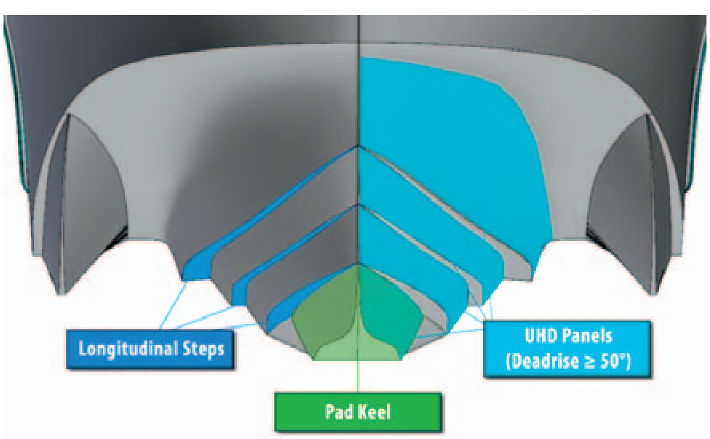
The Sea Blade hulls have been adopted by a number of Hawaiian tour operators because of their outstanding seakeeping and ride comfort at high speed.

THE SIX MILLION DOLLAR FISHING BOAT

The Sea Blade hull may look like an argument between chines and deadrise, but it's just the business for speeding tourists through rough waters off Hawaii.



The anatomy of a Sea Blade hull – narrow main hull made of steep risers and small flats that run full length, with an ama each side to form a tunnel and add stability.

Imagine owning a boatyard that gets paid by the US Navy to design and build prototypes for fast, seaworthy, highly capable boats. Imagine these craft range from a few metres to more than 50m in length, are capable of speeds in excess of 50kt, but that only start to get into their stride at more than 30kt in big seas. Imagine having a cluster of high-powered computers, running latest CFD and motion simulation software, operated by a team of enthusiastic and skilled designers – most of whom are also capable watermen. Given all that at your disposal, what would the design of your ultimate runabout look like?

Steven Loui, owner and chairman of Navatek Ltd, has answered this question. Based in Hawaii, his company develops hulls for the US Government, amongst others, and since 2006 has spent more than US$6 million on prototyping small powerboats, and R & D.

Navatek realised early on that the waters off Hawaii provided some of the most testing sea states around – the long Pacific swells rearing up the steep sides of the volcanic pinnacles to produce the world-renowned surfing locations. If a boat could function here, it could function anywhere.

As Loui readily admits, his designs are not necessarily the fastest in flat water, but he has some tricks up his sleeve to address that. He will claim they are faster in any significant sea state compared with a conventional deep-vee hull. The ability to maintain higher speeds in bigger waves, with excellent handling – up-sea and down – is the distinguishing attribute of his hulls. Now this novel hull-form is available to the general public in sizes from 16ft to 35ft under the brand name Sea Blade.

So, what does a multi-million dollar budget and nearly a decade of development get you? In general terms the Sea Blade hull is a high beam-to-length ratio, ultra-high deadrise hull with multiple longitudinal steps and a pad keel. Which is a bit of a mouthful, so let's simplify it down to a slender hull with an extremely deep vee made up of a series of steps. These steps are 0-deg deadrise flats that run fore and aft for the whole length with steep risers in between which have a nominal 50-degree vee angle.

Deadrise is generally accepted to be measured from the centre of the hull out to the widest point of the chine, and might

"...like hitting the cafe awning before landing on the sidewalk when falling from a building."

vary from 15-18 degrees to 20-25 degrees for deep vee hulls. Conventional vee-bottomed powerboats might have one chine out wide and several spray rails or lifting strakes appended to the vee bottom. In most cases the spray rails stop around the aft third of the hull; the inboard rails terminate further forward than those outboard – see Future Concepts April 2014.

The Sea Blade hull concept differs from a conventional deep vee hull in several ways. First, there is a flat keel pad – not unlike a ski pad, but extending almost full length. The risers have a vee angle of 50 degrees – twice as steep as any deep-vee monohull – but because they start from the outboard edge of each longitudinal flat pad, the effective vee of the bottom is nearer 38 degrees. The impressive sea-keeping comes from the way these steps and risers work together to progressively slow the boat on impact and spread the energy over a longer time rather than a sharp peak. See sidebar: Game Changer.

When heading up-sea the same principle applies, but with added benefits. As the Sea Blade hull has a lower running trim than a deep-vee hull, say 2.5 degrees or fewer compared to 3.5 or 4 degree, it leaves the water and re-engages less often. It also has a finer bow, having finely optimised the balance of vee for cleaving versus buoyancy to bring the bows up. As a result, pitching and stuffing into waves is significantly reduced in a like-for-like comparison.

The long and skinny main hull in isolation would be potentially unstable in roll, and for military or para-military operations where loitering is a large part of the mission profile, this would pose a problem. Fortunately for all the fishermen out there, the Sea Blade hull form includes a pair of amas or outrigger hulls, which have two primary functions. The first is to stabilise the vessel in roll by providing a pair of training wheels that pick up volume and give a wide waterline at rest. The period of roll is somewhere between the slow, high amplitude motion of a monohull and the short, snappy motion of a catamaran and is therefore quite bearable.

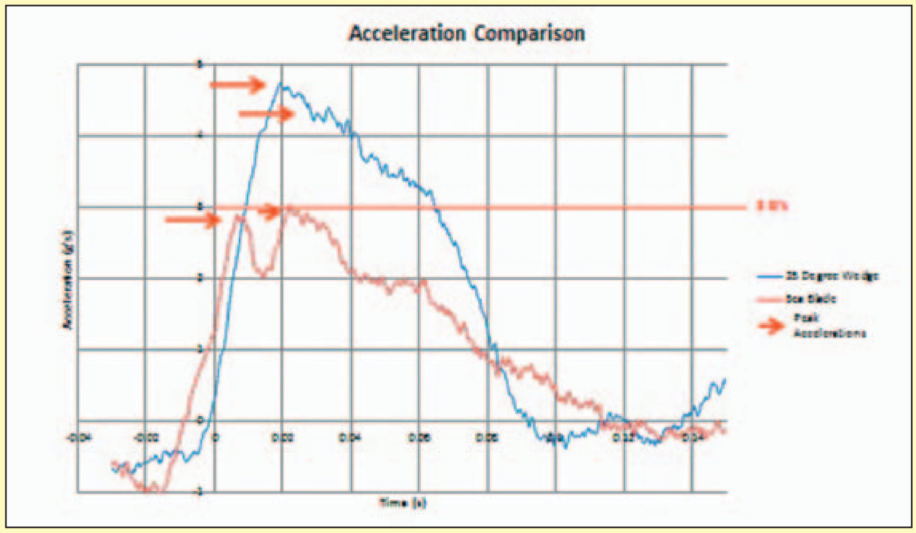
The second function is to form a tunnel between the ama

Breaking the fall

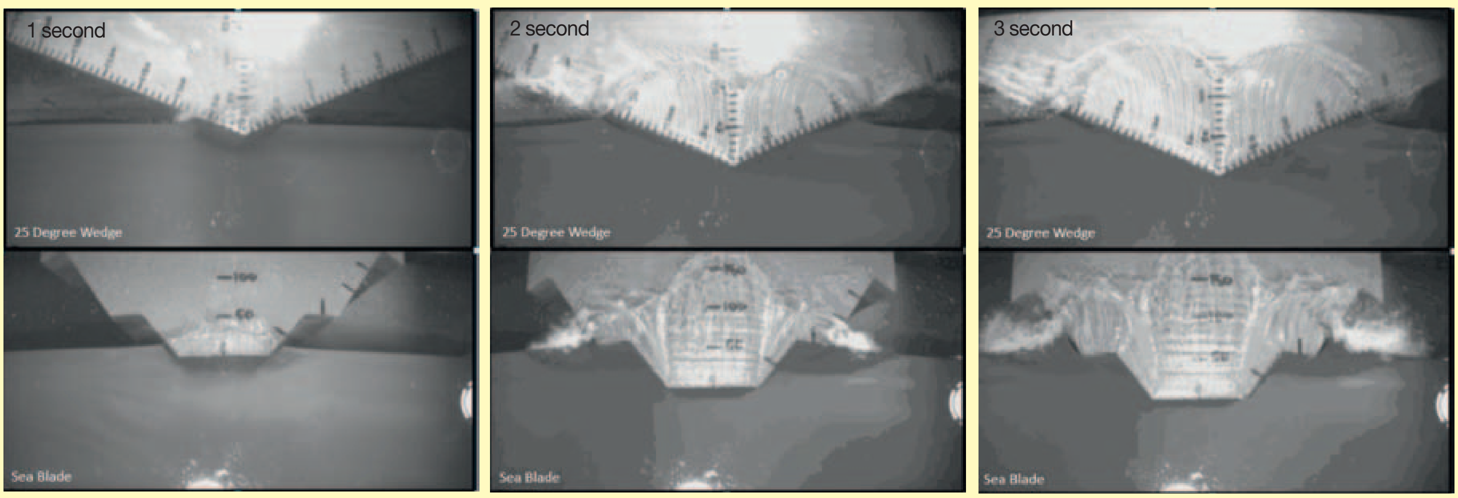
When a Sea Blade hull leaves the water and then re-engages, the keel pad hits first, but rather than slamming hard, it lands firmly, immediately slowing the fall. Steven Loui describes it as breaking the fall – "like hitting the café awning before landing on the sidewalk when falling from a building".

The keel pad is sized – using the powerful computers and CFD analysis – not to slap too hard, but to slow the fall marginally. The boat continues to plunge, with the 50-degree risers offering little resistance until the longitudinal flats hit the water. By this time, 0.02 seconds after impact, the vertical velocity is significantly reduced and the next 0-degree longitudinal flat imparts only a small – and therefore softer – deceleration, and the process is repeated up the hull.

The images and graph here show the peak slamming pressure of the Sea Blade hull is reduced by almost 40 per cent compared to a 25-degree, deep vee hull, with a characteristic double peak. The effect is to reduce the decelerations experienced, so comfort levels go up – or alternatively speed can be increased until the same threshold of discomfort is reached as for a deep-vee hull.



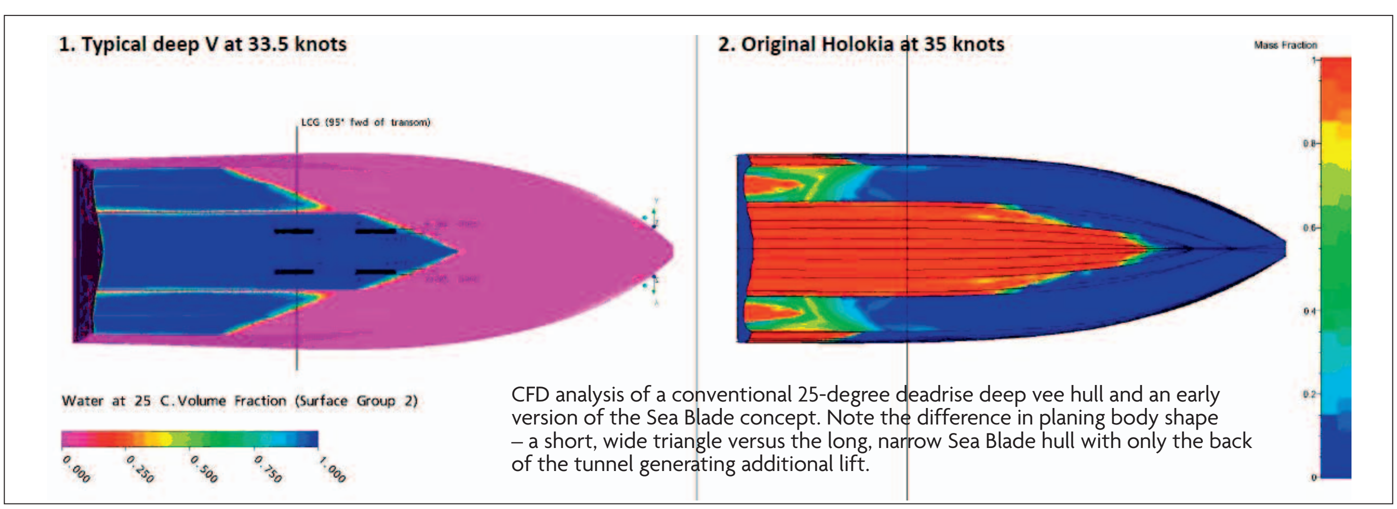
This graph shows the peak slamming pressures of a 25-degree, deep vee hull compared to a Sea Blade hull. The Sea Blade hull has two small peaks at around 3G's spread out over time, while the conventional hull has one big 5G peak over a shorter period. Lower G loads over a longer time are more comfortable for the occupants.



Three image sequence showing how the Sea Blade hull breaks the fall with the flat keel pad and then the smaller flat steps with 50-degree vee between them compared to a 25-degree deadrise vee bottom at 0.01 seconds, 0.02 seconds and 0.03 seconds after impact.

and main hull. The aft end of the tunnel is fully wet at full load and full speed, contributing to lift with a wide high-aspect ratio planing surface – see CFD graphics, below. But the really clever bit is the dynamic stability afforded by the ama. When hitting a wave obliquely or having partly rolled into it, the downhill ama forefoot sends up a sheet of spray that hits the tunnel roof and pushes the boat upright again.

The configuration of the narrow central hull and amas results in a deck layout a lot wider, and with that width carried further forward than in a similar-sized conventional boat. The Sea Blade has masses of deck space forward, wide walk-around sidedecks and a huge cockpit, lending itself equally to fishing, diving or family fun. While not suited to all applications – the narrow hull has a lack of internal volume that limits the options for accommodation and tankage for example – being stable at rest or at speed and eating up seas that stop some boats in their tracks, you would be forgiven for playing Special Forces when no one was looking. Sea Blade provides the hull – you'll have to supply your uniform. ■



CFD analysis of a conventional 25-degree deadrise deep vee hull and an early version of the Sea Blade concept. Note the difference in planing body shape – a short, wide triangle versus the long, narrow Sea Blade hull with only the back of the tunnel generating additional lift.