MEMORIA DE CÁLCULO ESTRUCTURAL

GOBERNACIÓN DEL CESAR

MEJORAMIENTO DE LA INFRAESTRUCTURA EDUCATIVA EN DISTINTOS MUNICIPIOS DEL DEPARTAMENTO DEL CESAR

INSTITUCIÓN EDUCATIVA SANTA ISABEL, EN EL CORREGIMIENTO DE SANTA ISABEL, MUNICIPIO DE CURUMANI

ZONA SALONES PRIMARIA

NORMA DE DISEÑO
NSR-10

William Fuentes

INGENIERO CALCULISTA
ING. WILLIAM FUENTES LACOUTURE
M.P. 25202150640 CND

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INSTITUCIÓN EDUCATIVA SANTA ISABEL, EN EL CORREGIMIENTO DE SANTA ISABEL, MUNICIPIO DE CURUMANI

ZONA SALONES PRIMARIA

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Elaboró: Ing. – **INGENIERO CALCULISTA** **ING. WILLIAM FUENTES LACOUTURE** **M.P. 25202150640 CND**	Revisó: Ing. I, Civil M.P.

MEMORIA DE CÁLCULO ESTRUCTURAL

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INSTITUCIÓN EDUCATIVA SANTA ISABEL, EN EL CORREGIMIENTO DE SANTA ISABEL, MUNICIPIO DE CURUMANI - ZONA SALONES PRIMARIA

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LOCALIZACIÓN

El presente proyecto se refiere a los MEJORAMIENTO DE LA INFRAESTRUCTURA EDUCATIVA EN DISTINTOS MUNICIPIOS DEL DEPARTAMENTO DEL CESAR.

NORMAS

Ley 400 de 1997 y sus decretos reglamentarios

- Decreto 926 del 19 de marzo de 2010
- Decreto 2525 del 13 de julio de 2010
- Decreto 092 del 17 de enero de 2011
- Decreto 340 del 13 de febrero de 2012
- Decreto 945 del 5 de junio de 2017
- Decreto 2113 del 25 de noviembre de 2019
- Resolución 0017 del 4 de diciembre de 2017

DESCRIPCIÓN DE LA ESTRUCTURA

La estructura de la zona de salones de primaria se compone por sistema estructural porticado. La cimentación será superficial. La cubierta será liviana.

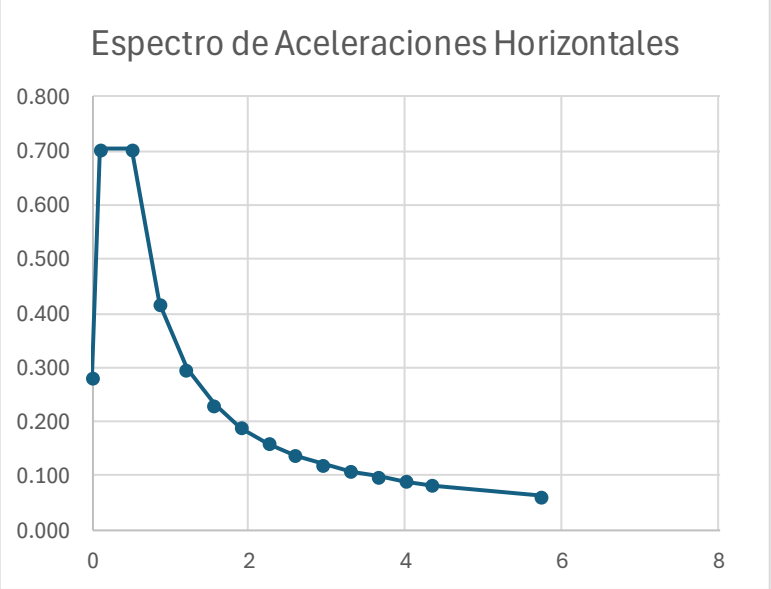
CIMENTACIÓN	"Dada las características del proyecto se considera entonces viable el uso de un sistema de cimentación superficial para la transmisión de las cargas de las estructuras al terreno por medio de zapatas desplantadas a una profundidad mínima de 1.50 metros y unidas entre sí por vigas de amarre diseñadas por el ingeniero estructural. La capacidad admisible del terreno será de 15.0 Ton/m2."
SISTEMA ESTRUCTURAL	Sistema de pórticos.
SISTEMA DE RESISTENCIA SÍSMICA	Porticos en concreto reforzado. DMO.
COEFICIENTE DE DISIPACIÓN DE ENERGÍA BÁSICO	5.00
FACTOR DE SOBRE RESISTENCIA	3.00
ALTURA MÁXIMA	Sin límite.
GRADO DE CAPACIDAD DE DISIPACIÓN DE ENERGÍA	Moderado – DMO

PARÁMETROS DE DISEÑO SÍSMICO

PERFIL DE SUELO	D
ACELERACIÓN HORIZONTAL PICO EFECTIVA Aa	0.15
VELOCIDAD HORIZONTAL PICO EFECTIVA Av	0.10
COEFICIENTE DE AMPLIACIÓN SÍSMICA EN PERIODOS CORTOS Fa	1.50
COEFICIENTE DE AMPLIACIÓN SÍSMICA EN PERIODOS MEDIOS Fv	2.40
GRUPO DE USO	III – Estructuras de atención a la comunidad
COEFICIENTE DE IMPORTANCIA	1.25

ESPECTRO DE DISEÑO					
UBICACIÓN	Curumani - Cesar				
DATOS					
GRUPO DE USO	III	**COEFICIENTE DE IMPORTANCIA**			1.25
PERFIL DE SUELO	D	**Fa**	1.5	**Fv**	2.4
AaFaI	0.28125	**Aa**	0.15	**Av**	0.1
Sa	0.703125	**T0**	0.10666667	**Tc**	0.512

T (s)	Sad (g)
0	0.281
0.106666667	0.703
0.512	0.703
0.862	0.418
1.212	0.297
1.562	0.230
1.912	0.188
2.262	0.159
2.612	0.138
2.962	0.122
3.312	0.109
3.662	0.098
4.012	0.090
4.362	0.083
5.76	0.063



CARACTERISTICAS DE MATERIALES

Los elementos estructurales de la estructura se analizaron con las siguientes características:

Resistencia a compresión del concreto

La resistencia a la compresión del concreto establecida es de:

Columnas y vigas: 21 MPa.
Cimentación: 21 MPa.

Módulo de elasticidad del concreto

El agregado usado para el concreto estructural deberá ser de origen metamórfico.

Su módulo de elasticidad se calcula según lo indica C.8.5.1.

Módulo de elasticidad del concreto: 3900√21MPa=17872.04 MPa

Acero de refuerzo

El refuerzo de los elementos de concreto y muros de perforación vertical consiste en varillas corrugadas de acero con diámetros desde 4mm hasta 1" y las siguientes resistencias a tensión fy.

Varillas de refuerzo: 420 MPa.
Mallas Electrosoldadas: 480 MPa.
Perfiles estructurales Tipo I: ASTM A572 G50 Fy=345 MPa Fu= 450 Mpa
Tuberia estructural: ASTM A500 Fy=345 MPa Fu=425 MPa
Platinas: ASTM A36
Tornillos y Pernos: A325

El acero de refuerzo utilizado debe cumplir con la norma NTC-2289, con módulo de elasticidad de 200000 MPa

CARGAS

Peso propio de los elementos estructurales:

Todos los elementos de concreto reforzado: 2400 Kg/m3
Todos los elementos en acero: 7800 Kg/m3

Cargas adicionales al peso propio de los elementos estructurales (gravitacionales):

Carga viva en cubierta: 50 Kg/m2
Carga muerta sobreimpuesta en cubierta: 80 kg/m2
Carga viento a compresión en cubierta: 50 kg/m2
Carga viento a succión en cubierta: 40.0 kg/m2

IDENTIFICACIÓN DE CARGAS EN MODELO

Condiciones de carga:

D	Carga muerta – Peso Propio
DS	Carga muerta sobreimpuesta
L	Carga Viva
SX	Cargas sísmicas En dirección X
SY	Cargas sísmicas En dirección Y
W	Carga de viento

COMBINACIONES DE CARGA

Name	Load Name	SF	Load Name	SF	Load Name	SF	Load Name	SF
CIM 0,6D	Dead	0.6	DS	0.6				
CIM 0,6D+0.7SX	Dead	0.6	DS	0.6	SX	0.7		
CIM 0,6D+0.7SY	Dead	0.6	DS	0.6	SY	0.7		
CIM 1.0D	Dead	1	DS	1				
CIM 1.0D+0.7SX	Dead	1	DS	1	SX	0.7		
CIM 1.0D+0.7SY	Dead	1	DS	1	SY	0.7		
CIM 1.0D+0.75L+0.5SX	Dead	1	DS	1	Live	0.75	SX	0.5
CIM 1.0D+0.75L+0.5SY	Dead	1	DS	1	Live	0.75	SY	0.5
CIM 1.0D+1.0L	Dead	1	DS	1	Live	1		
DES 0.6D+1.0SX	Dead	0.6	DS	0.6	SX	1		
DES 0.6D+1.0SY	Dead	0.6	DS	0.6	SY	1		
DES 1.0D+0.75L+0.75SX	Dead	1	DS	1	Live	0.75	SX	0.75
DES 1.0D+0.75L+0.75SY	Dead	1	DS	1	Live	0.75	SY	0.75
DES 1.0D+1.0SX	Dead	1	DS	1	SX	1		
DES 1.0D+1.0SY	Dead	1	DS	1	SY	1		
ELS 0.6D+0.7SX	Dead	0.6	DS	0.6	SX	0.7		
ELS 0.6D+0.7SY	Dead	0.6	DS	0.6	SY	0.7		
ELS 0.6D+1.0W1	Dead	0.6	DS	0.6	W1	1		
ELS 0.6D+1.0W2	Dead	0.6	DS	0.6	W2	1		
ELS 1.0D	Dead	1	DS	1				
ELS 1.0D+0.7SX	Dead	1	DS	1	SX	0.7		
ELS 1.0D+0.7SY	Dead	1	DS	1	SY	0.7		
ELS 1.0D+0.75L	Dead	1	DS	1	Live	0.75		
ELS 1.0D+0.75L+0.525SX	Dead	1	DS	1	Live	0.75	SX	0.525
ELS 1.0D+0.75L+0.525SY	Dead	1	DS	1	Live	0.75	SY	0.525

Name	Load Name	SF	Load Name	SF	Load Name	SF	Load Name	SF
ELS 1.0D+0.75W1+0.75L	Dead	1	DS	1	Live	0.75	W1	0.75
ELS 1.0D+0.75W2+0.75L	Dead	1	DS	1	Live	0.75	W2	0.75
ELS 1.0D+1.0L	Dead	1	DS	1	Live	1		
ELS 1.0D+1.0W1	Dead	1	DS	1	W1	1		
ELS 1.0D+1.0W2	Dead	1	DS	1	W2	1		
ELU 0.9D	Dead	0.9	DS	0.9				
ELU 0.9D-1.0SX-0.3SY	Dead	0.9	DS	0.9	SX	-1	SY	-0.3
ELU 0.9D-1.0SX+0.3SY	Dead	0.9	DS	0.9	SX	-1	SY	0.3
ELU 0.9D-1.0SY-0.3SX	Dead	0.9	DS	0.9	SX	-0.3	SY	-1
ELU 0.9D-1.0SY+0.3SX	Dead	0.9	DS	0.9	SX	0.3	SY	-1
ELU 0.9D+1.0SX-0.3SY	Dead	0.9	DS	0.9	SX	1	SY	-0.3
ELU 0.9D+1.0SX+0.3SY	Dead	0.9	DS	0.9	SX	1	SY	0.3
ELU 0.9D+1.0SY-0.3SX	Dead	0.9	DS	0.9	SX	-0.3	SY	1
ELU 0.9D+1.0SY+0.3SX	Dead	0.9	DS	0.9	SX	0.3	SY	1
ELU 0.9D+1.6W1	Dead	0.9	DS	0.9	W1	1.6		
ELU 0.9D+1.6W2	Dead	0.9	DS	0.9	W2	1.6		
ELU 1.2D+0.8W1	Dead	1.2	DS	1.2	W1	0.8		
ELU 1.2D+0.8W2	Dead	1.2	DS	1.2	W2	0.8		
ELU 1.2D+1.0L-1.0SX-0.3SY	Dead	1.2	DS	1.2	Live	1	SX	-1
ELU 1.2D+1.0L-1.0SX-0.3SY							SY	-0.3
ELU 1.2D+1.0L-1.0SX+0.3SY	Dead	1.2	DS	1.2	Live	1	SX	-1
ELU 1.2D+1.0L-1.0SX+0.3SY							SY	0.3
ELU 1.2D+1.0L-1.0SY-0.3SX	Dead	1.2	DS	1.2	Live	1	SX	-0.3
ELU 1.2D+1.0L-1.0SY-0.3SX							SY	-1
ELU 1.2D+1.0L-1.0SY+0.3SX	Dead	1.2	DS	1.2	Live	1	SX	0.3
ELU 1.2D+1.0L-1.0SY+0.3SX							SY	-1
ELU 1.2D+1.0L+1.0SX-0.3SY	Dead	1.2	DS	1.2	Live	1	SX	1
ELU 1.2D+1.0L+1.0SX-0.3SY							SY	-0.3
ELU 1.2D+1.0L+1.0SX+0.3SY	Dead	1.2	DS	1.2	Live	1	SX	1
ELU 1.2D+1.0L+1.0SX+0.3SY							SY	0.3
ELU 1.2D+1.0L+1.0SY-0.3SX	Dead	1.2	DS	1.2	Live	1	SX	-0.3
ELU 1.2D+1.0L+1.0SY-0.3SX							SY	1
ELU 1.2D+1.0L+1.0SY+0.3SX	Dead	1.2	DS	1.2	Live	1	SX	0.3
ELU 1.2D+1.0L+1.0SY+0.3SX							SY	1
ELU 1.2D+1.6L	Dead	1.2	DS	1.2	Live	1.6		

Name	Load Name	SF	Load Name	SF	Load Name	SF	Load Name	SF
ELU 1.2D+1.6W1+1.0L	Dead	1.2	DS	1.2	Live	1	W1	1.6
ELU 1.2D+1.6W2+1.0L	Dead	1.2	DS	1.2	Live	1	W2	1.6
ELU 1.4D	Dead	1.4	DS	1.4				

MODELO ANÁLITICO

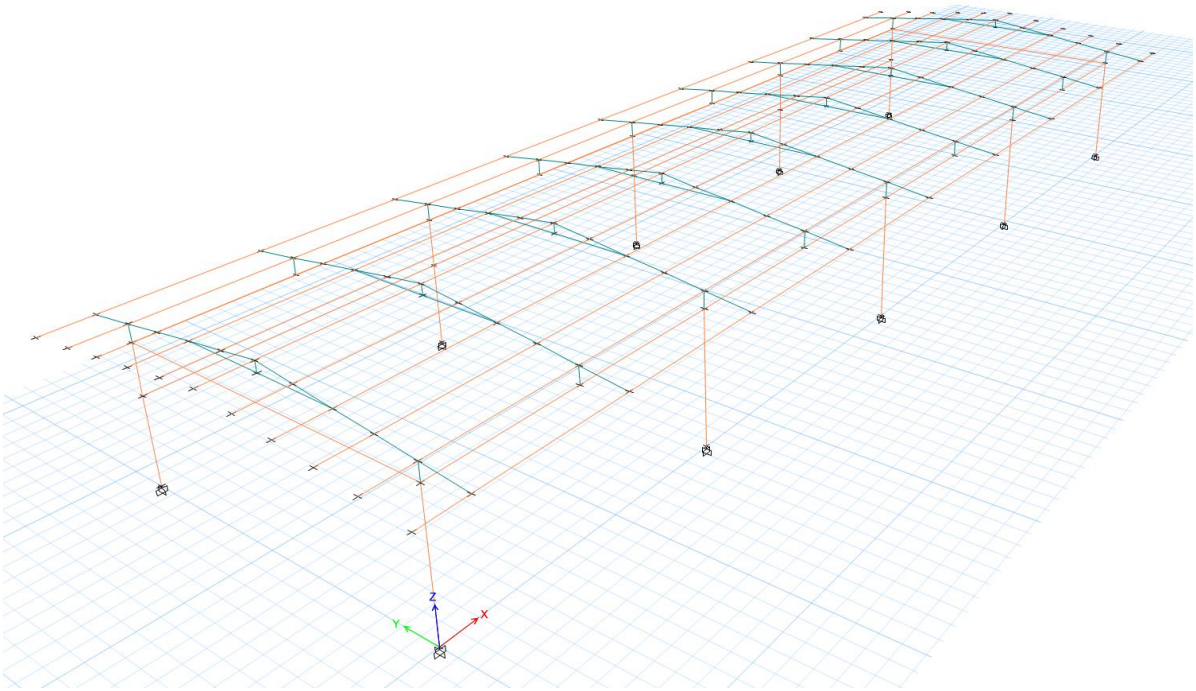


IMAGEN 1: Modelo tridimensional.

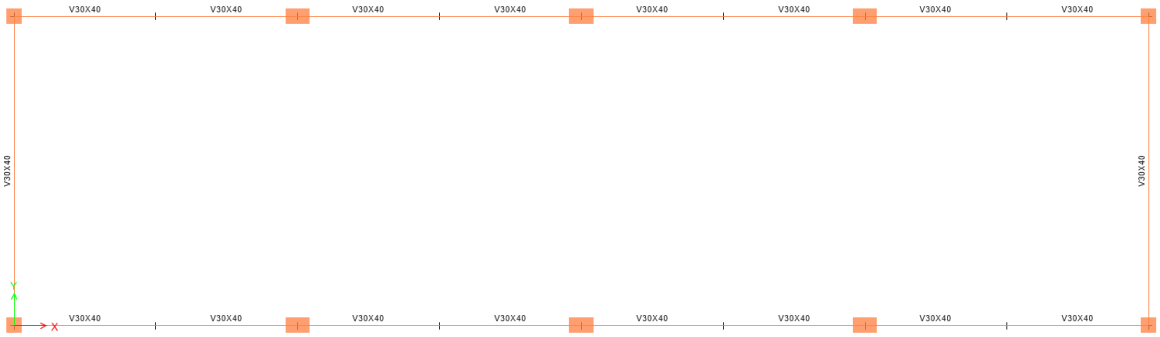


IMAGEN 2: Planta estructural de vigas aéreas– Identificación de elementos.

CARGAS INCLUIDAS EN EL MODELO

Story	UniqueName	Load Pattern	Load Type	Direction	Distance Type	Absolute Distance B	Force A	Force B
						m	kgf/m	kgf/m
Story3	196	L	Force	Gravity	Relative	4.1316	60	60
Story3	197	L	Force	Gravity	Relative	4.1316	60	60
Story3	198	L	Force	Gravity	Relative	4.1329	60	60
Story3	199	L	Force	Gravity	Relative	4.1329	60	60
Story3	200	L	Force	Gravity	Relative	4.1303	60	60
Story3	201	L	Force	Gravity	Relative	4.1303	60	60
Story3	202	L	Force	Gravity	Relative	4.1316	60	60
Story3	203	L	Force	Gravity	Relative	4.1316	60	60
Story3	204	L	Force	Gravity	Relative	4.1316	60	60
Story3	205	L	Force	Gravity	Relative	4.1316	60	60
Story3	206	L	Force	Gravity	Relative	4.1329	60	60
Story3	207	L	Force	Gravity	Relative	4.1329	60	60
Story3	208	L	Force	Gravity	Relative	4.1303	60	60
Story3	209	L	Force	Gravity	Relative	4.1303	60	60
Story3	210	L	Force	Gravity	Relative	4.1316	60	60
Story3	211	L	Force	Gravity	Relative	4.1316	60	60
Story3	212	L	Force	Gravity	Relative	4.1316	60	60
Story3	213	L	Force	Gravity	Relative	4.1316	60	60
Story3	214	L	Force	Gravity	Relative	4.1329	60	60
Story3	215	L	Force	Gravity	Relative	4.1329	60	60
Story3	216	L	Force	Gravity	Relative	4.1303	60	60
Story3	217	L	Force	Gravity	Relative	4.1303	60	60
Story3	218	L	Force	Gravity	Relative	4.1316	60	60
Story3	219	L	Force	Gravity	Relative	4.1316	60	60
Story3	220	L	Force	Gravity	Relative	4.1316	60	60
Story3	221	L	Force	Gravity	Relative	4.1316	60	60
Story3	222	L	Force	Gravity	Relative	4.1329	60	60
Story3	223	L	Force	Gravity	Relative	4.1329	60	60
Story3	224	L	Force	Gravity	Relative	4.1303	60	60
Story3	225	L	Force	Gravity	Relative	4.1303	60	60
Story3	226	L	Force	Gravity	Relative	4.1316	60	60

Story	UniqueName	Load Pattern	Load Type	Direction	Distance Type	Absolute Distance B	Force A	Force B
						m	kgf/m	kgf/m
Story3	227	L	Force	Gravity	Relative	4.1316	60	60
Story3	228	L	Force	Gravity	Relative	4.1316	60	60
Story3	229	L	Force	Gravity	Relative	4.1316	60	60
Story3	230	L	Force	Gravity	Relative	4.1329	60	60
Story3	231	L	Force	Gravity	Relative	4.1329	60	60
Story3	232	L	Force	Gravity	Relative	4.1303	60	60
Story3	233	L	Force	Gravity	Relative	4.1303	60	60
Story3	234	L	Force	Gravity	Relative	4.1316	60	60
Story3	235	L	Force	Gravity	Relative	4.1316	60	60
Story3	236	L	Force	Gravity	Relative	4.1316	60	60
Story3	237	L	Force	Gravity	Relative	4.1316	60	60
Story3	238	L	Force	Gravity	Relative	4.1329	60	60
Story3	239	L	Force	Gravity	Relative	4.1329	60	60
Story3	241	L	Force	Gravity	Relative	4.1303	60	60
Story3	242	L	Force	Gravity	Relative	4.1303	60	60
Story3	243	L	Force	Gravity	Relative	4.1316	60	60
Story3	244	L	Force	Gravity	Relative	4.1316	60	60
Story3	245	L	Force	Gravity	Relative	4.1316	60	60
Story3	246	L	Force	Gravity	Relative	4.1316	60	60
Story3	247	L	Force	Gravity	Relative	4.1329	60	60
Story3	248	L	Force	Gravity	Relative	4.1329	60	60
Story3	249	L	Force	Gravity	Relative	4.1303	60	60
Story3	250	L	Force	Gravity	Relative	4.1303	60	60
Story3	251	L	Force	Gravity	Relative	4.1316	60	60
Story3	252	L	Force	Gravity	Relative	4.1316	60	60
Story3	253	L	Force	Gravity	Relative	4.1316	60	60
Story3	254	L	Force	Gravity	Relative	4.1316	60	60
Story3	255	L	Force	Gravity	Relative	4.1329	60	60
Story3	256	L	Force	Gravity	Relative	4.1329	60	60
Story3	257	L	Force	Gravity	Relative	4.1303	60	60
Story3	258	L	Force	Gravity	Relative	4.1303	60	60
Story3	259	L	Force	Gravity	Relative	4.1316	60	60
Story3	260	L	Force	Gravity	Relative	4.1316	60	60

Story	UniqueName	Load Pattern	Load Type	Direction	Distance Type	Absolute Distance B	Force A	Force B
						m	kgf/m	kgf/m
Story3	261	L	Force	Gravity	Relative	4.1316	60	60
Story3	262	L	Force	Gravity	Relative	4.1316	60	60
Story3	263	L	Force	Gravity	Relative	4.1329	60	60
Story3	264	L	Force	Gravity	Relative	4.1329	60	60
Story3	265	L	Force	Gravity	Relative	4.1303	60	60
Story3	266	L	Force	Gravity	Relative	4.1303	60	60
Story3	267	L	Force	Gravity	Relative	4.1316	60	60
Story3	268	L	Force	Gravity	Relative	4.1316	60	60
Story3	269	L	Force	Gravity	Relative	4.1316	60	60
Story3	270	L	Force	Gravity	Relative	4.1316	60	60
Story3	271	L	Force	Gravity	Relative	4.1329	60	60
Story3	272	L	Force	Gravity	Relative	4.1329	60	60
Story3	273	L	Force	Gravity	Relative	4.1303	60	60
Story3	274	L	Force	Gravity	Relative	4.1303	60	60
Story3	275	L	Force	Gravity	Relative	4.1316	60	60
Story3	276	L	Force	Gravity	Relative	4.1316	60	60
Story3	277	L	Force	Gravity	Relative	4.1316	60	60
Story3	278	L	Force	Gravity	Relative	4.1316	60	60
Story3	279	L	Force	Gravity	Relative	4.1329	60	60
Story3	280	L	Force	Gravity	Relative	4.1329	60	60
Story3	281	L	Force	Gravity	Relative	4.1303	60	60
Story3	282	L	Force	Gravity	Relative	4.1303	60	60
Story3	283	L	Force	Gravity	Relative	4.1316	60	60
Story3	284	L	Force	Gravity	Relative	4.1316	60	60
Story3	13	L	Force	Gravity	Relative	1.3	60	60
Story3	15	L	Force	Gravity	Relative	1.3	60	60
Story3	17	L	Force	Gravity	Relative	1.3	60	60
Story3	19	L	Force	Gravity	Relative	1.3	60	60
Story3	42	L	Force	Gravity	Relative	1.3	60	60
Story3	44	L	Force	Gravity	Relative	1.3	60	60
Story3	83	L	Force	Gravity	Relative	1.3	60	60
Story3	85	L	Force	Gravity	Relative	1.3	60	60
Story3	94	L	Force	Gravity	Relative	1.3	60	60

Story	UniqueName	Load Pattern	Load Type	Direction	Distance Type	Absolute Distance B	Force A	Force B
						m	kgf/m	kgf/m
Story3	96	L	Force	Gravity	Relative	1.3	60	60
Story3	105	L	Force	Gravity	Relative	1.3	60	60
Story3	107	L	Force	Gravity	Relative	1.3	60	60
Story3	116	L	Force	Gravity	Relative	1.3	60	60
Story3	118	L	Force	Gravity	Relative	1.3	60	60
Story3	127	L	Force	Gravity	Relative	1.3	60	60
Story3	129	L	Force	Gravity	Relative	1.3	60	60
Story3	138	L	Force	Gravity	Relative	1.3	60	60
Story3	140	L	Force	Gravity	Relative	1.3	60	60
Story3	149	L	Force	Gravity	Relative	1.3	60	60
Story3	151	L	Force	Gravity	Relative	1.3	60	60
Story3	160	L	Force	Gravity	Relative	1.3	60	60
Story3	162	L	Force	Gravity	Relative	1.3	60	60
Story3	196	DS	Force	Gravity	Relative	4.1316	96	96
Story3	197	DS	Force	Gravity	Relative	4.1316	96	96
Story3	198	DS	Force	Gravity	Relative	4.1329	96	96
Story3	199	DS	Force	Gravity	Relative	4.1329	96	96
Story3	200	DS	Force	Gravity	Relative	4.1303	96	96
Story3	201	DS	Force	Gravity	Relative	4.1303	96	96
Story3	202	DS	Force	Gravity	Relative	4.1316	96	96
Story3	203	DS	Force	Gravity	Relative	4.1316	96	96
Story3	204	DS	Force	Gravity	Relative	4.1316	96	96
Story3	205	DS	Force	Gravity	Relative	4.1316	96	96
Story3	206	DS	Force	Gravity	Relative	4.1329	96	96
Story3	207	DS	Force	Gravity	Relative	4.1329	96	96
Story3	208	DS	Force	Gravity	Relative	4.1303	96	96
Story3	209	DS	Force	Gravity	Relative	4.1303	96	96
Story3	210	DS	Force	Gravity	Relative	4.1316	96	96
Story3	211	DS	Force	Gravity	Relative	4.1316	96	96
Story3	212	DS	Force	Gravity	Relative	4.1316	96	96
Story3	213	DS	Force	Gravity	Relative	4.1316	96	96
Story3	214	DS	Force	Gravity	Relative	4.1329	96	96
Story3	215	DS	Force	Gravity	Relative	4.1329	96	96

Story	UniqueName	Load Pattern	Load Type	Direction	Distance Type	Absolute Distance B	Force A	Force B
						m	kgf/m	kgf/m
Story3	216	DS	Force	Gravity	Relative	4.1303	96	96
Story3	217	DS	Force	Gravity	Relative	4.1303	96	96
Story3	218	DS	Force	Gravity	Relative	4.1316	96	96
Story3	219	DS	Force	Gravity	Relative	4.1316	96	96
Story3	220	DS	Force	Gravity	Relative	4.1316	96	96
Story3	221	DS	Force	Gravity	Relative	4.1316	96	96
Story3	222	DS	Force	Gravity	Relative	4.1329	96	96
Story3	223	DS	Force	Gravity	Relative	4.1329	96	96
Story3	224	DS	Force	Gravity	Relative	4.1303	96	96
Story3	225	DS	Force	Gravity	Relative	4.1303	96	96
Story3	226	DS	Force	Gravity	Relative	4.1316	96	96
Story3	227	DS	Force	Gravity	Relative	4.1316	96	96
Story3	228	DS	Force	Gravity	Relative	4.1316	96	96
Story3	229	DS	Force	Gravity	Relative	4.1316	96	96
Story3	230	DS	Force	Gravity	Relative	4.1329	96	96
Story3	231	DS	Force	Gravity	Relative	4.1329	96	96
Story3	232	DS	Force	Gravity	Relative	4.1303	96	96
Story3	233	DS	Force	Gravity	Relative	4.1303	96	96
Story3	234	DS	Force	Gravity	Relative	4.1316	96	96
Story3	235	DS	Force	Gravity	Relative	4.1316	96	96
Story3	236	DS	Force	Gravity	Relative	4.1316	96	96
Story3	237	DS	Force	Gravity	Relative	4.1316	96	96
Story3	238	DS	Force	Gravity	Relative	4.1329	96	96
Story3	239	DS	Force	Gravity	Relative	4.1329	96	96
Story3	241	DS	Force	Gravity	Relative	4.1303	96	96
Story3	242	DS	Force	Gravity	Relative	4.1303	96	96
Story3	243	DS	Force	Gravity	Relative	4.1316	96	96
Story3	244	DS	Force	Gravity	Relative	4.1316	96	96
Story3	245	DS	Force	Gravity	Relative	4.1316	96	96
Story3	246	DS	Force	Gravity	Relative	4.1316	96	96
Story3	247	DS	Force	Gravity	Relative	4.1329	96	96
Story3	248	DS	Force	Gravity	Relative	4.1329	96	96
Story3	249	DS	Force	Gravity	Relative	4.1303	96	96

Story	UniqueName	Load Pattern	Load Type	Direction	Distance Type	Absolute Distance B	Force A	Force B
						m	kgf/m	kgf/m
Story3	250	DS	Force	Gravity	Relative	4.1303	96	96
Story3	251	DS	Force	Gravity	Relative	4.1316	96	96
Story3	252	DS	Force	Gravity	Relative	4.1316	96	96
Story3	253	DS	Force	Gravity	Relative	4.1316	96	96
Story3	254	DS	Force	Gravity	Relative	4.1316	96	96
Story3	255	DS	Force	Gravity	Relative	4.1329	96	96
Story3	256	DS	Force	Gravity	Relative	4.1329	96	96
Story3	257	DS	Force	Gravity	Relative	4.1303	96	96
Story3	258	DS	Force	Gravity	Relative	4.1303	96	96
Story3	259	DS	Force	Gravity	Relative	4.1316	96	96
Story3	260	DS	Force	Gravity	Relative	4.1316	96	96
Story3	261	DS	Force	Gravity	Relative	4.1316	96	96
Story3	262	DS	Force	Gravity	Relative	4.1316	96	96
Story3	263	DS	Force	Gravity	Relative	4.1329	96	96
Story3	264	DS	Force	Gravity	Relative	4.1329	96	96
Story3	265	DS	Force	Gravity	Relative	4.1303	96	96
Story3	266	DS	Force	Gravity	Relative	4.1303	96	96
Story3	267	DS	Force	Gravity	Relative	4.1316	96	96
Story3	268	DS	Force	Gravity	Relative	4.1316	96	96
Story3	269	DS	Force	Gravity	Relative	4.1316	96	96
Story3	270	DS	Force	Gravity	Relative	4.1316	96	96
Story3	271	DS	Force	Gravity	Relative	4.1329	96	96
Story3	272	DS	Force	Gravity	Relative	4.1329	96	96
Story3	273	DS	Force	Gravity	Relative	4.1303	96	96
Story3	274	DS	Force	Gravity	Relative	4.1303	96	96
Story3	275	DS	Force	Gravity	Relative	4.1316	96	96
Story3	276	DS	Force	Gravity	Relative	4.1316	96	96
Story3	277	DS	Force	Gravity	Relative	4.1316	96	96
Story3	278	DS	Force	Gravity	Relative	4.1316	96	96
Story3	279	DS	Force	Gravity	Relative	4.1329	96	96
Story3	280	DS	Force	Gravity	Relative	4.1329	96	96
Story3	281	DS	Force	Gravity	Relative	4.1303	96	96
Story3	282	DS	Force	Gravity	Relative	4.1303	96	96

Story	UniqueName	Load Pattern	Load Type	Direction	Distance Type	Absolute Distance B	Force A	Force B
						m	kgf/m	kgf/m
Story3	283	DS	Force	Gravity	Relative	4.1316	96	96
Story3	284	DS	Force	Gravity	Relative	4.1316	96	96
Story3	13	DS	Force	Gravity	Relative	1.3	96	96
Story3	15	DS	Force	Gravity	Relative	1.3	96	96
Story3	17	DS	Force	Gravity	Relative	1.3	96	96
Story3	19	DS	Force	Gravity	Relative	1.3	96	96
Story3	42	DS	Force	Gravity	Relative	1.3	96	96
Story3	44	DS	Force	Gravity	Relative	1.3	96	96
Story3	83	DS	Force	Gravity	Relative	1.3	96	96
Story3	85	DS	Force	Gravity	Relative	1.3	96	96
Story3	94	DS	Force	Gravity	Relative	1.3	96	96
Story3	96	DS	Force	Gravity	Relative	1.3	96	96
Story3	105	DS	Force	Gravity	Relative	1.3	96	96
Story3	107	DS	Force	Gravity	Relative	1.3	96	96
Story3	116	DS	Force	Gravity	Relative	1.3	96	96
Story3	118	DS	Force	Gravity	Relative	1.3	96	96
Story3	127	DS	Force	Gravity	Relative	1.3	96	96
Story3	129	DS	Force	Gravity	Relative	1.3	96	96
Story3	138	DS	Force	Gravity	Relative	1.3	96	96
Story3	140	DS	Force	Gravity	Relative	1.3	96	96
Story3	149	DS	Force	Gravity	Relative	1.3	96	96
Story3	151	DS	Force	Gravity	Relative	1.3	96	96
Story3	160	DS	Force	Gravity	Relative	1.3	96	96
Story3	162	DS	Force	Gravity	Relative	1.3	96	96
Story3	196	W1	Force	Gravity	Relative	4.1316	60	60
Story3	197	W1	Force	Gravity	Relative	4.1316	60	60
Story3	198	W1	Force	Gravity	Relative	4.1329	60	60
Story3	199	W1	Force	Gravity	Relative	4.1329	60	60
Story3	200	W1	Force	Gravity	Relative	4.1303	60	60
Story3	201	W1	Force	Gravity	Relative	4.1303	60	60
Story3	202	W1	Force	Gravity	Relative	4.1316	60	60
Story3	203	W1	Force	Gravity	Relative	4.1316	60	60
Story3	204	W1	Force	Gravity	Relative	4.1316	60	60

Story	UniqueName	Load Pattern	Load Type	Direction	Distance Type	Absolute Distance B	Force A	Force B
						m	kgf/m	kgf/m
Story3	205	W1	Force	Gravity	Relative	4.1316	60	60
Story3	206	W1	Force	Gravity	Relative	4.1329	60	60
Story3	207	W1	Force	Gravity	Relative	4.1329	60	60
Story3	208	W1	Force	Gravity	Relative	4.1303	60	60
Story3	209	W1	Force	Gravity	Relative	4.1303	60	60
Story3	210	W1	Force	Gravity	Relative	4.1316	60	60
Story3	211	W1	Force	Gravity	Relative	4.1316	60	60
Story3	212	W1	Force	Gravity	Relative	4.1316	60	60
Story3	213	W1	Force	Gravity	Relative	4.1316	60	60
Story3	214	W1	Force	Gravity	Relative	4.1329	60	60
Story3	215	W1	Force	Gravity	Relative	4.1329	60	60
Story3	216	W1	Force	Gravity	Relative	4.1303	60	60
Story3	217	W1	Force	Gravity	Relative	4.1303	60	60
Story3	218	W1	Force	Gravity	Relative	4.1316	60	60
Story3	219	W1	Force	Gravity	Relative	4.1316	60	60
Story3	220	W1	Force	Gravity	Relative	4.1316	60	60
Story3	221	W1	Force	Gravity	Relative	4.1316	60	60
Story3	222	W1	Force	Gravity	Relative	4.1329	60	60
Story3	223	W1	Force	Gravity	Relative	4.1329	60	60
Story3	224	W1	Force	Gravity	Relative	4.1303	60	60
Story3	225	W1	Force	Gravity	Relative	4.1303	60	60
Story3	226	W1	Force	Gravity	Relative	4.1316	60	60
Story3	227	W1	Force	Gravity	Relative	4.1316	60	60
Story3	228	W1	Force	Gravity	Relative	4.1316	60	60
Story3	229	W1	Force	Gravity	Relative	4.1316	60	60
Story3	230	W1	Force	Gravity	Relative	4.1329	60	60
Story3	231	W1	Force	Gravity	Relative	4.1329	60	60
Story3	232	W1	Force	Gravity	Relative	4.1303	60	60
Story3	233	W1	Force	Gravity	Relative	4.1303	60	60
Story3	234	W1	Force	Gravity	Relative	4.1316	60	60
Story3	235	W1	Force	Gravity	Relative	4.1316	60	60
Story3	236	W1	Force	Gravity	Relative	4.1316	60	60
Story3	237	W1	Force	Gravity	Relative	4.1316	60	60

Story	UniqueName	Load Pattern	Load Type	Direction	Distance Type	Absolute Distance B	Force A	Force B
						m	kgf/m	kgf/m
Story3	238	W1	Force	Gravity	Relative	4.1329	60	60
Story3	239	W1	Force	Gravity	Relative	4.1329	60	60
Story3	241	W1	Force	Gravity	Relative	4.1303	60	60
Story3	242	W1	Force	Gravity	Relative	4.1303	60	60
Story3	243	W1	Force	Gravity	Relative	4.1316	60	60
Story3	244	W1	Force	Gravity	Relative	4.1316	60	60
Story3	245	W1	Force	Gravity	Relative	4.1316	60	60
Story3	246	W1	Force	Gravity	Relative	4.1316	60	60
Story3	247	W1	Force	Gravity	Relative	4.1329	60	60
Story3	248	W1	Force	Gravity	Relative	4.1329	60	60
Story3	249	W1	Force	Gravity	Relative	4.1303	60	60
Story3	250	W1	Force	Gravity	Relative	4.1303	60	60
Story3	251	W1	Force	Gravity	Relative	4.1316	60	60
Story3	252	W1	Force	Gravity	Relative	4.1316	60	60
Story3	253	W1	Force	Gravity	Relative	4.1316	60	60
Story3	254	W1	Force	Gravity	Relative	4.1316	60	60
Story3	255	W1	Force	Gravity	Relative	4.1329	60	60
Story3	256	W1	Force	Gravity	Relative	4.1329	60	60
Story3	257	W1	Force	Gravity	Relative	4.1303	60	60
Story3	258	W1	Force	Gravity	Relative	4.1303	60	60
Story3	259	W1	Force	Gravity	Relative	4.1316	60	60
Story3	260	W1	Force	Gravity	Relative	4.1316	60	60
Story3	261	W1	Force	Gravity	Relative	4.1316	60	60
Story3	262	W1	Force	Gravity	Relative	4.1316	60	60
Story3	263	W1	Force	Gravity	Relative	4.1329	60	60
Story3	264	W1	Force	Gravity	Relative	4.1329	60	60
Story3	265	W1	Force	Gravity	Relative	4.1303	60	60
Story3	266	W1	Force	Gravity	Relative	4.1303	60	60
Story3	267	W1	Force	Gravity	Relative	4.1316	60	60
Story3	268	W1	Force	Gravity	Relative	4.1316	60	60
Story3	269	W1	Force	Gravity	Relative	4.1316	60	60
Story3	270	W1	Force	Gravity	Relative	4.1316	60	60
Story3	271	W1	Force	Gravity	Relative	4.1329	60	60

Story	UniqueName	Load Pattern	Load Type	Direction	Distance Type	Absolute Distance B	Force A	Force B
						m	kgf/m	kgf/m
Story3	272	W1	Force	Gravity	Relative	4.1329	60	60
Story3	273	W1	Force	Gravity	Relative	4.1303	60	60
Story3	274	W1	Force	Gravity	Relative	4.1303	60	60
Story3	275	W1	Force	Gravity	Relative	4.1316	60	60
Story3	276	W1	Force	Gravity	Relative	4.1316	60	60
Story3	277	W1	Force	Gravity	Relative	4.1316	60	60
Story3	278	W1	Force	Gravity	Relative	4.1316	60	60
Story3	279	W1	Force	Gravity	Relative	4.1329	60	60
Story3	280	W1	Force	Gravity	Relative	4.1329	60	60
Story3	281	W1	Force	Gravity	Relative	4.1303	60	60
Story3	282	W1	Force	Gravity	Relative	4.1303	60	60
Story3	283	W1	Force	Gravity	Relative	4.1316	60	60
Story3	284	W1	Force	Gravity	Relative	4.1316	60	60
Story3	13	W1	Force	Gravity	Relative	1.3	60	60
Story3	15	W1	Force	Gravity	Relative	1.3	60	60
Story3	17	W1	Force	Gravity	Relative	1.3	60	60
Story3	19	W1	Force	Gravity	Relative	1.3	60	60
Story3	42	W1	Force	Gravity	Relative	1.3	60	60
Story3	44	W1	Force	Gravity	Relative	1.3	60	60
Story3	83	W1	Force	Gravity	Relative	1.3	60	60
Story3	85	W1	Force	Gravity	Relative	1.3	60	60
Story3	94	W1	Force	Gravity	Relative	1.3	60	60
Story3	96	W1	Force	Gravity	Relative	1.3	60	60
Story3	105	W1	Force	Gravity	Relative	1.3	60	60
Story3	107	W1	Force	Gravity	Relative	1.3	60	60
Story3	116	W1	Force	Gravity	Relative	1.3	60	60
Story3	118	W1	Force	Gravity	Relative	1.3	60	60
Story3	127	W1	Force	Gravity	Relative	1.3	60	60
Story3	129	W1	Force	Gravity	Relative	1.3	60	60
Story3	138	W1	Force	Gravity	Relative	1.3	60	60
Story3	140	W1	Force	Gravity	Relative	1.3	60	60
Story3	149	W1	Force	Gravity	Relative	1.3	60	60
Story3	151	W1	Force	Gravity	Relative	1.3	60	60

Story	UniqueName	Load Pattern	Load Type	Direction	Distance Type	Absolute Distance B	Force A	Force B
						m	kgf/m	kgf/m
Story3	160	W1	Force	Gravity	Relative	1.3	60	60
Story3	162	W1	Force	Gravity	Relative	1.3	60	60
Story3	196	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	197	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	198	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	199	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	200	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	201	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	202	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	203	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	204	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	205	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	206	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	207	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	208	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	209	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	210	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	211	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	212	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	213	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	214	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	215	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	216	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	217	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	218	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	219	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	220	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	221	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	222	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	223	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	224	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	225	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	226	W2	Force	Gravity	Relative	4.1316	-48	-48

Story	UniqueName	Load Pattern	Load Type	Direction	Distance Type	Absolute Distance B	Force A	Force B
						m	kgf/m	kgf/m
Story3	227	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	228	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	229	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	230	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	231	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	232	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	233	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	234	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	235	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	236	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	237	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	238	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	239	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	241	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	242	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	243	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	244	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	245	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	246	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	247	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	248	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	249	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	250	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	251	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	252	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	253	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	254	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	255	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	256	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	257	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	258	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	259	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	260	W2	Force	Gravity	Relative	4.1316	-48	-48

Story	UniqueName	Load Pattern	Load Type	Direction	Distance Type	Absolute Distance B	Force A	Force B
						m	kgf/m	kgf/m
Story3	261	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	262	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	263	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	264	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	265	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	266	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	267	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	268	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	269	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	270	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	271	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	272	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	273	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	274	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	275	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	276	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	277	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	278	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	279	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	280	W2	Force	Gravity	Relative	4.1329	-48	-48
Story3	281	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	282	W2	Force	Gravity	Relative	4.1303	-48	-48
Story3	283	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	284	W2	Force	Gravity	Relative	4.1316	-48	-48
Story3	13	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	15	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	17	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	19	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	42	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	44	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	83	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	85	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	94	W2	Force	Gravity	Relative	1.3	-48	-48

Story	UniqueName	Load Pattern	Load Type	Direction	Distance Type	Absolute Distance B	Force A	Force B
						m	kgf/m	kgf/m
Story3	96	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	105	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	107	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	116	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	118	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	127	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	129	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	138	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	140	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	149	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	151	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	160	W2	Force	Gravity	Relative	1.3	-48	-48
Story3	162	W2	Force	Gravity	Relative	1.3	-48	-48

ANÁLISIS SÍSMICO

Del programa de análisis estructural se obtienen los valores de cortante basal en las direcciones X y Y, además del valor de masa participante en el sísmo.

Output Case	Case Type	Step Type	FX	FY	FZ
			tonf	tonf	tonf
Dead	LinStatic		0	0	59.45
Live	LinStatic		0	0	21.81
SX	LinRespSpec	Max	39.65	5.95E-04	0
SY	LinRespSpec	Max	5.95E-04	50.99	0
SXEST	LinStatic		-63.45	0	0
SYEST	LinStatic		0.00E+00	-63.45	0
DS	LinStatic		0	0	34.9
W1	LinStatic		0	0	21.81
W2	LinStatic		0	0	-17.45

PESO DE LA ESTRUCTURA:	94.35 Ton	Sa:	0.703125
Vs Estático:	66.34 Ton	Vs Dinámico:	59.71
CORTANTE SÍSMICO:	63.45 Ton	Factor de corrección:	1.05
CORTANTE DINÁMICO X:	39.65 Ton	Factor de corrección:	1.51
CORTANTE DINÁMICO Y:	50.99 Ton	Factor de corrección:	1.17

Verificación de fuerza sísmica en la base

Aplicados los factores de corrección obtenemos la fuerza sísmica corregida en la base.

Output Case	Case Type	Step Type	FX	FY
			tonf	tonf
SX	LinRespSpec	Max	59.87	0.00
SY	LinRespSpec	Max	0.00	59.76
SXEST	LinStatic		-66.62	0.00
SYEST	LinStatic		0.00	-66.62

Porcentaje de participación de masas

Número De Modos De Vibración: Deben incluirse en el análisis dinámico todos los modos de vibración que contribuyan de una manera significativa a la respuesta dinámica de la estructura. Se considera que se ha cumplido este requisito cuando se demuestra que, con el número de modos empleados, p, se ha

incluido en el cálculo de la respuesta, de cada una de las direcciones horizontales de análisis, j, por lo menos el 90% de la masa participante de la estructura. La masa participante, Mj, en cada una de las direcciones de análisis, j, para el número de modos empleados, p.

Para nuestro caso se alcanzó el 90% de aportes de masa en el modo 17 en X y en el modo 13 en Y.

Case	Mode	Period	UX	UY	UZ	SumUX	SumUY
		sec					
Modal	1	0.594	0.3317	0	0	0.3317	0
Modal	2	0.254	0	0.7755	0	0.3317	0.7755
Modal	3	0.241	0	4.50E-06	0	0.3317	0.7755
Modal	4	0.223	0	0.051	0	0.3317	0.8266
Modal	5	0.206	0	0	0	0.3317	0.8266
Modal	6	0.142	0	0.0157	0	0.3317	0.8423
Modal	7	0.136	6.39E-06	0	0	0.3317	0.8423
Modal	8	0.13	0	0	0	0.3317	0.8423
Modal	9	0.126	0	0.034	0	0.3317	0.8763
Modal	10	0.117	0.0002	1.08E-06	0	0.3318	0.8763
Modal	11	0.111	0	0.0754	0	0.3318	0.9517
Modal	12	0.104	0.2749	0	0	0.6067	0.9517
Modal	13	0.094	0.3654	0	0	0.9721	0.9517
Modal	14	0.083	4.13E-06	0	0	0.9721	0.9517
Modal	15	0.083	0	4.27E-05	0	0.9721	0.9517
Modal	16	0.083	1.05E-06	6.22E-06	0	0.9721	0.9517
Modal	17	0.082	0	0.001	0	0.9721	0.9528
Modal	18	0.078	1.27E-05	0	0	0.9721	0.9528

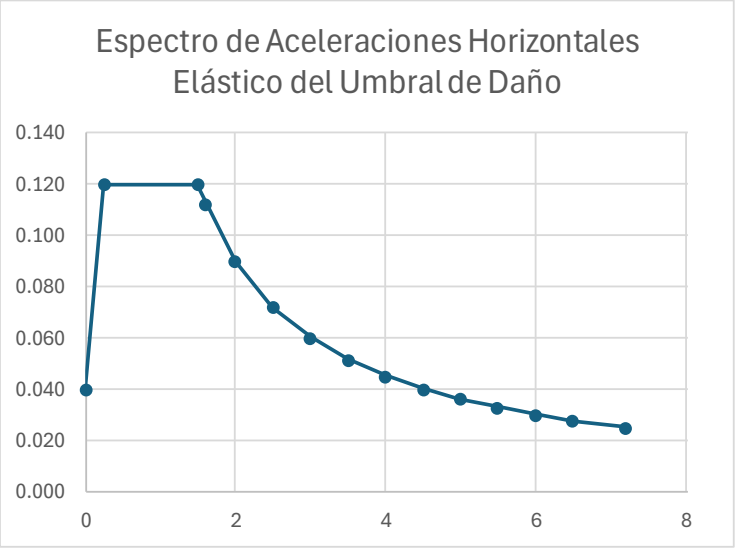
Verificación valor periodo de vibración	
H=	4.60 m
Ta=	0.186
Cu=	1.496
Cu*Ta=	0.278
T=	0.254
T<CuTa	CUMPLE

Se verifica el valor de Sa para el periodo de vibración más significativo en la tabla de participación de masa, donde se comprueba que la aceleración no cambia para el periodo significativo.

VERIFICACIÓN DE REQUISITOS ESPECIALES ACORDE AL CAPITULO A.12 NSR-10

UMBRAL DE DAÑO					
UBICACIÓN	Curumani - Cesar				
DATOS					
GRUPO DE USO	III	**COEFICIENTE DE IMPORTANCIA**			1.25
PERFIL DE SUELO	D	**Fa**	1.5	**Fv**	2.4
AaFaI	0.075	**Ad**	0.04	**S**	3
Sa	0.1875				

T (s)	**Sad (g)**
0	0.040
0.25	0.120
1.5	0.120
1.6	0.113
2	0.090
2.5	0.072
3	0.060
3.5	0.051
4	0.045
4.5	0.040
5	0.036
5.5	0.033
6	0.030
6.5	0.028
7.2	0.025



Output Case	Case Type	Step Type	FX	FY	FZ
			tonf	tonf	tonf
Dead	LinStatic		0	0	59.45
Live	LinStatic		0	0	21.81
DS	LinStatic		0	0	34.9
W1	LinStatic		0	0	21.81
W2	LinStatic		0	0	-17.45
SX-UMBRAL	LinRespSpec	Max	5.07	6.41E-05	0
SY-UMBRAL	LinRespSpec	Max	6.41E-05	8.63	0
SX-UMBRAL1	LinStatic		-10.83	0	0
SY-UMBRAL1	LinStatic		0	-10.83	0

PESO DE LA ESTRUCTURA:	94.35 Ton	Sa:	0.12
Vs Estático:	11.32 Ton	Vs Dinámico:	10.19
CORTANTE SÍSMICO:	10.83 Ton	Factor de corrección:	1.05
CORTANTE DINÁMICO X:	5.07 Ton	Factor de corrección:	2.01
CORTANTE DINÁMICO Y:	8.63 Ton	Factor de corrección:	1.18

Aplicados los factores de corrección obtenemos:

Output Case	Case Type	Step Type	FX	FY
			tonf	tonf
SX-UMBRAL	LinRespSpec	Max	10.2	0
SY-UMBRAL	LinRespSpec	Max	0	10.21
SX-UMBRAL-EST	LinStatic		-11.37	0
SY-UMBRAL-EST	LinStatic		0	-11.37

DERIVAS POR UMBRAL DE DAÑO

Story	Output Case	Case Type	Step Type	Direction	Drift	Verificación	
Story2	SX	LinRespSpec	Max	X	0.10%	<1.0%	OK
Story2	SY	LinRespSpec	Max	Y	0.46%	<1.0%	OK
Story2	SXEST	LinStatic		X	0.10%	<1.0%	OK
Story2	SYEST	LinStatic		Y	0.41%	<1.0%	OK
Story2	SX-UMBRAL	LinRespSpec	Max	X	0.02%	<0.4%	OK
Story2	SY-UMBRAL	LinRespSpec	Max	Y	0.08%	<0.4%	OK
Story2	SX-UMBRAL-EST	LinStatic		X	0.02%	<0.4%	OK
Story2	SY-UMBRAL-EST	LinStatic		Y	0.07%	<0.4%	OK
Story1	SX	LinRespSpec	Max	X	0.07%	<1.0%	OK
Story1	SY	LinRespSpec	Max	Y	0.24%	<1.0%	OK
Story1	SXEST	LinStatic		X	0.07%	<1.0%	OK
Story1	SYEST	LinStatic		Y	0.22%	<1.0%	OK
Story1	SX-UMBRAL	LinRespSpec	Max	X	0.01%	<0.4%	OK
Story1	SY-UMBRAL	LinRespSpec	Max	Y	0.04%	<0.4%	OK
Story1	SX-UMBRAL-EST	LinStatic		X	0.01%	<0.4%	OK
Story1	SY-UMBRAL-EST	LinStatic		Y	0.04%	<0.4%	OK

ANÁLISIS DE IRREGULARIDADES

Irregularidades en planta

Tipo 1aP y 1Bp

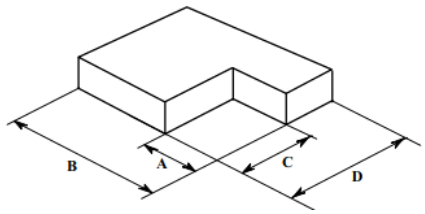
IRREGULARIDAD TORSIONAL - TIPO 1aP	IRREGULARIDAD TORSIONAL EXTREMA - TIPO 1bP
$\phi p = 0.90$	$\phi p = 0.80$
$1.4\left(\frac{\Delta 1+\Delta 2}{2}\right) \geq \Delta 1 > 1.2\left(\frac{\Delta 1+\Delta 2}{2}\right)$	$\Delta 1 > 1.4\left(\frac{\Delta 1+\Delta 2}{2}\right)$

SISMO X					Tipo 1aP	Tipo 1bP
PISO 1	Δ1	3.55 mm	1.4((Δ1+Δ2)/2)	4.52 mm	OK	OK
	Δ2	2.90 mm	1.2((Δ1+Δ2)/2)	3.87 mm		

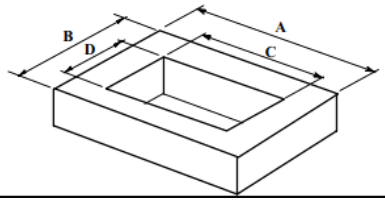
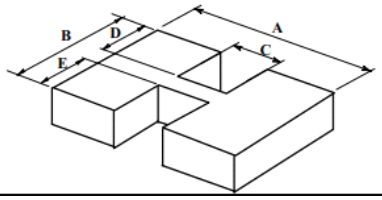
IRREGULARIDAD TORSIONAL - TIPO 1aP	IRREGULARIDAD TORSIONAL EXTREMA - TIPO 1bP
$\phi p = 0.90$	$\phi p = 0.80$
$1.4\left(\frac{\Delta 1+\Delta 2}{2}\right) \geq \Delta 1 > 1.2\left(\frac{\Delta 1+\Delta 2}{2}\right)$	$\Delta 1 > 1.4\left(\frac{\Delta 1+\Delta 2}{2}\right)$

SISMO Y					Tipo 1aP	Tipo 1bP
PISO 1	Δ1	10.13 mm	1.4((Δ1+Δ2)/2)	11.55 mm	NO CUMPLE, OP=0.9	OK
	Δ2	6.37 mm	1.2((Δ1+Δ2)/2)	9.90 mm		

Tipo 2P

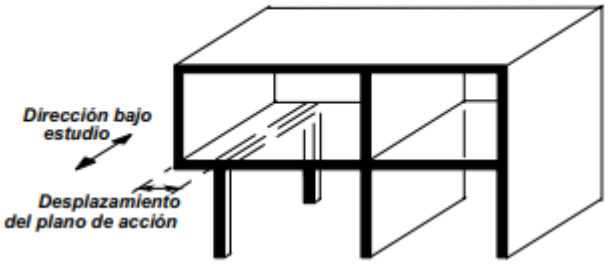
	RETROCESO EN LAS ESQUINAS - TIPO 2P			
	Φp=0.90			
NO APLICA				
	DATOS DE ENTRADA			
	A=	0	mm	STORY1
	B=	0	mm	
	C=	0	mm	
	D=	0	mm	
	A>0.15B	NO CUMPLE OP=1,0		
	C>0.15D	NO CUMPLE OP=1,0		

Tipo 3P

NO APLICA	IRREGULARIDAD DEL DIAFRAGMA - TIPO 3P				NO APLICA	IRREGULARIDAD DEL DIAFRAGMA - TIPO 3P			
	Φp=0.90					Φp=0.90			
	1) $C \times D > 0.5\,A \times B$					2) $(C \times D + C \times E) > 0.5\,A \times B$			
									
	DATOS DE ENTRADA					DATOS DE ENTRADA			
	A=	0	mm	STORY1		A=	0	mm	STORY1
	B=	0	mm			B=	0	mm	
	C=	0	mm			C=	0	mm	
	D=	0	mm			D=	0	mm	
						E=	0	mm	
	C*D=	0	0.5A*B=	0					
	iNO CUMPLE! OP=1.00					(C*D+C*E)=	0	0.5A*B=	0

Tipo 4P

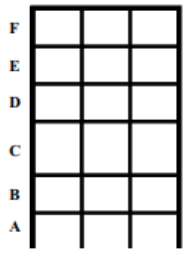
Tipo 4P — Desplazamiento de los planos de Acción — $\phi_p = 0.8$



No aplica

Irregularidades en altura

Tipo 1aA y 1bA

Tipo 1aA — Piso flexible $\phi_a = 0.9$ 0.60 Rigidez $K_D \leq$ Rigidez $K_C < 0.70$ Rigidez K_D o $0.70\ (K_D+K_E+K_F)/3 \leq$ Rigidez $K_C < 0.80\ (K_D+K_E+K_F)/3$	
Tipo 1bA — Piso flexible extremo $\phi_a = 0.8$ Rigidez $K_C < 0.60$ Rigidez K_D o Rigidez $K_C < 0.70\ (K_D+K_E+K_F)/3$	

No aplica.

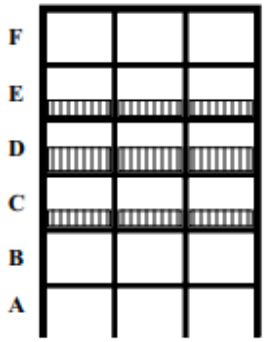
Tipo 2A

Tipo 2A — Distribución masa — $\phi_a = 0.9$

$m_D > 1.50\ m_E$

o

$m_D > 1.50\ m_C$

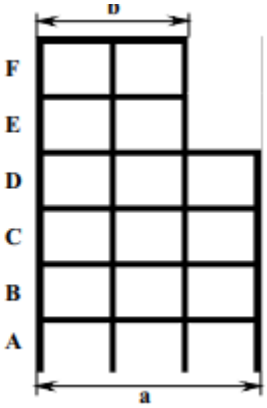


No aplica.

Tipo 3A

Tipo 3A — Geométrica — $\phi_a = 0.9$

$a > 1.30\ b$

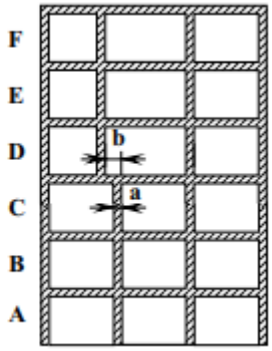


No Aplica

Tipo 4A

Tipo 4A — Desplazamiento dentro del plano de acción — $\phi_a = 0.8$

b > a



No aplica.

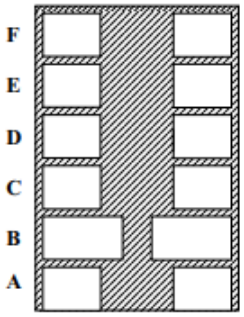
Tipo 5aA – Tipo 5bA

Tipo 5aA — Piso débil
$\phi_a = 0.9$

0.65 Resist. Piso C ≤ Resist. Piso B < 0.80 Resist. Piso C

Tipo 5bA — Piso débil extremo
$\phi_a = 0.8$

Resistencia Piso B < 0.65 Resistencia Piso C



No aplica

Ausencia de redundancia

Acorde a lo mencionado en el articulo A.3.3.8 de la norma NSR-10, se evalua que el factor de reducción por ausencia de redundancia será:

$$\emptyset rx = 1.00$$
$$\emptyset ry = 0.75$$

En conclusión, los factores de reducción de sismo quedan asi:

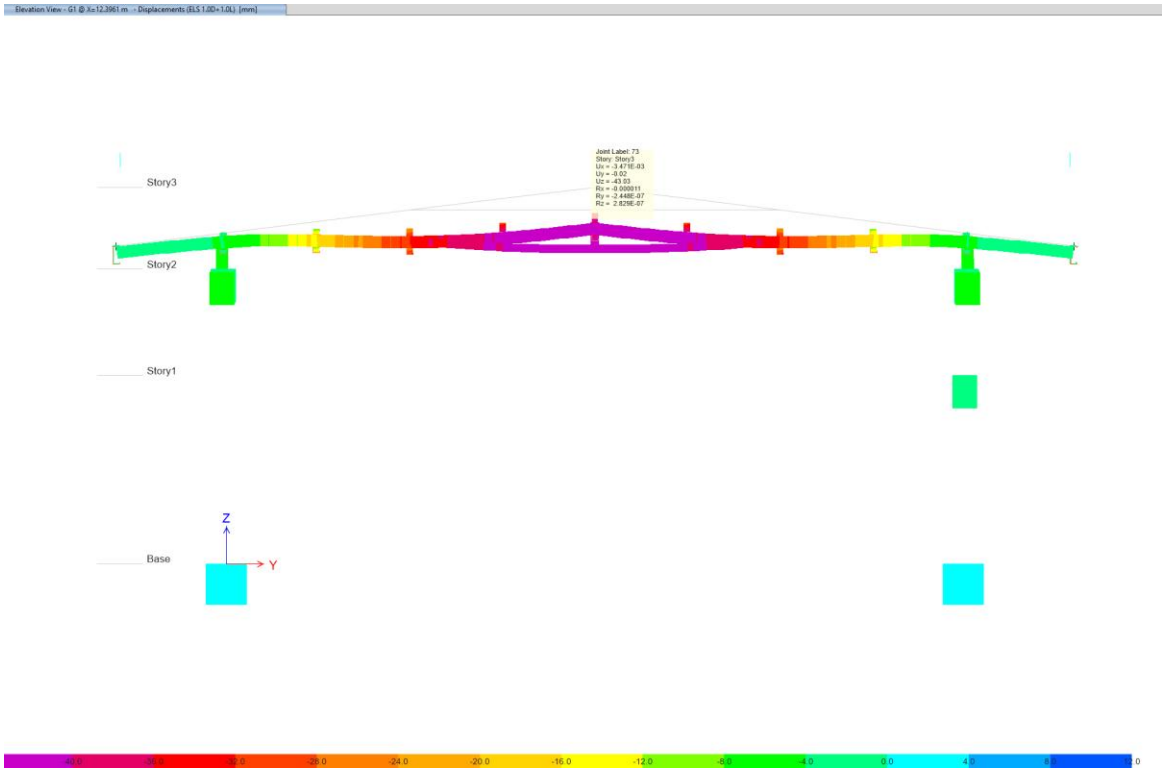
$$\emptyset a = 1.0$$
$$\emptyset px = 1.0$$
$$\emptyset py = 0.9$$
$$\emptyset rx = 1.0$$
$$\emptyset ry = 0.75$$

VERIFICACIÓN DE DEFLEXIONES

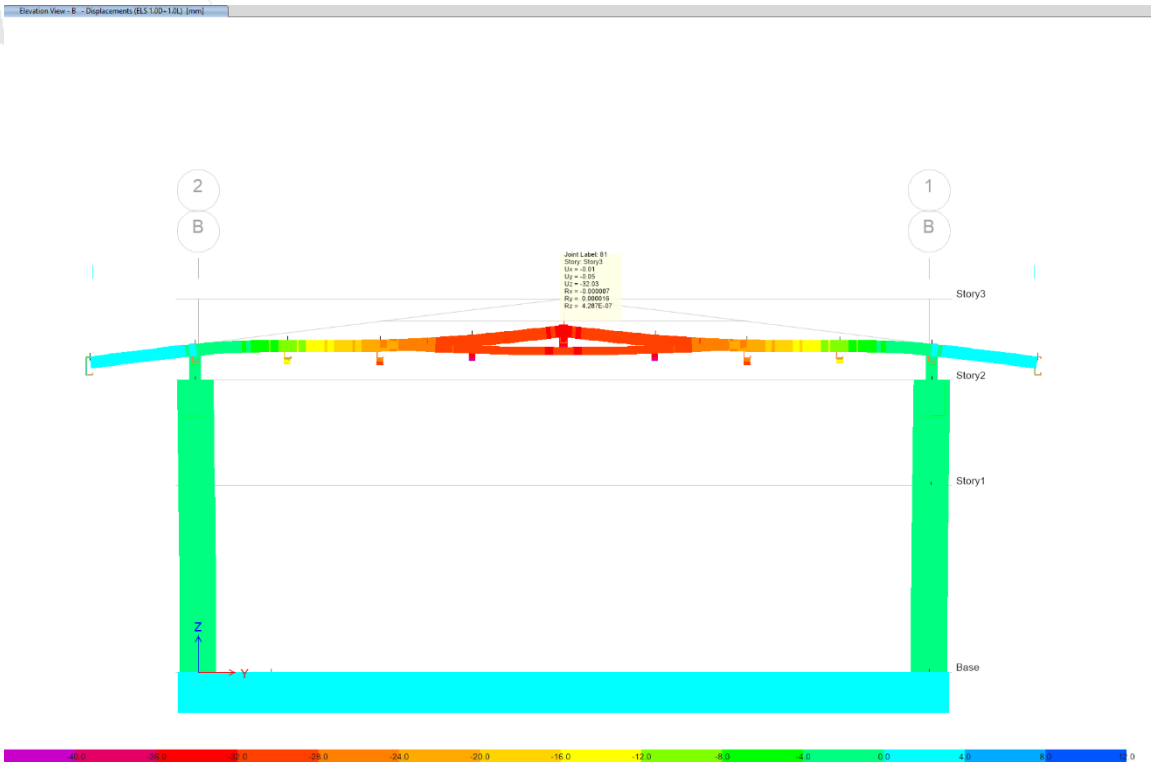
TABLA C.9.5(b) — Deflexión máxima admisible calculada

Tipo de elemento	Deflexión considerada	Límite de deflexión
Cubiertas planas que no soporten ni estén ligadas a elementos no estructurales susceptibles de sufrir daños debido a deflexiones grandes.	Deflexión inmediata debida a la carga viva, **L**	$\ell/180$ *
Entrepisos que no soporten ni estén ligados a elementos no estructurales susceptibles de sufrir daños debido a deflexiones grandes.	Deflexión inmediata debida a la carga viva, **L**	$\ell/360$
Sistema de entrepiso o cubierta que soporte o esté ligado a elementos no estructurales susceptibles de sufrir daños debido a deflexiones grandes.	La parte de la deflexión total que ocurre después de la unión de los elementos no estructurales (la suma de la deflexión a largo plazo debida a todas las cargas permanentes, y la deflexión inmediata debida a cualquier carga viva adicional)†	$\ell/480$ ‡
Sistema de entrepiso o cubierta que soporte o esté ligado a elementos no estructurales no susceptibles de sufrir daños debido a deflexiones grandes.		$\ell/240$§

$$\frac{l}{180} = \frac{9000mm}{180} = 50mm$$



Deflexión máxima por carga viva más carga muerta: 43.03 mm



Deflexión máxima por carga viva más carga muerta: 32.02 mm

DISEÑO DE ELEMENTOS ESTRUCTURALES

Verificados los chequeos de deflexiones y análisis, procedemos a reducir el sismo de acuerdo con el capitulo A3 de la norma NSR-10.

Acorde a lo mencionado en la descripción de la estructura y análisis de irregularidades,

$$\mathrm{Ro} = 5.00$$

$$\emptyset a = 1.0$$

$$\emptyset px = 1.0$$

$$\emptyset py = 0.9$$

$$\emptyset rx = 1.0$$

$$\emptyset ry = 0.75$$

$$Rx = Ro * \emptyset a * \emptyset p * \emptyset rx = 5.00$$

$$Ry = Ro * \emptyset a * \emptyset p * \emptyset ry = 3.375$$

Aplicados los valores de reducción en el sísmo procedemos a diseñar.

Diseño de elementos en concreto reforzado

Se aporta anexo donde se verifica el diseño estructural de los elementos tipo viga y columna.

Diseño de elementos metálicos en cubierta

Se aporta anexo donde se verifica el diseño estructural de los elementos tipo correa.

Diseño de elementos de cubierta

Story	Design Type	Design Section	PMM Combo	PMM Ratio	P Ratio	M Major Ratio	M Minor Ratio	V Major Ratio	V Minor Ratio
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.417	0.015	0.063	0.339	0.029	0.213
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.413	0.015	0.059	0.338	0.029	0.213
Story3	Column	TUB100X100X3	(T)	0.016	0.001	0.014	0.001	0.007	0.004
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.509	0.03	0.018	0.461	0.028	0.092
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.506	0.03	0.014	0.462	0.025	0.092
Story3	Column	TUB100X100X3	(T)	0.018	0.002	0.013	0.002	0.008	0.01
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.463	0.03	0.002	0.431	0.011	0.123
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.46	0.03	0.0003042	0.43	0.011	0.123
Story3	Column	TUB100X100X3	(T)	0.018	0.002	0.013	0.002	0.008	0.01
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.545	0.03	0.001	0.514	0.015	0.068
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.545	0.03	0.002	0.514	0.015	0.068
Story3	Column	TUB100X100X3	(T)	0.019	0.002	0.013	0.003	0.008	0.014
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.454	0.03	0	0.425	0.01	0.126
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.454	0.03	0	0.425	0.01	0.126
Story3	Column	TUB100X100X3	(T)	0.018	0.002	0.013	0.003	0.008	0.012
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.545	0.03	0.001	0.515	0.015	0.068
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.545	0.03	0.002	0.514	0.015	0.068
Story3	Column	TUB100X100X3	(T)	0.019	0.002	0.013	0.003	0.008	0.014
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.463	0.03	0.002	0.431	0.011	0.123
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.46	0.03	0.0003199	0.43	0.011	0.123
Story3	Column	TUB100X100X3	(T)	0.018	0.002	0.013	0.002	0.008	0.01
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.509	0.03	0.018	0.461	0.028	0.092
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.506	0.03	0.014	0.462	0.025	0.092
Story3	Column	TUB100X100X3	(T)	0.018	0.002	0.013	0.002	0.008	0.01
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.417	0.015	0.063	0.339	0.029	0.213
Story3	Column	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.413	0.015	0.059	0.338	0.029	0.213
Story3	Column	TUB100X100X3	(T)	0.016	0.001	0.014	0.001	0.007	0.004
Story3	Beam	TUB100X100X3	ELU 0.9D+1.6W2(C)	0.008	0.002	0.005	0.0003185	0.005	0.004

Story	Design Type	Design Section	PMM Combo	PMM Ratio	P Ratio	M Major Ratio	M Minor Ratio	V Major Ratio	V Minor Ratio
Story3	Beam	TUB100X100X3	ELU 0.9D+1.6W2(T)	0.096	0.006	0.001	0.089		
Story3	Beam	TUB100X100X3	ELU 0.9D+1.6W2(C)	0.008	0.002	0.005	0.00037	0.005	0.004
Story3	Beam	TUB100X100X3	ELU 0.9D+1.6W2(T)	0.096	0.006	0.001	0.089		
Story3	Beam	TUB 150X150X6MM	(T)	0.129	0.00034	0.123	0.006	0.019	0.001
Story3	Beam	TUB 150X150X6MM	(T)	0.127	0.00034	0.123	0.004	0.019	0.001
Story3	Beam	TUB100X100X3	(T)	0.606	0.349	0.255	0.002	0.01	0.004
Story3	Beam	TUB100X100X3	(T)	0.606	0.349	0.255	0.002	0.01	0.004
Story3	Beam	TUB 150X150X6MM	(T)	0.252	0.001	0.241	0.01	0.037	0.002
Story3	Beam	TUB 150X150X6MM	(T)	0.249	0.001	0.241	0.007	0.037	0.001
Story3	Beam	TUB100X100X3	(T)	0.53	0.303	0.226	0.001	0.009	0.004
Story3	Beam	TUB100X100X3	(T)	0.53	0.303	0.227	0.001	0.009	0.004
Story3	Beam	TUB 150X150X6MM	(T)	0.245	0.001	0.241	0.003	0.037	0.001
Story3	Beam	TUB 150X150X6MM	(T)	0.246	0.001	0.241	0.004	0.037	0.001
Story3	Beam	TUB100X100X3	(T)	0.631	0.369	0.261	0.0001827	0.01	0.004
Story3	Beam	TUB100X100X3	(T)	0.631	0.369	0.262	0.0002982	0.01	0.004
Story3	Beam	TUB 150X150X6MM	(T)	0.243	0.001	0.241	0.001	0.037	0.001
Story3	Beam	TUB 150X150X6MM	(T)	0.243	0.001	0.241	0.001	0.037	0.0004555
Story3	Beam	TUB100X100X3	(T)	0.525	0.3	0.225	0	0.009	0.004
Story3	Beam	TUB100X100X3	(T)	0.525	0.3	0.225	0	0.009	0.004
Story3	Beam	TUB 150X150X6MM	(T)	0.242	0.001	0.241	0	0.037	0.0002147
Story3	Beam	TUB 150X150X6MM	(T)	0.242	0.001	0.241	0	0.037	0.0002026
Story3	Beam	TUB100X100X3	(T)	0.631	0.37	0.262	0.0001821	0.01	0.004
Story3	Beam	TUB100X100X3	(T)	0.632	0.37	0.262	0.0002975	0.01	0.004
Story3	Beam	TUB 150X150X6MM	(T)	0.243	0.001	0.241	0.001	0.037	0.001
Story3	Beam	TUB 150X150X6MM	(T)	0.243	0.001	0.241	0.001	0.037	0.0004553
Story3	Beam	TUB100X100X3	(T)	0.53	0.303	0.226	0.001	0.009	0.004
Story3	Beam	TUB100X100X3	(T)	0.531	0.303	0.227	0.001	0.009	0.004
Story3	Beam	TUB 150X150X6MM	(T)	0.245	0.001	0.241	0.003	0.037	0.001
Story3	Beam	TUB 150X150X6MM	(T)	0.246	0.001	0.241	0.004	0.037	0.001
Story3	Beam	TUB100X100X3	(T)	0.606	0.349	0.255	0.002	0.01	0.004
Story3	Beam	TUB100X100X3	(T)	0.606	0.349	0.255	0.002	0.01	0.004
Story3	Beam	TUB 150X150X6MM	(T)	0.252	0.001	0.241	0.01	0.037	0.002
Story3	Beam	TUB 150X150X6MM	(T)	0.249	0.001	0.241	0.007	0.037	0.001
Story3	Beam	TUB100X100X3	ELU 0.9D+1.6W2(C)	0.008	0.002	0.005	0.0003185	0.005	0.004

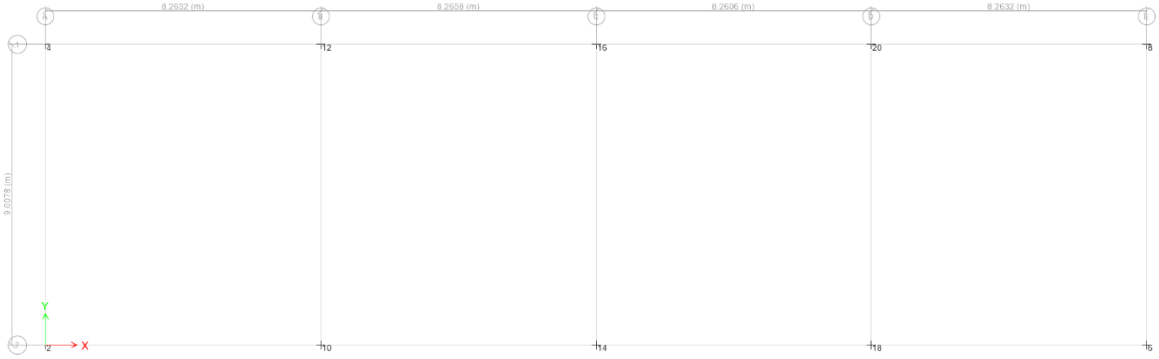
Story	Design Type	Design Section	PMM Combo	PMM Ratio	P Ratio	M Major Ratio	M Minor Ratio	V Major Ratio	V Minor Ratio
Story3	Beam	TUB100X100X3	ELU 0.9D+1.6W2(T)	0.096	0.006	0.001	0.089		
Story3	Beam	TUB100X100X3	ELU 0.9D+1.6W2(C)	0.008	0.002	0.005	0.0003701	0.005	0.004
Story3	Beam	TUB100X100X3	ELU 0.9D+1.6W2(T)	0.096	0.006	0.001	0.089		
Story3	Beam	TUB 150X150X6MM	(T)	0.129	0.00034	0.123	0.006	0.019	0.001
Story3	Beam	TUB 150X150X6MM	(T)	0.127	0.00034	0.123	0.004	0.019	0.001
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.369	0.048	0.281	0.04	0.042	0.015
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.143	0.047	0.092	0.004	0.023	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.369	0.048	0.282	0.04	0.042	0.015
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.143	0.047	0.092	0.004	0.023	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.815	0.023	0.778	0.013	0.12	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.42	0.022	0.395	0.003	0.083	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.816	0.023	0.779	0.014	0.12	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.42	0.022	0.395	0.003	0.083	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.817	0.03	0.785	0.002	0.116	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.374	0.029	0.344	0.001	0.079	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.814	0.03	0.784	0	0.116	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.375	0.029	0.345	0.001	0.079	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.82	0.018	0.802	0.0002381	0.123	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.423	0.017	0.406	0	0.086	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.819	0.018	0.801	0.0002739	0.123	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.423	0.017	0.406	0.00024	0.086	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.813	0.031	0.783	0	0.116	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.372	0.03	0.342	0	0.079	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.813	0.031	0.782	0	0.116	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.372	0.03	0.342	0	0.079	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.82	0.018	0.802	0.0002416	0.123	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.423	0.017	0.406	0	0.086	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.82	0.018	0.801	0.0002693	0.123	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.424	0.017	0.406	0.0002389	0.086	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.817	0.03	0.786	0.002	0.116	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.374	0.029	0.344	0.001	0.079	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.814	0.03	0.784	0	0.116	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.375	0.029	0.345	0.001	0.079	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.815	0.023	0.778	0.013	0.12	0.011

Story	Design Type	Design Section	PMM Combo	PMM Ratio	P Ratio	M Major Ratio	M Minor Ratio	V Major Ratio	V Minor Ratio
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.42	0.022	0.395	0.003	0.083	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.816	0.023	0.779	0.014	0.12	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.42	0.022	0.395	0.003	0.083	0.011
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.369	0.048	0.281	0.04	0.042	0.015
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.143	0.047	0.092	0.004	0.023	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.369	0.048	0.282	0.04	0.042	0.015
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.143	0.047	0.092	0.004	0.023	0.01
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.0L-1.0SX-0.3SY(C)	0.164	0.035	0.058	0.071	0.002	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.0L-1.0SX-0.3SY(C)	0.164	0.035	0.012	0.117	0.018	0.008
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.0L-1.0SX-0.3SY(C)	0.164	0.035	0.057	0.071	0.002	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.0L-1.0SX-0.3SY(C)	0.164	0.035	0.012	0.117	0.018	0.008
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.519	0.219	0.298	0.002	0.003	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.508	0.217	0.289	0.002	0.039	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.519	0.219	0.298	0.002	0.003	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.508	0.217	0.288	0.002	0.039	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.473	0.209	0.263	0.001	0.002	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.471	0.207	0.263	0.001	0.037	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.473	0.209	0.263	0.001	0.002	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.471	0.207	0.263	0.001	0.037	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.525	0.219	0.306	0	0.003	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.514	0.217	0.297	0.001	0.039	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.526	0.219	0.307	0.0001523	0.003	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.515	0.217	0.297	0.001	0.039	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.47	0.209	0.261	0	0.002	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.468	0.207	0.261	0	0.037	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.47	0.209	0.261	0	0.002	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.468	0.207	0.261	0	0.037	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.526	0.219	0.307	0	0.003	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.515	0.217	0.297	0.001	0.039	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.526	0.219	0.307	0.0001515	0.003	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.515	0.217	0.297	0.001	0.04	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.473	0.209	0.263	0.001	0.002	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.471	0.207	0.263	0.001	0.037	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.473	0.209	0.263	0.001	0.002	0.009

Story	Design Type	Design Section	PMM Combo	PMM Ratio	P Ratio	M Major Ratio	M Minor Ratio	V Major Ratio	V Minor Ratio
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.471	0.207	0.263	0.001	0.037	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.519	0.219	0.298	0.002	0.003	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.508	0.217	0.289	0.002	0.039	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.519	0.219	0.298	0.002	0.003	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.6W1+1.0L(C)	0.508	0.217	0.288	0.002	0.039	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.0L-1.0SX-0.3SY(C)	0.164	0.035	0.058	0.071	0.002	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.0L-1.0SX-0.3SY(C)	0.164	0.035	0.012	0.117	0.018	0.008
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.0L-1.0SX-0.3SY(C)	0.164	0.035	0.057	0.071	0.002	0.009
Story3	Beam	TUB 150X150X6MM	ELU 1.2D+1.0L-1.0SX-0.3SY(C)	0.164	0.035	0.012	0.117	0.018	0.008

Diseño de elementos de cimentación.

Cargas en la base para diseño de cimentaciones.



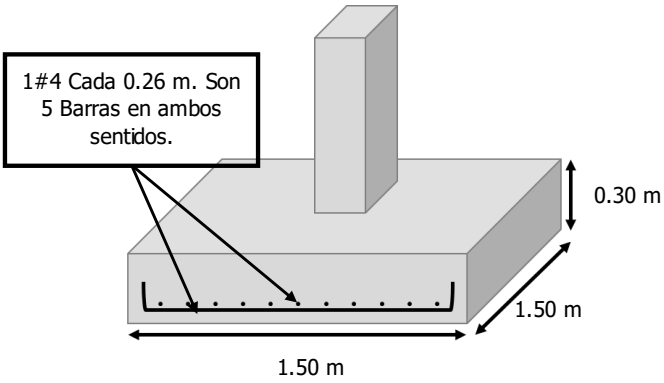
Story	Unique Name	Output Case	Case Type	Step Type	FZ	MX	MY
					tonf	tonf-m	tonf-m
Base	2	Live	LinStatic		1.31	0.09	0.49
Base	2	SX	LinRespSpec	Max	0.20	0.05	1.49
Base	2	SY	LinRespSpec	Max	0.25	2.27	0.03
Base	2	W1	LinStatic		1.31	0.09	0.49
Base	2	W2	LinStatic		-1.05	-0.07	-0.39
Base	2	CIM 1.0D	Combination		6.51	-0.59	1.45
Base	4	Live	LinStatic		1.32	-0.04	0.17
Base	4	SX	LinRespSpec	Max	0.30	0.05	1.49
Base	4	SY	LinRespSpec	Max	0.25	2.30	0.01
Base	4	W1	LinStatic		1.32	-0.04	0.17

Story	Unique Name	Output Case	Case Type	Step Type	FZ	MX	MY
					tonf	tonf-m	tonf-m
Base	4	W2	LinStatic		-1.06	0.03	-0.13
Base	4	CIM 1.0D	Combination		7.63	0.68	0.85
Base	6	Live	LinStatic		1.31	0.09	-0.49
Base	6	SX	LinRespSpec	Max	0.20	0.05	1.49
Base	6	SY	LinRespSpec	Max	0.25	2.27	0.03
Base	6	W1	LinStatic		1.31	0.09	-0.49
Base	6	W2	LinStatic		-1.05	-0.07	0.39
Base	6	CIM 1.0D	Combination		6.51	-0.59	-1.45
Base	8	Live	LinStatic		1.32	-0.04	-0.17
Base	8	SX	LinRespSpec	Max	0.30	0.05	1.49
Base	8	SY	LinRespSpec	Max	0.25	2.31	0.01
Base	8	W1	LinStatic		1.32	-0.04	-0.17
Base	8	W2	LinStatic		-1.06	0.03	0.13
Base	8	CIM 1.0D	Combination		7.63	0.68	-0.85
Base	10	Live	LinStatic		2.78	-3.80	-0.12
Base	10	SX	LinRespSpec	Max	0.01	0.04	4.98
Base	10	SY	LinRespSpec	Max	0.15	6.48	0.02
Base	10	W1	LinStatic		2.78	-3.80	-0.12
Base	10	W2	LinStatic		-2.22	3.04	0.10
Base	10	CIM 1.0D	Combination		9.97	-6.98	-0.36
Base	12	Live	LinStatic		2.77	3.74	0.15
Base	12	SX	LinRespSpec	Max	0.01	0.04	5.10
Base	12	SY	LinRespSpec	Max	0.15	6.64	0.02
Base	12	W1	LinStatic		2.77	3.74	0.15
Base	12	W2	LinStatic		-2.21	-2.99	-0.12
Base	12	CIM 1.0D	Combination		12.14	6.87	0.42
Base	14	Live	LinStatic		2.73	-3.70	0.00
Base	14	SX	LinRespSpec	Max	0.00	0.00	4.96
Base	14	SY	LinRespSpec	Max	0.17	7.42	0.00
Base	14	W1	LinStatic		2.73	-3.70	0.00
Base	14	W2	LinStatic		-2.18	2.96	0.00
Base	14	CIM 1.0D	Combination		9.82	-6.77	0.00
Base	16	Live	LinStatic		2.74	3.69	0.00

Story	Unique Name	Output Case	Case Type	Step Type	FZ	MX	MY
					tonf	tonf-m	tonf-m
Base	16	SX	LinRespSpec	Max	0.00	0.00	5.05
Base	16	SY	LinRespSpec	Max	0.17	7.60	0.00
Base	16	W1	LinStatic		2.74	3.69	0.00
Base	16	W2	LinStatic		-2.19	-2.95	0.00
Base	16	CIM 1.0D	Combination		12.04	6.75	0.00
Base	18	Live	LinStatic		2.78	-3.80	0.12
Base	18	SX	LinRespSpec	Max	0.01	0.04	4.98
Base	18	SY	LinRespSpec	Max	0.15	6.47	0.02
Base	18	W1	LinStatic		2.78	-3.80	0.12
Base	18	W2	LinStatic		-2.22	3.04	-0.10
Base	18	CIM 1.0D	Combination		9.97	-6.98	0.37
Base	20	Live	LinStatic		2.77	3.73	-0.15
Base	20	SX	LinRespSpec	Max	0.01	0.04	5.10
Base	20	SY	LinRespSpec	Max	0.15	6.63	0.02
Base	20	W1	LinStatic		2.77	3.73	-0.15
Base	20	W2	LinStatic		-2.21	-2.99	0.12
Base	20	CIM 1.0D	Combination		12.14	6.86	-0.41

DISEÑO ESTRUCTURAL DE ZAPATA AISLADA CUADRADA - ZAPATAS EJES A y E

DIMENSIONES DE COLUMNA	
Base	0.45 m
Largo	0.45 m
CARGAS DE DISEÑO	
C. Muerta CM:	13.07 Ton
C. Viva CV:	2.64 Ton
Momento MX:	2.31 Ton-m
Momento MY:	1.49 Ton-m
PRESIÓN ADMISIBLE DEL TERRENO	
Capacidad Portante:	15.00 Ton/m2
MATERIALES	
Concreto:	21.00 MPa
Acero de Refuerzo:	420.00 MPa



REVISIÓN DE LA PRESIÓN DE CONTACTO

$Pu = 1.2CM + 1.6CV =$	19.92 Ton
$\emptyset * 0.85 * f'c * A1 =$	2349.51 Ton
$Pu \leq \emptyset 0.85 * f'c * A1$	**¡CUMPLE!**
$Ps = Cm + Cv =$	15.72 Ton

No se necesita pedestal. El área de acero pasante será la mínima (0.005Ag) y no se requiere fuerza adicional proporcionada por el refuerzo para la transferencia de la carga.

CÁLCULO DE LAS EXCENTRICIDADES

$e_x = \frac{My}{Ps} =$ 0.09 m $\qquad e_y = \frac{Mx}{Ps} =$ 0.15 m

CÁLCULO DE LA PRESIÓN ÚLTIMA DEL TERRENO

La zapata se dimensiona de tal manera que no se sobrepase el esfuerzo admisible del suelo, pero igualmente que tampoco se presenten esfuerzos negativos en la zapata. Para esto, se presta especial atención a los puntos 1 y 3. El máximo esfuerzo se presenta para el punto 3 y el mínimo para el punto 1 y se calculan como:

$$\sigma_1 = \frac{P}{BH}\left(1 - \frac{6e_x}{H} - \frac{6e_Y}{B}\right) \geq 0 \qquad \sigma_2 = \frac{P}{BH}\left(1 - \frac{6e_x}{H} + \frac{6e_Y}{B}\right) \qquad \sigma_3 = \frac{P}{BH}\left(1 + \frac{6e_x}{H} + \frac{6e_Y}{B}\right) \leq \sigma_{adm}$$

$$\sigma_4 = \frac{P}{BH}\left(1 + \frac{6e_x}{H} - \frac{6e_Y}{B}\right)$$

Lado H=	1.50 m
Lado B=	1.50 m

$\overline{I_X}$	$\overline{I_Y}$	σ_1	σ_2	σ_3	σ_4
0.42 m4	0.42 m4	0.23 Ton-m2	8.44 Ton-m2	13.74 Ton-m2	5.53 Ton-m2
		¡CUMPLE!		**¡CUMPLE!**	

Altura h' asumida para la zapata:	0.30 m
Altura efectiva d:	0.22 m

$A.Z. = \frac{P.S.}{q_u} =$ 1.05 m $\quad \sigma_{ult} = \frac{Pu}{AZ} =$ 8.85 Ton/m2

VERIFICACIÓN DE LAS EXCENTRICIDADES

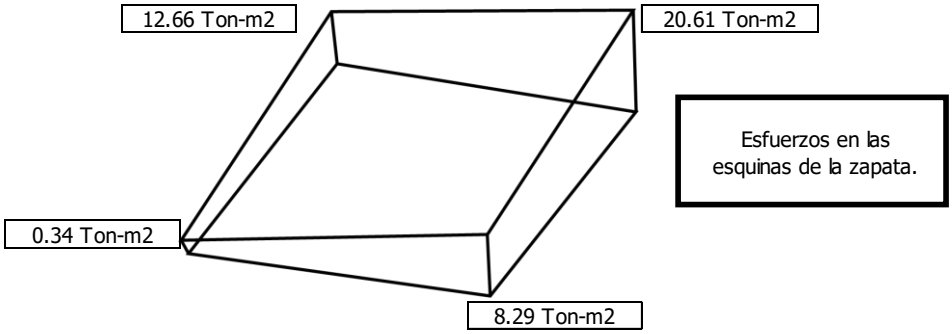
$e_x \leq \frac{H}{6} =$ 0.25 m **¡CUMPLE!**

$e_Y \leq \frac{B}{6} =$ 0.25 m **¡CUMPLE!**

Cálculo de los esfuerzos últimos sobre la zapata. Se asume un coeficiente de mayoración de 1.5 para Ps.

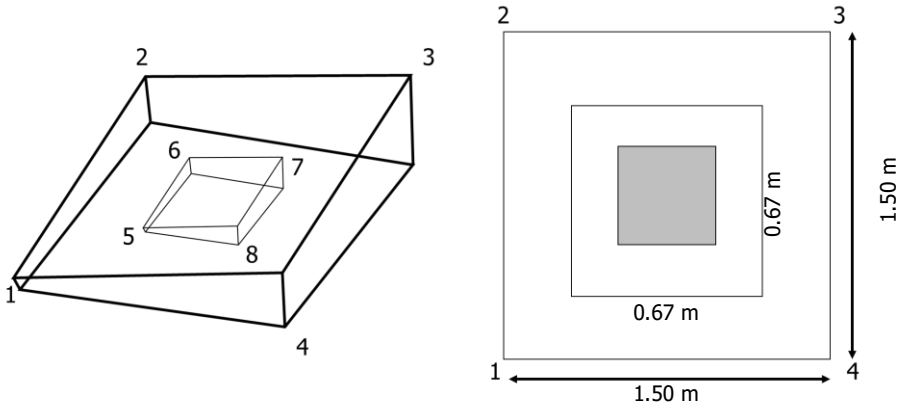
$1.5Ps =$ 23.57 Ton

σ_1	σ_2	σ_3	σ_4
0.34 Ton-m2	12.66 Ton-m2	20.61 Ton-m2	8.29 Ton-m2



CORTANTE EN DOS DIRECCIONES

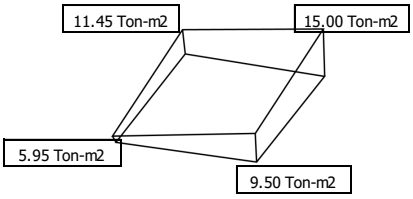
El cortante se evalua a una distancia d/2 de la cara de la columna.



Para esto se deben calcular los esfuerzo en los puntos 5, 6, 7 y 8. Estos esfuerzos pueden calcularse directamente por medio de:

$$\sigma = \frac{Pu}{A} \pm \frac{M_{uy}L_x}{I_y} \pm \frac{M_{ux}L_y}{I_x}$$

σ_5	σ_6	σ_7	σ_8
5.95 Ton-m2	11.45 Ton-m2	15.00 Ton-m2	9.50 Ton-m2



VERIFICACIÓN DEL ESPESOR ASUMIDO

$Vu = Pu - \sigma A =$ 18.87 Ton

$b_0 = 2(h+d) + 2(b+d) =$ 268.00 cm

$$d1 = \frac{Vu}{0.75 * 0.17 * \left(1 + \frac{2}{\beta}\right) * \lambda * \sqrt{f'c} * b_0} = 4.02 \text{ cm}$$

$d > d1$ **¡CUMPLE!**

$$d2 = \frac{Vu}{0.75 * 0.083 * \left(\frac{\alpha_s * d_2}{b_0} + 2\right) * \lambda * \sqrt{f'c} * b_0} = 4.29 \text{ cm}$$

$d > d2$ **¡CUMPLE!**

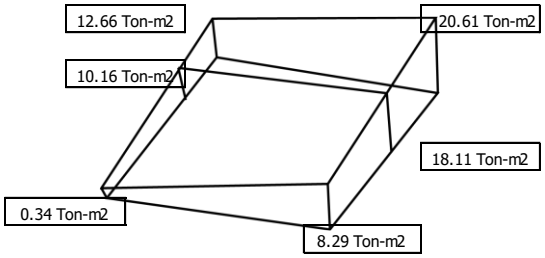
$$d3 = \frac{Vu}{0.75 * 0.33 * \lambda * \sqrt{f'c} * b_0} = 6.21 \text{ cm}$$

$d > d3$ **¡CUMPLE!**

CORTANTE EN UNA DIRECCIÓN

Se analiza el cortante en la dirección paralela a la que se presentan los esfuerzos mayores (2-3). El cortante se evalua a una distancia *d* de la cara de la columna.

σ_1	σ_2	σ_3	σ_4	σ_{1-2}	σ_{3-4}
0.34 Ton-m2	12.66 Ton-m2	20.61 Ton-m2	8.29 Ton-m2	10.16 Ton-m2	18.11 Ton-m2



$Vu = \sigma_{ult} * A =$ 7.04 Ton

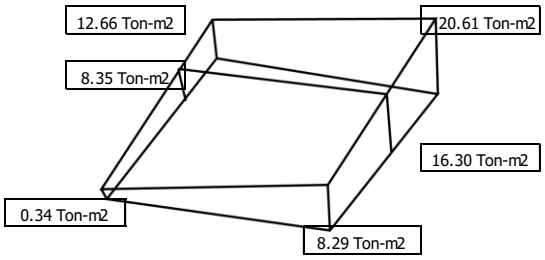
$$d \geq \frac{Vu}{0.75 * 0.17 * \lambda * \sqrt{f'c} * B} = 8.03 \text{ cm}$$

¡CUMPLE!

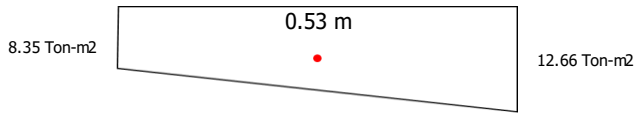
DISEÑO A FLEXIÓN

Se diseña para la sección más cargada, o sea para una linea paralela a 2-3 pasando por la cara de la columna.

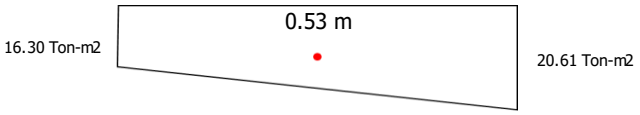
σ_1	σ_2	σ_3	σ_4	σ_{1-2}	σ_{3-4}
0.34 Ton-m2	12.66 Ton-m2	20.61 Ton-m2	8.29 Ton-m2	8.35 Ton-m2	16.30 Ton-m2



$Vu = \sigma_{ult} * A =$ 11.40 Ton



$\bar{X}_1 =$ 0.28 m



$\bar{X}_2 =$ 0.27 m

$\bar{X}_{PROMEDIO} =$ 0.28 m

$Mu = Vu * \bar{X}_{PROMEDIO} =$ 3.15 Ton-m

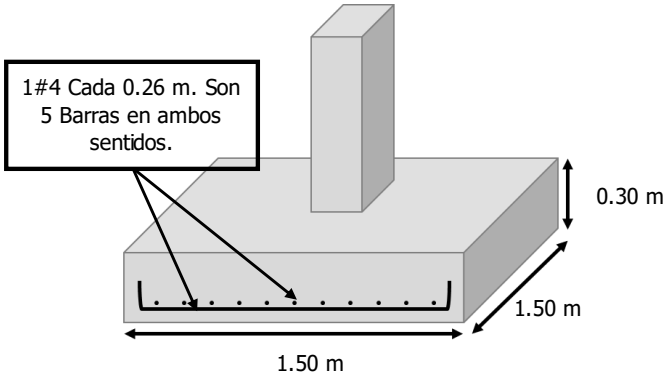
$$Rn = \frac{Mu}{0.9 * b * d^2} = 0.48 \text{ N/mm2}$$

$$\rho = \frac{0.85 * f'c}{fy} * \left(1 - \sqrt{1 - \frac{2 * Rn}{0.85 * f'c}}\right) = 0.0012$$

$As = \rho * b * d =$ 5.94 cm2

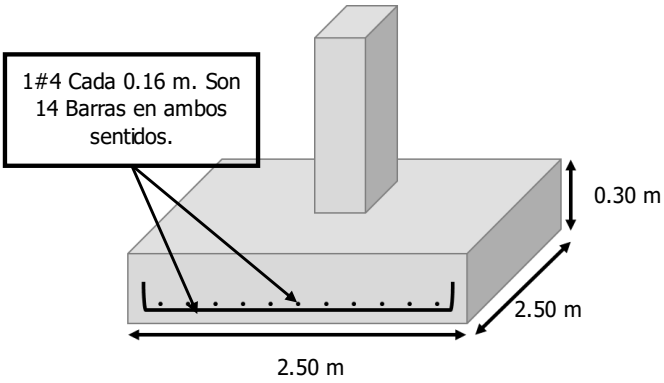
$\rho min =$ 0.0018

Ref. Barra	Área	N° de Barras	Separación
#4	1.29 cm2	5	0.26 m



DISEÑO ESTRUCTURAL DE ZAPATA AISLADA CUADRADA - ZAPATAS EJES B, C y D

DIMENSIONES DE COLUMNA	
Base	0.70 m
Largo	0.45 m
CARGAS DE DISEÑO	
C. Muerta CM:	26.55 Ton
C. Viva CV:	5.56 Ton
Momento MX:	7.60 Ton-m
Momento MY:	5.10 Ton-m
PRESIÓN ADMISIBLE DEL TERRENO	
Capacidad Portante:	15.00 Ton/m2
MATERIALES	
Concreto:	21.00 MPa
Acero de Refuerzo:	420.00 MPa



REVISIÓN DE LA PRESIÓN DE CONTACTO

$Pu = 1.2CM + 1.6CV =$	40.75 Ton
$\emptyset * 0.85 * f'c * A1 =$	3654.79 Ton
$Pu \leq \emptyset 0.85 * f'c * A1$	**¡CUMPLE!**
$Ps = Cm + Cv =$	32.11 Ton

No se necesita pedestal. El área de acero pasante será la mínima (0.005Ag) y no se requiere fuerza adicional proporcionada por el refuerzo para la transferencia de la carga.

CÁLCULO DE LAS EXCENTRICIDADES

$e_x = \frac{My}{Ps} =$ 0.16 m $\qquad e_y = \frac{Mx}{Ps} =$ 0.24 m

CÁLCULO DE LA PRESIÓN ÚLTIMA DEL TERRENO

La zapata se dimensiona de tal manera que no se sobrepase el esfuerzo admisible del suelo, pero igualmente que tampoco se presenten esfuerzos negativos en la zapata. Para esto, se presta especial atención a los puntos 1 y 3. El máximo esfuerzo se presenta para el punto 3 y el mínimo para el punto 1 y se calculan como:

$$\sigma_1 = \frac{P}{BH}\left(1 - \frac{6e_x}{H} - \frac{6e_Y}{B}\right) \geq 0 \qquad \sigma_2 = \frac{P}{BH}\left(1 - \frac{6e_x}{H} + \frac{6e_Y}{B}\right) \qquad \sigma_3 = \frac{P}{BH}\left(1 + \frac{6e_x}{H} + \frac{6e_Y}{B}\right) \leq \sigma_{adm}$$

$$\sigma_4 = \frac{P}{BH}\left(1 + \frac{6e_x}{H} - \frac{6e_Y}{B}\right)$$

Lado H=	2.50 m
Lado B=	2.50 m

$\overline{I_X}$	$\overline{I_Y}$	σ_1	σ_2	σ_3	σ_4
3.26 m4	3.26 m4	0.26 Ton-m2	6.10 Ton-m2	10.01 Ton-m2	4.18 Ton-m2
		¡CUMPLE!		**¡CUMPLE!**	

Altura h' asumida para la zapata:	0.30 m
Altura efectiva d:	0.22 m

$A.Z. = \frac{P.S.}{q_u} =$ 2.14 m $\quad \sigma_{ult} = \frac{Pu}{AZ} =$ 6.52 Ton/m2

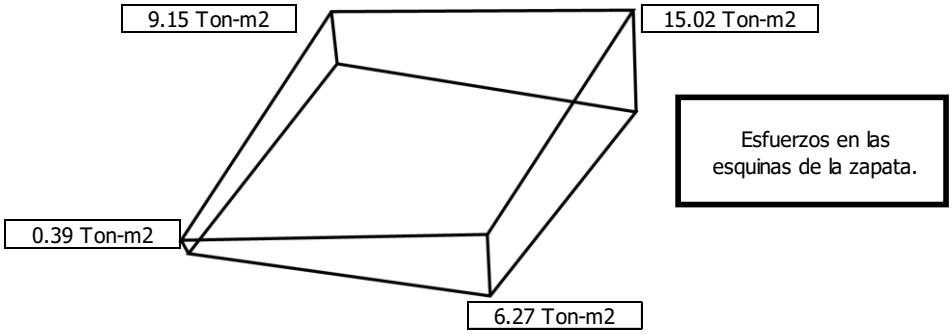
VERIFICACIÓN DE LAS EXCENTRICIDADES

$e_x \leq \frac{H}{6} =$ 0.42 m **¡CUMPLE!** $e_Y \leq \frac{B}{6} =$ 0.42 m **¡CUMPLE!**

Cálculo de los esfuerzos últimos sobre la zapata. Se asume un coeficiente de mayoración de 1.5 para Ps.

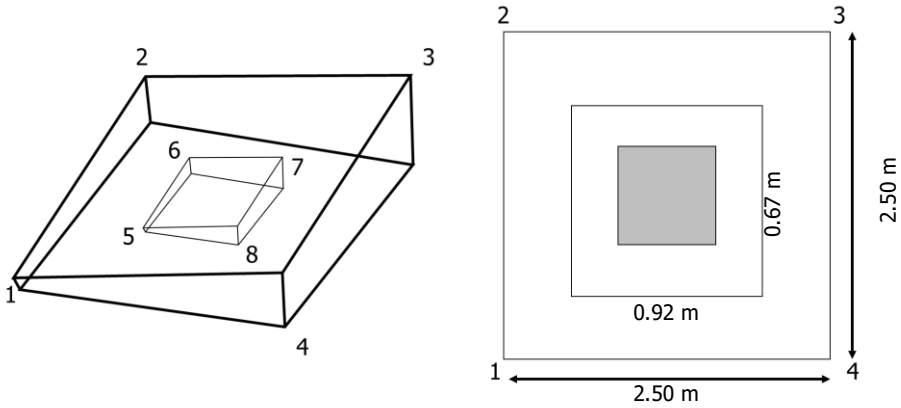
$1.5Ps =$	48.16 Ton

σ_1	σ_2	σ_3	σ_4
0.39 Ton-m2	9.15 Ton-m2	15.02 Ton-m2	6.27 Ton-m2



CORTANTE EN DOS DIRECCIONES

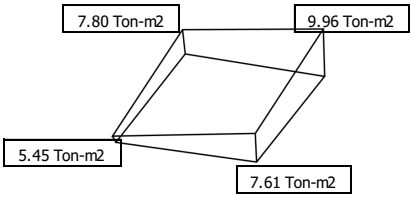
El cortante se evalua a una distancia d/2 de la cara de la columna.



Para esto se deben calcular los esfuerzo en los puntos 5, 6, 7 y 8. Estos esfuerzos pueden calcularse directamente por medio de:

$$\sigma = \frac{Pu}{A} \pm \frac{M_{uy}L_x}{I_y} \pm \frac{M_{ux}L_y}{I_x}$$

σ_5	σ_6	σ_7	σ_8
5.45 Ton-m2	7.80 Ton-m2	9.96 Ton-m2	7.61 Ton-m2



VERIFICACIÓN DEL ESPESOR ASUMIDO

$Vu = Pu - \sigma A =$ 43.41 Ton

$b_0 = 2(h+d) + 2(b+d) =$ 318.00 cm

$$d1 = \frac{Vu}{0.75 * 0.17 * \left(1 + \frac{2}{\beta}\right) * \lambda * \sqrt{f'c} * b_0} = 7.79 \text{ cm}$$

$d > d1$ **¡CUMPLE!**

$$d2 = \frac{Vu}{0.75 * 0.083 * \left(\frac{\alpha_s * d_2}{b_0} + 2\right) * \lambda * \sqrt{f'c} * b_0} = 8.32 \text{ cm}$$

$d > d2$ **¡CUMPLE!**

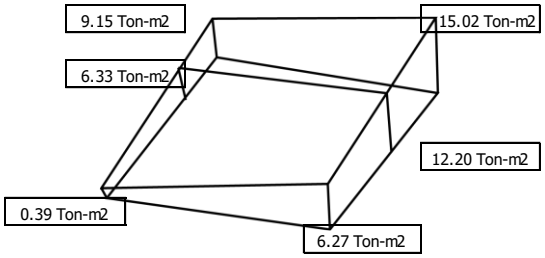
$$d3 = \frac{Vu}{0.75 * 0.33 * \lambda * \sqrt{f'c} * b_0} = 12.04 \text{ cm}$$

$d > d3$ **¡CUMPLE!**

CORTANTE EN UNA DIRECCIÓN

Se analiza el cortante en la dirección paralela a la que se presentan los esfuerzos mayores (2-3). El cortante se evalua a una distancia *d* de la cara de la columna.

σ_1	σ_2	σ_3	σ_4	σ_{1-2}	σ_{3-4}
0.39 Ton-m2	9.15 Ton-m2	15.02 Ton-m2	6.27 Ton-m2	6.33 Ton-m2	12.20 Ton-m2



$Vu = \sigma_{ult} * A =$ 21.48 Ton

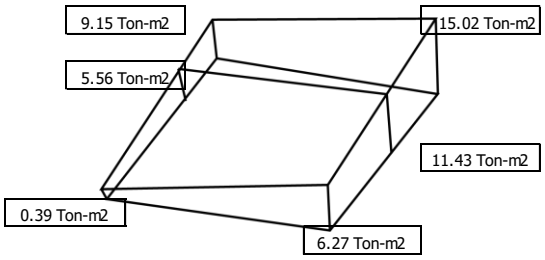
$$d \geq \frac{Vu}{0.75 * 0.17 * \lambda * \sqrt{f'c} * B} = 14.71 \text{ cm}$$

¡CUMPLE!

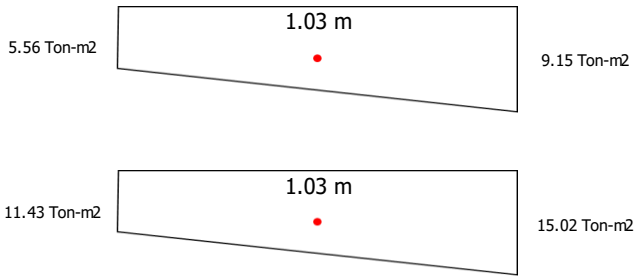
DISEÑO A FLEXIÓN

Se diseña para la sección más cargada, o sea para una linea paralela a 2-3 pasando por la cara de la columna.

σ_1	σ_2	σ_3	σ_4	σ_{1-2}	σ_{3-4}
0.39 Ton-m2	9.15 Ton-m2	15.02 Ton-m2	6.27 Ton-m2	5.56 Ton-m2	11.43 Ton-m2



$Vu = \sigma_{ult} * A =$ 26.36 Ton



$\bar{X}_1 =$	0.55 m
$\bar{X}_2 =$	0.54 m

$\bar{X}_{PROMEDIO} =$	0.54 m
$Mu = Vu * \bar{X}_{PROMEDIO} =$	14.37 Ton-m

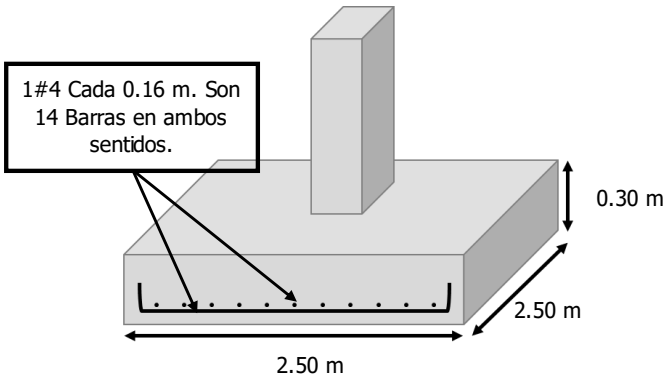
$$Rn = \frac{Mu}{0.9 * b * d^2} = 1.32 \text{ N/mm2}$$

$$\rho = \frac{0.85 * f'c}{fy} * \left(1 - \sqrt{1 - \frac{2 * Rn}{0.85 * f'c}}\right) = 0.0033$$

$As = \rho * b * d =$	17.97 cm2

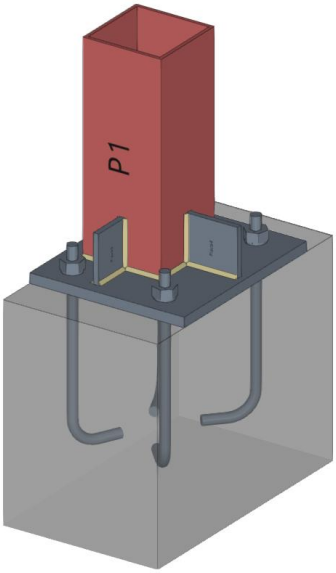
$\rho min =$	0.0018

Ref. Barra	Área	N° de Barras	Separación
#4	1.29 cm2	14	0.16 m

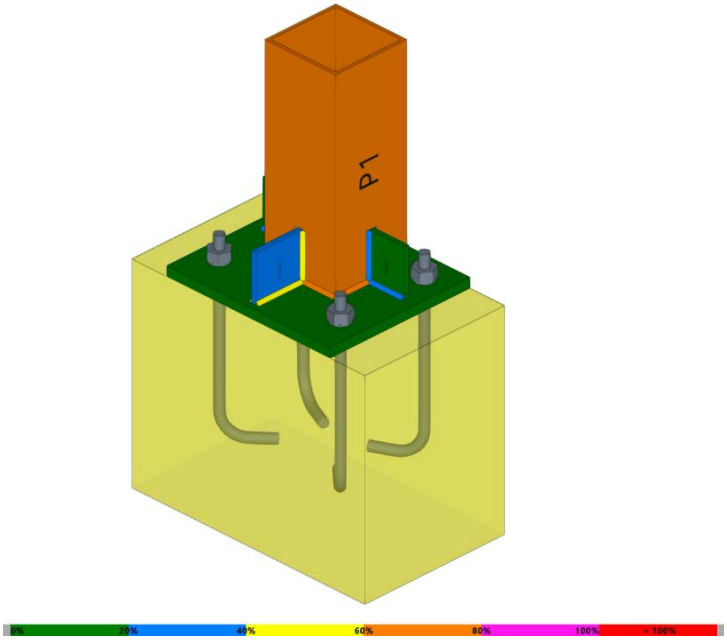


DISEÑO DE PLACA BASE

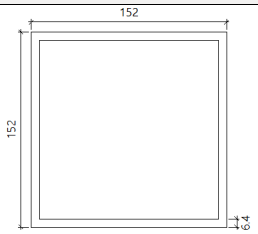
Modelo



Verificación de elementos



1. COMPONENTES DE LA UNIÓN

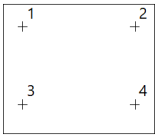
Perfiles de acero					
Elemento	Descripción	Geometría	Acero		
			Tipo	f_y (MPa)	f_u (MPa)
P1	HSS150X150X6		A36	248.30	400.03

Placas					
Elemento	Material	Espesor (mm)	Taladros (mm)	Área (mm^2)	Peso (kg)
Placa1	A36	19.0	4 x 21.10	105000.00	15.66
Placa2	A36	10.0	--	7500.00	0.59
Placa4	A36	10.0	--	10000.00	0.79
Placa5	A36	10.0	--	2500.00	0.20
Placa3	A36	10.0	--	7500.00	0.59

Cordones de soldadura							
Elemento	Tipo	Electrodo	a (mm)	z (mm)	l (mm)	t (mm)	Ángulo (°)
Ajuste1 - Ala Sup. Ajuste1 - Ala Sup. - Trasero Ajuste1 - Ala inf. Ajuste1 - Ala inf. - Trasero Ajuste1 - Alma izq. Ajuste1 - Alma der.	Soldadura en ángulo	E70XX	4.2	6.0	152.0	6.4	90.0
Ajuste1 - Alma izq. - Trasero Ajuste1 - Alma der. - Trasero	Soldadura en ángulo	E70XX	4.2	6.0	139.2	6.4	90.0
Soldadura1 - Frontal Soldadura1 - Trasero Soldadura5 - Frontal Soldadura5 - Trasero Soldadura7 - Frontal Soldadura7 - Trasero Soldadura3 - Frontal Soldadura3 - Trasero	Soldadura en ángulo	E70XX	4.2	6.0	90.5	6.4	90.0
Soldadura6 - Frontal Soldadura6 - Trasero	Soldadura en ángulo	E70XX	4.2	6.0	100.0	10.0	90.0
Soldadura8 - Frontal Soldadura8 - Trasero	Soldadura en ángulo	E70XX	4.2	6.0	25.0	10.0	90.0
Soldadura2 - Frontal Soldadura2 - Trasero Soldadura4 - Frontal Soldadura4 - Trasero	Soldadura en ángulo	E70XX	4.2	6.0	75.0	10.0	90.0

Cordones de soldadura							
Elemento	Tipo	Electrodo	a (mm)	z (mm)	l (mm)	t (mm)	Ángulo (°)

a: Espesor de garganta
z: Longitud del lado
l: Longitud de la soldadura
t: Espesor de la pieza más delgada a unir

Anclaje preinstalado						
Elemento	Tipo	Serie	Material	Dimensiones	Longitud (mm)	Cantidad
Anclaje1	Anclaje (H-90º)		A36	3/4"	366.4	4
	Tuerca	ASTM A563	DH	3/4"	--	4
	Arandela	ASTM F436	1	3/4"	--	4

2. CARGAS

P1 (HSS150X150X6) - Esfuerzos en el extremo de la barra						
Casos de carga	N (kN)	Vy (kN)	Vz (kN)	Mx (kN·m)	My (kN·m)	Mz (kN·m)
1 - LC1	-63.62	20.93	0.00	0.00	29.82	0.00

3. ESFUERZOS EN LOS ANCLAJES

Esfuerzos en los anclajes				
Anclaje	Caso de carga	N (kN)	Vx (kN)	Vy (kN)
Anclaje1 - 1	1 - LC1	52.83	8.05	2.57
Anclaje1 - 2	1 - LC1	53.54	3.22	1.51

Esfuerzos en los anclajes				
Anclaje	Caso de carga	N (kN)	Vx (kN)	Vy (kN)
Anclaje1 - 3	1 - LC1	0.66	4.72	-1.62
Anclaje1 - 4	1 - LC1	2.67	4.94	-2.46

4. RESUMEN DE LAS COMPROBACIONES

4.1. Tensión / Deformación

Deformación - Perfiles				
Elemento	Comb.	Deformación plástica (%)	Límite (%)	Aprov. (%)
P1 - Ala Sup.	1 - LC1	0.514	5.000	10.27
P1 - Ala inf.	1 - LC1	3.492	5.000	69.84
P1 - Alma izq.	1 - LC1	1.549	5.000	30.97
P1 - Alma der.	1 - LC1	1.884	5.000	37.68

Esfuerzo de compresión en el concreto				
Elemento	Comb.	f_{cu} (MPa)	f_{ce} (MPa)	Aprov. (%)
Anclaje1 - Hormigón	1 - LC1	11.79	25.02	47.14

Deformación - Placas				
Elemento	Comb.	Deformación plástica (%)	Límite (%)	Aprov. (%)
Placa1	1 - LC1	0.502	5.000	10.05
Placa2	1 - LC1	0.095	5.000	1.90
Placa4	1 - LC1	1.316	5.000	26.31

Deformación - Placas				
Elemento	Comb.	Deformación plástica (%)	Límite (%)	Aprov. (%)
Placa5	1 - LC1	0.040	5.000	0.80
Placa3	1 - LC1	0.092	5.000	1.83

Cordones de soldadura										
Elemento	Dimensiones			Metal de soldadura				Metal base		
	w (mm)	w_{min} (mm)	w_{max} (mm)	F_{EXX} (MPa)	R_u (kN)	ϕR_n (kN)	Aprov. (%)	F_{nBM} (MPa)	ϕR_n (kN)	Aprov. (%)
Ajuste1 - Ala Sup.	6.0	5.0	6.4	482.80	23.42	56.69	41.30	240.02	54.00	43.36
Ajuste1 - Ala Sup. - Trasero	6.0	5.0	6.4	482.80	23.42	56.69	41.30	240.02	54.00	43.36
Ajuste1 - Ala inf.	6.0	5.0	6.4	482.80	40.38	68.89	58.61	240.02	54.00	74.77
Ajuste1 - Ala inf. - Trasero	6.0	5.0	6.4	482.80	40.38	68.89	58.61	240.02	54.00	74.77
Ajuste1 - Alma izq.	6.0	5.0	6.4	482.80	30.78	67.00	45.94	240.02	54.00	56.99
Ajuste1 - Alma izq. - Trasero	6.0	5.0	6.4	482.80	30.15	66.08	45.63	240.02	54.00	55.83
Ajuste1 - Alma der.	6.0	5.0	6.4	482.80	34.41	67.71	50.83	240.02	54.00	63.72
Ajuste1 - Alma der. - Trasero	6.0	5.0	6.4	482.80	31.95	66.83	47.81	240.02	54.00	59.17
Soldadura1 - Frontal	6.0	5.0	6.4	482.80	10.63	68.78	15.46	240.02	54.00	19.69
Soldadura1 - Trasero	6.0	5.0	6.4	482.80	10.63	68.78	15.46	240.02	54.00	19.69
Soldadura5 - Frontal	6.0	5.0	6.4	482.80	30.37	67.66	44.88	240.02	54.00	56.24
Soldadura5 - Trasero	6.0	5.0	6.4	482.80	30.37	67.66	44.88	240.02	54.00	56.24
Soldadura7 - Frontal	6.0	5.0	6.4	482.80	7.19	53.77	13.37	240.02	54.00	13.31
Soldadura7 - Trasero	6.0	5.0	6.4	482.80	7.19	53.77	13.37	240.02	54.00	13.31
Soldadura6 - Frontal	6.0	5.0	8.0	482.80	27.76	56.35	49.25	240.02	54.00	51.40

Cordones de soldadura										
Elemento	Dimensiones			Metal de soldadura				Metal base		
	w (mm)	w_{min} (mm)	w_{max} (mm)	F_{EXX} (MPa)	R_u (kN)	ϕR_n (kN)	Aprov. (%)	F_{nBM} (MPa)	ϕR_n (kN)	Aprov. (%)
Soldadura6 - Trasero	6.0	5.0	8.0	482.80	27.76	56.35	49.25	240.02	54.00	51.40
Soldadura8 - Frontal	6.0	5.0	8.0	482.80	7.07	32.34	21.85	240.02	27.00	26.17
Soldadura8 - Trasero	6.0	5.0	8.0	482.80	7.07	32.34	21.85	240.02	27.00	26.17
Soldadura3 - Frontal	6.0	5.0	6.4	482.80	14.06	67.29	20.89	240.02	54.00	26.03
Soldadura3 - Trasero	6.0	5.0	6.4	482.80	14.06	67.29	20.89	240.02	54.00	26.03
Soldadura2 - Frontal	6.0	5.0	8.0	482.80	10.11	48.60	20.81	240.02	54.00	18.73
Soldadura2 - Trasero	6.0	5.0	8.0	482.80	10.11	48.60	20.81	240.02	54.00	18.73
Soldadura4 - Frontal	6.0	5.0	8.0	482.80	10.81	47.37	22.82	240.02	54.00	20.02
Soldadura4 - Trasero	6.0	5.0	8.0	482.80	10.81	47.37	22.82	240.02	54.00	20.02

DISEÑO DE ELEMENTOS NO ESTRUCTURALES

DISEÑO DE ELEMENTOS NO ESTRUCTURALES				
Grado de desempeño				
Grupo de uso	III	Superior	Sa	0.703125
Aa	0.15		I	1.25
Fuerza sísmica de diseño				
As	0.28	ax	0.562416667	
hx	2.30	ap	2.5	
hn	4.60	Tipo de anclaje	Ductiles	
heq	3.45	Rp	6	
Fp	0.23	0.09375		
Masa del elemento no estructural				
Peso Unitario	2150 Kg/m3	Largo	1.00 m	
Altura	2.30 m	Mp	1.16 Ton/m	
PISO	**ALTURA**	**hx**	**ax**	**Fp**
Story1	3.60 m	3.60 m	0.73	0.11 Ton/m

DISEÑO A FLEXIÓN DE MURO EN MAMPOSTERIA DE PERFORACIÓN VERTICAL PARCIALMENTE REFORZADA							
ID:	MURO NO ESTRUCTURAL - PISO 1						
ALTURA DE MURO=			3.20 m	Vu=	5.68 Ton	Mu=	18.19 Ton-m
ESPESOR DE MURO=			0.14 m	Pu=	5.68 Ton	Mn=	75.65 Ton-m
LONGITUD DE MURO=			5.90 m			CUMPLE	
PROPIEDADES DE UNIDAD DE MAMPOSTERIA							
ALTURA=	0.19 m	BASE=	0.14 m	LARGO=	0.39 m	F'm=	7.71 MPa
Aneta=	30.03 mm2	t-efectivo=	84.00 mm	d=	1.40 m	Fy=	420.00 MPa
Consideración: celdas parcialmente llenas con refuerzo cada=					1.20 m	Mu-1.2=	21.82 Ton-m
$\rho = \left(1 - \sqrt{1 - \frac{2{,}5 * Mu}{0{,}8 * f'm * b * d^2}}\right) * \frac{f'm}{1{,}25 * fy} =$				0.002597	As=	5.09 cm2	
					Barra=	#4	
					Área de barra=	1.29 cm2	
a=	7.32 mm	c=	8.62 mm	Refuerzo de muro: 1#4 C/1.2m			
Verificación por carga axial							
Ae=	4956.00 cm2	h'/t=	22.86	<25 OK	Re=	0.704	
f'mAe=	381.96 Ton	Po=	310.91 Ton	PoRe=	218.82 Ton	ϕPoRe=	131.29 Ton
Pn=	105.04 Ton	CUMPLE					
Verificación para esfuerzos a cortante							
M/Vd=	2.29	>1	Fv=	0.23 MPa	Fv=	0.35 MPa	
Fs=	170.00 MPa	fv=	0.60 MPa	Necesita acero de refuerzo para cortante			