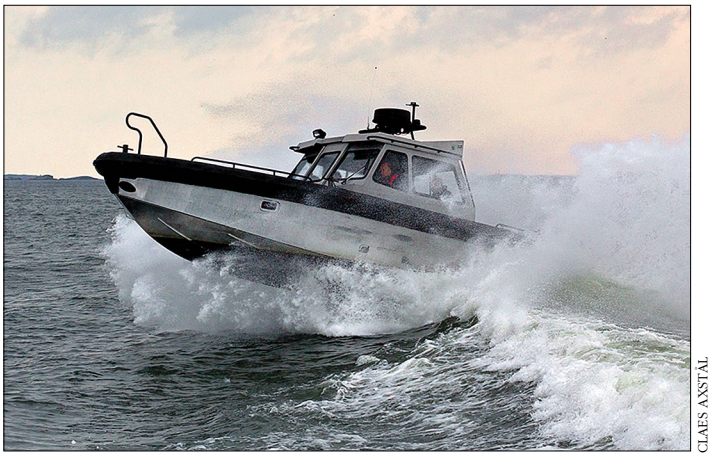
Speed Endured, Speed Considered



CLAES AXSTÅL

An aluminum Vector 28 (8.5m) built by Swedish builder Vector ProBoat is put through its paces in a test of seakeeping ability as part of the High Speed Boat Operations (HSBO) Forum in Gothenburg, Sweden, in May.

Most boat shows are about boats, and most academic conferences are about, well, academics. The biannual High Speed Boat Operations forum (HSBO) hosted by Swedish shock-dampening seat manufacturer Ullman Dynamics in Gothenburg, Sweden, is a rare and unlikely combination of the two that marries a dock full of high-performance professional-grade small craft—from rescue boats to coastal military operations and transport—with a convention hotel and lecture theater full of naval architects, professional boat operators, special forces and coast guard commanders from multiple countries, medical researchers, boatbuilders, propulsion experts, and components manufacturers.

As its name suggests, the latest four-day forum (May 6–9) was tightly focused on speed at sea, but not the thrill-seeking or testosterone-driven high-speed runs of recreational boaters. The majority of the 300-plus delegates know firsthand about the grinding, long offshore hours required of search-and-rescue crews and military forces who must run small craft at speed in often harsh sea conditions. And that means they thoughtfully and seriously discuss seakeeping, risks, pain, and regulations far more than they gossip about top speeds and record-setting passages. What follows are just a few high points of this well-run event.

In his opening keynote address, Ed Veen, director of the Dutch Coast Guard, articulated his complex love-hate relationship with high-speed boats: Most of the accidents and law enforcement actions his crews respond to involve high-speed boats; at the same time, the most efficient coast guard response vehicle is a high-speed boat of its own. The challenge comes in keeping the rescuers/enforcers safe while operating day after day in often extreme conditions. His conflicting emotions were common among professionals at the conference.

"Faster, harder, farther, and longer are becoming the norm," said retired Royal Marine and marine consultant Bob MacDonald, who specializes in working with government agencies and special forces on small-craft operations. MacDonald noted that with these trends and the increased capabilities of specialized vessels to run in extreme conditions, the crew are rapidly becoming the point of failure. They are where we need to focus. He called for an integrated approach to design of operator-and-passenger workspaces at a level equal to that invested in hull design. After all, "the boat without the people in it is nothing more than a platform," he said.

In spite of his crew-centric approach to high-speed boat design, MacDonald was critical of European Union's 2002 directive that limits exposure of crew and paying passengers to whole-body vibrations (note that the directive does not apply to recreational boats).

"Not a single fast boat can comply with these regulations," Veen agreed. And as a practical workaround, exemptions from the directive are granted by individual member countries on the condition that best available technologies are applied onboard to minimize shock exposure.

"Poor legislation is not respected and not enforced," MacDonald warned.

Duke University researcher Dr. Cameron Bass, who has been studying ways to predict human injury risks in high-speed boats for 20 years, called the 4-g threshold in ISO 2631-5 "way too low," especially when the actual impacts on the spines of high-speed boat operators can frequently reach 14 g to 16 g. He stressed the importance of calculating and recording the magnitude and the frequency of high impacts as boat operators conduct missions over time. In short, while 5 g may not be as bad as 10 g, its greater frequency can make the lower value a greater risk over time.

That reality points to the need for comprehensive health-monitoring programs for high-speed operators, an example of which was provided by Richard Finnemore of the U.K. Ministry of Defense, who explained his office's comprehensive approach to monitoring and tallying sailors' accumulated career exposure to slamming impacts.

The regulatory subject was summed up by host Johan Ullman and MacDonald in separate calls for the drafting and implementation of clear and measurable standards for impact exposure assessment (see "Slamming Standards," *Professional BoatBuilder* No. 149).

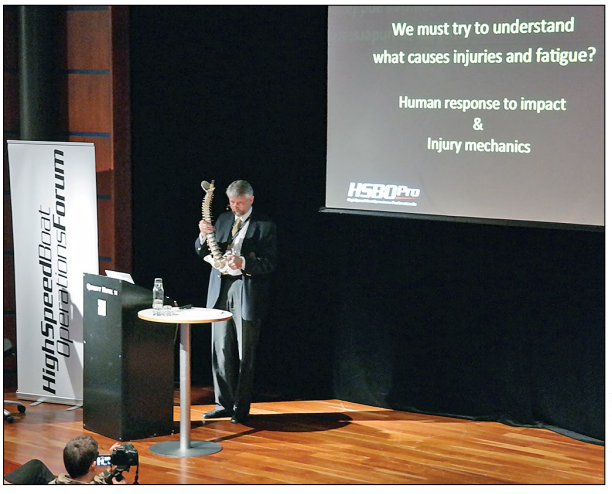
Presenters from the design side outlined numerous efforts to maximize seakeeping and minimize impact exposure for boat crews. Jeffrey Bowles of Donald L. Blount Associates delivered a practical overview of a naval architect's considerations in maximizing seakeeping abilities in high-speed boats to protect a vessel, its cargo, and its operators. While how a boat is driven affects ride quality, he insisted that boat geometry is the primary influence, adding

that vertical accelerations are extremely difficult to predict. He presented applications of Savitsky and Hoggard-Jones equations to determine theoretical accelerations at the center of gravity (CG) and bow of a boat to stay within exposure limits specified in a design brief.

Then he explored applications of computational fluid dynamics (CFD), finite element analysis (FEA), and tank-testing of models in a range of loading conditions, speeds, and sea states. His basic list of characteristics to maximize seakeeping ability: less than 20° deadrise, bell-shaped bottom sections, and a rounded keel section.

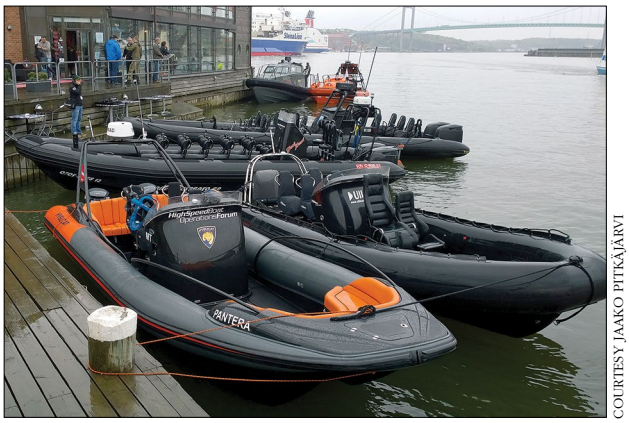
Andrew Lea and George Robson of Abu Dhabi MAR detailed their use of the same tools through the design-and-prototyping process with all the specifics allowable for a still-classified 60′ (18.3m) assault and special operations vessel tailored for high-speed service in rough sea conditions. Their CFD analysis revealed stress points in the hull during operation. In addition, they ran thorough FEA including all elements of the laminate schedule, fiber orientation, tapers, etc. for slamming, grounding, and crash-situation analysis with fine-mesh studies of dynamic areas such as rudders and hatches. In an additional design step that followed extensive model tank-testing, they built a 32.8′ (10m) manned prototype to confirm the performance of the innovative hull shape before investing in a full-scale model.

Japp Gelling of Damen Shipyards (Gorinchem, The Netherlands) traced development of the axe bow concept, a 1990s creation of Dr. Lex Keuning at TU Delft, The Netherlands, recalling that the narrow high-bow hullform was inspired by Keuning's own knee injuries sustained during testing of 98.4′ (30m) crew boats in the North Sea. Upon looking into vessel performance, Keuning found that 85% of speed reductions were due to crew trying to avoid peak accelerations, *because humans respond to peaks not averages*. In response, he explored the enlarged ship concept, which increased length but not beam for better seakeeping. Gelling said that concept evolved into the more extreme axe bow concept with the goal of a 50m (154′) boat capable of operating at 55 knots 365 days a year in the North Sea. Since then, Damen Shipyards has built multiple models, from large supply and patrol boats to an axe-bow catamaran crew boat. He cited reductions in vertical accelerations from 10 g in conventional high-speed crew boat hulls to 1.3 g on axe bow models.



AARON PORTER

HSBO host Dr. Johan Ullman demonstrates the motion and compaction of the human spine when exposed to extreme vertical accelerations from the slamming of high-speed boats operating in rough seas.



COURTESY JAAKO PITKÄJÄRVI

Some of the assembled HSBO fleet available for testing. In the foreground is the Hysucat, a hydrofoil-supported catamaran from Hysucat Marine, in South Africa.

Gerard Kutt of HWAC Technologies (Hong Kong) advocated a smaller-scale design solution to improved seakeeping: the hydrofoil-supported catamaran concept, known as the Hysucat. Briefly stated, a fixed foil between the asymmetrical hulls of the catamaran delivers passive ride control for this hullform. (For more on Hysucat design, see PBB No. 124, page 14.) I confess that the performance of a dihedral foil dipping in and out of the water at planing speeds is not as easy to envisage as, say, the axe bow, but that's where the in-water component of HSBO shines. Two Hysucat variations were available for testing, and they confirmed performance for any skeptics.

The fleet of nearly two dozen vessels for testing ranged from the venerable CB90 and the new axe-bow NH 1816 model rescue boat from Damen, to the practical C-RIB Police Rescue model patrol boat, a very fast and stable rough-water rescue prototype from Norsafe, an aluminum Vector 28 (8.5m) with an elastically mounted wheelhouse, and a versatile military-grade RIB from Boomeranger Boats.

The final day of the forum was devoted to a series of in-depth tutorials on specific design and safety subjects that we haven't the space to explore here, but some of which will undoubtedly show up in the pages of PBB in the coming year.

For more information about HSBO, visit www.HSBO.org.

—Aaron Porter