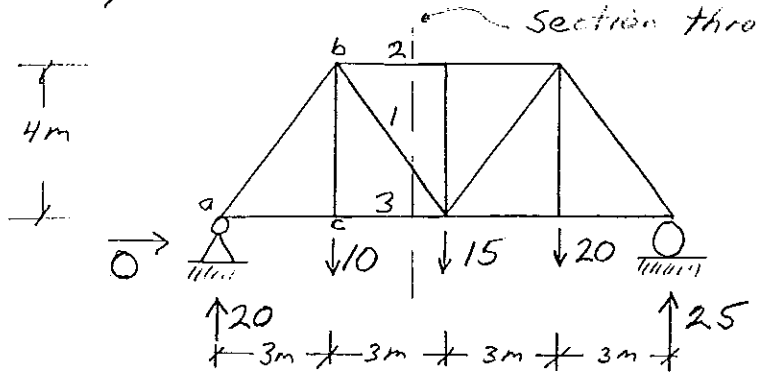
2.5 Method of Sections

- Divide Truss into free bodies by cutting a section through bars of interest.
- Method is usually used to determine forces in a few specified bars.
- Where bars are cut, each internal bar force is shown acting on the free body (see below).
- Usually try to cut three (or less) bars because there are only three equations of equilibrium.
- The usual sign convention is to show the unknown bar forces acting in tension. If the value of the force turns out negative, the force is compressive

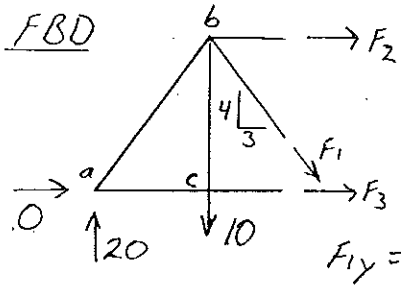
Example



Given: Loads & Reactions

Find: Forces in bars 1, 2, & 3

FBD



$+\uparrow \Sigma F_y = 0 \quad 20 - 10 - F_{1y} = 0$

$20 - 10 - \frac{4}{5} F_1 = 0$ (1)

$\circlearrowleft + \Sigma M_b = 0$

$-3 \cdot 20 + 4 \cdot 0 + 4 F_3 = 0$ (2)

$F_{1y} = \frac{4}{5} F_1$

$F_{1x} = \frac{3}{5} F_1$

$\pm \rightarrow \Sigma F_x = 0 \quad 0 + F_{1x} + F_2 + F_3 = 0$ (3)

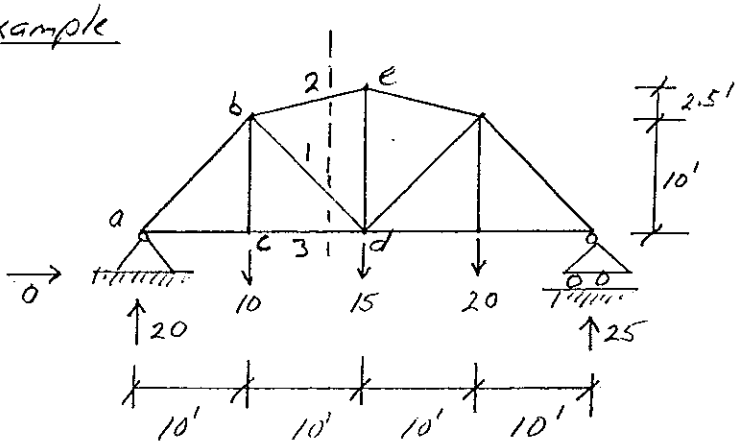
Equation (1) provides F_1

Equation (2) provides F_3

Equation (3) provides F_2 (after finding F_1 & F_3)

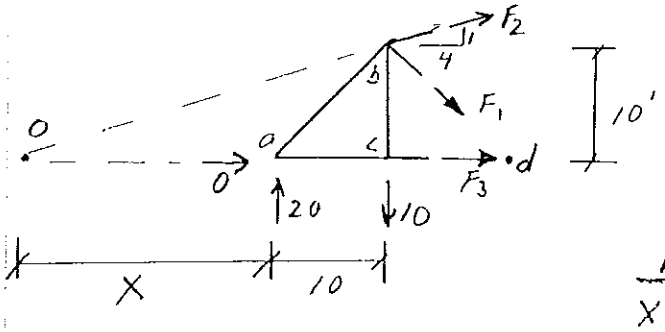
- Method of Sections involves cutting the truss in the right location to determine the needed bar forces, and choosing the correct equilibrium equations to write and solve.

Example



Given: Loads & Reactions

Find: forces in bars 1, 2, & 3



To Find F_1 use $\Sigma M_o = 0$

To Find F_3 use $\Sigma M_b = 0$

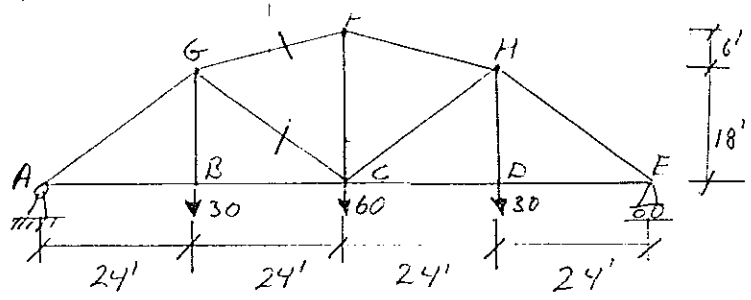
To Find F_2 use $\Sigma M_d = 0$

$$\frac{10}{X+10} = \frac{1}{4} \qquad X = 30$$

- Some problems may require the use of both Method of Sections & Method of Joints.

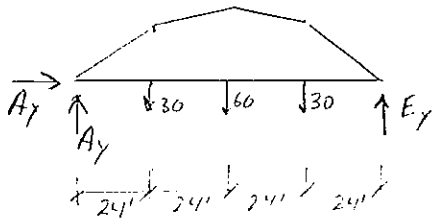
- Method of Sections Study Examples 3-5, 3-6, 3-7

Example



Determine forces in bars GF & GC

1. Reactions



$\rightarrow \Sigma F_x = 0$ $\quad A_x = 0$

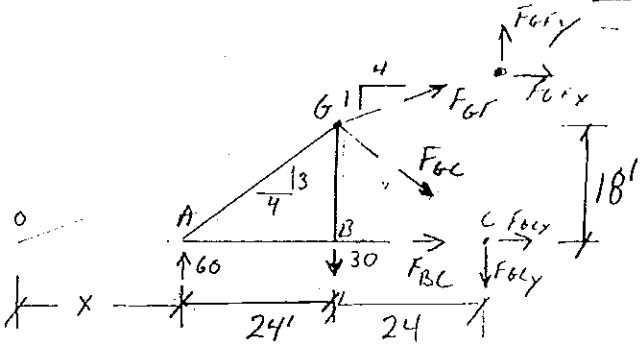
$\circlearrowleft \Sigma M_A = 0$ $\quad 96' E_y - 24'(30)^k - 48'(60)^k - 72'(30)^k = 0$

$E_y = 60^k$

$\Sigma F_y = 0$ $\quad E_y + A_y - 30^k - 60^k - 30^k = 0$

$A_y = 60^k$

2. Cut Section



$\frac{18}{X+24} = \frac{1}{4}$

$X = 48'$

F_{GC}

$\circlearrowleft + \Sigma M_0 = 0$ $\quad 48' \cdot 60^k - 72' \cdot 30^k - 96' F_{GCy} = 0$

(Translate F_{GC} to pt. C)

$F_{GCy} = 7.5^k$

$F_{GC} = \frac{5}{3} F_{GCy} = 12.5^k$

$F_{GCx} = \frac{4}{3} F_{GCy} = 10^k$

$\circlearrowleft + \Sigma M_0 = 0$ $\quad 48' \cdot 60^k - 72' \cdot 30^k - 72' F_{GCy} - 18' F_{GCy} = 0$

(Translate F_{GC} to pt. G)

$48' \cdot 60^k - 72' \cdot 30^k - 72 (3/5 F_{GC}) - 18 (4/5 F_{GC}) = 0$

$F_{GC} = 12.5^k$

F_{GF}

7.5

$\Sigma F_y = 0$ $\quad 60 - 30 - F_{GCy} + F_{GFy} = 0$

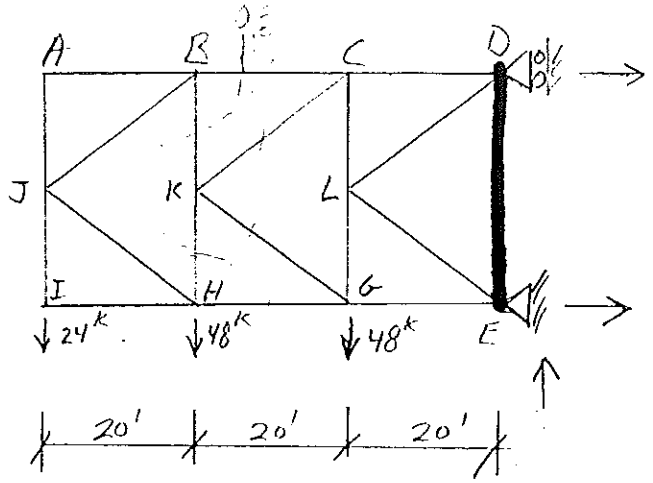
$F_{GFy} = 22.5$

$F_{GF} = \frac{\sqrt{17}}{1} \cdot F_{GFy} = 92.8$

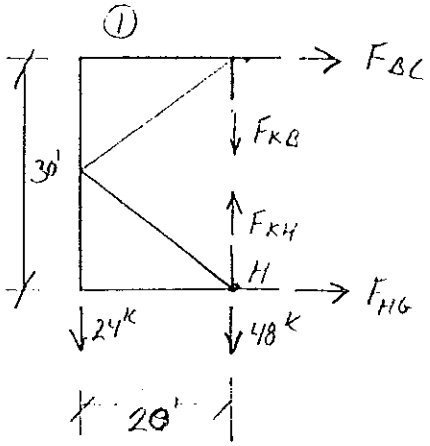
OR

$\circlearrowleft + \Sigma M_C$

Example



F_{BC}
F_{KC}
F_{KG}
F_{HG}



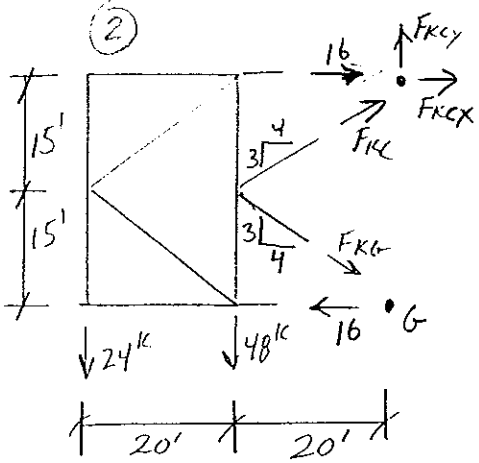
4 unknowns !

$\circlearrowleft + \sum M_H = 0 \quad -20'(24)^k - 30' F_{BC} = 0$

$F_{BC} = 16^k$

$\sum F_x = 0 \quad F_{HG} + F_{BC} = 0$

$F_{HG} = -16^k$



$\circlearrowleft + \sum M_G = 0 \quad 40'(24)^k + 20'(48)^k - 30'(16)^k - 30'(F_{KCx}) = 0$

$F_{KCx} = 48^k$

$F_{KCy} = \frac{3}{4} F_{KCx} = 36^k$

$F_{KC} = \frac{5}{4} F_{KCy} = 60^k$

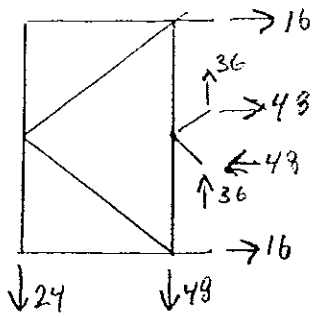
$\sum F_x = 0 \quad 16 - 16 + F_{KCx} + F_{KGx} = 0$

$F_{KGx} = -F_{KCx}$

$= -48^k$

$F_{KGy} = -36^k$

$F_{KG} = -60^k$



$\sum F_y = 0$? ✓