Team Sport

An experienced Delaware boatbuilder, a self-taught Florida yacht designer, and a legend of early fiberglass production boatbuilding strive to improve an already highly refined type—the offshore sportfisherman.

Text and photographs by Ralph Naranjo
(except where noted)

Above—*Carl Moesly, left, is the founder of Sea Craft and the designer of its original powerboats, and was a pioneer of offshore powerboat racing in the 1960s. His recent work with Florida-based designer Steve Matthews, right, has resulted in hullform alterations that boost offshore high-speed performance and incorporate pod drives as a propulsion option on a series of sportfishermen, most of them built by F&S Boatworks, in Bear, Delaware.*

In the quest for game fish, recreational fishermen are lured well offshore where the continental shelf gives way to a deeper ocean basin. Hudson Canyon lies 80 miles from Barnegat and Shinnecock inlets, in New Jersey. Hatteras Canyon, off the North Carolina coast, and the rich fishing waters between Florida and Bimini present similar challenges. Even with a crack-of-dawn departure, getting there and back in one day eats up a lot of fishing time. So it's no surprise that the ability to run fast and comfortably in open-ocean conditions has become a higher priority than ever for prospective buyers of the latest sportfishermen.

For designers and builders of these largely custom and semi-custom boats, seakeeping ability—which includes speed, safety, and minimization of dynamic instability—is the characteristic most likely to impress a client. If they get it right, their boats avoid common failings such as chine steering, berserk pitching, excessive vertical accelerations, and non-oscillatory gyrations. But the challenge is much more than settling on an optimum horsepower-to-displacement ratio, picking the right props, or maintaining strict weight control during the build. The nuance lies in hull shape, the hydrodynamics of how a planing hull rides on its own bow wave, and how

COURTESY F&S BOATWORKS

Jim Floyd and his crew at F&S Boatworks built this 50′ (15.2m) convertible, a design developed with Matthews and Moesly. The boat is propelled by a pair of Volvo Penta IPS pod drives.

the hullform handles slamming loads that spike with each wave impact.

At the International Boatbuilders' Exhibition & Conference (IBEX) naval architect Dean Schleicher has spoken about high-speed boats misbehaving, and he and Mike Riley outlined more analytical approaches to improving high-speed hull performance in the two-part feature "Analyzing Accelerations" (*Professional BoatBuilder* Nos. 140 and 141). Their work illustrates that by applying algorithms derived from performance data, naval architects have become better at predicting high-speed performance over a wide range of boat speeds, replacing what previously was a lot of guesswork.

While such a rigorous mathematical approach is now possible, this story is about the *intuitive* tradition of high-speed powerboat design that is still thriving and producing some very capable boats.

The Players

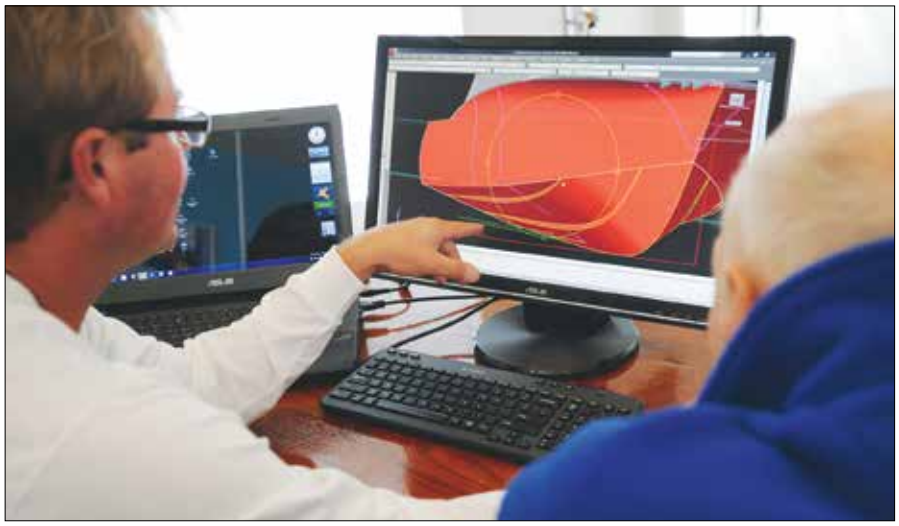
Floridian powerboat designer Steve Matthews has had a string of recent successes working in collaboration with F&S Boatworks (Bear, Delaware). His latest designs include a 36′ (11m) outboard, and 50′, 64′, 66′, and 72′(15m, 19.5m, 20m, and 22m) sportfishermen. (He also does frequent design work for North Carolina builders Spencer Yachts and Ritchie Howell.) He credits his success in developing larger and larger sportfishing hull shapes at least in part to a collaborative design relationship with octogenarian offshore-powerboat-racing pioneer Carl Moesly, the founder of Sea Craft and designer of its original motorboats (see Steve D'Antonio's profile, "The Amazing Mr. Moesly," PBB No. 91).

Back when 1960s seat-of-the-pants engineering prevailed, Moesly took innovative design ideas and built full-scale prototypes he personally raced offshore in an effort to win races and learn about high-speed hull performance. He was one of the early gurus who helped develop mainstream offshore powerboat racing. In a way, it was like an oceangoing graduate school, where boatbuilders were taking Karl Kiekhaefer's 1950s Lake X outboard and inboard/outboard (IO) development program one step further. They used the Gulf Stream and the stretch of ocean between Florida and Bimini as a turbulent test tank, and the results led to some significant advances in hull shapes and boat construction techniques.

In this pre-computer environment, Moesly came up with his own full-scale precursor to finite element analysis (FEA). He began by spraying up a female mold with an over-promoted and -catalyzed gelcoat—a finish that was bound to be brittle. Next came a layup with a 20%–50% reduction in the laminate schedule, which yielded a hull intentionally built with less transverse and longitudinal stiffening than required. The brittle gelcoat acted like fingerprint powder, mapping out the location of stresses and strains caused by the boat pounding through a seaway or bouncing along a rutted road on trailer bunks. The result was lots of crazing and gelcoat cracking that revealed where stress-risers focused the energy. Moesly's design program, based on feedback from full-scale destructive testing, was reminiscent of what was done in the early years of military and commercial aviation, in which he was also involved. It aided his development of a unique hullform and allowed him to patent his longitudinal step-bottom design that incorporated variable deadrise. His focus on bottom panel contributions to lift and drag and his quest for a level ride were ahead of their time.

Many owners of Moesly's offshore-capable Sea Craft powerboats found in them that elusive, relatively soft ride at speed in a seaway. Jim Floyd of F&S Boatworks was one of them. Today, Floyd still draws on the lessons he learned while navigating his Sea Craft 23 (7m) in the not-so-tranquil seas of North Carolina's Outer Banks, and applies them in building large sportfishermen in his shop just off the Chesapeake & Delaware Canal. He remembers the Sea Craft as "a boat with a bottom that seemed to ride on a cushion of air." On the strength of that experience, Floyd has followed Moesly's preference for a variable-deadrise bottom design. In its day, the hullform was a departure from the popular Ray Hunt deep-V constant-deadrise norm. Hunt's revolutionary bottom design carried a signature stepped deep-V from stem to stern, while Moesly's boats featured six bottom panels contoured in three sets of varying deadrise. The centerline pair was for high-speed planing, and the two outboard pairs with less deadrise boosted load carrying and coaxed the boat onto a plane without an exaggerated bow-up angle of attack.

When Matthews first started working with F&S in 2005, Floyd was already building his own rendition of the Moesly bottom shape, and had



Matthews and Moesly work together using 3D design software to tweak the running surface of a sportfisherman. Note the classic variable-deadrise panels of the modified Moesly hull on the screen.

forged a reputation as a builder of quality cold-molded powerboats. Matthews: "From our first collaboration, Jimmy was an advocate of what Carl Moesly had been pioneering way back in the 1960s. At first, all Jimmy let me do to a boat was a minor tweak or two at a time." But that would change when Moesly joined the design team, bringing with him his latest thinking on high-speed hullforms.

About the time the Matthews/F&S collaboration was getting off the ground, Matthews bought an old racing hull that had come from a Sea Craft 30′ (9.1m) mold, one of the largest models the company had ever built. It was an artifact from the early years of offshore racing when OMC produced a range of heavy V-4 outboards, from 50 hp to 75 hp (38 kW to 56 kW). And Mercury, which always maintained a keen racing interest, was beginning to introduce 6-cylinder motors that were approaching the triple-digit horsepower barrier. Lightweight, high-horsepower-to-weight-ratio diesels were still a long way off, and Moesly and other performance-driven designer/builders were hampered by an outboard horsepower deficit. They often opted for tuned-up 4-cylinder and small-block V-8s married to IO drivetrains. Developing efficient hull shapes and controlling weight were a way around the power plant limitations that effectively controlled boat size.

As Matthews looked for details about his vintage Moesly design, serendipity arrived in the form of a

United Parcel Service deliveryman with, like many Floridians, an eye for vintage powerboats. He recognized the classic Sea Craft and also recalled that a fellow just down the road had been a principal in the Sea Craft company back in its heyday. Twenty minutes later, Matthews was on the phone with a fellow who knew that the boat's designer-builder-founder lived in nearby Hobe Sound. The following day, Carl Moesly visited Matthews's shop, and the two kicked off what was to become a mutually beneficial relationship.

An important detail in this design collaboration is the absence of formal degree or diploma abbreviations following the Matthews and Moesly names. Both are self-taught designers. Moesly learned woodworking, boatbuilding, and drafting skills as a youth before serving as an aviator in WWII. In fact, on one occasion when credentialing was required for plans Moesly had drawn up for a home he was building in the British Virgin Islands, he scribed, "Carl Moesly, M.O.B.A." in the title block—the acronym for "my own bloody architect." As a boat designer, Moesly chiefly worked at a drafting table with ship curves and a sharp pencil taking the table of offsets that he would create and personally loft at full scale on the shop floor. Then he'd build a plug of strip-planked wood. Many plugs became prototype boats in Moesly's Sea Craft R&D program. This tight control of design and build from conception to completion, plus input from an offshore racing test program, gave Moesly and Sea Craft buyers confidence that the boats were well engineered.

Matthews had formal architectural and engineering training while attending North Georgia College and while working as a draftsman for the architectural firm Braden and Braden. He has considerable graphic- and computer-design skills and an innate aesthetic sense for proportion, sheerlines, and how a hull shape should unfold above and below the waterline. His inclination to make shape-based performance decisions comes from years of careful scrutiny of how planing hulls behave and a facility with 3D computer modeling programs. The computer allows him to easily convert his ideas into reproducible, measurable shapes in much the way generations of boat designers without design software or finite element analysis have refined their hull-forms in carved half-models—by eye. Matthews is quick to point out that with neither an NA (naval architect) nor a PE (professional engineer) designation on his shingle, he has had to develop important relationships rather than deny the need for such expertise. When necessary, he subcontracts with credentialed naval architects and engineers to review the engineering work and provide feedback.

In his daily design work Matthews relies more on software and screens than on splines and battens. His primary tool is AutoCAD, and he turns to Rhino for 3D modeling and to Orca to evaluate weight distribution and hull shape. Matthews also does enough traditional drafting to consider it a significant tool. With this software/pencil-in-hand combination

At F&S Boatworks a newly built 60' (18.3m) hull is turned by crane. The longitudinal steps of differing deadrise angle are clearly visible here, with the highest deadrise forward and in the center for high-speed operations, and the lowest angle out at the chine and aft to help the big boat get up on plane.

of talent it's an easy step to provide hydrostatics and parametric comparisons. One-off builders like F&S appreciate the value of his 3D modeling; it gives them the chance to see the finished product well before final commitments are made, and clients get a clearer picture of the finished boat.

Design Collaboration

Matthews and Moesly initially focused on refining the longitudinal steps that controlled the surface area a larger sportfisherman would ride on. The relationship between the smaller Sea Craft hulls and larger sportfishermen was by no means a simple translation or change in scale. Matthews and Moesly had to address all the variables involved in changing bottom design: location, run, and angle of the longitudinal steps; deadrise angle changes; cross-section and structural features; high-speed trim angle; and location of weights and volumes in relation to the planing surface at different speeds.

Throughout the formative '60s and '70s, the performance-oriented Ray Hunt–designed boats carried a 24° deadrise from the forefoot to the transom. The hullform lessens pounding, but the geometry also resulted in a hull that was harder to get onto a plane, and produced boats that were very sensitive to weight in the stern. Moesly's approach varied the deadrise laterally and longitudinally, yielding boats with a steeper angle forward to resist pounding, and less deadrise aft, a feature that helps the boat get onto a plane and keep the bow down when backing off the throttles. Some Carolina boats have traditionally applied this "warp" in the deadrise for the same reasons. Indeed, Floyd's earlier sportfishermen were built with sharp entry, longitudinally stepped

While the latest designs from the Matthews/Moesly collaboration are engineered to accept optional pod propulsion from an IPS, Zeus, or ZF system, conventional drivetrains with transmissions, shafts, struts, props, and rudders are still seen as the reliable standard for these sportfishermen.

bottom, and disappearing deadrise at the transom. Now he had Matthews and Moesly tweaking the basic form. The result is hard to deny.

Just as the limited propulsion options helped define Moesly's early designs, new drive systems created opportunities and challenges in his recent design work with Matthews. With the refinement and popularization of pod drives—primarily IPS, Zeus, and ZF systems—during the last decade, builders were asking Matthews and Moesly to include them as an option in new designs. The designers had to work out ways to transition the longitudinal steps into a pod-friendly planing surface. At first, engineers at Volvo were anxious about the complex bottom shapes and water flow over their new IPS running gear. But after the sea trial of the nimble F&S 50, it was clear that the IPS pod drives were entirely compatible with the hullform. From a practical performance perspective, the trials showed how effective pods can be in tight maneuvering; they delivered precise directional and throttle controls for trolling and boat handling when landing a fish, in addition to good top-end performance. However, the team at F&S still values the functional reliability and effectiveness of conventional drivetrains.

At the heart of this drivetrain philosophy is a conservatism that hinges on system reliability, and repairability in remote locations. For example, while the impact of a high-speed encounter with flotsam may only rosebud the prop, bend a shaft, and damage a strut, the same impact can rip a pod right off the boat. This may seem a six-of-one half-a-dozen-of-the-other proposition, but getting up and running again is likely a lot less costly with the former than the latter, and the conventional system can be repaired in most shipyards, yachting facilities, and outlying marinas around the world. It's also interesting to note that Matthews sees the top-end performance edge going to conventional shaft drivetrains.

When it comes to matching structural scantlings with dynamic forces

Left—*Chunky longitudinal stringers of laminated Douglas-fir with sections up to 16" x 6" (406mm x 154mm) are the structural base for the cold-molded wood hulls designed by Matthews and built by F&S.* ***Right—****In this smaller 36' (11m) Matthews design, the stiff wood stringers are married to a lighter-weight foam-cored FRP hull.*

on high-speed oceangoing craft, miscalculations can be disastrous. The big challenge lies in balancing the reality of lighter-is-faster with the punishment dealt out by high-speed impact loads. Matthews believes in the combination of data, an experienced builder's knowledge, and the specs published by materials manufacturers and classification societies.

In structuring large sportfishermen, one size doesn't fit all. Matthews says there are significantly different approaches to hull and deck construction in this high-end market for custom boats. For example, F&S favors tall stringers and cold-molded hull skins, while other reputable custom builders put their faith in foam-cored fiber-reinforced-plastic (FRP) construction. In either case, computer-derived FEA shows the hot spots where slamming loads boost panel pressures, and where there's a need to strengthen a localized section of the hull. But Matthews sees the builder, not the designer, as the final decision maker in how many layers of fabric or what thickness of wood needs to be applied in a given area of the boat. The designer points out that it's not only what materials are chosen, it's how effectively they

One advantage of Matthews's involvement with F&S is the potential to send electronic design files to the shop's computer numerically controlled (CNC) router. The capability to quickly cut out the parts of an intricate and precise building jig eliminates lofting and mold cutting, and assures that the mold shape is exactly what the designer provided.

are used, and that depends entirely on the build crew.

A typical F&S build applies multiple layers of okoume plywood, all glued with MAS epoxy; laminated Douglas-fir stringers built up to 16″ x 6″ (406mm x 154mm) in larger boats; Corecell foam for deck core; and FRP skins of stitched E-glass with MAS epoxy resin in a laminate schedule appropriate to vessel size and loads.

For Matthews and Floyd, building in an ample safety margin seems to be less a mathematical calculation and more an application of lessons learned from previous boats—a process not that different from the way Carl Moesly developed his Sea Craft boats over 40 years ago. Those early racers of offshore powerboats watched stringers twist and forward-section skin panels succumb to slamming loads. These same regions of the boat light up with warm tones on FEA program screens today. The challenge for the builder is matching the panel pressure of each region to the reinforcement required, and for Jim Floyd, structure is not where he wants to skimp.

The Build

One of F&S's greatest advances in recent years has been the efficiency that Matthews has brought to its build process. It starts at the design phase as the owner, builder, Matthews, and Moesly quickly agree on the basic form and look of a new boat that can be displayed on screen in Rhino or CAD formats. Online and phone conferencing nullifies the Florida-to-Delaware separation, and discussions

From inside the upside-down hull jig during a build, the dominating stringers are clearly visible, as are the flat plywood panels of the laminated bottom and the darker diagonal layers of the laminated topsides.

leading to design tweaks can be graphically modeled. The same communications technology and personal familiarity allow Floyd, Matthews, and Moesly to maintain a dialogue throughout the build, addressing challenges as they arise.

The next advantage to the builder comes from the efficiency of contracting a shop owning a computer numerically controlled (CNC) router to turn the designers' digital files into a jig that arrives at the build site on a tractor trailer and goes together like a barn-size 3D jigsaw puzzle. Every piece is carefully labeled and precisely fit for quick assembly. According to the F&S crew, these computer-milled hull and deck jigs save months of lofting and jig-building time. Their accuracy is especially important for high-speed craft, where any variation from the design can cause performance problems and bilateral symmetry is crucial. This type of jig/framework approach to boatbuilding is particularly appropriate for custom powerboats that feature hard chines, long, straight runs, and a minimum of compound curves.

A close look at the F&S approach to boatbuilding reveals a blend of new and old-school talents and recognition that wood, primarily in the form of marine plywood hull skins and laminated Douglas-fir structural members, is a viable material for building custom sportfishermen. When combined with good epoxy-gluing techniques, it can yield a stiff, high strength-to-weight ratio hull. Floyd's initial reasoning may have been more intuitive than empirical, but any expert in marine structures would agree with his belief in wood's resistance to fatigue due to cyclical loading, and its stiffness.

The fir stringers are the backbone of F&S's approach to boatbuilding. Not only are they major fore-and-aft load-bearing structures, they are also painstakingly laminated in place on the jig as the longitudinal chines of the Matthews/Moesly bottom shape, and to support the transverse structures that stiffen the hull.

In assembling the plywood hull skin, Floyd prefers to overbuild his boats, because, as he puts it, "it allows me to sleep better at night." He knows that when an owner or captain misjudges the size of a wave face and launches his 60′ (18.3m) boat

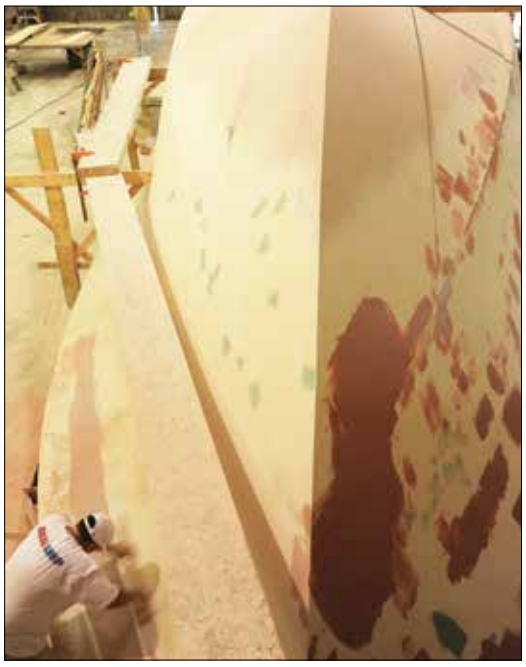
off a big one, the impact will be considerable. Accordingly, he builds boats to withstand much more punishment than a predictable flat-water pressure loading on the hull skin panels. The crew employs screws and clamps to exert a uniform squeeze on each layer of high-quality, low-void-content marine okoume plywood as they apply it; butt joints are carefully staggered; and when they finally pull the temporary fasteners after the epoxy has cured, they re-drill the holes and bung them with epoxy-wet dowels. In sections of the hull identified as high-impact areas, they bond extra layers of plywood, taking care to minimize voids in the skins.

To shorten build time, F&S crew have adopted CNC-cut deck jigs, which permit simultaneous assembly of the hull and deck parts in adjacent shop bays. Assembling the deck as a single large part also introduced the crew to building with Corecell foam and the structural benefits gained by applying different density foam core to meet varying structural requirements. As with the hull jig, Matthews's design work delivers a ready-to-assemble plywood deck jig with cut recesses that accept fore-and-aft and transverse framing, which will eventually be bonded to the deck's underside. During my visit, crew accustomed to building in wood/epoxy were learning to work with bead-and-cove foam planks custom-cut on a router table. Those planks are fitted to the jig and glued together with Gorilla glue, which has ample shear strength and is not as hard as epoxy or as costly as Core-Bond. Large shoulder washers on temporary screws hold the Corecell against the compound contours defined by the deck jig while the glue cures. Indeed, the ease of building

Building in the often-extreme bow flare is one challenge of planking the topsides of a sportfisherman. Here, the first strakes of the first layer of laminated okoume marine plywood are ready to be applied to the jig. During planking, butt joints are carefully staggered, and temporary fasteners hold the layers of wood into the tightest of curves until the epoxy cures.

more complex shapes in the deck part is one of the reasons that F&S switched to foam sandwich construction rather than conventional wood/epoxy deck structure. The deck's FRP skins are hand-laid E-glass and epoxy resin.

Turning the hull over and marrying the deck to it are milestones in any building project. But before mating the hull and deck, each part is faired, a time-consuming process that still requires longboarding, multiple passes of fairing compound, and sprayed fillers.



Above—*These bead-and-cove foam planks, joined with Gorilla glue, are the core material for the E-glass-skinned deck part, which is built over a separate CNC-cut jig at the same time the hull is being assembled.*
Right—*The time-consuming and physically demanding job of fairing the completed hull and deck ensures the quality of the final finish paint.*

For final finishing, F&S uses Awlgrip, starting with a variety of fairing compounds (including Awlfair, High Build, and Ultra Build) before priming with 545 and topcoating with Awlcraft. Floyd explains, "Awlcraft is not as abrasion resistant as traditional polyester-based Awlgrip, but Awlcraft's repairability and its user-friendliness in a less-than-paint-booth-like environment make it the right choice for us." In addition, once the boats are operating, repairs to scrapes and scuffs in the slightly softer acrylic-based LPU paint are easier to rub out and blend than in traditional Awlgrip.

Finally, systems installation and interior development are open-ended custom endeavors driven by each owner's tastes and budget. Yes, the F&S approach can pack in all the electronics, bright-finished contoured joinery, and luxurious fabric-covered surfaces seen aboard most fine motoryachts, but its real focus, from design to final finish,

In the finished hull F&S installs complex systems and the interior joinery of the client's choice. ***Left—****The big diesels that power these boats are firmly affixed to the structural fir stringers so prominent in the build photographs.* ***Right—****A mock-up of a master stateroom assembly.*

is the boats' speed, seaworthiness, and structural integrity.

For Floyd and his clients, the final test lies in how the boats handle the sprint to and from deepwater fishing grounds and how they feel at trolling speeds. He's got plenty of personal experience building boats to meet those specialized demands, and Matthews, a very hands-on designer, has improved the hydrodynamics and high-speed performance of F&S boats on the water and build efficiency in the shop. For his part, Matthews has coupled Moesly's mentoring with his own digital design finesse and production acumen to markedly improve how F&S and a handful of other specialized builders of sportfishermen approach their game. PBB

About the Author: *Ralph Naranjo, a freelance writer from Annapolis, Maryland, sailed around the world with his family in the 1970s, managed a full-service boatyard in the '80s, and served as the Vanderstar Sailing Chair at the U.S. Naval Academy in the '90s. His recently finished book on seamanship will be published by McGraw-Hill in early 2014.*