The NEWSLETTER

International Hydrofoil Society

P. O. Box 51, Cabin John MD 20818 USA

Editor: John R. Meyer | Spring-2004 | Sailing Editor: Martin Grimm

MDI'S CUSTOM DESIGNED LIFTING FOILS

[This article is a composite of material from Work Boat World (Jan 2003), the North West Bay Ships web site, and Maritime Dynamic, Inc.; all of whom have granted permission to use this information.]

Maritime Dynamics, Inc. (MDI) active lifting foil system provides hydrodynamic lift to reduce resistance for higher speed or lower power, and greatly reduces vessel motions for improved passenger comfort. MDI's ride control system electronics coordinate the action of the foils.

Their system was proved on Dolphin Ulsan, a 55 meter foil assisted trimaran ferry (formerly Triumphant; see an article in the Autumn 2001 IHS NL, p. 5) built by North West Bay Ships, Australia (www.nwbs.com.au/tri.html). The current owners changed the name from Triumphant to Dolphin Ulsan when they purchased it for operation in the Sea of Japan.

The Dolphin Ulsan - Fitted With MDI's Custom Lifting Foils

See MDI's Lifting Foils, Page 3

WHERE ARE YOU IN CYBERSPACE?!

IHS relies on electronic communication with the membership to improve timeliness and reduce mailing costs. If you are a member with email, **let us know your email address!** Thank you.

2004 DUES ARE DUE

IHS Membership is still only US$20 per calendar year (US$2.50 for students). Your renewal or new membership is critical. IHS accepts dues payment by personal check, bank check, money order or cash (all in US dollars only). We have also recently arranged for payment of regular membership dues by credit card using PAYPAL. To pay by credit card please go to the IHS membership page at <http://www.foils.org/member.htm> and follow the instructions.

INSIDE THIS ISSUE

PRESIDENT'S COLUMN

To All IHS Members:

The Society continues to grow with 5 new members added to the Membership roles during the first 2 months of the new year. By the way, you can view the Membership List by logging onto the IHS website and put in the proper password. All IHS members have been informed of this password. If you have been missed or forgot, please contact the webmaster. It is advisable for all to do this and check the information on the List. If it is incorrect, please send changes to: Steve Chorney: schorney@comcast.net

All IHS members are reminded that there are many offerings on the IHS website these days. You can get all the information about these on the IHS website. A new addition to the offerings is a CD containing all the IHS Newsletters from 1978-2003. This CD contains a wealth of information and it also has an Index prepared by Martin Grimm. With this index one can make a query and locate the issue(s) having the subject matter. An example of this is the search I was making for speeches made at the time of the PHM decommissioning. Martin advised by saying: "The speech by Admiral Mauz (an others) is reproduced in the Fall 1993 issue of the IHS NL starting page 8." Sure enough, there it was with the other speeches including the CNO's message stating at the end: "LAND THE SHIPS". Martin also mentioned that if one makes a query on "PHM", "you will get enough information from past Newsletters to write a book!".

I therefore recommend making this small purchase of the IHS Newsletter CD by logging onto the website: The announcement and ordering instructions are on the front page about half way down. It is a mere $12.00.

Martin Grimm has passed onto me an interesting item about Rodriquez Canteeri Navali who recently received a contract for 6 Foilmaster Class hydrofoils. They will be delivered in pairs in 2004, 2005, and 2006. Rodrique claims they can go 40 knots with 250 passengers and consume less than 600 litres per hour of fuel. Martin mentions that there is an article in a recent issue of Work Boat World (which I have not seen) entitled: "To Foil, or Not To Foil?" We will be looking for this and hopefully obtain permission to extract from it some material for the Summer Newsletter.

The news about the Foilmasters is encouraging since most of the news these days seems to be about "Foil Assisted" Catamarans, Trimarans, or monohulls. I'm convinced, in my own mind, that if an operator wants to go 40 to 50 knots consistently in rough water, "Foil Assisting" will not be satisfactory. He will require a "Fully Foil-Supported" craft; whether it is a monohull, catamaran or trimaran! As a good colleague of mine used to say: "What goes around, Comes around". Perhaps all the "Foil Assisted" craft will someday be converted to the more conventional hydrofoil type.

John Meyer

President

WELCOME NEW MEMBERS

Joel Billingsley – Joel became enamored with hydrofoils when assigned to the *Plainview AGEH-1* as an engineering officer. After his tour with the Hydrofoil Special Trials Unit, he went on to the Naval Ship Engineering Center as a mechanical engineer engaged in propulsion system design for high performance ships including the PHM and a large, trans-Atlantic hydrofoil. He was instrumental in rescuing the *Sea Legs,* an early experimental hydrofoil, and finding a home for her at the Mariners' Museum. This sparked a dream of one day owning a similar craft.

Peter Cahill - Peter is the person with Jetfoil moldings of HMS Speedy 929-320 and the commercial 929-115-100. He has been working on the Jetfoil model for many years and will soon be able to have a model fully working with ACS. Jetfoil or PHM require the same type of system for control, He has now sourced the outlets for Jetfoil control and hopes to be testing soon. He feels that in the past there was a complete lack of knowledge of the systems for control, but these systems are now available. Peter expects to have available molding for PT50, PT75, RHS 150/160/200 and PHM; complete, and ready to run.

Joseph Koelbel –Joe began his career in naval architecture at Sparkman and Stephens in 1947 where he worked on the design of sailboats and an experimental PT boat (PT 810). Since then he has worked at several naval architectural firms and has been in his own

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MDI's LIFTING FOILS
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The ride control system includes a set of foils that lift approximately one-third of the vessel's displacement at the 40-knot service speed. This enables the vessel to achieve its service speed with approximately 25% less power than competing hull forms.

The lifting foils in conjunction with a center-hull mounted trim tab, stabilize vessel trim and list in addition to damping heave, pitch and roll motions.

Lifting Foil Concept

The system consists of an active trim tab aft on the center hull and lifting foils near midships which span from the center hull to the outer hulls. The trim tab controls the pitch motion of the vessel while maintaining optimum trim of the vessel.

View of outboard starboard hull and foil

In addition to generating the necessary dynamic lift for the hybrid vessel, the lifting foils actively control the heave and roll motion of the vessel.

Since initial delivery, MDI is retrofitting a stabilizing fin aft on the center hull, near the vessel's centerline. The vertically oriented fin is used primarily for directional stability.

North West Bay Ships (NWBS) trimaran vessels have been developed over an extensive design period to provide a technologically superior hull form and large platform to suit a full range of marine transport applications.

Trimarans feature an easily driven long slender center hull containing all drive train machinery. This center hull is supported by smaller side hulls to provide reserve buoyancy and stability for the passenger platform in a seaway.

The result is a vessel authorized (under DNV rules) to maintain speed in significantly greater sea states than either similarly sized catamarans or monohulls.

NWBS flagship trimaran fast passenger ferry is the 55 meter Dolphin Ulsan, which operates a daily return open water crossing of the Korea Strait, total 250 nm, between Kita Kyushu, Japan and Ulsan, South Korea.

With most ferry traffic on the Korea Strait operating into Pusan, the NWBS 55 meter trimaran Dolphin Ulsan's run is slightly longer and more open. The vessel's ability to carry significantly increased passenger numbers, with reduced operating costs allows Dolphin Ulsan to compete favorably for passenger share resulting in increased passenger numbers on the route.

Fitted with an active foil ride control system, this vessel achieves an operating speed of 40 knots with 3 x MTU 16V 4000 M70 marine diesel engines driving through Reintjes VLJ 930 gearboxes, with Geislinger carbon fibre drive shafts and Kamewa 63 S11 water jets.

An equivalent catamaran or monohull requires 4 engines of equal capacity to achieve the same speeds, adding US$550,000 to an operator's annual fuel and engine maintenance costs.

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PURSUING PERFECTION IN PROPELLER DESIGN

(Extracts From Speed at Sea, December 2003)

by Doug Woodyard

Developments in propeller design and. materials continue to target higher propulsive efficiency and reduced noise and vibration.

Propeller efficiency is now approaching that which is theoretically possible, says Rolls-Royce. Great strides have been made in developing more efficient designs in the past 30 years but the trend is now flattening out. On the other hand, significant efficiency advances can be gained when hull/propeller/rudder interaction is considered as a whole.

Propeller/rudder interaction leading to cavitation damage over parts of the

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rudder blade tends to occur on fast vessels with high propeller loadings, and can take place even when the propeller itself is cavitation free. The main cause is the amount of energy in the slipstream of the propeller, Rolls-Royce explains.

Rolls-Royce has studied the phenomenon at its Hydrodynamics Research Center in Sweden. The solutions developed include changes to the rudder shape in three dimensions to avoid self induced cavitation, and a better integration of hull, propeller and rudder hydrodynamics to avoid damaging conditions.

CLT blades installed on **Superfast Levante**

The high amount of energy in propeller slipstreams can cause other problems, particularly the energy in tip vortices shed by the propeller. Flow conditions downstream of propellers and rudders are now closely scrutinized since noise from this source can be fed into the ship's structure. The frequency is much higher than that caused by pressure fluctuations at blade passing frequency and can be of concern in passenger tonnage. Propellers have traditionally been a major source of noise and vibration but better blade shapes and highly skewed blades have contributed to reduced effects.

Cavitation can be a potent noise source, particularly with highly loaded propellers, Rolls Royce notes. Now, however, there is a better understanding of the various types of cavitation, in which local low- pressure areas on the propeller blades cause vapor pockets to form, which collapse with a hammering noise. By suitable design, this can be reduced or eliminated.

Often the propeller designer is constrained by the ship design, forcing propellers to be of smaller diameter than the optimum or to have insufficient clearance between the blade tips and the adjacent hull surfaces. Lack of clearance also leads to pressure pulses at the blade passing frequency being fed into the hull as noise.

Solutions such as contra-rotating propellers can help here, since the total power is then split between two propellers which work in opposite hand rotation, reducing the blade loading.

R&D is pursued by the classification society ABS in response to the growing problem of propulsion-induced vibration encountered in service from both traditional and innovative propulsor configurations. The results include sophisticated analytical software and continual revision of the relevant ABS rule criteria. Analytical capabilities have been strengthened by a series of advanced programs, either in-house at American Bureau of Shipping (ABS) or as part of joint industry initiatives. These apply computational fluid dynamics (CFD) and finite element analysis (FEA) models to assess propeller strength and analyze vibration when verifying designs.

ABS has also replaced its empirically-based calculations of the stresses created by propeller cavitation with sophisticated analyses based on direct simulation using CFD and FEA methods. ABS says it can provide criteria for propeller designs that limit vibration.

Many unconventional propulsor designs have emerged in recent years as designers have sought to minimize the level of propeller cavitation and the associated vibration. Among such innovations are highly-skewed propellers, tractor pods, propellers with wake-equalizing ducts and spoilers.

Numerous contracted and loaded tip (CLT) propellers are now in service or on order worldwide with tonnage ranging from fishing vessels and high speed craft to diverse merchant ships. The installations cover a power band up to 26.5MW and are applied to fixed and CP hub designs.

Sistemar, the Spanish designer, cites the following merits for the CLT propeller:
- reduction in fuel consumption of more than 8 % or an increase in ship speed for the same consumption
- reduction/elimination of hull-induced vibrations
- improved maneuverability (smaller turning circle and shorter stopping distance in crash stops)
- enhanced course stability.

Among the references is a twin-screw installation on the 7,200 dwt RoRo freight carrier *Superfast Levante.* A service speed of 22 knots was sought from the four 6,300kW medium speed engines driving 4.5m-diameter propellers with a blade area ratio of 0.48. The CLT blades, designed by Sistemar and built by Navalips of Cadiz, are mounted on CP hubs from John

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Crane-Lips (now Wartsila Propulsion). Sistemar reports that the ship's speed is over 23.5 knots.

Given the comparatively high propulsive power installed - 12.6MW per shaft - the owner, Trasmediterranea, was keen to ensure there would be no excessive propeller cavitation that could cause unacceptable hull vibrations and blade erosion. Independent hull vibration studies showed that: the cavitation level developed on the CLT blades was negligible from the ship's structural integrity viewpoint; vibration and noise levels were excellent in terms of onboard comfort; and the contractual ship speed was much better than predicted.

Most propellers in service today were developed using theories based on helical surfaces with straight generator lines. A different class of propulsor with enhanced efficiency is the propeller with non-planar lifting surfaces (that is, no longer based on a helical surface with a straight generator line). An example is the Kappel propeller with blades smoothly curved towards the suction side and applying non-planar lifting surfaces.

In line with predictions based on model tests, it was determined through sea trials that the Kappel propeller reduced power consumption by four per cent at 15 knots compared with the original conventional propeller installed on the tanker.

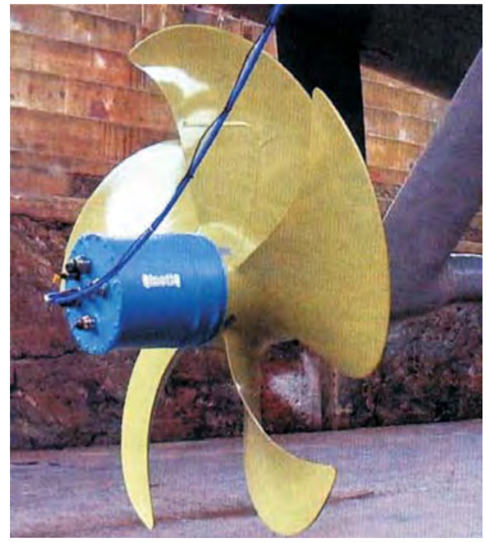
The cavitation appearance of both propellers was very similar to the appearance in model scale, although the full-scale conventional propeller showed a pronounced stronger tip vortex. The full-scale pressure pulse level measured was very close to predictions in the case of the conventional propeller. The level generated by the Kappel propeller was predicted to be lower than for the conventional propeller, but the full-scale measurement showed it yielded a more significant reduction of the pressure pulse levels (averaging 40 per cent).

Kappel propellers can be supplied as fixed pitch or controllable pitch designs for single screw and multiple screw as well as for contra-rotating propeller systems.

Continuing sales are enjoyed by the propeller boss cap fins (PBCF) developed by Mitsui OSK Lines, the West Japan Fluid Engineering Laboratory and Mikado Propeller. First installed in 1987, the system now serves over 830 ships.

Applicable at the newbuilding stage or by retrofit to fixed and CP propellers, the PBCF system exploits a boss cap with fins that rectify the propeller hub vortex and recover rotational energy otherwise lost in the slipstream. Propeller thrust is reportedly increased by over one per cent and propeller torque reduced by more than three per cent, thereby underwriting fuel savings of up to five per cent. A speed gain of two per cent can be delivered with the same engine output. Apart from enhancing propulsive efficiency, the PBCF is said to reduce stern vibrations and propeller noise, and resolve a number of rudder erosion problems.

Advances in materials technology are exploited by designers, sea trials earlier this year demonstrating the promise of Qinetig's composite propeller. The world's largest composite propeller (2.9m-diameter and weighing much less than a traditional equivalent cast from a nickel-aluminum-bronze alloy) was successfully tested on the Qinetiq's trimaran warship prototype, *Triton*.



Qinetiqs composite propeller pictured on the trimaran Triton

Featuring five rigid composite blades bolted and bonded to a traditional alloy hub, the propeller replaced the vessel's original fixed pitch unit. Immediate benefits were noted on trials from the smooth take-up of power and reduced vibration.

Using lighter composite material allowed the blades to be thicker without significantly adding to the weight of the propeller. Thicker blades offer the potential for improved cavitation performance, so reducing vibration and underwater signatures.

Lower weight will be particularly attractive to podded-propulsor designers. The weight saving in this initial application was around 20 per cent but savings of 30-40 per cent are considered possible if the hub is also made of composite material.

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Led by UK-based Qinetiq, the development project involved Dowty Propellers, which manufactured the composite blades, and Wartsila Propulsion, which produced the nickel-aluminum-bronze hub and assembled the propeller.

Summarizing the potential benefits of the composite propeller, Qinetiq cites: weight saving, reduced corrosion effects, improved vibration characteristics (tunable frequency response), reduced wear on gear-

IMPROVED GAS TURBINES READY FOR UPTURN

[This is the continuation of the article appearing in the Winter 2003-2004 issue extracted from Speed at Sea, August 2003]

Rated at 25MW, the WR-21 is based on the successful Rolls-Royce aero RB211 and Trent engines with modifications to marinise the components and effectively integrate the heat exchangers and variable geometry. The first seagoing installations (featuring twin sets) will enter service from 2007 in the UK Royal Navy's new Type 45 D class destroyers. The fuel consumption characteristics - approximately 205 g/kWh from full power down to around 30 per cent power - enable the WR-21 to fulfil the role of both cruise and boost engines.

Compared with simple-cycle turbines, the benefits cited for the WR-21 include an improvement in fuel efficiency over the entire operating range (with a radical improvement at low power), easier maintenance through enhanced modularisation, and the facility to retrofit ultra low emission reduction systems.

Rolls-Royce continues to promote its marine Spey gas turbine for fast commercial vessel projects requiring sustained unit power outputs of 18MW (a rating of 19.5MW is quoted for naval duty).

The marine Spey first went to sea in 1985 and is now in service in nine warship classes, including the Royal Navy's Type 23 frigates and a number of vessels in Japan's Maritime Self-Defence Force.

Currently extending the reference list is the Royal Netherlands Navy's new LCF air-defence command frigates, a class of four headed into service last year by HNLMS *De Zeven Provincien.* A maximum speed of 28 knots is secured by the twin 19.5MW Spey components of the CODOG propulsion plant, while two 5,000 kW diesel engines are deployed for cruising at up to 18 knots.

At the other end of the Rolls-Royce power spectrum, the compact and lightweight Allison 501 gas turbine addresses propulsion and auxiliary drives requiring outputs from 3,900kW to 5,400kW. Derived from the T-56 aero engine, which powers a number of civil and military aircraft, the twin-spool, hot end drive Allison 501 is particularly suited to Jetfoil and hydrofoil propulsion. Over 130 high speed craft are currently served and applications include fast patrol boats and cruise power installations for frigates.

Success in commercial and military propulsion markets can be claimed by US-based Vericor Power Systems for its TF-series gas turbines, adapted for marine use from Honeywell's aero engine designs. A programme based on the TF40 and TF50 turbines and their respective twinned TF80 and TF100 configurations cover a maximum continuous power band from 3,432kW to 7,409kW

More than 500 TF40 and TF50 turbines are reportedly in service worldwide, the reference fleet including frigates, corvettes, fast offshore patrol boats, missile craft and hovercraft.

Four TF50A sets in a CODOG configuration were specified for the Royal Swedish Navy's Visby-class corvettes commissioned from the domestic yard Kockums with 'stealth' characteristics. The turbines - driving twin waterjets via two gearboxes - are deployed for full power mode, while MTU 16V 2000 high speed diesel engines are engaged for loitering.

Twin TF40 turbines drive both the propulsion and lift fans of the Finnish Navy's T2000 combat air cushion vehicle, built by Aker Finnyards.

Upgraded TF40B turbines are being supplied for a service life extension program for the US Navy's fleet of landing craft air cushion (LCAC) vehicles. Over 400 TF40Bs delivered for the fleet have together logged more than 400,000 operating hours under demanding conditions. The enhanced engine, designated the ETF40B, generates 15 per cent more power (at maximum intermittent rating) and promises improved fuel efficiency and significantly reduced life-cycle costs than the original design.

The 118 Wallypower fast yacht, built by Intermarine in Italy for Wally Yacht, features three TF50 turbines as part of a 12.53MW CODOG propul-

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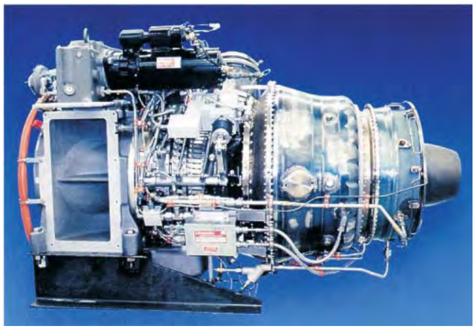
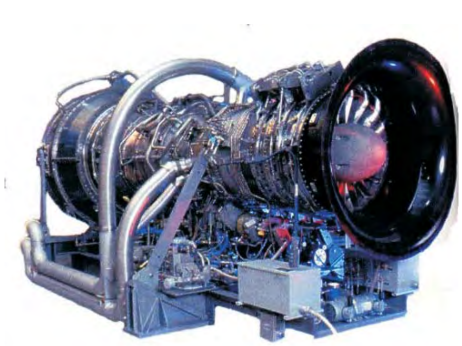
sion plant delivering a cruising speed of 60 knots and a maximum speed of 70 knots. And the megayacht *Detroit Eagle,* built in The Netherlands by Feadship de Vries, is powered by a CODAG system incorporating a TF50 turbine.



TF50A Gas Turbine Engine

Another contender keen to serve the commercial shipping market as a supplier of integrated gas turbine and diesel engine packages, Germany's formidable MAN B&W Diesel group teamed up with MAN GHH Borsig, a packager of Pratt & Whitney FT8 gas turbines for mechanical and generator drives. Based on Pratt & Whitney's JT8D turbine, the aero-derived FT8 is rated at 25.5MW in standard form and 27.25MW in uprated FT8+ form.



Pratt & WhitneyAero-derived FT8

A strong commercial, leisure and military propulsion pedigree is claimed by Pratt & Whitney Power Systems, over 300 gas turbines having been supplied for diverse vessel types. Smaller aero-derived designs such as the ST series offer base power outputs extending up to 4,000kW, with a 4,900kW peak rating. A free power turbine element suits variable speed mechanical drive duties imposed by propeller and waterjet propulsors.

Lower operating costs through burning cheaper fuels than the light gas and diesel oils normally required by aero-derived gas turbines are promised by Alstom Power, which inherited the lightweight industrial-based turbine interests of Sweden's ABB Stal. Successful fast ferry service experience on IF30 intermediate fuel is cited for its GT35 turbine, with a capability to burn IF180 fuel. The design has an output rating of 17.3MW at 3,450 rpm for mechanical drive applications, with an efficiency of 33 per cent.

A Japanese challenge in the aero-derived marine gas turbine market was spurred by the country's Techno-Superliner (TSL) fast freight carrier project of the early 1990s, which called for an indigenous high output prime mover with a very low weight. In response, Mitsubishi created the MFT-8 from the marriage of its own power turbine and the GG-8 gas generator from Pratt & Whitney.

After the prototype achieved a full power rating of 24.3MW during shop trials, two production sets were delivered for installation in the TSL craft built by Mitsubishi. The Japanese designer subsequently offered the MFT-8 turbine to the wider market with a propulsion plant rating of 25.79MW and a thermal efficiency approaching 39 per cent.

Experience in supplying sets for the former Soviet Navy and some overseas navies is tapped by the Zorya-Mashproekt Gas Turbine Research & Production Complex in Ukraine, its portfolio embracing marine designs with outputs ranging from 3,000kW to 27.5MW

Projects in recent years have included propulsion and auxiliary power gas turbines for large Zubr-type landing hovercraft commissioned by the Greek ministry of defence from Russian and Ukrainian yards. Each package comprises five DP71L2 turbines (with individual ratings of 7,355kW at 40 degrees C ambient) arranged to drive the air propellers and horizontal air cushion fans. The three-shaft turbine can deliver 7,800kW.

More powerful turbines have been supplied by Zorya-Mashproekt for frigates and destroyers ordered by China and India from Russian yards. Twin-screw COGAG plant for Indian Navy frigates, for example, incorporate pairs of UGT-6000 and UGT-16000 reversible turbines, the model designations reflecting the rating in kW.

Disclaimer

IHS chooses articles and photos for potential interest to IHS members, but does not endorse products or necessarily agree with the authors' opinions or claims.

Interested in hydrofoil history, pioneers, photographs? Visit the history and photo gallery pages of the IHS website.
http://www.foils.org

SCAT UPDATE

By Sam Bradfield, IHS Member

Here's where we are as of today (Feb 19, 2004). Every week a new challenge, right?

Our minimum takeoff true (ambient) windspeed with 7000 lbs displacement and 1900 sqft sail area is 11 to 13 kts. Our minimum takeoff boat speed is 13 kts. The apparent windspeed at which takeoff boat speed is attained will vary depending on the heading to the true wind.

On Feb 15, we finally hit our "flight design point boat speed" for SCAT; 31.6 kts reaching on the river with wind in the 15 to 20 kt range. Our river course is of length about 3 ½ nm of the IC Waterway in front of the Florida Tech Anchorage where we slip our boat. We had a blustery west wind and a river chop interspersed with wake from the waterway thru-traffic...not too bad. Over most of the run boat speed was averaging 26 to the 31.6 kt max.

The small chop made it a pretty rough ride. Larger wakes were present but SCAT eases through them no problem. Our foil extension was only 6 ft because of the shallow water but it works OK with the small chop. 8 ft extensions are used for ocean sailing.

Our next ocean outing is the Miami-Nassau Race March 19. It'll be our first scrimmage with other multihulls in our class. Philip Steggall, experienced ocean racer, is going to lead the crew of three experienced RAVE hydrofoil racers: Mike McGarry, Hollis Caffee, and Keith Zwart. Tom Haman and I are sitting this one out although Tom will be bringing the boat back from Nassau.

Based on our experience up to now, I believe SCAT will be OK for boat speed up to 35 kts beam reaching in steady wind (in flat water)...our "maximum speed design condition". I also believe her speed made good when flying close reaching to 60 degrees will be very competitive in her multihull class. We'll get more info from this next race. We think we're race-ready now except we need to practice some spinnaker runs foilborne this coming weekend.

A BIT OF HISTORY - CROCCO'S HYDROFOIL

Extract from "The History of Hydrofoils" by Leslie Hayward in "Hovering Craft and Hydrofoil", provided by Martin Grimm, IHS Member.

A patent of considerable interest is US Patent 1,187,268, granted to G.A. Crocco of Italy in 1917. The proposed foil system is the forerunner of those employed on many present-day hydrofoil craft.

Crocco's proposed foils are of the canard type, and although a submerged as well as a surface-piercing system was proposed, the surface-piercing system appears to be of the greater interest and practical importance.

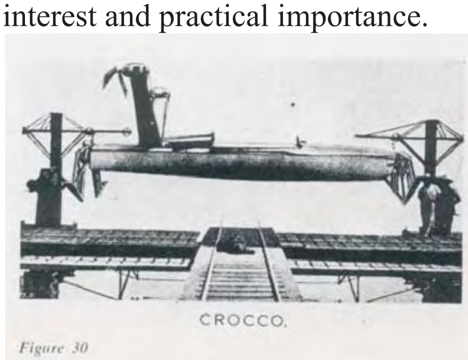


Figure 30

For the surface-piercing system Crocco proposed a complete V bow and an incomplete V stern foil (Figs 30 and 31). Modern development shows that this type has good pitch and roll stability.

Figure 31

Crocco and his fellow experimenter Ricaldoni had been engaged on hydrofoil development for about ten years and they developed a craft supported by a monoplane dihedral foil, illustrated in Fig. 32.

Figure 32

The craft, displacing 1.5 tons and powered by an 80 hp engine, attained a reported speed of 50 mph. Used to test airship engines, this craft was the first to employ inclined single surface-piercing hydrofoils bow and stern. Crocco was the first man to successfully execute a take-off in a hydrofoil-supported seaplane; but the landing was much less successful; the craft nosed over and Crocco almost executed himself.

SEALIFT STUDY OPTS FOR AXIAL FLOW WATERJETS

(Extract from Speed at Sea, December 2003)

by David Foxwell

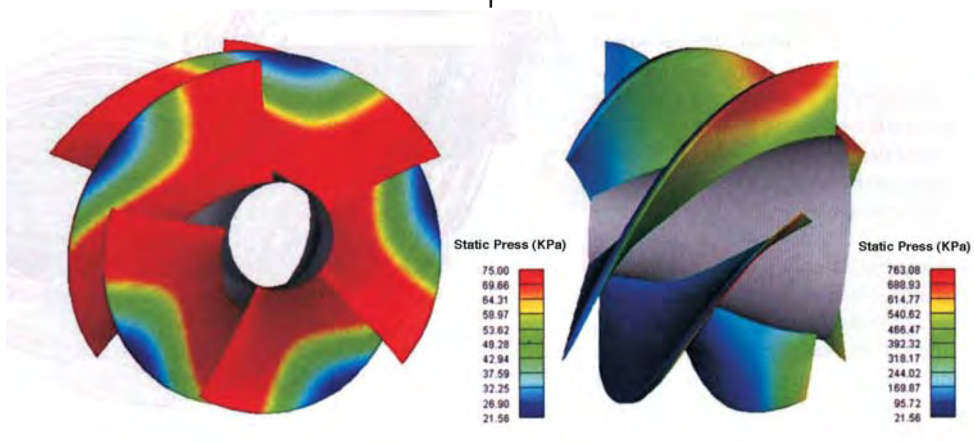
Ongoing research and development work in the USA suggests that axial-flow waterjets, rather than mixed-flow waterjets of the type widely used on fast craft to date, could be the most efficient and effective means of propelling the next generation of naval high speed craft

Waterjets offer a number of advantages for high speed craft compared with other types of propulsor - such as reduced drag, reduced draft, improved maneuverability, reduced stopping distance and reduced noise and vibration - and it is interesting to note that all of the proposals put forward in the current phase of the 40-50 knot littoral combat craft programme make use of waterjets rather than conventional propellers, as do a number of other high speed craft in which the US Navy has expressed an interest.

Low-drag slender hulls will be essential for the next generation of high speed craft, but slender hulls make it more difficult to install the machinery necessary to achieve high speed. A conventional propeller with exposed shaft, shaft supports, and rudder experiences significant drag, and adversely affects the desired hull shape, so that, above 25-35 knots, waterjet propulsion has been increasingly the propulsion system of choice.

In fact, waterjet propulsion has many desirable features for high speed craft, because the propulsor can be mounted within the hull - which eliminates ‘appendage drag’ - and the hull-mounted waterjet inlet is an inherently low-drag type arrangement, especially when installed flush with the hull. Steering is accomplished by deflecting the jet nozzle flow, and because the steering systems can be located out of the free-stream flow they cause little additional drag.

In addition to producing minimal drag, waterjets also have performance benefits that allow for high propulsive coefficients or efficiencies to be attained - propulsive coefficients in the 60 to 70 plus per cent range being achievable for very high speed waterjet propelled vessels.



5-bladed waterjet rotor design using TURBOdesign

High speed ships will require enormous amounts of power for any ship of meaningful commercial size, and high propulsive efficiency will be an important consideration for both economic and ship impact reasons. Marinised gas turbines will undoubtedly be the primary power source for any large high speed vessel, and the ultimate size of the ship will depend not only on the ultimate design speed, but also on the number of gas turbine engine and waterjet units that can be installed in the space available.

These conflicting requirements of slender hulls and large amounts of installed power with multiple waterjets have led to the need to determine the best hullform and propulsion machinery arrangement for high speed sealift ships, and the development of a new generation of advanced waterjets for the next generation of fast craft has been identified as a key priority by the US Navy, leading to a wide-ranging programme of research and development work, much of it conducted by CDI Marine Company’s systems development division (formerly Band, Lavis & Associates) in Severna Park, Maryland, USA.

CDI Marine has extensive marine waterjet experience, having worked with Bird Johnson (nowadays part of Rolls-Royce Marine) and the Defense Advanced Research Projects Agency on the development of larger types of pumps, on pumpjets for the US Marine Corps, axial and axial inducer waterjets for the US Marine Corps, axial inducer waterjets for fast scalift ships, large axial flow waterjet designs for the Office of Naval Research, and on a number of hull/waterjet interaction studies.

[Editor’s Note: The second part of this article will appear in the Summer 2004 IHS Newsletter.]

FOILING AT MOTH WORLDS IN FRANCE

Report by Rohan Veal, International Moth Class Association.
Photos by M. Poitevineau - Sports Nautiques Sablais

[Continued from Winter 2003-2004 IHS Newsletter.]

Veal's Hydrofoil Development…

Rohan Veal's 9.5kg Prowler hull is fitted with hydrofoils manufactured by John Ilett at Fastacraft in Perth, Australia. These consist of a fully submerged T-foil centerboard and similar T-foil rudder both made from a mould using pre-preg carbon fibre. Both are on the centerline of the boat. The centerboard is a very thin straight section blade (120mm x 14.5mm) angled forward from the hull towards the foil to stop air traveling down the blade. An 800mm NACA 63412 hydrofoil wing (120mm x 14mm) is mounted at its base. The rudder is also a symmetrical section with straight planform and is mounted from a large carbon fibre outrigger attached to the transom. This is used to increase the longitudinal distance between the two foils and so improve pitch stability.

The two foils each have an adjustable flap at the trailing edge. The centerboard is automatically adjusted by a ride height sensor arm mounted at the bow on a moulded carbon fibre bracket. The ride height sensor arm is a tapered fiberglass batten that is inserted into a slightly bent alloy tube. This tube attaches to a hinge on the bow and allows the arm to swing up and down so that it skims the waters surface. The constant touching of the water is maintained by some 2mm spectra passing through a micro pulley on the bow and attached to shock chord that leads back into the boat for adjustment. An adjustable cable then attaches to the top end of the alloy section on the control arm, and leads back into the cockpit where it mounts onto a block just in front of the centerboard case. The end of this cable attaches to a pivoting arm at the top of the centerboard, which in turn activates a thin fiberglass leading down the centerboard to the flap.

As the hull rests in the water at low speeds, the control arm is pushed back which in turn adjusts the trailing edge flap so that it induces maximum lift on the centerboard hydrofoil to assist takeoff. Once airborne, the control arm drops down to the water's surface with the aid of the shock cord, thereby adjusting the trailing edge flap and reducing the amount of lift generated. Without this control, the boat would simply want to keep on lifting until the foil breaks through the water's surface. This would promptly be followed by a spectacular crash landing of the boat.

An Amazing Balancing Act by Rohan Veal sailing "White Knuckle Express" in 2003, France

If the foil does break the water's surface in waves, this is usually followed by a rather loud underwater explosion like a bomb going off underneath the boat. The effect is only increased when traveling at high speeds due to the increase in pressure around the foil. From Veal's experience, hydrofoil ventilation or cavitation is only caused when sitting too far back on the wing bar or when sailing into a big wave. However this is easily counteracted by doing one or all of the following. Firstly more tension can be applied to the shock cord which forces the end of control arm to dig deeper in the water and hence reduce the lift on the main foil. Secondly, move body weight forward once the boat is airborne to reduce the angle of attack and hence reduce lift on both foils. Finally, the rudder also has an adjustable trailing edge flap that can be manually controlled by means of twisting the tiller extension in either direction to regulate lift.

When the conditions in Les Sables proved ideal for hydrofoiling, Veal's on-water speed and display was amazing. Using a GPS, he regularly clocked over 18 knots of boat speed in about 15 knot sea breeze. Veal also managed to perform gybes and tacks whilst completely airborne, providing a great spectacle for onlookers,

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FOILING
(Continued From Previous Page)

not to mention if it was followed by an airborne catapult. Veal also comments that it is extremely enjoyable when foiling, especially when passing Hobie catamarans and Formula sailboards in 10-15 knots.

Surprisingly it is also quite easy to sail fast upwind in waves. Instead of punching through waves, the boat simply sails completely over the top of them making the ride a lot more comfortable. This necessitates sitting a long way aft in order to maintain a high angle of attack on the foils for the more moderate speeds. It is an unusual feeling at first, but with an extremely efficient sail and light weight boat, it powers up immediately allowing the skipper to heel the boat to windward whilst completely airborne to carve a path upwind just as high as a conventional Moth configuration would sail, but at greater speed.

Tacking involves slowing the boat down to a comfortable speed by slowly pointing up into the wind. As pressure decreases in the rig, the boat will try to lift slightly, however this is controlled by moving body weight forward and making small adjustments in the rudder flaps to keep the bow down. With practice, hydrofoiling Moth sailors could tack quite comfortably and no differently to a conventional moth, yet be foiling again on the new tack within seconds.

Downwind is also a treat as it is now possible to tack down a square run at speed instead of trying to balance on the boat like an acrobat [ed: the current generation of narrow Moth hulls are inherently fairly unstable]. Reaching is also the best part of Foiler Moth sailing, but it also adds that extra fun, speed and excitement, not to mention the tactical advantage in picking the favoured side of the run that has more pressure or sailing faster with more apparent wind.

Gybing is by far the most challenging part of sailing a hydrofoiled Moth, as it involves a lot of controlled speed. If you sail too fast, you might go too high when you gybe. If you sail too slow, you'll probably drop the new leeward wing in the water and tip over (and that's not uncommon when gybing slow conventional Moth anyway). A perfect "foil-to-foil" gybe involves a manageable speed and leaning into the boat so that the leeward wing is close to the water's surface, while at the same time, making rudder flap adjustments so that the bow does not lift up. The boat will almost turn itself slowly, but one very small constant rudder trim will be enough to get you on the new gybe with the boat now healed to windward and the helmsman on the new windward wing. The mainsheet should never need to be sheeted out much anyway, so the boom should come over fairly easily, but a quick flick of the main on the way through the gybe, will see a fully battened main flip over. From here, the boat should still have enough speed to be airborne. If the boat touches the water, it will be back up in no time with a fully powered mainsail.

Even after mastering the basics of sailing this new Moth, using the hydrofoils still proved to be a gamble each day at the Worlds, as a competitive run relies on ideal weather conditions for foiling. Before any race, it could be perfect foiling conditions, but an hour later, the wind could easily drop off to nothing. The drag created by the large foils when hullborne then becomes a disadvantage.

Even though the International Moth Class Association have banned the use of transversely mounted foils, not all members of the International Moth Class Association believe that hydrofoil development in the form of T-foil centerboards is the best direction for the class, even though the current class rules do not prohibit them or indeed a change in configuration during a championship to suit conditions for each heat.

There is mixed reaction between members, however history tells us that controversy over issues such as the foils is not all that uncommon in the class. In the 1980's Andrew McDougall was the first to win an Australian Championship in a skiff, breaking away from the traditional scow type Moths that had been present since 1928. Traditional scow sailors saw this as anarchy, but 'development' was the primary object of the class, so the skiff Moths dominated from then on and have progressed to the slim 300mm wide boats that are seen racing all over the world today.

The Moth class has been, and always will be, the only true international development class, and so will continue to take a lead into the future of sailing.

More info, photos and videos can be found on the following web sites:

www.rohanveal.com
www.moth.asn.au
www.moth-sailing.org
www.fastacraft.com
www.kasail.com

WELCOME NEW MEMBERS
(Continued From Page 2)

consulting business. While with Grumman's Marine Engineering Department he was responsible for most of the naval architectural aspects of hydrofoil craft including the H.S. Denison and the AGE(H) Plainview. He contributed to parametric performance studies and economic analyses for hydrofoil applications worldwide. While chief naval architect for Atlantic Hydrofoils, Inc. he was engaged in the design of hydrofoil boats, foil assisted catamarans, planing boats, and large displacement vessels, including short run high-speed passenger ferries, sight-seeing boats, the Coastal Patrol and Interdiction Craft (CPIC), and ferries for the State of Massachusetts. Joe's present interest in hydrofoils stems from his work with Eugene Clement in a development of stepped hull technology. In contrast to the usual configuration, which has the afterbody planing on the wake of the forebody, this design uses a hydrofoil as a stern stabilizer and aft lifting surface.

Stephen McDonald – Stephen spent six years in the USS Submarine Service stationed aboard the USS Trumpetfish (SS425). He was a sonar tech second class and enjoyed every minute of it. He is presently the CEO of a wholesale produce company in New York, and has just gotten back into modeling after an absence of about fifteen years. About twelve years ago he purchased and put in storage two hydrofoil model kits . One purchased from a shop in England is a German Police Boat manufactured by the Hegi company and the other is the VS-8 German hydrofoil kit purchased here in the U.S. from the 32nd Parallel. Stephen actually happened across the IHS searching for help to build these two kits. Reading a lot of the old messages on the bulletin board has been a great help, especially from Mr. Martin Grimm.

Other New Members include:

Johnny Dominguez – Johnny is from Guayaquil, Ecuador
Andrew Essex - Andrew is from Lincolnshire, UK
Alexander Karas - Alexander is from Baltimore, MD
James T. Lang – James is from Palo Alto, CA
Adrian Motie – Adrian is from Ashford Middx, UK
Max Runyan - Max is from Huntington Beach, CA
Gareth Watson - Gareth is from North Yorshire, UK
Chung Leung Yung - Chung is from Hong Kong, China

IHS OFFICERS 2000 - 2001

John Meyer	President
Mark Bebar	Vice President
George Jenkins	Treasurer
Ken Spaulding	Secretary

INTERESTING MESSAGE

Historic First Nationals on Foils! Just want to let everyone know that Rohan Veal of the Moth Class has an insurmountable lead in the Australian Moth Nationals. He is sailing a Moth on hydrofoils! This is the first time in history that a hydrofoil equipped boat has won a Nationals using foils. It is clearly a dramatic step forward for hydrofoils and sailing in general! He has won five races against 30 plus boats by leads of three to nine minutes. In the race he won by nine minutes second place was also a hydrofoil! Rohans boat sails on just two foils: one on the dagger-board and one on the rudder. Altitude control is by use of a "wand" system. Stability is provided entirely by the crew. The boat and foils were built by John Ilett of Perth Western Australia and he deserves congratulations as well. Doug Lord; Email: lorsail@webtv.net

GOOD BENEFIT

IHS provides a free link from the IHS website to members' personal and/or corporate site. To request your link, contact Bill White, IHS Home Page Editor at webmaster@foils.org

IHS BOARD OF DIRECTORS

2001-2004	2002-2005	2003-2006
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The NEWSLETTER

International Hydrofoil Society

P. O. Box 51, Cabin John MD 20818 USA

Editor: John R. Meyer | Summer-2004 | Sailing Editor: Martin Grimm

IT'S A HYDROFOIL, IT'S AN AUTO........ IT'S BOTH!!!

(Extracted from Rinspeed web site www.rinspeed.com)

Rinspeed Splash - A Dream Comes True

In what has become a fond tradition Rinspeed Design, the Swiss creative powerhouse for automotive concepts and emotions, presented yet another surprising and astounding attraction at the Geneva Motor Show in March. To celebrate their 10th concept vehicle the Rinspeed crew has created the **Rinspeed "Splash"**.

Splash on Foils

Under the ultra-light carbon-composite skin lies much more than just an agile and lively sports car. The Rinspeed "Splash" is the true incar-

See SPLASH, Page 3

WHERE ARE YOU IN CYBERSPACE?!

IHS relies on electronic communication with the membership to improve timeliness and reduce mailing costs. If you are a member with email, **let us know your email address!** Thank you.

2004 DUES ARE DUE

IHS Membership is US$20 per calendar year. Your renewal or new membership is critical. IHS accepts dues payment by personal check, bank check, money order or cash (all in US dollars only). We have also arranged for payment of regular membership dues by credit card using PAYPAL. To pay by credit card please go to the IHS membership page at www.foils.org/member.htm and follow the instructions.

INSIDE THIS ISSUE

PRESIDENT'S COLUMN

To All IHS Members

Several issues ago, I mentioned that the IHS Board of Directors was committed to a "soul searching", "planning" effort in which we would reconsider IHS objectives/goals and play them against ongoing and projected activities. Board member Dennis Clark is leading the planning effort. In March of last year, he presented a "Planning Framework and Approach". The initial step was a Planning Meeting held on September 10, 2003. It was attended by six of the Board members and two invited guests who have served as Board members previously. Recently Society five Goals were established in the following areas:

Goal #1: Communication Tools
Goal #2: Knowledge Management
Goal #3: Membership
Goal #4: Educational Outreach
Goal #5: Society Management

"Desired Outcomes" were then developed for each of the Goals and priorities set for each in accordance with the following definitions:

A-Primary Importance. (in process, required to support other initiatives, etc.) Resources (manpower, funding, expertise) presently available.
B-Primary Importance. Resources not yet available or requires completion of other Dos.
C-Secondary importance. Resources presently available.
D-Secondary importance. Resources not yet available, or requires completion of other DOs.

A comprehensive report will be forthcoming sometime after the Board of Directors meeting in June at which time the Planning Process" will be wrapped up.

The Society continues to grow with 14 new members added to the Membership roles during the first 5 months of this year. By the way, you can view the Membership List by logging onto the IHS website and put in the proper password. All IHS members have been informed of this password. If you have been missed or forgot, please contact the webmaster (webmaster@foils.org). It is advisable for all to do this and check the information on the List. If it is incorrect, please send changes to: Steve Chorney:

IHS is a volunteer member organization. Many of the hydrodynamic and other technical questions posted on the bulletin board have been answered by Barney Black, Tom Speers and Martin Grimm, and others. IHS thanks them for their participation. The IHS Board of Directors would like to see more members contribute like these members to enhance our organization.

I cannot over-emphasize the amount and nature of the pertinent technical papers and reports that reside on the two Advanced Marine Vehicle CDs the IHS has produced. If you have not acquired these CDs, you should do so from the IHS website.

John R. Meyer, President

WELCOME NEW MEMBERS

Louis Adamo – Lou received his degree in physical oceanography from Johns Hopkins, and worked for many years in ocean wind waves. He closed the loop on large forecasting systems by integrating Datawell's Waveriders into practical, satellite-reporting, wave data systems. His current interests are in fast, coastal, passenger ferries as alternative transportation to freeways, rail, and air shuttles.

William E Eisenhower Sr. – Mr. Eisenhower was born in western Pennsylvania, and grew up in Philadelphia suburbs. He retired from US Navy as a Chief Aviation Electronics Technician, having served with Airships, on a Destroyer, an Aircraft Carrier, Aircrew on C47 and P3C aircraft and as an Instructor at Monterey Naval Postgraduate School. He has been employed as a Computer programmer, International field engineer, Configuration Manger for DOD Contractors and presently support the Navy F18 E/F Program. With interests in hydrofoils, other fast ship designs, and other than oil-based power plants, Bill is as an enterprising dreamer with no preconceived limits.

Robert J. Etter – Bob has worked at NSWCCD (DTMB) for the past 20 years. Prior to that he worked for 18 years at Hydronautics, Inc. and participated heavily in the Navy's SES Program. He designed the variable-area flush waterjet inlet system for the SES-100A, conducted design and test work for both Bell and Rohr for the 2KSES/3KSES waterjet propulsion systems and de-

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SPLASH
(Continued From Page 1)

nation of a really cool and fun sports toy. At the push of a button a cleverly thought-out hydraulic mechanism transforms the sports car into an amphibious vehicle. But that alone wasn't enough for Frank M. Rinderknecht, founder and boss of Rinspeed. A highly complex integrated hydrofoil system enables the "Splash" to 'fly' at an altitude of about 60 cm (just under 2 feet) above the water.

Underwater View of *Splash* "Hullborne"

The almost magical transformation from a street vehicle into a floating and 'flying' all-rounder is made possible by an electronically controlled hydraulic system with an array of sophisticated sensors.

The transformation starts with the nondescript rear panel, which flips up to reveal a Z-drive in horizontal rest position, borrowed from a watercraft. The Z-drive is fitted with a conventional 3-bladed propeller and can be lowered to its fully 'standing' position from the cockpit. The position of the drive is infinitely variable, which guarantees immediate propulsion upon entering the water. A custom-designed transfer case sends power to the rear wheels, the propeller or both, depending on the input from the pilot. Starting at a water depth of about 1.1 meters the Z-drive can be lowered all the way to its fully 'standing' position. Steering commands are entered via the steering wheel and transferred to the Z-drive.

At a minimum water depth of about 1.3 meters the pilot can deploy a highly complex system of hydrofoils integrated into the sleek body of the "Splash." The Formula-1 type rear spoiler rotates 180 degrees down and comes to rest below the "Splash." To the left and right of the high side walls of the cockpit two hydrofoils integrated into the outside skin rotate 90 degrees to point straight down before unfolding into their lifting V shape.

The angle of attack of each hydrofoil can be adjusted individually by the pilot to account for the various operating states. Already at low speeds the vehicle begins to lift itself out of the water. The fully suspended position can be reached at speeds as low as 30 km/h (about 17 knots), and attains a speed of approx. 45 knots.

"Splash" is powered by an environmentally friendly bivalent turbocharged natural-gas engine. Natural gas is an extremely clean-burning fuel that consists almost entirely of methane with near-zero sulfur content. The "Splash" is the world's first amphibious vehicle to be equipped with this future-oriented engine technology.

Street performance is nothing to be ashamed of: The 825 kg quick-change artist accelerates in about 5.9 seconds to 100 km/h and reaches a top speed of 200 km/h. The sleek lines of the "Splash" draw attention at first glance.

The interior of the "Splash" clearly pays tribute to its maritime qualities. Lightweight and waterproof plastics cover the tubular frame and the ergonomically shaped plastic seats. The small sport steering wheel is perfect for the agile handling characteristics of the lively and highly maneuverable "Splash." A number of chrome-plated shift knobs, which govern the amphibious functions and the angle of attack of the hydrofoils, exude an atmosphere reminiscent of an airplane cockpit.

***Splash* Ready to Roll**

It should be noted that there is no price set for the Rinspeed "Splash". It is not for sale.

SEASCAPE CATAMARAN HYDROFOIL YACHT

(Extracted, by permission from PR website)

Seascape Marine Industries has been awarded the contract to build the first ever catamaran hydrofoil motor yacht of its size and type in the Pacific Northwest. Apollonio Naval Architecture and Marine Engineering of Bellingham, WA designed the high-speed 67' motor yacht. The Seascape yard is located about a 90-minute drive away on the Fraser River in Maple Ridge, a suburb of Vancouver, British Columbia, Canada.

The 67', a fibreglass composite jet boat with twin 1500 hp engines, will have a maximum speed of 45 knots at near empty displacement, with a cruising speed of 35 knots. The hulls and decks are designed to American Bureau of Shipping (ABS) high-speed craft guide, with 1" Core-Cell A550 or 600 hull bottom and 1" Core-Cell A500 sides. Two stainless steel hydrofoils with vertical struts at center will be installed between inner chines.

"Seascape's success in securing this project demonstrates our ability to work with designers and owners to develop advanced yachts that stay within their budget requirements," says company President Julie James. "This ability flows directly from our team members' long experience in boat design and building."

Sesacape's strengths are its high quality work – especially its outstanding finishing and excellent fibreglass work — and professional approach, says Apollonio. "I have worked with many of Seascape's staff when they were with other yards, so I have great confidence in the yard – they really know what they're doing and they have catamaran experience," he says

The pilothouse features include joystick control, weather-tight port and starboard doors and a corner computer station aft to port.

The 67' HYDROFOIL CAT specifications are as follows:

LOA: 67'5";
Beam (Molded): 26'6"
Draft (Full load): 3'9"
Empty (Dry Wt.) Displacement: 99,000 lbs.
Full Load Displ.: 123,000 lbs.
Max Speed at Near Empty Displacement: 45 knots +/-
Cruise Speed, avg. at max con't power: 35knots
Fuel capacity 2,300 U.S. Gal.
Freshwater capacity: 300 U.S. gal.
Power: Twin MAN 2842 LE 409 rated 1500 hp
Generators: (2) 2KW 120/240 VAC 60 HZ Northern Lights
Construction: Fiberglass Composite

For more information, contact Julie James Email: julie@seascapemarine.com

[Ed Note: Unfortunately, at this writing, a picture of the foil system is not available.]

MORRELLI & MELVIN ARE ON THE MOVE

(Extracted from Work Boat World, June 2003, Page 39 and April 2004, Page 24)

The past year has been a busy one at the offices of Morrelli & Melvin Design and Engineering based in Newport Beach, California.

This leading yacht design and engineering firm has a diverse portfolio of projects, many of which are high-performance multihulls. In addition to designing record-breaking sailing catamarans, cruising catamarans, power catamaran yachts, and even the occasional monohull, over half of their work involves the design of commercial vessels.

Amongst the several commercial vessel and power catamaran projects on the drawing board or launched in the past year, there was a 15 metre composite foil-assisted catamaran expedition vessel. A HYSUCAT (Hydrofoil Supported Catamaran) foil system designed by Professor Gunter Hoppe will enable this long-range excursion vessel to maintain high speeds over long distances without refueling. Weight will be kept to a minimum by incorporating advanced composites and by using the latest-technology diesel engines. Advanced propeller design will increase fuel economy and reduce fuel

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MORRELLI & MELVIN

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weight. This will be a multipurpose vessel to be used for record passage making, third world river exploration and humanitarian aid.

Morrelli & Melvin also have two other foil assisted catamarans under construction that incorporate their unique hydrofoil system.

After designing over forty power catamarans, Morrelli & Melvin have developed high-speed displacement and planning catamaran hull shapes optimised for a wide range of applications.

Another area of expansion has been the incorporation of hydrofoils on several existing Morrelli & Melvin catamaran designs. Morrelli & Melvin recently undertook a two-year testing program to analyse foil design. Consequently, a unique and highly efficient hydrofoil system was developed and is now offered on some of the new designs.

For further information contact: Morrelli & Melvin, USA.

PH: +1 949 723 7640, FX: +1 949 723 7645,

Email: info@morrellimelvin.com

Web: www.morrellimelvin.com

TO FOIL OR NOT TO FOIL

(Extract from "Work Boat World" September 2003, 'Aft Lines' column, page 83. Author unknown.)

Hydrofoils, like those digital diary things, are something I've never really been able to decide whether I like or not. They certainly look flashy, and the efficiency benefits appear great on paper but in the back of my mind there's always been this nagging doubt about the upfront cost and just how operator friendly they really are. (For some reason whenever I think about these issues I'm reminded of the thoughts that went through my mind in the hours before my wedding.)

Over the last couple of months I thought the pendulum had finally swung in favour of foils, primarily because they seemed to be having somewhat of a renaissance.

First, one of my buddies from Vietnam (not the war; he lives there) called me up to say he'd heard that one of the local shipyards was building a hydrofoil ferry to a Russian design and did I want him to organise a seat on the sea trials for me. While I politely declined the offer - no disrespect to those involved in the project-I'm just a conservative type who would rather be left in the dark ages than test something new. The kids consider that I am most successful in this regard.

The news from the East did get me thinking, though, that there must still be some merit in hydrofoils, even though shipyards have had so many years to come up with something better. That thought moved from the back to the front of my mind more recently when I read that another ferry service between Fukuoka, Japan and Pusan in Korea would be making use of a hydrofoil. This is a rough stretch of sea that has turned passengers on other, larger and more modern but surface borne fast craft decidedly green so the apparent success of the foil-borne ships indicates they still have a role.

This was virtually confirmed in my mind when rumours started to circulate about a new order emanating from Italy for either four or six new hydrofoils (depending on who you believe). In fact, I was at the stage of marching down the aisle and confirming my vows to the maritime world's winged wonders.

I should have remembered, however, that no matter how blissful things seem, for every better there is a worse, and for every health there is sickness. Along they came with a couple of nasty accidents that showed that flying above the water is not always plain sailing.

On July 21, one of the numerous hydrofoils operating in Greece crashed into rocks while travelling at about 25 knots, not surprisingly injuring a number of those onboard. While it is almost certainly yet another case of human error, in my mind I can't help but think that rapidly going from foil-borne to rock-borne has to be worse on passengers than a grounding from the same speed on a surface craft.

Close encounters with rocks should, clearly, not be part of any navigational plan but every master that I have ever met expects to encounter waves - it doesn't take a PhD in hydrodynamics to work that out. So, I find it rather worrying that 22 people were injured when, to quote news reports, "a hydrofoil travelling from Hong Kong to Macau hit a large wave."

Admittedly a typhoon had passed through that had resulted in ferry services being suspended. Clearly it had been determined that it was safe for travel to resume but the 227 passengers on the hydrofoil would presum-

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TO FOIL OR NOT TO FOIL
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ably conclude otherwise after having their trip so rudely interrupted.

The problem in this case, as in others, was that the ferry came off its foils when it hit the wave. The question in my mind is what would have been the outcome of a monohull or catamaran travelling at the same speed and hitting the same wave? I'm not sure, but my gut feeling is that it wouldn't have been three people in hospital with broken bones and/or concussion.

The upshot is that I'm back to getting those pre-nuptial doubts whenever the hydrofoil question is asked.

[Ed Note: This article was included in this issue of the IHS Newsletter to present another view. However, the editor has no doubt that the damage and injuries mentioned above would NOT have been less severe for a comparable dispacement hullform. From all indications that we have seen, Hydrofoils ARE NOT a dying breed!!]

UPDATE ON MANU WAI

By Garry Fry, IHS Member

There is some news on Manu Wai, looks like she will be relocated to Phuket, Thailand to operate alongside the two RHS 70's ex Red Funnel. I intend to go with her and work the high season there for 6 months each year and return to Australia in the low season. The company there, Kontiki Dive, have a good business and the hydrofoils are proving to be very popular. We have yet to enter into a business arrangement but the only thing holding us back is the cost to transport Manu Wai to Thailand and refit prior to service.

Kontiki is preparing a prospectus from which we hope to attract an investor to come up with the money required. Would rather send her up as deck cargo due to the political climate and risk of encounters with pirates but first quote is very high, about $90,000 Australian from Sydney. Part of that being removal of foils and shafting and reassembly at other end.We estimate fuel cost of approx $30,000 to deliver under own power so that option looks attractive although money will have to be spent on the vessel by way of antifoul docking and other work to make fit for the voyage.

The plan is to run Manu Wai from Patong to the Phi Phi Islands, 30nm, and the RHS 70's will continue to run to the Similan Islands from Patong, 55nm, and Kao Lak, 40nm, respectively. Am about to burn CD of Manu Wai showing work in progress and earlier photos from purchase in 1995 from New Zealand and recent Thailand photos.

HIGH FLYING BANANA

(By Ray Vellinga, IHS Member)

Surf's not up? No problem, Dude. Not if your surfboard has a motor and hydrofoils.

That's *Hyfybe*, a hot new hydrofoil idea out of Southern California. *Hyfybe*, High Flying Banana, is actually a wind-surfer board fitted with an 8 HP long shaft outboard motor.

Ninety percent of the weight is supported in flight by a carbon fiber & epoxy composite foil mounted behind the pilot and ahead of the motor. It is surface piercing for roll stability.

At the bow are two aluminum foils welded to a variable incidence strut. The lower foil is submerged 29" below the bow and provides 5% of lift. This has an extruded Clark-Y section and operates deep enough to avoid ventilation. The second bow foil is placed 13" higher on the same strut and provides the balance of lift. It operates in a constant state of ventilation and is lightly loaded to bounce along the surface. Its machine- milled cross-section is a 10% thick wedge with the sharp edge forward. It has 27 degrees of dihedral to soften the ride.

The High Flying Banana Foils

Heave at the bow is manually trimmed through an aircraft-type control stick. The stick is pushed forward or back to reduce or increase the angle

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HYFYBE

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of incidence of the two-tiered front foils.

Flying technique involves accelerating the craft to take-off speed, about 6.5 mph with the stick far forward. The stick is gingerly brought back and then relaxed to bring the upper front foil to the surface. This increases the angle of attack on the rear foil, and it rises to find its correct level. The stick is held relatively steady during stable flight. However any pitch disturbance requires the pilot to respond quickly with the stick to prevent dramatic excursions. It's a game of skill. The maximum speed is about 10mph.

This is a wind-surfer that needs neither wind nor surf. There are no plans to commercialize this just-for-fun prototype.

A FOLD BOAT AS A HYDROFOIL

Provided by Christof Schramm, IHS Member

This is a story about a hydrofoil conversion from the German Democratic Republic from 1961

Normally foldboats and other boats, which could be taken apart to save space, are not known for high speeds and hydrodynamical innovations. But the designers of the Mathias-Thesen shipyard in Wismar, GDR, did not accept the technical restrictions in this category of small crafts. In the late fifties they developed a conversion of one of their products, the foldboat "*Delphin 110*", that ride on surface piercing hydrofoils at speeds of 50 km/h.

The "*Delphin 110*" is a small light weighted craft with a length of 4.8m and a width of 1.1m, that could carry about 4 to 5 persons and has normally been driven by a 7.5 hp outboard engine. It has been built in a quite large number and has been used on the plenty of lakes in the North of the socialistic German Democratic Republic. An important advantage was, that this craft could be taken apart into a small package, which easily could be stowed on the roof of a car. Some used this boat for water skiing, but the speed that could be obtained by the poor engine has not satisfied more advanced water skiers.

So some open-minded engineers of the shipyard developed a new version using hydrofoils, capable of running foilborne at 50 km/h. The hydrofoil system was quite similar to many other systems of this era. Two V-shaped foils of a similar size have been installed under the fore ship and the stern of the craft. Like the basic design this fast craft could also be taken apart easily.

A not often seen detail has been a small vertical fin under the tip of the foils, that helped to stabilize the direction and has been used to connect both halves of each foil with bolts.

A lengthened outboard engine with even 7.5 hp has delivered the power. On account of the lightweight and the shallow smooth waters on the lakes the boat ran successfully and was able to pull a water skier with even higher speeds than it's predecessor.

Unfortunately this conversion has not spread widely. So only a prototype has been built. There is also only poor information available about this craft, taken from some articles in the newspapers of the socialist party SED from 1961. For those, who are interested to learn more about this little hydrofoil is the website is: www.derpoly.privat.t-online.de

Disclaimer

IHS chooses articles and photos for potential interest to IHS members, but does not endorse products or necessarily agree with the authors' opinions or claims.

Interested in hydrofoil history, pioneers, photographs? Visit the history and photo gallery pages of the IHS website. http://www.foils.org

PHM MODEL KIT

By Felix Bustalo; Extracted from Web Site: steelnavy.com/wem_pegasus.htm

White Ensign Models appears to be on a Cold War United States Navy kick recently. The USS Pegasus kit is the third in this category with a few more planned for future release. White Ensign has earned a reputation for producing high quality resin kits and photo-etch detail sets, so one can anticipate that this kit would meet those benchmarks. This is a very simple kit to build and is comprised of a one-piece resin main hull/superstructure assembly and 9 white metal parts. A small photo-etched brass detail set is also provided.

The main resin piece is well done and required practically no clean-up; just a little bit of sanding along the keel to remove some remnants of the casting block. There is a very nice level of detail cast into the hull and superstructure but I found one minor omission. The Pegasus class of boats had vent grills on the either side of the superstructure towards the aft. My example had one on the starboard side but it was missing the one on the port side of the superstructure. The grill that was present on the starboard side was the only detail not cleanly cast as some excess resin clogged up the grid work. I correct the starboard vent and to add the missing port grill I used some generic radar grid from the Gold Medal Models 1/500 scale Naval Set, cut down to the correct size. In my opinion the generic grid from this set looked more in-scale and could pass for the vent grills. When I surfed the Net looking for photographic references I came across a site with some construction images (since then the URL is no longer active). One photo on the Taurus clearly shows a pair of stabilizers on the underside of the hull at the stern. This was overlooked in the kit but in my spares box I had something that would fit the bill. The photo-etch from the White Ensign Models HMS Nurton minehunter kit has a pair of rudders that are about the same size and shape. Since I opted to buy the waterline version of the kit, I did not need them for that build. So I utilized them here for the missing stabilizers. The white metal parts include the 76mm Oto Melara gun, the Harpoon missile tubes, the main mast array, the Mk. 94 GFCS radome, engine exhaust duct and the fore and aft foils. The white metal parts were also very well cast and required very little cleanup. All I had to do was remove some flash from the mast yards. Locator holes are cast into the deck and hull for the turret, mast, exhaust duct and aft foil. This simplifies construction and provides for a better bond when you glue the parts into place. I wish that a locator hole was cast into the hull for the fore foil. I drilled a small hole into the bottom of the hull and into the top of the fore foil's arm. I glued a small bit of brass rod into the foil and glued that into to the opening I made into the hull. The photo-etched brass set is beautifully done with crisp relief etched details. The kit contains the railings, radome support legs, 12 bollards, two Harpoon launcher cradles, main mast brace and the jackstaff. A brass etched nameplate is also provided which can be used to display your model. The railings are all in pre-measured sections, which saves time and effort. The quality of the photo-etch is up to the standards that I expect from Peter Hall's designs and White Ensign Models.

This model is a quick build and would take only a few days if you were able to work on it without interruption. Alas, I don't normally have such good fortune so I did a little here and a little there. Basically once I made corrections mentioned above and I painted the all of the parts and subassemblies, the kits just fell into place very easily. To mount the model I drilled two holes along the keel to accommodate two lengths of 3/8-inch diameter brass rod that I used as pedestals. I painted the model using mainly Testors Model Masters paints although the kit's color guide provides Humbrol reference numbers. I used Testors Model Master Neutral Gray (#1725) for the hull, superstructure, deckhouses, gun and missile launchers Gunship Gray (#1723) for the decks, Aluminum (#1781) for the hull below the waterline and foils and Flat Black (#1749) for the boot topping. My photographic references show that the radome and the whip antenna were painted white; for these I used Humbrol Satin White (#130) because I have heard that this brand of white paint is much more resistant to yellowing. For the whip antenna I used a length of brass wire. Decals are not provided with the kit, so I used a combination of sources to decorate the model. For the larger hull numbers, I used the Gold Medal Models Naval

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PHM KIT
(Continued From Previous Page)

Ship Decals (Part Number 350-1D). For the "E" efficiency markings on the turret and the smaller hull numbers that appear aft I used a sheet that Duane Fowler created for me when he started producing decals. For the ship's name on the transom, I created my own using a word processor, a standard HP laser printer and some compatible decal paper.

This kit was a fun and relatively easy build of a very unique subject. While there were some very minor flaws that are easily corrected, it is an excellent kit. If you like modern United States Naval ships or small combatants, then I would recommend you add this to your collection. I purchased my kit mail order from Warshipbooks.com but you can also buy it directly from White Ensign Models.

INTERESTING MESSAGES

RC PHM-1 Pegasus

I am in the process of undertaking the construction of a 6' Radio Controlled PHM-1 Pegasus. My father was a Chief on the first crew, and I stood on the pier as a 9 year old kid on her first arrival to Key West. I would like to know if anyone has a copy of schematics, or technical drawings for her or the others. Due to the fact that she's gone and I'll never see her fly again, I want to build one that will. Are there anymore out there. Feel free to contact me at: laseredgt01@aol.com Thanks, T.D. Mehl

Hydrofoil ALBATROSS

I recently received some inquiries as to the status of the hydrofoil ALBATROSS. However, in my usual procrastinating manner, I deleted the emails before I could copy the addresses of those who sent them. My apologies on this. The ALBATROSS is still in Centereach, Long Island in a rather neglected state. Still hoping to interest a museum in adopting her. She was the only one of her class to be built in Costa Mesa, CA. All the others were built in West Chester, PA. Wilson was supposed to build them at their yard but according to Helmut Kock, they did not have the experience in welding aluminum so a sub-contractor was used. Again my apologies on the belated response to the inquiries. Robert Miller Email: cbbi@aol.com

MK 75 MOD 1 Gun System ISEA

Have been reading posted messages on the bulletin board at your site. I, too, spent lots of time at MLSG, Key West on TDY performing MK 75 CASREP repairs and ORDALT upgrades on the PHMs. Most of my days in doing so were between 1982 and 1987. The one name I noticed in the posted messages that I recall is the one of Bob Adams. He gave me some 76mm spent brass casings once when I was there to conduct a MK 75 change-out on the TAURUS. I'm still an engineer in the MK 75 ISEA Office which has always been here in Louisville, KY. Would appreciate hearing from anyone that has some 'good' photos of the PHMs for our office. Thanks for the Memories, Jerry R. Grasmick, EE, NSWC (alias Naval Ordnance Station Louisvile; NOSL) MK 75 ISEA, Code G41 DSN 989-5045

To: George Jenkins: I found your article on the Web Site about the PHM acquisition program most informative. Your Article/Paper was well written. A lot of myths about the PHM Program were clarified in your paper; exorbitant costs of manufacture, maintenance, etc. I had heard back in the mid '80s that Congress initially was going to procure ~ 35 of this class and deploy them with Battle Groups; a PHM would be carried (cradled) by a host battle group ship. Then, the PHM program just froze....Congress debated over the completion of PHM-6 USS GEMINI. I just wished that Congress and others had not terminated the program. The ship class had so much potential; even in today's world conflicts in the Mid East region and for Close-In areas of protection against the "small boat" threat. Regards, JRG, Engineer,Code G41 MK 75 ISEA; Jerry R. Grasmick; Jerry.Grasmick@navy.mil

Supercavitating Spoiler

The Russians were apparently developing torpedo designs that operated in a supercavitating mode through the use of a particular nose shape that promoted a vapour cavity over the aft portion of the torpedo. This may have had a wedge or step to trigger the cavity aft of the nose. Supramar AG in Switzerland has also been researching the use of foil profiles with a groove that promotes (or prevents?) supercavitating flow. I don't know if that was also intended to serve as a means of motion control. Some information about this work is on the Supramar website: www.supramar.ch; Martin Grimm

Plainview Vet

I found this forum on a Google search after I came across the Plainview's hulk on a recent vaca-

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SAILOR'S PAGE

SCAT UPDATE

By Sam Bradfield, IHS Member

SCAT sailed the Miami-Nassau Race March 19 and 20...her Maiden Race! It was a hundred and seventy five miles of crossing the Gulf Stream and beating upwind hullborne except for the last twenty five miles close reaching. The wind was 15 to 30 knots gusting to 40. The seas were six to fourteen feet and short and steep...unpleasant conditions for a first race for a foiler and crew.

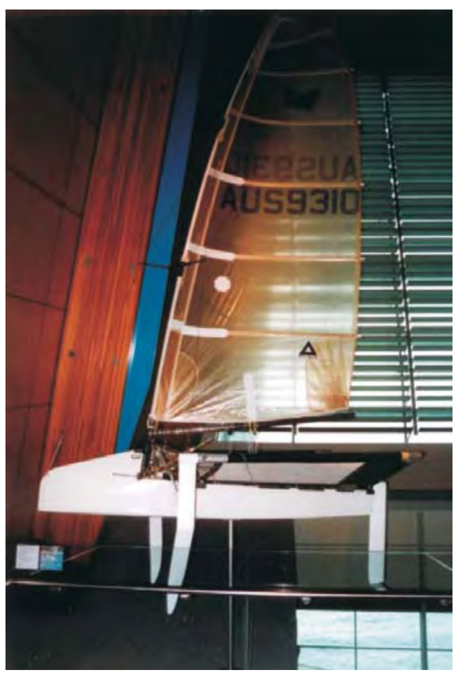
A mixed fleet of 22 boats entered, 9 multihulls and 13 monohulls. Only eight boats finished...two multihulls, catamaran Green Flash (Dave Calvert) and foiler SCAT (Philip Steggall) and six monohulls. The multihulls led the pack crossing the finish line first and second, two hours ahead of the first monohull. Scat took Second Place in the race and beat the first finishing monohull by more than an hour. The winning elapsed finish time was 25 1/2 hours. We don't have a writeup of the details of action in the race itself as yet. The crew members, Steggall, McGarry, Caffee, and Zwart are preparing tech notes for the project use, but we don't have them in publishable form as yet.

SCAT came in second with very little damage. She's a tough boat with a good crew. Too bad the course was directly upwind for 150 miles of the race. Next time I hope we'll be favored with more reaching (flying) wind angle than beating. SCAT deserves a chance to show her speed flying!

HYDROFOIL MOTH NEWS

By Martin Grimm, HIS Member

I had the pleasure of meeting the small but dedicated group of Western Australian Moth sailers on Sunday 25 May at the Nedlands Yacht Club in Perth. A race had been arranged as there had been no state championships over the previous summer. With only light wind on the day, conditions were not favourable for hydrofoil equipped moths. In such conditions it is difficult to become foilborne and consequently the additional wetted surface area of the foils simply creates more resistance than a standard Moth.



Windrush Foiler Moth on Display in the Western Australian Maritime Museum.

Although Garth Ilett brought along his foils for 'On the Prowl' [refer to article in Spring 2003 NL], he decided to enter the race with a conventional centreboard and rudder. Brett Burvill's moth on the other hand was built to run only with hydrofoils and so he was not able to exchange the foils for a centreboard. While the conventional moths had good runs, Brett was only able to become foilborne intermittently and was slowed by the foils when the wind dropped or the heading was unfavourable. The potential of the hydrofoils was however made very apparent at the end of the last race when he was able to make a foilborne burst to the last mark. The acceleration of the boat as it became foilborne was impressive and he rapidly gained ground on the moth leading him before the mark was reached.

The original moth foiler built and sailed by Brett Burvill [refer to Spring 2000 NL] is now on display at the Western Australian Maritime Museum in Fremantle where it shares pride of place with 'Australia II', the 12m yacht which won the America's Cup in 1983. The attached photos show this craft and its foils. Although the moth is a developmental class intended to give as much freedom as possible to allow the design to evolve for higher performance, last year a ruling was made that the laterally split foil arrangement would no longer be permitted as this could be considered as a multi-hull configuration. The bi-foiler arrangement as applied on other moths where the centreboard and rudder are replaced with inverted T-foils remains permissible under the moth class rules and so this design path will undoubtedly see further development effort.

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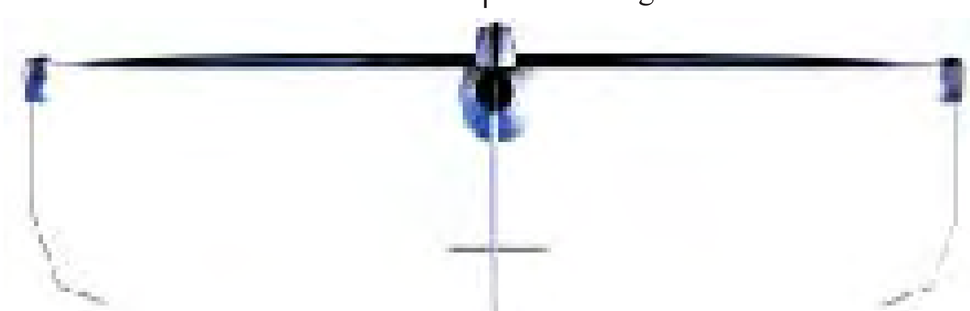
JEFOILER MOTH
(Continued From Previous Page)

Based on the good performance already demonstrated with 'On the Prowl', John Ilett has been busy producing new carbon fibre foil units for an experienced moth sailor in Melbourne. These are of a similar arrangement as illustrated in the last newsletter however with minor refinements in design and production. The foils are again fitted with flaps as described previously and illustrated in the accompanying photo. John is able to manufacture both carbon fibre foil sections and complete T-foil assemblies in his workshop. More details can be found at his website: http:/www.fastacraft.com

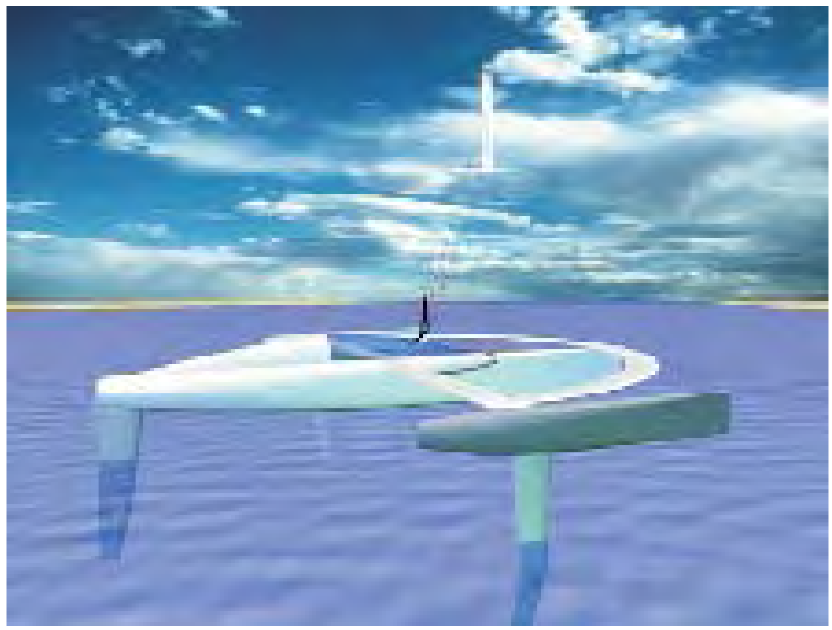
JELLYFISH FOILER – KITE POWERED HYDROFOIL CONCEPT FOR SAILING SPEED RECORD

Courtesy of Sebastien Francois (www.jellyfish-foiler.com)

In the Winter 2000-01 and Spring 2001 newsletters, a review was provided of some of the past sailing speed record holders. Since that time, several new concepts have evolved to challenge the sailing speed record, and once again these include hydrofoil-supported craft.



One such concept is the innovative Jellyfish Foiler. This hydrofoil sailboat will be powered by a rigid kite developing 870 kg (1900lb) thrust at full speed. When foilborne, the hull will fly some 80cm above the water supported by two outrigger mounted J-shaped foils and a T-foil rudder mounted aft of the hull. Flying tests of the Jellyfish Foiler while towed by a motorboat commenced in late 2000 and were completed in the spring of 2001. These tests demonstrated that the boat was able to fly in a stable manner.
The team has undertaken testing of



kite propulsion using a more conventional Hobie cat hull. Sebastien reports sailing under kite power is very stable and requires relatively little wind strength.

The kite is supplied by KITECH, a surf kite manufacturer. For Jellyfish Foiler, KITECH has produced an extra strong kite with a 22m² wing area intended to be able to fly in 20-30 knot winds. The current absolute water sailing speed record holder is the Yellow Pages Endeavour, which achieved an average speed of 46.52 knots over a 500m course on 26 Oct. 1993. The objective for Jellyfish Foiler is to initially break the 50-knot barrier with a subsequent target of 54 knots (or 100 km/h).

While the project was on hold during the Canadian winter (rivers are frozen in Montreal during that time), Sebastien is working on a new hydrofoil concept and was hoping to test this towards the end of April. The intention is to set-up the foil system while using an engine for propulsion, then to commence testing under kite power.

Work is also underway on the development of a kite autopilot and electronic measurement equipment has been fitted to the craft. New team members are sought to help with further development of this interesting project.

Welcome New Members
(Continued From Page 2)

signed the TSM bow seal for the SES-200. He has authored and co-authored numerous papers and reports on AMVs including hydrofoils. At DTMB he was Chief Engineer of the LCC Project, responsible for the design, construction and initial operation of the Navy's $125M Large Cavitation Channel, the world's largest variable-pressure water tunnel. He was later team leader for the DTMB group designing submarine propulsors including the new Virginia Class. Currently he is working on propulsion, cavitation and frictional drag reduction problems at DTMB. He is an enthusiast for the history of AMVs and test facilities.

Adam Mendel – Adam is a high school student from Atlanta, GA who became interested in hydrofoils while researching boat building on the internet. He intends to build a small experimental hydrofoil within the next year and hopes to achieve speeds of 30 - 40 knots on calm water. Adam is always interested in learning about new ideas and concepts, and plans to major in industrial design in college.

Marcelo Paredes – Marcelo is a Navy Officer from Ecuador. Currently he is studying Naval Engineering in the ESPOL University in Guayaquil, Ecuador. In one year he will get a Bachelor Degree but the prerequisite is to present a thesis or final project. Marcelo feels that Advance Marine Vehicles is the wave of the future for maritime transport. For his thesis he wants to prepare a Preliminary Design of patrol craft. He is certain he will find the right people who could help him with his work. Marcelo hopes to make a contribution with his work in the Society.

Max Runyan - Max has been a water person his whole life. From motor driven to wind driven to individual person driven water craft of any kind, Max has always been interested in learning more about how they work. For the past 18 years Max has been pursuing a research and development career in the aerospace industry applying advanced metal joining technology to the next generation of aircraft designs. The combination of Max's research and development aerospace background and his love for water vehicle activity has lead him to become interested in hydrofoil development both past and present. Max reports that the IHS has been a wonderful source of hydrofoil history and information and he looks forward to receiving his next newsletter with information on the latest hydrofoil developments.

IHS OFFICERS 2000 - 2001

John Meyer	President
Mark Bebar	Vice President
George Jenkins	Treasurer
Ken Spaulding	Secretary

INTERESTING MESSAGES
(Continued From Page 9)

tion. As a member of the last active crew (Operations Specialist) I was shocked when I sighted the instantly recognizable hulk while driving west along the Columbia river enroute to the Oregon coast. I pulled the car over and confirmed that it was the Plainview. I was able to climb up the tail strut mount and board the ship. It is in sad shape. There are holes and tears in the aluminum hull and superstructure. The tail foil is lying on the mudflats aft of the ship. What a sad end to a once marvel of engineering. Although the Plainview suffered many problems, when it was fully operational it was an amazing ride. I personally can attest to experiencing 65 knots as a member of the navigation watch during one trail. It literally flew. Michael Temple; onedog@nventure.com

WEB BENEFIT

IHS provides a free link from the IHS website to members' personal and/or corporate site. To request your link, contact William White, IHS Home Page Editor at webmaster@foils.org

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The NEWSLETTER

International Hydrofoil Society
P. O. Box 51, Cabin John MD 20818 USA

Editor: John R. Meyer | Autumn-2004 | Sailing Editor: Martin Grimm

MIAMI-NASSAU FEEDER RACE AND RETURN - SCAT SHOWS HER STUFF

By Sam Bradfield and Tom Haman, IHS Members

SCAT sailed the Miami-Nassau Feeder Race and return to Florida in March 2004. See the IHS Summer 2004 NL in the Sailor's Page section. We didn't sail the race, but Tom flew out to Nassau to bring the boat back to Florida Institute of Technology. The return trip is where SCAT really "showed her stuff".

It's hard for us to place a fair evaluation on the racecourse performance of SCAT and crew based on this one race. It was our first ocean race and conditions were the worst possible: beating hullborne di-

SCAT on Trials Before the Race

See SCAT, Page 3

WHERE ARE YOU IN CYBERSPACE?!

IHS relies on electronic communication with the membership to improve timeliness and reduce mailing costs. If your email has changed recently, **let us know your new email address!** Thanks.

2005 DUES SOON

IHS Membership is still only US$20 per calendar year (US$10.00 for students). Your renewal or new membership is critical. IHS accepts dues payment by personal check, bank check, money order or cash (all in US dollars only). We have also recently arranged for payment of regular membership dues by credit card using PayPal. To pay by credit card please go to the IHS membership page at www.foils.org/member.htm and follow the instructions.

INSIDE THIS ISSUE

PRESIDENT'S COLUMN

To All Members,

At the June 2, 2004 Board of Directors meeting, the voting by the general membership for the Board members to serve during 2004-2007 was reviewed. Results were that Sumi Arima, Malin Dixon, John Meyer and William White were reelected to the Board for the years 2004 through 2007. Election of officers by the Board members was held at the July 21, 2004 meeting. The four incumbent officers, having indicated their continuing willingness to serve, were unanimously re-elected: President, John Meyer; Vice President, Mark Bebar; Treasurer, George Jenkins; Secretary; Ken Spaulding.

During the June Board meeting, several "Dues and Other Financial Policies" were adopted:

- Payment of Annual Dues. Annual dues are payable as of 1 January. Members who have not paid by 30 July will have all membership privileges suspended until payment is made. If no payment is made by 31 December, the member will be disenrolled. If the former member desires to rejoin the Society within two years of his disenrollment, he will be liable for back dues plus dues for the year in which he rejoins. After two years, the former member will be treated as a new member, except that a new membership certificate will not be issued.

- Student Memberships. Student memberships will increase from $2.50 to $10.00 effective immediately. Student members who have paid their dues in advance will be "grandfathered" at $2.50 per year in the years for which they have paid.

- Members Joining During the Year. Dues paid by new members and received by IHS prior to 15 November will be credited to the year in which paid. Back issues of the Newsletter for that year and other membership benefits will be provided at no cost if requested by the new member. Dues received from new members on 15 November or later will be credited to the following year, but all membership benefits remaining for the year in which paid (e.g., Winter Newsletter) will be provided to the new member.

- Sustaining Memberships. Sustaining Members are corporations, companies institutions and other organizations who wish to support the work of the Society. The names and/or corporate logos of Sustaining Members will be prominently displayed on the IHS website, Newsletter, and letterhead stationery. Additionally, links from the IHS website to the Sustaining Member's website will be provided. Once annually, Sustaining Members may submit for publication in the Newsletter an article (not to exceed 250 words) describing its corporate/institutional activity in the recent past and intentions for the future. Up to 12 employees of the Sustaining Member may be designated as Regular Members. Annual dues for Sustaining Members will be $250.

Best regards to all,

John R. Meyer, President

WELCOME NEW MEMBERS

Thomas Bein – Tom heads up the Marine Division of the Maritime Applied Physics Corporation. He came to MAPC after 25 years at NSWC in Annapolis where in his early days he worked on the development of the composite piping that was installed in some of the US Navy's hydrofoils. He is currently managing an R&D program to design and fabricate a 35 ft unmanned hydrofoil that will be used to rapidly deploy sensors used for ASW and ASuW. The prototype vessel will be diesel powered using gear boxes mounted in the retractable struts to drive propellers. Launch is expected in the Fall of '04.

Philip Bradley - Although his career for the last 20 years has been in high tech, Philip has always built experimental vehicles in his spare time. Over the last 10 years he has built two hovercrafts and one gyrocopter (like a helicopter). He was recently introduced to hydrofoils and was immediately captivated. He has read with interest many of the IHS Q&A pages and looks forward to his next project that he plans to start this Autumn.

John Budden – John is a software validation engineer for pharmaceutical control systems since the early 1990's, and before that a control system programmer. His hobby however, is aerodynamics which has developed into interest in surface effect craft (WIG) using a hydrofoil to lift the craft clear of the surface and allow the speed and ram effect to build up such that the foils lift clear of the water and can be re-

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SCAT
(Continued From Page 1)

rectly into the wind and steep choppy seas for the first 125 miles to the second mark; and, after rounding, close reaching with "skimming" and some flying the last 50 miles to the finish line in Nassau Harbor. SCAT made up an hour on the lead catamaran on this final leg despite having taken some damage to the foil control system rigging early on in the race.

SCAT in Light Air Off Port Canaveral

The crew were veteran sail boat racers and three of the four are experienced foiler (RAVE) racers. But we all know that ocean conditions are more demanding and that racing a sail rig "power plant" on this very stable platform plus managing a lifting foil system for racing is most demanding at our present level of expertise. It was the first race on a foiler for the skipper (Philip Steggall). It was also the first offshore race for the foiler sailors. Mike McGarry made good use of the GPS data in recording details of the race and we hope to benefit from those in future efforts. At present, we are repairing the damage to the foil system controls including overhauling the main foil incidence control hydraulics and latching as well as the tail foil rudder box. We are completing the Raymarine velocity performance instrument system. We're doing this by adding a digital compass masthead mounted mast rotation instrument that was developed in the Ocean Engineering Department of Florida Institute of Technology with Hydrosail, Inc. sponsorship.

Photo by Mike McGarry on Return Trip from Nassau to Fort Pierce, Florida

The return trip presents a fairer, broader view of the boat's capability as a lifting hydrofoil equipped sailing trimaran performing foilborne at speeds exceeding windspeed as she was designed to do. The weather and sea conditions and layout of the course to windward for the FEEDER RACE to Nassau forced the boat to perform hullborne 85% of the time for that first portion of the trip. The average boat speed for the 175 mile course was 6 ½ knots. Not a fair test for a foiler. She did well to finish second to a well sailed high performance catamaran in that race where only a third of the starters were able to finish. On the return trip she achieved speeds of 20 to 25 knots for appreciable stretches returning to Fort Pierce. She proved that she can really live up to the name "SCAT"!

The Miami-Nassau Race was very expensive. I don't think we'll do the 2005 STAR. That's an upwind race and based on what we just saw, SCAT's hydrofoil sailing technique upwind needs additional work. What we must work on is optimizing the tradeoffs between pinching and footing to windward to maximize speed made good to windward racing without overstressing the boat. Note:"pinching" is steering at 40 to 45 degrees heading to the wind; "footing " is 55 to 60 degrees heading to the wind.

We've decided to pursue our summer series of experiments in the gulf stream here in our "front yard", so to speak, until we're truly "race-ready". We can get some "rough and ready" practice there. If we can get sponsorship we'd like to try a "downwind" run from New York to Lizard Point in 2005 if this summer's experience encourages it. Lizard Point is in southwest Cornwall, England. It is the westernmost point in England and transatlantic races and/or time trials are frequently run to and from that vicinity from New York and other east coast sailing sites. In our practices we'll be shooting for an average speed of at least 20 kts over long distances.......Who knows?

****

RECOLLECTIONS OF THE PLAINVIEW

By Greg Bender, LCDR, USN (Ret.), IHS Member, USS Plainview (AGEH-1) Engineer Officer 1975-1977

From the Long Beach, WA Chinook Observer, Wed. May 19, 2004 (with permission):

Derelict Ship Being Scrapped. A landmark along WA SR 401 will soon be a thing of the past. The Giant Experimental Hydrofoil AGEH-1 (Plainview), at 200 feet, the world's largest aluminum ship when it was launched in 1969, is being dismantled for scrap by its owners, the Stambaugh family.

I remember the day I first walked aboard the *USS PLAINVIEW (AGEH-1)*. I had just completed Surface Warfare Officer School (Basic) and was wearing the shoulder boards of an Ensign having received my commission through the Navy Enlisted Scientific Education Program (NESEP) only six months earlier. As a Navy enlisted man in San Diego some four years earlier I had seen the USS Tucumcari and USS Flagstaff at the San Diego Naval Station. They were conducting local operations following their return from Vietnam. My curiosity had gotten the better of me, and I had asked for a tour. The OIC of the Flagstaff rewarded my curiosity with a tour and pictures of the Flagstaff in operation. I was soon hooked on the new high-speed Navy and requested hydrofoil duty as I prepared for my commissioning. To my surprise, I received orders to the *USS PLAINVIEW (AGEH-1)*, then the world's largest hydrofoil.

On the IHS website Bill Ellsworth describes the *PLAINVIEW*…

This 320-ton hydrofoil was characterized by its long, slender hull. One might wonder why there was no "A" on the hull of PLAINVIEW in view of its "AGEH-1" designation. It turns out that it is not customary to include the "A" on the hull of US Navy auxiliary ships [AGEH stands for Auxiliary General Experimental Hydrofoil].

The ship had a length of 212 feet and an extreme beam with foils down of 70.8 feet. It attained foilborne speeds of over 50 knots from two General Electric LM-1500 gas turbine engines driving two supercavitating propellers. Two Detroit Diesel engines drove propellers for low-speed hullborne operations.

[For additional information about *PLAINVIEW*, see the IHS website.]

I stepped aboard the *PLAINVIEW* in June of 1975 at Todd Pacific Shipyard expecting to be the Assistant Engineer/Damage Control Assistant/ Supply Officer. I soon found that there was no Assistant Engineer assigned and the *PLAINVIEW's* Engineer Officer, LT Mitch Berdinka, was separating from the Navy five days later and the *PLAINVIEW's* vital bits and pieces were spread across Todd Shipyard, Puget Sound Naval Shipyard and Boeing's Renton Plant. *PLAINVIEW's* OIC, LT Frank Hudson, said not to worry too much about a relieving letter, but to do anything and everything I could to pick Mitch's brain before he left and figure out where everything was and what condition it was in. The XO, LTJG Joe Hugill, offered his encouragement.

PLAINVIEW was the victim of on-again/off-again overhaul & conversion funding following a December 1972 casualty to the starboard main foil incidence control link while the ship was returning from open ocean testing. In January 1973 *PLAINVIEW* had begun an overhaul at Puget Sound, only to be sent to Lockheed's yard for minimal repairs when Puget ran into capacity problems. In May of 1974, *PLAINVIEW* was towed to Todd's Seattle yard to begin what was to have been a two year overhaul and conversion.

With shepherding from the Hydrofoil Special Trials Unit (HYSTU), we set about helping Todd with the task of finding, fixing and installing all the bits of piping, machinery and electrical gear that made up the Navy's largest hydrofoil. Corporate memory was vital. Sumi Arima, Boeing's Dwain Sorenson and PSNS Pipe Shop Foreman Sib LeBeau had lived with the *PLAINVIEW* throughout its early years. Their memory of where things were installed and how they worked were crucial to getting it all back together without too many pieces left over. By the time we finally left the yards in January 1977, we only had one sailor, RM1 Charlie Smoot, who had ever been foilborne on *PLAINVIEW*.

During our final six months at Todd, ENCS George Hayes and I must have worked about five and a half 18-hour days a week monitoring production work, tracing systems, figuring out how things were to function and training the crew for the start of operations. At times we were reminded just how unique the ship was. These times frequently came about when we were trying to find some spare part or

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PLAINVIEW
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other only to discover that the world's last two widgets of a particular type were either already installed elsewhere on *PLAINVIEW* or were the property of the Iraqi Air Force. Eventually, the work package was complete, or at least as complete as could be expected, and the *PLAINVIEW*

Plainview and High Point

was moved to PSNS for the start of testing.

The Captain was determined that *PLAINVIEW* would look and act like a "real ship" in as many ways as possible from damage control and firefighting to the daily routine and turned the crew loose to make it so. This inevitably caused concern with the HYSTU folks as, in its earlier incarnation, the ship had been terribly sensitive to weight and LCG. Previously, everything that went aboard was weighed and its destination logged. *PLAINVIEW's* newfound capability to fly at greater displacements allowed us to treat *PLAINVIEW* more like a ship and less like an aircraft. Although on one occasion I can recall it behaving very much like an aircraft. We were testing the autopilot's high-speed taxi mode and were at about 45 knots hullborne on the turbines with struts down when we flew right out of the water. The folks at Draper Labs who built the autopilot had made a little mistake in the algorithms. This had the effect of setting the foils to zero degrees incidence with respect to the baseline. The foils still had some lift at this angle and the large forward struts had more than the tail strut. As the bow started to come up, this increased the angle of attack and things progressed quickly. I was on the bridge and remember thinking, "How are you supposed to see where you are going when you can't see over the bow?" The instrumentation showed that we were trimmed about 11 degrees bow-up when the main foils left the water and the turbines oversped and shut down. I remember hearing the turbines trip off the line then remember falling. Fortunately, the main foils re-wetted and regained lift at about the same time. Other than a typewriter that committed suicide, I don't recall anyone being injured. I think we finally figured out that the main foils had been about 4 feet out of the

USS Plainview (AGEH-1) Underway in Puget Sound

water at the apogee of our flight.

We eventually got most of the bugs worked out, and *PLAINVIEW* began conducting fairly regular test flights in Puget Sound. We were invited to visit the Canadian naval base at Esquimalt near Victoria, British Columbia for Canadian Armed Forces Day and Victoria Day in the summer of 1977. *PLAINVIEW* performed flawlessly and decked in signal flags and with orange and black striped struts retracted was the center of curiosity for thousands of visitors to the base.

I left *PLAINVIEW* that summer for my next duty station, and was relieved by LTJG Bob Butherus. Apparently my turnover to him was less disheartening than that which I received from Mitch Berdinka, because Bob followed me to the *USS ELLIOT (DD-967)* where he served as Damage Control Assistant and eventually relieved me as Main Propulsion Assistant. As *PLAINVIEW's* final Chief Engineer, Bob witnessed the undoing of all the long hours spent making *PLAINVIEW* work every bit as well as its designers had hoped.

As Bill Ellsworth recounts…

Unfortunately, soon after emerging from a program of deficiencies correction and returning to the trials program with many successful operations in its log, PLAINVIEW fell victim to the Congressional budget knife. She made her last foilborne flight on 17 July 1978, ending with a total of 268 foilborne hours and without ever being tested to the limits of her rough water capability. The ship was officially inactivated on 22 September 1978 and towed to the inactive fleet at Bremerton WA. In May of 1979, the hull (less the struts and foils, gas turbines, and other special equipment) was sold to a private party for the sum of $128,000. The engines, foils, and transmissions were retained by the Navy for possible use on another prototype hydrofoil or another advanced naval vehicle.

Long after my having left the *PLAINVIEW*, Dwain Sorenson sent me a picture of the ship on the Astoria

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PLAINVIEW
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Ex-USS Plainview on Mudflats

mudflats. I had it framed and used to keep it over my desk at NAVSEA along with a photo of the ship foilborne with Mt. Rainier in the background. People would ask me why I had a picture of a derelict vessel. I used to explain that the two photos were the same ship, but in the first photo we hadn't yet run out of imagination.

CARDEROCK DIVISION TO STUDY FLEXIBLE PROPELLER BLADES

By Richard Szwerc and Ki-Han Kim

(Excerpted from NSWCCD *Wavelengths*, April 2004, by permission)

The Propulsion and Fluid Systems Division at the naval Surface Warfare Center, Carderock Division (NSWCCD) is beginning a three- year program to determine the merits of composite marine propellers with adaptive blade pitch (flexible blades) for Navy ships. The Department of Defense Comparative Testing Office is funding this program through the Foreign Comparative Testing (FCT) program.

Over the duration of the program, the hydrodynamic performance of multiple propellers will be tested in the Carderock towing tanks, the 36" water tunnel, the Large Cavitation Channel, and at sea on an operational vessel. Large blades, including blades for a 25' diameter propeller, will be built and fatigue tested at the University of Rostock (Rostock, Germany) and at the United States Naval Academy. At the conclusion of the program, the Navy will have experience designing and insight into the manufacturing of flexible composite propeller blades and will have the technical basis for providing recommendations to an acquisition office for procurement strategies.

At the conclusion of the program, the Navy will have experience designing and insight into the manufacturing of flexible composite propeller blades.

The propellers will all be designed by NSWCD and built by the German company A.I.R. Fertigung-Technologie GmbH in Rostock. AIR has been in business for more than 10 years designing and building carbon fiber composite propellers, including pitch-adapting or flexible propellers. They have built more than 400 ship sets. While the principal users of these propellers have been mega yacht owners, two navies have also purchased large propellers from AIR. Most propellers constructed have been the rigid design and range in size up to 13 ft. in diameter, but the company's latest product is the flexible, or pitch-adapting propeller.

In the pitch-adapting design, the blade pitch angle is allowed to adapt to optimize propeller performance under operational loads by taking advantage of the ability to create direction- dependent stiffness in the blades through the use of fiber orientation. For example, if the leading edge is stiffer than the trailing edge, the blade will tend to twist (or change pitch), rather than bend uniformly as the propeller rotates. Designed correctly, this pitch change can reduce cavitation noise and vibration and increase hydrodynamic efficiency.

One innovation that is planned for the model propeller testing is to incorporate fiber optic strain gauges into the blades beneath the outer layer of fibers. With these gauges, the engineers at the Center will measure the blade strains as the blades rotate ahead and in reverse, including the crash-back condition. The strain will be compared against predicted levels to validate prediction codes and will be used to estimate the service life of the propellers. Some of the work with the fiber optic strain gauges will be performed jointly with NRL and will be funded by the ONR NICOP (Naval International Cooperative Opportunities in Science & Technology Program) project managed by Dr. Ki-Han Kim.

RIM~DRIVEN POD PROMISES RELIABILITY AND HIGH SPEEDS

(From *Marine Propulsion* June 04)

By David Foxwell

General Dynamics Electric Boat is developing a new type of rim-driven propulsor pod which it believes is inherently more flexible, reliable and maintainable than a conventional hub-driven podded propulsor, and better suited to applications on fast ships.

Podded propulsors are widely used in a variety of applications, most nota-

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RIM~DRIVEN POD
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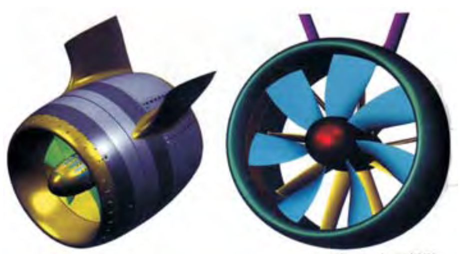
ble on cruise ships, and provide a high level of design flexibility, increased payload, improved efficiency and enhanced maneuvering.

Offering the opportunity to eliminate long shaft lines and sensitive bearing alignments, and significantly reduce noise and vibration on board, pods have proved popular with ship-owners, but the first generation of pods have also suffered from reliability problems. Moreover, although highly flexible, the speed achievable with first generation hub-driven pods is limited - primarily due to cavitation, but also due to pod size.



Under development for a number of years, but rarely described outside specialized technical conferences, the rim-driven propulsor pod that General Dynamics Electric Boat is developing in the USA is, the company believes, intrinsically more reliable than hub-driven pods, allowing for greater optimization of each element of the system, and capable of supporting higher ship speeds.

The rim-driven propulsor pod consists of a ducted, multi-blade row propulsor with a permanent - magnet radial - flux- motor rotor mounted on the tips of the propulsor blades, and the motor stator mounted within the duct of the propulsor.

Both the motor rotor and stator are separately 'canned', which allows them to be fully immersed in seawater, with seawater in the gap between them - hence the rim-drive does not require a rotating seal, said Bill Van Blarcom, who is a principal engineer at General Dynamics Electric Boat, involved in advanced concept development and evaluation of integrated electric power/propulsion system components. The rotor shaft and bearings are housed in a relatively small hub, which is free flooding and supported by a set of downstream stator blades. The stator blades also transmit thrust from the rotor as well as recover swirl energy from the rotating blades.

The key features that distinguish a rim-driven pod (RDP) propulsor from a hub-driven pod (HDP) - which help to make the concept inherently more reliable and maintainable - are the hydrodynamics, motor, bearings, seals and clearances, Mr Van Blarcom said. "The RDP concept eliminates a number of design and operating liabilities that are inherent to hub-driven propulsors". The rim-driven propulsor pod is strut-mounted to the hull via the aft portion of the duct.

"In a hub-driven propulsor, interaction occurs between the propeller and pod, resulting in vibration and cavitation. This does not happen in a rim-driven propulsor pod, and the flow velocities over the exterior of the RDP duct and struts are low compared to that over the HDP, resulting in relatively low drag. In addition, the presence of the rim on the rotating blade row and the duct on the RDP make for improved vibration and cavitation performance compared to a hub-driven pod."

The presence of the rim allows the blades to carry significant hydrodynamic loading at the tips without generating tip vortices, Mr Van Blarcom said, and the duct 'straightens' non -uniformities in the flow ingested by the propulsor due to currents, hull wake, and azimuthing, thus improving vibration and cavitation performance. The duct also provides a level of shielding of the propeller induced hull unsteady pressures, improving hull vibration.

Another advantage is that the RDP has an inherently higher level of protection against damage, compared with the open wheel blades of a hub-driven propulsor, the RDP rim and duct helping to protect the blades from damage due to foreign objects.

The RDP is powered by a high power density, low loss permanent magnet (PM) motor, which makes use of General Dynamics Electric Boat's patented embedded magnet retention system. The high power density of the motor - generally 40 to 100 per cent greater than the power density by volume of wound field synchronous or induction motors - is one of many features that facilitate the compact design of the RDP and its high level of hydrodynamic efficiency.

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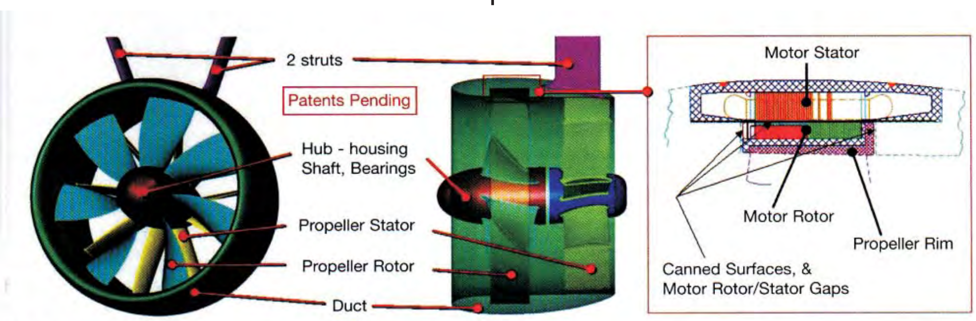
Interested in hydrofoil history, pioneers, photographs? Visit the history and photo gallery pages of the IHS website.
http://www.foils.org

RIM~DRIVEN POD
(Continued From Previous Page)

Electric Boat says its embedded PM design is an order of magnitude more fault tolerant than a surface-mounted magnet design. Impact resistance is provided in part by the magnet location and retention method, and - because the electrical gap between the stator and rotor is greater than typical motors - they can be separated sufficiently to allow the surfaces of each to be canned and maintain a relatively large water gap between them. This also enables an allowance for bearing wear, and provides more room for shock excursion.



Main components of the Rim Drive Pod

The motor in question also has large operating temperature margins. At full load, an 18.5MW RDP has a normal operating temperature of 114 degrees C, but the insulation system is good for continuous operation at 155 degrees C. The motor rotor is located at a large diameter on the propeller rim, which produces higher torque at the same power compared with locating it at the propeller hub, and therefore enables lower rpm. it also results in a shorter motor length and therefore high power density, and low rpm in turn results in low relative velocities, which in turn yields low drag and high efficiencies, and further enables high cavitation free speeds, and low cavitation erosion.

When these features are combined with the RDP's hydrodynamic attributes, it can enable an RDP to achieve very high cavitation-free speeds.

The cans for the stator and rotor incorporate Electric Boat-developed and patented composites and canning techniques that provide a high integrity, corrosion-resistant barrier between the surrounding sea water and the motor stator and rotor with a low level of electrical connectivity. Mr Van Blarcom said the low electrical conductivity of the composites resulted in a reduction in electrical losses of some 6 per cent compared with metal cans, and the low level of electrical conductivity ensured that the varying magnetic field does not set up eddy currents in the can itself.

The motor is cooled by the seawater flowing past the pod, a mechanism that is enabled by the high-efficiency, low-loss PM motor, waterflow past the duct outside diameter, which is a conducting surface for the stator the strut configuration; this is integrated with the duct to preclude stator hot spots, and the motor can, that allows seawater flow through the motor/stator gap for improved stator cooling.

Electric Boat's PM motors are compatible with pulse width modulation (PWM), which is offered by several manufacturers, including ABB, AsiRobicon, Toshiba and others, or pulse density modulated (PDM) drives. The company has followed a step-by-step approach in the development of its PM motors, development having formally begun in 1991, but has also drawn on more than 100 years of high performance motor design and manufacturing experience for the US Navy.

Shaft/hub driven, non-submersible PM motors have been produced and tested to date, including a 4.5MW motor, which was produced in 2000 and is now operating the US Navy's new large-scale submarine test vehicle. Rim-drive submersible motors have also been developed in the same way, the largest to date being a 1.6MW motor in an RDP that begun testing in July 2003.

A number of additional designs have been completed or are currently under development for both low rpm shaft-driven and rim-driven PM motors that range up to 30MW Electric Boat shaft/hub driven 150kW and 4.5MW PM motors have also been tested under a variety of off-design conditions, and their impact tolerance demonstrated by shock testing to US military standards.

A 1.6MW RDP demonstrator completed testing in March, and the same unit is due to be installed on an as yet unidentified vessel in 2006, at which time tests up to full loading and for maneuvering will be conducted, and reliability data collected.

Cavitation testing to date has been conducted at speeds of up to 26 knots for an RDP designed for a 25 knot maximum speed. That testing showed no damaging cavitation at the highest speed tested, and the conclusion from the tests is that RDPs have great potential for higher speed vessels.

INTERESTING MESSAGES ON THE BULLETIN BOARD

Yoichi Takahashi and Aimee Eng have been corresponding with each other via the IHS Bulletin Board on the subject of radio-controlled (RC) hydrofoils. Your editor has attempted to summarize their admirable efforts. They both have done some good work, partially described here along with pictures.

Yoichi Takahashi lives in Kyoto. Aimee is an architectural model builder out of Portland and builds architectural models for customers in Seattle. In her spare time she has been building about a 6- foot model of the PHM. She is now in the process of working on the foils and waterjet system. Yoichi has been giving her advice.

Yoichi has succeeded in constructing radio-controlled models of two hydrofoil boats and would like other modelers in the world to know about them. One is ¼0 scale model of the Boeing Jetfoil. Control of these hydrofoils uses small gyroscopes from model radio-controlled helicopters. Although the full-scale hydrofoil has a waterjet for propulsion, he resorted to a propeller system for the model.

The second radio-controlled model is the hydrofoil patrol guided missile of the Maritime Self Defense Force of Japan (a version of the Sparviero). This hydrofoil is propelled using a scaled down version of the water jet propulsion system. The water jet pump is a miniature version of the turbine pump of the full-size hydrofoil. Hydrofoil control is accomplished using the gyroscopes for model radio controlled helicopters. Both RC models are powered by electric motors and a nickel-Cd 7.2 volt battery. If anyone has a question about Yoichi's excellent work, please contact him by E-mail: Yoichi Takahashi (skyex@triton.ocn.ne.jp)

Aimee hasn't done a lot on the PHM model yet. She is working with an ex-Boeing engineer, Cliff Shaw. When she mentioned this project to him, he said he really wanted to do the pump designs.

Cliff plans to test the pump and water intakes prior to any hull construction. The proposed PHM model is scaled at ¼8 and they are trying to keep the weight down to 5 lbs.

EUGENE WEINERT REMEMBERED

[Your editor received word recently that IHS Member, Eugene Weinert passed away in September 2003. Jerry Gore, and Bill White, IHS Members, remember him well and have written the following.]

Gene Weinert was the senior gas turbine engineer at Philadelphia (OLD BOILER AND TURBINE LAB). Jerry Gore first made his acquaintance working on the Naval Inshore Warfare Craft Program, later Naval Special Warfare Craft Program.

Gene was the go-to-guy at Philadelphia when we tested the complete TF-25 gas turbine and gear/shaft train for 1000 hours in the land-based test bed for Coastal Patrol Interdiction Craft (CPIC-X).

Gene was likewise involved in every GT project over his entire career and I recollect that included the LM-2500 land test bed and the USNS ship that was the seabed test ship for LM-2500—-also the TF-35's and TF-40's. Gene during the 70's also supported the 3KSES program with testing of the LM2500, FT-9 and Salt water GT Demisting systems for the LCACs and other SES. We also worked on developing huge 50000 hp water- brakes for their big GT test facilities. Gene was a fine gentleman who was unafraid of progress and change. It was a pleasure to work with him during those early days.

He was a valued professional contributor as well as a consummate gentleman in every way—he is one of the few who helped get the US Navy out of steam and into gas turbines.

He has authored/co-authored many papers on gas turbines.

We in the advanced ships community owe Gene a lot—-he was one of us.

SAILOR'S PAGE

DEVELOPMENT OF DINGHY FOILERS

By Dr. Ian Ward, Past President IMCA, Developer of the first Dinghy foiler, Bifoiler and Unifoiler Moths

Moths on Foils

To lift and glide silently and effortlessly above the waves with exciting bursts of speed has long been an ideal for those who dream! The potential has always been there, but practical reality has been lacking. It seems so simple to just place a foil under the hull and go! yet in practice, it is far more complex.

The International Moth class is an ideal forum for developing and evaluating hydrofoils based dinghies. The class offers a forum of open design rules and competitive international sailing. Moths are just 3.35m long with 8.0sqm of sail and have no minimum weight limit. A competitive all-carbon boat weighs about 30 kg and so is an ideal platform for foiling. Brett Burvill, Marc Pivac and John & Garth Ilett from Perth in Western Australia have clearly demonstrated that Moths have sufficient power to weight in order to fly on foils. They have been demonstrated to be faster than displacement or planing hulls when sailing in over 6 knots of wind where they become foilborne. While these boats are currently reaching speeds of 22 knots, it should eventually be possible to sail at around 30-35 knots in 18-20 knots of wind!

In spite of how difficult it may appear to balance on foils only mounted on the centreboard and rudder, the foil is much wider and more stable than a narrow displacement craft. Hydrofoil Moths have the potential to be 15-20% faster than the fastest current skiffs, while the older Scow designs could easily double their speed with foils fitted! It is now possible to outperform many current skiff and catamaran classes both upwind and down.

The introduction of foils was one further step in the development of the class as evident from the progressive lowering of their yardstick over the past 75 years. I am sure there is even more to come! Unlike recent developments in skiff classes where increased speed is primarily achieved with larger boats, more powerful rigs and increased righting moment, Moths have made improvements through increased efficiency and reduced weight. Each small improvement results in higher speed, which creates higher apparent wind, so "the faster you go, the faster you can go!"

Ian Ward sailing the first ever "Bifoiler" Dinghy Foiler, Sydney, November 1999.

Dinghy Foilers

"Dinghy Foilers" hardly dreamt of until six years ago are now a reality. Winning a national sailing championship on foils has never been achieved before in any International class. Rohan Veal from Australia has shown in no uncertain terms that this is possible with his resounding victory in the 2003 Australian Moth Nationals, winning some 40 minute races by as much as 9 minutes!

Foiling sailboats have been around for many years, but mastering dinghies with only centerline foils is the latest frontier. It was only in recent years that foils have been applied to the Moths class. Initial efforts were with trifoil arrangements, but this effectively categorized them as multihulls which have since been ruled out.

It was not until 1998 that using only centerline foils placed on the rudder and centreboard was proven to be viable. This had probably not been attempted earlier simply because it was not thought to be workable. Such "bifoiler" arrangements exhibit quite different behavior from trifoilers. I will refer to this new breed of efficient sailboats as "Dinghy Foilers". The efficiency of dinghy designs has improved considerably over the last 75 years.

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DINGHY FOILERS
(Continued From Previous Page)

[Readers are encouraged to see the unabridged version of this paper on the IHS website at: www.foils.org/]

Moth & Dinghy Foiler Developments

Moth Dinghy Foiling has been developing quietly over the past six years:

- An initial attempt at foiling by Ian Ward in 1998 was based on the Trifoiler "Longshot" which achieved a sailing speed record and formed the basis of the Hobie Trifoiler. While fast in a breeze, the craft was complex and impractical to rig & launch, heavy and was also too stable, making it boring to sail!

- Consequently the "Bifoiler" arrangement was developed and sailed in 1999, the first time any dinghy had sailed on rudder and centreboard foils alone. It addressed perceived limitations of the Trifoiler arrangement and proved the feasibility of sailing such a foil configuration.

- In 2000 Brett Burvill and Marc Pivac independently introduced a trifoil Moth arrangement with surface piercing wing mounted foils. The boat sailed well in varied conditions and put foiling Moths on the map, winning heats in the Australian Moth Nationals that year. There were still some handling difficulties and problems for rigging and launching. Understanding that it was practical to foil on just centerline mounted foils and considering trifoiler moths to be multihulls, the International Moth Class Association voted to rule out the latter configuration as being contrary to the existing rule.

- In 2002 John and Garth Ilett took up the considerable challenge and independently built their own bifoiler Moths that would satisfy the existing rule. They had solved significant control problems and John continues to produced bifoiler conversion kits available from Fastacraft.

- With a set of Fastacraft foils, Rohan Veal mastered bifoiler sailing technique in a short time frame to place 3rd in the 2003 World Moth Championships and went on to convincingly win the Australian National titles in January 2004 with speeds some 20% faster than the current top displacement hull Moths.

The bifoiler arrangement has proven very successful, now being introduced in Japan and the UK. The ease with which sailors have mastered sailing with foils suggests that they are simpler to sail than a narrow skiff Moth in displacement mode. The bifoiler also outperforms the original trifoil arrangement in terms of ease of rigging, handling, speed around the course and race results.

Unifoilers

While "bifoilers" are the best solution available to date, they are by no means the only or simplest solution for Dinghy Foilers. Another configuration under development is a "Unifoiler", consisting of a single lifting foil on the centreboard with a canard at the bow acting as a sensor, effectively using the boat itself as the sensor arm. This arrangement is even simpler than a bifoiler, as the main foil does not require control flaps or sensor connections and no rudder foil or outrigger modification is required either. With a small, retractable canard foil at the bow, just slip the centreboard foil in the casing and go!

The canard can be fixed or fitted with a sensor, surface running or immersed. Many variations are currently being trialed. It may also be retracted due to its small size and the light loads applied to it. The key benefits are simplicity, low cost and that lift is generated by one foil working at maximum efficiency. Extra foil surface area is available for lift-out but is reduced when the surface running sensor canard foil leaves the water.

The Unifoiler concept was first applied by Rich Miller to his foiling sailboard in California. To date only one dinghy has flown as a Unifoiler. This is a wingless scow Moth, which is being used by Ian Ward as a test platform for foiler developments. This photo illustrates what is possible in just 6-7 knots of breeze!

Ian Ward sailing the first ever "Unifoiler", a foiling Scow Moth, Sydney, March 2004

The challenge now is to establish improved and simplified height and pitch control. Proving such design improvements within a proper racing forum is the next step, made possible by competing within the Moth class.

[To be continued in the Winter 2004 issue of the IHS Newsletter.]

WELCOME NEW MEMBERS
(Continued From Page2)

tracted allowing the craft to fly in ground effect. His eventual target is to build 1/6 scale model of this craft, but wants first to master the function of the hydrofoils on a "clipped wing" version of the model with only a 2.4M span. The main "T" hydrofoil is based on the Moth foils designed by Adam May and Lynton Jenkins of Full Force Boats, Portland, UK. This foil has been re-enforced and profiled to take an all up weight of 190kg and a lift off at 47Km/h. Construction is progressing at a snail's pace-quality problems with components and some of the raw material the principal culprits. The eventual aim is to look for a configuration that will achieve 70 Km/hr cruise in 0.5M wave height in ground effect at a fraction of full thrust. The hydrofoils will be designed to achieve lift off as close as possible to cruise power.

Leonardo Lella – Leonardo is from Italy where he works as an aero-maritime consultant, master in Nautical Science, and a fully-rated professional pilot both fixed wing and helicopters. He is very interested in these fields, and acts also as historian, and when possible publishes reports. Leonardo's interest in hydrofoils comes from his early years in Naples and his many trips between Naples and Capri Island. He has spent almost 40 years of hydrofoil travel, during which time he has flown on all kinds of European hydrofoils. Now he is really afraid that their slow progress and introduction of newer models has resulted in replacement by "inadequate catamarans and monohulls". He has an interest in models of some hydrofoil types, and is interested in contacting others working on hydrofoil models.

Robert Morazes - Bob comes from Norwalk, CT where he joined the U.S. Navy and spent 4 years working at NAS Pax River, MD, as a mechanic. He stayed in the Southern MD area after his discharge, and managed the St. Mary's Co. Airport. Bob worked as a draftsman and engineer with Bendix Field Engineering. St Mary's College of MD granted him a BS in Math, after 8 years of study. He then went to work for Maritime Dynamics Inc. While there he worked on vent valves, trim tabs, big and little T-foils, fixed fins and retractable ones. Bob also worked with the SES 200, for too many of its iterations, many other Norwegian and German SES's, and many of the Fast Ferry's operating in Europe. He is now employed by Island Engineering where his first job was to work, yet again, on the old SES 200 being converted to Hydrofoil Small Waterplane Area Craft (HYSWAC).

Terence Chung-Leung Yung - Terence graduated from The Chinese University of Hong Kong in 1966 majoring in Mathematics with Physics as a minor. He completed a Course of Marine Navigation in Word-Wide Sea Training School. In 1968 and served as a Deck Officer on board various ships managed by World-Wide Shipping Group of HK. During 1971-1973 he was Chief Officer on board various ships owned by Cosmopolitan Shipping Inc of New York. Since 1973 Terence has served as Chief Officer/Master aboard various hydrofoils, Boeing Jetfoils and High-Speed Cata- marans of Shun Tak Shipping Co., and now called Shun Tak - China Travel Ship Management Ltd after merger in 1999. At present Terence is a captain commanding one of the Tricats.

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The NEWSLETTER

International Hydrofoil Society

P. O. Box 51, Cabin John MD 20818 USA

Editor: John R. Meyer | Winter-2004-2005 | Sailing Editor: Martin Grimm

TESTING TO START THIS FALL ONR DEVELOPING TWO UNMANNED SEA SURFACE VEHICLE PROTOTYPES

The Office of Naval Research (ONR) is developing two unmanned surface vehicle prototypes that it sees as future options for a common Unmanned Surface Vehicle (USV) or a family of USVs.

A high-speed prototype and a low-speed prototype of the Unmanned Sea Surface Vehicle (USSV) are expected to be in the water by this fall, said Scott Littlefield, director of the ship science and technology office at ONR. Both will be about 11 meters long, allowing them to fit on a Littoral Combat Ship (LCS), he told *Inside the Navy* in an interview July 21.

To reach speeds of more than 45 knots, the high-speed USSV will use hydrofoils, which will fold down when the vehicle is in the water and fold up when it is in stowage aboard a ship, he said. The low-speed USSV will be optimized for towing arrays and other heavier payloads, traveling at 20 knots on a semi-planing monohull, he said. Maritime Applied Physics in Baltimore is building both prototypes. The USSV effort has about $9 million to build the vehicles, develop automated capabilities and test them, Littlefield said.

When the two prototypes deliver in the fall, they will undergo basic testing to verify their speed, power, towing and sea-keeping abilities, he said. In early 2005, integration with payloads will begin. The LCS missions are a top focus of the USSV effort, and the program executive office for ships, which is in charge of LCS development, is working with ONR, he said. The high-speed USSV prototype is expected to have payloads for anti-surface warfare, while the low-speed prototype is expected to have payloads for mine warfare and anti-submarine war-

See USSV, Page 3

WHERE ARE YOU IN CYBERSPACE?!

IHS relies on electronic communication with the membership to improve timeliness and reduce mailing costs. If you are a member with email, **let us know your email address!** Thank you.

2005 DUES ARE DUE

IHS Membership is still only US$20 per calendar year (US$10.00 for students). Your renewal or new membership is critical. IHS accepts dues payment by personal check, bank check, money order or cash (all in US dollars only). We have also recently arranged for payment of regular membership dues by credit card using PAYPAL. To pay by credit card please go to the IHS membership page at <http://www.foils.org/member.htm> and follow the instructions.

INSIDE THIS ISSUE

PRESIDENT'S COLUMN

Greetings to All IHS Members and Best Wishes for the Holiday Season.

I want to call to your attention to several recent additions to the IHS Website:

1. IHS Webmaster, Bill White, has posted the LCS (Littoral Combat Ship) presentation on the BBS with a link to the IHS Web site where there is a downloadable copy of the presentation. You can find it under the section: **Hydrofoil Articles, Papers, Books & Other References** on the Home page Site Directory. This presentation was made at a joint meeting of the IHS and SNAME SD-5 in September, 2004.

2. A very comprehensive paper on Hydrofoil Ship Design by William C. O'Neill (IHS Member) can be found in the section: **Educational Pages**

3. "The Quest for Speed at Sea". In 2003 IHS members Dennis Clark, William Ellsworth and John Meyer were invited to write the feature article for the *Technical Digest*. This publication is distributed every several years by the Naval Surface Warfare Center, Carderock Division showcasing the work of the Division. In the October issue of the Center's *Wavlengths*, it stated, referring to the recently published *Technical Digest* : "In the feature article, *The Quest for Speed at Sea,* Dennis Clark, William Ellsworth, and John Meyer, (former Division employees) showcase the history of the development of concepts and technologies to increase the speed of naval vehicles and include a pictorial timeline of high-speed naval vehicles from 1900 to the present." IHS has obtained permission to place the article on its website. It can be found under section: **Educational Pages**. All members are encouraged to view these 3 items.

We have noticed that inquiries on the IHS Bulletin Board are going unanswered. All members are encouraged to check the BBS for information and questions that you may be helpful in answering. I encourage all members to make an effort to visit the BBS at least weekly and try to answer some of the questions, even if briefly. We have rightly tried to discourage direct email contact by steering people to the BBS. That sets the stage for technical discussions to be documented. So please follow through and provide responses so the exchange of information will be documented and available to all. At the same time, please invite non-members to join the IHS and become an official member of the hydrofoil community.

The Society continues to grow with 32 new members added to the Membership roles during 2004. You can view the Membership List by logging onto the IHS website and put in the proper password. All IHS members have been informed of this password. If you have been missed or forgot, please contact the webmaster. It is advisable for all to do this and check the information on the List. If it is incorrect, please send changes to: Steve Chorney: schorney@comcast.net

John R. Meyer
President

WELCOME NEW MEMBERS

William P. Carl - Bill Carl's contribution to the hydrofoil community started many years ago. During the 1950's, known as the "Decade of Experimental Progress." The U.S. Navy, in its early development work, evaluated a hydrofoil configuration having ladder foils on the XCH-4 (Experimental Carl Hydrofoil No. 4). This 16,500 pound, 53 foot craft, was known as the "Carl Boat", after its principal designer, William P. Carl. It had a seaplane-type hull supported by two sets of foils forward and a single strut and foil aft. Two 450 hp Pratt and Whitney R-985 aircraft engines with two-bladed controllable pitch propellers 8 feet in diameter provided the thrust to carry this craft to the highest speeds since those achieved by Alexander Graham Bell's HD-4. In 1953, its design speed of 65 mph was exceeded in three to four foot waves. Later, a maximum speed of 74.4 mph was recorded, which in 1954 was a speed record for hydrofoils, exceeding Bell's 1919 record of 70.85 mph. The good performance of the XCH-4 encouraged U.S. Navy officials to continue hydrofoil development. Shortly after final tests of the XCH-4, Bill Carl left J. H. Carl and Sons to form his own company, Dynamic Developments, Inc. Where he and R. Gilruth developed and produced a hydrofoil kit for conversion of small runabouts. Grumman Aircraft Engineering Corp. purchased an interest in the company and later acquired it as a base for their entry into the hydrofoil market.

Thomas Haman –Tom is an oceanographer by trade and worked in the underwater world, developing re-

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USSV
(Continued From Page 1)

fare. The USSV effort started a year ago and has been on a fast track, he noted.

"We felt there was an urgent need to get some prototypes out in the water so we could start doing some experimentation and find out what works and what doesn't work," Littlefield said. "So everything we've done has been on a fairly rapid time frame."

The USSV effort is not meant as a "one-size-fits-all" approach, but interfaces between the vehicle and payloads are being designed for commonality, he said. Some payloads, however, may not migrate from one variant to another because the variant may not be optimized for a particular mission, he said. "We're trying to do the maximum number of payloads on the minimum number of different hull forms," he said. But whether that eventually will mean one hull or two hulls remains to be seen, he added.

ONR generally is focused on developing the hull and propulsion for the USSVs, he said. The program executive office for littoral and mine warfare, the Spartan USV program, and other agencies are contributing to the development of the payloads, he said. Littlefield said he has also had discussions with the Defense Advanced Research Projects Agency (DARPA) about using a potential payload called Hologram.

Still a concept and not yet a program, Hologram is an effort to demonstrate technologies for a "disruptive" approach to littoral warfare, according to a statement DARPA spokeswoman Jan Walker provided to *Inside the Navy*. The Hologram effort will investigate and develop "Micro- Autonomous Ocean Craft (MAOC) to spectrally emulate platforms comprising U.S. maritime expeditionary forces," she said. MAOC will operate in a networked environment, providing a multidimensional countermeasure for naval forces, she said.

The main technical challenges in the USSV effort are developing an automated launch and recovery system and giving the vehicle autonomous navigation capabilities in high sea states, Littlefield said. The launch and recovery system will be a "very difficult problem" because two vessels of different sizes would be moving at different periods of motion, he said. The host ship must grapple the USSV without damaging each other, a task made more difficult in heavy sea states, he said. The automation is necessary because it is safer than having a sailor manually secure the USSV, he noted. In addition, the smaller crew size of ships like LCS, with its complement of other offboard vehicles running at high operational tempos, will also put a premium on automated systems, he said. The Program Executive Office (PEO) for ships is working with ONR on the launch and recovery problem, he said.

Autonomous navigation in choppy waves will be a challenge too. Current autonomous navigation provides point-to-point commands, guiding the vessel in a straight line, Littlefield said. But a straight line is not always the best course in high sea states, he pointed out. Rudder and throttle adjustments are necessary to prevent the vessel from capsizing, as well as sensors to detect the waves and algorithms to react to them, he said. "Programming that kind of behavior into an unmanned vehicle, I think, is going to be very challenging," he said.

The high-speed USSV prototype will have more technical risk than the low-speed prototype, he said. Transferring power from the high-speed USSV's diesel generator down to the propellers on the hydrofoils, which extend outward from the hull, will be a challenge, he said. Another issue is getting the hydrofoils to fold up for stowage on a host ship, he said. The low-speed prototype will not have hydrofoils.

With the increasing attention being given to unmanned aerial vehicles and unmanned underwater vehicles, USVs may have been an "overlooked opportunity," he said. Until the Spartan program, there was not much investment in USVs, but it has been growing lately, he said. This spring, the Navy started working on its first USV master plan, which is being led by the PEO for littoral and mine warfare, he said. By contrast, the Navy issued a UUV master plan in 2000 and is already updating it. Littlefield said he sees an important niche that USVs can fill, especially with the future introduction of LCS into the fleet.

"It's incumbent on ONR to start getting into that game a little bit and to look at where we should be going long term," he said. "This [USSV] is getting us started, getting us a couple of prototypes that we can experiment with and then looking at some of the harder problems for how you operate and control those vehicles." — *Jason Ma*

COMPANY HAS DESIGNS ON FERRY OF THE FUTURE

Reproduced by permission from the Seattle Post-Intelligencer, Tuesday, August 24, 2004, by the Seattle Post-Intelligencer Staff

The buzz around redesigned hydrofoil calls it smoother-riding, more fuel-efficient

Ferry rides of the future could be faster and smoother, if a Bremerton company's invention takes off.

Advanced Marine Concepts has developed what it says is a new design for hydrofoils — boats with underwater wing-like structures that can lift the vessels above waves. Two prototypes of its hydrofoil, called Dragonfly, will be built later this year.

Photo By Phil H. Webber, P-I

Eric Anderson of Advanced Marine Concepts shows a Dragonfly model, a hydrofoil for the commercial ferry industry and the military.

The Bremerton company — started in 1998 by Philip Whitener, a former Boeing Co. engineer, and Eric Anderson, chief executive of Art Anderson Associates — eventually plans to show its prototypes to the commercial ferry industry and the military.

As a hydrofoil's speed increases, the underwater wing-like structure lifts the boat off the water. The results are a smaller wake, smoother ride and less fuel consumption.

"I think they are the future," said Dick Hayes, executive director of Kitsap Transit.

The agency is trying to get funding to build a 149-passenger boat that was designed by Art Anderson Associates, Hayes said. The new vessel would reduce fuel costs by about 25 percent, he estimates.

Hydrofoils aren't new and can be found on boats — even wakeboards — around the country. Alexander Graham Bell toyed with one in the early 1900s, according to Encyclopedia Britannica. Boeing began producing them in the 1960s for commercial and military uses; it ended the commercial business in the mid-1980s.

Whitener, who worked for Boeing for 42 years before retiring in 1983, was the engineering manager of a Boeing hydrofoil developed for the Navy.

Advanced Marine Concepts' prototype is unique, Anderson said, because it is designed for boats with a wide beam. It can also create its own air cushion, which helps the boat transition to the wing-like structure, without using fans, which consumes motor power, he said.

Radix Marine Inc. in Silverdale is manufacturing the company's prototypes, which will be 15 feet long by 8 feet wide and seat a driver and up to six passengers.

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CORSAIR FOILER 2200

By Michael Hauenstein

Reprinted with permission from Soundings Publications LLC.

Trailerable trimaran builder Corsair Marine has begun production of its new Foiler 2200 center console power catamaran.

The Foiler uses an aluminum hydrofoil designed by Morrelli & Melvin Design & Engineering of Huntington Beach, Calif., designers of Steve Fossett's record-setting 125-foot sailing catamaran Cheyenne. Located between the hulls about two-thirds of the way from the bow to the stem, the hydrofoil is shaped like an inverted T and spans the tunnel from the bottom of one hull to the bottom of the other. The hydrofoil and hulls work together for better performance, ride and handling, according to Corsair, and create a dryer ride and less wake. The company says the hydrofoil lifts the hull clear of chop and reduces drag.

"The ride is just miles better than any monohull in a chop," says Corsair Marine owner Paul Koch.

Corsair uses the same foam-core sandwich construction as in its sailing trimarans, which it has been building since 1985. The trailerable Foiler displaces 2,920 pounds with a

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CORSAIR FOILER 2200
(Continued From Previous Page)

pair of Honda 90-hp outboards. It can accommodate optional power up to 260 hp from single or twin outboards, according to Corsair.

The cat tops out at more than 50 mph, according to Koch. “It is very fast, smooth and stable, and leans into turns,” he says, explaining that the Foiler’s asymmetrical hulls account for that turning characteristic, uncommon for a catamaran. Base price with standard 90-hp engines is $62,510.

Contact is: Corsair Marine, Chula Vista, Calif. Phone: (619) 585-3005. www.corsairmarine.com

HIGH SPEED CRAFT CONFERENCE

Contributed by Martin Grimm (IHS Member)

I have just been reading the program for the RINA High Speed Craft Conference (17-18 November 2004, RINA HQ, London). It was nice to read that a paper on a hydrofoil design is being offered, but with an unusual twist.

Here is the description of the paper: “Design of High Speed Low Wake Hydrofoil Passenger Ferry” Endicott M. Fay, Teignbridge Propellers Ltd, UK

In many areas around the world it has been imperative that fast passenger ferries provide fast reliable service across protected harbours, bays and rivers. While traveling at high speed, the existing ferry configurations create relatively low, high-energy waves that can erode shorelines and upset small vessels. The paper introduces a trimaran-configured hydrofoil to reduce the wake to an acceptable level while maintaining the speed necessary to provide a competitive service. The design will provide a passenger carrying capacity of 350 and cruise speed of 35 knots. The hydrofoil will be a canard style arrangement using a diesel electric drive system with a pair of pod drives. The paper focuses on the preliminary design of the vessel with emphasis on the hull design, hydrofoil arrangement and propulsion system.

POWER LEVELS MULTIPLIED IN NEW GENERATION THRUST

From Speed at Sea, June 2004

By Doug Woodyard

The maximum installed waterjet power per vessel has risen from around 2,000kW in the 1980s to quadruple-jet installations with a power input of 70MW today. Waterjets designed to absorb over 25MW are primed for service and applications calling for unit powers of 50MW and 250 MW per vessel - are being addressed by designers.

Providing an impetus for the development of a new large waterjet generation is Japan’s Techno- Superliner (TSL) ferry project at Mitsui Engineering & Shipbuilding. The 140m long, 14,500gt aluminium -hulled vessel is designed to carry 725 passengers and 210 tonnes of cargo on a 1,000-nautical mile domestic route at a service speed of 37 knots, with a maximum speed of 40 knots. Services between Tokyo and the Ogasawara Islands are due to start next year.

Few could have envisaged that the waterjet would evolve in 20 years or so from an alternative to the propeller for leisure craft and shallow draught vessels into a powerful propulsor for hi-speed commercial and naval tonnage.

Rolls-Royce was commissioned to supply the twin Kamewa 235 waterjets, each to be driven by a GE Marine LM2500+ gas turbine. With an impeller diameter of around 2.35m, each jet is designed to handle up to 27MW.

Twin Kamewa 235 WJ are specified for the TSL. Each has an impeller diameter of about 2.35 m.

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POWER LEVELS MULTIPLIED IN NEW GENERATION THRUST
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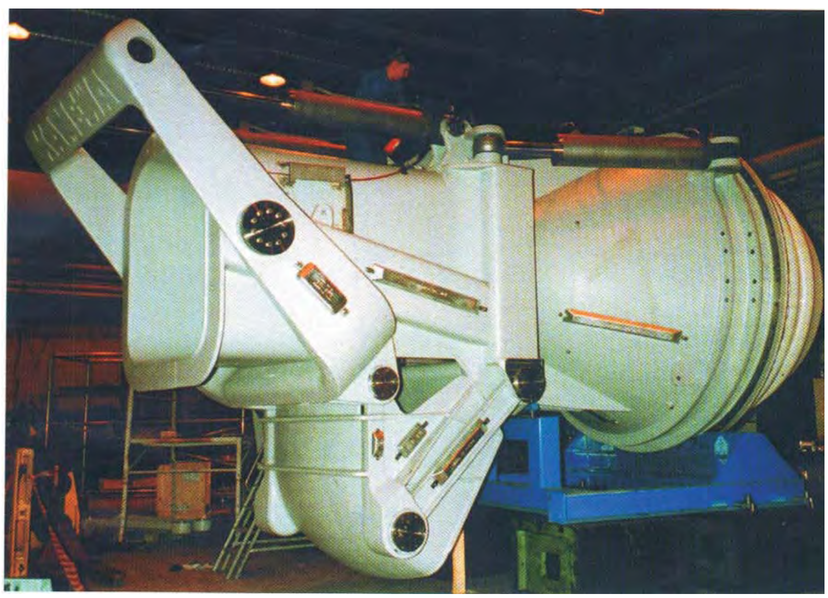
Kamewa's established stainless steel SII series waterjets have proven efficient and reliable propulsors, Rolls-Royce notes, but when considerably more input power has to be absorbed, and impeller diameters exceed 2m, a new approach to design and construction was dictated.

The resulting VLWJ (very large waterjet) design, addressing input power applications from 20MW to 50MW, is divided into a series of elements, with the inlet duct integrated into the hull structure and the impeller chamber bolted to the duct and the transom. Outboard of the impeller chamber is the guide vane chamber and the steering/reversing unit; the latter is operated by a hydraulic steering actuator located inside the vessel and stem that protrudes downward from the compartment over the waterjet units.

The impeller shaft is supported by a water-lubricated bearing in the guide vane chamber, with the seal box at its inboard end on the inlet duct, and supported within the hull by a split bearing. The massive thrust is taken by a separate thrust block in the hull, connected to the impeller shaft by a stub shaft and coupling.

Each driveline for the waterjets incorporates two bearings from British specialist Cooper Bearings. A 440mm design serves the intermediate shaft while a heavier duty 440mm bearing is integral with the waterjet. Overlapping with the VLWJ, the well established Kamewa S-series embraces 11 models with input ratings from around 1,500kW to 24MW.

The hydrodynamic performance of the mixed-flow pump is sustained by built-in bearings which keep the impeller in the correct position and provide control of tip clearance. The outboard bearing location also simplifies the overall load distribution in the aftship and promotes efficient use of the inlet duct as a load-carrying structure. Stainless steel is used as the manufacturing material throughout to maximise wear and corrosion resistance.



The Rolls-Royce VLWJ design addresses input power applications from 20MW to 50MW. Note technician on top.

Five impeller blade angles, eight pump outlet nozzles and at least 10 inlet duct design variations are available to optimise a waterjet for the given application. Simple and minimal cable installation is fostered by a computerised databus- based system for steering and reversing control, which can be used for both manual and joystick manoeuvring. Redundancy and realtime control with a high level of security is claimed by the designer.

Among the latest references for Kamewa S-series waterjets is the 73m-long catamaran ferry *Fairweather,* which entered service this spring with the Alaska Marine Highway System on a 135- nautical-mile route *(Speed at Sea,* April 2004). With capacity for 250 passengers and 35 large cars, the Nigel Gee-designed/ Derecktor-built vessel has a service speed of 35 knots at 85 per cent maximum continuous rating of the 14.4 MW propulsion plant based on four MTU 16V595 TE70 diesel engines.

Each engine, derated to deliver 3,600kW at 1,750 rpm, drives a Kamewa 90SIl steerable/reversible waterjet via a Reintjes VLJ2230 gearbox and Centa composite shafting.

Typically serving smaller passenger ferries, rescue boats and small high speed naval craft - with four models covering inputs up to 3,000kW - Kamewa A-series waterjets were claimed to be the first in the world to use mixed-flow pump technology. In conjunction with hydrodynamically- optimised design and exacting production techniques, this feature reportedly achieves a 5-10 per cent higher efficiency than competing axial-flow waterjets.

The original article goes on to describe several other waterjet designs

TIP-DRIVEN IMPELLERS PROMISE BENEFITS

From Speed at Sea, June 2004

Specialists at the UK's University of Southampton have carried out a concept investigation using a tip-driven electromagnetic propulsor as part of a waterjet propulsion unit. Potential benefits are hydrodynamic performance improvements, easier assembly and integration into the hull, and greater flexibility in machinery location.

A primary advantage is that there is no need to insert a driveshaft within the waterjet inflow; this significantly reduces cyclic variations in the propulsor inflow and removes an area of flow separation around the shaft. It also provides the designer with greater freedom with regard to the types of propulsion systems available and where they can be placed within the vessel.

Concept viability was examined by considering the performance of an axial-flow electromagnetic thruster developed for the Remote Operating Vehicle (ROV) market and numerically studying its performance within a typical waterjet inflow. A study was also conducted to examine the scalability of such propulsion units.

It was concluded that for a typical size of waterjet with an input power requirement of 110kW and a diameter of 0.25m, the maximum delivered power at 2,200 rpm would be 90kW. The design would offer the benefits of no shaft-induced losses and reduced cyclic blade loadings, and should deliver a higher thrust than comparable conventional waterjet units using geared electric motor drives.

Driving the waterjet impeller via its blade tips completely eliminates the presence of the driveshaft protruding through the waterjet duct walls and upsetting the onset flow to the impeller. Furthermore, the length of the waterjet inlet duct must be kept as short as possible to avoid additional added weight from the entrained water; and the ramp angle of the duct must be as shallow as possible to avoid excessive flow distortion.

In conventional waterjet systems with shaft-driven impellers these two dimensions are constrained by the position of the engines. A rim-driven impeller, however, should allow greater freedom with the positioning of the duct within the hull.

BUMPY FLYING

Scalloped Flippers Of Whales Could Reshape Wings

By Steven Ashley
Reprinted by permission from Scientific American, August 2004

One day in the early 1980s Frank E. Fish noticed a small statue of a humpback whale in a Boston sculpture gallery. On closer examination, he saw that the creature's large, wing-like pectoral flippers were studded with evenly spaced bumps along their leading edges. Fish was taken by surprise. As a specialist in the hydrodynamics of vertebrate swimming, he knew of no cetacean flippers, fish fins or avian wings that bore such odd features - all of those have smooth front edges. He mentioned this to his wife and conjectured aloud that the artist must have made a mistake. The storeowner, overhearing Fish's comments and knowing the sculptor's meticulous attention to detail, soon produced a photograph that clearly showed the humpback's lumpy flippers. Fish marked down the unusual protuberances for future research.

After intermittent study over the next two decades-involving in one instance the sawing off of three-meter long flippers from a rotting, beached humpback-the biology professor at Pennsylvania's West Chester University and several colleagues have recently shown that the whale's knobby side appendages in some ways trump the more conventional sleek designs of both human and nature.

Working, with fluid dynamics engineer Laurens E. Howle of Duke University and David S. Miklosovic and Mark M. Murray of the U.S. Naval Academy, Fish fabricated two 56-centimeter-long plastic facsimiles of humpback pectoral flippers-one with the characteristic humps. one without. In wind tunnel tests at the Naval Academy, the scale model of the smooth flipper performed similarly to a standard airplane wing. The hump back flipper replica meanwhile exhibited significantly better aerodynamic efficiency.

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Disclaimer

IHS chooses articles and photos for potential interest to IHS members, but does not endorse products or necessarily agree with the authors' opinions or claims.

Interested in hydrofoil history, pioneers, photographs? Visit the history and photo gallery pages of the IHS website. http://www.foils.org

BUMPY FLYING
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As the researchers reported in the May 2004 issue of *Physics of Fluids,* the whale's bumpy-fronted flippers generate 8 percent more lift and as much as 32 percent less drag than comparably sized smooth flippers. Further, the humpback's large, scalloped fins withstand stall at angles of attack (into the on-rushing flow) 40 percent steeper than their seemingly more streamlined counterparts. "These structures are so counter to our understanding of fluid dynamics that no one had previously analyzed them," Fish says.

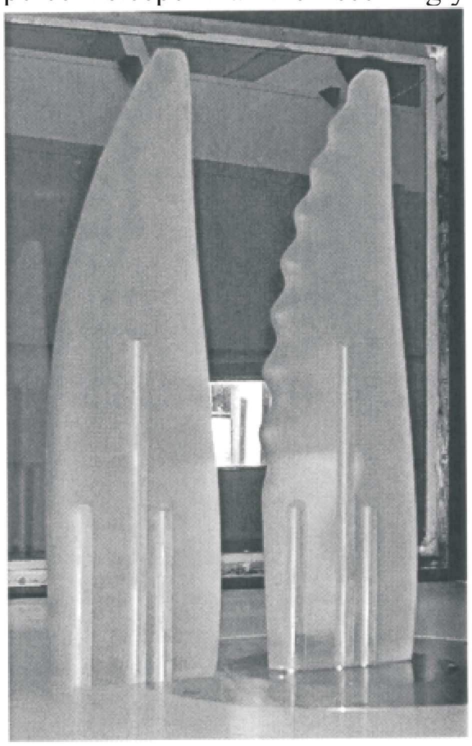

Photo Courtesy of Prof. Howle

Pectoral Flipper Replicas with and without bumps, went fin-to-fin in wind tunnel tests

The key reason for the improved performance are the pairs of counter-rotating swirls created at either side of the leading-edge bumps, called tubercles. The tubercles act as vortex generators," Howle explains. "The swirling vortices inject momentum into the fluid flow, which keeps the f1ow attached to upper surface rather than allowing it to separate as it would otherwise. This effect delays stall at higher angles of attack." As a result, the leviathans can make tighter turns and maneuver more nimbly - a capability that comes in handy when hunting fast-moving schools of herring and sardines.

Fish, who has patented the concept of lumpy lift surfaces, says that tests of a more accurate flipper model and functional optimization of the tubercle geometry are in the offing, which could lead to better man-made wings. Improved resistance to stall could add a new safety margin to flight and could also make aircraft more agile.

"This discovery has potential applications not only in airplane wings but also in airplane propellers, helicopter rotors and ship rudders," Howle notes. He speculates that the next America's Cup victor might tack more sharply using a bumpy rudder.

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As a result of your editor making the "IHS Core" aware of this article, several interesting responses were received; one of which is reproduced here. Others will be published in the Spring Newsletter.

From Tom Speer: "Personally, I wasn't convinced by the article. For one thing, it's not necessarily the case that they evolved for hydrodynamic reasons. There are certainly enough examples of strange biological developments, so long as they don't do too much harm. I doubt a peacock's tail is especially aerodynamic, for example. What if whale mates just like the feel of being rubbed by ribbed flippers better than smooth ones?

"There's a fair amount of research in the literature on various leading edge devices like sawtooth shapes, etc. These haven't proven to be especially helpful except in very specific circumstances - typically at low Reynolds Numbers where laminar separation may be a problem.

"Much the same goes for vortex generators. If you have separated flow to begin with, vortex generators pay off by promoting attached flow. But if the flow is attached already, vortex generators just add drag. A test pilot friend calls them "the horns of ignorance" because they're used to fix unexpected problems.

"At the same time, there are similar structures that are designed for specific purposes. One is the "Gaster bump". It's kind of like a single tubercle on the leading edge near the root of a swept wing. The purpose is to stop attachment line transition along the leading edge by causing disturbances from the fuselage boundary layer to be diverted from flowing outboard along the attachment line. The bump allows the leading edge to start with a fresh boundary layer at the bump. Since the whale flippers often act high sweep angles, the tubercles may do the same thing. See page 1 of NASA Technical Paper 3623 for additional related information"

Bill Degentesh wrote: "Some time ago, in celebration of the Wright Bros first flight, a Public Television Special examined the rather sparse scientific and engineering data they had, in

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BUMPY FLYING
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their day, to draw from when designing the Wright Flyer. One of the better references of that day was a set of design tables by the German Glider Pioneer, Lilienthal. The Wright Brothers found Lilienthal's data overstated the lift, and understated the drag of the airfoil wing, and subsequently had to conduct elaborate tests of their own to ascertain the correct performance. The Wright results were said (on the program) to be accurate to within 3%, based on current knowledge, while Lilienthal overstated lift by 1/3 or more.

"How could Lilienthal, a good scientist with a fine record of success in his glider experiments, have misstated his results? His Gliders certainly flew well.

"Perhaps it was airframe workmanship - perhaps the Lilienthal wing did NOT use a smooth leading edge, but rather the airfoil ribs bulged substantially, protruding the fabric, to produce some of the dual-vortex lift enhancement recently noted? The Wright-built Flyer in the Smithsonian has smooth leading edge airfoils...and illustrations of a Lilienthal glider which I recall from my youth, displayed wing-ribs with definite protrusions - enough to cast a shadow on the wing surface.

Could the error in Lilienthal's data be simply the omission of a statement of the necessary size of the rib- protrusions? Someone perhaps should contact the History Detectives!"

In response to Tom Speer's message, John Meyer wrote: "We can always count on you for a good response, Tom. Thanks. I guess we need to mull this over and need to pursue the aero tests in more detail.

"I have heard similar remarks re: A test pilot friend calls them "the horns of ignorance" because they're used to fix unexpected problems. But then again they DID fix problems, so not really a bad idea."

Tom Speer responded: "Please don't misunderstand me - I think tubercles are a valid and interesting area of research. But I wouldn't expect that someone could just sand a bunch of bumps on a leading edge and get a significant, or even a measurable, gain in performance for a hydrofoil. What I'd like to see is an investigation that integrated a computational fluid dynamics element and an experimental element, where each guided and supported the other. I think that's the best way to both understand the fluid dynamics and to come up with something that can be engineered.

Bill Degentesh wrote again: "Perhaps the 'History Detectives' are at work already. The validity of the current 'horns of ignorance' patent depends upon originality - no prior art may exist - and if any prior wing-design used protrusions for lift enhancement (any discovery counts as prior art), then prior art does exist.

"My own thought was that Lilienthal might have been the first… Tom Speer indicates (in a IHS posting) that Lilienthal's wing was fully described in his own tables and reconcilable with the Wright's wing. That being the case (I do not plan to check) Lilienthal did certainly not use vortex-enhanced lift obtained through protrusions.

"I hope Tom is right - and also there is no prior art - added lift and reduced drag would enhance both aircraft and hydrofoils. The concept of Europe via the sea within 24 hours has always interested me; the prospect the technology for this is patentable (and the patent legally defensible) will certainly excite investment interest."

[Editors Note: Other comments will be published in the Spring Newsletter since this topic has generated considerable interest.]

INTERESTING MESSAGE

Solar Electric Boat Design (Abridged) – "I have a question that you might be able to help on. I am part of a solar electric boat team from The College of New Jersey. We take a boat up to a buffalo river to race every year. This year we are designing a new hull. We run primarily two events: Sprint (a 300 m drag race) and Endurance (a 2 hour race in which the most laps is desired). Building a hull runs into a problem here. The endurance event is worth more points and usually speeds of around 5 mph are kept for the 2 hours. Since we run off of only two batteries in this event, efficiency is vital. During the sprint, speeds of around 25 mph are the goals. Last year our boat was a deep-V towards the bow and this displacement hull kept us from ever getting on plane in the sprint event. The hull surprisingly did not perform that well in the endurance heats either, but I think this is due to our larger weight. I was wondering how you thought a catamaran might do in this type of application. I was wondering could it get on plane or would it at least do well in the sprint portion. I am assuming it would do very well at speeds of the 5 mph but I was wonder-

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DEVELOPMENT OF DINGHY FOILERS

By Dr. Ian Ward, Past President IMCA, Developer of the First Dinghy Foiler, Bifoiler and Unifoiler Moths

This is a continuation of Dr. Ward's article that appeared in this section of the Autumn 2004 Newletter.

Misconceptions

There has recently been significant international publicity concerning foiling Moths, thanks to Rohan Veal's efforts. Hopefully this will result in new Moths entering the competition and more boats racing regularly.

While sailing magazines around the world have interviewed top sailors of various classes about their views on foiling, surprisingly they have largely overlooked the small core of people currently developing these craft. The commentators should also take the opportunity to sail Dinghy Foilers themselves and recognised the true differences!

Some articles have presented significant misconceptions about foiling, how it works, the pros and cons and the role of the International Moth Association in fostering this significant step forward in sailboat design. Areas of misconception include:

A) Stability: Sailing on foils is easier than it looks, being more stable than existing Moths without foils. There is considerable dynamic stability generated by a foil around 800mm wide as opposed to a 300mm wide displacement hull.

B) Dinghy qualities: Some designers are still trying to add stability to dinghies by using a wide foil base with surface piercing wing mounted foils. This makes the boat excessively stable removing the possibility for skilful sailing to achieve maximum efficiency and responsiveness. The dinghy foiler concept forces the sailor to use his body weight and skill to achieve sailing equilibrium, rather than relying on the foil restoring forces, as generated on a trifoiler, to maintain balance. This can lead to a more efficient (greater lift to drag ratio) mode of sailing. Miller's sailboard foiler is an exceptional example of this efficiency. The analogy might be likened to the often quoted case that glider pilots fly more efficiently than powered aircraft pilots.

C) Dinghy Foiler: By heeling the Dinghy Foiler to windward, not only does the rig produce some lift, but also the weight of the skipper, rig, and hull are now out of water and to windward of the centre of lift on the foil. All are working together to provide a positive righting moment. This is only possible with foils arranged on the hull centreline.

Fastacraft Bifoiler

D) Upwind: When sailing upwind, even with the hull still partially hullborne, the foils provide significant lift which can be more efficient than pure displacement sailing. The best foiling Moths have consistently shown they can sail both higher into the wind and faster upwind than displacement hull Moths. Dinghy Foilers are therefore not just one-tack speed machines.

E) Tacking and Gybing: There may be a perceptions that foiling is OK for straight line sailing, but the boat would be slow when tacking and jybing as is the case with catamarans. This is not so! Foiler moths are able to tack 'on a dime' and simply keep going! They even sail through jybes, maintaining high speed and remaining easy to handle. Well sailed, they are faster to tack and safer to jybe than conventional Moths!

F) Tactical racing: Tactics are a critical part of dinghy sailing. As Dinghy Foilers have been found to go higher and faster upwind and tack faster than conventional boats, the ability to race tactically remains crucial! It would also appear Dinghy Foilers are fast

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enough to tack downwind as well, again requiring tactical skills when racing.

G) Height control: The most difficult aspect to foiling is controlling height and countering longitudinal pitching. Current Bifoiler Moths utilize a sensor wand activated elevator on the main centreboard foil. In some conditions, this can induce significant height variations with the hull occasionally touching the water. Level flight just above the waves would naturally be preferable and is an area that still requires refinement. The Unifoiler offers one potential solution.

H) Displacement performance: In light wind while hullborne, foils can certainly slow the boat. Experience has shown that moving bodyweight forward and reducing the foil angle of attack can minimise overall resistance. By keeping the boat light and foil size to a minimum, it is found that when displacement sailing the foils are not as great a disadvantage as initially thought. Proposals to further reduce resistance in light airs include tilting, retracting or folding the foils or allowing them to align with the flow. These options remain to be explored.

I) Sensor simplicity: In its current basic form, the height control sensor consists of a wand that adjusts the lifting foil attitude. Given the complexity of many high performance craft today, such a sensor should not be seen as "complex" as sometimes reported. I suspect it is simply that the function of the mechanism is not properly understood. Some foil arrangements can even operate with no moving parts.

Bifoiler Tipped Showing Foils and Struts

Ideas For Possible Further Development Of Foilers

The current "bifoiler" arrangement works very well under most conditions. I congratulate John and Garth Ilett in persevering to develop this very good solution and make it available to other sailors. For those wanting to get into foiling right away, I recommend buying a set of foils from Fastacraft.

An alternative is to make your own foils. This is not so difficult or expensive. Be very sure to make them strong enough noting you are supporting the entire weight of boat and crew. My home-made timber and carbon foils cost around AU$300 to produce. The Australian Moth website is being used as a forum for sharing details on how to build foils as well as where to buy them and how to get the best performance out of them.

I believe we should be looking to develop foil systems which are simple to attach and can be easily retracted. They should be strong, light, cheap and simple to operate and provide a smooth transition from displacement sailing to foiling. They should also provide sufficient stability to overcome some of the difficulties of handling the current narrow skiff Moths but not so much as to override the skills inherent in dinghy sailing. The centreboard and rudder mounted foils meet most of these requirements. Many uncertainties remain in the field of Dinghy Foiler design and further design advances can be expected. This does not yet require advanced hydrodynamics not computer aided design. Engineering experts do not have all the answers and neither the initial development of sailboards or dinghy foilers have required such skills. Proper engineering design can surely help refine designs, but the basic configurations need to be conceived and prototypes built by those prepared to test by themselves. Initially no one thought bifoilers would work and I suspect the same scepticism may exist for Unifoilers.

An excellent discussion forum for such developments is available at www.boatdesign.net. This includes test results and freely provided ideas. You can also contribute ideas yourself. Technical discussion is now also available at the IMCA website forum www.moth.asn.au/forum/index.php

INTERESTING MESSAGE
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ing how you thought it would do at these lower speeds. During the sprint we start from a dead stop and go 300 meters so time to get up on plane is important. I have been investigating a cat with a hydrofoil involved that you could change angle of attack so it could help us get on plane in a sprit race and be changed to reduce the drag in an endurance race. Your posting about hydrofoils was very helpful, and I would like to know more about hydrofoils and if you think it would be feasible and advantageous to use it on a project such as this. Our website is: Any opinions would be greatly appreciated. Thanks for your time. Brad Lynch: lynch10@tcnj.edu

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mote vehicles and equipment for Ribicoff Underwater Products, Real Eight Inc., Harbor Branch, Taylor Diving and Perry Submarine. He met Sam Bradfield in 1987 at Florida Institute of Technology in Melbourne where he was a sailing instructor for the school. He has been working together with Sam Bradfield ever since. They develop and sail hydrofoil sailing boats including NF3, Mosquito, HS21, EIFO, and Rave by Windrider. Currently, he and Sam are developing a hydrofoil sailboat named SCAT, a 37 footer being developed for offshore racing.

Leonard Hanson - Leonard graduated from the University of Manitoba in 1980 with a General Science degree and in 1984 with a degree in Civil Engineering. He moved to Surrey, British Columbia, Canada in 1986 where he joined the Surrey Sailing Club, a dinghy sailing club that is racing intensive. Interest in hydrofoils developed as a consequence of attempting to wring more and more speed out of the small sailboats. Information from the local library was used in order to experiment with small hand made hydrofoils to attach to his own boat, a fourteen foot Tasar with 130 square feet of sail area and weighing in at 155 pounds (sans captain or crew). The objective is to develop a hydrofoil kit that can be adapted easily to existing sailboats that will provide extra speed at low cost.

David Helgerson - David is a Naval Architect and Marine Engineer who graduated from Webb Institute of Naval Architecture in 1977, As Technical Director for the Advanced Marine Center of Computer Sciences Corporation, he is responsible for auditing quality assurance activities within CSC AMC and supports technical projects. Mr. Helgerson's career has included a wide range of projects from early stage concept studies through detailed design and construction support. Primarily, his experience has been with US Navy ships and other US Government ships, with a strong emphasis on Strategic Sealift and auxiliary ships. He was a US Delegate to the Electronic Commerce Workshop held in conjunction with ICCAS'97 in Yokohama, Japan, October, 1997.

Matthew Jabloner – Matthew has a Civil Engineering degree from the University of Delaware and is employed by the US Navy in Washington State. He has worked on a variety of civil and environmental engineering projects and programs specializing in water quality regulatory issues. While his professional work does not involve hydrofoils he has had a interest in them since his grandfather took him to the Bell Museum, in Nova Scotia, as a child.

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