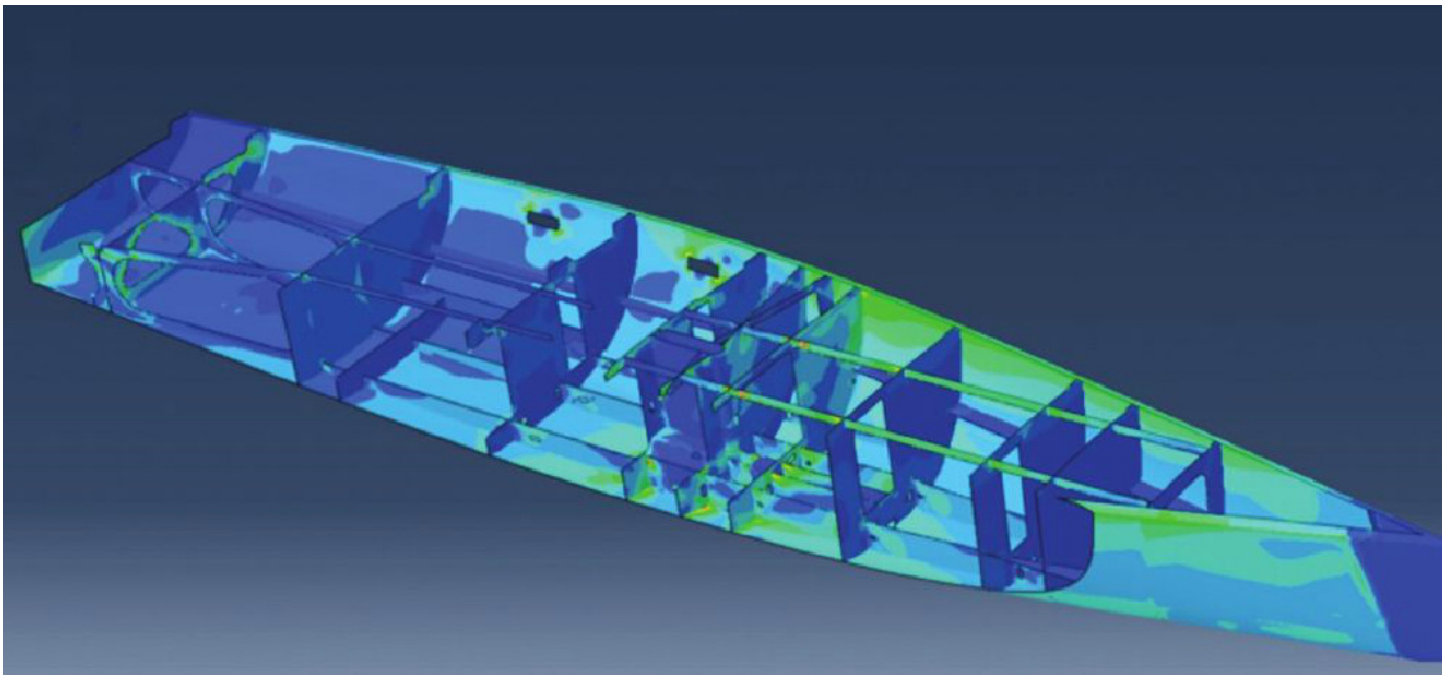
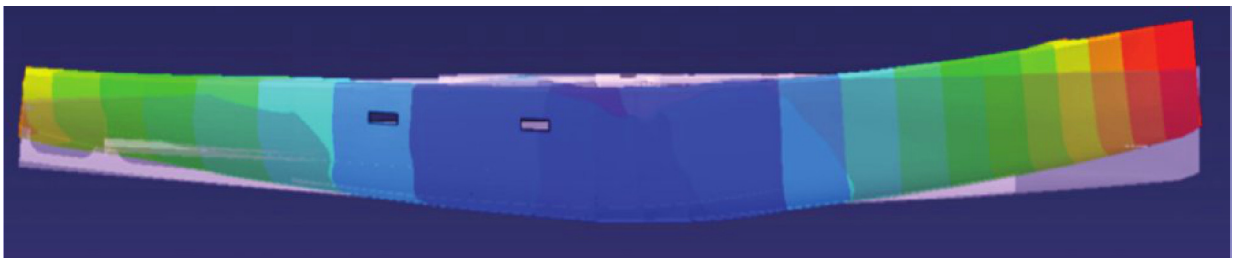




# Worth getting right

## Even for Giovanni Belgrano and his team at Pure Engineering the latest WallyCento that is in build at Persico Marine was no small undertaking

**Holding it together**

Pure Engineering were involved in the early days of the design process of this new Maxi, working closely with Mark Mills and the project design group to come up with a unique new WallyCento. Exhibiting a powerful rig, light displacement and high ballast ratio, this class of yachts stands out from other 'conventional' superyachts but it demands a tremendous design and build effort to achieve high sailing performance as well as style and luxury.

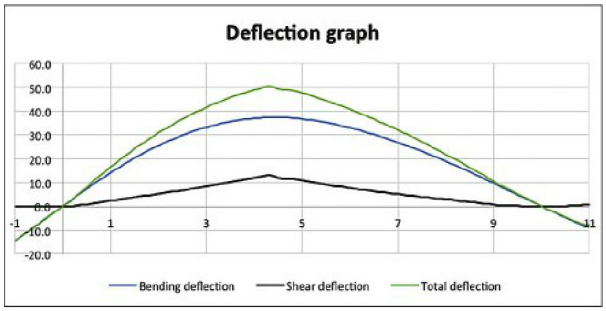
The principle behind our effort on projects like this is based on committing to developing the most efficient configuration and solutions possible with composite materials, and then fully detailing and carefully engineering the entire structure in a way that can then be built to our weight targets. We believe that this approach is appropriate considering the difference that a good composite structure design makes to sailing performance, and that high-quality detail-engineering makes to construction and reliability.

Structurally the layout of these large yachts tends to be very much driven by the interior arrangement. The Cento rule clearly defines the extents of this interior, but a primary focus has been to reduce the structural compromises that add significant parasitic weight. Rather than working around a pre-defined interior layout we proposed an optimised structural arrangement, especially around the mast/keel area, and submitted it to the design group to integrate a layout compliant with the Cento rules and the Wally spirit.

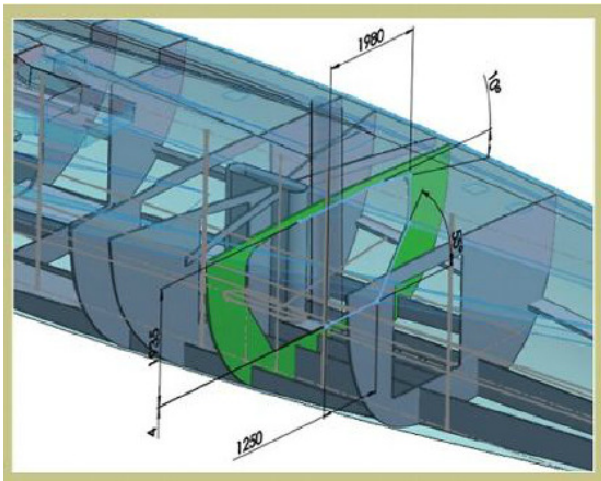
We went around several iterations using a parametric 3D SolidWorks model and the resulting arrangement is closer to a Mini Maxi than a conventional 100-footer. Notably, this arrangement features a reduced amount of framing which could only be achieved by using materials more commonly specified on smaller inshore race yachts.

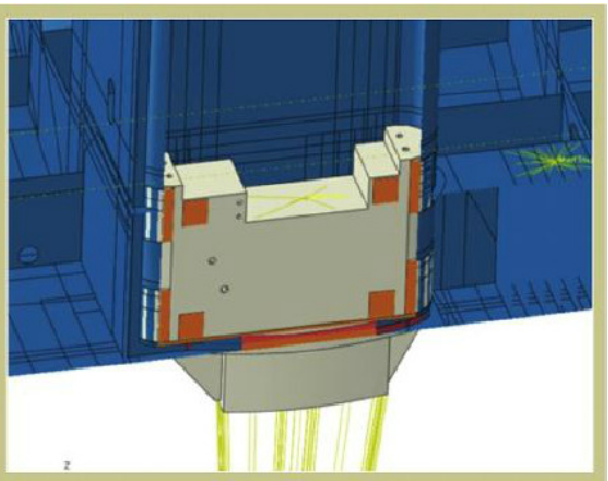
The scantlings of all Centos have to be compliant with the Germanischer Lloyd (GL) rule for race yachts over 24m. As the boat isn't intended to be raced offshore we pushed the core selection quite hard and ended up with an exotic mix of SAN foam in the slamming area and 64-72kg/m³ Kevlar honeycomb elsewhere.

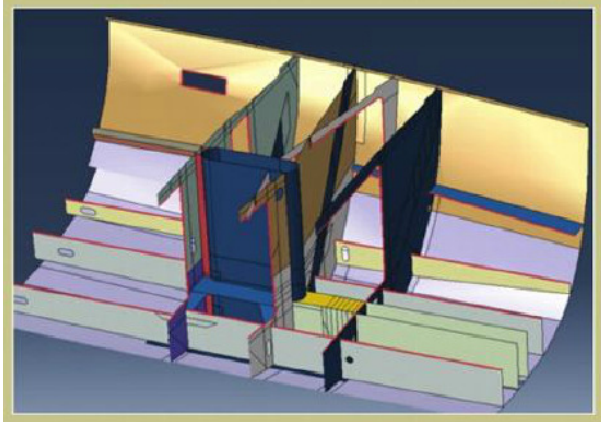
In parallel we ran a testing program with APD in the UK to confirm

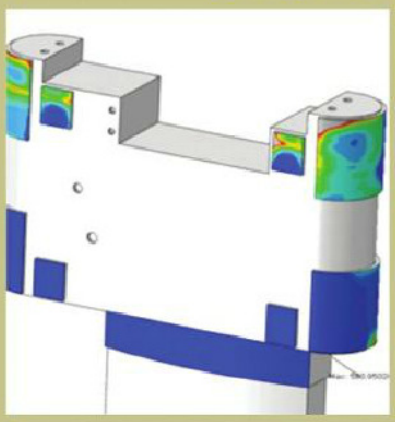


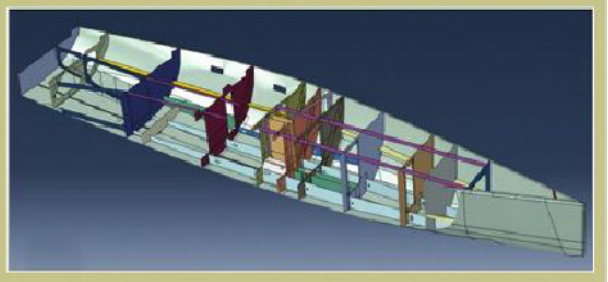

***Header:*** **FEA results for the steady state upwind sailing case. The colours indicate the magnitude of the strain in the laminates.** ***Top*****: hull-bending deformation (x15) for the upwind sailing case.** ***Above*****: prior to FEA, we explore the global stiffness and strength of the hull girder using our in-house programs. This helps us to get an initial grip on the loads involved and investigate various mixes of materials and layups for the hull and deck shells**









***Clockwise from above*: the mast/keel area – this highly loaded area is the spine of the boat for which the geometry and layups need to be extremely accurate; the internal structure is modelled parametrically on SolidWorks. As the design evolves, this enables us to modify the position and geometry of specific structural items which automatically updates the surrounding structure; FEA model of the keel fin and composite supporting structure. In this sub-model the contact interaction between the keel head and carbon case is defined to achieve an accurate distribution of the reaction loads and surrounding structure; FEA output of the keel trunk strains – this shows areas of peak stresses due to the keel head bearing pads loading into the front end of the carbon case and hull bottom shell; FEA output of the keel head showing the magnitude of the contact pressure between the bearing pads and the carbon trunk; FEA model of the boat with primary internal structure. All composite layups and material properties are assigned to specific regions in order to achieve an accurate representation of the as-built boat. Various load cases are simulated from steady state sailing to extreme cases such as grounding or 90° knockdown. Layups can then be optimised accordingly to design requirements**

core selection and gain confidence on the intended lay-ups. All the laminates are of pre-preg intermediate modulus carbon, which adds fore and aft stiffness to the hull girder but also to the large unsupported panels in the aft end of the boat.

The structural weight target for this design is quite challenging and we first looked at reducing the shell area as an efficient way to keep the weights down. One of the distinguishing features of the new boat is the ramped flush deck layout (*Alegre* Maxi 72-style) which worked very well in that regard.

The freeboard was also pushed hard which the aero team were quite pleased about. However, this 'shallow beam' arrangement induces significant compression in the deck due to rig load and we used an in-house program to look at the trade-offs between global deflection, forestay sag, additional weight of reinforcements and ultimately the global strength of the hull girder. This was further optimised using FEA techniques – FEA also being extensively used to check other individual elements of the structure.

Pure were also contracted to provide laminates and full construction drawings for the carbon lifting-keel cassette. As for the rest of the structure, we started by optimising the keel geometry and worked closely with APM as well as with Mark Mills and Dimitri Nicolopoulos (KND) to come up with a refined solution suiting everyone's requirements.

One particular feature we pushed forward is the rounded front and back surfaces on the keel cassette. Combined with a tight-fit bearing arrangement, this considerably reduces the local stress concentration from the bearing pads that you would normally get with a conventional square-angled box.

A full non-linear solid model of the case and keel-head was developed to assess the strains and contact pressure at bearing heights for various load cases. Having a horizontal shelf positioned at keel head height to react with righting moment reduces the internal loads considerably and we managed to pull out a substantial amount of weight from the composite case. The arrangement also provides transverse stiffness to the keel, translating into less bulb fall-off hence extra righting moment.

Compared to previous-generation carbon-keel cases, the net gain is about 60% which resolves into more weight in the bulb.

*Martin Bivoit, Pure Design & Engineering*

*Next month... Persico Marine and building the beast* ❑