My Flat Bottom Finn Musings

I had finally finished remodeling NZL193's bow to replicate the sucked in cheeks of a modern Finn. Back in the day she was build (1972) there was a rule that reverse curves were not allowed in the hull surface.

When originally rebuilding my Finn I missed the opportunity to fine up the bow entry angle as enabled by the change in rule D3.2 (f) – "From Station 0 to Station 6, hollows in the hull form are prohibited. From Station 6 to the Stem, hollows in the plane of the Sections are prohibited. Minor distortion due to curing of plastic hulls is acceptable." Interpretation = no vertical hollows allowed but horizontal hollows are fine. A fine entry angle on the bow makes not only cutting waves easier but takes a bit of positive displacement buoyancy out of the bow, allowing it to be driven down to achieve maximum water line length and have greater directional stability. With extra hull fullness low done around Station 8, the buoyancy required to carry the mast is taken from the now fine entry bow to directly under the mast (see photo next page).

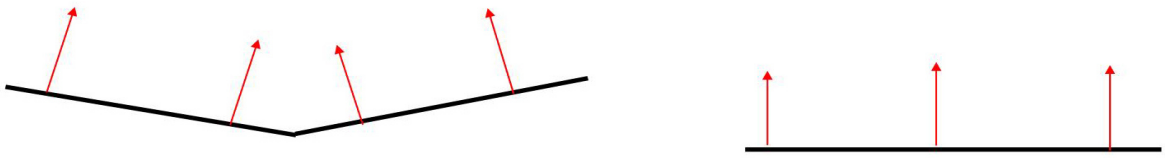
If you saw me scuttling around the boat park with a straight edge and a ruler recently, it was for measuring how sucked in the bow profile was in the horizontal plane on the Devoti Classic boats. The new bow cheeks, especially low down and close to the bow stem line, on NZL193 went from being about 10mm puffed out to 8mm sucked in.

About the same time and during post race debriefs (the bulldust sessions over a few beers) questions were raised why the Devoti Fantasticas were so fast. "Flat bottoms" was the answer. Cool, but why are flat bottomed Finns faster? And could one convert a Devoti Classic to a Fantastica (simple answer, no - long answer, maybe with just a flat bottom from aft of the centre case back to the transom)?

Flat bottoms boats are faster as they generate greater levels of dynamic lift with reduced levels of dynamic drag, whilst Finns with V bottoms generate greater levels of dynamic drag and less dynamic lift.

The reason for this is the facts that lift from any surface moving over water generate lifting forces at a right angle to it. With V shaped bottoms, much of that lifting force is directed inwards, where it does nothing for performance as the lifting forces have a cancelling out effect.

Put in a simplistic diagrammatic form, we have this;



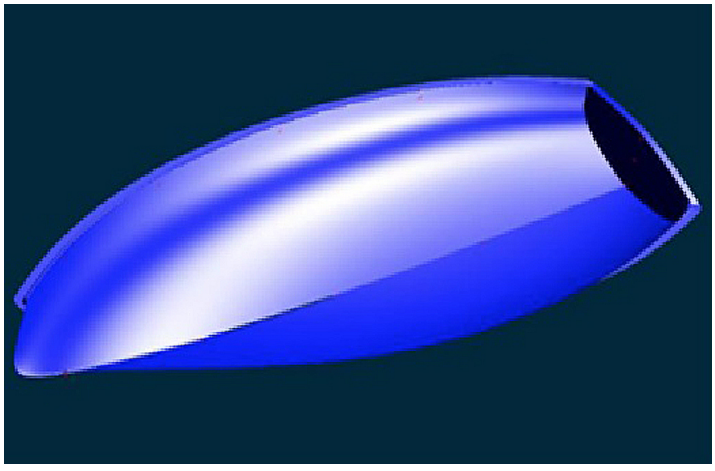
When being driven forward, the V bottom boat generates lift on the starboard side that cantilevers the port side downwards into the water. Similarly the port side cantilevers the starboard side downwards, creating what is called dynamic drag. There is also form drag to consider but let's not get too complicated.

The flat bottom boat generates dynamic lift straight up. A flat bottom also has less surface area contact with the water when being driven forward and lifted. Less surface area in the water = greater speed.

Not being a naval architect, please don't ask me to quantify how much drag or lift is created with what is a very, very shallow angled V bottom on a Finn. I don't know. However these two publications are worth a read in full.

https://sailcraftblog.wordpress.com/2016/11/23/pt-2-2-shapes-in-the-liquid-the-hull-of-todays-performance-dinghy/

http://www.uk-cherub.org/lib/exe/fetch.php/designs/20120521_behind_the_enos.pdf



Whilst they pertain to skiffs, the information is relevant to the hull shape of the Devoti Fantastica. Prior to the release of the Devoti Fantastica, all Finns had a V shaped bottom.

This is a 3D solid model rendering of the Petticrow Finn.

It is an exact replica of Ben Ainslie's world famous "Rita" Devoti Finn.

The V shape in the hull aft sections being clearly visible.

If we look at the photos of a Fantastica in the measuring jig, published in the April 2018 edition of Finnfare (pages 16 and 17), we can see just where the flat areas are. They are not large but together with the elliptically shaped bottom, are huge departures from the traditional Finn V bottom hulls.

https://issuu.com/finn-class/docs/finnfare_april_2018

Station 2 is representative of what the flat area and elliptical bottom looks like. (the red line added may not represent the exact shape but indicates the general profile)

Station 2 template

Flat area on Fantastica at station 2, but still within 10mm tolerance

The brown piece of wood under the template is the calibrated measuring wedge.

Station 0 template

Station 0 (transom) with template. Note how the flat area diminishes in width but the elliptical hull shape is retained. Still passing through the fixed measuring position but putting more positive buoyancy in the back of the boat so she float higher, gets on the plane quicker and drives the bow down.

It would seem that the flat area and elliptical hull shape starts somewhere along the centre case forward of Station 6.

Station 8 template

This is not the only reason the Fantastica's are fast. They have the absolute minimum hull rocker profile which together with a narrower sheerline, change completely the Finn hull shape.

This is station 8, note the hull fullness retained directly under the keel line that indicates greater positive hull displacement volume, to carry the mast weight plus prevent nose diving,

Be interesting to see how much the 3 dimensional hull shape from the X axis bow stem profile back to the Y axis hull section at Stations 8 and 6, differs from the Classic hull shape.

There are a myriad of construction details and glass layup reasons that the Devoti Fantastica is fast but I'm just looking at hull shape. With the new bow finished on NZL193, I had her upside down as a mold to lay-up a new beach trolley cradle and to give her a repaint. Could I convert the back half of NZL193 to be shaped like a Fantastica?. That would give me a boat with a Devoti Classic front end and a Fantastica back end.

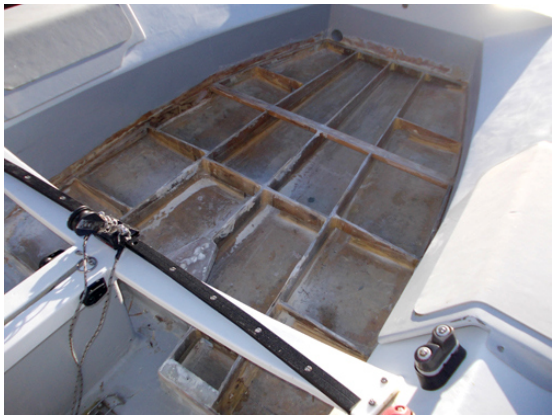
Punting around in my much modified old Mk2 Marten (built in 1972 and with only original part left being the centre case and 2/3 of the hull shell thickness) decided that the further improvements of a flat bottom aft of the centre case could theoretically make the boat go faster.

First place to start is the rocker profiles. Searching through my stack of measuring certificates and looked at the various rocker profiles to see how the Fantastica differed.

	Transom 0	St 1 500mm	St 2 1000mm	St 4 2000mm	St 6 3000mm	St 8 4000mm
Rule Allowable Variation	**-201 0**	**-152 +/- 5mm**	**-109 +/- 10mm**	**-45 +/- 10mm**	**-16 +/- 10mm**	**-52 0**
Devoti 2001	-201	-150	-106	-45	-13	-52
Devoti 2010	-201	-154	-108	-43	-10	-52
Devoti Fantastica	-201	-156	-117	-54	-26	-52
Pata 2015	-201	-156	-115	-50	-22	-52
Mk2 Marten Original	-201	-153	-108	-38	-18	-52
NZL193 Classic Copy	-201	-153	-108	-38	-9	-52
NZL193 Hybrid	-201	-156	-117	-43	-9	-52

Note the huge difference in rocker profiles at Station 2, and the smaller differences at 4 and 6, between a Classic and a Fantastica. Be mindful that depending upon the bow stem offset, the spline curve from the bow stem, through the fixed point at -52mm for Station 8 to the -26mm point at Station 6, can influence the rocker profile offset at the unmeasured and theoretical Station 7, thus potentially increasing the displacement volume between Stations 6 and 8.

Biggest worry for NZL193; will there was enough fiberglass left in the hull to be able to re profile the rocker, especially the 9mm required at Station 2. Only way to find out was to run a string line from the correct height blocks at the fixed offsets for Station 0 and 8. Grind away and measured down to the required datum point at each station along the rocker centreline. From my full scale CAD drawings also established the rocker profile datum points at Station 3 and 5. With the datum areas at each hull station established, ground and sanded out the new rocker profile from aft of the centre case (Station 4) to the transom.



After grinding away the old rocker, was there enough fiberglass left in the hull shell? No, there was a large hole roughly 400mm long either side of station 2 plus I could see the pencil marks on the inside of the hull made when building the boat elsewhere. Made up some quad bias fiberglass panels to slide into the holes and glue onto the inside of the hull to make it water tight again.

Have plenty of scantlings between hull and floor so strength wise, no worries.

With the boat level on its trolley, a spirit level was used to make sure we kept the new flat surface horizontal as the new rocker profile was extended outwards. Interestingly the flat areas faired into the hull very naturally and without much effort to get a nice rounded elliptical shape.

The flat area is not all that wide, some 300mm at its very widest between Stations 2 and 4, to almost zero at Station 0.

This technically does not give a true Fantastica shape to the aft part of NZL193, (due to the wider sheerline) but at least gives the desired flat bottom hull shape.

Filled, faired and long boarded the hull ready for paint.

Fresh paint and all ready to go.

Placed NZL193 on the scales and checked her weight.

Whilst having ground away the V section it necessitated the inclusion of new fiberglass panels inside the hull thus unsurprisingly no change in the weight was seen.

Without a change in weight there was no need for another swing test.

As I did when adding the Devoti Classic forward rocker profile, the hull shape at Station 2 was re-measured using a 10mm oversize cardboard template cut as per the offsets from the Finn offset tables on Gilbert Lamboley Web Site . Similarly to how I did the Station 6 re-measurement when adding the Devoti Classic Rocker Profile to the bow off NZL193, in 2014.

How did we go performance wise?

Bearing in mind the skipper is two years shy of reaching Finn Legend status, results race wise will always be at the fat end of the field.

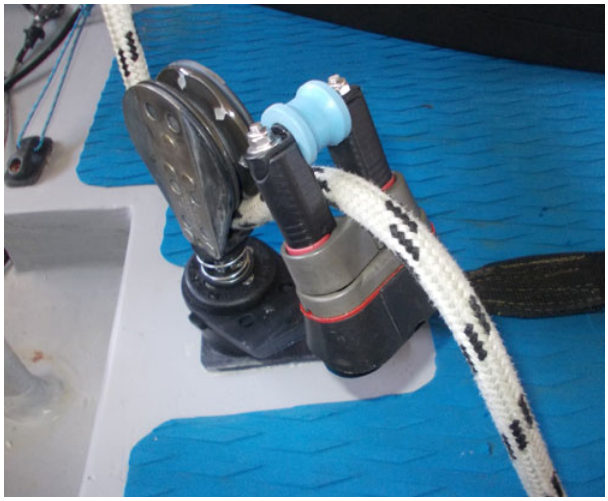
The leaner, narrower and sucked in bow has made wave sailing just so much better. Where before she would be lifted and pushed sideways on each wave, it now slices and dices through each one.

Windward boat speed is much improved. One has to be mindful not to pinch too high. Having to unlearn some bad habits and relearn that pointing comes from speed, not by pinching her up. This is much more noticeable with the new flat bottom.

Downwind the flat bottom is very stable but in light winds below 5 knots the boat felt slower. Could just be the skipper trying too hard catching waves to keep up with competitors and slowing the boat?

When broad reaching a very stable boat. Even in the 35 knot rain squall during the 2019 Nationals, the boat was manageable and responding markedly better to mainsheet adjustments. Could almost steer the boat in that wind by mainsheet alone (almost – not that silly to let go of the tiller). Maybe the boat skids more sideways for it never felt like if would "hook" to windward. Possibly need to leave the centre board down a little further if sideways slip becomes an issue.

With more displacement in the front of NZL193, due to having more rocker profile as per the Classic shape, the boat has a bow up tendency.



With the installation of the central mainsheet cleat (should have done that years ago) I can now sit further forward in the boat and push the bow down a bit more. Not experimented with mast or centerboard positions during New Zealand Finn week so the boat may be able to carry the mast a little further forward.

As per usual my last beat in the last race of any regatta is always my best. No different at the 2019 Nationals. Near last around the top mark so just gave the boat her head and went for maximum power. No pinching, just kept her bouncing on a bit of weather helm to keep the speed up. Mid fleet was to windward and over my shoulder so no gauge on speed comparison. Head down ass up for the whole beat and we popped up at the top mark in 7th. The "woohooing" was however, short-lived as I was passed by three boats on the final run to the finish.

That last beat opened a few eyes, how can a fat old man, two years away from being a legend, in an old; home modified boat, be that much faster than we have seen him go before? A flat bottom?

Led to the question at the regatta debrief, could a Classic Devoti be modified with a flat bottom. Yes it is possible but a biggish job and possibly not for the faint hearted.

I would have doubt if the Devoti Classic has enough fiberglass in the bottom of the hull to achieve a flat bottom finish without major surgery.

Easiest and most simplest way would be to flatten out the V bottom with an epoxy filler compound and fair the bottom. Won't add much weight but will not replicate the rocker profile of a Fantastica. Doing this may result in a hull that no longer fits under the hull measuring templates, thus in need of a re-weigh and possibly a new swing test.

Second but more radical option is to cut out the whole of the bottom of the boat under the existing false floor. Roughly from a point where the mainsheet block position is, back to just short of Station 0. Thus using the glued squared joint, where the cockpit floor meets the hull and the left over lip at the transom, as a rebuilding interface.

Before doing this it would be advisable to place the boat on a solid foundation and clamp the gunnels to a support network to maintain the hull shape.

Once the V bottom has been cut off and the bottom of the false floor cleaned up, new foam and class scantlings can be glued onto the bottom of the false floor and extended out to the transom to replicate the new for and aft rocker profile and sideways elliptical hull shape desired. A simple layer of quad bias fiberglass to cover the scantlings be glued on, some filling and fairings and some paint and she is a done job.

A new measuring certificate will need to be obtained.

Might be cheaper to buy a Devoti Fantastica. Unless you are an old man with a hunger to tinker.

Gerrit Bearda

www.vanaheim.co.nz