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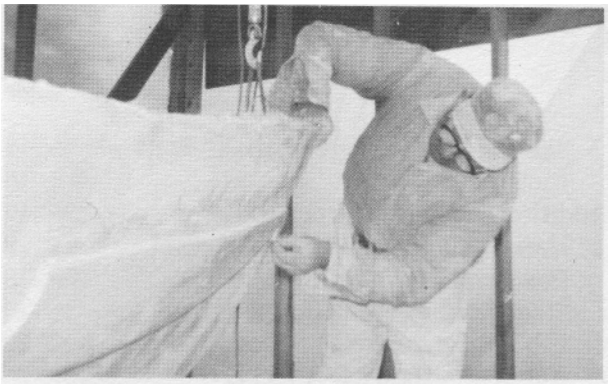
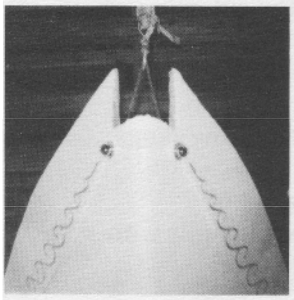
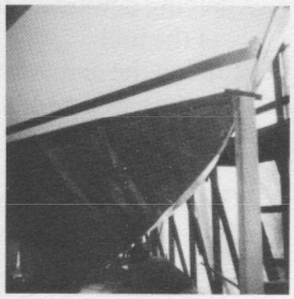
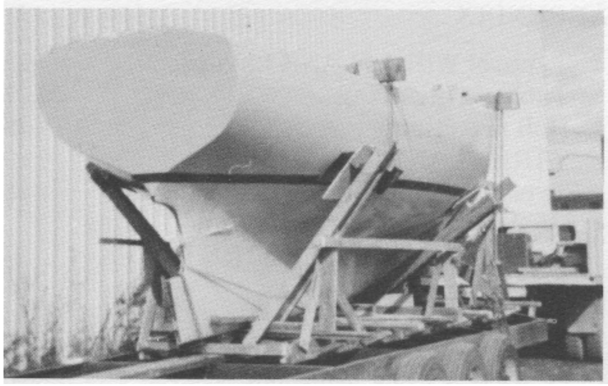
Look At These



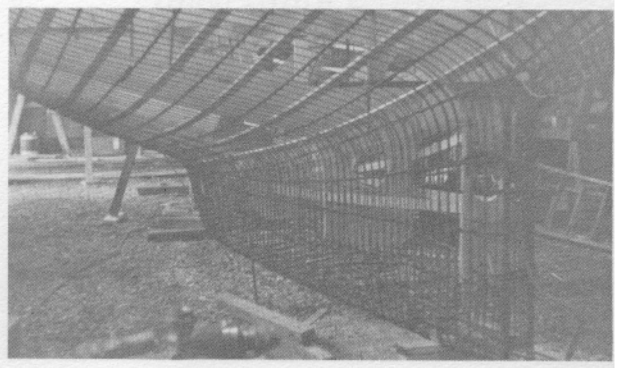




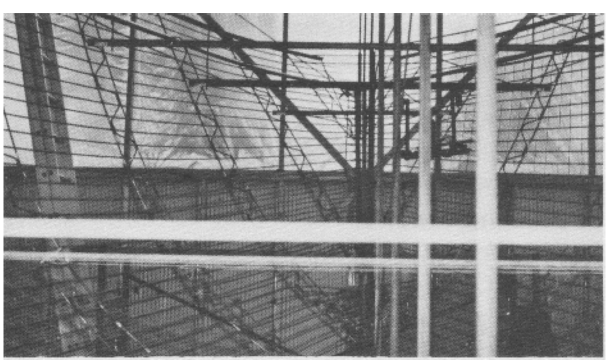
Views of an interesting job being done by Veikko Ackren using FER-A-LITE type mortar to make trailboards for an "Endurance 35".



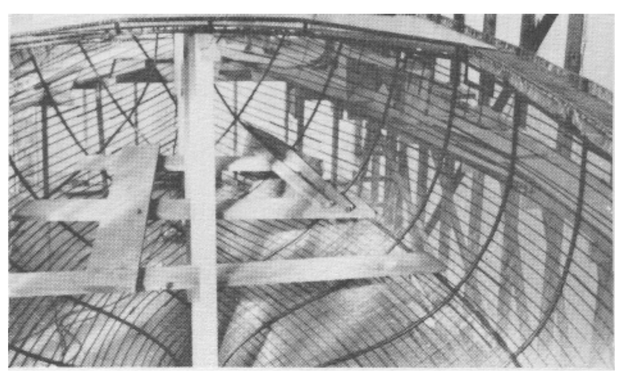
An outstanding job done by Sam Bufalina and Randy Kempf with a Bingham "Flicka"; (3) layers of W14x.437 stapled to an open wood mold.



50' "Romack" Motorsailer framework built on a wooden mold has longitudinal rod stiffeners. Wood Ribbands between rods will facilitate stapled assembly of WIRE PLANK type mesh.



A Peter /bold "Endurance" with truss frames ready for WIRE PLANK.



Another "Endurance" with pipe frame mold system.

Introduction

WIRE PLANK and FER-A-LITE were engineered to provide both the home builder and the commercial yard with the two principal materials used in ferro-cement boatbuilding developed and improved specifically for use in boats.

In 1969 a 13 foot double-ended Peapod was built as a vehicle to test the WIRE PLANK system. Its hull was plastered with Portland cement only $^{1}/8$th inch thick and is probably the thinnest ferro-cement boat ever built. It weighs approximately 250 pounds, is extremely rugged, and although deliberately abused is still hale and hardy.

Then in 1972, the ten foot dinghy shown in this book was constructed using both WIRE PLANK and FER-A-LITE brand synthetic mortar. An effort was made to produce a much lighter structure than the Peapod by utilizing wider wire spacing and the new lightweight mortar. The boat weighs only 148 pounds and is indeed extremely rugged and appears to be highly successful!.., time will tell.

This book tells how we built this dinghy and we are offering plans for this 10 ft "SWEETHEART". The method is practical; however, this construction method offers a much greater relative advantage in constructing large boats. For example, since practically all of the steps are the same it would take very little more effort to build a 20 footer.

We hope that people will not become discouraged with the tediousness of the method on the basis of a small boat. It makes good sense for the beginner builder to try a small boat first. Make no mistake, the little dinghy is easy, it just takes a bit of time. To balance these thoughts one should consider the job it would be for the amateur to tackle a round bottom steam bent frame dinghy built of wood.

It may appear that we have written a sales brochure.. .this is not the case. The materials described herein are new and experimental. Fantastic interest has been aroused.

The purpose of this book is to pass on to the builder of Ferro-cement boats the knowledge and experience which we have gained during six years development, testing and use of these materials. We are explaining what we have learned and attempting to answer the many questions that have been raised.

As of the summer of 1974 we are preparing the 2nd edition. It gives us the opportunity to include the answers to many questions we've had by adding to the FER-A-LITE properties on Page 29. Most important we are building an L. F. Herreshoff "MOBJACK" ketch, where the WIRE PLANK is stapled on the longitudinal wood stringer method. Work has progressed quite rapidly and we have enough completed on this 45 footer to include photos of most of the details pertinent to constructing the basic hull.

We now know of over 75, major projects in the works utilizing FER-A-LITE brand plaster. Some are contemporary designed armatures originally planned for Portland cement and the rest use WIRE PLANK. A good many of these boats are over 40 ft with one 67 ft.

Typical of the Ferro Cement concept, numerous armature configurations have been utilized, surely many more will be devised. We like the method used on "Mobjack" very much, particularly the stapling. It is fast, easy and without frustrations. The fact that the staples will not have to be removed is also a happy thought. We have heard much wailing about the woes of removing a cedar mold and grinding of staples. On the other hand we are not looking forward to the job of laying the fiberglass over the inside of the ribband stringers. It won't be difficult; however, there are many, many linear feet to deal with.

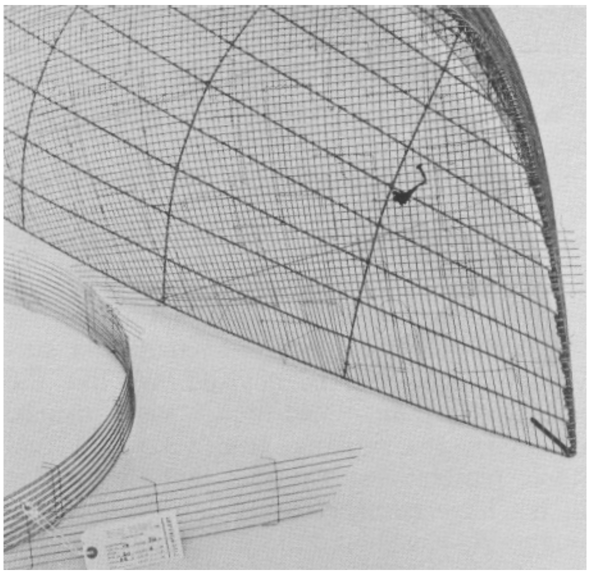
All things considered we are very happy with the plywood deck configuration. A glass covering will be carried right up the inside of the bulwarks and will surely be completely water tight.

Another experiment which we rate as a great success was **arc** welding WIRE PLANK. We have found that reliable welds can be made to end terminate the 14 ga wires. I want to stress the importance of solidly securing all WIRE PLANK ends. This welding is very fast and quite simple to do. The important point being that arc welders are inexpensive, common and a basic requirement for this type of construction.

The information in this book is, to our best knowledge, true and accurate. However, since conditions of use are beyond our control, all recommendations or suggestions are presented without guaranty or responsibility on our part.

WHAT IS WIRE PLANK?

WIRE PLANK is a trademark for an innovation engineered to improve upon the ferro-cement concept of boat building. WIRE PLANK refers to a system of eight parallel continuous wires held in place with widely spaced light gauge cross wires. The material is supplied in 500 ft rolls and provides an easy method for shaping beautiful hulls because it is applied in layers of narrow strips. This system enables application of the steel wire reinforcement in continuous lengths transversely, diagonally and longitudinally on a hull armature.

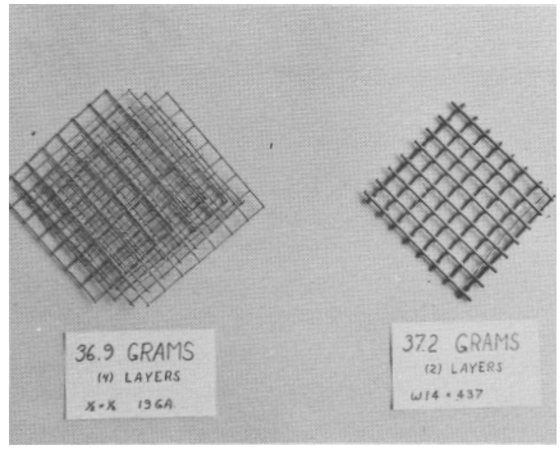


WIRE PLANK armature results in a 3-D shaped piece of wire mesh

There are no joints, butts, or overlaps in the wire. Every strand is full length. As these strips are only 3-1/2 inches wide they are easily shaped in compound curvature and therefore proportionally much larger diameter wire is used than with previous ferro-cement construction methods.

The large diameter wire used in WIRE PLANK provides more than double the steel content provided by ordinary roll mesh material.. .up to 14% by volume and 70 pounds per cubic foot. This high steel content provides greater strength than is afforded by chicken wire or other light gauge mesh and therefore hull thickness can be cut down to reduce weight and still maintain high strength.

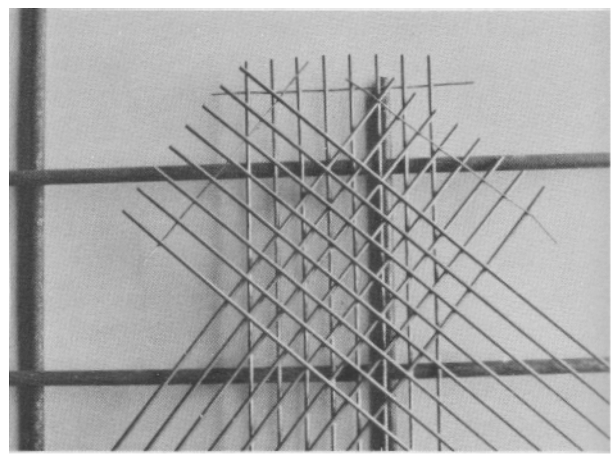
As a result of reduced thickness, application of mortar into the open mesh of the system is simplified. Complete penetration and capture is assured. Dry mix mortar is no problem and we expect that gunite application of cement would be practical.



An equal weight comparison between WIRE PLANK and 19 Go square welded mesh shows why plastering is simplified.

THEORY OF WIRE PLANK

The design philosophy of this system is based on applying a rigid mesh of heavy gauge continuous wires over the outside of a rod framework.



Typical lay-up with three layers of WIRE PLANK on rod framework

.

The rod framework is made sufficiently stiff to carry the stress of impact and bending loads. The mesh provides a tough, high strength diaphragm over the grid work of the rod frame.

The resulting mesh produced by the multi-layer diagonal stripping with WIRE PLANK brand wire provides a continuous three dimensional structure. There are, of course, no butts, darts or overlaps inherent with roll material to reduce strength.

The rod framework is located on the inner side of the panel, standing proud above the cement and mesh in a grid pattern. In this location, it carries efficiently the tensile stress in bending instead of being buried in the neutral axis of a sandwich of light weight mesh.

The cement carries very little stress. Its main function is simply to keep the water out. The part of the cement that ordinarily encased the rod work, essentially a heavy core material between the mesh layers, is eliminated at a great weight reduction.

High tensile pre-stressed rod, 1/4-inch diameter, is desirable to use longitudinally because of its very high strength. The fact that it is supplied in straightened condition makes it lie into fair hull curves like battens. Spacing width of the longitudinal rods is variable to suit the weight and duty of the boat.

When this high tensile, high carbon steel is to be used, it should be understood that no welding techniques are to be used for assembly. All joints should be made with ties, lacing or similar methods.

The transverse frame rods are made from mild steel such as concrete Re-Bar or pipe. The diameter to choose will vary with the size of the vessel. It should be as large as practical that can be conveniently bent into hull shape. This framing should be bent so that it will lie against the longitudinal rods without distortion. Again, spacing is selected as required. See the table of suggested scantlings in the Appendix of this book.

FER-A-LITE BRAND SYNTHETIC MORTAR

FER-A-LITE brand mortar is a new material designed to replace Portland cement in ferro-cement boatbuilding. It is light, stronger, and easier to apply to boat hulls constructed with steel reinforcement than the mortar used in ferro-cement construction heretofore. It comes in two parts, a liquid polyester resin and an aggregate material called REINFOR-CEMENT, which are applied to the hull as is ordinary mortar, except for some important advantages. FER-A-LITE brand mortar is much easier to mix and handle when applying it to the hull. Its light weight reduces the material-handling labor, compared with hauling heavy pails of cement up onto a scaffold. The pre-measured batches in which FER-A-LITE is supplied simplifies mixing. It penetrates the wire mesh easily, without voids, since it has a cohesive, easy-flowing consistency very much like peanut butter. The material is trowelled on in batches sized for the convenience, mixing facilities, and pace desired by the builder. Work can be stopped at any time, since new mortar applied to previously cured material will bond with almost 100 per cent strength. Depending upon temperature, the mortar gels in three to four hours and gains 90 per cent of its ultimate strength in one week. There is no need to keep it wet or apply steam or perform any other curing treatments. These advantages of great strength, light weight, easy mixing and application, and uncomplicated curing make this mortar an ideal boat construction material.

When cured, FER-A-LITE brand mortar has five times the bending strength of Portland cement. It is also resilient and possesses greater impact strength than Portland cement. It weights only 60 pounds per cubic foot, compared with 140 to 160 pounds for cement. This weight factor is very important since many ferro-cement boats are compromise designs with major consideration given to the penalty carried by excessive weight. Some ferro-cement boats have insufficient righting moment to carry sail efficiently, others may float below their design water line.

COMPOSITE CONSTRUCTION-WIRE PLANK AND FER-A-LITE

Use of this wire system enables packing a greater amount of steel reinforcement into the hull shell than when using ordinary mesh. This, in turn, permits construction of a thinner, hence lighter, hull. Use of both WIRE PLANK and FER-A-LITE in composite construction provides still greater advantage providing lighter and more resilient hulls having strength and weight comparable to aluminum.

The 13 foot Peapod shown was constructed of WIRE PLANK brand mesh and plastered with Portland cement to a shell thickness of only 1/8 inch. This boat weighs 250 pounds and has withstood severe abuse without any sign of weakness or

First WIRE PLANK boat built in 1969 was a 13′6″ Downeast Peapod which has a 1/8 inch thick Portland cement hull shell.

failure. The ten foot dinghy was then built using both materials in a composite construction. This boat weighs only 148 pounds and is extremely rugged.

SELECTION OF HULL DESIGN AND WHY IT IS IMPORTANT

The design of a boat is probably the most important factor contributing to the success of the finished product. Many considerations enter into a successful design such as arrangement, materials, structural design, and hull shape suited for the intended use. If these design elements are correct, the project is started on the right track. If they are wrong, the best materials and craftsmanship can be wasted.

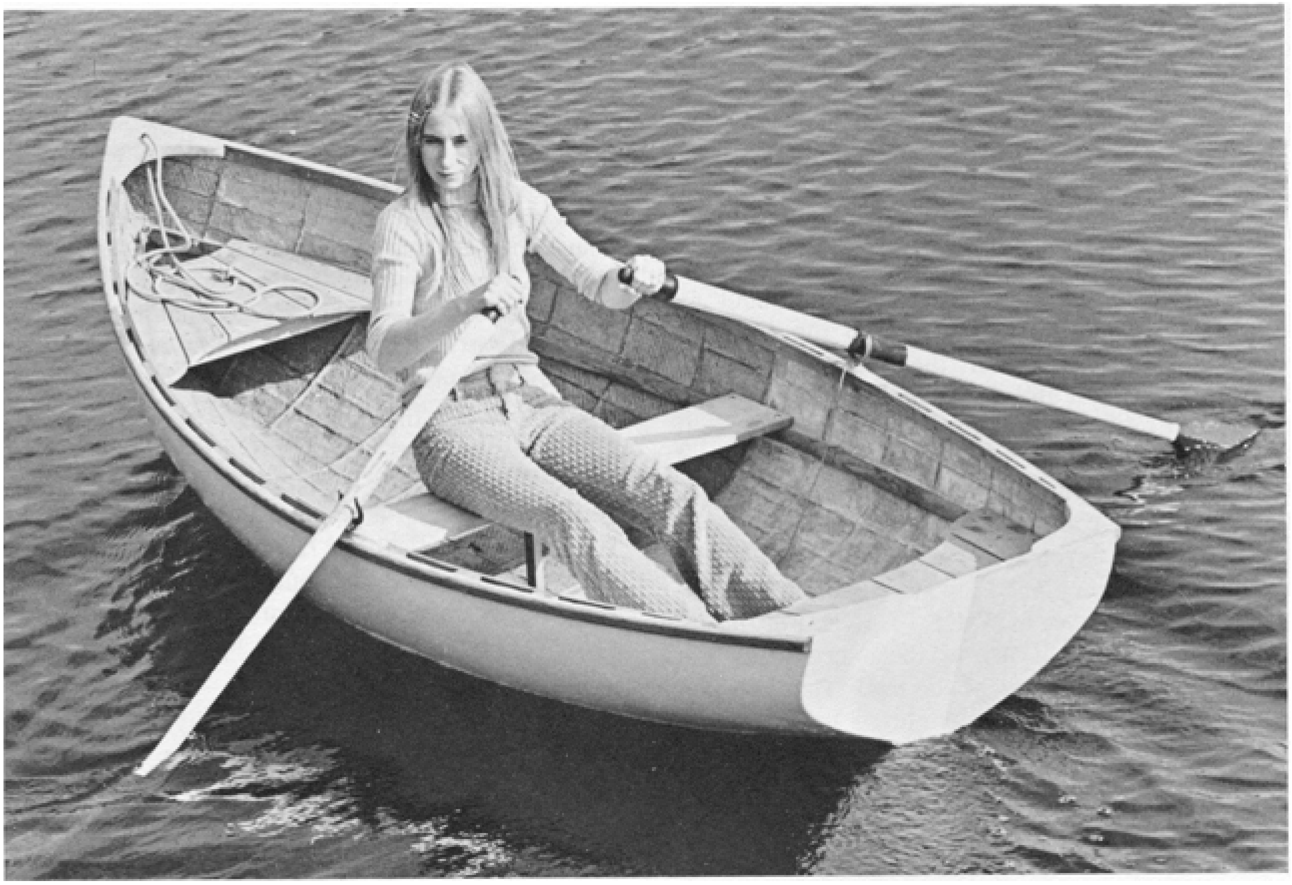
Many boats are created out of the builders head and this is fine if he has the experience and talent to build upon. If the builder does not have such a background he is well advised to invest in the relatively small cost of a good design from the most reliable source available.

ROUND HULLS VS. HARD CHINES

When selecting a design for ferro-cement construction it is wise to remember that compound curved surfaces are inherently stronger than flat surfaces which are developed into hard chine construction.

Ordinary mesh material requires considerable persuasion to make it fit smoothly in compound curvature. WIRE PLANK brand mesh is unique in that it has a natural tendency to lie smoothly in fair curves and therefore it is simple to assemble in a compound shaped hull.

More work is required to form the corners at the chine than to form free-flowing curved surfaces. The joints, overlaps, bends and angles which occur at the chines contribute to this difficulty.



The next section of this manual is devoted primarily to explaining the methods used to build this traditional round bottom boat.

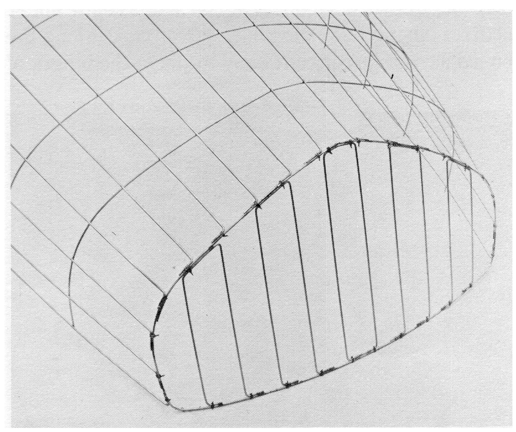
THE CONSTRUCTION OF A 10 FOOT DINGHY

APPLICATION OF RODS

First, the building form is prepared according to the plans. The positions of the transverse rods must be layed out and marked on the ribbands. Some care will be needed to ensure that the transverse rods lie squarely across the boat. They are then bent to the approximate shape of the station and secured to the form. If an old hull is used as a building form the wire ties must be passed through holes drilled in the hull. If the rod is bent closely to the shape of the station before application, it will not distort the form and will help to produce a fair hull shape.

TRANSOM

If the boat has a transom, it should now be bent from wire or rod according to the plans. Using an old boat, it can be formed using the original transom as a pattern. This will be slightly smaller than the original since it will be spaced and blocked an inch or so aft of the old transom in order to pass the wire ties. Careful work will be needed to produce a fair, pleasing shape and this will probably be the most difficult part of all the rod work.



Transom view of rod work some joints are spot welded others show 1 inch tails for lacing with 18 Go wire.

TRANSOM RODS

Vertical #10 gauge rods should be placed about 2-1/2 rod work together as a unit and prevent distortion during the mesh lay-up.

APPLICATION OF WIRE PLANK

Lay on the first "strake" of WIRE PLANK diagonally at 45 degrees to the keel, near the middle of the boat, between bow and stern. Measure the required length of each strake using a tape stretched from gunwale to gunwale in the desired location. Cut the length needed at an angle of about 45 degrees on each end and to match the angle at which the strake meets the gunwale. WIRE PLANK is straight and quite stiff. It is advisable to pre-bend it to the approximate curvature of the hull before applying it. It then conforms easily to the shape required without undue stress on and distortion of the rod framework. The small cross-wires which extend beyond the edges of the WIRE PLANK should be placed toward the outside of the hull on the first layer of WIRE PLANK. For the second and subsequent layers these cross-ties are placed toward the inside of the boat. This leaves a smooth, closely spaced, uninterrupted layer of parallel wires on the outside surface of the hull. The cross tie wires are always buried on the inside, between layers of mesh.

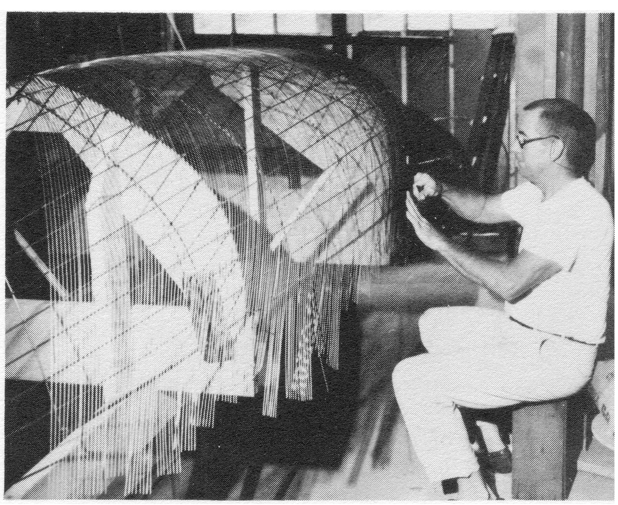
CUTTING THE WIRE PLANK

A handy method of cutting the WIRE PLANK to the length required is to make up a measuring board, marked off in feet, up to the maximum length required. Place this on the floor and unroll the wire on top of the board and cut it with heavy tinsnips. A turn of soft wire around the coil will keep it under control during this operation. Tick marks along the board as you go make it easy to judge the length of each strake from the one previously applied. As the first strake goes on, it will take what looks like a lazy S curve twist as it goes around the bilge. Don't try to straighten this out. The following strakes will also fall into the same curvature quite naturally and lie parallel to the adjacent wires. Wire ties can be used to secure the WIRE PLANK to the rodwork. The light .20 gauge cross-tie wires of the WIRE PLANK can be used to tie the groups together side by side and to the rodwork. The ends of the wires are left to extend beyond the gunwales until the entire layer is installed.

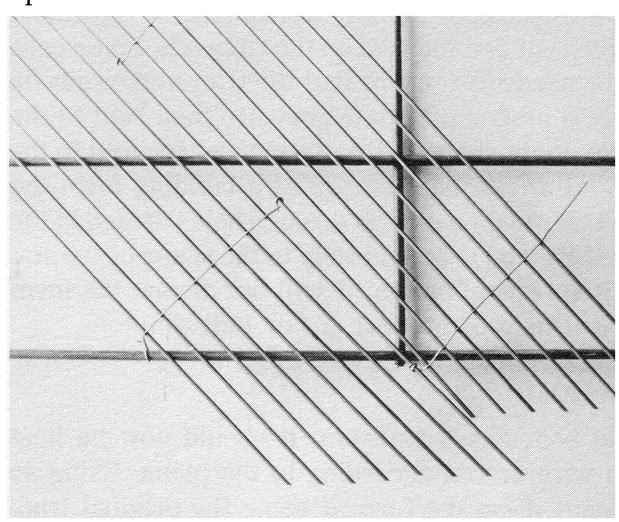
You will notice that when the first layer of WIRE PLANK is installed, there will be slight undulations perpendicular to the direction of the wire. The second layer, which is applied at right angles to the first, will smooth these ripples out and result in a very fair hull form. In applying WIRE PLANK, it will be very helpful to utilize small clamps (clothespins, will do) to hold the strip in position while it is being tied in place.

As work progresses it will generally be necessary, due to the compound curvature of the hull, to vary the spacing slightly between strips to compensate for this curvature. Usually the ends will have to be brought together and more space left toward the middle of the strips. Further compensation can be accomplished by working small joggles or kinks into the cross wires. This shaping is important to keep the strakes running fair.

On certain portions of the hull, where there is sharp curvature, the strakes have to be twisted. This may result in a tendency for one side of a group to lift away from the rod frame. A pull on the wire ends of



WIRE PLANK being installed. Lengths should be cut closer to actual requirements roughly at the required angle.

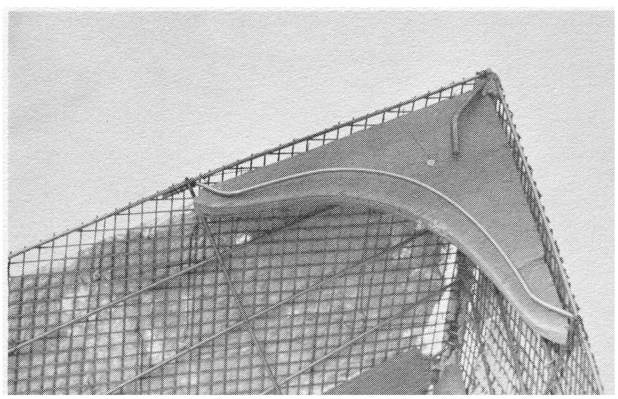


Compensation for compound curvature by plank edge spacing.
Note cross wire ends used to hold spacing.

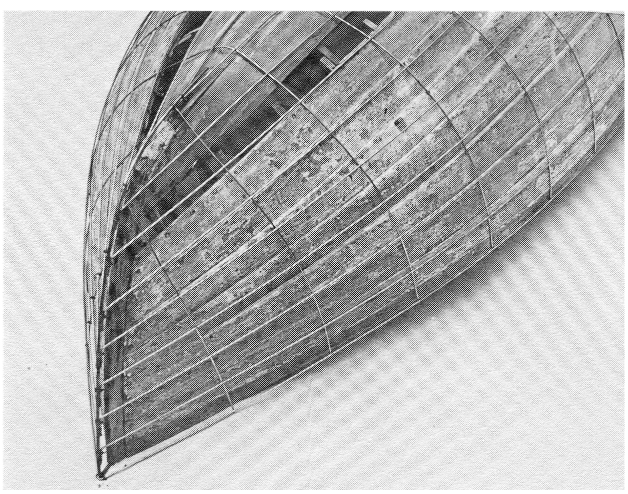
inches apart to fill in the transom. These rods should be bent at each end with 1 inch tails to be laced to the transom member. The two center rods should be bent from one piece in a modified "U" pattern. Let the base of the "U" fall across the transom butt joint. The transom will be supported by the longitudinal rods to be installed later.

STEM ROD

The stem rod should now be bent to shape from the lofted lines or according to plan and positioned on the building form. The top of the stem rod should be bent aft to form a reinforcement for the breast hook. The rods are firmly laced in place and care must be taken throughout construction to keep the stem vertical and fair. Triangular gussets fixed to the foremost station mold, notched for the stem rod, will help support it.



The stem rod is bent over the breasthook filler block to insure against pull out. Blotchy appearance on hull is due to FER-A-LITE being applied.



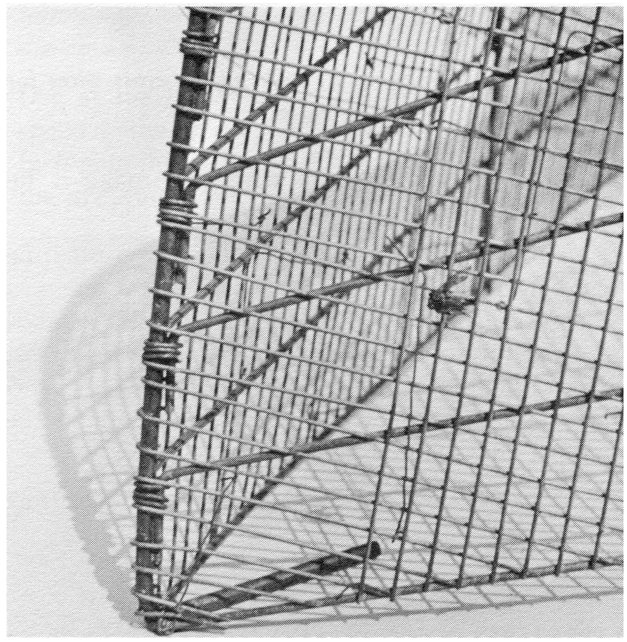
A derelict boat used for a building form. The Peapod had a similar stem rod framing except it was carried full length along keel.

ROD END TREATMENT

All framework rods should be bent with tabs, or tails, if possible, where they attach to terminal members. An h18 gauge annealed wire tie is used to make a secure fastening.

LONGITUDINAL RODS

The first longitudinal rod to be installed is the sheer rod which should be carefully positioned to the marks previously placed on the station molds and carefully sighted for fairness. The sheer rod should be lightly laced to the transverse rods and adjusted until fair. When it is in place the lacings are tightened. The ends of the longitudinal rods are bent and laced to the stem and transom rods as shown.

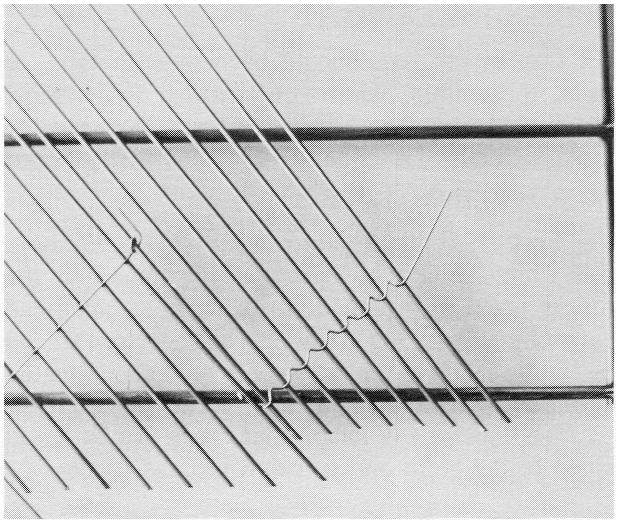


Longitudinal rods are laced to stem.

The remaining longitudinals are now placed taking care that the rods lie in fair curves, evenly spaced, which will result in a pleasing appearance inside the hull and not exceed the spacing given in the plans or the scantlings table. The longitudinals should be securely laced to the transverse rods with several turns of wire.

GLUE THE JOINTS

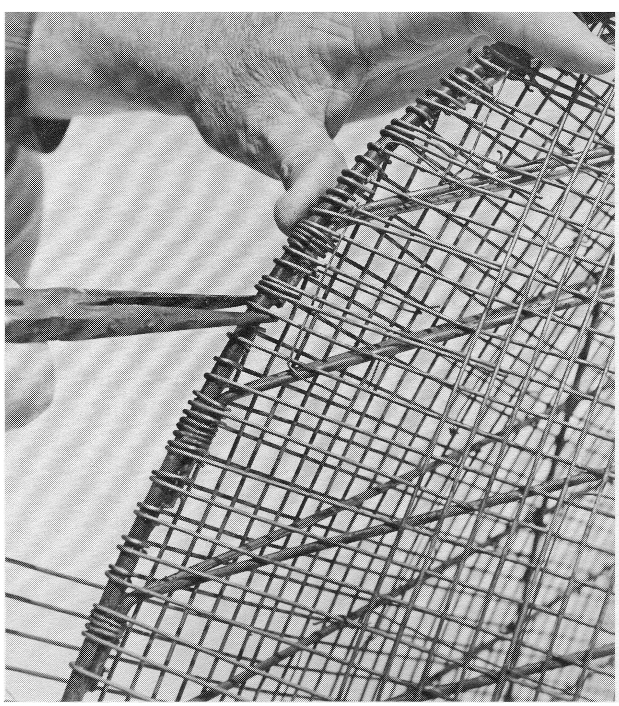
When the entire rod framework is fair and true, a spot of adhesive is applied to each joint. "GIT"-ROT (see appendix) is recommended. Regular epoxy cement can also be used. "GIT"-ROT is preferable, however, since it is flexible and resilient and will not fracture due to flexure of the hull during subsequent work on the armature. "GIT"-ROT also penetrates very well into the lacing and forms a blob of material which will tie the



"Plank" is easily tapered by kinks in the cross wires for more compound curvature correction.

the strake to "skew" the wire will make it lie smoothly.

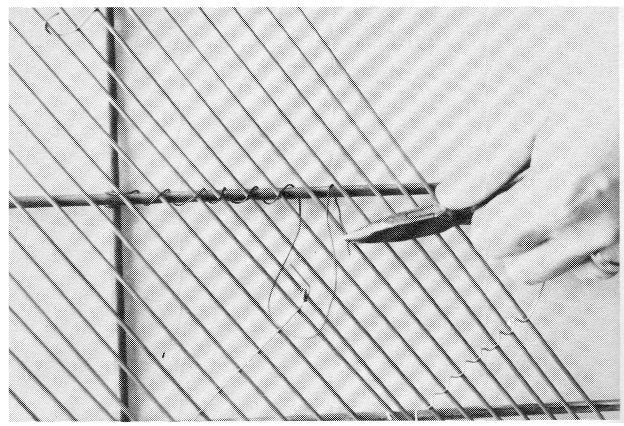
In an area where the wires meet a terminating member, such as the stem, at an acute angle, a special treatment of the ends of the WIRE PLANK is called for. At the point where the wire crosses, each strand is bent at right angles to the terminating member and then wrapped around the member to anchor it securely.



View at stem shows typical wire end treatment. This a little tedious but very strong and light.

LACING

Annealed wire, 22 gauge, can be used to sew the WIRE PLANK to the rod frame instead of using individual wire ties. Lengths about one foot long are best to work with. A hook is bent in one end of the wire, pushed through the mesh, passed around a rod and pulled back out. Grab the end of the hook with pliers and pull the wire tight. The wire is soft and can be laced around the rod and each strand of WIRE PLANK. After a number of pulls the wire will become work hardened and brittle. At this point simply cut off the wire, make it fast and start a new lacing.

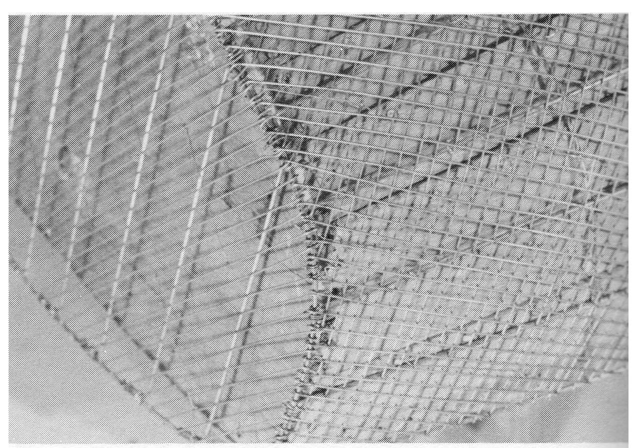


22 Ga. annealed wire lacing to fasten to longitudinal rods.

A two-man team can speed up the lacing process a great deal by having one man inside and the other outside the hull.

THE SECOND LAYER OF WIRE-PLANK

The second layer of mesh is applied at 90 degrees to the first. Again, the first strip is started near the middle of the boat. With this layer, a considerable amount of tying is accomplished by utilizing the

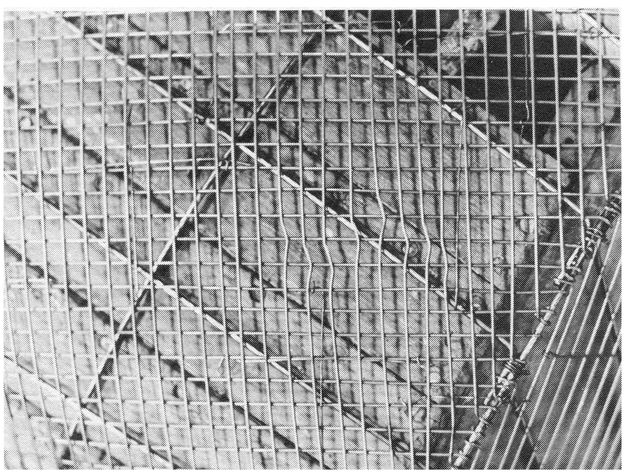


Second layer completed; photo shows end wrap at transom frame.

cross wires of the WIRE PLANK. The strakes are pulled tight to the first layer and sufficient side-to-side tying is performed to properly align the strips. Remember to place the WIRE PLANK cross-tie wires toward the inside of the boat.

FAIRING THE HULL

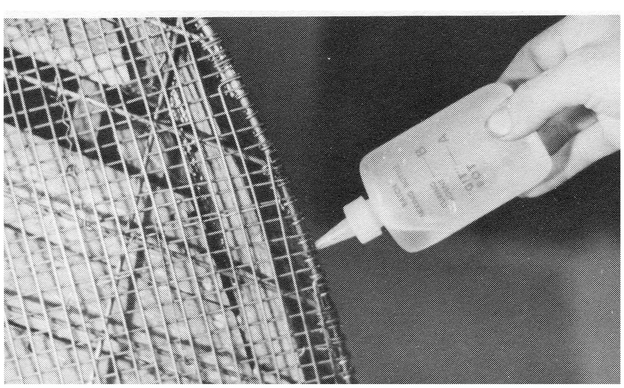
When all the required layers of WIRE PLANK have been applied, there will probably be spots which are not fair and smoothly contoured. In some places, where the WIRE PLANK has been forced into place, there will be a slight excess in length of the wire which can be "shortened" by putting numerous little joggles or kinks in the wire. In other places there will be little valleys and depressions which can be pulled out to some extent and faired smoothly.



Method of joggling wires to remove occasional slight bumps in fair shape.

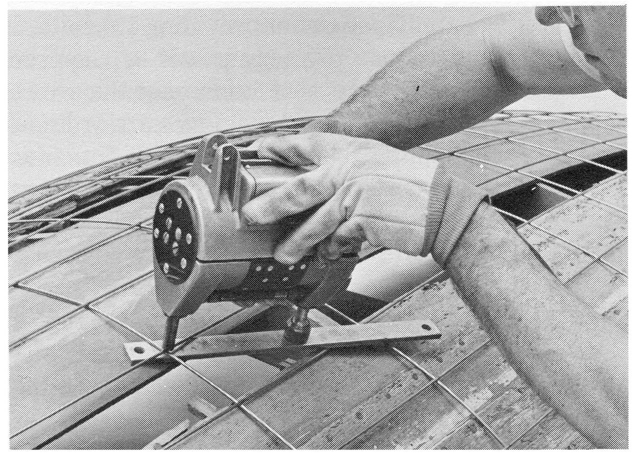
ADHESIVE TREATMENT

When all of the WIRE PLANK is in place a penetrating adhesive such as "GIT"ROT is used to seal all wrapped joints and fill the voids and spaces where mortar will not penetrate.



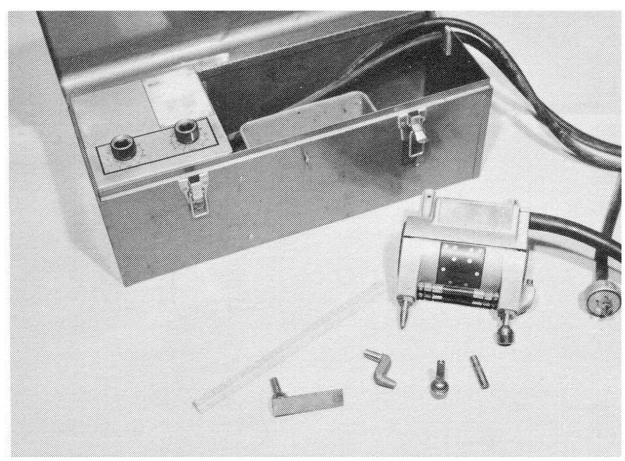
Method used to apply "GIT"-ROT to wrapped joints.

SPOT WELDING



Portable spot welder is used to join rod framework and eliminate wire ties.

Use of the spot welder will greatly simplify and speed up the process of joining the rodwork and also fastening the WIRE PLANK during construction of the armature.



Delonics portable spot welder. Box is combination carrying case and timer control. Various electrodes attach in taper receptacles.

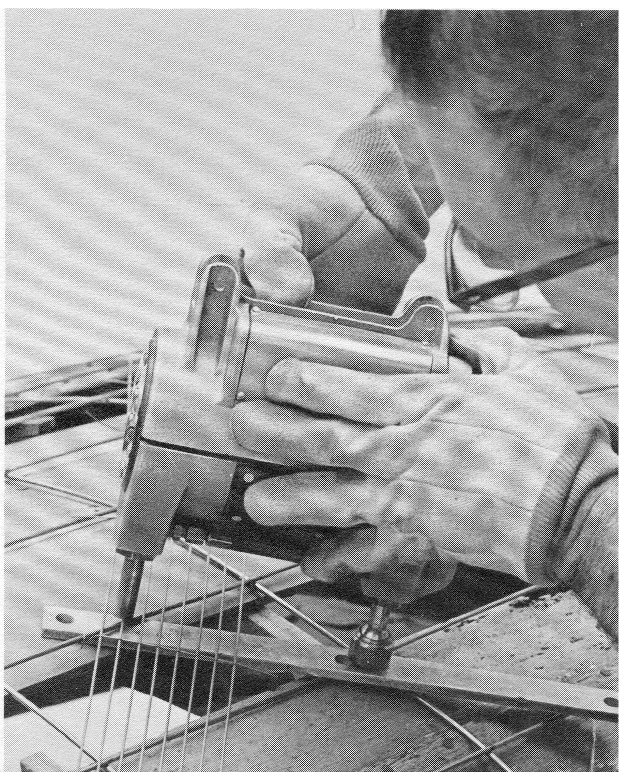
These machines are rather expensive but if a second hand job is obtained it can be sold later to another builder after the project is completed. These tools vary in form and weight, some are self contained units and others work with flexible chord electrodes. The air cooled models are limited to how many welds that can be made per minute by overheating of the electrodes. Welding is easily accomplished by pressing the two electrodes against junction points of the rods or wires to be fastened. The switch is pressed and two welds are made in one quick pulse. This can be repeated rapidly along a frame rod from spot to spot.

OPERATING THE WELDER

Generally an appliance outlet providing 220 volts, 30 ampere, single phase primary power is required. Flat face electrodes are used to increase the area in contact with the wire. These machines are ordinarily used on sheet metal, and then they use dome faced electrodes, so some slight rework may be required with a file. Wear cotton gloves to prevent accidental contact with a hot wire. Remove your wrist watch when welding as the tool generates a very strong magnetic field which could total a watch. If you get a water cooled model, only a very slow trickle flow of water is needed for adequate cooling.

SHORTING BARS

Due to the high resistance of the steel wire, it is sometimes necessary to use a copper shorting bar on the back of the rod or mesh to ensure that sufficient current will flow to make the weld. This shorting bar should be used on the first layer of WIRE PLANK particularly in order to produce the strongest weld possible.



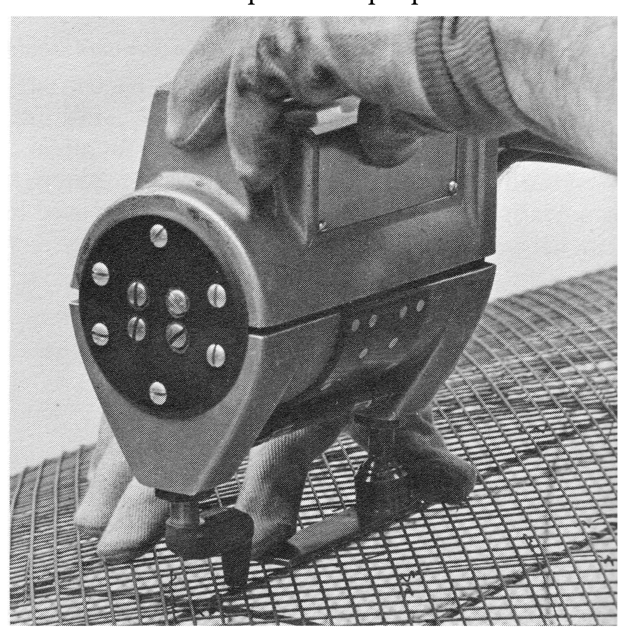
Copper shorting bar is used to increase current at weld. Bar is slipped under edge of last plank applied.

RUSTY RODS

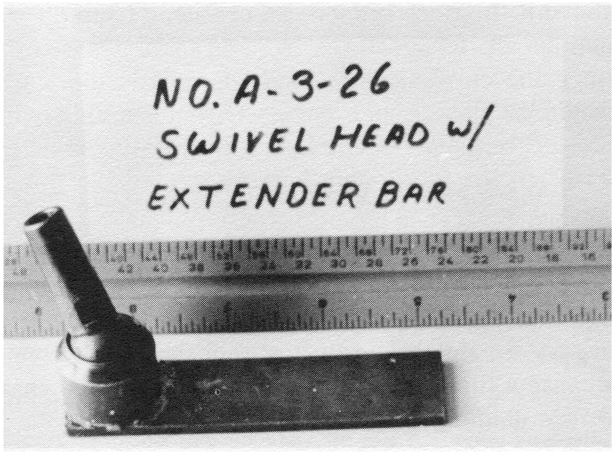
Spot welding will not work on rusty steel. It is necessary to use bright, shiny steel for the rod work if spot welding is to be utilized to fasten WIRE PLANK to the frame. If an occasional spot of rust is evident on the rods, a smooth file or emery cloth can be used to burnish the steel bright. If the rod framework become thoroughly rusty, a light scuffing with a disc sander will clean up the rust speedily. Should you wish to spot weld to pipe frames, disc sanding is also advised. Do not overdo the sanding and develop a flat surface on the rod work as the welding works best between two round surfaces.

WELDING SUBSEQUENT LAYERS OF WIRE PLANK

The second and subsequent layers of WIRE PLANK are spot welded in sandwich fashion along the longitudinal rods. Place the electrodes to hit the intersection of two wires that cross nearest to an underlying frame rod. Some experimenting may be called for here to get the best combination of current, time and spacing between electrodes. This will vary depending upon the configuration of the welder's electrodes. An extender bar can be used to shorten the distance between electrodes. This amounts to a piece of copper, approximately 1/8 inch thick by 1 inch wide, soldered to one electrode. Be sure to maintain a minimum of '/2 inch gap between electrodes. It will work best to solder the extender bar to a swivel head electrode if available for the particular welder. Another method that can be used to increase zap at the welds is to hold a copper bar on the opposite side of the skin matching the position of the electrodes. Of course this will require two people.

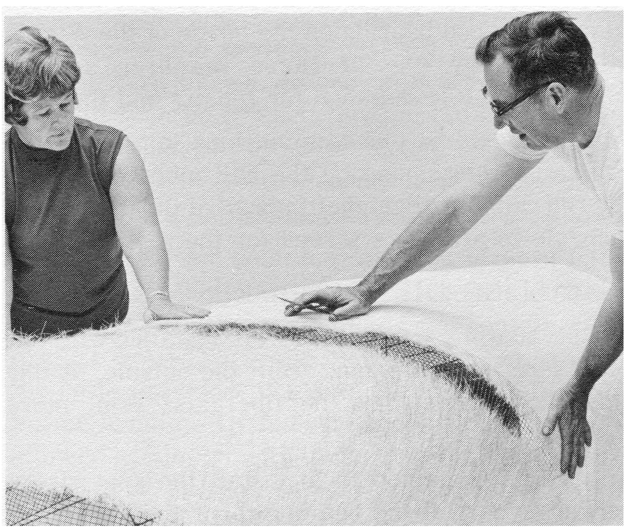


Extender bar shortens distance between electrodes. Note: Finger holds end of bar in contact with wire. Offset electrode also used.



SKINNING WITH FIBERGLASS

The mesh armature will now be rigid enough to remove from the building form. It should be left in place, however, all wire ties and other fastening holding the armature to the form should be removed so that the armature can be separated from the building form later.



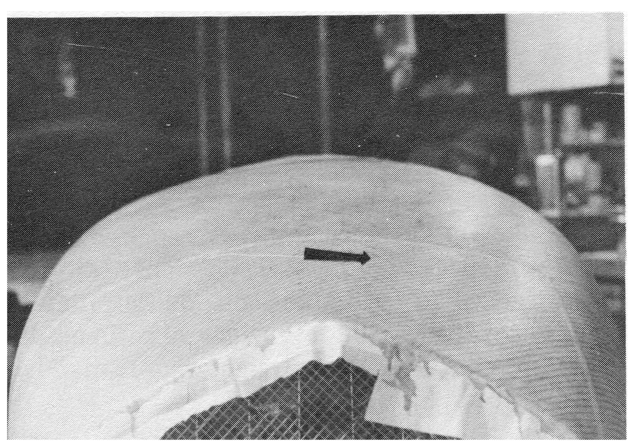
Tailoring fiberglass mat for exterior skin. Note: cotton fabric on right hand side.

Wash the mesh and rodwork thoroughly with solvent such as acetone, MEK, or similar cleaning fluid to remove any mill oil that may remain on the wire. This is important in order to assure a good bond with the fiberglass and also the FER-A-LITE mortar. If the armature rusts slightly, this will cause no problem with bonding. The important thing is to remove any oil or grease. Most solvents are very volatile and flammable. They should be used only in a well ventilated space with no smoking or open flame in the area. Beware of the fire hazard.

The fiberglass skin consists of one layer of $^3/4$ ounce mat with no overlaps. This is covered with a thin, inexpensive fine-weave cotton fabric from a dry goods or department store. It is supplied in 36 inch width which will conform to the compound curvature of the hull without wrinkling. Allow several inches at each end for clamping. Prepare the fiberglass mat into strips about two feet wide.

When tearing fiberglass mat grab with a space between fingers.

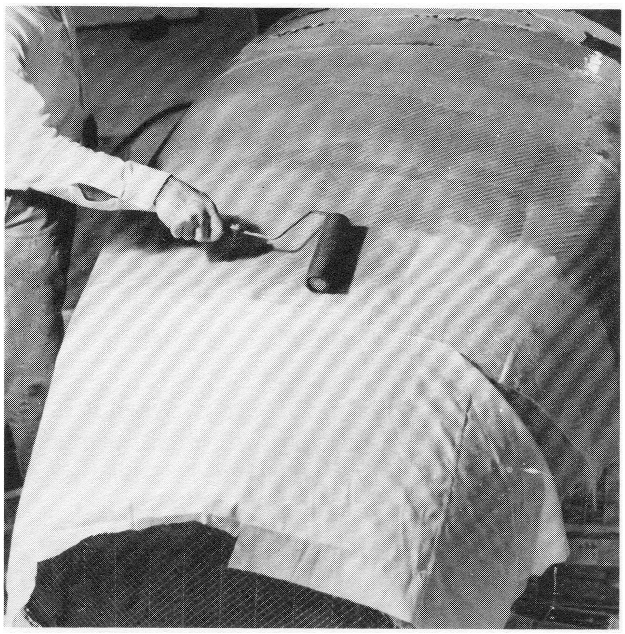
Instead of cutting the mat, tear it. When it is wet with resin, the ragged edge will blend together to make an invisible joint which will be smoother and stronger than a butt joint.
Fit the fiberglass mat to the hull diagonally as shown. Tear the edges of adjacent strips so they fit together roughly in the shape required to cover the hull. When mat is dry it will not follow the compound curvature of the hull and will not fit smoothly to the adjacent strip. When it is wet with resin however, it becomes limp and pliable enough to be



Arrow shows area with excess resin, causes second layer of wire starting to show through.

easily worked to a smooth, rounded contour. Fit the strips of mat on the hull and lay the fabric on top of it as smoothly as possible. Apply the resin with a roller until the wires show through clearly. If too much resin is applied, droplets will be seen forming below the wire and these may flow down to the second layer of WIRE PLANK which will then also be visible through the mat. Avoid this.

When placing the next strip, fold back the cotton along the edge so that the two pieces of mat will blend together. Then overlap the cotton and pull it smooth. When the entire surface of the hull is covered and wetted, pull the cotton fabric taut and smooth and clamp the ends until the resin cures.



Apply resin with roller. Cotton overlay may be overlapped or butt joined.

SKINNING RESIN

The type of resin to use with the fiberglass and cotton skin should be thixotropic or "super" boatbuilding resin with low wax content which can be obtained at most boat yards. It is very important to have all the material needed for the job at hand before starting this task.

An estimate of the amount of resin required can be made by weighing all the fiberglass mat and cotton fabric needed to cover the hull. Multiply this by four; this is the amount, by weight, of resin needed to saturate the skin. Resin weighs approximately 9 pounds per gallon.

Prior to working with polyester resin on the hull with either fiberglass skinning or FER-A-LITE, one should consider the following: Best results are obtained if the work is done indoors away from direct sunlight in temperatures from 50 to 70 degrees F. Since the cure is inhibited by dampness the work should be done under cover. Direct sunlight will accelerate the cure to the point that it may start to gel when the job is only half completed.

One quart is a good batch size. A large clean and dry fruit juice can may be used as a mixing container. The required amount of catalyst will vary according to the manufacturers specifications. Select the largest amount of catalyst within the range given because a thin skin is slow to cure and that is what we are dealing with.

REMOVE, THE BOAT FROM THE FORM

After the fiberglass skin is cured, the entire structure is lifted off the building form and placed upright on a suitable cradle. Handle the boat gently and avoid racking the hull at this point.

FITTING THE RUB RAILS

Make up and fit rub rails. They are fastened bow and stern with flat head stainless machine screws. The nuts are buried within the plaster. Use washers to provide good hearing on the inside of the WIRE PLANK. The use of these machine screws facilitates future removal for repairs and the like.

A strut should be placed amidships to prevent the rub rails from squeezing the hull inboard. Locate the rub rail slightly higher than all of the wire at the gunwale to provide a screed for the mortar.

INSTALLING THE SEAT RISERS

On this boat, these members were installed with flat head screws countersunk from the outside, at this time just hanging on the fiberglass skin, more details later.

An alternate method is to install the seat risers earlier as part of the building form and fasten the transverse rods to the riser with round head screws.

BREASTHOOK AND KNEES

These members add strength at the bow and stern. They are made up of 3/4 inch plywood to fit in a position about 3/8 inch below the sheer line and shaped as shown. A precision fit is not required as space is left between the wood and the wire mesh on each side. This is filled later during plastering. A curved wire is installed flush with the top of each knee and breasthook. This wire ties the sheer rods together at the bow and to the transom at the stern. The wooden pieces are laced to the rod work and wire mesh with mesh with .18 gauge wire passed through holes drilled near the edges of the wood.

Marine plywood filler block is wired in place. Note: shaped rod member added for extra strength.

MIXING FER-A-LITE

Before starting to mix FER-A-LITE brand synthetic mortar and applying it to the armature, be sure that the wire mesh is thoroughly clean and free of oil. A little rust will not matter, but oil will prevent a good bond between the metal and the mortar. You will need a one gallon measuring can with a wide mouth, and some wooden stirring paddles.

Cleanliness and neatness pays off when doing this kind of work since drips and spills of resin and mortar will soon be tracked through the shop and surrounding spaces if considerable care is not taken to prevent this. A good measuring container can be made out of a one gallon can with the top removed.

A very important point to remember is that FER-ALITE is synthetic mortar and doesn't mix with water. Be sure the mixing pails and containers are dry. FER-A-LITE brand mortar is mixed only with the resin provided. Water is not used at all in mixing or handling it. Indeed, water should never be allowed in contact with the mortar until it has cured completely.

BLENDING THE CATALYST

Due to the very small amount of catalyst that is used in each batch it is better to mix the catalyst into the resin before actually completing the mix. This is easily accomplished by making a conical depression in the REINFOR-CEMENT type aggregate in which the resin and catalyst will be mixed. Pour resin next, then the catalyst. Thoroughy mix the resin catalyst mixture before stirring it into the aggregate. Stir from the top down keeping a resin cover over the aggregate to avoid fluffing up a lot of dust which is irritating, particularly to the eyes. Continue stirring until the dark grey lumps disappear, this will indicate thorough mixing.

The curing time of the resin is affected primarily by the amount of MEK peroxide catalyst mixed into the resin and the temperature of the resin, the armature and the surroundings. Slight variations can be expected between different lots of resin and of catalyst. High humidity may retard curing time. Pigments and fillers can retard or accelerate curing. It is recommended that curing characteristics be checked by mixing small quantities under the working conditions at hand. The following table shows the amount of catalyst which should be added to one gallon of resin at 70 degrees F. to obtain the gel time shown. Gel is said to occur when the resin takes a "set". It should not be handled or disturbed from that time until cure is completed.

TYPICAL CURE CHARACTERISTICS OF

FER-A-LITE BRAND MORTAR

AT 70 Degrees F.

(tsp/gal Catalyst]	(minutes)
2	70 to 100
4	40 to 60

Experiment carefully in mixing larger batches or when using mixing equipment. This material cures with an exothermic (heat producing) reaction which is more pronounced the larger the batch or mass of material. Removal of the material from the mixing container and trowelling it onto the armature will moderate this effect.

After emptying the container of one batch, scrape the remains out thoroughly as any large amount of residual material will tend to accelerate the cure of the next batch. When mixing is completed for the day, equipment should be thoroughly wiped and cleaned. Hot water and Soilax, acetone, or MEK solvent can be used. Always observe ventilation and fire precautions when using the volatile solvents.

ESTIMATING THE AMOUNT OF FER-A-LITE REQUIRED

If the armature is finished or the building form completed to the stage where the ribbands are in place, the job of estimating the area of the hull is quite easy. Simply snap on some rough guidelines which outline three foot squares (square yards) on the hull or building form. A chalk line can sometimes be used here. Count the number of squares and multiply by nine to obtain the area in square feet. The size of the odd areas can be estimated.

Estimating the area from the plans is more difficult. One way is to scale off from the drawings the linear distance around the hull from gunwale to gunwale at each station. Multiply the average length of two stations by the distance between them, measured along the gunwale, to obtain the hull area between those stations. Do this for all stations and add them up to obtain the total hull area.

Knowing the surface area and the thickness use the table in the appendix to compute the volume required.

PLASTERING THE HULL WITH FER-A-LITE

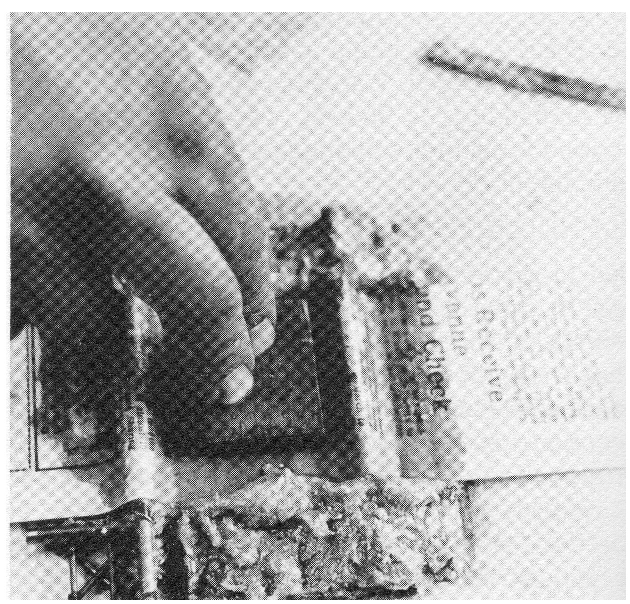
FER-A-LITE brand mortar is trowelled on starting inside the hull at either end of the boat. It is worked into the mesh systematically filling the area between the transverse rods one section at a time. Start from the keel and work upwards. A small pointed trowel will be needed to work the mortar into the mesh in the narrow space around the stem rod. Disposable wooden paddles in various shapes will be helpful in coaxing the mortar into place. Properly mixed mortar will allow a working time of about two hours, more or less, depending upon the temperature and thickness of application. Scoop up a large blob of mortar with the trowel and apply it to the panels formed by the transverse and longitudinal rods. Mash it down so that it spreads out and fills the void between the fiberglass outer skin and the rod work covering the wire mesh at the same time. Avoid as much as possible making bubbles or cavities by applying each trowel full of mortar on top of the last, near the edge, and work upwards toward the gunwales on each side of the boat. Only a few minutes of work in handling the mortar are necessary to get the "feel" of it. Press it down firmly and squash it out so the mortar penetrates the mesh and oozes along the hull and over the rod work.

Do not try to finish the entire boat in one session. Stop, rest, and clean up the equipment while the first trial application cures. As a double check on the correct amount of catalyst required, note the time it takes for the FER-A-LITE to cure and then, if necessary, adjust slightly the amount of catalyst in the next mix. If curing takes more than about four hours, add an additional 1/2-teaspoon of catalyst.

If the cure occurs too rapidly, reduce the amount of catalyst 1/2-teaspoon until the right balance is achieved between gel time and working time required before gel sets in. Temperature will have a marked effect on curing time with higher temperature resulting in a faster cure. Avoid plastering in direct sunlight or in temperatures below 50 degrees F. Be sure to work the mortar well up into the space between the seat riser and the mesh and form it into a fillet or a 45 degree chamfer under the seat riser.

COVERING INTERIOR WITH NEWSPRINT

You will find that it is not possible to trowel the FER-A-LITE to an absolutely smooth finish because of the somewhat tacky consistency of the mortar. By placing strips of newspaper directly on the mortar between the longitudinal rods, a barrier is formed which permits smoothing the surface nicely. The newspaper is left on during the cure and becomes impregnated with some of the resin from the system. It develops into a tough hide similar to kitchen counter tops and serves to provide a positive minimum cover thickness over all of the wire. The paper strips should be cut to fit between the rods so that they do not cover the junctions at the transverse rods. Wrinkles are a problem here. A small wood block, about 1 1/2 inches x 3 inches, can be used as a smoothing, tamping tool to produce a finished surface. Do not worry about the ends of the paper strips where they overlap as the excess can be torn off and the edges sanded or wire brushed smooth after the resin cures.



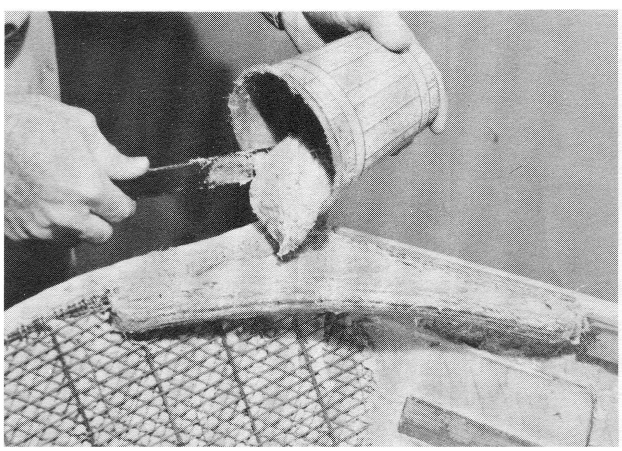
Wood block used to flatten paper and shape fillet
over

SHEER CLAMP

As the plastering progresses, spacer blocks for the sheer clamp are pressed into the wet mortar and clamped in place, until it is cured. Later on when the wood work is being completed, you will find it helpful to work pilot holes for screws through the blocks and sheer clamp from the outside of the hull. (This is because of locating the holes to miss the wires). Of course, the rub rail has to be removed to do this job.

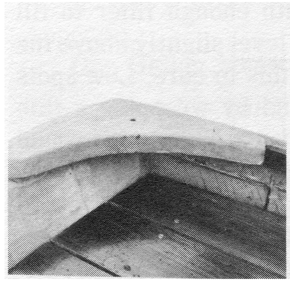
FINISHING BREASTHOOK AND KNEES

After the hull is plastered and the sheer clamp installed, the breasthook and knees can be finished. This is done in two stages. First, the mortar is plastered to a thickness of at least 1/4 inch over the wood parts previously installed. This is trowelled flush with the gunwale and the top of the transom. To get the curved shape at the inner edge of the knees and breasthook, use a cardboard dam taped to the blocks and to the hull. Be sure to work the mortar well down between the block and the inner hull as these parts are subjected to high stress and must be well bonded. Do not plaster around the sheer clamp as this would complicate future repair work should it be necessary to replace the sheer clamp. Smooth the mortar as much as possible but don't worry about surface finish at this time. Let the first coat cure, then scuff it down with rasp and coarse sandpaper to remove the high spots. Then apply a second finish coat of mortar, filling in the valleys and hollows. This is sanded smooth after it cures.

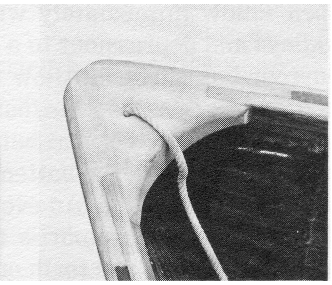


Pouring FER-A-LITE onto knee assembly. Note: transom is plastered half way through (2 shot method). This was done with a newspaper outer surface as another experiment.

An excellent way to save the cost of hardware and to provide a good strong mounting point for the painter is to drill a hole down through the breasthook slightly larger than the painter diameter. Use a 7/16 inch hole for a 3/8 inch painter and round the edges of the hole smoothly. Pass the painter down through the hole and tie a figure eight knot to secure it.



Completed stern knee.



Method of installing painter. This boat has wrong end treatment of sheer clamp. It would make repairs difficult.

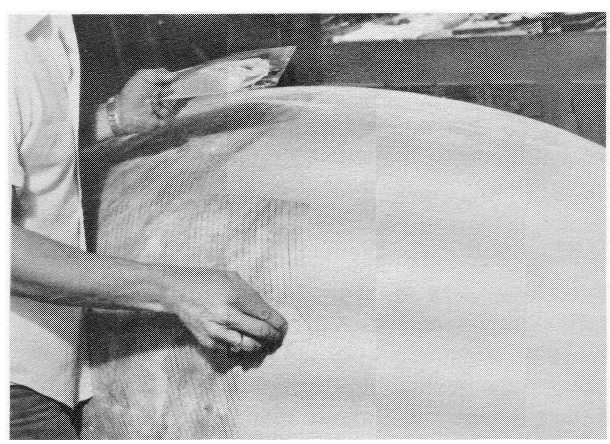
INTERIOR SEALING

When all the interior plastering has been completed, a sealing coat of epoxy or polyester resin is brushed on. Pigment can be added for color. This coating seals the mortar, fills tiny voids, covers bare spots in the wire and provides a smooth, pleasing appearance to the inside of the boat.

EXTERIOR FINISH WITH BODY PUTTY

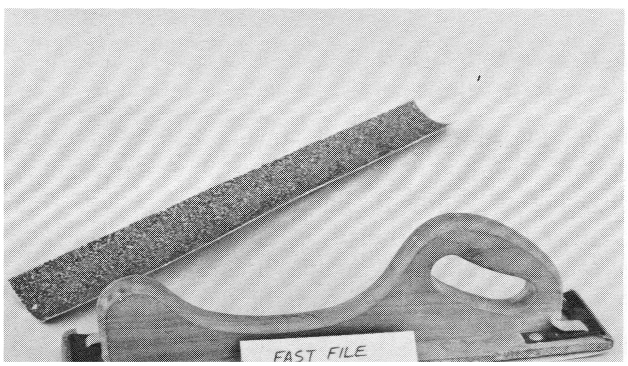
A high gloss finish similar to fiberglass can be achieved by fine fairing with auto body putty prior to enameling.

Scuff off the high spots with coarse sandpaper and apply polyester auto body sanding surfacer putty, Ditzler No. 999, White. Mix together, on a palate, a strip of cream hardener No. DX 672, about three inches long, to a portion of the putty about the size of a golf ball. Blend thoroughly so that there are no streaks of color evident. Be careful not to whip air



Applying first coat of auto body fairing into the mixture and do not use an excess of hardener. Under no conditions should activated filler be saved and put back into the container.

Using a flexible squeegee, apply a thin glaze coat first, in order to fill scratches and grinder marks, then follow immediately with enough filler to fill valleys and depressions to a level slightly above the surrounding surface. Allow this to cure. Low spots and depressions can be found by wrapping a thin wooden batten over the hull and sliding it around over the surface. The batten will bridge the valleys which must be filled. An even more precise method for gauging the contour is to use a straight edge, and rock it back and forth on a convex contour. Using this method you can easily detect and feel the slightest flat spot.

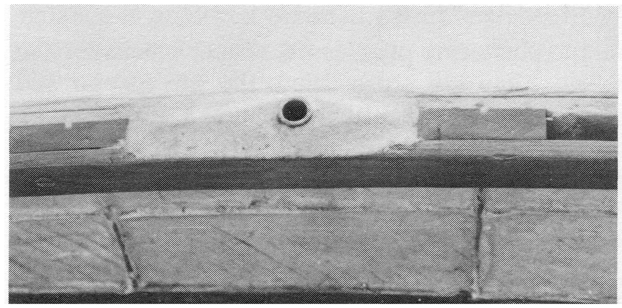


This tool has a quick paper change release feature.

Sanding technique is very important because if it is not done with proper equipment you may take off material in the wrong places. A "Flat File" surface sander about 17 inches long and $2^3/4$ inches wide can be made up or purchased at an auto body shop. This is used with aluminum oxide open coat body paper, 36D and 80 grit. A short base sanding block is not satisfactory because it will follow the existing contour and will not remove the high spots.
The hull is then painted with a good grade of marine paint in accordance with the paint manufacturer's instructions.

OARLOCK SOCKETS

Oarlock sockets are very simple to make and install. Simply cut two pieces of $^1/z$ inch inside diameter brass pipe $2^1/2$ inches long and fit them between the inwale and the hull so that they stick up above the sheer line about $^1/z$ inch. Mortar them in place with a smooth fillet to within about $^1/a$ inch of the top of the pipe as shown.


Low cost highly functional oarlock socket.

SKEG

A skeg or keel can be built up with starter rods worked into the mesh and wired fast to the transverse rods. This rod framework is then covered with wire mesh and filled with mortar.
The method used to complete this boat was to bond fast a wooden skeg with Epon-6 Adhesive and fasten with (5) large flat head wood screws. "LIFECALK", a one part Thiokol compound, would be a convenient sealer for this job.


Wood skeg was bonded in place and fastened with large screws.

FINISHING UP

Since this book was written primarily to provide the builder with instructions on handling WIRE PLANK and FER-A-LITE, the details pertaining to installation of interior joiner work, seats, and hardware have been omitted. Some ideas of how to treat these items are shown; specific information will be contained in the building plans. Additional information can be found in most books on boatbuilding.

ADDITIONAL IDEAS FOR LARGER BOATS

This section of the book contains assorted useful ideas and methods for handling these materials on larger boats.

HANDLING A 55 GALLON DRUM OF RESIN

There are some tricks that simplify handling 55 gallon drums of resin. When the truck arrives with drums of resin, many times, the truck will not have a power tail gate.

If this is the case the problem can be handled by using old auto tire cases as a cushion on the ground upon which the drum can be safely dropped. Never attempt dropping the drum directly from the tail gate to the ground, it may split open. Stack four or five tires on their sides and located so that as the drum rolls off the tail gate it will land centered on the tire stack.

The drum of resin is laid on its side and rolled in a position parallel to the edge of the tail gate. Grip both end rims with heavy gloves and firmly roll the drum off the gate onto the tires. Hold fast and guide the drum as it takes its first bounce, then tilt it onto an end. Naturally let go the hand that is heading towards the ground.

This whole procedure seems a little frightening the first time; however, it is something like your first bike ride. It is easy after you have done it once.

Hey! Watch your toes.

While the drum is on end, install a valve, either 3/4 inch gate drumcock or a 2 inch molasses valve. You will need to either build a stout wooden stand or get a metal tilting drum stand to set the drum in position to drain into a gallon measure.

POWER MIXING OF FER-A-LITE

The relative ease with which this mortar can be mixed using simple equipment greatly facilitates dispensing large quantities of mortar.

The following equipment is needed:

5 Gallon Pail

1/z Inch Slow-speed Drill Motor
A "Jiffy-Mixer" Model P or Equivalent
(see Appendix)

One Gallon Measuring Pail for Resin

The material is handled similarly to hand mixing except that the actual stirring is accomplished by the jiffy mixer. Be sure to work into the corners of the pail so as to get all of the catalyst thoroughly and uniformly mixed into the aggregate.

If it is necessary during the plastering job to leave the mixing equipment soiled and unused between batches, it is important to scrape off the captured mortar that clings to the mixer. Otherwise it is possible to introduce globs of half-cured material into the next batch to be mixed.

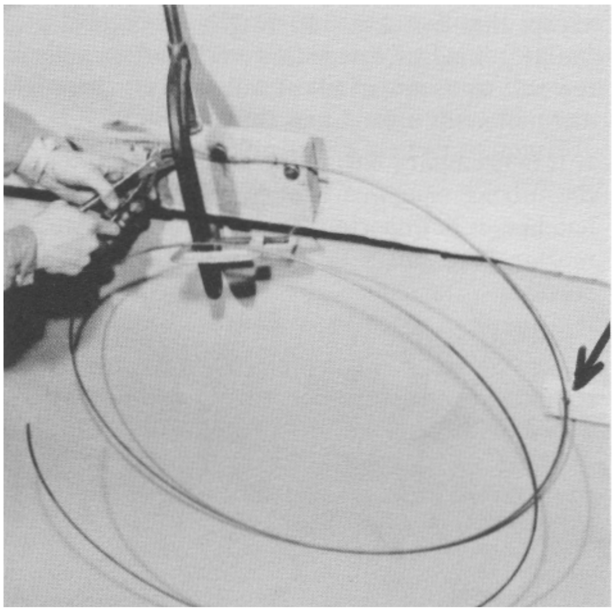
When the days mixing has been completed, all equipment should be thoroughly scraped off and wiped with acetone in a well-ventilated place. Acetone is very volatile. Do not run the drill motor near an open can of acetone as there might be a serious fire or explosive hazard.

Bag *of REINFOR-CEMENT,* gallon of resin *and "JIFFYMIXER"*

STRAIGHTENING SMALL DIAMETER RODS

Due to the difficulty in obtaining straight rod in long lengths it is better to purchase the rod in coils and pass it through a simple straightener. A home-made three-roller straightener can easily be made using roller skate wheels, ball bearings or plain rollers. The center roller is mounted so that it is adjustable. The rod is fed into the straightener through a screw eye positioned to guide the rod into the roller in the correct alignment, normal to the helix angle of the coil. (This is a must for this type of

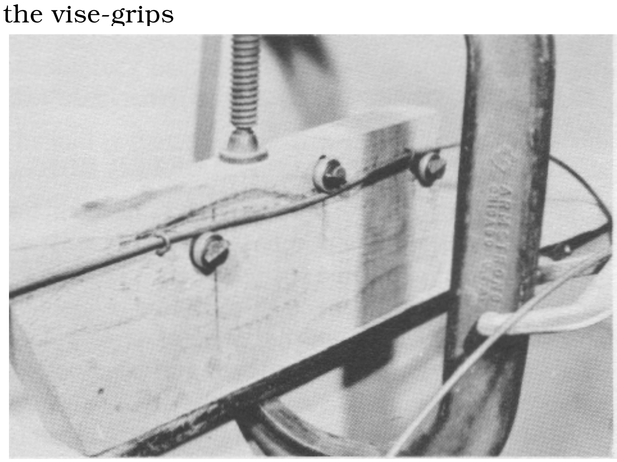
The rod is led in over the first roller, under the middle one and over the third. A bit of persuasion is required here using vise-grip pliers and a screwdriver. Pull a short length of rod through the straightener to check the adjustment of the center roller and adjust the setting of the roller so that the rod comes out straight. Lock the adjustment and it should need no further attention unless another coil is received having a larger or smaller diameter.



Note: guide eye at arrow ...keeps wire at a constant angle

Determine the length of the rod for each turn on the coil. Then simply pick up the end so that it comes off the coil like a giant spring, count the number of

turns required and cut it off with bolt cutters. Thread the end into the straightener, clamp on the vise-grips and walk away with it. Stop just before the far end passes through the eye, go back to the straightener, take another grip with the vise-grips



Rod straightener. Note: center roller is adjustable.

and pull the bitter end through smartly, making sure the rod does not twist out of line. Of course, the straightener should be mounted securely on a sturdy support at a convenient working height.

FIBERGLASS SKINNING

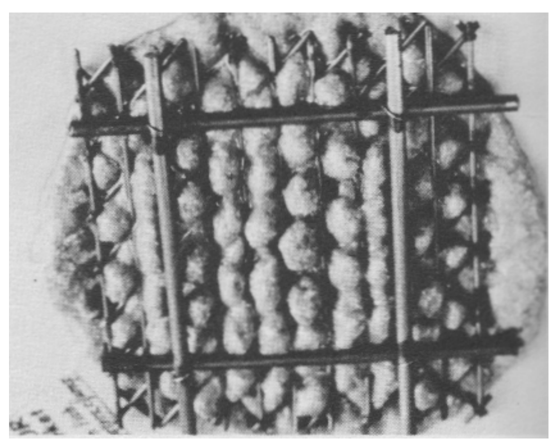
This method has many advantages and is recommended for all boats where an open type of mold is used, facilitating access to the inside of the hull. The fiberglass skin can be very thin and therefore, inexpensive; but it provides an ex

cellent water tight barrier over the wires with an exact minimum thickness. Utilizing the techniques previously described, this skin is simple to apply and will be an invaluable help to simplify the problems of plastering day.

When working this trick upside down, care must be taken not to bridge hollow curves like the under side of a wine glass section and try stretch pulling the skin tight as it may lift away from the armature. It will be necessary to orient the strips of material so that it always lays in a direction of convex curvature.

APPLICATION OF FER-A-LITE TO LARGER HULLS

If an external skin of fiberglass is not used as sheathing, the hull is plastered from the outside as with ordinary cement. The FER-A-LITE brand mortar is applied with a trowel and forced into the mesh until it penetrates through to the inside of the hull with a dimpled effect. Place each trowel full near the edge of the mortar already applied and work it out as previously described. The fibers in the aggregate tend to mat on the surface of the top layer of wire mesh. Always work with an excess of mortar which, when flowed on the wire, will sweep these fibers through the opening; then sweep the



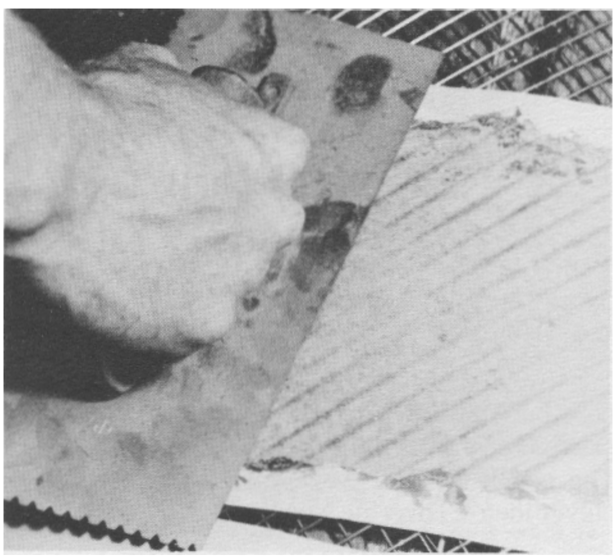
Mock up of inside of open grid frame type hull while plastering.

trowel with a jittering, oscillating motion in short, rapid strokes to work the mortar down to the desired cover thickness. Fair it around the rods as smoothly as possible.

APPLYING NEWSPRINT TO THE EXTERIOR *OF* THE HULL

In some instances on larger boats where the fiberglass skinning technique is not used, the newspaper covering idea is helpful as an assist in troweling the surface smooth.

As the mesh is being troweled full of mortar, apply an excess about 1/8 inch thick over the wires. Sheets of newspaper are layed onto the wet mortar. A dry flat trowel is used on top of the paper to press mortar to the desired cover thickness over the wires - 1/16 inch is ideal.



Troweling the paper smooth while working on a dry surface.

The troweling action is more like patting to press the paper smooth with a little rotational rubbing. The paper will remain dry on the outside for a short while and it is easier to get the paper smooth while it is dry.

The compound curvature depending upon the size of the boat will prevent the paper from conforming to the shape of the hull. Some places it must be tailored with slits or cut to smaller size pieces to fit in place.

The overlaps that are created in this process are of no consequence. After the mortar is cured the excess paper is torn off and the edges feathered smooth with sandpaper.

If for any reason the newspaper effect is desired for display it will require a clear resin coat on the outside to seal it.

STAPLING THE ARMATURE

WIRE PLANK lends to all of the known Ferro-cement construction methods: however, stapling to a disposable wooden form is probably the most practical. This is similar to the common cedar mold method except the WIRE PLANK and FER-ALITE materials are far better suited to the process. The open thinner mesh and excellent flowing characteristics of FER-A-LITE facilitates this process without the problem of trapped voids occurring on the back side of plastering.

The natural tendency of WIRE PLANK to hold fair shapes permits this process to be done on widely spaced ribbands, rather than a full male plug, which makes the job even simpler.

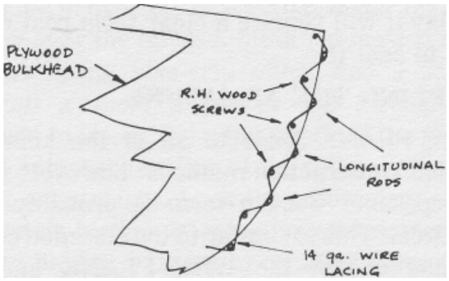
An air operated power stapler which will drive staples up to 1-3/4 inches long is available, from Power Line Products

There are some interesting possibilities when using this construction approach. One is that the ribbands may be left in place in the hull after plastering. They can then serve as battens upon which a ceiling (perforated exterior masonite for example) can be attached.

If the WIRE PLANK layup type is either the simple shell or sandwich, an interesting approach is to use galvanized insect screen as the first layer over the ribbands. This will provide a back stop to retain the mortar when plastering, yet let air through to eliminate trapped voids. This is particularly helpful in tight spots where it might be difficult to get at the inside of the hull for finishing.

INSTALLATION *OF* BULKHEADS

Plywood bulkheads can be installed during construction of the armature at an early stage, or later when the hull shell is completed. There are several advantages to the former method such as ease of installation, greater strength and use of the bulkhead as a station mold. In this method, round-head wood screws are inserted about 5/8 inch from the edge of the bulkhead, spaced between the longitudinal rods. Leave about 3/32-inch clearance under the head of each screw. Then, as the rodwork is applied, a galvanized wire lacing is passed alternately around each rod and under the screws to fasten the bulkhead to the armature. The size of this wire lacing would vary from No. 14 to No. 10 gauge, depending upon the size of the boat. When the assembly is complete, tighten the screws and then the assembly is completely embedded in mortar.



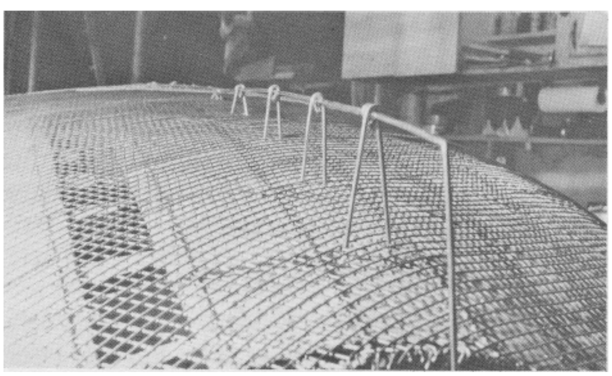
Bulkhead installation detail

Another method for installing plywood bulkheads is to bond them in place with fiberglass tape and resin after the hull shell is completed.

ALTERNATE METHODS OF INSTALLING

SKEGS AND KEELS

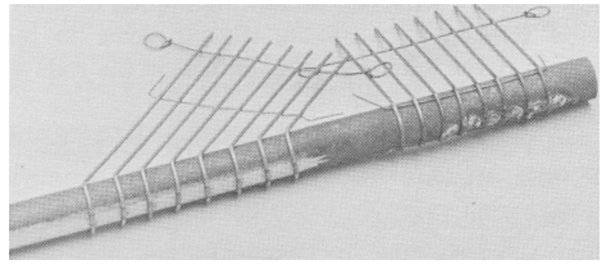
On certail hull shapes such as a "Cape Cod Cat" or a "Jonesport Lobster Boat" it would be simpler and better to layup the rod framework and WIRE PLANK to the basic hull contour. The keel is then added as a falsework. Starter rods are worked through the mesh and fastened to the transverse frames then keel framework is built upon the starter rods. Mesh is applied and the whole works would be filled with Portland cement. Of course this description is over-simplified however the principal can be varied in many ways.



Starter rods worked into hull frame as a base for a skeg framework.

WIRE PLANK END TREATMENT

Where WIRE PLANK ends at a terminal member like the stem, an alternate treatment to welding or wrapping turns is to carry the wire around the member in an overlap. When doing this, be sure to fold the wires so that the ends of the overlap lie like fingers between the wires of the strips on the other side of the boat. This will eliminate any build up of thickness or bumps.



Treatment of WIRE PLANK when terminating at a pipe frame member. Note: angle is corrected for straight wrap around. Left side is spot welded. Right side is arc welded. This proved very difficult, probably heliarc would work o.k.

REJUVENATION OF OLD WOODEN HULLS

NUHULL™

ARMOR PLATING
FOR
WOODEN HULLS

Using Palmer Diversified Ventures, Inc., WIRE PLANK® and FER-A-LITE® to restore and strengthen old wood boats.

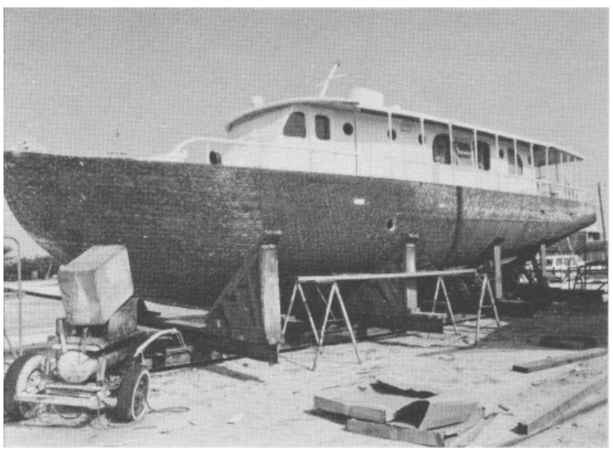
These materials were developed primarily for boat building. It turns out that their properties proved to be suitable for numerous other things. The people at Boot Key Marina pioneered the clever idea of covering wooden boats.

ADVANTAGES

1. Eliminates leaks caused by working hull by adding tremendous strength. (Like diagonal strapping.)
2. Wormproof.
3. Re-attach external ballast (encapsulate)
4. Prevents catastrophic failure such as sprung garboards.
5. Reduces annual maintenance . . . no more seams to caulk.
6. Will not separate or peel from hull.
7. Has long life expectancy similar to fiberglass.
8. Lightweight.
9. Plastering can be done in small increments and does not require a skilled mason.
10. Easy to repair.

Many wooden boats are dearly loved but become impossible due to skyrocketing main-

New Hull on Dockmaster Bob Foright's 57' "African Queen" was applied at Boot Key Marina, Marathon, Florida.



(3) layers Type W14x.437 WIRE PLANK FERRO-MESF1`R' were used. Note: rub rails were removed.

tenance costs. "NU-HULL" is a system for FERRO treating wooden hulls that really works. The features of this system are ideally suited to "beef up" an aging hull. The continuous length steel strands of the WIRE PLANK Brand Mesh are applied diagonally and transversely to provide a tremendously strong membrane over the hull. FER-A-LITE type synthetic mortar, being a close cousin to fiberglass, is fairly easy to apply. Its resilience is compatible with wood and the system is waterproof, which of course, prevents any rust on the wires.

Unlike a FERRO-CEMENT coating, this system does not add an unreasonable amount of weight to the hull. A good portion of the added weight is offset by the fact the hull becomes slightly larger and displaces more water. The FER-A-LITE has neutral buoyancy and supports its own weight below the water line.

Depending on the size of the boat and condition of the frames, two or three layers of W14x.437 WIRE PLANK would be used. The hull should be wooded and a heavy barrier coat of resin applied. The purpose is to isolate the wire from the salt soaked wood.

Thousands of heavy staples provide tremendous strength in the tie to the wood, which in addition to the adhesion of the FER-A-LITE eliminates the possibility of separation.

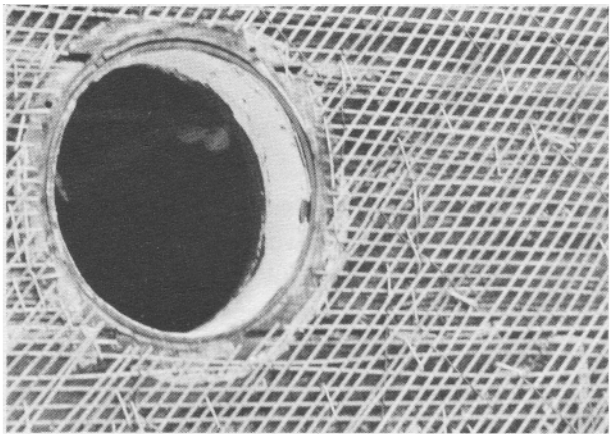
The WIRE PLANK should be securely fastened with #16 gauge galvanized staples. The first two layers should be applied @ approximately 45 degrees diagonal, a third layer thwartships and always start layers amidships and progress toward ends. Preshape hard bends to lie fair before stapling. Because the mesh is supplied in 500' lengths, it is practical to always use full length strips, which avoid any weak spots in the skin. Anticipate the direction of the next WIRE PLANK layer and orient staple heads parallel to that. The staples will lie between wires and eliminate bumps. Wherever practical, the ends of the wires can be bent at 90 degrees and driven in like nails. Pilot holes are advisable to prevent splitting.

The outer layer should be applied without staples, using the cross wires for ties or use light staples on the cross wires only. This will simplify the plastering by eliminating any bumps.

In areas where the FERRO-MESH would be in contact with Bronze thru hull fittings, a barrier of 1/16" thickness of FER-A-LITE should be applied to preclude the possibilities of electrolysis.

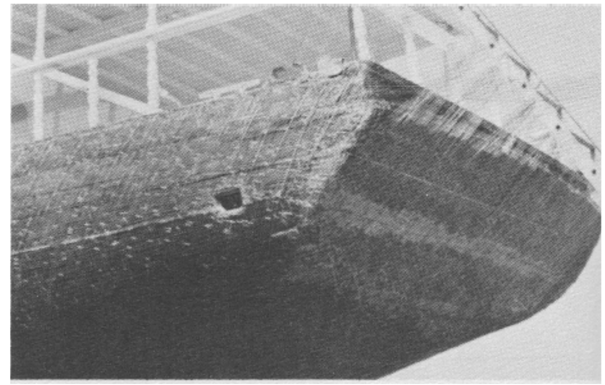
Any Dry Rot should be removed or "GIT"-ROT® treated. While on this subject, if decks or waterways are holding or leaking any water, they should be fixed. Fresh water getting inside is the reason for failures on some fiberglassing jobs and would have the same effect here. A thoroughly prepared job done carefully will not cause Dry Rot to propagate.

On sailboats, outside ballast should be completely encased with the WIRE PLANK. This is great insurance against drop outs. On many older boats there is a nagging worry . . . do those keel bolts need replacing? It is quite simple to run the transverse layer of WIRE PLANK from gunwale to gunwale full length. However, diagonal planks are more difficult to work around the corners and should be worked from each side.



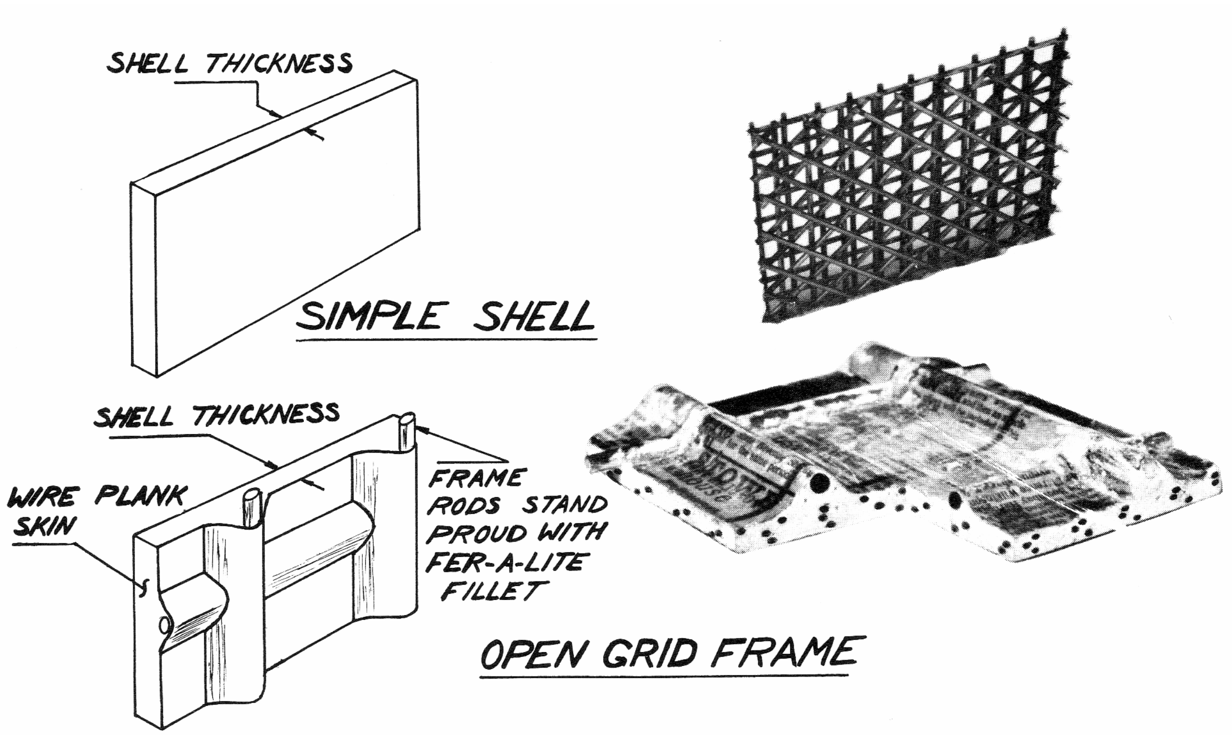
Port Hole Treatment: The steel Wire Plank is trimmed short of all bronze fittings to avoid electrolysis.

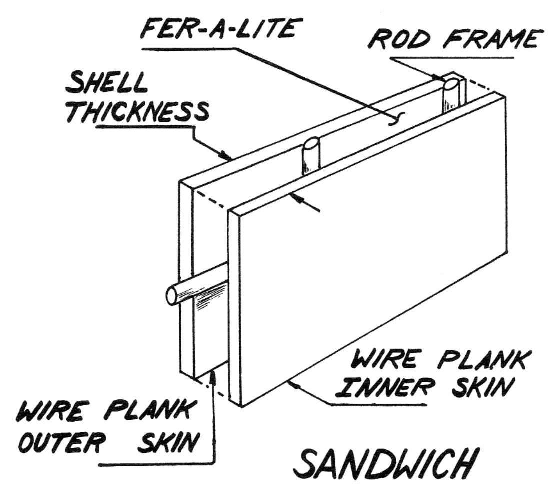
Police all wires for bumps before starting to plaster ... mix FER-A-LITE extra wet to assure penetration.



The simplest end treatment is to cut off at the gunwale. Trim first layer before applying next. Greater strength is achieved by bending last layer over deck and adding a toe rail after plastering.

LAYUP TYPES





BASIC TYPES OF WIRE PLANK LAY-UP

These three lay-up arrangements are used in the following scantling tables. The sandwich type is the closest to typical Ferro-cement construction.

The open grid frame is the lightest and least expensive type of construction. The reason for this is the fact that a lot of the rigidity is derived from the rod work and that is the cheapest item to buy. It is obvious that less mortar is used because of the open space between the rods and this contributes to the weight reduction. It does add some effort in working the mortar smoothly over the rods.

The simple shell has been limited to the smaller boats because of cost. Both simple shell and sandwich have an advantage of a smooth inner skin, which in turn relates to utilizing simple construction methods such as open mold types.

Wherever possible, when using more than two layers of WIRE PLANK, it is advisable to orient the outer layers of the opposite sides of the WIRE PLANK skin in the same direction. This will produce a balanced lay-up - similar to the outer skins of plywood.

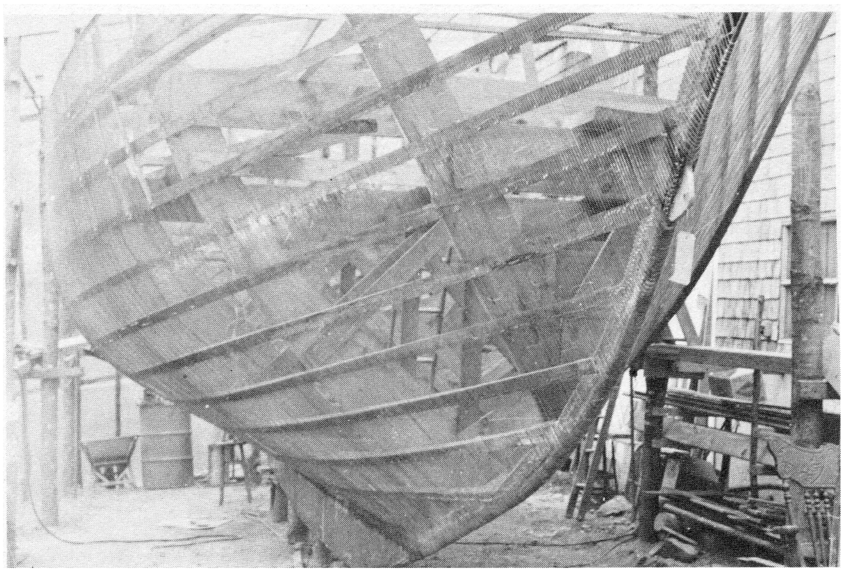
These tables are for preliminary planning only and a complete design analysis should be done for each boat.. .for example, it is expected that normal bulkheads and stiffeners will be included.

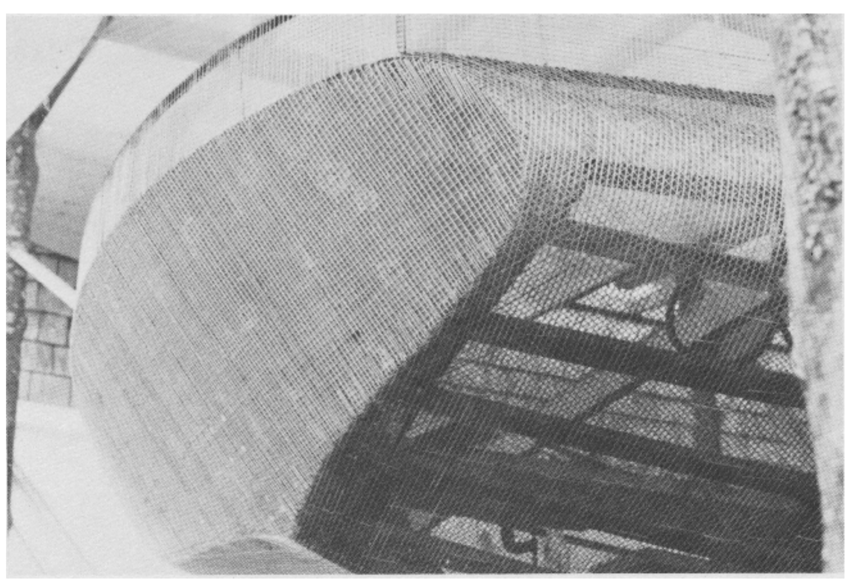
LIGHT HULL CONSTRUCTION

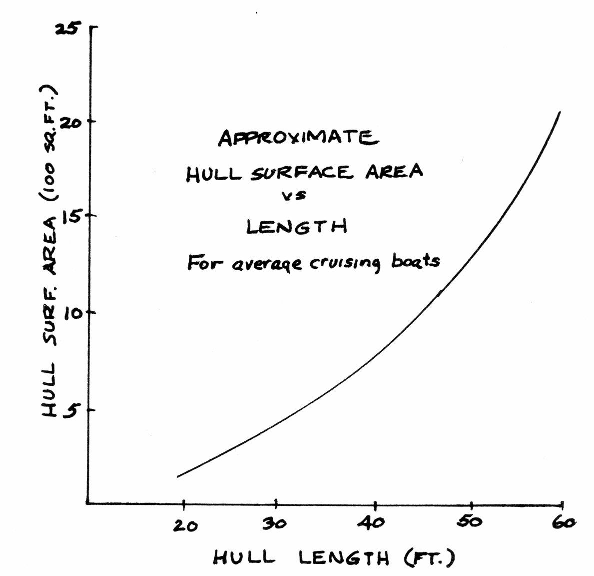
Boat Type Layup* Transverse Longitudinal Shell Fin. Hull Length & No.Layers Rod Dia. Rod Dia. Thick.** wt.W/P & (feet) WIRE PLANK & Space & Space (in.) F/L (lbs/sq.ft)

10-15	grid frame (2) W16x437	1/8 x 8	1/8 x 4	5/32	1.4
15-18	grid frame (2) W16x437		3/16 x 4	5/32	1.6
18-21	grid frame (2) W16x437	1/4 x 8	3/16 x 3	5/32	1.6
21-25	simple shell (3) W16x437			1/4	2.2
25-30	simple shell (3) W14x437			5/16	3.0
30-35	grid frame (3) W14x437	1/4x8	1/4x6	5/16	3.5
35-40	grid frame (3)W14x437	3/4 pipe x 24	1/4x4	5/16	4.0
40-45	grid frame (3) W 14x437	1" thin wall pipe x 24	1/4x3	5/16	4.3
45-50	grid frame (3) W14x437	1" thin wall pipe x 24	1/4x3	5/16	5.0
50-60	grid frame (4) W 14x437	1" thin wall pipe x 24	5/16x3	13/32	5.5
60-70	grid frame (5) W 14x437	1" thin wall pipe x 24	3/8x4	1/2	6.8

IT HAS BEEN STATED THAT WIRE PLANK built boats are the "Fairest in the Land", these shots show "MOBJACK" from various angles and it is easy to see why they say that. The final armature is something like a boat shaped basket, as layers go on in different directions the hull develops the characteristics of a woven object. The inherent strength becomes quite obvious.







LENGTH VERSUS HULL AREA

A very rough guide for the hull area of a typical "cruising" boat is shown in the graph above. This is included only for the estimating preliminary requirements of WIRE PLANK and FER-A-LITE. Precise computation or measurement of hull must be made for each specific boat.

WIRE PLANK Brand mesh is constructed of eight parallel hard-drawn mild steel wires having a tensile strength of 100,000 to 120,000 psi.

WIRE PLANK is packaged in 500 foot continuous length rolls in each carton.

WIRE PLANK SPECIFICATIONS

Type Designation	W16x.437	W14x.437
Wire size	16 GA.	14 GA.
Wire spacing	7/16 inch	7/16 inch
Lay-up width	$3^1/_2$ inches	$3^1/_2$ inches
Wt. per sq.. ft.	.291b.	.471b.
Layer thickness	.062 inch	.080 inch
Sq.. ft. per carton	146	146
Cost per sq.. ft.	$.	$.

TYPICAL WIRE PLANK REQUIREMENTS

(Average Cruising Boats)

Boat Length	Hull Area (sq.. ft.	No. Layers	No. Rolls	Cost $
10	55	2	1	
15	100	2	2	
20	200	3	4	
30	450	4	12	
40	800	4	22	
45	1000	4	28	
50	1250	5	43	

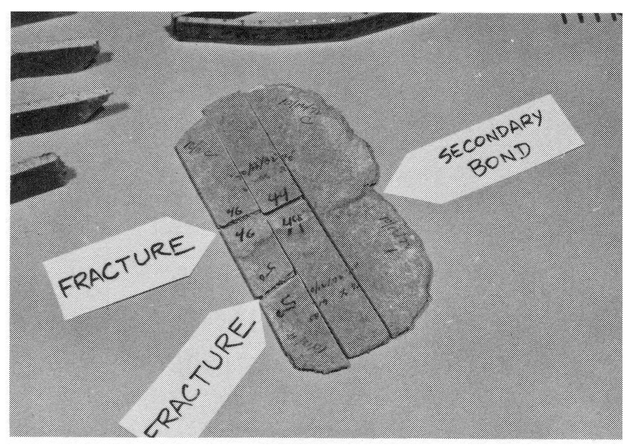
DEVELOPMENT, FORMULATION AND TESTING OF FER-A-LITE AND WIRE PLANK

In an effort to provide the ferro-cement boat builder with the strongest, lightest, easiest handling materials for the lowest cost, literally thousands of tests were made during the last six years using different resins, aggregate components and combinations thereof in the formulation of the synthetic mortar.

The following characteristics were desired:

*High tensile and impact strength
*High resiliency
*Good secondary bonding to permit plastering in stages
*Ease of mixing, handling and trowelling
*Good penetration and capture
*Adequate working time
*Simple, uncomplicated curing procedure in a reasonable working environment
*Easy finishing and fairing
*Reasonable cost

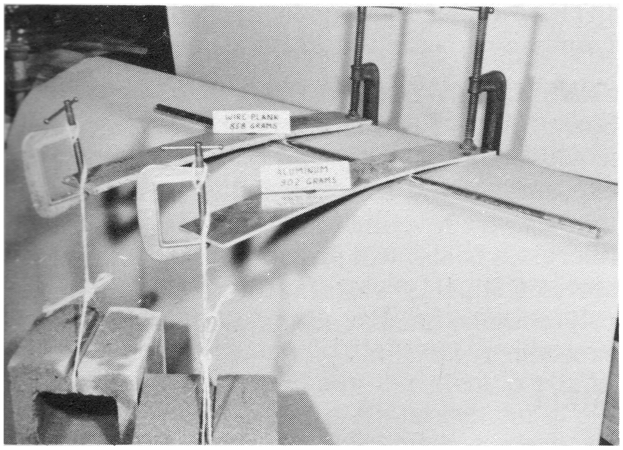
A great many specimens were constructed and tested for these various characteristics. The result is a product which has five times the breaking strength (modulus of rupture) far greater resiliency and impact strength and only 40% the weight of Portland cement. When reinforced with WIRE PLANK brand mesh, specimens were obtained with bending strength and rigidity equal to or better than aluminum plate of comparable weight.



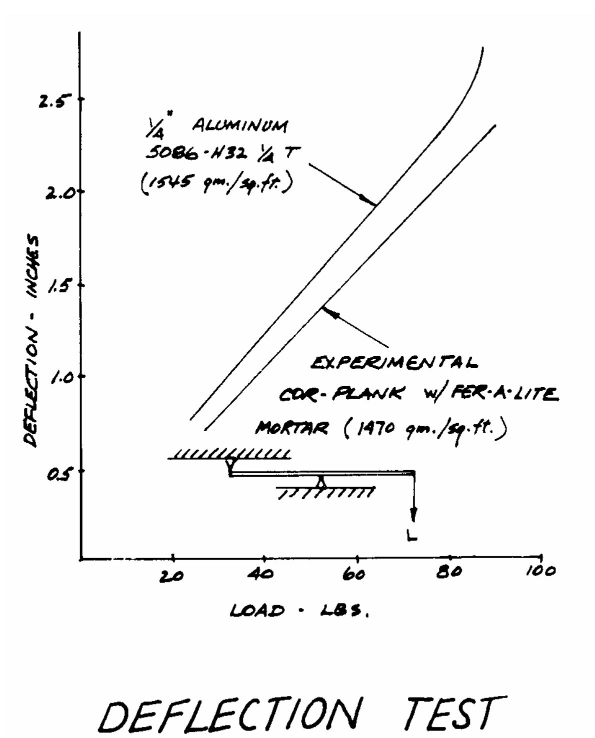
Typical modulus of rupture test was run on the FER-A-LITE specimen with no wire reinforcement. The load was applied on an area that had been bonded to a previously cured piece.

DEFLECTION TESTS

The photo opposite top shows two specimens set up for comparison of bending strength of aluminum and a composite of WIRE PLANK and FER-A-LITE. The specimens were supported on a bench over a fulcrum and weights were suspended from the ends to cause bending. The deflection of each specimen at the load end was measured and is shown in the graph. In the experiment shown, the deflection of the composite material was about 12% less than aluminum.



Bending test ...aluminum plate .242" thick- weighs 902 grams.
WIRE PLANK composite of same size is .400" thick- only weighs 858 grams.



FER-A-LITE DATA
PHYSICAL PROPERTIES COMPARISON
(without wire reinforcing)

	Portland Cement	FER-A-LITE
bending strength (Modulus of Rupture)	700 psi	3600 plus psi
Compression strength	5-10,000 psi	8000 psi
Weight lbs per cu. ft.	144	60

FER-A-LITE Coverage per 10 cubic foot basic unit :

Thickness	Sq. Ft.	Lbs/Sq. Ft.
1"	120	5.0
3/4"	160	3.75
1/2"	240	2.5
3/8"	320	1.88
1/4"	480	1.25
1/8"	960	.63

TYPICAL, REQUIREMENTS

A typical 45 foot cruising sailboat hull using WIRE PLANK brand mesh reinforcement would have the following:

Hull surface area	1000 square feet
Hull shell thickness	3 /8 inch
FER- A-LITE required	30 cubic feet
FER-A-LITE weight	1800 pounds
FER-A-LITE cost	

PROPERTIES OF FER-A-LITE
& answers to typical questions we have had.

INSTALLATION OF BALLAST

Molten lead should not be poured into a FER-A-LITE shell directly. Ballast weight should be cast in place using ordinary cement mortar.

INSULATION

FER-A-LITE has fairly good insulation properties compared with Portland cement, however, a wire reinforced lay-up will take away from this insulation factor. Ice boxes should be insulated with urethane foam.

CONDENSATION

FER-A-LITE type mortar is a much better insulation than Portland cement and condensation is considerably less. However, if condensation does occur, ventilation and insulation will prevent it.

COLOR

FER-A-LITE is light grey about the same color as ordinary concrete.

SWITCHING FROM CEMENT TO FER-A-LITE

Structurally there should be no problem in a direct switch over; however, some consideration must be given to ballast. The lighter material will generally permit additional ballast to be installed-, of course, this is ideal in a sail boat because there will be a greater righting moment. Consult the designer.

FUEL TANKS

FER-A-LITE may be used for construction of tanks, however, fuel tanks should be internally coated with Thiokol compound (from BoatLIFE Inc.)

THERMAL EXPANSION

There is a slight difference between the thermal coefficient of expansion of FER-A-LITE and WIRE PLANK or other steel mesh. This will occasionally be evident as stress warpage on certain types of lay-up in flat panels. The resultant stress is well within the elastic limit of both the FER-A-LITE and the steel. It will cause no problems whatever in a normal hull lay-up.

SHRINKAGE

Some shrinkage will occur during the curing process. This has not been measured precisely. It is evident by very slight depressions between the reinforcing wires if they are too close to the surface. The effect is not noticeable with a cover of 1/16 inch or more.

FLAMMABILITY

FER-A-LITE will support combustion with a characteristic like an ordinary fiberglass boat. FER-A-LITE is not offered with fire retarding resin, as it is expensive and not generally available. For example, whereas the government has a specification for boat building fire retardant polyester resin, there are no listed qualified manufacturers.

The requirement for fire retardancy in this application is far less than for ordinary fiberglass boats, due to the fact that the interior of a home built boat is generally built of wood, while a production fiberglass boat is completely molded of resin and glass.

Most fires start in the galley or in the engine room; so if you let them burn to the extent of the hull shell, you are already in serious trouble.. .so, obviously, the answer is fire prevention! The use of fireproof paneling, such as cement asbestos board, stainless steel or even formica will be of much greater importance, than a fire proof hull shell.

POROSITY

It is not porous. A very small percentage of water (difficult to measure) is absorbed in the FER-ALITE. A sealer is normally applied primarily for cosmetic purposes and to fill small voids.

SENSITIVITY TO SUNLIGHT

Since FER-A-LITE is a polyester base material it will become chalky and dull after prolonged exposure to the sun, much like fiberglass. A marine grade paint coat (the type used on fiberglass boats) will provide an ultra violet protection that is satisfactory. High quality polyurethane finishes are available that provide exceedingly long life.

SMELL

The characteristic smell of polyester resin will be strong during mixing and application of FER-ALITE synthetic mortar. It decreases rapidly during the curing process and is not detectable after cure is complete.

DAMAGE AND REPAIRS

Over stress by severe impact would cause thin hair line cracking in the mortar, resulting in minor controlled seepage. The wire mesh prevents catastrophic leakage. Repairs are done by pulverizing the mortar in the damaged area with a hammer and a heavy weight on the other side. Loose particles are removed and the area re-plastered.

ELECTROLYSIS

FER-A-LITE is an excellent electrical insulator and will not contribute to any galvanic action. All metal through hull fittings should be installed to prevent contact with the steel in the armature by providing a plaster layer of a minimum of 1/16 inch thickness.

MARINE BORERS AND ROT

There are no know marine organisms that can attack and destroy FER-A-LITE: of course, dry rot can be forgotten. As with any hull material, antifouling paint must be used to prevent the growth of weed and barnacles.

ADHESION TO PORTLAND CEMENT

In addition to FER-A-LITE adhering to itself in secondary bonds, it will stick to cured, dry Portland cement with sufficient strength to pull the cement apart when tested.

Many people with Ferro-cement boats under construction are interested in completing their boats with FER-A-LITE decks. This, of course, is an excellent idea, it will contribute a great deal on the righting moment by keeping the center of gravity lower.

LONG TERM AGING

As of the 3rd edition of the manual, with several hulls in excess of 20 yrs, the results are excellent. Watch for future articles on the excellent aging of this material. Fiberglass has received a blemish on its reputation associated with aging and getting brittle. Poor workmanship and cheap construction results in resin rich areas with little or no glass reinforcing. Such spots will eventually craze or crack. This cracking is not age embrittlement. In ferro construction with sufficient strength in the wire reinforcement, brittle is not the key to a problem; witness the many excellent Portland cement boats, of course, Portland cement is extremely brittle. The key always goes back to the reinforcement. A high strength armature is a must for a really durable hull and this is what you get with WIRE-PLANK and Fer-A-Lite Mortar improves on an already time proven process.

RUST

Light rust on an armature will do no harm; however, should construction be in an exposed site where rust would get heavy, an alcoholic phosphoric wash primer should be employed (see equipment list) This material flows very well and can be worked into the mesh quite easily, especially if applied on each layer. It is also a good idea to use this primer on all of the iron fabrication.

COMPARISON WITH PLYWOOD

On a weight/weight basis, plywood is stiffer than the WIRE-PLANK/FER-A-LITE composite, which is why for single curved surfaces like cabin sides & decks, glass covered plywood is recommended.

FER-A-LITE will bond to plywood and a combination of the materials is quite feasible. In this case, wood deck beams are used. Thin plywood is installed and WIRE-PLANK is stapled in place with the staples applied into the beams. This provides the warmth of the traditional wood inside and the strength and weather protection of a composite.

FEASIBILITY FOR MULTI-HULLS

There is no doubt that WIRE-PLANK can be successfully utilized in multi-hull construction, particularly in large sizes. However, it is a very complicated engineering project that should only be tackled by an experienced designer.

FER-A-LITE BOND TO STEEL?

The question of how well FER-A-LITE bonds to steel is probably best answered: "Quite well but don't count on it". There are too many variables which relate to metal surface cleanliness. Adhesive bonding to metal has a discouraging characteristic of weakening with age, even with some of the very sophisticated mill-spec. adhesive systems. Don't let this discourage you. They speak of the quality of the bond with Portland cement. Don't be deceived by this ... the bond strength with Portland cannot exceed its tensile strength, which is so very low. No doubt this is why Re-Bar has the distorted shape. Getting back to FER-A-LITE, we have found that there is sufficient tensile strength in the material to produce a mechanical lock around the mesh configuration sufficient to hold together when loaded beyond the yield point of the wire.

COMPARISON WITH FIBERGLASS

Steel reinforcement is cheaper than fiberglass reinforcement, and has a much higher modulus of elasticity. This composite has greater stiffness on a weight/weight basis to an ordinary fiberglass lay-up (fabric-mat-woven roving-mat, etc . .).

The mold requirements are much simpler, which is ideal for the amateur or small shipyard. It is not competitive to fiberglass on small boats where the mold cost is quickly amortized in quantity.

MOLD RELEASE

Sometimes there are places where a release agent should be utilized, such as casting in place port hole openings using wood plugs. The systems used in fiberglass boat building are O.K.. .. such as wax (Simonize) followed by PVA Film (Plastilease 512-B or equiv..) sprayed or brushed on ... the PVA is an interesting material, in that it is water soluble but resists the resin.

Layers of paper can also be employed, for example: an open wood mold could be first covered with polyethylene, next heavy brown kraft paper, followed by a layer of newsprint. This sounds complicated but you won't find it hard to do. The newsprint will get fully saturated and the brown paper partially impregnated and will peel apart when removing the mold. Scuff off any loose residue with a wire brush; then, add a sealing resin coat. The polyethylene is there for a sort of insurance policy. Poly, by itself is unsatisfactory because when the resin hits it, it puckers badly.

SPONTANEOUS COMBUSTION

Be careful about leftover batches of FER-A-LITE discarded in trash. The tremendous exothermic heat that can result in a large lump can cause spontaneous combustion. We know of one project where this combination included acetone soaked papers from cleanup; fortunately the owner smelled smoke before leaving the project.

STORAGE OF UNMIXED FER-A-LITE

FER-A-LITE Reinforced Aggregate Has An Indefinite Shelf Life Stored Dry.

WARNING:

When mixing aggregate with resin and pouring it from bags, take care not to agitate it excessively and disperse it into the air, like dust. Avoid breathing this dust, if it should become stirred up. Keep sleeves rolled down and buttoned. Neatness and cleanliness is the watchword when handling the aggregate.

PERMANENT LONGITUDINAL WOOD STIFFENER CONSTRUCTION METHOD

As WIRE PLANK lends to installing on fairly widely spaced wood stringers, this lay-up system has been devised to offer a number of distinct advantages over other Ferro-cement methods. Wood station molds are quite satisfactory and may be widely spaced; however, other materials would be quite acceptable. For example, if pipe frames were desired because of their low cost, it would be very easy to tie the wood ribbands in place with wire lacings.

The main advantage of permanent wood ribband construction method is that the WIRE PLANK can be stapled to the wood, rapidly. The second advantage is the fact that materials used for the mold are not wasted but instead become part of the finished boat.

Wood ribbands are far better than rod for fairing up the building form because the section of the wood is much larger and is stiffer in bending, therefore the wood will lie in fair curves. It also turns out on a weight to weight basis ... wood is stiffer than steel rod, which is helpful to the final product. We used mahogany, the particular grade that we received turned out to be brittle ... maybe it was too dry. I would recommend using clear fir.

Of course, one of the reasons this system is practical, is the fact that the FER-A-LITE will bond to the wood. However, because wood is somewhat unstable when subject to alternate wetting and drying, we recommend that the wood stringers be sealed.

There are two schools of thought here. One is to apply a foam in place material between the wood strips. This offers considerable flotation and excellent insulation. The other idea is to add a fiberglass lay-up which would be done with strips of $1^1/z$ oz glass mat. This lay-up would go over the wood and bond to the inside of the hull shell in "Hat" section. The edges of the wood should be bevelled to ease the glass at the corners.

The longitudinal wood stiffeners will be sufficient support over long spans and in most cases the ordinary bulkheads and floor timbers will provide the required backup structure. Heavy galvanized fastenings are used wherever possible and a heavy glass tape added along the edges of all members joining the hull shell.

It is obvious at this point that we now have a boat with a fair amount of wood in it, as compared with a typical Ferro-cement hull with cement bulkheads and cemented web frames. There will, of course, be more expense; however, when the chips are all down, the trade-off will pay off. The whole job is to produce a complete boat not just a hull shell.

The wood frame of the mold is good to have in the boat because it provides an ideal material upon which to fasten the interior joiner work.

A consideration that deserves attention is the construction of floor timbers. Although they could be plywood, in view of the probability of utilizing Portland cement to cast the ballast in place in the keel, a welded steel structure is probably the best. Angle iron floors are quite straight forward to fabricate and install, however, they must be well protected from corrosion. Hot dipped galvanizing is not expensive and can be performed after fabricating prior to installation. An alternate protection is accomplished with Zinc Rich paint. After the floors are welded in place to the keel frame the weld should be buried in the cement when filling the keel. These trusses would be cast right into the ballast and should be cement covered so as to prevent corrosion.

A suggested procedure would be to set up a pipe backbone member, in a typical way. The backbone structure may vary depending upon the boat shape. The MOBJACK has a long straight keel, which lends to a box truss. We used heavy wall pipe for the stem and horn post. $^1/4$" x 2" steel clips were welded in place wherever a stringer ended with '/a galvanized flat head stove bolts holding the wood.

Station frames are next built and erected at the proper locations. angle clips should be used here to fasten to the backbone. Arrange to be able to remove the frames as required.

The longitudinal wood stringers (ribbands) are next installed. The ends are cut at the proper angle to fit the plywood web and large galvanized screws are used for fastening. Toe screws are used to fasten stringers to the station molds to facilitate future removal.

Glass covered plywood decks are recommended and in this case wood sheer clamps should be utilized as in ordinary wood construction. Laminating with thin strips is advised. Deck beams should be fitted before installing the WIRE PLANK.

Heavy galvanized staples are to be used to fasten the WIRE PLANK in place. These may be the air driven type or the one time builder could rent a roof shingle stapler, which works sort of like a hammer. On the outer WIRE PLANK layer, the staples may be omitted and simply utilize the wire tails of the WIRE PLANK for fastening in place. The idea here is to eliminate any bumps, which would cause trouble with plastering.

The WIRE PLANK is first fastened to the stringers with light gauge staples. Be careful not to set the staples too hard or you will make reverse bends in the WIRE PLANK After the next to the last layer of WIRE PLANK is in place is the time to go over the entire hull with heavy (16 gauge galvanized staples). You should fasten the outer WIRE PLANK layer as lightly as possible. Use the cross tie wire ends, light staples & 22 ga. annealed wire lacings. The idea here is to eliminate bumps to simplify plastering.

SKINNING WITH FIBERGLASS?

On page 13 we explain how to apply a fiberglass skin on the armature before plastering. The main reason for this was to provide a sort of female mold for the plaster. The two layer lay-up being too thin to hang the plaster in. The additional layer of fine weave cotton cloth was used to control the fibers of the chopped strand fiberglass mat. A problem occurs when applying resin to the mat. The fibers lose their orientation and do such things as snarling up all over a roller. An overlay material, such as #120 grade of cheesecloth is thin enough to allow resin penetration and yet hold the fibers in place. Other materials may be employed as an overlay surfacer but the cheesecloth has an advantage in that it will conform to the severe compound curves of a small hull.

The fact that fiberglass can be embedded into wet FER-A-LITE offers some other advantages. The use of a thin grade of glass at (3/4 or 1 oz) as a surfacing membrane is helpful in producing a positive minimum thickness, corrosion protective barrier cover over the wires. By utilizing the batten-like characteristics of WIRE PLANK, an incredibly fair armature can be produced. Plastering is simplified by pressing dry fiberglass mat on to an approximately 1/8" thickness mortar cover over the wires. A flat trowel is used to pat the glass down to lightly feel the wires. This eliminates the requirement of your becoming an expert plasterer. The mat will not necessarily become fully saturated with resin. You should apply more straight catalyzed resin without aggregate on the outside to fully saturate the mat. It will not need much and if you apply it with a broad putty knife, you won't have a problem with the fibers becoming disoriented. Woven glass fabric will conform to compound curves the best and it is tempting to use; however, the mat will produce a much less permeable skin. The open weave in the fabric tends to produce pin hole voids in the resin. Furthermore there is a tendency for moisture to travel along the glass fibers. Obviously, the nature of an over and under weave could carry that moisture inside. The mat will conform to compound curves as it wets out. However, it is best to tailor the material so as to take advantage of the hull shape to reduce the compound effect.

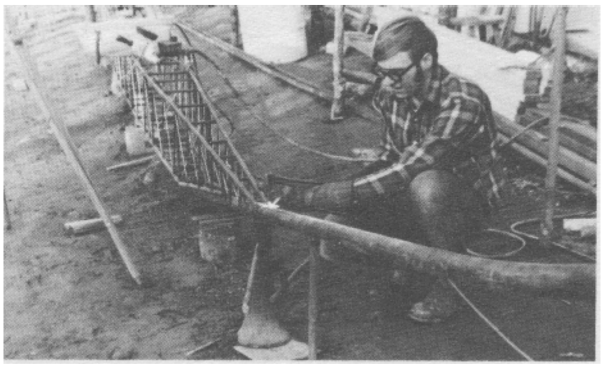
2 SHOT PLASTERING

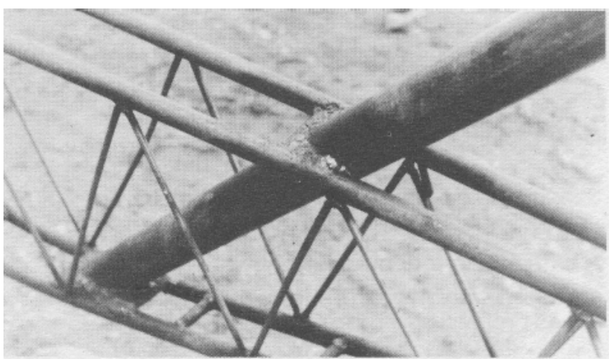
Because FER-A-LITE bonds to itself so well on cold joints there are advantages to be found by plastering in layers. The first application of FER-A-LITE is a scratch coat, working right down to the wires. After this is cured all minor bumps are sanded off. A second coat of FER-A-LITE is added. the solid base helps to make a 1/16"' uniform thickness. Glass is applied as above. Shrinkage distortion is minimal and results are smooth. A big advantage is the division of problems.

Building Mobjack

BASIC SETUP

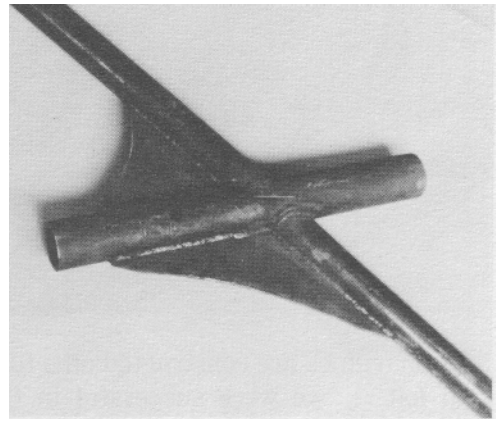
Main supports are logs buried deep into the ground at each station . . . tops are cut off to conform to offset heights of profile ... allow for angle iron support, upon which the keel is tack welded. Keel backbone consists of a box truss, ideal on this boat with simple contour and long straight shape ... Stem is in place.



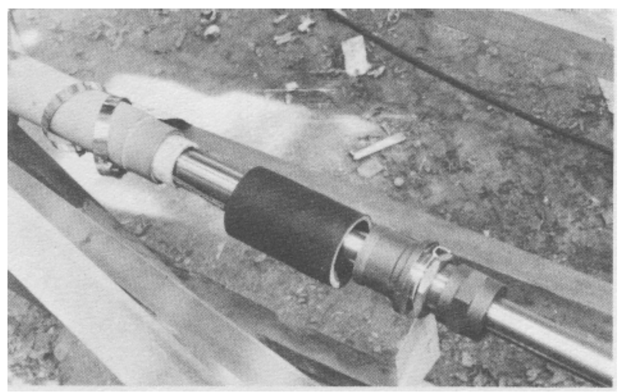


Sides of truss are built first, complete box section is assembled. Horn member welded into keel truss. A plate is fitted under heel end.

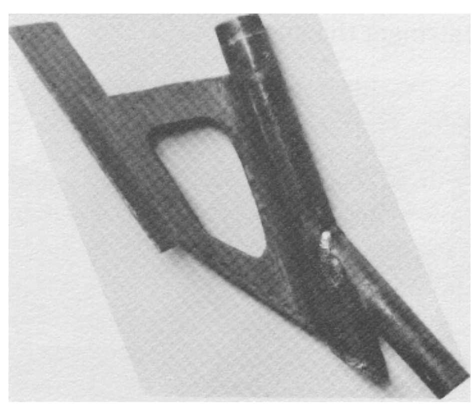
Iron pipe stem intersection with round bars of truss.



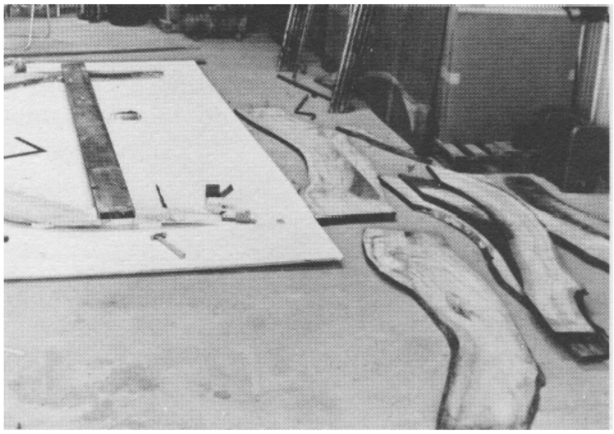
Propellor shaft alley assembly in to horn member . . . all black iron. Corrosion protection is maintained with PVC tube liner epoxy'd in place.



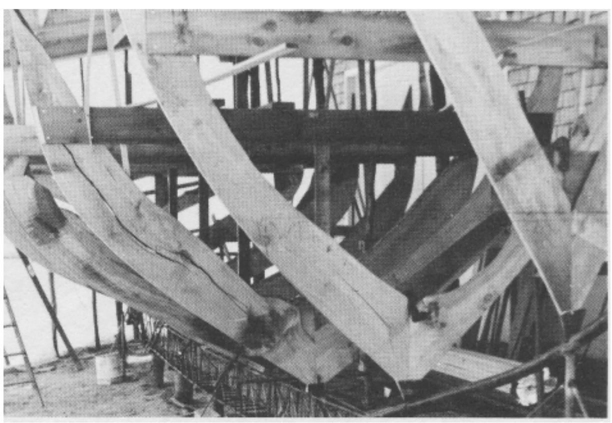
End of shaft alley is turned to 2-1/4 dia. to accept rubber coupling of stuffing box.



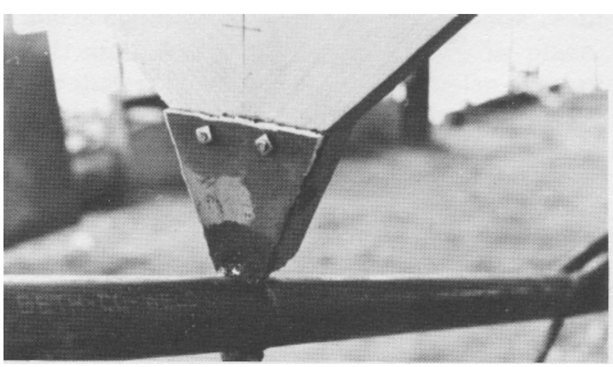
Rudder shaft tube welded to horn member & transom knee. Rudder shaft is stainless steel and rides in a teflon epoxy cast in place bearing.



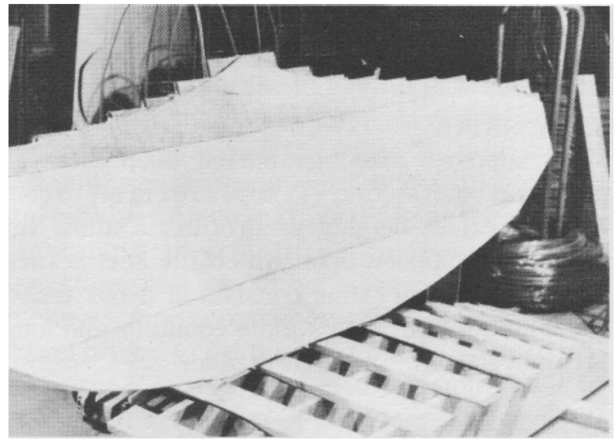
Station frames are constructed on a full size station loft ... we were successful in fairing the lines on a 2" = 1 ft scale full loft. Note: natural curved lumber available from some Marine lumber mills: called mold stock or box boards. Important to place cross member carefully on 2 ft. above waterline.



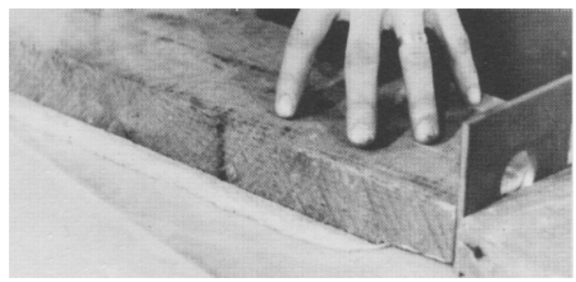
Station frames are set up on same spacing as lines drawing. Frames are corrected for skin and stringer thickness.



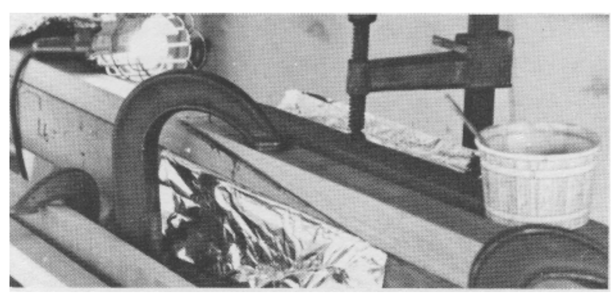
Angle bracket or tab is tack welded to backbone. 1/4" bolts hold station frame in place.



A sandwich transom core was laminated on a radius form. It consists of (2) 3/8" plywood faces with 3/4" cedar core. FER-A-LITE was used as a test for adhesive. Clamping was accomplished with (3) 1 x 2 straps nailed over the curve.

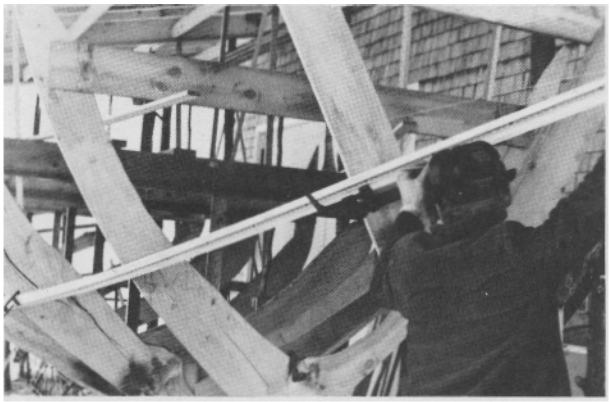


A well seasoned 2 x 6 oak frame was added to the transom. No need to shape this to the curve, a thick bedding of FER-A-LITE was used. Large galvanized screws were located to miss the stringers. The transom was then set in place on the transom knee and secured with carriage bolts.

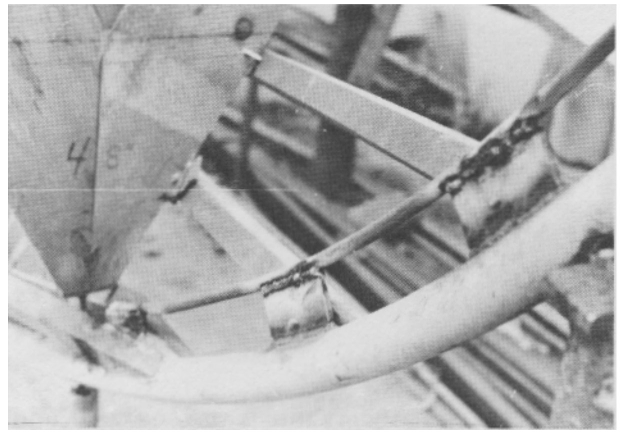


Ribband stringer joints are glued with a 10:1 taper, using epoxy. Aluminum foil serves double : it was used to wrap around a lamp, making an oven for cold temp gluing and a release of any dripped glue.

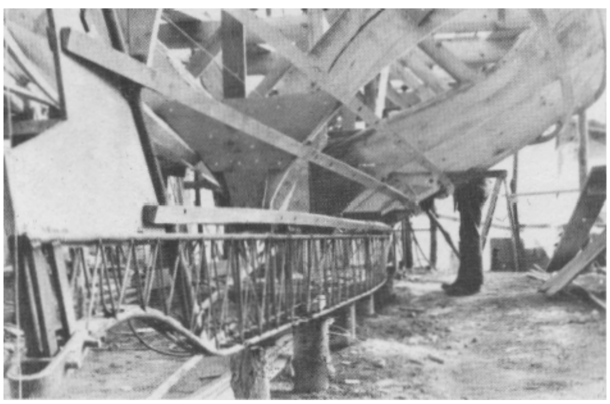
INSTALLING STRINGERS



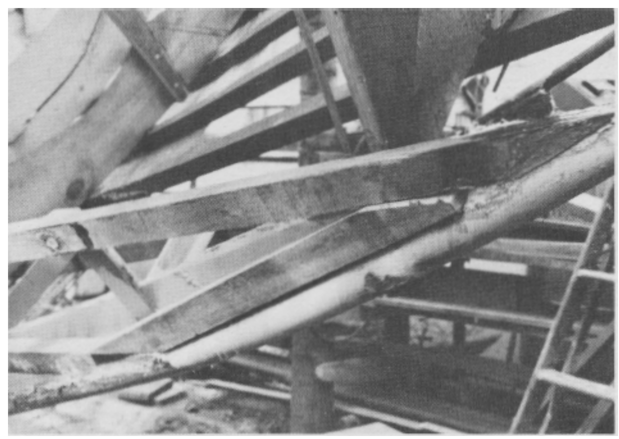
When all frames are set true plumb and square use temporary 1 x 2 stringers set at gunwale, place a bilge stringer to further align and correct for any warpage in frames. Compare lengths on both sides of boat and set to the average.



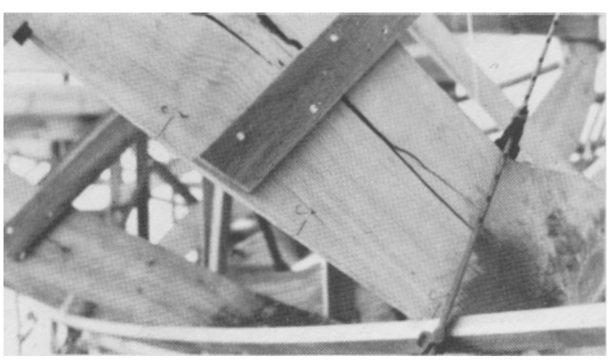
1/8" steel tabs are welded to stem. These provide a strong and simple means of terminating stringers by using flat head bolts. A 1/2 round bar is added and the stem becomes a truss.



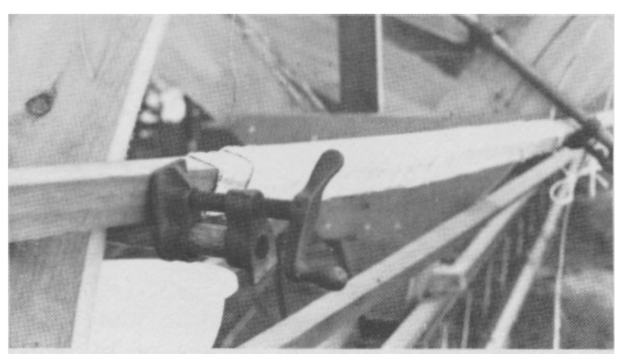
Place first stringer with 1" space up from keel. Note (2) missing stringers. These are left off while internal steel work is accomplished: mast steps, floors, stuffing box, engine bed, etc ..



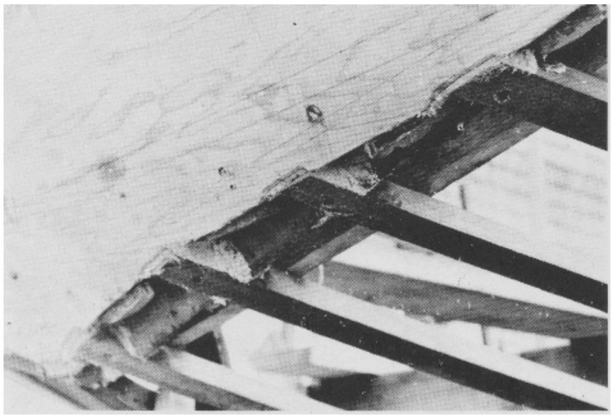
Sleepers are roughly fitted along the stem. These will simplify stapling WIRE PLANK. All Woodwork gets bedded with FER-A-LITE as it is set in place.



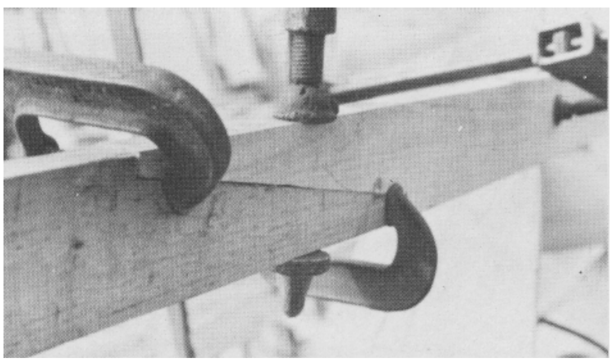
You should place marks on alternate stations to give equal space between all stringers and clamp member. Start with station amidships.



An overnight wet pack will help you make the twist that occurs aft on a couple of stringers.

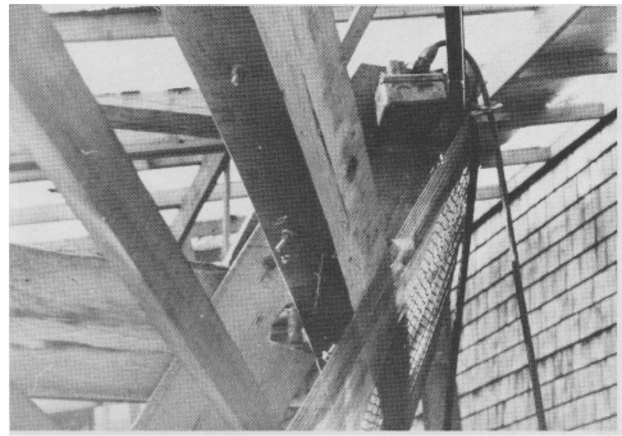


Roughly notch stringers into transom frame and bed with FER-A-LITE as heavy screws are set. The important thing here is to be sure that the fair line of the stringer intersects the transom profile, corrected for $^{1}/z$" skin thickness.

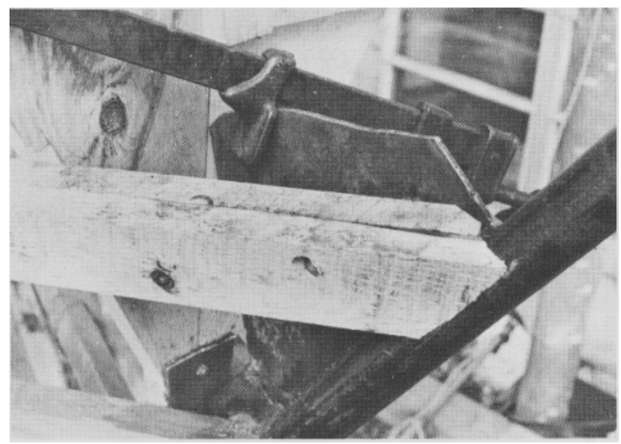


Laminate the white oak clamp member in place utilizing (2) layers 1 x 3 (full). Glue with epoxy ... use galvanized nails to assist clamping.

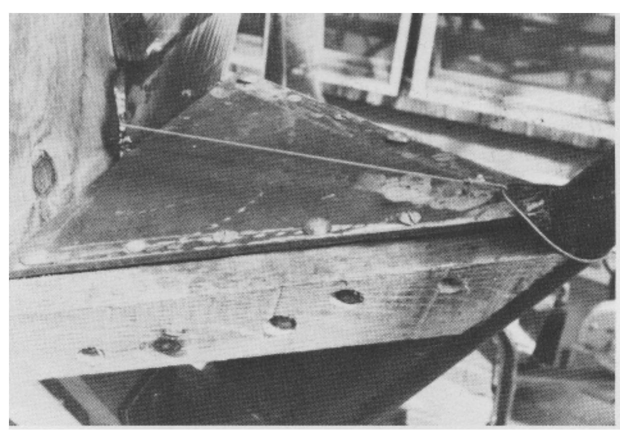
Clamp is spaced down to accommodate deck thickness. Deck may be layers of plywood laminated (without deck beams) in this case the clamp should have a third lamination on the inside stepped down one plywood thickness.



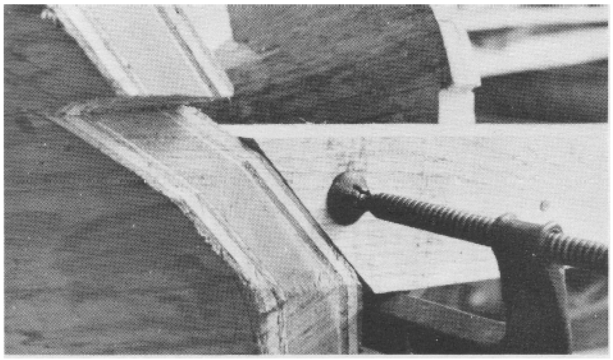
Should deck beams be employed a wood shelf can be fitted under the clamp.



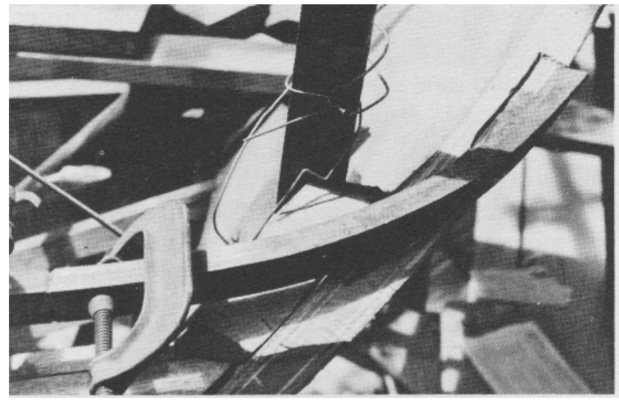
Fit a healthy 1/4" plate at stem for clamp member ends. When top is cut off, allow for deck crown.



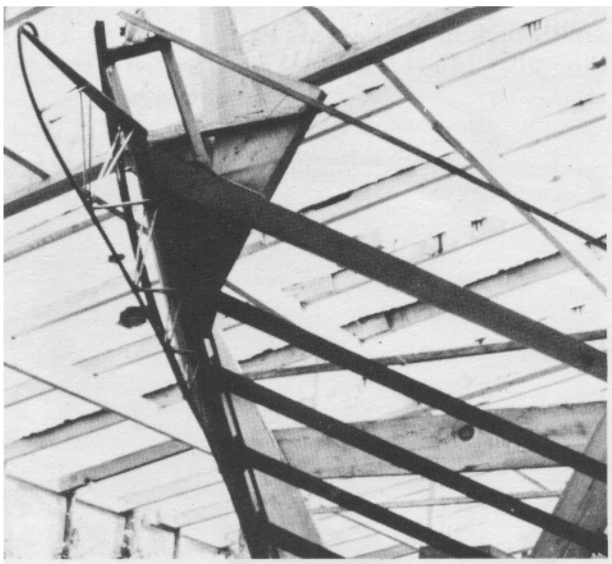
After clamp is well bolted a breast plate is installed. The weld bead at C/L on the underside will bend this plate down to approximate deck crown.



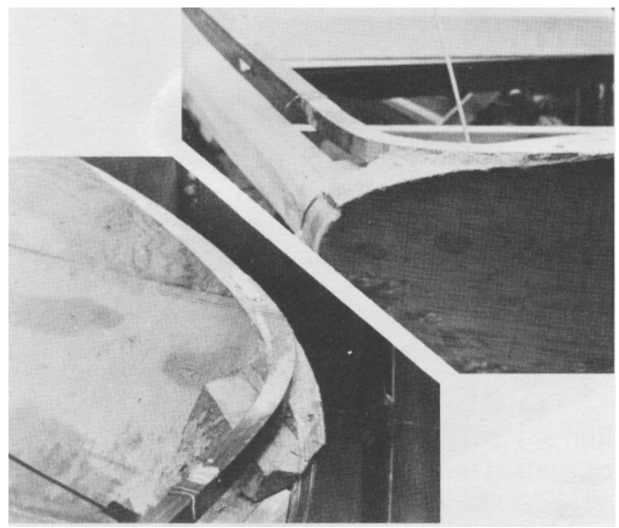
In fitting the clamp member to the transom core use 3/8" carriage bolts into the transom frame.



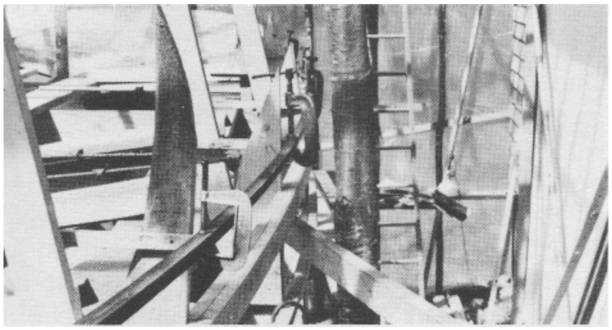
A curved piece of angle is fashioned with a healthy vise and big hammer. It is fitted into transom and ready for welding.



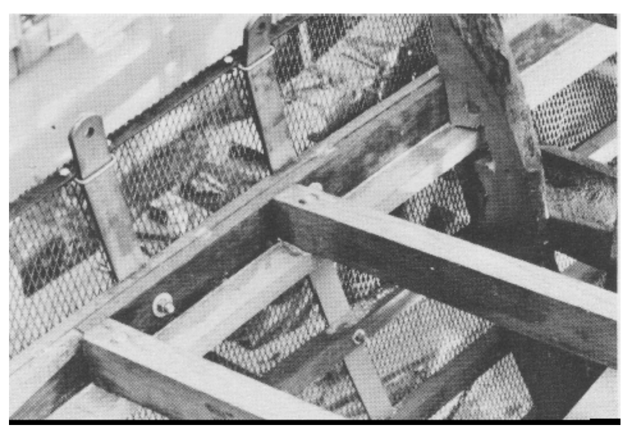
Developing the hull contour is simplified by the false clipper bow, as all lines run into a straight stem section. Note: S.S. frame for bowsprit ...this is welded to breast plate.



It gets a little tricky where the rail cap rolls into the tumble home at the transom.

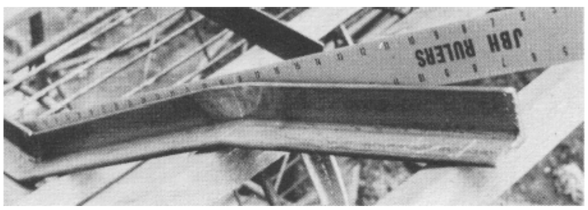


One inch steel angle is used for a rail cap base. Select straight, stock butt weld for full length one piece. This member springs in place fair; however, it must be clamped to overcome a tendency to twist out on top.

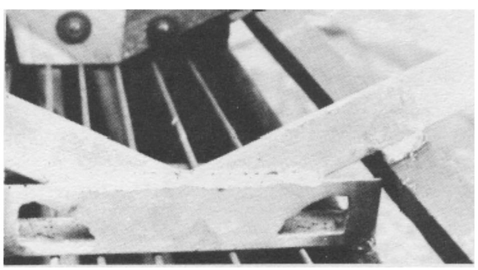


Stainless steel chain plates are rabbeted into wood members, bedded with FER-A-LITE and bolted fast. Deck beams are bolted to shelf.

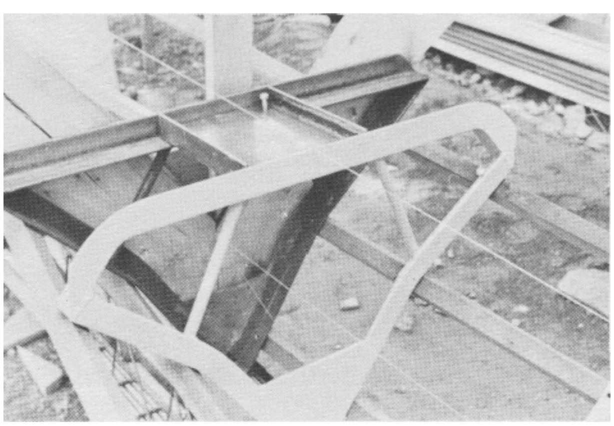
With this construction system many arrangements for floors are possible. Angle iron seemed simple and easy to us and we are pleased with the results. 1/4" steel was used for this work. Corrosion protection is obtained either by hot dip galvanizing or Zinc Rich painting. On assemblies like the mast step, which was fabricated place, 'the paint system was selected. A cheap portable sandblast rig was used to clean the metal. considering the time involved in cleaning and painting, it was quite inexpensive to have the floor assemblies hot dip galvanized. Although it is not apparent in these photos, the floors have a horizontal cross tie member which also serves as sole beams.



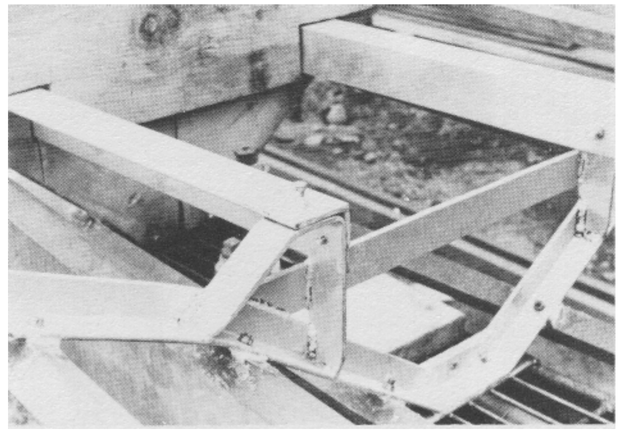
Using an oxy-acetylene torch and a little practice it is quite easy to shape the steel to fit the hull shape (a series of angle bends).



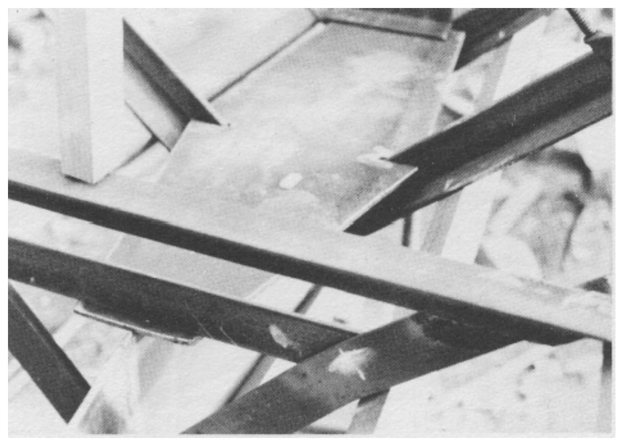
Each floor has an angle iron base which is welded to the keel structure.



Mizzen mast step is a bridge for the prop shaft to go under.



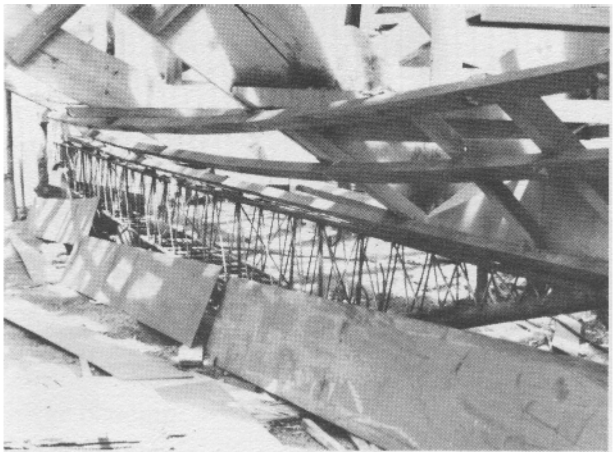
Engine bearers are supported by three floors. A small blob of FER-A-LITE was used as a bedding filler where the floors were bolted fast to the stringers.



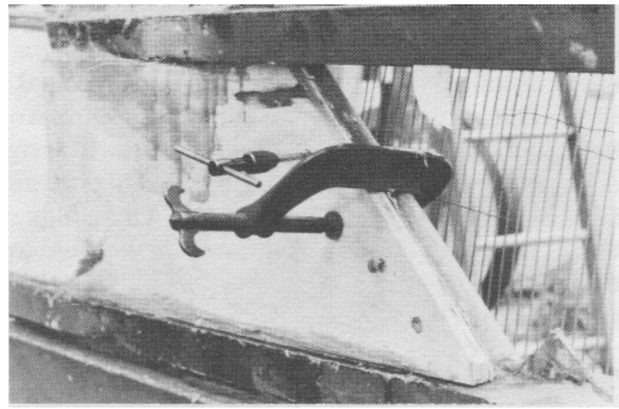
Main mast step has a long vertical web plate for support to the keel truss and stem member.

STEEL PLATED KEEL

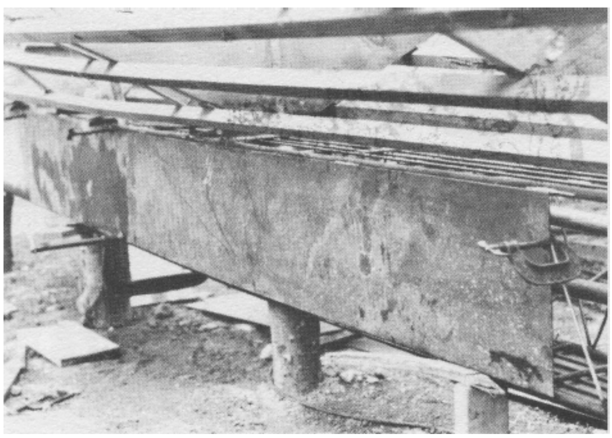
Due to 3 factors a decision was made to apply 10 ga steel plate over the keel box truss. 1st: the design calls for a cast lead ballast and this would produce an ideal mold. 2nd: it was a simple slab sided shape. 3rd: we wanted to experiment with attaching WIRE PLANK to a steel shell. An internal bulkhead plate was installed for the aft end of the lead. The aft end of the keel box is filled with light weight (vermiculite aggregate) portland cement. The results of this steel plating are impressively rugged; however, considering the cost of lead, it would have been smart to redesign the shape to accommodate steel punchings and concrete ballast.



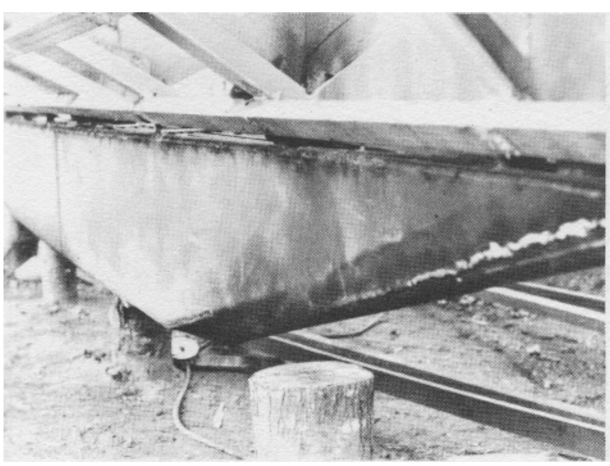
10 ga. steel was purchased sheared to size.



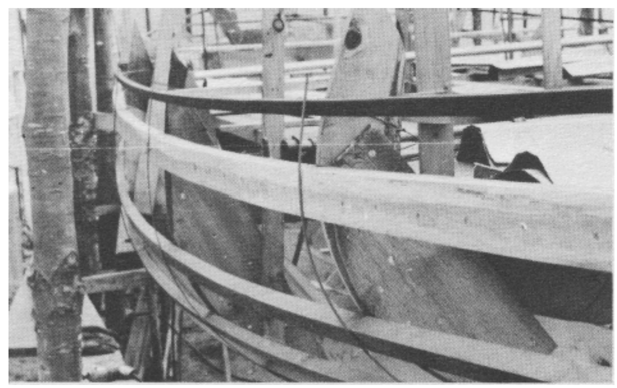
Plywood fairing boards are bedded into FER-A-LITE. Flat head galvanized screws are threaded into the pipe horn member.



Clamp in place and weld to the 3/4" dia. rods of the box truss. First use a number of short tack welds to prevent warpage. By the time all of the welding is complete (especially the underneath stuff) you will feel like you could weld for hire.



A little persuasion with a 3 lb hammer produced the transition shape to meet the pipe stem.

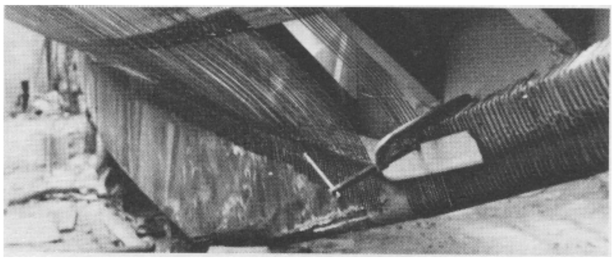


Before starting to apply WIRE PLANK, the hull should be gone over with transverse battens to double check fairing, any high spots can be planed-off.

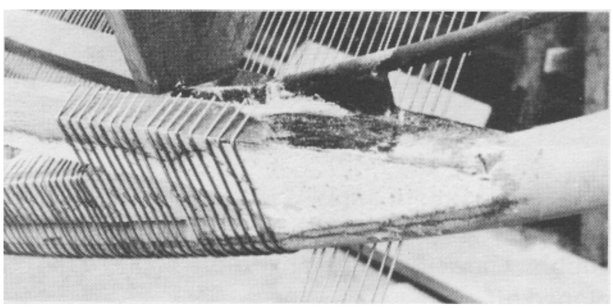
PLANKING THE HULL

We learned some tricks, had a few problems and ended up feeling very satisfied with the results. The first layer was applied transverse. Due to certain areas where the contour has to be free formed, the transverse direction was very important. The second and third layers were opposite diagonals and this was no picnic on this shaped hull. It wouldn't lend to being bent into the sharp radius at the garboard so we poked the planks into the keel areas, bent hooks on the wire ends and cast the ballast around them. Another area with the diagonals was the rather sharp radius at the tumblehome of the topsides near the transom. Probably the easiest way we found to get the WIRE PLANK laying fair was to cut the WIRE PLANK cross wires in the tumblehome area.

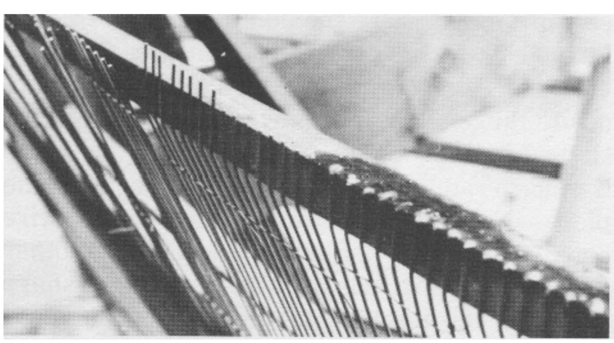
With the first layer, the entire hull was planked one side at a time. It went on fast considering each "Plank" had to be pre-bent at the garboard. (1) roll 146 sq ft took (5) man hours). Later on we had to pay the piper because we found the inverted weld along the keel to be a extremely tedious and time consuming. Also it was fairly tedious end terminating the wires along the stem forefoot. The payoff came on the weld to the angle iron rail cap member. This was easy, fast and fun.



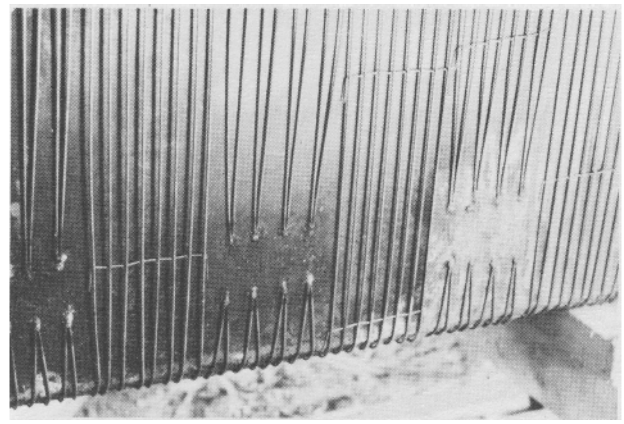
Transition flair from keel to stem. Do not secure ends until complete, in case some adjustment is required. In areas like this, pre-shape the bend before stapling on to hull.



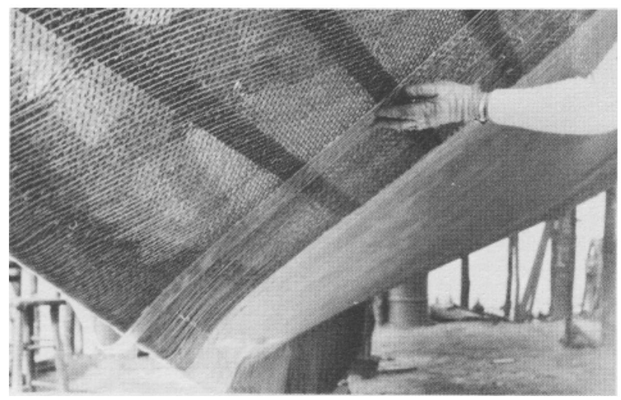
Bring ends around pipe back over sleeper. Anticipate direction of wires from other side, keep parallel to allow fingering. Later these ends will be buried into FER-A-LITE.



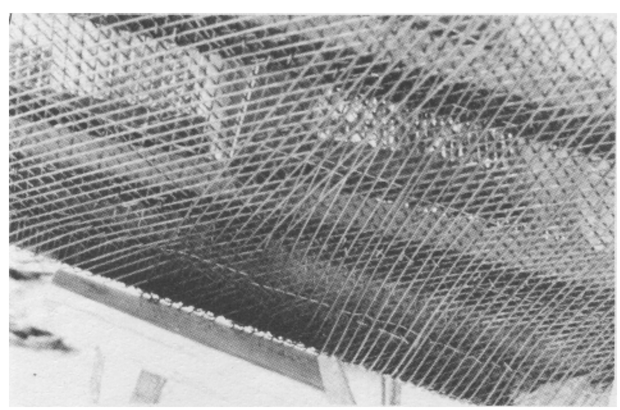
Wires bent to fit rail angle - any bulges pulled out. Cut off and welded. Set arc welder to lowest current. Use 1/16" 6013 rod.



The welding became quite easy when we learned to do pairs. A single wire tends to melt away faster than .you can make a weld. The double wire acts like one large wire if they are touching.

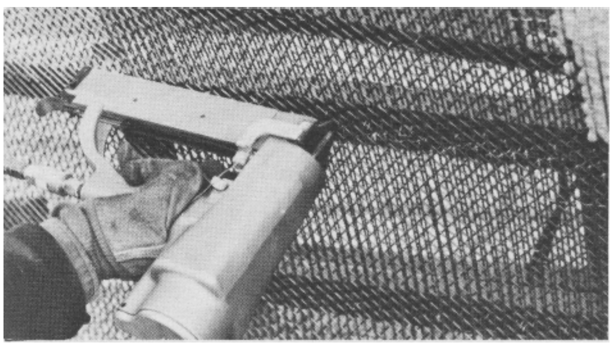


Here is an easier way to go. Use full length wire from gunwale to gunwale. The small radius at the stem should be pre-formed over a piece of pipe.

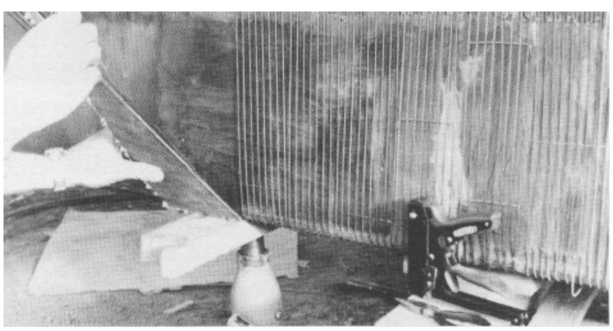


A little trick used as the profile works into an angle up the stem. Jam a block of wood, with a stick under to hold the radius in place. The WIRE PLANK is then steered sideways to lay parallel.

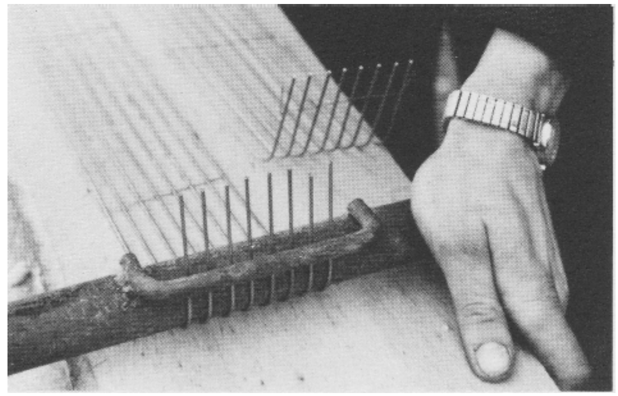
It was faster to staple all the WIRE PLANK in place with a hand gun. Heavy 16 gauge 1^{1}/a long galvanized staples driven with an air gun were then used to go over the third layer. Of course, this sandwiched the under layers and made a rugged tie to the wood stringers. On all of the stapling we had to be careful not to sink the staples too hard or it would make a reverse knuckle resulting in a bulge between the stringers. One trick that works well is to aim the staples directly where a wire crossed another wire ... this provides support to prevent reverse bending.



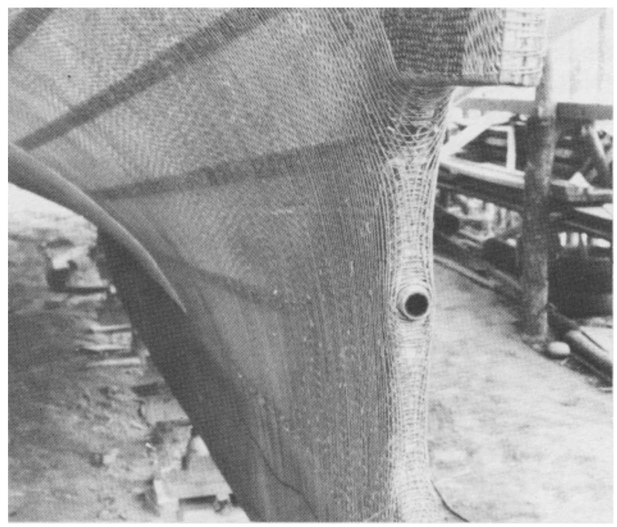
With the 4th layer applied, the staples can be shot between wires, to anchor the 3rd layer. The added thickness of the 4th layer prevents over sinking the staples.



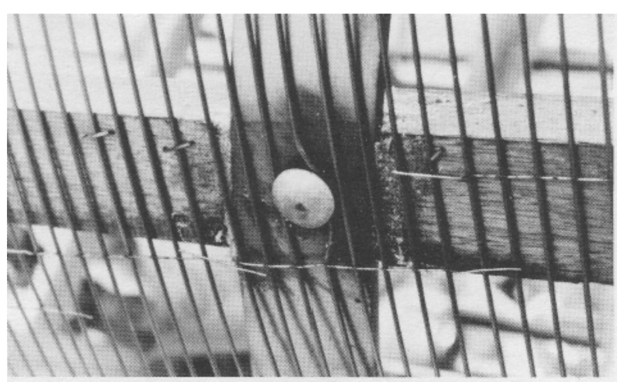
The fourth WIRE PLANK layer was worked around the keel plating. Again we started in, working each side of the boat. Sort of by accident, we tried one full length "Plank" from gunwale to gunwale. It took a little fussing to get the bend right, but in the end it was a better way to go because it eliminated the welding. Amazingly the full length "Plank" worked out O.K. quite a ways up the stem forefoot. The distortion made the "Plank" a little narrow, which did not matter. The garboard bend is made with a piece of pipe & hammer. To get the base radius tight, lower the jack and over-bend



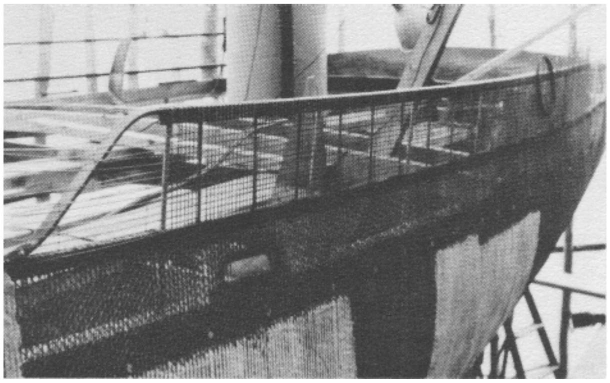
A 3/8" dia bar welded to a piece of 1" pipe made a fine bending fixture to provide a uniform radius at the garboard.



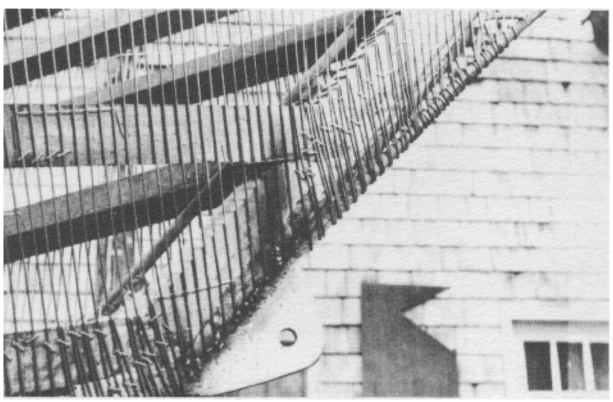
A little painstaking effort in neatness here will pay off in a slick plastering job. Wire ends are bent at 90 degrees and driven into pilot holes. This method of wire end treatment is neat, secure, without thickness buildup.



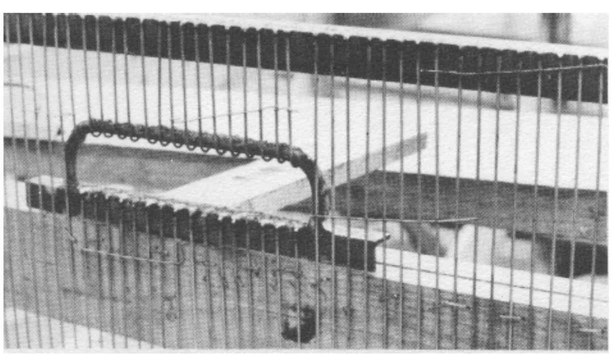
Wires are worked around carriage bolt heads at chain plates.



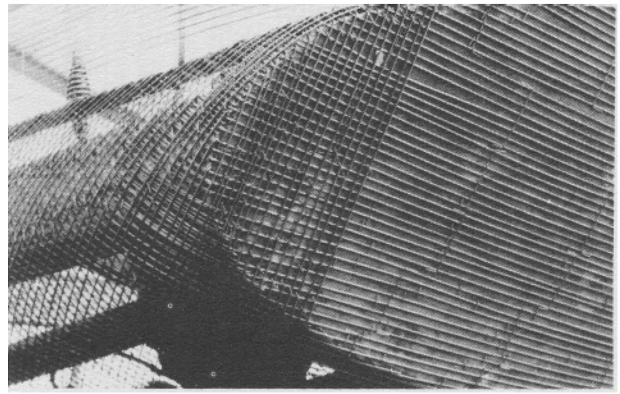
The taffrail is framed with 1 x 1 angle, plug welded onto 3/8" dia galvanized rods (18"). Rods are drilled thru main rail cap angle & driven into pilot holes in wood clamp member. 1/4" dia rods are welded in place between angles on 6" center lines. 4th WIRE PLANK layer runs to top of taffrail. A 22 ga lacing was used to hold 4th layer tight where the tumblehome terminates at the main rail cap.



Stainless bobstay fitting welded to stem. Note : all wire ends either welded or terminated with wrap-around.

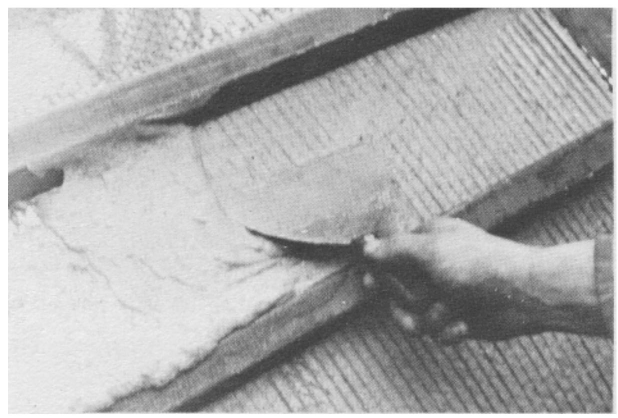


Core for deck scupper - 3/4" angle, setup on a shim to allow for deck. Pre-drill for countersink screws.

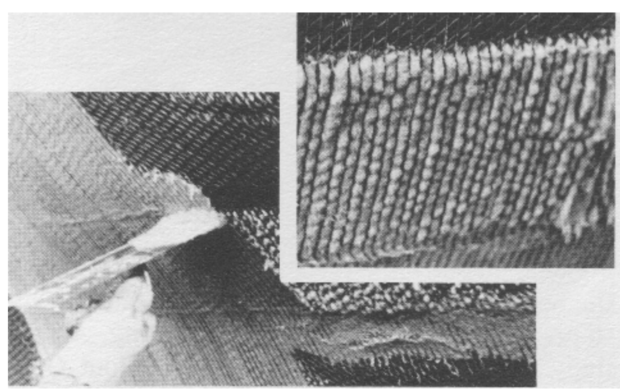


The horizontal transom wires run fair with the first diagonal layer. The vertical transom wires are a continuation of the second diagonal layer. These wires also extend above the transom onto the taffrail.

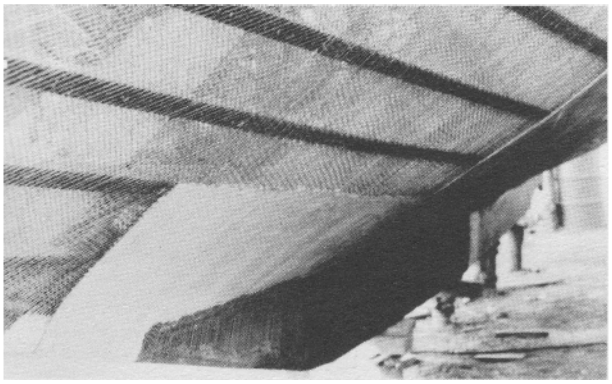
PLASTERING



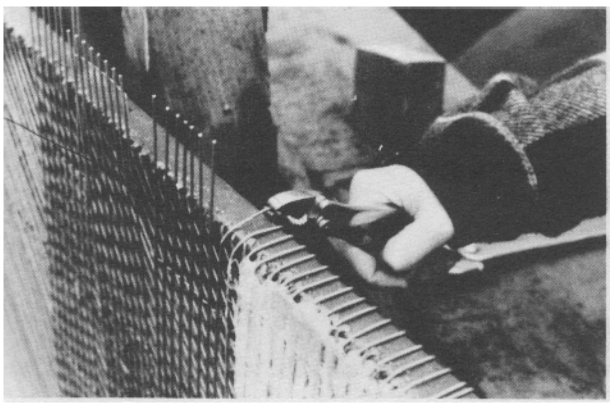
A two man plastering team is needed. The inside man pours out some FER-A-LITE plaster and spreads with a broad putty knife.



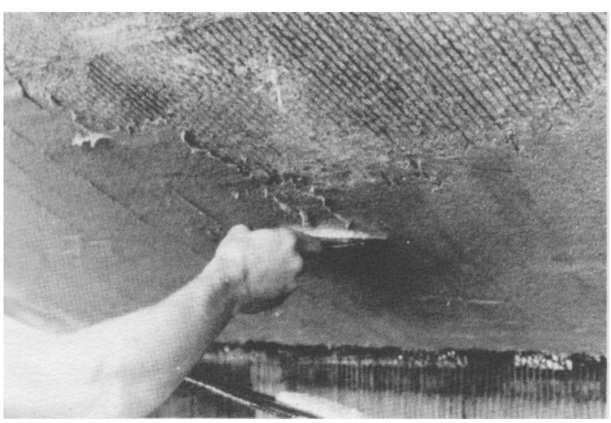
The insert illustrates the ideal amount of plaster to apply. On the right side, the excess makes the outside man's job quite sloppy. Obviously he also has to work plaster onto the stringers.



Plaster was applied up from the keel through the concave section and allowed to cure.

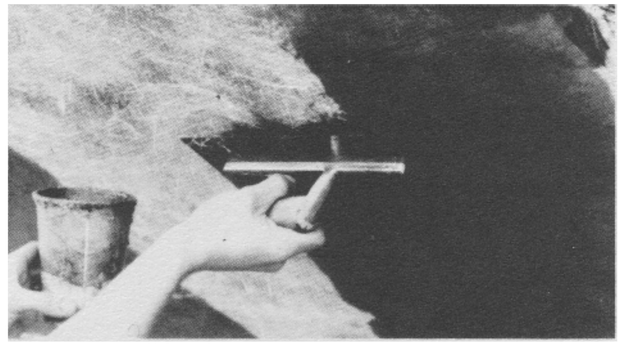


With the bottom of the wires anchored in plaster the tops are pulled tight with a sort of lever action by pliers. After this, all of staples holding the outer layer can be removed to provide a dead fair surface.

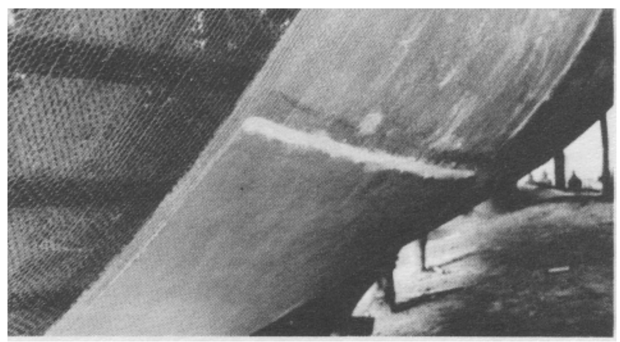


GLASS COVERING

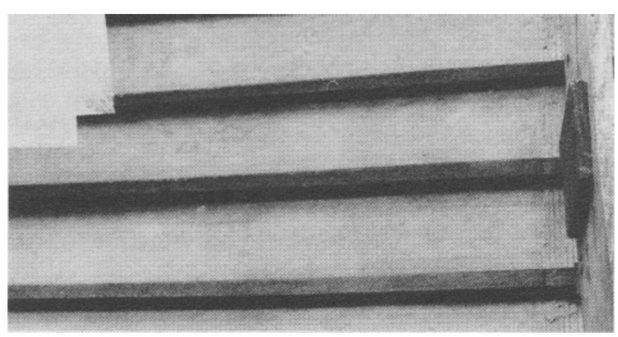
Select a fairly flat section of the hull and cut material to fit, then mark an outline of the area where you are working. A 1/16" thick second coat of plaster is easily applied.



Pat the glass layer of 3/4 oz. mat lightly in place onto the wet mortar with a flat trowel. Stop when the trowel starts to get wet and sticky. Now mix a small batch of plain catalyzed polyester resin (no aggregate). Pour some resin on the trowel and sweep over the hairy glass surface. Keep the trowel juicy. Sight the surface for any bumps and press a little harder to smooth out any irregularities.



The edges of a glass coated section should be angled to provide a scarf overlap with the next area. Most of this shaping can be done with a trowel while the resin is wet. A light scuffing with a sander finishes the job.



An equivalent of (2) layers of $1^1/_2$ oz glass mat is used over the stringers. The inside hull between the stringers has the same treatment as the outside