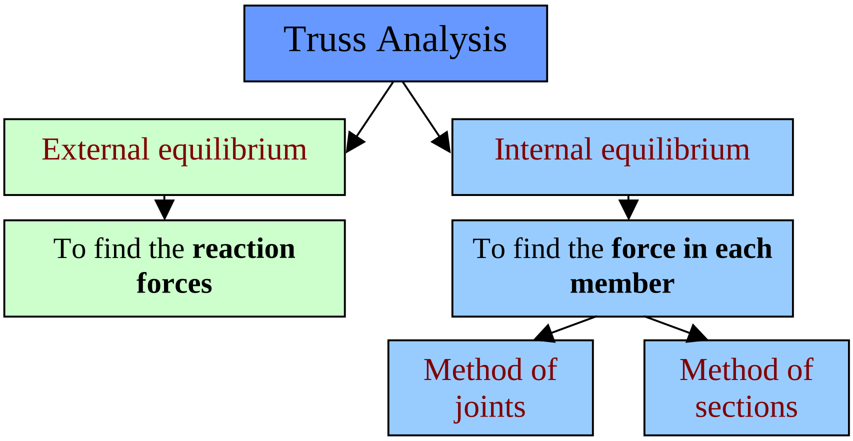
Simple trusses: Part 3

Analysis of trusses (Internal equilibrium):

There are two types of analysis:

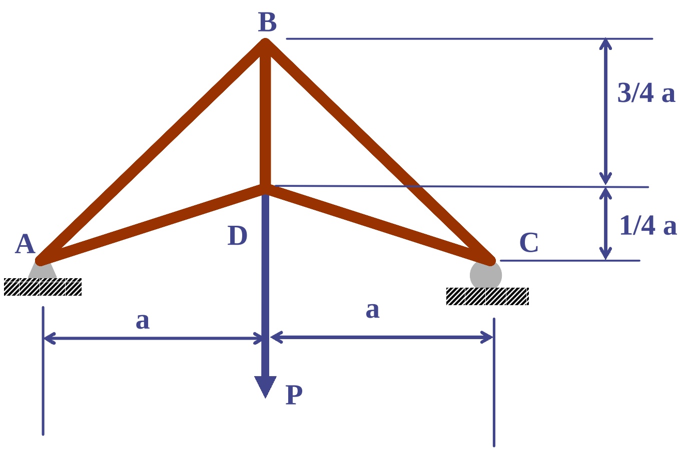


Internal equilibrium (Method of joints):

1. Draw FBD of entire truss and solve for support reactions.
2. Draw FBD of a joint with at least one known force and at most two unknown forces.
3. Either assume all unknown member forces are tensile. Positive results indicate tension and negative results indicate compression.
4. Otherwise determine the correct sense for unknowns by inspection. Positive results indicate correct assumption and negative results indicate incorrect assumption.
5. Continue selecting joints where there are at least one known force and at most two unknown forces.
6. Tension pulls on a member, compression pushes on (compresses) a member.
7. Present member forces as positive numbers with (T) or (C) indicating tension or compression.

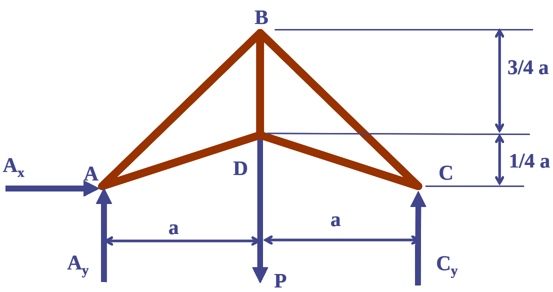
Example:

In the following truss, determine the force P if the maximum tension or compression force in the members CD, AD and DB is 1500 lb and in the members AB and CB is 800 lb. Length *a* is 10 ft.

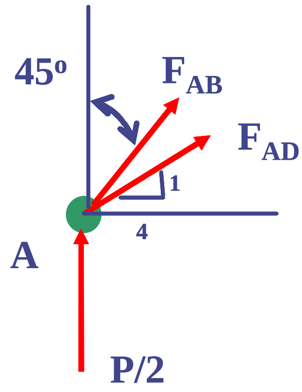


Solution:

The FBD is:



Solving for the support reactions:



$$\boxed{\begin{array}{c}\sum F_x = 0 \Rightarrow A_x = 0 \\ \sum F_y = 0 \Rightarrow A_y + C_y - P = 0 \\ \sum M_A = 0 \Rightarrow -Pa + C_y(2a) = 0 \\ C_y = \frac{P}{2} \qquad A_y = \frac{P}{2}\end{array}}$$

$$\sum F_x = 0$$

$$\frac{4}{\sqrt{17}} F_{AD} + \frac{1}{\sqrt{2}} F_{AB} = 0$$

$$\sum F_y = 0$$

$$\frac{P}{2} + \frac{1}{\sqrt{17}} F_{AD} + \frac{1}{\sqrt{2}} F_{AB} = 0$$

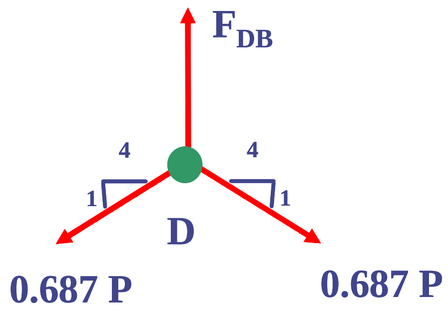
$$F_{AD} = 0.687\ P \quad (T)$$

$$F_{AB} = 0.943\ P \quad (C)$$

By symmetry:

$$F_{CD} = 0.943\ P \quad (T)$$

$$F_{CB} = 0.943\ P \quad (C)$$



$$\sum F_y = 0$$

$$F_{DB} - \frac{1}{\sqrt{17}}(0.687\ P) - \frac{1}{\sqrt{17}}(0.687\ P) = 0$$

$$F_{DB} = 1.33\ P \quad (T)$$

So the members which are in tension are:

CD	(T)
AD	(T)
DB	(T)

And those in compression are:

CB	(C)
AB	(C)

$F_{AD} = 0.687\ P\ (T)$

$F_{AB} = 0.943\ P\ (C)$

Assume:

$F_{AD} = 1500\ \text{lb}$

$P = 2183.4\ \text{lb}$

Then: $F_{AB} = 2059\ \text{lb}$

So assume: $F_{AB} = 800\ \text{lb}$

$P = 848.4\ \text{lb}$

Then: $F_{AD} = 583\ \text{lb}$ ok

$F_{DB} = 1.33\ P\ (T)$

$F_{DB} = 1131.4\ \text{lb}$ ok

$P_{max} = 848.4\ \text{lb}$