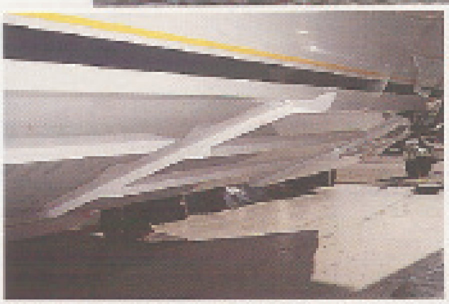
2 Boats & planes



Powerful offshore racing cats and leisure boats like the Donzi ZX26 sport stepped hulls.

Why do stepped hulls go faster? It's a well-known fact that a hull must generate lift in order to skim across the water: in other words, to plane. To develop lift, like a wing, the bottom of the boat must meet the water at an angle. The faster you go, the more lift is generated, the higher out of the water the hull rises, and the smaller the planing surface in contact with the water. This is good because it reduces drag. However, the planing surface also moves further aft as the vee-bottomed boat goes faster, which is not so good because it can upset the balance of the boat.

Planing surfaces on a hull and aeroplane wings share some other characteristics. One is that long, thin surfaces are more efficient than short, wide ones. In pure efficiency terms a glider's long, elegant wings (high-aspect ratio) are more efficient than a stubby delta-winged fighter plane (low-aspect ratio). Unfortunately, the planing surface of a conventional vee-bottom hull is pretty much a low-aspect delta (see Fig 1). If we could increase the aspect ratio by making the planing surface shorter and wider (see Fig 2), it would give us the same lift for less drag and we'd go faster.

There is clearly a limit to how wide we can make our boat if we still want it to be good in rough weather. But, if we cut the total planing area in half, each surface will be the same width but shorter. They'll still be delta shaped, but we'll have increased the aspect ratio. And, of course, the way to achieve this with a monohull is to cut away the bit in between. Do this, and you get something like Fig 3, and, oops, we've invented the stepped hull.

Of course, even if we didn't know all this about aeroplane wings, we just might have invented the stepped hull anyway, based on the assumption that all those air bubbles under the hull would reduce the friction and increase the speed.

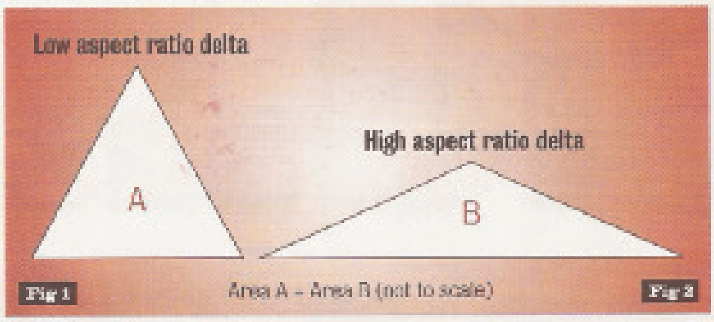


Fig 1 Fig 2

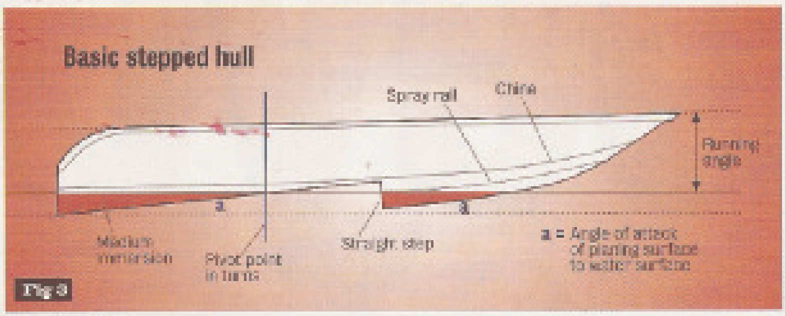
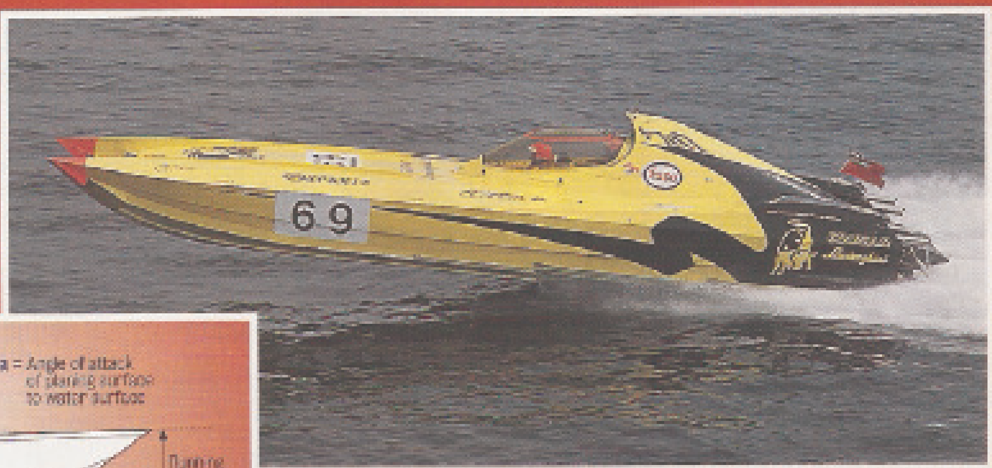


Fig 3

3 Steps forward

If two steps are good, perhaps three would be even better? Then each one would be of an even higher aspect ratio and reduce drag further. However, we want to make sure that the water breaks away as cleanly from the bottom of each step as it does at the transom. If we don't, we'll have lots of draggy turbulence and all our steps will be doing is creating a low-pressure area sucking the boat downwards – which is just what we don't want. That means getting some air down there. We could ventilate the step artificially by ducting air from deck level, but there is an easier way. If we sweep the step forward from the keel to the chine, the boat's forward motion will help air flow downwards and inwards along the rear face of the step to where we want it. This not only allows clean water separation, but also provides a cushion of air behind each step, which might help soften the ride. To ease the air flow even more, let's round off the sharp corner at the chine and enlarge the pathway by angling the bottom panel just aft of the step upwards. Our refined design now looks like Fig 4.



Stepping out: maximum speed means minimum contact.

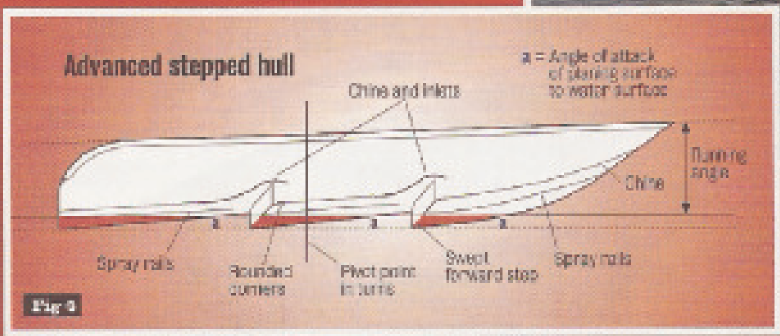


Fig 4