The NEWSLETTER

International Hydrofoil Society

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

Editor: John R. Meyer | SPRING 2000 | Publisher: Barney C. Black

HALTER MARINE INSTALLS FOILS ON E-CAT CATAMARAN

(From Fast Ferry International, January-February 2000)

Development of Halter Marine's E-Cat project took a significant step forward last year when the prototype was retrofitted with a pair of foils. Launched in 1998 at the Equitable Shipyard facility in Eastern New Orleans, the catamaran was built to United States Coast Guard Subchapter H rules for vessels over 100 gross tons.

Two Caterpillar 3516B diesels driving MJP/Bird-Johnson 650 waterjets, via Reintjes WVS 930 gearboxes and Centa composite shafting, originally gave the vessel a speed of 30-31 knots. The foils, Halter Marine reports, have increased performance by 6-7 knots at the same 95% of maximum continuous engine rating.

Development

Referring to the origins of the project, the company says, "The Halter E-Cat was developed specifically to minimize the environmental impact of a fast ferry operation. In 1991, Halter recognized the need to address wake wash, engine emissions, noise, and operational safety. This resulted in the development of a design that featured long, slender, gently curving hulls with a fine entrance. Model test results met or exceeded all expectations.

Halter Marine's E-Cat With A Foil

"In 1994, Halter Marine was awarded a cost share contract by the Advanced Research Pro-

See Halter Marine, Page 3

NEW MAGAZINE IN CYBERSPACE

Classic Fast Ferries is a free new virtual magazine with lots of photos. It's at http://classicfast-f.homepage.dk. Editor Tim Timoleon introduces the magazine in Letters to the Editor, page 15 inside.

2000 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. Please remit 2000 dues as soon as possible. We regret that high bank fees make it impractical for IHS to accept payment by credit card or a check drawn on a non-US bank, or by other than US funds. Overseas members with no easy way to send US funds, are advised to send money order to IHS or US Dollars cash.

INSIDE THIS ISSUE

PRESIDENT'S COLUMN

Just as the Winter 1999-2000 Newsletter was in the process of printing and mailing, we received word that Admiral Elmo R. Zumwalt, Jr. USN (Ret) had passed away. The Admiral was keynote speaker at the IHS 25th Anniversary Celebration and Conference in 1995. A brief biographical sketch and notes of his talk on that occasion are provided on page 4. As Honorary Life Member of the IHS and a forward-thinking proponent of advanced marine vehicles, he will be sorely missed by all of us in that community.

The IHS Board of Directors continues to strive toward production of a hydrofoil video. Several inquiries with the Discovery and History channels have been disappointing. James King is now pursuing another route and hopes to have positive results soon. However, if not, we are interested in knowing if any of our IHS members have any contacts in the television production industry who might have an interest in supporting such a venture, please let us know.

The IHS and its members in the Washington DC area continue to support the quarterly dinner meetings held in conjunction with the U.S. Hovercraft Society and the Society of Naval Architecture and Marine Engineers Ship Design-5 Panel (Advanced Marine Vehicles). The talk in February was on "Potomac RiverJet" given by Captain James Bamberger, and proved to be quite interesting. Potomac RiverJet plans to provide Washington commuters a new and welcome alternative to their present means of transportation starting in Spring 2001. Their fleet of modern 35-knot catamaran ferries will connect points along the Potomac River in Virginia and Maryland to points in the District of Columbia and nearby, including the Washington Navy Yard and the Pentagon. Captain Bamberger provided an overview of the entire project, tracing the basic studies of commuter market demand through to the eventual decisions as to the type and number of craft to buy and all of the other elements of the complete ferry system. He also discussed the economics of the planned service and alluded to the many problems associated with legal authorities in the areas to be served. The main features of the service, the areas to be served, the terminal facilities and infrastructure improvements being made, and the agreements with government authorities that have influenced the company's planning were briefly described.

Your Society continues to make progress on the objective to have all of our members "online" so they can be contacted by e-mail and also will have the capability to download the Newsletter from the IHS website. Over 50% of our members accept the Newsletter electronically. This constitutes a considerable savings in terms of cost and effort on the part of the Board members who are involved in the mailing process.

John R. Meyer, President

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WELCOME NEW MEMBERS

Duane C. Ohly - Mr. Ohly is President of Island Express Boatlines, LTD., Sandusky Ohio. The company currently operates 2 high speed ferries, one of which has a foil. The details of these vessels are provided in the latest editions in several trade publications about Island Rocket II. (December 1999 Fast Ferry International, January 2000 Work Boat World). One can visit his web site at: www.islandrocket.com.

Derek Chandler - Derek is a senior engineering major at Cedarville College, in Cedarville Ohio. Part of his senior year is being devoted to developing a hydrofoil system for a solar powered boat, and is trying to research the "pros and cons" of a fully submerged system versus a self-stabilizing design. He found out about the IHS on its website.

Bradford S. Gatenby - Mr. Gatenby, from South Dartmouth, Massachusetts is a specialist in mechanical devices and worked in that field for many years. He has admiringly observed hydrofoils operating, and with his keen interest in flying machines, namely ultra-lights, of which he has 3, he now intends to have his 18-foot boat fly over the water with the addition of surface-piercing foils.

Robert Boyle - Bob, from Mt. Clemens, Michigan, is planning the construction of a trawler style catamaran early this year. It will be 50 feet and 16 tons. He is very much interested in the incorporation of hydrofoils on this boat. However, Bob is interested in economy, not speed, as this will be a live-aboard boat. He mentioned that any help from fellow IHS members would be appreciated.

HALTER MARINE E-CAT

(Continued From Page 1)

ject Agency to develop the low wake ferry concept into a marketable design and prototype vessel. During the performance of this ARPA/Maritech contract, research determined the design needed to be larger, faster, and have more passenger carrying capacity to meet market demand." The resulting design, the E-Cat 500, had a speed range of 32-40 knots, depending on the choice of main engines, when carrying up to 500 passengers.
Halter Marine reports, "Model testing was conducted to determine bare hull resistance in calm water and in varying sea states to evaluate seakeeping. These tests were run over a range of displacements, trims, and hull separations to study the effects of varying the parameters. In addition, preliminary wash data was measured at model scale to compare to later Computational Fluid Dynamics analyses.

"The results were impressive. They revealed an extremely smooth running hull with minimal hull motions. Slamming was absent in waves up to a significant wave height of 6 feet [1.5m]. Accelerations were well below the O'Hanlon and McCauley criteria for 95% comfort with a one hour crossing corrected for women, children, and the elderly, in seas with a significant wave height of 2 feet [0.5m]."

E-Cat 350

There followed an optimized design, the E-Cat 350, based on a hull form that, Halter Marine confirms, "exhibits many features of the original E-Cat such as a fine entrance angle, round bilge sections amidships to allow for a minimum of wetted surface, high length to beam ratio, and minimal transom immersion. In addition to physical model testing, HMI conducted a series of CFD predictions to investigate vessel wash characteristics while varying parameters.

"These investigations correlated well to the model tests and indicated that the E-Cat 350 design would meet even the most stringent wake wash criteria. Comfortable with the results, Halter proceeded with the construction of a full size E-Cat prototype vessel. This has performed hundreds of hours of testing in varying load conditions, water depths, and sea conditions."

Foils

Last year, a foil support system that "radically improves the resistance performance of the E-Cat hull" was installed on the prototype. Two submerged foils now span the hulls forward and aft. According to the company, "The resistance of the E-Cat with the hydrofoil system has been calculated using the results of extensive model testing of similar hulls with foils fitted. The system provides significant lift to the vessel, greatly reducing the displaced volume and wetted surface.

"The wake wash was independently measured [before foils were fitted] by Washington State Ferries. The E-Cat has the lowest wake wash height of any known design over the largest speed range, 12 inches [30 cm] or less. The hydrofoil support system reduces the wake wash characteristics even further, these have been measured, again independently, and show a 20% reduction in wake height."

Production Designs

Halter Marine is currently offering single deck, one and a half deck and twin deck versions of the E-Cat powered by a choice of four propulsion packages. Typically, the single deck design could be fitted out for 299 passengers. Capacities of the other variants are approximately 350 and 400 passengers.

Service speeds are in the range of 30-40 knots without foils and 38-48 knots with foils. With a pair of MTU/Detroit Diesel 16V 4000 M70 diesels installed, Halter Marine anticipates that figures of 35 knots will be achieved by a single deck E-Cat without foils and 42 knots by a twin deck version with foils.

PANAMA CANAL MILESTONES

According to the Panama Canal Commemorative Award Ceremony Program dated September 26, 1979, USS PEGASUS, the US Navy hydrofoil missile ship PHM-1, set the record for fastest transit of the canal in 1979: 2 hours, 41 minutes. Other interesting milestones for the Panama Canal, which first opened in 1914: The smallest toll (36 cents), was paid in 1928 by Richard Halliburton for swimming through the Canal; the Canal began 24-hour operation in 1963; the longest ship, the MARCONA PROSPECTOR 973 feet long and 106 feet wide, transited the Canal in 1973; toll rates were increased in 1974 for the first time since 1914; the highest toll of $68,499.46 was paid by the Queen Elizabeth 2 (QE2) in 1977. Our thanks to Leigh DuPré for sharing this bit of hydrofoil and other Panama Canal history.

IN MEMORY OF ADMIRAL ELMO RUSSELL ZUMWALT, JR., USN (Ret.)

We regret to report that Admiral Zumwalt passed away on January 2, 2000. He was a cum laude graduate of the United States Naval Academy. At age 44, Admiral Zumwalt became the youngest officer ever promoted to rear admiral. At age 49, he became the youngest four-star admiral in United States history. He was promoted over 35 senior admirals to become the youngest man ever to serve as Chief of Naval Operations.

Admiral Zumwalt initiated wide-ranging reforms in a dramatic effort to revitalize the Navy. Time magazine hailed Admiral Zumwalt as "the Navy's most popular leader since World War II." As the Navy's senior officer, he increased the fighting capabilities of the dwindling United States fleet by outfitting remaining ships with more sophisticated and efficient weapons.

Admiral Zumwalt was Commander of the United States Naval Forces in Vietnam from 1968 to 1970, and served as Chief of Naval Operations and a member of the Joint Chiefs of Staff from 1970 to 1974. He served as President of the firm, Admiral Zumwalt and Consultants, Inc., a consulting firm in the fields of management, energy, health care, overseas business operations, foreign and defense policy and strategic planning, until his death.

Admiral Zumwalt is the author of two books. On Watch (1976) recounts his Navy career and warns Americans about the Soviet naval threat. My Father, My Son (1986) was co-authored by his late son, Elmo III, and is an account of their Vietnam experiences and the tragedy that resulted.

Admiral Zumwalt served as a Director of eleven corporations and organizations.

At the **IHS 25th Anniversary Celebration and Conference,** Admiral Zumwalt presented the keynote address. Here are his reconstructed Comments made on June 14, 1995:

"I summarized factors contributing to development of hydrofoil and other fast craft at the time that I was CNO and concluded that the same factors pertain today. Such fast vehicles are even more desperately needed today.

In 1970, the situation was that we were fighting a war on a "guns and butter" basis and that the money which heretofore had been used for other purposes was going into the expenditure of ammunition and replacement of attrition aircraft. The country was in the midst of an anti-war anti-military mood. Budgets were at best level and usually declining.

The Soviet Union with the expenditure of roughly $1 billion a year to aid Vietnam was driving us to expenditures of in excess of $30 billion a year. The PRC and the USSR were working together to our disadvantage in Vietnam as they were in all of their client states.

With the foregoing, I found myself in a position of having to cut the number of our ships, the technologically obsolescent ones, by nearly 50 percent to free up dollars to go into research and development and procurement of new ships. We came up with the "high-low" mix. At the high end, we achieved appropriations for the CVN 70 and the Spruance class destroyers; at the low end we sought funding for the sea control ship, the surface effect ship, the Oliver Hazard Perry class frigate and the hydrofoil craft.

With regard to the hydrofoil program, the original plan was to procure 35 of them...only six were built in the formal program. Our concept was to achieve a small, high performance, small radar cross section, high speed, all weather capability with sufficient armament to deal with likely threats. Our planned use was to achieve presence in the smaller seas, i.e., Adriatic, Aegean, Gulf of Sidra, Red Sea, Persian Gulf, Arabian Sea, Pacific Rim areas, the Baltic and Black Sea. This would permit our larger ships to avoid risk by laying back until coming in for war-time operations at the ready. It was capability that would have been particularly useful against regional threats initiated by Soviets. The PHM was born in 1970 and died in 1992.

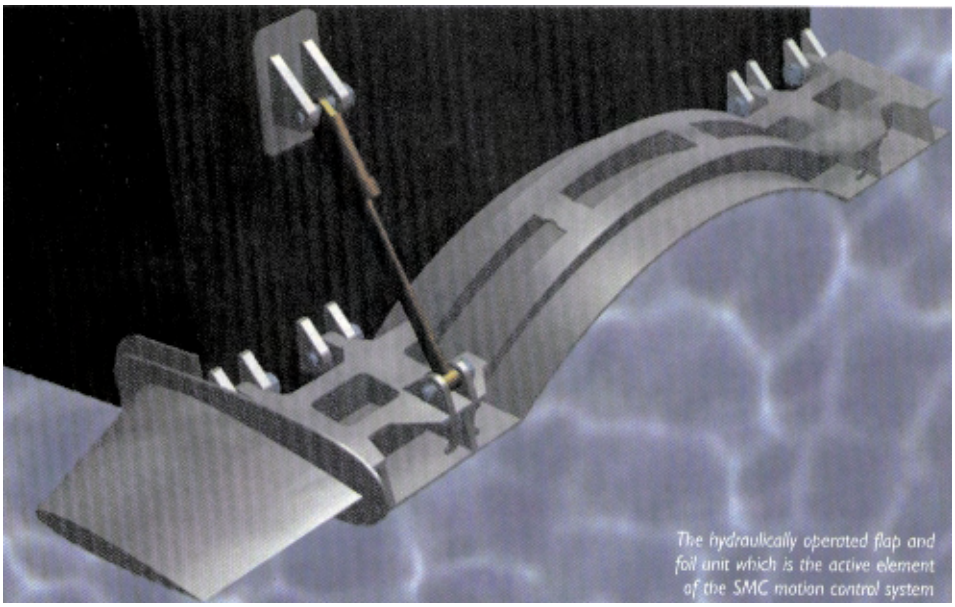
The future threats that we face are many fold; a revanchist Russia, the PRC, Bosnian-type operations, North Korea, Syria, Libya, Iraq, and Iran as the center of a bloc of fundamentalist religiously fanatic nations. Readiness to deal with these threats makes hydrofoil craft of modern design ideal as the low end of a modern high-low mix.

The commercial development of high-speed craft is serving to reduce the costs of military craft. In this day of threats not subject to the rational control of the former Soviet Union, we would be much better off if we had PHMs in our force. I give tribute to the progenitors of the hydrofoil and other fast combat craft and urge you all to hang in there."

ADDED FOIL REFINES TRANSOM FLAPS

(From Speed at Sea, December 1999) by Richard White

A motion control system now in service on fast catamaran ferries operating in the north of Norway combines a transom flap and a small hydrofoil moving together. The Nautica SMC system has been developed by Bergen-based design and consultancy company Paradis Nautica AS, which claims that the SMC is cheaper and simpler than T-foil systems, but more effective than a normal flap system.



A motion control system combining a transom flap and a small hydrofoil moving together is cheaper and simpler than T-foil systems but more effective than a normal flap system, according to its developer.

The SMC system provides active motion control to limit roll, pitch and heave. It can also be used for both passive trim adjustment and active optimization of trim to give the best possible speed under different loading conditions.

At the heart of the system is a clever twist to the long established technology of the hydraulically operated transom flap. Such flaps usually provide lift to alter trim when they are hinged down to deflect the water flow coming off the bottom of the hull at the transom, while the vessel reverts to its natural trim angle if the flap is raised.

In the Nautica SMC, however, a small hydrofoil extends sideways from the flap and moves with it. The foil flies in the water flow at the side, providing a lifting or lowering force depending on its angle of incidence. These forces are large but controllable, and give a positive or negative trimming moment with the minimum of associated drag.

If a unit is fitted to each transom of a catamaran with its hydrofoil sticking into the tunnel flow, operating them differentially can provide a rolling moment. The same effect can be generated with two units on the stern of a monohull.

The complete system comprises the flap/fin units, the hydraulic cylinders and valves to operate them, a PC-based control system with sensors and signal filters, and a control panel with display.

Paradis Nautica claims a number of advantages, specifically that the system is cost efficient both to buy and maintain. It can easily be retrofitted to existing vessels and does not increase draught significantly, so that drydocking is not affected. It is also claimed to be safe in operation, involving the minimum of risk to the vessel and its passengers in the event of malfunction.

SMC systems have been fitted to catamarans of different sizes. Because the design is held in parametric form it is a relatively straight forward process to feed in data on a vessel and produce a tailor-made unit, eliminating the need to develop a standardized series of flap/fin units.

Two 30m propeller-driven catamarans from Oma Baatbyggeri, Renoy and Fjordprinsessen (Speed at Sea, October 1999), have been fitted with the ride control system, with reported good results. So has a 24m, 148-passenger catamaran from the same yard. A somewhat different motive lay behind the application of SMC to the 38.8m catamaran Solundir, operating in Sogn and Fjordane. This vessel had a heavy trim by the stern and the fin and flap system was fitted for passive trim control. The desired trim angle was achieved, with a corresponding speed increase of 1-2 knots at the same power, and reduced roll due to increased roll stiffness.

For most conditions Paradis Nautica says that the SMC system on its own is sufficient to give good motion control. For particular routes and sea con-

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ADDED FOIL REFINES TRANSOM FLAPS

ditions a forward T-foil system can be offered in addition, and the company has also developed a V-foil 'wave basher' as an alternative to the T-foil.

INTERCEPTOR OUTDATES TRANSOM FLAPS

(From Speed at Sea, Dec1999) by Evelyn Duffy

Western Australian company Seastate has brought an innovative dimension to ride control with its use of an active interceptor as a replacement for the traditionally installed transom-mounted flaps. Use of the interceptor, as opposed to a flap, offers several advantages, with the greatest of these being a significant reduction in power demand.

Seastate began marketing its active interceptor last month (Nov. 1999), beginning from experience of systems installed on 39 Austal LTD.-built vessels of various types and sizes since 1992

The interceptor represents the hallmark of Seastate, which began trading in November to market ride control and associated technology to the international maritime community While the interceptor concept has its origins in Russian technology it was not commercialized until after extensive trialing by a research and development team at Seastate's sister company Austal Ltd.

Seastate's general manager Tony Elms said full scale trials on a 79m car ferry found the interceptor advantageous for high speed vessels (above 30 knots), whereas the traditional flaps were more effective for lower speeds. Power reduction was of considerable magnitude, down from 110 kw for a flap to 11 kw for the interceptor. This allowed hydraulics to be electrically driven, thereby creating a significant weight reduction which has a measurable effect on vessel performance.

Another advantage was that, unlike the flaps, the installation of an interceptor did not require a recess in a vessel's hull. "The structural interference of a flap is significant. With the interceptor there is no need for structural discontinuity in the way of jet structure," Mr Elms said. "It can be applied to any shape of transom and is ideal for retrofit."

The point of force application for the interceptor was further aft than a flap, Mr Elms said, making it very effective at trimming. He emphasized the interceptor was non-linear and required a full understanding to control it effectively.

Mr Elms, a naval architect, heads up the team of 15 former Austal Ship's employees who have refined and developed the ride control system since the first one was installed in a 40m catamaran for a Chinese ferry operator in 1992. The team's expertise covers the fields of mechanical engineering, control programming, information technology, electronics, electrical, naval architecture, aeronautical, and hydraulics. This combination of skills enables Seastate - which can supply simulation, the control system and all hydraulics and mechanical devices - to sell complete project solutions.

Seastate's ride control system can be integrated with other onboard systems to yield an efficient, lightweight and maintenance friendly operating system.

Trials found the system can reduce vertical acceleration by up to 50 per cent and a vessel equipped with ride control requires less power to maintain speed than a ship without it. Precise motion reduction levels depend on the system's configuration which is dictated by an operator's requirements. Reductions between 40 and 50 per cent have been achieved on both monohull and catamaran craft with a variety of control surfaces.

The Seastate system (photo above) comprises a vertical plate that is lowered below the transom bottom to provide a high pressure under the transom. By adjusting the depth of plate immersion into the water flow leaving the transom, the amount of lift can be rapidly adjusted to provide optimum trim or simultaneous motion damping forces.

Studies show Seastate's systems will suit vessels up to 120m. They have been installed in 39 Austal-built vessels since 1992, including vessels up to 92m, 30m patrol boats and a 52m luxury motor yacht. Seastate will adapt its system - which can be tailored to meet operational constraints

Continued on Next Page

such as reduced draught - for high speed freight vessels, military vessels, research platforms and the luxury motor yacht industry.

In predicting a big future for the application of ride control, Mr Elms said it would eventually be regarded as essential as users of sea transport demanded similar standards of comfort/control that were taken for granted on aircraft. "High speed vessels are a relatively new thing and there are a lot of parallels with the high-speed industry and the aircraft industry," he said. "There is virtually no high speed vessel that wouldn't benefit from ride control."

Enumerating the "far reaching" benefits of ride control, Mr Elms noted: reduced sea sickness, the provision of a more stable platform for weapons, aircraft or scientific equipment, the prevention of broaching, deck wetness, spray or slamming, and the ability to lessen the impact of wave-induced loads on a ship's structure.

Ride control could be used to eliminate sailing cancellations due to rough weather, enable an operator to size a vessel according to capacity instead of seakeeping, reduce operator fatigue in high seas and prevent cargo damage. "For instance an isolated event could result in severe damage to cargo such as fresh produce. Ride control could prevent this from happening."

Discussing the limitations of ride control systems, Mr Elms said: "The limit of any ride control system is dependent on, amongst other things, how much force can be generated to counter the upsetting motion. The ability to generate force typically depends on an operator's willingness to trade off calm water speed for rough water performance.

BOEING JETFOILS RETURN TO UNITED STATES

(From Fast Ferry International, December 1999)

Boeing Marine Systems Jetfoil 929-115 hydrofoil SeaJet Kara left the Port of Palm Beach on November 6 on its first commercial crossing to Grand Bahama Island. The inauguration date was some two months later than previously reported as the introduction of the service was delayed by the United States Coast Guard certification program for the vessel.

The operating company SeaJets, has imported two 250 seat Jetfoils that were operated across the English Channel from 1981 until 1997 by RTM and then sold to Adler Ships for a planned service in Germany. This failed to materialize and Adler Ships has now formed a joint venture in Florida with local interests.

SeaJet Kara and sister vessel SeaJet Kristen were both refurbished at the beginning of 1999. A one craft service is currently being operated. SeaJet Kara is timetabled to make two return crossings a day on Thursday -Monday, leaving Palm Beach at 0900 and 1630 and Freeport at 1130 and 1850. The schedule for the 65 nautical mile route is based on 99 minutes on foil, 21 minutes of foilborne running and turnarounds of 20 or 30 minutes. The crew comprises two masters, two first officers and five cabin attendants.

The standard return fare, which includes complimentary snacks and soft drinks, is $99 plus $25 departure taxes. According to the president and chief executive officer of SeaJets,

BMS Jetfoil 929-115 SeaJet Kara entered service with SeaJets in early November

George Bradley, "Our revenue projections for the tourism sector on Grand Bahama Island should exceed $10 million after the first 18 months of operation. The economic impact on Palm Beach County, in addition to $750,000 to the Port of Palm Beach, is estimated to be a total of $3.5 million, dispersed throughout the tourism sector."

NEW BOOK FROM WIT PRESS

The following book has just been published at WIT Press: *Marine Technology III* , Editors: T. Graczyk and T. Jastrzebski, Technical University of Szczecin, Poland and C.A. Brebbia, Wessex Institute of Technology, UK. This book contains some of the reviewed papers presented at the Third International Conference on Marine Technology. Held in Szczecin, Poland, an important center of shipbuilding and research on marine sciences, the meeting attracted participants from nearly 20 countries.

A wide variety of organizations including international shipbuilding enterprises, relevant professional bodies as well as classification societies, research and design centers, and hydraulics and shipping companies were represented.

NEWS OF MEMBERS

From time to time we receive interesting information and news about the Society's very diverse members. Two examples of this, from Martinn Mandles and Stan Siegel, are provided here for the benefit of the IHS membership.

ABM Industries Chairman of the Board Martinn Mandles, center, an ex-aviator and engineer, is flanked by his "Cosmonaut Classmates" Scott Fitzimmons of Zegrahm Expeditions Adventure Travel and Russian-born American entrepreneur Boris Krutonog, as they begin training in the full-scale working model of Russia's Mir space station.

Martinn Mandles is awarded his diploma after completing a one-week Cosmonaut Basic Training Course at Star City near Moscow. The certificate was presented by Mandles' spaceflight instructor, Russian Air Force Colonel Gennadi Manakov, who received his country's highest honor, "Hero of Russia", for personally commanding two Soyuz-Mir missions that totaled more than one year in orbit. Mandles presented Colonel Manakov with the ABM Family of Services lapel pin circled to the left of his "Hero of Russia" medal.

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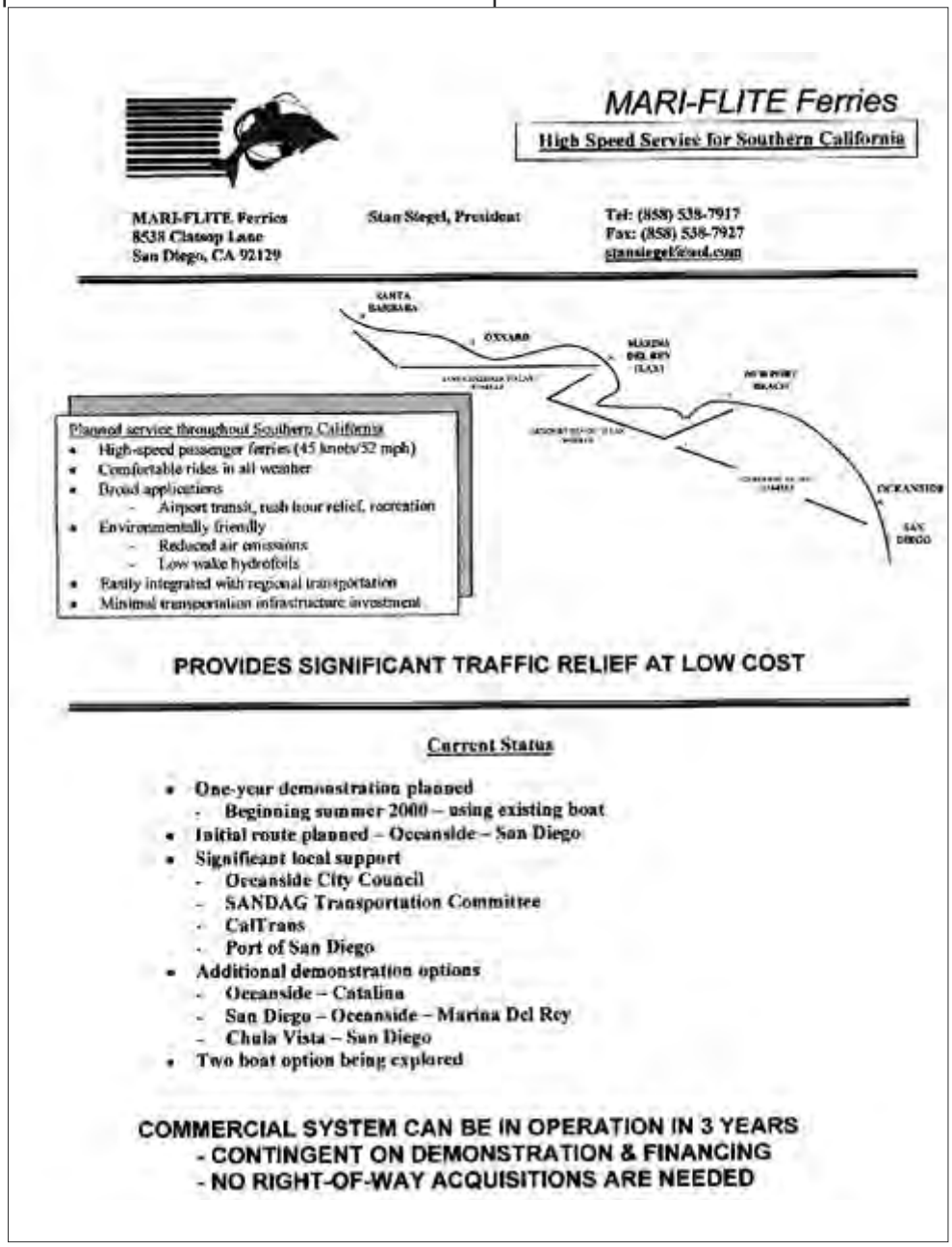
Stan Siegel has been busy forging ahead with the possibility of a high speed ferry operation off the coast of California.

A Flyer that he forwarded to the IHS is reproduced below:



MARI-FLITE Ferries

High Speed Service for Southern California

MARI-FLITE Ferries
8538 Clatsop Lane
San Diego, CA 92129

Stan Siegel, President

Tel: (858) 538-7917
Fax: (858) 538-7927
stansiegel@aol.com

Planned service throughout Southern California
- High-speed passenger ferries (45 knots/52 mph)
- Comfortable rides in all weather
- Broad applications
  - Airport transit, rush hour relief, recreation
- Environmentally friendly
  - Reduced air emissions
  - Low wake hydrofoils
- Easily integrated with regional transportation
- Minimal transportation infrastructure investment

PROVIDES SIGNIFICANT TRAFFIC RELIEF AT LOW COST

Current Status

- One-year demonstration planned
  - Beginning summer 2000 – using existing boat
- Initial route planned – Oceanside – San Diego
- Significant local support
  - Oceanside City Council
  - SANDAG Transportation Committee
  - CalTrans
  - Port of San Diego
- Additional demonstration options
  - Oceanside – Catalina
  - San Diego – Oceanside – Marina Del Rey
  - Chula Vista – San Diego
- Two boat option being explored

COMMERCIAL SYSTEM CAN BE IN OPERATION IN 3 YEARS
- CONTINGENT ON DEMONSTRATION & FINANCING
- NO RIGHT-OF-WAY ACQUISITIONS ARE NEEDED

MARQUETTE SOLAR HYDROFOIL

By Anthony Scott Daniels

I was at the Solar Splash competitions against the Marquette boat. it was a good concept and based off of one of the entries by Kanazawa Institute of Technology, Japan. The only ironic thing is that the boat did better without the foils than with them. I have seen them race that boat 4 times and every time they had the same problems, dynamic stability when on foil. On the flip side the Kanazawa boat had a stability system that was rock solid. As a monohull alone the Marquette boat did fine though, in endurance. Most of the slender monohull types didn't fare well in the sprint competition. If you want the hands down overall best design look at the KIT boat. For more info, check out the Solar Splash Site at www.sunrayce.com

Marquette University Solar-Powered Hydrofoil

Overall, Marquette has probably one of the better all around teams at the competition. They regularly support multiple boats at the competition. Something that no other school does on a regular basis. Their entire university on the whole does a great job supporting the tech project cause. The tech teams are an active part of their curriculum. They are also one of the major reasons for the existence of the competition as they have been the host of the event since its inception.

SOLAR POWERED FOILER CANOE

By Derek Chandler

As a senior project at Cedarville College, we are designing a solar powered manned hydrofoil. I am currently writing a program that will predict the correcting moment a surface piercing foil would have as well as a program to predict any turning moment created by a surface-piercing/fully submerged combination.

Our boat is a 19' canoe type hull. It is 1.75' wide in the center section. Past Cedarville solar splash teams have had trouble with control and drag. We are attempting to attack both of these issues. We would like to have the forward foils support 60-70 percent of the weight. We plan on controlling the aft foil with some type of mechanical system to control the angle of attack.

We are planning on a sunny day and expect about 480 Watts from the sun. This does not include batteries. The efficiency of the prop is 80% and we expect over 80% for the motor. The weight of the boat will be approximately 350 lbs for the Sprint race (Larger motor and more batteries are allowed). I am guessing that the Endurance race will be about 275 to 300 lbs. We also attempting to achieve 10 mph and 30 mph respectively.

For more information, contact
Derek Chandler at:
S1178082@cedarnet.cedarville.edu

SEAWING ON A POSTCARD

The hydrofoil Sea Wing was as thrilling to see as this postcard from the late 1970s depicts (see below). It operated as a ferry for a short time, running from Pt. Judith on the mainland to Block Island, Rhode Island, until the ocean waves proved to be too much of a match for the vessel. Here the ferry has entered — at full tilt, up on its foils — through the breakwaters at Old Harbor on Block Island. Once power was decreased, the ferry seemed to stop on a dime.

SAILORS PAGE

By Sam Bradfield

Veterans of design often refer to a process known as "the design spiral". It should start with a clear and succinct innovative mission statement. And it should proceed boldly, smoothly and expeditiously turn by turn to a lovely out-the-door piece of hardware accompanied by, if it's a vehicle, sophisticated instrumentation and elegantly written software. Unfortunately...those of us who are veterans in this area are well aware that technical and economic monsters lurk to attack us technicians at every turn of the spiral. And that we'll be lucky indeed to proceed smoothly and unimpeded to our mission statement goal. But there's the challenge. And that leads us to Volantis (Figures 1. and 2.)...a wing powered, lifting hydrofoil equipped 60 foot sailing vehicle concept created by four enthusiastic multihull sailors: Mark Ott, Nigel Irens, David Hubbard and including, yours truly, Sam Bradfield.

Figure 1 - VOLANTIS

Figure 2 - 1/3 Scale Model of VOLANTIS

In August 1998 we enjoyed a two day meeting to put together the vehicle concept of Figure 1, and to outline a mission statement that would attract funding for this 60 foot trimaran research and development project. Unfortunately, no funds have materialized to date.

Figure 3 - VOLANTIS Jr in Flight

Of course, as anyone who reads this column knows, we AYRS'rs cannot be stopped from thinking and doing "technical" by lack of anything as nonessential as money. We usually even manage to do a little development work on our own hook, so to speak. As an example, Figure 3, Volantis Jr, is our low (no) budget 1/3 scale model of a Volantis type vehicle photographed in flight. David is proposing development work on VoJr's rig which will be scaled up to Volantis size when funding becomes available. Nigel's group did the original drawings and renderings of the concept and he is currently scouting for a suitable intermediate sized (40 or 45ft) trimaran to be retrofitted and used in the intermediate developmental stage of the project. Sam's group at Florida Tech is working on improvement of the automatic control subsystem for the inverted T-foil lifting system.

Mark Ott has been working hard at putting together a business organization to support this project and provide funding. During this process he has focused the original mission discussion into the following objectives: 1. To develop a sail powered, hydrofoil lifted open ocean vehicle which improves present day high speed multihull heel and pitch stability while at the same time increasing present day sustained top speeds by a significant amount; 2. To significantly reduce current long distance open ocean point to point records by sail powered craft; 3. To adapt and develop technology from aeronautical, navigational, robotics, military, entertainment, scientific, search and rescue, and environmentally clean power generation which will have multiple applications to ocean going sailing boats; 4. To develop technology which when retrofitted will increase safety and efficiency levels of all types of sailing craft; 5. To race as an exhibition class in any ocean distance race worldwide.

The estimated time for completion of the vehicle of Figure 1 from the date of funding is two years. If anyone wishes to fund or to participate in the funding of this project, you are cordially invited to contact: Mark Ott, Project Leader Volantis Project; 540 Kamani Street; Honolulu, HI 96813; (808) 591-0176; HydroWing@aol.com

FOILER MOTH NEWS

By Ian Ward

In a world first, Western Australian International Moth Class dinghy sailor, Brett Burville, has cracked it

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FOILER MOTH
(Continued From Previous Page)

with a Foiler Moth, winning outright two heats of the World International Moth Class Championships held in Perth last week and finishing a creditable 10th place overall; go to www.freeyellow.com/members7/imca-wa/

The International Moth class is one of the few truly development International sailing classes and also allows foil development. At times he was traveling at up to 1-1/2 times the speed of the top existing designs. This is no mean feat, keeping in mind that an existing Moth can outpace a 505 and is already the fastest 11' monohull in the world (for more info, go to www.moth.asn.au/)

Brett's boat is a standard Moth, with a larger than usual T-foil on the rudder and forward V-foils mounted at the end of the wings. See the photo below by John Hilton. Mark Pivac is the Aero engineer who Brett worked with on the set up.

Moth Operating in a Stiff Breeze
(photo by John Hilton)

It appears that Brett showed bursts of incredible speed in the stronger winds, punctuated by many capsizes. Clearly there is scope for further development, perhaps with some form of sensor. He was foilborne above about 8-10 kts of wind and sailed both downwind and also upwind on the foils. In the light wind races he removed the foils from the simple mountings in a couple of minutes.

This is a major achievement, as most foilers to date are only reaching speed machines, like sailboards. This is the first time EVER for a foilborne craft to compete successfully around the buoys in all conditions in a truly International standard sailing competition.

It is hoped that Brett will produce some further details and it is expected a lot of further development will now proceed, as it is possible to take any existing Moth and truly revolutionize its speed in winds over 10 knots! Who will be first to take it further?!

NEWS FROM EUROPE

Here's an excerpt of a letter from my friend Walter van Varik whom I regard as a real moving force for the acceptance of sail powered hydrofoils in Europe. Walter says: "There is also the subject of priorities. I became the sole agent for Windrider sailboats in Europe. There were three people who wanted to become my partner in this venture. They are:

- Eelco Piena - a well known sailor, author, and previous business manager of the watersport division of the largest tourist organization in Netherlands (ANWB). At the same time the initiator (together with Chris Heil) of European Multihull Center (EMC), an organization that markets multihulls (see www.multihulls.nl). They also participate in a boat yard in Latvia, most of the boats they sell are being built in Latvia.

- Chris Heil, a long time sailor and sailboat fanatic and friend of Eelco,

- Michell Marecau, the person who was the Windrider agent in Europe, and who decided to join us in selling Windrider and Rave. I believe that you met Michel.

The four of us founded European Hydrosail Systems BV (EHS) with the mission to manufacture and market hydrofoil sailboats and wave piercing craft.

All year last year we spent "grilling" a couple of Raves. We loaned 2 Raves and 2 Windriders to a sailing school. The mission to the instructors was to really beat the hell out of them. The final verdict was that both the Rave and the 16' Windrider are well designed, well built sailboats in which we can invest our time and money in order to popularize them. The principal improvement on the Rave is a boom on the mainsail. The Rave becomes an entirely different sailboat with the boom because of the greater stability of the mainsail. As a result, controlling the wands (automatic control systems) becomes much easier. I have not sailed her yet, but I understand that you can clamp the elastics for a good deal of the time while sailing. We just ordered 24 Raves from Windrider. We are now negotiating to become the sole agent for the Catri line of hydrofoil trimarans. The concept of the Catri is 2 Bruce foils much before the sailpoint of the rig, way up front, 2 fins (small T-foils) on the stern of each outrigger, and 1 fin (looks like a big fence) on the rudder. This contraption raises 90% of the main hull out of the water so that she planes over the water while being supported on three points: one Bruce foil, one stern fin and the rudder fin. Because the Bruce foil is so much forward, there is a very

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30 YEARS AGO

(From Fast Ferry International, December 1999)

The December 1969 issue of *Hovering Craft & Hydrofoil* included a review, by Anthony Brindle, of the Red Funnel hydrofoil operation which had started seven months before on the south coast of England. He concluded that the service "is a useful, competitive and worthwhile addition to the ferry operations between the mainland and the Isle of Wight. The careful commercial approach during the initial season by the operator is commendable, particularly in technical terms, and is likely to show a dividend in the future."

Red Funnel's first hydrofoil, Seaflight H.57 Shearwater, *entered service on the operator's Southampton-West Cowes route in May 1969*

Developments were continuing to take place in the Soviet Union as well, "The first Soviet craft with automatically controlled hydrofoils, the Typhoon, was launched in Leningrad on December 12. Unlike vessels with fixed hydrofoils which have a rather limited seaworthiness, the 100-seat Typhoon experiences no shocks or overloads as her foils remain in the water all the time. The designers have copied from aircraft flaps which will be controlled by a complex automatic system incorporating a computer."

NEWS FROM EUROPE

(Continued From Previous Page)

high pitch stability. To increase the pitch stability even further, the crew and all heavy items are concentrated in the stern of the main hull. This concept was developed in Latvia (I believe under the sponsorship of the Russian armed forces during Soviet days). A prototype sailed in Dutch waters a couple of years ago. She attained a speed of 27 knots with baggy sails. We know that this boat is extremely fast. The designer thinks that she will be faster than the Rave. He is so convinced that I bet a bottle of whiskey that she is not.

MAJOR BENEFIT

IHS provides a free link from the IHS website to members' personal and/or corporate site. To request your link, contact Barney C. Black, IHS Home Page Editor at foiler@erols.com.

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OUR REGRETS

Sumiyasu Arima wrote:

Long-time employee of Boeing Marine Systems and hydrofoil enthusiast, Phil Janosik, lost his granddaughter, Rachel Janosik, in the Alaska 261 MD-83 airplane crash. She worked for Horizon Air as a food attendant, while attending Bellevue Community College. She was 20 years old.

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LETTERS TO THE EDITOR

Cavitation...

[25 Feb. 00] I'm a French student working an a project, and I'm searching information about the phenomenon of cavitation or ventilation that occurs when a boat lifted with foil goes fast enough. Is there any solution for those problems, or could anyone tell me something about the subject? — L. Pério (loicmush@easynet.fr)

More on the Historic Upright Hydrofoil Kit...

[24 Feb. 00] It is extremely interesting and exciting to read your history of the development of the Up-Right Hydrofoil Kit. I first saw this hydrofoil when I was newly married (1963) and on a business trip with my wife in Coeur d'Alene Idaho. They were mounted on a 17 foot boat and seemed to be the answer to my dreams of making a boat go faster and easier. I had to have a set and not long later purchased a set from the Up-Right company. My wife went along with it even though she must have felt there were much better things to spend our money on. They were mounted on my 14.5 ft Fiberglas runabout with 40 hp Johnson outboard. It was soon apparent that they worked like everything but the motor was not properly loaded and could overrev. I then was told that the OJ Johnson propeller company in California was excellent at making propellers for fast boats so I contacted them. They sold me a three blade bronze propeller with about three more inches of pitch and cupped trailing edges. It worked beautifully. More than one fellow with a V-8 inboard speed boat was a little surprised and annoyed when I passed him with my little outboard boat. Also the foils worked very well in Georgia Strait off Vancouver harbor where I used it often. They did dive though, when in a following sea. This was a frustrating deficiency.

The major problem was the "shear plate, string-in-the-bottle" system. I believe I did strike small debris a few times and the foils separated as intended and I was able to retrieve them. One day though, I was traveling under the Lions Gate Bridge In Vancouver, B.C. and one of the rear foils broke loose. The nylon line payed out OK but there was too much current and I could not pull the hydrofoil back up. The string even cut into my hands a bit. I let the foil go and there was no way we could find it later. I was able to buy a replacement from a man in Oregon and was back flying again for a while. Eventually other things became more important (two sons as example) and I sold the boat. I did keep the foils though and they moved with us from place to place. (Vancouver to Pine Hill Alabama, to Aberdeen Washington, to Vancouver, to Mackenzie B.C., to Tswassen B.C., to West Vancouver, two moves)

In about 1986 my 15 year old son expressed an interest in the propeller and the foils that had been in the household all his life. We bought a fourteen foot aluminum boat and an older 40 hp Johnson so the propeller would fit. Remembering the problems with the shear plates I modified the mounting of the foils so they would tilt up like an outboard does when it hits an object. Once again we were foil borne. All went well for a while and the set-up performed like the good old days. One day the front foil hit a submerged plastic bag and the foil rotated back against the boat. It then acted like a huge brake in the water and the boat very abruptly stopped. Luckily my son was not hurt although he was not impressed. Another time one stern foil hit something and rotated back out of the way, however it did not rotate completely out of the water and it too acted like a huge brake. It actually pulled hard enough to bent the foil out of shape.

Next I cut the front foil in two at the point of the V. The two pieces were held together at the V with a shear bolt. The foil was made so that the main tube would not rotate on impact but the join between the top of the foil and the cross tube would allow each half of the foil to rotate away from the center towards the outside of the boat when something was struck. This actually worked very well.

The rear foil was straightened and a different solution was used to make it continue rotating until it was completely out of the water. A fairly large piece of plywood was attached with hinges to the top support extrusion of the foil. This was held up in the horizontal position by a pin in the side of the boat when the foils were in use. If the foil started to rotate backwards due to striking something the piece of plywood would come off the pin and swing down and be caught by the water. It would go against the leading edge of the foil so the water could not pass through the triangular inside shape of the foil and therefore the water would push the foil up and completely free of the water. This system also worked very well.

By this time we were getting tired of experimenting and the young fellow indicated that he was not really interested in foils but just wanted a nice boat to play with. The foils went back in the basement where they remain to this day. I still have dreams of buying a suitable boat and using them again but it is hard to justify when I already have two boats not suitable for these foils. Actually I have a 7,000lb-26ft Fiberglas cabin cruiser that I would like to put foils on. I think their fuel efficiency and weight carrying ability would be a great advantage for that type of boat. — John Hards (jhards@talk21.com)

Response...

[24 Feb 00] We were delighted to receive your email, and we thank you for taking the time to write it because it contains much good information. Unless you object, we will add it as a large footnote to the article. Of course we will forward your email to Tom Lang, the designer of the Upright kits; he is a member of IHS. As far as adding foils to your current

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LETTERS TO THE EDITOR
(Continued From Previous Page)

boat, a 26 foot cabin cruiser, you may want to contact IHS member Harry Larsen for inspiration and information. Visit his website for information on his boat TALARIA III and a link to read a Popular Mechanics magazine article on his boat. Harry once estimated that it would cost $20,000 to add a fully submerged foil system with automatic control as he did. However, recent advances in mass produced sensors might allow a good cost reduction in the automatic control system. The IHS member who could help you on that is Malin Dixon.

Project Start 1948; Estimated Completion Date?

[20 Feb 00] A friend and I have bought a hydrofoil project. It is a small wooden powerboat. It began in 1948 and it is still not finished. We hope the boat can be on water in April 00. Please take a look at: www.inocean.no/trixi3.html — Svenn Erik Kristoffersen (svennek@online.no)

Spanish Student Develops a Project...

[18 Feb 00] I am a Spanish student of naval engineering, and I want to do my final degree project about a hydrofoil. But I don't know how and where I can start to do it. Could you guide me in this work? Could you advise me how I can do it and from which books can I get this information? — Belen Vega Mesa (bunny_d@email.com)

Response...

[18 Feb 00] Please spend some time exploring our website, including the sections on links, references, and frequently asked questions. Then, if you have specific questions, IHS can find a better answer for you. Your question is so general that I can provide no better answer. After all, a hydrofoil could be a radio-controlled model weighing a few pounds up to a ferry or warship weighing hundreds of tons. Choices of power range from human-powered, to motor driven, to sail powered. As you realize, there is a variation in the information needed, depending on details of the hydrofoil that interests you. Note also that student membership in IHS costs only $US 2.50 per year. Information on how and why to join is posted at http://www.erols.com/foiler/member.htm.
— Barney C. Black (foiler@erols.com)

Business Opportunity...

[18 Feb 00] We are a North Cyprus based shipping company. We are operating 2 RO-RO ferry ships and 4 Hydrofoils (KOMETA-Russian made) between N. Cyprus and Turkey ports. We are interested in operating Hydrofoils or Catamarans on joint venture basis or perhaps on a Time Charter basis. However, we would also consider a good bargain sale offer. We would also like to have offer about low tonnage (Grt.900-1500) RO-RO ships or RO-RO ferries. — Kufi Birinci (mr.teko@usa.net)

Hydrofoil Ferries, Wanted to Buy...

[24 Feb 00] Do you know of the possible availability for purchase of any Hydrofoil or Hovercraft ships, capable of carrying 60 to 100 passengers comfortably, along the coast on ocean waters? Please advise. — Jon Freed (jonfreed@sinfo.net)

Adding Foils To a Ski Boat...

[18 Feb 00] I was reading an internet article named "the upright hydrofoil kits". I was wondering if such kits were available today. I am interested in putting hydrofoils on my 1978 16' Chrysler trihull ski boat. Any info would be greatly appreciated. — Rick Bailes (bailesrs@wirefire.com)

Response...

[18 Feb 00] There are no kits offered today that I know of. Tom Lang, the author of the article you read, may be willing to offer answers to specific questions. Also, there were some articles several years ago in how-to magazines about adding foils. See the IHS page on popular magazines at http://www.erols.com/foiler/refpop.htm.
You can find copies of these magazines at certain antique stores, or you can search for them on www.ebay.com periodically... sooner or later everything turns up on ebay. The foils treated in the magazine articles are not exactly what I would call high performance. — Barney C. Black (foiler@erols.com)

Source of Model Testing...

[18 Feb 00] I thought, it could be of interest for you, that there is a lot of model-building and -testing going on here at Vienna/Austria, though it's far away from the main boatbuilding places! - If anybody has a new design and wants to test a small version, before he starts the REAL one, feel free to contact me; - don't forget, a model of 2 meters is only 1/125 expense of a real 10 Meter Yacht. I'm building these models on request, but also to have a comparison to the speed and performance of the outrigger boats (proas - models and big ones up to 33ft this far) I'm building. In spring I will start to build a NEW, bigger, faster and lighter Proa - so if you are interested, please reply to me. It's a cold and lonely place right now here at Austria for a boatbuilder. — Ernst Zemann (ernstzemann@hotmail.com) website: (http://www.multihull.de/zeman/).

Response...

[18 Feb 00] Thanks for your proposal, but I have the same service in France... One of biggest model building company in the world and an hydro laboratory are offered to me a free service using engineer students to realize it... All my past boats have been model tested... It's a good way to get some information on reality of the VPP. If you request some info on proas, don't hesitate to ask to me. — Guy Delage (guydelage@guydelage.fr)

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LETTERS TO THE EDITOR
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VOLANTIS 60' Sailing Trimaran...

[12 Feb 00] I just attended a meeting of the Northwest Multihulls in Seattle where Duff Sigurdson of Canada presented the latest news on the 60-foot trimaran planned to be built in Hawaii. Sam Bradfield has designed the foils thus she will have inverted T-foils and small amas. Nigel Irens is the designer. They plan a solid wing with reefable/furlable center section, and a hard vertical tab on the lower leech of the rig for depowering. It looks like a more delicate Rave Trifoiler, with a single CF gull-wing crossbar. I was impressed, even considering that Queen Elizabeth II is supposed to christen it. It is not immediately clear that "Volantis" is meant for The Race. Burt Rutan will build the foils in his "Composites" shop in the Mojave Desert, and the majordomo is Adm. Stuart F. Plott, formerly head of seaborne infiltration efforts during the late unpleasantness in Vietnam. Duff also talked about aquatic satellites- small versions of the hardsail Trifoiler that would be permanently at sea, monitoring the shipping lanes and seaport accesses, video-monitoring incoming ships for oil dumping/bilge pumping. Solid wings again? Contact Duff Sigurdson for more accurate news- he is the new publicist: formerly associated with the Ronin project for The Race. Dave Carlson (dacarls@nersp.nerdc.ufl.edu)

HIGH POINT Offered For Sale...

[12 Feb 00] After long discussions with a naval architect, I can't find a way to put the HIGH POINT to any use. So I am going to put it on the market for one year at $100,000. If there is no interest by next January, off she goes to the scrapper. I don't know what else I can do. — William Knuth (wil@pacifier.com)

Build a Sailing Hydrofoil...

[12 Feb 00] I just came on your site because I'm researching foils now. I've done a lot of boatbuilding, primarily because I can afford boats that way, and because I enjoy it. Since I can't afford to buy a RAVE, I guess I'll have to build one next. I was working on a planing sort of boat, sort of a trimaran built with windsurfer hulls, but an experience with foils has got me started in this direction. — Rusty Clauss (rustyclauss@erols.com) website: http://www.pan.com/folksinger

New "Cyberzine" Classic Fast Ferries... http://classicfast-f.homepage.dk

[23 Jan 00] I would like to draw your attention to a new virtual magazine, CLASSIC FAST FERRIES, of which the premier issue is just out. As its title suggests, CFF is not only about hydrofoils, but incorporates also other "traditional" fast ferries such as catamarans and hovercraft. What you will not find in CFF though are stories about conventional ferries or ships in general, as these are being covered in multitude by others already. I do not intend to start charging money for CFF - at least not in its present form. and right now I can't see it in any other form. but I might just reconsider the minute a big spender walks in the joint and offers me to fund the transformation of CFF into a real magazine, glossy paper and all! How will it survive? By means of a lot of devotion to and enthusiasm for the subject! It isn't always money that makes the world go around (though it usually helps) - some of the best works are those made out of love for the subject in question; i.e. wherever a natural can't-help-myself enthusiasm is allowed to flourish and be the driving force. My interests lie in this topic - fast ferries in general and hydrofoils in particular - and my decision to launch this venture is no sudden impulse.

Letters To the Editor allows hydrofoilers to ask for or provide information, to exchange ideas, and to inform the readership of interesting developments. **More correspondence is published in the Posted Messages and Frequently Asked Questions (FAQ) section of the IHS internet web site at http://www.erols.com/foiler.** All are invited to participate. Opinions expressed are those of the authors, not of IHS.

I've been collecting info/photos/memorabilia for years and wish to think that I know what I'm talking about. However, CFF will not survive without help. Hopefully IHS members and others will consider donating some photos. As to writers guidelines for submitting articles... can't say I've drawn any such up yet as to what depth or breath an article should have. As long as the prospective author writes about what he (she) knows best, and it slots in with the magazine's coverage. For instance, we do not intend to include military craft (unless converted into passenger vessels) or 'hobby' craft - not to be confused with scale models of (commercial) fast ferries which are indeed welcome. — Tim Timoleon (classicfast-f@email.dk)

Force Model...

[23 Jan 00] I am looking for a theoretical model of the force of bearing on a supercavitating hydrofoil or the name of a French research laboratory that is working on the subject. Do you know if there are some French ships with supercavitating hydrofoils? — C. Gouel (cgouel@libertysurf.fr)

Hydrofoils For R/C Model Sailing Catamaran...

[21 Jan 00] I was hoping to add hydrofoils to my new 2m sailing boat. It seems it's much more complicated than I thought. I am worried about stability. The model is six foot long with out riggers six foot wide with a mast of about nine feet. The hulls are about eight inches wide. So its very wide for its length and weight. I am worried that the foils will just make it skim on top of the water. Is it just trial and error to get the foils at the proper angle? Its like I just entered a different world, there is so much to know, but it looks fun. Please look at the web site, they are the fastest model sail boats on earth, without foils. RC Sailing- www.ns.net/griggair/2meter/ — Jerry (grigg@ns.net); Fax: USA (916) 721-1417

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LETTERS TO THE EDITOR
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Response...

[21 Jan 00] You will need a height control system and a roll control system if you are to have fully submerged hydrofoils. It is no good to just fix the angles; you need to reduce the angle of attack of the front foils as the boat lifts to its correct flying height. A simple skate has been used to control the front foil angle for ride height control in TALARIA III, a converted Bayliner, and on Trampofoils, a human powered hydrofoil, and several others. A skate runs on the water in front of the hydrofoil, and this is attached to the front foil so that the height of the skate alters the angle of the front foil. This controls the height of the front, and the back follows the front in height control, just as the front follows the skate. The roll control is more difficult. In TALARIA III an electronic control system was used to control flaps on the rear foils to stop it falling sideways, and on the Trampofoil it was up to the rider to move up to the high side if it started to roll. The wide wing, low speed and the undivided attention of the rider on the Trampofoil made this possible. A skate on each side has been used, as in Halobates (see www.onspec.co.uk/ihs) for the pictures, but the skates tend to get very large if you are trying to control the angle of larger rear foils. You can't get the amplification affect of the ride height control with a fixed rear foil, which relies on the rear foil having a larger angle of attack when it is deeper, which is true if the front is held at a fixed height. In a sailing boat, there is a large roll torque from the sail, so you want to run with much more lift on the lee side, and probably down force on the windward side, although that can be a bit dangerous, because if you lift a foil out of the water there is no downforce and you capsize.

Anyhow, you need to alter the angles or flaps of the main foils to counteract the torque from the sails. This will have to respond too quickly to do by hand. Our model used a "heading hold" gyroscope, with a trim input from an accelerometer that measured the tilt. The gyroscope was mounted with its axis fore - aft, as it was holding that axis steady, while it was designed to be used in a model helicopter with its axis up - down, preventing spins. There was a fast servo connected to the output of the gyroscope, and that altered the angle of attack of the foil tips, one up and one down, like ailerons on a plane. Many sailing hydrofoils use V-foils, often mounted far from the center of the boat to give roll stability. As the boat rolls, the down side has more wing in the water, so more lift. They need to be very wide but they don't need a control system. Email me if you have more questions. — Malin Dixon (malin@onspec.co.uk)

Need More Info on WHITE HAWK...

[21 Jan 00] I am researching the hydrofoil WHITE HAWK which unsuccessfully attempted the water speed record at Windermere in 1952-3. I have a number of photos and various press cuttings, plus the recollections of a US Navy officer who was involved with a trial run of the boat in the USA in 1952 for the Navy. Any info you could supply would help. — Simon Lewis (simon.lewisbooks@virgin.net)

Response...

[21 Jan 00] If you have visited our webpage on the Hanning-Lees at and Leslie Field's webpage of newspaper clippings then you already know all that we know. The Hanning-Lees were a fascinating couple, and I always thought that their life would make a good movie script. Please share with us (and with Leslie Field) anything else you may find of interest so that we can post it. — Barney C. Black (foiler@erols.com)

Foils For 50' Cat...

[19 Jan 00] I am planning the construction of a trawler style catamaran early this year. It will be 50 feet, displacement approximately 16 tons. I would be very interested in the incorporation of hydrofoils on this boat. I am interested in economy, not speed, as this will be a live-aboard boat. I didn't find on your website any information specific to this style boat. Any help would be appreciated. — Bob Boyle (sojern@ netscape.net)

Solar Powered Hydrofoil Design Info Wanted...

[19 Jan 00] I am a senior engineering major at Cedarville College. Part of my senior year is being devoted to developing a hydrofoil system for a solar powered boat. I am trying to research the pros and cons of a fully submerged system versus a self-stabilizing design. My Senior Design Team is modifying a 19' canoe type hull to enter the Solar Splash competition. Our hope is to put hydrofoil on the boat in a manner that gives us the least amount of drag, adequate maneuverability, and good stability. SOLAR SPLASH is the World Championship of Solar/Electric boating. It is an international intercollegiate competition which takes place over five days. The first two days are Technical Inspections and Qualifying and the final three days are on-the-water competitions. Points are awarded in 6 events including the newest which is called the SOLAR SLALOM. The various events stress system design and both short distance speed and long distance endurance. The Event this year will be held in New Orleans, Louisiana. SOLAR SPLASH is a practical educational experience which helps to develop teamwork and inter-disciplinary skills. In recent years, a few highly qualified High School teams have joined the Event as a natural educational path from secondary school to college. The Event combines the fun of competition with education in a way which is not a major disruption to the student's academic schedule. The project can be accomplished at a relatively low cost. See www.sunrayce.com for more info. You can also go to www.cedarville.edu/student_org/solsplsh/ and find out about Cedarville's past team and sponsors. Would you be able to provide me with any information about various design concepts and their various characteristics? I would be grateful. — Derek Chandler S1178082@cedarnet.cedarville.edu

EXTRA FOR THE ELECTRONIC EDITION

LETTERS TO THE EDITOR
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Response...

[21 Jan 00] I strongly recommend a self-stabilizing (surface piercing) foil system. Fully submerged requires technical sophistication (height sensors and automatic control system) that are not warranted for a recreational hydrofoil application. — Mark Bebar (BebarMR@navsea.navy.mil)

2nd Response...

[21 Jan 00] I am afraid I must respectfully disagree with Mark Bebar here. Fully submerged hydrofoils need roll control and height control systems, but control systems are now so small and cheap that I feel that the benefits outweigh the costs. Fully submerged hydrofoils have better seakeeping than surface-piercing systems. On surface-piercing hydrofoils it is often necessary to have the foils set very far apart to give enough roll stability, while fully submerged foils can often be kept within the hull width. I would like to know more about what sort of boat you will be making. I think that one of the biggest problems will be getting enough power to overcome hull drag at take-off. Here the foil design is of little importance, except in the take-off speed required. — Malin Dixon (malin@onspec.co.uk)

3rd Response...

[18 Feb 00] I worked on the Massachusetts Institute of Technology DECAVITATOR project, and I just wanted to respond to some of the questions that were being raised. We tried for 2 years to use a surface piercing V foil on our project. The obvious advantages of this configuration are automatic depth and roll stability. However, we found that there was no way to control ventilation. We tried fences and dramatic sweep angles with no avail. If you have lots of power to spare, then just plan on the foil cavitating all the time. Of course, with human power, we didn't have this luxury. We ended up with a large and small foil directly under the pilot. The large foil could be retracted at higher speeds. Pitch stability came from the skimmer/small horizontal surface in front. Having one on each pontoon gave us enough roll stability by required serious bracing to keep the pontoon/cockpit frame rigid enough. The pilot controlled depth with a lever that set the angle of attack of the main foil. We used a 3-axis CNC machine to make our foil molds. The foils themselves were solid carbon fiber. Sizing the foils is pretty complicated. You have to be able to go fast enough to 'take off', but you don't want them so big that your top speed suffers. There is a lot more information about our design available at: http://lancet.mit.edu/decavitator/. I hope this helps. — Marc Schafer (spaceboy@sgi.com)

More Responses...

[1 Mar 00] Regarding difference in surface-piercing foil effects on propulsion: This of course relates to lift/drag ratio for the particular size foils you would be using and the speed you will be running at. I and most of the hydrofoilers have dealt with much larger weights (like tons instead of pounds) than you are concerned with. There is an impact of the small scale you are designing with which I have had very little experience, but you can probably expect a small larger difference in power required from the surface-piercing foil. I would still like to know how much power you expect to be able to put into an electric motor from the sun. What efficiency do expect from the motor and prop? What is total weight of craft? Will it be manned? How fast do you expect it to go? It sounds like some students worked on this before, so you should have this information. — John Meyer (jmeyer@erols.com)

[1 Mar 00] I would intend to agree with John on drag differences - it will depend on the number of elements in the surface piercing foil geometry. Doing a quick wetted area comparison might tell you something. A fully submerged system will generally yield a higher aspect ratio foil overall which should have a better lift/drag ratio. — Mark Bebar (BebarMR@navsea.navy.mil)

Follow-Up Question...

[18 Feb 00] Would a hydrofoil system consisting of a fully-submerged rear hydrofoil and a surface piercing front foil be subject to porpoising? Would the surface-piercing foil naturally damp that out? — Derek Chandler S1178082@cedarnet.cedarville.edu

Response...

[18 Feb 00] I see no reason that such a system would be prone to porpoising. There will be an influence based on the weight distribution. Will you have an airplane configuration with a majority of the craft's weight on the forward foils or a canard arrangement with most of the weight on the aft foils? One of the issues with an airplane configuration is making sure the aft system has enough weight on it to keep the foil fully loaded. Also, how do you intend to maintain control of the aft foil submergence? — Mark Bebar (BebarMR@navsea.navy.mil)

2nd Response...

[18 Feb 00] I realize this is a far cry from a solar powered hydrofoil, but you might find it

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EXTRA CONTENTS

LETTERS TO THE EDITOR
(Continued From Previous Page)

interesting to know that a combination of surface- piercing and fully-submerged foil has been done before - by the Russians on their ship SARANCHA. However, for a solar powered hydrofoil with severe weight limitations, a surface-piercing system for and aft (without the need for an automatic control system) would be prefered in my mind. Please tell us more about the size of the vehicle that you plan to build. How much power are you counting on from the sun? We would like to hear more about the project which might make a good article for the IHS Newsletter. — John Meyer (jmeyer@erols.com)

Assessment of TALARIA III...

[7 Jan 99] When I was last in Seattle I had the pleasure of not only meeting Harry Larsen but actually getting to ride in his hydrofoil TALARIA III. This is the first time I have been able to ride one foilborne and I can tell you it is amazing!

When she is sitting in the water it is not obvious that she is very different from any other cabin cruiser. The fully submerged foil system is controlled with a custom build analog computer using an inclinometer (pendulum type device) for roll control and a front mounted ski type of mechanical height control. Mr. Larsen tells me it was an important design criteria not to use expensive aerospace equipment like gyros. Propulsion is provided by an extended I.O. The system is fully retractable and appropriate measures have been taken to minimize damage from drift strikes.

Exiting the harbor was much like any other at a slow pace to minimize wake, advancing the throttle, the small block Chevrolet engine revs smoothly and then becomes slightly louder as the exhaust rises out of the water. The change from hull to foil is not felt so much as a lift sensation but more like some one let go a trailing line that was towing an anchor. The motor revs up with the reduced drag and the boat speed increases. looking aft, the wake nearly disappears. You feel a change in the ride immediately as the waves seem to vanish. There is still some feeling but it is as though you just went from riding in a buckboard wagon to a fine Cadillac automobile. The slamming of waves normal to crossing the wake (we went looking) was completely gone.

The real difference was when he let me drive. As the craft became foilborne, the response to the helm changed from the feeling of driving a boat to that of flying an aircraft. Albeit a small aircraft that had rudder input tied to the ailerons (as a few do) but it I found the similarities amazing. Turning the helm banked the craft and directed the boat into a turn with a minimal of lateral acceleration. A very tight turn was possible without stalling.

I was most amazed at the stability and feel of control, after becoming comfortable there is no doubt that you could cruise at speed right through most traffic with confidence which Mr. Larsen demonstrated at he took her back into the harbor. He tells me that while it is safe and there is less wake than at all but idle speed hullborne the problem with such a maneuver is that it will scare the wits out of others in the harbor to see this big cabin cruiser moving at 25 knots so close. It would result in someone immediately calling the Coast Guard or harbor master! Fortunately for us this was a cool fall day and there was no one else around.

This would be the perfect answer to big lakes like the Lake of the Ozarks that are nearly unbearable due to the rough conditions from so much traffic. I simply find it ridiculous that there are so few hydrofoils out there. This is a gold mine I swear. For no more than it would cost to have a conversion done, after riding Mr. Larsen's boat there is no way I would spend the kind of money a cruiser of that size cost without having it fit with foils! — Elliot S. James (esjames@cvalley.net)

Fences..

[5 Jan 00] I am about to start my hydrofoil setup for my solo sailing 18 Square, but I have some questions about certain aspects of design. The main question is what are fences on hydrofoils for? What do they do and how should the be arranged on a foil shape? I want to make foils like those from ICARUS and I know they used fences. Are they a way to keep water down? Visual marker for the skipper? Another question is what is the chord size for ICARUS ? It looks like 4"-5" because it is larger than the crossbeam on a Tornado beach catamaran. What size do you think would suit a 360 pound catamaran sailing at or above 25 knots with 200-400 pounds of crew weight? This assumes I do use the ICARUS foil setup. I may use the ICARUS II setup and use a smaller chord, this is pretty much just a doubled up bottom lifter foil. This setup was used when they had the double rig. I noticed you didn't have any photos of this great boat either, I have found two of them on the site: http://home.worldonline.nl/~hbsmits/hydrofoi.htm — Michael Coleman (MECcoleman@aol.com)

Response...

[5 Jan 00] Fences reduce spanwise flow. Since the pressure under the foil is greater than that on top, the water wants up any way it can. Going around the tip reduces the lift; therefore, fences or tiplets or tiprings. If you are making an exact copy of ICARUS foils use the same fences. If not, the best is to do some simple tank tests (try the Naval Academy).

If you want to risk a little loss in efficiency scale the ICARUS foils and fences. ALSO, do not change the aspect ratio of the foils without testing. Reducing it will change flight characteristics. Increasing it will change structural loads. SUPPLEMENT: Strut fences are good for reducing downflow on the strut, both water, which reduces lift and air, which ventilates the foil and screws everything up. GOOD LUCK!!! — Nat Kobitz (kobitzn@ctc.com)

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TRAMPOFOIL IS DISCONTINUED

By Malin Dixon

Sadly the Trampofoil company in Sweden has failed. Only about 100 units were sold. I believe that they were too expensive and not well enough advertized.

Like all hydrofoils, the Trampofoil has a wing that supports the weight by hydrodynamic lift. The rear wing is 2.9m in span and has a chord of 0.1m and is under the step, taking just about all the weight. 6 knots will give enough lift. The front wing is about 0.4m by 0.05m.

Ride height control is by a skate that controls the angle of the front wing. The rudder also joins the skate to the front wing and supports the front wing. The skate, rudder and front wing form one rigid assembly, which is rotated to steer the craft and tilts freely, controlled by the skate. The angle of the rear wing adjusts itself because the front is held at the correct height by the skate, and as the rear becomes deeper, the angle of attack become larger.

The Trampofoil is unstable in roll, and the rider has to shift his weight to the side to keep it upright. However it takes several seconds to roll over so this is easy.

Propulsion comes from the rider "jumping." The body that joins the step to the front wing is flexible, so that as the rider pushes down, the rear wing points down (negative angle of attack), so the lift force is slightly forwards. As the rider pulls his feet up, the angle of attack is positive, so the wing rides up, and the lift force is backwards, but it is smaller because there is less weight on the wing at that time.

This is how a bird flies. Like the Trampofoil, a bird's big muscles move the wings up and down relative to the center of gravity. Like the Trampofoil, the angle of attack is negative on the downstroke. The birds alter the angle of attack actively, but it is passive on the Trampofoil. However some control can be achieved by jumping on the front or back of the step.

The Trampofoil cannot be started from in the water. It is easiest to start from a jetty where a single push can get the rider and Trampofoil to the minimum flying speed. Also, before the start, the rider can hold the Trampofoil and himself, in the same attitude and height as during flying. So the rider just needs to add speed.

Beach starting is possible, but much more difficult. The rider stands in water about 10cm deep, holds the Trampofoil wings just under the surface. Then he pushes the Trampofoil forwards. On its own, it flies at about 1 knot, so it's flying immediately. The steering is not held at this point, but the exact direction of launch isn't important. The rider holds either side of the step and accelerates until the water is about 40cm deep. He then jumps onto the Trampofoil, jumping off the bottom with one foot and landing with the other knee on the step. He then climbs up and starts jumping. If that doesn't sound too difficult, on a steeply sloping beach, there is one step from standing to jump and the whole lot takes about 2 seconds.

There is no way of slowing down quickly. The rider just stops jumping and coasts. It's possible to land "dry" if the jetty is undercut so that the end of the wing can fit under. It's also possible to stop at the corner of a jetty, but timing the stop is difficult. Emergency stopping is by jumping off the back and catching the step to stop the Trampofoil as water drag on the rider stops him.

It is unfortunate to see the Trampofoil discontinued. Jake Free, whose website is http://members.aol.com/jfreeent/, sells other human powered hydrofoils, but their cost is about $5000. They all have floats so that they can water start, and they are propeller driven.

MORE ON THE FOILER MOTH

By Peter Kovesi

(photos by John Hilton)

The most exciting development seen at the 1999/2000 Australian and World Moth Championships hosted by the Mounts Bay Sailing Club was undoubtedly Brett Burvill's hydrofoils. He had only used them twice before the championships and spent much of the series learning how to sail with them.

The boat was supported by two foils attached at the front of the wings and a very deep rudder with a large T foil at its base. The front foils were generous in size and were angled inwards by about 45 degrees (Bruce foils for the technically inclined). They were capable of lifting the boat out of the water in under 10 knots of wind.

When going well in ideal conditions, the speed Brett achieved was truly awesome - possibly comparable to a 49er! The main issue with the foils was control. Sitting too far back in the boat caused the front foils to porpoise upwards and then stall, producing a usually catastrophic nose-dive.

Heeling the boat excessively to windward would cause the leeward foil to come out of the water, the windward foil would then slide in on itself producing a sudden windward lurch and nose-dive. This behaviour was particularly a problem when sailing side on to waves (ie. on most of the legs of an M course!) when the leeward foil went into a trough. Upwind, the foils were quite straightforward to sail, even in rough conditions.

Quite unexpectedly it was found that the boat could be tacked faster on foils than without. It was not unusual

for Brett to get to the top mark well clear of the fleet, but to have dropped many places by the time he reached the bottom mark.

After the series Nigel Oswald from the UK bought Brett's foils. The UK group were intending to display a Moth with the foils at the London Dinghy Show at the end of February. No doubt we can look forward to some developments in the UK over the northern hemisphere summer.

At the World AGM there was much discussion on the foils. The general sentiment, while being somewhat apprehensive, was generally supportive with a feeling that we have a duty to sailing to pursue these developments because we are one of the few classes that can actually do this sort of thing.

For more information, the International Moth Class Association of Western Australia (IMCA-WA) website is located at http://www.freeyellow.com/members7/imca-wa.

Local IMCA-WA Contacts:

- Glen Oldfield; 179 Healy Rd; Hamilton Hill 6163; Western Australia; Tel: +61 8 9337 6643
- Garth Ilett; 38 Stanley St; Nedlands 6009; Western Australia; Tel: +61 8 9386 6561; email: guspar@hotmail.com
- Peter Kovesi; 20 Stanmore St; Shenton Park 6008; Western Australia; Tel: +61 8 9388 1197; email: pk@cs.uwa.edu.au

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Interested in hydrofoil history, pioneers, photographs? Visit the history and photo gallery pages of the IHS website. Do you have photos to contribute? Scan them and send them in so we can post them for others to enjoy.

http://www.erols.com/foiler.

MOTHS TAKE TO THE WING

By Mark Pivac, "By Design Group"
www.bydesigngroup.com/au

From Boating Oz, 25 Jan 00
www.boatingoz.com.au

A revolutionary new lifting foil design fitted to WINDRUSH, a competitor in the recent 2000 Moths World Championship in Perth, made it the first fully flying hydrofoil Moth to be competitive in all wind strengths, on all points of sail. Although it has some vices, the yacht is competitive in all conditions, from drifting to gale.

WINDRUSH, sailed by Brett Burvill, didn't win the championships outright, but it won a few heats in a boat that still has plenty of scope for further development. "By Design Group" director Mark Pivac made a significant contribution to the development of WINDRUSH.

The foil concept is not limited to Moths. By Design Group and Windrush Yachts Australia are both keen on a production version. Windrush Yachts has produced thousands of WINDRUSH 14 cats, but production levels are now far below the heydays of the seventies and eighties. A simple-to-build, relatively cheap and easy to sail hydrofoil could be a fantastic boost to the popularity of sailing. If all goes well, we can look forward to a one or two person off-the-beach boat with kick up folding foils and a smooth and fast ride. Such a craft has been predicted since the fifties, but we are now realistically close to achieving a boat as suitable for the masses as a Hobie Cat or WINDRUSH 14.

Hydrofoils and Moths aren't a new match, and hydrofoil sail craft have been around for decades. As an example, Hobie make the Trifoiler, which can do more than 30 knots out of the box. A few Moth class stalwarts have been experimenting with lifting hydrofoils for years. To avoid confusion I'll call the lifting foils on WINDRUSH "Piv Foils."

So what is unique about WINDRUSH and its Piv Foils? It's the first fully flying hydrofoil Moth to be competitive in all wind strengths, on all points of sail. It's the first and only hydrofoil Moth to finish a world championship race, and it is the first to have won a heat (WINDRUSH won two).

To give an idea of how fast it can be, in one race Burvill ended up on the wrong side of a light wind beat. The wind was a land breeze whispering at around three to eight knots, so it was pretty important to be in the right place at all times. Burvill rounded the top mark 35th whilst the leaders were in a pack down past the wing mark. On the first reach he passed 20 boats as WINDRUSH popped onto the foils in less than eight knots of breeze. He rounded the bottom mark in 5th place.

In another heat, in about 18 knots of breeze, he crossed a few transoms at the start and by pointing as high but footing faster on the foils, led around the first windward mark by a minute. Moths are so competitive that this sort of thing rarely happens. But it was happening in Perth in every race.

So why didn't WINDRUSH win overall? The answer is simple. It takes more than expert sailing on a boat with blinding boat speed to win a world championship. Burvill is a brilliant sailor, WINDRUSH is a brilliant concept, but the synergy that links mind, body, and boat were missing in the early races. In some conditions WINDRUSH is as tame as a pussycat, but her wildest point is flying downwind in a breeze with chop. However, sometimes the surface-piercing foils lift too high, pass through a wave trough and ventilate. It looks hilarious as WINDRUSH instantly bears off and capsizes to windward. Fortunately this doesn't happen frequently, and Burvill is learning how to control this tendency.

In the early races, Burvill was probably struggling with the fear of capsize, but towards the end of the series he could think less about staying upright and concentrate on winning races. By sailing conservatively and trying to avoid the worst waves when heading downwind, Burvill managed to keep WINDRUSH on her feet. He won two of the last three heats and came close to winning another five.

This steep learning curve came about because the Piv Foils had only been

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The underside of the foiler moth on its trailer *(photo by John Hilton)*

MOTHS TAKE TO THE WING

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sailed four times before the championship.

Burvill initially built WINDRUSH to his own design as a fairly conservative but narrow skiff Moth. The rig and wing bars are all state-of-the-art carbon fibre, an incremental improvement on current Moth best practice.

The foil idea was rekindled when By Design Group received a brief to make a set of inclined foils for an 8.5 trimaran WHITE WAVE that was being modified. Burvill and I have been discussing hydrofoils for a few years and in early September we started talking about how to get a set of foils to really work on the Moth class. We agreed that if By Design Group would design and machine the foils, Burvill would finish, fit and sail them. We agreed that the foils had to be simple, strong, easy to fit with minimal modification and fast.

By Design Group has expertise in the design and development of new equipment and products, especially those with an aeronautical slant such as fans, composite structures and aircraft. Our centreboard and rudder designs are currently widely successful in the dinghy, cat and skiff classes. In designing the Piv Foils, I was acutely aware of the need for both simplicity and stability. We pared the design down to its essential elements. We got rid of everything we could and took the simplest path. I carefully worked out foil geometry and sizing so the boat would sail to windward foilborne in light airs. It's a tough job to balance low speed lift off and high speed stability.

Moths Approaching the Buoy

(photo by John Hilton)

Although we started seriously thinking about it in September, this was the busiest time of the year for both By Design and WINDRUSH, so the foil project had to fit in after everything else. You need to spend a lot of time with new ideas if you want to win races. Burvill nearly didn't use the Piv Foils at this World Championship because he was only barely comfortable with them. However, we wanted to see the concept advance as rapidly as possible. Additionally we wanted to get the foils further forward on the boat but there wasn't enough time to do it. This compromised down wind controllability.

The boat takes off exactly as predicted and performs well overall. This was our first attempt at hydrofoils and to see it work so well and win some heats was a real thrill. Together we are confident that the next boat will solve the few problems that WINDRUSH has.

The keys to a successful sailing hydrofoil design are always to think of stability and drag. Although it looks so simple and only the rudder is a moving part, WINDRUSH has a naturally stable arrangement in pitch and ride height, has reasonable yaw damping, and she has improved roll stability compared to a standard skiff moth. The hydrofoils on WINDRUSH are an advanced design. The main lifting surfaces are the forward hydrofoils mounted from the hiking out wing tips. These foils are inclined at around 45 to the horizontal so that they provide both lift and side force. The toe in/toe out angles and the incidence angle of the rudder foil are critical. We also use a special hydrofoil section shape and planform shape that blends a range of features to minimise drag, spray and the tendency to ventilate or cavitate.

The horizontal aft or rudder foil is used primarily for stability. It has an elliptical plan form and a symmetrical low drag section shape. The rudder uses a section shape that is very

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WINDRUSH Rounding the Buoy

(photo by John Hilton)

MOTHS TAKE TO THE WING

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tolerant of operating close to the surface. It has a fairly sharp leading edge to reduce spray and it can also generate significant side force. As boat speed increases the inclined foils ride higher on the water to maintain the optimum lift coefficient and in doing so their area in contact with the water decreases. The T foil on the bottom of the rudder is essential for stability. It lifts up or down, depending on the pitch angle and pitch rate of the boat. To minimize drag it is essential to have as few foil intersections and water surface penetrations as possible. We use very efficient, low drag laminar flow hydrofoils with very smooth surfaces so the parasitic drag of corner joints and spray making surface penetrations is a substantial part of the total drag.

When you look at WINDRUSH sailing there is almost no spray and no visible wake. She just glides past very smoothly at an impressive speed. "In an eighteen knot breeze on a choppy course the ride up wind is quite smooth, you do bounce around as the foils flex through waves but the hull never slams," says Burvill. "On a normal boat you often pound quite a bit going up wind.

"By keeping the support strut intersections above the waterline and by only having three foils we have really minimized the drag. If we could get away with one foil we would to do it, but we need three for stability."

The boat does not have a centreboard. The angled Piv Foils off the wing tips are asymmetrical so that the leeward foil produces most of the lift. It actually lifts the boat to windward. The rudder is around 300mm deeper than a standard Moth rudder to keep the rudder foil in the water. Each main foil is similar in size to a standard Moth centreboard.

Although the total wetted area has been increased by slightly more than the area of a centreboard, this is offset by the reduced hull wetted area as the boat starts lifting out of the water. The hull rides noticeably higher even at speeds of only a few knots.

For very high speed sailing, hydrofoils may not be the answer. Above 45 knots it is very difficult to control ventilation with the sideloads and waves that sail craft encounter. Really high speed craft are likely to continue to be planing craft like sailboards. However the International Moth is not in that league. Beam, length and sail area restrictions place limits on power-to-weight ratios that make hydrofoils the perfect solution to improving Moth performance.

Future plans to improve the Piv Foil layout on WINDRUSH include moving the main or forward foils further forward. We will also experiment with incidence controlled main foils using surface sensing "feeler'" skis. Neither of us is convinced yet that these will be better all round. Surface sensing will be good at high speed to maintain a constant foil depth and help to avoid ventilation by keeping the lifting surface deep, but it will be difficult to maintain low drag at low speed without adding complication. More likely to work is some on-the-course angle adjustment to the rudder foil or all three Piv Foils. The basic arrangement is stable, however both handling and geometry changes with speed. This is quite similar to aircraft which must be trimmed when flying at different speeds.

WINDRUSH is a simple concept that is already reviving the Moth class. With further development it is very likely that the next world championships will be won on hydrofoils. With hydrofoil production boats in the wind, it is already shaping up to be an exciting century.

By Design Group has plans for an unlimited offshore racer. We would love to discuss this in detail with someone serious about taking on the big budget, big boat teams in around the world racing. Our vision encompasses a sailing hydrofoil about 11m (35 feet) long, doing 45 knots. With hydrofoils, size hardly matters, the boat need only be big enough to carry the crew and supplies for the duration of the race.

About the author: Mark Pivac (29) graduated from RMIT with a B Eng (Aerospace) Hons degree. He won the Tom Shelton Memorial Prize for his thesis on Performance Improvement and Stability Analysis of High Speed Sailboards. This was followed by three years as an Engineer Officer in the RAAF. He then ran his own engineering design consultancy before joining By Design Group at its inception in 1996. He has been interested in high speed sailing and racing for many years.

Windrush Yachts Australia is managed by Commercial Director Graham Burvill. Production is managed by Brett Burvill.

Contact Windrush at:

Windrush Yachts

1B Stockdale Road

O'Connor. 6163

Western Australia.

Website: www.wevo.com

TALARIA III -- EXPANDED WEBSITE

Harry Larsen reports that he has expanded his web page to add more pictures of TALARIA III. Also he has included a parts list with approximate cost for each of the elements in his Bayliner's fully submerged, automatically controlled hydrofoil system. Harry hopes that the parts list may be useful to builders for their better understanding of the cost of the various subsystems.

Harry can be contacted by email at hlarsen0@gte.net (the "0" in that address is a zero, not a letter "O." Harry's is at the following URL: http://home1.gte.net/hlarsen0 (the "1" is a one, and the "0" is a zero!) Following are some features of TALARIA III:

Vehicle Description

Boat:
- 24 foot (nominal) deep Vee hull
- 200 hp Volvo outdrive powered
- Canard configuration
- Boat weight 4000 lbs.
- Foil spans within the boat's beam (8')
- Hydraulic retraction of bow and stern foils (trailerable)
- Manual hydraulic bow strut steering
- Rear foil loading 375 lbs/sq ft
- Bow foil loading 500 lbs/sq ft

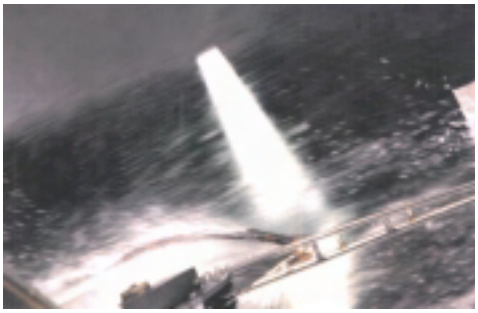
Hydrofoil Materials:
- Bow strut - stainless steel
- Aft center strut - galvanized steel
- Bow foil & side struts - high density FRP
- Aft foil - aluminum

Hydrofoil Control System:
- Height - Surface ski articulating bow foil angle of attack
- Roll - Differentially actuated flaps on rear foil controlled by analog computer
- Hydraulic system: servo valve, 4way valves, pump, heat exchanger, filter, stainless steel cylinders

Computers:
- Analog computer flight controller (speed variable gains),
- 286 lap top powering instrument display

Data acquisition:
- 8 channel 8 bit 20 samples per second PC based data acquisition system

Performance:
- Cruise typically at 25 knots, 31 knots at 4200 rpm
- Take off speed about 18 knots
- Have negotiated 3' steep / short waves



View over the bow with the bow foil submerged at 2 ft depth. Note the small twig caught on the strut.

LETTERS TO THE EDITOR
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2nd Response...

[5 Jan 00] I do not know of any hydrofoil ship with fences on the foil itself. Fences were put on the struts to interrupt ventilation. Ventilation is when the air flows from the water surface creating a cavity between the strut surface and the water. Due to the difference in density of air and water, ventilation could cause loss of lift and/or control.

The fences are essentially flat plates attached to the strut perpendicular to the strut surface and in line with the water flow. Generally they were contoured in similar shape as the strut. A good example is the cavitation plate on an outboard motor or the I/O drive. Fences were not used on any of the Navy hydrofoils.

As far as the remainder of your questions, I plead ignorance. — Sumi Arima (arimas1@juno.com)

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Harry Larsen's TALARIA III

TALARIA III -- EXPANDED WEBSITE

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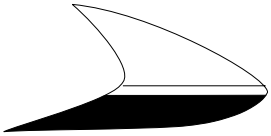
TALARIA III In the Hoist, Struts Retracted, Ready For Trailering

TALARIA III With Stern Struts Retracted For Trailoring

Front Strut Retracted

The NEWSLETTER



International Hydrofoil Society

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

Editor: John R. Meyer SUMMER 2000

DEVELOPMENTS CONTINUE TO ENHANCE PERFORMANCE

by Paul Hynds

(Extracted from Speed at Sea, December 1999)

A new device introduced by the Milan-based marine division of LA.ME srl is specifically designed to, as the company puts it, "accelerate the ship's performance." Humphree is an advanced appendage designed to enhance the hydrodynamics of semi-planing and planing vessels. The technology underpinning the new development is based on the interceptor type of device.

On-ship assessment has demonstrated superior means to improve a vessel's performance in terms of hull resistance, wash waves, speed, motion control and maneuverability, according to LA.ME. Upgrading installations have already been completed, between March and May this year, on Tourships' three Rodriquez designed high speed monohull Aquastrada car ferries, Corsica Express II, Corsica Express III and Sardinia Express.

The fundamental working principle of the Humphree device is, in some ways, similar to that of the now familiar transom-mounted trim tab flaps and wedges seen on most high speed ferries. In this case, though, there are several important differences that distinguish the new system.

The first difference is that the Humphree device generates a high pressure area on a planing surface by intercepting the flow at the transom by a blade. Even when this blade is only projected a small distance beyond the transom edge, the upstream decelerating effect on the flow is substantial and the area of increased pressure extends far ahead of the transom. The resulting effects of this action are a positive hydrodynamic lift generated at the expense of only minimal hydrody-

See Enhanced Performance, 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.

2000 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. Please remit 2000 dues as soon as possible. We regret that high bank fees make it impractical for IHS to accept payment by credit card or a check drawn on a non-US bank, or by other than US funds. Overseas members with no easy way to send US funds, are advised to send money order to IHS or US Dollars cash.

INSIDE THIS ISSUE

PRESIDENT'S COLUMN

Since the publication of the Spring Newsletter, the Board of Directors for the Class of 2000-2003 has been elected by the his membership. Those directors are: Mark Bebar, William Hockberger, George Jenkins and Ralph Patterson. Also, the Board met in July to elect the IHS officers for the year 2000-2001. The Officers are: *President:* John R. Meyer, *Vice President:* Mark Bebar, *Secretary:* Ken Spaulding, and *Treasurer:* George Jenkins.

Several months ago, one of our members raised the issue of goals that Board of Directors may (or may not) have in mind when consenting to serve the Society. This was discussed at a Board meeting in April. The Board is serious about incorporating such goals in the Ballot next year. However, I am reminded of the goals I had set for the Society when I was first elected President in 1992. I have summarized the progress the Society has made since that time.

1. A fantastic Web Site for which we receive many compliments. Thanks to Barney Black-- Big job; well done.

2. Increased membership to the tune of 3 new members per quarter. We have exceeded this year after year. Steve Chorney has put IHS membership on EXCEL with many columns of information - Big job; well done.

3. Publicizing hydrofoil technology and the use of hydrofoils around the world via the web and Newsletter. The Newsletter has been upgraded from that earlier time period by an order of magnitude. Barney Black set up the newer format and I have utilized it. The Newsletter has technical articles from time to time. Martin Grimm has made up an index of all the Newsletter articles - big job; well done.

4. We have IHS members, Malin Dixon in the UK helping on the web with the Photo Gallery, and more recently Sam Bradfield has become the Hydrofoil Sailor's Page editor.

5. Hydrofoil Video - This has not come about. However, Ken Spaulding has recently proposed and followed up with the Smithsonian Institution on their "Road Show" program with the intent to put one together on Hydrofoils. This may be even better than a one-shot video on Discovery Channel. Needs a lot of work. See article by Ken Spaulding on page 5 in this Newsletter.

6. Hydrofoil Text Book. This has not come about either, BUT, thanks to Mark Bebar, we will be putting many of the key hydrofoil documents on the "AMV ONLINE" through Naval Sea Systems Command (NAVSEA). We have just gathered about 50 documents to pass on to NAVSEA for the first batch of about 500 documents planned. All at no cost to the IHS!! More on this later.

As I have said many times in this column, we are always looking for suggestions for improvement of the Society, and material for both the IHS Web Site and the NL. We will continue to welcome your comments and contributions.

John R. Meyer, President

WELCOME NEW MEMBERS

Michalis Chatziapostolou - Michalis is associated with Comeract Ltd., in Rhodas, Greece. The organization is a source of engine parts for Russian hydrofoils like Kometa, and Russian ships of the types "Alexander Green" and "Efpatoria."

Thomas Eckey - Thomas is a Naval Architect in Oslo, Norway. He is mainly involved in offshore activities related to oil production. Through his business relations with classification societies such as ABS, Det Norske Veritas etc, the news has come around that he is about to test a hydrofoil, and the interest has been great. Especially from the fast ferries division at DnV. Together with a friend, Svenn Erik Kristoffersen, (svennek@online.no), they are in the process of finalizing a hydrofoil project started in 1947. For more info contact him at: te@inocean.no

Timothy Graul - Timothy is a consultant in the marine world in Sturgeon Bay, WI. He received a B.S.E. degree in naval architecture at the College of Engineering, University of Michigan in 1964. He was attracted to the field by a desire to design sailboats. Tim retained his interest in drawing and small craft; expanding it to include the larger sphere of small commercial vessels; boats under 200 feet in length that work for a living. In l981, feeling that he had achieved the necessary experience and "seasoning" needed to strike out on his own, he rented an office in downtown Sturgeon Bay. His first major design job was a 90

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ENHANCED PERFORMANCE
(Continued From Page 1)

namic drag due to the low surface area of the projected blade, despite being subjected to high pressure.

The lift/drag ratio of the interceptor has been proven to be inherently higher than that of an equivalent device such as a flap or wedge, LA.ME says. Consequently the drag generated by the interceptor is, for the same amount of lift produced, always lower than the drag generated by the trim tab flap or wedge device.

Additionally the projection or depth of the interceptor blade is several times less than corresponding depth of the flap's trailing edge. Furthermore, the maximum pressure is in line with the interceptor blade and the center of pressure acts more toward aft, promoting a larger actuating moment about the vessel's center of gravity.

The LA.ME-developed Humphree device consists of a single compact and robust design featuring the interceptor blade, its supports and bearings as an integral unit. The movement of the blade is initiated from a hydraulic servo actuator located inside the unit itself. Due the relatively small mass of the interceptor blade, the actuating mechanism and hydraulic systems can be engaged quickly and without the need for high power consumption.

[Ed Note: The Speed at Sea article did not show a picture or illustration of the "Humphree" device, nor explain the derivation of the name. We suspect that this is due to the fact that patents are "pending".]

There are alternatives for mounting the Humphree system devices on to the vessel with the preferred locations being on either the bottom of the transom or, if the vessel incurs a significant degree of wetted sides at high speed operations, on the side edge of the transom.

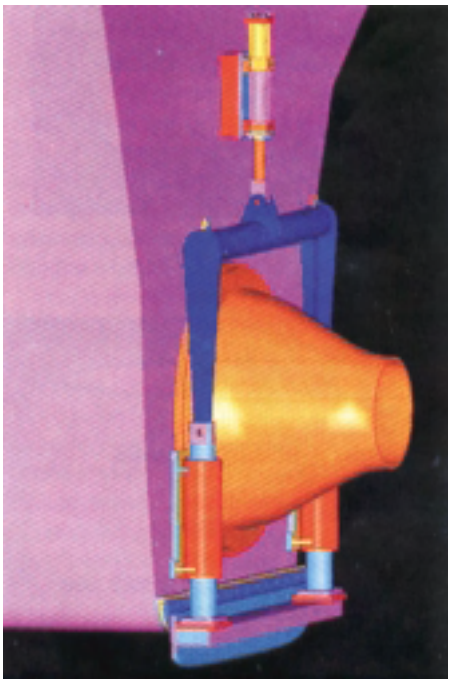
Norwegian fast ferry specialist Kvaerner Fjellstrand has its own ride control system designated Motion Dampening System. Originally designed as an enhancement intended for the company's range of high speed passenger vessels, the system has subsequently been developed and improved as Kvaerner Fjellstrand has moved into the high speed car ferry market.

A typical existing installation combines trim tabs aft with inverted T-foils forward. The ride control devices are fully active and linked separately to bridge stations for override commands. A decrease in bow accelerations of up to 36 per cent has been recorded in sea conditions with wave heights measuring 2m.

The latest improvements to the Motion Dampening System specifically for larger vehicle carrying fast ferries built by Kvaerner Fjellstrand include the redesign of the forward T-foils to enhance dynamic efficiency at speeds in excess of 40 knots. This redesign also incorporates measures to reduce drag, thus a consequent performance gain in terms of maximum speed attainable compared to previous systems developed.

The transom flaps originally installed on all Kvaerner Fjellstrand vessels for the purpose of adjusting trim have also been redesigned and are now fully integrated into the Motion Dampening System by connecting through a single control network. An additional feature now allows the crew to make separate adjustments on the forward and aft forces while considerably reducing roll characteristics.

Maritime Dynamics Inc. has been conducting its own research into interceptor devices to complement its range of inverted T-foils and trim tabs developed for both catamarans and monohulls. MDI's first ride control system that uses interceptors aft will enter service in the Spring. This installation incorporates MDI's findings during extensive model and simulation tests. The company has also specialized in the development of fin appendages specific to SWATH hull types.



MDI's Ride Control Interceptor

Typical installation incorporates the wheelhouse control station linked to the hull motion sensor processors which in turn receive data transmitted

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ENHANCED PERFORMANCE

(Continued From Page 3)

directly from the fin, foil or trim tab. The control station provides real-time displays of the attitude or angle of incidence of each ride control device via a monitor in the form of bar graphs. To facilitate fast response alterations to the system settings, for example if sea trials indicate necessary action, the system calibration coefficients are logged and stored using a ROM databank.

In sea conditions producing wave heights of up to 2m on the bow, MDI says that its ride control system can consistently return a 30 per cent reduction in pitch moment and a 60 per cent reduction in roll.

A motion control system being fitted to SNCM's 134m Corsaire 13000 monohull under construction at Alstom Leroux Naval incorporates MDI's largest T-Foil, at 13.4 M^2. The system also employs four 3.5 M^2 fins and two 13.5 M^2 trim tabs.

As Italian fast ferry builder Rodriquez Cantieri Navali SpA nears delivery of its first 114m Aquastrada monohull to Spanish operator Armas, the ride control system as described by Rodriquez Engineering managing director Dr Alcide Sculati will be keenly anticipated by the fast ferry industry (Speed at Sea, August 1998).

In order to address some specific sea and swell conditions found in the operator's Canary Islands sector, Rodriquez has developed an integrated system combining trim tabs, fins and adjustable trailing trim flaps on fully submerged, lift-generating foils. The section shape of the fins has been determined to deliver the maximum possible lift with minimum resistance while avoiding cavitation. Control of the foil appendages can be either fully automatic or manual.

Tank testing has proved that the monohull design is marginally sensitive to roll, pitch, yaw and accelerations from rough sea any direction, By installing this combined ride control system, says Rodriquez, excellent stabilization is achieved. Roll motions are controlled by two lifting surfaces forward and two aft of the center of gravity. Pitch and heave motions, and vertical accelerations are dampened by the T- foil fitted forward and 'Pi -foil' aft.

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WELCOME NEW MEMBERS

(Continued From Page 2)

foot ferry for the Madeline Island Ferry Line which runs between Bayfield and Madeline Island in Lake Superior. Although much of his design work involves passenger and ferry boats, he has done everything from weed harvesters to trap boats; from patrol craft to floating cement plants.

Hans Jorgen Hansen - Hans is from Espergaerde, Denmark, and has a great number of hobbies including remote control of model boats, airplanes, and cars. He recently was successful in getting a 11.5 kg electric driven hydrofoil model to have an endurance of about 1 hour before the battery ran down. He closed his letter of introduction to us with the phrase "Think Foiling".

Dr. Eugene O. Jackim - Dr. Jackim, from Wakefield, RI, has always been interested in sailing, and more recently in building a model hydrofoil sailboat. He is anxious to know more about scaling the model up to a full size boat, and the intricacies of hydrofoil design in general. Helpful IHS members can reach him at: JACKIM1@home.com

Michael Mirfield - Michael is a student of Naval Architecture and Small Craft Engineering at the University of Strathclyde in Glasgow, Scotland. His thesis is the design of a detachable hydrofoil kit for the Hobie 16, a design which he hopes to build very soon. His interest in hydrofoils was raised when he came across a book called "Hydrofoil Sailing" by James Grogono et al. Since then he has studied hydrofoils in as much depth as his time has allowed. He would like to thank all the members of the society who have already given him a great deal of help and made him feel welcome to the world of hydrofoils.

Alan Mirucki - Alan is from Live Oak, Florida. He wrote that he is interested in building a small hydrofoil, and can use a lot of help from various members. He can be reached at: 4263 89th Road, Live Oak, FL 32060.

PRESIDENT NAMES NEW SHIP CLASS AFTER ADMIRAL ZUMWALT

The President announced on July 4, 2000 that the Navy will honor Navy Adm. Elmo R. "Bud" Zumwalt Jr., by naming its 21st Century Land Attack Destroyer (DD 21) after him.

Zumwalt, who became the youngest man ever to serve as chief of Naval Operations (CNO) in 1970, passed away in Durham, N.C., on Jan. 2, 2000. Appropriately, this class of 32 future warships will embody Zumwalt's visionary leadership and well-known reputation as a Navy reformer.

Entering the fleet at the end of this decade, USS Zumwalt will usher in the Navy's newest class of destroyers. These revolutionary warships are being designed to meet post-Cold War requirements using 21st century naval warfare concepts. The Zumwalt class will incorporate several advanced technologies and introduce features to improve the DD 21 sailor's quality of life.

Armed with an array of land attack weapons, USS Zumwalt will be capable of delivering an unprecedented level of offensive firepower from the sea. It will also be the first U.S. Navy ship to be powered and propelled by a fully integrated power system, including modern electric drive. The Zumwalt will be manned by a crew approaching one hundred and will feature new habitability standards and shipboard amenities. She will be a platform that values its crew more than any other ship on which sailors have ever lived, fought, and worked," said Secretary of the Navy Richard Danzig. "It is a fitting tribute to the legacy of Admiral Bud Zumwalt."

A TRAVELING HYDROFOIL MUSEUM EXHIBIT

By Ken Spaulding

Your IHS Board of Directors has, for some time, been considering possibilities for bringing "The Hydrofoil Story" to the public's attention. Several years ago John Meyer authored a book "Ships That Fly, a Story of the Modern Hydrofoil", but a willing publisher is yet to be found. Proposals have been made to the History and Discovery channels for the production of a one hour TV documentary without success. In March the Board agreed to pursue the possibility of fielding a traveling hydrofoil museum exhibit.

This exhibit, if shown at leading maritime museums, could reach a large percentage of the interested public. The American Society of Museums lists 135 US maritime museums. The Council of American Maritime Museums has 45 members.

The Smithsonian Institution Traveling Exhibition Service (SITES) is a long established and experienced vehicle for such an exhibit. They currently have 60 shows on the road around the US. Their catalog of available exhibits is very widely distributed. Categories include; Art, History & Culture, Science and Miscellaneous. Hydrofoils would fall under Science or Miscellaneous.

The Board intends to prepare a proposal for SITES consideration. Dr. Paul Johnston, Smithsonian Curator of Maritime History has agreed to serve as internal SI sponsor for the proposal. Currently we are attempting to scope the format and content of a successful proposal. Corporate sponsors will be required as well as letters of interest from a sampling of museums.

At this time the exhibit is envisioned to include a comprehensive history of military, commercial and recreational hydrofoils. The show that hits the road must be a polished, professional production. It may contain actual foils and models, as well as interactive displays and videos. It would cover the early experimental craft, principles of hydrofoil design, sailing hydrofoils, military and commercial craft in the US and abroad, current hybrids and ride control applications. Comprehensive material on Soviet foils is now available. Interactive displays could include a simplistic design model, PHM war games, a virtual hydrofoil trip, etc.

Your thoughts and ideas on this initiative are solicited. Specifically: What content would you envision for such an exhibit? What corporate sources might make significant contributions? What "interactive" displays could be economically produced? Would an exhibit without foils and models (much cheaper) be successful? Which maritime museums should we target? Please reply to Ken Spaulding at kboyd@erols.com.

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HELMUT KOCK AWARD

In a recent letter from Helmut Kock, he acknowledges receipt of the IHS Award as follows: It was a surprise and great pleasure for me to receive the International Hydrofoil Society Award. I thank you and the members of the Board of Directors for my nomination. Please forgive me for my belated acknowledgment of the receipt

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PIVOTING HYDROFOILS AND POWERED PLANING CRAFT

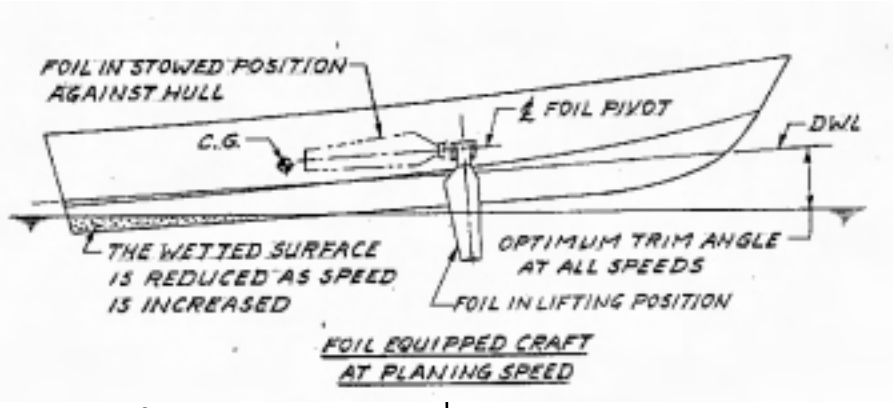
(by James Stewart, IHS Member)

I have originated and patented a new hydrofoil concept, which may be of interest to International Hydrofoil Society members.

The concept came about from watching my son and his friends windsurf on the Lake of Two Mountains at Hudson, Quebec. The stern of their sailboards dragged deeply in the water creating a lot of drag and I thought "there must be a solution to that". This thought resulted, some years later, in a patent (U.S. Patent No. 4,811,674) covering the pivoting foil concept for drag reduction of sailboards and other craft including powered planing craft.

The following is a brief description of this foil concept for drag reduction as it applies to powered planing craft. The reduced drag of the planing craft's hull will result in its increased acceleration to higher maximum speed and more efficient operation at all speeds which translates into greater fuel economy and an extended operating range.

The pivoting foils, much smaller than the foils on conventional hydrofoil craft, are installed directly on the hull without any intervening support structure between the foils and the hull. The pivoting feature has a unique and important role in the foils' operation. By allowing the foils to pivot downward from a lifting position to a non-lifting position, the pivoting feature prevents the foils from generating the negative lift which would otherwise occur under some conditions.



These small foils, by generating a lifting force which interacts hydrodynamically with the hull in a specific manner, create a synergistic effect which makes both the hull and the foils more efficient than if they were functioning separately. This synergistic action is the key to the effectiveness of this concept.

The small size of the foils allows them to be rotated to a stowed or inactive position alongside the hull for operation in shallow water and for convenience in docking.

The efficiency gained by using these foils will vary from craft to craft depending on a number of variable factors. However, it can be said that substantial hull drag reductions would be readily achievable – up to 50 percent in some cases. It is expected that the lower fuel consumption provided by the foils would over the life span of the craft more than pay back the original cost of the foils and thus make the foil installation a profitable investment. The rate of saving would increase over time due to the inevitable increase in the price of fuel. This is seen as an important factor in evaluating the foil concept.

Individuals or companies interested in additional information on this new concept and the possibility of investing in the development of a prototype are invited to contact Motion Design Creations Inc. Jbstwrt@n46.com.

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FRESH-1 INFORMATION

By Sumi Arima

I would like to clarify the statement made by Malin Dixon that cavitation is bad for hydrofoils. Cavitation is a detriment for sub cavitating foils, causing loss of lift, but if the foils are of super cavitating design, theoretically cavitation does not become a factor. FRESH-1 used super cavitating demonstration foils and attained speeds of 70 knots, approximately 78 mph. I left the program after the unfortunate turn over, and thus cannot attest to the exact speed reached after the restoration. It was powered by a Pratt and Whitney JTD-1 pure jet engine providing 16,000 pounds of thrust. After the accident, a military version of the engine was used which provided a little more thrust.

Although another set of foils was designed by Grumman called the "transit foils" for the FRESH-1, the Navy chose to pursue the sub-cavitating foil research rather

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1999 DELIVERIES AND ORDERS

(Extracted from Fast Ferry International, January-February 2000)

Last year's total of 92 fast ferries delivered or on order is the lowest since the magazine started compiling figures in 1986. Deliveries were not that much lower than in previous years. What has dragged the total down is the very low figure for outstanding orders at year-end.

Breakdown of Deliveries and Orders

	Deliveries	Orders	Total
Catamarans	36	23	'59
Foil assisted Catamarans	-	-	-
Hovercraft	-	-	-
Hydrofoils	-	2	2
Hydrofoil Catamarans	-	-	-
Monohulls	17	6	23
Surface Effect Ships	1	1	2
SWATHs	-	1	1
Wavepiercing Catamarans	3	2	5
Totals	57	35	92
Passenger ferries			
50-99 seats	-	-	-
100- 149 seats	8	8	16
150-199 seats	6	3	9
200-249'seats	4	2	6
250-299 seats	- 2	3	5
300-349 seats	2	4	6
350-399 seats	5	2	7
400-449 seats	3	1	4
450 + seats	9	-	9
Totals	39	23	62
Passenger/Vehicle ferries			
10-49 cars	1	1	2
50-99 cars	5	2	7
100- 149 cars	1	-	1
150-199 cars	5	1	6
200-249 cars	3	4	7
250-299 cars	-	2	2
300-349 cars	1	1	2
350-399 cars	-	1	1
400-449 cars	-	-	-
450-499 cars	2	-	2
Totals	18	12	30

Although the number of deliveries and orders has fallen, the vessels themselves continue to increase in size and value. The number of vehicle ferries delivered, for example, is the highest since 1996.

As always, a fast ferry is regarded as a vessel, delivered to or ordered by a commercial company, capable of carrying at least 50 passengers, or an equivalent amount of passengers plus cargo, and having a minimum service speed of 25 knots.

PHM RESTORATION UPDATE

By Eliot James, (IHS Member)
Custom Composites Company
esjames@cvalley.net

We have been working on an Integrated Bridge System (IBS), and are creating our own due to the lack of knowledge of commercially available systems. This will enable one person to monitor all ship functions (conning, and navigation) from the bridge, the navigation station, or EOS. Our experience is based on industrial automation and "Man Machine Interfacing" (MMI). The commercially available marine control units that I have seen (electronic steering systems or engine control for instance) have all been based on this technology but often use proprietary hardware packaged in a nice enclosure and carried an astronomical price tag with less functionality.

We have solved a big hurdle in power generation. There are about 40 different 400 hz motors on the ship from fuel pumps to vent fans as well as nearly that many fluorescent 400 hz lights. These units save significant space and weight above commercially available 60 hz units , are far superior in construction (and should be for the price of new ones) are cheap on the surplus market because few others use them, and most importantly, are all in place, and in good working order.

The challenge has been in constructing a power plant to power both the 400hz as well as the new 60 hz loads. We had quotes on having inverters built but the cost was nearly $150,000.00. All the surplus motor generators we have found are for lower voltage and are extremely heavy. We were just about settled on building a custom gearbox to drive 2 generator ends from one diesel engine. Again, we found our answer in our own industry. Variable Frequency Drives (VFDs) have been in use to change speed of 3 phase motors for many years. They are made to ramp up and down but if we compensate with a large enough unit, we can drop motors on and off line with no problem, we consulted the factory on this and while they never heard of using a VFD for a power supply and they were a little tentative in saying it was OK, their engineer could not give any reason that it wouldn't work fine. We purchased a small one (off of ebay no less) that would go up to 400hz. It is rated for 20 kva and only weighs about 40 lb. We took the 400 lb. 12 kva motor generator and the 200 lb. of transformers (needed to boost output to 440 volts), that run basic ship systems (lights, fresh water pumps,

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PHM RESTORATION UPDATE
(Continued From Page 7)

etc) off line and wired in the VFD. In testing it works great. These units are made for integrating into MMIs and will be far easier to incorporate to the IBS that any other unit. New, a unit to run the entire ship 400hz equipment would cost $50,300.00, but because these are so prolific in industry, I have found two 3-year old units for $5,000.00 each, and think I can do better. I can enclose them in a NEMA 12 stainless steel enclosure and be far more "marinized" than what was originally aboard.

The lights still hum at that high freq. but being a VFD we can "tune" the resonance out and quiet them a bit so they are now quieter than when we used the generator. We have not been able to tune out the hum from the lighting isolation transformers that change 440 v 400hz to 110 v 400hz. Since the VFD is not quite as "clean" as a generator, the resonance moves in and out between the three transformers like three flutes almost in tune with each other. There is no extra heat building up, just noisy. Is there another way to quiet the hum in the transformers?

We are mounting the hydraulic pumps on electric motors. By running them through their own VFDs. we can reduce idle horsepower requirements as well as add the ability to have a fully variable bow thruster instead of just on or off as it was originally (again through the MMI).

One of the major advantages to this approach is that instead of building a custom diesel power unit, we can use a common commercially available 60 hz. gen. Set.

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ESTIMATION AND COMPENSATION OF HYDROFOIL DEFORMATIONS DURING OPERATIONAL SEASON

By K.I. Matveev (California Institute of Technology, Pasadena, California, USA, IHS Member) and I.I. Matveev (Central Hydrofoil Design Bureau, Nizhniy Novgorod, Russia)

One of the restrictions on the use of commercial hydrofoil craft, which have advantages in comparison with common displacement ships, is the necessity for specialized maintenance of the foil systems. Such work usually requires complicated equipment and experienced specialists.

This paper offers a new method effectively restoring of a hydrofoil after foil damage. A simplified method for conservation of the lift coefficient, which greatly influences on ship's performance, is obtained from consideration of the factors defining the lift. The technology of the process is briefly described. This method enables operators to reduce repair expenses and time drastically, which is very important during a season of operation.

Peculiarities of the maintenance of hydrofoil craft are caused by their specific structural elements: light-weight alloy hulls, powerful engines, hydrofoils, complex geometry propellers, inclined shaft lines, etc. In operation, hydrofoil systems can be subjected to impacts with the sea bed and floating objects, to vibrations from shaft lines and propellers (when they are not in good working state), and to chemical and biological action of the water environment. Foil-strut and strut-hull connections also sustain sharp wave loads in rough seas. These factors come down to the formation of dents, bends, cracks, breakage, or changes in the geometry of hydrofoil systems. The phenomenon of hydrofoil singing caused by flow-induced oscillations of the foil trailing edge can also lead to the foil damage.

In this paper we consider only distortions of cross-section foil profiles and the installed incidence angles of hydrofoils. The precision of the hydrofoil system geometry is a very important issue because of the high sensitivity of the lifting force to the profile geometry and to the interaction between fore and aft foil system . These deformations can be treated by the original method given in this paper, which are based on the expression for the lift coefficient. The advantages of this method are simplicity and rapidity of the repair relative to the standard procedures requiring a change in the hydrofoil installation. The method has been successfully applied to hydrofoil craft, such as the Katran (Kolhida) shown in the Frontispiece, operating in the Mediterranean basin.

(Editor's Note: A complete version of this paper can be found on the IHS Home Page and on the author's site: http://www.cco.caltech.edu/~matveev/).

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.erols.com/foiler.

USA CATAMARANS COMPLETES FOIL-ASSISTED DESIGNS

(From Speed at Sea, April 2000)

Based in Fort Lauderdale, Florida, USA Catamarans Inc. is completing two fast tourist boats of unique design. Both are foil-assisted catamarans, but the hull forms are very different: one is based on what the company calls its Super Critical Dyna-Cat hull form and the other is a planing catamaran. Both designs have been developed by in-house naval architect Chuck Baum, and details will be featured in a future issue of Speed at Sea.

USA Catamarans' Super Critical Dyna-Cat Hull

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AIR RIDE FERRY ENTERS SERVICE ON LAKE ERIE

(Extracted from Fast Ferry International, December 1999)

The first Seacoaster catamaran ferry to feature Air Ride Craft's patented air assisted hull design entered service in the United States in August, 1999. The vessel, *Island Rocket II*, was introduced on a 10 nautical mile route on Lake Erie by Island Express Boat Lines, an operator based in Sandusky, Ohio.

Describing the concept in a paper presented at the Ferries 99 conference last month, Air Ride Craft president Don Burg said, "The Seacoaster has wave slicing fine entry sidehulls, however it differs in that there are recesses built into the underside of each hull. When pressurized air is supplied to the recesses, the air cushions formed support about 80% of displacement.

There results a decrease in draft and a substantial reduction in wetted area resistance. Propulsive power requirements are about half those of a conventional catamaran or monohull at cruise speeds. After adding blower power, Seacoaster still requires only about 60% of the power required by a catamaran or monohull."

The original programme had a variety of financial backers. As Don Burg explains, "Funding was received from a group of private investors and from a grant from the Department of Energy, as Seacoaster was selected as a favored energy saving invention by the DoE.

Air Ride Seacoaster 20m Island Rocket II entered service on Lake Erie in August, 1999

"Support was also received from Caterpillar and Pantropic Power in the form of a Cat 3116 blower engine and two Cat 3406E propulsor engines. Twin Disc supplied the gears and ASD 12 Arneson drives.

"Further assistance was received from HVIDE Marine, who desires to build larger Seacoasters for the offshore oil industry, and from the Office of Naval Research in the form of funding of a test and evaluation program.

"The demonstrator was launched in the spring of 1998. Several modifications were required to achieve predicted performance. The performance goals were met in late 1998, when 44 knots was achieved at 30,385 kg displacement with the main engines at 522 kW each. Total blower power was 89 kW.

"ONR tests in February 1999 were run with a hydrofoil that spanned the distance between the sidehulls slightly forward of midship. This was installed to add load carrying capability to handle the extra displacement of the boat when it was converted to a passenger ferry.

"The effect of the hydrofoil at the test displacement was to slow the boat down by about 5 knots. However, as shown later, it did improve load carrying capability by about 8,163 kg at 40 knots.

"On the ONR tests, the maximum g forces measured during operation at 32 knots, while running into 4-6 foot [1.2m to 1.8m] head seas, were only three-tenths of 1 g rms. The wake signature of the 19.8m Seacoaster has not been measured. However, the wake appears to be substantially less than that of a similar size catamaran or monohull operating at the same displacement and cruise speed."

[Editor's Note: The FFI article is rather lengthy. The reader is referred to it or Don Burg's paper from "Ferries 99" Conference for full details.]

SAILORS PAGE

DEVELOPMENT OF *BASILISCUS*

By Tom Speer (IHS Member)

This is a design case study for my sailboat, *Basiliscus* which is currently in preliminary design. As the design proceeds I will be publishing her development. The study will include methods and design tools as well as results for this design.

Basiliscus will be a cruising, hydrofoil trimaran, only the second of its type; none have been built since David Keiper's Williwaw proved out all of the essential elements of the cruising hydrofoil sailboat:

- Trimaran configuration, which allows the boat to heel, (a catamaran heels very little). A multihull configuration is essential for a hydrofoil, to avoid lifting the weight of ballast and to allow the boat to reach a takeoff speed which does not require excessively large hydrofoils to lift off. The trimaran configuration works in concert with the foil arrangement, which was a Keiper invention.

- "Diamond" foil arrangement consisting of a bow foil, stern foil, and two lateral foils, which lets the windward foil come completely out of the water. The bow and stern foils balance the boat in pitch, with the bow foil acting like a sensor to adjust the angle of attack of the lateral foil. The lateral foil carries most of the weight of the boat as it resists the side force and heeling moment of the rig. Since the lateral foil is near the center of gravity of the boat, its loading can change significantly without disturbing the pitch trim of the boat.

- Surface piercing ladder foils for simplicity, strength, and robustness in the demanding offshore environment. Other foil types may be feasible, and will be investigated during the design effort.

- Ability of the hydrofoils to improve seaworthiness of the boat in extreme conditions, even when hullborne.

Why has Williwaw remained unique for 30 years? Williwaw, a contemporary of the Brown Searunner series of designs, was built in 1969. It was destroyed at anchor in 1977, having cruised 20,000 miles in the Pacific, from San Francisco to New Zealand, in conditions from calms to storms. Keiper was not able to develop his design further; he was unable to sell Williwaw for money to build a second-generation boat, and it was not insured when destroyed. These were the pioneering days of multihulls - both Keiper and Brown were Piver devotees - and one can only wonder where the state of the art of sailing craft would be today had hydrofoils become popular. But at a time when the very idea of multihull sailboats was a radical concept, the idea of hydrofoils offshore was too great a leap for general acceptance. Hydrofoils also require careful engineering using aeronautical technology which was unfamiliar to most sailboat designers of the day. Had Keiper been able to afford to develop the concept through a series of boats, as Brown was able to do, we might have many more hydrofoils sailing today.

The advent of the personal computer has given the individual designer capabilities which in the days of Williwaw only existed in the biggest aerospace and naval architecture firms. The purpose of this project is to apply the principles of modern marine engineering and flight dynamics to the design of the sailing hydrofoil, to capitalize on the advances in materials and operational experience with multihulls gained over the last three decades, and build a boat that I can enjoy and take pride in having created. This case study is primarily for my own benefit in organizing the engineering of *Basiliscus*. I also hope that the documentation and the computer tools that result will be of value to other designers in the engineering of their craft.

MICROFOILER F3 - THE SAGA

By Doug Lord (lorsail@webtv.net)

We just test sailed our new radio controlled MicroFoiler F3 for the first time. This is the production version as we built no prototype. We learned a whole lot from the modifications Dr. Sam Bradfield and Tom Haman made to a 68" radio controlled trifoiler of our design last year.

Micro Foiler F3 Underway

The Micro Foiler F3 , including the foils rig etc, was designed by me, but I can assure you, inspired by Dr. Bradfield's work. The idea was to come up with a radio controlled foiler that could be sailed by anybody and that would fly in a FIVE MPH wind. That was important because so many RC sites are on ponds and protected small lakes all across the country.

The foils we came up with are 13" in span with a flap having a 4" span using a sealed Mylar hinge that is molded integral with the foil. The nominal thickness-to-chord ratio over the foil area including the flap is 11% the nominal chord here is 2.08 inches. Viewed from above the foil, the flap is centered and sticks out behind the trailing edge of the rest of the foil 3/8ths of an inch and is 3/4" in chord making up 37.5% of the chord of the center part of the foil. The outside of the foil is 15% thickness/chord ratio. We believe we can build these foils thinner and will be experimenting with it.

Altitude sensing is basically the same system pioneered by Dr. Bradfield using a "wand" to sense the water's surface.

The production model has servos that allow the skipper to vary spring tension on the wand, and it is advantageous when racing to slack off tension on the lee side allowing the boat to sail more level and slightly reducing wetted surface.

Close up of MicroFoiler F3

The rear foil has a servo mounted to it allowing the skipper to adjust the down force of the rear foil; it is not normally adjusted during sailing. It is primarily there so that I, the designer can take the boat out on a windy day and see if a non catastrophic technique can be found to "jump" the foiler right out of the water and then back in for a safe landing in one piece. I should point out that my mentor and friend Dr. Bradfield thinks I'm nuts for this particular fantasy; we'll see!

Foil Detail of MicroFoiler F3

The boat has a single torsionally reinforced carbon cross arm that seems to be stiff enough, though as of this writing we have only sailed in 5 mph wind (at least twice the wind speed ,by the way). The rig is a Wing Tip Rig designed by me with a swept back upper tip which is nothing more than a modern version of a gaff rig with one exception: the camber can be adjusted at the top of the sail as well as with the outhaul along the foot. This rig gives a powerful planform and yet does not require full battens which helps in an RC model(and should reduce weight aloft on a full-size rig).

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CALL FOR PAPERS

Fast Ferry International has issued a call for papers for presentation at the 17th International Fast Ferry Conference, in New Orleans, USA to be held on the 13th - 15th March 2001. Synopses of no more than 300 words should arrive no later than 30th September 2000. Acceptance notices will be sent out by 31st October 2000. Completed papers should be in the Fast Ferry Conference office no later than; 15th January 2001. Postal Address: Windmill Oast, Benenden Road, Rolvenden, Cranbrook, Kent TN17 4PF, UK; or email to: info@fastferry.co.uk.

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UPDATE ON WHITE HAWK HISTORY

Jean Buhler (IHS Member) recently sent IHS a page from an old magazine (unidentified) showing several pictures of White Hawk. Two of them are reproduced here:

Leslie Field (Hydroplane History http://www.lesliefield.com, Vancouver, BC CANADA) recently wrote:

I have received an enquiry from Simon Lewis in the UK who is preparing an article for the Speed Record Club magazine. We have subsequently located the sons of the Hanning-Lees. Simon will be talking with Vaughan in the UK and soon I'll speak with Mark who lives in California. I'm anxious to find out what happened to both the boat and the Hanning-Lees. We'll then pool our information. I'll pass on anything I learn to the IHS website. For a two page article photo and text on the Hanning-Lees, see Popular Mechanics Magazine of August 1953, pp 70 and 71.

KOCK AWARD
(Continued From Page 5)

of the documents, which I got only a few days ago at my return from Chile. Sorry that I left for Chile only two days after I received your kind telephone call in which you told me about the Award nomination and mailing of the papers.

Sincerely,
Helmut Kock

FRESH-1
(Continued From Page 6)

than the high speed supercavitating foils, and thus was never tested. The FRESH-1 was subsequently surplused.

By the way, if I remember correctly, FRESH is an acronym for "Futuristic Research Experimental Super-cavitating Hydrofoil."

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NEW BENEFIT

IHS provides a free link from the IHS website to members' personal and/or corporate site. To request your link, contact Barney C. Black, IHS Home Page Editor at foiler@erols.com.

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LETTERS TO THE EDITOR

Hydrofoil Service From Miami...

[22 Jul 00] I'm working on a feasibility study for hydrofoil/ fast ferry passenger transport between Miami FL USA and Bimini Bahamas route length is approx. 50 miles. I'm looking for information on broker or shipyard that can provide new or used 50-80 passenger vessel. — Alessandro Di Bari (aledibba@aethrausa.com)

Foil Adjusters For Human Powered Hydrofoil...

[7 Jul 00] I am a mechanical engineer and big hydrofoil enthusiast. My partner and I are currently building a prototype for a human powered hydrofoil for recreational purposes. I need some information on self-trimming foils. I have ridden a Trampofoil and do not want to use their canard configuration. I have seen photos of a hydrofoil trimaran that has some kind of rod dragging in the water which looks like it trims the angle of attack of the outrigger foils. — Ben Lochner (benl@kingsley.co.za)

Responses... [11 Jul 00] Self trimming is most easily achieved by using a canard (single small foil forward, main lift aft with dual foils) all surface piercing, configuration. A better design, though, is a single V in the rear with a fully submerged section between the V sections. — Nat Kobitz (KobitzN@ctc.com) [11 Jul 00] In response to your message, I think the hydrofoil trimaran you are referring to may be the 'Rave' which is a relatively small recreational sailing boat (www.ravepage.com). If you are able to get hold of the Nov / Dec 1999 issue of Multihulls magazine, it features an article on a race meeting of a number of these sailing hydrofoils. There are also a number of posted messages or items on the 'Rave' in the IHS website as far as I recall. The rod dragging though the water either side of the boat does indeed serve as the means of adjustment for the angle of the foils (or perhaps it has flaps) mounted on the outriggers of the 'Rave'. I say this as the linkages at the top of the rod are quite clearly shown on one photo in the issue of Multihull I mentioned. In that design, it seems that as the rod becomes submerged it is pulled back by the drag of the water and this in turn increases the foil angle and hence lift on the foil such that the craft rises again. The more common alternative is to have a surface sensor or feeler arm which projects forward of the foil unit and has a relatively small planing surface mounted on its tip. The planing surface then skims above the water surface such that when it encounters a wave, or the craft settles, the feeler arm is pushed upwards and the foil or flap angle is again increased proportionally via a pushrod which goes down the inside of the foil support strut. The solar boat of Marquette University is an example of a design that uses this approach. I recall they have a web site about their design but I don't have the details. There are also a number of human powered hydrofoils which operate on the same principle such as the Flying Fish and Decavitator, for which I think there are some web sites as well. I don't think it is an easy task to determine the size of the surface sensor arm, the planing surface, the linkage arrangements or the pivot point of the foil unit such that a stabilization system that works well is obtained. I certainly don't have any experience in doing this so perhaps others could help. The book by Christopher Hook and A.C. Kermode 'Hydrofoils Without Formulae Series' published by Pitman Paperbacks in 1967, gives a good description of the use of mechanical surface sensor systems for foil control. This book is likely to be on your local library bookshelf if any hydrofoil book is. Christopher Hook was one of the early (if not the first) developers of fully submerged hydrofoil designs. In the late 40's, electronic autopilot systems for controlling the attitude of hydrofoils were not really available so Mr. Hook developed his designs using mechanical sensors. The use of a mechanical surface sensors on each of the two bow foils helps to control heave (height above water), pitch and roll. It is usually not necessary to have a surface sensor for the rear foil(s) as they tend to be controlled by the change in attitude of the boat as a whole. The angle of incidence of the rear foil(s) then just need to be adjusted once on shore so that they are carrying the desired percentage of the craft weight when sailing in calm water. — Martin Grimm (contact M. Grimm c/o IHS).

[22 Jul 00] Fully submerged foil hydrofoils are unstable, so some type of angle control is needed. For height control, the front foil has to have angle control, so it is much easier if the front foil is small. (I think that rear foil angle control is possible, but the control algorithms would be very complicated. It's like reversing a trailer) When DECAVITATOR was made, there was a lot of trouble with V-foils with ventilation. On the other hand, I saw on "Tomorrow's World" on the BBC, about 10 years ago, a human powered hydrofoil with a V-foil at the front. I think that it was a canard configuration. As with a fully submerged foil, making the front foil small reduces magnitudes of the problems of the ride height control. Anyhow, for a foil angle control, the immersion depth must be measured and from that the foil angle must be set. The simplest method is a surface skate, like on the Trampofoil, but it doesn't have to be in front of the foil, and it can be arranged to alter the angle of a foil that is separately pivoted. If you look at the drawings of TALARIA III, you can see one such arrangement. If you want to have automatic roll control, it can be done by having two separate ride height control systems either side of the center of the boat. However they have to have enough roll authority, so they have to be large and widely spaced if the center of gravity is high. Trimarans are quite low and have a broad beam so they are easier to give roll control like this, although the sail force has to be considered. Two early hydrofoils, ICARUS and

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LETTERS TO THE EDITOR
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HALOBATES, had very large surface skates to give roll authority because the craft were high and not very wide. (There are photos and info elsewhere on the IHS site about all the hydrofoil craft I have mentioned above). — Malin Dixon (malin@onspec.co.uk)

[22 Jul 00] You would do well to visit Jake Free's web site and note the already made self trimming foils which he has for sale in his product section. Go a bit down the page to: INTERNAL PUSH/PULL/FLAP ATTITUDE CONTROL STRUT. all carbon fiber (above, and right) has hinge and flap foil, internal push/pull rod to control attitude. — Warren Lemoi (savitar@earthlink.net)

[22 Jul 00] What you describe may have been a "drag link", which was a concept first explored about 1960 to self position trailing edge flaps on fully submerged foils to control height or submergence. It was basically an attempt at a mechanical autopilot. The drag link was a vertical vane or rod pivoting at the top, where it was connected to the trailing edge of the foil strut. As the foil and strut lowered into the water the drag link would pick up drag, pivot and through mechanical linkage within the strut transmit the turning moment to the foil flap, thereby increasing lift. As the lift increased the foil (and strut) would lift, reducing drag on the drag link. The drag link would return to its neutral position (sometimes augmented by a return spring), and through the linkage return the foil flap to neutral. That was the theory. In practice it was a mechanical nightmare. It had no way to anticipate height needs, which later electronic autopilots solved with forward/downward looking (radar) height sensors. Even with dampers the drag link concept tended to oscillate. — Charlie Pieroth (SoundTM@ix.netcom.com)

PHM Ships Service Power Units (SSPUs)...

[28 Jun 00] I am presently working on the conceptual design of an integrated electrical power plant for a naval warship. While researching options for producing emergency power, I was interested to learn of the SSPUs used aboard the PHM class ships. I am attempting to learn more, so that I don't champion the "reinvention of the wheel". Could you tell me who I could contact that would have detailed technical insight into the design of the SSPU's, the systems that they were used in, and the integration into the PHM class ships? Any contact information or insight may be very helpful. —Wayland Comer (wscomer@visto.com) Office: (408) 735-2644

Response... [28 Jun 00] Most of the personnel that worked on the PHMs have retired from Boeing. The SSPU for PHMs were manufactured by Garrett Airesearch, in Phoenix, AZ. They might have someone that can spell out the particulars. The PHM SSPU powered a 400 hz "Y" connected generator, an air start compressor, and hydraulic pump. I am not aware of any other use than the PHMs, but contacting the manufacturer would be your best bet. My only contact was a one-day visit to witness the ongoing qualification tests for the Navy. — Sumi Arima (arimas1@juno.com)

Automated Lift Formula in MS Excel...

[28 Jun 00] I have placed an Excel implementation of Konstantin Matveev's lift formula on my webpage. — Harry Larsen (hlarsen0@gte.net)

Encyclopedia Publisher Needs Early Photos...

[27 Jun 00] I am collecting illustrations for the Marshall Editions - C20 Science & Technology Encyclopaedia which is to be published early in 2001, and I would be most grateful for your help. We would particularly like to include photographs of Enrico Forlanini's 1909 first catamaran and his hydrofoil ship and also Alexander Bell's 1918 hydrofoil boat that created a new water-speed record. Please could you advise me how to obtain the material. I'm afraid I'm not very Internet proficient and ideally I would like to receive the material by post. If that is possible please could you send the photographs to my colleague, Jane Moore at 188 Tufnell Park Road London N7 0EE and advise me by return e-mail? The material will be returned promptly after publication and credited in the book. — Dee Robinson (deerobpicresearch@cwcom.net)

Response... [27 Jun 00] 1. As to Enrico Forlanini, photos of his craft have appeared in books and magazine articles, so I know that they exist. I will ask around within the society and will post your request on our website to see if I can find a good hard copy somewhere. Hopefully visitors to this site will suggest sources of the photos you require. 2. As for Bells HD-4 hydrofoil, there is an immense quantity of historical photos posted on the Internet by the Alexander Graham Bell Institute. The postal mailing address is c/o University College of Cape Breton; PO Box 5300, Sydney, NS, B1P-6L2; Phone: 902-563-1378 — FAX: 902-562-0119. They sell a CD-ROM containing the entire collection. Note that your printer may very likely be able to download the images you select from; however, you should certainly contact the museum for permission to use the photos. Quoting from their website, "The Alexander Graham Bell Institute (The Bell Institute) of the University College of Cape Breton was incorporated on September 13, 1977. It is directed by a Board of Trustees representing the Bell family, University College of Cape Breton and members of the community. Over the years, the Bell institute has achieved several notable milestones including consolidating photographs, personal notes, and technical work of Alexander Graham Bell, completing a comprehensive index of these holdings, and conducting scholarly study of these materials. The Bell Institute is dedicated to the memory of Dr. Alexander Graham Bell and his work. Continued study of Dr. Bell's work ("Mining for nuggets") and development of new applied research projects are motivated by a desire to continue his high standard of

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LETTERS TO THE EDITOR
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principle, his practical spirit and his social conscience. The Alexander Graham Bell family collection brings together a wide range of documents accumulated by Dr. Bell and his family during their time in Baddeck, Nova Scotia. The Alexander Graham Bell institute has developed a comprehensive index of these materials. This index, with on-line access to several components of the Bell collection, can be accessed using the World Wide Web." 3. There is a virtual reality movie on the Internet. This is like standing in front of the restored HD-4 hydrofoil, and you are able to turn around to look behind you, up, down, left, right, etc. — Barney C. Black (foiler@erols.com)

Another PHM Veteran Checks In...

[27 Jun 00] I served onboard GEMINI 1989-91 as one of the Radiomen. I found it a very rewarding tour of duty. We had a very tight knit community down there in Key West. I wish those ships were still around as I would gladly go back there for more 20-hour work days. Good site...keep it up. Let's not forget these hard working ships. ITC(SW) Rich Powell (rpowell@salts.navy.mil)

Fluid Dynamic Drag and Fluid Dynamic Lift...

[6 Jun 00] I notice that copies of these two out-of-print, self published books, Fluid Dynamic Drag by Sighard F. Hoerner (1965) and Fluid Dynamic Lift (1975) by Hoerner and editor Henry V. Borst (published posthumously) have gone up for auction on www.ebay.com. These remarkable technical sources cover their respective subjects pretty close to 100%. — Barney C. Black (foiler@erols.com)

Responses... [6 Jun 00] I have 1 or 2 copies of the 2nd edition, which I believe this is. I also have a copy of the 1st edition, which I contributed to, when I was at Cornell Lab. — Nat Kobitz, (KobitzN@ctc.com)

[6 Jun 00] These excellent reference books were frequently used back in the days when we were designing hydrofoil boats. A must for designers. — Neil Lien (nlien@inwave.com)

Rodriquez USA Office...

[3 Jun 00] As you are well aware Rodriquez has a long history of hydrofoil building and operation. Given the shallow water wake wash problem that even so called "low wake" fast ferry designs can't get around, we feel that there is an increasing US market for passenger only hydrofoils. Fuel efficiency and building cost are also strong points for hydrofoils. We would be very interested in your opinion on how to best market our designs and hear about any leads you may have. — Mats Feldtmann, Vice President, Engineering, Rodriquez Marine Systems USA, Inc.; 16 Center Street, Concord, NH 03301; phone (603) 228-9797, fax (603) 228-9898; website: http://www.rodriquez-ms.com

New Website Dedicated to Bernard Smith...

[1 Jun 00] I have a website you may be interested in viewing, Mr. Smith's Amazing Sailboats. It concerns the hydrofoil sailboat designs of the American scientist Bernard Smith who wrote the book "The 40-knot Sailboat" in the early 1960s detailing his ideas. Bernard Smith developed several different hydrofoil sailboat concepts over 40-plus years of experimenting. He worked with small unmanned designs as well as full-sized machines. Part of my site also features a variety of sailing hydrofoil designs made by various inventors around the world. — Paul Dunlop (dunlopp@admin.chchpoly.ac.nz)

Response... [1 Jun 00] This is a great site, and a great honor to Barney Smith. I knew Barney when he started this work, and observed his first foil/hull model test in the Free Surface Water Tunnel at Caltech. — Tom Lang (tglang@earthlink.net)

[2 Jun 00] You know, Bernard Smith is responsible for getting me started in this sailing hydrofoil activity with his book The 40 Knot Sailboat. Some of my students and I working in the AYRS context took off from there in the early 1970s and haven't stopped yet. We're still trying to develop a practical ocean-roving sail-powered hydrofoil. We won't stop until/unless somebody else beats us to it. Could happen! — Sam Bradfield, Hydrosail, Inc. (HYDROSAIL@aol.com)

Vintage TUCUMCARI Models...

[5 May 00] My number four son has located 2 Monarch USS TUCUMCARI (PGH-2) models in Virginia They sell for $125 and $160. If anyone is interested give me an e-mail and I will get ordering info. They are not too bad. I had two of them when I was still with Boeing. Several years ago now. They cost at that time $5. — John Monk (JMonkx@aol.com)

Response...[5 May 00] These model kits go up for auction on www.ebay.com from time to time...most that I have seen have sold for well under $100. Ebay has an automatic shopper feature that you can turn on... it looks for key words that you specify, then emails you if it finds anything. This is a frequently asked question on the website posted messages page (http://www.erols.com/foiler/models.htm) and also there are photos in the photo gallery... an entire page is devoted to models.

Letters To the Editor allows hydrofoilers to ask for or provide information, to exchange ideas, and to inform the readership of interesting developments. **More correspondence is published in the Posted Messages and Frequently Asked Questions (FAQ) section of the IHS Internet web site at http://www.erols.com/foiler.** All are invited to participate. Opinions expressed are those of the authors, not of IHS.

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LETTERS TO THE EDITOR
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Partner Wanted For Caribbean Joint Venture...

[30 Apr 00] I am looking for a partner with a hydrofoil or access to a hydrofoil for business in a very lucrative tourist market in the Northern Caribbean. Discussions and information will be confidential, details can be obtained via my email address. — Keven O'Kelly (pier77@yahoo.com).

Which Foils Are Best to Use?

[29 Mar 00] I'd like to design a hydrofoil sailboat, and I need data about the foil profiles to use. This boat is not for business. I just want to build my own race boat with a friend and sail it as fast as possible. I'd like to know whose profiles are frequently used for 5 to 20 knots speed (length ratio /thickness / profile name / symmetric or not) and at which angle to use them. The goal is not to lift the entire boat (surfing shaped hull) but to help it. — (Francois.Rougier@matranortel.com)

Structural Impact of Adding Foils to a Motor Yacht ...

[29 Mar 00] If you were to somehow succeed against all odds, hydrodynamic and otherwise, in converting the typical aluminum motor yacht in the 50' to 90' range from a 10 to 15 knot vessel to a35 to 50 knot vessel by re-powering and adding foils, would it be likely that the hull could withstand the impact from the occasional large wave? Stated another way, is it correct to presume that faster speeds demand stronger hulls, and that it is unlikely that an aluminum hull designed for lower speeds could withstand the stress at higher speeds? — David (ny@mindspring.com)

Responses...

[29 Mar 00] Both displacement (10-15 knots) and planing (35-50 knots) craft are designed for hydrodynamic and wave bending loads. Planing craft must additionally be designed for bottom slamming loads (and bending stresses resulting from the slams). As you note, a hydrofoil craft will experience "occasional" slams. The structure of the 10-15 knot craft would have to be analyzed for these added loads probably resulting in a requirement for strengthening - both for local slamming loads and the associated longitudinal bending. — Ken Spaulding (Ken@LYPC.com)

[29 Mar 00] According to classification society structural design rules (such as ABS, Lloyd's), the slamming pressure of a fast craft is proportional to V^2. It will be subject to damage for a hull designed for 10-15 knots when it is re-powered to 35-50 knots. —Weimin Hu (whu@mapcorp.com)

[29 Mar 00] The answer to your question is: not likely because the local wave impact pressures would tend to increase with the square of the vessel speed, i.e. (50\15)2 = 11.1. This problem is bad enough, but the hull would have to be extensively reinforced at the foil attachment points and a more powerful engine(s) might have to be added to go foilborne. In any case the propeller shaft(s) would have to be lengthened for the propellers to remain submerged while foilborne. On a more positive note, in 1954 a Chris Craft cabin cruiser L= 28.5 ft., B= 9 ft., displ. = about 5 tons and equipped with 235 hp. marine engine was modified to add foils. This craft, named SEA LEGS, flew successfully with a vacuum tube autopilot and sonic height sensor. — Bill Buckley (wbuckley@erols.com)

[29 Mar 00] I'm not a structures expert, but I think the answer is no. The loads will go up as the square of the speed, and if this is an aluminum hull with lower structural modulus than steel, deformation and hull failure would be expected by speed increases that are 3 to 4 times the design speed. I doubt that the hull could be modified sufficiently with additional intermediate stiffeners, since there would be potential mis-match between skin thicknesses and stresses at the stiffener/shell weldments. — Mark Bebar (bebarmr@navsea.navy.mil)

[29 Mar 00] This would be a very difficult generalization to make since there are widely varying design approaches for a 15 knot 50-foot motor yacht. In general, we would expect to use design pressures of about 40 psi on the forward hull of a hydrofoil where wave slamming could occur. This is higher than the normal design pressures for a traditional displacement vessel. — Mark Rice (mrice@mapcorp.com)

[11 Jun 00] The premise of the question is wrong. Yachts are built of aluminum to be light so that they, with sufficient power, will go fast. If the premise is changed to a yacht with a planing speed, 20 + knots, and if the conversion maintains the same power, then a conversion to a hydrofoil is more feasible. The hull form will be about right, usually deep V. By maintaining the same power the hydrofoil speed will not be dramatically faster and the slamming load increase a small rather than large factor. Further, the slamming, with the proper ride pitch, will impact the finer bow section rather than at a mid section. In the case of SEA LEGS and TALARIA III perhaps the most significant (only) modification beyond the hydrofoils was in their propulsion systems. SEA LEGS utilized a very long V drive. Talaria extended a Volvo outdrive. Although I have not personally inspected SEA LEGS, from the drawings I have seen, I am not aware of any significant hull modifications other than at the strut attachment points. TALARIA has no hull modifications other than at attachment points, For both of these boats and perhaps for larger planing craft the structural requirements of a planing design dominated the loads that would be experienced by a hydrofoil modification. By changing the craft to be converted from a slow aluminum craft, (that largely do not exist), to a fast aluminum craft (that do exist), a hydrofoil conversion, although still not easy, is at least possible. In some cases, historically, even successful. — Harry Larsen (hlarsen0@gte.net)

The NEWSLETTER

International Hydrofoil Society

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

Editor: John R. Meyer | Summer 2000 Extra | Co-Editor: Barney C. Black

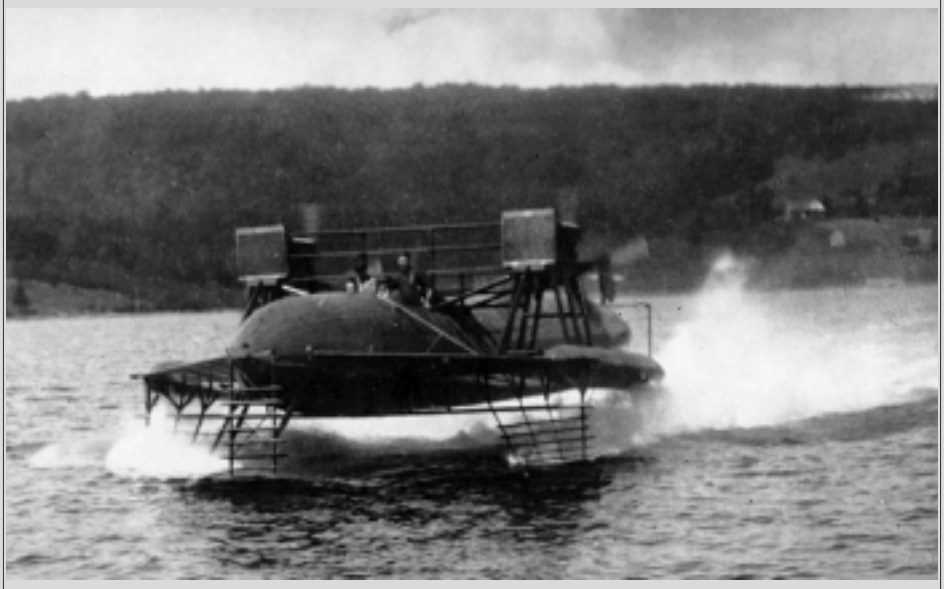
Craftsmanship and History in Miniature...

Modelling The Bell - Baldwin Hydrofoil HD-4

By Dave Acker

From *Model Shipbuilder* No. 118, March/April 1999

September 9, 1919. Cattle milled nervously in distant pastures as the two Liberty engines began blowing through twenty-four short exhaust stacks. The heart-stopping blast of noise and spray amplified as the craft moved awkwardly away from the dock, and forward speed increased so slowly as to put the issue in doubt. Finally the vessel began its painful rise from the surface. At some distance out, the HD-4 became fully extended on its main foils and, at about 50 mph, turned and began its clocked run on tip toe down the Bras D'Or at 70.86 miles per hour! I wish I had been there that day.



See Bell HD-4, Page 2

NEWSLETTER NEWS

The electronic edition of the IHS newsletter now has *bookmarks* and *hot links*. Bookmarks are like a detailed table of contents on the left side of your computer screen. By a click of the mouse you can jump directly to the article or section that interests you. Hot links are hidden HTML commands. To use these, move your cursor over the URL address of a website or an email address cited in the newsletter text, then click... you will jump directly to the website, or a window will open to compose an email. Go ahead and try the IHS hot links below:

http://www.foils.org
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When the electronic edition opens, it is optimized for a 21 inch monitor screen. If your screen is smaller, use the "Zoom" feature in Acrobat Reader to adjust the size of the page so you can read it. You can also close the bookmark window to gain more screen width for viewing.

INSIDE THIS SPECIAL ISSUE

Bell HD-4

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The HD-4 was an outgrowth of Alexander Graham Bell's early flight experiments with man-lifting tetrahedral kites. The kites had become large and heavy enough to require towed water launches. Hydrofoils attached to the catamaran launching hulls provided about the only real successes in this dead-end search for heavier-than-air flight. Subsequently, hydrofoil development became a separate area of inquiry, catalyzed in 1911 when Bell met Enrico Forlanini, the hydrofoil pioneer, in Italy and rode in his ladder foil boat.

Bell and Frederick W. "Casey" Baldwin's first "Hydrodromes" (HD-1, -2, -3) were basically penguin (non-flying) biplanes whose major lift was stubby air foil wings. These proved unrewarding because of persistent structural weaknesses, and the aircraft-oriented approach was all but terminated with the outbreak of the Great War in Europe in 1914.

Bell's laboratories and home at Beinn Breagh, near Baddeck, Nova Scotia, placed him in a delicate political situation. As an American citizen in Canada, a combatant nation, he was reluctant to violate the spirit of neutrality that was the official U.S. position at that time by developing a potential instrument of war. The picture changed, however, when the US entered the war in 1917, and the Allied admiralties sought proposals for submarine chasers.

Bell and Baldwin tendered two designs for hydrofoil craft stressing the high speed potential and slight immersion which would immunize them from torpedo hazard and give the ability to operate over the top of anti-submarine nets. The capacity and lift of these boats was adequate for the carrying of torpedoes and depth charges. The first wartime proposal, the HD-4, designed by Baldwin, was pretty much what you will see in this article. The vessel was a creature of the air as much as the water.

Enrico Forlanini's hydrofoil on Lake Maggiore in 1906

Vessel Description

As prelude it should be known that the hull/fuselage of the HD-4 was very lightly built... much like an old-fashioned canoe, which is to say it was made of formers or bulkheads connected by longitudinal stringers. This assembly was covered spirally with scarphed veneer stock and finally topped by a layer of ½ inch strip laid fore and aft. Embedded in the outer shell were steel wires for stiffness in the long axis, and spirally wound about the hull were eight pairs of cables for resistance in torsion. Final covering was marine glue, canvas and dark gray paint.

The hull was a 60-foot cigar-shaped cylinder with a maximum diameter of about 5.75 feet. This hull was the main structural member providing flotation at rest, crew accommodation, fuel, and proposed military load. The forward wing-like sponsons supported the power plants and their mountings and carried "Balancing Hulls" or pontoons of about 20 feet in length at their extremities.

There were four sets of multiple-blade hydrofoils. Each blade had an air foil cross-section:

1. The ladder-like bow "preventer" was essentially an anti-pitch device helping in initial rising and was clear of the water when the craft was fully extended.

2. The main foil sets, one on each sponson, were mounted on four braced struts and were adjustable for angle of attack as well as being set at a fixed dihedral.

3. The stern set pivoted on a braced post. The vertical members of this set acted as rudders, supplemented by a small conventional water rudder and an air rudder fixed atop an extension of the post. Control was by a steering wheel in the cockpit via a conventional cable and drum arrangement.

4. Large triangular spray shields were fitted from the bow to the leading edges of the sponsons. Later, another shield encircling the bow augmented these. These combined surfaces provided some

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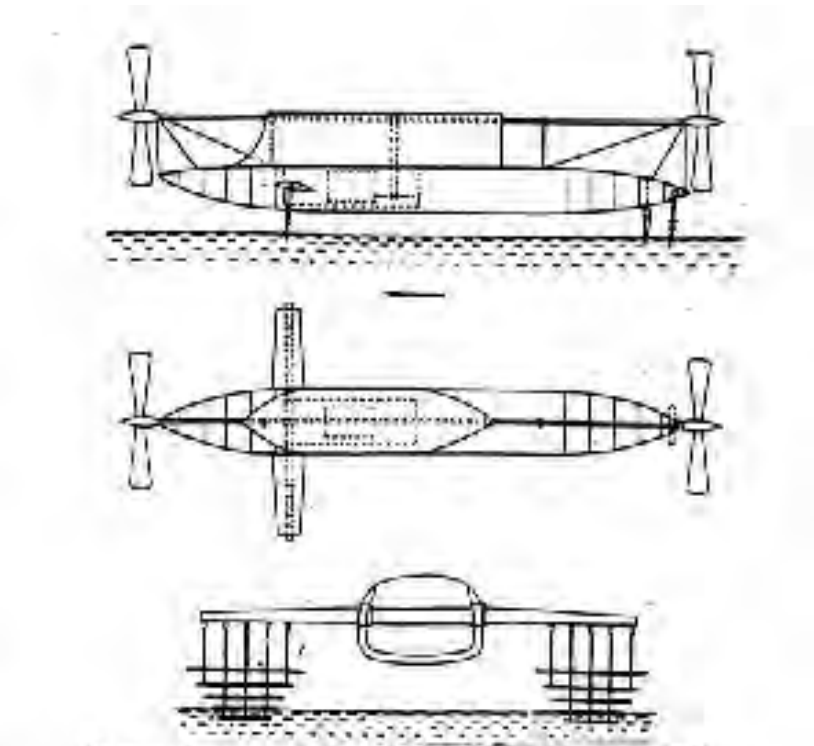

Drawing of Forlanini's Hydrofoil

Enrico Forlanini

By John Meyer, Jr.
Excerpt From *Ships That Fly*

Forlanini was an Italian engineer whose interests included airships, aircraft, and helicopters. His hydrofoil developments started in 1898 with a series of model tests from which he arrived at several simple mathematical relationships. These allowed him to proceed with designing and building a full scale craft.

Forlanini's designs were characterized by a "ladder" foil system. You can see from a drawing of his concept and a copy of an old photograph what is meant by this apt name. Forlanini's model experiments had shown him that lift was proportional to the square of speed; therefore, less foil area was required to hold the vessel out of the water as speed increased. He obtained this decrease in foil area with the ladder scheme. Forlanini's craft weighed about 2,650 pounds and had a 60 hp engine driving contrarotating coaxial air screws.

Although designed to fly at a speed of 56 mph, records show that during tests on Lake Maggiore, Italy in 1906, a speed of 42.5 mph was attained.

The ladder foil system was a rather complicated structure, but the craft operated well and represented an advancement in the state of the art. Forlanini obtained a number of British and American patents on his designs, most aimed at seaplane applications.

According to Leslie Hayward, who wrote a comprehensive history of hydrofoils in a 14-part series in Hovering Craft and Hydrofoils, the first evidence of the use of hydrofoils on a boat or ship was in a British patent of 1869 granted to Emmanuel Denis Farcot, a Parisian. There were numerous patents during the immediately ensuing years, all claiming, by a variety of means to life the vessel either partially or fully out of the water. Such patents were exemplified by inventors and experimenters like Horatio Phillips, G. W. Napier, Count de Lambert, and the Meacham brothers.

FRONT COVER

The front page photo is from the *Beinn Breagh Recorder* Nov 20, 1919 XXIV. This and many other contemporary photos of HD-4 and other prototypes are on the web at http://bell.uccb.ns.ca/images/hd4.html. This site is maintained by the Alexander Graham Bell Institute.

"The Alexander Graham Bell Institute (The Bell Institute) of the University College of Cape Breton was incorporated on September 13, 1977. It is directed by a Board of Trustees representing the Bell family, University College of Cape Breton and members of the community. Over the years, the Bell institute has achieved several notable milestones including consolidating photographs, personal notes, and technical work of Alexander Graham Bell, completing an index of these holdings, and conducting scholarly study of these materials.

"The Bell Institute is dedicated to the memory of Dr. Alexander Graham Bell and his work. Continued study of Dr. Bell's work ("Mining for nuggets") and development of new applied research projects are motivated by a desire to continue his high standard of principle, his practical spirit and his social conscience."

The AGB family collection brings together a wide range of documents accumulated by Dr. Bell and his family in Baddeck, Nova Scotia. The AGB Institute has developed a comprehensive index of these materials. This index, with online access to several components of the Bell collection, is at http://bell.uccb.ns.ca/. AGB Institute is located at University College of Cape Breton, PO Box 5300, Sydney, NS, B1P-6L2, Canada

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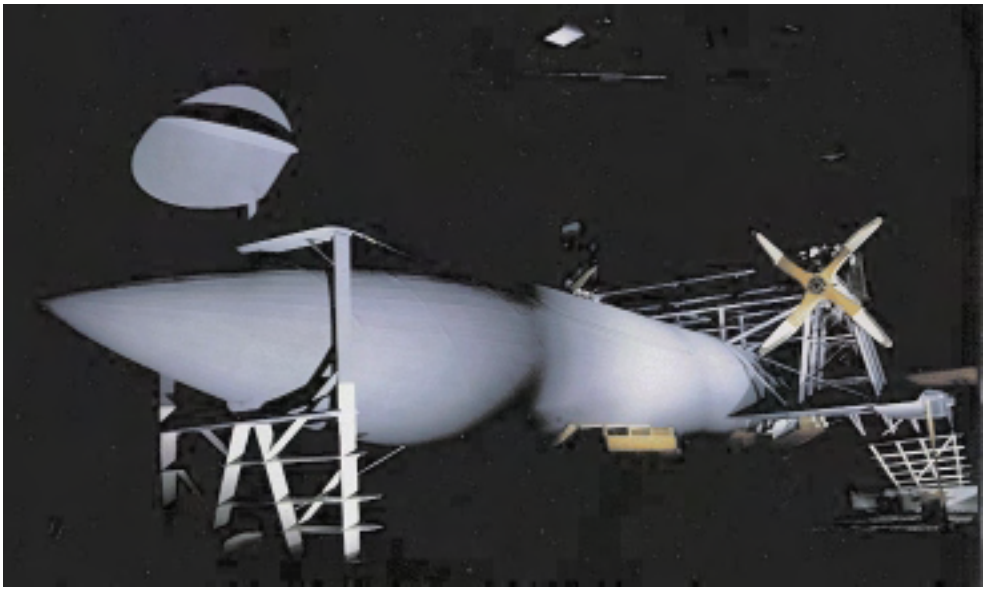
paltry and inefficient lift, but did fulfill their function of protecting the propellers from spray.

The HD-4 was, from the outset, a test bed whose specifications changed frequently if not constantly. In fact, no two pictures seem to be the same in detail. The full-size replica at Baddeck captures its aspect on a given day and cannot show it as it was earlier or later. In fact, the drawing from which I worked did not match in every respect the replica which I viewed. This is not meant as criticism, but only as an observation of the ever-changing look of it. A few of several changes that occurred over a short time were:

- Tendered drawings and patent applications show no air rudder.
- The pontoons began as hull-shaped cylinders and were soon changed to shorter, flatter, rectangular cross-sections.
- Early trials were with Renault V-12 engines of nominal 250 HP each.
- Two-blade propellers were replaced by 4-blade types.
- De-tuned Liberty V-12 engines of 350 HP each replaced the Renaults.
- Motor supports were shortened.
- The airfoil "nest" above the cockpit was lowered.
- Spray shield applications and conformation varied.
- A rectangular camera port was cut into the port side spray shield which may have required an additional strut on that side. The replica exhibits this asymmetry; the drawing does not.
- The hydrofoils themselves underwent constant re-design and refinement in addition to adjustments of the angle of attack (the angle between the mean chord line of the foil set and the flow).
- Chronic underestimation of the needed material strength for struts and foils resulted in a harried search for ways to avoid the plague of parts failures in these components. Finally, the smallest foils — those at the very bottom of the sets — were fabricated of saw blade steel and took nearly the full five tons of the craft's weight on their 6.37 square feet spared only the 500 or so pounds carried by the "dirty" lift of the spray shields and sponsons.
- A large foil spanning the two main foil sets was swept away by misadventure on the day of the performance trial and was not replaced at the time or thereafter.



HD-4 Full-Size Replica at AGB National Historic Site, "a unique exhibit complex -- situated on 10 hectares of landscaped grounds overlooking scenic Bras d'Or Lake and Baddeck Bay — where models, replicas, photo displays, artifacts, and films describe the fascinating life and work of Alexander Graham Bell." -- AGB Institute Photo

Construction of the Model

The project began in earnest when I saw a kit for a model of this vessel offered by a Canadian model airplane manufacturer, Easy Built Models. Typically, their offerings are of the traditional rubber band powered balsa wood and tissue paper type. Conceive of my astonishment at the prospect of a stick and tissue hydrofoil! I bought the kit at once in order to get the drawings, for I had never seen such a thing. If the original vessel was lightly built, then this kit was surely more fragile than a butterfly as it ironically duplicated the construction of the original more accurately than I subsequently did in the project at hand.

After examining the contents of the kit: good quality balsa sheet, print wood, sticks and silk span covering material, I felt that undertaking construction would surely tax even a master builder and result in a heart-breakingly fragile object.

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The working drawing was printed in parts on several sheets of small paper which I finally organized, glued-up into a 2 x 3 foot sheet, and began to study carefully. My first act was to consign all of the balsa material and silk span to my stockpile of surplus and consider for some months just what it was I was going to do about it. *Not* building it was never a consideration.

The Hull — One day, serendipitously, the UPS man delivered a stout mailing tube of three feet in length, three and a quarter inches in outside diameter, and having a wall thickness of 1/8 inch. Here it was—strength, size and shape: a perfect main structural member. The plan, however, called for a hull of three inches in diameter. A quick calculation told me that 3 1/4 inches was 1/l2th larger than 3 inches and if I was going to proceed, I had better break out my long unused calculator and install fresh batteries.

The plan also called for a total overall length of thirty inches. Well, if the diameter is increased by 1/l2th to 3 1/4 inches, then the length must be increased by 1/l2th to 32.5 inches. Suddenly I was leaving the realm of 1/24th size an entering 1/22.5 territory. My resolve was firm. I got a table of decimal-to-fraction equivalents and for the next three months, off and on, every dimension was increased by .083, or 8.3%, or 1/l2th, or what have you. There was much rounding-off up and down, but things rarely got more than .030 - .060 (1/32nd - 1/l6th) inches out of size. All this can be avoided, however, if you find a tube of just three inches in diameter. Then you can work right from the drawing and use the kit-provided material for patterns or application. I'll speak no more of it.

The tube was carefully sawn to proper length and centerlines pencilled full-length top and bottom, 180 degrees apart. Establish the location of the cockpit opening and lay it out on the top centerline. A pencil compass and a long straight edge make it easy. Drill several 5/16" or 3/8" holes carefully well inside — 3/8" or more — and all around the cockpit layout line. The cardboard tube drills easily, but have a care. Any cutting or drilling will leave ragged and weak-edged openings. Sawing or sanding the tube is the safest and most accurate way to alter it. Connect the just drilled holes with a carefully cut or sawn line and remove the ugly result. What I did was fashion a v-block of six or seven inches in length on which to rest the fat, round tube. Establish its true vertical orientation while in the v-block. I mounted a 1" diameter sanding drum (the rubber expansible type that uses abrasive sleeves) in my drill press, lowered the quill until it was well-inside the ragged hole just formed in the tube now mounted on the v-block and locked it in that down position. Turning the drill press on, it was the work of five minutes to feed the tube into the drum and make a clean, vertical sided cockpit opening precisely to the layout line. An electric hand drill using the same drum with careful employment could do almost as well. Even a high speed rotary hand tool could do it.

Next, to strengthen the tube, I coated it with epoxy resin. This may sound like a nastiness, but it is not and I consider the step to be among the most important phases of the work. The only tools required are a cheap, stiff brush of about 1 inch in width and somebody's hair dryer (I have little hair, so I borrowed a hair dryer for the job). Hobby shops and home supply stores have those metal-handled, short bristle brushes that are specific for glues and epoxy application and are meant to be expendable.

Mix a small batch — one ounce or so — of slow cure (2-hour type) epoxy. You'll probably require more, but the one ounce will give you a feeling of how much you'l1 need and how to work with it. There's plenty of time, so you can always mix more as you go, of course. Start by heating the tube with the dryer and be-

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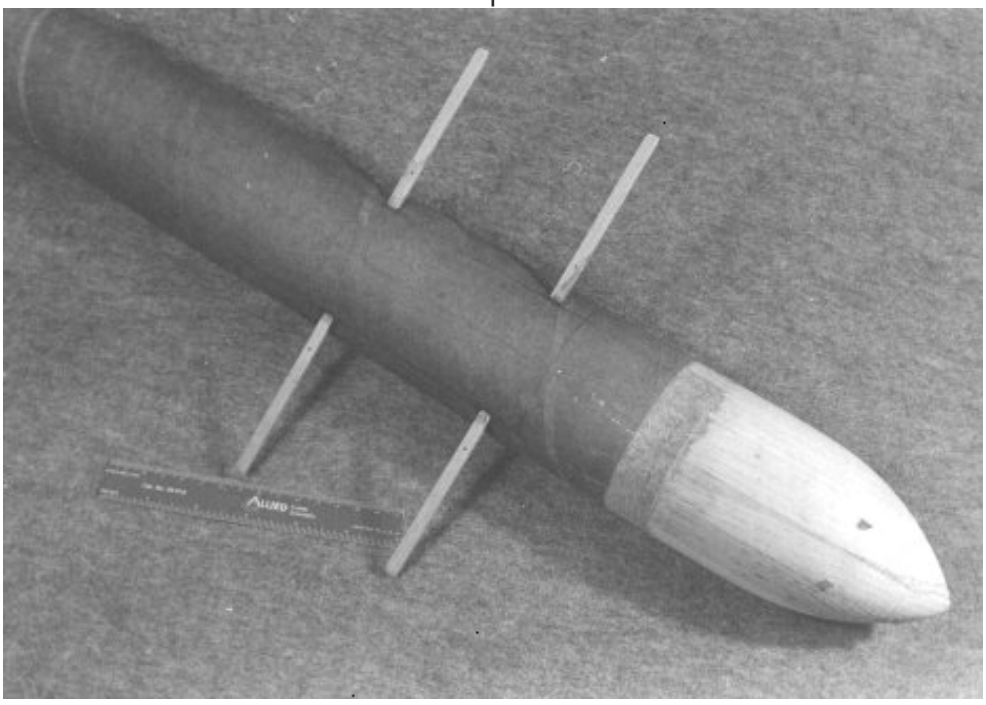

A 3-1/4 in. dia. mailing tube reinforced with epoxy makes up the hull body. This bottom view shows the hull with sponson spars and nosecone installed

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gin applying the resin generously to the heated area and keep the dryer pointed at and up close to the brush.

The resin immediately thins out from a heavy syrup to almost water consistency and penetrates spectacularly into the cardboard tube. You can gauge your progress as the tube becomes darkly soaked with the warm liquid. Work quickly since no delicacy is required. Fuzz, dust, and other junk will begin to raise from the cardboard. Ignore it, mix more resin if needed, and keep going. When the whole surface and *all edges* are thoroughly soaked — it's over. The heat will speed up the cure considerably. If runs appear, brush them out. It will be tacky dry in a fairly short time, but I would suggest letting it go overnight or even an extra day. When the surface is rock-hard to the touch, it may be sanded. Despite its formidable hardness, the material sands easily. Medium grit paper and a little time will yield a glass smooth surface on a cardboard tube that has become a plastic pipe!

At this stage I departed almost totally from the Easy Built kit drawing. You may wish to work closely with it or follow me. Frankly, if you've come this far, you are surely qualified to make your own choice.

My choice was that the model — or more precisely, my impression of the HD-4 — should be robust and palpable, and to that end it would be built as sub-assemblies fastened to the hull with small screws. The use of adhesives would be kept to a minimum.

The Nose and Tail Cones — These can be built with the balsa wood and tissue per the plan and be quite attractive and appropriate in appearance. The downside is that they would be feloniously fragile and quite unsuitable as mounts for any but the most ephemeral of attachments. I chose to glue up into blocks some scraps of clear white pine left over from an earlier project and prepared to carve. Obviously, however, they are a lathe project. Regrettably, I don't have a wood lathe.

I went to see my friend, Rick the carpenter, with the intention of using his lathe and turning the cones between centers. He suggested turning them on a face plate. Lagging the block, nose-end first, to the face plate with sheet rock screw nails, he proceeded with the turning at the fat end and worked toward the point at the head stock, glancing at the drawing from time to time. In less than 10 minutes he smoothed it with sandpaper, turned off the machine, and was done.

My jaw was still slack with amazement when he turned the lathe on again and proceeded to hollow it! Now this is surely beyond what most modelers, including me, have to work with. I mention it because the unerring skill with which Rick worked is worth mentioning and is a shining example of the mastery of tools. Humbly, I finished off the point of the cone with a knife and sand paper after the block was dismounted from the plate. My estimate is that whittling both cones from blocks would cost 5 to 8 hours of work. Hollowing-out is not necessary.

When the cones are finished I would recommend they not be glued to the tube yet because, (a) their added length makes handling the craft awkward, (b) there is work to be done on both cones in mounting foil sets and (c) installing some kind of cockpit interior is easier if you are able to work from each end of the tube.

Installing the rudder post is probably best done with the rear cone mounted on the tube. Drilling and bushing that hole I found to be among the most difficult jobs in the project because I didn't do it that way.

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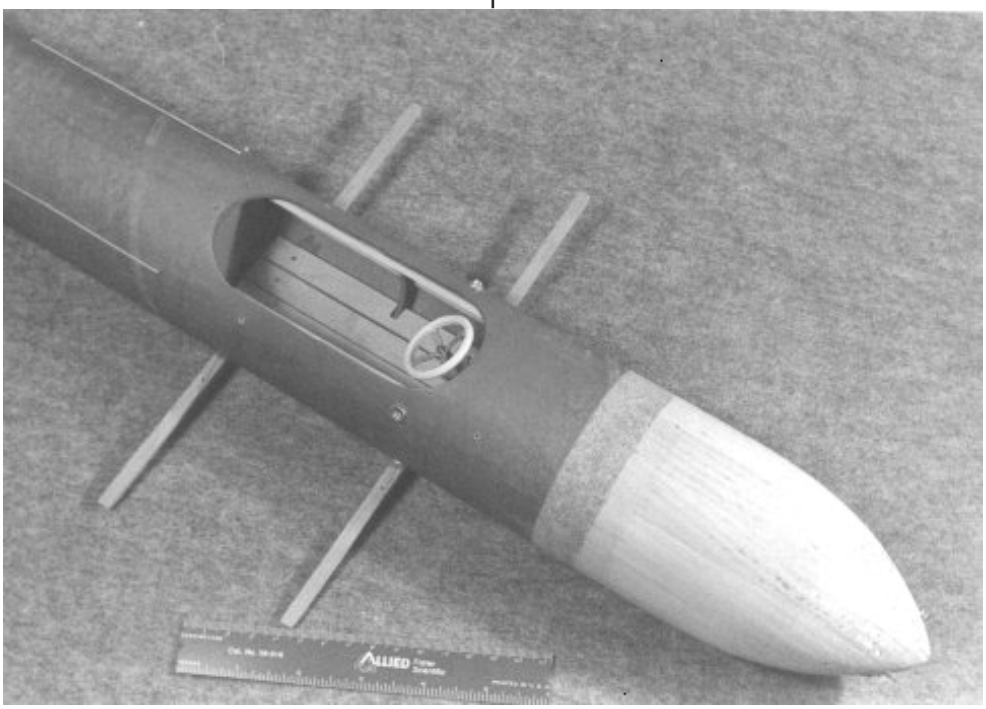

With the hull flipped right side up, you can see the sponson spars, floorboards, and steering wheel.

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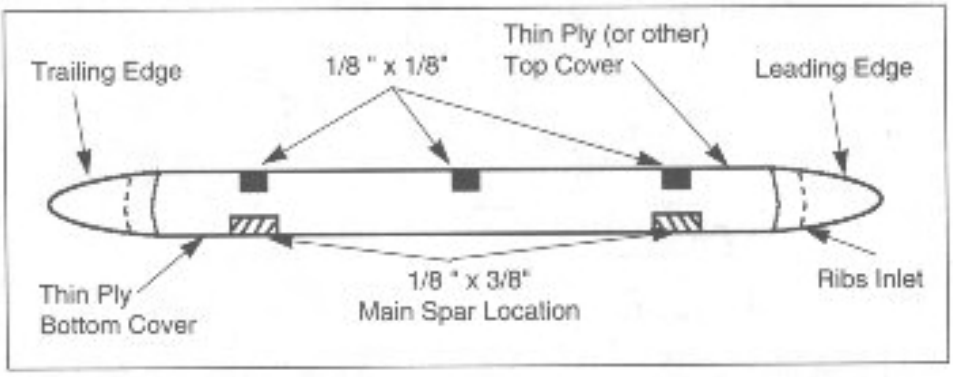
The Sponsons — If you are not going to make these structures removable, the drawing can be followed fairly closely, and the work is straight-forward. However, if the structures are to be removable, some planning and advance work is in order.

I would suggest building the motor bearers at this time in order to determine just where on the sponsons their mounting spots will be so that hard points can be provided for the screws.

A local craft store offered large bags of what appear to be popsicle sticks. Their size was correct for both uprights and cross members of the pedestals, and more to the point, they are of polished birch and extremely strong. Departing from the drawing slightly, I made all the uprights of the same length. Merely flattening slightly the upper surface profile of the sponsons allowed the motor bearers to be built incorporating a flat base which lent itself to a strong screwed-down fastening. A wooden gauge block assisted the construction greatly (see sketch).

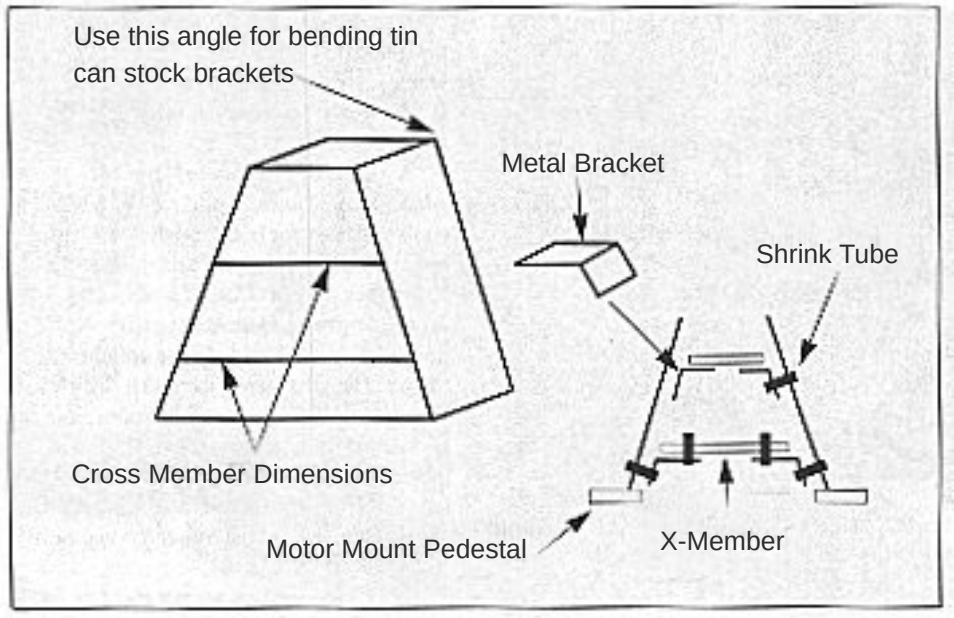


Construction of the Sponsons - Illustration Not to Scale

The cross members are not glued to the uprights directly, but to sheet metal brackets which are in turn attached to the uprights. Epoxy is my choice of adhesive. Each end of the bracket is strain-relieved with a ring of shrink-tube. When all the joints are cured and the tubing shrunk, the structure becomes extremely rigid and able to take all reasonable stress put to it. Now the frames of the sponsons can be laid out with an eye to where the motor bearers will mount.

The ribs of the sponsons I made of hard 1/8th thick balsa. The leading and trailing edges can be of pine, hard balsa or anything that comes to hand. I used hard balsa from my scrap box. My first choice would be yellow pine parting strip obtainable from any lumber yard. The drawing shows the path I took:

- Inlet the ribs into the leading and trailing edge stock. Deeper is better. Avoid butt joints.
- The 3 top spars are located so that the middle one is able to take a fastener from the front of the motor pedestal in its correct position.
- The two large bottom spars are located directly beneath the front and rear top spars. The main mounting fasteners utilize both these pairs.
- When building the sponson, use dummy spars for the bottom pair and *do not glue them to the ribs* or anything else.
- Shape the leading and trailing edges.
- Construct the pontoons from pine or hard balsa, attach to the end of the sponson and match to the top sponson surface.
- Cover the sponson bottom surfaces, preferably with 1/64th plywood.



The gauge block was made f rom ¾" wood to the inside shape of the pedestal structure.

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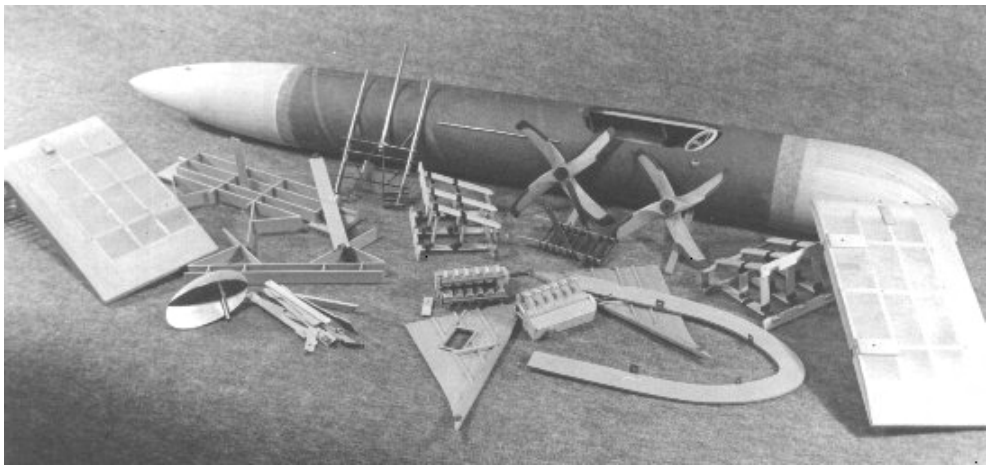
If you're familiar with the polyester heat shrink materials, they could be used here in conjunction with the ply. In any case, when the bottom is ply covered, there will be created boxes to capture both bottom spars which will be built into the hull. The function of the dummy spars, then, is to align the bottom spar notches while the sponson is being built.

Main Spar Installation in Hull — Begin by precisely locating the sponson in its fore and aft alignment and mark the leading and trailing edge positions on the hull with pencil marks or tape. Now determine the precise height of the bottom surface of the sponson from the bottom centerline on the hull and mark it. Use a straight edge and pencil a line on the hull at that height parallel to the bottom center line. The bottom of the bottom spars will lie on this line. Carefully apply the sponson structure to its fore and aft and bottom marks and mark the locations of the bottom spars on the just pencilled height line using the empty spar boxes as guides. Do both sides at the same time, and verify that all marks are properly in register.

Carefully pierce the epoxy shell at the spar locations with a small drill or sharp, pointed blade and, with a sanding stick or small file, make the four rectangular holes that will allow snug passage through the hull of the spar material. Be sure the holes don't extend below the height line.

Each spar should be of one piece and long enough to reach through the outermost rib notch and butt into the pontoon on the sponson's extremity. Make trial fits and trim until this condition is achieved. If all is done fairly, the spars will extend the proper length on each side, be perpendicular to the hull's vertical center line, and — when viewed from front, rear, or measured — be of the same height, and be a snug fit in the sponson "boxes." Fit everything together snugly to the hull, verify alignments, and apply epoxy or other glue to the hull/spar union inside the cockpit and allow to cure.



The hull and all detachable subassemblies are shown above.

It is now self-evident where the mounting screws go — as near as is practical to the hull, through the front and rear top spars and into the larger bottom spars. The motor bearer pedestals should align along the spars for mounting point: The pontoons or outer ribs should take the two outer screws; the middle upper spar should take the inboard front corner fastener, and the rear spar mounting screw should be able to clamp the rear inboard corner with a dog made of the birch popsicle stick material, or a piece of stiff metal if you prefer.

The Hydrofoils — These items were built, in my case, in three different ways: The bow "preventers" were of 1/32nd ply for the verticals and .015 sheet iron (tin can stock) for the blades, all cyanoed and epoxied together. The stern set had epoxy laminated aluminum strip verticals and .015 sheet iron blades except for the top blade which was an .022 (22 gauge) strain bearer taking the rudder post, all cyanoed and epoxied together. The main foils are entirely of .022 sheet iron strips soldered.

Early on, I considered all-wood construction and even had the front set built of thin basswood strip. It looked good and built easily, but was extremely fragile and was totally unsuitable for anything except the original stick-and-tissue construction.

The composite wood and metal front set, strongly braced as it is, I would judge to be minimally adequate. The rear all-metal cyano/epoxy set is notably more rigid and more adequate for my purposes. The main sets of soldered iron strip are incredibly strong, and their ultimate strain limit will not be met in any foreseeable situation. The choice of construction materials and adhesives, then, is for the builder to decide.

The construction method called for in the drawing was to build them like grating, that is to say that intersecting members locked in half-depth notches. The technique is sound, and with care any reasonably competent worker can manage. When working with metal, though, the material offers greatly increased resistance to your efforts.

I had never used a high speed rotary hand tool and did not own one. A good friend who does china repair and restoration loaned me one of his old tools

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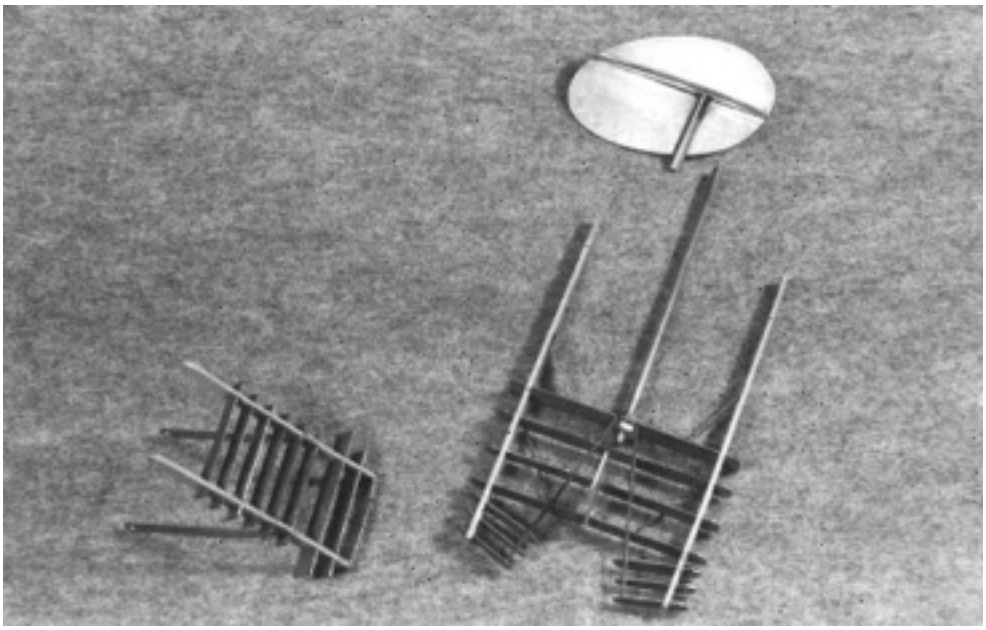
for my first trial. What drew my attention was the stack of little abrasive cut-off wheels. I was assured that they were, indeed, extremely effective cutters-off. More interestingly, the little wheels were a nominal .020 thick and would be perfect as notch makers in the tough 22 gauge iron — and everything else.

If I had possessed more experience with the rotary hand tool, the job would have gone more quickly with fewer false starts. As it was, with a jeweler's saw for the thin slots and the .020 wheels for the thick ones, the job became, if not easy, at least do-able. Here is some free advice:

- Draw a pattern or make a jig on a piece of wood for construction of the foils, especially the main sets. There will be lots of handling before the job is done.

The bow "preventer" foil is an anti-pitch device that assists in initial rising, but is fully clear of the water when the craft is foilborne. The photo is of the full-size replica HD-4.



Left: **bow preventers;** ***Lower Right:*** **Rear Foil Set;** ***Upper Right:*** **Air Rudder**

It will also be possible to fasten the work down, and it will be easier to check bends and angles as you go.

- If there will be no great stress put on the parts, then cyano and epoxy are adequate adhesives, even for metal in conjunction with the grate-type construction.

- When grinding slots or sawing, use a steel straight edge as a guide, not marks. Alignment is critical. Misalignment wastes time, causes warps and makes scrap.

- When all slots are properly cut, the grate assembly should snap together dry and become quite strong. That is the time for glue, cyano, epoxy, solder, or what-have-you.

- Metal strips, if used, are best made with a shear — they come out flat, smooth-edged, and free of distortion. If you use snips (I do), they come out sharp-edged, distorted, and curled and must be flattened and filed before use. A small bench vise is invaluable in swaging pieces flat.

- Wear eye protection when grinding slots. The cut-off wheels are brittle, and a shattered one could be a calamity on your face.

- Make a stand for the boat as soon as the hull tube is prepared — work is eased considerably.

The rear set of foils is shown on the Easy Built plan as a ladder structure similar to the front anti-dive set. The replica craft at Baddeck, has a different form, which I used. The photos on the next page will show the difference. Make your choice.

The Air Rudder — Straightforward construction per the kit if you choose. I made mine from 22 gauge iron

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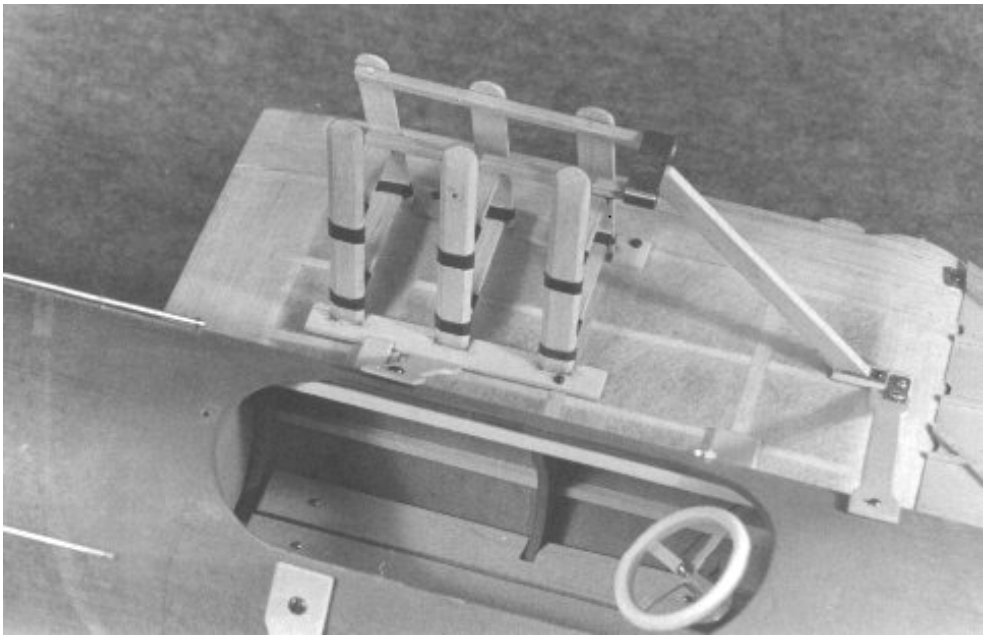
(Continued From Previous Page)

for the sake of strength. A tube was included so it could be dismounted for removal of the rear foil assembly.

The Spray Shields — The main shields can be built right on the hull/sponson assembly. Curiously, the drawing is mute as to the covering. at first I didn't know that they were spray shields. I thought they were bracing for the sponsons. A query to the kit manufacturer yielded a response that the structure was uncovered. This was the event that prompted my week-long sojourn to Nova Scotia. I had to see for myself. I can report that the main shields (on the replica) are wood covered on the bottom surface only. In my version I epoxied small metal tabs to enable screw fastening it to the nose cone and sponson leading edge. The bow shield shown on the plan is at variance with the replica at Baddeck. I went with the replica type. Useful in making this closely fitted piece is the ODD profile gauge. A hardware store or building supply outlet should stock them. It looks like a comb whose teeth are moveable. It takes on the form of any object against which it is pressed and makes the production of patterns easy. The attachment of small metal tabs enabled a nice screw fastener fit to the nose cone.



A Motor Mount is shown above

The Cockpit Interior — Sources indicated that the cockpit was fully instrumented, i.e. switches, tachometers, water temperature, oil pressure, oil temperatures, inclinometer, air speed indicator, air tank pressure (the starter motors were air driven), ammeters, and probably a fuel level indicator of some sort. The drawing is again mute, and the replica at Baddeck had a drop cloth over the cockpit at the time of my visit. I'm not sure that if it were uncovered anything would have been visible.

I had a badly obscured glimpse of the steering wheel and it appeared to be a disc of wood of about two or two and a half feet in diameter! Once more the plan was no help. The wooden wheel, I felt, was an execrable lapse in aesthetics, and I could not bring myself to make it. Instead, a dashing item of flat aluminum and a slice of plastic pipe .was built for which no apology is offered.

I decided to place "faux" bulkheads and stringers in the cockpit before affixing the front and rear cones. The circular cross section of the hull interior made this easy. The assembly consists of 3 identical balsa rings carefully notched on the same pattern, and any number of 1/8th square spruce or balsa sticks (I used nine). The cockpit interior was sprayed a

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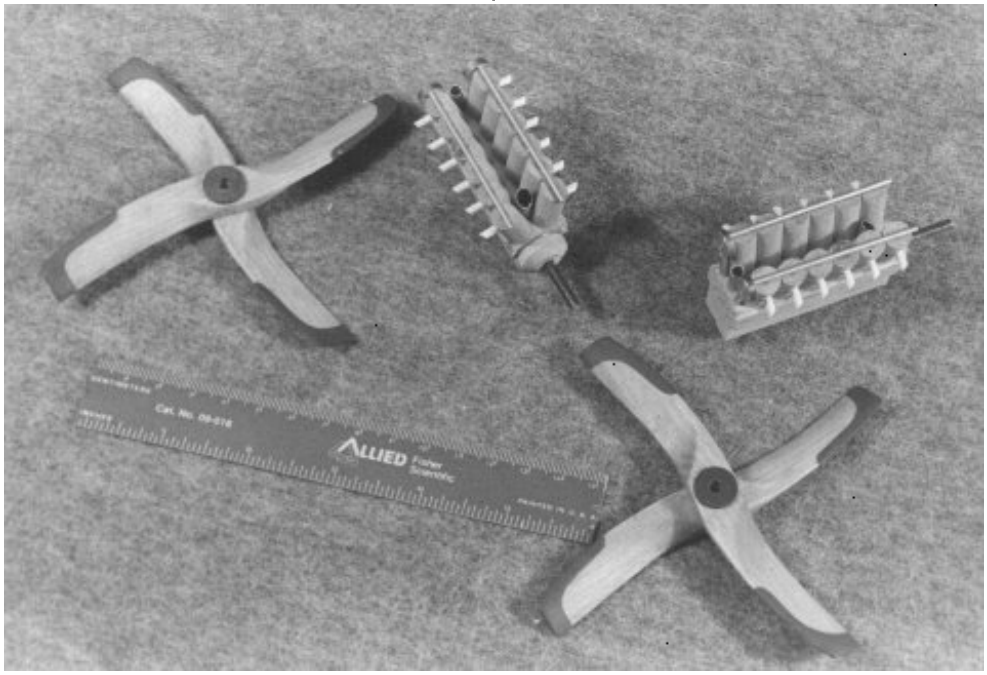
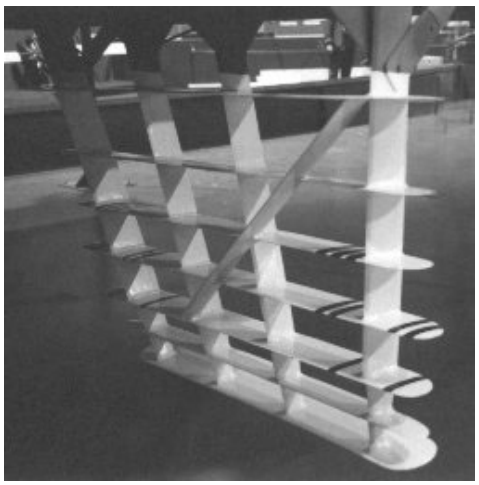


Yellow Pine Propellers and V-12 Liberty Engines

BELL HD-4
(Continued From Previous Page)

dark gray before the installation, and the bulk head/formers and stringers were left unfinished. Unfinished floorboards were installed across the spars. No instrumentation was installed.

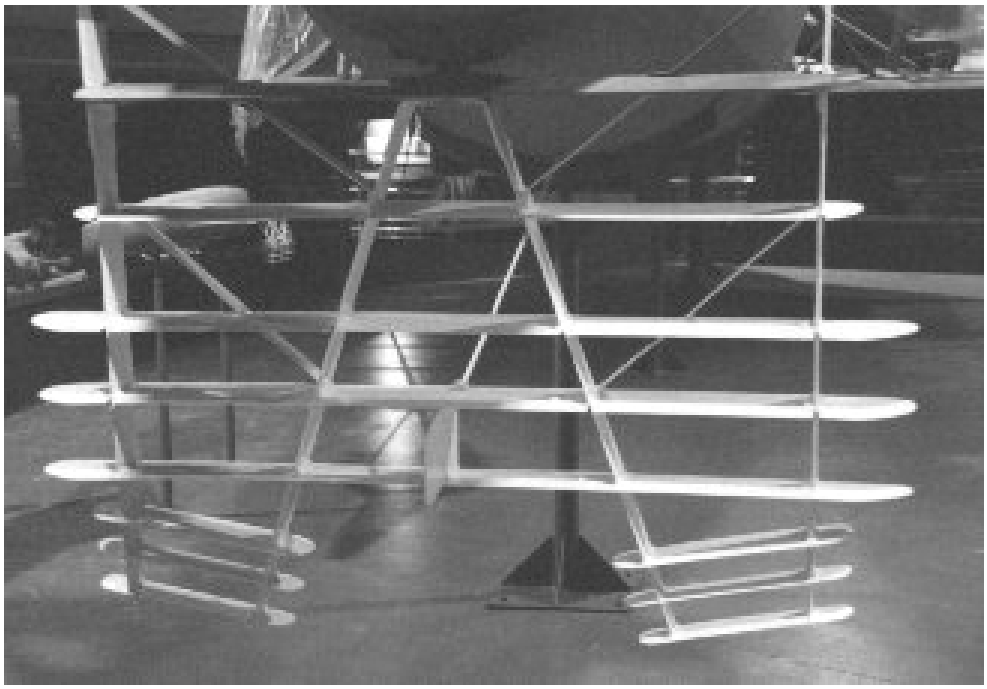
The Topside Airfoil "Nest" — The drawings are good, and the structures can be built right on the plan. I used 1/l6th inch bass strip and attempted no airfoil cross sections. I deviated from the drawing to eliminate some of the weaker aspects of the structures and to enable them to be attached with screws. The more elaborate front set is a tight fit in the cockpit opening and is wedged against the motor mount bases and has a longitudinal member screwed to the rear set.



Port foil under pontoon. Photo is of the full-size replica HD-4

The middle airfoil is metal bracketed and screwed to the inside of the middle vertical member of each motor mount.

The rear set is wedged against the motor mount bases and is screwed to the top of the hull/fuselage. It also is screwed to the longitudinal member of the front set. The whole "nest," thereby, is wedged and screw-fastened firmly and becomes a rigidly fixed and strong assembly.



Aft foil structure on the full-size HD-4 replica differs from the design on the Easy-Built Model drawing... you must choose which to follow.

The Motors — The Liberty motors are separate modeling projects in themselves. I gave them a slightly more (1/l2th?) elaborate treatment than the drawing and omitted all wiring, accessories, and plumbing from the radiators in the interest of easy assembly and disassembly. The builders may take their construction as far as desired. My motors are through-pinned to the mounting rails of the motor pedestals.

The propellers of yellow pine are easier to carve than it would appear.

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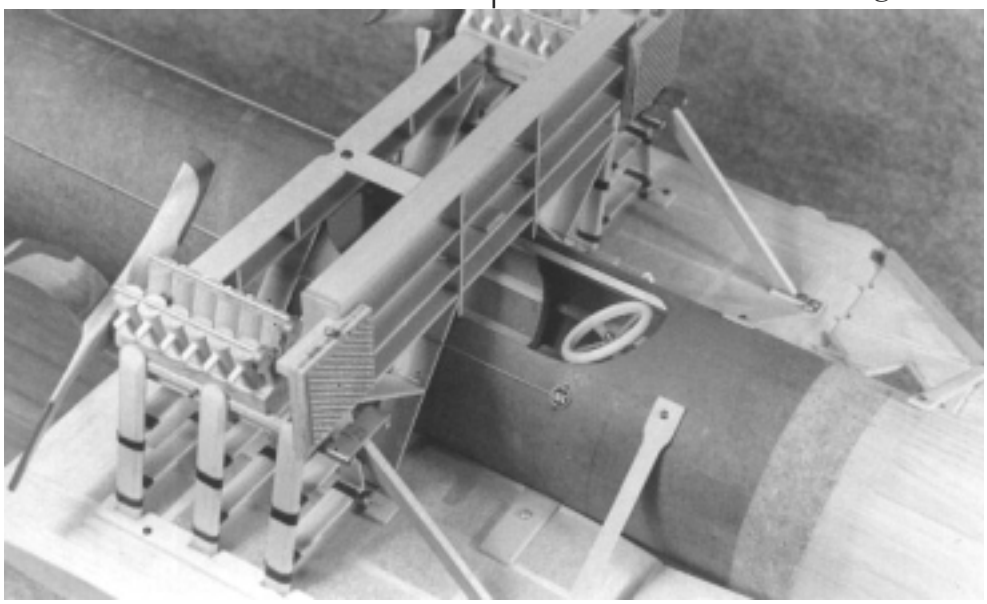


Airfoil "nest" and Liberty engines shown mounted in position on the scale model. Note the interior stringers visible in the cockpit opening.

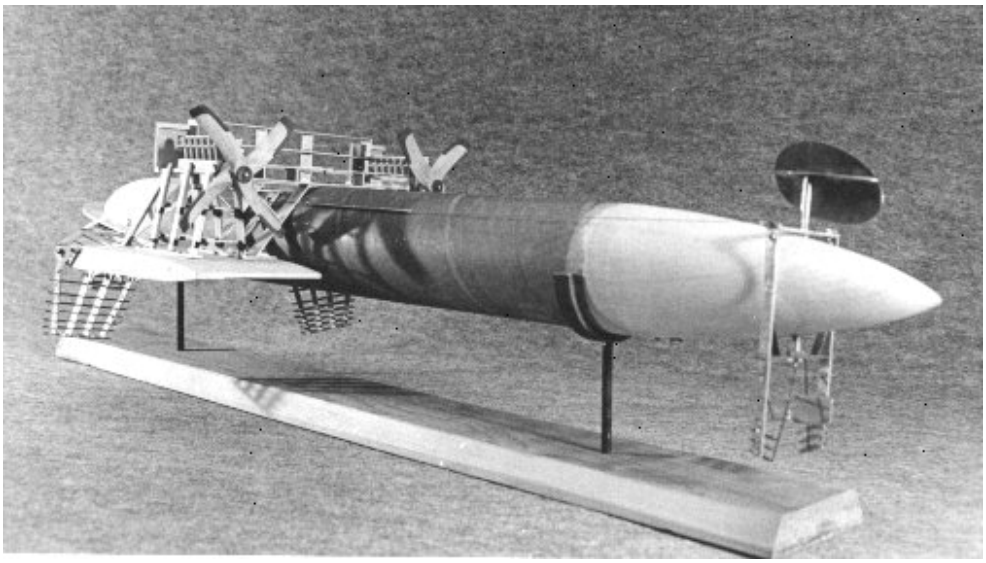
BELL HD-4
(Continued From Previous Page)

However, I claim some experience in this area. The plan offers adequate drawings as a guide. Yes, the 4-blade propellers are each a pair of 2-bladers on the same shaft, 1919 style.

The Paint — The overall color of the replica at Baddeck is a very dark, flat gray. The main hydrofoil blades and struts (excluding the braces) are a milky yellow — about like a canary, and the outer tips of the 3rd, 4th and 5th blades from the bottom are marked I, II, III respectively for photographic observation.

The rear foil blades except for the top one are of the same yellow color, as are the struts. The verticals are yellow to a point even with the hull bottom.

On the front set only the 3 bottom blades are yellow. The verticals are yellow their full length. The braces are yellow for 6 or 8 inches back from their connection with the vertical struts.



View of the assembled model from aft, port side.

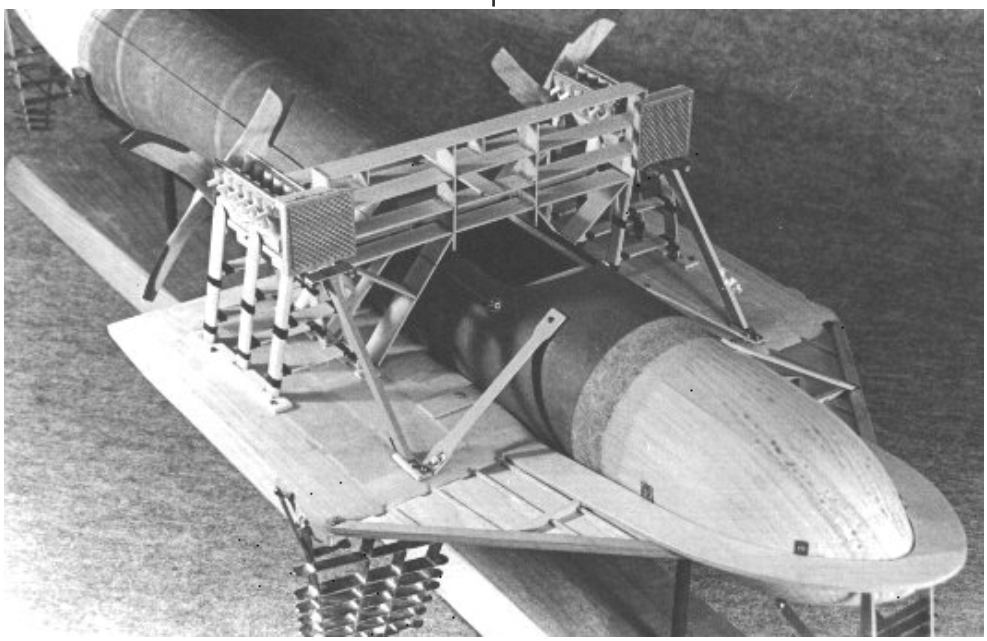
Historical Epilogue

By the time the HD-4 had reached its peak of development, the war in Europe had bled to a close and both the British and American admiralties, if they had ever been enthusiastic, were cooling rapidly. Committees listlessly evaluated, and commissions dutifully tested.

But the craft was not an efficient load carrier. It was fragile and easily disabled. Its abilities in rough water and open seas were suspect. And worst, the naval treaties following the war restricted expansion so the funding of development was unlikely.

In the end, the hull was refused as a target by the Canadian government in 1921. The clapped-out motors were junked — one later rescued — and the remains were beached at Beinn Breagh and weathered outside until 1953.

Bell himself never rode in the HD-4, although his wife Mabel audaciously passengered over to Baddeck one day at 31.5 mph. Patents on the HD-4 and a proposed HD-5 shared with Casey Baldwin and Sydney Breeze were the last to appear in Bell's name. He died in August, 1922.



Note that the front struts attached at the hull and at the forward motor pedestal struts are quite functional and stiffen the structure considerably.

Reflections

- The life of Alexander Graham Bell, his broad range of interests, and his many endeavors and accomplishments will reward even casual study.

- More should be known of the redoubtable "Casey" Baldwin, Bell's right-hand man, licensed engineer, in-

Continued on Next Page

trepid hydrofoil and airplane pilot, and skilled craftsman.

- The HD-4 is not likely to be mistaken for any other vessel.
- Nova Scotia is a curious and interesting place to visit whose abundant native sea scallops are best eaten fried.
- Small sheetmetal screws hold better than small wood screws and are easier to obtain these days.
- The front struts from the motor mount/strut bases to the hull are quite functional and stiffen the structure considerably.
- At the Bell historical site there was a model of the HD-4 built from this kit probably by the designer. It was fatally damaged from shipping or from handling while being put on display.

More Models - More History

A working Radio Controlled (R/C) model of the World War II era German Hydrofoil VS-8 is offered in kit form by 23rd Parallel Corp. The 1/32 scale (3/8" = 1 foot) model is 38.5" long.

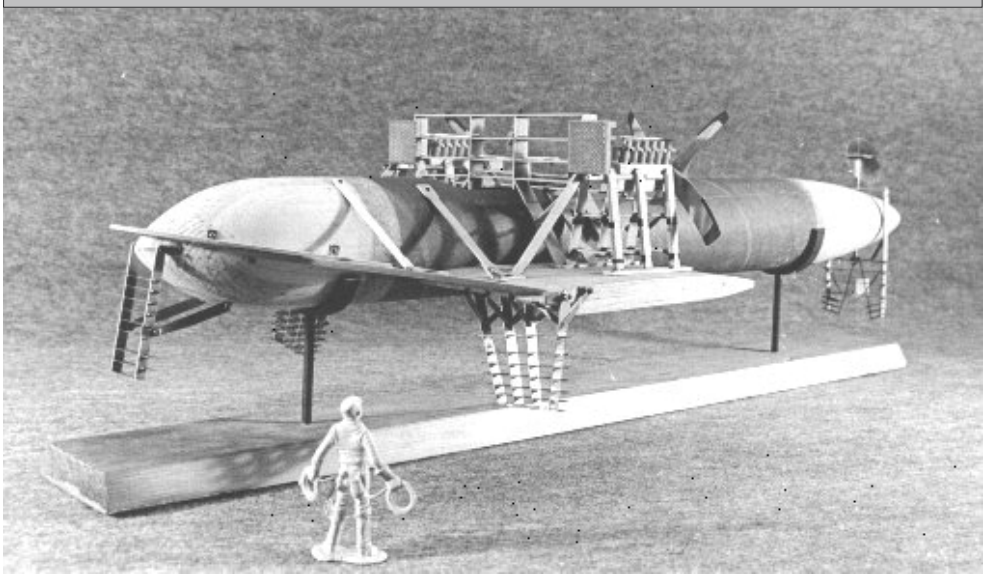
The Germans experimented with hydrofoils thoughout the war, culminating in the 80 ton VS-8, which then held the record as the world's largest hydrofoil for 25 years. The vessel was a prototype for a class of fast transports intended to carry supplies to Rommel's troops in Africa. It was designed to cross from Sicily to North Africa and return in one night. For more info, visit the 32ndP site http://www.32ndparallel.com/vs8.htm, visit your local dealer, or send email to simon32P@aol.com.

Sources

- **HD-4 kit, Item MB-2, USD 27.00 + 5.00 shipping — Easy Built Models, 1851 Dutch Rd., Fairview PA 16415, USA, phone: 814-474-9110. Website: http://easybuiltmodels.com. The email address is: david@easybuiltmodels.com**
- **Micro Fasteners, 110 Hillcrest Rd., Flemington NJ 08822, USA. Phone: 800-892-6917. Visit their website at: http://www.microfasteners.com. Email: info@microfasteners.com. Good to deal with on the phone. Excellent source for small fasteners. Ask for catalog.**
- **Yazoo Mills, Inc., PO Box 369 (305 Commerce Street), Oxford PA 17350-0369, USA. 800-242-5216 or 717-624-8993.Visit their site on the Internet: http://www.yazoomills.com. Email: sales@yazoomills.com. Cardboard tubes and cores of all sizes. No minimum order.**

Resources

- **Parc Historique National Alexander Graham Bell (PHNAGB); Box 159; Baddeck, Nova Scotia. Site of the reconstructed HD-4. A large archive on the premises. A splendid museum dedicated to Bell. Helpful staff.**
- **Extract from a draft report EA-PC-82-15, *Reconstruction of the HD-4 Hydrofoil 1976-79*. Parks Canada, Atlantic Region. Alex Barbour. Courtesy PHNAGB.**
- **A monograph, *Search for Yesterday*, Apr 81, Baddeck Public Library. PHNAGB.**
- **Leavy, Roy, *Hovercraft and Hydrofoils*, Arco Publishing Co., Inc. 219 Park Ave., South, NYC 10003. 1977.**
- **Fostle, Don W., *Speedboat*, Published jointly by US Historical Society and Mystic Seaport Museum Stores. ISBN 0-939510-07-3, 1988, 218 pages, out of print. http://store.mysticseaport.org/. Good photos of Liberty engines.**



LETTERS TO THE EDITOR

VENTURES...

Proposed Hydrofoil Ferry Route: Surat - Bhavnagar

[6 Aug 00] We are interested in acquiring or dry/wet leasing for long term hydrofoil or Jetfoil passenger vessel to ply at Surat Port to Bhavnagar Port in India. Kindly suggest us your valuable advice. — We are San Ferry Company, Indo World Commercial Complex, 1st floor, Behind Kadiwala School, Majura Gate, SURAT (gujarat) India. Email: lordsint@suratbbs.com.

Nilesh Bansal M.D.
fillink@suratbbs.com

Barbados Route

I'm looking for a joint venture partner to operate a hydrofoil in Barbados as a solution to the crowded streets. I will provide full details on a one-to-one basis upon request.

Ian E. Rock
irock@caribsurf.com

Jetfoils Wanted...

I am searching for info on the Jetfoils that were sold to Indonesia. I understand that there were six of them, that they were never used, and that they are presently in a Sarabaya Indonesia shipyard. I have a prospective client that is interested in purchasing the vessels but info is sketchy at best.

Ken Plyler
kfppfk@aol.com

Cyprus/Turkey Hydrofoil Route

We are a North Cyprus based shipping company. We are operating 2 RO-RO ferry ships and 4 Hydrofoils (Russian KOMETA) between N. Cyprus and Turkey ports. We are interested in operating Hydrofoils or Catamarans on joint venture basis or perhaps on a Time Charter basis. We would also consider a good bargain sale offer. We would also like to have offers for low tonnage (Grt.900-1500) RO-RO ships or RO-RO ferries.

Kufi Birinci
mr.teko@usa.net

TV Project Solicits Proposals

I am currently planning a TV-series on sailing in general, especially on performance sailboats or extreme projects, such as navigating in arctic or tropic waters or racing. The report will be a feature like documentation and is planned to start preferably from the very beginning. Any of your serious proposals are highly welcome, The project is planned to start in very near future. Strict confidence, if required, is guaranteed. About us: We are an independent full service TV film and editing team, supplying German and European TV and electronic media. As a journalist, I specialized on multihull sailing (and will of course vote for the multihulled project)

Claus-C. Plaass
Wulle 7 - 24159 Kiel
West Germany
plaass@ki.comcity.de
ph+fax +49-431-36 800

SCALE MODELS...

Radio Controlled Model Kits...

I have been looking for a R/C hydrofoil kit for some time, without luck - are you aware of any available?

Nick James
ncjames@lineone.net

Response...

I suggest you contact the IHS photo archivist Malin Dixon because he is personally involved in motor-powered R/C model hydrofoil boats. His email is malin@onspec.co.uk, and his website is http://www.onspec.co.uk/ihs/model.htm.

There are only two R/C kits I know of personally; one was offered by Hydrofoils, Inc., but they have recently discontinued their models to concentrate on full size ferry vessels. The other is a historical reproduction of the WWII-era German VS-8 available from 32nd Parallel, site: http://www.32ndparallel.com/vs8.htm. There are some R/C kits, discontinued now, that can still be obtained: Shockwave, PT-50, Super Comet, etc. From time to time one of these will show up for auction at http://www.ebay.com. You can set up eBay's "Personal Shopper" feature to automatically look for them and notify you by email. There are photos of R/C models in the IHS photo gallery at www.cks-precision.ltd.uk / ihs / models.htm. There have been articles with plans in modeling magazines such as *Marine Modeling* Monthly (Traplet Publications UK) about building hydrofoil R/C boats, see Graham Taylor's *RAPIER* and *MK1* (http://www.home-taylor.freeserve.co.uk/). I have presumed that you want a motor powered boat. If it is a sailboat you want, please take a look at the 750mm site at: http://www.home.aone.net.au/cybernautics//750future.html. If you encounter any other hydrofoil model products or websites in your search, please let me know about them so I can cover them on our site.

Barney C. Black
foiler@erols.com

Hydrofoils, Inc. Discontinues R/C Model Product Line...

I have tried to contact Hydrofoils, Inc., manufacturer of an interesting R/C electric hydrofoil. Unfortunately I heard that they don't build the R/C models anymore. Do you still have any contacts to this company? Do you know if there is any of these models in stock anywhere, maybe a last surplus at Hydrofoils Inc.?

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LETTERS TO THE EDITOR
(Continued From Previous Page)

Thomas Lange
tomlange@ukonline.co.uk

Response...

We are not selling models anymore, and are currently concentrating only on the ferry industry. Our current business focus is on larger, high-speed marine transportation industry as indicated by the 100-knot ferry on the front of our web site home page. We no longer have the models, smaller hydrofoils, parts, or plans in production. We will advise you should we reenter that market.

Ken Cook, Hydrofoils, Inc.
kencook@hydrofoil.com

DESIGN/BUILD PROJECTS...

Roving, *RAVE*-ing Folksinger

I'm researching foils now. I've done a lot of boatbuilding, primarily because I can afford boats that way, and because I enjoy it. Since I can't afford to buy my own Windrider *RAVE*, I guess I'll have to build a hydrofoil next. I was working on a planing sort of boat, sort of a trimaran built with windsurfer hulls, but my experience sailing a borrowed *RAVE* from Florida across the Gulf of Mexico to the Yucatan and on to Belize has got me started in the direction of a foiler craft. Hmm, I guess its my way of saying thanks to share this story with you. The entire Captain's Log about my RAVE trip and also my personal journal for this trip are in the archives section of my website http://www.pan.com/folksinger. Hope you find it interesting, I just buckled on my swash and went for a little trip.

Brian Douglas, Folksinger
folksinger@iname.com

Response...

Actually, you went on a *big* trip in a *little* boat. Your narrative is reminiscent of Dave Keiper's book *Hydrofoil Voyager* about his travels across the Pacific in his 31-foot hydrofoil sailing yacht *WILLIWAW*. You seem to have a similar seafaring spirit of adventure and appreciation for hydrofoils. *WILLIWAW* would seem to be more suited to open ocean than *RAVE*; it might be possible to recreate this vessel from the original plans, but it would be a major project.

Barney C. Black
foiler@erols.com

Determining Foil Size/Profile For Human-Powered Hydrofoil

I am not an engineer although I do have a technical background. I am familiar with aircraft operations as I am a general aviation pilot. My design goals are a craft which weighs approximately 200 lbs with occupant and a design speed of around 10-15 mph. Here are three specific questions:

- I found, in one of the responses on the FAQ's, a formula to ballpark foil sizing. The formula read as follows: L = 0.5 x CL x RHO x A x V^2 where, L = Lift (total craft weight supported by the foils in Newtons); CL = Coefficient of Lift (between 0.25 and 0.4) ; RHO = Water Density; A = Total vertically projected area of submerged foils; and V = Speed in meters per second. Questions:

  » What is the Coefficient of Lift figure, and why 0.25 to 0.4? Are these desired figures, or do all foils range between these figures?

  » "Total vertically projected area of submerged foils" (A)? Should this be total horizontally projected area?

  » My assumption is I simply solve for "A" to obtain the desired foil area?

- I understand that surface piercing foils are self-stabilizing and do not require control surfaces. Most surface piercing foils I've seen are either "V" shaped, or more half-circular shaped. Any benefits of one over the other? Are there other types?

- Would one of the NACA Symmetrical foils be a good choice for the parameters I listed above?

Wade Bissell
wbissell@uswest.net

Response #1...

- How about just buying a *FLYING FISH* for about US$7,000? You can get to the company that sells them at: http://members.aol.com/jfreeent/hf.htm.

- The coefficient of lift is almost defined by the equation that you saw in the FAQs. A clearer way of writing the equation is L = CL x A x P, where P is the dynamic pressure. The dynamic pressure is the pressure increase that a gauge with its opening pointing straight forward would measure. The dynamic pressure is given by P = 0.5 x RHO x V x V, which gives the same value for the lift. Another way of looking at the dynamic pressure is the water pressure needed in a hose to give a jet at that speed. The coefficient of lift is used because it has no dimensions, so you don't need to define units for it to be meaningful. The coefficient of lift will depend on the wing form, the angle of attack and the aspect ratio.

- There are one or two other things but they won't make much difference. Let me explain the terms before going on:

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Letters To the Editor allows hydrofoilers to ask for or provide information, to exchange ideas, and to inform the readership of interesting developments. **More correspondence is published in the Posted Messages and Frequently Asked Questions (FAQ) section of the IHS internet web site at http://www.erols.com/foiler.** All are invited to participate. Opinions expressed are those of the authors, not of IHS.

HYDROFOILS FOR SALE

IHS receives notices of hydrofoils for sale from all over the world. Here are some of the latest notices. The complete listings of vessels for sale can be found on the Announcements page of the IHS site http://www.erols.com/announce.htm.

MANU WAI PT 20 - Australia

Possibly the best surviving PT20. Built 1964, completely rebuilt and modernized in 1990. Extensive aft cabin modifications, aft deck extensions, modern galley, audio-video entertainment system.

MTU 12V493 1350HP main engine 600 hrs on new alloy block, 15kva Onan genset. Length 20.75m,Beam 8m, Draft hullborne 2.8m, foilborne 1.4 m, Cruising speed 32 knots, max 36 knots. Complete with spares, docking cradles, drawings, documented history. ABS class. May suit use as private cruiser. Asking US$300,000.

Garry Fry
gfry@vtown.com.au

Garry Fry's PT-20 Hydrofoil *MANU WAI* is offered for sale

3 Foilers -- Australia

My father Ian Berkley McRostie passed away recently and left me three hydrofoils. The first is called *PHARAOH* and is powered by 2 Volvo Penta 4cyl turbo diesel engines and carries 10 passengers. The other two carry 12 passengers: *PHOENIX* (powered by two 6 cyl turbo diesel Volvo penta engines) and *PHIDIAN* (powered by 2 4cyl Volvo penta petrol engines) are at a friend's factory site in Bayswater here in Melbourne. I am told that these two hydrofoils are of a design by International Aquavion, and the model is called the Aquavit. *PHARAOH* is in drydock at Hasting on Westernport Bay. He was operating a ferry service from the mainland here in Victoria Australia out of Stony Point on Western Port Bay to French Island. He stopped operating this service about five years ago and as he was suffering from cancer and the hydrofoils were in dry dock and fell into disrepair. I would like to advertise them on your site.

Daniele Galli
dgalli@connexus.net.au
phone (work): 61 3 98657225
phone (home): 61 3 95576664
17 Hutchinson St; Bentliegh 3204
Victoria Australia

Above: PHARAOH in Service

Below: PHARAOH today

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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.

Hydrofoil Ferry/ Tour Boat

For sale by the owners, passenger hydrofoils: Type: METEOR; Class: KM*1 II; Built: 1988; Passenger Capacity: 123; Crew: 4: Service Speed: 35 knots; L.O.A.: 34.00 m; Beam: 9.5 m; Hullborne Draft: 2.35m; Foilborne draft: 1.20m; DWT: 36.40 T; GRT: 53/40 T; Engines: M-400 2X1100 HP; Navigation Eqpt: GPS, NAVTEX, Radar, GMDSS; Safety Eqpt: Safety vests and 20-passenger safety raft; Fuel Capacity: 3.2T; Navigation Range: 324 nm; Trade Area: Restricted II; Complete set of spare parts is available on board; Price idea: 135,000 USD as is, where is (Try FOB UKR Port); Inspection: Black Sea, Ukraine. The vessel is fully ready for sea sailing. Ship's documentation is available upon expression of firm interest. For details, go to: http://www.egida.com/hydrofoil.html; Note: We provide these details in good faith, but without guarantee, as owners/exclusive brokers.

EGIDA Agency
72/74 B. Arnautskaya St.
(offices 70-72)
Odessa 65045, Ukraine
Tel (direct): + 380 482 229645
Tel/Fax: + 380 482 229745
Tel/Fax: + 380 482 291901
USA Fax: + 1 561 3827612
http://www.egida.com/

Russian Hydrofoils

We offer for sale:

- Two (2) Kolchida, build 1984, class register till 2004, fully equipment, very good condition, located , Black sea, Ukraine, asking for each U.S $ 430.000 and 410.000 FOB/ Odessa
- Two Meteors, built 1989/91, "as is" Kiev/ Dnepr and FOB Black Sea Ukraine, asking US$60,000 and $100,000.
- Voschod-7 built 1986, complete, FOB Odessa/ Black sea asking US$ 85,000

We will assist the prospective buyer with his trip to inspect the vessel(s) of interest and guarantee his security and that the deal will close successfully. We just sold successfully two Meteor "Admiral ½" to Egypt from Odessa.

Mrs. Raisa Steinigk
steinigkr@tpp24.net
fax 0049(361)2261183

PT-4 -- New Zealand

Supramar PT4, 16 passengers, 4 ½ ton, built Porthleven shipyard UK 1965, POA.

Dave Esler
neville.beker@xtra.co.nz

PT 4 Hydrofoil offered for sale in New Zealand

Remembering Dave Keiper and *WILLIWAW*

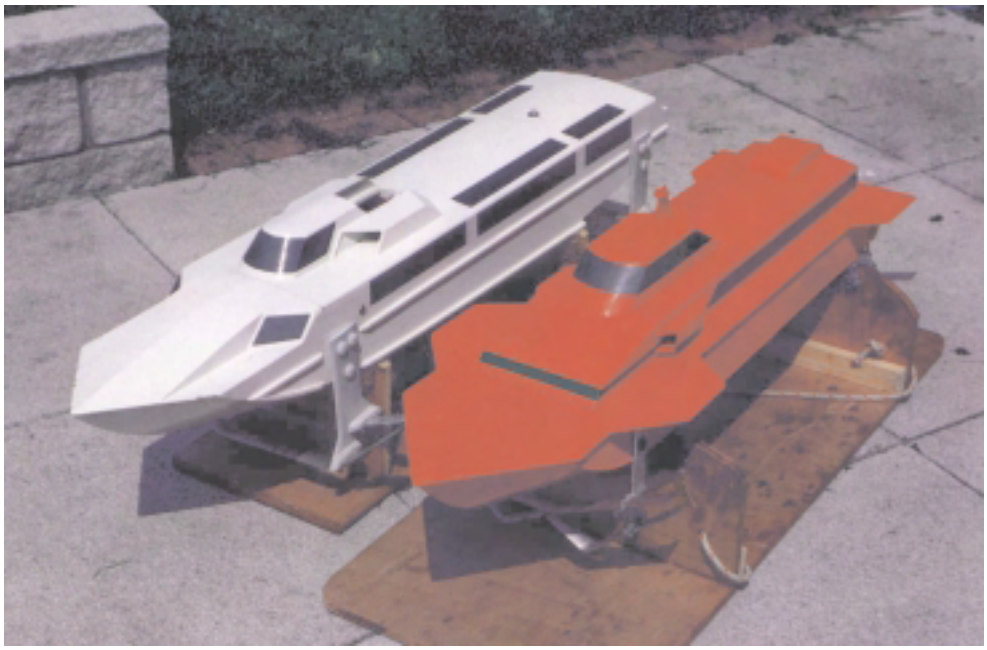
By Jim Wrenn
wrennj@webcombo.net

I was lucky enough in life to have sailed with Dave Keiper in the summer of 1971 on the most incredible boat I have ever sailed on. We were anchored in the middle of Hanalei Bay on the island of Kauai when Dave came in and dropped anchor. We had seen *WILLIWAW* flying around Wakiki a month or so before and were surprised to see her here.

I had sailed over with a man named Gordy Gladson on his tri, and as all trimaran sailors in those days knew each other, we swam over to have a visit . Of course Dave (most gracious) had to show off the boat. We put out to sea in about a 15 knot trade wind on a beam reach. The boat started heeling like a monohull, and then the foils got a bite and the boat came up out of the water and accelerated like a car...what a rush!!! The boat was so fast and stable Dave could walk away from the tiller and she would run like she was on rails. This was truly one of the most memorable days of my sailing life of 35 years.

I'm sorry to learn that Dave has joined my friend Gory where ever sailors go when they leave us. Someday I hope to sail with them again. I may have some super eight film of *WILLIWAW* that was shot that day. The footage is probably not very good; I haven't seen it in years. ***[For more on Dave Keiper and WILLIWAW, see the Hydrofoil Pioneers section in the IHS site: http://www.erols.com/foiler/dak.htm - Ed.]***

Introducing Graham Taylor's Radio-Controlled (R/C) Model Hydrofoils



Above: **The MK1 boat (white) and *RAPIER* (orange). Both have tandem/ladder surface-piercing front foils and surface piercing rear foils.**

Below: **MK4 is a Wing-in-Ground Effect (WIG) craft. It was recently filmed in action by Discovery Channel for a new series called *Model Mania* that will be shown beginning in Autumn 2000.**

The white MK1 hydrofoil model was featured in "Experimental Hydrofoil," an article for *Marine Modeling Monthly* Jan 1992 pages 26 - 30.

The design and build of the orange *RAPIER* model hydrofoil was featured in *Marine Modeling Monthly*, Dec 1992 issue, by Traplet Publications UK, pages 36 - 41. Plans for this model are still available from Traplet Publications. Unfortunately since publication the "half-round" aluminum strip (sold in hardware shops for edging worktops and the like) used for the foils may now be difficult to find. Modelers may try metal strip, such as a 3 foot/1 meter ruler.

In addition to the hydrofoil models shown, Graham Taylor has built WIG (Wing in Ground effect) craft. His MK4 WIG was recently filmed in action by a camera crew for the Discovery Channel. "They are making a series called *Model Mania* that will be shown in the Fall,"Graham Taylor reports. " They had brought their big cameras especially for my model. Seasoned modelers will know that the performance of a model is inversely proportional to the number of people hoping to watch it and the size of their cameras. This show will be broadcast to the world, so I was really under pressure! Fortunately MK4 put on a good show, so you will be able to see footage of it in action, as well seeing as yours truly! The series starts on Sunday 3rd Sep 2000 on Tuesdays. My ekranoplans should be in program 10, first broadcast on Monday 18th Sep 2000 and repeated on Thursday the 21st. Check your local listings for times."

Continued on Next Page

Graham Taylor's R/C Models
(Continued From Previous Page)

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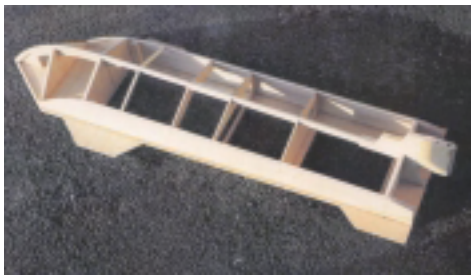

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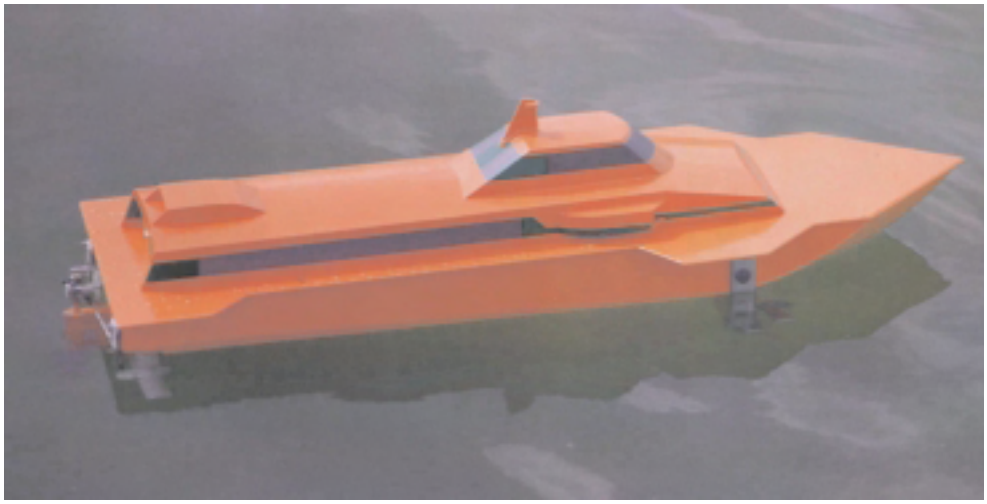
Above: **MK1 at speed**

Left: **technical view showing the rear foil incidence control that is linked to the rudder to achieve tight banked turns as shown below.**

***Below Left: RAPIER*'s simple "slab-sided" hull structure**

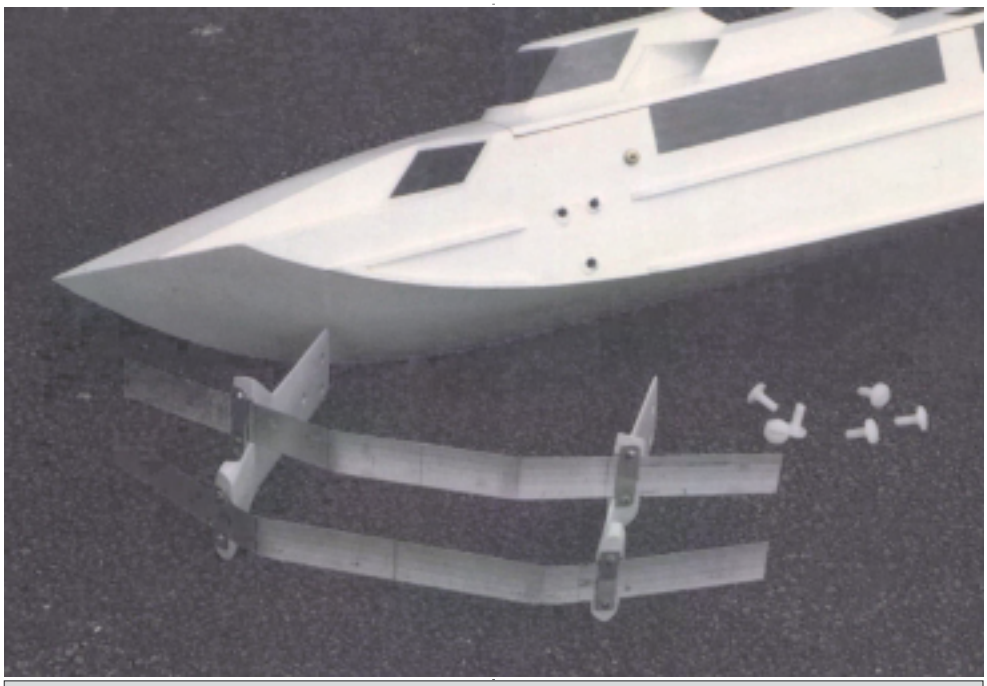
Below: ***RAPIER*** **makes a banked turn.**

The International Hydrofoil Society is an all volunteer, not-for-profit organization of and for people who design, build, operate, or simply are interested in commercial, military, research, or recreational hydrofoils of any size... power (including human power!) or sail. Your participation is encouraged and welcomed. Membership is still only US$20 per calendar year (US$2.50 for students).



Above: **Graham Taylor's *RAPIER* at rest.**

Below: **The foil assemblies on MK1 are fully detachable, fixed by nylon bolts which shear off on impact without damage to the hull. Yes, this feature has been tested in a full-speed run up the bank! Note: the upper foil in the assembly comes out of the water at speed and is only used for stability and take off.**



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LETTERS - DESIGN/BUILD

(Continued From Page 15)

» The *wing form* is the shape exposed if you were to cut off the foils with a vertical cut parallel to the forward-backward direction. The more curved the wing form, the bigger the coefficient of lift. The more like an airplane wing, the larger the coefficient of lift that can be produced without a lot of drag or stalling.

» The *angle of attack* is the angle between the longest front-back line through the foil and the horizontal. The bigger the angle of attack, the bigger the coefficient of lift.

» The *aspect ratio* is the ratio of the wingspan to the length of the longest front-back line through the foil.

- The aspect ratio doesn't have much direct effect on the coefficient of lift, but the larger the aspect ratio, the larger the coefficient of lift can get, and the less the drag that is caused by that lift.

» Large aspect ratio foils (say more than 8 or so) with a sophisticated shape and a big angle of attack can get coefficients of lift above 1.0, but they are difficult to make.

» If you can keep the coefficient of lift below 0.5 then almost any flat shape will work (that's why paper airplanes work).

» On the other hand, 200 lbs including occupant doesn't leave a lot weight left for an engine, so you may need to put more effort into wing design to get the drag low enough for you to pedal it.

- A low coefficient of lift means a larger wing or a higher speed, both of which mean more drag. The wings on hu-

Continued on Next Page

LETTERS - DESIGN/BUILD
(Continued From Previous Page)

man-powered hydrofoils are usually almost the same shape in all respects as a glider wing.

» By *vertically projected area*, what is meant is the area of the shadow if the sun is vertically overhead, and the foils are in the normal flying attitude.

- As to your assumption "that I would simply solve for 'A' to obtain the desired foil area," yes, it's as easy as that. Have a look at a couple of websites, http://www.onspec.co.uk/trampo, and try Bob Hogden's Trampofoil page, http://ourworld.compuserve.com/homepages/roberthodgen/tramp.htm. Unfortunately Trampofoil is no longer made.

Malin Dixon
malin@onspec.co.uk

Response #2...

When I prepared the response that you saw in the FAQs, I did skip over a bit of the background to try to keep it brief.

The range of coefficients of lift I had suggested were obtained by "reverse engineering" the details of a number of existing hydrofoil designs where the submerged foil area, displacement (i.e. the weight of the craft) and speed were all known. These craft ranged in size from small human powered hydrofoils such as the *FLYING FISH* and *DECAVITATOR* through to large passenger-carrying surface-piercing hydrofoils of Supramar and Rodriquez design. Despite that range in vessel size and speed, the coefficient of lift for the foils remained in the band from 0.25 to 0.4, which is why I proposed that range. Staying between those limits can be considered to be good design practice.

On the matter of projected foil areas, we are both thinking alike but are simply using the opposite terminology! When you refer to "total horizontally projected area" you refer to the area projected onto a horizontal surface. When I referred to "vertically projected area," I meant vertically projected onto a horizontal surface. The reason I used the term "total vertically projected area of submerged foils" rather than simply "total foil area" was that I had surface-piercing V-foils in mind as well as the horizontal foils more common on fully submerged hydrofoil designs. For V-foils, it can effectively be considered that only the area of the foil as seen from directly above (Malin has nicely described this in terms of the shadow that is cast) is making a useful contribution to supporting the weight of the craft.

To explain this reasoning a little, I will use an example with which you are familiar, an aircraft. The lift generated on a wing acts at right angles to its surface and as such, if the wing is horizontal, the lift acts in the vertical direction opposing the weight of the plane. When the aircraft is in a banking turn, only part of the lift on the wing acts in the vertical direction and the rest acts sidewards into the turn. In the extreme case of the aircraft in a 90 degree bank, none of the lift on the wing acts vertically to oppose the weight. So, for that third case, even though the actual wing area has not changed, the amount of wing area as seen from directly above has reduced to zero just as the component of lift in the vertical direction has done.

The two foil sections on a surface-piercing V foil are essentially acting like two banking wings stuck together so that the component of the lift force on one half of the V-foil is "wasted" in pushing against the equal but opposite component of lift produced on the other side of the foil. However, the dihedral angle of a V-foil (the angle of the foil sections to the horizontal when viewed from in front) is not that large on typical surface-piercing hydrofoils, normally between 15 to 35 degrees. As a result, a reasonably high proportion of the total lift that is generated still acts in the useful vertical direction to support the weight of the craft.

I have simply found it more expedient to calculate the lift on the basis of the foil area as seen from above, as that avoids having to account separately for the component of lift on the various foil elements which acts in the vertical direction.

Another, and perhaps better way of calculating the vertical component of the lift generated by an inclined hydrofoil is to calculate the lift perpendicular to the foil surface (LT) first and then obtain the vertical component of that lift (the part that supports the craft weight which I will define this time with the symbol LV), by using trigonometry:

$$LT = 0.5 \times CL \times RHO \times AT \times V^2$$

... is the total lift generated perpendicular to the foil surface, where AT is the area of the foil perpendicular to its surface. Then, the component of lift in the vertical direction is given by:

$$LV = LT \times \cos(THETA)$$

...where THETA is the dihedral angle defined previously. Combining the two equations gives:

$$LV = 0.5 \times CL \times RHO \times AT \times \cos(THETA) \times V^2$$

...but now it can be seen that part of the previous equation actually represents the submerged area of the foil when viewed from above (previously referred to simply as A):

$$A = AT \times \cos(THETA)$$

So we have now come full circle back to the form of the equation as I had originally presented it for the vertical

Continued on Next Page

LETTERS - DESIGN/BUILD
(Continued From Previous Page)

component of lift in terms of the foil area as seen from above:

$$LV = 0.5 \times CL \times RHO \times A \times V^2$$

...(in my previous reply to Jim I had simply referred to LV as L). Now, re-expressing the equation in terms of foil area gives:

$$A = LV / (0.5 \times CL \times RHO \times V^2)$$

...and applying this equation to your case with the following particulars...

$LV = m \times g = 90.7\ kg \times 9.81\ m/s^2$
$= 890\ N\ (200\ lbs)$
CL = 0.25 to 0.4
RHO = about 1000 kg/m^3 in fresh water, 1025 kg/m^3 in salt water
V = 4.5 to 6.7 m/s (10 to 15 mph)

...leads to a foil area viewed from above (A) from 0.099 to 0.352 m^2 in fresh water or 0.097 to 0.343 m^2 in salt water depending on the speed and CL values which are used.

As you can see, there is not much difference in the required foil area whether you are in salt or fresh water. The speed of the craft and the lift coefficient of the hydrofoils has a far greater impact. For a nice high aspect ratio fully submerged foil with an efficient foil profile (or wing form), you should be able to get away with a combined area of foils on the low side of the range above.

On the other hand, if you have a stumpy foil with a "rough" profile, then a higher area will be necessary. In the latter case, the resistance will also be greater. Even if a *FLYING FISH* off the shelf is not what you are after, it would be worth your while looking at the foil arrangements on that type of craft or the similar human powered *DECAVITATOR* for some good tips on the optimum foil design for a human powered hydrofoil.
Martin Grimm

'47 Hydrofoil Needs Better Prop

I'm in the process of completing a hydrofoil project started in 1947. The design is Swedish, called *TRIXIE de LUXE*, and was designed by an engineer named Ivar Troeng (see photos at left). The boat is built in Oregon pine and mahogany, and everything is made at a immaculate standard. The builder is now 85 years old, and he never had the boat on water. But I did. 1 week ago, the boat was launched, at it hardly took in any water, after 53 years on land. The problem is, the engine is not strong enough the get the boat flying. It is an appr. 90 hp Volvo engine, with 1:1 gearing to a straight shaft propeller, max rpm is 5000. The current propeller on is a 12" x approximately 22" (dia. x pitch). After a phone call to the propeller expert at the Norwegian university in Trondheim (SINTEF), I was told that I should have a 12" x 13" size propeller. But they were not sure. I have also been told that I ideally should have a reduction gearbox say 2:1. The boat is 17 feet long. I do not know the weight. I would be very grateful for any information on how to choose a propeller, or information on manufacturers of variable pitch propeller for rigid shaft system. More pictures of the boat can be found on the internet at these URLs:

http://www.inocean.no/trixi1.html
http://www.inocean.no/trixi2.html
http://www.inocean.no/trixi3.html

Thomas Eckey, Norway
te@inocean.no
Svenn Erik Kristoffersen
svennek@online.no

Response...

Veteran hydrofoil designer and IHS member Niel Lien suggests that you obtain a drag profile for this craft by towing it at various speeds and measuring the drag. Then get an engine horsepower profile and send these to a propeller manufacturer for a recommendation.

Response...

For any particular speed and power, there is a propeller diameter for best efficiency. There are power losses from the speed of the wash (the water pushed backwards by the propeller) which is larger for smaller propellers.

There is also power lost from the drag of the blades which is larger for larger propellers, so there is a size with least total losses. However, efficiency does not decrease much if the size is near to the best, and the best size is often too big to fit on small power boats. There is

Continued on Next Page

also a propeller pitch for best efficiency. If the pitch is very small the blades have to rotate very fast so there is a lot of drag, as there is with large diameters. If the pitch is very large, the propeller turns very slowly with a large pressure on the surface, so there are large losses from the propeller tip vortices.

The most important aspect is getting the pitch to match the engine and boat speed. A problem with hydrofoils is that there is a lot of thrust needed at low speeds while the maximum speed is a lot higher, and some thrust is needed at maximum speed.

I haven't yet looked at your boat, but I'll guess that you are looking for about 15 m/s (54 km/h) max speed. The pitch is the distance that the propeller tries to advance each turn. 5000 rpm is 83.3 turns per second, so the pitch should be 15/83.3 = 0.18m pitch, or 7 inches, or about 8 to 9 inches to allow for slip. 13 inches is too much, and the engine will not get to full speed, so it will not produce full power (unless the top speed of the boat is a lot more than what I estimated).

A 17 foot boat will start to hydroplane at about 6 m/s. With a 22 inch pitch the engine will only turn at about 1500 rpm or less and produce about 30hp just when you need the most thrust. You must get the pitch about right to get anywhere near the full power of the engine.

There will be a small loss of efficiency from using an 8 inch pitch propeller at 5000 rpm, compared to using a 16 inch pitch propeller at 2500 rpm with a gearbox, but I do not think that it will be a big problem, unless you cannot buy a propeller of the correct pitch.

I've just found my book about propeller sizing, and the expected boat speed is one of the most important factors in deciding the best propeller. I'll estimate some speeds and try to work out what will be needed. I can't give you the equations because there is a chart and I don't have that in electronic form.

For 15 m/s and 90 hp at 5000 rpm, the best propeller efficiency will be about 66%. This will use a 10 inch diameter propeller. For lower speeds a larger diameter is better, but I can't accurately estimate the efficiency. Also a larger diameter makes the efficiency less at 15 m/s. I think that the efficiency at 15 m/s with a 12 inch diameter propeller is about 50%, but the chart give a pitch of about 6 inches for those conditions, which is too low. It seems that making the propeller larger than optimum by 20% makes the efficiency worse than making the propeller smaller than optimum by 20%. However, you might need the best efficiency when there is most drag, which is while the hull is still in the water.

Malin Dixon
malin@onspec.co.uk

Response...

The advice your received from the university seems about right. *TALARIA III,* weighing 4000 pounds, with 200hp, and a 1 to 1.7 gear reduction, has a 15/17 dia./pitch prop. A 12/12 prop. would be roughly equivalent to *TALARIA's* for 90hp, 1 to1. If your power to weight ratio is higher than *TALARIA's* then a higher pitch propeller (12/13) would be better.

Harry Larsen
hlarsen0@gte.net

Build Foiler "From Scratch"

I read your postings regarding sailing hydrofoil plans, and was wondering if anyone has had any success with building a reasonably priced hydrofoil sailboat? I am familiar with the *RAVE* and others out there, but I am unwilling to pay the $10K price. I am interested in any successes anyone has had, or any info. My family recently purchased a marina, and thus I have resources available to construct my boat.

Kevin Knull
KDKnull@aol.com

Response...

You may want to take a look at Dave Carlson's website, which is at http://members.xoom.com/catcobbler/. He has continued to refine and test designs begun by Dave Keiper and appears to be having good success.

Boat Plans Wanted

I am looking for plans for a small outboard hydrofoil.

Michel Bourgault
bourgaul@ntic.qc.ca

Response...

Look at this page on the IHS site: http:// users.erols.com / foiler / popmags.htm. Also, read this article on our website: http://users.erols.com/foiler/upright.htm.

HYDROFOIL MODELS...

750mm Radio-Controlled (R/C Model Sailing) Yacht Web Site...

Please check out our site for possible inclusion on your links page? http://www.home.aone.net.au/cybernautics//750future.html. We have been using inverted T-foils on our rudders for years to prevent nose diving.

Malcolm Smith, Secretary
750mm R.C. Yacht Assoc.
mal@cybernautics.com.au

Source of PT-20 Model Kits

I have a German model magazine where I can order a blue print and description how to build a model PT-20 (1:25, 83cm long 30cm broad.)for about $15USD. Also some hovercrafts (SRN-1$15,00/ Bell SK 5 $25 in French) warships, towing, sailships, airplanes and even engines more than 2000 ! For

Continued on Next Page

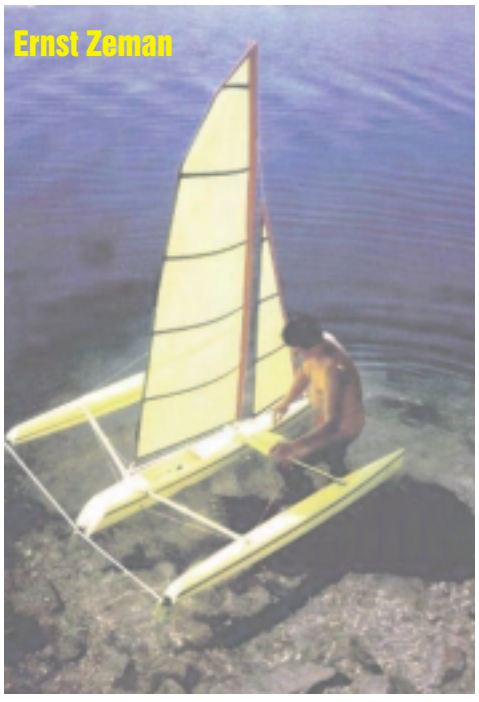
LETTERS - MODELLING
(Continued From Previous Page)

who is interested I can scan the list of models. Addresses/phones for ordering the plans: Phone: 07221-508722; Email: vth-service@t-online.de; Address: Verlag für technik und handelswerk GmbH, Bestellservice, D-76526 Baden-Baden, Germany (main office). In Holland: Tel: 0031-294-450460; Fax: 0031-294-452782; E-mail: muiderkr@euronet.nl; Address: De muiderkring BV, Postbus 313, NL-1380 AH Weesp. They accept: Eurocard, MasterCard, Access, and Visa.

Mark van Rijzen
Makkie.sannie@hetnet.nl

Source of Model Testing...

There is a lot of model-building and -testing going on here at Vienna, Austria, though it's far from the main boatbuilding places! - If anybody has a new design and wants to test a small version, before he starts the REAL one, contact me; a model of 2 meters is only 1/125 the expense of a real 10 Meter Yacht. I'm building these models on request, but also to have a comparison to the speed and performance of the outrigger boats (proas - models and big ones up to 33ft this far) I'm building. In spring I will start to build a NEW, bigger, faster and lighter Proa - so if you are interested, please reply. It's a cold and lonely place right now in Austria for a boatbuilder.



Ernst Zemann
ernstzemann@hotmail.com
http://www.multihull.de/zeman/

Response...

I have the same service in France... One of biggest model building companies in the world and an hydro laboratory offered me a free service using engineer students... All my past boats have been model tested... It's a good way to get some info on realité of the VPP. If you need some info on proas, don't hesitate to ask me.

Guy Delage
guydelage@guydelage.fr

PT 20
Tragflächenboot
Ing. Kurt Matuszcak, M: 1:25, L: 830 mm, Breite: 300 mm, Tiefgang: 105 mm, A: Einschrauber/Verbrennungsmotor, Spantbauweise, 1 Blatt, B: Einfacher Modellbauplan mit Begleittext und Stückliste.

HYDROFOIL VENTURES...

Hydrofoil Boat of New Properties, My Inventions, Looking For Partners

Hydrofoils are my hobby. I have several ideas that can considerably widen areas of uses of hydrofoil boats, I believe. My dream is little hydrofoil (max. 2 tons of draught) equipped with a quiet drive (probably electric or combined drive system). This vessel should be: (1) human error resistant (shallow water entry, for example), (2) to be able to profit from little harbor or even to operate without any wharf (shallow water problem), and (3) transportable by a passenger car trailer. Such ecological and cheap water vehicle would be able to become a hit of a sport/turistic boat market, I think. I have invented several of constructional solutions, which in connection with existing know-how will make it possible to manufacture such a hydrofoil. I have the benefit of my experience geared while working in the Polish aviation industry to project devices (including suitable calculations) of the aforementioned water vehicle. I have verified my ideas on models. Now I seek partners experienced in manufacturing and trading conventional hydrofoils interested in utilization of my ideas. Even suggestions for such a partner would be welcomed.

Bogus³aw P³oszajczak
ul. Ko¶ciuszki 45
390-300 Mielec, Poland
gstec@powiat.mielec.pl

Continued on Next Page

LETTERS - VENTURES
(Continued From Previous Page)

Bold Ideas

We are an innovative group who intend to promote inventions and new ideas. We are located in Romania. As well, we are in possession of some valuable ideas, and we want to patent them in any country and, if possible, to sell on the international market. These are not toys!!, and some of them have military applications. We guarantee our seriousness and the value of our projects. We need help to promote and sell our inventions. Please contact us for further info.

Dan Sobol
larko_58@yahoo.fr
phone: 04 094 25 44 33

Hydrofoils Excluded From TheRace2000...

TheRace headquarters has limited the entry of our hydrofoiler for the "No Limits Race" around the world. Their discrimination against foils has seriously impeded the development of effective offshore sailing hydrofoils. Our potential sponsor withdrew when our entry was denied. The prototype is complete. Our 9' wide horizontal spans are designed to retract when we hit the inevitable obstacles. Please send an email to kevin.church@disney.com with a copy to stephanie.schroeder@therace.org and ask them why they are discriminating against hydrofoils. Thank you for your support.

Peter Murray
therace2000@hotmail.com
Tel.#(1)561-286-2643

PARTS & MATERIAL...

Russian Parts Received...

I wanted to let you know that my company has successfully ordered new spare parts out of Russia. We have received our 1st shipment (5 propeller shafts and 1 V-drive). Also have we ordered 3 (new) front and 2 (new) aft foils.

Mark van Rijzen
Makkie.sannie@hetnet.nl

Source of Engine Parts for Russian Hydrofoils

My company, Comeract, Ltd is a source of spare parts of Russian engines, including engines in Russian hydrofoils like Kometa and in other Russian vessels of the type Alexander Green and Efpatoria. My fax is: 0030 241 22728; address is: 9 Mitropolitou Apostolou; Rodos-Greece

Mihail Hatziapostolou
comeractgr@hotmail.com

ENGINEERING DESIGN...

References: Planing Hull Specifications

I am a university student studying ocean engineering and I was wondering if you could assist me in gathering some information on planing hull specifications for one of my assignments.

Daniel Lewis
31322172@students.amc.edu.au

Response...

Here are some references for you:

- Savitsky, Daniel, "Hydrodynamic Design of Planing Hulls," *Marine Technology*, Vol 1, No.1, Oct 64
- DuCane, Peter, *High Speed Small Craft*, Temple Press Books, London, 1964, 3rd Edition.
- Blount, D.L., "Small Craft Power Prediction," Vol 13, No.1, SNAME Transactions, 1976.
- Heller, S.R. & H. H. Jasper, "On the Structural Design of Planing Craft," Quarterly Transactions, RINA, Jul 60.
- Allen, R. G. and R.R Jones "A Simplified Method for Determining Structural Design-Limit Pressures on High Performance Marine Vehicles," Paper No. 78-754, AIAA/SNAME Advanced Marine Vehicles Conference, San Diego CA, Apr 78
- Spencer, J.S., "Structural Design of Aluminum Crew Boats," *Marine Technology*, Vol. 12, No.3, Jul 75
- Silvia, P.A., "Small Craft Design: Structures," paper presented at Small Craft Engineering Symposium, University of Michigan, Oct 71

Ken Spaulding
ken@lypc.com

Tidal Turbines...

I thought you might be able to help, since there would seem to be some similarity between hydrofoil sections and those for free-flow tidal turbines. Having spent 20 years developing and building wind turbines in Britain and California, I am now looking to develop electricity-producing turbines for strongly tidal areas. These will eventually be up to 20m diameter or so, with a capacity of about 500 kW per rotor.

My website shows what these might look like. The first thing I want to do is build a small demonstration model, about 5 ft diameter, and test it in the Thames near my home in London. However, I am stumped on what hydrofoil section to use, and where the cavitation limits on speed will be. For the model, the chord at 75% radius will be about 0.1m, traveling through the water at say 8 m/s (i.e. 11 m/s tip speed), giving a Reynolds number of about 800,000. This is low, compared to the data in Abbott and von Doenhof, however it is roughly comparable to a 5m diameter wind turbine rotor. Most of these have airfoils with gentle and predictable stall, and are given taper and twist resulting in a

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LETTERS - ENGINEERING
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flat-topped limit to power (at constant rotational speed). I would think underwater mills could operate in the same way, subject only to a cavitation limit and, of course, lower speeds and turbulence than in air. I am assuming 11 m/s (22 knots) is about the limit to avoid cavitation, and that a standard NACA 15% or so airfoil would be OK. Do you agree? What about cavitation speed limit - any other comments?

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76 Dukes Avenue
LONDON W4 2AF
http://www.jac.ndirect.co.uk
http://www.windenergy.co.uk

Response...

A cursory look leads me to say that there is no problem whatsoever at the speeds anticipated. Cavitation is not a problem if designed for. We ran the SES efficiently with supercavitating props at 80+ knots, with no damage. More of a problem that can be expected is logs, debris, etc. in the water. Also remember, water is incompressible, and high aspect ratio, thin foils tend to oscillate destructively. Good luck.

Kobitz, Nat
KobitzN@ctc.com

Response...

I have the following response which I know is not a full answer to your questions:

1. As you have already noted, there should be many similarities between wind turbines and water turbines as the basic physics behind their operation remains the same. The differences are all in the nature of the fluid the turbine is operating in as illustrated in Martin Grimm -- Table 1 below. The fact that salt water density is about 840 times greater than air density means that for the same inflow conditions, including the flow velocity, a given turbine (if strong enough to handle the extra load) would produce about 840 times as much power in water than in air!

2. Cavitation is a phenomenon which, of course, does not occur for wind turbines but could be a problem with water turbines. The cause of cavitation is straightforward. If at any location on the blades of a hydrofoil (in this case, the blades on the water turbine), the water pressure is reduced below vapor pressure for water, then it will change state and become steam. Normally we are familiar with steam being produced when water is heated beyond 100 degrees Celsius at atmospheric pressure. In the case of water flowing over a hydrofoil section, the combination of an ambient water temperature of say 15 degrees Celsius combined with a very low pressure will produce the same result. The vapor pressure below which water turns to gas (or cavitates) is quite variable and depends on whether we are dealing with fresh or salt water, the water temperature and even the gas content in the water. Gas content and other "impurities" in the water can trigger cavitation at a higher pressure than would otherwise be the case.

	Air	Salt Water
Density	1.223 kg/m^3	1025.9 kg/m^3
Kinematic Viscosity	~1.4x10^{-5} m^2/s	1.188x10^{-6} m^2/s
Typical Velocity	10 m/s (say, in a good breeze)	3 m/s (say, in a tidal stream)

Martin Grimm - Table 1

3. The onset of cavitation can have the following detrimental effects on hydrofoils, including propeller blades and water turbines: A lift breakdown occurs for hydrofoils and in the case of propellers, this corresponds to a thrust breakdown in comparison to the thrust which would have been produced without cavitation occurring. The collapse of the cavitation bubbles on the blades or downstream causes underwater noise and can also induce vibration. Under certain conditions, the collapse of cavitation bubbles, as the pressure rises above vapor pressure again, can cause erosion of the hydrofoil surface / propeller blade. This is evident by distinct pitting of the surface of the hydrofoil / propeller blade. In the case of propeller blades, it is often visible at the leading edge near the outer tips or also at the blade root near the propeller hub.

4. There are foil sections for both hydrofoil craft and for propeller blades which are specifically designed to operate in a fully cavitating condition. These are known as supercavitating hydrofoils or propellers. In that case the hydrofoil or propeller blade profile is wedge shaped with a blunt trailing edge. The idea is that the water turns to vapor (steam) at the leading edge of the foil on the low pressure side and this vapor cavity remains over the whole of the low pressure side of the foil / blade and only collapses back into water well downstream of the blade. Such hydrofoils or propellers are however not as efficient as the more conventional sub-cavitating or fully wetted hydrofoils / propellers.

5. A final clarification: Cavitation is not the same as ventilation. Ventilation occurs when air is sucked down from the

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LETTERS - ENGINEERING
(Continued From Previous Page)

water surface and onto a hydrofoil or into a propeller due to the low pressure it is creating. On outboard propeller legs, "anti-cavitation plates" are often fitted. I believe these actually act as fences which help to stop air being sucked down from the surface and into the propeller. Ventilation also causes propeller thrust to be reduced just as cavitation will do. The same is possible for a water turbine and you will have to ensure ventilation is avoided to get the best performance from your turbine.

6. For ship's propellers there are some rules of thumb concerning the avoidance of cavitation and also far more sophisticated methods of calculating the pressure distribution over the blades to check on the risk of cavitation. I don't know how well the rules of thumb will apply to turbines which take energy out of the water rather than put energy into the water as propellers do. The simplest propeller cavitation criteria I am aware of is the Keller Criteria which sets the required blade area for a given propeller design and depends on the submergence of the propeller below the waterline, the thrust required to be produced, the number of blades and the vapor pressure. At this stage, I am unclear how the formula can be applied to a water turbine as a turbine does not produce a thrust, but rather has a drag force acting on it as it spins. I will give that some further thought.

7. A more rigorous approach for designing propellers is to use what are commonly known as "cavitation bucket" diagrams. These show the limits of cavitation free performance on a hydrofoil / propeller blade profile at various angles of attack as a function of their cavitation number. The cavitation number is in turn dependant on the ambient water pressure at the location of the foil, the flow velocity over the foil and the vapor pressure of the water. The diagrams vary depending on the blade shape selected. Limits for both cavitation on the face and back are provided on such diagrams. Thus the diagrams show the range of angles of attack, both positive and negative, which the foil section can tolerate without cavitating for a particular flow velocity and head of water pressure (or in other words, foil submergence). I do not have any cavitation bucket diagrams handy at the moment so I can't give you a worked example. In any case, to do that, you would need to give me more details of the RPM vs torque characteristics of the generator load on your turbine, and details of the envisaged pitch and number of blades etc. on the turbine impeller. Better still, if you defined the inflow conditions (flow velocity past blade and angle of attack of blade) at various radii on the blades then a direct check on cavitation could be made using a suitable diagram.

8. My gut feeling is that 22 knots combined with a small blade angle of attack and a streamlined blade section should be OK for cavitation free operation, but I would prefer to see that is actually the case by reference to the appropriate cavitation bucked diagram.

9. A NACA 15% (or NACA 0015) foil profile is symmetrical for both its upper and lower surface. Such foil sections are typically used for surfaces which need to produce an equal amount of lift in both directions such as ship's rudders, yacht keels etc. I believe you would get a more efficient turbine if an asymmetrical foil section was used (such as is the case on the wings of an aircraft or the blade sections on a propeller). I also have a feeling that a thinner foil section (with a thickness to chord ratio more like 10%) would give greater efficiency and hence more output power. This will depend on the strength required of the turbine blades as there is no point in having too thin a section only to see it snap in half! For typical ship or aircraft propellers, the thickness to chord ratio increases the closer you go from the tip towards the hub of the propeller. The same would apply to a turbine where the bending forces increase as you near the hub.

I hope this partial response helps you in the meantime but I will give your questions more thought and try to give a more complete answer as time permits.

Martin Grimm

HUMAN POWER HYDROFOILS...

Marquette's Solar Powered Hydrofoil...

I was at the Solar Splash competitions against the Marquette boat. It was a good concept and based off of one of the entries by Kanazawa Institute of Technology, Japan. The only ironic thing is that the boat did better without the foils than with them. I have seen them race that boat 4 times and every time they had the same problems, dynamic stability when on foil.

On the flip side, the Kanazawa boat had a stability system that was rock solid. As a monohull alone the Marquette boat did fine though, in endurance. Most of the slender monohull types didn't fare well in the sprint competition. If you want the hands-down overall best design look at the KIT boat. Check out the Solar Splash website http://www.sunrayce.com.

Over all, Marquette has probably one of the better all around teams at the competition. They regularly support multiple boats at the competition. Something that no other school does on a regular basis. Their entire university on the whole does a great job supporting the tech project cause. The tech teams are an active part of their curriculum. They are also one of the major reasons for the existence of the competition; they have been the host of the event since its inception.

Anthony Scott Daniels
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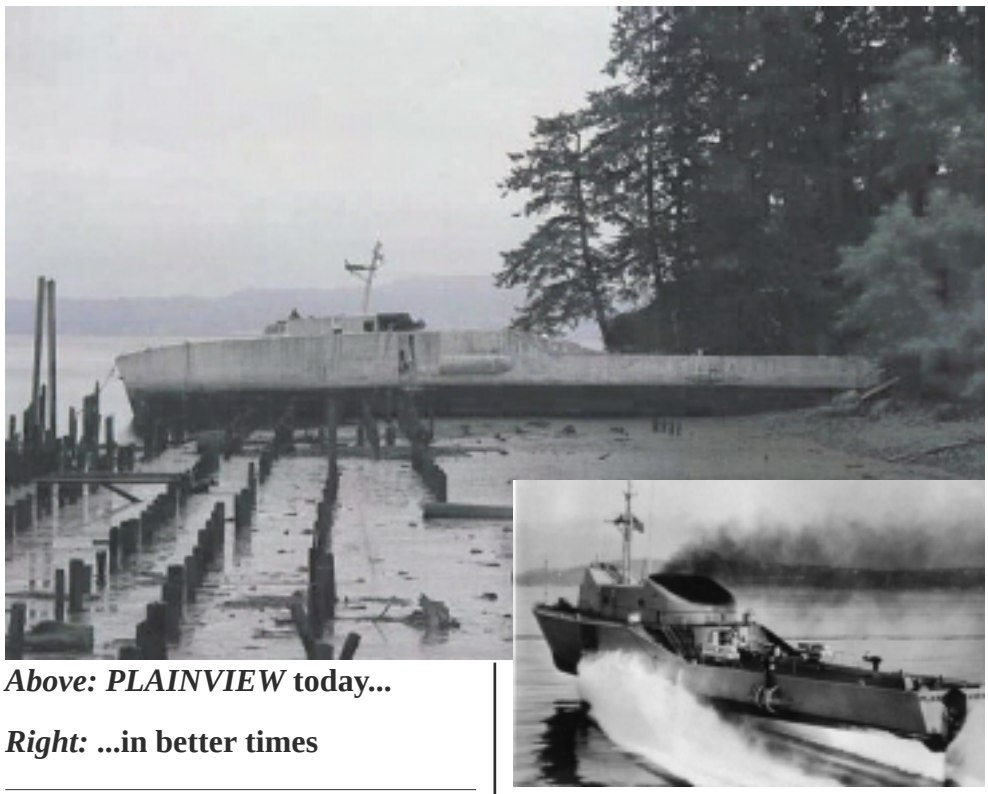
HISTORY/RESTORATIONS...

PLAINVIEW's Owner Identified...

On a short trip to the Oregon coast, I stopped to take pictures of *PLAINVIEW*, which is located about 2 miles east of the Astoria bridge on the Washington side of the Columbia. When traveling east, you cannot see the ship since it will be behind you. Traveling west, it is in plain view across the slight inlet. As I was taking pictures, a fellow stopped and started talking about the owner and the abandoned plans. I subsequently made an e-mail inquiry, and have been given permission to let IHS know that the current owner is Lowell Stambaugh. His e-mail address is nmstambaugh@hotmail.com and his telephone number is (360) 777-8798. He apparently lives across the road and up in the hills from the ship. I would like to be copied to: if anyone makes e-mail contact with Lowell. Working for the Navy Department, I was the principal engineer following the design and construction of the *PLAINVIEW*. Upon construction, I was hired by David Taylor Naval Ship R&D Center to conduct the Navy's Hydrofoil R&D program using the *PLAINVIEW* and *HIGH POINT*. Trials of various types were conducted which included ship system improvements; analysis of torpedo, missile, and gun firing; and confirming modeling/computer techniques based on full scale measurements. The *PLAINVIEW* was especially useful in learning structural calculation concerns, large hydraulic system design, and foil system loads. The *PLAINVIEW* also provided the research bed for plastic piping, fiberglass piping, stainless tubing with automated butt welder, and many other features now found on many new Navy ships.

Sumi Arima
arimas1@juno.com



***Above: PLAINVIEW* today...**

***Right:* ...in better times**

Which Grumman Hydrofoil?

I am currently looking for information on a Grumman hydrofoil, 75 Ft. in length, 1968 all aluminum model. This is the only info I have on this vessel. Do you know where I could get information on this vessel, possibly a picture, and would it be a good choice for conversion to a charter yacht or a tour boat?

The Marauder
bigal12many@aol.com

Response...

I think this is either the passenger ferry *DOLPHIN* or the military gunboat, PG(H)-1 *FLAGSTAFF*. The *DOLPHIN* carried 88 passengers and had a hull length overall of just under 75 feet. The hull had conventional sheer. The passenger cabin was raised about three feet above the main deck. The *FLAGSTAFF* had reverse sheer, which made the height amidships higher, the resulting flush deck eliminated the need for a raised cabin. As a result the length on the flush deck was about a foot shorter, or about 74 ft. Both were built in the 1964 - 1967 timeframe, the *DOLPHIN* first. Both designs shared components and features. One of the last things Grumman did before getting out of the business was to ship all the spare engines, foils, struts, props and other parts to the Navy at Carderock. Last I heard someone in New Jersey was trying to put the *FLAGSTAFF* back in operation. The *DENISON* was about 95 to 100 feet in length, and was built in the late fifties. *XCH4* ("The Carl Boat" so called after Bill Carl) looked like a twin engine high engine seaplane with the outer wings missing. It had been built in the mid fifties and by 1962 had been scrapped. The *XCH6* was a modified 23 foot (I think). Grumman pleasure boat with a gas turbine and various foils including I believe fully submerged supercavs. It was built in the late fifties and flew on the Great South Bay of Long Island. Let me know if you need any further recall.

Charlie Pieroth
SoundTM@ix.netcom.com

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LETTERS - HISTORY/RESTORATIONS
(Continued From Previous Page)

1954 German Sport Hydrofoil

I found a German-built *WING* sport hydrofoil built in 1954, abandoned and rotting in the bush in Northwestern, Ontario, Canada. The only info that I have found is from the Sept 54 Life Magazine article featured in the Hydrofoil Bibliography on this site. We would like to attempt a restoration but need more information, ANYTHING PLEASE!!

Greg Wilkinson
gwilkins@hofferwilkinson.mb.ca

WHISKER Foil Boat

I go back to the late 1950s for my first hydrofoil ride on a 16 foot Challenger outboard boat with a 35 hp Evinrude engine. I am a contemporary of John Gill and Company, and had the pleasure of driving their *WHISKER* foil boat with Jim Wynne and Walt Walters.

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Historic Upright Hydrofoil Kit

It is exciting to read your history of the development of the Up-Right Hydrofoil Kit. I first saw this hydrofoil when I was newly married (1963) and on a business trip with my wife in Coeur-Delane Idaho. They were mounted on a 17 foot boat and seemed to be the answer to my dreams of making a boat go faster and easier. I had to have a set and not long later purchased a set from the Up-Right company. My wife went along with it even though she must have felt there were much better things to spend our money on. They were mounted on my 14.5ft Fiberglas runabout with 40 hp Johnson outboard. It was soon apparent that they worked like everything but the motor was not properly loaded and could overrev. I then was told that the OJ Johnson propeller company in California was excellent at making propellers for fast boats so I contacted them. They sold me a three blade bronze propeller with about three more inches of pitch and cupped trailing edges. It worked beautifully. More than one fellow with a V-8 inboard speed boat was a little surprised and annoyed when I passed him with my little outboard boat. Also the foils worked very well in Georgia Straight off Vancouver harbor where I used it often. They did dive though, when in a following sea. This was a frustrating deficiency. The major problem was the "shear plate, string-in-the-bottle" system. I believe I did strike small debris a few times and the foils separated as intended and I was able to retrieve them. One day though, I was traveling under the Lions Gate Bridge In Vancouver, B.C. and one of the rear foils broke loose. The nylon line payed out OK but there was too much current and I could not pull the hydrofoil back up. The string even cut into my hands a bit. I let the foil go and there was no way we could find it later. I was able to buy a replacement from a man in Oregon and was back flying again for a while. Eventually other things became more important (two sons as example) and I sold the boat. I did keep the foils though and they moved with us from place to place. (Vancouver to Pine Hill Alabama, To Aberdeen Washington, to Vancouver, to Mackenzie B.C., to Tswassen B.C., to West Vancouver, two moves). In about 1986 my 15 year old son expressed an interest in the propeller and the foils that had been in the household all his life. We bought a fourteen foot aluminum boat and an older 40 hp Johnson so the propeller would fit. Remembering the problems with the shear plates I modified the mounting of the foils so they would tilt up like an outboard does when it hits an

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With the Upright Hydrofoil Kit installed, this boat achieved 47 mph with a 65 hp Mercury outboard motor.

object. Once again we were foilborne. All went well for a while and the set-up performed like the good old days.

One day the front foil hit a submerged plastic bag and the foil rotated back against the boat. It then acted like a huge brake in the water and the boat very abruptly stopped. Luckily my son was not hurt although he was not impressed.

Another time one stern foil hit something and rotated back out of the way, however it did not rotate completely out of the water and it too acted like a huge brake. It actually pulled hard enough to bend the foil out of shape.

Next I cut the front foil in two at the point of the V. The two pieces were held together at the V with a shear bolt. The foil was made so that the main tube would not rotate on impact but the join between the top of the foil and the cross tube would allow each half of the foil to rotate away from the center towards the outside of the boat when something was struck. This actually worked very well.

The rear foil was straightened and a different solution was used to make it continue rotating until it was completely out of the water. A fairly large piece of plywood was attached with hinges to the top support extrusion of the foil. This was held up in the horizontal position by a pin in the side of the boat when the foils were in use. If the foil started to rotate backwards due to striking something the piece of plywood would come off the pin and swing down and be caught by the water. It would go against the leading edge of the foil so the water could not pass through the triangular inside shape of the foil and therefore the water would push the foil up and completely free of the water. This system also worked very well.

By this time we were getting tired of experimenting, and the young fellow indicated that he was not really interested in foils but just wanted a nice boat to play with. The foils went back in the basement where they remain to this day. I still have dreams of buying a suitable boat and using them again but it is hard to justify when I already have two boats not suitable for these foils.

Actually I have a 7,000lb-26ft Fiberglas cabin cruiser that I would like to put foils on. I think their fuel efficiency and weight carrying ability would be a great advantage for that type of boat. There has to be an economic justification for adding hydrofoils. If I can cut fuel usage by one half or more that could do it. The foils would have to very simple and inexpensive.

I am thinking of a straight foil on each side at the stern, about 3 feet long each, that would replace the trim tabs. They would be parallel to the 20 degree V of the boat and about a foot or so below the bottom of the boat. At the bow, mounted to the stem, would be another foil to balance the lifting of the stern and to lift the bow. The idea would not be to lift the boat completely clear of the water but to take 80 or 90% of the weight of the boat but leave much of the bottom of the deep-V and the propeller in the water. As long as there is enough of the boat still in the water enable it to be controlled there should be no need for fancy controls on the foils. What do you think of that idea?

John Hards
jhards@talk21.com

Response...

We were delighted to receive your email, and we thank you for taking the time to write it because it contains much good information. Unless you object, we will add it as a large footnote to the article. Of course we will forward your email to Tom Lang, the designer of the Upright kits; he is a member of IHS. As far as adding foils to your current boat, a 26 foot cabin cruiser, you may want to contact IHS member Harry Larsen for inspiration and information. Visit his website for information on his boat *TALARIA III*. Harry estimates that it would cost $20,000 to add a fully submerged foil system with automatic control as he did. *[Tom Lang's article on his experiences designing the Upright hydrofoil kit is posted on the IHS site: http://www.erols.com/foiler/upright.htm. - Ed.]*

Barney C. Black
foiler@erols.com

Miami Shipbuilding History

I write, edit and publish and annual historical magazine for the Friends of the South African Air Force Museum. Last year one of the articles I wrote was on the SAAF crashboats/ rescue boats. From that an interest arose on researching the full history of the Motor Boat Unit. To this end I have been engaged in a number of interviews with surviving members, and archival research. One of the people instrumental in us getting these boats was the designer a Mr. Dair N. Long, a naval architect at the University of Michigan. He designed what were known as "Miami Boats," which were built by the Miami Shipbuilding Company (MSC). I wonder if it would be possible for you to tell me anything about this man, more about the company, and if there are relevant documents available.

Guy Ellis
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MONITOR & *SEA LEGS*

The Mariner's Museum in Newport News VA is planning a multimillion-dollar exhibition building for small boats. According to the Curator the *MONITOR* hydrofoil sailboat has the highest requests for information on it; therefore it will be a featured exhibition along with *SEA LEGS*. The Mariner's Museum would like to be a facility where people might go to study hydrofoils.

Neil Lien

The 750mm Radio Controlled Yacht — Future Hydrofoil Development

Malcolm Smith, Secretary
750mm Model Yacht Association
mal@cybernautics.com.au

Sailing hydrofoil development is hotting up, with the advent of the Hobie Trifoiler, the Windrider Rave, and recently the foil supported Moth class dinghy. So why not a fully foil supported 750? The preliminary design sketch shown was prepared by Mal Smith.

The Foil System

The two forward foils are surface piercing foils attached to a cross beam that is freely hinged along the centreline of the hull, so that the hull can roll while the forward foils remain level. The aft cross beam is fixed to the hull. The two rear foils are fully submerged t-foils, each similar to the rudder foils currently used on 750's to prevent nose diving. The rear foil supports are hinged transversely on the ends of the aft cross beam. A rod fixed to the rear foil supports is connected to the forward cross beam with a sliding hinge joint. This rod controls the angle of incidence of the rear foils when the boat rolls, or heels due to wind pressure. The forward foils are set at a positive angle of incidence. The rear foils are both at roughly zero angle of incidence when the boat is level. When heeled, the windward rear foil is at a negative angle of incidence and the leeward rear foil is at a positive angle of incidence. Thus the forward foils provide the bulk of the lift, control the ride height and provide level sensing for the rear foil system. The rear foils provide some lift, all of the heeling resistance and also pitch resistance. The rig is situated well aft, and most of the side loads will be carried by the deep rudders. The general philosophy of the design is distribute the foil loads as evenly as possible over the four foils, and of course to keep the design as simple possible consistent with a self adjusting system. The disadvantages of the design are that there are six struts penetrating the free surface (the current practical minimum is three and the ideal is one) and the use of surface piercing foils which are prone to ventilation.

Rule Considerations

The design shown challenges the 'no multihulls' rule of the 750mm class. While there are no distinct stabilizing hulls, the design does rely on the cross beams, which are wedge shaped in section, to provide stability until the foils begin to operate. The acceptance of the design may depend on how early the foils begin to provide stability as wind speed increases. Of course if the foils don't provide stability early, the design will be a dud anyway.

Interestingly, the Moth class is currently discussing the use of foils on their boats, and the general consensus seems to be that as the Moth is the only dinghy class that allows the development of hydrofoils, it is their duty to the sailing fraternity to do so. Perhaps the 750mm class has the same duty towards R/C yachting?

For more information and plenty of interesting photos, visit our website: http://www.home.aone.net.au/cybernautics//750future.html

750 mm Brief History

The 750mm model yacht class began in 1986 in Sydney Australia. What was conceived as a one off race event grew into a monthly series.

The first boats had rigs up to 1.2m, keels of around 300mm and bulb weights of less than 1kg. The more lightly ballasted boats fared well at this stage as the limiting factor for the ability to carry sail was nosediving when running downwind. The nosediving problem was largely overcome in early 1988 with the introduction of the foil rudder.

From this time on the more heavily ballasted, longer keeled boats began to prove superior. This led to the current restrictions being placed on these two variables.

750 designers have experimented with wing masts, multiple rudders, una rigs and wing top rigs. This experimentation, which is the basis of the class, continues today.

Currently, the only venue for regular 750 regattas is Queenscliff Lagoon, Pittwater road, Queescliff, NSW Australia. Racing at this venue is usually held on the second Sunday of each month. The organizational style of the 750mm Model Yacht Association is 'very casual'.

The NEWSLETTER

International Hydrofoil Society

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

Editor: John R. Meyer | Autumn 2000 | Sailing Editor: Sam Bradfield

850 Ton HYSWAS for Mine Countermeasures

By William Hockberger (IHS Member)

A joint dinner meeting of IHS, the SNAME SD-5 Panel (Advanced Marine Vehicles), and the U.S. Hovercraft Society (USHS) was held on 21 June at the Fort Myer Officers' Club, in Arlington, VA. The evening's presentation, about the recently completed study of an 850 ton HYSWAS (Hydrofoil Small Waterplane Area Ship) for mine countermeasures, was made by Mr. John P. Galloway and Mr. Mark S. Rice.

Mr. Galloway was the Naval Sea Systems Command sponsor of the work and at the time was responsible for development of new Navy mine countermeasures ships in PMS 303. He spoke first and gave a broad overview of the mine countermeasures problem and the many types of mines that exist, their numbers in various countries' arsenals, and how we are presently able to deal with them. Each counter-mine system was then presented briefly and its mode of operation described, along with a discussion of how it is transported to the area of operations.

Model of MCM(X) (Courtesy of MAPC)

Our present mine countermeasures ships are not designed for speed or good sea- keeping and can be deployed only very slowly, especially across

Continued: See 850 Ton HYSWAS, 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.

2000 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. Please remit 2000 dues as soon as possible. We regret that high bank fees make it impractical for IHS to accept payment by credit card or a check drawn on a non-US bank, or by other than US funds. Overseas members with no easy way to send US funds, are advised to send money order to IHS or US Dollars cash.

INSIDE THIS ISSUE

PRESIDENT'S COLUMN

The IHS has reached another milestone in its development, namely, a new Web Site (www.foils.org). Barney Black has informed me that after a month at the new URL and after checking the counter, he noted that we received over 1500 hits on the website during the month of September, and an average of over 75 hits per day. A couple of these hits are Barney working on the site, but the rest are from other people, members and visitors. This is actually an improved hit rate over the previous site location at erols, where we were getting about 50 hits per day. As an example of how well this has been received, a hydrofoil enthusiast, Michael BARANSKI (foiler@internet-australia.com) recently wrote, in part: "I wish to congratulate you for becoming an independent new web site and keep up this amazing work. Your activities have been priceless and are fulfilling a vital role for the hydrofoil community worldwide."

Not only has Barney Black been very busy maintaining and upgrading the IHS web site, he was motivated to produce an "Extra Summer Newsletter". All of you should have either a hard copy of the "Regular" Summer Newsletter which you received through the regular mail, or downloaded from the IHS Web Site. For those of you who do not have access to internet, and would like a hard copy of the "Extra Summer Newsletter", please write to Ken Spaulding at the IHS mail box (Box 51, Cabin John, MD, 20818, USA). He will be pleased to send you a copy.

In connection with this activity, the IHS board of Directors has frequently expressed our appreciation for the dedication and effort put forth by our Webmaster, Barney Black. He, with the help of Malin Dixon in the UK, continually upgrade and update the website. We have also recently become aware of the amount of time Barney Black spends in maintaining the site. We always knew that a considerable number of hours each week were required to maintain the Site at its high level of currency. We are concerned about the amount of personal time Barney spends; time he could otherwise spend with his family rather than glued to a computer screen! Therefore we are seeking help for Barney, so he will have more of his time at home to do other things than webmastering. By this time, many of you will have received an e-mail message from me in which I have elaborated on the tasks for which Barney could use some assistance.

Again, I must regretfully report that one of our fellow hydrofoilers has departed this world. Ronald Adler died suddenly on 6 June 2000 at his home in Washington, D.C., after a long bout with Parkinson's disease. Please see page 3 for details. As Mark Bebar wrote when he heard the news, Ron was unique in his particular field of expertise, and he will be sorely missed.

John Meyer

IHS President

WELCOME NEW MEMBERS

Allan L. Brown - Allan had his first hydrofoil ride on a 16' Challenger outboard boat with a 35 hp Evinrude engine. He is a contemporary of John Gill and Company, and had the pleasure of driving their "whisker" foil boat. Allan is a member of SNAME and several other marine organizations.

Robert E. Harris - Robert is from Jamaica, West Indies. He wants to develop a new hydrofoil or aircavity vessel using the latest space age material to use in the Carribean. He feels that a 50 to 80 passenger craft with a 50 to 60 knot capability in rough water would rival and take the place of existing airplane routes at 1/2 the cost.

Douglas W. Lord - Doug is founder of microSAIL, a small company working on several new hydrofoil models besides the F3 (see story in Summer 2000 NL). Doug studied at the Westlawn School of Yacht Design. He has filled positions from Ship's Carpenter, Chief electrician, to managing the Marine Divisions of Guilford Construction and Thomson Sailcraft while in design and production of 18 to 60 foot powered catamarans, sailboats, commercial fishing boats and more. Doug designed and developed several working prototypes and pre-production prototypes of Video Piloted Helicopters before getting completely into Radio Control Sailboat design and manufacturing. His company has an interesting web site (www.microsail.com).

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MISO

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open oceans. In situations requiring their use there could be substantial delays before actual military operations could proceed. The need was shown for a self-contained, self-deploying ship system capable of traveling fast to distant trouble spots in any sea conditions and able to accomplish mine clearance quickly upon arrival. Mr. Galloway made it clear that this mission is one for which a HYSWAS is actually well suited, not one concocted by technology enthusiasts to provide a false rationale for an interesting project.

Mr. Mark Rice continued the presentation. He is a founder and Principal Engineer of Maritime Applied Physics Corp. (MAPC), of Annapolis MD, and is uniquely qualified, having been a pioneer in HYSWAS technology development and design. (He worked closely with IHS President John Meyer for many years to bring the 12-ton HYSWAS prototype "QUEST" to reality.)[*Note: See related article, Winter 99-00 IHS NL, p.1. HYSWAS is a hybrid hull form combining buoyancy and dynamic lift in the foilborne mode.*]

Mr. Rice outlined the Navy's vision for the future mine countermeasures platform – the MCM(X) – stating that it is to be basically a mother ship carrying deployable vehicles (some of them unmanned and remotely operated) to do the mine countermeasures work. It must be able to serve as a communications hub for an extended task force, and he noted that it should also be capable of sprinting ahead of its task force to initiate MCM operations as early as possible. The performance objectives include:

- Rapid deployability
  - » Sustained speed greater than 30 knots in sea state 5
  - » 3000 nautical miles unrefueled range at 30 knots
- Carry advanced mine warfare systems (in modules)
  - » CH-60s helicopter
  - » Remote Mine Hunting System
  - » Large Synthetic Aperture Sonar
  - » Very shallow water detachment
- High survivability
  - » Low detectability (signatures)
  - » Special operational concepts
  - » Sea state 8 hullborne survivability
- Minimal manning
- High on-station endurance

There is an additional objective of low cost: $30 million or less to acquire the hull, machinery and electrical (HM&E) parts of the system.

Mr. Rice noted that these requirements were not simply handed down from OPNAV but were developed systematically by an IPT (integrated product team), and he was highly complimentary of that process and its participants from several Navy organizations and a number of companies.

One conclusion of the design studies is that a HYSWAS is a niche answer to specific technical and operational requirements and not a generally applicable vehicle type. A flow chart of design choices illustrated that a HYSWAS may be right when displacement is below 2,500 long tons, speed is greater than 35 knots, high speed is needed in high sea states, and an endurance of 2,000 nautical miles or more is required at high speed.

The sensitivity of the design to small changes in certain assumptions and technical parameters was explained. Nevertheless, it was found that the optimal proportions of buoyant support and foil support remained close to 70% and 30%, respectively, for essentially all alternatives studied. It was also found that the sum of payload and fuel constituted a fairly constant 47% of displacement for all MCM(X) alternatives above a few hundred tons displacement.

The characteristics and performance of the final 850 Lton MCM(X) HYSWAS are:

Weight, full load	850 long tons
Weight of mission systems	80 long tons
Length	157 feet
Beam	54 feet
Depth	55 feet
Draft hullborne	26.9 feet
foilborne	21 feet
Speed, maximum (12 ft sig. wave height)	42 knots
endurance	37 knots
minimum foilborne	20 knots
hullborne mission	9 knots
Range at 37 knot endurance speed	3000 n.miles
Survival sea state	8
Crew	22

Propulsion is provided by a single LM-2500 gas turbine rated at 29,600 horsepower. It drives a 12-foot propeller yielding a 0.78 propulsive coefficient. Electric drive was examined but rejected because of its substantially higher weight and lower efficiency compared with mechanical drive (roughly 92 percent efficiency versus 97 percent).

All structure is aluminum. The lower hull has submarine-like primary loadings, while the upper hull has the normal surface ship loadings plus a

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850 TON HYSWAS

(Continued From Previous Page)

significant wave impact component. The helicopter platform is designed to accommodate the dynamic loads generated by a CH-60 helicopter.

The ship is supported on its upper hull at speeds below 20 knots and becomes foilborne above that. It can launch and recover all of its deployable mission systems while hullborne except helicopters, for which foilborne operation is essential to providing the required steadiness of the flight deck.

Mr. Rice closed by outlining the broad features of the next step planned for HYSWAS development. That will be a follow-on MCM(X) project to design a 2,000 ton HYSWAS with expanded capabilities. It will be propelled by two LM-2500 gas turbines (a total of 59,000 horsepower) driving a contrarotating propeller. With its higher PC of about 0.85, the CR propeller will lead to some speed improvement and underwater noise reduction, plus lower fuel consumption and higher mission payload than the 850 ton ship. That increased payload will include more unmanned systems and an enhanced capability for onboard helicopter servicing and maintenance. Survivability will also be enhanced. The same speed and endurance as in the 850 ton ship will be provided, but in sea state 6 instead of sea state 5. This work has already begun and is scheduled to be completed November 1, 2001.

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IN MEMORIUM -

RONALD EDWARD ADLER

Ronald E. Adler (Class of 1953, US Naval Academy) died suddenly on 6 June 2000, at his home in Washington, D.C., after a long bout with Parkinson's disease. He had lived in the Washington, D.C. area since 1965.

Ron was born on 20 November 1930, grew up in Chicago and Highland Park, IL. He served in the Navy for 20 years, in a career that included five sea tours and four management tours. He developed a special interest in systems analysis and operations research, focusing on analysis of anti-submarine and anti-air systems. His final position prior to retirement from the Navy in 1973 as a commander was director of the Ship Characteristics and Weapon Systems Analysis Division of the Naval Ordnance Systems Command, where he had a special interest in high-speed and advanced ships. Prior to that, he had been director of the Naval Engineering Office at the Applied Physics Lab, Johns Hopkins University and director of Systems Analysis for the Anti-Submarine Warfare Systems Project Office.

Following retirement, Ron founded Adler Corporation, a firm specializing in systems analysis and operations research.

Ron served as Vice President of the North American Chapter of the IHS in 1982 and 1983, and later as President in 1984. He also served as Chairman of the Interim Council during the 1985 transition of management responsibilities of the IHS from London to North America.

UPDATE: RODRIQUEZ PT20 MANU WAI

By Garry Fry (IHS Member)

As a result of pursuing a childhood dream of becoming a hydrofoil captain when I grew up I have spent the last 5 years intimately involved with the purchase, repair and operation of this unique vessel. Manu Wai was built by theRodriquez shipyard and delivered to New Zealand owners Kerridge Odeon Tourist Services commencing service between Auckland and Waiheke Island on 22 June 1964. She was acquired by another local operator North Shore Ferries in 1968 continuing to provide a commuter service to the residents of Waiheke Island until December 1973 when she fell foul of a manning dispute between the owners and the Seaman's Union and never reentered service.

Some time later, Ossie James struck a deal with Dominion Breweries to return Manu Wai to commercial service as a tourist ferry, and in 1989 she was completely rebuilt as a luxury corporate charter boat for use on Auckland Harbour. Originally a 72 passenger ferry, Manu Wai re-emerged modernized and modified with a reduced capacity of 50 passengers. She was extensively modified, including widening of the aft deck to add a landing platform for a small helicopter. Total cost of rebuild was $1.3m NZ.

Surprisingly, Manu Wai saw little use in her new role and was sold to a company called the Caret Group whom had intended to relocate Manu Wai to the Bay of Islands area as tourist boat in 1993. Northland Port Corporation, whom had undertaken the 1989/90

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MANU WAI
(Continued From Previous Page)

rebuild carried out a refit late 1993 prior to transfer to Bay of Islands. Unfortunately, on her delivery voyage Manu Wai was run aground on a mud flat whilst foilborne causing considerable damage to the aft foil, bending the tailshaft and minor damage to the propellor. After being salvaged, Manu Wai was towed back to NPC at Whangarei. The insurance company wrote her off and decided to sell her by tender some 12 months later.

I had heard about Manu Wai through friend and fellow IHS member Martin Grimm. To me the damage appeared much less than I had envisaged and armed with video and still camera filmed and photographed the damaged aft foil from every possible angle and sent copy of same to Rodriquez for assessment. Rodriquez advised that the aft foil, which had been bent to an angle of -3 degrees, could be straightened although the photo's didn't show enough detail to allow them to see precisely where the foil was bent it would first have to be reassembled to the hull and the angle measured before the full extent of the damage was known.

I returned to Sydney, prepared a business plan to repair and operate Manu Wai on tourist trips on Sydney Harbour and surrounding areas, secured a business partner, formed a company, Sea flight Cruises and successfully tendered for the vessel. Manu Wai was shipped to Sydney where repairs and the process of reclassification commenced at my partners ship repair facility in July 1995. No one to our knowledge had the expertise in Australia to repair the aft foil so we flew an engineer out from Rodriquez whose specialty was foil repair and modifications. He had to do the job under very primitive conditions compared to what he would have had back in Messina with specialised equipment. Rodriquez were very helpful during the whole exercise and the engineer succeeded in straightening the foil on the first attempt. To ensure that the foil performed properly he was working to an accuracy of quarter of one degree, returning it to as new specs.

Manu Wai was relaunched in September 1996 and carried her first passengers on New Years Eve charter that year before commencing excursion trips on Sydney Harbour during 1997. During the transport, repair and reclassification process between July 96 and Sept. 97 many things beyond our control occurred which put us way over budget, ultimately having a serious effect on our ability as a very small company to keep our heads above water during the crucial first 12 months of business. Realising that we would be unable to survive on walk up trade for the 12 to 18 months, we had to cease our operations prematurely or wind up going broke. Consequently, Manu Wai has had little use since then other than occasional charter work.

With the recent death of my business partner and subsequent loss of access to repair facilities at his shipyard when sold shortly, Manu Wai will have to be sold if I am unable to relocate business elsewhere in Australia. I can provide details of a proposed hydrofoil service which would involve a second larger vessel to run alongside the PT20.

Any entrepreneur, business person/ hydrofoil enthusiast that may be interested in helping to set this up as partnership, joint venture or other arrangement or just to provide feedback is invited to contact me at any time. (e-mail: gfry@vtown.com.au)

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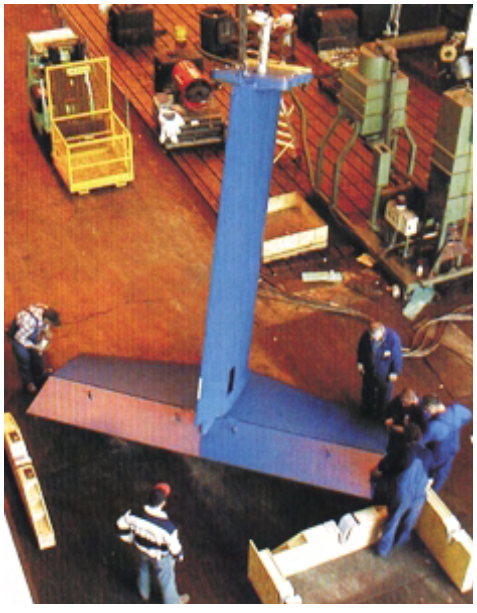
RETRACTABLE T-FOIL FITTED ON INCAT EVOLUTION 10 WAVEPIERCER

(*From Fast Ferry International, July-August 2000)*

Shortly after Incat Tasmania 74m wavepiercing catamaran, Hoverspeed *Great Britain*, entered service in 1990 on the Ports mouth - Cherbourg route, some passengers began complaining about the ride quality in rough seas. As the winter wore on and the weather worsened, so did the number and voracity of the complaints. A local newspaper even dubbed the vessel 'The Vomit Comet'.

One possible modification considered at the time was the installation of a T-foil that would be stowed behind the center bow section and lowered into position as required. In the event, Incat and Maritime Dynamics Inc. designed and fitted a ride control system utilizing two active trim tabs that became a standard item on all future vessels. This was followed by the development of forward pivoting T-foils fitted with aft flaps.



The T-foil installed on Incat Evolution 10 Millennium has an area of about 9 sq.m.

Now, ten years after the idea was first proposed, a retractable pivoting T-foil has been installed on Incat Evolution 10 wavepiercer Millennium. MDI was responsible for the design of the T-foil and Incat contributed the structural modifications around the center bow. When retracted, the strut of the T-foil is stowed within a notch down the centerline of the bow. Two hydraulic rams lower and raise the T-foil, a third pivots it to change the angle of incidence.

John Adams of MDI describes the T-foil as being larger than that fitted on the Boeing Marine Systems Jetfoil 929-115 hydrofoil and roughly the same size as the one on the BMS PHM hydrofoil. The strut is approximately 4.0m long. The foil, which is about 9 square metres, has a tapered leading edge that reduces its width from approximately 2.0m in the center to 1.5m at the edges.

According to MDI, "The foil has a shape that will allow cavitation free operation well into the 45 knot speed range and features MDI's standard trailing edge flaps and inverted-T design." The foil area is much the same as the total of the two foils fitted on previous wavepiercers. The weight of the single T-foil with its longer strut is heavier, but there are significant operational advantages in having a retractable unit.

As Incat points out, "In seas up to 2.5m it is generally found that the T-foil is not required. With the T-foil housed in the center bow, fuel consumption plus wear and tear is lowered and 1.5 knots is added to the vessel's speed. With its location in the center bow, full access to the T-foil is gained through an inspection hatch. The need for anti-fouling on the foil is eliminated and so too is the need for drydocking should the foil require attention.

"Previous bolted T-foils, though extremely efficient, are exposed to damage or loss from submerged objects. On the new design, hydraulic dampers are fitted that will absorb energy and allow the foil to pivot upwards in the event of a foil strike while deployed."

Incat and MDI recommend that the T-foil should be lowered or raised at vessel speeds of 20 knots or less. However, during trials MDI deployed and retracted the unit on Millennium at speeds of up to 44 knots without incident - apart from an initial reduction in speed of up to 10 knots as the foil acts as a water brake.

UPDATE ON PLAINVIEW

By Sumi Arima (IHS Member)

In July of this year I found out that the owner of Plainview is Lowell and Nancy Stambaugh (nmstambaugh@hotmail.com) who live across the road from where the ship lies. Lowell, at the time, was in Alaska fishing but has been working on dismantling the ship in his spare time. The naval architects discouraged him from converting the ship to a cannery tender.

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

ALN MONOHULLS ENTER SERVICE IN FRANCE AND GREECE

(From Fast Ferry International, June 2000)

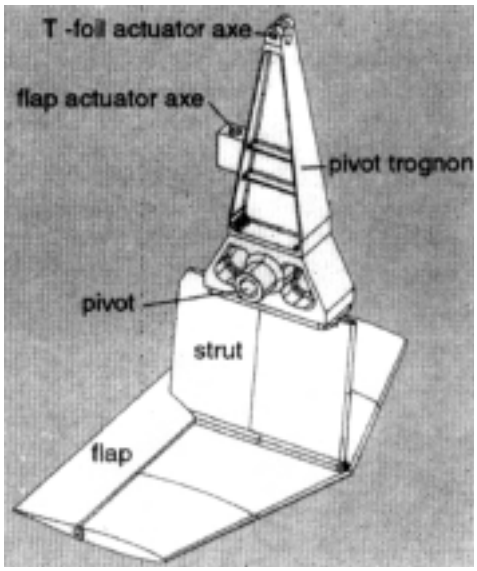
The latest two monohulls delivered by Alstom Leroux Naval's yard in Lorient, Corsaire 13000 NGV Liamone and Corsaire 12000 Aeolos Express, entered service during May in France and Greece. NGV Liamone is the third fast ferry to be introduced by SNCM, the French company has been operating ALN Corsaire I 1000s NGV Asco and NGV Aliso since 1996. Aeolos Express is NEL Lines' first fast ferry, although ALN is currently building two more vessels, a Corsaire 10000 and a Corsaire 14000, that are due to enter service with the company in mid 2001.

[Editor's Note: The FFI article goes on to describe various aspects of the Corsaire 13000 vessel; however only the ride control system will be provided here.]

Ride control system

Much attention was paid to the ride control system during the development of the Corsaire 13000 as SNCM plans to operate a year round service on its routes between the south coast of France and Corsica.

Studies have shown there is an 80% probability of conditions less than or equal to 1.5m significant waves and 5.0 second wave periods, a 90% probability of conditions less than or equal to 2.25m significant waves and 6.5 second wave periods, and a 95% probability of conditions less than or equal to 3.25m significant waves and 7.5 second wave periods.



Corsaire 13000 ride control system Tracing the background to the design of the Corsaire 13000 in a paper given at the 16th Fast Ferry International conference, Christian Gaudin of ALN and Raymond Dussert-Vidalet of SNCM said, "Work performed by DCN Basin d'Essais de Carenes consisted of evaluating a 1/14th scale model. The resistance, draught, trim characteristics and seakeeping were investigated. Preliminary tests consisted of adapting the lines of the Corsaire 11000 to another scale and length to beam ratio.

"These trials quickly showed that predicted hull resistance results satisfied the shipowner's speed and seakeeping requirements, with some minor hull line modifications; a longer waterline length, 120m in place of 115m, decreased vertical accelerations by 20%; and a modified shape decreased hull resistance by 6%.

"Several resistance tests were carried out with a second Corsaire 13000 model, investigating several draughts, LCG positions and the influence of different trims.

"Seakeeping behaviour was investigated at the same time in order to determine ship motion without any stabilization appendages, and allow Maritime Dynamics to size exactly its system.

"After naked hull performance optimization, some tests were devoted to determine the neutral position of the T-foil, two aft fins, two fore fins and two transom trim tabs, in order to minimize their influence on resistance in calm seas.

"Then tests in waves were carried out to determine the effect of the passive fitting of appendages on motions and accelerations. These tests, and feed back from Corsaire 11000s Asco and Aliso, showed the necessity of installing seven stabilization appendages of three kinds.

The T-foil uses both incidence and flap control. Its mechanism, including the rotation axis, is inside the ship. The thin shape of the T-foil is optimized from a hydrodynamic point of view and minimizes appendage resistance.

"Two pairs of fins, one forward and the other aft, are installed principally to improve course stability, and to stabilize roll. These four appendages rotate around a vertical axis. They are driven by an electro-hydraulic mechanism installed inside the ship.

"The two transom flaps are used to reduce roll or pitch or both movements simultaneously. These are installed flush under the hull bottom close to the transom. When the ship is traveling fast, the flaps work on the free surface of the water. Hydraulic jacks attached to the transom move the flaps.

"The ride control computer receives platform motion data from a central-

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ALN MONOHULLS ENTER SERVICE IN FRANCE AND GREECE

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ized movement and acceleration acquisition module, and then gives commands to electro-mechanisms. The module, located close to the center of gravity of the ship, contains gyros and accelerometers, which measure the six components of ship motion.

"An algorithm receives input data from the module and return data appendage position transmitters. So, after a real time calculation, it delivers commands to the electro-hydraulic

Corsaire 13000 motion sickness incidence model test results

Sig wave height	Wave period	Ship heading	MSI Required at CG	MSI Measured at CG
1.5m	5.0s	0°	1%	-
		45°	2%	-
		75°	2%	-
2.25m	6.5s	0°	2%	<1%
		45°	4%	<1%
		75°	6%	5%
3.25m	7.5s	0°	2%	1%
		45°	5%	2%
		75°	18%	12%
4.5m	8.5s	0°	-	5%
		45°	-	5%
		75°	-	20%

mechanisms to ensure the optimal position of the seven appendages at any time. For these calculations, the algorithm takes into account inertial characteristics, speed, wave heading of the ship and wave height.

"As model test seakeeping results were very good for sea states 4 and 5, and the shipowner's requirements were easily met without stabilization, the contractual tests focused on sea state 5 (Irregular Jonswap wave spectrum having a significant waveheight of 3.25m and a wave period of maximum energy of 7.5 second period). "The stabilization system works so well that the required motion sickness incidence is achieved not only at the center of gravity but also in all passenger accommodation spaces."

MORYE RELEASES DETAILS OF 30M FOIL ASSISTED CATAMARAN

(From Fast Ferry International, June 2000)

Morye, the Ukrainian company based in Feodosia, has released details of a 30m catamaran design fitted with T-foils forward and interceptors aft. Based on hard chine, semi-planing hulls, the vessel would be powered by four MTU 12V 4000 M70 diesels rated at 788 kW at 2,100 rpm.

These would drive two fixed pitch propellers via ZF BW 190A and BW 190V gearboxes, to give a calm water speed of 45 knots with 21.7 deadweight tonnes on board when the engines are operating at 100% maximum continuous rating. The payload includes a 65% fuel capacity of 3,850 litres, resulting in a maximum range of approximately 200 nautical miles, with a 10% fuel margin.

According to Morye, "The vessel is capable of running in foilborne mode, at maximum available engine power, up to 2.0m significant waveheight (or 2.7m with a 3% probability) with rms acceleration values, distributed over the 1/3 octave frequency range, below the two hour limit of ISO 2631/3-85 requirements.

"Above 2.0m significant waveheights (or 2.7m with 3% probability), the vessel is capable of running in hullborne mode with reduced power depending on heading and wave spectra."

The bow foils would be fabricated in high strength PT-3V titanium alloy. Morye reports, "The submerged part of the foils, at service speed, is solid and without moving parts. The foil is equipped with a weak link, which is designed to break if it hits ground or floating debris. All foil hinges, bearings, hydraulics and feedback accessories are inside the hull.

General arrangement of Morye 30m foil assisted catamaran

"The transom interceptors are designed with the capacity to fully control the draught of the aft part of vessel at speed exceeding hump speed, thus giving low resistance and good ride control in combination with the forward foils. The interceptors are also made of PT-3V titanium alloy and designed with all hydraulics and

NEW DESIGNS FROM ZELENODOLSK BUREAU

(From Fast Ferry International, June 2000)

Details have been revealed of five fast ferry designs from Russia's Zelenodolsk Design Marine Bureau. Two, the Star of the East and the Izumrud-M, are fully submerged hydrofoils. The others are a Passat-M catamaran, a Katran catamaran hydrofoil and a Vega air cavity mono-

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DESIGNS FROM ZELENODOLSK
(Continued From Previous Page)

hull. All would have welded aluminum alloy hulls and would be powered by diesel engines and waterjets. The foils on three of the vessels would be fabricated in titanium alloy. Referring to the Vega, Zelenodolsk says, "The air cavity and ventilated waterjets allow reductions in fuel consumption, noise and vibration levels."

Zelenodolsk Design Bureau Katran hydrofoil (top), Star of the East fully submerged hydrofoil (middle), Izumrud-M fully submerged hydrofoil (bottom)

NEW VESSELS AND NEW COLOURS IN GREEK WATERS

(*From Fast Ferry International, June 2000)*

The Piraeus waterfront looks a lot different these days. In less than two years, the domestic ferry scene in Greece has undergone its biggest change in more than two decades. Both fast ferries and conventional ferries have been involved. As a result of recent mergers and acquisitions, familiar companies have disappeared, ships have been renamed and schedules have been consolidated.

Minoan Flying Dolphins

Most of the developments are the result of an aggressive growth policy initiated by one company, Minoan Flying Dolphins. MFD itself is less than two years old, having been formed towards the end of 1998 by the merger of Minoan Lines High Speed and Ceres Flying Dolphins.

Minoan contributed a single Royal Schelde CAT 70HL passenger/car catamaran and a conventional ferry to the fleet. Ceres contributed 22 Kometa hydrofoils, four Kolkhida hydrofoils, three Rodriquez RHS 160F hydrofoils, a Kvaerner Fjellstrand Flying Cat 40m catamaran and an Austal Ships 49m catamaran. The companies' combined traffic during 1998 totaled 2,350,000 passengers.

Kometa hydrofoils are the backbone of the Minoan Flying Dolphins fleet

Ceres had operated hydrofoil services from the Athenian ports of Piraeus and Zea to the Argosaronic Gulf for more than 20 years and throughout the Sporades region of northeastern Greece for more than ten years. Both companies were also recent entrants to the Cyclades islands market.

Last July, MFD placed its first contract for new tonnage when it ordered one Austal Auto Express 92 and two Austal Auto Express 72 catamarans that were to be delivered within 12 months.

At around the same time, the company acquired Goutos Lines, which operated an FBM TriCat 45m catamaran and two conventional vessels between Rafina and the Cyclades islands. This gave MFD a presence at the newest port being developed for the Athens region and put the company into direct competition with two Westamaran 4200 catamarans operated by Strintzis Lines.

Then, during the final quarter of 1999, MFD acquired another dozen companies who operated a total of 33 conventional ferries. One of the companies, Agapitos Lines, was also leasing an FBM Marine TriCat 53m catamaran.

At the beginning of this year, MFD purchased a 46% share in Aktoploiki Maritime. Apart from Aktoploiki Maritime, which continues to trade as GA Ferries, MFD's fleet of conventional ships appeared from winter refit in the colours of Hellas Ferries and Saronikos Lines.

However, the two fast ferries taken over from Goutos Lines and Agapitos Lines have been absorbed into the Minoan Flying Dolphins fleet, and renamed Flyingcat 3 and Flyingcat 4. The original Flying Dolphin fleet has also been renamed.

MFD continues to operate Kometa hydrofoils, and occasionally one or two Kolkhida hydrofoils, on four routes from Piraeus.

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ON RETROFITTING HYDROFOILS TO RACER/CRUISER SAILING BOATS

By Sam Bradfield

At HydroSail, Inc we get fairly frequent requests for information regarding hydrofoil retrofits for racer/cruiser trimarans in the 25 to 55ft range. (And I see similar requests for info in the letters to the editor section of the News Letter.) As a result, we've done several feasibility studies on racer/cruisers in the 25 to 40 ft range. The result? Yeah, retrofitting for flying appears feasible given certain inherent design qualities of the subject boat. However, no takers so far. I think most people don't realize how expensive it's going to be because I think most people don't realize that you can't just slap 2 or 3 lifting foils on a sailboat, especially a big sailboat, and turn it into a successful flying hydrofoil.

There haven't been many successful ocean capable flying hydrofoils under sail. Most IHS readers are familiar with the Navy's Monitor, Dave Keiper's Williwaw, and Taberly's Paul Ricard, and, of course, the French Hydroptere looms on the horizon. The only one in this size group currently flyable (that I know of) is HydroSail's 25ft EIFO and we designed her as a coastal racing day sailer around the buoys and along shore ... not a racer/cruiser. She's only 25 ft because that's all I could afford to spend on a developmental project. She was successful in her role. But she came in so grossly over design weight she approximates a one tonner racer/cruiser in that respect. Naturally, she whetted my appetite for a bigger boat project to work on.

Recently I told Dick Newick, a well respected long time friend, that what I'd really like to do as the next step toward developing the ocean capable racer/cruiser trimaran is to see if we could do a successful retrofit to a really well designed 40 footer like one of his. In a sort of "put your money where your mouth is" challenge he generously sent me a package of technical information on two of his boats in that size group. After saying Geez! I've done it again! I said: well, I might as well have a go at this and I warmed up the computer and headed out ... computer sailing and optimizing a lifting foil system for Dicks' ECHO during February, March, and April 2000 in my spare time. The result was a feasibility study of retrofitting ECHO as a flying hydrofoil sailboat. Following, is a summary of results of that study.

MULTIHULL DESIGNS - Dick Newick's Echo II Retrofitted with HydroSail, Inc.'s Hydrofoils

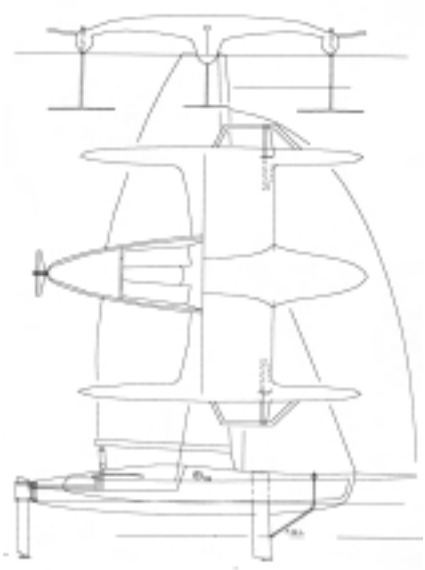
By Sam Bradfield and Dick Newick

Dick Newick's Echo 11 Series of performance trimarans is ideally suited for hydrofoil supercharging. Sam Bradfield's hydrofoil system has emerged from ten years of development and on-the-water testing and racing; 16 ft RAVE in sheltered water and 25 ft EIFO in coastal waters.

Now we're ready to take the last step on to the open ocean with a racer/cruiser. And, with Dick's endorsement, we think Echo 11 is an ideal vehicle to equip with our foil system.

With completely retractable ama mounted foils, Echo's nineteen inch hull draft means easy beaching for maintenance, also shallow harbor access. The retractable foil installation permits passing safely over two foot deep reefs or taking advantage of two foot tides in the tropics to beach the boat for maintenance. Fully extended, the lee daggerboard provides total sideforce holding capability for windward work.

[Editor's Note: "ama" is multihull lingo for the outer hulls or floats of a trimaran sailboat. It's polynesian derivation. Those outer hulls are also frequently called outriggers, sponsons, etc.]



LOA: 36' 6"; BEAM: 30 Ft
SAIL AREA: 600 Ft^2
DISPLACEMENT: 5,600 lbs.

The ama mounted foil eliminates the need for a main hull daggerboard installation and significantly increases available mainhull space. Newick

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crash boxes are installed in the amas to prevent serious grounding damage. The transom mounted retractable rudder foil swings up if struck. An 8 to 10 HP long shaft four cycle outboard motor will give over seven knots in a calm with a minimum of weight, noise, and vibration with no drag when not in use. A 25 HP long shaft will permit foilborne powering at 15 to 20 knots in a calm!

Echo's ample aka clearance ensures the absence of wave slam with this boat. And the narrow waterline beam is the secret to easy motion in waves, especially to windward. The lifting foils put the final touch on comfortable sailing to windward by sharing the load with ama and hull.
[Editor's Note: "aka" is known as a crossbeam]

With both main foils extended, Echo flies on beam reaching headings when the wind speed exceeds 10 kts. As the windspeed increases, so does the flight heading range until, with a windspeed of 20 knots, she's flying all the way from 50 degrees heading to 160 degrees. She'll be most comfortable flying in the 20 to 30 knot boatspeed range in the 12 to 18 knot windspeed range. With Echo's rig, she won't be at full power at the top of this sea breeze speed range. She'll have the capability of doing 30 to 35 knots at 105 to 125 degrees to the wind. But you may not want to take her there ... unless you're a hell-for-leather racer. It's scary up there ... at least, for me it is!

"KUPAPA" 36 FOOT ECHO I IN NEW ZEALAND

I think of the expense of retrofitting Echo to fly as replacing one main hull daggerboard and one standard rudder and steering control system with two daggers, a long rudder and rudder box, three lifters and a foil control system. The cost will be a minimum of 1-1/2 to 2 times the expense of the conventional rudder/dagger foil system.

Newick recommends fiberglass sheathed strip planked hull construction as giving the best combination of strong, moderate cost durable construction. However, the more highly stressed elements of the flying hydrofoil system require the strategic use of carbon fiber reinforcement.

Editor's Note: Dick, as a pioneer in US (actually worldwide, I would say) modern sailing trimaran development, introduced some of the polynesian terminology into the trimaran lingo: ama: outrigger; aka: crossbeam; vaka: main hull, were three words he borrowed in giving the polynesians just due for their early development of the sailing multihull genre.

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The second annual **RAVE** Nationals is being held in October 2000 in Florida. Between 20 and 25 hydrofoil sailboats are expected on the starting line. It's still the only hydrofoil class sailboat racing event in the world, so far as I know.

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Czech Sailing Hydrofoil - See a short note on the website about a front steering home built effort that might help inspire some amateur building in this country. There are several pix there. Reminds Sam Bradfield of some of his and some of his student's efforts in the 1970's. It shows what you can do part time and without spending a lot of money if you're interested in foiling. See: http://www.cks-precision.ltd.uk/ihs/dactylop.htm

WELCOME NEW MEMBERS
(Continued From Page 2)

Barry Steele - Barry is an electrical controls engineer currently attending Clemson University, South Carolina to obtain a mechanical engineering degree. He has built several boats (30 ft), but his next two are to be fully submerged hydrofoils. The first, a personal watercraft with manual, 3-axis aircraft-like controls. The second, to be a modified aluminum pontoon boat with fully automated controls. Barry's only hands-on experience with hydrofoils are with the SkySki and Stevenson's Sportfoil. He feels that it is so similar to his flying & hang gliding interests that he's hooked. He commented "that much of the experience at the IHS is in the tonnage range, while much of the interest is in the "pleasurecraft" sizes. (After all, these are much more fun to build and test.... and certainly easier to fund.)"

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NEW BENEFIT

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

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TRASMEDITERRANEA'S JETFOILS

(From Fast Ferry International, July-August 2000)

July 2000 marks the 20th anniversary of Trasmediterranea's first Jetfoil fully submerged hydrofoil service. On August 7 1980, a leased Boeing Marine Systems Jetfoil 929-100 Princesa Voladora, was introduced on a route in the Canary Islands between Las Palmas, Gran Canaria, and Santa Cruz, Tenerife.

JETFOIL operating in Canary Islands

This was replaced the following year by a pair of BMS Jetfoil 929-115s, Princesa Guacimara and Princesa Guayarmia, and in 1987 a second route was introduced between Las Palmas and Morro Jable, Fuerteventura. Trasmediterranea's two 929-115s were replaced in 1990-1991 by Jetfoil 929-117s Princesa Dacil and Princesa Teguise, which were built under license by Kawasaki Heavy Industries.

The operator estimates that the five vessels have carried over 9 million passengers on more than 60,000 crossings and travelled a distance of approximately 3.3 million miles. The two 929-117s face an uncertain future in the Canary Islands however. With Naviera Armas having introduced a Rodriquez TMV 114 Aquastrada monohull this summer on both Jetfoil routes and Fred Olsen operating two Incat 96m wavepiercers between Tenerife and Gran Canaria, Trasmediterranea has publicly questioned whether a passenger only fast ferry service can survive for much longer.

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.

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LETTERS TO THE EDITOR

Mexican Hydrofoil History...

[20 Sep 00]Does anyone have any idea what happened to the couple of Rodriquez hydrofoils that were sold (?) in Mexico in the early 80s, NICTE-HA and XEL-HA? Ever seen any pics of them there, operational or otherwise? Tim Timoleon, Editor, Classic Fast Ferries (classicfast-f@email.dk) website: http://go.to/classicfastferries.

Foil Kits For Hobie 21...

[19 Sep 00] : Do you know of any foils available for add-on to a Hobie 21? — Greg (cheryl.M.willocks@worldnet.att.net)

Response...

[19 Sep 00] The most recent person to tackle the project of providing add-on hydrofoil kits commercially was Dave Keiper, but unfortunately he died before he could get his design into production. His website is still up at http://www.wingo.com/~dakh/index.html. Dave Carlson worked closely with Keiper to help debug the design and specify details suitable for production. I don't know if he intends to go the next step of producing kits for sale or not. In any case, his website URL is: http://members.nbci.com/catcobbler/ and I suggest you contact him to pursue the idea further. — Barney C. Black (webmaster@foils.org)

More on Feeler Arms...

[19 Sep 00] Relative to the postings by Lochner, Grimm and Dixon, I am sorry that my files are so deeply buried in my attic or mini-warehouse that it would take a search team to find them. However, I will offer a few comments off the top on my head. While working as liaison between Hook and the Navy we, at Miami Ship, used the Gibbs and Cox term "spatial anticipation" for distance between the Hook "Jockey", or surface feeler, and the forward foil center of lift. Because of the potential hazard of forward reaching anticipators we frequently discussed designing aft facing feelers, which we facetiously called "regrettors" but never designed. After Marine Systems folded, John Gill joined Jim Wynne, and they did build a submerged foil boat with "regretters" which, to the best of my knowledge worked well. Unfortunately now both John and Jim are dead so I doubt at this time that I can dig up any data. Also, Gordon Baker made some experiments with "regretters;" perhaps you can get some data from Neil Lien. About 1956 Miami Ship built the CIGAR for which you have a story in your files by me and Bob Johnston. The Cigar had two incidence controlled submerged foils on two splayed struts forward and a single submerged foil aft attached to an extended shaft outboard engine. The craft was provided with a single surface feeler forward for altitude sensing and the pilot was provided with a joy-stick to modulate the feeler signal for elevation and to which he could provide differential incidence control of the forward foils for banking. Foot pedals were provided for steering. The Hook Jockeys did control altitude with pilot override but not pitch or roll; roll was done by the seat of your pants and pitch was a function of speed. I do not think the ICARUS Jockeys were too widely spaced, but when scaled up to HALOBATES they were obviously too cumbersome. We knew this from the start but installed the feeler/incidence controlled system while developing an electronic autopilot with zero spatial anticipation and a coordinated turn and bank that worked very well on HALOBATES & DUKW. The system was later further developed by Marine Systems Corp. for ENTERPRISE. If you do use a mechanical control system with surface feelers, I highly recommend that you control flaps and not incidence of the foil. — Jean E. Buhler, Naval Architect/Marine Consultant, 5169 S.W. 71 Place; Miami, FL 33155, phone: (305) 667-8385

Two Hydrofoils in Europe...

[18 Sep 00] I have 2 hydrofoils for sale for export to the US or to remain in Europe. If I may place an notice at your website it may save these rare birds — Steve Canning (sales@commercialdepot.com)

Indonesia Hydrofoil Info Wanted...

[16 Sep 00] When I was a kid growing up in the jungle oil camps of Sumatra Indonesia during the 1950s and early 1960s I vividly remember the excitement of traveling across the Strait of Malaca from Indonesia to Singapore on board a modern (for the time) passenger hydrofoil called the LUMBA LUMBA (which is the Indonesian word for the grey dolphin in the area). I am trying to obtain any information I can on this wonderful vessel. Perhaps it is even still in service somewhere. I was in a model shop in London maybe 10 years ago and saw a kit for the LUMBA LUMBA. I wish I had purchased it. Any information would be appreciated...and will help bring back fond memories. — Rob Briggs, Atlanta, GA, USA (briggsfamily@mediaone.net)

Response...

[16 Aug 00] Thanks for your most interesting inquiry, but LUMBA LUMBA on the Indonesia/Singapore route is a new one on me. I will post this on our website and also forward it to several of the "old timers" in our membership in the hopes that someone will know something about that vessel. You should browse through the photo gallery section of our website to see if you recognize the model from any of our photos. Also, Janes used to publish an annual or biannual directory "Janes Surface Skimmers" dating back to 1968; with many photos and descriptions, organized by country of manufacture. A library or old book shop may have an early edition, or they occasionally go up for auction on

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www.Ebay.com. I looked in the 1969/70 edition and did not see this vessel by name, but you might recognize the type from photos. For example, the Supramar PT-20 type was popular in the oil industry dating back as far as 1957. You could also contact the Classic Fast Ferries website. The Fast Ferry International Database of 1995 lists a LUMBA LUMBA being operated by the Pulau Seribu Marine Resort in Indonesia, but this is a monohull built by Yamaha in 1989. As for models, there is a secondary market for old model kits, so it may be possible to find one. Occasionally they go up for sale on Ebay, though in 2+ years of monitoring this site for hydrofoil-related items I have never seen a kit specifically of LUMBA LUMBA. — Barney C. Black (webmaster@foils.org)

Remembering the ALBATROSS...

[9 Sep 00] When I was a kid, my dad was hydrofoil operations manager for the Wilson Line in Washington DC. He was able to talk management into moving one of the boats to Crisfield MD to run tourist to and from Smith and Tangier Islands in the Chesapeake Bay. I have a few photos and one brochure (also an 8 mm film) The boat was a pretty popular attraction in the area, and the cruises were usually full. I seem to remember, though, that the boat was a little under powered and would not 'lift' loaded into a stiff breeze. I was on one boat in 1983 in Miami. I heard something about a mobile bank for Key Biscayne (sounds familiar). I enjoyed your articles. —Skip Lilliston (firefan@mindspring.com)

DUKW Hunting...

[8 Sep 00] I am seeking to buy DUKWs, GMC World War 2 era Amphibian (G353/G501) nicknamed the "Duck" to use in Berlin, Germany! Also need documentation: operation and maintenance, emergency field maintenance manuals for service and repair. — Rolf Brill email address: rolf.brill@bln.siemens.de, Siemens Business Services, GmbH & Co. OHG, Siemens IT Service, Headquarters/Zentrale Funktionen, Escalation Management; Tel.: (+49) 0 30/386-41392; Fax.: (+49) 0 30/386-44326; Mobile.:(+49) 0 170/7945543, website: http://intranet.its.siemens.com/em-kdz.htm.

Composite Foils Available...

I am an enthusiast boat builder/sailor in Perth Western Australia. I have some info that maybe could be posted on your website. I have produced a moulded hydrofoil section for sailing dinghies or other which can be fitted in whatever configuration. It is a NACA 63412 120mm x 14mm x 1.8m. The section is hollow with a sandwich stringer. Manufactured from pre preg carbon, a 1.8m length weighs just 1kg. The laminate can be altered to suit if strength is a high priority. I am fitting the foils to an International Moth class dinghy in a unique configuration There was never any great intent to sell these as they were really just for this project. Since I have come this far I might as well test the water and see if there is any interest. They would cost $360 Australian per 1.8m length plus freight, which I can arrange. If there is anyone interested in discussing my design, I would welcome this also. — John Ilett (fastacraft@hotmail.com)

A Test Engineer Finds the IHS Website...

I was there when we laid the keels for PHM boat 2 through boat 6, worked on all functional tests, for all systems. I have not read your page completely; I will do it later. I will also call a few of the test people and engineers to let them know about your site. — Charles A. Stearns, Boeing Marine Systems (retired) (cstearns@wolfenet.com)

Sydney Harbor Hydrofoils...

[8 Sep 00] A total of 7 hydrofoils operated on Sydney Harbour over 26 years, as listed below. The LONG REEF, CURL CURL, and SYDNEY were part of State Transit's fleet of hydrofoils, which operated between Sydney and Manly from 1965 to 1991 before being replaced by Incat Jetcats. MANU WAI (now offered for sale after extensive renovations and repair of grounding damage) was shipped as deck cargo from Auckland NZ after our purchase.

MANLY, Hitachi Zosen PT20 (1965)

FAIRLIGHT, Rodriquez PT50 (1966)

DEE WHY, Rodriquez PT50 (1970)

CURL CURL Rodriquez RHS140 (1973)

PALM BEACH [ex-PATANE], Rodriquez PT50 (1969/1976)

LONG REEF [ex-FRECCIA del MERGELLINA], Rodriquez PT50 (1968/ 1978)

MANLY, Rodriquez RHS160F (1984)

SYDNEY, Rodriquez RHS160F (1985)

LONG REEF, CURL CURL, MANLY, and SYDNEY survived until 1991 and were taken back to Italy by Rodriquez to be resold or leased in the Mediterannean by various operators. CURL CURL was renamed SPARGI and is now on the market for US$500 000. Both RHS160Fs are in service to the best of my knowledge, I am unsure of LONG REEF's current status. — Garry Fry (gfry@vtown.com.au)

Russian Hydrofoil Summary Data...

[8 Sep 00] I put pictures (and production years) of ALL Russian-made commercial hydrofoils on my web page at http://www.geocities.com/matveev.geo/hf.html — Konstantin Matveev; email address: (matveev@its.caltech.edu)

Hong Kong Hydrofoil??...

[8 Sep 00] I have a couple of questions that your page does not answer. I've lived in Hong Kong, and I've seen the hydrofoil ferries, they looked pretty big (at least 500

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tonnes) to me. Yet somewhere on the IHS page, it says those only weigh 35 tons. So I'm wondering if you know their displacement, and whether or not there had been a missing zero. With the current technology (composite material, new turbine engine, etc.), what is the maximum speed, weight and range for an hydrofoil? And what will the fuel economy of this ship be like, e.g. how many passengers can it take? (in other words, is it possible to build a 1000-tonne ship with max. speed of 60 knots that can go for 500 miles at 40 knots, and the ticket still cost half those of a jetliner? — Kenneth Chan (panzerkommand@hotmail.com)

Response...

[8 Sep 00] Maybe the hydrofoil ferries you saw looked big, but they weren't 500 tons. The largest hydrofoils to date were the Russian military built BABOCHKA at 400 + tons, and the US Navy-built PLAINVIEW at 315 tons (long time out of commission). On the other hand, 35 tons would be a very small hydrofoil. You probably saw the Boeing built Jetfoil, which is about 100 tons. There are pictures on the IHS web site Photo Gallery. As to 1000 tons? That would take some doing and a VERY large investment. Also it would be more state of the art to stay with 50 knots and under. The 500 n miles at 40 knots should be no problem with hydrofoils 150 tons and up. Range is tied to payload or passengers carried, and one would have to set up a calculation to figure this all out. — John Meyer (president@foils.org)

About the New Website...

[8 Sep 00] I wish to congratulate you for becoming an independent new web site and keep up this amazing work. Your activities have been priceless and are fulfilling a vital role for the hydrofoil community worldwide. When browsing your IHS announcement page, it came by surprise to find out the news about the new passenger hydrofoil "Jetfoil" operating between Florida and the Bahamas Is. Does that mean hydrofoils have been revived in USA as the ultimate means of transport or perhaps just lucky "one off" commercial operation? How does the public in US feel about recreational hydrofoil versions of RAVE and TRIFOILER? — Michael Baranski. Email address: (foiler@internet-australia.com)

Student Hydrofoil Project...

[31 Aug 00] I am doing my Mech Eng. final year from V.I.T. under Pune Univ. As a part of curriculum, we have to present a seminar. I am very much interested in "Hydrodynamics" so I selected my topic as "Hydrofoils". So could you please e-mail me the detailed info about Hydrodynamics giving stress on basics, mathematical relations, etc.? — Suraaj Doshi (suraaj_doshi@rediffmail.com)

West Palm Beach FL to Freeport, Grand Bahama by Hydrofoil...

[29 Aug 00] For all of you that are interested in riding a Boeing Built Jetfoil. We operate between West Palm Beach, Florida and Freeport, Grand Bahama. Our operation is almost a year old and reception to this "unique" type of marine transportation has been fairly good. After our annual drydocking we are looking forward to a very successful second year and we invite everyone to come fly with us to the Bahamas. Please see http://www.seajets.com for more information or email me. — Andrew Pisani (andrewpisani@hotmail.com); Director of Maintenance, Seajets Inc. (sea_jets@bellsouth.net)

Which Foil Section is Best...

[29 Aug 00] I wish to construct a few recreational dynamically supported pleasure craft. I have been conversing with Mr. Larson (an IHS member) and Mr. Mattveev (Cal Tech and IHS Member). They have been most helpful in helping me to assess the basic design constraints required. Based on their correspondence, I would first like to pursue the construction of a hydraulically retractable surface piercing (shallow draft) hydrofoil.

The prototype craft is to be in the 20 foot (6 meter) range with a displacement of 2500 to 3000 lbs. (1150 kilograms to 1350 kilograms). I believe this to be the standard displacement for this size of craft. Target speed to be 50 knots. Power to come from an I/O arrangement with a standard V-8 gasoline motor generating approximately 300 hp (223.8 kW). Engine may be further modified to increase output. Leg to be a modified unit with a "Vari-Prop" pitch adjustable prop. Ride height is as of yet undetermined. I have not purchased the boat yet.

I am hoping to construct a two piece interlocking foil arrangement that could hydraulically split for the purpose of retraction. Time line is (10) months to construction. Among these design criterion is foil selection. I was referred to you by Professor Kinnas (University of Texas at Austin, Department of Civil Engineering, Ocean Engineering Studies). I presently have little knowledge of the physics involved in foil selection. Any assistance would be gratefully accepted. — Wayne Gillespie (wayneg99@telus.net)

Response...

[29 Aug 00] Regarding hydrofoil sections, I like the NACA 16-series hydrofoils because they provide good cavitation resistance, which you will need at 50 knots. As design speed increases, the hydrofoil thickness/chord ratio and lift coefficient must reduce to prevent cavitation. I used a NACA 16-510 hydrofoil section for surface piercing hydrofoils developed in the 1950's, which had a max speed of 46 mph with the 65 hp outboard I was using at the time. You might want to read my article on hydrofoil boats in

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the pioneer section of the International Hydrofoil Society Web Pages. An excellent source for other hydrofoil cross sections is in the book "Airfoil Design and Data" by Richard Eppler, published by Springer-Verlag, 1990. — Tom Lang (tglang@earthlink.net)

Follow Up...

[8 Sep 00] Thank you very much for the input. I suppose that I will have to find a supplier/method of production for the foil(s). How are the actual; dimensions obtained? Are there on line resources available to this end? Distance between supports will have to be determined as well. I have visited the University of Texas at Austin pages and found an interactive applet design page that models relative lift and drag ratios of given foil dimensions. Most interesting. I however presently lack the understanding of the data to interpolate. Do you know the approximate cost of dies for aluminum extrusion? Are there any points of interest in the production end of foil extrusion that you have learned through your experience? I will endeavour to obtain the referenced book. You mentioned that a 1.5 deg twist in the foil of your kit allowed the craft to lean into the turn by allowing the inner foil (on the turn) to ventilate first. Can you elaborate on the process involved that cause this to happen? Conversely, it there is information within existing reference texts, I would be most grateful if you might simply direct me in the appropriate direction. — Wayne Gillespie (wayneg99@telus.net)

Response...

[8 Sep 00] You might want to consider making composite hydrofoils; however, extrusions are easier to work with. The foil cross sectional dimensions are available from the Eppler book, or in the case of NACA sections from the Dover book by Abbott et al, "Theory of Wing Sections". The Marks Handbook on Mechanical Engineering is one of many references on beams and structural strength. You might re-contact IHS to see if he has a list of references on hydrofoil design, and if they know of any sources of extrusions. Also, you could contact Alcoa for their list of existing dies and the cost of new dies. I think that there are many hydrofoil enthusiasts who would like to buy extrusions. You might ask IHS about references concerning ventilation. Also, it would be helpful to join the IHS; the special student cost is very low. My experience showed that ventilation occurred when angle of attack increased around two-to-three degrees above the design angle at a 30 deg dihedral, more with a higher dihedral, and less with a lower dihedral. Much depends on the accuracy of the hydrofoil nose region. Ventilation occurs when the hydrofoil boundary layer separates near the nose on the upper side, and air fills the separated region, generally superventilating the entire foil section downward for several inches; the result is the sudden loss of all lift in the supervented region. Sharp nose sections ventilate sooner than airfoil noses. Fences can be used to stop ventilation at intervals, but add some drag. — Tom Lang (tglang@earthlink.net)

Miami Shipbuilding History...

[18 Aug 00] I write, edit and publish and annual historical magazine for the Friends of the South African Air Force Museum. Last year one of the articles I wrote was on the SAAF crash boats/rescue boats. From that an interest arose on researching the full history of the Motor Boat Unit. To this end I have been engaged in a number of interviews with surviving members, and archival research. One of the people instrumental in us getting these boats was the designer a Mr. Dair N. Long, a naval architect at the University of Michigan. He designed what were known as Miami boats which were built by the Miami Shipbuilding Company (MSC). I wonder if it would be possible for you to tell me anything about this gentleman, more about the company and if there are any relevant documents available. — Guy Ellis (Guy@datasoft.co.za) website: http://www.dynagen.co.za/eugene/guy.html

Response...

[9 Sep 00] My father worked at MSC around 1939-41 when the USA entered World War II. They were building and repairing ASRs then for the European arena. We attended a party when MSC went out of business as that company, the current owner, Mr. Brown was there. If you're interested, My father has many stories about the times back then. You can contact him at the following address (or c/o my email address): Dick Besola, Sr., tel: 305-891-5942, fax: 305-891-2116, — 1570 NE 141 Street, N. Miami, FL 33161 — Dick Besola, Jr. (Shark1dick@aol.com)

Sea Wing Hydofoil Kit Questions...

[7 Oct 00] I have a Grumman SEA WINGS hydrofoil kit, and a small tin (aluminum) boat which is suitable for installing the kit on. Still need a motor, finding a long shaft OB of the proper horsepower CHEAP isn't easy. Does anyone have more information, experience with the SEA WINGS kit? Can I safely exceed the rated power/speed of the kit? i.e., 55 HP. Anyone done one of these installations? I know it's been a long time since these were manufactured, but the kit is complete, and I have a copy of the installation manual. -- Peter Jacobs (pjjacobs@itol.com)

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Letters To the Editor allows hydrofoilers to ask for or provide information, to exchange ideas, and to inform the readership of interesting developments. **More correspondence is published in the Posted Messages and Frequently Asked Questions (FAQ) section of the IHS internet web site at http://www.foils.org/.** All are invited to participate. Opinions expressed are those of the authors, not of IHS.

EXTRA FOR THE ELECTRONIC EDITION

LETTERS TO THE EDITOR

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MDI's T-Foil

In the current newsletter, there's an article about MDI's retractable T-foil for Incat, with most of the historical information coming from Fast Ferry International, and some information from John Adams here at MDI. I would like to add a few statements on a more personal plane.

The original 74m wave piercer ride control system was basically as stated in the newsletter (as an excerpt from Fast Ferry International) except- the first 4 square meter pivoting T-foils with flaps (1 per hull) were designed at that time as well (not the center mounted retractable). I know because I did the 3D CAD integration of the concept, and came up with some interesting features of the 4 sq M foil actuation mechanisms myself. Most of these features are still in use today, some were a learning curve.

The previous pioneering ROCS for a non-SES vessel was a smaller foil stabilized catamaran, *CONDOR 9*, which had hull mounted fins.

The T-Foil idea was originally pushed very hard by a 'staunch' engineer (who would NOT let go of it...) from the UK- Lionel Frampton of Marine and General Engineering, Ltd. UK. Without Lionel's persistence, the foils may have taken a much different tack indeed, and I feel he should receive some acknowledgement for the prevalence of the T-foil today.

I also worked on the Corsaire 11000, 12000, and 13000 designs, actually building two model scale T-foils and integrating them in the tank model at David Taylor Research Center (DTRC), in what I believe was the first tank testing of an active ride control system of this type. It was, in fact, the 1/14th scale model referenced in the article (paper given by Christian Gaudin of ALN and Raymond Dussert-Vidalet of SNCM at the 16th Fast Ferry International conference). I also designed the integration of the trim tabs and roll fins for these model tests. The model T-foils are still being used for various tests.

It was pretty exciting to see them in the IHS newsletter!

Rick Loheed, Project Engineer-Mechanical
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The NEWSLETTER

International Hydrofoil Society

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

Editor: John R. Meyer | Winter 2000-2001 | Sailing Editor: Martin Grimm

GERMAN JETFOILS IN FLORIDA

By Christian Eckardt and Tim Timoleon

[The following was extracted from a comprehensive article appearing in the December 2000-January 2001 issue of *Classic Fast Ferries* (http://classicfast-f.homepage.dk/)]

Some History

A pair of Boeing 929-115 Jetfoil hydrofoils previously operated across the English Channel, between Oostende and Ramsgate, by Belgian operator Regie voor Maritiem Transport (RMT) have taken a new lease of life in the United States. Well, at least one of them has; the other remains inactive for the time being. The craft, both of which originated in the USA, arrived in Florida in July 2000, at which point they had not seen regular service for more than two years.

The first of the Belgian Jetfoils, *Princesse Clementine,* was launched at the Boeing Marine Systems Renton, Washington plant at the beginning of 1981 and inaugurated the new cross-Channel Jetfoil service between Oostende, Belgium and Dover on May 31st, reducing journey time on the 64 nautical mile route from four hours by conventional ferry to 1 hour 40 minutes. The second craft, *Prinses Stephanie,* entered service two months later, in July 1981.

It was not the first time Jetfoils were in the area, however, as a couple of other on again off again attempts had been made during 1977-80. But the state-owned Belgian company, which already operated conventional ferries across the Channel, would prove that there is indeed some truth to the expression third time lucky,

Continued: *See JETFOILS, Page 3*

WHERE ARE YOU IN CYBERSPACE?!

IHS relies on electronic communication with the members to improve timeliness and reduce mailing costs. If your email address changes... let us know!

2001 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. Please remit 2001 dues as soon as possible. We regret that high bank fees make it impractical for IHS to accept payment by credit card or a check drawn on a non-US bank, or by other than US funds. Overseas members with no easy way to send US funds, are advised to send money order to IHS or US Dollars cash.

INSIDE THIS ISSUE

PRESIDENT'S COLUMN

Another year of very successful operations of the International Hydrofoil Society has passed. I am pleased to report that the Society is thriving with a constantly improving web site, a treasury that is adequate for our operations, and a ever growing membership list. We can boast a list of new members in the Year 2000 of 23 - a new record!!

Also, an area of great progress in 2000 was the scanning of about 25 documents to be made available to our members. Please see an article on this subject by Ken Spaulding on page 5. Much work remains to be done, but we are pleased with the progress to date.

In response to my plea for help for our Webmaster, Barney Black, I am pleased to report that several members have stepped up to the plate. Bill White has joined in to keep the various "Links" up to date and functioning. Also Martin Grimm and Jim King have volunteered to help. Ken Spaulding continues to contact potential members and has been successful in that endeavor.

I would like to mention that you all should take advantage of the Membership List that is sent to you on occasion. Rather than sending questions only to me or the webmaster, write directly to persons that are experts in the area in which you have questions. Addresses, telephone numbers and e-mail addresses are listed along with Company affiliations. The latter can be a clue. Please always cc me and the webmaster so we can be aware of your interests and Barney Black can still put your question on the IHS website.

We have previously made reference to a Hydrofoil Museum Exhibit initiative. At a recent IHS Board meeting, Ken Spaulding advised that current Smithsonian Institution Traveling Exhibition Service (SITES) direction was that our proposal could not be considered since the direction of the new Smithsonian Secretary is that all new SITES exhibitions are to come from the Smithsonian collections. Lauren Telchin, the SITES Proposal Coordinator, was asked that if: (1) IHS turned over a "Hydrofoil Collection" to Paul Johnston in American History and (2) if someone like Boeing agreed to bankroll the exhibit, would this change the situation. She replied that this condition would certainly be grounds for reconsideration of our proposal. Ken reported that he would discuss the entire situation with Paul Johnston, however, this initiative is currently "on hold."

All of you should note that this issue of the Newsletter contains articles by several of our newer members. We continue to encourage ALL of you to consider preparing articles about hydrofoils for publication.

I would like to take this opportunity to wish all of our IHS members a Happy and very successful Year 2001!

John R. Meyer, President

WELCOME NEW MEMBERS

Dimitrios Alepoudeas - Dimitrios is a 4 th year student at the Department of Ship and Marine Technology of the University of Strathclyde in Glasgow, Scotland. His final year project is on the subject of the performance of a "Water Jet Propelled Hydrofoil Catamaran". He was particularly interested in the IHS website, and believes that it will be useful towards his research and the final result of his thesis.

Richard J. DiSanto - Richard is a former crew member of PEGASUS, PHM-1. He is currently serving in the U.S. Navy stationed at Guantanamo Bay.

Duane A. Leiker - Duane is President and CEO of International Submarine Museum in Fairfax Virginia. Under his own initiative he has taken 4 rolls of film of Flagstaff (PGH-1) and has prepared an article about his trip to see and document the status of this once upon a time great hydrofoil (see page 6).

G. Edward Niedermair - Ed is from Washington D.C. He entered the US Navy 1950 and served on the USS Bennington, CVA-20 during 1953-1954. Ed is a graduate of University of Maryland (Mech. Eng.) 1959-1962, and served as President, William I. Jordan Construction Co, Georgetown, D.C. He was Chief Engineer/Flight Engineer, Northwest Hydrofoil Lines from 1967 to 1971 aboard H.S. Victoria (see story on page 7). He worked for the Xerox Corporation for several years before retiring from Xerox as System Analyst for Boeing Sales Team 1994.

James Straus - James is Director of Antares Research and Development, Inc. in Sante Fe, New Mexico.

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JETFOILS
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as its two Jetfoils remained in these waters for the next sixteen years. The one millionth Jetfoil passenger was carried within 3 years.

To make a long story short, the era of Jetfoil hydrofoils in the Channel came to an end on the last day of February 1997. As it would prove, this also marked the end - at least for the time being - of an original Boeing Marine Systems US-built Jetfoil in regular service in Europe. The only remaining craft in this part of the world now being a pair of Jetfoil 929-117s built under license by Kawasaki Heavy Industries, Japan, in 1990-91 and owned by Spanish operator Trasmediterrinea.

After the demise of RMT in the English Channel both Jetfoils were put up for sale and pending this, laid up at Oostende. On July 10, 1998 *Princesse Clementine* and *Prinses Stephanie* were purchased by the owner of German company Adler-Schiffe, based in the island of Sylt, and renamed *Adler Blizzard* and *Adler Wizard.* At the end of September the two Jetfoils arrived in Bremerhaven, in north-west Germany. After a DM 1 million refit program, *Adler Blizzard* had been renamed and emerged as *Alderney Blizzard.*

A company based in the Channel Island of Jersey, Channel Hoppers, announced that it was to lease the Jetfoil for a route linking Southampton and the French port of St.Malo with the Channel Islands of Jersey and Alderney as replacement for a Fiellstrand 38.8 m catamaran. However, this charter fell through, and the return of Jetfoils to the English Channel now seemed unlikely.

Florida Operations

At this stage Adler-Schiffe was looking for a U.S. based business partner as putting the Jetfoils into service in Florida waters or the Caribbean seemed the right thing to do. A joint venture had been formed with local interests and SeaJets was adopted as operating name for the new service.

Photo Courtesy of SeaJets Bahamas, Ltd.

On June 23rd 1999 the two Jetfoils left Europe, as deck cargo on board *Thor Simba*, for their native country, eighteen years after they had made the reverse journey. The Florida seaboard was reached in fifteen days and on arrival *Alderney* Blizzard and *Alderney* Wizard were renamed *SeaJet Kara* and *SeaJet Kristen.* The start-up date for the Florida to Bahamas service was set to early September 1999, but was delayed, due to U.S. Coast Guard certification, and did not get underway until early November. Since then you can board a Jetfoil hydrofoil at Palm Beach, Florida, subside into one of the 250 comfy aircraft-style seats, enjoy a complimentary refreshment and arrive in the Bahamas 99 minutes and $99 later.

Now, in fairness, this only goes as far as to the first glimpse at the company's advertising, as actual journey time for the 65 nautical mile route is two hours; the highlighted 99 minutes refers to the 'flying time', i.e. the part of the journey where the Jetfoil is running foilborne at 43 knots, the remaining twenty-one minutes of the trip being spent off foil at slow speed.

Also, a total of $33 is added to the ninety-nine dollar fare covering departure taxes and arrival fees and fuel surcharge. But then you will also get back again on the same ticket.

The new service, marketed as SeaJets, between the Port of Palm Beach and Freeport in Grand Bahama Island was inaugurated on November 6, 1999. Initially, two round trips a day Thursday-Monday were operated. This was increased to daily except Tuesday earlier in 2000, with departures from Palm Beach at 9:00 am and 3:30 PM and from Grand Bahama at noon and 6:15 PM.

So far only one of the two Jetfoils, *SeaJet Kara,* has been used. Even with this in annual dry dock earlier this fall the company did not expect to operate sister vessel *SeaJet Kristen* to cover for the former. It was anticipated to resume service in early November, reverting to a Thursday -Monday operation until after Thanksgiving when Wednesday would be added.

Both vessels are still owned by the German Adler company, and bare-boat chartered to SeaJet Bahamas Ltd. They are currently Bahama-flagged and home port is Nassau, while Hamburg remains their port of registry.

In addition to a 'strictly transportation' ticket, SeaJets also offers special round trip and vacation packages, with over-night stay at various resort hotels in the Bahamas.

FAST FERRY OPERATORS RESPOND TO ORESUND FIXED LINK

(Excerpt From Fast Ferry International, September 2000)

By Tim Timoleon (IHS Member)

July I saw the opening of what has been mooted for decades and debated by locals for the past several years - a fixed link across the Oresund, connecting Denmark and Sweden. A combined bridge and tunnel, the new link not only makes it possible to take one's car dry-tyred across the Oresund, without the fuss and time-consuming wait at ferry terminals, it also offers fast and frequent trips by train or bus between the Danish capital of Copenhagen and Malmo, Sweden's third largest city.

Millions and millions of Danish and Swedish kroner have been invested in the new rail link, the construction of four new stations en route including one at Copenhagen Airport - and specially designed trains. In addition, an agreement between some Danish and Swedish taxi operators now allows their cabs to carry passengers between destinations in the two countries.

One might think that there is no longer a future in the area for something as old fashioned as fast ferries. And this is fast ferry territory. As long ago as September 1960, a Finnish owned Rodriquez PT.50 hydrofoil was leased by a Swedish company to operate between Malmo and Copenhagen for six months. While perhaps not the most glamorous time of year for tourists and day shoppers, passenger loads were reportedly very good.

In 1963, a local businessman in Malmo - the Swedes have generally had a greater interest in visiting Copenhagen than the Danes have had in visiting Malmo - introduced two smaller Westermoen PT.20 hydrofoils. Two years later, the company now known as Scandlines entered the scene with two Westermoen PT.50 hydrofoils.

Since then, new operators, new routes, and newer and, usually, bigger fast ferries have come and gone. Vessels have included, in approximate chronological order: Rodriquez RHS 140 hydrofoils, Westermoen PT. 150 hydrofoils, Vosper Thornycroft VT. I semi- amphibious hovercraft, - Westamaran 95 catamarans, Marinteknik 33m catamarans, BHC AP.1-88/100 hovercraft, Karlskronavarvet Jet Rider 3400 surface effect ships, Fjellstrand 38.8m catamarans, Kvaerner Fjellstrand Flying Cat 40m catamarans and a Westamaran 88. Plus SR.N6 hovercraft, a couple of monohulls, an Austal Auto Express 82 catamaran, and even a Boeing 929-100 Jetfoil on a European sales tour.

The article goes on for several pages to elaborate on the bridge link and other ferry operations in the area.

INCAT LAUNCHES FIRST EVOLUTION 10b WAVEPIERCER

(Excerpts from Fast Ferry International, October 2000)

The latest wavepiercing catamaran design launched in Hobart, Evolution 10b *Incat Tasmania,* continues Incat's philosophy of modifying the previous production vessel by approximately 10% to increase payload while maintaining performance at the same installed power. As usual, the first of class is also the largest vessel built to date by Incat Tasmania.

Compared with *Milenium,* the Evolution 10 delivered to Trasmediteranea this summer, *Incat Tasmania is* 1.2m longer overall, 6.0m longer on the waterline and 0.6m wider. Total truck lane length has been increased by 50m, the maximum deadweight is at least 40 tonnes more, and the repositioning of aft skegs has reduced full load draught by 0.3m and improved maneuverability.

According to Incat Tasmania, the first Evolution 10b is also the largest aluminum ship yet launched in Australia. In common with previous designs, the vessel is built from 5383-H116 and 5518-H116 aluminum alloy plate and 5383 and 6082 T6 extrusions. The hull lines, however, are different. The bows are longer, the center bow section has a greater clearance, the midship sections are fuller, and stern skeglets have been fitted.

The ride control system, developed by Incat and Maritime Dynamics, is

identical to the one installed on *Milenium.* There is a single retractable T-foil (shown here) forward lo-

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cated within the center bow section and two transom mounted trim tabs. Incat reports, "These, combined with the new hull form, mean motion sickness incidence has been reduced by up to 40% in higher sea states by reducing pitch, roll and heave." The first Incat Evolution 10b, Incat Tasmania, was launched on July 29, 2000.

The long article continues to describe many aspects of the vessel in considerable detail.

A HYDROFOIL LIBRARY FOR IHS MEMBERS?

By Ken Spaulding (IHS Member)

The history and technology of hydrofoils has, in fact, been reasonably well documented. Our IHS web site currently lists, and annotates, 88 basic references. Most of our members have a periodic need to access these documents. Easier said than done. Actually acquiring hard copy or electronic versions of the documents may be difficult. The documents listed on the web site are in the open literature. Much of the technical documentation still resides behind the NAVSEA firewall.

We are pleased to report that an expanded, annotated, hydrofoil bibliography with IHS password access to complete source documents may soon be a reality.

In 1993 the Advanced Marine Vehicles (AMV) group (SD-5) of SNAME initiated an effort to identify and annotate a listing of key documents addressing history, design, technology and operation of the various AMV types (ACVs, Catamarans, Hydrofoils, SES, SWATH, Wingships and miscellaneous hybrids). SD-5, at that time, consisted of 50 US and foreign AMV principles. A panel of 15 experts was chosen to review documents proposed by SD-5 members. A draft listing of 578 documents was developed. In addition to AMV type specific documents, AMV comparisons, mission/cost analyses, seakeeping, regulatory codes, power/propulsors, structures and stability were included. 225 of the 578 documents listed were hydrofoil specific. It was intended that each listing be annotated to provide the user with a "road map".

This project was not completed by SD-5 but, for the past three years, a committee of three persons representing IHS, US Hovercraft Society and SD-5 have been working to identify funding for these documents, all of which are available at the Navy Model Basin at Carderock, and to secure Navy release of documents not in the open literature. These documents were to be available on the web.

NAVSEA has now agreed to provide scanning services and to release those unclassified documents under NAVSEA control. Scanning to CD-ROM is underway. For the hydrofoil documents a password access listing (eventually annotated) will be provided on the IHS website. Requests, by IHS members, for individual documents will be answered with complete electronic documents from CD-ROM or a web database.

When this "hydrofoil library" becomes available, IHS members will be requested to assist in updating and annotating the list. Something akin to the Amazon.com reader review might be considered.

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SNAME AWARD - Thomas G. Lang

Several months ago, Thomas G. Lang (IHS Member) was given an award by SNAME for "notable achievement in naval architecture and/or marine engineering". The citation read:

Thomas G. Lang has been a leader and an innovator in the design and development of unique hydrodynamic hull forms. Most notably he is known and respected for his developmental efforts and his enthusiastic promotion of the SWATH (Small Waterplane Area Twin Hull) concept.

Dr. Lang began his career at the Naval Ordinance Test Station, in Pasadena, California where he served as a Member of the Bureau of Weapons Hydrodynamics Advisory Committee. His early accomplishments were related to hydrodynamic design of torpedoes. Early in his professional career, as he completed his doctoral dissertation in the Aerospace Department at Penn State University, he was laying the groundwork for the engineering procedures that lead to his pioneering development work on SWATH.

Dr. Lang was instrumental in his development of the SWATH. He has been granted over twenty patents, including a number specifically related to the SWATH concept. He took this basic technology work and developed design concepts leading to free running model tests in San Diego Bay and then to a series of towing tank tests. He personally solved many of the vexing technical and administrative problems and ultimately oversaw the construction of the first operational prototype SWATH, the 190-ton

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Kaimalino. It was this ship that established the first full-scale database for this type of hull form, and furthermore demonstrated the viability of SWATH as a stable platform in high sea states underway at substantial speeds.

His forty-nine years of experience in ship research, innovative marine design, analysis, test and program management has been well shared with his profession by virtue of his patents and over eighty technical papers and publications. These cover the subjects of SWATH, hydrofoils, torpedoes and underwater propulsors. He was a key consultant in the hydrodynamic testing of the finned keel and designed the riblets used on *Stars and Stripes,* which won the America's Cup back from Australia in 1987.

Dr. Lang was elected to the grade of Fellow in SNAME in 1996, and has received numerous awards over his distinguished career. He is most deserving of this award for notable achievement in naval architecture.

LAST VISIT TO FLAGSTAFF

By Duane A. Leiker (IHS Member)

On a bright and clear Friday morning the 11th of August, my sons and I went on a road trip to view the Flagstaff in Tuckahoe, New Jersey. From a distance where it sat in dry dock, my first impression was, "what a piece of junk." But once the closer inspection began, my opinion slowly changed.

While one son circled the ship taking pictures, the other son and I studied the hull condition. There was over a foot of sand surrounding the ship with some places even deeper. The hull had been scraped and sand blasted. The three foils and sides had not been finished but it would not have taken very long to finish the hull sand blasting. The rear out-drive foil needed a small casing repaired or replaced due to corrosion. The foil itself was in very good condition. The dual water jet drive nozzles for hull borne operation were missing and the water induction ports under the hull were at

one time sealed but now open allowing entry into the ship.

Squeezing through the water induction ports to gain entry, the small room entered contained a generator and air compressor from what I could understand from the labeling throughout. Since the upper deck covering was removed, we were able to climb up onto the deck on the port side of the turbine house. The deck also had been sand blasted along with the bridge and turbine house. The only parts I noticed that were not sand blasted were the bridge roof (fiberglass), mast and both raised foils. The deck cover plate starboard of the turbine house had also been removed for work access. The ship railings were removed, sand blasted and stored in the bow arms room and on deck. A circular plate replaced the gun mount on the bow. The two gun mounts aft of the bridge had been removed as well.

Entering the pilothouse, we noticed that approx. 98% of the gauges, seats, fuse boxes and related equipment were present and in very good condition for the age. Down the stairway from the pilothouse into the ship, the Captains quarters were on the starboard while a maintenance room was to port. The Captains room was intact but like all the rooms inside the ship, paint was peeling and very light surface rust was noticeable. The ships plumbing was complete and together minus the connections of the main drain. One fuse box and the control station for the engineer had been removed along with the mess tables. Water was in the bilges due to the rear cover plates being removed. The diesel propulsion room was rusty, without engines but still had the electrical, hydraulic and plumbing present. The turbine was present and from an external view, very good condition. A clear inspection could not be done due to the cramped space and my size.

The previous owner added numerous repairs and replacement parts. A few were: pilothouse glass, electrical cables, hydraulic lines, galley equipment, welded plumbing, heater pipe replacement and many others. Painting was begun on deck aft of the pilothouse as was rewiring in the pilothouse.

Although I'm not a naval surveyor I'll rate what I've seen to make the ship operational. The hull was in very good + condition - Sand basting, priming and paint. The deck was excellent - Prime and paint. Inside Pilothouse - Sand, prime, paint, minor electrical work. Plumbing & Heating - Reconnection. Engine Room - 2 Diesels, shafts and propulsion water jets. Auxiliary Rooms - Generators, compressors, fresh water connection. Turbine House - Rebuild turbine.

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LAST VISIT TO FLAGSTAFF

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Most of the repair needed would be manual labor. With the proper funding, I believe the ship could have been in operation in about a 1 ½ years. Of course, I'm an optimist too.

My sons and I took as many photos as we could for historical records. Even standing and in need of attention, the ship was truly a pleasure to behold. I was given the firm date of 31st of August to buy the ship. After funding was disapproved by the investors, I tried to get the funds myself. I liquidated most everything I own and still came up short. The ship was scrapped 1 September 2000. *[Ed Note: A picture of Flagstaff in operational mode is shown in the Winter '99-'00 Issue.]*

35 YEARS AGO-LAUNCH OF HS VICTORIA MARKS TRANSPORTATION BREAKTHROUGH

In 1965 a hydrofoil named the VICTORIA, was placed in service between downtown Victoria, British Columbia and Seattle, Washington. The VICTORIA was designed by Gibbs and Cox and constructed by Maryland Shipbuilding and Drydock Co. Financing was arranged under Title XI with the Maritime Administration. Victoria had a Canard configuration with fully submerged, non-retractable, incidence controlled foil system. Like most one-of-kind transportation systems, with no back-up, the VICTORIA was not a profitable operation. A story about VICTORIA appeared in a *Hovering Craft and Hydrofoils* publication (the forerunner of Fast Ferry International) as follows. It was provided by a new IHS member, G. Edward Niedermair.

BALTIMORE, Md., - The wave of the future in over-water transportation broke on the shores of Chesapeake Bay when the HS VICTORIA, a 75-passenger hydrofoil, constructed by Maryland Shipbuilding and Drydock Co. was launched here, July 29.

The new concept in water transportation could affect every major port city in the United States and a large segment of the marine industry.

Following sea trials in the Chesapeake Bay area, the high speed VICTORIA - propelled by twin General Electric gas turbines like those that power an array of today's commercial and military helicopters - will begin passenger service this fall between Seattle, Washington, and Victoria, British Columbia.

Establishment of the rapid over-water passenger service is expected to prove that commercial hydrofoils can economically bridge the gap between ships and aircraft.

Northwest Hydrofoil Lines, Inc., owner of the VICTORIA, will be the first privately-financed hydrofoil line in the United States to operate in deep water over long distances. The VICTORIA is predecessor to a fleet of seacraft planned for operation between major port cities in the United States and foreign countries. Boston, New York, Baltimore, Norfolk, Washington, D. C., and Miami on the east coast, New Orleans and Galveston on the gulf coast, Chicago, Cleveland, and Detroit on the Great Lakes, Los Angeles, San Francisco, San Diego, and Seattle on the west coast, and the Mississippi River ports are prime areas where the ship- airplane hybrid is expected to prove competitive with aircraft and ships.

The advent of domestic and international hydrofoil service similar to the VICTORIA' s was forecast long ago. Alexander Graham Bell, who worked with hydrofoils more than 70 years ago, is credited with this prediction. The new breed of seacraft will work on an airline-styled schedule in Puget Sound. Three round trips a day will carry 75 passengers on the 75-mile run each trip.

The VICTORIA will operate on a year-round basis in contrast to the present Seattle to Victoria ferry service that only runs at the peak of the tourist season between June and September.

"The HS VICTORIA will operate like a short range airline with passengers being able to make reservations, leave and arrive on a fixed schedule all year long," reports William I. Niedermair, president of Northwest Hydrofoil Lines.

In explaining his concept of marine transportation, Niedermair said that the VICTORIA hydrofoil will be competitive with aircraft in terms of time and passenger rates.

Another competitive advantage, Niedermair points out, is that docking facilities are located at the heart of both Victoria and Seattle thus elimi-

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VICTORIA
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nating airport commuting time in both cities.

Taking a note from the airline operation, the VICTORIA will have a captain and first officer to operate the vessel, and a stewardess. Refreshments will be served on the "flight".

The hydrofoil derives Its name from underwater "wings" which work in water much the same as an aircraft's wings or airfoils operate in the air.

Another feature the hydrofoil has in common with aircraft is its two General Electric LM100 gas turbines, derived from the type G.E. builds for helicopters. Each LM100 gas turbine is rated at 1,000 shaft horsepower for this application yet weighs only about 350 pounds and occupies approximately 10 cubic feet. It Is this combination of high horsepower, light weight and small size of the propulsion engine that help make hydrofoils of the VICTORIA-class possible.

In addition, the captain maneuvers and "flies" the ship as it skims over the water with a General Electric autopilot much like the ones G . E. makes for jet aircraft.

In the "flying" attitude, the hull is free of the frictional drag of water, opening the way to speeds not otherwise attainable - and at important economies of fuel.

The craft leaves little wake, a further advantage in restricted river and harbor waters. As the first of a line of ocean-going commercial hydrofoils, the VICTORIA required some unique construction methods and materials. Her struts and foils, for example, are fabricated of a special steel - the same type used in the construction of hulls of nuclear submarines.

Initial demonstrations call for the VICTORIA to carry on a two-month passenger service in the Puget Sound area before leaving on a 2,500 mile sea run to Honolulu and several months of inter-island demonstration service there. The vessel will be returned to Puget Sound next spring where it will be operated permanently. When available, subsequent vessels of this class will be placed in Hawaiian service on a year-round basis.

Northwest Hydrofoil Lines considered the nature of the waters around Hawaii before proposing inter-island service by the VICTORIA.

Designed to navigate in seas with an average wind of 20 knots and waves four to eight feet, the hydrofoil-borne traveler will glide past Waikiki and around Diamond Head seven feet above the water on wings of steel. Niedermair, one of today's seafaring entrepreneurs, is a former research chief of the U.S. Maritime Administration. Considered by many as a pioneer in the same sense as the Wright Brothers at Kitty Hawk, Niedermair has staked his 27 years of experience in the Marine industry on the development of the VICTORIA.

Establishment of rapid over-water passenger service by the HS VICTORIA is expected to prove that commercial hydrofoils can economically bridge the gap between ships and aircraft. The VICTORIA is powered by twin General Electric LM100 gas turbines rated at 1,000 shaft horsepower, with a weight of only 350 pounds.

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UPDATE ON MDI T-FOILS

By Richard Loheed, IHS Member

In the IHS Fall Newsletter, there's an article about MDI's, Maritime Dynamics, Inc., retractable T-foil for Incat, with most of the historical information coming from Fast Ferry International, and some information from John Adams here at MDI. I would like to add a few (Hopefully noteworthy..) statements on a more personal plane.

The original 74m wave piercer ride control system was basically as stated in the newsletter (as an excerpt from Fast Ferry International) except- the first 4 square meter pivoting T-foils with flaps (1 per hull) were designed at that time as well. (not the center mounted retractable) I know because I did the 3D CAD integration of the concept, and came up with some interesting features of the 4 sq M foil actuation mechanisms myself. Most of these features are still in use today, some were a learning curve...

The previous pioneering ROCS for a non-SES vessel was a smaller foil stabilized catamaran, 'Condor 9', which had hull mounted fins.

The T-Foil idea was originally pushed very hard by a 'staunch' engineer (who would NOT let go of it...) from the UK- Lionel Frampton of Marine and General Engineering, Ltd. UK. Without Lionel's persistence, the foils may have taken a much different tack indeed, and I feel he should receive some acknowledgment for the prevalence of the T-foil today. I also worked on the Corsaire 11000, 12000, and 13000 designs, actually building 2 model scale T-foils

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UPDATE ON MDI T-FOILS
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and integrating them in the tank model at DTRC, in what I believe was the first tank testing of an active ride control system of this type. It was, in fact, the 1/14th scale model referenced in the article (paper given by Christian Gaudin of ALN and Raymond Dussert-Vidalet of SNCM at the 16th Fast Ferry International conference). I also designed the integration of the trim tabs and roll fins for these model tests. The model T-foils are still being used for various tests. Rick Loheed is a former Project Engineer-Mechanical at Maritime Dynamics, Inc. His current email is: rloheed@islandengineering.com

CINCINNATI INTRODUCES NEW COMPACT LIGHTWEIGHT GEARBOX

(*From Speed at Sea, August 2000)*

Cincinnati Gear has extended its MA-series of lightweight gas turbine marine reduction gears with the introduction of a new compact MA-635 unit, with output speeds ranging from 1,100 to 1,800 rpm. The company says that the gearbox was initially designed for use in megayachts and patrol boats utilising Honeywell's TF50 gas turbine engines, but has the potential to be used in many types of marine craft with gas turbines of similar output torque.


Cincinnati Gear's new MA-635 marine reduction gearbox

The MA-635 takes the same elements as the MA 107 and condenses them to a smaller, lighter design package, Cincinnati says. The new design lightens the gearbox by 2,000 pounds (907kg) and reduces the size by 25 per cent compared with the standard MA-107 design.

While the MA-107 utilises parallel shaft gearbox technology, the MA-635 is a two-stage epicyclic (planetary)/parallel shaft design, making it even more compact and efficient, Cincinnati says. Other features of the MA-635 include hardened and ground gearing, antifriction bearings, aluminum housing and complete lube system with optional disconnect clutch and PTO accessories.

UK-BASED STUDY INVESTIGATES HSC WASH EFFECTS

(From Speed at Sea, August 2000)

Prompted by pressure from environmental groups, the fast ferry industry and pleasure craft users, the UK's Maritime & Coastguard Agency (MCA), in partnership with maritime research and engineering specialist Marinetech South Ltd, has announced that work has started on a three-year research project to investigate the effects of wash generated from high speed craft (HSC).

Ships Wash Impact Management (SWIM) is a collaborative project involving all aspects of the industry, and the results of the study are scheduled to be released in mid-2003. "This is an industry problem," said Marinetech's Richard Clements, who is SWIM's project manager. Around 20 companies, agencies and university departments are being brought together to form the project partnership.

The MCA says that SWIM aims to develop the capability to predict wash generation from high speed craft, and techniques to assess wash impact on the environment. The project organisers hope that results will provide a basis for planning high speed craft operations and their regulation, and to limit unnecessary restrictions on certain operating routes.

The project is divided into five work packages: wash generation; wash propagation; wash impact; collation of results and the implications these have on future operating rules and regulations; and management of the project. SWIM is a progressive project, which stemmed from a previous Marinetech study, the High Speed Craft Program, completed last year. This study raised questions about generation of wash and the hydrodynamics involved. SWIM will take a closer look at the implications of different hull designs and the amount of wash generated. "This is commer-

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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

SAILOR'S PAGE

THE MILLER HYDROFOIL

By Rich Miller (IHS Member)

[*This is an excerpt from the full article, originally appearing in the San Franciso Bay Board Sailing Assoc. Newsletter May 1997 and updated on the IHS Web Site]*

For Racers of the Future, This Design Provides Fast Acceleration and a Smoother Ride On Choppy Seas.

Since the beginning, board sailors have been talking about putting hydrofoils on a sailboard, flying up out of the water, getting rid of lots of drag, and going really fast. Now there is a hydrofoil sail-board system that may turn the fantasy of great hydrofoil performance into reality. Developed over the last six years, the Miller Hydrofoil delivers a smooth and very stable high-speed ride. Steering is extremely precise. In short board conditions, it planes up very quickly, then undergoes terrific acceleration, to speeds often exceeding those attainable on conventional boards. It points extraordinarily high when working to windward, and the ride on bearing off to a beam reach is breathtaking.

The Miller Hydrofoil was designed to handle just like a conventional sailboard. It works with standard sails and harness systems, and all the controlling movements are what you'd expect. It is steered by rolling, and trimmed by raking the mast in the usual way. Jibing, too, is conventional, except that the jibing maneuver must be preceded by a simple manipulation. The board remains flying throughout the jibe.

The Miller Hydrofoil system consists of a main foil assembly, mounted in the fin box, and a "canard" foil assembly mounted in a special frame that is glued into a hole cut in the board near the tip. The canard is a controlling, rather than a weight bearing, foil. The main foil, mounted almost directly under the sailor, supports almost all the weight of the board and rider. It is designed to remain submerged at all times, and it is guided in doing so by the canard foil, which pops to the surface before board take-off, and generally remains there during subsequent operation. The key to the high performance of the Miller Hydrofoil is the reliability with which the canard foil tracks the surface.

Miller Hydrofoil Foilborne

Testing early in the development of the Miller Hydrofoil showed that a special type of foil is needed if the canard is to remain reliably on the surface. The type is called "supercavitating" and doesn't look at all like a standard wing. Rather than having the usual tear-drop shaped section, it has one more like a narrow wedge, with its point facing forward.

Miller Hydrofoil in Choppy Seas

Since this article appeared in 1997, I have made a number of changes in the design, most notably the replacement of the inverted T main foil by one in the shape of an inverted Y with anhedral angle of 35 degrees on each side. This rather improbable change led to startling improvement in performance. In addition, I have gone to very high aspect, constant chord wings, again with significant gain in performance. You can arrange a free lesson and demo ride by calling (510) 525-8006 or by approaching Rich Miller when you see him at one of the local sailing sites. He's easy to find — he's the one sailing just a little *above* the water. Rich Miller (rich@ski.org); 640 Colusa Avenue; Berkeley CA 94707 USA.

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World Sailing Speed Record

By Martin Grimm (IHS Member)

A recent inquiry to the IHS concerning the sailing speed record holding craft *Yellow Pages Endeavour* has prompted some searching for more information on this and other sail speed record craft.

Sail speed records can be broadly divided into two categories:

1. Average speeds achieved over significant distances or durations such as round the world challenges or 24-hour distance records.
2. Maximum speeds achieved over a relatively short run of say 500 metres.

This review looks at the latter of category. It would appear that hydrofoils have been a popular option for attempts to gain sailing speed records, and some have achieved records in their class though the absolute sailing speed record over all classes has apparently never been held by a purely hydrofoil supported design.

A quick surf of the Internet has revealed a number of sites that provide good information on the rules governing ratification of such speed records as well as details of some of the past record holders and new contenders.

The Rules:

The UK based World Speed Sailing Record Committee (WSSRC) sets the rules and ratifies sailing speed records.

To bid for a sailing speed record the contender must provide an IYRU/WSSRC approved observer and arrange for a surveyed course of 500 metres or longer and appropriately calibrated timing equipment to record run times. To achieve a new record, the contending craft must maintain an average speed over its surveyed course that should be in excess of the previous record by a speed margin of at least 2%. The speed may be achieved while sailing on any heading and need not be averaged in both directions.

There are five classes of sail craft for which records can be awarded. These classes depend only on the sail area of the craft: Under 10 sq.m (or ~108 sq.ft), Class A from ~108 sq.ft to 150 sq.ft, Class B from 150 sq.ft to 235 sq.ft, Class C from 235 sq.ft to 300 sq.ft and Class D (previously called Unlimited Class) beyond 300 sq.ft of sail area. There is naturally also an outright speed record over all classes.

Dave Culp's site: lists some frequently asked questions about speed sailing and gives good answers as to the rationale of the rules as they have stood for many years.

Brief History of Record Holders:

It is reported that in the mid 1950's Gordon Baker achieved 30.4 knots with his hydrofoil sailboat *Monitor* built under a US Navy development contract in September 1955. In fact there is a suggestion that unofficial boat speed measurements close to 40 knots were even obtained. Unfortunately, the speeds attained by the *Monitor* were not officially observed or ratified, otherwise it may have held the title of worlds fastest sailing craft until at least 1975 when the proa *Crossbow* officially attained a speed of 31.1 knots.

Sailing speed record attempts essentially began when in 1972 a week-long series of World Sailing Speed Record contests was initiated at Portland Harbour near Weymouth, UK. This gathering was organised by the Royal Yachting Association (RYA). The contest became an annual event that later became known as Speedweek. A series of buoys were set around the circumference of a circle with a diameter of 500 metres. This allowed any competing sail boat to adopt the most favourable course between opposite buoys of the marked circle thus covering a distance of 500 metres.

A long-standing record holder at the Portland Harbour events was *Crossbow* designed by Rod Macalpine-Downie and owned by Timothy Coleman. This craft was a 55 ft proa hull with a sloop rig (sail area of 873 sq. ft.) sail arrangement, and displacing about one ton. There was a plan to fit hydrofoils to the main hull also but this never eventuated. Indeed, the *Crossbow* had achieved the highest overall speed of 26.3 knots in the first year of the Portland Harbour event and that was raised to 31.1 knots in 1975 without the need for foil support of the main hull. By 1980 the catboat *Crossbow II* had raised the outright speed record to 36.0 knots. The *Crossbow* series retained the title of outright fastest sailboat until 1986 when it was gained by a sailboarder.

In the second race at Portland Harbour in 1973, thirteen of the seventeen competing craft were fitted with hydrofoils in one form or another.

A runner up in the early years of the Portland Harbour events was *Icarus* owned by the syndicate of James Grogono, David Pelly and John Fowler. They had achieved 25.5 knots with the craft by the early 70's. *Icarus* was an elegant fully foil supported Tornado type catamaran.

WASH EFFECTS
(Continued From Page 9)

cially important, because if hull resistance can be reduced, wash will also decrease and this will lead to more efficient and cheaper vessel to operate," Mr. Clements said.

Four main objectives for SWIM have been proposed:
1. Development of validated techniques for predicting 'near-field' wave generation identifying the impact of hull form, trim, speed and water depth on wash characteristics.
2. Enhance the methods for predicting wash propagation from 'near-field' to 'far-field', with 'farfield' validation against model and full scale data. 3. Developing of methodologies to quantify ecological impacts of wash, addressing littoral stress and seabed particle re-suspension, and key safety implications. 4. Proposal of guidelines for managing wash impacts, addressing ship design and operation factors as well as regulatory procedures based on robust understanding of wash effects.

HYDROFOIL ACCIDENTS IN GREECE AND RUSSIA

(*From Fast Ferry International, September 2000)*

A Minoan Flying Dolphins Kometa hydrofoil, *Flying Dolphin V*, suffered an engine room fire on August 22, 2000 while operating a service between the Greek islands of Aegina and Poros. There were no casualties amongst the 69 passengers and crew of seven. *Flying Dolphin V* was later towed to Piraeus for inspection. Early reports indicated that the superstructure is extensively damaged and the hydrofoil is likely to be scrapped. A far more serious accident occurred in Russia five days later, when six people were killed and another 17 injured when a Voskhod hydrofoil, *Voskhod-42*, collided with a barge. The vessel was traveling from Perm to Nabereznyje Celny, on the Kama River, with about 25 passengers on board. There was apparently thick fog in the area at the time. *Voskhod-42* remained afloat after the collision and was towed to a local port.

IHS OFFICERS 2000 - 2001

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

WELCOME NEW MEMBERS
(Continued From Page 2)

Timothy Timoleon - Tim is from Denmark where he edits a very fine publication called "Classic Fast Ferries." It contains in-depth reporting on ferries of all types, including hydrofoils. There are now nine in the series which can be viewed and downloaded for printing at: http://classicfast-f.homepage.dk/ The IHS web site has a link to Tim's site.

Joseph C. Tyler - Joe is from Saratoga Springs, NY and has a BS in Aerospace Engineering from Purdue and an MS from the University of Maryland. He is currently President of Visionary Software Solutions, Inc, an Internet application development company. Joe is working on a hydrofoil design as a hobby.

Benjamin Willock - Benjamin is from Reno, Nevada. Hydrofoils is an offshoot to his interests in human powered vehicles and sailing. He noticed that missing from the IHS book list is "Human Powered Vehicles" by Allan Abbott and David Wilson, ISBN 0873228278. It has an informative chapter on Hydrofoils including Mark Drela's Decavitator, Sid Shutt's Hydroped, and Abbott / Brooks' Flying Fish II.

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NEW BENEFIT

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

IHS BOARD OF DIRECTORS

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LETTERS TO THE EDITOR

Web Site Appreciation....

[Dec 2000) Just wanted to let you know how much I enjoy all your hard work. I am particularly interested in all of the sail powered craft but find everything to be absolutely fascinating. Some time between now and next summer, if you have the time, would you be able to direct me towards some modem information pertaining to the foil style of Donald Nigg's "flying fish", and L'Hydroptere if anything is currently available. Books or magazine articles. I have a pretty good understanding of the foils but was interested in whether the foils had a built in wash-in or wash-out "twist" to them, or if moveable ballast is used? Being without a surface "wand" or sensor how does the windward foil stay submerged when on a reach. I won't go on but if you can suggest anything I would be interested. If you are too busy I understand. I'll keep digging. Thanks again for all your hard work. Rob Dewar c/o, flynn43@attglobal.net

LITTLE SQUIRT Today...

[12 Dec 00] Last week, leaving Paine Field in Everett Washington, I spotted a familiar shape next to the fence. Going over, I checked and sure enough, it was LITTLE SQUIRT, up on blocks for storage. Its against the fence, on Boeing property, close to the main airport entrance drive, just beyond the Museum of Flight restoration facility. Next time I'm up there, I'll get a picture of it. — David Lednicer (dave@amiwest.com)

Model Building Techniques— Scaling Lessons Learned...

[10 Dec 00] I of course try to design my models as close as possible to the state-of-the-art (full size) ORMA 60 trimaran yachts, but there are also some fundamental differences, mainly regarding building techniques and achievable weights. The basic relationships apply, as the physical laws are the same for 60ft - or 2M, 6ft, or 4ft models. The aim for the models is to get the models as close to the full size vessels as possible. For the relation of 60ft to 4ft, the scale is 15:1. Since ships are three-dimensional structures, you have to calculate: 15x15x15 : 1= 3375 : 1. So for overall dimensions like: length, width, height, the scale remains 15:1, but for the sail area it becomes 15x15:1 = 225:1 and for the structure and their weights it is 3375:1. Now if you look at the currently achieved weights of ORMA 60s, you'll find weights between 5.1 tons (or 5100 kg) and 6,6 tons (or 6600 kg). 5100 divided by 3375 is only 1.51 kg and this weight has never been achieved by a fully functional 4ft. scale model. Even if you take the high end of the ORMA 60 weight range (6600 kg) and divide it by 3375, you'll get only 1.95 kg; almost impossible to build/achieve. Actually achieved weights are between 2.25 and 3.0 kg. Now turn it the other way round: The R/C set of a 4ft trimaran including batteries and sail winch weighs about 0.33 kg. Multiplied by 3375 to scale up to full size, it would become 1113,75 kg or 1.1 tons... that is a weight of equipment for a ORMA 60 that is never reached in reality. Now you'll understand, that our models cannot really be designed and built as real "scale" models to ORMA 60s. They need to be designed to their actually achievable weights. And if you miscalculate the volume of the hulls to about 0.2 to 0.3 kg to the actually achieved weight, your boat won't sail safely at all. Ernst Zeman (petra.zemann@chello.at) *[Ed Note: Zeman goes on to elaborate in great detail on weights. The full text can be found on the IHS Web Site.]* and on p. 19 of this NL edition.

Volga Engine Info Needed Fast...

[8 Dec 00] We have just acquired a Volga 28 foot hydrofoil and urgently need technical information on the engine. I believe it is a Yak engine and the number is GAZ-53,90. Have you any information or can you suggest anywhere where I might find it. This is a very urgent request as the boat is being used in a major motion picture we a currently shooting here in Casablanca. Please let me have anything you can as soon as possible. My email address is jonathanfrost@yahoo.com, fax no +212 22 30 15 45 mobile +44 7831 643 172. HELP! — Jonathan Frost

HIGH POINT Offered For Sale, Last Chance...

[5 Dec 00] IHS received a call from Janice Fraser about her frustration with HIGH POINT. She says she's just gotta get rid of her by the end of this month (Dec 00). The cost of keeping the boat at the dock is too high, and apparently the lease runs out and needs to be renewed Jan 1, 2001. If interested, contact: Ms. Janice Fraser; 200 Harbor Drive, Apt #2703; San Diego, CA 92101; Tel: 619-233-3549

Model Sailing Yacht...

[5 Dec 00] I am studying A-Levels in England at the moment and for my main project I'm building a model yacht (monohull). It is for a competition run by Strathclyde Uni. in Glasgow. There are few design restrictions and having spoken to the university I have confirmed that I can have a hydrofoil design. The restrictions that I have are as follows: Max LOA: 700mm, Max Draft: 300mm, Max Mast Height: 900mm, Min Mass: 2kg, Max Sail Area: 2000mm2, Keel bulb must be no more than 55% of total mass, must be monohull in the true sense of the word. I was thinking of having a 'Y' shaped keel with the diagonals as hydrofoils as I can only have one keel. What I need is, one: Will it work? and two, What kind of hydrofoils should I use for the best results, if any. — Philip Eltringham (phill_eltringham@hotmail.com)

Continued on Next Page

Who Invented the Hydrofoil?...

[2 Dec 00] Who invented the hydrofoil? — Various... this is a FAQ

Response..."The first hydrofoil boat was the product of an accident in 1861, when Thomas Moy, an Englishman, decided to study the aerodynamics of wings by observing the underwater swirls they created. Having attached wings to his craft, he ventured out onto the Surrey Canal. To his surprise the ship rose from the water — and unintentionally he had invented hydrofoils. But it was not until 1898 that the first efficient hydrofoil was designed by Enrico Forlanini of Milan in Italy. His craft, powered by aircraft-type propellers, reached a speed of 44 knots (81.5 km/hr or 50.6 mph)." Source: Hamilton, Ian, "The Hydrofoil as Weapon," Pacific Defence Reporter, Aug 1981 "The first evidence of the use of hydrofoils on a boat or ship was in a British patent of 1869. It was granted to Emmanuel Denis Farcot, a Parisian, who claimed that 'adapting to the sides and bottom of the vessel a series or inclined planes or wedge formed pieces, which as the vessel is driven forward will have the effect of lifting it in the water and reducing the draught.'" Source: Hayward, Leslie, "The History of Hydrofoils," Hovering Craft and Hydrofoils, Vol 4. No. 8 (May 1965) through Vol. 6, No. 6 (Feb 1967).

JUNEAU FLYER Info Wanted...

[2 Dec 00] I am the current owner of a 36' hydrofoil that operated out of Juneau, Alaska in the late 1970s. It is a welded aluminum, stepped hull passenger ferry that was crashed. I recovered it 15 years ago in Ballard, Washington (it was stripped down, with no motor, or foils). I don't know the builder's name, but I have the hull identification number. It was called the JUNEAU FLYER. I am thinking about restoring it as a hydrofoil. I am interested in any information regarding hydrofoil technology and information on the JUNEAU FLYER. I know that she had a gas turbine engine in her, and I think she had fixed foils. If you've seen the James Bond movie "Thunderball," there is a hydrofoil that detaches from the front of a larger boat, and the hydrofoil looks very similar to the JUNEAU FLYER. — Carl Van Valkenburg (carlnat@buttes.net)

Response...[2 Dec 00] The Thunderball vessel was named DISCO VOLANTE. There is a picture and a sales brochure on the Rodriquez Cantari Navali webpage on this subject: "Safe, thrilling, spectacular, FLYING FISH was used in Thunderball, one of the most popular 007 James Bond [movie] sagas. FLYING FISH was the first commercial hydrofoil [for] sightseeing use in the Western Hemisphere. The advertisement: All-aluminum, 20 tons, 65 feet long, propeller-driven. She moves at 20 m.p.h. with her hull in the water. When up on her foils, she glides smoothly above the seas at 40 m.p.h. Comfortable, all-enclosed, wide window passenger compartments. Deep cushioned aircraft-type seats. Forced-air ventilation. Capacity: 60 passengers. Completely safe, Coast Guard approved. Unsinkable hull has eight watertight compartments for buoyancy. Diesel powered, no fire hazard. Smoking permitted at all times. Type: PT 20 ; Seats: 72; Yard building number: 052 ; Delivered in: 1957; Line: Manila-Corregidor; Country: Philippines" — Barney C. Black (webmaster@foils.org)

Hydrofoils for Trimaran...

[2 Dec 00] I have recently rebuilt a James Brown Searunner (28'). The outboard hulls are each attached by four 2" aluminum box beams, each roughly 5' long. There are two wooden struts each about 10' long going out to each of the outboard hulls as well. As you know these connecting beams or struts are called akas and the outboard hulls are called amahs. The aluminum akas are used to create two vertically aligned right angled triangles. The vertical side is about 2' high and formed by the connection of the akas to the two main bulkheads of the main hull. The shorter of the akas is horizontal, both akas meet the amah at the inboard side of it's upper deck. The wooden akas provide rigidity fore and aft. It seems to me that retractable foils could be attached to the aluminum akas. The foils might be deployed when the boat reached 10 knots, and designed not to lift the boat entirely out of the water but only to provide enough lift to reduce the wetted surface, and increase the righting moment of the leeward hull. I'm not expecting such a project to be "cost effective". I look at the boat as a platform to experiment with (if only in my head.) I am not an engineer, but I am beginning to learn about how beams can be made light and strong, and shaped like hulls or foils. I have a nice shop at my home. I might undertake such a project next winter once I have finished fine tuning and tweaking the boat (the first shakedown cruise was in late Aug 00. — Nip (d_ensley@tpo.org)

Hanning-Lee WHITE HAWK Update...

[24 Nov 00] My feature on the WHITE HAWK was printed in the summer edition of FAST FASTS, the Speed Record Club magazine. I interviewed the son who was 7 years old at the time of the Windermere attempts and got a good deal of information out of him as well as some superb photos. He was very helpful indeed, it was just a shame that his dad had died only last year, as no doubt he could have filled in all the gaps!

I will post the whole article on my web site. I also had a long and totally absorbing talk with the boat's designer Ken Norris and spent most of a day with him at his aircraft company at Bournemouth Airport. He is of course involved in the new QUICKSILVER boat, and I had the opportunity to see wind tunnel and tank models of that as well as some of the drawings. It was a wonderful day for a record enthusiast! I also spoke to the photographer who covered the runs for a major news agency and got some nice anecdotes from him. — Simon Lewis (simon.lewisbooks@virgin.net)

New Site Devoted to Ekranoplans (WIG) Craft... http://aquaglide.ru

[2 Dec 00] The Center of Ekranoplan Technologies (ALSIN) has a website with detailed info on WIGs including a small ekranoplan AQUAGLIDE, an achievement in aircraft and shipbuilding that can glide above water, snow and land in all climatic zones, all weather with speed up to 170 km/h. The Center has other developments in this field with information on the website. — ALSIN email: (aquaglide@mtu-net.ru)

Section and Materials For Supercavitating Foils...

[23 Nov 00] This concerns foils for a 22ft racing catamaran powerboat a friend of mine is currently constructing. The HYSUCAT concept consists of a main foil supported on the lowest point of the hull and spans horizontally across the tunnel between the two hulls just in front of the center of gravity. There are also two smaller aft foils close to the stern that does not span the whole distance across the tunnel. On this particular boat the chord length is 160 mm and the span approximately 950mm. As this boat is powered by two 150Hp outboards, the maximum speed would be around 70 Mph. The main purpose of the fwd foil is to reduce the slamming of the hulls and also to bring it onto a plane much quicker. The foil section currently used on a slower boat is an arc of circle foil manufactured from stainless steel. This foil section was probably used for ease of manufacturing. I have recently manufactured a couple of carbon/kevlar foils for my Trampofoil with great success and would thus like to manufacture another foil for the racing boat using a more optimum foil section and composite materials. The section I have picked was the E817 but I am wary that this foil section might cavitate at these high speeds. My knowledge on super cavitating foils is very limited but I have seen some sections with the sharp entry and flat rear end witch looks promising. What section would you propose to use in such an application and where can I get hold of some data and information regarding these high speed foils? What would the implications be in using a composite material and corrosion due to cavitation? — Ben Lochner, Cape Town, South Africa (benl@kingsley.co.za)

Drag Testing of Hydrofoils...

[21 Nov 00, updated 2 Dec 00] I am currently working on a project that deals with tests the drag produced by two different hydrofoils. One would be a conventional hydrofoil and the other would be modified so that an electric field is produced (interacts with ions in the water). I am a Georgia Tech Aerospace Engineering student. We are currently working on presentations in a fluids laboratory and everyone has been assigned a topic. My topic deals with these two hydrofoils and the goal is to come up with the best experimental technique and present it to the class. I found some info on the David Taylor Model Basins and they seem like a great idea for testing hydrofoils. It does not, however, elaborate on what type of measuring equipment is used. I'm only familiar with equipment used along with wind tunnels (i.e. LDA and PIV systems). Do you have any information on what equipment can be used to measure drag and investigate the boundary layer in water facilities? . I appreciate all of the feedback from members of your society and welcome anymore as it comes available. — Lauren Ihrig (Lauren_Ihrig@excite.com)

Response...[23 Nov 00, updated 2 Dec 00] I am very curious as to what prompted you to ask the question to include a hydrofoil with an electric field. There is good info on the reason for the electric field on a website entitled Control of Flow Separation in Weakly Conducting Liquids by Means of Electromagnetic Forces. The articles on the site show very good improvements in foil flow separation and therefore drag reduction, and lift improvement. Question is how practical is it, how much electrical power is required, and a host of other questions and clarifications. Have you access to any technical papers on theoretical or experimental work along this line? Are they available to us? Wouldn't the tests have to be carried out in salt water? If so, tank tests are out. Testing of the foil system with and without the electric field would have to be done from an instrumented vehicle in a protected bay under calm conditions. Both lift and drag would have to be measured because the important issue is lift to drag ratio. This would not be the first time foils have been tested in open water. — John Meyer (president@foils.org)

[23 Nov 00] Just based on fundamentals, I suppose that there might be a problem. Lift and drag are functionally related so I imagine that if this EM field method would reduce drag it would also reduce lift. Jim King (KingJH@nswccd.navy.mil)

[2 Dec 00] I don't know what is meant by an "electric field is produced (interacts with ions in the water)." There's been some work done on electromagnetic turbulence control where local EM fields have been produced that interact with the boundary layer (in sea water) to produce a Lorentz force. If done correctly this has been shown to lead to substantial reductions in friction drag. Scaling to high Reynolds numbers hasn't been demonstrated although DNC computations suggest it should work. DARPA had funded some work in this area that was mostly proprietary. NUWC has done some work and could likely provide some published data that could be forwarded. In response to the comment about this affecting lift, the phenomena I described above all takes place in the boundary layer so lift is (to first order) unaffected. — Stan Siegel (stansiegel@aol.com)

Hydrofoil Construction Methods and Materials...

[19 Nov 00] I was wondering if it was possible for you to send me some information on the construction of hydrofoils. I am doing a college term paper on the construction of hydrofoils and I am having some trouble finding information on that topic. I'm mainly

looking for material specs, type's of steel used to reduce weight, propulsion systems, foil systems, welding techniques, and hull considerations. I checked out the webpage and saw all the basic constructions but, if possible, I need some more specific info. — Matt Ferruccio (matt300@hotmail.com)
Response...[19 Nov 00] There are three pages of hydrofoil references accessible from the main page of our website: Technical References, Popular Magazines, and Popular Books. Most of these are out of print, but many can be found in libraries, book sales, online auction sites, especially Ebay. — Barney C. Black (webmaster@foils.org)

TUCUMCARI...

[11 Nov 00] I have an uncle that served aboard the PGH-2 TUCUMCARI. He was aboard her when she hit the reef. I was wondering if you knew where she was today? I have been looking for a long time and just now found this site. — Caleb Hagarty (CCH1985@aol.com)
Response...[19 Nov 00] After the TUCUMCARI was put on the reef, it was transported to David Taylor Naval Ship Research and Development Center, Annapolis MD Division (across the water from the US Naval Academy). The ship was stripped of many of the major equipment, and the remaining hull was used to study fire fighting techniques for aluminum ships. Some of the lessons learned were the use of various plastic and fiberglass pipes, which ones held up, which ones melted, and which ones were toxic. This led to establishing specifications which are used in many of the current Navy ships. Also studied were the effectiveness of various fire extinguishing materials such as CO_2, Halon, and foam. — Sumi Arima (arimas1@juno.com)

VOLANTIS Update...

[28 Oct 00] I was just by the IHS website for a visit and note that on your "Hydrofoil Articles in Popular Magazines" you have a reference to our boat as featured on the Multihulls World cover and article. Just to update you, we have been given some good press from many magazines including, Seahorse Magazine (Nov 2000), Multihulls Magazine (Mar/Apr 2000), Composites Fabrication (March 2000), Canadian Yachting Magazine (Regatta 2000), Yachting World (July[??] 2000). Our project is coming together, both on the defense side and for the recreational/racing boats, and much goes on behind the scenes as we pull the program into shape. I will have significant press releases in the early new year which you will receive as part of our media contact list. — Duff Sigurdson, Media Relations, HydroWing Hawaii, Tel./Fax. (1) 250 753-9747, email: (duffrey@telus.net), website: http://www3.telus.net/hydrowinghawaii

Wanted to Buy Passenger Ferry...

[20 Oct 00] We require a passenger boat carrying 100-150 passengers. Could you please email us the specs and price? — Mano Karimi (mehrzad@emirates.net.ae)
Response...[10 Oct 00]IHS does not recommend or endorse products or services, and we do not sell hydrofoils. However, there are several resources on our website for locating sources of new or used hydrofoils. The most recent notices are posted on our announcements page. A more complete listing is on the appropriate FAQ page. Our links page has several manufacturers and brokers. That should get you started in your search. I would like to have some more details of your requirements. For example, the choice of vessel depends on whether you are operating in fresh water, sheltered seawater, or open ocean. It is also necessary to know whether you require a new vessel or if a used vessel may be acceptable. — Barney C. Black (webmaster@foils.org)

First Hydrofoil Ride...

Oct. 20, 2000 - I had my first hydrofoil boat ride during a summer international goodwill peace tour to Europe and the then USSR. I had a ride of almost 40 mph on the Neva River in Leningrad. I also viewed a large commercial passenger hydrofoil roaring down the Black Sea. I was very impressed, as that was almost 40 years ago. I suggest that ways of having the Staten Island, New York ferries (passenger) converted to hydrofoil service be investigated. I would like to have a ride on a hydrofoil in the USA in the near future, and, hopefully, in New York Harbor. Del Eberhardt 10 Lakewood Rd. Staten, Island, N.Y. 10301 Tel: 718-442-8797

Wanted to Buy Small Ferry...

[13 Oct 00] I am looking for information for a abt. 15 passenger capacity open sea (coat-line) hydrofoil producers, manufacturers, offers for new or second hand. Thank you very much for your assistance. — Benedikt Schmitz (benbeni@monaco.mc); International Business Development, 19 Bd de Suisse, MC 98000 Monaco; T + 377 977 077 47; F + 377 977 077 57; M + 336 075 347 36
Response...[13 Oct 00] The Supramar PT-4 Meteor III which was offered for sale in New Zealand (and listed in the IHS website) is around that passenger capacity but is intended more for sheltered water operations. I suspect most hydrofoils of 15 passenger capacity would not have a true open ocean or coastal operating capability. A PT-20 sized craft with around 70 passenger capacity is about the minimum practical for coastal operations, and even then with some restrictions. — Martin Grimm

Letters To the Editor allows hydrofoilers to ask for or provide information, to exchange ideas, and to inform the readership of interesting developments. **More correspondence is published in the Posted Messages and Frequently Asked Questions (FAQs) section of the IHS internet web site at http://www.foils.org.** All are invited to participate. Opinions expressed are those of the authors, not of IHS.

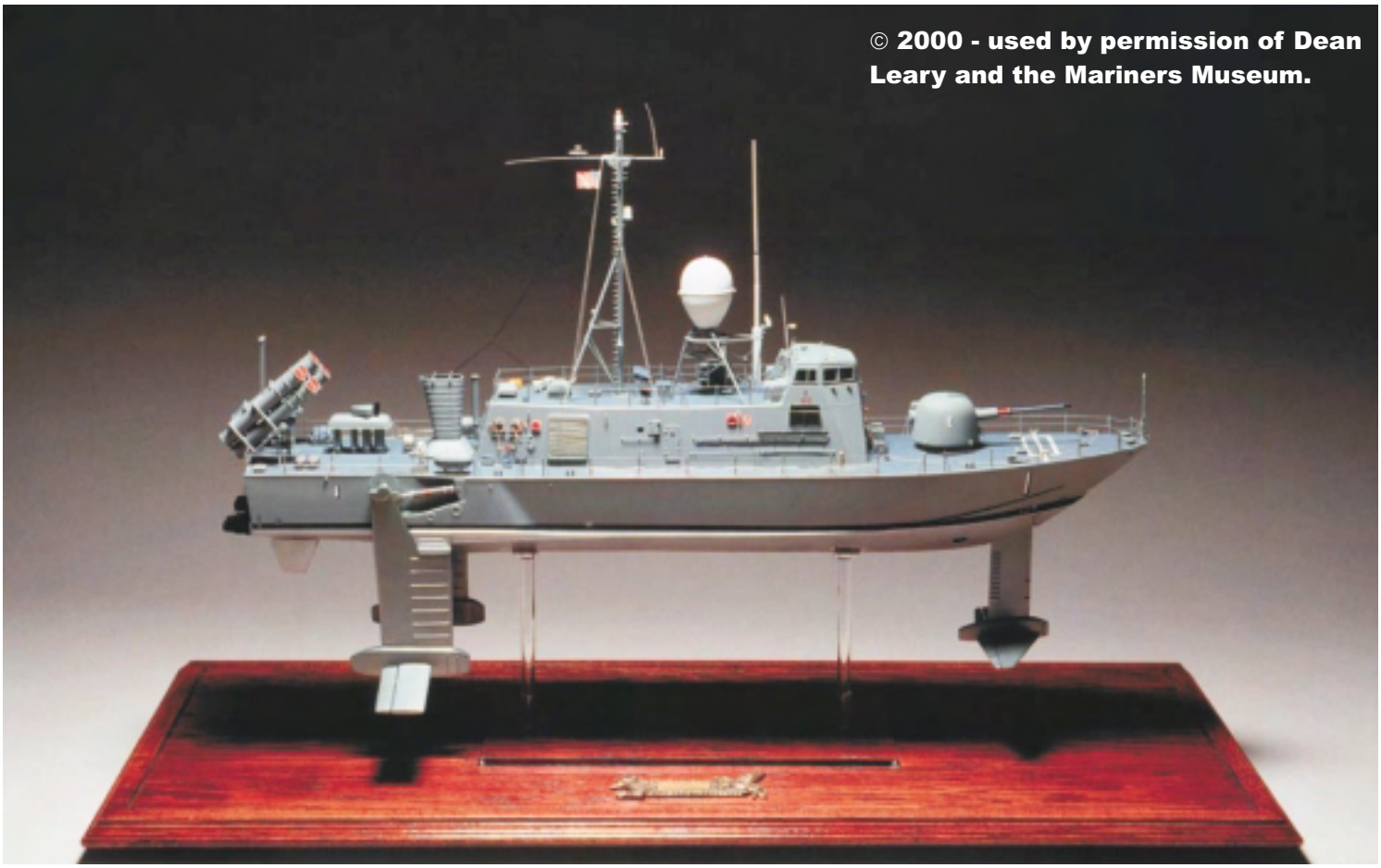
EXTRA FOR THE ELECTRONIC EDITION

HYDROFOIL COLLECTIBLES ON THE WORLD WIDE WEB

The Photo Gallery section of the IHS website features a new page devoted to hydrofoil collectibles... stamps, first day covers, picture post cards, and squadron patches. Members are invited not only to visit this page, but to scan or photograph their own hoard of collectibles and send them in for possible inclusion on the page. If you have detailed info or a personal story about any of the items depicted, let us hear about it so we can share it with other hydrofoilers! You can email electronic files to Malin Dixon at gallery@foils.org or you can mail hard copy photos to the webmaster c/o IHS at PO Box 51, Cabin John MD 20818 USA. We will exercise care in the handling of your photos and will return them to you after scanning, but cannot be responsible for damage in transit by snail mail.

HYDROFOILS IN THE MOVIES

The Great Jetfoil Robbery (1996) — A shipment of $10 million in transit by jetfoil to Hong Kong is seized by armed thieves who redirect the boat to a secret island hideout and vanish without a trace, leaving the Hong Kong and Macau police scrambling to solve the case. Tony Chun Chung stars. 82 min. In Cantonese with English subtitles. Available in VHS from Movies Unlimited, http://www.moviesunlimited.com.



IHS congratulates Dean Leary of Statesville NC for his award-winning model of the hydrofoil missile ship USS PEGASUS (PHM-1). This model took the Gold Medal in Division I Class B: Scratchbuilt Powered Ships category of the 2000 Scale Ship Model Competition sponsored by The Mariners' Museum, Newport News VA. Scratchbuilt models are those employing no manufactured items except cordage, chain, and fastenings such as pins and nails. Such materials as dimensioned lumber, sheet metal, tubing, wire, and milled shapes are allowed as raw materials. Photo-etched, laser-cut, cast, or similar parts mechanically or chemically duplicated by others from the entrant's original master or pattern shall be considered as scratchbuilt.

To recognize and encourage excellence in the art of building scale ship models, The Mariners' Museum holds an international competition and exhibition every five years.

The competition is open to completed models built to scale by individual modelmakers, professional or amateur, of all ages. Known by many as the "Olympics" of ship model building, this fascinating competition attracts models from every seafaring corner of the world. From the simplest primitive craft to the intricacies of a present day aircraft carrier, these models represent the essence of the art of scale ship model building. Nationally recognized ship model authorities, selected by The Mariners' Museum, judged the competition and chose the winning models. The winning ship models were displayed in the Museum's Collections Gallery through Oct 00. For more information about the Mariners' Museum, visit the website at http://www.mariner.org

HOW MODEL BUILDERS SCALE DOWN BY ERNST ZEMANN

[This is the full text of the letter appearing on as an exerpt on page 13]

I of course try to design my models as close as possible to the state-of-the-art (full size) ORMA 60 trimaran yachts, but there are also some fundamental differences, mainly regarding building techniques and achievable weights. The basic relationships apply, as the physical laws are the same for 60ft - or 2M, 6ft, or 4ft models. The aim for the models is to get the models as close to the full size vessels as possible.

For the relation of 60ft to 4ft, the scale is 15:1. Since ships are 3-D structures, you have to calculate: 15x15x15 : 1 = 3375 : 1. So for overall dimensions like: length, width, height, the scale remains 15:1, but for the sail area it becomes 15x15 : 1 = 225:1 and for the structure and their weights it is 3375:1.

Now if you look at the currently achieved weights of ORMA 60s, you'll find weights between 5.1 tons (or 5100 kg) and 6.6 tons (or 6600 kg). 5100 divided by 3375 is only 1.51 kg, and this weight has never been achieved by a fully functional 4ft. scale model. Even if you take the high end of the ORMA 60 weight range (6600 kg) and divide it by 3375, you'll get only 1.95 kg; almost impossible to build/achieve. Actually achieved weights are between 2.25 and 3.0 kg.

Model Builder Ernst Zemann

Now turn it the other way round: The R/C set of a 4ft trimaran including batteries and sail winch weighs about 0.33 kg. Multiplied by 3375 to scale up to full size, it would become 1113.75 kg or 1.1 tons... that is a weight of equipment for an ORMA 60 that is never reached in reality.

Now you'll understand that our models cannot really be designed and built as real "scale" models to ORMA 60s. They need to be designed to their actually achievable weights. And if you miscalculate the volume of the hulls to about 0.2 to 0.3 kg to the actually achieved weight, your boat won't sail safely at all.

Have a look below at the weights of the single (full size) components, then to the corresponding scale weights that would be ideal. Now take a look at the weights I have actually achieved, which are — I believe — the lowest weights ever achieved:

- *FONCIA*: Floats: 500 kg each; Crossbars: 500 kg each; Mainhull: 1000 kg; Mast: 750 kg

- *BANQUE POPULAIRE II*: (remember, this ship was destroyed in it's first race) Floats: 420 kg each; Crossbars: 460 kg each; Mainhull: not sure (800 to 900 kg); Mast: not sure (650 to 750 kg)

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HOW MODEL BUILDERS SCALE DOWN BY MARTIN GRIMM

I have read Ernst Zemann's posted message of 10 Dec 00 on the IHS website and offer this reply. Ernst indicated that in his experience it is not practically possible to achieve a proper scaled weight for an ORMA 60 trimaran yacht model of 15:1 scale. While I have never built a sailing yacht model, I have in the past built RC model aircraft and an RC scale model of a hydrofoil passenger ferry. I thought it might be an interesting contrast with the ORMA 60 models to look at the achieved weights of those models compared to their full-scale equivalents.

Looking first at a scale aircraft model. I have built a 1:6.75 scale de Havilland DH82 Tiger Moth bi-plane model from a kit. This model is powered by a .40 size two-stroke internal combustion model aircraft engine. With a full tank of fuel and all radio control equipment fitted (4 channels with servos), the model weight is about 2.500 kg (the plans suggest anything in the range of 2.3 to 2.5 kg). By comparison, the maximum takeoff weight of the full scale DH82 is variously listed as being 803 to 827.8 kg which, when scaled down to 1:6.75, would correspond to 2.611 to 2.692 kg (up to 7.7% more than the actually achieved model weight).

It should be noted that the Tiger Moth can carry two people at say 75 kg each, and that would make up part of the full load weight of the aircraft. At model scale these two people would correspond to a total of 0.488 kg, whereas my "equivalent" of a pilot is the radio control equipment (quite old gear with a large battery and servos), which weighs around 0.550 kg.

In any case, this example demonstrated it is possible to build a scale air-

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ERNST ZEMANN
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- *GROUPAMA*: (here I got most data, but I'm not sure how reliable they are) Floats: 400 kg each; Crossbars: 400 kg each; Mainhull: 800 kg; Mast: 650 kg; Centerboard: 150 kg; Forestay, shrouds, and hydraulics to tilt the mast: 400 kg each

For the 4ft models, the ideal weights therefore should be:

- Floats: 0.12 to 0.15 kg each - achieved weights 0.25 kg (!) (each one is the achieved minimum)
- Crossbars: 0.12 to 0.15 kg each - achieved weights 0.15 kg
- Mainhull: 0.24 to 0.30 kg - achieved weights 0.50 kg (!)
- Mast: 0.19 to 0.22 kg - achieved weights 0.25 kg
- Total: 0.91 to 1.12 kg - achieved weight 1.55 kg

As you can see, these are only the main components. A lot of other parts relate in the same way: rudder, centerboard, centerboard trunk, boom(s), sails, forestay and shrouds and so on.

The achieved weight that is most irritating to me is the weight of the crossbars! Although these parts are the most difficult ones to build, I almost achieved the ideal weight. So the (maybe strange and maybe wrong) idea came up in my mind, these crossbars could be too weak. It would be bad if they bend too much, but even worse, if they break! But they *seem* to be strong and stiff enough (according to my tests) This then would mean all hull shells I had built so far although they are very light already - must still be far too heavy. That is one more reason, why I left the workshop alone for some time and went back to drawing and calculating again. Unfortunately, it also confused me quite a bit; and held me back from continuing the model itself.

The fact is, not one R/C trimaran model-builder except me (neither for Mini40, Formula 48, 2M nor for any other size) has been willing so far to share the actually achieved weights of his own models with anybody else. The R/C multihull enthusiasts should be able to work together and help each other. So I will simply publish my own data from now on, and others can compare my modeling results to their own. I hope some good discussions will happen in the near future. I also will publish all data of my older and bigger models and also of my new (although I started to build it two years ago) 2M carbon trimaran soon.

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craft model to a weight less than the actual aircraft weight scaled down to model size using scaling laws. This seems surprising given that full-scale aircraft are typically already lightly constructed. The model in question is quite solidly built, though the wings and fuselage consist largely of fabric covered balsa wood. The reason the model can be built to less weight than its "scaled weight" is perhaps explained by strength considerations as discussed at the end of this article.

Now let's turn to my 1:20 scale model of a Rodriquez RHS 140 hydrofoil passenger ferry. The initial intention was to ensure that the model weight was correctly scaled and therefore that the model floated at the correct waterline. As the full scale vessel displaced 65 tons (or about 66 tonnes) fully loaded according to Jane's Surface Skimmers 1974/75, the corresponding model weight could therefore be permitted to be up to 8.250 kg*. If it was less than this weight, then ballast (or preferably more batteries to give improved endurance) could be added to achieve the correct scale mass.

- * Note: For model resistance testing, which is usually performed in fresh water towing tanks, the test results are usually extrapolated to the full-scale craft operating in salt water. For such tests the model should float at the correct waterline corresponding to the full-scale hydrofoil operating in salt water. Consequently there is a slight correction that needs to be made to the model mass to account for the difference in density between fresh water (~1000 kg/m^3) and salt water (~1025 kg/m^3). The 1:20 scale RHS 140 model would in that case be ballasted to: $66000/20^3/1.025 = 8.049$ kg.

During preliminary trials of the hydrofoil model before it was fully completed, the performance was found to be somewhat sluggish at a weight of only 5.500 kg. This was considered to be due to the insufficient power available from the twin electric motors used to propel the model and also to a less than optimum choice of propellers. I therefore accepted that the model weight should remain less than the properly scaled weight to maintain a reasonable foilborne performance.

While the model has not been completed yet, the final weight is estimated to be 5.920 kg. A breakdown of this weight is provided on the next page.

This is only around 72% of the correct scaled weight, so the model could in this case again be built to less than the scaled weight. There is at least one reason why such a light weight could be achieved. This is simply that the model does not have to contend with 140 scaled

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down passengers on board (that being the maximum capacity of the RHS 140). At full scale these would weigh around 10.5 tonnes while the correctly scaled passenger weight at model scale would still have amounted to 1.312 kg. Of course my model does not have dummy passengers nor does it have any interior outfit, all of which would have added weight to the model and brought it closer to the scaled weight.

At the start of the project to build this model, I estimated I had plenty of weight budget to spare, and therefore I did not skimp on the hull construction material. The model is thus quite solidly built from 2.5 mm plywood. The foils are solid wood construction with steel rod reinforcement at the leading and trailing edges. Once again, it can be seen that it is relatively straightforward to build a scale hydrofoil ferry model at a weight that is less than that of scaling down the corresponding full-scale hydrofoil displacement. Fellow hydrofoil modelers in Denmark have built much lighter models than mine despite their being of a similar size. In one example, this has been achieved even though a high degree of detailed outfit has been included on the model. Some of these models are built of light alloy sheeting.

Ernst Zemann remarked with some satisfaction that he has managed to achieve the weight target on the crossbars of his ORMA 60 yacht model. This has reminded me of an interesting result I once stumbled across when it comes to scaling of strength between model and full scale craft, or for that matter from one size of hydrofoil to a larger geometrically identical one.

It turns out that if an identical material is used and the construction of the structure (be that a foil or a cross bar) is also accurately scaled, the model will experience less stress that the larger scale equivalent for the same scale loading cases. I will use as an example the stress in two cantilevered beams being equivalent to one another except that they are at two different scales:

Breakout of Component Weights -- M. Grimm's Model RHS140

Component	Wt. (grams)	% of Total
Hull	**2440**	**41**
Superstructure	**645**	**11**
Forward foils and cross beam	**245**	**4**
Aft foils	**150**	**3**
RC receiver, servos, RC batteries, etc.	**550**	**9**
1800 mAh NiCad batteries (2)	**660**	**11**
2x Motors and controllers	**585**	**10**
Deck Fittings	**250**	**4**
Shafting, propellers, and couplings	**150**	**3**
Tubing for fenders, etc.	**75**	**1**
Stainless steel hand railing	**170**	**3**
Total:	**5920**	**100**

The smaller beam is solid aluminum alloy, say 6062-T6 grade with a yield strength of 110 MPa and Youngs Modulus (E) of 70 GPa, and has a cross section of 10 mm x 10 mm and a cantilever of 1.0 m span. One end is rigidly fixed to a wall. On the other end of this horizontal beam, a mass of 1 kg is suspended. The maximum stress in the beam develops at the wall end and can be calculated by applying a common engineering formula:

Stress = M.y/I (Pascals)

Where:

- M = the moment exerted in the beam at the wall end = mass x gravity x Span = 1.0 x 9.81 x 1.0 = 9.81 Nm.

- y = the distance from the Neutral Axis of the beam cross section to its extreme fibers, which in this case is half the height of the beam or 5mm (0.005m) since the neutral axis lies at the center of this symmetrical section beam.

- I = the Moment of Inertia of the beam cross section. For a solid rectangular cross section this is given by: $b.h^3/12$ where b is the base width and h is the height of the cross section of the beam. Hence I = 0.01 x 0.01^3 / 12 = 8.3333×10^{-10} m^4.

Consequently, the stress in the beam is:

Stress = 9.81 x 0.005 / 8.3333×10^{-10}
= 5.886×10^7 Pa or 58.86 MPa

Now, if we double all the dimensions of the beam and cube the mass suspended from the beam (following the reasoning of mass scaling given by Ernst), the beam cross section is now 20mm x 20mm while the span is 2.0 m. Of course the weight suspended from the

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beam is now increased by the dimension cubed, so it becomes 1 kg x 2 x 2 x 2 = 8 kg. Repeating the above calculation process for the larger beam and mass we now get the following stress in the larger cantilevered beam:

$$\text{Stress}=156.96 \times 0.01 / (1.3333\times10^{-8}) = 1.1772\times10^{8} \text{ Pa or } 117.72 \text{ Mpa}$$

So it can be seen that the stress level has doubled rather than remaining constant as may at first have been expected. The example is such that, while the smaller scale beam is still well below the yield stress, the larger scale beam has exceeded the yield stress for the same alloy.

Taking this result the other way, the structure of a model in some instances can be built to less than the geometric equivalent thickness if the same material is used, or alternatively, a weaker material can be selected. A good example of this is the pair of foils on my 1:20 scale RHS 140 model. While the foils supporting the 65-ton full scale RHS 140 are constructed of hollow welded steel, the scaled foils for the 5.5 kg model are instead constructed mainly of solid wood. These foils have been demonstrated to be sufficiently strong even when the model has been tested by towing it in rough head seas when the model was ballasted to its correct scale weight of 8.25 kg. If the full-scale hydrofoil had employed solid wood foils rather than steel foils, they would surely break on the first attempt to lift out of the water when becoming foilborne!

Returning to the example of the two cantilevered beams, it is also worth looking at how the deflections at the tips of these two beams compare to one another when the mass is applied. The formula for the tip deflection of a cantilevered beam with a load applied at the tip is:

$$\text{Deflection} = F.L^2/(2.E.I)$$

Where:

- F = The force applied due to the load, i.e. 1 x 9.81 = 9.81 N for the smaller beam case.
- L = The beam length or span = 1 m for the smaller case.
- E = Youngs Modulus for the beam material = 70×10^{9} Pa or 70 GPa.
- I = Section modulus of the beam as defined previously

Now, for the smaller beam, we have a deflection of:

$$\text{Deflection} = F.L^2/(2.E.I)$$

$$= 9.81 \times 1.0^2 / (2 \times 70\times10^{9} \times 8.3333\times10^{-10})$$

$$= 0.084 \text{ m} = 84 \text{ mm}$$

Likewise, for the larger scale beam the deflection is 168 mm, or twice as much as the smaller beam. So, just as with the stress level, the deflections increase in proportion to the scale. It must however be appreciated that allowable deflections for engineering design purposes are usually related to the size of the structure itself. In this example it can be seen that the deflections remain in the same proportion as the dimensions of the structure so are not a bigger problem at larger scale than at the smaller scale.

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Fast Ferry Conference

Mitsubishi is giving a paper on its experiences with the fully submerged hydrofoil catamaran, *RAINBOW* at the Fast Ferry Conference in New Orleans, 13th - 15th March 2001. The second diesel-driven, fully-submerged hydrofoil catamaran *RAINBOW 2* operated by the company, entered service in 1998 following the 5 year operation of its sister vessel *RAINBOW*.

The paper looks at the trials and tribulations of bringing both craft into service and how the technical upgrading of both craft allowed the pair to run a technically free service from 1999 - 2000. If you want to know more about the 17th Fast Ferry Conference & Exhibition, either drop me a line or go to the website and click on the conference logo at the bottom of the page.

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Foil Design Software

The XFOIL airfoil design/analysis code has been recently placed in the public domain. It can be downloaded at http://raphael.mit.edu/xfoil.

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Jackson, William D, Naval Architect, *Build Your Own Hydrofoil Speedboat,* Science and Mechanics Feb 1960, Craft Print Project No. 304. p.176-179. Plans for building add-on hydrofoils for almost any boat up to 16 feet. Foils are constructed of steel framework with fiberglass foil-shaped lifting surfaces.