

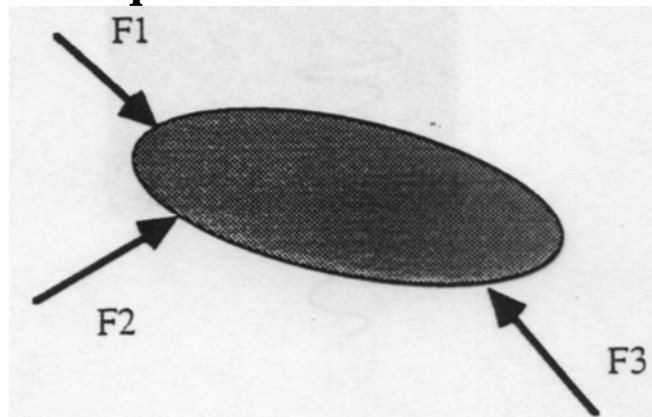
MECHANICS

Mechanics - Science (study) of MOTION of objects
- motion needs ENERGY

STEP 1: Choose axis system (2D)

- Rectangular Co-ordinates (Cartesian)
- Normal & Tangential (N&T) Co-ordinates

STEP 2: Overall Equilibrium

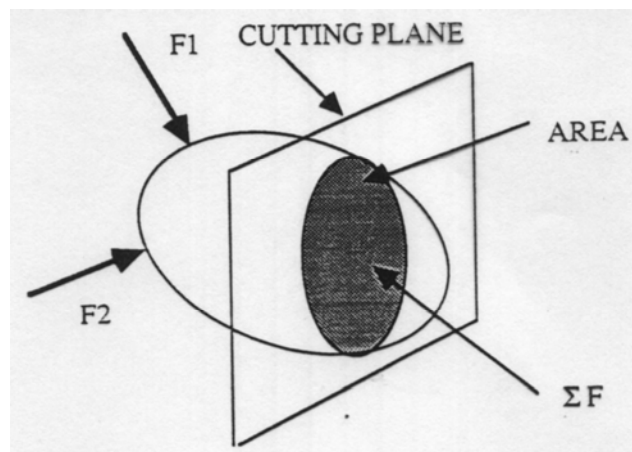


$$\sum F_V = \sum F_H = \sum M = 0 \text{ or } \neq 0$$

Equilibrium Satisfied
STATIC

Equilibrium Not Satisfied
DYNAMIC

STEP 3: Method of Sections / Free Body Analysis



Free Body Equilibrium:

$$\begin{aligned}\sum F_V = \sum F_H = \sum M = 0 & \quad \text{STATIC} \\ \sum F_V = \sum F_H = \sum M \neq 0 & \quad \text{DYNAMIC} \\ & = \text{MASS} \times \text{ACC}^n \\ & - \text{“Equations of Motion”} \\ & - \text{“Degrees of Freedom”}\end{aligned}$$

STEP 4: Determinate or Indeterminate??

Three equations of equilibrium

≤ 3 unknowns - determinate

> 3 unknowns – indeterminate

Statically Determinate

SOLVE

Dynamically Determinate

SOLVE

STEP 5: Indeterminate Systems

Need more Independent equations – *COMPATIBILITY*

For a structure to move in a *Compatible* manner the movement of adjacent parts should be the same.

**Statically Indeterminate
Displacement Compatibility**

$$\begin{aligned}\Delta_1 = \Delta_2 \\ \text{SOLVE}\end{aligned}$$

**Dynamically Indeterminate
Kinematic Compatibility**

$$\begin{aligned}V_1 = V_2 \\ \text{SOLVE}\end{aligned}$$

NOTE: This “Methodology” or “Paradigm” will specify all mechanics problems. Non-linear problems require a further *Linearisation* step and a *Minimum Energy* criterion.

The "Free Bodies" are *FINITE* therefore when combined with *Matrix Methods* and solved on a computer this methodology is known as *FINITE ELEMENT ANALYSIS*