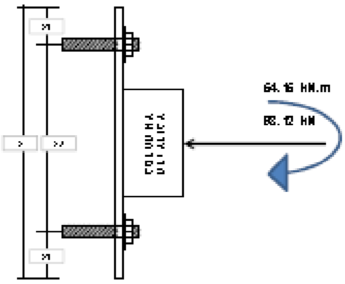
80.78 = 2T

T_u = 40.39 kN

At_u = 0.303 cm^2 *4 Pernos de 1/2" Acero A325* 5.16 cm^2

$T_{resistente\,u}$ = 268.83 kN

3.2 *DISEÑO DE PERNOS EN SENTIDO TRANSVERSAL:*



X1= 0.070 m

X2= 0.280 m

X1= 0.070 m

X= 0.40 m

Número total de anclajes: 4 Und.

CARGA POR CORTANTE:

VR = 164.95 kN

$V_{ACTUANTE}$ = VR / # total de anclajes = 41.24 kN

$V_{RESISTENTE}$ = 178.12 kN

CARGA POR COMPRESIÓN:

$P_{ACTUANTE}$ = Pu / # total de anclajes = 24.62 kN

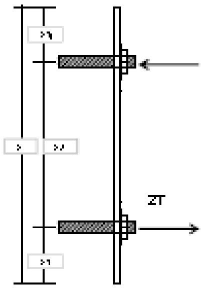
CARGA POR MOMENTO:

X1= 0.070 m

X2= 0.280 m

X1= 0.070 m

X= 0.40 m

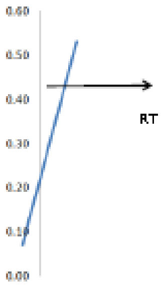


σ_{max} = 18834.81 kN/m

e = 0.55 m

X= 0.19 m

σ_{min} = -17032.88 kN/m



1 eje de pernos de anclaje trabajan en tensión.

RT_{22} = 420.28 kN

420.28 = 2T

T_{22} = 210.14 kN

At_{22} = 4.176 cm^2 *4 Pernos de 1/2" Acero A325* 5.16 cm^2

$T_{RESISTENTE\ 22}$ = 268.83 kN

At_{TOTAL} = 10.32 cm^2 *4 Pernos de 1/2" Acero A325* 10.32 cm^2

$T_{RESISTENTE\ TOTAL}$ = 618.88 kN

VERIFICACIÓN EFECTOS COMBINADOS:

$T_{ACTUANTE\ TOTAL} = T_{11} + T_{22}$ = 260.68 kN

$(T_{ACTUANTE\ TOTAL} / T_{RESISTENTE\ TOTAL})^2 + (V_{ACTUANTE} / V_{RESISTENTE})^2 \leq 1$

0.28 ≤ 1 OK

PROYECTO:I.E. MERCEDES ABREGO
DISEÑO MIEMBROS ENSAMBLADOS
TER 250X150X5.00 A VIGA

MATERIALES

Acero A-36

f_y= 252 N/mm^2

F_u = 400 N/mm^2

CARGAS

V = 19.31 KN

Pernos Φ = 12.7 mm
Agujeros Φ = 15.9 mm

Espesor platina = 12.70 mm

DATOS DEL ELEMENTO

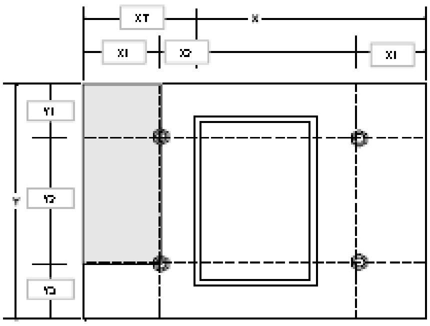
X1 = 70 mm
X2 = 70 mm
t = 260 mm
XT = 400 mm

Y1 = 70 mm
Y2 = 460 mm
Y3 = 70 mm

YT = 600 mm

A_g = 6731 mm^2

A_n = 6227 mm^2



FLUENCIA EN LA SECCIÓN BRUTA

Se debe cumplir:

$Pu < 0.90\ F_y\ A_g$

Pu < 1527 kN
OK

$A_{g\ Lisanc}$ = 86 mm^2
OK

FRACTURA EN LA SECCIÓN EFECTIVA

Se debe cumplir:

$Pu < 0.75\ F_u\ A_e$

Pu < 1868 kN
OK

$A_{u\ Lisanc}$ = 65 mm^2
OK

Resistencia al desgarre de un bloque por tensión y cortante

A_{nv}= 6227 mm^2
A_{nt}= 789 mm^2
$F_u\ A_{nt}$= - KN
$0.6\ F_u\ A_{nv}$= 1494 KN

Para el analisis se supone riesgo de falla por bloque,
con base en dos estados limites definidos asi:

Si $F_u\ A_{nt} > 0.6\ F_u\ A_{nv}$ entonces; $P_u = \Phi\ [0.6\ F_y\ A_{gv} + F_u\ A_{nt}]$

Si $0.6\ F_u\ A_{nv} > F_u\ A_{nv}$ entonces; $P_u = \Phi\ [0.6\ F_u\ A_{nv} + F_y\ A_{gt}]$

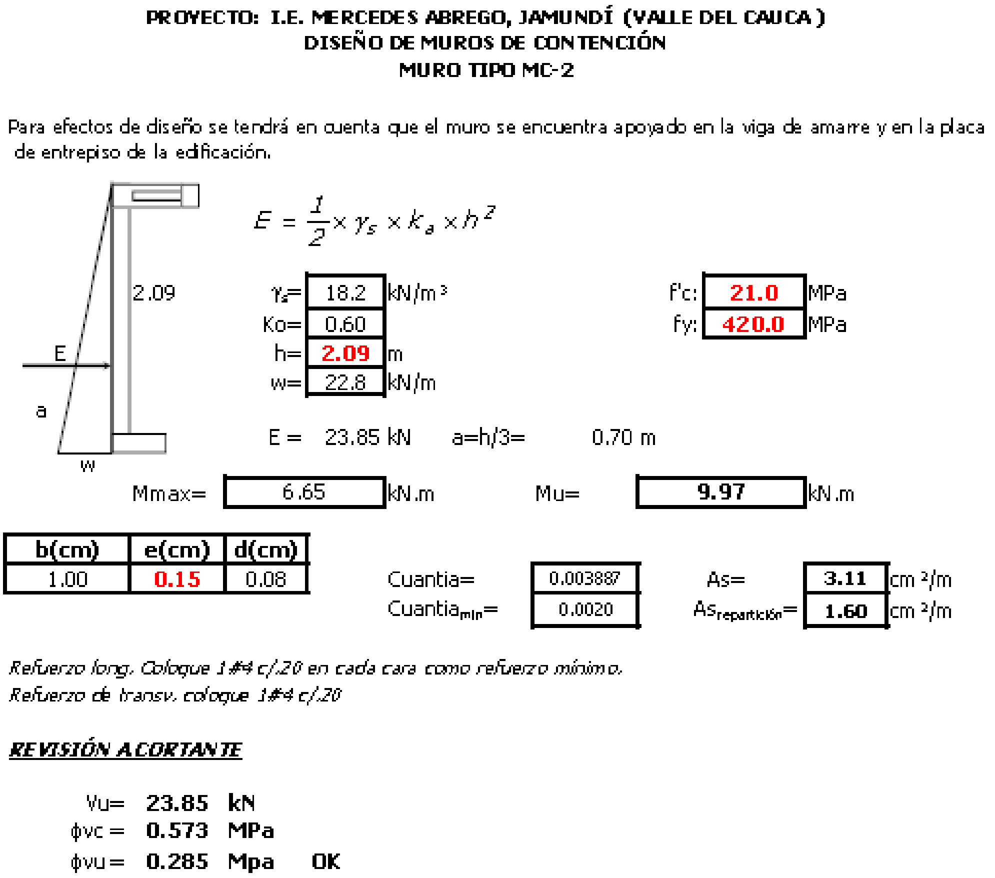
Fractura de la sección neta a tensión y fluencia de la sección bruta a corte.

A_{gv}= 7620 mm^2
A_{gt}= 889 mm^2

Por lo tanto,

P_u= 1101 kN OK

7.5.5 MURO DE CONTENCIÓN



PROYECTO: I.E. MERCEDES ABREGO, JAMUNDÍ (VALLE DEL CAUCA)
DISEÑO DE MUROS DE CONTENCIÓN
MURO TIPO MC-2

Para efectos de diseño se tendrá en cuenta que el muro se encuentra apoyado en la viga de amarre y en la placa de entrepiso de la edificación.

$$E = \frac{1}{2} \times \gamma_s \times k_a \times h^2$$

γ_s= 18.2 kN/m³
Ko= 0.60
h= **2.09** m
w= 22.8 kN/m

f'c: **21.0** MPa
fy: **420.0** MPa

E = 23.85 kN   a=h/3= 0.70 m

Mmax= 6.65 kN.m   Mu= **9.97** kN.m

b(cm)	e(cm)	d(cm)
1.00	**0.15**	0.08

Cuantia= 0.003887
Cuantia_{min}= 0.0020

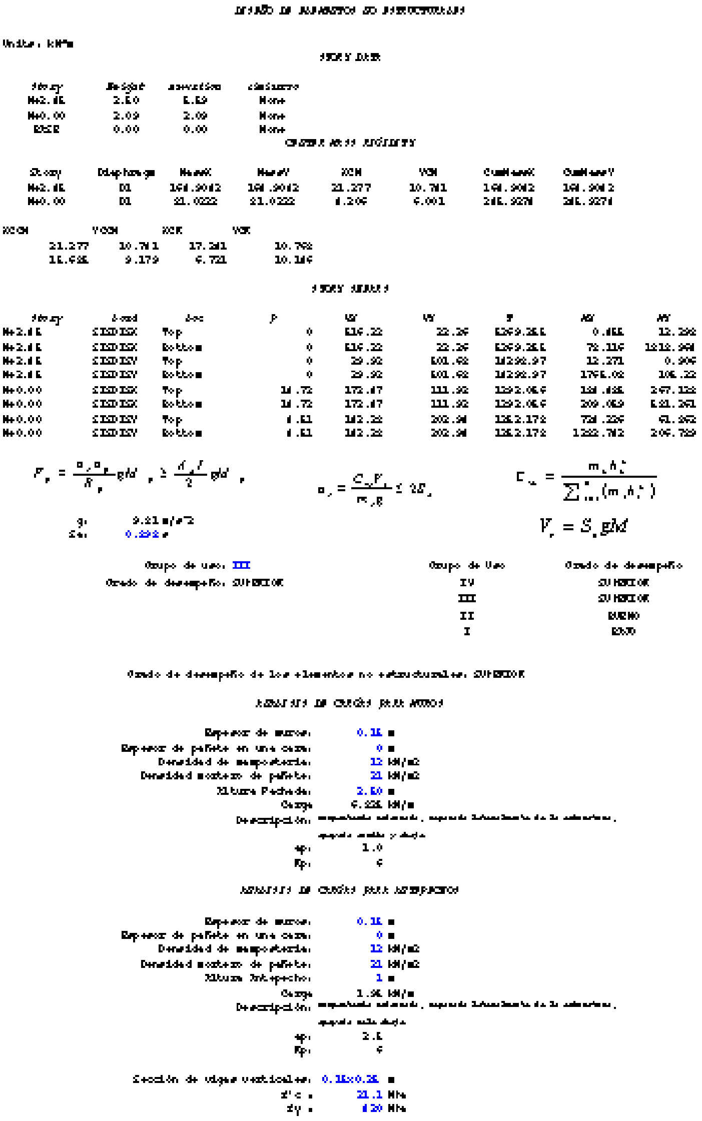
As= **3.11** cm ²/m
$\text{As}_{repartición}$= **1.60** cm ²/m

Refuerzo long. Coloque 1#4 c/.20 en cada cara como refuerzo mínimo.
Refuerzo de transv. coloque 1#4 c/.20

REVISIÓN A CORTANTE

Vu= **23.85 kN**
ϕvc = **0.573 MPa**
ϕvu = **0.285 Mpa OK**

7.6 DISEÑO DE ELEMENTOS NO ESTRUCTURALES



DISEÑO DE ELEMENTOS NO ESTRUCTURALES

Units: kN-m

STORY DATA

Story	Height	Elevation	Similar to
N+2.45	2.50	4.59	None
N+0.00	2.09	2.09	None
BASE	0.00	0.00	None

CENTER MASS RIGIDITY

Story	Diaphragm	MassX	MassY	XCM	YCM	CumMassX	CumMassY
N+2.45	D1	164.9042	164.9042	21.277	10.781	164.9042	164.9042
N+0.00	D1	81.0222	81.0232	4.206	6.001	245.9274	245.9274

XCCM	YCCM	XCR	YCR
21.277	10.781	17.241	10.792
15.645	9.179	6.721	10.146

STORY SHEARS

Story	Load	Loc	P	VX	VY	T	MX	MY
N+2.45	SISMOX	Top	0	516.22	22.26	5269.255	0.455	12.292
N+2.45	SISMOX	Bottom	0	516.22	22.26	5269.255	72.116	1212.941
N+2.45	SISMOY	Top	0	29.92	501.42	11292.97	12.271	0.906
N+2.45	SISMOY	Bottom	0	29.92	501.42	11292.97	1755.02	105.22
N+0.00	SISMOX	Top	14.72	172.47	111.92	1292.069	131.485	247.132
N+0.00	SISMOX	Bottom	14.72	172.47	111.92	1292.069	299.059	521.261
N+0.00	SISMOY	Top	4.51	142.22	202.94	1252.172	721.226	41.262
N+0.00	SISMOY	Bottom	4.51	142.22	202.94	1252.172	1232.782	206.729

$$F_p = \frac{a_x a_p}{R_p} g M_p \geq \frac{A_a I}{2} g M_p$$

$$a_x = \frac{C_{vx} V_s}{m_x g} \leq 2 S_a$$

$$C_{vx} = \frac{m_x h_x^k}{\sum_{i=1}^{n} (m_i h_i^k)}$$

$$V_s = S_a g M$$

g: 9.81 m/s^2

Sa: 0.292 g

Grupo de uso: III

Grado de desempeño: SUPERIOR

Grupo de Uso	Grado de desempeño
IV	SUPERIOR
III	SUPERIOR
II	BUENO
I	BAJO

Grado de desempeño de los elementos no estructurales: SUPERIOR

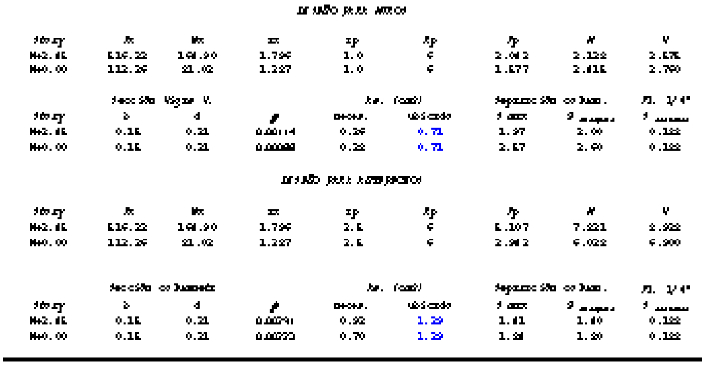
ANALISIS DE CARGAS PARA MUROS

Espesor de muros: 0.15 m
Espesor de pañete en una cara: 0 m
Densidad de mampostería: 12 kN/m3
Densidad mortero de pañete: 21 kN/m3
Altura Fachada: 2.50 m
Carga: 4.225 kN/m
Descripción: [illegible]
ap: 1.0
Rp: 6

ANALISIS DE CARGAS PARA ANTEPECHOS

Espesor de muros: 0.15 m
Espesor de pañete en una cara: 0 m
Densidad de mampostería: 12 kN/m3
Densidad mortero de pañete: 21 kN/m3
Altura Antepecho: 1 m
Carga: 1.95 kN/m
Descripción: [illegible]
ap: 2.5
Rp: 6

Sección de vigas verticales: 0.15x0.25 m
f'c = 21.1 MPa
fy = 420 MPa

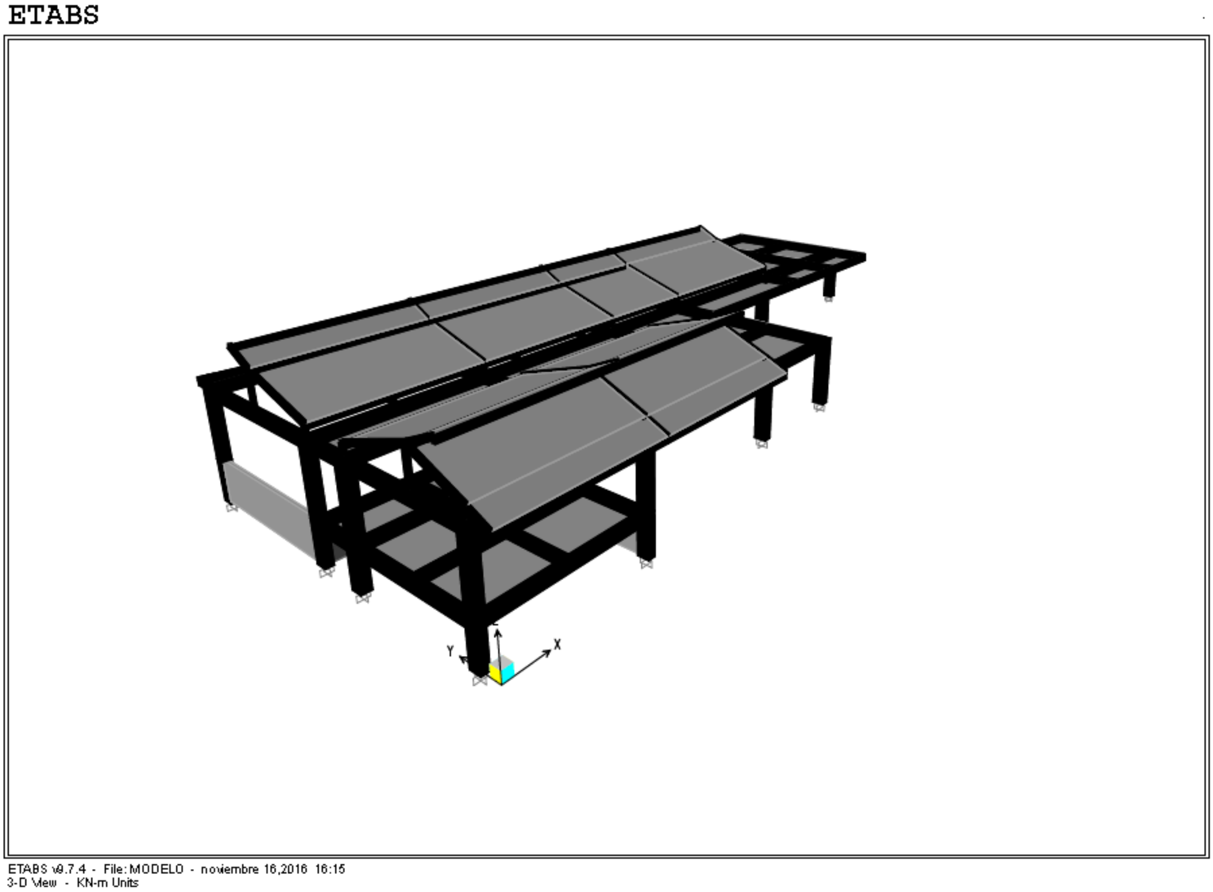


8 ESPECIFICACIONES TÉCNICAS

Los materiales utilizados son:

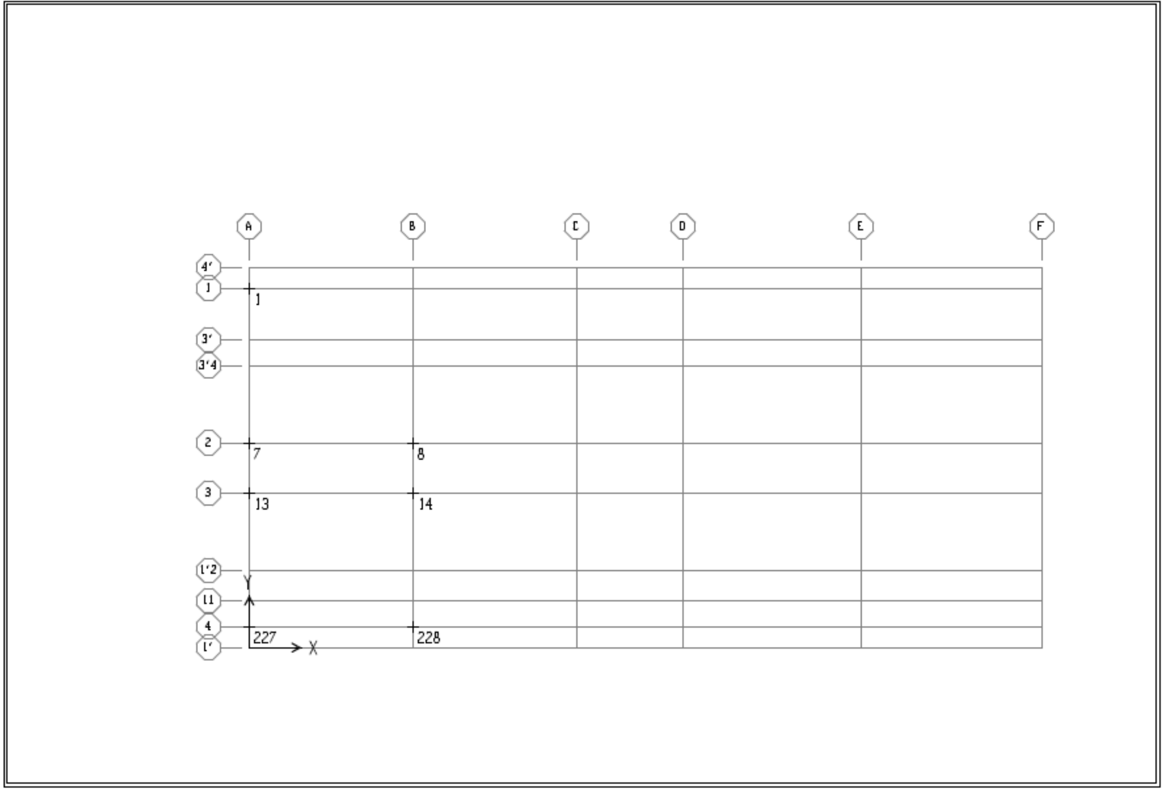
Concreto	21.1 MPa para vigas, placas, zapatas y
columnas. Concreto	14 MPa (para concreto de limpieza).
Acero para refuerzo:	fy = 420 MPa para todos los diámetros.
Acero estructural	A36 cuñas de anclaje y platinas
Acero estructural	A500 en perfiles metálicos

9 ANEXOS


ETABS

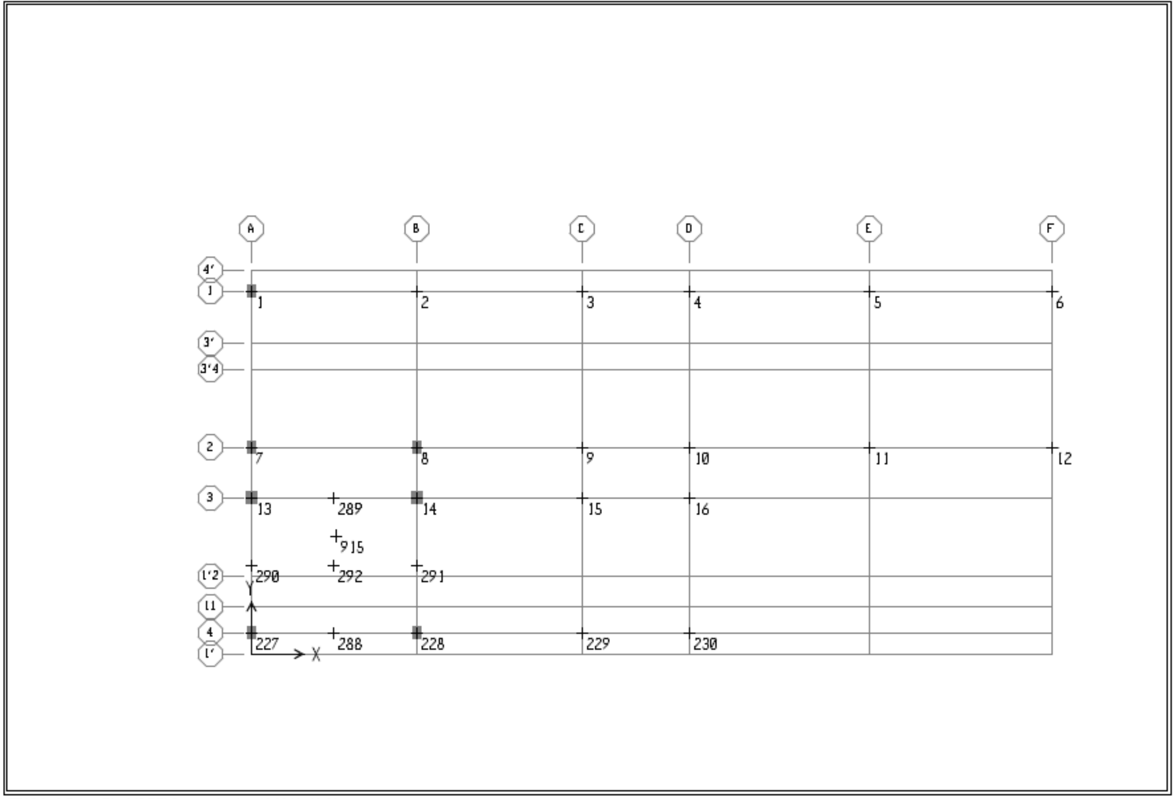
ETABS v9.7.4 - File: MODELO - noviembre 16,2016 16:15
3-D View - KN-m Units

ETABS


A
B
C
D
E
F
4'
1
3'
3'4
2
3
1'2
11
4
1'
1
7
8
13
14
227
228
Y
X

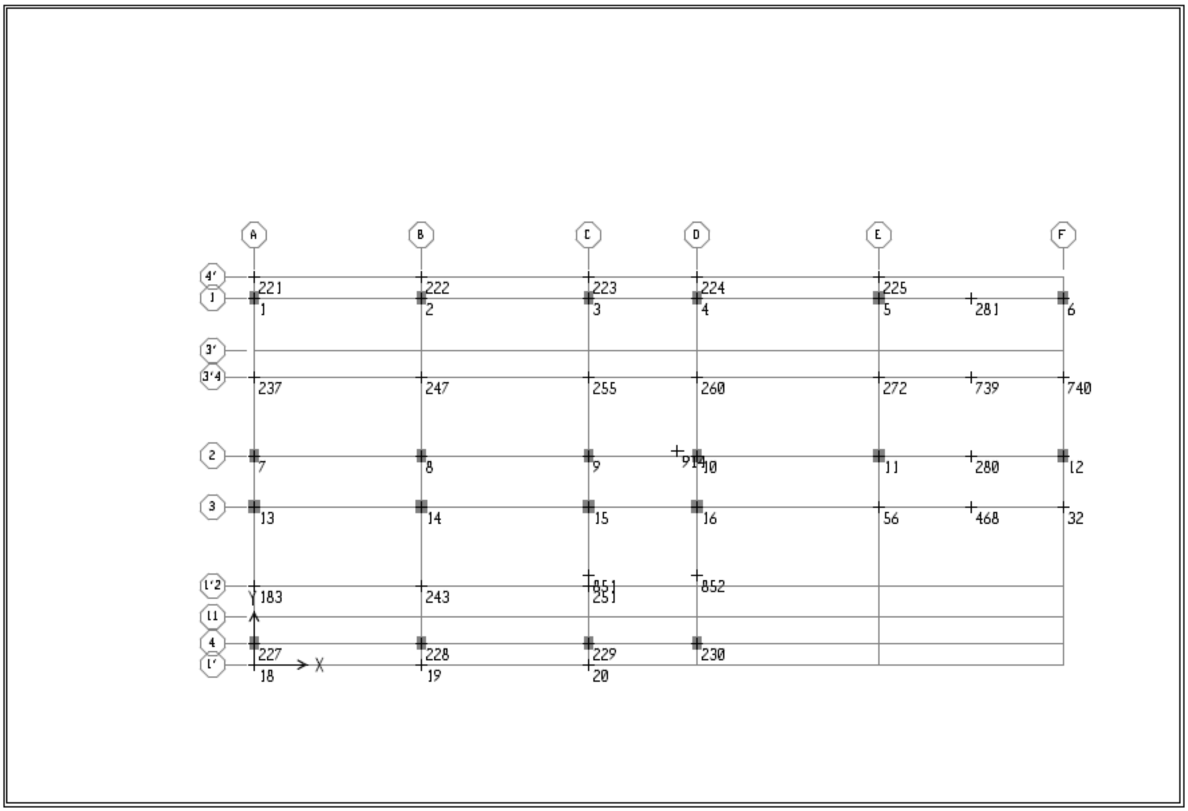
ETABS v9.7.4 - File: MODELO - noviembre 10,2016 10:29
Plan View - BASE - Elevation 0 - KN-m Units

ETABS


A
B
C
D
E
F
4'
1
3'
3'4
2
3
1'2
11
4
1'
1
2
3
4
5
6
7
8
9
10
11
12
13
289
14
15
16
915
290
292
291
Y
227
288
228
229
230
X

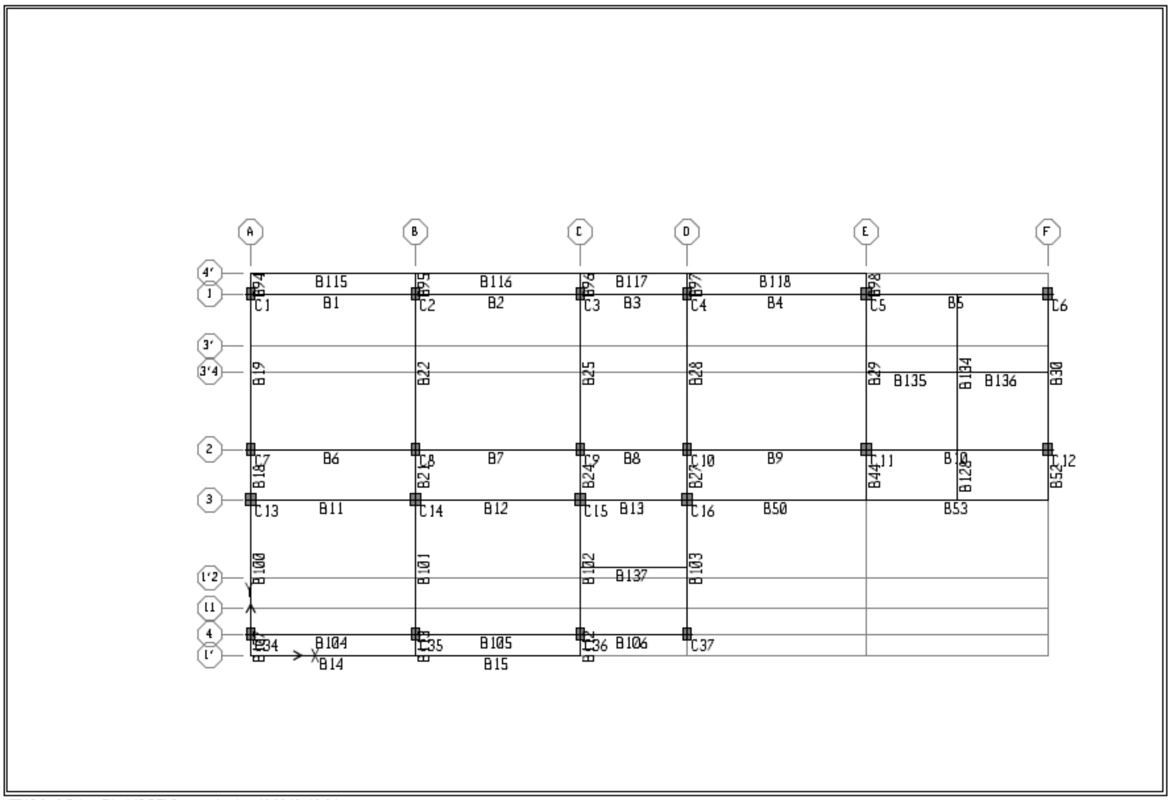
ETABS v9.7.4 - File: MODELO - noviembre 10,2016 10:30
Plan View - N+0.00 - Elevation 2.09 - KN-m Units

ETABS


A
B
C
D
E
F
4'
1
3'
3'4
2
3
1'2
L1
4
1'
221
222
223
224
225
1
2
3
4
5
281
6
237
247
255
260
272
739
740
7
8
9
914
10
11
280
12
13
14
15
16
56
468
32
183
243
851
251
852
Y
227
228
229
230
X
18
19
20

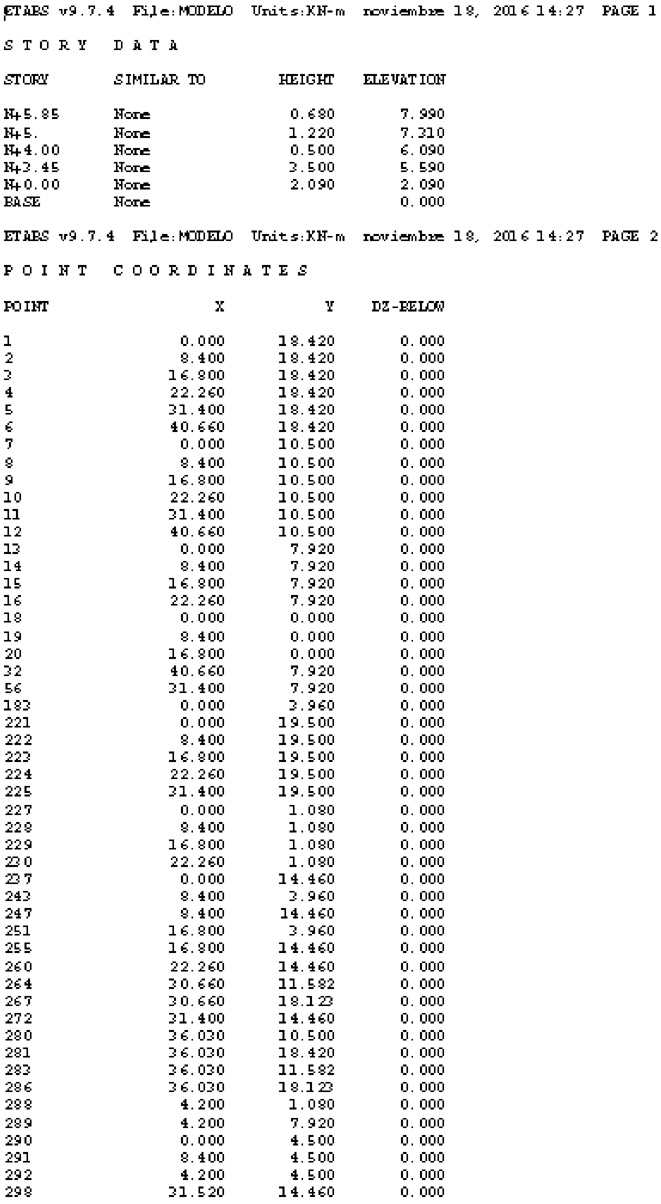
ETABS v9.7.4 - File: MODELO - noviembre 10,2016 10:30
Plan View - N+3.45 - Elevation 5.59 - KN-m Units

ETABS


A
B
C
D
E
F
4'
1
3'
3'4
2
3
1'2
11
4
1'
B94
B115
B95
B116
B96
B117
B97
B118
B98
C1
B1
C2
B2
C3
B3
C4
B4
C5
B5
C6
B19
B22
B25
B28
B29
B135
B134
B136
B30
C7
B6
C8
B7
C9
B8
C10
B9
C11
B10
C12
B18
B21
B24
B27
B44
B128
B52
C13
B11
C14
B12
C15
B13
C16
B50
B53
B100
B101
B102
B137
B103
C34
B104
C35
B105
C36
B106
C37
B14
B15
Y
X

ETABS v9.7.4 - File: MODELO - noviembre 10,2016 10:34
Plan View - N+3.45 - Elevation 5.59 - KN-m Units

9.1 DATOS DE ENTRADA



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ETABS v9.7.4  File:MODELO  Units:KN-m  noviembre 18, 2016 14:27  PAGE 1

S T O R Y   D A T A

STORY        SIMILAR TO        HEIGHT   ELEVATION

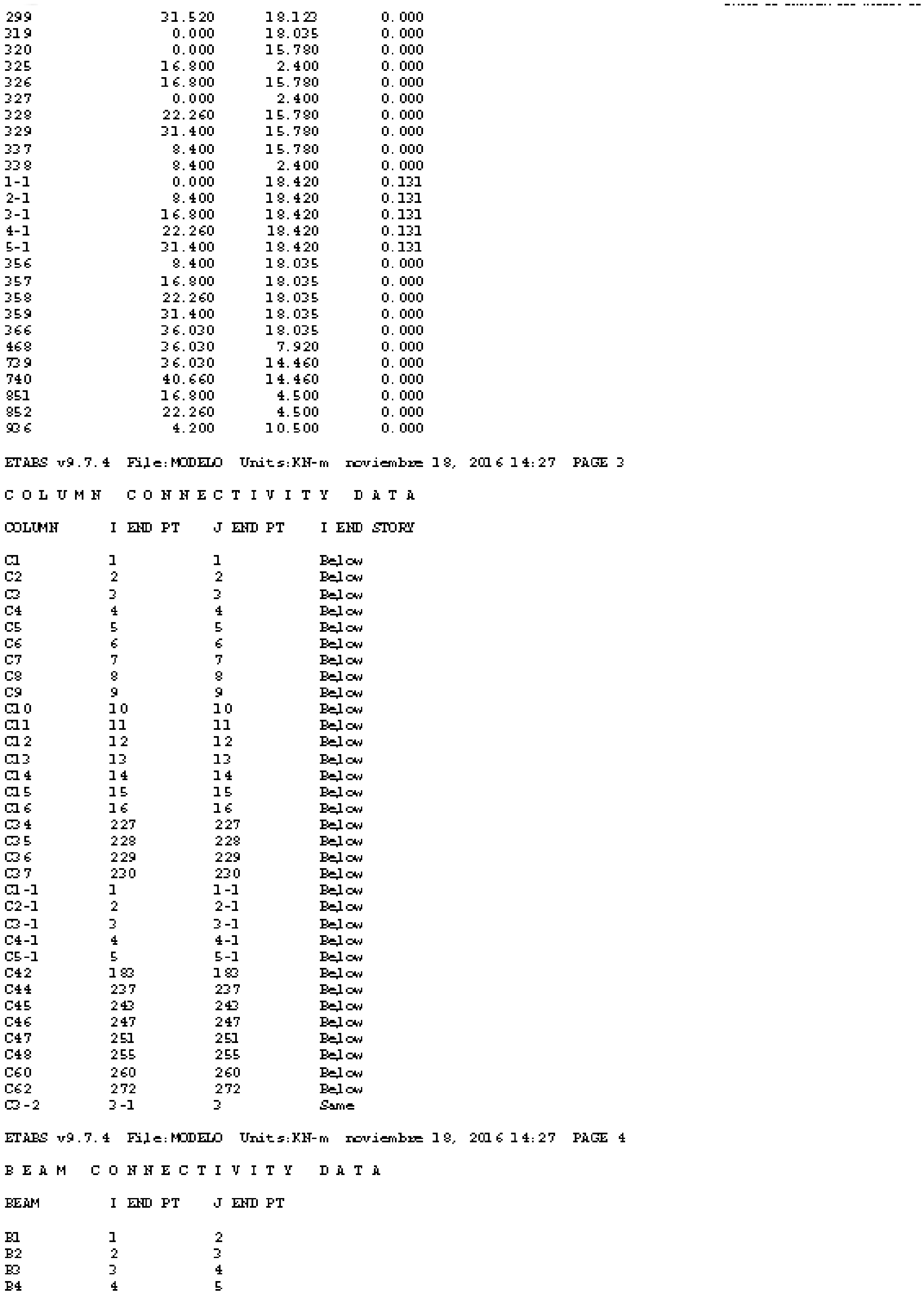
N+5.85       None               0.680       7.990
N+5.         None               1.220       7.310
N+4.00       None               0.500       6.090
N+3.45       None               3.500       5.590
N+0.00       None               2.090       2.090
BASE         None                           0.000

ETABS v9.7.4  File:MODELO  Units:KN-m  noviembre 18, 2016 14:27  PAGE 2

P O I N T   C O O R D I N A T E S

POINT                  X           Y    DZ-BELOW

1                  0.000      18.420       0.000
2                  8.400      18.420       0.000
3                 16.800      18.420       0.000
4                 22.260      18.420       0.000
5                 31.400      18.420       0.000
6                 40.660      18.420       0.000
7                  0.000      10.500       0.000
8                  8.400      10.500       0.000
9                 16.800      10.500       0.000
10                22.260      10.500       0.000
11                31.400      10.500       0.000
12                40.660      10.500       0.000
13                 0.000       7.920       0.000
14                 8.400       7.920       0.000
15                16.800       7.920       0.000
16                22.260       7.920       0.000
18                 0.000       0.000       0.000
19                 8.400       0.000       0.000
20                16.800       0.000       0.000
32                40.660       7.920       0.000
56                31.400       7.920       0.000
183                0.000       3.960       0.000
221                0.000      19.500       0.000
222                8.400      19.500       0.000
223               16.800      19.500       0.000
224               22.260      19.500       0.000
225               31.400      19.500       0.000
227                0.000       1.080       0.000
228                8.400       1.080       0.000
229               16.800       1.080       0.000
230               22.260       1.080       0.000
237                0.000      14.460       0.000
243                8.400       3.960       0.000
247                8.400      14.460       0.000
251               16.800       3.960       0.000
255               16.800      14.460       0.000
260               22.260      14.460       0.000
264               30.660      11.582       0.000
267               30.660      18.123       0.000
272               31.400      14.460       0.000
280               36.030      10.500       0.000
281               36.030      18.420       0.000
283               36.030      11.582       0.000
286               36.030      18.123       0.000
288                4.200       1.080       0.000
289                4.200       7.920       0.000
290                0.000       4.500       0.000
291                8.400       4.500       0.000
292                4.200       4.500       0.000
298               31.520      14.460       0.000
```



```
299             31.520     18.123       0.000
319              0.000     18.035       0.000
320              0.000     15.780       0.000
325             16.800      2.400       0.000
326             16.800     15.780       0.000
327              0.000      2.400       0.000
328             22.260     15.780       0.000
329             31.400     15.780       0.000
337              8.400     15.780       0.000
338              8.400      2.400       0.000
1-1              0.000     18.420       0.131
2-1              8.400     18.420       0.131
3-1             16.800     18.420       0.131
4-1             22.260     18.420       0.131
5-1             31.400     18.420       0.131
356              8.400     18.035       0.000
357             16.800     18.035       0.000
358             22.260     18.035       0.000
359             31.400     18.035       0.000
366             36.030     18.035       0.000
468             36.030      7.920       0.000
739             36.030     14.460       0.000
740             40.660     14.460       0.000
851             16.800      4.500       0.000
852             22.260      4.500       0.000
936              4.200     10.500       0.000

ETABS v9.7.4  File:MODELO  Units:KN-m  noviembre 18, 2016 14:27  PAGE 3

C O L U M N   C O N N E C T I V I T Y   D A T A

COLUMN       I END PT    J END PT    I END STORY

C1           1           1           Below
C2           2           2           Below
C3           3           3           Below
C4           4           4           Below
C5           5           5           Below
C6           6           6           Below
C7           7           7           Below
C8           8           8           Below
C9           9           9           Below
C10          10          10          Below
C11          11          11          Below
C12          12          12          Below
C13          13          13          Below
C14          14          14          Below
C15          15          15          Below
C16          16          16          Below
C34          227         227         Below
C35          228         228         Below
C36          229         229         Below
C37          230         230         Below
C1-1         1           1-1         Below
C2-1         2           2-1         Below
C3-1         3           3-1         Below
C4-1         4           4-1         Below
C5-1         5           5-1         Below
C42          183         183         Below
C44          237         237         Below
C45          243         243         Below
C46          247         247         Below
C47          251         251         Below
C48          255         255         Below
C60          260         260         Below
C62          272         272         Below
C3-2         3-1         3           Same

ETABS v9.7.4  File:MODELO  Units:KN-m  noviembre 18, 2016 14:27  PAGE 4

B E A M   C O N N E C T I V I T Y   D A T A

BEAM         I END PT    J END PT

B1           1           2
B2           2           3
B3           3           4
B4           4           5
```

```
B5          5           6
B6          7           8
B7          8           9
B8          9           10
B9          10          11
B10         11          12
B11         13          14
B12         14          15
B13         15          16
B14         18          19
B15         19          20
B18         13          7
B19         7           1
B21         14          8
B22         8           2
B24         15          9
B25         9           3
B27         16          10
B28         10          4
B29         11          5
B30         12          6
B52         32          12
B44         11          56
B50         16          56
B53         56          32
B94         1           221
B95         2           222
B96         3           223
B97         4           224
B98         5           225
B100        227         13
B101        228         14
B102        229         15
B103        230         16
B104        227         228
B105        228         229
B106        229         230
B107        227         18
B112        20          229
B113        19          228
B115        221         222
B116        222         223
B117        223         224
B118        224         225
B121        288         289
B123        290         291
B128        280         468
B134        280         281
B135        272         739
B136        739         740
B137        851         852
B138        183         243
B139        243         251
B140        237         247
B141        247         255
B142        255         260
B146        320         337
B147        337         326
B148        326         328
B149        328         329
B150        327         338
B151        338         325
B152        289         936

ETABS v9.7.4  File:MODELO  Units:KN-m  noviembre 18, 2016 14:27  PAGE 5

B R A C E   C O N N E C T I V I T Y   D A T A

BRACE       I END PT    J END PT    I END STORY

D119        13          183         Below
D120        7           237         Below
D121        14          243         Below
D122        8           247         Below
D123        15          251         Below
D124        9           255         Below
D125        10          260         Below
D130        11          272         Below
```

```
D1 51        319          237          Below
D1 52        237          320          Below
D1 57        251          325          Below
D1 58        255          326          Below
D1 59        183          327          Below
D1 60        260          328          Below
D1 61        272          329          Below
D1 68        247          337          Below
D1 69        243          338          Below
D1 70        221          1-1          Below
D1 71        1-1          319          Same
D1 75        18           227          Below
D1 76        227          183          Below
D1 84        19           228          Below
D1 85        228          243          Below
D1 86        356          247          Below
D1 87        222          2-1          Below
D1 88        2-1          356          Same
D1 89        20           229          Below
D1 90        229          251          Below
D1 91        357          255          Below
D1 92        223          3-1          Below
D1 93        3-1          357          Same
D1 94        358          260          Below
D1 95        224          4-1          Below
D1 96        4-1          358          Same
D1 97        359          272          Below
D1 98        225          5-1          Below
D1 99        5-1          359          Same

ETABS v9.7.4  File:MODELO  Units:KN-m  noviembre 18, 2016 14:27  PAGE 6

R I G I D   D I A P H R A G M   P O I N T   C O N N E C T I V I T Y   D A T A

STORY        DIAPHRAGM    POINT        POINT        POINT        POINT        POINT

N+3.45       D1           1            2            3            4            5
                          6            7            8            9            10
                          11           12           13           14           15
                          16           32           56           221          222
                          223          224          225          227          228
                          229          230          18           19           20
                          280          281          183          243          251
                          237          247          255          260          272
                          468          739          740          851          852


ETABS v9.7.4  File:MODELO  Units:KN-m  noviembre 18, 2016 14:27  PAGE 7

M A T E R I A L   P R O P E R T Y   D A T A

MATERIAL     MATERIAL     DESIGN       MATERIAL       MODULUS OF   POISSON'S      THERMAL        SHEAR
NAME         TYPE         TYPE         DIR/PLANE      ELASTICITY       RATIO        COEFF      MODULUS

A500         Iso          Steel        All          199900000.00      0.3000  1.1700E-05  76884615.38
CONC         Iso          Concrete     All           24821128.402     0.2000  9.9000E-0610342136.834
OTHER        Iso          None         All          199947978.80      0.3000  1.1700E-05  76903068.77
CON21        Iso          Concrete     All           21538110.000     0.2000  9.9000E-06  8974212.500
MASA         Iso          Concrete     All                  0.000     0.2000  9.9000E-06        0.000


M A T E R I A L   P R O P E R T Y   M A S S   A N D   W E I G H T

MATERIAL        MASS PER  WEIGHT PER
NAME            UNIT VOL    UNIT VOL

A500          7.8271E+00  7.6820E+01
CONC          2.4007E+00  2.3562E+01
OTHER         7.8271E+00  7.6820E+01
CON21         2.4000E+00  2.4000E+01
MASA          2.4000E+00  0.0000E+00


M A T E R I A L   D E S I G N   D A T A   F O R   S T E E L   M A T E R I A L S

MATERIAL           STEEL        STEEL        STEEL
NAME                  FY           FU   COST ($)
```

```
A500           322000.000  400000.000     5000.00

M A T E R I A L   D E S I G N   D A T A   F O R   C O N C R E T E   M A T E R I A L S

MATERIAL     LIGHTWEIGHT      CONCRETE       REBAR        REBAR     LIGHTWT
NAME         CONCRETE               FC          FY          FYS  REDUC FACT

CONC         No              27579.032  413685.473  413685.473          N/A
CON21        No              21000.000  420000.000  420000.000          N/A
MASA         No              21000.000  420000.000  420000.000          N/A

ETABS v9.7.4  File:MODELO  Units:KN-m  noviembre 18, 2016 14:27  PAGE 8

F R A M E   S E C T I O N   P R O P E R T Y   D A T A

                                    MATERIAL   SECTION SHAPE NAME OR NAME     CONC        CONC
FRAME SECTION NAME                  NAME       IN SECTION DATABASE FILE       COL         BEAM

VIGA40X45                           CON21      Rectangular                                Yes
VIGA15X45                           CON21      Rectangular                                Yes
COL40X60                            CON21      Rectangular                    Yes
VIGA20X45                           CON21      Rectangular                                Yes
VIGA30X45                           CON21      Rectangular                                Yes
PERFILMETALICO25X15                 A500       Box/Tube
COLMETALICA25X15                    A500       Box/Tube
VIGA45X60                           CON21      Rectangular                                Yes
COL50X60                            CON21      Rectangular                    Yes
COL60X60                            CON21      Rectangular                    Yes
CHEQUEO                             CON21      SD Section

F R A M E   S E C T I O N   P R O P E R T Y   D A T A

                                       SECTION     FLANGE     FLANGE        WEB     FLANGE     FLANGE
FRAME SECTION NAME                       DEPTH  WIDTH TOP  THICK TOP      THICK  WIDTH BOT  THICK BOT

VIGA40X45                               0.4500     0.4000     0.0000     0.0000     0.4000     0.0000
VIGA15X45                               0.4500     0.1500     0.0000     0.0000     0.1500     0.0000
COL40X60                                0.4000     0.6000     0.0000     0.0000     0.6000     0.0000
VIGA20X45                               0.4500     0.2000     0.0000     0.0000     0.2000     0.0000
VIGA30X45                               0.4500     0.3000     0.0000     0.0000     0.0000     0.0000
PERFILMETALICO25X15                     0.2500     0.1500     0.0050     0.0050     0.0000     0.0000
COLMETALICA25X15                        0.1500     0.2500     0.0050     0.0050     0.0000     0.0000
VIGA45X60                               0.6000     0.4500     0.0000     0.0000     0.0000     0.0000
COL50X60                                0.5000     0.6000     0.0000     0.0000     0.0000     0.0000
COL60X60                                0.6000     0.6000     0.0000     0.0000     0.0000     0.0000
CHEQUEO                                 0.6000     0.5000     0.0000     0.0000     0.0000     0.0000

F R A M E   S E C T I O N   P R O P E R T Y   D A T A

                                       SECTION  TORSIONAL      MOMENTS OF INERTIA           SHEAR AREAS
FRAME SECTION NAME                        AREA   CONSTANT        I33        I22         A2         A3

VIGA40X45                               0.1800     0.0045     0.0030     0.0024     0.1500     0.1500
VIGA15X45                               0.0675     0.0004     0.0011     0.0001     0.0563     0.0563
COL40X60                                0.2400     0.0075     0.0032     0.0072     0.2000     0.2000
VIGA20X45                               0.0900     0.0009     0.0015     0.0003     0.0750     0.0750
VIGA30X45                               0.1350     0.0024     0.0023     0.0010     0.1125     0.1125
PERFILMETALICO25X15                     0.0039     0.0000     0.0000     0.0000     0.0025     0.0015
COLMETALICA25X15                        0.0039     0.0000     0.0000     0.0000     0.0015     0.0025
VIGA45X60                               0.2700     0.0098     0.0081     0.0046     0.2250     0.2250
COL50X60                                0.3000     0.0124     0.0063     0.0090     0.2500     0.2500
COL60X60                                0.3600     0.0183     0.0108     0.0108     0.3000     0.3000
CHEQUEO                                 0.3457     0.0126     0.0104     0.0072     0.2881     0.2881

F R A M E   S E C T I O N   P R O P E R T Y   D A T A

                                           SECTION MODULI         PLASTIC MODULI     RADIUS OF GYRATION
FRAME SECTION NAME                         S33        S22        Z33        Z22        R33        R22

VIGA40X45                               0.0135     0.0120     0.0203     0.0180     0.1299     0.1155
VIGA15X45                               0.0051     0.0017     0.0076     0.0025     0.1299     0.0433
COL40X60                                0.0160     0.0240     0.0240     0.0360     0.1155     0.1732
VIGA20X45                               0.0068     0.0030     0.0101     0.0045     0.1299     0.0577
VIGA30X45                               0.0101     0.0068     0.0152     0.0101     0.1299     0.0866
```

```
PERFILMETALICO25X15                         0.0003      0.0002      0.0003      0.0002      0.0934      0.0629
COLMETALICA25X15                            0.0002      0.0003      0.0002      0.0003      0.0629      0.0934
VIGA45X60                                   0.0270      0.0203      0.0405      0.0304      0.1732      0.1299
COL50X60                                    0.0250      0.0300      0.0375      0.0450      0.1443      0.1732
COL60X60                                    0.0360      0.0360      0.0540      0.0540      0.1732      0.1732
CHEQUEO                                     0.0346      0.0288      0.0450      0.0375      0.1732      0.1443


F R A M E   S E C T I O N   W E I G H T S   A N D   M A S S E S

                                             TOTAL       TOTAL
FRAME SECTION NAME                          WEIGHT        MASS

VIGA40X45                                1538.0928    153.8093
VIGA15X45                                  12.8304      1.2830
COL40X60                                  350.4960     35.0496
VIGA20X45                                  39.7440      3.9744
VIGA30X45                                 162.2592     16.2259
PERFILMETALICO25X15                       127.5026     12.9912
COLMETALICA25X15                            6.3223      0.6442
VIGA45X60                                  60.0048      6.0005
COL50X60                                  206.4960     20.6496
COL60X60                                   30.2400      3.0240
CHEQUEO                                     0.0000      0.0000


C O N C R E T E   C O L U M N   D A T A

                                  REINF CONFIGURATION    REINF           NUM BARS    NUM BARS         BAR
FRAME SECTION NAME                LONGIT     LATERAL     SIZE/TYPE      3DIR/2DIR    CIRCULAR       COVER

COL40X60                          Rectangular Ties       #8/Design            6/4         N/A      0.0500
COL50X60                          Rectangular Ties       #8/Design            6/5         N/A      0.0500
COL60X60                          Rectangular Ties       #8/Design            6/6         N/A      0.0600


C O N C R E T E   B E A M   D A T A

                                               TOP         BOT    TOP LEFT   TOP RIGHT    BOT LEFT   BOT RIGHT
FRAME SECTION NAME                           COVER       COVER        AREA        AREA        AREA        AREA

VIGA40X45                                   0.0457      0.0457       0.000       0.000       0.000       0.000
VIGA15X45                                   0.0450      0.0450       0.000       0.000       0.000       0.000
VIGA20X45                                   0.0450      0.0450       0.000       0.000       0.000       0.000
VIGA30X45                                   0.0457      0.0457       0.000       0.000       0.000       0.000
VIGA45X60                                   0.0500      0.0500       0.000       0.000       0.000       0.000

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S H E L L   S E C T I O N   P R O P E R T Y   D A T A

SHELL       MATERIAL    SHELL       LOAD DIST      MEMBRANE     BENDING       TOTAL       TOTAL
SECTION     NAME        TYPE        ONE WAY           THICK       THICK      WEIGHT        MASS

WALL1       CON21       Shell-Thin  No               0.2500      0.2500      0.0000      0.0000
CUBIERTA    CON21       Membrane    No               0.1960      0.1960    633.0474     63.3047
SALONES     CON21       Membrane    No               0.2250      0.2250    310.2624     31.0262
CORREDORES  CON21       Shell-Thin  No               0.1420      0.1420     73.8582      7.3858
CUBIERTALIV CON21       Membrane    No               0.0130      0.0130     25.2757      2.5276
MURO1       CON21       Shell-Thin  No               0.1500      0.1500    193.6678     19.3668
CUBIERTAMET MASA        Membrane    Yes              0.0130      0.0130      0.0000     16.0586

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S T A T I C   L O A D   C A S E S

STATIC      CASE        AUTO LAT         SELF WT    NOTIONAL    NOTIONAL
CASE        TYPE        LOAD          MULTIPLIER      FACTOR   DIRECTION

DEAD        DEAD        N/A               1.0000
LIVE        LIVE        N/A               0.0000

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R E S P O N S E   S P E C T R U M   C A S E S
```

```
RESP SPEC CASE: SISDERX

  BASIC RESPONSE SPECTRUM DATA

    MODAL       DIRECTION          MODAL    SPECTRUM     TYPICAL
    COMBO       COMBO            DAMPING       ANGLE       ECCEN

    SRSS        SRSS              0.0500      0.0000      0.0500


  RESPONSE SPECTRUM FUNCTION ASSIGNMENT DATA

    DIRECTION   FUNCTION      SCALE FACT

    U1          DERIVAS          13.8800
    U2          ----                 N/A
    UZ          ----                 N/A

RESP SPEC CASE: SISDERY

  BASIC RESPONSE SPECTRUM DATA

    MODAL       DIRECTION          MODAL    SPECTRUM     TYPICAL
    COMBO       COMBO            DAMPING       ANGLE       ECCEN

    SRSS        SRSS              0.0500      0.0000      0.0500


  RESPONSE SPECTRUM FUNCTION ASSIGNMENT DATA

    DIRECTION   FUNCTION      SCALE FACT

    U1          ----                 N/A
    U2          DERIVAS          23.7000
    UZ          ----                 N/A

RESP SPEC CASE: SISDISX

  BASIC RESPONSE SPECTRUM DATA

    MODAL       DIRECTION          MODAL    SPECTRUM     TYPICAL
    COMBO       COMBO            DAMPING       ANGLE       ECCEN

    SRSS        SRSS              0.0500      0.0000      0.0500


  RESPONSE SPECTRUM FUNCTION ASSIGNMENT DATA

    DIRECTION   FUNCTION      SCALE FACT

    U1          DISENO           13.8800
    U2          ----                 N/A
    UZ          ----                 N/A

RESP SPEC CASE: SISDISY

  BASIC RESPONSE SPECTRUM DATA

    MODAL       DIRECTION          MODAL    SPECTRUM     TYPICAL
    COMBO       COMBO            DAMPING       ANGLE       ECCEN

    SRSS        SRSS              0.0500      0.0000      0.0500


  RESPONSE SPECTRUM FUNCTION ASSIGNMENT DATA

    DIRECTION   FUNCTION      SCALE FACT

    U1          ----                 N/A
    U2          DISENO           23.7000
    UZ          ----                 N/A

RESP SPEC CASE: SISUMBX
```

```
  BASIC RESPONSE SPECTRUM DATA

    MODAL       DIRECTION           MODAL    SPECTRUM     TYPICAL
    COMBO       COMBO             DAMPING       ANGLE       ECCEN

    SRSS        SRSS               0.0200      0.0000      0.0500

  RESPONSE SPECTRUM FUNCTION ASSIGNMENT DATA

    DIRECTION   FUNCTION      SCALE FACT

    U1          UMBRAL           20.2600
    U2          ----                 N/A
    UZ          ----                 N/A

RESP SPEC CASE: SISUMBY

  BASIC RESPONSE SPECTRUM DATA

    MODAL       DIRECTION           MODAL    SPECTRUM     TYPICAL
    COMBO       COMBO             DAMPING       ANGLE       ECCEN

    SRSS        SRSS               0.0200      0.0000      0.0500

  RESPONSE SPECTRUM FUNCTION ASSIGNMENT DATA

    DIRECTION   FUNCTION      SCALE FACT

    U1          ----                 N/A
    U2          UMBRAL           33.8100
    UZ          ----                 N/A

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L O A D I N G   C O M B I N A T I O N S

            COMBO                   CASE                 SCALE
COMBO       TYPE        CASE        TYPE                FACTOR

COMDER1     ADD         SISDERX     Spectra             1.0000
                        SISDERY     Spectra             0.3000
COMDER2     ADD         SISDERX     Spectra             0.3000
                        SISDERY     Spectra             1.0000
COMDIS1     ADD         DEAD        Static              1.4000
COMDIS2     ADD         LIVE        Static              1.6000
                        DEAD        Static              1.2000
COMDIS3     ADD         LIVE        Static              1.0000
                        DEAD        Static              1.2000
                        SISDISX     Spectra             1.0000
                        SISDISY     Spectra             0.3000
COMDIS4     ADD         LIVE        Static              1.0000
                        DEAD        Static              1.2000
                        SISDISX     Spectra             0.3000
                        SISDISY     Spectra             1.0000
COMDIS5     ADD         DEAD        Static              0.9000
                        SISDISX     Spectra             1.0000
                        SISDISY     Spectra             0.3000
COMDIS6     ADD         DEAD        Static              0.9000
                        SISDISX     Spectra             0.3000
                        SISDISY     Spectra             1.0000
ENVOLVENTE  ENVE        COMDIS1     Combo               1.0000
                        COMDIS2     Combo               1.0000
                        COMDIS3     Combo               1.0000
                        COMDIS4     Combo               1.0000
                        COMDIS5     Combo               1.0000
                        COMDIS6     Combo               1.0000
COMDERUMBE  ADD         SISUMBX     Spectra             1.0000
                        SISUMBY     Spectra             0.3000
COMDERUMB2  ADD         SISUMBX     Spectra             0.3000
                        SISUMBY     Spectra             1.0000
CIM         ADD         DEAD        Static              1.0000
                        LIVE        Static              1.0000
CIM2        ADD         DEAD        Static              1.0000
                        LIVE        Static              0.7500
                        SISDISY     Spectra          0.1500
CIM3        ADD         DEAD        Static           1.0000
                        LIVE        Static           0.7500
                        SISDISX     Spectra          0.1500
                        SISDISY     Spectra          0.5250

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R E S P O N S E   S P E C T R U M   F U N C T I O N   -   F R O M   F I L E

FUNCTION NAME: DERIVAS

  FILE NAME: c:\users\user\desktop\juan camilo\proyectos\mercedes abrego\modelo\derivas.txt
  DATA TYPE: Period vs Acceleration
  NUMBER OF HEADER LINES = 0


        PERIOD       ACCEL

        0.0000      1.1330
        0.0500      1.1330
        0.1000      1.1330
        0.1600      1.1330
        0.2100      1.1330
        0.4000      1.1330
        0.6000      1.1330
        0.8000      1.1330
        0.9900      1.1330
        1.3400      0.9410
        1.6800      0.6690
        2.0300      0.5550
        2.3700      0.4740
        2.7200      0.4140
        3.0600      0.3670
        3.4100      0.3300
        3.7500      0.3000
        4.1000      0.2750
        4.4400      0.2530
        4.7900      0.2350
        5.1300      0.2190
        5.4800      0.2050
        5.8200      0.1930
        6.1700      0.1820
        6.5100      0.1730
        6.8600      0.1640
        7.2000      0.1560
        8.2000      0.1200
        9.2000      0.0960


FUNCTION NAME: DISENO

  FILE NAME: c:\users\user\desktop\juan camilo\proyectos\mercedes abrego\modelo\diseño.txt
  DATA TYPE: Period vs Acceleration
  NUMBER OF HEADER LINES = 0


        PERIOD       ACCEL

        0.0000      0.1800
        0.0500      0.1800
        0.1000      0.1800
        0.1600      0.1800
        0.2100      0.1800
        0.4000      0.1800
        0.6000      0.1800
        0.8000      0.1800
        0.9900      0.1800
        1.3400      0.1330
        1.6800      0.1060
        2.0300      0.0880
        2.3700      0.0750
        2.7200      0.0660
        3.0600      0.0580
        3.4100      0.0520
        3.7500      0.0480
        4.1000      0.0440
        4.4400      0.0400
```

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       4.7900      0.0370
       5.1300      0.0350
       5.4800      0.0330
       5.8200      0.0310
       6.1700      0.0290
       6.5100      0.0270
       6.8600      0.0260
       7.2000      0.0250
       8.2000      0.0190
       9.2000      0.0150

FUNCTION NAME: UMBRAL

  FILE NAME: c:\users\user\desktop\juan camilo\proyectos\mercedes abrego\modelo\umbral.txt
  DATA TYPE: Period vs Acceleration
  NUMBER OF HEADER LINES = 0


       PERIOD       ACCEL

       0.0000      0.1000
       0.0500      0.1400
       0.1000      0.1800
       0.1500      0.2200
       0.2000      0.2600
       0.2500      0.3000
       0.4900      0.3000
       0.7300      0.3000
       0.9800      0.3000
       1.2200      0.3000
       1.4600      0.3000
       1.7000      0.3000
       1.9500      0.3000
       2.1900      0.3000
       2.7800      0.2360
       3.3800      0.1940
       3.9700      0.1650
       4.5600      0.1440
       5.1600      0.1270
       5.7500      0.1140
       6.3400      0.1030
       6.9400      0.0950
       7.5300      0.0870
       8.1300      0.0810
       8.7200      0.0750
       9.3100      0.0700
       9.9100      0.0660
      10.5000      0.0630
      11.5000      0.0520
      12.5000      0.0440

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F R A M E   S E C T I O N   A S S I G N M E N T S   T O   L I N E   O B J E C T S

STORY     LINE      LINE      SECTION             AUTO SELECT ANALYSIS   DESIGN     DESIGN
LEVEL     ID        TYPE      TYPE                SECTION   SECTION   PROCEDURE  SECTION

N+5.      C42       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+5.      C44       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+5.      C45       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+5.      C46       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+5.      C47       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+5.      C49       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+5.      C60       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+5.      C62       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+4.00    C7        Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+4.00    C8        Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+4.00    C9        Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+4.00    C10       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+4.00    C11       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+4.00    C13       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+4.00    C14       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+4.00    C15       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+4.00    C34       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+4.00    C35       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
N+4.00    C36       Column    Box/Tube            None      COLMETALICA Steel Frame COLMETALICA
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N+4.00	C1-1	Column	Box/Tube	None	COLMETALICA	Steel	Frame	COLMETALICA
N+4.00	C2-1	Column	Box/Tube	None	COLMETALICA	Steel	Frame	COLMETALICA
N+4.00	C3-1	Column	Box/Tube	None	COLMETALICA	Steel	Frame	COLMETALICA
N+4.00	C4-1	Column	Box/Tube	None	COLMETALICA	Steel	Frame	COLMETALICA
N+4.00	C5-1	Column	Box/Tube	None	COLMETALICA	Steel	Frame	COLMETALICA
N+4.00	C42	Column	Box/Tube	None	COLMETALICA	Steel	Frame	COLMETALICA
N+4.00	C44	Column	Box/Tube	None	COLMETALICA	Steel	Frame	COLMETALICA
N+4.00	C45	Column	Box/Tube	None	COLMETALICA	Steel	Frame	COLMETALICA
N+4.00	C46	Column	Box/Tube	None	COLMETALICA	Steel	Frame	COLMETALICA
N+4.00	C47	Column	Box/Tube	None	COLMETALICA	Steel	Frame	COLMETALICA
N+4.00	C48	Column	Box/Tube	None	COLMETALICA	Steel	Frame	COLMETALICA
N+4.00	C60	Column	Box/Tube	None	COLMETALICA	Steel	Frame	COLMETALICA
N+4.00	C62	Column	Box/Tube	None	COLMETALICA	Steel	Frame	COLMETALICA
N+4.00	C3-2	Column	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+3.45	C1	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+3.45	C2	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+3.45	C3	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+3.45	C4	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+3.45	C5	Column	Rectangular	None	COL50X60	Conc	Frame	COL50X60
N+3.45	C6	Column	Rectangular	None	COL50X60	Conc	Frame	COL50X60
N+3.45	C7	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+3.45	C8	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+3.45	C9	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+3.45	C10	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+3.45	C11	Column	Rectangular	None	COL60X60	Conc	Frame	COL60X60
N+3.45	C12	Column	Rectangular	None	COL50X60	Conc	Frame	COL50X60
N+3.45	C13	Column	Rectangular	None	COL50X60	Conc	Frame	COL50X60
N+3.45	C14	Column	Rectangular	None	COL50X60	Conc	Frame	COL50X60
N+3.45	C15	Column	Rectangular	None	COL50X60	Conc	Frame	COL50X60
N+3.45	C16	Column	Rectangular	None	COL50X60	Conc	Frame	COL50X60
N+3.45	C34	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+3.45	C35	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+3.45	C36	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+3.45	C37	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+0.00	C1	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+0.00	C7	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+0.00	C8	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+0.00	C13	Column	Rectangular	None	COL50X60	Conc	Frame	COL50X60
N+0.00	C14	Column	Rectangular	None	COL50X60	Conc	Frame	COL50X60
N+0.00	C34	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+0.00	C35	Column	Rectangular	None	COL40X60	Conc	Frame	COL40X60
N+5.85	B146	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+5.85	B147	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+5.85	B148	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+5.85	B149	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+5.85	B150	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+5.85	B151	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+5.	B138	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+5.	B139	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+5.	B140	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+5.	B141	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+5.	B142	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+4.00	B6	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+4.00	B7	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+4.00	B8	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+4.00	B9	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+4.00	B11	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+4.00	B12	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+3.45	B1	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B2	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B3	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B4	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B5	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B6	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B7	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B8	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B9	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B10	Beam	Rectangular	None	VIGA45X60	Conc	Frame	VIGA45X60
N+3.45	B11	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B12	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B13	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B14	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+3.45	B15	Beam	Box/Tube	None	PERFILMETAL	Steel	Frame	PERFILMETAL
N+3.45	B18	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B19	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B21	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B22	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45
N+3.45	B24	Beam	Rectangular	None	VIGA40X45	Conc	Frame	VIGA40X45

N+3.45	B25	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B27	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B28	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B29	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B30	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B52	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B44	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B50	Beam	Rectangular	None	VIGA20X45	Conc Frame	VIGA20X45
N+3.45	B53	Beam	Rectangular	None	VIGA20X45	Conc Frame	VIGA20X45
N+3.45	B94	Beam	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+3.45	B95	Beam	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+3.45	B96	Beam	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+3.45	B97	Beam	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+3.45	B98	Beam	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+3.45	B100	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B101	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B102	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B103	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B104	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B105	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B106	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B107	Beam	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+3.45	B112	Beam	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+3.45	B113	Beam	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+3.45	B115	Beam	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+3.45	B116	Beam	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+3.45	B117	Beam	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+3.45	B118	Beam	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+3.45	B128	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B134	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B135	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B136	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+3.45	B137	Beam	Rectangular	None	VIGA30X45	Conc Frame	VIGA30X45
N+0.00	B6	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+0.00	B11	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+0.00	B18	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+0.00	B21	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+0.00	B100	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+0.00	B101	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+0.00	B104	Beam	Rectangular	None	VIGA40X45	Conc Frame	VIGA40X45
N+0.00	B121	Beam	Rectangular	None	VIGA30X45	Conc Frame	VIGA30X45
N+0.00	B123	Beam	Rectangular	None	VIGA30X45	Conc Frame	VIGA30X45
N+0.00	B152	Beam	Rectangular	None	VIGA30X45	Conc Frame	VIGA30X45
N+5.85	D152	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.85	D157	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.85	D158	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.85	D159	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.85	D160	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.85	D161	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.85	D168	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.85	D169	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D119	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D120	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D121	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D122	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D123	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D124	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D125	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D130	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D151	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D176	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D185	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D186	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D190	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D191	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D194	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+5.	D197	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+4.00	D170	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+4.00	D171	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+4.00	D175	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+4.00	D184	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+4.00	D187	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+4.00	D188	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+4.00	D189	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+4.00	D192	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+4.00	D193	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+4.00	D195	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL
N+4.00	D196	Brace	Box/Tube	None	PERFILMETAL	Steel Frame	PERFILMETAL

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N+4.00       D198         Brace        Box/Tube                 None         PERFILMETAL Steel Frame PERFILMETAL
N+4.00       D199         Brace        Box/Tube                 None         PERFILMETAL Steel Frame PERFILMETAL

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D I S T R I B U T E D   L O A D   A S S I G N M E N T S   T O   L I N E   O B J E C T S

LOAD         STORY        LINE         LOAD         LOAD              ABSOLUTE     ABSOLUTE       LOAD A       LOAD B
CASE         LEVEL        ID           TYPE         DIRECTION       DISTANCE A   DISTANCE B   PER LENGTH   PER LENGTH

LIVE         N+4.00       C1-1         Force        Gravity              0.000        0.369        1.470        1.470
DEAD         N+5.85       D152         Force        Gravity              0.000        1.485        1.260        1.260
DEAD         N+5.85       D157         Force        Gravity              0.000        1.702        2.079        2.079
DEAD         N+5.85       D158         Force        Gravity              0.000        1.485        2.079        2.079
DEAD         N+5.85       D159         Force        Gravity              0.000        1.702        1.260        1.260
DEAD         N+5.85       D160         Force        Gravity              0.000        1.485        2.190        2.190
DEAD         N+5.85       D161         Force        Gravity              0.000        1.485        1.389        1.389
DEAD         N+5.85       D168         Force        Gravity              0.000        1.485        2.560        2.560
DEAD         N+5.85       D169         Force        Gravity              0.000        1.702        2.560        2.560
DEAD         N+5.         D119         Force        Gravity              0.000        4.144        1.260        1.260
DEAD         N+5.         D120         Force        Gravity              0.000        4.144        1.260        1.260
DEAD         N+5.         D121         Force        Gravity              0.000        4.144        2.560        2.560
DEAD         N+5.         D122         Force        Gravity              0.000        4.144        2.560        2.560
DEAD         N+5.         D123         Force        Gravity              0.000        4.144        2.079        2.079
DEAD         N+5.         D124         Force        Gravity              0.000        4.144        2.079        2.079
DEAD         N+5.         D125         Force        Gravity              0.000        4.144        2.190        2.190
DEAD         N+5.         D130         Force        Gravity              0.000        4.144        1.389        1.389
DEAD         N+5.         D151         Force        Gravity              0.000        3.777        1.260        1.260
DEAD         N+5.         D176         Force        Gravity              0.000        3.128        1.260        1.260
DEAD         N+5.         D185         Force        Gravity              0.000        3.128        2.560        2.560
DEAD         N+5.         D186         Force        Gravity              0.000        3.777        2.560        2.560
DEAD         N+5.         D190         Force        Gravity              0.000        3.128        2.079        2.079
DEAD         N+5.         D191         Force        Gravity              0.000        3.777        2.080        2.080
DEAD         N+5.         D194         Force        Gravity              0.000        3.777        2.190        2.190
DEAD         N+5.         D197         Force        Gravity              0.000        3.777        1.390        1.390
DEAD         N+4.00       D170         Force        Gravity              0.000        1.141        1.260        1.260
DEAD         N+4.00       D171         Force        Gravity              0.000        0.407        1.260        1.260
DEAD         N+4.00       D175         Force        Gravity              0.000        1.190        1.260        1.260
DEAD         N+4.00       D184         Force        Gravity              0.000        1.190        2.560        2.560
DEAD         N+4.00       D187         Force        Gravity              0.000        1.141        2.560        2.560
DEAD         N+4.00       D187         Force        Gravity              1.141        1.141        2.560        2.560
DEAD         N+4.00       D188         Force        Gravity              0.000        0.407        2.560        2.560
DEAD         N+4.00       D189         Force        Gravity              0.000        1.190        2.079        2.079
DEAD         N+4.00       D192         Force        Gravity              0.000        1.141        2.079        2.079
DEAD         N+4.00       D193         Force        Gravity              0.000        0.407        2.080        2.080
DEAD         N+4.00       D195         Force        Gravity              0.000        1.141        2.190        2.190
DEAD         N+4.00       D196         Force        Gravity              0.000        0.407        2.190        2.190
DEAD         N+4.00       D198         Force        Gravity              0.000        1.141        1.389        1.389
DEAD         N+4.00       D199         Force        Gravity              0.000        0.407        1.390        1.390
LIVE         N+5.85       D152         Force        Gravity              0.000        1.485        1.470        1.470
LIVE         N+5.85       D157         Force        Gravity              0.000        1.702        2.420        2.420
LIVE         N+5.85       D158         Force        Gravity              0.000        1.485        2.420        2.420
LIVE         N+5.85       D159         Force        Gravity              0.000        1.702        1.470        1.470
LIVE         N+5.85       D160         Force        Gravity              0.000        1.485        2.550        2.550
LIVE         N+5.85       D161         Force        Gravity              0.000        1.485        1.620        1.620
LIVE         N+5.85       D168         Force        Gravity              0.000        1.485        2.940        2.940
LIVE         N+5.85       D169         Force        Gravity              0.000        1.702        2.940        2.940
LIVE         N+5.         D119         Force        Gravity              0.000        4.144        1.470        1.470
LIVE         N+5.         D120         Force        Gravity              0.000        4.144        1.470        1.470
LIVE         N+5.         D121         Force        Gravity              0.000        4.144        2.940        2.940
LIVE         N+5.         D122         Force        Gravity              0.000        4.144        2.940        2.940
LIVE         N+5.         D123         Force        Gravity              0.000        4.144        2.420        2.420
LIVE         N+5.         D124         Force        Gravity              0.000        4.144        2.420        2.420
LIVE         N+5.         D125         Force        Gravity              0.000        4.144        2.550        2.550
LIVE         N+5.         D130         Force        Gravity              0.000        4.144        1.620        1.620
LIVE         N+5.         D151         Force        Gravity              0.000        3.777        1.470        1.470
LIVE         N+5.         D176         Force        Gravity              0.000        3.128        1.470        1.470
LIVE         N+5.         D185         Force        Gravity              0.000        3.128        2.940        2.940
LIVE         N+5.         D186         Force        Gravity              0.000        3.777        2.940        2.940
LIVE         N+5.         D190         Force        Gravity              0.000        3.128        2.420        2.420
LIVE         N+5.         D191         Force        Gravity              0.000        3.777        2.420        2.420
LIVE         N+5.         D194         Force        Gravity              0.000        3.777        2.550        2.550
LIVE         N+5.         D197         Force        Gravity              0.000        3.777        1.620        1.620
LIVE         N+4.00       D170         Force        Gravity              0.000        1.141        1.470        1.470
LIVE         N+4.00       D171         Force        Gravity              0.000        0.407        1.470        1.470
LIVE         N+4.00       D175         Force        Gravity              0.000        1.190        1.470        1.470
LIVE         N+4.00       D184         Force        Gravity              0.000        1.190        2.940        2.940
LIVE         N+4.00       D187         Force        Gravity              0.000        1.141        2.940        2.940
LIVE       N+4.00     D187       Force      Gravity          1.141      1.141      2.940      2.940
LIVE       N+4.00     D188       Force      Gravity          0.000      0.407      2.940      2.940
LIVE       N+4.00     D189       Force      Gravity          0.000      1.190      2.420      2.420
LIVE       N+4.00     D192       Force      Gravity          0.000      1.141      2.420      2.420
LIVE       N+4.00     D193       Force      Gravity          0.000      0.407      2.420      2.420
LIVE       N+4.00     D195       Force      Gravity          0.000      1.141      2.550      2.550
LIVE       N+4.00     D196       Force      Gravity          0.000      0.407      2.550      2.550
LIVE       N+4.00     D198       Force      Gravity          0.000      1.141      1.620      1.620
LIVE       N+4.00     D199       Force      Gravity          0.000      0.407      1.620      1.620

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U N I F O R M   L O A D   A S S I G N M E N T S   T O   A R E A   O B J E C T S

CASE       STORY      AREA       AREATYPE   DIRECTION          LOAD

LIVE       N+3.45     F32        Floor      Gravity          0.3500
LIVE       N+3.45     F35        Floor      Gravity          5.0000
LIVE       N+3.45     F36        Floor      Gravity          5.0000
LIVE       N+3.45     F37        Floor      Gravity          0.3500
LIVE       N+3.45     F38        Floor      Gravity          0.3500
LIVE       N+3.45     F39        Floor      Gravity          0.3500
LIVE       N+3.45     F44        Floor      Gravity          5.0000
LIVE       N+3.45     F45        Floor      Gravity          5.0000
LIVE       N+3.45     F46        Floor      Gravity          5.0000
LIVE       N+3.45     F47        Floor      Gravity          5.0000
LIVE       N+3.45     F48        Floor      Gravity          5.0000
LIVE       N+3.45     F49        Floor      Gravity          5.0000
LIVE       N+0.00     F27        Floor      Gravity          2.0000
LIVE       N+0.00     F28        Floor      Gravity          2.0000
LIVE       N+0.00     F29        Floor      Gravity          2.0000
LIVE       N+0.00     F30        Floor      Gravity          2.0000
LIVE       N+0.00     F50        Floor      Gravity          5.0000
LIVE       N+0.00     F51        Floor      Gravity          5.0000
```
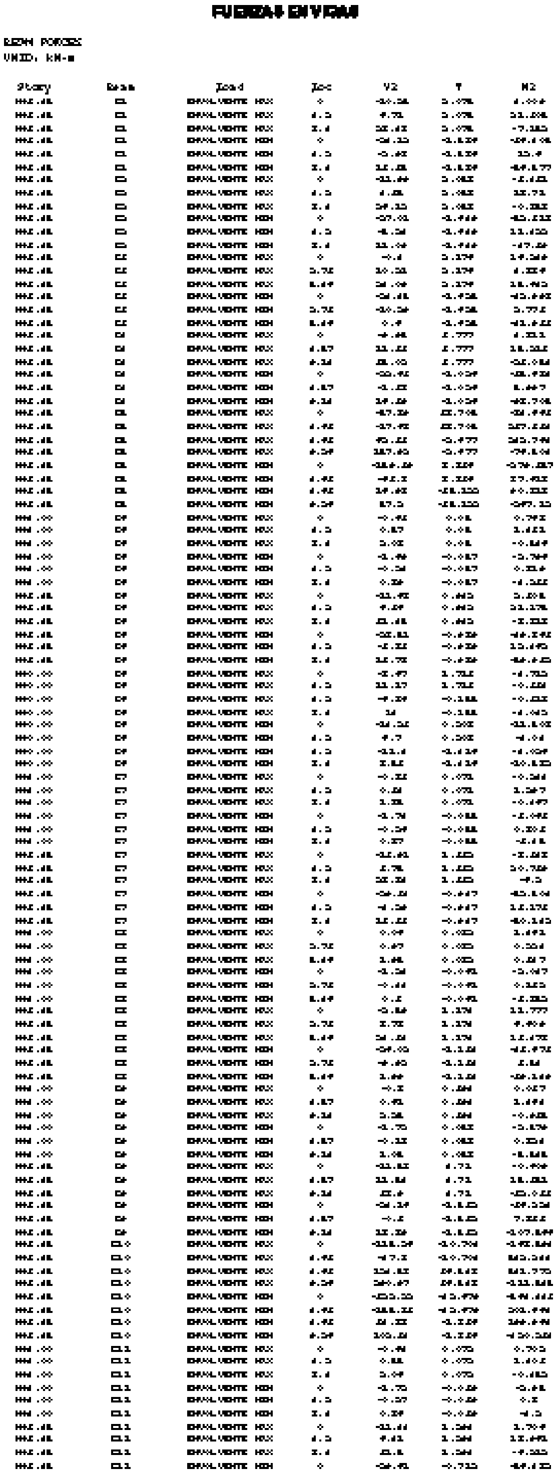

9.2 DATOS DE SALIDA



FUERZAS EN VIGAS

BEAM FORCES
UNID: kN-m

Story
Beam
Load
Loc
V2
T
M2

FUERZAS EN COLUMNAS

COLUMN FORCES
UNID: kN-m

Story	Column	Load	Loc	P	V2	V3	T	M2	M3
N+3.45	C1	ENVOLVENTE MAX	0.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C1	ENVOLVENTE MAX	1.750	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C1	ENVOLVENTE MAX	3.500	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C1	ENVOLVENTE MIN	0.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C1	ENVOLVENTE MIN	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C1	ENVOLVENTE MIN	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C1	ENVOLVENTE MAX	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C1	ENVOLVENTE MAX	1.045	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C1	ENVOLVENTE MAX	2.09	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C1	ENVOLVENTE MIN	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C1	ENVOLVENTE MIN	1.045	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C1	ENVOLVENTE MIN	2.09	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C2	ENVOLVENTE MAX	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C2	ENVOLVENTE MAX	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C2	ENVOLVENTE MAX	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C2	ENVOLVENTE MIN	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C2	ENVOLVENTE MIN	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C2	ENVOLVENTE MIN	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C3	ENVOLVENTE MAX	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C3	ENVOLVENTE MAX	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C3	ENVOLVENTE MAX	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C3	ENVOLVENTE MIN	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C3	ENVOLVENTE MIN	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C3	ENVOLVENTE MIN	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C4	ENVOLVENTE MAX	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C4	ENVOLVENTE MAX	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C4	ENVOLVENTE MAX	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C4	ENVOLVENTE MIN	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C4	ENVOLVENTE MIN	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C4	ENVOLVENTE MIN	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C5	ENVOLVENTE MAX	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C5	ENVOLVENTE MAX	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C5	ENVOLVENTE MAX	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C5	ENVOLVENTE MIN	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C5	ENVOLVENTE MIN	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C5	ENVOLVENTE MIN	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C6	ENVOLVENTE MAX	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C6	ENVOLVENTE MAX	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C6	ENVOLVENTE MAX	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C6	ENVOLVENTE MIN	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C6	ENVOLVENTE MIN	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C6	ENVOLVENTE MIN	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C7	ENVOLVENTE MAX	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C7	ENVOLVENTE MAX	0.25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C7	ENVOLVENTE MAX	0.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C7	ENVOLVENTE MIN	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C7	ENVOLVENTE MIN	0.25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C7	ENVOLVENTE MIN	0.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C7	ENVOLVENTE MAX	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C7	ENVOLVENTE MAX	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C7	ENVOLVENTE MAX	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C7	ENVOLVENTE MIN	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C7	ENVOLVENTE MIN	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C7	ENVOLVENTE MIN	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C7	ENVOLVENTE MAX	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C7	ENVOLVENTE MAX	1.045	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C7	ENVOLVENTE MAX	2.09	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C7	ENVOLVENTE MIN	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C7	ENVOLVENTE MIN	1.045	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C7	ENVOLVENTE MIN	2.09	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C8	ENVOLVENTE MAX	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C8	ENVOLVENTE MAX	0.25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C8	ENVOLVENTE MAX	0.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C8	ENVOLVENTE MIN	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C8	ENVOLVENTE MIN	0.25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C8	ENVOLVENTE MIN	0.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C8	ENVOLVENTE MAX	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C8	ENVOLVENTE MAX	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C8	ENVOLVENTE MAX	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C8	ENVOLVENTE MIN	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C8	ENVOLVENTE MIN	1.75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+3.45	C8	ENVOLVENTE MIN	3.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C8	ENVOLVENTE MAX	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C8	ENVOLVENTE MAX	1.045	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C8	ENVOLVENTE MAX	2.09	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C8	ENVOLVENTE MIN	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C8	ENVOLVENTE MIN	1.045	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+0.00	C8	ENVOLVENTE MIN	2.09	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C9	ENVOLVENTE MAX	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C9	ENVOLVENTE MAX	0.25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C9	ENVOLVENTE MAX	0.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N+4.00	C9	ENVOLVENTE MIN	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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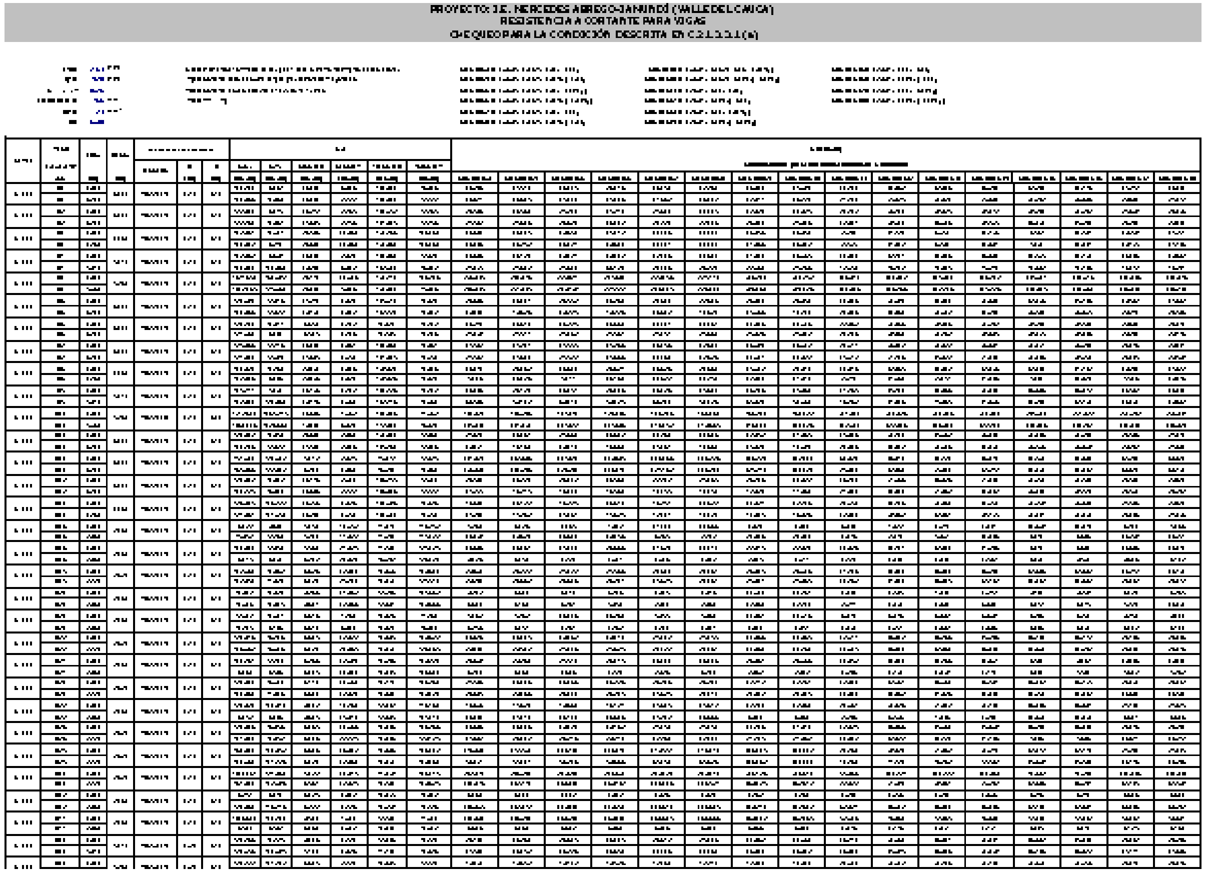
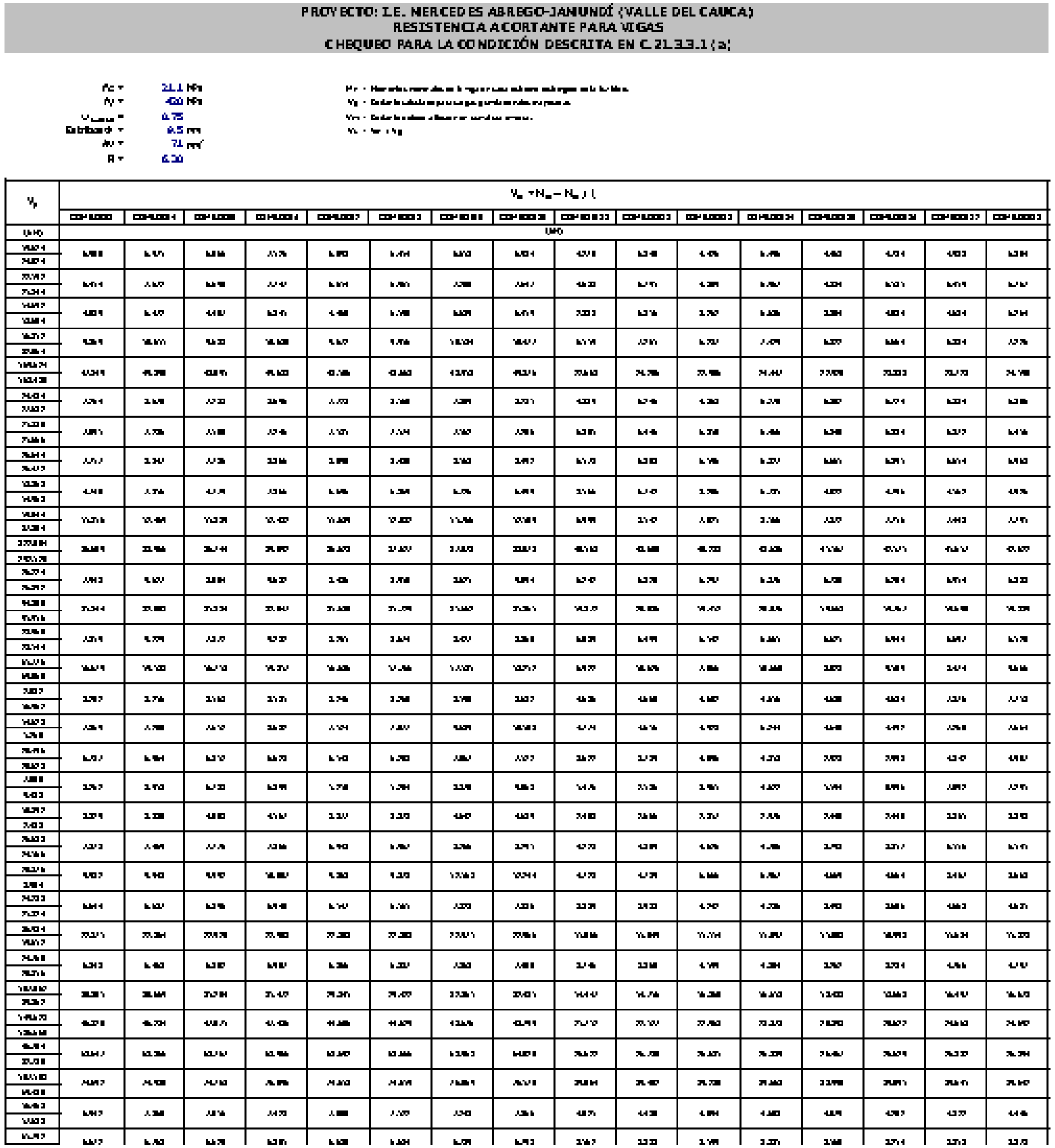
9.3 VERIFICACIONES



PROYECTO: I.E. MERCEDES ABREGO-JAMUNDÍ (VALLE DEL CAUCA)
RESISTENCIA A CORTANTE PARA VIGAS
CHEQUEO PARA LA CONDICIÓN DESCRITA EN C.21.3.3.1(a)



PROYECTO: I.E. MERCEDES ABREGO-JAMUNDÍ (VALLE DEL CAUCA)
RESISTENCIA A CORTANTE PARA VIGAS
CHEQUEO PARA LA CONDICIÓN DESCRITA EN C.21.3.3.1 (a)

f'c = 21.1 MPa
fy = 420 MPa
ϕ_{corte} = 0.75
Av = 71 mm²
R = 6.30

PROYECTO: I.E. MERCEDES ABREGO-JAMUNDÍ (VALLE DEL CAUCA)
RESISTENCIA A CORTANTE PARA VIGAS
CHEQUEO PARA LA CONDICIÓN DESCRITA EN C.21.3.3.1 (a)

$f'c$ = 21.1 MPa
fy = 420 MPa
ϕ_{corte} = 0.75
Estribos φ = 9.5 mm
Av = 71 mm²
R = 6.30

Ve = [illegible]
Vg = [illegible]
Vm = [illegible]
Vu = Ve + Vg

Ve = Vm − Vg																Vu_{max}	S	φVs	φVc	φVn	$φVn > Vu_{max}$
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
(kN)																(kN)	(m)	(kN)	(kN)	(kN)	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
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PROYECTO: I.E. MERCEDES ABREGO-JAMUNDÍ (VALLE DEL CAUCA)
RESISTENCIA A CORTANTE PARA VIGAS
CHEQUEO PARA LA CONDICIÓN DESCRITA EN C.21.3.3.1 (a)

f'c = 21.1 MPa
fy = 420 MPa
φ = 0.75
Estribo ф = 9.5 mm
Av = 71 mm²
R = 6.30

PROYECTO: I.E. MERCEDES ABREGO-JAMUNDÍ (VALLE DEL CAUCA)
RESISTENCIA A CORTANTE PARA VIGAS
CHEQUEO PARA LA CONDICIÓN DESCRITA EN C.21.3.3.1 (a)

f'c = 21.1 MPa
fy = 420 MPa
$\phi_{cortante}$ = 0.75
Estribos Ø = 9.5 mm
Av = 71 mm²
[illegible] = 6.30

[illegible]
[illegible]
[illegible]
[illegible]

V_p	$V_e = [illegible]$															
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(kN)	(kN)															
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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PROYECTO: I.E. MERCEDES ABREGO-JAMUNDÍ (VALLE DEL CAUCA)
RESISTENCIA A CORTANTE PARA VIGAS
CHEQUEO PARA LA CONDICIÓN DESCRITA EN C.21.3.3.1 (a)

f'c = 21.1 MPa
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$\phi_{cortante}$ = 0.75
Estribos ϕ = 9.5 mm
Av = 71 mm²
R = 6.20

Mpr = [illegible]
Vg = [illegible]
Vm = [illegible]
Vu = Vm + Vg

Vu = Vm − Vg																Vu max	s	φVs	φVc	φVn	φVn > Vu max
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
							(kN)									(kN)	(m)	(kN)	(kN)	(kN)	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
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CHEQUEO PARA LA CONDICIÓN DESCRITA EN C.21.3.3.1 (b)

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Av = 71 mm²
R = 4.50

ΣV = [illegible]

COMBO23 = [illegible]
COMBO24 = [illegible]
COMBO25 = [illegible]
COMBO26 = [illegible]
COMBO27 = [illegible]
COMBO28 = [illegible]
COMBO29 = [illegible]
COMBO210 = [illegible]
COMBO211 = [illegible]
COMBO212 = [illegible]
COMBO213 = [illegible]
COMBO214 = [illegible]
COMBO215 = [illegible]
COMBO216 = [illegible]
COMBO217 = [illegible]
COMBO217 = [illegible]

NIVEL	VIGA ELEMENTO No	LOC. (m)	LONG. (m)	[illegible] SECCIÓN	b (m)	d (m)	V2 CM (kN.m)	CV (kN.m)	SISMO X (kN.m)	SISMO Y (kN.m)	-SISMO X (kN.m)	-SISMO Y (kN.m)	ΣV Combinaciones de carga de diseño para el doble del cortante donde se incluye E COMBO23	COMBO24	COMBO25	COMBO26	COMBO27	COMBO28	COMBO29	COMBO210	COMBO211	COMBO212	COMBO213	COMBO214	COMBO215	COMBO216	COMBO217	COMBO218	$\Sigma V_{máx}$ (kN)	S (m)	φVs (kN)	φVc (kN)	φVn (kN)	$\phi Vn > \Sigma V_{máx}$
[illegible]	B1	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	B1	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	B2	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	B2	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	B3	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	B3	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	B4	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	B4	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	B5	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	B5	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	B6	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	B6	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+0.00	B6	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	B6	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	B7	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	B7	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	B8	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	B8	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	B9	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	B9	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA45X60	0.45	0.55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.14	178.92	141.77	320.69	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+0.00	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+0.00	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+0.00	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA30X40	0.30	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	[illegible]	[illegible]	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA30X40	0.30	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	[illegible]	[illegible]	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+0.00	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+0.00	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
[illegible]	[illegible]	0	[illegible]	VIGA40X40	0.40	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.10	178.92	91.65	270.57	OK
	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						

PROYECTO: I.E. MERCEDES ABREGO-JAMUNDÍ (VALLE DEL CAUCA)
RESISTENCIA A CORTANTE PARA VIGAS
CHEQUEO PARA LA CONDICIÓN DESCRITA EN C.21.3.3.1 (b)

f'c = 21.0 MPa
fy = 420 MPa
$\phi_{cortante}$ = 0.75
Estribos φ = 9.5 mm
Av = 71 mm²
R = 4.50

2VE = [illegible]

[illegible]

NIVEL	VIGA ELEMENTO No.	LOC.	LONG.	[illegible]			V2						2V																2V	S	φVs	φVc	φVn	φVn > 2V
				SECCIÓN	b	d	CM	CV	SISMO X	SISMO Y	-SISMO X	-SISMO Y	Combinaciones de carga de diseño para el doble del cortante donde se incluye E																					
		(m)	(m)		(m)	(m)	(kN.m)	(kN.m)	(kN.m)	(kN.m)	(kN.m)	(kN.m)	COMBDS3	COMBDS4	COMBDS5	COMBDS6	COMBDS7	COMBDS8	COMBDS9	COMBDS10	COMBDS11	COMBDS12	COMBDS13	COMBDS14	COMBDS15	COMBDS16	COMBDS17	COMBDS18	(kN)	(m)	(kN)	(kN)	(kN)	
N+3.45	B101	0	6.64	VGA40X40	0.40	0.40	-47.22	-30.09	2.1	0.6	-2.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	90.3	0.10	178.92	91.65	270.57	OK
	B101	6.64					47.31	30.36	1.4	11.27	-1.4	-11.27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+3.45	B104	0	4.4	VGA40X40	0.40	0.40	-17.37	-0.1	7.96	1.6	-7.96	-1.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	34.5	0.10	178.92	91.65	270.57	OK
	B104	4.4					16.77	-0.1	7.96	1.6	-7.96	-1.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+0.00	B104	0	4.4	VGA40X40	0.40	0.40	-60.60	-19.11	4.96	2.66	-4.96	-2.66	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	88.4	0.10	178.92	91.65	270.57	OK
	B104	4.4					58.18	8.4	4.37	1.37	-4.37	-1.37	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+3.45	B105	0	4.4	VGA40X40	0.40	0.40	-16.93	1.11	6.46	1.16	-6.46	-1.16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	36.0	0.10	178.92	91.65	270.57	OK
	B105	4.4					19.36	1.11	6.46	1.16	-6.46	-1.16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+3.45	B106	0	5.46	VGA40X40	0.40	0.40	-37.97	-16.66	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	57.6	0.10	178.92	91.65	270.57	OK
	B106	5.46					31.79	15.31	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+0.00	B121	0	6.64	VGA30X40	0.30	0.40	-36.73	-10.49	0.7	0.76	-0.7	-0.76	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	78.3	0.10	178.92	68.74	247.66	OK
	B121	6.64					57.36	14.8	1.3	2.5	-1.3	-2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+0.00	B123	0	4.4	VGA30X40	0.30	0.40	-46.67	-11.55	1.09	0.7	-1.09	-0.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	99.5	0.10	178.92	68.74	247.66	OK
	B123	4.4					66.4	10.49	1.06	1.8	-1.06	-1.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+3.45	B128	0	2.58	VGA40X40	0.40	0.40	-44.62	-30.21	1.2	4.27	-1.2	-4.27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	64.8	0.10	178.92	91.65	270.57	OK
	B128	2.58					-17.82	-11.56	1.2	4.27	-1.2	-4.27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+3.45	B134	0	7.92	VGA40X40	0.40	0.40	-73.53	-55.53	0.8	6.27	-0.8	-6.27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	148.1	0.10	178.92	91.65	270.57	OK
	B134	7.92					52.9	39.6	0.4	4.46	-0.4	-4.46	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+3.45	B135	0	4.63	VGA40X40	0.40	0.40	-61.11	-45.33	2.57	2.4	-2.57	-2.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	119.4	0.10	178.92	91.65	270.57	OK
	B135	4.63					8.76	7.14	2.57	2.4	-2.57	-2.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+3.45	B136	0	4.63	VGA40X40	0.40	0.40	-17.19	4.63	2.24	1.07	-2.24	-1.07	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	110.0	0.10	178.92	91.65	270.57	OK
	B136	4.63					57.17	42.04	2.24	1.07	-2.24	-1.07	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
N+3.45	B137	0	5.46	VGA30X40	0.30	0.40	-40.54	-32.97	4.24	1.27	-4.24	-1.27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	83.7	0.10	178.92	68.74	247.66	OK
	B137	5.46					37.49	31.31	4.24	1.27	-4.24	-1.27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						

PROYECTO: I.E. MERCEDES ABREGO-JAMUNDÍ (VALLE DEL CAUCA)
RESISTENCIA A CORTANTE PARA COLUMNAS
CHEQUEO PARA LA CONDICIÓN DESCRITA EN C.21.3.3.2 (a) - COLUMNA S=50X60 (18/#8 #7 (2.6%))

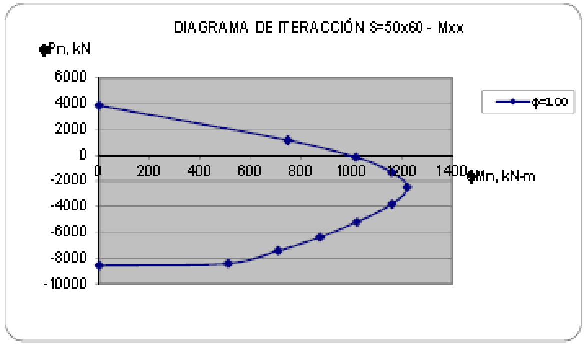
f'c = 21.1 MPa
fy = 420 MPa
$\Phi_{cortante}$ = 0.75
bx = 0.50 m
by = 0.60 m
Lcol = 3.45 m

Estribos Φ = 9.5 mm
Av = 71 mm^2
Cantidad de ramas = 5
S = 0.10 m
Recub. = 0.05 m

C.21.3.3.2(a) El cortante ΦVn no debe ser menor que la suma del cortante debido a flexión en curvatura inversa asociado con el desarrollo de los momentos nominales de la columna en cada extremo restringido de la longitud libre.

DATOS PARA LOS DIAGRAMAS DE ITERACCIÓN

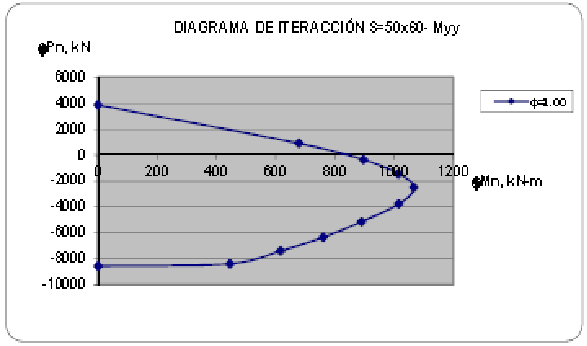
No.	Curve 1	0. degrees	
	P	M3	M2
1	-8572.00	0.00	0.00
2	-8403.00	511.01	0.00
3	-7414.00	710.07	0.00
4	-6363.00	876.30	0.00
5	-5191.00	1022.37	0.00
6	-3804.00	1161.31	0.00
7	-2504.00	1222.13	0.00
8	-1331.00	1160.43	0.00
9	-169.92	1019.38	0.00
10	1160.84	749.17	0.00
11	3856.61	0.00	0.00



P_{ua} = 583.73 kN
P_{ub} = 565.59 kN
ΦM_{na} = 902.20 kN-m
ΦM_{nb} = 898.52 kN-m
V_{umax} = 521.95 kN
ΦV_c = 603.86 kN
ΦV_s = 155.03 kN
ΦV_n = 758.88 kN
$\Phi V_n > V_{umax}$ = OK

DATOS PARA LOS DIAGRAMAS DE ITERACCIÓN

No.	Curve 7	90. degrees	
	P	M3	M2
1	-8572.00	0.00	0.00
2	-8390.00	0.00	446.32
3	-7396.00	0.00	616.64
4	-6340.00	0.00	760.89
5	-5144.00	0.00	890.34
6	-3764.00	0.00	1016.07
7	-2509.00	0.00	1066.88
8	-1445.00	0.00	1015.35
9	-361.54	0.00	896.54
10	896.93	0.00	678.89
11	3856.61	0.00	0.00



P_{ua} = 586.29 kN
P_{ub} = 568.15 kN
ΦM_{na} = 842.82 kN-m
ΦM_{nb} = 839.68 kN-m
V_{umax} = 487.68 kN
ΦV_c = 615.04 kN
ΦV_s = 157.90 kN
ΦV_n = 772.94 kN
$\Phi V_n > V_{umax}$ = OK

PROYECTO: I.E. MERCEDES ABREGO-JAMUNDÍ (VALLE DEL CAUCA)
RESISTENCIA A CORTANTE PARA COLUMNAS
CHEQUEO PARA LA CONDICIÓN DESCRITA EN C.21.3.3.2 (b)

f'c = 21.1 MPa
fy = 420 MPa
$\Phi_{Cortante}$ = 0.75
bx = 0.50 m
by = 0.60 m

Estribos Φ = 9.5 mm
Av = 71 mm^2
Cantidad de ramas = 5
S = 0.10 m
Ω_0= 3.00
Recub. = 0.05 m

C21.3.3.2(b) El cortante ΦVn no debe ser menor que el cortante maximo obtenido de las combinaciones de carga de diseño que incluyan E, con E incrementado por medio de Ωo.

Para cortante V2

$\Omega_o{}^*V_{umax}$ = 241.87 kN
ΦV_s = 603.86 kN
ΦV_c = 155.03 kN
ΦV_n = 758.88 kN
$\Phi V_n > \Omega_o{}^*V_{umax}$ = OK

Para cortante V3

$\Omega_o{}^*V_{umax}$ = 136.45 kN
ΦV_s = 615.04 kN
ΦV_c = 157.90 kN
ΦV_n = 772.94 kN
$\Phi V_n > \Omega_o{}^*V_{umax}$ = OK

10 CONCLUSIONES Y RECOMENDACIONES

Finalizado el diseño y análisis estructural de la institución educativa Mercedes Abrego, Grupo 002 basado en la Norma Colombiana de Diseño y Construcción Sismo Resistente Ley 400 de 1997 (Modificada Ley 1229 de 2008) y Decreto 926 de Marzo de 2010, Decreto 092 del 17 de Enero de 2011, Decreto 0340 del 13 de Febrero de 2012 y en el Reglamento para Concreto Estructural ACI 318S-08, hemos llegado a las siguientes conclusiones y recomendaciones.

- Se cumplió satisfactoriamente con los objetivos del cálculo y diseño estructural mediante la aplicación de la norma sismo resistente (NSR-10) y el reglamento para concreto estructural ACI 318S-08, además de la ayuda del software ETABS V9.7.4 se puede garantizar el buen funcionamiento de la estructura que presenta una buena respuesta ante un evento sísmico.
- La revisión de los desplazamientos laterales (derivas) de la estructura teniendo en cuenta las direcciones "X" y "y", nos arrojó que los resultados obtenidos son aceptables permitiendo un buen funcionamiento ante la actuación de un sismo y que cumple con lo establecido en la norma sismo resistente (NSR-10).
- En cuanto a la revisión de columnas y vigas determinamos que cumplen con los requisitos, ya que en estructuras de edificios aporticados es obligatorio que los miembros horizontales fallen antes que los verticales, permitiendo de esa manera un retraso del colapso total de la estructura.
- Para la construcción de la estructura se recomienda llevar un estricto control en la calidad de los materiales a utilizar, ya que estos deberán cumplir con requisitos especiales para el buen funcionamiento de la edificación. Además, que estos deberán ser supervisados a la hora de la puesta en marcha por el ingeniero residente.

11 BIBLIOGRAFIA

- Norma Colombiana de Diseño y Construcción Sismo Resistente Ley 400 de 1997 (Modificada Ley 1229 de 2008) y Decreto 926 de Marzo de 2010, Decreto 092 del 17 de Enero de 2011, Decreto 0340 del 13 de Febrero de 2012
- Reglamento para Concreto Estructural ACI 318S-08.

ELABORACIÓN DE DIAGNÓSTICOS, ESTUDIOS TÉCNICOS, AJUSTES A DISEÑOS O DISEÑOS INTEGRALES, CONSTRUCCIÓN Y PUESTA EN FUNCIONAMIENTO DE LAS OBRAS DE INFRAESTRUCTURA EDUCATIVA – UBICADAS EN EL DEPARTAMENTO DE VALLE DEL CAUCA – GRUPO 02

Contrato No. PAF-JU02-G02DC-2015

INFORME CÁLCULO Y ANALISIS ESTRUCTURAL INSTITUCIÓN EDUCATIVA MERCEDES ABREGO RAMPA

BOGOTÁ
2017

CONTROL DE REVISIONES

REVISIÓN	FECHA	OBSERVACIONES
1	30/12/16	Primera Redacción

Elaborado por: Edgar Rolando Barrera Firma:	**Revisado por**: Javier José Carrillo Ortega Fecha: febrero 2017 Firma:	**Aprobado por:** Director de Interventoría Fecha: Firma:

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1 INTRODUCCIÓN

El presente documento contiene las memorias de análisis y diseño estructural correspondiente al proyecto de la “INSTITUCIÓN EDUCATIVA MERCEDES ABREGO-RAMPA” ubicado en la ciudad de Cali en el departamento de VALLE DEL CAUCA de acuerdo al contrato No. PAF-JU02-G02DC-2015 realizando el estudio de acuerdo a la Norma Colombiana de Diseño y Construcción Sismo Resistente Ley 400 de 1997 (Modificada Ley 1229 de 2008) y Decreto 926 de Marzo de 2010, Decreto 092 del 17 de Enero de 2011, Decreto 0340 del 13 de Febrero de 2012 y en el Reglamento para Concreto Estructural ACI 318S-08.

Para la evaluación de la edificación se ha seguido un proceso normativo que incluye las etapas de inspección, evaluación, pruebas y ensayos, revisión analítica, propuesta de intervención y soluciones constructivas, que tomen en cuenta los aspectos de resistencia, ductilidad, comportamiento y estabilidad de la estructura.

2 DESCRIPCIÓN DEL TRABAJO DE OFICINA

De acuerdo a los planos arquitectónicos y visitas realizadas en campo se procedió al desarrollo del estudio y análisis estructural con la ayuda de diferentes programas tales como ETABS v9.7.4, el cual tiene en cuenta los efectos de segundo orden. Por otro lado, se siguieron las recomendaciones descritas en el respectivo estudio de suelos

3 DESCRIPCIÓN DE LOS CRITERIOS BÁSICOS DE DISEÑO

El proyecto se soluciona mediante el diseño de una estructura aporticada, utilizando para el entrepiso del nivel N:-2.09 m Y N:-0.05 m placa maciza de espesor e= 0.10 m en N:+3.45 m placa maciza en dos direcciones de espesor e=0.15 m para soportar la carga del tanque. La cubierta liviana se compone de perfiles y correas en el nivel N:+6.95 m. Se manejan luces entre 5.00 m y 7.00 m en los dos sentidos de la estructura.

4 NORMAS Y CÓDIGOS A LOS CUALES SE CIÑEN LOS DISEÑOS

El diseño de todas las estructuras se realizó basado en la Norma Colombiana de Diseño y Construcción Sismo Resistente Ley 400 de 1997 (Modificada Ley 1229 de 2008) y Decreto 926 de Marzo de 2010, Decreto 092 del 17 de Enero de 2011, Decreto 0340 del 13 de Febrero de 2012 y en el Reglamento para Concreto Estructural ACI 318S-08.

5 DESCRIPCIÓN DE LA METODOLOGÍA DE DISEÑO EMPLEADA.

El proyecto se soluciona mediante el diseño de una estructura aporticada, utilizando para el entrepiso del nivel N:-2.09 m Y N:-0.05 m placa maciza de espesor e= 0.10 m en N:+3.45 m placa maciza en dos direcciones de espesor e=0.15 m para soportar la carga del tanque. La cubierta liviana se compone de perfiles y correas en el nivel N:+6.95 m. Se manejan luces entre 5.00 m y 7.00 m en los dos sentidos de la estructura.

Las cargas horizontales fueron distribuidas entre los diferentes pórticos en proporción a su rigidez y teniendo en cuenta los efectos de torsión.

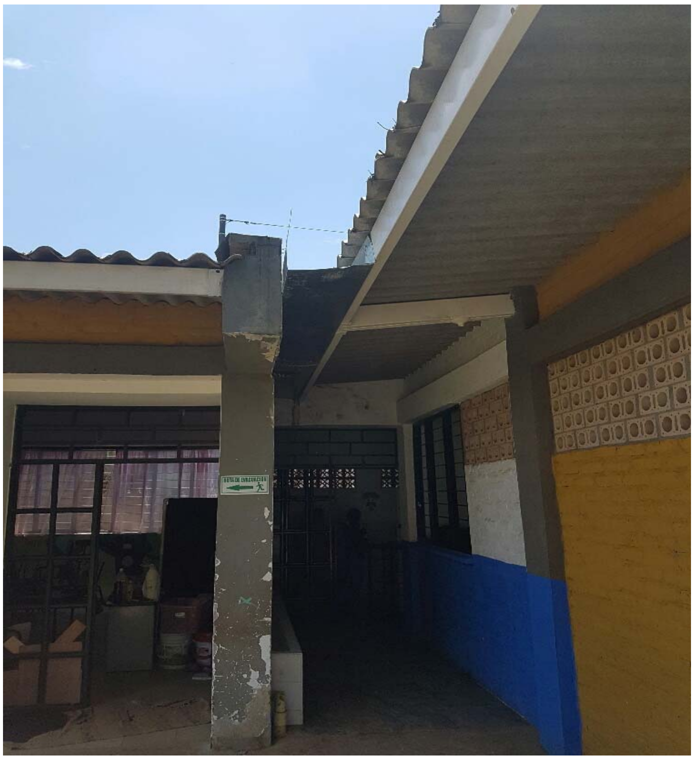
El dimensionamiento dado a todos los elementos que intervienen en las estructuras satisfacen los requerimientos de solicitación ocasionados por las derivas presentes. Las cargas vivas de diseño son: **2.00 kN/ m²** para salones de clase, **5.00 kN/ m²** para tanques y corredores, y **0.35 kN/ m²** para cubiertas.

Para la cimentación se siguieron las recomendaciones descritas en el respectivo estudio de suelos, que recomienda apoyar la estructura a **-1.00 m** del nivel de la placa aérea de cimentación, apoyando las zapatas a **-1.00 m**, según lo indicado en los planos estructurales. La capacidad portante de seguridad admisible del suelo es **0.092 MPa** y el tipo de suelo es **E**.

6 DESCRIPCIÓN Y ANÁLISIS DE LAS CONDICIONES EXISTENTES

El sitio donde se procederá a la construcción de la estructura se encuentra ubicado una edificación existente, como se evidencia en las fotos mostradas a continuación.

1. Fotografía Estructura existente



Fuente: Propia

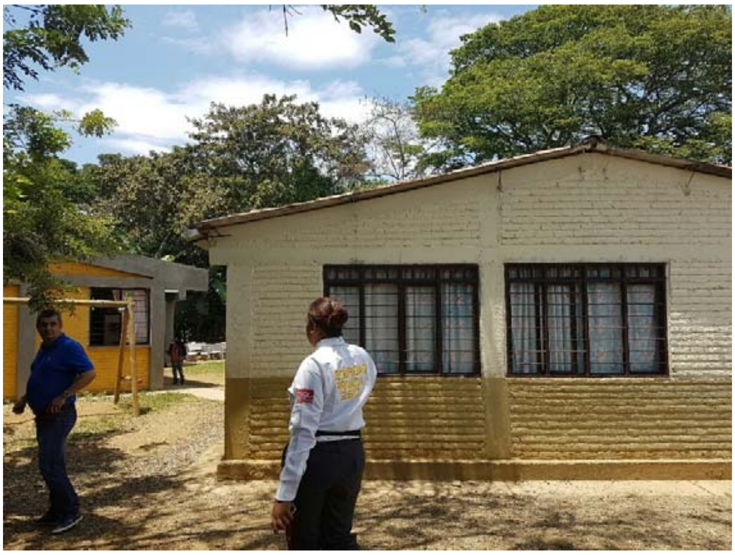
2. Fotografía Estructura existente

Fuente: Propia

3. Fotografía Estructura existente

Fuente: Propia

4. Fotografía Estructura existente



Fuente: Propia

MEMORIAL DE RESPONSABILIDAD

JAMUNDÍ (VALLE DEL CAUCA). Enero de 2017.

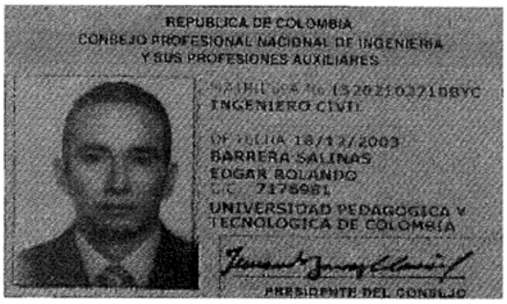
Señores
PLANEACIÓN MUNICIPAL
La Ciudad

Yo, **EDGAR ROLANDO BARRERA,** ingeniero civil con Matrícula Profesional Nº **15202-102710** de **BOYACÁ,** debidamente registrado en el consejo profesional de Ingeniería y Arquitectura de Cundinamarca, presento los Cálculos y Diseños Estructurales elaborados de acuerdo a los requerimientos de la **NORMA COLOMBIANA DE DISEÑO Y CONSTRUCCIÓN SISMO RESISTENTE LEY 400 DE 1997 (MODIFICADA LEY 1229 DE 2008) Y DECRETO 926 DE MARZO DE 2010**, para el proyecto INSTITUCIÓN EDUCATIVA MERCEDES ABREGO, ubicado en municipio de Jamundí en el departamento de Valle Del Cauca, declaro que asumo la responsabilidad por los perjuicios que causa de ellos puedan deducirse, exonerando a esta PLANEACIÓN MUNICIPAL de cualquier responsabilidad.

Acepto y reconozco que la revisión efectuada por PLANEACIÓN MUNICIPAL no constituye una aprobación al Diseño Estructural, sino una verificación del cumplimiento de la **NORMA COLOMBIANA DE DISEÑO Y CONSTRUCCIÓN SISMO RESISTENTE.**

Atentamente,

EDGAR ROLANDO BARRERA
ING. ESTRUCTURAL
T.P. 15202-102710 BYC



REPUBLICA DE COLOMBIA
CONSEJO PROFESIONAL NACIONAL DE INGENIERIA
Y SUS PROFESIONES AUXILIARES

MATRICULA No 15202103710BYC
INGENIERO CIVIL

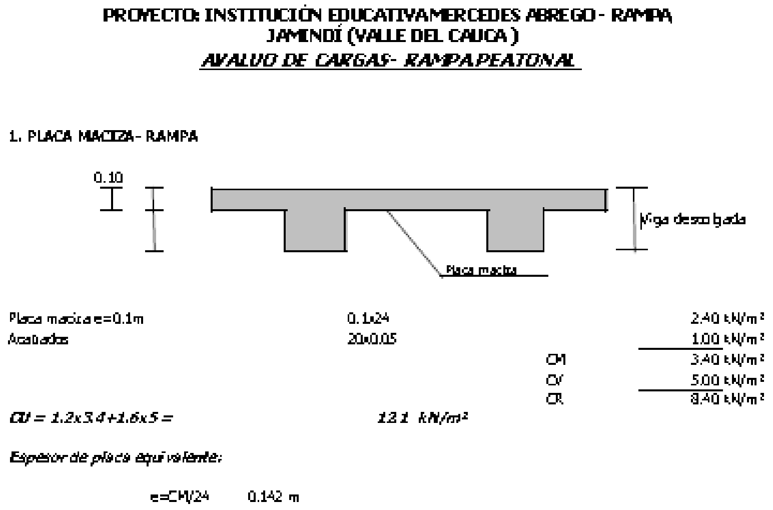
DE FECHA 18/12/2003
BARRERA SALINAS
EDGAR ROLANDO
C.C. 7178981
UNIVERSIDAD PEDAGOGICA Y
TECNOLOGICA DE COLOMBIA

PRESIDENTE DEL CONSEJO

7 MEMORIA DE CÁLCULO

7.1 AVALUO DE CARGAS

PROYECTO: INSTITUCIÓN EDUCATIVA MERCEDES ABREGO JAMUNDÍ (VALLE DEL CAUCA)
AVALUO DE CARGAS



PROYECTO: INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - RAMPA
JAMUNDÍ (VALLE DEL CAUCA)
AVALUO DE CARGAS- RAMPA PEATONAL

1. PLACA MACIZA - RAMPA

Placa maciza e=0.1m	0.1x24		2.40 kN/m²
Acabados	20x0.05		1.00 kN/m²
		CM	3.40 kN/m²
		CV	5.00 kN/m²
		CR	8.40 kN/m²

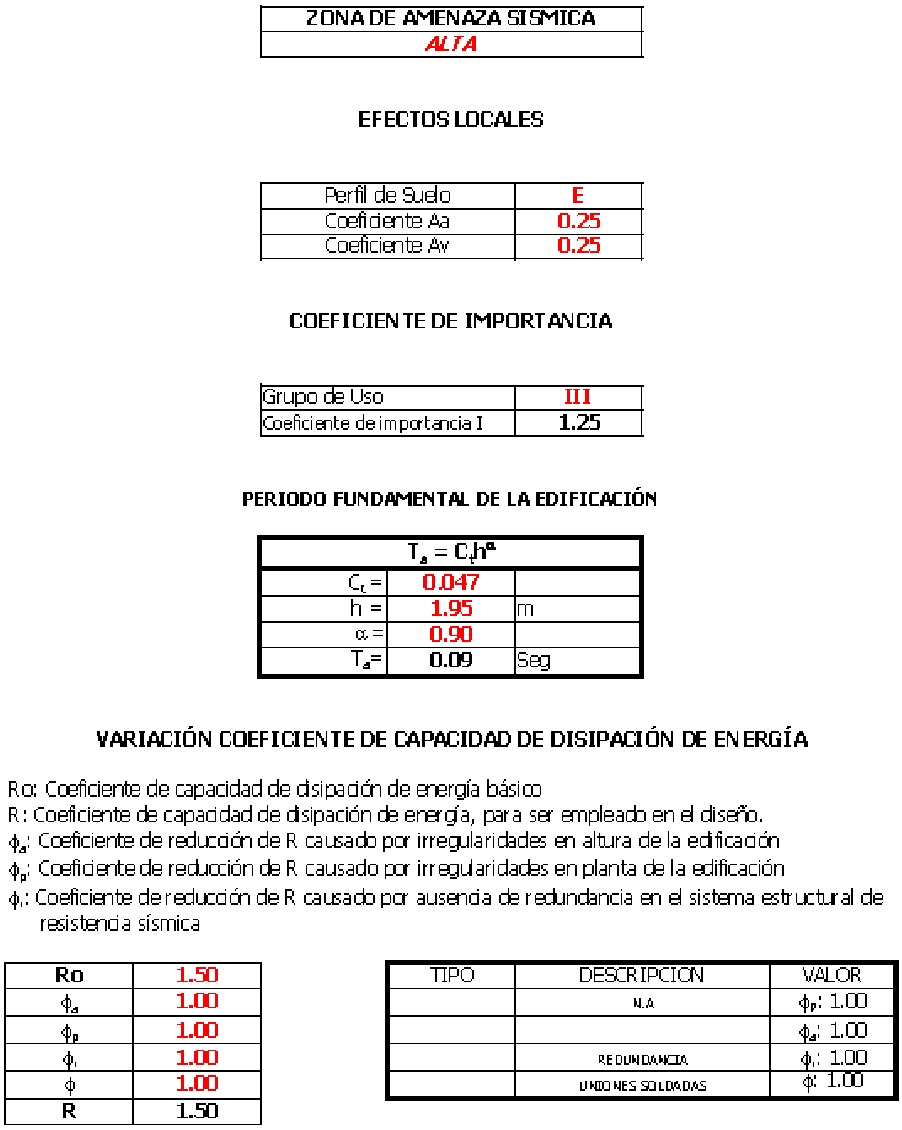
CU = 1.2x3.4+1.6x5 = 12.1 kN/m²

Espesor de placa equivalente:

e=CM/24 0.142 m

7.2 ANALISIS SISMICO

7.2.1 ESPECTRO DE DISEÑO NSR10



ZONA DE AMENAZA SISMICA
ALTA

EFECTOS LOCALES

Perfil de Suelo	**E**
Coeficiente Aa	**0.25**
Coeficiente Av	**0.25**

COEFICIENTE DE IMPORTANCIA

Grupo de Uso	**III**
Coeficiente de importancia I	**1.25**

PERIODO FUNDAMENTAL DE LA EDIFICACIÓN

$T_a = C_t h^\alpha$		
$C_t =$	**0.047**	
$h =$	**1.95**	m
$\alpha =$	**0.90**	
$T_a =$	**0.09**	Seg

VARIACIÓN COEFICIENTE DE CAPACIDAD DE DISIPACIÓN DE ENERGÍA

Ro: Coeficiente de capacidad de disipación de energía básico
R: Coeficiente de capacidad de disipación de energía, para ser empleado en el diseño.
ϕ_a: Coeficiente de reducción de R causado por irregularidades en altura de la edificación
ϕ_p: Coeficiente de reducción de R causado por irregularidades en planta de la edificación
ϕ_r: Coeficiente de reducción de R causado por ausencia de redundancia en el sistema estructural de resistencia sísmica

Ro	**1.50**
ϕ_a	**1.00**
ϕ_p	**1.00**
ϕ_r	**1.00**
ϕ	**1.00**
R	**1.50**

TIPO	DESCRIPCION	VALOR
	N.A	ϕ_p: 1.00
		ϕ_a: 1.00
	REDUNDANCIA	ϕ_r: 1.00
	UNIONES SOLDADAS	ϕ: 1.00

ESPECTRO DE DISEÑO (AMORTIGUAMIENTO $\xi = 5\%$ DEL CRÍTICO)

Fa: Factor de ampliación de la aceleración.
Fv: Factor de ampliación de la aceleración en el rango de velocidades constantes.
Sa: Valor del espectro de aceleraciones de diseño para un periodo de vibración dado.
Aa: Coeficiente que representa la aceleración horizontal pico efectiva para diseño.
Av: Coeficiente que representa la velocidad horizontal pico efectiva para diseño.
T: Periodo de vibración del sistema elástico, en segundos.
T_C: Periodo de vibración, en segundos, correspondiente a la transición entre la zona de aceleración constante del espectro de diseño, para periodos cortos, y la parte descendiente del mismo.
T_L: Periodo de vibración, en segundos, correspondiente al inicio de la zona de desplazamiento aproximadamente constante del espectro de diseño para periodos largos.

ZONA DE AMENAZA ALTA

T_o:	0.21	Seg
T_C:	0.99	Seg
T_L:	7.20	Seg
Aa:	0.25	
Av:	0.25	
Fa:	1.45	
Fv:	3.00	

T (Seg)	Sa (%g)	$Sa/R_{adoptado}$ (%g)
0.00	1.133	0.755
0.05	1.133	0.755
0.10	1.133	0.755
0.16	1.133	0.755
0.21	1.133	0.755
0.40	1.133	0.755
0.60	1.133	0.755
0.80	1.133	0.755
0.99	1.133	0.755
1.34	0.841	0.561
1.68	0.669	0.446
2.03	0.555	0.370
2.37	0.474	0.316
2.72	0.414	0.276
3.06	0.367	0.245
3.41	0.330	0.220
3.75	0.300	0.200
4.10	0.275	0.183
4.44	0.253	0.169
4.79	0.235	0.157
5.13	0.219	0.146
5.48	0.205	0.137
5.82	0.193	0.129
6.17	0.182	0.122
6.51	0.173	0.115
6.86	0.164	0.109
7.20	0.156	0.104
8.20	0.120	0.080
9.20	0.096	0.064

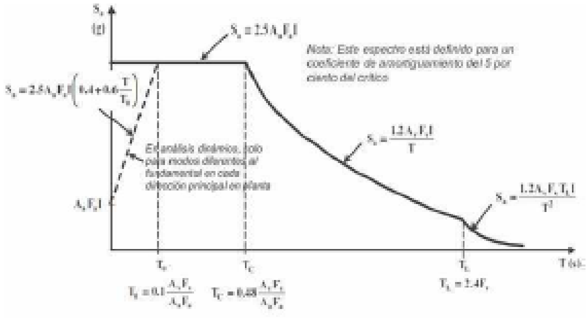
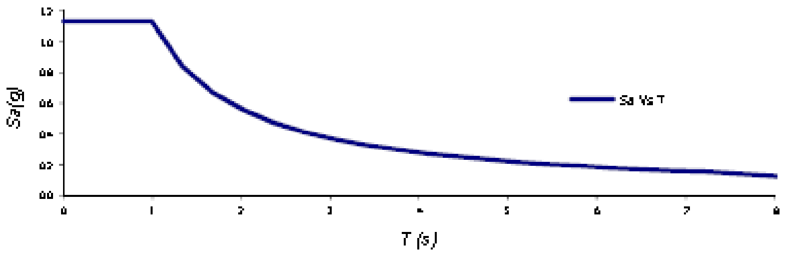
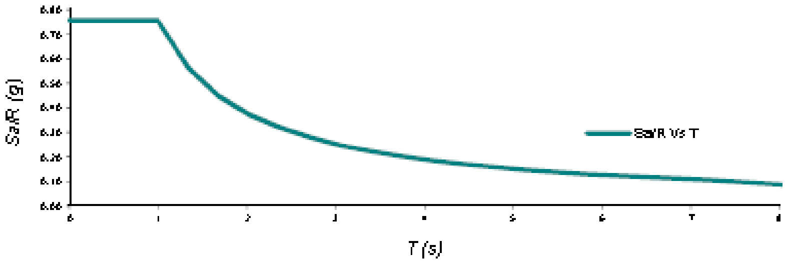


Figura A.2.6-1 — Espectro Elástico de Aceleraciones de Diseño como fracción de g

Espectro Elástico de Diseño



Espectro Elástico de Diseño/R[illegible]



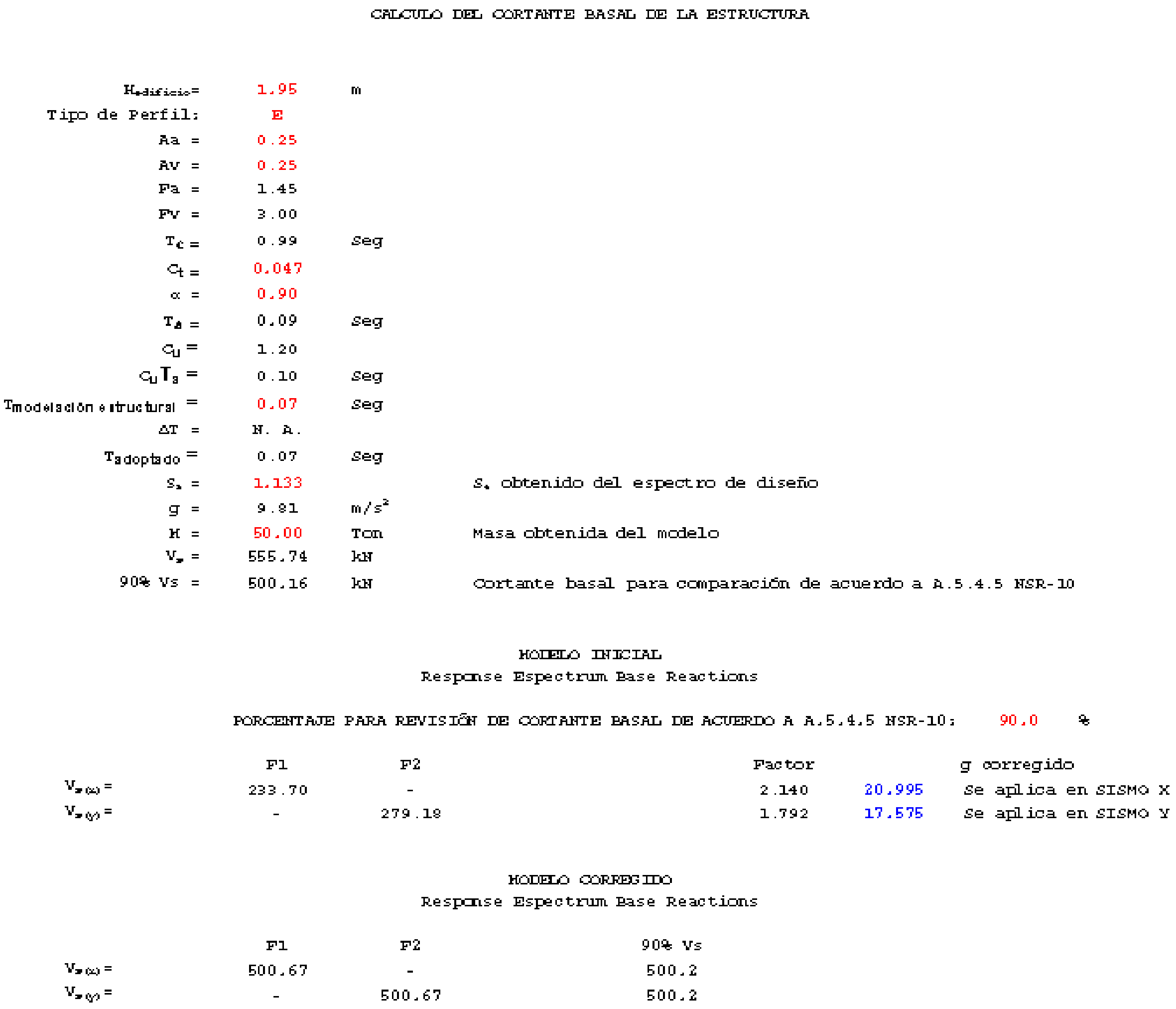
Sistema de resistencia Sísmica: Pórticos resistentes a momentos con Capacidad Especial de Disipación de Energía (DES).

Nota: El sistema de pórtico es un sistema estructural compuesto por un pórtico espacial, resistente a momentos, esencialmente completo, sin diagonales, que resiste todas las cargas verticales y las fuerzas horizontales.

MODELO MATEMÁTICO

Modelo Tridimensional con Diafragma Rígido: En este modelo los entrepisos se consideran diafragmas infinitamente rígidos en su propio plano. La masa de cada diafragma se considera concentrada en su centro de masa. Los efectos torsionales accidentales son incluidos haciendo ajustes en la localización de los centros de masa de los diafragmas.
Los efectos direccionales son tomados en cuenta a través de las componentes de los desplazamientos de los grados de libertad horizontales ortogonales del diafragma.

7.2.2 CALCULO DEL CORTANTE BASAL DE LA ESTRUCTURA (ESPECTRO DE DISEÑO NSR-10)



CALCULO DEL CORTANTE BASAL DE LA ESTRUCTURA

$H_{edificio}$ =	1.95	m	
Tipo de Perfil:	E		
Aa =	0.25		
Av =	0.25		
Fa =	1.45		
Fv =	3.00		
T_C =	0.99	Seg	
C_t =	0.047		
α =	0.90		
T_a =	0.09	Seg	
C_u =	1.20		
$C_u T_a$ =	0.10	Seg	
$T_{modelación\ estructural}$ =	0.07	Seg	
ΔT =	N. A.		
$T_{adoptado}$ =	0.07	Seg	
S_a =	1.133		S_a obtenido del espectro de diseño
g =	9.81	m/s^2	
M =	50.00	Ton	Masa obtenida del modelo
V_s =	555.74	kN	
90% Vs =	500.16	kN	Cortante basal para comparación de acuerdo a A.5.4.5 NSR-10

MODELO INICIAL
Response Espectrum Base Reactions

PORCENTAJE PARA REVISIÓN DE CORTANTE BASAL DE ACUERDO A A.5.4.5 NSR-10: 90.0 %

	F1	F2	Factor	g corregido	
$V_{s(x)}$ =	233.70	-	2.140	20.995	Se aplica en SISMO X
$V_{s(y)}$ =	-	279.18	1.792	17.575	Se aplica en SISMO Y

MODELO CORREGIDO
Response Espectrum Base Reactions

	F1	F2	90% Vs
$V_{s(x)}$ =	500.67	-	500.2
$V_{s(y)}$ =	-	500.67	500.2

7.2.3 ANÁLISIS SÍSMICO (ESPECTRO DE UMBRAL DE DAÑO NSR-10)

ZONA DE AMENAZA SISMICA
ALTA

EFECTOS LOCALES

Perfil de Suelo	E
Coeficiente Ad	**0.10**
Coeficiente Fv	**3.50**

COEFICIENTE DE IMPORTANCIA

Grupo de Uso	III
Coeficiente de importancia I	**1.25**
Coeficiente de Sitio Š:	**4.38**

ESPECTRO DE UMBRAL DE DAÑO (AMORTIGUAMIENTO ξ=2% DEL CRÍTICO)

Sad: Valor del espectro de aceleraciones del umbral de daño para un periodo de vibración dado.
Ad: Máxima aceleración pico efectiva para el umbral de daño.
T: Periodo de vibración del sistema elástico, en segundos.
T_{Cd}: Periodo de vibración, en segundos, correspondiente a la transición entre la zona de aceleración constante del espectro sísmico del umbral de daño, para periodos cortos, y la parte descendiente del mismo.
T_{Ld}: Periodo de vibración, en segundos, correspondiente a la transición entre la zona de desplazamiento constante del espectro sísmico del umbral de daño, para periodos largos.

Ad: **0.10**
T_{Cd}: 2.19 Seg
T_{Ld}: 10.5 Seg

T (Seg)	Sad (%g)
0.00	0.100
0.05	0.140
0.10	0.180
0.15	0.220
0.20	0.260
0.25	0.300
0.49	0.300
0.73	0.300
0.98	0.300
1.22	0.300
1.46	0.300
1.70	0.300
1.95	0.300

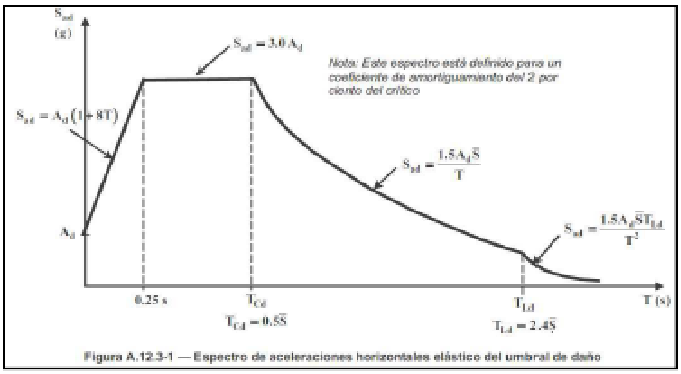
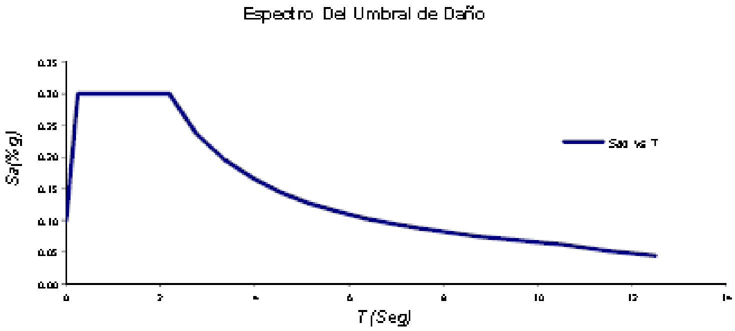

S_{ad}
(g)
$S_{ad} = 3.0\,A_d$
Nota: Este espectro está definido para un coeficiente de amortiguamiento del 2 por ciento del crítico
$S_{ad} = A_d(1+8T)$
$S_{ad} = \frac{1.5A_d\bar{S}}{T}$
$S_{ad} = \frac{1.5A_d\bar{S}T_{Ld}}{T^2}$
A_d
0.25 s
T_{Cd}
$T_{Cd} = 0.5\bar{S}$
T_{Ld}
$T_{Ld} = 2.4\bar{S}$
T (s)

Figura A.12.3-1 — Espectro de aceleraciones horizontales elástico del umbral de daño

2.19	0.300
2.78	0.236
3.38	0.194
3.97	0.165
4.56	0.144
5.16	0.127
5.75	0.114
6.34	0.103
6.94	0.095
7.53	0.087
8.13	0.081
8.72	0.075
9.31	0.070
9.91	0.066
10.50	0.063
11.50	0.052
12.50	0.044


Espectro Del Umbral de Daño

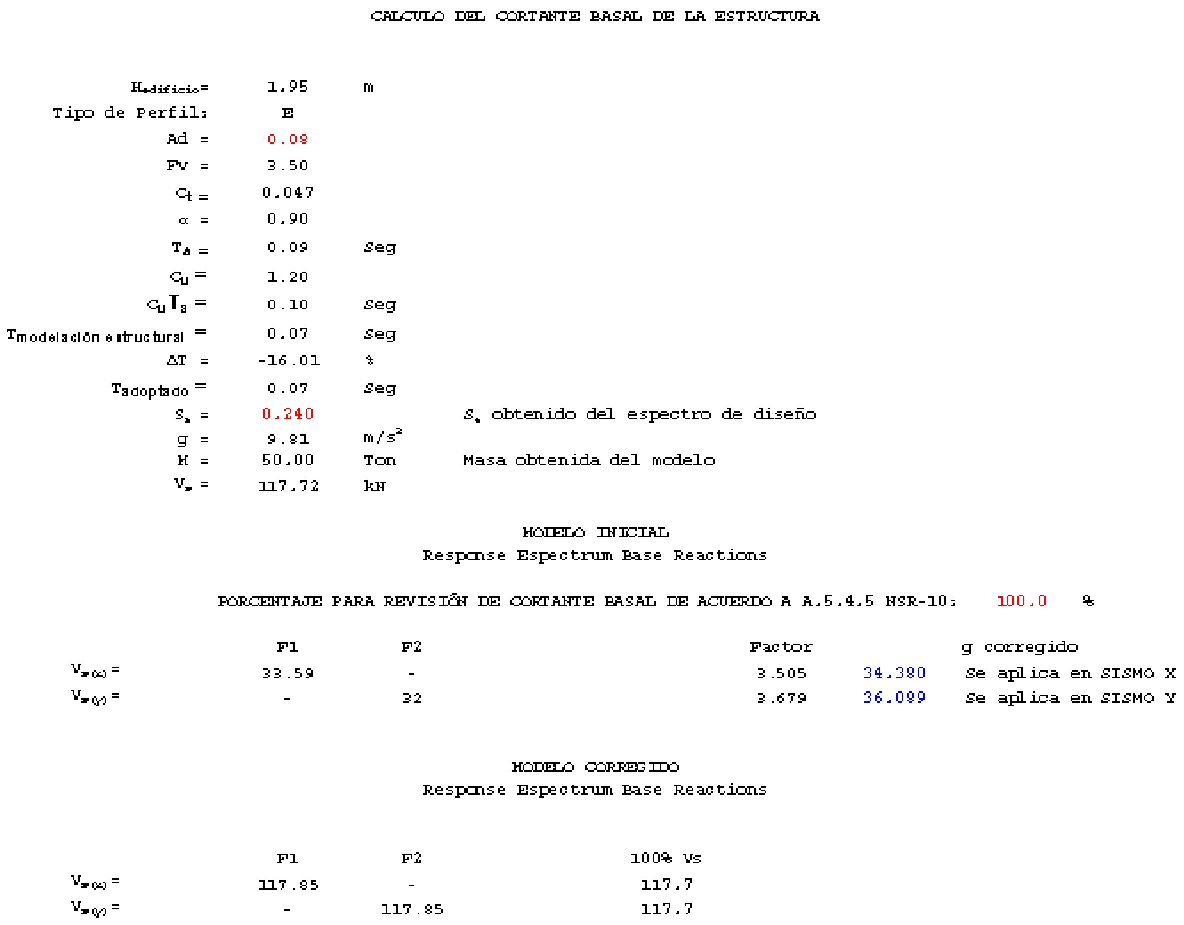
Sistema de resistencia Sísmica: Pórticos resistentes a momentos con Capacidad Especial de Disipación de Energía (DES).

Nota: El sistema de pórtico es un sistema estructural compuesto por un pórtico espacial, resistente a momentos, esencialmente completo, sin diagonales, que resiste todas las cargas verticales y las fuerzas horizontales.

MODELO MATEMÁTICO

Modelo Tridimensional con Diafragma Rígido: En este modelo los entrepisos se consideran diafragmas infinitamente rigidos en su propio plano. La masa de cada diafragma se considera concentrada en su centro de masa. Los efectos torsionales accidentales son inducidos haciendo ajustes en la localización de los centros de masa de los diafragmas.
Los efectos direccionales son tomados en cuenta a través de las componentes de los desplazamientos de los grados de libertad horizontales ortogonales del diafragma.

7.2.4 CALCULO DEL CORTANTE BASAL DE LA ESTRUCTURA (ESPECTRO DE UMBRAL DE DAÑO NSR-10)



CALCULO DEL CORTANTE BASAL DE LA ESTRUCTURA

$H_{edificio}$ = 1.95 m

Tipo de Perfil: E

Ad = 0.08

Fv = 3.50

C_t = 0.047

α = 0.90

T_a = 0.09 Seg

C_u = 1.20

$C_u T_a$ = 0.10 Seg

$T_{modelación\ estructural}$ = 0.07 Seg

ΔT = -16.01 %

$T_{adoptado}$ = 0.07 Seg

S_a = 0.240 — S_a obtenido del espectro de diseño

g = 9.81 m/s^2

M = 50.00 Ton — Masa obtenida del modelo

V_s = 117.72 kN

MODELO INICIAL
Response Espectrum Base Reactions

PORCENTAJE PARA REVISIÓN DE CORTANTE BASAL DE ACUERDO A A.5.4.5 NSR-10: 100.0 %

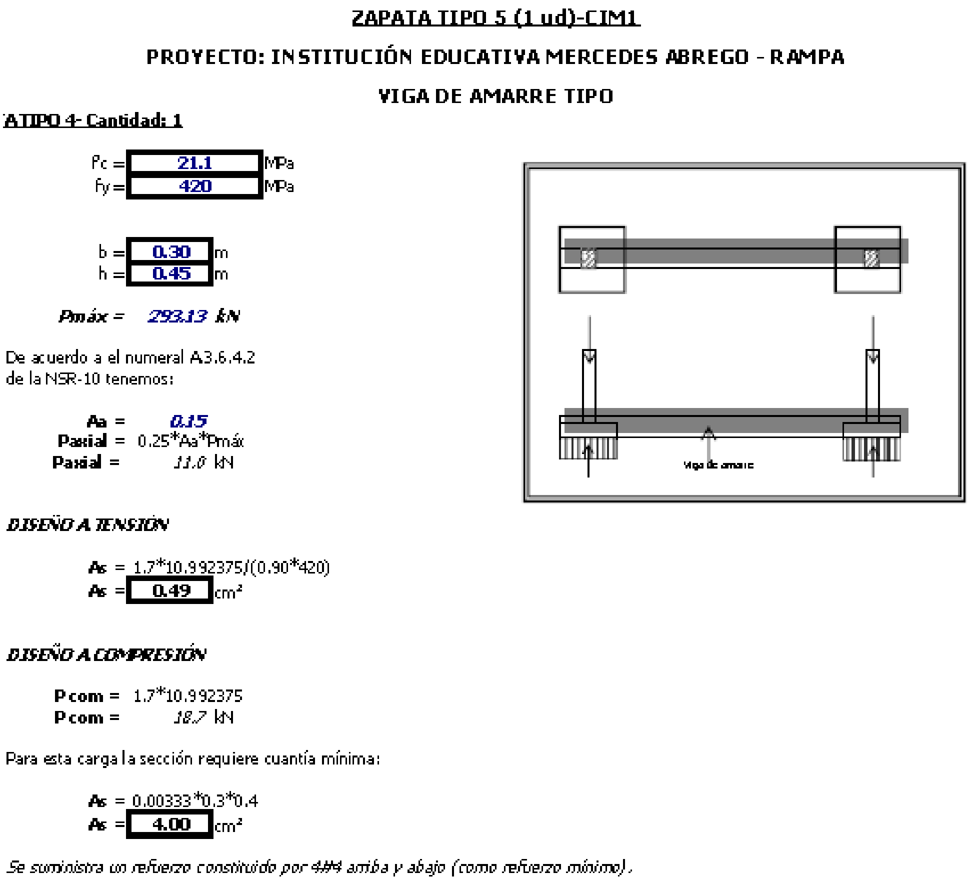
	F1	F2	Factor		g corregido
$V_{s(x)}$ =	33.59	-	3.505	34.380	Se aplica en SISMO X
$V_{s(y)}$ =	-	32	3.679	36.099	Se aplica en SISMO Y

MODELO CORREGIDO
Response Espectrum Base Reactions

	F1	F2	100% Vs
$V_{s(x)}$ =	117.85	-	117.7
$V_{s(y)}$ =	-	117.85	117.7

7.3 DISEÑO DE CIMENTACIÓN

7.3.1 DISEÑO VIGAS DE AMARRE



ZAPATA TIPO 5 (1 ud)-CIM1

PROYECTO: INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - RAMPA

VIGA DE AMARRE TIPO

ATIPO 4- Cantidad: 1

$f'c$ = **21.1** MPa
fy = **420** MPa

b = **0.30** m
h = **0.45** m

Pmáx = 293.13 kN

De acuerdo a el numeral A3.6.4.2
de la NSR-10 tenemos:

Aa = ***0.15***
Paxial = 0.25*Aa*Pmáx
Paxial = *11.0* kN

DISEÑO A TENSIÓN

As = 1.7*10.992375/(0.90*420)
As = **0.49** cm^2

DISEÑO A COMPRESIÓN

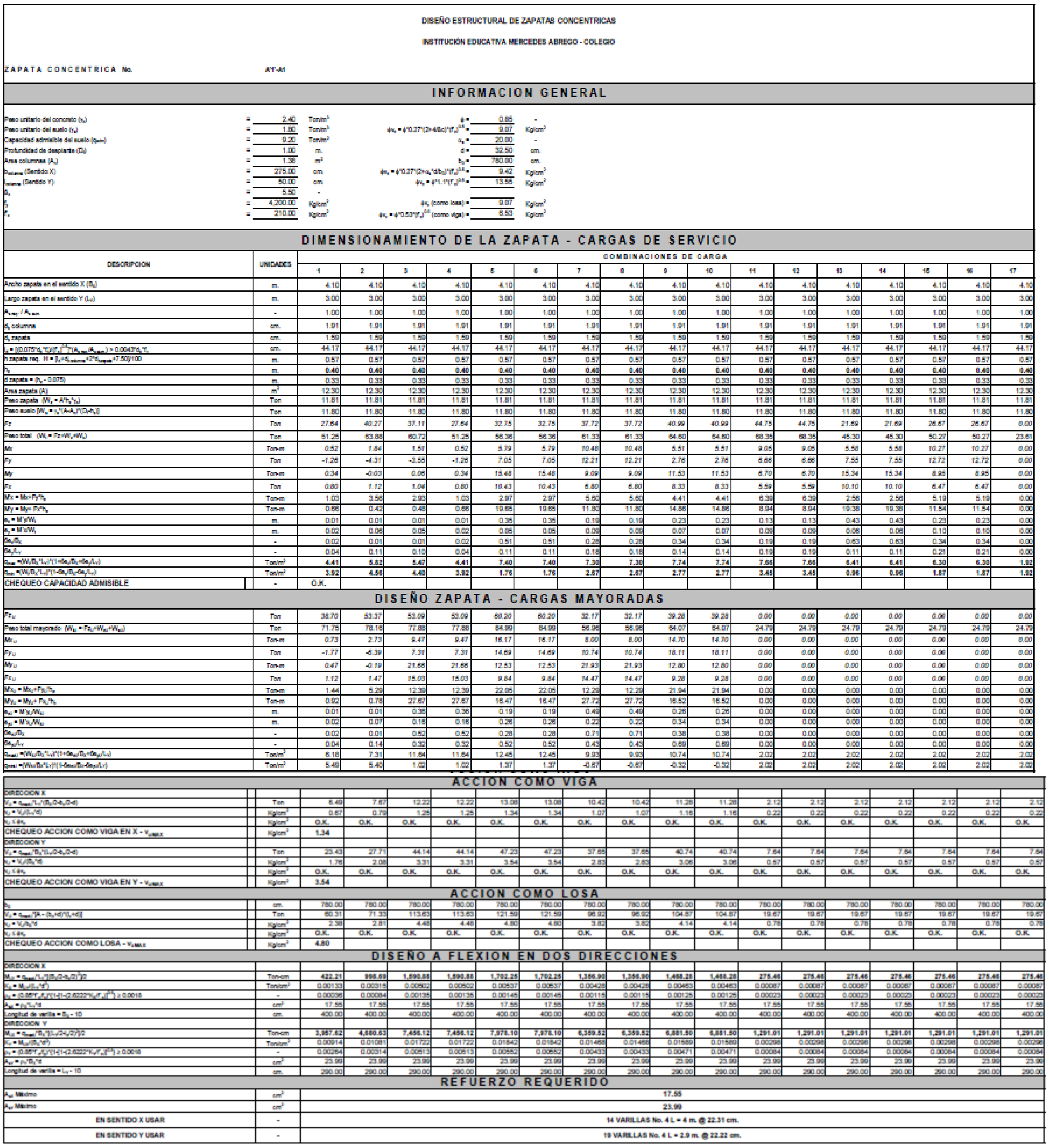
Pcom = 1.7*10.992375
Pcom = *18.7* kN

Para esta carga la sección requiere cuantía mínima:

As = 0.00333*0.3*0.4
As = **4.00** cm^2

Se suministra un refuerzo constituido por 4#4 arriba y abajo (como refuerzo mínimo).

7.3.2 DISEÑO DE ZAPATAS



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. A'1'-A1

INFORMACION GENERAL

Peso unitario del concreto (γ_c)	=	2.40	Ton/m³	ϕ =	0.85	-
Peso unitario del suelo (γ_s)	=	1.80	Ton/m³	$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ =	9.07	Kg/cm²
Capacidad admisible del suelo (q_{adm})	=	9.20	Ton/m²	α_s =	20.00	-
Profundidad de desplante (D_f)	=	1.00	m.	d =	32.50	cm.
Area columnas (A_c)	=	1.38	m²	b_0 =	780.00	cm.
$b_{columna}$ (Sentido X)	=	275.00	cm.	$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ =	9.42	Kg/cm²
$l_{columna}$ (Sentido Y)	=	50.00	cm.	$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ =	13.55	Kg/cm²
β_c	=	5.50	-			
f_y	=	4,200.00	Kg/cm²	ϕv_c (como losa) =	9.07	Kg/cm²
f'_c	=	210.00	Kg/cm²	$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) =	6.53	Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_x)	m.	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10
Largo zapata en el sentido Y (L_y)	m.	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
$A_{s\,req}$ / $A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
d_b zapata	cm.	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
$l_d = [(0.075*d_b*f_y)/(f'_c)^{1/2}]*(A_{s\,req}/A_{s\,sum}) > 0.0043*d_b*f_y$	cm.	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17	44.17
h zapata req. $H = [l_d+d_{b\,columna}+2*d_{b\,zapata}+7.50]/100$	m.	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
h_z	m.	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**
d zapata = (h_z - 0.075)	m.	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Area zapata (A)	m²	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	11.81	11.81	11.81	11.81	11.81	11.81	11.81	11.81	11.81	11.81	11.81	11.81	11.81	11.81	11.81	11.81	11.81
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	11.80	11.80	11.80	11.80	11.80	11.80	11.80	11.80	11.80	11.80	11.80	11.80	11.80	11.80	11.80	11.80	11.80
Fz	Ton	27.64	40.27	37.11	27.64	32.75	32.75	37.72	37.72	40.99	40.99	44.75	44.75	21.69	21.69	26.67	26.67	0.00
Peso total (W_t = Fz+W_z+W_s)	Ton	51.25	63.88	60.72	51.25	56.36	56.36	61.33	61.33	64.60	64.60	68.35	68.35	45.30	45.30	50.27	50.27	23.61
Mx	Ton-m	0.52	1.84	1.51	0.52	5.79	5.79	10.48	10.48	5.51	5.51	9.05	9.05	5.58	5.58	10.27	10.27	0.00
Fy	Ton	-1.26	-4.31	-3.55	-1.26	7.05	7.05	12.21	12.21	2.76	2.76	6.66	6.66	7.55	7.55	12.72	12.72	0.00
My	Ton-m	0.34	-0.03	0.06	0.34	15.48	15.48	9.09	9.09	11.53	11.53	6.70	6.70	15.34	15.34	8.95	8.95	0.00
Fx	Ton	0.80	1.12	1.04	0.80	10.43	10.43	6.80	6.80	8.33	8.33	5.59	5.59	10.10	10.10	6.47	6.47	0.00
M'x = Mx+Fy*h_z	Ton-m	1.03	3.56	2.93	1.03	2.97	2.97	5.60	5.60	4.41	4.41	6.39	6.39	2.56	2.56	5.19	5.19	0.00
M'y = My+ Fx*h_z	Ton-m	0.66	0.42	0.48	0.66	19.65	19.65	11.80	11.80	14.86	14.86	8.94	8.94	19.38	19.38	11.54	11.54	0.00
e_x = M'y/W_t	m.	0.01	0.01	0.01	0.01	0.35	0.35	0.19	0.19	0.23	0.23	0.13	0.13	0.43	0.43	0.23	0.23	0.00
e_y = M'x/W_t	m.	0.02	0.06	0.05	0.02	0.05	0.05	0.09	0.09	0.07	0.07	0.09	0.09	0.06	0.06	0.10	0.10	0.00
6e_x/B_x	-	0.02	0.01	0.01	0.02	0.51	0.51	0.28	0.28	0.34	0.34	0.19	0.19	0.63	0.63	0.34	0.34	0.00
6e_y/L_y	-	0.04	0.11	0.10	0.04	0.11	0.11	0.18	0.18	0.14	0.14	0.19	0.19	0.11	0.11	0.21	0.21	0.00
$q_{max} = (W_t/(B_x*L_y))*(1+6e_x/B_x+6e_y/L_y)$	Ton/m²	**4.41**	**5.82**	**5.47**	**4.41**	**7.40**	**7.40**	**7.30**	**7.30**	**7.74**	**7.74**	**7.66**	**7.66**	**6.41**	**6.41**	**6.30**	**6.30**	**1.92**
$q_{min} = (W_t/(B_x*L_y))*(1-6e_x/B_x-6e_y/L_y)$	Ton/m²	**3.92**	**4.56**	**4.40**	**3.92**	**1.76**	**1.76**	**2.67**	**2.67**	**2.77**	**2.77**	**3.45**	**3.45**	**0.96**	**0.96**	**1.87**	**1.87**	**1.92**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																
DISEÑO ZAPATA - CARGAS MAYORADAS																		
Fz_U	Ton	38.70	53.37	53.09	53.09	60.20	60.20	32.17	32.17	39.28	39.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Peso total mayorado ($W_{tU} = Fz_U+W_{zU}+W_{sU}$)	Ton	71.75	78.16	77.88	77.88	84.99	84.99	56.96	56.96	64.07	64.07	24.79	24.79	24.79	24.79	24.79	24.79	24.79
Mx_U	Ton-m	0.73	2.73	9.47	9.47	16.17	16.17	8.00	8.00	14.70	14.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fy_U	Ton	-1.77	-6.39	7.31	7.31	14.69	14.69	10.74	10.74	18.11	18.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
My_U	Ton-m	0.47	-0.19	21.66	21.66	12.53	12.53	21.93	21.93	12.80	12.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fx_U	Ton	1.12	1.47	15.03	15.03	9.84	9.84	14.47	14.47	9.28	9.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'x_U = Mx_U+Fy_U*h_z$	Ton-m	1.44	5.29	12.39	12.39	22.06	22.06	12.29	12.29	21.94	21.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U+ Fx_U*h_z$	Ton-m	0.92	0.78	27.67	27.67	16.47	16.47	27.72	27.72	16.52	16.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_{tU}$	m.	0.01	0.01	0.36	0.36	0.19	0.19	0.49	0.49	0.26	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_{tU}$	m.	0.02	0.07	0.16	0.16	0.26	0.26	0.22	0.22	0.34	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_x$	-	0.02	0.01	0.52	0.52	0.28	0.28	0.71	0.71	0.38	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_y$	-	0.04	0.14	0.32	0.32	0.52	0.52	0.43	0.43	0.69	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_{tU}/(B_x*L_y))*(1+6e_{xU}/B_x+6e_{yU}/L_y)$	Ton/m²	6.18	7.31	11.64	11.64	12.45	12.45	9.93	9.93	10.74	10.74	2.02	2.02	2.02	2.02	2.02	2.02	2.02
$q_{minU} = (W_{tU}/(B_x*L_y))*(1-6e_{xU}/B_x-6e_{yU}/L_y)$	Ton/m²	5.49	5.40	1.02	1.02	1.37	1.37	-0.67	-0.67	-0.32	-0.32	2.02	2.02	2.02	2.02	2.02	2.02	2.02
ACCION COMO VIGA																		
DIRECCION X																		
$V_U = q_{maxU}*L_y*(B_x/2-b_c/2-d)$	Ton	6.49	7.67	12.22	12.22	13.08	13.08	10.42	10.42	11.28	11.28	2.12	2.12	2.12	2.12	2.12	2.12	2.12
$v_U = V_U/(L_y*d)$	Kg/cm²	0.67	0.79	1.25	1.25	1.34	1.34	1.07	1.07	1.16	1.16	0.22	0.22	0.22	0.22	0.22	0.22	0.22
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{uMAX}	Kg/cm²	**1.34**																
DIRECCION Y																		
$V_U = q_{maxU}*B_x*(L_y/2-l_c/2-d)$	Ton	23.43	27.71	44.14	44.14	47.23	47.23	37.65	37.65	40.74	40.74	7.64	7.64	7.64	7.64	7.64	7.64	7.64
$v_U = V_U/(B_x*d)$	Kg/cm²	1.76	2.08	3.31	3.31	3.54	3.54	2.83	2.83	3.06	3.06	0.57	0.57	0.57	0.57	0.57	0.57	0.57
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{uMAX}	Kg/cm²	**3.54**																
ACCION COMO LOSA																		
b_0	cm.	780.00	780.00	780.00	780.00	780.00	780.00	780.00	780.00	780.00	780.00	780.00	780.00	780.00	780.00	780.00	780.00	780.00
$V_U = q_{maxU}*[A - (b_c+d)*(l_c+d)]$	Ton	60.31	71.33	113.63	113.63	121.59	121.59	96.92	96.92	104.87	104.87	19.67	19.67	19.67	19.67	19.67	19.67	19.67
$v_U = V_U/b_0*d$	Kg/cm²	2.38	2.81	4.48	4.48	4.80	4.80	3.82	3.82	4.14	4.14	0.78	0.78	0.78	0.78	0.78	0.78	0.78
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{uMAX}	Kg/cm²	**4.80**																
DISEÑO A FLEXION EN DOS DIRECCIONES																		
DIRECCION X																		
$M_{UX} = q_{maxU}*L_y*[(B_x/2-b_c/2)^2]/2$	Ton-cm	**422.21**	**998.69**	**1,590.88**	**1,590.88**	**1,702.25**	**1,702.25**	**1,356.90**	**1,356.90**	**1,468.28**	**1,468.28**	**275.46**	**275.46**	**275.46**	**275.46**	**275.46**	**275.46**	**275.46**
$K_X = M_{UX}/(L_y*d^2)$	Ton/cm²	0.00133	0.00315	0.00502	0.00502	0.00537	0.00537	0.00428	0.00428	0.00463	0.00463	0.00087	0.00087	0.00087	0.00087	0.00087	0.00087	0.00087
$\rho_X = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_X/f'_c)]^{0.5}) \geq 0.0018$	-	0.00036	0.00084	0.00135	0.00135	0.00145	0.00145	0.00115	0.00115	0.00125	0.00125	0.00023	0.00023	0.00023	0.00023	0.00023	0.00023	0.00023
$A_{sX} = \rho_X*L_y*d$	cm²	17.55	17.55	17.55	17.55	17.55	17.55	17.55	17.55	17.55	17.55	17.55	17.55	17.55	17.55	17.55	17.55	17.55
Longitud de varilla = B_x - 10	cm.	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_x*[(L_y/2-l_c/2)^2]/2$	Ton-cm	**3,957.62**	**4,680.63**	**7,456.12**	**7,456.12**	**7,978.10**	**7,978.10**	**6,359.52**	**6,359.52**	**6,881.50**	**6,881.50**	**1,291.01**	**1,291.01**	**1,291.01**	**1,291.01**	**1,291.01**	**1,291.01**	**1,291.01**
$K_Y = M_{UY}/(B_x*d^2)$	Ton/cm²	0.00914	0.01081	0.01722	0.01722	0.01842	0.01842	0.01468	0.01468	0.01589	0.01589	0.00298	0.00298	0.00298	0.00298	0.00298	0.00298	0.00298
$\rho_Y = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_Y/f'_c)]^{0.5}) \geq 0.0018$	-	0.00264	0.00314	0.00513	0.00513	0.00552	0.00552	0.00433	0.00433	0.00471	0.00471	0.00084	0.00084	0.00084	0.00084	0.00084	0.00084	0.00084
$A_{sY} = \rho_Y*B_x*d$	cm²	23.99	23.99	23.99	23.99	23.99	23.99	23.99	23.99	23.99	23.99	23.99	23.99	23.99	23.99	23.99	23.99	23.99
Longitud de varilla = L_y - 10	cm.	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00	290.00
REFUERZO REQUERIDO																		
A_{sX} Máximo	cm²	17.55																
A_{sY} Máximo	cm²	23.99																
EN SENTIDO X USAR	-	14 VARILLAS No. 4 L = 4 m. @ 22.31 cm.																
EN SENTIDO Y USAR	-	19 VARILLAS No. 4 L = 2.9 m. @ 22.22 cm.																

DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. A2'-A2

INFORMACION GENERAL

Peso unitario del concreto (γ_c)	=	2.40	Ton/m³	ϕ =	0.85	-
Peso unitario del suelo (γ_s)	=	1.80	Ton/m³	$\phi v_c = \phi \cdot 0.27 \cdot (2+4/\beta c) \cdot (f'_c)^{0.5}$ =	9.07	Kg/cm²
Capacidad admisible del suelo (q_{adm})	=	9.20	Ton/m²	α_s =	20.00	-
Profundidad de desplante (D_f)	=	1.00	m.	d =	37.50	cm.
Area columnas (A_c)	=	1.38	m²	b_0 =	800.00	cm.
$b_{columna}$ (Sentido X)	=	275.00	cm.	$\phi v_c = \phi \cdot 0.27 \cdot (2+\alpha_s \cdot d/b_0) \cdot (f'_c)^{0.5}$ =	9.77	Kg/cm²
$l_{columna}$ (Sentido Y)	=	50.00	cm.	$\phi v_c = \phi \cdot 1.1 \cdot (f'_c)^{0.5}$ =	13.58	Kg/cm²
β_c	=	5.50	-			
f_y	=	4,200.00	Kg/cm²	ϕv_c (como losa) =	9.07	Kg/cm²
f'_c	=	210.00	Kg/cm²	$\phi v_c = \phi \cdot 0.53 \cdot (f'_c)^{0.5}$ (como viga) =	6.53	Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Largo zapata en el sentido Y (L_Y)	m.	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90
$A_{s\,req} / A_{s\,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22
d_b zapata	cm.	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
$l_d = [(0.075 \cdot d_b \cdot f_y)/(f'_c)^{0.5}] \cdot (A_{s\,req}/A_{s\,sum}) > 0.0043 \cdot d_b \cdot f_y$	cm.	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53
h zapata req. $H = [l_d + d_{columna} + 2 \cdot d_{zapata} + 7.50]/100$	m.	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
h_z	m.	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**
d zapata = (h_z - 0.075)	m.	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Area zapata (A)	m²	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50	14.50
Peso zapata ($W_z = A \cdot h_z \cdot \gamma_c$)	Ton	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66
Peso suelo [$W_s = \gamma_s \cdot (A-A_c) \cdot (D_f-h_z)$]	Ton	12.99	12.99	12.99	12.99	12.99	12.99	12.99	12.99	12.99	12.99	12.99	12.99	12.99	12.99	12.99	12.99	12.99
Fz	Ton	*39.07*	*56.13*	*51.87*	*39.07*	*44.41*	*44.41*	*44.43*	*44.43*	*55.92*	*55.92*	*55.93*	*55.93*	*28.78*	*28.78*	*28.80*	*28.80*	*0.00*
Peso total ($W_t = Fz + W_z + W_s$)	Ton	67.72	84.79	80.52	67.72	73.06	73.06	73.08	73.08	84.57	84.57	84.59	84.59	57.43	57.43	57.46	57.46	28.65
Mx	Ton-m	*4.90*	*7.44*	*6.81*	*4.90*	*9.50*	*9.50*	*10.66*	*10.66*	*10.30*	*10.30*	*11.17*	*11.17*	*7.54*	*7.54*	*8.70*	*8.70*	*0.00*
Fy	Ton	*-7.39*	*-10.87*	*-10.00*	*-7.39*	*1.94*	*1.94*	*7.57*	*7.57*	*-2.91*	*-2.91*	*1.34*	*1.34*	*4.90*	*4.90*	*10.53*	*10.53*	*0.00*
My	Ton-m	*6.75*	*11.90*	*10.61*	*6.75*	*21.74*	*21.74*	*12.98*	*12.98*	*21.97*	*21.97*	*15.35*	*15.35*	*19.04*	*19.04*	*10.28*	*10.28*	*0.00*
Fx	Ton	*9.06*	*13.04*	*12.05*	*9.06*	*24.44*	*24.44*	*19.59*	*19.59*	*23.70*	*23.70*	*20.04*	*20.04*	*20.81*	*20.81*	*15.97*	*15.97*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	8.23	12.33	11.31	8.23	8.62	8.62	7.25	7.25	11.60	11.60	10.57	10.57	5.33	5.33	3.96	3.96	0.00
M'y = My+ Fx*h_z	Ton-m	10.83	17.77	16.03	10.83	32.74	32.74	21.80	21.80	32.63	32.63	24.37	24.37	28.41	28.41	17.46	17.46	0.00
e_x = M'y/W_t	m.	0.16	0.21	0.20	0.16	0.45	0.45	0.30	0.30	0.39	0.39	0.29	0.29	0.49	0.49	0.30	0.30	0.00
e_y = M'x/W_t	m.	0.12	0.15	0.14	0.12	0.12	0.12	0.10	0.10	0.14	0.14	0.12	0.12	0.09	0.09	0.07	0.07	0.00
$6e_x/B_X$	-	0.19	0.25	0.24	0.19	0.54	0.54	0.36	0.36	0.46	0.46	0.35	0.35	0.59	0.59	0.36	0.36	0.00
$6e_y/L_Y$	-	0.25	0.30	0.29	0.25	0.24	0.24	0.21	0.21	0.28	0.28	0.26	0.26	0.19	0.19	0.14	0.14	0.00
$q_{max} = (W_t/B_X \cdot L_Y) \cdot (1+6e_x/B_X+6e_y/L_Y)$	Ton/m²	**6.74**	**9.08**	**8.49**	**6.74**	**8.98**	**8.98**	**7.88**	**7.88**	**10.19**	**10.19**	**9.36**	**9.36**	**7.07**	**7.07**	**5.97**	**5.97**	**1.98**
$q_{min} = (W_t/B_X \cdot L_Y) \cdot (1-6e_x/B_X-6e_y/L_Y)$	Ton/m²	**2.60**	**2.62**	**2.61**	**2.60**	**1.10**	**1.10**	**2.20**	**2.20**	**1.48**	**1.48**	**2.31**	**2.31**	**0.85**	**0.85**	**1.95**	**1.95**	**1.98**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																

DISEÑO ZAPATA - CARGAS MAYORADAS

DESCRIPCION	UNIDADES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fz_U	Ton	*30.41*	*33.87*	*37.95*	*37.95*	*37.66*	*37.66*	*26.56*	*26.56*	*26.26*	*26.26*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado ($W_U = Fz_U + W_{zU} + W_{sU}$)	Ton	70.52	63.95	68.04	68.04	67.74	67.74	56.65	56.65	56.35	56.35	30.09	30.09	30.09	30.09	30.09	30.09	30.09
Mx_U	Ton-m	*4.08*	*5.86*	*8.35*	*8.35*	*8.15*	*8.15*	*5.99*	*5.99*	*5.79*	*5.79*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*-5.44*	*-7.64*	*2.78*	*2.78*	*8.79*	*8.79*	*5.81*	*5.81*	*11.81*	*11.81*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*9.33*	*14.85*	*14.26*	*14.26*	*13.34*	*13.34*	*7.98*	*7.98*	*7.06*	*7.06*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*14.81*	*21.57*	*30.34*	*30.34*	*27.86*	*27.86*	*21.62*	*21.62*	*19.14*	*19.14*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U = Mx_U + Fy_U \cdot h_z$	Ton-m	6.53	9.30	9.60	9.60	12.10	12.10	8.61	8.61	11.11	11.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U + Fx_U \cdot h_z$	Ton-m	15.99	24.55	27.91	27.91	25.88	25.88	17.71	17.71	15.67	15.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_U$	m.	0.23	0.38	0.41	0.41	0.38	0.38	0.31	0.31	0.28	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_U$	m.	0.09	0.15	0.14	0.14	0.18	0.18	0.15	0.15	0.20	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.27	0.46	0.49	0.49	0.46	0.46	0.38	0.38	0.33	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.19	0.30	0.29	0.29	0.37	0.37	0.31	0.31	0.41	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_U/B_X \cdot L_Y) \cdot (1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m²	7.12	7.77	8.37	8.37	8.54	8.54	6.60	6.60	6.77	6.77	2.07	2.07	2.07	2.07	2.07	2.07	2.07
$q_{minU} = (W_U/B_X \cdot L_Y) \cdot (1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m²	2.61	1.05	1.01	1.01	0.80	0.80	1.21	1.21	1.00	1.00	2.07	2.07	2.07	2.07	2.07	2.07	2.07

ACCION COMO VIGA

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$V_U = q_{maxU} \cdot L_Y \cdot (B_X/2-b_c/2-d)$	Ton	15.48	16.90	18.21	18.21	18.58	18.58	14.36	14.36	14.72	14.72	4.51	4.51	4.51	4.51	4.51	4.51	4.51
$v_U = V_U/(L_Y \cdot d)$	Kg/cm²	1.42	1.55	1.67	1.67	1.71	1.71	1.32	1.32	1.35	1.35	0.41	0.41	0.41	0.41	0.41	0.41	0.41
$v_U \le \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN X - v_{uMAX}	Kg/cm²	1.71																
DIRECCION Y																		
$V_U = q_{maxU} \cdot B_X \cdot (L_Y/2-b_c/2-d)$	Ton	29.37	32.05	34.54	34.54	35.23	35.23	27.23	27.23	27.92	27.92	8.56	8.56	8.56	8.56	8.56	8.56	8.56
$v_U = V_U/(B_X \cdot d)$	Kg/cm²	1.57	1.71	1.84	1.84	1.88	1.88	1.45	1.45	1.49	1.49	0.46	0.46	0.46	0.46	0.46	0.46	0.46
$v_U \le \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO VIGA EN Y - v_{uMAX}	Kg/cm²	1.88																

ACCION COMO LOSA

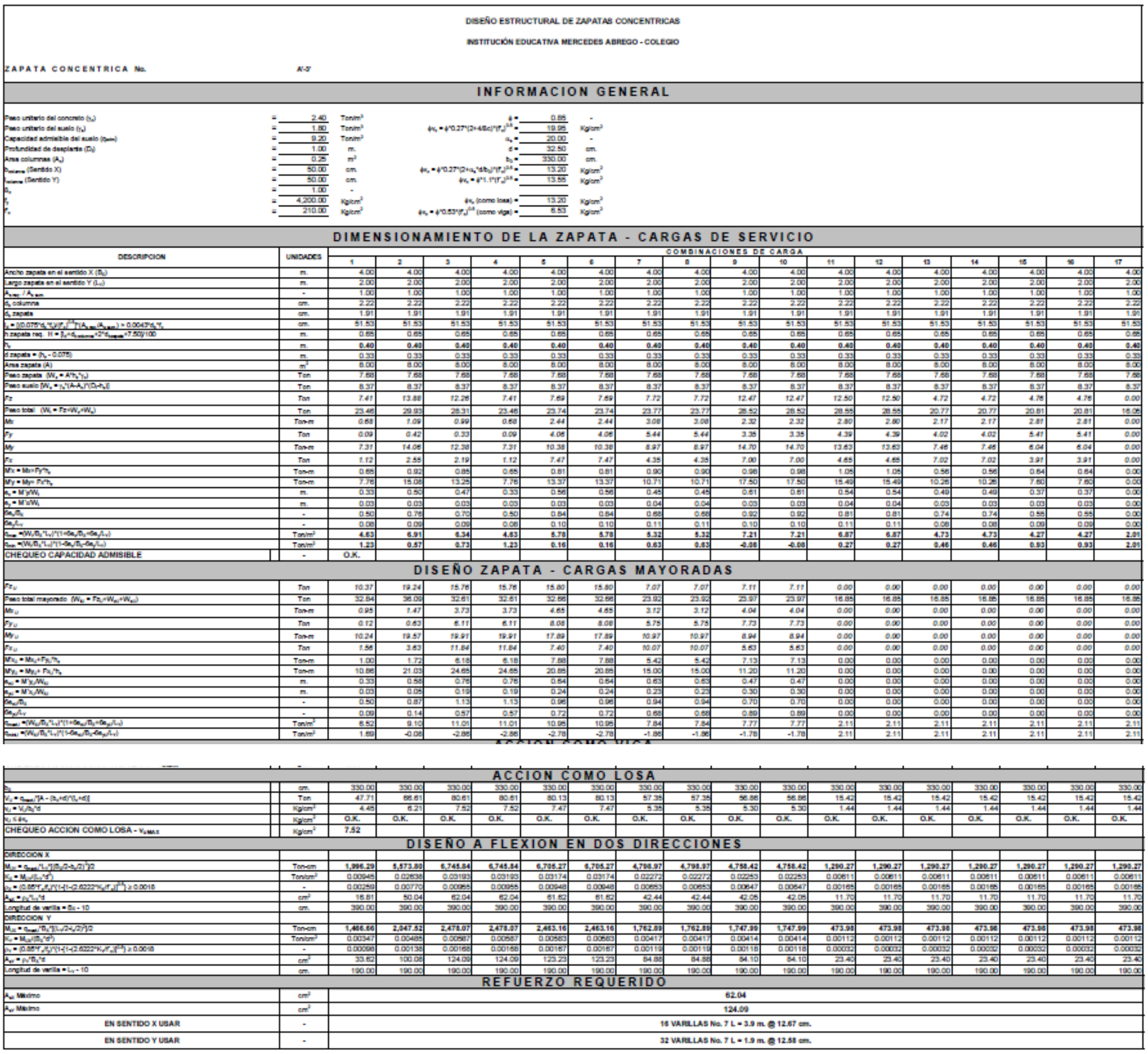
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
b_0	cm.	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
$V_U = q_{maxU} \cdot [A - (b_c+d) \cdot (l_c+d)]$	Ton	83.76	91.42	98.50	98.50	100.48	100.48	77.66	77.66	79.63	79.63	24.41	24.41	24.41	24.41	24.41	24.41	24.41
$v_U = V_U/b_0 \cdot d$	Kg/cm²	2.79	3.05	3.28	3.28	3.35	3.35	2.59	2.59	2.65	2.65	0.81	0.81	0.81	0.81	0.81	0.81	0.81
$v_U \le \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - v_{uMAX}	Kg/cm²	3.35																

DISEÑO A FLEXION EN DOS DIRECCIONES

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
DIRECCION X																		
$M_{UX} = q_{maxU} \cdot L_Y \cdot [(B_X/2-b_c/2)^2]/2$	Ton-cm	**1,306.43**	**2,851.78**	**3,072.85**	**3,072.85**	**3,134.54**	**3,134.54**	**2,422.51**	**2,422.51**	**2,484.20**	**2,484.20**	**761.56**	**761.56**	**761.56**	**761.56**	**761.56**	**761.56**	**761.56**
$K_X = M_{UX}/(L_Y \cdot d^2)$	Ton/cm²	0.00320	0.00699	0.00753	0.00753	0.00769	0.00769	0.00594	0.00594	0.00609	0.00609	0.00187	0.00187	0.00187	0.00187	0.00187	0.00187	0.00187
$\rho_X = (0.85 \cdot f'_c/f_y) \cdot \{1-[1-(2.6222 \cdot K_X/f'_c)]^{0.5}\} \ge 0.0018$	-	0.00086	0.00190	0.00205	0.00205	0.00209	0.00209	0.00161	0.00161	0.00165	0.00165	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050
$A_{sX} = \rho_X \cdot L_Y \cdot d$	cm²	19.58	20.64	22.28	22.28	22.74	22.74	19.58	19.58	19.58	19.58	19.58	19.58	19.58	19.58	19.58	19.58	19.58
Longitud de varilla = B_X - 10	cm.	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00
DIRECCION Y																		
$M_{UY} = q_{maxU} \cdot B_X \cdot [(L_Y/2-l_c/2)^2]/2$	Ton-cm	**5,125.59**	**5,594.30**	**6,027.96**	**6,027.96**	**6,148.98**	**6,148.98**	**4,752.20**	**4,752.20**	**4,873.22**	**4,873.22**	**1,493.95**	**1,493.95**	**1,493.95**	**1,493.95**	**1,493.95**	**1,493.95**	**1,493.95**
$K_Y = M_{UY}/(B_X \cdot d^2)$	Ton/cm²	0.00729	0.00796	0.00857	0.00857	0.00875	0.00875	0.00676	0.00676	0.00693	0.00693	0.00212	0.00212	0.00212	0.00212	0.00212	0.00212	0.00212
$\rho_Y = (0.85 \cdot f'_c/f_y) \cdot \{1-[1-(2.6222 \cdot K_Y/f'_c)]^{0.5}\} \ge 0.0018$	-	0.00209	0.00229	0.00247	0.00247	0.00252	0.00252	0.00194	0.00194	0.00199	0.00199	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060
$A_{sY} = \rho_Y \cdot B_X \cdot d$	cm²	33.75	35.59	38.41	38.41	39.20	39.20	33.75	33.75	33.75	33.75	33.75	33.75	33.75	33.75	33.75	33.75	33.75
Longitud de varilla = L_Y - 10	cm.	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	22.74
A_{sY} Máximo	cm²	39.20
EN SENTIDO X USAR	-	5 VARILLAS No. 6 L = 4.9 m. @ 40 cm.
EN SENTIDO Y USAR	-	14 VARILLAS No. 6 L = 2.8 m. @ 37.69 cm.



DISEÑO ESTRUCTURAL DE ZAPATAS CONCENTRICAS

INSTITUCIÓN EDUCATIVA MERCEDES ABREGO - COLEGIO

ZAPATA CONCENTRICA No. A'-3'

INFORMACION GENERAL

Peso unitario del concreto (γ_c) = 2.40 Ton/m³
Peso unitario del suelo (γ_s) = 1.80 Ton/m³
Capacidad admisible del suelo (q_{adm}) = 9.20 Ton/m²
Profundidad de desplante (D_f) = 1.00 m.
Area columnas (A_c) = 0.25 m²
$b_{columna}$ (Sentido X) = 50.00 cm.
$l_{columna}$ (Sentido Y) = 50.00 cm.
β_c = 1.00 -
f_y = 4,200.00 Kg/cm²
f'_c = 210.00 Kg/cm²

ϕ = 0.85 -
$\phi v_c = \phi*0.27*(2+4/\beta c)*(f'_c)^{0.5}$ = 19.95 Kg/cm²
α_s = 20.00 -
d = 32.50 cm.
b_0 = 330.00 cm.
$\phi v_c = \phi*0.27*(2+\alpha_s*d/b_0)*(f'_c)^{0.5}$ = 13.20 Kg/cm²
$\phi v_c = \phi*1.1*(f'_c)^{0.5}$ = 13.55 Kg/cm²
ϕv_c (como losa) = 13.20 Kg/cm²
$\phi v_c = \phi*0.53*(f'_c)^{0.5}$ (como viga) = 6.53 Kg/cm²

DIMENSIONAMIENTO DE LA ZAPATA - CARGAS DE SERVICIO

DESCRIPCION	UNIDADES	COMBINACIONES DE CARGA																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ancho zapata en el sentido X (B_X)	m.	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Largo zapata en el sentido Y (L_Y)	m.	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
$A_{s,req} / A_{s,sum}$	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d_b columna	cm.	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22
d_b zapata	cm.	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
$l_d = [(0.075*d_b*f_y)/(f'_c)^{0.5}]*(A_{s,req}/A_{s,sum}) > 0.0043*d_b*f_y$	cm.	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53	51.53
h zapata req. $H = [l_d+d_{columna}+2*d_{zapata}+7.50]/100$	m.	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
h_z	m.	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**
d zapata = (h_z - 0.075)	m.	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Area zapata (A)	m²	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Peso zapata ($W_z = A*h_z*\gamma_c$)	Ton	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68	7.68
Peso suelo [$W_s = \gamma_s*(A-A_c)*(D_f-h_z)$]	Ton	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37	8.37
Fz	Ton	*7.41*	*13.88*	*12.26*	*7.41*	*7.69*	*7.69*	*7.72*	*7.72*	*12.47*	*12.47*	*12.50*	*12.50*	*4.72*	*4.72*	*4.76*	*4.76*	*0.00*
Peso total (W_t = Fz+W_z+W_s)	Ton	23.46	29.93	28.31	23.46	23.74	23.74	23.77	23.77	28.52	28.52	28.55	28.55	20.77	20.77	20.81	20.81	16.05
Mx	Ton-m	*0.68*	*1.09*	*0.99*	*0.68*	*2.44*	*2.44*	*3.08*	*3.08*	*2.32*	*2.32*	*2.80*	*2.80*	*2.17*	*2.17*	*2.81*	*2.81*	*0.00*
Fy	Ton	*0.09*	*0.42*	*0.33*	*0.09*	*4.06*	*4.06*	*5.44*	*5.44*	*3.35*	*3.35*	*4.39*	*4.39*	*4.02*	*4.02*	*5.41*	*5.41*	*0.00*
My	Ton-m	*7.31*	*14.06*	*12.38*	*7.31*	*10.38*	*10.38*	*8.97*	*8.97*	*14.70*	*14.70*	*13.63*	*13.63*	*7.46*	*7.46*	*6.04*	*6.04*	*0.00*
Fx	Ton	*1.12*	*2.55*	*2.19*	*1.12*	*7.47*	*7.47*	*4.35*	*4.35*	*7.00*	*7.00*	*4.65*	*4.65*	*7.02*	*7.02*	*3.91*	*3.91*	*0.00*
M'x = Mx+Fy*h_z	Ton-m	0.68	0.92	0.85	0.68	0.81	0.81	0.90	0.90	0.98	0.98	1.05	1.05	0.56	0.56	0.64	0.64	0.00
M'y = My+ Fx*h_z	Ton-m	7.76	15.08	13.25	7.76	13.37	13.37	10.71	10.71	17.50	17.50	15.49	15.49	10.28	10.28	7.60	7.60	0.00
e_x = M'y/W_t	m.	0.33	0.50	0.47	0.33	0.56	0.56	0.45	0.45	0.61	0.61	0.54	0.54	0.49	0.49	0.37	0.37	0.00
e_y = M'x/W_t	m.	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.03	0.04	0.04	0.03	0.03	0.03	0.03	0.00
$6e_x/B_X$	-	0.50	0.76	0.70	0.50	0.84	0.84	0.68	0.68	0.92	0.92	0.81	0.81	0.74	0.74	0.55	0.55	0.00
$6e_y/L_Y$	-	0.08	0.09	0.09	0.08	0.10	0.10	0.11	0.11	0.10	0.10	0.11	0.11	0.08	0.08	0.09	0.09	0.00
$q_{max} = (W_t/B_X*L_Y)*(1+6e_x/B_X+6e_y/L_Y)$	Ton/m²	**4.63**	**6.91**	**6.34**	**4.63**	**5.78**	**5.78**	**5.32**	**5.32**	**7.21**	**7.21**	**6.87**	**6.87**	**4.73**	**4.73**	**4.27**	**4.27**	**2.01**
$q_{min} = (W_t/B_X*L_Y)*(1-6e_x/B_X-6e_y/L_Y)$	Ton/m²	**1.23**	**0.57**	**0.73**	**1.23**	**0.16**	**0.16**	**0.63**	**0.63**	**-0.08**	**-0.08**	**0.27**	**0.27**	**0.46**	**0.46**	**0.93**	**0.93**	**2.01**
CHEQUEO CAPACIDAD ADMISIBLE	-	O.K.																
DISEÑO ZAPATA - CARGAS MAYORADAS																		
Fz_U	Ton	*10.37*	*19.24*	*15.76*	*15.76*	*15.80*	*15.80*	*7.07*	*7.07*	*7.11*	*7.11*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Peso total mayorado ($W_{tU} = Fz_U+W_{zU}+W_{sU}$)	Ton	32.84	38.09	32.61	32.61	32.66	32.66	23.92	23.92	23.97	23.97	16.85	16.85	16.85	16.85	16.85	16.85	16.85
Mx_U	Ton-m	*0.95*	*1.47*	*3.73*	*3.73*	*4.65*	*4.65*	*3.12*	*3.12*	*4.04*	*4.04*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fy_U	Ton	*0.12*	*0.63*	*6.11*	*6.11*	*8.08*	*8.08*	*5.75*	*5.75*	*7.73*	*7.73*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
My_U	Ton-m	*10.24*	*19.57*	*19.91*	*19.91*	*17.89*	*17.89*	*10.97*	*10.97*	*8.94*	*8.94*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Fx_U	Ton	*1.56*	*3.63*	*11.84*	*11.84*	*7.40*	*7.40*	*10.07*	*10.07*	*5.63*	*5.63*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$M'x_U = Mx_U+Fy_U*h_z$	Ton-m	1.00	1.72	6.18	6.18	7.88	7.88	5.42	5.42	7.13	7.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$M'y_U = My_U+ Fx_U*h_z$	Ton-m	10.86	21.03	24.65	24.65	20.85	20.85	15.00	15.00	11.20	11.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{xU} = M'y_U/W_{tU}$	m.	0.33	0.58	0.76	0.76	0.64	0.64	0.63	0.63	0.47	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$e_{yU} = M'x_U/W_{tU}$	m.	0.03	0.05	0.19	0.19	0.24	0.24	0.23	0.23	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{xU}/B_X$	-	0.50	0.87	1.13	1.13	0.96	0.96	0.94	0.94	0.70	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$6e_{yU}/L_Y$	-	0.09	0.14	0.57	0.57	0.72	0.72	0.68	0.68	0.89	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$q_{maxU} = (W_{tU}/B_X*L_Y)*(1+6e_{xU}/B_X+6e_{yU}/L_Y)$	Ton/m²	6.52	9.10	11.01	11.01	10.95	10.95	7.84	7.84	7.77	7.77	2.11	2.11	2.11	2.11	2.11	2.11	2.11
$q_{minU} = (W_{tU}/B_X*L_Y)*(1-6e_{xU}/B_X-6e_{yU}/L_Y)$	Ton/m²	1.69	-0.08	-2.86	-2.86	-2.78	-2.78	-1.86	-1.86	-1.78	-1.78	2.11	2.11	2.11	2.11	2.11	2.11	2.11
ACCION COMO LOSA																		
b_0	cm.	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00
$V_U = q_{maxU}*[A - (b_c+d)*(l_c+d)]$	Ton	47.71	66.61	80.61	80.61	80.13	80.13	57.35	57.35	56.86	56.86	15.42	15.42	15.42	15.42	15.42	15.42	15.42
$v_U = V_U/b_0*d$	Kg/cm²	4.45	6.21	7.52	7.52	7.47	7.47	5.35	5.35	5.30	5.30	1.44	1.44	1.44	1.44	1.44	1.44	1.44
$v_U \leq \phi v_c$	Kg/cm²	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.	O.K.
CHEQUEO ACCION COMO LOSA - $v_{u MAX}$	Kg/cm²	7.52																
DISEÑO A FLEXION EN DOS DIRECCIONES																		
DIRECCION X																		
$M_{UX} = q_{maxU}*L_Y*[(B_X/2-b_c/2)^2]/2$	Ton-cm	**1,996.29**	**5,573.80**	**6,745.84**	**6,745.84**	**6,706.27**	**6,706.27**	**4,798.97**	**4,798.97**	**4,758.42**	**4,758.42**	**1,290.27**	**1,290.27**	**1,290.27**	**1,290.27**	**1,290.27**	**1,290.27**	**1,290.27**
$K_X = M_{UX}/(L_Y*d^2)$	Ton/cm²	0.00945	0.02638	0.03193	0.03193	0.03174	0.03174	0.02272	0.02272	0.02253	0.02253	0.00611	0.00611	0.00611	0.00611	0.00611	0.00611	0.00611
$\rho_X = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_X/f'_c)]^{0.5}) \geq 0.0018$	-	0.00259	0.00770	0.00955	0.00955	0.00948	0.00948	0.00653	0.00653	0.00647	0.00647	0.00165	0.00165	0.00165	0.00165	0.00165	0.00165	0.00165
$A_{sX} = \rho_X*L_Y*d$	cm²	16.81	50.04	62.04	62.04	61.62	61.62	42.44	42.44	42.05	42.05	11.70	11.70	11.70	11.70	11.70	11.70	11.70
Longitud de varilla = Bx - 10	cm.	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00	390.00
DIRECCION Y																		
$M_{UY} = q_{maxU}*B_X*[(L_Y/2-l_c/2)^2]/2$	Ton-cm	**1,466.66**	**2,047.52**	**2,478.07**	**2,478.07**	**2,463.16**	**2,463.16**	**1,762.89**	**1,762.89**	**1,747.99**	**1,747.99**	**473.98**	**473.98**	**473.98**	**473.98**	**473.98**	**473.98**	**473.98**
$K_Y = M_{UY}/(B_X*d^2)$	Ton/cm²	0.00347	0.00485	0.00587	0.00587	0.00583	0.00583	0.00417	0.00417	0.00414	0.00414	0.00112	0.00112	0.00112	0.00112	0.00112	0.00112	0.00112
$\rho_Y = (0.85*f'_c/f_y)*(1-[1-(2.6222*K_Y/f'_c)]^{0.5}) \geq 0.0018$	-	0.00098	0.00138	0.00168	0.00168	0.00167	0.00167	0.00119	0.00119	0.00118	0.00118	0.00032	0.00032	0.00032	0.00032	0.00032	0.00032	0.00032
$A_{sY} = \rho_Y*B_X*d$	cm²	33.62	100.08	124.09	124.09	123.23	123.23	84.88	84.88	84.10	84.10	23.40	23.40	23.40	23.40	23.40	23.40	23.40
Longitud de varilla = L_Y - 10	cm.	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00

REFUERZO REQUERIDO

A_{sX} Máximo	cm²	**62.04**
A_{sY} Máximo	cm²	**124.09**
EN SENTIDO X USAR	-	**16 VARILLAS No. 7 L = 3.9 m. @ 12.67 cm.**
EN SENTIDO Y USAR	-	**32 VARILLAS No. 7 L = 1.9 m. @ 12.58 cm.**

7.4 DISEÑO DE VIGAS Y COLUMNAS

7.4.1 VIGAS

VR08/ BASE

B= 0.40 H= 0.40 L= 1.82		
Mu=-2.67		Mu=-0.00
As=4.57		As=4.57
	Mu=2.15	
	As=4.57	
Vu=-6.25	Vu=-1.59	Vu=4.58

VR07/ N+0.44

B= 0.40 H= 0.40 L= 1.69		
Mu=-0.00		Mu=-174.13
As=4.57		As=15.30
	Mu=0.00	
	As=4.57	
Vu=83.38	Vu=88.02	Vu=92.66

VR10/ N+0.44

B= 0.15 H= 0.40 L= 4.56			B= 0.15 H= 0.40 L= 4.58			B= 0.15 H= 0.40 L= 1.53		
Mu=-0.00		Mu=-45.99	Mu=-51.02		Mu=-12.76	Mu=-12.79		Mu=-51.18
As=1.71		As=3.85	As=4.33		As=1.71	As=1.71		As=4.34
	Mu=22.69			Mu=25.51			Mu=12.79	
	As=2.12			As=2.05			As=1.71	
Vu=-22.99	Vu=10.99	Vu=44.96	Vu=-46.12	Vu=-12.14	Vu=21.84	Vu=25.03	Vu=32.73	Vu=40.43

B= 0.15 H= 0.40 L= 6.45			B= 0.40 H= 0.40 L= 1.76		
Mu=-55.58		Mu=-54.86	Mu=-79.28		Mu=-0.00
As=4.76		As=4.69	As=6.41		As=4.57
	Mu=28.28			Mu=0.00	
	As=2.28			As=4.57	
Vu=-48.19	Vu=1.59	Vu=47.98	Vu=-56.26	Vu=-41.27	Vu=-26.28

VR03/ N+0.88

B= 0.40 H= 0.40 L= 1.69		
Mu=-3.31		Mu=-191.88
As=4.57		As=17.18
	Mu=0.00	
	As=4.57	
Vu=83.02	Vu=93.79	Vu=104.56

VR04/ N+2.09

B= 0.40 H= 0.40 L= 1.69		
Mu=-163.01 As=14.17		Mu=-2.28 As=4.57
	Mu=0.00 As=4.57	
Vu=-93.12	Vu=-80.00	Vu=-66.87

VR06/ N+2.09

B= 0.15 H= 0.40 L= 1.87		
Mu=-3.05 As=1.71		Mu=-2.80 As=1.71
	Mu=3.24 As=1.71	
Vu=-10.35	Vu=-0.59	Vu=10.10

VR11/ N+2.09

B= 0.15 H= 0.40 L= 1.53			B= 0.15 H= 0.40 L= 6.45		
Mu=-0.19 As=1.71		Mu=-35.06 As=2.87	Mu=-55.07 As= 4.71		Mu=-55.15 As=4.72
	Mu=0.00 As=1.71			Mu=28.39 As=2.29	
Vu=10.35	Vu=19.35	Vu=28.35	Vu=48.07	Vu=-1.71	Vu=-48.10

VR12/ N+2.09

B= 0.15 H= 0.40 L= 1.58			B= 0.15 H= 0.40 L= 6.55			B= 0.15 H= 0.40 L= 1.81		
Mu=-0.83 As=1.71		Mu=-36.25 As=2.97	Mu=-47.46 As= 3.99		Mu=-55.13 As=4.72	Mu=-41.59 As= 3.45		Mu=-3.46 As=1.71
	Mu=0.00 As=1.71			Mu=32.21 As=2.62			Mu=0.00 As=1.71	
Vu=10.10	Vu=19.09	Vu=28.09	Vu=46.98	Vu=-2.55	Vu=-49.19	Vu=-29.12	Vu=-18.29	Vu=-7.45

VR05/ N+0.88

B= 0.15 H= 0.40 L= 1.87		
Mu=-2.68		Mu=-6.20
As=1.71		As=1.71
	Mu=1.55	
	As=1.71	
Vu=-5.86	Vu=2.39	Vu=9.87

VR01/ N+1.485

B= 0.15 H= 0.40 L= 1.87			B= 0.15 H= 0.40 L= 1.87		
Mu=-4.23		Mu=-10.30	Mu=-10.31		Mu=-4.65
As=1.71		As=1.71	As=1.71		As=1.71
	Mu=2.57			Mu=2.58	
	As=1.71			As=1.71	
Vu=-7.32	Vu=3.25	Vu=13.21	Vu=-13.07	Vu=-3.38	Vu=7.45

VR02/ N+1.485

B= 0.40 H= 0.40 L= 1.69			B= 0.40 H= 0.40 L= 1.69		
Mu=-1.54		Mu=-151.39	Mu=-173.44		Mu=-2.79
As=4.57		As=13.02	As=15.23		As=4.57
	Mu=0.00			Mu=0.00	
	As=4.57			As=4.57	
Vu=64.40	Vu=75.21	Vu=86.02	Vu=-96.18	Vu=-85.37	Vu=-74.57

VR09/ N+1.485

B= 0.15 H= 0.40 L= 9.64			B= 0.15 H= 0.40 L= 1.73			B= 0.15 H= 0.40 L= 6.70		
Mu=-11.01		Mu=-11.01	Mu=-14.15		Mu=-56.62	Mu=-55.09		Mu=-52.36
As=1.71		As=1.71	As=1.71		As=4.87	As=4.72		As=4.45
	Mu=22.50			Mu=14.15			Mu=29.78	
	As=1.79			As=1.71			As=2.41	
Vu=-29.10	Vu=-44.88	Vu=23.08	Vu=29.83	Vu=37.53	Vu=45.23	Vu=-48.48	Vu=-0.39	Vu=47.69

B= 0.40 H= 0.40 L= 1.81		
Mu=-41.15		Mu=-3.30
As=4.57		As=4.57
	Mu=0.00	
	As=4.57	
Vu=-28.99	Vu=-18.15	Vu=-7.32

7.4.2 COLUMNAS

Colum na A'-2

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+2.09					159.85	28.95				12#6 #7 (1.5%)	0.75	2.01	3.68
	.81	.40	.50	.50			-145.45	161.98	63.45				
					295.58	7.46				12#6 #7 (1.5%)	0.96		
N+0.88					-186.86	-25.96				12#6 #7 (1.5%)	0.73	3.64	5.54
	.48	.40	.50	.50			-161.57	171.76	140.86				
		1.00			255.45	58.04				12#6 #7 (1.5%)	0.87		

Colum na A'-1'

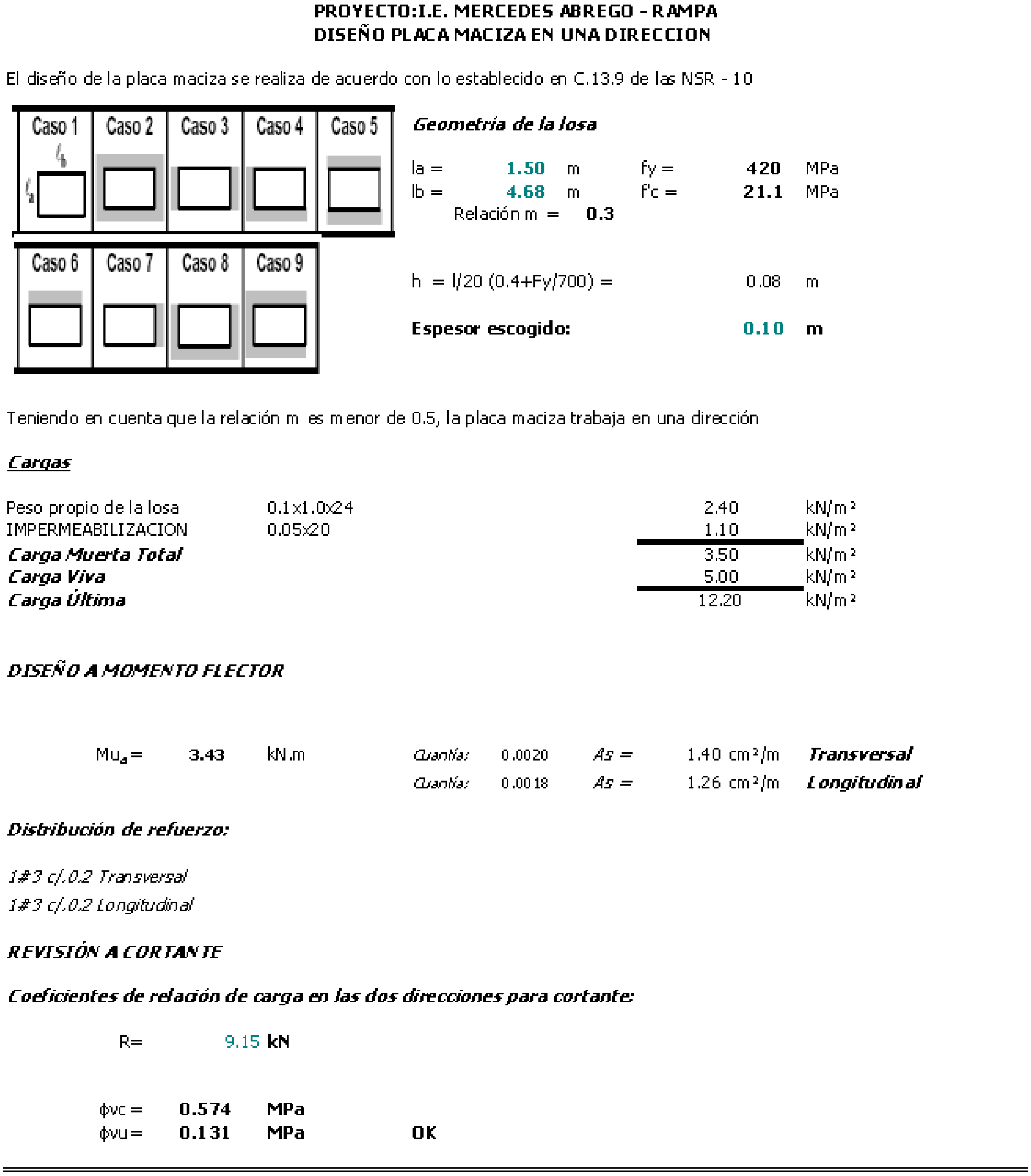
Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+1.485					54.16	11.45				12#6 #7 (1.5%)	0.58	1.41	1.86
	1.09	.40	.50	.50			-121.23	196.55	135.93				
		1.00			140.55	67.20				12#6 #7 (1.5%)	0.70		

Colum na A'-3'

Nivel	H Libre	Losa	B	H	M1	M2	P	V1	V2	Cuantia	m/mr	Col/Vig Eje ppal	Col/vig Eje sec
N+0.44					-176.17	17.15				12#5 #6 (1.1%)	0.76	1.50	1.87
	.04	.40	.50	.50			-189.05	175.95	125.24				
		1.00			-224.37	-31.23				12#5 #6 (1.1%)	0.96		

7.5 DISEÑO DE ELEMENTOS COMPLEMENTARIOS

7.5.1 DISEÑO DE PLACA MACIZAS


Caso 1
Caso 2
Caso 3
Caso 4
Caso 5
Caso 6
Caso 7
Caso 8
Caso 9
l_b
l_a

PROYECTO:I.E. MERCEDES ABREGO - RAMPA
DISEÑO PLACA MACIZA EN UNA DIRECCION

El diseño de la placa maciza se realiza de acuerdo con lo establecido en C.13.9 de las NSR - 10

Geometría de la losa

la =	**1.50**	m	fy =	**420**	MPa
lb =	**4.68**	m	f'c =	**21.1**	MPa

Relación m = **0.3**

h = l/20 (0.4+Fy/700) = 0.08 m

Espesor escogido: **0.10** **m**

Teniendo en cuenta que la relación m es menor de 0.5, la placa maciza trabaja en una dirección

Cargas

Peso propio de la losa	0.1x1.0x24	2.40	kN/m²
IMPERMEABILIZACION	0.05x20	1.10	kN/m²
Carga Muerta Total		3.50	kN/m²
Carga Viva		5.00	kN/m²
Carga Última		12.20	kN/m²

DISEÑO A MOMENTO FLECTOR

Mu_a =	**3.43**	kN.m	*Cuantía:*	0.0020	*As =*	1.40 cm²/m	***Transversal***
			Cuantía:	0.0018	*As =*	1.26 cm²/m	***Longitudinal***

Distribución de refuerzo:

1#3 c/.0.2 Transversal
1#3 c/.0.2 Longitudinal

REVISIÓN A CORTANTE

Coeficientes de relación de carga en las dos direcciones para cortante:

R= 9.15 **kN**

ϕvc = **0.574** **MPa**
ϕvu = **0.131** **MPa** **OK**

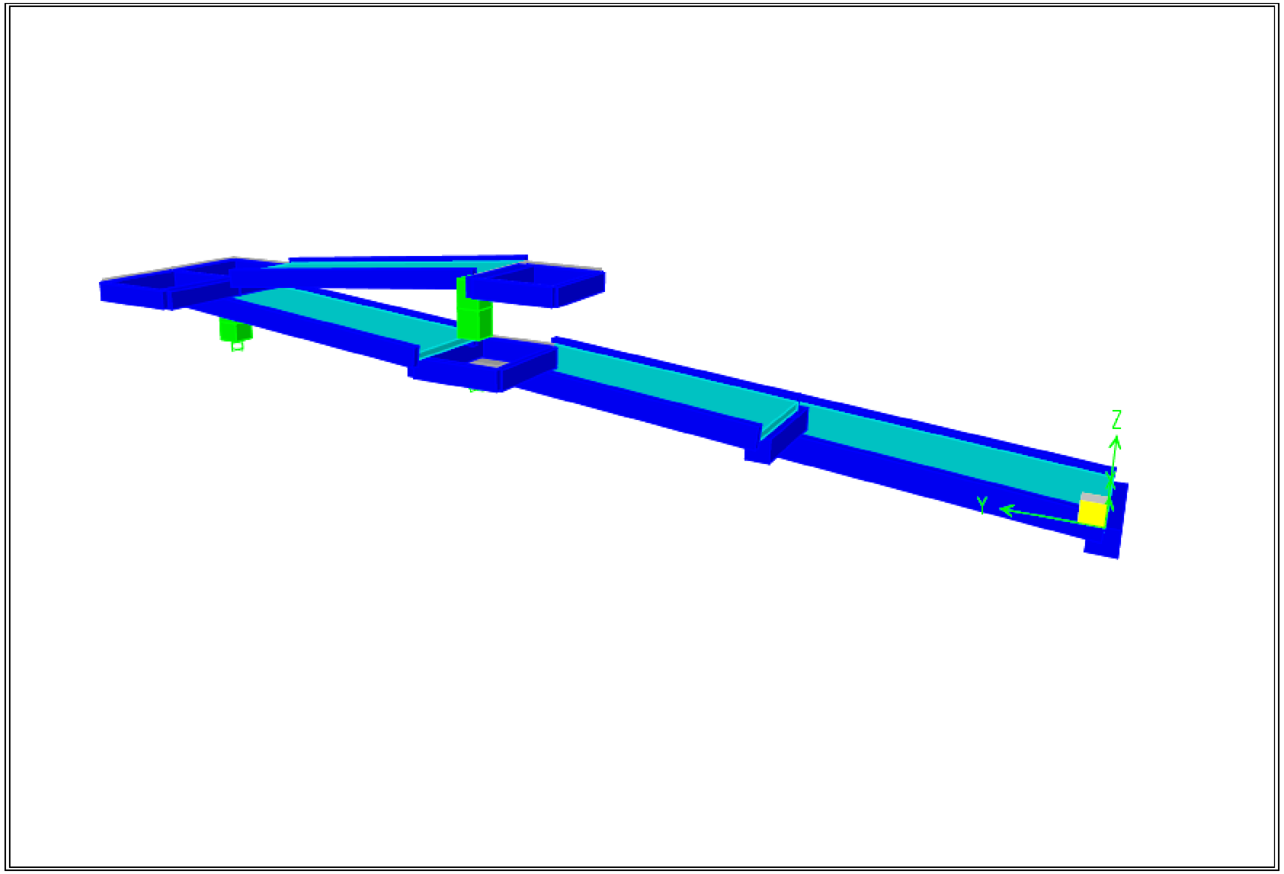
8 ESPECIFICACIONES TÉCNICAS

Los materiales utilizados son:

Concreto	21.1 MPa para vigas, placas, zapatas y
columnas. Concreto	14 MPa (para concreto de limpieza).
Acero para refuerzo:	fy = 420 MPa para todos los diámetros.

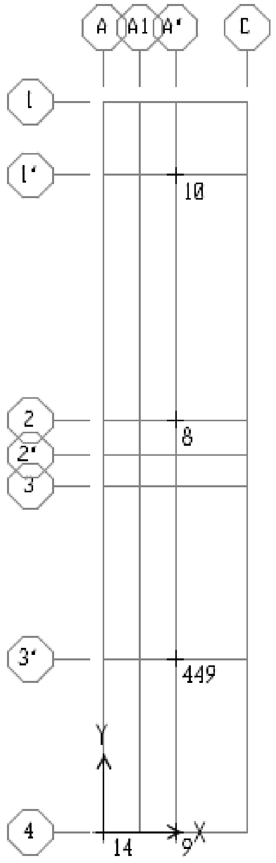
9 ANEXOS

ETABS



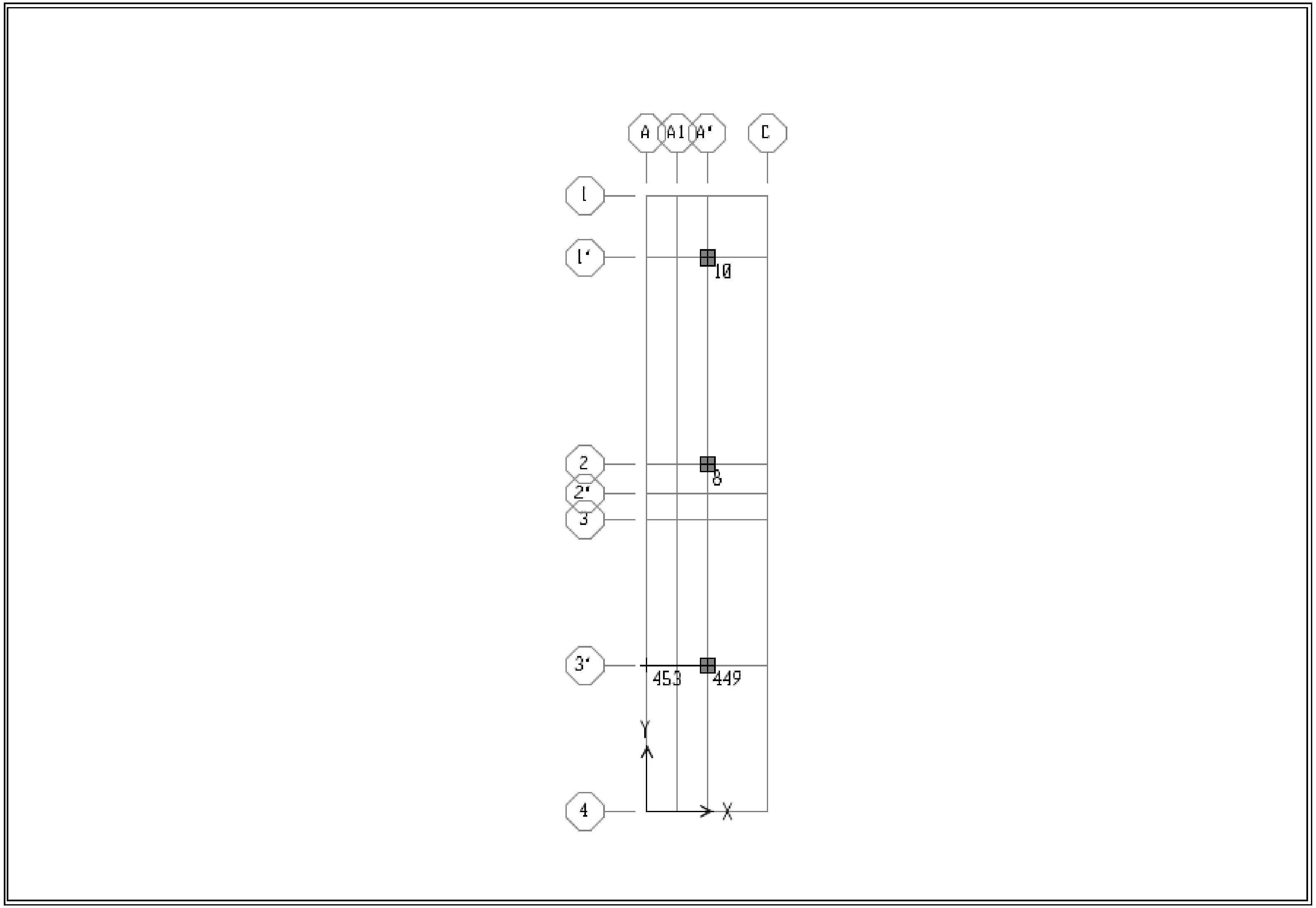
ETABS v9.7.4 - File: MODELO RAMPA 1 - noviembre 9,2016 8:22
3-D View - KN-m Units

ETABS


A
A1
A'
C
1
1'
2
2'
3
3'
4
10
8
449
14
9
Y
X

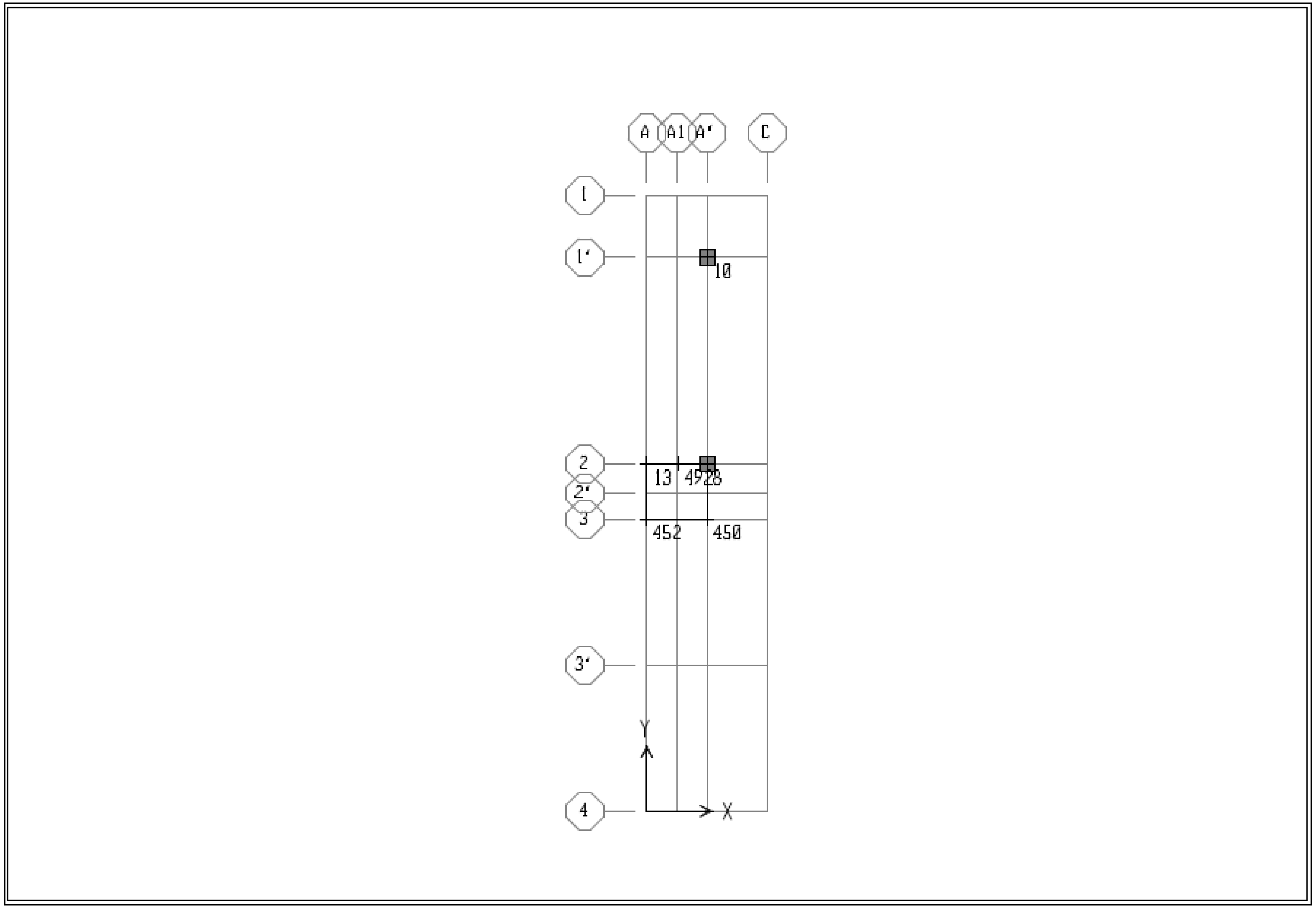
ETABS v9.7.4 - File: MODELO RAMPA 1 - noviembre 9,2016 8:34
Plan View - BASE - Elevation 0 - KN-m Units

ETABS


A
A1
A'
C
1
1'
2
2'
3
3'
4
10
8
453
449
Y
X

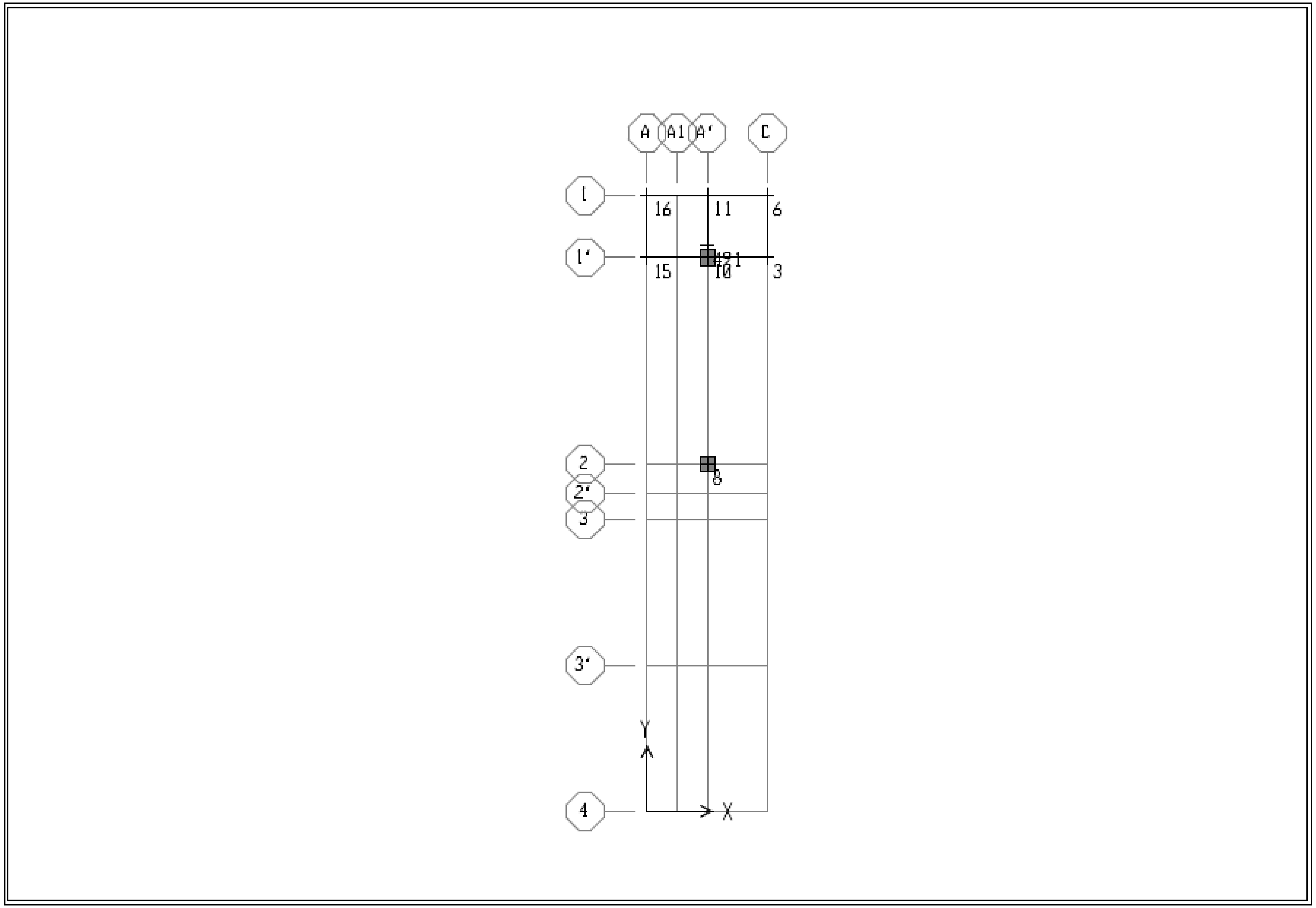
ETABS v9.7.4 - File: MODELO RAMPA 1 - noviembre 9,2016 8:35
Plan View - N+0.44 - Elevation 0.44 - KN-m Units

ETABS

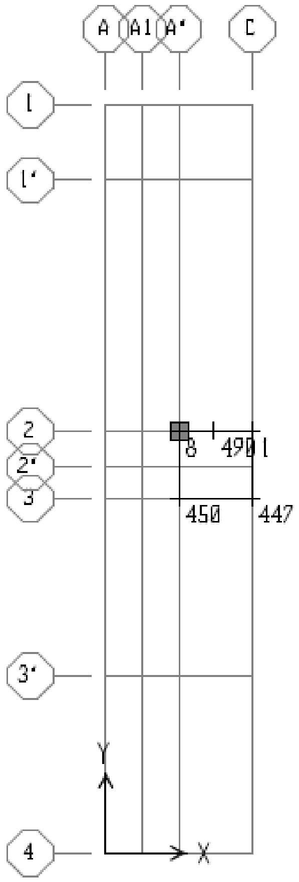

A
A1
A'
C
1
1'
10
2
13
4928
2'
3
452
450
3'
Y
X
4

ETABS v9.7.4 - File: MODELO RAMPA 1 - noviembre 9,2016 8:35
Plan View - N+0.88 - Elevation 0.8804 - KN-m Units

ETABS

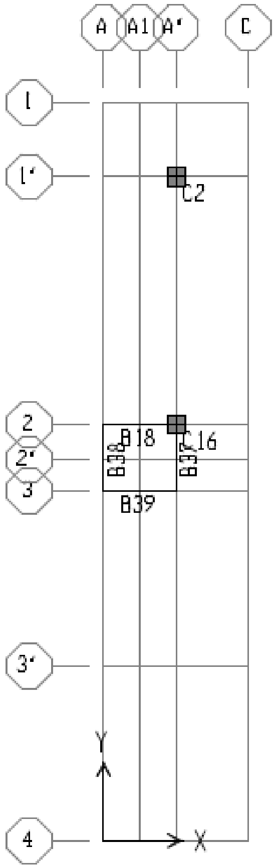

A
A1
A'
C
1
1'
2
2'
3
3'
4
16
11
6
15
#21
10
3
8
Y
X

ETABS v9.7.4 - File: MODELO RAMPA 1 - noviembre 9,2016 8:36
Plan View - N+1.485 - Elevation 1.4852 - KN-m Units


A
A1
A'
C
1
1'
2
2'
3
3'
4
8
490
1
450
447
Y
X

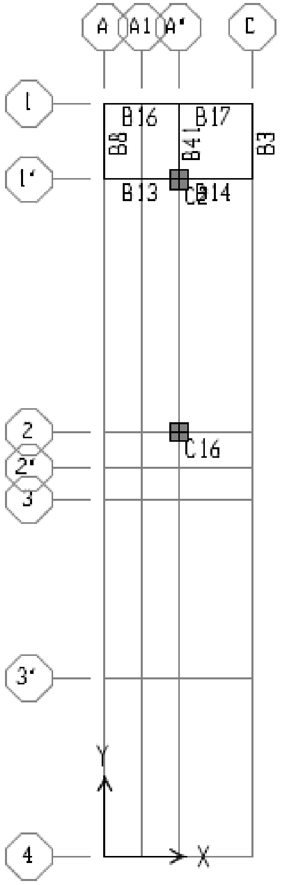
ETABS v9.7.4 - File: MODELO RAMPA 1 - noviembre 9,2016 8:36
Plan View - N+2.09 - Elevation 2.09 - KN-m Units

ETABS


A
A1
A'
C
1
1'
C2
2
2'
3
B18
C16
B38
B37
B39
3'
4
Y
X

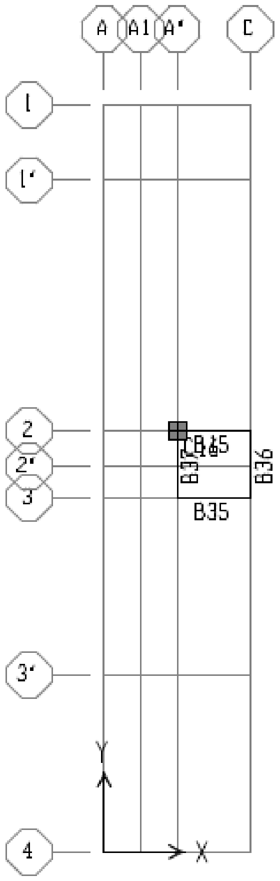
ETABS v9.7.4 - File: MODELO RAMPA 1 - noviembre 9,2016 8:37
Plan View - N+0.88 - Elevation 0.8804 - KN-m Units

ETABS


A
A1
A'
C
1
1'
2
2'
3
3'
4
B16
B17
B8
B41
B3
B13
C2
B14
C16
Y
X

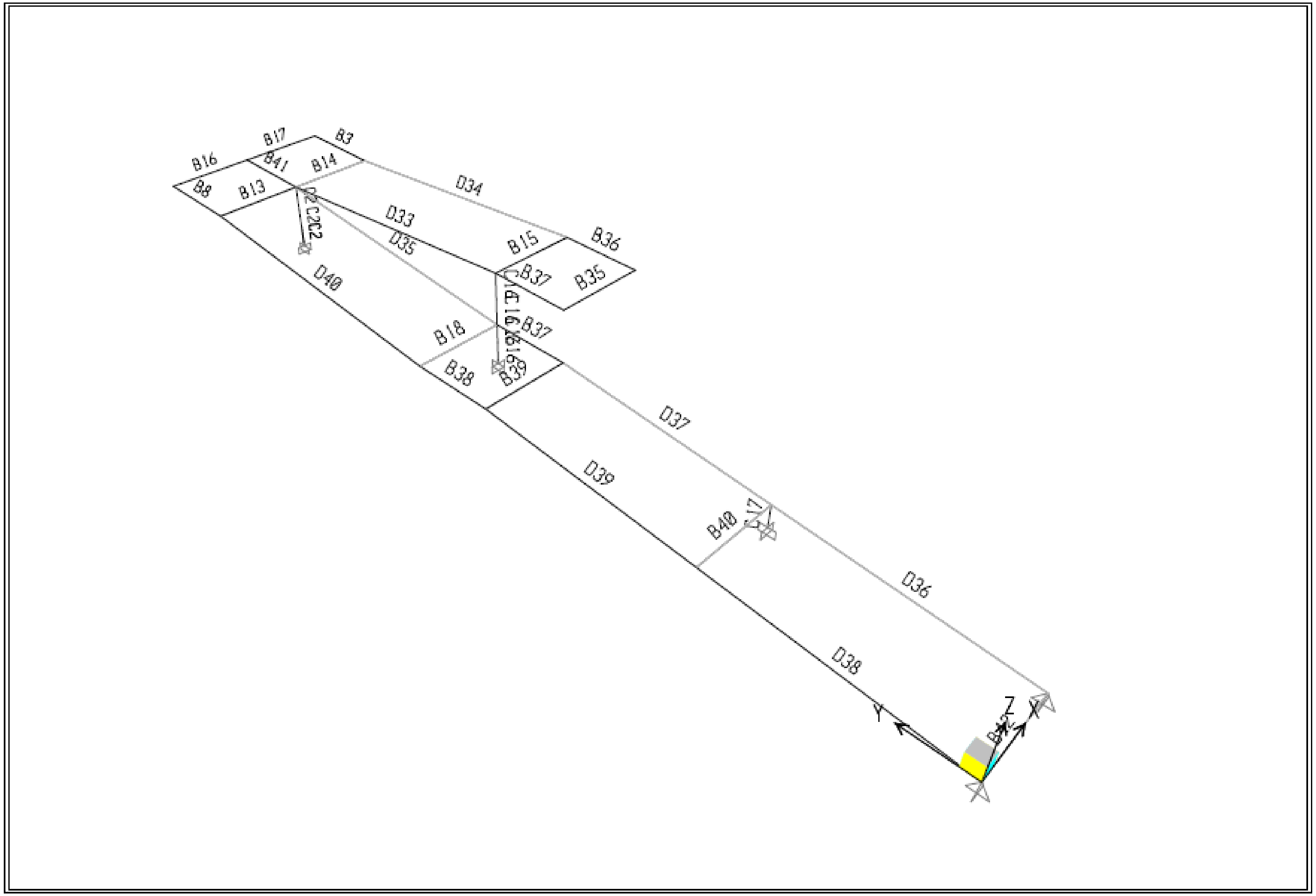
ETABS v9.7.4 - File: MODELO RAMPA 1 - noviembre 9,2016 8:37
Plan View - N+1.485 - Elevation 1.4852 - KN-m Units

ETABS


A
A1
A'
C
1
1'
2
2'
3
3'
4
B35
B36
Y
X

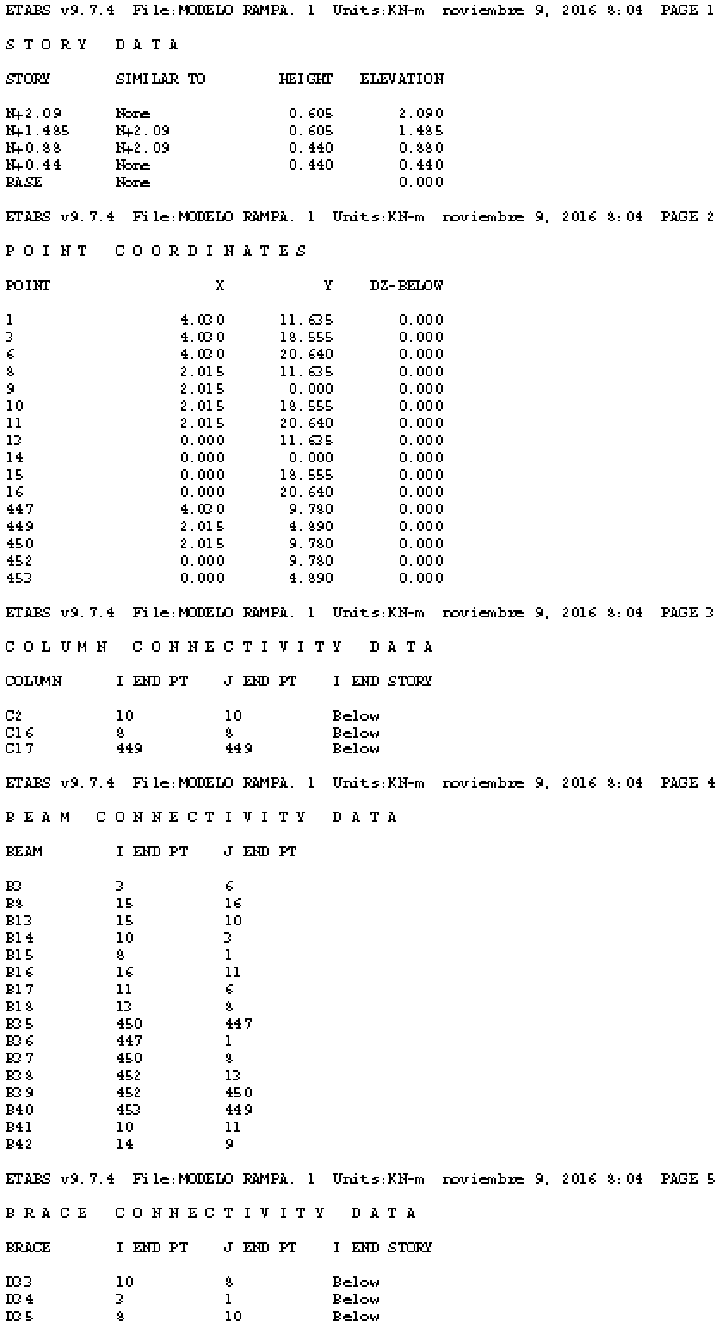
ETABS v9.7.4 - File: MODELO RAMPA 1 - noviembre 9,2016 8:37
Plan View - N+2.09 - Elevation 2.09 - KN-m Units

ETABS

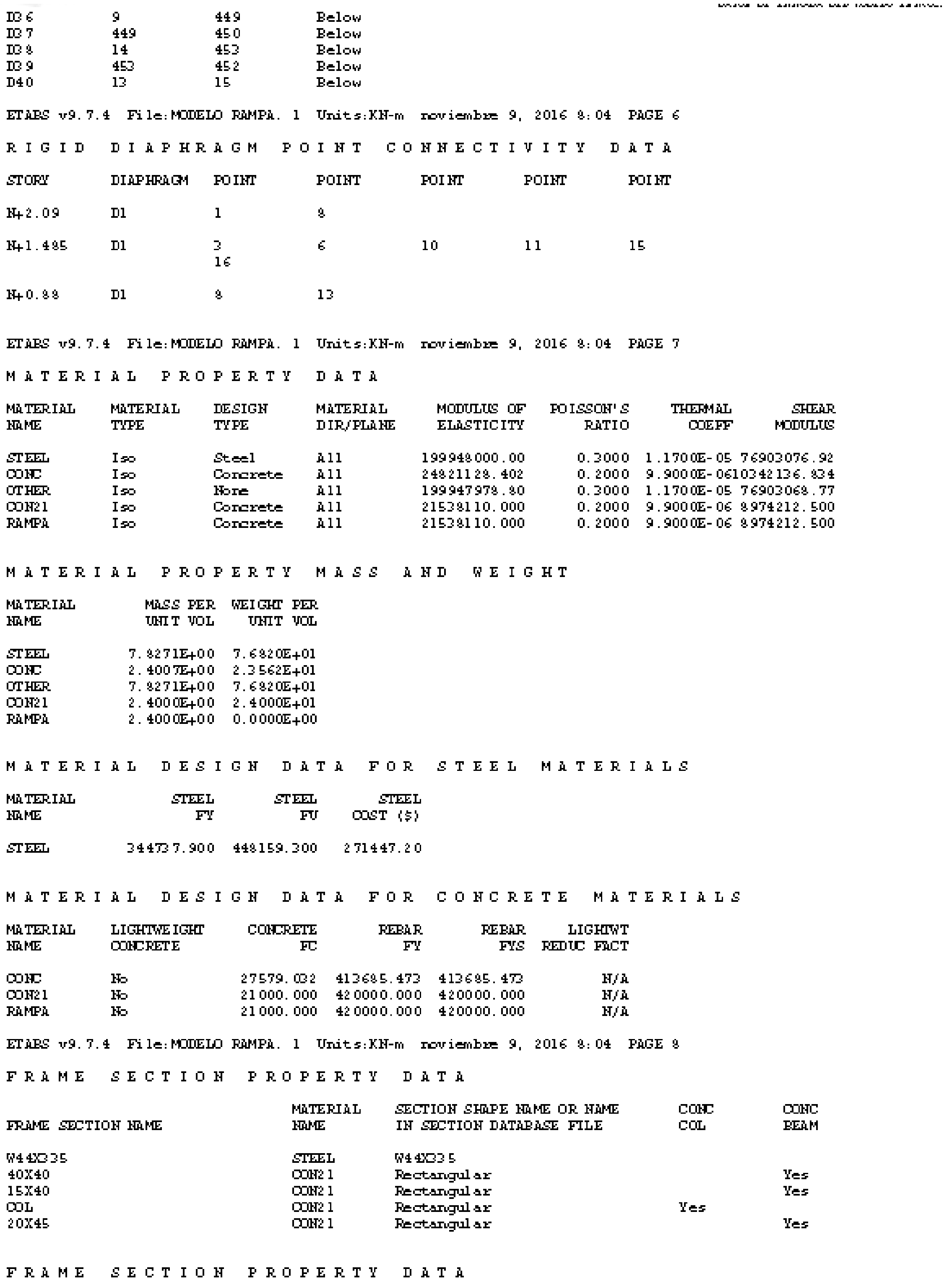

B17
B3
B16
B41
B14
B8
B13
D34
C2C2
D33
D35
B15
B36
B37
B35
D40
C16
B37
B18
B38
B39
D37
D39
B40
C17
D36
D38
Y
Z
X

ETABS v9.7.4 - File: MODELO RAMPA 1 - noviembre 9,2016 8:38
3-D View - KN-m Units

9.1 DATOS DE ENTRADA



```
ETABS v9.7.4  File:MODELO RAMPA. 1  Units:KN-m  noviembre 9, 2016 8:04  PAGE 1

S T O R Y   D A T A

STORY       SIMILAR TO        HEIGHT   ELEVATION

N+2.09      None               0.605       2.090
N+1.485     N+2.09             0.605       1.485
N+0.88      N+2.09             0.440       0.880
N+0.44      None               0.440       0.440
BASE        None                           0.000

ETABS v9.7.4  File:MODELO RAMPA. 1  Units:KN-m  noviembre 9, 2016 8:04  PAGE 2

P O I N T   C O O R D I N A T E S

POINT                  X          Y    DZ-BELOW

1                  4.030     11.635       0.000
3                  4.030     18.555       0.000
6                  4.030     20.640       0.000
8                  2.015     11.635       0.000
9                  2.015      0.000       0.000
10                 2.015     18.555       0.000
11                 2.015     20.640       0.000
13                 0.000     11.635       0.000
14                 0.000      0.000       0.000
15                 0.000     18.555       0.000
16                 0.000     20.640       0.000
447                4.030      9.780       0.000
449                2.015      4.890       0.000
450                2.015      9.780       0.000
452                0.000      9.780       0.000
453                0.000      4.890       0.000

ETABS v9.7.4  File:MODELO RAMPA. 1  Units:KN-m  noviembre 9, 2016 8:04  PAGE 3

C O L U M N   C O N N E C T I V I T Y   D A T A

COLUMN      I END PT    J END PT    I END STORY

C2          10          10          Below
C16         8           8           Below
C17         449         449         Below

ETABS v9.7.4  File:MODELO RAMPA. 1  Units:KN-m  noviembre 9, 2016 8:04  PAGE 4

B E A M   C O N N E C T I V I T Y   D A T A

BEAM        I END PT    J END PT

B3          3           6
B8          15          16
B13         15          10
B14         10          3
B15         8           1
B16         16          11
B17         11          6
B18         13          8
B35         450         447
B36         447         1
B37         450         8
B38         452         13
B39         452         450
B40         453         449
B41         10          11
B42         14          9

ETABS v9.7.4  File:MODELO RAMPA. 1  Units:KN-m  noviembre 9, 2016 8:04  PAGE 5

B R A C E   C O N N E C T I V I T Y   D A T A

BRACE       I END PT    J END PT    I END STORY

D33         10          8           Below
D34         3           1           Below
D35         8           10          Below
```



```
D36         9           449         Below
D37         449         450         Below
D38         14          453         Below
D39         453         452         Below
D40         13          15          Below

ETABS v9.7.4  File:MODELO RAMPA. 1  Units:KN-m  noviembre 9, 2016 8:04  PAGE 6

R I G I D   D I A P H R A G M   P O I N T   C O N N E C T I V I T Y   D A T A

STORY       DIAPHRAGM   POINT       POINT       POINT       POINT       POINT

N+2.09      D1          1           8

N+1.485     D1          3           6           10          11          15
                        16

N+0.88      D1          8           13


ETABS v9.7.4  File:MODELO RAMPA. 1  Units:KN-m  noviembre 9, 2016 8:04  PAGE 7

M A T E R I A L   P R O P E R T Y   D A T A

MATERIAL    MATERIAL    DESIGN      MATERIAL      MODULUS OF  POISSON'S     THERMAL       SHEAR
NAME        TYPE        TYPE        DIR/PLANE     ELASTICITY      RATIO       COEFF     MODULUS

STEEL       Iso         Steel       All         199948000.00     0.3000  1.1700E-05 76903076.92
CONC        Iso         Concrete    All         24821128.402     0.2000  9.9000E-0610342136.834
OTHER       Iso         None        All         199947978.80     0.3000  1.1700E-05 76903068.77
CON21       Iso         Concrete    All         21538110.000     0.2000  9.9000E-06 8974212.500
RAMPA       Iso         Concrete    All         21538110.000     0.2000  9.9000E-06 8974212.500


M A T E R I A L   P R O P E R T Y   M A S S   A N D   W E I G H T

MATERIAL        MASS PER  WEIGHT PER
NAME            UNIT VOL    UNIT VOL

STEEL         7.8271E+00  7.6820E+01
CONC          2.4007E+00  2.3562E+01
OTHER         7.8271E+00  7.6820E+01
CON21         2.4000E+00  2.4000E+01
RAMPA         2.4000E+00  0.0000E+00


M A T E R I A L   D E S I G N   D A T A   F O R   S T E E L   M A T E R I A L S

MATERIAL           STEEL       STEEL       STEEL
NAME                  FY          FU   COST ($)

STEEL         344737.900  448159.300   271447.20


M A T E R I A L   D E S I G N   D A T A   F O R   C O N C R E T E   M A T E R I A L S

MATERIAL    LIGHTWEIGHT      CONCRETE       REBAR       REBAR    LIGHTWT
NAME        CONCRETE               FC          FY         FYS REDUC FACT

CONC        No              27579.032  413685.473  413685.473        N/A
CON21       No              21000.000  420000.000  420000.000        N/A
RAMPA       No              21000.000  420000.000  420000.000        N/A

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F R A M E   S E C T I O N   P R O P E R T Y   D A T A

                                  MATERIAL    SECTION SHAPE NAME OR NAME     CONC        CONC
FRAME SECTION NAME                NAME        IN SECTION DATABASE FILE       COL         BEAM

W44X335                           STEEL       W44X335
40X40                             CON21       Rectangular                                Yes
15X40                             CON21       Rectangular                                Yes
COL                               CON21       Rectangular                    Yes
20X45                             CON21       Rectangular                                Yes


F R A M E   S E C T I O N   P R O P E R T Y   D A T A
```

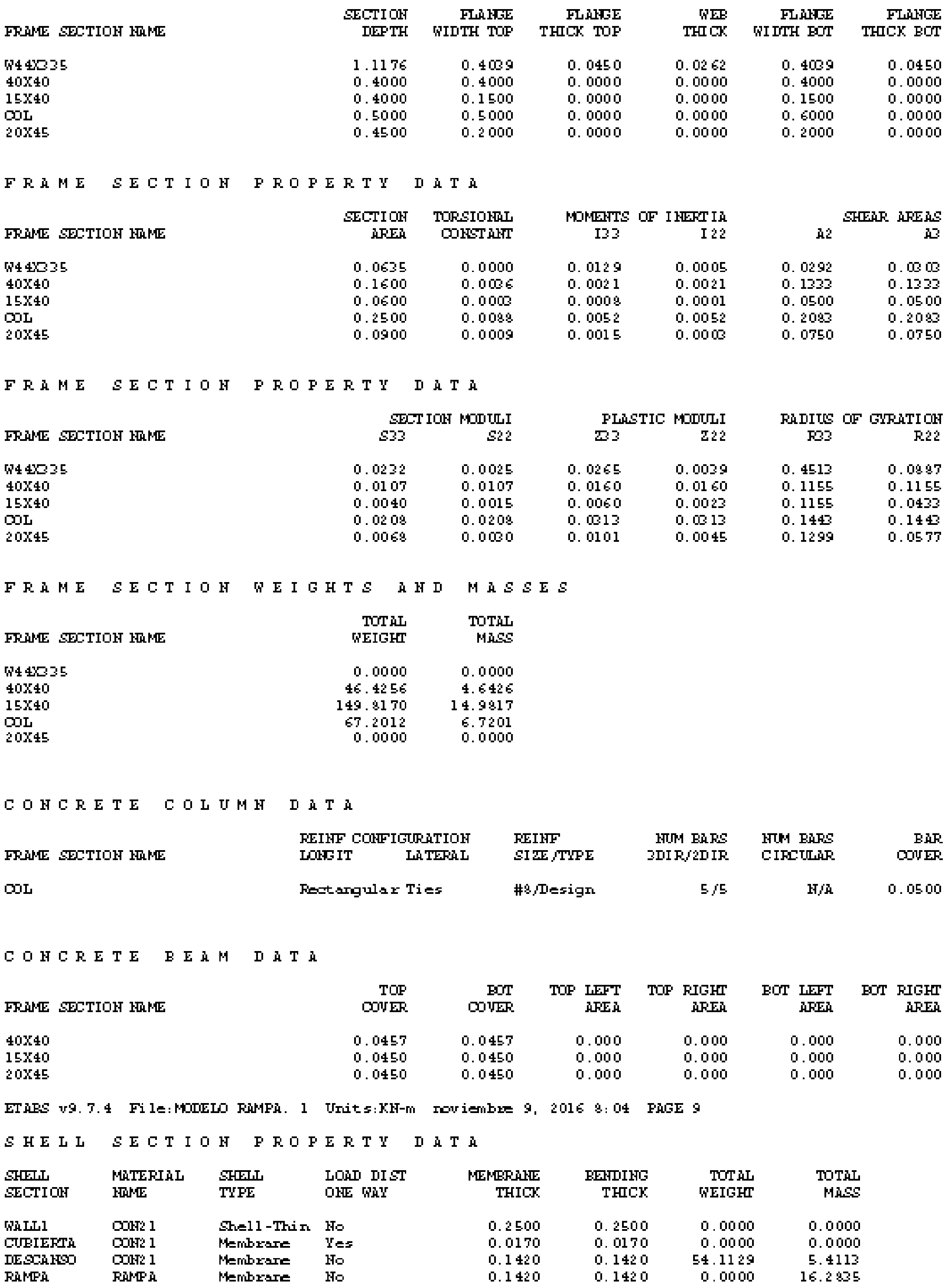

```
                                     SECTION      FLANGE      FLANGE         WEB      FLANGE      FLANGE
FRAME SECTION NAME                     DEPTH   WIDTH TOP   THICK TOP       THICK   WIDTH BOT   THICK BOT

W44X335                               1.1176      0.4039      0.0450      0.0262      0.4039      0.0450
40X40                                 0.4000      0.4000      0.0000      0.0000      0.4000      0.0000
15X40                                 0.4000      0.1500      0.0000      0.0000      0.1500      0.0000
COL                                   0.5000      0.5000      0.0000      0.0000      0.6000      0.0000
20X45                                 0.4500      0.2000      0.0000      0.0000      0.2000      0.0000

F R A M E   S E C T I O N   P R O P E R T Y   D A T A

                                     SECTION   TORSIONAL     MOMENTS OF INERTIA          SHEAR AREAS
FRAME SECTION NAME                      AREA    CONSTANT         I33         I22          A2          A3

W44X335                               0.0635      0.0000      0.0129      0.0005      0.0292      0.0303
40X40                                 0.1600      0.0036      0.0021      0.0021      0.1333      0.1333
15X40                                 0.0600      0.0003      0.0008      0.0001      0.0500      0.0500
COL                                   0.2500      0.0088      0.0052      0.0052      0.2083      0.2083
20X45                                 0.0900      0.0009      0.0015      0.0003      0.0750      0.0750

F R A M E   S E C T I O N   P R O P E R T Y   D A T A

                                        SECTION MODULI          PLASTIC MODULI      RADIUS OF GYRATION
FRAME SECTION NAME                       S33         S22         Z33         Z22         R33         R22

W44X335                               0.0232      0.0025      0.0265      0.0039      0.4513      0.0887
40X40                                 0.0107      0.0107      0.0160      0.0160      0.1155      0.1155
15X40                                 0.0040      0.0015      0.0060      0.0023      0.1155      0.0433
COL                                   0.0208      0.0208      0.0313      0.0313      0.1443      0.1443
20X45                                 0.0068      0.0030      0.0101      0.0045      0.1299      0.0577

F R A M E   S E C T I O N   W E I G H T S   A N D   M A S S E S

                                       TOTAL       TOTAL
FRAME SECTION NAME                    WEIGHT        MASS

W44X335                               0.0000      0.0000
40X40                                46.4256      4.6426
15X40                               149.8170     14.9817
COL                                  67.2012      6.7201
20X45                                 0.0000      0.0000


C O N C R E T E   C O L U M N   D A T A

                                 REINF CONFIGURATION    REINF             NUM BARS    NUM BARS         BAR
FRAME SECTION NAME               LONGIT      LATERAL    SIZE/TYPE        3DIR/2DIR    CIRCULAR       COVER

COL                              Rectangular Ties       #8/Design              5/5         N/A      0.0500


C O N C R E T E   B E A M   D A T A

                                         TOP         BOT    TOP LEFT   TOP RIGHT    BOT LEFT   BOT RIGHT
FRAME SECTION NAME                     COVER       COVER        AREA        AREA        AREA        AREA

40X40                                 0.0457      0.0457       0.000       0.000       0.000       0.000
15X40                                 0.0450      0.0450       0.000       0.000       0.000       0.000
20X45                                 0.0450      0.0450       0.000       0.000       0.000       0.000

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S H E L L   S E C T I O N   P R O P E R T Y   D A T A

SHELL       MATERIAL    SHELL       LOAD DIST      MEMBRANE     BENDING       TOTAL       TOTAL
SECTION     NAME        TYPE        ONE WAY           THICK       THICK      WEIGHT        MASS

WALL1       CON21       Shell-Thin  No               0.2500      0.2500      0.0000      0.0000
CUBIERTA    CON21       Membrane    Yes              0.0170      0.0170      0.0000      0.0000
DESCANSO    CON21       Membrane    No               0.1420      0.1420     54.1129      5.4113
RAMPA       RAMPA       Membrane    No               0.1420      0.1420      0.0000     16.2835
```

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S T A T I C   L O A D   C A S E S

STATIC      CASE        AUTO LAT          SELF WT    NOTIONAL    NOTIONAL
CASE        TYPE        LOAD           MULTIPLIER      FACTOR   DIRECTION

DEAD        DEAD        N/A                1.0000
LIVE        LIVE        N/A                0.0000

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R E S P O N S E   S P E C T R U M   C A S E S

RESP SPEC CASE: SISDERX

  BASIC RESPONSE SPECTRUM DATA

    MODAL        DIRECTION         MODAL    SPECTRUM      TYPICAL
    COMBO        COMBO           DAMPING       ANGLE        ECCEN

    SRSS         SRSS             0.0500      0.0000       0.0500


  RESPONSE SPECTRUM FUNCTION ASSIGNMENT DATA

    DIRECTION    FUNCTION      SCALE FACT

    U1           DERIVAS          20.9950
    U2           ----                 N/A
    UZ           ----                 N/A


RESP SPEC CASE: SISDERY

  BASIC RESPONSE SPECTRUM DATA

    MODAL        DIRECTION         MODAL    SPECTRUM      TYPICAL
    COMBO        COMBO           DAMPING       ANGLE        ECCEN

    SRSS         SRSS             0.0500      0.0000       0.0500


  RESPONSE SPECTRUM FUNCTION ASSIGNMENT DATA

    DIRECTION    FUNCTION      SCALE FACT

    U1           ----                 N/A
    U2           DERIVAS          17.5750
    UZ           ----                 N/A


RESP SPEC CASE: SISDISX

  BASIC RESPONSE SPECTRUM DATA

    MODAL        DIRECTION         MODAL    SPECTRUM      TYPICAL
    COMBO        COMBO           DAMPING       ANGLE        ECCEN

    SRSS         SRSS             0.0500      0.0000       0.0500


  RESPONSE SPECTRUM FUNCTION ASSIGNMENT DATA

    DIRECTION    FUNCTION      SCALE FACT

    U1           DISENO           20.9950
    U2           ----                 N/A
    UZ           ----                 N/A


RESP SPEC CASE: SISDISY

  BASIC RESPONSE SPECTRUM DATA

    MODAL        DIRECTION         MODAL    SPECTRUM      TYPICAL
    COMBO        COMBO           DAMPING       ANGLE        ECCEN
    SRSS        SRSS              0.0500      0.0000      0.0500

  RESPONSE SPECTRUM FUNCTION ASSIGNMENT DATA

    DIRECTION   FUNCTION      SCALE FACT

    U1          ----                 N/A
    U2          DISENO           17.5750
    UZ          ----                 N/A

RESP SPEC CASE: SISUMEX

  BASIC RESPONSE SPECTRUM DATA

    MODAL       DIRECTION          MODAL    SPECTRUM     TYPICAL
    COMBO       COMBO            DAMPING       ANGLE       ECCEN

    SRSS        SRSS              0.0200      0.0000      0.0500

  RESPONSE SPECTRUM FUNCTION ASSIGNMENT DATA

    DIRECTION   FUNCTION      SCALE FACT

    U1          UMBRAL           34.3800
    U2          ----                 N/A
    UZ          ----                 N/A

RESP SPEC CASE: SISUMBY

  BASIC RESPONSE SPECTRUM DATA

    MODAL       DIRECTION          MODAL    SPECTRUM     TYPICAL
    COMBO       COMBO            DAMPING       ANGLE       ECCEN

    SRSS        SRSS              0.0200      0.0000      0.0500

  RESPONSE SPECTRUM FUNCTION ASSIGNMENT DATA

    DIRECTION   FUNCTION      SCALE FACT

    U1          ----                 N/A
    U2          UMBRAL           36.0890
    UZ          ----                 N/A
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L O A D I N G   C O M B I N A T I O N S

            COMBO                   CASE               SCALE
COMBO       TYPE        CASE        TYPE              FACTOR

COMDER1     ADD         SISDERX     Spectra           1.0000
                        SISDERY     Spectra           0.3000
COMDER2     ADD         SISDERX     Spectra           0.3000
                        SISDERY     Spectra           1.0000
COMDIS1     ADD         DEAD        Static            1.4000
COMDIS2     ADD         LIVE        Static            1.6000
                        DEAD        Static            1.2000
COMDIS3     ADD         LIVE        Static            1.0000
                        DEAD        Static            1.2000
                        SISDISX     Spectra           1.0000
                        SISDISY     Spectra           0.3000
COMDIS4     ADD         LIVE        Static            1.0000
                        DEAD        Static            1.2000
                        SISDISX     Spectra           0.3000
                        SISDISY     Spectra           1.0000
COMDIS5     ADD         DEAD        Static            0.9000
                        SISDISX     Spectra           1.0000
                        SISDISY     Spectra           0.3000
COMDIS6     ADD         DEAD        Static            0.9000
                        SISDISX     Spectra           0.3000
                        SISDISY     Spectra           1.0000
ENVOLVENTE  ENVE        COMDIS1     Combo             1.0000
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                      COMDIS2     Combo           1.0000
                      COMDIS3     Combo           1.0000
                      COMDIS4     Combo           1.0000
                      COMDIS5     Combo           1.0000
                      COMDIS6     Combo           1.0000
COMDERUMBE  ADD       SISUMEX     Spectra         1.0000
                      SISUMEY     Spectra         0.3000
COMDERUMB2  ADD       SISUMEX     Spectra         0.3000
                      SISUMEY     Spectra         1.0000
CIM         ADD       DEAD        Static          1.0000
                      LIVE        Static          1.0000
CIM2        ADD       DEAD        Static          1.0000
                      LIVE        Static          0.7500
                      SISDISX     Spectra         0.5250
                      SISDISY     Spectra         0.1500
CIM3        ADD       DEAD        Static          1.0000
                      LIVE        Static          0.7500
                      SISDISX     Spectra         0.1500
                      SISDISY     Spectra         0.5250
DCON1       ADD       DEAD        Static          1.4000
DCON2       ADD       DEAD        Static          1.2000
                      LIVE        Static          1.6000
DCON3       ADD       DEAD        Static          1.4000
                      LIVE        Static          1.0000
                      SISDERX     Spectra         1.0000
DCON4       ADD       DEAD        Static          1.4000
                      LIVE        Static          1.0000
                      SISDERY     Spectra         1.0000
DCON5       ADD       DEAD        Static          1.4000
                      LIVE        Static          1.0000
                      SISDISX     Spectra         1.0000
DCON6       ADD       DEAD        Static          1.4000
                      LIVE        Static          1.0000
                      SISDISY     Spectra         1.0000
DCON7       ADD       DEAD        Static          1.4000
                      LIVE        Static          1.0000
                      SISUMEX     Spectra         1.0000
DCON8       ADD       DEAD        Static          1.4000
                      LIVE        Static          1.0000
                      SISUMEY     Spectra         1.0000
DCON9       ADD       DEAD        Static          0.7000
                      SISDERX     Spectra         1.0000
DCON10      ADD       DEAD        Static          0.7000
                      SISDERY     Spectra         1.0000
DCON11      ADD       DEAD        Static          0.7000
                      SISDISX     Spectra         1.0000
DCON12      ADD       DEAD        Static          0.7000
                      SISDISY     Spectra         1.0000
DCON13      ADD       DEAD        Static          0.7000
                      SISUMEX     Spectra         1.0000
DCON14      ADD       DEAD        Static          0.7000
                      SISUMEY     Spectra         1.0000

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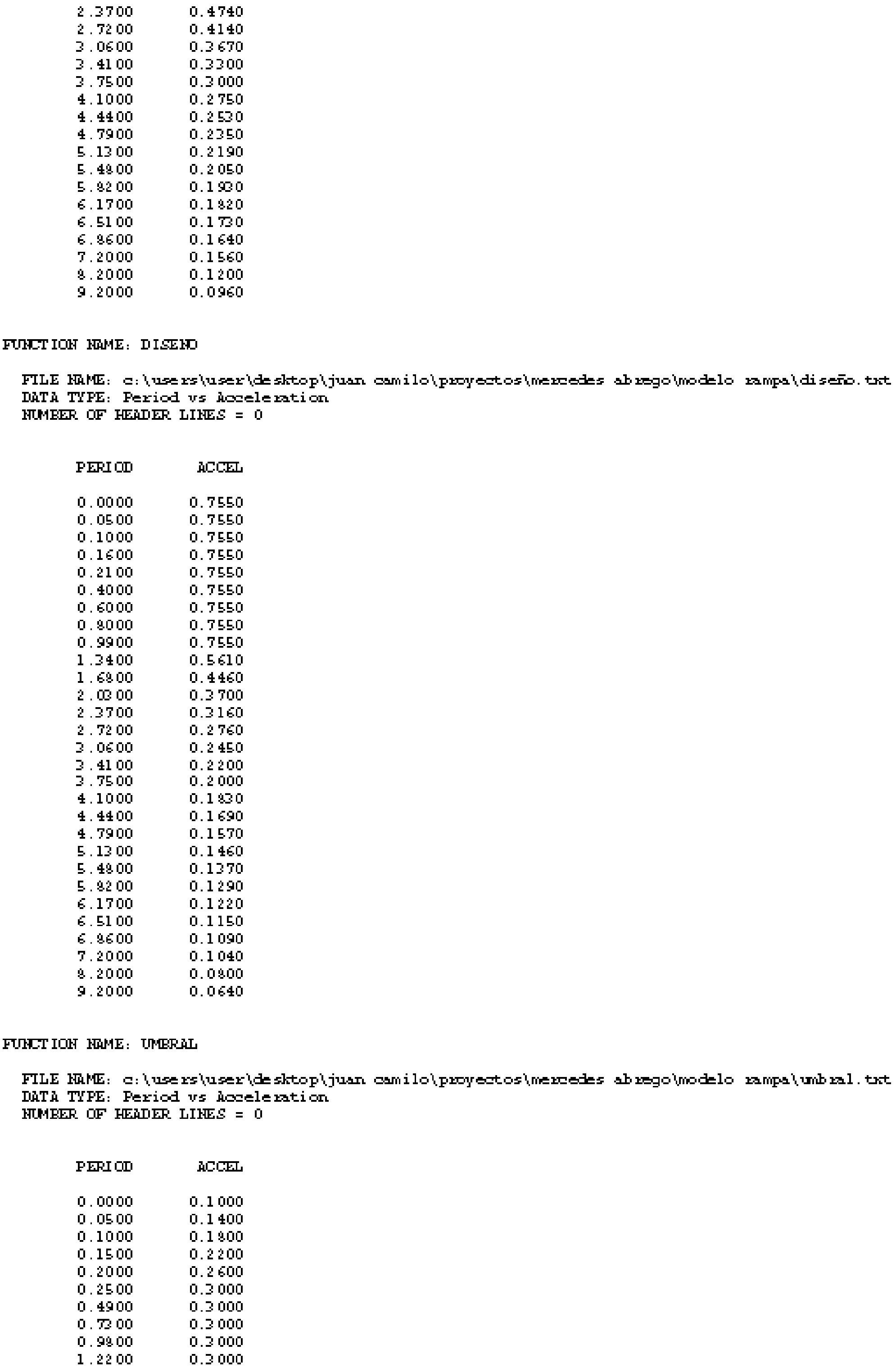
R E S P O N S E   S P E C T R U M   F U N C T I O N  -  F R O M   F I L E

FUNCTION NAME: DERIVAS

  FILE NAME: c:\users\user\desktop\juan camilo\proyectos\mercedes abrego\modelo rampa\derivas.txt
  DATA TYPE: Period vs Acceleration
  NUMBER OF HEADER LINES = 0


        PERIOD       ACCEL

        0.0000      1.1330
        0.0500      1.1330
        0.1000      1.1330
        0.1600      1.1330
        0.2100      1.1330
        0.4000      1.1330
        0.6000      1.1330
        0.8000      1.1330
        0.9900      1.1330
        1.3400      0.8410
        1.6800      0.6690
        2.0300      0.5550
```



```
        2.3700      0.4740
        2.7200      0.4140
        3.0600      0.3670
        3.4100      0.3300
        3.7500      0.3000
        4.1000      0.2750
        4.4400      0.2530
        4.7900      0.2350
        5.1300      0.2190
        5.4800      0.2050
        5.8200      0.1930
        6.1700      0.1820
        6.5100      0.1730
        6.8600      0.1640
        7.2000      0.1560
        8.2000      0.1200
        9.2000      0.0960

FUNCTION NAME: DISENO

  FILE NAME: c:\users\user\desktop\juan camilo\proyectos\mercedes abrego\modelo rampa\diseño.txt
  DATA TYPE: Period vs Acceleration
  NUMBER OF HEADER LINES = 0


        PERIOD       ACCEL

        0.0000      0.7550
        0.0500      0.7550
        0.1000      0.7550
        0.1600      0.7550
        0.2100      0.7550
        0.4000      0.7550
        0.6000      0.7550
        0.8000      0.7550
        0.9900      0.7550
        1.3400      0.5610
        1.6800      0.4460
        2.0300      0.3700
        2.3700      0.3160
        2.7200      0.2760
        3.0600      0.2450
        3.4100      0.2200
        3.7500      0.2000
        4.1000      0.1830
        4.4400      0.1690
        4.7900      0.1570
        5.1300      0.1460
        5.4800      0.1370
        5.8200      0.1290
        6.1700      0.1220
        6.5100      0.1150
        6.8600      0.1090
        7.2000      0.1040
        8.2000      0.0800
        9.2000      0.0640

FUNCTION NAME: UMBRAL

  FILE NAME: c:\users\user\desktop\juan camilo\proyectos\mercedes abrego\modelo rampa\umbral.txt
  DATA TYPE: Period vs Acceleration
  NUMBER OF HEADER LINES = 0


        PERIOD       ACCEL

        0.0000      0.1000
        0.0500      0.1400
        0.1000      0.1800
        0.1500      0.2200
        0.2000      0.2600
        0.2500      0.3000
        0.4900      0.3000
        0.7300      0.3000
        0.9800      0.3000
        1.2200      0.3000
```

```
     1.4600      0.3000
     1.7000      0.3000
     1.9500      0.3000
     2.1900      0.3000
     2.7800      0.2360
     3.3800      0.1940
     3.9700      0.1650
     4.5600      0.1440
     5.1600      0.1270
     5.7500      0.1140
     6.3400      0.1020
     6.9400      0.0950
     7.5300      0.0870
     8.1300      0.0810
     8.7200      0.0750
     9.3100      0.0700
     9.9100      0.0660
    10.5000      0.0630
    11.5000      0.0520
    12.5000      0.0440

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F R A M E   S E C T I O N   A S S I G N M E N T S   T O   L I N E   O B J E C T S

STORY     LINE      LINE      SECTION              AUTO SELECT ANALYSIS   DESIGN     DESIGN
LEVEL     ID        TYPE      TYPE                 SECTION     SECTION    PROCEDURE  SECTION

N+2.09    C16       Column    Rectangular          None        COL        Conc Frame COL
N+1.485   C2        Column    Rectangular          None        COL        Conc Frame COL
N+1.485   C16       Column    Rectangular          None        COL        Conc Frame COL
N+0.88    C2        Column    Rectangular          None        COL        Conc Frame COL
N+0.88    C16       Column    Rectangular          None        COL        Conc Frame COL
N+0.44    C2        Column    Rectangular          None        COL        Conc Frame COL
N+0.44    C16       Column    Rectangular          None        COL        Conc Frame COL
N+0.44    C17       Column    Rectangular          None        COL        Conc Frame COL
N+2.09    B15       Beam      Rectangular          None        40X40      Conc Frame 40X40
N+2.09    B35       Beam      Rectangular          None        15X40      Conc Frame 15X40
N+2.09    B36       Beam      Rectangular          None        15X40      Conc Frame 15X40
N+2.09    B37       Beam      Rectangular          None        15X40      Conc Frame 15X40
N+1.485   B3        Beam      Rectangular          None        15X40      Conc Frame 15X40
N+1.485   B8        Beam      Rectangular          None        15X40      Conc Frame 15X40
N+1.485   B13       Beam      Rectangular          None        40X40      Conc Frame 40X40
N+1.485   B14       Beam      Rectangular          None        40X40      Conc Frame 40X40
N+1.485   B16       Beam      Rectangular          None        15X40      Conc Frame 15X40
N+1.485   B17       Beam      Rectangular          None        15X40      Conc Frame 15X40
N+1.485   B41       Beam      Rectangular          None        15X40      Conc Frame 15X40
N+0.88    B18       Beam      Rectangular          None        40X40      Conc Frame 40X40
N+0.88    B37       Beam      Rectangular          None        15X40      Conc Frame 15X40
N+0.88    B38       Beam      Rectangular          None        15X40      Conc Frame 15X40
N+0.88    B39       Beam      Rectangular          None        15X40      Conc Frame 15X40
N+0.44    B40       Beam      Rectangular          None        40X40      Conc Frame 40X40
BASE      B42       Beam      Rectangular          None        40X40      Conc Frame 40X40
N+2.09    D33       Brace     Rectangular          None        15X40      Conc Frame 15X40
N+2.09    D34       Brace     Rectangular          None        15X40      Conc Frame 15X40
N+1.485   D35       Brace     Rectangular          None        15X40      Conc Frame 15X40
N+1.485   D40       Brace     Rectangular          None        15X40      Conc Frame 15X40
N+0.88    D37       Brace     Rectangular          None        15X40      Conc Frame 15X40
N+0.88    D39       Brace     Rectangular          None        15X40      Conc Frame 15X40
N+0.44    D36       Brace     Rectangular          None        15X40      Conc Frame 15X40
N+0.44    D38       Brace     Rectangular          None        15X40      Conc Frame 15X40

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D I S T R I B U T E D   L O A D   A S S I G N M E N T S   T O   L I N E   O B J E C T S

LOAD      STORY     LINE      LOAD      LOAD          ABSOLUTE   ABSOLUTE     LOAD A     LOAD B
CASE      LEVEL     ID        TYPE      DIRECTION   DISTANCE A DISTANCE B PER LENGTH PER LENGTH

DEAD      N+2.09    B15       Force     Gravity          0.000      2.015      1.950      1.950
DEAD      N+2.09    B35       Force     Gravity          0.000      2.015      1.950      1.950
DEAD      N+2.09    B36       Force     Gravity          0.000      1.855      1.950      1.950
DEAD      N+2.09    B37       Force     Gravity          0.000      1.855      1.950      1.950
DEAD      N+1.485   B3        Force     Gravity          0.000      2.085      1.950      1.950
DEAD      N+1.485   B8        Force     Gravity          0.000      2.085      1.950      1.950
DEAD      N+1.485   B16       Force     Gravity          0.000      2.015      1.950      1.950
DEAD      N+1.485   B17       Force     Gravity          0.000      2.015      1.950      1.950
DEAD      N+0.88    B37       Force     Gravity          0.000      1.855      1.950      1.950
DEAD        N+0.88      B38         Force       Gravity          0.000       1.855       1.950       1.950
DEAD        N+2.09      D33         Force       Gravity          0.000       6.946       3.425       3.425
DEAD        N+2.09      D34         Force       Gravity          0.000       6.946       3.425       3.425
DEAD        N+1.485     D35         Force       Gravity          0.000       6.946       3.425       3.425
DEAD        N+1.485     D40         Force       Gravity          0.000       6.946       3.425       3.425
DEAD        N+0.88      D37         Force       Gravity          0.000       4.910       3.425       3.425
DEAD        N+0.88      D39         Force       Gravity          0.000       4.910       3.425       3.425
DEAD        N+0.44      D36         Force       Gravity          0.000       4.910       3.425       3.425
DEAD        N+0.44      D38         Force       Gravity          0.000       4.910       3.425       3.425
LIVE        N+2.09      D33         Force       Gravity          0.000       6.946       5.037       5.037
LIVE        N+2.09      D34         Force       Gravity          0.000       6.946       5.037       5.037
LIVE        N+1.485     D35         Force       Gravity          0.000       6.946       5.037       5.037
LIVE        N+1.485     D40         Force       Gravity          0.000       6.946       5.037       5.037
LIVE        N+0.88      D37         Force       Gravity          0.000       4.910       5.037       5.037
LIVE        N+0.88      D39         Force       Gravity          0.000       4.910       5.037       5.037
LIVE        N+0.44      D36         Force       Gravity          0.000       4.910       5.037       5.037
LIVE        N+0.44      D38         Force       Gravity          0.000       4.910       5.037       5.037

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U N I F O R M   L O A D   A S S I G N M E N T S   T O   A R E A   O B J E C T S

CASE        STORY       AREA        AREATYPE    DIRECTION          LOAD

LIVE        N+2.09      F17         Floor       Gravity          5.0060
LIVE        N+1.485     F19         Floor       Gravity          5.0060
LIVE        N+1.485     F20         Floor       Gravity          5.0060
LIVE        N+0.88      F18         Floor       Gravity          5.0060
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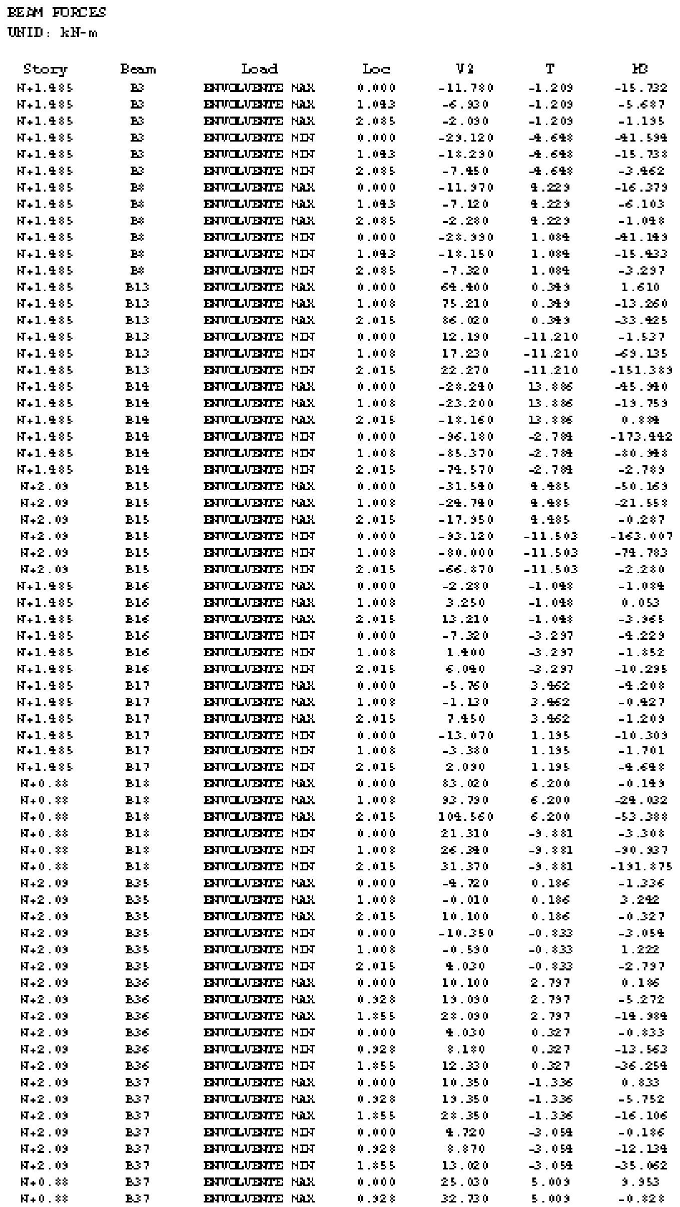
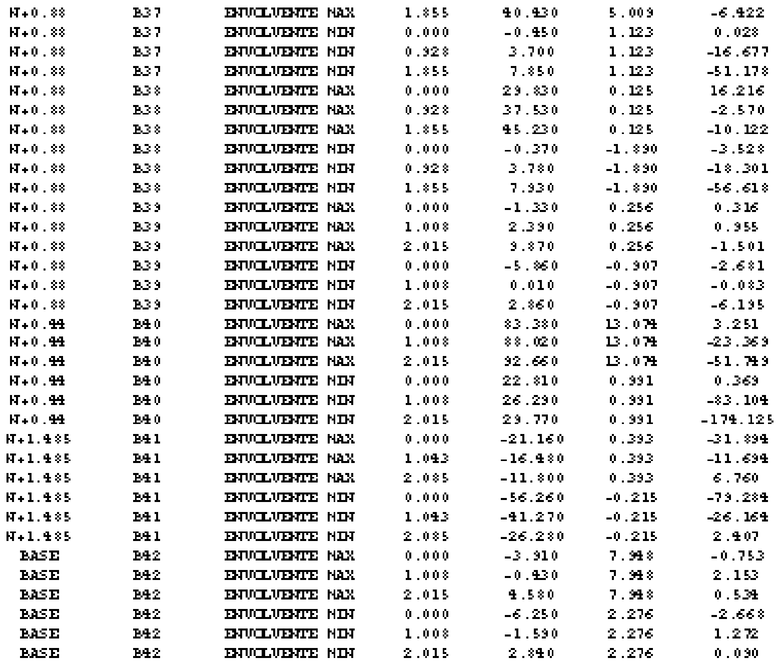
9.2 DATOS DE SALIDA

FUERZAS EN VIGAS



BEAM FORCES
UNID: kN-m

Story	Beam	Load	Loc	V2	T	M3
N+1.485	B3	ENVOLVENTE MAX	0.000	-11.780	-1.209	-15.732
N+1.485	B3	ENVOLVENTE MAX	1.043	-6.930	-1.209	-5.687
N+1.485	B3	ENVOLVENTE MAX	2.085	-2.090	-1.209	-1.195
N+1.485	B3	ENVOLVENTE MIN	0.000	-29.120	-4.648	-41.594
N+1.485	B3	ENVOLVENTE MIN	1.043	-18.290	-4.648	-15.738
N+1.485	B3	ENVOLVENTE MIN	2.085	-7.450	-4.648	-3.462
N+1.485	B8	ENVOLVENTE MAX	0.000	-11.970	4.229	-16.379
N+1.485	B8	ENVOLVENTE MAX	1.043	-7.120	4.229	-6.103
N+1.485	B8	ENVOLVENTE MAX	2.085	-2.280	4.229	-1.048
N+1.485	B8	ENVOLVENTE MIN	0.000	-28.990	1.084	-41.149
N+1.485	B8	ENVOLVENTE MIN	1.043	-18.150	1.084	-15.433
N+1.485	B8	ENVOLVENTE MIN	2.085	-7.320	1.084	-3.297
N+1.485	B13	ENVOLVENTE MAX	0.000	64.400	0.349	1.610
N+1.485	B13	ENVOLVENTE MAX	1.008	75.210	0.349	-13.260
N+1.485	B13	ENVOLVENTE MAX	2.015	86.020	0.349	-33.425
N+1.485	B13	ENVOLVENTE MIN	0.000	12.190	-11.210	-1.537
N+1.485	B13	ENVOLVENTE MIN	1.008	17.230	-11.210	-69.135
N+1.485	B13	ENVOLVENTE MIN	2.015	22.270	-11.210	-151.389
N+1.485	B14	ENVOLVENTE MAX	0.000	-28.240	13.886	-45.940
N+1.485	B14	ENVOLVENTE MAX	1.008	-23.200	13.886	-19.759
N+1.485	B14	ENVOLVENTE MAX	2.015	-18.160	13.886	0.884
N+1.485	B14	ENVOLVENTE MIN	0.000	-96.180	-2.784	-173.442
N+1.485	B14	ENVOLVENTE MIN	1.008	-85.370	-2.784	-80.948
N+1.485	B14	ENVOLVENTE MIN	2.015	-74.570	-2.784	-2.789
N+2.09	B15	ENVOLVENTE MAX	0.000	-31.540	4.485	-50.169
N+2.09	B15	ENVOLVENTE MAX	1.008	-24.740	4.485	-21.558
N+2.09	B15	ENVOLVENTE MAX	2.015	-17.950	4.485	-0.287
N+2.09	B15	ENVOLVENTE MIN	0.000	-93.120	-11.503	-163.007
N+2.09	B15	ENVOLVENTE MIN	1.008	-80.000	-11.503	-74.783
N+2.09	B15	ENVOLVENTE MIN	2.015	-66.870	-11.503	-2.280
N+1.485	B16	ENVOLVENTE MAX	0.000	-2.280	-1.048	-1.084
N+1.485	B16	ENVOLVENTE MAX	1.008	3.250	-1.048	0.053
N+1.485	B16	ENVOLVENTE MAX	2.015	13.210	-1.048	-3.965
N+1.485	B16	ENVOLVENTE MIN	0.000	-7.320	-3.297	-4.229
N+1.485	B16	ENVOLVENTE MIN	1.008	1.400	-3.297	-1.852
N+1.485	B16	ENVOLVENTE MIN	2.015	6.040	-3.297	-10.295
N+1.485	B17	ENVOLVENTE MAX	0.000	-5.760	3.462	-4.208
N+1.485	B17	ENVOLVENTE MAX	1.008	-1.130	3.462	-0.427
N+1.485	B17	ENVOLVENTE MAX	2.015	7.450	3.462	-1.209
N+1.485	B17	ENVOLVENTE MIN	0.000	-13.070	1.195	-10.309
N+1.485	B17	ENVOLVENTE MIN	1.008	-3.380	1.195	-1.701
N+1.485	B17	ENVOLVENTE MIN	2.015	2.090	1.195	-4.648
N+0.88	B18	ENVOLVENTE MAX	0.000	83.020	6.200	-0.149
N+0.88	B18	ENVOLVENTE MAX	1.008	93.790	6.200	-24.032
N+0.88	B18	ENVOLVENTE MAX	2.015	104.560	6.200	-53.388
N+0.88	B18	ENVOLVENTE MIN	0.000	21.310	-9.881	-3.308
N+0.88	B18	ENVOLVENTE MIN	1.008	26.340	-9.881	-90.937
N+0.88	B18	ENVOLVENTE MIN	2.015	31.370	-9.881	-191.875
N+2.09	B35	ENVOLVENTE MAX	0.000	-4.720	0.186	-1.336
N+2.09	B35	ENVOLVENTE MAX	1.008	-0.010	0.186	3.242
N+2.09	B35	ENVOLVENTE MAX	2.015	10.100	0.186	-0.327
N+2.09	B35	ENVOLVENTE MIN	0.000	-10.350	-0.833	-3.054
N+2.09	B35	ENVOLVENTE MIN	1.008	-0.590	-0.833	1.222
N+2.09	B35	ENVOLVENTE MIN	2.015	4.030	-0.833	-2.797
N+2.09	B36	ENVOLVENTE MAX	0.000	10.100	2.797	0.186
N+2.09	B36	ENVOLVENTE MAX	0.928	19.090	2.797	-5.272
N+2.09	B36	ENVOLVENTE MAX	1.855	28.090	2.797	-14.984
N+2.09	B36	ENVOLVENTE MIN	0.000	4.030	0.327	-0.833
N+2.09	B36	ENVOLVENTE MIN	0.928	8.180	0.327	-13.563
N+2.09	B36	ENVOLVENTE MIN	1.855	12.330	0.327	-36.254
N+2.09	B37	ENVOLVENTE MAX	0.000	10.350	-1.336	0.833
N+2.09	B37	ENVOLVENTE MAX	0.928	19.350	-1.336	-5.752
N+2.09	B37	ENVOLVENTE MAX	1.855	28.350	-1.336	-16.106
N+2.09	B37	ENVOLVENTE MIN	0.000	4.720	-3.054	-0.186
N+2.09	B37	ENVOLVENTE MIN	0.928	8.870	-3.054	-12.134
N+2.09	B37	ENVOLVENTE MIN	1.855	13.020	-3.054	-35.062
N+0.88	B37	ENVOLVENTE MAX	0.000	25.030	5.009	9.953
N+0.88	B37	ENVOLVENTE MAX	0.928	32.730	5.009	-0.828



N+0.88	B37	ENVOLVENTE MAX	1.855	40.430	5.009	-6.422
N+0.88	B37	ENVOLVENTE MIN	0.000	-0.450	1.123	0.028
N+0.88	B37	ENVOLVENTE MIN	0.928	3.700	1.123	-16.677
N+0.88	B37	ENVOLVENTE MIN	1.855	7.850	1.123	-51.178
N+0.88	B38	ENVOLVENTE MAX	0.000	29.830	0.125	16.216
N+0.88	B38	ENVOLVENTE MAX	0.928	37.530	0.125	-2.570
N+0.88	B38	ENVOLVENTE MAX	1.855	45.230	0.125	-10.122
N+0.88	B38	ENVOLVENTE MIN	0.000	-0.370	-1.890	-3.528
N+0.88	B38	ENVOLVENTE MIN	0.928	3.780	-1.890	-18.301
N+0.88	B38	ENVOLVENTE MIN	1.855	7.930	-1.890	-56.618
N+0.88	B39	ENVOLVENTE MAX	0.000	-1.330	0.256	0.316
N+0.88	B39	ENVOLVENTE MAX	1.008	2.390	0.256	0.955
N+0.88	B39	ENVOLVENTE MAX	2.015	9.870	0.256	-1.501
N+0.88	B39	ENVOLVENTE MIN	0.000	-5.860	-0.907	-2.681
N+0.88	B39	ENVOLVENTE MIN	1.008	0.010	-0.907	-0.083
N+0.88	B39	ENVOLVENTE MIN	2.015	2.860	-0.907	-6.195
N+0.44	B40	ENVOLVENTE MAX	0.000	83.380	13.074	3.251
N+0.44	B40	ENVOLVENTE MAX	1.008	88.020	13.074	-23.369
N+0.44	B40	ENVOLVENTE MAX	2.015	92.660	13.074	-51.749
N+0.44	B40	ENVOLVENTE MIN	0.000	22.810	0.991	0.369
N+0.44	B40	ENVOLVENTE MIN	1.008	26.290	0.991	-83.104
N+0.44	B40	ENVOLVENTE MIN	2.015	29.770	0.991	-174.125
N+1.485	B41	ENVOLVENTE MAX	0.000	-21.160	0.393	-31.894
N+1.485	B41	ENVOLVENTE MAX	1.043	-16.480	0.393	-11.694
N+1.485	B41	ENVOLVENTE MAX	2.085	-11.800	0.393	6.760
N+1.485	B41	ENVOLVENTE MIN	0.000	-56.260	-0.215	-79.284
N+1.485	B41	ENVOLVENTE MIN	1.043	-41.270	-0.215	-26.164
N+1.485	B41	ENVOLVENTE MIN	2.085	-26.280	-0.215	2.407
BASE	B42	ENVOLVENTE MAX	0.000	-3.910	7.948	-0.753
BASE	B42	ENVOLVENTE MAX	1.008	-0.430	7.948	2.153
BASE	B42	ENVOLVENTE MAX	2.015	4.580	7.948	0.534
BASE	B42	ENVOLVENTE MIN	0.000	-6.250	2.276	-2.668
BASE	B42	ENVOLVENTE MIN	1.008	-1.590	2.276	1.272
BASE	B42	ENVOLVENTE MIN	2.015	2.840	2.276	0.090

FUERZAS EN COLUMNAS

COLUMN FORCES
UNID: kN-m

Story	Column	Load	Loc	P	V2	V3	T	M2	M3
N+1.485	C2	ENVOLVENTE MA	0.000	-105.270	186.400	134.300	16.186	36.691	123.371
N+1.485	C2	ENVOLVENTE MA	0.302	-103.640	186.400	134.300	16.186	7.532	76.118
N+1.485	C2	ENVOLVENTE MA	0.605	-102.000	186.400	134.300	16.186	12.746	65.084
N+1.485	C2	ENVOLVENTE MI	0.000	-357.410	-194.920	-73.130	-28.210	-41.065	-99.850
N+1.485	C2	ENVOLVENTE MI	0.302	-355.230	-194.920	-73.130	-28.210	-34.348	-50.020
N+1.485	C2	ENVOLVENTE MI	0.605	-353.060	-194.920	-73.130	-28.210	-55.469	-36.410
N+0.88	C2	ENVOLVENTE MA	0.000	-107.650	188.020	135.930	16.186	86.989	201.100
N+0.88	C2	ENVOLVENTE MA	0.220	-106.460	188.020	135.930	16.186	58.294	161.756
N+0.88	C2	ENVOLVENTE MA	0.440	-105.270	188.020	135.930	16.186	36.691	123.371
N+0.88	C2	ENVOLVENTE MI	0.000	-360.580	-196.550	-74.770	-28.210	-64.427	-181.332
N+0.88	C2	ENVOLVENTE MI	0.220	-359.000	-196.550	-74.770	-28.210	-49.200	-140.111
N+0.88	C2	ENVOLVENTE MI	0.440	-357.410	-196.550	-74.770	-28.210	-41.065	-99.850
N+0.44	C2	ENVOLVENTE MA	0.000	-56.200	94.270	68.230	8.093	73.517	140.552
N+0.44	C2	ENVOLVENTE MA	0.220	-55.010	94.270	68.230	8.093	58.506	120.488
N+0.44	C2	ENVOLVENTE MA	0.440	-53.820	94.270	68.230	8.093	43.495	100.550
N+0.44	C2	ENVOLVENTE MI	0.000	-183.460	-98.530	-37.650	-14.105	-48.780	-132.542
N+0.44	C2	ENVOLVENTE MI	0.220	-181.870	-98.530	-37.650	-14.105	-40.497	-111.541
N+0.44	C2	ENVOLVENTE MI	0.440	-180.290	-98.530	-37.650	-14.105	-32.214	-90.666
N+2.09	C16	ENVOLVENTE MA	0.000	-61.540	137.130	21.690	22.696	9.339	215.164
N+2.09	C16	ENVOLVENTE MA	0.302	-59.910	137.130	21.690	22.696	17.597	177.000
N+2.09	C16	ENVOLVENTE MA	0.605	-58.270	137.130	21.690	22.696	31.209	177.518
N+2.09	C16	ENVOLVENTE MI	0.000	-178.530	-157.670	-59.560	-19.178	-11.782	-13.088
N+2.09	C16	ENVOLVENTE MI	0.302	-176.350	-157.670	-59.560	-19.178	-3.810	31.286
N+2.09	C16	ENVOLVENTE MI	0.605	-174.170	-157.670	-59.560	-19.178	-8.515	54.646
N+1.485	C16	ENVOLVENTE MA	0.000	-64.810	141.450	25.580	22.696	20.351	295.584
N+1.485	C16	ENVOLVENTE MA	0.302	-63.170	141.450	25.580	22.696	12.691	255.292
N+1.485	C16	ENVOLVENTE MA	0.605	-61.540	141.450	25.580	22.696	9.339	215.164
N+1.485	C16	ENVOLVENTE MI	0.000	-182.880	-161.980	-63.450	-19.178	-45.699	-105.929
N+1.485	C16	ENVOLVENTE MI	0.302	-180.710	-161.980	-63.450	-19.178	-26.586	-59.427
N+1.485	C16	ENVOLVENTE MI	0.605	-178.530	-161.980	-63.450	-19.178	-11.782	-13.088
N+0.88	C16	ENVOLVENTE MA	0.000	-136.980	170.870	140.150	-2.383	42.423	194.604
N+0.88	C16	ENVOLVENTE MA	0.220	-135.790	170.870	140.150	-2.383	16.252	166.705
N+0.88	C16	ENVOLVENTE MA	0.440	-134.600	170.870	140.150	-2.383	6.594	140.885
N+0.88	C16	ENVOLVENTE MI	0.000	-391.700	-128.270	-57.640	-27.587	-32.261	-227.638
N+0.88	C16	ENVOLVENTE MI	0.220	-390.120	-128.270	-57.640	-27.587	-24.259	-209.119
N+0.88	C16	ENVOLVENTE MI	0.440	-388.530	-128.270	-57.640	-27.587	-32.771	-192.679
N+0.44	C16	ENVOLVENTE MA	0.000	-139.350	171.760	140.860	-2.383	101.989	255.445
N+0.44	C16	ENVOLVENTE MA	0.220	-138.160	171.760	140.860	-2.383	71.640	224.403
N+0.44	C16	ENVOLVENTE MA	0.440	-136.980	171.760	140.860	-2.383	42.423	194.604
N+0.44	C16	ENVOLVENTE MI	0.000	-394.870	-129.160	-58.350	-27.587	-55.522	-269.736
N+0.44	C16	ENVOLVENTE MI	0.220	-393.290	-129.160	-58.350	-27.587	-43.325	-248.066
N+0.44	C16	ENVOLVENTE MI	0.440	-391.700	-129.160	-58.350	-27.587	-32.261	-227.638
N+0.44	C17	ENVOLVENTE MA	0.000	-59.100	138.600	113.080	5.573	61.929	7.587
N+0.44	C17	ENVOLVENTE MA	0.220	-57.910	138.600	113.080	5.573	38.317	-22.610
N+0.44	C17	ENVOLVENTE MA	0.440	-56.720	138.600	113.080	5.573	17.148	-51.406
N+0.44	C17	ENVOLVENTE MI	0.000	-189.050	-175.950	-125.240	-10.693	-47.029	-224.370
N+0.44	C17	ENVOLVENTE MI	0.220	-187.460	-175.950	-125.240	-10.693	-20.742	-185.955
N+0.44	C17	ENVOLVENTE MI	0.440	-185.880	-175.950	-125.240	-10.693	5.255	-176.171

10 CONCLUSIONES Y RECOMENDACIONES

Finalizado el diseño y análisis estructural de la institución educativa Mercedes Abrego, Grupo 002 basado en la Norma Colombiana de Diseño y Construcción Sismo Resistente Ley 400 de 1997 (Modificada Ley 1229 de 2008) y Decreto 926 de Marzo de 2010, Decreto 092 del 17 de Enero de 2011, Decreto 0340 del 13 de Febrero de 2012 y en el Reglamento para Concreto Estructural ACI 318S-08, hemos llegado a las siguientes conclusiones y recomendaciones.

- Se cumplió satisfactoriamente con los objetivos del cálculo y diseño estructural mediante la aplicación de la norma sismo resistente (NSR-10) y el reglamento para concreto estructural ACI 318S-08, además de la ayuda del software ETABS V9.7.4 se puede garantizar el buen funcionamiento de la estructura que presenta una buena respuesta ante un evento sísmico.
- La revisión de los desplazamientos laterales (derivas) de la estructura teniendo en cuenta las direcciones "X" y "y", nos arrojó que los resultados obtenidos son aceptables permitiendo un buen funcionamiento ante la actuación de un sismo y que cumple con lo establecido en la norma sismo resistente (NSR-10).
- En cuanto a la revisión de columnas y vigas determinamos que cumplen con los requisitos, ya que en estructuras de edificios aporticados es obligatorio que los miembros horizontales fallen antes que los verticales, permitiendo de esa manera un retraso del colapso total de la estructura.
- Para la construcción de la estructura se recomienda llevar un estricto control en la calidad de los materiales a utilizar, ya que estos deberán cumplir con requisitos especiales para el buen funcionamiento de la edificación. Además, que estos deberán ser supervisados a la hora de la puesta en marcha por el ingeniero residente.

11 BIBLIOGRAFIA

- Norma Colombiana de Diseño y Construcción Sismo Resistente Ley 400 de 1997 (Modificada Ley 1229 de 2008) y Decreto 926 de Marzo de 2010, Decreto 092 del 17 de Enero de 2011, Decreto 0340 del 13 de Febrero de 2012
- Reglamento para Concreto Estructural ACI 318S-08.