# Spinster F3K beginner DLG

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a J&H Aerospace free plan download

The new Spinster DLG is a super low-tech DLG that will cost about $30 to build and serves as an excellent introduction to DLG/F3K. It only takes a couple of evenings to build and has a removable wing so you can easily transport it to the flying field! Do you need more convincing? Take a look at the flight video!

The parts list below will cost you more than $30 because plywood and the like are not usually available in such minimal quantities. No doubt you will use those materials on future builds, however, so I have not counted them in the cost.

***Part 1: Introduction***

You will need the following materials to build this model:

1. 2 sheets of Adams foam board
2. 1 sheet of 3/32”x3”x36” balsa, preferably C-grain

3. 1 carbon fiber arrow shaft or Goodwinds.com boom, at least 32" long (NOT a pultruded boom–those are too heavy).
4. 4 micro servos; the Hextronic/Towerpro 9 g analog servos are more than sufficient. Search Ebay for "9g servo" to find the current lowest prices.
5. 1 4+ channel micro receiver. Banggood has reliable dsm2 receivers for $6.
6. 1 round cell Lipo battery (Turnigy 1000 mah is excellent).
7. 1 Jst connector for the battery.
8. Up to 3 servo extension wires (battery and aileron servos, depending upon length of wires–I only needed a battery extension).
9. 1 small piece of 1/4" balsa sheet.
10. 1 piece of 1/64" plywood (5"x5" is sufficient).
11. 1 piece of 1/32" plywood (2"x2" is sufficient).
12. 1 piece of 1/16" plywood (3"x10" is sufficient).
13. 1 .070"x.437"x23" Carbon Rectangle strip from CST.
14. 1 .016"x.118" Carbon Rectangle strip from CST (at least 5" long)
15. 30 lb test spiderwire braided fishing line.
16. 1 36" length of .039 piano wire.
17. 1 small block of blue foam or similar (at least 2" cube).
18. 1 sheet of computer paper.
19. Masking tape, packing tape (or Blenderm), CA glue, and hot glue.
20. 10" length of .010 piano wire (up to .015 will work, but could gradually wear down the tail surfaces)

While it is possible to fly this model with a 4 channel radio, you will need to fly with a forward CG and use a y connector to slave the ailerons, which will eliminate the flapperon function. DLGs are very mode-sensitive (I use 1/8" flapperon droop in glide and 45 degrees droop for landing). I recommend at minimum a Spektrum DX6i or equivalent (Flysky i6 *may* be sufficient with a micro receiver).

Plans are located here:
https://drive.google.com/drive/folders/0B9t_4cR6_fI7QjhEdlNYOW1qd3M?usp=sharing

For best results, you should begin by watching Nerdnic's speed wing build video, which is somewhat similar to the building methods used for this model's wing. Figure 1 shows the layout of the plans. The long dotted lines represent score lines for cutting into the paper for beveling the wing. The short dotted lines represent the hinge lines for control surfaces.

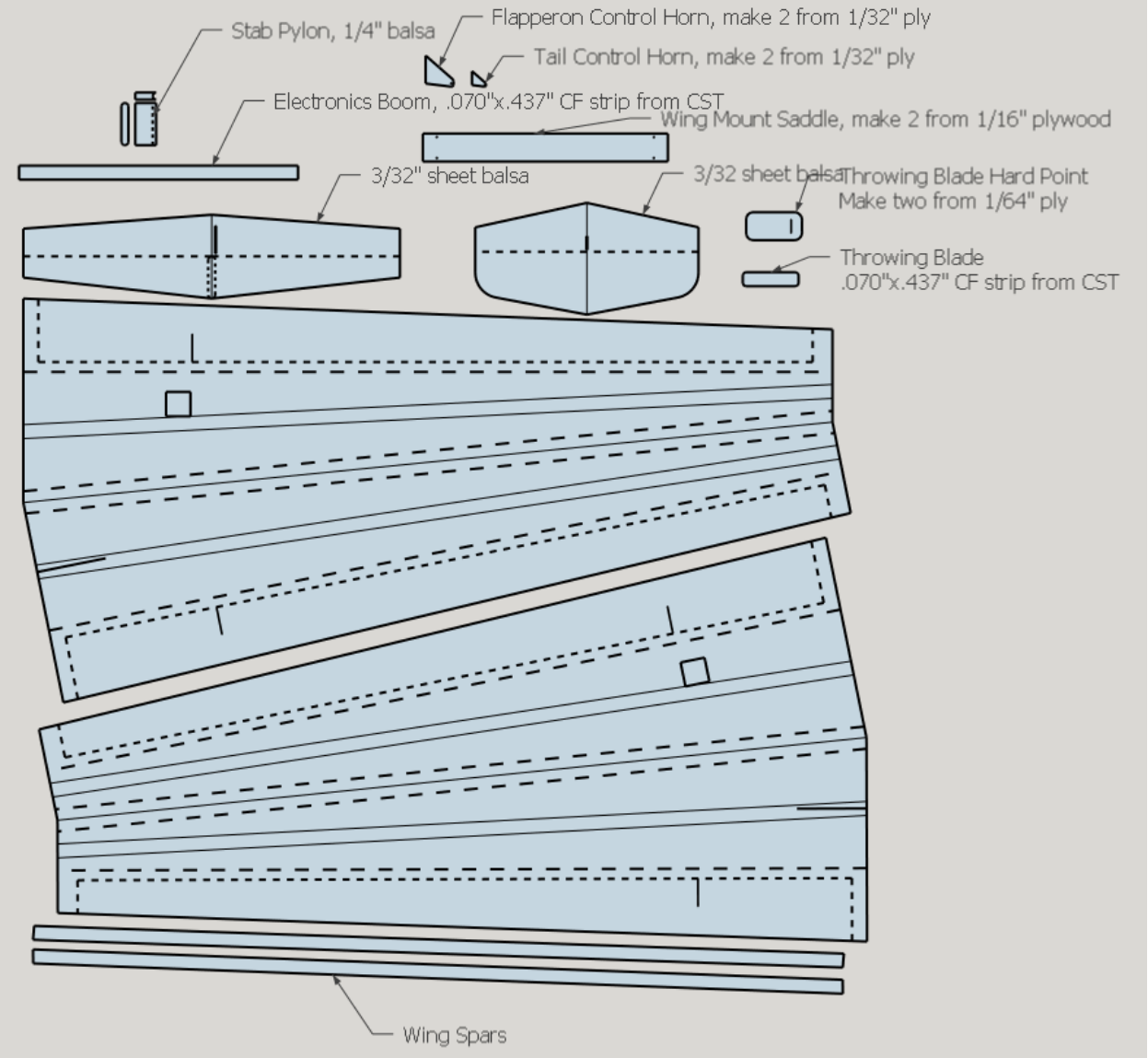


Figure 1: Plans layout; exept as noted, all parts are Adams foamboard

Figure 2 shows the basic layout of the finished DLG. Refer back to this figure as needed.

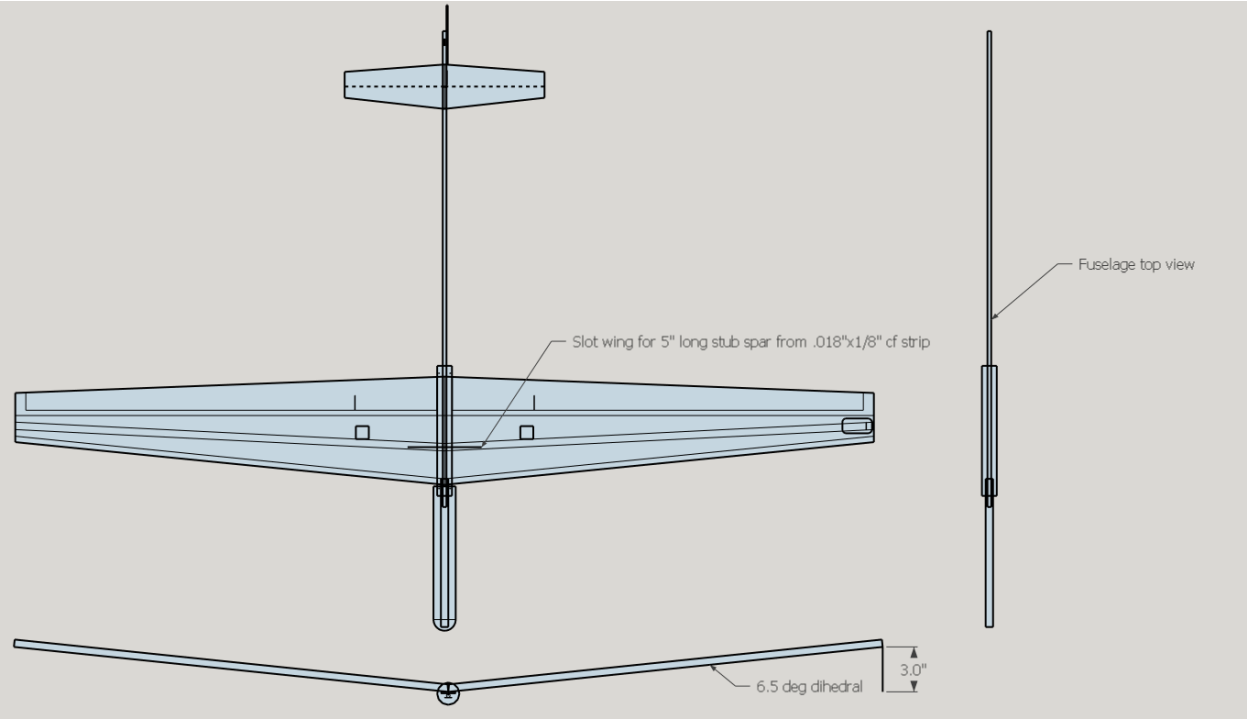


Figure 2: General layout of completed DLG

***Part 2: Wing blank preparation***

Print out the plans at full size and cut them out. Note that originally the plans were for a full 1.5m span, but this has been shortened by 1 inch to make the wings fit on a sheet of DTFB as shown by the tip editing shown in Figure 3

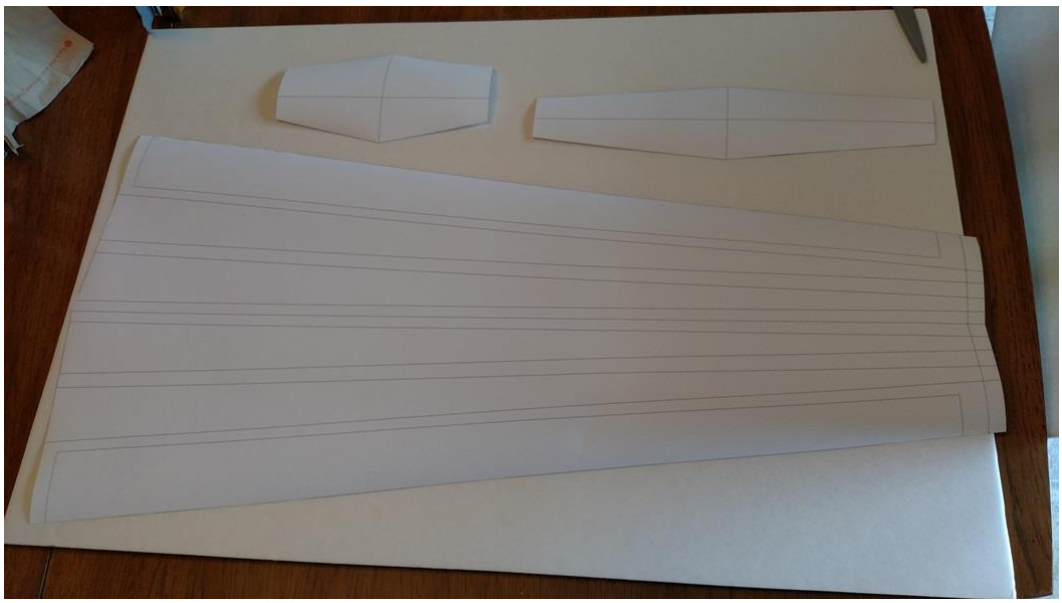

Figure 3: Original plan templates laid out on a sheet of DTFB; note that tail surfaces are not made from DTFB. The wings will not fit together on a single sheet of DTFB unfortunately.

Lay the wings out and get started marking all of the lines as shown in Figure 4.

Figure 4: Marking up DTFB for wing construction

The completed mark-up is shown in Figure 5.

Figure 5: Sheets of DTFB marked up for wings

Use a new razor blade to cut out the wings and wing spars as shown in Figure 6.

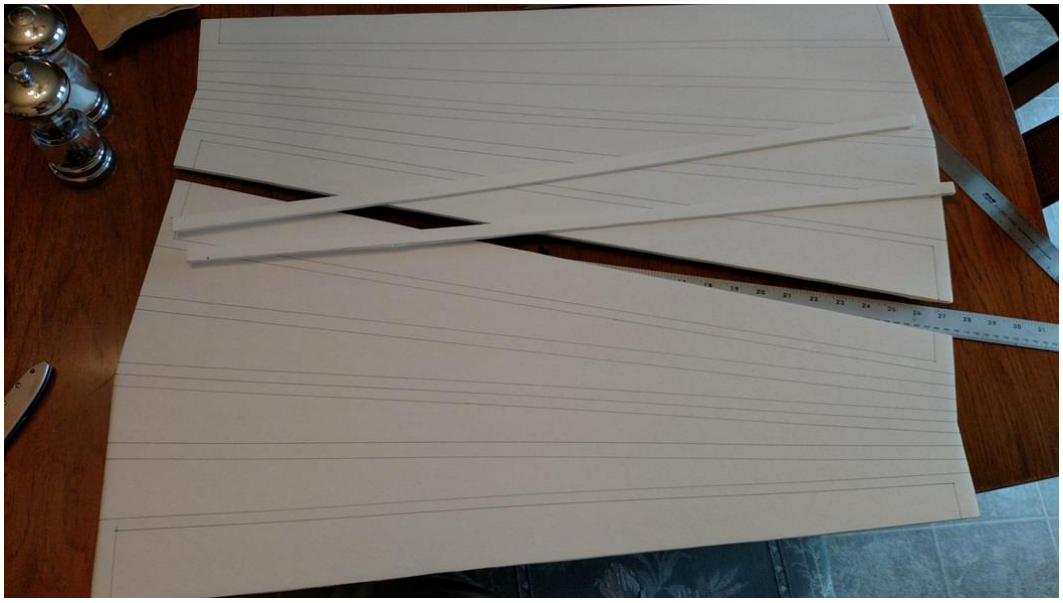

Figure 6: Wing parts cut out from DTFB

Score the wings along all of the lines except the flapperons. Peel up the paper for the spar location and the trailing edge taper as shown in Figure 7.

Figure 7: Paper peeled up from flapperons and spar location

Begin beveling the trailing edges as shown in Figure 8 using a serrated steak knife.

Figure 8: Initial taper of wing trailing edge.

Make a second pass with the steak knife to complete the wing taper as shown in Figure 9. As you can tell, this is a messy process and does take some practice to get perfect results. You don't need absolute perfection to get a good flying DLG, but do your absolute best here, since every slight aerodynamic improvement to a DLG will add significantly to its performance.

Figure 9: Completing the wing taper

Score through first layer of the wing along the center line as shown in Figure 10 and fold the wing in half.

Figure 10: Wing leading edge cut

Bevel the wing leading edge with a knife on both sides as shown in Figure 11 using the leading edge lines to guide how far back to bevel.

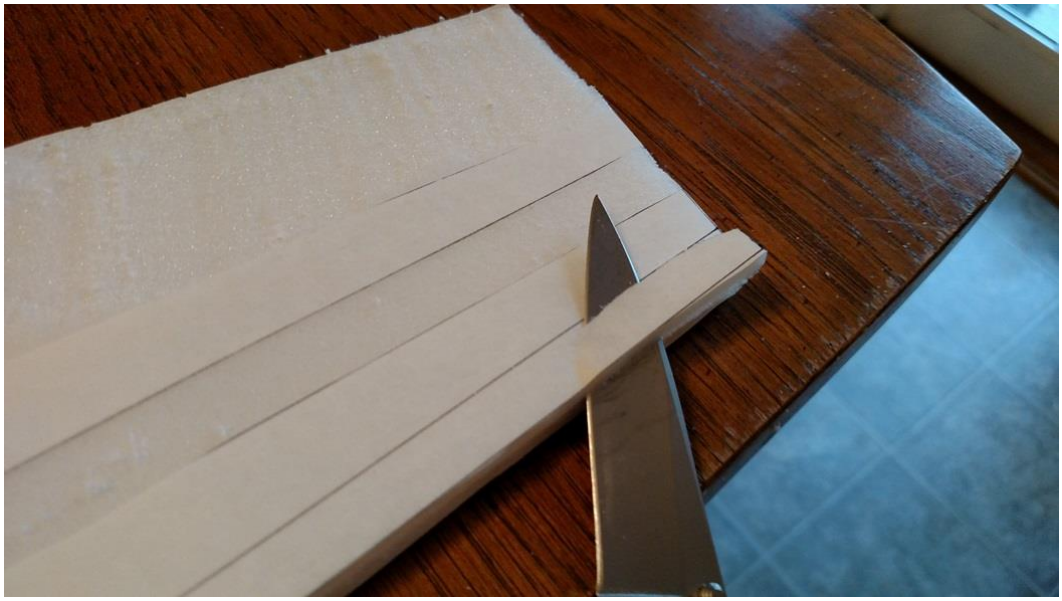

Figure 11: Beveling the wing leading edge

You should now have a wing blank resembling the example in Figure 12.

Figure 12: Completed wing blank

Round off the wingtips as shown in Figure 13. This feature will reduce damage from imperfect landings. Square wingtips are to be avoided on DLGs!

Figure 13: Rounded wingtip leading edges

Continue the taper around the wingtip per Figure 14 so that it can be fully closed when assembled.

Figure 14: internal taper of wingtip

Begin peeling the paper off one side of each wing spar as shown in Figure 15.

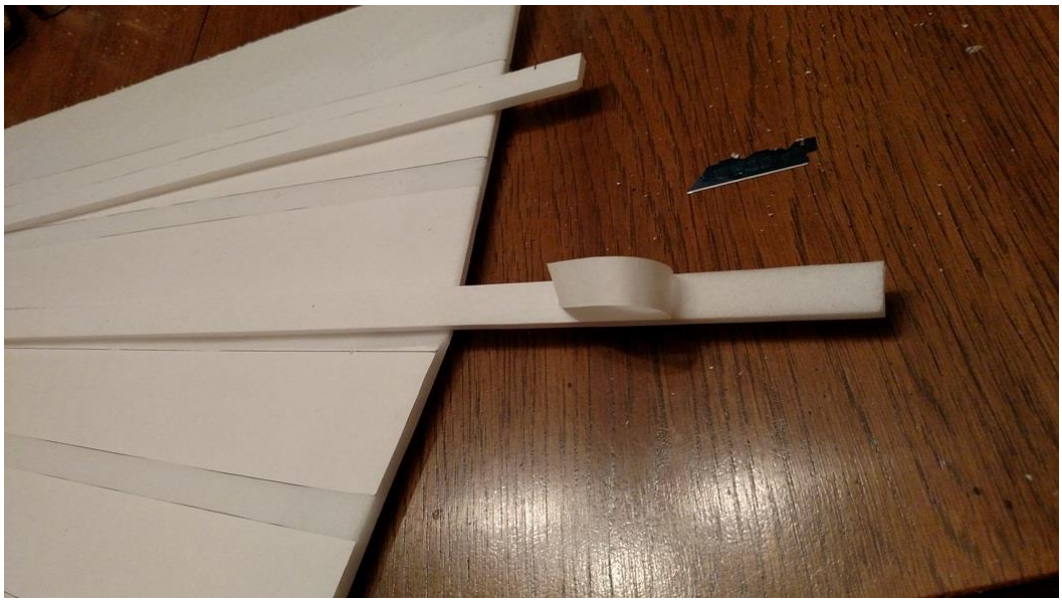

Figure 15: Peeling the wing spars

The spars will now bow heavily as shown in Figure 16. This is alarming but not a problem. Brace yourself, it'll get worse in a few steps!

Figure 16: Wing spars peeled on one side each

Use hot glue to fasten the spars down (bare side down) onto the bare foam strips as shown in Figure 17. Be careful to avoid building two left or two right wings.

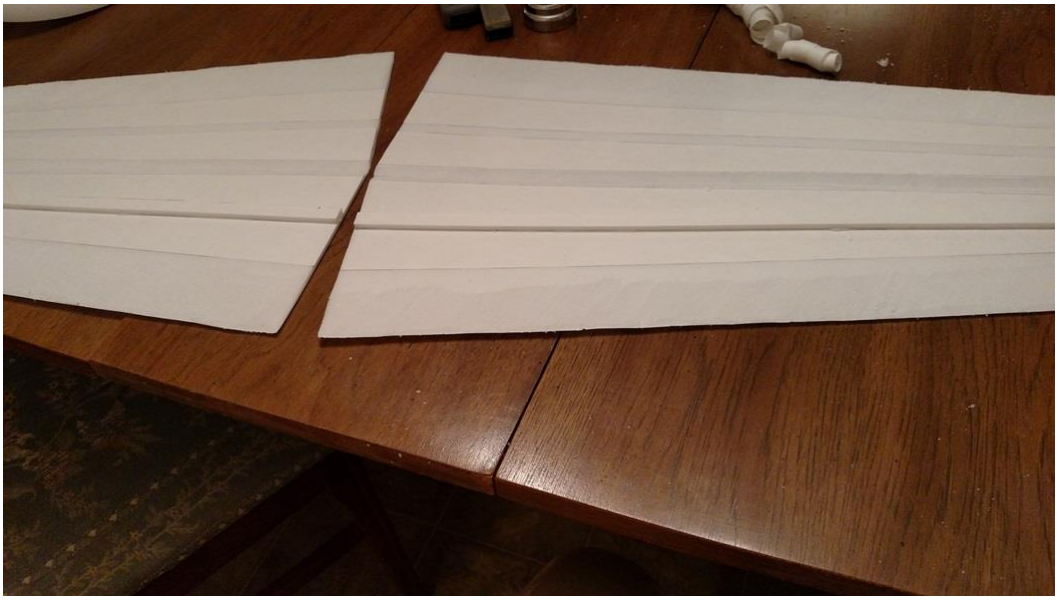

Figure 17: Wing spars fastened down

Be sure to taper the ends of the spars at the wingtips so that they match the rest of the taper as shown in Figure 18.

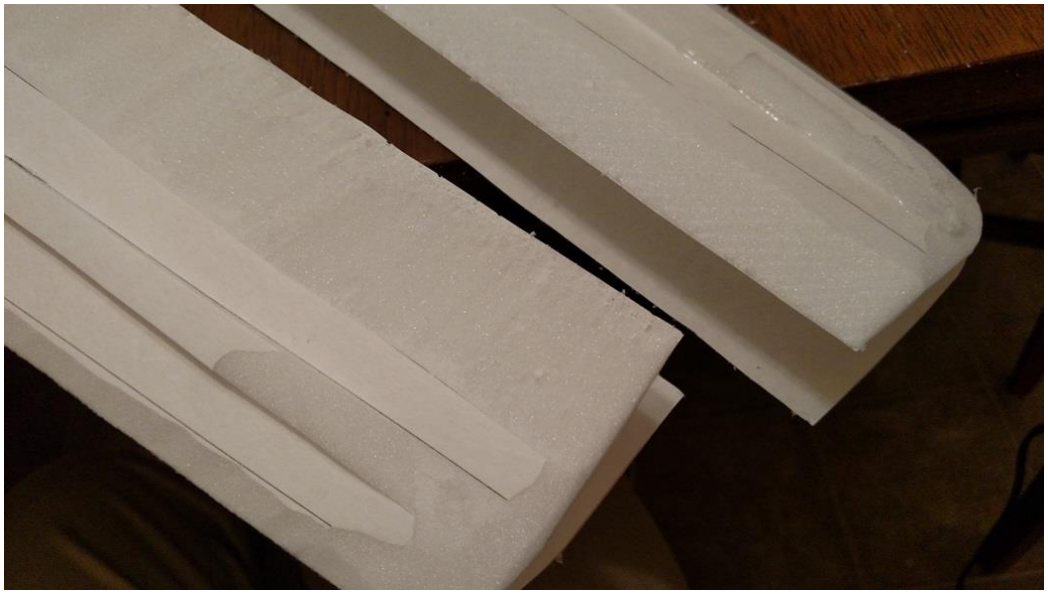

Figure 18: Wing spars tapered at the wingtips

Brace yourself. Peel *all* of the remaining paper off the inside of both wings. All of it. The wings will bow up alarmingly as shown in Figure 19. This is okay and will be eliminated by the closing process.

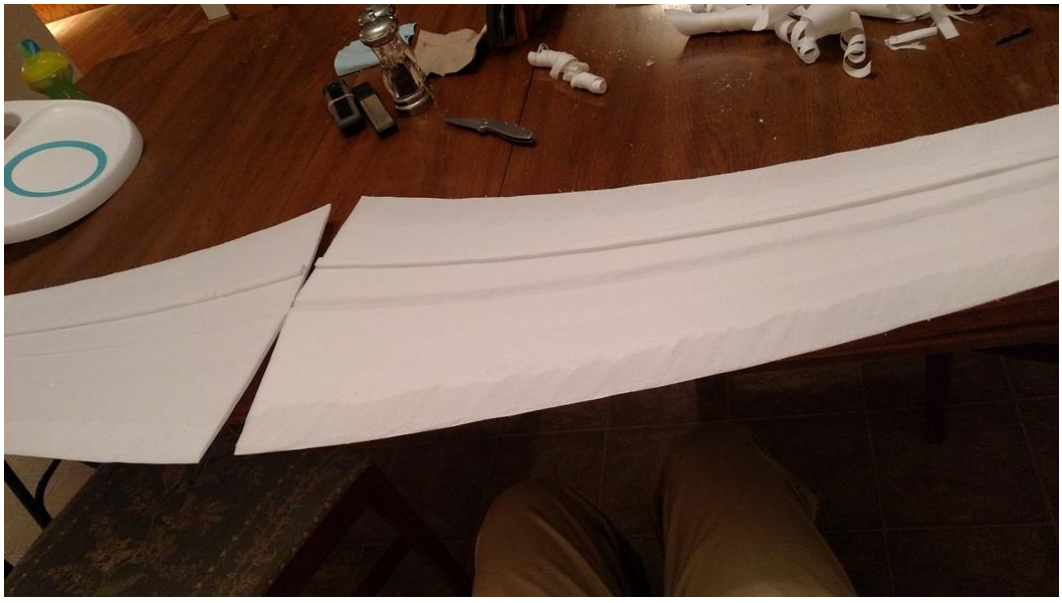

Figure 19: Wings with all paper removed from the inside

Carefully test fold the wings as shown in Figure 20 to get the airfoil started.

Figure 20: Test closure of the wing

***Part 3: Wing assembly***

Take a deep breath now and make sure your glue gun is extra hot. You need to glue up the entire wing in one step (refer to Figure 21) except for the tip, which is not glued yet. This must be done quickly so as to ensure that all of the glue is still liquid as you close up the wing.

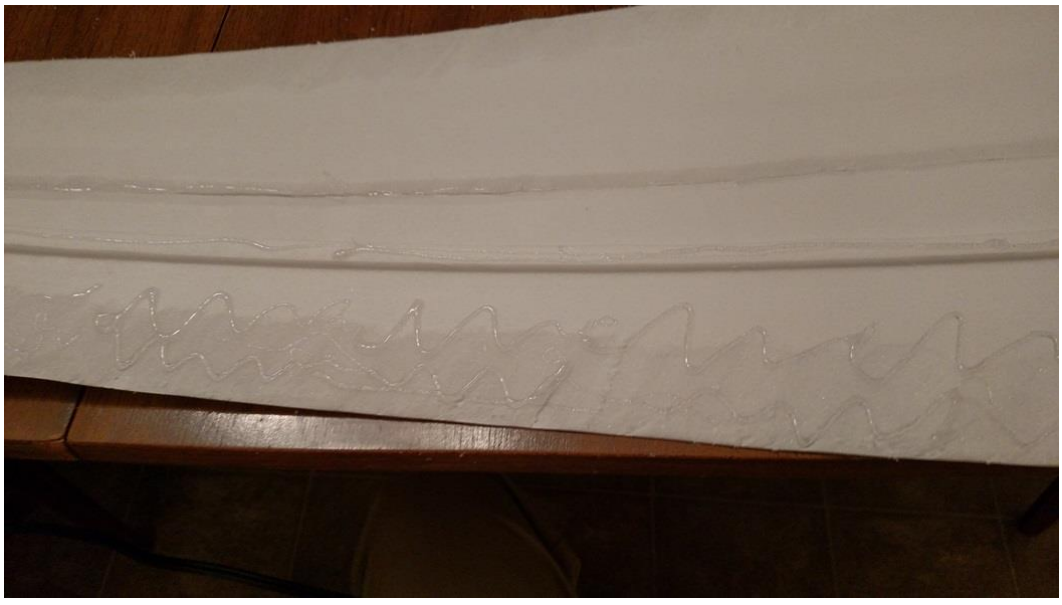

Figure 21: Wing glued and ready for closing

Quickly close the wing and apply even pressure across all of the gluing surfaces. If you have someone to assist in this task, get them to help. Ideally you will have the bottom of the wing mostly flat rather than of the same curvature as the top, and also ideally the wingtips will have a little washout. As such,  be

careful to ensure again that your wings are matched—not two left wings or two right. Admire your work and compare it to Figure 22.

Figure 22: Wing glued closed

You'll now have the wingtip open as shown in Figure 23.

Figure 23: Wingtip still needs to be glued closed

Squirt hot glue into the wingtip and close it to get the result shown in Figure 24.

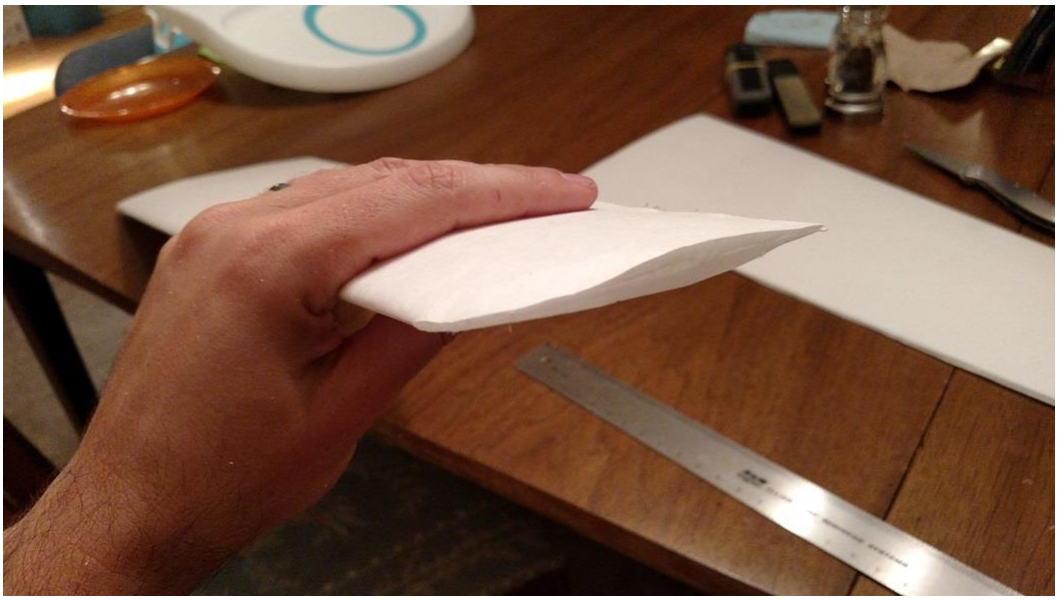

Figure 24: wing tip completed

Bevel the wing root as shown in Figure 25 to achieve a gap-free dihedral join. Again pay close attention to the top vs the bottom of the wing.

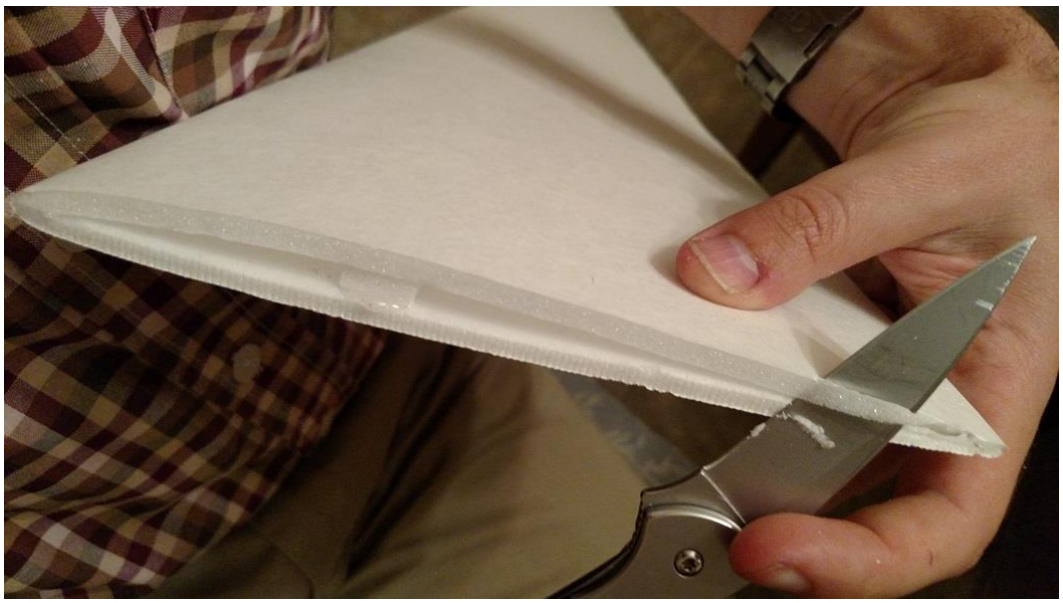

Figure 25: Beveling the wing root

Use the plans to mark the aileron locations on the outside of the wing on both the top and bottom as shown in Figure 26.

Figure 26: Ailerons marked out on the wings

Now cut the ailerons from the bottom surface of the wing and cut 1/16” wide slots at the ends of each aileron as shown in Figure 27. Note that you’ll need to cut the hinge lines all the way through to the other side, through a layer of hot glue, but without cutting through the paper on the top surface of the wing, which will serve as your hinge.

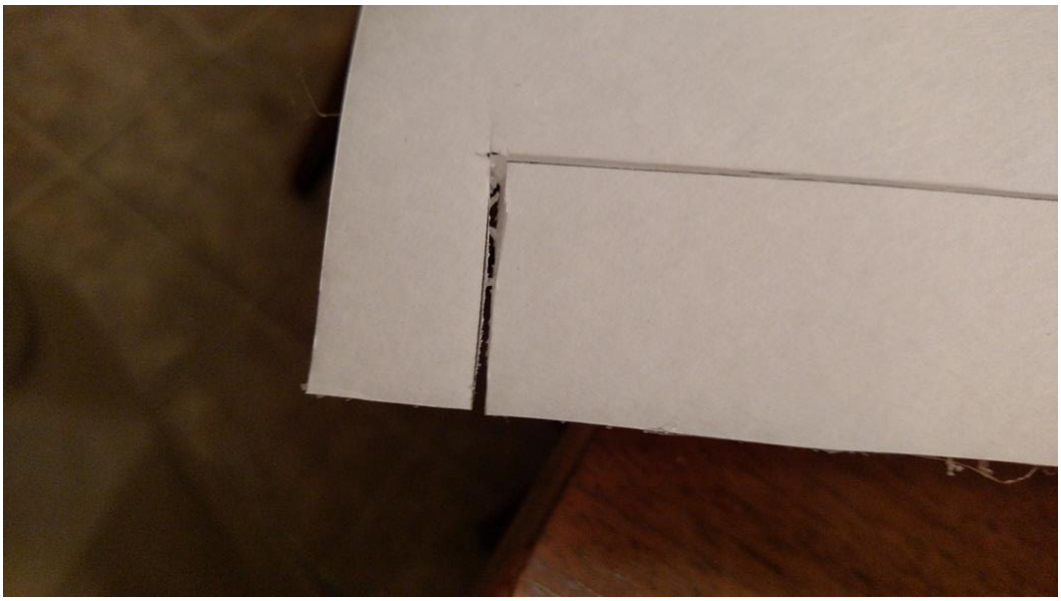

Figure 27: Slotted aileron ends

Fold the aileron completely over onto the top of the wing. If you have any gaps like those shown in Figure 28, squirt glue into them and press the wing closed until the glue hardens. It is extremely important that these gaps be closed because they open up the torsion tube formed by the wing structure.

Figure 28: Aileron folded over showing gaps due to incomplete gluing

Use a sharp knife to bevel the aileron and wing trailing edge faces roughly 30 degrees each to get a total of 60 degrees of down travel.  The result is a V notch as shown in Figure 29.

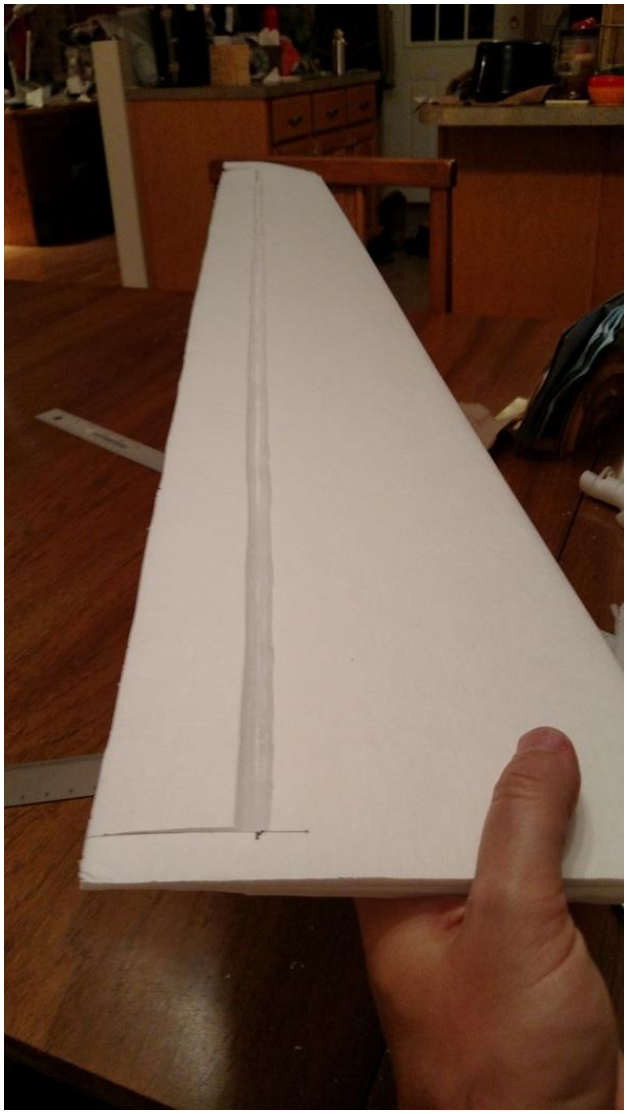

Figure 29: Aileron groove

Figure 30 shows the correct amount of down travel range for the aileron.

Figure 30: Aileron down travel (wing held upside down)

***Part 4: Wing completion and flight controls***

Use a servo to mark out the servo pocket just behind the wing spar per the plans as shown in Figure 31. Leave as little extra cutout space as possible. Any extra weakens the wing, and we will eventually seal the wing shut around the servo.

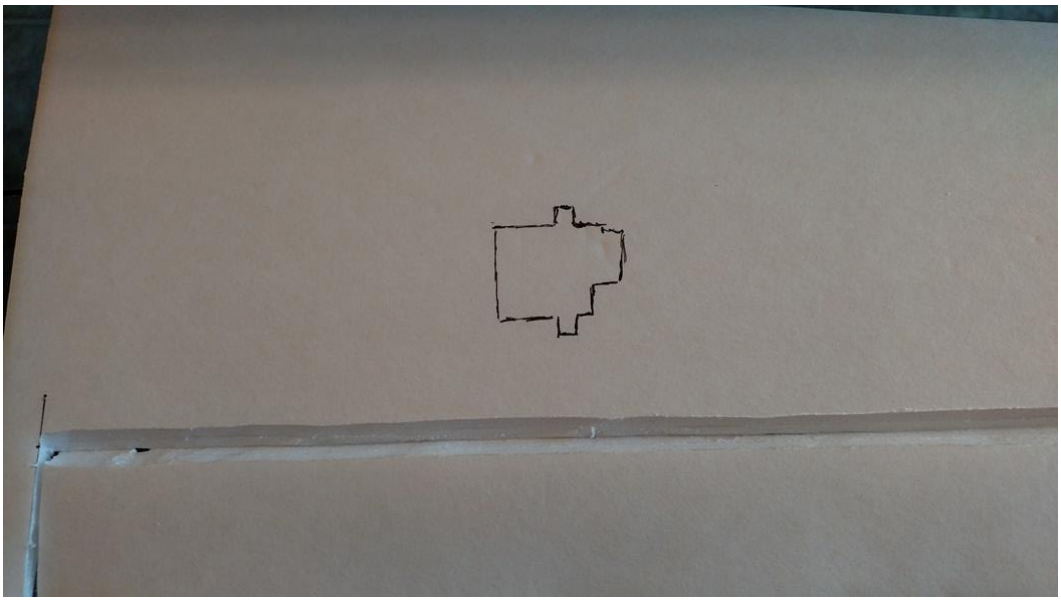

Figure 31: Servo pocket location marked out

Center up your servos and install the control horns angled back slightly as shown in Figure 32.

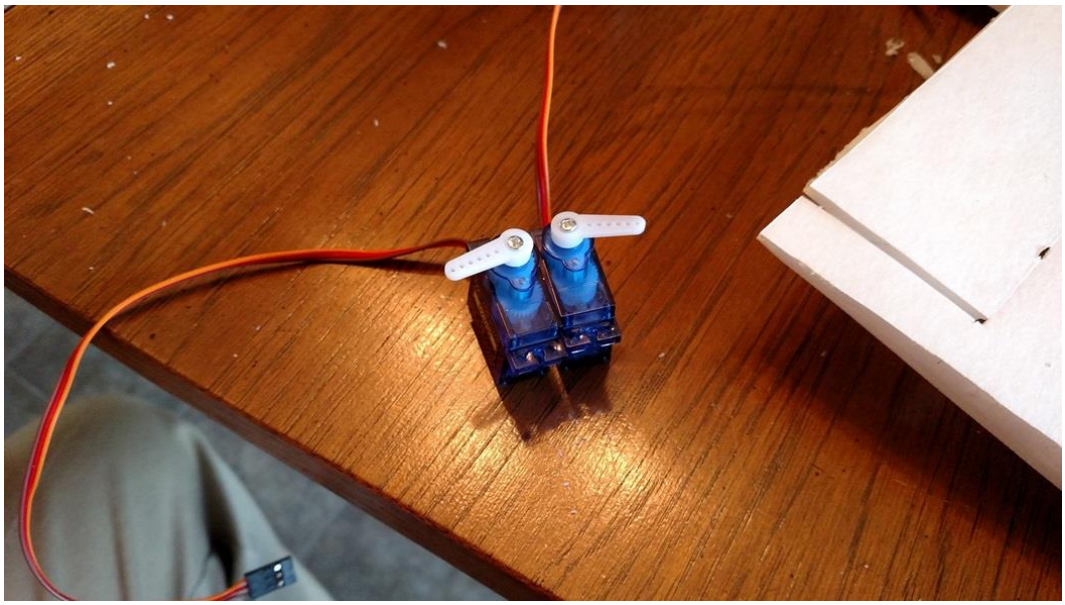

Figure 32: Centered wing servos

Cut out the servo pocket, thread the servo wire through as shown in Figure 33, and test fit the servo.

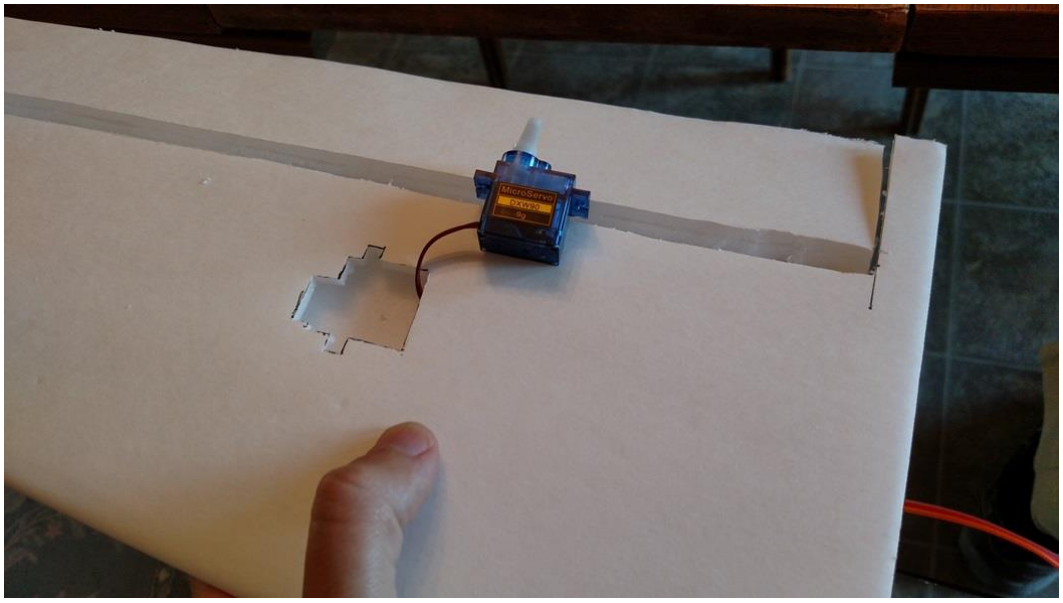

Figure 33: Servo pocket with servo wire threaded through to the wing root

Hog out enough of the upper surface foam per Figure 34 to allow the servo to fit into the wing with only 1/16 inch or so exposed above the surface.

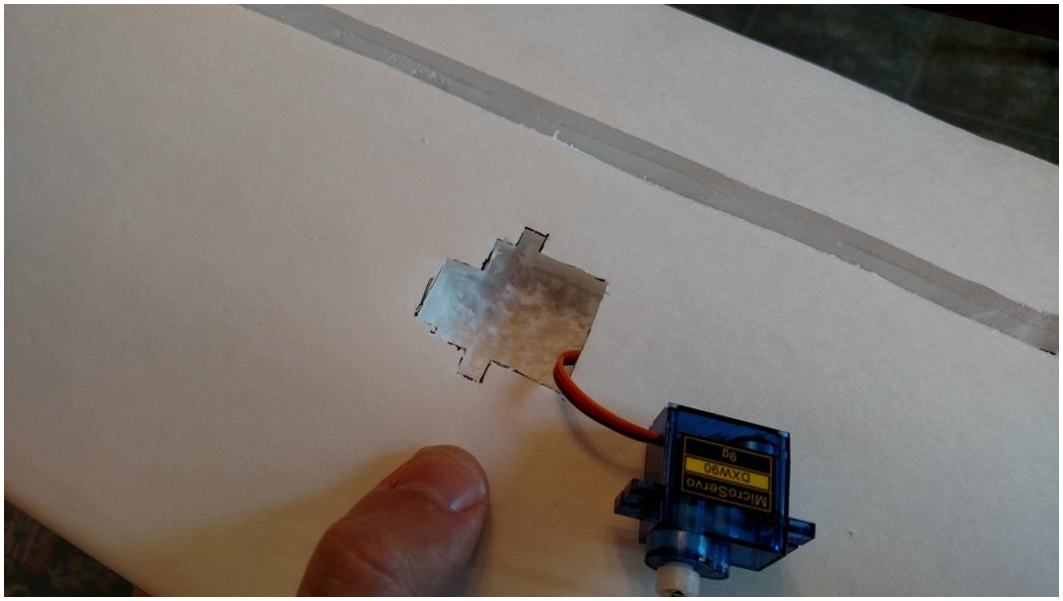

Figure 34: wing upper surface foam hogged out to allow better fit of the servo

Hot glue the servo into place per Figure 35. Be careful to avoid getting glue near the servo output horn.

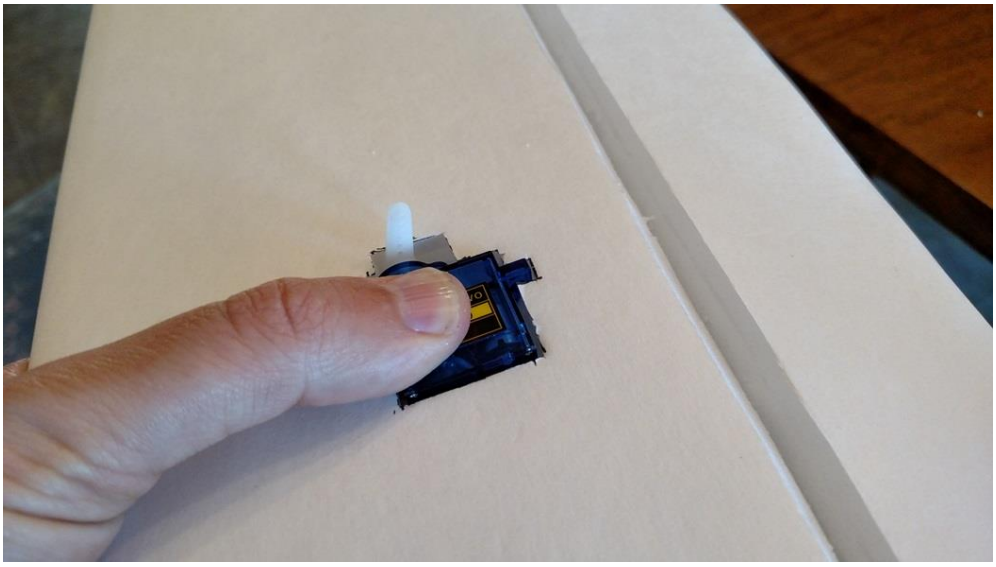

Figure 35: Servo glued into place; note minimal surface of servo sticking out

Hot glue a fillet around the entire edge of the servo except the output arm to bond the lower surface skin to the servo as shown in Figure 36. Now the only actual hole in the wing is the small one around the servo output horn.

Figure 36: glue fillets around the edges of the servos

Use a sharpened piece of ¼" tubing to cut holes into the lower surface of the wing and thread the servo wires through these holes as shown in Figure 37.

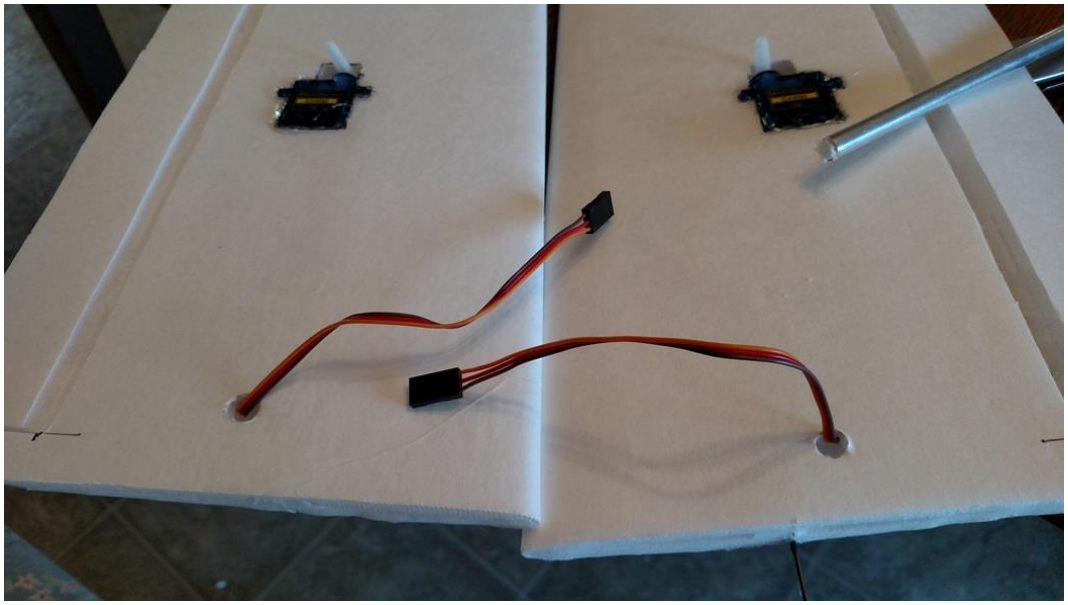

Figure 37: Servo cables threaded through the bottom of the wing

Trim the piece of .016x.118 inch carbon strip to 5 inches length. Cut a slot into the top of the wing all the way through the spar to the bottom of the wing (but not through the bottom paper) as shown in Figure 38.

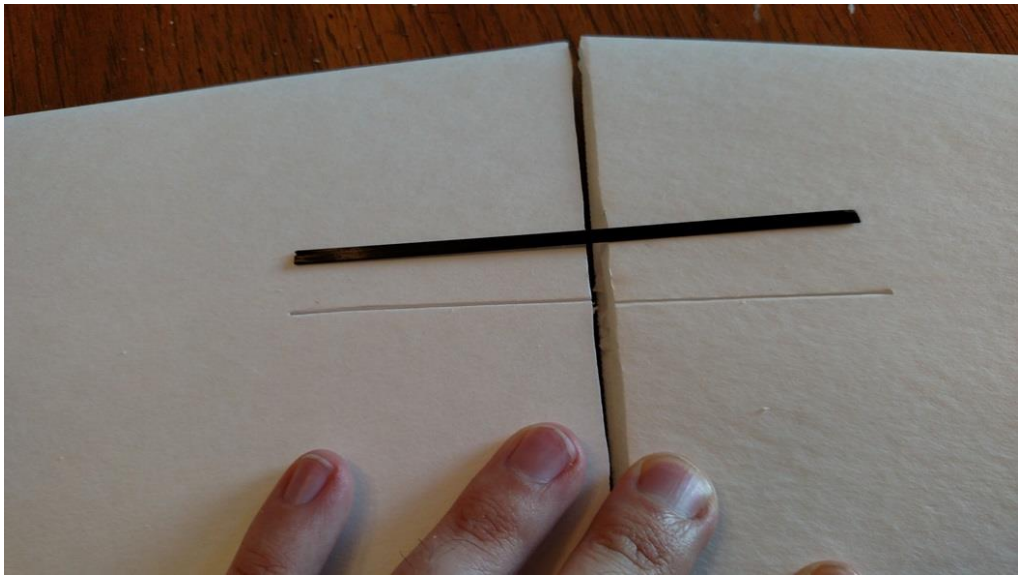

Figure 38: Carbon fiber stub spar and slot in top of wing

Squirt glue into the slot on one wing; get as much glue into the slot as possible. Install the stub spar quickly inclined to match half of the 6.5 deg dihedral (3.25 deg) as shown in Figure39. This angle need not be perfect, as there is some wiggle room built into the design.

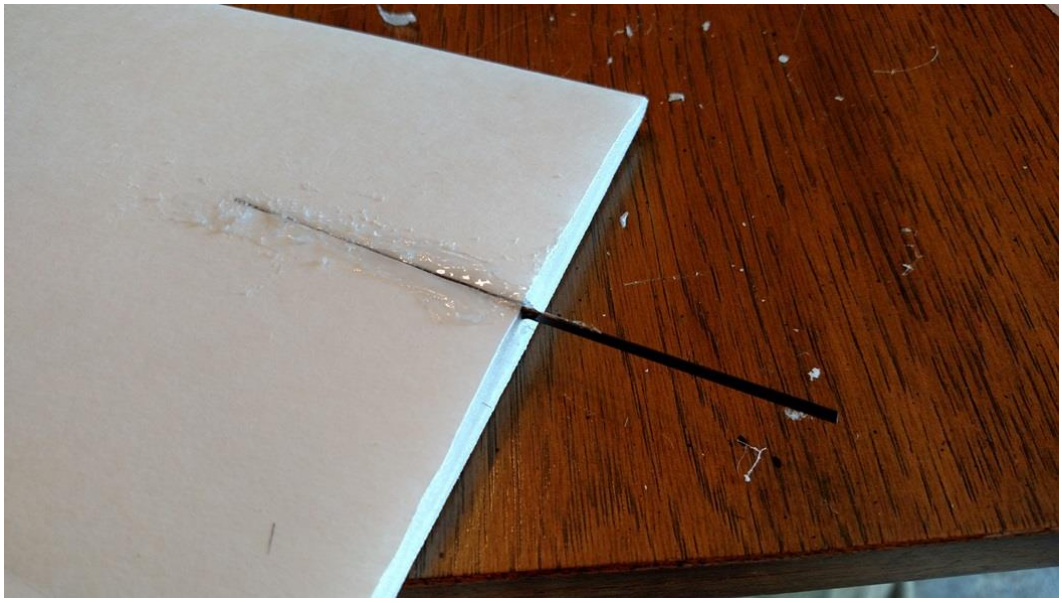

Figure 39: Wing stub spar installed at 3.25 deg angle

Glue the entire face of the opposite wing (the one without the stub spar) and squirt as much glue into its spar slot as possible. Quickly join the wings at the 6.5 deg dihedral angle specified on the plans. Hold the wings tightly in place and with their leading and trailing edges aligned until the glue has hardened, resulting in a join like that shown in Figure 40-41.

Figure 40: Joined wings, top view

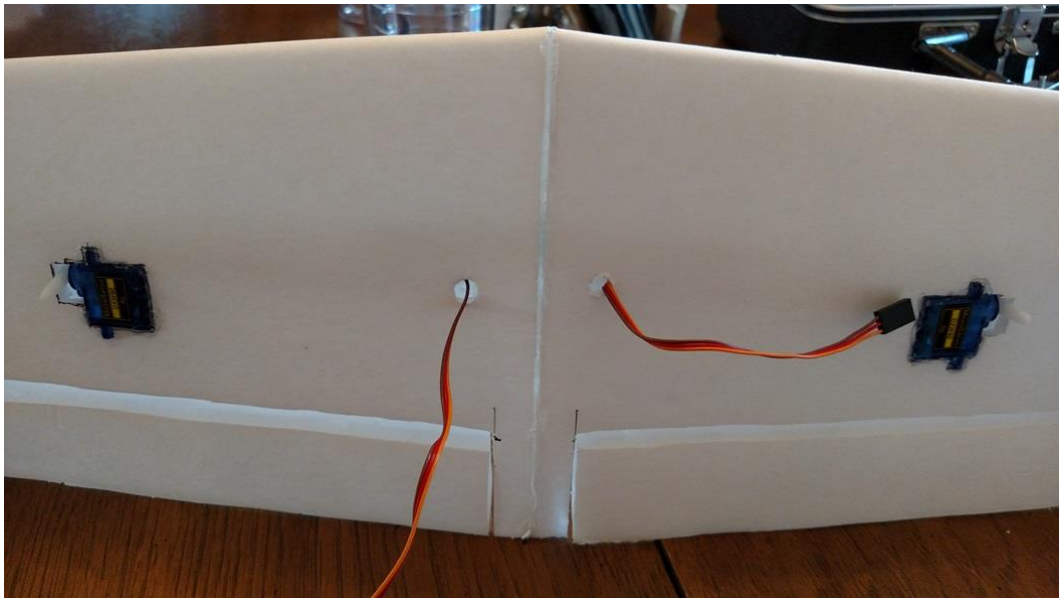

Figure 41: Joined wings, bottom view

If there are any gaps in the join, fillet them in now as shown in Figure 42.

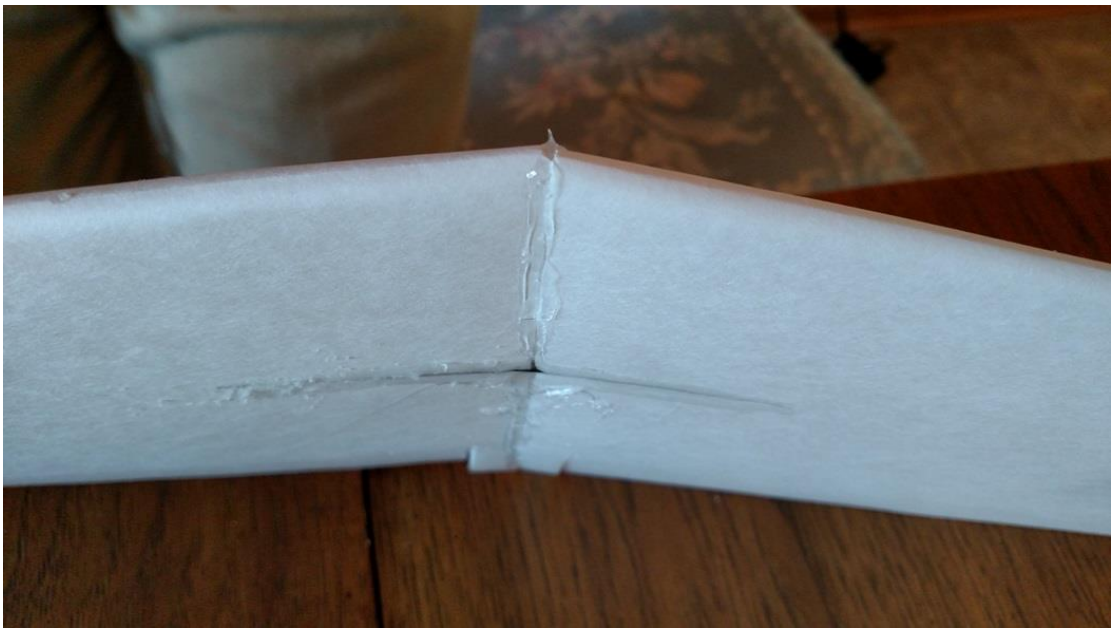

Figure 42: Filleted wing join

Cut out the two wing joining saddles from 1/16” plywood as shown on the plans as shown in Figure 43. Note that I tapered the trailing edges but have concluded that this is unnecessary at best.

***Part 5: Wing mounts and fuselage construction***

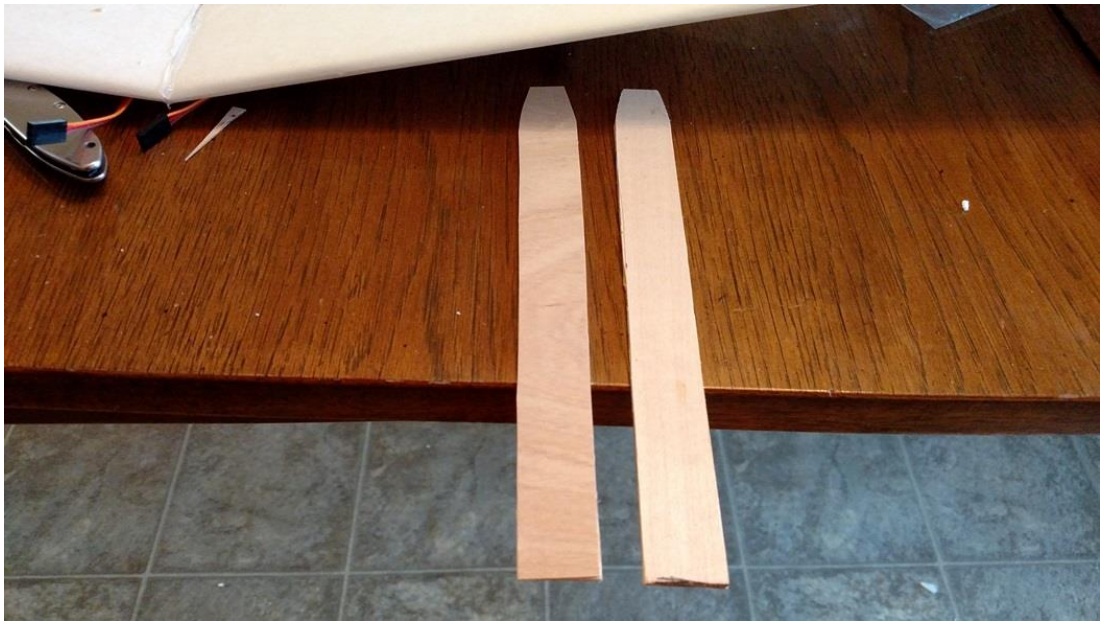

Figure 43: Wing saddles

Hot glue one of the saddles to the bottom of the wing per the plans and Figure 44-45. Completely fillet this join as it takes a lot of stress on launch; Also ensure that the saddle is fastened flush to the wing center all along its length. Even if it is curved slightly, the fastening process will flatted it back out.

Figure 44: Wing Saddle glued to bottom of the wing, bottom view

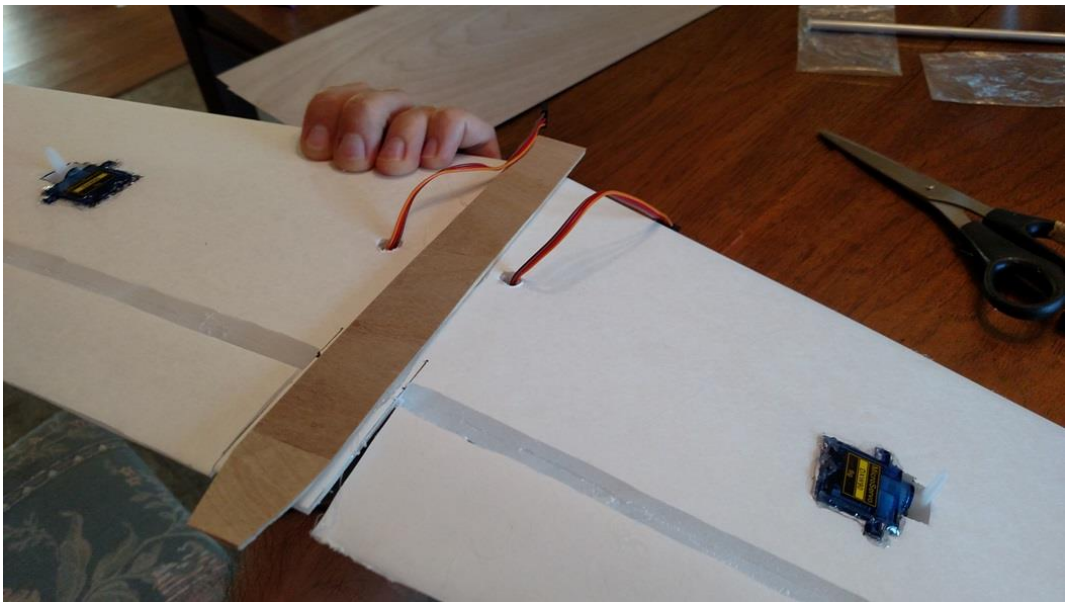

Figure 45: Wing Saddle glued to bottom of the wing, top view

You will now get out your ¼” fuselage boom shown in Figure 46 and clean it with acetone and give it a very light sanding to improve bonding to ca glue. Trim the boom to length.

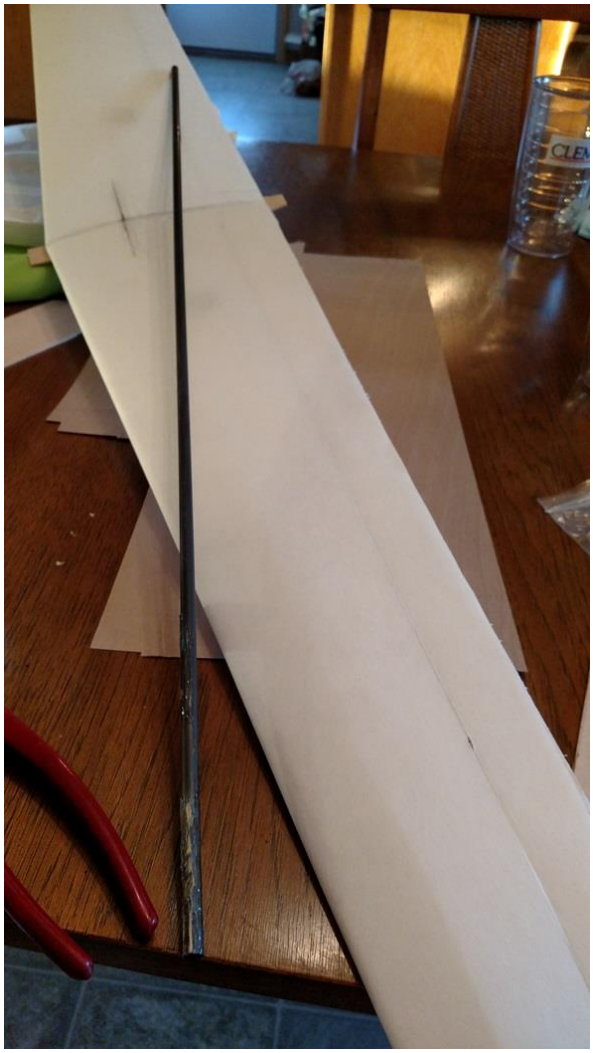

Figure 46: Fuselage boom cleaned, sanded, and ready for gluing

Cut the electronics boom to length and round it off at the corners per Figure 47.

Figure 47: Electronics boom

Glue the electronics boom to the fuselage boom per the plans and wrap with 30 lb spiderwire or Kevlar thread before soaking the wrapping in glue as shown in Figure 48. I used ca glue for the join, but you may also use epoxy if you jig the assembly in place and leave it alone until it is fully cured.

Figure 48: Electronics boom fastened to fuselage boom

Use CA glue or epoxy to bond the second wing saddle to the fuselage boom as shown on the plans and in Figure 49-50. This is a critical joint. Make sure it is fully bonded and has at least a slight fillet.

Figure 49: Wing saddle bonded to fuselage, bottom view

Figure 50: Wing saddle bonded to fuselage, top view

Hold the wing in place on the fuselage and drill it for the mounting screws with a 1/32” drill bit. Use the servo mounting screws included with your aileron servos per Figure 51. See? Nothing gets wasted!

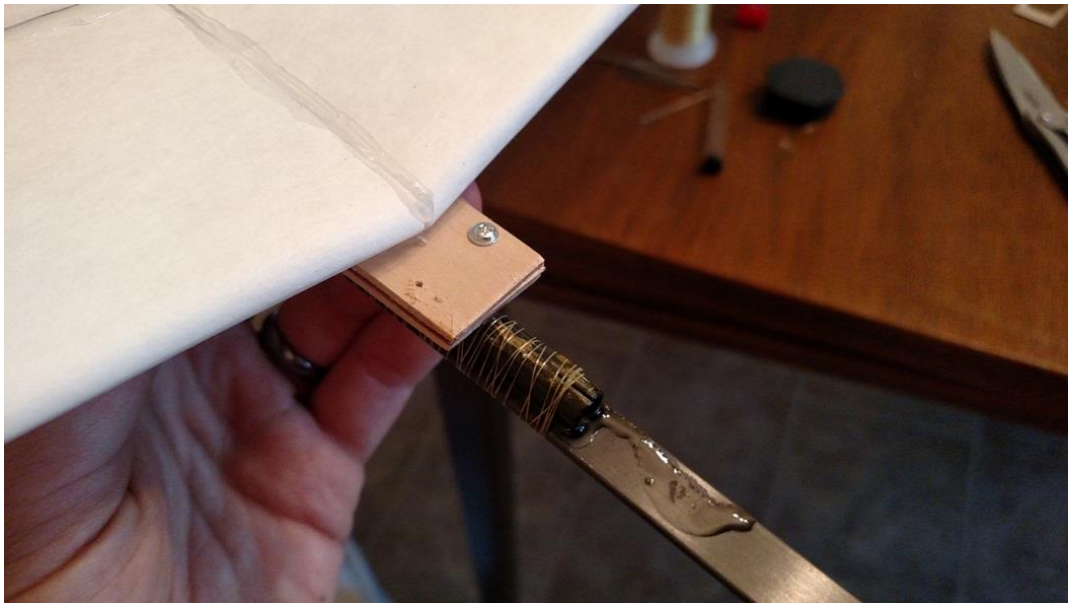

Figure 51: Drilling and screwing the wing in place

Mount the wing with the four screws as shown in Figure 52. This should provide a strong enough join to withstand launch forces. It also lets you remove the wing for transportation.

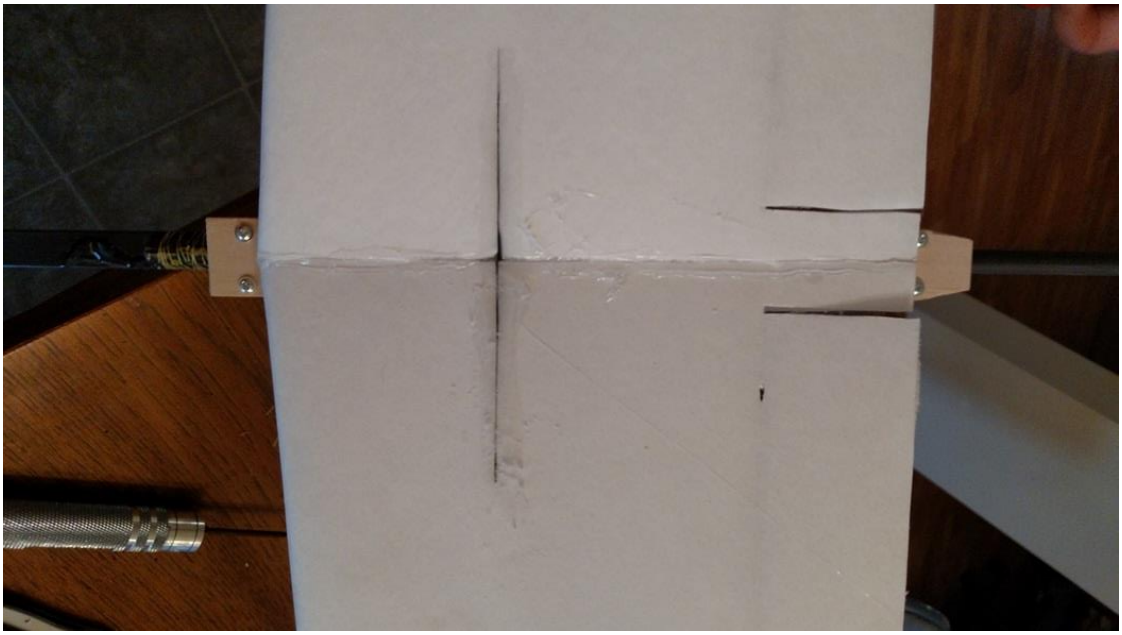

Figure 52: Wing mounted to fuselage

Admire your work. It should resemble that shown in Figure 53.

Figure 53: Overall view of DLG

***Part 6: Throwing blade and flapperon connections***

Cut the wingtip reinforcements from 1/64” plywood per the plans as shown in Figure 54. If you are left handed, remember that the wing reinforcements go on the right wing rather than the left as shown here.

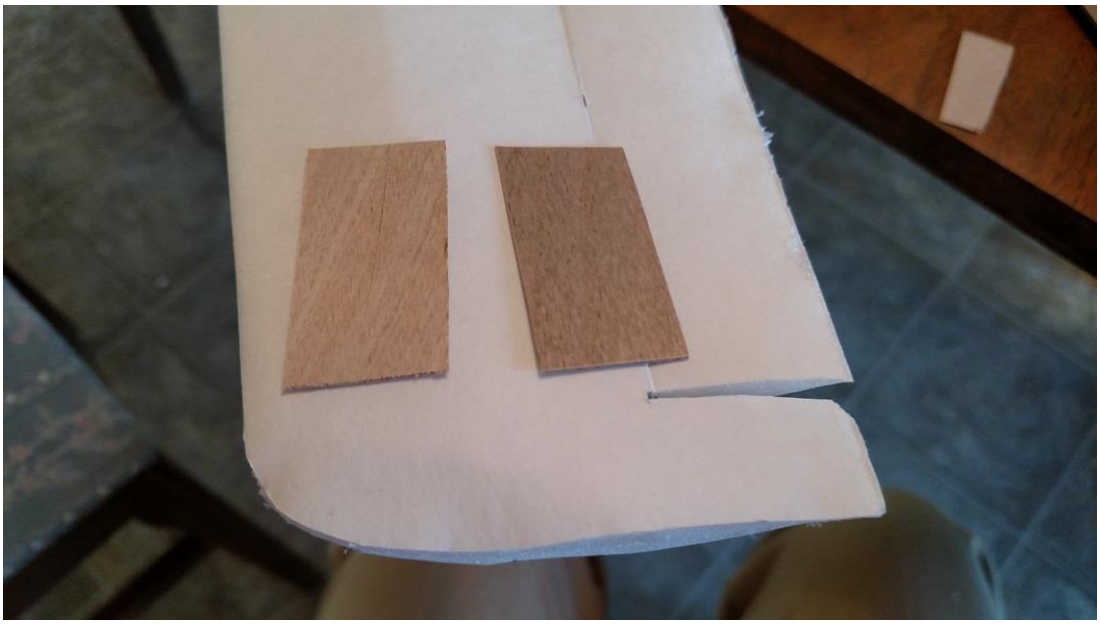

Figure 54: Wingtip reinforcements

Glue your 2” long throwing blade into a slot cut into the wingtip reinforcements as shown in Figure 55 after they have been thoroughly hot glued to the wingtip top and bottom. Notice that the blade shown

is much smaller than what is shown on the planes. I later switched to the blade shown on the plans because this one proved uncomfortable and weak.

You will not need to laterally balance the wing to offset the weight in the throwing tip. The difference in flight trim is minimal at worst.

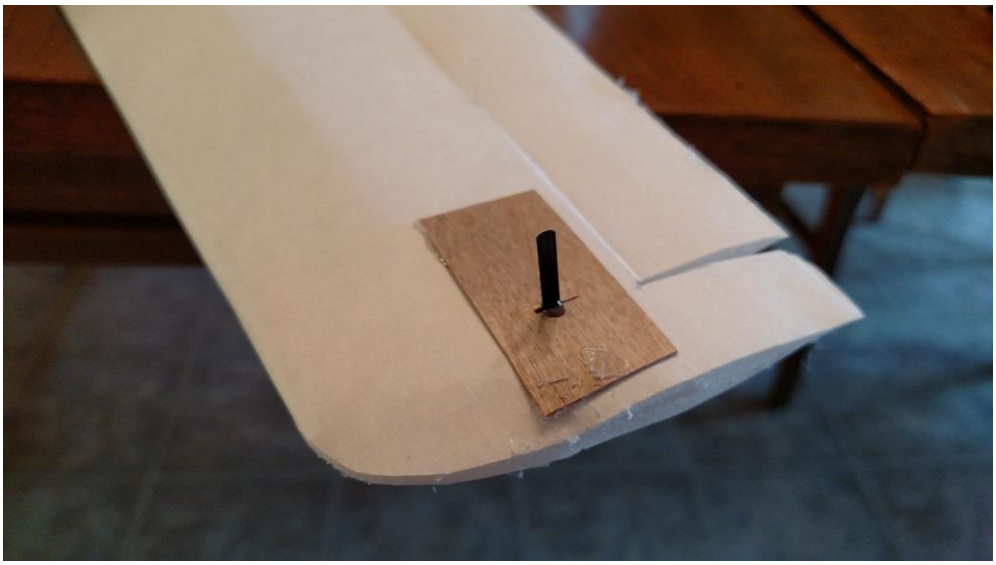

Figure 55: Throwing blade and wingtip reinforcements installed

Cut out the control horns from 1/32” plywood per the plans as shown in Figure 56 and drill them for .039 wire pushrods.

Figure 56: Control horns

Slot the aileron at the location designated on the plans and Figure 57. You are slotting all the way through from the top surface to the bottom because the control horns bond into the top surface as well as the bottom to prevent delamination of the hinges.

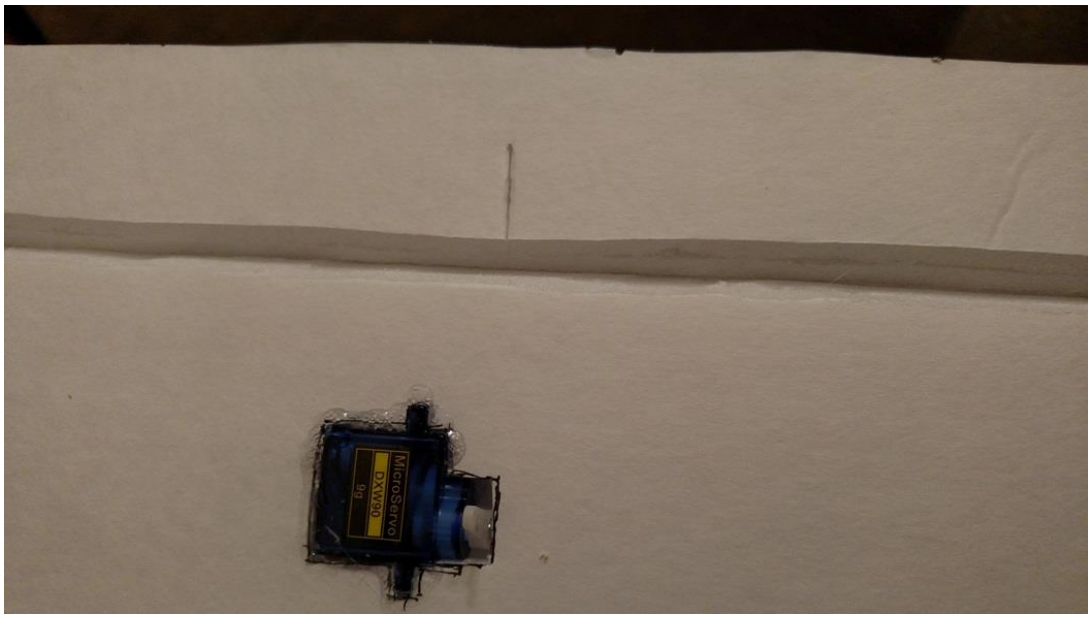

Figure 57: Aileron slotted for control horn

Slide the control horn through the top surface as shown in Figure 58 into position to verify that it the slot is big enough (Figure 59). Remove the control horn, squirt glue into the slot, and reinsert the horn from the bottom so that it slightly protrudes through the top (Figure 60). Completely fasten the horn by gluing it on the top surface (Figure 61)

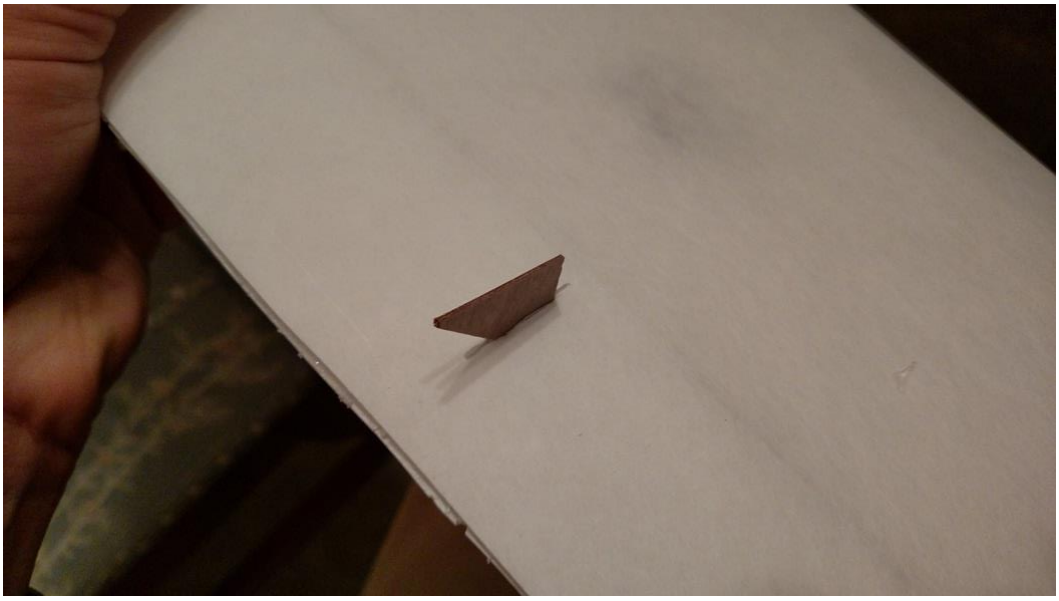
Figure 58: Inserting control horn through top of aileron

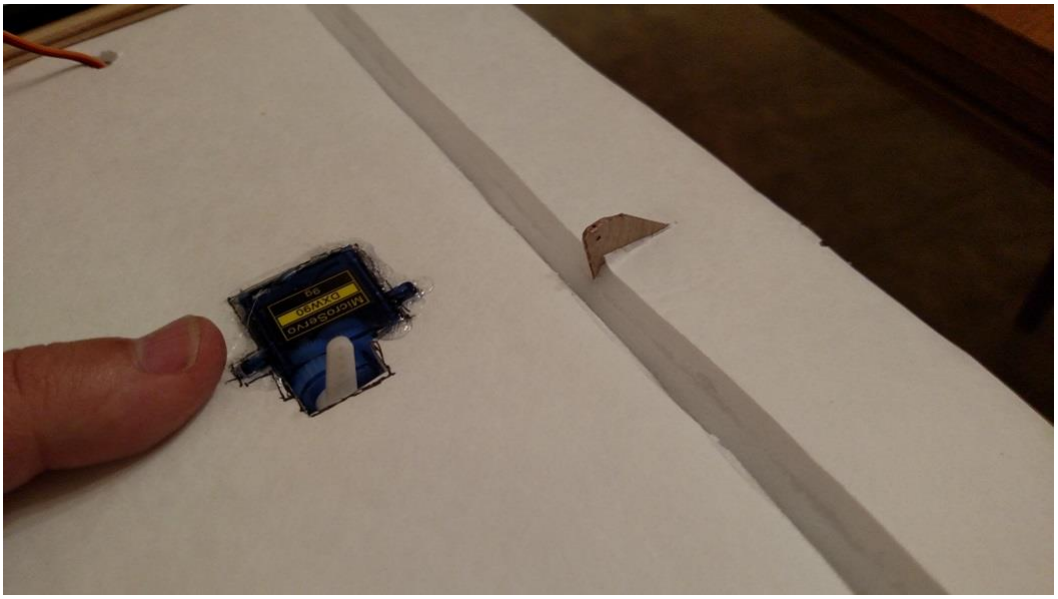


Figure 59: Test fitting of control horn

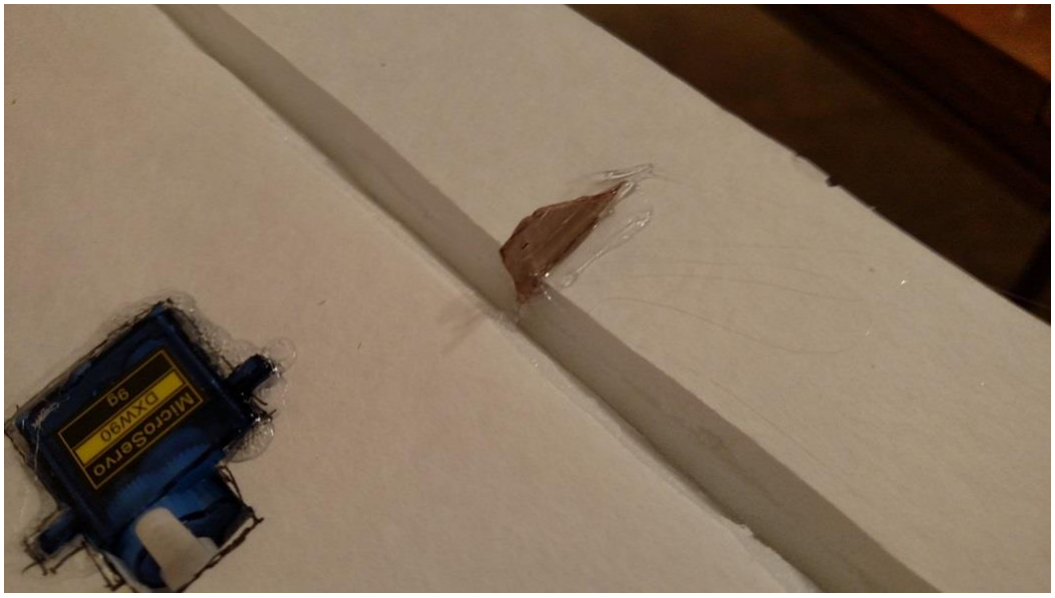


Figure 60: Control horn glued in place

Figure 61: Aileron control horn protruding through top surface and sealed in place

With both control horns installed, things are looking pretty good as shown in Figure 62.

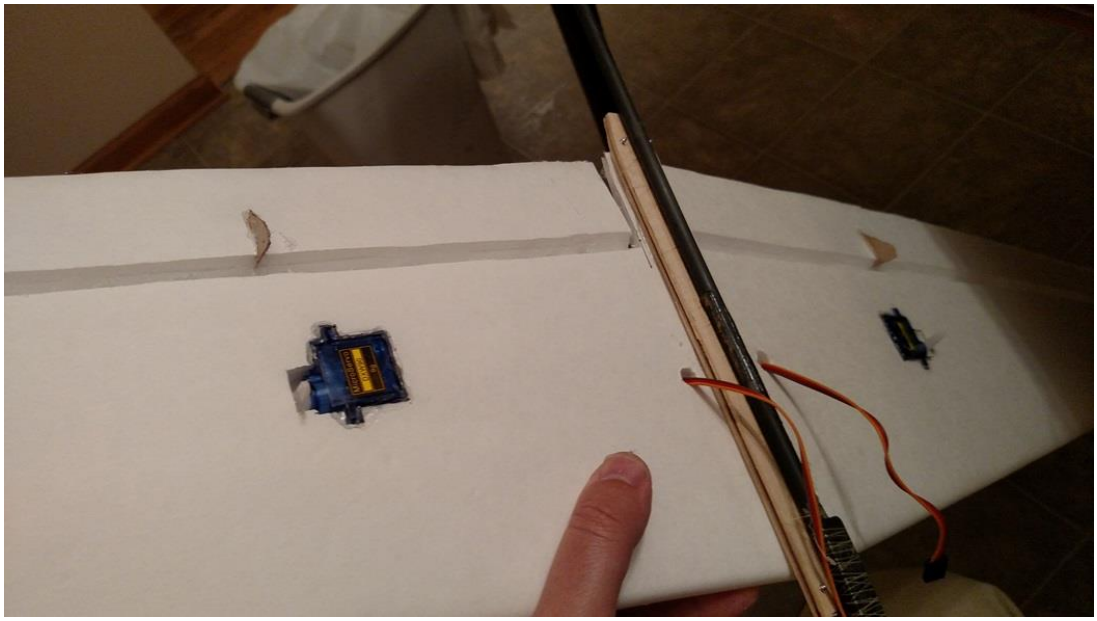

Figure 62: Aileron control horns installed

Power the servos up again to ensure that they are centered. Bend a pushrod for each servo/aileron as shown in Figure 63. Make the bend for the aileron horn so that with the servo centered, the aileron is in its neutral position. Doing so will ensure maximum aileron travel is available. Secure the control horn with a piece of wire insulation ca'ed in place as shown in Figure 64. For safety in operation, round off the protruding end of the pushrod at the servo and cover it with a blob of hot glue. I have caught the model close to this location a couple of times and the exposed end cuts into one's finger like a knife—very painful.

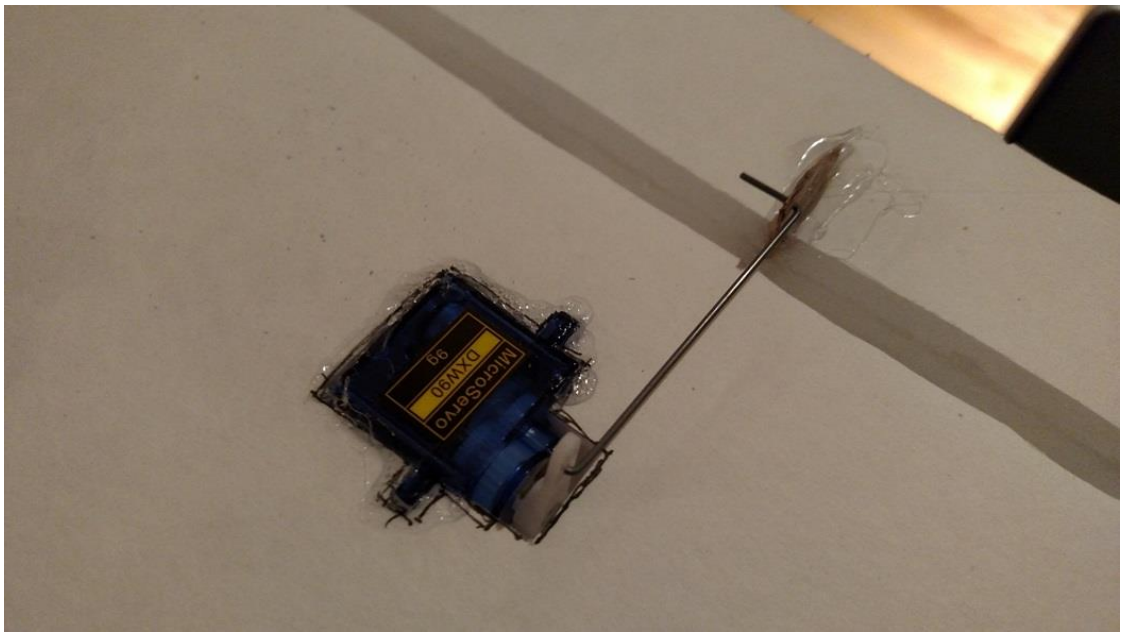


Figure 63: Aileron pushrod installation

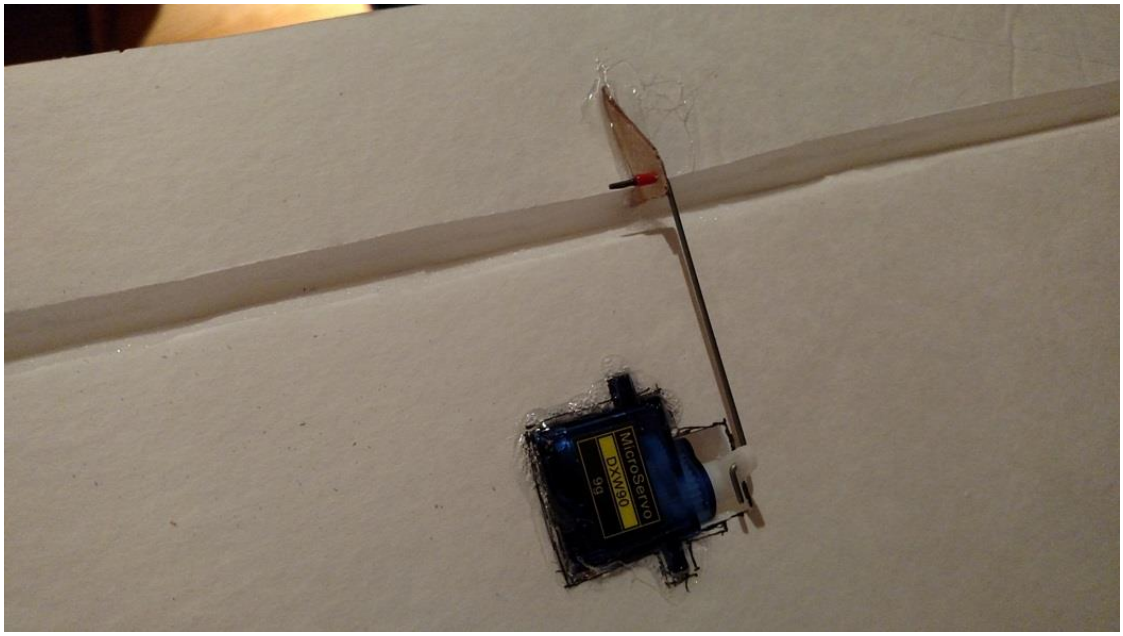


Figure 64: Aileron pushrod secured

***Part 7: Tail surfaces***

I used medium B-grain balsa for the tail surfaces (7-8 lb density, nearly quarter cut). For those new to DLG, 8-10 lb C grain would probably be better for the rudder, while the stab should remain the same. If you can't find light C grain balsa, don't worry. I built this model to get the best tail surfaces possible without composite construction.

Lay out the template for the vertical stab as shown in Figure 65 and round off the leading edges per Figure 66 to prevent snags on ground landings from tearing up the vertical stab. Round off the leading edges and tips and taper the trailing edge to get a slight airfoil. I used a razor plane and sanding block to speed up this process.

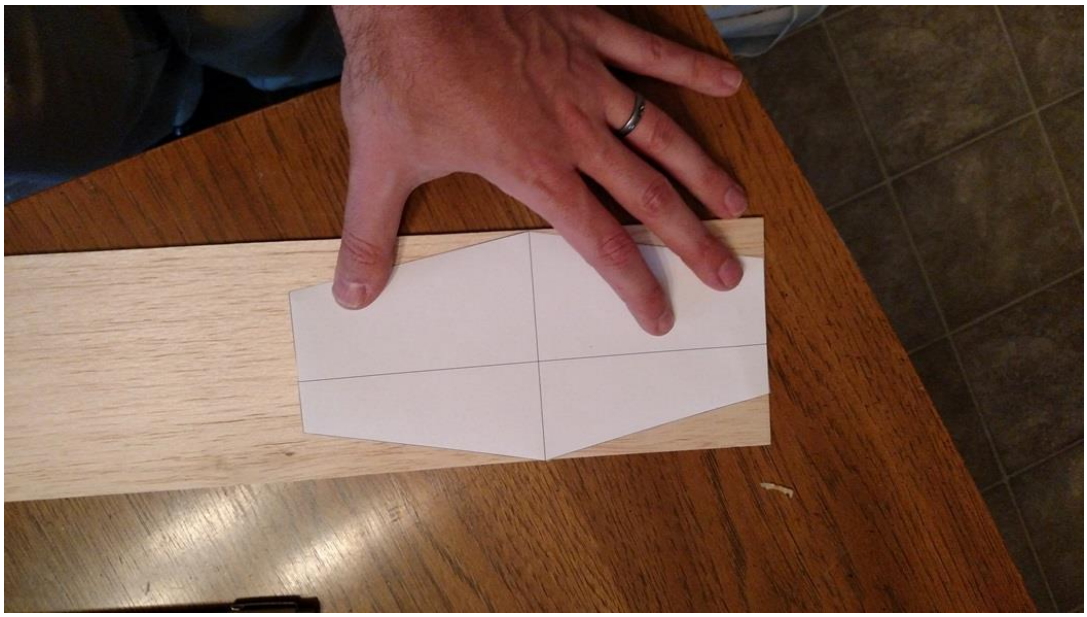

Figure 65: laying out the vertical stab

Figure 66: Vertical stab finished and marked for rudder hinge

As shown in Figure 67, cut the rudder free from the vertical stab free and bevel the hinge line using a razor plane and sandpaper. Join the rudder back to the tail using blender tape or packing tape as shown in Figure 68.

Figure 67: Rudder cut free from vertical stab and beveled for hinge

Figure 68: Tape hinge on vertical stab

Use .010 piano wire to form a hinge spring like that shown in Figure 69. The ends are roughly ¾" long and the torsion section (the middle) is 1.5" long. If you use .015 wire, extend the center section to 2". Insert the ends into the tail as shown in Figure 70. One end goes into the hinge face of the rudder and the other into the hinge face of the vertical stab as shown in Figure 71. The purpose of this wire is to pull the rudder toward the position in which you are currently holding it. A pull spring connected to a control horn will provide travel in the opposite direction.

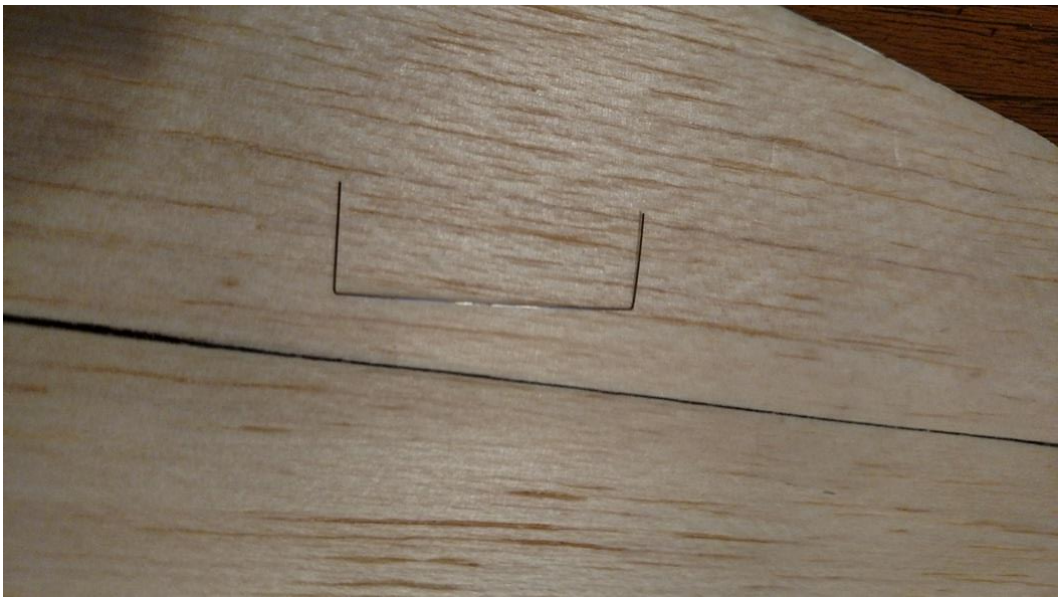

Figure 69: Rudder hinge spring

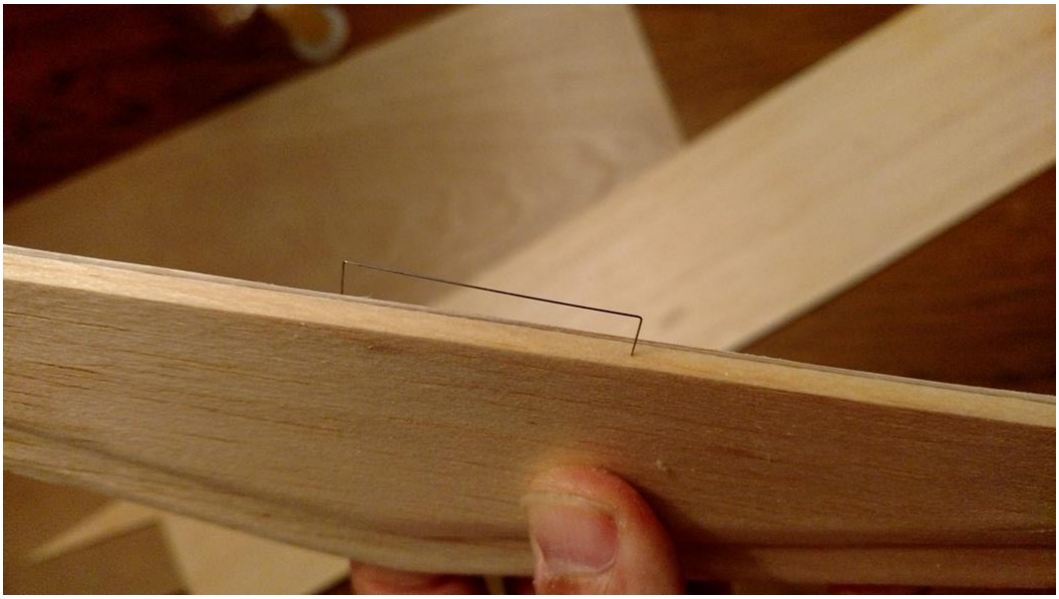

Figure 70: Hinge spring partially inserted into fully opened rudder/vertical stab hingeline

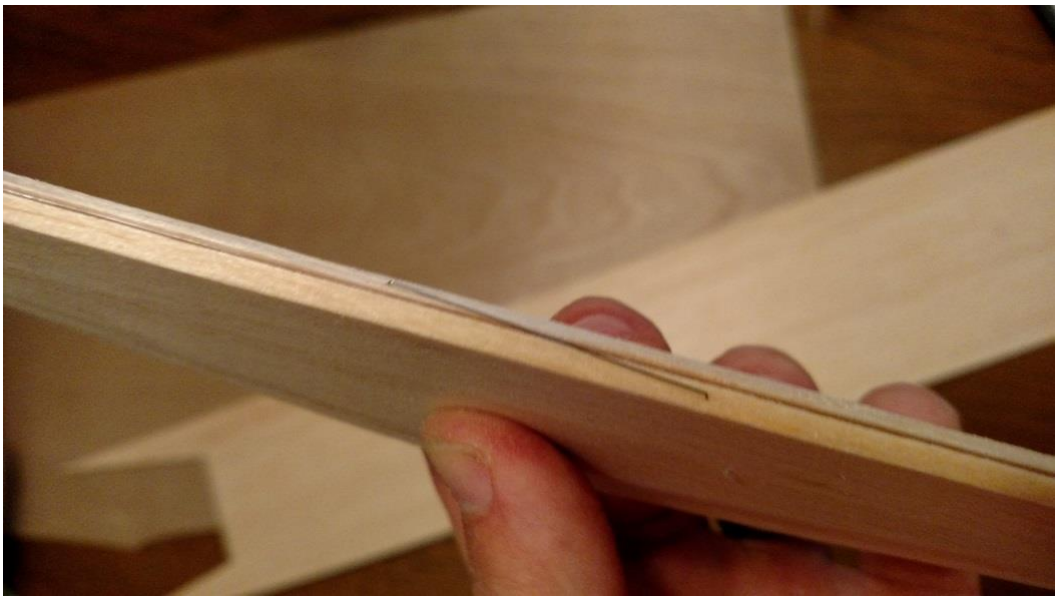

Figure 71: Hinge spring fully installed into vertical stab/rudder

If you are right handed, glue the vertical stab to the tailboom as shown in Figure 72 with the rudder's deflected direction shown. If you are left handed, reverse the direction and the side of the boom to which the vertical stab is glued.

Figure 72: Vertical tail installed for right-handed throwing

As shown in Figure 73, lay out the horizontal tail template and cut it out just like the vertical tail. Figure 74 shows that I used two springs to actuate the horizontal tail. Alternatively, a single .015 wire spring would work.

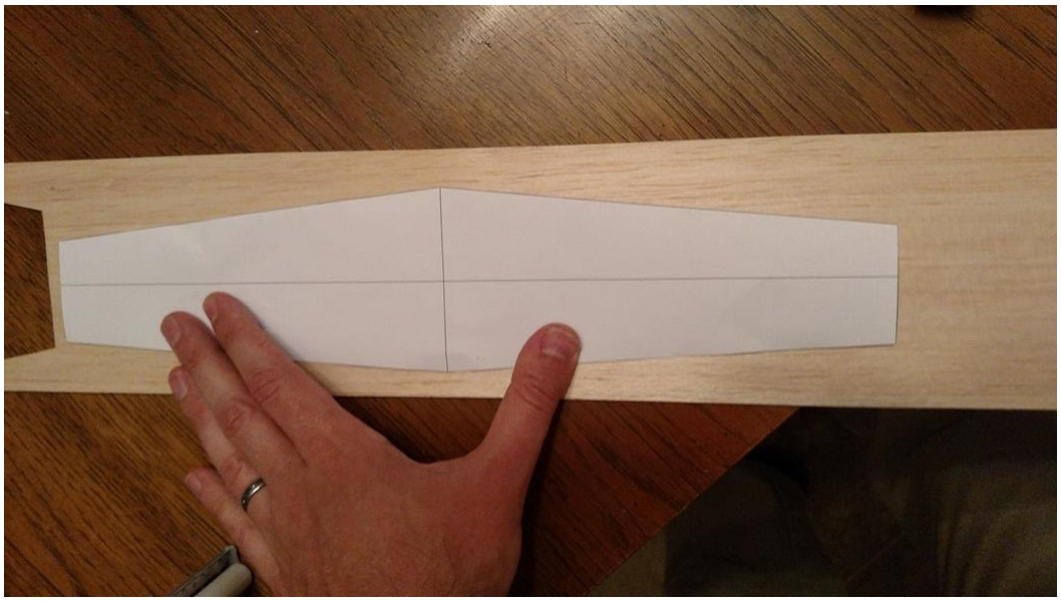

Figure 73: Horizontal tail layout

Figure 74: Dual springs installed in horizontal tail

The horizontal stab pylon assembly is detailed in Figures 75-78. I used light C grain balsa, but 9-10 lb balsa would probably be more durable. Sand the concave face which bonds to the tailboom by wrapping sandpaper around the boom to sand that face of the pylon blank, then cut the pylon free from the sheet to get the correct pylon height. Sand the leading and trailing edges round as shown in Figure 78.

Figure 75: Tail pylon blank cut to width

Figure 76: Sanding the pylon’s boom mount surface

Figure 77: Concave surface sanded into pylon

Figure 78: completed tail pylon

Glue the pylon to the stab using ca glue as shown in Figure 79. Note that the pylon shown is smaller than that shown in the plans. I undersized the pylon on the prototype which weakened the join by reducing the mating surface area. Glue the stab assembly to the top of the tailboom as shown in Figure 80. Some fliers mount their stabs to the bottom of the boom, but I do not recommend doing so on this model since the boom's torsional rigidity isn't strong enough to keep the stab from striking the ground and tearing free on ground landings.

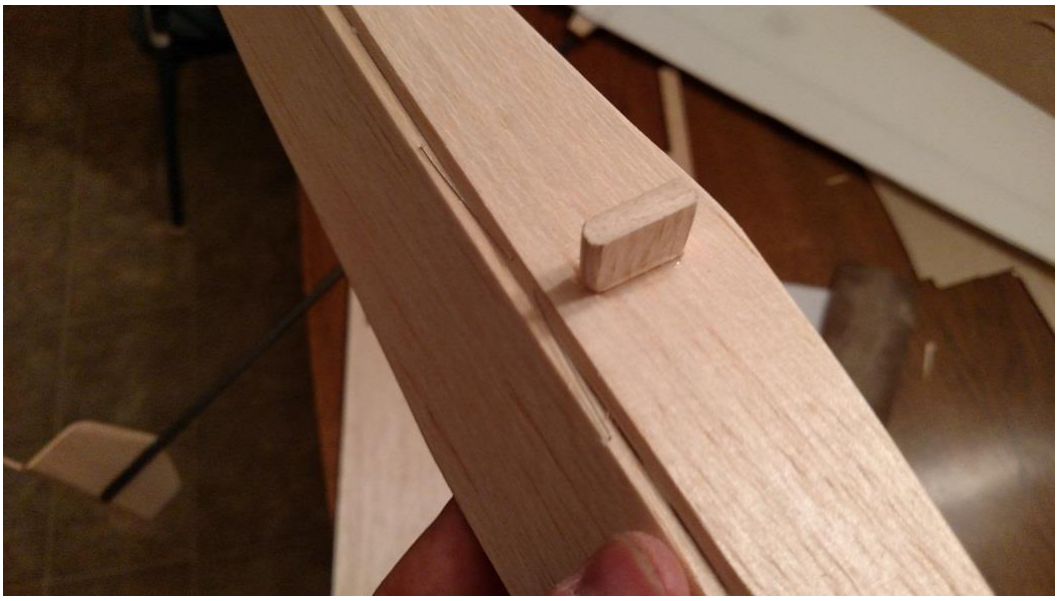

Figure 79: Tail pylon cemented to horizontal stab

Figure 80: Horizontal stab mounted to top of tailboom

Admire your work and compare it to Figure 81. You're almost done!

Figure 81: Nearly finished model!

***Part 8: Tail surface control rigging, electronics installation, and nose sheath***

Install the tail control horns as shown in Figure 82. Remember that the rudder is reversed in a left handed setup.

Figure 82: Tail control horns installed

Drill a 1/16” hole in the side of the tailboom just ahead of the stab pylon and thread 30 lb spiderwire through the tailboom to the front. Use a fishing knot to secure the end of the line to the control horn (you really do not want this knot to fail!) as shown in Figure 83. Do the same for the rudder. Leave about 10” of extra line at the front of the fuselage to simplify the connection to the servos.

Figure 83: Elevator control string installation through a hole drilled into the tailboom

Study the electronics installation shown in Figure 84. The receiver is taped down to the electronics boom about ½" ahead of the front of the tailboom. Wrap each servo tightly in masking tape and glue them firmly in place with ca glue. Notice the 1000 mah round cell lipo taped to the front with enough space left at the front for the nose plug.

Before installing your receiver, slide thin pushrod or etched Teflon tubes about 3" long each over each of the pull strings as shown in Figure 85 and glue and bind them down to the electronics boom to protect the lines from chaffing on the entrance to the tailboom.

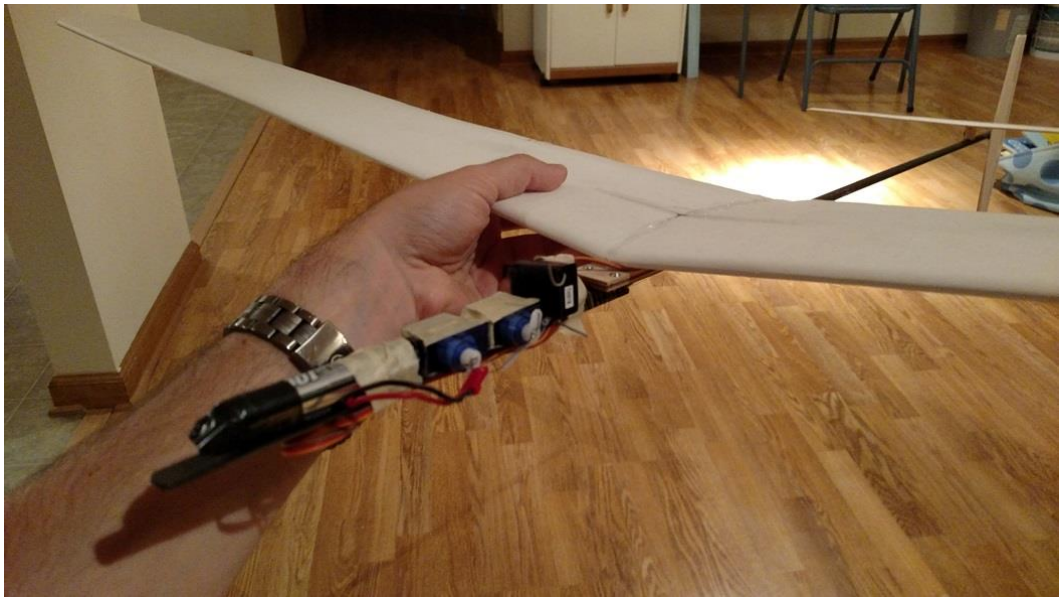

Figure 84: Electronics install on nose assembly

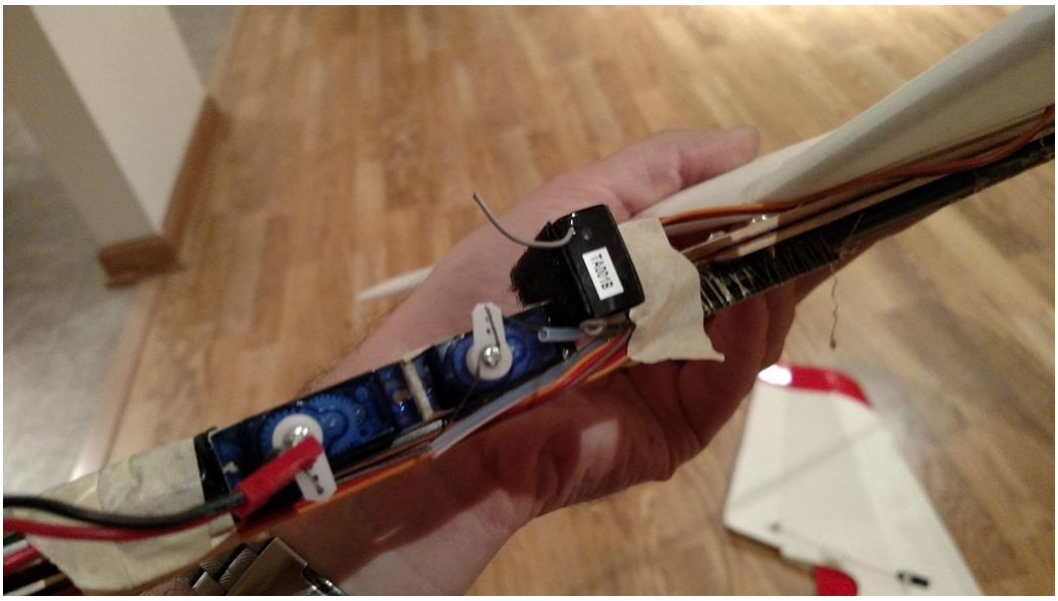

Figure 85: Control cable protective tubing and installation on nose assembly

After centering the servos and installing the control horns in the positions shown in Figure 85, slide the pull springs through the control horns as shown and hold them down with the control horn mounting screws while tensioning the tail surfaces to their neutral positions as shown in Figure 86. Be careful with the servos, but tighten the control horn screws firmly so that the lines will not slip. I wrapped each line around its respective screw twice to ensure proper retention. It make take a few tries to get each control surface aligned perfectly. Take your time to get it right.

Figure 86: Tail surfaces tensioned into neutral position by servos

You may need an extension wire to get the battery connected to the receiver. You are running unfiltered 4.2V power into the receiver, and this is ok with most Spektrum, Lemon, Orange, and Frsky receivers. Towerpro, Hextronic, and Turnigy 9g analog servos will run fine down into the low 3.X V range. Most of

these receivers remain safe down to 3.6V. I typically recharge the cells before they get below 3.9V because that cutoff gives me at least 12 hours operating time even with hard flying.

Your model should now resemble Figure 87. Except for the cabinet and wood floor. Those are my cabinet and wood floor and I'd be worried if you had them.

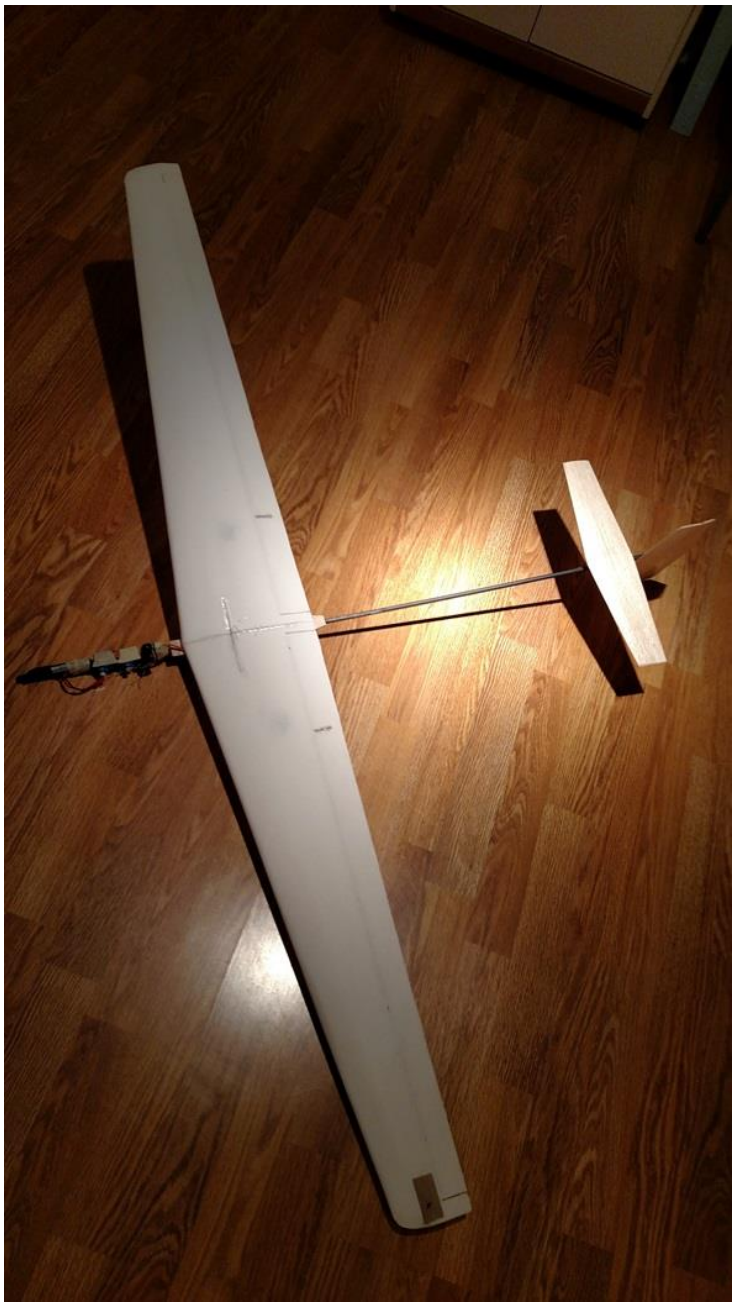

Figure 87: Spinster DLG ready for nose sheath

Carve a block of blue foam or similar material to the shape shown in Figure 88. A slot is cut into the back of this nose plug so that it fits onto the front of the electronics boom. A little masking tape reinforcement will prevent the boom from punching through the plug on poor landings.

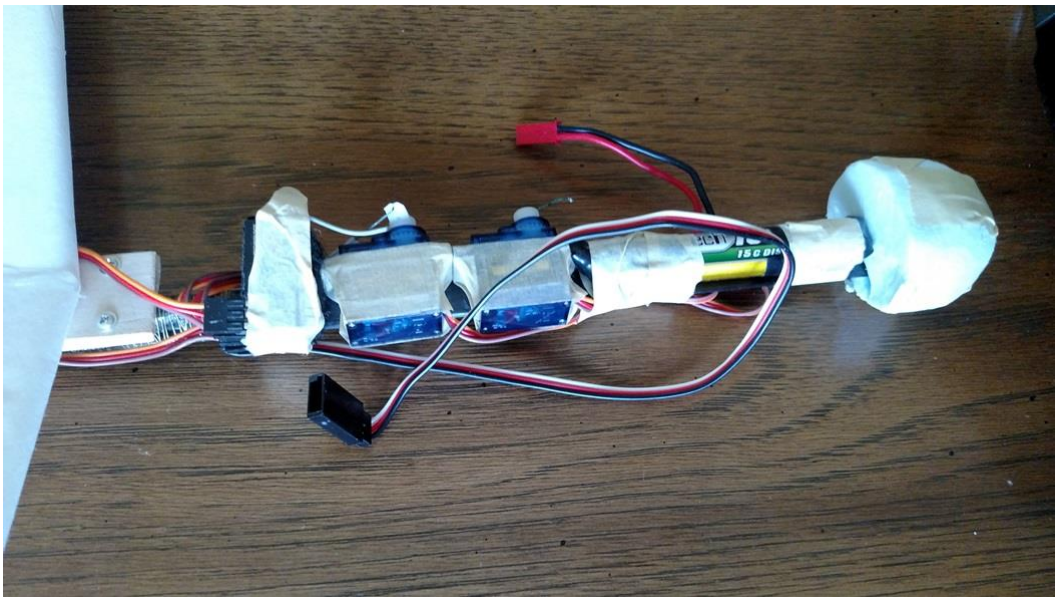

Figure 88: Nose plug carved from foam

Wrap an 8.5”x11” sheet of paper into a tube (8.5” long) of a diameter that allows a tight fit to the nose plug. Tape it to the nose plug with masking tape or blenderm (use tape or glue to hold down the seam as well). You should now have a sheath which will slide over the electronics and fasten lightly in place using the nose plug slot which fits over the electronics boom as shown in Figure 89.

Figure 89: Finished nose sheath

Congratulations! Your new Spinster DLG is finished and ready for flying.

Be sure to enable dual ailerons on your transmitter so that your flap function droops both flapperons 1/8”. You will need enough elevator down travel that the elevator trailing edge lightly touches the tailboom at full nose down. A similarly large amount of up travel should also be enabled. Get as much rudder travel as possible. Your flapperons should deflect 20 degrees up and 30 degrees down travel, and you should mix throttle to flaps so that at full throttle position, the flapperons are neutral, and at zero throttle, the flapperons are fully deflected downward.

Mix a momentary switch readily available to your left hand (if right handed) to mix in 5% up elevator for launch. You will hold this switch while spinning and release it immediately after the model leaves your hand so that it pitches the model straight up and then allows it to continue straight until you nose it over.

Balance your Spinster 40% back from the leading edge at the wing root to get started, and trim the model for a flat, fast glide with flaps neutral. Adding flaps should trim the model for minimum sink rate. As you get more comfortable, you can move the CG back until the model becomes marginally stable for maximum glide performance.

Visit the RCGroups Hand Launch forum for advice and programs to install on your transmitter for maximum utility with your new DLG, and watch Flite Test's Discus Launched Glider video to learn the correct launching technique.

If you have any further questions, you can contact me directly through the contact form at J&H Aerospace.