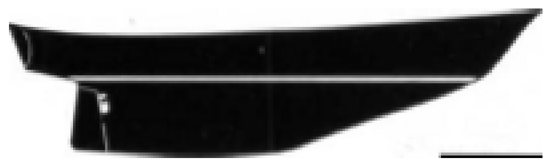
Shannon Design Criteria

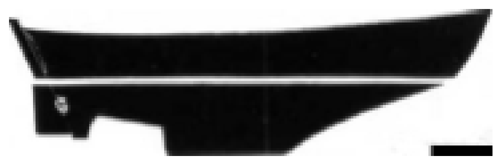
The Shannon 28, 38, and 50 each had unique and special considerations, so each model had to incorporate some different design aspects. For instance, **the Shannon 38** was designed around a 5-foot draft limitation, thus lateral plane in the keel took precedence. **The Shannon 28** was designed to be steered with a tiller (as well as a wheel). Therefore, the rudder was removed outboard so the helmsman could sit aft without having the rudder shaft located in the center of the cockpit sole. The **Shannon 50** required the rudder aft to aid in docking and maneuvering, and a centerboard option for shoal draft. In each case, effective utilization based on size and function, dictated the design. Moreover, while at first glance, the designs may seem different, each model has much in common with the others.

The following items represent only some of the important design criteria common in every Shannon.

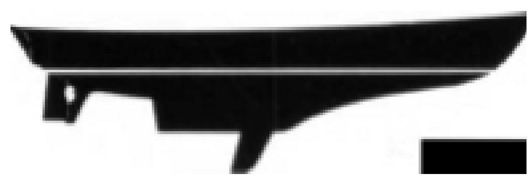
1. One piece hull with internal molded lead ballast
2. Displacement necessary to carry the stores, gear, tankage, accommodations required for extended offshore passages and weekend sailing.
3. A protected propeller and shaft to prevent fouling and to ease haul-out.
4 A keel shape to allow the vessel to stand on her bottom.
5. Reserve buoyancy in the bow and stern sections.
6. Sufficient forefoot area and "veeing" of the sections to prevent pounding.
7. Flat buttocks and a good "run" aft for comfort and performance.
8. Excellent tracking ability and ease of helm resulting from proper keel shape and lateral planeratio.
9. Flare in the bow section for dry sailing.
10 A strong and structurally-mounted rudder.
11. Hydro-dynamically shaped keel sections for windward performance.
12. Form stability for comfort and ability to carry sail area.
13. Excellent sail area to displacement ratio for fast, light air sailing.
14. Keel stepped masts.
15. Internal hull to deck flanges.
16. A comfortable motion in a seaway.
17. Diesel engines mounted conventionally out of the bilge without "vee drives."
18. Simple to handle balanced rigs.
19. Safe, comfortable and dry cockpits.
20. Rugged fiberglass laminate schedule for strength.



Shannon 38



Shannon 28



Shannon 50

Walt Schulz oversees lofting the latest Shannon model

Construction Techniques

Boat building has been a part of man's endeavors since the dawn of civilization. However, it is one of our most dynamic and evolutionary crafts due to improved technology, and methods of building. Today fiberglass construction dominates the boating industry and while wood is still beautiful, fiberglass is superior in practicality and strength for hull and deck construction. Steel and aluminum are being used, but both techniques have inherent disadvantages and cost factors.

Fiberglass has proven its merit as a viable construction material over the past 30 years. As a matter of fact, fiberglass was first experimented with and introduced over 70 years ago. However, the material used is only as good as the people involved. Due to mass production, there has been a marketing effort to produce the largest size boat for the smallest amount of money. While in theory the concept is excellent, it has created certain “shortcuts;” which in some cases, may affect the overall structural integrity and longevity of the boat.

For the prospective yacht buyer, there are several critical areas of fiberglass construction methods to investigate in order to evaluate the true value of a boat.

Fiberglass

While most boats in the United States are built of fiberglass, many people are not fully aware of what constitutes a fiberglass hull. Unlike wood, steel and aluminum, which depend upon rigid frames holding a generally uniform thick “skin ‘(wood planking, steel or aluminum plates), fiberglass hulls depend solely on the skin or laminate to provide strength and water integrity. While longitudinal stiffeners (fore and aft) and transverse supports such interior bulkheads are used to reinforce the hull, most of the strength depends on the construction of the hull or skin.

Fiberglass, or GRP (glass reinforced plastic) was first introduced in 1909 as an experimental method of stiffening shirt collars as a substitute to celluloid. After the Second World War, the Navy began to experiment with fiberglass for small craft and it was not until the late 1950’s that fiberglass construction, due to increased technology became an accepted yacht building material in the U.S.

Fiberglass boats are not completely constructed of glass fibers, but consist of a combination of glass fibers saturated in resin. Resin is a liquid plastic compound that is chemically activated lo create a rigid material. Pure resin is extremely brittle and has little strength by itself. It is the balance of glass fibers for strength and flexibility and resin for rigidity and bonding that create a fiberglass hull.

There are five generally used materials in fiberglass boat construction.. MAT (matt) is comprised of randomly interlocked strands of glass fibers held together by a resin compound. Since mat is highly absorbent and requires a great deal of resin for saturation, it is the weakest of the fiberglass laminate available. However, mat is important because it provides the necessary waterproof integrity and the “glue” between the other woven laminates. WOVEN CLOTH is considered the strongest of the laminates because it has a very tight weave which reduces the amount of resin content (the more resin content the weaker the laminate). Cloth is also the mo t expensive of the available laminates. WOVEN ROVING is much like cloth except that it is made from loosely woven non-twisted fiberglass strands creating a heavy laminate which resembles knitted sweater material. Roving is an easily saturated material and like cloth, has less resin content than mat. There has been some debate on whether cloth is stronger than roving. in laboratory tests, cloth proved to be stronger and more abrasion-resistant, but under actual conditions, roving has shown to have a greater overall impact resistance in collisions. FABMAT (there are several trade names) is the other commonly used laminate. Fabmat is merely the combination of mat and roving put together at the factory and applied from one roll. While Fabmat increases speed of production, it is difficult to saturate and care must be taken to remove air pockets .

GEL COAT creates the exterior smooth finish on a fiberglass hull. Gel coat is made of primarily pure resin with a color additive and sprayed into the mold before the layup procedure. While gel coat offers some waterproof properties, it has no strength factor and is used for aesthetic purposes.

So, it is the combination of mat, cloth, roving, and/or fabmat that comprise the skin of a fiberglass boat. The word “combination” is an important factor since a hull made up of just one type of laminate would not be desirable. Too much mat creates a resin “rich” weak hull. However, woven material does not “stick” together well and mat provides the bond between the laminates. Once all the alternating layers of fiberglass have cured, an incredibly strong one piece hull is created that does not depend upon any fastenings or welds to create the hull.

While Madison Avenue has used the “maintenance free” aspect of fiberglass as a primary virtue of fiberglass boats, the strength, durability, imperviousness to rot, boring worms, and corrosion far outweigh any lack of routine maintenance gains. Of course, a poorly built fiberglass boat, especially since it can sometimes be difficult to detect by inspection of the finished product, is certainly no better than a poorly built wood, steel, or aluminum boat.

Hull Construction

While general hull thickness is certainly important, the method and procedure of laying up a hull warrants close scrutiny. The term “hand layed up” has been used for advertising purposes to differentiate between the use of a “chopper gun” (chopped fiberglass mat fibers sprayed into a mold) and a layup of continuous roll fiberglass mat installed and rolled out by hand. Obviously, spraying mat fibers is quicker and less expensive labor-wise. However, a chopper gun is not considered an ideal hull lay-up procedure because of the difficulty in obtaining uniform thickness and a tendency by some manufacturers of not rolling out the mat (removing the air). Unless air pockets are carefully removed in the laminate during the layup, air voids and resin-rich pockets will develop and weaken the hull. Thus, it is usually the speed of layup that controls quality, since rolling or removing air pockets is slow and painstaking and it is not just the term “hand layed up” that determines strength in the hull.

“One-piece hull” is another term usually seen in advertising literature. Because of internal deck flanges, hull shape and size, many builders use a two-piece hull mold which separates down the center of the boat. The two-piece mold is bolted together before layup and then the mold is opened after the hull is completed. So it is possible to have a one-piece hull built in a two-piece mold without affecting structural quality. (The Shannons are built this way). However, there are many boat manufacturers, for reasons of speed and mass production, that lay up hulls in two pieces with the mold open and then bolt the mold together and bond the two halves together along the seam. Obviously, a one piece hull with a contiguous layup is more advantageous than a hull depending upon a secondary bond at the critical centerline joint as used in a two piece hull.

Laminate schedule is another item that is important for evaluation purposes. Hull thickness alone should not be the only criteria. A thin laminate creates flexing and fatigue, so a hull should have the necessary build-up for strength. For instance, using a great deal of mat is one way to increase thickness without increasing strength. There are no laws regulating standards for hull thickness or laminate procedure. There are published standards provided by Lloyds of London and Gibbs and Cox that set forth standards for fiberglass boat building which some builders use. Although it is possible to find a boat that is built to “exceed Lloyds,” there is no gain due to low quality material, poor workmanship, and lack of structural integrity advantage. It is possible, especially overseas, where there are more inspectors, to obtain a Lloyds certificate which insures an inspection of material and layup procedures. On the other hand, there are many Naval Architects and builders that feel Lloyds specifications on hull laminates are a minimum standard and not an ultimate goal.

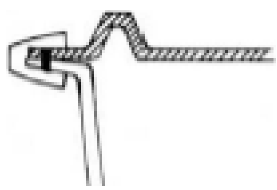
Shannon Hull Laminate Schedule

<u>We feel the hull laminates on the Shannon 28, 38, and 50 are among the strongest in the World, far exceeding accepted standards.</u> Hull layup are staggered to provide maximum strength at critical areas while taking into consideration weight factor above the waterline. Each hull is one piece carefully layed up by hand to maintain quality. All hull layups begin with 20-23 mills of gelcoat, ¾ oz. mat, 1 1/2 oz. mat, 1 1/2 oz. mat, 6 oz. cloth <u>(Shannon is one of the few builder still using expensive cloth in the laminate for strength and abrasion integrity),</u> and then followed by alternating layers of 1-1/2 oz. mat and 24 oz. woven roving with the laminate sequence based on position and size of the vessel. **<u>The hull laminate on a Shannon 28 exceeds the hull laminates of most production boats over 40 feet in both quality and strength.</u>**

Wherever a through-hull is cut into a Shannon hull for seacocks, the plug is saved and delivered to the owner as proof of the laminate schedule. For additional safety, every Shannon has the final laminate covered with fireproof resin. The Shannon warranty on each hull and deck laminate is not taken lightly and we are confident that a properly executed fiberglass hull and deck will last a lifetime. ***At Shannon, we welcome marine surveyors to confirm that our claim of structural superiority is well founded.***

Hull to Deck Bonding

The joining of the fiberglass deck to the hull is an important area for consideration. There are several methods being used by various builders and manufacturers.

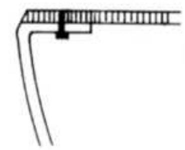


Exterior Deck Flange

In order to release a hull from a one-piece mold it is necessary to use an exterior deck flange. This method utilizes external deck and hull flanges that are screwed or bolted together and then covered with a rubber or aluminum rub rail to cover the seam. For production purposes, this is an inexpensive and quick procedure. The seam is usually bonded with a layer of mat or a waterproof compound between the flanges to prevent leaks. Since the deck to hull joint becomes the exposed rub rail, it is usually the first place to hit a piling or other obstruction. The hull to deck bond may be damaged and open up without any obvious or noticeable fractures at the rub rail.

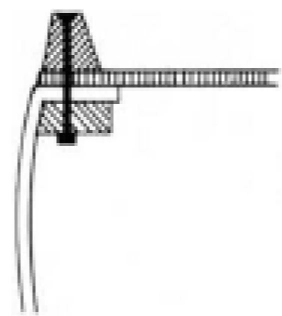
Deck Over

This system of deck bonding incorporates a male and female lip, usually a molded toe rail, to join the deck and hull. Primarily used on smaller boats, the deck is set in fiberglass and no fastenings are used to reinforce the bond. A small synthetic rub rail usually covers the seam.



Internal Deck Flange

In order to use an internal deck flange, the hull is usually made from a two-piece mold. This method is generally accepted as the best design, depending upon the size of the fastenings, as bolts as well as fiberglass can be used at the joint.



Shannon Deck Flange

Shannon uses an internal deck flange (one-piece hull, two piece mold). The bond is epoxied and bolted with stainless steel bolts on 8" centers. In addition, there is a full length bow to stern wooden flange cleat bonded under the flange to act as a backing block for the nuts and washers. The toe rail and rub rail are also jointed to this point. **The combination of the bolts, epoxy bond, and flange cleat provide, in our opinion, one of the strongest hull to deck joints in the industry.**

Screwed Deck Joint with Aluminum Toe Rail

This method is used by many production boats that have two-piece hulls. The deck is layed on a very narrow hull flange in bedding compound and then an aluminum toe rail is machine screwed or bolted to the flange.

Ballast

Probably one of the least talked about items in boat brochures, ballast is perhaps one of the most important factors on a sailing vessel. ln addition to ballast/displacement ratios, (in a moderate displacement cruising yacht, it should be approximately 35%), the material and construction of the ballast are equally important. Lead, because of its density, is the most desirable ballast material. However, it is expensive compared to cast iron, concrete, iron punchings, resin, and other materials used. Lead brings the weight (720 lbs. per cubic foot) down to the lowest point in the keel providing maximum stability. ln an equal sized hull, internal lead ballast will provide more leverage than an equal weight of other ballast material because the weight can be placed lower due to the decreased size of lead per pound

Construction should also be considered. Today, ballast is either placed internally in the hull or it is bolted externally beneath the hull. In racing boats, the bolted-on fin keel enabled the designers to reduce wetted surface, and obtain high aspect ratio shapes. There are also some fiberglass cruising boats that bolt the ballast externally to simplify the building process with the builders claiming that in a grounding situation, the lead (or iron) will absorb the damage ignoring the sheer load problems of keel bolts. Unfortunately, externally bolted ballast in fiberglass construction suffers from the same problems that it does in wood vessels- keel bolts. Keel bolt are the weak link in an external ballast design. The bolts have a tendency to work loose, corrode, suffer from electrolysis, and fail. It is difficult to a certain their condition, and it can be very costly to repair them. On a racing boat it may be a necessity, but on a cruising vessel, keel bolts are not worth the problems.

The Shannon, in addition to having approximately 2" of fiberglass at the shoe (base of the keel), has a tapered keel which is wider at the top than at the bottom. This tapered lead ballast cannot drop out of the bottom if the shoe is severely damaged because it will not fit. Also, the ballast in the Shannon is molded in two pieces, which interlock in the keel, so in the event of an unlikely massive and critical grounding situation in which the entire forward section of the keel is fractured, only the forward half of the ballast is jeopardized. As a further assurance, the entire keel area is fiberglassed over the ballast to prevent any sea water from entering the rest of the vessel. The Shannon 38 also offers movable trim ballast in small blocks, so the vessel can be trimmed to offset any weight distribution problems from loading a tremendous amount of provisions for a long voyage.

Rigging

Since Shannon builds yachts for serious offshore sailing, our masts, booms, .blocks, and standing and running rigging are all oversized for an added measure of safety. The mast and booms are heavy section coated aluminum with sail slide tracks and external halyards.

The main standing rigging on a Shannon 28 Cutter is 1/4" 1 x 19 strand stainless steel wire to non-barrel open type turnbuckles. All sail halyards are pre-stretched dacron and the sheets are Samson-braid.

The Shannon 38 and 50 have rod standing rigging as standard equipment, with external pre-stretched dacron halyards and Samson-braid sheets.

All the rigging on Shannons is custom made to our rigid specifications and is installed by Shannon riggers at our yard and then tuned and seatrialed before delivery.

Keel Stepped Masts

Although stepping the main mast on the cabin top is seen on many boats today, with the exception of small trailerable boats, there is not one good reason for a deck stepped mast in an offshore cruising vessel. 1t should be noted that most of the pressure on a mast is straight down due to the tension on the stays, and a cabin top can never be reinforced to equal the strength of a mast shoe located in the keel section. While a deck stepped mast does alleviate interior layout problems and provides a certain ease of construction, mast compression load factors, loss of a mast stay or turnbuckle, and general structural integrity dictate that a mast be keel stepped.

Chainplates

An important factor to consider when discussing chainplates is the angle they are placed in relationship to the mast stays. A chain plate should follow the angle of upward "pull" from a mast stay. If the chain plate must be bent to create the proper lead for the stay, excessive stress is placed on the chainplates and chainplate bolts. While exterior and interior chain plates that are bent to the shape of the hull and then further bent to create a lead to the stay are seen on many wooden and some fiberglass vessels, fiberglass construction does not provide the localized strength at chainplate areas because of the lack of wooden frames to transfer the load. However, a properly installed chainplate on a fiberglass vessel will easily withstand any mast stay loading factors.

Shannon utilizes 2" x ¼", 316 type stainless steel chainplates secured with stainless steel bolts. The chain plates are installed on transverse bulkheads which are fiberglassed to the hull. By placing the chainplates transverse (wide part of the chain plate port to starboard) the correct mast stay angle can be achieved.

Intermediate Main Mast Stay

Most large fiberglass cruising vessels use an upper stay, forestay, and backstay to the top of the mast, and forward and aft lower stays to a position beneath the spreaders. It is the combination of one upper and two lower stays on the windward side of the boat that absorb a great deal of the pressure. In the event of the windward upper stay breaking due to a turnbuckle, chain plate or wire failure, the entire section of the mast above the spreaders becomes unsupported and can result in losing the mast.

On Shannons, in addition to the normal mast stays, we also incorporate port and starboard intermediate mast stays which run approximately half way between the spreaders and the top of the mast to the deck. The intermediate stay, in addition to supporting the forward staysail stay, also acts as a back-up to the upper stay in the event of a failure and spreads the overall loading of the primary upper.

Books for reference:

The following list of books has been provided to offer additional information and to qualify some of the thinking, planning, and construction of Shannon-built yachts.

SEA SURVIVAL *by Dougal Robertson Praeger Publishers, Inc., New York*

SINGLEHANDED SAILING *by Richard Henderson International Marine Publishing Company, Camden,* Maine

SAILING ALONE AROUND THE WORLD *by Joshua Slocum AdJard Coles Ltd, London*

THE OCEAN SAILING YACHT *by Donald M. Street, Jr. W.W. Norton and Company,Inc., New York*

THE PROPER YACHT *by Arthur Beiser The Macmillan Company, Collier-Macmillan, Ltd., London*

SELF STEERING FOR SAILING CRAFT by John S. Letcher, Jr. International Marine Publishing Co., Camden, Maine

GIPSY MOTH CIRCLES THE WORLD *by Sir Francis Chichester Coward-McCann, Inc., New York*

VOYAGING UNDER SAIL *by Eric C. Hiscock Oxford University Press, New York*

BECAUSE THE HORN IS THERE *by Miles Smeeton Gray's Publishing, Ltd., British Columbia, Canada*

AFTER 50,000 MILES *by Hal Roth ,W. W. Norton & Company, New York, New York*

SURVEYING SMALL CRAFT *by Ian Nicolson International Marine Publishing Co., Camden, Maine*

HEAVY WEATHER SAILING *by K. Adlard Coles John DeGraff, Inc., Tuckahoe, New York*

OCEAN VOYAGING *by David M. Parker John de Graff, Inc., Tuckahoe, New York*

VERTUE XXXV *by Humphrey Barton Rupert Hart-Davis, London*

THE CIRCUMNAVIGATORS *by Donald Holm Prentice-Hall, Englewood, N.J.*

THE LONG WAY *by Bernard Moitessicr Doubleday & Company, Inc., New York*

THE COMPLEAT CRUISER *by L. Francis Herrcshoff Sheridan House, New York*

THE COMMON SENSE OF YACHT DESIGN *by L. Francis Herreshoff Caravan-Maritime Books,* **Jamaica, New York**

SELF STEERING *by A.Y.R.S. The Amateur Yacht Research Society, Woodacres, Huthe, Kent, London*