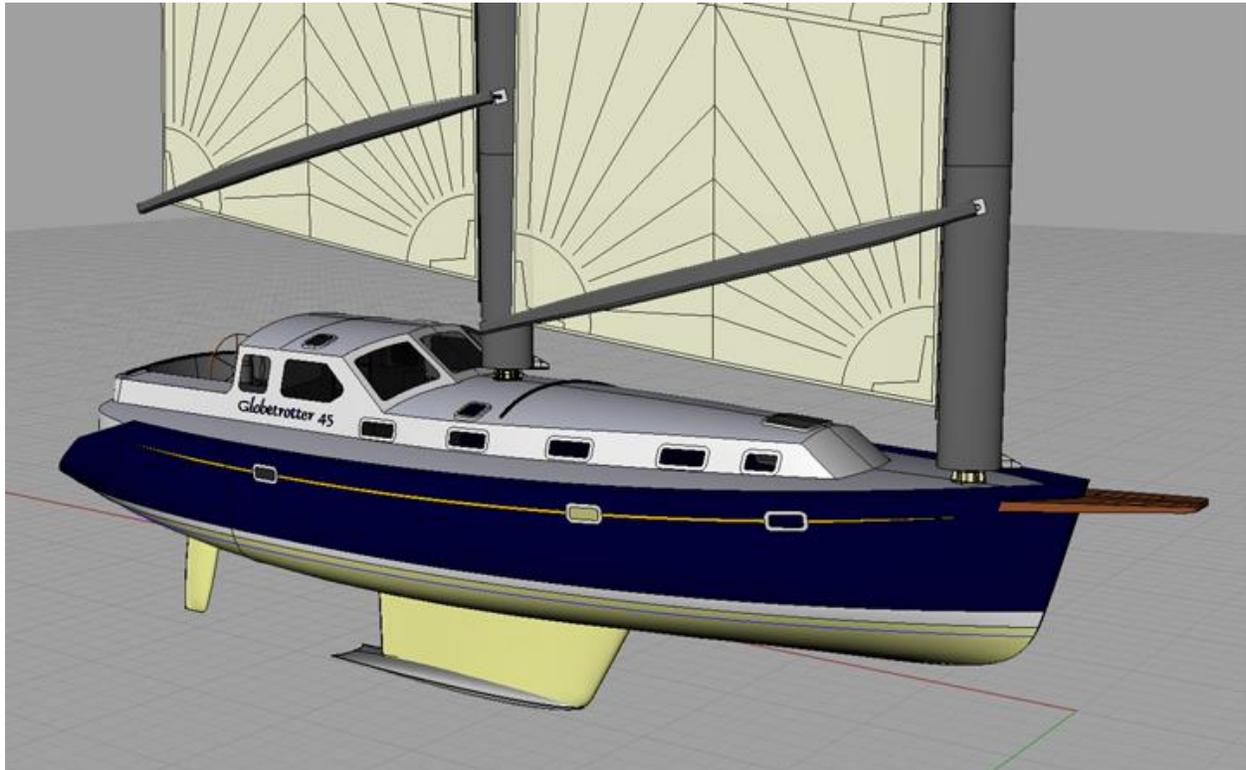


How to Commission a Yacht Design and Have It Built.

The following article describes how you can commission a yacht to be designed and built. It is a long article, and you may not want to read it at your computer in one sitting (or maybe you do!) Feel free to print this article so that you can read it anywhere at your leisure.



The Globetrotter 45 by Eric W. Sponberg.

Creating a brand new yacht design is a unique adventure and a very soul-satisfying experience. There is nothing quite like conceiving a yacht design, working out details and poring over the drawings with the naval architect, reviewing construction bids, making decisions, watching the boat materialize before your eyes, and finally seeing it slip into the water for the first time. After successful sea trials, you cast off the mooring lines and sail off into the sunset—or sunrise, if you prefer. The process is straightforward and passes through six elementary stages:

- Concept of the Yacht
- Preliminary Design
- Building Quotes
- Final Design
- Yacht Construction
- Proof of Concept: Launching, Sea Trials, and Delivery

An adventure is always easier and more enjoyable if you know where you are going. As your guide for the moment, and hopefully someday, as your naval architect, I can offer you the benefit of my 30+ years of experience on taking this trip. Along the way, I will point out common

pitfalls so you can avoid the costly mistakes to which other travelers, less prepared, have succumbed.

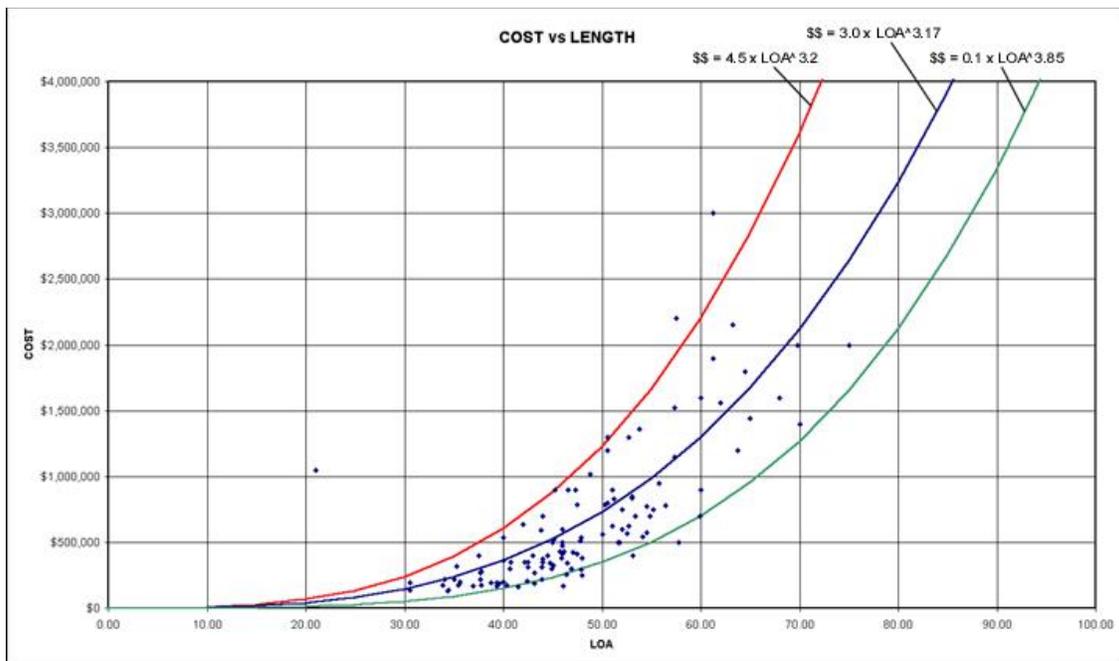
Concept of the Yacht

Most yacht designs begin with a phone call to the naval architect: “My name is _____, and I would like to build a boat.” You know a few things about the boat already: whether it’s power or sail, its overall length, and maybe the material in which it will be built. You know what you want to do with the boat, perhaps cruise around the world, or just live aboard. You have probably looked over the entire production boat market and at innumerable used boats, but you just haven’t found that certain *je ne sais quoi* that defines *your boat*. Finally, you have a realistic budget that measures up to your dreams.

The Cost of Boats. Let’s tackle the budget right off the bat, because it’s no good talking details if you can’t afford the yacht in the first place. Boats are expensive, plain and simple. When people don’t have the money for a new custom yacht, they often look for an angle: “I’ll build it myself,” or, “We’ll build in Timbuktu where labor is cheap,” or, “We’ll go to Asia where the exchange rate is so favorable.” Stop right there.

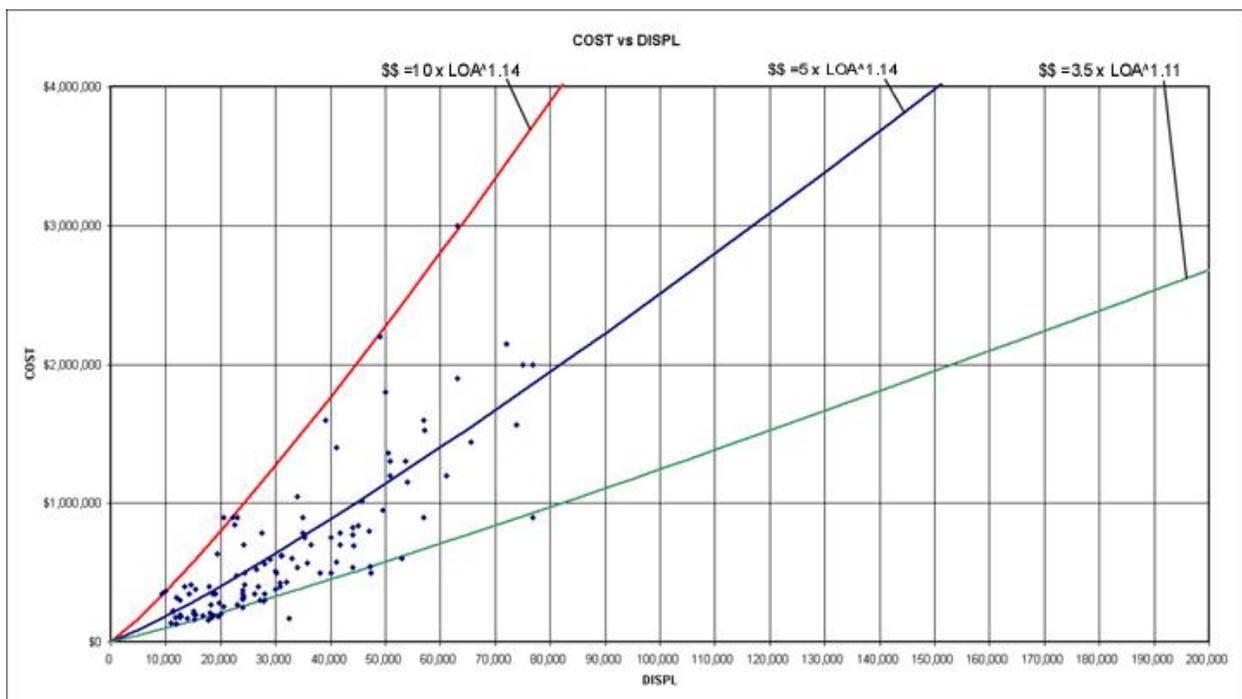
There is no free lunch. Whatever you end up saving in one way you will only spend ten times over another way. You need a realistic budget with about a 25-30% buffer factor, and the closer you can build to home, either to yourself or your naval architect, the better. More on that later.

How much do boats cost? In larger sizes, say, over 40’, custom boats are not that much more expensive than production boats. I have been tracking the prices of custom and production sailing yachts over the last five years as published in magazines like *Ocean Navigator*, *Blue Water Sailing*, *Cruising World*, and *Sail*, and have tabulated and plotted them in a spreadsheet. Interestingly, purchase price follows pretty simple exponential functions of length or displacement, with length being a better determinant. See the figures below.



Each graph shows a scatter plot of the data (over 150 yachts) and three curves. On the first chart, Cost vs. Length, the blue curve goes through the center of the data points, so it is the trend line of the data. The equation for this line is shown in the upper right. Knowing the length of the boat you want, enter it into the chart on the baseline, go directly up to the blue trend line, and read off the cost on the ordinate to the left. Or you can use the equation. That's how much your boat should cost on average, according to new yacht prices over the last five years.

Of course, there is scatter above and below the trend line. The red line represents the upper boundary of Cost vs. Length, and the green line represents the lower boundary. The cost of your boat should fall somewhere between the red and green lines. Again, the equations for the lines are shown. As you might expect, as length increases, yachts become more complex and cost can vary widely.



A similar trend is present in Cost vs. Displacement, but the scatter is wider. The equation for the trend line is almost purely linear. Because of the wide scatter, displacement is not as reliable a determinant as length. This is because it is oftentimes more expensive to build a lighter boat than a heavy one—more engineering and higher quality construction are involved in building lightweight boats.

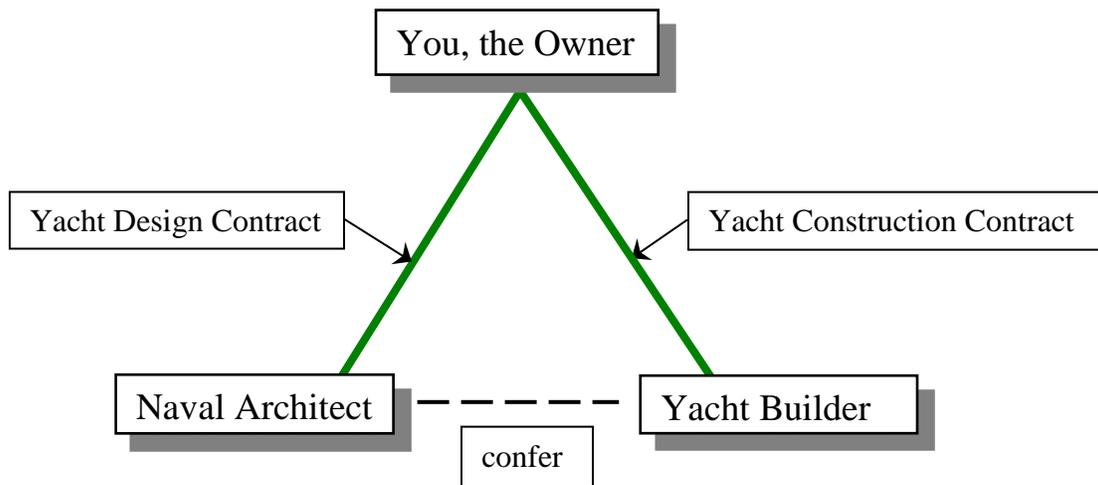
Quality, Time and Price. These are three factors that govern the cost of any yacht. The general rule is: pick any two. If you want a high-quality boat at a low price, then it is going to take extra time—a fill-in job for the builder who has a low priority for getting it finished. If you want a high-quality yacht in a set time, then the price will be higher—the better, higher-paid workers will be on the project, perhaps with some overtime, and higher-quality materials and equipment will be used. If you want the boat at a low price and on time, then quality decreases.

The Phone Call. OK, so you have a concept for your boat, and you have the money—what do you do? You call me, of course, and we'll discuss the general size and layout of your boat, how

and where it could be built, and all the design details you want included. You may have a list of required equipment, and perhaps photos or advertisements of boats that come close to your ideal. Anything you can provide by way of photographs, advertisements, articles, notes, drawings, and sketches will be helpful.

The Yacht Design Contract. The naval architect will review all your information and get back to you with a price for the yacht design. In general, the cost for the design will be somewhere between 7% and 10% of the cost to build the yacht, but that is not how you pay for the design. At Sponberg Yacht Design Inc., and at most yacht design offices, yacht designs are paid for in a series of progress payments before construction of the boat begins. Your contract with the naval architect is separate and independent of your construction contract with the yacht builder.

Your contractual relationship with your naval architect and your yacht builder can be represented by the Greek letter Lambda, “ Λ ”, as shown below:



You control the process because it is your money. You develop the yacht design first with the naval architect, and together you seek bids from various builders. When the builder is selected, you sign a separate contract with him; the naval architect usually has no direct link in that contract. But the naval architect has to confer regularly with the builder, so there is an avenue of communication there—the builder obviously needs the naval architect’s drawings and specifications, and the naval architect should monitor the construction to ensure the boat is built according to the owner’s intentions.

The naval architect works for the owner during the construction of the yacht. Usually, the cost for monitoring construction is in addition to developing the design itself, and this service can be specified in the yacht design contract. It can also be handled by another party such as a project manager or marine surveyor of your choosing. But the naval architect should still be allowed, and be paid, to at least inspect the yacht at certain milestones. Designing and building a yacht is a complex and fluid process, and having the naval architect on site to confer with the builder can resolve questions, generate improvements, and catch mistakes that may have crept in. This will more than pay for itself in eliminating headaches and extra costs in the long run.

At SYDI, our Yacht Design Contract is a fairly short document, about 4 pages long. It specifies the scope of the design, the cost, and payment schedule, and the documents the naval architect will provide. The owner pays the design fee as certain tasks and/or drawings are completed. There is a clause that covers on-site inspections, as mentioned above. There are also boilerplate clauses that specify how the contract may be modified, the governing law authority (the state in which the naval architect practices), and enforceability—pretty straightforward stuff.

There are also three very important clauses that are worth describing individually:

- Building and Marketing Rights
- Designer Design Rights
- Liability of the Designer

Building and Marketing Rights. As the owner of a custom yacht, you buy the rights to build one boat to the naval architect's design. If you are a yacht builder client, you obtain the exclusive rights to build and market more than one yacht to the design. Neither the owner of a custom yacht nor a yacht builder client owns the design itself; it belongs to the naval architect. That is covered in the next clause.

Designer Design Rights. The naval architect owns the design and its worldwide copyright. This is the same as the author of a book owning the book's manuscript and copyright. The creator of the art owns the art. If a client wishes to produce more copies of the same yacht design, then a royalty is due to the naval architect, usually 1.5% of the price of the yacht. This is paid as each successive yacht is contracted for beginning with the second yacht. If a client wants to obtain ownership of the design, as has been done from time to time, then that costs a little more money, either by fee up front or by a higher royalty rate.

Liability of the Designer. Any new boat design, by its nature, is very much experimental, and its performance, therefore, is impossible to guarantee. A boat floats and moves at the interface between two mediums—air and water—a very complicated place to be where a lot of things can happen that are beyond human control. As sophisticated as we are in our knowledge of boat design, we cannot guarantee a new boat's exact performance unless one of the same design has been built before.

In addition, naval architects do not have access to “Errors and Omissions” (E&O) insurance, otherwise known as “Professional Liability” (PL) insurance; coverage simply does not exist. This is because when boats sink and disappear, there is no evidence an insurance company can use to defend its clients.

Finally, the construction of the boat depends very much on the builder's expertise and how well he interprets the naval architect's design. Beyond blatant stupidity and obvious negligence, naval architects cannot be held liable for most design deficiencies related to the boat's quality, strength, stiffness, durability, and seaworthiness. About the only thing you can hold the naval architect liable for is if he does not create the design documents according to the agreement—that is, if he does not do his job. Naval architects may be able to refund the design fee, but we cannot repay the cost of the yacht itself. There is just no way that we can cover that.

So you and the naval architect come to terms of a yacht design agreement, and the process begins.

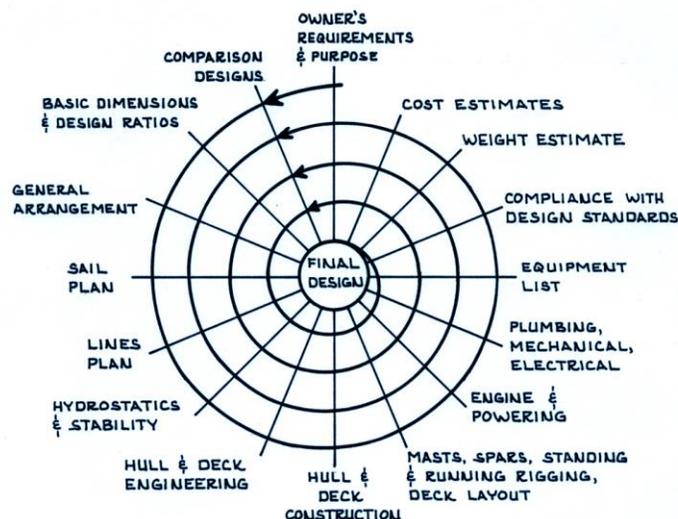
Preliminary Design

The purpose of the preliminary design is to prove the viability of your concept of the yacht—we'll find out if it will actually work. It is a fun and intense process and to my mind the most pleasurable part of yacht design. All of the ideas and the major construction details are wrapped up in the envelope of the boat, and of course the design will be beautiful!

I like to work with 2-dimensional drawings to lay out the concept. It brings the appearance of the boat to light in the quickest way. I advise you on the naval architectural and construction aspects, and you offer your approval or comments and changes. We talk in person or by phone, fax and email. We solidify the construction and equipment specifications, and we may begin a 3-dimensional model of the hull in order to get a first pass on hydrostatics (still water properties) and stability. We'll also make a first estimate at speed and power requirements. We have to know the size of the engine and propeller to allow sufficient room for them. We also start the weight estimate so we know if the boat, as conceived, will float at the intended waterline. We take into account other sizeable weights in the boat such as tankage, the rig, and ballast, as they all affect flotation, center of gravity location, and stability.

This is known as going around the design spiral. At each spoke in the spiral, a little bit of information is created, details drawn, engineering calculations done. As the details are filled in, areas already addressed get revised and the design is updated. Work proceeds around the design spiral until the design is finished.

The Design Spiral



The preliminary design will most likely be composed of a few 2-D drawings and a written specification for construction and outfit with some supporting documents like the weight estimate and a stability curve. There might be a speed-and-power prediction with supporting

calculations. We might include some of your original sketches, photos, or clipped ads with comments: “Build the interior like this.” The goal of the preliminary design is to create enough information for builders to offer a preliminary quote. We present our best estimates of weights, surface areas, major structural details, items of equipment, and level of finish so that the builders can provide a reasonably detailed quote for construction. These will not be hard and fast prices, merely estimates. A contractual price is determined when a builder receives and reviews the final design documents. Which leads us to the next step along the adventure:

Building Quotes

This is another fun part of the yacht design process. The preliminary design is done, and the yacht is already real in your mind. What governs your choice of yacht builder? In my experience, there are two primary considerations: the quality of the workmanship and reputation of the builder in the style and type of yacht at hand, and the builder’s proximity to either you or the naval architect.

Builder’s workmanship and reputation. You’re probably already aware of builders’ reputations. You may have been attracted to the quality of their workmanship that you’ve read about in the press and seen at the boat shows. The naval architect will also have valuable input based on his experiences. You should ask the builder for references, past customers for whom they have built boats. All builders will be happy to supply these, and you are encouraged to call these owners and seek their advice.

The fun part of the Building Quotes process is that you and your naval architect should go visit each yard from which you are requesting a bid. You get to meet new and interesting people, wander through boatyards, talk boats all day long, and have a nice meal with a bit of local wine at the end of the day. This also gives you an opportunity to visit first-hand with the people you will be “married” to for a year or so. Boatbuilding is all personalities, an indefinable element. Something just has to click between you, the builder, and your naval architect that says, “This is where I want to build my boat.”

Builder’s proximity. Assuming you live in the United States, there are perfectly good yacht builders in Europe, South Africa, The Far East, Australia, New Zealand—all around the world. If you happen to travel to any particular region regularly for other reasons, and you know the people there, then it might make sense to consider builders in those locations. You can keep an eye on construction at a cost that is within your budget. But if you have never been in the faraway place and don’t know the language or the people, your yacht building project faces real obstacles.

Why is this? Yacht building requires constant attention to details. Either you have to be there all the time, or your representative—the naval architect or a project manager—has to be on site to watch the project very closely. Thousands of decisions have to be made, and without oversight, the simplest, tiniest things can grow into big headaches. Remember, it is your money. The logistics and costs to monitor construction close to home are so much less that you mitigate any extra costs by a tremendous amount. Your chances of getting a superbly built yacht increase many times over. That is the best advice that I can ever give—build close to home.

The potential builders will review the preliminary design package and come back to you with tentative prices. You'll review them with the naval architect, consider all the pros and cons of each bid, and decide on the best builder for your yacht. At that point, the naval architect can tailor the design to that builder's preferred methods of construction. Anything the naval architect can do to make the builder's job simpler will result in fewer surprises, fewer cost changes, fewer mistakes, and a lower, more reliable price for you.

Final Design

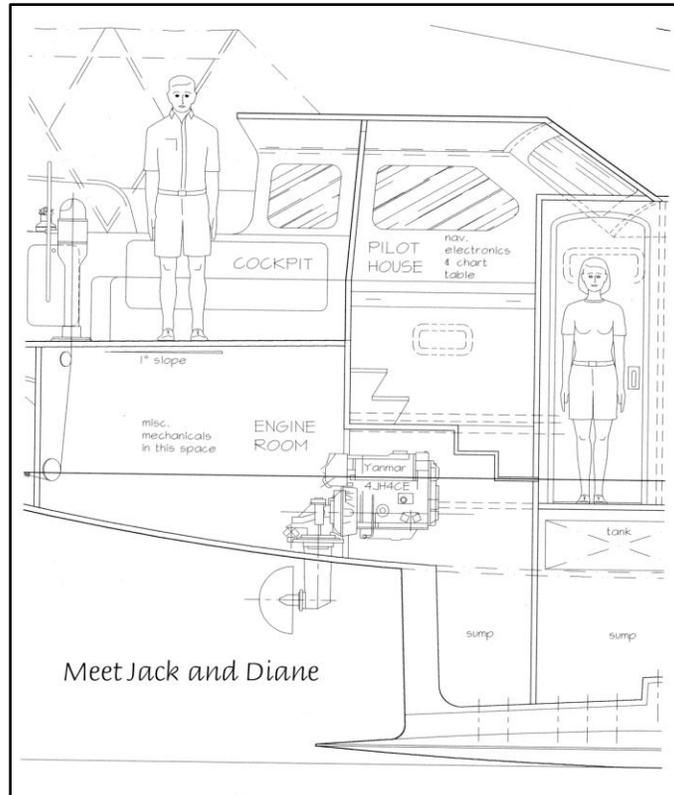
Now the bulk of the design work begins, and the naval architect simply cranks out the exact details the builder needs. This will be in the form of finished 2-D drawings that cover all the major aspects of the yacht. The builder will fill in the rest from the written construction specifications and your equipment list. You will make further decisions about design and construction as we go along so that the builder has your approved details when he produces his final contractual quote.

3-D modeling and 2-D Architectural Drawings. The overall envelope of the yacht design is created in 3-D in what is called a surface model. It is a 3-dimensional mathematical definition of all the exterior surfaces of the yacht, and maybe some interior structures as well. From this 3-D surface model we take "cuts" or slices through it to obtain traces of the cut edges of the hull and deck. These cuts are used to create architectural 2-D drawings with construction notes and dimensions that the craftsmen use on the shop floor to build your yacht.

The level of detail created depends on the builder. Some builders want a minimal number of drawings, but most builders appreciate as much information as you can give them. On smaller yachts, plumbing and electrical drawings are left up to the builder, if he needs them. On larger yachts, we will likely do plumbing schematics here and hire a marine electrical engineer to produce the basic electrical drawings. These are usually limited to the primary AC and DC wiring and panels. Electrical distribution details are usually worked out during construction by the owner, naval architect, and builder.

For composite and wood-epoxy yachts, we do all the engineering and drawing detail here at Sponberg Yacht Design. We are expert enough in these materials to engineer and detail the laminate schedules and convey them to the builder through the drawings.

We refine the details on the general arrangement plans and produce inboard profiles and joiner cross-sections, all of which you review with care. They are laid out, taking into account the room needed behind the scenes to fit all the structure, tankage, ballast, house services, etc. We show architectural models of adult human figures (whom we call Jack and Diane here in the office) on the drawings so that you can gauge the fit and room within the yacht. Additional details are created for the keel, rudder, rig, deck layout, and anything else that may require specialized drawings.



3-D Structural Modeling. On larger yacht designs, say over 60' long, and particularly for yachts made of steel or aluminum, it's advantageous to create all of the yacht's internal structure in 3-D. This is a very large and complex computer model which includes every last piece of structure in the yacht right down to the tiniest bracket. This model is then "exploded" onto computer images of metal plates of varying thicknesses, according to the requirements of the design, and the individual parts are nested together for the highest utilization of each and every plate. The nesting is adjusted by hand by the draftsmen, each part is numbered and given reference marks, and then the cutting path is defined for the plate cutting machine to cut out the parts.

All these data are then transferred to a cutting tape that will ultimately be fed into the metal supplier's plate cutting machine. The plates are inserted into the machine, the parts are cut out, and all the metal, including the waste parts, are loaded onto a flatbed trailer and shipped to the builder. An entire yacht can be cut in just a few days.

Also from this cutting file are generated complete assembly and subassembly drawings and a complete spreadsheet weight and center of gravity tabulation. The hull and deck structures become the most highly detailed and accurate parts of the yacht design. It is really quite remarkable.

At Sponberg Yacht Design, we don't have the permanent staff to create the 3-D structural models, so when necessary, we hire it out to another naval architectural firm. The computer programs that are required for this service cost tens of thousands of dollars and require specialized talent to operate them. It is not cost-effective for us to maintain that kind of service for the few large metal yacht designs that we do, and it is not in my interest to specialize in that

kind of work. The cost for this service is passed through to the owner, and we will have an idea of this cost in the Preliminary Design process.

3-D Architectural Renderings. I am sure you have seen many examples of 3-D architectural renderings in yachting magazines. We can do some of that here, but more detailed renderings are subcontracted to artists who specialize in that sort of work. Some yacht design projects are big enough that the owner can absorb the cost for such renderings. You can expect a good 3-D model, from which you can derive a number of images, to cost between \$5,000 and \$10,000 at a minimum, and more, of course, the larger the yacht gets.

Yacht Construction

As the final design nears completion, the owner and naval architect return to the builder of choice and present the contract drawings and specifications on which a price can be made. The builder presents the construction contract, which will detail the responsibilities and rights of the owner and the builder to build the yacht according to the drawings and specifications. The total cost of the yacht is usually broken down into milestone payments beginning with a deposit on signing the contract and ending with successful completion of sea trials.

During construction, you are free to come and go, being courteous to notify the builder of every visit. You should have the naval architect and/or a project manager or marine surveyor visit the yacht at various stages to make sure the construction is proceeding according to accepted boatbuilding standards and to answer questions about details.

This is another really fun part of the process because now the boat is literally coming to life. Each boat is unique and the process slightly different each time. This is your moment, and it is meant to be enjoyed.

Proof of Concept: Launching, Sea Trials, and Delivery

Finally, the day comes when your yacht is launched. Most builders have a big party for the entire work crew, and this is usually paid for by the owner. It is a time of celebration for a job well done. Speeches are made, the bottle of champagne is broken against the bow, and the yacht is lowered into the water for the first time. The naval architect usually has sweaty palms because the boat should float on the predicted waterline. If he, the builder, and the owner have done their homework right, it will.

A good yacht builder will then take a week or two or maybe longer to finish minor details and make sure all the systems on the yacht are operational. He may take the yacht out for a trial run or two in what are called Builder's Trials. This gives him a chance to correct any mistakes and follow up on details before presenting the yacht to you.

Finally, the yacht will be ready for official sea trials. You, the naval architect, and your project manager or marine surveyor should be present to assess the quality of the yacht and its operational capabilities. You'll need a complete marine survey for insurance coverage. On smaller yachts, the sea trials are fairly informal. On a sailing yacht, we'll put up all the sails and test her on different tacks. The engine will be run up to full speed, and maneuvers are done to assess the handling of the yacht under power. For a motoryacht, different cruising and full-speed

maneuvers are done, including crash stops ahead and astern. Safety systems are addressed such as sounding alarms and emergency shut-downs, if provided. You should drop and raise the anchors. If a dinghy is provided on davits, the dinghy should be raised and lowered. Computer and navigation systems, if provided, should be fully operational.

You should participate directly in the sea trials handling the controls so that you can see how the boat works. An attentive owner will have studied the necessary equipment manuals ahead of time and maybe even have received hands-on training from the technicians who provided or installed the equipment. In the end, you will likely take some weeks to get used to the new yacht before you feel totally comfortable with it. This is only natural, like buying a new house, a new car, or bringing home a new baby.

When you are ready to accept your new yacht, you will write the last check to the builder and he'll help you cast off your lines. From here, the continuing adventure is of your own making....

Bon Voyage!

Eric W. Sponberg
Naval Architect (retired)

P.S. Send postcards!