The system shown in the figure is made up of a cable connected on its left end to a truss. The next parameters of the cable are known: distance between points A and B $D_{ab} = 12m$, weight per unit of length p = 100 N/m and the value of the minimum tension of the cable $T_0 = 1$ kN.

Data:

$L_{12} = L_{23} = L_{34} = L_{41} = L_{35}$

Determine:

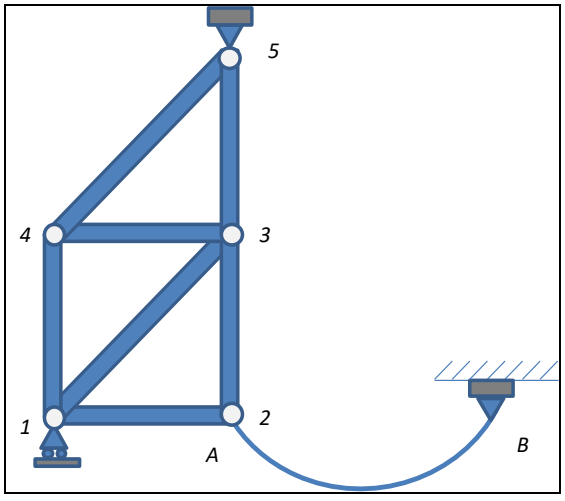
a) Reaction forces in points a and b.

b) Length of the cable.

c) DSI of the truss and its possible implications.

d) Using the **method of the joints**, the axial forces in all members of the structure indicating if they are tensile or compressive.

e) Using the **method of the sections**, the axial forces in bars 45 and 35 and the reaction force at the support located in point 1, indicating if they are tensile or compressive.



1) Reaction forces calculation:

$$a = \frac{T_o}{p} = \frac{1000\ N}{100\ N/m} = 10\ m$$

$$y = a\cosh\left(\frac{x}{a}\right) = 10\cosh\left(\frac{6}{10}\right) = 11{,}85m$$

$$T_{max} = p.y_{max} = 1185\ N$$

$$T_y = \sqrt{T_{max}^2 - T_o^2} \cong 635\ N$$

$$\boldsymbol{T_A = (-1000, 635)\ N}$$

$$\boldsymbol{T_B = (1000, 635)\ N}$$

2) Length of the cable:

$$s = \sqrt{y^2 - a^2} = 6{,}35\ m$$

$$\boldsymbol{s_{tot} = 2.s = 12{,}7\ m}$$

Verification of the value of s and T_y

$$s = a.\sinh\left(\frac{x}{a}\right) = 10.\sinh\left(\frac{6}{10}\right) = 6{,}35\ m$$

$$T_y = \frac{p.s_{tot}}{2} = \frac{100\ {}^{N}/_{m}\ .12{,}7\ m}{2} = 635\ N$$

3) DSI calculation:

$$DSI = m + r - 2j$$

$$m = 7, r = 3\ and\ j = 5$$

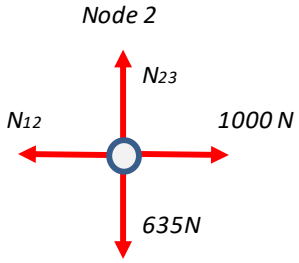
$$\boldsymbol{DSI = 7 + 3 - 2.5 = 0}$$

The structure is entirely linked therefore it is possible to determine the value of the reactions exerted by the supports.

4) Method of the joints:

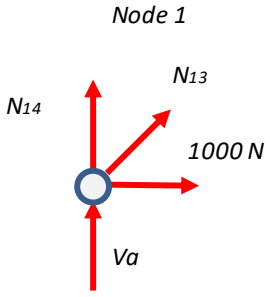
In order to perform this calculation, we isolate the truss.

As a result, reactions forces in point 2 have the same magnitude and opposite sign to the ones exerted by the cable.



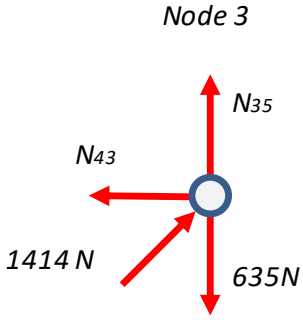
$$\sum F_x = 0 \rightarrow \boldsymbol{N_{12} = 1000\ N\ (T)}$$

$$\sum F_y = 0 \rightarrow \boldsymbol{N_{23} = 635\ N\ (T)}$$



$$\sum F_x = 0 \rightarrow \frac{\sqrt{2}}{2} N_{13} + 1000 = 0$$

$$\boldsymbol{N_{13} = -1000.\sqrt{2}\ N\ (C)}$$

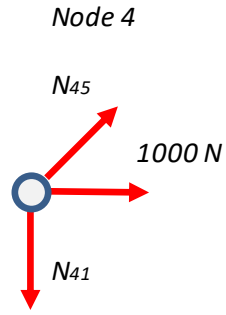


$$\sum F_x = 0 \rightarrow N_{43} - \sqrt{2}.1000.\frac{\sqrt{2}}{2} = 0$$

$$\sum F_y = 0 \rightarrow N_{35} + 1000 - 635 = 0$$

$$\boldsymbol{N_{43} = 1000\ N\ (T)}$$

$$\boldsymbol{N_{35} = -365\ N\ (C)}$$



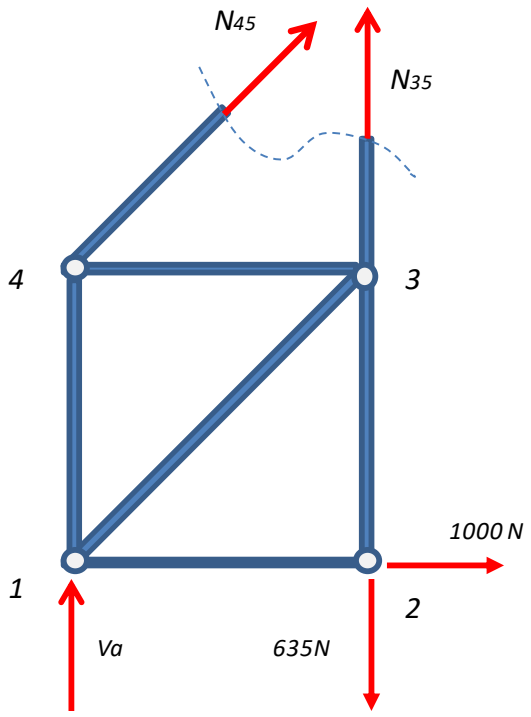
$$\sum F_x = 0 \rightarrow \frac{\sqrt{2}}{2} N_{45} + 1000 = 0$$

$$\sum F_y = 0 \rightarrow N_{41} - \frac{\sqrt{2}}{2} N_{45} = 0$$

$$\boldsymbol{N_{45} = -1000.\sqrt{2}\ N\ (C)}$$

$$\boldsymbol{N_{41} = -1000\ N\ (C)}$$

5) Method of the sections:



$$\sum M_4 = 0 \rightarrow (N_{35} + 1.000 - 635).L = 0$$

$$\boldsymbol{N_{35} = -365\ N\ (C)}$$

$$\sum F_x = 0 \rightarrow N_{45}\frac{\sqrt{2}}{2} + 1000 = 0$$

$$\boldsymbol{N_{45} = -1000.\sqrt{2}\ N\ (C)}$$

$$\sum F_y = 0 \rightarrow V_a - 365 - 1000 - 635 = 0$$

$$\boldsymbol{V_a = 2000\ kN}$$

Obtaining the same results by both methods.