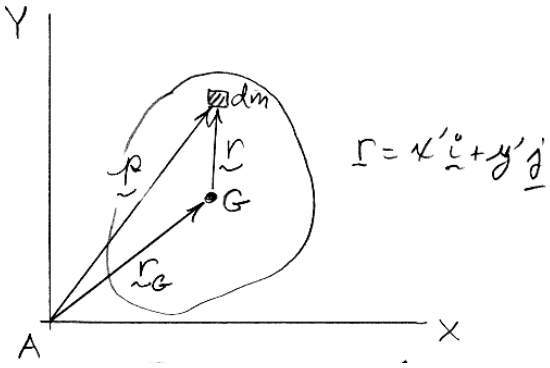
ME 2580 Dynamics
Center of Mass in Two Dimensions

Definition of Mass Center

The figure depicts a rigid body in two dimensions. The mass center of the body is defined as that point where

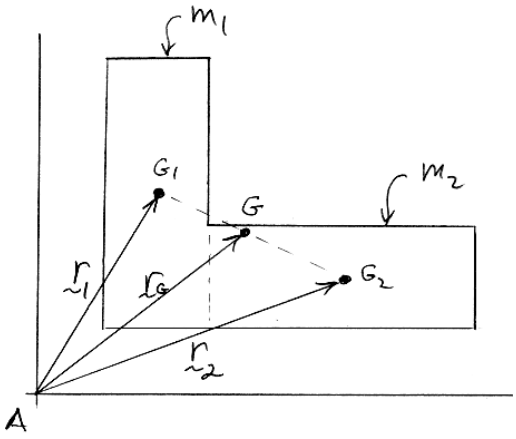
$$\boxed{\int_B \underset{\sim}{r}\, dm = 0} \quad \begin{cases} \int_B x'\, dm = 0 \\ \int_B y'\, dm = 0 \end{cases}$$



A more ***practical definition*** of the location of the mass center of a body may be developed as follows:

$$\int_B \underset{\sim}{\rho}\, dm = \int_B \left(\underset{\sim}{r}_G + \underset{\sim}{r}\right) dm = \left(\int_B dm\right) \underset{\sim}{r}_G + \int_B \underset{\sim}{r}\, dm = M\, \underset{\sim}{r}_G \qquad \text{or} \qquad \boxed{\underset{\sim}{r}_G = \frac{1}{M}\int_B \underset{\sim}{\rho}\, dm}$$

Mass Center – Composite Shapes

For composite shapes, use the ***tables*** to determine the mass center locations of common geometric shapes, then compute the location of the mass center of the composite shape as follows

$$\boxed{\underset{\sim}{r}_G = \frac{\sum_i m_i \underset{\sim}{r}_i}{\sum_i m_i}}$$