A Better Rudder. ......Jim Fisher DS 2967
From the Day Sailer Quarterly, #104 Spring 1987

Those of you that have raced against me might have noticed that my boat is slow. My boat, that is.... certainly, not me! (Deep down inside, I am afraid to get a Lindsay centerboard. If I get that board and I am still slow, I shall be really hard pressed for an excuse!)

No matter. In the course of my quest for equipment oriented solutions to the boat speed problem, I noticed that several top boats have rudders that are significantly different from the original O'Day design. The deficiencies of the original design became painfully apparent to me in a photo of my boat on a broad reach in a nice breeze. My boat made a rooster tail like an unlimited class hydroplane; she left a bubbling white wake like a steam-powered torpedo! This was a drag! Obviously, something had to be done. Between various books and discussions with some of the other members of Fleet One (particularly Rob Bonney and Jack Colwell) I listed the following design goals for a new rudder system;

a. Conform with class rules.
b. Light weight.
c. Reduce drag.
d. Increase strength.
e. Increase control.
f. Simplicity.
g. Low cost.
h.

As you may note in a review of the drawings, the rudder system is quite different from the original O'Day unit, but bears some resemblance to the Rebel, Spindrift, and Precision designs. In terms of our stated goals:

a. Ken Bay, our class measurer, has reviewed and approved the design.

b. The assembly is about five pounds lighter than the original system.
This is particularly advantageous, in that the extreme ends are the best place to reduce weight. I further reduced weight of the rudder stock through judicious application of a friend's hydraulic hole cutter. If you are not fortunate enough to have access to one of these, an electric drill with a half inch bit can remove a lot of weight. Just a few words of caution: first, hole saws will not work, even on a good quality drill press. Second, don't leave any square corners in your hole cutting efforts, or stress fractures may result.

c. The system reduces drag three ways. First, the new design of the rudder head reduces the frontal area below the waterline. Second, the new design also eliminates a source of turbulence. Third, the new rudder blade has a superior foil shape.
d. This new rudder system is strong, particularly in the gudgeons and pintles. This was a weakness on many older boats, and an equipment failure here can have particularly disastrous consequences. Buy me a beer this summer, and I'll tell you some sea stories!
e. We have better control through tighter tolerances. This is especially important for a competitive boat. I have seen boats that had so much slop in the rudder system that the end of the tiller moved through a six-inch arc before there was any related movement in the rudder blade.
f. My basic goal here was to "Make it work, keep it simple" so that I could build it in my home workshop. The only power tools used in this project were a portable circular saw with metal cutting blade, an electric drill, and a router. In retrospect, I suppose that I could have done it without the router which I only used to get a rough shape on the rudder blade. The router does save a lot of time and effort, though. I ran it lengthwise down the wooden rudder blade with

cuts at progressively greater depths to get a terraced effect which I worked down with a plane and a surform.

g. Low cost goals were met by use of standard materials readily available in most areas.

CONSTRUCTIOH NOTES ON RUDDER STOCK

1. Rudder blade is one and one eighth inches thick, and the two plates of the rudder stock must be spaced accordingly.
2. All bolts are one-quarter inch stainless, except that the rudder pivot is three eighths.
3. The aluminum tube is cut into one and one eighth segments to provide spacers for the bolts.
4. If you make the tiller from one-inch aluminum box channel, you need shims. (I don't think that my wife has noticed her missing aluminum cookie sheet yet). If you want a wooden tiller, use seasoned hickory or other appropriate hardwood. Pine is simply not adequate.
5. Mounting the tiller with bolts "A" and "B" provides an extremely strong, tight system with excellent control. As an alternative that offers more convenience with only a slight reduction in control, install the tiller so that it can pivot upward on bolt "B", and rest on a bolt and spacer located at the A position. If you use the aluminum tiller, I recommend that you attach a hardwood handle to the end for comfort.
6. When the rudder blade is fully down, the spacers on the lower gudgeon bolts act as stops to retard further rotation forward. When the blade kicks up, rotation past the horizontal position is prevented by the spacer and bolt at position "D". You may wish to rig a shock cord or other system to keep the rudder blade down, as it is very buoyant, and tends to kick up (and stay up), at inopportune times.
7. Prime and paint all aluminum parts with paints recommended for this metal. A preferable finish is anodizing, and better yet is the flat black anodizing finish done to military specifications.
8. Install the stainless steel hardware with zinc paste to inhibit galvanic corrosion. This is especially important for salt water sailors. Use lock nuts or epoxy to keep your assembly tight.

CONSTRUCTION NOTES ON THE RUDDER BLADE

1. The sides of the rudder blade above line ABC are parallel and one and one eighth inches apart. The foil shape below line ABC is shown in the attached drawings. The board profile must be in accordance with DS class specifications
2. The leading edge is rounded on a one eighth inch radius. You can check this by drilling a one-quarter inch hole in a scrap of sheet metal. Cut the metal in two pieces, bisecting the hole, and you have a good measuring gauge.
3. The trailing edge should be squared off cleanly with a one eighth inch flat.
4. Cut about half an Inch off the upper leading corner of the blade, so that it can clear the transom during rotation.
5. The maximum thickness, or chord, of the blade is located 30% or about three and five eighths aft of the leading edge.
6. The rudder blade must be fair and extremely smooth. This is especially true with respect to the leading edges. Attention to detail is really important here.
7. The foil shape data is based on an article by a gentleman named Lindsay. The article appeared in the April 1981 issue of "Yacht Racing & Cruising".
8. The blade must be covered with fiberglass in accordance with DS class specifications. Epoxy resin costs more, but adheres better.

INSTALLATION NOTES

1. Invert the boat and extend the centerboard.

2. Measure from your chainplates to the centerboard tip to ensure that the board is true. If not, shim the board accordingly.
3. Estimate approximate correct location for the transom pintle closer to the waterline, and drill one hole. Hold rudder assemble in place. (It pays to have an assistant for this part).
4. Align rudder blade with centerboard and mark remaining holes for drilling.
5. Check to ensure that the center of the rudder pivot bolt is no more than one inch above a line extending aft from the bottom of the boat, as specified in the class rules.
6. Drill remaining holes in transom for new rudder fittings. Mount new fittings. Ensure that the fittings are solidly bedded in epoxy or other appropriate compound to ensure strength and watertight integrity.
7.   Fill the old holes, install your tiller extension, and you are ready! (Good sailing)

MATERIAL REQUIREMENTS

1.Stainless steel bolts	1-3/4X1/4	5 ea.
	2X1/4	2 ea.
	1-3/4X3/8	1 ea.
2. Aluminum sheet	3/16X24X19-3/4	1 ea.
3. Aluminum shim stock	1/16x1x3-5/8	2. ea.
4. Aluminum tubing	1/2 O.D. X 6-3/4	

5. Wood (clear pine, mahogany, or other suitable type) 1X12X28
6. Aluminum extrusion one-inch square box channel, 48 inches long
7. RHO rudder gudgeon RO 753 and transom pintle RO 741 2 ea.
8. RHO transom clip RO 761 (retains rudder in event of capsize)
9. Glass cloth and epoxy resin
10. Sandpaper
11. Zinc paste
12. Tiller extension
13. Primer and paint.

COPYRIGHTS, PATENTS, ROYALTIES, AND ASSOCIATED LEGALISTIC ABMINISTRIVIA.
This design is the property of the DS class association.

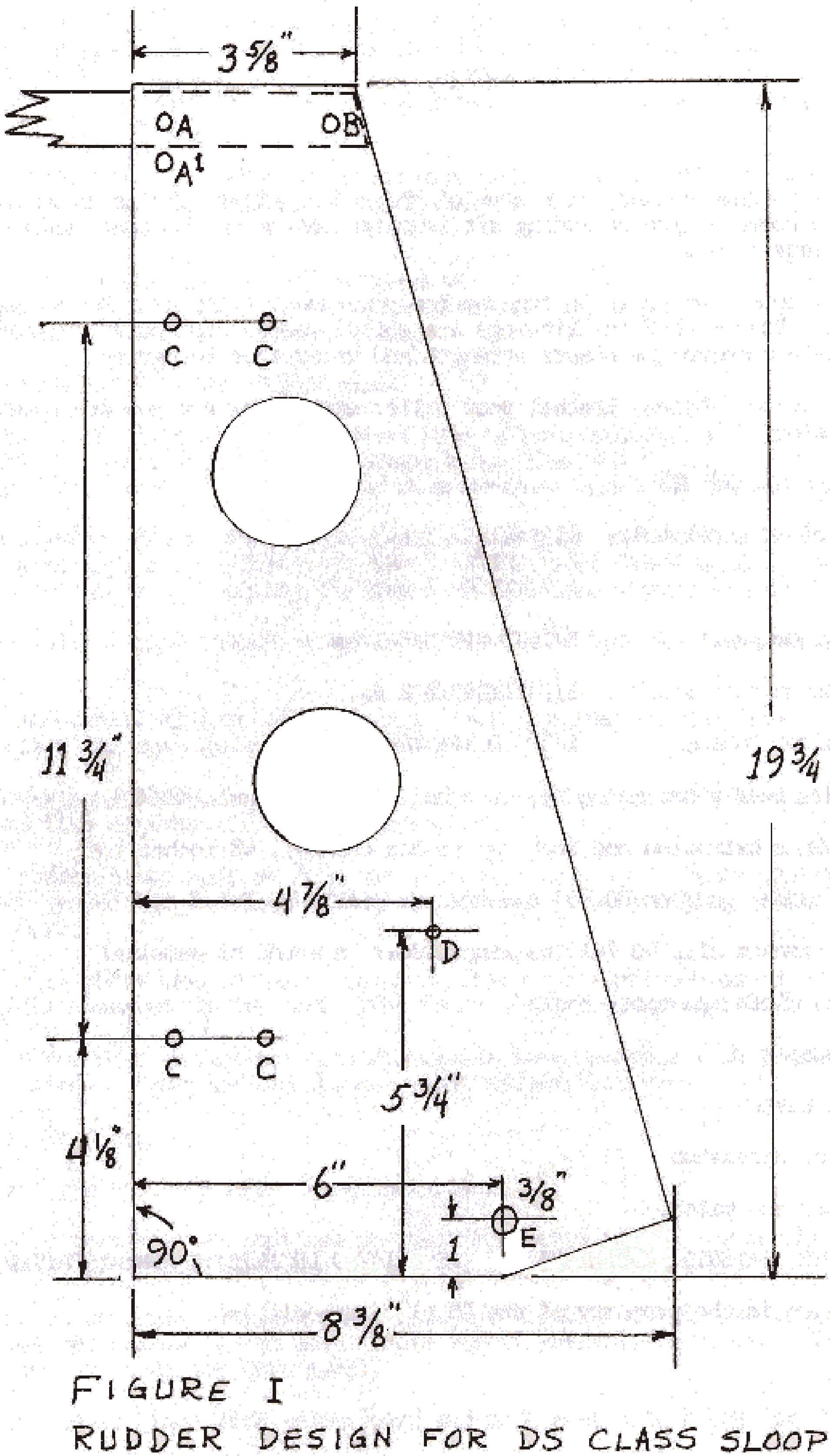

FIGURE I
RUDDER DESIGN FOR DS CLASS SLOOP
JAMES G. FISHER 28FEB86

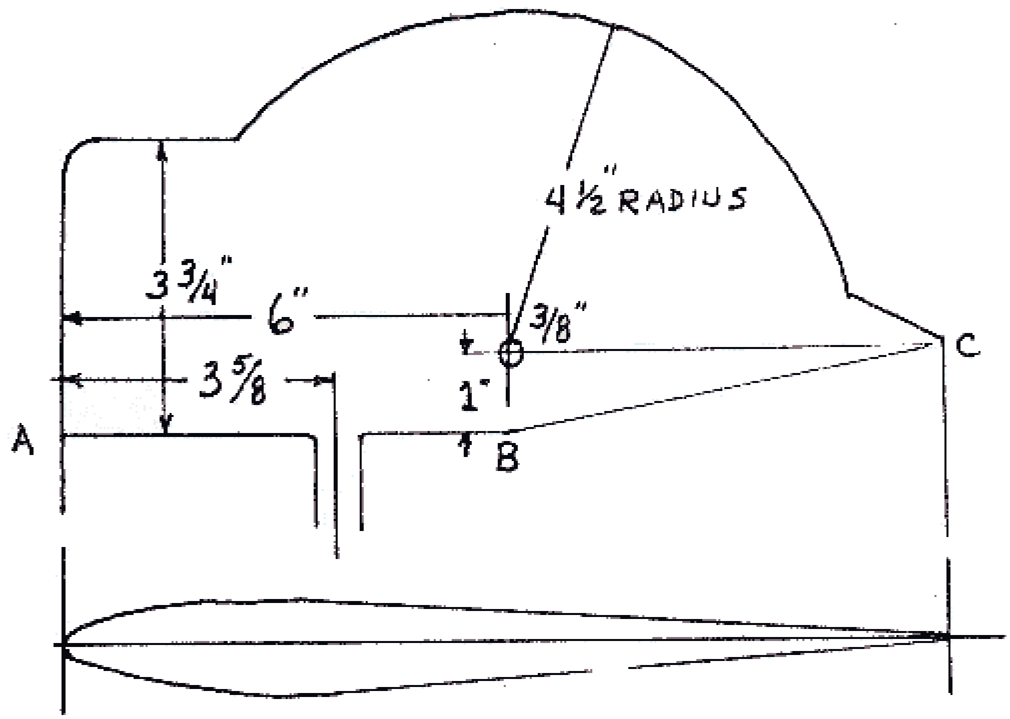

FIGURE II