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Rowing Skiff *«Forest Stream+»*

Construction manual

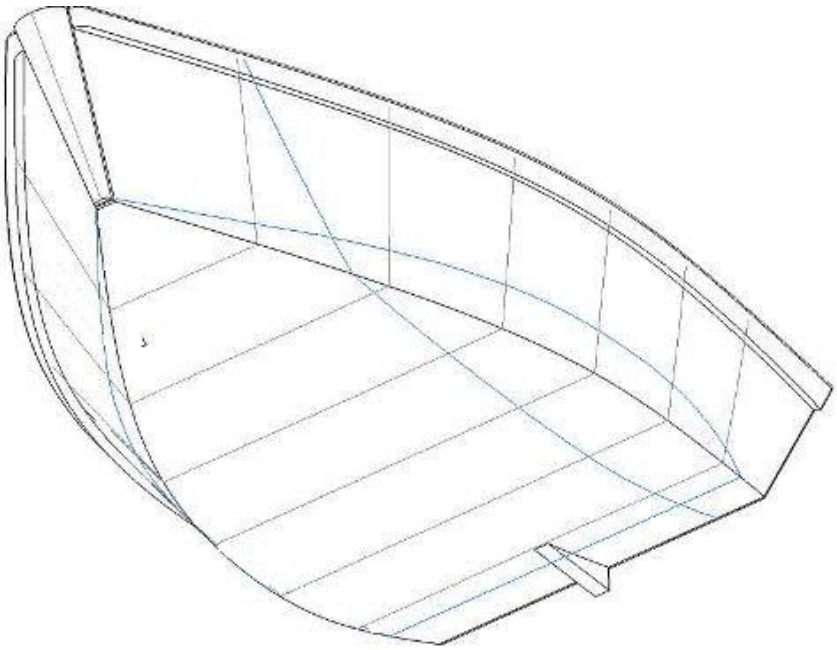
1. General characteristics

1.1. Introduction

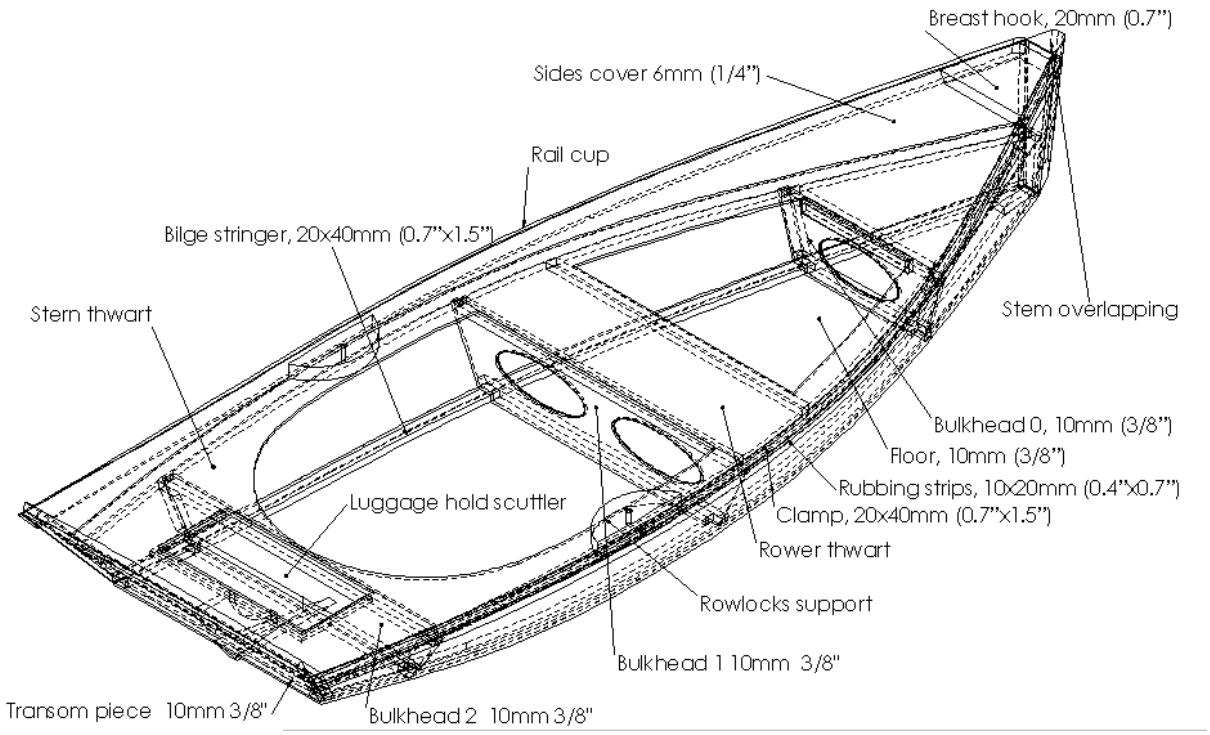
"Forest Stream" lines were developed as a result of summarizing high quality reliable ships construction methods in 1890 of the one before last century. The boat was «brought back to life» on the basis of modern composite technologies and up-to date construction techniques. It is very light under oars. Transom piece is used for low power (up to 3 horse power) outboard motor installation. Keel line bending helps running in shallow waters. Foodability is provided by a considerable amount of foam plastics (pvc) under the deck along the boat. Closed kit lockers distinguish the boat from the original.

Due to light weight of the boat it can be transported on the top bonnet of a motor car (class C).

1.2. Lines and general layout



Puc.1. Lines.



Puc.2. General layout.

1.3.Characteristics

Yacht main characteristics are given in the Table 1.

Table 1

Maximal length, mm	**3100**
Maximal width, mm	**1156**
Full load draft, mm	**90**
Weight, kg	**~50**
Passenger capacity, persons	**2-3**
Navigability, wind force	**2**

2. Pre-construction works

2.1. Premises requirements

Regarding the premises boat construction process can be divided in two stages:

1. Parts manufacturing and stocking;
2. Assembly-installation-finishing.

The boat can be constructed in different premises on these stages. Mounting assembly can be manufactured in a small warm workroom in winter or in an apartment (not recommended), assembly and finishing works can be conducted in a garage or any other unheated premises of good size in warm seasons.

At the first stage you will need a room equipped with a table or work bench on which you can lay 2 plywood sheets of a standard size (2440x1220) and some place where made parts can be stocked. Plywood sheets can be stocked on bars placed on the even surface. Bars height should provide free run of the tools (jigsaw, drill). The length of the premises should not be less than 3 m.

The second stage works can be done in a standard size garage, equipped with electricity systems or any other premises at the size of not less than 2,5x4,5 m.

2.2. Tools and appliances

Baseline construction tool set:

1. **Electric tools:**
   - ✓ *Power drill* with speed switch , wood rill set and changeable drill heads for screwing nails;
   - ✓ *Power jigsaw* – a necessary tool. Board sawing set (with large saw tooth) and plywood (small saw tooth).
   - ✓ *Band electric grinder.* Preferably equipped with a cutting waste collector. It is used instead of a jack plate in many cases.
   - ✓ *Plain grinder*. It helps save time and strength when finishing the hull of the boat.
2. **Manual tools:**
   - ✓ Big jack plate, better metal long plane.
   - ✓ Small jack plate, sliding.
   - ✓ Stapler 12-14 mm (Better square staples as more reliable).
   - ✓ Narrow (10mm) and wide wood chisel (20 mm).
   - ✓ Hammer.
   - ✓ Wooden hammer
   - ✓ Cross screwdriver.
   - ✓ Flat screwdriver.
   - ✓ Manual wood saw
   - ✓ Pliers
   - ✓ Nail claw
   - ✓ Claw flange set (the more the better, best 4 min)
   - ✓ Builder's level
   - ✓ Plump line
   - ✓ Long (10x20x2500 mm) flexible smooth strip without knots.
   - ✓ Long metal ruler
   - ✓ Square
   - ✓ Protractor
   - ✓ Metal filling knife
   - ✓ Rubber filling knife
   - ✓ Rollers for glass cloth turning over
   - ✓ Brushes, dishware etc.

The list can be extended, but you can get by with the things mentioned. *It is possible to use not so many tools, for instance, electric tools are not absolutely necessary, but your job will be more labor intensive.*

2.3. Materials preparation

According to specification, see Appendix.

3. Manufacturing process

Yacht hull construction technology includes hull parts manufacturing and their assembly, finishing and equipping.

Assembly knots:

1. Keel laying, including bottom plate with cross set joint parts.
2. Bulkheads and transom.
3. Thwart (deck) with supports
4. Sides plates
5. Raw locks support
6. Breast hook

Extra manufactured or purchased:

1. Luggage hold scuttler
2. Oars
3. Rowlocks with sub rowlocks
4. Bailer
5. Warping ring

Yacht assembly order is given below in the chapters about assembling.

4. Side cover manufacturing

4.1. Laying out

Right laying out requires:

- ✓ A pencil or a ball-point pen;
- ✓ Strip support equipment;
- ✓ Long (2500 mm) ruler (a plank with a spilled off edges)
- ✓ Long smooth (without knots) flexible plank, 2500x 10x10 mm;
- ✓ Big straightedge.

4 moisture-resistant standard plywood sheets (1220x2440) are necessary for cover sheets laying out. Each sheet is marked off in accordance with the drawings. Laying out is conducted in the following way: certain points are marked on the plywood sheets accordingly; they outline a certain belt than the points should be connected with the help of a flexible strip of wood, which is fixed by nails and loads. Laying out and cover process can be seen here http://boatbuildercentral.com/howto/camber.php .

4.2. Sheets connection and assembly preparation.

Bottom sheets and side strakes consist of two parts. If two parts of the side strakes are cut, they should be joined (end-to-end). Jointing (on the inner side of the strakes) can be conducted with the help of:

1. **Edge strips** made from the same plywood 120 mm wide. Joined parts of the belt should be placed on the floor at the distance equal to half width of the edge strip, adhesive tape is pasted on each part and the edge is covered with epoxy resin. Edge strip total length of which is 100 mm smaller than the belt's width is put in the middle of the joint (in such a way that 50 mm distance is left at the edges) the whole package is done by the stapler or with the help of loads. (Fig. 5).
2. **Glass cloth layer on epoxy resin.** Strakes butts are covered with epoxy resin. Strakes covered with epoxy resin are covered with 150 mm glass cloth. After that resin is added and rolled over jointed belt's parts. (Fig.6.).

Best results can be shown if plywood sheets are connected and marked out before strakes laying out. For that a room in total length of not less than 5 m is required.

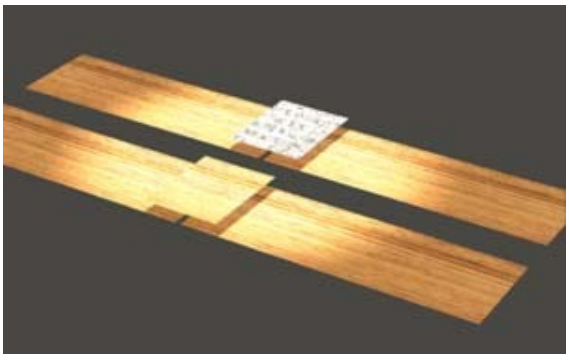


Fig.5. Belt's parts jointing

Fig.6. Jointing with the help of glass cloth

Ready made equal strakes are put together and processed until identical. Here you can find information about boat parts marking off and sheets jointing:

How To Cut a Plywood Frame http://boatbuildercentral.com/howto/frame.php
How To Make A Long Panel http://boatbuildercentral.com/howto/long_panel.php
Make Your Own Oars http://boatbuildercentral.com/howto/oars.php

4.3. Bulkheads manufacture

All parts are marked off according to the drawing on 8-10 mm plywood sheet and cut by an electric jigsaw or a manual wood saw.

Fig.7. Bulkhead 0 – Sternward view.

Fig.8. Bulkhead 1. Sternward view.

Fig.9Bulkhead 2 - Stern. Forward view.

Fig.10. Transom. ***The strap should be installed under the motor after thwarts assembly****.*

After the cutout timbers (wood rods that serve for element support and provide jointing with other parts) are mounted on the bulkheads as specified in the drawings. Stud's parts on self tappers (25x3mm) and glue are jointed with a bulkhead, than they are treated along the outline of the bulkhead and the seams. According to the drawing, basic DP line should be drawn on each bulkhead. Bulkheads should be dressed by sandpaper and double cover with antiseptic and ornamental covering.

4.4. Keel laying manufacture

The boat is assembled with its bottom down without a standard slide. Placed on the edge 50 mm board with spilled off edge can serve as a support. Middle line is marked on the edge of the board where the boat floor will touch it. According to keel laying drawing (page3) bars are made and connected to the board with the help of self tappers within the distance from the middle line, as specified in the drawing. These bars define the skiff bottom curve.

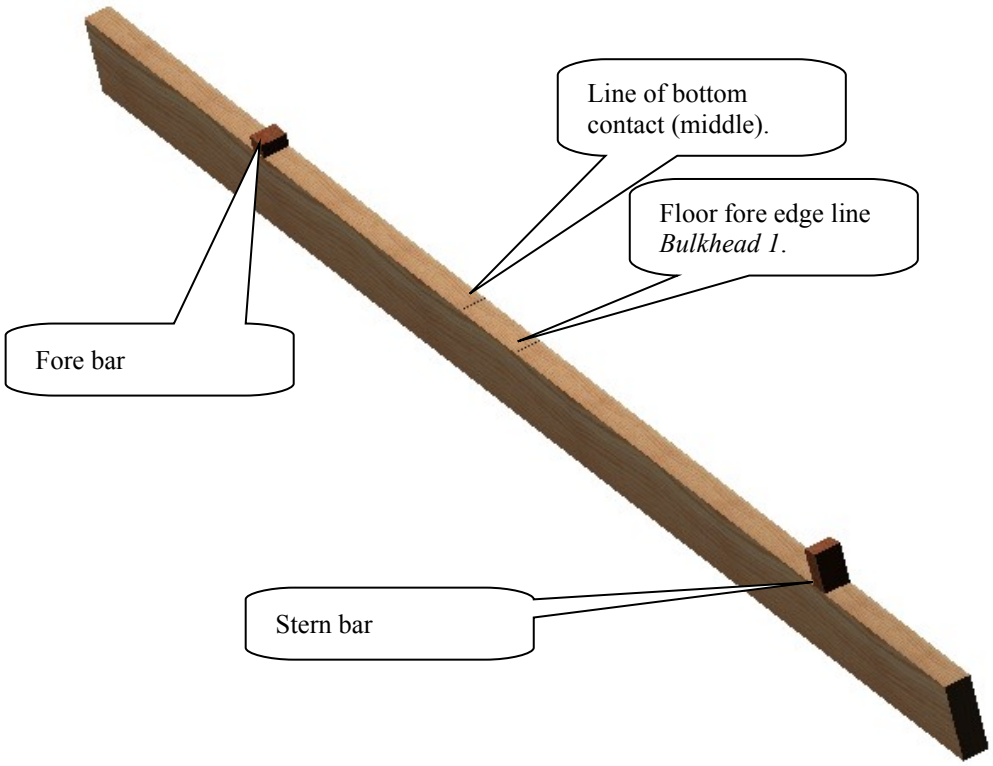


Fig.11. Slide.

Fig.12. Keel laying.

Bottom plate is cut from 10 mm Marine plywood. Standard plywood sheets should be leveled off till the necessary length. It is advisable to perform sheets connection with miter cutting (miter cutting width – 100 mm), a strap cam also be applied (200 mm width) from the same sheet of plywood not brining its edges 40 mm from bottom plate edge. Centerline (middle, along the sheet) should be done on the cut sheet and frame timbers floors installation places should be marked (in accordance with the drawing- sheet 6). Holes (100 mm pitch) should be drilled on the sheet from the bottom side:

1. Along the perimeter for bilge stringers mounting
2. At floor installation places and other backing plates

All holes have to be counter bored from the bottom side so that the fixing system will be 1-1.5 mm deepened in the cover.

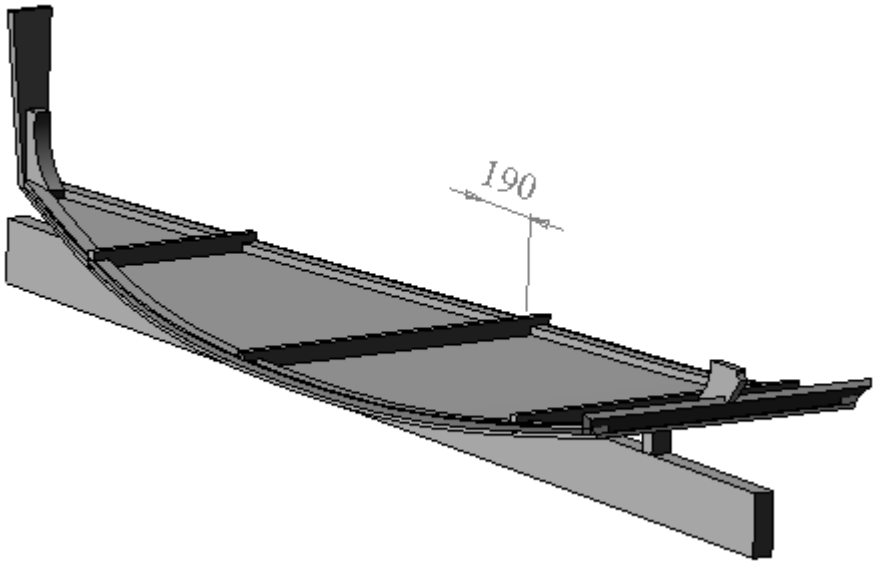


Fig.13.Sheet slide fixing point is 190 mm aside from floor fore base plan Bulkhead 1.

Then the sheet is mounted to the slide board with self tappers through “flies” (or a bar) to the middle line, marked on the board. It is not necessary to mount it to the bars, because sheet curve will provide the necessary toughness.

The next step is stem forefoot mounting installation and transom mounting stern knee plate installation. After that bilge stringers from a20x40 bar are mounted. Stringers have to stand proud of the bottom plate edges 11 mm in the stern and 5-7 mm at the forefront. It is important for further longitudinal framing beveling. Stringers are glued to the sheet by epoxy glue and self tappers screwed from the bottom side in the holes made in advance.

Keel laying process is finished by floor mounting that serve as assembly elements for frame timbers.

Bilge stringers mounting should be conducted on the sheet that has already acquired the necessary shape, that means sheets installation on the slide.

5. Hull assembly.

Assembly order is shown below.

Fig.14. Bulkheads installation. The bulkheads are mounted to the floors on the keel laying with the help of epoxy glue and self tappers.

Fig.15. Bulkheads installation. Sternward view.

Fig.16. Deck installation. The deck is connected with forefoot at the forefront and a rod on the transom piece. Lateral rods of the deck have to fit in the daps of the frame timbers. Than frame timbers are leveled off and the deck is mounted to them with the help of glue and self tappers.

Fig.17. The board is mounted on the transom piece and rowlocks pillows. The distance between stern ward edge of the middle thwart and the rowlocks should be around 300 mm. Bottom stringers and deck stringers are beveled for side cover installation. Whether beveling is right can be checked by applying 400x1000mm plywood piece to the sides of the boat.

Fig.18.Side cover is fixed with help of glue and self tappers to bottom stringers and deck stringers.

Fig.19. Keel laying is mounted on the stem (from the whole bar or 2 boards leftovers 25 mm). The strap is treated aflush together with the bottom and the sides. A slight rounding off is made from the side of the bottom. External clamps and rail cups are mounted.

5.1. Floorboards assembly

Boat floorboard can be detachable made of the rods; it can be marked off and installed at the place. However, if plywood planks or wood planks (6-8 mm j") are glued to the bottom and fill the daps between the planks with epoxy front putty, treat the planks with alkyd colorant creating the look of fine woods, shear and apply several layers of alkyd-urethane varnish , as a result you get a fine and robust surface.

5.2. External works

After the turning the bilges are treated with a riffler or a big sand paper, all uneven things and splits are filled with epoxy (or polyether) front putty. It is evened by sandpaper again and prepared to lining.

Fig.27. Hull turning (Lotus).

6. Boat finishing

Yacht hull is covered with thin layer (1-2 layers) of glass cloth.
Boat finishing ways are given in the following articles:

- http://boatbuildercentral.com/howto/epoxy_basics.php
- http://www.yachtpaint.com/usa/

7. Useful things

As a mooring fitting anchor ring bolt ring is used 10 mm at the fore deck. Blocks and load – line sheaves of 6 mm.

8. Appendix

8.1. List of materials

1. Plywood 2440x1220 9-10mm 3/8” (3 sheets)
2. Plywood 2440x1220 6mm 1/4” 1 sheet
3. Pine rods 20x40 (0,75x1,5”), 20x15 (0,75x0,6”), 40x15 (1,5x0,6”)
4. Brass or zinc-plated fixing
5. Glass cloth 15 running meters
6. Epoxy resin 6kg
7. Epoxy front putty 2 kg

8.2. Drawings set

1. General overlook
2. Design. 3D view
3. Keel-laying (bottom)
4. Bulkheads
5. Deck
6. Cover laying -out
7. Oars