A simple brief

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'The fastest monohull sailing boat ever', the request given by duty-free shopping tycoon Robert Miller to his design team back in 2000. *Mari-Cha IV* co-designer Philippe Briand describes what happened next...

Six days, 17 hours and 53 minutes to cross the Atlantic Ocean. We could not have hoped for better. Co-designers Clay Oliver (USA), Greg Elliott (New Zealand) and myself were expecting a crossing in around seven to seven-and-a-half days.

The crew, with Mike Sanderson as lead helm, were able to get the very best out of *Mari-Cha IV*, the biggest racing yacht in the world, almost straight out the wrapper.

Thanks to SP Technologies' excellent structural calculations and the brilliant job done by the JMV shipyard, the boat had no structural problems whatsoever. Quite rare, in fact, and an extremely pleasant state of affairs for a racing yacht designer.

Certainly, however, there was no set date for the event, no predetermined competition date. And both the time and the means necessary were made available to the project, managed overall by Jean François (Jef) d'Etiveaud.

It all started out in a bar in Ponsomby, Auckland on 20 March 2000. A temperature of 30°C and Team New Zealand's recent victory combined to make for a joyful atmosphere. This was the first time I had met Clay Oliver, a VPP specialist and Team New Zealand's naval architect, with his 'Harrison Ford' physique, together with Greg Elliott, the pragmatic New Zealand architect, something of an iconoclast, and creator of many winning ULDB yachts in the Pacific zone.

The fathers of the project, Mike Sanderson (aka 'Moose') and Jean François d'Etiveaud, set out a design brief that could be summed up in a single line: 'to beat the monohull transatlantic record under sail'. That was the long and the short of it.

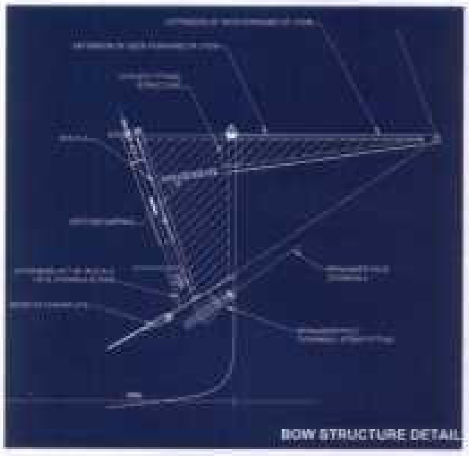
We had a clean sheet of paper (dangerous in careless hands), and we had the experience of *Mari-Cha III* (I had been onboard myself during the previous transatlantic record set in 1998), but a yacht like that was simply too powerful to be pushed at 100 per cent for any length of time.

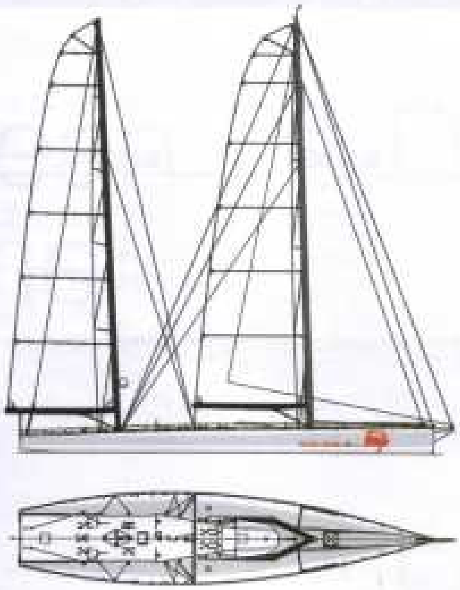
Through the course of successive meetings of the design team, at Mr Miller's New York offices, the following criteria gradually evolved:

- No single sail surface should be greater than 300m², in order to be comfortably manageable without mechanical assistance
- To comply with criteria set down in safety rules and regulations, the minimum possible permanent ballast weight had to guarantee a minimum positive stability angle of 110°

A choice between two principal possibilities soon became clear:

- Firstly, with regard to sailplan, choice A: a sloop, either two 300m² sails, or a ketch or schooner with three 300m² upwind sails, in addition to downwind sails set off the mizzen mast. The sloop option was commensurate with a 35m boat, whereas a ketch or schooner meant a hull length of up to 45m
- Secondly, concerning stability, choice B: a fixed keel with water ballast (as on a VOR





The numerous technical and design challenges presented by *Mari-Cha IV* were moderated somewhat by the early decision to restrict the sail area on each rig, then to opt for water ballast *and* a swinging keel – but with the absolute proviso that both would never be fully employed at the same time. In this way many loads were kept close to existing technology

60) or a canting keel, made efficient with a relatively deep draft (as on an Open 60)

Choice A involved aerodynamics. We produced numerous 1/20th-scale models of possible sloops, ketches and schooners. These models were tested for several weeks in the famous Twisted Flow Wind Tunnel at the University of Auckland, Team New Zealand 2000's secret weapon, with its unique capacity to allow testing in true wind gradient – just as it occurs in real life. Results obtained enabled the accurate calibration of our own VPP, with which we then compared the performances of a 35m sloop with a 40m schooner. While the results were very similar, and slightly in favour of the sloop upwind in light air, in any other type of weather, particularly over the 'span' of the Atlantic, a split rig had already begun to look essential.

As for choice B, it was not long before we asked ourselves why should we not have our cake and eat it! Choosing to have both water ballast *and* a canting keel meant that we would be able to have an upwind configuration with the keel vertical and the water ballast's righting moment (and beneficial added displacement), and a reaching configuration without the weight of the water ballast but with a righting moment induced by the weight of the bulb canted to windward – which was precisely what we opted for.

Having established the overall philosophy of a 40m schooner with water ballast and a canting keel, next the various elements making up the whole had to be defined in greater detail: characteristics of length, beam, hull forms, etc...

Come August 2000 and we had three 6.5m models sailing in Gosport dock in the UK. After having spent a week testing these models – and having fished Clay's glasses out from the bottom of the dock basin (which nearly put paid to the whole project) – we drew up a synthesis of the best two models which then became the starting point for the main hull model.

Systematic variations of beam and RMC were tested via the VPP, and their influence was measured on a typical route, like a crossing of the Atlantic or over the Volvo Ocean Race course. A maximum beam of 9.5m and 'sufficient' RMC were retained, bearing in mind that we had ruled out the possibility of combining the effects of the water ballast and the canting keel; which would only have resulted in a drastic increase in rig scantlings that we judged counterproductive for our purposes. (The crew now 'must' adhere to what are in effect a set of sailing instructions for the final design!)

That left the length. Increasing length favoured the separation of the two masts and thus efficiency downwind, also measured via wind tunnel testing. However, more length always means more weight and more wetted surface, which is negative. We struck a final balance at an overall length of 42.50m.

Meanwhile, SP Technologies had begun to study the lightest structure (see also *Seahorse* January 2004). It had also been agreed at the outset that the inside would be completely empty but for some basic living quarters for Mr Miller... being the owner does still carry one or two advantages. In other words, the hull-deck assembly would now remain the heaviest element throughout the weight studies.

We had asked SP to concentrate their thinking on the best general arrangement in relation to weight, rather than in relation to any constraints dictated by accommodation layout, the latter now being all but non-existent. The result was shell scantlings and a structural mesh that varied considerably along the length of the hull. Some areas are monolithic, others made of sandwich, structured transversally or by longitudinal bulkheads. A logical variation, in fact, which responds to local demands from the shell.

All this exploration naturally involved a great number of man hours (some 4,500 engineer-hours in total). And lots and lots of finite element calculations were devoted to the keel area...

Mari-Cha IV has the biggest canting keel made to date. A 200-ton hydraulic cylinder (built by Cariboni) pushes and pulls the top of the keel, a load equivalent to the weight of 200 cars which has to be borne by a few millimetres of carbon at the point where the cylinder attaches!

And there was no way we would now allow all the efforts made up to that point to be traded away in exchange for heavy internal systems, which Guillaume Kruyskamp was forced to calculate to the absolute minimum. For safety reasons alone there is an inboard engine, but it pushes the boat at a speed of only 11kt, less than half her obtainable average speed under sail over 24 hours!

As a result, *Mari-Cha IV*'s displacement is half that of her predecessor, *Mari-Cha III*, which of course herself has no equal in this size range. This means that *Mari-Cha IV* can be sailed in the same way as a much smaller racing yacht. Deck layout has exactly the same functions and features as a smaller boat, simply scaled up.

Her North sails are every bit as refined as on a typical America's Cup boat (3DL, code 0, jib top etc.) and can be trimmed with a similar degree of precision. Genuine ultra-light displacement (just 60 tonnes) quite simply removes the need for compromise typical of other large 'fast' yachts.

Construction got under way in November 2001 and ended in August 2003. The JMV shipyard built the carbon hull in a carbon female mould, another premiere for a yacht of this size. The boat was cured in a vast new oven measuring 40m by 10m. And perfect construction enabled it to sail straight away without any problems whatsoever.

Right from the very start, with sea trials in August 2003, she was so easy to handle and to tack that we had the distinct impression that we were sailing a 40ft IMS boat upwind, or a multihull downwind. Off the wind *Mari-Cha IV* is currently in a class of her own, free from heel (with her canting keel) and making 17kt in a true wind of 10kt, with the apparent wind steady at 45° – even when almost square!

And for the designers, since her launch this yacht has continued to sail slightly above our VPP – proof that even in our wildest dreams we had underestimated her, and that we really were playing in new and unknown territory. And now there is talk of something perhaps even faster... ❑