

## Foiler for AC-2021

### Background

The idea of stabilising a monohull with canted hydrofoils is more than 100 years old. In 1903 Fredrik Ljungström (most famous among sailors for his furling, airfoil rig) patented hydrofoils for stabilising a monohull yacht. After the modified L-foils were successfully used in AC-2012, William Sunnucks and team installed T-foils, canted 20°, on the outer gunwales on his M-20/Vampire, so the active foil-system on the leeward hull worked as on a foiling Moth. This provides for more righting moment, hydrodynamic and structural efficiency than L-foils inside the gunwale. On the water they demonstrated that this worked much better than other foiling catamarans of the same size.

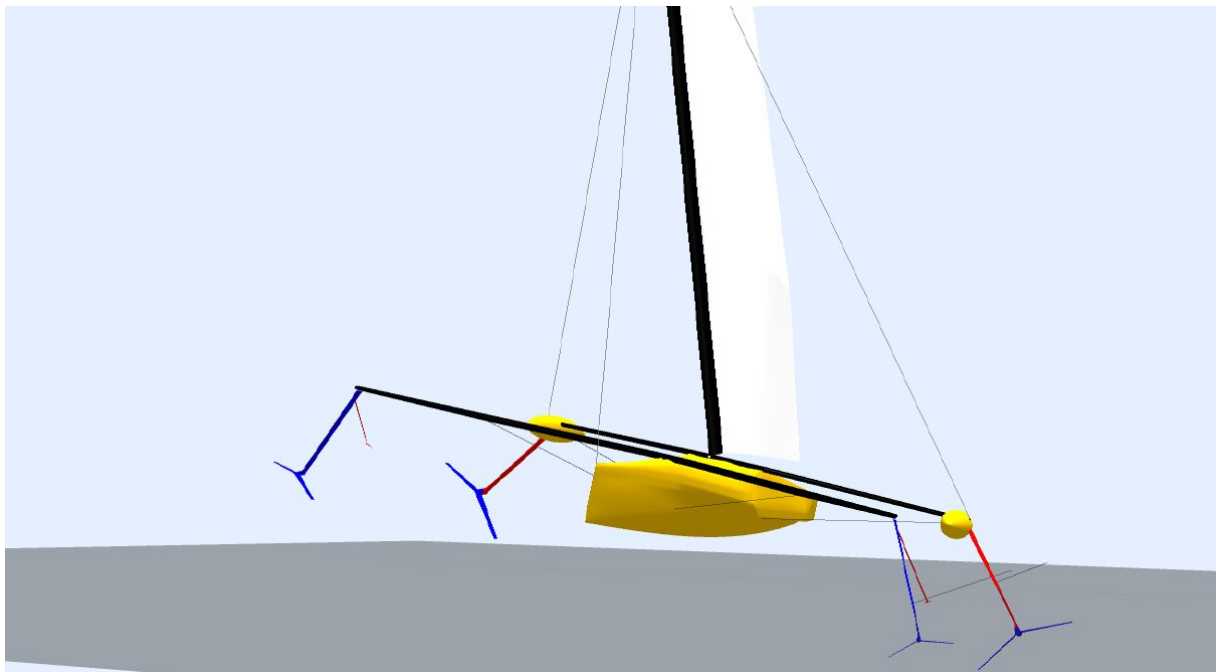
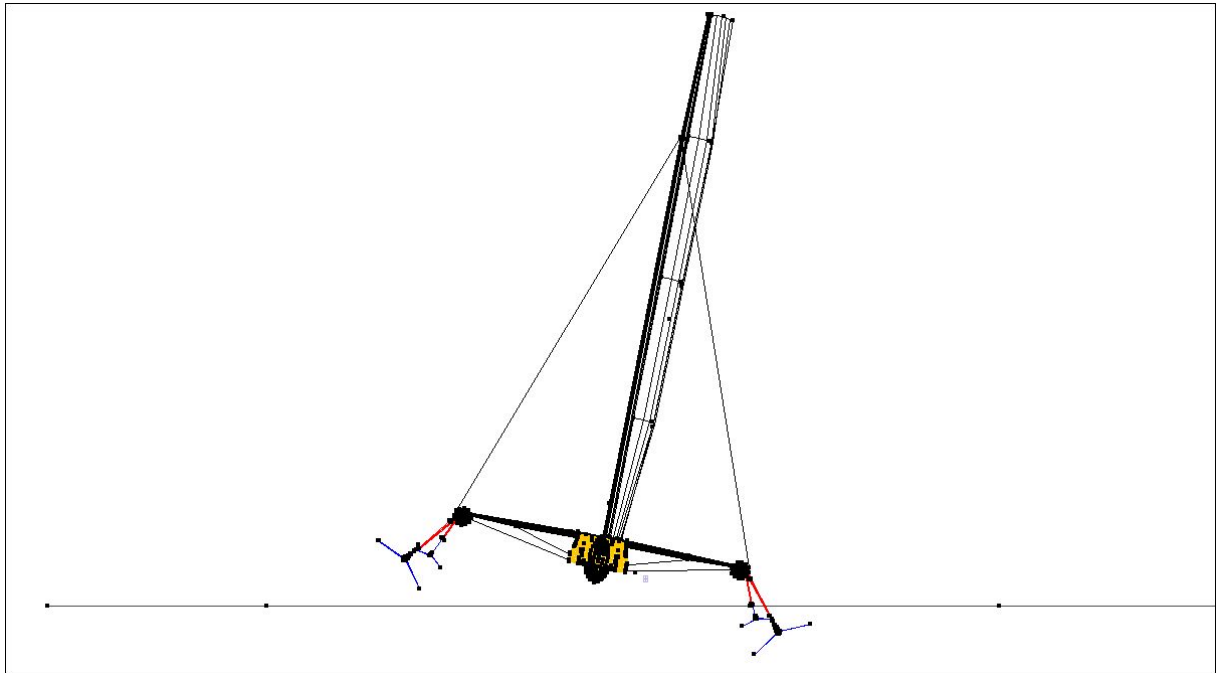
The new feature on the AC-75 is that the T-foils will carry ballast, which will increase the drag-angle some 1° at 30 knots. The ballasted foils will also require very powerful hydraulics. The boats may certainly work, but will be unnecessarily complicated, heavy and expensive. Without stored energy, shifting foils in each tack will require at least 50 kW, or some half minutes work by 4 very powerful grinders.

Another quite serious issue for the proposed foiler is that the rudder/stabilizer T-foil will be at the hull centreline, while the lifting main-foil is some 7 m outside that centreline. If the main-foil is controlled, so it flies on constant submergence, a sudden increase in heel, e.g. because of a gust, will cause the hull and hence the rudder-foil to rise, and in worst case leave the water, so stability and control are lost. Or they will have to use a very deep rudder, which will increase the drag further.

Provided that the rig is very light and the sail doesn't catch too much water, the AC-75 can be righted with the keels, yes. But if you make an ordinary capsize to leeward in the regular sailing configuration, you need energy (stored or from the grinders) to move the keels, so they can right the boat up. Pretty much as you can do with the unballasted foiler, (and many multihulls with buoyant masts) described below.

### An alternative configuration

If the requirements for the new boats are that it shall be possible for the sailing crew to easily right the boat on their own after a capsize, the boats shall be easy to tack or gybe and they shall be faster than non-foiling boats. I suggest something like this:

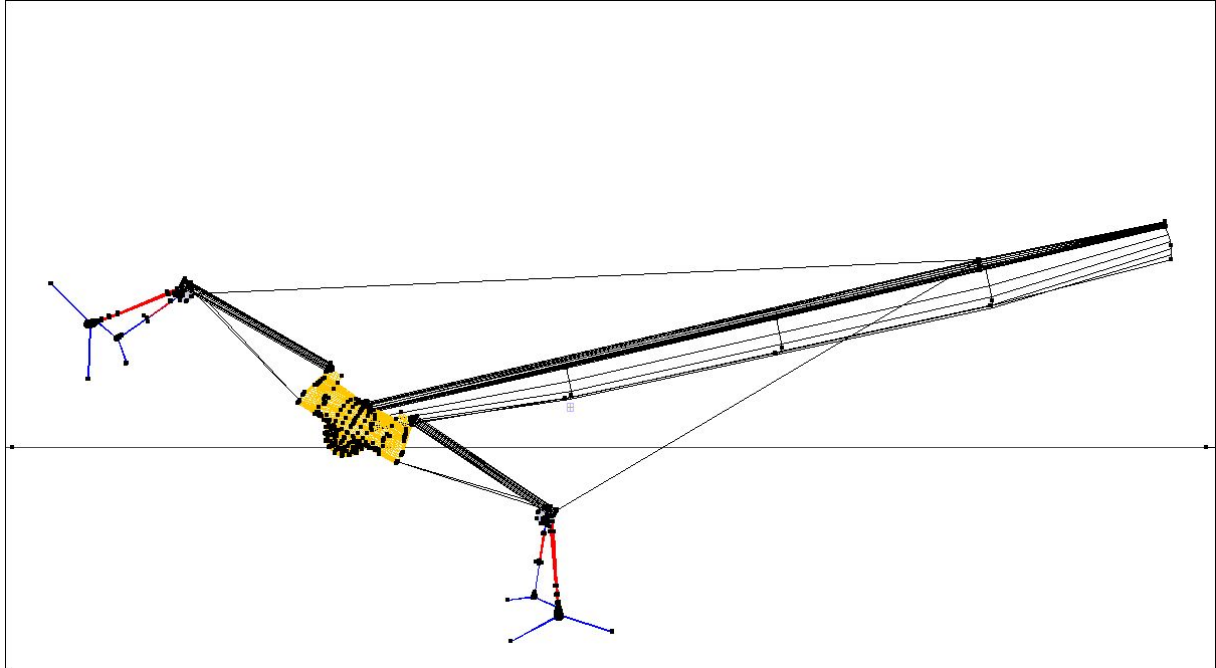


This is a foiler with canted T-foils on wide beams. The rear beam is equipped with floats with just the buoyancy required for lifting the rig out of the water after a capsize. When sailing, the main T-foils are fixed, and in the normal flight-mode the boat is heeled some  $10^\circ$  to  $15^\circ$ , so the windward foils are lifted out of the water. The crew is in the central cockpit when sailing, so no trampolines are required between the hull and beams. The shroud-base is wide, so a rotating wing-mast with diamond-stays is practical and also allows a light mast. The mast shall have about the same buoyancy as one float. In the pictures the boat has a canard-configuration. This allows for a simple and stable automatic altitude-keeping with a wand connected to the front foil. The surface-sensor wand and foils are almost on the same lateral position, so the heeling angle has no influence on foil submergence.

You can do foiling tacks with the foils in their regular position, but when entering the tack you trim the altitude a little higher on the leeward foils just before letting the windward foils enter the water.

The shrouds are adjustable so the mast can be canted some  $20^\circ$  to windward for some increase in speed on a long tack.

After a capsize you can use the old idea with the adjustable shrouds to rise the boat like this:



The foils will be so light that the crew can retract them manually. Then the draft is 0.5 m, so the boat can be moored on shallow water. There have also been developed several systems to fold the beams on trimarans. If necessary one of them can be applied.

**This proposed boat can sail more efficiently than the AC-75 without any reconfiguring of appendages or movement of ballast in tacks or gybes. The only system for handling the boat besides steering and normal trimming of the sail is the winch for the adjustable shrouds. This is certainly easier than handling the 2 swing-keels of the AC-75.**

**This was one possible configuration for an efficient and practical course-racing boat and there are certainly others that may work as well or even better.**

### The new class-rule for America's Cup 2021

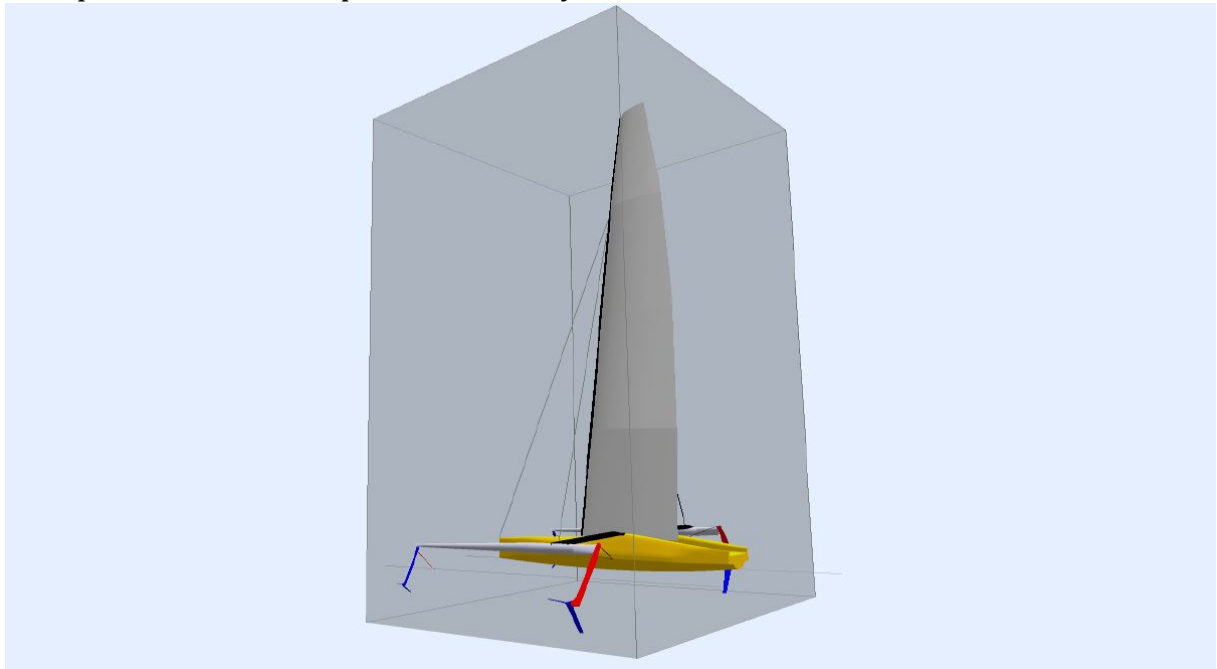
It has been announced that there will be a box-rule. But there is a serious risk, that the parameters will be adapted to the concept-boat of november 2017. If there e.g. is a minimum weight, there may not be so much advantage to make more efficient configurations.

The design-element of the Cup would be more interesting if the teams were able to develop more efficient, reliable and less complicated boats than the ballasted twin swing-keel foiler of november 2017.

If the development work in the America's Cup shall be meaningful, the class-rule shall be as open as possible. Such a rule shall only require reasonable safety and practical characteristics.

I suggest something like this:

- 1) The boat, ready to sail, shall fit inside a box, say 75 x 75 x 110 feet.
- 2) The onboard sailing crew shall be able to right the boat after a capsize in less than 10 minutes without any outside assistance.
- 3) If any system for storing energy shall be allowed, the energy of that system must be higher at the finish than before the start.
- 4) The sailing crew shall be able to haul down the sail(s) in 10 minutes on the water, so the remaining parts of the rig has a maximum projected area less than 500 square-feet.
- 5) There may also be a rule specifying that the boat shall be able to be dismantled for transportation in some specified time, say 12 hours.



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