6. HANDLING TWIN SCREW SHIPS

Twin-screw ships have generally excellent manoeuvring qualities at zero and low speed, especially in the case of twin rudders and propellers well spread (fig. 6-1a). Additional turning moment improving manoeuvring qualities is created by:

- Difference of propeller thrust directions (for example one propeller going astern, one propeller going ahead or one propeller going ahead and the second stopped);
- Transverse thrust of propellers;
- Cross-force created by difference of pressure on the deadwood of the ship.

On the other hand, ships with very small distance between shafts (fig. 6-1b) or ships equipped with single rudder situated on the centre line between the two propellers (fig. 6-1c) are well known because of their poor steering qualities. This is the case of many warships or of old generation of container ships.

Appropriate settings of pitch for ships equipped with C.P. propellers or appropriate settings of propeller revolutions in the case of F.P. propellers, together with appropriate rudder deflection or bow thruster setting, allow the twin-screw ship to move in any direction - from pure turn to pure transversal motion (fig. 6-2 and 6-3).

Many factors influence the value of this additional turning moment. The most important are:

6.1 Shaft convergence:

In the case of parallel shafts (fig. 6-4a) the maximum available turning moment is:

$$N = T_0 \cdot d$$

$$\text{where}: T_0 - \text{max. thrust at zero speed}$$
$$d - \text{distance between shafts}$$

In the case of converging shafts (fig. 6-4b) the maximum available turning moment is:

$$N = 2 \cdot T_0 \cdot \left(\frac{d}{2}\cos\alpha + l_p \cdot \sin\alpha\right)$$

$$\text{where}: \alpha - \text{angle between axis of the shaft and center line of the ship}$$
$$l_p - \text{distance between the propeller plane and the main section of the ship}$$

In the case of diverging shafts (fig. 6-4c), the maximum turning moment is

$$N = 2 \cdot T_0 \cdot \left(\frac{d}{2}\cos\alpha - l_p \cdot \sin\alpha\right)$$

From analysis of the above figures, it is clear that the case of diverging shafts is less favourable.

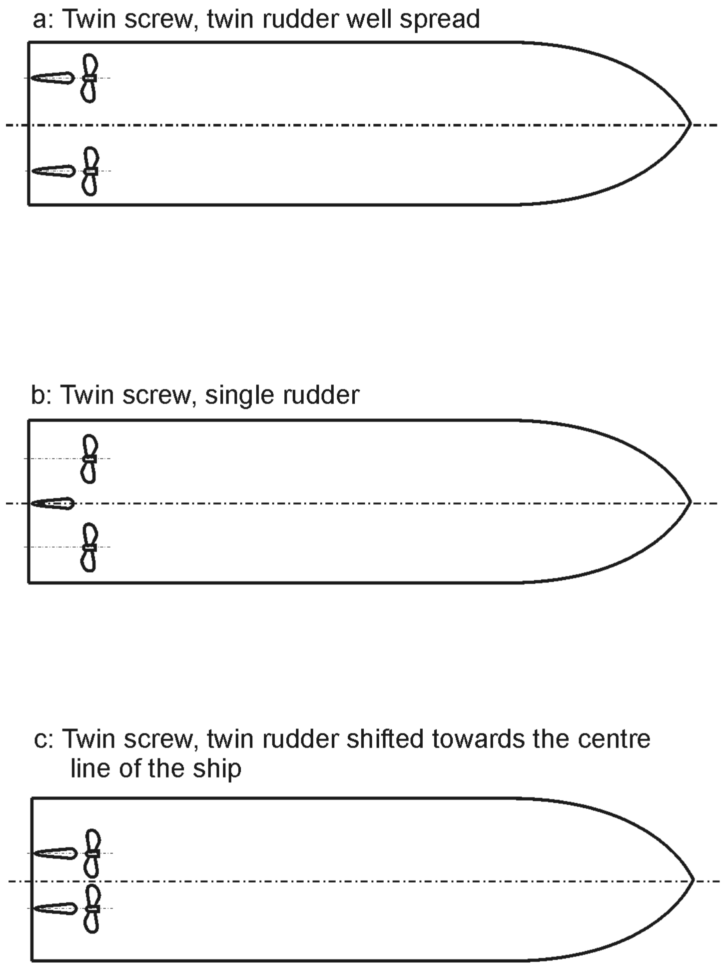


Fig. 6-1 Configuration of twin screw propulsion

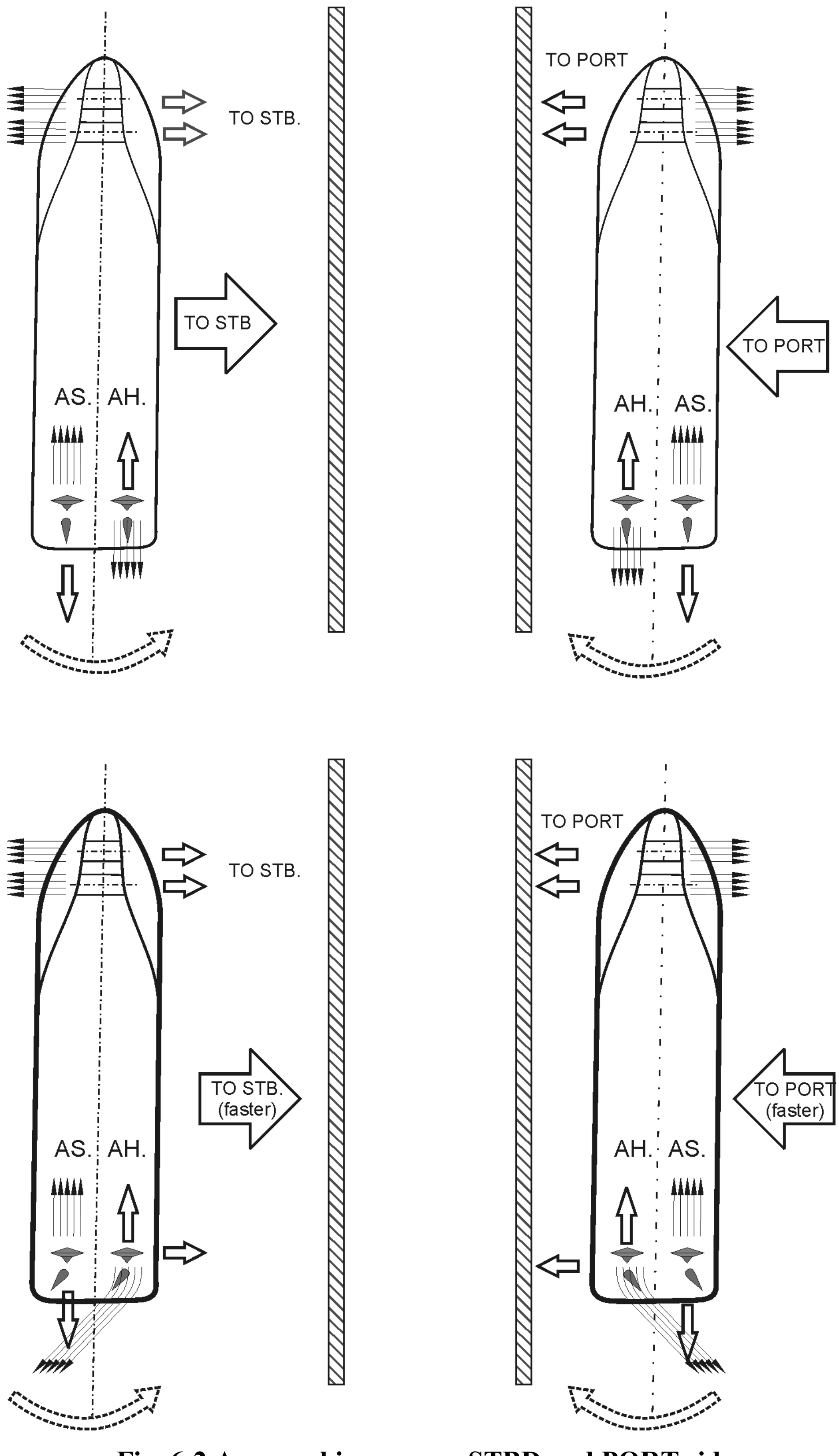


Fig. 6-2 Approaching a quay STBD and PORT side

Twin- screw vessel

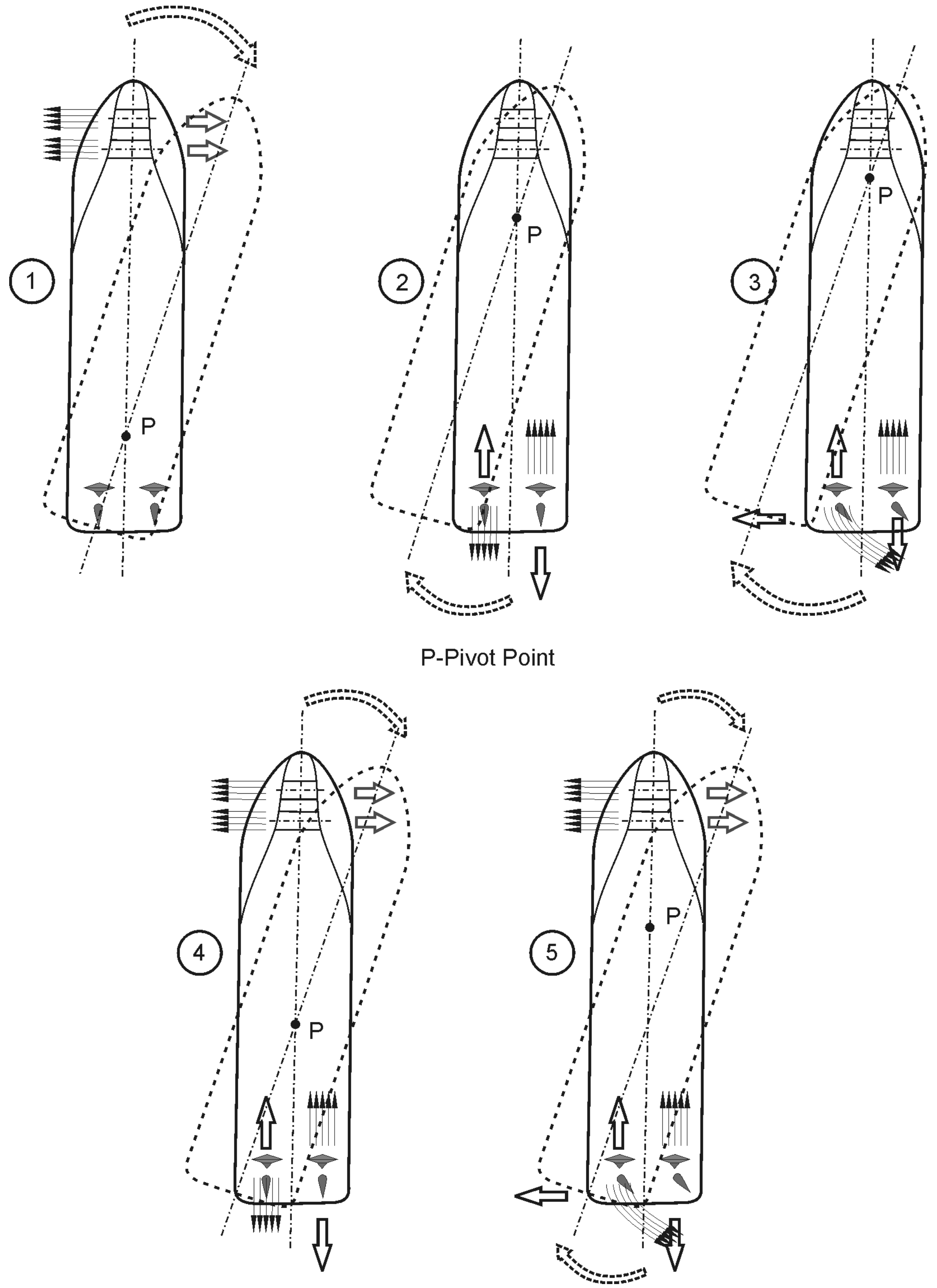


Fig. 6-3 Turning of a twin-screw vessel

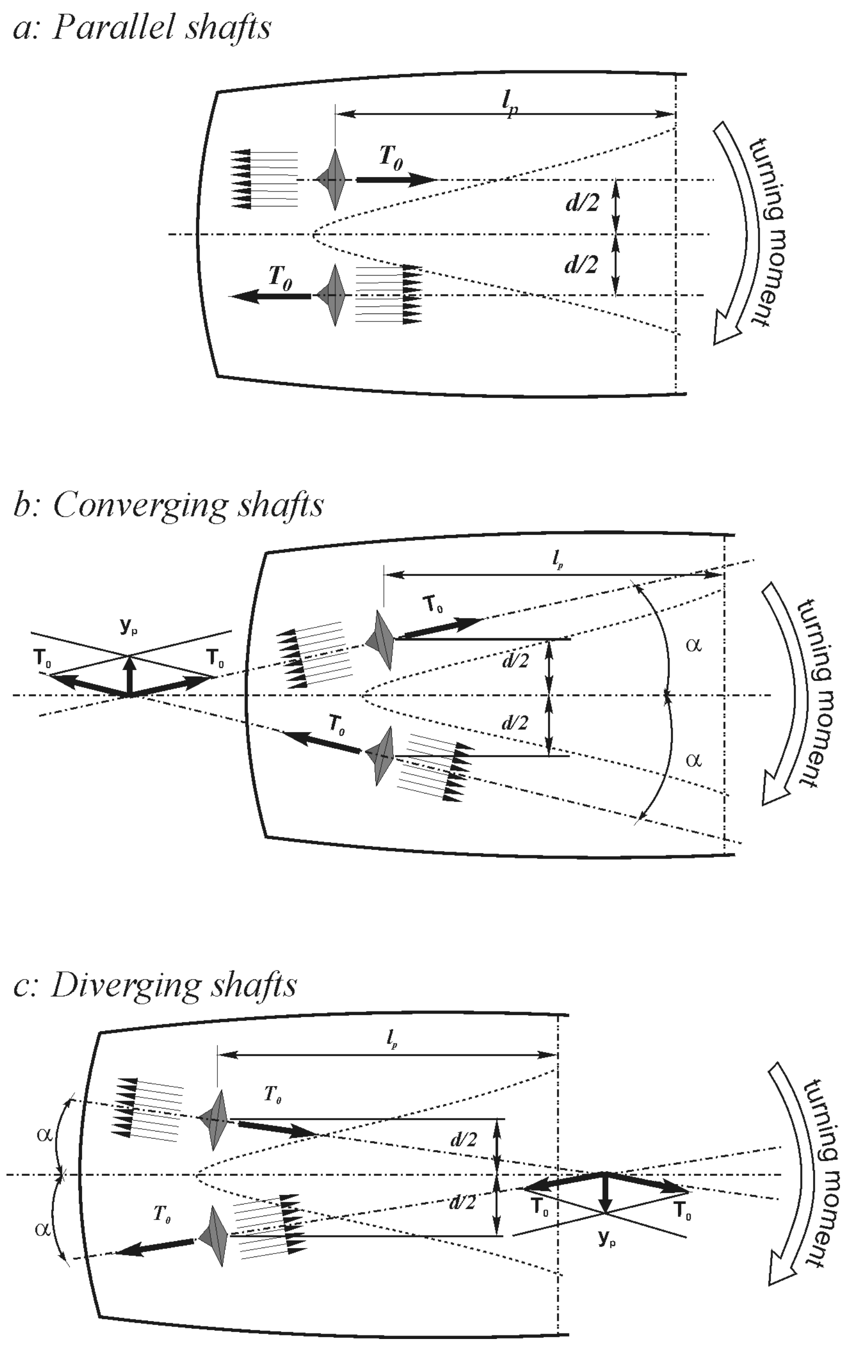


Fig. 6-4 Twin screw propulsion

6.2 Sense of propeller rotation and type of propeller:

It is well known, that rotating propellers create also transversal thrust. The source of this force is non-uniform field of water velocities. The orientation of this transversal force is the function of propeller's type and sense of rotation. The explanation of the way the above factors influence the value of additional turning moment, is shown in figures 6-5 and 6-6.

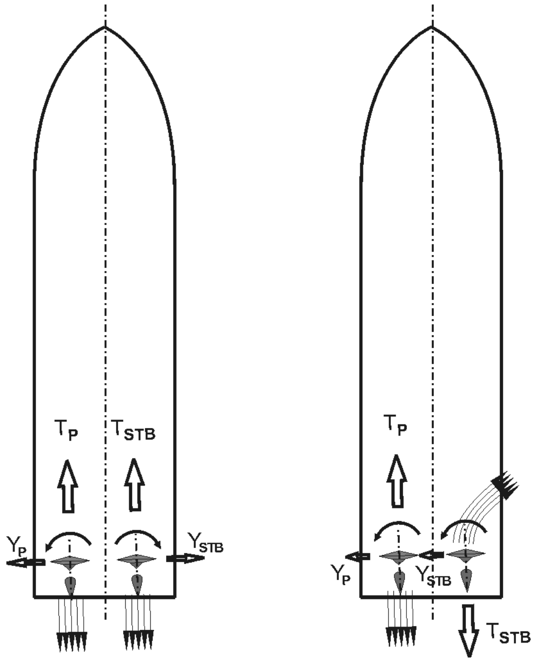


Fig. 6-5 Transversal propeller force for F.P. propeller-sense of rotation: outward

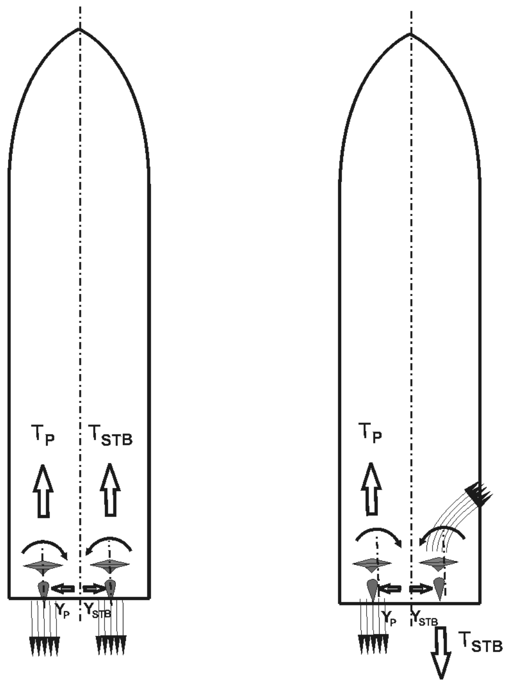
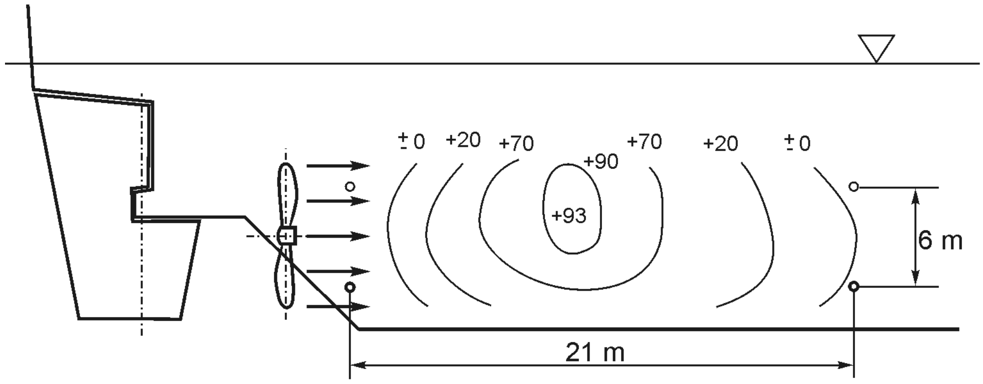


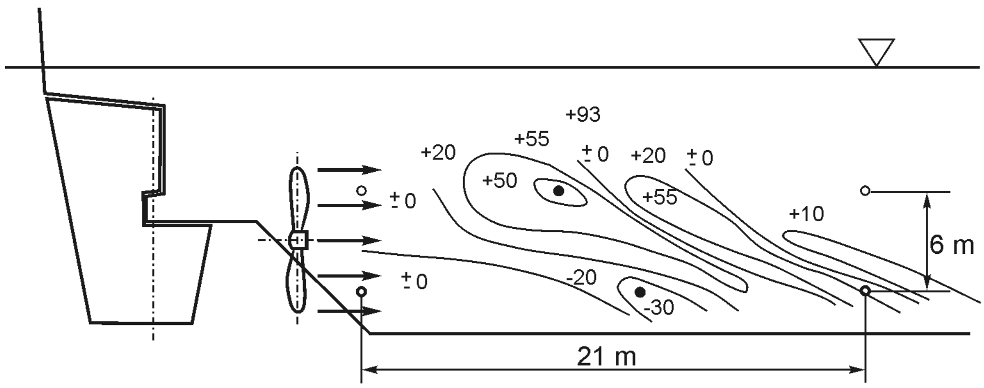
Fig. 6-6 Transversal propeller force for C.P. propeller - sense of rotation: inward

6.3 Presence of deadwood:

In fig 6-7, visualisation of the distribution of water pressure on the deadwood for different sense of propeller rotation when working astern is shown. This figure and fig. 6-8 clarify reasons for which more useful is outward sense of rotation for F.P. propeller and inward sense of rotation for C.P. propeller.



Starboard propeller going astern: sense of rotation when going astern - **inward**



Starboard propeller going astern: sense of rotation when going astern - **outward**

Fig. 6-7 Pressure distribution on the deadwood of a twin screw container ship

(Source: J.Brix "Manoeuvring Technical Manual")

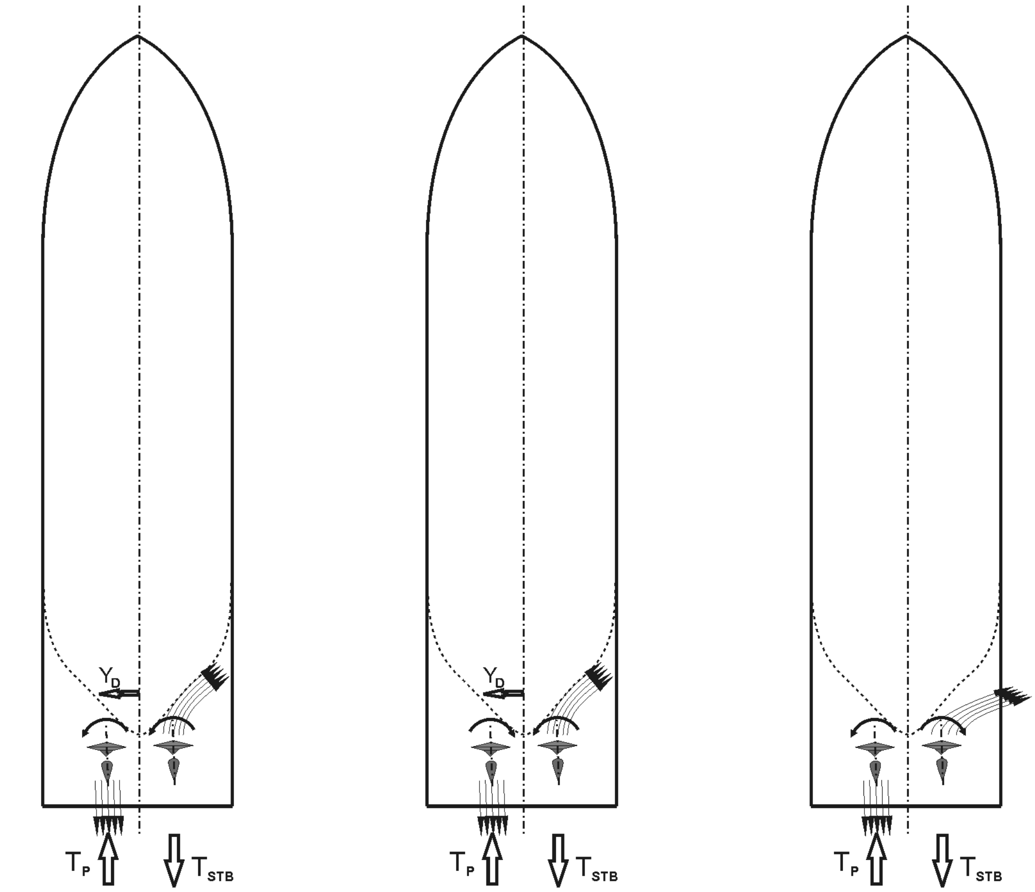


Fig. 6-8 Influence of sense of propeller rotation on creation of additional transversal force on the deadwood.