

Determinar los esfuerzos en cada barra de la siguiente estructura reticulada (Viga de alma calada)

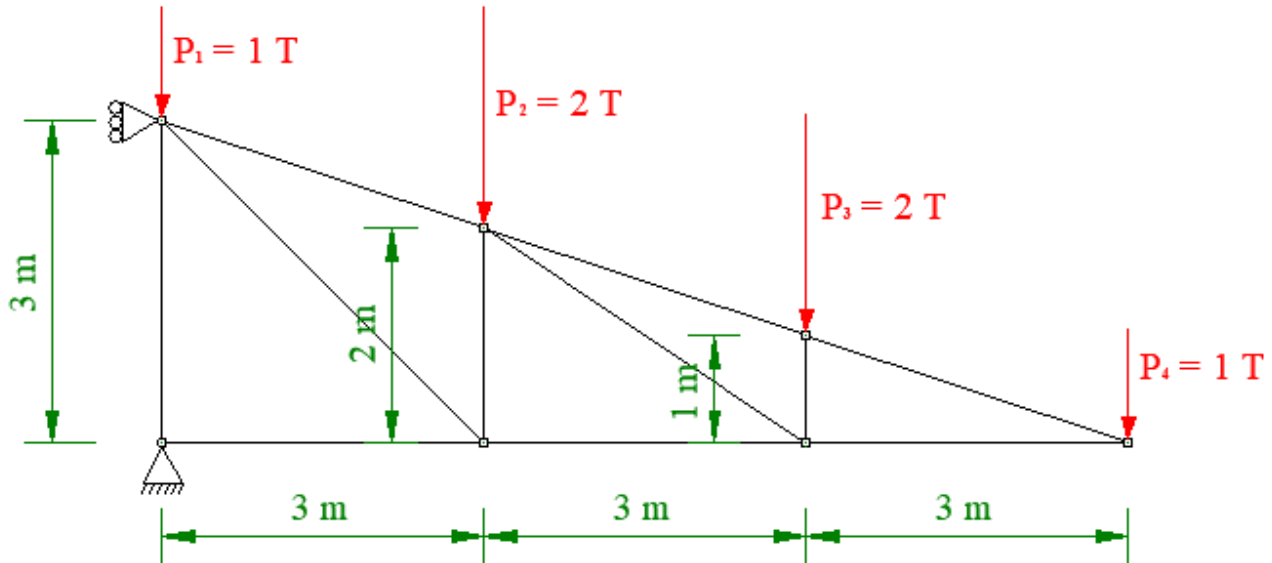
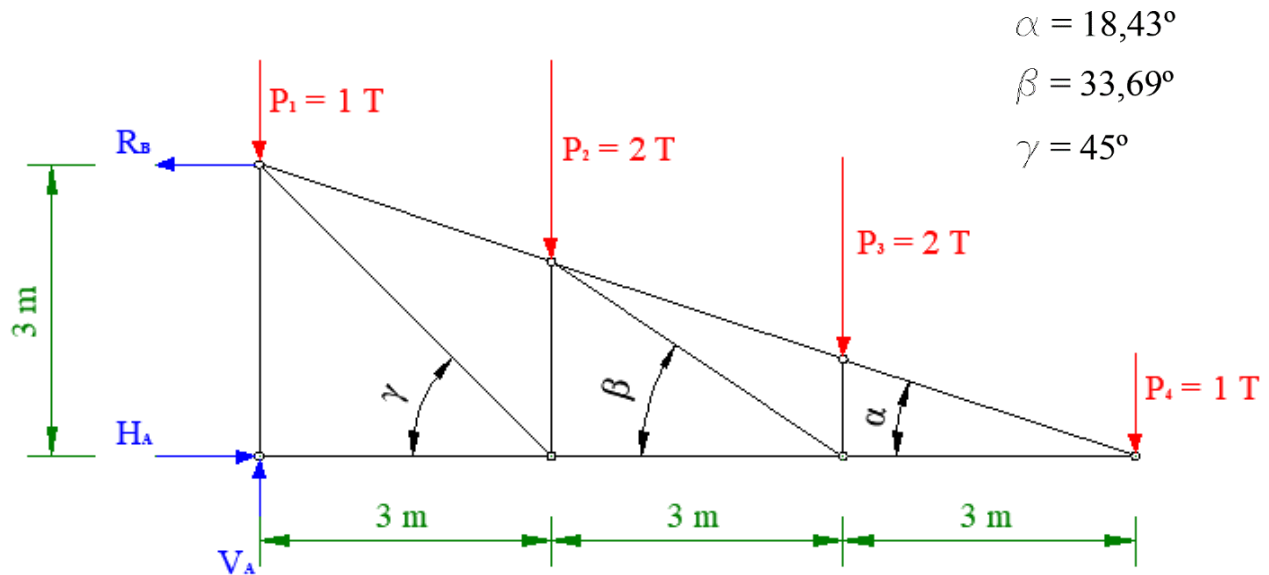


Diagrama de Cuerpo Libre (D.C.L.)



Cálculo de Reacciones de Vínculo

$$\Sigma M_A = 0 \quad - R_B \cdot 3 \text{ m} + P_2 \cdot 3 \text{ m} + P_3 \cdot 6 \text{ m} + P_4 \cdot 9 \text{ m} = 0$$

$$R_B = (2 \text{ T} \cdot 3 \text{ m} + 2 \text{ T} \cdot 6 \text{ m} + 1 \text{ T} \cdot 9 \text{ m}) / 3 \text{ m}$$

$$R_B = 9 \text{ T}$$

$$\Sigma F_x = 0 \quad - R_B + H_A = 0$$

$$H_A = R_B$$

$$H_A = 9 \text{ T}$$

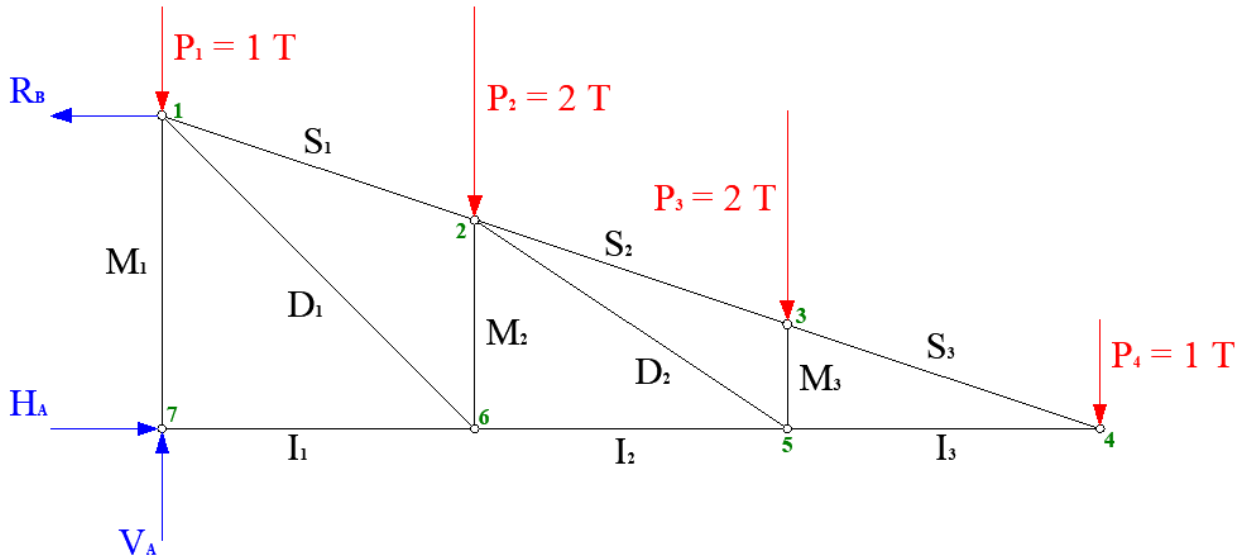
$$\Sigma F_y = 0 \quad V_A - P_1 - P_2 - P_3 - P_4 = 0$$

$$V_A = P_1 + P_2 + P_3 + P_4 = 1 \text{ T} + 2 \text{ T} + 2 \text{ T} + 1 \text{ T}$$

$$V_A = 6 \text{ T}$$

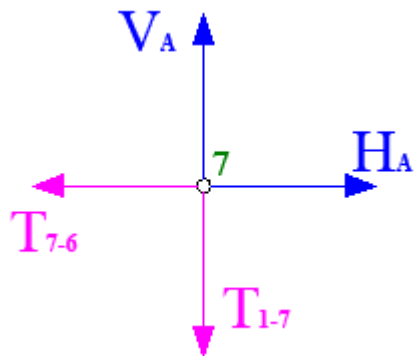
Análisis del equilibrio de cada Nudo

- Se comienza el análisis por los nudos a los cuales incidan dos barras de esfuerzos incógnitas, ya que puedo plantear solo dos ecuaciones de equilibrio para fuerzas concurrentes; por ejemplo, se podría comenzar por los Nudos 4 ó 7.



Comenzamos por el Nudo 7 – Vínculo A

Nudo 7

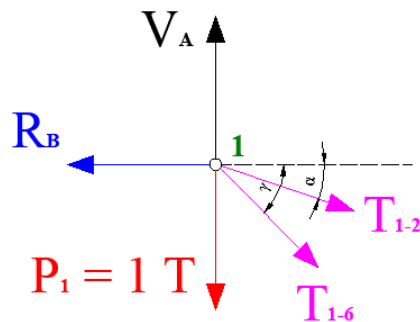


$$\Sigma F_x = 0 \quad H_A - T_{7-6} = 0$$

$$T_{7-6} = 9 \text{ T} \quad (-)$$

$$\Sigma F_y = 0 \quad V_A - T_{1-7} = 0$$

$$T_{1-7} = 6 \text{ T} \quad (-)$$



Nudo 1

$$\Sigma F_x = 0 \quad T_{1-2} \cdot \cos 18,43^\circ + T_{1-6} \cdot \cos 45^\circ - R_B = 0$$

$$T_{1-2} = (R_B - T_{1-6} \cdot \cos 45^\circ) / \cos 18,43^\circ$$

$$T_{1-2} = (R_B - T_{1-6} \cdot \cos 45^\circ) / \cos 18,43^\circ$$

$$\Sigma F_y = 0 \quad -T_{1-2} \cdot \sen 18,43^\circ - T_{1-6} \cdot \sen 45^\circ - 1 T + V_A = 0$$

$$-((R_B - T_{1-6} \cdot \cos 45^\circ) / \cos 18,43^\circ) \cdot \sen 18,43^\circ - T_{1-6} \cdot \sen 45^\circ - 1 T + V_A = 0$$

$$-R_B \cdot \operatorname{tg} 18,43^\circ + T_{1-6} \cdot \cos 45^\circ \cdot \operatorname{tg} 18,43^\circ - T_{1-6} \cdot \sen 45^\circ - 1 T + V_A = 0$$

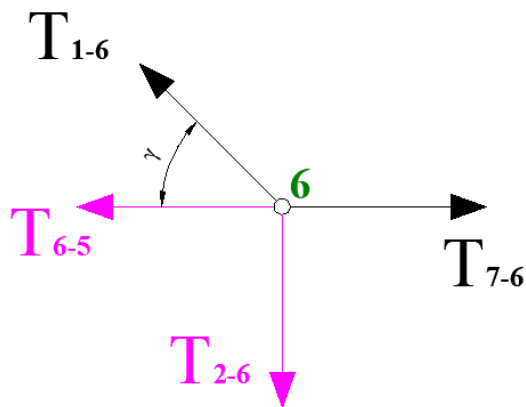
$$T_{1-6} \cdot (\cos 45^\circ \cdot \operatorname{tg} 18,43^\circ - \sen 45^\circ) = R_B \cdot \operatorname{tg} 18,43^\circ + 1 T - V_A$$

$$T_{1-6} = (R_B \cdot \operatorname{tg} 18,43^\circ + 1 T - V_A) / (\cos 45^\circ \cdot \operatorname{tg} 18,43^\circ - \sen 45^\circ)$$

$$T_{1-6} = 4,2 T \quad (+)$$

$$T_{1-2} = 6,3 T \quad (+)$$

Nudo 6



$$\Sigma F_x = 0 \quad T_{7-6} - T_{6-5} - T_{1-6} \cdot \cos 45^\circ = 0$$

$$T_{6-5} = T_{7-6} - T_{1-6} \cdot \cos 45^\circ = 0$$

$$T_{6-5} = 6 T \quad (-)$$

$$\Sigma F_y = 0 \quad T_{1-6} \cdot \sin 45^\circ - T_{2-6} = 0$$

$$T_{2-6} = T_{1-6} \cdot \sin 45^\circ$$

$$T_{2-6} = 2,96 T \approx 3 T \quad (-)$$

Nudo 2

$$\Sigma F_x = 0 \quad -T_{1-2} \cdot \cos 18,43^\circ + T_{2-3} \cdot \cos 18,43^\circ + T_{2-5} \cdot \cos 33,69^\circ = 0$$

$$T_{2-3} = (T_{1-2} \cdot \cos 18,43^\circ - T_{2-5} \cdot \cos 33,69^\circ) / \cos 18,43^\circ = 0$$

$$\Sigma F_y = 0 \quad T_{1-2} \cdot \sen 18,43^\circ + T_{2-6} - T_{2-3} \cdot \sen 18,43^\circ - T_{2-5} \cdot \sen 33,69^\circ - P_2 = 0$$

$$T_{1-2} \cdot \sen 18,43^\circ + T_{2-6} - ((T_{1-2} \cdot \cos 18,43^\circ - T_{2-5} \cdot \cos 33,69^\circ) / \cos 18,43^\circ) \cdot \sen 18,43^\circ - T_{2-5} \cdot \sen 33,69^\circ - P_2 = 0$$

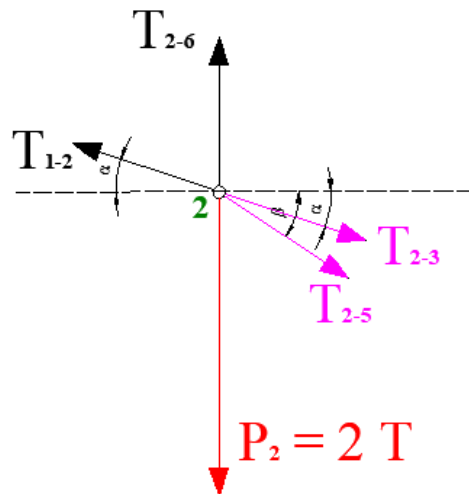
$$T_{1-2} \cdot \sen 18,43^\circ + T_{2-6} - T_{1-2} \cdot \sen 18,43^\circ + ((T_{2-5} \cdot \cos 33,69^\circ) / \cos 18,43^\circ) \cdot \sen 18,43^\circ - T_{2-5} \cdot \sen 33,69^\circ - P_2 = 0$$

$$T_{2-6} + T_{2-5} \cdot ((\cos 33,69^\circ \cdot \operatorname{tg} 18,43^\circ) - \sen 33,69^\circ) - P_2 = 0$$

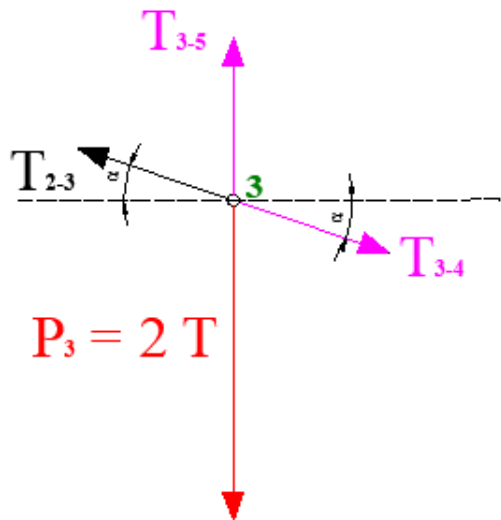
$$T_{2-5} = (P_2 - T_{2-6}) / ((\cos 33,69^\circ \cdot \operatorname{tg} 18,43^\circ) - \sen 33,69^\circ)$$

$$T_{2-5} = 3,6 \text{ T } (+)$$

$$T_{2-3} = 3,1 \text{ T } (+)$$



Nudo 3



$$\Sigma F_x = 0 \quad T_{3-4} \cdot \cos 18,43^\circ - T_{2-3} \cdot \cos 18,43^\circ = 0$$

$$T_{3-4} = T_{2-3} \cdot \cos 18,43^\circ / \cos 18,43^\circ$$

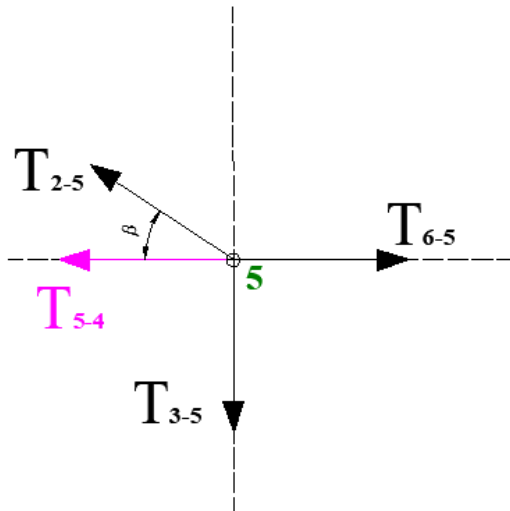
$$T_{3-4} = 3,1 T \quad (+)$$

$$\Sigma F_y = 0 \quad T_{3-5} + T_{2-3} \cdot \text{sen } 18,43^\circ - T_{3-4} \cdot \text{sen } 18,43^\circ - P_3 = 0$$

$$T_{3-5} - P_3 = 0$$

$$T_{3-5} = 2 T \quad (-)$$

Nudo 5



$$\Sigma F_x = 0 \quad -T_{5-4} - T_{2-5} \cdot \cos 33,69^\circ + T_{6-5} = 0$$

$$T_{5-4} = -T_{2-5} \cdot \cos 33,69^\circ + T_{6-5}$$

$$T_{5-4} = 3 T \quad (-)$$

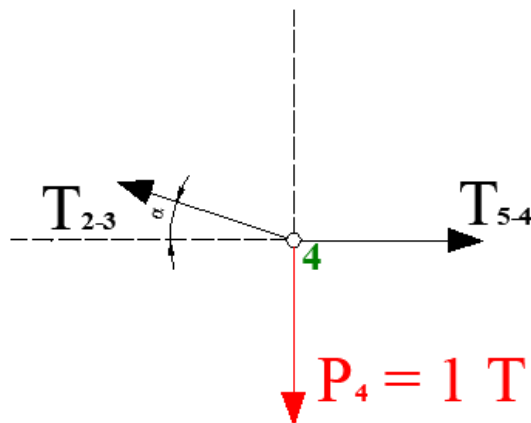
Verificación:

$$\Sigma F_y = 0 \quad -T_{3-5} + T_{2-5} \cdot \sen 33,69^\circ = 0$$

$$-2 T + 3,6 T \cdot \sen 33,69^\circ = 0$$

$$-2 T + 2 T = 0$$

Nudo 4



Verificación:

$$\Sigma F_x = 0 \quad T_{5-4} - T_{2-3} \cdot \cos 18,43^\circ = 0$$

$$3 T - 3,1 T \cdot \cos 18,43^\circ = 0$$

$$3 T - 3 T = 0$$

$$\Sigma F_y = 0 \quad T_{2-3} \cdot \sen 18,43^\circ - P_4 = 0$$

$$3,1 T \cdot \sen 18,43^\circ - 1 T = 0$$

$$1 T - 1 T = 0$$

**CUADRO
RESUMEN**

Barra		Esfuerzo	
		Tracción	Compresión
S ₁	1 - 2	6,3	-
S ₂	2 - 3	3,1	-
S ₃	3 - 4	3,1	-
I ₃	5 - 4	-	3,0
I ₂	6 - 5	-	6,0
I ₁	7 - 6	-	9,0
M ₁	1 - 7	-	6,0
M ₂	2 - 6	-	3,0
M ₃	3 - 5	-	2,0
D ₁	1 - 6	4,2	-
D ₂	2 - 5	3,6	-