Appendix 4- A Replacement Rudder

After the first season of sailing the boat, I did a very stupid thing. While hauling the boat for its winter repairs, I removed the rudder at the dock so that I wouldn't drag it across the parking lot as I pulled the boat up the ramp. It was late and quite dark, and my little Nissan Frontier could barely pull the boat up the ramp… I thought I may have ruined my transmission… and I busied myself with lowering and stowing the mast. When I launched again in the spring, it dawned on me where I last saw my rudder… lying on the public dock five months ago.

So one of my first jobs that season was to build a new rudder. Fortunately I had an excellent resource for replacing a rudder blade… my friend Tom Stockwell has written an excellent article about making a water-ballasted MacGregor rudder using a stitch-and-glue boatbuilding technique. This article can be seen at:

http://www.geocities.com/thomas_m_stockwell/rudder.html

(This link was correct as of 10/25/2003, at least. Personal web pages seem to change quite often, as increased traffic causes the servers to charge more or remove the page. Individuals often move the site to a commercial space or delete the site altogether.)

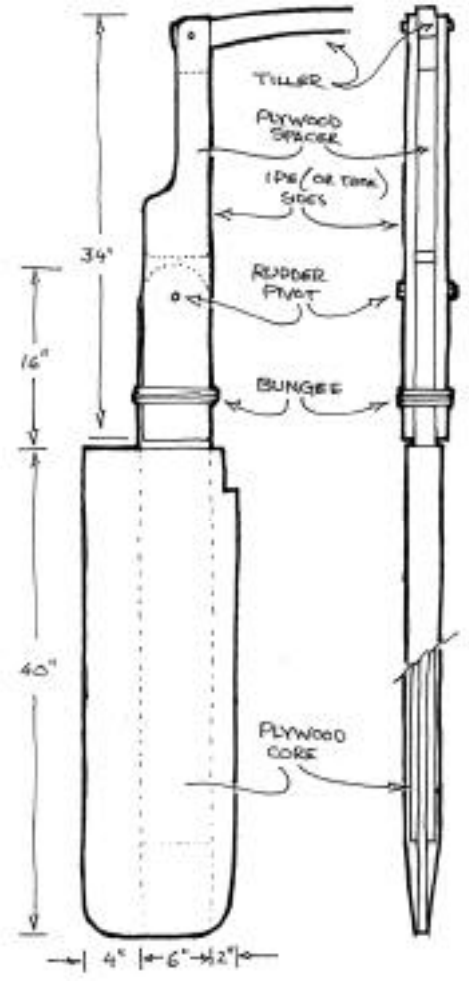
Tom's article was the starting point for fabricating an entirely new rudder assembly. I built the blade of the rudder mostly as he described, except that the leading edge was reduced from 3" forward of the rudder post to 2". This meant a slight alteration in the plywood core pattern… Tom calls this part a "key." My blade is 40" long by 6" wide. This may be a touch oversized, as the chance to thoroughly test the rudder hasn't presented itself. If it is, then it can be corrected by either shaving an inch or two off the bottom of the blade, or raking the mast aft.

Building the rudder blade was a fairly straightforward process, thanks to the help that Tom's article provides. The core, or "key," is cut from a half sheet of 1/2" exterior plywood. Three layers are laminated together to create a 1 1/2" thick core. The keel is glued with a special woodworking glue called "Gorilla Glue®," which foams and expands as it cures. It's a strong, waterproof, gap-filling adhesive that is very well suited to this application. The core was completed by coating all surfaces with epoxy resin.

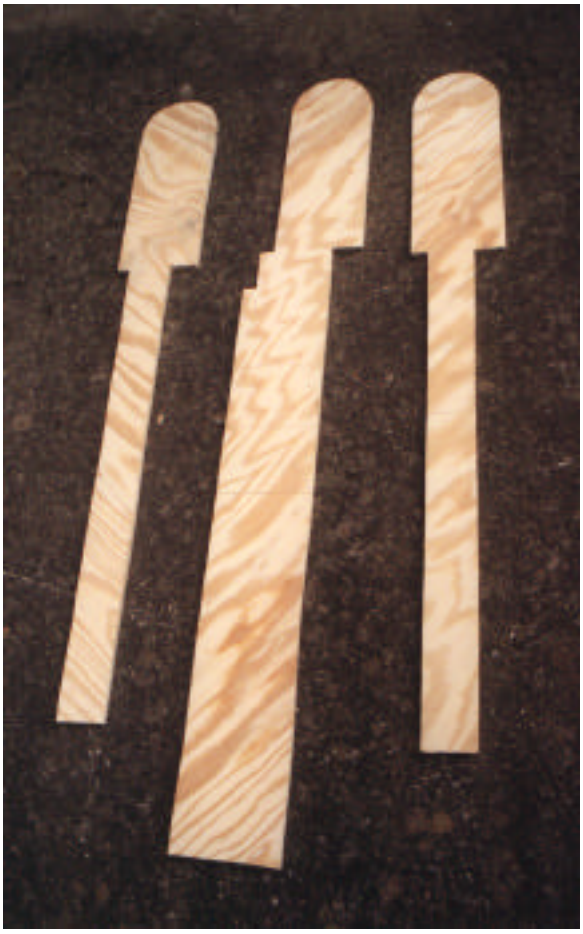
The blade was formed by wrapping the core with a piece of 1/4" plywood. Exterior fir is recommended, though I had to use Luan, as it was all that I could find locally. The two halves are secured by nylon zip ties until the glue cures, then the entire thing coated with epoxy. I took the additional step of laminating the entire surface of the rudder with a layer of fiberglass. The rudder shell is open at the top and bottom of the blade, allowing water to fill the cavity. This makes the rudder essentially water-ballasted. It results in a lightweight yet neutrally-buoyant rudder.

Where I had to be inventive was the upper part of the blade, where the rudder attaches to the transom. The piece I ended up making was designed primarily to accommodate my very last piece of ipe hardwood, which was 5 1/2" wide and 54" long. The assembly can be thought of as a kind of sandwich… 1 1/2" of plywood is captured by two ipe sides, which support both the rudder and the tiller, allowing them to pivot. The illustration explains it best.

The kick-up system is simply several wraps of bungee a few inches below the pivot



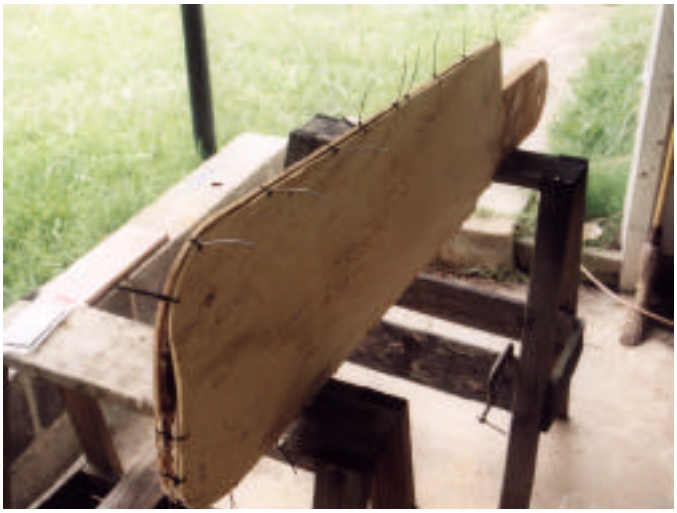
a73. Dimensions for the new rudder



a75. 1/2" plywood cut to shape a rudder core, or "key."

a76. When glued and screwed together, the "key" forms a very strong, rigid structure.

a77. The parts for the lower half of the rudder… the plywood "skins" and a "key."



a78. Everything assembled with zip ties.

a79. Laminating the exterior with a layer of fiberglass cloth and epoxy.

a80. The lower rudder saturated easily, and now is ready for sanding and painting.

point of the blade. If the pressure against the blade causes it to kick up too easily, then it's a simple matter to increase the tension or number of wraps on the bungee cord.

This rudder design has several advantages over the stock MacGregor rudder. The section is a very close approximation of a NACA foil, causing less turbulence through the water as well as decreasing the likelihood of stalling in sharp turns. Since it's water-ballasted, it's lighter than the stock rudder as well. The hollow construction makes it possibly easier to break, though the entire thing is coated with epoxy resin inside and out. A layer of fiberglass laminate on the outer shell makes the total assembly very strong, and it's as likely to pull the pintles and gudgeons from the transom before the blade itself breaks.

One mistake that I did make was trusting the people at Lowes who said this was exterior plywood… it wasn't, as the trailing edge of my rudder began to seperate after about a month in the water. It was fairly easy to correct with a little more gorrilla glue and some epoxy and glass over the trailing edge.

a81. A fabricated replacement rudder before installation.

a82. The new rudder in place. It's a touch higher than I'd prefer, but it looks and works well.