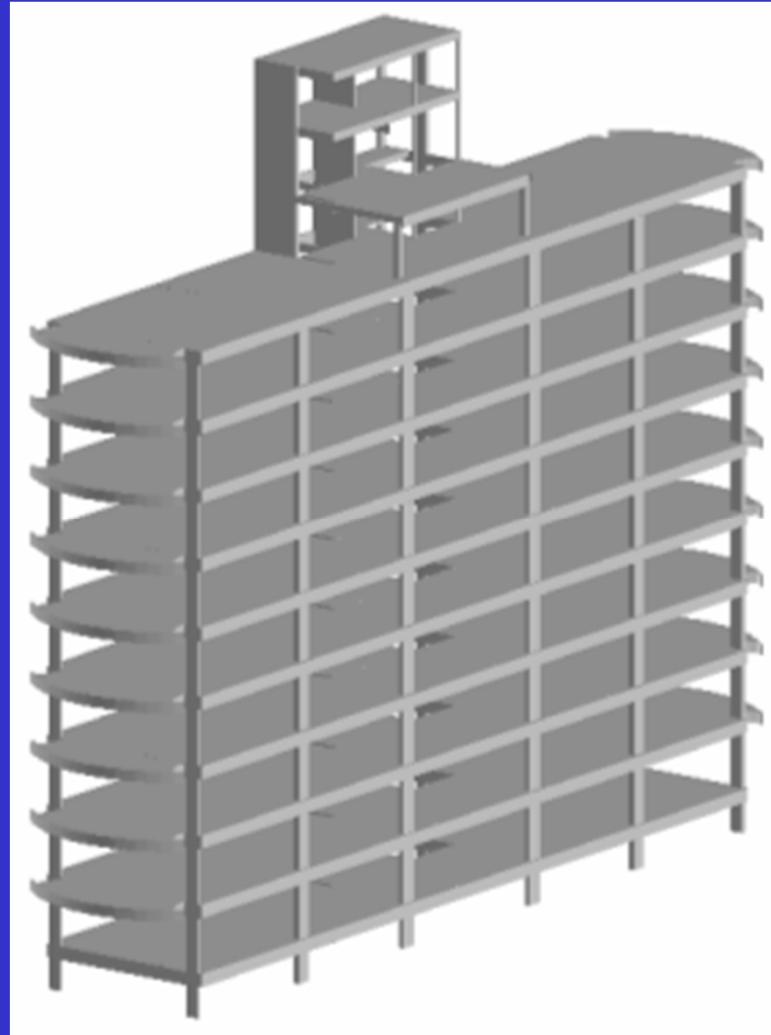


Introdução

Motivação



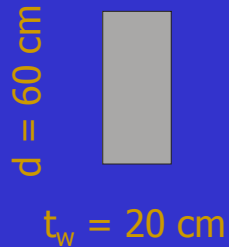
Modelos de placas com vigas e pilares

Introdução

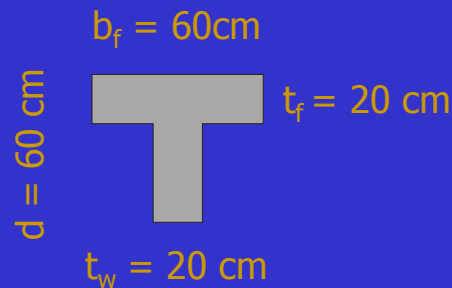
Exercício – Pórtico 3D

$f_{ck} = 30 \text{ MPa}$

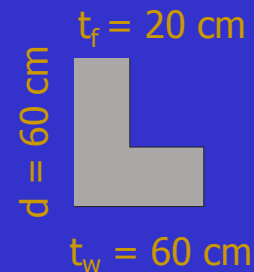
Pilar tipo 1



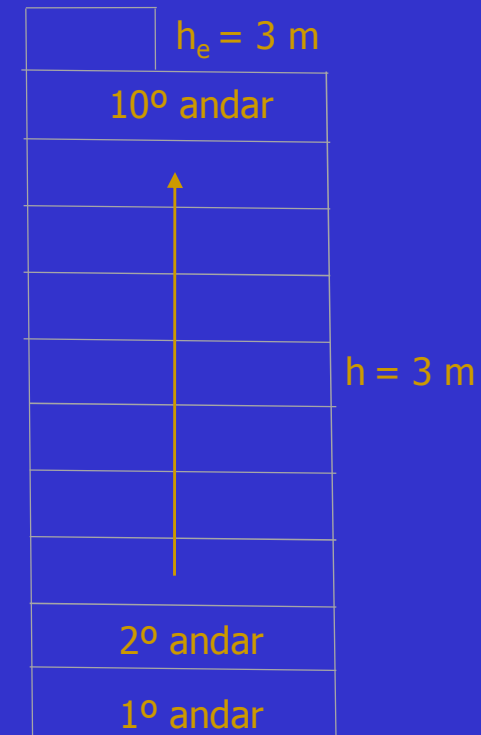
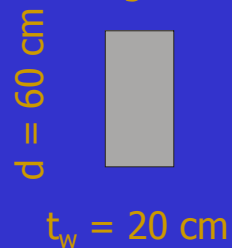
Pilar tipo 2



Pilar tipo 3

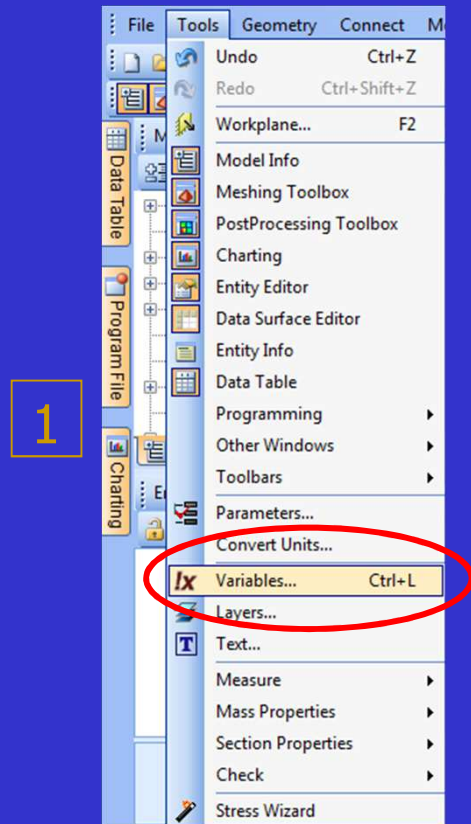


Vigas



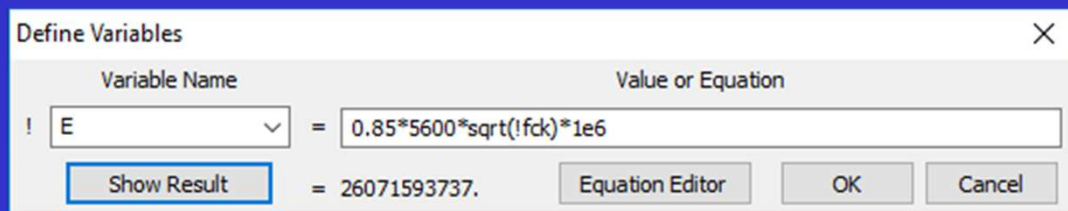
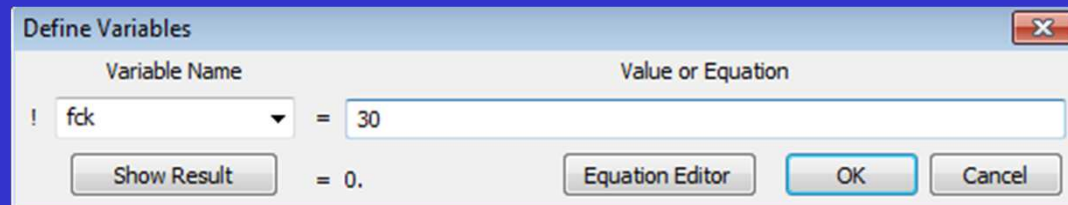
Modelagem

Parâmetros



2

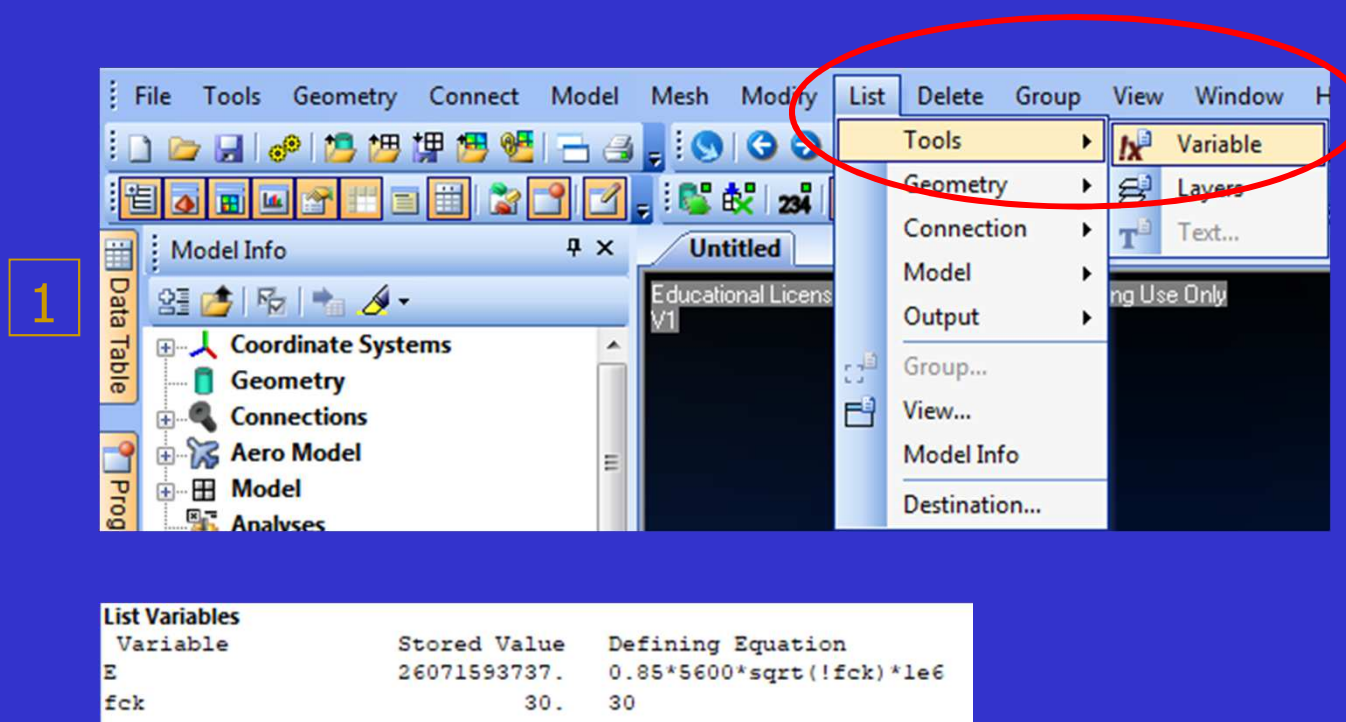
3



Modelos de placas com vigas e pilares

Modelagem

Parâmetros



Modelos de placas com vigas e pilares

Modelagem

Geometria

- Pontos

Geometry : Point : Method(Locate) :

ID1 (0.,0.,0.) ID2 (6.,0.,0.) ... ID6 (30.,0.,0.)

ID7 (0.,10.,0.) ID8 (6.,10.,0.) ... ID12 (30.,10.,0.)

ID13 (12.,7.,0.) ID14 (18.,7.,0.)

ID15 (0.,0.,3.) ID16 (6.,0.,3.) ... ID20 (30.,0.,3.)

ID21 (0.,10.,3.) ID22 (6.,10.,3.) ... ID26 (30.,10.,3.)

ID27 (12.,7.,3.) ID28 (18.,7.,3.)

Modelagem

Geometria

- Curvas: Pilares

Geometry : Curve-Line : Points :

ID1 (Pt 1 To Pt 15) ID2 (Pt 2 To Pt 16) ... ID14 (Pt 14 To Pt 28)

- Curvas: Vigas

Geometry : Curve-Line : Points :

ID15 (Pt 15 To Pt 17) ID16 (Pt 16 To Pt 18) ... ID24 (Pt 24 To Pt 26)

ID25 (Pt 27 To Pt 28)

ID26 (Pt 15 To Pt 16) ID27 (Pt 17 To Pt 18) ID28 (Pt 19 To Pt 27)

ID29 (Pt 27 To Pt 20) ID30 (Pt 21 To Pt 28) ID31 (Pt 28 To Pt 22)

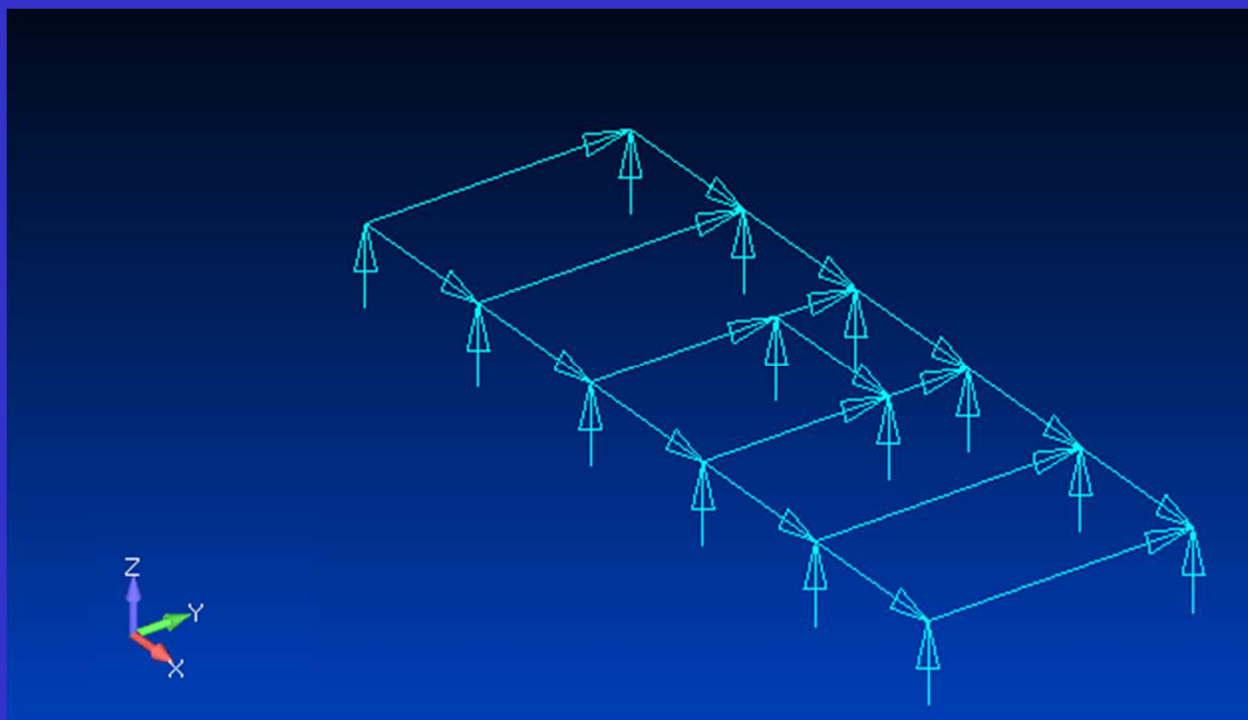
ID32 (Pt 23 To Pt 24) ID33 (Pt 25 To Pt 26)

Modelagem

Geometria

- Curvas: Vigas

View : Options : Labels : Curve / Surface Directions :Curve Arrows



Modelos de placas com vigas e pilares

Modelagem

Materiais e Propriedades

- Material

Title : Concreto $f_{ck} = 30\text{MPa}$

E : 10^5 N/mm^2 & $\nu = 0.2$ & $d = 2500$

- Propriedade 1

Model : Property : Beam

Title : Pilares tipo 1

Rectangular Bar & Height : 60×10^{-2} & Width : 20×10^{-2}

- Propriedade 2

Model : Property : Beam

Title : Pilares tipo 2

T Section & Height : 60×10^{-2} & Width : 60×10^{-2} & Thick = Thickness : 20×10^{-2}

Modelagem

Materiais e Propriedades

- propriedade 3

Model : Property : Beam

Title : Pilares tipo 3

Angle (L) section & Height : 60e-2 & Width : 60e-2 & Thick = Thickness : 20e-2

- Propriedade 4

Model : Property : Beam

Title : Vigas

Rectangular Bar & Height : 60e-2 & Width : 20e-2

- Propriedade 5

Model : Property : Plate

Title : Lajes

Thicknesses : 20e-2

Modelagem

Malha

- refinamento pilares e vigas (1 elemento/m)

Mesh : Mesh Control : Size Along Curve :

Cr n : Pilares (3 el)

Cr n : Vigas (6 el), (10 el), (7 el), (3 el)

- nós & elementos

Mesh : Geometry : Curve (1, 6, 7, 12) : Property : Pilares tipo 1

Method (Locate) : $\{v\} = \{Tip\} - \{Base\} = (1.,0.,0.) - (0.,0.,0.)$

Mesh : Geometry : Curve (2...5) : Property : Pilares tipo 2

Method (Locate) : $\{v\} = \{Tip\} - \{Base\} = (-1.,0.,0.) - (0.,0.,0.)$

Mesh : Geometry : Curve (8...11) : Property : Pilares tipo 2

Method (Locate) : $\{v\} = \{Tip\} - \{Base\} = (1.,0.,0.) - (0.,0.,0.)$

Mesh : Geometry : Curve (13) : Property : Pilares tipo 3

Method (Locate) : $\{v\} = \{Tip\} - \{Base\} = (1.,0.,0.) - (0.,0.,0.)$

Modelagem

Malha

Mesh : Geometry : Curve (14) : Property : Pilares tipo 3

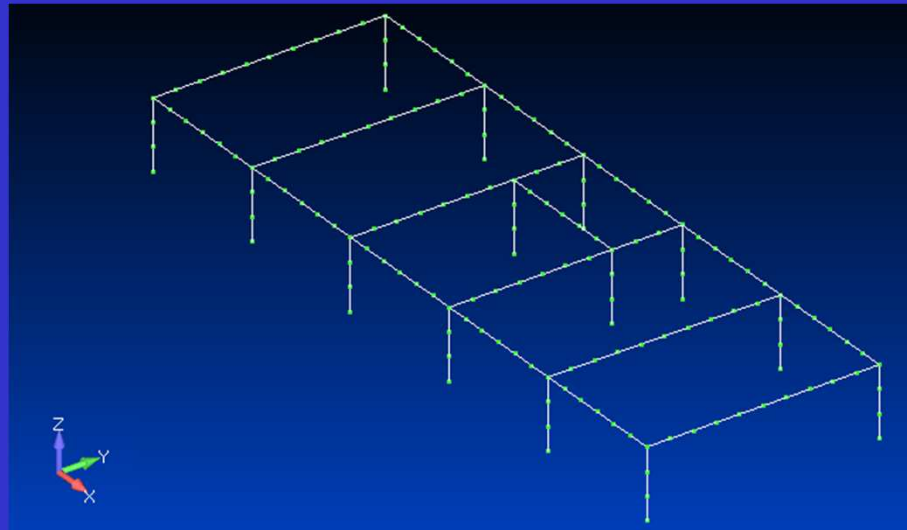
Method (Locate) : $\{v\} = \{Tip\} - \{Base\} = (-1.,0.,0.) - (0.,0.,0.)$

Mesh : Geometry : Curve (15 ... 25) : Property : Vigas

Method (Locate) : $\{v\} = \{Tip\} - \{Base\} = (0.,1.,0.) - (0.,0.,0.)$

Mesh : Geometry : Curve (26 ... 33) : Property : Vigas

Method (Locate) : $\{v\} = \{Tip\} - \{Base\} = (-1.,0.,0.) - (0.,0.,0.)$

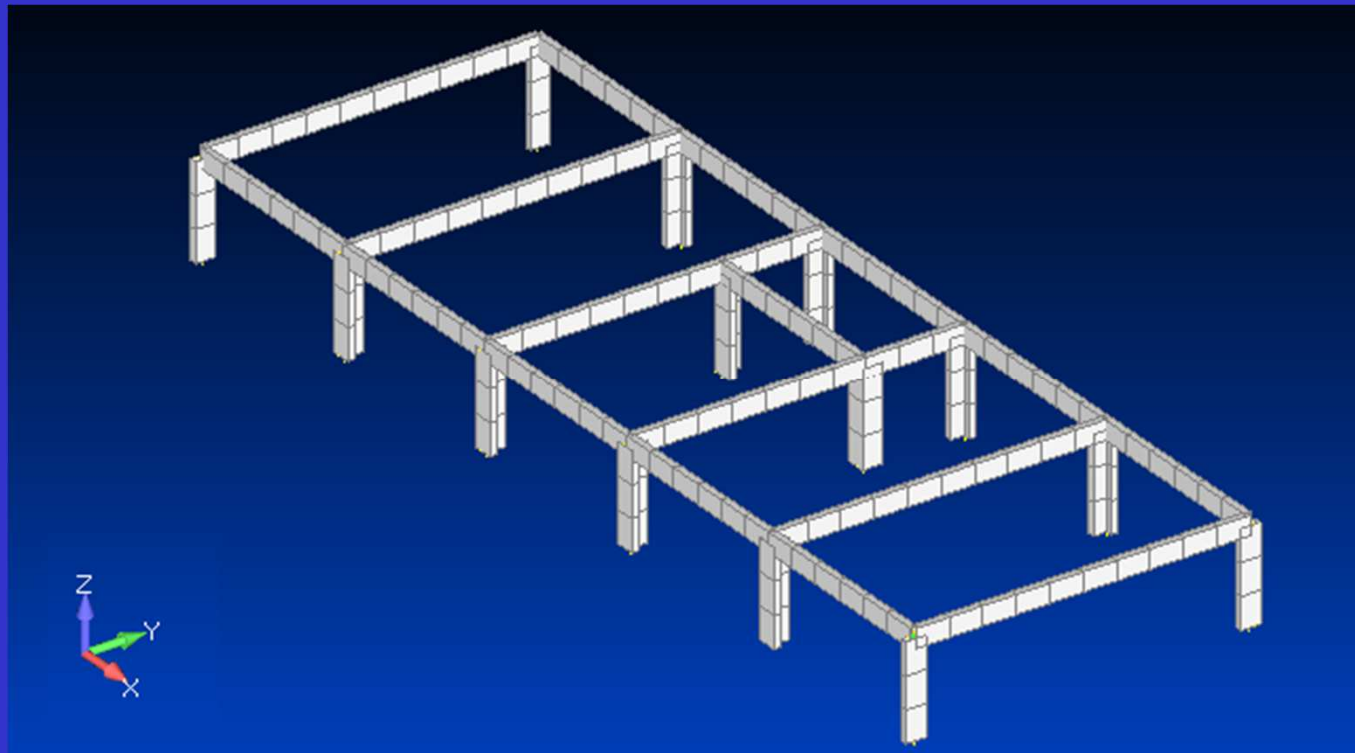


Modelos de placas com vigas e pilares

Modelagem

Malha

View : Options : Labels : Element – Orientation/Shape : Show Cross Section



Modelos de placas com vigas e pilares

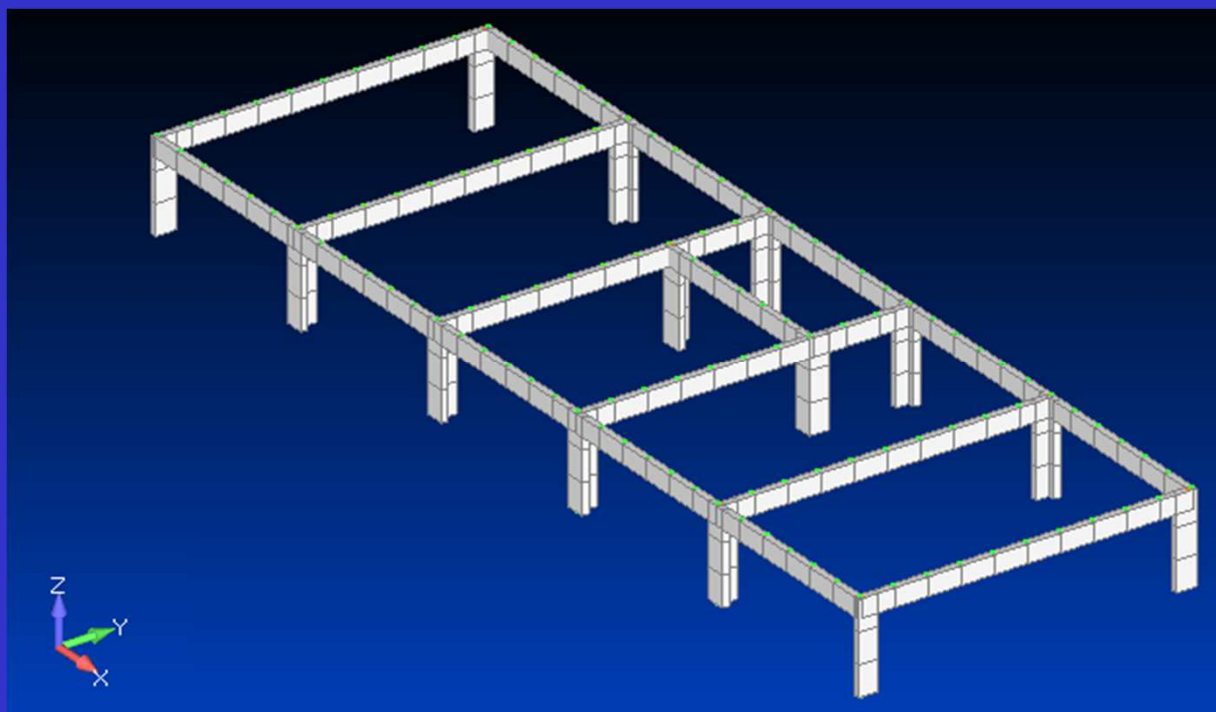
Modelagem

Malha

Model : Edit : Property : Change Shape : Reference Point

Modify : Update Elements : Line Element Offsets : Method : By Property

Set EndB = endA : OK Move to reference point



Modelos de placas com vigas e pilares

Modelagem

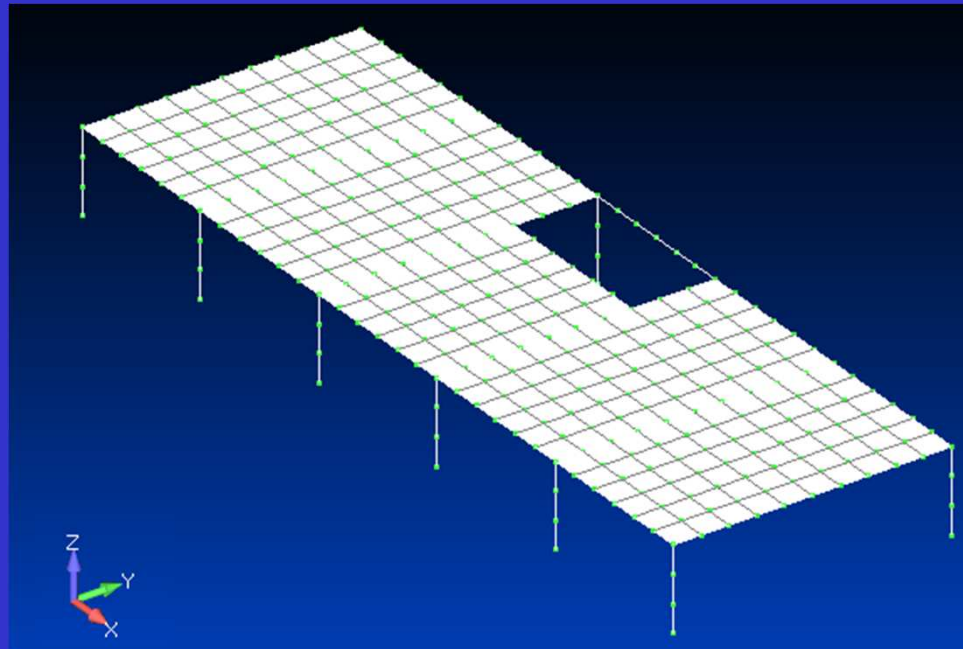
Malha

- refinamento lajes (elemento de 1m x 1m)

Model : Element : Property : 5 .. Lajes : Nodes : ...

Mesh : Extrude : Elements : ... : Property : Lajes Elements along length : 30

Method (Direction) : {X} = (0.,0.,0.), {dX} = (1.,0.,0.) Length = 30



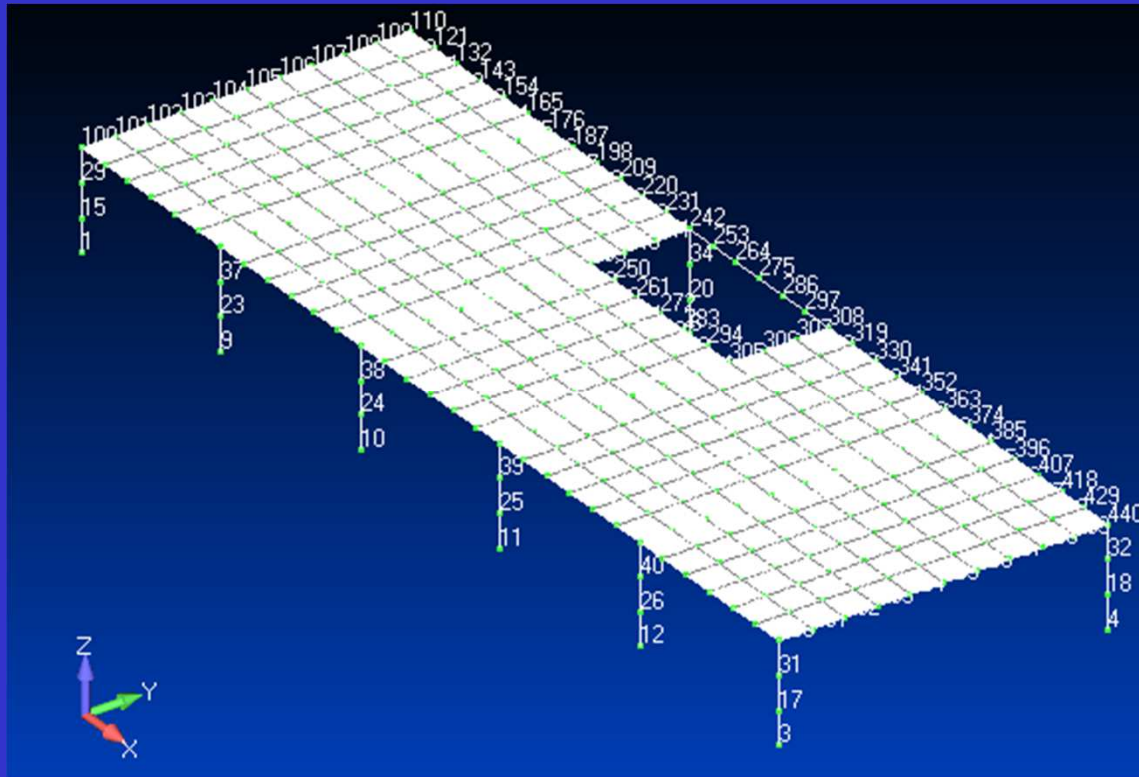
Modelos de placas com vigas e pilares

Modelagem

Malha

- refinamento lajes (elemento de 1m x 1m)

Tools : Check : Coincident Nodes : Select all : Tolerance = 0.001 : Ok



Modelos de placas com vigas e pilares

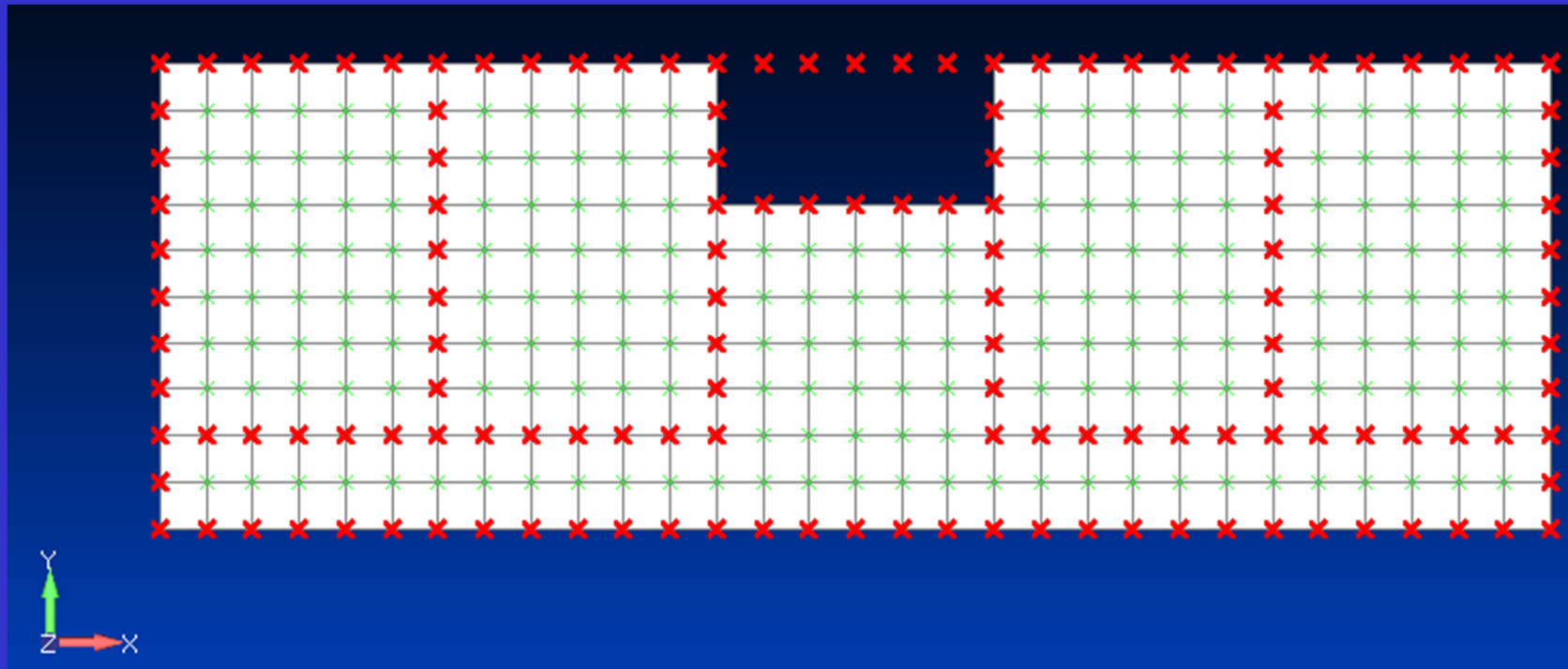
Modelagem

Malha

- Nós de apoio das paredes:

View : Options : Tools View Style: Symbols : Nodes, Points Mesh : 2. Symbols – All.

Modify : Color : Node : ... : 255 : Ok



Modelos de placas com vigas e pilares

Modelagem

Malha

- Malha dos pavimentos tipo:

Mesh : Copy : Element : Select All :

Repetitions : 9 : Method(Locate):

{Base} = (0.,0.,0.) & {Topo} = (0.,0.,3.)

- Malha da caixa de elevadores:

Mesh : Copy : Element : (Vigas + Pilares)

Repetitions : 1 : Method(Locate):

{Base} = (0.,0.,0.) & {Topo} = (0.,0.,3.)

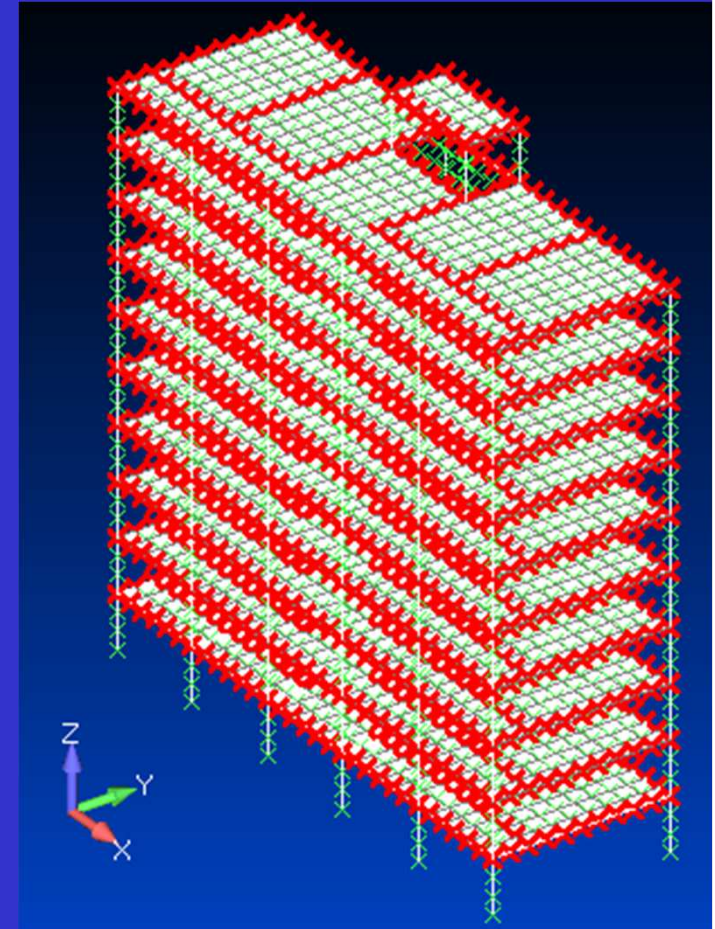
Mesh : Extrude : Elements : ... : Property : Lajes

Elements along length : 6

Method (Direction) :

{X} = (0.,0.,0.), {dX} = (1.,0.,0.) Length = 6

Tools : Check : Coincident Nodes : Select All : Ok



Modelos de placas com vigas e pilares

Modelagem

Condições de Contorno

- carregamento permanente (g):

Peso próprio + elementos construtivos (13 kN/m³)

Model : Load : Create Set : New

Title : Carga permanente

Model : Load : Body : Az: -10

Model : Load : Nodal : Method (Color) : Fz: -6240

- carregamento accidental (q):

Edifícios residencias (2 kN/m²)

Model : Load : Create Set : New

Title : Carga accidental

Model : Load : Elemental : Method (Property) : Pressure : -2000

Specify direction : (0.,0.,1.) : Face : 2

Ações verticais

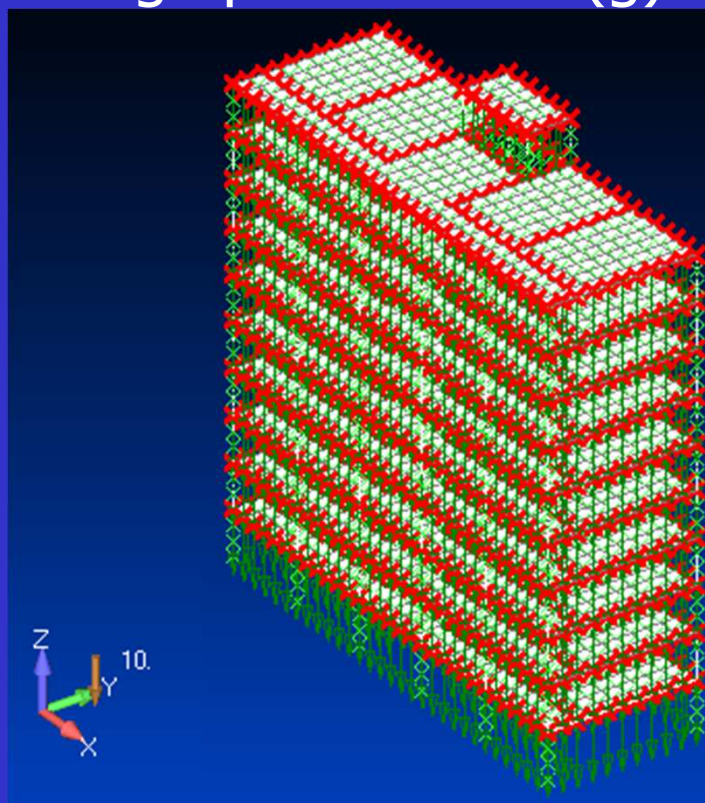
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Palavras-chave: Edificação, Estrutura		1 página

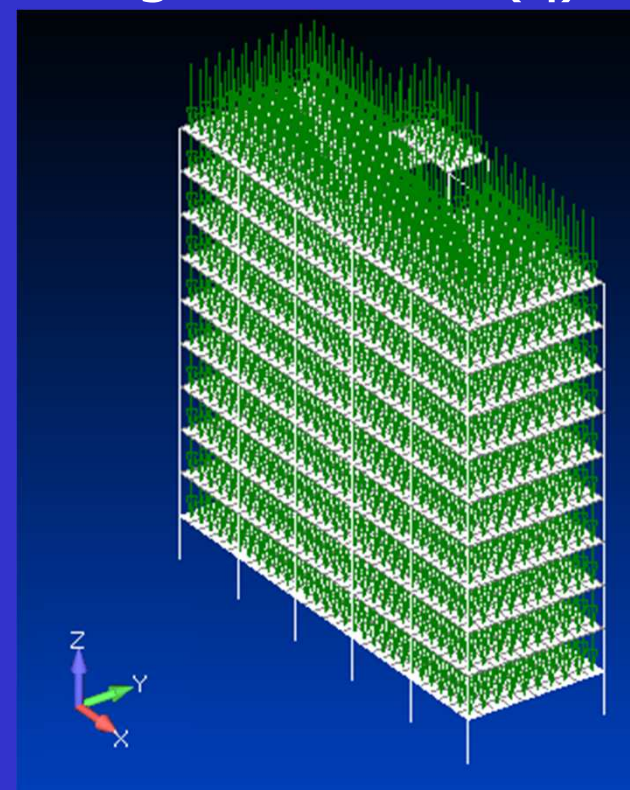
Modelagem

Condições de Contorno

carga permanente (g):



carga acidental (q):



Modelos de placas com vigas e pilares

Modelagem

Condições de Contorno

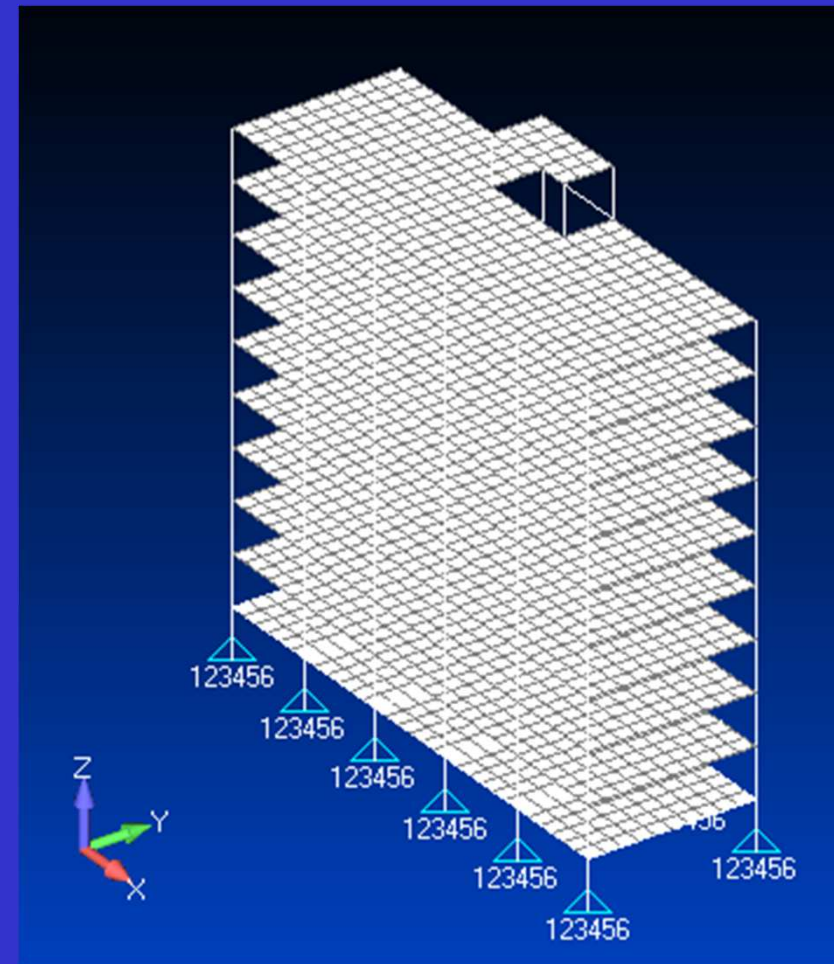
- Restrições

Model : Constraint : Create Set : New

Title : Engaste

Model : Constraint : Nodal :

Nd 1, 2, 3, ..., 14: Fixed



Modelos de placas com vigas e pilares

Análise & Pós-Processamento

Análise Linear

- solução estática linear

Model : Analysis : New :

Title : Linear & Type : Static :

Master Request and Conditions : Boundary Conditions :

Constraints : None Loads : None

Multiset : Constraint : 1 Loads : 1,2

Analyze

- Combinação ELU

Model : Output : Process : Linear Combination :

Scale fator : 1,4 Nastran Case 1 + Scale fator : 1,4 Nastran Case 2

- Combinação ELS

Model : Output : Process : Linear Combination :

Scale fator : 1,0 Nastran Case 1 + Scale fator : 0,7 Nastran Case 2

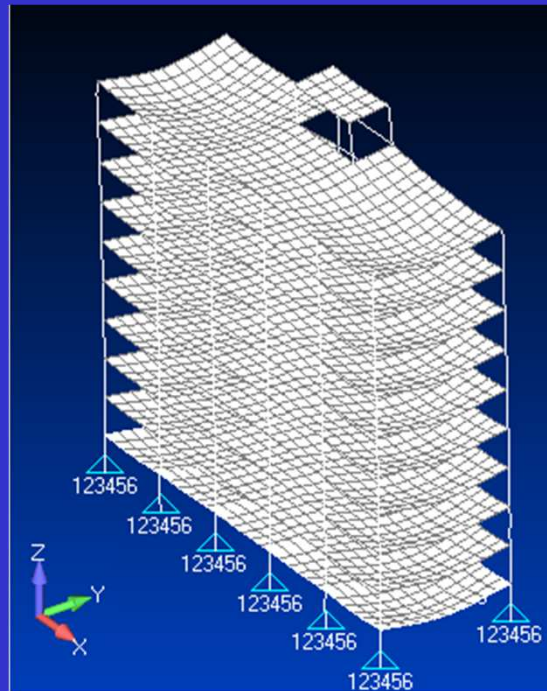
Análise & Pós-Processamento

SOL 101

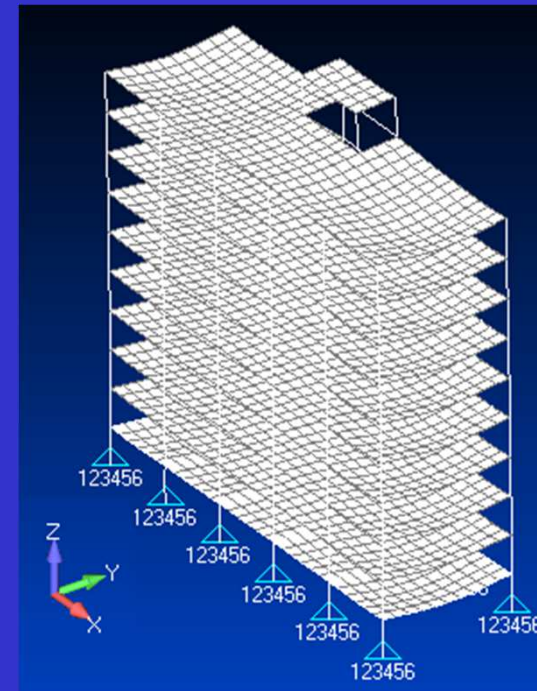
- configuração deformada

View : Select : Deform : Total Translation (Scale deformation : 100)

ELU: $1,4(g+q)$



ELS: $1,0 g + 0,7 q$



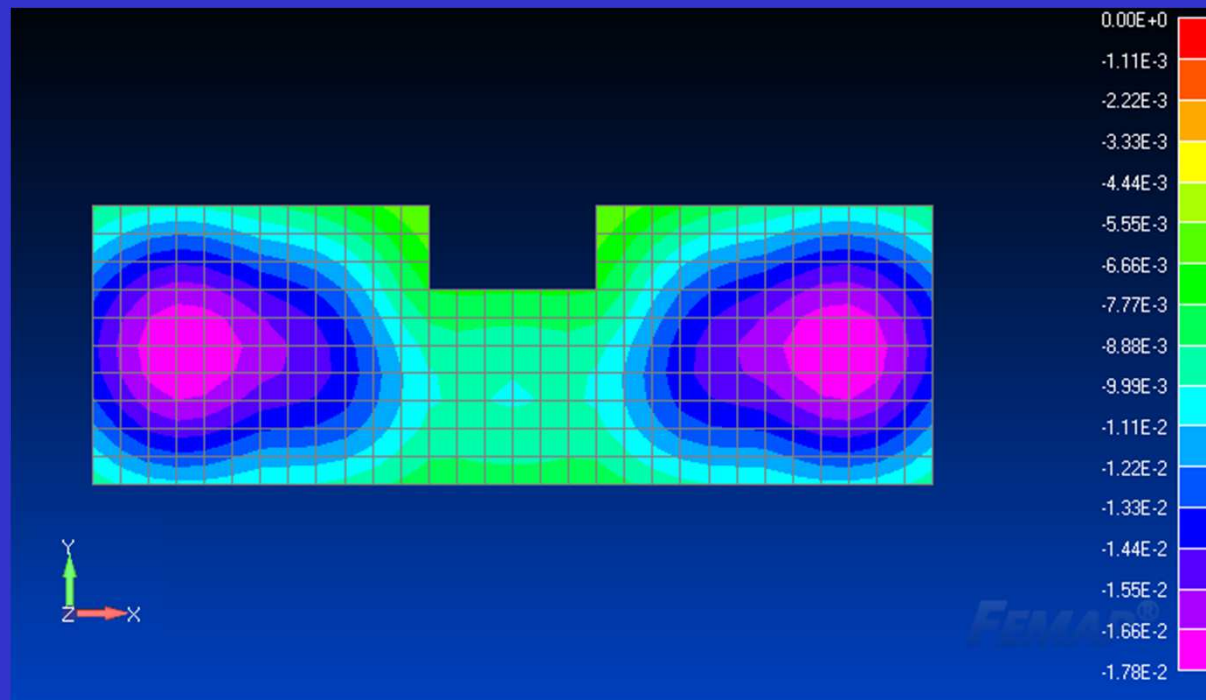
Modelos de placas com vigas e pilares

Análise & Pós-Processamento

SOL 101

- Flechas nas lajes

View : Select : Deformed countour data : Linear combination : $1,0 g + 0,7 q$
(4 T3 Translation)



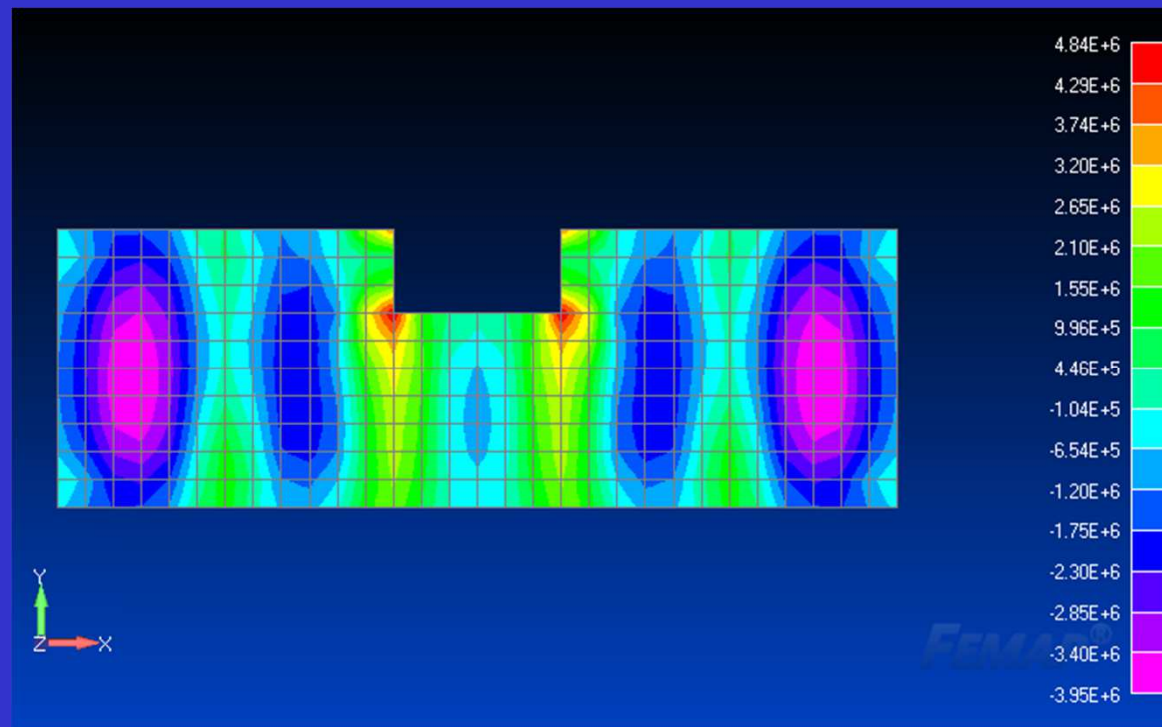
Modelos de placas com vigas e pilares

Análise & Pós-Processamento

SOL 101

- Tensões normais nas faces superiores das lajes: direção X

View : Select : Deformed countour data : Linear combination : 1,4 g + 1,4 q
(7020 Plate Top x Normal Stress)

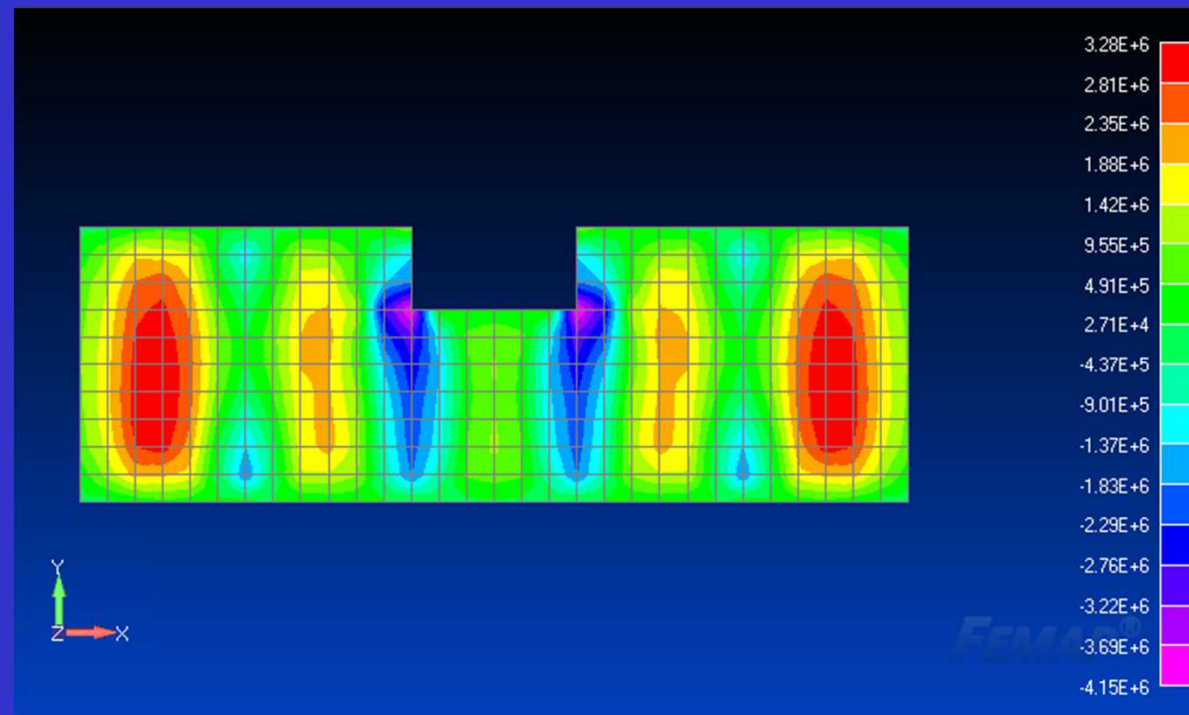


Análise & Pós-Processamento

SOL 101

- Tensões normais nas faces inferiores das lajes: direção X

View : Select : Deformed countour data : Linear combination : 1,4 g + 1,4 q
(7420 Plate Bot x Normal Stress)

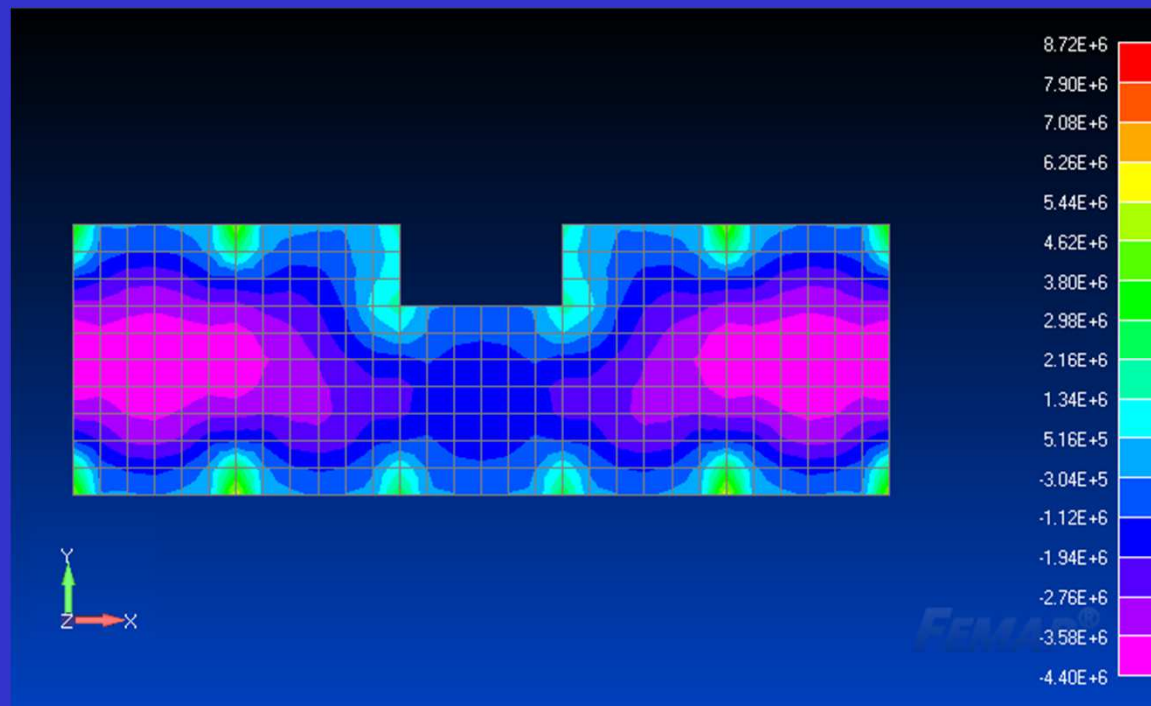


Análise & Pós-Processamento

SOL 101

- Tensões normais nas faces superiores das lajes: direção Y

View : Select : Deformed countour data : Linear combination : 1,4 g + 1,4 q
(7021 Plate Top y Normal Stress)



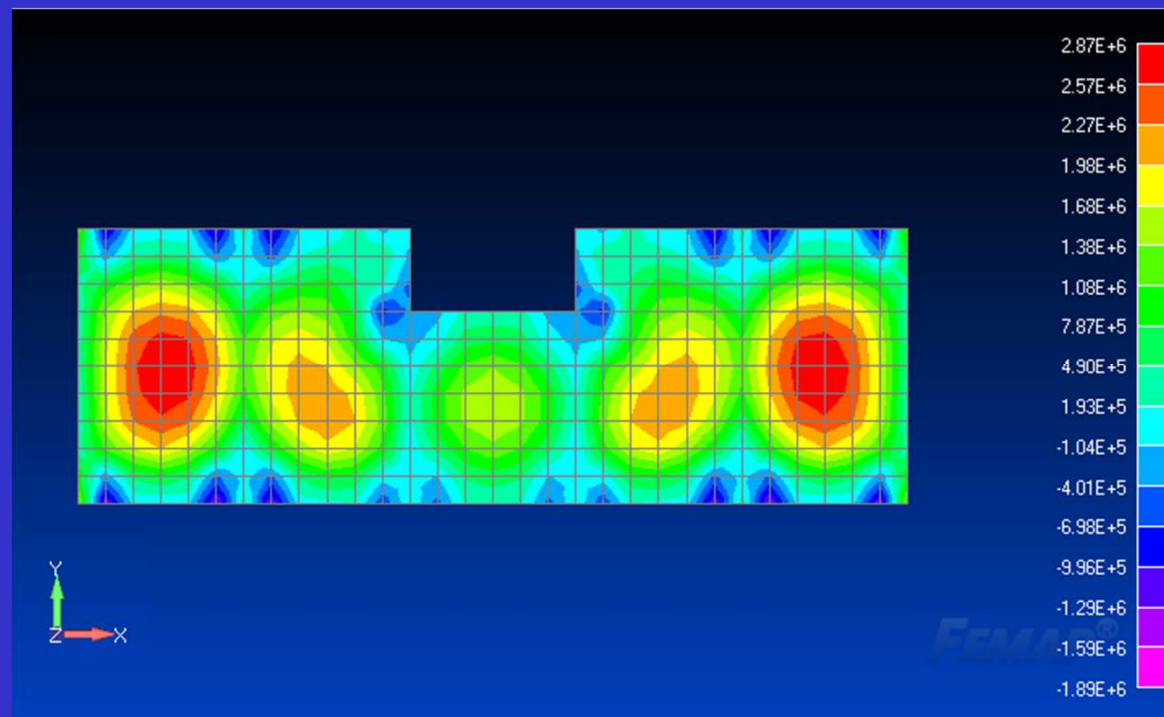
Modelos de placas com vigas e pilares

Análise & Pós-Processamento

SOL 101

- Tensões normais nas faces inferiores das lajes: direção Y

View : Select : Deformed countour data : Linear combination : 1,4 g + 1,4 q
(7421 Plate Bot y Normal Stress)



Exercício – Casa

Au boulot!

Para as lajes do pavimento tipo do modelo estrutural, pede-se:

(1) ELS: As flechas nas lajes considerando a fluência;

Combinação ELS (com fluência): $2,4 g + 0,7 q$

(2) ELU: As tensões normais (Top e Bottom) nas direções X e Y;

(3) ELU: As forças de membrana nas direções X e Y;

(4) ELU: Os momentos de flexão nas direções X e Y;

Combinação ELU: $1,4 g + 1,4 q$

(5) Qual a relação entre as tensões normais, as forças de membrana e os momentos de flexão para o elemento Plate?