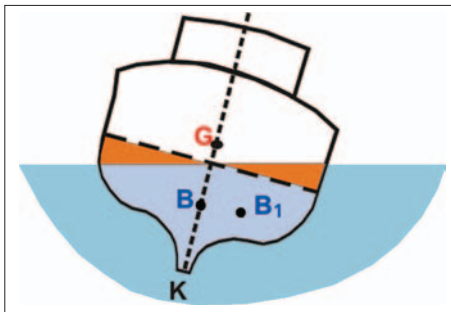
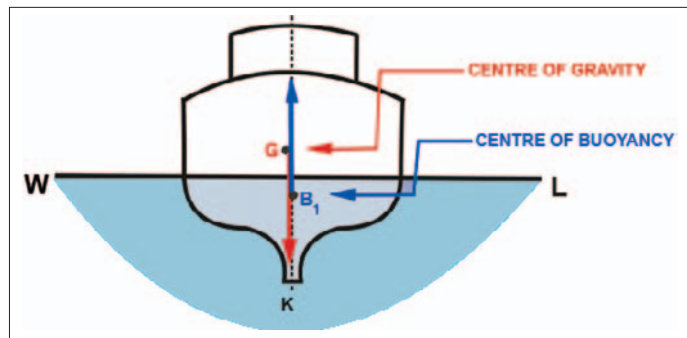


## TRANSVERSE STABILITY

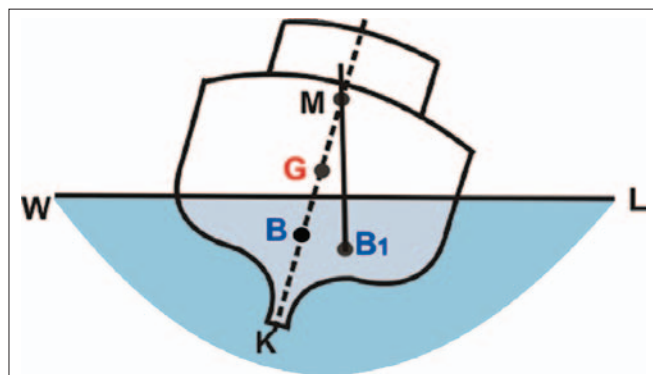
When a vessel is floating upright (at equilibrium) in still water, the centre of buoyancy (upthrust) and the centre of gravity (downthrust) will be on the same line, vertically above the keel (**K**).



If the vessel is inclined by an external force (i.e. without moving internal weight) a wedge of buoyancy is brought out of the water on one side and a similar wedge of buoyancy is immersed on the other side. The centre of buoyancy being the centre of the underwater section of the vessel has now moved from point **B** to **B<sub>1</sub>**.

## METACENTRE

Vertical lines drawn from the centre of buoyancy at consecutive small angles of heel will intersect at a point called the metacentre (**M**). The metacentre can be considered as being similar to a pivot point when a vessel is inclined at small angles of heel.



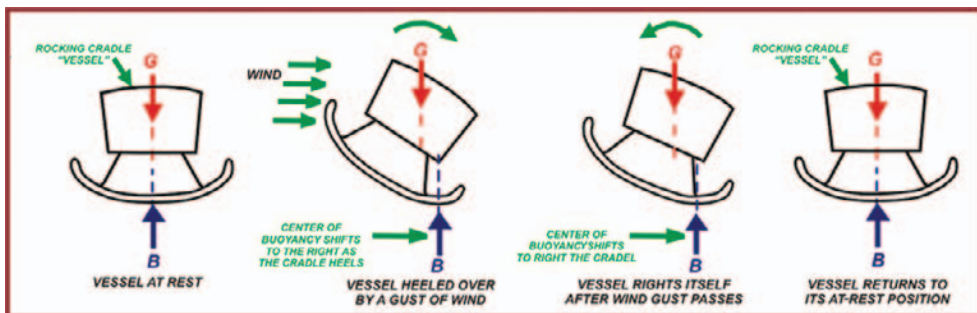
The height of the metacentre is measured from the reference point (**K**) and is, therefore, called **KM**.

## WHY A FISHING VESSEL REMAINS UPRIGHT

Another way of understanding how a fishing vessel stays upright is to imagine the rocking of a baby cradle, as shown in the figure. The fishing vessel (weight) is represented by the cradle, and its centre of gravity (**G**) is the near the centre of the cradle. The “buoyant force” supporting the cradle is represented by the rocker resting on the floor and the centre of buoyancy (**B**) is the point where rocker contacts the floor.

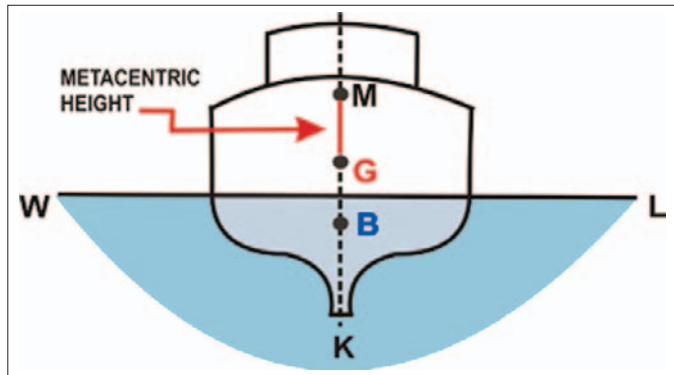
As with a fishing vessel, the cradle’s (vessel’s) centre of gravity (**G**) is above its rocker, the centre of buoyancy (**B**). The slightest disturbance (wind or waves) causes the cradle (vessel) to roll (heel) to one side.

As the cradle (vessel) rolls to one side, the point where the rocker touches the floor (the centre of buoyancy (**B**)) shifts outboard. To keep the cradle (vessel) upright, the point where the rocker touches the floor (the centre of buoyancy (**B**)) must shift outboard. It is this shifting of the centre of buoyancy (**B**) that allows a fishing vessel to return to upright after being heeled by an external force.



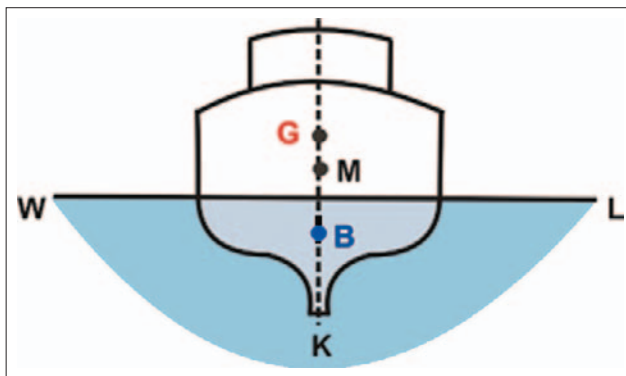
### EQUILIBRIUM

A vessel is said to be in stable equilibrium if, when inclined, it tends to return to the upright. For this to occur the centre of gravity ( $G$ ) must be below the metacentre ( $M$ ).



### METACENTRIC HEIGHT

The distance between  $G$  and  $M$  is known as the metacentric height ( $GM$ ). A stable vessel when upright is said to have a positive metacentric height ( $GM$ ), i.e. when the metacentre ( $M$ ) is found to be above the centre of gravity ( $G$ ). This is usually referred to as having a positive  $GM$  or a positive initial stability.



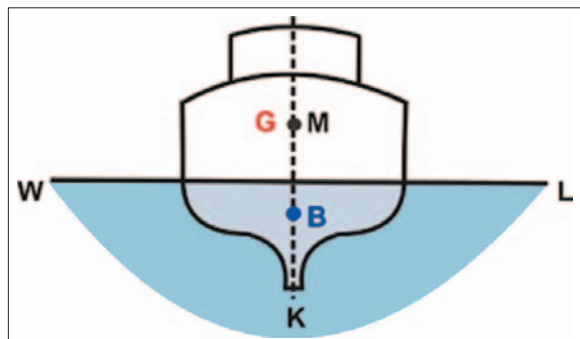
### UNSTABLE EQUILIBRIUM

If the centre of gravity ( $G$ ) of a vessel is above the metacentre ( $M$ ) the vessel is said to have a negative  $GM$  or a negative initial stability. A vessel in this state has a loll, i.e. it floats at an angle from the upright to one side or the other and there is a danger that it may capsize.

(See also the section on loll on page 5.)

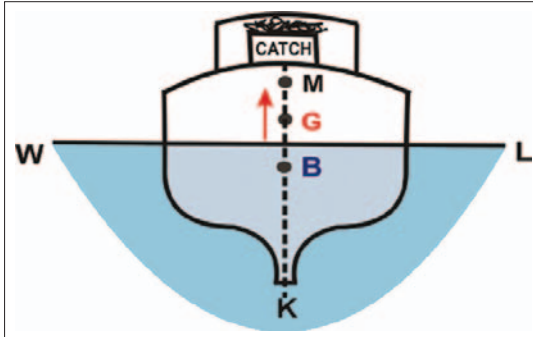
### NEUTRAL EQUILIBRIUM

When the position of a vessel's centre of gravity ( $G$ ) and the metacentre ( $M$ ) coincide the vessel is said to be in neutral equilibrium ( $Zero\ GM$ ) and if inclined to a small angle of heel it will tend to remain at that angle.



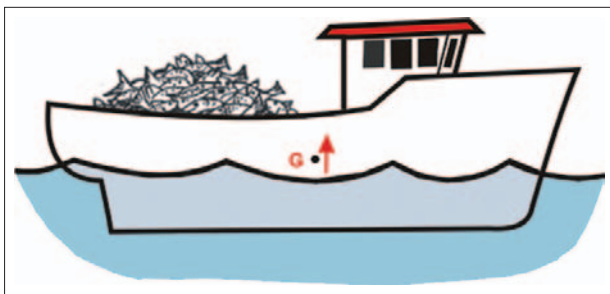
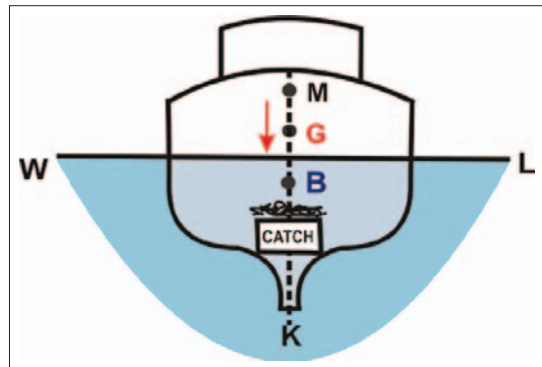
### STIFF AND TENDER VESSELS

When weight is added to a vessel, the centre of gravity ( $G$ ) of the vessel always moves in the direction of the added weight.



Weight added at deck level results in the vessel's centre of gravity ( $G$ ) rising, causing a decrease in the vessel's metacentric height ( $GM$ ) and thereby its stability. A vessel with little or no metacentric height is said to be **tender**.

Weight added low down in the vessel lowers the vessel's centre of gravity ( $G$ ) and consequently causes an increase in the vessel's metacentric height ( $GM$ ). A vessel with a large metacentric height is said to be a **stiff** vessel.



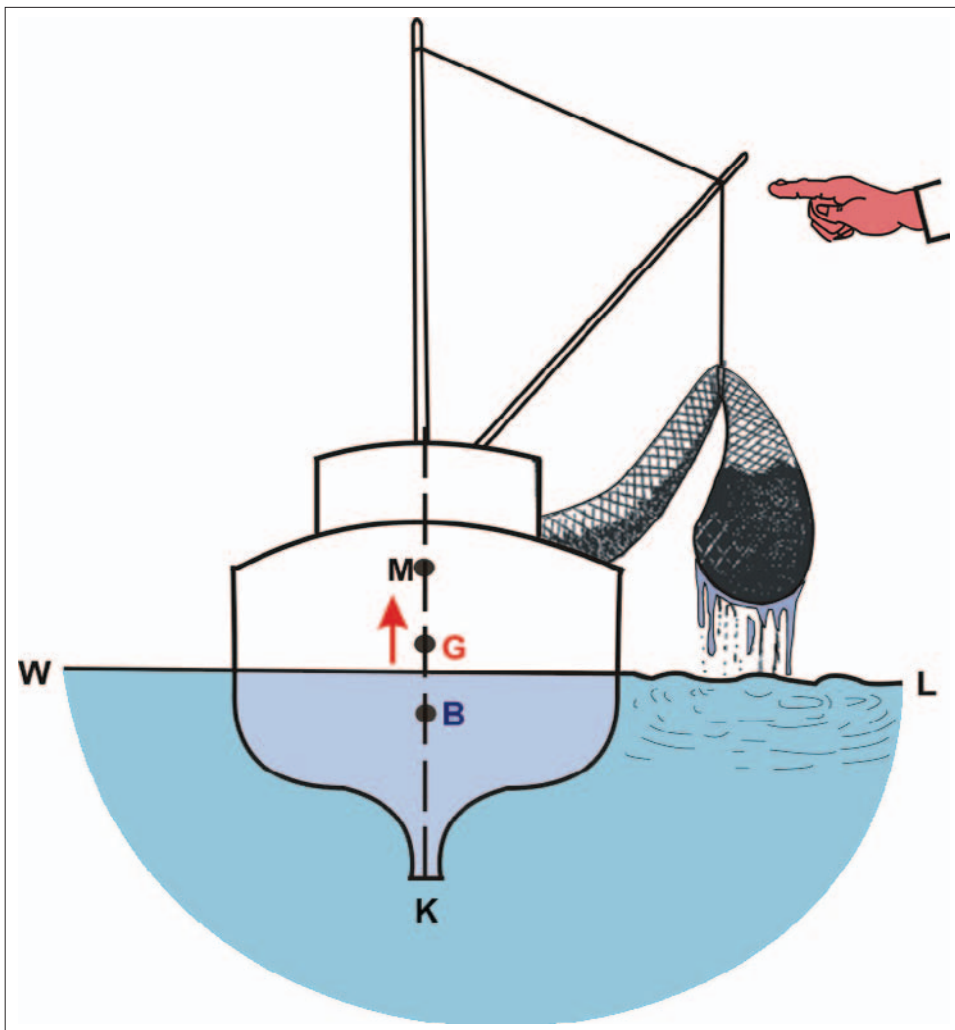
Heavy weights should always be positioned as low as possible and catch should generally not be carried on deck as the vessel's centre of gravity ( $G$ ) will rise and the metacentric height ( $GM$ ) will decrease which will increase the likelihood of a capsizing of the vessel.

A stiff vessel tends to be comparatively difficult to heel and will roll from side to side very quickly and perhaps violently.

A tender vessel will be much easier to incline and will not tend to return quickly to the upright. The time period taken to roll from side to side will be comparatively long. This condition is not desirable and can be corrected by lowering the vessel's centre of gravity ( $G$ ).

(See also the section on rolling period tests on page 31.)

## SUSPENDED WEIGHT



The centre of gravity of a suspended weight can be considered to be acting at the point of suspension. Therefore, a net lifted clear of the water has the same effect on the vessel's centre of gravity (G) as if the net were actually at the head of the boom.

If not at the centreline, this weight will also exert a heeling force upon the vessel and may, under unfavourable circumstances, capsize the vessel.