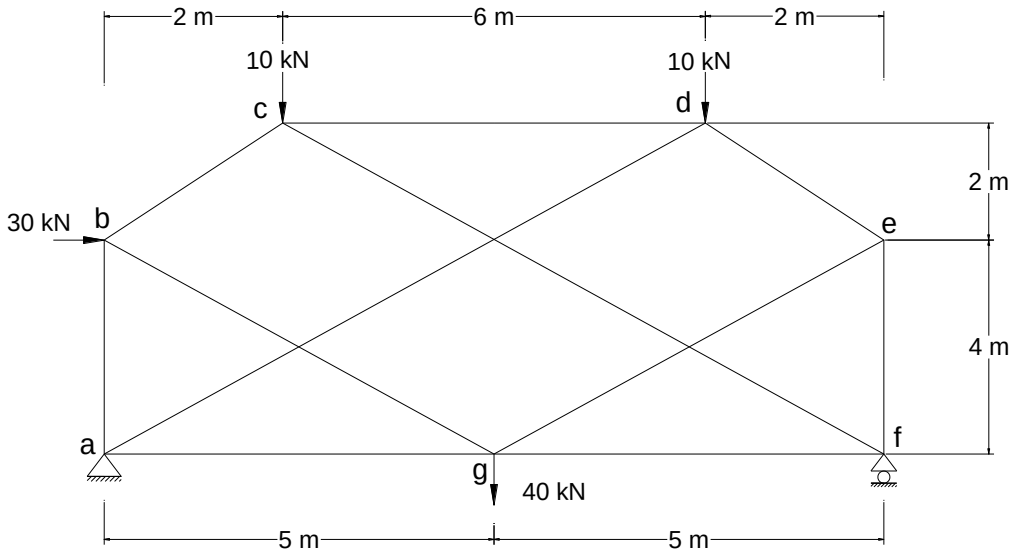
Ex 6 Analysis the truss shown in fig. finds all bars forces.



Solution procedure

1- Assume the force in any bar for example (ad) and equal (R) in tension
2- Calculate the force in another bar for example (ab) in term of (R) by following two paths.
   a) First path: (joint d), (joint c) & (joint b). By applying equilibrium equations we find the force in bar (ad) in term of (R).
   b) Second path: (joint a), from it we find the value of force in the bar (ab) in term of (R).
3- We equal the forces outputs in bar (ab) which Obtained from the two paths, we solve the equation to find the value of (R).
4- All the forces of the bars can now be calculated after identifying the value of (R).

Solution:

$\sum M_A = 0$ => fy = 42 kN ↑

$\sum F_y = 0$ => ay = 18 kN ↑

$\sum F_x = 0$ => ax = 30 kN ←

Let force in bar ad = R (tension)

Use joint d

$\uparrow \sum F_y = 0$

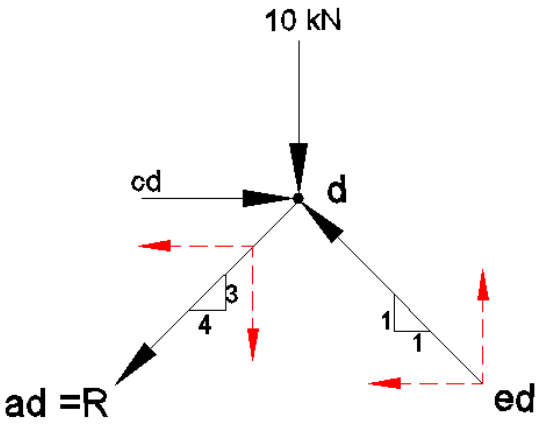
$$ed * \frac{1}{\sqrt{2}} - 10 - 0.6R = 0$$

$$ed = \sqrt{2}\,(10 + 0.6R)$$

$\rightarrow \sum F_x = 0$

$$d - 0.8R - \sqrt{2}\,(10 + 0.6R) * \frac{1}{\sqrt{2}} = 0$$

$$cd = 10 + 1.4R$$



Use joint c

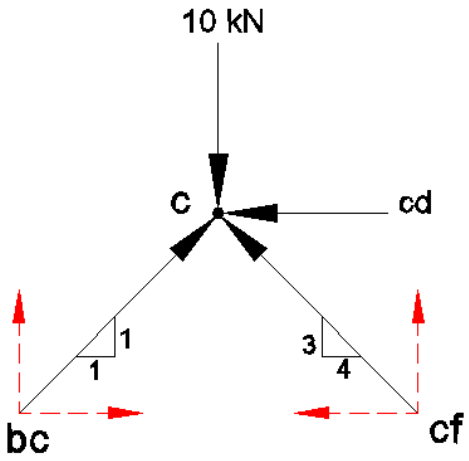
$\uparrow \sum F_y = 0$

$$bc * \frac{1}{\sqrt{2}} + cf * \frac{3}{5} - 10 = 0$$

$$bc = \sqrt{2}\,(10 - 0.6\,cf) \ldots\ldots\ldots 1$$

$\rightarrow \sum F_x = 0$

$$bc * \frac{1}{\sqrt{2}} - cf * \frac{4}{5} - 10 - 1.4R = 0 \ \ldots\ldots\ldots 2$$



Sub equation 1 in equation 2

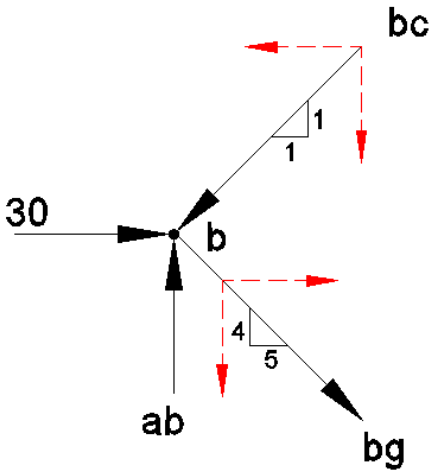
$$(\sqrt{2}\,(10 - 0.6\,cf) * \frac{1}{\sqrt{2}}) - (cf * \frac{4}{5}) - 10 - 1.4R = 0$$

$$cf = -R$$

$$bc = \sqrt{2}\,(10 - 0.6 * (-R))$$

$$bc = \sqrt{2}\,(10 + 0.6R)$$

Use joint b



$\rightarrow \sum F_x = 0, \Rightarrow 30 - 10 - 0.6R + bg * \frac{5}{\sqrt{41}} = 0$

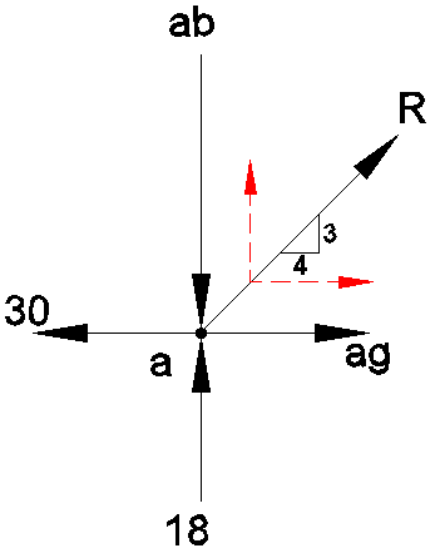
$bg = \frac{\sqrt{41}}{5}(0.6R - 20)$

$\uparrow \sum F_y = 0$

$ab - 10 - 0.6R - (0.6R - 20) * \frac{\sqrt{41}}{5} * \frac{4}{\sqrt{41}} = 0$

$ab = -6 + 1.08R$

Use joint a



$\rightarrow \sum F_x = 0$

ag + 0.8R - 30 = 0

ag= 30 – 0.8R

$\sum F_y = 0$

18 + 0.6R = -6 + 1.08R

R = 50 kN (ten.)

ad= 50 kN (ten.)

ab = -6 + (1.08*50) = -48 = 48 kN (comp.)

cd= 10+1.4 *50 =80 kN (ten.)

$bg = \frac{\sqrt{41}}{5}(0.6 * 50 - 20) \Rightarrow bg = 2\sqrt{41}$ kN (ten.)

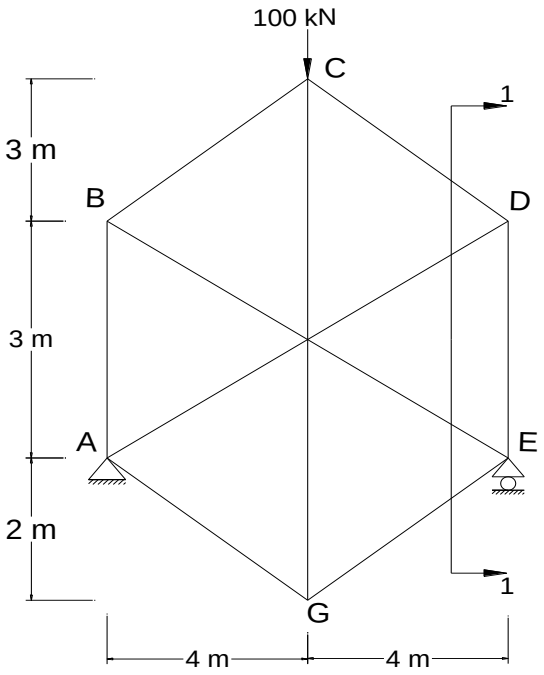
ag = 30 – 0.8*50 = 10 kN (ten.)

cf= -R = -50 = 50 kN (comp.)

$bc = \sqrt{2}(10 + 0.6 * 50) \Rightarrow bc = 40\sqrt{2}$ kN (comp.)

Ex 7: Analysis the truss shown in fig.

1- classify the truss
2- find the force in bar AD.



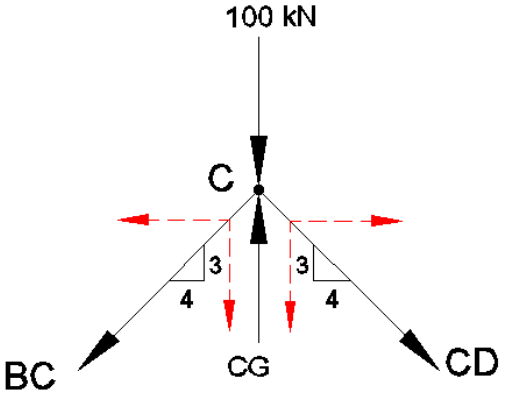
Sol:

Section 1 ------1

$\sum M_o = 0$

$$(50 * 4) + \left(\text{CD} * \frac{4}{5} * 4.5\right) - (GE * \frac{2}{\sqrt{5}} * 3.5) = 0 \dots\dots\dots 1$$

Joint C as F.B.D



$\rightarrow \sum F_x = 0$

$$\text{CD} * \frac{4}{5} - BC * \frac{4}{5} = 0$$

CD = BC

$\uparrow \sum F_y = 0$

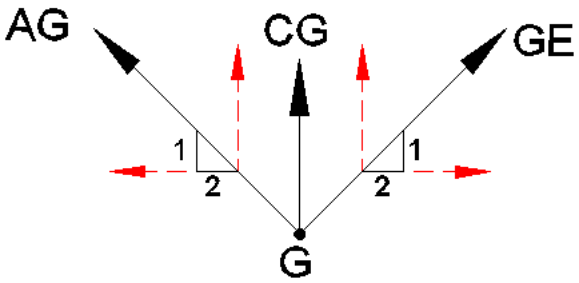
$$100 + 2 * \text{CD} * \frac{3}{5} = CG \dots\dots\dots 2$$

(Joint G) as F.B.D

$\rightarrow \sum F_x = 0$

$\text{GE} * \frac{2}{\sqrt{5}} - AG * \frac{2}{\sqrt{5}} = 0$

GE = AG



$\uparrow \sum F_y = 0$

$\text{CG} = 2\text{GE} * \frac{1}{\sqrt{5}} \ldots\ldots\ldots\ldots 3$

From equation 2&3

$100 + 2 * \text{CD} * \frac{3}{5} = 2\text{GE} * \frac{1}{\sqrt{5}} \ldots\ldots\ldots 4$

Solve equation 1 & equation 4similary to find

Cd = -249.6 kN (Comp.)

GE = -223.2 kN (Comp.)

Use joint D

$\rightarrow \sum F_x = 0$

$\text{AD} * \frac{8}{\sqrt{73}} + 249.6 * \frac{4}{5} = 0$

AD = -213.76 kN = 213.76 kN (Ten.)