

#16

Examples Trusses

Method of Joints & Zero-Force Members

Example 1:

Given:

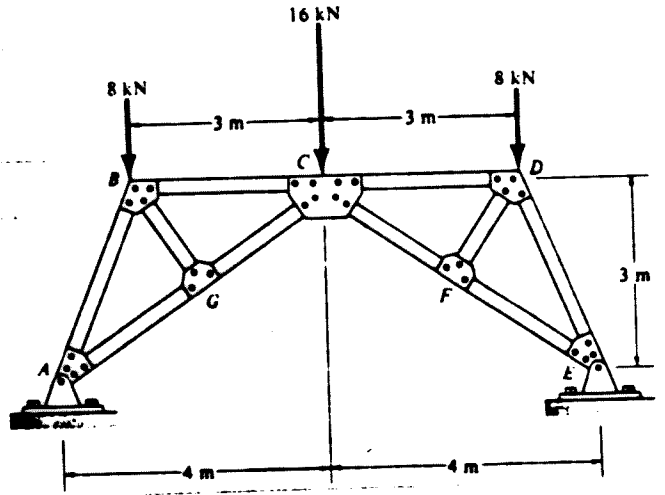
The truss shown

Req.d.:

The forces in all members.

Soln.:

Note that there are 4 reactions and only 3 equations \Rightarrow They can not be found all. (They may not be needed!)



From symmetry, $F_{AB} = F_{DE}$; $F_{AG} = F_{FE}$; $F_{BC} = F_{CD}$; $F_{BG} = F_{DF}$; $F_{CG} = F_{CF}$

Note that BG and DF are zero-force members \Rightarrow

FBD of joint B:

$$\uparrow \sum F_y = 0 \Rightarrow -8 - F_{BA} \left(\frac{3}{\sqrt{10}}\right) = 0$$

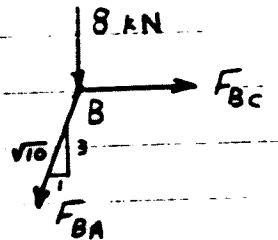
$$\Rightarrow F_{BA} = -8.43 \text{ kN} \Rightarrow$$

$$F_{BA} = F_{DF} = 8.43 \text{ kN (C)}$$

$$\rightarrow \sum F_x = 0 \Rightarrow F_{BC} \oplus 8.43 \left(\frac{1}{\sqrt{10}}\right)$$

$$\Rightarrow F_{BC} = -2.67 \text{ kN} \Rightarrow$$

$$F_{BC} = F_{CD} = 2.67 \text{ kN (C)}$$



Note that once we know

the direction of the force (T or C), then we

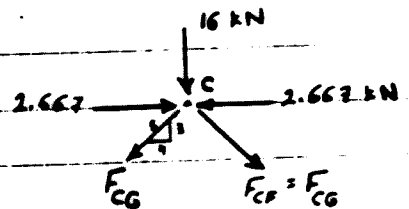
can not assume it (i.e., we have to show it in the correct direction.)

FBD of joint C:

$$\uparrow \sum F_y = 0 \Rightarrow -16 - 2 F_{CG} \left(\frac{3}{5}\right) = 0$$

$$\Rightarrow F_{CG} = F_{CF} = -13.3 \text{ kN} \Rightarrow$$

$$F_{CG} = F_{CF} = 13.3 \text{ kN (C)}$$



FBD of joint G

Note that for joint G, the member

BG is a zero-force member. Also

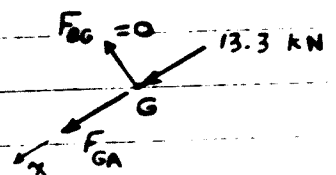
note that it is easier to choose

the x-axis along members GA and GC.

$$\downarrow \sum F_x = 0 \Rightarrow F_{GA} + 13.3 = 0$$

$$\Rightarrow F_{GA} = -13.3 \text{ kN} \Rightarrow$$

$$F_{GA} = F_{FE} = 13.3 \text{ kN (C)}$$



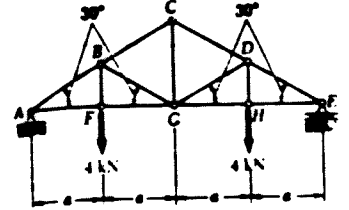
By inspection, GA is under compression. \Rightarrow It can be assumed so.

#16

Example 2:

Given:

The truss shown



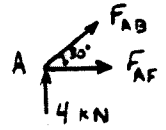
Req'd.:

The forces in all members by the method of joints.

Soln.:

Symmetry will be taken advantage of.

Reactions: $A_x = 0$; $A_y = E_y = \frac{\sum F_y}{2} = 4 \text{ kN}$



Joint A FBD

$\uparrow \sum F_y = 0 \Rightarrow 4 + F_{AB} \sin 30^\circ = 0 \Rightarrow$

$F_{AB} = F_{ED} = 8 \text{ kN (C)}$

$\Rightarrow \sum F_x = 0 \Rightarrow$

$F_{AF} + (-8 \cos 30^\circ) = 0 \Rightarrow$

$F_{AF} = F_{EH} = 6.93 \text{ kN (T)}$

Joint F FBD

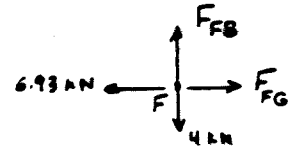
$\Rightarrow \sum F_x = 0 \Rightarrow F_{FG} - 6.93 = 0 \Rightarrow$

$F_{FG} = F_{GH} = 6.93 \text{ kN (T)}$

$\uparrow \sum F_y = 0 \Rightarrow$

$F_{FB} - 4 = 0 \Rightarrow$

$F_{FB} = F_{HD} = 4 \text{ kN (T)}$



Joint B FBD

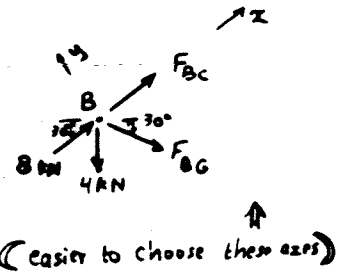
$\uparrow \sum F_y = 0 = -4 \cos 30^\circ - F_{BG} \cos 30^\circ \Rightarrow$

$F_{BG} = F_{CG} = 4 \text{ kN (C)}$

$\Rightarrow \sum F_x = 0 \Rightarrow$

$8 + F_{BC} - 4 \cos 60^\circ - 4 \cos 60^\circ = 0 \Rightarrow$

$F_{BC} = F_{DC} = 4 \text{ kN (C)}$



Joint C FBD

$\uparrow \sum F_y = 0 = 2(4 \sin 30^\circ) - F_{CG} \Rightarrow$

$F_{CG} = 4 \text{ kN (T)}$

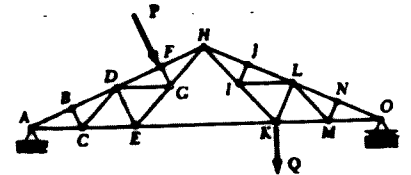


Are the answers "reasonable" ?!

Example 3:

Given:

The truss shown



Req'd.:

All zero-force members

Soln.:

Using the logic discussed in class, the zero-force members are (in order):

BC \Rightarrow CD ; NM \Rightarrow ML ; JL \Rightarrow IL \Rightarrow LK