ESSENTIALLY A BIG WINDSURFER

One of the fundamental keys to *Sailrocket*'s performance is eliminating the heeling force, but she's not the first to do this by a long way. By canting their rigs to windward and with the sails above their heads, windsurfers do it all the time to balance out the forces. Once in equilibrium, as they hammer along in a straight line, there is no heeling moment on the board itself. Instead, it's all about balancing the sail forces against the skeg.

In practice, *Sailrocket* is rather more complex because of her size, but essentially she is just a big windsurfer with the hull and crew pulling down on the tip of the mast and a strut lower down instead of sitting in a harness attached to the wishbone.

FACTS AND FIGURES

LOA	12.2m	40ft 0in
Beam	12.2m	40ft 0in
Total wing area	22m²	237ft²
Projected wing area	18m²	194ft²
Crew	1 or 2	

Apparent wind speed 73 knots on record run
Construction: pre-preg carbon and Nomex honeycomb core. All metalwork titanium. When dismantled *VSR2* is designed to fit into a single 40ft shipping container.
Main foil supported by Ekspan and built by Composite Craft, Cowes.
Datalogging: Cosworth datalogging system measuring everything from wind speed to structural loads.
Record runs timed using sophisticated Trimble GPS systems.
Design team: Malcolm Barnsley, Chris Hornzee-Jones, George Dadd, Paul Larsen, Wang Feng.
Build team: Ben Quemenar, Matt Meltzer, Paul Larsen, Helena Darvelid, Composite Craft-foils, Bob Preston, Ian Monk, Gavin Tappenden.

Key aerodynamicists, from left: Chris Hornzee-Jones and Wang Feng, both of Aerotrope

A The hull, which looks rather like the fuselage of an aircraft, is angled at 20° to the direction of travel to take account of the apparent wind angle and ensure that it is always aligned with it to reduce drag. Because *Sailrocket* is sailed on a reach she's like an aircraft coming into land in a crosswind. Instead of crabbing across the runway on the approach, which drags the fuselage sideways trough the air, she's been built skewed into the wind

B Ignore the rest of the boat for a moment, turn the page anticlockwise through 90° and imagine that this is a commercial airliner's wing with a winglet at its outer end

C The wing develops forward thrust as does the wing extension (winglet) on the outboard end as we see it in this view

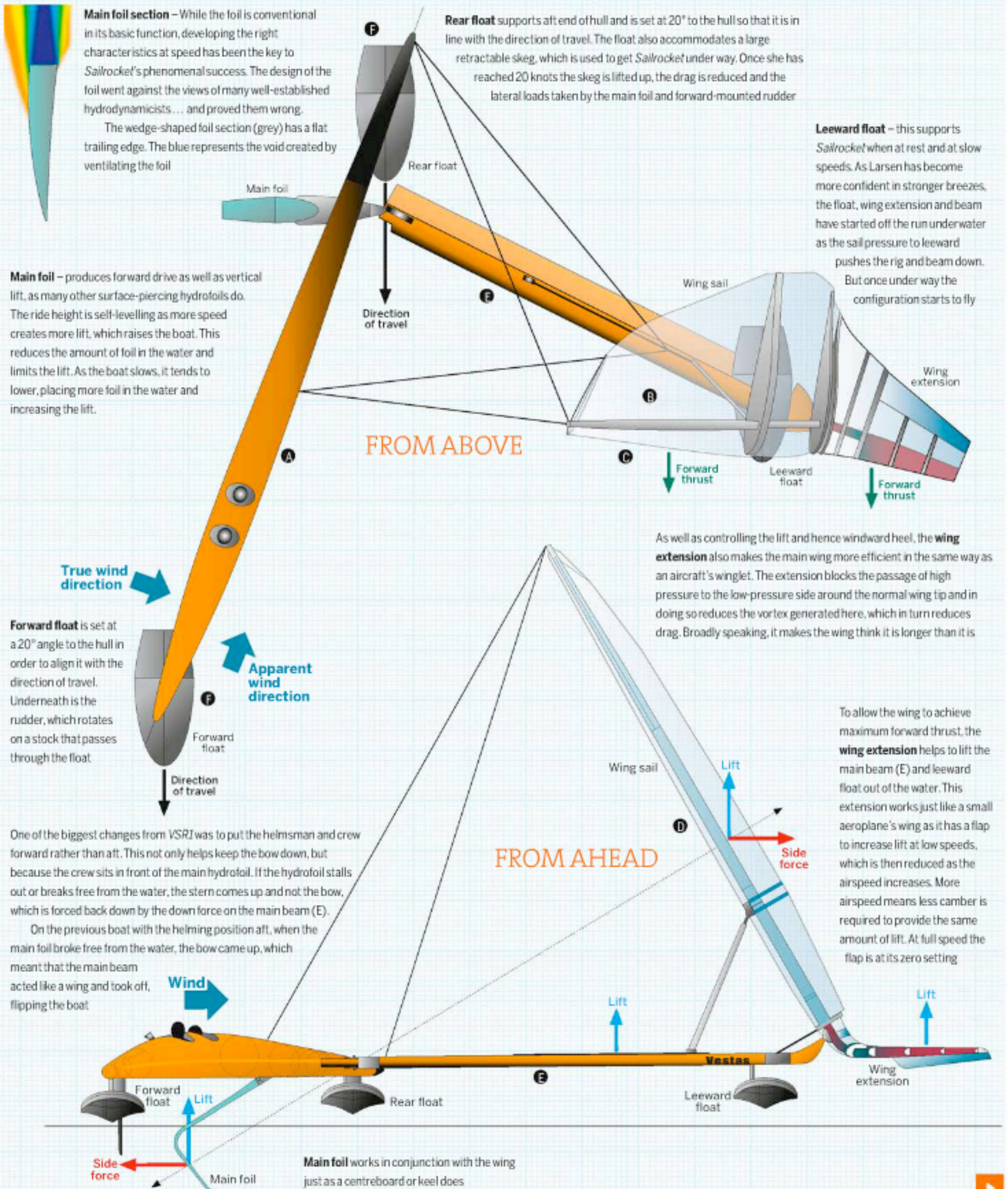
D Wing provides the main forward thrust and can be altered in its angle depending on conditions, just like the sail on a windsurfer.

Pull the tip of the mast to windward and the wing provides more vertical lift and less forward drive. Tilt the sail more upright and the opposite happens: more side force and less vertical force

E Main beam – this is an aerofoil section and provides vertical lift as the boat speed and hence airspeed increases. In early designs the beam was intended to provide all the lift, but this proved problematic. The wing extension solves the problem

F All floats have stepped hulls to reduce drag at speed. Both fore and aft foils provide the fore and aft balance for the main hull. The forward float supports the rudder stock, which extends through it. The unusual-shaped rudder blade steers the boat from the front

G If *Sailrocket* were a giant sailboard her crew would appear as depicted by the giant man in the drawing below



Main foil section – While the foil is conventional in its basic function, developing the right characteristics at speed has been the key to *Sailrocket*'s phenomenal success. The design of the foil went against the views of many well-established hydrodynamicists … and proved them wrong.

The wedge-shaped foil section (grey) has a flat trailing edge. The blue represents the void created by ventilating the foil

Main foil – produces forward drive as well as vertical lift, as many other surface-piercing hydrofoils do. The ride height is self-levelling as more speed creates more lift, which raises the boat. This reduces the amount of foil in the water and limits the lift. As the boat slows, it tends to lower, placing more foil in the water and increasing the lift.

Forward float is set at a 20° angle to the hull in order to align it with the direction of travel. Underneath is the rudder, which rotates on a stock that passes through the float

Rear float supports aft end of hull and is set at 20° to the hull so that it is in line with the direction of travel. The float also accommodates a large retractable skeg, which is used to get *Sailrocket* under way. Once she has reached 20 knots the skeg is lifted up, the drag is reduced and the lateral loads taken by the main foil and forward-mounted rudder

Leeward float – this supports *Sailrocket* when at rest and at slow speeds. As Larsen has become more confident in stronger breezes, the float, wing extension and beam have started off the run underwater as the sail pressure to leeward pushes the rig and beam down. But once under way the configuration starts to fly

As well as controlling the lift and hence windward heel, the **wing extension** also makes the main wing more efficient in the same way as an aircraft's winglet. The extension blocks the passage of high pressure to the low-pressure side around the normal wing tip and in doing so reduces the vortex generated here, which in turn reduces drag. Broadly speaking, it makes the wing think it is longer than it is

To allow the wing to achieve maximum forward thrust, the **wing extension** helps to lift the main beam (E) and leeward float out of the water. This extension works just like a small aeroplane's wing as it has a flap to increase lift at low speeds, which is then reduced as the airspeed increases. More airspeed means less camber is required to provide the same amount of lift. At full speed the flap is at its zero setting

One of the biggest changes from *VSR1* was to put the helmsman and crew forward rather than aft. This not only helps keep the bow down, but because the crew sits in front of the main hydrofoil. If the hydrofoil stalls out or breaks free from the water, the stern comes up and not the bow, which is forced back down by the down force on the main beam (E).

On the previous boat with the helming position aft, when the main foil broke free from the water, the bow came up, which meant that the main beam acted like a wing and took off, flipping the boat

Main foil works in conjunction with the wing just as a centreboard or keel does