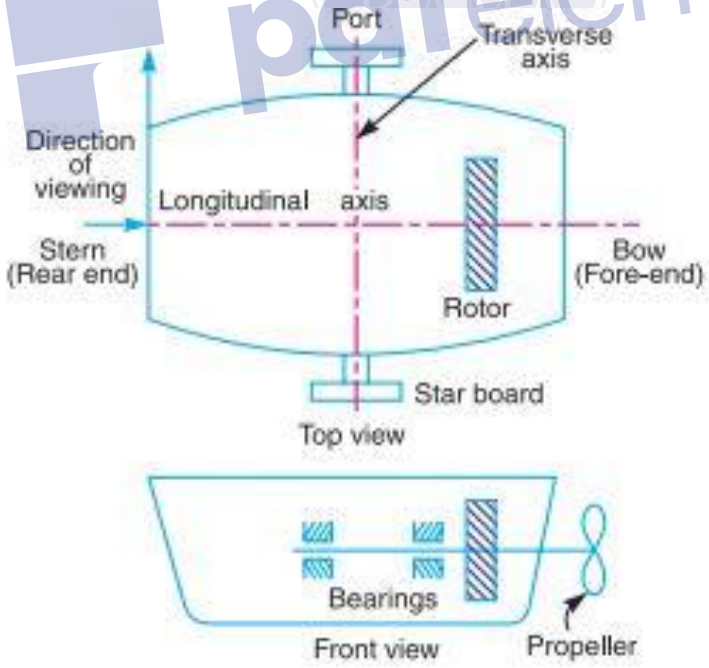
Terms Used in a Naval Ship

The top and front views of a naval ship are shown in Fig. The fore end of the ship is called bow and the rear end is known as stern or aft.The left hand and right hand sides of the ship,
when viewed from the stern are called portand star-board respectively. We shall now discuss the effect of gyroscopic couple on the naval ship in the following three cases:

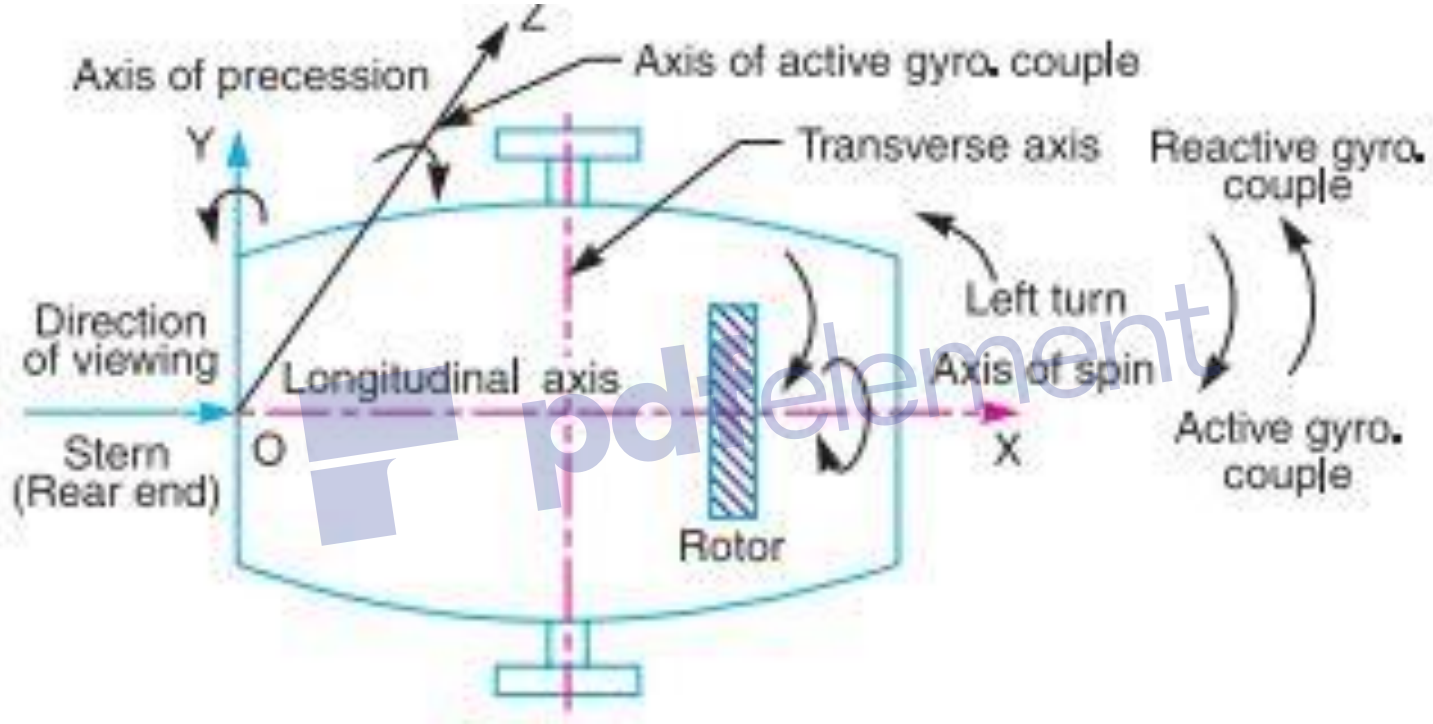
1. Steering,
2. Pitching, and
3. Rolling



Effect of Gyroscopic Couple on a Naval Ship during Steering

Steering is the turning of a complete ship in a curve towards left or right, while it moves forward. Consider the ship taking a left turn, and rotor rotates in the clockwise direction when viewed from the stern, as shown in Fig. The effect of gyroscopic couple on a naval ship during steering taking left or right turn may be obtained in the similar way as for an aeroplane as discussed in Art. Fig.Naval ship taking a left turn.

When the rotor of the ship rotates in the clockwise direction when viewed from the stern, it will have its angular momentum vector in the direction oxas shown in Fig. (a). As the ship steers to the left, the active gyroscopic couple will change the angular momentum vector from ox to ox′. The vector xx′ now represents the active gyroscopic couple and is perpendicular to ox. Thus the plane of active gyroscopic couple is perpendicular to xx′ and its direction in the axis OZfor left hand turn is clockwise as shown in Fig.. The reactive gyroscopic couple of the same magnitude will act in the



Stability of a Four Wheel Drive Moving in a Curved Path

Consider the four wheels A, B, Cand Dof an automobile locomotive taking a turn towards left as shown in Fig. The wheels Aand Care inner wheels, whereas Band Dare outer wheels. The centre of gravity (C.G.) of the vehicle lies vertically above the road surface.

Let m= Mass of the vehicle in kg,

W= Weight of the vehicle in newtons = m.g,

rW= Radius of the wheels in metres,

R= Radius of curvature in metres

(R> rW),

h= Distance of centre of gravity, vertically above the road surface in metres,

x= Width of track in metres,

IW= Mass moment of inertia of one of the wheels in kg-m2,

ωW= Angular velocity of the wheels or velocity of spin in rad/s,

I E= Mass moment of inertia of the rotating

parts of the engine in kg-m2,

ωE= Angular velocity of the rotating parts of the engine in rad/s,

G= Gear ratio = ωE /ωW ,

v= Linear velocity of the vehicle in m/s = ωW .r W