PARALLEL AXIS THEOREM AND PURE ROTATIONAL MOTION

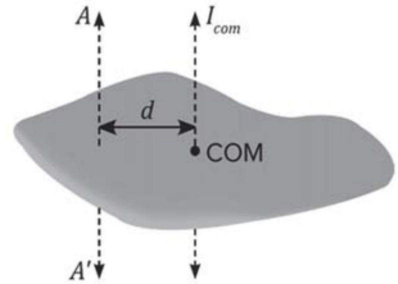
Parallel Axis Theorem:

The moment of inertia of a body about an axis parallel to the centroidal axis, but separated by a perpendicular distance d, is expressed as follows:

$$I_{AA'} = I_{com} + Md^2$$

or

$$(I_{sys})_{AA'} = (I_{sys})_{com} + (I_{cum})_{AA'}$$



Concept of Pure Rotational Motion:

A rigid body in motion, maintaining a fixed axis of rotation relative to the frame of reference, is termed to be undergoing pure rotational motion. The comparison between translational and rotational motion is illustrated by,

$$(\sum \vec{F}_{ext})_{sys} = M_{sys}\vec{a}_{com}$$

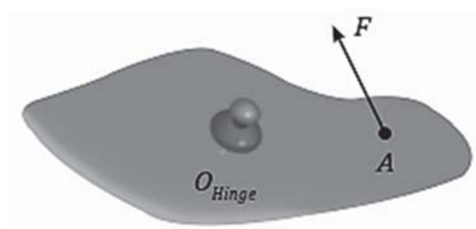
And, $$(\sum \vec{\tau}_{ext})_{axis} = I_{axis}\vec{\alpha}$$

Note:

In the scenario of pure rotational motion, the axis of rotation remains stationary throughout the motion. Both torque and moment of inertia are referenced to this unchanging axis of rotation.

The initiation of rotation occurs when an applied force is exerted, but only if the axis of rotation is fixed at a particular point.

The torque (τ) component responsible for the rotation is non-zero and aligned parallel to the intended axis of rotation.



To establish a stationary axis, it is necessary to hinge the rotation point accordingly. The total external torque around this hinge point is represented by,

$$\vec{\tau}_{Hinge} = I_{Hinge}\vec{\alpha}$$