Deck camber

The convex upward curve of a deck. Its function is to increase the load bearing capacity of the deck and also to allow water to run overboard rapidly through the freeing ports.

Bow flare

The outward sweep of a vessel's bows. As the vessel sinks down into oncoming waves, the beam and internal underwater volume of the hull increases, providing greater reserve buoyancy. It also tends to force water away from the bows when the vessel pitches into a seaway.

Tumblehome

The curve of a vessel's topsides back inboard towards the centreline of the hull. A vessel with tumblehome has its greatest beam below the gunwale. It is a common design feature of many yachts.

Sheer

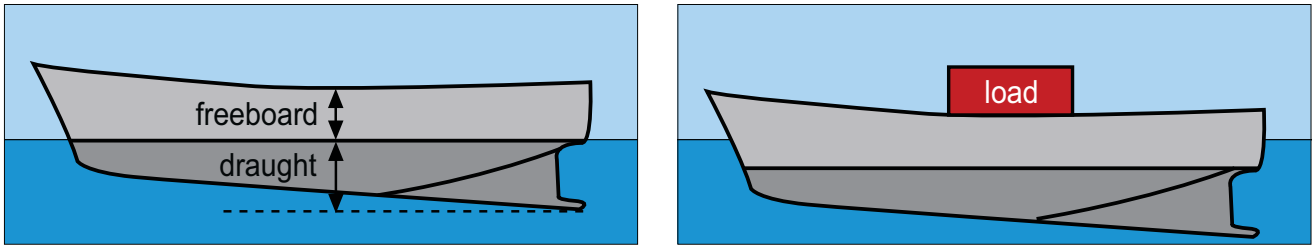
The sweeping curve of the deck line — usually upwards towards the bow and stern and lowest amidships. Sometimes a vessel may have a flat sheer, such as a barge or tanker, or even a reverse sheer, such as a modern sports cruiser.

Buoyancy and stability

Crew members should have a sound knowledge of buoyancy and stability concepts to ensure that the vessel won't be overloaded over the course of its activities while at sea.

Key terms

Buoyancy is the upward force on a vessel derived from the displacement of a weight of water equal to the weight of the vessel (produced by watertight volume below the waterline).



Freeboard is the vertical distance from the lowest point of the main deck (usually near midships) to the waterline.

Reserve buoyancy is the watertight volume of a ship above the water line. That is, the distance from the waterline to the uppermost continuous deck. As fish catch is added to the hold, the freeboard will reduce and the draft will increase. The ship will have less reserve buoyancy.

Stability is the ability of the ship to remain upright. It is determined not only by the design of the vessel, but also by crew members by determining the amount and distribution of weight onboard.

Because the design of the ship cannot be controlled, it is vital to control the amount and distribution of weight onboard.

The stability of the ship is mainly determined by the distance between two points:

- Centre of gravity — the point of the ship where the weight of the whole ship and everything in it is said to act vertically downwards due to the force of gravity.
- Centre of buoyancy — is the point at the centre of the ship's underwater volume where the force due to buoyancy is said to act vertically upwards.

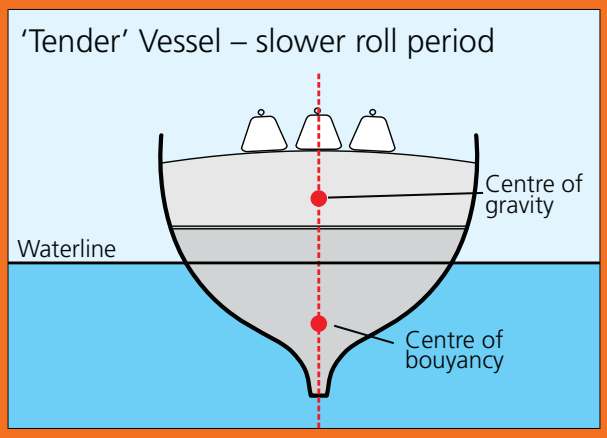
Overloading is dangerous and one of the easiest ways to capsize a vessel. The more weight in the boat, the lower the freeboard. Overloading compromises the safety of everyone onboard and increases the chance of swamping or capsizing.

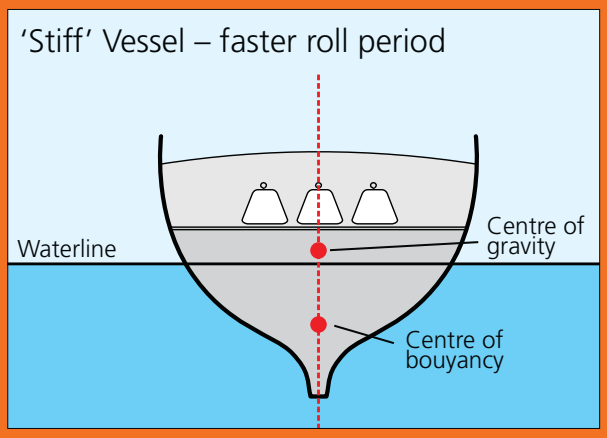
When preparing for a trip, the master is responsible for assessing the load onboard — both people and objects. For example:

- Heavy items should be stowed in a low and central place where they cannot move around.
- Weight, including passengers, should be distributed evenly through the boat.
- The weight of extra fuel and water should be taken into account.

Case Study

Study the same vessel loaded with cargo in two different ways:





The loading condition on the left is less stable because the distance between the centre of gravity and the centre of buoyancy is greater. This vessel would be referred to as 'tender' as its rolling period (the time it takes to compete a roll from one side to other and back again) is longer. The vessel on the right is referred to as 'stiff' as its rolling period would be shorter. In adverse conditions, this vessel would be less likely to capsize.

Free surface effect has the same result on the stability of the ship as raising the centre of gravity. It occurs when free moving weight onboard such as a half full water tank, sea water on the deck or an uncontained catch of fish on the deck, is moved about by the action of the sea on the vessel. For example, if a vessel takes a heavy sea onboard and the freeing ports are closed or blocked, the action of tonnes of water moving to one side of the vessel changes the stability of the ship and may result in capsize. Where possible, tanks should always be kept pressed up (full) or empty to reduce free surface effect. In a larger ship, the combined effect of many slack (partially full) tanks on the overall stability of the ship can be considerable.

This ship's stability was not monitored correctly during loading operations at the dock, with disastrous results!

Deck fittings, equipment and machinery

Bollards, bitts and **cleats** differ in design, but their general function is the same — to belay or fasten a line. Methods are covered in chapter 5 (seamanship).

Hatches are openings in the deck that may be closed and clamped to maintain the watertight integrity of the hull. Often, these hatches have a raised perimeter around them called coamings that prevent the down flooding of any water that may be on deck when the hatches are open.

Hatch with coaming on a vessel in 2B survey.

A **windlass** is a device used to haul in lines or chain under load. On most small vessels the only windlass onboard is used for setting and retrieving the anchor. On some vessels, however, the windlass can be used to haul nets and other fishing equipment.

Cranes are a common piece of deck equipment, even on small vessels. They may be electrically or hydraulically driven and used to stow tenders and other heavy equipment on deck. Close attention to the stability of the ship is necessary when using cranes, as the centre of

gravity of the load actually acts from the very end of the boom. Usually this is well outboard from the centreline of the ship when in operation and can cause the ship to list.

A **derrick** is a boom used for lifting heavy weights. Derricks are often used to haul nets on fishing vessels and similar stability issues as cranes are encountered, particularly when hauling nets abeam rather than astern.

This vessel uses a derrick rather than a crane for handling cargo.

Most accidents at sea occur on deck. Make sure you are trained in the use of deck machinery and always wear PPE appropriate for the task. Deck machinery is under tremendous load and, combined with the ship's motion, requires great care to be taken when operating.

Steering

There are many different methods of steering a vessel and the methods differ between ships. It may be as simple as a tiller held in the hand or as complex as a power-assisted hydraulic system.

All commercial vessels are required to have a means of emergency steering should the main system fail. The rudder of any vessel is under massive load when at sea and wheel steering arrangements usually employ some system of mechanical or hydraulic advantage to ease the effort of steering the ship and holding a course.

Twin engine vessels may be steered by adjusting the revolutions of each propeller

should the steering system fail. (This is easier in catamarans than it is in monohulls due the wide separation of the propellers.)

Electrical systems

Commercial vessels often run 12, 24 and 240 volt electrical systems onboard.

A DC circuit breaker panel on a small commercial vessel. Fire alarm, warning lights, engine instruments, voltmeter and ammeter are also incorporated. A separate panel exists for the AC system.

Batteries, often linked together in banks, provide 12 and 24 voltage, while a mechanically powered alternator known as a genset provides 240 volts to the ship.

Batteries need careful monitoring and maintenance. The master or engineer will usually assign this duty to a crew member along with other engine room duties. Batteries contain corrosive fluid, and also produce highly explosive hydrogen gas, particularly when they are charging, so occupational health and safety procedures must be followed when monitoring and maintaining the vessel's batteries.

Commercial vessels have a larger requirement for AC (alternating current, or 240/415 volt) systems than recreational vessels. Batteries cannot run equipment such as large refrigeration units, floodlights or electric ovens and deep fryers. In the engine room there will be a separate diesel engine from the main propulsion engine that drives an alternator-producing AC power. On fishing vessels, this unit usually runs 24 hours a day when at sea and requires careful and regular monitoring and maintenance.