

# My Balsa & Glass Workshop

## Andy Clancy's Stagger Bee Build Description

Updated Version 19 October 2025

The Stagger Bee captures the special classic grace of a Stagger-wing Beechcraft. It is a fun 29" top and 24" bottom wingspan three channel sport biplane, which is still very much a Bee. You know: Oversized control surfaces, hands-off stability, extremely low minimum flying speed, and easy aerobatics. The Stagger Bee is just a Bee that is a biplane. It can manage having more power than a Lazy Bee.

### Stagger Bee Model Specifications:

Wingspans: 29.6" top and 24.2" bottom.

Wing Chord: 10"

Total Wing Area: 465.3 sq. in. (Top - 260.5 sq. in.; Bottom - 204.8 sq. in.)

Stabilizer Span: 18.5"

Stabilizer Chord: 6.25"

Total Stab Area: 86.25 sq. in.

Rudder Height: 6.5"

Rudder Area: 30.6 sq. in.

Fuselage Length: 24.4"

Fuselage Width: 2.35"

Rec. No. of Channels: 3 - Throttle, Elevator, and Rudder. (Note - I will be adding flaperons to the top wing)

Weight: 30 oz. to 42 oz. depending on power system selected.

Glow engines: from .061-.15 two-stroke or up to .30 four-stroke.

Electric: Output of 250 - 600 watts, 3-cell LiPo pack sized up to 4,000 mah.



Figure 1 - An Example of a Nice Stagger Bee Build.

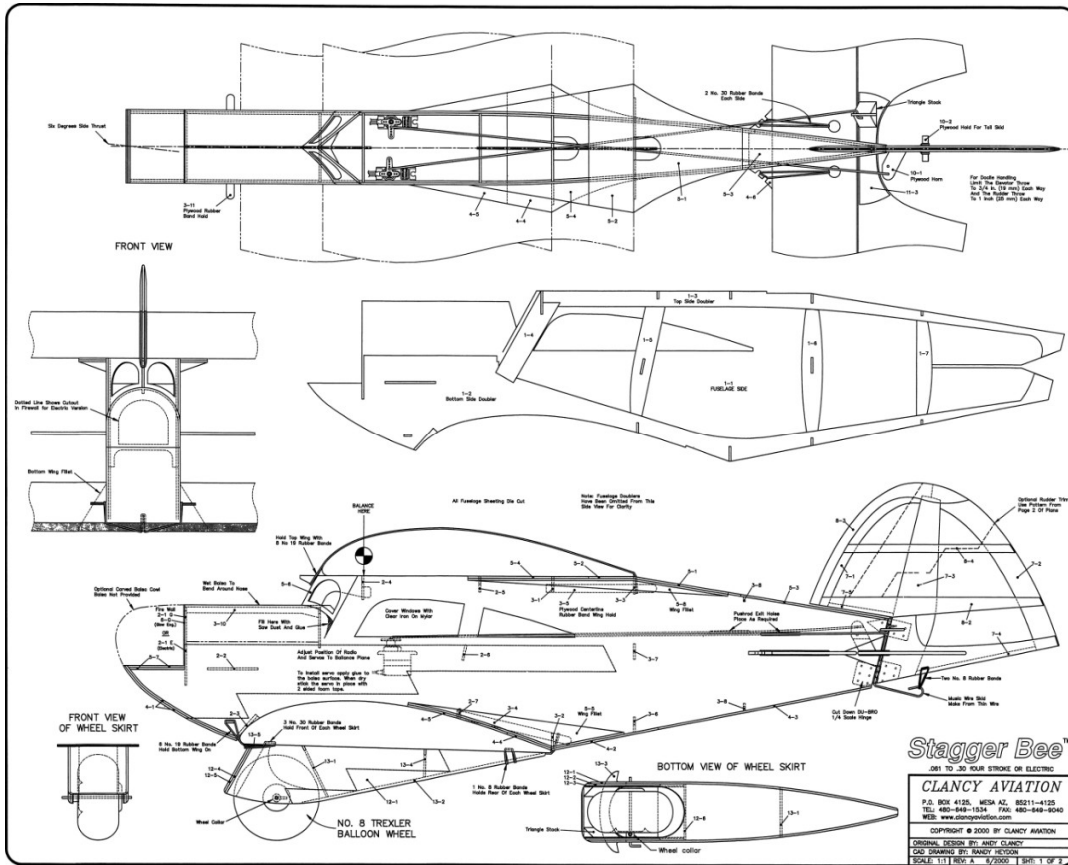
Image Source: <https://www.rcgroups.com/forums/showthread.php?2681389-Clancy-Aviation-Stagger-Bee-Build/page6>.

Clancy's Stagger Bee is designed to fly with glow engines as small as a .061, and strong enough to manage larger engines up to .15 sport two-cycles or even up to .30 four-cycles. With larger engines it will have vertical capabilities.

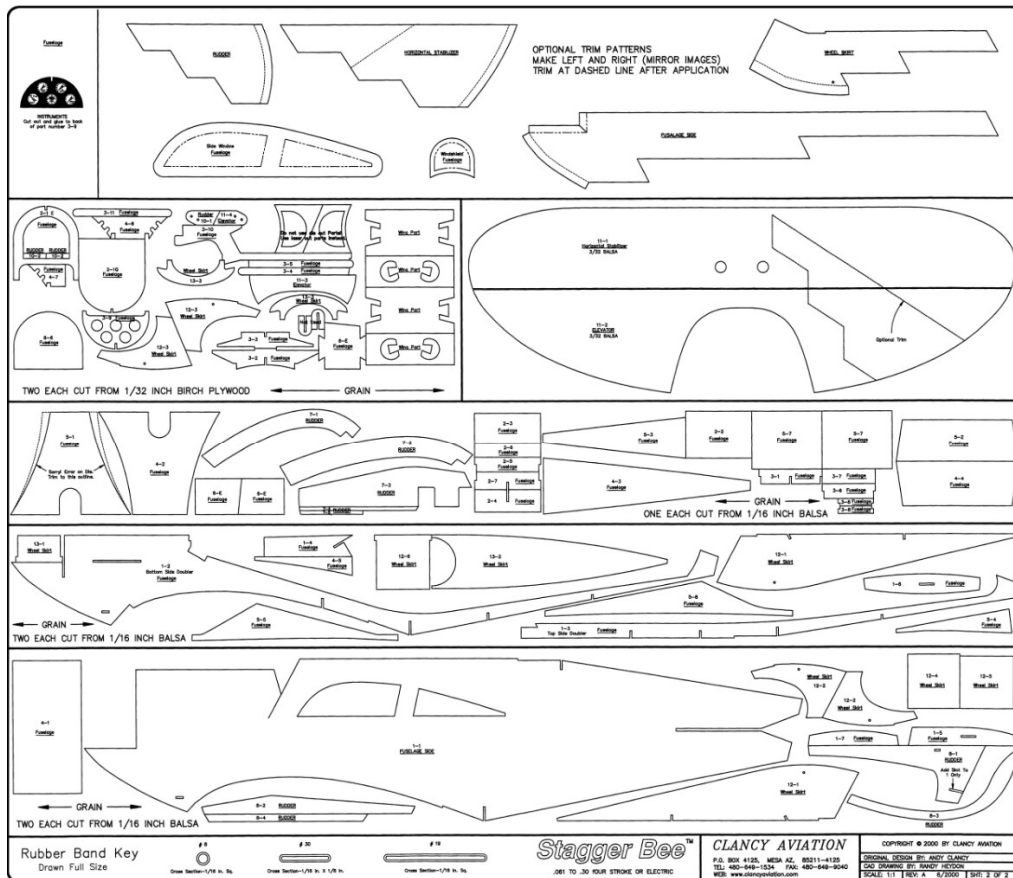
An electric-powered Stagger Bee typically will have a total flying weight of around 30 to 40 ounces ready to fly. It is recommended you use motors with a power output of 250 - 600 watts. The electric Stagger Bee tends to be tail heavy with brushless motors. You might want to use an oversize motor to help balance the plane even though you do not need the extra power. Larger motors can be detuned by throttling them down, or by using a smaller prop than specified for the motor, or by not using the maximum number of cells. The best battery size to use is a 3-cell LiPo pack up to 4,000 mah. **Be sure to decide on the power plant and other options before you glue the first piece!**

I found a good Stagger Bee build log that lists several modifications needed, which I plan to use in my build. You can find this build log on the RC Groups website @: <https://www.rcgroups.com/forums/showthread.php?2681389-Clancy-Aviation-Stagger-Bee-Build>.

Andy Clancy Aviation Stagger Bee plans, assembly manual, and an RCM review can download from Aerofred.com @: [https://aerofred.com/details.php?image\\_id=91104](https://aerofred.com/details.php?image_id=91104), and/or Outerzone.co.uk @: [https://outerzone.co.uk/plan\\_details.asp?ID=3705](https://outerzone.co.uk/plan_details.asp?ID=3705).



Images Source: Extract from the Andy Clancy Aviation Stagger Bee Plans.



Figures 2 & 3 - Andy Clancy Aviation Stagger Bee Plan Sheets

Using the Stagger Bee plans, I determine what materials I will need to make my scratch build. Once I have a complete wood and material list, any balsa sticks and sheets, basswood sticks, and plywood needed are ordered from Balsa USA (<https://balsausa.com/>). The four Hitec HS-81 16.6g Nylon Gear Analog Micro Servos, Spektrum AR620 6-Channel RC Sport Receiver, Gold-in-Rod control rod set, main landing gear wheels, steerable tail wheel assembly, and all other required hardware can easily be located on the web or purchased from your local hobby shop. Since I will increase the span of the top wing and add flaperons, to power this little beauty I will use a BadAss Power System that puts out 566 watts, which is equivalent to a .25 two-cycle glow engine. *Yes, I am building an electric powered model. I know that is hard to believe.* This BadAss Power System is comprised of the following components: - Motor: BadAss 2814-1560Kv Brushless; ESC: BadAss Rebel V2 Series Brushless ESC, 60A; Battery: BadAss 45C 3,300mah 3S LiPo; Prop: APC 9x6 E-Series. You can purchase the system from "Innov8tive Designs" at <https://innov8tivedesigns.com/>. Stagger Bees can use #8 Trexler Wheels, which you can purchase through "Andy Clancy Designs" at <https://www.andyclancydesigns.com/>.

*The "Stagger Bee Materials and Hardware List" below contains all materials and hardware required to build my Stagger Bee. I update this list as I proceed through the build.*

### Stagger Bee Materials and Hardware List

Amount	Description	Use
<b>Balsa</b>		
2	1/16" x 3" x 36" med. balsa sheets	fuselage side doublers
5	1/16" x 4" x 36" med. balsa sheets	various fuselage, wheel skirts, vertical stab./rudder parts
2	3/32" x 3" x 36" med. balsa sheets	wing ribs, tips parts
1	1/8" x 3" x 24" med. balsa sheet	horizontal stab
1	1/8" x 4" x 24" med. balsa sheet	elevator
2	3/32" x 7/16" x 36" med. balsa sticks	top/bottom wing leading edge
2	3/32" x 1/2" x 36" med. balsa sticks	top/bottom wing leading edge
2	3/32" x 3/4" x 36" med. balsa sticks	top/bottom wing trailing edge
2	1/8" x 1/8" x 36" med. balsa sticks	top wing aft spar
2	1/8" x 1/4" x 36" med. balsa sticks	top wing aft spar, flaperon leading edge
1	1/4" x 36" triangular balsa stock	ESC and LiPo battery shelve side supports
1	3/8" x 36" triangular balsa stock	firewall backup brace, bottom wing bracing
<b>Basswood/Hardwood</b>		
2	1/8" x 1/8" x 24" basswood sticks	top/bottom wing front spar
1	1/8" x 1/4" x 24" basswood stick	bottom wing spar
1	1/8" x 1/4" x 36" basswood stick	top wing spar
2	1/8" x 3/8" x 24" basswood sticks	bottom wing main spars
2	1/8" x 3/8" x 36" basswood sticks	top wing main spars
1	1/4" x 1/4" x 12" basswood stick	flaperon servo bay rails

1 3/8" x 2" x 6" hardwood top/bottom wing aft mounting bolt blocks

### Plywood

1 1/32" 3-ply birch plywood various wing, fuselage, and wheel skirt parts

1 1/16" 3-ply birch plywood flaperon hatch covers, fuselage parts #1-4

1 3/32" 5-ply birch plywood top/bottom wings, electric version firewall, fuselage parts

1 1/8" 5-ply birch plywood steerable tailwheel mounting plate

1 1/4" 5-ply birch plywood top/bottom wing forward mounting plates

### Flight Control System

1 Spektrum AR620 6-Channel RC Sport Receiver 2.4GHz DSMX receiver

4 Hitch HS-81 16.6g Nylon Gear Analog Micro Servo servos for all control surfaces

2 8" Servo Lead Extension flaperon servo leads

### Electric Power System

1 BadAss 2814-1560Kv Brushless Motor

1 BadAss Rebel V2 Series Brushless ESC, 60A

1 BadAss 45C 3,300mah 3S LiPo Battery

1 Battery Adapter - XT90 Male to XT60 Female

1 APC 9x6E Propeller

1 DUB286 4 Pin Prop Spinner, 2-1/2" Red

### Miscellaneous Items

1 Du-Bro #275SL 2.75" Wheel Set MLG wheels

1 1/8" x 12" music wire MLG axles

4 Du-Bro #139 1/8" Wheel Collars MLG assembly

8 #3 x 5/16" Socket Head Screws MLG wheel skirt mounting screws

1 Du-Bro #100MW 1" Mini Lite Wheel tailwheel

1 1/16" x 6" music wire tailwheel axle

3 Du-Bro #137 1/16" Wheel Collars tailwheel assembly

2 #3 x 5/16" Socket Head Screws tailwheel bracket

1 Du-Bro #164 10-32 Nylon Wing Bolts (set of 4) top/bottom wing mounting bolts

1 Du-Bro #129 Socket Head Bolt & Blind Nut Set motor cross brace to firewall mounting

4 1/4" O.D. Plastic Spacers, 1" in length motor cross brace to firewall spacers

10 Du-Bro #116 Standard Nylon Hinges elevator, and flaperons hinging

2 Du-Bro #257 Quarter Scale Nylon Hinges combined horizontal stab/rudder hinging

1 Du-Bro #500 36" Lazer Rod Pushrods rudder/elevator control rods

1 Du-Bro #502 Lazer Rod Pushrods Exits rudder/elevator control rods

2 Du-Bro #237 T-style Nylon Control Horns (2 each) control surfaces rigging

2 Du-Bro #600 2-56 Spring Steel Kwik-Link Clevises control surfaces rigging

2 Du-Bro #855 E/Z Links flaperon rigging

2 6" 2-56 control rods flaperon rigging

6	2-56 nuts	rudder, elevator, flaperons rigging
8	#1 x 3/8" pan head screws	flaperon servo hatch covers
1	2" x 12" VELCRO fastener tape	ESC and LiPo battery mounting
1	Hangar 9 Self Stick Weight 6 Oz HAN3626	CG balancing
1 bottle	Titebond Ultimate III wood glue	
1 set	15-minute two-part epoxy	
1 sheet	220 grit sandpaper	finish sanding
1 jar	Flat Black Enamel	use to paint inside of wheel skirts
1 can	Coverite Balsarite/Deluxe Materials Cover-Grip	preps wood surfaces for covering
2 rolls	Ultracote Covering Film	

## Building the Modified Top Wing

So, with all that said, let us get started with our Stagger Bee scratch build. The first thing I do with all my builds is to print out the plans on my Canon printer using the "poster" settings for a full-size plan. Then I take all those pages and put them together to get all four full-size plan sheets for the Stagger Bee. You may also have your plans printed out at any Staples Store, which will run you approximately \$30.

**Builders Notes** - 1) The Stagger Bee plans contain templates for all the various pieces that will need to be cut out, so you may want to crop those areas using your favorite .pdf editor and then use a thicker stock paper (80#) when printing versus standard printer paper. 2) As I had indicated earlier, I want to extend the wingspan of the top wing with the addition of an extra 4" rib spacing on each side of the center line. To do this on the plans, I print out that area from the original plans and position them into the top wing plan sheet when putting all the plan sheets together. 3) I also want to add flaperons to the top wing and use a bolt-on mount versus the rubber bands, so I draw in the required changes to the wing structure directly on the modified top wing plan sheet. You can see these changes in Figure 4.

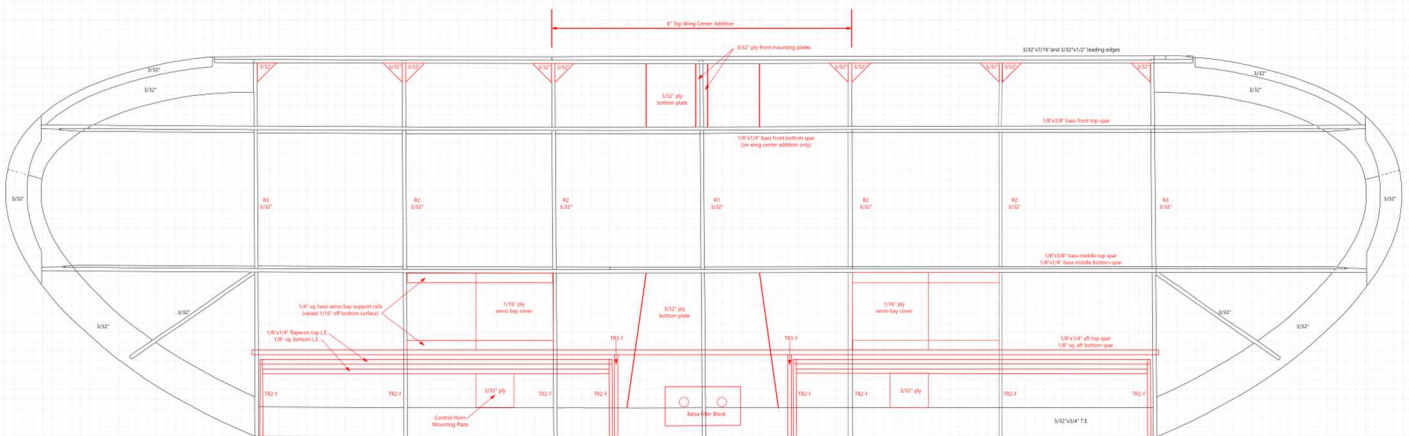


Figure 4 - Extended Top Wing Plan with Bolt-On Mount and Flaperon Modifications in Red

**Builders Notes** - Modifications required to build a bolt-on top wing and incorporate flaperons includes: 1) Add 3/32" birch plywood to the aft bottom center of wing from the center spar back to the trailing edge, and from the front spar forward to the leading edge; 2) Add a balsa filler to the area around where the two 13/64" holes will be drilled for the 10-32 nylon wing mounting bolts pass-thru; 3) Fabricate seven new top wing ribs per the drawings in Figure 5; 4) Add all the new top and bottom spars per the sizes called out on the rib profiles; 4) Add 3/32" balsa corner braces at nose of each rib; 5) Add the new flaperon top and bottom leading edges, and fabricate the two flaperons; 6) Cut the nose piece off fuselage part #3-10, eliminate notches in part #'s 3-1 and 3-3, omit part #3-5; 7) Make fuselage part #2-4 from 1/4" birch plywood and cut the center slot 5/16" wide so it can accept the new wing front hold-down mounting plates; 8) Widen the notches in fuselage part #'s 1-3 and 1-4 to fit the 1/4" wide part #2-4; 9) Fabricate two wing front hold-down mounting plates from 3/32" birch plywood which will be epoxied to each side at the front of centerline rib TR1; 10) Fabricate the fuselage aft wing mounting bolt block from 3/8" hardwood and install below fuselage part #5-2, drill and tap two holes for the 10-32 nylon wing mounting bolts, omit notch in #5-1; 11) Add the two flaperon servo bays per the modified plan.

I will run through the modifications needed for a bolt-on bottom wing and bolt-on wheel pylons when we get to that stage of the build.

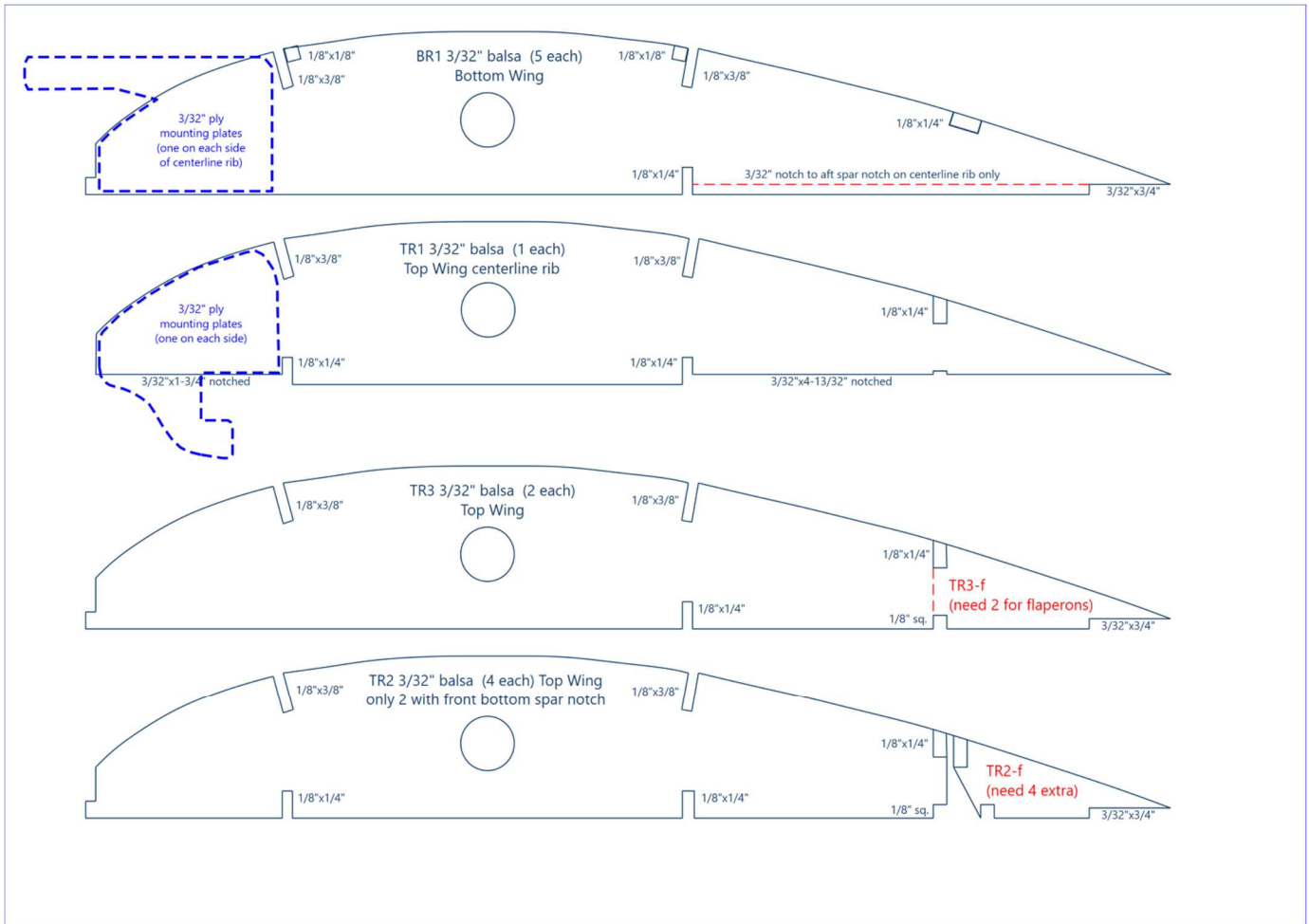


Figure 5 - Modified Wing Ribs

Now the real fun begins. For this scratch build I will use my magnetic building board and mag fixtures, so I put the modified top wing plan sheet on the mag board and cover it with transparent plastic film to prevent the glue from sticking to the plan. Using the plan templates, cut out the various wingtip pieces from 3/32" balsa sheet and place them flat over the plan to check for proper fitting. Once everything fits, place each wingtip piece over the plan (see Figure 6 below) and start gluing them together using Titebond III Ultimate wood glue. You will find it much easier to glue parts if you put the Titebond III in a plastic syringe with a large diameter needle, versus trying to place the glue straight from a large glue bottle. You can find them on Amazon.

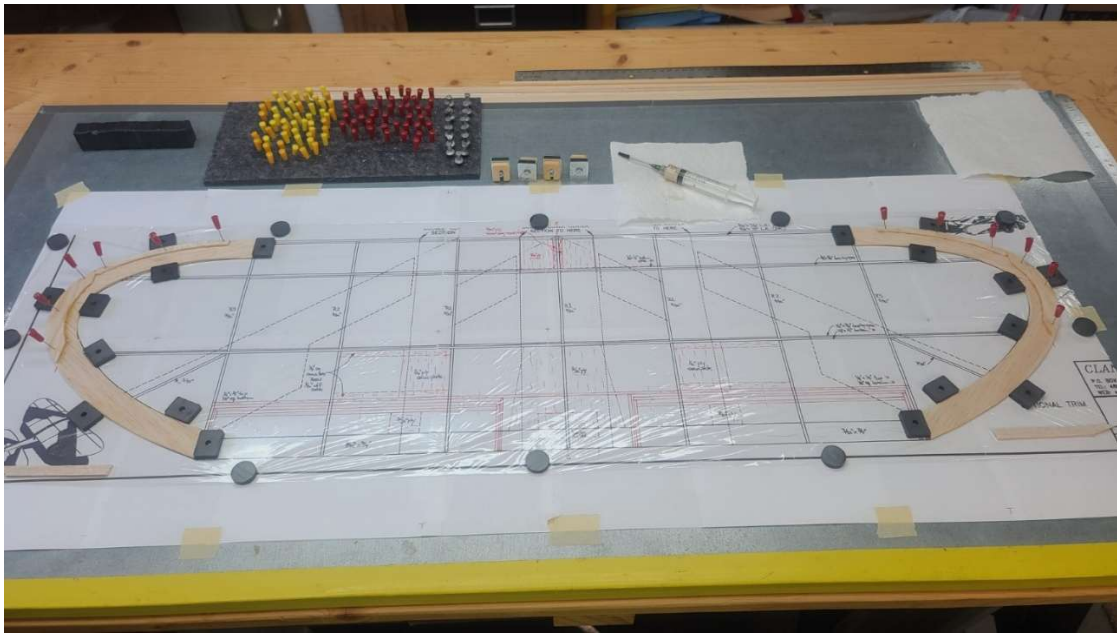


Figure 6 - Modified Top Wing Wingtips Build

I am not going to duplicate all the build instructions contained in the Andy Clancy Stagger Bee plans and manual referenced earlier, but I will try to point out things that need attention and other recommendations based on what I find during my scratch build. OK, now cut out all the wing ribs and other parts needed for the top wing assembly, paying attention to the directions of the balsa grain shown on the plan for each part. You can see my modified top wing ribs in Figure 7 below.

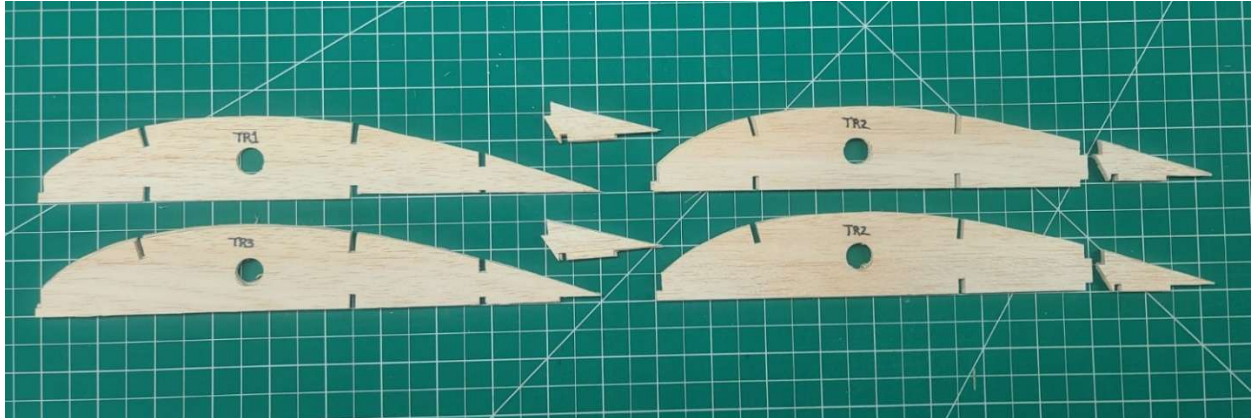


Figure 7 - Top Wing Ribs and Flaperon Parts

**Builders Note** - Due to the increased wingspan of my top wing, I substituted 1/8" x 3/8" basswood for the two top main spars versus the 3/32" balsa called out on the plan. I also used 1/8" square basswood for the front bottom spar.

Figure 8 below shows the modified top wing in a full-up dry fit check. *Here is the real beauty of a magnetic building board.* You can take most, if not all, of the parts for an assembly, and verify how they all fit together *before* you glue anything. In this fit check I found a modification needed on the centerline rib TR1, and that I also needed two more partial TR3 ribs for the flaperon bays. These changes are now captured in the modified ribs drawing (Figure 5). This is the part of a scratch build that I really enjoy.

Seeing how the 2-D drawing of a modified plan comes together for a functional 3-D balsa model aircraft. Note the two front hold-down mounting plates made from 3/32" birch plywood laying on the building board in front of the wing leading edge. **These will be epoxied to each side of the centerline rib TR1 after the fuselage is built.**



*Figure 8 - Modified Top Wing Full-Up Dry Fit Check on Magnetic Build Board*

With the fit check done we can now complete the assembly of the top wing using Titebond III Ultimate wood glue.

**Builders Notes** - 1) Remember to cut the slots in the forward centerline 3/32" plywood bottom plate for the two front hold-down mounting plates to pass through; 2) Add the balsa filler to the area around where the two 13/64" holes will be drilled for the two 10-32 nylon wing mounting bolts pass thru; 3) Also remember to raise the 1/4" square basswood rails in the two flaperon servo bays 1/16" off the building board surface so that the servo bay hatches will be flush with the wing bottom surface.

Now make four cuts in the 3/32" x 3/4" balsa trailing edge to form the trailing edges for the two flaperons. Remove the top wing from the mag building board and then finish the assembly of the two flaperons. Lightly sand everything and shape the wingtips/leading edge. Temporarily install the flaperon Du-Bro #116 Standard Nylon Hinges (you may want to add balsa hinge blocks depending on the type of hinge you use), fabricate the two flaperon servo bay covers, and install a Hitch HS-81 16.6g Nylon Gear Analog Micro Servo on each. Your modified top wing should now look something like Figure 9. The modified top wing can be set aside until we get into the fuselage build.



Figure 9 - Modified Top Wing

### Building the Modified Wheel Skirts

Before I dive into the modifications of the bottom wing, I need to fully understand how the wheel skirts will be modified so they can be mounted to the bottom wing with wood screws or hex head bolts, versus the rubber bands shown in the plan. I also need their final size to establish the related modifications to the bottom wing, therefore I'm going to build the wheel skirts first. So, let's get started.

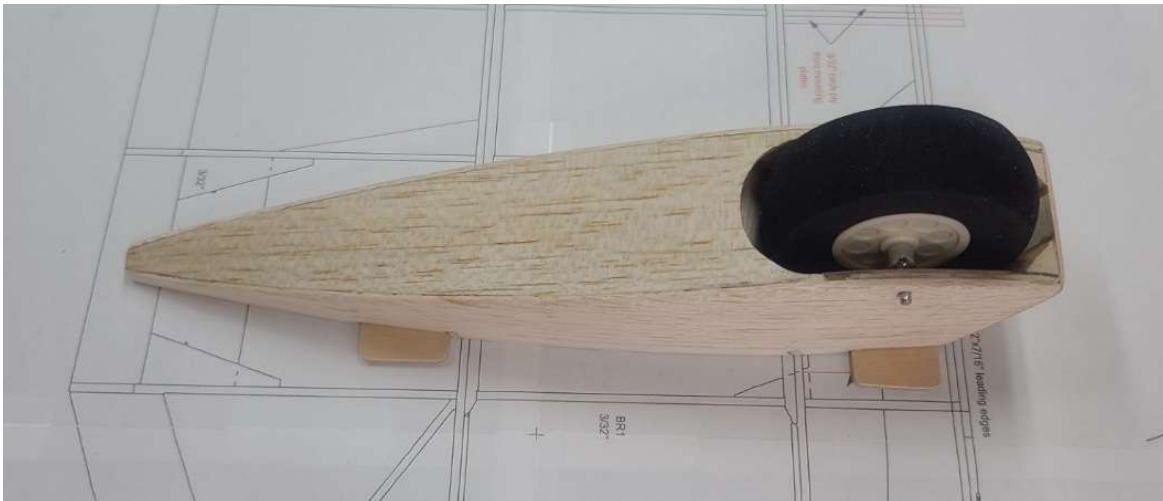
**Builders Notes** - Looking over the various wheel skirt template pieces, the things I see that will require modification are: 1) Replace four 1/32" birch plywood forward mounting plates parts #13-3 with two 3/32" birch ply parts; 2) Addition of two new 3/32" birch plywood aft mounting plates; 3) Add an aft notch cut into the top of the four 1/16" balsa parts #12-1 that will fit the new aft mounting plate; 4) Move the top notch at the front of these four parts aft approximately 3/4" so that parts #13-3 will be even with the front of the wheel skirts; Trim 3/32" off the tops of parts #12-2 and 12-3 for front mounting plate.

Using the templates plan sheet, cut out the various *balsa* wheel skirt parts paying special attention to the grain directions. Fabricate two modified forward mounting plates parts #13-3 and two new aft mounting plates **using 3/32" birch plywood** for all parts. The forward plates should be 1"x2.75", and the aft plates 1"x2.25", all with rounded corners. Now cut the required notches in parts #12-1 to accept the new mounting plates. **Note** - The axle hole location on the plan for part #12-1 is not in the correct location. Use part #12-3 as a template to establish the correct hole location. The aft mounting plate notch should be just aft of the existing notch for part #13-1. When finished you should have the parts shown in Figure 10 below.



*Figure 10 - Wheel Skirts Parts*

Assemble the wheel skirts per the Stagger Bee Manual. To add some strength to the skirt mounts, I would recommend adding small balsa triangle pieces (see Figure 10) where the mounting plates connect to inside of each part #12-1 and epoxy the four 3/32" birch ply mounting plates to the wheel skirts. Make the MLG axles using 1/8" music wire and Du-Bro #139 1/8" Wheel Collars and install the MLG wheels per the manual. Use spacers as needed to center the wheels in the skirts. The skirt should now look like the one in Figure 11 below, which has been placed over the bottom wing plan so the location of the forward and aft mounting plates in the wing can be determined.



*Figure 11 - Modified Wheel Skirt Positioned Over the Original Bottom Wing Plan*

## Building the Modified Bottom Wing

How about some modifications to the bottom wing plan for a bolt-on wing and bolt-on wheel skirts. Using a similar approach as used on the top wing, I modified the bottom wing plan to incorporate the changes needed. You can see these changes below in Figure 12.

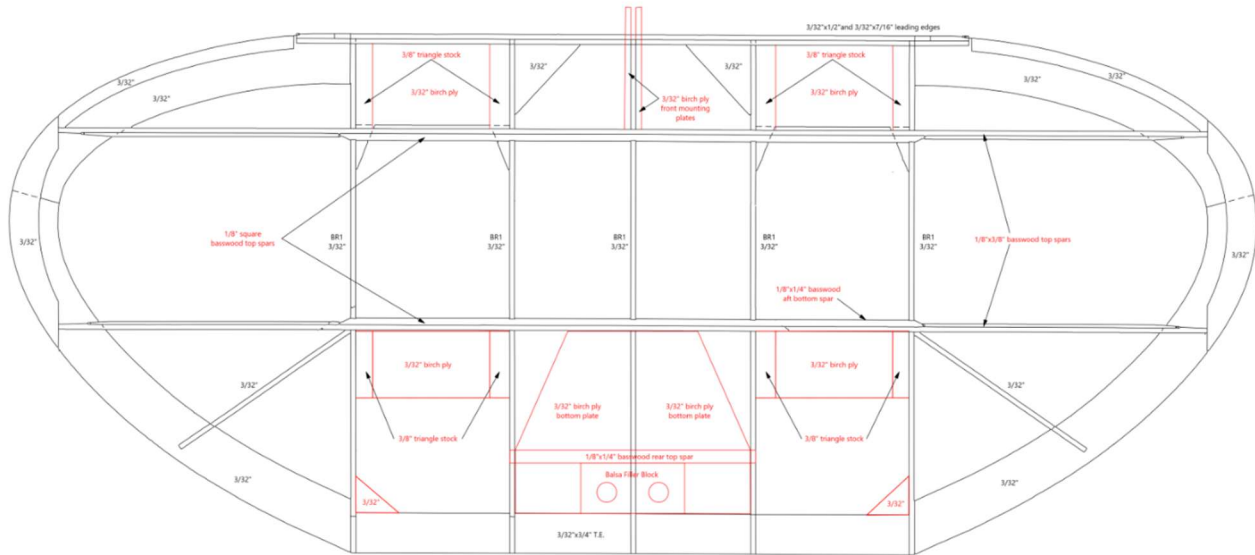


Figure 12 - Modified Bottom Wing Plan

**Builders Notes** - Modifications required to build a bolt-on bottom wing and incorporate bolt-on wheel skirts includes: 1) Add a 3/32" birch plywood plate to the aft bottom center of wing from the bottom center spar back to the trailing edge; 2) Fabricate five new bottom wing ribs per the drawing in Figure 5; 3) Add all the new top and bottom spars per the sizes and the materials called out on the modified bottom wing plan; 4) Add the four new 3/32" birch plywood wheel skirt mounting plates as shown in the plan and add 3/8" triangle stock to each corner with ribs BR1; 5) Add a balsa filler to the area around where the two 13/64" holes will be drilled for the 10-32 nylon wing mounting bolts pass-thru; 6) Eliminate notices in part #'s 2-7 and 3-2, omit part #3-4 and #3-11; 7) Make fuselage part #2-3 from 1/4" birch plywood and cut the center slot 5/16" wide so it can accept the new bottom wing front mounting plates; 8) Cut a new notch in fuselage part #1-2 to fit the 1/4" wide part #2-3; 9) Fabricate two bottom wing front mounting plates from 3/32" birch plywood which will be epoxied to each side at the front of centerline rib BR1; 10) Fabricate the fuselage aft bottom wing mounting bolt block from 3/8" hardwood and install under fuselage part #4-2 and forward of part #3-2, drill and tap two holes for the 10-32 nylon wing mounting bolts, omit notch in fuselage part #4-2.

The bottom wing is built on my magnetic building board using the same steps as were used for the top wing. Figure 13 below shows the modified bottom wing in a full-up dry fit check.

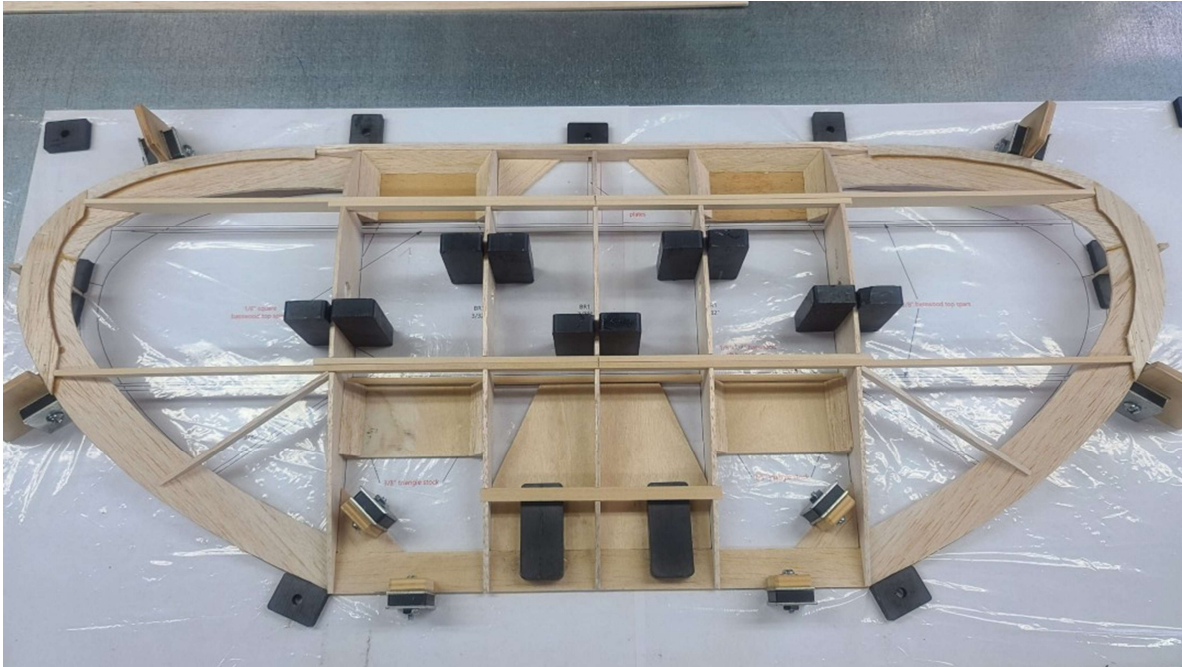


Figure 13 - Modified Bottom Wing Full-Up Dry Fit Check on Magnetic Build Board

With the dry fit check complete, disassemble the wing and then rebuild using Titebond III Ultimate wood glue. After drying overnight, remove from building board and lightly sand everything and shape the wingtips/leading edge. Your modified bottom wing should now look like the wing in Figure 14 below. Note the two front mounting plates made from 3/32" birch plywood laying on the building board in front of the wing leading edge. **These will be epoxied to each side of the centerline rib BR1 after the fuselage is built.** The bottom wing can now be set aside until we get into the fuselage build.



Figure 14 - Modified Bottom Wing

## Building the Modified Fuselage

As detailed earlier in my **"Builders Notes"** when building the modified wings and wheel skirts, there are several modifications that will be required when building the fuselage to support the bolt-on wings and wheel skirts. I tried to capture these modifications in Figure 15 below, but I recommend you go back and review the notes to ensure you understand what will be needed.

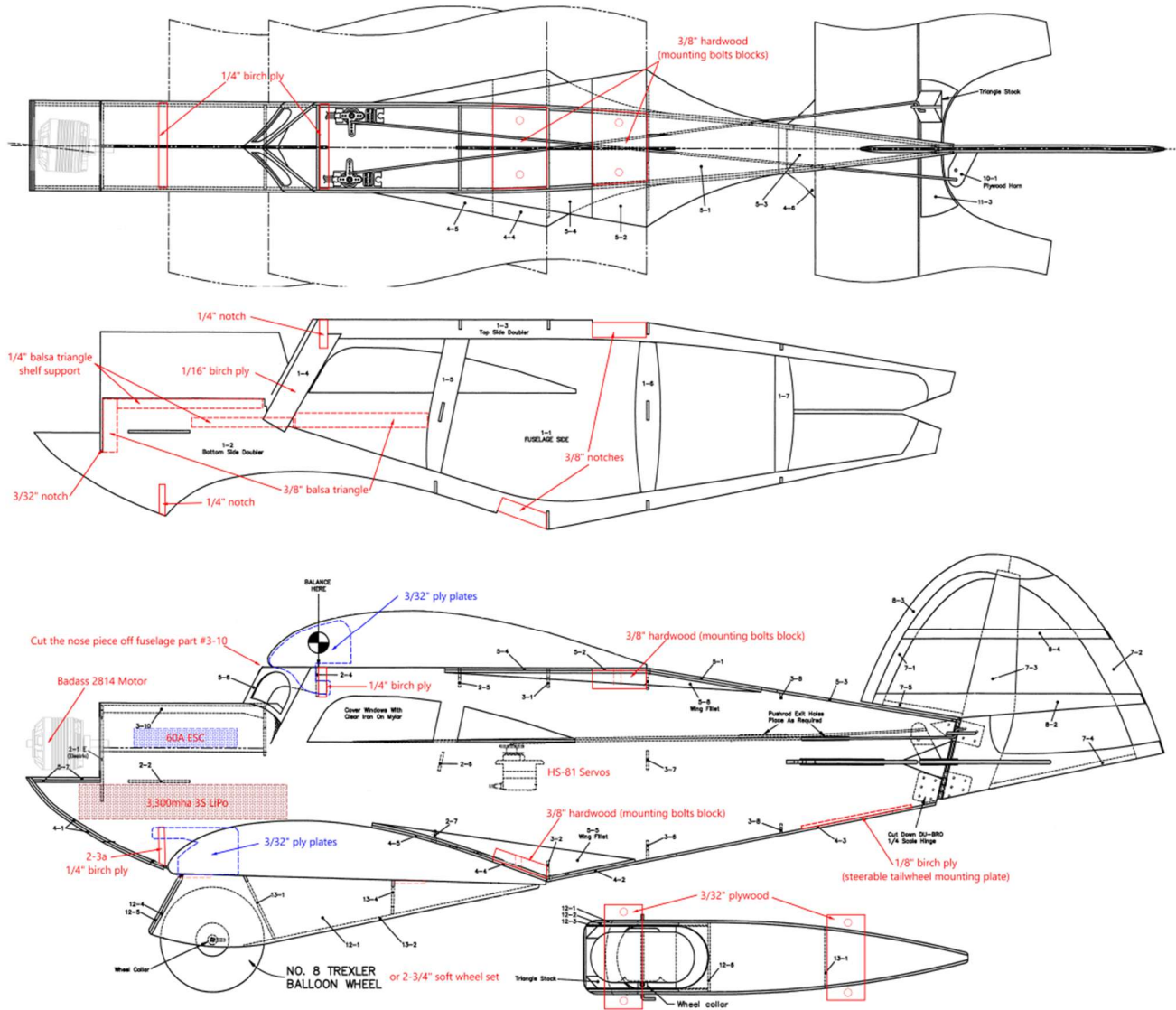
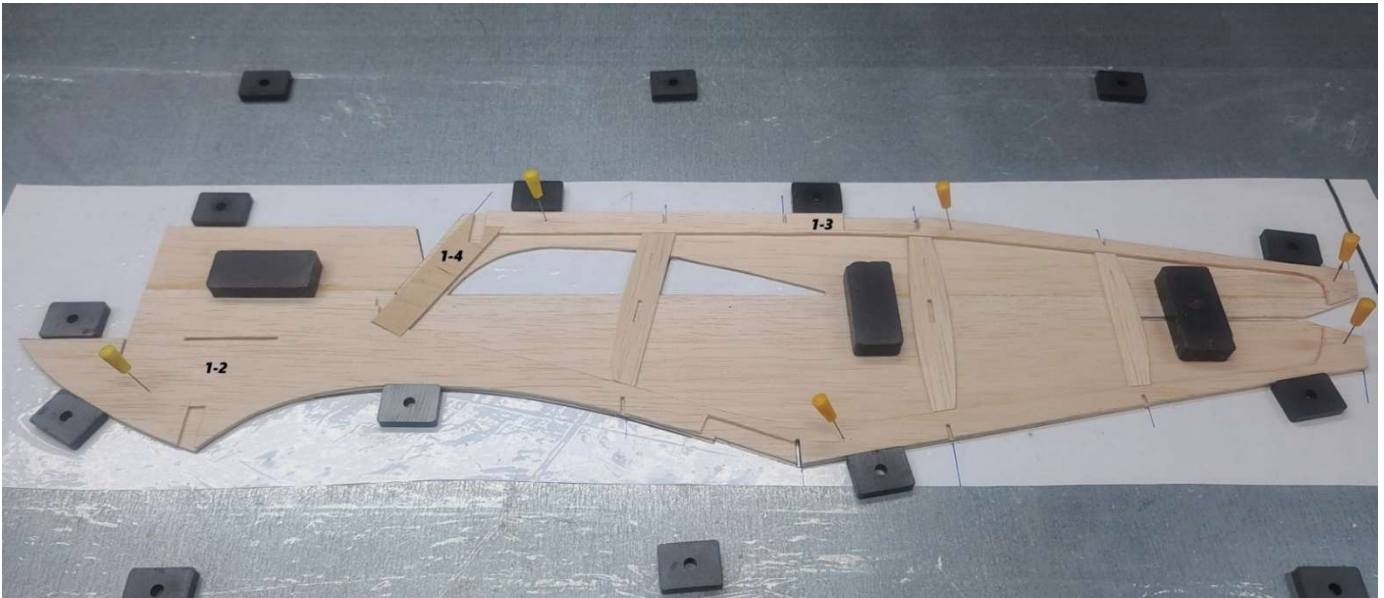


Figure 15 - Modified Fuselage Plan

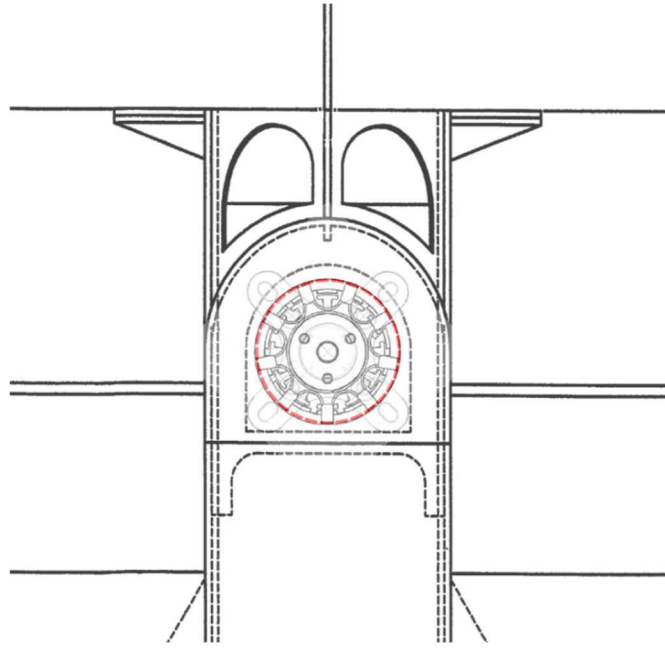
Using the Stagger Bee templates plan sheet (sheet 2 of 4), I cut out all the parts required to build the two fuselage sides (two each of part #s 1-1 through 1-7). Unless you ordered 6" wide balsa sheets, each part #1-1 (fuselage side) is cut from a 1/16" x 2" x 25" and 1/16" x 4" x 25" balsa sheet joined at the long edge. I start my fuselage build by making the required modifications to fuselage side part #s 1-2, 1-3, and 1-4 to accept the new 1/4" plywood and 3/8" hardwood top and bottom wing mounting blocks. **To support the added stress from a bolt on 39" top wing, make part #1-4 from 1/16" birch plywood, versus the balsa called out in the plan.**

Now is the time to decide what power system you are going to install. As indicated earlier, I will be using a BadAss Power System comprised of the following components: - Motor: BadAss 2814-1560Kv Brushless; ESC: BadAss Rebel V2 Series Brushless ESC, 60A; Battery: BadAss 45C 3,300mah 3S LiPo; Prop: APC 9x6 E-Series. I need to determine the location of the components in the fuselage to establish where the 1/4" and 3/8" balsa triangle shelf supports need to be placed on the fuselage sides. You can see these in Figure 15 above. For this build I won't use a servo tray for the Hitch HS-81 rudder and elevator servos. Each will be mounted to the fuselage sides using double sided servo tape and positioned further aft than shown in the original plans to allow room for the 3S LiPo battery pack and to balance the model at the correct CG location. Both fuselage sides (a right and left side) are assembled directly over plan sheet 1 of 4, doing a dry-run fit check first. The fuselage right side is shown in Figure 16 below. **Note the modifications to part #s 1-2, 1-3, and 1-4.**



*Figure 16 - Right Fuselage Side Fit Check*

With both fuselage sides are built, the next step is to modify the plywood firewall (part #2-1e) so the motor cross mount can be properly positioned to establish the location for the motor 4-40 hex head mounting bolt blind nuts on the backside of the firewall, and a new center firewall opening needed for cooling air and motor power leads pass-through. Figure 17 below shows where the 2814-1560Kv motor will sit, along with the motor cross mount and new 1" diameter center firewall opening (in red).



*Figure 17 - Fuselage Front View & 2814 Motor Placement Details*

Again, using the Stagger Bee templates plan sheet (sheet 2 of 4), I cut out all the remaining parts required to assemble the fuselage. **Builders Notes** - 1) Anywhere the plan calls for using two pieces of 1/32" plywood, I replaced with a single piece of 1/16" plywood. 2) I used 3/32" plywood for the electric version firewall part #2-1e. This not only adds strength in a critical area, but also provides the thickness needed for the installation of the motor mount 4-40 blind nuts. 3) I placed 3/8" balsa triangle along the joints between the firewall and the fuselage sides. 4) The instrument panel part #3-9 is modified with a single opening large enough to allow installation of the ESC onto the 1/16" plywood ESC support shelf. Figure 18 below captures all the parts required to finish the fuselage build.

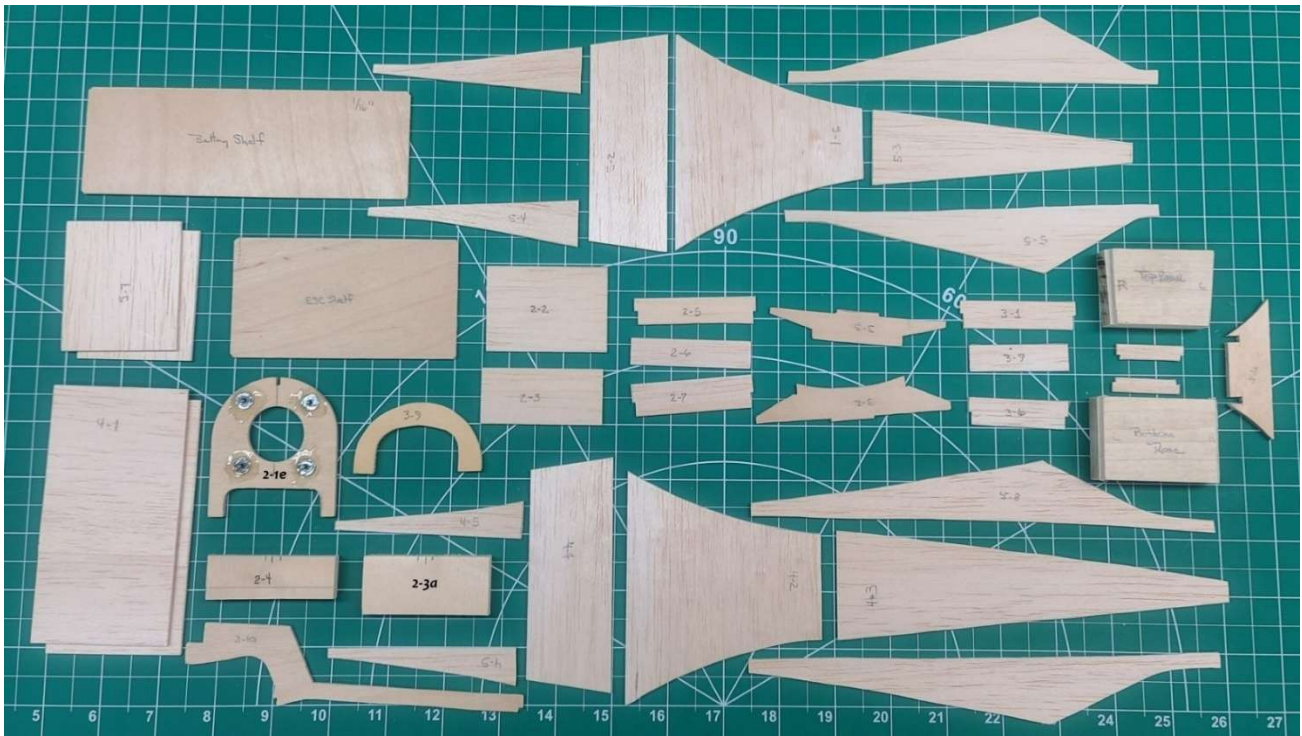


Figure 18 - Modified Fuselage Parts

Because I will need to divert from the steps in the Stagger Bee manual, the following is my sequence for the fuselage assembly. My modified Stagger Bee fuselage assembly starts with installation of part #s 2-1e (blind nuts on backside), 2-2, 2-3, and 2-5 through 2-7 cross members into their respective notches in the right fuselage side. All these parts **MUST** be installed perpendicular to the fuselage side. I use my magnetic board fixtures and magnets to hold parts in place until the glue dries and epoxy cures. Use 15-minute epoxy for #2-1e (firewall) and its 3/8" balsa triangle backside support. Figure 19 below shows the layup of this first step.

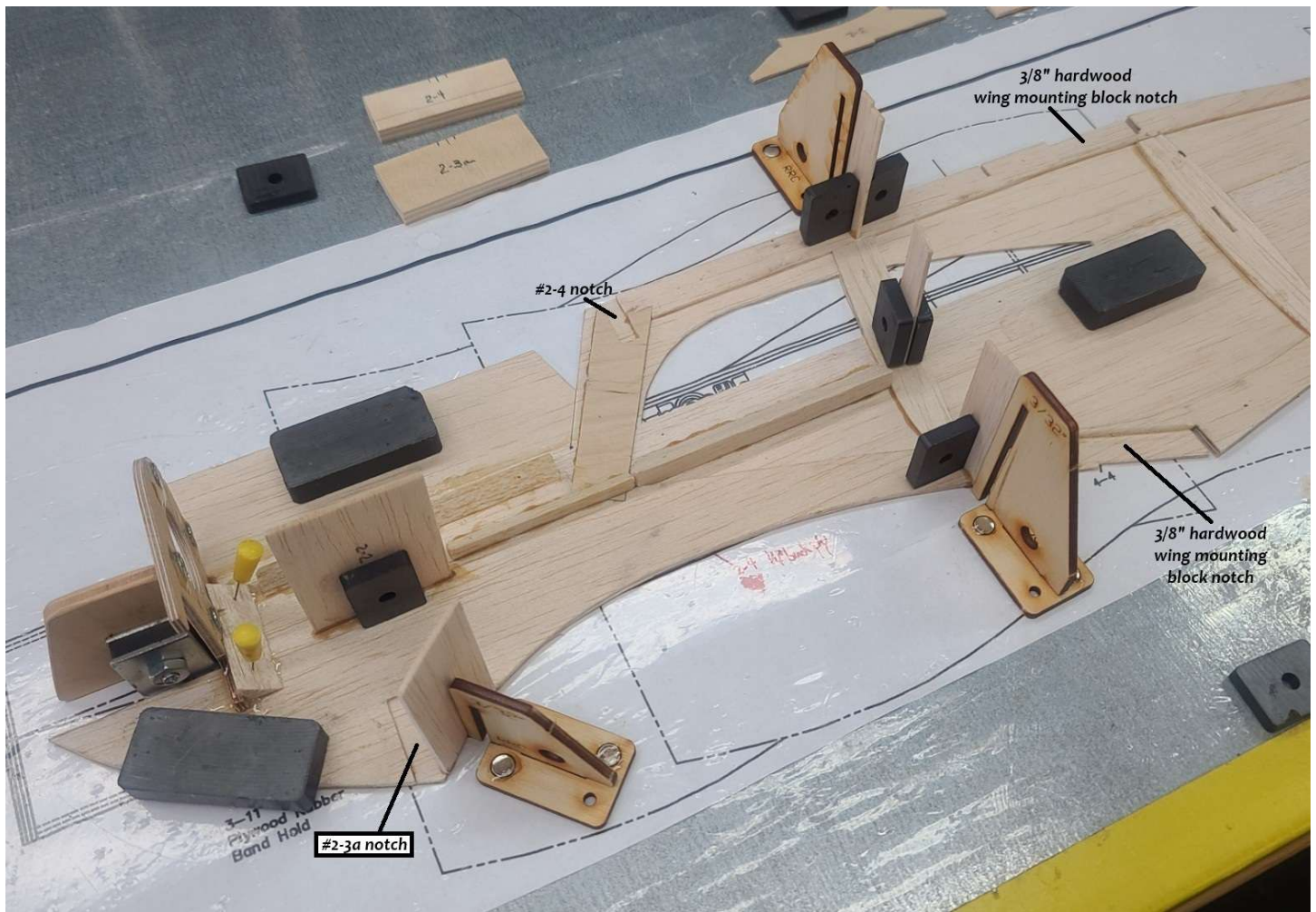


Figure 19 - Fuselage Right Side - First Step in Fuselage Assembly

After the glue has cured on the right fuselage side, put some Titebond III wood glue in the fuselage left side notches for part #s 2-2, 2-3, 2-5 through 2-7, and seat these five cross members into their respective notches in the fuselage left side. **Temporarily** insert part #s 2-3a (the new 1/4" plywood bottom wing forward mount), 2-4 (new 1/4" plywood top wing forward mount), and 3-1 thru 3-3 cross members in their respective notches between the two fuselage sides. Now turn the fuselage assembly upside down and position directly over the top view on plan sheet 1. Carefully align both side with the plan drawing and then secure in place using pins, clamps, and/or magnetic board fixtures/magnets. With both fuselage sides evenly aligned and perpendicular to the building board, glue part #s 3-2, 3-6 and 3-7 cross members between the two fuselage sides. Epoxy the new 3/8" hardwood bottom wing aft mounting block into its notches just forward of part #3-2, and the firewall (#2-1e) with 3/8" balsa triangle backside bracing to the left fuselage side. **Do NOT** epoxy part #2-3a (the new 1/4" plywood bottom wing forward mount) yet. Once all that has dried/cured, glue both part #s 3-8 (two each) cross members and #4-6 into their respective notches by carefully pulling the two fuselage sides together so they are in alignment with the top view drawing. Ensure the two sides remain perpendicular to the building board and secure in place. Figure 20 below shows the build progress at this step.

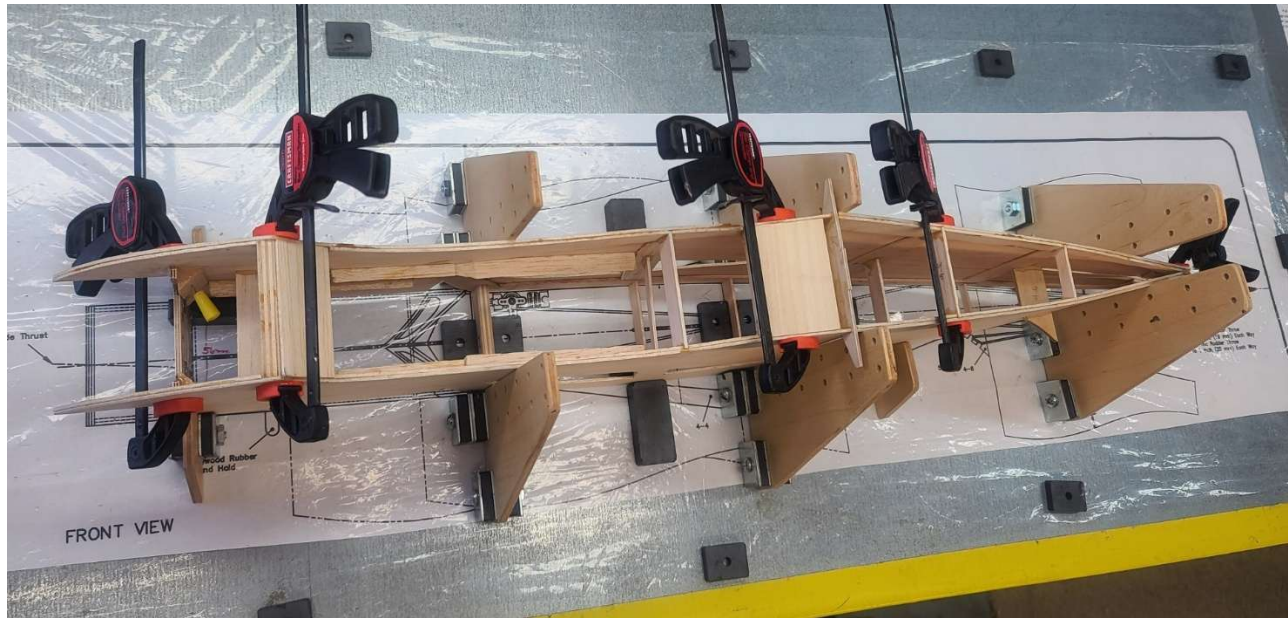


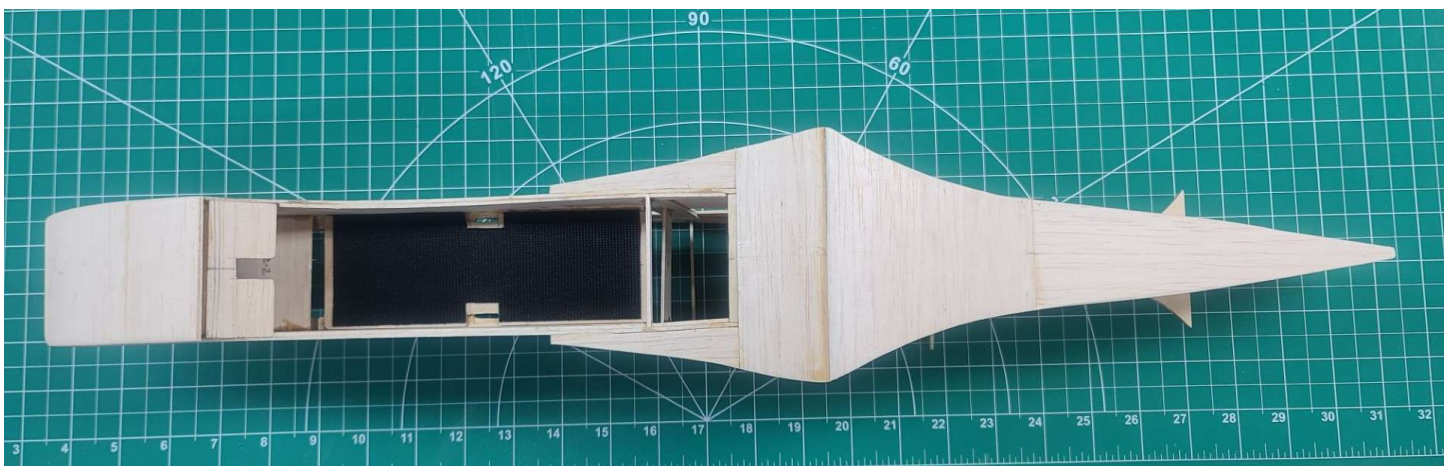
Figure 20 - Fuselage Sides Joining - Second Step in Fuselage Assembly

Alright, the next step is to sheet the bottom side of the fuselage and establish the fitting between the two bottom wing forward mounting plates and fuselage part #2-3a. First glue fuselage bottom sheeting part #s 4-2 through 4-5, trimming and beveling as needed. Once that has dried, take the bottom wing and **temporarily clamp** the two 3/32" plywood mounting plates in position on each side of the BR1 centerline rib. Pull the 1/4" plywood part #2-3a out of its fuselage sides notches and then center the bottom wing into its position on the fuselage wing saddle and establish where a notch in the 1/16" balsa part #2-3 is needed to allow the two 3/32" plywood mounting plates noses to pass through. **NOTE** - During this step I discovered the two 3/32" plywood mounting plates needed modifying to move the long noses higher up on the BR1 center rib profile. **I updated Figures 5 and 15 to reflect the modification.** Cut out the notch and then set the bottom wing back into its correct position in the fuselage wing saddle. **Double check that the wing is centered on the fuselage at the front and back edges of the wing.** Carefully measure where a notch in part #2-3a must be cut to accept the two bottom wing forward mounting plate long noses. This notch in part #2-3a should be 5/16" wide (just wide enough to accept the two mounting plate noses separated by rib BR1), and just deep enough to hold the wing snugly against the fuselage bottom wing saddle. Figure 21 below shows the final fitting.



*Figure 21 - Bottom Wing Forward Mounting Plates to Fuselage Part #2-3a Fitting*

Once all the fitting is verified, epoxy part # 2-3a into its fuselage notches, and the two 3/32" plywood mounting plates to each side of the BR1 centerline rib. Glue a 3/32" balsa filler between the two 3/32" plywood mounting plate noses. Glue the two parts #4-1 sheets to the bottom of the forward fuselage. Now glue the new 1/16" plywood LiPo battery support shelf in place on the balsa triangles we added earlier to the inside of the fuselage sides. Apply one side of some 2" wide VELCRO adhesive backed fastener tape to the bottom side of the battery support shelf, and the other side of the VELCRO tape to the LiPo battery pack for mounting later. Install a small battery strap if desired. Figure 22 below shows the fuselage at this stage of the build.



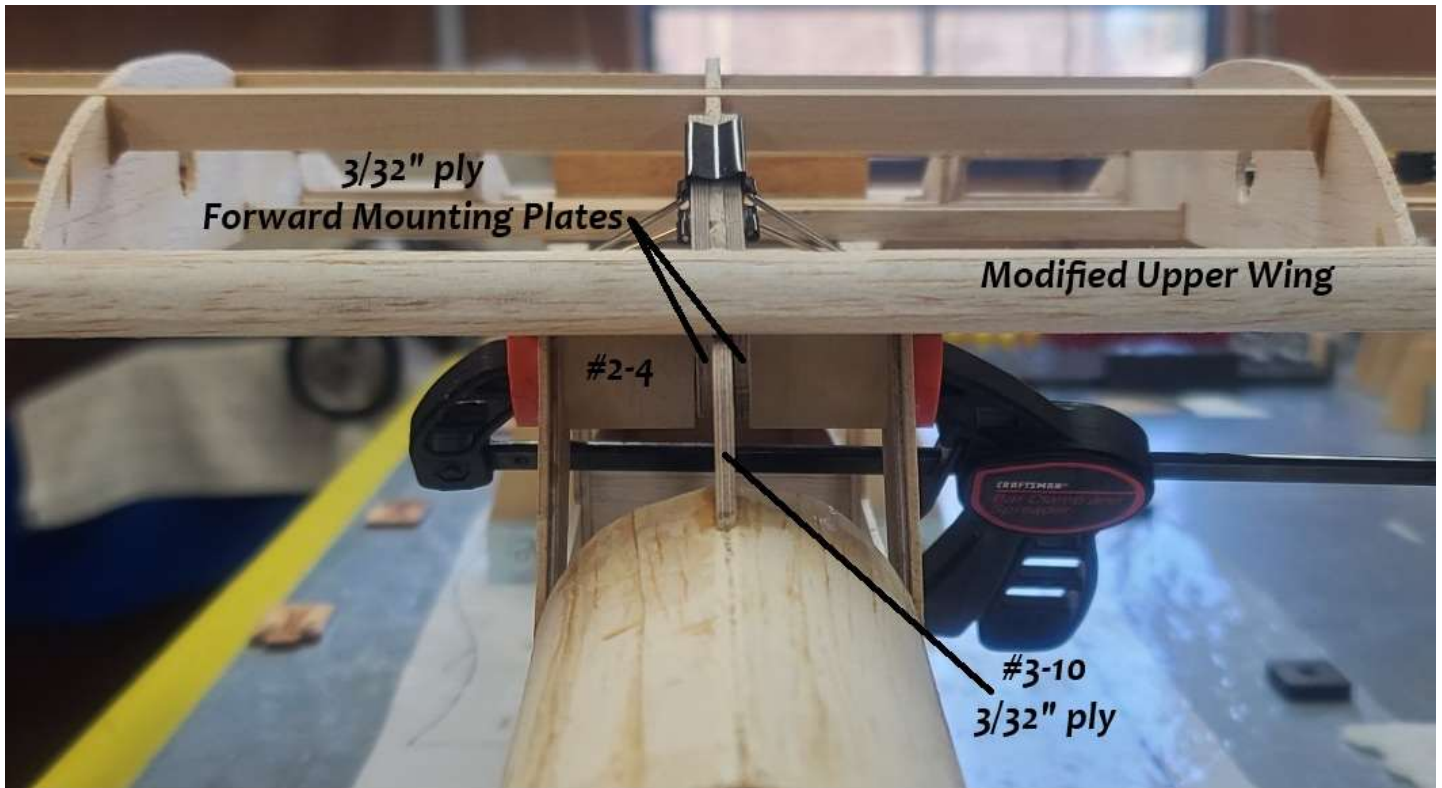
*Figure 22 - Fuselage Bottom Sheeting*

With all that completed, take the fuselage and flip it upright and position it back on the building board. Verify that both fuselage sides are perpendicular to the building board and then glue part #s 3-1 and 3-3 cross members between the two fuselage sides. Epoxy the new 3/8" hardwood top wing aft mounting block into its fuselage sides notches just forward of part #3-3.

**Builders Update** - As with many of my scratch builds, as I work through the steps I have planned out for the build, I sometime find things need modification. Well, I have found another one in this build. While doing a fit check of part #s 3-9, 3-10, the planned new ESC support shelf, and the installation of the ESC, I found my initial plan was not going to work. The power leads on the ESC are not long enough to reach the connector on the LiPo battery pack. Therefore, I will need to mount the ESC on the top side of the support shelf I have already installed for the LiPo battery. The originally planned ESC support shelf will not be required. I also decided to fab part #s 3-9 and 3-10 out of 3/32" plywood, versus the 1/16" plywood originally planned. **I updated the Figure 15 drawing to reflect these changes.** Given this change, apply one side of some 2" wide VELCRO adhesive backed fastener tape to the top of the LiPo battery support shelf, and the other side of the VELCRO tape to the ESC for mounting later.

Pull the 1/4" plywood part #2-4 out of its fuselage sides notches and then position and glue part #s 3-9 and 3-10 in place. Next, pull the forward fuselage sides around the top of the firewall and glue to part #s 2-1e, 3-9, and 3-10. Pin to hold the fuselage sides in place until the glue dries. **Note** - you can use some hot water gently sprayed on the outside surface of the fuselage sides to help shape the 1/16" balsa sheeting around the rounded nose parts. If you are going to use a steerable tail wheel assembly that will attach to the bottom of the fuselage, now is the time to install a 1/8" plywood mounting plate inside the fuselage near the tail.

Position and glue the two parts #5-7 sheets forward of the firewall. Next, we need to sheet the top side of the fuselage and establish the fitting between the top wing 3/32" plywood forward mounting plates and fuselage part #2-4. First glue fuselage top sheeting part #s 5-1 through 5-5, and 5-8, trimming and beveling of the wing fillets as needed. Once all that has dried, take the top wing and **temporarily clamp** the two 3/32" plywood mounting plates in position on each side of the TR1 centerline rib, then center the top wing on the top fuselage surface. **Double check that the wing is centered on the fuselage at the front and back edges of the wing.** Carefully measure where **two 3/32" wide notches** in part #2-4 must be cut to accept the two top wing mounting plates on each side of part #3-10. The notches in part #2-4 should be just deep enough to hold the wing snugly against the top of the fuselage. Figure 23 below shows this fitting.



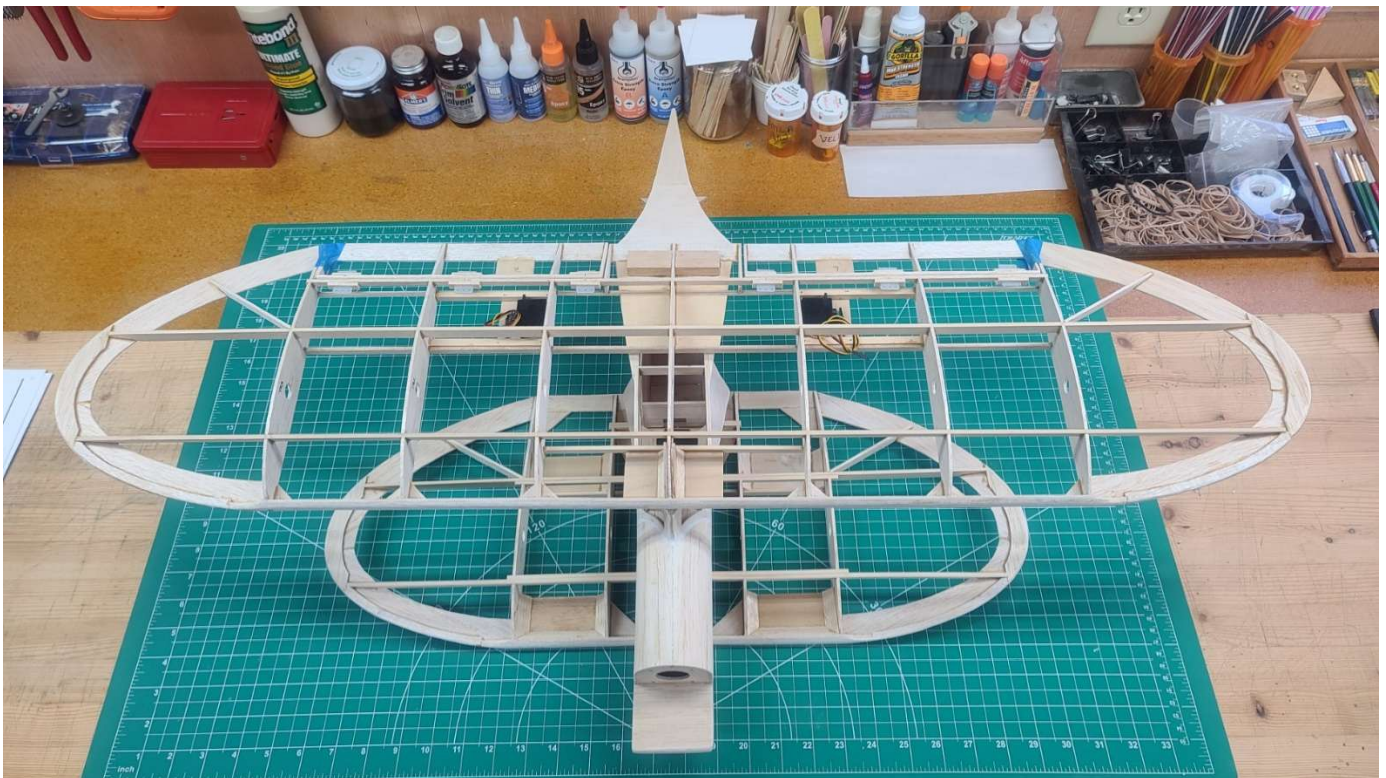
*Figure 23 - Top Wing Forward Mounting Plates to Fuselage Part #2-4 Fitting*

Once all this fitting is verified, epoxy part #2-4 into its fuselage sides notches, part #3-10 to part #2-4, and the two 3/32" plywood mounting plates to each side of the TR1 centerline rib. Test fit and shape as required the two windshields, parts #5-6. Once a good fit is established glue them in place on each side of part #3-10. To help with ESC cooling air flow, I do not plan install clear plastic windshields or fuselage side windows. Using 220 grit sandpaper, sand all surfaces of the fuselage, shaping and tapering the wing fillets and fuselage side corners. Deluxe Model Lite Balsa Filler should be used to fill in any transitions and/or openings between the fuselage sides and wing fillets, and around the two windshields mounting. Figure 24 below shows the fuselage at this stage of the build.



*Figure 24 - Fuselage Top Sheeting*

In Figures 25 and 26 below you see the wings positioned on the fuselage. Both wings will be drilled and the aft hardwood mounting blocks taped for two 10-32 nylon hold-down bolts prior to the full-up fit checks.



*Figure 25 - Fuselage and Wings Initial Fit Check*

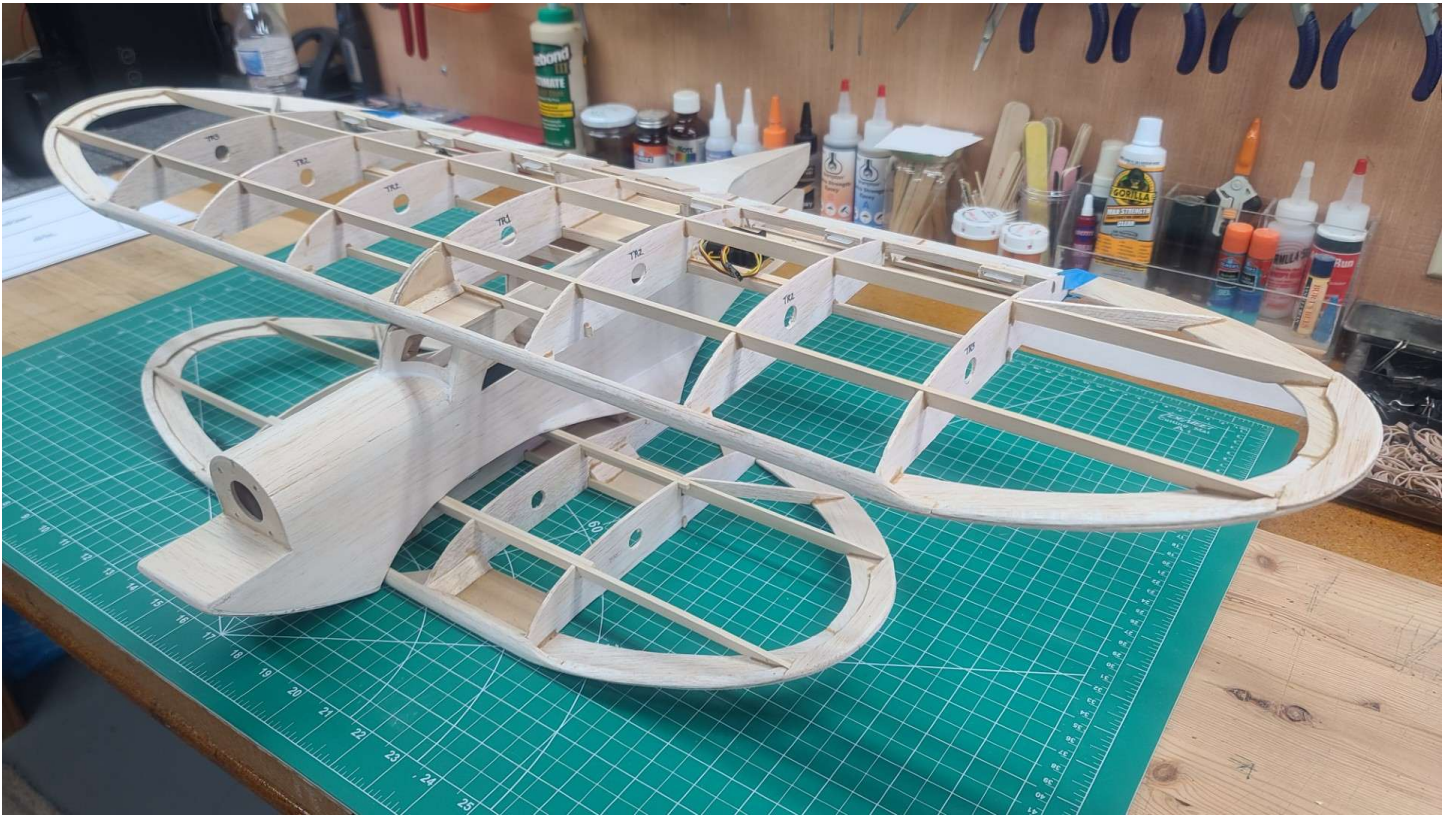


Figure 26 - Fuselage and Wings Initial Fit Check

## Building the Modified Tail Feathers

So, with all that done you can sit everything off to the side for now and we need to see about building some tail feathers for this little beast. One more trip to the template plan sheet to make patterns of all the parts needed to build a **combined** vertical stabilizer/rudder. In Figure 27 you see all the parts cut from 1/16" balsa sheet, and two parts #11-3 for the elevator cut from 1/32" ply. **Note** - I **did not** cut a slot in one part #8-1 as shown on the template because I plan to use Du-Bro #237 T-style Nylon Control Horns versus the plywood control horns in the plan.

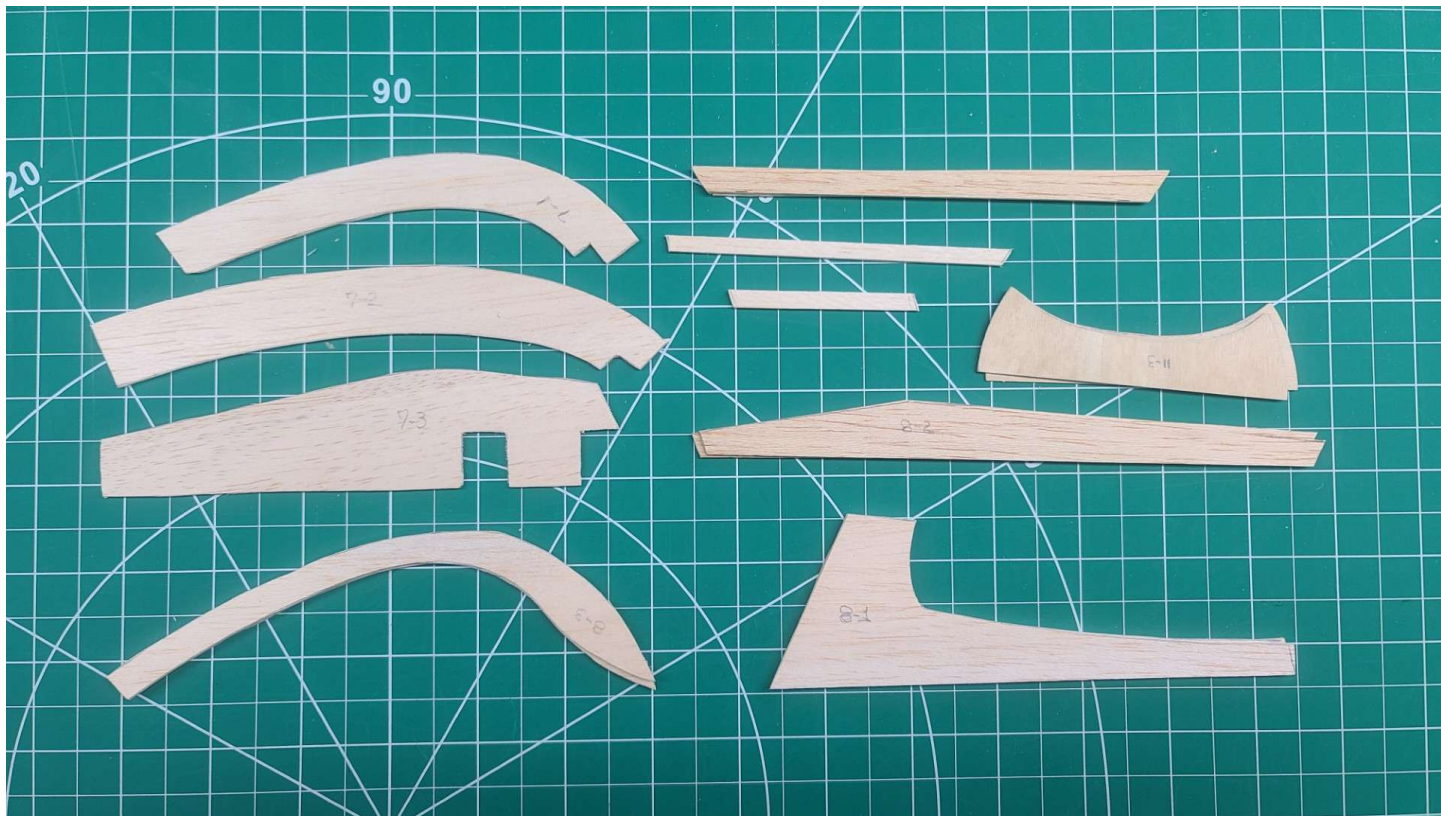


Figure 27 - Combined Vertical Stabilizer/Rudder Parts

The combined stab/rudder is built directly over the fuselage side view plan sheet. In Figure 28 below you can see the start of the build, and as normal, I made a couple of modifications. First, the tail feathers will be permanently mounted, versus using rubber bands as indicated in the plans. Second, as indicated earlier, I want to use a steerable tailwheel assembly versus the wire tail skid in the plans. I cut the two Du-Bro #257 Quarter Scale Nylon Hinges as shown on the plan and drilled out the hinges to accept 1/16" music wire. I then modified part #s 7-3 and 7-5 to allow placement of the upper tailwheel wire between the two parts #8-2, which will be epoxied in place along with the rudder side of the two nylon hinges. To strengthen the area of the two hinges and tailwheel wire, I will epoxy a small strip of 1/64" plywood on each side of part #7-3 before adding part #s 8-1 and 8-2. To transfer the weight of the model to the fuselage versus the tail hinges, I will install a metal plate on the bottom of the fuselage so the tailwheel music wire runs down thru it, and then a 1/16" wheel collar will be installed on the tailwheel wire below that metal plate.

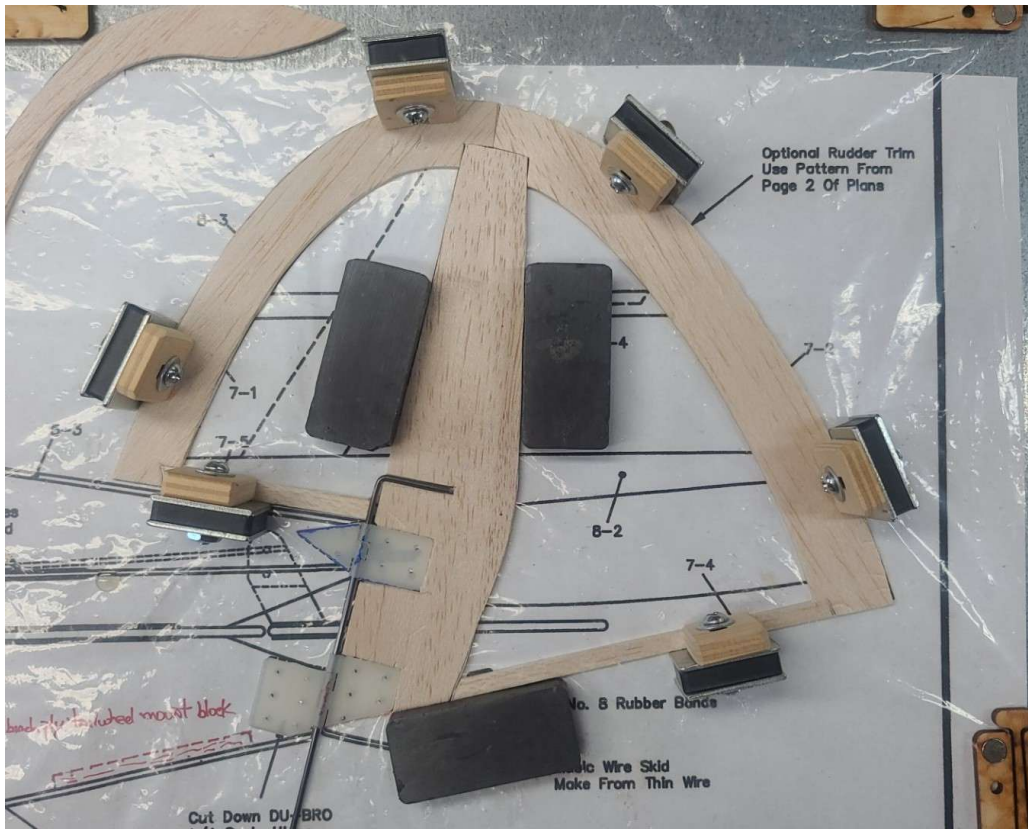


Figure 28 - Combined Vertical Stabilizer/Rudder and Tailwheel Assembly Fit Check

Figure 29 below shows all parts assembled on the first side of the vertical stabilizer/rudder.

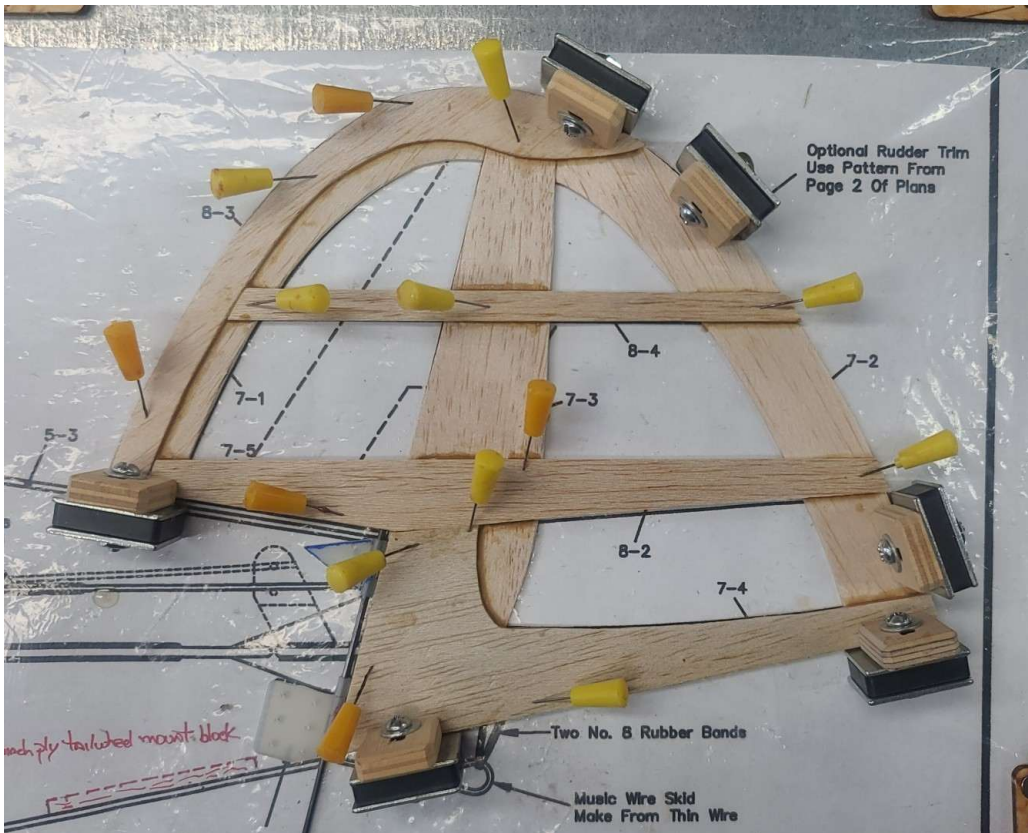


Figure 29 - Combined Vertical Stabilizer/Rudder Build

After both sides are assembled, sand and shape the leading and trailing edges to a nice airfoil shape until you have something as shown in Figure 30.

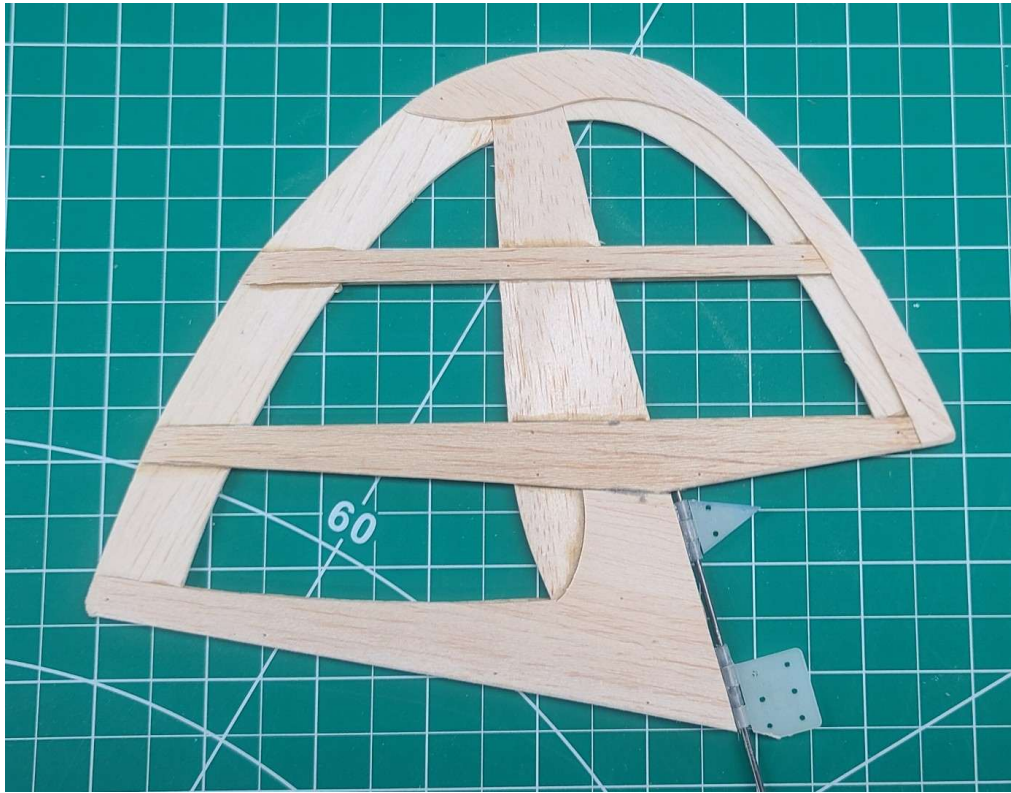


Figure 30 -Finished Combined Vertical Stabilizer/Rudder

Now one more *final* trip to the template plan sheet for the horizontal stabilizer (part #11-1) and elevator (part #11-2). Cut the horizontal stab from a 1/8" x 3" balsa sheet, and the elevator from a 1/8" x 4" balsa sheet. ***I found the 3/32" sheet too thin to cut the hinge pockets, so I used 1/8" balsa sheets instead.*** Glue the two 1/32" plywood parts #11-3 to each side of the elevator and then ***temporarily*** install four Du-Bro #116 Standard Nylon Hinges. No holes are needed in the horizontal stabilizer since it will be permanently installed in the fuselage. Bevel the leading edge of the elevator and lightly sand and shape all the outer edges. Figure 31 shows the results for this part of the build.

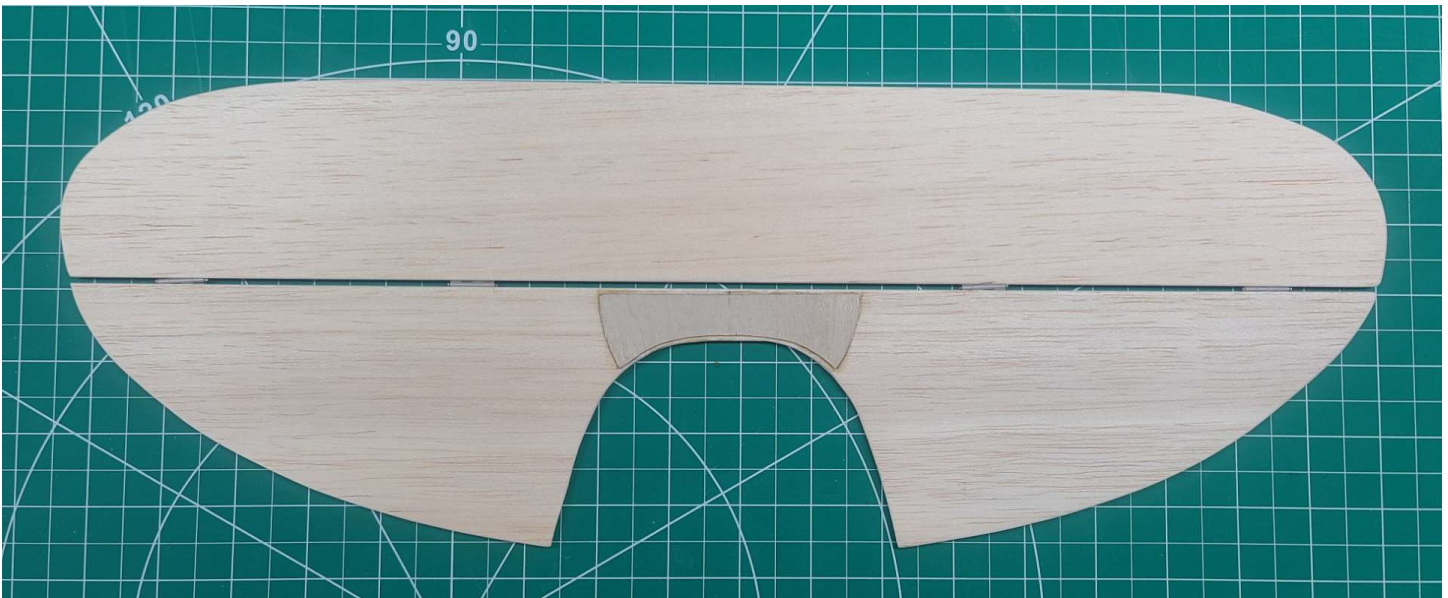


Figure 31 -Finished Horizontal Stabilizer and Elevator

### Full-Up Fit Check & Initial Center of Gravity (CG) Check

Let's see, we have two wings, two wheel skirts with wheels, a fuselage, some tail feathers, a motor, propeller, ESC, LiPo battery, receiver, and two servos. It looks like we are about ready for a full-up fit check of all the various assemblies to verify everything fits together as originally intended and then run an initial center of gravity (CG) check to establish the final positions for the rudder and elevator servos.

The first thing we need to do is finish mounting each of the wings to the fuselage. Starting with the bottom wing, place the wing in the fuselage bottom wing saddle, carefully center the wing trailing edge on the fuselage, then pin in place. Carefully drill the two holes for the 10-24 nylon mounting screws. **Builders Note** - I placed mine 1" forward of the wing trailing edge, and 3/4" to each side of the centerline. I drilled the initial holes through both the wing and mounting block using a #25 drill bit, then remove the wing from the fuselage and enlarge the holes through the wing using a #9 drill bit. Tap the holes in the hardwood mounting block with a 10-24 tap and harden the threads using thin CA.

For the top wing, place the wing on top of the fuselage, center the trailing edge on the fuselage, then pin in place. Next, **check to ensure the top wing is parallel to the bottom wing** by take measurements at each wingtip. If not equal, sand the fuselage top wing saddle until the wings are parallel. Now repeat the same process used on the bottom wing to complete the mounts for the top wing.

Next we need to mount the two wheel skirts to the bottom wing. Drill #40 holes in each wheel skirt 3/32" mounting plate, carefully align both wheel skirt mounting plates with the 3/32" plywood plates on the bottom of the wing, mark the location of the holes, and then drill #48 pilot holes in the wing plates. Attach the wheel skirts to the bottom wing using #3 x 5/16" socket head screws.

Now for the motor, propeller, ESC, LiPo battery, and receiver. I mounted the motor to the firewall using four 4-40 x 1" socket head bolts and 1/4" O.D. plastic spacers. The spacers need to be cut to lengths that will place the motor far enough away from the firewall so the propeller will clear the forward edge of the fuselage and also place the motor on a 5 degree right thrust line. Mount the ESC and LiPo battery

to the fuselage support shelf using VELCRO fastener tape. Mount the receiver to the fuselage using VELCRO fastener tape. I placed my receiver just aft of part #3-2 on the inside of the fuselage.

Temporarily install the tail feathers on the fuselage and pin in place. Slip the tailwheel fuselage metal mounting plate and 1/16" wheel collar onto the tailwheel wire and then determine where to bend the 1/16" tailwheel wire. Bend and cut the tailwheel wire to complete the installation of the 1" tailwheel and its two collars. Figure 32 shows the results of the full-up fit check and the model sitting on digital kitchen scales for an initial center of gravity (CG) check.



*Figure 32 -Full-up Fit Check*

How about we accomplish an initial CG check to establish the final rudder and elevator servo positions. I first placed the rudder and elevator servos on the top wing in the approximate lateral location they will be mounted inside the fuselage. As you can see in Figure 32 above, I placed them just aft of the middle spar. Then I placed the assembled model on my three digital kitchen scales *in a normal flying attitude* (tail raised off the table for a wing zero angle of attack) and recorded the resulting weights. I measured the distance from the MLG axles to the tailwheel axle, and the distance from the MLG axles to the required location of the CG. I then input all these measurements into my handy dandy CG Calculation by Weight spreadsheet and the resulting initial CG location was calculated as shown in Figure 33 below.

Stagger Bee Initial CG Calculation by Weight				
Model	Details			Weight: 2.44 lbs
Stagger Bee	Tail Dragger Bi-Plane			Imperial
D	530.0	mm	Distance between center point of MLG and tail wheel	20.87
CG(s)	70.0	mm	Distance of specified CG location from MLG axles	2.76
W(p)	435.0	g	Measured weight at left wheel	15.34
W(s)	460.0	g	Measured weight at right wheel	16.23
W(t)	214.0	g	Measured weight at tail wheel	7.55
W(total)	1109.0	g	Total weight of plane: W(p) + W(s) + W(t)	39.12
CG(a)	102.3	mm	Actual CG location from MLG: W(t) x D / W(total)	4.03
W(t)	146.5	g	Weight required at tail wheel for balanced CG: W(total) x CG(a) / D	5.17
W(delta t)	-67.5	g	Delta from weight required at tail wheel	-2.38
CG(diff)	32.3	mm	Difference between actual and specified CG: CG(a) - CG(s)	1.27
Legend:	Aircraft-specific; enter once and do not alter for this aircraft			
	Measured weights; change with every weight session			
	Calculated values; do not edit these fields			

Figure 33 - Stagger Bee Initial CG Location Calculations

So, the model is currently tail heavy with a CG difference of 32.3mm, or 1.27", aft of the required location, and she comes in at a total weigh of 1,109 grams or 2.44 lbs. (39.12 oz.). This was expected because I placed both the LiPo battery pack and ESC as far aft as I could. It should be easy to obtain the required CG location by simply moving these two components further forward, where I have lots of available space. Once the model is covered with Ultracoat and I have all the tail feather control rods and horns installed, I will accomplish another CG location measurement to establish the final position for the LiPo battery pack and/or ESC. The two control surface servos will be installed in the fuselage as far forward as possible, which is just aft of cross member part #2-6.

The initial total weight looks good using the larger sized motor and 3,300mah 3S LiPo battery pack. Given I modified the top wing by adding 8" to its overall length, this results in a total wing area of 545 square inches, or 3.78 square feet, which gives use a wing loading of 10.35 oz. per square foot. She should be a good "floater".

Using a second method of CG calculation based on "aerodynamic" areas, I plugged the required measurements of my Stagger Bee model into an online CG calculator (<https://www.ecalc.ch>) to calculate the "required" CG range based on a measurement from the leading edge of the bottom wing. The measurement entries and results of the eCalc calculator are shown in Figures 34 and 35.

Aircraft or Project Name:

Units:

**Wing:**

Root Chord [R]:  in

Tip Chord [T1-T5]:  -  -  -  -  in

Sweep [S1 - S5]:  -  -  -  -  in

Panel Span [W1 - W5]:  -  -  -  -  in

**rear Wing - Stagger:**  in

Root Chord [R]:  in

Tip Chord [T1-T5]:  -  -  -  -  in

Sweep [S1 - S5]:  -  -  -  -  in

Panel Span [W1 - W5]:  -  -  -  -  in

**Tail:**  (Tail Effectiveness)

Root Chord [R]:  in

Tip Chord [T1-T5]:  -  -  -  -  in

Sweep [S1 - S5]:  -  -  -  -  in

Panel Span [W1 - W5]:  -  -  -  -  in

Distance LE Wing to Tail [D]:  in (use negative value for canard)

AC Position:  % of MAC (default: 25%)

Static Margin:  % of MAC (recommended: 12.5...5%)

**Fuselage:**

Width:  in

Length:  in

Nose Overhang:  in

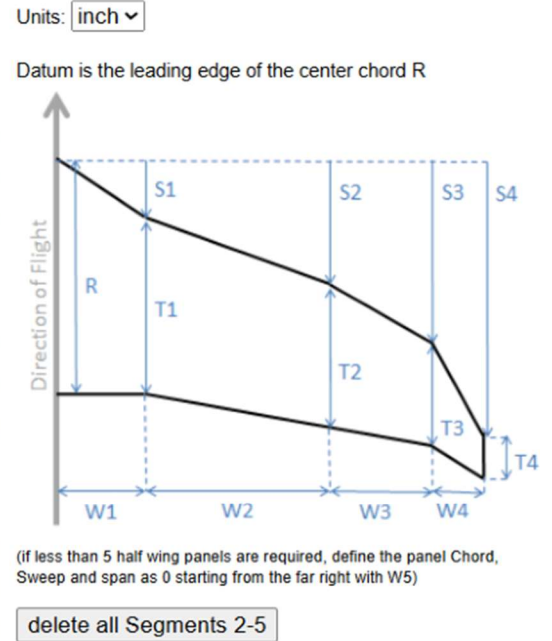


Figure 34 - eCalc Stagger Bee Measurement Entries

**Results:**

[Link to recall Stagger Bee](#)

**Aircraft CG range [●]:** 3.23 ... 3.84 in (@ 24.42 ... 29.42% of MAC)

**Aircraft NP [●]:** 4.75 in (@ 36.92% of MAC)

Wing AC [●]: 2.51 / 2.51 in (@ 25% of MAC)  
Wing MAC @ Distance: 9.02 in @ 5.16 in / 9.40 @ 8.34  
Wing Sweep @ MAC: 0.26 / 0.16 in  
Wing Span: 24.00 / 37.00 in  
Wing Area: **199.75 + 329.75 = 529.5 in<sup>2</sup>**  
Wing Aspect Ratio: 2.88 / 4.15  
Fuselage influence: -0.04in (= -0.29% of MAC)

Tail AC [●]: 1.33 in (@ 25% of MAC)  
Tail MAC @ Distance: 5.18 in @ 4.14 in  
Tail Sweep @ MAC: 0.04 in  
Tail Span: 18.50 in  
Tail Area: **87.21 in<sup>2</sup>**  
Tail Aspect Ratio: 3.92  
Stabilizer Volume ( $V_{bar}$ ): 0.19

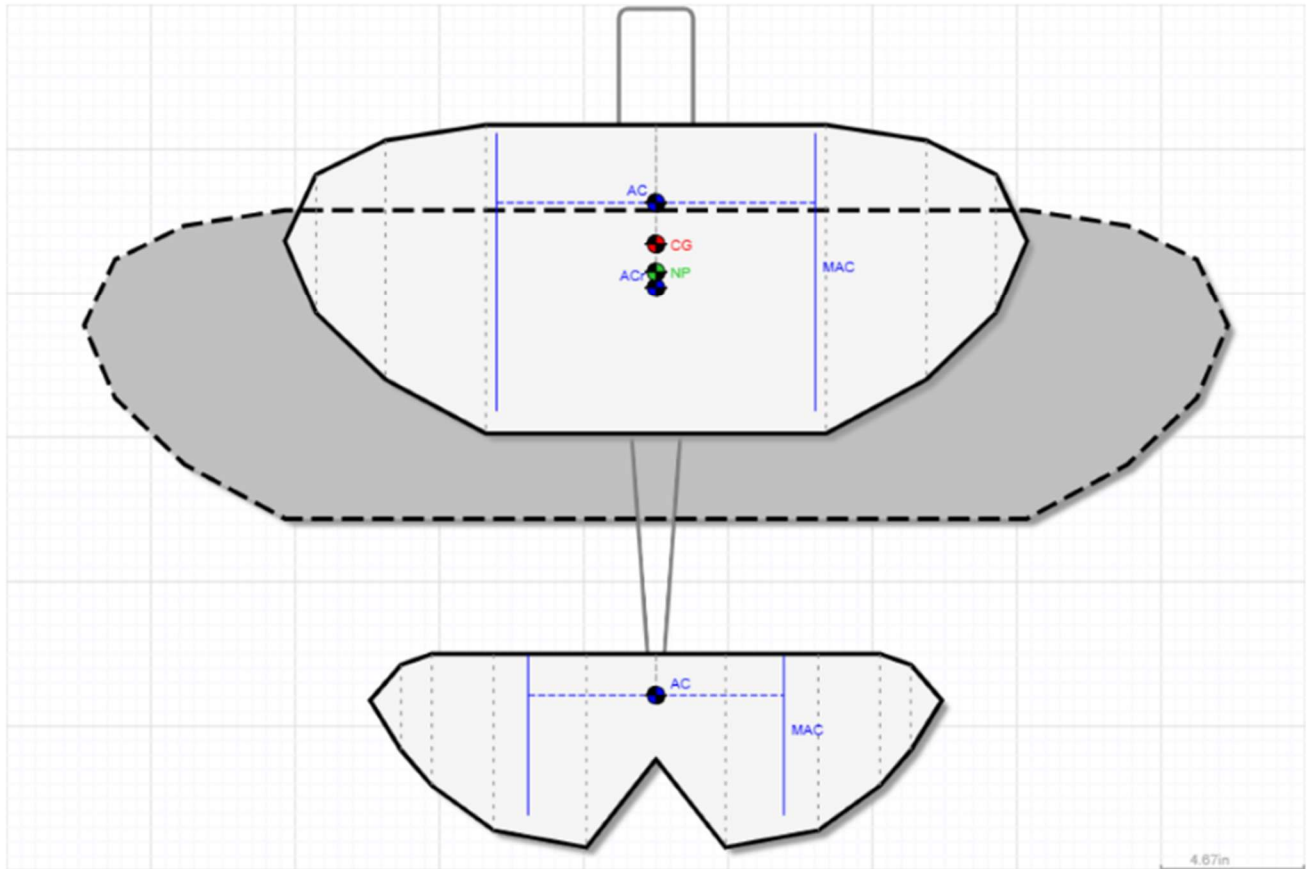


Figure 35 - eCalc Results (bottom wing shown on top)

Using this method with the static margin set at 12.5 - 7.5% of MAC, the calculated model CG range comes out at 3.23" - 3.84" aft of the bottom wing leading edge. The required CG location given on the Stagger Bee plan is 4" aft of the bottom wing leading edge, or 2.8" aft of the MLG axles. Therefore, I need to make sure my **final CG** is located somewhat forward of the CG location on the Stagger Bee plans.

## Covering and Final Finishing

Well, it is now time to prepare for covering and final finishing. After disassembling everything, I first go over both MLG wheel skirts with 220 grit sandpaper. I then vacuumed all the surfaces and finished up by wiping everything down with a painter's tack cloth to remove any remaining sanding dust. To help the covering film stick to the balsa and plywood surfaces, I brushed on a coat of Coverite Balsarite (<https://www.flyhobbies.com/Coverite-Balsarite-Fabric-8-oz>), or Deluxe Materials Cover-Grip (<https://deluxematerials.co.uk/products/cover-grip>). Both clear coatings absorb into the wood, water proofing it, strengthening it, and they react with adhesives to lock covering films on with an unbreakable bond.

First, to protect the balsa from moisture, I painted the inside of both skirt wheel wells with flat black enamel. I then applied True Red Ultracote Covering Film (<https://www.horizonhobby.com/search?q=Ultracote&lang=default>) to the two skirts. Once that was finished, I reinstalled the 1/8" wire axles, 2.75" wheels, some plastic spacers, and 1/8" wheel collars. Make sure you put a small amount of Loctite Threadlocker Blue 242 Removable Thread Lock Glue ([https://www.amazon.com/s?k=Loctite&ref=bl\\_dp\\_s\\_web\\_2595662011](https://www.amazon.com/s?k=Loctite&ref=bl_dp_s_web_2595662011)) on the wheel collar set screws. The finished MLG wheel skirts are shown in Figure 36 below.



*Figure 36 - Wheel Skirts*

Next I moved to the fuselage. I first prepared the fuselage surfaces just as I had for the wheel skirts. I also applied a coating of Balsarite to the inside of the fuselage sides where the two sided servo tape. You might also want to cut out the openings on each side of the aft fuselage for the tail feather control rods to pass through. With that completed I then applied True Red Ultracote Covering Film to the fuselage, starting on the bottom, followed by the two sides, front windows, then the top of the fuselage, front of the firewall, and the underside of the top

wing fairings. To finish off the window openings, I applied some Testers Silver enamel to the edges of the window cut-outs. The results of the fuselage covering are shown in Figure 37 below.



*Figure 37 - Fuselage Covering Completed*

So, what is next? How about the bottom wing. After preparing the wing surfaces as I had done for the fuselage, I started the covering of the bottom wing with the wing bottom surface. Here I used Bright Yellow Ultracoat Covering Film. After covering the bottom surface, I then covered the wing top surface wrapping the covering film around the leading and trailing edges, and wingtips. I found that with this wing design there is not a lot of balsa surface area to attach the covering against.



*Figure 38 - Bottom Wing Covering Completed*

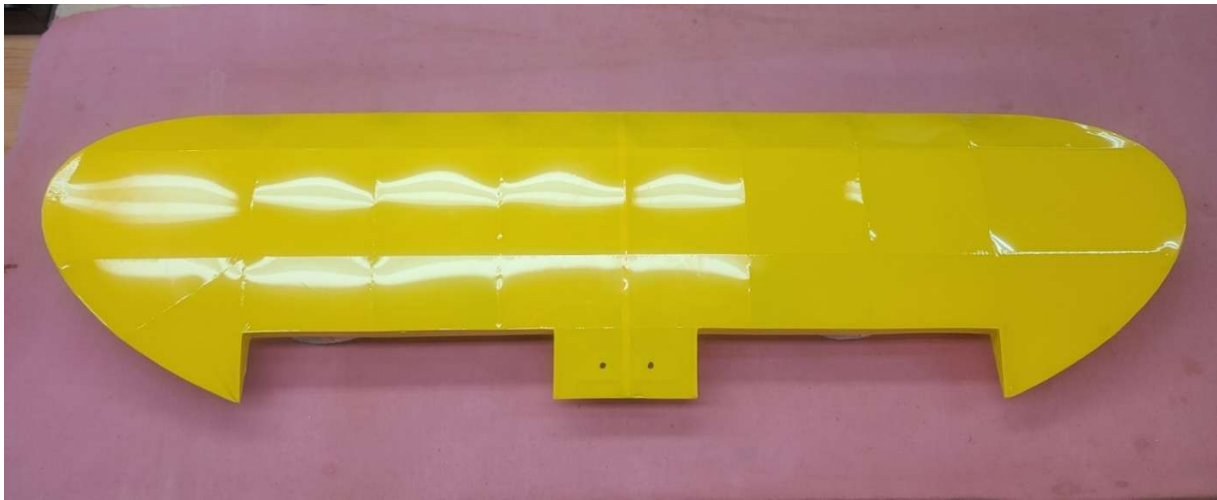
I then mounted the MLG wheel skirts to the underside of the bottom wing using #3 x 5/16" socket head screws.



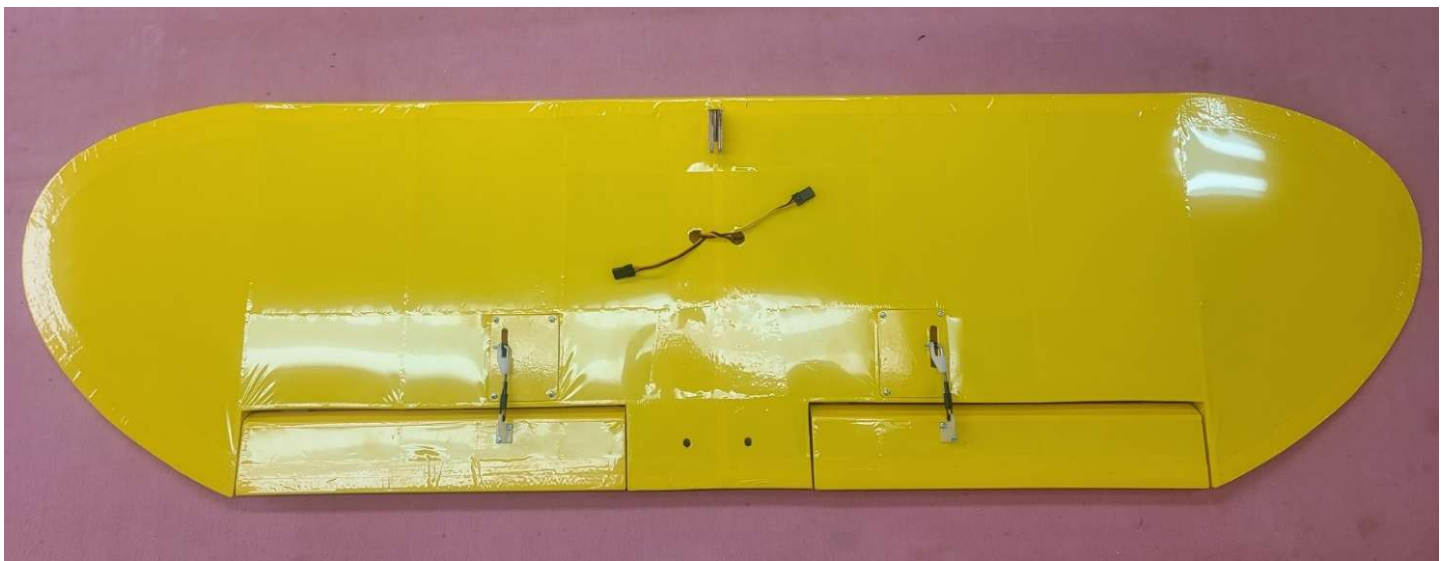
*Figure 39 - MLG Wheel Skirts Installation*

Moving on to the top wing, I first removed the flaperons and their servo bay covers. After preparing the wing surfaces just as I had done for the bottom wing, I start by covering the servo bay covers and then each of the flaperons. With those finished, I applied Bright Yellow Ultracoat Covering Film over the bottom surface of the top wing and along the inside surfaces of the flaperon openings. **Builders Note -** Before covering film can be applied to the wing upper surface, both flaperon bay covers need to be installed using #1 x 3/8" pan head screws, and the servo leads passed through wing ribs R2 and joined at the centerline rib R1 before passing through openings in the wing bottom covering. I **highly recommend** you also run a quick check of the flaperon servo installation by connecting them to the receiver ports you will be using and verify the correct functioning of aileron and flap settings.

I then covered the wing top surface wrapping the covering film around the leading and trailing edges, the wingtips, and the inside edges of the flaperon openings. Using four Du-Bro #116 Standard Nylon Hinges, I epoxied the flaperons to the top wing, and once that had cured I installed the Du-Bro #237 T-style Nylon Control Horns (2 each), Du-Bro #600 2-56 Spring Steel Kwik-Link Clevises, Du-Bro #855 E/Z Links, 2-56 control rods to connect the flaperons to the servo arms. The resulting top wing is shown in the next two figures below.

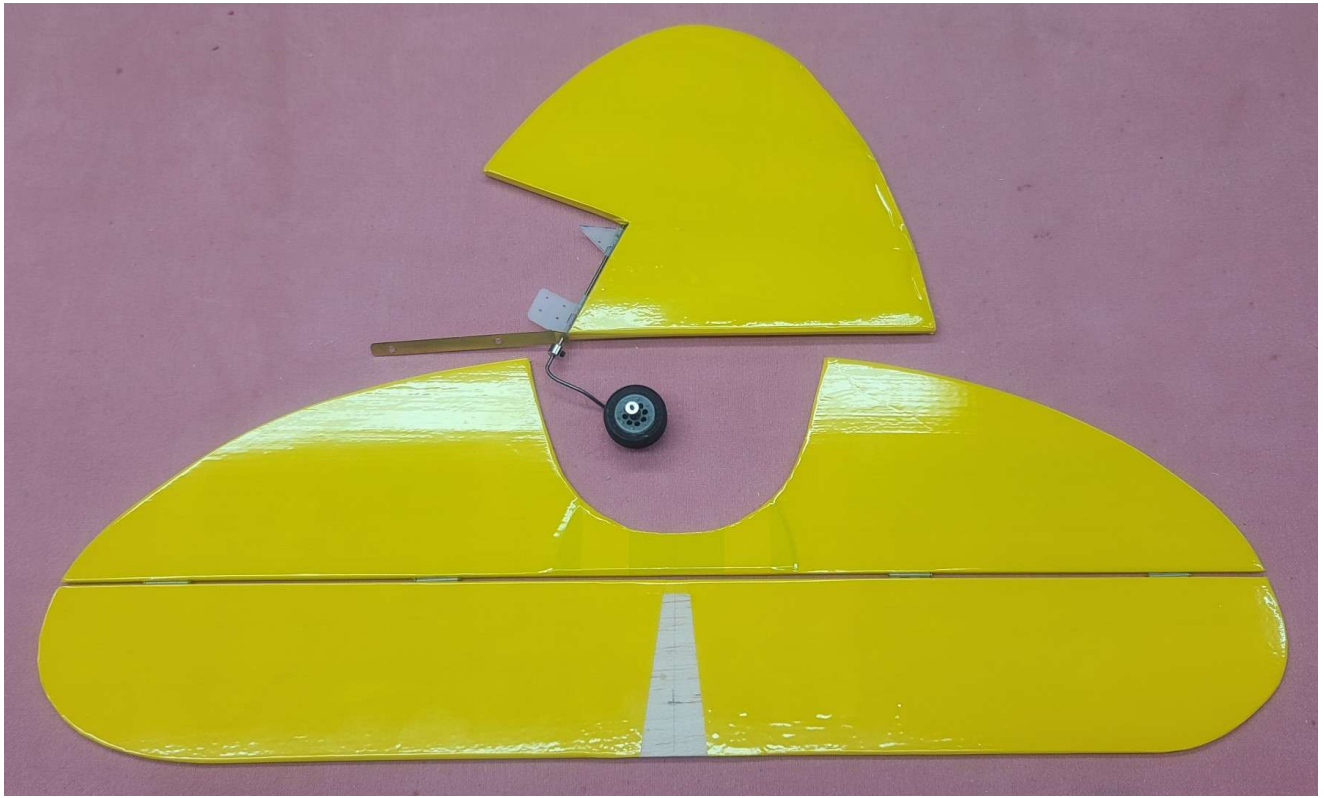


*Figure 40 - Top Wing Covering Completed*



*Figure 41 - Flaperons and Control Fittings Installed*

The last items that need covering are the tail feathers. Again, using Bright Yellow Ultracoat Covering Film I covered both sides of the horizontal stabilizer and elevator, and temporarily put them together using four Du-Bro #116 Standard Nylon Hinges. I then covered both sides of the combined vertical stabilizer/rudder. Figure 42 shows the completed tail feathers, including the 1" tailwheel and its two collars.



*Figure 42 - Completed Tail Feathers*

## Final Assembly and Functional Checks

It is time to put some tail feathers on this little beast. I first mounted the bottom wing with wheel skirts to the fuselage. Using my magnetic build board and fixtures, I then attached the horizontal stabilizer to the fuselage aft structure using 15-minute epoxy. I used magnetic board fixtures to ensure the horizontal stab was installed parallel to the top and bottom wings in the horizontal plane. You can see this in Figure 43 with small bubble levels on the fuselage top wing saddle, bottom wing front spar, and on the horizontal stabilizer. I also made sure the measurements between the building board surface and the bottom of both stabilizer tips were equal.



*Figure 43 - Horizontal Stabilizer Installation*

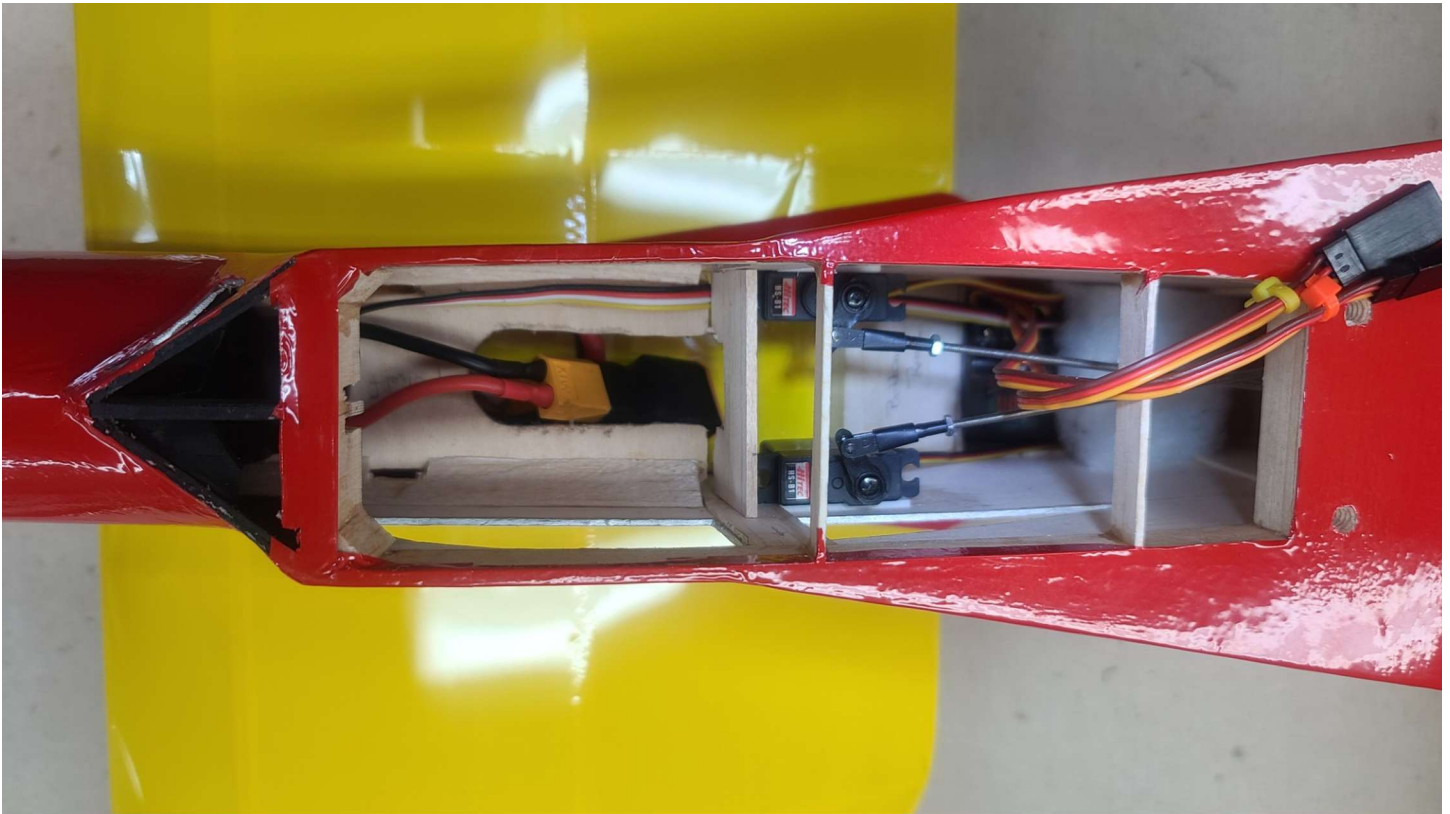
Next, all four Du-Bro #116 Standard Nylon Hinges for the elevator were epoxied in place. Then I attached the vertical stabilizer/rudder by placing the two modified Du-Bro #257 Quarter Scale Nylon Hinges into the hinge slots at the back of the fuselage with 15-minute epoxy. Finally, I secured the fuselage tailwheel metal mounting plate to the bottom of the fuselage. In Figure 44 you can see the vertical stab/rudder held in place by a magnetic fixture and clamp, so it is 90-degrees to the horizontal stab. This was also verified using a plastic 30-60-90 triangle.



*Figure 44 - Vertical Stabilizer/Rudder Installation*

To control the tail feathers, I used double sided servo tape to attach the Hitch HS-81 rudder and elevator servos to the inside walls of the fuselage just aft of cross member #2-3. Using Du-Bro #237 T-style Nylon Control Horns, Du-Bro #600 2-56 Spring Steel Kwik-Link Clevises, and 2-56 control rods, I connected the rudder and elevator to their respective servo arms.

Now for the motor, propeller, ESC, LiPo battery, and receiver. I re-installed the motor to the firewall using four 4-40 x 1" socket head bolts and 1/4" O.D. plastic spacers. The spacers were installed so the motor has a **5 degree "right" thrust line**. The ESC and LiPo battery were re-installed on the fuselage support shelf. I connected the two tail feather servos, ESC throttle, and two 8" flaperon servo extension leads to the respective ports and using VELCRO fastener tape I secured the Spektrum AR620 6-Channel RC Sport Receiver to the bottom of the fuselage just aft of cross member #3-2. Figure 45 shows the final arrangement of everything installed in the fuselage below the top wing saddle. Then I attached the top wing to the fuselage.



*Figure 45 - Fuselage Bay Components Installation*

With all that finished it was time to power up the transmitter and receiver to run through all the controls to set-up and verify correct control throw directions, end points, exponentials, flaperon function, and motor kill switch. To measure the resulting center of gravity (CG) location, I positioned the assembled model on three digital kitchen scales in a standard flying attitude, as depicted earlier in Figure 32. The weight measurements obtained were then entered into my CG calculation spreadsheet. The resulting CG was 20mm aft of the required location, or in simple terms we were tail heavy, **which is NOT good**.

To try and correct this I first moved the ESC and LiPo forward as far as possible (note - I updated Figure 15 to reflect this change). I then placed lead weights along each side of the motor and re-accomplished the CG check. With 4 oz. of lead weight placed in the nose below the motor, and a red prop spinner installed on the motor, the final spreadsheet results are shown in Figure 46. The CG was -1.2mm from the required location of 70mm aft of the MLG axles, and the total weight of the model (with BadAss 45C 3,300mah 3S LiPo Battery) is 1,395 grams, or 49.2 ounces. Having a total wing area of 545 square inches, or 3.78 square feet, this results in a final wing loading of 13.0 oz./square foot. This is in the range for standard "trainer" and "Park Flyer" models.

Based on the performance data from Innov8tive Designs in Figure 47, for the BadAss BA-2814-1560 motor, using an APC 9x6E propeller with a 3-cell LiPo, the power system can produce 63.76 oz. of thrust @ 13,083 RPM. This results in a power ratio of 1.30 for my Stagger Bee, which should provide for some good take-off and vertical performance.

Stagger Bee CG Calculation by Weight				
Model	Details			Weight: 3.08 lbs
Stagger Bee		Tail Dragger Bi-Plane		Imperial
D	530.0	mm	Distance between center point of MLG and tail wheel	20.9
CG(s)	70.0	mm	Distance of specified CG location from MLG axles	2.8
W(p)	602.0	g	Measured weight at left wheel	21.2
W(s)	612.0	g	Measured weight at right wheel	21.6
W(t)	181.0	g	Measured weight at tail wheel	6.4
W(total)	1395.0	g	Total weight of plane: W(p) + W(s) + W(t)	49.2
CG(a)	68.8	mm	Actual CG location from MLG: W(t) x D / W(total)	2.7
W(t)	184.2	g	Weight required at tail wheel for balanced CG: W(total) x CG(a) / D	6.5
W(delta t)	3.2	g	Delta from weight required at tail wheel	0.1
CG(diff)	-1.2	mm	Difference between actual and specified CG: CG(a) - CG(s)	0.0
Legend:				
			Aircraft-specific; enter once and do not alter for this aircraft	
			Measured weights; change with every weight session	
			Calculated values; do not edit these fields	

Figure 46 - Stagger Bee Final CG Location Calculation

BadAss BA-2814-1560 Motor Propeller Data										
Magnets 14-Pole	Motor Wind 10-Turn Delta	Motor Kv 1560 RPM/Volt	No-Load Current I <sub>o</sub> = 2.93 Amps @ 10v		Motor Resistance R <sub>m</sub> = 0.020 Ohms	I Max 65 Amps	P Max (6S) 1440 W			
Stator 12-Slot	Outside Diameter 35.6 mm, 1.402 in.	Body Length 34.0 mm, 1.339 in.	Total Shaft Length 55.5 mm, 2.185 in.		Shaft Diameter 5.00 mm, 0.197 in.	Motor Weight 117 gm, 4.13 oz				
Test Data From Sample Motor		Input I <sub>o</sub> Value	8.0 V 2.712 A	10.0 V 2.925 A	12.0V 3.131 A	14.0V 3.333 A	Measured Kv value 1518 RPM/Volt @ 10V		Measured R <sub>m</sub> Value 0.0203 Ohms	
3-cell Li-Po Test Data										
Prop Manf.	Prop Size	Li-Po Cells	Input Voltage	Motor Amps	Input Watts	Prop RPM	Pitch Speed in MPH	Thrust Grams	Thrust Ounces	Thrust Eff. Grams/W
APC	7x6-E	3	11.1	28.26	313.7	14,734	83.7	1076	37.95	3.43
APC	7x7-E	3	11.1	34.29	380.6	14,313	94.9	1061	37.43	2.79
APC	8x4-E	3	11.1	31.83	353.3	14,475	54.8	1356	47.81	3.84
APC	8x6-E	3	11.1	44.57	494.7	13,569	77.1	1526	53.83	3.09
APC	8x8-E	3	11.1	60.38	670.2	12,368	93.7	1300	45.86	1.94
APC	9x4.5-E	3	11.1	44.63	495.4	13,559	57.8	1892	66.74	3.82
APC	9x6-E	3	11.1	50.98	565.9	13,083	74.3	1808	63.76	3.19

Figure 47 - BadAss BA-2814-1560 Motor/Propeller Performance Data

To finish this scratch build I put my AMA and FAA registration numbers on the rudder just below the "Stagger Bee" graphics. I also placed my address and cell phone number on the top of the bottom wing. Figures 48 & 49 are my finished Stagger Bee ready to head to the flying field for her maiden flight.



Figure 48 - Stagger Bee Frontal View



Figure 49 - Stagger Bee Aft View

**New update.** Well, one thing I learned a long, long time ago was that if you are going to stay with this hobby, you need to accept the downs that will come sooner or later. Things happen which can result in your model needing a minor repair, or some major repairs, or even a total loss of the model. Such is the case with my Stagger Bee. First flight did NOT go well, and I now need to build a new fuselage as a result of *one wild first flight*. On the good side, both of the wings, all tail feathers, and all flight hardware (except the prop) were recoverable and will be used in my rebuild.

I had two primary issues during my "first flight attempt." First, the ground handling was really squirrely, and second, once in the air she was way more responsive (in pitch) and faster than I could keep up with. She was also still tail heavy even after I had added 4 oz. of lead weight in the nose. The first two issues are the result of the short coupling distance between the MLG to tail wheel, and the CG to elevator. So, to try and hopefully eliminate all of these issues I have decided to redesign the fuselage to add two inches to the nose section ahead of the bottom wing and four inches to the fuselage behind the top wing.

After several hours working with my 2D CAD program, I was able to produce an updated plan for the fuselage for my now *Stagger Bee II*, which you can see in Figures 50 and 51.

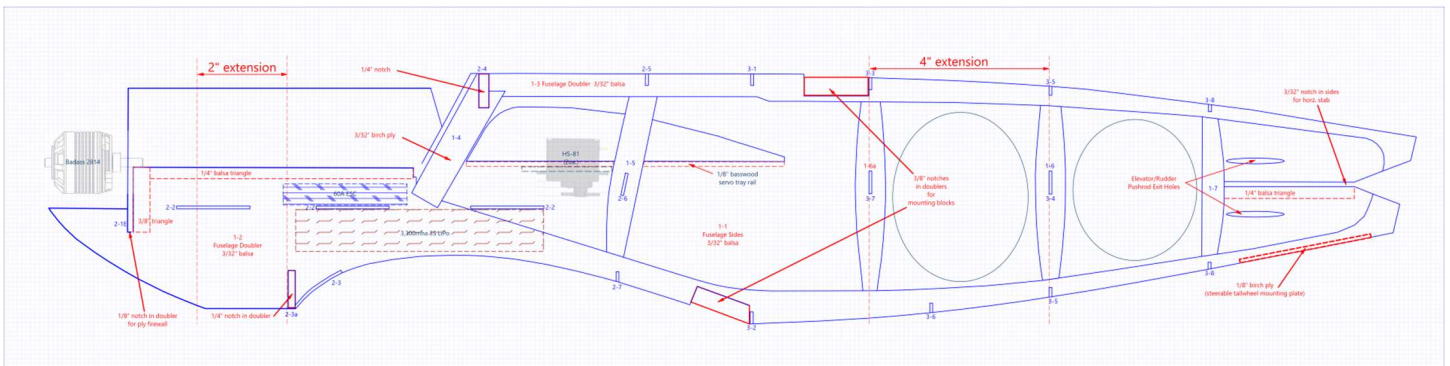


Figure 50 - Stagger Bee II Extended Fuselage Right Side View

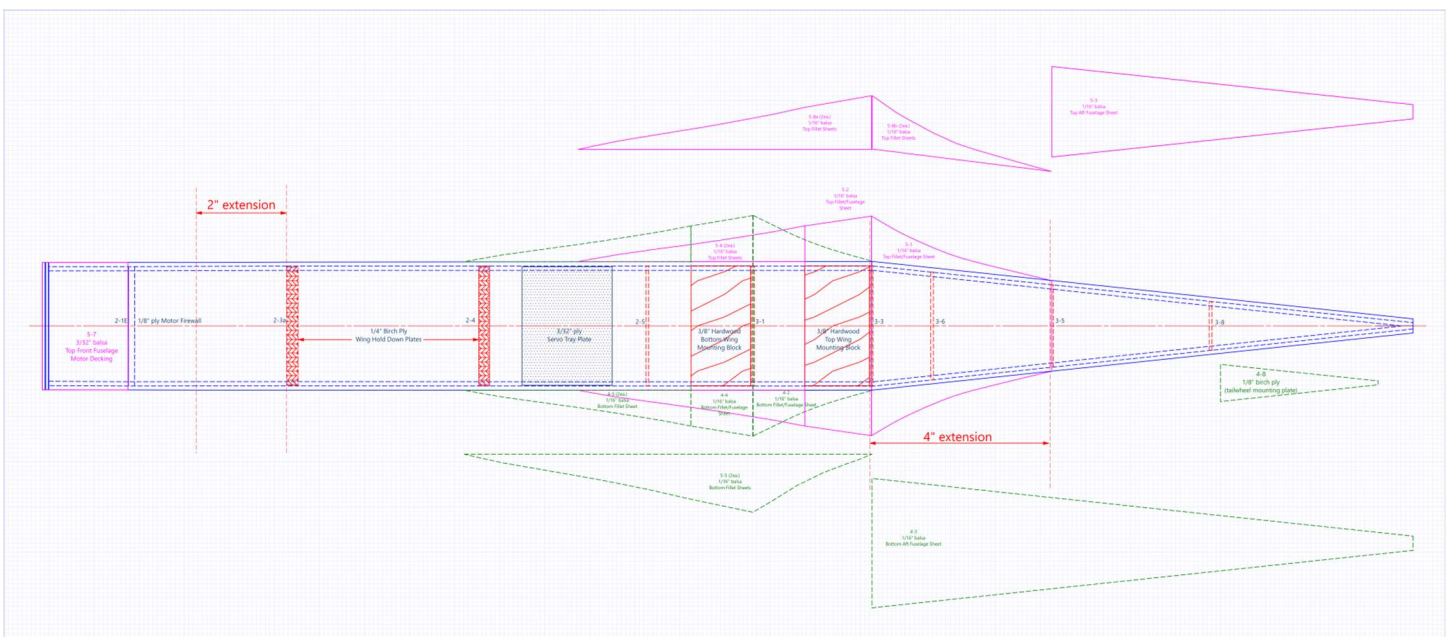


Figure 51 - Stagger Bee II Extended Fuselage Top View

## Building the Stagger Bee II Extended Fuselage

Using the new updated side view plan for templates, parts #1-1 (fuselage sides) are cut from a 3/32" x 2" x 36" and 3/32" x 4" x 36" balsa sheet joined at the long edge. All the fuselage doublers are cut from 3/32" sheet balsa with exception of part #1-4, which is cut from 3/32" plywood. I decided to use 3/32" sheet balsa in my rebuild because the original 1/16" was just too fragile. Note - there is a new part #1-6a. I'm not going to go through all the build steps for the extended fuselage since it is basically a redo of all the same steps I used for the first fuselage.

In Figure 52 below both sides and all cross members are ready for joining over the top view plan.

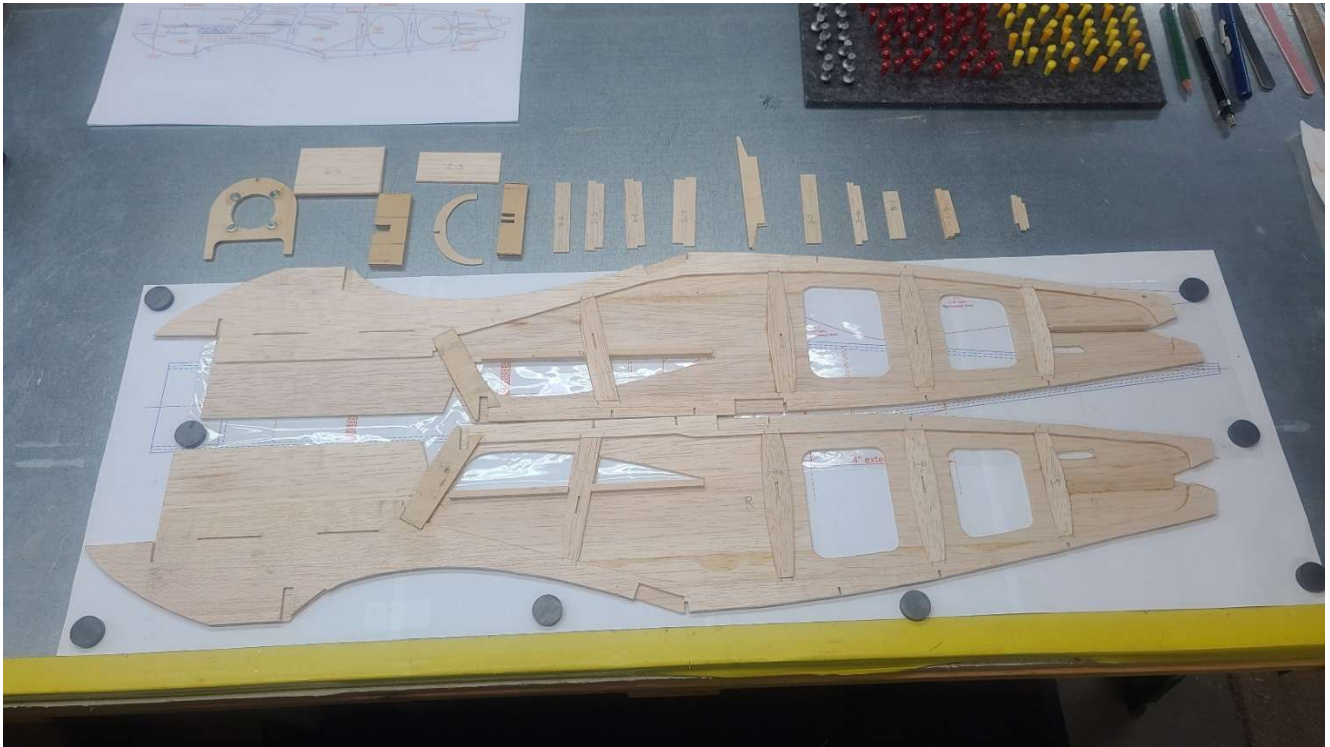


Figure 52 - Stagger Bee II Extender Fuselage Sides & All Cross Members

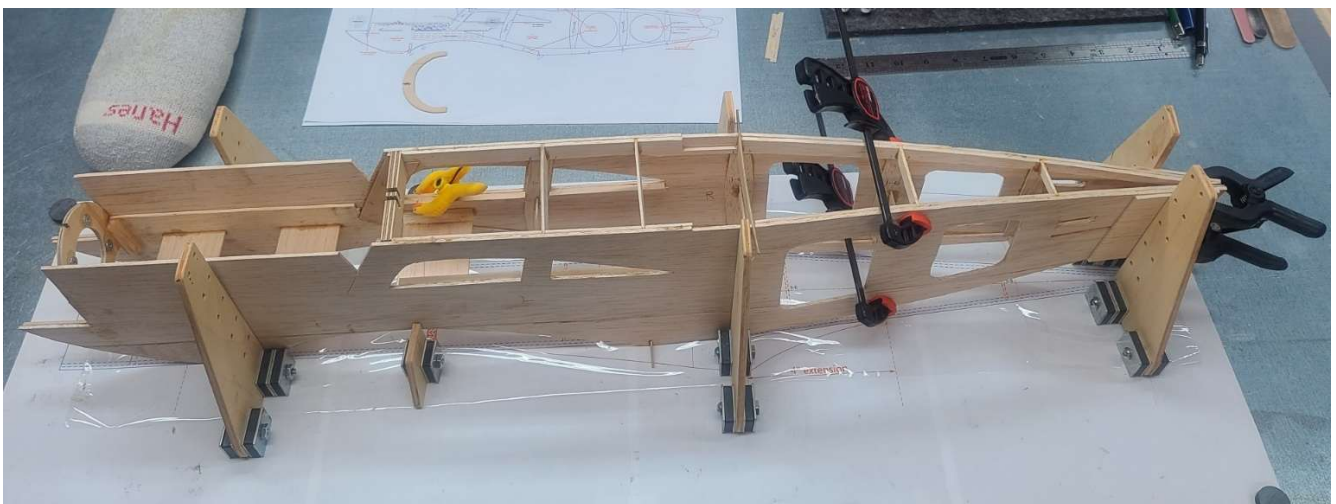


Figure 53 - Joining the Stagger Bee II Extender Fuselage Sides

As you can see in Figure 53, I added two more cross members at the forward fuselage so that I would have plenty of space to move the ESC and LiPo battery to obtain the correct CG. Once their locations are set, I will add a 3/32" plywood shelf against the cross members for a solid ESC/LiPo mounting shelf with VELCRO fastener tape. Rudder and elevator servos will be mounted in a standard servo tray this time.

After joining the two sides, I then added the 1/16" balsa sheet covering to the top, bottom, wing fillets, and motor deck. Everything was sanded to shape and the resulting new fuselage, ready for Ultracoat red covering is shown in Figure 54.

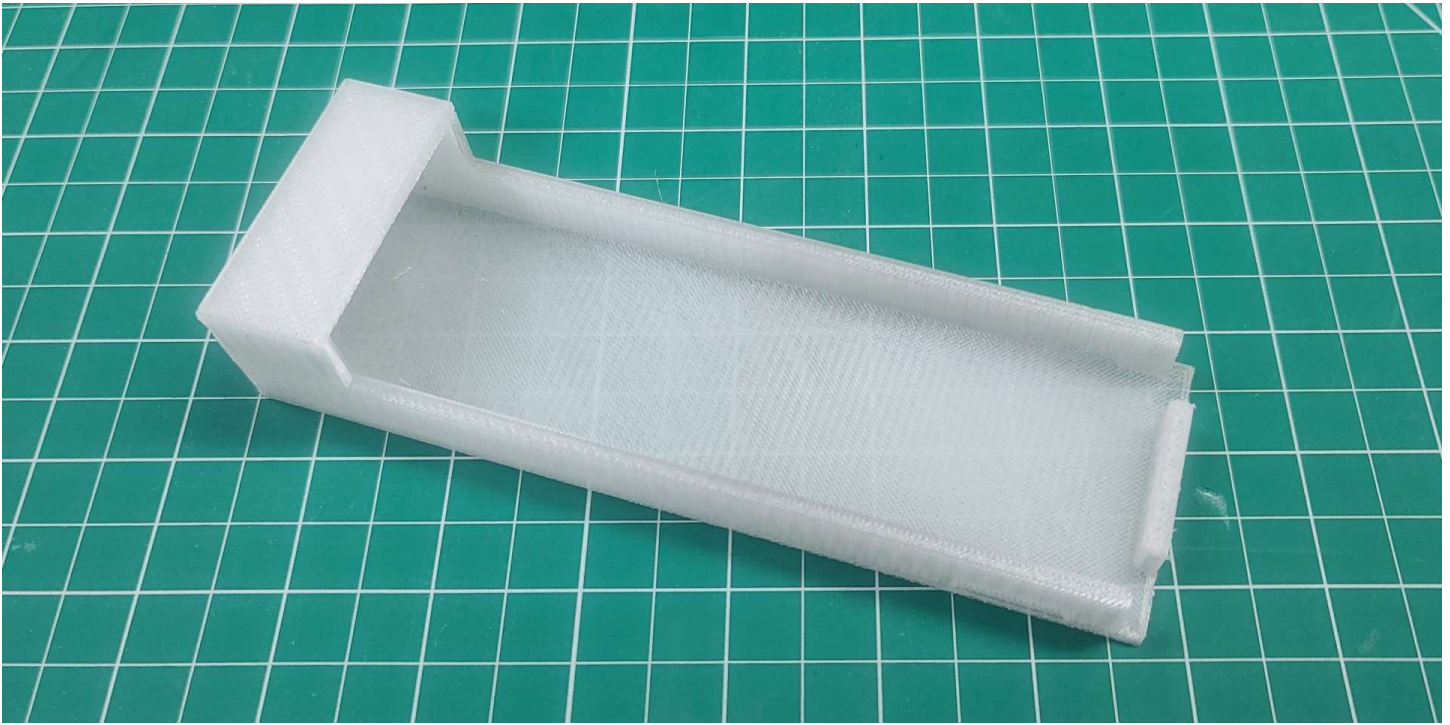


*Figure 54 - Stagger Bee II Fuselage Ready for Ultracoat Covering*



*Figure 55 - Stagger Bee II Fuselage Covering Completed*

To make installation of the 3,300mah 3S LiPo battery easier, I downloaded an STL file for a LiPo mounting tray, modified its dimensions for what I needed, and then 3D printed the tray using my Creality Ender-3 V3 with some transparent Hyper-PETG filament. You can see the tray in Figures 56 & 57. I also had to add a 6" extension lead to the LiPo connector so I could loop it back and connect with the ESC connector.



Figures 56 & 57 - 3D Printed LiPo Battery Mounting Tray



*Figure 58 - Stagger Bee II Frontal View*



*Figure 59 - Stagger Bee II Aft View*