Centroid and centre of gravity.

Centre of gravity - It is the point where entire weight of the system or body is assumed to be concentrated.

Centre of Mass :- It is the point where entire mass of system or body is assumed to be concentrated.

Centroid : These are geometrical centres, defined for 3-D, 2D and 1D objects, where entire volume, area and length are assumed to be concentrated. called

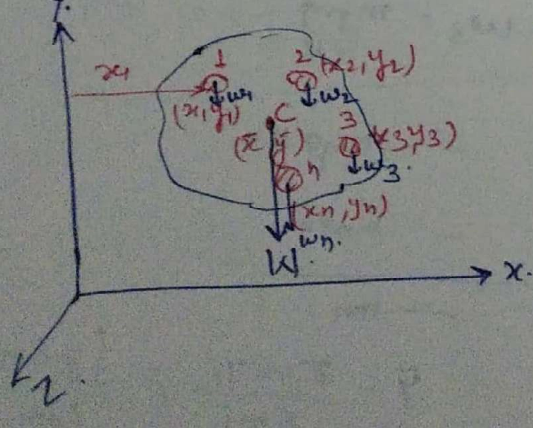
COV [centroid of volume] - for space

COA [" " Area] - For Area

CoL [" " Length] - For Line.

* If the value of gravity is uniform for each part and the solid is of uniform density throughout, then the centroid, centre of gravity are centre of mass are coincident.

centre of gravity of any body or system :-



weight of body W

Mass of body M

Area of body A

Volume " " V

density - ρ.

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$W = w_1 + w_2 + w_3 + \dots w_n$

$M = m_1 + m_2 + m_3 + \dots m_n$

Varignon's theorem:

$$R \times d = F_1 d_1 + F_2 d_2 + \dots F_n d_n.$$

abbly varignon's theorem about Y Axis. for moment of weight

$$W \times \bar{x} = w_1 x_1 + w_2 x_2 + w_3 x_3 + \dots w_n x_n.$$

$$\bar{x} = \frac{w_1 x_1 + w_2 x_2 + \dots w_n x_n}{W}$$

$$= \frac{w_1 x_1 + w_2 x_2 + \dots + w_n x_n}{w_1 + w_2 + \dots + w_n}$$

$$\bar{x} = \frac{\Sigma w_i x_i}{\Sigma w_i} \quad \& \quad \bar{x} = \frac{\int x \cdot dw}{\int dw}$$

Similarly → $\bar{y} = \frac{\Sigma w_i y_i}{\Sigma w_i}$ & $\bar{y} = \frac{\int y\, dw}{\int dw}$.

If the gravitational acceleration (g) will be constant or uniform throughout the body or system. then the C.O.M and C.O.G will be the same.

$W = M \cdot g$

$w_1 = m_1 g, \quad w_2 = m_2 g, \quad w_3 = m_3 \cdot g \dots$

$$M \times g \times \bar{x} = m_1 g x_1 + m_2 g x_2 + \dots m_n g x_n$$

$$\bar{x} = \frac{m_1 x_1 + m_2 x_2 + \dots m_n x_n}{m_1 + m_2 + \dots m_n}$$

$$\bar{x} = \frac{\Sigma m_i x_i}{\Sigma m_i} = \frac{\int x\, dm}{\int dm}, \quad \bar{y} = \frac{\Sigma m_i y_i}{\Sigma m_i} = \frac{\int y\, dm}{\int dm}$$

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all sections are of same material (ρ density).

$m_1 = \rho V_1$, $m_2 = \rho V_2$, $m_3 = \rho V_3$.

total Volume = $V_1 + V_2 + V_3$ — —— V_n.

$$\bar{x} = \frac{\Sigma \rho V . x}{\Sigma \rho V} = \frac{\Sigma V x}{\Sigma V}$$

$$\bar{y} = \frac{\Sigma \rho V . y}{\Sigma \rho V} = \frac{\Sigma V y}{\Sigma V}$$

systems/bodies are of same cross section but different lengths.

$V_1 = a l_1$, $V_2 = a l_2$, - -

$V = a l_1 + a l_2 +$ - - -

$$\bar{x} = \frac{\Sigma a l x}{\Sigma a l} = \frac{\Sigma l x}{\Sigma l}$$

$$\bar{y} = \frac{\Sigma a l . y}{\Sigma a l} = \frac{\Sigma l y}{\Sigma l}$$

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