WEIRD OR WONDERFUL?

THE STRANGE LOOKING PROTOTYPE INFLATED WING SAIL IS TRULY INNOVATIVE. MATTHEW SHEAHAN SAILS A CONCEPT THAT COULD MAKE SAILING MUCH EASIER

As the mist rose off the water's surface in the picturesque harbour of Morges on the north bank of Lake Geneva, only the gentle buzz of a small air compressor broke the tranquillity of the picture-perfect setting.

Few of those passing by on their morning stroll along the Swiss dockside would have thought anything odd, doubtless putting the noise down to someone inflating a car tyre or jetwashing a dinghy. And, unless they'd stopped, even fewer would have noticed what was really happening as the head of a black sail started to rise above the quay.

Getting ready to go sailing on Edouard Kessi's converted 5.5m yacht with its towering una-rigged wing sail is very simple. Climb aboard, flick the switch and wait two minutes as the compressor pumps air into a five-section, telescopic aluminium mast which rises within the black sail cloth neatly stacked on the boom. ›

Photos by Paul Wyeth

‘FOR MANY, SUCH RADICAL CONCEPTS HAVE A DRAWBACK – THEIR APPEARANCE’

Once the mast has reached full hoist and the sail is up, the main pump stops and there is only the gentle hum of two small fans in the leading edge of the wing, responsible for inflating the sail. From there, you simply slip your lines, sheet in and sail out.

Even in this snug little harbour, with its maze of pontoons, piles and mooring buoys, sailing is easy – this rig has no shrouds and can rotate through 360°.

But these advantages are still just fringe benefits of a prototype design that is truly innovative.

The Inflated Wing Sail (IWS) is the brainchild of Edouard Kessi and his business partner, Laurent de Kalbermatten. Both have reputations for lateral thinking and have impressive track records in making wild ideas come to life (see page 32). But even when you know their backstories, this rig is so different that it takes a while for the true benefits to hit home.

Broadly speaking, the IWS is simply an alternative to a time-honoured concept. From modern interpretations of ancient junk rigs, to the Freedom rigs of the 1970s and 1980s and then the AeroRigs of the 1990s, it was the ease of handling and the efficiency of the sailplan that were among the key advantages. The same is true of the IWS. Yet, no matter how worthy the technical attributes, for many such radical concepts have a drawback – their appearance.

In the deeply conservative world of cruising monohulls, few want to stand out from the crowd. I’ll admit that when I first saw the IWS, I too was sceptical about whether its benefits could outweigh its unusual looks. But having sailed the boat I am far more convinced that it is.

How it works

Setting aside the inflatable aspect for a moment, the first issue to deal with is the wing itself.

It’s a fact that symmetrical wing sections are more efficient than soft sails, and while solid wings have been around for some time, broader acceptance came just over 10 years ago when the America’s Cup switched to cats for the 34th Cup in San Francisco. Although wingsails had been around for many years before that, the resources thrown in during this Cup cycle meant that development was rapid – and so were the results.

It took little time to prove that wingsails are aerodynamically efficient, have very low drag, can operate at much lower apparent wind angles and provide more power through a tack, which is good for a high windage multihull with poor manoeuvrability.

But solid wings have downsides too, most notably that it’s harder to stop them producing driving force, harder to raise and lower them, impossible to reef them and storing them is a major hassle.

In addition, they are heavy unless built from high tech materials, are expensive to produce and invariably fragile. All of which adds up to a concept that doesn’t lend itself well to normal boats in the real world.

This is one of several key areas where Kessi and Kalbermatten believe they have an advantage.

“The telescopic 13m tall mast is a straightforward ›

Edouard Kessi and business partner Laurent de Kalbermatten created the Inflated Wing Sail (IWS) and have proved its versatility on a 5.5m hull

SPECIFICATION

IWS Prototype	
Hull	former 5.5m racing yacht
Mast height	13m
Mast construction	5 x section pneumatically raised
Sail area	42m²
Sail pressure	1.5g/cm²

‘BECAUSE THE SAIL PRESSURE IS LOW, WE DON’T NEED TO WORRY ABOUT LEAKS’

Sailcloth is inexpensive basic parachute material which folds down to minimal size and requires only light pressure to keep inflated. Reefing simply requires lowering the mast and hauling on a reefing line

‘THE TELESCOPIC MAST IS AN OFF-THE-SHELF ITEM FOR PHONE MASTS’

off-the-shelf item used for temporary phone masts,” said Kessi. “The sailcloth that we use is basic parachute material; it’s not expensive, it’s very light and the pressure that we need to achieve to keep the sail inflated is just 2 millibars, around 1.5 grams/cm^2. That’s more than a thousand times less than the pressure in your car tyre. And because the pressure is low, we don’t have to worry about leaks as it take so little to keep it inflated.”

Indeed, under sail, Kessi encouraged me to unzip the bottom inspection hatch of the sail. Aside from a light flow of warm air across my face, nothing happened to the sail.

As on any unstayed rig, there is no load from the shrouds carried into the chainplates, which would in turn transfer the load through the reinforced hull. There is no mast compression either. Instead, the main load on the rotating, keel-stepped mast is a bending moment around the deck. This area does carry load but because the rig is light, along with the better aerodynamic efficiency of the sail, the loads here are not unduly high. Put simply, the boat can be lighter without compromising performance.

“A lack of heeling moment is another big benefit of this rig because the wing itself is more efficient at generating lift,” Kessi said. “The load distribution is more efficient too as the aerodynamic forces act through the mast rather than behind it. You can think of the IWS as like a balanced spade rudder where you’d expect the feel to be neutral when compared to an old fashioned rudder blade, where the area is all behind the stock.”

You can feel straight away when you get under sail that there is very little feel on the helm. Even when you over sheet the sail, the helm balance barely changes. This is good and bad. In general, if you’re fighting control you are putting drag into the system somewhere. For example, the load associated with weather helm means that you’re pulling the rudder sideways through the water, inducing drag as you go.

A new set of skills

But the lightness of the helm and the general lack of feel aboard the IWS takes some getting used to.

To add to this lack of feedback, the sail doesn’t physically deform or backwind like a conventional sail does when you luff. Plus, wingsails operate at much smaller angles of attack than soft sails, so while the IWS is not that efficient at 20° to the apparent wind, it is still driving.

The upshot is that finding the groove in the normal sense is tricky at first, especially as the telltales on the wingsail don’t move. Why would they? The airflow hasn’t stalled at 20°.

Instead, to get to grips with the rig and the boat you have to watch the Windex, which is mounted on the bow. It’s not hard; it’s just different.

When you do look up the mast, even in flat water and light winds, the tip is gently wandering around in the sky, moving around like a tall, mature conifer in the breeze. The movement in the sail further down as the sail’s ribbed sections flex like a set of giant bellows is an indication of what the mast is doing inside, yet still you feel little on the helm that relates to this motion.

The mainsheet is also very light. In fact, the only reason you sheet it in is to provide a small angle of attack to create a difference in aerodynamic pressure. That also creates a little bit of feel, but it’s way less that you would be used to.

“If you let the sheet go the boat will continue to sail no matter where you put the bow,” said Kessi. “The wing has no idea or interest in where the front of the boat is. So long as there is air passing over the sail and there’s a difference in air speed from one side to the other, the sail just keeps developing lift.”

We started our sailing trials in around 4-5 knots of breeze, hardly the best conditions to test such a radical concept. Yet even so, the boat sailed upwind at ❯

Below: control lines feed up inside the sail. Right: mast is keel stepped but unstayed

‘THE SAIL FLEXES LIKE A SET OF GIANT BELLOWS’

over 3 knots. When the breeze got up later in the day to around 6-8 we were positively barrelling along by comparison at around 5.3 knots.

Through manoeuvres, tacks are the same as for a conventional rig, while gybes can be executed in the normal way or the rig can be rotated around the bow.

Either way, the typical shock loads and drama that go with a hard gybe on a conventionally rigged boat simply don’t exist as there is nothing for the boom to hit. Only cleating the mainsheet would achieve this on the IWS and there’s no reason to do that. As a result, the boat is extremely nimble.

When it comes to reefing you simply let air pressure out to lower the mast and haul in on one of the reefing lines, which operate internally. In fact, the lines work more like internal lazyjacks and prevent the sail from spilling over the edge of the boom, which Kessi refers to as the ‘nest’.

A real world solution

The ease of handling, both under sail and in and out of harbour, is clear to see. So too is the appeal of a rig that can be reduced in height as the breeze and sea state get up.

The technology and materials are pretty straightforward too – there is little cutting edge about the hardware itself.

In the superyacht market, sailhandling is a big deal, but in the arms race to go bigger and better so, too, is the problem of getting under some of the world’s key bridges, not least the Centennial Bridge on the Panama Canal, the gateway between the Atlantic and Pacific.

As the world seeks ways to reduce the emissions of the most polluting vessels (just 15 of the biggest ships emit more of the noxious oxides of nitrogen and sulphur than all the world’s cars put together, according to a report in *The Economist*), Kessi and Kalbermatten believe the IWS provides plenty of viable answers for the shipping world.

But perhaps the most telling indication that the system could find its way into the sailing scene is adoption by the world’s biggest boatbuilder.

“Beneteau is currently working towards producing a new cruising cat with an IWS rig that will be available in two years time,” said Kessi.

When and if it does, IWS will have proved that it is more than an overinflated idea. ■

The IWS-powered yacht under way on Lake Geneva

EDOUARD KESSI

Sails, advanced technology and inflatable structures have been a large part of Edouard Kessi’s professional life. He remains a keen and successful sailor and still holds the record for the fastest time for the annual race on Lake Geneva the Bol d’Or.

In the 1970s, he worked for the innovative designer Lars Bergstrom at Windex. He then went on to team up with Gérard Gautier and co-founded the sailmaking company Voiles Gautier in Switzerland. The pair worked closely with DuPont, leading to Kessi and Gautier producing some of the very first Kevlar sails in the 1980s.

But sailing wasn’t his only interest and in the early 1980s he developed the first paragliders and worked with inflated textiles for over 15 years with his company, Ailes de K.

From there, Kessi and Gautier were behind the groundbreaking black sails for America’s Cup team Alinghi in 2002, creating technology that was sold to the North Sails group to then become 3Di. After that came the co-founding of North TPT (Thin Ply Technology) in 2010.

Among the many projects he was involved in was the giant inflatable hangar for Bertrand Piccard’s Solar Impulse project that housed the giant solar powered plane with its 100m wingspan during its pit stops around the world.

“The hangar was crucial to the success of the project as once the plane had landed it was so lightly built there was no way to tie it down, so we needed to put it away quickly in advance bad weather. It took 10 people five hours to build the hangar, which didn’t require any cranes to assemble.”

Two years ago he started work on the Inflated Wing Sail through his company Next technologies Sàrl.

LAURENT DE KALBERMATTEN

Flying has been at the heart of Kalbermatten’s world since he was a teenager. At just 18 years old he became Swiss hang gliding national champion in 1974. Aftter studying economics at university and working in private banking, in the 1980s he changed careers to aviation.

He is a fixed wing and helicopter pilot and co-founded Ailes de K with Kessi to build the first paragliders.

Among his many projects, he developed a powered aircraft that can be packed into the boot of a car and uses an inflatable wing, the ‘Woopy’. The development of this aircraft was instrumental in creating the IWS.