THE AUSTRALIAN NAVAL ARCHITECT

Volume 3 Number 1
February 1999










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Newsletter of

The Royal Institution of Naval Architects (Australian Division)

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Cover Photo:

The first of the British Columbia Ferry Corporation's Pacificat class high speed passenger and vehicle catamaran ferries, designed by Incat Designs Sydney. (Photo courtesy Incat Designs)

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A NOTE FROM THE DIVISION PRESIDENT

A President's column for a publication such as *The Australian Naval Architect* should, I suppose, be a little like a keynote address at a conference or seminar. It should provide a few pointers as to the direction of the conference, or particular edition of the publication, highlight some salient issues, and provide the participant, or reader, with some encapsulated thoughts on the issues for consideration.

For this issue I find that rather difficult. So many events and activities of importance to us as naval architects have happened recently, or are happening around us now, that choosing those which matter most is far from easy.

Perhaps the issue most recent in our minds will be the tragedy of the recent Sydney–Hobart yacht race. While the Coroner's inquests and the Cruising Yacht Club of Australia inquiry are yet to be completed expressions of opinion may not be appropriate. However the loss of lives and vessels, and the injuries inflicted on participants in this race, should concern us, particularly when viewed against the backdrop of the recreational craft scene generally in this country. These losses provided the stimulus for what should be a significant one-day workshop on the Safety of Ocean Racing Yachts to be held at the University of N.S.W. on 28 March. Details of this event are given elsewhere in this issue, and from the roll call of speakers engaged for the workshop it will be a significant contribution by RINA to the safety of ocean yacht racing in Australia.

Still with the subject of safety, and loss of life, the findings of the Naval Board of Inquiry into the fire on board HMAS *Westralia*, which occurred in May last year, were recently released. This report, which is discussed elsewhere in this issue, makes some very direct comments regarding non-adherence to prescribed processes and inadequate implementation of quality assurance procedures. It is also worth noting that the polar vessel *Aurora Australis* is currently undergoing repairs to damage caused by what appears to be a very similar fire – but fortunately without any loss of life – and that there have been a number of other engine room fires on Australian-registered vessels over the last 12 months.

A further issue of significant concern to naval architects, not least because of its potential impact on safety, is that of privatisation of Government survey functions. This subject will be discussed in a later issue. In the meantime, for a discussion on the risks to which those who undertake such work expose themselves, see "Miller's Tales" in *Engineers Australia,* January 1999. This may be found on the Internet if you don't have the magazine.

On a completely separate subject, two important agreements have been signed recently. The first is a Co-operation Agreement between RINA (Australian Division) and IMarE (Australia/New Zealand Division), which establishes areas of co-operation between these two bodies with a view to the possibility of an ultimate merger of RINA and IMarE. The second is a Heads of Agreement between RINA – at the London level – and IEAust on mutual recognition, dual membership and closer cooperation. This is a significant document, which will be covered in detail in a future issue of *The Australian Naval Architect*.

Finally I want to mention the subject of elections to the London Council. You will find below a message from the Chief Executive, Trevor Blakeley, on this subject. **There is a chance here for Australia to have two members on the London Council.** The President is a member of the Council *ex officio*. In addition to this Noel Riley, immediate past-president, has nominated for election to the London Council, and voting will occur in the not-too-distant future. The numbers of the situation are such that if Australian members generally vote for Noel he will almost certainly be elected. So when your voting papers arrive, don't throw them out in accordance with normal practice. Please take the trouble to read them, then complete and return them in accordance with the instructions. Our Division is big enough and well organized enough to deserve those two places on the Council.

Bryan Chapman

FROM THE CHIEF EXECUTIVE

The voting forms for the 1999 elections to Council will be included with the March edition of RINA Affairs. The more observant members of the Division will see that for the first time ever, a member of the Australian Division has been nominated. This follows the Council's decision, reported in the September edition of RINA Affairs, to waive the requirement for Members of Council to attend at least 50% of meetings, thereby making it a practical proposition for members living overseas to become members of Council. At the same time, the Council also determined that every standing committee should contain four overseas corresponding members.However, such decisions are rendered meaningless unless individuals are nominated and members exercise their right to vote. I would therefore urge all members of the Division to retrieve the voting form from the waste-paper basket and fill it out. A pre-paid envelope will be supplied, but I am happy to receive votes by fax.

And finally, may I congratulate the Division on the proposed formation of the new Queensland Section. May I wish it every success, and look forward to hearing further details of its programme etc. for publication in *RINA Affairs* (which has followed the lead of the ANA and is now published in full on the RINA Web site). I hope I may have the opportunity to visit the new Section this year.

Trevor Blakeley
Chief Executive

EDITORIAL

A ship can be said to be seaworthy if it has a strong durable and watertight construction, with good survival characteristics in extreme weather conditions, and is fitted with rig and equipment for its designed purpose which will continue to function at sea in those conditions. Characteristics of seakindliness and habitability are closely related, for a ship that experiences motions and accelerations in a seaway which render the crew and hence the ship incapable of performance could be said to be unseaworthy.

The 1998 Sydney–Hobart Race, with its tragic loss of life and impressive rescues has inevitably caused many to ask if the pursuit of performance compromises seaworthiness in some modern yacht designs. It certainly reminded us that the sea itself is the greatest test - a truth which everyone who designs, builds or sails in ships and boats must never forget. That test begins the moment the mooring or wharf is left behind.

When HMAS *Westralia* sailed from Fleet Base West on 5 May 1998 she was unseaworthy. Four lives were lost as a consequence of inappropriate maintenance (in the Inquiry Board's view), however much those responsible had acted in what they believed to be the best interests of the ship. Other deficiencies hindered the fire fighting and the management of the emergency generally. Luckily the fire broke out close to port and immediate assistance, and the ship was saved.

There is a tendency today, particularly with warships, to regard the payload technology to be the dominating factor in the design and production of ships. Those less glamorous 'platform' technologies are regarded as being of secondary importance. Yet any ship which cannot keep the seas reliably, provide the services that the payload requires, and ensure that the crew are safe and capable of operating the payload in all but the most extreme conditions is a liability, not an asset.

It is time we stopped calling ships 'platforms' and recognised that the design, construction and maintenance of ships demand professionalism of the highest standard.

John Jeremy

LETTERS TO THE EDITOR

Dear Sir,

I am always pleased to see the latest copy of *ANA* arrive. I think that it is now sufficiently established to be a continuing part of our scene in Australia. Keep up the good work John J and helpers.

I believe that one of the great advantages in having our own publication is that the content is not driven by economics and therefore a realistic and impartial view of our industry and profession can be given in its pages. When I compare the content with contemporary commercial publications I find that there are other than fast ferries still being designed and built in Australia. To this end we have recently completed the design of a 22 m fish farm vessel for South Australian interests and are currently designing a 42 m purse seine tuna vessel for the same client.

The implications of the problems experienced in the recent Sydney–Hobart yacht race have still to be fully considered. I was saddened by the loss of life that occurred and in particular to learn that one of those lost was Jim Lawler who was well-known and very respected in shipbuilding and shipping circles. I hope that those designing current ocean racing yachts will take cognisance of the fact that these craft have to be built to survive in weather that is found on the Australian coast and I repeat the plea that I made at a function at the CYC in December 1997 which was for the reintroduction of a scantling allowance in the handicapping process.

I was touched by our Chief Executive's concern for my little wrist that he slapped (October ANA p.5). On a recent visit to London I loaned him a copy of Manning Clark's *A Short History of Australia* to give him some insight into national character. I hope that he will now understand that we, the descendants of good convict stock, have come to terms with being knocked about by the Establishment.

Noel Riley

NEWS FROM THE SECTIONS

Victoria

Following the Annual Meeting of the Victoria/ Tasmania Branch of the Institute of Marine Engineers on 20 October 1998, the members of both IMarE and RINA were entertained by short presentations based on the experiences of three of the Branch's members.

Jack Crane, formerly with Shell and ANL recounted an experience some 48 years ago, which highlighted the saying "necessity is the mother of invention".

Shell Company was operating a war-time built diesel-powered coastal tanker of some 750 tons deadweight and 600 bhp, based on Singapore and serving Saigon, Phom Penh, the Philippines and the Indonesian Archipelago.

This vessel, when about to enter Benoa in Bali, suffered a failure of an intermediate spur wheel operating between similar wheels on the crankshaft coupling flange and on the camshaft. Examination revealed the intermediate spur wheel missing five teeth. With limited basic tools and using the only suitable material available, a ¾ inch blank flange for the 10 inch cargo discharge reducers, a plate with appropriate teeth was made and bolted to the damaged spur wheel, replacing the missing teeth and then satisfactorily tested. The repair took 7 days and with a 3 day run back to Benoa, the voyage was resumed. After inspection in Surabaya a new wheel was located and fitted.

Colin Burke, well known for his long association with ANL, gave a brief history of roll-on/roll-off vessels of the Australian National Line. Starting with the entry into service of *Princess of Tasmania* in 1959, followed by the first *Bass Trader* in 1961 and the *Empress of Australia* in 1965, over a period of some 20 years the ANL commissioned a variety of roll-on/roll-off vessels and hybrid roll-on/roll-off/cellular container vessels. (The 1998-1999 Edition of Lloyd's Register lists the ex *Princess of Tasmania* as the *Al Mahrousa* owned by the Fayez Trading Shipping and Contracting Co. Ltd. of Jeddah, Saudi Arabia).

The countries of build included Australia, Japan, Norway and Sweden and the range of engine makes was diverse, including Polar, Napier Deltic, M.A.N., and Pielstick engines.

Guy Nettleship, recently retired as Laboratory Manager for Swinburne Institute of Technology Extended Campus began his seagoing career as an apprentice in Salvorsen whaling factory ships operating out of Leith Harbour, South Georgia.

After describing some of his experiences in whaling and the manner in which the industry operated, Guy showed a video of selected facets of life at sea in the Antarctic. For those of us with little or no experience of the area, the evening was brought to a satisfying conclusion.

At the joint meeting held on November 17, Alan Colquhoun gave an illustrated presentation *Raising from the Depths (In The Antipodes).*

Alan first reviewed the principles involved in raising sunken vessels, paying particular attention to the critical factors of transverse and longitudinal stability and to the pressure effects on the integrity of hull compartments.

Case histories which he illustrated and discussed included

- ❑ M.V. *Oleanda*, a 40 m cruise vessel sunk in Lautoka Harbour, Fiji
- ❑ Bucket dredge *H C Meyer* capsized and sunk in Port Adelaide
- ❑ Motor tanker *Lady Jane* sunk in Wewak, New Guinea
- ❑ H.M.A.S. *Woolongong* sunk and half submerged at Gabo Island
- ❑ Heavy lift ship *Gabriella* capsized and sunk in Port Kembla

By way of contrast Alan then showed slides of the raising of the sunken German battle fleet in Scapa Flow after the First World War.

At the joint meeting on 10 December, Dr B H Thomas, Managing Director of Vibration Consultants and Instrumentation, U.K., gave an illustrated presentation *The Practical Application of Vibration Knowledge and Monitoring Systems to Australian Ships*.

Dr Thomas showed examples of the benefits to be obtained in using vibrations as an indicator of corrective action needed to be taken to resolve a range of problems including problems with bearings, inadequate structural stiffening of engine and other structures and incorrect installation or application of resilient mountings. Some of these problems arose on ships known to some of the attentive and appreciative audience. The benefits to be derived from recording vibration signatures and their analyses were convincingly presented.

Queensland

Members in the Sunshine State have indicated overwhelming support for the formation of a Queensland Section, which will increase the input of the Australian Division to the Institution.

In Queensland, where it is fair sailing one day and even better the next along the State's 7,400 kilometre coastline, which includes The Great Barrier Reef, RINA members have responded favourably to a survey conducted in November/December. Members have not only indicated support for the first meeting of the new Section in late February but have also provided encouragement for the initiative and offered support in the form of equipment, provision of technical papers, and a preparedness to take on official positions.

It is proposed to hold the inaugural meeting at the Yeronga Institute of TAFE in Brisbane with a telephone hook-up to ensure members along the coast are able to participate.

Feedback on the survey has been provided to members and a Working Party will be formed to ensure a smooth launching of the Queensland Section. Many thanks to Allan Mitchell (former Honorary Secretary/Treasurer) for his encouragement, and to Keith Adams (the current Secretary) for his support, encouragement and contribution.

Brian Hutchison

Canberra

In a meeting arranged by IMarE Canberra Branch on 20 October, Greg Hellessey of the Australian Customs Service provided an overview of the selection process, contract negotiations and construction program for the new Customs patrol boats currently under construction at Austal Ships. The presentation was followed by a series of slides showing the rapid progress being made on construction of these vessels. Greg's arm has been twisted to make a further presentation to the local sections once the prototype craft has completed sea trials.

The Joint Annual Dinner of the Canberra sections of RINA and IMarE was held at the Boat House by the lake on 18 November. This date inadvertently coincided with the 50th anniversary celebrations of the Sydney IMarE Branch and their combined dinner with the RINA Australian Division in Sydney on the same night. We offer an apology for this oversight in our planning, particularly to those members who had wished to attend both functions, but had committed to attending the activities in Sydney. The Canberra sections of IMarE and RINA certainly shared in the spirit of the Sydney function with a very pleasant evening. Following the dinner our guest speaker, Peter Hawker, the former Director of the Australian War Memorial, talked us through the various phases of construction of a 43' ketch that he and his wife Elizabeth have been working on in 'retirement'. Only one other yacht of this design has been completed so there were many aspects of the design that had to be solved along the way. While Peter and Elizabeth may not have a naval engineering background, they certainly impressed their audience with their perseverance, expertise and the craftsmanship that was apparent in the slides of the yacht. Thanks go to John Lord for suggesting and arranging for our guest speaker to attend the dinner.

Martin Grimm

New South Wales

Committee

Jennifer Knox has accepted nomination to the NSW Section Committee, and has taken up the position of Secretary. NSW matters secretarial should be directed to Jennifer at (02) 9979 9815, fax 9979 1448, PO Box 393 Church Point 2105, or e-mail navlight@ozemail.com.au.

Rodney Humphrey (Det Norske Veritas) and Alan Soars (Advanced Multhull Designs) have also accepted nomination to the NSW Section Committee.

The full committee now looks like this:

Chair	Phil Hercus (Incat Designs)
Deputy Chair	Phil Helmore (University of NSW)
Secretary	Jennifer Knox (Lightning Naval Architecture)
Treasurer	James Fenning (Incat Designs)
Members	Don Gillies (Advance Ship Design)
	Rod Humphrey (Det Norske Veritas)
	Todd Maybury (Incat Designs)
	Paul O'Connor (ADI Marine)
	Noel Riley (Commercial Marine Design)
	Alan Soars (Advanced Multihull Designs)

The full committee met on 15 December and discussed, at some length, the programme of meetings for the New Year.

Phil Helmore

COMING EVENTS

RINA Meetings in NSW

Three RINA meetings will be held on the afternoon of Friday 26 March. The first meeting for 1999 of the Council of the Australian Division will commence at 3:00 p.m. Tea and bikkies will be served from 5:00 to 5:30 p.m. The Nineteenth Annual General Meeting of the Australian Division (and the first under the new Division structure) will commence at 5:30 p.m. This meeting welcomes all financial members resident in Australia.

The First Annual General Meeting of the New South Wales Section will commence at 6:00 p.m. (or on completion of the Annual General Meeting of the Australian Division should it extend past 6:00 p.m.) This meeting welcomes all financial members resident in NSW.

All these meetings will be in the Harricks Auditorium of the Institution of Engineers, Australia, Eagle House, 118 Alfred St, Milsons Point, NSW.

The following technical meetings and visits for 1999 are subject to confirmation:

24 Feb	*	W. Malinowski	*Aluminium Const: Dos and Don'ts.* (PC)
24 Mar	*	G. MacFarlane & M. Renilson	*Wake Waves and Effect on Environ't* (PC)
14 Apr		AMD	*Designing B60, a 60-knot Car Ferry* (LCC)
28 Apr	*	G. Cleary	*Devel't of RTA Series Sulzer Diesels* (PC)
26 May	*	S.Quigley	*18-ft Skiffs: Sailing and Technology* (ANMM)
23 Jun	*	K. Porter	*Problems with Carbon Fibre* (PC)
28 Jul	*	G. Taylor & E. Ironside	*Design and Const. of MRS* Pioneer (PC)
? Aug	*		Visit to bulk carrier (Dock)
25 Aug	*	K. Gaylor	*Design of Smart Ships for the RAN* (PC)
22 Sep	*	M. Green & G. Doyle	*Solar Boat Technology* (PC)
27 Oct		I. Murray & A. Dovell	*The America's Cup Challenge* (LCC)

ANMM Australian National Maritime Museum, Darling Harbour

LCC Lane Cove Club, 1 Birdwood Ave, Lane Cove

PC Portside Centre, Level 5, 207 Kent St, Sydney

* Meeting combined with the Institute of Marine Engineers (Sydney Branch).

Reunion of UNSW Naval Architects

A reunion dinner for all UNSW naval architecture graduates, current students, past and present staff, and their partners will be held to coincide with the University's 50th Anniversary celebrations. The dinner will be held on Saturday evening, 27 March 1999 in the Kensington Room in the Squarehouse at the University. For further details and bookings use the registration form on the flyer which you received with this issue of *The Australian Naval Architect,* or which may be down-loaded from the web-site at `www.ozemail.com.au/~dkay/unsw-navarch`.

Workshop on the Safety of Ocean Racing Yachts

The University of New South Wales, in conjunction with the Royal Institution of Naval Architects (Australian Division), is organising a workshop on the Safety of Ocean Racing Yachts, to be held at the University on Sunday 28 March 1999 (the day after the reunion dinner). The workshop was prompted by the latest Sydney–Hobart yacht race, but is directed at ocean racing in general. There is much first-hand experience immediately available, and it is in the best interests of all designers for this to be shared. Experts will cover race organisation, handicapping, weather forecasting, rescue operations, design, safety versus performance, classification and regulation, and a panel session on safety. For further details and bookings use the registration form on the flyer which you received with this issue of *The Australian Naval Architect*

Workshop on High-speed Ferries

The University of New South Wales is organising a workshop on High-speed Ferries to be held at the University from Wednesday 7 to Friday 9 July 1999 (note the change of dates!) This workshop will have experts from industry, the regulatory authorities and academia giving presentations on feasibility analysis, general arrangement, resistance, powering, motion analysis and control, structural analysis, mathematical modelling and optimisation, safety regulations, classification society rules, design principles, and contracts and specifications for high-speed ferries. Further information may be obtained from Dr Prabhat Pal, phone (02) 9385 4092, fax 9663 1222 or e-mail p.pal@unsw.edu.au.

Sea Australia 2000

This conference will be held in Sydney from Tuesday 1 to Thursday 3 February 2000 (note the change of dates!), in conjunction with the Pacific 2000 Exhibition. Organised by RINA, IMarE, IEAust and the AMECRC, the Sea Australia 2000 Conference will cover a wide range of topics relevant to the new millennium, including innovations in marine design, novel proposals for propulsion, trends in port handling facilities, developments in offshore industries, safety regulation and the marine environment. Further information can be obtained from the conference secretariat, Ms Anne Lewis at ICMS Ltd, phone (02) 9976 3245, fax 9976 3774 or e-mail `seaaust2000@icms.com.au.`

STAB2000

The Seventh International Conference on Stability of Ships and Ocean Vehicles will be held in Launceston from Monday 7 to Friday 11 February 2000 (note the change of dates!) Organised by the AMECRC, AMC, UNSW, AMSA and RINA, this conference will promote a full exchange of ideas and methodologies on the stability of ships and ocean vehicles of all types. Topics include updates to IMO, USL Code and RAN stability criteria, damaged stability of ro-ro vessels, stability of high-speed craft, model testing and correlation, computer techniques, stability of offshore engineering structures, design aspects, and the human/vehicle interface. Further information can be obtained from the conference secretariat at the AMECRC Launceston, phone (03) 6335 4885, fax 6326 6261, e-mail `stab2000@crc.amc.edu.au` or web-site `www.amc.edu.au`.

Victorian Section Technical Meetings

The Victorian Section participates in the monthly technical meetings held by the IMarE Victoria/Tasmania Branch. Meetings are held on the third Tuesday of each month, generally at the IEAust. Building, 21 Bedford Street, North Melbourne. They start at 5:30 p.m. for 6:00 p.m., and generally finish by about 8:00 p.m. Light refreshments are normally available.

The programme for 1999 is presently being developed, and the sessions settled to date are:

16 Feb. Mr Mhamedi H. Jadliwala, Kansai Paint (Singapore) Pte Ltd, *Development of a New Anti-fouling Paint Based on a Novel Zinc Acrylate Co-polymer*.

16 Mar. Mr Rowan Smith, AMECRC, *The Prediction of Motion Sickness on Marine Vessels*.

18 May Mr Stephen Kennett, DSTO, *Fire Modelling for Naval Vessels*.

20 July Ms Janice Cocking, DSTO, *Unmanned Underwater Vehicles*..

16 Nov. Mr Martin Robson, Mar-Tek International Pty Ltd, *The Development of Ring Propellers and Variable Pitch Propellers for Small Craft*.

Victorian members generally are included on the IMarE mailing list, and can anticipate receiving a notice a few weeks before each meeting giving further details. Victorian Section members are encouraged to attend these meetings – you've already made a financial contribution to them, so make the most of it!

IMarE Conference – 2001

The Aust./NZ Division of IMarE will host a major conference in Wellington, New Zealand, in October/November 2001. The general theme of the conference will include High Speed Craft development. Details of this conference will be developed over the next few months – watch this space!

GENERAL NEWS

NEW RAN SHIPS

The RAN took delivery of the second of its Anzac frigates on 30 October 1998 when *Arunta* was accepted from her builders, Tenix, in a ceremony at Williamstown, Victoria. HMAS *Arunta* was commissioned on 12 December at Station Pier in Melbourne. Tenix will complete six more of these 3,600 tonne ships for the RAN. The last *Perth*, is expected to complete in November 2004. (Photo, above, by John Jeremy).

Sea trials for the RAN's fourth Collins class submarine began on 4 November 1998. The *Dechaineux*, launched on 12 March, sailed from the Australian Submarine Corporation's wharf on the Port River in Adelaide to begin a ten-day initial trial period. These surface trials included anchor and cable trials, and tests of propulsion, radar, periscopes, navigation and communications systems tests. (Photo, below, courtesy Australian Submarine Corporation).

AUSMARINE 98

The Port of Fremantle was again the appropriate venue for what has become the principal regular national meeting of those involved in Australia's maritime activities. Ausmarine '98 was the third biennial conference and exhibition organised by Baird Publications of Melbourne. The three-day event from 3 to 5 November 1998 served the purpose of bringing together vessel owners, naval architects, marine engineers, shipbuilders and manufacturers of engineering components required in the construction of high-speed ferries and other vessels.

The principal activity of Ausmarine '98 was the technical conference itself, at which fifty papers were presented. Topics covered passenger vessels, harbour craft, pilot boats, naval and patrol vessels, the offshore industry, fishing vessels, export ship sales and joint venture opportunities, fast freight vessels, naval architecture/design developments, safety and risk, rules, classification societies, fisheries education, shipbuilding techniques, shipbuilding materials, electronic developments, engines, finance, fishing gear, ride control, propulsion systems, fuel and lubricants, and navigation.

There were about 190 registrants, who showed a particularly keen interest in the presentations. The audience participated eagerly in issues of safety and regulation, this being an indication of how much concern there is regarding this aspect of the industry.

The 288-page proceedings provides an excellent demonstration of how mature the maritime community has become in the last decade. It would be difficult to imagine such a conference being held in Australia ten years ago.

The manufacturers' exhibitions provided the second main attraction of the conference. There were approximately 85 exhibitors and 135 stands altogether. The exhibitors included fast-ferry shipyards, engine manufacturers, waterjet manufacturers, construction-material suppliers, component suppliers and classification societies.

Without doubt, the centrepiece of the display was the latest ferry from Austal Ships. This 86-metre catamaran was available for inspection and a special demonstration cruise was also provided. The vessel can carry 200 cars and 800 passengers at a cruising speed of 42 knots. The ship is fitted with a ride-control system in order to reduce motions in rough water. The vessel, *Turgut Özal*, departed on her delivery voyage to Turkey on 7 November, where she will join a number of other Australian-built ferries in the large fleet of fast ferries operated by Istanbul Deniz Otobüsleri (IDO).

On a personal note, it was a delight for me to meet such an impressive number of UNSW graduates who are now naval architects at Austal Ships and have contributed so much to that company's success.

Constituting a further bonus was the one-day conference on the theme of Fast Sea Transportation, which was most ably organised by the Western Australia Section of RINA. This took place on 5 November and there were seven high-level lectures in all. Topics covered the performance of waterjets, resistance prediction, the commissioning of the AMECRC cavitation tunnel, and the economic planning of suitable ferry routes.

The dates for Ausmarine 2000 are 31 October to 2 November, 2000. Further information can be obtained from Baird Publications on (03) 9645-0411 or e-mail `marinfo@baird.com.au`.

Lawry Doctors

Turgut Özal during trials off the coast of Western Australia
(Photo courtesy Austal Ships)

FFG UPGRADE CONTRACT FOR ADI LIMITED

On 13 November 1998 the Minister for Defence, John Moore, announced that ADI Limited had been selected as the preferred tenderer for the upgrade of the Royal Australian Navy's six Adelaide Class Guided Missile Frigates (FFG). Competing offers had been received from ADI Limited and Tenix Defence Systems Pty Ltd. The FFG Upgrade project (worth almost $1 billion) entails major improvements to the capability of the RAN ships to defend themselves, particularly against modern anti-ship missiles, introduced after the ships had entered service.

The ADI proposals include the upgrading of the existing Mk 92 Fire Control System from Mod 2 to Mod 12, the installation of a tactical length vertical launching system (VLS) Mk 41, allowing ESSM and SM-2 launch capability and the upgrade of the AN/SPS-49 long range air surveillance radar. There will be a wide range of other electronic systems improvements, including the replacement of the hull-mounted sonar. The FFG 7 class frigates were originally designed as a relatively economical anti-submarine warship and this modernisation will provide an increased level of capability that allows the FFGs to operate in a multiple mission environment.

ADI has assembled a well-qualified team of participating companies to undertake this project. ADI will be the prime contractor, with Lockheed Martin the combat system design authority. Thompson Marconi Sonar will be the integrator of the underwater warfare suite. This company is already involved in the Collins class submarine, Anzac Frigate and Huon minehunter projects. Boeing Australia and CEA Technologies will also make a major contribution to the project. ADI's plans anticipate 60% Australian industry involvement, with the gun and missile control systems to be manufactured in Australia.

Gibbs & Cox Inc. will be the platform (i.e. ship) systems design authority responsible for ensuring that the overall structural integrity, stability and other crucial ship characteristics are appropriately maintained. This well known US company has over 65 years experience in naval ship design, and have designed many famous ships like the passenger liner *United States*. They have had a long relationship with the RAN, as they were the detailed designers of the Charles F Adams class guided missile destroyers, three of which *Perth*, *Hobart*, and *Brisbane* have given long and fine service to the RAN. Gibbs &Cox were involved in the competition for the RAN Light Destroyer (DDL) project, cancelled in 1973. At that time they were engaged in the detailed design of the FFG 7 class and they have continued as the US Navy design agent for the class.

An impression of a modernised FFG firing an Evolved Sea Sparrow missile (ESSM) from a vertical launcher (Courtesy ADI Limited)

HIGH SPEED CAR FERRY DELIVERY FROM INCAT

Incat 050, launched on 7 November 1998 by Incat Tasmania Pty Ltd is the first of a new Incat 96 metre class aluminium high-speed ferry. The new ship has an increased deadweight capacity of 60% more than her immediate predecessor and can transport a mix of light and heavy road vehicles. *Devil Cat* is being operated by the TT Line between Port Melbourne and Georgetown, Tasmania during the summer of 1998/99.

Devil Cat is 96 metres long overall, with a beam of 26 metres and a draft of 3.7 metres. The beam of each demi-hull is 4.5 metres. The total deadweight is 800 tonnes. Propulsion is by four Caterpillar 3618 marine diesel engines of 7,200 kW each at 1,300 rpm. They drive four Lips 150D waterjets, which are configured for steering and reverse, through Reintjes VIJ6831 gearboxes. Electric power is provided by four Caterpillar 3406B 230 kW alternators at 415V, 50 Hz, 3 phase. On trials a maximum speed of 49.3 knots was achieved with 55 tonnes deadweight. The best loaded speed achieved was 42.2 knots at with 670 tonnes dwt. Based on this performance, *Devil Cat* is expected to easily exceed her designed target of 37.5 knots with 800 tonnes.

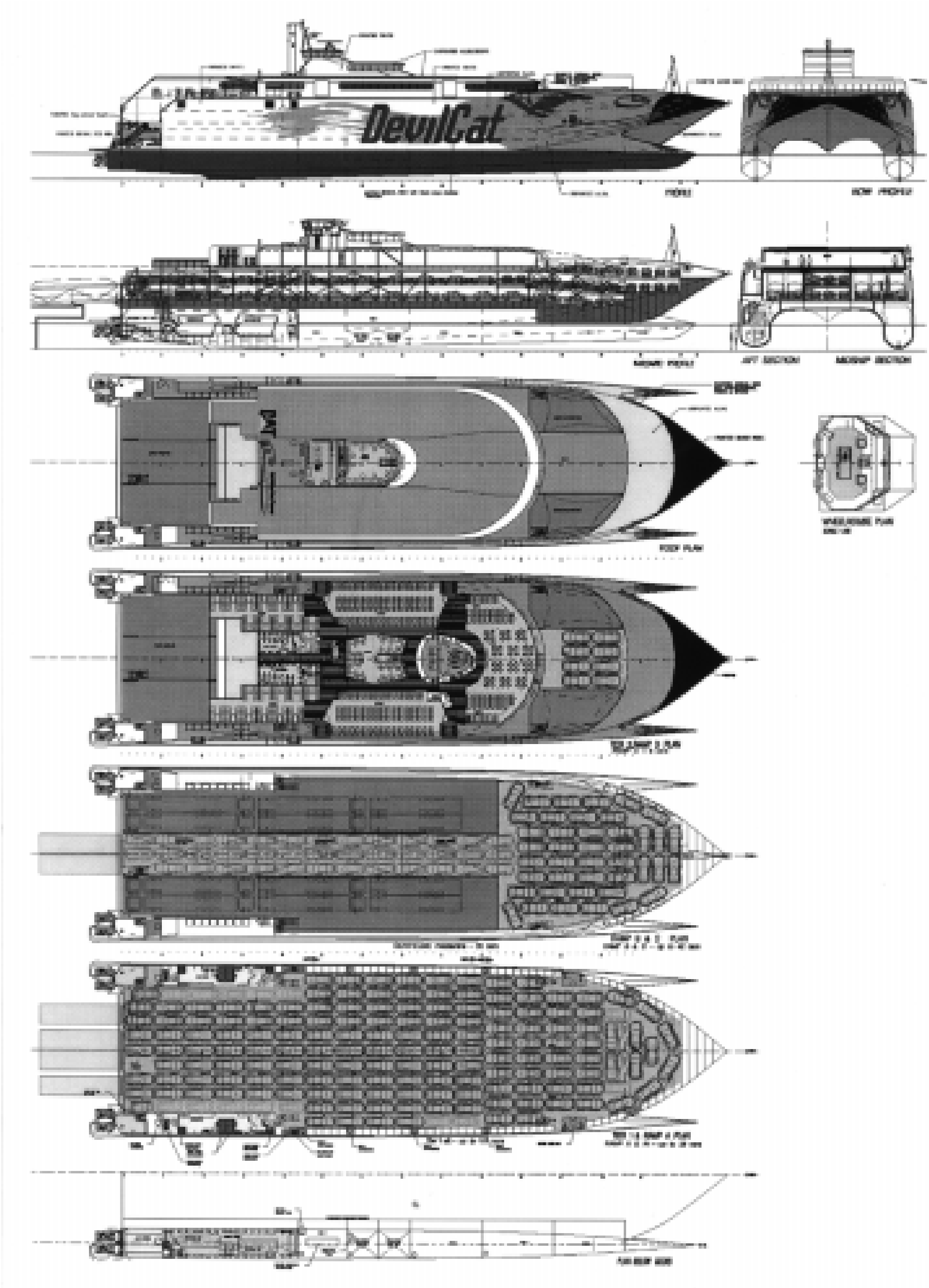
Loading is from the stern. With 330 truck lane metres at 2.7m wide and 4.3m clear height *Devil Cat* is capable of carrying a diverse range of vehicle deck cargo. 240 cars can be carried, or a combination of cars and road freight trailers, for example 85 cars with up to 24 trailers carrying 46 TEU.

The ship can carry 600 people, including the crew. It has a light and airy passenger space that is fully air-conditioned. The passenger cabin is serviced by combined café/bar. To improve ride comfort a Ride Control System by Maritime Dynamic Inc. has been fitted, incorporating active aft trim tabs and active forward T-foils. The system is said to dramatically reduce pitch, roll and heave.

Devil Cat has a high level of reserve bouyancy, fire detection and protection equipment and systems redundancy. An IMO approved marine evacuation system is fitted. It comprises four inflatable slides which connect with multiple 100 person liferafts. Engine rooms, vehicle decks and any other areas of moderate fire risk are monitored from the wheelhouse by CCTV cameras. Smoke and heat detectors are distributed throughout the ship. Engine rooms are protected by a CO2 system, which can be activated from the wheelhouse or locally. Each independent system is cross-connected allowing a second shot in either engine room in the event of a fire. Vehicle decks, passenger spaces and engine rooms are all protected by a zoned fixed fire sprinkler system and manual hydrants.

Devil Cat at speed
(Richard Bennett photo courtesy Incat Tasmania)

Passenger accommodation in *Devil Cat* (above) and the wheelhouse (below)
(Richard Bennett photos courtesy Incat Tasmania)



Devil Cat General Arrangement
(courtesy Incat Tasmania)

PROGRESS ON TUGS AT OCEANFAST

Work at Oceanfast on the six 32 metre tugs for Adsteam is proceeding apace with the first, *Bunbury,* handed over in February 1999. The second tug, *Tingari,* is expected to be handed over in April and the hull of the third, *Bullara,* is well underway. Fabrication of the remaining three Adsteam tugs has also commenced.

The 34 metre tug *Gurrong*, being built for Howard Smith Towage is also well advanced, and the ship has been fitted with its Daihatsu engines, Ulstein winches and Nigata Z-drives. When completed in April the tug is expected to be the most powerful and manoeuverable Australian tug for its size.

NEW SOUTH WALES NEWS

New Construction

Stebercraft have recently completed an order for ten 13.1 m GRP patrol vessels for Defence Maritime Services, the Defence support-craft contractor. These vessels will be based in the major ports around Australia.

A 21-metre aluminium high-speed monohull dive-charter vessel is being built by Roger Mutimer at Newcastle to a design by Tony Armstrong. The vessel is fitted with three 400 kW MTU engines driving jet units, and is nearing completion.

A 24 m aluminium low-wash catamaran ferry destined for NSW is currently under construction at Brisbane Ship Constructions.

An application for survey has just been received for an 18.6 m trawler designed by Owen Cropp. The builder is yet to be decided.

Tenders have recently closed on an order for seven police vessels to be used during the Olympic Games; the successful tenderer should be advised in early February

Around and About

Nautical Instrument makers Edwin Bowers and Sons Pty Ltd recently shifted premises to 199 Balgowlah Rd, Balgowlah 2093, phone and fax (02) 9948 7037, holding an auction of equipment in August, prior to the move. Long-time naval architect customers will be pleased to know that they are still very much in business, in particular as suppliers of quality marine hydrometers.

The construction of the Wharf 7 Maritime Heritage Centre, about 100 metres north of the Australian National Maritime Museum building at Darling Harbour, is well underway. The steel frame components are being fabricated off-site by John Holland Constructions, and are now being erected on site. This is a three-storey complex which will house the collections, collection management, and research facilities of both the Australian National Maritime Museum and the Sydney Heritage Fleet.

Blowering Dam is currently at a low level (about 38% capacity) and needs good rain for Ken Warby's water speed record runs in November this year. Michael Tait, who maintains Ken's Australian web-site, has added heaps of information recently (including daily charting of Blowering levels, details of the jet engine, Ken's other toys, etc.), and the site is becoming comprehensive. It's worth another look if you haven't visited recently (`www.kenwarby.com`).

Australia's *Endeavour* replica, built in Western Australia, recently won the English Tourist Board's award for the best tourist event in England during 1997–98. *Endeavour* will arrive in San Diego at about publication date, having come via New York, east-coast ports, the Panama Canal and the Galapagos Islands. From San Diego she will tour the west-coast ports to Vancouver, then head across the Pacific via Hawaii to Wellington for the Year 2000 celebrations, Auckland for the *America*'s Cup, and Sydney for the Olympics.

Phil Helmore

NORTH QUEENSLAND NEWS

The major event in recent months has been NQEA securing a $40 million contract with the Port of Brisbane Corporation for construction of a 3500 tonne dwt twin-screw hopper suction dredge. This order comes at an opportune time as the RAN hydrographic ships *Leeuwin* and *Melville* are approaching completion.

The dredge will be classed with Lloyds Register and will be 84 metres long with a beam of 16 metres and a depth of 7 metres. The hopper capacity will be 2,900 cubic metres.

Two 600 kW dredging pumps will be fitted and the ship will be propelled by twin 1800 kW diesels with controllable pitch propellers. A bow thruster will also be fitted.

NQEA has designed the vessel and the dredging equipment will be supplied by Krupp Fortechnik.

NQEA has also started construction of two River Runner 200 low wash catamarans for export to Europe. These vessels are 35 metres in length and are destined for an inland river service carrying 150 passengers at a speed of 30 knots. They are slightly larger than, but similar to, the two River Runner 150 ferries delivered to Tahiti last year, which are now successfully servicing the island of Bora Bora.

The River Runner ferries have been designed in-house by NQEA, and further success with the design has been achieved with the granting of a licence to a European shipyard to build four ferries to the River Runner 150 design.

Amongst the smaller builders, a general downturn in construction activity has been noted in recent months. Work continues on a number of game boats and day dive-boats in the 15–17 metre range. Cairns Custom Craft have just completed a 17 metre cruiser for export to Japan, with follow on orders expected.

Goeff Glanville

NORTHERN TERRITORY NEWS

Cyclone Thelma breezed along the Northern Territory coast within earshot of Darwin depositing copious amounts of rain and knocking down a few trees but it failed to dampen the spirits of the marine industry.

At time of writing there are ten vessels on the hard at Darwin Ship Repair and Engineering, representing a fair cross-section of all types of vessels varying from the last of the RAN's Attack Class patrol boats, prawn trawlers of the northern prawn fleet, pearling vessels and an offshore supply vessel. The slipway at Perkins is in constant use maintaining their fleet whilst the travelift at Sadgroves Quay remains active during the wet season as the yachting fraternity get into their lay-up period.

The frenetic ship repair season historically falls off in February and March and this year is expected to be no different, excepting conversion works to the Army's fleet of LCM8 landing craft.

Oil and gas related works offshore are forging ahead with the installation and testing of the flow lines for the Laminaria/Corralina fields. Seismic survey activity remains very busy which can only lead to further exploration and development in the Timor and Arafura Seas. The NT Government continues to be upbeat about all facets of the offshore industry and the increasingly apparent spin-offs for local businesses in the Darwin area. Many of the more well-known service industry players are now putting down roots or allying themselves locally in expectation of greater things.

Whilst the oil industry grabs the headlines, the "bread and butter" elements of our industry plough on regardless. The manganese from Groote Eylandt continues to be shipped since the mine changed hands, with BHP divesting itself of this long-term Territory interest. Other large operations at Gove (aluminium) and Bing Bong/ MacArthur River (zinc) are reliant on sea transportation for all aspects of export and logistics and are constantly supported out of Darwin.

As the monsoonal troughs set in, our minds turn to the start of the dry season to the upturn in business and the lure of the barramundi as the rains run off the floodplains.

Ian Stevens

COULD THIS BE THE WORLD'S MOST EXPENSIVE MARINE TURBO ALTERNATOR?

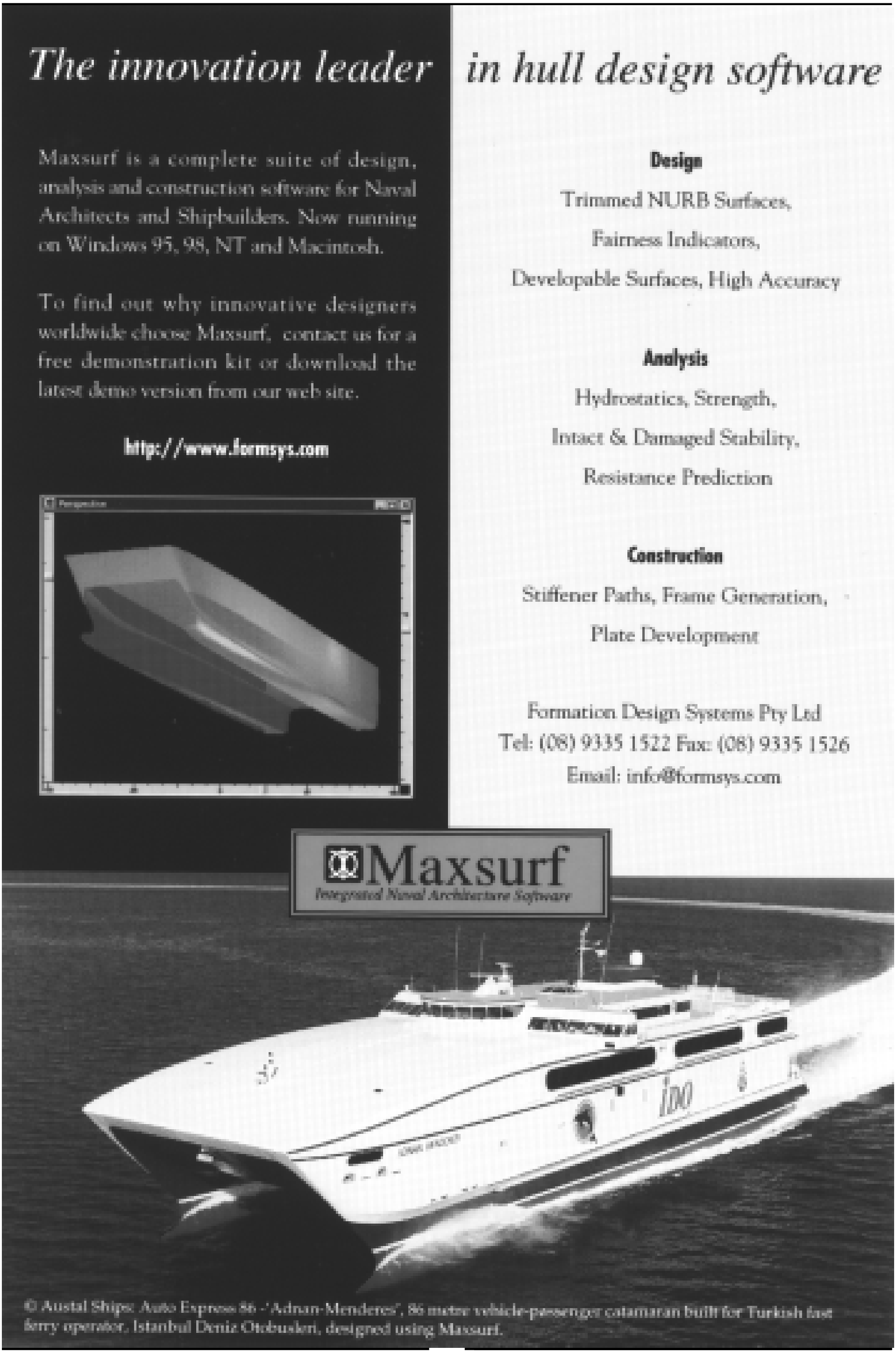
In the last edition of *The Australian Naval Architect* we reported a contract for the construction of a rather expensive bulkhead.

As a follow-up to that story, and to continue to keep our lives in perspective, we can now report a contract for a very expensive turbo-alternator.

Electric Boat Corp. of Groton, Connecticut, has received $US66 million (about $A105 million) to exercise an option under a previously-awarded contract to provide for the manufacture, testing and delivery of **one** ship service turbine generator set for the *Virginia* class nuclear submarine.

The work will be performed in Sunnyvale, California, by a major subcontractor, Northrop Grumman Marine Systems, and is expected to be completed by November 2002.

(Watch this space - Ed.)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Email: info@formsys.com
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IDO
© Austal Ships: Auto Express 86 - 'Adnan-Menderes', 86 metre vehicle-passenger catamaran built for Turkish fast ferry operator, Istanbul Deniz Otobusleri, designed using Maxsurf.

Australian Maritime College

The AMC/AMECRC / RINA presentation on *Building the Largest ever Container Ships* by IHI Kure Shipyards was presented by Henk Kortekass, Machinery Inspector/Chief Engineer of P & O Nedlloyd on 14 October 1998. *Experimental & Numerical Developments* was presented by Dr Paul Brandner, manager of The Tom Fink Cavitation Tunnel Manager on 21 October 1998. This presentation spoke of the development and function of the cavitation tunnel including an overview of planned experimental capabilities, instrumentation, complementary numerical tools and a demonstration of a cavitating hydrofoil in the tunnel.

The presentations on final year research theses were made on 24 October and the invited guest from the Industry was Dr. Stuart Cannon of DSTO. Some of his observations are given below.

- They were of excellent quality, many better than I have seen at International conferences. Each presenter gave clear explanations of their projects which would have been understood by non-experts in their chosen field.
- The diversity of topics was encouraging and many were on topics of relevance to industry. This shows flexibility in the students which is very useful for potential employers.
- It was very encouraging to listen to the types of questions raised by other students. This shows clear thought across many disciplines.
- Overall an excellent day. I would like to see a more formal set of proceedings on the day. Most students had written a couple of pages and diagrams were already there on PowerPoint format.

Professor R. Hannesson of the Norwegian School of Economics and Business Administration delivered a presentation on *Marine reserves - what do they achieve?* It was well attended by students and staff of AMC.

The first graduates from the Australian Maritime College's Department of Naval Architecture and Ocean Engineering obtained their Bachelor of Engineering in 1990. To date (not including the 18 students who completed their degrees late in 1998), a total of 105 graduates have obtained a degree in either naval architecture or maritime engineering. The Department has kept in contact with nearly 90% of graduates and a breakdown of employer type and the geographical spread makes interesting reading, as shown below:

Employer	
Ship builders / designers	26.7 %
Naval architecture consultancies	12.4 %
Royal Australian Navy	11.4 %
Government / classification societies	10.5 %
Research / academic	9.50%
Ocean and maritime consultancies	7.6 %
Other engineering	7.6 %
Other employment	2.9 %
Unknown	11.4 %

Location	
Western Australia	24.8 %
Tasmania	20.0 %
Queensland	11.4 %
New South Wales	8.6 %
Victoria	7.6 %
Australian Capital Territory	3.8 %
Northern Territory	1.9 %
South Australia	10.0 %
Overseas	10.5 %
(including Aberdeen, London, Auckland, Suva, New York, Seattle)	
Unknown	11.4 %

In addition, a further 12 students completed their degree in the last month or so with many of them already gaining employment within the maritime industry. A complete listing of all Bachelor of Engineering graduates and their place of employment is available on the AMC web page at `www.amc.edu.au`.This list is periodically updated and thus, the Department would appreciate notification of any alterations required. Please pass this information on to Gregor Macfarlane at the AMC Ship Hydrodynamics Centre, phone (03) 6335 4880, fax (03) 6335 4720, or email `G.Macfarlane@mte.amc.edu.au`.

Prasanta Sahoo

University of New South Wales

Changes

After ten years in their respective positions, the Head of the School of Mechanical and Manufacturing Engineering, Prof. Brian Milton and the Executive Assistant to the Head of School, A/Prof. Eleonora Kopalinsky both retired at the end of 1998. A/Prof. Kopalinsky was appointed as a lecturer in the School in 1971, and was the first woman so appointed in engineering in Australia as Prof. Tom Fink (a former

Dean of Engineering at UNSW) was fond of pointing out. Brian has been appointed Emeritus Professor and Eleonora Visiting Fellow to continue their research within the School. Prof. Kerry Byrne has taken over as the Head of School, and Dr John Challen as the Executive Assistant.

The structure of the university faculties has been overhauled, and there are no longer departments within schools. A/Prof. Lawry Doctors is now the course coordinator for naval architecture.

Within the naval architecture course, A/Prof. Lawry Doctors resumes teaching Ship Hydrostatics for 1999, and introduces the hydrodynamics of high-speed craft to Principles of Ship Design 2, the majority of the subject remaining with Dr Pal. Mr Phil Helmore takes over teaching Principles of Ship Design 1.

Undergraduate News

In addition to those who graduated in May 1998, the following graduated with degrees in naval architecture at the October ceremony:

Christopher Hughes	H2/1
Antony Krokowsi	
John Lembke	
Steven McCoombe	H2/2

Post-graduate and Other News

Our 1998 graduates are now employed as follows:

Christopher Hughes - BMT Seatech, UK
Tristan Harris - CBI Constructions, Gladstone
Brad Hillman - Inter-Ship Navigation Co., Cyprus
Antony Krokowski - NSW Waterways Authority, Sydney
John Lembke - Austal Ships, Fremantle
Steven McCoombe - German Frers, Spain
Scott McErlane - 46 m Charter Yacht, France/Turkey
Shaun Phelps - Masco Design Services, Sydney
Tauhid Rahman - ABS Pacific, Sydney
Robert Rostron - DNV, Sydney
Timothy Sexton - Contracting, Albury

A/Prof. Lawry Doctors recently spent a week in the West to attend the AusMarine '98 conference. He presented a paper on his recent work on the development of low-wash vessels. This work is an extension of his earlier research on this subject, which is important to operators of modern high-speed vessels. The paper included a description of his computer program that calculates the wave wake of a monohull or catamaran proceeding at a steady speed in a river. Among other points, A/Prof. Doctors emphasized the pressing need to develop hull forms that are extremely slender and have a low prismatic coefficient.

Dr Mac Chowdhury was recently invited by the Institution of Engineers, Bangladesh to deliver a lecture on the occasion of their Fifth Annual Paper Meeting organised by the Mechanical Engineering Division. The conference was a regional one, held from 5 to 7 November in the port city of Chittagong and was attended by delegates from India and Nepal as well as locals. Dr Chowdury's invited lecture was *Fatigue Life of Ship Structures: Modeling Strategies*. He also presented a research paper at the conference and chaired a session. Both papers are included in the proceedings that can be obtained via Dr Chowdhury.

Phil Helmore

Curtin University

Postgraduate Activities

Teaching people to sail can often be fraught with difficulty. The environment can be perceived by an absolute beginner as cold, wet and altogether daunting, to such an extent that it is hard to concentrate on learning the necessary motor skills. Researchers at the University of Tasmania have developed a dry land sailing simulator based on the laser dinghy. The simulator allows the helmsman to steer the boat, hike out to counteract the sail heeling moment and watch their progress on a computer screen all in a controlled environment. Curtin University, in conjunction with the University of Tasmania and yacht marketing company Starboard Products, has been successful in gaining an ARC SPIRT grant to further develop the simulator and expand its capabilities. The primary aim of the work, which will see a PhD student based at Curtin, is to enable the modeling of modern racing dinghies such as the Olympic Class 49er. This will enable the simulator to be used not only for teaching but also for training crews of these tricky-to-sail dinghies.

Short Courses

Courses in Design for Small Craft, Applied Hydrodynamics, and Marine Structures and Materials will be offered in the second semester. These courses are run jointly by AME CRC and the Department of Applied Physics at Curtin University.

Postgraduate Activity

Amongst the new postgraduates commencing at the Centre for Oil & Gas Engineering, University of Western Australiain January 1999 are two in the field of naval architecture with Dr Krish Thiagarajan. The first, through ARC SPIRT funding with industrial partner Marintek is entitled 'Wave run-up on vertical columns of an offshore structure'. This numerical & experimental study will entail investigating different column shapes and their effect on wave run-up (wave run-up is a local accumulation of mass at the face of a column due to steep waves). The second project, also funded through ARC SPIRT with industry partner Kvaerner Oil & Gas Australia, is a comparative evaluation of deep-water spars and deep-draft floaters for oil and gas production. This project will investigate the hydrodynamic performance comparison of two different production concepts for deep water. Further details of the centre's activities can be found from the web site `www.oil-gas.uwa.edu.au`.

Undergraduate Activity

This year for the first time a course 'Introduction to Naval Architecture' is being offered within the B Eng degree Resource Engineering. The course is part of the stream within the degree called Offshore Engineering.

Giles Thomas

MEMBERSHIP NEWS

Eric Trivett

We regret to advise the death in Canberra, on 26 November last year, of Eric Trivett. Eric was the foundation Treasurer of the Australian Branch of the RINA from 1954 to 1965. He then became Honorary Secretary/Treasurer until 1970, when his employer, the Department of Defence, moved him to Canberra from Sydney. He kept in touch with the activities of the Institution through the Canberra Section until he retired from the Department.

Recognition of RINA membership

The Minister for Transport and Main Roads of the Queensland Government has recently confirmed that membership of RINA meets the qualification component of the standard required for accreditation in Queensland as a ship designer and marine surveyor. The full requirement for accreditation is ten years of relevant experience, or the appropriate qualifications plus five years of relevant experience in each of the areas for which accreditation is sought.

PROFESSIONAL NOTES

The Year 2000 Problem

The Year 2000 problem is now widely accepted as an issue which must be addressed in all walks of life. Any computers of any description *or* equipment using electronics may be subject to the problem. In the maritime world the IMO, national administrations, classification societies and insurers are all taking this issue very seriously. You must do the same.

What is the problem?

There are several problems which have come to be known collectively as the Year 2000 problem (or the millennium bug). One problem stems from the common use of two-digit date representations in software or embedded microchips, where the two most significant digits are assumed. When the date becomes 1 January 2000, it will be represented by 00, and the results will depend on the particular system or program. Some will assume that the date is 1900 rather than 2000, others may register no date at all, and others may show no immediate malfunction. However, programs which rely on differences between dates will be immediately subject to errors if 00 is not recognised as representing 2000.

Another problem arises from the year 2000 being a leap year, because some computers do not recognise this and so date information may be corrupted. The leap year error has a knock-on effect at the end of 2000, where the last day may not exist, and possibly the leap year in 2004. The leap year problem has already been demonstrated at the end of 1996 at aluminium smelters in New Zealand and Tasmania, with complete loss of process control computers.

Date-related errors in computer systems include the Global Positioning System (GPS), which uses a week counter with a 10-bit field which overflows after 1024 weeks from the initial set-up date. The marine industry is aware that some GPS receivers may not be able to handle this properly and fail on 22 August 1999. As a further unrelated example, some early Unix systems may fail in 2005 for similar reasons.

Another series of potential problems are related to the use of "99999" or "9/9/99" in date fields to indicate the end of data (or file) or stop codes.

There is a raft of potential problems associated with embedded systems, i.e. microprocessors or programmable logic controllers which form part of a larger product, usually in control, alarm or data acquisition systems. Use of dates for some functions is becoming common, and the failure mode may be unpredictable rather than safe.

What is Year 2000 Conformity?

The British Standards Institution has a document Disc PD2000-1:1998 *A Definition of Year 2000 Conformity Requirements* which is available on their web-site `www.bsi.org.uk`.Their definition section (in its entirety) says:

"Year 2000 conformity shall mean that neither performance nor functionality is affected by dates prior to, during and after the year 2000.

In particular:

Rule 1 No value for current date will cause any interruption in operation.
Rule 2 Date-based functionality must behave consistently for dates prior to, during and after the year 2000.
Rule 3 In all interfaces and data storage, the century in any date must be specified either explicitly or by unambiguous algorithms or inferencing rules.
Rule 4 Year 2000 must be recognised as a leap year."

If you have web access, perusal of this document for further details is recommended.

Do I have a problem?

At the very least, you should check your own computer. A quick way to see if your PC has a BIOS (Built In Operating System) problem is given on the MPI web-site `www.y2k-schedules.com`:

"Make and test a 3.5" boot disk for your PC, then set your system clock to 11:59 p.m. on 31/12/99. Switch your PC off, have a quick cup of coffee and switch on again. If everything works OK, your system (but not necessarily your software) is probably Y2k proof. If your PC fails to boot, restart using your boot disk, reset the system clock to the correct date and time, and make plans to upgrade or replace your BIOS (or PC)."

Further date roll-over problems can be tested in the same way:

8 Sep 1999 to 9 Sep 1999	(use of 9/9/99)
9 Sep 1999 to 10 Sep 1999	
31 Dec 1999 to 1 Jan 2000	(first use of "00")
28 Feb 2000 to 29 Feb 2000	(leap year day)
29 Feb 2000 to 1 Mar 2000	
30 Dec 2000 to 31 Dec 2000	(366th day of 2000)
31 Dec 2000 to 1 Jan 2001	
28 Feb 2001 to 1 Mar 2001	(not a leap year day)
28 Feb 2004 to 29 Feb 2004	(next leap year day)

This, of course, tests only the BIOS and this is independent of the operating system (e.g. DOS, Windows 95+, etc.) which should also be checked by contacting the vendor.

All software needs to be checked for operation on and across the above dates, and this may require some care. For example, some multiple-user software is subject to licence expiry dates, and setting the operating system clock forward for checking purposes may expire the licence! Check with the software vendor first. All data and software should be copied before commencing testing (provided that the software licence allows copying).

There are software packages around which claim to check PCs for Year 2000 conformity. Check 2000 from Greenwich Mean Time is one of the few software packages which checks both software and PC hardware for all of the above-mentioned PC problems. It opens every file and scans line-by-line for two-digit date calculations, in addition to checking the PC's clock and BIOS. Further information about Check 2000 can be found on the web at `www.gmt-2000.com.au`.

If you have a company with many computers and much electronic equipment, then the scale of the problem dictates that you need to have a testing program in place (tomorrow, if you don't have one already). Simply hoping for the best will not impress an inquisitorial barrister at a court of marine enquiry!

What Can I Do?

There are four types of remedial action should you discover a problem:

Repair: You may have the equipment repaired by the manufacturer, e.g. by replacement of an electronic component.

Replacement/Upgrade: You may decide that the time has come to replace or upgrade the equipment anyway, from the same or another manufacturer.

Retire: You may take the equipment out of service because it is no longer required.

Work-around: You may decide that there is no point in repair or replacement because there is an acceptable work-around. For example, your PC might not recognise any leap years but work correctly in all other respects. The work-around would be to mark any reports as printed on 29 February when it displays 1 March and then put the calendar clock back by one day.

Where can I find More Information?

There is a plethora of information about the Year 2000 problem, both printed and on the web. There has been coverage in the media and technical journals (e.g. *Engineers Australia,* August 1998 and October 1998), AMSA put out Marine Notice 1/1998 *Management of Computer Systems,* and Standards Australia ran a series of seminars on the subject in all capital cities in August/September last year.

Of the printed material, a good guide is the thirty-nine page document published by Lloyd's Register of Shipping, *Guidelines for Year 2000 Projects: A guide to Solving the Problems Associated with Ships and the Millennium Bug,* November 1998. Standards Australia have published two guides, HB99 *Addressing the Compliance of Dates for the Year 2000 and Beyond,* and HB104 *A Guide to Year 2000 Compliance.*

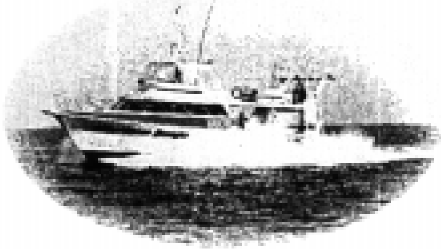
On the web, there are literally hundreds of sites devoted to the Year 2000 problem, most of which have links to others. Apart from the ones mentioned above, some of the helpful ones are those of the Australian Government at `www.y2k.gov.au`, the UK Institute of Electrical Engineers at `www.iee.org.uk/2000risk` and, for shipboard systems, Lloyd's Register in association with the UK P&I Clubs at `www.ship2000.com`.

Conclusion

The Year 2000 problem is real, and it has the potential to affect you and all of your systems. If you have not yet done anything then you should start today. By the time you read this there will be less than 320 days to go till the year 2000!

Phil Helmore

Ship Knowledge for Ship Builders



South Metro TAFE's Fremantle Maritime Centre is offering the following Part Time course for 1999 beginning 10th February.

- 44091 Ship Construction for Ship Builders
- 44092 Ship Construction for Ship Builders
- 44090 Naval Architecture
- 44093 Marine Engineering Practice
- 44094 Ship Drawing Practice

To find out more call (08) 9239 8007

http://www.training.wa.gov.au/tafe/smc

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The BC Ferries Catamarans

by

Robert J Tulk BE MEM

Abstract

The Pacificat is a high-speed passenger and vehicle catamaran ferry owned and operated by the British Columbia Ferry Corporation on the Horseshoe Bay – Nanaimo route. At 122 m overall length, she is the second largest aluminium catamaran in the world, eclipsed only by the STENA HSS Catamaran. She was designed by International Catamaran Designs, Sydney, in a joint venture arrangement with Canadian naval architects, Robert Allan Ltd.

This paper reviews the major challenges associated with a project of this scale, beginning with the challenges facing BC Ferry Corporation and their decision to go to fast ferries. Secondly, it considers the challenges faced by Incat Designs and RAL in the design of the vessel. The paper outlines the development of the tank and wind tunnel testing programs, and the certification, classification and primary structural design of the vessel. It examines aspects of the global finite element design and fatigue analysis. Various components of the design requiring special attention such as the bow and stern ramps, waterjets, transom flange and weight control are discussed.

Lastly, this paper briefly describes the challenges associated with the vessel's construction in British Columbia and the revitalisation of the local shipbuilding industry. The Pacificat fast ferry is the result of a design process that has evolved over the past four years through the cooperation of the vessel's designers, builders, local support industry and owner/operator BC Ferries to create a unique vessel for British Columbia.

The Challenge Facing BC Ferries

BC Ferries was established in 1960, beginning operations with one route, two terminals and two ships. Since 1960 there has been a 3000% increase in growth, and BC Ferries now operates forty ships on twenty-six different routes. Last year these ships carried 22 million passengers and 8 million vehicles. As a comparison, the State Transit Authority on Sydney Harbour carried 13 million passengers last year, albeit on shorter journeys and without vehicles. Approximately 15% of BC Ferries' passengers are on the Horseshoe Bay to Nanaimo route (equating to 3.5 million passengers and 1.2 million vehicles last year). Traffic on this route is forecast to grow by 17% over the next decade.

One of the major challenges facing BC Ferries was to increase capacity on this route. Both terminals operate at close to full capacity for much of the year, and during the summer months there is often a queue extending along the approaches. On a busy day commuters face the prospect of spending several hours in these queues waiting for available space on the next ferry. The difficulty occurs because it is almost impossible to expand the terminals in any meaningful way. On the mainland, the Horseshoe Bay terminal has a mountain on one side and a community in very close proximity on the other. Similarly, on Vancouver Island, the Departure Bay terminal is surrounded by the rapidly growing city of Nanaimo.

To alleviate the increasing congestion at the terminals, two solutions were identified by BC Ferries, and both are being implemented. The first solution is to reduce traffic on the route, and to facilitate this, all heavy commercial traffic has been redirected to a new terminal at Duke Point, south of Nanaimo, serviced from the mainland via the Tsawwassen terminal in Vancouver.

The Duke Point terminal was opened in 1997 in conjunction with a new expressway and this integrated approach to transport has allowed both heavy and conventional traffic to travel to mid-Vancouver Island destinations. Duke Point frees up some terminal space at both ends of the Horseshoe Bay – Nanaimo route, but there are still excess vehicles wanting to travel this route at the same time.

The second solution identified by BC Ferries was to lift off smaller pulses of traffic at more frequent intervals. One way, and in the view of BC Ferries, the best way, was to introduce a fast ferry solution. This solution would also assist in solving another challenge facing BC Ferries, which is that the current average age of the fleet is 28 years. New ships are required to allow replacement of some of the older vessels (the original ships from the 1960 operation are still in service, 39 years later).

In 1994, BC Ferries called for Expressions of Interest from marine designers around the world. Their aim was to put together the best possible team to design and construct a high-speed car and passenger carrying ferry system that would bring the greatest economical benefit, not only to BC Ferries, but also to the province of British Columbia as a whole. A set of performance criteria was specified, including the following:

- A roll-on/roll-off design;
- Ability to load vehicles over two decks,
- Vessel to interface with existing terminal structure with a minimum of modification (this was to save cost of infrastructure, but also to allow the new ships to be progressively introduced alongside current vessels using the terminals);
- Dry exhaust system to minimise unnecessary noise;
- Low wake and wash; and
- Acceptable exhaust emission levels.

BC Ferries received proposals from some of the most prestigious marine designers in the world, covering SWATHS, wave-piercers, catamarans and monohulls. Twenty-two of these proponents were considered in detail. The review panel, given the opportunity to consider the whole gamut of fast ferry technology at the time, learnt the following:

> *The SWATH hull gave the best seakeeping performance, but was the most expensive to build and required very high power.*
>
> *The monohull had the least expensive hull form and had reasonably good seakeeping characteristics in severe storms but had fairly high power requirements and presented challenges with over-the-bow ro-ro operation.*
>
> *The catamaran had good seakeeping abilities (particularly when fitted with a ride-control system) and had the lowest powering requirement.*

Of the twenty two proposals, fourteen were for catamarans. BC Ferries established that the proposal that best met all the needs of BC Ferries and the province came from a joint venture between Incat Designs, Sydney, Australia, and Canadian naval architects Robert Allan Ltd. In December 1994, BC Ferries awarded the design contract to Incat Designs and RAL.

Meeting the Design Challenge

December 1994 was the beginning of what was to become a major design challenge and effort for Incat Designs. Having won the design contract, the first step was to determine what the design parameters would be for the vessel. The broad technical requirements were identified as follows:

- The vessel was to be of a catamaran form.
- A vital consideration was that the vessels would have to use the existing terminal infrastructure at Horseshoe Bay and Departure Bay, sometimes concurrently with the existing monohull ferries. This placed a limit on the breadth of the design to no more than 27 metres — a relatively low figure for a catamaran of this length and capacity.
- The vessels had to be capable of loading vehicles on two levels simultaneously with two parallel lanes per deck using the existing ramps. The height of the car decks had to be such that vehicles loading or discharging over the existing shore ramps would not 'bottom out'. This requirement limited the design freeboard, which in turn limited the available tunnel height to about 2.5 metres.
- To facilitate fast loading and unloading, the vessels had to be arranged to allow vehicles to unload without having to reverse. As with the majority of the existing double-ended ferries, the solution was to make the design capable of docking at the terminals both bow or stern-to.
- Finally, a proven hull design was required by BC Ferries to ensure that speed and seakeeping performance could be achieved while carrying the required payload. A proven hull form would provide an acceptable estimate of the resistance and horsepower requirement that would enable accurate economic analyses to be performed. The proven hull form would provide an ideal benchmark for further refinement to enhance sea keeping and manoeuvring characteristics.

Economic Analysis

BC Ferries were keenly interested in minimising not only the capital cost of the project but also the projected running costs. Over ten different engine configurations including gas turbines, CODAG and four and six diesel engines were evaluated using an economic model developed specifically for the project. Every option went through a preliminary design process as part of the economic modeling to ensure each vessel configuration was optimised around the power plant being considered. One option even looked at construction of four smaller vessels rather than three larger ones. Four- and six-engine configurations were considered, the decision ultimately being made for the former on the basis of weight, capital and through-life costs.

There was a continual balancing of the owner's requirements and wishes against weight, powering and running costs. Most requirements were modified until a final Statement of Requirements was determined and a General Arrangement decided upon. This formed the basis for the initial design phase.

Statement of Requirements:

The final statement of requirements called for a vessel capable of carrying 250 cars of the larger North American standard size and 1000 passengers at 37 knots. The lower vehicle deck was to carry vehicles up to 9.3 tonnes, with the centre lanes available for buses in place of some cars. The upper vehicle deck was designed to carry cars up to 2.5 tonnes. Fuel oil capacity was to be sufficient for 13 crossings, representing a full day's service plus an allowance for one emergency crossing. Seakeeping and passenger ride comfort was to be equivalent to the existing slower conventional ferries on the same route. Passenger facilities were to include seating for all, a cafeteria, coffee bar, video games area, work station facilities, children's play area, a passenger elevator accessing all decks and a gift shop. The vessels were required to meet the IMO Code for High Speed Craft and be classed with Det Norske Veritas.

General Arrangement

To meet the requirements, Incat Designs and Robert Allan Ltd developed a design for a conventional catamaran 122 metres long by 25.8 metres breadth (including sponsons). This is the second largest catamaran ever constructed, being eclipsed only by the STENA HSS vessel which is a couple of metres longer, but considerably wider at 40 m beam. This arrangement would also comply with classification society and high speed craft code rules and regulations.

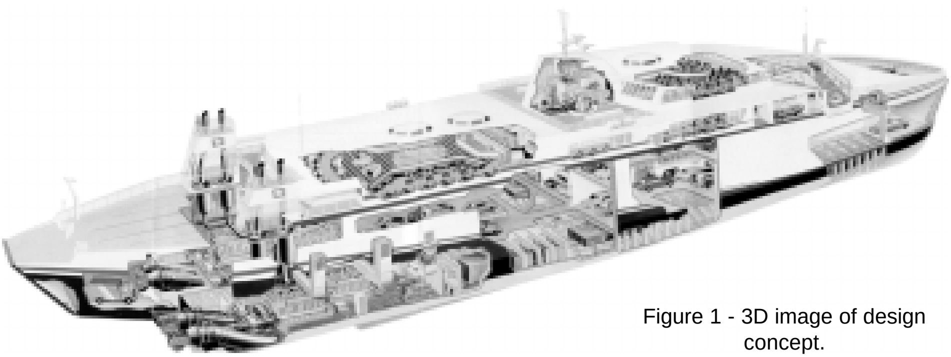

Figure 1 - 3D image of design concept.

The lower hull compartments contain waterjet rooms, main engine rooms, fuel and fresh water tank spaces, sullage treatment and water fog fire sprinkler pump modules and bow thruster machinery. The two vehicle decks are enclosed spaces, arranged for drive-through loading and unloading. The lower vehicle decks are fitted with bow and stern loading ramps that provide a weathertight closure when raised. The upper vehicle deck is provided with forward and aft roller doors. No vehicle ramps are fitted between decks. Enclosed passenger stairways that are structurally fire protected provide access between vehicle and passenger decks. The two passenger decks, including the wheelhouse, are isolated from the main hull structures by resilient mounts to reduce noise and vibration being transmitted to these areas.

The propulsion package comprises 4 x MTU 20V1163 engines driving 4 x 112 KaMeWa jets through Renk gearboxes using dry exhausts. Total installed propulsion power is 26000 kW. Active trim tabs are fitted to the transom to reduce motions and thus improve ride characteristics.

A double-bottom structure is included forward of the engine room to the collision bulkhead. No watertight doors providing access between hull voids and machinery compartments are fitted. Extra plating thickness and additional sub-frames forward are included to withstand log strikes (Canada is world renowned for beautiful fir trees, which unfortunately occasionally find their way into Georgia Strait.)

Tank Testing and Hull Lines

The hulls are based on a well-proven Incat Designs hull form. However, some tank testing was justified to confirm resistance predictions due to the vessel size and the large capital expenditure involved. In addition to resistance, an extensive tank testing programme was undertaken to determine the various hull loads and acceleration levels imposed on the structure as well as to study the seakeeping and manoeuvring characteristics. A scale model approx 5 m long (1:18.5) was tested at the Marintek facilities in Norway.

Resistance testing

Towed resistance tests on the Incat Designs proven hull form were undertaken, which confirmed the predicted resistance. Marintek proposed some modifications to the bow and stern sections, derived from their extensive database of tested models. The model was tested with these different sections, however no improvement in the resistance was obtained in the operational envelope determined for this project. In terms of resistance, the effect of the ride control tabs (in a static mode) was tested and allowed for in the resistance results.

Self-propulsion testing

A self-propelled model test was also undertaken. At this stage of the project, the engine package had not been finally selected and one of the proposals at the time consisted of three engines per hull, each connected to a separate waterjet. The self-propulsion testing indicated that there were some unfavourable interactions between the three jets for this project, due in part to their close proximity to each other. At a later stage this option was rejected and the two engine per hull MTU package as fitted was proven to be the most economical.

Ocean basin testing

The test model was modified to include the superstructure and then tested in the Maritek ocean basin. This facility is one of the best in the world, consisting of a pool 80 m x 50 m in size, with an adjustable floor giving depths up to 10 m. Wave makers are positioned along two sides of the tank, and a carriage runs over the entire area of the pool, enabling the self-propelled model to be tested without heavy and cumbersome equipment being fitted to the model.

Seakeeping motions and accelerations were recorded for regular and irregular waves of 1, 2 and 3 m significant height at headings ranging from head to following seas. These results were used not only for manoeuvring analysis, but also for comparison with the computer simulated hydrodynamic analysis (discussed below).

With a relatively small freeboard to the tunnel of only 2.5 m, some slamming was predicted. The model was fitted with pressure-sensitive patches along the tunnel, on the bow door and on the aft overhang. Tank testing confirmed this prediction and, more importantly, indicated at what headings and wave heights slamming might be expected. With this information the speed/wave height curve was formulated and some practical recommendations are now available to the masters on possible avoidance measures.

The model was cut in half down the longitudinal centre of the vessel, and strain gauge load cells were fitted across the break. Running the model in the same regular and irregular seas allowed measurements of the expected global loads to be made for the pitch connection and transverse bending load cases. These results were also later compared to the computer simulated load cases.

Low speed/high speed manoeuvring tests

Manoeuvring tests were also conducted with the self-propelled model in the ocean basin.

Computer simulated hydrodynamic modeling

A computer-aided hydrodynamic analysis was undertaken using Fastsea, a Norwegian hydrodynamic prediction program. Fastsea was the most suitable DNV-approved program applicable to vessels of this speed at the time of the design work. Results from this analysis were compared to the tank testing results, showing good correlation between the two and with accepted criteria. Utilising the Fastsea results, the design loads were able to be refined. The most significant area was a reduction in the dynamic acceleration component below the generally-accepted DNV minimum of 1 x g (9.81m/s^2) to 0.75 g. This enabled the design to be further refined, allowing for significant weight reductions in the scantlings of the vessel.

Another aspect of the combined Fastsea and tank testing results was the predicted extent and severity of slamming. In this case, it was found necessary to increase the slamming loads above the rule DNV requirements. The magnitude of slamming and transverse accelerations in 3 metre significant seas confirmed the designers' predictions that the boat was best-suited to operations in seas up to 2.5 metres because of its relatively low tunnel height and hull separation. Nevertheless, this sea state limitation should be quite satisfactory for operation across the relatively sheltered waters of Georgia Strait. The significant wave height in the Georgia Strait exceeds 2.5 metres less than 0.05% of the time (approximately 3 hours per year).

Wind Tunnel Testing

In order to confirm the forces and moments produced by wind on the catamaran ferry a series of wind tunnel tests were undertaken at Melbourne's Monash University, Australia, to determine the slow speed manoeuvrability of the vessel and air resistance at high speeds. Tests were conducted at all headings up to wind speeds of 80 knots. Results from testing enabled a study to be made on the merits of fitting a bow thruster. Our previous experience had indicated that sufficient manoeuvrability could be achieved by the jets, particularly for quad jet installations, where all jets have steering capability. Due to the restricted beam of this vessel, it was determined that a bow thruster would be required for windy conditions when berthing.

Certification and Classification

The vessels are to be certified by Transport Canada, Marine Safety Branch. Because of the nature and size of these vessels, Transport Canada MSB decided at an early stage to adopt the HSC Code with some additional stability and safety requirements. Det Norske Veritas is the classification society for this project. As with Transport Canada MSB, DNV has nominated the provisions of IMO's High Speed Craft Code to be the measure of compliance for these vessels. Under the HSC Code, the BC Ferry is classified as a Category B craft as it carries more than 450 passengers. It therefore must have machinery and safety systems arranged such that, in the event of damage disabling any essential machinery and safety systems in one compartment, the craft retains the capability to navigate safely. By virtue of the catamaran configuration, fulfilling this requirement is relatively straightforward. Other special requirements pertaining to Category B craft include the need to divide the passenger spaces into safety zones, increased length of assumed bottom damage for the purposes of subdivision calculations, additional fire-fighting equipment and a second rescue boat.

STRUCTURAL ANALYSIS

Structural Concept

The structure of the Pacificat comprises two slender aluminium hulls joined together by an integral aluminium bridging structure which extends for most of the length of the craft. The bridging structure is formed by the box-like enclosure for vehicles extending from the underside of the tunnel to the top of tier three deck which supports the rafted superstructure. The vehicle decks and side structure play an important role in the global strength of the vessel.

All the decks are composed of a range of extruded planks welded to fabricated deck beams. Extrusions are used for the stiffener members in the hull. The deck panels are primarily fabricated from extruded planks, the majority of which were delivered pre-welded, by the aluminium supplier in 1.9 m wide by up to 10 m long sections. These large sections incorporate close spacing of stiffeners to minimise plate weight. The superstructure is isolated from the main hull on a rafted resiliently-mounted deck. While this helps to reduce global loading of the superstructure, it also required special analysis of the mount arrangement.

Following the high-speed grounding of a large Incat-designed catamaran some years back, a double-bottom has been built into the hulls extending forward of the engine room up to the collision bulkheads. In addition, the stems and the forward quarter length of the hulls have been strengthened with 20 mm plate and half-spaced sub-frames to cope with the potential problem of impact with floating logs.

The hinged bow and stern ramps are fitted to reduce the length of overhangs which would otherwise be necessary to match the terminal facilities and to provide the weathertight seal necessary for the operation of the water fog system. The hinged ramps are designed for sustaining the combination of berthing loads, passenger coaches, B-train fuel trucks and sea pressures associated with slamming. This has consequently resulted in a very complex and robust structure. The bow ramp alone is 12 metres by 20 metres by 2 metres. It is as large as the hull of a 150-passenger ferry but much more strongly built. Because of its size, global strength considerations are an important factor in the design of this vessel. As well as the usual longitudinal bending analysis, the global analysis has investigated the special torsional, transverse and shear loadings applicable to a craft of catamaran configuration.

The Pacificat is primarily fabricated from 5383-H321 and 6082-T6 series aluminium alloys. The project was among the first to use 5383-H321 alloy with its improved welded condition strength. Extrusions are of 6082-T6 and 6061-T6 alloy.

Primary Structural Design

The structural design of this vessel has been an iterative process balancing the needs of the client, the demands of the service, the weight and performance of the vessel, the cost of construction, reliability and requirements of the classification society. Because of the need to operate at high speed economically, the analysis of the structure has been rigorous in an attempt to optimise the scantlings wherever practicable.

The structure was refined through direct strength calculations using a computer frame analysis program, in order to verify and optimise the scantlings. These programs model the interaction of the various structural members and loadings on such complex 2D & 3D structures based on actual geometry. The vessel has been designed in accordance with the DNV HSLC Rules and Classification Notes, as modified as a result of experience gained from the tank testing program and from the Fastsea computer hydrodynamic analysis.

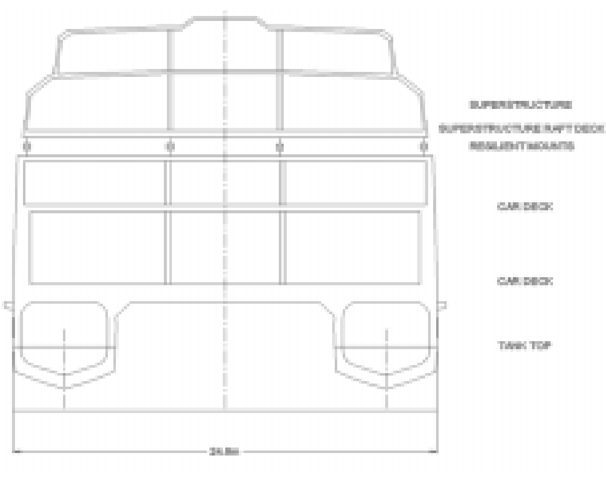

Figure 2 - Simplified midship section.

Global Analysis

A full 3D finite element model of the vessel was developed for analysis of the global stresses having 9314 grid points and 18419 elements. The global finite element analysis was carried out in accordance with the DNV Finite Element Modeling Guidelines. The load cases studied included:

- Split moment load case.
- Crest landing load case at design speed.
- Sagging moment load case at survival speed.
- Pitch connection moment load case.

These load cases were investigated individually and in combination with each other. Adjustments to the scantlings were made as a result of analysis, allowing further reductions in weight to be made.

Shell and Deck Penetrations

The vessel has been designed to minimise the number of penetrations through important structural members. However, some penetrations are unavoidable. Among these are:

- stairway and exhaust penetrations through the accommodation support deck;
- engine room and vehicle deck ventilation penetrations;
- passenger elevator shaft;
- freeing ports;
- bunkering and ventilation openings in the side shell; and
- hatchway and exhaust penetrations through the main vehicle deck.

Because the structure has been optimised, penetrations through major structural members must be closely analysed to determine the effect on local stresses. The penetrations act as stress raisers: the magnitude of the stress increases depending on the geometry of the opening and the provision for compensation if any. Starting with the worst case free field stress for the particular location determined from the FEA, a corner stress was determined for each location using an applicable stress concentration factor which is based upon the shape and size of the opening. Values for stress concentration factors applicable for openings of varying geometry were determined in accordance with guidelines provided by DNV. In cases where the stress magnitude was excessive the penetration was modified by changing the corner geometry and/or adding reinforcement. The reinforcement may be insert plates of increased thickness or a rider bar or in some situations both. Where changes were made, the penetration was again analysed to ensure that the corner stress was within acceptable limits.

Superstructure Design

The superstructure is resiliently supported on rubber mounts in order to reduce noise and vibration emanating from the hull and machinery beneath. An independent evaluation carried out by DNV confirmed the effectiveness of the isolation mounts in reducing noise in the accommodation spaces. The rafted superstructure also has the advantage that it helps detach the relatively light passenger accommodation structure from the hull, avoiding the large stresses that would otherwise arise from the global deflections.

In order to model the structure taking into account the complex interrelationships between the various mounts of varying stiffness and location, the distribution of weights in the superstructure and the behaviour of the structure, it was necessary to analyse the raft structure using 3D frame analysis methods.

SELECTED DESIGN COMPONENTS

The following items have been discussed as interesting examples of the more specific analysis that was required on many aspects of the vessel's overall design.

Bow and Stern Ramp Design

The bow and stern ramps are large structures subject to a variety of loads including those from berthing, slamming and vehicles. While normally in the raised position the ramps are lowered prior to docking. Their wedge shape locates the vessel between the terminal wing walls in order to receive the shore-based ramps and aprons. Hence the ramps, hinges and actuating linkages are liable to be subjected to high impact loads. The design speed for berthing is in the range of two to three knots. The bow ramp in particular is also subject to high potential slamming loads.

The bow ramp has been analysed using a finite element model and a 3D-frame analysis model. Each of the three load cases has been modeled and the resultant stresses determined. The hinges, locking pins and actuating linkages have been designed taking into account the reaction loads applicable from each load case.

Global Fatigue Analysis

The fatigue analysis is based upon stresses obtained from the global FEM model. The areas of highest stress were isolated and the individual components further analysed. The magnitude of the stress reversal is determined together with its probability of occurrence. The fatigue calculations for welded aluminium details have been based on the ECCS: European Recommendations for Aluminium Alloy Structures Fatigue Design. The analysis takes into account the nature of the detail and the number of cycles likely over the lifetime of the vessel. DNV have indicated that 1×10^{7} cycles is appropriate for high-speed craft with an expected vessel lifetime of twenty years.

Significant areas analysed for fatigue include plate butts in the keel and accommodation support decks (these being hull girder extreme fibres), side shell and deck openings, longitudinal bridging deck bulkhead butts, portal connections, tank-top connections and bracket connections to longitudinals.

Waterjet Room and Transom Flange Design

A detailed FEA model has been made of the jet room structure including the waterjet intakes. The model provides a global analysis of the stern area to analyse the effect of waterjets when steering, in crash stops and continued high power operation. A natural frequency investigation has also been carried out to ensure vibrations due to resonance are avoided. A modal investigation of the "as–built" structure has also been completed to verify the earlier analyses and provide valuable data for future designs. The loads used for the jet room investigation and estimates for the number of loading cycles have been provided by the jet supplier, KaMeWa. These have been verified against estimates determined in-house by Incat Designs.

The transom flange has also been modeled using the FEA, based upon loads and cycles determined by KaMeWa.

Its chief purpose is to analyse the fatigue characteristics of this component, based on a study of the flange's structural behaviour under axisymmetric loading. The fatigue analysis of the transom flange has been carried out assuming a minimum fatigue life of at least twenty years.

WEIGHT CONTROL

Effective weight minimisation is critical to the success of any high-speed vessel. This has proven to be a major challenge for all players in the design and construction of the Pacificat, due in part to the complete absence of a high-speed craft industry in Canada, and the strong objective of maximising the local content during the build program. It was immediately apparent that the weight budget could not be achieved by conventional shipbuilding methods and materials. To achieve the weight targets, it was useful to break down the lightship weight into the various major components as shown in Table 1.

DESCRIPTION	PORTION OF TOTAL WEIGHT
Structure	66
Accommodation Outfit	10
Deck Machinery	1
Propulsion Machinery	13
Electrical	3
Piping Systems	3
HVAC and Plumbing	2
Control, Communication & Navigation	1
Contingency	1

Table 1 Lightship Weight Components

Structure, consisting of the alloy and steel components in the vessel, is the major lightship weight group, and thus an obvious target for weight minimisation. Structural optimisation and the use of finite element analysis has allowed a minimum practical weight to be achieved. It must be remembered that the structure is designed to a maximum displacement. Should this design displacement increase, then not only does the structural weight increase to carry the additional weight, but the propulsive power must increase, requiring additional fuel, and soon the whole design can spiral to impractical limits. Thus, every item in the vessel became a target in the effort to prune weights to the minimum possible.

Robert Allan Ltd was tasked with the design of the complete machinery, auxiliary systems, electrical and the outfitting aspects of the ferries. At the earliest stage of the design, RAL determined the present value of the through-life cost of each additional kilogram of weight to be $75. This value assisted in establishing those items where additional initial cost for a lighter solution was warranted.

The second major weight item is the propulsion machinery. As the weight of the machinery is significant, it also contributes to the vessel's resistance, and thus the total fuel required to meet the 18 hours per day operational profile. Auxiliary systems for various machinery options were also significantly different, so machinery proponents were requested to submit bids including not only main machinery, but also the starting system, fuel system and fuel, lube oil, ventilation and exhaust systems. All bids were requested to be made on the basis of through-life costs, with penalties applied if the final weights were in excess of those bid. The proposals received are set out in Table 2.

Not surprisingly, the gas turbine bids gave the lowest total weight, but their initial costs, operating cost (including fuel) and maintenance costs for this project were all higher than the diesel engine offers. In the end, the MTU engine was the only engine proposed with sufficient power, minimal through-life costs and a proven track record at the time. Of course it was not possible to win on every system, and some weight increases became apparent during the design phase. These occurred for a variety of reasons, a contributing cause being the lack of local products meeting the strict requirements of the various marine rules for fire safety and toxicity. However, there were also many successes with local industry as Table 3 indicates.

Engine Type & rpm	Quantity per ship	Rated Power	System Weight (tonnes)	Fuel Component (tonnes)
Turbine	2	25 MW	136	74
Turbine	2	25 MW	160	75
20V @1300 (MTU)	4	26 MW	232	60
20V @ 1000	4	27.5 MW	250	62
4x12 + 2x16	6	27.1 MW	275	57.8
2x12 + 4x16	6	29.8 MW	285	58.3
4x12 + 2x16	6	27.5 MW	294	59.1

Table 2 Summary of Machinery Proposals

Description	Weight Saving
Elec – 600V system	1 tonne
Elec – cable installation	3 tonnes
Elec – thin walled high temp military cables	3 tonnes
Structural Fire Protection	18 tonnes
Shafting	5 tonnes
Bilge pumping	3 tonnes
Manuals and operating instructions	1 tonne

Table 3 Summary of Weight Savings

Of the total electrical weight budget, the cables are by far the heaviest component. Had we utilised the conventional North American bronze braid armoured marine cables, the cable weight would have approached 70 tonnes. Even so, the weight estimates indicated a cable weight of the order of twenty tonnes would be required. A number of weight reduction measures were taken including the following:

- A 600 volt system was chosen with local transformers reducing voltage at the location required. This saved approximately 1 tonne over a 480 or 230 volt system, including the weight of the transformers.
- The use of high temperature military cables, which have been used successfully for many years by the military, but not very much in commercial vessels, saved 3 tonnes.
- A further 3 tonnes saving was identified by carefully considering the installation, in terms of minimising the number of major cable routes, reducing their length, and using aluminium cable hangers with phenolic cross ties.

Structural Fire Protection (SFP) is required in many areas of the ship, in order to maintain the structural properties of the aluminium and prevent heat transfer across boundaries when in contact with a fire. Initially the SFP system by Colbeck and Gunton in Australia was proposed, weighing 8.5 kg/m^2 at that time. Proposals were received from Europe including Blohm and Voss, who were able to reduce the weight to 4.8 kg/m^2. Finally, Josco Industries, a local Canadian company, were chosen, using a system adapted from an industrial insulation system which weighed 4.7 kg/m^2 on bulkheads and 3.8 kg/m^2 for deckheads. This resulted in a saving of 18 tonnes.

Shafting weights were minimised by adopting a machinery arrangement with the gearboxes in the jet room, immediately in front of the waterjets, This allowed the high-speed low-torque shafts to be run for the greater length of the shafting. With this arrangement, conventional steel shafting would have weighed 7 tonnes per shipset. A reduction to 4 tonnes was achieved through the use of hollow steel shafts. Composite shafting permitted real savings to be made, both by reducing shaft weight and reducing the number of bearings — the longest shaft span between bearings is 8.4 m. The entire shafting system, including bearings, was reduced to less than 2 tonnes.

Bilge pumping was another interesting case. By deleting the conventional bilge main system and manifold, and replacing it with individual pumps in every compartment with overboard discharge, the total bilge system was reduced to approximately 300 kg (about the weight of the conventional manifolds alone).

The conventional vessels servicing the Horseshoe Bay – Nanaimo route have over 1 tonne of manuals and documentation on board. This has been deleted on the Pacificat by using an integrated computer management system, which contains all manuals and operating instructions in electronic format, not only saving weight but facilitating rapid access to information. These and many other weight savings were investigated and implemented where appropriate to ensure the vessel would meet the technical and performance requirements identified at the outset of the design and build program.

The Construction Challenge

At the outset of the project, it was anticipated that construction of the BC Ferries' catamarans would take place at one of the existing shipyards within British Columbia. However, it became increasingly difficult to find a lead yard that would take on such a large project, although many wished to participate in a smaller capacity. In an effort to overcome this challenge, BC Ferries in 1996 established Catamaran Ferries International (CFI), a wholly owned subsidiary, to build the ferries.

CFI became responsible for detailed engineering work, project management and planning, purchasing, quality assurance and control, production and marketing. It had been decided at a reasonably early stage of the project to follow the modular construction philosophy (similar to Finnyards who had at the time gained extensive experience with the Stena HSS vessel). Modular construction allowed the aluminium fabrication to be broken down into smaller parts, thus allowing multiple shipyards to undertake construction. As part of the management process, CFI sub-contracted six existing shipyards to undertake construction of various modules and final assembly, as shown in Figure 3.

It is significant that these shipyards were originally competitors, and part of the CFI challenge was to turn this historical outlook around into a functional team effort to produce an integrated ship between all builders. Apart from the modular construction challenge involving multiple subcontractors, CFI faced three other major challenges where the project was significantly different from conventional shipbuilding. These challenges were:

- The IMO High Speed Craft (HSC) Code, and DNV High Speed Light Craft (HSLC) Rules;
- Use of aluminium; and
- Use of lightweight materials and equipment.

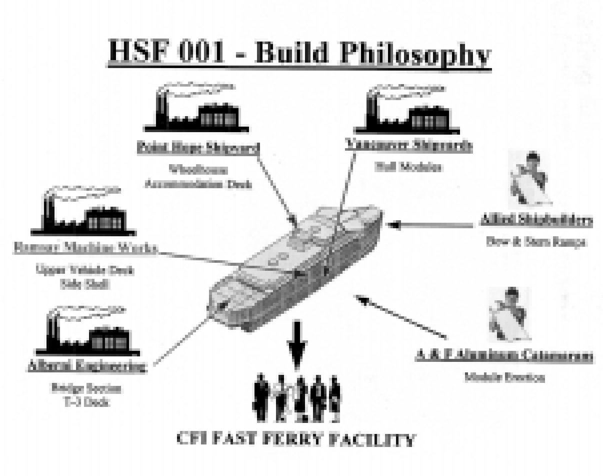

Figure 3 - CFI contractor philosophy.

The HSLC Rule Challenges

DNV has adopted aspects of the IMO HSC Code in the development of their HSLC rules. Transport Canada's Marine Safety Branch also adopted the IMO HSC Code as the governing document to determine safety standards for the Pacificat. The challenges facing fabricators were building within the DNV acceptance criteria for alignment of welded joints (more difficult when utilising modular construction), weld quality and welder qualification. The challenges for suppliers of equipment was to meet all the requirements under these rules, including provision of material certificates for many items used in the construction of the vessels.

Use of Aluminium

Due to the conventional nature of the shipbuilding industry in British Columbia at the time, the use of a new material in itself created a learning curve that contained a number of challenges. The material characteristics of aluminium are markedly different from steel, with shrinkage and sensitivity to impurities during welding being major differences. Inspection criteria and storage and handling were also completely different from what the industry was used to. The utilisation of specifically-designed interlocking extrusions also presented some challenges during the early stages.

Some of these challenges could be met by improvements over time, leading to greater productivity towards the end of the first vessel and certainly on the second vessel currently under construction. However, some did not have any allowance for a learning curve, for example material certification, welder qualification and inspection requirements were fully applied from day one of construction. As a result of the learning curves and mutual co-operation between yards, the CFI Sub-Contractors are now producing welding statistics that are equal to world's best practice.

Use of Lightweight Material

To meet the weight budgets, Incat Designs and RAL had specified many lightweight items in the construction and fit-out of the vessels. This presented a number of challenges to CFI, both in terms of locating local manufacturers where possible, and sourcing items with the necessary DNV and Transport Canada certificates.

In addition to these restrictions, CFI also implemented a number of weight saving measures in areas such as equipment enclosures, paint, piping supports and thermal insulation. Meeting the lightweight requirements of the project required CFI to work with local suppliers, assisting them to upgrade their capabilities to suit a fast ferry industry.

Figure 4 - The launching of *Pacificat*.

Conclusion

The Pacificat has been an exciting but challenging project for BC Ferries, Incat Designs, Robert Allan Ltd and the various shipyards in British Columbia. The successes enjoyed have been all the richer for the challenges involved. The other significant outcome of the project is the revitalisation of the shipbuilding industry on the Canadian west coast, embracing and establishing new technology. The co-operation between what were previously competing yards, and the establishment of a range of local support industries have laid the foundation for future growth and development into the world market.

Acknowledgements

The author gratefully acknowledges the assistance and contributions provided by Chris Da Roza and Peter Goss of Incat Designs, Robert Allan and Ken Harford of Robert Allan Ltd, Tom Ward of BC Ferries and Eamonn Deegan of Catamaran Ferries International.

Changing Bookmark Titles

When you make a bookmark for a good site on the web, the title which shows up may not seem to you to be an accurate description. You can change the description in Netscape (Navigator or Communicator) by clicking on Window, Bookmarks (or simply pressing Ctrl-B in lieu of these two clicks). Then click on the title which you wish to change, click Item, Properties, and then edit the Name, and click OK.

Internet Public Library

There are many excellent reference sites on the web, but there are also plenty of poor ones. Sorting the good from the bad would be a time-consuming task, so it's lucky that someone else has volunteered for the chore. A group of librarians has set up the Internet Public Library, a collection of online references, rated, sorted and described at `www.ipl.org`.

Australian Ship Repairers' Group

The Australian Ship Repairers' Group has a web-site which details the status of the industry, the history, aims and objectives of the association, standard terms and conditions of vessel slipping and/or repair, and detailed entries for association members. The website is at `www.asrg.asn.au`. Further information can be obtained from Geoff Mitchell (02) 6273 6555 or e-mail `geoffmitchell@asrg.org.au`.

Vessel Equipment and Fish Information

C.H. Smith Marine and the Melbourne Fish Market, in a collaborative effort, have provided integrated websites making the click of a mouse button all that is needed to switch between the two. Both sites are catalogues of sorts; Smith's of fishing vessel equipment, and the Market's of, naturally, fish. For those who need information on all sorts of fishing and other vessel equipment (like anchors, radios, etc.), including details and prices, C.H. Smith's catalogue is available online. The Fish Market's site provides detailed information on fish species including colour images, scientific and common names, market trading information, and even recipes. The site can be found at `www.chsmith.com.au`.

Resumes

Producing a resume is an art-form in which everyone ought to be skilled, and can be with the help of `www.provenresumes.com`. The site, which is adapted from a series of books on the subject, includes tips on writing a polished resume and cover letter. It also deals with electronic resumes, which are becoming common.

Freeware

You may be familiar with some of the quality shareware sites on the web, but good freeware sites are thin on the ground. One worth visiting is `www.freewarenow.com.`

Bookshops

There are many bookshops with sites on the web, including Dymocks at `www.dymocks.com.au`, and Angus and Robertson at `www.angusrobertson.com.au`. A good one is the self-styled "Earth's Biggest Bookstore" at `www.amazon.com`. This site has over 3 million titles indexed, and all can be ordered online. A real bonus is that, in addition to books in print, they index books which are no longer in print and may be hard to find, and will also accept orders for these books online. Amazon has a secure server, but it may be safer to phone through your credit card details when establishing an account.

Phil Helmore

WESTRALIA REPORT

On the morning of 5 May 1998, the RAN replenishment tanker HMAS *Westralia* left Fleet Base West at Garden Island, Western Australia, bound for the Western Australian exercise area and then northern waters with other fleet units. *Westralia* was built by Cammell Laird as the *Hudson Cavalier*, but was completed in 1979 for RFA service as *Appleleaf*. She is 171 metres long, 26 metres in beam and has a full load displacement of 40,800 tons. The ship was leased to the RAN in 1989 for five years, and purchased outright in 1994. *Westralia* was built to the requirements of Lloyd's Register, and is still classed by them. She is propelled by two SEMT Pielstick 14 PC2.2V diesel engines driving one shaft. Soon after sailing on 5 May, at about 1030, a fuel leak was seen on the port main engine. Action was taken to shut down the port main engine and to fix the leak, but about four minutes later, another leak was seen on the starboard main engine. Almost immediately a major fire broke out on the starboard side of the engine room. The fire was extinguished about two hours later and the ship was saved. Four lives were lost in the fire.

A Board of Inquiry into the accident was convened by the Maritime Commander Australia. The President of the Board was Commodore Richard Lamacraft RAN, and hearings began on 11 May 1998. After evidence from 93 witnesses the Board completed its hearings on 17 July. The report was completed on 28 August 1998.

In its report, the Board found that: *"The fire in HMAS* Westralia *on 5 May 1998 was caused by diesel fuel from a burst flexible hose spraying onto a hot engine component and then igniting. The hose was one of a number of new flexible hoses supplied by the ship's support contractor, ADI Limited, to replace the original rigid pipes. In the Board's view, the hoses were not properly designed and were unfit for the intended purpose. A change of this type should have been processed through the RAN configuration change process as well as being approved by the ship's classification society, Lloyds Register. Both processes were bypassed..."*

The Board made 114 recommendations, many of which relate to RAN training and operating procedures. A number are relevant to any organisation involved in the maintenance of RAN ships, for the report identifies shortcomings in the management of work packages, configuration management, staff training and quality control. The recommendations include:

- A firm reminder of the importance of a disciplined approach to configuration management to the RAN community should be issued and reinforced on a regular basis.
- A technical review of work packages by a competent professional engineering authority should be introduced as part of the procedure for authorising work
- A review of the RAN configuration management process in the light of shortcomings revealed to this Inquiry and the recent organisational changes such as Class Logistic Offices and Refit Planning Logistic Support Services (RPLSS) contractors should be conducted. The review should include an assessment of the level of expertise available in the RPLSS offices.
- RAN contract managers and ship's staff should thoroughly check work instructions to ensure that all requirements are accurately specified and the appropriate level of QA checks are included.
- Work should not be accepted until all QA requirements have been met, including the provision of the appropriate documentation.
- RAN contract managers should insist on receiving all appropriate quality documentation (including test certificates and opening/closing reports) and check them for accuracy and completeness prior to approving payment.
- Defence should re-examine the policy of quality accreditation for companies engaged in Defence work with a view to contracting the accrediting organisations to work on Defence's behalf.

There are many things in the body of the report that will be of interest to people engaged in the design, construction and maintenance of ships. Many remind us of design detail requirements that should be well known or understood. For example, when power was isolated from the main switchboard shortly after the fire began, and the emergency source of electrical power started, normal radio communications were lost. The emergency supply to the radios was through the emergency switchboard and there was no transitory power supply. Power spikes made the radios inoperative and the Comcentre had to be abandoned because of smoke drawn into the air conditioning. This resulted in the extraordinary situation where an emergency in a major unit of the RAN had to be notified by mobile telephone! The report can be found on the internet at `www.navy.gov.au`.

SOME MARINE CASUALTIES EXERCISES IN FORENSIC NAVAL ARCHITECTURE (PART 2)

by

Robert J Herd

5 Foundering of MV *Noongah*

Noongah and her sister *Nilpena* were built on the Clyde by James Lamont and Co. The *Noongah*, which was completed in 1955, was a raised quarter deck coaster, 230 feet long BP, 37 feet wide with depth to the main deck of 15 feet 9 inches and to the raised quarterdeck of 19 feet 9 inches. The assigned summer freeboard was 4 feet 9 ½ inches.

A winch platform was located at the break. Two holds were provided, No.1 forward of the winch platform and No.2 abaft it.

Experience with the vessels in service on the Australian coast indicated that they pounded badly when light. A deep tank subdivided into port and starboard tanks was installed at the after end of No.1 hold.

Noongah traded on the Australian coast and from early August 1969 till she foundered on the morning of 25 August 1969 was engaged in the carriage of steel products from Newcastle and Port Kembla to Townsville.

Noongah sailed from Newcastle for Townsville on its final voyage at about 11.15 am on Saturday 23 August. The crew numbered 26 of whom only five survived the foundering: the Second Engineer, the Third Engineer, a greaser, a seaman and a steward.

As far as could be ascertained the cargo of steel was distributed with about 657 tons in No. 1 hold and 815 tons in No. 2 hold. Freeboard on departure was 4 feet 10 inches against the assigned value of 4 feet 9 ½ inches. The draughts were 14 feet forward, 16 feet aft and 15 feet mean.

After leaving Newcastle, the weather deteriorated. On Sunday morning breathing pipes were plugged, sounding caps and hold doors were checked for tightness. Hold bilges were pumped. The result is not known.

In the afternoon speed was reduced due to the wind and sea conditions on the starboard bow being experienced.

In the early evening two crew members detected a slight starboard list, though the Second Engineer coming on watch at 8 pm did not observe this. The Third Engineer who came on watch at midnight noticed a starboard list. The Master was on the bridge from 8 pm till about 12.15 am when he was relieved by the Second Officer. The Third Engineer found that Nos. 1, 2 and 3 double-bottom tanks were dry when he came on watch at midnight.

The degree of list at midnight, though noticeable, was apparently not such as to cause any concern. Between 2 am and 2.30 am it was observed that the list had increased significantly causing fluctuations in the main engine oil pressure which resulted in further attempts to correct the list. The starboard double-bottom tanks were checked again and found dry.

At about 2.30 am, inspection by Aldis lamp showed considerable volumes of water on the fore deck. *Noongah* had solid bulwarks and freeing ports in accordance with the 1930 Load Line Convention requirements. It also had an open forecastle. At the break of the raised quarterdeck the distance from the upper deck to the water was only 14 inches.

Once the vessel started to trim heavily by the head, the water trapped between the upper deck bulwarks and the hatch cover would not escape. Additionally, once water collected in the open forecastle it had no avenue for escape. One wonders whether the Second Mate’s considerable experience in tanker operation clouded his reactions to the water collecting on deck.

At about 3.15 am the Second Engineer was called to the engine room. The starboard double-bottom tanks were checked and found dry. The situation of the ship was causing considerable alarm. At about 3.30 am the surviving greaser was called to the engine room. He had difficulty leaving his bunk because of the list. He was instructed to clean the filters of the oily bilge pump.

Some conflict of appreciation of the ship's attitude in the water arose about this time. The engineer had to sit down to remove the main engine No. 2 crankcase doors. The Second Engineer stated that the oil was high forward and coming out the crank case breathers. The Second Engineer described the oil surface as he saw it with the vessel trimmed and listed, as being clear of the oil return pipe in the after port corner of the engine crank case. From a drawing of the engine it was evident that in addition to a severe trim by the head, the vessel was heeled at least 30°.

Because of failure of the oil pressure the engine was stopped at 3.40 am and the vessel lost way about 3.45 am.

Action was taken by filling No. 3 port double-bottom and pumping out the starboard deep tank to improve the ship's attitude.

Checks on No. 1 starboard bilge indicated the presence of water.

At 3.52 am a signal was sent indicating a starboard list of 15° increasing, and unable to be corrected.

At 4.37 am a signal was sent indicating that the ship was being abandoned. At about 4.40 am the ship went down by the head with a wall of water coming over the bridge.

The judge found conflict between the naval architects' opinion that the list was 30° at 3.45 am and the Master's signal of 3.52 am that the list was only 15°. He was of the view that the difference between the two was so significant that there could be no misunderstanding. The former figure was based, as stated above, on the engineer's evidence of the level of the oil just prior to the engine being shut down when viewed against the engine arrangement as shown on the plans. It is agreed that a heel of 30° is significantly greater than one of 15°. As the Master did not survive it was not possible to establish the basis for his estimate.

For reasons which could not be established, the starboard lifeboat was jammed and could not be launched. Two survivors escaped by life raft, one in each and three were rescued when clinging to a plank.

In order to cause the vessel to founder a mass of water in excess of 500 tons was required. Based on the attitude of the vessel at about 3.45 am some 350 to 400 tons of water were in the vessel. If some significant event took place some five hours before the loss then the rate of inflow must have been of the order of 80 tons per hour.

By comparison a missing one-inch rivet some nine feet below the water line could admit water at the rate of some 8 tons per hour.

Where did the water come from? Seven possible points of entry were canvassed, but none suggested itself as being the more likely:

1. Rupture of the ship's deck.
2. Rupture of the air pipe to No. 1 double-bottom tank.
3. Breaching of sounding pipes.
4. Breaching of ventilator trunks.
5. Entry though hold access door.
6. Breaching of the hatches.
7. Rupture of the ship's side.

The cause of this most unfortunate loss remains a perplexing mystery.

6 *Sedco Helen* Foundering

Sister vessels *Sedco Helen* and *Sedco Ann* were designed by Eken and Doherty as oil rig supply vessels to the order of Sedco Incorporated of Dallas, Texas.

Sedco Helen's main functions at the time of loss were stated to be:

1. To assist in the supply of men, equipment and material from Darwin to the oil rig *Sedco 135G* engaged in drilling in the continental shelf.
2. To tow the oil rig from location to location.
3. To carry and place anchors on the sea bed and marker buoys attached thereto.
4. To raise such anchors and move them.
5. To act as a drilling agent.
6. To supply bulk cement to the oil rig from a cement compartment on the vessel.

The principal characteristics of the vessel were:

Length overall	200 feet 1-1/8 inches
Beam overall	40 feet 0 inches
Maximum load draft	14 feet 4 inches
Displacement	1680 tons
Power	2 GM 12 cylinder engines, 4300 BHP total at 900 RPM.
Propellers	2 SMM CP propellers
Rudders	2
Speed (maximum)	13 – 14 knots
Equipment	125 ton work winch
	40 ton towing winch
	25 ton travelling deck crane
	10 ton cargo derrick

Sedco Helen was built at Carrington Slipways Pty Ltd, Newcastle.

The oil rig *Sedco 135G* was of triangular plan form with three anchors laid from each corner. In August 1969 *Sedco 135G* struck a pocket of natural gas while drilling in some 300 feet of water. The gas was accidentally ignited at the surface, damaging the rig badly, necessitating towage to Singapore for repairs.

As built, *Sedco Helen* and *Sedco Ann* had a concavity in the stern plating at the after part of their hulls. Both vessels had experienced severe vibration in the stern and it was decided to modify the underside of the stern from a concave to a convex shape. This work together with other repairs was carried out in Singapore in late 1969.

After the work on *Sedco Ann* was completed she was involved in an incident in Singapore Harbour which had considerable significance for the fate of *Sedco Helen* though this was not appreciated at the time.

The arrangement of compartments from aft was:

Pitch control and steering compartment
Cement space
Engine room

The bulkheads separating these compartments were each penetrated by a hinged watertight door, fitted with dogs and a rubber gasket, which folded back against the after side of the bulkhead, where it was clipped in place.

The bulkhead between the engine room and the cement space was pierced above the watertight door by an air vent. To isolate the cement space in an emergency such as fire or collision, a valve was fitted on the engine room side, operable by T-wrench from the working deck above. The T-wrench was clipped to adjacent structure.

Each propeller was provided with a propeller guard to shield it against contact with foreign objects. The propeller guard was in the form of a bent Y shape with the leg horizontal and the arms vertical. The guard was welded to doubling plates which in turn were welded to the shell. The doubling plates were of ½ inch thick plate 36 inches x 10 inches for the lower leg and 20 inches x 10 inches for the two arms. The guards were designed to break from the doublers in the event of severe contact, leaving the shell intact, otherwise if the guards broke away they could damage the hull.

When *Sedco Ann* was on trials she hit a coral reef with considerable hull damage. On one side the propeller guard came off the doubling plate, but on the other side the doubling plate was pulled loose, fracturing the skeg plating and producing a triangular hole 12 inches x 6 inches.

The two watertight doors were closed but the pitch compartment filled in half an hour. The vessel remained afloat. With either of the cement space or pitch control compartment flooded the vessel could stay afloat. With both spaces flooded the water line would cross the deck and survival would depend on the condition of loading. With all three compartments flooded the vessel could stay afloat under certain conditions of loading but generally the vessel would be lost.

On its return from Singapore, the tug *Rude Zee* pulled the rig into position while *Sedco Helen* dropped No. 8 fifteen ton anchor to be used as a brake till the other anchors were dropped, some few days prior to 31 January 1970.

The test load on the fifteen ton anchors was in excess of 500,000 pounds. Attached to the anchor crown eye was a 2 ½ inch diameter anchor pendant with a breaking strength in excess of one million pounds. The mooring buoys were of ¼ inch steel plate, cylindrical in form, 9 feet long and 6 feet diameter, filled with polythene foam and fitted with ribs on the outside surface for protection against chafing. The weight of a buoy was about 2 tons. Through the centre of the buoy was a pipe fitted with a heavy pad-eye at both ends. The lower pad-eye was connected to the anchor pendant while the upper pad-eye was for use in towing the rig. The top pad-eye projected approximately 21 inches above the buoy and was pierced at right angles by a bar about 2 inches in diameter with its axis parallel to that of the buoy. The whole was designed to withstand a 100 tons pull through the centre of the buoy when towing.

When the mooring was completed in the afternoon of 31 January 1970, buoy No. 8 was the only one that was not visible. There was either some tangle in the pendant or the buoy had been dropped in a hole. Opinions as to the distance from the surface to the top of the buoy varied from about 6 feet to about 10 feet. It was decided to raise the buoy and anchor to clear or lengthen the pendant and reposition it.

The inquiry was told that none of the persons involved had any experience of raising a submerged buoy with its anchor pendant and anchor.

It was decided to use a loop of 5/8 inch wire to lasso the buoy and secure it to the stern while a 2 inch wire was secured to the buoy so that the winch could hoist the buoy, pendant and anchor onto the deck. As the 2 inch wire weighed 10 pounds per running foot it was agreed that this was too heavy to be taken in a small boat to lasso the buoy directly.

The plan of action adopted by the Master called for *Sedco Helen* to back up against the wind, tide and current which meant that the ship travelled in a westerly direction. This also meant that the master had the sun in his eyes. Initially he could see the buoy in the water, but the Acting Marine Superintendent and others were standing at the ship's stern to give directions to the Master and carry out the operation.

In anchor operations, the mate was normally in control but he was off watch till 7 pm. The Acting Marine Superintendent had no marine experience or qualifications, but was experienced in drilling operations.

The engine room could be unmanned for a period up to 14 hours. The Chief Engineer was on deck preparing to operate the heavy winch. The Second Engineer was off watch and probably in his cabin.

Signals were conveyed to the Master by the Acting Marine Superintendent, sometimes directly and sometimes through a crewman on deck amidships.

With the vessel backing up at a speed of ¼ to ½ knot with corrections for wind and tide, the stern was brought to the buoy and an unsuccessful attempt at lassooing the buoy made with the 5/8 inch wire. More maneuvering resulted in the buoy disappearing under the stern, lost to sight of those standing on the after deck. Knocking or bumping noises were heard on the ship's bottom, but these were no worse than normally heard when the ship contacted a buoy. The buoy was not visible either aft or to port or starboard. The Master was signalled to give a short burst on the engines and then stop. The buoy did not appear. A further signal for more power was made. As the ship surged ahead the buoy appeared on the starboard side, breaking the surface as it did so. In the words of the Master "the buoy went out of the water, she was visible and she went 'boom'."

The buoy was now off to port and the Master tried to bring the stern to port by starboarding the helm, half ahead port, half astern starboard, but the ship did not move.

The engines were still running, the helm was hard-a-starboard, the rudder was amidships, the steering gear pump control lamps were lit, but all other pump control lamps of the main engines were out. The Master's attempt to come away from the buoy was unsuccessful and he realised he had a blackout.

The Acting Marine Superintendent went to the bridge and observed that the main engines instead of going half ahead were going full astern. The Master and the Superintendent de-clutched the main engines. Though the ship had a hand hydraulic steering system, this was not tried because of the blackout. The Chief Engineer was sent below to the engine room to investigate, accompanied by the electrician. They reported that there was already water in the engine room, confirmed by the attitude of the vessel down by the stern. The water was about 18 inches deep over the door sill, flowing from the cement space to the engine room, but had not risen sufficiently to cover the engine room plates.

The Superintendent took a party of three to help him close the cement room door. In the meantime the Master told the Chief Engineer to abandon the engine room and to stop the main engines. The Superintendent met the Chief Engineer leaving the engine room and asked him to try the ballast pumps.

The pitch control compartment door was too deep in water to attempt to close it. The cement room door was unclipped and closed, but with the dogs in the wrong position. Because of the pressure the door seals were nearly complete though water was spraying round the perimeter of the door. Water commenced to flow through the valve in the air trunk despite efforts by the crew on deck to close it with the T-wrench. At some stage the Second Engineer was observed in the vicinity of the engine room. When the vessel subsequently capsized, all three engine room personnel were still engaged in their activities in the engine room.

The Master radioed the *Rude Zee* for assistance and gave the general alarm on the whistle. This sounded for 1½ minutes and then stopped. Crew members were sent into the accommodation to warn others that the ship was sinking, but both the bearers and recipients of the message found it hard to believe that a ship of such strength and power was sinking.

The ship sank about 6.50 to 6.55 pm. There were 20 persons aboard during the day, 4 officers, 6 crew and 10 rig personnel. Of these the 2 engineers and 2 crew from *Sedco Helen* and 5 of the rig party were lost. It was estimated that from the time the buoy disappeared under the stern till the sinking 10 minutes elapsed and from the closing of the watertight door to the sinking 5 minutes elapsed.

A problem which concerned the court throughout the inquiry was whether there were signs on the two watertight doors, either painted or on Traffolite panels, requiring the doors to be kept closed at sea at all times other than when passage was required. Additionally, had instructions been given to the engineers in this regard? While a check was made on the situation in *Sedco Ann*, the question for *Sedco Helen* was never resolved, it being suggested that the Master had given oral instruction but on his engine room visits had not policed it. Had even one of the doors been closed, it is likely that *Sedco Helen* could have survived.

Why did she sink? The most likely explanation, which the Court accepted, could not be checked by divers because the stern was buried in mud. In order to lift the buoy, pendant and anchor so that a buoy some 6–10 feet under the surface will break the surface with a "boom" requires a degree of force.

It is considered that when the buoy disappeared under the stern the horizontal leg of the starboard propeller guard became lodged between the 2 inch bar and the top of the buoy. When the ship surged ahead the buoy was pulled by the guard until the guard came away with its doubling plate and a section of shell. On release the buoy sprang back and broke the surface. Having regard to the time involved an area of shell equivalent to 16 inches x 16 inches would need to be open to the sea.

It was felt that during the stay in Singapore the doubling pads had been firmly welded both to the shell and to the guard – remembering that on arrival in Singapore, both guards were missing. No confirmation of this fact could be obtained from Singapore.

References

5. C.M.I. Report No. 151, Court of Marine Inquiry under Section 364 as to the circumstance of the Foundering of the Motor Vessel *Noongah* off Nambucca Heads, New South Wales, on 25 August 1969.

6. C.M.I. Report No.152, Court of Marine Inquiry under Section 364 as to the circumstances of the foundering of the motor vessel *Sedco Helen* in the Joseph Bonaparte Gulf on 31 January 1970 and the consequential loss of life.

(To be continued...)

FROM THE ARCHIVES

The small welded ship in the roll-over jig in the last edition seems to have been a puzzle for members. One suggested it might be the ferry *Kooleen*, built by the State Dockyard in 1956. She was built in a roll-over jig, but this little ship was one of the 75 ft tugs built in Australia during the Second World War for the US Army. The photo was taken at Hexham on the Hunter River.

Popular history suggests that prefabrication began in shipbuilding during the War, notably for the construction of the Liberty ships in the USA. Of course, prefabrication of flat panels like bulkheads has been a common shipbuilding practice for many decades. Three dimensional units were more of a challenge, not least because of the limitations of shipyard cranes before the 1940s. The photo below shows a riveted stern unit being erected on the slipway, but where and when was the photo taken?