Detereminacy & Stability

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1. Determinacy

I

1. Determinacy

Définition

- The structure is statically determinate when all forces in a structure can be determined strictly from equilibrium equations.
- The structure is statically indeterminate when structures having more unknown forces than available equilibrium equations.
  We have:

$$r = 3n, \text{ statically determinate}$$
$$r > 3n, \text{ statically indeterminate}$$

Where:

r: is the number of force and moment reaction components

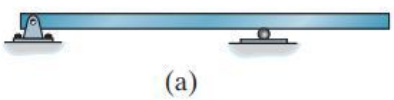
n: is the number of parts

The additional number of equations required for the solution refers to the degree of indeterminacy.

For truss, we have:

$$b + r = 2j \quad \text{statically determinate}$$
$$b + r > 2j \quad \text{statically indeterminate}$$

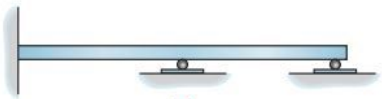
Exemple



(a)

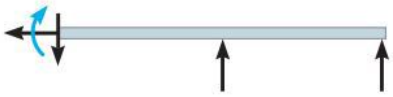
$r = 3, n = 1, 3 = 3(1)$

Statically determinate

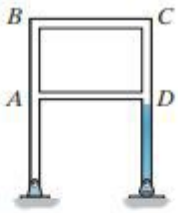


(b)

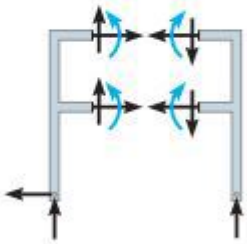
$r = 5, n = 1, 5 > 3(1)$



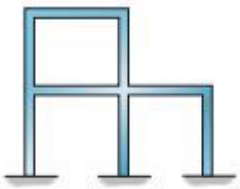
Statically indeterminate to the second degree

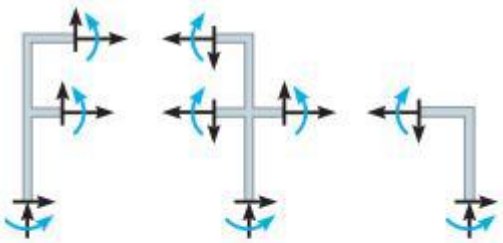


(a)

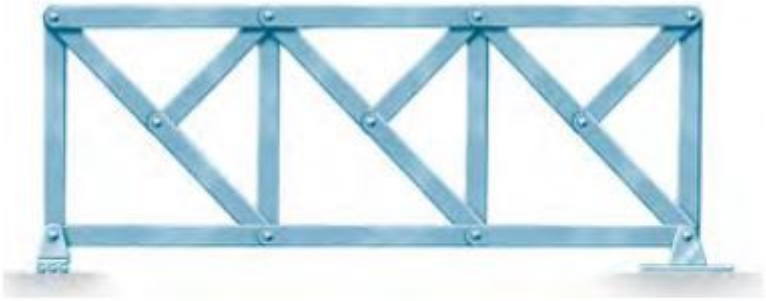


$r = 9, n = 2, 9 > 6,$
Statically indeterminate to the third degree

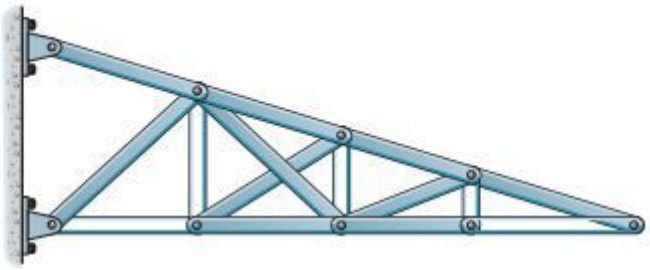




$r = 18, n = 3, 18 > 9,$
Statically indeterminate to the ninth degree



Since $b = 19$, $r = 3$, $j = 11$, then $b + r = 2j$ or $22 = 22$. Therefore, the truss is *statically determinate*.



Since $b = 15$, $r = 4$, $j = 9$, then $b + r > 2j$ or $19 > 18$. The truss is *statically indeterminate* to the first degree.

2. Stability

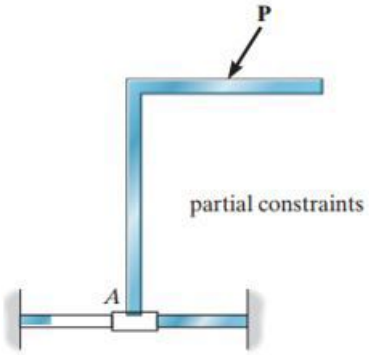
II

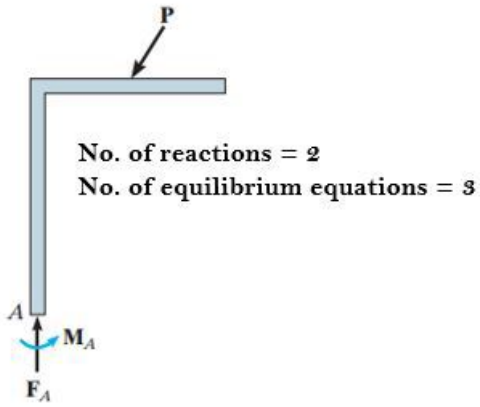
1. Stability

Définition : a) Partial constraints

A structure or one of its members may have fewer reactive forces than equations of equilibrium thar must be satisfied.

Exemple





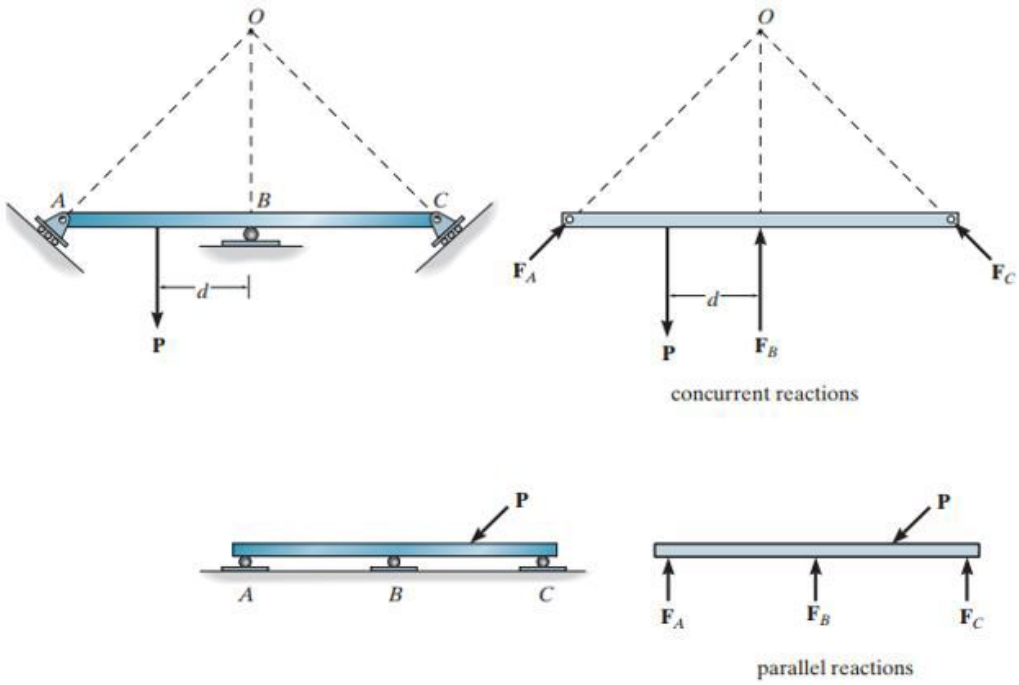
Définition : b) Improper constraints

Improper constraining by the supports causing instability although there may be as many unknown forces as there are equations of equilibrium.

This can occur if:

- All the supports reactions are concurrent at a point.
- The reactive forces are all parallel

Cases of Improper constraints



Remarque

If the structure in unstable, it does not matter if it is statically determinate or indeterminate. In all cases such types of structutres must be avoided in practice.