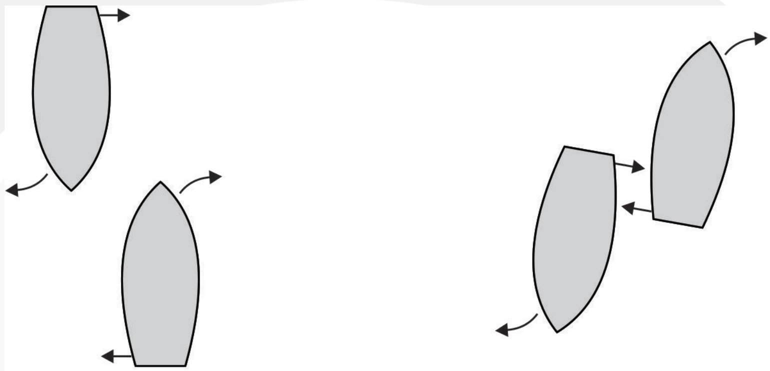
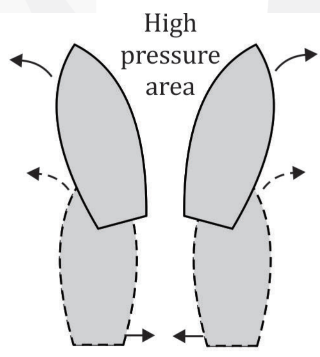
Ship Handling Principles

Interaction When two vessels are moving at high speed on opposite courses and passing close to each other, the pressure builds up at the bow section between the two vessels; this causes them to swing off course and their sterns to come close together, with the possibility of collision. A similar interaction occurs when two vessels are moving in the same direction; the bows of the two vessels will swing away in opposite directions, causing the sterns to come close together.

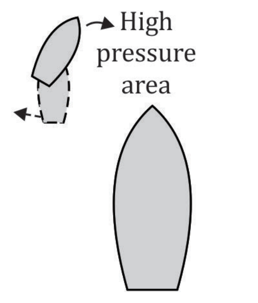


Interaction when moving close to each other in opposite directions

The interaction is more dangerous when a large vessel is overtaking a smaller vessel. The water pressure builds up at the bow of the large vessel, pushing the stern of the small vessel away and causing the small vessel to swing across the path or towards the side of the large vessel. This interaction also affects a vessel moving near a shoal; the ship will tend to swing away from the shoal.



Interaction when moving close to each other in same direction

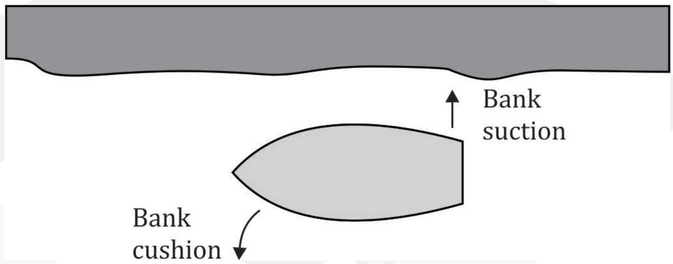


Interaction when large vessel is overtaking small vessel

Squat When a ship moves through the water, due to the changes in pressure and water displacement it tends to sink lower. At moderate speeds most vessels tend to trim by the head, but at high speeds vessels might trim by the stern. When a ship is moving through shallow water, it tends to sink lower.

Bow Cushion and Bank Suction

In a restricted channel, when the ship moves near the bank, the bow is pushed away from the bank, an effect known as bow cushion, and the vessel is bodily attracted toward the bank, an effect known as bank suction. The bank cushion results from high pressure build-up between the bank and the bow of the ship, and the bank suction is caused by loss of pressure and increased velocity of water in the restricted space between the vessel and the bank.

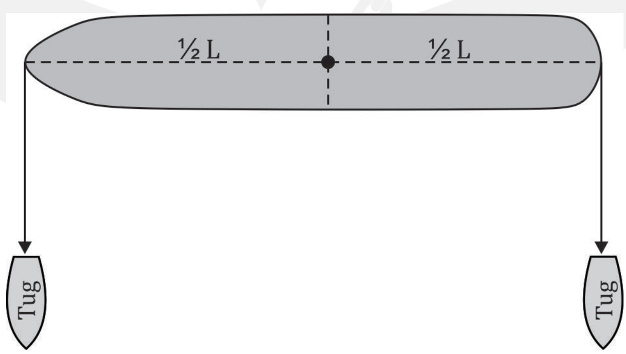


Pivot Point

Pivot Point is an imaginary point about which the vessel rotates when turning. When the ship stops, the pivot point is about amidships. When the ship starts making headway, the momentum of the ship and high resistance of the water longitudinally cause the pivot point to move forward, approximately one eighth the length of the ship from forward; as the ship gains speed, the pivot shifts toward amidships about one quarter the length of the ship from forward, and when the ship is steady with speed, it settles to about one third the length of the ship from forward. Conversely, when the ship is making sternway, the pivot point moves aft and settles at a distance about one quarter the length of the ship from the stern.

From understanding the movement of the pivot point, we can figure out the behaviour of the ship's movement, especially her turning characteristics. For example, a ship L metres in length is stopped with two tugs secured fore and aft, pulling the ship sideways with the same bollard pull power (P). As explained in the Physics section of this book, the moment of turning power from each tug can be calculated as follows:

$$\text{Moment} = \text{Force} \times \text{Length of Lever} = P \times \frac{L}{2}$$

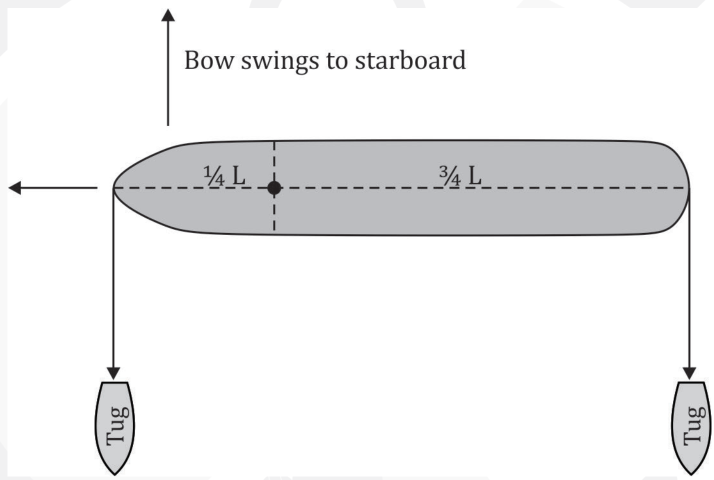


In this case, the turning power of two tugs is equalizing, so there is no turning, and the ship will be moved sideways uniformly.

If the ship makes headway, the pivot point will move forward, and the turning levers are now changed:

The turning power of the bow tug: $\text{Moment}_{\text{Bow}} = P \times \frac{L}{4}$

The turning power of the stern tug: $\text{Moment}_{\text{Stern}} = P \times \frac{3L}{4}$



Turning power at the stern is greater than the turning power at the bow, so the stern will move faster and the bow swings to starboard. Conversely, when the ship makes sternway, the bow will swing to port.