A new big beastie

Farr Yacht Design president Russ Bowler talks to Dobbs Davis about Mike Slade's new Maxi *Leopard 3*

Mike Slade's new *Leopard 3* is a rarity in this class, as its design brief was not just for major offshore events. If this were the case, it would be a very different design, likely narrower, lighter and wholly different in deck and interior layout. Instead, Slade's vision was to build a platform that can achieve those twin goals that remain elusive for many performance yachts: speed and comfort. Collaboration by Farr, builder McConaghy and interior designer Ken Freivokh has created an integrated design that attempts to achieve both goals.

Slade's schedule is first to have an aggressive run at the big races and events – Fastnet, Sydney-Hobart, Newport-Bermuda, Sardinia – but then plug in the modular interior for the charter trade.

'I've run all the Leopard programmes as a business,' says Slade, 'so at the end of the day the numbers have to work.' As a charter boat with Ocean Marine, *Leopard 3* will have to perform safely and reliably, and give guests an experience worth the price. Also, she must have a reasonable resale value, which the stripped-out raceboats don't have. 'We wanted a fast boat that would become a yacht,' said Slade. His recent sale of his Reichel-Pugh *Leopard of London* for a fair price has convinced him of the efficacy of this path.

Nonetheless, this design has had tremendous effort and talent applied to its speed potential. Mike Sanderson, bringing a wealth of knowledge from the ABN AMRO and Mari Cha programmes, has been hired as a consultant, and has been working with North Sails' JB Braun and Steve Calder on optimising the 18-sail inventory. Downwind sail designs have been run through the Twisted Flow Tunnel facility in New Zealand, with an emphasis on powerful sails to enhance light-air performance.

Hull

A relatively wide, powerful hull – successor to FYD's Open 60, Volvo 70 and Cookson 50 designs – provides the platform for high average speeds, plus the volume for good accommodations, and is a notable departure from the current narrow genre. The wider hull is especially suited for high-speed offshore sailing and is enhanced with a chine to improve water release and reduce structural weight.

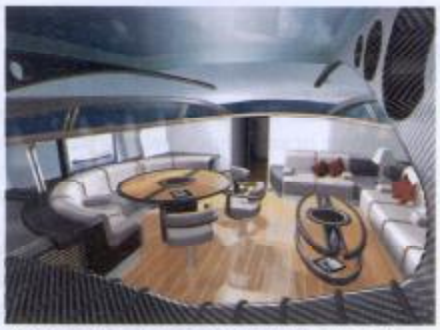
The hull is matched to a purposeful set of foils comprising canting keel, twin asymmetric lifting canards forward and a single rudder on centreline aft. The single, aft rudder was selected as the best arrangement after carefully considering a heavier and more complicated twin-rudder scheme.

Two hydraulic cylinders typically operating at loads around 60 tonnes cant the keel. The canards, sited either side of the mast to balance the sail forces, are raised and lowered by hydraulically powered pinch rollers – essential for charter use in particular.

Deck

FYD created the deck geometry and layout with cabin geometry and styling provided by Ken Freivokh. Combining the deck layout of a supermaxi with a large cruising boat presented several challenges that have been addressed with some novel features.

A fundamental goal was to provide an area for guests that afforded safety and protection from the elements but with easy access into the interior. By shifting all the racing functions, including pit area, aft of the central cockpit FYD have created a guest cockpit while also concentrating all the sail handling into one place.



A cut above... what you might normally expect inside a modern canting-keel maxi

Hydraulically driven winches and sail control rams allow this grouping to exist in a more confined space than on a typical grand prix racing boat with its grinder pedestals. Rope-tail storage below deck that is accessed through tubes means that the cockpit spaces can stay relatively clutter-free. Underdeck control systems, line runs and halyard tunnels intrude minimally into the interior while keeping a clean look on-deck.

Tidy structuring allows hardware to be accessed from on-deck while keeping a clean profile. By carefully monitoring line loading during the design work FYD have also tried to ensure that key hardware and winch components can be semi-standard parts without having to pursue extreme custom solutions.

Construction

The structural design has centred on the conflicting balance of a weight-optimised raceboat versus the interior and functionality requirements of a cruising/chartering operation. For the structure to carry extremely high loads with sometimes less than optimal placement of structural members, due to accommodation requirements, the design and build team had to approach this project with an unusually open mind. Of prime importance was the desire to eliminate redundant structure and provide an internal arrangement as sympathetic as possible to interior requirements.

This goal was primarily achieved by tending towards a thicker cored structure to reduce internal framing members. This has been made possible with honeycomb and carbon prepreg construction using multiple variations of thickness, density and type to give a lightweight structure. Close attention was paid to the structural detailing in conjunction with McConaghy Boats to optimise it for their own build methodology.

For charter it was also necessary to have *Leopard 3* approved by a regulatory body.

Det Norske Veritas were chosen and FYD worked closely with them during the initial structural concept stages to ensure the aggressive weight-saving measures undertaken would meet their requirements.

Canards

Like everything else on *Leopard 3*, the canards are large! The enormous sailplan develops massive sideforces, which must be counteracted by the underwater appendages to power the boat to windward at low angles of leeway. Since the keel fin is canted and not very efficient at producing lift the majority of the sideforce must be produced by the leeward canard. Fortunately the canards can do this quite efficiently because they are immersed well below the waterline when the boat is heeled.

The canards on *Leopard 3* have been designed for maximum lift efficiency at minimum drag. This is achieved by maximising the depth (ie span) of the canards. By maximising span induced drag is minimised. The foil section is a proprietary FYD design based on Volvo 70 canard foils. The philosophy behind it is to give minimum viscous drag at the typical lift coefficients in which the canards operate.

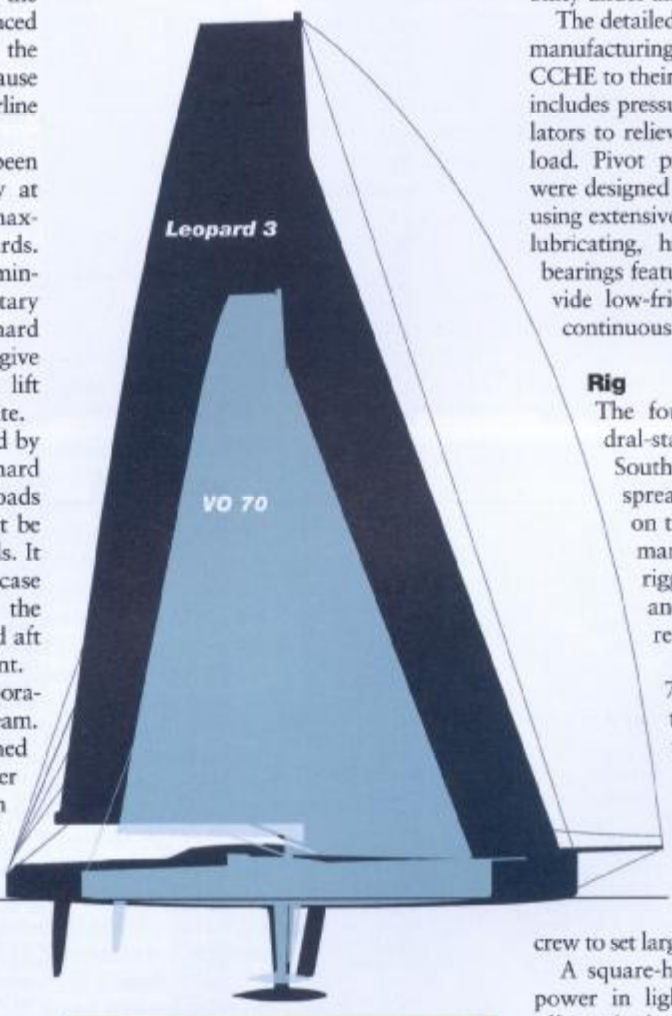
The substantial side forces produced by the canards must be reacted at the canard support structure. The large reaction loads result in large friction loads that must be overcome to raise or lower the canards. It quickly became apparent that in this case conventional methods of moving the canards under load (typically ropes led aft to deck winches) would not be sufficient.

This is a good example of the collaboration between FYD and the Leopard 3 team. Nick McGarry of C Designs was assigned the task of solving this problem and after some development work, in consultation with FYD's engineering team, a set of hydraulically powered rollers were created. A test jig was set up to prove the concept and, once satisfied with the result, these power-rollers made it onto the boat.

Keel and canting system

This incorporates proven technology optimised for reliability and performance. The design of the various elements has been led by FYD in collaboration with Central Coast Hydraulics and Engineering (CCHE) in Australia, and Advanced Project Management (APM) in Italy.

The keel fin has been sized based on structural requirements, as it is not a primary lift-producing device. This includes exceeding relevant DNV and ABS scantlings, as well as internal FYD requirements based upon several years of data collection and analysis for canting-keel yachts. The fin structural design has been further validated through extensive use of in-house finite element analysis. The fin is made from high-strength forged carbon steel and CNC machined by APM. The bulb is made from a high-density calcium-lead casting and CNC machined by Broens Industries in Australia.



LEOPARD 3	
LOA	30.0m
DWL	29.4m
BEAM	6.8m
DRAFT	5.5m
DSPL	38,500kg
BALLAST	19,200kg
SA upwind	626m²
SA downwind	1,358m²

The foil shape for the fin is a proprietary, low-drag section and the bulb shape has been optimised using in-house CFD for low drag combined with a low centre of gravity.

The canting system includes dual-opposed hydraulic rams designed and produced by CCHE of high-strength stainless steel with heat treatment and plating for optimum resistance and wear characteristics. Cylinder sizing and system pressures have been carefully addressed to provide for a balance between two-cylinder and single-cylinder operation, to ensure reliability under all operating conditions.

The detailed hydraulic system design and manufacturing has been carried out by CCHE to their own exacting standards and includes pressure relief valves and accumulators to relieve the system of shock overload. Pivot pins and mounting brackets were designed by FYD working with APM using extensive finite element analysis. Self-lubricating, high-strength fibre-reinforced bearings feature at all pivot points to provide low-friction operation even under continuous immersion in seawater.

Rig

The four-spreader rig with cathedral-stayed topmast was built by Southern Spars, with swept spreaders to reduce dependence on the running backstays during manoeuvres. PBO standing rigging minimises rig weight and a full set of halyard locks reduce mast compression.

FYD's Open 60 and Volvo 70 experience indicated that a tall rig with ample sail area for upwind and reaching sails is required to reach the full performance potential of these large canting-keel yachts. In light air *Leopard 3* will set a masthead genoa upwind, and a long bowsprit will allow the crew to set large reaching sails on furlers.

A square-headed mainsail will provide power in light conditions and depower efficiently through twist in stronger winds. When wind and sea conditions dictate, multiple forestays and headsail tack locations allow for sail area to be efficiently reduced, combined with a lower centre of effort to improve control while maintaining high speeds. This also allows the boat to be conveniently operated with reduced sails for shorthanded charter sailing... ❑