Design Brief

One Hull Fits All

The author became his own client, and designed a kit-built dinghy whose three distinct rigs will satisfy several constituencies, ranging from novice through recreational to expert sailor.

by Dudley Dix

This design was in the back of my head for many years before it finally became a reality. The seeds of it were sown when I served on the committees that manage sailing in my native South Africa. I saw a need then for a versatile training boat to hold the attention of novice sailors and keep them in the sport. To achieve that end, the boat should challenge people to progressively improve their skills. It would have to be a fast dinghy to provide the excitement missing, in my opinion, from many existing classes.

Another problem I saw was that boats were becoming too expensive, keeping many *families* out of sailing. Where money contributes considerably to success on the race course the result is a higher dropout rate among those who lack the means to buy top boats.

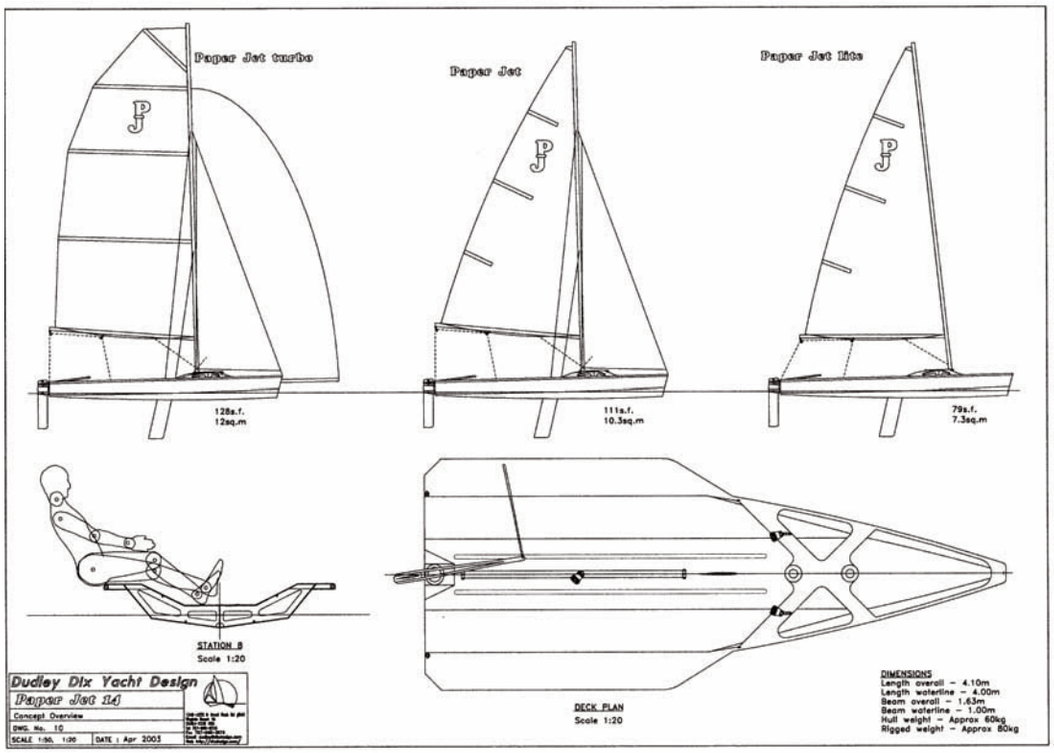
While there is of course a place for expensive, world-class racing, there must also be a route for young sailors from all backgrounds to work their way up to that level. Without such opportunity, all of sailing suffers by their absence. Worldwide, those declining entry-level dinghy fleets must be revived.

So, given that thinking, I gradually developed a design concept. Once I began drawing, the concept took on a more definite form. It started as a boat for beginning sailors, but the features it acquired along the way made it suitable for more than I originally intended. Once I saw that it was going to be *my* kind of boat as well, I kept designing it with myself in mind.

On only one previous occasion had I played the role of my own client, and, happily, that resulted in my most popular group of designs. That first time, I wanted a lightweight boat to race across the South Atlantic. So I designed the Didi 38 (11.5m), built it, and sailed the prototype, *Black Cat*, twice across the Atlantic before setting up to sell plans for the boat. In drawing and building that design I developed the radius-chine

IKE HOWELL

Dudley Dix's Paper Jet 14 (4.1m) at speed under her standard rig. The white upper section of the mast is a carbon fiber sleeve that can be easily replaced by a taller version with additional rigging for the large, high-performance, "turbo" setup. (See the rig options on the next page.)



DUDLEY DIX

Dix's inexpensive kit-boat concept features: three different sail plans for sailors of varying experience and ability; a very modern, minimal hull; and a fast, wet ride (Dix is a strong believer in the joys thereof). His design lends itself to club sailing.

plywood hullform and building method, which spawned a series of performance plywood designs, ranging from the 21′ (6.5m) Didi Mini-Transat racer to the DH550 (16.75m) catamaran. There are now hundreds of boats being built worldwide to this series of designs. The key here was to give myself total freedom to think laterally and do things differently, proving features and concepts to myself rather than to an "outside" client.

[For more on Mini-class single-handed ocean racers and a close look at a recent advanced-composite example of one, see the article titled "606" in Professional BoatBuilder *No. 109—Ed.]*

This second time as my own client I came up with a boat I call the Paper Jet 14 (4.1m). During the design phase, it became a fairly radical boat, of very modern image, or "look." I intended every aspect of the boat to be thoroughly contemporary—and the construction method to be within the abilities of amateur builders.

At that point I was still living in South Africa. I had a kit cut for all the plywood components, but my emigration to Virginia intervened, so the kit traveled in the shipping container along with our furniture.

In the meantime, two other kits were cut for builders in South Africa who understood they would have to figure out for themselves how to build it. They both ran into problems in the assembly process. When I started my own build in Virginia Beach, I ran into the same assembly problems the South Africans did, but puzzled through them and developed solutions to proceed. After that initial stumbling block, my prototype progressed well.

When I'm building my own boats, the realities of sourcing and buying materials and equipment always come to the fore. I decided it would be great to design a boat that could be built primarily from *stuff* that can be bought at a typical suburban hardware store or lumberyard. That occasionally sent me wandering through my local franchise superstores in search of items I could put to a totally different use from what their manufacturers intended.

During this reconnaisance phase the concept of the boat itself changed. It retained the contemporary look, but acquired features I borrowed from much more traditional craft. Those features are primarily in the rigging details, adapted from older gaff-rigged vessels. The final craft that came out of my garage is a mix of older methods and modern styling, with a host of attractive details to encourage quality construction.

Again: I designed the Paper Jet 14 to cater to a wide range of sailing skills. I wanted a boat that would allow a club to race it as a class boat—thereby providing exciting sailing to experienced sailors—while also allowing individuals with less experience to develop their sailing skills in the same boat. And, the features I designed into it for club sailing will enable a family to put this hull to multiple use: as the platform for a skilled sailor to blast across the bay; or, fitted with a smaller rig, the platform for novices and children to sail at slower speed.

AARON PORTER

In keeping with the spirit of simplicity that inspired the Paper Jet, the tiller extension is a basic bamboo pole connected to the tiller with a piece of flexible tubing and a stainless steel bolt.

I achieved this versatility with some modular components. The wooden mast has two interchangeable carbon topmasts and two mainsails of different sizes. These—along with a jib and asymmetrical spinnaker and retractable bowsprit—are set up in different combinations, creating three distinct rigs. The mast is supported at gunwale level by an X-shaped brace that distributes the loads, stiffens the hull, and accepts two mast positions.

The Rig

Rig details taken from traditional sailing craft include thumb cleats, lashings, and "soft eyes" instead of stainless steel hardware. These tie the standing and running rigging to the hull and boom with greater strength than if one were to through-bolt stainless straps to the wooden structure. They also reduce cost and weight.

Mast and boom are of hollow, so-called bird's-mouth construction, finished bright and given a striped appearance, thanks to alternating strips of cedar and poplar. They're both lightweight species; the poplar, a hardwood, supplies strength and stiffness.

(This particular combination came about because the superstores in my area did not stock spruce, and their cedar was not the best quality. I selected carefully from what cedar they did have, but I still needed to strengthen it. I required tough timber on the fore-and-aft and 'thwartship axes to supplement the cedar on the 45° axes, and chose poplar only because of availability.)

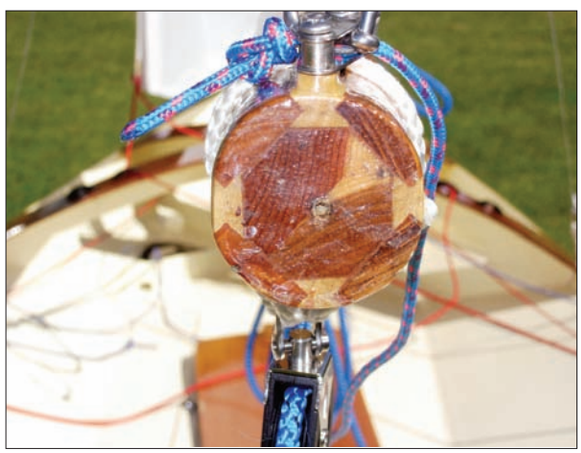
The sail track is a length of plastic pipe cut along one side to form the slot; it's epoxied to the mast, and faired. This is an experiment with a very inexpensive, lightweight tube. If it doesn't last, I'll replace it with a carbon or aluminum tube.

One benefit of the wooden mast being a hollow, sealed structure is that the mast then has a lot of buoyancy. In capsize testing to date, the mast has floated the rig and prevented the boat from inverting—a big benefit for a training boat, which will occasionally capsize well away from rescue craft. The only drawback, though, to this arrangement is that the halyards cannot be run inside the spar.

The carbon topmast was formed over a shaped foam core dissolved with solvent once the epoxy cured. I took a sheet of 2″ Styrofoam insulation, cut it to the width needed, and glued it with polyvinyl acetate glue to the specified thickness. Then I shaped it with a sanding block to match the top of the wooden mast—but made slightly smaller to accommodate the thickness of the carbon laminate. Next, I wrapped this foam stick with layers of carbon, tapering the number of layers progressively toward the top. In retrospect, I should have left the foam inside the mast and sealed it top and bottom. The rig floats nicely when capsized, but the topmast does fill with water. That's extra weight to pull up when righting the boat. I'll leave the foam in the taller topmast of the high-performance (a.k.a. "Turbo") rig, as yet unbuilt at this writing.

The topmast slides onto the top of the wooden mast just above the hounds. A carbon topmast is, admittedly, an advanced-technology departure from the simplicity that characterizes the rest of the boat, but it seems a reasonable solution to the need for two different mast lengths. Rather than build two complete masts with two sets of hardware, I wanted to have one basic mast that included one set of hardware and could be lengthened by merely changing the top of it.

The "Lite" rig—smallest of the three—can be set up fully freestanding for sailors of light weight and/or little experience. This setup permits the mast to bend freely, depowering the sail as the wind strengthens. For sailors who are ready for a bit more power, a forestay stiffens the mast considerably to extend the power range of the sail. The resulting raked rig, which stands in the forward of the two mast positions, maintains balance and allows the same sheeting positions for the main with all three rigs.



AARON PORTER

The end of the hollow boom clearly shows its birds-mouth construction; in this case (due to ready availability in the part of Virginia where Dix resides), with strips of poplar and cedar.

DUDLEY DIX

A prototype Paper Jet in mid-construction. Note the longitudinal backbone and interlocking transverse plywood frames that keep the hull lightweight but stiff.

The two larger rigs ("Standard" and Turbo) stand in the aft maststep and are supported by upper and lower shrouds. The uppers lash to the solid wood at the leading edges of the hull "wings"; the lowers lash to the gunwales, sharing the loads with the hull skin, gunwale, and crossbrace.

One of my experiments with the Paper Jet was in the standing rigging. The forestay mentioned above is stainless steel wire rope, sewn into the luff of the jib. I made a set of shrouds with stainless steel wire rope from components bought at a local chandlery. But I also made a similar set of shrouds from 12-gauge galvanized fencing wire, the way my dad showed me when I was an early teen rigging my first boat. The latter rigging costs less than 10% of the stainless version and can be made in any workshop that has a vise, wire cutters, and a pair of pliers.

As for longevity, the rigging on that first boat of mine was still serviceable when I last saw it around seven or eight years later. Note, however, that galvanized wire, like rod rigging, cannot be coiled. So I leave mine lashed to the mast when this rig is not in use. (To date, the stainless rigging has remained in the bottom of my sail bag, untouched.)

The Hull

Hull construction is stitch-and-glue plywood—with a difference. The entire boat is built from 4mm plywood, so it's very light and therefore needs more internal support than it would if built with thicker plywood. That support is provided by a full-length plywood ladder-frame backbone along with interlocking transverse plywood frames. A few small stringers stiffen the hull bottom panel as well as those deck panels that may be at risk when the crew comes in off the trapeze during a tack or jibe.

Conventional stitch-and-glue construction of small boats is normally done *without* a strongback. But that system won't work here: the boat's framework must be securely supported to maintain its shape while the hull bottom skins are flexed into position and secured to the framing. Which means the builder must secure the framework to the strongback to provide rigidity until the hull skin is complete.

Deck and upper-wing panels are also assembled by stitch-and-glue. The crossbrace, built atop the deck and fitted between the upper hull panels, is built entirely of plywood; it spans the boat, setting flush into the gunwales. The reinforced mast partners are part of this web, which transmits its lateral loads to the hull and deck.

I applied cedar along the gunwales and leading edges of the wings, to save weight. Those parts are capped with poplar for visual contrast, and for added strength and stiffness. The result is a strong and lightweight hull at 90 lbs (45 kg).

The Paper Jet's body plan shows a shallow V-bottom with a fine entrance; she approximates a wedge shape in plan view.

Performance and Price

I can report from my own experience that the Paper Jet planes easily, producing a soft ride at high speed in lumpy water. The boat is quick in any wind condition, leaving almost no wake at all speeds, and planes to windward in a stiff breeze.

Wings are at gunwale level, not raked upward (to keep them clear of the water) as is typical in boats emulating a form popularized by Australian sailing skiffs. Were the wings on my design conventional, this approach would result in the boat tripping when the leeward wing is immersed. But the Paper Jet's wings are low drag and have a lifting-foil leading edge. The leeward wing can be immersed at speed and will *not* trip the boat. Instead, the leading edge provides some lift to help the boat

DUDLEY DIX

A nicely shaped X-brace strengthens the hull and supports the two maststeps needed for the Paper Jet's multiple rigs.

stay on its feet. At speed and heeled, with the leeward wing skimming the surface, the Paper Jet gains planing surface from the underside of the wing. This moves the center of the planing area to leeward, which means the crew weight to windward gains greater leverage, thereby increasing power. The added buoyancy of the wings helps keep the Paper Jet upright in gusty conditions, making it a more forgiving training craft.

This boat takes me back to my roots in small dinghies and to my first sailboat, a popular South African junior scow called the Dabchick—essentially an oversized surfboard with a sloop rig—a wet and exciting ride for young sailors. I happen to believe that most of the really fun things in life do involve getting wet; the more fun a boat is, the more likely it will be to attract new sailors and hold their attention to the sport. Like a Dabchick, the Paper Jet is relatively flat and is a wet boat at speed.

Again: With the Paper Jet I'm not trying to produce a design that will sail the pants off any other skiff or singlehander. It is nonetheless fast, challenging, and exciting to sail. Also, as stated earlier, this design was intended to provide an economical path for sailors to progress through the multiple steps that ordinarily separate performance boats—the transition from, say, an Optimist pram to costly singlehanded skiffs—*without having to trade up each time*. A Paper Jet can be built at the basic level, or at the level the builder/sailor thinks he or she can handle, and progress from there to a really challenging boat.

The cost of my own boat to date is approximately $3,750, excluding the Turbo rig. Once I've made and tried out that rig, I expect its components will add $1,000 to $1,500.

With the Standard rig the boat has proven quick, responsive, well balanced, and loads of fun. She accelerates quickly, and surfs on the smallest chop. The Lite rig tames her quite a bit, but she remains responsive and well balanced. I look forward to the excitement of sailing under the extra mainsail area and asymmetrical spinnaker of the Turbo rig.

All Paper Jets will be built from kits to ensure that they are as identical as possible. Plans are not available for scratch-built boats. Kits will be available from suppliers in various countries. Agreements are already in place for kit cutting in Australia, Italy, South Africa, Turkey, the United Kingdom, and the United States. The base kit will include all plywood components, pre-cut by computer numerically controlled router. Solid lumber required in the structure will be offered by some suppliers; others will make available additional items such as sails and hardware. Each supplier will have its own pricing structure, which I do not know at this stage. PBB

About the Author: *A Westlawn graduate, Dudley Dix has been designing boats professionally since 1979, after winning* Cruising World *magazine's design competition that year. His Shearwater 45 was awarded 2001 Sailboat of the Year at the Annapolis Sailboat Show. Dudley was based in Cape Town, South Africa, until moving to Virginia in 2004.*