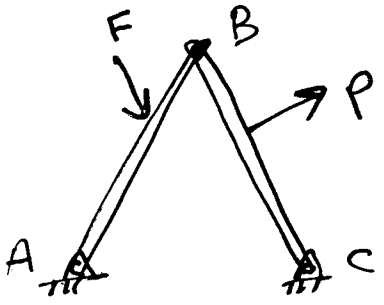
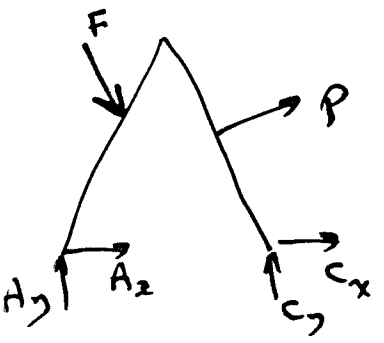
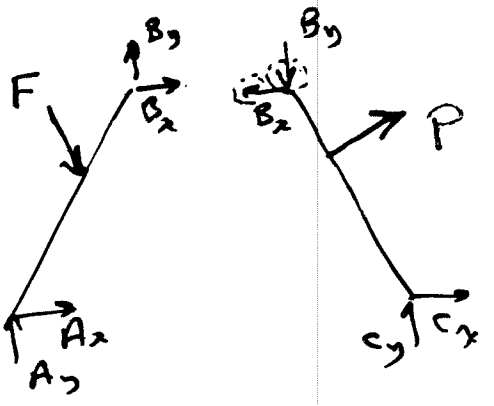
Structural Analysis





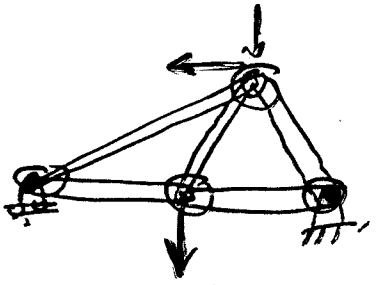


You may need to <u>dismember</u> ≡ <u>disassemble</u> ≡ <u>separate</u> or <u>take the members apart</u> in the structure.

By doing so, you can then analyze (ie., find the reactions, the <u>internal</u> forces, ...etc.) the structure.

* If a system/structure is in equilibrium, then any part of it must be in equilibrium.

Truss



① Straight members
② Connected at their extremities (ends) at joints.
③ Loads applied at joints only
④ Weights are neglected or assumed to be applied to the joints ($\frac{1}{2}w$ /joint).
⑤ Joints are smooth pins (thus no moment).

[{ thus no member is continuous through a joint }]

From the assumptions above, it can be concluded that all truss members are TWO-FORCE members which under tension (T) { T → ← T } or compression (C).

* Simple Truss

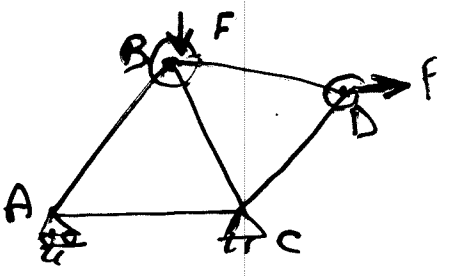
$m = 2n - 3$

m = # of members
n = # of joints

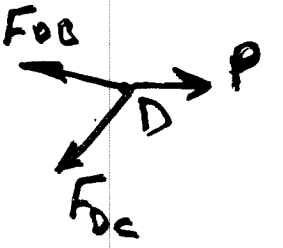
.... etc.

Truss Analysis by the Method of Joints:

To <u>design</u> a truss, the <u>internal</u> forces in all members are needed.

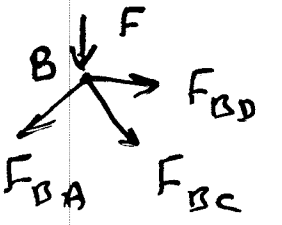


One way to find these forces is to write the equilibrium equations for each joint (particle).



$$\Sigma F_x = 0 \quad (1)$$

$$\Sigma F_y = 0 \quad (2)$$



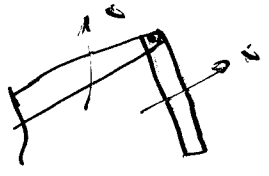
2-D Particle $\Rightarrow$

2 eq. $\Rightarrow$ max 2 unknowns

The reactions may or may NOT be needed!

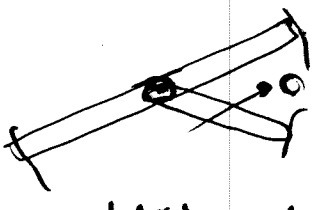
* Zero-Force Members

In some members, it may be possible to know that the member carries no force by inspection. These are called zero-force members.



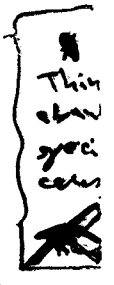
* two members
* not on the same line
* no load on the joint

$\Rightarrow$ Both are zero-force members



* three members
* two on the same line
* one inclined
* no load on the joint

$\Rightarrow$ The inclined member is zero-force



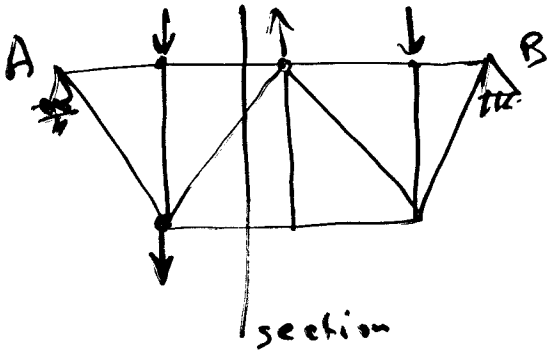
Analysis of Truss by the method of Sections

How? :

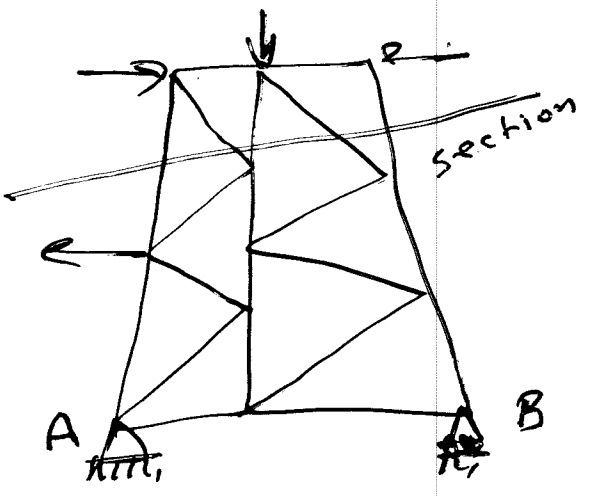
Pass a {section / cut} through the truss which intersects not more than 3 members, if possible; then 3 eq. & 3 unknowns can be solved from one of the two parts of the truss; it is a rigid body. ⇒

$\Sigma F_x = 0$ ①; $\Sigma F_y = 0$ ②; $\Sigma M = 0$ ③

This method is usually used when the force(s) in one or a few members is (are) desired.



Either of the reaction(s) at A & B is/are needed.



If the upper section is chosen, then no need to find the reactions at A and B.

If the lower portion is selected, then the reactions at A & B are needed.