THE ULTIMATE SAILING CRAFT - A WING BORNE HYDROFOIL (WBHF)

A number of years ago we presented some of the history of speed sailing in the IHS Newsletter including a brief review of some of the hydrofoil sailing craft which had achieved sailing speed records.

There is renewed interest in breaking the outright speed sailing record, which is currently held by Finian Maynard who achieved 48.7 knots on his wind surfer in April 2005.

At least three speed sailing projects are at various stages of development or trials in Australia. One such project is the Wing Borne Hydrofoil (WBHF) conceptualised and developed theoretically by Mr Stephen Bourn, a mathematician and scientist with the Defence Science and Technology Organisation in Adelaide, Australia.

Although radio control model testing of the concept had already been undertaken previously, work commenced in 2007 on the detailed design and manufacture of a full scale prototype of a WBHF to Stephen's design as a mechanical engineering undergraduate student project at the University of Adelaide. This will be ongoing in 2008. Supervisors for the project are A/Prof. Ben Cazzolato, Stephen Bourn and Dr Carl Howard.

After proving the concept, the intention is to attempt to break the world sailing speed record and ultimately achieve the goal of 54 knots (100 km/h). Thereafter, commercial production may be undertaken to satisfy demand for such high performance sail craft for either the sailing equivalent of Formula 1 racing or as a form of recreational 'extreme sport'.

DESIGN

The design was inspired after a fresh look at the basic principles of sailing and examination of the absolute limits to high performance sailing.

This craft is intended to fly more like a plane than sail like a boat. The hull is supported and propelled by a wing sail inclined and offset to one side as shown in Figure 1 & 2. The wing pulls the hull up to fly smoothly just above the waves while a hydrofoil assembly provides lateral resistance to counteract the sail force as well as generating additional lift. The craft has been designed to sail at more than twice the wind speed. It is expected that in light to moderate winds, with the hull still in the water, the WBHF will be just as fast but easier and safer to sail than the quickest existing boats, because of its inherent stability and self-righting properties.

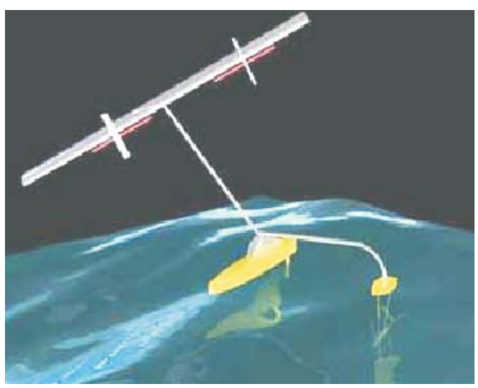

Figure 1: Rendered images of the WBHF illustrating its configuration when sailing. Image courtesy of Stephen Bourn.

Unlike many dedicated speed sailing craft, the WBHF has the ability to tack and sail in all directions, in a range of wind conditions and in exposed waters. The wing is able to adjust to the optimal angle relative to the wind via servo tabs. Although the craft incorporates design features to self-correct and stabilise should it be disturbed, there will be provision for the quick release of the wing in case of an emergency situation.

Figure 2: Rendering of WBHF showing the components of the craft. Image courtesy University of Adelaide.

The hull, designed to support either one or two people, is lifted out of the water when the craft achieves sufficient speed in 10-15 knots of wind, thus eliminating a significant source of drag, and accelerating the craft to considerably high speeds.

The craft is intended to employ several control systems to ensure stability once flight is achieved and also provide pilot control. Given these unique characteristics, it is believed the WBHF has the potential to challenge several sailing records including the bi-directional nautical mile sailing speed record and ultimately the world sailing speed record.

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The craft can be carried on a trailer, and should be able to be rigged quickly and be launched from a beach. The wing will be collapsible.

Main dimensions and weight for the craft are:

Hull length	3.6 m
Wing span	8.0 m
Wing area	16 m^2
Hydrofoil span	0.9 m
Width	5.5 m
Weight	75 kg
Ballast	30 kg

CONSTRUCTION

The craft is being constructed with extensive use of carbon fibre composite sandwich materials using vacuum resin infusion techniques to ensure high strength and minimum weight.

Over the 2007-2008 summer work was underway on various components of the craft. After initial difficulties achieving satisfactory resin infusion of the curved tubes for the cage connecting the hull to the main beam, a good technique was developed and all four cage tubes are now ready for fitting to the hull. One hydro stabiliser foil has been successfully moulded, with the second one currently in progress. The remaining work on the hull, main beam, bearings and outrigger float is yet to be undertaken. The hull and foil assembly are seen in Figure 3 and 4.

The goals of the 2008 student project will be to complete the design and construction, launch the craft and test and tune the control systems. Specific tasks in 2008 will include:

- design and construction of the twin joystick control inputs and power supply,

- program, test and tune the hydrofoil control (including towing trials),

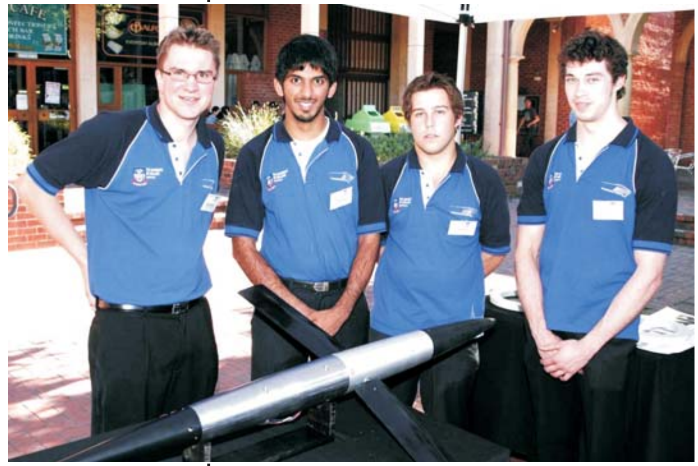

Figure 4: The students display the progress made on the hydrofoil assembly for the craft. Photo courtesy University of Adelaide

Figure 3: Adelaide University mechanical engineering students display the composite hull behind a scale model of the craft. Photo courtesy University of Adelaide.

- review and complete the aerofoil design and construction,

- program, test and tune the aerofoil control (including captive carriage trials),

- test and tune the complete craft (starting with towed trials and finally independent operation),

- design and build a canopy for the cockpit and fairings for the main beam interconnecting the float, hull and wing assembly,

- design and build hydrofoils capable of operating at 50 knots free of cavitation, and

- review the aerofoil design and if necessary develop design modifications for operation at 50 knots.

Further details of this interesting project including a detailed report are available at the University of Adelaide School of Mechanical Engineering's WBHF website: http//www.mecheng.adelaide.edu.au/robotics/robotics_projects.php?wpage_id=44&title=43&browsebytitle=1 with further details at the wing-borne hydrofoil website: www.wingbornehydrofoil.com which contains a technical paper containing the sailing performance analysis for the craft. The designer,Stephen Bourn, can be contacted via e-mail: sbourn@ wingbornehydrofoil.com