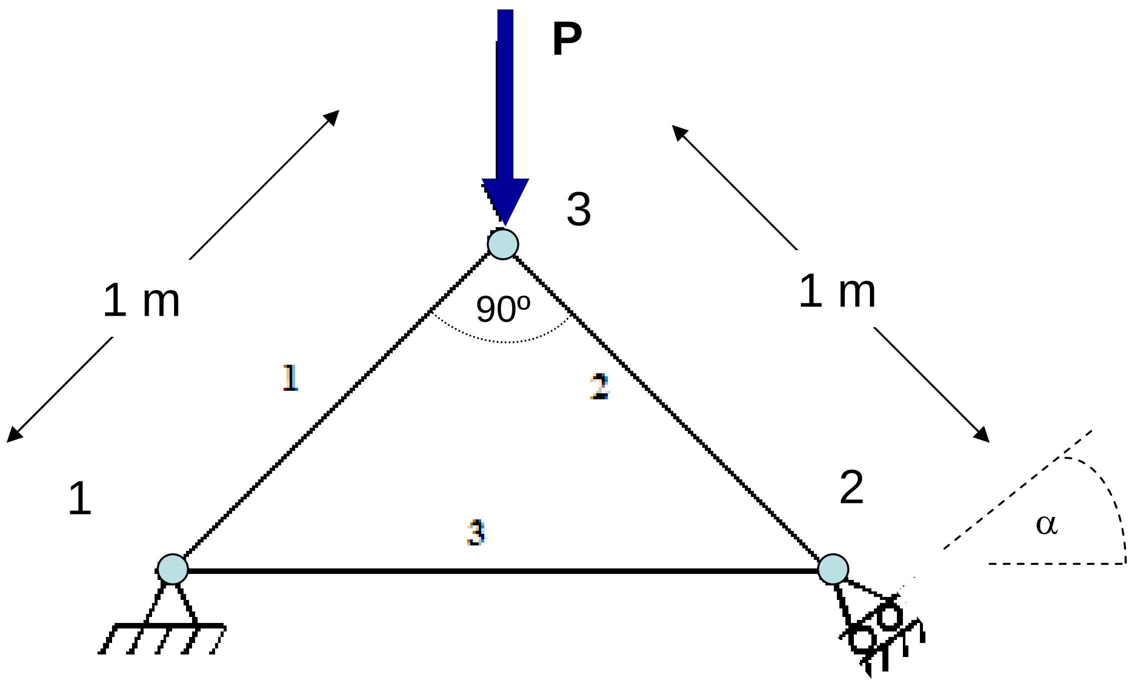
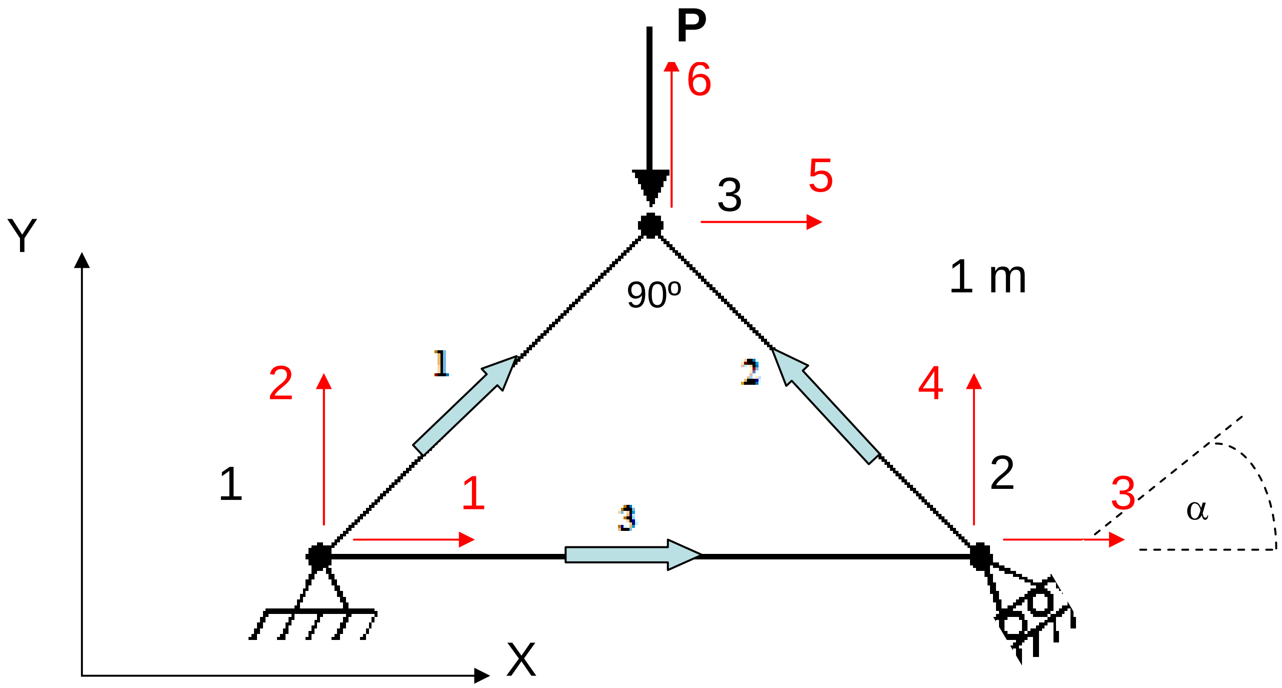
Determinar las reacciones y el desplazamiento de los nudos 2 y 3 en la estructura de la figura para los dos valores del ángulo α siguientes: 45º y 30º.
Explicar los resultados que se obtienen cuando α=45º.
E=70 GPa, A=1 cm^2, P=1 kN



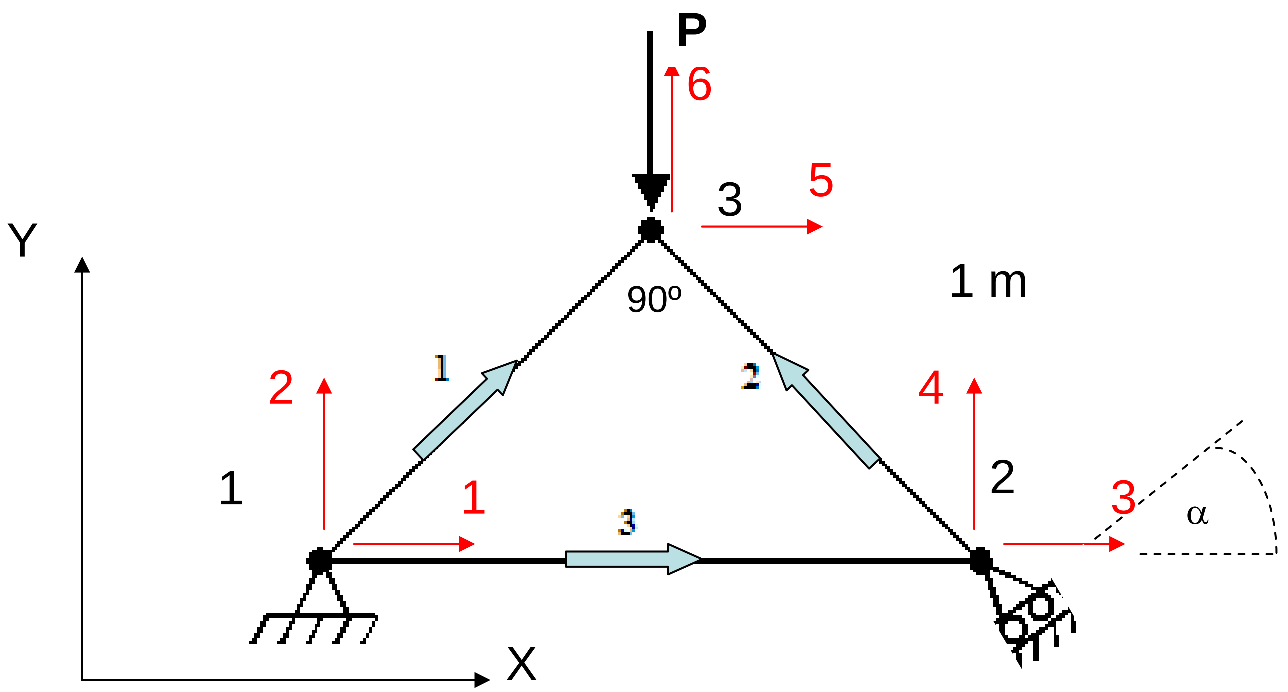


Matrices de rigidez de las barras en ejes globales:

$$\mathbf{k}(1) = \begin{pmatrix} 3.5\times 10^6 & 3.5\times 10^6 & -3.5\times 10^6 & -3.5\times 10^6 \\ 3.5\times 10^6 & 3.5\times 10^6 & -3.5\times 10^6 & -3.5\times 10^6 \\ -3.5\times 10^6 & -3.5\times 10^6 & 3.5\times 10^6 & 3.5\times 10^6 \\ -3.5\times 10^6 & -3.5\times 10^6 & 3.5\times 10^6 & 3.5\times 10^6 \end{pmatrix}$$

$$\mathbf{k}(2) = \begin{pmatrix} 3.5\times 10^6 & -3.5\times 10^6 & -3.5\times 10^6 & 3.5\times 10^6 \\ -3.5\times 10^6 & 3.5\times 10^6 & 3.5\times 10^6 & -3.5\times 10^6 \\ -3.5\times 10^6 & 3.5\times 10^6 & 3.5\times 10^6 & -3.5\times 10^6 \\ 3.5\times 10^6 & -3.5\times 10^6 & -3.5\times 10^6 & 3.5\times 10^6 \end{pmatrix}$$

$$\mathbf{k}(3) = \begin{pmatrix} 4.95\times 10^6 & 0 & -4.95\times 10^6 & 0 \\ 0 & 0 & 0 & 0 \\ -4.95\times 10^6 & 0 & 4.95\times 10^6 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$



$$\mathbf{K} = \begin{pmatrix} 8.45\times 10^6 & 3.5\times 10^6 & -4.95\times 10^6 & 0 & -3.5\times 10^6 & -3.5\times 10^6 \\ 3.5\times 10^6 & 3.5\times 10^6 & 0 & 0 & -3.5\times 10^6 & -3.5\times 10^6 \\ -4.95\times 10^6 & 0 & 8.45\times 10^6 & -3.5\times 10^6 & -3.5\times 10^6 & 3.5\times 10^6 \\ 0 & 0 & -3.5\times 10^6 & 3.5\times 10^6 & 3.5\times 10^6 & -3.5\times 10^6 \\ -3.5\times 10^6 & -3.5\times 10^6 & -3.5\times 10^6 & 3.5\times 10^6 & 7\times 10^6 & -33.559 \\ -3.5\times 10^6 & -3.5\times 10^6 & 3.5\times 10^6 & -3.5\times 10^6 & -33.559 & 7\times 10^6 \end{pmatrix}$$

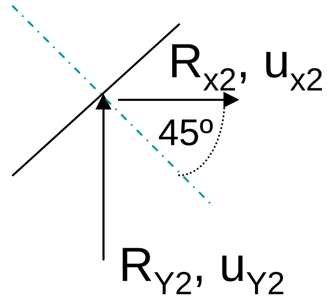
Ecuaciones que podemos plantear (α=45º):

$$\begin{Bmatrix} R_{X1} \\ R_{Y1} \\ R_{X2} \\ R_{Y2} \\ 0 \\ -1000 \end{Bmatrix} = \begin{pmatrix} 8.45\times10^6 & 3.5\times10^6 & -4.95\times10^6 & 0 & -3.5\times10^6 & -3.5\times10^6 \\ 3.5\times10^6 & 3.5\times10^6 & 0 & 0 & -3.5\times10^6 & -3.5\times10^6 \\ -4.95\times10^6 & 0 & 8.45\times10^6 & -3.5\times10^6 & -3.5\times10^6 & 3.5\times10^6 \\ 0 & 0 & -3.5\times10^6 & 3.5\times10^6 & 3.5\times10^6 & -3.5\times10^6 \\ -3.5\times10^6 & -3.5\times10^6 & -3.5\times10^6 & 3.5\times10^6 & 7\times10^6 & -33.559 \\ -3.5\times10^6 & -3.5\times10^6 & 3.5\times10^6 & -3.5\times10^6 & -33.559 & 7\times10^6 \end{pmatrix} \begin{Bmatrix} 0 \\ 0 \\ u_{X2} \\ u_{Y2} \\ u_{X3} \\ u_{Y3} \end{Bmatrix}$$

4 Ecuaciones +

$R_{X2}\cos 45 + R_{Y2}\cos 45 = 0$ ó $R_{X2}+R_{Y2}=0$

$-u_{X2}\,\mathrm{sen}\,45 + u_{Y2}\cos 45 = 0$ ó $u_{X2}=u_{Y2}$



R_{X2}=-500 N R_{Y2}=500 N

$u_{X2}=u_{Y2}=0$ $u_{X3}=0$ $u_{Y3}=-1{,}429\times10^{-4}$ m

Hay simetría de esfuerzos y reacciones respecto del eje vertical que pasa por el nudo 3.

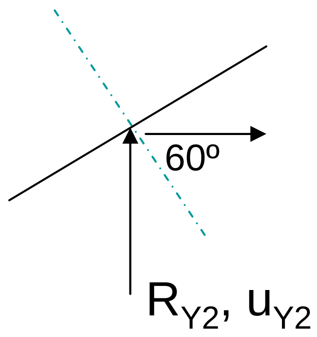
Ecuaciones que podemos plantear (α=30º):

$$\begin{Bmatrix} R_{X1} \\ R_{Y1} \\ R_{X2} \\ R_{Y2} \\ 0 \\ -1000 \end{Bmatrix} = \begin{pmatrix} 8.45\times 10^{6} & 3.5\times 10^{6} & -4.95\times 10^{6} & 0 & -3.5\times 10^{6} & -3.5\times 10^{6} \\ 3.5\times 10^{6} & 3.5\times 10^{6} & 0 & 0 & -3.5\times 10^{6} & -3.5\times 10^{6} \\ -4.95\times 10^{6} & 0 & 8.45\times 10^{6} & -3.5\times 10^{6} & -3.5\times 10^{6} & 3.5\times 10^{6} \\ 0 & 0 & -3.5\times 10^{6} & 3.5\times 10^{6} & 3.5\times 10^{6} & -3.5\times 10^{6} \\ -3.5\times 10^{6} & -3.5\times 10^{6} & -3.5\times 10^{6} & 3.5\times 10^{6} & 7\times 10^{6} & -33.559 \\ -3.5\times 10^{6} & -3.5\times 10^{6} & 3.5\times 10^{6} & -3.5\times 10^{6} & -33.559 & 7\times 10^{6} \end{pmatrix} \begin{Bmatrix} 0 \\ 0 \\ u_{X2} \\ u_{Y2} \\ u_{X3} \\ u_{Y3} \end{Bmatrix}$$

4 Ecuaciones +

R_{X2} cos 30 + R_{Y2} sen 30 = 0

-u_{X2} sen 30 + u_{Y2} cos 30 = 0



R_{X2}=-288,674 N R_{Y2}=500 N

u_{X2}= 4,269x10^{-5} m u_{Y2}= 2,465x10^{-5} m

u_{X3}=9,021x10^{-6} m u_{Y3}=-1,519x10^{-4} m