



Understanding Balance

A boat is balanced when it will sail close hauled at a consistent angle to the wind without rudder input from the skipper. There are significant advantages when racing in having a radio yacht balanced. Without needing constant rudder input, drag is reduced to a minimum, so the boat will go as fast as the sails can drive it. The skipper of a balanced boat also has the luxury of being able to take eyes off the boat periodically to look around the course; keeping track of other competitors or changes in the wind.

Balanced means the forces on the boat are constant and aligned so the boat wants to continue in a straight line.



Forces on a boat

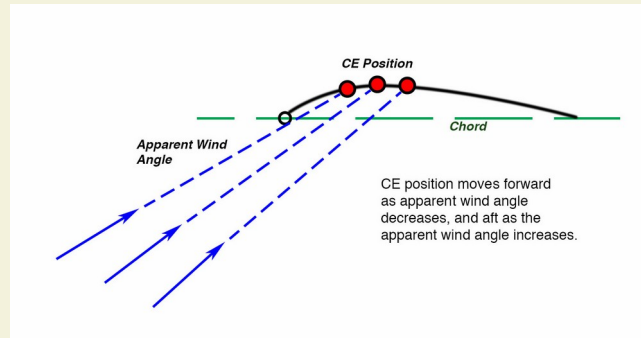
The full set of forces on sails and hull are rather more complex than shown here, but this simplified view will suit our purposes. The centre of lateral resistance (CLR) is the sum of all the sideways forces on hull, keel and rudder. These are the forces that prevent the boat slipping sideways. The position of CLR is fixed and determined by the designer.

The centre of effort (CE) is the sum of all forces on the sails. Its fore and aft position can be varied with sail trim. If the sails are at a small angle to the wind, the CE will move forward. When sails are trimmed in, their angle to the wind increases and CE moves a little further aft.

When CE is forward of CLR, the boat will bear away (turn the bow away from the eye of the wind). When CE is aft of CLR, the boat wants to round up (turn the bow towards the eye of the wind). When CE is aligned with CLR, the boat will sail a constant heading and the boat is balanced.

However, the position of CE is not constant while the boat is sailing. It shifts with apparent wind angle, wind

strength and sail shape. From a balance point of view, the most important of these is apparent wind angle.



Apparent Wind Angle and Position of CE

If the apparent wind shifts forward (angle decreases), CE goes forward and if the apparent wind angle goes aft (angle increases) the CE position moves aft.

So now we have a boat that will potentially self correct as the wind shifts. All we have to do is set the boat up so it is balanced and let CE do it's work.

When we tune for balance, we are essentially trimming the sails to get CE applying itself above CLR so that the boat will want to sail at a constant angle to the wind. If the wind changes direction, a nicely balanced boat will change direction to match it.