

ANGELWING DESIGNS



MICRO *Aquila*

A simple 2 channel micro glider designed for ParkZone brick radio systems.



Specs:

2 channel (Rudder & Elevator)

31.5" wing Span

88 Sq. In.

2 oz. Flying Weight

3.25 oz./ Ft. wing loading

Thank you for purchasing your **Micro Aquila** kit from **Alien Technologies**. It is designed to be an easy building, fun to fly anywhere 2 channel micro glider. The Aquila, designed by Lee Renaud and kitted by Airtronics is the inspiration for this kit. It is perfect size to toss around the school yard, local slope or keep in the back seat of your car for a quick lunchtime thermal session. I hope you enjoy it as much as I do.

Although it is easy to build, it does require a nice flat surface that will accept pins to ensure the wing is built straight & warp free. A balsa building board is ideal, but an acoustic ceiling tile or nice flat piece of cardboard will suffice.

Care should be taken in the covering that you choose. Lightweight film or tissue must be used. Traditional covering like Monokote and Ultracote will warp and crush the structure, do not use them! The prototype was covered in Parklite film. You must make sure not to over tighten the covering and induce warps in the lightweight structure.

All part markings should face inward and right side up unless otherwise noted. Parts should be left in their sheets until needed to prevent damage. When removing, cut the tab holding them in place carefully with an X-acto knife and sand any remnants of the tab away with 220G sandpaper for a nice tight fit.

This kit was designed in CAD and laser cut in my garage. If you have any questions, comments or concerns, please do not hesitate to contact me.

Thanks

Red

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Equipment needed:

- ParkZone brick radio system
- Covering (Coverite MicroLite, CoverLite, UltraCote Lite etc.)

Tools needed to Complete:

- Masking tape
- Waxed paper
- Straight or T pins
- Straightedge
- Sandpaper 80 (block) 150 (block) , 220 & 400 grit
- X-Acto knife
- 90 deg. triangle
- Covering iron
- Thin & Med CA, Hot glue, ShooGoo or silicone equivalent
- Small piece of Velcro

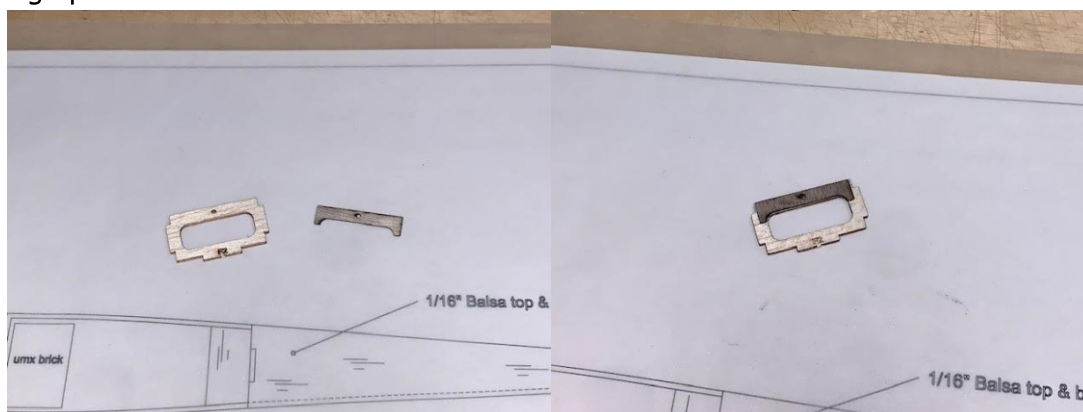
I like to use a pipette for precise CA joints, especially with the thin stuff. The parts are small and it can run everywhere right out of the bottle if you aren't careful. They are available from a few different sources, I get mine from CSTsales.com Give them a try, I won't build without them now. Most of the construction uses thin CA, except in a few instances where med CA is called for. The fine one is shown, one with a larger tip for medium CA is also available.



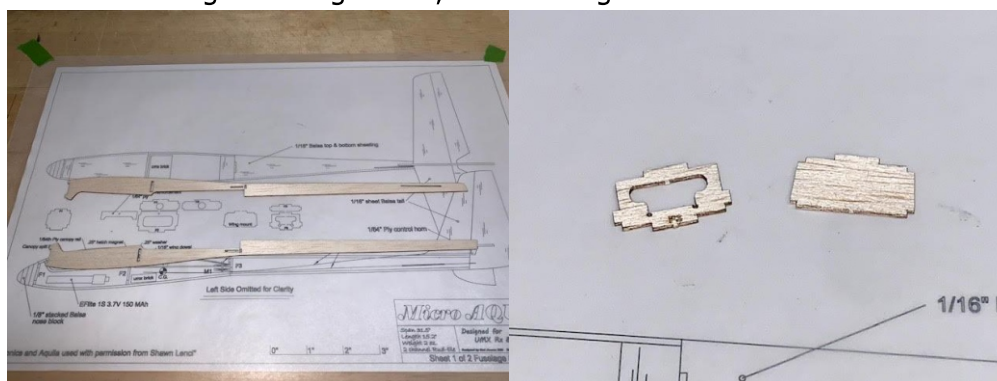
Fuselage Construction

Use thin CA unless otherwise noted

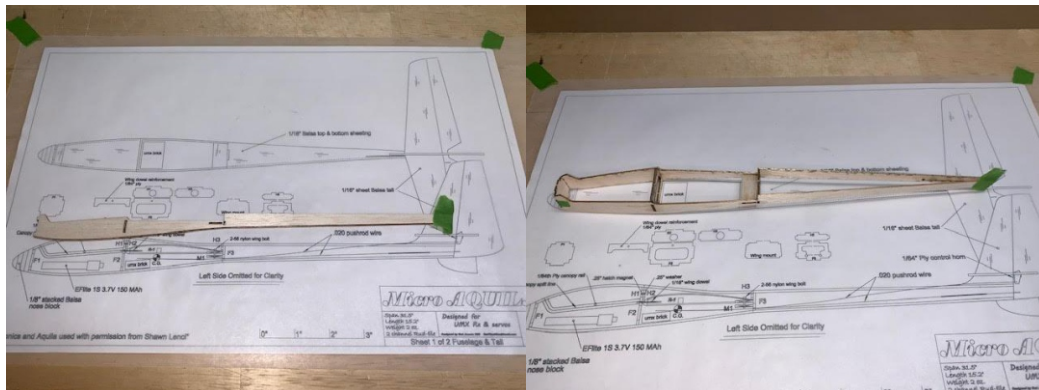
1. Pin or tape your plans to the building board and cover with waxed paper or some other protective film. It is not necessary to build the fuselage over the plans; use them for reference to keep it straight however.
2. Locate former F2 and the 1/64" ply reinforcement. Laminate them with medium CA lining up the center hole.



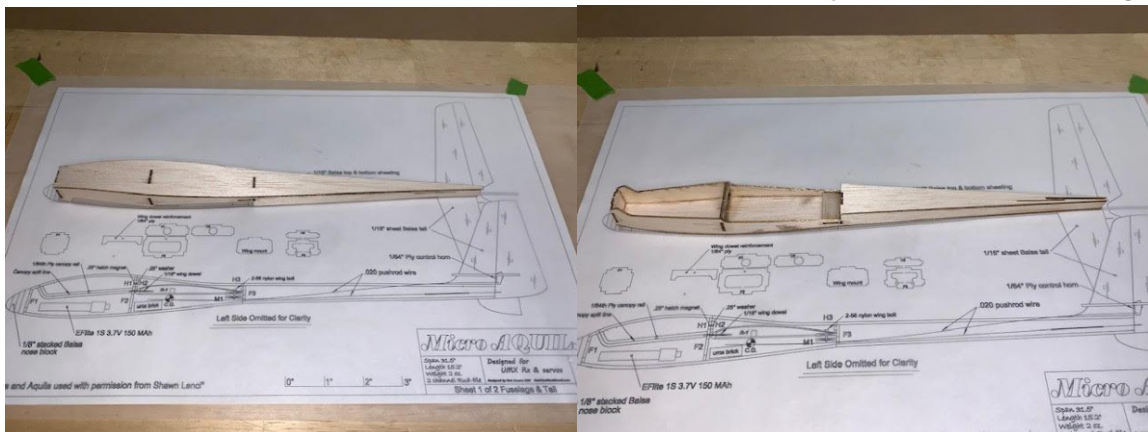
3. Locate the left and right fuselage sides, F3 and wing mount.



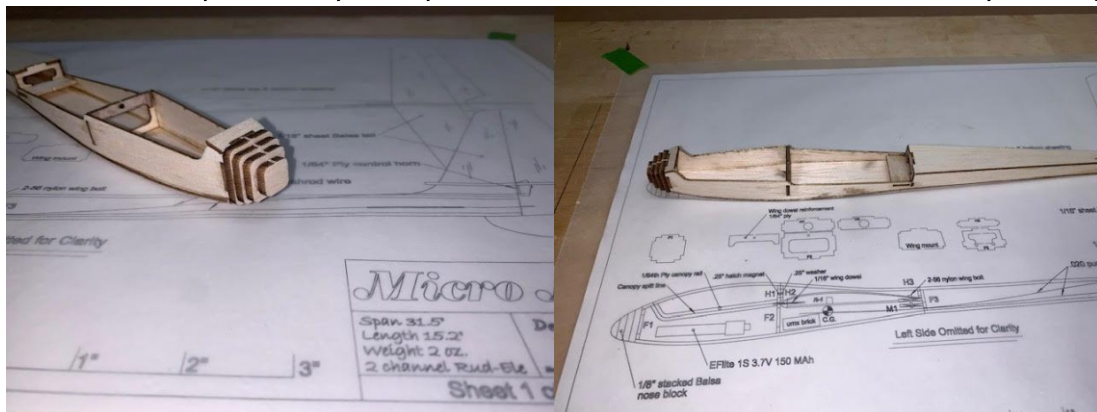
4. Tape the aft edge of the fuselage sides together. Locate F3, using a 1/16" drill bit enlarge the pushrod holes. Insert the wing mount into F3, and place it between the fuselage sides, do not glue. Add F2 + F1, do not glue. Once satisfied with the alignment, tack each former in place. Once all tacked, go over each joint and glue permanently.



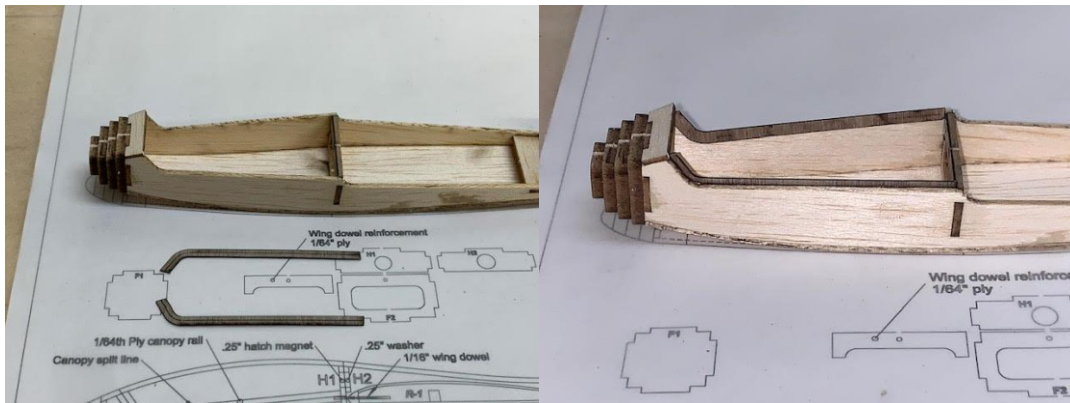
5. Turn the fuselage over and add the bottom sheeting. I like to tack glue it in the area of F3 to hold the curve, then move fore and aft from there. Add top front and aft sheeting.



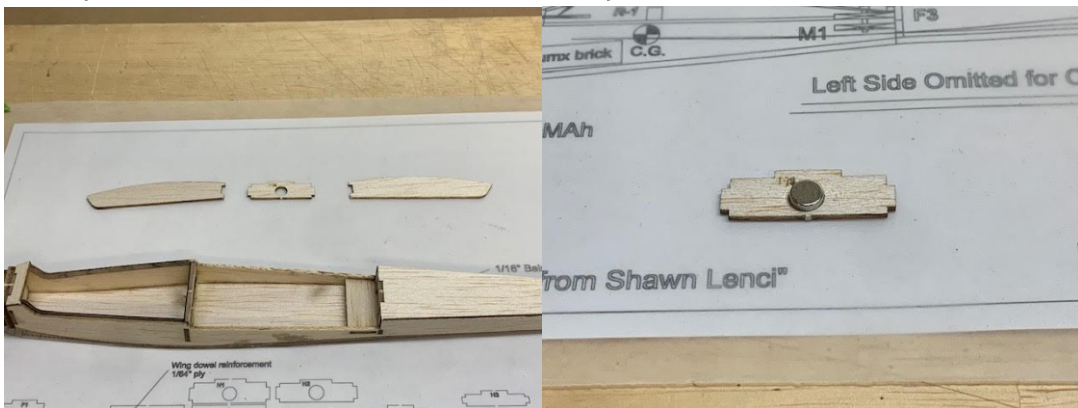
6. Locate the 1/8" balsa nose blocks. Starting with the largest glue them in place roughly concentric. *Pro Tip: Use only a drop or two of med CA near the center for easy sanding.*



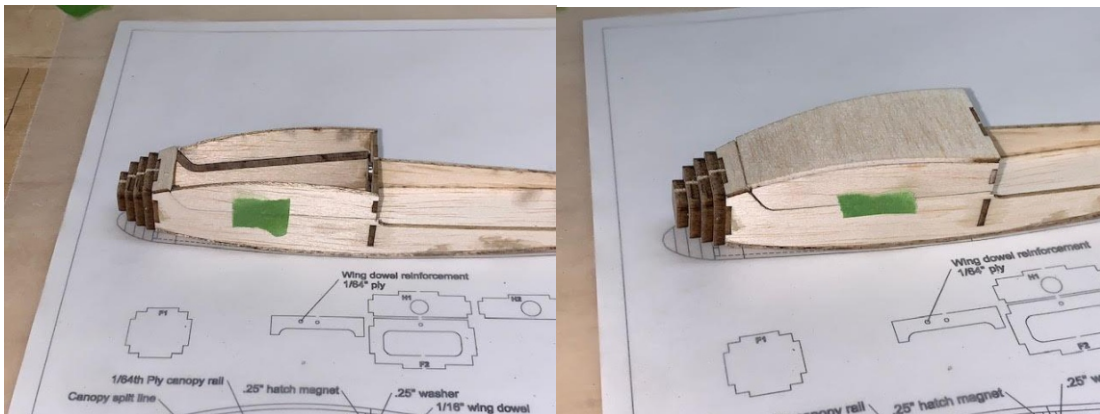
7. Locate the 1/64" ply canopy doublers. Notice that there an etched line down the center for alignment. This line should rest on the fuselage edge. Glue with a drop or two of thin CA.



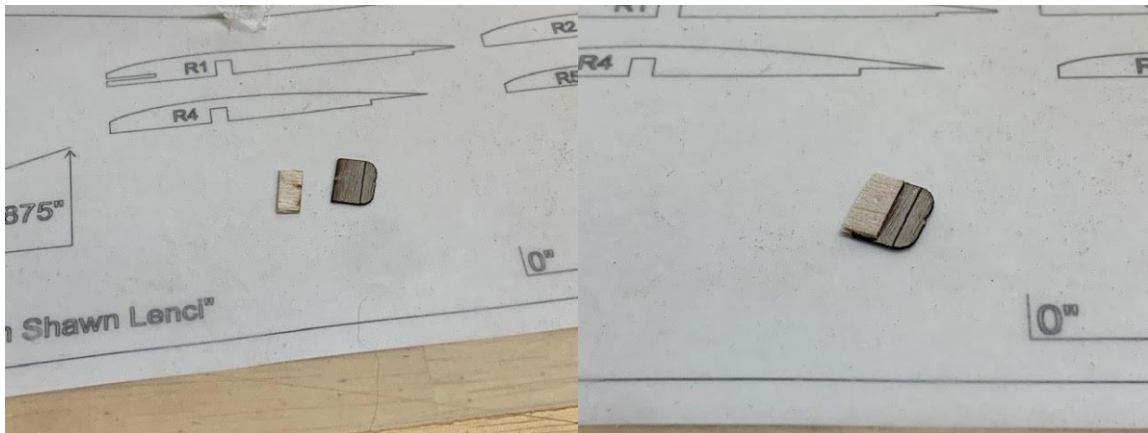
8. Locate the canopy sides, H1 & magnet. Glue the magnet flush with the *backside* of H1; it will sit proud on the front side as shown in the pic. Use med CA for this.



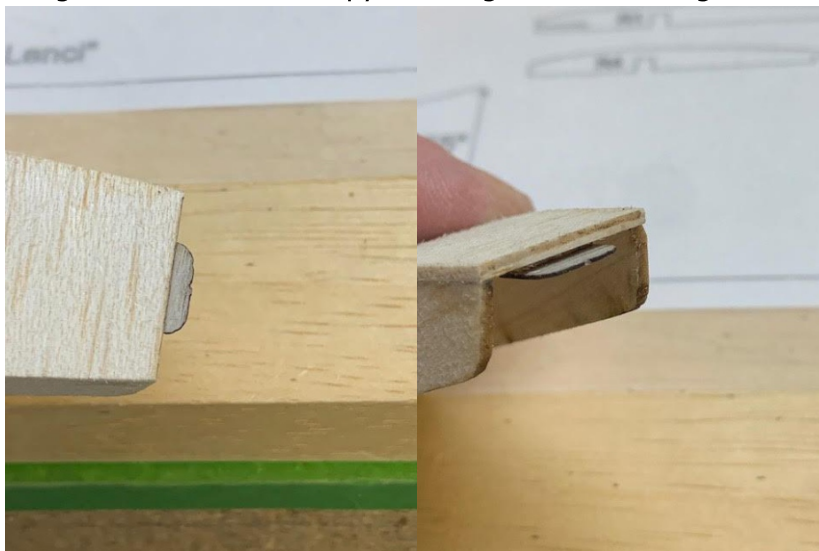
9. Tape the canopy sides and H1 in place on the fuselage. Tack glue H1 to the sides with the smallest drop of CA. You need to be very careful not to glue the canopy to the fuselage. Add the top sheeting and tack in place. Remove the canopy and thoroughly glue all the joints from underneath.



10. Locate the 1/64" ply hatch tongue and the 1/32" balsa spacer. Glue the spacer to the aft (non-rounded) part of the tongue.



11. Glue the tongue to the hatch balsa side down to create a small gap. The etched line on the tongue should be even with the front edge of the canopy. This will create a bit of spring in the tongue and hold the canopy down tight to the fuselage.



12. The fuselage can now be rough sanded to shape. Keep shaping & rounding the nose block until the laser cut edges disappear and blend it into the nose so it is nice and round.

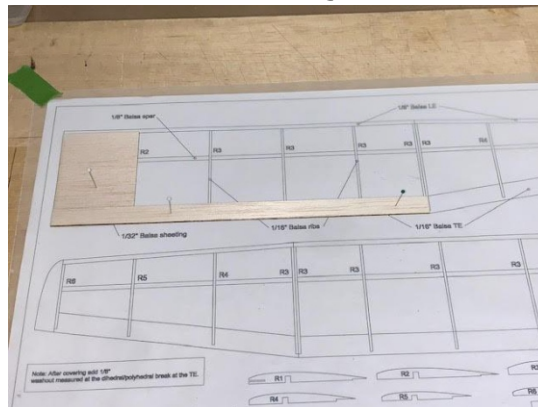
Wing Construction

Although the wing is built directly over the plans, humidity (*or lack thereof*) can cause the plans to shrink or stretch. This can make the parts appear not to fit exactly. Not to worry; the parts are self-jigging and will end up in the right place. Use the plans as a reference to keep the ribs straight etc., don't fret if the parts don't match the plans exactly.

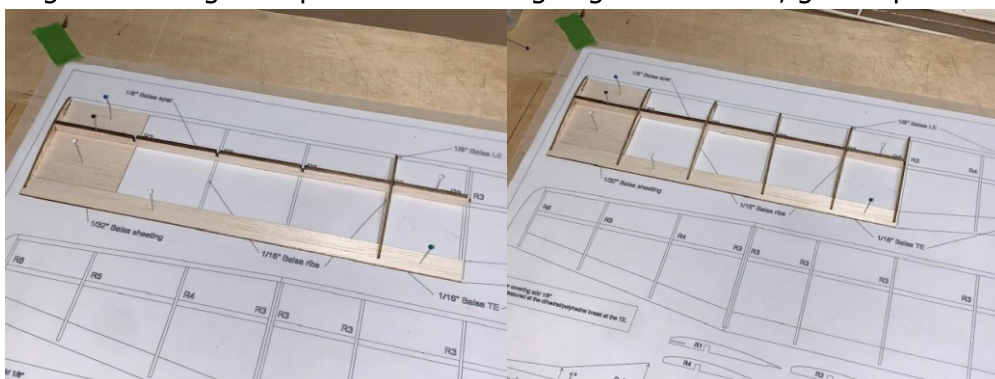
Each wing half is built in two sections; inner and outer. They are joined together later to get the proper dihedral and polyhedral angles. The spars have the dihedral & polyhedral angles pre-cut. It is important to get the angles to match the diagram on the plans within reason. The angles may need to be adjusted by sanding with a block to provide a nice tight joint. Since there is no spar carry through on this model, the wing's strength relies primarily on a tight joint. Take care while setting the rib angles while building and this will be a non-issue.

Begin with the right wing.

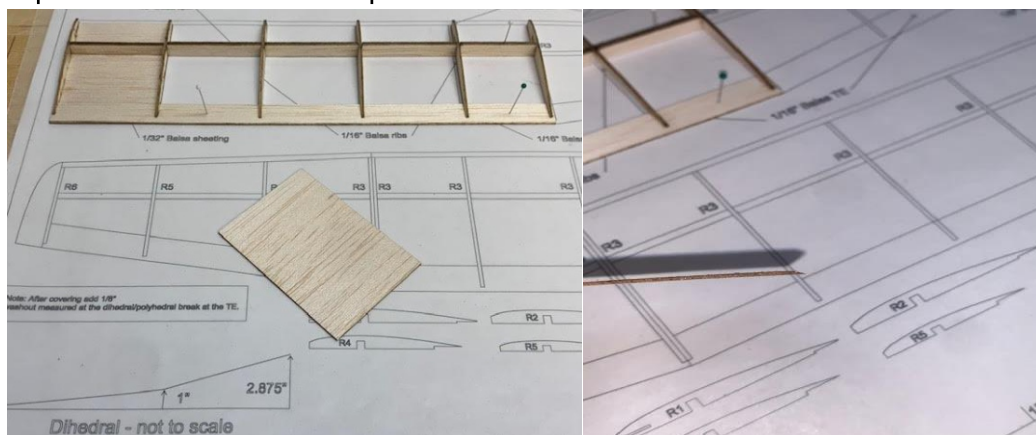
1. Lay out the plans as before and protect them. Start by pinning the trailing edge and center sheeting in place. Note the lower sheeting is the shorter of the two.



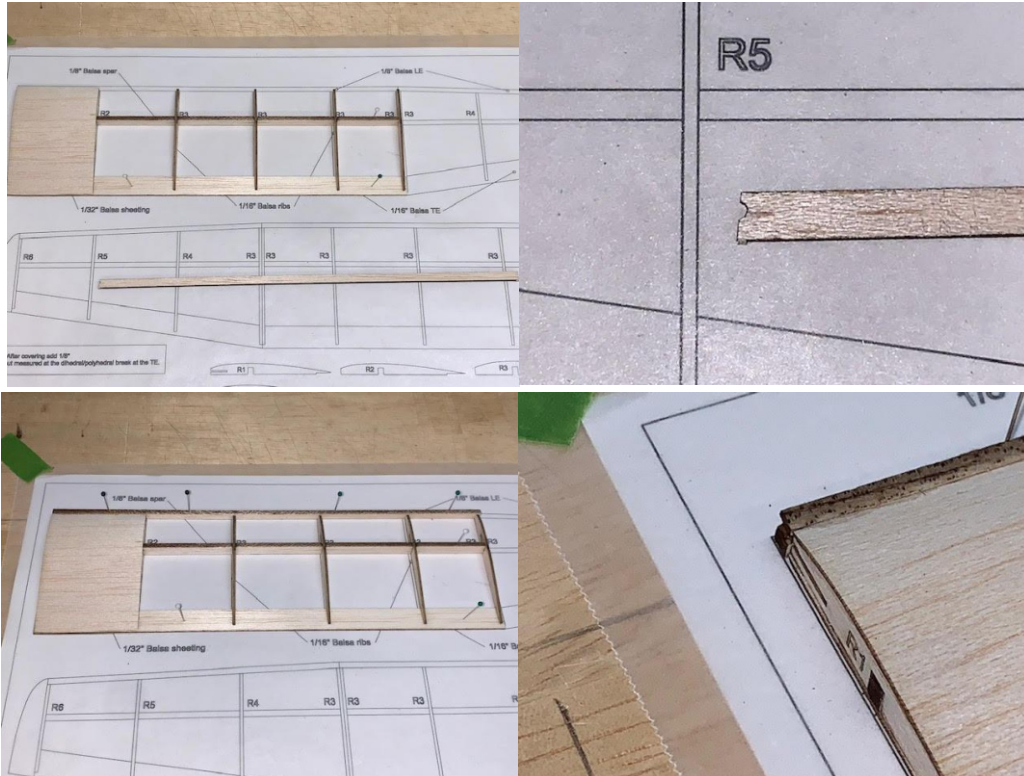
13. Locate (1) R1& (1) R3 along with the main spar. Set R3 in place one bay in from the tip and place R1 at root, but do not glue. Slide the spar with two ribs in place with the notches of the ribs fully seated on the trailing edge. This will set the fore/aft location of the spar. Pin the spar in place and add R2 as well as the remaining R3 ribs. Pay close attention to R1, it does not sit vertical. The dihedral angle is already cut into the spar, so make sure R1 is fully seated at the proper angle before gluing in place. Once the remaining ribs are aligned square to the trailing edge and vertical, glue in place.



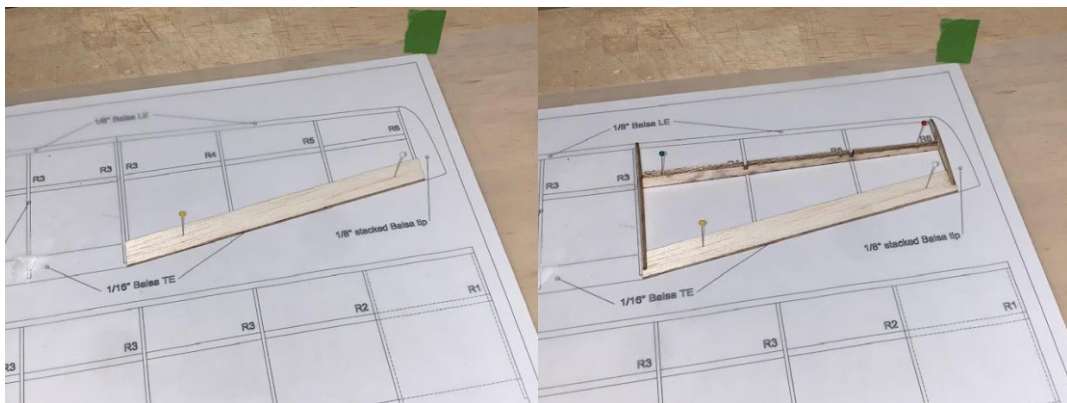
14. Locate the longer piece of sheeting for the upper wing. You will need to sand a shallow bevel on the aft edge before installing; this will produce a nice sharp joint at the trailing edge. Once satisfied with the fit glue in place with med CA. Don't forget to glue the entire perimeter as well as the spar.



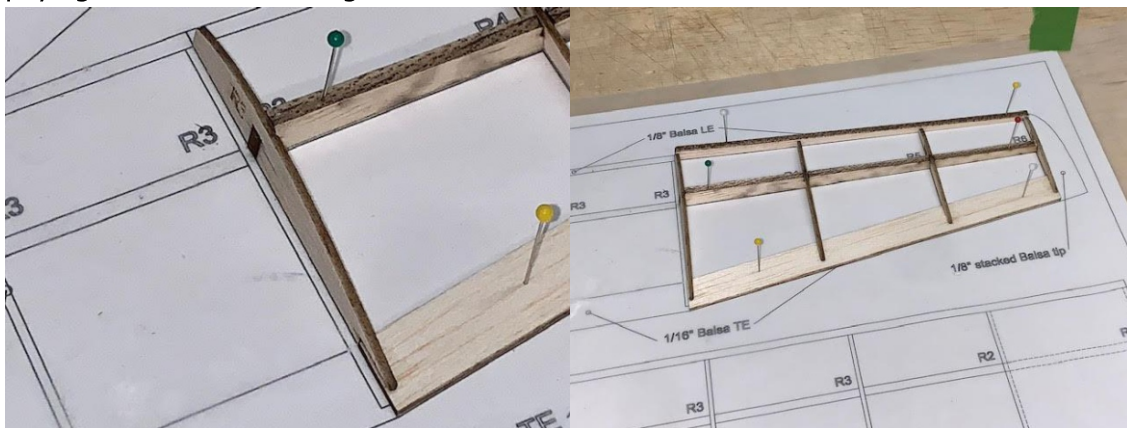
15. Locate one of the center leading edge pieces. This will be easy to spot; it has a notch in one end for the dowel. Glue in place taking care to match the angle of R1.



16. Remove the center panel from the board and set aside. Pin the outer wing trailing edge in place making sure the angles are correct. Using the same method as you did on the inner panel, use ribs R3 & R6 to set the spar depth correctly and pin in place.



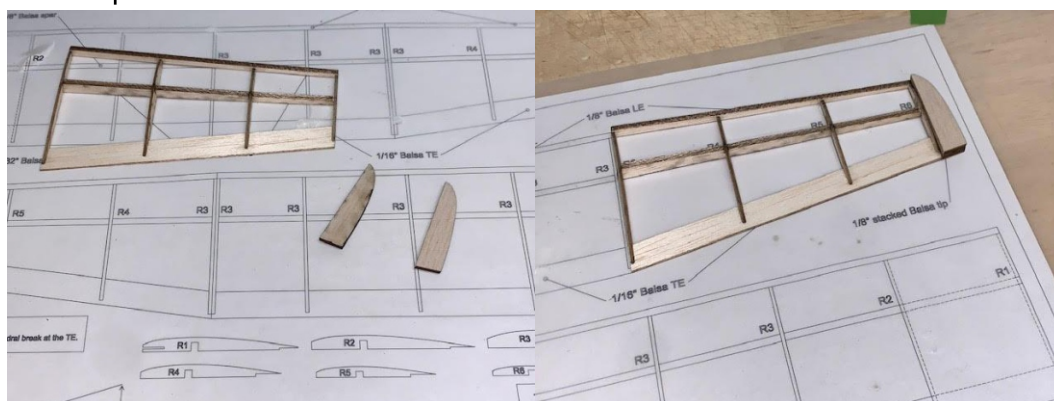
17. Add ribs R4 & R5. Verify R3 is at the correct angle and tight to the spar and glue in place. Once the remaining ribs are square, glue in place. Glue the leading edge in place paying attention to the angle cut in it as well.



18. Remove the tip panel from the board and sand the R3 and R6 ends flush.



19. Locate the two 1/8\" balsa wing tips. Laminate these together with med CA. Pro *Tip: use only a drop or two at the center, this will make sanding easier*. Once cured, glue the laminated tip block to R6 as shown.

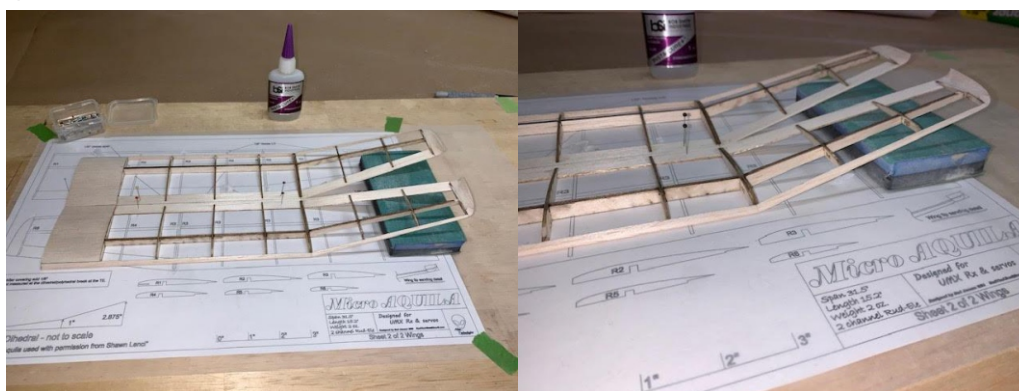


20. Repeat the above steps for the left inner and outer panels. With all panels built, I find it is easier to sand all the leading edges to shape while they are still flat before they are joined.

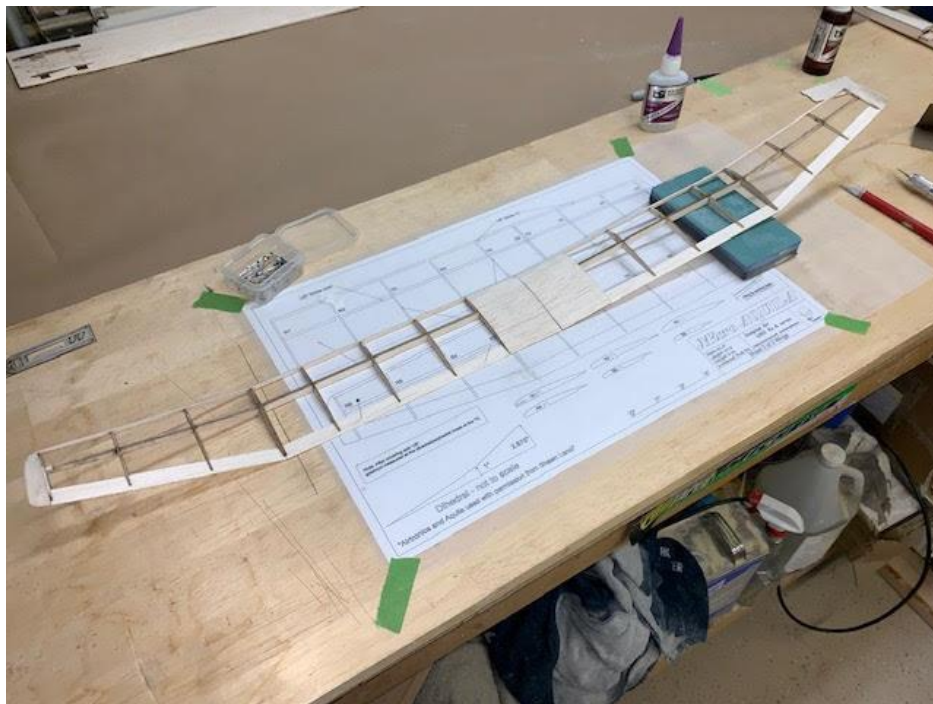
21. Now it is time to shape the tip. One of the most distinct features of the Aquila is its upturned tips. This is quite easy to achieve using a round sanding block top, and flat block on the bottom. Use a pencil and mark a guide curve at the back of the block the thickness of the trailing edge curved upward to vertical. I used a Sharpie pen with some self-adhesive 80g paper wrapped around it to get the concave shape. Refer to the plans and pictures.



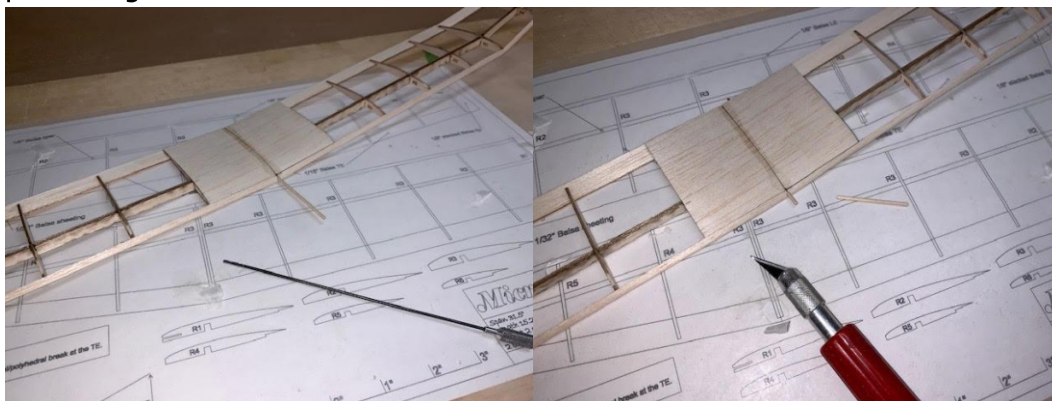
22. Joining the wing. With the inner panel pinned flat, block the tip up to achieve 1.875" of polyhedral. Sand the inner/outer joints so they match for a good bond. Pin the second wing right behind it so you can match the angles precisely. When satisfied glue with med CA.



23. Block the center panel up to achieve 2" total dihedral. Once satisfied glue in place with med CA.



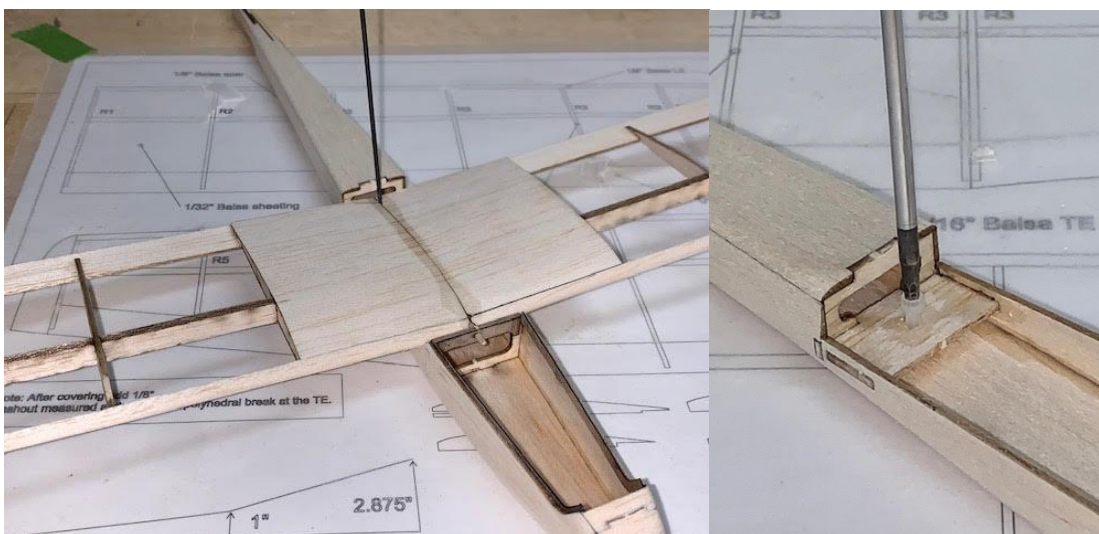
24. Locate the 1/16" wing dowel. Using a 1/16" drill bit, clear the hole through the leading edge and into the slots in R1 but do not glue yet. Cut off to approximately 1/4" length protruding.



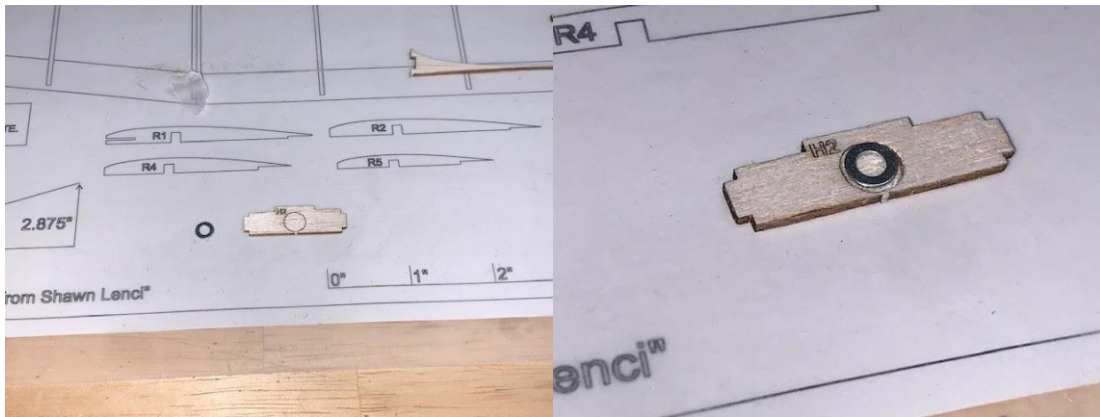
25. Test fit the wing in place. You will likely have to enlarge the hole in F2 for the dowel to fit with a $1/16''$ drill bit. Go slowly, you want the dowel to fit through easily, but not be snug. A sharp X-Acto knife can also be used to carefully fine-tune it. The goal is for the dowel to pass through F2, and the wing to sit flat on the fuselage without requiring any pressure. Go slow and get this right, this is important.



26. Square up the wing in the saddle in preparation of drilling hole for the bolt. A neat trick is that the tick mark for the aft sheeting is right in the center, line up the tick and the center wing joint and it will be very close. Measure each wing tip to the aft fuselage to be sure. Once satisfied, again use a $1/16''$ drill bit and drill through the wing centerline $1/4''$ forward of the trailing edge. An exact measurement is not critical, but you do want the hole to be near the middle of the wing hold mount pad. Once drilled through, remove the wing and harden the threads in the mount with thin CA. Once the CA has cured, you can thread in the 2-56 bolt in and out a couple times and recoat the threads with CA one more time. If the threads loosen up later, you can apply more CA and recut them.



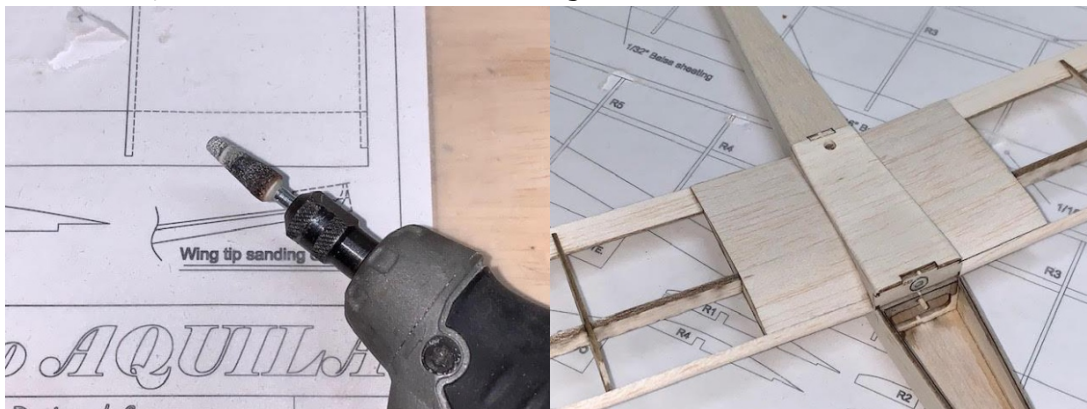
27. Locate H2; notice it has an etched circle in one side. Using an X-Acto knife, scrape away enough balsa so that the provided washer sits flush with the surface. Glue the washer in place with medium CA



28. Find H3, and the two wing cover sides. The sides are very thin and must be handled with care to avoid breakage. Gently tape them in place along with H2 & H3. When satisfied with the fit, tack glue together being careful not to glue it to the fuselage. Remove it from the fuse, add the top sheeting and glue it all together.



29. Install the wing, and place the wing cover back on top, you can now add the top sheeting. The cover can be glued down to the wing now, keeping everything aligned. Once cured, drill an access hole for the wing bolt.



Covering

Sand the entire airframe in preparation for covering, finishing with 320-400g.

Once again go over the entire airframe, this is your last chance to check for blemishes. I'm going to assume that you know how to cover, so I will not go over it step by step. However I will offer a few tips.

- Cover the bottom of the wings first. This helps to hide the seams and makes for a nicer job. I was able to cover the bottom in of both wings in one piece. Move to the top next. This I had to do in 4 pieces, 1 each left and right inner and outer panel.
- Cover the fuselage starting with the bottom, each side and finally the top. Add the 1/64th ply pull tab to the hatch after its covered

The sequence below describes my method for using covering as a hinge. Although it takes a bit more time this makes for a very durable hinge and I think a nicer looking model. If you plan to use another hinging method, please read though below and deviate where appropriate to suit your needs.

1. Locate all of the tail pieces. Tape the rudder in place and sand to fit if necessary to achieve a tight, straight gap.
2. Round all of the leading edges and trailing edges, but *do not* sand the hinge lines.
3. Next sand a 45 degree angle into the bottom LE of the elevator. Pay attention the slot for the control horn will be on the **left side**.
4. Sand a 45 degree angle into the LE of the Rudder. Notice the bevel is in the **left side** of the Rudder.
5. Sand all of the tail pieces in preparation for covering. Be sure to round all of the edges except for the TE of the Stabilizer and Fin, leave these squared off.
6. Cover both sides of the fin and glue in place. You can use thin CA directly to the covering, no need for bare wood.
7. Cover both sides of the stabilizer and glue in place using the same method as above.
8. Cover the bottom of the elevator first. Next cover the top finishing all sides except leaving a 1/4" flap on the hingeline. Tape the elevator to the stabilizer on the bottom side and iron down the flap from the elevator to the stabilizer. If the hinge is too tight and there is not enough down motion, simply apply downward pressure on the elevator while heating it and it will loosen up. This will yield a nice tight gap free hinge.
9. Use the same process for the rudder.

Final Assembly

Locate the two .020 music wire pushrods (they are taped inside the shipping box). Both ends will use a modified "Z" bend for control hook up. While not difficult, care must be taken as once they are bent, there is no adjustment. It is best to use two small pair of needle nose pliers to make these bends. This type of bend allows removal by "rolling" the pushrod out of the servo arm or horn. You can fudge the length a little when you glue the control horn in place however.

1. Start the process by making a 90 degree bend 1/8" from one end.



2. Make the second bend 90 degrees from the first.



3. Repeat for other pushrod.

4. *Installing the pushrods* - Right up front I am going to tell you that this is a pain in the posterior. You will probably swear a little at me and I understand. The good news is you only have to do this once for each one and then never again. As a last resort, you can cut an access hole behind F3 to guide the pushrods through, then recover.
5. *Please pay attention to which side of your brick controls the elevator and rudder before you install the pushrods. Note which hole each pushrod must pass through for the corresponding control surface. This will save grief further down the line*
6. Insert the pushrods one at a time through the slots in the aft fuse and must pass through the holes in F3 under the wing mount. It is a real pain, but one trick I found is to put a slight bend about ¼" from the end of the pushrod. This way when you twist it with your fingers you can change the direction as you try to pass through F3. Once you have it through, tape it in place so it will not fall out while you install the other one.
7. Using a couple dabs of hot glue, secure the brick in place up against F-2 making sure it does not rub. Measure pushrod length at the servos and make another Z bend. Install both pushrods into the tabs on the brick servos.
8. Turn on your radio system and make sure the servos are centered
9. Starting with the Elevator, locate the 1/64th ply control horn. Uncover the horn slot in the elevator with an X-acto knife.
10. Place the horn in on the pushrod and install in the slot.
11. Tape the elevator straight. Making sure the servo is still centered, and then fit the horn in the slot in the Elevator. Adjust the horn until it is vertical looking from the rear and keeps the elevator centered. Glue in place with thin CA.
12. Repeat for Rudder.
13. Add a piece of Velcro in the fuselage to hold the battery in place.
14. Bolt the wing in place.
15. The CG is located on the front edge of the spar. Add nose weight to achieve proper balance. It should hang slightly nose low. BB's and epoxy as well as lead shot work well for this. I added shot inside the hatch cavity up against F1.

After covering, do not forget to add 1/8" washout to each wing measured at the TE joint of the inner and outer panel.

Congrats! Your Aquila is now complete!

Preflight

- Double check CG. You can always move it to suit your taste later.
- Check for proper direction of Rudder & Elevator. **Caution:** *do not* set your servo travel beyond 100% as this can cause the servos to bind up at the end of the travel.
- I use about 20% expo but it is not necessary at all.

Flying

Start with a few gentle hand tosses to check CG, then wind up and let it rip. It will withstand the hardest javelin style launches you can muster. It is also very at home on the slope. There is no provision for a tow hook, however I have had good luck bending one out of pushrod wire and taping it in place near the CG. Experiment with placement for best position.

Of course it is most at home just tooling around at minimum sink looking for the next thermal bump, but simple 2 channel aerobatics including loops, wingovers, spins etc. are all in its bag of tricks.

Options

- A simple strip of 3M packing tape on the bottom of the fuselage will help protect the covering on rough flying fields.
- Make a tow hook from left over pushrod wire. If you bend a triangle shaped base on it you can tape it to the belly. The hook should be no further aft than the CG to start; you can move it later to suit your taste.
- Make a simple bungee from 1/4" (or larger) free flight rubber and a length of lightweight monofilament line. The lengths are up to you and should suit your flying area. A general rule of thumb is about 1/4 rubber to 3/4ths line. Attach a brightly colored ribbon near the loop so you can easily find it after you land.
- Alternatively, make an aero-tow hook from the same .020 wire. I simply glued it to the right side of the nose block straight out to the side about 1/2". You can bend this slightly back to hold onto the towline, and when it's time to release you can simply turn sharply left and the towline will slide off.

Enjoy!

Red

