Distributed Forces

Centre of Gravity and Centroids

Faculty of Mechanical Engineering

In this section, you will be able to :

- Determine the coordinates of the Center of Gravity of various bodies.
- Determine the coordinates of the Centroid of various shapes, lines and volumes.
- Determine the generated surface area and volume of line and area respectively by using Pappus-Guldinus Theorem.

Centre of Gravity

- Considering that a body is made of finite elements, , the coordinates of CoG then is ;

$$\bar{X} = \frac{\Sigma\, \bar{x}\, \Delta W}{\Sigma\, \Delta W} \quad \text{and} \quad \bar{Y} = \frac{\Sigma\, \bar{y}\, \Delta W}{\Sigma\, \Delta W}$$

and similar expression for the Z coordinate.

- For non-homogenous or composite body, the elements will be made up of each body ;

$$\bar{x}_1\, \Delta W_1 + \bar{x}_2\, \Delta W_2 + \bar{x}_3\, \Delta W_3 + \ldots$$

Centroid of Area, Line and Volume

- Knowing $\Delta W = \rho g t \Delta A$,where

$$\bar{X} = \frac{\Sigma \bar{x} \Delta A}{\Sigma \Delta A}$$

Similar expression for the Y and Z coordinate.

ρ = density of the plate

g = 9.81 m/s²

t = plate thickness

A = plate area

ΔA = element area

- Knowing $\Delta W = \rho g a \Delta L$,where

$$\bar{X} = \frac{\Sigma \bar{x} \Delta L}{\Sigma \Delta L}$$

Similar expression for the Y and Z coordinate.

ρ = density of the line

g = 9.81 m/s²

a = cross-sectional area

L = length of line

ΔL = length of element

- Knowing $\Delta W = \rho g \Delta V$,where

$$\bar{X} = \frac{\Sigma \bar{x} \Delta V}{\Sigma \Delta V}$$

Similar expression for the Y and Z coordinate.

ρ = density of the body

g = 9.81 m/s²

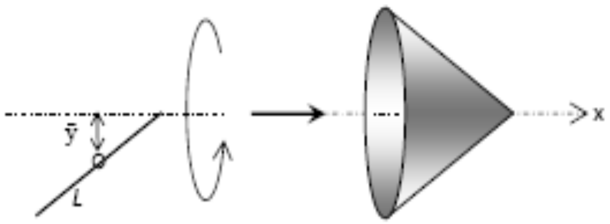
V = overall body volume

ΔV = volume of element

Theorem of Pappus Guildinus

- Theorems is used to determine a generated surface or volume by rotating the line or surface about an axis respectively.

Generated surface



Generated volume