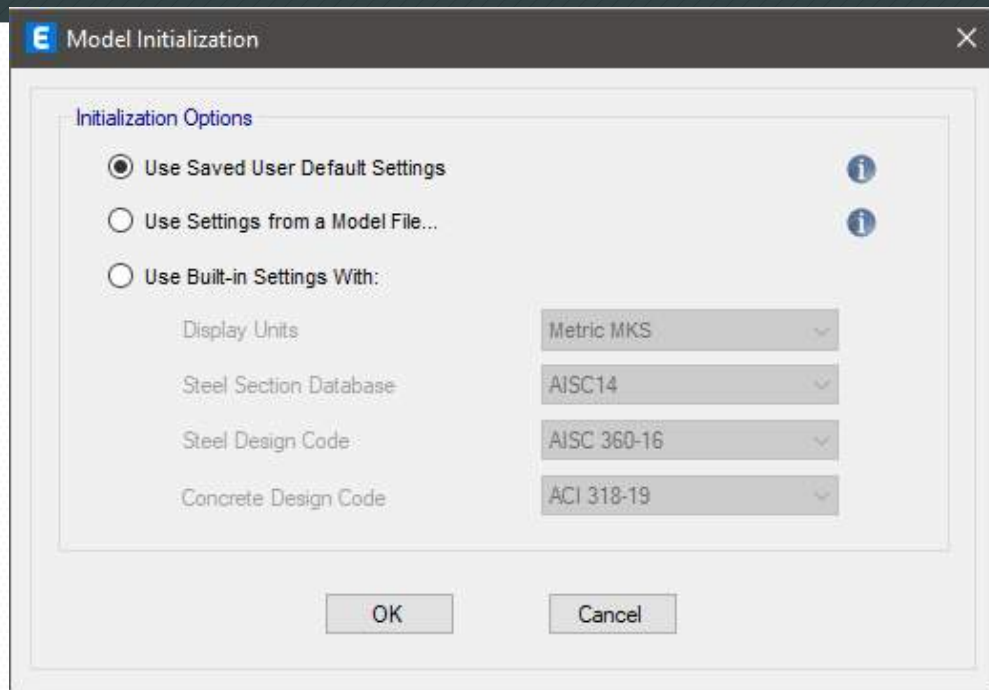


Introducción

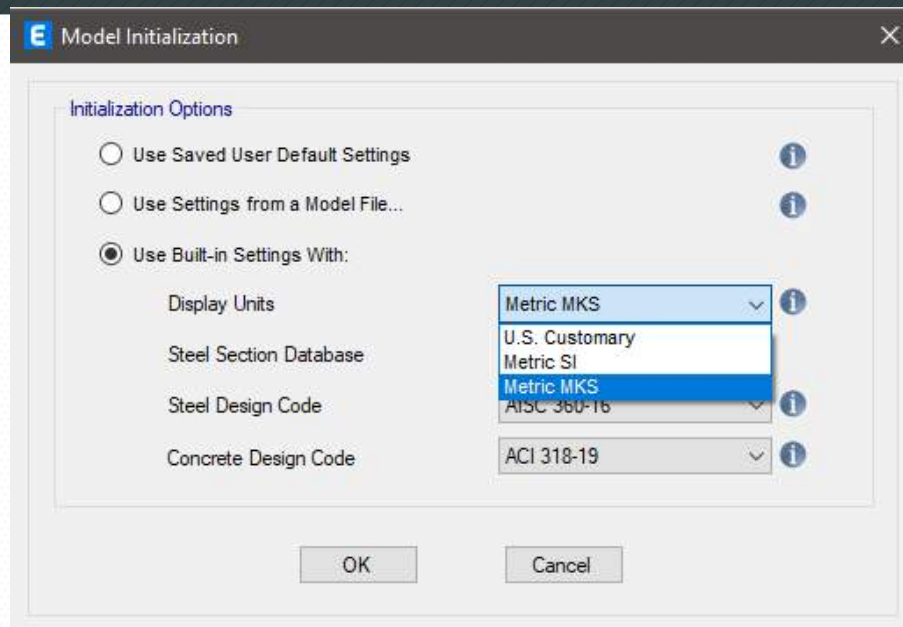
1. Inicio del programa
2. Líneas guías (grids)
3. Materiales y normativas
4. Barras de refuerzo
5. Pre-dimensionamiento de elementos estructurales

DISEÑO ESTRUCTURAL ASISTIDO POR COMPUTADORA

Inicio del programa



Inicia con la configuración definida por el programa
Inicia con la configuración de un modelo existente
Inicia con la configuración definida por el usuario



Sistema ingles (Libras, pies, segundos)
Sistema internacional (Newton, metro, segundo)
Sistema MKS (Kilogramo, metro, segundo)

E Model Initialization

Initialization Options

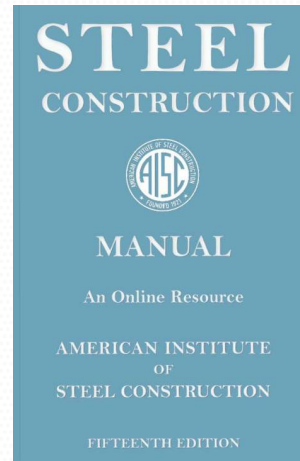
☐ Use Saved User Default Settings

☐ Use Settings from a Model File...

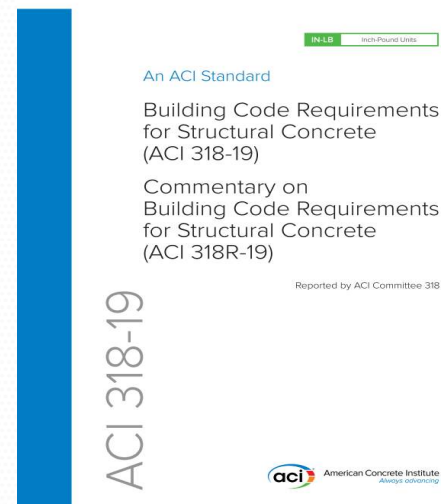
☒ Use Built-in Settings With:

Display Units	Metric MKS	
Steel Section Database	AISC14	
Steel Design Code	AISC 360-16	
Concrete Design Code	ACI 318-19	

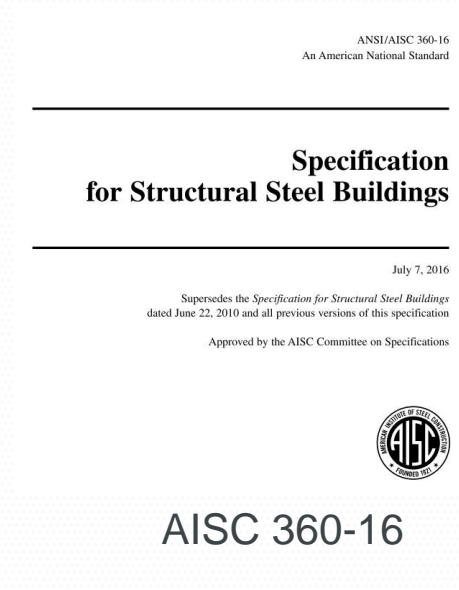
OK Cancel



Steel Data Base



ACI 318-19



Lineas Grids

E New Model Quick Templates ✕

Grid Dimensions (Plan)

☒ **Uniform Grid Spacing**

Number of Grid Lines in X Direction

Number of Grid Lines in Y Direction

Spacing of Grids in X Direction m

Spacing of Grids in Y Direction m

Specify Grid Labeling Options

☐ **Custom Grid Spacing**

Specify Data for Grid Lines

Story Dimensions

☒ **Simple Story Data**

Number of Stories


Typical Story Height m

Bottom Story Height m


☐ **Custom Story Data**

Specify Custom Story Data

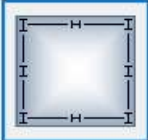
Add Structural Objects




Blank




Grid Only




Steel Deck




Staggered Truss




Flat Slab



Flat Slab with Perimeter Beams



Waffle Slab



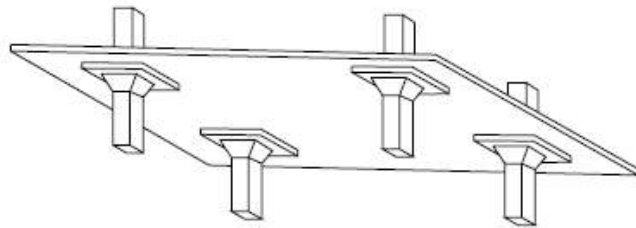
Two Way or Ribbed Slab



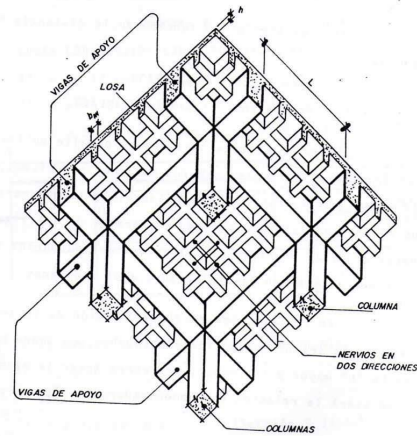
Steel Deck



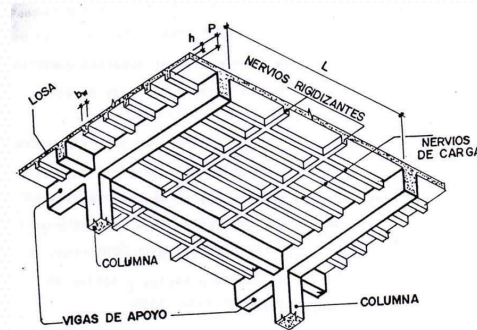
Staggered Truss



Flat Slab

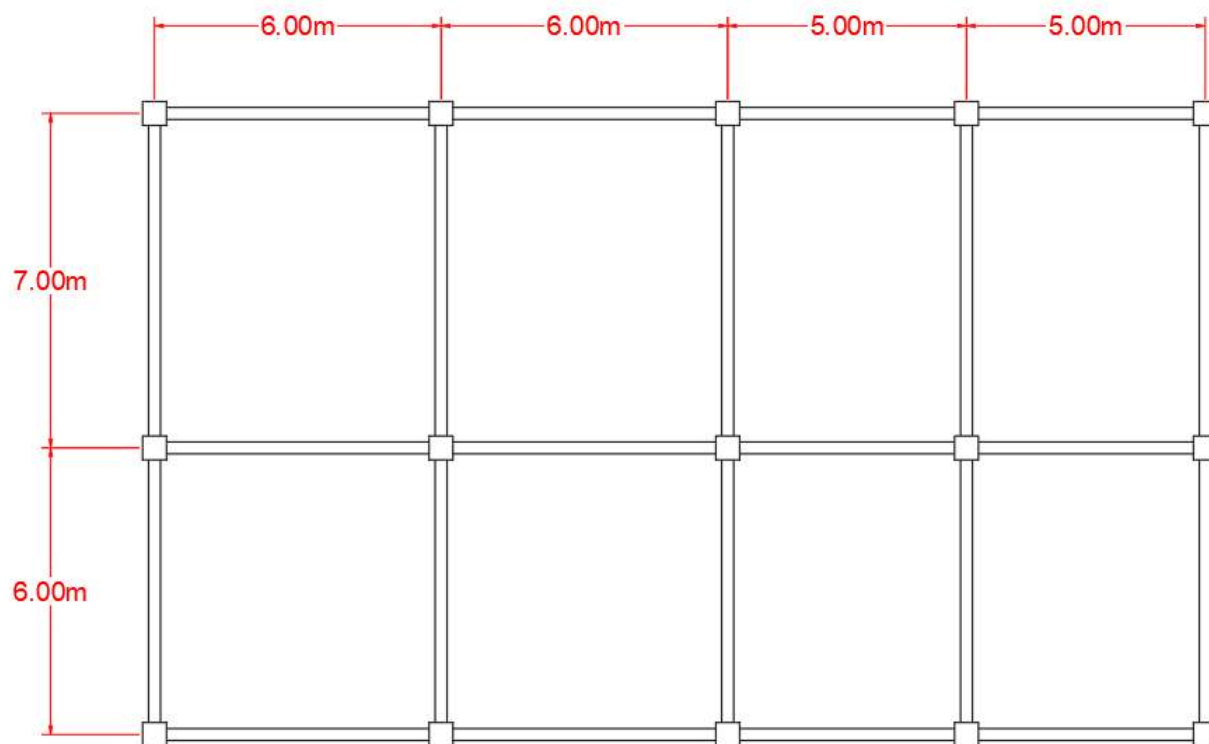


Waffle Slab



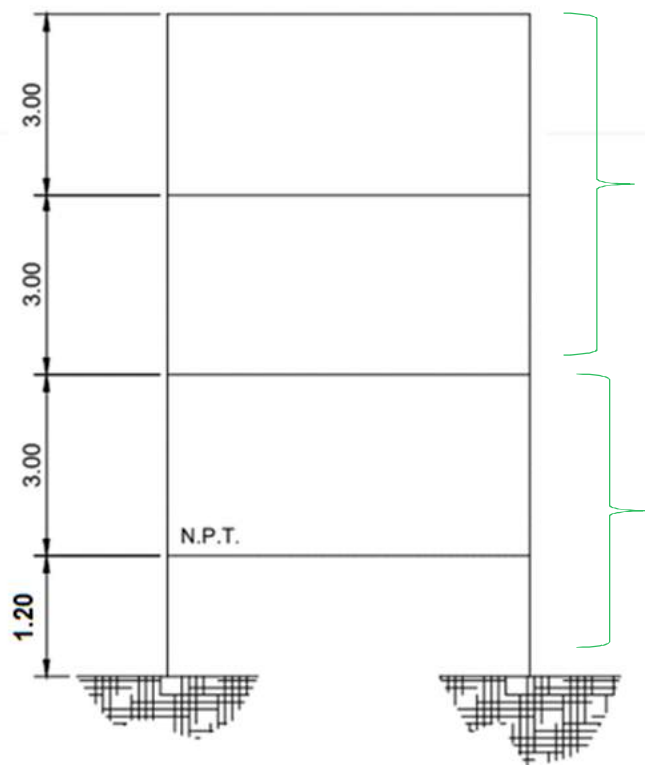
Ribbed Slab

Modelos
básicos



Lineas guías dirección "X"= 5

Lineas guías dirección "Y"= 3

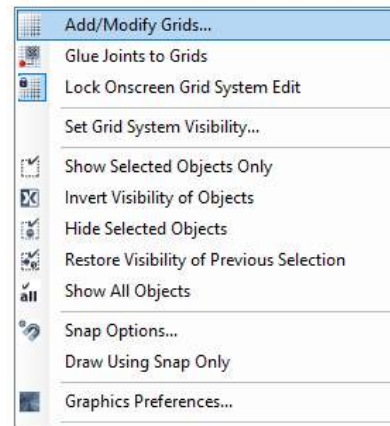
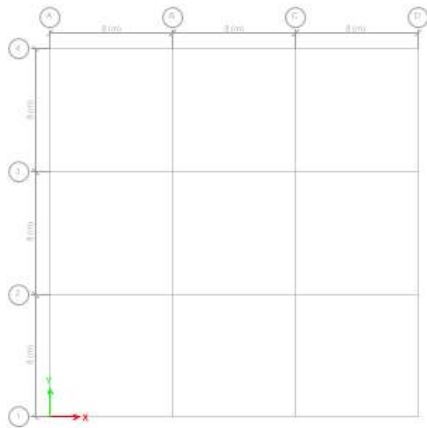


Typical Story Height

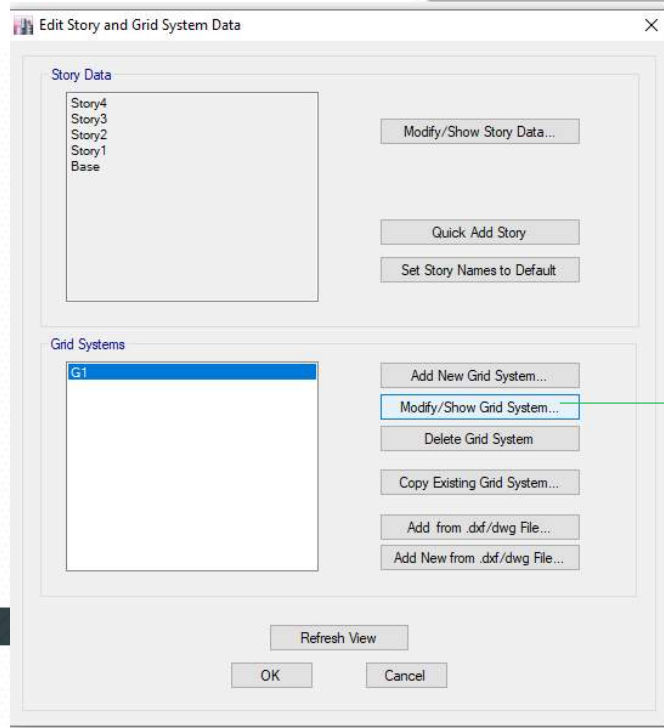
Numero de niveles 3

Bottom Story Height

ELEVACIÓN GENERAL
ESC: 1:50



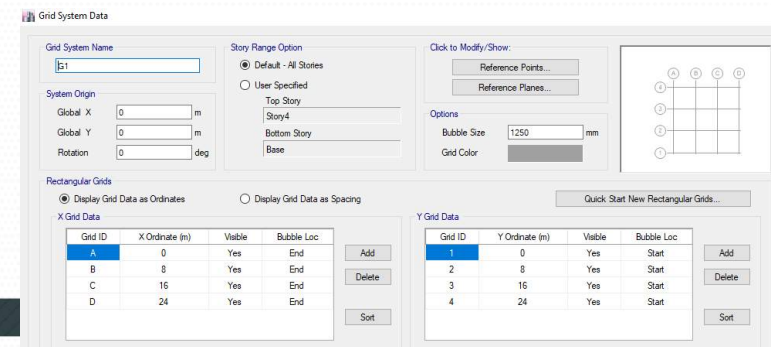
Modificar o editar la distancia entre líneas guías en planta y elevación



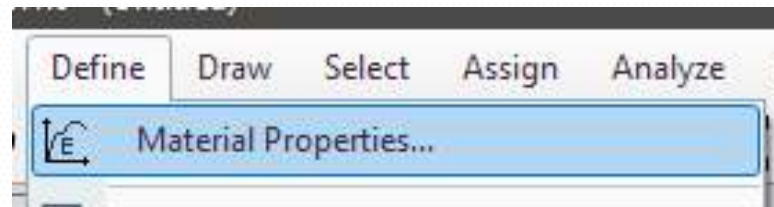
Edición de distancia e elevación

Story	Height m	Elevation m	Master Story	Similar To	Splice Story	Splice Height m	Story Color
Story4	3	12	Yes	None	No	0	Blue
Story3	3	9	No	Story4	No	0	Green
Story2	3	6	No	Story4	No	0	Cyan
Story1	3	3	No	Story4	No	0	Red
Base		0					

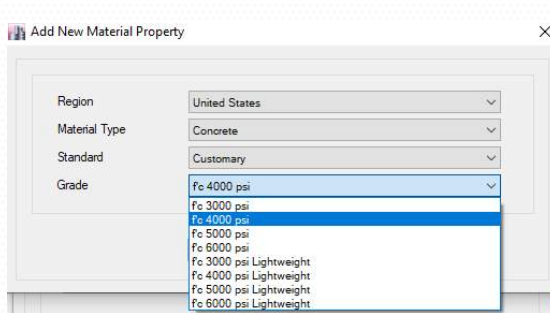
Edición de distancias en planta



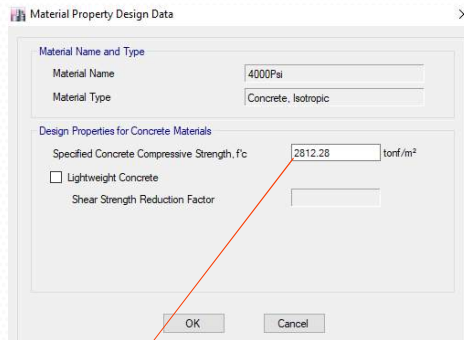
Materiales y normativas



Concreto



Clic "ok"



Definir la resistencia del concreto a los 28 días

Coloque el nombre deseado

Definir el peso específico $W_c = 2400 \text{ kg/m}^3$

Modulo de elasticidad en kg/cm^2
 $15100\sqrt{f'_c}$ (19.2.2.1)

Relación de Poisson = 0.25 (6.6.3)

Coefficiente de expansión térmica

Módulo de rigidez o cortante (6.6.3)

Acero

Add New Material Property

Region: United States

Material Type: Rebar

Standard: ASTM A615

Grade: ASTM A615

OK Cancel

Barras normadas para el concreto reforzado

ASTM A706



ASTM A615



Add New Material Property

Region: United States

Material Type: Rebar

Standard: ASTM A615

Grade: ASTM A615, ASTM A706, User

OK Cancel



Definir el grado

Grade: Grade 60

OK Cancel



Material Property Data

General Data

Material Name: A706Gr60-1

Material Type: Rebar

Directional Symmetry Type: Uniaxial

Material Display Color: Change...

Material Notes: Modify/Show Notes...

Material Weight and Mass

☒ Specify Weight Density ☐ Specify Mass Density

Weight per Unit Volume: 7.849 tonf/m³

Mass per Unit Volume: 0.80038 tonf-s²/m⁴

Mechanical Property Data

Modulus of Elasticity, E: 20389019.16 tonf/m²

Coefficient of Thermal Expansion, A: 0.0000117 1/C

Design Property Data

Modify/Show Material Property Design Data...

Advanced Material Property Data

Nonlinear Material Data... Material Damping Properties... Time Dependent Properties...

Dejar datos por Default ya que cumple con la normativa asignada

Barras de refuerzo

CUADRO 1 – Designación de la barra corrugada, masa nominal dimensiones nominales y requisitos de las corrugaciones

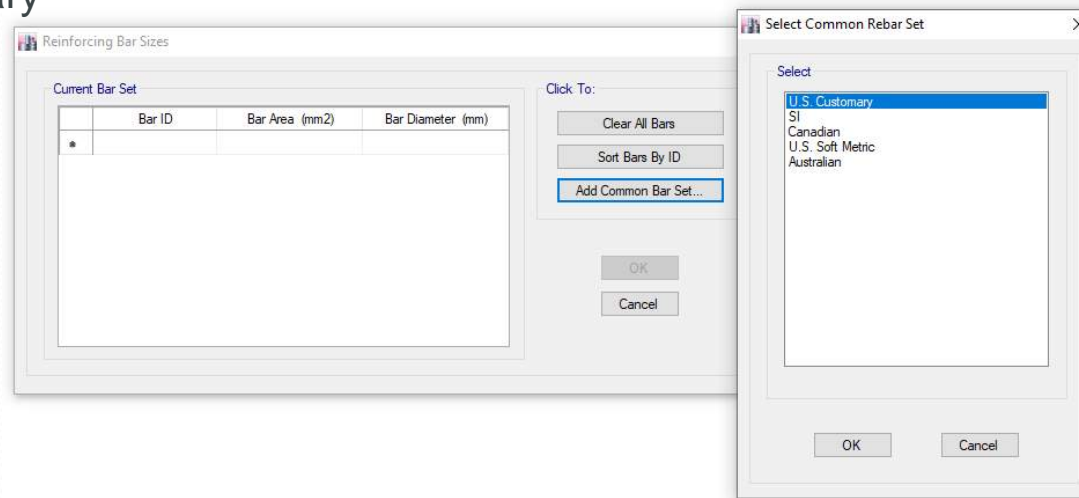
No. de designación de barra ^A	Masa nominal kg/m (lb/pie)	Dimensiones nominales ^B			Requerimientos de corrugaciones mm (pulg)		
		Diámetro mm (pulg)	Área de la sección transversal mm ² (pulg ²)	Perímetro mm (pulg)	Espaciamiento máximo promedio	Altura mínima promedio	Ancho máximo sin corrugaciones ^C (cordón de 12.5% del perímetro nominal)
7M ^D	0.302 (0.203)	7.0 (0.276)	38 (0.06)	22.0 (0.866)	4.9 (0.193)	0.38 (0.015)	2.7 (0.108)
8M ^D	0.395 (0.265)	8.0 (0.315)	50 (0.08)	25.1 (0.990)	5.6 (0.220)	0.38 (0.015)	3.1 (0.124)
10 (3)	0.560 (0.376)	9.5 (0.375)	71 (0.11)	29.9 (1.178)	6.7 (0.262)	0.38 (0.015)	3.6 (0.143)
11M ^D	0.746 (0.501)	11.0 (0.147)	95 (0.15)	34.6 (1.361)	7.7 (0.303)	0.51 (0.020)	4.3 (0.170)
13 (4)	0.994 (0.668)	12.7 (0.500)	129 (0.20)	39.9 (1.571)	8.9 (0.350)	0.51 (0.020)	4.9 (0.191)
16 (5)	1.552 (1.439)	15.9 (0.625)	199 (0.31)	49.9 (1.963)	11.1 (0.437)	0.71 (0.028)	6.1 (0.239)
19 (6)	2.235 (1.502)	19.1 (0.750)	284 (0.44)	59.8 (2.356)	13.3 (0.525)	0.97 (0.038)	7.3 (0.286)
22 (7)	3.042 (2.044)	22.2 (0.875)	387 (0.60)	69.8 (2.749)	15.5 (0.612)	1.12 (0.044)	8.5 (0.334)
25 (8)	3.973 (2.670)	25.4 (1.000)	510 (0.79)	79.8 (3.142)	17.8 (0.700)	1.27 (0.050)	9.7 (0.383)
29 (9)	5.060 (3.400)	28.7 (1.128)	645 (1.00)	90.0 (3.544)	20.1 (0.790)	1.42 (0.056)	10.9 (0.431)
32 (10)	6.404 (4.303)	32.3 (1.270)	819 (1.27)	101.3 (3.990)	22.6 (0.889)	1.63 (0.064)	12.4 (0.487)
36 (11)	7.907 (5.313)	35.8 (1.410)	1006 (1.56)	112.5 (4.430)	25.1 (0.987)	1.80 (0.071)	13.7 (0.540)
38 (12)	8.950 (6.014)	38.1 (1.500)	1140 (1.77)	119.7 (4.712)	26.7 (1.050)	1.91 (0.075)	15.0 (0.589)
43 (14)	11.38 (7.65)	43.0 (1.643)	1452 (2.25)	135.1 (5.32)	30.1 (1.185)	2.16 (0.085)	16.5 (0.648)
57 (18)	20.24 (13.60)	57.3 (2.257)	2581 (4.00)	180.1 (7.09)	40.1 (1.58)	2.59 (0.102)	21.9 (0.864)

Número Designación	Diámetro Nominal (pulg)	Diámetro Nominal (pulg)		Diámetro Pin* Ensayo Doblado (pulg.)		Varillas por Quintal		
		Mínimo	Máximo	Grado 40	Grado 60	6 mts	9 mts	12 mts
3	3/8	9.24	9.50	1.31	1.31	13.29	8.86	6.65
4	1/2	12.31	12.70	1.75	1.75	7.48	4.99	3.74
5	5/8	15.39	15.90	2.19	2.19	4.79	3.20	2.40
6	3/4	18.47	19.10	3.75	3.75	3.32	2.22	1.66
7	7/8	21.55	22.20	4.38	4.38	2.45	1.63	1.22
8	1	24.63	25.40	5.00	5.00	1.87	1.25	0.94
9	1 1/8	27.78	28.70	-----	7.90	1.47	0.98	0.74
10	1 1/4	31.28	32.30	-----	8.89	1.16	0.77	0.58
11	1 3/8	34.72	35.80	-----	12.69	0.94	0.63	0.47

- Definición de barras de acero

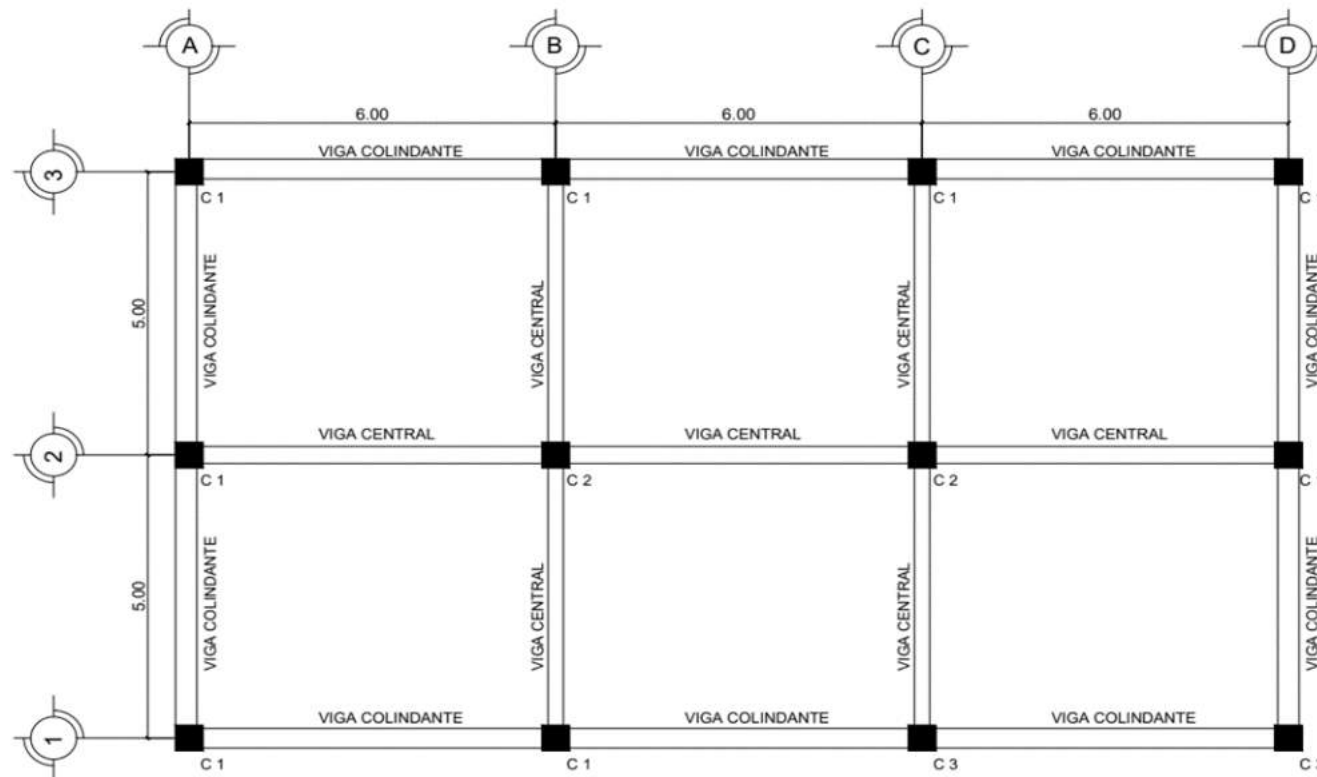


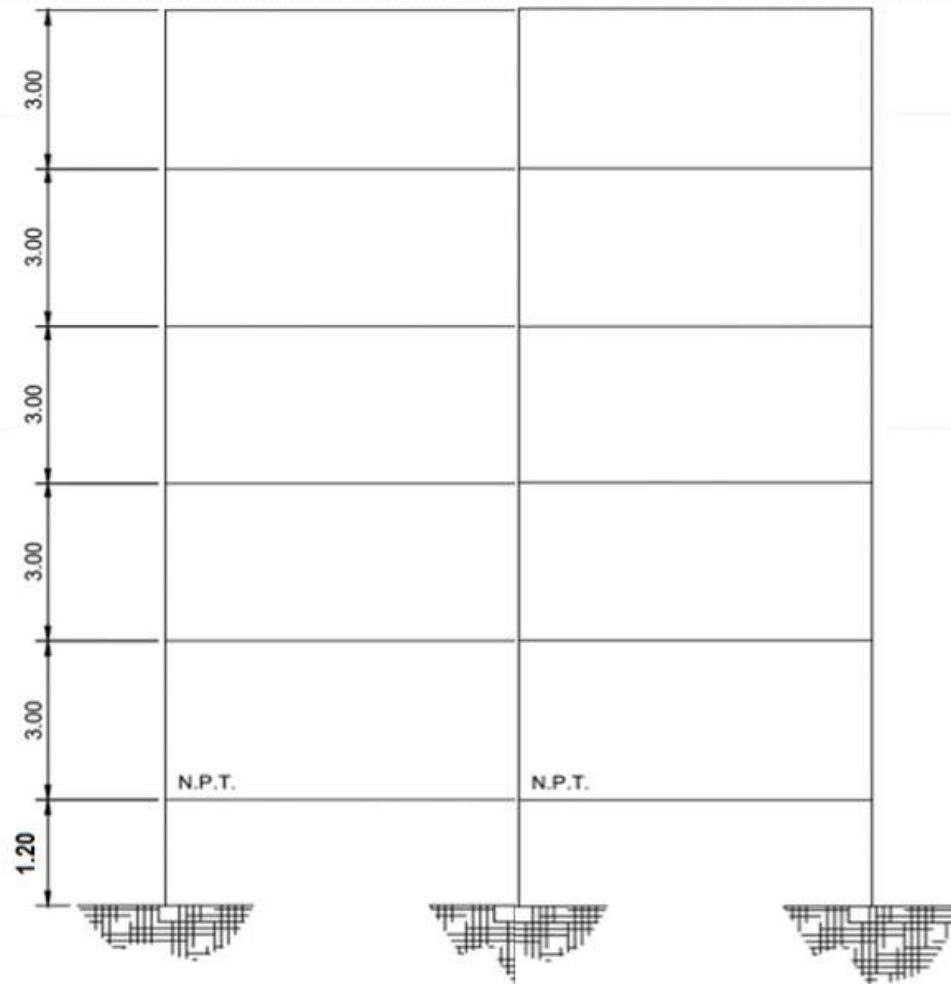
Dar clic en “Clear All Bars” y luego seleccionar “Add Common Bar set” dar clic en “U.S. Customary”



Pre-dimensionamiento de elementos estructurales

Planta a diseñar:





ELEVACIÓN GENERAL

ESC:

1:50

Uso: Hospital en Quetzaltenango, Quetzaltenango

- Carga viva nivel 1,2,3, y 4 = 350 kg/m^2
- Carga viva techo = 200 kg/m^2
- Sobrecarga nivel 1,2,3,4 = 300 kg/m^2
- Sobrecarga de techo = 200 kg/m^2
- Sobrecarga lineal vigas nivel 1,2,3,4 = 500 kg/m
- Sobrecarga lineal vigas colindantes de techo = 100 kg/m
- Concreto $f'c = 280 \text{ kg/cm}^2$
- Acero A706 Grado 60

Pre-dimensionamiento de losa

- Losas en dos sentidos

$$t = \text{Perímetro} / 180$$

Table 8.3.1.2—Minimum thickness of nonprestressed two-way slabs with beams spanning between supports on all sides

$\alpha_{fm}^{[1]}$	Minimum h , in.		
$\alpha_{fm} \leq 0.2$	8.3.1.1 applies		(a)
$0.2 < \alpha_{fm} \leq 2.0$	Greater of:	$\frac{\ell_n \left(0.8 + \frac{f_y}{200,000} \right)}{36 + 5\beta(\alpha_{fm} - 0.2)}$	(b) ^{[1],[2]}
		5.0	(c)
$\alpha_{fm} > 2.0$	Greater of:	$\frac{\ell_n \left(0.8 + \frac{f_y}{200,000} \right)}{36 + 9\beta}$	(d)
		3.5	(e)

^[1] α_{fm} is the average value of α_f for all beams on edges of a panel.

^[2] ℓ_n is the clear span in the long direction, measured face-to-face of beams (in.).

^[3] β is the ratio of clear spans in long to short directions of slab.

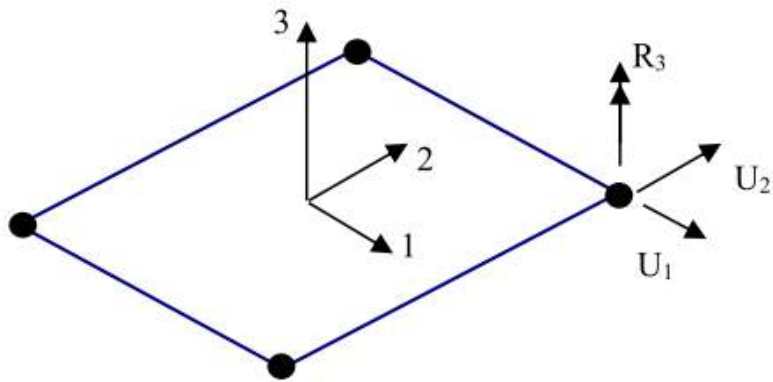
Losas en un sentido

Table 7.3.1.1—Minimum thickness of solid nonprestressed one-way slabs

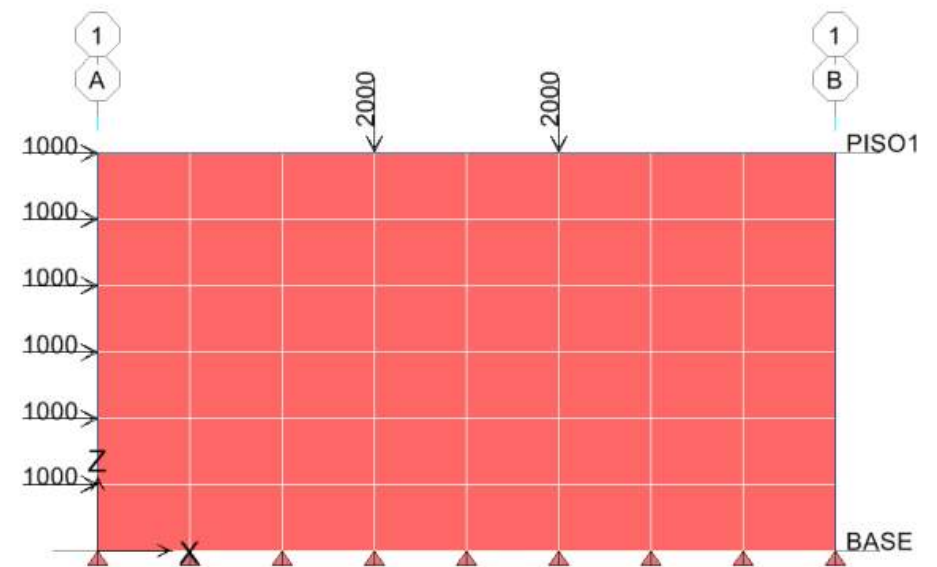
Support condition	Minimum $h^{[1]}$
Simply supported	$\ell/20$
One end continuous	$\ell/24$
Both ends continuous	$\ell/28$
Cantilever	$\ell/10$

^[1]Expression applicable for normalweight concrete and $f_y = 60,000$ psi. For other cases, minimum h shall be modified in accordance with 7.3.1.1.1 through 7.3.1.1.3, as appropriate.

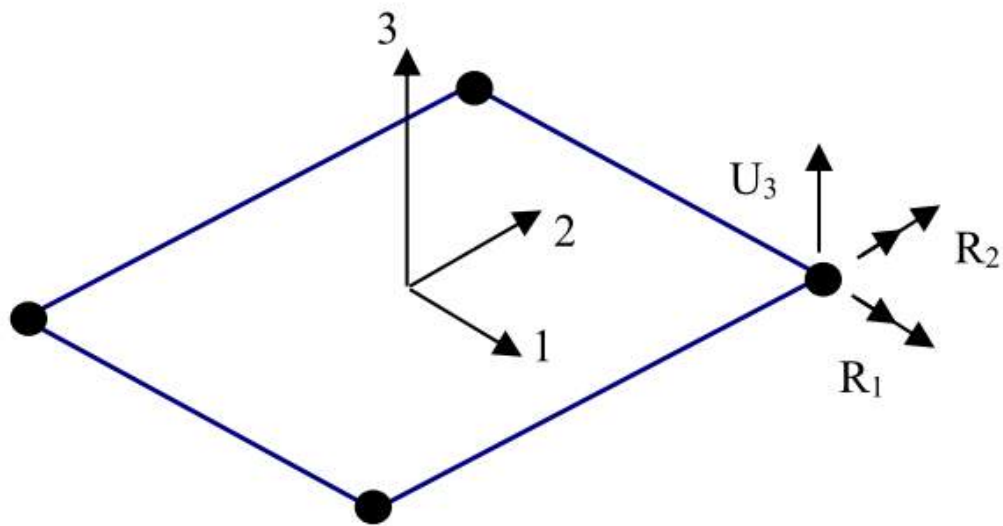
Elemento Tipo Membrane.



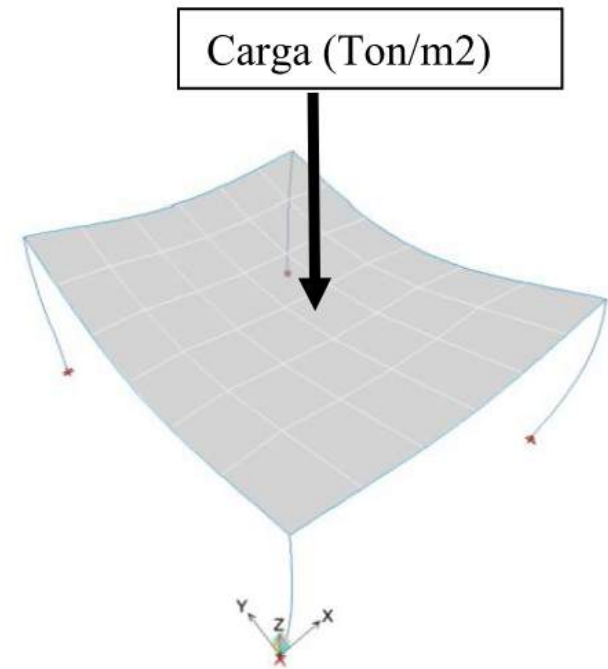
Fuente: Manual de Aplicación del Programa ETABS v9
Msc. Ing. Eliud Hernández



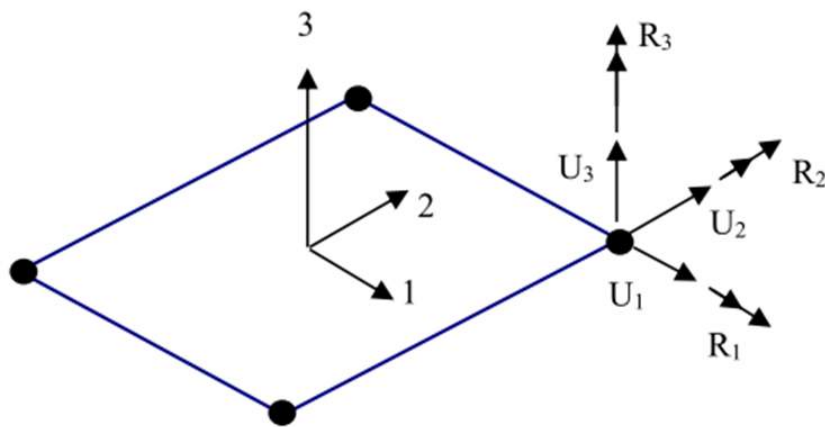
Elemento Tipo Plate.



Fuente: Manual de Aplicación del Programa ETABS v9
Msc. Ing. Eliud Hernández



Elemento Tipo Shell.



Elemento tipo membrana + tipo plate

Fuente: Manual de Aplicación del Programa ETABS v9
Msc. Ing. Eliud Hernández

Shell-thin: Cascara delgada ($L/t > 20$)

Shell-thick: Cascara gruesa ($L/t < 20$)



Nombre de la sección
Material

Slab Property Data

General Data

Property Name: Slab1

Slab Material: 4000Psi

Modeling Type: Shell-Thin

Property Notes

Property Data

Type: Slab

Thickness: 0.2 m

OK Cancel

Definición del modelado de elementos finitos

Seleccionar tipo "Slab"

Espesor de losa

Pre-dimensionamiento de vigas

$$\frac{Ln}{14} < h < \frac{Ln}{10}$$
$$\frac{h}{2} < b < \frac{2h}{3}$$



Table 9.3.1.1—Minimum depth of nonprestressed beams

Support condition	Minimum h ^[1]
Simply supported	$\ell/16$
One end continuous	$\ell/18.5$
Both ends continuous	$\ell/21$
Cantilever	$\ell/8$

^[1]Expressions applicable for normalweight concrete and $f'_c = 60,000$ psi. For other cases, minimum h shall be modified in accordance with 9.3.1.1.1 through 9.3.1.1.3, as appropriate.

18.6.2 Dimensional limits

18.6.2.1 Beams shall satisfy (a) through (c):

- (a) Clear span ℓ_n shall be at least **$4d$**
- (b) Width b_w shall be at least the lesser of **$0.3h$** and 10 in.
- (c) Projection of the beam width beyond the width of the supporting column on each side shall not exceed the lesser of c_2 and **$0.75c_1$** .



Material

Altura

Base

Frame Section Property Data

General Data

Property Name: YY 45X25

Material: CONCRETO F'C=281

Notional Size Data: Modify/Show Notional Size...

Display Color: Change...

Notes: Modify/Show Notes...

Shape

Section Shape: Concrete Rectangular

Section Property Source

Source: User Defined

Section Dimensions

Depth: 0.45 m

Width: 0.25 m

Property Modifiers

Modify/Show Modifiers...
Currently Default

Reinforcement

Modify/Show Rebar...

OK

Cancel

Show Section Properties...

Selección tipo de sección "Beam"

Acero de refuerzo para barras longitudinales y estribos

Frame Section Property Reinforcement Data

Design Type

☐ P-M2-M3 Design (Column)

☒ M3 Design Only (Beam)

Rebar Material

Longitudinal Bars: A706Gr60

Confinement Bars (Ties): A706Gr60

Cover to Longitudinal Rebar Group Centroid

Top Bars: 0.06 m

Bottom Bars: 0.06 m

Reinforcement Area Overwrites for Ductile Beams

Top Bars at I-End: 0 m²

Top Bars at J-End: 0 m²

Bottom Bars at I-End: 0 m²

Bottom Bars at J-End: 0 m²

OK

Cancel

$Rec + \Phi_{est} + \Phi_{long}/2$

Armado propuesto
(Se realiza al final del diseño)

Pre-dimensionamiento de columnas

$$A_{COL} = \frac{\lambda P_G}{\eta f'_c} \quad (Ec. 3.4)$$

Dónde:

A_{COL} : Área de Columna.

P_G : Carga por Gravedad.

λ, η : Factores que dependen de la ubicación de la columna.

Tabla 3.4 Factores para el
predimensionamiento de columnas.

TIPO DE COLUMNA	λ	η
CENTRAL	1.1	0.3
PERIMETRAL	1.25	0.25
ESQUINA	1.5	0.2

18.7.2 Dimensional limits

18.7.2.1 Columns shall satisfy (a) and (b):

- (a) The shortest cross-sectional dimension, measured on a straight line passing through the geometric centroid, shall be at least 12 in.
- (b) The ratio of the shortest cross-sectional dimension to the perpendicular dimension shall be at least 0.4.



Selección tipo de sección "Column"

Acero de refuerzo para barras longitudinales y estribos

Nombre de la sección

Material

Altura o profundidad

Base

Frame Section Property Data

General Data

Property Name: C 45X45

Material: CONCRETO FC=281

Notional Size Data: Modify/Show Notional Size...

Display Color: Change...

Notes: Modify/Show Notes...

Shape

Section Shape: Concrete Rectangular

Section Property Source

Source: User Defined

Section Dimensions

Depth: 0.45 m

Width: 0.45 m

Property Modifiers

Modify/Show Modifiers...
Currently Default

Reinforcement

Modify/Show Rebar...

OK
Cancel

Show Section Properties...

Frame Section Property Reinforcement Data

Design Type

☒ P-M2-M3 Design (Column)
☐ M3 Design Only (Beam)

Rebar Material

Longitudinal Bars: A706Gr60
Confinement Bars (Ties): A706Gr60

Reinforcement Configuration

☒ Rectangular
☐ Circular

Confinement Bars

☒ Ties
☐ Spirals

Check/Design

☒ Reinforcement to be Checked
☐ Reinforcement to be Designed

Longitudinal Bars

Clear Cover for Confinement Bars: 0.04 m

Number of Longitudinal Bars Along 3-dir Face: 3

Number of Longitudinal Bars Along 2-dir Face: 3

Longitudinal Bar Size and Area: #7 0.000387 m²

Cornor Bar Size and Area: #7 0.000387 m²

Confinement Bars

Confinement Bar Size and Area: #3 0.000071 m²

Longitudinal Spacing of Confinement Bars (Along 1-Axis): 0.15 m

Number of Confinement Bars in 3-dir: 3

Number of Confinement Bars in 2-dir: 3

OK
Cancel

Checked: verificar el armado propuesto,

Designed: el programa diseña

Armado longitudinal

Armado transversal