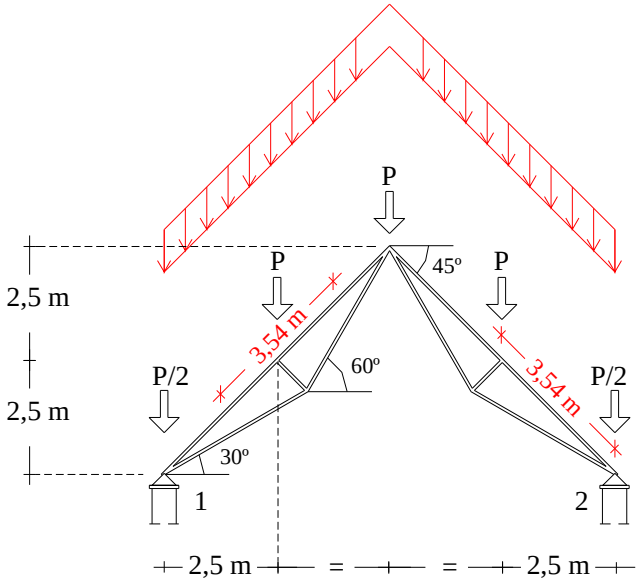
three-hinged trusses

three-hinged trusses

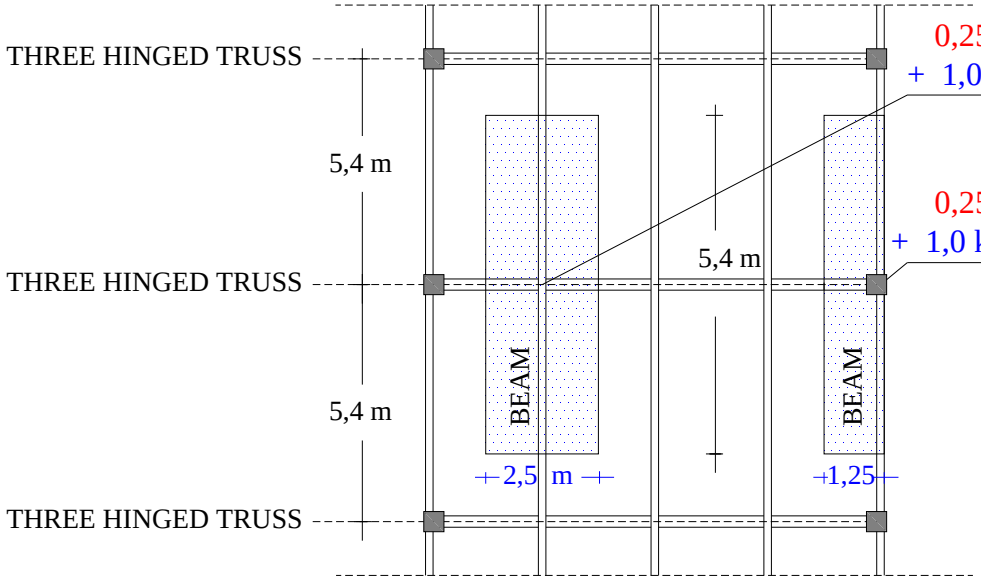
GRAVITY LOADS

VARIABLE LOAD (SNOW LOAD): Q = 1,0 kN/m^2
(MEASURED ON HORIZONTAL PLANE)

SELF WEIGHT STRUCTRURE AND ROOF: G = 0,25 kN/m^2
(MEASURED ON ROOF PLANE)



SECTION - ELEVATION



0,25 kN/m^2 · 5,4 · 3,54 = 4,8 kN
\+ 1,0 kN/m^2 · 5,4 · 2,5 = 13,5 kN

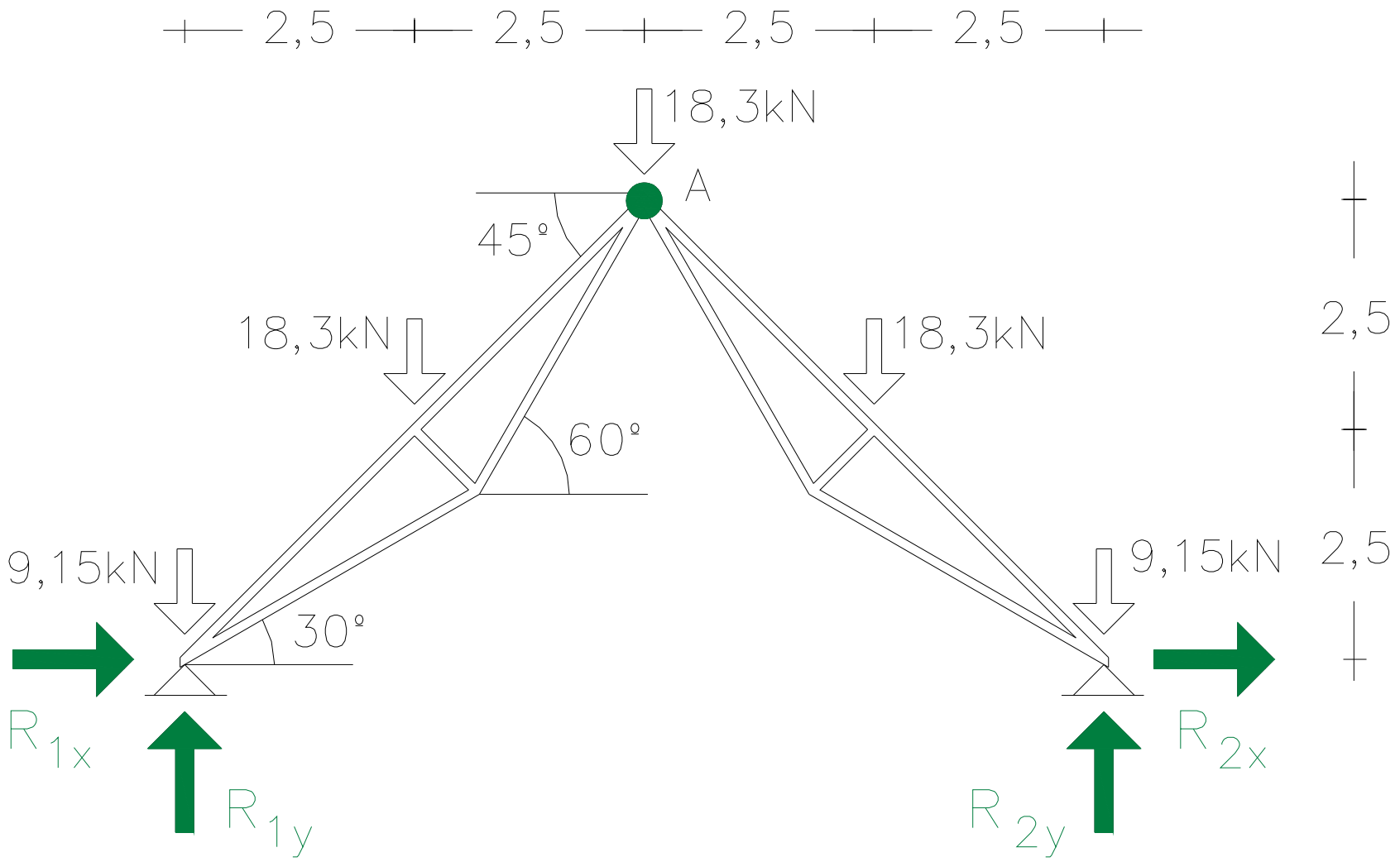
P = 18,3 kN

0,25 kN/m^2 · 5,4 · 1,77 = 2,4 kN
\+ 1,0 kN/m^2 · 5,4 · 1,25 = 6,75 kN

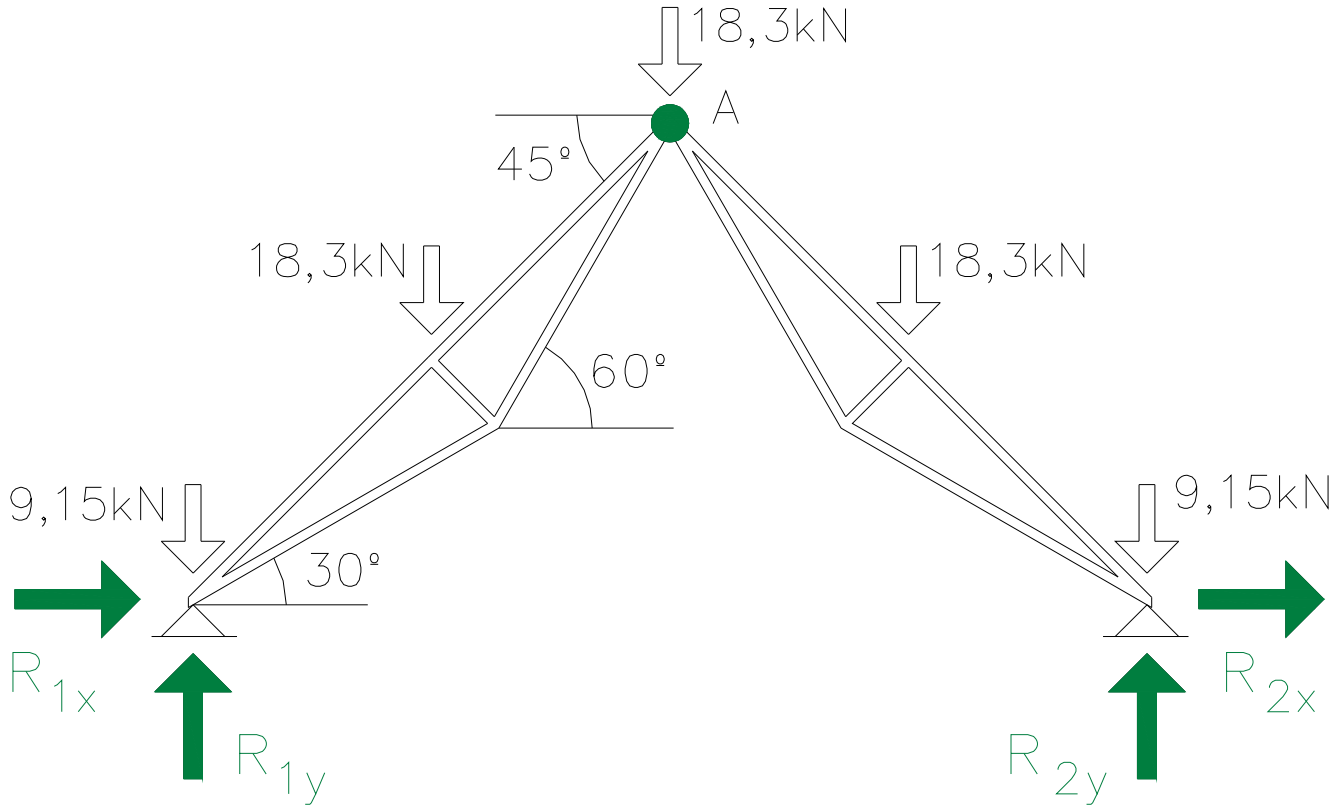
P/2 = 9,15 kN

PLAN - FLOOR

three-hinged truss: gravity loads



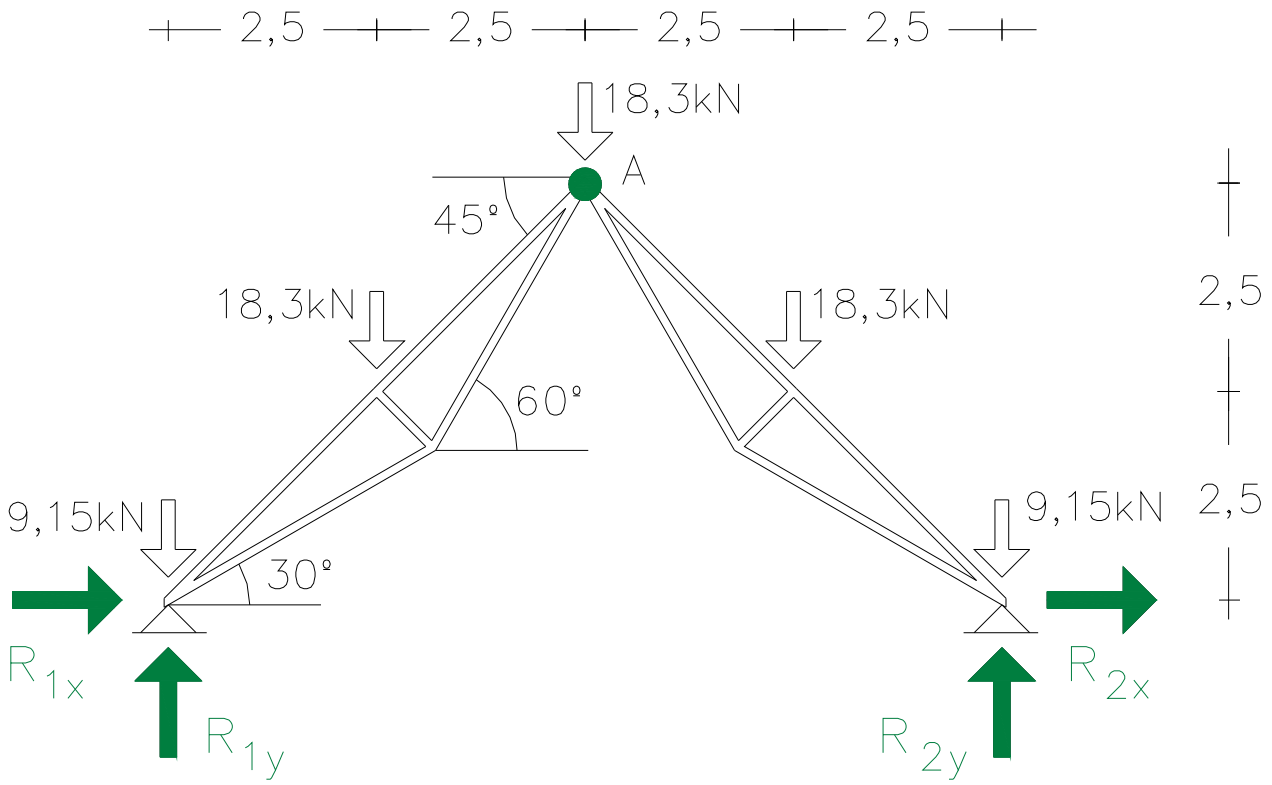
statical determinancy



Unknowns: 4 reactions + 10 axial forces = 14

Equations: 7 joints x 2 equations/joint = 14

equilibrium of external forces (3 equations; 4 unknowns)



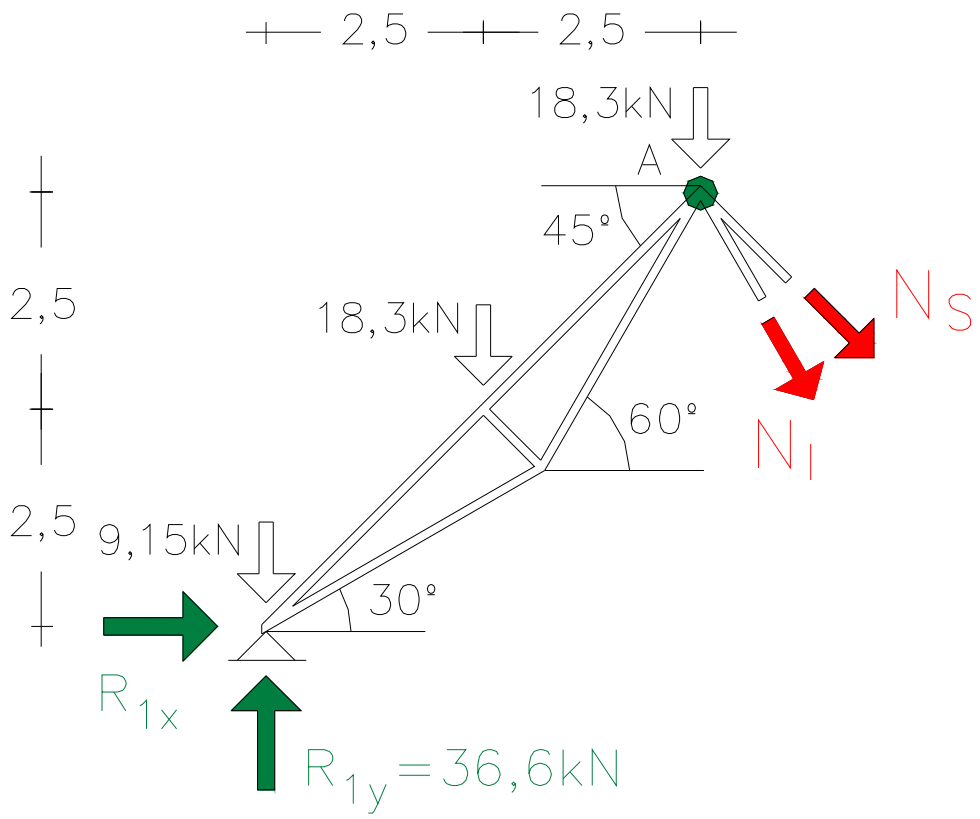
$$\Sigma F_x = 0 \; : \quad \boxed{R_{1x} + R_{2x} = 0}$$

$$\Sigma F_y = 0 \; : \; -2 \cdot 9,15 - 3 \cdot 18,3 + R_{1y} + R_{2y} = 0 \; : \; R_{1y} + R_{2y} = 73,2\text{kN}$$

$$\Sigma M_2 = 0 \; : \; 9,15 \cdot 10 + 18,3 \cdot (7,5 + 5 + 2,5) - R_{1y} \cdot 10 = 0$$

$$\boxed{R_{1y} = 36,6\text{kN}} \qquad \boxed{R_{2y} = 36,6\text{kN}}$$

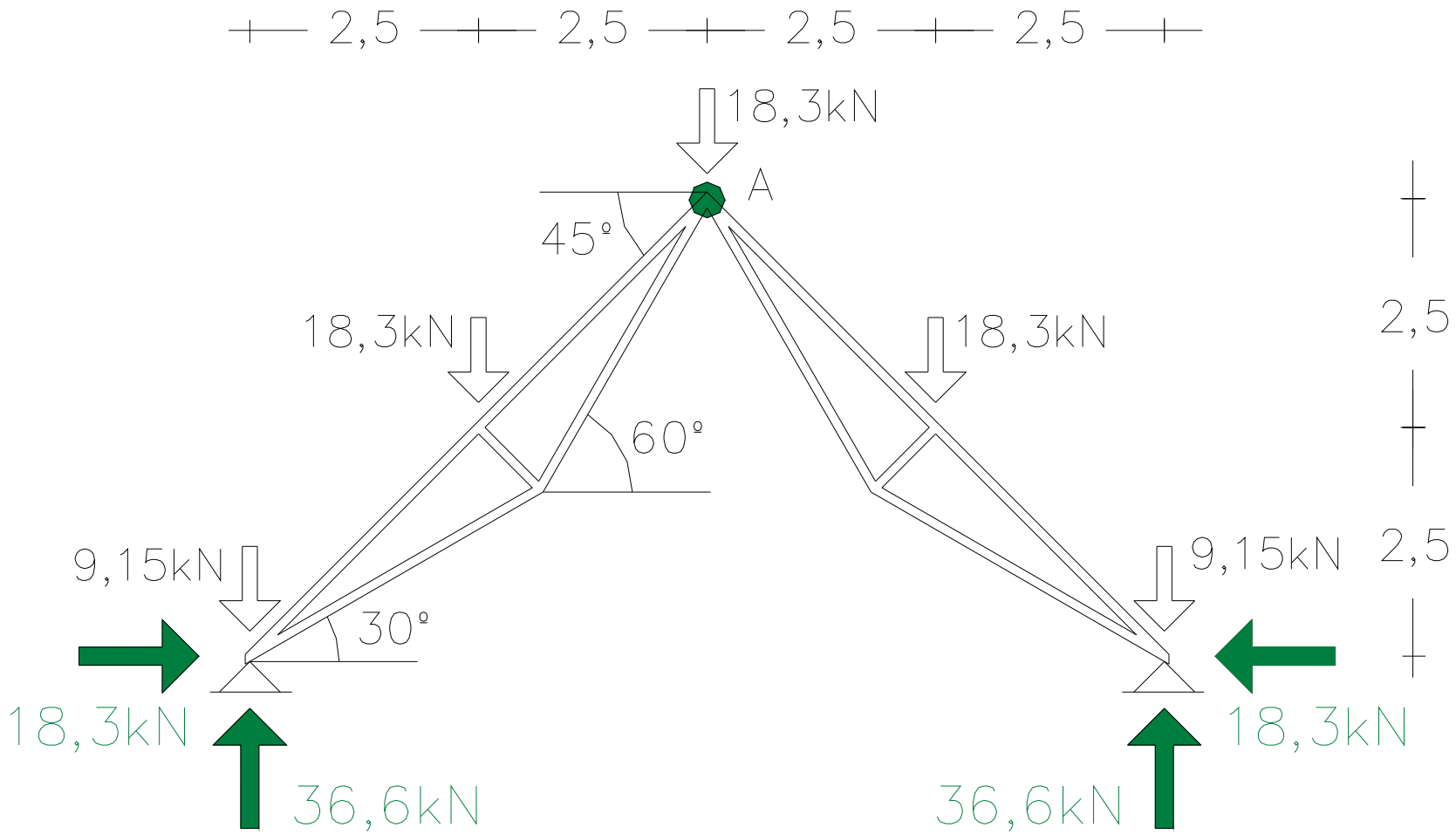
‘internal’ equilibrium: ‘extra’ equation (third hinge!)



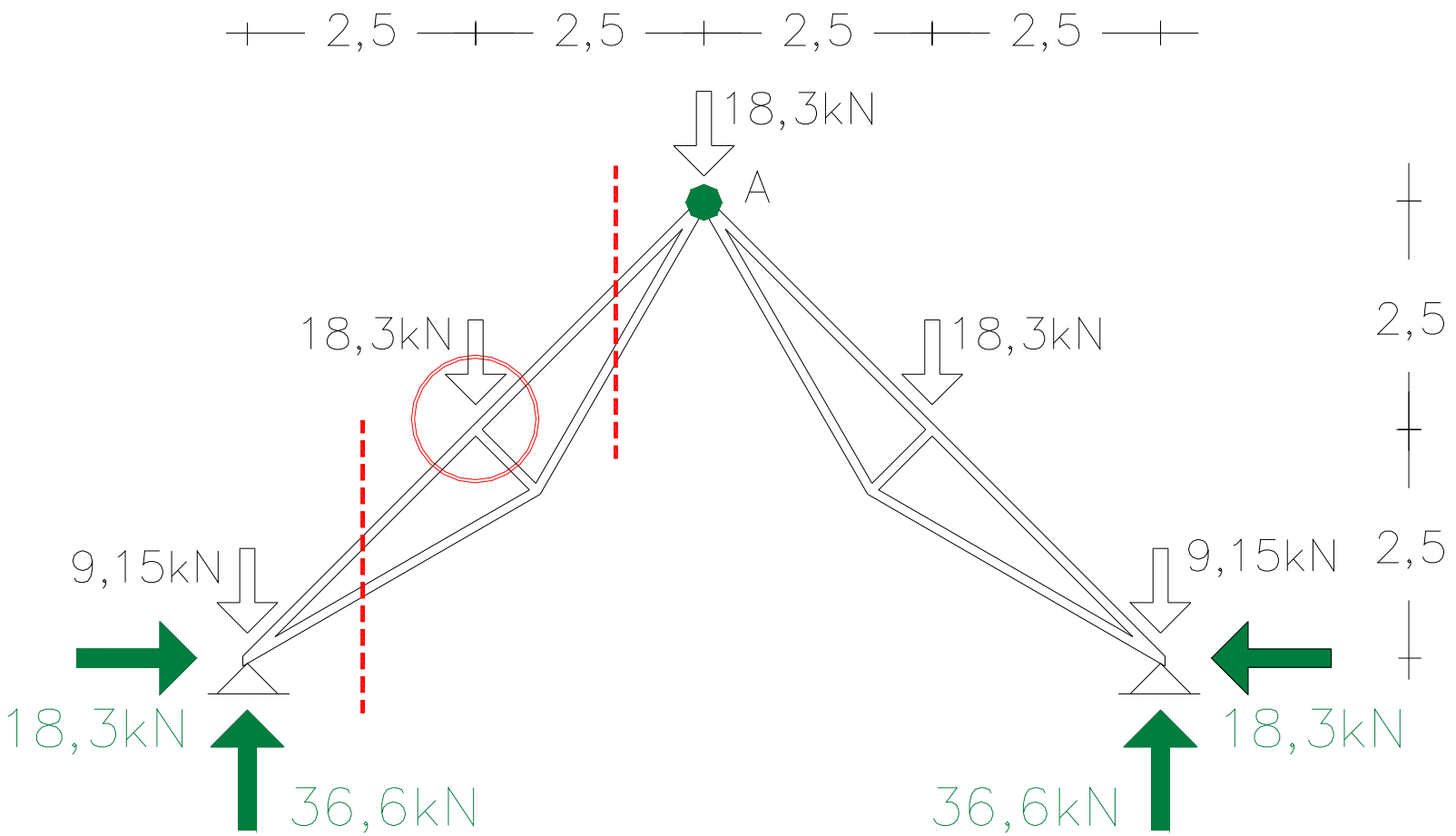
$$\Sigma M_A = 0 \;:\; 9,15 \cdot 5 + 18,3 \cdot 2,5 - 36,6 \cdot 5 + R_{1x} \cdot 5 = 0$$

$$\boxed{R_{1x} = \quad 18,3\text{kN}} \qquad \boxed{R_{2x} = -18,3\text{kN}}$$

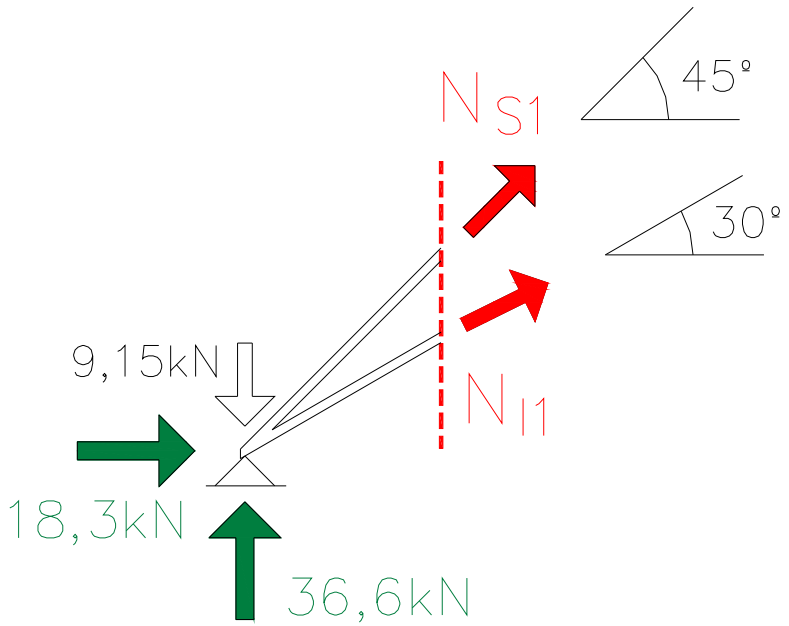
external + internal equilibrium → reactions

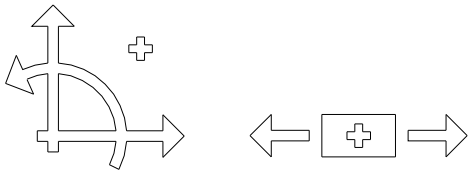


internal equilibrium → axial forces



internal equilibrium → axial forces





$$\Sigma F_x = 0 \;:\; 18,3 + N_{S1}\cos 45^o + N_{I1}\cos 30^o = 0 \quad : \quad \boxed{N_{S1} = -56,6\text{kN}}$$

$$\Sigma F_y = 0 \;:\; 36,6 - 9,15 + N_{S1}\sin 45^o + N_{I1}\sin 30^o = 0 \quad : \quad \boxed{N_{I1} = +25,0\text{kN}}$$

gravity loads: reaction and axial forces