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JavelinSkiff

Introduction

The Javelin is a high performance, single trapeze, 14ft two-handed skiff raced competitively throughout New Zealand and Australia. Its lightweight 70kg hull, and powerful, efficient sail plan allow it to exceed speeds of 25 knots and provide an exhilarating "ride" and exciting fleet racing.

The Javelin is a restricted development class, which offers close exciting racing at a very affordable price. The Javelin is a lightweight boat, and carries a large sail area for its size. This combination makes the Javelin a very exciting boat to race and sail.

The Javelin was designed in New Zealand by John Spencer in 1961. Its popularity has seen it become a National Class with fleets throughout New Zealand and Australia.

Design History

This is a short racing and construction history of the Lee Mk I Javelin design, currently there are 6 boats built to this design.

This design was built to attempt to take advantage of the class changes to Gennaker racing, and had proven to be a fast and all round performer.

July 1998	International Class rules allow Gennakers
January 2000	New hull design ideas discussed at Otago Nationals. Hull designed using 3D CAD software.
August 2000	Auckland Squadron builds a male hull and foredeck mould with assistance from Unitec in CNC cutting the hull frames. Three vacuum bagged boats were boat. NZ 374 “Flying Circus” – Taranaki NZ 375 “Plan A” – Wellington NZ 376 “Bungholio” – Auckland The construction of these hulls was followed on the Javelin web site as the Virtual Javelin project. *http://www.javelins.org/Technical/virtualJavelin/virtual_index.htm*
April 2002	Bungholio wins New Zealand Nationals
Winter 2002	AUS 670 “Phlegm Bouyant” – Perth built on male moulds as plug for a female mould. Male cockpit/deck plug built. Female hull and deck moulds completed.
January 2003	Bungholio wins South Pacific title in Perth, Flying Circus is 7th. NZ 380 “Riders on the Storm” – Gisborne becomes 1st boat out of the female moulds.
September 2003	AUS 672 “The Edge” – Perth is the 2nd boat built the female moulds.
January 2004	The Edge gets 2nd in Australian Nationals, and 3 months later wins the Western Australian State championships.

Design Ideas

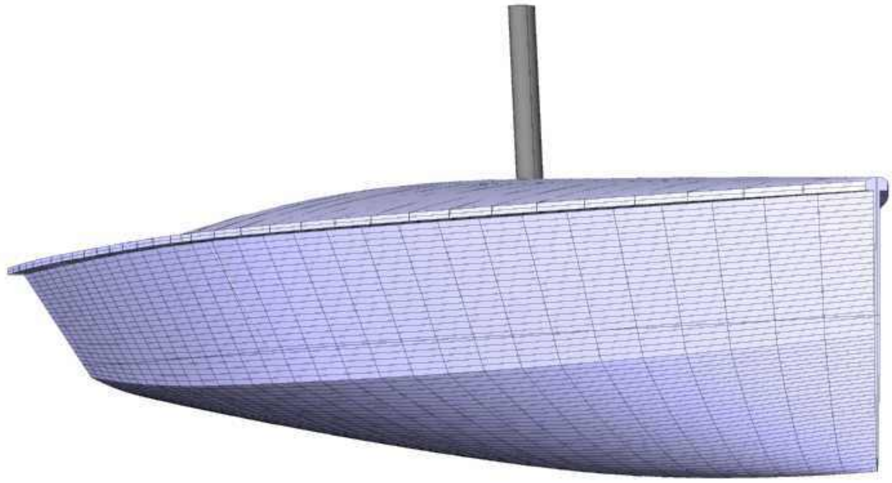
The Lee Mk I was designed by David Lee. David was at Auckland University doing his Phd in Engineering at the time.

To measure the speed differences between the current designs as well as any new design David developed a performance estimation programme. This programme is based on experimental work carried out at the Delft University of Technology in the Netherlands.

The work at Delft involved the systematic variation of different hull parameters such as prismatic coefficient, length to displacement ratio, centre of buoyancy, etc to determine their effect on hull drag. This work is the foundation of many velocity prediction programs used by yacht designers.

Once the programme was developed, analysis was performed on the currently successful McNeill, Stacey and Salthouse designs to establish a design benchmark.

Approximately 80 new designs were developed in different corners of the Javelin class rules and run through the programme. The results showed that hulls with a very fine entry, minimum beam, maximum rise from keel to chine at mid-length and a minimum width stern gave the least drag.



Experience in the class found that very narrow sterns tend to cause downhill control difficulties due to the swept in flow exiting the hull. The effect of rocker in the design was to decrease drag at low speed by reducing the wetted surface area. However, reducing wetted surface area via increased rocker comes at the cost of planing performance. It was found that wetted surface area could be effectively reduced by increased section curvature in the aft of the hull. An added bonus of doing this was that the aft waterlines could be straightened while still keeping the stern reasonably narrow.

From these ideas the design was refined with the help of 3D CAD graphics and CNC machined 1/5th-scale polystyrene models to visualise the actual hull shape.

Moulds & Templates

The class has constructed two female moulds, these moulds are available to use for anyone wanting to build a Javelin.

Hull Mould	Full hull, gunwale and transom mould, with removable centre-case and transom components for de-moulding.
Deck Mould	Foredeck, gennaker chute, main bulkhead, false floor and side tanks. Gunwale edge moulded to cap gunwale from hull mould.
Gennaker Chute	A small mould for the reversed inside portion of the gennaker chute.
Templates	3mm MDF templates of all panels and frames to reduce construction time and material wastage.

Hulls and decks can be pre-undercoated in the mould, and are complete and ready to paint except for the following areas:

Transom – Outside of transom finished, top of transom needs to be capped with carbon or equivalent tube to take top rudder gudgeon, with compression strut to floor.

Stem – Retractable gennaker prod sleeve needs to be fitted through a hole drilled in the stem, and fixed in place.

Centre case – Finishing work around centre case where the centre case mould from the hull is joined to the false floor from the deck mould.

False Floor - Glass tape reinforcing of the false floor to the transom, and the main bulkhead on the foredeck mould to the main bulkhead on the deck mould.

Construction

Approximately 120 hours are required to construct a Javelin to a stage ready to screw/bolt on the fittings.

With a team of 2-3 people working bribed with Beer and Pizza it is possible to get the majority of a hull or deck constructed in a single weekend.

Depending on interest, in most cases we try to construct 3 boats at a time, this way we achieve economies of scale in materials, and construction times.

Hull Construction

1. Paint hull mould with undercoat.
2. Laminate outside skins of glass on hull bottom, sides, centre case & transom.
3. Cut foam using templates, and glue to outside skins of glass using vacuum bagging.
4. Glue reinforcing blocks for fitting locations into foam.
5. Laminate up inside skins of glass.

Deck Construction

1. Paint deck mould with undercoat.
2. Laminate outside skins of glass on foredeck, side decks, false floor and front bulkhead.
3. Cut foam using templates, and glue to outside skins of glass using vacuum bagging.
4. Glue reinforcing blocks for fitting locations into foam.
5. Laminate up inside skins of glass.

Frames

6. Laminate both sides of 2 sheets of foam for frames and front false floor.
7. Cut frames and false floor from foam using MDF templates.
8. Glue the main bulkhead into the hull.
9. Glass tape main bulkhead, glue in remainder of sub false floor frames.

Other

10. Fit and glue in the front false floor.
11. Fit and attach the retractable bowsprit outer tube to stem.
12. Join deck and hull together.
13. Finish around centre case, transom, front bulkhead and gennaker chute.

Materials

The materials we have typically used for the construction of the hulls have been chosen to produce a strong hull for an affordable price. Hulls have been built in batches of three, so we minimise the number of different materials to reduce wastage and keep costs down.

The typical materials used to construct the hull are:

Foam core	Herex® or Klegecell®, 8mm &10mm, 80 kg/m3
Skins	Outer surfaces 2 x Layers 200g e-glass Inside surfaces 1 layer 200g e-glass
Resin	Adhesive Technologies ADR246 / ADH28 Epoxy Laminating Resin

This is the suggested core lay-up:

Component	**m^2**	**Material**
False Floor	2.9	80 kg/m^3 8mm
False Floor (Front)	1.4	80 kg/m^3 5mm
Side Decks	2.5	80 kg/m^3 8mm
Foredeck	2.0	80 kg/m^3 8mm
Hull Bottom (below chines)	4.6	80 kg/m^3 10mm
Hull sides	3.1	80 kg/m^3 8mm
Transom	0.5	60 kg/m^3 8mm
Gunwales	0.5	60 kg/m^3 8mm
Frames	1.6	60 kg/m^3 8mm

There is no limitation on the materials that can be used to construct a Javelin, so you could build a Balsa cored, Carbon/Kevlar reinforced boat using Polyester resins if you liked.

Weight

Target weight for a finished, painted hull, with a fitted retractable bowsprit ready to attach fittings is 62 - 65kg. This allows a sailing weight of 70kg, which includes 2 - 5kg of lead weight correctors.

Class Rules on Weight:

8.15.2 *The hull, to be weighed in a dry condition, and inclusive of all normal permanently fixed fittings, but excluding centerboard, rudder, rudder box, sheets, tiller and extensions, mast, standing rigging, boom, sails and ram strut shall not be less than 70kg. Any item, which in the opinion of the measurer constitutes ballast, shall be removed before weighing.*

8.15.3 *In the event of a boat being underweight, one weight corrector weighting not more than 5kg will be permitted. The weight corrector shall be lead and be bolted or screwed along the centerline of the boat between the mast base and the front of the centre case and be clearly visible at all times. The weight corrector must be able to be removed and weighted separately. Any other weight deficiency shall be added by structural additions that must be permanently fastened (eg. by glue), lead being deemed not a structural material.*

Costings

The costings below assume that you build your own hull, or build it as part of a class building programme and hence there is no labour cost.

The material costs, including consumables for a hull are around the $3,000 to $4,000 mark using the suggested lay-up.

Spars, Foils and Sails can be ordered directly from the manufacturers to specifications provided by the Javelin class.

There is no set manufacturer for sails, spars, foils etc, you can use anyone you like, or even build the gear yourself.

Most Auckland based manufacturers have built gear for Javelins; the equipment listed below is what we consider to be the currently best performing.

Approximate (ex GST) costs for these components are:

Spars (C-Tech)	
Carbon Fibre Mast including spreaders	$1,650
Carbon Fibre Boom	$530
Gennaker Prod & Prod Outer	$420
Foils (C-Tech)	
Carbon / Foam Centreboard	$650
Carbon Rudder	$500
Rudder Stock / Tiller	$500
Sails (Fyfe Sails)	
Mylar, Spectra Mainsail including battens	$1,440
Mylar, Spectra Jib	$750
Silicon Dynalite Gennaker	$1,200

Estimated costs for fitting out the hull:

Fittings	
Ronstan / Harken Deck Gear, and Fastenings	$1,500
Control lines, Rigging and Sheets	$1,000

This will arrive at a ready to sail Javelin in the $16,000 - $18,000 range.