

Length Beam Ratio

We have all heard that the theoretical speed limit for a displacement boat (i.e. a boat displacing the volume of water equivalent to her own weight, as opposed to a planing hull which is lifted) is its hull speed, calculated as 1.34 times the square root of the hull waterline length in feet.

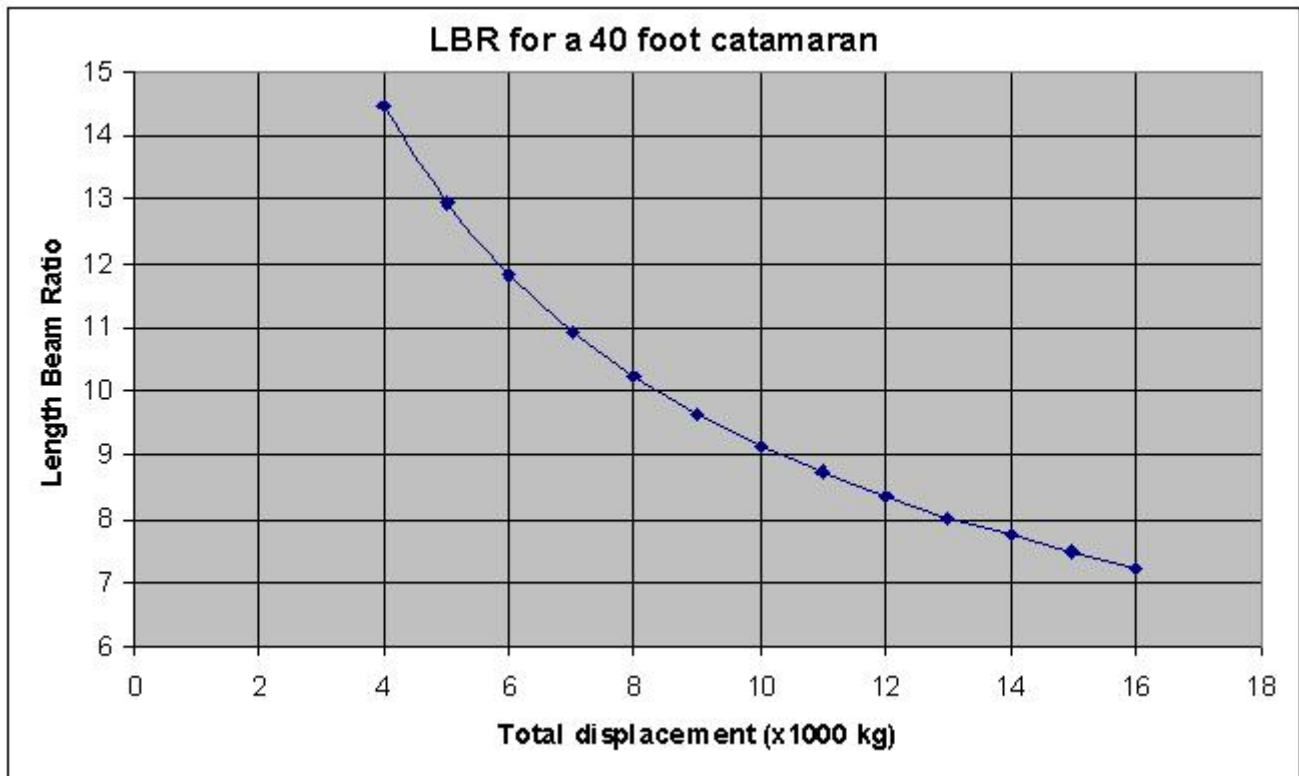
So, a Hobbie Cat 16 being theoretically limited to a speed of 5.36 knots, how come we see them regularly overtaking cruising yachts at speeds far higher than this limit?

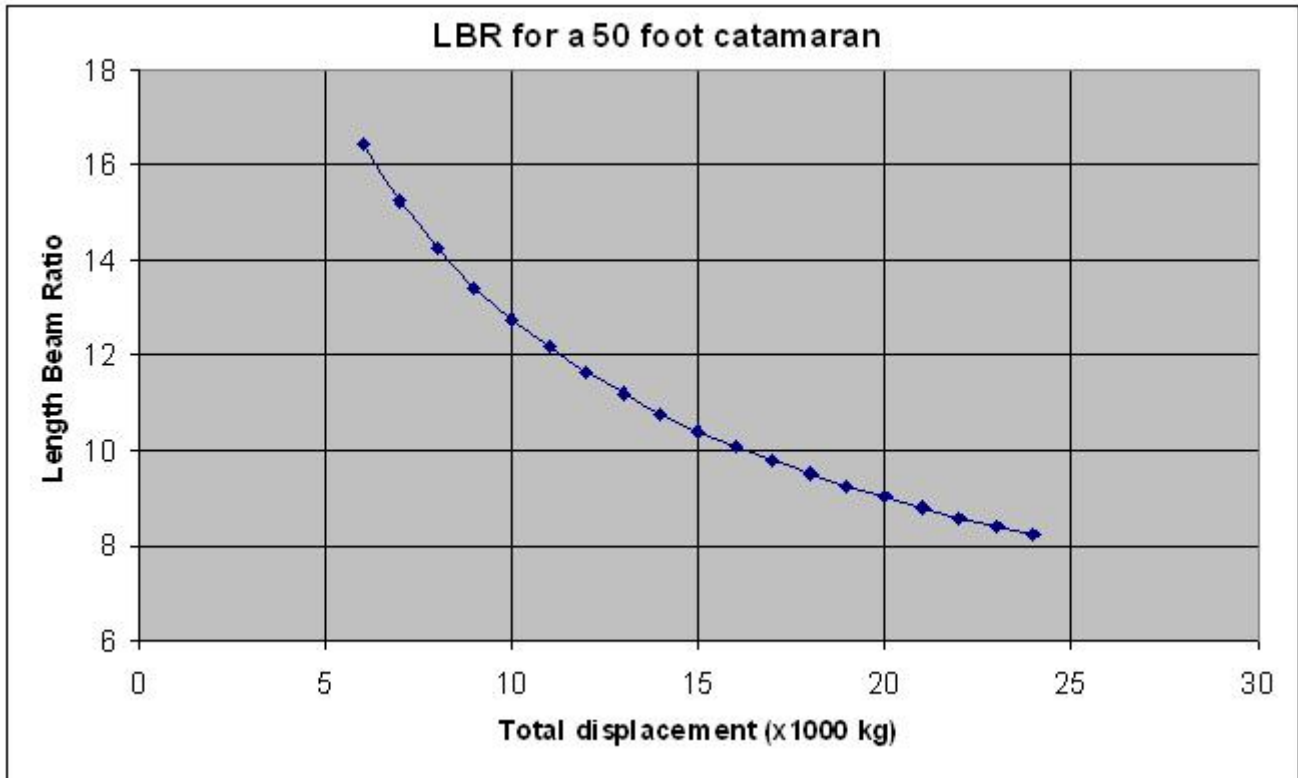
The main factor limiting the performance of a boat in light winds and low speeds is the hull water drag, directly proportional to the immersed surface of the hull. The semi-circle being the shape giving the minimum surface for the same width, designers tend to draw semi-circular shapes for the sections of the hulls of sailing yachts, to decrease water drag to the minimum in light winds.

At higher winds and speeds, the water drag will become negligible as compared to the wave drag. The hull speed of 1.34 LWL actually represents the speed for which the aft wave will get behind the transom, and this wave tends to 'suck' the boat and pull her backwards. Therefore the hull speed is not a definitive speed limit, but rather a speed over which a huge energy will be needed to overcome the aft wave suction. We could compare this limit to the sound barrier for the planes...

However tank tests have confirmed the trivial intuition that very thin hulls will create less wave drag: the energy needed to overcome the hull speed limit will start decreasing with length:beam ratios (LBR) above 8:1, and will become far smaller for LBR ratios above 11:1.

Indeed there is a penalty to high LBR, which is low volume hence low weight carrying. A bigger catamaran will be able to have thinner hulls and go faster, with less incidence on the displacement and payload.





A LBR ratio of 8:1 to 9:1 is generally found on charter catamarans, where the design is axed on comfort and amenities, built with heavy and economical materials; and a ratio above 11:1 will be found on catamarans where the design is axed on performance, and they will have to be built with light and high-tech materials to keep a reasonable payload.