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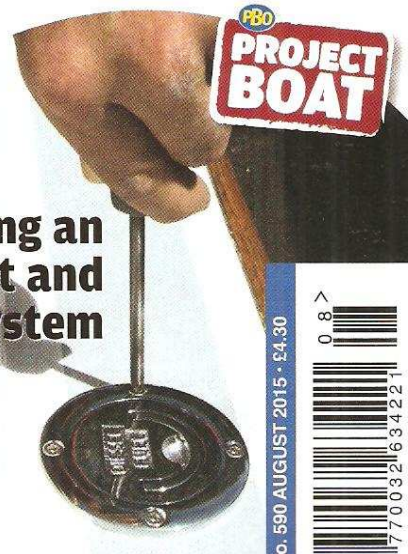

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Haber 34: the boat that sails by computer

A shoal-draught cruising yacht that holds her course in any conditions and on all points of sail with no help from an autopilot or windvane? It really does exist – as David Harding reports

All sorts of things have happened in yacht design over the past few years. Catamarans with rigid wing sails fly around on foils. Racing monohulls have sprouted canting keels, horizontal daggerboards, carbon-fibre bowsprits and giant asymmetric spinnakers that allow them to plane downwind at speeds undreamed of by sailors from earlier generations.

And cruising yachts? Well, they've grown a bit higher and wider, their ends have become shorter and their keels sometimes have bulbs on the bottom – but, in terms of the headlines, that's about it. Sounds a bit boring by comparison.

This gradual evolution in cruising-yacht design is only to be expected in a sector of the boating world that's conservative for good reason. It doesn't mean that designers and builders haven't been coming up with good ideas, great designs or inspiring combinations of features, because they have. What it does mean is that it might be a few years before a wing-sailed, 33ft foiling catamaran or a planing monohull with water ballast and a canting keel takes over the centre ground from the likes of the Bavaria 33. By the time that happens, maybe foils and wing sails will be considered old hat anyway. Who knows?

In the meantime, if you want to see one of the more interesting and potentially practical new ideas to be incorporated into a cruising yacht, have a look at the Haber 34C4 (Haber being pronounced Harber – let's get that right straight away). Here's a deck-saloon cruiser with four computer-controlled centerboards that are raised and lowered automatically to keep her on a constant course relative to the wind. Since this is the real world, they can also be controlled manually, or electrically via a touch-screen.

Does that perhaps sound a little far-fetched? After all, if you want a boat to steer herself, what's wrong with an autopilot or windvane self-steering? That's what most people use, because those are about the only ways of getting a boat to sail herself for prolonged periods unless you have one that's blessed with remarkable directional stability or kept on track by an alternative such as a sheet-to-tiller arrangement.

Achieving balance

For most people and most boats, a windvane or autopilot is a perfectly good solution – as far as it goes. But Janusz Konkol – an innovative and free-thinking sailor, designer, engineer and boatbuilder from Poland – doesn't see either of them as the answer because, in his view, they're having to compensate for imbalances that are a natural characteristic of a sailing yacht.

Every sailor worth his or her salt knows that a boat's balance changes according to a host of inter-related factors including point of sail, wind strength, sea state, sail plan, sail trim and, most importantly, angle of heel. These changes in balance result in a turning moment one way or the other: most of the time the boat is trying either to round up or to bear away. The helmsman compensates by turning the wheel or moving the tiller accordingly, angling the rudder to force the boat to go the way he wants – effectively against its will. Any given boat will need a very particular combination of sail trim and heel angle to achieve perfect balance and hold her course with the helm unattended.

In a way, rudders are a necessary evil, because every movement slows the boat down by presenting the blade at an angle to the water flow. Beyond a certain angle – either of heel or to the centreline – a rudder will stop working anyway.

Of course, it's faster to steer vigorously to avoid a broach or to get surfing or, going upwind, to save slamming into a steep wave, but in a way it's like turning the wheel in a car: when the tyres are no longer in line, you're burning rubber and increasing friction.

There's also a big difference between helming for speed, as it were – playing the waves or

The sail plan works well goose-winged on a run

She's a chunky boat, but the Haber 34C4 can get a move on

responding to a shift – and playing tug-of-war with the helm to keep the boat on course. If constant weather helm means you're dragging the rudder sideways through the water to stop the boat rounding up, something's wrong. Perhaps you're simply heeling too far, or it might be a case of too much power in the mainsail in relation to the headsail resulting from any number of sail-trim factors. Then again, that extra chain you added to the anchor might have moved the CLR (centre of lateral resistance) further forward by inducing bow-down trim. It can make a difference.

Many elements have a part to play, and the question of how they relate to each other and how they affect your day-to-day sailing is one that we have addressed within these pages on many occasions. If you fancy a refresher, have a look at 'Curing lee helm' (PBO April 2006) and our Boat Skills series (November 2008 to January 2009).

After that – or, ideally, before – get in a dinghy and go sailing. Remove the rudder and tack and gybe your way around a triangular course without it. Sail backwards. Sail upwind without the centreboard. Make the boat perform pirouettes and handstands. Go out when it's blowing old boots, then go racing, get to the top of your club fleet, give the big guns in your class a few scares in open meetings or national events, and do some team-racing or match-racing. This way you will develop an instinctive feel for the balance and dynamics of sailing for which there is simply no substitute.

Whatever and wherever you sail, you will become a better sailor for this seat-of-the-pants experience. And getting to grips with some of the theory is no bad thing either. Should all this be more than you have time for this afternoon, however, or right now you're more interested in learning what this Polish boat with four centreboards is all about, then just keep reading.

Better with boards?

For Janusz Konkol, achieving balance in a cruising yacht is all about safety and comfort: reducing the load on both the rudder and the crew, and creating a boat with an easier motion that will also be better able to cope with heavy weather. Maintaining a constant course helps the sails to work more efficiently, too, contributing to greater speed.

Unfortunate things do happen in extreme conditions. A boat can be broached by steep following seas, a serious broach potentially leading to a man overboard, a knockdown, or an inversion and possible dismasting.

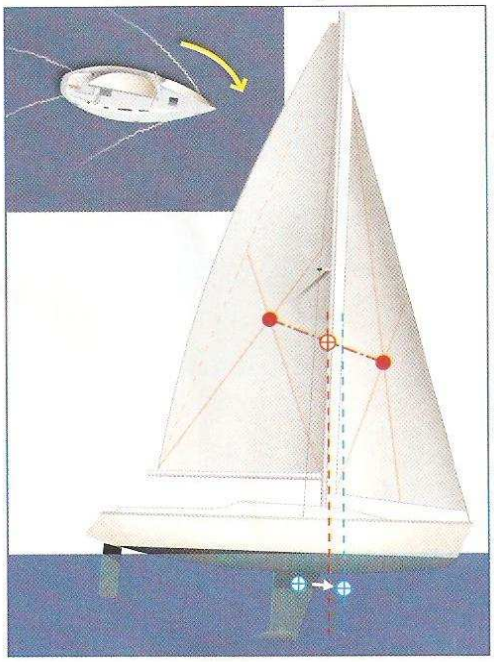
Keels can fall off, whereupon a boat will roll over and quite possibly sink. Rudders break, leading to loss of control and, in some instances, to water entering the hull. Halyards can fail or sails tear, whereupon a boat might be compromised by a sail plan that upsets her balance and makes her hard to handle or to sail efficiently. Despite their lower centre of gravity, boats with deep fin keels are more prone to being knocked down by a breaking wave than are shallow-draught alternatives that can slide sideways instead (assuming the latter are properly ballasted).

Thankfully these sort of incidents are relatively rare – but they're not unknown. Many of us have friends or acquaintances with first-hand experience of such things. I know people from two crews who have been airlifted from their yachts in mid-Atlantic following keel bolt failure. Two people I knew have lost their lives at sea in heavy weather, also in the North Atlantic.

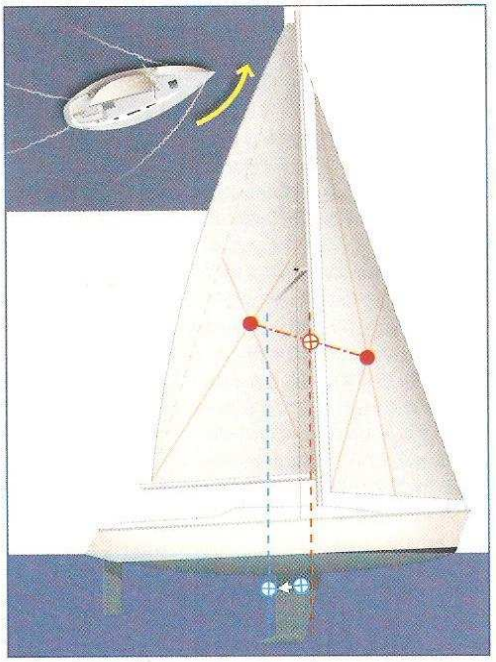
On a less dramatic level, I lived through a particularly unfriendly gale in Biscay on a 30ft trimaran that got us through unscathed. A deep-keeled monohull of similar size in the same area was rolled through 360° and limped into Madeira some time after us with a broken spreader – a lucky escape.

Such things can and do happen, but Janusz Konkol is devoting his working life to the creation of boats that minimise the risks as well as offering practical advantages for everyday sailing. Janusz has decades of racing and cruising experience in the Baltic – a stretch of water not known for its benign nature. He spent many years racing quarter-tonners, surviving some pretty extreme conditions during passage races and becoming aware of ways in which yachts can make life difficult or

Fore-and-aft trim can turn the boat

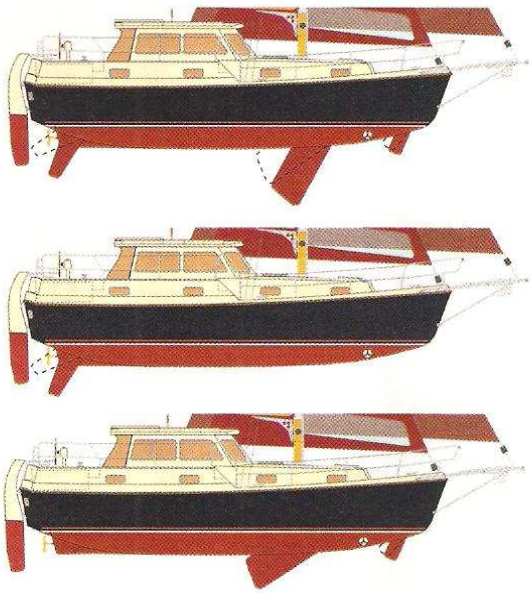


Bow-down trim moves the centre of lateral resistance (CLR) forward and the boat rounds up...



...but if she's heavy at the stern, the CLR moves aft and can encourage a tendency to bear away

Shifting centres: board control



All boards down: the bow board, main board and two at the stern

Downwind, lifting the bow and main boards moves the CLR aft

Upwind under just a storm jib, the CLR can be moved forward

dangerous for their crews. These included their propensity to broach downwind, to be knocked down by steep seas and to be hard or impossible to sail upwind under seriously reduced canvas, such as a storm jib on its own.

One of the biggest problems, he realised, is that the crew has no control over the boat's centre of lateral resistance (CLR), other than that effected by heel or fore-and-aft trim. By contrast, the rig's centre of effort (CE) moves forward or aft according to the sail plan, sail trim, point of sail and other factors, so it's little wonder that a state of imbalance is the norm. Surely the logical approach, figured Janusz, is to develop a way of shifting the CLR forward and aft as well?

Safety downwind

His project started with the fitting of twin retractable (external) boards to the stern of some relatively small designs with conventional centreboards. Moving the CLR aft by raising the main board and dropping the stern boards allowed the boat to pivot from a point further aft, becoming directionally more stable and less prone to broaching in a following sea.

It's a simple concept and it worked. Trials showed it was even possible to maintain a course, without anyone at the helm, under bare poles dead downwind or, in heavier weather when you don't want to be dead downwind, on a broad reach. Most boats lie with the wind on the beam (plus or minus a few degrees) if left to their own devices, which is one reason for the towing of warps or the use of drogues or sea anchors. There will always be situations when drogues or sea anchors will be needed – to maintain sea-room, for example – but having a boat that will steer herself and behave well in following seas rather than demanding constant attention at the helm is no small deal.

I can vouch for the fact that hand-steering a small boat for hours on end, at night, after two days of a full gale, listening for the roar of a breaking crest over your shoulder, fearful of the consequences of a broach and bracing yourself to make sure the tiller doesn't pull you across the cockpit is not a relaxing or enjoyable experience, especially when there are only two of you on board. In those conditions, most autopilots just couldn't cope.

For Janusz, the combination of stern boards and a centreboard pretty well sorted the downwind issues. Next he turned his attention to upwind sailing in heavy weather. There can come a time when you have to reduce sail to a storm jib and trysail – or perhaps just a storm jib. He's been there and done that.

The trouble with trying to make upwind in strong winds and heavy seas with only a storm jib is that the bow is in prone to being knocked off by the waves, making it hard to regain enough speed to establish steerageway and generate the lift from the keel necessary for clawing your way to windward. Sometimes the only answer is to use a heavily-reefed mainsail or a trysail as well, which is more canvas than you need and gives you more speed than you want. The result is that you crash into, through and off the waves harder and faster than is good for either the boat or the crew.

That's when you need a bow board. With just the storm jib, the rig's CE has shifted forward. So you raise the stern boards as much as necessary, partially raise the centreboard and lower the bow board to move the CLR forward. Balance is restored, the bow is no longer knocked off and you can continue to make upwind at a gentler pace.

Such a configuration might also be necessary if you have lost or broken the main halyard, for example, or damaged the mainsail. It increases your options.

With a centreboard, two stern boards (one each side, windward/leeward) and a bow board the CLR can be shifted wherever it's needed to achieve balance.

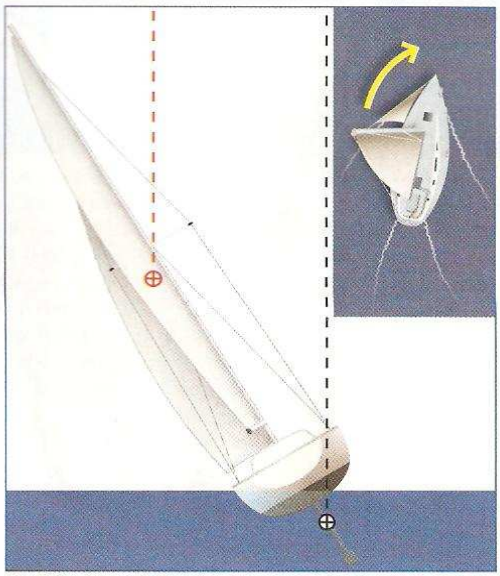
We introduced the concept in PBO November 2009, after I had sailed a Haber 800C4 with Janusz from one side of the IJsselmeer to the other without touching the tiller.

Getting bigger

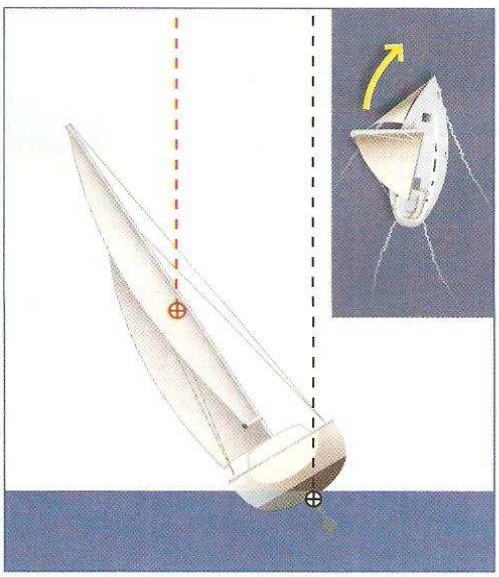
The Haber 800 is a 26-footer with a deck saloon to offer all-round visibility from down below, shelter in the cockpit, plenty to hold on to when moving forward on deck and, importantly, a positive righting moment all the way to 180°. She also has what Janusz calls the Huari gaff rig – a sort of high-peaked hybrid between a gaff and a gunter that uses a single halyard. It keeps the main mast short, so no spreaders are needed, and means the height of the rig is reduced when the sail is reefed or the mainsail lowered altogether in heavy weather: less weight and windage aloft. Shallow draught and easy mast-lowering make her well suited to inland waters as well as to offshore sailing.

Not surprisingly, her big sister follows the same theme. She

Moving moments: the long and the short of it



The relative movements of the CE and CG on a boat with a tall rig and deep keel induce a substantial rounding-up moment...



...while the effect is appreciably less when the rig is shorter and the centre of gravity is higher

Here the boat is sailing along happily with the rudder fully raised

In one easy move, Janusz initiates a tack

spreads her canvas fore-and-aft instead of vertically which, points out Janusz, keeps the rig's centre of effort closer to the centre of gravity when the boat heels, thereby reducing the rounding-up moment and the relative differences in balance between a boat that's heeled and one that's upright. Internal ballast helps in that respect, too.

The effect of heel on a boat's course is something that many sailors underestimate. Wherever the rig's centre of effort because of the sail trim, if a boat is heeling too far it will usually win the battle with the helmsman.

On the 800, you adjust the boards manually, using control lines on the bow and centre boards and rotating handles on the stern boards (as in fully manual mode with the 34C4). The big development with the new boat is not only the option of electrical control via a touch-screen that shows the position of each board, but also the use of a computer program that allows you to go a step further by making the adjustment of the boards fully automatic. When automatic mode is selected, the program raises and lowers the boards to keep the boat on a course relative to the apparent wind. You enter the wind angle you want, trim the sails accordingly and the system does the rest. Watching the screen, you see each board going up or down according to whether the boat is sailing too high or too low.

At the moment the automatic system can't be used in conjunction with an autopilot to maintain a compass course; that's something Janusz has in mind for future development. In the meantime, there's no reason why the boards can't be controlled in manual or semi-manual (electric) mode and used with a conventional autopilot. Anything that improves a boat's directional stability will reduce the load on the helm and make an autopilot's life easier, allowing it to continue working in conditions when it couldn't otherwise.

During my three days of testing in the Gulf of Gdansk – which involved some night sailing too – Janusz's programming team was on board, using the time to refine the software. Every deviation from course and every movement of every board, together with the wind strength and angle, was recorded and adjustments were made if necessary to improve the response in certain situations.

It's clear from the wake that she's turning at a good speed...

...and the tack is complete. A video of this is on Haber Yachts' website

Nerve centre: the controls for raising and lowering the boards. Systems for manual operation are fully independent from those used in automatic and electrical modes, to provide a complete back-up

The big question, of course, is does it work? The simple answer to that is yes, it does. It's not yet perfect – it struggles very occasionally in fluky and changeable conditions – but most of the time it's impressive. On our first afternoon, in about 15 knots of wind, we set off on a broad reach with the bow and main (centre) boards up, experimenting with combinations of rudder and stern boards. The rudder isn't used for steering unless you're actively helming the boat. It's locked in a central position, or offset a few degrees if necessary, to provide extra area at the stern and help move the CLR further aft. In some situations – mostly in light airs – it can be raised entirely. Janusz's party trick is to tack without using the rudder. We did that several times. (How? Answers on a postcard, please).

Later that evening we had the boat sailing for lengthy periods in fully-automatic mode, holding a course to within 2-3° with 17-18 knots of wind on the beam. After dark the wind increased, gusting up to 35 knots. Still

under jib and full mainsail, and with our angle of heel never exceeding around 25°, we carried on with the system still keeping us on track to within a few degrees.

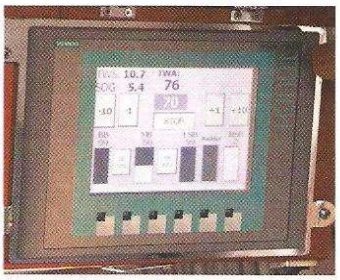
Balancing the boards

The best way to understand how the system of board-balance works is to sail in fully manual mode, as I tried off Gdynia on the evening of our second day. Set the boat up on any course you choose, trim the sails appropriately, see whether you're carrying weather helm or lee helm, then tweak the boards. If the boat wants to round up, move the CLR aft by lifting the bow board and lowering one or both of the stern boards all or part of the way. If she wants to bear away, lower the bow board and (partially) raise one or both of the stern boards.

Upwind in a breeze you will progressively raise the main board until, in a full gale or more, it's all the way up and you're using just bow and stern boards. This is exactly what the system does for you when you engage auto mode.

On the last day, in 25 to 30 knots from a more onshore direction that kicked up an appreciable sea, we headed over towards the Hel peninsula. We beat, we ran and finally we reached home from the town of Hel to the Wisła Miała (how many people can honestly say they've been to Hel and back?).

Janusz makes the point that, in fresher winds with the main board mostly or fully raised, the boat is subject to much less tripping movement than a boat with a deep keel. The result is a smoother motion, with the boat rolling less as each wave passes under the hull. She will need to be sailed a few degrees higher to compensate for the extra leeway, but the yawing, rolling and even the amount of spray finding its way

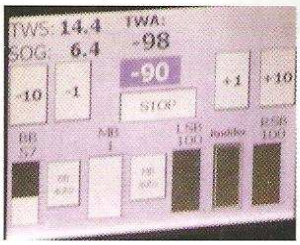


Here's the touch-screen display and control unit inside the companionway

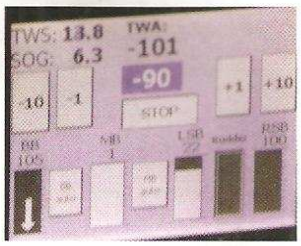
on deck are all less than you would expect. Boat speed can be improved, too, because a constant course ensures that optimum sail trim is maintained. If you're yawing through 20° or more, the sails will be wrongly trimmed much of the time unless the crew is working flat out. We maintained a regular 6-7 knots, which is perfectly respectable for a chunky 34-footer.

Even in variable conditions the C4 system copes better than many conventional alternatives. On one occasion we were on a fetch in a wind of over 30 knots which, within a couple of minutes, dropped to 12-14 knots. After a little whirring of winches to adjust the boards, the boat carried on as though nothing had happened. Even when, on another day, Janusz provoked the system by suddenly lowering and then raising the rudder (thereby moving the CLR), the aft boards responded and deviation from course was minimal.

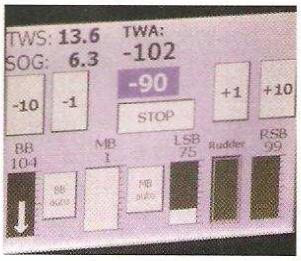
How wind strength affects a boat's steering – and how the centreboards respond



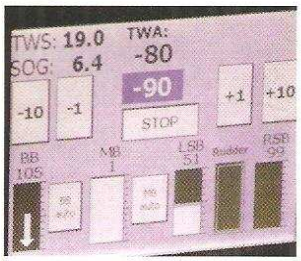
1 The boat has been sailing in a wind of 18-20 knots with the main board raised, both stern boards fully down (LSB is 'left' stern board; RSB is 'right' stern board) and 57% of the bow board down. A lull in the wind (it has dropped to 14.4 knots) allows the boat to dip 8° below her course



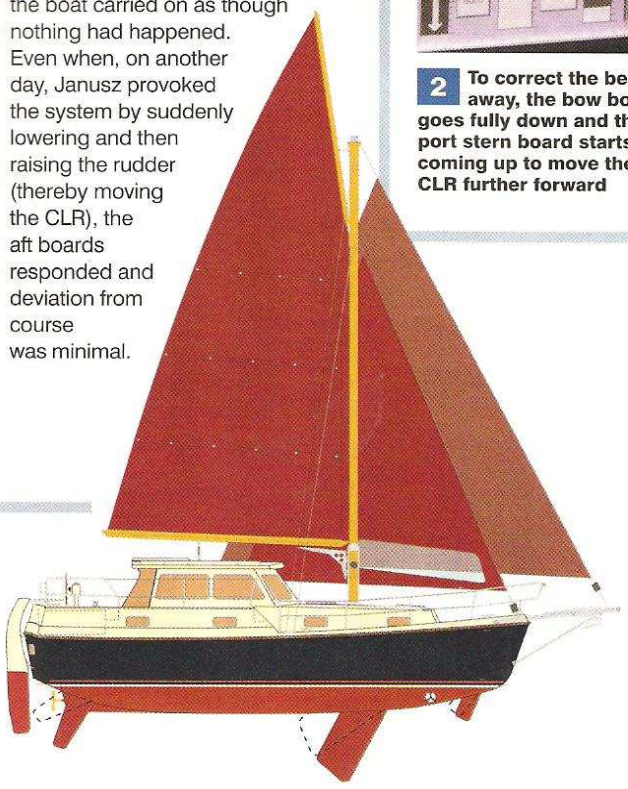
3 The port stern board comes most of the way up as the bow board stays down, helping her to start heading back up. Now, however, the wind has just started to pick up again, which acts to increase the rounding-up moment. Gusty winds are testing, because they affect heel and, therefore, balance

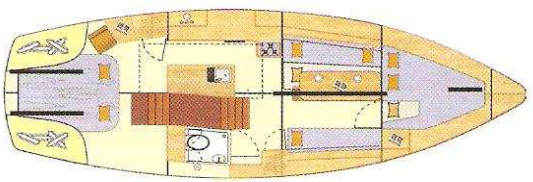


2 To correct the bearing away, the bow board goes fully down and the port stern board starts coming up to move the CLR further forward



4 Because of the extra wind, the boat is now slightly above her course, so the port stern board goes down again to help her bear away closer to the programmed angle





Tech spec

Haber 34C4

Price: from £206,000
Length including bowsprit: 12.50m (41ft 0in)
LOA: 10.50m (34ft 5in)
LWL: 9.40m (30ft 10in)
Beam: 3.65m (12ft 0in)
Draught: – centreboards down 2.20m (7ft 3in)
– centreboards up 0.70m (2ft 4in)
Displacement: 10,200kg (22,487lb)
Ballast: 3,000kg (6,613lb)
Sail area: (main & genoa) 65sq m (700sq ft)
Displacement/length ratio: 343
Sail area/displacement ratio: 14.0
RCD category: A
Engine: Yanmar 39hp
Designer: Janusz Konkol
Builder: Haber Yachts, www.haber-yachts.com

PBO verdict

The Haber 34C4 is an interesting and unusual boat that would be interesting and unusual even without the computer-controlled multiple centreboards. She's designed, engineered and built by Janusz and his team at a yard that not only builds boats – in glassfibre, composites, wood and aluminium – but also makes components in any material you care to name. Yards for the 360ft square-rigger, *Star Clipper*? No problem. Add some aluminium tenders to the order while you're at it, and don't forget the wooden blocks. As for the Haber 34, whether or not the concept of this particular boat appeals to you, the principles that Janusz is addressing in her design are of direct relevance to everyone who sails.