ment that it needs more and more power (and more fuel) to make its 30-knot cruise, creating a sorry state of affairs. Much better that the boat should have more beam and waterline length to lower the bottom loading and increase efficiency. Rather than reducing the hull's bottom loading and cutting some weight out of its structure, the builder — and there are many like this one — took the easy way out and just added horsepower. Oh well, the boat rides better with more weight, anyway, they rationalize, and their customers buy into it.

Now if one boat weighs 10,000 pounds and has 250 square feet of bottom area, then bottom loading is 40 pounds per square foot. If the next 10,000-pound boat has 300 square feet of bottom, then bottom loading drops to 33 pounds per square foot. This weight per unit area of bottom makes a huge difference in how easily a boat can get up on plane and on the minimum speed at which it can stay on plane.

The deeper the transom is immersed (this is a great visual indicator of bottom loading) when the boat is at rest, the more power it will take to get on plane, the more water it will displace as it planes, creating a big wake, and the less efficient it will be. The more lightly loaded 10,000-pounder with a bigger bottom can stay on plane with a flat wake astern at 12 knots, while the other one, like our 40-footer above, starts wallowing and falling off plane at 17 knots. Guess which one is more efficient?

This ability to plane at lower speeds also lets a boat come home in rough weather at 12 to 14 knots, still efficiently on plane, while the more heavily loaded boat will be in semidisplacement mode at the same speed, burning a lot more fuel.

One lesson that presents itself in this discussion is that all the speed/length guidelines about how fast a boat has to go to semiplane or fully plane are only very rough rules of thumb. A lightly loaded 40-footer can be on plane, defined as a rise in the center of gravity with a clean wake astern, at 11 knots. The same 40-footer with 10,000 pounds of fish in the hold might not be on plane until it's making 16 or 17 knots.

TRIM MATTERS, TOO

If weight matters the most, then trim is a very close second, because trim determines lift as well as drag. Compare two 30-footers of the same displacement running along at 30 knots. One runs at 6 degrees of trim and the other at 3 degrees. The transom on the first boat will be more deeply immersed, so it will displace (push aside) more water, create more form drag with its deeper hull, burn more fuel, and pound more in a chop than the next

THE FOLKS WHO DID IT FIRST

A pair of Hunt-designed pilot boats running hard. If any boat can launch eight feet off a wave and land without rattling your kidneys, it's one of these.

By Eric Sorensen
TECHNICAL WRITER

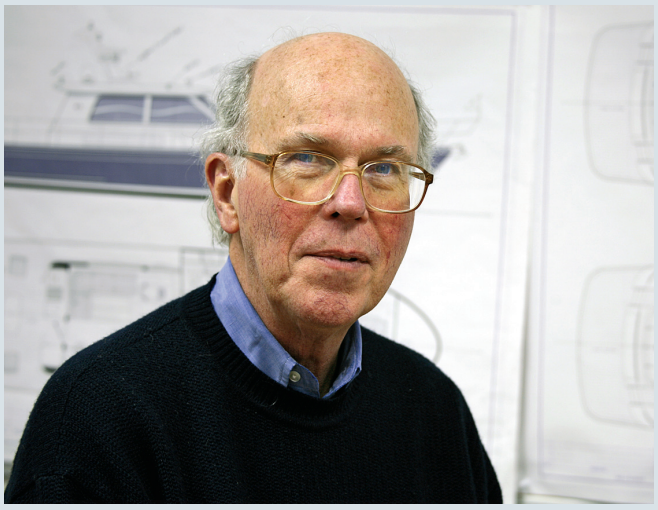
There are plenty of forceful personalities in yacht design, and perhaps even more degreed professional engineers, but one of the most competent is also one of the most unassuming.

John Deknatel, owner of C. Raymond Hunt Associates in New Bedford, Mass., is a man with a keen intellect and an encyclopedic, intuitive grasp of the nuances of hull design. He has been enthusiastically immersed in the business of planing hull design since the mid-1960s and, for the record, is also responsible for a number of successful displacement sail- and powerboats. Deknatel's distaste for drum beating might explain why more boatbuilders who desperately need to haven't hired his firm to improve their products.

Ray Hunt conceived the deep-vee hull form in the late 1950s. It was his Moppie series that started trouncing the field in the Miami-Nassau races in the early '60s, and that evolved into the original Bertrams. Hunt had no formal education beyond high school, but he designed the original 13-foot Boston Whaler, the Concordia Yawl, the 12 Meter Easterner, and other boats reflecting his considerable range and genius.

Deknatel, a Harvard graduate who studied at the Harvard School of Design and began working for Philip Rhodes in the early '60s, had similar qualities and complementary abilities. He began working with Ray Hunt as his business partner in 1966 and has focused on refining the original Hunt hull ever since.

In my experience, Hunt is one of the few naval architecture firms that gets the alchemy of planing-hull design right, with consistently superb boats coming out of its New Bedford office. They are smooth-running upsea, dry with the wind broad on the bow, and they track nonchalantly downsea, with none of the course-keeping issues or other handling quirks common to all too many other boats.



John Deknatel of C. Raymond Hunt Associates.

While a designer can't control all the gear that goes into a boat, or the methods and materials used to build it, Hunt designs run efficiently for their displacement. Although the same design philosophy and understanding informs all the firm's designs, the hulls vary in shape depending on their intended use, speed and propulsion type.

"There are lots of preconceptions about planing hull efficiency, and a lot of them are pretty much bogus," says Deknatel. "For example, transom deadrise is just one efficiency factor in a dozen, but it's all you hear a lot of other people talking about.

"Weight, beam, chines and strakes, and deadrise forward as well as at the transom are all very important to get right in terms of both efficiency and comfort," he says. "Keeping the weight down is certainly critical. Our early Concordia 46 had a moderate beam, and it was cored, keeping the weight down, and it performed very well with modest power — a pair of 320-hp Cummins. There are a lot of boats the same size out there today with twice the power that don't go any faster because they're too wide and they're all loaded up with teak, dishwashers and granite countertops."

Today's Hunt hulls are the result of years of incremental improvements. The original designs had a constant 24-degree deadrise in the aft half of the hull and very narrow chine flats that were there basically for water flow separation. They ran comparatively bow high, were less stable at rest, and not as forgiving with longitudinal weight shifts.

The early Bertrams were good rough-water boats, but they also were underpowered and ran bow high, with full

boat running at 3 degrees of trim. In fact, there is a direct correspondence between trim and both efficiency and ride quality/vertical accelerations. And, yes, even a fast planing hull displaces water — that's what creates wake.

Getting the right trim is a balancing act in search of a sweet spot. Trim the bow up with the drives, and form resistance increases as the hull plows a deeper trough through the water, though frictional drag decreases with less hull in contact with the water. Drop the bow down with drives and tabs, and form drag decreases as less water is displaced by the less deeply immersed stern, but the increased wetted surface forward adds frictional drag. The trick is to find the precise trim that produces the optimum balance of lowest combined form and frictional drag for greatest efficiency. To get a hull to run naturally at the optimum trim, hull shape, weight distribution and the force vectors created by the particular propulsion system all have to be taken into account.

SUMMING UP

The biggest factor in planing hull efficiency is weight, specifically the amount of weight per square foot of hull bottom. Reducing weight using cored construction is a good start, but just as important is reconsidering whether you really need the icemaker, large-screen television, vacuum cleaner system, washer and dryer, teak decks, 30-foot tower and the 12-foot dinghy. Simplicity can be its own reward.

And do you really need to cruise at 30-plus knots? If a 22- to 24-knot cruise will do, you might cut your power requirements in half, which reduces both engine and fuel weight. And it is so much more pleasant, in terms of both noise level and boat motion, to run at 20 knots rather than 30.

A 20-knot boat also can use conventional inboard power efficiently, since running gear drag doesn't become a major issue until well above these speeds. A longer, narrower boat runs more efficiently and comfortably than a shorter, wider one in part because its unaided trim angle is more moderate. It will stay on plane at a lower hull speed, so it will run efficiently in semidisplacement mode as well.

The very best way to go about designing a boat is to settle on the size you need — say a 40-footer — then make it 15 percent longer, with nothing added other than length. This will make it more efficient and faster with the same power, and it will be more comfortable to boot.

Keep it simple and light, with fewer things to break and add stress, and you just might find yourself having more fun on the water. ■

STILL DO IT BEST

fuel tanks right under the cockpit. That didn't help the hull form's reputation. But even with these growing pains, they were still the best-running offshore boats available at the time.

"What we did on some of these early boats in the 1960s and 1970s was add a wedge to get the stern up as needed, and this worked fine at a certain speed range — say up to 25 knots," says Deknatel. "But what we lost with this approach was the flexibility to adjust trim for different sea conditions, and if the boat was repowered for higher performance, it would develop too much bow-down trim."

This led Deknatel's team to reshape the hull, typically putting some twist in the bottom and adding wider chine flats aft to flatten out trim a few degrees — usually, but not always, because Hunt hulls vary below the waterline, depending on the propulsion system and performance specifications.

"For instance, we would have very little twist with a jetboat because, with its horizontal thrust, it runs pretty flat to start with," says Deknatel. The jet also benefits from a little more deadrise aft, which helps it track in a straight line without yawing about its course.

"Same thing with a surface-drive boat, which has a lot of lift aft from the partially submerged prop, and with a pod-powered boat, which also tends to run bow-up," Deknatel says. "We have to account for all this in the hull shape and weight distribution."

One of the reasons Hunt hulls are as efficient as they are is precisely their lower running trim. "These improvements raised the stern and dropped the bow," says Deknatel, "so our boats are now typically running at 2 or 3 degrees trim instead of 5 or 6 degrees like the more common constant-deadrise hulls. That really helped not only efficiency, but also comfort, since boats run more smoothly at lower trim angles.

"Now when you add speed or shift weight around in one of our boats, they are less sensitive to speed and loading and do a better job staying at a trim angle that makes them perform well," he says.

Another efficiency-related reason to keep the bow down is the propeller. When you add the prop-shaft angle — typically 10 to 14 degrees on an inboard — to the boat's trim, you might have a prop hacking its way along at up to 20 degrees offset from horizontal, which not only decreases efficiency but also increases vibrations.

Size is volume, so it's quantifiable by length, beam and height, but it's the proportions that matter. A 42-by-13-footer might be the same size as one that's 37 by 14 feet, 8 inches, but its extra length makes trim less sensitive to weight shifts. The longer/narrower boat has about the same top speed, and it has a wider operating range because it can stay on plane at a lower speed. It also gets on plane with less fuss and bow rise, and it's more efficient and comfortable offshore.

This Hunt 52 features a deep-vee hull with steep entry, bow flare and efficient chines.

"By staying disciplined about beam, it's easier to refine the hull so it naturally runs at the best angle," says Deknatel. "We design the boats to run efficiently and comfortably at their realistic cruise speed, but they also do well at low planing speeds, since at design weight they can stay on plane at 11 or 12 knots, which makes the boat more comfortable and efficient coming home in rough weather."

Bottom-loading management is also key to Hunt's success. "A key to improving efficiency is to build the boat with enough bottom to support the weight easily," says Deknatel. "We try to work with the builder to keep the weight down. If we're designing a boat and it comes out a little heavier than we'd originally thought, we might add a little chine beam and length to drop the bottom loading back down. We've had moderately loaded 50s run faster and more efficiently than heavily loaded 40s with the same power."

But managing overall weight and optimizing hull form alone are not enough to produce an efficient boat. "The center of gravity and the drive train are also very important and have to be matched to the intended speed of the boat," says Deknatel. "A boat can run perfectly at 25 knots, but run bow-down at 35, so we tend to move CG further aft in faster boats. This lets the bottom dry out at high speed, but you can still use the tabs to drop the bow in a head sea, for example, for a better ride. This also helps when running downsea when you want the bow higher. You can always bring the bow down, but it's very hard to bring it up unless you've got outboard or sterndrive power, and even then you're limited."

For me, the proof is in the pudding. The many Hunt hulls I've run are the best all-around running boats I know of, and the ones I've learned the most from. The secret is in the sauce — the fine half-angle of entry, the rounded stem that helps prevent bow-steering downsea, the high chine elevation forward, and the generous deadrise in the middle of the hull, where most wave impact takes place. The chine flats lift and separate without pounding, and the radiused prop pockets minimize local loss of buoyancy and lift.

Riding on the Hunt 25 in a stiff Narragansett Bay chop last summer was a reaffirmation of just how smooth and dry a monohull can run when it's sloppy out. Take a spin on an Eastbay, a larger Four Winns, the Wellcraft 36, any of the Grady-Whites, the Global 68, Southport or one of the Hunt Yachts boats built in Rhode Island.

"You really should ride the boat you're thinking about buying in rough water first," says Deknatel. "We have pretty good success when they run the other guy's boat first and then run ours. That usually brings them over."