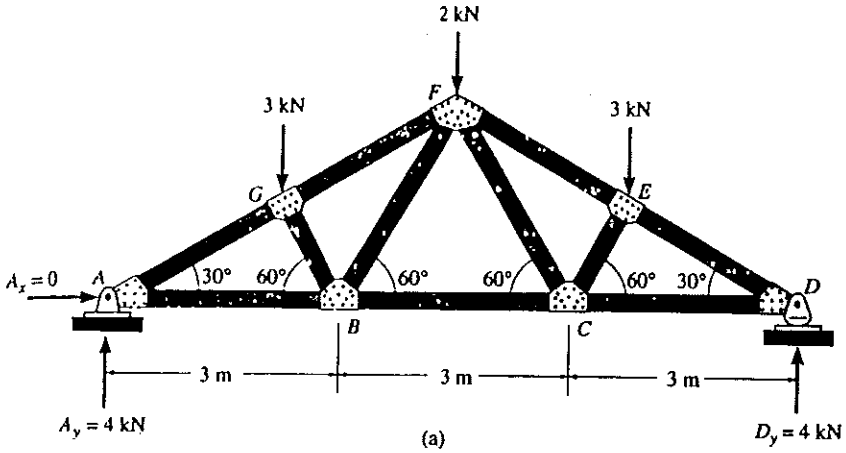
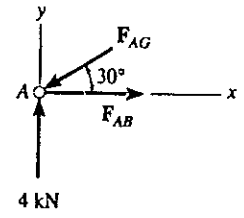
Example 3–2

Determine the force in each member of the roof truss shown in Fig. 3–20*a*. State whether the members are in tension or compression. The reactions at the supports are given.



(a)



(b)

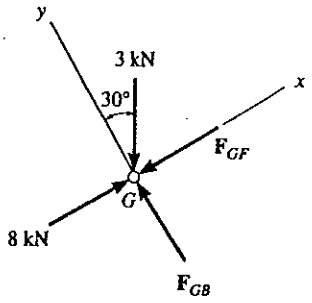
Solution

Only the forces in half the members have to be determined, since the truss is symmetric with respect to *both* loading and geometry.

Joint A, Fig. 3–20b. We can start the analysis at joint A. Why? The free-body diagram is shown in Fig. 3–20*b*.

$+\uparrow \Sigma F_y = 0;\quad 4 - F_{AG} \sin 30° = 0 \qquad F_{AG} = 8 \text{ kN (C)}$ **Ans.**

$\pm \Sigma F_x = 0;\quad F_{AB} - 8 \cos 30° = 0 \qquad F_{AB} = 6.93 \text{ kN (T)}$ **Ans.**

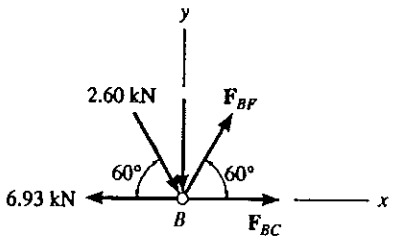


(c)

Joint G, Fig. 3–20c. In this case note how the orientation of the *x*, *y* axes avoids simultaneous solution of equations.

$+\nwarrow \Sigma F_y = 0;\quad F_{GB} - 3 \cos 30° = 0 \qquad F_{GB} = 2.60 \text{ kN (C)}$ **Ans.**

$+\nearrow \Sigma F_x = 0;\quad 8 - 3 \sin 30° - F_{GF} = 0 \qquad F_{GF} = 6.50 \text{ kN (C)}$ **Ans.**



(d)

Joint B, Fig. 3–20d

$+\uparrow \Sigma F_y = 0;\quad F_{BF} \sin 60° - 2.60 \sin 60° = 0$

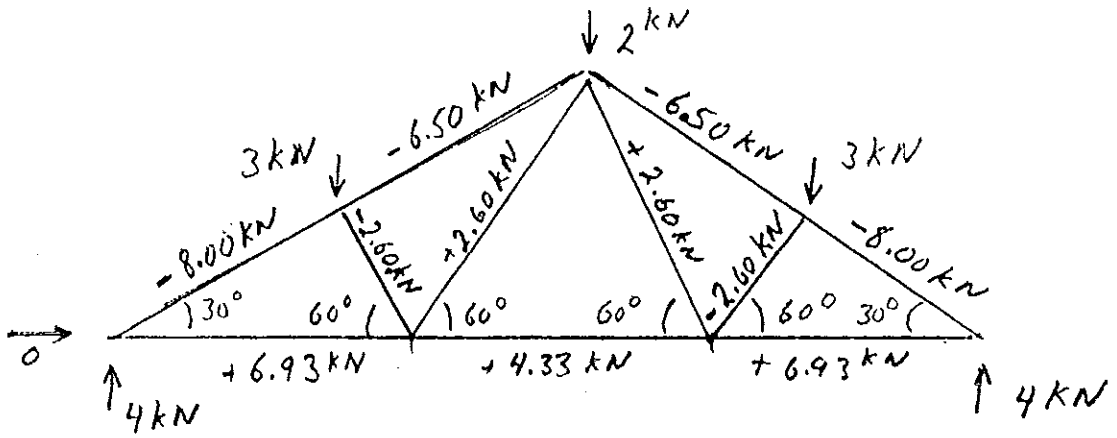
$F_{BF} = 2.60 \text{ kN (T)}$ **Ans.**

$\pm \Sigma F_x = 0;\quad F_{BC} + 2.60 \cos 60° + 2.60 \cos 60° - 6.93 = 0$

$F_{BC} = 4.33 \text{ kN (T)}$ **Ans.**

Fig. 3–20

Results are same but signs are different.



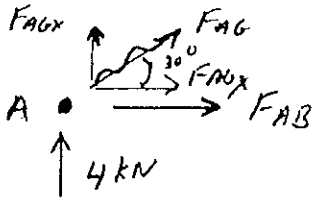
Results are symmetric.
(Structure & Loads are symmetric)

Example 3-2 (From Text book) (pg 96)

(show problem from overhead of page 2.15)

Solution by approach 1 - Assuming unknowns in tension.

Joint A



① $+\uparrow \Sigma F_y = 0$ $\quad 4 + F_{AGy} = 0$

$F_{AGy} = -4\ kN$

$F_{AGy} = F_{AG} \sin 30°$

$F_{AG} = -8\ kN$ (compr.)

② $\overset{+}{\rightarrow} \Sigma F_x = 0$

$F_{AB} + F_{AGx} = 0$

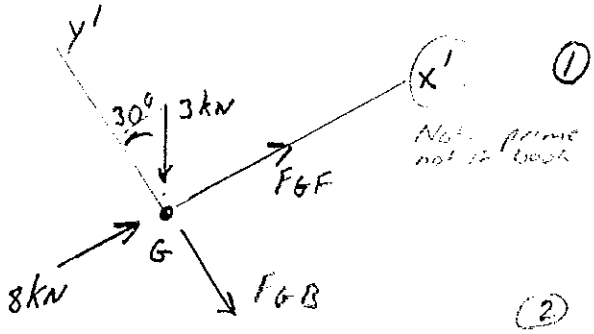
$F_{AB} - 6.93 = 0$

$F_{AB} = 6.93\ kN$ (tension)

$F_{AGx} = F_{AG} \cos 30°$

$F_{AGx} = -6.93 kN$

Joint G



① $+\uparrow \Sigma F_{y'} = 0$

$-F_{GB} - 3 \cos 30° = 0$

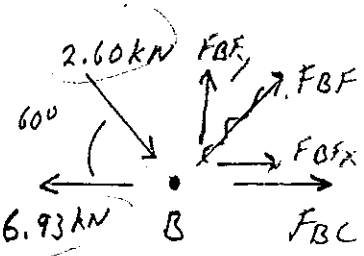
$F_{GB} = -2.60\ kN$ (compr.)

② $+\nearrow \Sigma F_{x'} = 0$

$8 - 3 \sin 30° + F_{GF} = 0$

$F_{GF} = -6.50\ kN$ (compr.)

Joint B



① $+\uparrow \Sigma F_y = 0$

$-2.60 \sin 60° + F_{BF_y} = 0$

$F_{BF_y} = 2.25\ kN$

$F_{BF_y} = F_{BF} \cos 60°$

$F_{BF} = 2.60\ kN$ (tens.)

$F_{BF_x} = F_{BF} \sin 60° = 1.30\ kN$

② $\overset{+}{\rightarrow} \Sigma F_x = 0$

$-6.93 + 2.60 \cos 60° + F_{BF_x} + F_{BC} = 0$

$F_{BC} = 4.33\ kN$ (tens.)