New Zealand Naval Architect

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The New Generation of Patrol Craft

By

Nic de Waal

As a result of terrorist activities and other security threats occurring more regularly and creating the current state of insecurity in the world, patrol craft have received renewed interest in recent times. The modern tactics employed by terror groups and people smugglers, together with their often unconventional methods of executing the terror acts, have prompted designers of patrol craft to have a fresh approach to the role of these craft, and to produce vessels that are capable of dealing efficiently with threats. This article considers the approach of a leading design company to the new generation of patrol craft, incorporating innovative design features that have been proven successful in other applications of high-speed vessels.

Patrol Craft Thresher

INSIDE

Teknicraft Design has been involved in the design of high-speed vessels for some 20 years. During the nineteen-eighties Teknicraft was based in South Africa, a country that, at the time was in a state of isolation. The political situation prompted sanctions against South Africa which meant that it was not possible to import technology or hardware from any of the developed countries in the world.

Being in a state of guerrilla warfare with the communist insurgents at the time, weaponry and craft were urgently needed to protect the borders. Working on a clean sheet of paper, it was an ideal opportunity

A Word from the President

I am writing this as the Christmas holiday period is finishing and having just heard a financial expert on the Breakfast program encouraging New Zealanders to save next year. The NZ dollar is back to 70cents US and manufacturers and the boat exporting industry are finding it tough going It seems to me that increasing interest rates is only attracting more foreign investment forcing the dollar to remain high. Surely there are other controls that can be introduced if there was a will to do it. One would think that our Government and private companies would be paying back debt as fast as they could, because our dollar is going to crash- probably too late for many in manufacturing.

Well I am not a financial expert and can be told off for not understanding the big picture. However I am an expert in the Marine Industry and it is disappointing to me to see how our industry suffers neglect. Perhaps it's our fault, and it probably is. Take for example the invitation to Tender for the new Police/ Customs/Coastguard vessels. You may have not noticed that the invitation was directed to boat builders not naval architects. To me this represents a tacit statement that naval architects are of secondary importance and I

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suggest that arises because we have failed to advertise the fact that we have world class designers here in New Zealand equipped with all the modern tools necessary to meet a clients needs for performance, budget and delivery. (The excellent articles from Nic de Waal and Brett Bakewell White in this Naval Architect only re-enforce my opinion). The tools that I refer to cover the most sophisticated engineering modelling techniques structural design, hydrodynamics, ship motions, vibrations. I believe that as Naval Architects we have the resources to satisfy any client need and I believe that a client is much better off to have a vessel designed and specified by the best Naval Architect that can be found and then proceed with a competitive tender to find the best builder. I have no doubt that the Naval Architect representing the clients interests during construction by being the supervising engineer means that the client does not loose control, remains better informed, and the outcome is better in every way.

The direction followed by the Police ignores their past successful history of working through Naval Architects and to my mind represents a lack of understanding of our capabilities by the boat operators who believe in their own design abilities rather than ours. If that is the case, it our problem to resolve.

There is a malaise in New Zealand that I became aware of very early on in my professional career that is a lack of confidence in our own abilities. When I arrived in NZ in 1974 Australia did not have a meaningful marine industry, wave piercing catamarans were still in their infancy. However the Australian Government showed an early commitment by going ahead with the Inshore Patrol Craft and the GRP Minesweepers. The former were not the greatest success but at least lessons were learnt and I remain impressed by the Australian belief in themselves.

I want the same commitment from our Government and their agencies. Our public money should be being reinvested in this country not overseas and I say this without qualification. It seems to me that the belief that foreigners can do better than us is based on a myth. I very much doubt that Project Protector will deliver to the $500 million budget and the choice of Logistic Support vessel invites ridicule. I remember contacting an old boss, Eric Tupper (Author of the modern text books in Naval Architecture and who rose to senior level in Defence in the UK), at the time of that the ANZAC frigates were being proposed. He said to me, and this was in 1980, that he doubted that there was any real frigate design expertise left in Europe simply because few were being designed and any experienced professionals had been replaced.

So what do we as naval Architects have to do? We have been constrained by our own professional culture of restraint. I hope the NZ Division will get behind me when I say that we have to lobby Government and educate them as to our resources and capability and encourage the "Think NZ First" drive to include professional such as ourselves.

And finally please note the plea for new council members on page 8. We need enthusiastic members to help run the New Zealand division.

John Harrhy

to think outside the square and devise innovative ways to deal with the seas around the Cape of Storms. Although the designs that were developed, built, and put into operation in those days often still form the backbone of modern designs, the major development effort has taken place in the past 8 years or so since Teknicraft established itself in New Zealand. The hull shapes and features have evolved considerably over many years and many thousands of hours of operation of these craft in many different applications, and our database of successful application of these features in operation keeps expanding every year.

In modern times the necessity to have suitable patrol craft has become the responsibility of not only large nations, but equally so for smaller or less developed countries' defence forces, as well as for other non-defence or paramilitary departments such as fisheries, research, police, passenger transportation, search and rescue, etc. To enable such countries to obtain and operate a suitable fleet of patrol craft, it is essential that vessels with the necessary capabilities be available within affordable budgets, and which are able to be serviced and maintained without the need for specially skilled technicians.

The Requirements

Although there is still a role for conventional patrol vessels with sophisticated attack and defence capabilities, the requirement for smaller, multi-role, high speed, all weather craft has become very prominent. Modern day terrorists often strive to launch an attack using an element of surprise. Time is therefore of essence, and it is critically important that patrol craft be able to be deployed in a very short time, and reach potential trouble areas fast. A length of 33m (100 ft) is generally the upper limit for a vessel to be able to be ready for immediate deployment, and which two crew can navigate safely.

Patrol craft are often deployed on multi day endurance missions, and it is therefore important that the vessel motions and particularly vertical accelerations are such that crew fatigue is minimised. Soft and comfortable ride is therefore a determining factor in the number of crew needed, and therefore it has a bearing on both the capital cost of the vessel and its operational costs.

Seakeeping and handling in rough sea conditions is not only essential to ensure that relatively high speeds can be maintained in such conditions, but good seakeeping also reduces the slamming forces an pressures on the hull, thereby increasing longevity and reliability of the vessel.

Fuel consumption is always important. Perhaps the cost of fuel is not as much a factor as the weight of the fuel in patrol craft. Lower fuel consumption means that range can be extended, which often is a critical factor in determining if a suspect should be pursued over a long distance.

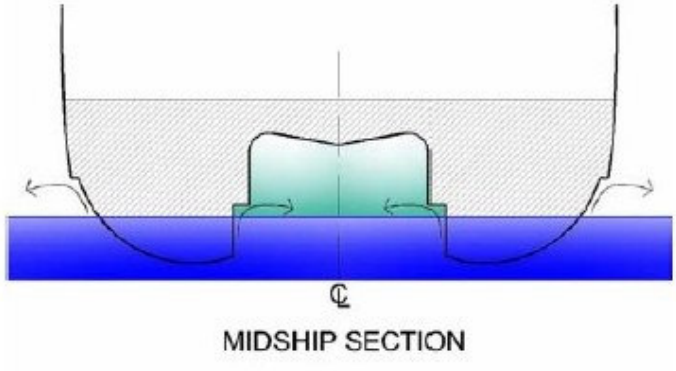
High speed is critical. The crime syndicates often have devious ways of obtaining technology, and patrol craft designers, engine and propulsion manufacturers, construction material manufacturers and the industry as a whole need to remain innovative to stay ahead in the quest for speed. High speed in calm water is important, however, of far more importance is the requirement for high speed when sea conditions start to deteriorate. Engine and propulsion systems must also enable the craft to patrol at loiter speed for many hours on end. Needless to say, patrol craft have to be reliable and simple to operate and maintain.

Meeting the Requirements

Over the years Teknicraft not only designed patrol and paramilitary vessels, but became increasingly involved in high–speed passenger vessels. Their expertise in designing hulls with low resistance and high degree of ride comfort enabled them to provide designs to a very competitive and demanding commercial market. However, it also afforded them the opportunity to further develop the hull forms and fine-tune the features. Passenger vessels and patrol craft have many common characteristics. High speed, good seakeeping, good manoeuvrability, reliability, large deck space, are some of many requirements that are found in both applications. It is therefore not surprising that the initial patrol boat experience led them into the field of passenger craft design, and the commercial experience of these vessels enabled them to apply the enhanced technology to the latest patrol craft designs.

In recent years construction has moved from lightweight composites to aluminium. The obvious reasons are less risk of fire and far better impact resistance, and with the new generation alloys such as Corus' Alustar and Pechiney's Sealium, hulls can now be designed to be lighter and stronger than composite sandwich construction. Further benefits are that each design can be custom designed as there is no need for a mould, and using the benefits of laser cutting of plating, construction speed is much faster. As it is important that structural material be placed in the areas where it is needed most from a strength point of view, designs incorporate many aluminium extrusions with shapes to suit particular areas in the boat.

As has been proven over many years in the high speed passenger ferry market, a catamaran hull shape provides the best balance of properties in applications which demand speed and good sea keeping. Teknicraft's catamaran hull has, essentially, an asymmetrical shape. The outside bottom of the demi-hull has a round bilge shape. This shape contributes to the soft riding characteristic of the hull. With its large curvature, it also becomes a very strong structure, highly resistant to impacts. On the inboard side of the demi hull, the tunnel sides are vertical. There are a number of benefits that derive from this, but the main reasons for



High-density Space inside Tunnel

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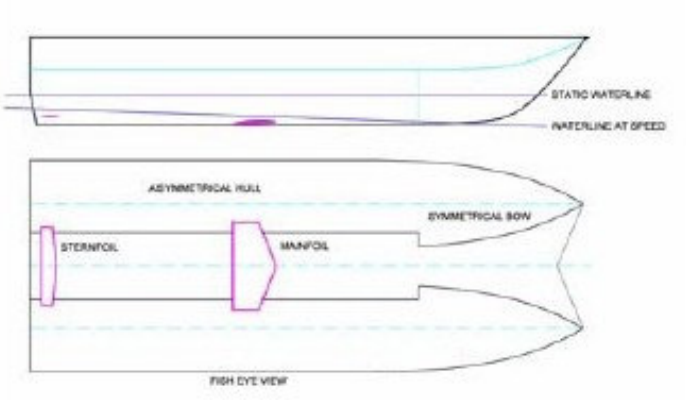
the vertical shape are to reduce vertical accelerations and to enlarge the tunnel opening to maximum possible size. The tunnel height and width is critically important for good seakeeping. Experience has determined the optimum ratios between tunnel size, beam, speed, and displacement. The important requirement is to prevent any slamming in the tunnel to take place. To reduce resistance caused by wetted area, the water travelling up the insides of the hulls must be deflected away from the hull without creating wave interference between the hulls. This is done with longitudinal chines along the tunnel. A further benefit of deflecting green water away from the hull, is the fact that the deflected water breaks up into spray as it leaves the chine. This spray mixes with air streaming down the tunnel at high speed, combines into a high density mixture of water and air, and provides a cushioning effect every time the vessel enters the trough of a wave.

A typical problem with asymmetrical hulls, though, is its lack of directional stability. To overcome the problem, the bow is designed to be symmetrical. Therefore, under operation in rough seas, particular on quartering headings, in following seas, or at slower cruising speeds when the bows are submerged more than usual, the vessel remains on a straight course. In calmer seas or at high speed the symmetrical bow is clear of the water and the vessel can benefit from the advantages of the asymmetrical midship and aft sections.



A hull design is always a balancing act in an attempt to meet all requirements, and therefore some attributes may have to be compromised in favour of others. In this case where the hull is designed to provide excellent sea keeping and soft ride, there are no flat areas on the bottom, similar to most monohull designs, to provide dynamic lift. To solve this problem a hydrofoil system has been developed which partly lifts the hull from the water. The main purpose of the foil is to reduce the wetted area and the wave making resistance, which reduces the overall resistance. Lower resistance means an increase in speed. Typical improvements are 25% to 30% increase in speed using the hydrofoil system. The foil is designed and fitted in a position to ensure that a significant part of the hull remains submerged, even at maximum speed. This is important

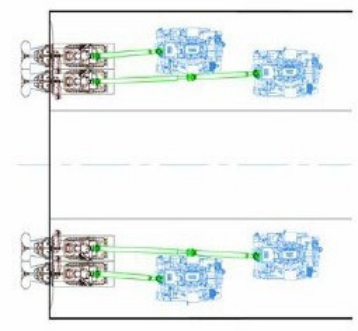
to ensure dynamic stability at high speed, particularly in rough water. A system has also been developed that enables the lift provided by the foil to be adjustable, thereby optimising the speed and fuel consumption for a particular sea condition and loading.

The result is that a hull has been developed which incorporates the two most important criteria of coastal patrol craft, namely high speed and soft and comfortable ride.

Following their experience in ferry designs, Teknicraft believes the most suitable propulsion systems for high speed patrol craft in the 20m to 40m range, to be quadruple engines, fitted to quadruple jets. One may ask how this can possibly be more efficient than conventional twin engine installations, but the interesting aspect is that if two systems, one a twin, and the other a quad installation, with the same total power are compared, it is found that both the cost and the weight are similar. However, having four completely independent propulsion systems provides redundancy. Typically a 45 knot vessel can maintain over 30 knots on three engines, should one engine fail during a mission. Furthermore when operating in loitering mode, only two engines are used with the other two shut down, whereby the two operating engines work at higher power percentage to prevent carbon build-up in cylinders.

It is also more convenient to service the engines, with more space around two small engines, compared with one large engine inside an engine room. Generally speaking there are less options of different engine manufacturers and power ratings as the engine sizes increase, and by using multiple smaller engines, a client can often specify a manufacturer who is already servicing his fleet.

The ideal propulsion for a multiple engine installation is waterjets. This provides a further benefit in enhancing manoeuvrability. Hamilton jets, for example, are designed to allow the captain to manoeuvre the vessel completely sideways, or rotate it within its own length. Apprehending a suspect vessel for boarding becomes a safe and simple manoeuvre in almost any seas using waterjets. The catamaran has a very small roll amplitude at low speed or when stopped, enabling easy transfer of personnel onto another vessel. A further benefit of waterjets is the ability to maintain speed in rough seas. When a vessel navigates at high speed in rough water it will often encounter waves which are larger than the significant average waves at the time. Using conventional propulsion systems the captain would reduce throttle and slow down the vessel as the vessel approaches such a wave. When it has passed he would apply power and the vessel would accelerate again. The overall average speed over a long distance could be seriously affected by these manoeuvres. However, on a waterjet propelled boat in rough weather circumstances, the captain would set his throttle at a speed setting suitable for the average wave height condition. From then on he would keep his right hand on the bucket control only. When a large wave is encountered, he simply pulls the buckets down fractionally, slows the boat to a suitable speed, and upon leaving the wave push the throttles forward. Due to the throttles being still at the original rpm, the thrust



Typical multiple Engine Arrangement

is immediately available and far more distance is covered in the same time. The low draft of the catamaran hull, together with waterjet propulsion, allows it to operate in shallow water, and also allows it to be beach landed. This is often an advantage in remote areas lacking berthing facilities.

Conclusion

Thinking outside the square and being innovative has become necessary to ensure that patrol craft can fulfil the challenging duties which have been placed upon them in recent times. With the benefit of many years experience and thousands of successful operational hours, it is evident that a hydrofoil supported catamaran is currently at the forefront of patrol craft development.

NZ Division Library

The library is on the move to the Maritime Museum. Watch this space for information on how to access it.

Dedicated Followers of Fashion

by

Brett Bakewell-White

Have race yacht designers actually made any progress in the past one hundred years? The media and campaign managers alike often make much of the latest race yacht being at the cutting edge of design, high-tech, and a breakthrough, but are they really that innovative? For all the effort and technology that is put into the design of a modern performance yacht are they actually any better or further advanced than the yachts designed at the end of the 19th century?

Well the answer is probably yes, but when you consider the advances made over that period in aircraft design which has gone from being unable to get off the ground to supersonic travel in 60 years and then into space, the moon and beyond, the advance in yacht design is not exactly stellar. So why is this the case?

If we consider the anatomy of a modern yacht then we would probably list the following as major features:

- Light to moderate displacement
- Fin keel with ballast bulb
- Separate spade rudder
- Fractional rig.

More recently we might even add moveable ballast as well. Maybe even the retractable canard?

All of these features along with tandem keels can be found in yachts designed and built in the late 1800s, so what have we been doing?

Well largely Rating and Handicap rules have got in the way. Over the last century we have seen yachts morph into heavy, full keel dinosaurs, develop long elegant overhangs and then lose them again. They have grown bumps and creases, been skinny and then extremely wide. Even though it was clear what made a boat go fast a century ago we have been putting tremendous effort into making boats slow so that they rate well.

The Americas Cup is a portrait of this massive spending on going slow and it continues today. OK, well if we accept that rating rules had to be developed to have a level playing field, then how come cruising yachts have gone through the same cycle?

It is simply because it was fashionable – if the top race yacht looked "kinda weird" but won races then it is good enough for my cruising yacht to look the same. The most obvious example of this was the winged keel. After Australia II won the Americas Cup with her winged keel every manufacturer who was anybody was bolting wings onto their latest models and the public loved it. We all know that given the options you would never put a winged keel on a high speed yacht unless driven there by a rating rule or a severe draft restriction.

It is my belief that we are working in a fashion industry that is driven by the badges and brands just as much as the automotive industry and no matter how hard we market and spend money on research, we seem to simply have been rearranging the deck chairs. With the launch of almost any 'new' and 'breakthrough' design feature it is possible to find an example of where it has been done before.

No matter how much hi-tech computer power, test tanks and wind tunnels we throw at projects there always seems to have been someone who got 90% of the way there by the seat of his pants sometime before my grandfather started secondary school. I guess that is because no matter what we do the physics involved has always remained the same, and it also emphasizes the fact that it is the skill and natural talent of the designer that is the important factor and all of the hi-tech tools are just that – tools.

This was recently brought home to me when commissioned to design a 'breakthrough' Arabian Jalboot, or racing dhow, for a client in Abu Dhabi. These rather strange looking craft are built from 8mm teak planks and weigh only 710kg – 44ft long and 10.5ft wide, they only take about 12 days to build. The client felt sure that with all of our modern computer programs and knowledge, and his money, we would be able to

make a quantum leap in performance over these 'primitive' craft that are built on the beach beneath the coconut palms – he was thinking 10%.

I looked at the boats sitting on the beach and figured that there were some obvious changes to make that would improve performance. But then I discovered that along with the evolution of their boats design, which is evidenced by the numerous discarded craft in the yards around the harbour, there had also evolved a rather strict box rule controlling the dimensions and the construction of the vessels! Still these things are crude wooden boats built on the beach, right?

Then we took one sailing with a GPS to record the performance. In 10knots of wind we recorded an average speed of 13knots, and a top speed of 14.6kts!

So who needs expensive design tools!

Countdown to the HPYD

Final preparations are underway for the second High Performance Yacht Design Conference, jointly hosted by the NZ Division of RINA, the University of Auckland and Massey University, opening on 14th February.

With 27 approved papers by delegates from 14 nations, the quality and breadth of the content presented will be outstanding. A full list of contributing authors and the titles of their papers can be viewed online at www.hpyd.org.nz.

We are also excited to announced that High Modulus, New Zealand's leading supplier of composite technology to the international marine industry, is now confirmed as a Gold Sponsor. High Modulus will ensure the conference finishes on a fun and memorable note, by hosting a dinner party - the closing function on Thursday 16th February. The evening will be an opportunity to mix and mingle in a unique environment with both delegates and New Zealand leaders of the marine industry. Other 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 on www.hpyd.org.nz and REGISTER NOW for this respected international event. Or contact info@hpyd.org.nz for more details.

Don't forget to look up our RINA web site
www.rina.org.nz

What's Going On?

LAVRANOS MARINE DESIGN

Under construction we have a dozen ongoing production vessels in South Africa and two in New Zealand. One offs are building in the USA, Canada, Thailand, South Africa and in New Zealand.

New design work includes a 44 ft production monohull sport fisher building in China, a new 46 ft Powercat built as a "kitset" in Duflex composite panels to be built in Malaysia, and a new 64 ft sailing cat for building in Italy.

ROGER HILL YACHT DESIGN LTD.

RHYD Ltd. starts off the new year with an interesting variety of design commissions and proposals on the drawing board. As for most of the work we were involved with last year this current crop are not large vessels but work never the less!

Two sailing cats at 12.6m and 10.5m, an 11m composite motor sailer cat, a 7.5m 'retro' style mono hull motor boat/ launch, and a 15m high speed alloy mono hull 'patrol' boat for private use accounts for the current work in progress.

A Bit of a Do

On December 9th the RINA New Zealand Division held its annual Christmas dinner. This took place at the Royal Yacht Squadron in the member's lounge. Twenty five members and council members were present for the occasion. It was a great evening with good food and company. At the end of the dinner Chris Mitchel, who is standing down from the committee after many years service both to RINA NZ and its predecessor the NZ Naval Architectural Society (no one could get an exact number out of him), was presented with a barometer as a thank-you for all his hard work and commitment.

Chris Mitchel being presented with a barometer by the present RINA president John Harrhy and former President Michael Eaglen

Forthcoming events

February 14th: HPYD Design Session

Conference Centre, School of Architecture, University of Auckland,,Symonds Street, Auckland City.

Tuesday 11th April: AGM (6:30pm)

Notices of motion for the AGM need to be received by the 12th March 2006

Further details to be advised in RINA Update .

WANTED — New Council members

Can you spare a couple of hours every second month? Two council members (Michael Eaglen and Helen Quekett) have to stand down in April in accordance with RINA bylaws and we need some volunteers to step into their shoes/jandals. There are up to 5 vacancies, which can be filled from any grade of membership.

Nominations need to be received by Helen Quekett, Vice President, NZ Division RINA, 44 Palmerston Road, Auckland by 4th March 2006, signed by a proposer and seconded each of whom shall be a current member of the NZ Division, and countersigned by the person nominated stating that he consents to be nominated.

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