DESIGN CONCEPTS

When a yacht is designed, one way or the other all of the elements we've been discussing in this section are involved. If you modify one characteristic, it has ramifications for a whole series of other areas. Keeping track of it all can become a daunting, sometimes confusing task.

What we do when we're initially working on a new design, and I think what many others do as well, is to develop a design concept. This provides a reference to fall back on as the many compromises that are part of the design process are made.

The interrelationship between the hydrostatic elements give a design a specific look and feel, not to mention behavior pattern. Once a designer gets these relationships into a successful package, he tends to stay within the known parameters. He or she may push or pull a bit here or there, but the basic relationships typically remain in the same ballpark.

How the hydrostatic elements work together is part science and part intuition. Experience at sea or feedback from clients helps with the fine-tuning process. The end result is typically a closely guarded secret.

This is, after all, a competitive business, and who wants to give the opposition any help?

As much as many in the marine business would like to think their design concepts are new or unique, there is very little under or on the water that has not been used before.

Take our own boats, for example. Over the years our narrow, long waterline hulls have been called radical, ugly, breakthrough, and many other not-so-flattering names. But the Chinese designers were using similar or even more radical shapes on their seagoing junks 1,200 years ago. They were also using freestanding rigs and full-battened sails. Hollow waterlines, currently such a rage with some IMS racing boats, were used by Donald McKay on his extreme clippers in the 1840s (along with 6- and 7-to-1 beam-to-length ratios, high prismatics, and full waterlines). The Herreshoffs were building yachts with fin keels and spade rudders at the turn of the century.

In spite of the secrecy in this business, we thought it would be interesting to try to get a couple of modern designers to give us a brief on their design concept, to show how it varies from what others are doing in a technical sense.

We'll start off with our own approach to the design process.

DEERFOOT/SUNDEER

Our approach to cruising design starts with the premise that the boat is going to be used for offshore voyaging, and that *heavy-weather capability is the primary design criteria*. In this context, the limit of positive stability, skid factors in reaction to a breaking sea, and steering control are the major design factors. They provide the absolutes against which we judge all other issues.

We are prepared to take performance hits in light air to get a configuration that does its best for the crew when the chips are down, and one that keeps the crew comfortable in breezy weather.

Since our boats are intended for cruising, draft is always a major issue. Not only does this limit keel depth, but it acts as a restriction on rudder depth as well.

Another major criterion is maintenance. In a design context, this means allowing for systems space so that there is good access to gear. We've learned over the years that aft engine rooms are efficient to build and very efficient for our owner's maintenance chores. In addition, they have the advantage of separating the machinery noise, heat, and odor from the living spaces. Obviously putting all of this weight aft has an impact on hull shape. Interestingly, in many ways, once you learn to work with it,

Two good views of the Sundeer 64 close-reaching at speed. She is sailing here at 10 knots, a speed-length ratio of 1.25 yet there is just a hint of bow wave. The small bow wave and fine entry angle are two of the reasons these boats are so dry at sea. (Billy Black photos)

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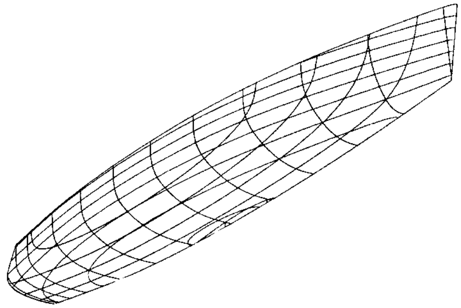
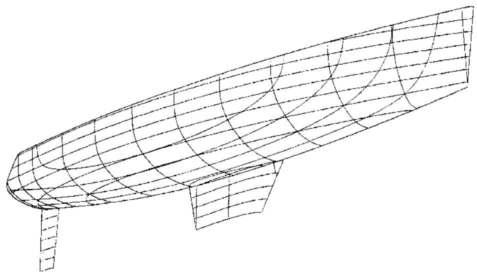
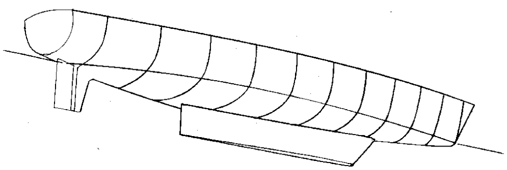
The Sundeer 64 was based on what we learned from the Sundeer 67. The hull was flattened a bit, and displacement was reduced with little noticeable change in comfort. These two drawings, with and without fins, give you a feel for the shape and how fine the bow was.

At the same time, because the waterline was carried so far forward, there was plenty of buoyancy to keep the bow high when driving hard off the wind.

Longitudinal stability is typically expressed in terms of foot pounds required to trim an inch. The Sundeer 64 requires 10,000 foot pounds per inch, a number in keeping with a lot of maxi-boats sporting huge rigs!

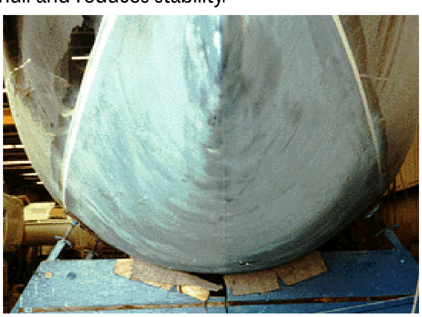






Compare the Sundeer 64 hull shape to *Wakaroa*'s hull and fins from 18 years previous. The bow on *Wakaroa* is much fuller, the canoe body a lot deeper, and the keel enormous. The skeg-mounted rudder has since been changed to a spade configuration.

When we developed the keel for *Wakaroa*, the owner, Jim Schmidt, wanted 850 gallons (3,300 liters) of fuel and water. With a shallow canoe body, the logical place for this was in a long fin. This had the added advantage of forcing the lead into a long, low pancake at the bottom of the keel with a very low center of gravity. This works well as long as the keel is 50% or more filled with liquid. But when it is close to empty all that keel volume lifts the hull and reduces stability.



The original Sundeer 67 (left photo) has a very fine half-entry angle, just 11 degrees. Her hull was quite rounded to reduce wetted surface and ease motion. Since initial form stability was moderate, she would heel to about 10 degrees before stiffening up. From 10 degrees on, she was very powerful.

This hull shape made for a very, very soft motion at sea and in rolly anchorages. In hindsight, we went farther than needed and came back a bit on subsequent designs (to where there was more initial stability).

The Sundeer 64 (right photo) has a half-entry angle of 12.5 degrees and somewhat flatter hull sections. The motion was a little quicker than in the 67, but in most cases this is not noticeable. However, we have worked hard at maintaining the soft initial stability curve so that at sea and anchor in rolly conditions she remains very comfortable. This tendency can be mistaken for being tender. However, this design type quickly stiffens up once the initial heel angle is attained.

there are some significant advantages in a cruising context to the hull design modifications required to accommodate the machinery weight aft.

The very first boat we did in 1978 had fore-and-aft watertight bulkheads, a tradition that has carried on without change since. In the forward end of the boat we always have a collision bulkhead which separates ground tackle and sails from living quarters. This provides a safety feature, as well as isolating the odor and mildew usually associated with dirty chain and wet sails.

The forepeaks are designed so that a breach will not materially affect sailing trim.

Finally, we try to be realistic about the cruising payload that our design is going to carry, and allow for it in the hull lines right from the start.

Evolutionary Design

Over the years we've been privileged to work with some very experienced and forward-looking owners. They have given us the latitude to create designs based on what worked best at sea in a cruising context, with no regard for fads or handicap rules. Building so many cruising yachts over the years has allowed us to "bracket" design issues (such as bow shape) with full-scale models. Then, after real-world experience

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at sea on these designs, come back to the drawing board for the next generation. Along the way, we've learned a lot of lessons about how the various theoretical ingredients work in the real world of bluewater cruising. And while today's designs have a certain family resemblance to our early boats, they are significantly different in most hull, keel, and rig parameters.

Hull Shape

When we started this process in the late 1970s, the market forced us to have bow- and stern-overhangs. Although the early Deerfoot designs were considered radical in their day, the reality is that they were quite conservative. It was not unusual for us to give away 10 to 14 percent of the overall length to overhangs. We thought it was dumb, but you can only get so far ahead of your market and sell boats.

Today we give away virtually nothing — perhaps a foot (300 mm) in the bow to help with aesthetics and the anchor.

The result has been much narrower bow half-entry angles (around 11 to 12 degrees today, compared to 14 to 15 degrees 18 years ago). Our structural scantlings have remained constant, as has our payload-carrying ability. However, displacement-length ratios have dropped from the 150 range to an average of between 60 and 100 today.

We've found that the prismatic coefficient is less critical with the lower displacement-length ratios and we pay more attention to the curve of area (how the volume is distributed throughout the canoe body). Aft PCs tend to be up around 0.66, while forward PCs are typically around 0.44, with the average of the two ranging from 0.545 to 0.57.

Our beam-to-length ratios have stayed in the 4/ 5.5-to-1 range.

As waterlines have gotten longer and half-entry angles narrower, we've also found that we've been able to reduce volume in the forward section of the bows. Reserve buoyancy is down probably 20% from what we used to feel was necessary, yet our modern boats can be driven harder downwind, under better control than our earlier designs.

The longer waterlines have made this possible as our longitudinal stability — the ability to keep the bow dry when driving hard down wind — has gone way up. These finer bows obviously penetrate waves better when going uphill. They also do extremely well when being driven hard downwind due to their very high initial longitudinal stability. They have the ability to drive into a trough without slowing significantly due to the friction of excess reserve buoyancy. In terms of keeping the foredeck dry in heavy downwind sailing, our modern hulls are even better behaved than our first- and second-generation designs.

A death-defying photo by your author of one of our early pilothouse designs, my dad's *Deerfoot II*. This 74-foot (22.8 m) cutter was just 14.5 feet (4.46 m) wide. She is very easily driven under sail and power. She'll do 9.5 knots for about 2.7 gallons (10.4 liters) per hour of fuel.

She had a narrow (for her day) waterline half-entry angle of just under 15 degrees. Combined with the narrow beam, she would make very smooth progress upwind, especially when motorsailing.

When we developed the lines for *Sundeer* we were trying for a comparably soft motion to *Deerfoot II*, but in a shorter length. While she was 1 foot (0.3 m) wider on deck, she was much narrower underwater, with almost 18 inches (450 mm) less waterline beam.

The half-entry angle of the bow was just over 11 degrees!

We felt that she would be as comfortable as the larger designs under adverse conditions.

We were wrong! She proved to have a much smoother motion going upwind. The difference was not subtle; rather, it was immediately noticeable.

The key was the underwater shape and minimal topsides flare. This allows the bow to cut well into the wave before starting to rise. When you compare these deck photos you would think that *Sundeer* has a fatter bow. Right at the deck line, this is true. But below the deck she is indeed narrower.

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Bow-Spray Patterns

Bow spray indicates efficiency (the less spray, the less energy used to get through a wave) and is a major comfort concern (dry boats are more comfortable than wet boats!). The following photos are all lifted from videos of our designs working in waves.

The upper five images were taken during a midwinter crossing of the North Atlantic by a Sundeer 64 under the command of sailmaker John Conser. The boat is close-reaching with reefed main and staysail in 35 knots plus of wind, with a long swell and wind chop running about 50 degrees off the bow.

Each of these images was taken as the bow pitched down into the wave. Notice how there is very little spray, and what there is blows to leeward by the time it gets back to the cutter stay.

These two images are from a 40-knot-plus day aboard *Sundeer*, wind at about 75 degrees, with much steeper although smaller waves on the bow. Once again, note how far forward the spray pattern crosses the hull. We could stand at the mainmast shrouds in these conditions and stay quite dry.

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Bow Waves

As we've discussed before, hull efficiency is indicated by the magnitude of the bow wave at various speeds. The faster you go, the more bow wave you find. Vessels with heavy-displacement-length ratios spend most of their energy creating and overcoming bow and stern waves. The Deerfoot and Sundeer design series we've done over the years feature relatively low displacement-length ratios, so the bow and stern waves are commensurately small.

At right, a Sundeer 64 is close reaching at 9 knots (a speed-length ratio of 1.125). The bow wave is quite small, and by this speed the stern wave has moved off and aft of the hull.

Now compare *Intermezzo II* (above) at the same boatspeed, but a much higher speed-length ratio due to her shorter waterline length. She has more heel and is pushing a lot more water forward (although some of this is from a wave she's just pushed through). As the wind and boatspeed increase, the disparity between these two designs will increase even more dramatically. Where the longer waterline design in the top photo will continue to accelerate rapidly with a modest buildup of drag, *Intermezzo II* is close to her reaching limit. She will need a reduction in sail area much sooner and will labor more as she tries to accelerate.

If you look carefully at the corner of the stern of *Intermezzo II* you will notice a splash of stern wave. This has started two feet (0.6 m) in from the end of the transom. Compare this to the top photo of the Sundeer 64 where the stern wave does not start until after the end of the boat.

Intermezzo II was designed almost two decades ago and was considered a breakthrough design. And we were tickled with her easy 200-mile days. But we've learned a lot in the ensuing years. Today 200 miles a day is a bit of a slug in a vessel this size. We now achieve much better speed and more comfort, with a lot less effort (under sail and power).

Two shots (above) of the original *Sundeer* at moderate speed in a small chop. She is sailing here at 8 knots (or just over a speed-length ratio of 1.0). The bow wave is almost nonexistent (as you would by now expect). What is interesting here is the comparison between the two photos. In the left photo *Sundeer* is on her lines. The right photo shows the bow immersed in a small sea. Note how cleanly the bow goes through this sea. That's a function of the very fine entry angle and high longitudinal stability. In big seas, when you can't get this type of photo, the characteristics are similar, leading to a very smooth ride uphill.

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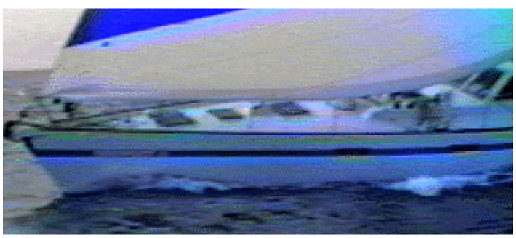
Above: Two different bow waves on a Sundeer 56. In the upper left photo the boat is moving at 7.5 knots (a speed-length ratio of 1.0). The bow wave is hardly noticeable. In the upper right photo speed is increased to 9.5 knots (a speed-length ratio of 1.25). This is where you start to see large-magnitude bow waves on shorter waterline designs. Yet the bow wave on the Sundeer 56 has barely begun to form. Even at very high speeds there will not be significantly more bow wave than what you see here.

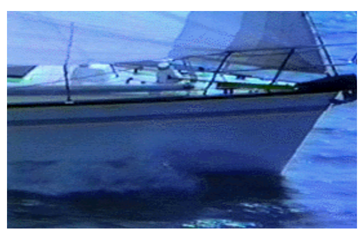
Two more views of this very efficient cruising hull (above). In both of these shots the Sundeer 56 is moving at 9 knots (or a speed-length ratio of 1.2). Note how clean the transition is between the bow and the middle of the boat. It is not uncommon on many designs to see a distinct hollow starting around the mast (which then gives way to a large stern wave).

You can see in the right photo that the midship area of the hull has a very smooth passage through the water, giving way to a stern wave that has actually moved off the hull and behind the transom.



The photo above is a Sundeer 74 beam-reaching at 10 knots (a speed-length ratio of 1.21). This is one of our early designs, with a displacement-length ratio of about 125 (compared to 80 for the Sundeer 64). Given these characteristics, you would expect that this design would have a much larger bow wave than the Sundeer 64 — which it does. Yet for a 75,000-pound (34,000kg) motorsailer, that's a pretty small bow wave!

The three photos to the right are another early design, *Locura*, reaching with a real head of steam. She's doing a steady 10 knots (a speed-length ratio of 1.25). *Locura* was optimized for downwind sailing at her owner's request, so she has a much fuller bow under water than our other designs.



The half-entry angle of 16 degrees (compared to *Sundeer's* at 11 degrees) gives her a lot of buoyancy forward.

It also kicks up a fair amount of water as she pushes through this moderate wind chop. This indicates that she will be less comfortable upwind than the other designs, which make less fuss going through the water.

This theory is born out in practice. On the other hand, she steers like a dream and surfs off the smallest waves.

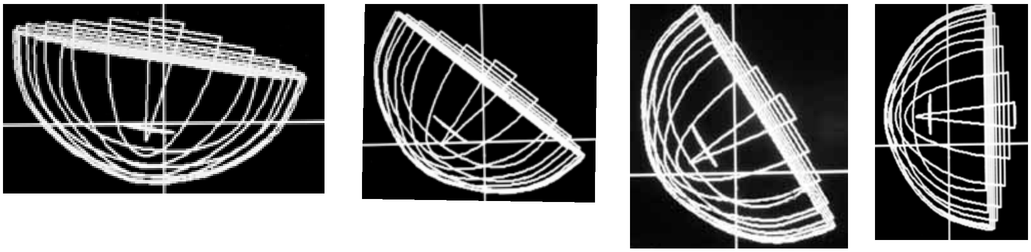
Locura and *Deerfoot II* went into the water at about the same time, providing us with a two full-size test beds. We found that a compromise between the two shapes offered the best of both worlds. Subsequent designs went this route and were better all-around boats.

Hull Balance

We have always made sure that our hull lines were balanced in terms of curve of area between an upright attitude and normal sailing angles (typically 17 degrees). If you overlay two curves of area, they will sit almost on top of each other.

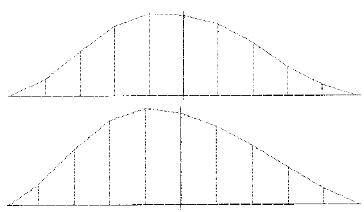
Where draft and therefore rudder control is highly restricted, we sometimes develop a heeled hull shape that increases volume forward and thereby shoves the stern down (keeping the rudder immersed longer).

You cannot get away with this on beamy boats, as bow volume will cause all sorts of motion problems beating and reaching. But with our very narrow entries, motion with these hulls has not proven a problem.



These four schematics (above) of *Sundeer* being heeled by the computer show several factors you should watch for on your own boat. First, with 10 degrees of heel, note the relative positions of the bow and stern (the stern is that horizontal line which seems to intersect the bow section.) At 45 degrees of heel, the fore-and-aft trim has hardly changed at all, and the center of the transom is still just touching the water. This means the rudder, which is somewhat forward of the transom, still has an end-plate effect, which keeps it twice as efficient as if the top of the rudder were uncovered. The third position is a 60 degree heel, about where we go with a wind-induced knockdown (confirmed with the spinnaker one sunny afternoon in 35 knots of wind!) All the deck openings that might be subject to flooding, like dorade vents, should be inside of this line. In our case, we can go down to about 70 degrees before we start to worry about getting wet inside (although the dorades all have caps that can be screwed down from inside to seal them). Finally, at 90 degrees, which is about the worst we would expect from a wave-induced knockdown (and it would have to be a hell of a big hit at that), we want to be sure that any deck gear subject to damage (such as a life raft) will be inside this flood line. Obviously all hatches and dorades would have to be sealed if the threat of such a knock existed. These last two views of heel angle and flood line would probably apply to a lot of modern, medium-displacement, high-freeboard cruising yachts. However, if you're curious what will happen to your own yacht or one you're thinking about, you can get a series of schematics from Veleocity in Annapolis, Maryland, or from one of the designers who uses their software.

These two shots (left and below) of *Sundeer* being moved out of the hull-builder's shed give the best view of her canoe body. The waterline beam looks extremely narrow in this view — because it is. She's just 11 feet (3.4 m) wide on the water when sitting on her lines compared to a beam on deck of 15.25 feet (4.7 m). Yet she was very stiff due to an extremely low center of gravity. The "softness" in these lines made for the most comfortable ride of any boat we'd built to this point, regardless of size.



Curves-of-area are usually kept secret as they detail the distribution of hull volume — one of the key factors in the design of a hull. These two curves (above) are typical for one of our current designs. The upper curve is for a hull that is upright. The lower curve is for the same hull heeled 20 degrees. If you look carefully, you will see that as the boat heels, it actually picks up a small amount of volume forward, forcing the stern down in the process. This helps steering control enormously.

With many designs, this would make for such a full bow that going upwind in waves would be very difficult. However, with our long-waterline hull shape we can have this type of volume distribution in the topsides and still have a narrow entry angle for good wave penetration.

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Keel Design

While our waterlines have been getting longer, our keels have been shortened. We've learned that the combination of more efficient rigs (better sailcloth and design) coupled with our finer bows and longer waterlines (for better speed) has allowed us to reduce keel size to a point at which the major factor today is the ability to store lead and work in our battery bank.

The keels we do now, within the context of a very shallow draft (typically a maximum of 6.5 feet/2 m), are about 40 percent shorter in length than what we did 10 years ago. The boats are faster to windward and tack better as a result.

If the keel is stalled, flow will reattach more quickly with the shorter fin as well.

Where we used to use a certain percentage of sail area for keel size, today we look at the lift-to-drag curves for the keel at various speeds, see what the computer says about leeway angles, and then decide what we think is a reasonable assumption for sailing upwind in a tradewind sea based on our real-world database. We typically target a projected 5.0 to 6.5 degrees of leeway in moderate conditions. We know it will be worse than this in bigger seas and stronger winds, but the boats have the ability to maintain good speed to weather in pretty nasty seas, so the keels don't have too big a problem with stalling.

How Much Draft?

This is a problem we wrestle with all of the time, both on our own boats and on those of our clients. The bigger the boat, typically the deeper the draft. After all, bigger boats usually have deeper canoe bodies and that means, within a given amount of draft, less room for a keel. Throw in the bigger rig that comes with the bigger boat and keel loads go up. So you need more lift from the keel, but if draft is restricted.....well, you get the story.

When you put this in the context of moderate-draft cruising, where 6.5 feet (2 m) is usually the limit, the upwind equation can get difficult. In our case, however, we have a couple of things going for us that are not the norm.

The first is that the canoe bodies, by nature of their long waterlines, don't need as much depth to float their displacement. So there is more depth left for the keel. As we've discussed, increasing the span (draft) of the fin, with the attendant increase in aspect ratio, increases lift in a geometric fashion. So very small increments of fin span increase yield dramatic results.

Second, because our waterlines are so long there is more theoretical speed available upwind. Throw in the fine entry angles for a smoother ride, and lift again increases (with the square of the increase in boatspeed).

Finally, we do not require huge amounts of driving force from the rig to propel our boats uphill. A smaller rig means sails can be trimmed better, the mast can be smaller and interfere less with the sails, which in turn increases efficiency. The reduced sail area and increased efficiency means a smaller keel can do the job. The smaller keel ends up with a shorter chord and a higher effective aspect ratio within our fixed draft.

What this means in the end is that for shallow-draft cruising, these boats tend to be very quick upwind.

Now, if you are willing to cruise with another foot (300 mm) of draft, we can do wonders for your upwind performance.

Rudder/Propeller Relationship

While our hull shapes have gotten easier to steer, the limiting factor on rudder design has remained maneuvering under power in tight quarters. Because our props are typically quite close to the leading edge of the rudder, the rudder acts as a thrust deflector and we end up with a huge stern thruster.

In order to make this thruster work well, the rudder needs to be quite large. This means that we probably have a third more rudder than we need for normal sailing. But then that big rudder helps a lot when one is steering in big seas. Our rudders typically are sized at around 1 1/4 percent of measured sail area. This is a large rudder for our type of vessel because the steering loads at sea are so low. However, with a less favorable beam-to-length ratio or heeled curve-of-area, a much larger rudder would be required.

The Sailing/Powering Balance

Our own experience, and that of our owners, indicates that probably half of all miles at sea are spent under power. This holds true for just about any cruiser who has comfortable powering abilities (where machinery noise, vibration, or heat does not force them to sail) and adequate range.

We first learned this lesson with *Intermezzo II*. We were in Mexico, with a long uphill slog

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ahead of us, and diesel fuel was 12 cents per gallon. It didn't take a genius to deduce that it was much less costly and far more comfortable to motorsail the 1,200 miles left on our trip, which was dead upwind. We spent a total of U.S. $93 for that passage. Compared to wear and tear on the sails and rig — not to mention crew — this was a real deal!

After this experience, we began to spend as much time on the design factors that affect powering as we did on the sailing design issues. As a result, all our subsequent designs have had at least a 1,200-mile range under power, aft engine rooms that are quiet, and efficient propulsion systems (where we've concentrated on getting as much horsepower into the water as possible).

Which leads us to light-air capabilities. For daysailing or racing, light-air sailing ability is paramount. All trade-offs lead towards light airs (and usually upwind performance). But with a large cruising vessel, our experience indicates the approach should be different.

We usually establish a minimum acceptable light-air performance level and size the rig and hull parameters around this point. This ends up with a boat that doesn't need to be reefed as quickly and does quite nicely in a blow.

The very slight weakness, in cruising terms, in light airs is never really felt because the propulsion system is used to motorsail (which is also the case with most light-air designs when they are cruising!).

Stern Shape

This logic leads to a controversial approach to stern shape.

Because of our low displacement-length ratios, stern waves are quite small in magnitude and quickly move aft of the hull itself once the vessel in question has attained a relatively modest forward velocity.

As a result, we design some of our hulls to have a small amount of immersed transom area at rest and at low speeds (typically below a speed-length ratio of one).

Practical experience has shown that this immersion costs us between four percent of speed at speed-length ratios of 0.4 to 0.6 and half of this between an SLR of 0.6 and 0.8.

While this is a huge number in racing terms, it seems nearly meaningless in a cruising context.

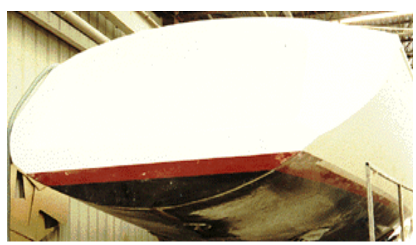
If we are talking about 4 percent of 4 knots, it is less than 4 miles in a 24-hour passage.

And when you look at the advantages (better performance at top speed, more efficient powering, much better prop characteristics when motoring into head seas, higher longitudinal stability) this seems like a small price to pay, especially in light of the fact that with an efficient powering set-up, you are going to be motorsailing on passages during light airs anyway — regardless of how fast the boat sails in these conditions.

A Sundeer 64 (above) at rest in Newport, Rhode Island. She's at about 90% load here ready to head for the Virgin Islands. About three inches (75 mm) of the transom is immersed in this trim.

Two views of loaded Sundeer 64s. Above, the boat is close-reaching at about 11 knots, a speed-length ratio of 1.37. The stern wave is starting to stretch out behind the boat and is quite small in magnitude.

Below, the Sundeer 64 is sailing at 9 knots, a speed-length ratio of 1.125. At this speed, the stern wave has just broken free of the transom.



Here's a shot of the Sundeer 64 out of the water. The distance from the bottom of the canoe body to the bottom of the bootstripe is about 6 inches (150 mm). Even when the transom is immersed a full 3 inches (75 mm), you can see that there is very little vertical area for the stern wave to cling onto, which is why the slow-speed penalties are so small compared to the higher speed gains.

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Of course, if we were doing a boat that was to be used as a daysailer, or where light-air sailing was a major factor, we'd take a different approach. However, to us this seems like a very good trade-off for serious cruising.

Confirmation of our approach to stern design is to be seen on all competitive BOC and IMS racers. Today, all of these boats have very small amounts of stern clearance when unloaded (no crew or supplies) and have their sterns just touching when fully loaded. In light-going they trim down by the bow (by moving crew or water ballast). And as soon as the breeze comes up they change to a stern-down trim.

In an absolute sense, where sail-area-to-wetted-surface ratios are comparable, our designs of the last 10 years are considerably faster, anchor to anchor, on lightwind passages, than our earlier designs with transoms that are always clear of the water. In day-sailing trim, in light airs, there is no measurable difference in performance between the two design conditions.

There's one caveat to all of this for heavier designs: If you have a relatively high displacement-length ratio and the large quarter wave which typically accompanies this, using an immersed transom would be the same as dragging an anchor.

It is our very long waterlines that reduce our DLR, which in turn make it possible for us to take advantage of this type of transom design.

The Sundeer 56 here is traveling at 6 knots (a speed-length ratio of 0.80). There is a small wake attached to the vertical transom. This increases drag relative to a transom which is clear of the water at rest. However, the difference in boatspeed between the two transom configurations is less than a quarter of a knot at this speed.

The Sundeer 56 on a light spinnaker reach. She is traveling here at 7 knots (a speed-length ratio of 0.94). You can see here that the wake behind the immersed transom has begun to flatten out and draw away from the hull. At this speed-length ratio, the immersed transom has begun to pay performance dividends.

A heavily laden Sundeer 64 at the same 7-knot speed (but at a lower speed-length ratio — just 0.875). The stern wave is not yet releasing from the vertical transom, so extra drag is associated with the immersed transom. They are probably giving up about 2 percent in pure boatspeed (around an eighth of a knot). For cruising, the question becomes is this eighth of a knot — or 3 miles a day — worth the gain at higher speeds, when the performance gains are more like 25 to 40 miles a day?

Here she's reaching at 9 knots, or a speed-length ratio of 1.125. The stern wave has now broken free of the transom and is trailing just behind. Considering that this boat is heavily loaded, ready to head to the Caribbean for a charter season, and the true-wind speed is just 10 knots, the range of conditions in which she pays a penalty for her immersed transom seems pretty small.

This photo shows *Sundeer* sailing at a steady 14 knots (a speed-length ratio of 1.75). At this speed, the stern wave has moved well aft of the boat (in this case, about 10 feet/3 m aft.)

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Rig and Keel Balance

Now we need to look at the balance between rig, keel, and rudder. Because our keels are small, and because our steering loads are very light (there's typically very small amounts of weather helm developed with heel), we tend to "load" our rudders quite a bit.

We do this by pulling the keel forward relative the center of lift in the rig, so that the rudder does some of the lifting to offset the rig loads. This has been for many years a common tactic on race boats.

We typically look to keep the center of lift of the keel between 2 1/2 and 3 1/2 percent of the waterline forward of the center of lift of the rig.

The amount of this varies with keel configuration, but we typically aim for a rudder which when the boat is driving hard, maintains a 5 to 7 degree angle of attack.

Rudder Design

Rudder configuration is a somewhat controversial subject. Two of our earliest boats were done with skeg-mounted fins at the owner's insistence. All boats since then have been spade-rudder configurations.

Our experience with both of these skeg hung rudders indicated that they took substantially more crew effort or autopilot power than our spade rudders. One of these vessels subsequently changed their engine room and in the process lengthened the stern and changed to a spade rudder. As would be expected, she now steers more easily than she did before.

With 42 spade-rudder designs sailing (as this is written) and with literally hundreds of ocean crossings worth of experience, we have never had, to our knowledge, a structural failure in one of our rudders.

We've always sized our rudders for maneuvering under power and heavy weather rather than for normal sailing requirements. As such, they are considerably larger than would otherwise be required. The rudder shown here is on a Sundeer 64.

Rig Design

Our approach to rigs is very much tied to the concept that the boat will be handled by a couple, even if the design in question is an 80-foot (24.6m) long. This means we do everything possible to generate horsepower while keeping the rigs relatively small and easily managed.

This has led us over the years to increase the size of the mainsail (and/or mizzen), while reducing forward triangle size and headsail overlap. Mains typically have aggressive roaches, and where a permanent backstay is present a 2-foot (600mm) overlap of the backstay is not uncommon.

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This approach to the mainsail creates a sail that is highly efficient, with lots of horsepower and a low center of effort (to reduce heeling). The long upper battens create a sail that is easier to handle within lazyjacks.

The rigs we are using today appear to generate as much as 20% more horsepower per unit of sail area than did our earlier rigs, and at the same time they have less drag and less heel. They are also much easier to use.

Fractional-Rig Configurations

Once the mainsail has been tamed to where it is easy to hoist, trim, reef, drop, and cover, the next step is to make it as large as possible. Mains are more efficient than jibs any time you are cracked off the wind, and when shaped properly they are as efficient as a jib to weather.

They can be feathered through squalls without luffing if properly battened. Off the wind, being a boomed sail, they present a much more efficient sail shape than an unboomed jib. When reaching, this efficiency pays big comfort dividends with less heel. And, if the proportions are right, you can sail bare-headed, something that's very handy when maneuvering under sail in tight quarters.

With all of these advantages you just want to make the main bigger and bigger, hence the fractional rig, with big main and very small jib.The Sundeer 56's rig is a good example of this philosophy. The mainsail is almost 800 square feet (76 square meters) of actual sail area, yet the working jib comes in at under 500 square feet (47 square meters). With the headstay set well back from the bow, there is plenty of room to set a large free-flying reacher or asymmetrical spinnaker between the end of the anchor roller and the masthead. This gives you plenty of passaging power in light airs. But in moderate conditions the boat is very quick with an all-inboard rig.

Main halyard and reef controls lead to the cockpit, where an electric halyard winch does double duty with the main sheet and clew reef lines. Reefing can be done by a single watchstander in less than a minute.

Ketch Rig Development

When we started cruising years ago, we felt that ketch rigs were heavy, expensive, a pain to sail, and typically very slow compared to single-stickers. However, at a certain size of vessel with a short-handed crew, one had no choice.

Wakaroa was the first ketch in the Deerfoot series. She was designed with a moderately powerful mizzen, about 65 percent of the size of the mainsail. She proved to be a much better sailer than we had anticipated, primarily, we felt at the time, due to the good separation between the two spars.

Locura was the second big ketch we did. *Locura*'s rig was a bit more conventional, in that her mainmast was much taller in scale than *Wakaroa*'s and she had a very large forward triangle. However, the mizzen was a lot more than an afterthought as it is on so many ketches. What surprised us during sea trials and subsequent passages we made aboard her was how efficient the mizzen was, even to weather. That got us thinking.

When the time came to look at the rig for *Sundeer*, we felt that at 67 feet (20.6 m) she was right on the edge (for us) of the ketch/single-sticker threshold. As we decided to go with the ketch rig, it appeared there was an opportunity to further develop the rig in terms of performance. *Sundeer* was drawn with a very large mizzen and relatively small forward triangle. The mizzen was about 85 percent of the mainsail in size, with the forward triangle area being about the same size in area as the mizzen. We increased the separation between the spars significantly.

We found that with these new proportions we could carry mizzen headsails (spinnakers and jibs) through a much wider wind range, in terms of both apparent-wind angle and windspeed, than had been the case before. These mizzen headsails were inboard sails, easy to handle, and gave us a tremendous boost in performance for very little effort. In fact, they were reason enough to go for a ketch rig!

We could carry the mizzen spinnaker up through 35 knots of wind while sailing with a jib forward (on a broad reach). It was the ideal sail for squally conditions in the trades.

Sundeer would sail nicely bare-headed, although her tacks were a bit slow in this configuration.

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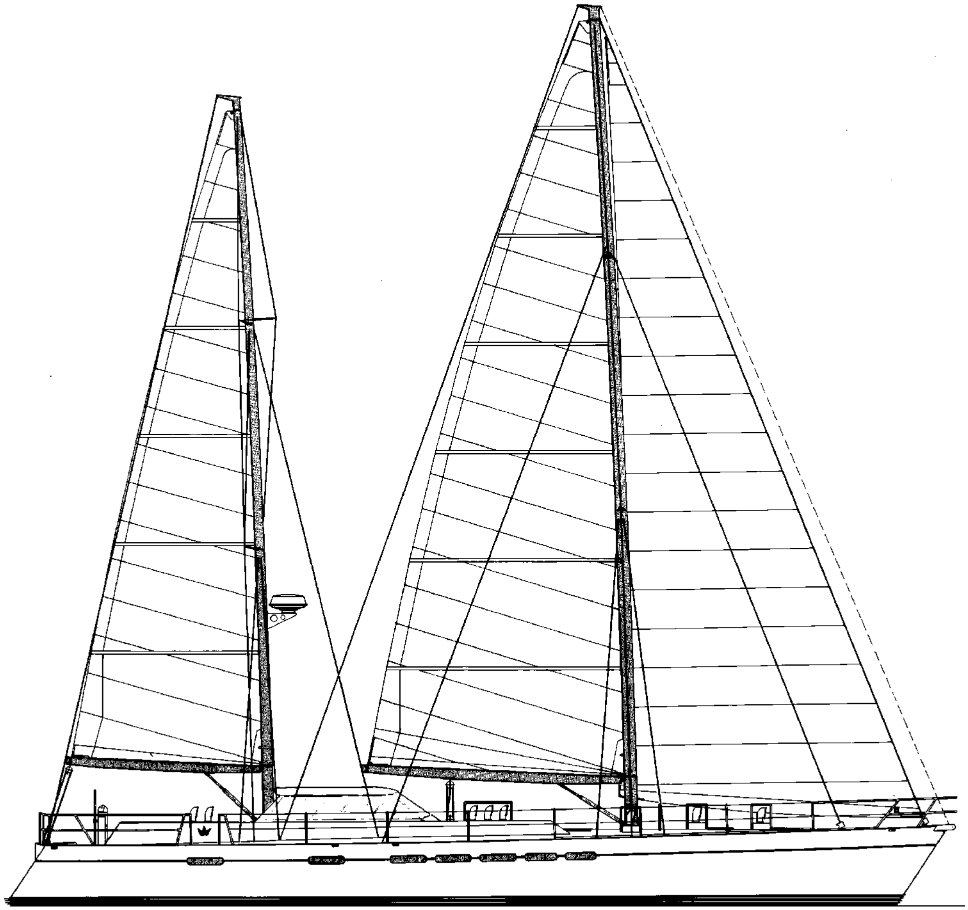

The Deerfoot 74 *Maya* was the last of our ketch rigs before we started developing the Sundeer prototype. The mizzen is a little on the small size, at the owner's request. (There were some trade-offs in the cockpit/aft deck area that would have been necessary for a more efficient aft rig).

This is a much larger vessel with a significantly taller rig (and higher VCG) than is shown on the following page for the Sundeer 64. Yet the Sundeer 64 rig actually carries more sail area in a significantly more efficient array. The 64 is not only faster, but easier to sail.

Eliminating the Permanent Backstay

When we started to develop the ketch rig for the Sundeer 64, we used what we'd learned over the years with the original *Sundeer* as a starting point.

With so much better performance available from the high-roach configuration, and the mizzen headsails playing such an important part, we decided to look at doing away with the standing main backstay. This would allow us to have a fully roached main, and much-easier-to-fly, more efficient mizzen headsails (with no permanent main backstay in the way).

Early on we had changed *Sundeer*'s mizzen mast rigging plan to one with swept spreaders (she was built with in-line spreaders and a standing backstay, attached to a boomkin). The spreaders were swept aft at 19 degrees. Our engineering indicated this was enough, through 30-plus knots apparent, to stand up without a runner to the masthead. However, with masthead headsails a runner would be required.

This change allowed us to go to a fully roached mizzen and was a huge improvement in performance.

So with this as a basis, we started to explore doing the same thing for the mainsail — sweeping the spreaders aft and doing away with the standing backstay.

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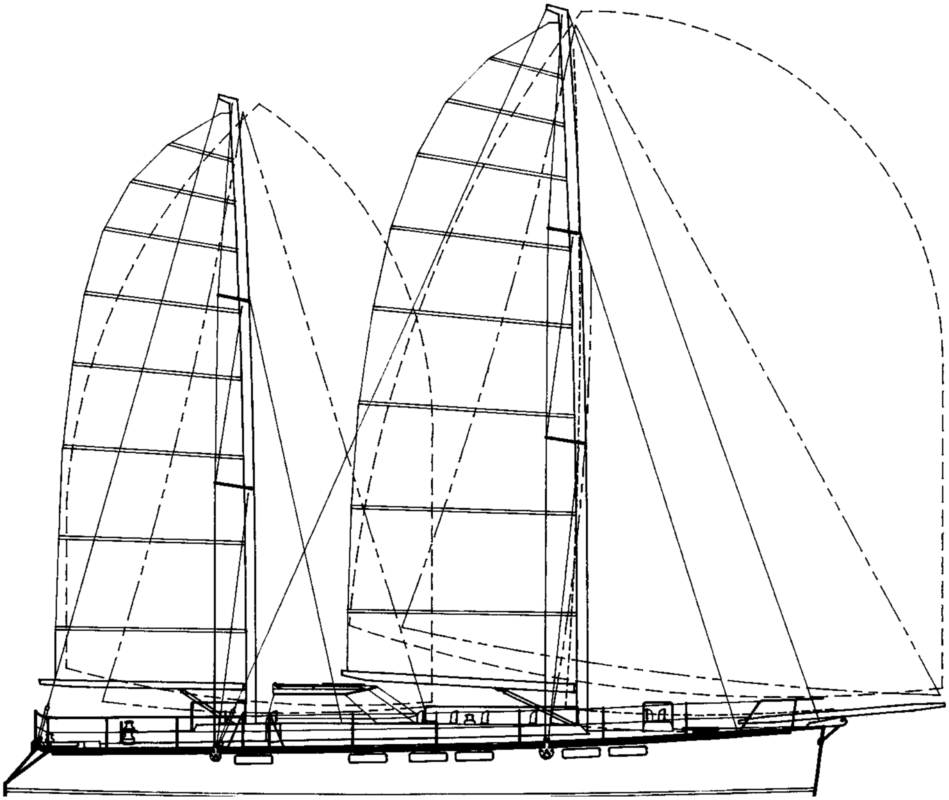

The ketch rig designed for the Sundeer 64 was very conservative in proportions. We were shooting for a configuration that was very easy for a couple to handle, with good versatility through a wide range of offshore conditions. Ease of handling as the wind progressed up the Beaufort Scale was the chief design criteria. The boat could easily handle additional sail area, but this would make her more difficult to sail for crews not used to large-boat seamanship.

Even with her very short rig this design has proven itself quick in moderate conditions, setting a transatlantic record in one of the ARC races, and doing a one-year circumnavigation with the Teschke family, in just 155 days at sea.

Analysis of what had worked with *Sundeer* and what we had to deal with on the new Sundeer 64, led us to a 25-degree sweep angle for both main and mizzen spreaders. This just about eliminated the need for masthead runners, except in heavy airs or when a spinnaker was flying.

Runners were available, however, to tighten the headstay, and to induce mast bend for sail-shaping control.

The Sundeer 64 ketch rig proved to be very efficient and easy to sail. In an offshore context, with a small crew, perhaps just a couple, it is a very forgiving configuration. With better sailcloth and a wider choice of battens, we were able to increase the profile of the main and mizzen to a point where we could place effective sail area in 78 percent of the available rectangle.

Boom Height

The height of booms is a critical issue in terms of making a boat easy and efficient to sail. If a boom overhangs a cockpit area then it must give head clearance. However, if you can arrange your deck layout so the booms do not create a threat to crew working in the cockpit, then they can be lowered.

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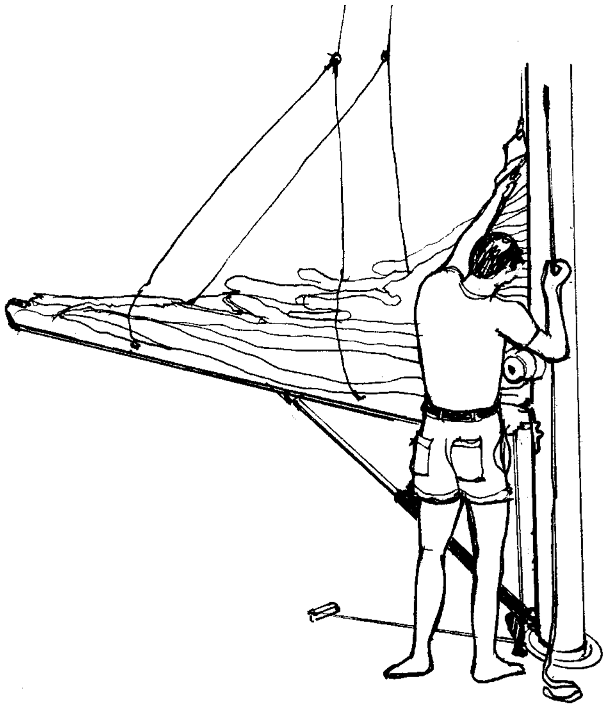
The limit in this situation typically comes from vang geometry.

We work very hard to get our booms as low as possible. We like to see them at stomach height, so that you can attach the main halyard without too much difficulty. The low boom makes sail furling and covering much easier. And, of course, it lowers the center of effort and center of gravity of the rig.

You then have to ask the question about working forward, where the boom can catch you. In an unexpected jibe this could have serious consequences. However, it is our feeling that if we are to be struck by a boom we'd rather be hit in the chest than the head.

Obviously, whenever you are working to leeward of a boom you need to be mindful that the sheet is well cleated. And if you are running the boom should have a preventer set. These commonsense caveats apply to all boom configurations!



A low boom lowers the overall center of gravity of the rig, lowers the center of effort for the rig, and is much easier to work with. However, in order to be safe, the boom should not overhang the cockpit area.

Competition

When you draw a hull that has a relatively narrow beam, and couple that with light displacement, you typically end up having difficulty carrying a lot of sail area. On the other hand, the drag factors on the narrower, lighter hull are a lot lower and you don't need as much power in rig or engine to push the boat. Because the engine, prop, and tankage can be less for a given boatspeed and range, drag from these items is a lot less. With less displacement, less drag, and a smaller, more efficient rig you end of being able to sail very quickly in light-to-moderate airs, on a configuration that is very stiff when the wind blows.

Where this logic fails, however, is in drifting conditions. Our hulls are efficient at high speed, with very low drag characteristics. But in the light stuff it is wetted surface that counts in the drag equation, and our type of hulls have lots of that for their displacement.

On the face of this you would say that compared to a light-air-optimized boat, we'd get killed in a race.

Around the buoys, on a fully crewed basis, that is exactly right.

But when you say "let's have a race across the ocean, both boats sailed by couples," look what happens.

With our short rig we are designed from the beginning to make good use of light canvas (spinnakers, reachers, etc.). The sails are quite small relative to the power of stability of the hull and steering control of the autopilot system.

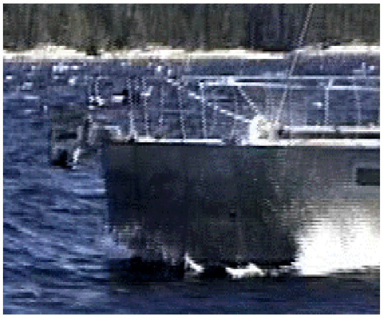
Because they know they can stand up to squalls, our couple can push their boat hard. In the trades, in light airs, with squalls about, they will still use light sails.

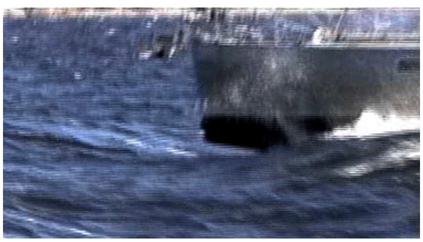
The competitor, on the other hand, has a towering rig. Will this couple use their spinnaker or light-reacher? Not likely, especially if squalls are prevalent. The result is that our crew will arrive a lot quicker at the other side of the ocean (and that's without talking about their abilities under power).

Powering Into Waves

Powering into a headsea is always an interesting exercise. And while most sailboats actually do better when heeled than taking the waves straight on, powering straight into waves is a good indicator of how a given design will do when sailing at an angle to the waves, with the hull heeled over fifteen or so degrees.

Because we find ourselves on a lot of dead beats, with the engine on, we decided to try to soften *Sundeer*'s motion when heading straight into the waves. This lead us to a very narrow and deep forefoot. The trade-off, if there was to be one, would be in steering control at high speed down wind. However, with a very narrow waterline beam to length ratio (six to one) and totally balanced hull lines), high-speed steering control did not prove to be a problem.





This series of shots was taken by my dad in British Columbia. We were motoring into 20 knots of breeze with a 3- to 4-foot (0.9 to 1.2m) chop. If you watch *Sundeer*'s deck line in this succession of photos, you'll see very little vertical displacement. She just blasts through.

These images show a series of waves. The top left photo has the trough ahead of the crest starting to hit the bow. Then comes the crest. Notice how there is little discernable displacement at the deck line as the bow pushes through the wave. By the third shot the crest has started to pass, and in the fourth you can see the bow suspended over the following trough. The final shot has the sequence starting again.

This is carried on offshore as well, only on a much larger scale. With our types of designs the waves' faces are not a motion issue because our hulls *penentrate* the wave face so easily. But the troughs that follow facecan be, under some conditions, a problem. That's where the slamming comes from, falling into the trough. How a bow shape does as it falls into the trough is a product of the same characteristics that get it through the wave face. If it handles the wave face smoothly, it will handle the trough which follows as well.

Seagoing Comfort

It sounds obvious to say that for a cruising yacht to fulfill its design mission it must go cruising. Yet very few do. There are lots of reasons for this, but the one that seems to be the most prevalent is lack of comfort — either emotional or physical.

These comfort issues come into play mainly during offshore passages. Sure, most of your time is spent at anchor, but that 10 to 15 percent of the time which is spent at sea is the bottom line. If you are not comfortable heading offshore, for whatever reason, you won't go cruising.

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I enjoy being at sea on a comfortable, efficient vessel. I love the feel of the boat working its way through the waves (as long as it is mainly downwind that the working is going on!). I can even tolerate a few days of upwind sailing. But I intensely dislike rolling around off the wind, slewing on and off course while reaching, and hobby-horsing when heading up wind.

Linda, on the other hand, enjoys being in port. Period. She puts up with our passages as a means to an end. If conditions are ideal, moderate breezes, seas that aren't too rambunctious, and perhaps a full moon, she'll enjoy the passages, too. But most of the time she tolerates the ride.

If she didn't tolerate the ride, then we wouldn't be cruising. Of course, having cut our teeth on the discomforts inherent in a typical CCA cruising design like *Intermezzo*, we know what it is to put up with a less-than-ideal motion on a long passage!

Fortunately, the very design factors thst make for good performance in heavy weather also yield very comfortable boats in more moderate conditions. And that's what we've always worked towards — comfortable sea boats that do their best to help their crews cope should they be caught in a real blow.

We can see no reason why the lessons we've learned along the way cannot be applied by others in the cruising fraternity.

In the past two decades our designs have evolved along the path of least resistance (pun intended). As we've found ways to reduce resistance (drag) in hull, fins, and rig, we've been able to reduce rig size (making the boats easier to handle) while maintaining a reasonable turn of speed in light airs.

The same design characteristics we've been discussing in previous sections, when taken to their most *efficient* combination, also yield very comfortable hull shapes.

Take the relationship between overhangs and displacement for example. If you compare *Intermezzo II*, one of the first in the Deerfoot series, which was just under 63 feet (19.4 m) long with a displacement of 47,000 pounds (21,315 kg) and a waterline length of 54 feet (16.6 m), to a design like the Sundeer 64 with the same displacement but a waterline of 64 feet (19.7 m), look what happens to motion.

First, the entry angles are much finer with the longer waterline. The Sundeer 64 comes in at 12.5 degrees while *Intermezzo II* is 16.7 degrees.

At the same time, as the waterline is lengthened, longitudinal stability goes up. *Intermezzo II* required 6,550 foot pounds to trim her one inch, while the Sundeer 64 has a longitudinal stability of 10,000 foot pounds to trim an inch. That's a 50 percent increase in fore-and-aft stability.

Intermezzo II, with her shorter waterline and lower longitudinal stability, required significantly more flare in her topsides to create reserve buoyancy so that she would keep her decks dry when running downwind in big seas. On the other hand, the longer waterline of the Sundeer 64 and its much higher longitudinal stability mean that almost no topsides flare is required. The buoyancy required for hard driving downwind is inherent in the longer waterline right from the beginning.

Now look what happens when you are beating into a trade-wind sea, say making the passage from Panama upwind to the West Indies or Florida.

One design has a very fine bow coupled with very high longitudinal stability. As bow meets wave, the bow begins to slice through the sea. Because there is little topside flare the bow can get well into the wave before the wave really gets a grip and starts to force the bow up. At the same time this battle in the forward end is going on the higher longitudinal stability, is causing the overall hull to resist any change in trim. In other words, it does not want to start hobby-horsing.

When the bow of *Intermezzo II* first begins to slice into the wave, it is 32 percent fatter at the waterline than the Sundeer 64. As the wave moves aft down the hull it begins to lift up the topsides and so feels the reserve buoyancy. Between the fuller entry angle and reserve buoyancy there's a lot more volume for the wave to push against. Resisting this is 40 percent *less* longitudinal buoyancy. So, this shorter waterline design is going to start hobby-horsing a lot sooner, and with a lot more magnitude than the longer waterline vessel.

Hobby-horsing is a big issue with sailing and motorsailing. At some point, even motorsailing becomes problematic and you have to slow way down and/or change course so that the waves are more at an angle to the bow.

As the hull pushes through the wave, especially if you have on a good head of steam, the bow drops into the trough which follows the wave. It is at this point that a lot of modern designs have a comfort problem. If you combine light displacement with wide entry angles, you end up with a lot of area at the bottom of the hull that slams down into the trough of the wave.

The finer the bow section, the less area when it first meets the water, and so the less violent the collision.

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Some designers feel that a V-shape has a softer impact. This is indeed the case if you are taking the wave straight on. However, if you are heeled over, and taking the wave at a normal sailing angle, the V actually will put more flat into contact with the trough bottom than a nicely rounded, narrow U shape.

I can tell you unequivocally that as our waterlines have gotten longer, entry angles narrower, and forward sections more U shaped, our ability to maintain a good head of steam with reasonable motion has increased wonderfully.

Now turn this whole question 180 degrees and look at what happens when you are driving hard downwind, perhaps running before a major storm in breaking seas.

Here the hull shape needs revolve around two issues. First is the ability to maintain steering control. As we've already discussed at length, you know that balanced hull lines, good length-to-beam ratios, and large spade rudders are all key ingredients to this capability.

Equally important in breaking seas, however, is the ability of the hull shape to accelerate down a wave face, hit the bottom of the trough, penetrate the back of the next wave, lift, and keep moving with minimum loss of speed.

If the hull does not have enough longitudinal buoyancy, the bow may bury itself into the back of the next wave, decelerating rapidly in the process. This decelaration, if accompanied by a breaking sea rearing up behind, can lead to a severe broach or pitchpole. It also puts huge strains on the rig.

On the other hand, if you have too much reserve buoyancy the same thing can happen. As the hull drives down the sea and into the back of the next wave, as you begin to call on the bow's reserve buoyancy drag builds up, and the boat decelerates rapidly. You then have the same problems as a bow that lacks buoyancy, only your feet are initially drier, as there will be less water on deck with this type of hull when sailing downwind.

We know from experience that in breaking seas and strong winds (70 knots plus) that *Intermezzo II* would do the job, although you would need to take care on particularly steep seas to "pull out" before hitting the bottom (head a little to windward). We also know that the newer generation of bow shapes do an even better job, decelerating less as they overrun the next wave while at the same time keeping the decks dry.

The same mechanics that work upwind also work downwind. You want to be able to slide into the sea with little resistance, at the same time bringing lots of longitudinal buoyancy to bear keeping the hull in trim.

And when you have 40 percent more longitudinal stability working for you at the waterline level, you don't need all that bulky reserve buoyancy to get the job done.

This is a point missed by a lot of "experts." They take a look at our very narrow bows and exclaim that we'll be stuffing our bows into the next wave. What they forget is that narrow shape is very *long*. What we are doing, in effect, is removing the "fat" volume of a full bow and adding back in the form of waterline length which is very narrow. And because this volume is added to the end of the boat, it has a longer lever arm with which to exert force. This is why the longitudinal stability is so much higher in the Sundeer 64 when compared to *Intermezzo II*. The net effect is that these very narrow bows are actually much more efficient at staying on their lines as they drive down a breaking sea. And the longer waterline, as you already know, has a lot lower drag at speed.

The bottom line is that when the chips are down, our newer designs can run before a storm at much higher speeds than the older Deerfoot-style vessels, with the same level or better steering control.

It is a happy coincidence that all of the issues we've just been discussing, which lend themselves to better performance in heavy weather and when sailing upwind, also contribute to comfort. There is less pitching motion, and with the boat able to maintain a straighter course there is less slewing around on all angles of sail. This is especially important when sailing downwind in the trades, as trade-wind roll can be almost totally eliminated.

You are probably sitting there wondering what the trade-offs are. This is, after all, a sailboat we're talking about, and there is always a negative somewhere to balance the positive.

In our case, as we've already alluded, it comes in light-air performance. We do have a hair more wetted surface in our higher speed hull shape than would be the case for a lighter air design. And we pay that much-discussed drag penalty for a stern that tends to submerge at full load. However, in a cruising (not racing) context, we feel that the advantages far outweigh the disadvantages.

Interior Issues

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Having discussed hull and rig design, fins, and comfort, we come finally to interior design issues. If your cruising design has successfully made its passage and you are cozily at anchor, you then look to the interior for your comfort.

From a cost, weight, and comfort-at-sea standpoint, keeping the interior centralized — i.e., in the middle of the boat as opposed to the ends — makes a lot of sense.

We find that over the years a third or more of our hulls have ended up being devoted to ground tackle, sails, machinery, and lazaret space (in the fore-and-aft watertight areas). This may sound like a lot of the hull “wasted,” but I can assure you that it is more critical to your cruising happiness to have the ends properly used in this manner than just about anything else you can think of.

This leaves us with two-thirds of the hull left for interior accommodations, and all of this is in the center of the boat, where beam and depth are greatest, *and where motion is least*.

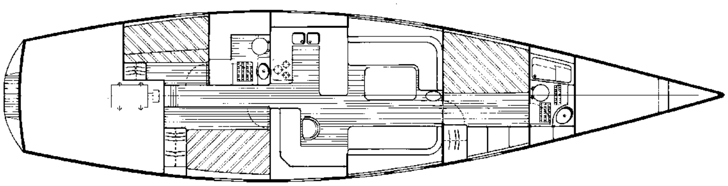
A lot of folks ask us questions about narrow beam and interior layout. And while our maximum beams are typically 10 to 20 percent narrower than other cruising designs, this beam is spread out over a much longer waterline. When you look at it this way, you find that our *average* beam, where the accommodations are fitted, is not that much different than fat boats with pinched ends.

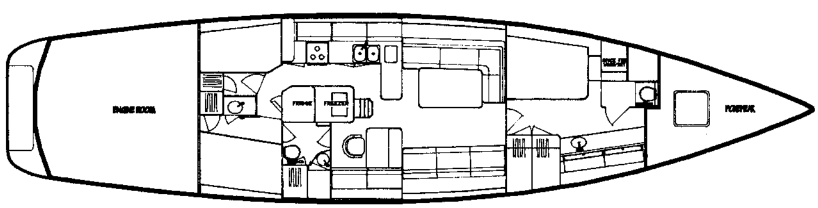
We typically have better space at the ends of our living areas than others. It is in the saloon/ galley areas where our beam is less. However, the use of flush decks, hull windows, and relatively wide sole areas gives us the visual impression in the saloon/galley areas of much wider designs, without having to carry the negative baggage in terms of weight, drag, steering control, and cost associated with excessively beamy boats.

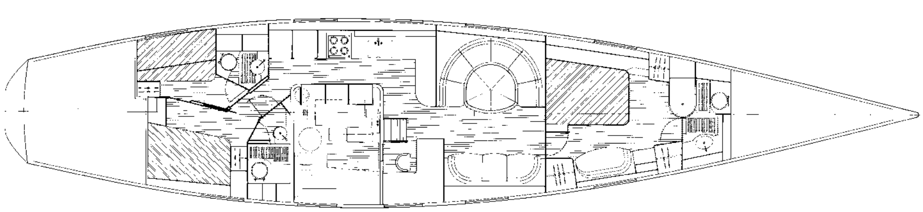
The feeling of space below is very much a function of how the interior is designed. This is far more important than a bit of hull beam. We maximize our visual openness by keeping furniture above counter height to a minimum. This way your eye is allowed to go right to the hull edge. If there are lots of high lockers then your eye stops at the inner edge of the joinerwork (this whole issue of interior design is covered in much more detail toward the end of the book).

All of our yachts have had the owner’s suite located forward, for several reasons: Ventilation is much better forward than aft. Under power, the forward stateroom is further from prop and engine noise. At anchor it is easier to hear anchor-chain noise — a comforting factor in less-than-ideal anchoring conditions. In most cases, if you want to have two guest cabins, these have more space aft in which to fit.

One negative with this arrangement is that sleeping forward is less comfortable at sea. In any case, most of our clients prefer to sleep closer to the cockpit or pilothouse when sailing short-handed. This way they can be easily awakened should the watch require assistance.







Three interior plans of past projects. Top to bottom these are a Deerfoot 58, Sundeer 64, and Deerfoot 74. They all include significant space in the forepeak and lazaret.

Of the three boats, the Sundeer 64 (middle) has by far the narrowest entry angle, almost 20-percent finer at the load water line than the earlier designs. They all have hull forms which are balanced with heel. The Sundeer 64 in scale has the smoothest ride up and down wind.

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SUNDEER PRODUCTION SERIES

In the fall of 1991, after a cold but exciting spring and summer cruising in Canada and Alaska with *Sundeer*, we were back in Southern California for a couple of months waiting for the right season to head to the South Pacific. We decided to take a drive to the high desert in Arizona and New Mexico.

After a week of driving and enjoying the scenery we stopped in Tucson for the evening, had a wonderful Mexican meal, and saw a shooting star (always an omen).

Before long we were looking for a house or apartment to rent for a couple of months before we headed off again on the boat. Everyone said it was impossible, but within a week we'd found a lovely little house, furnished completely, at a very reasonable price.

We settled in and began to enjoy life in this small but invigorating university town. We've both always loved the high desert, and the Tucson area offered us an interesting mix of intellectual stimulation, wonderful flora and fauna, and a slower paced lifestyle than that of Southern California. In short order we had found a piece of property and decided to build a house.

This meant *Sundeer* would be sitting at the dock for a year plus while the house was constructed. That seemed like kind of a shame, and besides, after 27,000 miles we had some ideas on how the breed could be improved.

Neither one of us really wanted to sell *Sundeer*, yet it was the prudent thing to do. It just didn't make sense leaving her at the dock for the next 12 to 15 months. The market was quite weak, and I didn't really think she'd sell.

However, within a month of the first ad being printed we had two good offers on her, and before we realized it we were without a boat.

Over the next couple of months we had a number of calls from disappointed folks who had seen the ad but called too late. Several of them asked about us doing a sistership for them. However, we were retired from the boat business by this time and really didn't want to take on the onus of one or more new custom projects. We'd save that energy for our own next boat!

Linda and I have now been involved in close to 50 large cruising-yacht projects. These have involved all sorts of designs and owners, and while the majority of the projects have been over 65-feet (20m) in length, they've almost all been optimized for use by a couple — even our 80-foot (24.6) designs. We'd been asked on a number of occasions to do production boats, but didn't want to deal with the quality problems, and we didn't want to make compromises.

Sundeer 64

I mentioned the reaction of the folks who'd called too late about *Sundeer* to a friend in the publishing business, Jim Gray, and he suggested I call Everett Pearson at TPI. They had a reputation for building quality production boats but normally did only "house" brands — i.e., boats in which they had a financial stake. He felt that we and TPI might make a good team. I was dubious, but at that moment had the time, and if we could find a low-effort means of building ourselves a new boat and a few other boat buyers came along for the ride, well that might be okay too.

As it turned out, Everett felt there might be a market for our type of high-performance cruising vessel, so we agreed to a meeting.

I went back and visited with the guys at TPI and was very impressed by what I saw. They were not building our type of boat, or to our structural or finish standards, but they had the skills to do what we wanted. What excited me the most was the potential efficiency of building a whole series of sisterships on a production line. If this worked out, we could deliver a very high-quality cruising yacht at an extremely affordable price.

I returned home to do the design work and see if we could round up some orders. TPI made engineering and production time available, and we started to work as a team.

The initial results surprised everyone. It seemed like only a few months into the program we'd sold out the first run of ten 65-foot (20m) yachts. This was at a time when the marine industry worldwide was in the doldrums and in a depression in the U.S.

All of a sudden we were faced with doing a detailed design for a production boat. After six hectic months of almost round-the-clock work, Linda and I were taking a breather, driving through the Navajo country in Northern Arizona. We were talking about our own next boat.

We had originally intended to take one of the Sundeer 64s for our own use. After all, this boat represented the best of our original *Sundeer* with refinements that had come from a lot of experience and dreaming. But as much as we liked the 64 we felt there was a lot in the boat that was oriented toward making guests comfortable. We were in Monument Valley, eating sheepherder's stew at a restaurant overlooking some magnificent buttes, when a new idea started to catch fire.

With both kids now out of the nest and unlikely to visit us for more than short periods, what was the point of letting guest accommodations figure so heavily into the equation? Why not do a boat

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for just the two of us, that would accommodate a couple of guests for a week or two a year, but for the rest of the time be *totally* oriented toward *our* needs?

The minute you take this approach, all sorts of good things begin to happen. For one, we could create almost as much visual space in the saloon/galley area as we'd had on *Sundeer* and *Intermezzo II*, in a much smaller boat. The smaller size was a big plus in terms of acquisition and maintenance costs.

I started to think about the type of rig and hull shape while Linda thought about the accommodations we'd like to have.

When we reached our stop for the night, I was ready for some scratch paper. We started to draw layouts and rigs. Before long I was hooked on the concept. Linda, with a more realistic view of the work involved in a totally new design, was more sanguine about the concept.

However, by the time we'd returned to Tucson four days later she was intrigued enough with the potential to sign on for the ride.

Sundeer 56

We decided to see just how small a boat we could work in what we felt to be our minimum requirements. We dug out the drawings for four of our favorite designs, *Intermezzo II*, *Terra Nova* (a 58-foot/17.8m cutter we'd built in Denmark) the Deerfoot 61, and our own *Sundeer.*

We dissected each of these designs into their best features. I went into the garage and found the "next boat" notebooks from the sea trials of these designs (wherein we record our initial impressions of what we'd change the next time) and reviewed them. Within a few days we'd settled on a basic concept: we wanted a saloon/galley area which had the feel of *Intermezzo II*, but scaled back to something in the size range of *Terra Nova*. The owner's suite would again be forward, with an aft engine room.

The galley layout was up for grabs, and we had a number of different approaches that would fit well in the space allocated. We felt a single aft cabin would work fine for guests and, if positioned correctly, be a good sea cabin for us when passaging.

The one area in which we disagreed was the head. I was in favor of a single, compact head that would take minimal space from the interior. Linda felt the head should have a separate shower, room for a washer/dryer, and be spacious enough not to feel claustrophobic.

With some dimensions on paper for interior elements the rest came pretty easily. An aft engine room, with a straight-drive four-cylinder Yanmar was added to the back end. A forepeak for sails and ground tackle was added to the bow.

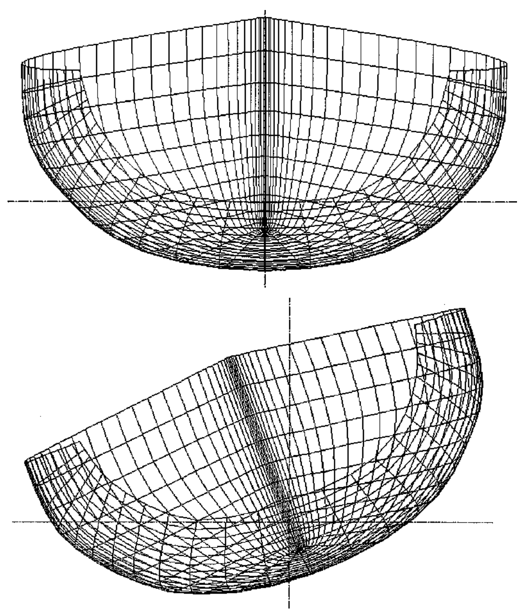
Before long we had come up with a length of around 52 feet (16 m) as a start. I fired up the old computer and began to draw hulls.

Hull Shapes

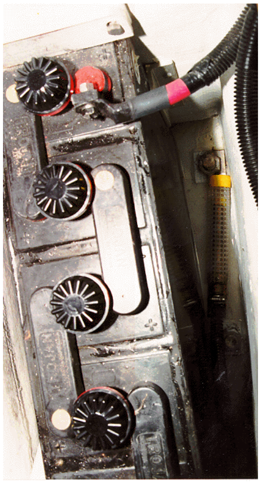
I'll readily admit that when it comes to making passages, Linda and I are spoiled. We like to make them fast and in a reasonable degree of comfort (we've paid our dues on wet, uncomfortable boats in the past!). One of the problems that quickly became apparent in a hull of this length was that it was going to be tough to draw a nicely balanced hull, that need good steering characteristics, and would make reasonable progress up wind.

Try as I might, I couldn't get a fine enough bow shape that would fair into a balanced set of lines in 52 feet (16 m). No problem here, just add some waterline. Keep everything else the same, and stick some more point on the pointy end.

After several hundred hull shapes we settled on an additional 5 feet (1.54m) of waterline. This addition to the hull would greatly



Two views of the Sundeer 56 hull. As you can see at the bottom, even when heeled to 20 degrees this hull shape remains balanced. This gets harder as cruising boats get smaller, as the length-to-beam ratios increase. With a beam of 13.75 feet (4.23 m) the length-to-beam ratio is 4.14 at the deck and 4.9 to 1 at the waterline. The half-entry angle at the bow is 13 degrees, which accounts for the smooth motion uphill.



We made the keel a hair wider than required for ballast so that we could install a large bank of traction batteries (above) in the sump.

improve boatspeed, heeled balance, and upwind penetration of waves. The cost was moderate — just a small increase in the amount of hull and deck laminate. It wouldn't affect handling, as we'd keep stability in the same range. Except for some extra tooling costs and the cost associated with the extra laminate, this was a total win/win situation.

As the design progressed, we realized that significantly lengthening the waterline would yield benefits in boatspeed, comfort, and wave penetration. We also found that it would be possible to design the hull so that we could mold it in two lengths, making it possible to amortize the tooling over more boats. We ended up with 60-foot (18.5m) lines than could efficiently be shortened to 57 feet (17.5m) if required.

Fins

This was the easy part of the equation. We figured that 6 feet (1.85m) of draft was acceptable. With a smaller boat we knew the rig would be smaller, so a much shorter chord keel foil could be used. This increased aspect ratio, so we knew we'd have a more efficient foil than on some of our larger boats where draft was still limited to the same range.

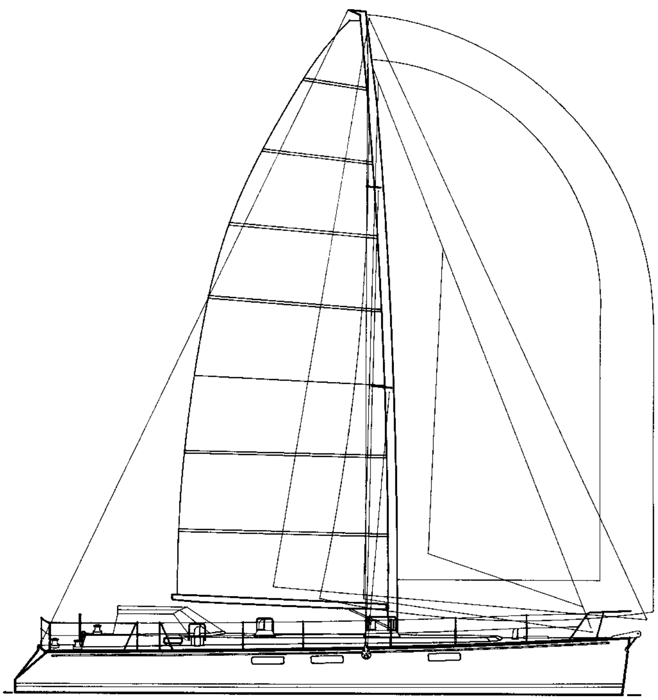
We'd had such good luck with the special foils that Dave Vacanti had designed for the 64 that we decided to use the same approach again, allowing enough volume in the keel sump for a set of traction batteries.

Sailplan

The sailplan offered us some new opportunities. With a smaller, very easily driven hull shape, the rig could be larger in scale (compared to the boat size) than we normally used, yet still easily handled by the two of us. After looking at a variety of configurations it became apparent that a large mainsail and small jib, laid out on a fractionally rigged spar, offered the most boatspeed for the least effort on the part of the crew.

The final dimensions gave us a working jib of less than 500 square feet (47 square meters), not much larger than the staysail on some of our boats.

Working with Dan Neri at North Sails Rhode Island, we came up with a mainsail that stuck almost 3 feet (0.9m) past the standing backstay. However, because of the angle of the backstay this mainsail would clear when tacking or jibing, as long as there was three to four knots of apparent wind on the sail. In very light airs, or when motorsailing, we could pop in the first reef which would keep the leech clear or the backstay.



As long as you can handle the large main, the fractional sailplan, with its small headsails, is the easiest to handle and most efficient cruising rig. You have an additional benefit in the longevity of the mainsail (as compared to jibs, which typically have relatively short useful lives).

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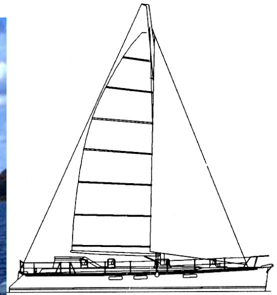
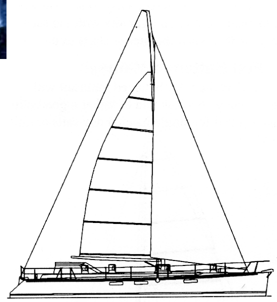
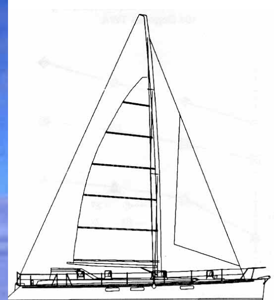
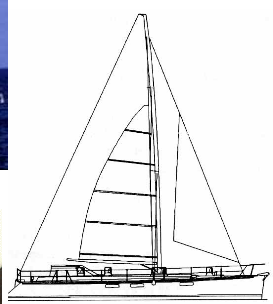
Although the mainsail is large, full battens make it very easy to handle. And when the time comes to shorten down, popping deep reefs into the main from the comfort of the cockpit it about as secure as you can get.

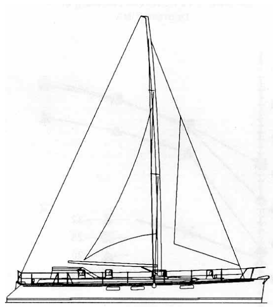
Keeping the jib back from the bow makes it far simpler to change headsails and to work with the anchor.











The fractional rig made it possible for the boat to sail with mainsail only, a factor that was very important to us.

We decided to keep the headstay well back from the bow. This is more efficient for the sail, makes the foredeck easier to work on (for changing sails or using the windlass), and makes it possible to set a large reacher or asymmetric spinnaker between the masthead and end of the bow roller. There's enough space so both clear during inside.

Deck Design

The cockpit design, like the rest of the boat, was optimized for a couple with occasional guests, the way we expected to be using the boat most of the time. Cockpit seats were laid out long enough so that we could sleep on them if desired (or they could be used for an overflow of guests). The best way to get into the engine room turned out to be via the cockpit seat.

The coamings were created with an eye toward either a large, enclosed dodger, or a hard pilothouse roof (Linda favors the latter, while I much prefer a dodger which can be folded down and out of the way).

As we had done on *Intermezzo II*, we brought the main halyard and reef lines aft. The halyard, clew reef controls, and mainsheet were put on the starboard side. We specified an electric winch and series of rope clutches to make reefing, jibing, and raising the mainsail easier. On the port side of the coamings we allowed for the luff reef lines, the vang tackle, and the traveler controls.

We arranged the wheel and surrounding cockpit area so that whoever was on the helm could steer and trim sails at the same time. The primary and mainsheet winches were all easily within reach (we initially looked at twin wheels, but discarded them, as they interfered with the mainsheet and reefing controls). In order to have adequate headroom without making the topsides too bulky, we utilized a very low trunk cabin.

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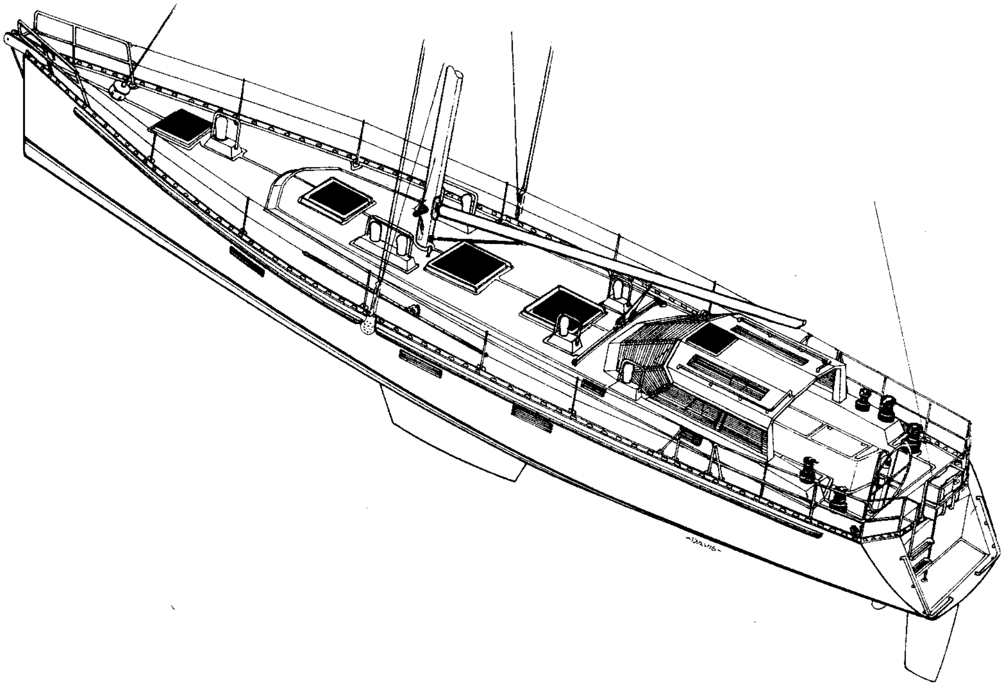
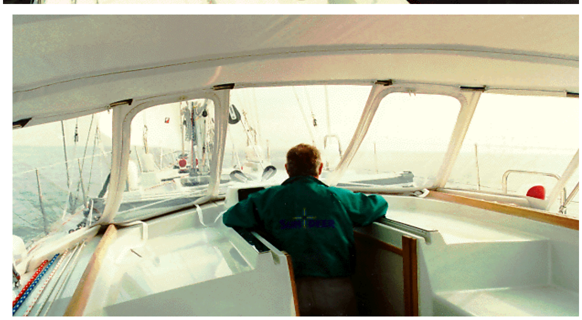


When we think we're getting close to the end on a design we frequently ask Steve Davis, up in Port Townsend, Washington, to do a rendering so we can get a 3-D feel for how things look. This was his second drawing for us on the Sundeer 56. By this point the overall detail is pretty close to what the final drawings show.



We did the first boat with a soft dodger. It was as as large as a pilot house but cost about a quarter as much and weighed a lot less. However, many of our clients on these boats chose to go with a pilot house (right photos). The main sheet, main halyard, and clew reef lines lead down the starboard coaming to an electric winch. While the powered winch is not a necessity, it does make things a lot easier, and when jibing or reefing in a blow it comes in very handy (upper left). One of the advantages of a production boat is the neat details you can work into the molds. All of the hatches have molded-in breakwaters to stop direct hits by waves, and to provide a base for the attachment of storm covers (lower left photo).

This trunk provided a base for Dorade boxes, and splash rails, for all of the hatches. The extra height, in connection with the splash rails, reduces the risk of an errant wave slap getting below when the saloon hatches are cracked at sea.

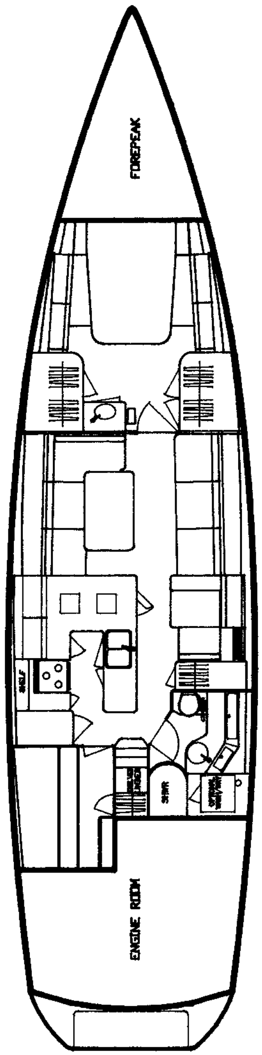
Final Interior Layout

We wrestled with the interior layout for months, going back and forth in each of the living areas with Phillip and Anne Harrill (who are the interior-design part of our team). In the end, we came up with what we both feel is the most livable interior we've ever drawn for a couple.

Starting forward, we decided to reverse the master bunk, so that our head was forward and our feet aft. We did this recognizing the fact that it would be less comfortable to sleep this way at sea, but the space worked so much better in port we were willing to accept this compromise (besides, we knew from experience that we'd be sleeping in the saloon or aft cabin on passages).

There were lockers along the full length of the hull side, ending in a huge hanging locker on each side.

Rather than force a second head into this cabin, we decided to build in a vanity. This way one person could be washing up or shaving at this sink while the aft head was likewise employed by the other crewmember.



Two views of the main saloon (above). We kept as much of the vertical surface light-colored to open the area visually. The corner posts and fiddle rails are in timber to add some contrast and warmth. This combination not only looks good, but is easy to maintain over the years.

The sea cabin (lower right) has two good seaberths. There's a large port through the side of the cockpit footwell that allows good ventilation (the port is protected by the dodger) and instantaneous communication with the person on watch above.

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The nav station is compact, but there is enough desk space to work well as an office. On a starboard tack you can brace yourself against the fridge box to leeward. The locker aft of the nav station can be used as a wet locker, and the top is ideally positioned if there's a TV in use.

The galley is laid out so you can work in it at sea without standing in front of the stove. Fridge access (top right photo) is from the top and side. The freezer is top loading.

The master stateroom forward has the feel of many of our larger yachts, with plenty of hull side storage on both sides (including almost as much hanging space as we had aboard *Sundeer*!).

In the bottom photo you can see the vanity with sink and mirror against the aft bulkhead. We both really like this layout, as it gives us two places to wash up. A number of these boats were built with a head up forward. While this does give you two heads aboard, you rarely need the second one and it seems like a big price to pay in terms of visual space and storage area. (You lose one of the hull-side hanging lockers with this arrangement).

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The saloon/galley area ended up slightly longer than what we'd had with many of our designs, but just a hair narrower due to the somewhat narrower beam of this design. The overall impression is one of space — lots of it.

The galley has a huge amount of counter area, with stove and sink offset so that you can work at sea without being in the line of fire with anything that is hot. The fridge has top- and side-opening doors while the freezer is top opening for maximum efficiency.

We were able to work in a very nice ship's office with a large hanging locker behind it. The top shelf of this locker would work well for a TV, if there was to be one aboard, and the hanging locker could be used for foul-weather gear or saved for something more valuable.

Nothing took more design work than the aft cabin. We had decided early on to have a single cabin. By placing it adjacent to the cockpit, the off-watch was a whisper away from the crew on deck, something which makes both of us sleep better.

We eventually went with an over and under design on the bunks, although a case could be made for one bunk — a tight double — up at counter height. This would be somewhat less comfortable at sea due to the higher position but offer all sorts of storage potential below and provide a great work surface for big projects if required.

The aft head is quite large.There's a toilet at the forward end (well wedged in for use at sea).The sink and vanity provide plenty of space for doing all those things that are required before going out on the town. At the aft end of the compartment is a shower area with room for a compact washer/dryer.

And in the aft head? As you might expect, Linda got her wish. A really large space, with room for a washer/dryer and a separate aft shower area.

Systems

Systems were based on an all-DC approach, the same as we'd been using for a number of years. Traction batteries in the keel, DC refrigeration, and heavy-duty alternators on the engine.

Two large aluminum fuel tanks were worked into the engine room, giving us 240 gallons (930 liters) of fuel. That's enough to move us 1,500 miles or more in smooth water at a speed of around 8 knots.

Water tanks were designed in behind the furniture, in the form of ballast tanks between the main saloon bulkhead and the aft end of the galley. These provided 340 gallons (1,310 liters) of capacity. The concept was to just carry the windward tank full when passaging to reduce heel angle.

An 88-horsepower Yanmar was specified. In theory, this should give us about 10 knots of boat speed flat out. However, 8.5 to 9.25 knots is a more realistic cruising speed.

In Production

By the time we'd finished the design work, Linda and I and the Harrills were very excited about this boat. The question was, would anyone else share our enthusiasm? We needed a minimum of eight orders to make it worth starting a separate production line at TPI.

TPI was willing to commit to a fixed price for 12 boats. So we put together some propaganda and within a very short period of time the first eight customers had signed on the dotted line (eventually 16 of these boats were built in the initial production run). This was especially gratifying, as a whole series of industry experts had told us that the design was too specialized to be commercially successful.

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At Sea

In the water the Sundeer 56 has proven to be as exciting as she looked on paper. She is a fast sailor (we regularly hear from owners who average 175 to 200 miles a day on passages), motors efficiently, and has the most livable interior of any of the smaller boats we've designed.

The fractional rig is an absolute dream to sail. In light-to-medium airs you can almost tack the jib by hand once you get your timing down.

The boat balances well and can fly downwind in the strongest breezes with WH Pilot doing the steering. Of the 16 boats built so far, 13 have gone cruising.

We'd be sailing one ourselves right now except for the legend of *Beowulf*.

Next?

By the time we'd sold a majority of the Sundeer 64s and 56s, Linda and I had realized that building production boats was no panacea. It was every bit as hard as doing custom yachts, and there were a lot more people to deal with. Rather than simply doing one design, getting a few sailors to go along with us, and then getting a boat and going sailing, we'd created another large, complex business. And while we'd enjoyed meeting the new clients and helping them fulfill their dreams, the demands on our time were far more than we had planned on at the start.

The bottom line was that we were not doing any cruising, and something had to give. Accordingly, when the last of the Sundeer 56 production run was completed we decided to forgo the production-boat business. There just wasn't enough time for it, the odd custom project, and our own cruising.

We felt bad in that we realized there were folks who would still like to buy these boats (and since only one of the 56s have come on the market — and it sold quickly — the wait is liable to be long).

However, Linda and I had been too long away from the sea, and it was time for some serious cruising. But you never know, maybe we'll get bored and then......

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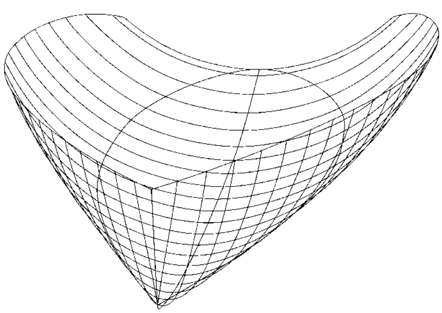
OTHER VIEWPOINTS

So far we've been hogging the stage with our own view of what makes an ideal cruising boat. That there are other opinions on the subject goes without saying. There are, in fact, about as many views on any given design subject as there are designers, boatbuilders, and owners.

Figuring that you might benefit from viewpoints other than those of ours, we've asked several designers whose work we respect to submit one of their seminal designs for your perusal, and then let them tell you in their own words what they feel about what goes into a good cruising yacht.

The 68-foot (20.9m) *Route 66* at speed on Narragansett Bay. The asymmetrical spinnaker is a real powerhouse downwind. With 3,000 square feet (284 square meters) of area, projected well forward on the bowsprit, you know you are going to be moving right along.

The small, high-clewed staysail is actually the normal working headsail. The outer headstay is used for a light reacher. (Billy Black photo)



Even though *Route 66* is very beamy on deck, she has a narrow waterline. The hull sections are totally circular, reducing wetted surface to the minimum.

LARS BERGSTROM

Lars Bergstrom is one of the most innovative yacht designers we've known. Over the years he has developed all sorts of interesting things, from his B&R rigs to pivoting rudders controlled aircraft-style with small trim tabs. Lars has also done a series of extremely interesting racing and cruising designs.

I first became aware of his racing designs with *Tuesday's Child*, which he did for Warren Luhrs. Next came *Thursday's Child*. Both boats were innovative in the extreme and pointed the way toward *Hunter's Child* in which Warren Luhrs, Lars, and Steve Pettengil broke the New York–to–San Francisco clippership record via Cape Horn. *Hunter's Child* was recently raced by Steve Pettengil to a second overall in the BOC.

Subsequently Lars did an Ultimate 30, *Benz Express*, for Bill Whitmore. Bill and Lars got to figuring that a blown-up version of *Benz Express* might make a really interesting cruising boat.

The result: *Route 66*.

Hull Design Criteria

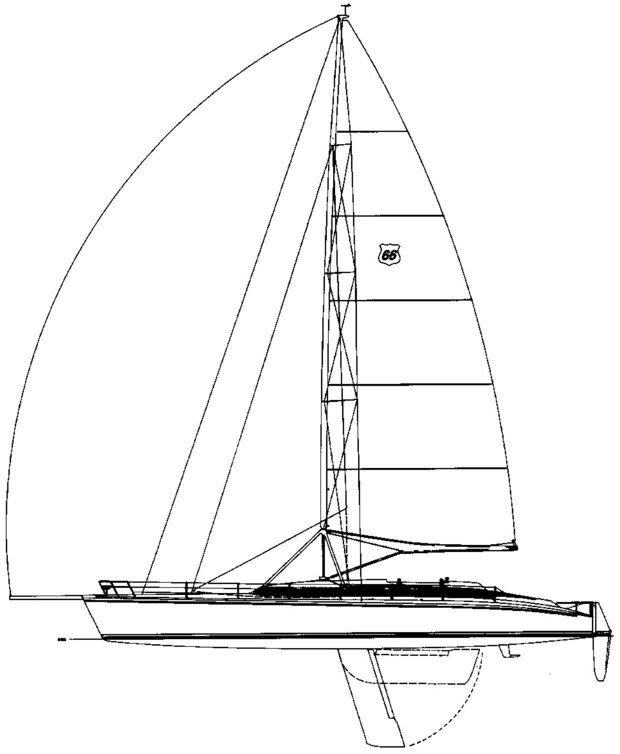
Lars works toward the same criteria as the rest of the designers in this section: the hull needs to be balanced with heel so that it is easily steered, and to be comfortable at sea.

The shape of *Route 66* is what I would call a modified BOC hull.

It is quite narrow on the waterline, with a broad beam (19 feet/5.84 m) at the deck carried well aft.

Cruising displacement is a very light 34,000 pounds (15,420 kg).

The heeled hull sections are elliptical in shape in plan view, and maintain a constant curve-of-area as heel increases.



The profile view gives you a good idea of the compact yet efficient rig proportions of this cruising rig. The main is 1,250 square feet (118 square meters), while the jib is 550 square feet (52 square meters).

This can, however, get you into difficulty if those heeled sections keep the bow in the water and angle the hull and keel relative to the water flow. When this occurs, it is like a huge leeway angle being placed on the boat and tends to be very slow.

What Lars does to get around this is provide enough volume forward so that the bow actually lifts out of the water a bit with heel. In effect the heeled alignment of the boat is almost parallel with the upright alignment.

Lars puts it this way: "When a B&R hull heels, the bow rolls around the line (parallel with the center) and out of the water, and the stern stays the same. Our hulls have circular sections only, like a barrel, and have the same waterline with any degree of heel."

Lars adds that, "We have found it very important not to have a deep foreship (forward hull section) on the hulls, as the foreship has a tendency to steer the boat, which in turn requires more rudder surface."

The half-entry angle of the hull is 11 degrees, the narrowest of all the boats in this section, and comparable to what we draw. When you couple this with a fore-and-aft prismatic of 0.60, you start to see the potential for some serious boatspeed, with reasonable comfort with a bit of sea running.

Lars is an aeronautical engineer by training, so it is natural that he would look at how to create a stable aircraft, and then apply the same principles to sailboat design. In an airplane, you always design the center of gravity so it is forward of the center of lift in the wings. This way, if you have your elevator (horizontal tail assembly) trimmed for a certain speed, the airplane will maintain that altitude, even when you let go of the controls.

Lars uses the same approach in hull and fin design. If the center of gravity can be brought forward of the center of lift for the hull and keel, the boat hull will track (assuming the sails are balanced) without input from a rudder.

Of course, in a cruising boat, it is sometimes very difficult to get the CG that far forward. The alternative is to have a small, fixed, vertical surface well aft. On *Route 66* this takes the form of a skeg from which the prop protrudes. Another way to deal with this, according to Lars, is to make the top 15 percent or so of the rudder fixed to the hull. If the rudder is lost, you still have that small fixed section to help with tracking.

Spray Deflectors

Some heavy-weather, real-world experience, together with tank-test data, indicated to Lars that at very high speeds, above 24 knots, the energy from the bow wave climbing the topsides tends to pull the bow down, causing it to submarine.

To get around this potential problem, he fits spray deflectors from the bow aft about a third the length of the hull. These deflectors are perpendicular to the hull and 2 inches (50 mm) wide. When the spray climbs the topsides and encounters these deflectors, there is a reaction, forcing the water back down and creating a lifting force for the bow in the process.

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Keel Design

As you have seen in the photos of Lars' keels in the keel section, he is no stranger to bulbed fins. But for a cruising boat, a deep, fixed bulb has a lot of disadvantages. For *Route 66,* Lars developed a pivoting keel. In effect, this works like a giant centerboard. Draft with the keel deployed is 16 feet (4.9 m). With the keel rotated up it is 5.5 feet (1.7 m).

The fin has a small trim tab that helps to create lift, reducing the need for the hull to assume a leeway angle.

The keel is operated hydraulically, with a small electric motor turning a hydraulic pump (which also powers the primary winches). There is a pressure-relief valve to allow the keel to kick up if it takes the ground.

Steering Control

Lars has long been an advocate of a *tilting* rudder. Using a transom-hung rudder blade, with a pivot at the top and track at the bottom of the transom, the rudder blade can be angled from side to side to keep it vertical as the boat heels. This has two advantages: First, with the rudder kept vertical when the boat is heeled, it is far more efficient than it would otherwise be with the boat at high heel angles. Second, because of this higher efficiency, the rudder can be smaller than would otherwise be the case.

The rudder is fitted with a small trim tab, to which is attached the autopilot drive. The trim tab forces are very light, so a small pilot does the job. The trim tab in turn develops huge amounts of force to control the rudder.

B&R Rigs

Lars, together with his partner, Sven Ridder, developed the B&R rig many years ago. With *Route 66* they took the process one step farther, mounting the mast on a tripod, efficiently distributing the compression load to the hull.

Lars explains the rig logic: "In addition to the safety factor, the B&R rig on *Route 66* is completely self-tending and trouble-free once properly set up. There is little risk of metal fatigue, except in the forestays, because none of the wires ever go slack. Having no backstay allows for a large, full-roached, fully battened, long-life mainsail for extra horsepower and ease of handling. The only price to pay is some increased mainsail chafe from the 30-degree swept spreaders, and some loss of upper-end headstay tension, which is of little, if any, consequence if jibes are properly designed. Also, changes in mainsail shape must be done with outhaul, vang, and luff tension rather than changing mast bend, which should be fixed with this rig. The fixed vang-sheeting arrangement for the mainsail greatly reduced mainsheet loads and makes for a much safer cockpit area with the boom at a fixed height overhead."

Sail proportions are modest for a vessel of this size. Note the very large mainsail and small headsail. This keeps most of the drive in the main, where it is most efficient, especially downwind. Mainsails are also much longer-lived than jibs, which means that over time this rig configuration will cost a lot less to own than one that is headsail-dependent.

Water Ballast

Lars is a strong proponent of water ballast for cruising. As he puts it, "I very strongly believe that water ballast is the simplest, easiest, and least costly way to achieve stability for the first 20 degrees of heel. The amount of water required is very easy to control. An empty tank has the added advantage of being buoyancy area should it be required. As the hull shapes that we use have a narrow waterline beam that is around half the beam of the boat, using water ballast means that the weight of the water ballast has a long moment arm." Each side has 220 gallons (1,892 liters) of salt-water capacity.

Air Slot

Hunter's Child and *Route 66* are both fitted with air slots aft of the keel. Lars explains, "There are three basic types of resistance on a hull — wave resistance, surface friction, induced resistance.

"Wave resistance is caused by the hull changing the water surface — it induces waves, by higher- and lower-pressure areas on the hull. These areas deform the water surface (wave). This increases rapidly with speed.

"Induced resistance is caused by side forces from keel and rudder to counteract the side force from the wind on the sails.

A bird's-eye view of *Route 66* and her swept-spreader rig. With a 30-degree sweep angle on the spreaders, there is enough force in the side stays to react to the headstay loads, eliminating the need for a standing backstay or runners. This in turn reduces rig load. Most important, however, is that it allows you to have a highly efficient mainsail profile. Lots of sail area, with a low center of effort, and low induced drag. The ultimate formula for speed and comfort. (Lars Bergstrom photo)

The tripod support for the main mast is clearly visible here. It takes some getting used to visually, but it makes a lot of engineering sense. (Lars Bergstrom photo)

"Surface friction is a resistance caused by accelerating the water that is close to the hull (boundary layer). Next to the hull, the water has the same speed as the hull and a little farther out it has the speed of the surrounding water. The area with a change in speed is the boundary layer. It takes energy to accelerate the water in the boundary layer. In the rear part of the boats just in front of where the water is pulled up to make a wave, a suction forms. It is this area that we fit a slot with tubes usually going up to the cockpit area so that air can be ventilated, by the suction, down to the underside of the hull. Water is about 840 times heavier than air, and therefore it takes more energy to accelerate water than air. At the same time we think it changes the wave resistance, and in the near future we hope to be able to study and test the air slot so we will better understand and be able to optimize the size and position of air slots."

Owner's Comments

When you have a design this new, it is always a good idea to talk to the folks who sail it. If they've done some miles, so much the better. It gives you a real-world look at how well the boat achieves its design objectives. Bill and Mary Whitmore live aboard *Route 66* full time and have put 22,000 miles under her keel since she was launched, including two trips back and forth across the Atlantic.

So when Bill returned my call from a phone booth in Norfolk, Virginia, I was really interested in his comments on how the design has stood up to cruising.

My first question was about the average passage times at sea. Obviously this design has extremely high speed potential, but just what can Bill and his wife get out of the boat when they are cruising?

"Two hundred miles a day is a really bad day for us" was Bill's comment. "We mostly average 230 to 240 miles per day. Our best day's run is 341 miles in 24 hours. We did this along the coast of Portugal. The wind was 110 to 115 degrees apparent and blowing about 30 true. When my wife and I are sailing alone, we don't push it. At night, we slow down. If we're hitting 15 or 16, at night my wife gets nervous, so we ease off."

When I asked about the autopilot control at these speeds, Bill indicated there were some problems with the way the Alpha pilot steered the boat at higher speeds. "Sailing along at 14, 15, 16 knots, everything is fine. Then, if we get a strong gust and we start sailing at 21, 22, or 23, the boat starts to slalom back and forth. It's very uncomfortable. So when we're sailing fast, we steer by hand."

Bill continues, "The problem is really more the Alpha pilot than the speed. We set it for a certain speed, fast or slow, and everything is fine. But when the boat accelerates, it starts to oversteer."

Since *Route 66* has a very aggressive liquid-ballast system, I was interested to hear how Bill used this feature.

"The water ballast takes 30 to 40 seconds to transfer from side to side. There are two 4-inch (100mm) diameter pipes for this task. It takes about three minutes to fill the tanks using a 200-gallon (760 liters) per minute Pacer pump that is belted to the engine. We also carry up to 550 gallons (2,081 liters) of diesel fuel in two side tanks and a day tank. What I usually do is keep the day tank filled and keep another 200 gallons (757 liters) of fuel to windward. This is pumped electrically at 12 gallons (45 liters) per hour. If we are short tacking, we do not transfer the fuel, just sea water."

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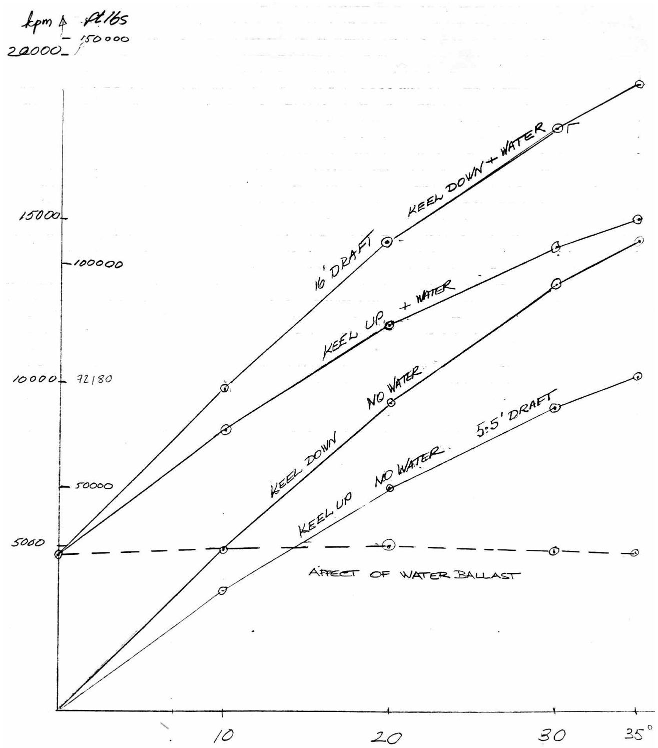
Deciding how much water ballast to use is a trade-off between comfort and speed. Overballasting, sailing more upright, is typically slower than letting the boat heel a bit more. But sailing upright is much more comfortable than heeling.

Bill says that "off the wind we rarely allow the boat to heel more than 10 degrees. Upwind and reaching heel angle will vary between 15 and 20 degrees. At night we increase ballast or reduce sail to ease up on heel angle."

Bill loves the fixed-vang effect on the boom. This means that the mainsheet only adjusts angle of attack on the sail, the uploads being taken by the fixed vang. This reduces trimming loads and allows a faster gear ratio between winch and sheet. They adjust draft with luff tension and the outhaul, very much like you would with a headsail.



Lars sent us this very interesting stability curve for *Route 66*. The righting moments are found along the left side, while heel angle is at the bottom.

The lowest figures are for the keel up, shallow-draft configuration with no water ballast. Notice how little diffrence there is between this configuration and when the keel is lowered.

Where the stability really starts to jump is when the water ballast is added.

The impact on *Route 66* of the water ballast is far more than any other cruising yacht we've seen, an increase in stability of almost 40 percent!

Downwind in the trades they have a large reacher that they attach to the outer headstay. "The spinnaker gets a lot more use than I thought it would," Bill continues. We've carried it up to 28 knots true-wind speed with just the two of us aboard. But we usually just carry it to 14 knots true, and then switch to the big jib."

I asked Bill what he thought about the pivoting rudder. "Short tacking we just leave it on the centerline. Offshore it is very easy to adjust it to vertical. We unload the steering and crank it over. The in-transom storage that this allows for the dinghy is great. We never leave our dink in the water as a result."

Under power Bill reports that they do 7.5 to 8 knots with the 50-horsepower Yanmar in smooth water. Motorsailing they can get up to 12 knots very quickly with just the main up and a fair breeze. They tend not to power upwind, finding they can sail faster and more comfortably. Offshore, Bill says they typically reach between weather systems, avoiding beating as much as possible.

Bill says that they tack through 80 degrees and the boat typically does not slam when going uphill, unless they are in very short seas.

When I asked Bill what he would change if he were doing the boat again, there was a long pause. "I think I'd go with a 75-horsepower engine so we had better speed upwind. We'd add a washer/dryer and a small genset."

That's a pretty short list!

(We are saddened to report that as were going to press we learned that Lars had lost his life while testing a prototype for a motorized glider he was producing. The glider was a radically new design with exciting performance potential. Right to the end, he was pushing the edge of the design envelope. Everyone in the marine industry will miss his creative drive.)

ANGELO LAVARANOS

We met Angelo Lavaranos back in 1979 on our first visit to Cape Town, South Africa. He had started in yacht design in the UK with Angus Primrose, then moved on to the Sparkman & Stephens in New York, before starting out on his own.

By the time we'd gotten together he had a string of very nice-looking cruising boats and winning racers to his credit.

Linda and I were Angelo's first big cruising-boat client. As we worked together on the design on *Intermezzo II*, I became more and more impressed with his range of talents. Not only was he able to draw a variety of design types, but he was an engineer as well (a combination not often found in a yacht designer).

At the time we did *Intermezzo II*, Angelo had on his board the preliminary designs for a very interesting singlehanded racer which went on to become *Voortrekker II*. This BOC and OSTAR racer started many design trends at the beginning of the singlehanded racing phenomenon.

When I looked at those plans I just about started over on *Intermezzo II*. It was obvious the short-overhang approach was the way to go. But we were committed to a tight time schedule and were working on a very tight budget. In reality, at the time the *Vortrekker* approach was just a little too risky for us in terms of resale.

In the ensuing years Angelo became very well known for his innovative cruising and racing designs. In 1990 he pioneered the "aircraft carrier" approach to singlehanded design with *Allied Bank*. This was the first of the super-wide, elliptically shaped hulls with twin rudders to come onto the racing scene. In 1990 she won the Twostar transatlantic race, beating the next two boats by over two days. Not only did she sport the hull-design approach which the French were to copy so successfully, but she had one of the early large-mainsail, small-forward-triangle rig layouts. And below the water *Allied Bank* sported a keel molded partially from spent uranium for a low VCG!

In the BOC around-the-world race in 1991, *Allied Bank* was leading the pack by almost a day when she fell to grief in a collision with ice near Cape Horn.

Keel Design

I asked Angelo how he approached the keel design issues of this innovative BOC design. "*Allied Bank* had a normal elliptical fin (as opposed to a bulb) because we used depleted uranium, which we cast into three different 400kg pellets that stacked solid in the fin, with the same VCG as a bulb. They could not manage a big casting for a bulb. With the high-aspect fin (whose chord would have been shorter on the bulb version), the platform could well have had a straight taper and still had the right spanwise loading, etc. It would not have looked as good, though!"

Allied Bank at speed, planing on a beam reach. Angelo Lavaranos pioneered the wide-stern approach to the singlehanded racers, showing the way to the French with this development. (Angelo Lavaranos photo)

Twin Rudders

And on the question of steering one of these hulls, Angelo reports, "We have found twin rudders well-suited to the BOC type. Indeed, a single rudder would present a real problem [ventilation when heeling] on the more extreme ones like *Allied*. These boats are so light and high-powered, they can have very full [almost powerboat] sterns with not much curvature or rocker, and no drag. The lee rudder increases immersion and does not ventilate. *Allied*, with the two rudders equalling 1.25 times the area of a single rudder, was broachproof and stable when driven hard under auto-pilot. With one rudder out [of the water], there is less drag. We have used twin rudders quite a lot, and on some cruisers where shallow draft is a problem and in one case where redundancy [on a high-latitude 50] and broach proofness was wanted.

"Theoretically they have to be more vulnerable to collision, although in practice I have had no negative experience in that respect. Maneuvering with a single engine [on some I have used twin-engine installations] like *Beluga* is a pain. You have to maneuver at speed to keep flow over the rudders! At times this leads to good spectator sport!"

Prismatic and Heel

There is a lot of debate about prismatic coefficient [the distribution of volume in the hull] and heel angles. Angelo's comment on the *Allied Bank* type of shape is interesting. "What happens to the PC when heeling is more affected by the characteristics of the midsection. My boats tend not to 'bulge' on mid-topsides, like an old IOR boat, when the PC would drop on heeling. The wide stern would equilibrate the volume [neglecting any rig-generated trimming moments] it would have had upright, and so [usually] trim a little by the bow on heeling. [As a result]...the prismatic would not change much [with heel]."

Water Ballast

I asked Angelo his opinion on water ballast for cruising. "Water ballast has a good, if muted, application on cruisers. On a boat like *Allied* it is 40 percent of the lightship weight acting a long way off center. Phenomenal improvements, not only upwind but reaching, are also to be had. The wider boat theoretically loses something dead downwind [with due allowances for bigger rig], which is more than made up for by the more stable [non-rolling] platform. They always reach anyway, there are no pluses to dead running."

And about the wide beam, Angelo says, "The large beam is misleading. They are dish-shaped because they are light and have no depth. The amount of flare is terrific, and while not unusually narrow, waterline beam is actually normal. So are the penetration and entry angles. We tend not to use the ballast for fore-aft trim, even though *Voortrekker II* had three tanks per side and *Allied* had two. For beamy light-displacement cruisers, you can have more rig and have the same power as a full crew sitting on the rail. Even on heavier boats, the improvement is 5 to 10 percent upwind, and better penetration in a slop."

Beluga

If you take the type of experience that a designer like Angelo has and turn it loose on a no-holds-barred cruising boat, the outcome is bound to be intriguing. That's certainly the case with this 49 1/2-foot (15.13m) design. She's got a powerful, plumb-bowed hull shape with the beam carried well aft. This adds stability and room to the boat.

You can get away with this in heavy weather if you have twin rudders, which *Beluga* does. This design displaces 24,000 pounds (10,700 kg), quite reasonable for a boat with a 44-foot (13.5m) waterline and 14.7-foot (4.5m) beam.

The half-entry angle is 17 degrees at the waterline, fine for a boat with this sort of beam-to-length ratio, so she should do reasonably well upwind against tradewind headseas.

Lifting Keel

The really interesting part of this design, however, is the lifting keel. With the keel up, the draft is just 3 feet (0.9 m), and with it down draft is 8.5 feet (2.6 m).

The trade-off is in the interior space. The keel casing comes right up to the deck. It takes a whopping big visual chunk out of the main saloon. Still, when you think about a 3-foot (0.9m) draft, maybe it is not such a big price to pay.

Another potential advantage of the lifting keel approach comes in a stranding. If you have the mechanical ability to raise the keel when you're aground, the escape back to deep water is going to be a lot easier.

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Beluga is an extremely interesting cruising design. She is plumb-bowed, with a powerful aft hull shape then lends stability as well as interior room to the hull. With a centerline rudder she'd be very difficult to handle due to rudder ventilation problems. Angelo solves this problem with twin outboard rudders, á la his BOC designs. (Angelo Lavaranos photo)

I asked Angelo about range of stability and how the boat handled with the keel retracted. "The boat is positively stable to 110 degrees keel down. She was not intended to sail with the keel fully up, only motor into shallow anchorages. There was a half-up position. Fully up, the stability is still better than 90. With the keel right up and sailing hard, I suspect steering could be a problem."

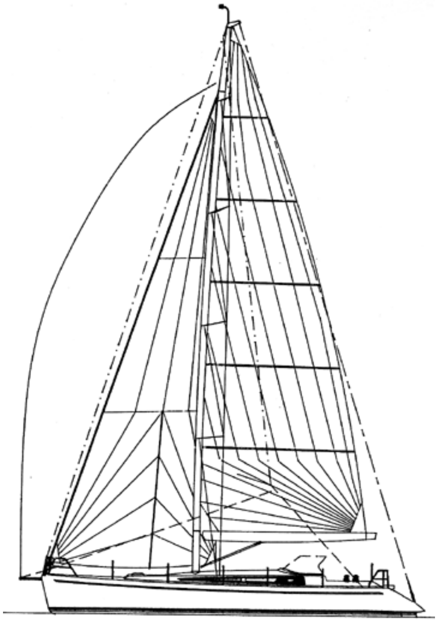
Angelo goes on, "She went very well reaching and running in light and moderate airs with the keel half up. Theoretically she would motor a little better with the keel up, but the slim fin was not a high proportion of the drag. The bulb was still out there."

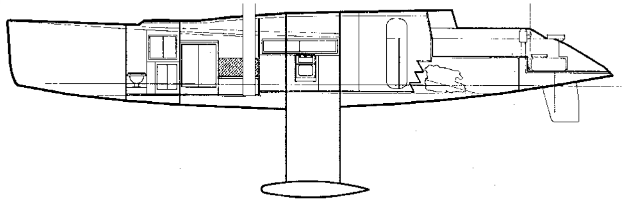
The keel is raised with a heavy-duty cable winch. There is a hydraulic locking mechanism to prevent vibration, plus a mechanical lock to ensure the keel stays in place when down.

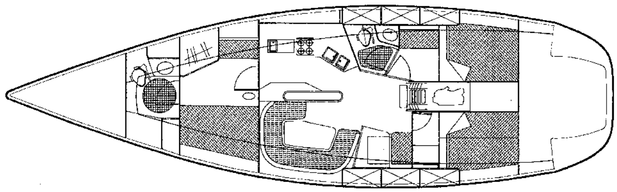
In order to improve stability and carry more sail, the *Beluga* design is fitted with ballast tanks under the deck edge.

Two views of *Beluga* before launching. Left: You get a good feel for the bow shape. Look back toward the middle of the canoe body and you will see the keel bulb in the raised position.

Right: The relationship of the twin rudders and propeller are quite apparent. With the rudder off-center like this, the leeward rudder will always be operating at 100 percent efficiency. No loss due to heel angle with a full end plate over the rudder at all times. This is a broachproof steering system, the only way you can get a powerful stern to behave in heavy going. (Angelo Lavaranos photo)







I love the looks of this boat in profile. The almost plumb bow, nicely sprung shear, and heavily raked transom seem to work together. With the keel in the retracted position, performance under power is going to improve. The negative is in the keel casing bisecting the main saloon.

Beluga was originally fitted with a masthead rig. The current version of the boat is drawn with a fractional sail-plan (above). The large main and smaller headsails are more cruise-friendly. There's also a better chance of being able to sail under mainsail only with this rig.

Look behind the mast in this photo (above) and you'll see a hatch in the deck, through which the keel protrudes when it is in the raised position.

The big question is how to deal with the keel casing. Angelo has used it as a divider between galley and the salon/nav area.

Notice the large beams at each end of the keel casing to stabilize the containment area and tie the deck and keel together. (Angelo Lavaranos photos)

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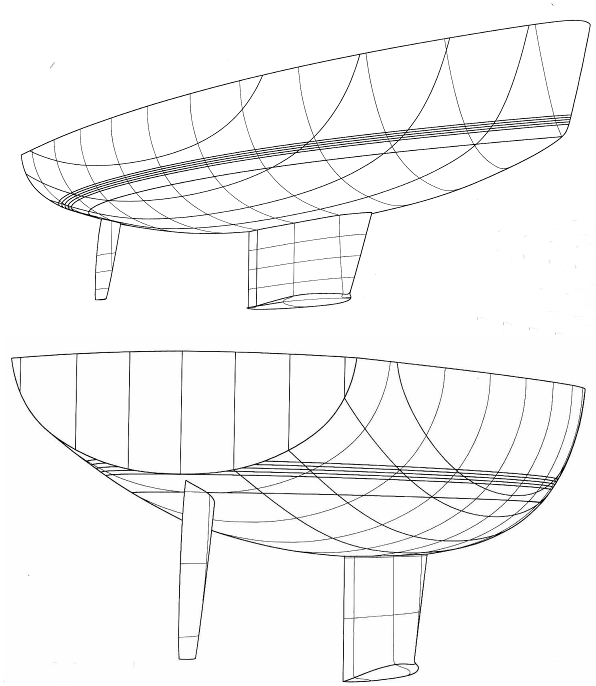
ROGER MARTIN

In the USA the name Roger Martin comes up when you think of performance cruising and especially the BOC. Roger has been drawing innovative, high-performance cruisers for years. BOC boats like *Airco Distributor*, *Duracel*, *Grinnaker*, and *Coyote* have done better competing with the French than any other boats from the USA.

When I called Roger about contributing to this section, he immediately suggested we look at *Cetacea*, a recent 45-foot (13.8m) design. *Cetacea* was designed for Geoffrey Palmer, a practicing architect with many years of cruising, including a circumnavigation, in his past.

About the design brief, Roger says "An integral part of this philosophy was that the boat be simple. The owner's understanding that simplicity is only achieved by working through complexity, was an invaluable asset. It is surprising how few people in any field understand this!"



These two views of *Cetacea* give you a good feel for the soft shape Roger Martin has drawn.The effect of the fore-and-aft rocker and moderate displacement in the stern will make for an easy motion as the boat works its way through the waves.

This is very much a function of the displacement and length of the hull. Roger feels that as beam is reduced, you can get away with less rocker and relatively more powerful hull sections in the ends and still have a soft motion.

Simplicity is a relative term. A generator or air-conditioning can be considered simple! When Roger drew the lines for this boat, he allowed a bit of a fudge factor, for later use by the owner, and worked toward a cruising displacement of 26,000 pounds (11,800 kg) The boat floats a little high on her lines at this point, as she really has been kept simple.

Hull-Design Philosophy

Cetacea is a moderate-displacement boat by Roger's standards. She has lots of freeboard, a generous beam, conservative scantlings, and a powerful hull shape. When you couple this with an aluminum mast and cruising draft of just 5.6 feet (1.7 m), keeping the vertical center of gravity low enough requires lots of lead.

As this is a cruising design, the key objectives in the hull shape, according to Roger, were to come up with a comfortable motion, moderate heel angles, and good performance (in that order).

Roger starts out with a boat that has a fair amount of beam for its length, 14 1/4 feet (4.4 m) for a length-to-beam ratio of 3.15. This immediately raises the question of hull balance and steering control. Roger deals with this by drawing a hull that has very little change in trim with heel. Part of this is accomplished with a full bow (half-entry angle is 20 degrees) and part with a soft stern shape.

If you combine a beamy hull with powerful ends, you can end up with a very quick, unforgettable motion. To mitigate this, and to improve steering control, Roger has drawn a lot of curvature to the bottom (when looked at in profile). The bow is barely immersed at the cutwater, and the stern sections are very modest in volume.

This allows the boat to give to the waves as it moves upwind or on a close reach.

Roger says that *Cetacea* has an extremely soft motion.

He comments that "this Cadillac motion can be attributed to several special features of the hull design such as appropriate displacement, soft stern sections, a balanced waterplane in both fore-and-aft and athwartships axes with little angle or no shape change when heeled, sufficient rocker,

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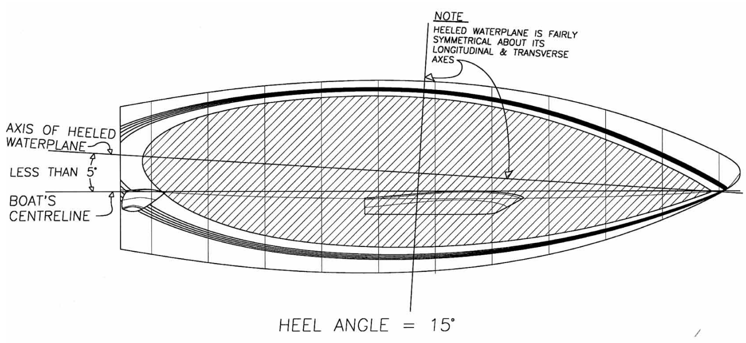

Roger sent us this very interesting drawing to explain some of the performance and steering issues that arise with heel. The hatched area represents the waterplane area of this hull when heeled 15 degrees. This shape is quite close to what it looks like upwind. The centerline of this shape would ideally be parallel with the upright centerline. But this is very hard to achieve unless the boat is quite narrow. The 5-degree divergence between upright and heeled shape is very close.

The photo below shows a simple, no-nonsense approach to the rig. (Mauricio Barreto photo)

shallow forefoot, an 'end plate' bulb on the keel, generous freeboard, short overhangs, and a beamy hull that sails at low heel angles. The hull has round sections forward and sails upwind very well without slamming."

He continues, "These features are serendipitously interrelated. For example, you cannot easily have a balanced waterplane with hard, dinghy-like stern sections, or certainly one that keeps an angle close to the hull's centerline with a 'hard' stern — a shallow forefoot encourages you to give generous rocker [the curvature of the canoe body in profile]."

Roger feels that "generous freeboard and short overhangs keep the boat dry and provide great buoyancy. They also give a more spacious, better-ventilated interior." I agree totally.

This design has a moderately high prismatic of 0.56. This gives the boat an effective waterline of 42 feet (12.9 m), about a foot (0.3 m) longer than the actual measured waterline. The displacement-length ratio is 146.

Keel Shape

Cetacea has a bulbed fin for a lower center of gravity. Roger has some interesting thoughts on this as it applies to cruising motion.

"A moderate-draft keel with a flattened end plate bulb 'entrains' the water-flow and dampens heaving and rolling motions."

Rig

Roger's client did not want to deal with overlapping headsails. For spars, he wanted to stay with aluminum for the simplicity and strength of a known material.

"(The mainsail is) large to make up for the lack of overlapping headsails and to give adequate sail area in light air without the necessity of extra sails [another work-boat philosophy], the main is fully battened, the headsail roller-furling, and the staysail hanked. An asymmetrical spinnaker with an ATN sleeve can be flown from the stem" is the way Roger describes this rig.

Interior Layout

The more experienced the client, the easier he or she is to work with. If you add in professional training in architecture, the results are bound to be interesting.

I'll let Roger tell you about the interior.

"The boat is designed for a couple to cruise aboard, with a few extra berths for short visits by

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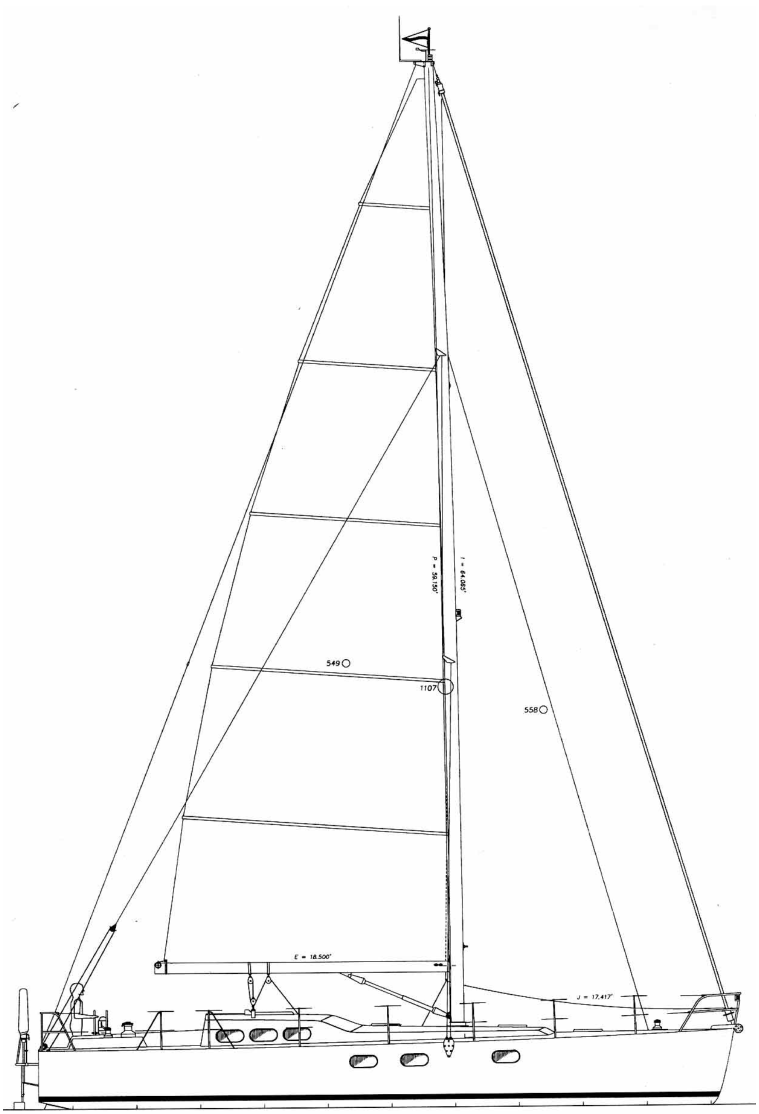


This is a very generous sailplan, with a sail area-to-wetted-surface ratio of 2.49. In light airs she will move right along. The cutter stay lends support to the mast and provides a convenient place to fly storm canvas when it is blowing. I suspect with double-reefed main and heavy staysail *Cetacea* is a delight to sail.

friends and family. Galley and nav/drafting table area are raised for good visibility and space for tankage and batteries is below the sole. Head and quarterberth (with storage beneath) are also on this level.

“The saloon is 9 inches (228 mm) lower, clearly lit by both natural and incandescent lights. It is especially cool and airy, even in the tropics, and is open forward to the owner’s cabin. There is a watertight bulkhead [BOC genes showing] between this and the forepeak, which is fitted for two pipe berths and anchor stowage.

“Aft, a large engine space has four-side access and vents through a dorade-type use of the winch-island above.

“For maintenance jobs, the lid of the cockpit seat above gives plenty of light and air. In the extreme stern there is a flammables locker, watertight to the rest of the boat with cooking gas and outboard fuel tanks, draining to the sea.

“There is no refrigeration, as the owner likes to buy local foods daily while in port, and serves a rum-punch which soon numbs you to the lack of ice. Water is by foot pump in the head and galley. Simplicity.”

I like this interior a lot. The galley provides an enclosed area in which the cook can work without being in line with the stove, a major safety issue at sea. The single head aft will also be easy to use at sea. Isolation of machinery in its own compartment makes it easier to live with your systems.

The drafting table is a compromise. Running the large dimension fore-and-aft is the only way to get a good-sized table, and this works well in port. But at sea, this will not be as efficient for watch standing as would be a smaller, athwartships table at which you could sit facing forward.

Deck Design

It’s obvious by now that there are going to be interesting features wherever you look on this boat. The deck layout is no exception.

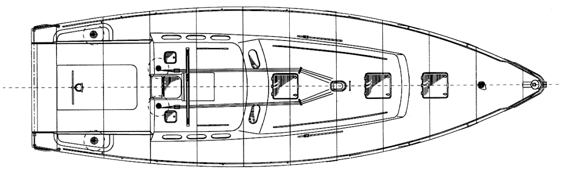
Roger comments, "In warm climates, most of the time is spent on deck, so the cockpit is huge, with a permanent dropleaf table and full awning attached to the dodger. In the tropics, the boat is sailed with the awning up. *Cetacea*'s great beam (14.3 feet/4.4 m) allows broad side decks. Overlapping jibs were eschewed on day one, so chainplates attach to the hull and do not obstruct the deck. The main sheet is on the housetop to keep the cockpit clear.

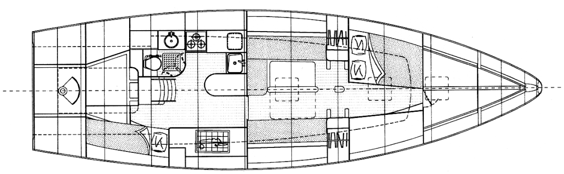
"Rainwater is collected on deck, with special dams abreast the winch-islands allowing the water to be diverted from the scupper drain directly to the tanks once it has passed the taste test. A gate in the stern rail leads to a transom ladder. A barbecue is mounted to the rail in one corner, GPS antenna to the other. The Monitor windvane is an integral part of the design, and the life raft is below the helm seat.

"At the other end, a broad foredeck with a large bow radius makes anchor handling easier. Stainless-steel handrails (through-bolted to matching ones below) run down the sides of both upper and lower deck houses.

"In another workboat vein, there is no wood on deck. Full-length glass-and-foam toerails are integral and stanchions are set into 6-inch (150 mm) sockets. These are BOC-boat features that avoid leaks and maintenance."

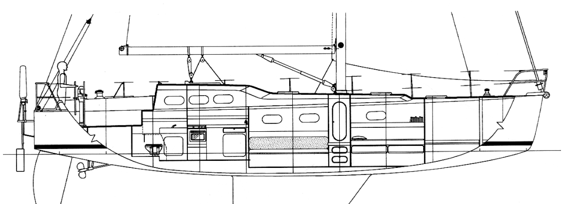
Cetacea is the creative blend of an experienced owner and talented designer. She is going to be a lot of fun to cross oceans aboard.

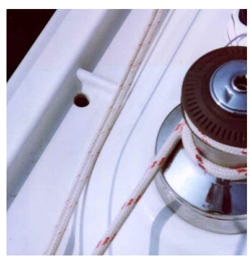




The deck view (top) shows wide side decks and a significantly large cockpit for a vessel of this size.

The two interior views show a very functional use of space. This will be a great boat to cruise aboard for a couple. The quarterberth aft and the saloon berths can be used for occasional guests, but most of the time the owners have the entire interior to themselves. Of particular note is the single, compact head. The tight space makes it easier to work in at sea. Location aft keeps motion to a minimum, and the bulkhead, alongside the companionway makes is a lot easier to go up or down the ladder when the boat is rocking around a bit.





A nice detail on deck for capturing rain water. The small dam just forward of the deck fill catches dirt before it gets into the tank. (Roger Martin photo)

A good shot of the stern shape. The circular shape reduces wetted surface and volume aft. This helps keep the boat in trim when she is heeled. If the stern were more powerful, it would force the bow down and skew the boat on its axis, creating steering difficulties. (Roger Martin photo)

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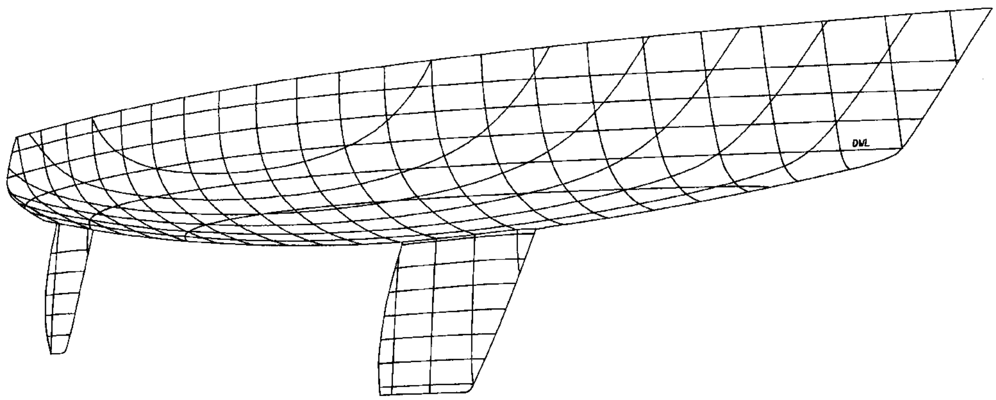

This hull shape has what would be called "sweet" lines in the olden days. She has quite a bit of flare forward, a moderate amount of fore-and-aft rocker in the hull, and a nice flat run aft for good downwind speed. Wetted surface is minimized at the same time there is good form stability to keep the boat on her feet when beating and reaching. This shape will develop more stability for less wetted surface than if she had a full waterline — i.e., no overhang. In light airs, this will be a quicker configuration.

CARL SCHUMACHER

Carl Schumacher is probably the dean of California cruiser/racer designers. Over the years, he's done a series of moderate-to-light displacement performance-cruising yachts that have done themselves proud on both the racing and cruising circuit.

My favorite was his Express series, especially the Express 37. To my eye, this design achieved just the right balance between simplicity, functionality, cruising amenities and performance.

When I discussed with Carl which of his designs he wanted to use as an example, *Heart of Gold* was his immediate answer.

Heart of Gold is a moderate-displacement design with some overhang fore-and-aft. She has a 43-foot (13.2m) waterline and a 50-foot (15.4m) length overall. Her beam is 13 2/3 feet (4.2 m) for a length-to-beam ratio of 3.66. Her displacement in lightship trim is 22,000 pounds (9,977 kg) of which 10,000 pounds (4,535 kg) is ballast.

Like most good cruising boats, this one is the result of a creative partnership between experienced owners and the designer.

Carl puts it this way: "*Heart of Gold*, named after a fictional spaceship that runs on 'infinite improbability,' was designed for Jim and Sue Corenman of Oakland, California. Having gained a great deal of ocean and coastal sailing time in their previous boats, a Catalina 30 and Nordic 40, the Corenmans decided to utilize that experience in a custom yacht. The preliminary work began with notes generated while delivering the Nordic 40 back from a second place finish in the 1988 Pacific Cup. They had very explicit ideas about the boat's systems and interior layout, while I was given total freedom in establishing its performance, styling, and deck layout."

Carl goes on, "The design brief was for a larger, updated version of the Express line of boats that this office had designed for the now-defunct Santa Cruz boatbuilder. This concept called for a boat that is as light as practical, with an open yet comfortable interior, and without sacrificing strength. State-of-the-art construction methods were to be used, utilizing a core with unidirectional reinforcing. Above decks, the styling was to be clean and simple with much effort made to keep the profile low and sleek. Because the Corenmans do a lot of doublehanded cruising, the light weight would allow the boat to perform well with a smaller, more manageable rig than heavier 50-footers."

Hull Design

As you are aware, all hull shapes are a compromise. Carl went about his shape by looking at several possibilities.

"The hull shape was developed by first generating two different forms. The first was a long waterline, free-form shape that is a development from the Express series. The second was a shorter waterline hull similar to a rating rule boat. These shapes were analyzed by the Design Sys-

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tems Velocity Prediction Program and 'raced' on a typical Hawaii Race. The results showed the 'free-form' shape to finish first and save her time. This sort of testing is easy and quite cost-effective when developing a new design."

Deck Layout

As you can see from the drawings, the deck is laid out for short-handed cruising *and* ocean racing. All the halyards and reef lines lead back to the companionway. The mainsheet leads forward along the boom, out to the chainplates and back along each side of the house to winches in the cockpit.

Carl engineered this so that "by utilizing sheet stoppers, these winches can be used for spinnaker sheets, as can the secondary winches at the back side of the house."

Heart of Gold has large primaries for a cruising yacht of this size: three-speed Lewmar 700s. The forward part of the cockpit has conventional seats with backs; the aft end is a shallow, wide well that is raised and sports a 6-foot (1.9m) wheel.

Here are two shots of *Heart of Gold* (above and below) trucking along on a reach with the spinnaker pulling her along. The wake is nice and clean, as you would expect from that flat run aft that shows up in her lines plan. The bow and stern wave magnitude is a bit greater than some of the other designs presented, due to the somewhat heavier displacement. (Carl Schumacher photos)

Rig Design

Given the dual nature of this design, you would expect the rig to be lofty — and it is. The way Carl puts it, "The Hall Spars three-spreader rig is designed to be flexible enough to shape the sails, but not too fragile for ocean sailing off rugged Northern California. The foretriangle is small for a masthead rig, and the main is large. This is done to keep the size of the headsails down and add a better balance to the sailplan."

Fins in general, and keels in particular, are a real trade-off on cruisers. In this case, the Corenmans went for a draft of 8 1/2 feet (2.6 m). That's quite deep for a lot of cruising. However, for the West Coast of the U.S., Mexico, and Central America, and most of the South Pacific, it is not going to be a problem. And with that draft comes a huge increase in upwind and reaching performance.

The notch in the keel serves two purposes. First, it provides a sump for collection of bilge water. Second, it acts as a stop when the owners run aground. This helps to reduce the shear loading on the keelbolts.

The Corenmans say that so far they've only been denied access to one harbor the might have gone into, and that one required a 5-foot (1.5 m) draft.

The rudder is a balanced spade, set on a carbon-fiber rudder shaft. (Carl Schumacher photos)

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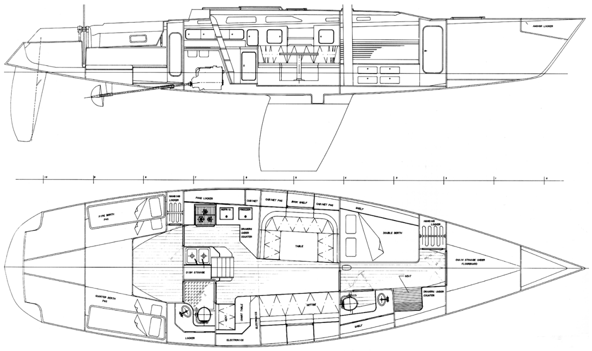
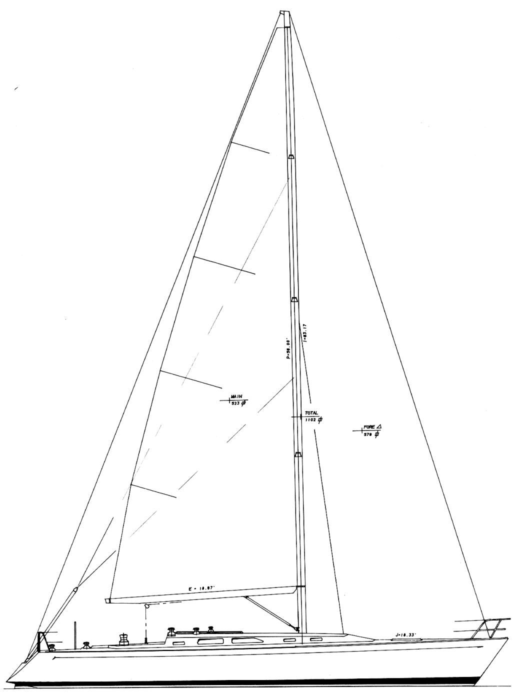


This is a good two-person layout (above) , with lots of room aft for that racing crew or a bunch of friends. However, most of the time the aft space will be used for storage, as it is a bit tight for sleeping in the tropics.

By not trying to cram a bunch of full headroom spaces into the boat, Carl and his clients were able to reduce freeboard, and have a large, open cockpit (which would have otherwise interfered with the aft accommodations).

The rest of the layout has the owner's suite forward (as you would by now expect) with a large forepeak for sails and ground tackle in the bow.

One feature I don't like is the stove opposite the sink. There's some risk of being thrown against it when working in the galley.



This is probably the most aggressive rig we've shown you, in a cruising context. There are running backstays and check stays to the middle of the spar. These control bend, so the mainsail can be shaped nicely, and minimize mast pumping. Of course, they also require a certain amount of diligence from the crew.

The fact that the rig is still in the boat after many thousands of miles of sailing indicates the engineering was pretty good.

Mainsail area is 523 square feet (49.5 square meters), while the forward triangle has 579 square feet (54.8 square meters).

Owner's Comments

Carl has been kind enough to pass along to us a few of the comments the Corenmans have made to him about this boat. After two Transpacs, a couple of Mexican races, and now several years in the South Pacific, their experience has been interesting:

"The more we sail this boat, the happier we are with her. The versatility is just incredible and is a powerful asset when the conditions are as changeable as they have been. We wrote about beating around the west end of Nuku Hiva (in the Marquesas Islands) in 25 to 30 knots, #3 jib, and one reef. The boat was a little over-canvassed for the conditions, but we bladed everything out, sailed her very high on the breeze with 15 to 20 degrees of heel, and were tacking through 70 degrees on the compass. Our friends in the Norsemen 447 — a decent boat and good sailors — turned back and went around the leeward side, a much longer trip."

"A week or two later, we did an overnight beat from Ua Pou to Hiva Oa, in winds anywhere from 8 to 22 knots. With the #3 again, and a reef for the windy stuff, the boat did great, tacking through 90 degrees, doing 7 to 7.5 knots with a VMG of around 5 knots. Our friends in a Perry-designed Cheoy Lee 35 couldn't get there at all and returned to Ua Pou."

Jim then goes on to describe their 500-mile trip from the Marquesas to Tahanea in the Tuamotus. They crossed a weather front, and the narration continues:

"We averaged 8.5 knots made good for the rest of the trip, with the #4 jib and one or two reefs, no help from the current (half a knot on the beam), and did the 510 miles in 68 hours. In spite of the speed, the motion was good as reaching into 6- to 10-foot (1.9m to

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3.1m) seas can be, and the trip was generally quite comfortable. The autopilot drove the whole thing and did just fine. As long as we don't pile on too much main and keep the standing rudder angle down to maybe 10 degrees or less, she does a great job on any point of sail. I'm convinced that the balance of the boat and responsiveness of the helm is a tremendous advantage for the autopilot. The folks with the Norsemen 447 had a slower trip, but did fine; the Cheoy Lee 35 got stuck running off in the trough (weather) as they couldn't reach up enough to get out of it and spent 10 days getting carried right past the Tuamotus altogether before conditions moderated and they limped into Papeete."

"The trip from Rangiroa to Papeete was another great sail. The trades were up, 15 to 20 knots, as we went tearing out of the anchorage at 7 knots under main alone. We thought it would be a little reachy and breezy for the blast reacher, so we set a baby blaster [a Dacron 110% reacher.] Reaching past the west end of Rangiroa, in the lee of the atoll, was a great piece of sailing. We caught and passed *Anaho*, a big French cruising cat that had left a half-hour earlier (something called a Fontaine Pajot 57 that looked like a big Lagoon cat.) It wasn't a fair contest as we passed them when they luffed up to reef (sticky sliders on a full-batten main.) But even after they got straightened out they never gained on us, and we got to Papeete two hours ahead of them. They weren't pressing, but we weren't either. The trip across was great, 12 to 18 knots and shifty, anywhere from 70 to 120 degrees magnetic (50 to 75 degrees apparent wind angle). We reefed for a while when the wind was up and forward, and *Goldie* just ate it up, doing the 195-mile trip in 23 hours."

In conclusion, Jim says, "We honestly haven't seen another boat out cruising that is even in the same class with *Goldie*, and I don't think there is another boat, of any size, that can be sailed as quickly (and as easily) by two people. We hate to keep going on like raving lunatics, but she has exceeded our expectations in every respect, in every condition, and on every point of sail that we have encountered so far."

Does this sound like a happy owner to you?

Heart of Gold frequently turns in 200-mile days when she passages. Her performance allowed her to outrun the infamous Queen's Birthday Storm on a New Zealand-to-Tonga passage in June 1994.

The racing influence on this design is clearly seen in the cockpit layout and rig. This cockpit provides maximum flexibility for a good-sized crew. The large-diameter wheel makes it possible to steer from either side deck with a good view forward.

There are some negatives from a purely cruising perspective. Lack of back support is one, but this can be cured with removable seat backs, with their support posts set into flush deck sockets. The big wheel impedes access aft, but I'll bet she's so much fun to steer that the Corenmans wouldn't trade it for a smaller helm, and besides, you can always fit a smaller wheel if you feel the urge. (Carl Schumacher photo)

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CHUCK PAINE

Chuck Paine is a traditionally trained yacht designer who made his early reputation on very conservative cruising designs. In 1989 he began to design yachts along the lines of our early Deerfoot series, only with longer overhangs and somewhat heavier displacements. To date he has 15 of these vessels sailing, ranging in length upwards from 42 feet (12.9 m).

I should tell you at the outset that although we are friends, we also frequently compete for clients. There are many areas where I agree with Chuck on design issues. But there are also lots of areas where we disagree.

His body of work in this area is substantial, and his concepts worth considering.

Chuck has sent us data on one of his current designs, a 66-foot (20.3 m) yacht named *Evolution*.

Chuck feels that "a custom design is the creature of two parents, the designer with his own predilections, and an owner who brings a lifetime of personal experience to the drafting table. Usually the naval architecture is left to the designer, while the particular character of the individual yacht is the province of the owner. A healthy tension develops, with the designer attempting to fit the design as closely to his database of past successes as possible, and the owner trying to create a yacht that is unlike anything ever built before, uniquely reflecting his personal taste."

Chuck goes on to say, "A highly successful design office gets that way by avoiding failure at all costs. The history of sailing-yacht design is rife with highly creative, breakthrough designs — usually of light displacement — that become instant white elephants, built at enormous expense and immediately worthless upon launching. The enduring design offices never stray too far from the center, while the upstarts, in shooting for the stratosphere, invariably crash and burn. In developing the Bermuda series, the Paine office recognized the brilliance of the Deerfoot concept, but pulled it halfway back toward the center. In comparison with Deerfoots, the standard model Bermuda series is not quite so narrow, has a shorter waterline owing to its elevated transom, has a keel that is more windward-oriented, is considerably heavier, [and] has a larger sailplan."

Evolution

"The first thing a designer must know about a new design is its target displacement [weight]. From the outset, *Evolution* was to be built in aluminum. Her owner was a resident of Holland [he now lives aboard the boat and travels the world], and the Dutch are the world's finest metal-yacht builders," says Chuck — although he'd get some argument on where the best hulls come from in New Zealand, Denmark, Canada, and even the USA. "This influenced her weight," he goes on, "for an aluminum yacht cannot be built as light as a composite one."

"Furthermore," says Chuck, "initial owner/designer discussions revealed that the owner was unwilling to sacrifice quite a number of heavy creature comforts, insisting upon central heating and the extensive insulation that goes with it, hull subdivision using watertight bulkheads, full damage-control pumping, a luxurious interior, spares for everything well beyond the norm (would you believe a spare propeller shaft in the bilge?) enormous anchors and chain, rebuildable diesels with sleeved cylinders — heavier than the usual engines — a 12kW genera-

Evolution, a Chuck Paine–designed 66-footer (20.3 m), is reaching in 20 knots of beam wind. She's carrying a blade jib with reefed main and doing about 10 knots in this photo. (Chuck Paine photo)

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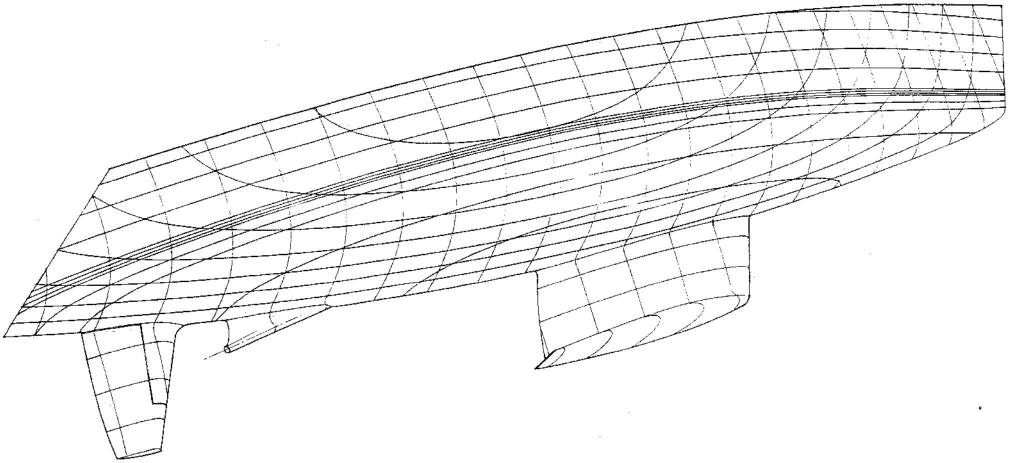

Chuck's hull has a lot more beam than we are used to below the waterline, as well as a bit more depth to the hull. This, in turn, allows him to support his greater displacement on a design with long overhangs. Note the counterbalance portion of the rudder (at the bottom of the skeg). This is a tried-and-true method of reducing rudder load. The only problem is with nets. They tend to hang up on the leading edge below the skeg.

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tor, and fully convertible paralleling electrical panel for use within both European and American alternating current environments. The yacht was to be sailed in the high latitudes, requiring the bow and areas around the waterline to be strengthened against ice impact. Weighed against this (pun intended) was the owner's willingness to invest whatever money it might take to buy the lightest hull-construction techniques obtainable. The more money you are willing to spend, the lighter a yacht may be built. The result was a displacement-length ratio at half load of 177 — the upper end of the Bermuda series scale, which runs from a low of 125 to that number. Compare this with displacement-length ratios of 250 to 325 for fully modern oceangoing designs of the traditional, shorter waterline type, and well below 100 for some of the Dashew designs."

So far, Chuck's clients sound like ours; they want to carry a full cruising payload and have all of the conveniences of home.

Now we get to where we really disagree, the design details.

Chuck feels, "Virtually any boat built to a displacement-length ratio of 125 to 177 will sail beautifully off the wind, for hulls of such a light weight are capable of semi-planing. The trick is to make them go the other way. This requires a sharp bow, high transverse stability, an effective keel, a transom that does not drag water, good helm balance so the rudder does not act as a brake, and a windward-oriented sailplan."

Bow Shape

"Here is one area where the demands for upwind and downwind performance are not in severe conflict. The sharper the bow in plan view, the better going both ways. One way to achieve this is to make the stem profile vertical, since this brings the cutwater further forward, and the present IMS, Whitbread, and BOC fleets illustrated the result — a vertical straight stem. The sharpness of the bow is typically measured by its half-entry angle at the designed waterline. This angle, for the entire fleet of our sailboat designs, from which over 750 yachts have been built, ranges from 15.75 degrees to 25.5. Among the Bermuda series designs, the range is 15.75 to 20.5 degrees, with *Evolution*'s half-entry angle at 16.5 degrees.

"But liveaboard owners have to spend their lives looking at their boat, it being their home, and few will tolerate the look of a vertical stem. The 20-degree stem angle on *Evolution* was specifically stipulated by the owner, and its the man who pays the piper calls the tune. Offwind-oriented designs have 'flatter' bows — more U-shaped than V — which makes them easier to steer and quicker to get up on a plane. *Evolution*'s bow was modeled with the V-shape fairing further aft than many, so that she would not pound as severely to windward as the more downwind-oriented shapes."

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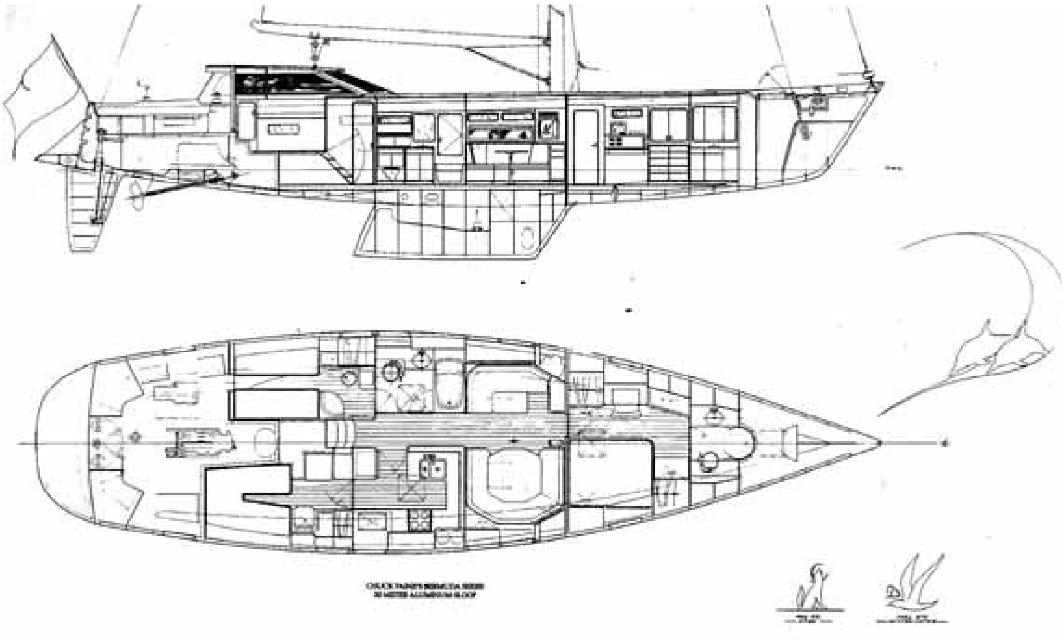
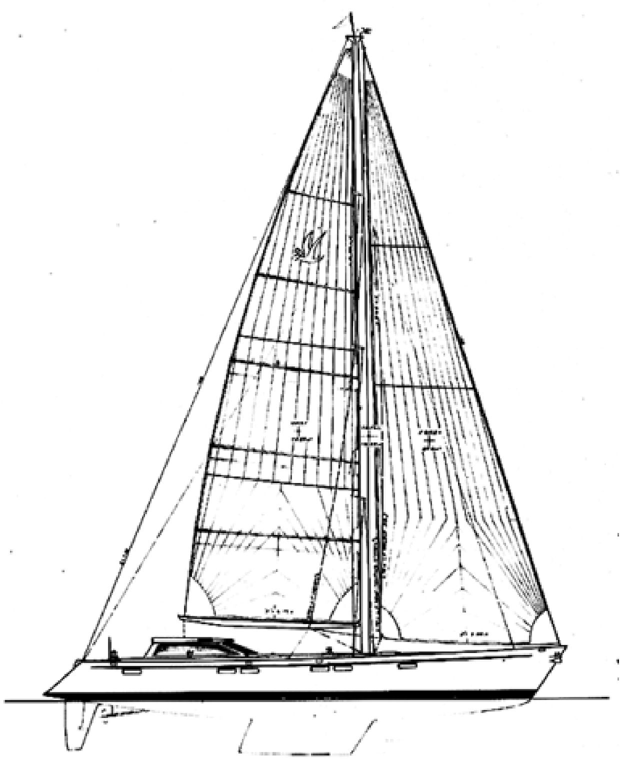


Chuck's hulls require more canoe-body depth than we use to support their greater displacement on a shorter waterline. Because there is less depth available for the keel within a given amount of draft, the fin is elongated in a fore-and-aft direction to fit in the required ballast and sump.

The interior layout is dominated by the need to generate headroom under the hard dodger while keeping the overall profile low. This cuts into the volume of the aft cabins. They're somewhat on the tight side for a vessel of this size, but then this boat is designed to be sailed by a couple. If you give the guests too much space, they'll get comfortable and extend their stay. Better to keep them on edge so they go home early!



Chuck's rigs are a lot taller than what we like to use. This will be a very quick boat in light airs, but in a breeze it will be more difficult to handle than one of our designs. The crossover point in performance is going to come in about 9 to 10 knots of breeze.

Chuck goes on to say, "All these light and long designs — Deerfoots, Sundeers, Bermuda series, and the lot — pound harder when on the wind in heavy airs than traditional types — their most serious design compromise."

This is another area where we disagree. The only way to find out who's right is to make a voyage on each type!

Transverse Stability

"All other things being equal, stability is directly proportional to weight — a boat that is twice as heavy is twice as stable. So it should surprise no one that light-displacement designs tend to lack sail-carrying stability. In compensation, most light boats tend to be beamy, so as to gain back some of the stability lost. In the case of the narrow Deerfoots and Sundeers, very small sailplans do the compensating. The overriding objective of my Bermuda series has been to develop a light, narrow type that, owing to other factors, is very stable and can carry a "normal" sized rig to windward in heavier airs.

"The other factors are: Seeking out owners who are willing to build to high specifications at a high price. The more money an owner will spend on better construction materials and techniques, the lower the center of gravity and the stiffer his sailboat. One can easily build an aluminum boat cheaply, by using thick plating and relatively few frames to support it, and by avoiding longitudinal stringers. *Evolution* is just the opposite, plated with 5-millimeter topsides and 6-millimeter plate in the bottom, backed up with closely spaced longitudinals and a large number of lightweight frames whose section and spacing varies to match the applied loads. With all members computer drawn and plasma cut, the fit-ups are, in a word, perfect, so very little fairing putty was required in the finishing stages, further reducing weight. Both the design cost and the fabrication hours are probably double those for cheap construction, but the hull and deck are far lighter and stronger, and the VCG far lower, as a result.

"Using bulb keels: Putting some or all of the ballast in a voluminous bulb at the bottom of the keel vastly increases the stability that can be gained from each pound of lead. The keel that has developed is a highly sophisticated shape that combines a low center of gravity with low resistance, tolerable wetted surface for a bulbed keel, and minimal vulnerability to damage.

"Hull shape: The Bermuda series yachts are always of minimal freeboard, to lower the weights, and have a flatter hull shape, especially aft, than others of the genre. *Evolution* uses such devices as welded-in piping troughs in the tops of the floors and very elaborate, low-profile tanks in order to lower the freeboard while still retaining adequate headroom belowdecks."

The Keel

Chuck is quite specific about his keel requirements. He feels, "If one development has made the advent of the Bermuda series possible, it has been the bulb keel. None of this series of designs would perform very well to windward without it. A properly designed, flattish bulb will not only markedly lower the center of gravity, but will also act partially as an endplate to prevent leakage of the high-pressure fluid on the leeward side of the keel around the bottom to the low-pressure windward side, so the bulb does double duty. Unfortunately, bulbs are trendy, so if you go to a boat show you will see every conceivable variation of bulb keel on offer, many of which look pretty improbable."

"*Evolution*'s owner insisted upon quite shoal draft for his yacht — just 6 1/2 feet (2 m) at half load. Thus her keel is quite long in profile, in fact the lowest aspect-ratio (ratio of depth to length) of all the Bermuda series yachts. But probably owing to the endplate bulb being very effective, the keel works brilliantly, with no detectable sideslipping and brutal stability."

The Stern and Transom

Now we get to the back end of the boat. Chuck's current designs are quite reminiscent of what we did with our Deerfoot series almost two decades ago.

He states, "Herein lies the greatest difference between my Bermuda series and the Sundeers. We have had lively debates over this. If you accept the argument that gentlemen never sail to windward — that the engine will always be used to go into the wind or to make progress in light airs — then the transom edge ought to be immersed. No planing powerboat worth considering has its transom edge out of water. When sailing offwind, the depressed stern encourages the onset of planing and maximizes the waterline length.

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"If, however, a yacht is to sail well to windward, it must have an elevated counter and the lower transom edge 4 to 8 inches above the water when at rest. Otherwise the transom will drag water when not planing, adding significantly to resistance, and will prevent the bow lifting to each oncoming wave when punching into the wave train as it does when sailing to windward. When a yacht is moving at over, say, 5 knots, the quarter wave travels up the counter to the transom edge anyway, so the elevated counter yacht has just as long an effective waterline as the immersed transom one whenever it is moving at even this modest speed. *Evolution*'s transom edge is 6 inches above the waterplane when loaded with extensive liveaboard effects and tanks nearly full, which is about right for a boat that will be normally sailed to windward rather than motored."

Steering

Chuck states, "High-speed yachts need more careful attention to steering than slower ones. The question of helm balance is also more critical. A yacht that is slow and a little out of balance might develop a mildly annoying bit of weather helm. But since the force developed by a rudder varies as the square of the speed, the same amount of imbalance on the faster yacht would pull the wheel right out of your hands. Only spade rudders or high-aspect-ratio, partially balanced skeg-supported rudders are appropriate on boats of this type, since the rudder's center of pressure in either case can be designed to be very close to the pivot axis. *Evolution* uses a small partial skeg in order to lower the bottommost bearing and thereby relieve the loads on the ruddershaft. The fairing of the skeg and rudder to the computer-generated airfoils is Dutch perfection, and the matching of the rudder radius to the skeg cove is accomplished to very tight tolerances so as to minimize the discontinuity at the slot, reducing the possibility of flow separation at this juncture."

He goes on, "The balance of the sailplan's center of effort versus the hull's center of lateral resistance is absolutely critical to windward performance. If done perfectly, the helm will be dead in light airs when steerage way is just barely established, and weather helm will result in about a 4-degree rudder deflection at the point where a reef must be taken to keep the rail out of the water. This is achieved in the Paine office by computing the juxtaposition of the two centers in three different ways and tracking the results on the spreadsheet database. After hundreds of boats, we're just fine-tuning, and a perfect result just spits out of the process with little effort."

The Rig

And what about the rig? From Chuck's viewpoint, "Once again, with the emphasis upon retaining windward ability, the sailing rig must be oriented in that direction. What is required is that the sailplan be large enough in sail area to drive the boat even in light airs, the leading edge of the leading headsail be as long as the stability of the hull allows, and the mast be of a small enough section to not overly disturb flow into the mainsail. And the weight of the rig must be kept as light as prudent engineering will allow."

Chuck feels, "The best measure of the power of the rig is the sail area–displacement ratio. That ratio for all Bermuda series designs, using the displacement at honest liveaboard halfload and neglecting all mainsail roach and headsail overlap, ranges from a low of 16.55 to 20.66. *Evolution*'s sail area–displacement ratio is 16.58. Note that since this number is used in sales efforts, it is widely abused. Many designers and probably all boat salesmen abuse the denominator, using for displacement the IMS measurement displacement, which assumes the boat with virtually nothing aboard, or worse still, the as-built weight. Likewise, many include the mainsail roach and/or headsail overlap in the numerator. Turn a jaundiced eye towards figures of 18 to 20 on purported ocean cruisers — the 3 to 5 tons of personal effects and fuel and water are most likely not included in the displacement when such figures are quoted."

I could not agree more. In a cruising boat, looking at any displacement other than the one at which the boat is going to be sailed is a waste of time.

Chuck concludes, "In order to keep the weight of the rig down, the mast of *Evolution* is of a small and therefore light section. This is permitted by a combination of the triple-spreader staying and the abnormally wide staying base. The upper shrouds come right out to the gunwale, which significantly reduces the loads in the stays (and consequently their size and weight) and the compression load in the mast. As a result of the wide staying base, no genoa jibs can be carried, at least to windward, but this was one of the owner's unalterable requirements when the design was commissioned. No overlapping headsails means easy tacking and allows the sheeting angles of the headsails to be narrow, allowing the yacht to point very close to the wind." Again we agree, this time with the owner. Overlapping headsails are both inefficient and a pain to deal with in a cruising context.

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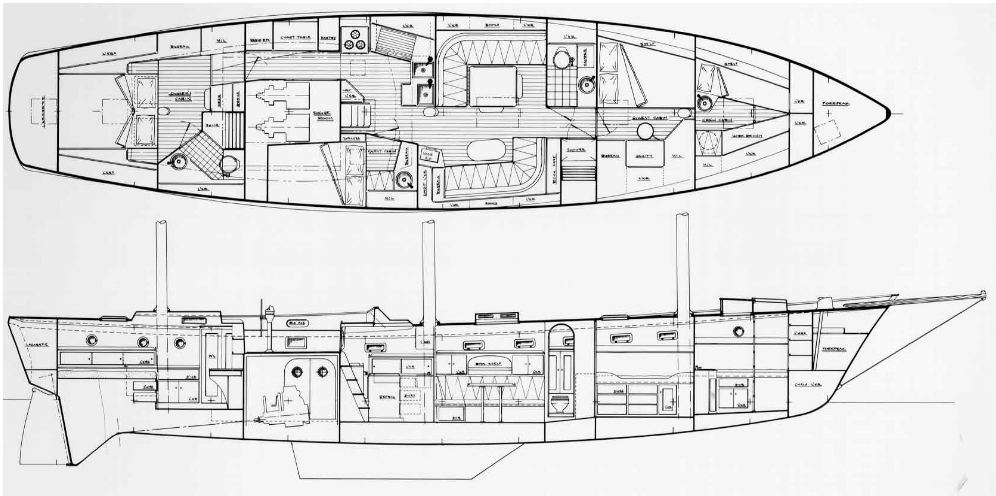
TED BREWER

Ted Brewer has been around the yacht-design business about as long as anyone I know. His designs tend toward the heavy, with long overhangs (by our standards). When I talked to him about this section of the book he sent us data on a 60-foot (18.4m) steel-schooner design that has been cruising on the West Coast of the U.S. and Mexico for the last couple of years.

Millenium Falcon

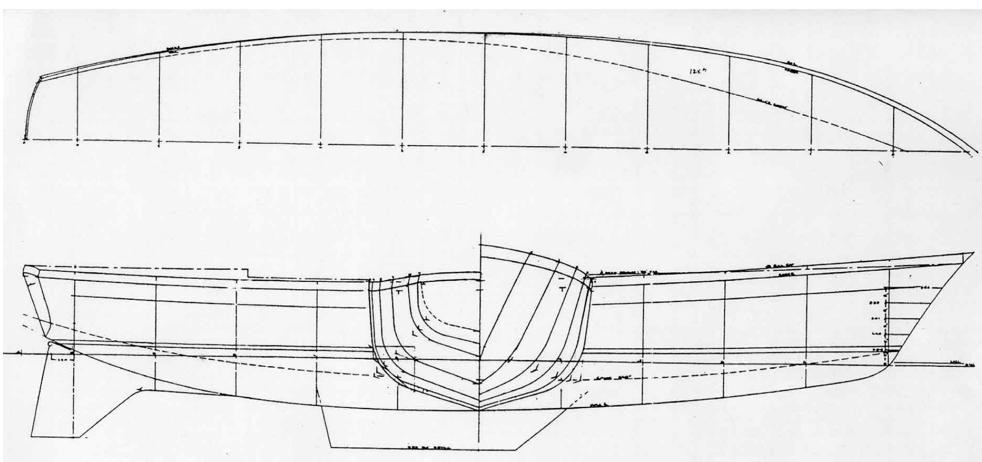
Millennium Falcon is designed as a go-anywhere, do-anything, bulletproof-steel cruising yacht. For a boat of her type she gives little away in terms of overhang.

Check out the lines plan and outboard profile. They show a slippery-looking shape that ought to move quite nicely in the trades.



These views of the accommodations also give you a sense of hull balance. Notice how the topsides flare forward. As the boat heels, this will tend to balance the volume aft. Given the hull shape and length-to-beam ratio, I would expect this design to track very nicely.

There are a lot of cabins worked into this interior. And she'll sleep a bunch of people. For charter work, or for sailing with a large family, this will work out well, with three nice double cabins, each separated from the other by some intermediate bulkheads.

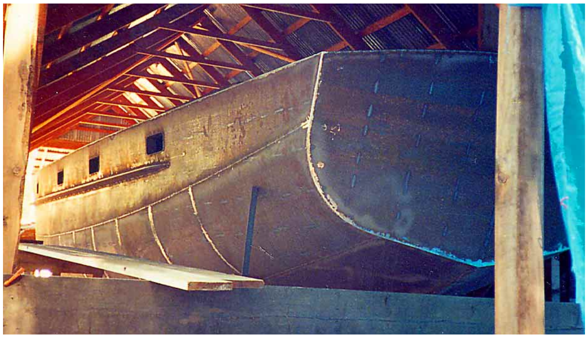


Here's a look at this design from the builder's perspective. This is what we call a preliminary set of lines. Enough to give you a feel for the shape, but not so much that you could copy the design without paying the designer his fee!

As mentioned above, this hull shape will be well behaved with heel. The entry angle is 19 degrees, which by a lot of standards is quite fine.

The rig is a variation on L. Francis Herreshoff's *Marco Polo* design (I'd prefer to see her with a ketch rig).What's so interesting about this boat is that she appears to be a very traditional design when you first look at her — and indeed she is. It is just that she is traditional in a pre-handicap rule sort of way. Short overhangs, modest beam-to-length-ratio, and a very moderate displacement-length ratio, even though she's heavily built of steel.

In any sort of a breeze, this boat is going to be a real mover, especially on a reach.



Here are two photos taken during construction. These give you an idea of what the bow looks like as well as the stern.

Notice the flair in the topsides.This helps keep the boat balanced with heel. However, it also produces a lot of drag when trying to push that volume through waves beating and reaching. It is one of those trade-offs that makes yacht designing so interesting. (Ted Brewer photos)

Millenium Falcon at anchor. A purposeful-looking design with a very nice shear.

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HISTORICAL PERSPECTIVE

As we've said before, there is nothing new in the field of yacht design. Everytime you hear about a major innovation the odds are someone before has used it.

Take balanced hull shapes, about which you've been reading a lot in this book. Prior to the 1960s, these were the rule rather than the exception.

Narrow length-to-beam rations and hollow-forward waterlines? They were very controversial at the start of the clipper ship era. In fact, the same criticisms that were leveled at some of Donald McKay's clippers — that they would nose-dive in heavy going — have been thrown at our boats. In both cases, the accusations were wrong.

A thousand years ago the Chinese were building highly efficient hull shapes, with high aspect-ratio daggerboards, and sails that carried lots of area up high, precursors to our *latest* thinking.

In more recent times, much of what we are doing today was anticipated in the 1950s. Skip Caulkins designed a series of light-displacement fliers that decimated the racing fleet and were quickly legislated to the backwaters. That these boats had much better interiors, were faster, more easily driven, and safer than the "normal" CCA designs of the era had little impact on the establishment. As is almost always the case, the establishment wanted to protect its base, and if that heeded progress, well, the new boats were "ugly" anyway.

In the same time frame, Bill Garden was designing light-displacement cruisers that had the features to which we aspire today. Narrow entries made for soft motion uphill. Easily driven hulls meant a smaller rig could be used, more easily handled by a couple. In an era when a cruising couple was thought to be stretching the limits of seamanship with a 38-foot (12m) yacht, he and his wife were cruising aboard the 60-foot (18.5m) *Oceanus*.

When Skip Caulkins and Bill Garden were doing there early work, my interests as a teenager were elsewhere. I was into hot dinghies, fast cars, and the pursuit of the fairer sex (not necessarily in that order). It wasn't until after a string of multihull designs and the initial cruising aboard *Intermezzo* that I began to think about the ultimate cruising boat.

I understood the basics, knew what was wrong with the CCA-era boats, aboard which we had sailed many thousands of miles, but didn't have the urge to do anything about it.

Until the day Bernie Schmidt invited us to go for a sail on *Innismara* in 1977.

INNISMARA

We had been berthed in Auckland, New Zealand's Westhaven Marina for several weeks when a long, sleek, radical-looking boat pulled into her berth astern of where we'd moored *Intermezzo*.

I was immediately attracted to the radical look of this 67 1/2-foot (20.8m) boat. Virtually no overhangs, very modest beam (just 10 feet/3.1 m), and a rig that seemed quite small in proportion to the boat, although it was large in an absolute sense.

Bernie and his family were just returning from a few weeks of cruising, and while they were all anxious to get home, he patiently answered my many questions.

"Why don't you come for a sail with us tomorrow?" he asked.

The next day Linda and I walked over as soon as we saw Bernie on board. The breeze

Innismara driving to weather in a fresh breeze. She has a beautifully clean wake, no stern wave to speak of, and a very small bow wave. Look at how little fuss her hull makes going through this afternoon chop. She is sailing with a full main and staysail, in effect an extreme fractional rig (although she had a masthead headstay for light airs). This is a rig configuration that the French "invented" 30 years later for their BOC boats. (Sobstad New Zealand photo) was from the north, about 15 knots, making the passage up and down Auckland Harbor a beam reach.

As is the case with many Kiwi sailors, Bernie had spent most of his life tinkering with sailboats. He'd designed and built a series of dinghies, mostly 18-footers (5.5m), while studying to be an optometrist.

He'd spent five years designing and building *Innismara*, and when she went into the water in 1968 she was the terror of Auckland harbor.

With a waterline length of 60 feet (18.5 m) and a displacement of 27,000 pounds (12,244 kg), you can see how she might be quick. Add in a 10-foot (3.1m) draft and 1,600 square feet (152 square meters) of sail, and the fun factor climbs to the top of the meter.

The keel was a fin type, and she had a spade rudder mounted well aft. The hull, by itself, drew just 18 inches (457 mm) of water.

Once clear of the marina, we hoisted the large main and then set a small staysail. As the sails were sheeted home, the boat accelerated like a rocket. Within the blink of an eye we were hitting a steady 10 to 11 knots. The boat was easy to steer, the sails were a dream to handle, there was little tendency to round up in the puffs, and as we'd hit the wake of a passing launch or ship the bow would slice through with hardly a quiver.

Below, the space was very limited. The combination of low freeboard and trunk cabin, with wide side decks, really closed things in. Yet there was much more storage and visual space than we had aboard *Intermezzo*.

Immediately apparent was the fact that by making this a flush-deck design, doing away with the trunk cabin and raising the topside height, you would have an enormous interior for very little increase in structural weight.

That sail started the two of us thinking. What could we get for *Intermezzo* if we sold her? How much would it cost to build a new boat? Should we interrupt our trip and start now?

During the next couple of months every spare moment was spent sketching, thinking, and checking the piggybank.When my folks came to visit, I showed my Dad what we'd been working on, took him to see *Innismara*, and did a round of visits to local boatyards. His reaction was the same as mine, and being without a boat at the time, we decided to joint-venture a mold and build a couple of boats. We didn't think about this as a business. We just wanted to build ourselves a couple of good cruising boats. The rest, as they say, is history.

Bill Garden's *Oceanus* was a design that was ahead of her time. She was 60 feet (18.5 m) overall, with a 12-foot (3.7m) beam, a 48-foot (14.8m) waterline, and a draft of just 6 3/4 feet (2m). She displaced 36,000 pounds (16,326 kg) and had a displacement-length ratio of 145. Bill designed her to be easy to sail for himself and his wife. *Oceanus* was built in 1954!

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In 1958 (the olden days) my dad started design and construction work on the first large cruising cat built in the U.S. The *Hu Ka Makani* was 58 feet (17.8 m) overall and 20 feet (6.15 m) wide. She served the family well for over a decade, cruising up and down the coast. But both my Dad and I quickly realized that she was not a good offshore choice. Fast for her day and very stable, she had the typical cat problem of pounding her wing. We treated her very cautiously when cruising.

MULTIHULLS

We've saved the multihull-design issues for last. They are such a controversial subject that they deserve a section of their own.

Nowhere does internecine warfare in the cruising community rage as fiercely as between monohull and multihull cruisers. The specter of lead-filled bubbles bursting their seams and going to the bottom like rocks is held up by one group, and the nightmare of floating upside-down in mid-Atlantic, or off the Cape of Good Hope, is raised by the other.

Well, I'm here to warn you to consider *all aspects carefully* in reference to your own skills and your proposed cruising area before taking off in a multihull.

Before I jump into this discussion, let me give you a little of my own background. One day, way back in 1958 at the One-of-a-Kind Regatta in Newport Beach, California, I saw an ugly monstrosity with a birdlike sail whip the tar out of a sister to my beloved 17-foot (5.23m) Thistle — in light airs and to weather, no less. Repulsed by the ugliness of this "thing," I was nonetheless overcome with curiosity about its origins. I wandered over to the beach where the boats were hauled between races and met Dan Sanderson and Roy Hicok, the builders and sailors of *Wildcat*. They offered her to me for a sail. "No thanks," I said. "I just wanted to take a look at it."

But curiosity soon got the better of me, and it wasn't long before I was screaming around the bay in *Wildcat*, out of my mind with enthusiasm. I put the boat back in Dan and Roy's hands, ordered one, and never looked at my Thistle again.

For many years after that I raced, then designed and built a series of catamarans (eight in total). Along the way, we won a few races, set a record here and there, and generally had a good time. My dad got the bug and built a luxurious 58-foot cruising cat, one of the first big cruising cats in the USA.

Our boats were lightweight and high-strung, and their sheets were never cleated — even day-sailing in light airs. It was our last boat, *Beowulf VI*, a 39-foot (12m) cat with a small cabin, that gave Linda and me the idea to really go cruising.

As a designer, the problem I continually saw with *cruising* multilhulls was weight. They wouldn't carry a big enough payload to cruise *at speed*. And speed, after all, is the name of their game. Their other problem is lack of ultimate stability. Multihulls have high initial stability, but once one hull is out of the water, very little besides quick reflexes separates you from getting wet. I couldn't see exposing my family to a potential capsize in an offshore environment, brought on by a lapse in clear thinking. (We did take Elyse and Sarah "cruising" on our cats from the time they were babies, but it was always within sight of land and during daylight.)

We wanted to sail without crew, and the boat would have to take care of herself from time to time, which is simply not possible with a multihull in heavy weather.

As a result, we bought a "lead mine," and while *Intermezzo* was faster than most cruisers in that era, her top sustainable speed in the 8-knot range didn't begin to compare with the steady 28 to 30

Linda, Sarah, and Elyse when life was a lot simpler and the cruising was a good deal faster. *Beowulf VI* gave us our first real taste of cruising, enough to let us know we should sell the house and business, get a lead mine (monohull), and head for the South Pacific.

The "interior" of our cruising cat had two single bunks, a PortaPotty, a stove, and a small icebox, plus a bit of room for a couple of small duffles.

This boat would cruise at an easy 1.8 to twice windspeed in moderate conditions. If there were moderate whitecaps, we would average better than 20 knots.

Beowulf VI here in cruising trim, heading south in the 1974 Ensenada Race, during which she set a course record. She is sailing with the wind on the aft quarter, averaging 26 knots in 14 knots of wind. The reaching jib is being flown, since apparent wind is too far forward to carry lighter sails.

knots *Beowulf VI* was capable of doing in the open ocean (sea conditions permitting).

After the first half of our shakedown cruise in *Intermezzo*, I was ready to bring her back, sell her, and start on a 55-foot, high-performance multihull cruiser. This would be a boat with an interior similar to perhaps a 30-foot monohull, light on her feet, that would fly. Sailing downwind at 6 knots in 10 knots of wind aboard *Intermezzo* when I could have been moving at 14 or 15 in a high-performance cat was just too much to take.

On our way back we stopped off at Cedros Island, just off the Baja California coast. We were anchored off the northern end in a small open bight close to the beach. The seals and sea lions made inquisitive forays into our territory, and we exchanged pleasantries with some fishermen anchored to the north of us.

It was a clear night and the barometer was high — good conditions for a northeasterly gale to develop. When the barometer started moving up and the stars began to twinkle, I set an anchor watch. Then we saw the fishing boats head out to sea. An hour later, a swell from the northeast began to roll in. There was no doubt; a northeaster was about to hit. We hurriedly got the hook up and worked our way off what would soon become an extremely dangerous lee shore.

It wasn't long before 60-knot gusts of wind were blowing across the deck. I decided it was foolish to try to go uphill in these conditions, so we turned *Intermezzo* around and ran off before the storm toward Bahia Sur on the southern end of the island, where we would find shelter from the

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sea. By the time the sun was up, the true wind was steady in the 60s and *Intermezzo*, under her double-reefed main and storm staysail, was wildly surfing down the short seas that had built up.

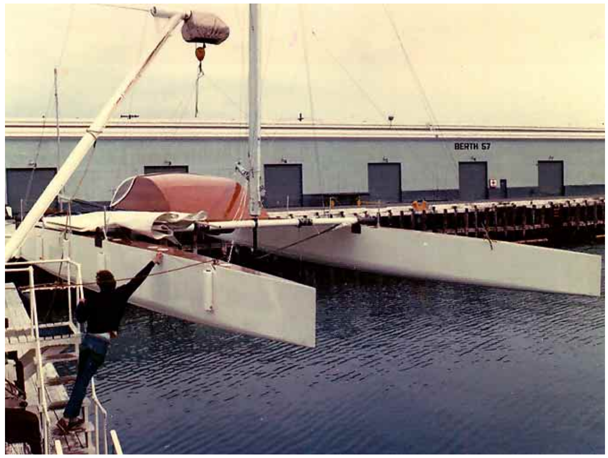
Nearing the southeast corner of the island I realized that the shape of the land would create a downslope condition to accelerate the wind, and that we'd get some pretty good gusts. We pulled the main down to the third reef, put both kids in the pilot berths below with their leeboards up, and put in and locked the companionway slides.

The main was jibed to port and we were ready to turn the corner. All during this procedure I'd been thinking how it would be to be out here in the new multihull now forming in my mind's eye. I figured we would be having one heck of a ride, but that it would be safe.

As I eased the helm up on *Intermezzo* and allowed her to come under the land, we could see the first gusts heading toward us. The water was absolutely white and spray was everywhere, although the sea was essentially calm in the lee. As the first gust hit *Intermezzo*, it heeled her down until her spreaders were in the water, and held her there. *Intermezzo*, of course, put her 7 tons of lead to work and came back; we continued on and were flattened once more before we were able to beat our way slowly into the protection of Bahia Sur. Had we been in a multihull I would have used the same tactics. Only we would have been capsized and blown out to sea 400 or 500 miles.

A week later we were beating up the coast toward Ensenada in the teeth of a northwesterly gale, common at that time of year. The crew was a bit under the weather, but, shortened down comfortably, *Intermezzo* was driving herself easily uphill. Occasionally a squall would bring gusts in the low 50s, and she would be momentarily overpowered. By this time I was worn out and had to let her fend for herself. I never could have done that in a multihull.

As a result of these two experiences we kept *Intermezzo*. I came to realize very quickly that in spite of all my previous experience in multihulls, if we were to go offshore in one I would have to stay continually alert and could not afford a mistake like turning the corner of Cedros Island.



Beowulf VI was a big step up from the open trampoline boats we sailed before. She was 39 feet (12 m) long and weighed just 2,140 pounds (970 kg) all up *in cruising trim*! She had a displacement-length ratio of 20 and could carry 10 square feet of sail for every square foot of wetted surface!

There are two ways to look at these photos. Isn't it wonderful that the boat didn't sink when it flipped? On the other hand, maybe it would be better to have a self-righting monohull design. I suspect this argument will rage for some time to come. There certainly are good arguments in each direction.

If you do consider a multihull, do so with your eyes wide open. This could happen to you (but then you could also sink in your monohull, too!).

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The Joe Quig–built *Hokulea* has spent years cruising the rigorous waters of the Hawaiian Islands. She's even had a passage down to French Polynesia. The very long hulls, high wing clearance, and small, light accommodations plan are the way to go if you want safety and performance in a multihull. (Why have one if you don't go fast?)

This 55-foot (16.9m) English cat, *Sonodora*, crossed the Indian Ocean at the same time as *Intermezzo*. In spite of the much faster theoretical speed of this powerful multihull, they were a week slower in total crossing time, and this was in strong broad-reaching conditions.

Actuarial Statistics

Four years later, sitting in beautiful Gran Baie on the island of Mauritius in the Indian Ocean, I was discussing just these experiences with Sally and John Wishovich on their Pivar trimaran *Windrose*. Sally had kept track of multihull disasters during the four years they had been cruising. It appeared that eight percent of the multihulls they were aware of had flipped or been reported missing during their journeys in the Pacific Basin. They thought it might be a leadmine for them the next time.

The gigantic offshore multihulls now making such incredible voyages back and forth across the Atlantic are wonderful speed machines and, for the most part, are obviously able to cope with the sea. If I had been born 15 years later there's no doubt I would be out there on one of them myself, scared to death but loving it just the same. But these animals do get into trouble, usually by being overpowered by heavy squalls or "rogue" waves. And sometimes, as in the recent singlehanded Atlantic race, they flip in moderate conditions when a slight change in true-wind velocity or direction, or an autopilot problem, catches them unawares. The men who go to sea in them are occasionally lost, and recognize the risks they are taking.

They Don't Sink

But there's another side to the story. Multihulls offer several real advantages. The first, of course, is that they are virtually unsinkable. And while I think that the chances of sinking are remote in a monohull if she has a collision bulkhead, good pumps, and keeps a reasonable lookout, it remains a factor to consider. Gerard Eaton, an old sailing buddy of mine from way back, told me years ago about an experience he'd had setting out in a trimaran from Puerto Vallarta for the Marquesas Islands. Several days out from the coast they spotted a school of killer whales. As the whales played around their 40-foot (12.3m) tri, Gerry and his friends tried to communicate by whistling. Apparently they hit the wrong note, because the next thing they knew one of their black-and-white "friends" had poked his head up through the main hull, leaving a gaping hole that rapidly filled with water. Supported by their amas (floats) until a patch could be made and the main hull bailed out, they returned promptly to Mexico somewhat the worse for the experience, but still floating. Had they been on a monohull they'd have taken to their life raft.

Another advantage is draft. The shallow draft inherent in the multihull concept has a major safety side to it. On average, one in 12 boats that spends more than two years in the Pacific Basin ends up on a reef, permanently. I know of three instances in which multihulls hit reefs and escaped with scratches. On each occasion a monohull would have been a total loss. While this is not usually a life-or-death situation, it's still a major factor to consider. Today, with the capability of 406MHz EPIRBs to bring rescue, the capsize issue is not as great a factor as a few years ago.

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Advantages

There are some advantages that I'll grant to a multihull. First is lack of heel. Yes, they do sail upright. Of course, with their high initial stability, motion is quick, but they get rid of that lean which monohull sailors have to accept.

Second, they have lots and lots of deck space. This is nice for spreading out, and if you are into solar panels or rain collection or even wind mills, you'll find them all easier on the multihull.

Performance

Speed? Those dreams of dashing here and there are hard to come by in the real world. I have seen only one cruising multihull of any size that was remotely capable of keeping up with *Intermezzo* on a passage-by-passage basis. This was the beautifully executed 42-foot (12.9m) cat *Ned Kelly,* whose Australian crew watched weight like hawks. But even her times were at best equal to ours, and usually a few miles a day less. The average multihull found cruising is slower on tradewind passages than a comparably sized monohull. Yes, they will have some exciting daysailing speeds to brag about, but loaded down with gear, sailing in a good sized sea, and prudently shortened down, the knots just aren't there.

Costs to Build

Now let's take a look beyond the basic points. Contrary to what some people say, multihulls are relatively expensive for the amount of interior room and payload they carry. If you're thinking about home building, they will take more time to build and require higher skills to be successfully completed than comparable home-built monohulls.

If you start out with a bucket of money and ask the question, how do I get the most payload carrying capacity, the best passaging speed, and the most interior space for those funds, the answer will be with a monohull.

In Heavy Weather

If after all these words of caution you are still hot for a multihull, there's one last thing you should do. Buy a copy of Adlard Coles's *Heavy Weather Sailing,* and study the photographs carefully. Then consider if you want to be out there in these sorts of conditions with your multihull. Keep in mind that 95 percent of the damage inflicted on cruising yachts comes from the sea, not the wind. You can deal with the wind by using small sails or cracking a sheet at a critical moment, but when the right sea catches you at the wrong angle, no amount of seamanship or alertness can prevent disaster in a multihull.

Cruising-Design Criteria

Multihulls, to take advantage of their design, must be light. There's really no way to keep a reasonable size multihull from getting too heavy when it's fitted out with all the gear you need for long-distance cruising, unless you're willing to put up with a totally spartan lifestyle. If you want performance, be sure that the vessels you are looking at have a total all-up weight including payload, that does not exceed a displacement-length ratio of 80.

Second, don't have more sail than can be safely handled with a beam-length ratio of 2 to 1. Increasing beam beyond this ratio adds weight to the boat at a very fast clip and makes you more subject to pitchpoling.

Next, make sure your rudders are strong, deep, and capable of handling your multihull at a speed-length ratio of at least 4 without ventilating. In a trimaran, the main hull should have a collision bulkhead as far forward as possible, with a watertight bulkhead just aft of that. The amas should be segmented into compartments so that a puncture in any one of them will not disable you with water. A catamaran should be bulkheaded the same way.

Your sheet loads and winch setup must be such that you can quickly cast off any sails if you start raising a hull. Provision must be made for access to your vessel if she is upside-down, so that food, water, and shelter will be available. If possible, the hulls should each have solid foam in their bottoms up to their load waterlines, so that if you're holed, the watertight section that is breached will not hold a significant volume of water.

Wing clearance is a major issue. There will always be conditions in which your wing or area between amas and main hull collide with sea tops. This is noisy and, over time, debilitating to the crew. You can reduce this by having more wing clearance. This, of course, adds weight, as the freeboard of the hulls must go up.

What is an acceptable wing clearance varies from person to person. There are no hard-and-fast rules of which we are aware.

Talk with experienced multihull sailors and see what they've found about slamming with their own boats, and then make up your own mind as to what you will tolerate.

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Finally, don't take chances with the hurricane season, try to avoid sailing in regions such as the Tasman Sea or off the bottom of Africa. *And always have a hand on the sheets.*

Capsize Preparations

And finally, make sure you have made preparations in advance for dealing with a capsize. This means access to the interior supplies, and a place to rest out of the weather, which is relatively dry. A thorough read of *Capsized* by James Nalepka and Steve Callahan (about spending four months on an overturned trimaran) will help with your planning.

Here's one of John's 47s at play off Maui in the Hawaiian islands. An indicator that these boats have some seakeeping ability is the fact that the Hawaiian boats have been U.S. Coast Guard–certified to carry passengers. They're regularly sailed at 20 knots with a deck load of guests in the brisk trades. (Jeri Conser photo)

CONSER CATAMARANS

John Conser has been playing with catamarans almost as long as I have. His first was an interesting amalgam of two surfboards and an Aquacat rig (over three decades ago). We've raced against and with each other in many venues.

While John was playing with cats he was also developing a successful sail loft in Southern California. When we started building lead mines (monomarans), John was a natural choice to work with in the development of full-battened rigs.

While I decided against multihulls for cruising, John has swung both ways (he's a little kinky that way). With thousands and thousands of sea miles, in all sorts of weather, in everything from heavy CCA-type lead mines, to the very hottest ULDB sleds, and lots of offshore multihull experience, if anyone is qualified to build this type of boat, John would be the guy.

He has sailed both the Atlantic and Pacific on cats, including a record passage to Hawaii, and spent the better part of the day in a survival suit in the North Atlantic, wondering if he'd see another sunrise (sitting on the hull of a cat that had slit her leeward hull).

After a series of smaller designs that saw commercial success before multihulls were in vogue, John's latest offering is of interest.

Conser 47

The Conser 47 looks to me the way a cruising cat ought to appear — nice long waterline, moderate beam, with reasonable although not excessive accommodations. And check out the rig — a fully rotating carbon-fiber wing mast.

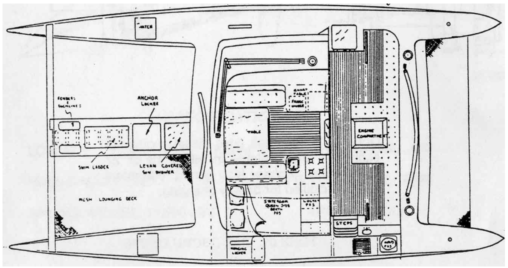
With a waterline of 45 feet (13.8 m) and a displacement in light trim of 12,000 pounds (5,440 kg), this cruising cat has a displacement-length ratio of 58. Combine this with the wing mast, and the initial stability of the 24-foot (7.4m) beam, and you can see where the speed comes from. Wing clearance in cruising trim is 32 inches (812 mm), which is enough to keep the wing from pounding in moderate conditions.

Power is offered with outboard or inboard propulsion. With a 50-horsepower four-stroke outboard the boat cruises at 10 knots (and a very comfortable 8 knots at 1.5 gallons (5.8 liters) per hour).

This boat will cruise in the high teens and low 20s in moderate trades (say, force 5 or above) as long as you are paying attention to the trim.

LAVARANOS CATS

It is not often that you find a designer who swings both ways, doing mono- and multihulls, but Angelo Lavaranos does just that. Since his boats have been influenced by the "cruising" conditions to be found off the South African coast, we thought one of his multihulls would be worth a look. I asked Angelo to comment on the background behind this design.



The standard layout for the Conser 47 has the saloon and galley on the bridge deck, with staterooms and heads in the hulls. Quite a bit of space is leftover fore-and-aft of the accommodations on the wing, compared to a lot of production cats. That is how to save weight, as well as how to get the boat to sail well. And after all, if it doesn't sail well, what's the point of having a multihull?(The layout shown would work quite well for a couple with occasional guests.)

Feel ambitious? John has a kit-boat package that allows you to save between a quarter and a third of the total cost, in trade for a year of devoted weekends, nights, and holidays. If your devotion wanes, figure a year and-a-half. (Jeri Conser photo)

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Via E-mail (the computer revolution has done wonders for us in the publishing mode!) from his new base in Auckland, New Zealand, Angelo says, "I have personally put in many miles (including the 1993 Cape-to-Rio Race) on an earlier design (1986) of mine, the St. Francis 43, of which 25 are built, and which has been a very successful boat. They have sailed all over the place — there is even one here at Gulf Harbour at Whangaoroa, New Zealand — and have been very popular chartering in the Caribbean."

Angelo goes on, "Modern catamarans have come a long way. On the Rio race we had six days of no wind and six days of light winds, yet we did it in 20 days and easily managed 200-plus miles a day in the proper trades. That's as good as old *Intermezzo II*! We finished second in the St. Francis class (by an hour) and among the 50-foot (15.4m) cruiser-racers."

"We had all our meals spread out on the saloon or cockpit table — glasses, pickle jars, etc., no problem. Agreed, the performance profile is more varied than a mono, and overall performances similar. Downwind they are pretty average. With the shallow stub keels they are equivalent upwind velocity-made-good to an equivalent modern mono-cruiser. Reaching, they are pure vanilla and duck soup! What else do you want for cruising?

"Sit there like driving a car, with the asymmetrical chute up and 26 knots across the deck and the clock never less than 12 — with 14 and 16 often down the waves. All with four ensuite doubles, 360-degree visibility, inside/outside living saloon cockpit area, shallow draft, excellent low-altitude motion, no slamming upwind, nonsinkability. Also they don't often capsize these days. In bad weather upwind, you need to shut up shop sooner than a mono, either because you are ramping off the waves too fast or because you have reduced sail to avoid aforesaid ramping and are no longer making progress! I think a lot of multihulls are poor performers because they are overweight due to over-equipping or cheap construction. Then they can't accelerate when cracking off (hence no velocity made good) and are underpowered at all windspeeds.

"With decent beam (and a decent rig to match!) and careful construction they definitely are a great way to go and deserve a place in the sun! A lot are too voluminous and greedy and nothing better than medium-speed houseboats. While I would not especially choose one to go round Cape Horn, they are an excellent tradewind cruiser. With a good para-anchor and sea room, they are as safe as anything else in the terminal stuff.

"According to the builder of the St. Francis (who has deliveries all the time up and down the South African coast), she surfs big-breaking waves just as easily sideways or backwards when hove-to trailing nothing."

Admiral 47

The catamaran which Angelo has sent us for this section has been sailing now for a couple of years. The first of these designs sailed up the Indian Ocean to the Seychelles and Comoro Islands from Durban. Two of the boats did the Cape Town–to–Rio race and one of these returned to Cape Town via the Southern Ocean and Tristan da Cunia — rugged sailing, indeed!

The rig is stayed in small catamaran fashion with swept spreader angles, so no standing backstays or runners are required. With triple-diamond stays on the spar, it is self-supporting in column.

Twin 20kW sail drive motors provide the power.

The wing section is held back from the bow as it is in the Conser 47 which reduces the slamming that is so prevalent in a lot of cruising cats.

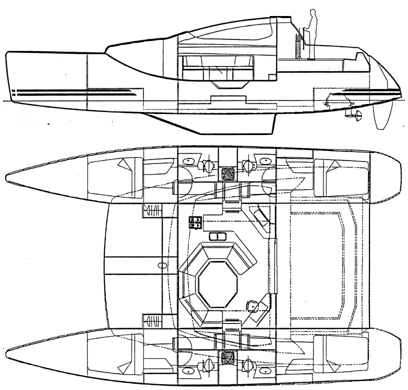
Angelo has shaped the hulls so that the longitudinal center of buoyancy is somewhat forward from the norm. This means that as you add cruising payload, rather than trim down by the bow (as so many multihulls do), this design will stay on her lines.

Beam is 27.5 feet (8.5 m), while draft is just 4.25 feet (1.3 m). There are twin shallow keels (which are used for tankage). These provide enough lift "provided the boat is kept footing while on a beat," according to Angelo.

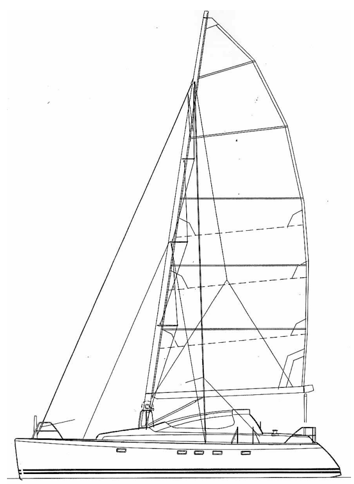
I like the looks of this boat. She has a clean, no-nonsense way about her. The rig is conservative, and the wide beam is certainly going to keep her upright with side wind and wave loading. Given the Southern Ocean pedigree, she certainly must be considered seaworthy, in multihull terms.

How could you not like the looks of this catamaran? She's got that low-windage "Eurostyle" which fits form and function together so nicely. Check out the twin swim steps and moderate size of the cockpit area. (Angelo Lavaranos photo)

The Admiral 47 at play, and moving right along. She is 46.5 feet (14.3 m) long and weighs 23,000 pounds (10,500 kg), for a displacement ratio of 100. (Angelo Lavaranos photo.)



This profile and plan view offers a good idea of the interior layout. There is definitely some space to live in on this design. Four double cabins with heads ensuite are in the hulls. The saloon and galley are on the bridgedeck for best ventilation and visibility.



This is very much a dinghy-like rig. The swept-diamond stays will keep the mast in column, while the widely spaced cap shrouds keep the headstay tight without runners. The highly raked spar will move the reefed center of effort forward, easing steering chores when the boat is pressed. There are also some theoretical aerodynamic advantages. Besides, it looks good.

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THE TRIMARAN QUESTION

In the olden days, when we sailed cats, there was quite a debate between trimaran aficionados and catamaran fans. In a racing context, the issue was quickly settled in favor of the cat. Today the performance issue is much more clouded. The French maxi-tris are formidable machines of unparalleled power upwind and reaching. It appears the big cats still have a bit of an edge downwind.

But in a cruising context — in the production-multihull business anyway — the cat is king. This is probably due as much to the higher cost of producing a tri as anything else.

However, when you start hitting the remote anchorages you will see quite a few cruising trimarans, most of which have been home-built to Piver, Cross, and Jim Brown designs.

Many of these boats have long ocean-cruising histories behind them. And some of them have been through the cruising wars, so to speak.

Our friends, the Sandstroms, on their 40-foot (12.3m) Brown-designed tri *Andural*, for instance, found the Wallis Islands the hard way, by running into the fringing reef. They bounced over the edge and sat, just out of reach of the breaking sea. As the tide came up, they made their way into the lagoon, minus most of their rudder. Still in one piece, they eventually completed their circumnavigation via the Suez Canal. After a hiatus ashore, they went out and did a second circumnavigation.

In spite of my misgivings, both of these completed their circumnavigations. The Piver design on the right was one of the real pioneers, while the Jim Brown design on the left represents the second generation. A lot of both types are cruising right now.

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