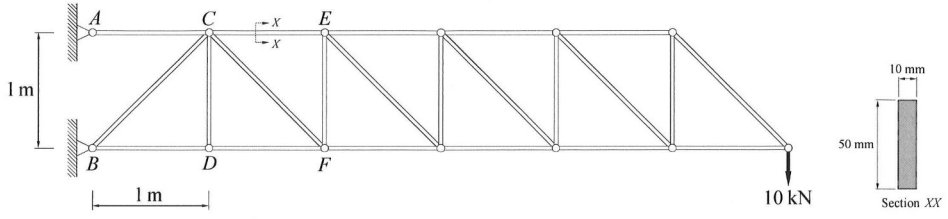
Example 1.4 – The plane, pin-jointed truss shown in Figure 1(a) is loaded vertically with a single downward force of 10 kN at the end. Horizontal and vertical members are 1 m long. The truss is mounted on pinned supports at *A* and *B*.

a) Calculate the horizontal and vertical components of reactions at *A* and *B*.
b) Calculate the forces in the five members connecting joints *C*, *D*, *E*, and *F*.
c) Calculate the direct stress in element *CE*, assuming a solid rectangular cross-section of 10 mm × 50 mm for all truss members, as shown in Figure 1(b).



(a) (b)

Figure 1: (a) A long pin-jointed truss and (b) cross-section of all its members.

Global FBD:

$\Sigma M_B = 0$ (CW)

$(10\,kN)(6\,m) + R_{Ax}(1\,m) = 0$

$R_{Ax} = -60\,kN$

$\Sigma F_y = 0$

$R_{By} - (10\,kN) = 0$

$R_{By} = 10\,kN$

Joint A

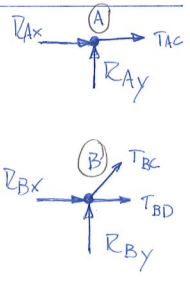
Collinearity Rule 1:

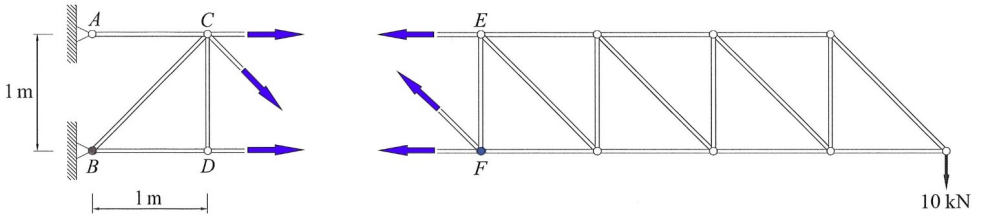
$R_{Ay} = 0$

$\Sigma F_x = 0$

$R_{Bx} + R_{Ax} = 0$

$R_{Bx} = 60\,kN$





RHS:

$\Sigma M_F = 0 \quad \circlearrowleft$

$(10\,kN)(4\,m) - T_{CE}(1\,m) = 0$

$\boxed{T_{CE} = 40\,kN}$

$\Sigma F_y = 0$

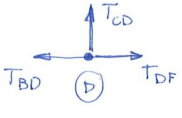
$T_{CF}\sin\theta - (10\,kN) = 0$

$\boxed{T_{CF} = 14.14\,kN}$

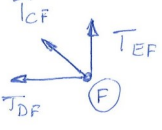
$\Sigma F_x = 0$

$-T_{CE} - T_{CF}\cos\theta - T_{DF} = 0$

$\boxed{T_{DF} = -50\,kN}$



Collinearity Rule 1: $\boxed{T_{CD} = 0}$



$\Sigma F_y = 0$

$T_{EF} + T_{CF}\sin\theta = 0$

$T_{EF} + (14.14)\left(\frac{1}{\sqrt{2}}\right) = 0$

$\boxed{T_{EF} = -10\,kN}$

$\sigma = \frac{F}{A}$

$\sigma_{CE} = \frac{40\,kN}{(10\,mm)(50\,mm)} = \frac{40\,kN}{500\,mm^2}$

$\boxed{\sigma_{CE} = 80\,MPa}$