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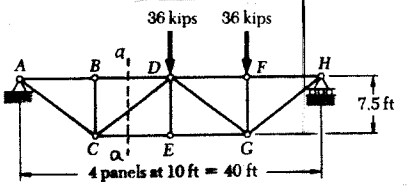
Examples
Trusses
Method of Sections

Example 1:



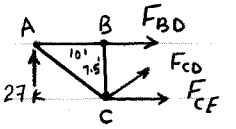
Given:

The truss shown

Req'd.:

The forces in bars BD and CD

Soln.:



Reactions: $\Sigma F_x = 0 \Rightarrow A_x = 0$

$\Sigma M_H = 0 \Rightarrow A_y = 27\ k$

Consider section aa and draw the left FBD.

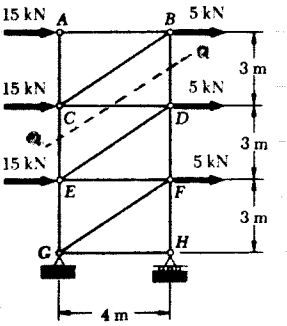
$\circlearrowleft + \Sigma M_C = 0 \Rightarrow -27(10) - 7.5\,F_{BD} = 0 \Rightarrow$ $\boxed{F_{BD} = 36\ k\ (C)}$

$+\uparrow \Sigma F_y = 0 \Rightarrow$

$27 + F_{CD}\left(7.5/\sqrt{156.25}\right) = 0 \Rightarrow$ $\boxed{F_{CD} = 45\ k\ (C)}$

⇐⇑ Answers seem ok?!

Example 2:



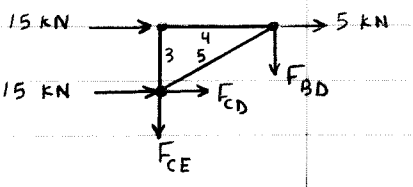
Given:

The truss shown

Req'd.:

The forces in members CD, BD, and CE

Soln.:



Consider section aa. ⇒ Draw top FBD and note that reactions are not needed.

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

$15 + 15 + 5 + F_{CD} = 0 \Rightarrow F_{CD} = -35\ kN \Rightarrow$ $\boxed{F_{CD} = 35\ kN\ (C)}$

$\circlearrowleft + \Sigma M_C = 0 \Rightarrow$

$-15(3) - 5(3) - 4\,F_{BD} = 0 \Rightarrow$ $\boxed{F_{BD} = 15\ kN\ (C)}$

$+\uparrow \Sigma F_y = 0 \Rightarrow$

$-F_{CE} - (-15) = 0 \Rightarrow -F_{CE} + 15 = 0 \Rightarrow$ $\boxed{F_{CE} = 15\ kN\ (T)}$

⇑

* must be careful about direction
* must indicate T or C for each member
* Start with the "easy" equation (ΣF_x, ΣF_y, or $\Sigma M = 0$)

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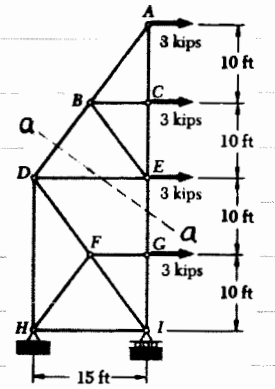
Example 3 :



Given :

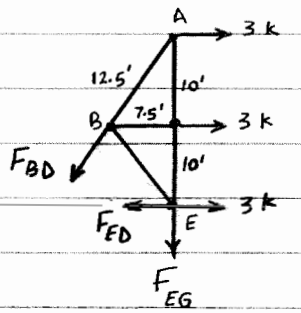
The truss shown

Req.d :

The forces in members BD and DE

Soln. : « Guess the answers ! »

The truss is sectioned along line aa as shown. Since F_{BD} and F_{DE} only are needed, the top FBD is chosen, and the reactions are not calculated.



$+\circlearrowleft \Sigma M_E = 0 \Rightarrow$

$$-3(20) - 3(10) + F_{BD}\left(\frac{7.5}{12.5}\right)10 + F_{BD}\left(\frac{10}{12.5}\right)7.5 = 0$$

$$\Rightarrow \boxed{F_{BD} = 7.5 \text{ k (T)}}$$

$\pm\rightarrow \Sigma F_x = 0 \Rightarrow$

$$3 + 3 + 3 - 7.5\left(\frac{7.5}{12.5}\right) - F_{ED} = 0$$

$$\Rightarrow \boxed{F_{ED} = 4.5 \text{ k (T)}}$$

* Compare the answers with you guessing ! $\Rightarrow$?!

Note :

- The section (cut) you choose should (if possible)
  - * not pass through more than 3 members (3 eqs. & 3 unks.)
  - * pass through most, if not all, of the members which their forces are needed or required.

- The part you choose should be the one which does not include any supports (if possible) so that the (unknown) reactions will not appear in the FBD.

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Example 4 :

Given :

The tower truss shown

Reqd. :

F_{CF} and F_{BG}

Soln. :

Make section aa and draw FBD ①.

To have one eq. and one unknown (F_{CF}),

take $\Sigma M_o = 0$

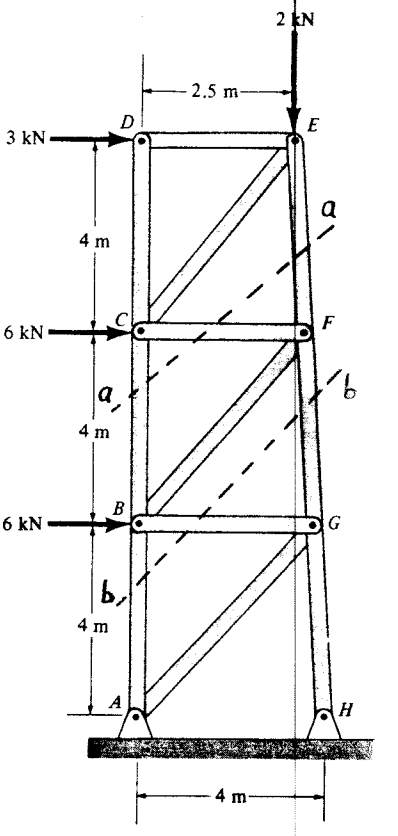
$$\frac{d}{2.5} = \frac{d+12}{4} \Rightarrow d = 20 \text{ m}$$

$$+\circlearrowleft \Sigma M_o = 0 \Rightarrow$$

$$3(20) + 6(24) - 2(2.5) + 24 F_{CF} = 0$$

$$\Rightarrow F_{CF} = -8.29 \text{ kN}$$

$$\Rightarrow \boxed{F_{CF} = 8.29 \text{ kN (C)}}$$



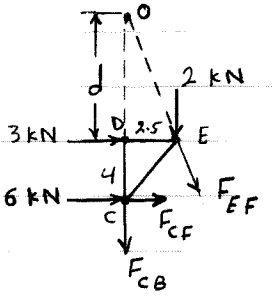
Similarly, make section bb and draw FBD ②.

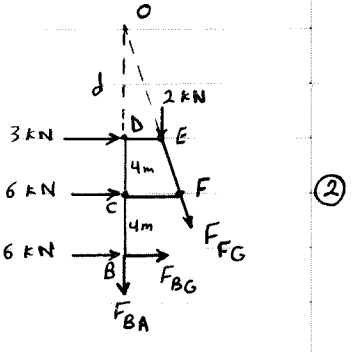
$$+\circlearrowleft \Sigma M_o = 0 \Rightarrow$$

$$3(20) + 6(24) + 6(28) - 2(2.5) + 28 F_{BG} = 0$$

$$\Rightarrow F_{BG} = -13.1 \text{ kN}$$

$$\Rightarrow \boxed{F_{BG} = 13.1 \text{ kN (C)}}$$





Note that in this problem, no need to determine the reactions.

Also note that we had to make two sections. We could not make one section only. (Why ?!)

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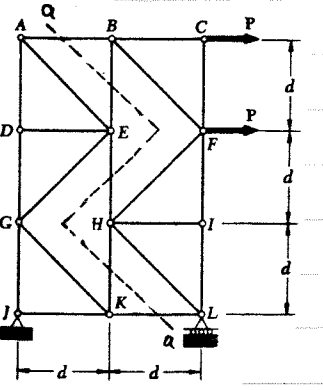
Example 5 :

Given :

The K truss shown

Req.d. :

F_{AB} and F_{KL}



Soln. :

First, the reactions are calculated by considering the FBD of the entire truss as shown in ①.

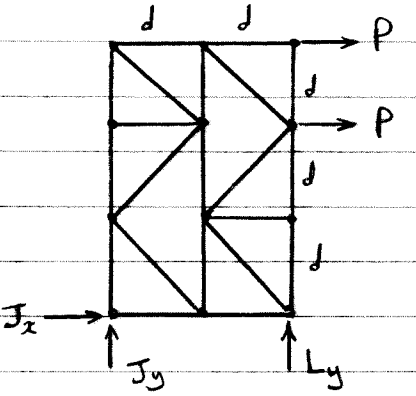
$\overset{+}{\rightarrow} \Sigma F_x = 0 \Rightarrow \quad J_x + P + P = 0$

$\Rightarrow J_x = -2P = 2P \ (\leftarrow)$

$\overset{+}{\circlearrowleft} \Sigma M_L = 0 \Rightarrow$

$-2dP - 3dP - 2d\,J_y = 0$

$\Rightarrow J_y = -\frac{5}{2}P = \frac{5}{2}P \ (\downarrow)$



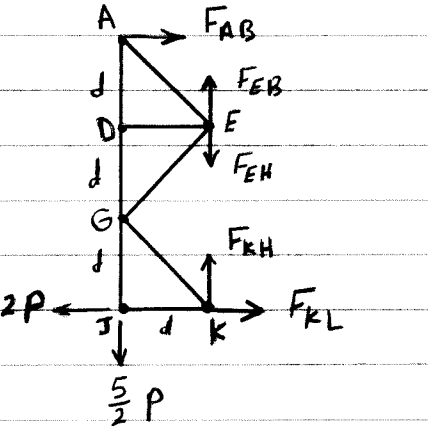
①

Note that L_y is not needed because the FBD to the left of section aa is considered.

This truss is called K truss because its members form letter K.

The section taken in this type of trusses is usually as shown ($\lessgtr$ or $\gtrless$) : section aa.

This will make it possible to solve for some of the force members in the "easiest" way.



②

Try another section (e.g. one straight line only). What can you conclude ?!

In FBD ②, $\overset{+}{\circlearrowleft} \Sigma M_K = 0 = \frac{5}{2}Pd - 3d\,F_{AB} \Rightarrow$ $\boxed{F_{AB} = \frac{5}{6}P \ (T)}$

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

$\frac{5}{6}P + F_{KL} - 2P = 0 \quad \Rightarrow$ $\boxed{F_{KL} = \frac{7}{6}P \ (T)}$