CONSORCIO DISEÑOS
YUMBO

# ESTUDIO ESTRUCTURAL
# LA CALLE 12 DEL MUNICIPIO DE YUMBO



**ESTUDIOS Y DISEÑOS TÉCNICOS PARA LA CONSTRUCCIÓN DE LA VIA CALLE DE LOS ESTUDIANTE**
**MUNICIPIO DE YUMBO**
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YUMBO

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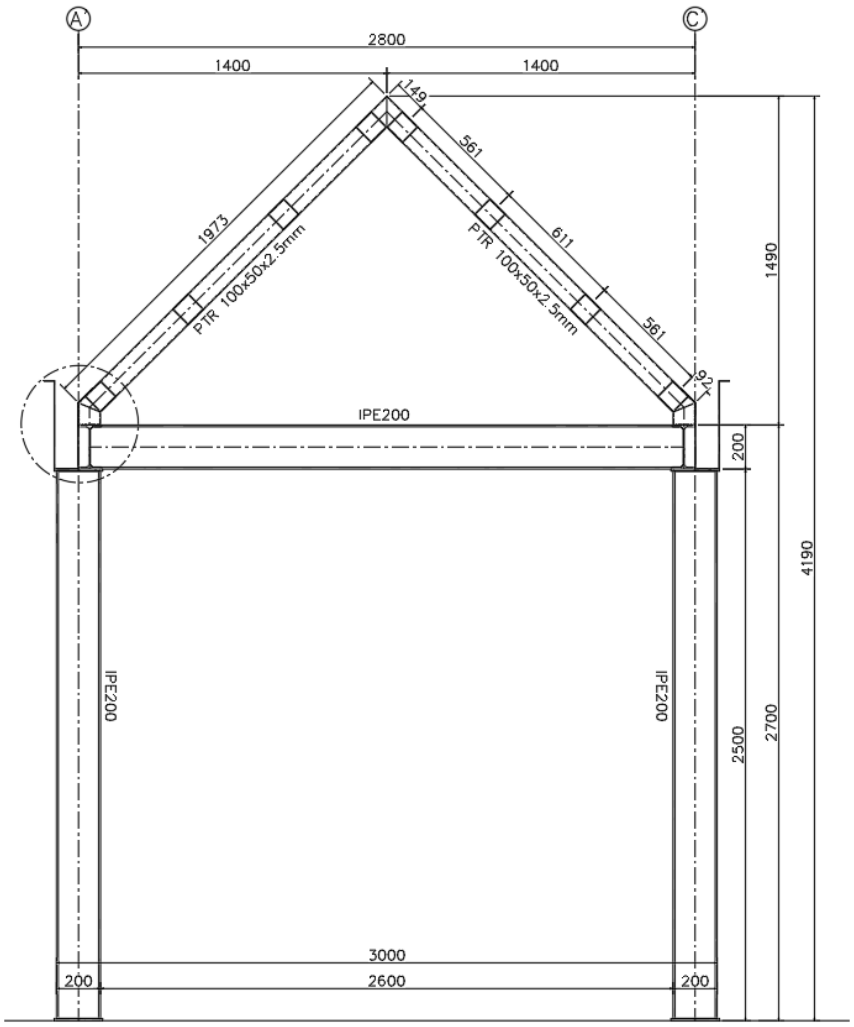
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# 1. INTRODUCCIÓN

El presente documento contiene la información del Estudio Estructural para realizar las diferentes obras propuestas en el desarrollo del proyecto para la construcción del corredor de la calle 12, entre la Carrera 1A y la Carrera 12, en el Municipio de Yumbo departamento de Valle del Cauca. Lo anterior bajo la normativa nacional actualmente vigente, Código Colombiano de Diseño Sismo Resistente NSR-10.

El presente informe corresponde alas memorias de cáclculo para la estructura de acero del la Cafeteria.




CORTE LATERAL TIPICO – CAFETERIA
CUBIERTA – NIVEL N+4.19

Figura 1. Geometria general de estructura de pergola, vista en alzada.

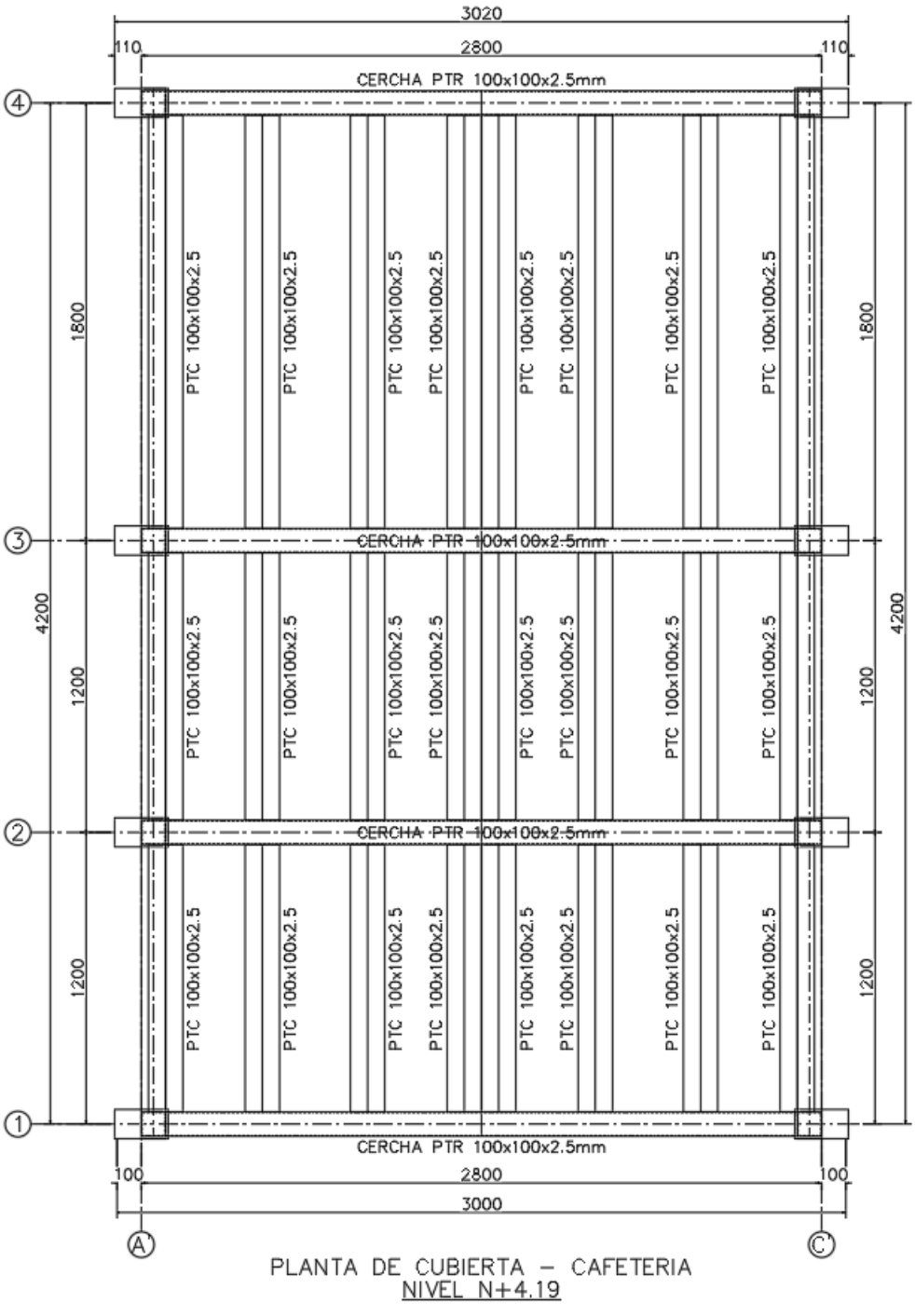



Figura 2. Geometria general de estructura de pergola, vista en planta de cubierta.

# 2. OBJETIVOS

## 2.1 OBJETIVO GENERAL

El objetivo general del estudio es la ejecución del diseño estructural de la nueva estructura aporticada de acero de un nivel tipo pergola, bajo el Código Colombiano de Diseño Sismo resistente NSR-10. En especial recomendaciones de los títulos F para estructuras de acero.

## 2.2 OBJETIVOS ESPECIFICOS

- Determinar las solicitaciones de cargas permanentes y transitorias, producto del peso propio de los materiales de la estructura y la carga viva actuante para este tipo de edificaciones.
- Dimensionar los diferentes elementos estructurales de la cimentación y demás estructuras de acuerdo a las solicitaciones anteriores y a los requerimientos arquitectónicos.
- Determinar las solicitaciones más desfavorables actuantes en los elementos estructurales.
- Diseñar el refuerzo requerido ante las solicitaciones previamente determinadas.
- Planos estructurales de construcción.
- Informe de memorias de cálculo.
- Cuantificar las cantidades de obra.

# 3. DESCRIPCIÓN DE LA ESTRUCTURA NUEVA

La estructura corresponde a un sistema aporticado en acero estructural, conformado por perfiles tubulares rectangulares (PTR), diseñado para soportar una cubierta liviana con pendiente longitudinal para evacuación de aguas lluvias.

El módulo presenta una configuración rectangular en planta y está compuesto por:

- Pórticos principales en sentido transversal.
- Vigas longitudinales de amarre.
- Correas o elementos secundarios de cubierta.
- Sistema perimetral de rigidización.
- Canal de recolección de aguas lluvias.
- Placa de para anclaje de columnas.

# 4. CRITERIOS Y PARÁMETROS DE DISEÑO

Para el diseño se siguen los lineamientos establecidos en las siguientes normas:

- Reglamento de Construcción Sismoresistente **NSR-10.**

## 4.1 CARGAS

La estructura se diseña para soportar las siguientes cargas:

### 4.1.1 Carga Muerta, DC

Se considera como carga muerta el peso propio de la estructura, considerando una densidad del material de 2.4 ton/$m^3$ vigas de amarre de muros y de cimentación. Para los elementos de cubierta acero estructural densidad 7.85 ton/$m^3$.

Se considera como carga sobreimpuesta en las vigas de cubierta de teraza por 200 kg/$m^2$, esto para cubrir acabados en el piso y equipos de aires acondicionados.

### 4.1.2 Carga Viva, LL

Cargas mínimas en cubierta B.4.2.1 :

- Por tratarse de una terraza y de manera conservadora se asume una carga viva de uso residencial de 180 kg/$m^2$.

### 4.1.3 Viento, W.

Se considera una carga mínima de viento de 40 kg/$m^2$.

## 4.2 COMBINACIONES DE CARGA

Para el diseño de la estructura se tienen en cuenta los grupos o combinaciones de carga y los factores de mayoración establecidos en el Reglamento Colombiano de Construcción Sismoresistente NSR-10.

El diseño de las estructuras, sus componentes y cimentaciones debe hacerse de tal forma que sus resistencias de diseño igualen o excedan los efectos producidos por las cargas mayoradas en las siguientes combinaciones: B.2.4 NSR-10.

Resistencia:

1.4(D+ F) (B.2.4-1)

1.2(D+ F + T) + 1.6(L + H) + 0.5(Lr ó G ó Le ) (B.2.4-2)

1.2D+ 1.6(Lr ó G ó Le ) + (L ó 0.8W) (B.2.4-3)
1.2D+ 1.6W+ 1.0L + 0.5(Lr ó G ó Le ) (B.2.4-4)
1.2D+ 1.0E + 1.0L (B.2.4-5)
0.9D+ 1.6W+ 1.6H (B.2.4-6)
0.9D+ 1.0E + 1.6H (B.2.4-7)

Servicio:

D+ F (B.2.3-1)
D+ H + F + L + T (B.2.3-2)
D+ H+ F + (Lr ó G ó Le ) (B.2.3-3)
D+ H+ F + 0.75(L + T) + 0.75(Lr ó G ó Le ) (B.2.3-4)
D+ H + F + W (B.2.3-5)
D+ H + F + 0.7E (B.2.3-6)
D+ H+ F + 0.75W+ 0.75L + 0.75(Lr ó G ó Le ) (B.2.3-7)
D+ H + F + 0.75(0.7E) + 0.75L + 0.75(Lr ó G ó Le ) (B.2.3-8)
0.6D+W+ H (B.2.3-9)
0.6D+ 0.7E + H (B.2.3-10)

## 4.3 MATERIALES

Los materiales que conforman los diferentes elementos estructurales del puente son:

### 4.3.1 Concreto

- Vigas: f'c = 210 kgf/cm$^2$
- Zapatas: f'c = 210 kgf/cm$^2$
- Concreto de limpieza f'c = 140 kgf/cm$^2$

### 4.3.2 Acero Estructural

| | |
|---|---|
| Platinas y láminas: | ASTM A36 |
| Perfil IPE: | ASTM A572 Gr. 50 |
| Soldadura | E60XX, |
| Tornillería y tuercas: | ASTM A325 |
| Pernos de anclaje: | Acero ASTM F1554 GR.36 |
| Pintura: | Imprimante epóxico fosfato de zinc 3 mils. Acabado pintura epoxica 3 mils. |
| Limpieza: | Limpieza Sand Blasting SSPC-SP 6 grado comercial. |

### 4.3.3 Acero de Refuerzo

El refuerzo debe ser corrugado con una resistencia nominal a la fluencia de 4218 kg /cm2 y debe cumplir con la norma NTC 2289 (ASTM A706).

## 5. MEMORIAS DE ANALISIS Y DISEÑO ESTRUCTURAL

Para el análisis y el diseño de los elementos de la estructura de acero se utiliza el programa ETABS. Los listados del análisis y diseño obtenidos de los diferentes elementos estructurales, se presentan como Anexos del presente informe.

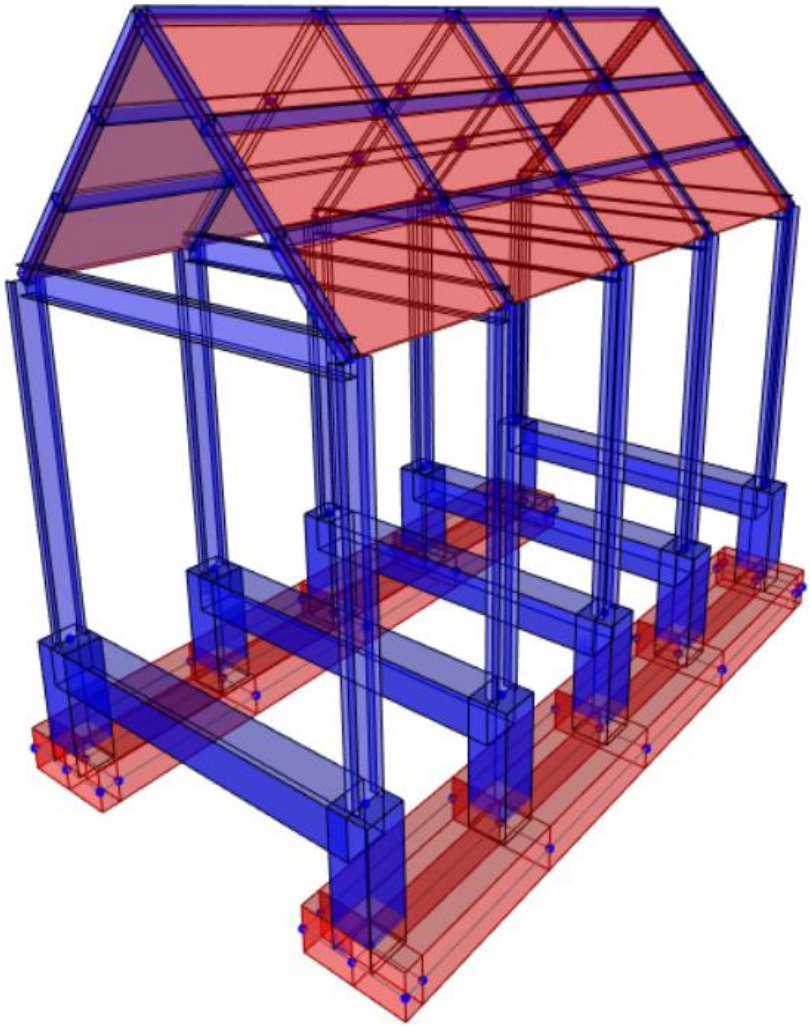


Figura 3. Modelo tridimensional estructura de acero de pergola, mediante el programa SAP2000.

## 5.1 SISTEMA ESTRUCTURAL

El método de análisis a utilizar es el análisis dinámico elástico, que según el A.3.4.2 (NSR-10) permite analizar casi cualquier tipo de edificación. Dentro del análisis dinámico, se utilizará el análisis dinámico elástico espectral, cumpliendo con los requisitos del título A.5.4. Las fuerzas sísmicas de diseño se introducirán por medio del espectro elástico de diseño definido en el A.2 NSR-10.

El reglamento NSR-10 reconoce 4 tipos de Sistemas Estructurales de resistencia sísmica. Cada uno de ellos se subdivide según los tipos de elementos verticales utilizados para resistir las fuerzas sísmicas y gravitacionales y el grado de capacidad de disipación de energía del material estructural empleado.

Para el pressente proyecto el sistema estructural de acuerdo con la norma es el que se presenta a continuacion según definicion.

**3.2.1.3 — 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 fuerzas horizontales.

El uso de la edificación será residencial; según la información arquitectónica entregada. A continuación, se describen las cargas de diseño:

**Avaluo de Cargas**
**Cubierta**

| Tipo de carga | cantidad | unidad |
|---|---|---|
| Cielo raso | 10 | kg/m2 |
| Equipos Aires o Paneles | 15 | kg/m2 |
| Ductos | 5 | kg/m2 |
| **TOTAL, MUERTA X M2** | **30** | **kg/m2** |

| | | |
|---|---|---|
| **Carga Viva: Cubierta** | **50** | **kg/m2** |
| **Carga de Viento: W min** | **40** | **kg/m2** |

Tabla 1. Evaluacion de cargas de cubierta.

### 5.1.1 Carga Muerta de Cubierta (DL)

La carga muerta sobreimpuesta en el modelo de la estructura incluyendo el peso de acabados 200 kg/m$^2$.

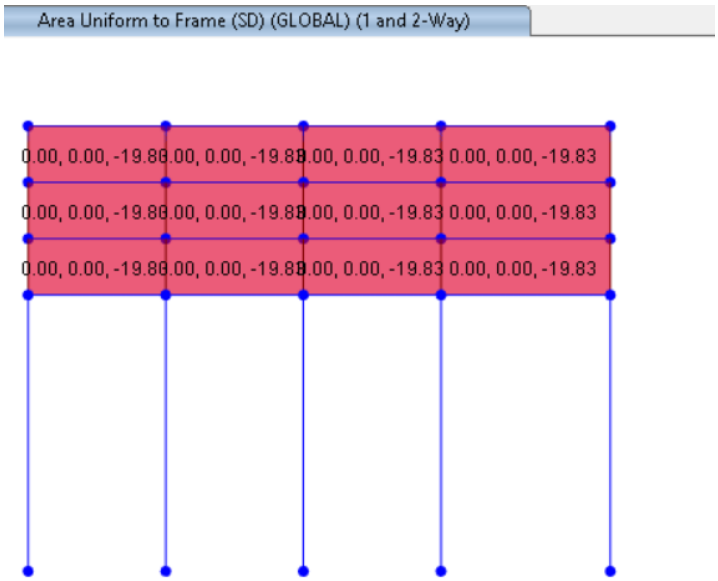



Figura 4. Carga muerta sobre cubierta (kg/m$^2$). (DL).

### 5.1.2 Carga Viva de Cubierta (Lr)

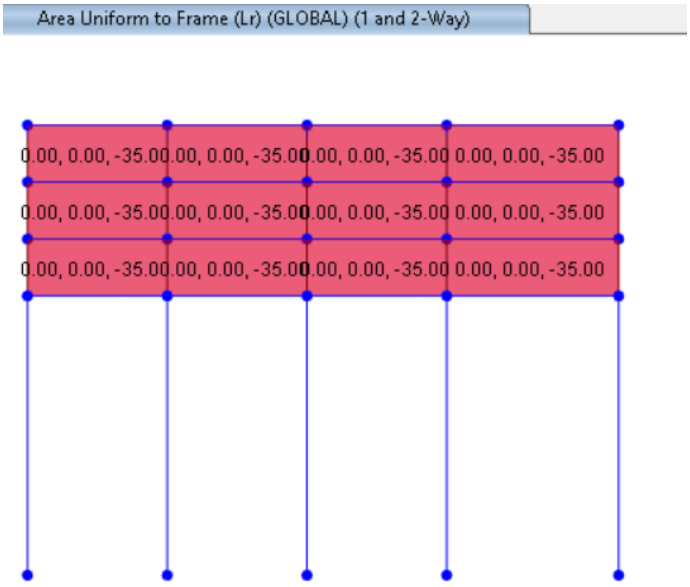



Figura 5. Carga viva sobre cubierta (kg/m$^2$). (Lr)

### 5.1.3 Carga de Viento (W)




Figura 6. Carga de viento sobre cubierta (kg/m$^2$). (W)

## 5.2 PROPIEDADES MECÁNICAS DE LOS MATERIALES

Concreto

La NSR-10 permite el uso de dos correlaciones para el cálculo del módulo de elasticidad, para la aplicación de estas es necesario conocer la resistencia y masa unitaria del concreto. Dichas correlaciones se presentan en las ecuaciones ( 1) y (2).

$$E_c = 4700\sqrt{f'_c} \qquad (1) \qquad E_c = W_c^{1.5} 0{,}043 \sqrt{f'_c} \qquad (2)$$

Dónde:

$f'_c = Resistencia\ del\ concreto\ en\ (MPa)$
$W_c = Masa\ unitario\ (kg/m^3)$

Una vez obtenido el módulo de elasticidad por medio de las ecuaciones ( 1) y (2), se procede a determinar los valores promedios teniendo en cuenta la situación más crítica, la cual se presenta con la ecuación ( 1).

f´c murete, pedestales y zapata cimentacion = 21 MPa, 3000psi

$E = 4700\sqrt{f'c}$ (Cap, C,8,5, NSR-10) Ec= 21538 MPa

Acero de Refuerzo
Acero Grado 60 Corrugado, (A615Gr60)
fy= 420 MPa

Acero Estructural
Perfiles Tubulares, ASTM A572-gr50, Fy= 345Mpa
Ángulos y contravientos: A36, Fy=350 Mpa, Fu=400 MPa
Laminas de conexiones, ASTM A572-gr50, Fy= 345Mpa
Pernos: Acero A325 y A490
Anclajes: acero ASTM A193 Grado B7

## 5.3 ANÁLISIS DINÁMICO

El método de análisis usado para a modelación dinámica de la estructura es el Análisis Dinámico Elástico Espectral, para el cual la normativa colombiana NSR-10 en el capítulo A.4, plantea los requerimientos que se muestran a continuación:

### 5.3.1 Metodología del Análisis

Deben tenerse en cuenta los siguientes requisitos, cuando se utilice el método de análisis dinámico elástico espectral:

**(a)** Obtención de los modos de vibración — Los modos de vibración deben obtenerse utilizando metodologías establecidas de dinámica estructural, Deben utilizarse todos los modos de vibración de la estructura que contribuyan de una manera significativa a la respuesta dinámica de la misma, cumpliendo los requisitos de A.5.4.2.

**(b)** Respuesta espectral modal — La respuesta máxima de cada modo se obtiene utilizando las ordenadas del espectro de diseño definido en A.5.3.2. para el período de vibración propio del modo.

**(c)** Respuesta total — Las respuestas máximas modales, incluyendo las de deflexiones, derivas, fuerzas en los pisos, cortantes de piso, cortante en la base y fuerzas en los elementos, se combinan de una manera estadística para obtener la respuesta total de la estructura a los movimientos sísmicos de diseño, Deben cumplirse los requisitos de A.5.4.4 en la combinación estadística de las respuestas modales máximas.

**(d)** Ajuste de los resultados — Si los resultados de la respuesta total son menores que los valores mínimos prescritos en A.5.4.5, los resultados totales del análisis dinámico deben ser ajustados como se indica allí, El ajuste debe cubrir todos los resultados

del análisis dinámico, incluyendo las deflexiones, derivas, fuerzas en los pisos, cortantes de piso, cortante en la base y fuerzas en los elementos.

**(e)** Evaluación de las derivas — Se debe verificar que las derivas totales obtenidas, debidamente ajustadas de acuerdo con los requisitos de A.5.4.5, no excedan los límites establecidos en el Capítulo A.6.

**(f)** Fuerzas de diseño en los elementos — Las fuerzas sísmicas internas totales de los elementos, s F , debidamente ajustadas de acuerdo con los requisitos de A.5.4.5, se dividen por el valor del coeficiente de capacidad de disipación de energía, R, del sistema de resistencia sísmica, modificado de acuerdo con la irregularidad y la ausencia de redundancia según los requisitos de A.3.3.3, para obtener las fuerzas sísmicas reducidas de diseño, E, y se combinan con las otras cargas prescritas por este Reglamento, de acuerdo con el Título B.

**(g)** Diseño de los elementos estructurales — Los elementos estructurales se diseñan y detallan siguiendo los requisitos propios del grado de capacidad de disipación de energía correspondiente del material, de acuerdo con los requisitos del Capitulo A.3,

Adicionalmente, para la elaboración del espectro es necesario establecer el coeficiente de importancia de la edificación, para lo cual se siguen los lineamientos de la Norma de Sismo Resistencia Colombiana en el capítulo A:

### 5.3.2 Coeficiente de Importancia

**A.2.5.2** El Coeficiente de Importancia, I, modifica el espectro, y con ello las fuerzas de diseño, de acuerdo con el grupo de uso a que esté asignada la edificación para tomar en cuenta que para edificaciones de los grupos II, III y IV deben considerarse valores de aceleración con una probabilidad menor de ser excedidos que aquella del diez por ciento en un lapso de cincuenta años considerada en el numeral A.2.2.1, Los valores de I se dan en la tabla A.2.5-1.

**Tabla A.2.5-1**
**Valores del coeficiente de importancia, I**

| Grupo de Uso | Coeficiente de Importancia, I |
|---|---|
| IV | 1.50 |
| III | 1.25 |
| II | 1.10 |
| I | 1.00 |

Tabla 2. Valores de coeficiende de importancia, I.

Para el presente proyecto por tratarse de una edificacion para uso de vivienda el coeficiente de importancia I = 1.0.

### 5.3.3 Análisis Modal y Periodos Fundamentales

La modelación de la estructura debe garantizar que efectivamente se cumplan los parámetros y limitaciones que exige la normativa colombiana, a continuación, se indican los peridos y frecuencias fundamentales de la estructura y la participacion modal de la masa.

| TABLE: Modal Participating Mass Ratios | | | | | | |
|---|---|---|---|---|---|---|
| **OutputCase** | **StepType** | **StepNum** | **Period** | **SumUX** | **SumUY** | **SumRZ** |
| Text | Text | Unitless | Sec | Unitless | Unitless | Unitless |
| MODAL | Mode | 1 | 0.18 | 0.00 | 1.00 | 0.00 |
| MODAL | Mode | 2 | 0.08 | 0.00 | 1.00 | 1.00 |
| MODAL | Mode | 3 | 0.05 | 1.00 | 1.00 | 1.00 |
| MODAL | Mode | 4 | 0.02 | 1.00 | 1.00 | 1.00 |
| MODAL | Mode | 5 | 0.02 | 1.00 | 1.00 | 1.00 |
| MODAL | Mode | 6 | 0.02 | 1.00 | 1.00 | 1.00 |
| MODAL | Mode | 7 | 0.02 | 1.00 | 1.00 | 1.00 |
| MODAL | Mode | 8 | 0.02 | 1.00 | 1.00 | 1.00 |
| MODAL | Mode | 9 | 0.02 | 1.00 | 1.00 | 1.00 |
| MODAL | Mode | 10 | 0.02 | 1.00 | 1.00 | 1.00 |
| MODAL | Mode | 11 | 0.02 | 1.00 | 1.00 | 1.00 |
| MODAL | Mode | 12 | 0.02 | 1.00 | 1.00 | 1.00 |

Tabla 3. Periodos y frecuencias fundamentales de la estructura.

### 5.3.4 Evaluación Sismica

La interacción suelo estructura durante sismos se puede evaluar de acuerdo con la metodología propuesta en el Título A-2 de la norma NSR-10. Se usarán los siguientes parámetros:

Tipo de perfil del suelo: D
Coeficiente de amplificación de aceleración (períodos cortos) (Fa): 1.30
Coeficiente de amplificación de aceleración (períodos intermedios) (Fv): 1.90
Coeficiente de aceleración (Aa) pico efectiva: 0.25
Coeficiente de velocidad (Av) pico efectiva: 0.25

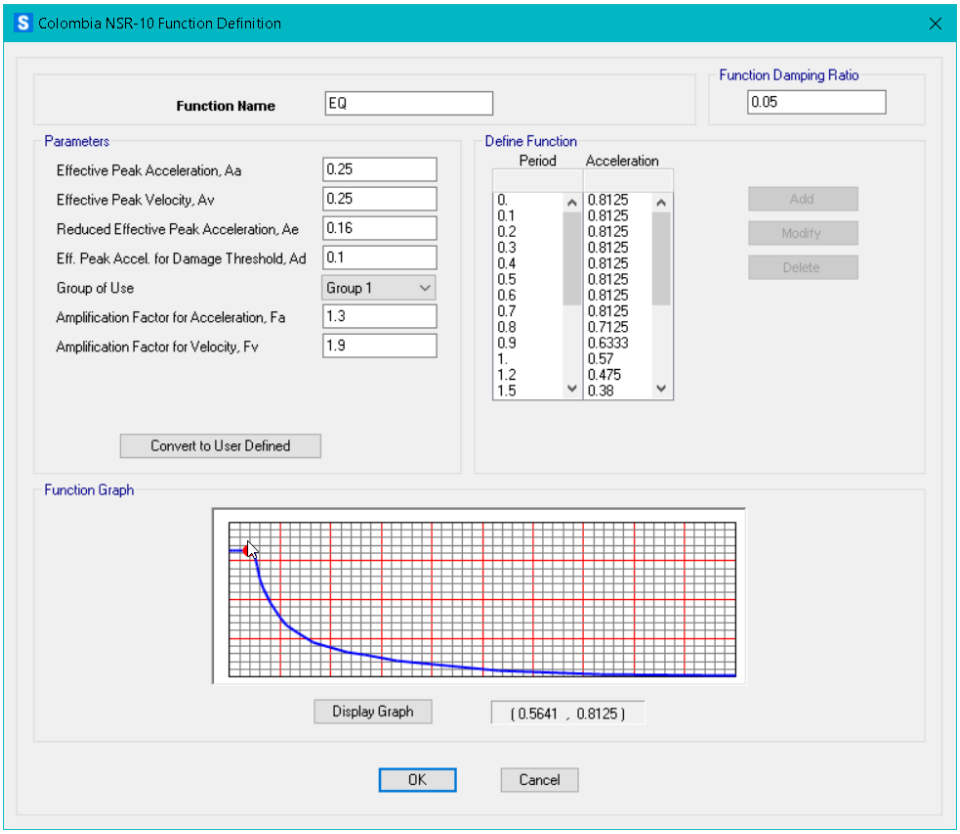



Figura 7. Espectro elastico de aceleraciones NSR-10.

Sa = 0.8125 g
% de Amotiguaminto critico = 5 %
Tc = 1.46 s.
$T_L$ = 4.56 s.

### 5.3.5 Periodo Fundamental de la Estructura

| TABLE: Modal Periods And Frequencies | | |
|---|---|---|
| Case | Mode | Period |
| | | sec |
| Modal | 1 | 0.10 |
| Modal | 2 | 0.10 |

Tabla 4. Periodos fundamentales de los modos 1 y 2, de analisis modal. ETABS.

| | | | |
|---|---|---|---|
| Cu = 1.75 - 1.2AvFv = | 1.18 | | A.4.2-2 |
| Av = | 0.25 | | |
| Fv = | 1.90 | | |
| Ta = | 0.17 | seg | A.4.2.2 |
| $C_t$ = | 0.072 | | |
| $\alpha$ = | 0.8 | | |
| h = | 3.0 | m | |
| Cu*Ta = | 0.20 | seg | |

### 5.3.6 Ajuste de Cortante

| Output Case | Case Type | Step Type | FX | FY | FZ |
|---|---|---|---|---|---|
| | | | tonf | tonf | tonf |
| EQ | LinRespSpec | Max | 0.23 | 0.23 | 0.00 |
| DL Total | Combination | | 0.00 | 0.00 | 1.81 |

Tabla 5. Sumatoria de fuerzas de reaccion en la base de las columnas. ETABS.

| | | | |
|---|---|---|---|
| Peso Total | **w=** | 1.81 | Ton |
| Periodo en X | **$T_x$=** | 0.15 | seg |
| Periodo en Y | **$T_y$=** | 0.11 | seg |
| Aceleracion Horizontal en X | **$Sa_x$=** | 0.81 | g |
| Aceleracion Horizontal en Y | **$Sa_y$=** | 0.81 | g |
| Cortante Basal en X | **$Vs_x$=** | 0.28 | Ton |
| Cortante Basal en Y | **$Vs_y$=** | 0.28 | Ton |
| Cortante del Modelo en X | **Vx=** | 0.23 | Ton |
| Cortante del Modelo en Y | **Vy=** | 0.23 | Ton |
| Factores de Ajuste: | **0.9*Vsx/Vx =** | 0.95 | |
| | **0.9*Vsy/Vy =** | 0.95 | |

### 5.3.7 Chequeo de Irregularidades

El chequeo de irregularidades se realiza a partir de lo expuesto en la NSR-10 en las tablas A.3-6 y A.3-7 en el capítulo A.

**Chequeo de Irregularidades NSR10 - A.3.3.3**

Cuando una estructura se clasifica como irregular, el valor del coeficiente de disipación de energía R que se utilice en diseño se debe reducir multiplicandolo por ϕp y por ϕa:

| En planta: | ϕp |
|---|---|
| 1P: Irregularidad Torsional | 1.0 |
| 2P: Retrocesos en las esquinas | 1.0 |
| 3P: Irregularidad del diafragma | 1.0 |
| 4P: Desplazamientos planos de Accion | 1.0 |
| 5P: Sistemas no paralelos | 1.0 |

| En alzada: | ϕa |
|---|---|
| 1A: Piso flexible | 1.0 |
| 2A: Distribucion de masa | 1.0 |
| 3A: Geometrica | 1.0 |
| 4A: Desplazamientos planos | 1.0 |
| 5A: Piso debil | 1.0 |

**Factor de reducción de resistencia por irregularidad altura** $\phi_a = 1.0$
**Factor de reducción de resistencia por irregularidad en planta** $\phi_p = 0.9$
**Factor de reducción de resistencia por ausencia de redundancia** $\phi_r = 0.75$
Cc

| | | |
|---|---|---|
| **Ro y=** | **7.0** | Portico resistente a momento DES. tabla A.3-2.3.A NSR-10 |

Teniendo en cuenta las irregularidades, el factor de modidicación de respuesta es :

| | |
|---|---|
| **Rx =** | **5.25** |
| **Ω0=** | **3.0** |

| | |
|---|---|
| **Ry =** | **5.25** |
| **Ω0=** | **3.0** |

El valor del coeficiente de capacidad de disipación de energía para ser empleado en el diseño, corresponde al coeficiente de disipación de energía básico, Ro, multiplicado por el menor valor de los coeficientes de reducción de capacidad de disipación de energía por irregularidades en altura y en planta (R = φa*φp*φr*Ro) de acuerdo también al A.3.3.3.

## 5.3.8 Cálculo de La Deriva

En el capítulo A.6 de la norma NSR-10, se establecen los parámetros para la evaluación de la deriva en las estructuras. A continuación, se presenta los requisitos presentes en la norma.

# 6. DISEÑO ESTRUCTURAL DE ELEMENTOS DE ACERO

Para el diseño de los elelementos de acero asi como la verificacion de la mamposteria de acuerdo con el titulo F de la norma NSR-10. El Título F2 adopta criterios basados principalmente en especificaciones tipo AISC, incorporando factores de resistencia (ϕ) para LRFD o factores de seguridad (Ω) para ASD, y establece requisitos adicionales cuando la estructura forma parte del sistema sismorresistente.

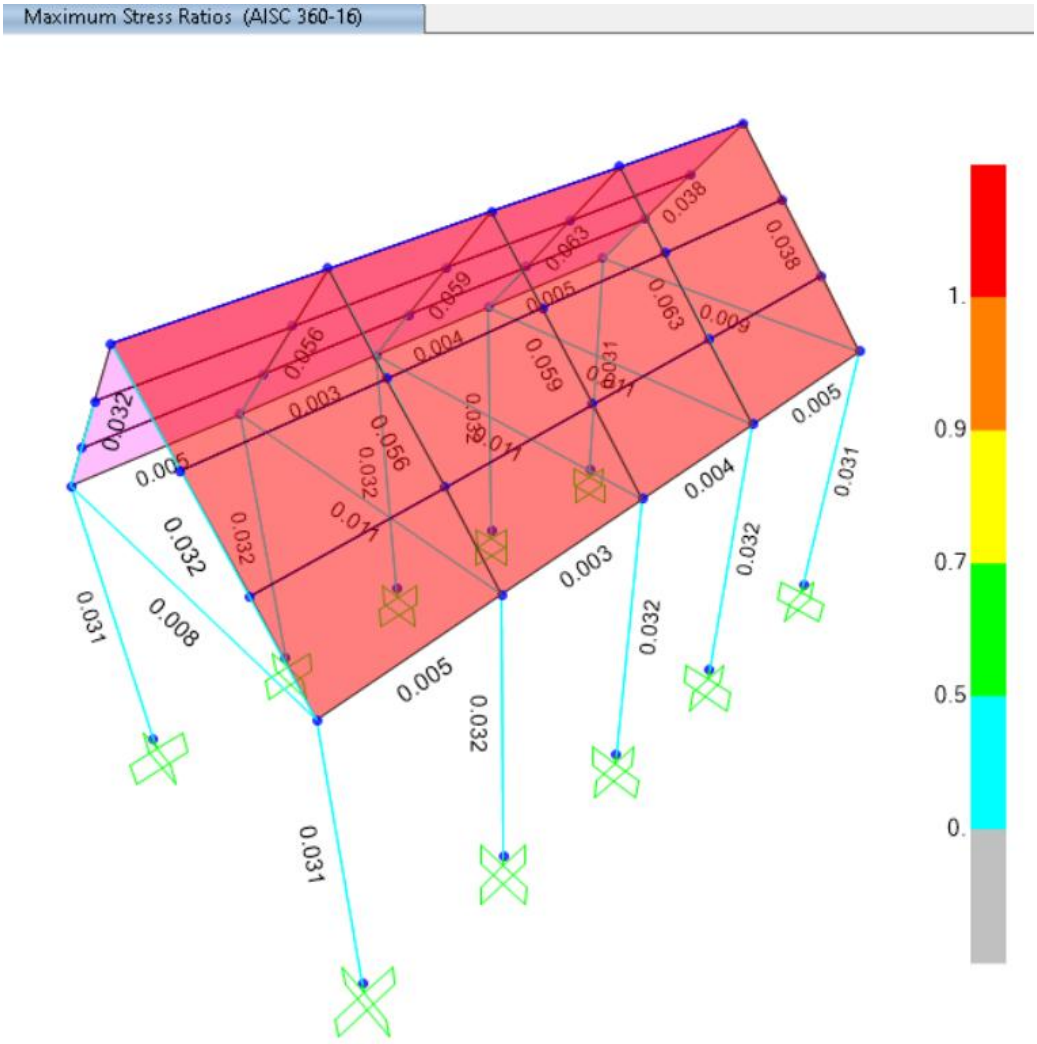
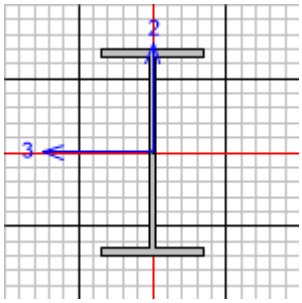



Figura 8. Resultados de diseño indices de sobreesfuerzo de vigas de acero de pergola. SAP2000.

## 6.1 Diseño de Columnas IPE200




AISC 360-16 STEEL SECTION CHECK (Summary for Combo and Station)
Units : Tonf, m, C

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Frame : | 12 | X Mid: | 2.6 | Combo: | B.2.4-5 | Design Type: | Column |
| Length: | 2.6 | Y Mid: | 2.8 | Shape: | IPE200 | Frame Type: | OMF |
| Loc : | 0. | Z Mid: | 1.3 | Class: | Seismic HD | Princpl Rot: | 0. degrees |

Provision: LRFD Analysis: Effective Length
D/C Limit=0.95 2nd Order: General 2nd Order
Ignore Seismic Code? No Ignore Special EQ Load? No D/P Plug Welded? Yes

| | | | |
|---|---|---|---|
| SDC: D | I=1. | Rho=1. | Sds=0.5 |
| R=8. | Omega0=3. | Cd=5.5 | |
| PhiB=0.9 | PhiC=0.9 | PhiTY=0.9 | PhiTF=0.75 |
| PhiS=0.9 | PhiS-RI=1. | PhiST=0.9 | |
| A=0.003 | I33=1.943E-05 | r33=0.083 | S33=1.943E-04 |
| Av3=0.001 | | | |
| J=6.920E-08 | I22=1.420E-06 | r22=0.022 | S22=2.840E-05 |
| Av2=0.001 | | | |
| E=20389019.16 | Fy=35153.481 | Ry=1.1 | z33=2.210E-04 |
| Cw=1.299E-08 | | | |
| RLLF=1. | Fu=45699.526 | | z22=4.460E-05 |

SLENDERNESS CHECK

| Buckling mode | K | L | r | KL/r | KL/r Limit | L/r | L/r Limit |
|---|---|---|---|---|---|---|---|
| Major (3-3) | 1.042 | 2.6 | 0.083 | 32.799 | 200 | 31.489 | 300 |
| Minor (2-2) | 1.013 | 2.6 | 0.022 | 118.024 | 200 | 116.48 | 300 |

UNBRACED LENGTH LIMIT CHECK

| Buckling mode | K | L | KL/r |
|---|---|---|---|
| K1 Major Flexure | 1. | 2.6 | 31.489 |
| K1 Minor Flexure | 1. | 2.6 | 116.48 |
| K2 Major Flexure | 1.042 | 2.6 | 32.799 |
| K2 Minor Flexure | 1.013 | 2.6 | 118.024 |
| LTB | 1.013 | 2.6 | 118.024 |

STRESS CHECK FORCES & MOMENTS (Combo B.2.4-5)

| Location | Pu | Mu33 | Mu22 | Vu2 | Vu3 | Tu |
|---|---|---|---|---|---|---|
| 0. | -0.257 | -0.034 | 0.033 | 0.025 | -0.021 | -1.623E-06 |

PMM DEMAND/CAPACITY RATIO (H1-1b)

D/C Ratio: 0.032 = 0.004 + 0.005 + 0.023
= (1/2)(Pr/Pc) + (Mr33/Mc33) + (Mr22/Mc22)

COMPACTNESS

| Slenderness | Lambda | Lambda_hd | Lambda_md | Lambda_p | Lambda_r | Lambda_s | Compactness |
|---|---|---|---|---|---|---|---|
| Major/Flange | 5.882 | 7.348 | 9.185 | 9.152 | 24.083 | | Seismic HD |
| /Web | 28.393 | 58.854 | 90.215 | 90.553 | 137.274 | 232. | Seismic HD |
| Minor/Flange | 5.882 | 7.348 | 9.185 | 9.152 | 24.083 | | Seismic HD |
| /Web | 28.393 | 58.854 | 90.215 | 90.553 | 137.274 | 232. | Seismic HD |
| Axial/Flange | 5.882 | | | | 13.487 | | Seismic HD |
| /Web | 28.393 | | | | | 35.884 | Seismic HD |

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-1b)

| Factor | L | K1 | K2 | B1 | B2 | Cm |
|---|---|---|---|---|---|---|
| Major Bending | 1. | 1. | 1.042 | 1. | 1. | 0.961 |
| Minor Bending | 1. | 1. | 1.013 | 1. | 1. | 0.925 |

| | Lltb | Kltb | Cb |
|---|---|---|---|
| LTB | 1. | 1.013 | 2.198 |

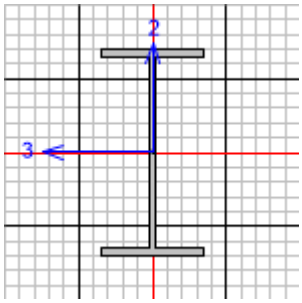
| | Pu Force | phi*Pnc Capacity | phi*Pnt Capacity |
|---|---|---|---|
| Axial | -0.257 | 32.497 | 90.169 |

| | Mu Moment | phi*Mn Capacity | phi*Mn No LTB | phi*Mn Cb=1 |
|---|---|---|---|---|
| Major Moment | -0.034 | 6.992 | 6.992 | 4.951 |
| Minor Moment | 0.033 | 1.411 | | |

SHEAR CHECK

| | Vu Force | phi*Vn Capacity | Stress Ratio | Status Check |
|---|---|---|---|---|
| Major Shear | 0.025 | 23.623 | 0.001 | OK |
| Minor Shear | 0.025 | 32.271 | 0.001 | OK |

## 6.2 Diseño de Vigas IPE 200




AISC 360-16 STEEL SECTION CHECK (Summary for Combo and Station)
Units : Tonf, m, C
Frame : 13 X Mid: 2.6 Combo: B.2.4-2a Design Type: Beam
Length: 2.8 Y Mid: 1.4 Shape: IPE200 Frame Type: OMF
Loc : 1.4 Z Mid: 2.6 Class: Compact Princpl Rot: 0. degrees

Provision: LRFD Analysis: Effective Length
D/C Limit=0.95 2nd Order: General 2nd Order
Ignore Seismic Code? No Ignore Special EQ Load? No D/P Plug Welded? Yes
SDC: D I=1. Rho=1. Sds=0.5
R=8. Omega0=3. Cd=5.5
PhiB=0.9 PhiC=0.9 PhiTY=0.9 PhiTF=0.75
PhiS=0.9 PhiS-RI=1. PhiST=0.9

A=0.003 I33=1.943E-05 r33=0.083 S33=1.943E-04 Av3=0.001
J=6.920E-08 I22=1.420E-06 r22=0.022 S22=2.840E-05 Av2=0.001
E=20389019.16 Fy=35153.481 Ry=1.1 z33=2.210E-04 Cw=1.299E-08
RLLF=1. Fu=45699.526 z22=4.460E-05

SLENDERNESS CHECK

| Buckling mode | K | L | r | KL/r | KL/r Limit | L/r Limit |
|---|---|---|---|---|---|---|
| Major (3-3) | 1. | 2.8 | 0.083 | 33.911 | 200 | 300 |
| Minor (2-2) | 1. | 2.8 | 0.022 | 125.44 | 200 | 300 |

UNBRACED LENGTH LIMIT CHECK

| Buckling mode | K | L | KL/r |
|---|---|---|---|
| K1 Major Flexure | 1. | 2.8 | 33.911 |
| K1 Minor Flexure | 1. | 2.8 | 125.44 |
| K2 Major Flexure | 1. | 2.8 | 33.911 |
| K2 Minor Flexure | 1. | 2.8 | 125.44 |
| LTB | 1. | 2.8 | 125.44 |

STRESS CHECK FORCES & MOMENTS (Combo B.2.4-2a)

| Location | Pu | Mu33 | Mu22 | Vu2 | Vu3 | Tu |
|---|---|---|---|---|---|---|
| 1.4 | 0.059 | 0.055 | -4.536E-06 | -1.927E-04 | 2.757E-08 | -2.844E-11 |

PMM DEMAND/CAPACITY RATIO (H1.2,H1-1b)

D/C Ratio: 0.011 = 0. + 0.011 + 0.

= (1/2)(Pr/Pc) + (Mr33/Mc33) + (Mr22/Mc22)

COMPACTNESS

| Slenderness | Lambda | Lambda_p | Lambda_r | Lambda_s | Compactness |
|---|---|---|---|---|---|
| Major/Flange | 5.882 | 9.152 | 24.083 | | Compact |
| /Web | 28.393 | 90.553 | 137.274 | 232. | Compact |
| Minor/Flange | 5.882 | 9.152 | 24.083 | | Compact |
| /Web | 28.393 | 90.553 | 137.274 | 232. | Compact |
| Axial/Flange | 5.882 | | 13.487 | | Compact |
| /Web | 28.393 | | 35.884 | | Compact |

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1.2,H1-1b)

| Factor | L | K1 | K2 | B1 | B2 | Cm |
|---|---|---|---|---|---|---|
| Major Bending | 1. | 1. | 1. | 1. | 1. | 1. |
| Minor Bending | 1. | 1. | 1. | 1. | 1. | 1. |

| | Lltb | Kltb | Cb |
|---|---|---|---|
| LTB | 1. | 1. | 1.069 |

| | Pu Force | phi*Pnc Capacity | phi*Pnt Capacity |
|---|---|---|---|
| Axial | 0.059 | 28.768 | 90.169 |

| | Mu Moment | phi*Mn Capacity | phi*Mn No LTB | phi*Mn Cb=1 |
|---|---|---|---|---|
| Major Moment | 0.055 | 5.081 | 6.992 | 4.75 |
| Minor Moment | -4.536E-06 | 1.411 | | |

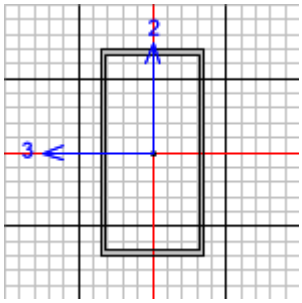
SHEAR CHECK

| | Vu Force | phi*Vn Capacity | Stress Ratio | Status Check |
|---|---|---|---|---|
| Major Shear | 1.927E-04 | 23.623 | 8.157E-06 | OK |
| Minor Shear | 2.757E-08 | 32.271 | 0. | OK |

**CONNECTION SHEAR FORCES FOR BEAMS**

| | VMajor Left | VMajor Right |
|---|---|---|
| Major (V2) | 0.044 | 0.044 |

## 6.3 Diseño de Vigas Tubo 100X50X2.5mm




AISC 360-16 STEEL SECTION CHECK (Summary for Combo and Station)
Units : Tonf, m, C

Frame : 44 X Mid: 3.9 Combo: B.2.4-2a Design Type: Brace
Length: 2.119 Y Mid: 0.7 Shape: Tub100X50X2.5mm Frame Type: OMF
Loc : 2.119 Z Mid: 3.395 Class: Compact Princpl Rot: 0. degrees

Provision: LRFD Analysis: Effective Length
D/C Limit=0.95 2nd Order: General 2nd Order
Ignore Seismic Code? No Ignore Special EQ Load? No D/P Plug Welded? Yes

SDC: D I=1. Rho=1. Sds=0.5
R=8. Omega0=3. Cd=5.5
PhiB=0.9 PhiC=0.9 PhiTY=0.9 PhiTF=0.75
PhiS=0.9 PhiS-RI=1. PhiST=0.9

A=7.250E-04 I33=9.515E-07 r33=0.036 S33=1.903E-05 Av3=2.500E-04
J=7.396E-07 I22=3.203E-07 r22=0.021 S22=1.281E-05 Av2=5.000E-04
Ae=7.250E-04 Se33=1.903E-05 Se22=1.239E-05
E=20389019.16 Fy=35153.481 Ry=1.1 z33=2.347E-05 Cw = Not Required
RLLF=1. Fu=43590.317 z22=1.441E-05

HSS Welding: ERW Reduce HSS Thickness? No

SLENDERNESS CHECK

| Buckling mode | K | L | r | KL/r | KL/r Limit | L/r | L/r Limit |
|---|---|---|---|---|---|---|---|
| Major (3-3) | 1. | 2.119 | 0.036 | 58.478 | 200 | 58.478 | 300 |
| Minor (2-2) | 1. | 0.706 | 0.021 | 33.599 | 200 | 33.599 | 300 |

UNBRACED LENGTH LIMIT CHECK

| Buckling mode | K | L | KL/r |
|---|---|---|---|
| K1 Major Flexure | 1. | 2.119 | 58.478 |
| K1 Minor Flexure | 1. | 0.706 | 33.599 |
| K2 Major Flexure | 1. | 2.119 | 58.478 |

K2 Minor Flexure 1. 0.706 33.599

LTB 1. 0.706 33.599

STRESS CHECK FORCES & MOMENTS (Combo B.2.4-2a)

| Location | Pu | Mu33 | Mu22 | Vu2 | Vu3 | Tu |
|---|---|---|---|---|---|---|
| 2.119 | 0.001 | -0.047 | 5.326E-06 | 0.128 | 5.518E-06 | 1.140E-04 |

PMM DEMAND/CAPACITY RATIO (H1.2,H1-1b)

D/C Ratio: 0.063 = 0. + 0.063 + 0.
= (1/2)(Pr/Pc) + (Mr33/Mc33) + (Mr22/Mc22)

COMPACTNESS

| Slenderness | Lambda | Lambda_p | Lambda_r | Lambda_s | Compactness |
|---|---|---|---|---|---|
| Major/Flange | 18. | 26.973 | 35.884 | | Compact |
| /Web | 38. | 58.281 | 137.274 | | Compact |
| Minor/Flange | 18. | 58.281 | 137.274 | | Compact |
| /Web | 38. | 26.973 | 35.884 | | Slender |
| Axial/Flange | 18. | | 35.884 | | Compact |
| /Web | 38. | | 35.884 | | Slender |

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1.2,H1-1b)

| Factor | L | K1 | K2 | B1 | B2 | Cm |
|---|---|---|---|---|---|---|
| Major Bending | 1. | 1. | 1. | 1. | 1. | 1. |
| Minor Bending | 0.333 | 1. | 1. | 1. | 1. | 1. |

| | Lltb | Kltb | Cb |
|---|---|---|---|
| LTB | 0.333 | 1. | 1.082 |

| | Pu Force | phi*Pnc Capacity | phi*Pnt Capacity |
|---|---|---|---|
| Axial | 0.001 | 17.863 | 22.938 |

| | Mu Moment | phi*Mn Capacity | phi*Mn No LTB | phi*Mn Cb=1 |
|---|---|---|---|---|
| Major Moment | -0.047 | 0.743 | 0.743 | 0.743 |
| Minor Moment | 5.326E-06 | 0.392 | | |

| | Tu Moment | Tn Capacity | phi*Tn Capacity |
|---|---|---|---|
| Torsion | 1.140E-04 | 0.487 | 0.438 |

SHEAR CHECK

| | Vu Force | phi*Vn Capacity | Stress Ratio | Status Check |
|---|---|---|---|---|
| Major Shear | 0.128 | 9.017 | 0.014 | OK |
| Minor Shear | 5.518E-06 | 4.271 | 1.292E-06 | OK |

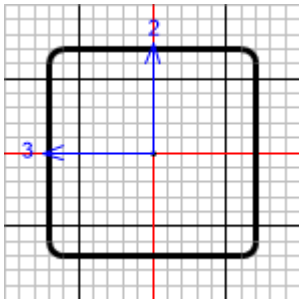
**BRACE MAXIMUM AXIAL LOADS**

| | P Comp | P Tens |
|---|---|---|
| Axial | -0.051 | 0.001 |

| TABLE: Steel Design 1 - Summary Data - AISC 360-16 | | | | | | |
|---|---|---|---|---|---|---|
| **Frame** | **DesignSect** | **DesignType** | **Ratio** | **RatioType** | **Combo** | **Location** |
| Text | Text | Text | Unitless | Text | Text | m |
| 1 | IPE200 | Column | 0.03 | PMM | B.2.4-5 | 0 |
| 2 | IPE200 | Column | 0.03 | PMM | B.2.4-5 | 0 |
| 3 | IPE200 | Beam | 0.01 | PMM | B.2.4-2a | 1.4 |
| 6 | IPE200 | Column | 0.03 | PMM | B.2.4-5 | 0 |
| 7 | IPE200 | Column | 0.03 | PMM | B.2.4-5 | 0 |
| 8 | IPE200 | Beam | 0.01 | PMM | B.2.4-2a | 1.4 |
| 11 | IPE200 | Column | 0.03 | PMM | B.2.4-5 | 0 |
| 12 | IPE200 | Column | 0.03 | PMM | B.2.4-5 | 0 |
| 13 | IPE200 | Beam | 0.01 | PMM | B.2.4-2a | 1.4 |
| 16 | IPE200 | Column | 0.03 | PMM | B.2.4-5 | 0 |
| 17 | IPE200 | Column | 0.03 | PMM | B.2.4-5 | 0 |
| 18 | IPE200 | Beam | 0.01 | PMM | B.2.4-2a | 1.4 |
| 21 | IPE200 | Column | 0.03 | PMM | B.2.4-5 | 0 |
| 22 | IPE200 | Column | 0.03 | PMM | B.2.4-5 | 0 |
| 23 | IPE200 | Beam | 0.01 | PMM | B.2.4-2a | 1.4 |
| 26 | Tub100X50X2.5mm | Brace | 0.03 | PMM | B.2.4-2a | 2.11851 |
| 29 | Tub100X50X2.5mm | Brace | 0.03 | PMM | B.2.4-2a | 0 |
| 32 | Tub100X50X2.5mm | Brace | 0.06 | PMM | B.2.4-2a | 2.11851 |
| 35 | Tub100X50X2.5mm | Brace | 0.06 | PMM | B.2.4-2a | 0 |
| 38 | Tub100X50X2.5mm | Brace | 0.06 | PMM | B.2.4-2a | 2.11851 |
| 41 | Tub100X50X2.5mm | Brace | 0.06 | PMM | B.2.4-2a | 0 |
| 44 | Tub100X50X2.5mm | Brace | 0.06 | PMM | B.2.4-2a | 2.11851 |
| 47 | Tub100X50X2.5mm | Brace | 0.06 | PMM | B.2.4-2a | 0 |
| 50 | Tub100X50X2.5mm | Brace | 0.04 | PMM | B.2.4-2a | 2.11851 |
| 53 | Tub100X50X2.5mm | Brace | 0.04 | PMM | B.2.4-2a | 0 |
| 15 | IPE200 | Beam | 0.00 | PMM | B.2.4-5 | 0 |
| 19 | IPE200 | Beam | 0.00 | PMM | B.2.4-5 | 1.3 |
| 20 | IPE200 | Beam | 0.00 | PMM | B.2.4-5 | 1.3 |
| 24 | IPE200 | Beam | 0.00 | PMM | B.2.4-5 | 1.6 |
| 25 | IPE200 | Beam | 0.00 | PMM | B.2.4-5 | 0 |
| 27 | IPE200 | Beam | 0.00 | PMM | B.2.4-5 | 1.3 |
| 28 | IPE200 | Beam | 0.00 | PMM | B.2.4-5 | 1.3 |
| 30 | IPE200 | Beam | 0.00 | PMM | B.2.4-5 | 1.6 |

Tabla 6. Resultados de indices de sobreesfuerzo de elementos de acero de pergola. ETABS.

## 6.4 Diseño de Correas 2P-100-16




AISI-16 COLD-FORMED STEEL SECTION CHECK
Units : Tonf, m, C

| | | | |
|---|---|---|---|
| Frame : 58 | Design Sect : 2P-100-16 | | Through-Fastened To Deck: No |
| X Mid : 3.25 | Design Type : Beam | | Fastener Eccentricity : N/A |
| Y Mid : 0.467 | Frame Type : Braced | | Fastening R Value : N/A |
| Z Mid : 3.13 | 2nd-Order Method: General 2nd-Order | | Design Provision : LRFD |
| Length : 1.3 | LLRF : 1. | | Consider Lateral Factor : No |
| Loc : 0. | Major Axis : 0. degrees | | |

| MATERIAL PROPERTIES | E | Fy | Fu | G | U |
|---|---|---|---|---|---|
| | 20740553.971 | 35153.481 | 45699.526 | 7977136.1 | 0.3 |

| ELEMENT/SEGMENT INFO | L | K | Lg | LNet | iBraceLoc | jBraceLoc | LhRatio | Lh |
|---|---|---|---|---|---|---|---|---|
| Major | 1.3 | 1. | 1.3 | 0. | 0. | 1.3 | 0. | 0. |
| Minor | 1.3 | 1. | 1.3 | 0. | 0. | 1.3 | 0. | 0. |
| LTB | 1.3 | 1. | 1.3 | 0. | 0. | 1.3 | 0. | 0. |
| Distortional | 1.3 | 1. | N/A | N/A | 0. | 1.3 | N/A | N/A |

| SECTION PROPERTIES | rxx | ryy | Sxx Top | Sxx Bot | Syy Left | Syy Right |
|---|---|---|---|---|---|---|
| GROSS | 0.04 | 0.04 | 1.233E-05 | 1.233E-05 | 1.233E-05 | 1.233E-05 |

| | Ax | Ay | Ixx | Iyy | J | x0 | y0 | Cw |
|---|---|---|---|---|---|---|---|---|
| GROSS | 3.84E-04 | 3.842E-04 | 6.167E-07 | 6.167E-07 | 9.703E-07 | 0. | 0. | 0. |

| RESISTANCE FACTORS | PhiTy | PhiTr | PhiC | PhiB | PhiBPipe | PhiV |
|---|---|---|---|---|---|---|
| | 0.9 | 0.75 | 0.85 | 0.9 | 0.95 | 0.95 |

STRESS CHECK FORCES & MOMENTS
COMB. RATIO EQUATION - (H1.1-2)- GOVERNS THE DESIGN

| | | Mx/Max | + | My/May | - | T/Ta |
|---|---|---|---|---|---|---|
| COMB. RATIO | 0.005 = | 0.003 | + | 0.002 | - | 0. |
| COMB. RATIO LIMIT | 1. | | | | | |

| | | Combo | P | M33 | | |
|---|---|---|---|---|---|---|
| | | M22 | V2 | V3 | | |
| DEMANDS | DCLD7 | 0.002 | -8.822E-04 | -4.377E-04 | -0.003 | -9.234E-04 |
| CAPACITIES | | 5.616 | 0.276 | 0.276 | 2.23 | 2.23 |
| DEMAND/CAPACITY | | 0. | 0.003 | 0.002 | 0.001 | 0. |

EFFECTIVE WIDTH METHOD Applicability Limits
All limits are satisfied

| AXIAL - TENSION | Area Ag | Area An | PhiTy*Yielding Tn | PhiTr*Rupture Tn | Phi*Tension Tn |
|---|---|---|---|---|---|
| | 3.842E-04 | 3.842E-04 | 12.157 | 13.17 | 12.157 |

AXIAL - COMPRESSION

| GLOBAL BUCKLING | Fcre | LambdaC | Fn | PhiC*Pne | Buckling Axes | Hole Effects |
|---|---|---|---|---|---|---|
| Flex | 101698. | 0.588 | 30418.327 | 9.935 | Geometric | Not Required |

| FcrlFlange | FcrlWeb | L0Major | RrMajor | L0Minor | RrMinor |
|---|---|---|---|---|---|
| 10305.27 | 10305.27 | 5.646 | 0.723 | 5.646 | 0.723 |

| LOCAL BUCKLING | Web | TopFlange | BotFlange | Lip | Corner | Total |
|---|---|---|---|---|---|---|
| Stiffening Condition | S | S | S | N/A | | |
| Hole Diameter, dh | 0. | N/A | N/A | N/A | N/A | |
| Hole Length, Lh | 0. | N/A | N/A | N/A | N/A | |
| k | 4. | 4. | 4. | N/A | N/A | |
| Fcrl | 10305.27 | 10305.27 | 10305.27 | N/A | N/A | |
| Lambda | 1.718 | 1.718 | 1.718 | N/A | N/A | |
| Rho | 0.508 | 0.508 | 0.508 | N/A | N/A | |
| Flat Width, w | 0.085 | 0.085 | 0.085 | N/A | N/A | |
| Effective Width, b | 0.043 | 0.043 | 0.043 | N/A | N/A | |
| Effective Area, Ae | 8.658E-05 | 4.329E-05 | 4.329E-05 | N/A | 4.304E-05 | 2.162E-04 |
| Global stress, Fn | 30418.327 | 30418.327 | 30418.327 | N/A | 30418.327 | 30418.327 |
| PhiC*Pnl | 2.239 | 1.119 | 1.119 | N/A | 1.113 | 5.616** |
| Hole at This Location | NO | | | | | |

DISTORT. BUCKLING Not Required

** INTERACTION BETWEEN MEMBER AND LOCAL BUCKLINGS governs AXIAL COMPRESSION CAPACITY

FLEXURE

| YIELDING | Fy | Sfy | SfyNet | PhiB*My | PhiB*MyNet | At Hole |
|---|---|---|---|---|---|---|
| Major | 35153. | 1.233E-05 | N/A | 0.39 | N/A | NO |
| Minor | 35153. | 1.233E-05 | N/A | 0.39 | N/A | NO |

| GLOBAL BUCKLING | Fcre | Fn | Sf | PhiB*Mne | Buckling Axes | Hole Effects |
|---|---|---|---|---|---|---|
| Major | N/A | 35153.481 | 1.233E-05 | 0.39 | Geometric | Not Required |
| Minor | N/A | 35153.481 | 1.233E-05 | 0.39 | Geometric | Not Required |

| Cb | Cs | CTF | j | Lu | Sigma_ex | Sigma_ey | Sigma_t |
|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Major | 2.182 | 1. | 1. | |
| | | 0. | 56.629 | 194414.608 | 194414.608 | 6275158.8 | | |
| | Minor | 2.188 | 1. | 1. | 0. | 56.785 | | |

| LOCAL BUCKLING | Ie | Eff. N.A. | Se | Set | PhiB*Mnl | PhiB*Set*Fy | At hole |
|---|---|---|---|---|---|---|---|
| Major | 4.9E-07 | 0.043 | 8.726E-06 | 1.134E-05 | 0.276** | 0.359 | NO |
| Minor | 4.9E-07 | 0.043 | 8.726E-06 | 1.134E-05 | 0.276** | 0.359 | NO |

| EFFECTIVE WIDTH | Web | Top Web | Bot Web | TopFlange | BotFlange | Top Lip | Bot Lip |
|---|---|---|---|---|---|---|---|
| Major | | | | | | | |
| Stiffening Condition | S | N/A | N/A | S | S | N/A | N/A |
| Stress Condition | Grad | N/A | N/A | Tension | UniComp | N/A | N/A |
| Buckling stress, Fn | 35153.481 | N/A | N/A | 35153.481 | 35153.481 | N/A | N/A |
| f1 | -30580.654 | N/A | N/A | N/A | N/A | N/A | N/A |
| f2 | 22489.032 | N/A | N/A | N/A | N/A | N/A | N/A |
| f | -30580.654 | N/A | N/A | 27061.859 | -35153.481 | N/A | N/A |
| Psi | 0.735 | N/A | N/A | N/A | N/A | N/A | N/A |
| k | 17.924 | N/A | N/A | N/A | 4. | N/A | N/A |
| Fcrl | 46176.678 | N/A | N/A | N/A | 10305.27 | N/A | N/A |
| Lambda | 0.814 | N/A | N/A | N/A | 1.847 | N/A | N/A |
| Rho | 0.897 | N/A | N/A | N/A | 0.477 | N/A | N/A |
| Flat Width, w | 0.085 | N/A | N/A | 0.085 | 0.085 | N/A | N/A |
| Effective Width, b (be) | 0.076 | N/A | N/A | 0.085 | 0.041 | N/A | N/A |
| Effective Width, b1 | 0.02 | N/A | N/A | N/A | N/A | N/A | N/A |
| Effective Width, b2 | 0.038 | N/A | N/A | N/A | N/A | N/A | N/A |
| ho/bo | 1. | N/A | N/A | N/A | N/A | N/A | N/A |

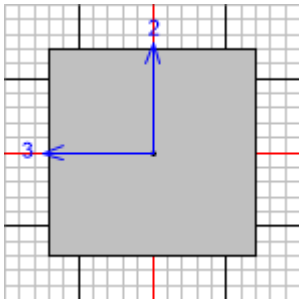
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Minor | | | | | | | |
| Stiffening Condition | S | | | S | S | N/A | N/A |
| Stress Condition | UniComp | | | Grad | Grad | N/A | N/A |
| Buckling stress, Fn | 35153.481 | | | 35153.481 | 35153.481 | 35153.481 | 35153.481 |
| f1 | N/A | | | -30580.654 | -30580.654 | N/A | N/A |
| f2 | N/A | | | 22489.032 | 22489.032 | N/A | N/A |
| f | -35153.481 | | | -30580.654 | -30580.654 | N/A | N/A |
| Psi | N/A | | | 0.735 | 0.735 | N/A | N/A |
| k | 4. | | | 17.924 | 17.924 | N/A | N/A |
| Fcrl | 10305.27 | | | 46176.678 | | 46176.678 | N/A |
| Lambda | 1.847 | | | 0.814 | | 0.814 | N/A |
| Rho | 0.477 | | | 0.897 | | 0.897 | N/A |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Flat Width, w | 0.085 | | | |
| | | | 0.085 | 0.085 | N/A | N/A | | | |
| | | Effective Width, b (be) | | 0.041 | | | | 0.076 | |
| 0.076 | N/A | N/A | | | | | | | |
| | Effective Width, b1 | | N/A | | | N/A | N/A | | |
| N/A | N/A | | | | | | | | |
| | Effective Width, b2 | | N/A | | | N/A | N/A | | |
| N/A | N/A | | | | | | | | |
| | ho/bo | | N/A | | | N/A | N/A | | |
| N/A | N/A | | | | | | | | |

| SHEAR | kv | Fcr | LambdaV | Vcr | Fy | Aw | Vy | PhiV*Vn |
|---|---|---|---|---|---|---|---|---|
| At Hole | | | | | | | | |
| Major | 5.34 | 13757.536 | 1.238 | 2.347 | 35153.481 | 1.706E-04 | 3.598 | 2.23 |
| NO | | | | | | | | |
| Minor | 5.34 | 13757.536 | 1.238 | 2.347 | 35153.481 | 1.706E-04 | 3.598 | 2.23 |
| NO | | | | | | | | |

# 7. DISEÑO DE ZAPATAS DE CIMENTACION

## 7.1 Diseño de Vigas de Cimentacion 30X30




ACI 318-19 BEAM SECTION DESIGN Type:Sway Special Units: Tonf, cm, C (Summary)

| | | | |
|---|---|---|---|
| Element : 9 | D=30. | B=30. | bf=30. |
| Section ID : V30X30 | ds=0. | dct=6. | dcb=6. |
| Combo ID : B.2.4-7 | E=219.5 | fc=0.211 | Lt.Wt. Fac.=1. |
| Station Loc : 280. | L=280. | Fy=4.218 | fys=4.218 |

Phi(Bending): 0.9
Phi(Shear): 0.75
Phi(Seis Shear): 0.6
Phi(Torsion): 0.75

Design Moments, M3

| Positive Moment | Negative Moment | Special +Moment | Special -Moment | Axial Force |
|---|---|---|---|---|
| 7.886 | -11.316 | 7.886 | -11.316 | 0. |

Flexural Reinforcement for Moment, M3

| | Design Moment | Design Pu | Required Rebar | +Moment Rebar | -Moment Rebar | Minimum Rebar |
|---|---|---|---|---|---|---|
| Top (+2 Axis) | -11.316 | 0. | 2.4 | 0. | 0.124 | 2.4 |
| Bottom (-2 Axis) | 7.886 | 0. | 2.4 | 0.087 | 0. | 2.4 |

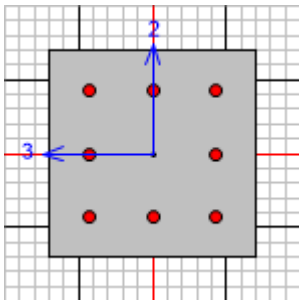
Shear Reinforcement for Shear, V2

| Rebar Av/s | Shear Vu | Shear phi*Vc | Shear phi*Vs | Shear Vp |
|---|---|---|---|---|
| 0.031 | 2.336 | 0. | 2.336 | 2.063 |

Reinforcement for Torsion, T

| Rebar At/s | Rebar Al | Factored Tu | Design Tu | Threshold Phi*Tth | Area Ao | Perimeter Ph |
|---|---|---|---|---|---|---|
| 0. | 0. | 0.097 | 0.097 | 19.495 | 378.787 | 84.44 |

## 7.2 Diseño de pedestales 30X30




ACI 318-19 COLUMN SECTION DESIGN Type: Sway Special Units: Tonf, cm, C (Summary)

| | | | |
|---|---|---|---|
| Element : 83 | B=30. | D=30. | dc=5.746 |
| Section ID : C30X30 | E=219.5 | fc=0.211 | Lt.Wt. Fac.=1. |
| Combo ID : B.2.4-7 | L=100. | Fy=4.218 | fys=4.218 |
| Station Loc : 100. | RLLF=1. | | |

| | | | |
|---|---|---|---|
| Phi(Compression-Spiral): | 0.75 | Overstrength Factor: | 1.25 |
| Phi(Compression-Tied): | 0.65 | | |
| Phi(Tension Controlled): | 0.9 | | |
| Phi(Shear): | 0.75 | | |
| Phi(Seismic Shear): | 0.6 | | |
| Phi(Joint Shear): | 0.85 | | |

AXIAL FORCE & BIAXIAL MOMENT DESIGN FOR PU, M2, M3

| Rebar Area | Design Pu | Design M2 | Design M3 | Minimum M2 | Minimum M3 |
|---|---|---|---|---|---|
| 9. | 0.428 | -126.064 | -3.094 | 1.037 | 1.037 |

AXIAL FORCE & BIAXIAL MOMENT FACTORS

| | Cm Factor | Delta_ns Factor | Delta_s Factor | K Factor | L Length |
|---|---|---|---|---|---|
| Major Bending(M3) | 0.702 | 1. | 1. | 1. | 100. |
| Minor Bending(M2) | 0.682 | 1. | 1. | 1. | 100. |

SHEAR DESIGN FOR V2,V3

| | Rebar Av/s | Shear Vu | Shear phi*Vc | Shear phi*Vs | Shear Vp |
|---|---|---|---|---|---|
| Major Shear(V2) | 0.025 | 0.146 | 3.397 | 1.535 | 0. |
| Minor Shear(V3) | 0.025 | 1.605 | 0. | 1.918 | 1.605 |

## 7.3 Presiones de contacto con suelo de cimentación

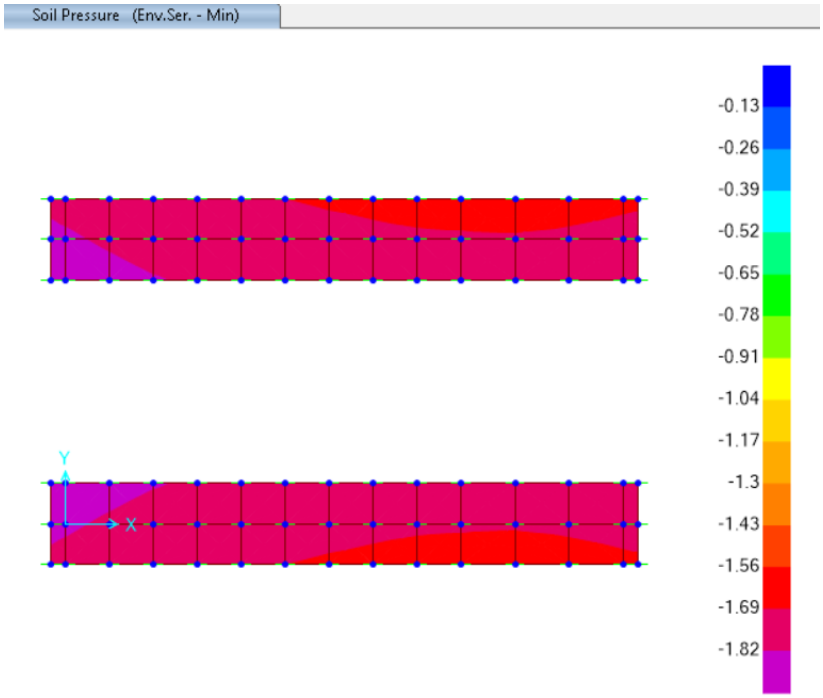



Figura 9. Resultados de presiones de contacto para envolvente de combinaciones de servicio (Ton/m$^2$). SAP2000.

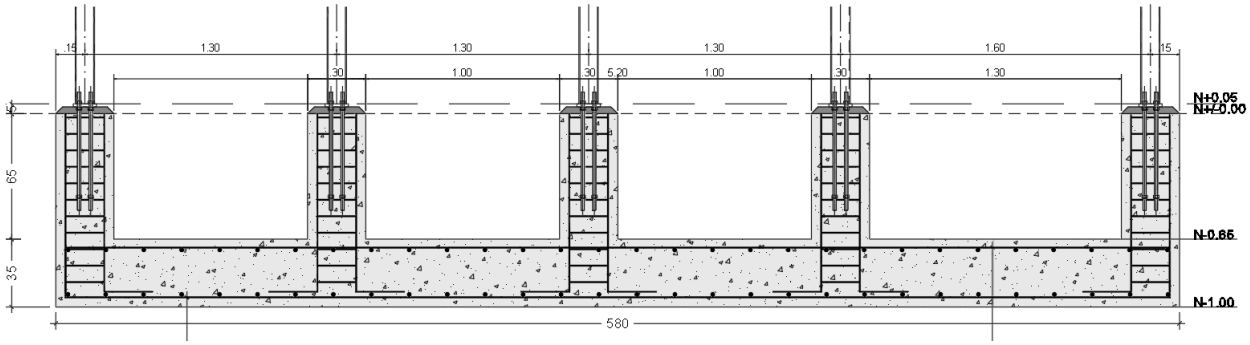



Figura 10. Seccion en alzada de zapatas y acero de refuerzo. Ver plano.

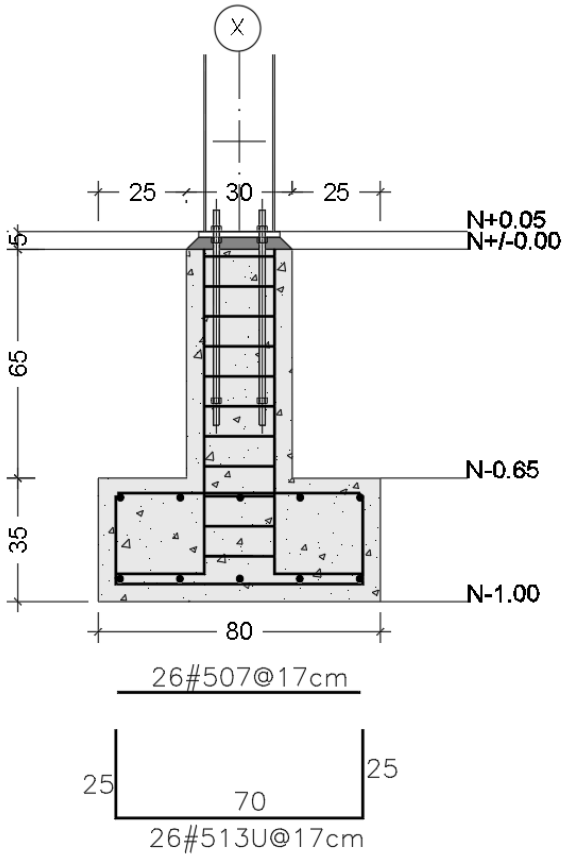



Figura 11. Detalle de refuerzo de zapatas. Ver plano.

| TIPO CIMENTACIÓN | DATOS | | | | | | | | CAP. CARGA | | MOD. VERT. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Df | B | L | γ | $q_{carga}$ | $S_u$-c´ | $\phi_u$-$\phi$´ | NF | $q_u$ | $q_{adm}$ | $k_v$ |
| | m | m | m | T/m³ | T/m³ | kg/cm² | º | m | T/m² | | T/m³ |
| | | 1.00 | 1.00 | | | | | | 44.1 | 14.7 | 821 |
| ZAPATA RECTANGULAR | 1.00 | 0.50 | 0.75 | 1.78 | 1.78 | 0.07 | 21.5 | 10.0 | 35.8 | 11.9 | 1641 |
| | | 0.60 | 0.90 | | | | | | 36.8 | 12.3 | 1368 |
| | | 0.70 | 1.05 | | | | | | 37.8 | 12.6 | 1172 |
| | | 0.80 | 1.20 | | | | | | 38.8 | 12.9 | 1026 |
| | | 0.90 | 1.35 | | | | | | 39.8 | 13.3 | 912 |
| | | 1.00 | 1.50 | | | | | | 40.8 | 13.6 | 821 |
| ZAPATA CONTINUA | 1.00 | 0.25 | | 1.78 | 1.78 | 0.07 | 21.5 | 10.0 | 27.1 | 9.0 | 3283 |
| | | 0.30 | | | | | | | 27.6 | 9.2 | 2736 |
| | | 0.35 | | | | | | | 28.1 | 9.4 | 2345 |
| | | 0.40 | | | | | | | 28.6 | 9.5 | 2052 |
| | | 0.45 | | | | | | | 29.1 | 9.7 | 1824 |
| | | 1.00 | | | | | | | 29.6 | 9.9 | 1641 |

Tabla 7. Sumatoria de fuerzas de reaccion en la base de las columnas. SAP2000.

# 8. DISEÑO DE VIGAS DE CIMENTACION

Para vigas sobre el terreno diseñadas para actuar como amarres horizontales entre las zapatas, según C.21.12.3. Las vigas sobre el terreno que estén sometidas a flexión por las columnas que son parte del sistema de resistencia ante fuerzas sísmicas deben cumplir con lo indicado en C.21.5.

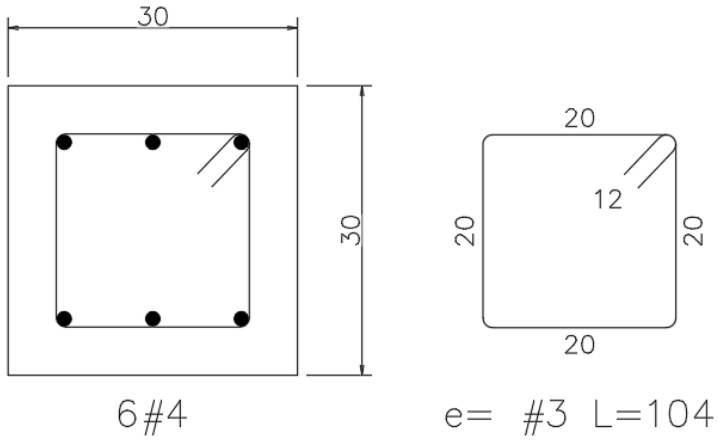
En cualquier sección de un elemento a flexión, excepto por lo dispuesto en C.10.5.3, para el refuerzo tanto superior como inferior, el área de refuerzo no debe ser menor que:

$$A_{s,min} = \frac{0.25\sqrt{f'_c}}{f_y} b_w d \qquad \text{(C.10-3)}$$

$$1.4 b_w d / f_y$$

**Para vigas de 30X30:**

$$A_{s,\,min} = 0.0033 b_w d = 2.38\ cm^2$$




Recubrimiento: 5 cm.

# 9. REQUISITOS DE PROTECCION CONTRA FUEGO

## GRUPO DE OCUPACIÓN I-3 (Educacion)

De acuerdo con J.3.3.3.2 - Edificaciones clasificadas en el subgrupo de ocupación I-3 (Educación), que tengan un solo piso y cuya área construida no exceda 1 200 m² NO requiere proteccion contra fuego.

# 10. DISEÑO DE CONEXIÓN PLACA BASE

## Steel connections

**Results**

---

**Connection name : Fixed biaxial BP**
**Connection ID : 1**

---

Family: Column - Base (CB)
Type: Base plate
Design code: AISC 360-16 LRFD, ACI 318-08

**DEMANDS**

| Description | Pu [T] | Mu22 [T*m] | Mu33 [T*m] | Vu2 [T] | Vu3 [T] | Load type |
|---|---|---|---|---|---|---|
| DL | 0.68 | 0.00 | 0.00 | 0.00 | 0.00 | Design |
| Lr | 1.02 | 0.00 | 0.00 | 0.00 | 0.00 | Design |
| W | 0.81 | 0.00 | 0.00 | 0.00 | 0.00 | Design |
| D1 | 0.95 | 0.00 | 0.00 | 0.00 | 0.00 | Design |
| D2 | 1.33 | 0.00 | 0.00 | 0.00 | 0.00 | Design |
| D3 | 2.45 | 0.00 | 0.00 | 0.00 | 0.00 | Design |
| D4 | 1.22 | 0.00 | 0.00 | 0.00 | 0.00 | Design |
| D5 | 2.85 | 0.00 | 0.00 | 0.00 | 0.00 | Design |
| D6 | 1.63 | 0.00 | 0.00 | 0.00 | 0.00 | Design |
| D7 | 2.14 | 0.00 | 0.00 | 0.00 | 0.00 | Design |
| D8 | 1.42 | 0.00 | 0.00 | 0.00 | 0.00 | Design |

**Design for major axis**
**Base plate (AISC 360-16 LRFD)**

**GEOMETRIC CONSIDERATIONS**

| Dimensions References | Unit | Value | Min. value | Max. value | Sta. |
|---|---|---|---|---|---|
| Base plate | | | | | |
| Distance from anchor to edge | [cm] | 2.21 | 0.64 | -- | ✔ |
| Weld size table J2.4 | [1/16in] | 5 | 2 | -- | ✔ |

**DESIGN CHECK**

| Verification | Unit | Capacity | Demand | Ctrl EQ | Ratio | References |
|---|---|---|---|---|---|---|
| Concrete base | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Axial bearing | | | [Ton/cm2] | 0.23 | 0.00 | DL |
| Base plate | | | | | | |
| Flexural yielding (bearing interface) | [Ton*m/m] | 0.57 | 0.57 | 0.00 DL | 0.00 | |
| Flexural yielding (tension interface)<br>DG1 Eq. 3.3.13 | [Ton*m/m] | 0.57 | 0.36 | D5 | 0.63 | |
| Column | | | | | | |
| Weld capacity<br>HSS Manual p. 7-10<br>Sec. J2.5,<br>Sec. J2.4, | [Ton/m] | 186.45 | 11.72 | D5 | 0.06 | p. 8-9, |
| Elastic method weld shear and axial capacity<br>HSS Manual p. 7-10<br>Sec. J2.5,<br>Sec. J2.4 | [Ton/m] | 186.45 | 7.69 | D5 | 0.04 | p. 8-9, |
| **Ratio** | **0.63** | | | | | |

## Design for minor axis
## Base plate (AISC 360-16 LRFD)

**GEOMETRIC CONSIDERATIONS**

| Dimensions<br>References | Unit | Value | Min. value | Max. value | Sta. |
|---|---|---|---|---|---|
| Base plate | | | | | |
| Distance from anchor to edge | [cm] | 2.21 | 0.64 | -- | ✔ |
| Weld size<br>table J2.4 | [1/16in] | 5 | 2 | -- | ✔ |

**DESIGN CHECK**

| Verification<br>References | Unit | Capacity | Demand | Ctrl EQ | Ratio | |
|---|---|---|---|---|---|---|
| Concrete base | | | | | | |
| Axial bearing<br>DG1 3.1.1; | [Ton/cm2] | 0.23 | 0.00 | DL | 0.00 | |
| Base plate | | | | | | |
| Flexural yielding (bearing interface)<br>DG1 Eq. 3.3.13 | [Ton*m/m] | 0.57 | 0.00 | DL | 0.00 | |
| Flexural yielding (tension interface)<br>DG1 Eq. 3.3.13 | [Ton*m/m] | 0.57 | 0.36 | D5 | 0.63 | |
| Column | | | | | | |
| Weld capacity<br>HSS Manual p. 7-10<br>Sec. J2.5,<br>Sec. J2.4, | [Ton/m] | 186.45 | 11.72 | D5 | 0.06 | p. 8-9, |
| Elastic method weld shear and axial capacity<br>HSS Manual p. 7-10<br>Sec. J2.5,<br>Sec. J2.4 | [Ton/m] | 186.45 | 7.69 | D5 | 0.04 | p. 8-9, |
| **Ratio** | **0.63** | | | | | |

## Major axis
## Anchors

**GEOMETRIC CONSIDERATIONS**

| Dimensions | | | | Unit | Value | Min. value | Max |
|---|---|---|---|---|---|---|---|
| Anchors | | | | | | | |
| Anchor spacing<br>Sec. D.8.1 | [cm] | 14.00 | 6.35 | -- | ✔ | | |
| Concrete cover<br>Sec. 7.7.1 | [cm] | 42.21 | 7.62 | -- | ✔ | | |
| Effective length | [cm] | 11.03 | -- | 13.97 | ✔ | | |

**DESIGN CHECK**

| Verification<br>References | Unit | Capacity | Demand | Ctrl EQ | Ratio |
|---|---|---|---|---|---|
| Anchor tension<br>Eq. D-3 | [Ton] | 4.46 | 0.71 | D5 | 0.16 |
| Breakout of anchor in tension<br>Eq. D-4,<br><br>Sec. D.4.1.1 | [Ton] | 4.08 | 0.71 | D5 | 0.18 |
| Breakout of group of anchors in tension<br>Eq. D-5,<br><br>Sec. D.4.1.1 | [Ton] | 8.77 | 2.85 | D5 | 0.33 |
| Pullout of anchor in tension<br>Sec. D.4.1.1 | [Ton] | 4.85 | 0.71 | D5 | 0.15 |
| Anchor shear<br>Eq. D-20 | [Ton] | 2.32 | 0.00 | DL | 0.00 |
| Breakout of anchor in shear<br>Sec. D.4.1.1 | [Ton] | 4.70 | 0.00 | DL | 0.00 |
| Pryout of anchor in shear<br>Eq. D-4,<br><br>Sec. D.4.1.1 | [Ton] | 8.15 | 0.00 | DL | 0.00 |
| Pryout of group of anchors in shear<br>Eq. D-5,<br><br>Sec. D.4.1.1 | [Ton] | 17.53 | 0.00 | DL | 0.00 |
| **Ratio** | **0.33** | | | | |

## Minor axis
## Anchors

**GEOMETRIC CONSIDERATIONS**

| Dimensions<br>References | Unit | Value | Min. value | Max. value | Sta. |
|---|---|---|---|---|---|
| Anchors | | | | | |
| Anchor spacing<br>Sec. D.8.1 | [cm] | 14.00 | 6.35 | -- | ✔ |
| Concrete cover<br>Sec. 7.7.1 | [cm] | 42.21 | 7.62 | -- | ✔ |
| Effective length | [cm] | 11.03 | -- | 13.97 | ✔ |

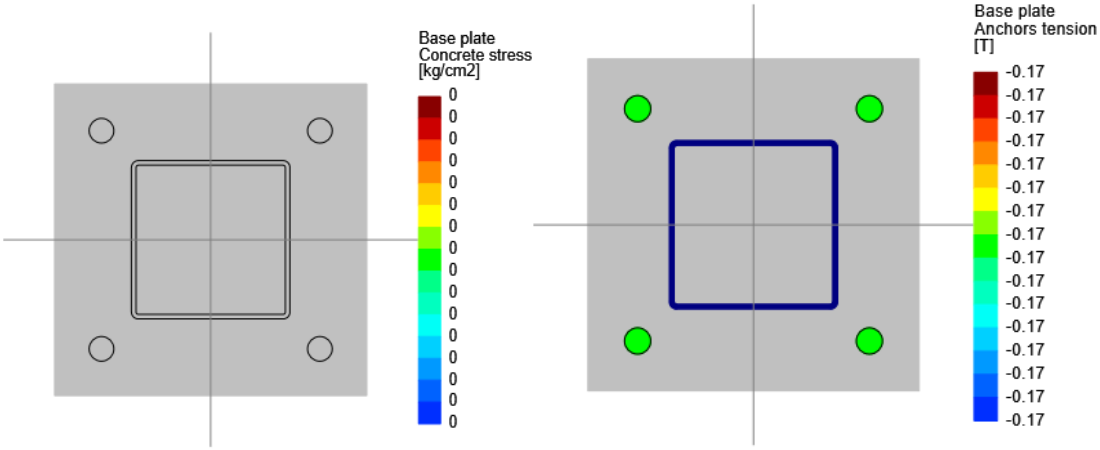
**DESIGN CHECK**

| Verification<br>References | Unit | Capacity | Demand | Ctrl EQ | Ratio | |
|---|---|---|---|---|---|---|
| Anchor tension<br>Eq. D-3 | [Ton] | 4.46 | 0.71 | D5 | 0.16 | |
| Breakout of anchor in tension | [Ton] | 4.08 | 0.71 | D5 | 0.18 | Eq. D-4,<br>Sec. D.4.1.1 |
| Breakout of group of anchors in tension | [Ton] | 8.77 | 2.85 | D5 | 0.33 | Eq. D-5,<br>Sec. D.4.1.1 |
| Pullout of anchor in tension | [Ton] | 4.85 | 0.71 | D5 | 0.15 | Sec. D.4.1.1 |
| Anchor shear | [Ton] | 2.32 | 0.00 | DL | 0.00 | Eq. D-20 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Breakout of anchor in shear | [Ton] | 4.70 | 0.00 | DL | | |
| Pryout of anchor in shear | [Ton] | 8.15 | 0.00 | DL | | |
| | | Sec. D.4.1.1 | | | | |
| Pryout of group of anchors in shear Eq. D-5, Sec. D.4.1.1 | [Ton] | 17.53 | 0.00 | DL | 0.00 | |

| | |
|---|---|
| **Ratio** | **0.33** |
| **Global critical strength ratio** | **0.63** |

**Biaxial**
**Maximum compression (DL)**

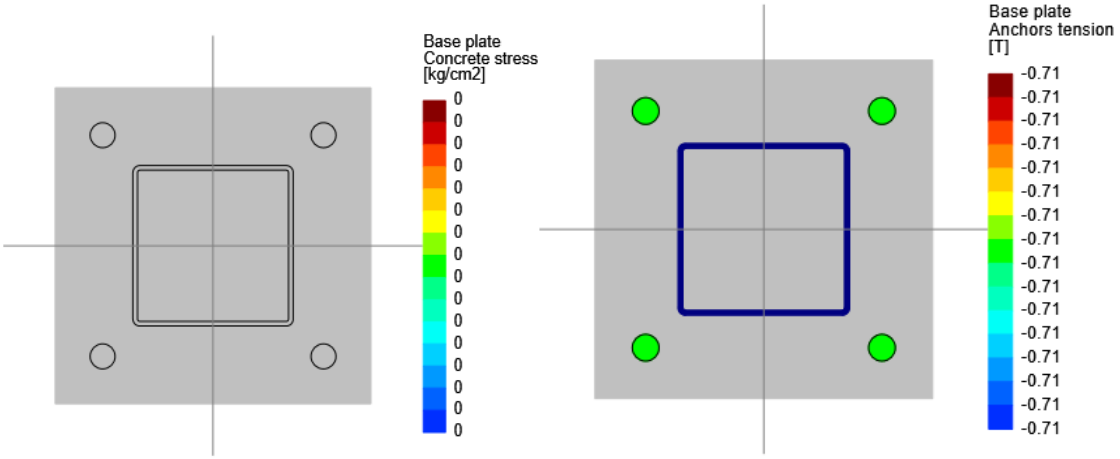



| | | |
|---|---|---|
| Maximum bearing pressure | 0.00 | [kg/cm2] |
| Minimum bearing pressure | 0.00 | [kg/cm2] |
| Maximum anchor tension | 0.17 | [T] |
| Minimum anchor tension | 0.17 | [T] |
| Neutral axis angle | 0.00 | [deg] |
| Bearing length | -1E32 | [cm] |

**Anchors tensions**

| Anchor | Transverse [cm] | Longitudinal [cm] | Shear [T] | Tension [T] |
|---|---|---|---|---|
| 1 | -7.00 | -7.00 | 0.00 | 0.17 |
| 2 | -7.00 | 7.00 | 0.00 | 0.17 |
| 3 | 7.00 | 7.00 | 0.00 | 0.17 |
| 4 | 7.00 | -7.00 | 0.00 | 0.17 |

**Maximum tension (D5)**



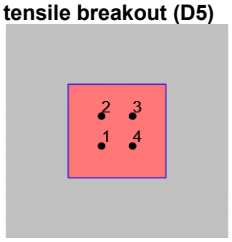

| | | |
|---|---|---|
| Maximum bearing pressure | 0.00 | [kg/cm2] |
| Minimum bearing pressure | 0.00 | [kg/cm2] |
| Maximum anchor tension | 0.71 | [T] |
| Minimum anchor tension | 0.71 | [T] |
| Neutral axis angle | 0.00 | [deg] |
| Bearing length | -1E32 | [cm] |

**Anchors tensions**

| Anchor | Transverse [cm] | Longitudinal [cm] | Shear [T] | Tension [T] |
|---|---|---|---|---|
| 1 | -7.00 | -7.00 | 0.00 | 0.71 |
| 2 | -7.00 | 7.00 | 0.00 | 0.71 |
| 3 | 7.00 | 7.00 | 0.00 | 0.71 |
| 4 | 7.00 | -7.00 | 0.00 | 0.71 |

## Major axis

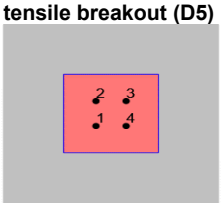
**Results for tensile breakout (D5)**




| Group | Area [cm2] | Tension [T] | Anchors |
|---|---|---|---|
| 1 | 1936.00 | 2.85 | 1, 2, 3, 4 |

## Minor axis

**Results for tensile breakout (D5)**




| Group | Area [cm2] | Tension [T] | Anchors |
|---|---|---|---|
| 1 | 1936.00 | 2.85 | 1, 2, 3, 4 |

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# ANEXO 1
# REPORTE DE ENTRADA Y SALIDA DE DATOS

## 1. Model geometry

This section provides model geometry information, including items such as joint coordinates, joint restraints, and element connectivity.

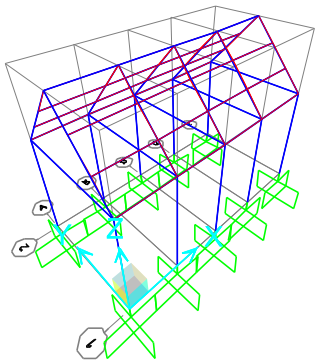


**Figure 1: Finite element model**

## *1.1. Joint coordinates*

### Table 1: Joint Coordinates

**Table 1: Joint Coordinates**

| Joint | CoordSys | CoordType | GlobalX | GlobalY | GlobalZ |
|---|---|---|---|---|---|
| | | | m | m | m |
| 1 | GLOBAL | Cartesian | 0. | 0. | 0. |
| 2 | GLOBAL | Cartesian | 0. | 0. | 2.6 |
| 3 | GLOBAL | Cartesian | 0. | 2.8 | 0. |
| 4 | GLOBAL | Cartesian | 0. | 2.8 | 2.6 |
| 5 | GLOBAL | Cartesian | 0. | 1.4 | 4.19 |
| 6 | GLOBAL | Cartesian | 1.3 | 0. | 0. |
| 7 | GLOBAL | Cartesian | 1.3 | 0. | 2.6 |
| 8 | GLOBAL | Cartesian | 1.3 | 2.8 | 0. |
| 9 | GLOBAL | Cartesian | 1.3 | 2.8 | 2.6 |
| 10 | GLOBAL | Cartesian | 1.3 | 1.4 | 4.19 |
| 11 | GLOBAL | Cartesian | 2.6 | 0. | 0. |
| 12 | GLOBAL | Cartesian | 2.6 | 0. | 2.6 |
| 13 | GLOBAL | Cartesian | 2.6 | 2.8 | 0. |
| 14 | GLOBAL | Cartesian | 2.6 | 2.8 | 2.6 |
| 15 | GLOBAL | Cartesian | 2.6 | 1.4 | 4.19 |
| 16 | GLOBAL | Cartesian | 3.9 | 0. | 0. |
| 17 | GLOBAL | Cartesian | 3.9 | 0. | 2.6 |
| 18 | GLOBAL | Cartesian | 3.9 | 2.8 | 0. |
| 19 | GLOBAL | Cartesian | 3.9 | 2.8 | 2.6 |
| 20 | GLOBAL | Cartesian | 3.9 | 1.4 | 4.19 |
| 21 | GLOBAL | Cartesian | 5.5 | 0. | 0. |
| 22 | GLOBAL | Cartesian | 5.5 | 0. | 2.6 |
| 23 | GLOBAL | Cartesian | 5.5 | 2.8 | 0. |
| 24 | GLOBAL | Cartesian | 5.5 | 2.8 | 2.6 |
| 25 | GLOBAL | Cartesian | 5.5 | 1.4 | 4.19 |
| 26 | GLOBAL | Cartesian | 0. | 0.46667 | 3.13 |

Table 1: Joint Coordinates

| Joint | CoordSys | CoordType | GlobalX | GlobalY | GlobalZ |
|---|---|---|---|---|---|
| | | | m | m | m |
| 27 | GLOBAL | Cartesian | 0. | 0.93333 | 3.66 |
| 28 | GLOBAL | Cartesian | 0. | 1.86667 | 3.66 |
| 29 | GLOBAL | Cartesian | 0. | 2.33333 | 3.13 |
| 30 | GLOBAL | Cartesian | 1.3 | 0.46667 | 3.13 |
| 31 | GLOBAL | Cartesian | 1.3 | 0.93333 | 3.66 |
| 32 | GLOBAL | Cartesian | 1.3 | 1.86667 | 3.66 |
| 33 | GLOBAL | Cartesian | 1.3 | 2.33333 | 3.13 |
| 34 | GLOBAL | Cartesian | 2.6 | 0.46667 | 3.13 |
| 35 | GLOBAL | Cartesian | 2.6 | 0.93333 | 3.66 |
| 36 | GLOBAL | Cartesian | 2.6 | 1.86667 | 3.66 |
| 37 | GLOBAL | Cartesian | 2.6 | 2.33333 | 3.13 |
| 38 | GLOBAL | Cartesian | 3.9 | 0.46667 | 3.13 |
| 39 | GLOBAL | Cartesian | 3.9 | 0.93333 | 3.66 |
| 40 | GLOBAL | Cartesian | 3.9 | 1.86667 | 3.66 |
| 41 | GLOBAL | Cartesian | 3.9 | 2.33333 | 3.13 |
| 42 | GLOBAL | Cartesian | 5.5 | 0.46667 | 3.13 |
| 43 | GLOBAL | Cartesian | 5.5 | 0.93333 | 3.66 |
| 44 | GLOBAL | Cartesian | 5.5 | 1.86667 | 3.66 |
| 45 | GLOBAL | Cartesian | 5.5 | 2.33333 | 3.13 |

## *1.2. Joint restraints*

### Table 2: Joint Restraint Assignments

Table 2: Joint Restraint Assignments

| Joint | U1 | U2 | U3 | R1 | R2 | R3 |
|---|---|---|---|---|---|---|
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 3 | Yes | Yes | Yes | Yes | Yes | Yes |
| 6 | Yes | Yes | Yes | Yes | Yes | Yes |
| 8 | Yes | Yes | Yes | Yes | Yes | Yes |
| 11 | Yes | Yes | Yes | Yes | Yes | Yes |
| 13 | Yes | Yes | Yes | Yes | Yes | Yes |
| 16 | Yes | Yes | Yes | Yes | Yes | Yes |
| 18 | Yes | Yes | Yes | Yes | Yes | Yes |
| 21 | Yes | Yes | Yes | Yes | Yes | Yes |
| 23 | Yes | Yes | Yes | Yes | Yes | Yes |

## *1.3. Element connectivity*

### Table 3: Connectivity - Frame

Table 3: Connectivity - Frame

| Frame | JointI | JointJ | Length |
|---|---|---|---|
| | | | m |
| 1 | 1 | 2 | 2.6 |
| 2 | 3 | 4 | 2.6 |
| 3 | 2 | 4 | 2.8 |
| 6 | 6 | 7 | 2.6 |
| 7 | 8 | 9 | 2.6 |
| 8 | 7 | 9 | 2.8 |
| 11 | 11 | 12 | 2.6 |
| 12 | 13 | 14 | 2.6 |
| 13 | 12 | 14 | 2.8 |
| 15 | 4 | 9 | 1.3 |
| 16 | 16 | 17 | 2.6 |
| 17 | 18 | 19 | 2.6 |
| 18 | 17 | 19 | 2.8 |
| 19 | 9 | 14 | 1.3 |
| 20 | 14 | 19 | 1.3 |
| 21 | 21 | 22 | 2.6 |
| 22 | 23 | 24 | 2.6 |
| 23 | 22 | 24 | 2.8 |
| 24 | 19 | 24 | 1.6 |
| 25 | 2 | 7 | 1.3 |
| 26 | 2 | 5 | 2.11851 |
| 27 | 7 | 12 | 1.3 |
| 28 | 12 | 17 | 1.3 |
| 29 | 5 | 4 | 2.11851 |
| 30 | 17 | 22 | 1.6 |
| 32 | 7 | 10 | 2.11851 |
| 35 | 10 | 9 | 2.11851 |
| 38 | 12 | 15 | 2.11851 |
| 41 | 15 | 14 | 2.11851 |
| 44 | 17 | 20 | 2.11851 |
| 47 | 20 | 19 | 2.11851 |
| 50 | 22 | 25 | 2.11851 |
| 53 | 25 | 24 | 2.11851 |
| 56 | 26 | 30 | 1.3 |
| 57 | 30 | 34 | 1.3 |
| 58 | 34 | 38 | 1.3 |
| 59 | 38 | 42 | 1.6 |
| 60 | 27 | 31 | 1.3 |
| 61 | 31 | 35 | 1.3 |
| 62 | 35 | 39 | 1.3 |
| 63 | 39 | 43 | 1.6 |
| 64 | 5 | 10 | 1.3 |
| 65 | 10 | 15 | 1.3 |
| 66 | 15 | 20 | 1.3 |
| 67 | 20 | 25 | 1.6 |
| 68 | 28 | 32 | 1.3 |
| 69 | 32 | 36 | 1.3 |
| 70 | 36 | 40 | 1.3 |
| 71 | 40 | 44 | 1.6 |
| 72 | 29 | 33 | 1.3 |
| 73 | 33 | 37 | 1.3 |
| 74 | 37 | 41 | 1.3 |

Table 3: Connectivity - Frame

| Frame | JointI | JointJ | Length m |
|---|---|---|---|
| 75 | 41 | 45 | 1.6 |

## Table 4: Frame Section Assignments

Table 4: Frame Section Assignments

| Frame | AnalSect | DesignSect | MatProp |
|---|---|---|---|
| 1 | IPE200 | IPE200 | Default |
| 2 | IPE200 | IPE200 | Default |
| 3 | IPE200 | IPE200 | Default |
| 6 | IPE200 | IPE200 | Default |
| 7 | IPE200 | IPE200 | Default |
| 8 | IPE200 | IPE200 | Default |
| 11 | IPE200 | IPE200 | Default |
| 12 | IPE200 | IPE200 | Default |
| 13 | IPE200 | IPE200 | Default |
| 15 | IPE200 | IPE200 | Default |
| 16 | IPE200 | IPE200 | Default |
| 17 | IPE200 | IPE200 | Default |
| 18 | IPE200 | IPE200 | Default |
| 19 | IPE200 | IPE200 | Default |
| 20 | IPE200 | IPE200 | Default |
| 21 | IPE200 | IPE200 | Default |
| 22 | IPE200 | IPE200 | Default |
| 23 | IPE200 | IPE200 | Default |
| 24 | IPE200 | IPE200 | Default |
| 25 | IPE200 | IPE200 | Default |
| 26 | Tub100X50X2.5 mm | Tub100X50X2.5 mm | Default |
| 27 | IPE200 | IPE200 | Default |
| 28 | IPE200 | IPE200 | Default |
| 29 | Tub100X50X2.5 mm | Tub100X50X2.5 mm | Default |
| 30 | IPE200 | IPE200 | Default |
| 32 | Tub100X50X2.5 mm | Tub100X50X2.5 mm | Default |
| 35 | Tub100X50X2.5 mm | Tub100X50X2.5 mm | Default |
| 38 | Tub100X50X2.5 mm | Tub100X50X2.5 mm | Default |
| 41 | Tub100X50X2.5 mm | Tub100X50X2.5 mm | Default |
| 44 | Tub100X50X2.5 mm | Tub100X50X2.5 mm | Default |
| 47 | Tub100X50X2.5 mm | Tub100X50X2.5 mm | Default |
| 50 | Tub100X50X2.5 mm | Tub100X50X2.5 mm | Default |
| 53 | Tub100X50X2.5 mm | Tub100X50X2.5 mm | Default |
| 56 | 2P-100-16 | 2P-100-16 | Default |

Table 4: Frame Section Assignments

| Frame | AnalSect | DesignSect | MatProp |
|---|---|---|---|
| 57 | 2P-100-16 | 2P-100-16 | Default |
| 58 | 2P-100-16 | 2P-100-16 | Default |
| 59 | 2P-100-16 | 2P-100-16 | Default |
| 60 | 2P-100-16 | 2P-100-16 | Default |
| 61 | 2P-100-16 | 2P-100-16 | Default |
| 62 | 2P-100-16 | 2P-100-16 | Default |
| 63 | 2P-100-16 | 2P-100-16 | Default |
| 64 | 2P-100-16 | 2P-100-16 | Default |
| 65 | 2P-100-16 | 2P-100-16 | Default |
| 66 | 2P-100-16 | 2P-100-16 | Default |
| 67 | 2P-100-16 | 2P-100-16 | Default |
| 68 | 2P-100-16 | 2P-100-16 | Default |
| 69 | 2P-100-16 | 2P-100-16 | Default |
| 70 | 2P-100-16 | 2P-100-16 | Default |
| 71 | 2P-100-16 | 2P-100-16 | Default |
| 72 | 2P-100-16 | 2P-100-16 | Default |
| 73 | 2P-100-16 | 2P-100-16 | Default |
| 74 | 2P-100-16 | 2P-100-16 | Default |
| 75 | 2P-100-16 | 2P-100-16 | Default |

## Table 5: Connectivity - Area

Table 5: Connectivity - Area

| Area | Joint1 | Joint2 | Joint3 | Joint4 |
|---|---|---|---|---|
| 3 | 2 | 7 | 30 | 26 |
| 4 | 26 | 30 | 31 | 27 |
| 5 | 27 | 31 | 10 | 5 |
| 12 | 12 | 17 | 38 | 34 |
| 13 | 34 | 38 | 39 | 35 |
| 14 | 35 | 39 | 20 | 15 |
| 15 | 17 | 22 | 42 | 38 |
| 16 | 38 | 42 | 43 | 39 |
| 41 | 39 | 43 | 25 | 20 |
| 42 | 4 | 29 | 33 | 9 |
| 43 | 9 | 33 | 37 | 14 |
| 44 | 14 | 37 | 41 | 19 |
| 45 | 19 | 41 | 45 | 24 |
| 46 | 29 | 28 | 32 | 33 |
| 47 | 33 | 32 | 36 | 37 |
| 48 | 37 | 36 | 40 | 41 |
| 49 | 41 | 40 | 44 | 45 |
| 50 | 28 | 5 | 10 | 32 |
| 51 | 32 | 10 | 15 | 36 |
| 52 | 36 | 15 | 20 | 40 |
| 53 | 40 | 20 | 25 | 44 |
| 54 | 7 | 12 | 34 | 30 |
| 55 | 30 | 34 | 35 | 31 |
| 56 | 31 | 35 | 15 | 10 |

### Table 6: Area Section Assignments

Table 6: Area Section Assignments

| Area | Section | MatProp |
|---|---|---|
| 3 | Teja | Default |
| 4 | Teja | Default |
| 5 | Teja | Default |
| 12 | Teja | Default |
| 13 | Teja | Default |
| 14 | Teja | Default |
| 15 | Teja | Default |
| 16 | Teja | Default |
| 41 | Teja | Default |
| 42 | Teja | Default |
| 43 | Teja | Default |
| 44 | Teja | Default |
| 45 | Teja | Default |
| 46 | Teja | Default |
| 47 | Teja | Default |
| 48 | Teja | Default |
| 49 | Teja | Default |
| 50 | Teja | Default |
| 51 | Teja | Default |
| 52 | Teja | Default |
| 53 | Teja | Default |
| 54 | Teja | Default |
| 55 | Teja | Default |
| 56 | Teja | Default |

# 2. Material properties

This section provides material property information for materials used in the model.

### Table 7: Material Properties 02 - Basic Mechanical Properties

Table 7: Material Properties 02 - Basic Mechanical Properties

| Material | UnitWeight | UnitMass | E1 | G12 | U12 | A1 |
|---|---|---|---|---|---|---|
| | Tonf/m3 | Tonf-s2/m4 | Tonf/m2 | Tonf/m2 | | 1/C |
| 3000Psi | 2.4028E+00 | 2.4501E-01 | 2194996.45 | 914581.85 | 0.2 | 9.9000E-06 |
| 4000Psi | 2.4028E+00 | 2.4501E-01 | 2534563.54 | 1056068.14 | 0.2 | 9.9000E-06 |
| A416Gr270 | 7.8490E+00 | 8.0038E-01 | 20037484.34 | | | 1.1700E-05 |
| A500GrC | 7.8490E+00 | 8.0038E-01 | 20389019.16 | 7841930.45 | 0.3 | 1.1700E-05 |
| A572Gr50 | 7.8490E+00 | 8.0038E-01 | 20389019.16 | 7841930.45 | 0.3 | 1.1700E-05 |

Table 7: Material Properties 02 - Basic Mechanical Properties

| Material | UnitWeight | UnitMass | E1 | G12 | U12 | A1 |
|---|---|---|---|---|---|---|
| | Tonf/m3 | Tonf-s2/m4 | Tonf/m2 | Tonf/m2 | | 1/C |
| A615Gr60 | 7.8490E+00 | 8.0038E-01 | 20389019.16 | | | 1.1700E-05 |
| A653SQGr50 | 7.8490E+00 | 8.0038E-01 | 20740553.97 | 7977136.14 | 0.3 | 1.1700E-05 |
| A992Fy50 | 7.8490E+00 | 8.0038E-01 | 20389019.16 | 7841930.45 | 0.3 | 1.1700E-05 |

## Table 8: Material Properties 03a - Steel Data

Table 8: Material Properties 03a - Steel Data

| Material | Fy | Fu | FinalSlope | CoupModType |
|---|---|---|---|---|
| | Tonf/m2 | Tonf/m2 | | |
| A500GrC | 35153.48 | 43590.32 | -0.1 | Von Mises |
| A572Gr50 | 35153.48 | 45699.53 | -0.1 | Von Mises |
| A992Fy50 | 35153.48 | 45699.53 | -0.1 | Von Mises |

## Table 9: Material Properties 03b - Concrete Data

Table 9: Material Properties 03b - Concrete Data

| Material | Fc | eFc | FinalSlope | CoupModType |
|---|---|---|---|---|
| | Tonf/m2 | Tonf/m2 | | |
| 3000Psi | 2109.21 | 2109.21 | -0.1 | Modified Darwin-Pecknold |
| 4000Psi | 2812.28 | 2812.28 | -0.1 | Modified Darwin-Pecknold |

## Table 10: Material Properties 03d - Cold Formed Data

Table 10: Material Properties 03d - Cold Formed Data

| Material | Fy | Fu | CoupModType |
|---|---|---|---|
| | Tonf/m2 | Tonf/m2 | |
| A653SQGr50 | 35153.48 | 45699.53 | Von Mises |

## Table 11: Material Properties 03e - Rebar Data

Table 11: Material Properties 03e - Rebar Data

| Material | Fy | Fu | FinalSlope | CoupModType |
|---|---|---|---|---|
| | Tonf/m2 | Tonf/m2 | | |

Table 11: Material Properties 03e - Rebar Data

| Material | Fy | Fu | FinalSlope | CoupModType |
|---|---|---|---|---|
| | Tonf/m2 | Tonf/m2 | | |
| A615Gr60 | 42184.18 | 63276.27 | -0.1 | Von Mises |

## Table 12: Material Properties 03f - Tendon Data

Table 12: Material Properties 03f - Tendon Data

| Material | Fy | Fu | FinalSlope | CoupModType |
|---|---|---|---|---|
| | Tonf/m2 | Tonf/m2 | | |
| A416Gr270 | 172322.37 | 189828.8 | -0.1 | Von Mises |

# 3. Section properties

This section provides section property information for objects used in the model.

## *3.1. Frames*

## Table 13: Frame Section Properties 01 - General, Part 1 of 7

Table 13: Frame Section Properties 01 - General, Part 1 of 7

| SectionName | Material | Shape | t3 | t2 | FilletRadius | tf | tw |
|---|---|---|---|---|---|---|---|
| | | | m | m | m | m | m |
| 2P-100-16 | A653SQGr50 | Cold Formed Box | 0.1 | 0.1 | | | 0.001 |
| 2Tub200X100X3mm | A500GrC | SD Section | | | | | |
| C30X30 | 3000Psi | Rectangular | 0.3 | 0.3 | | | |
| IPE200 | A572Gr50 | I/Wide Flange | 0.2 | 0.1 | 0.012 | 0.0085 | 0.0056 |
| IPE240 | A572Gr50 | I/Wide Flange | 0.24 | 0.12 | 0.015 | 0.0098 | 0.0062 |
| L2X2X1/4 | A572Gr50 | Angle | 0.0508 | 0.0508 | 0.00635 | 0.00635 | 0.00635 |
| L2X2X3/16 | A572Gr50 | Angle | 0.0508 | 0.0508 | 0.00635 | 0.004775 | 0.004775 |
| P150-11 | A653SQGr50 | Cold Formed C | 0.15 | 0.05 | | | 0.003 |
| P150-12 | A653SQGr50 | Cold Formed C | 0.15 | 0.05 | | | 0.0025 |
| P150-14 | A653SQGr50 | Cold Formed C | 0.15 | 0.05 | | | 0.002 |
| P150-8 | A653SQGr50 | Cold Formed C | 0.15 | 0.05 | | | 0.0045 |
| Tub 8"x5mm | A500GrC | Pipe | 0.2191 | | | | 0.005 |
| Tub100X100X2.5mm | A500GrC | Box/Tube | 0.1 | 0.1 | 0. | 0.0025 | 0.0025 |
| Tub100X50X2.5mm | A500GrC | Box/Tube | 0.1 | 0.05 | 0. | 0.0025 | 0.0025 |

Table 13: Frame Section Properties 01 - General, Part 1 of 7

| SectionName | Material | Shape | t3 | t2 | FilletRadius | tf | tw |
|---|---|---|---|---|---|---|---|
| | | | m | m | m | m | m |
| Tub100X50X2mm | A500GrC | Box/Tube | 0.1 | 0.05 | 0. | 0.002 | 0.002 |
| Tub200X100X2.5mm | A500GrC | Box/Tube | 0.2 | 0.1 | 0. | 0.0025 | 0.0025 |
| Tub200X100X3mm | A500GrC | Box/Tube | 0.2 | 0.1 | 0. | 0.003 | 0.003 |
| V30X30 | 3000Psi | Rectangular | 0.3 | 0.3 | | | |

## Table 13: Frame Section Properties 01 - General, Part 2 of 7

Table 13: Frame Section Properties 01 - General, Part 2 of 7

| SectionName | t2b | tfb |
|---|---|---|
| | m | m |
| 2P-100-16 | | |
| 2Tub200X100X3mm | | |
| C30X30 | | |
| IPE200 | 0.1 | 0.0085 |
| IPE240 | 0.12 | 0.0098 |
| L2X2X1/4 | | |
| L2X2X3/16 | | |
| P150-11 | | |
| P150-12 | | |
| P150-14 | | |
| P150-8 | | |
| Tub 8"x5mm | | |
| Tub100X100X2.5mm | | |
| Tub100X50X2.5mm | | |
| Tub100X50X2mm | | |
| Tub200X100X2.5mm | | |
| Tub200X100X3mm | | |
| V30X30 | | |

## Table 13: Frame Section Properties 01 - General, Part 3 of 7

Table 13: Frame Section Properties 01 - General, Part 3 of 7

| SectionName | Area | TorsConst | S33Top | I33 | S33Bot | I22 | S22Left | I23 |
|---|---|---|---|---|---|---|---|---|
| | m2 | m4 | m3 | m4 | m3 | m4 | m3 | m4 |

Table 13: Frame Section Properties 01 - General, Part 3 of 7

| SectionName | Area | TorsConst | S33Top | I33 | S33Bot | I22 | S22Left | I23 |
|---|---|---|---|---|---|---|---|---|
| | m2 | m4 | m3 | m4 | m3 | m4 | m3 | m4 |
| 2P-100-16 | 0.000384 | 9.703E-07 | 0.000012 | 6.167E-07 | 0.000012 | 6.167E-07 | 0.000012 | 0. |
| 2Tub200X100X3mm | 0.003528 | 0.000023 | 0.000189 | 0.000019 | 0.000189 | 0.000015 | 0.000153 | 0. |
| C30X30 | 0.09 | 0.001141 | 0.0045 | 0.000675 | 0.0045 | 0.000675 | 0.0045 | 0. |
| IPE200 | 0.00285 | 6.920E-08 | 0.000194 | 0.000019 | 0.000194 | 1.420E-06 | 0.000028 | -1.355E-20 |
| IPE240 | 0.00391 | 1.300E-07 | 0.000324 | 0.000039 | 0.000324 | 2.840E-06 | 0.000047 | 0. |
| L2X2X1/4 | 0.000609 | 8.699E-09 | 4.010E-06 | 1.440E-07 | 9.676E-06 | 1.440E-07 | 9.676E-06 | 8.449E-08 |
| L2X2X3/16 | 0.000466 | 3.833E-09 | 3.086E-06 | 1.128E-07 | 7.916E-06 | 1.128E-07 | 7.916E-06 | 6.676E-08 |
| P150-11 | 0.000794 | 2.381E-09 | 0.000034 | 2.553E-06 | 0.000034 | 2.563E-07 | 0.000017 | 0. |
| P150-12 | 0.000667 | 1.390E-09 | 0.000029 | 2.169E-06 | 0.000029 | 2.214E-07 | 0.000015 | 0. |
| P150-14 | 0.000539 | 7.184E-10 | 0.000024 | 1.768E-06 | 0.000024 | 1.835E-07 | 0.000012 | 0. |
| P150-8 | 0.001158 | 7.814E-09 | 0.000048 | 3.614E-06 | 0.000048 | 3.443E-07 | 0.000023 | 0. |
| Tub 8"x5mm | 0.003363 | 0.000039 | 0.000176 | 0.000019 | 0.000176 | 0.000019 | 0.000176 | 0. |
| Tub100X100X2.5mm | 0.000975 | 2.317E-06 | 0.000031 | 1.546E-06 | 0.000031 | 1.546E-06 | 0.000031 | 0. |
| Tub100X50X2.5mm | 0.000725 | 7.396E-07 | 0.000019 | 9.515E-07 | 0.000019 | 3.203E-07 | 0.000013 | 0. |
| Tub100X50X2mm | 0.000584 | 6.062E-07 | 0.000016 | 7.752E-07 | 0.000016 | 2.630E-07 | 0.000011 | 0. |
| Tub200X100X2.5mm | 0.001475 | 6.285E-06 | 0.00008 | 7.966E-06 | 0.00008 | 2.734E-06 | 0.000055 | 0. |
| Tub200X100X3mm | 0.001764 | 7.452E-06 | 0.000095 | 9.472E-06 | 0.000095 | 3.239E-06 | 0.000065 | 0. |
| V30X30 | 0.09 | 0.001141 | 0.0045 | 0.000675 | 0.0045 | 0.000675 | 0.0045 | 0. |

## Table 13: Frame Section Properties 01 - General, Part 4 of 7

Table 13: Frame Section Properties 01 - General, Part 4 of 7

| SectionName | AS2 | S22Right | AS3 |
|---|---|---|---|
| | m2 | m3 | m2 |
| 2P-100-16 | 0.000171 | 0.000012 | 0.000171 |
| 2Tub200X100X3mm | 0.002314 | 0.000153 | 0.00123 |
| C30X30 | 0.075 | 0.0045 | 0.075 |
| IPE200 | 0.00112 | 0.000028 | 0.001417 |
| IPE240 | 0.001488 | 0.000047 | 0.00196 |
| L2X2X1/4 | 0.000323 | 4.010E-06 | 0.000323 |
| L2X2X3/16 | 0.000243 | 3.086E-06 | 0.000243 |
| P150-11 | 0.000394 | 7.372E-06 | 0.000188 |
| P150-12 | 0.000331 | 6.364E-06 | 0.000162 |
| P150-14 | 0.000267 | 5.272E-06 | 0.000133 |
| P150-8 | 0.000577 | 9.913E-06 | 0.000255 |
| Tub 8"x5mm | 0.001682 | 0.000176 | 0.001682 |
| Tub100X100X2.5mm | 0.0005 | 0.000031 | 0.0005 |
| Tub100X50X2.5mm | 0.0005 | 0.000013 | 0.00025 |
| Tub100X50X2mm | 0.0004 | 0.000011 | 0.0002 |

Table 13: Frame Section Properties 01 - General, Part 4 of 7

| | | | | SectionName | AS2 | S22Right | AS3 |
|---|---|---|---|---|---|---|---|
| | | | | | m2 | m3 | m2 |
| Tub200X100X2.5mm | 0.001 | 0.000055 | 0.0005 | | | | |
| Tub200X100X3mm | 0.0012 | 0.000065 | 0.0006 | | | | |
| V30X30 | 0.075 | 0.0045 | 0.075 | | | | |

## Table 13: Frame Section Properties 01 - General, Part 5 of 7

Table 13: Frame Section Properties 01 - General, Part 5 of 7

| SectionName | Z33 | CGOffset3 | Z22 | R33 | CGOffset2 | R22 |
|---|---|---|---|---|---|---|
| | m3 | m | m3 | m | m | m |
| 2P-100-16 | 0.000012 | 0. | 0.000012 | 0.040063 | 0. | 0.040063 |
| 2Tub200X100X3mm | 0.000231 | 6.939E-18 | 0.000176 | 0.07328 | 0. | 0.065849 |
| C30X30 | 0.00675 | 0. | 0.00675 | 0.086603 | 0. | 0.086603 |
| IPE200 | 0.000221 | 2.082E-17 | 0.000045 | 0.082568 | 0. | 0.022321 |
| IPE240 | 0.000367 | 1.388E-17 | 0.000074 | 0.09977 | 0. | 0.026951 |
| L2X2X1/4 | 7.210E-06 | 0.010516 | 7.210E-06 | 0.015378 | -0.010516 | 0.015378 |
| L2X2X3/16 | 5.539E-06 | 0.011151 | 5.539E-06 | 0.015561 | -0.011151 | 0.015561 |
| P150-11 | 0.000034 | 0.009772 | 7.372E-06 | 0.056725 | 0. | 0.017973 |
| P150-12 | 0.000029 | 0.009786 | 6.364E-06 | 0.057005 | 0. | 0.018213 |
| P150-14 | 0.000024 | 0.0098 | 5.272E-06 | 0.057283 | 0. | 0.018454 |
| P150-8 | 0.000048 | 0.009728 | 9.913E-06 | 0.055876 | 0. | 0.017246 |
| Tub 8"x5mm | 0.000229 | 0. | 0.000229 | 0.075716 | 0. | 0.075716 |
| Tub100X100X2.5mm | 0.000036 | 0. | 0.000036 | 0.039817 | 0. | 0.039817 |
| Tub100X50X2.5mm | 0.000023 | 0. | 0.000014 | 0.036227 | 0. | 0.021018 |
| Tub100X50X2mm | 0.000019 | 0. | 0.000012 | 0.036433 | 0. | 0.02122 |
| Tub200X100X2.5mm | 0.000097 | 0. | 0.00006 | 0.073487 | 0. | 0.043056 |
| Tub200X100X3mm | 0.000116 | 0. | 0.000071 | 0.07328 | 0. | 0.04285 |
| V30X30 | 0.00675 | 0. | 0.00675 | 0.086603 | 0. | 0.086603 |

## Table 13: Frame Section Properties 01 - General, Part 6 of 7

Table 13: Frame Section Properties 01 - General, Part 6 of 7

| SectionName | EccV2 | EccV3 | Cw | IncludeSCAn | AMod | A2Mod | A3Mod | JMod |
|---|---|---|---|---|---|---|---|---|
| | m | m | m6 | | | | | |
| 2P-100-16 | 0. | 0. | 0. | | 1. | 1. | 1. | 1. |
| 2Tub200X100X3mm | 0. | 0. | 0. | | 1. | 1. | 1. | 1. |
| C30X30 | 0. | 0. | 0. | | 1. | 1. | 1. | 1. |

Table 13: Frame Section Properties 01 - General, Part 6 of 7

| SectionName | EccV2 | EccV3 | Cw | IncludeSCAn | AMod | A2Mod | A3Mod | JMod |
|---|---|---|---|---|---|---|---|---|
| | m | m | m6 | | | | | |
| IPE200 | 0. | 0. | 1.299E-08 | | 1. | 1. | 1. | 1. |
| IPE240 | 0. | 0. | 3.739E-08 | | 1. | 1. | 1. | 1. |
| L2X2X1/4 | 0.011321 | -0.011321 | 1.536E-12 | | 1. | 1. | 1. | 1. |
| L2X2X3/16 | 0.011667 | -0.011667 | 6.821E-13 | | 1. | 1. | 1. | 1. |
| P150-11 | 0.036538 | 0. | 1.362E-09 | Yes | 1. | 1. | 1. | 1. |
| P150-12 | 0.037088 | 0. | 1.182E-09 | Yes | 1. | 1. | 1. | 1. |
| P150-14 | 0.037638 | 0. | 9.843E-10 | Yes | 1. | 1. | 1. | 1. |
| P150-8 | 0.034893 | 0. | 1.805E-09 | Yes | 1. | 1. | 1. | 1. |
| Tub 8"x5mm | 0. | 0. | 0. | | 1. | 1. | 1. | 1. |
| Tub100X100X2.5mm | 0. | 0. | 0. | | 1. | 1. | 1. | 1. |
| Tub100X50X2.5mm | 0. | 0. | 0. | | 1. | 1. | 1. | 1. |
| Tub100X50X2mm | 0. | 0. | 0. | | 1. | 1. | 1. | 1. |
| Tub200X100X2.5mm | 0. | 0. | 0. | | 1. | 1. | 1. | 1. |
| Tub200X100X3mm | 0. | 0. | 0. | | 1. | 1. | 1. | 1. |
| V30X30 | 0. | 0. | 0. | | 1. | 1. | 1. | 1. |

## Table 13: Frame Section Properties 01 - General, Part 7 of 7

Table 13: Frame Section Properties 01 - General, Part 7 of 7

| SectionName | I2Mod | I3Mod | MMod | WMod |
|---|---|---|---|---|
| 2P-100-16 | 1. | 1. | 1. | 1. |
| 2Tub200X100X3mm | 1. | 1. | 1. | 1. |
| C30X30 | 1. | 1. | 1. | 1. |
| IPE200 | 1. | 1. | 1. | 1. |
| IPE240 | 1. | 1. | 1. | 1. |
| L2X2X1/4 | 1. | 1. | 1. | 1. |
| L2X2X3/16 | 1. | 1. | 1. | 1. |
| P150-11 | 1. | 1. | 1. | 1. |
| P150-12 | 1. | 1. | 1. | 1. |
| P150-14 | 1. | 1. | 1. | 1. |
| P150-8 | 1. | 1. | 1. | 1. |
| Tub 8"x5mm | 1. | 1. | 1. | 1. |
| Tub100X100X2.5mm | 1. | 1. | 1. | 1. |
| Tub100X50X2.5mm | 1. | 1. | 1. | 1. |
| Tub100X50X2mm | 1. | 1. | 1. | 1. |
| Tub200X100X2.5mm | 1. | 1. | 1. | 1. |
| Tub200X100X3mm | 1. | 1. | 1. | 1. |

Table 13: Frame Section Properties 01 - General, Part 7 of 7

| SectionName | I2Mod | I3Mod | MMod | WMod |
|---|---|---|---|---|
| V30X30 | 1. | 1. | 1. | 1. |

## Table 14: Frame Section Properties 02 - Concrete Column, Part 1 of 2

Table 14: Frame Section Properties 02 - Concrete Column, Part 1 of 2

| SectionName | RebarMatL | RebarMatC | ReinfConfig | LatReinf | Cover | NumBars3Dir | NumBars2Dir |
|---|---|---|---|---|---|---|---|
| | | | | | m | | |
| C30X30 | A615Gr60 | A615Gr60 | Rectangular | Ties | 0.04 | 3 | 3 |

## Table 14: Frame Section Properties 02 - Concrete Column, Part 2 of 2

Table 14: Frame Section Properties 02 - Concrete Column, Part 2 of 2

| SectionName | BarSizeL | BarSizeC | SpacingC | NumCBars2 | NumCBars3 |
|---|---|---|---|---|---|
| | | | m | | |
| C30X30 | #5 | #3 | 0.15 | 2 | 2 |

## Table 15: Frame Section Properties 03 - Concrete Beam, Part 1 of 2

Table 15: Frame Section Properties 03 - Concrete Beam, Part 1 of 2

| SectionName | RebarMatL | RebarMatC | TopCover | BotCover |
|---|---|---|---|---|
| | | | m | m |
| V30X30 | A615Gr60 | A615Gr60 | 0.06 | 0.06 |

## Table 15: Frame Section Properties 03 - Concrete Beam, Part 2 of 2

Table 15: Frame Section Properties 03 - Concrete Beam, Part 2 of 2

| SectionName | TopLeftArea | TopRghtArea | BotLeftArea | BotRghtArea |
|---|---|---|---|---|
| | m2 | m2 | m2 | m2 |
| V30X30 | 0. | 0. | 0. | 0. |

# *3.2. Areas*

## Table 16: Area Section Properties, Part 1 of 3

Table 16: Area Section Properties, Part 1 of 3

| Section | Material | AreaType | Type | DrillDOF | Thickness | BendThick | F11Mod |
|---|---|---|---|---|---|---|---|
| | | | | | m | m | |

Table 16: Area Section Properties, Part 1 of 3

| Section | Material | AreaType | Type | DrillDOF | Thickness | BendThick | F11Mod |
|---|---|---|---|---|---|---|---|
| | | | | | m | m | |
| SL35 | 3000Psi | Shell | Shell-Thin | Yes | 0.35 | 0.35 | 1. |
| Teja | 3000Psi | Shell | Membrane | Yes | 0.025 | 0.025 | 1. |

### Table 16: Area Section Properties, Part 2 of 3

Table 16: Area Section Properties, Part 2 of 3

| Section | F22Mod | F12Mod | M11Mod | M22Mod | M12Mod | V13Mod | V23Mod |
|---|---|---|---|---|---|---|---|
| SL35 | 1. | 1. | 1. | 1. | 1. | 1. | 1. |
| Teja | 1. | 1. | 1. | 1. | 1. | 1. | 1. |

### Table 16: Area Section Properties, Part 3 of 3

Table 16: Area Section Properties, Part 3 of 3

| Section | MMod | WMod |
|---|---|---|
| SL35 | 1. | 1. |
| Teja | 1. | 0. |

## 3.3. Solids

### Table 17: Solid Property Definitions

Table 17: Solid Property Definitions

| SolidProp | Material | MatAngleA | MatAngleB | MatAngleC |
|---|---|---|---|---|
| | | Degrees | Degrees | Degrees |
| Solid1 | 4000Psi | 0. | 0. | 0. |

# 4. Load patterns

This section provides loading information as applied to the model.

## 4.1. Definitions

### Table 18: Load Pattern Definitions

Table 18: Load Pattern Definitions

| LoadPat | DesignType | SelfWtMult | AutoLoad |
|---|---|---|---|
| DL | Dead | 1. | |
| SD | Dead | 0. | |

Table 18: Load Pattern Definitions

| LoadPat | DesignType | SelfWtMult | AutoLoad |
|---|---|---|---|
| Lr | Roof Live | 0. | |
| W | Wind | 0. | None |

# 5. Load cases

This section provides load case information.

## 5.1. Definitions

### Table 19: Load Case Definitions, Part 1 of 2

Table 19: Load Case Definitions, Part 1 of 2

| Case | Type | InitialCond | ModalCase | BaseCase | MassSource | DesActOpt |
|---|---|---|---|---|---|---|
| DL | LinStatic | Zero | | | | Prog Det |
| MODAL | LinModal | Zero | | | | Prog Det |
| SD | LinStatic | Zero | | | | Prog Det |
| Lr | LinStatic | Zero | | | | Prog Det |
| W | LinStatic | Zero | | | | Prog Det |
| EQ | LinRespSpec | | MODAL | | | Prog Det |

### Table 19: Load Case Definitions, Part 2 of 2

Table 19: Load Case Definitions, Part 2 of 2

| Case | DesignAct |
|---|---|
| DL | Non-Composite |
| MODAL | Other |
| SD | Non-Composite |
| Lr | Short-Term Composite |
| W | Short-Term Composite |
| EQ | Short-Term Composite |

## 5.2. Static case load assignments

### Table 20: Case - Static 1 - Load Assignments

Table 20: Case - Static 1 - Load Assignments

| Case | LoadType | LoadName | LoadSF |
|---|---|---|---|

| | | | |
|---|---|---|---|
| DL | Load pattern | DL | 1. |
| SD | Load pattern | SD | 1. |
| Lr | Load pattern | Lr | 1. |
| W | Load pattern | W | 1. |

## *5.3. Response spectrum case load assignments*

### Table 21: Case - Response Spectrum 1 - General, Part 1 of 2

**Table 21: Case - Response Spectrum 1 - General, Part 1 of 2**

| Case | ModalCombo | GMCf1 | GMCf2 | PerRigid | DirCombo | MotionType | DampingType |
|---|---|---|---|---|---|---|---|
| | | Cyc/sec | Cyc/sec | | | | |
| EQ | CQC | 1.0000E+00 | 0.0000E+00 | SRSS | SRSS | Acceleration | Constant |

### Table 21: Case - Response Spectrum 1 - General, Part 2 of 2

**Table 21: Case - Response Spectrum 1 - General, Part 2 of 2**

| Case | ConstDamp |
|---|---|
| EQ | 0.05 |

### Table 22: Case - Response Spectrum 2 - Load Assignments

**Table 22: Case - Response Spectrum 2 - Load Assignments**

| Case | LoadType | LoadName | CoordSys | Function | Angle | TransAccSF |
|---|---|---|---|---|---|---|
| | | | | | Degrees | m/sec2 |
| EQ | Acceleration | U1 | GLOBAL | EQ | 0. | 1.86794 |
| EQ | Acceleration | U2 | GLOBAL | EQ | 0. | 1.86794 |

### Table 23: Function - Response Spectrum - Colombia NSR-10, Part 1 of 2

**Table 23: Function - Response Spectrum - Colombia NSR-10, Part 1 of 2**

| Name | Period | Accel | FuncDamp | Aa | Av | Ae | Ad |
|---|---|---|---|---|---|---|---|
| | Sec | | | | | | |
| EQ | 0. | 0.8125 | 0.05 | 0.25 | 0.25 | 0.16 | 0.1 |
| EQ | 0.1 | 0.8125 | | | | | |
| EQ | 0.2 | 0.8125 | | | | | |
| EQ | 0.3 | 0.8125 | | | | | |

Table 23: Function - Response Spectrum - Colombia NSR-10, Part 1 of 2

| Name | Period | Accel | FuncDamp | Aa | Av | Ae | Ad |
|---|---|---|---|---|---|---|---|
| | Sec | | | | | | |
| EQ | 0.4 | 0.8125 | | | | | |
| EQ | 0.5 | 0.8125 | | | | | |
| EQ | 0.6 | 0.8125 | | | | | |
| EQ | 0.7 | 0.8125 | | | | | |
| EQ | 0.8 | 0.7125 | | | | | |
| EQ | 0.9 | 0.633333 | | | | | |
| EQ | 1. | 0.57 | | | | | |
| EQ | 1.2 | 0.475 | | | | | |
| EQ | 1.5 | 0.38 | | | | | |
| EQ | 1.7 | 0.335294 | | | | | |
| EQ | 2. | 0.285 | | | | | |
| EQ | 2.5 | 0.228 | | | | | |
| EQ | 3. | 0.19 | | | | | |
| EQ | 3.5 | 0.162857 | | | | | |
| EQ | 4. | 0.1425 | | | | | |
| EQ | 5. | 0.103968 | | | | | |
| EQ | 8. | 0.040612 | | | | | |
| EQ | 11. | 0.021481 | | | | | |
| EQ | 15. | 0.011552 | | | | | |

## Table 23: Function - Response Spectrum - Colombia NSR-10, Part 2 of 2

Table 23: Function - Response Spectrum - Colombia NSR-10, Part 2 of 2

| Name | Period | GroupUse | Fa | Fv |
|---|---|---|---|---|
| | Sec | | | |
| EQ | 0. | Group 1 | 1.3 | 1.9 |
| EQ | 0.1 | | | |
| EQ | 0.2 | | | |
| EQ | 0.3 | | | |
| EQ | 0.4 | | | |
| EQ | 0.5 | | | |
| EQ | 0.6 | | | |
| EQ | 0.7 | | | |
| EQ | 0.8 | | | |
| EQ | 0.9 | | | |
| EQ | 1. | | | |
| EQ | 1.2 | | | |
| EQ | 1.5 | | | |
| EQ | 1.7 | | | |
| EQ | 2. | | | |
| EQ | 2.5 | | | |
| EQ | 3. | | | |
| EQ | 3.5 | | | |
| EQ | 4. | | | |
| EQ | 5. | | | |
| EQ | 8. | | | |
| EQ | 11. | | | |
| EQ | 15. | | | |

# 6. Load combinations

This section provides load combination information.

## Table 24: Combination Definitions

Table 24: Combination Definitions

| ComboName | ComboType | CaseName | ScaleFactor |
|---|---|---|---|
| B.2.3-7 | Linear Add | DL | 1. |
| B.2.3-7 | | SD | 1. |
| B.2.3-7 | | W | 0.75 |
| B.2.3-7 | | Lr | 0.75 |
| B.2.3-8 | Linear Add | DL | 1. |
| B.2.3-8 | | SD | 1. |
| B.2.3-8 | | EQ | 0.525 |
| B.2.3-8 | | Lr | 0.75 |
| B.2.3-9 | Linear Add | DL | 0.6 |
| B.2.3-9 | | SD | 0.6 |
| B.2.3-9 | | W | 1. |
| B.2.3-10 | Linear Add | DL | 0.6 |
| B.2.3-10 | | SD | 0.6 |
| B.2.3-10 | | EQ | 0.7 |
| B.2.4-1 | Linear Add | DL | 1.4 |
| B.2.4-1 | | SD | 1.4 |
| B.2.4-2a | Linear Add | DL | 1.2 |
| B.2.4-2a | | SD | 1.2 |
| B.2.4-2a | | Lr | 1.6 |
| B.2.4-2a | | W | 0.8 |
| B.2.4-2b | Linear Add | DL | 1.2 |
| B.2.4-2b | | SD | 1.2 |
| B.2.4-2b | | Lr | 1.6 |
| B.2.4-2b | | W | -0.8 |
| B.2.4-4a | Linear Add | DL | 1.2 |
| B.2.4-4a | | SD | 1.2 |
| B.2.4-4a | | Lr | 0.5 |
| B.2.4-4a | | W | 1.6 |
| B.2.4-4b | Linear Add | DL | 1.2 |
| B.2.4-4b | | SD | 1.2 |
| B.2.4-4b | | Lr | 0.5 |
| B.2.4-4b | | W | -1.6 |
| B.2.4-5 | Linear Add | DL | 1.2 |
| B.2.4-5 | | SD | 1.2 |
| B.2.4-5 | | EQ | 1. |
| B.2.4-6a | Linear Add | DL | 0.9 |
| B.2.4-6a | | SD | 0.9 |
| B.2.4-6a | | W | 1.6 |
| B.2.4-6b | Linear Add | DL | 0.9 |
| B.2.4-6b | | SD | 0.9 |
| B.2.4-6b | | W | -1.6 |
| B.2.4-7 | Linear Add | DL | 0.9 |

Table 24: Combination Definitions

| ComboName | ComboType | CaseName | ScaleFactor |
|---|---|---|---|
| B.2.4-7 | SD | 0.9 | |
| B.2.4-7 | EQ | 1. | |
| Env.Ser. | Envelope | B.2.3-10 | 1. |
| Env.Ser. | | B.2.3-7 | 1. |
| Env.Ser. | | B.2.3-8 | 1. |
| Env.Ser. | | B.2.3-9 | 1. |
| Env.Ult. | Envelope | B.2.4-1 | 1. |
| Env.Ult. | | B.2.4-2a | 1. |
| Env.Ult. | | B.2.4-2b | 1. |
| Env.Ult. | | B.2.4-4a | 1. |
| Env.Ult. | | B.2.4-4b | 1. |
| Env.Ult. | | B.2.4-5 | 1. |
| Env.Ult. | | B.2.4-6a | 1. |
| Env.Ult. | | B.2.4-6b | 1. |
| Env.Ult. | | B.2.4-7 | 1. |
| DL Total | Linear Add | DL | 1. |
| DL Total | | SD | 1. |
| Derivas | Linear Add | EQ | 6.3 |
| DCLD1 | Linear Add | DL | 1.4 |
| DCLD1 | | SD | 1.4 |
| DCLD2 | Linear Add | DL | 1.2 |
| DCLD2 | | SD | 1.2 |
| DCLD2 | | Lr | 1.6 |
| DCLD3 | Linear Add | DL | 1.2 |
| DCLD3 | | SD | 1.2 |
| DCLD3 | | W | 1. |
| DCLD4 | Linear Add | DL | 1.2 |
| DCLD4 | | SD | 1.2 |
| DCLD4 | | W | -1. |
| DCLD5 | Linear Add | DL | 1.2 |
| DCLD5 | | SD | 1.2 |
| DCLD5 | | Lr | 0.5 |
| DCLD5 | | W | 1. |
| DCLD6 | Linear Add | DL | 1.2 |
| DCLD6 | | SD | 1.2 |
| DCLD6 | | Lr | 0.5 |
| DCLD6 | | W | -1. |
| DCLD7 | Linear Add | DL | 1.2 |
| DCLD7 | | SD | 1.2 |
| DCLD7 | | Lr | 1.6 |
| DCLD7 | | W | 0.5 |
| DCLD8 | Linear Add | DL | 1.2 |
| DCLD8 | | SD | 1.2 |
| DCLD8 | | Lr | 1.6 |
| DCLD8 | | W | -0.5 |
| DCLD9 | Linear Add | DL | 0.9 |
| DCLD9 | | SD | 0.9 |
| DCLD9 | | W | 1. |
| DCLD10 | Linear Add | DL | 0.9 |
| DCLD10 | | SD | 0.9 |
| DCLD10 | | W | -1. |

Table 24: Combination Definitions

| ComboName | ComboType | CaseName | ScaleFactor |
|---|---|---|---|
| DCLD11 | Linear Add | DL | 1.2 |
| DCLD11 | | SD | 1.2 |
| DCLD11 | | EQ | 1. |
| DCLD12 | Linear Add | DL | 0.9 |
| DCLD12 | | SD | 0.9 |
| DCLD12 | | EQ | 1. |
| DCLD13 | Linear Add | DL | 1. |
| DCLD13 | | SD | 1. |

# 7. Structure results

This section provides structure results, including items such as structural periods and base reactions.

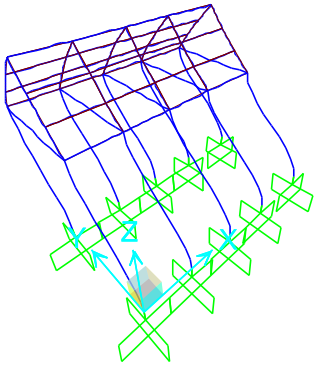


**Figure 2: Deformed shape**

## 7.1. Mass summary

### Table 25: Assembled Joint Masses, Part 1 of 2

**Table 25: Assembled Joint Masses, Part 1 of 2**

| Joint | MassSource | U1 | U2 | U3 | R1 | R2 | R3 | CenterX |
|---|---|---|---|---|---|---|---|---|
| | | Tonf-s2/m | Tonf-s2/m | Tonf-s2/m | Tonf-m-s2 | Tonf-m-s2 | Tonf-m-s2 | m |
| 1 | MSSSRC1 | 2.965E-03 | 2.965E-03 | 2.965E-03 | 0. | 0. | 0. | 0. |
| 2 | MSSSRC1 | 8.310E-03 | 8.310E-03 | 8.310E-03 | 0. | 0. | 0. | 0. |
| 3 | MSSSRC1 | 2.965E-03 | 2.965E-03 | 2.965E-03 | 0. | 0. | 0. | 0. |
| 4 | MSSSRC1 | 8.310E-03 | 8.310E-03 | 8.310E-03 | 0. | 0. | 0. | 0. |
| 5 | MSSSRC1 | 1.538E-03 | 1.538E-03 | 1.538E-03 | 0. | 0. | 0. | 0. |
| 6 | MSSSRC1 | 2.965E-03 | 2.965E-03 | 2.965E-03 | 0. | 0. | 0. | 1.3 |
| 7 | MSSSRC1 | 1.026E-02 | 1.026E-02 | 1.026E-02 | 0. | 0. | 0. | 1.3 |
| 8 | MSSSRC1 | 2.965E-03 | 2.965E-03 | 2.965E-03 | 0. | 0. | 0. | 1.3 |
| 9 | MSSSRC1 | 1.026E-02 | 1.026E-02 | 1.026E-02 | 0. | 0. | 0. | 1.3 |
| 10 | MSSSRC1 | 2.665E-03 | 2.665E-03 | 2.665E-03 | 0. | 0. | 0. | 1.3 |
| 11 | MSSSRC1 | 2.965E-03 | 2.965E-03 | 2.965E-03 | 0. | 0. | 0. | 2.6 |
| 12 | MSSSRC1 | 1.026E-02 | 1.026E-02 | 1.026E-02 | 0. | 0. | 0. | 2.6 |
| 13 | MSSSRC1 | 2.965E-03 | 2.965E-03 | 2.965E-03 | 0. | 0. | 0. | 2.6 |
| 14 | MSSSRC1 | 1.026E-02 | 1.026E-02 | 1.026E-02 | 0. | 0. | 0. | 2.6 |
| 15 | MSSSRC1 | 2.665E-03 | 2.665E-03 | 2.665E-03 | 0. | 0. | 0. | 2.6 |
| 16 | MSSSRC1 | 2.965E-03 | 2.965E-03 | 2.965E-03 | 0. | 0. | 0. | 3.9 |
| 17 | MSSSRC1 | 1.071E-02 | 1.071E-02 | 1.071E-02 | 0. | 0. | 0. | 3.9 |
| 18 | MSSSRC1 | 2.965E-03 | 2.965E-03 | 2.965E-03 | 0. | 0. | 0. | 3.9 |
| 19 | MSSSRC1 | 1.071E-02 | 1.071E-02 | 1.071E-02 | 0. | 0. | 0. | 3.9 |
| 20 | MSSSRC1 | 2.926E-03 | 2.926E-03 | 2.926E-03 | 0. | 0. | 0. | 3.9 |
| 21 | MSSSRC1 | 2.965E-03 | 2.965E-03 | 2.965E-03 | 0. | 0. | 0. | 5.5 |

Table 25: Assembled Joint Masses, Part 1 of 2

| Joint | MassSource | U1 | U2 | U3 | R1 | R2 | R3 | CenterX |
|---|---|---|---|---|---|---|---|---|
| | | Tonf-s2/m | Tonf-s2/m | Tonf-s2/m | Tonf-m-s2 | Tonf-m-s2 | Tonf-m-s2 | m |
| 22 | MSSSRC1 | 8.760E-03 | 8.760E-03 | 8.760E-03 | 0. | 0. | 0. | 5.5 |
| 23 | MSSSRC1 | 2.965E-03 | 2.965E-03 | 2.965E-03 | 0. | 0. | 0. | 5.5 |
| 24 | MSSSRC1 | 8.760E-03 | 8.760E-03 | 8.760E-03 | 0. | 0. | 0. | 5.5 |
| 25 | MSSSRC1 | 1.798E-03 | 1.798E-03 | 1.798E-03 | 0. | 0. | 0. | 5.5 |
| 26 | MSSSRC1 | 1.538E-03 | 1.538E-03 | 1.538E-03 | 0. | 0. | 0. | 0. |
| 27 | MSSSRC1 | 1.538E-03 | 1.538E-03 | 1.538E-03 | 0. | 0. | 0. | 0. |
| 28 | MSSSRC1 | 1.538E-03 | 1.538E-03 | 1.538E-03 | 0. | 0. | 0. | 0. |
| 29 | MSSSRC1 | 1.538E-03 | 1.538E-03 | 1.538E-03 | 0. | 0. | 0. | 0. |
| 30 | MSSSRC1 | 2.665E-03 | 2.665E-03 | 2.665E-03 | 0. | 0. | 0. | 1.3 |
| 31 | MSSSRC1 | 2.665E-03 | 2.665E-03 | 2.665E-03 | 0. | 0. | 0. | 1.3 |
| 32 | MSSSRC1 | 2.665E-03 | 2.665E-03 | 2.665E-03 | 0. | 0. | 0. | 1.3 |
| 33 | MSSSRC1 | 2.665E-03 | 2.665E-03 | 2.665E-03 | 0. | 0. | 0. | 1.3 |
| 34 | MSSSRC1 | 2.665E-03 | 2.665E-03 | 2.665E-03 | 0. | 0. | 0. | 2.6 |
| 35 | MSSSRC1 | 2.665E-03 | 2.665E-03 | 2.665E-03 | 0. | 0. | 0. | 2.6 |
| 36 | MSSSRC1 | 2.665E-03 | 2.665E-03 | 2.665E-03 | 0. | 0. | 0. | 2.6 |
| 37 | MSSSRC1 | 2.665E-03 | 2.665E-03 | 2.665E-03 | 0. | 0. | 0. | 2.6 |
| 38 | MSSSRC1 | 2.926E-03 | 2.926E-03 | 2.926E-03 | 0. | 0. | 0. | 3.9 |
| 39 | MSSSRC1 | 2.926E-03 | 2.926E-03 | 2.926E-03 | 0. | 0. | 0. | 3.9 |
| 40 | MSSSRC1 | 2.926E-03 | 2.926E-03 | 2.926E-03 | 0. | 0. | 0. | 3.9 |
| 41 | MSSSRC1 | 2.926E-03 | 2.926E-03 | 2.926E-03 | 0. | 0. | 0. | 3.9 |
| 42 | MSSSRC1 | 1.798E-03 | 1.798E-03 | 1.798E-03 | 0. | 0. | 0. | 5.5 |
| 43 | MSSSRC1 | 1.798E-03 | 1.798E-03 | 1.798E-03 | 0. | 0. | 0. | 5.5 |
| 44 | MSSSRC1 | 1.798E-03 | 1.798E-03 | 1.798E-03 | 0. | 0. | 0. | 5.5 |
| 45 | MSSSRC1 | 1.798E-03 | 1.798E-03 | 1.798E-03 | 0. | 0. | 0. | 5.5 |
| SumAccelUX | MSSSRC1 | 0.18 | 0. | 0. | 0. | 0. | 0. | 2.69941 |
| SumAccelUY | MSSSRC1 | 0. | 0.18 | 0. | 0. | 0. | 0. | 2.69941 |
| SumAccelUZ | MSSSRC1 | 0. | 0. | 0.18 | 0. | 0. | 0. | 2.69941 |

## Table 25: Assembled Joint Masses, Part 2 of 2

Table 25: Assembled Joint Masses, Part 2 of 2

| Joint | MassSource | CenterY | CenterZ |
|---|---|---|---|
| | | m | m |
| 1 | MSSSRC1 | 0. | 0. |
| 2 | MSSSRC1 | 0. | 2.6 |
| 3 | MSSSRC1 | 2.8 | 0. |
| 4 | MSSSRC1 | 2.8 | 2.6 |
| 5 | MSSSRC1 | 1.4 | 4.19 |
| 6 | MSSSRC1 | 0. | 0. |
| 7 | MSSSRC1 | 0. | 2.6 |
| 8 | MSSSRC1 | 2.8 | 0. |
| 9 | MSSSRC1 | 2.8 | 2.6 |
| 10 | MSSSRC1 | 1.4 | 4.19 |
| 11 | MSSSRC1 | 0. | 0. |
| 12 | MSSSRC1 | 0. | 2.6 |
| 13 | MSSSRC1 | 2.8 | 0. |
| 14 | MSSSRC1 | 2.8 | 2.6 |
| 15 | MSSSRC1 | 1.4 | 4.19 |

Table 25: Assembled Joint Masses, Part 2 of 2

| | | Joint | MassSource | CenterY | CenterZ |
|---|---|---|---|---|---|
| | | | | m | m |
| 16 | MSSSRC1 | 0. | 0. | | |
| 17 | MSSSRC1 | 0. | 2.6 | | |
| 18 | MSSSRC1 | 2.8 | 0. | | |
| 19 | MSSSRC1 | 2.8 | 2.6 | | |
| 20 | MSSSRC1 | 1.4 | 4.19 | | |
| 21 | MSSSRC1 | 0. | 0. | | |
| 22 | MSSSRC1 | 0. | 2.6 | | |
| 23 | MSSSRC1 | 2.8 | 0. | | |
| 24 | MSSSRC1 | 2.8 | 2.6 | | |
| 25 | MSSSRC1 | 1.4 | 4.19 | | |
| 26 | MSSSRC1 | 0.46667 | 3.13 | | |
| 27 | MSSSRC1 | 0.93333 | 3.66 | | |
| 28 | MSSSRC1 | 1.86667 | 3.66 | | |
| 29 | MSSSRC1 | 2.33333 | 3.13 | | |
| 30 | MSSSRC1 | 0.46667 | 3.13 | | |
| 31 | MSSSRC1 | 0.93333 | 3.66 | | |
| 32 | MSSSRC1 | 1.86667 | 3.66 | | |
| 33 | MSSSRC1 | 2.33333 | 3.13 | | |
| 34 | MSSSRC1 | 0.46667 | 3.13 | | |
| 35 | MSSSRC1 | 0.93333 | 3.66 | | |
| 36 | MSSSRC1 | 1.86667 | 3.66 | | |
| 37 | MSSSRC1 | 2.33333 | 3.13 | | |
| 38 | MSSSRC1 | 0.46667 | 3.13 | | |
| 39 | MSSSRC1 | 0.93333 | 3.66 | | |
| 40 | MSSSRC1 | 1.86667 | 3.66 | | |
| 41 | MSSSRC1 | 2.33333 | 3.13 | | |
| 42 | MSSSRC1 | 0.46667 | 3.13 | | |
| 43 | MSSSRC1 | 0.93333 | 3.66 | | |
| 44 | MSSSRC1 | 1.86667 | 3.66 | | |
| 45 | MSSSRC1 | 2.33333 | 3.13 | | |
| SumAccelUX | MSSSRC1 | 1.4 | 2.48162 | | |
| SumAccelUY | MSSSRC1 | 1.4 | 2.48162 | | |
| SumAccelUZ | MSSSRC1 | 1.4 | 2.48162 | | |

## *7.2. Modal results*

### Table 26: Modal Participating Mass Ratios

Table 26: Modal Participating Mass Ratios

| OutputCase | StepNum | Period | UX | UY | UZ | SumUX | SumUY | SumUZ |
|---|---|---|---|---|---|---|---|---|
| | | Sec | | | | | | |
| MODAL | 1. | 0.180423 | 0. | 0.999813 | 0. | 0. | 0.999813 | 0. |
| MODAL | 2. | 0.077631 | 0. | 0.000027 | 2.102E-20 | 0. | 0.999839 | 2.713E-20 |
| MODAL | 3. | 0.054092 | 0.999914 | 0. | 1.061E-07 | 0.999914 | 0.999839 | 1.061E-07 |

Table 26: Modal Participating Mass Ratios

| OutputCase | StepNum | Period | UX | UY | UZ | SumUX | SumUY | SumUZ |
|---|---|---|---|---|---|---|---|---|
| | | Sec | | | | | | |
| MODAL | 4. | 0.024602 | 3.127E-19 | 0.000114 | 1.113E-17 | 0.999914 | 0.999953 | 1.061E-07 |
| MODAL | 5. | 0.022824 | 3.139E-19 | 6.797E-06 | 1.032E-17 | 0.999914 | 0.99996 | 1.061E-07 |
| MODAL | 6. | 0.020311 | 6.182E-19 | 0.000034 | 4.053E-18 | 0.999914 | 0.999993 | 1.061E-07 |
| MODAL | 7. | 0.019455 | 1.865E-07 | 0. | 0.109077 | 0.999914 | 0.999993 | 0.109077 |
| MODAL | 8. | 0.018609 | 2.274E-18 | 7.874E-07 | 3.455E-17 | 0.999914 | 0.999994 | 0.109077 |
| MODAL | 9. | 0.018137 | 8.865E-07 | 0. | 0.008896 | 0.999915 | 0.999994 | 0.117973 |
| MODAL | 10. | 0.016753 | 4.358E-17 | 2.130E-06 | 2.833E-16 | 0.999915 | 0.999996 | 0.117973 |
| MODAL | 11. | 0.015791 | 9.550E-07 | 2.771E-19 | 0.022893 | 0.999916 | 0.999996 | 0.140866 |
| MODAL | 12. | 0.015056 | 7.570E-06 | 1.264E-19 | 0.001773 | 0.999923 | 0.999996 | 0.142638 |

## *7.3. Base reactions*

### Table 27: Base Reactions

Table 27: Base Reactions

| OutputCase | GlobalFX | GlobalFY | GlobalFZ | GlobalMX | GlobalMY | GlobalMZ |
|---|---|---|---|---|---|---|
| | Tonf | Tonf | Tonf | Tonf-m | Tonf-m | Tonf-m |
| DL | -2.973E-16 | -9.884E-16 | 1.3444 | 1.88209 | -3.60559 | -2.119E-15 |
| SD | -3.068E-16 | -8.209E-16 | 0.462 | 0.6468 | -1.2705 | -1.172E-15 |
| Lr | -5.591E-16 | -1.405E-15 | 0.8156 | 1.14188 | -2.24298 | -1.943E-15 |
| W | -6.068E-16 | -2.139E-15 | -8.367E-15 | -5.626E-15 | 9.552E-15 | -3.117E-15 |
| EQ | 0.2345 | 0.2345 | 9.900E-05 | 0.6937 | 0.69759 | 0.71697 |