

In presence of waves the *heaving motion* will cause a sharp reduction of the B_M^* , and therefore a considerable decrease of the *planing stability coefficient*.

6. The hydrodynamic lift axis during the turning path.

When a planing craft cover a turning path, besides the gravitational forces and the hydrodynamic forces, it arises a further force, due to the centrifugal acceleration, the centrifugal force F_r , which, in the *so called third phase* of the turning path, defined by a steady radius R , and a steady speed V , is

$$F_r = \Delta \frac{V^2}{Rg}.$$

For balancing this centrifugal force F_r , the craft, as well as any ship or vehicle when turning [7], needs a centripetal force F_y .

In a displacement ship this force is produced by the lateral resistance of the hull; and for this reason, as it is known, the ship advances on the turning path with a drift angle β .

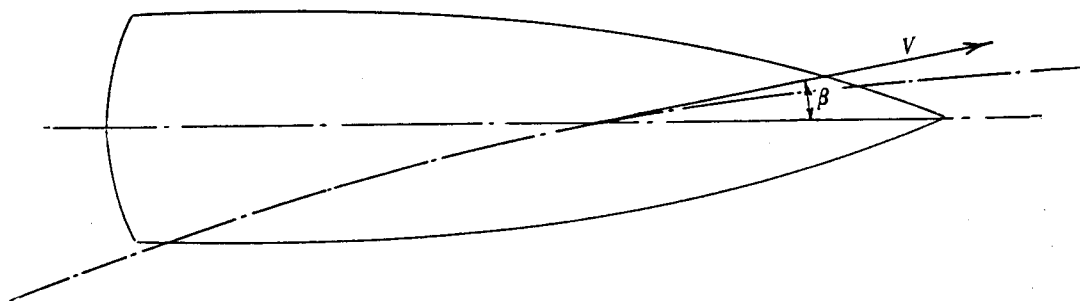


fig. 3

The giration point follows the curve, while the fore part of the hull drifts inwards and the aft part drifts outwards.

If we assume [2], temporarily, that in a planing vessel this point lies, as for the displacement hulls, well forward the midship section, figure 3, the wider part of the hull drifts outwards.

This drifting, while in a displacement ship produces an horizontal force F_Y , in the planing hulls, figure 4, owing to the peculiar shape of the bottom, and the high speeds concerned, produces in the transverse section of the hull, an hydrodynamic force, with an horizontal component $F_r = Y$, and a vertical component Z .

With reference to the athwartship sections of figure 4, in which it is represented the transversal equilibrium of a hight speed deep-vee deadrise craft, while advancing along the steady turn phase of the turning path, the acting forces are:

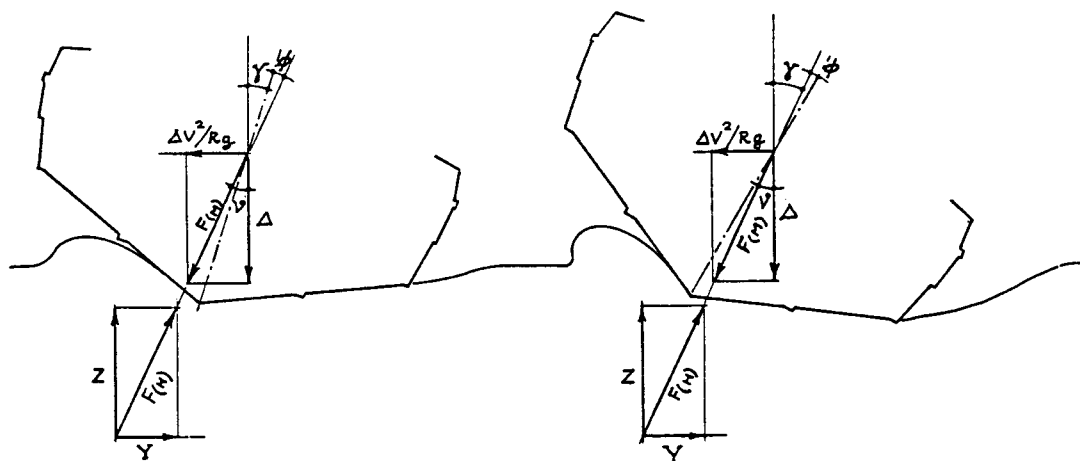


fig.4

a) mass forces $F_{(M)}$ acting along the resultant of the centrifugal acceleration and of the gravity acceleration; the direction of this resultant, the so called *dynamic vertical*, forms an angle

$$\nu = \text{arctg} \frac{a_r}{g}$$

with the *gravitational vertical*, and this angle depends, of course, on the speed and on the radius of the turning path; these mass forces $F_{(M)}$ are function of the centrifugal acceleration a_r and therefore of the velocity V and of the radius of the turning path, as well as of the gravity acceleration;

b) hydrodynamic force $F_{(H)}$, which is the sum of the hydrodynamic lift L and of the transversal component T_{yz} of the thrust.

It must be noticed that the hydrodynamic force $F_{(H)y}$ would be the horizontal component of the whole hydrodynamic lift, if the thrust were in the direction of the ship speed V ; but, owing to the fact that the thrust has a component outward, the lift axis during the turning path will result angled inward, in respect of the direction of $F_{(H)}$.

In the steady condition of turning, the mass force $F_{(M)}$ and the hydrodynamic force $F_{(H)}$ must be balanced:

$$F_{(M)} = F_{(H)},$$

and consequently the hydrodynamic lift axis passes through the centre of gravity, but, in general, as it is shown in the two sketches of figure 4, this axis does not lie in the longitudinal plane of the craft.

