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Performance Prediction of Olympic variant Tornado Catamarans

by

Daniel Jowett and Katherine Halliburton

The Test Rig Catamaran at the Auckland University Twisted Flow Wind Tunnel

The aim of this project was to develop a Velocity Prediction Program (VPP) for the Olympic variant Tornado yacht. A VPP takes both the wind speed and direction, and using equilibrium between the aerodynamic and hydrodynamic forces, predicts how fast the yacht will be travelling.

This research is the first of its type done on the Olympic variant Tornado, although work has been done on the original Tornado design which has a different sail and rig set-up. The methods developed here can also be applied to other multi-hull yachts.

A 1/5th scale model of the Tornado was placed in the University of Auckland twisted flow wind tunnel and forces and moments were recorded at wind angles between 10° and 180° apparent wind angle, both with and without the gennaker. A heel angle of 10° was used throughout. These measurements gave data that was able to be used in the VPP to find the lift, drag and roll moment coefficients for the sails at different settings.

When the roll moment produced by the sails is greater than the righting moment provided by the crew on the trapeze, the sails must be depowered. Depowering data was therefore also collected, which showed the effect on the yacht's performance when the roll moment created by the sails was decreased.

Hydrodynamic coefficients for the hull and centreboard were also needed for the VPP. A

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The Test Rig Catamaran at the Auckland University Twisted Flow Wind Tunnel

mathematical model was developed, based on a combination of established yacht theory and research that has been done on boats with similarly shaped hulls which gave the hydrodynamic force coefficients for the yacht. These were used to calculate the lift and drag forces acting on the hull.

The VPP is based around the fact that these hydrodynamic forces were equal and opposite to the previously calculated aerodynamic forces, when the yacht is travelling at a steady speed.

The fact that the heel angle was assumed to be 10° meant that the windward hull was clear of the water and therefore had no hydrodynamic effect.

The results from the above research were combined into a VPP, based on our research of existing software. This program enables prediction of a yacht's speed at any true wind speed and at most true wind angles, taking into account the rolling moments acting on the yacht. The VPP produces velocity polars, as well as other graphs, data and depowering information that may be useful to yachtsmen and academic researchers.

The following key results were obtained from the VPP:

- The highest boat speed reached is approximately 1.6 times the true wind speed and occurs at approximately 100° true wind angle (TWA).
- The best upwind velocity

A word from the editor

In this months issue we do not have a "word from the president" . Brendan Fagan has stood down from the position as he has taken a job in Scotland. We thank him for his hard work for the last two years and wish him well; we hope that he enjoys the weather over there!

Susan Lake has kindly stepped into his shoes to be acting president.

The council needs new members. Council members have to stand down after 6 years of service in accordance with RINA bylaws. We need some volunteers. There are five vacancies, which can be filled from any grade of membership. Tasks are not onerous. Council meetings are held for about an hour every four weeks. If you would like to see the division continue to flourish we need new enthusiastic members.

Nominations need to be 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/she consents to be nominated. Just ask a council member for their signature.

In this issue we bring you articles from some RINA NZ students. Katherine and Daniel were awarded the RINA/Fitzroy prize in 2007, and Brenan Hutchings studied at Unitec on the Bachelor of Applied Technology (Marine) course.

As editor I am always on the look out for articles from our NZ members. If you have anything you feel the other members will be interested in please send it in. Also we like to have feedback on the newsletter so any comments are appreciated.

It is your magazine and it gets read by RINA members from around the world so lets showcase the work that is being done in New Zealand.

made good (VMG) is at approximately 50° TWA and the best downwind VMG is at approximately 140° TWA.

- At 100 – 120° TWA the Tornado must be heavily depowered in wind speeds of 6m/s and above.
- At wind speeds of 10m/s and above the Tornado must be heavily depowered over a large range of angles.

The results from the project are similar to previously published results on Tornadoes, however they show that there is an increase in boat speed with the more powerful Olympic variant sail set-up.

Daniel Jowett and Katherine Halliburton were fourth year Mechanical Engineering students at The University of Auckland. They won the 2007 RINA NZ Fitzroy Prize. Their project on performance prediction of Olympic variant Tornado Catamarans, was supervised by Dr. Stuart Norris and carried out with the assistance of Professor Richard Flay and Mr. David Le Pelley, from the University of

HPYD 2008 -A Success

HIGH PERFORMANCE YACHT DESIGN CONFERENCE 2008
AUCKLAND NZ

The 3rd High Performance Yacht Design conference (2-4 December 2008), hosted by the University of Auckland and RINA-NZ was once again a highly successful event. Although we are entering tough times the event attracted 66 delegates from 14 countries including a number of the world's leading yacht designers and researchers. Over half of the delegates travelled from overseas to hear 28 papers submitted by prominent authors in areas such as motions and performance prediction, structural design and aero- and hydrodynamics.

Britt Ward from Farr Yacht Design started the conference with an entertaining keynote address. The now traditional open design session was by renowned naval architect Paul Bieker on the Tuesday evening. Paul was the chief structural designer at BMW Oracle Racing for the last America's Cup and for the recently launched Deed of Gift trimaran, and is also a very successful International 14 designer and builder. The session was attended by over 150 people and was an opportunity not only for delegates but RINA members and members of the public to learn some of his knowledge on structural design and efficient hull design processes.

The social events commenced with a cocktail reception at Bungalow8 in the Viaduct. There was match racing on board SailNZ's America's Cup yachts followed by a BBQ hosted by InterCAD in conjunction with Emirates Team New Zealand. For most this was one of the social highlights of the conference. It gave the delegates plenty of change to network and an opportunity to see the boats, and keels up close, that were used in February's Louis Vuitton Pacific series. The conference closed with the formal dinner on the Thursday evening at the Royal New Zealand Yacht Squadron.

Delegate feedback was extremely positive and confirms the HPYD conference's position as a high quality yacht design conference.

The organisers will announce a date for the fourth High Performance Yacht Design Conference in mid 2009. Sign up at the HPYD website to keep informed.

If you missed the conference, full abstracts of the papers can be found at http://www.hpyd.org.nz. You can also purchase the 2008 proceedings online.

Carbon Dream
by
Brenan Hutchings

With more speed in mind Brenan Hutchings felt that, the hard chined, home built, plywood rowing skiff he built during the Cert in Boatbuilding was in need of an upgrade. Although the vessel was great for casual rowing it lacked the looks and speed of a carbon fibre racing skiff.

For the 2nd year Technology project of his Applied Technology (Marine) Degree at Unitec in Auckland, he started designing the plans and rationale for a Carbon fibre Single Scull. The project brief specified it must be an innovative approach to a technological problem. After scrutinising current designs, he noticed that most boats on the market had a rounded bow shape. Whist this common shape allows the vessel to move at speed, the skiff pitches substantially, when underway.

To solve the technological problem Hutchings decided to extend the LWL so it was very close to the full length of the vessel. This would decrease the skiffs pitching and increase its speed, producing a smoother motion overall.

Could this be achieved while staying within the Rowing New Zealand rules and regulations?

It turns out that there is no rule on length. Therefore, the skiff was designed with a longer waterline length to increase speed through the water following the Froude number formula for the Speed Length ratio = $\frac{v}{L_{WL}}$

The design includes flat cockpit edges to allow the skiff to be transported on a roof rack of a car, a plum bow shape, and minimal BWL. It has a displacement of 94kgs to enable travel at optimum speed with an 80kg rower behind the sculls.

With support from technical advisor, Cristiana Chiappini, this concept was realised.

Over the summer of 2007/08 the skiff took shape at the Marine Tech workshop the carbon/honeycomb construction was laminated over a male mould using a wet layout epoxy resin system and cured under vacuum pressure.

Typically, for the first time using carbon fibre, all did not go to plan but a lot was learnt and a sound hull was produced.

The shell was trimmed prepped and the bulkheads installed. With the honeycomb backfilled and a pre-formed flange for the cockpit, the fwd deck was bonded in place.

After finding that there was a weak point aft of the cockpit, two CUD longitudinal short stringers were added to strengthen and stiffen the area up.

The fwd deck was produced from a female mould to include

Moulding the skiff

an angled bulkhead, after gluing it to the hull 50mm carbon woven roving tape was used to tie to the two together. Filling and fairing complete, the final coat of paint was sprayed on.

Launched in early April, the vessel had a few minor kinks but the skiff travels through the water effortlessly and smoothly. Pitching of the vessel is minimal and the weight is evenly distributed as the rower moves back and forth producing a fast and efficient momentum.

All that is left now for Hutchings is to enjoy the change from rowing a hard chined 34kg bath tub to a round bilged carbon fibre speed machine.

Principal Dimensions:

LOA - 8.6m

Max Beam - 0.490m

LWL - 8.574m

Draft - 0.096m

Min Weight of Vessel When Rigged - 14kg

Capacity of 75 - 85 kg

Brenan Hutchings attended the Certificate in Applied Technology (Boatbuilding) course at Unitec in 2005, and then went onto the Bachelor of Applied Technology specializing in Marine. At the end of the second year he was offered a job by Emirates Team NZ and started working with them in November 2007, but after the America's Cup "stalled" he moved to the design office at Southern Spars where he is busy drafting and designing while waiting to start again with Team NZ.

Brenan on the water with his new skiff

The RINA New Zealand Division Library

As members of the New Zealand Division of the Royal Institute of Naval Architects you have access to a library developed over the years by its members, committee and the New Zealand Naval Architects Society.

When the library was moved from Industrial Research Parnell, Gillian Ralph, the IRL librarian provided the Maritime Museum with a printed alphabetical list of all the books and periodicals that were considered for transfer to the Bill Laxon Maritime Library (BLML). Some of the books and periodicals were already in the BLML collection, so to ease the transfer all of the collection was taken to the BLML Avondale storage facility. Since then the collection has been gradually enlarged by titles requested by RINA members and approved by the RINA (NZ) committee.

At present there is no online list of the books that RINA donated or an on-line list of all the books held in the library that our members can look up, however this is work in progress and gradually BLML holding records are being added to the National Library of NZ catalogue. This is available for all members free via their local public library or institution library if they are a subscribing member.
http://webcat.natlib.govt.nz/

There are a few missing issues of journals that you, our members may be able to fill in, more will come to light as our collection is gradually incorporated fully into the BLML. It is known that the library is missing the following

3 volumes of the Transactions of the Royal Institution of Naval Architects: 1971, 1995 and 1996. If you can help to fill this gap please email Marlene Boyd at the archives.

The library can be visited Thursday 10.00am-4.00pm, or by appointment – preferably with at least 48 hours notice.

As members of RINA you can send emails, phone or fax requests for information to the library. For in depth research inquiries there is a research fee of $40.00 per hour (GST inclusive). At least 24 hours is required if items are required from the Avondale storage area or from less well known journals.

RINA has a corporate Friends membership to the New Zealand National Maritime Museum. This entitles up to five members to visit the library at any one time. Members of RINA need to show their RINA membership card at Front of House of the NZ National Maritime Museum to gain access to the BLML. Photocopying is available.

RINA members have the additional benefits by having access to:

Over 6000 books and maritime journals in the BLML. All BLML items are for reference use only.

Archives of the Auckland Harbour Board and smaller maritime business firms in Auckland

An extensive historical collection of maritime equipment, vessel photographs and marine equipment supply catalogues

A skilled library professional who can assist in providing quality information to RINA members.

Contact for the BLML is

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Student Awards

RINA (NZ) PRIZE 2008—Unitec

Council members Graeme Finch and Roger Hill attended the presentations of the Unitec Bachelor of Applied Technology (Marine) students final year projects. The council decided not to award a RINA(NZ) prize for 2008 as no project was deemed to be of sufficient standard. However Luke Kristensen was awarded a certificate of merit to in recognition of his project—Design of the vessel MIA. The prize will be a Naval Architecture book.

RINA (NZ) actively supports Unitec in the establishment of it Bachelor of Applied Technology (Marine) and is looking forward to seeing its graduates in the New Zealand marine industry.

RINA (NZ) –HPYD Travel Scholarship 2008

The inaugural HPYD-RINA Travel was awarded to Fredirik Gerhardt, at the HPYD Conference public talk. The Scholarship is awarded to a post-graduate student to allow them to travel to a conference abroad.

Susan Lake and the recipients of the 2007 RINA (NZ) Fitzroy Prize, Daniel Jowett and Katherine Halliburton. Daniel and Katherine were presented with their prize by Susan at the HPYD3 Conference

And a message from Daniel and Katherine:

We would like to thank RINA NZ Council and VT Fitzroy for the award given for our project display.

RINA Membership Structure —Proposed changes

On 30 April 2009 the Council will present at a Special General Meeting a proposal to change the membership structure. These changes are published in full in RINA Affairs. (February 2009)

The suggested changes to the current membership structure for corporate members are to allow for better understanding of the classes and to better reflect the role of naval architects and members in this century. The changes proposed would provide a less complicated and more easily understood membership structure.

Below is a summary of the membership structures current and proposed.

Current structure	Proposed structure
Fellow (FRINA)	Fellow (FRINA
Member (MRINA) (CEng) Associate Member (AMRINA)(IEng) Associate Member (ARINA)(EngTech)	Member (MRINA) (CEng/IEng/EngTech)
Graduate (GMRINA)	Associate member (AMRINA)
Student member	Student member
Junior member	Junior member
Companion	Associate (AssocRINA)

Forthcoming events

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.

Site visit: Doyles Sail Loft
***Date: Tues 7th April 2009* at 7pm**

Doyle NZ builds a vast range of sails supplying optimist through to the world's largest superyachts.

The site visit/tour will be presented by Chris McMaster, managing director of Doyle NZ. The tour will showcase the company's new premises, with all of the lofts now in one new location and a new 50m laminating table.

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