Building the flapdoodle: Part I – Not for the amateur

My daughter who is now in graduate school has become enamored with sailboats of all kinds and had crewed on several tall ships over the last few years. She wants her own small sailboat, but given her current nomadic life style a regular sailboat just doesn't make sense. So it is with great interest that I found the plans for the Flapdoodle at Duckworks. A folding sailboat that can be cartopped seems to be exactly what she needs. I ordered the plans and jumped right in. The plans present two version – Fladoodle 2 and Flapdoodle 3. The major difference is that the former has the panels joined with fishing line and the latter uses stainless steel hinges. I opted to build version #3.

I thought this would be a simple project since it would be the smallest boat I have built over the last 40 years (One peapod, nine canoes, two sharpies and three St. Pierre Dories). However, even with this experience I ran into problems. The plans require much interpretation, and I would not recommend this project for the novice boat builder. Some information critical to the construction is lacking and in my opinion some is in the wrong order.

I believe the basic concept of a folding pram, is great and unique but the plans need some more explanations and details. So, I am recording my observations to help others who are intrigued by the concept of a folding sailboat.

The Flapdoodle plans are downloaded from the web as a series of chapters that cover different parts (subunits) of the sailboat. I will discuss each chapter in the order suggested in the download, and provide clarifications that I believe may help others.

Chapter 1 - Getting Started

This is a good introduction and helps you get started.

Plywood – I found that 5mm underlayment works well. It is not the best looking plywood but I tested it and it is waterproof. I coated the major hull panels with pigmented epoxy, so the appearance of the wood did not matter. The epoxy coating also increased the strength of the panels, especially their resistance to punctures.

Fabric – I ended up using pieces from an old vinyl bimini top I had. This fabric is quite strong but flexible and is easy to glue.

Chapter 2 – Decisions

This is the list of decisions mentioned in the plans

1. Daggerboard
2. Daggerboard box (later you could use a leeboard)
3. Mast step (a step forward of the dagger box would be easy though)
4. Skeg could be eliminated, and the skeg does not have to have a wheel.
5. Rudder assembly

Decisions 1 - 5 all relate to making the flapdoodle a sailboat; so the first decision is whether to build a sailboat or not. If one goes with the sailboat, one will need all five of the items listed as subject to a decision. Furthermore, decisions 3 and 4 suggest there are some choices to be made regarding to a mast step and skeg. If one uses the sail plan provided (balanced lug) the mast step has to be forward of the dagger box. The center of effort of the sail would be behind the daggerboard if the mast step is attached to the central seat as indicated in chapter 10 (Center Seat). Also, it would be very cumbersome to try and sail with the mast in the center of the boat...no place to sit without being either too far forward or aft.

If one opts for the sail, a skeg is necessary to anchor the rudder plate. The skeg cannot be eliminated. The plans do not make that clear.

Chapter 3 Offsets (cutting the panels)

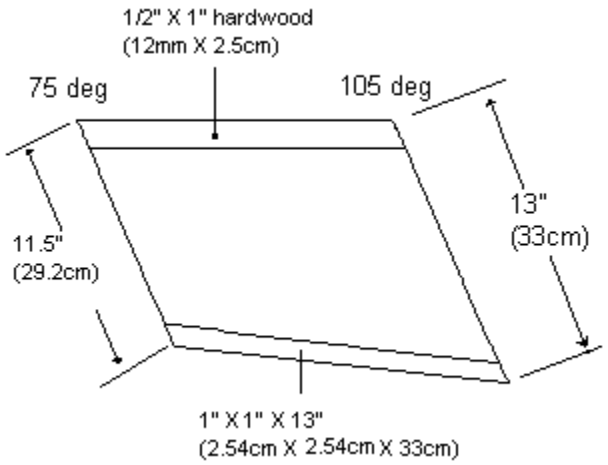
The description of how to mark the offsets and cut out the panels are good. I don't have any comments that might improve the process.

Chapter 4 Daggerboard and Dagger Board box

The dimensions of the plywood needed to rough out the dagger box are not correct. The directions say to use a piece 14" by 17" but then the drawing of the box shows that the base in only 13" and at angle (see below). If one built the box as proposed the box would be too big. Luckily, I started by first cutting out the sides using the angles and distances in the drawing and found the discrepancy before I glued everything together.

From the plans: *Glue and clamp the two spacer strips on the "ugly side" of one of the 14" X 17" (35.5cm X 43.2cm) box blanks. Use heavy weights on a FLAT surface if needed. I used the dagger board as a flat surface below.*

But then it shows the following size for the box. This is the correct size based on the design for the daggerboard.



picture from the plans

Chapter 5 Metal Hinges

Buying a 6ft stainless piano hinge is a great idea and works well. I found mine on Amazon and did not have to go to an Ace Hardware store. However, I did not look forward to cutting the long hinge into 24 smaller ones. The metal cutting blade of a standard angle grinder has a relatively large curf and will create a burr that makes it difficult to pull the pin out. On the other hand cutting the hinges with a small rotary tool such as the Dremel takes forever.

Solution: I like to find excuses to buy new tools so I bought a set of 5" metal shears. I could not cut through the entire hinge so I pulled out the pin (6feet of it) and cut each half of the hinge separately. This also let me cut the pins 1/8 inch shorter, as suggested in the plans without having to shorten each pin separately. I used a regular nail cutter for that.

Metal shears available on Amazon

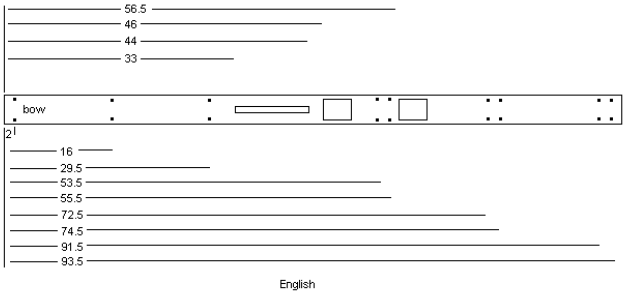
Chapter 6 Keel

In this chapter one builds the keel and everything that is attached to it (daggerboard box, steel hinges, and the pvc hinges). Several issues cropped up as I was following the instructions.

1. It is critical that one uses the thinnest nuts possible when attaching the hinges. Also make sure that the bolts do not extend above the base of the hinge more than the

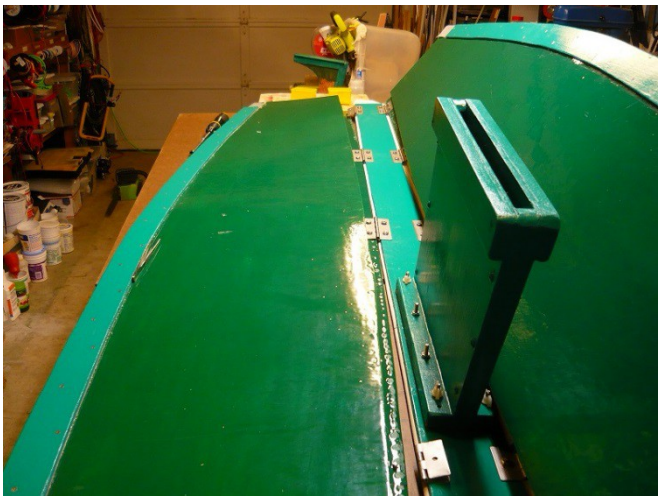
height of the gap between the two pieces of the hinge when it is folded over. I used stainless steel 3/8" #10 flathead machine screws. I found that I could not use lock washers under the nuts because the gap formed when the hinge is folded over was too small. I needed to use a threadlocker (the red type) to make sure the nuts did not come off during use.

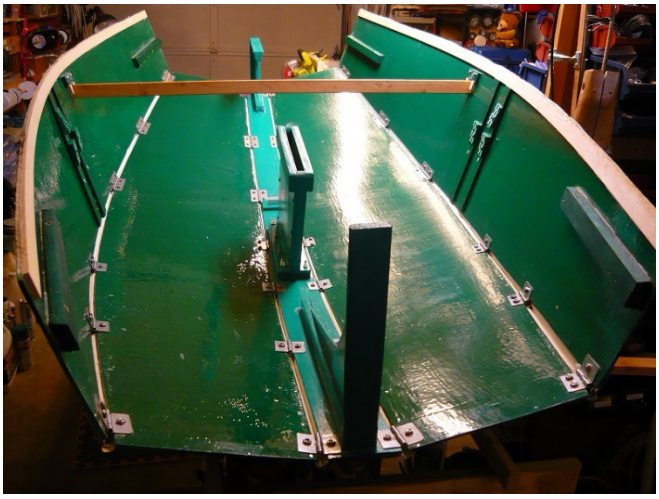
2. After I had attached the bottom panels to the keel, I found that the gap between the two hinges on either side of the daggerboard box was too large. The distance between the hinges at the box was 24 inches as shown below.



from plans- showing large gap in placement of hinges at the daggerboard slot.

When the sides were folded this gap created a very deformed bottom shape. Also any pressure on the box pushed the keel down with enough force that the pvc cloth hinges were heavily strained. I had to add another hinge under the box and then shape the cork gasket to fit around the hinge. The first picture shows the large gap in the location of the hinges, and the second picture shows the added one.

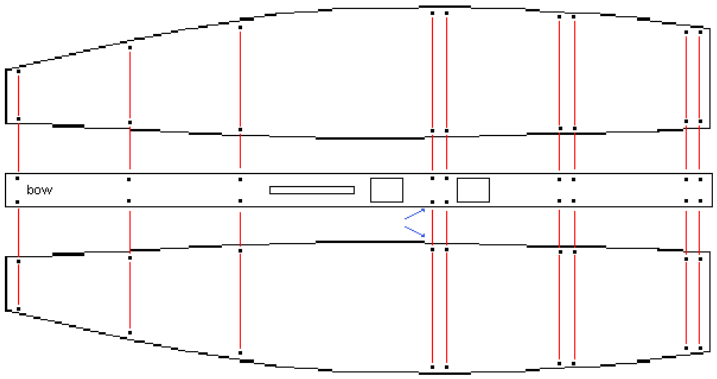




3. The plans call for attaching the cloth PVC hinge with PVC glue to the keel and then sealing the supporting strips that lie on top with an acrylic caulk. My experience with these two products suggest that this is not the best option. Once PVC glue dries it becomes as hard as your standard PVC pipe and will crack if subject to continuous flexing. I used a more flexible glue (E6000 that comes in 10oz cartridges). It is more of a "rubber" based glue that has enough of the right solvents to slightly soften and attach to PVC. I would also not recommend using a water based acrylic caulk. I have found that it may take 6-8 months to cure when it is used between layers that are 2-4 inches wide. The width of joint does not allow water to evaporate easily. Any contact with water will dissolve the caulk in the seam before it is fully cured. I would recommend using a solvent based caulk. Another product I am trying to the first time is a silicone based adhesive sealant from GE (Iron Grip). My tests show that it has good adhesion to painted or epoxied plywood and it does not put off vapors (except for a slight smell of ammonia).

Chapter 7 Panel Hinges

This chapter describes the procedure for attaching the two bottom panels to the keel. Below is the diagram from the plans.



from plans

However, I would not suggest using this diagram to locate the holes for the hinges in the bottom panels. When the panels are attached to the keel, the keel will bend along the curve of the bottom sheet. There is a ¼ inch discrepancy in the position of the holes at the bow and stern if one locates the holes as shown because the distance along the edges of the panels are not the same as the distance along the edge of the keep. The distance along the curve is 96 ½ inches not the 96 inches along the keel. One needs to measure the distance along the curve of the panel when placing the holes so they line up with the holes in the keel.

However, there is no need to adjust the holes between the bottom panels and the side panels. These curves are the same so there will be no offsets between the edges.

Chapter 8 Side Panels

This chapter should be placed before those in chapter 7. The first sentence even says to trim the sides before assembly.

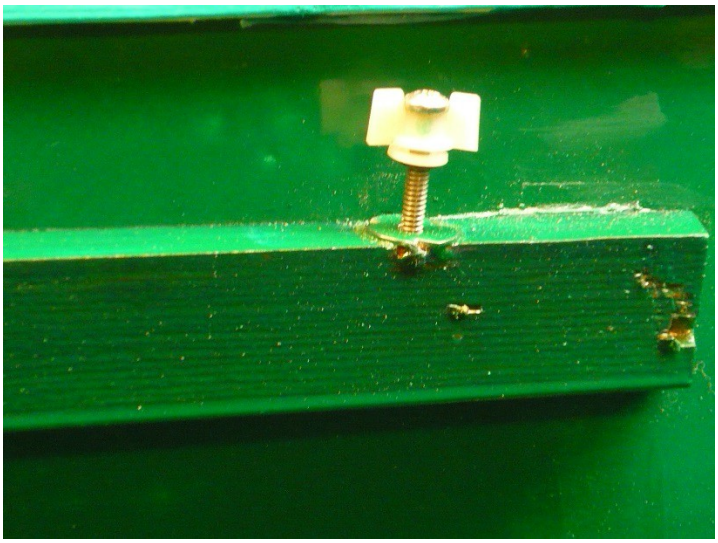
Building the flapdoodle: Part II

Continuing the story, chapter by chapter.

Chapter 9 Brackets.

The plans call for preparing a number brackets to hold the seats and other pieces. However, I changed the design enough that I only needed one bracket/support plate for the center frame.

Rather than using notches in brackets to hold down the forward and rear seat I used thumbscrews and T-nuts. The T-nuts were glued into holes using E6000. I have some concerns that the seats might "pop out" if there is some flexing of windward side when sailing at a heel. Since I could not find stainless thumbscrews I made my own using #10/24 machine screws and nylon wing nuts.



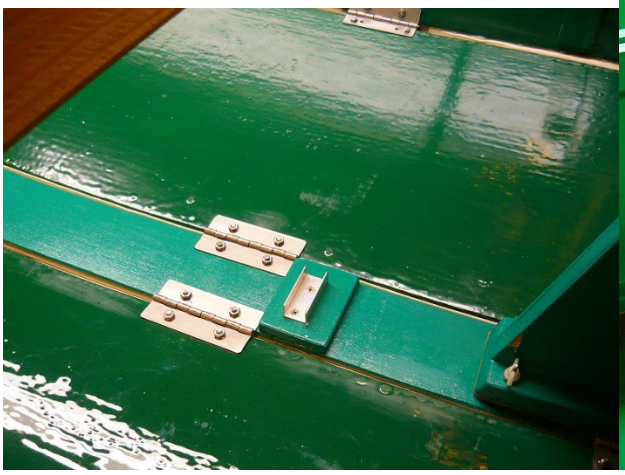
Chapter 10 Center Seat (thwart)

I opted for a center frame to increase the space inside the hull. This option is presented in a separate chapter called "Center Frame." However, the chapter is a stand-alone, and not accessible from within the sequence of chapters. In other words one cannot get to this section by hitting a link within the chapters or "next." I found it only by printing out everything in the index. As the designer states in the beginning…. Be sure to read everything before starting!

For some reason, I can't seem to follow plans exactly. I always think I can come up with a modification that improve things … sometimes they work, and sometimes they don't.

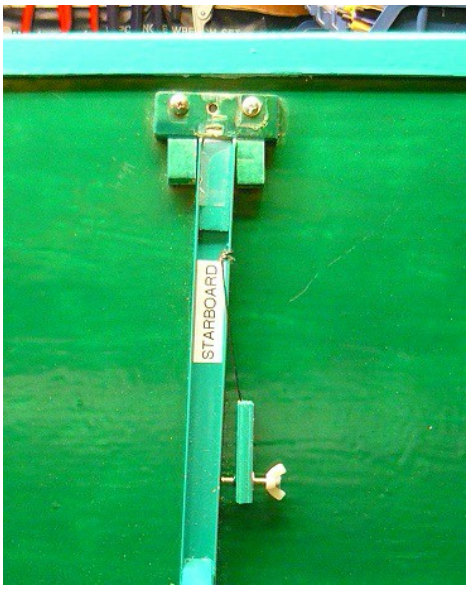
So again, I did not follow the plans for the frame exactly. I had some leftover ¾" aluminum channel from another project (a folding canoe using corrugated plastic) that I used for the sides. The channel was screwed into the 1 x 3 board along the bottom. To increase the stability I also added a small piece of the aluminum channel to the keel so there would be no chance for the frame to pivot. I found that the frame moved when I stepped inside. The floor panels had enough flex that the frame did not stay in place and bounced around.

There is something else that shows up in these photos: To improve the looks and keep dirt out of the PVC hinge I glued a 2" strip of polypropylene webbing along the gap. The first photo shows what it looked like before the webbing was added. The second shows the webbing in place. I believe this will also reduce the flexing in the areas between the hinges.



I noticed throughout the plans that there was little thought given to what might happen when the hull is severely flexed during sailing. The seats and frames are held in position with notches that are only 10 mm deep. I used thumbscrews and wing nuts wherever I could to minimize movement of the removable parts. This included the front and rear seats and the sides of the center frame. The center frame is fitted into a notch with a thumbscrew plug that goes entirely through the hull. The T nut is on the outside of the hull and the block of wood that hold the vertical position is attached with barrel bolts rather than just screws.

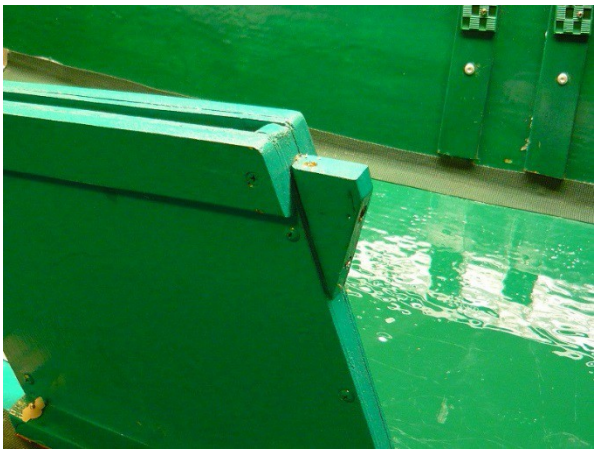
In all of my boat building I have yet to make the two sides mirror images of each other, and the Flapdoodle was no exception. The distance between the bottom panels and the top was off by 3/32" on the starboard side relative to the port side. So, I had to label the frame to make it fit properly.



Chapter 11 Pedestal

The design of the pedestal incorporates a hole for the mast. As mentioned previously, this is not an option for the suggested sail plan. Anyone building the sailing version will probably want to redesign the pedestal.

Boat builders opting for a center frame will also still need a thwart of some kind to keep the daggerboard box firmly in place. THIS IS CRITICAL IN THE SAILING VERSION and not mentioned at all in the plans. Rather than a full seat, I opted for a narrow seat/wide thwart from a 1x6 piece of pine. I notched the 1x6 to fit over the box and provided a support for it so it would not slide down. A pin (3/16" stainless cotter pin) going through the board into the support locks the seat in place. In this case I did not think it necessary to use thumbscrews because the main center frame is only a few inches away.



In the photo above you will also note that I have used a different method for supporting the thwart on the side panels. First I bolted and glued two vertical strips of 5mm plywood to the side using barrel bolts. These spanned the entire panel vertically rather than just being 4" wide brackets as suggested in the plans. My concern with using short brackets is that any weight on the seat might cause bulging of the sides. The 5 mm plywood sides are quite flexible, even when coated with epoxy. A true ¼ ply might be stiffer.

I like to re-use stuff I already have around in my workshop. Rather than cutting out new brackets to support the seat I used some flooring wedges that just happened to be the same color. The supports are angled to match the angle of the top of the daggerboard box.

Chapter 12 Gunwales/Rubrails

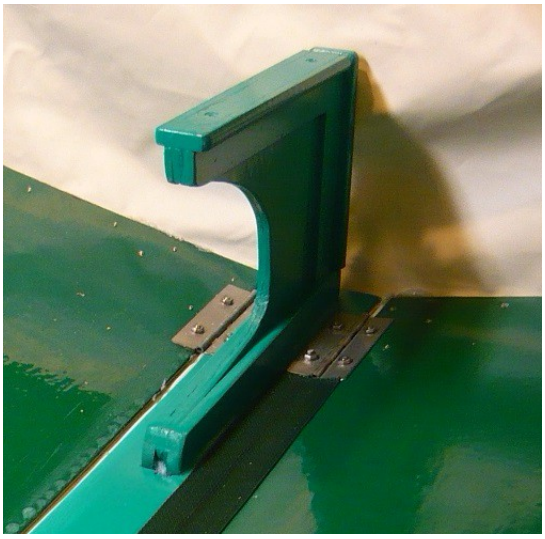
The 5 mm underlayment I was using was not very stiff in long narrow pieces, so I used 1.25" x ¼" lattice for both the gunwales and rubrails. These were first glued to the side panels using the flexible "Iron Grip" silicone glue for GE. Rather than screwing these together with wood screws I again opted for 10/24 barrel bolts and blue threadlocker. This way the two sides are as one unit. The barrel bolts, however, do require a 1/4" hole.

Chapter 13 Stern

Finally a set of directions that was straight forward and did not lead me to look for alternatives. The only difference was that I used hard maple rather than oak. I had some left over bed slats from a bunk bed that were just begging to be used for something.

I would, however, like to suggest that anyone adding a skeg drill additional screw holes through the bottom reinforcing straps of the stern. This will simplify attaching the skeg described in Chapter 18. The plans for the skeg (Chapter 18) indicate that it should be attached by screwing it to the keel from the inside through the stern support. This is not

possible if the stern support is already attached to the keel. The heads of all my 4 electric drills were too large to let me drill down straight. Of course I had to discover this refinement too late. I ended having to use a flexible drill shaft and screw driver.



I used cork for the gasket between the daggerboard box and the keel as suggested in the plans. However, for the stern I used the GE silicone adhesive instead of the cork as suggested in the plans. I layered about 1/8 on the support, put the support on the keel and let it cure in the vertical position. It was then very easy to lay the boat on its side and permanently fix the support with screws from the bottom. It meant I did not have to ask my wife to hold everything in place while I drilled pilot holes from the bottom. I do most of my building between 6 and 9 in the morning and she is not a morning person!

Chapter 14 Transom

Building the transom was not complicated and proceeded as described in the plans. My one modification was to use ½ aluminum square channel for the "lock brackets. I glued and screwed two pieces to the transom with the open part facing inwards. The T bracket on the stern slides between the two pieces and gets locked in place.

Chapter 15 Rear seat

I used 1/2" plywood for the seat rather than gluing up two pieces of 5mm ply. This saved one step in the process. As mentioned previously, I attached the seat the side brackets with thumbscrews. To provide additional stability I attached a horizontal piece of ½" aluminum channel to the transom so when the seat was slid over the T bracket the back of the seat would go into the channel. [I have a lot of recycled aluminum square channel so I used it wherever I could.] The picture below shows the aluminum channel used on the T bracket and along the transom. I suspect however that the black and white printings will not make this very evident.

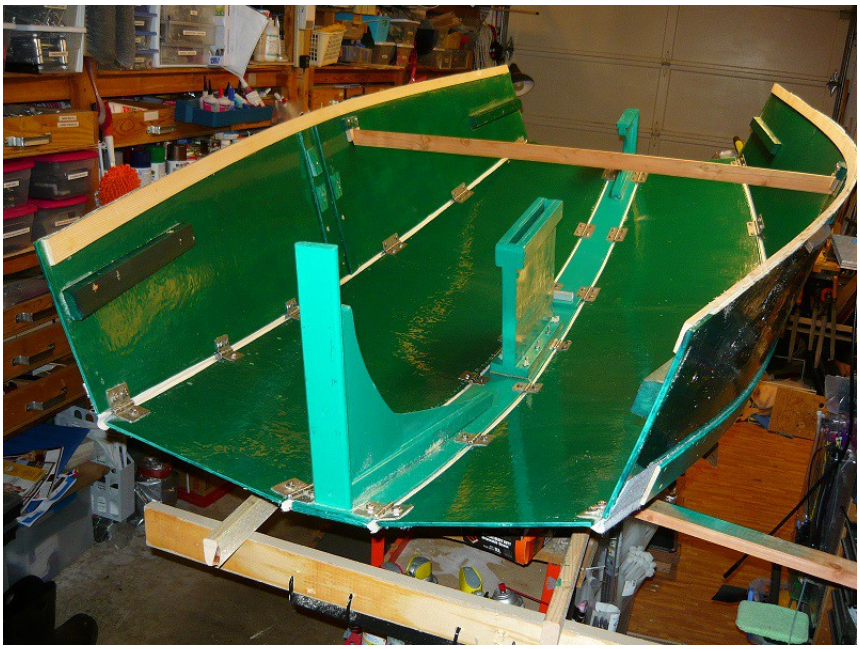
The pictures shows the hitch pins I used at first to hold the seat in place, but these still did not provide enough stability; so I replaced them with the thumbscrews. There was too much play between the seat and the side with the pins.

Chapter 16 Stem, Foredeck & Bowplate

In the sailing version the foredeck provides the major support for the mast and is the point at which most of the power of the sail is transmitted to the hull. The plans as drawn, however do not include any locking mechanisms between for the stem, foredeck and bowplate. They only include locking brackets for the foredeck that hold it to the sides.

I do not believe that this system will provide enough support for the mast and sail. I tested the design by attaching a closet pole to the foredeck and temporarily fixed it to the keel. I could easily bend the entire front end out of shape by pulling sideways on the pole. In order to strengthen the connections between these critical parts I added a locking mechanism between the stem and the bowplate like that found between the transom and the stern post. I also added a horizontal ½ inch aluminum channel on the bowplate into which the foredeck can be slid. Finally I again used thumbscrews to attach the foredeck to the supports along the sides. The thumbscrews keep the foredeck tight against and sides and in the square aluminum channel on the bowplate.

The picture below shows the additional maple board attached to the stem that is used to lock the bowplate. The board is that old slat from a bunkbed (3/8” thick by 1.5 inches wide).



The plans for the stem leave a major step out of the process – curving the bottom of the stem to conform to the curve in the keel. The stem is 22 inches long and if it is not curved there is a 3/8 inch gap between the stem and keel in the middle. The plans describe a process for curving the daggerbox (which is only 13" long) to conform to the keel, but not for the stem which is longer.

I transferred the curve onto a piece cardboard and then shaped the stem to match. One does not need complicated tools to draw this curve. Tape a pencil to a scrap piece of 1x2 or similar wood so the pencil extends about ½ inch beyond the end. Place a piece of cardboard that is at least 23 inches long vertically along the keel. With the hull in the open position, as in the picture above, draw the curve onto the cardboard using your homemade scribe. Cut the cardboard along the pencil line and use it as a template for the curve on the stem.

Chapter 17 Fabric Hinges

This is a repeat of what I wrote in Chapter 6 – the Keel. The issues I have described in putting together the keel apply to all the different places the PVC cloth needs to be attached.

The plans call for attaching the cloth PVC hinge with PVC glue and then sealing the supporting strips that lie on top with an acrylic caulk and screws. My experience with these two products suggest that this is not the best option. Once PVC glue dries it becomes as hard as your standard PVC pipe and will crack if subject to continuous flexing. I used a more flexible glue (E6000 that comes in 10oz cartridges). It is more of a "rubber" based glue that has enough of the right solvents to slightly soften and attach to PVC. I would also not recommend using a water based acrylic caulk. I have found that it may take 6-8 months to cure when it is used between layers that are 2-4 inches wide. The width of joint does not

allow water to evaporate easily. Any contact with water will dissolve the caulk in the seam before it is fully cured. I would recommend using a solvent based caulk. Another product I am trying to the first time is a silicone based adhesive sealant from GE (Iron Grip). My tests show that it has good adhesion to painted or epoxied plywood and it does not put off vapors (except for a slight smell of ammonia).

In general, however, the other descriptions of how to attach the fabric to the hull work well and I did not have any problems.

Chapter 18 Skeg

I really like the idea of putting a wheel in the skeg to help move the boat to the water. Once installed I have already used it to move the hull around the workshop.

The one problem that came up was that the description for attaching the skeg to the keel does not work as described.

"Position the skeg flush with the back edge of the keel and attach it from inside the boat with large screws. You may have to have a friend help. Try to locate the screws where the will not interfere with the screws that hold the stern post in place. Large screws attaching the stern post through the keel and into the skeg will give the stern assembly incredible strength."

It was almost impossible to drill the screw holes through the stern post. I had to use a flexible shaft because the drill head was too wide to drill a straight hole to the skeg. I suggest that these holes be drilled in advance before the stern post is attached to the keel.

As with the stern post and stem, I glued the skeg on first with the GE silicone and then flipped the boat over to add the screws.

Chapter 19 Rudder Assembly

The plans for the rudder hinges are intriguing, but I chickened out and opted for the standard pintles and gudgeons. I used a set from Duckworks that let me attach the gudgeons with flathead bolts through the back panel.

http://www.duckworksbbs.com/product-p/rl-358-brg-parent.htm

Since I deviated from the plans for the rudder post I had to modify the rudder plate. I cut it slightly longer at the bottom so it would fit into the notch in the skeg instead of the hinge bar.

I simplified the rudder assembly by using a piece of 1/8" aluminum sheet I had left over from previous rudders. I only included one line to lift the rudder up. I have found that the weight of the aluminum rudder is adequate to keep it down and I don't need the second line to hold it down. This also has the advantage that the rudder will kick up naturally when I run aground.

The suggestion to include large plastic lids as washers/bearings between the rudder box and the rudder is great. It works for the aluminum. I used the tops of 1 gal. yogurt containers.

I can't say how it works for a wooded rudder.

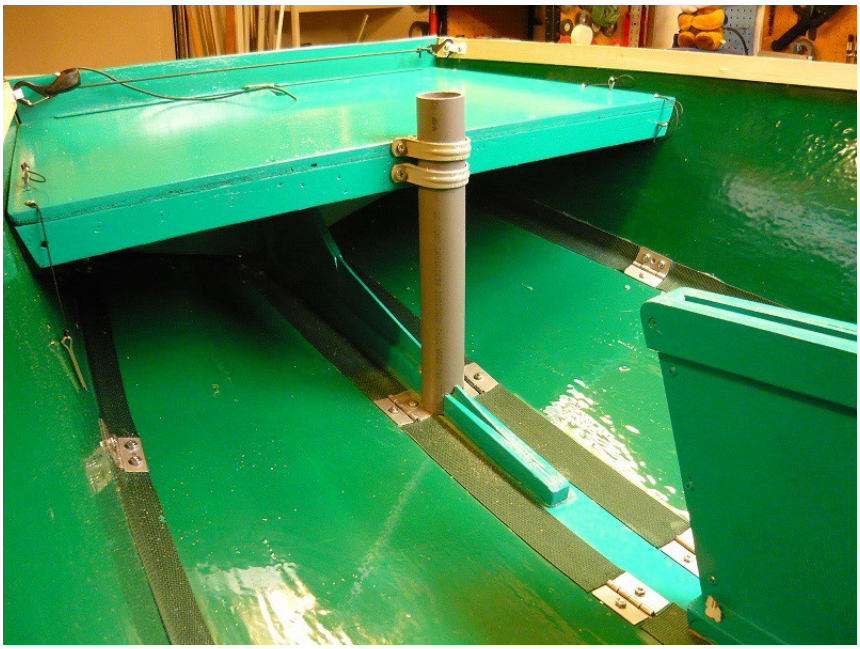
Chapter 20 Forward mast and socket

After reading the instructions for the forward mast socket I thought the system was fairly complicated with too many parts. Yes, it might look nice

But there were a lot of pieces to put together. To simplify the construction I attached two plastic (Carlon) pipe clamps used to hold down PVC conduit. One clamp was attached to the ½" plywood of the seat and the second to the cross brace under the seat.

I also used the grey PVC conduit rather than the white PVC water line because I could not find comparable plastic clamps for the white PVC. The conduit pipes are a little more expensive than the water pipes but it was a better color match.

The process for shaping the PVC pipe and the plug worked as described. I did not come up with any options that might be better or quicker.



For the mast I went to my local Lowes and Home Depot to find the clearest 8' closet pole with the tightest grain. After pawing through the couple dozen warped specimens I found a piece! Now, closet pole is 1.5 inches in diameter and I thought that might be somewhat narrow and not strong enough. To strengthen the mast I used the 2" braided, biaxial,

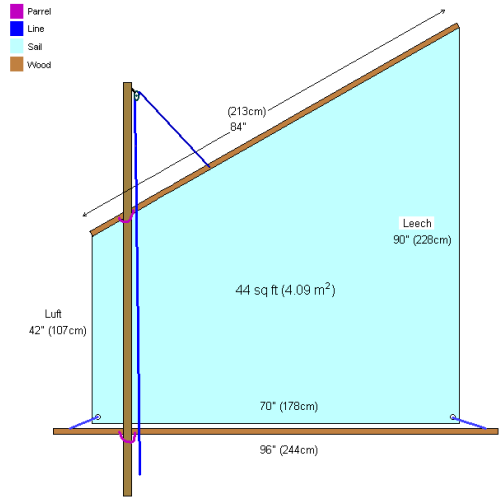
fiberglass sleeves available at Duckworks. A couple of coats of epoxy, and, voila, I had a great mast.

Chapter 21 Sail and Rigging

The sail plan as proposed seems to be more a sketch of an idea rather than an actual sail plan for the Flapdoode.

First, the plans show the halyard attached about 1/3 of the way up the yard.

Drawing from plans show the following:



Lifting the yard with this approach will make it very difficult to raise the sail. There will be a strong lateral force on the parrel. I have looked widely in books and on the internet and all the sail plans have the halyard attached to the parrel, or near it.

The sail plan also does not include some rounding in the foot, luff, and head. Generally it is a good idea to put some rounding in the sail to improve its aerodynamics.

Finally, I did not like the fact that the foot is horizontal to the boat. This means the boom will swing quite low across when tacking and get in the way of the skipper.

The plans for a small balanced lug sail I have seen generally have the peak at a much higher level and the clew as well to raise the boom. I used the conceptual plans given on the Polysail web site (http://www.polysail.com/lug.htm) to make a sail of comparable size. The dimensions ended up being as follows:

Foot – 7'6"; Luff – 4'6"; Head – 6'6"; Leech 8'7". I put about 3" of rounding on the foot and head and about 1.5" on the luff.

I found the concept of using cementing the head between two pieces of molding for the yard ingenious. My one change from the plans was to use barrel bolts that went through both pieces of molding and sail rather than screws.

_____-

So now the Flapdoodle is finished and waiting for its first excursion. I have to wait until April 1 when the open up the launching ramp on my local lake. Hopefully, I will have had my first sail before you read this.