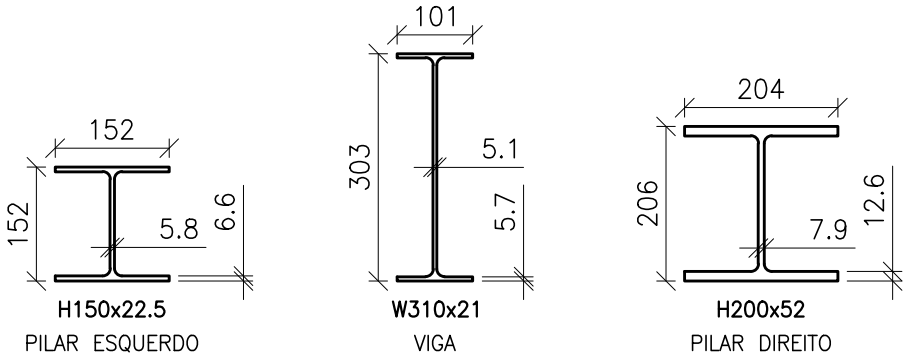
EXERCÍCIO 2.A



SEÇÃO TRANSVERSAL DAS BARRAS

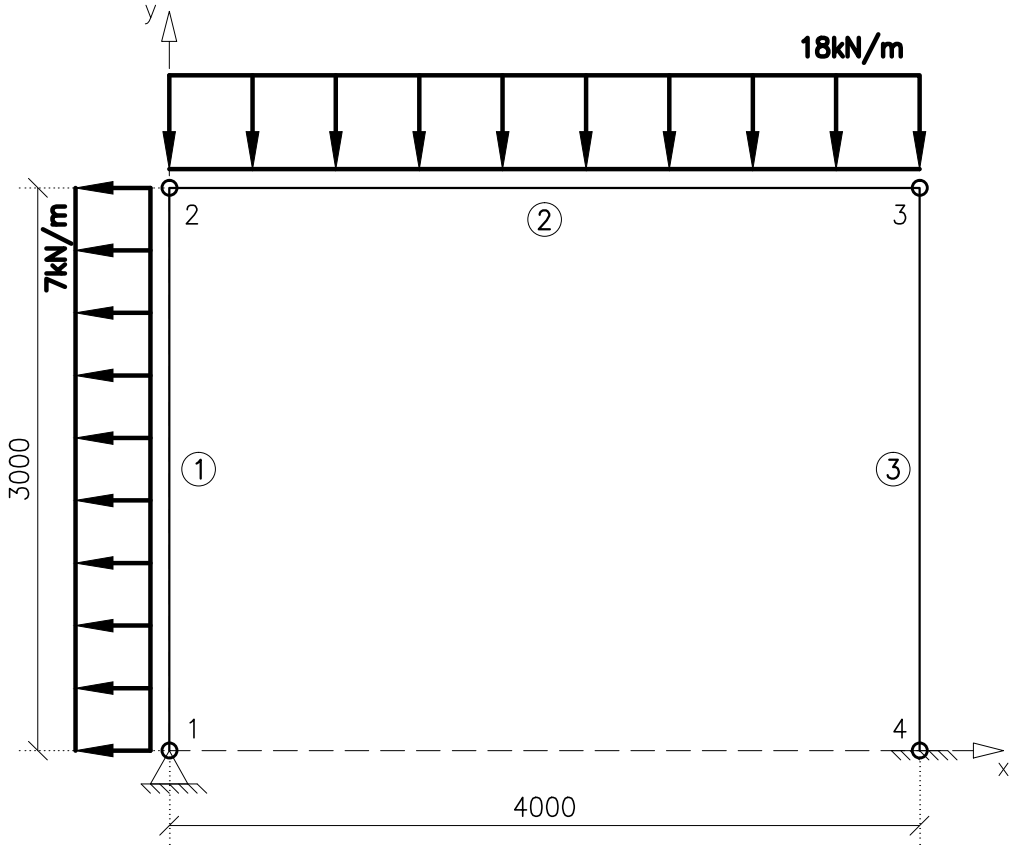
ESC.: 1/10 COTAS EM MILÍMETROS

PROBLEMA:

DESENHAR DIAGRAMAS DE FORÇA (AXIAL E CORTANTE), MOMENTO (FLETOR E TORÇOR) E TENSÃO (AXIAL E DE FLEXÃO).

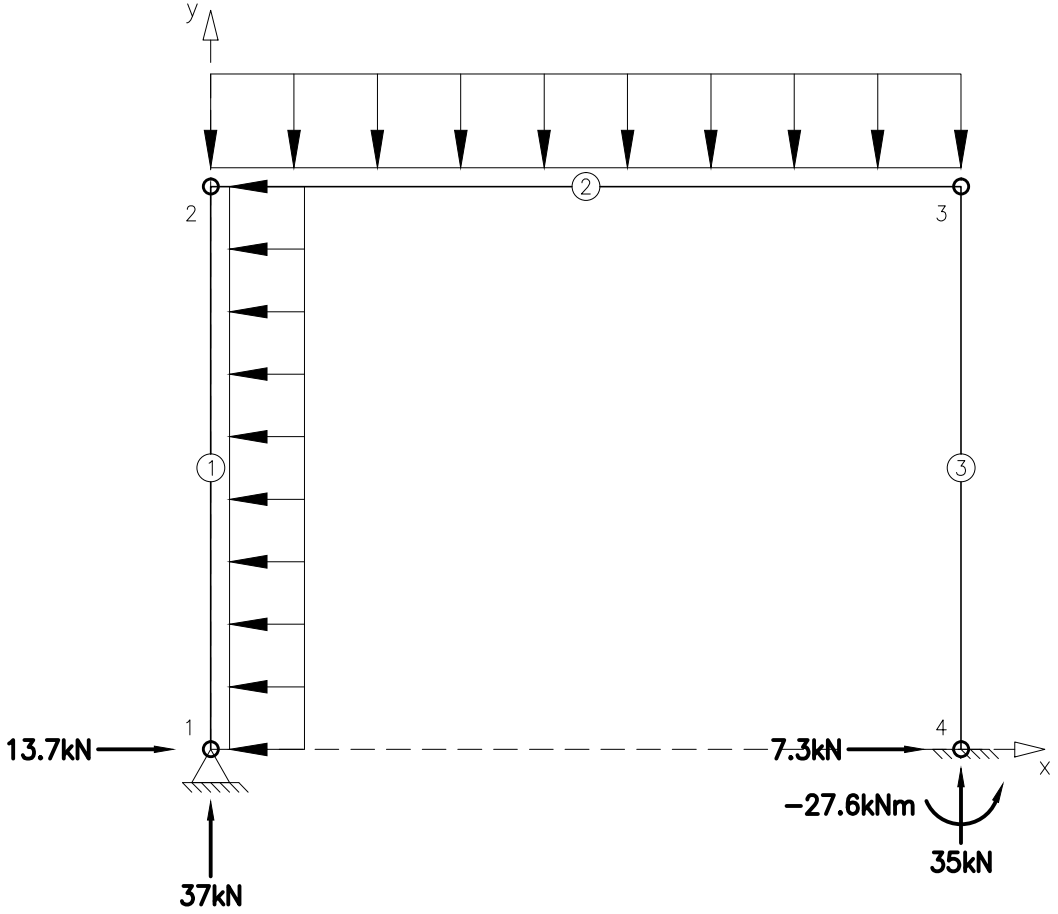
DADOS:

E = 200GPa
v = 0.3



ELEVAÇÃO DO PÓRTICO

ESC.: 1/40 COTAS EM MILÍMETROS



RESULTADOS DA ANÁLISE

ESC.: 1/40 COTAS EM MILÍMETROS

EXERCÍCIO 2.A

Análise de um pórtico plano

/prep7	Preprocessor	
ET,1,188	Element Type → Add/Edit/Delete → Add… → Library of Element Types = Structural Mass ; Beam ; 2 node 188 → OK → Close	
KEYOPT,1,3,2	Element Type → Add/Edit/Delete → Options… → Element behavior K3 = Quadradic Form. → OK → Close	
MP,EX,,2E11	Material Props → Material Models → Structural → Linear → Elastic → Isotropic → EX = 2E11 → OK	
K,1,0,0,0 K,2,0,3,0 K,3,4,3,0 K,4,4,0,0 K,5,-0.5,0,0 K,6,-0.5,3,0 K,7,0,3.5,0 K,8,4,3.5,0 K,9,4.5,3,0 K,10,4.5,0,0	Modeling → Create → Keypoints → In Active CS → Keypoint number = 1 Location in active CS = 0, 0, 0 → Apply → ***Repetir para*** *[#: x,y,z]:* [2: 0, 3, 0]; [3: 4, 3, 0]; [4: 4, 0, 0]; [5: -0.5, 0, 0]; [6: -0.5, 3, 0]; [7: 0, 3.5, 0]; [8: 4, 3.5, 0]; [9: 4.5, 3, 0] Keypoint number = 10 Location in active CS = 4.5, 0, 0 → OK	
L,1,2 L,2,3 L,4,3	Modeling → Create → Lines → Lines → Straight Line → ***Clicar nos keypoints 1 e 2*** → Apply → ***Clicar nos keypoints 2 e 3*** → Apply → ***Clicar nos keypoints 4 e 3*** → OK	
SECTYPE,1,BEAM,I,W150X22,3 SECDATA,0.152,0.152,0.152,0.0066,0.0066,0.0058 SECTYPE,2,BEAM,I,W310X21,3 SECDATA,0.101,0.101,0.303,0.0057,0.0057,0.0051 SECTYPE,3,BEAM,I,H200X52,3	Sections → Beam → Common Sections → ID = 1 Name = W150X22 Sub-Type = I *(perfil I)* W1 = 0.152 = W2 = W3 t1 = 0.0066 = t2 t3 = 0.0058 Coarse – Fine = 3 → Apply →	

SECDATA,0.204,0.204,0.206,0.0126,0.0126,0.0079	ID = 2 Name = W310X21 Sub-Type = I *(perfil I)* W1 = 0.101 = W2 W3 = 0.303 t1 = 0.0057 = t2 t3 = 0.0051 Coarse – Fine = 3 → Apply → ID = 3 Name = H200X52 Sub-Type = I *(perfil I)* W1 = 0.204 = W2 W3 = 0.206 t1 = 0.0126 = t2 t3 = 0.0079 Coarse – Fine = 3 → OK	
LSEL,S,LINE,,1 LATT,1,,,,5,6,1 LSEL,ALL LSEL,S,LINE,,2 LATT,1,,,,7,8,2 LSEL,ALL LSEL,S,LINE,,3 LATT,1,,,,10,9,3 LSEL,ALL	Meshing → Mesh Attributes → Picked Lines → ***Clicar na line 1*** → OK → Material number = 1 Element type number = 1 BEAM188 Element section = 1 W150X22 Pick Orientation Keypoint(s) = Yes → Apply → ***Clicar nos keypoints 5 e 6*** → Apply → ***Clicar na line 2*** → Apply → Material number = 1 Element type number = 1 BEAM188 Element section = 2 W310X21 Pick Orientation Keypoint(s) = Yes → Apply → ***Clicar nos keypoints 7 e 8*** → Apply → ***Clicar na line 3*** → Apply → Material number = 1 Element type number = 1 BEAM188 Element section = 3 H200X52 Pick Orientation Keypoint(s) = Yes → OK → ***Clicar nos keypoints 10 e 9*** → OK	
DK,4,UX,0,,,UY,UZ,ROTX,ROTY,ROTZ DK,1,UX,0,,,UY,UZ	Loads → Define Loads → Apply → Structural → Displacement → On Keypoints → ***Clicar no keypoint 4*** → OK → DOFs to be constrained = UX, UY,UZ,ROTX,ROTY,ROTZ → Apply → ***Clicar no keypoint 1*** → OK →	

	DOFs to be constrained = UX,UY,UZ → OK	
LESIZE,ALL,,,50	Meshing → Size Cntrls → ManualSize → Lines → All Lines → No. of element divisions = 50 → OK	
LMESH,ALL	Meshing → Mesh → Lines → Pick All	
LSEL,S,LINE,,1 ESLL,S	Select → Entities… → Lines By Num/Pick From Full → Apply → ***Clicar na line 1*** → OK → Select → Entities… → Elements Attached to Lines From Full → OK	
SFBEAM,ALL,1,PRES,-7000	Loads → Define Loads → Apply → Structural → Pressure → On Beams → Pick All → Load key = 1 Pressure value at node I = -7000 → OK	
ALLSEL	Select → Everything	
LSEL,S,LINE,,2 ESLL,S	Select → Entities… → Lines By Num/Pick From Full → Apply → ***Clicar na line 2*** → OK → Select → Entities… → Elements Attached to Lines From Full → OK	
SFBEAM,ALL,1,PRES,18000	Loads → Define Loads → Apply → Structural → Pressure → On Beams → Pick All → Load key = 1 Pressure value at node I = 18000 → OK	
ALLSEL	Select → Everything	
/ESHAPE,1	PlotCtrls → Style → Size and Shape → Display of Element = ON → OK	

/REPLOT		
EPLOT	Plot → Elements	
/solu	**Solution**	
SOLVE	Solve → Current LS → OK	
/post1	**General Postproc**	
SET,,1	Read Results → First Set	
PLDISP	Plot Results → Deformed Shape → Items to be plotted = Def shape only → OK	
PRRSOL	List Results → Reaction Solu → Item to be listed = All items → OK	
ETABLE,FXi,SMISC,1 ETABLE,FZi,SMISC,5 ETABLE,MYi,SMISC,2 ETABLE,FXj,SMISC,14 ETABLE,FZj,SMISC,18 ETABLE,MYj,SMISC,15 ETABLE,AXi,SMISC,31 ETABLE,AXj,SMISC,36 ETABLE,BSposZi,SMISC,34 ETABLE,BSposZj,SMISC,39	Element Table → Define Table → Add… → User label for item = FXi Results data item = By sequence num ; SMISC, 1 → Apply → User label for item = FZi Results data item = By sequence num ; SMISC, 5 → Apply → User label for item = MYi Results data item = By sequence num ; SMISC, 2 → Apply → User label for item = FXj Results data item = By sequence num ; SMISC, 14 → Apply → User label for item = FZj Results data item = By sequence num ; SMISC, 18 → Apply → User label for item = MYj Results data item = By sequence num ; SMISC, 15 → Apply → User label for item = AXi Results data item = By sequence num ; SMISC, 31 → Apply → User label for item = AXj Results data item = By sequence num ; SMISC, 36 → Apply → User label for item = BSposZi Results data item = By sequence num ; SMISC, 34 → Apply → User label for item = BSposZj Results data item = By sequence num ; SMISC, 39 → Apply → → OK → Close	
SALLOW,345E6	Safety Factor → Allowable Strs → Constant → Allowable stress = 345E6	

	→ OK	
SFCALC,SFAXi,AXi,,3 SFCALC,SFAXj,AXj,,3 SFCALC,SFBSPZi,BSposZi,,3 SFCALC,SFBSPZj,BSposZj,,3	Safety Factor → SF for ElemTable → Item to be calculated = 1/SF Label for calculated item = SFAXi Elem table item for stress = AXi → Apply → Item to be calculated = 1/SF Label for calculated item = SFAXj Elem table item for stress = AXj → Apply → Item to be calculated = 1/SF Label for calculated item = SFBSPZi Elem table item for stress = BSposZi → Apply → Item to be calculated = 1/SF Label for calculated item = SFBSPZj Elem table item for stress = BsposZj → OK	
PLLS,FXi,FXj,1	Plot Results → Contour Plot → Line Elem Res → Elem table item at node I = FXi Elem table item at node J = FXj → OK	
PLLS,FZi,FZj,1	Plot Results → Contour Plot → Line Elem Res → Elem table item at node I = FZi Elem table item at node J = FZj → OK	
PLLS,MYi,MYj,1	Plot Results → Contour Plot → Line Elem Res → Elem table item at node I = MYi Elem table item at node J = MYj → OK	
PLLS,AXi,AXj	Plot Results → Contour Plot → Line Elem Res → Elem table item at node I = AXi Elem table item at node J = AXj → OK	
PLLS,BSposZi,BSposZj	Plot Results → Contour Plot → Line Elem Res → Elem table item at node I = BSposZi Elem table item at node J = BSposZj → OK	

PLLS,SFAXi,SFAXj	Plot Results → Contour Plot → Line Elem Res → Elem table item at node I = SFAXi Elem table item at node J = SFAXj → OK	
PLLS,SFBSPZi,SFBSPZj	Plot Results → Contour Plot → Line Elem Res → Elem table item at node I = SFBSPZi Elem table item at node J = SFBSPZj → OK	
PLNSOL,S,EQV	Plot Results → Contour Plot → Nodal Solu → Nodal Solution → Stress → von Mises stress → OK	
FINISH	**Finish**	

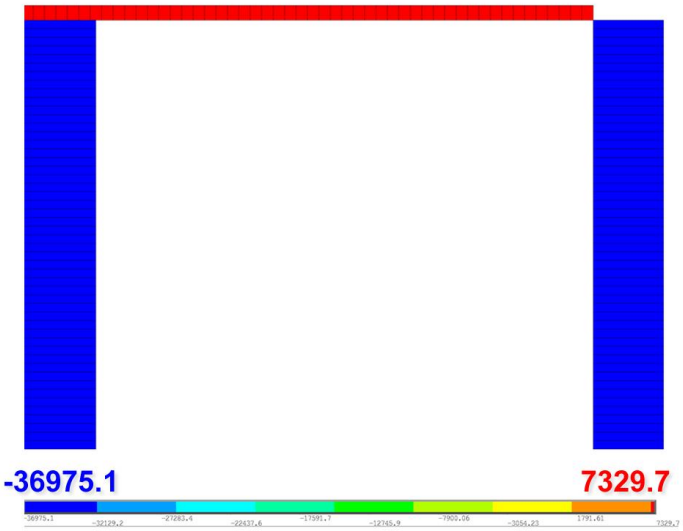


DIAGRAMA DE FORÇA AXIAL

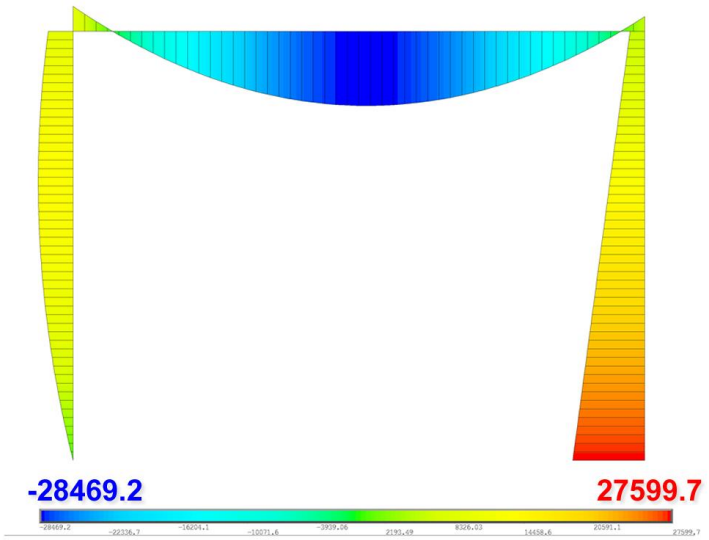


DIAGRAMA DE MOMENTO FLETOR (+Y)

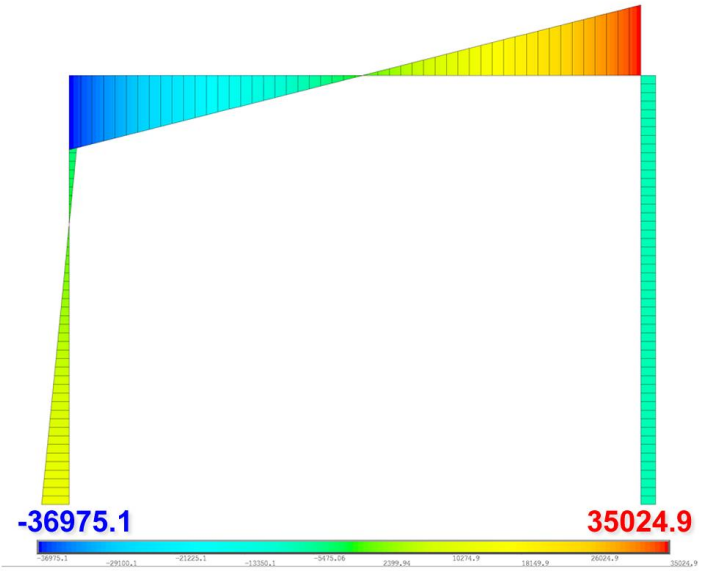


DIAGRAMA DE FORÇA CORTANTE

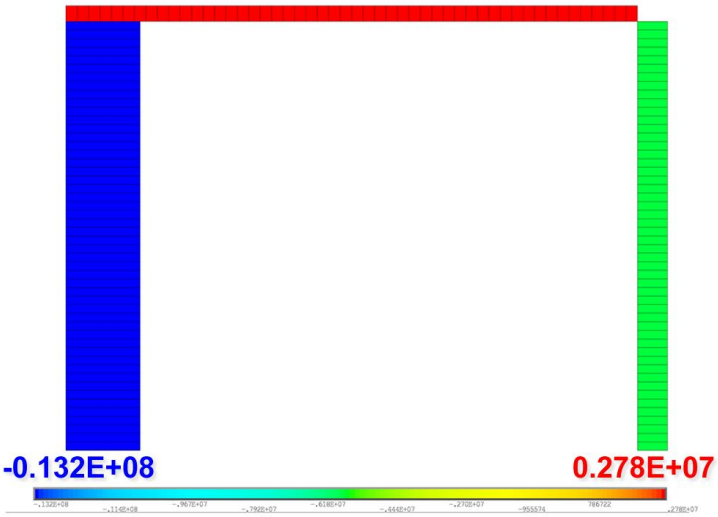


DIAGRAMA DE TENSÃO AXIAL DIRETA

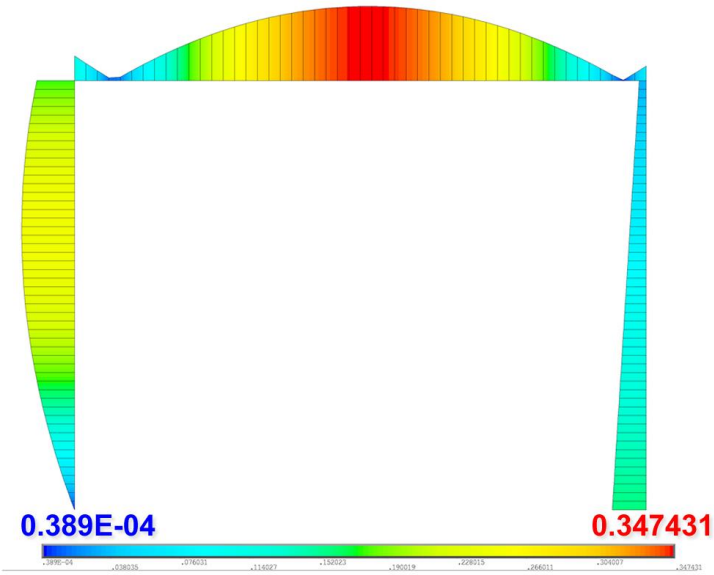


DIAGRAMA DE FATOR DE SEGURANÇA
TENSÃO AXIAL DE FLEXÃO (+Z)

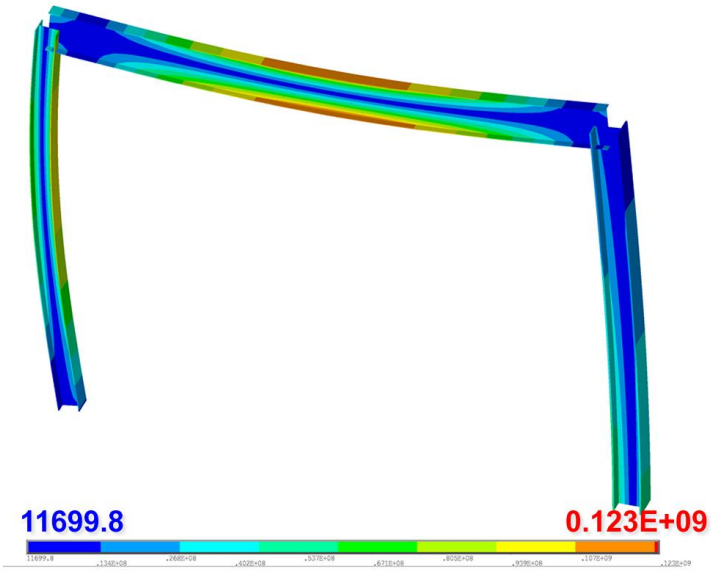
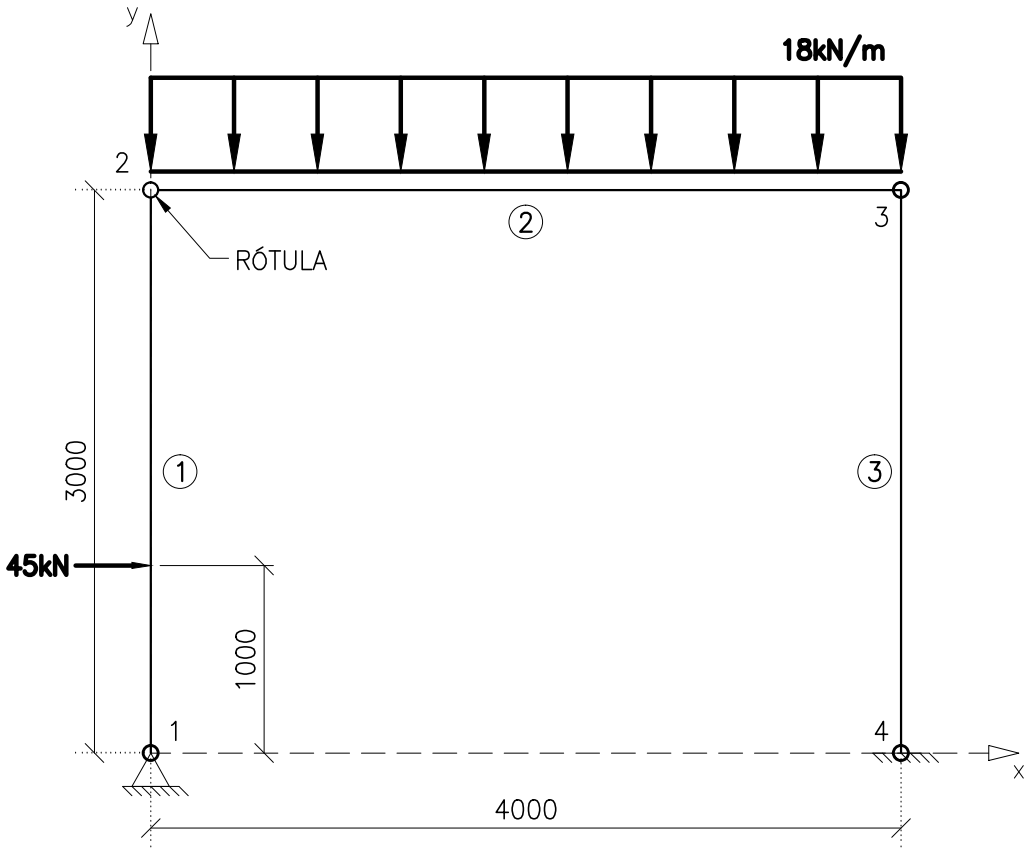


DIAGRAMA DE TENSÃO PRINCIPAL
TENSÃO EQUIVALENTE DE VON MISES

EXERCÍCIO 2.B



ELEVAÇÃO DO PÓRTICO
ESC.: 1/40 COTAS EM MILÍMETROS

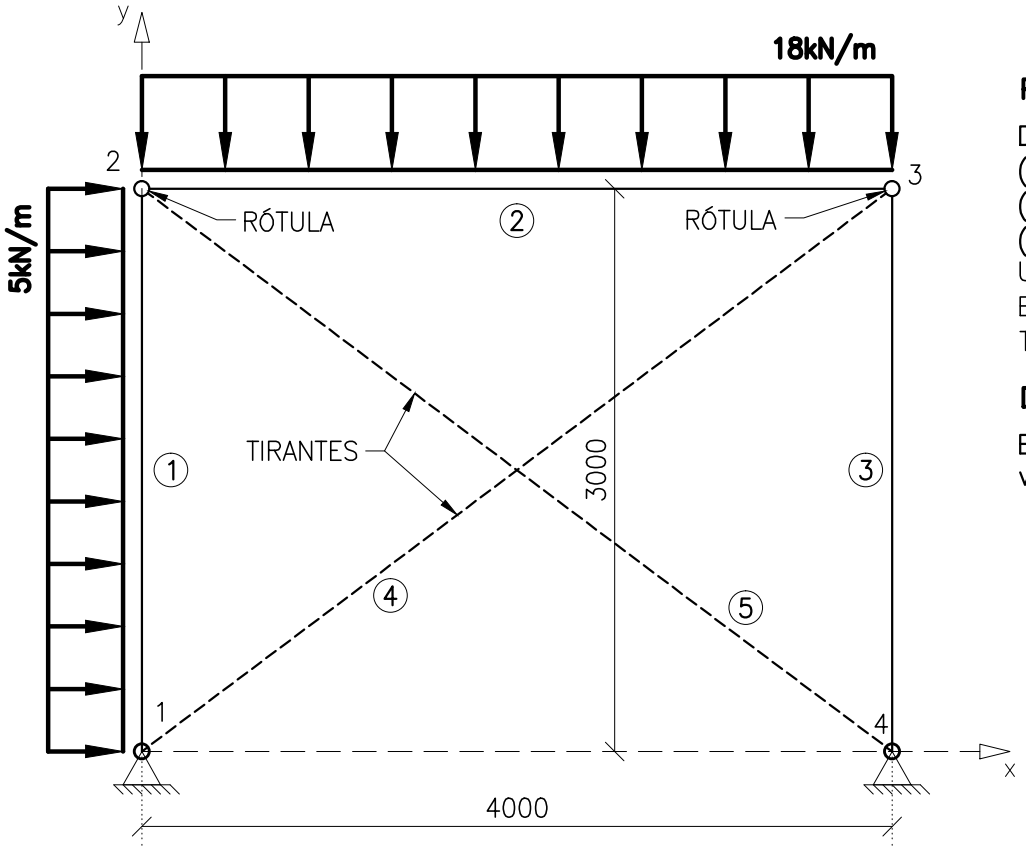
PROBLEMA:

DESENHAR DIAGRAMAS DE FORÇA (AXIAL E CORTANTE), MOMENTO (FLETOR E TORÇOR) E TENSÃO (AXIAL E DE FLEXÃO).
UTILIZAR OS MESMOS PERFIS DO EXERCÍCIO **2.A**.

DADOS:

E = 200GPa
v = 0.3

EXERCÍCIO 2.C



ELEVAÇÃO DO PÓRTICO
ESC.: 1/40 COTAS EM MILÍMETROS

PROBLEMA:

DESENHAR DIAGRAMAS DE FORÇA (AXIAL E CORTANTE), MOMENTO (FLETOR E TORÇOR) E TENSÃO (AXIAL E DE FLEXÃO).
UTILIZAR OS MESMOS PERFIS DO EXERCÍCIO **2.A** E O MESMO TIRANTE DO EXERCÍCIO **1.C**.

DADOS:

E = 200GPa
v = 0.3