Humphreys Class 40

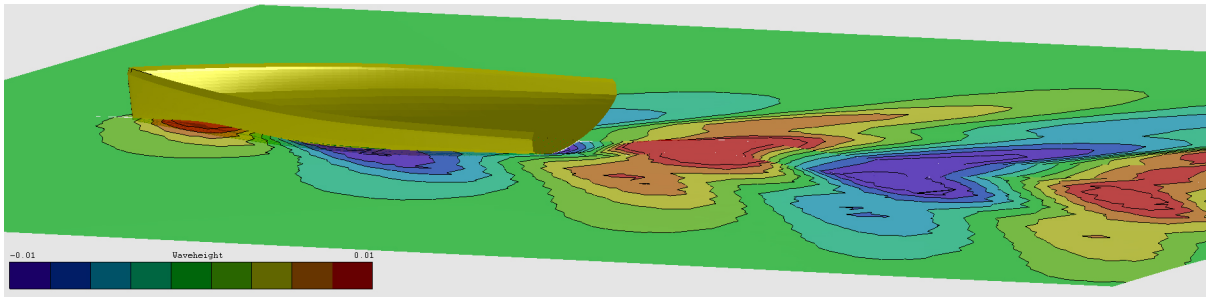
Length	12.19m
Beam	4.496m
Draft	3.000m
Displacement	4500kg
Water Ballast	750 litres per side
Engine	20kW (27.2hp) Vetus Mitsubishi M3.28 Diesel
Construction	Infused Epoxy / E-glass / PVC Foam Sandwich
Price	€325k (exc rig, sails, electronics & safety gear)

Design Notes

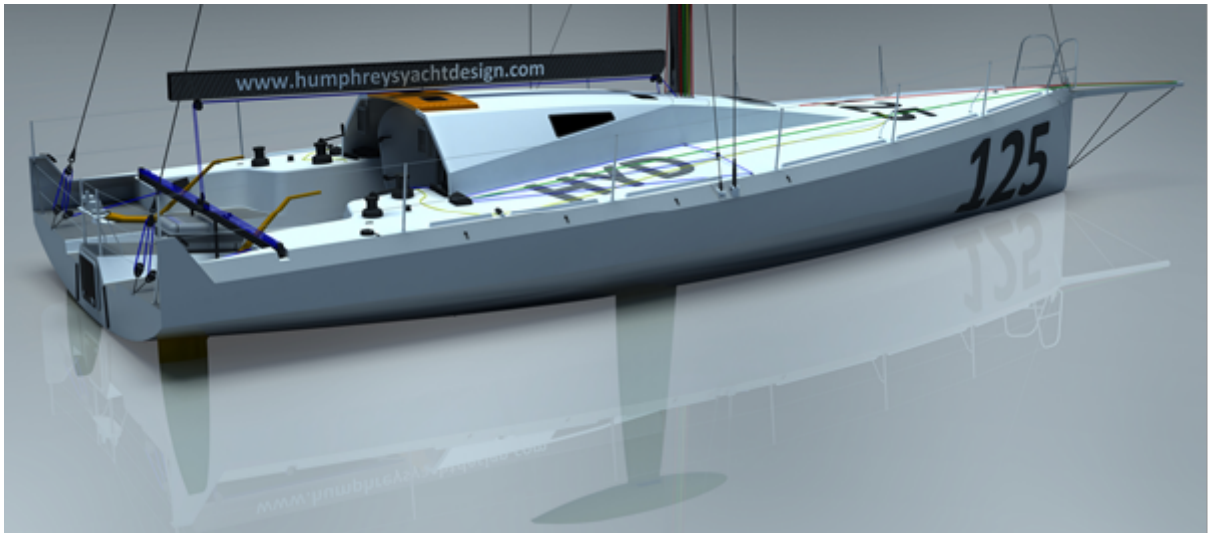
The all new Humphreys designed Class 40 represents the design studios latest venture into the Class. The aim has been to create a highly competitive design with excellent all-round performance and handling characteristics, incorporating all the latest in race boat design philosophy and technology, yet at a price considerably less than the bulk of other custom and small series produced designs.

Performance Optimisation

HYD have worked closely with CFD specialists KND-SailingPerformance during the optimisation of the hull, appendages and sail plan. The design brief for boat 1 (*Vaquita*) was to optimise performance for the Global Ocean Race. Initially KND-SP ran a performance analysis using real data downloaded from the owners current Class 40 in double-handed mode. This gave us a useful insight into how a well sailed, double-handed Class 40 performs in the open ocean in real terms against its design polars – what is often referred to as 'percentage polars'. As one would expect, when sailing shorthanded, the data revealed that it is a lot easier to maintain or exceed target boats speeds at points of sail that are either less sea state dependent and/or require less interaction from the crew in terms of helming and trimming and we felt it imperative that the weather and routing study, which ultimately forms the optimisation criteria for the design, should account for these 'real' factors.



KND-SP followed this up with a CFD & VPP study on our first series of design candidates. This allowed us to verify the data from our own in-house CFD and VPP software, enabling us to go on and investigate an even greater area of the design space with close to 100 different hull forms developed and analysed. A vast range of design parameters were investigated including beam/wetted area/stability trade-offs, volume distribution and bow fullness, chine height and orientation, transom immersion as well as aero aspects such as the rig geometry and sail inventories.



Detailed Design

Designed with Global Ocean Race compliance in mind, the design features minimum freeboard, maximum allowable deck edge chamfer and a relatively aft positioned coachroof, which contribute to minimising the required deck volume to enable self-righting, benefitting the design in terms of deck weight, VCG and windage. The large deck edge chamfer and minimum freeboard also aids the design during the 90 degree pull down test, allowing a lower VCG for the same maximum measured righting moment, of 320kgf, measured at the masthead. This effectively provides greater stability at typical sailing heel angles but for the same maximum measured righting moment.

The deck and cockpit design for boat 1 features a relatively conventional twin tiller type arrangement, offering excellent helming visibility. The deep cockpit helps drive the VCG even lower but also offers reassuring protection for the crew along with the coachroof overhang. There is a raised tunnel down the centre of the cockpit to allow access through the transom escape hatch. Boat 1 features a minimalist 4 winch layout, with some innovative solutions developed by Andreas Hanakamp (such as a tackable hydraulic backstay ram) employed to free up some of the usual winch functions.

The water ballast system has been highly refined, working closely with Andreas. Various longitudinal positions were investigated during the design process and the final position and configuration of the tanks has been optimised to maximise righting moment, considering both the transverse lever and vertical centre of gravity. With the Class 40 rule now requiring all water ballast plumbing to contribute to the maximum allowed tank volume, the transfer pipe has been removed and the fill pipes have been minimised. This requires the active tank to be emptied and the new tank filled in a tack, but as a result of a novel water dump system, the old tank

can be emptied in around 30 seconds, which opens up a lot more tactical opportunities for inshore and short course racing. The bottoms of the tanks have also been carefully orientated to allow the tanks to be completely emptied at any heel and trim angle. This has been achieved by using some of the rule required closed cell buoyancy foam to provide a suitably aligned surface ramp, to feed water towards the tank outlet.

In the end we optimised the fore-&-aft location for upwind and fetching angles, resulting in a fairly central tank position. The theory being that in these conditions, when you are punching waves, a little extra displacement can also help and the central location helps to minimise pitch inertia. For offwind sailing, however, you want to stay light to maximise performance. The typical amount of stackable gear on a Class 40 is a significant proportion of the boats all up weight, meaning that a large amount of extra righting moment can be generated without the need to increase displacement. With the tank located centrally it allows for a large outboard stacking area towards the aft end of the design, making the use of the ballast tank redundant when sailing offwind, in anything other than really powered up reaching. A little more hull form stability at around 15-20 degrees heel angle was also introduced in order to help achieve this whilst still maintaining a narrow waterline beam and low wetted area at low heel angles.

Structural Engineering
Structural engineering is by the New Zealand based company Pure Design & Engineering, noted for their role as lead engineers for Team New Zealand, including their two giant AC72 America's Cup catamarans. This design represents their third Class 40, providing invaluable experience into how best to optimise the structure in terms of weight, strength and stiffness trade-offs.

Rig Design
Lowering the VCG has been a fundamental driver of the rig design process, where we have been working closely with Southern Spars. Starting with a clean sheet of paper, Southern Spars performed a complete review of possible rig geometries, including various combinations of rig position, foretriangle height, deck v keel stepped, swept v inline spreaders and 2 v 3 sets of spreaders. The resulting rig layouts, weights and VCG values enabled us to run the various geometries through our VPP to monitor the effects on performance attributed to the differences in pitch gyradius, windage and variations in the distribution of sail area. Single topmast backstays with a low attachment point on the masthead and deflectors help to minimise the weight and centre of gravity of the rig package. For boat 1 (*Vaquita*), as a result of its initial goal to do the GOR, a 3 spreader, deck stepped mast was ultimately selected to offer a little more in terms of stability, particularly under masthead Code 0. A two spreader arrangement, with low spreaders and a longer topmast section was also studied and looks to provide some advantages in terms of rig weight and centre of gravity at the expense of requiring a little more management when under masthead Code 0 or other masthead reaching sails.

Project Management
Project management is by former Team Russia Volvo Ocean Race skipper Andreas Hanakamp, who will also co-skipper boat 1 (*Vaquita*). Andreas contributed valuable input during the design and build process based on his extensive experience within the Class. His continued input, based on his experiences of sailing on *Vaquita* will be continually fed back into the team for the benefit of all subsequent builds.

Construction
The build is by Ocean Tec in Slovenia, a yard vastly experienced with resin infusion technology. Construction is in the form of infused epoxy / E-glass / foam sandwich. Unlike typical serial production Class 40's, construction utilises thermoformed pin-hole foam to minimise resin content within the sandwich laminate as well as a paint (rather than gel coat) finish resulting in considerable weight savings. Fitout has been carried out to a very high level by Andreas Hanakamp's company Segelwelt.at.

This latest Class 40 design can be offered as a repeat build or as semi-custom or fully-custom packages. As a result of some innovative tooling methods and direct access by the yard to 5 axis CNC milling, extremely cost effective tooling can be produced, which opens the door to continued design development and a high degree of customisation, but at a cost more akin to a productionised offering. Please contact us here (info@humphreysdesign.com) for more information on the different Class 40 design and build packages available.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