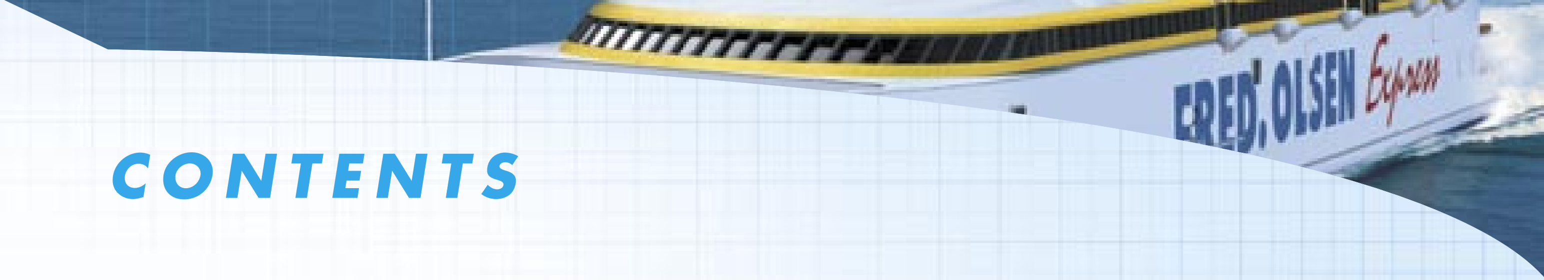
AUSTAL

Benchijigua Express

AUTO EXPRESS 127

"BENCHIJIGUA EXPRESS"… IS QUITE SIMPLY THE MOST SIGNIFICANT VESSEL TO ARRIVE ON THE FAST FERRY STAGE IN RECENT YEARS AND IS SET TO IMPROVE FAST SEA TRANSPORTATION AND OPEN NEW MARKETS BEYOND THE ABILITY OF EXISTING FAST FERRY DESIGNS.



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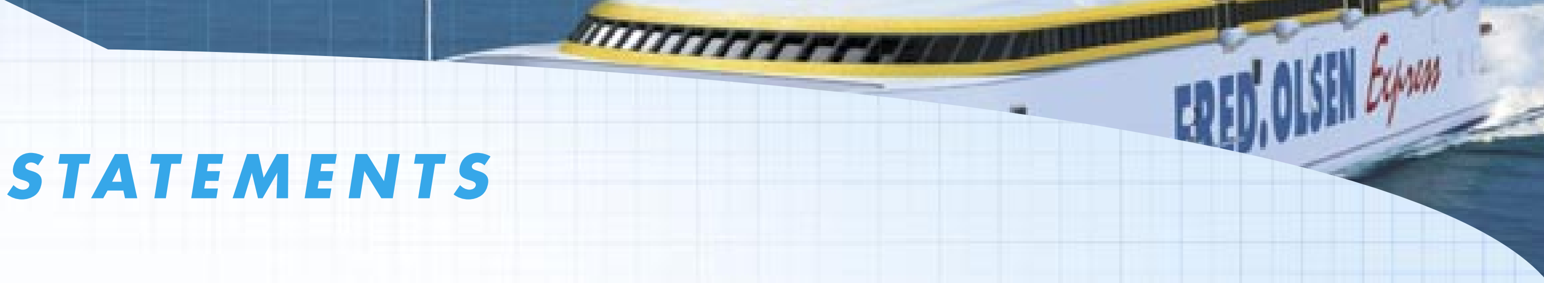
Austal workforce at the launch of "Benchijigua Express".



CHAIRMEN'S STATEMENTS

MR JOHN ROTHWELL A.O.

CHAIRMAN, AUSTAL

From the outset Austal has endeavoured to be the builder of choice for fast ferry transportation, exemplified in a large part by our commitment to customised design and to provide our customers the best possible solution for their operations.

The delivery of "Benchijigua Express" is a substantial milestone in the history of Austal and following an unprecedented five year program of research, is testament to the significant investment we make in product development.

Proof of Fred.Olsen, S.A.'s position as a world leader in the application of high speed ferry services has been their willingness to support this development phase before a shipbuilding contract was signed.

Having now tested the vessel in a wide range of conditions we are delighted to see the new ferry design exceeding our expectations. The trimaran is a genuine step forward for the industry and for the first time enables operators facing difficult sea conditions to specify a vessel based on payload without sacrificing sea keeping.

Personally it is pleasing to have been part of the large design, engineering and production team that has worked diligently through many challenges, and in cooperation with an equally dedicated team from Fred.Olsen, S.A., to create "Benchijigua Express".

AUSTAL

FRED. OLSEN, S.A.

MR FRED OLSEN JNR.

CHAIRMAN, FRED.OLSEN, S.A.

Through the close cooperation with Austal a highly versatile vessel with many improvements over our current fast ship fleet has been developed.

This began while our previous Austal vessel, "Bocayna Express" was under construction where we explored further research to refine a new concept for high-speed vessels which would develop from the low resistance, very good stability and carrying capacity of catamarans.

With these objectives in mind Fred.Olsen, S.A. and Austal cooperated on an extensive and dedicated programme of research, tank testing and other analysis to firstly develop a new design and then ensure it would meet our requirements in an efficient and cost-effective manner.

The result is a new "Benchijigua Express", a slender stabilised monohull more commonly referred to as a trimaran.

The characteristics of this new vessel, with a length of 126.7 metres and beam of 30.4 metres, will improve overall efficiency in terms of passenger capacity, deadweight and freight lane metres by more than 35%. At the same time passenger comfort will increase by 25% to 40% depending on the routes we operate.

This trimaran should, for us, be the solution for many years to come and could very well set the standard for a new generation of large fast ferries. We believe our customers deserve the best.

IN SEARCH OF PASSENGER COMFORT

THIS PROJECT COULD BE SAID TO HAVE STARTED IN 1999, WHEN AS A RESULT OF DISCUSSIONS WITH FRED.OLSEN, S.A., AUSTAL WAS ASKED TO DESIGN A LARGE CATAMARAN FOR USE IN THE CANARY ISLANDS. HOWEVER IT WAS CLEAR DURING THE ONGOING TECHNICAL DISCUSSIONS THAT FRED. OLSEN, S.A. WAS LOOKING FOR A FRESH APPROACH AND A BETTER SOLUTION TO THE ISSUE OF PASSENGER COMFORT, HULL EFFICIENCY AND FUEL CONSUMPTION.

Fred. Olsen, S.A. were aware that Austal had been investigating the trimaran hull form as a concept which could deliver improved passenger comfort. Their request initiated many months of intense research and development into what could be achieved with the new hull form. This involved developing a new General Arrangement, some preliminary tank testing and a large amount of Computational Fluid Dynamics (CFD) work. An unexpected issue was the number of patents that were in place describing various aspects of the trimaran design. The Austal trimaran took several months to design in order to achieve the platform capacity, to develop the hull shape to achieve the performance required by Fred. Olsen, S.A. and to comply with the HSC Code.

Sea keeping has been called the forgotten factor in the fast ferry market. Over the last decade builders of fast ferries have supplied larger and larger vessels to improve the deadweight carrying capacity of their product; a secondary effect of the increase in size has been the improvement in the vessel's seakeeping ability. However this has occurred as a consequence of the development and has not been its prime objective. Routes being considered for fast ferries today are typically longer and more exposed than the routes of yesterday. The expectations of comfort demanded by passengers are higher today than a few years ago. Ferries that are comfortable and seaworthy attract loyalty from the passengers who are also looking for a *super ferry* feel on fast ferries. Competition from short haul cut price airlines has further increased the pressure on the ferry market share.

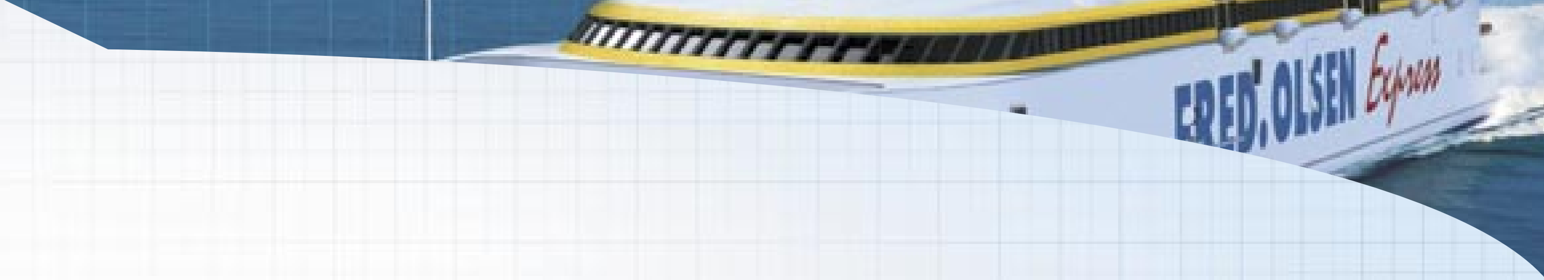
Improvements in computer simulation software now allow builders to investigate new solutions to improve the way a vessel behaves in a sea way. The use of wind and wave data from the proposed area of operation gives builders and operators the further opportunity to predict the operability of the proposed design whilst it is still in the conceptual stage of development. This allows a higher degree of experimentation on differing hull forms at a low cost and with no risk. Investigations into ships motions have proved to be a useful tool for several projects at Austal. For example the Royal Australian Navy Patrol Boat Project required all tenders to submit motion studies demonstrating that the location of compartments such as the Command Control Room, galleys, sleeping quarters and day rooms were located in the optimum position within the vessel's structure with respect to the motions of the whole vessel.

WHAT IS MEANT BY OPERABILITY?

Defining the Operability of a vessel can be split into several parts.

- Identification of the critical motions
- Definition of the limits on the critical motions
- Application of the environmental data
- Prediction of the vessel's response
- Evaluation of the outcome

It is important to first identify the motions that are important to the operation, these will differ depending on the vessel type. For instance in a military program, motions that dictate whether sonar, or helicopter operations can take place are paramount, whereas for a ferry operator the motions experienced on the passenger deck will be more important.



The definition of the limits to be placed on motions uses well established criteria that have been published for many years. At Austal the three criteria that have been used to measure the performance of passenger vessels are as follows;

- Motion sickness incidence (MSI)
- Lateral force estimator (LFE)
- Roll

The criteria can be defined as shown in Table 1.

- MSI is usually measured over a 1 or 2 hour period as this is typically representative of the voyage length under investigation.
- The Lateral acceleration limit is the amount of acceleration an average person is comfortable with whilst standing up and holding onto a rail.
- The Roll limit approximates the maximum roll that can occur before an object on a table will start sliding.

TABLE 1

MOTION CHARACTERISTIC	CRITERIA
Motion Sickness Incidence	
Exposure $^1/_2$ hour	
1 hours	10%
2 hours	10%
	10%
Lateral Accelerations	
Passengers on a ferry	0.05g (RMS)
Roll	
Passengers on a ferry	3.0º (RMS)

Analysis of the way the vessel behaves in a seaway against each of the criteria noted above consists of several stages which are illustrated in Figure 1.

The four stages can be defined as follows;

1. Transfer function calculation or RAOs. These functions describe the hull form's response to regular waves. The RAOs can be obtained from tank testing or by computer simulation. RAOs can include the effect of ride control systems.
2. Ship's response to irregular waves. This part of the calculation takes into consideration the response of the vessel to wave energies across a chosen wave spectrum.
3. Operational Limits. Establishes the wave height at which the motion criteria will be exceeded.
4. Operability. Expressed as a percentage, and describes the vessel's capability considering the time spent in each sea condition, heading and speed. This can be route specific.

The percentage operability generated by the process determines the proportion of the time that the vessel can operate in the environmental conditions as defined by the wave scatter and wave direction diagrams without exceeding the defined motion criteria.

The operability of the vessel can be shown as a polar diagram as illustrated in figure 2.

FIGURE 1 - FOUR STAGES OF ANALYSIS (AS DEFINED BY MARINTEK)

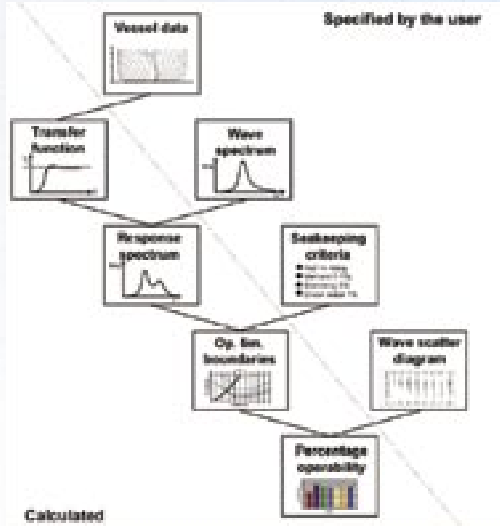


FIGURE 2 - LATERAL FORCE ESTIMATOR OPERABILITY

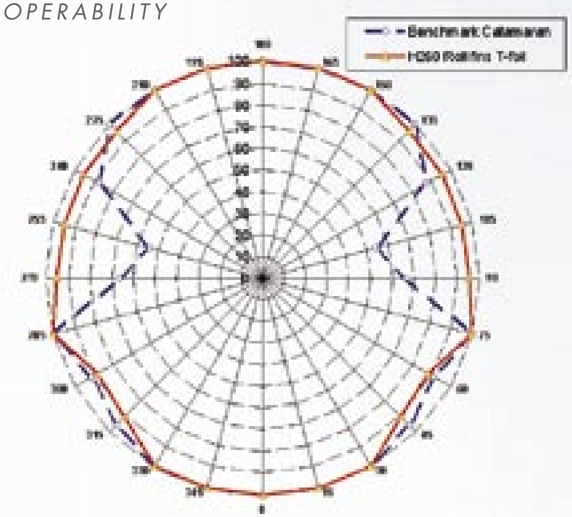


Figure 2 shows the LFE of the 127 metre trimaran compared to a 120 metre catamaran. The diagram shows that in a beam sea (on the route being considered) that;

- The trimaran can operate for 95% of the time without exceeding the LFE criteria.
- The catamaran can operate for 65% of the time without exceeding the LFE criteria.

Operability studies can also illustrate the output in a graphical manner as shown in figure 3.

Figure 3 illustrates the capability of a particular trimaran to operate in a higher sea state than a catamaran before either exceeds the roll criteria. For instance in a beam sea the trimaran can operate in a sea 3.8 metre higher than the catamaran hull being used in this comparison.

One of the first studies in the commercial arena that used operability as a way of quantifying a vessel's behaviour was for the development of the trimaran. The initial design proposal was for a 120 metre catamaran hull with a 1000 tonne deadweight capacity. Operability analysis of this design showed that whilst the increase in length over Fred.Olsen, S.A.'s current tonnage would provide some

• *The T-foil of "Benchijigua Express"*

percentage increase in operability, to gain the quantum improvement that was being sought would only be achieved by designing of a new hull form.

The operability studies were based on the actual sea conditions found in the Canary Islands. Conveniently there was a wave buoy near the proposed route from which a wave scatter diagram could be derived. This data combined with directional data enabled the performance of the vessel to be accurately modelled for each leg of the proposed route. The operability information was delivered to Fred.Olsen, S.A. as a series of polar diagrams which compared the catamaran and trimaran performances. The final report to Fred.Olsen, S.A. stated that the trimaran would offer a 26% improvement in operability over the compared hull forms. Encouraged by these early predictions there was a program of further design development including additional tank testing and the construction of an 11 metre manned model of the hullshape.

This year the Research and Development Department at Austal has conducted a number of operability studies for interested operators. These studies have followed the procedure outlined above and in all cases have demonstrated the superiority of the trimaran over other hull forms.

There have been a number of interesting outcomes from these studies.

When comparing two catamaran designs, for example, an Austal 101 metre design and the 120 metre design it is apparent that the increase in length whilst beneficial if operating in a head seas environment, only marginally improves operability when the seas are between a quarter head through to just aft of the beam. This is an important finding as it indicates that to achieve a significant

FIGURE 3

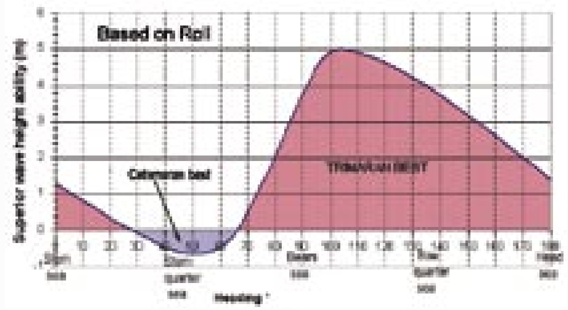
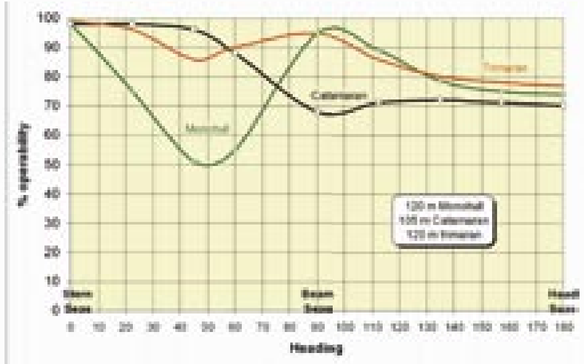


FIGURE 4



improvement in operability for a vessel operating with seas anywhere on the beam it is necessary to change the hull form.

The trimaran hull form allows Austal to decouple capacity from the overall length of the vessel. This is a very useful feature for operators who have a rough sea route requiring a larger vessel but a low deadweight requirement. A 100 metre long trimaran has the capability of being designed with a low deadweight whilst remaining cost competitive with the equivalent sized (in deadweight terms) catamaran.

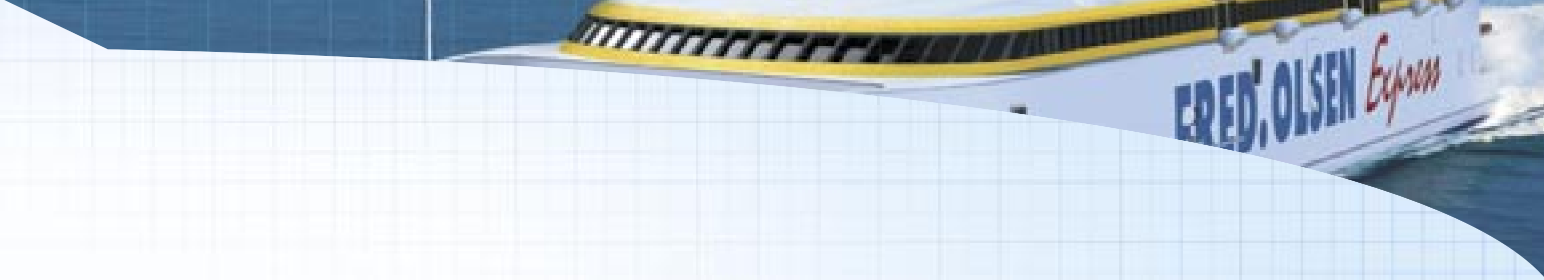


Figure 4 shows the overall Operability of three vessels operating in a typical sea spectrum and shows the relationship between the trimaran hull form, a monohull and a catamaran.

A catamaran with its high metacentric height can be controlled to a certain degree; there comes a point however where the control surfaces have to be so large in order to achieve the desired motions that they become unrealistic, due to the weight and speed loss due to wetted surface area. The trimaran hull form with its lower metacentric height and softer roll can be controlled with smaller control surfaces.

Whilst the catamaran and trimaran designs are similar in terms of powering and efficiency a comparable monohull requires up to 20% more power to achieve the same speed.

INCREASING THE OPERATIONAL PROFILE

It is clear from our discussions with operators in Europe that most high speed vessels have been restricted in their operations to a sea state not exceeding 3.5 metres. This limit has been imposed independently by a number of Flag States and should not be confused with the Classification Society speed wave height curves which typically show operations are permitted in sea states up to 4.5 to 5.0 metres significant. The Classification Speed wave height curves are calculated on inputs containing the vessel's length, displacement and other parameters with the purpose of restricting the vertical accelerations at amidships to 1g.

The High Speed Craft Code provides the method by which an operator or designer can demonstrate that the 3.5 metre wave height limitation should be reviewed for a particular design.

Annex 9 of the HSC Code is titled "Definitions, requirements and compliance criteria related to operational and safety performance". This annex describes the method by which a vessel should be sea trialled to demonstrate its characteristics in a seaway.

Section 3.2 of Annex 9 states that the vessel may be trialled in "*two relevant sea conditions*" and that "*model tests and mathematical simulations*" may be used to verify the performance in the worst intended conditions. Recent discussions within the IMO may alter this requirement to read, '*the worst intended conditions should not exceed 150% of the more severe of the two measured conditions*". The Annex states that the vessel must be trialled whilst controlled manually and under autopilot, with each run lasting 15 minutes.

The Code further states that the *normal operating limits* shall be documented by measuring the following;

- craft speed
- heading to the waves
- measuring horizontal accelerations

The horizontal accelerations measured may be interpolated to ensure that the levels do not exceed those shown in Annex 3, Table 1. This table shows four Levels of Safety as shown below;

Level 1	Minor effect	Moderate degradation of safety
Level 2	Major effect	Significant degradation of safety
Level 3	Hazardous effect	Major degradation of safety
Level 4	Catastrophic effect	

The intent of the regulations is that high speed craft operate within Safety Level 1.

The Code goes on to state that the *worst intended condition* shall be documented in much the same way as for the normal operating conditions, and that vertical accelerations shall also be measured close to the vessel's longitudinal centre of gravity.

There appears to be disagreement between some of the Flag States in Europe as to how to approach the use of computer modelling and the extrapolation method to demonstrate a vessel's performance in the worst intended conditions. However most Flag States accept that a linear relationship between the wave height and accelerations based on measurement in two sea conditions can be assumed.

The sea trials of "Benchijigua Express" in varying sea conditions off Fremantle has demonstrated that the vessel will achieve Safety Level 1 compliance in seas up to 4.5 metres significant wave height.

THE TRIMARAN CONCEPT

CONTRIBUTED BY MARINTEK, NORWAY

THE CATAMARAN HAS BEEN THE DOMINATING HIGH SPEED CRAFT CONCEPT FOR TRANSPORT OF PASSENGERS/CARGO IN RELATIVELY PROTECTED WATERS. FOR OPERATION ACROSS THE OCEANS IN HIGH SEA STATES THE TUNNEL CLEARANCE ON CATAMARANS RESULTS IN A SIGNIFICANT OPERATIONAL LIMIT DUE TO LARGE EXPOSED AREAS WITH HIGH IMPACT WAVE FORCES.

The conventional monohull has so far been the only realistic concept for operation in oceans and high sea states, but at lower speeds. To increase the speed of a monohull the slenderness of the hull has to be increased, however, this introduces stability problems. The trimaran concept is in principle a stabilized monohull, a monohull with outriggers. Such concepts were well known hundreds of years ago. We found such a concept from early times in the Maritime Museum in Fremantle, see below left.

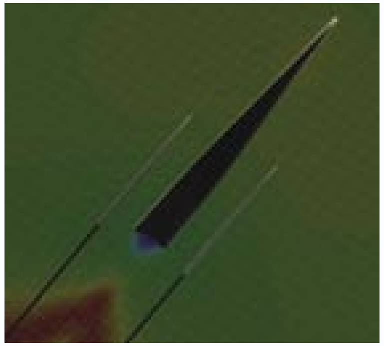
MARINTEK has over the last 20 years tested more than 200 different high speed craft concepts for customers around the world, including monohulls, catamarans, multihulls, Surface Effect Ships and foil assisted vehicles. Model tests in laboratories, tests with seagoing models and full scale tests have been carried out. We have seen that the most important limiting factor is high impact loads and operational control in waves.

Many concepts which have been very promising in calm water and low sea states have encountered considerable problems in higher waves.

We have been involved in development of trimaran concepts for many years. This work has comprised research and development studies and verification/documentation of performance for commercial projects. We are working closely together with NTNU, the Norwegian Centre of Excellence for Ships and Ocean Structures.

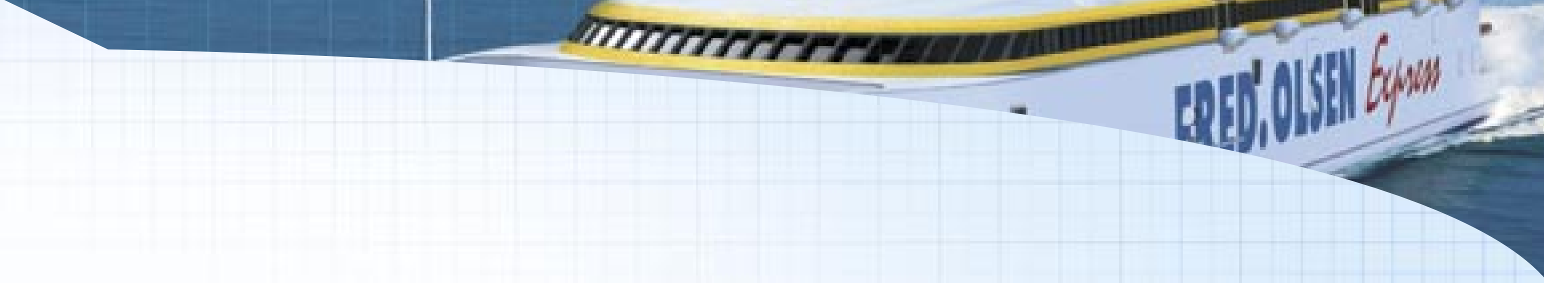
The Austal trimaran is the most advanced high speed concept we have been involved in regarding speed, size and rough weather behaviour. Extensive model tests have been carried out in order to optimize the hull and propulsion system with respect to fuel consumption and speed in a seaway, see for instance the model picture below right.

• *Indonesian Minahasan canoe with amahs found drifting in 1944. Now located in the Western Australian Maritime Museum.*



• *Numerical modelling developed by Austal using Shipflow software was used to evaluate trimaran hull designs prior to tank testing.*

• *5 metre tank test model used for seakeeping analysis.*

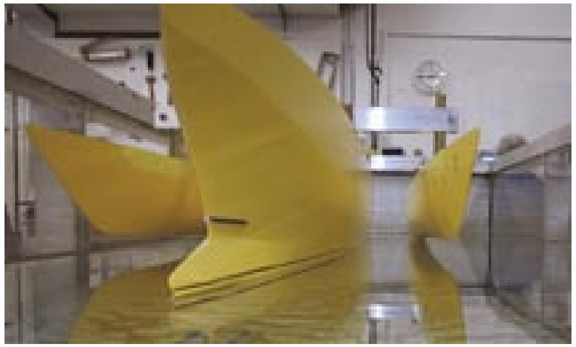


Our main efforts have been related to predicting and stimulating the forces on the hull and the operational characteristics of the ship in waves, headings and periods in normal and in extreme conditions.

In our unique Ocean Basin we can study models of high speed ships operating in two and three-dimensional waves, long and shortcrested waves in combination, in deep and shallow water, and under wind and current conditions.

Combined with our theoretical methods, which Austal also has access to, we provide our customers with the best basis for it's detailed structural optimisation.

• Formal sea trials off Fremantle, Western Australia 9 April 2005 – 40.5 knots, 500 tonnes deadweight, 32,800 kW with operating ride control



• 2.6 metre model with variable amah positions.

• 5 metre advanced hull model.

• 11 metre self-powered manned model, fully instrumented for motion and thrust analysis. Trialled between June 2001 and January 2002.

INTERIOR DESIGN

AUSTAL'S FIRST EXPERIENCE OF WORKING WITH FRED.OLSEN, S.A. WAS DURING THE CONSTRUCTION OF "BOCAYNA EXPRESS" THE 66 METRE AUTO EXPRESS DELIVERED IN NOVEMBER 2003. BOTH FRED OLSEN JR. AND THE APPOINTED OWNER'S REPRESENTATIVES DEVOTED MANY HOURS TO DEVELOPING THE LAYOUT OF THE PASSENGER SPACES AND VEHICLE DECK, AND IN SELECTING FURNISHINGS, FABRICS AND COLOUR SCHEMES FOR THE VESSEL THAT WERE IN HARMONY WITH THE FRED.OLSEN, S.A. CORPORATE IDENTITY AND COLOUR SCHEME. DURING THIS PROCESS THE AUSTAL INTERIOR DESIGN TEAM DEVELOPED A STRONG RESPECT FOR MR OLSEN'S KEEN EYE FOR DETAIL AND HIS PASSION FOR FINISHES AND COLOURS.

• *Transom design enables full beam car and truck loading and unloading.*

• *Vehicle deck showing mezzanine levels enabling mixed loading of cars and trucks/buses for flexible payload.*

The approach to the interior design of "Benchijigua Express" was undertaken with the same high level of cooperation and instrumental involvement in developing the general arrangement drawing.

The arrangement of the vehicle and passenger decks was the first areas of focus for Fred.Olsen, S.A.

In developing the vehicle deck layout the key factors were:

- To create a full width vehicle deck opening at the stern to accept the Fred.Olsen, S.A. terminal ramps. Each terminal has three ramps side by side which land on the stern of the vehicle deck and permit the simultaneous loading and/or unloading of three vehicle lanes.
- To achieve 450 truck lane metres with pillar spacing and deck planking arranged such that the heaviest freight vehicles can be carried in the centre lanes while lighter vehicles can be accommodated in the outer lanes but with sufficient space to drive around inside the vehicle deck.
- To create a highly flexible arrangement of lightweight hoistable ramps and mezzanine decks that would permit the vessel to switch between freight and passenger vehicle modes in the minimum time.
- To achieve minimum turnaround times in port of no more than 30 minutes.

• *Midship restaurant seating.*

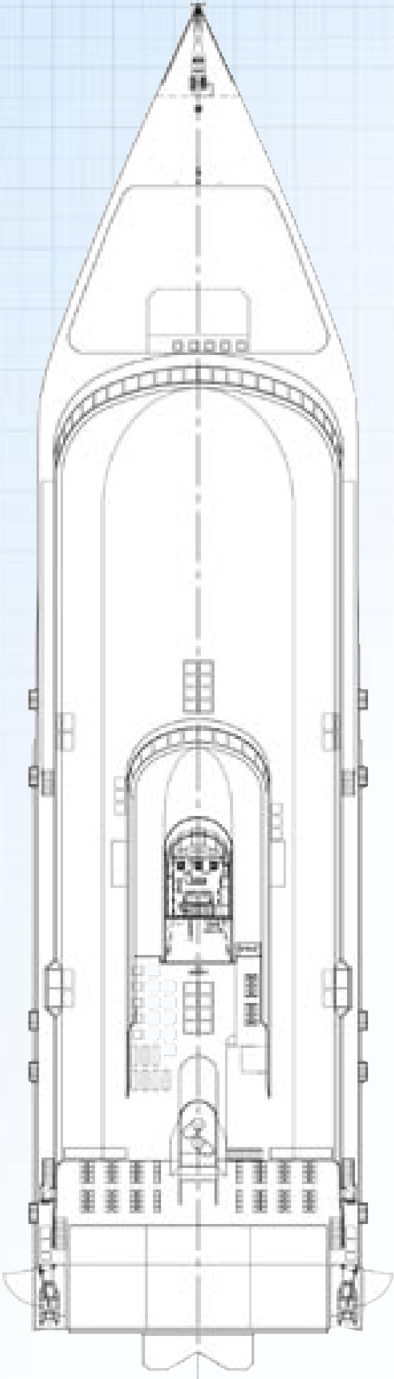
• *Wheelhouse designed for high speed operations.*

• *Crew mess for off-watch comfort.*

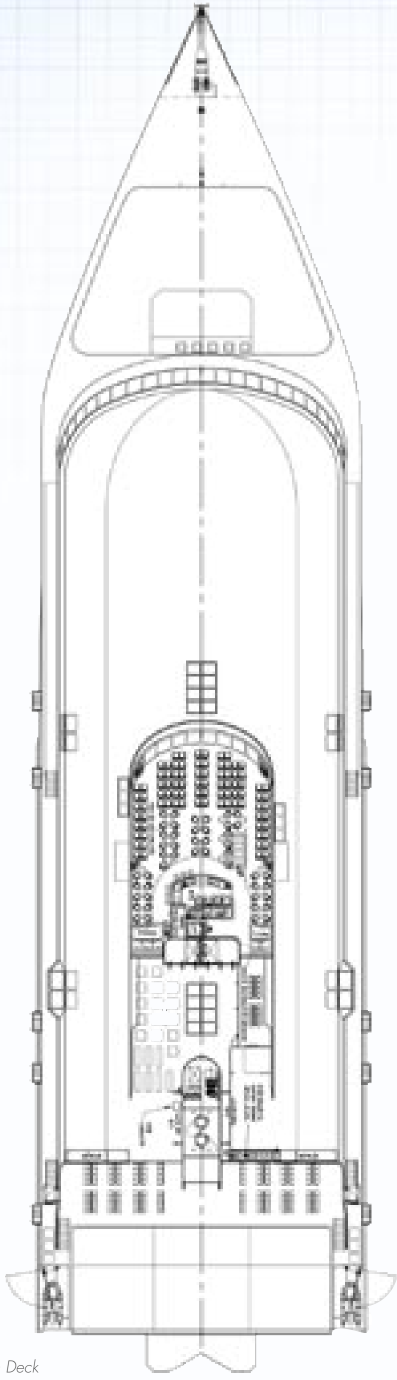
Similarly the arrangement of the passenger decks was developed by Fred.Olsen, S.A. to optimise passenger flow and to make the most effective use of natural light and available space. Particular attention was paid to the location and width of staircases in order to reduce passenger loading and unloading times and also to evacuation routes to ensure that all passengers can be quickly and safely evacuated in the event of an emergency. The arrangement and design of bars, shop and catering areas was another key element of the Fred.Olsen, S.A. developed interior.

Two other areas of contribution by Fred.Olsen, S.A. were the Bridge and Crew Accommodation. The Bridge is designed without bridge wings but with a centre manoeuvring console facing aft, equipped with a duplicate set of main engine, waterjet and bowthruster controls and colour TV monitors taking feed from berthing cameras. In addition the Master and the bridge team sit in line at the front of the wheelhouse with the Engineer's console to port and the Navigator's console to starboard. This layout was specifically chosen by Fred.Olsen, S.A. because it is consistent with the bridge layout and Bridge Resource Management practises in the rest of the high speed ferry fleet.

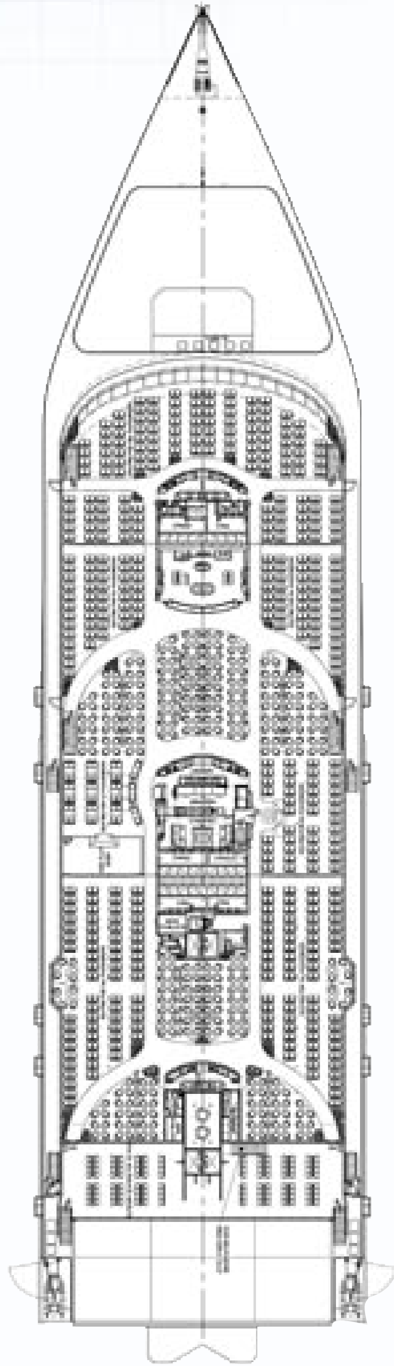
Crew accommodation is not normally provided in high speed ferries but here again Fred.Olsen, S.A. demonstrated a unique approach to crew management deciding that greater amenity would be provided to the crew by being able to accommodate them on board in port at night. To that end, a suite of single and double cabins together with showers, toilets and laundry facilities were installed in the centre hull forward of the engine rooms. Fred.Olsen, S.A. paying particular attention to ensure that the layout, furnishings and facilities would maximise comfort and restful qualities.



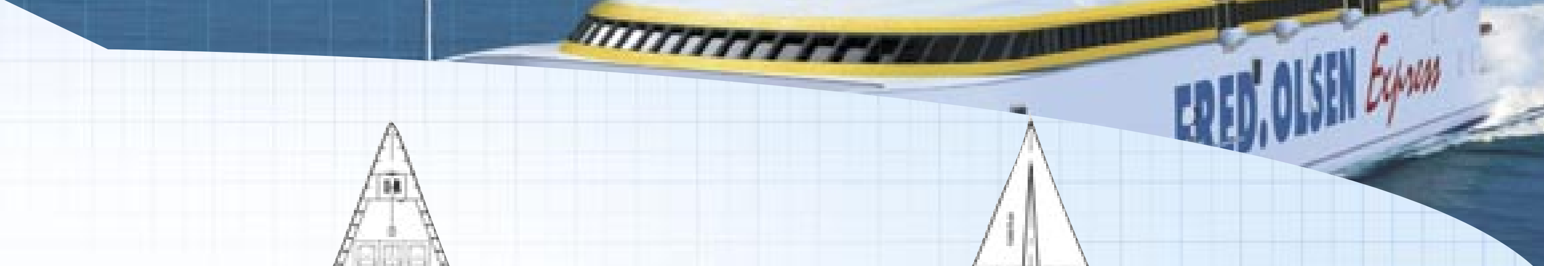
Bridge Deck

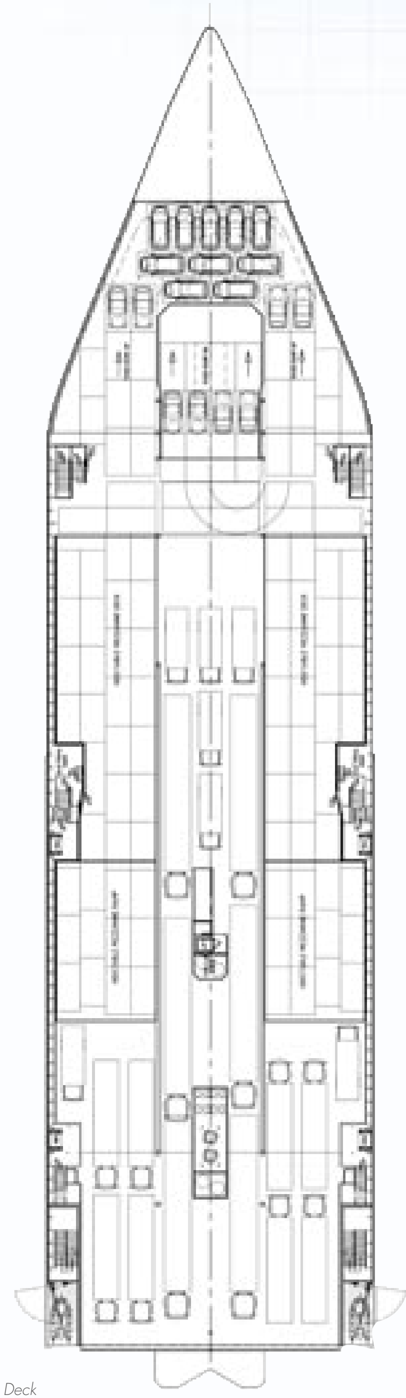


Observation Deck

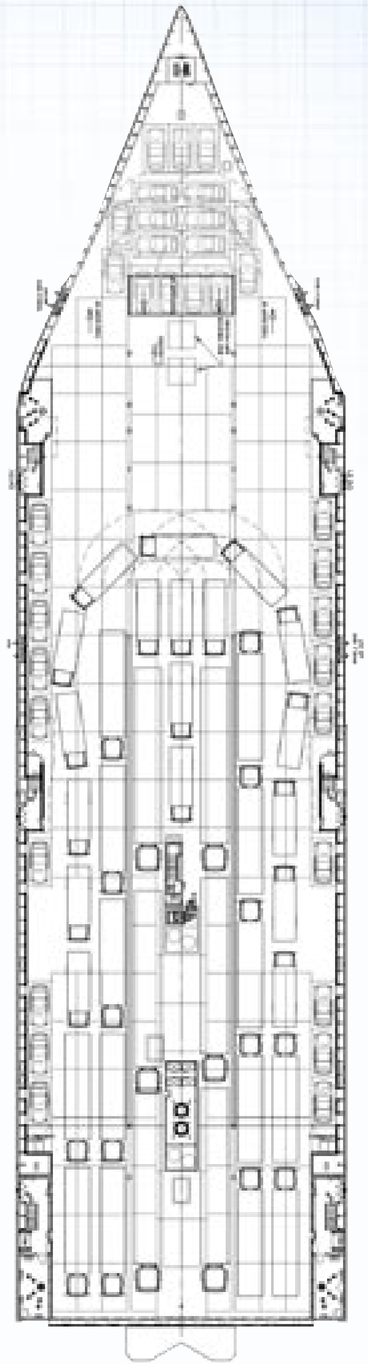


Upper Deck

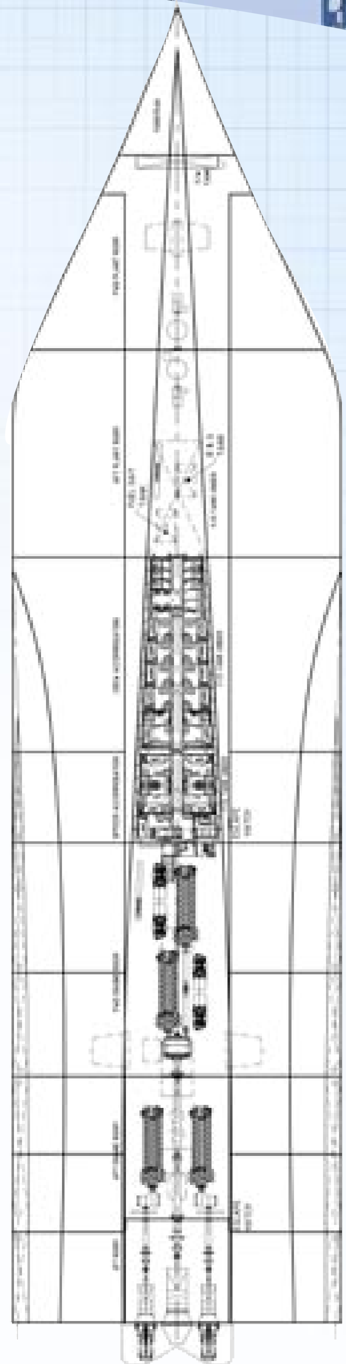




Mezzanine Deck



Main Deck



Hulls

With the basic arrangement of the passenger facilities determined Fred.Olsen, S.A. turned its attention to the colours, fabrics, furnishing and fittings. With a much larger passenger cabin and a more diverse range of facilities than any of its previous high speed vessels this process called for a greater range of fabrics, textures and colour combinations. The collaboration between the styling and colour sense of Mr Olsen and his team mixed with Austal's sound knowledge of materials and construction techniques ensured the end result - a superb interior finish.

In the initial design stages, Austal provided Fred.Olsen, S.A with a wide variety of material samples for consideration together with detailed sketches of the vessel's interiors including the passenger spaces, bars, shop, and crew spaces. Of key importance to Fred.Olsen, S.A. is achieving a high level of visual co-ordination within its fleet and therefore many ideas were carried over from existing vessels, particularly from "Bocayna Express". Corporate colours and themes were replicated in carpet designs, furniture fabrics and laminate selections.

The Fred.Olsen, S.A. project team were meticulous in their consideration of the interiors and in debating the choices of colours, materials and finishes, before making their final selections.

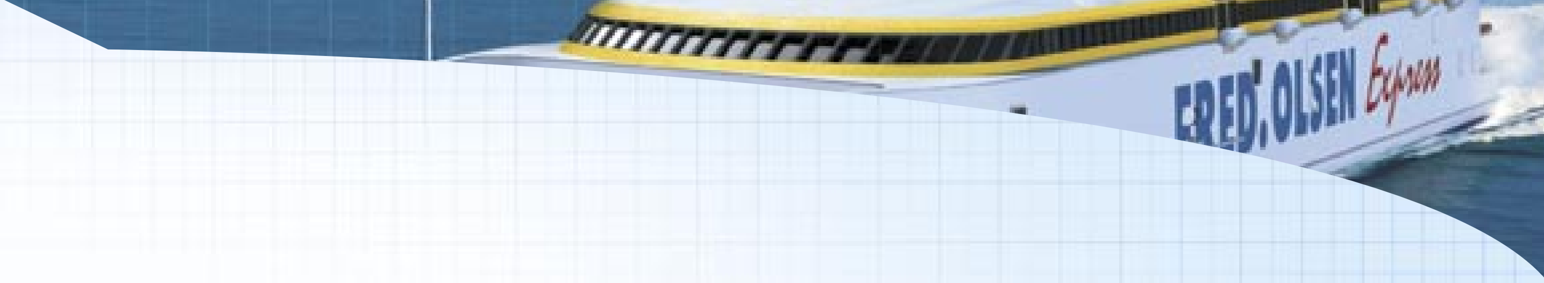
There are a number of key features of the passenger layout and interior that illustrate the rigour of this process. Feature bulkheads were designed to capture Mr Olsen's vision using a combination of feature panels combining specially selected laminates and upholstered leather. Cabin dividers added key focal points to smoke boundaries and frosted glass panels were also used as area highlights. Customised passenger areas, such as the shop, purser's office and children's playroom were distinguished to great effect with the incorporation of fine finishes in leather and glass.

• Starboard aft seating area.

• Forward seating allowing visibility ahead for passengers.

• Souvenir shopping facilities.

• Children's play room.



The VIP area was of particular importance to Mr Olsen and a series of luxury finishes and details were assembled for this area, with an additional focus on executive seats incorporating a leather finish and special laminates. Mr Olsen was also keen to incorporate innovative products such as leather in combination with baby ostrich accents, which were used to excellent effect on vessel compression posts, feature bulkheads and mullions.

Seating was another area to receive particular attention - Mr Olsen wished to update the design standard and so a new, modernised, prototype was produced in conjunction with Beurteaux Australia. With the aid of detailed sketches, Beurteaux spent many hours in refining the design until the finished seat was finally approved by Mr Olsen and the new improved seating approved for installation in the vessel.

This thorough and detailed approach to the interior design combining the passion and design flair of Mr Olsen and his team with the superb construction and outfitting skillbase of Austal has resulted in a vessel which not only co-ordinates with the rest of the Fred.Olsen, S.A. fleet but raises that standard to a new level.

• Large bay window features give passengers unrivalled views.

• Classe Oro for VIP passengers.

THE CONSTRUCTION PROCESS

JUNE 2001

A smaller trimaran was built and tested for research and development

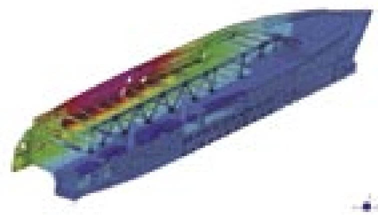
JUNE 2002

Tank testing of the hull form begins

AUGUST 2002

Tank Testing

APRIL 2003



Finite Element Model

APRIL 2004

Construction progress

APRIL 2004

Construction Progress

JULY 2004

The bow module is moved and attached to the main structure

JULY 2004

Engines are lifted and fitted into the hull

OCTOBER 2004

MES deployment trials

NOVEMBER 2004

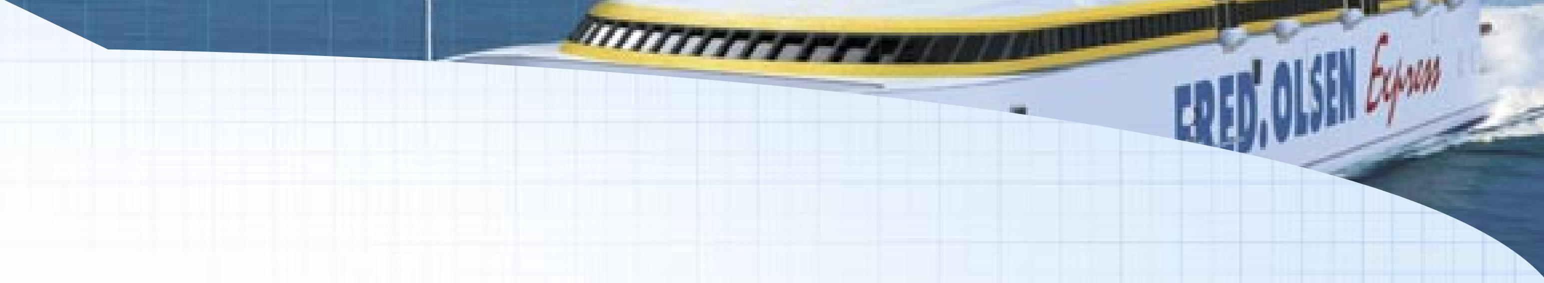
Christening of "Benchijigua Express"

NOVEMBER 2004

Austal holds a staff open day

FEBRUARY 2005

Finishing touches on the interior



MAY 2003

The signing of this contract in May 2003 symbolised an exciting new era of shipbuilding for our staff

AUGUST 2003

Plate cutting begins

FEBRUARY 2004

Construction progress

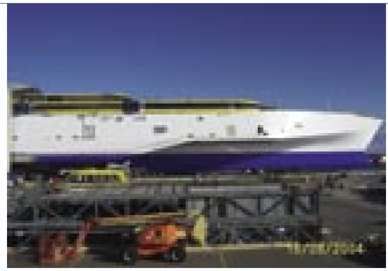
MARCH 2004

Construction progress

AUGUST 2004

Construction progress

AUGUST 2004



The main structure is moved out of the shed to fit the bridge section

AUGUST 2004

Bridge section about to be fitted

SEPTEMBER 2004

Launch of "Benchijigua Express"

MARCH 2005

Seatrials commence off the coast of Fremantle, Western Australia

APRIL 2005

"Benchijigua Express" is handed over to the proud new crew

APRIL 2005

"Benchijigua Express" leaves Western Australia for Spain

THE FUTURE

The Littoral Combat Ship based on the same hull form as "Benchijigua Express"

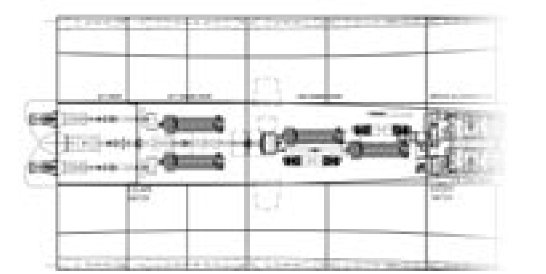
ENGINE SELECTION

CONTRIBUTED BY MTU

A TOTAL OF 44,000 HORSEPOWER WAS REQUIRED TO SATISFY THE DESIGN PARAMETERS OF "BENCHIJIGUA EXPRESS". THE FINAL DECISION WAS MADE BY FRED.OLSEN, S.A. TO EQUIP "BENCHIJIGUA EXPRESS" WITH THE MTU 20V8000M70, FOLLOWING AN AGREEMENT TO INCREASE AVAILABLE POWER FROM 8,200 KW TO 9,100 KW DURING THE FIRST QUARTER OF 2006. TO ACCOMMODATE THIS INCREASE IN HORSEPOWER, PROVISION WAS MADE BY AUSTAL WHEN SIZING THE WATERJETS, GEARBOXES, SHAFTING AND ASSOCIATED COMPONENTS TO ALLOW FOR A SEAMLESS POWER TRANSITION.

In addition to the main propulsion diesel engines, MTU has also supplied the on-board power generation system, comprising of four 12V 2000M40A series diesel engines. The electrical power produced by each unit is 540 kW. A stand-by power generation system has also been supplied by MTU. The MTU Series 60 engine provides 250 kW of electrical power for this purpose. The entire package is complimented by a comprehensive service and support agreement.

The two centre engines of this vessel share a common gearbox in what is called a CODAD (Combined Diesel And Diesel) configuration. MTU has taken responsibility for the control of these engines in this somewhat technically complex arrangement. The MTU designed and manufactured electronic control system (RCS/5 DAD / WJ), ensures that the two centre engines, which share the common gearbox, evenly share the load. This is achieved by a number of reporting mechanisms back to the control system, which adjust the power output of the individual engines accordingly.



• *Section of the Hulls showing engine rooms.*

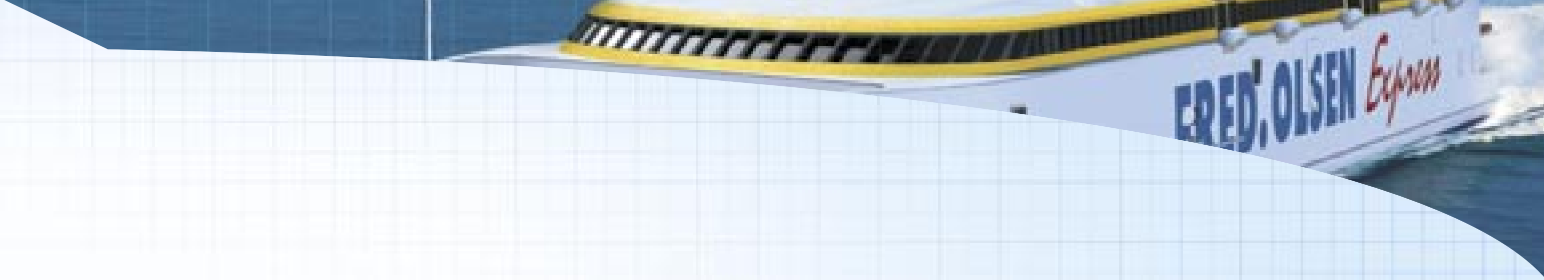
• *The aft engine room containing two MTU 20V8000M70 main propulsion diesel engines.*

Development of the 8000 series engine began in 1996, with an introduction to the market in September 2000. Since that time, 40 engines have been ordered into various applications ranging from Naval Vessels, Supply Vessels, Yachts and of course Fast Ferries. The first engines were commissioned into service in late 2003.

The Series 8000 was developed with the fast-ferry market in mind, placing an emphasis on the operator. Such features represented by this engine are the robust and yet relatively compact design, low fuel and oil consumption, long maintenance intervals combined with a user-friendly maintenance design, and importantly low exhaust emissions.

The engine crankcase comprises of an extremely stiff design with a slender 48°V configuration. Integrated charge air ducting, thus reducing external pipework, enhances the engine compactness whilst maintaining a cylinder displacement of 17.37 litres.

A characteristic of MTU Engines is the sequential turbo charging system. This technology considerably improves supercharged engines, enabling a wide performance map with good acceleration. It is also a contributing factor to low fuel consumption and exhaust emissions, and essential to meeting IMO (International Maritime Organization) regulations. This system of sequential turbocharging enables individual exhaust turbochargers to be utilized as required during engine operation, which is determined by the engine's power demand. This concept greatly improves the turbocharger, and overall engine efficiency. At rated engine power, the sequential turbocharging system on the 20V8000 series generates a remarkable 2,700kW of aspiration power. MTU first introduced this technology into series production in 1982. In the mean time, it has proven its worth in over ten million hours of operation.



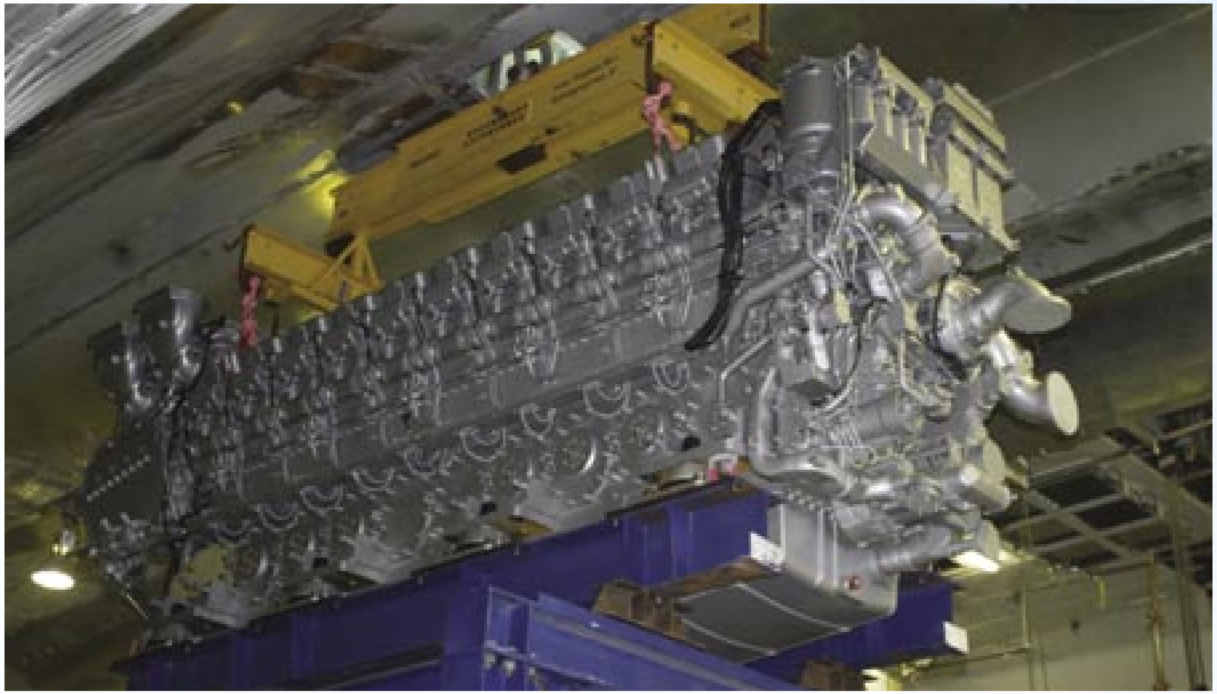
The Common Rail Fuel Injection system on the 8000 series is another key factor to the performance of this engine. The system provides high fuel injection pressure throughout the entire engine speed range, and continuously optimises injection timing, pressure and flow according to input from the engine management system. Optimisation of the fuel injection process ensures that fuel consumption is minimized throughout the entire power range. Specific fuel consumption at rated power is less than 195g/kWh, reducing to 190g/kWh at the most efficient point. On the basis of these values, the new engine attains the best fuel economy in its performance class.

The 8000 series is controlled and monitored by the MTU designed and manufactured electronic engine management system, MDEC (MTU Diesel Engine Control). Using this system, an optimal control of all engine functions is possible. Furthermore, the engine can be integrated in the overall control and monitoring system of the entire propulsion system, which can also include other areas of the ship. "Benchijigua Express" is also equipped with the MTU operating data recorder, MTU Assyst. MTU Assyst collates data from the engines for review by the operator, recording trends, parameters for analysis and also assisting with diagnosis and preventative maintenance.

The standard Time Between Overhauls (TBO) of the 20V8000M70, is 24,000hrs. The engine has been designed for minimal maintenance downtime, and one feature highlighting this concept is the Power Unit. The cylinder head, liner, piston and conrod are designed such that they are all removed together in the one procedure, lifted from the engine as a unit and replaced as a unit. This procedure minimizes the time for maintenance onboard the vessel, as replacement power units can be prepared in advance of scheduled maintenance, and the removed power units can be returned to MTU for overhaul at a time which suits the operator. Also assisting crew onboard the vessel during maintenance is the service module concept. Elements of the engine, which require regular minor maintenance, such as filters, are all located at the non-drive end of the engine. The engine interface with shipboard systems is also located at this end, simplifying the installation work for the shipbuilder.

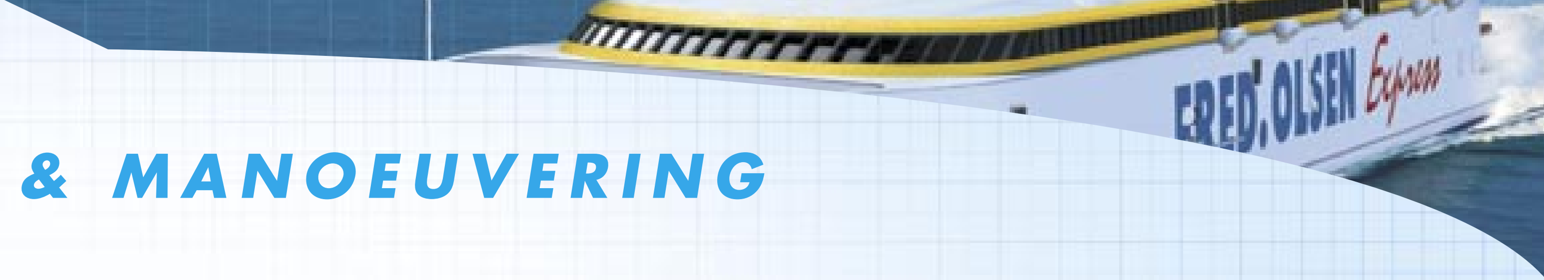
The scope of work and downtime experienced by the operator from this design concept is considerably reduced. Optimisation of fuel consumption and reduced through life costs further enhance the prospects of a profitable and reliable business.

As a business partner, MTU has a vested interest in the success of fast ferry operations. The MTU Series 8000 diesel engines have been designed, manufactured and supported to assist fast ferry operators in providing a reliable ferry service for their passengers.



• *The MTU 8000 Series diesel engine ready to installation.*


FRED. OLSEN Express
BENCHIJIGUA EXPRESS



PROPULSION & MANOEUVERING

CONTRIBUTED BY ROLLS-ROYCE MARINE

ROLLS-ROYCE IS PROUD TO HAVE BEEN SELECTED TO DEVELOP AND SUPPLY AN INTEGRATED PROPULSION SYSTEM FOR THIS LANDMARK VESSEL THAT IS OPTIMISED BOTH FOR HIGH SPEED TRANSIT AND SLOW SPEED MANOEUVERING.

A new standard has being created in hull form, motion control, passenger comfort and versatility of the platform for a commercial ferry. The result is a new class of vessel that utilises 21st century technology in systems and efficiency.

PROJECT DEVELOPMENT

Rolls-Royce was involved with Austal at an early stage of the project when powering options and water-jet selection were closely examined.

The hull form, available powering options and the operating profile or route analysis provided by Fred.Olsen, S.A. were a basis for an intense period with detailed technical and commercial analysis made to determine the final configuration. Increased power output available in the near term also had to be considered. Service conditions, harbour limitations and environmental factors such as wind speeds were also taken into consideration.

• "Benchijigua Express" a launch day showing stern and waterjet arrangement

FRED.OLSEN, S.A.

Fred.Olsen, S.A. demanded solutions that provided maximum efficiency, economy and functionality.

ROLLS-ROYCE WATER JETS AND AZIMUTH THRUSTERS

Rolls-Royce Marine has delivered triple Kamewa Water Jets and twin Ulstein Aquamaster Retractable Thrusters for this vessel. Selection of this equipment was made to fit precisely with the operational and design objectives.

KAMEWA WATER JETS

Two steerable units of size 125 SII 7B are fitted as outer jets on the main hull. Design power is 9,100 kW each

A central booster jet is provided for ocean transit and is shut down when entering port. Design power is 18,200 kW

IMPELLER CONFIGURATION – SEVEN BLADES

The impellers on all jets are the latest from Kamewa being originally developed for military applications.

The shift from 6 to 7 blades provides considerable reduction in noise and vibration on-board the vessel. The larger number of blades are more lightly loaded and offer increased cavitation margins against adverse operating conditions.

MANOEUVRING

The vessel proportions give the operator particular advantages with the platform however different constraints apply to this vessel compared with others necessitating the addition of auxiliary manoeuvring plant.

The design objective was to achieve a vessel with equal or superior manoeuvring to a similar size catamaran.

Use of tunnel thrusters is common on slower vessels however on a vessel that can travel in excess of 40 knots the presence of open tunnels, or elaborate closing plates is to be avoided.

After much discussion, the Rolls-Royce experience with azimuth thrusters was utilised and Aquamaster retractable units were proposed.

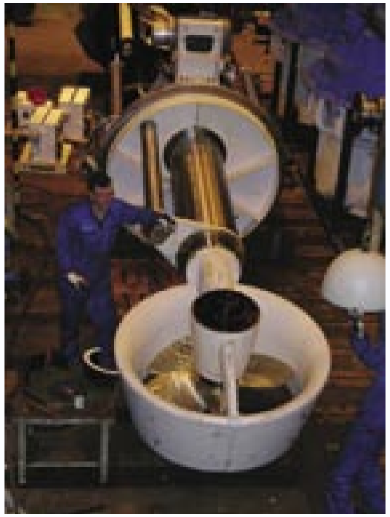
Compared to tunnel thrusters, the azimuth thruster with nozzle offers approximately 15% greater thrust for the same power as a tunnel thruster.

The presence of the structural elements of the nozzle provide a natural platform for mounting a hull closing plate (not shown). The thrusters are mounted in tandem in the vessel with opposed starting positions.

INTEGRATED CONTROL AND MANOEUVRING SYSTEM

Rolls-Royce delivered a common electronic control system for the water jets and thrusters, greatly simplifying the installation and providing the operator with considerable flexibility to operate each device individually or to integrate them all into one manoeuvring device for harbour or sea transit duty.

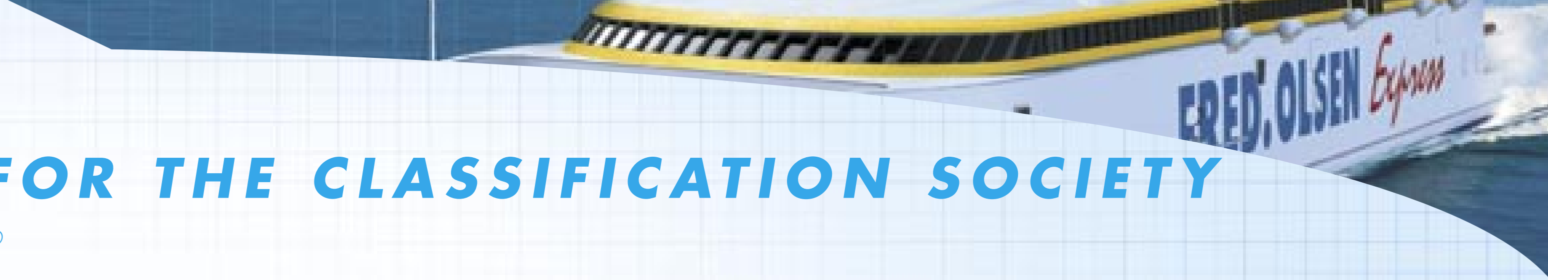
• The 180 BII 7B Kamewa central booster jet while still in the factory at Rolls-Royce AB.



• One of the two Ulstein Aquamaster Retractable Thrusters in the Rolls-Royce works in Finland.

SEA TRIALS

All equipment performed as predicted and it was pleasing that the owners noted that the quiet operation of the Aquamaster thrusters was quite different to their experience with other lateral thrust devices.



A MILESTONE FOR THE CLASSIFICATION SOCIETY

CONTRIBUTED BY GERMANISCHER LLOYD

HIGHLY OPTIMISED DESIGNS CALL FOR DETAILED INDIVIDUAL STUDIES

THE BUILDERS AND OPERATORS OF HIGH SPEED CRAFT REPEATEDLY TAKE ON A PIONEERING ROLE IN BLAZING A NEW TRAIL IN TECHNOLOGY. IN CONCERT WITH FRED. OLSEN, S.A. AND AUSTAL, THE CLASSIFICATION SOCIETY ALSO TOOK A NEW APPROACH IN THE DEVELOPMENT OF "BENCHIJIGUA EXPRESS" AS A COMPLETELY NEW DESIGN. AT THE SAME TIME, THE SUCCESSFUL TRIALS AND DELIVERY OF THIS EXCEPTIONAL VESSEL MARK ANOTHER HIGHLIGHT IN THE COOPERATION BETWEEN GERMANISCHER LLOYD (GL) AND AUSTAL, WHICH HAS BEEN A SUCCESS STORY SINCE 1995.

Modified panel model

Original panel model

There are no internationally valid construction rules for high-speed trimarans. For the Classification Society, the design and fabrication of the ship therefore presented a special challenge in several respects. It was necessary to apply the experience of Austal and GL as intensively as possible in interpreting the existing regulatory framework for high speed craft. At a very early stage, experts from GL were on site in Australia to discuss the design concepts with the engineers from Austal. The subsequent plan approval took place mainly at Austal in Australia. Both measures, coupled with the deployment of experienced HSC surveyors by GL, made a major contribution to completing the project within such a tight timeframe.

DETERMINING THE GLOBAL WAVE LOADS

A major role in the work of GL was the determination of the global wave-induced loads. Here GL made good use of the experience it had gained with in-house research and development as well as the hydrodynamic computations proven by testing. For the dimensioning of the ship structure, the global wave loads were first ascertained with the aid of complex seaway programs.

In determining these global loads, panel models for the hydrodynamic computations were created in an initial step. Together with the relevant sea state, the extreme values of the wave loads were then calculated. To reduce the wave loads caused in the forebody by the pitching movements of the ship, the width was reduced in this area.

These measures proved active design support for Austal.

From the safety viewpoint, the new trimaran is regarded as a monohull as far as its stability criteria are concerned, in agreement with the IMO. Another essential safety aspect is the evacuation of passengers. Lifeboats or liferafts must not be allowed to pass too closely to the side hulls, in case the ship starts to roll during the evacuation procedure. Even questions that at first glance appear to be relatively simple can present a challenge with such innovative ship designs. For example, this applies for the regulation-conformant definition of the ship length if, as in this case, the stern of the side hulls lies aft of the main hull.

A large number of high-speed monohulls and catamarans have have been built but, the fast multi-hull designs are still in the limelight. They are particularly suitable wherever slender, fast ships with a good seakeeping behaviour and large deck area are needed to accommodate passengers and motor vehicles. Their advantages make them attractive not only for passenger and Ro/Ro commercial traffic but also for military purposes. It therefore comes as no surprise that the new Austal trimaran has already attracted international attention.

In view of possible growth in the number of multi-hull newbuildings in future, the question arises as to whether specific construction rules will be needed to serve such vessels. However, one may expect that multi-hulls will remain a rather unusual species of ship. In the foreseeable future, their highly-optimized designs will still call for detailed individual studies.

PRINCIPAL PARTICULARS

Length overall:	126.7 metres
Length waterline:	114.8 metres
Beam moulded:	30.4 metres
Hull depth moulded:	8.2 metres
Hull draft (max):	4.2 metres
Deadweight (max):	1000 tonnes
Crew:	35
Passengers:	1291
Vehicles:	341 cars or
	450 truck lanes metres and 123 cars
Axle loads:	15.0/12.0 tonnes (dual/single axles) on central lanes
	9.0/12.0 tonnes (dual/single axles) outboard
	1.0 tonnes on forward ramps
	0.8 tonnes on mezzanine decks
Vehicle deck clear height (max):	4.60 metres
Speed:	40.5 knots, 500 dwt, 32.8 MW with operating RCS

TANKAGE

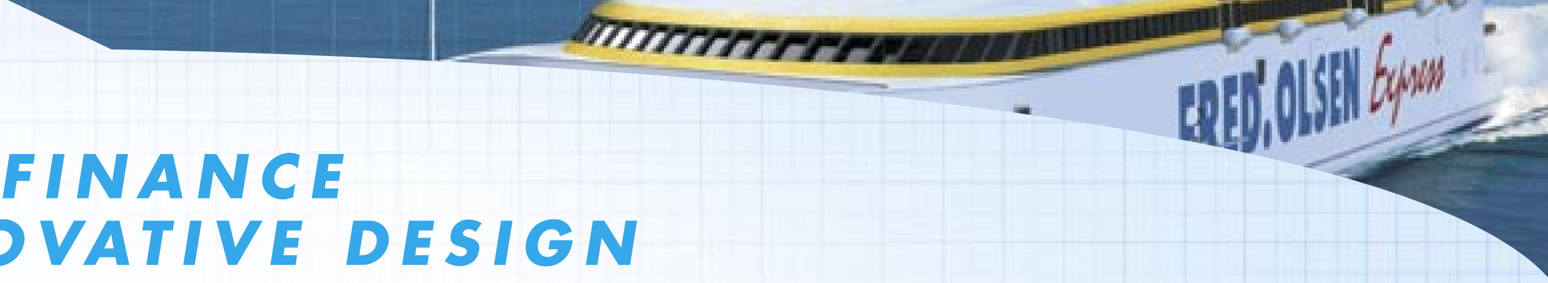
Fuel:	145,000 litres
Fresh water:	7000 litres
Black & grey water:	7000 litres
Lube oil:	2 x 600 litres
Hydraulic oil:	2 x 600 litres
Sludge:	1000 litres

PROPULSION

Main engines:	4 x MTU 20V 8000; 8,200kW at 1095rpm each
Gearboxes:	2 x Renk ASL65; 1 x Renk ASL 2X80
Waterjets:	2 x Kamewa 125 SII; 1 Kamewa 180 BII
Azimuthing bow thrusters:	2 x Ulstein Aquamaster UL601
Generator sets:	4 x MTU 12V 2000 M40, 540 kW each.

SURVEY

Classification:	Germanischer Lloyd ✠100A5, HSC-B OC3 High Speed Passenger/Ro-Ro Type ✠MC, AUT.



INNOVATIVE FINANCE FOR AN INNOVATIVE DESIGN

FINANCE PLAYS A MAJOR PART IN ANY SHIPBUILDING DECISION. AUSTAL HAS ESTABLISHED AN IN-HOUSE FINANCIAL TEAM THAT MAINTAINS RELATIONSHIPS WITH A NUMBER OF INTERNATIONAL FINANCIAL INSTITUTIONS THAT CAN ASSIST AUSTAL'S CLIENTS IN DEVELOPING CUSTOMISED VESSEL FINANCING SOLUTIONS.

Early in the discussions that lead to the eventual contract to build "Benchijigua Express" Fred.Olsen, S.A. identified that Austal's ability to provide an innovative and tailored finance package would be equally as important as its ability to design and construct the innovative and revolutionary trimaran design.

So while the technical teams were focussed on tank tests, operability analyses and structural design challenges, the financial team at Austal worked to source lenders and investors who would work with Austal to create a financial structure that would meet the objectives of Fred.Olsen, S.A.

Two key partners in this process were the Export Finance Insurance Corporation (EFIC) and ABN AMRO.

EFIC is an arm of the Australian government mandated to provide finance to facilitate export projects that fall within its qualifying parameters. Over the years EFIC has been a strong supporter of Australian high speed ferry exports having provided finance for multiple vessel orders with a total value of A $870 million.

ABN AMRO is one of the world's largest global financial institutions. Formed in the Netherlands over 180 years ago ABN AMRO today operates in over 60 countries and provides a wide range of financial products and services, including specialised financing for shipping. ABN AMRO has previously worked with Austal to provide shipbuilding finance for a number of its clients.

Together with ABN AMRO and EFIC, Austal was able to structure an innovative financial package that provides Fred. Olsen, S.A. with a tax effective ten year lease purchase structure and Austal with a cash sale.

As Andrew Lawson, the head of ABN AMRO's cross border structured finance team said:

"This transaction provided an excellent opportunity to demonstrate the benefits of our geographic reach, financial product range and structuring ability. It further consolidates the strong relationships between ABN AMRO, Fred.Olsen, S.A., Austal and EFIC".

THE AUSTAL COFFERDAM

DURING THE PRE-CONTRACT NEGOTIATIONS AND DISCUSSIONS WITH FRED.OLSEN, S.A., THE CONCEPT OF PROVIDING AN ALTERNATIVE MEANS TO INSPECT AND REPAIR THE WATERJETS ON THE VESSEL WITHOUT DRY DOCKING WAS DISCUSSED. FRED.OLSEN, S.A. HAD EXPERIENCED DELAYS AND HIGH COSTS WHEN DRY DOCKING HULLS IN THEIR CURRENT FAST FERRY FLEET.

• Cofferdam in position ready for use.

• Pneumatic air controls.

• The cofferdam pumped dry and in position under the vessel.

Initial studies were directed at investigating a full width drydock capable of lifting the aft end of the vessel out of the water, however the final selected design was a submergable cofferdam that would fit underneath the aft end of the centre hull.

The cofferdam was designed to the precise shape of the aft end of the vessel's underbody, with a labyrinth seal arrangement providing the watertight connection between the hull and the inside of the cofferdam.

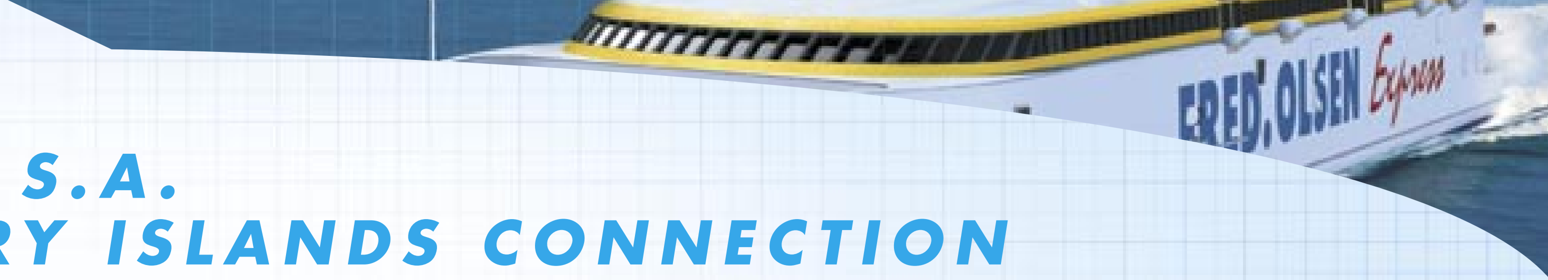
The cofferdam has a number of floodable ballast tanks located in its walls and cross structure which allow the complete unit to be submerged below the aft end of the centre hull. The amount of water in each ballast tank is controlled by pneumatically operated flooding valves. The pneumatic controls for the ballast tanks are located centrally in a raised control station. Pneumatic air and electrical power is supplied by the vessel's onboard supply.

The cofferdam is manoeuvred into position behind the centre hull of the trimaran prior to being flooded down. Once the cofferdam has been flooded it can be manoeuvred into position using guides built onto the cofferdam and chain blocks that may be attached to brackets located on the hulls. A diver is used to check that the seals have not been dislodged during the flooding operation. Pneumatic air is then used to force water out of the ballast tanks. The water remaining in the well of the cofferdam is pumped out using a submersible pump. Once the ballast tanks are pumped dry the cofferdam provides about 200 tonnes of uplift against the vessel's hull and this uplift provides the sealing force on the labyrinth seal arrangement. The well of the cofferdam is also fitted with a small submersible bilge pump which is designed to take care of any minor leaks that may occur through the seals.

Once in place under the vessel it is possible for a person to climb down into the cofferdam and to walk forward access any of the three waterjet sea intakes or either of the two rudders. Alternatively if it is necessary to inspect the aft section of the drive shaft in the waterjet, this is now possible without slipping the vessel.

Removing the cofferdam is the reverse of the above procedure. The cofferdam is designed to be stored ashore after it has been lifted out of the water. For convenience the cofferdam may be dismantled into smaller sections so that storage issues are reduced.

The Austal cofferdam for *"Benchijigua Express"* provides a cost effective and fast alternative to dry docking the vessel. The cofferdam design, design loads and construction were inspected and supervised by Germanischer Lloyd.



FRED.OLSEN, S.A. & THE CANARY ISLANDS CONNECTION

THE CANARY ISLANDS COMPRISE A GROUP OF ISLANDS IN THE NORTH ATLANIC OCEAN MAKING UP TWO PROVINCES OF SPAIN. THE ISLANDS HAVE A FINE CLIMATE WITH SANDY BEACHES, BLUE SEAS AND SUNSHINE ATTRACTING ABOUT 10 MILLION TOURISTS ANNUALLY. TODAY THE CANARY ISLANDS ECONOMY IS DRIVEN PRIMARILY BY TOURISM ALTHOUGH AGRICULTURE AND DEEP-SEA FISHING PROVIDE AN INCOME FOR THE PROVINCES.

Fred. Olsen & Co. was founded in Norway in 1848.

In 1904 the Fred Olsen family established trade and business relations with the Canary Islands. Initially this was only through shipping but developed to include a shipping agency, agricultural development, tourist promotion activities and ferry services.

It was in 1974 after a number of petitions from the people of La Gomera that Fred. Olsen Snr. established Ferry Gomera, S.A., and on July 8 of that year the first ferry to take the name "Benchijigua" commenced service between the ports of San Sebastián de La Gomera and Los Cristianos (Tenerife). For this island, one of the smallest in the archipelago, and at that time very isolated from the other islands the service enabled an immediate improvement in prosperity and a memorable change to the lives of the Gomerans.

Today the company operates five routes in the islands leading the passenger and cargo market with more than 2,700,000 passengers, 400,000 cars, and more than 150,000 trucks per year. At the same time the company also has a wide variety of interests in the hotel trade, restaurant industry and culture.

From the beginning the company's philosophy has been to connect the Canary Islands between the nearest points and to offer a combined service for passengers and cargo.

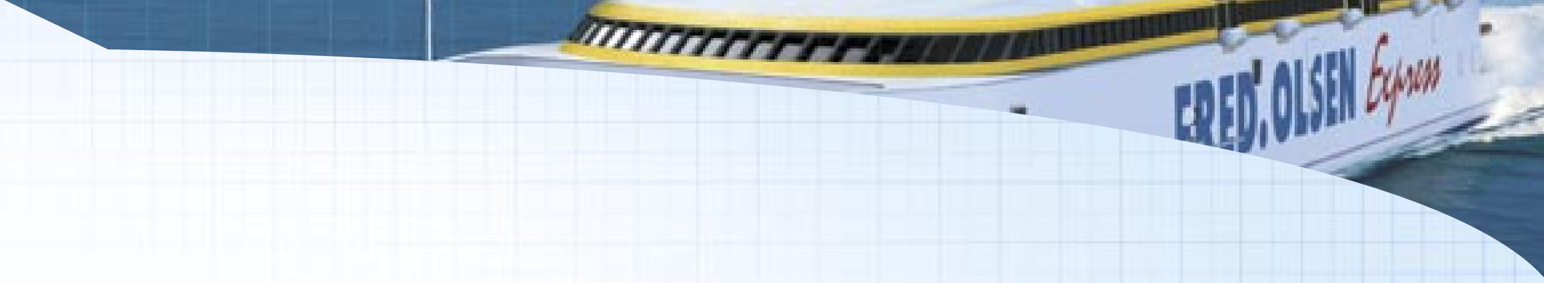
Once fast ferries were commercially operative the company decided to convert its fleet of conventional ferries into high speed ferries.

This landmark was achieved in 1999 with acquisition of the company’s first high speed ferry, “Bonanza Express”, an Incat 96 metre wave piercing catamaran, which inaugurated a 1 hour service between Santa Cruz de Tenerife and Agaete, Gran Canaria.

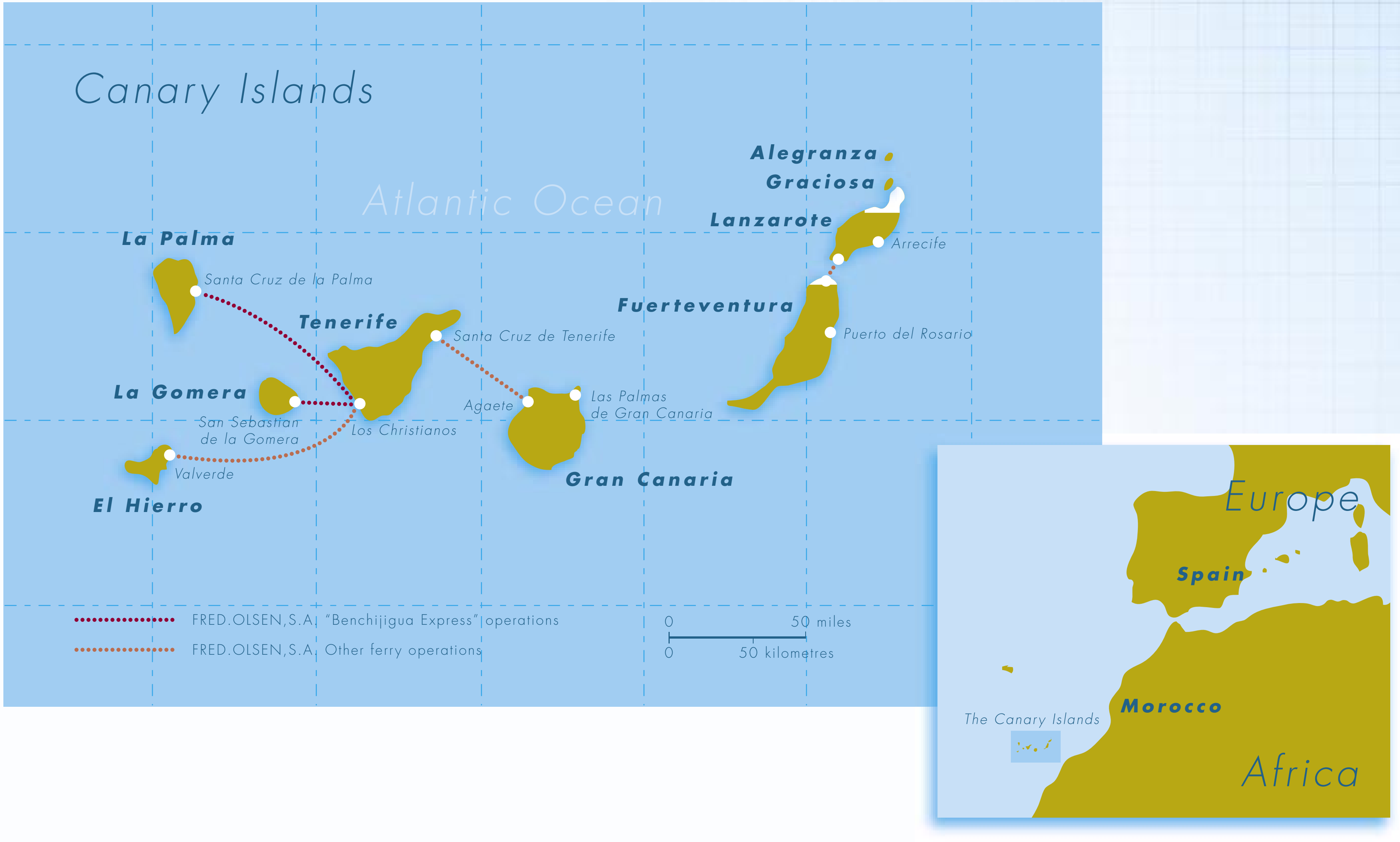
“Bonanza Express” was followed by two further 96 metre Incat wave piercing catamarans that allowed the company to also offer a 30 minute service between San Sebastián de La Gomera and Los Cristianos, Tenerife.

In December 2002, Fred. Olsen, S.A. contracted Austal to construct a vessel to operate between the islands of Lanzarote and Fuerteventura with capacity for 450 passengers and 69 cars or 110 lane metres of trucks plus 37 cars at a speed in excess of 30 knots. In November 2003 the vessel “Bocayna Express” was delivered.

• Drawing of “Benchijigua Express” by Mercedes Kerch Morales, age 10, winning entry used for the cover of the 2005 calendar for Fred.Olsen, S.A. and Austal.


FRED.OLSEN Express

OPERATIONS


Canary Islands
Atlantic Ocean
Alegranza
Graciosa
Lanzarote
Arrecife
La Palma
Santa Cruz de la Palma
Fuerteventura
Puerto del Rosario
Tenerife
Santa Cruz de Tenerife
La Gomera
San Sebastian de la Gomera
Los Christianos
Agaete
Las Palmas de Gran Canaria
Valverde
El Hierro
Gran Canaria
FRED.OLSEN,S.A. "Benchijigua Express" operations
FRED.OLSEN,S.A. Other ferry operations
0
50 miles
0
50 kilometres
Europe
Spain
Morocco
The Canary Islands
Africa

FUTURE TRIMARAN APPLICATIONS

AUSTAL IS THE VESSEL DESIGNER AND BUILDER IN THE GENERAL DYNAMICS TEAM FOR THE US NAVY'S NEW HIGH-SPEED SURFACE CLASS SHIP.

BACKGROUND INFORMATION

The Littoral Combat Ship (LCS) is a key element of the US Navy's plan to address asymmetric threats. Intended to operate in coastal areas worldwide, the ship will be fast, highly manoeuvrable and geared to supporting mine detection/elimination, anti-submarine warfare and surface warfare, particularly against small surface craft including terrorist boats.

The goal is to deliver a platform (vessel) that can be deployed in relatively large numbers to support a wide range of joint missions, with reconfigurable mission modules to assure access to the littoral (near shore) environment while also being able to independently deploy over long distances and remain on station for extended periods.

Some of the key characteristics of the LCS include the following:

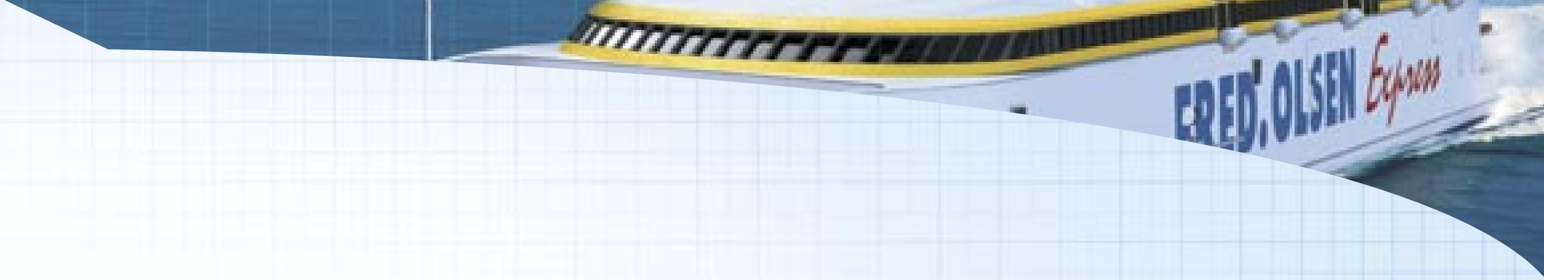
- Modular payload with rapid changeover capability to reconfigure in response to changes in mission, threat, and technology.
- Top speed in excess of 40 knots.
- Very low core manning for all ship navigation, engineering and self-defence functions.
- Very shallow draft to allow operations in littoral regions.

The LCS will rely heavily on manned and unmanned

• *127 metre Littoral Combat Ship design for US Navy.*

vehicles to execute assigned missions and will employ technologically advanced weapons, sensors, data fusion, C4ISR1 systems, hullform, propulsion, optimal manning concepts, smart control systems and self-defence systems.

The LCS must be capable of operating at low speeds for littoral mission operations, transit at economical speeds, and high-speed sprints, which may be necessary to avoid/prosecute a small boat or submarine threat, conduct intercept operations over the horizon, or for insertion or extraction missions.



GENERAL DYNAMICS LCS TEAM

Bath Iron Works, a General Dynamics company, is the prime contractor and leads an international team in which Austal takes the key role of the designer and builder of the trimaran platform.

Other Team members include CAE, BAE Systems, Maritime Applied Physics Corporation, Northrop Grumman Electronic Systems and four other General Dynamics companies: Advanced Information Systems, Armament and Technical Products, Electric Boat and General Dynamics Canada.

GENERAL DYNAMICS LCS TEAM PROPOSAL

The General Dynamics Team's LCS design is based upon Austal's innovative, high-speed trimaran design.

• Mult-role design for high speed troop and equipment transport.

The 127 metre long, 31.6 metre wide trimaran will be built in aluminium and powered by two gas turbine and two diesel engines to reach sustainable speeds in excess of 40 knots. The ship is designed to allow a crew of fewer than 40 sailors to fully operate, maintain and defend it.

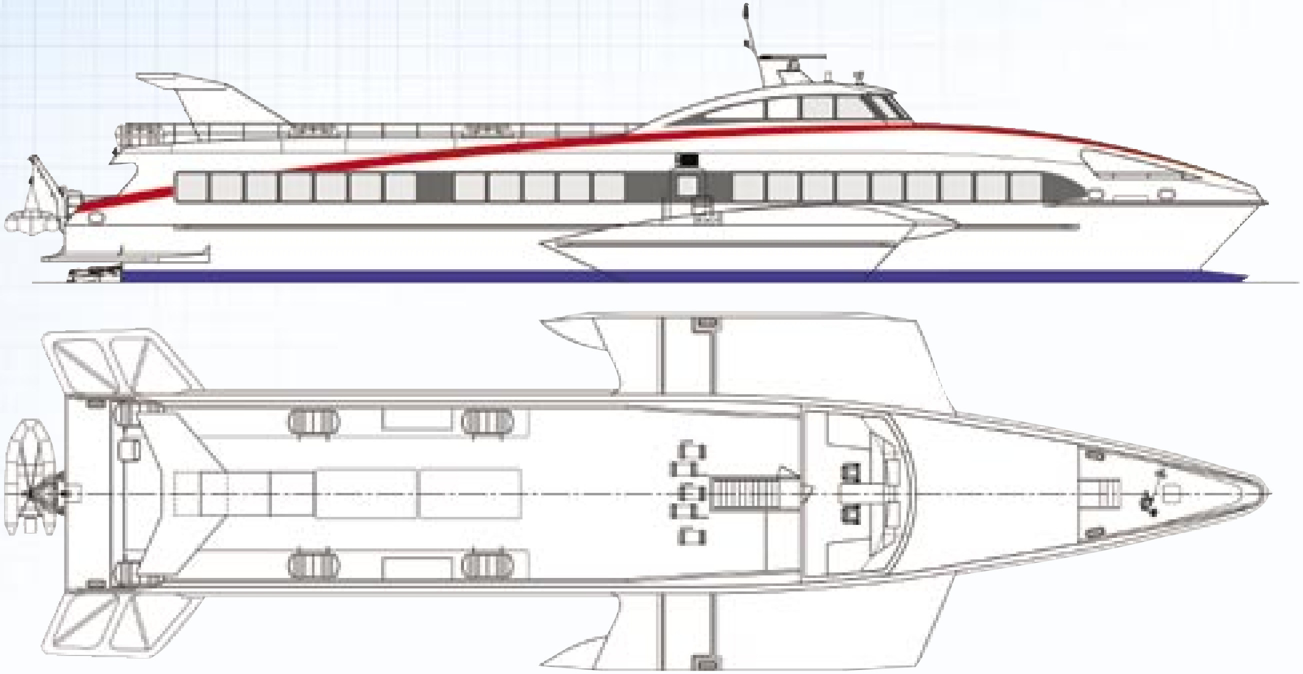
The flexibility, speed, endurance, volume, seakeeping, payload capacity, and manoeuvring characteristics of the trimaran, coupled with modular mission packages and other modifications to address military-specific requirements, provide an optimal solution for the US Navy's LCS requirements.

Key characteristics of the ship proposed by the General Dynamics Team include:

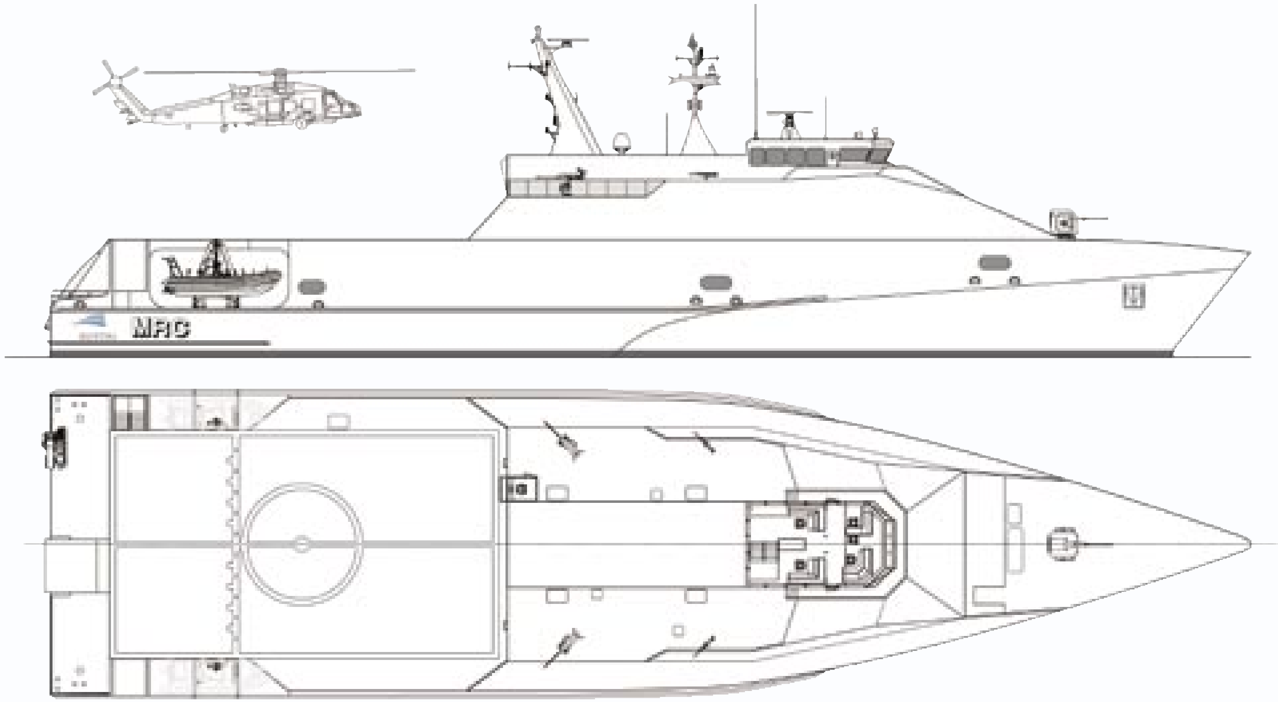
- Capable of supporting several missions simultaneously.
- Open-architecture information systems enable over-the-horizon surveillance and reconnaissance, global networking and coordinated air, surface and undersea tactical picture.
- Incorporation of stealth technologies increases ship and crew survivability.
- Shallow draft allows operations near the shore.
- More payload per tonne of displacement than any previous US warship.
- Huge interior volume delivers enhanced mission capabilities and endurance.
- Supports concurrent and simultaneous operation of two large (H-60) helicopters.

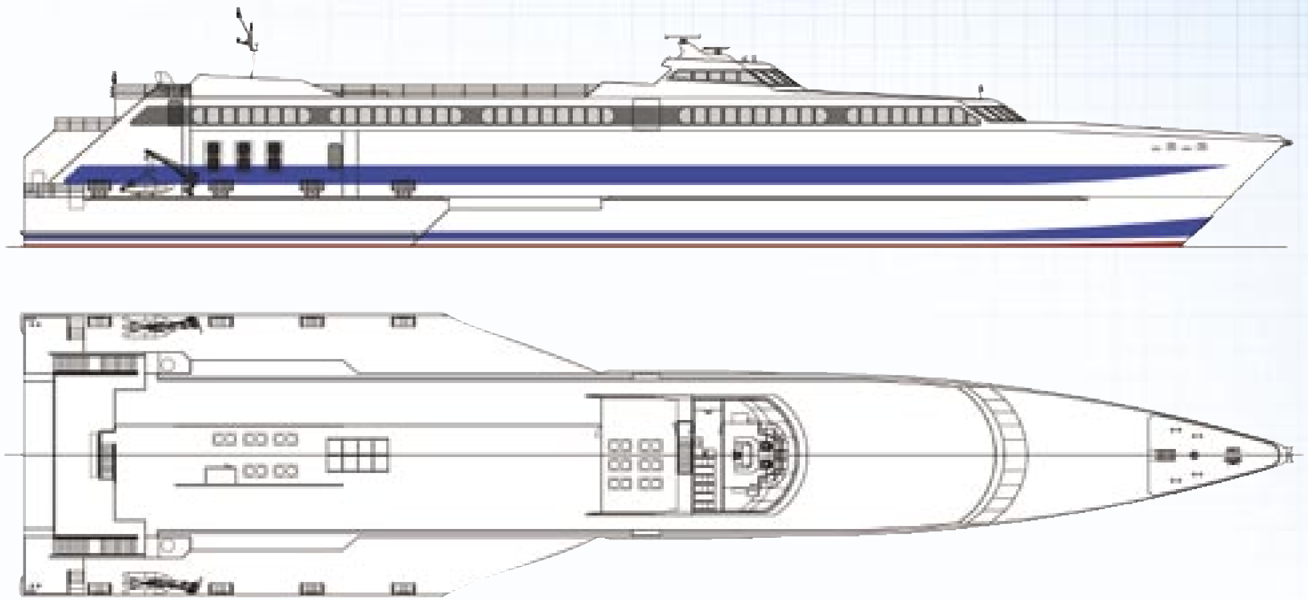
The trimaran's characteristics also make it applicable to a wide variety of other domestic and international navy, coastal defence, and high-speed logistics support programs.

• 50 metre Trimaran

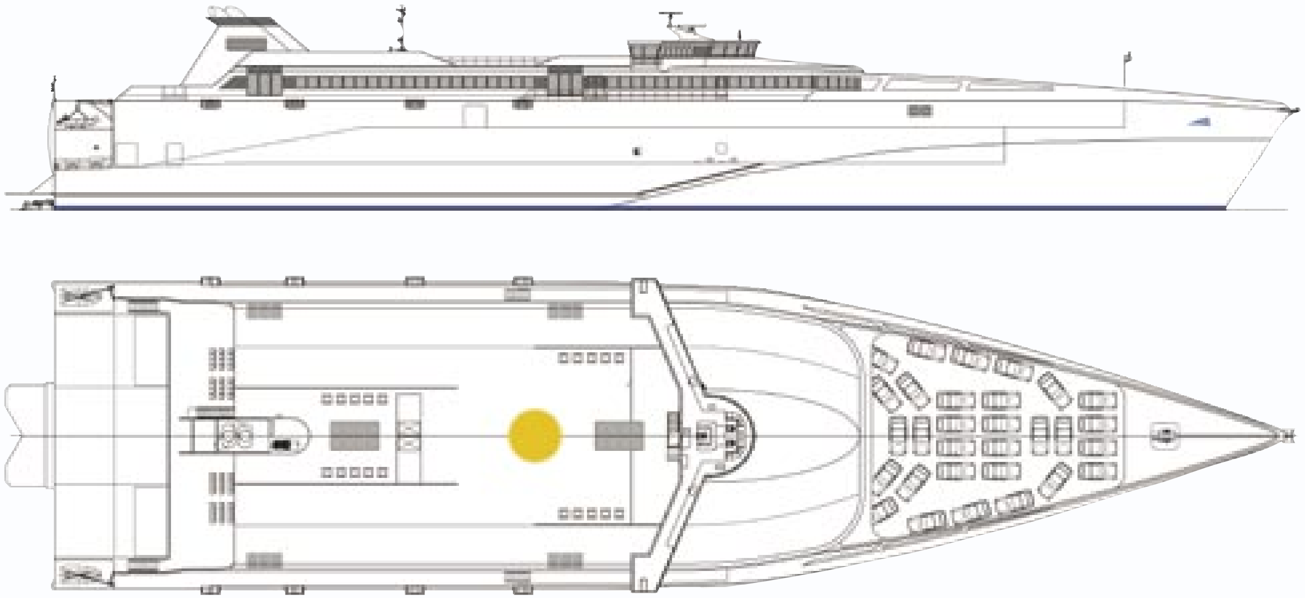


• 76 metre Trimaran





• 100 metre Trimaran



• 126 metre Trimaran

AUSTAL TRIMARAN TECHNOLOGY

- **GREATER PASSENGER APPEAL** – *A MORE COMFORTABLE RIDE, MORE OFTEN*
- **BETTER SERVICE RELIABILITY** – *MORE OPERATING DAYS AND FEWER DELAYS*
- **LOW OPERATING COSTS** – *BURN LESS FUEL THAN ALTERNATIVE HULLFORMS*
- **NEW OPPORTUNITIES** – *OPERATE WHEN AND WHERE OTHER FAST SHIPS CANNOT*
- **DEPENDABLE –** *DEVELOPED, DESIGNED AND BUILT BY THE EXPERTS*
- **FEWER COMPROMISES** – *ENHANCED SEAKEEPING NO LONGER DEPENDS ON SIZE*
- **MEETING YOUR NEEDS** – *SUITABLE FOR A RANGE OF VESSEL SIZES AND TYPES*
- **THE DISCERNING CHOICE** – *CHOSEN BY LEADING COMMERCIAL AND DEFENCE OPERATORS*

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