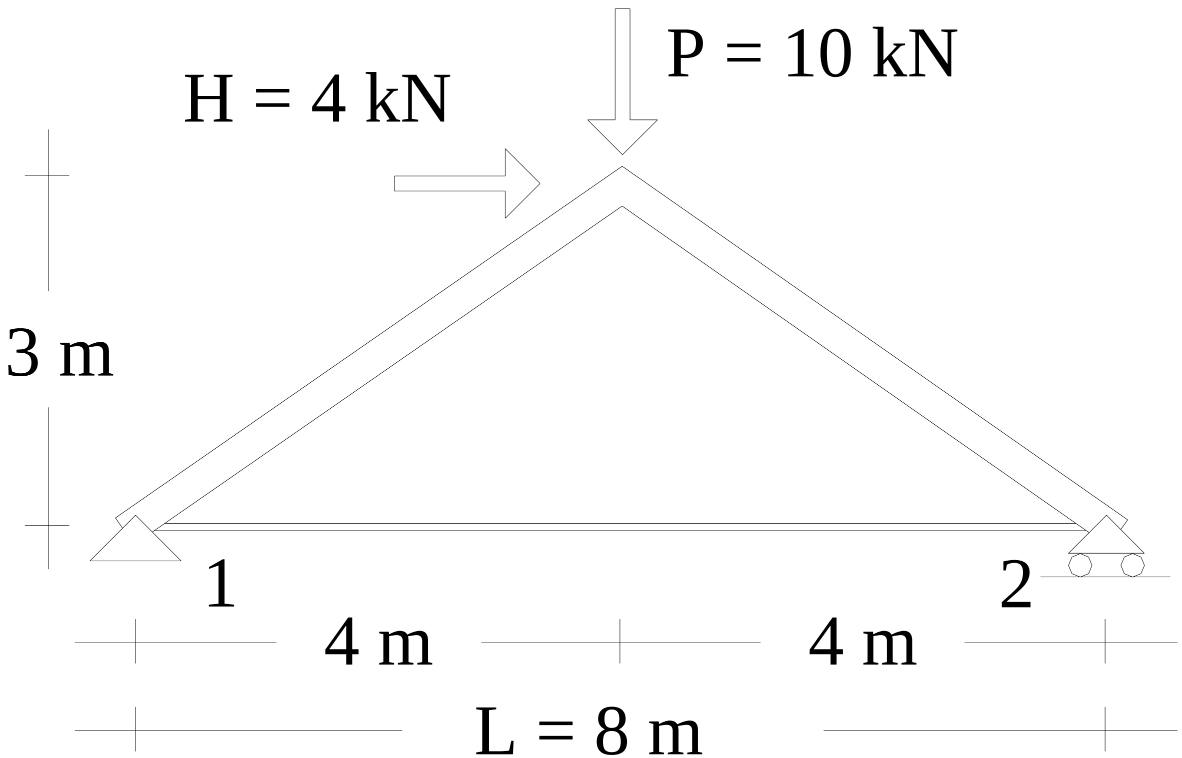
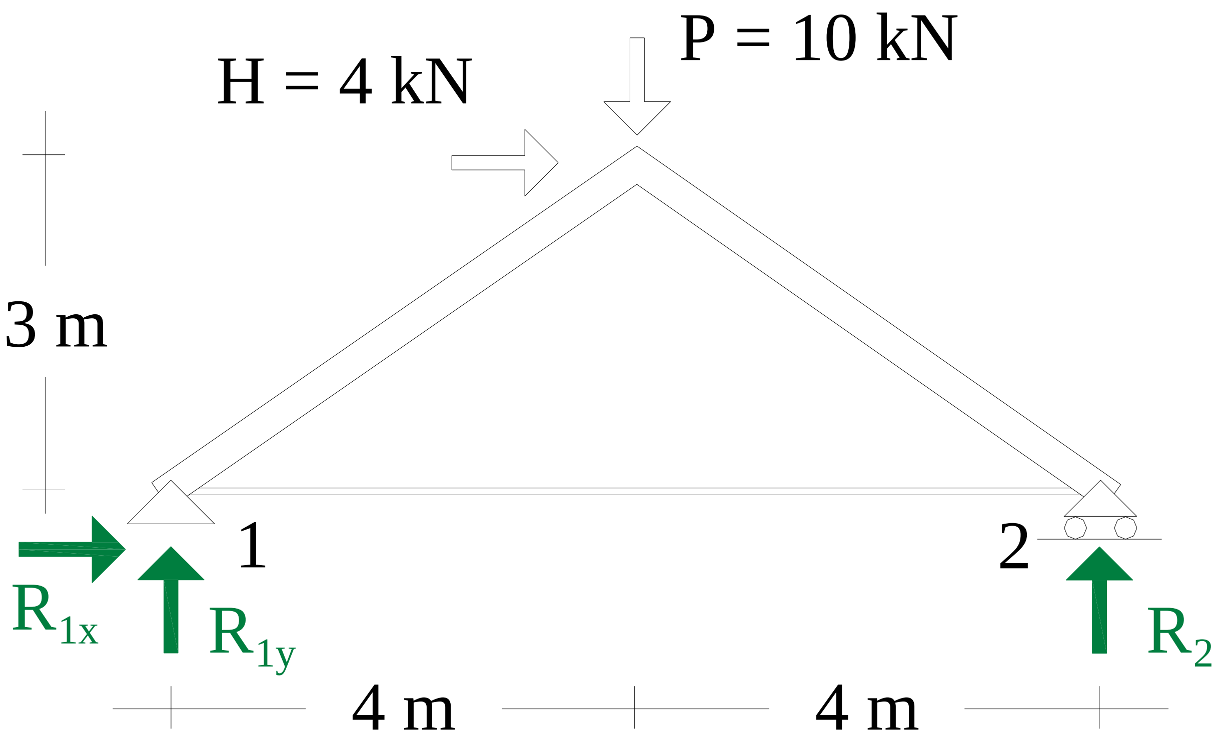
statical analysis of a simple truss

(a very first example)



static determinacy discussion

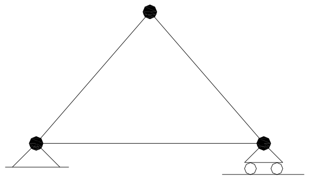


Unknowns: 3 reactions + 3 internal forces = 6

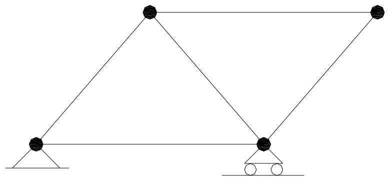
Equations : 3 joints x 2 equations / joint = 6

necessary but not sufficient condition !!!

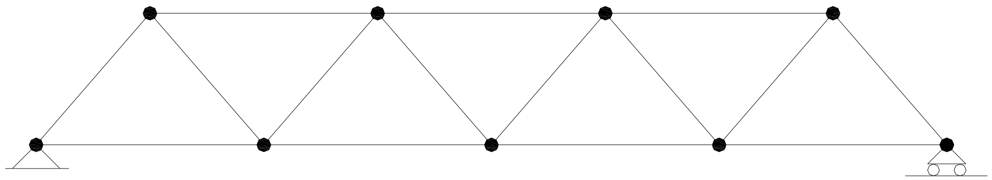
‘canonical’ statically determinate trusses

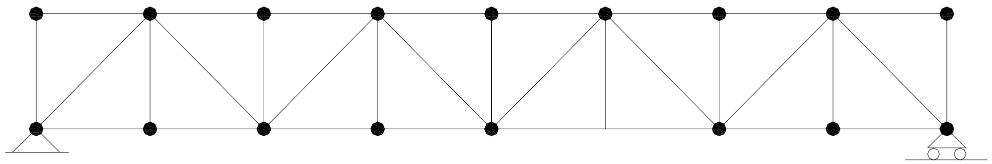


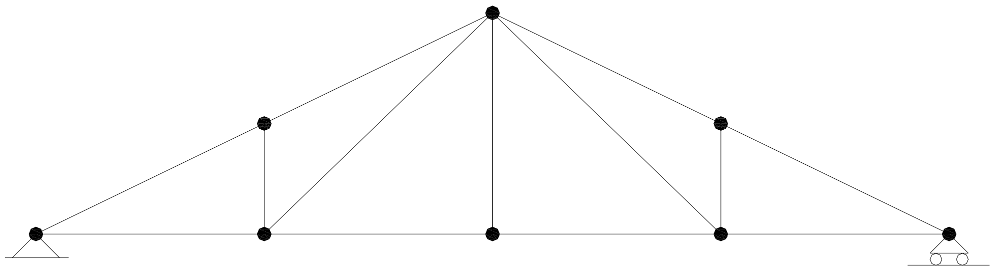
STATICALLY DETERMINATE
(3 + 3 = 6 UNKNOWN EXTERNAL/INTERNAL FORCES)
(3 x 2 = 6 EQUILIBRIUM EQUATIONS)



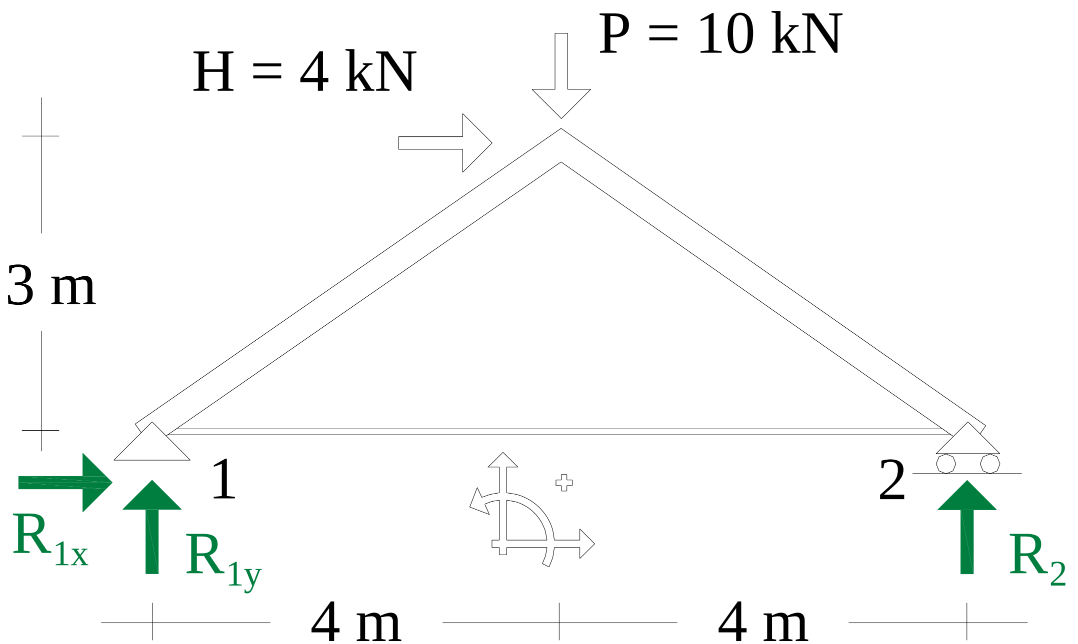
+ 2 BARS (2 UNKNOWN INTERNAL FORCES)
+ 1 JOINT (2 EQUILIBRIUM EQUATIONS)







'external' forces equilibrium: applied forces → reaction forces



$$\Sigma F_x = 0 \; : \; \boxed{R_{1x} = -4\text{kN}}$$

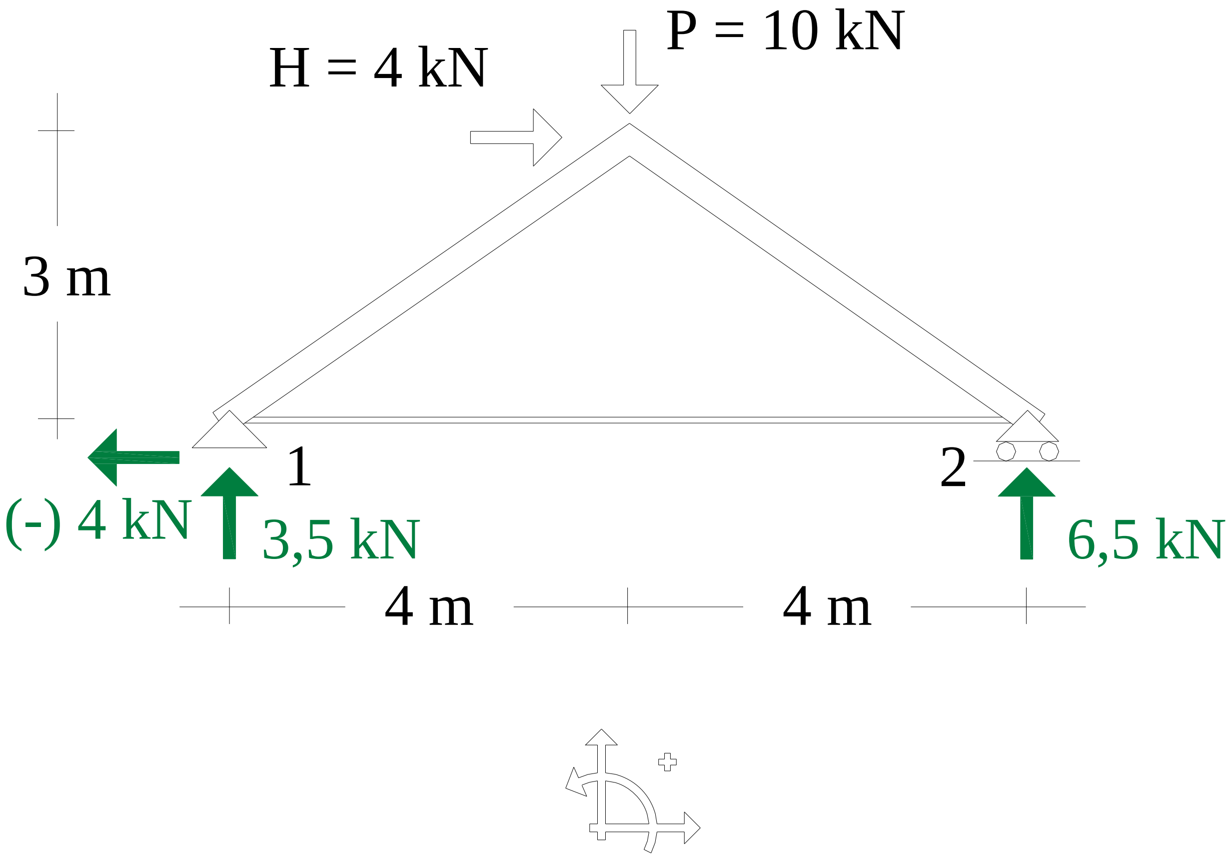
$$\Sigma F_y = 0 \; : \; -10 + R_{1y} + R_2 = 0 \; : \; R_{1y} + R_2 = 10\text{kN}$$

$$\Sigma M_2 = 0 \; : \; 10 \cdot 4 - 4 \cdot 3 - R_{1y} \cdot 8 = 0$$

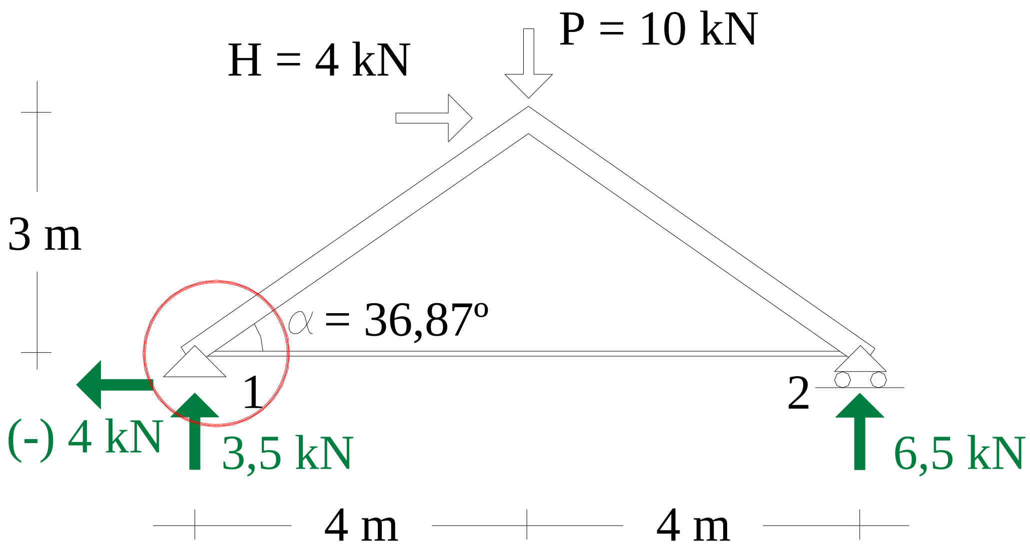
$$\boxed{R_{1y} = 3,5\text{kN}}$$

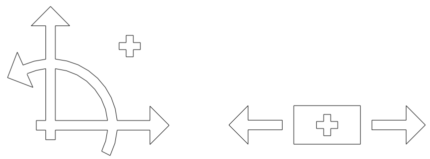
$$\boxed{R_2 \;\; = 6,5\text{kN}}$$

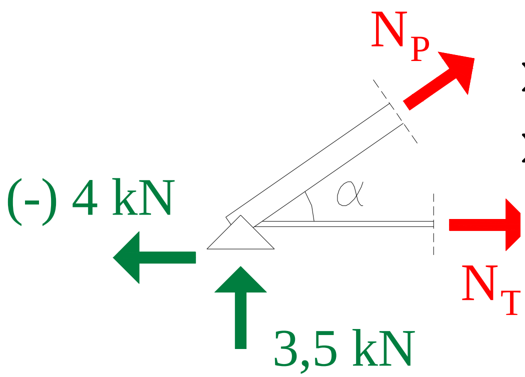
applied and reaction forces equilibrium



‘internal’ equilibrium → axial forces





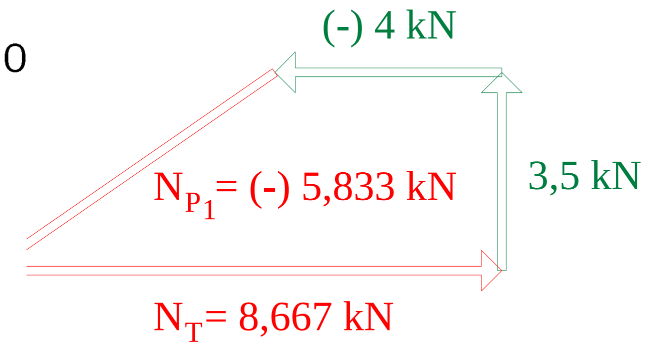


$$\Sigma F_x = 0 \;:\; -4 + N_{P1}\, cos\alpha + N_T = 0$$

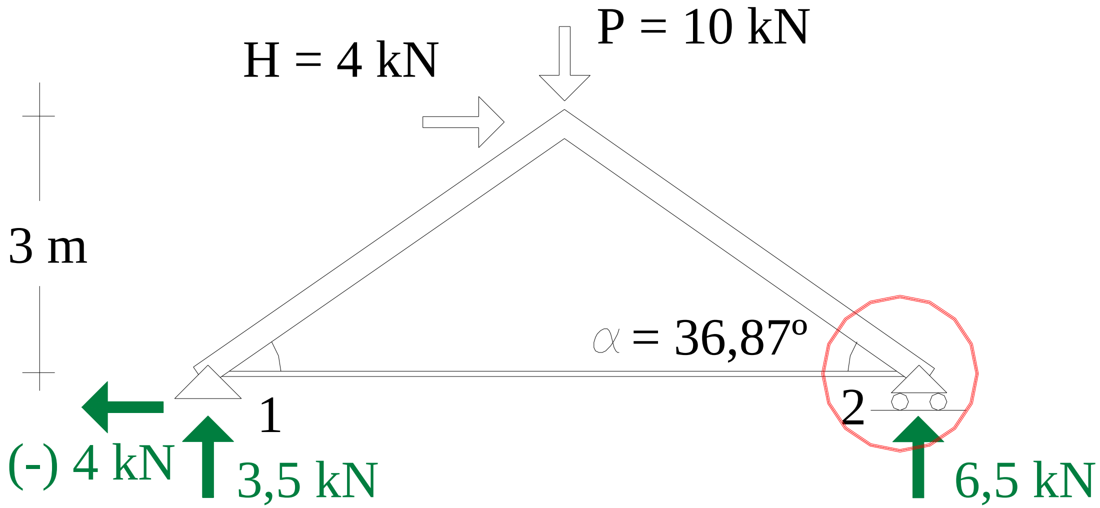
$$\Sigma F_y = 0 \;:\; 3,5 + N_{P1}\, sin\alpha = 0$$

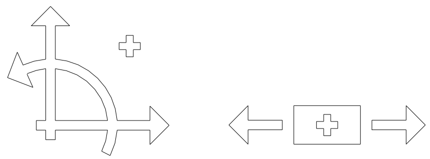
$$\boxed{N_{P1} = -5,833\text{kN}}$$

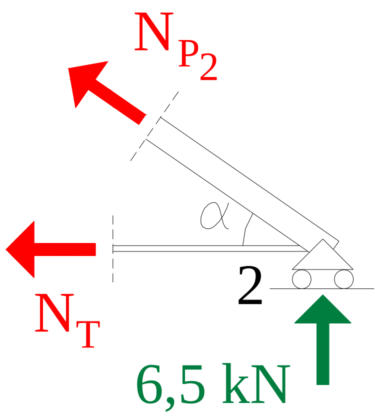
$$\boxed{N_T \;=\; 8,667\text{kN}}$$



joints equilibrium→ axial forces





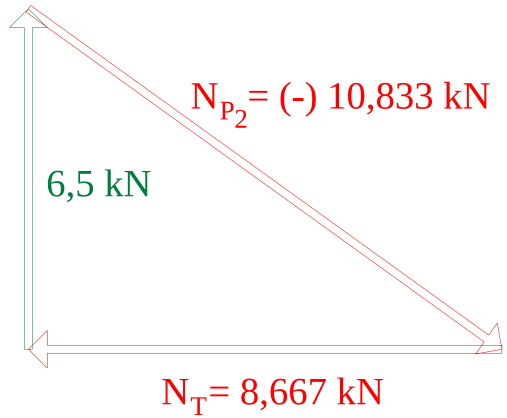


$$\Sigma F_x = 0 \;:\; -N_{P2}\,cos\alpha - N_T = 0$$

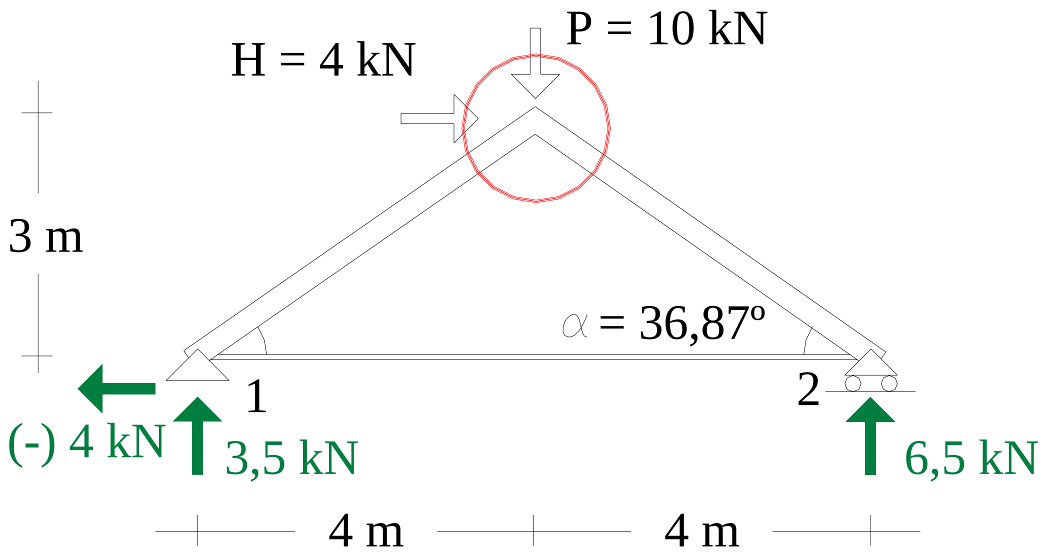
$$\Sigma F_y = 0 \;:\; 6,5 + N_{P2}\,sin\alpha = 0$$

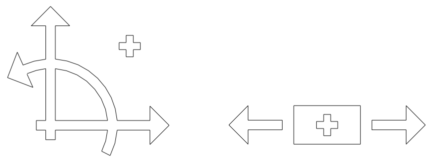
$$\boxed{N_{P2} = -10,833\text{kN}}$$

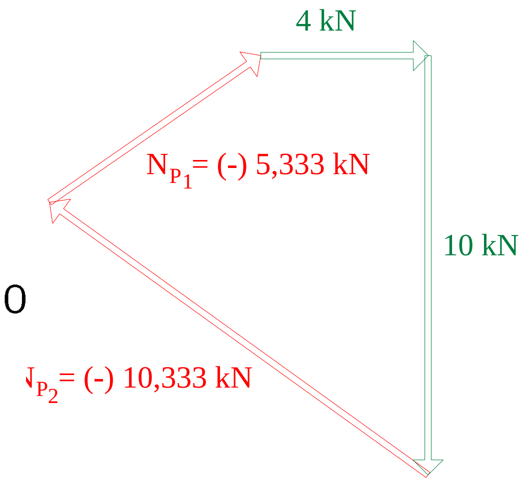
$$\boxed{N_T \;=\; 8,667\text{kN}}$$

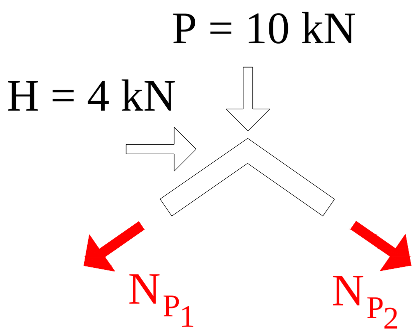


‘internal’ equilibrium → ‘internal forces’









$$\Sigma F_x = 0 \; : \; 4 - N_{P1}\,cos\alpha + N_{P2}\,cos\alpha = 0$$

$$\Sigma F_y = 0 \; : \; -10 - N_{P1}\,sin\alpha = 0 - N_{P2}\,sin\alpha = 0$$

$$\boxed{N_{P1} = \; -5,833\text{kN}}$$

$$\boxed{N_{P2} = -10,833\text{kN}}$$

equilibrium → reactions and axial forces