46' Ocean Cruiser Catamaran

Antrim Associates, Naval Architects

Design #67B

Preliminary Design Concepts

General Concept

A catamaran for people who intend to travel the oceans and wish to enjoy the voyage as much as the destination. The ideal cruising sailboat. Priorities include:

- Safety
- Ease of handling
- Comfortable motion
- Capable of high speed passages
- A pleasure to sail
- Ease of maintenance
- Moderate cost
- Attractive aesthetics

It is expected that the boat typically would be sailed by a couple with occasional guests. A single person on watch should be sufficient for normal sail handling. Interior accommodation will include a comfortable master stateroom and a double / twin single berth guest stateroom. Additional single berths may be available for extra guests.

The effort required to sail a boat is proportional to its displacement. Displacement directly affects the load on sails and hardware. Big boats are not harder to sail. Heavy boats are harder to sail. A longer boat of equivalent displacement is more easily driven, therefore capable of greater speed with the same rig configuration. The longer boat has greatly increased safety margin because its footprint on the water is larger relative to the overturning power of the rig. Furthermore a longer boat has a much more comfortable motion at sea.

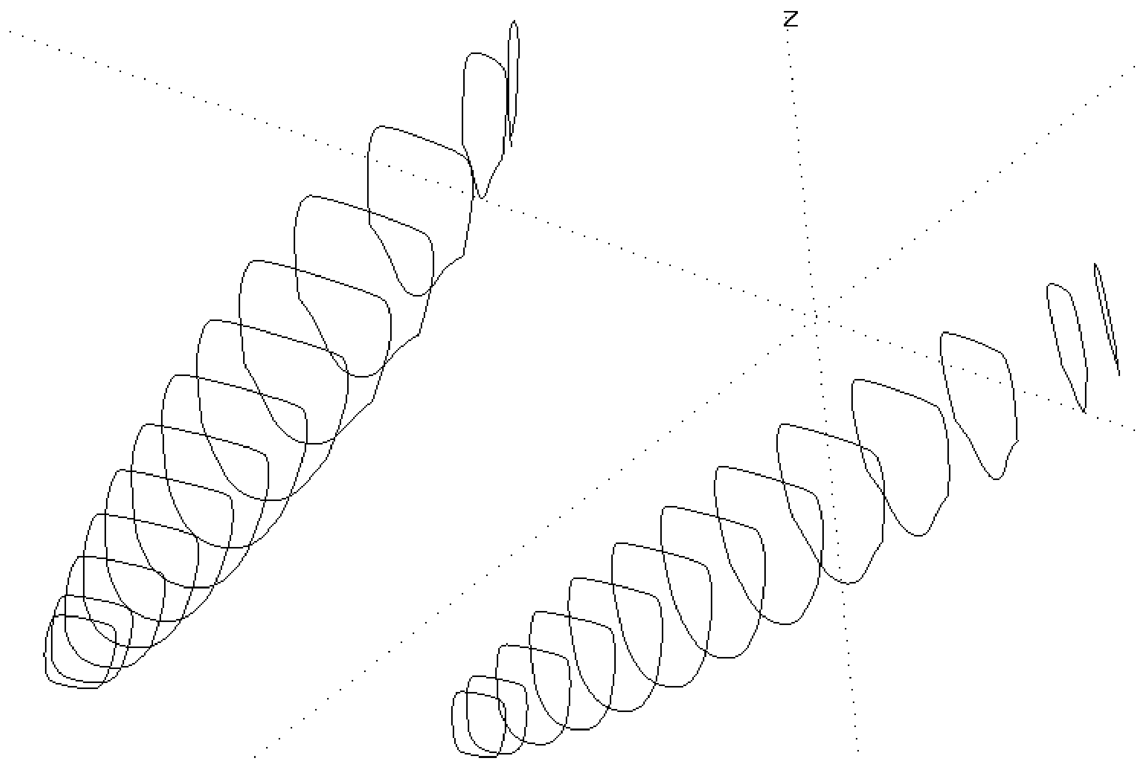
The concept behind this design is to retain the layout, displacement, and sail plan of a somewhat smaller catamaran, say a typical 40 to 42 foot boat, and stretch the hull length to 46 feet. This 10 - 15% increase in sailing length will greatly improve safety, comfort, and the joy of sailing. Increased waterplane will tolerate higher payload without being overburdened. The extra length will be used to increase room rather than material. More space, less stuff. More space means a less confining interior, easier maintenance, less cluttered stowage. Moreover, increasing length in this way should not substantially increase cost. Material is expensive. Space is free.

Preliminary Specifications

Length Overall	46'	Mainsail	780 sq.ft.
Length Waterline	42'	Jib	250 "
Beam Overall	27.75'	Reacher	575 "
Beam Hull	5.75'	Spinnaker	1750 "
Beam Waterline	4.0'	Mast height	57'
Draft (board down)	7.25'	Mast height off WL	63.2'
Draft (board raised)	3.25'	Displacement Light	10,750 lb.
Draft hull	1.54'	Displacement Typ load	14,500 lb.
Water Clearance (Typ)	2.75'	Displacement Max load	18,000 lb.

Hull Shape

Stated with a bit of oversimplification, the hull below the waterline is designed for low drag; it is rather narrow. The hull above waterline is designed for reserve buoyancy and maximizing useful interior space; it is rather wide.



All catamarans tend to depress the leeward bow when being sailed hard. This is the natural result of the driving force of the sails being centered high above the waterline. Limit of safety is determined by the amount of *reserve* buoyancy in the bows. Reserve buoyancy is the volume that is picked up when the bow is depressed. A fine bow cuts easily through the waves but is prone to burying off the wind, increasing the risk of pitchpole. Reserve buoyancy is not the amount of boat in the water at rest. This static buoyancy is ineffective in resisting trim

The bow features a narrow entry near the waterline, which will cut through waves easily. The shape flares above the waterline to a chine, which serves to shed water and make for a drier ride. The shape above the chine has enormous reserve buoyancy.

The bows have more rocker, less deep knuckle than many catamarans. More rocker helps hold the bows up at speed with dynamic water pressure. A piece of plywood makes a poor surfboard. A deep profile, deep knuckle shape is difficult to steer. Such a shape does not tack or maneuver well. When riding down a wave the knuckle digs in and overpowers the helmsman. Rocker in the bow ensures a light steady helm and good tacking ability.

Many multihull enthusiasts are obsessed with length/beam ratio. Obviously a boat that is narrow for its length will be easily driven; but a better way to evaluate drag or speed potential is with displacement/ length ratio and beam/depth ratio. A boat that is narrow for its length is fast primarily because it is light for its length. A semicircular section has the minimum wetted surface for a given displacement. Therefore the ideal hull section in light air has a 2:1 beam/depth ratio.

Beam/depth ratio of this hull is increased slightly over the light air optimum, which I have found to be very fast at high speeds by providing greatly increased dynamic lift (planing effect). A side benefit is the increased waterplane area of a wider hull sinks less with added payload and resists the tendency to pitch.

Stern shapes are broad and flat. Some designers favor a narrow stern which doesn't increase drag much when the boat pitches. I prefer a flat run which resists the tendency to pitch in the first place. The ride is more comfortable, the boat is faster. Weight always seems to creep aft on cruising boats. A broad stern can carry far more weight without being depressed.

The stern in profile shows a much flatter run (straighter buttock lines) than most multihulls. Round stern profiles are slow, tending to pull down and aft, like a spoon dragged across the water surface. As noted, all cruising boats tend to carry weight aft. Monohull designers can correct the tendency toward stern trim by shifting the ballast keel forward in the design. They don't draw round buttocks because they don't have to. Multihull designers don't have ballast to play with, so usually draw the stern profile round to shift buoyancy aft. I prefer to gain buoyancy aft with a broad stern shape, and work hard at keeping fixed weights forward. This is one reason I avoid the standard - engine room aft - layout.

Construction

Composite sandwich construction is essential to keep the weight down. Light weight is essential to responsiveness and pleasurable sailing performance. However, “composite sandwich” covers a broad spectrum from prepreg carbon with honeycomb core at one end, to strip plank wood with glass skins at the other extreme. The intent here is to strike a reasonable balance between weight, material costs, and ease of construction.

I anticipate that hulls will be foam core with fiberglass skins. A Kevlar layer might be used below the waterline forward for impact resistance. Some localized carbon reinforcement is likely where it is cost effective. Home built boats would use strip planked Core-cell for the core. DuraKore is a reasonable, somewhat heavier alternative. Strip plank Cedar is possible if the home builder has a strong preference.

Bridge deck and house will primarily be flat or single curvature panels. Cost/labor effective laminates I have been using use a thin plywood on the inner skin which can be bent over a simple form. The plywood becomes both the mold surface and an integral part of the structural sandwich. Foam is bonded to the plywood. Fiberglass forms the outer skin.

Builder

This construction project could go several ways:

1. Boat is entirely built by a professional.
2. With 2-3 orders in addition to the BAADS boat, hull molds are justifiable. Hulls could be built by a professional, and the empty shell delivered to the home builder. This gets you past the first big hurdle with a light, strong fair hull, one of the most skill intensive steps complete.
3. Obviously the professional could take it further, perhaps completing the empty bridge cabin and installing engines so the boat could be delivered by water.
4. Boat is entirely home built.
5. A former client approached me with the idea of designing a boat like this for a boat building “school.” Customers would sign up and attend “class” perhaps one day per week. Several customers would build identical boats side by side one step at a time. The school would have all materials ordered and on hand and would provide guidance, patterns, necessary tools, and the site. The idea is to build the boat in perhaps a year's time at very low cost.
6. To make the school project idea more realistic from a time to complete standpoint, it may be best to start with an empty shell, as in options (2) or (3).

Safety

I follow three simple premises in multihull safety.

1. Major leaks caused by heavy flotsam, unfriendly killer whales, or whatever need not be disastrous. Watertight compartments should be designed in from the start.
2. Conscientious design can minimize the risk of capsize.
3. Capsize need not be life threatening. Buoyant chambers when inverted should be designed in from the start, so that the crew can remain on board in safety and reasonable comfort.

As discussed in the hull shape section, I work hard at proper distribution of reserve buoyancy. The high knuckle, chined bow with very buoyant topsides shape is highly resistant to pitchpole, or "diagonal capsize", which is the typical capsize mode of a multihull.

Many catamarans, particularly the typical charter cat layouts, are open from bow to stern. While this maximizes useful interior space, it is not a safe arrangement in my opinion for an ocean cruiser. If holed, the entire hull would fill with water. If capsized, the entire boat would flood with water. Although it should remain afloat, freeboard may be too low for survival inside the hulls.

Rig

We have found the cutter rig to be extremely versatile on multihulls. It should make a wonderful cruising rig.

A "reacher" is set on the permanent headstay. This big jib is used upwind in light air; is very efficient reaching; and makes a great downwind sail in heavy air. Most sailors would prefer this sail to be roller furling.

A small working jib (Solent) can be self tacking and set on a detachable inner forestay. This is the moderate to heavy air upwind working sail. When reaching, even just slightly cracked off head to wind, the jib and reacher together are a powerful combination.

The third headsail would be an asymmetric spinnaker. Downwind a spinnaker is the difference between fast, delightful sailing and bobbing slowly along. With a snuffer the spinnaker can easily be set and handled by one person. When you're feeling lazy, you don't have to set it.

I am a big fan of wing masts. They are reliable, efficient, and simple to use. However, they are rather expensive, since stock sections are rare. A wing mast might cost an extra $15000 in a boat of this size. For cost reasons alone, I am inclined to specify a stock aluminum section.

Layout

From the outset I would intend this design to part from the crowd in three major ways:

> **Diesel engine down in the hulls, central or forward location**. By keeping the weight down in the hulls, the center of gravity is much lower - stability is increased. Hull motion in waves is greatly improved by keeping the weight low and centered. Cruisers tend to accumulate weight aft as gear is stowed, so moving the engines forward keeps the transom from dragging. Besides, why should the engines get to ride aft where the motion is most comfortable?
>
> **Fewer staterooms and heads**. Less useless joiner work to construct and carry around. How many people do you really cruise with overnight? Real cruisers care about room where it counts - in the galley, in working spaces, and plenty of room for stowage.

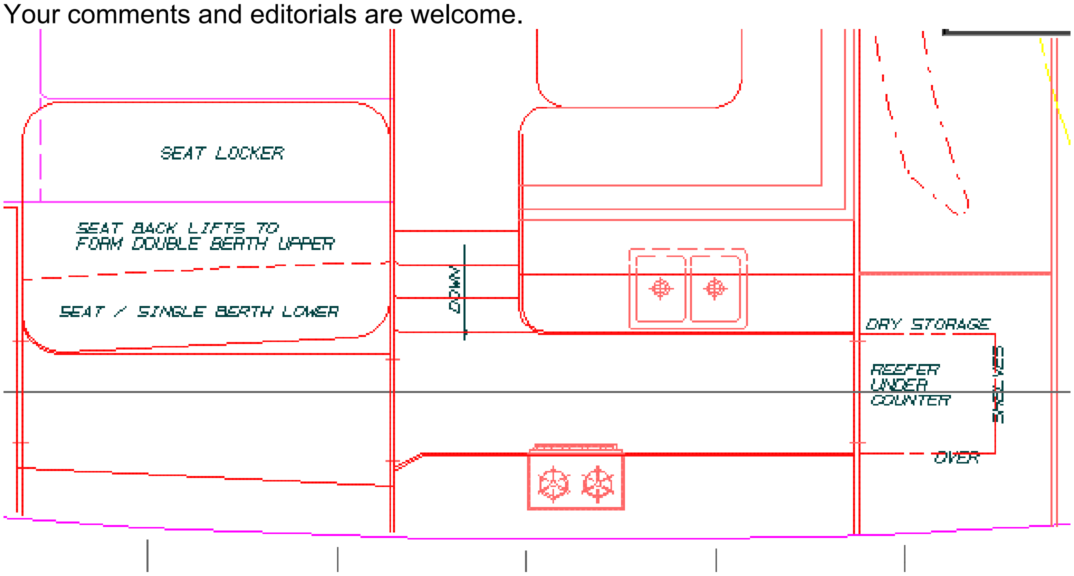
Watertight integrity, both upright and inverted. As discussed in the "safety" section, watertight compartments will be designed in from the outset. Where safety and convenience collide in the planning of the layout and no work around is possible, safety gets the nod.

Beyond these three general concepts, I am starting with a blank sheet of paper. Your response to the enclosed questionnaire will influence the design that develops. Conceivably 2 or 3 layout options could develop. My inclinations at this time would be:

- Owner's stateroom with queen size berth aft in one hull.
- Huge lazarette, utility room aft in opposite hull. This space might include auxiliary machinery, washer/dryer, spare berth, workbench, etc.
- Through transom deck hatches. These would provide fantastic ventilation for the owner stateroom, and would allow easier stowage in the lazarette for sailboards, bicycles, folding dinghies, etc. Also serves as escape hatch in case of fire or other catastrophe.
- Guest stateroom with the ability to convert for two single berths or double berth.
- Bridge deck with large cockpit and moderate size salon. The thinking here is just a bias toward a warm climate layout - more time spent outdoors.
- Galley down in one hull.
- Galley would probably be U shape with refrigerator/freezer at one end against a watertight bulkhead. Placing the freezer this way allows it to fit the full width of the hull so that it can be roomy and have thick insulation. Narrow hulls universal to multihulls usually force the typical side placed freezer to be small or have inadequate insulation.
- Large lazarette/sail stowage forward in one hull. Could include pipe berths for extra guests.
- Twin diesel inboards.
- Daggerboards, rather than fixed keels.

I am toying with other ideas, such as no bridge salon, or one that is just a rigid windbreak which could be closed off with fabric curtains in cold weather. Another notion is a twin pilot house layout - a pilot house set into each hull over the machinery space with access to the accommodations forward and aft. An alternative to the pure daggerboard solution might be a mini delta keel which could hide the prop shaft and protect the prop. A canted daggerboard would extend from the tip of the keel.

Your comments and editorials are welcome.



A U-shaped galley arrangement from my 37' cruising cat.