New Zealand Naval Architect

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Smart Material Specification for Outstanding Performance—Ermis^2

By

High Modulus

Ermis^2 in action

The Humphreys 37m (121ft) motor yacht, launched in September 2007, engineered by High Modulus and built by McMullen and Wing is an extraordinary vessel. For High Modulus the structural design brief was simple: to develop a structure to withstand twice the load at half the weight of a conventional high speed motoryacht.

It is unusual enough for a luxury motoryacht of this size to have a top speed in excess of 60 knots, but to couple this with extended ocean crossing range (2300 nm at 30 knots) and a design acceleration of 2.2g shows an uncommon dedication to serious boating. Such dedication extends to all facets of this complex project with all parties adopting a strict mindset of weight control.

It was made clear to the engineering team at the start of the project that the target

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INSIDE

A Word from the President

In this newsletter I am passing on the message that I gave to the MIA.

The New Zealand Division of RINA has had a very successful year running several CPD courses, conducting a number of company visits, arranging several technical talks and interacting with the tertiary training sector.

During the year we have run three continuing professional development course that were both well attended. The first on Copyright Law was provided by Cleandon's the divisions solicitors who are experts in the management of IP within the creative sector. John Harrhy Consulting Ltd delivered two CPD courses, one on Marine

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Structures and the other on Vessel Stability.

The boatyard visits to Alloy Yachts, Yachting Developments and Mc Dell Marine were both very informative and very much appreciated by our members.

The division appreciates the support of VT Fitzroy as the sponsor for the RINA/VTF student award at Auckland Universities, Department of Mechanical Engineering. The prize is aimed at encouraging students to focus their projects in the marine sector, with this year's award being won by, Henry Alasdair Donald and Joseph Reindler for their project "A Study of the Aerodynamics of the Olympic Variant Tornado Class Catamaran". The introduction of another student award sponsored by Alloy Yachts for the Marine technology degree at UNITEC is planned for this year.

An advisory board has been establish for the Massey University School of design to assist the development of the course and its continued recognition by RINA. The school is reviewing its current course structure and is keen to maintain formal recognition by RINA and for RINA members to be involved in the judging of the final year student projects

The NZ division will also organising the 3rd High Performance Yacht Design Conference which will be held at Auckland University in December 2008. This conference which is recognised as the premier international yacht design conference attracts the worlds leading designers and academics and provides a great opportunity for local industry to learn the latest international developments in this area.

We have maintained our strong working relationship with the MIA throughout the year. This included a meeting between RINA's CEO who is based in London with Peter Busfield the MIA CEO in February at which our commitment to work closely together was reaffirmed.

The AGM of NZ division of RINA was held on the 15th April with a very interesting and informative presentation by Ken Stevens of Glidepath. The AGM also raised the issue of the involvement of RINA as a body on marine related submissions to the Government via Maritime NZ, the idea of the division providing a submission on issue as opposed to individual submissions was well supported and the council will develop this further in 2008/9.

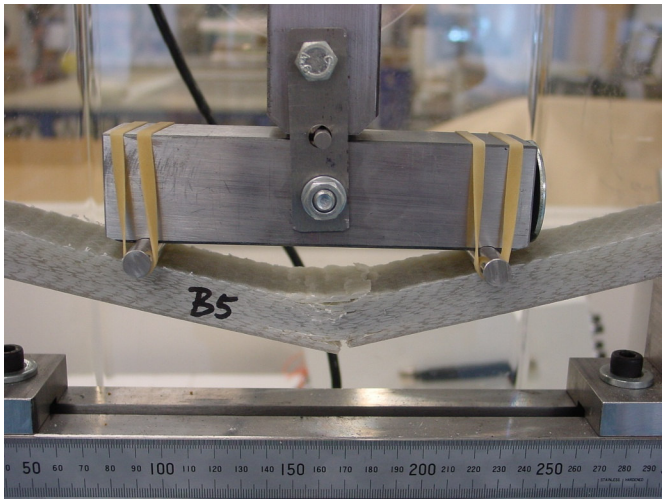
The Division relies on the support of its members, individuals and companies within the marine industry. I would like to thank all those people who are active in the division and the individuals and companies that continue to support our efforts in operating and promoting RINA within New Zealand. We aim to raise our profile and encourage the exchange of ideas and information between members and within the marine sector. We will be aiming to provide more technical meetings and articles in 2008/9 in addition to our current CPD and industrial visits.

Regards, Brendan Fagan,

maximum speed was 60 knots, the boat had to be able to withstand extremely rough seas, and the load benchmark was to be significantly higher than Germanischer Lloyd requires for commercial craft. For a boat of this size to achieve all of these performance targets it would be necessary to couple immense strength with light weight – a requirement not unfamiliar to the High Modulus team.

Structural optimisation to achieve the requirements began with an in-depth analysis of all of the construction options, from materials specification and structural arrangement, to construction method and the selection of classification society. As the design progressed, extensive use was made of global finite element analysis including full models of the whole structure. This tool was used to investigate both global behaviour of the yacht and local detail.

After thorough analysis of a wide range of construction materials and techniques, the decision was made to build a fully post cured, female-moulded, vacuum-infused carbon fibre-reinforced epoxy/ foam structure.



Flex testing of single skin laminate

Fundamentally, this decision was driven by an overriding focus on achieving the required strength and toughness at the minimum weight. By opting for a female mould process, weight can be reduced as the moulded component requires little or no fairing prior to painting, Likewise vacuum infusion enables a more accurate distribution of resin throughout the laminate, avoiding excess resin and therefore surplus weight. The infusion process also helps to produce a higher quality and stronger laminate than many other processes, as it dramatically reduces void content. Strength and toughness objectives were also achieved through the choice of epoxy resin and foam cores. Not only were foam cores specified for shell weight reduction, but also for impact toughness and to reduce internal framing, which in turn reduces weight and offers greater space below decks.

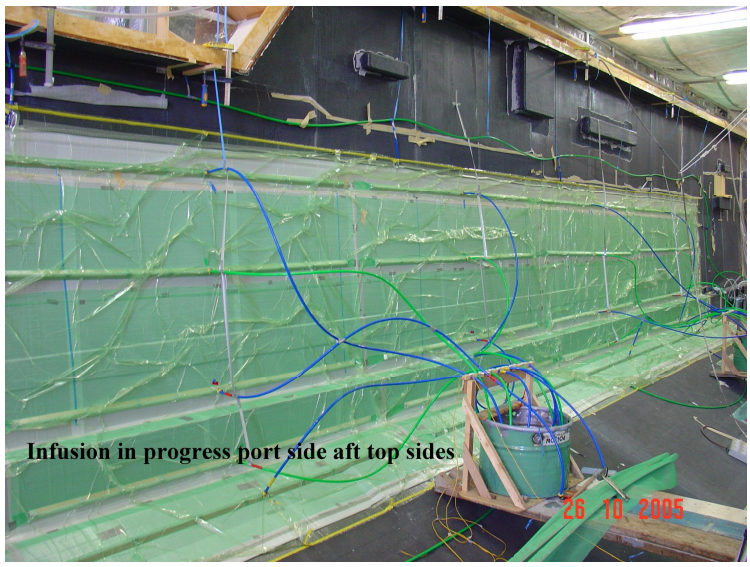
The most heavily loaded area of any high speed motoryacht structure is the bottom shell, and High Modulus engineers were quick to identify the need for extreme long-term toughness in this area. Backed-up with substantial experience and specialist research, High Modulus recommended the use of high elongation Airex R63 linear foam cores, coupled with carbon fibre and Kevlar®-reinforced epoxy skins. The resulting shell and structure were not only substantially lighter than the equivalent solid carbon fibre laminate: they were also substantially tougher.

To ensure the specifications were precisely matched to the strength requirements, core materials were manufactured to optimised thicknesses to suit each specific area, and custom carbon fibre multiaxial fabrics were designed and flown in to the boatyard from Europe.

The topsides, decks and superstructure are all vacuum infused multi axial carbon fibre with Airex C71 high temperature foam cores, while internal structures use unidirectional and multiaxial carbon fibre on Airex C70 foam cores.

Specification of the laminates was an iterative process that involved both intense analysis and extensive impact testing, together with close liaison with Germanischer Lloyd. The High Modulus in-house R&D team undertook mechanical testing of the panels, under the supervision of the Germanischer Lloyd surveyors, to ensure that all parties were happy that the final specification would deliver the performance objectives. Test reports were submitted to Germanischer Lloyd as part of the classification survey process for the vessel.

Impact tests were carried out to illustrate the benefits of linear cored sandwich construction over more traditional single skin laminates for the bottom shell. Interestingly, whilst there was more visual damage to the thin-skinned cored panels than to the solid panels, the damage deep within the solid panels – completely invisible to the eye or to tap-testing or other mechanical impedance methods - was



Infusion in Progress

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catastrophic. This provided a graphic illustration of the superiority of appropriately cored sandwich laminates over their solid laminate counterparts in serious impact loadings.

There was also an extensive programme of quantitative mechanical tests in which beam strip samples from bottom, topsides and several deck and superstructure laminates were tested to destruction at the High Modulus in-house testing facility. This was carried out to prove bending strength and bending stiffness values, as well as to prove the quality of the core bonding and core joining achieved by the vacuum infusion. Tests had to be performed in both transverse and longitudinal directions since the laminates had been precisely optimised to the requirements of each panel.

These beam tests provided an excellent validation of some of the less-publicised, quality-related benefits of vacuum infusion – in every case the laminates performed significantly better than would be expected of the equivalent wet-lay laminate specimens. The most dramatic improvement was in compressive strength, where the laminates withstood compressive strains normally only seen in autoclaved prepreg specimens – strong testament to the value of investing in quality processes, materials and engineering.

The result is a boat that truly represents the current state of the art – one of the highest technology luxury motoryachts ever built. The structure achieves excellent stiffness, strength and toughness, with considerable weight savings: the structural weight being approximately half that of a wet lay up glass, epoxy and foam core structure.

Reducing the Fuel Bills—Kite Power

Is your wallet feeling the pinch when you visit the petrol pumps? Imagine if you had to fill up your large superyacht or operated a fleet of tankers. Well the solution to your problem may not be far away. There are a number of companies looking at alternative fuel sources. Kites, wave power, solar and wind turbines are a few of the available options.

Of course what is driving this current interest in alternative power is the rising cost of fuel oil, which has topped $100 a barrel in futures markets. Anything that can reduce a vessel's fuel consumption is a good thing. Another factor is the Environmental costs. Ships' emissions are an important environmental topic for the shipping industry. In a report published by The Environmental Science and Technology Journal in 2007, 60,000 deaths per year worldwide were attributed to vessel emissions. Sulphur emissions are increasing most rapidly close to the world's shipping lanes. Fuel burnt by ships accounts for 4% of global CO_2 emissions - twice as much as the aviation industry produces.

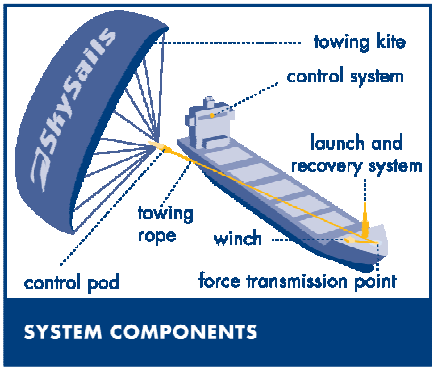
The most recent success in providing alternative "support" power has been by using kites.

MV Beluga Skysails

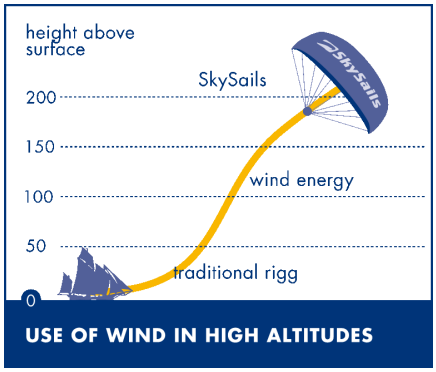
In March of this year the MV Beluga SkySails finished a double transatlantic passage, a journey of approximately 12,000 sea miles from Bremen to Venezuala and back to Norway using a kite for additional propulsion.

The 160m^2 large towing kite was flown as often as possible. It flew for periods of between a few minutes and up to eight consecutive hours.

Original expectations for the small trial kite (the kite size will be increased to 320 m^2) were validated. The trip established that a kite could be used as an auxiliary source of propulsion for the multipurpose heavy lift project carrier. It could produce five tons of power at force five



SYSTEM COMPONENTS



USE OF WIND IN HIGH ALTITUDES

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winds. This kite power means the ship's engines can work on reduced power: and that means fewer carbon emissions. It also means smaller fuel bills. With the price of shipping fuel having doubled in the past two years, kite power is promising big savings. MS Beluga SkySails believes its fuel bill will be cut by 2.5 tons of fuel a day producing savings of approximately $2000 a day.

The large towing kite resembles a paraglider and is shaped like an aircraft wing, enabling it to take advantage of different wind directions. It operates at 100-300m above surface level - much higher than a normal sailing craft - where winds are stronger and more stable. The kite can be used in winds of between 12-74km/h (7-40 knots) and not just when the wind is blowing directly from behind the ship.

The kite is launched using a telescopic mast at the bow. This means that it does not hinder cargo loading operations. The entire launch and recovery procedures are carried out fully automatically and take about 10 to 20 minutes each.

The force of the SkySails towing kite is transferred into the ship's structure at deck level. This means that the lever arm which causes heeling is minimised. In conventional sail propulsion this lever arm is much larger. In addition the vertical component of the force has the effect of improving the vessel's behaviour at sea.

So to reduce your annual fuel costs, and reduce harmful carbon emissions think about a kite. It may not work on your car but it will work on your superyacht!

Photos and diagrams reproduced with permission of Skysails. Text and additional material provided in the Skysails brochure and BBC news reports.

Maritime Rule Part 40E Design, construction and equipment – Sailing ships

Maritime Rule Part 40E *Design, construction and equipment – Sailing ships* is currently being drafted by Maritime New Zealand. It will apply to new commercial New Zealand sailing ships when it comes into force.

Appendix 1 of Part 40E sets out the intact stability requirements for commercial sailing ships. It allows for compliance with either the requirements set out in Appendix 1 or ISO 12217-2 *Small craft – Stability and buoyancy assessment and categorisation – Part 2: Sailing boats of hull length great than or equal to 6m*. This allows for sailing ships built in Europe and compliant with the ISO standard to be compliant with the intact stability requirements of Part 40E.

Part 40E is expected to be released for the second round of public consultation later in the year. If you would like to be included on the consultation, please contact: Sharyn Forsyth , Maritime NZ;

rules.coordinator@maritimenz.govt.nz ; Tel: 0508 225522 .

Malcolm Tennant

One of New Zealand's leading powerboat & multihull designers, Malcolm Tennant, died this month. Tony Stanton of Tennant Design writes about Malcolm and his designs.

Malcolm Tennant's life long involvement with multihulls began when he purchased his first beach cat in 1959, his hobby became his profession when 7 years later, Malcolm began designing and building A glass catamarans along with two of his friends, and later became a licensed builder of the Olympic Tornado. Malcolm's first large catamaran design was the "Vorpal Blade" (36'/11m) which he designed as a performance cruiser for himself in 1969. This boat sold before Malcolm could complete it but he moved on to design an increasing number of sailing Multihull following this design. In 1973 Malcolm designed the now legendary Great Barrier Express (28ft/8.5m) which became the archetype of the larger off-the-beach style catamarans. There are now over 300 of these iconic little vessels around the world including Malcolm's own vessel.

The GBE was followed by a stream of designs, from 1979, and over the next couple of years, the GBE and its bigger sisters, the 'Turissimo-9' and the 'Turissimo-10' also went into series production in a number of countries including New Zealand, Australia, Brazil, France and the United States.

In 1983, Malcolm made his entry into the world of power catamarans. Building on his design of the Cordova which was a motor sailer that could motor at 18-20 knots and yet sail at 24 knots, Malcolm made the leap to a an entirely new hull form that is now the standard in displacment powercat hull shape. The CS Hull with its canoe sterned under body with a square transom on the waters surface, and fine forward entry angle, has become the signature of Malcolm's powerboat designs and has been adopted by many.

One of Malcolm's Favourite Designs—Wildthing

The GBE

Over the 45 years of Malcolm's career a steady stream of designs have left the office, with over 270 designs at last count ranging over the whole multihull gamut, have issued from this office. From small racing craft and folding Trimarans up to large passenger carrying ferries and ocean crossing private motor yachts

Malcolm had a life long passion not only for boats but for learning the 'why' behind everything in life with interests that stretched in many directions. It was this thirst for knowledge, that always caused Malcolm to look beyond first impressions and to see what aspects of the design really contributed to its success or weakness and to build this into the next vessel.

Malcolm was always willing to share his thoughts on design with interested people and got great enjoyment from passing on the knowledge of his experience to all who would listen.

Malcolm passed away suddenly after an accident at his home in Auckland on the 10th of May, while pursuing another of his hobbies, gardening. He slipped a fell from a retaining wall and suf-

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Afterburner

fered a fatal head injury. Malcolm passed away in hospital several hours later.

He will be sadly missed by all his family, friends and by many people in the industry. It was one of Malcolm's great pleasures to hear from people with his designs, and there adventures and experiences afloat, and I am sure there can be no greater tribute to Malcolm than that his designs will continue to be enjoyed the world over.

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High Performance Yacht Design Conference 2008—Update

Preparations are underway for the third High Performance Yacht Design (HPYD) Conference, jointly hosted by the NZ Division of RINA and the University of Auckland. It will run from 2nd-4th December 2008.

So far we have around 27 abstracts by delegates from 14 nations. The quality and breadth of the content presented are being judged by a panel of technical experts but look to be just as good as in the previous two conferences. A full list of contributing authors and the titles of their papers will be able to be viewed online at www.hpyd.org.nz when papers have been accepted.

Evening events include a waterfront cocktail function and a formal dinner at the Royal New Zealand Yacht Squadron.

Interested people are invited to view the website at www.hpyd.org.nz and REGISTER NOW and receive an early-bird discount for this international event. This time we hope to see more representation from the New Zealand boating industry.

2008 RINA NZ AGM

The RINA NZ Division AGM was held at the MIA offices in Westhaven on April 17th. After hearing reports from the Treasurer and President the new council was determined. Nic de Waal stood down from the council, we thank him for his work as secretary for the past two years. Dima Ivanov also resigned. Jason Smith was elected onto the council. This leaves Brendan Fagan, Susan Lake, Roger Hill, Graeme Finch, Brett Bakewell-White, John Harrhy, Jarrod Hall and Philip Maxwell continuing their term on the council. A plea was put out for members to join the council as some of the existing members are due to come to the end of their term at the next AGM.

After the formal part of the evening the guest speaker, Ken Stevens, *DCNZM,* the Chairman of Glidepath (a manufacturer of baggage handling systems) and boat owner took the floor. Ken's talk was on how we as an industry group might be able to sell and market ourselves better to offshore clients. He discussed how Glidepath managed to break offshore, the pitfalls and the highs. It was an interesting and enlightening account and concluded with his thoughts on how the Free Trade agreement may benefit the industry if we work with it.

For those of you who missed the talk Ken's slides will be available on the RINA NZ webpage.

Copyright Act Amendment

A bill to amend the Copyright Act 1994 was introduced into Parliament last week, seeking to establish a royalty payment scheme for some copyright works, including graphic works and photographs, among others. A paper by Clendons, discussing the works and situations to which this Bill will apply, will be published in the next Newsline. If you wish to read how this might affect you before then, the paper will be available on the RINA NZ webpage.

Forthcoming events

High Modulus and Tony Whiting of Whiting Power Systems will be presenting at members evenings over the next couple of months. The dates are to be confirmed and emailed and posted.

Please watch your **Inbox** for the latest events listings. If you do not receive email please pass on your details to to the division and we will ensure you hear about our talks.

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