Building the Ice Opti –Part 2
Ken Smith DN4137

WORK TABLE AND LAYOUT

A flat table or ladder-bench 10 feet long and 2 feet wide works well as a building bench. I used a 2 x 12 x 10' joist on saw-horse legs, with plywood screwed to the top as my building bench.

After roughing out the bottom shape of the boat from 1/8 inch plywood, leaving an inch or so extra width on each side, I hot-glued the bottom skin edges to the bench. The skin was 4 inches wide at the bow and the stern was 2 feet wide, and the plywood was 8 feet long. On this, I struck a centerline the length of the bench with chalk line. I then laid out the boat on the bottom skin. I generally followed the drawings available on the web, except the hull is maximum length, the width fits my young skipper (20 inches at the top of the seat), and the sideboards are deeper at the seat back. To download a plan, see: http://www.icesailing.org/junior/index.htm .

On the bottom, I drew in the locations both inside and outside edges of the side boards, the two structural bulkheads and the plank contact area. The center of the plank is 2 m behind the center of the steering chock. The steering chock was laid out to match the hole in the Sarns chain plate, about 3.5 inches back from the bow. Now I had a full sized reference to use in making the rest of the boat parts.

Side boards. I picked three boards which were straight, knot free, and close to quarter sawn (i.e. looking at the end of the board, the grain went nearly perpendicular to the board). My first boat was built with basswood, the second with poplar, but pine, redwood, spruce, or fir would probably also work fine. I took all these boards to a millwright and had them planed to 9/16 thickness. Skip this step and the boat will be fine, just a little heavier. All the boards, for convenience, were the same thickness. The two best boards became sideboards. The other(s) became bottom structure.

Sidebar: I could not find basswood wide enough, so I edge-glued a piece to the side boards to get to the proper width. This is a bother which can be avoided by scrounging the proper sized lumber.

Remembering to account for the top and bottom skins, I then laid out the profile of the boat on one side board. I planned to use a seat back angle of 35 degrees and have the seat back intersect the side board at the rear corner. I made the boat deeper than a DN at the rear corner, 5-1/2 inches, the better to hold the skipper in the boat. I used a thin strip of wood (a batten) clamped to the board as a guide to draw a nice smooth curve. Using a table or saber saw, both side boards were cut to this profile. With the boards clamped together, a hand plane was used to make the profile smooth and fair. The side boards would be 8 feet long, except for a little trimming later at the bow.

HULL

The thickness of the hull is two skins (1/4") thicker than the sideboard. The profile of the side board is determined by three things: (1) the length of the bearings at the steering runner, (2) the length of the tiller post and (3) the desired sideboard height at the top of the seat back. The hull profile shape is a nice upslope and curve from the stem (bow), changing to flat between the mast step and tiller post. The hull then curves gently down until the rear seat. The finished hull thickness at the tiller post should be just less than 6-3/4 inches if you find or buy a standard Sarns part. The distance from the steering runner to the tiller sets where these parts will fall in the boat. If you build (or have a machine shop modify) a steering rod, I used 38 inches as the length between centers. Get these parts first, so you know. They can be new or from a scrapped DN hull. The steering chock location is fixed by the stem hardware if you use Sarns; otherwise, it should be a few inches back from the stem so the bearing does not touch the side boards.

Sidebar: I used old style solid steering rods and cut them to the desired length, then drilled and tapped the cut end in a lathe to accept the Sarns end piece. I then had an adjustable steering rod 38 – ½ inches long form bolt hole to bolt hole. Your solution may vary.

Next I set to work on the table saw. The Opti is a double-bottomed boat where the pilot sits (the cockpit) with wood listings separating the inside skin from the bottom skin. With the spare board, I cut off 18 inches to use for interior bulkheads. From the remainder, I cut five or six ¼" strips for listings. This left a board wide enough to use for a plank support structure and the bottom part of the tail structure.

Now the mast support structure. Unlike the DN, there are only two structural bulkheads. One will become the front of the cockpit and the other just forward of the mast. Since the mast compression loads are so much less than a DN, less wood is necessary in this area. See the diagram to understand what the wood structure under the mast looks like. The parts were sized so that the screws from the mast step would end in the vertical pieces.

The two structural bulkheads were trimmed to fit as marked on the bottom skin. The table saw was set to about 6^{o} so the edges of the bulkheads would be flush against the side boards. The heights of the bulkheads were checked against the side boards. The top edges of the bulkheads were beveled to accept the top piece of the mast support structure.

The stem consists of two boards trimmed to be inside the side boards on top and bottom and a few small blocks of wood at the very front to hold them apart. The shapes look tricky, but a belt sander takes them to shape quickly. This is similar to the DN standard plans as in the yearbook.

A strip of wood ¼ by ¾ is required as a stringer between the stem and the front bulkhead to support the top and bottom skins. Notches are left in the bulkhead and stem boards for these stringers, or plan on a generous epoxy fillet where they join.

The outline of the cockpit bottom was glued to the bottom made from ¼ inch listings. More of these ¼ inch listings were glued as cross pieces every three inches. From the 9/16 thick remainders, blocks were placed touching the outline and in about three inches, where the plank mountings would attach. Also from this wood, the bottom of the tail piece was glued to the bottom skin. This piece begins over the plank and extends aft. Listings to close out the bottom were added aft.

The bottom of the fuselage, a.k.a. the inner bottom, was glued to the top of all the listings, leaving about an inch of overhang all around. After the glue set, the overhang was trimmed. The slick way to do this is with a router and bit designed for trimming the edges of formica. One can be found at any good hardware store. It has a straight cutting blade and a little roller. Walking the router around the edges with the roller riding on the surface of the listings does a magnificent job. Alternately, careful trimming with a dremmel saw or a sharp box cutter, and finishing with a small hand plane is also effective.

The mast support structure was glued together with epoxy and structurally strong filler. Care was taken to fill all the gaps in the joints with epoxy and filler. Care was also taken to ensure everything was square and straight for this gluing operation. An extra listing or gusset is desirable to increase the strength of these joints. After the epoxy partially set, the mast structure was glued to the bottom skin. The bottom stringer and stem were glued to the bottom, and the stringer to the front bulkhead. The block that will support the tiller bearing was glued in place under the mast support structure. The rest of the stem parts are glued together, if they weren't already.

At some point, the tiller and steering bearing holes have to be drilled, and I do it now. I can see when everything is lined up and straight. I drill a guide hole first with a 10 inch drill bit of ~1/8 inch diameter and then use a very expensive bit of the right size. I drill right through the table. On purpose. Honest.

Now the side boards get glued on one at a time. Check the fit, as glue is likely to have squeezed out and will degrade fit if it is not removed with a sharp chisel or knife. This gluing operation means filled epoxy on the bottom edge of the side board, on the edges of the bulkheads and the stem. Do not forget the long listing under the cockpit floor along the side board. This is a lot of epoxy to get down before it starts to kick This is one place where an extra set of hands is particularly helpful. Repeat tomorrow on side two.

In the cockpit, I put two knees including a joining cross piece. I also added two small boards as heel braces. I added two gussets set at 45^{o} running from the knees to the end of the boat. The gussets were made from 3" x 1/2 inch wood. The seat back was fit over the top of these.

I glue two pieces of skin together to make the seat back. The trickiest fit-up is to get the seat back to fit tightly against both side boards and the floor in the right position. It needs also to fit tightly against the top piece of the tail stinger. At least in the Opti, the side

boards are straight in this area, unlike the DN. The seat is a structural member. It connects the sideboards to the top part of the tail piece. This means that the fit should be good, a strong filler in the glue and a generous fillet behind the seat where you cannot fit your hand. To be sure, I added a trim piece behind the seat back running side to side.

The front skin can go on at any time now. And the boat can be removed from the table by knifing through the hot glue at the edges of the bottom skin. They get trimmed like the fuselage bottom did.

PLANK AND RIGGING

Make the plank by building a cold molded slightly curved assembly ¾ inches thick. There are several descriptions of building strip and core DN planks on the internet builder's forum. (http://cerebus.winsite.com/DNboard/DNconst.html and find the "plank construction details" string.) This is the same, only shorter and thinner. I left out two strips on the bottom in the middle for the light-weight (45 pound) version of the pilot. To be cheap, ¾ inch high quality plywood would probably work, but for the ugly shape.

Mounting the chocks follows guidelines as described in folklore. There are many methods. I made a BIG triangle of aluminum angle and square extrusion. I use it to glue down both chocks on the OPTI. If it isn't right then, I use shim tape and check on a deflected plank using a dial indicator riding on the edges. I think THINK ICE describes the process.

To mount the plank, I bedded two ¼ inch steel pins in the plank on 15" centers. I took some Ace Hardware aluminum strip (3/4" wide) and drilled it to match. These I mounted on the bottom of the hull with countersunk screws going into those blocks I talked about by the plank location. The plank is held to the hull with parachute cord tied through a couple eyes mounted on the side of the boat. It sounds weak. It IS cheap. I sailed a DN with the same set up in terrible ice, and never had a problem.

The single rear block is mounted to two more pieces of the aluminum strip. They are mounted to the rear stinger at the top rear corner. A clevis pin fastens to the block.

The hound is made from a 3/8 inch screw mount from a good hardware store. I drilled through the mast and fasten a shackle to the hole in the mount. Inside the mast end is foamed to keep it water tight. The base is made from a 1.3" long piece of aluminum bar and is turned to fit inside the end of the mast with a small lip to hold it in place. It is riveted in place. A ¾" inch hole about 7/8" deep serves as the retainer for the mast ball. The shrouds are 1/8 inch Ace hardware galvanized wire with eyes in each end. Shroud adjusters from a dinghy are on all three ends.

The tiller is a Sarns tube with a plywood box over it, with a handle set on it. Since the tube is so long, the handle is not past the end. This is great for telescoping, but I am not happy with it and it may change. The sheet is soft line of about 10mm. Comfort and non-slip is more important than non-stretch. The line came from Fleet Farm.

The outside of the wood parts are sealed with epoxy and the sides are also painted in fluorescent colors, for visibility. I adopted the European preference for the front portion of the sides to be fluorescent yellow-green on the right and fluorescent red-pink on the left. That way, the young pilot knows green means go and red means stop, as an easier concept to reinforce port and starboard right of way rules.

I considered closing the tail to look more DNish. My plan was to use 3mm plywood for the sides and decks. I may yet do this, but am working on problems (1) and (2) first.