

Ships and Offshore Structures

Hall of Fame

A Pioneer of Naval Ship Design

**Professor David Andrews FREng, PhD, FRINA,
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Brief Citation

Professor David Andrews FREng was given a new Chair in Engineering Design at University College London in September 2000, following his early retirement from a wide ranging career in the UK Ministry of Defence, extensively involved in the design of a large number of naval vessels. He retired as Director of Frigates and Mine Countermeasures; prior to this he spent five years in the MoD Grade 5 post of Professor of Naval Architecture at UCL, and was before that Head of Preliminary Design in the Future Projects (Naval) Directorate after being Warship Project Manager for the

procurement of the Royal Navys Replacement Amphibious Shipping Programme. David Andrews is an acknowledged international authority on ship design methodology, with particular reference to naval ship design, including submarine and unconventional vessels, such as Trimaran design. As Chairman of the tri-annual International Marine Design Conferences Design Methodology Panel from 1997 he has edited and largely authored all the State of the Art Reports on Marine Vehicle Design Methodology to date and since 2015 has been Chair of the IMDC International Committee. In 2000 he was elected a Fellow of the Royal Academy of Engineering for his developments in ship design methods. In April 2020 the RINA Council approved the award of the William Froude Medal in recognition of David Andrews contribution to the field of ship design and to naval architecture.

Origins and Early Career (1947- 1984)

On his maternal side David is descended from a family of boat builders in the City of Hull on Humberside in the North of England, where sea going vessels have been built since time immorial. His mother went to sea as a nursing

stewardess before WWII and her ship was sunk in the Pacific in 1940 by a German commerce raider and with colleagues she was rescued from an island where they were marooned. David suspects this episode led to his fascination with ships. His earliest recall of wanting to specifically design ships was when eight years old in Australia, in the summer he was steering a boat of the Port Philip Pilots and replied clearly: No I dont want to be a sailor but a ship designer when I grow up.

At school he set his sights on winning a very prestigious cadetship into the Royal Corps of Naval Constructors, which he did aged just 18. This training, which was in uniform, was first in Devonport Dockyard and at the Royal Naval Engineering College, Plymouth and then to University College London to be in the first cohort of RCNC cadets to undertake the degree in Mechanical Engineering followed by the Masters in Naval Architecture. In the Masters unusually he persuaded the professor, the eminent submarine designer, Louis Rydill, RCNC, to let him produce a dissertation of his choice, which was his first foray into a methodological consideration of ship design. After the Masters, where he was top of his year class, he went to sea as a Constructor Lieutenant for over six months in a variety of vessels (frigates (including full Work Up and then off Iceland in the 1971 Cod War), a Mine Hunter, conventional and nuclear submarines, and finally a Helicopter Carrier) before appointment as an Assistant Constructor in the Ship Department, in the UK Ministry of Defence, Foxhill, Bath.

For the first year David Andrews was in a submarine section providing professional calculations on structures, stability and hydrodynamics for in-service and new build conventional submarines. He was responsible for monthly being the Conducting Officer for trim and inclining or check trim experiments on the class of RN conventional submarines. He moved after one year to the main nuclear submarine design section (SWIFTURE and SSNOY Classes), being specifically involved in vital work on pressure hull collapse under elasto-plastic mechanisms (working to his Chief Constructor (subsequently the eminent

Professor Douglas Faulkner and often directly answerable to the Deputy Director Submarines, Louis Rydill for deep dive abort criteria (which I attended) and dome bulkhead structural concessions. He was also given extra work to do on reactor containment strength, missile compensation systems and future submarine concepts.

On promotion at under 28 to one of the two Constructor posts in the project for the building first ship of the Invincible Class Carriers, he was responsible for all ship weapons, sensors, communications, hull equipment, upkeep and access arrangements. Aircraft, weapon and support design integration. This meant particular responsibility for incorporating the concurrently being developed Sea Harrier STOVL aircraft into the carrier design, including the design of the first flight deck ramp fitted to HMS INVINCIBLE before she went to the Falklands Campaign. (He co-authored with the last Project Director (Arthur Honnor, RCNC) the 1982 paper to the RINA on the Invincible Class design as a result.) His second post as a Constructor was as Deputy Head of Section in the Forward Design Group, where he was the initial Secretary to the 2* Ship Weapon Design Coordination Group (Chaired by senior Director, Louis Rydill); Project leader for major new surface ship concepts, including Type 23 Frigates, Type 24 (not built), Future Afloat Support Ship (AOR), Helicopter Support Ship and Corvette designs; and managed all other professional ship concept design study work for the Single Role Minehunter, Type 43 Destroyer and Landing Platform Dock. All this refined his ideas on innovative ship design.

David's next post (not a secondment so still an MoD appointment) was to UCL for four years, where he lectured to BSc course on strength and basic naval architecture; lectured to MSc courses in Naval Architecture (ship structures, finite elements and submarine structures) and Ocean Engineering (FE and submersible structures); and managed the MSc Ship Design Exercise and MSc Projects. His personal research into Computer Aided Preliminary Ship Design led to being awarded a PhD in 1984 for thesis Synthesis in Ship Design. Professor Rydill was his supervisor for this part time PhD

undertaken while lecturing. That research was based on a RINA Medal winning paper Creative Ship Design read in 1980 and provided a research programme for an innovative architecturally driven approach to ship synthesis. This PhD thesis was the first on ship design, so major underpinning research was required. At this time David also authored several papers to learned societies plus completed an invited chapter in FEA textbook on thin shell structures.

Returned to Ship Department to head up a section in the most important UK defence programme, that of the Trident submarine class (VANGUARD Class), with responsibility for submarine structural and hydrodynamic design. He undertook a full structural safety audit on the Trident Submarine hull design and his Section developed the rest of the vessels structure. He was the Project Officer responsible to Project Director for the Drawing Office Lead Yard Contract and for prototype propulsor Project Order contract also on shipbuilder (VSEL, Barrow), which meant monthly attendance at progress meetings in the shipyard.

Senior Career in the UK MoD (1984-2000)

From 1986 to 1990, on promotion to Chief Constructor David was the Warship Project Manager for the procurement of the Royal Navys Replacement Amphibious Shipping Programme. This involved managing the in-service Steam Frigate Group of warships as Design Authority, including managing the contractorisation of support below WPM level, with major ship safety issues; establishing the new warship group for Replacement Amphibious Shipping programme (£800M procurement) with novel procurement strategies for two Assault Ships, (LPD(R) including novel LCUs) subsequently HMSs ALBION & BULWARK), an Aviation Support Ship (subsequently LPH HMS OCEAN) and ensuring delivery of RFA ARGUS despite major (£45m) claim on MOD, which he personally defended in front of the House of Commons Defence Committee (HCDC); and finally managed a highly politically sensitive

and technically demanding project with a special team to produce a feasibility design for the Replacement of the Royal Yacht BRITANNIA, which had to be sent to the highest authority in the kingdom for approval.

Professor Andrews was subsequently Head of Preliminary Design in the Future Projects (Naval) Directorate, in Whitehall, MoD HQ, where he was responsible for the initial studies on the Royal Navys new Aircraft Carrier, Future Attack Submarine, Future Surface Combatant and the new class of Auxiliary Oilers (WAVE Class) and was the authority on unconventional hull forms. Appointed in 1993 to the MoD Grade 5 (Senior Civil Service) post of Professor of Naval Architecture at UCL in 1993, he was responsible for training and education of MoD, including Royal Navy, post graduate naval architects to the Head of Royal Corps of Naval Constructors (then Director General Submarines, MOD (PE)). He also developed research in the new Trimaran ship form, including supervising the definitive PhD on the design of ocean going trimarans (Dr J-W Zhang) and the design for the first Trimaran ship, whose form options were tested at MoD Haslar. Two further PhDs that he supervised developed his earlier PhD based studies on his radically new architectural approach to ship synthesis (Dr C Dicks, Dr J Bayliss). He was also responsible for integrating the Royal Navys Dagger Course into the parallel MSc in Marine Engineering at UCL and running the post-MSc Submarine Design Course. He gave a paper on Warship Project Management to the Royal Institution of Naval Architects in 1992 which received the comment in the formal discussion from a Vice President of RINA that the author is probably the most experienced designer of surface warships in the UK today and, as such, his views ... should be treated with great respect, The following paper to the RINA on Preliminary Warship Design in 1993 received the comment from another (Honorary) Vice President that it should be required reading for all young ship designers due to its exemplary explanation of such a complex process.

On return to the MoD proper at Bristol Abbey Wood in early 1998, in his last two

senior posts, he was first Director of Frigates and Mine Countermeasures (reporting as the only naval architect on the Board to Admiral Peter Spencer as Director General Surface Ships) and, latterly, the Team Leader for the Future Surface Combatant (FSC) Integrated Project Team. As Director of Frigates and Mine Countermeasures he was responsible for procuring both frigates and MCM vessels with over £200M annual equipment budget and £10.3B forward programme for future frigates, with over 200 civilian and naval staff. One building project was the revolutionary R.V. TRITON, the first trimaran ship, procured from Vosper Thornycroft as a two third scale prototype of Dr Zhangs design study, being the basis for a possible option for the FSC. Having set up the FSC IPT, when this major programme was delayed he decided to take early retirement from the RCNC and return to UCL as a proper academic and further develop his approach of designeing inside-out complex vessels.

Return to UCL as Professor of Engineering Design (2000 -)

Profesor Andrews was given a new Chair in Engineering Design at University College London in September 2000, following early retirement from the UK MoD. At UCL he set up a new Design Research Centre in the Department of Mechanical Engineering, which was scoped on computer aided preliminary ship design, trimaran research, ship combat system integration and design methodology for complex systems. As an acknowledged international authority on ship design methodology, he has been able to draw upon the very widest experience of all types and phases of naval ship design, including submarine and unconventional vessels, such as Trimaran design. He is the author of the most comprehensive set of published learned papers on Trimaran ship design and was interviewed by the national media on the occasion of the launch of the first Trimaran warship prototype in May 2000 and was invited to author the multi-hulled vessels chapter in prestigious

SNAME publication Ship Design and Construction (2003).

Invited by the US Navy Office of Naval Research to give a keynote paper on the ship design process to the first workshop of US government, academia and industry in May 2008 developing a roadmap for future US ship design tools (only non-US attendee). Invited by the US Navy Office of Naval Research to participate in the second (at Cambridge MD Oct 2008) and fourth (Carderock MD Dec 2009) and to present a paper at the third (Carderock MD March 2009) and fifth (Carderock MD Nov 2010) Ship Design Process Workshop. Subsequently, he was asked by the SNAME Chair of the Ship Design Panel, Robert Keane, to give the first of a series of webinars on Design for Layout, 100 attendees signed up and it was given on 24th May 2017.

As Chairman of International Marine Design Conferences Design Methodology Panel he conceived and produced the first State of the Art report on Marine Vehicle Design Methodology in 1997 and those for the 2006 & 2009 IMDC (and Design for Layout in 2012). The 2012 article in Proc Royal Society followed on from two earlier Royal Society Proceedings papers on design of complex systems and brought together the authors philosophical investigations as the international leading authority in marine design methodology. One of the 2012 articles referees commented: an interesting and insightful analysis. The paper offers an internationally important and useful contribution to the growing body of scientific knowledge about the most technically difficult design contexts. The investigations outlined in the paper were drawn on for the invited Keynote Address Is Marine Design now a Mature Discipline? given to the International Marine Design Conference in June 2012, in Glasgow.

The production of the SURFCON CAD tool using the methodology of the Design Building Block means of graphical representation as a module within Graphic Research Corporation (GRC) Limiteds PARAMARINE preliminary ship design suite, has brought to fruition a more holistic approach to ship design previously advocated by David for some two decades in

the journals concerned with ship design. The Design Research team he has assembled at UCL continues to apply the methodology to many of the critical ship design drivers that were not previously given appropriate attention in the initial stages of ship design. Over the last two decades the approach has been applied for industrial partners to topics such as Design for Production; identification of requirement capabilities; on fast vessels for military and fast integrated transport applications with UK MoD, US Navy and for projects with significant EU and EPSRC funding. The seminal medal winning paper in 2003 provoked an extensive written discussion in the RINA Transactions from several very eminent designers and academics, for example: I consider (the paper) to be particularly significant for naval architects because.. it demonstrates.. (how) the central role accorded to its architectural elements (can be restored) .. it is inescapable that this is a dauntingly complicated paper.. (Emeritus Professor L J Rydill); an excellent synthetic paper summarising his great experience in ship design and .. his longstanding contributions to ship design, the development of modern design methods and innovative ship design concepts. (Professor A Papanikolaou, Head of Ship Design Laboratory, NTU Athens); It is this practical and valuable output..that has...proved him right in the long run against earlier scepticism from the profession (including me). (C V Betts, former Director General Submarines, UK MoD and Head of the Royal Corps of Naval Constructors).

The investigations outlined in his 2012 article in Proceedings of the Royal Society were drawn on for the invited Keynote Address *Is Marine Design now a Mature Discipline?* given to the International Marine Design Conference in Strathclyde University, June 2012. At the IMDC in Tokyo University May 2015 David was elected as the International Chair of IMDC International Committee, in succession to Professor Papanikolaou, and he has chaired the 2018 IMDC in Aalto University, Helsinki in June 2018 and intends to chair 2021 IMDC in University of British Columbia, Vancouver in June 2021.

A comprehensive and seminal paper was published by the IJME as basis of its first ever Special Edition in Oct 2018. It was 53 pages in length (with two appendices and 148 references) plus a written discussion (and authors response) of 17 pages length. When this publication was considered by the RINA Publications Committee, in Feb 2020, they uniquely recommended the paper for Council Commendation and that it also be issued to all young members of the Institution. This would be in keeping with the unanimous view of the reviewers of *The Sophistication of the Early Stage Design of Complex Vessels*, who are all very eminent and outstanding ship designers, whose reviews used terms such as a Landmark paper, important paper on an important subject and clear and comprehensive. The papers standing was further reinforced by the S.E. published discussion, in particular from the top former UK submarine designer (C.V. Betts CB, FREng) and from the former top US Navy ship designer & NAVSEA Technical Director (Robert Keane Jr, LFSNAME): culmination of 40 years research and development, now accepted approach (to complex ship design) and remarkable compendium of design wisdom. The paper also details the DRCs application of my Design Building Block approach to ESSD with examples of innovative ship designs for UK MoD and other bodies (including US Navy and the Columbian Navy) as well as investigations for UK maritime industry into aspects of ship design opened up by this architectural approach.

On 15th April 2020 the RINA Council approved the award of the William Froude Medal (its highest award to an individual), in recognition of *your steadfast and professional contribution to the field of ship design, and particularly your work in challenging established practices which has benefited ship performance, safety and operational capability. Your work over the last 40 years has consistently enhanced the understanding of early stage ship design and developed tools and techniques for the designer to use. Through your research into design methodologies, published in over 90 papers, and also your work in the education of generations of naval architects and marine engineers in ship design,*

you have made a conspicuous contribution to naval architecture.

Professor Andrews is a Chartered Engineer, a Fellow of the Royal Society of Arts, Fellow of Institution of Mechanical Engineers and Fellow of the Royal Institution of Naval Architects, for whom he has chaired the Membership Committee, the Future Directions Committee, the recent working group on Publications and was a long standing Vice President, a Member of Council and of the Executive Committee and then the Board of Trustees and remains Editor of the IJME and a member of the Maritime Innovations Committee and the Publications Committee. In 2000 he was elected a Fellow of the Royal Academy of Engineering for his developments in ship design methods. In 2005 he was appointed to the 2008 UK Research Assessment Exercise panel for mechanical, aeronautical and maritime engineering and also elected to the UK Engineering and Physical Sciences Research Councils Peer Review College. He has advised several UK and European universities on their senior academic appointments and departmental research environments as well as examining PhD theses worldwide. He has conducted technical audits for the Research Council of Norway, the European Commission Framework 6, QinetiQs Marine Division, Dstls Synthetic Environments Reviews and for several (classified) industry and government projects.

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