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ISSUE 143





FIRST FULLY ELECTRIC FERRY LAUNCHED

BY MARGARET WIND – PHOTOS BY SIMON HOYLE

All eyes were focussed on Wellington Harbour on August 6 as Australasia's first fully electric commuter ferry hit the water.

Co-owner Jeremy Ward, the pioneer of this project, who is Managing Director of East by West ferries in Wellington, was there with his team to proudly witness the first of what they hope will be the start of many 'built to order' electric vessels for the New Zealand and international market.

As is traditional, Ward requested a local iwi elder to come up with the perfect name, *Ika Rere*, meaning 'flying fish'.

As focus throughout the world turns to how transportation can reduce its impact on the environment, Ward knew he had to put a stake in the ground and do things differently when it came to purchasing a new ferry for his Wellington Harbour route.

Starting work on such an ambitious project was no mean feat, but partnering with Fraser Foote, who has extensive manufacturing experience with composite construction technology, and who is now Managing Director of the Wellington Electric Boat Building Company (WEBBCo), led to the launch of a 19m high performance, all-electric passenger ferry on the established East by West Queen's Wharf to Days Bay route.

This 19m catamaran has a passenger capacity of 135, with three

crew, an on-board café, two heads (with capacity for three) and inside and outside seating options. She cruises effortlessly and almost silently across Wellington Harbour from Queen's Wharf to Days Bay seven times a day.

This ground-breaking project brought together several New Zealand maritime experts, who worked alongside the East by West and WEBBCo teams towards the shared vision.

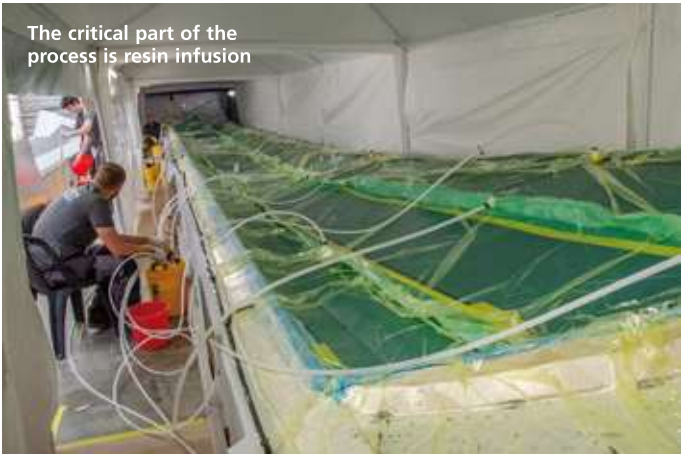
"Building a conventional boat required the integration of many aspects of design to ensure it met performance, quality and cost requirements as closely as possible," says Ward.

The addition of electrification, however, brought a whole new dimension which impacted every area of boat design, build and commissioning.

"This project was therefore highly collaborative," says Foote, "and could only be achieved through a proactive approach and an openness to find workable compromises. All parties had an unwavering belief that the team could successfully bring this landmark vessel into service, and be the first in the southern hemisphere to do so."

EFFICIENT HULL DESIGN

In designing the ferry, the naval architecture and design consultancy SSC Marine's first step was to identify the total maximum displacement for the mass of batteries required to deliver the operating power for the required speed and targeted recharge frequency.



The critical part of the process is resin infusion



The top deck out of the mould

There was a requirement for the hulls to be as slender as possible to achieve minimum resistance, as resistance determines the energy required to move a vessel through the water. However, the hulls also had to accommodate the volume of the batteries required for the energy to overcome the resistance.

Once the principal dimensions and battery mass were determined, the rest of the vessel could be detailed out, including the construction materials and manufacturing processes.

To achieve the optimal shapes and therefore expected through-water performance, the hull bottoms were produced from moulds. Composite flat panels were chosen for cost-effective and quicker construction of the topsides and deck.

“The aesthetics and general arrangement were influenced by these manufacturing choices, but also by East by West’s operational requirements and Maritime NZ regulations, which ▶



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Ika Rere afloat waiting final fitout and seatrials



Annie and Jeremy Ward wet the baby's head

stipulate exit routes, number of heads, sightlines, handholds and so on," Ward says.

This is where Jackson Industries came in. Jackson's brief for this project was to produce the hull moulds using its large-format five-axis CNC routers. After meeting with the owners, it was clear that while accuracy and weight saving was paramount in this project, mould production also needed to be cost-effective, easily transportable (from Jackson's factory in Auckland to WEBBCo's construction base in Wellington) and produced in a timely fashion to fit within the project milestones they were looking to achieve.

To keep the 19m moulds transportable while meeting the owner's build methodology for the hull sections, the mould was designed into a total of six individual sections. These were fabricated and transported individually to Wellington, where the WEBBCo team reassembled the sections back into the full hull mould lengths before continuing their manufacturing process.

It was critical to keep the overall weight of the structures down, while maintaining stability within the finished moulds, so PET foam (polyethylene terephthalate) core material was chosen for the machining mould surface. This was supported by a rigid sub-structure.

Jackson's is known for utilising new and innovative materials. Wherever possible, they aim to select materials made from recyclable ingredients and this project was no different. PET foam, which is manufactured from no less than 85 percent recyclable materials, was chosen for the job.

Jackson's selection of bespoke tooling for this job allowed for large amounts of material to be removed in much less time than is typically achieved by standard tooling. This ensured that critical milestones for completing the project were met.

Jackson's has a long history of being involved in projects of this nature in the marine industry, producing plug and moulds for hulls, decks, cabins and auxiliary components. Notably, the company was recently chosen as the partner to produce hull and deck plugs for Tristram Marine's flagship 821 Offshore trailer boat.

CARBON COMPOSITE CONSTRUCTION

Considerations in the selection of construction materials were displacement, energy consumption and longevity. Through energy modelling and cost analysis, it became apparent that the vessel's energy consumption was a main driver in the long-term cost of the vessel, and that the key to reducing the energy consumption was to reduce weight. ▶

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Photo courtesy of Simon Hoyle at Southlight Studio

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At the business end underwater



A glimpse at the main controls

Gurit, who specialise in light-weight and composite solutions, supplied structural engineering and materials to the ferry following evaluation of various construction options. This resulted in the selection of light, high-strength carbon fibre as the enabling technology for the electrification of the East by West ferry.

The composite structure had to not only be light weight and robust, but also to provide fire resistance around the energy storage system of the vessel. Some innovative solutions needed to be developed, particularly for the battery compartment. Gurit and WEBBCo developed an innovative solution of composite battery wracking that allows for the batteries to be removed from *Ika Rere*, while providing a continuous fireproof boundary.

A unique solution of fire retardant composite panels and low flame spread Spabond were used throughout critical areas of the



The vessel hypercharger unit arrives

boat. WEBBCo worked with Gurit to consider not only material selection and structural integrity for both performance and robustness, but also manufacturing efficiency. A modular carbon fibre panel system was developed to allow rapid manufacture of the composite shell, reducing labour and tooling costs for the first vessel, and to leapfrog the initial setup phase that would have otherwise occurred.

The panels were vacuum-infused to ensure accurate resin uptake and avoid excess weight, and the decision to thermoform the foam also afforded a significant overall weight saving.

INTELLIGENT BATTERY MANAGEMENT

The electric propulsion and power management system was custom developed and designed by McKay specifically for the East by West route and charging infrastructure.

The batteries themselves were supplied by McKay and came from Xalt Energy, whose headquarters are based in Midland in the United States. The 72 DNV batteries are distributed throughout each of the hulls.

The electrical distribution system is based on a DC bus concept, and power is distributed around the vessel at 750VDC, which minimises conversion and distribution losses. The propulsion inverters and motors have exceptional efficiency, allowing for 97 percent efficiency from the distribution grid to the propeller shaft.

Ika Rere's batteries are arranged in redundant systems, with independent battery stacks positioned throughout each hull. The advanced battery management system provides constant system supervision, providing safety functions as well as real-time system capacity and health data.

An advanced algorithm supplies a constant estimate of the vessel's range, using benchmarked conditions and real-time ►

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Jackson Advanced Engineering boasts one of the largest 5-axis CNC routers in New Zealand with a total machinable area of 10.5m x 3.8m x 2.4m. Machining large scale items such as trailer boat hulls and decks, rowing skiffs, super yacht booms and spreaders are projects our team of experts have extensive experience with.

The combination of our skilled designers and machine programmers plus our high spec advanced CNC machining technology allows for large scale projects to be machined as a single piece, avoiding breaking up moulds into smaller pieces. Culminating in more accurate, efficient and affordable projects for our customers.

*Main image: TRISTRAM BOAT DECK
Bottom right: CMS MX5 5-AXIS CNC MILL
Top Left: CNC MACHINE SPINDLE*

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feedback of the performance of the vessel. The VCAM provides the skipper and crew with dynamic visual performance data and an overview of all the systems at any point in time, allowing them to make optimal operational decisions.

While the electrical system has been optimised for a 20 knot, 25km round trip at full passenger capacity (the typical commute), the ferry can operate at lower speeds for significantly longer distances and times between charges, allowing East by West to charter the ferry for dinner cruises and sightseeing trips.

The charging rate was a significant consideration in the boat's design, impacting areas such as hull size, battery specification, weight and displacement. WEBBCo and East by West worked with independent electric vehicle consultants Retyna on the coordination of the landside charging infrastructure. This included wharf strengthening requirements, supplier selection and various approvals.

WHO IS SSC MARINE?

SSC Marine is a collaboration between three independent design houses, each with expertise and experience in complementary areas of design. In coming together, SSC Marine can offer a co-ordinated and integrated approach, resulting in a vessel that is truly optimised to your operational requirements.

Tennant Designs Ltd, brings 20 years of design and practical experience in catamaran design. The design office made a name for itself designing performance multihulls, offshore long-range power catamarans and fuel efficient passenger ferries. Originally starting with performance sailing multihulls, Malcolm Tennant progressively developed the CS hull shape for high speed displacement power catamarans, since then the Tennant office had continued to develop this unique hull form and it is this technology underpins SSC Marine's designs, backed up with real world data.

www.tennantdesign.co.nz

Stimson Yacht Design and Naval Architecture, led by Christian Stimson, FRINA, has 30 years' experience designing and building fast yet efficient vessels, ranging from 50knot patrol craft for governmental agencies to America's Cup yachts. Using the most modern design and analysis tools – including in-house CFD capability – theirs is a methodical approach to seeking the optimum design. Building on the Tennant database, their role is to produce the next generation of efficient catamaran hull forms for SSC Marine.

www.stimsonyachts.com

Kit Carlier Design, led by Kit Carlier MRINA, who has 20 years' experience as both boatbuilder and designer. With responsibility for the exterior aesthetics and interior ergonomics, they bring experience from both the super yacht arena and commercial workboats. With weight and weight management front and foremost, their role is also to balance selecting materials and finishes for great effect while minimising weight and reducing build time, as well as producing SSC Marine's distinctive 'look'.

www.kitcarlierdesign.com

Local electricity network capacity, access, viewshafts, aesthetics and dockside infrastructure were equally important, as the dock is located in a popular heritage area, with restaurants and waterfront walkways attracting many pedestrians. By bringing all the interested parties together, Retyna was asked to project-manage a solution that meets the current charging needs of this ferry, and is future-proof and ready to meet further growth in the electrification of Wellington's public transport.

Ika Rere has been designed and built to global specifications, meeting Maritime New Zealand and DNV-GL quality and safety standards for the commercial operation of electric vessels. She can complete one return run of 25km before charging at the dockside at a rate of 1MW for 15 minutes, while passengers disembark and board. For the first year of operation, she will be charged from a 300kW charger at her overnight berth.

PROPULSION AND RUDDERS

With so much effort going into the unique build of this ferry, reliable machinery was needed to compliment the design. Ian Mitchell, from the Henley Group, says it was a great opportunity to be involved in such a ground breaking project. "Henley's partnered with WEBBCo on the design collaboration, manufacture and supply of complete drive lines, engine mounts, thrust bearings, shafts and couplings, shaft brakes, seals, stern tube, bearings and propellers." A comprehensive package was delivered and fitted by the Henley team.

In keeping with the owner's objective to keep everything light weight, MG Composites in Wellington were engaged to produce the carbon fibre rudders. The moulds and mandrels were cut out using their in-house CNC (computer numerical control) router, and the rudder stocks were constructed with a male PVC foam mandrel, and laminated with prepreg carbon fibre.

Prepreg is the common term for a reinforcing fabric which has been pre-impregnated with resin. As a result, the prepreg is ready to lay into the mould without having to add more resin. A combination of pressure and heat is necessary for the laminate to cure.

The rudder blades were made in female moulds, laminated in dry carbon fibre/foam and resin-infused. All the parts were post-cured and then assembled with rubber-toughened epoxy.

"Once the rudder blades and rudder stocks were assembled we set up, fitted and installed the JP3 self-aligning rudder bearings into the hulls and associated structure," said Matt Gottard from MG Composites. "We also set up and fitted the composite prop shaft tubes, prop shaft thrust bearing bulkheads and prop shaft brake mountings."

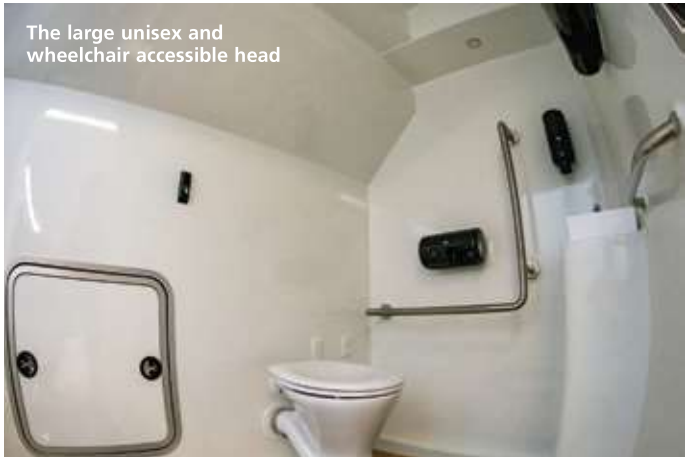
Throughout the build, MG Composites manufactured several moulds, jigs and mock-up panels for WEBBCo for manufacturing fittings and parts.

The steering system was supplied by Lusty and Blundell.

ELECTRONICS

The extensive navigation suite consists of two Simrad NSO 16in displays and a single Simrad 16in HD touch display, making it three in total. Other gadgets include a Dual AP70 autopilot computer and a single AC70 controller that contains the steering computer, with a QS80 quick joystick lever. A Simrad Satellite compass, AIS module, sounder module and weather station complete the package.

The single 16in screen is the skipper's dashboard and primary gateway into operating the vessel. It shows current distances to empty, operating modes and other information, and also displays the McKay EVCam energy management and control system, which interfaces with the propulsion, energy and navigational systems.



The large unisex and wheelchair accessible head



Topsides the radar and aerial mast

This system was developed to enable continuous monitoring with any faults relayed back to the user in real time. An equivalent system on a conventional vessel would identify engine performance and fuel consumption.

INTERIOR

Once on board, the first thing that stands out is how seamless the interior lines are. The seating throughout is bench style, with smooth, rounded edgings made of lightweight composite material to keep weight to a minimum. The seating was developed in collaboration with structural seat bases made by WEBBCo, and the seats themselves were made by Fibreglass Developments in Fielding and upholstered by Merje in Lower Hutt, who are well known for their design and manufacture of theatre and train seats.

The windows were supplied by Seamac in Whangarei, with flat panels supplied by Nice Glass in Wellington. This aligns with WEBBCo's mandate to use as many local suppliers as possible throughout the project.

There is a fully stocked bar and café inside the main cabin, serving coffee, alcohol and a good range of snacks.

The water tanks are gravity-fed to remove the requirement for water pumps. "Additional equipment such as pumps just add to the weight of the vessel," says Foote. "The tanks are up on the top level and each of the two toilets and the bar hold just 50 litres for day use. This is increased to 100 litres for charter use. The concept of reducing water storage on board is once again designed to minimise weight."

EXTERIOR

Such a ground-breaking build deserves a really good finish. After all, she will be in the spotlight for all to see. Top of the South Marine Coatings Ltd, were chosen for the job. At the time, owners Greg and Keely McDonald were based in Marlborough, so Greg was living on their yacht in the Seaview Marina, going home as often as possible. Greg, who has been involved in the boatbuilding industry for thirty years, was the sole spray painter involved with preparation and painting of the ferry and played an important role in the overall finish of the ferry.

PERFORMANCE

Sea trials are due to take place later this month and by all accounts, the *Ika Rere* looks like living up to all expectations. The really hard work has now been done and WEBBCo aim to capitalise on this using their technology and expertise to produce other models for the New Zealand and international market.


"We have worked incredibly closely with our key partners in this project, SSC Marine, Gurit, McKay and Retyna," says

Ward. "Simply put, the ferry wouldn't have come to life like it has without our collaboration with these four companies, and our client, East by West Ferries, who have had great support from Meridian."

The ferry will be powered by Meridian Energy, with charging at Queens Wharf. Meridian says it jumped at the chance to provide electrification and support for the project. "The electrification of transport is a huge opportunity for New Zealand/Aotearoa to fight climate change and build climate-resilience," says Meridian Chief Executive Neal Barclay.

"We're proud to lend our experience and energy to ground-breaking projects like this one that prove the potential for renewable energy to disrupt the status quo and improve New Zealanders' lives," says Barclay.

"While the quiet hum of an electric boat is a much more pleasurable experience for passengers, this project is driven by our desire to take climate action from the outset," says Jeremy Ward.

We look forward to seeing more new-generation electric vessels throughout the maritime fleet. 

SPECIFICATIONS	
LOA	19m
Beam	7m
Draft	1.1m
Construction	Light-weight carbon composite
Power	Battery powered – electric 750V DC
Top speed	20 knots
Passengers	135
Crew	3
Builder	WEBBCo. Ltd



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