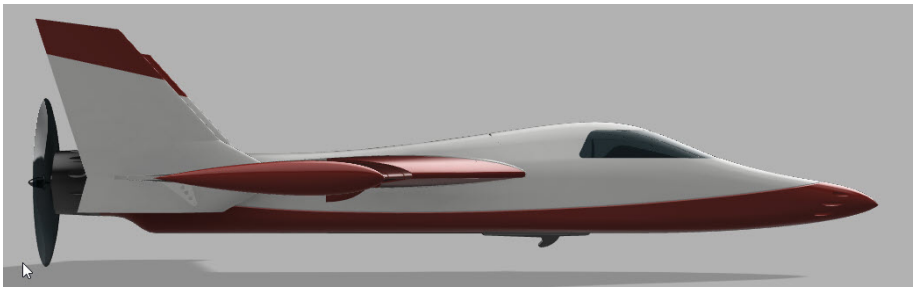
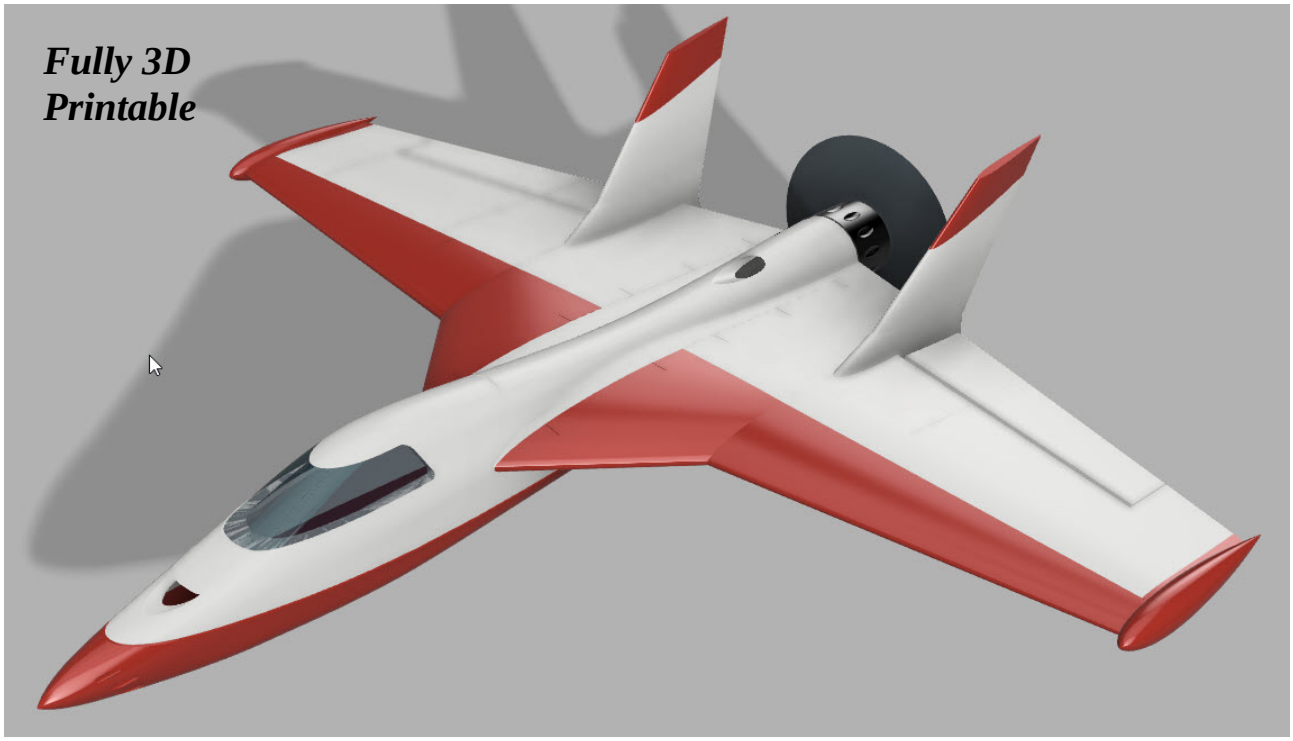
the world's best designers united

Razor Blade

Higher Performance Flying Wing

User Guide





Wingspan 815mm (32")

Donald Wright

Here's a modern take on a propjet that has had a cult like following for many years. A favorite for experimenting with different power setups, all in the search for highest speeds.

Now you can print your own airframes. Trying different setups and livery schemes is a fun part of the RC hobby. At last, it's not quite as dire when the inevitable mishap happens, simply print another airframe or replacement parts at a fraction of the alternatives. Almost two complete airframes can be fabricated from a single 1kg roll of PLA.

There is now also a lighter weight alternative to typical PLA, A light-weight PLA that has yet to be experimented with by this designer. Hopefully we'll begin to get feedback from the forums and others on this new product. I have some and look forward to it.

Also available (at 3DLabGang) is a modular ramp to be used with bungee launches. Using readily available 1/2" PVC and your printed fittings, you have a great alternative to hand launches. Watch the videos here.

Flying wings are unique in that there is little to no fuselage and no empennage. This typically means less drag, lighter wing loading, faster speeds and more maneuverability. However, flying wings suffer from being more sensitive to CG than typical airplanes and they can be hard to successfully maiden. This is where a proven design and setup is very helpful.

A high performance flying wing is a lot of fun and will be the envy of the flying field. Follow this manual for printing and setup and you'll be rewarded with with a plane that will be your "go to" plane regardless of outside conditions. Windy days is where this design eats; add a stabilized RX and fly when everyone else is grounded.

Here are just a few of the innovations applied to this new design;

- Battery strap slots
- Adequate cooling intakes
- Robust double wall fuselage
- Internal wing space for carbon or other reinforcement
- Lightweight (for printing) single layer printing and webbing
- Plenty of space for different powerplants, ESC's and batteries

- Sliding canopy with locking index
- Modular construction
- Servo covers and internal wire routing though the wingtips
- Supplied file for bungee launch hook
- Four supplied files for printing your own decals for livery decoration.
- Wing Root design has "slits" to help minimize print lift from shrinkage

Let's get to it.

If you have questions or run into trouble, visit the 3DLabGang forums and find the dedicated thread for this project.

Bill of Materials (note hyperlinks for suggestions)

1. Your favorite quality PLA printing material. Use a brand that you've trusted before and know the printing parameters for. The supplied "Gcode" files are files that have been set up for Prusa type machines at a size of 200x200x200 and use readily available PLA. You may find that these files work without any modification. If you need to make parameter changes you might want to start with the supplied "factory" files. These are Simplify 3D files and a great way to understand the "single line" printing processes and how the particular Gcodes were arrived at. Otherwise, the supplied STL files are also supplied as well as "ini" files for basic Cura settings.
2. Motor – A good quality high performance motor is recommended. We're looking for about 500-800 watts. Due to the higher wing loading we want a minimum of about 200 watts per pound (2.5lbs AUW) The Himax 3514-2900 is made specifically for this type of model and a great choice. Info on HC3514. But any suitable motor with a maximum diameter of a 35mm with a front mounted "X" (43mm center distance)motor mount (on the propeller end)
3. Battery – Test flights were made with a 3S 2200mah battery. But this will be dependent on your choice of power systems. The battery bay is gracious and 4,5, and 6S batteries may be accommodated. Higher C ratings helps with battery life, minimizes "puffing" and heat.

4. ESC – Any good quality ESC will work. 60-80 Amp minimum size recommended. The design uses only two servos, so the BEC will not be overworked at all.
5. RX/TX – A programmable radio that allows for "delta" wing configuration is one alternative. A preferred configuration is to use a receiver that allows on board delta configuration and also offers gyro stabilization such as this Lemon RX.
6. Propeller - APC 6x6 Thin Electric PUSHER Propeller A non-pusher propeller may be used, but extra care must be taken to make sure the prop nut is tight and stays tight. A drop of blue locktite helps. Pusher props ensure the nut tightens itself if the hub slips.
7. Servos – 2X - 12g Digital Metal Gear Sub-Micro Servo The molded servo recesses are for this size servo – so make sure they are this size or smaller. Digital servos are a better choice when gyro/stabilization is used and metal gears are better for withstanding rough landings.
8. Various bits of wire for pushrods and some screws for motor mounts etc. Velcro and a battery strap are needed.
9. Decal Sheets - if you wish to use the included graphics. This Decal Suggestion may also be found on Ebay.
10. Carbon – you'll need a short piece of carbon tube, 8mm in diameter. Carbon arrow shafts can be used. If unavailable, hardwood rod may be used at a weight penalty.
11. Servo Extensions – may be needed based on your RX placment and the length of the leads on your choice of servos.

General specifications

Length: 775mm (30.5in) nose to spinner
Wingspan: 815mm (32in)
Height: 180mm (7in)
Wing area: 15.4 dm2
Wing loading: 72.72 g/dm2
Airfoil: semi-symmetrical
Print weight: @520 g
Empty weight (w/o battery): 932g
Takeoff weight (3s 2200 lipo): 1120g

Flying Wings - wiki

Flying wings have been experimented with throughout the last century with mild success. Even though the promise of more efficient flight looks great on paper, the reality for full scale aircraft is one of compromise. Often the wing must be increased in thickness to accommodate pilot, engines, etc. and this can eliminate the sought after advantages. But the real problem has always been one of control, effective rudder (yaw) control is a challenge and the designs are pitch sensitive and prone to CG problems.

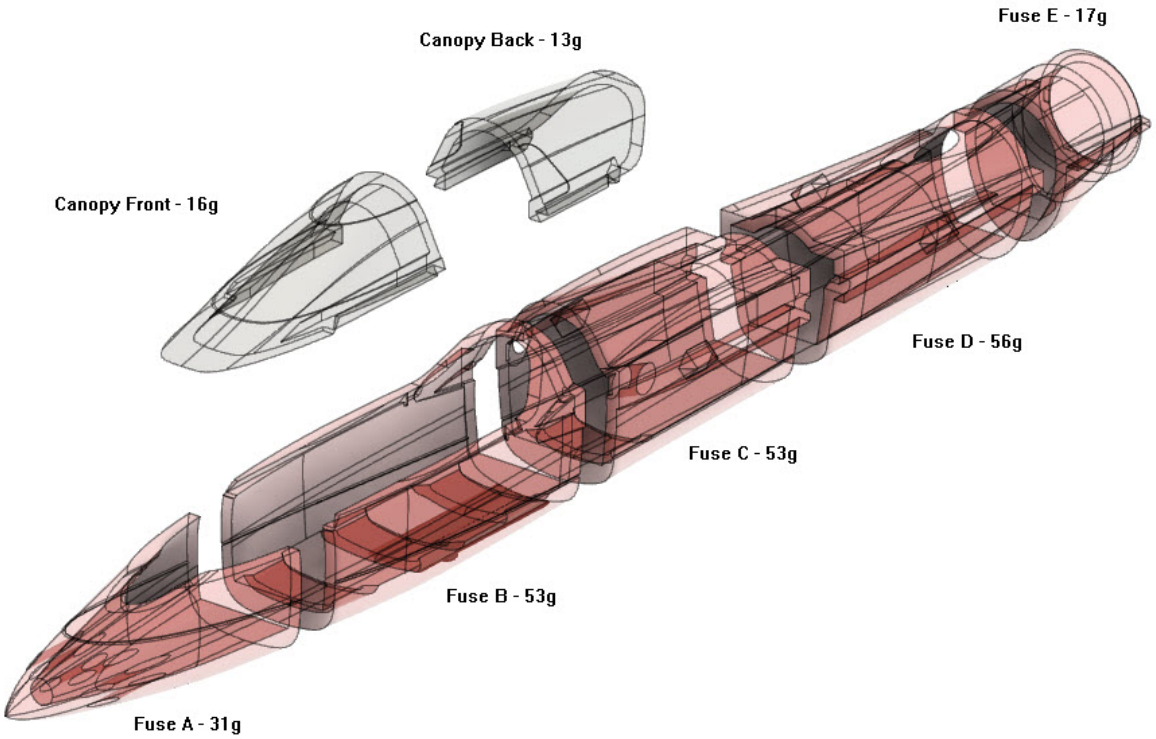
Fly-by-wire for modern aircraft have overcome many of these control problems as the computer now does the driving by interpreting the pilot's intentions and making the needed changes in control surfaces.

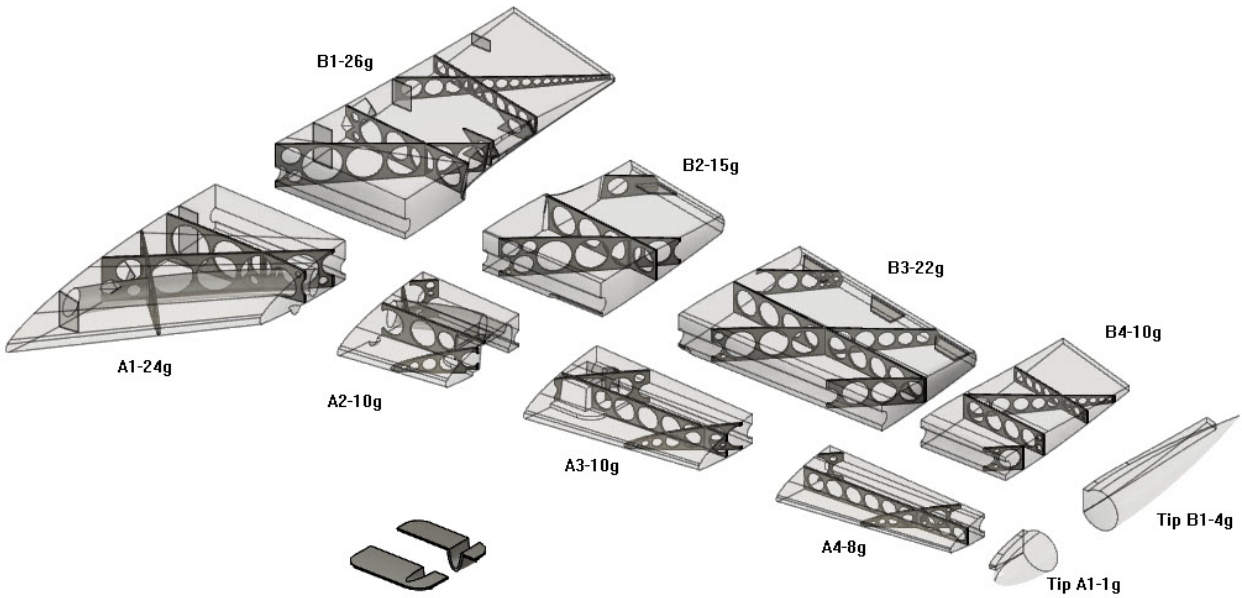
Our models don't have to adhere to strict safety and control constraints that full scale aircraft do, our flight envelope is considerably smaller. Modern electronics have also impacted our RC model wings. Aileron and Elevator mixing in our radios and has resulted in "Delta" wing configurations turning our once dedicated "ailerons" in "elevons".

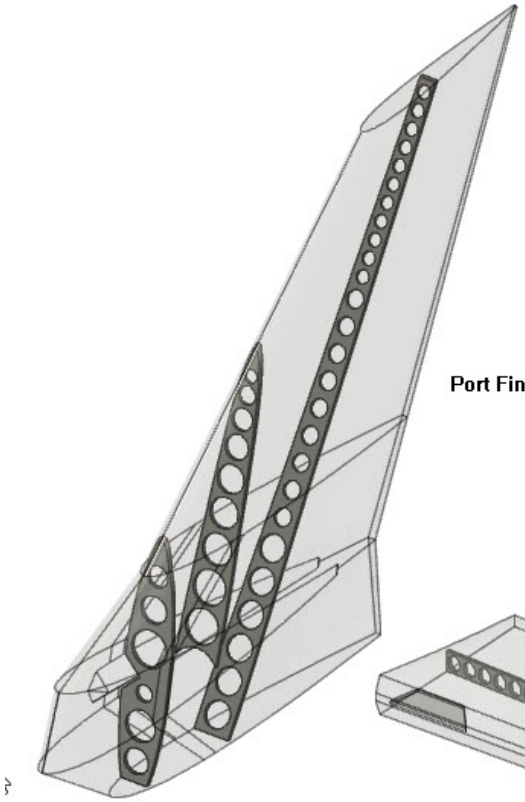
Yaw control is typically not controlled by a dedicated rudder, the aircraft is turned by a method called "bank and crank". The very same method used by most model fliers of performance aircraft. As one's piloting skill increases we tend to move from the classic high wing trainer aircraft to low wing, higher speed, more maneuverable airframes. Where a rudder is effective for low speed turns on high lift craft with inherent stability, higher speed turns as on jets, warbirds and wings are typically accomplished by rolling the aircraft left or right, the "bank" then pulling back on the stick, the "crank".

Many lightweight RC models such as warbirds, EDFs (jets) and flying wings have no rudder control at all. Flight control is achieved strictly though three surfaces, left and right ailerons and an elevator. In the case of flying wings, only two surfaces, the ailerons. These re-purposed flight control surfaces move in opposite directions for roll and in unison for pitch. The radio, or in some cases, the receiver, mix these two functions in varying degrees based on the pilots input. The right stick (mode 2) works as usual however, up and down for elevator, right and left for aileron.

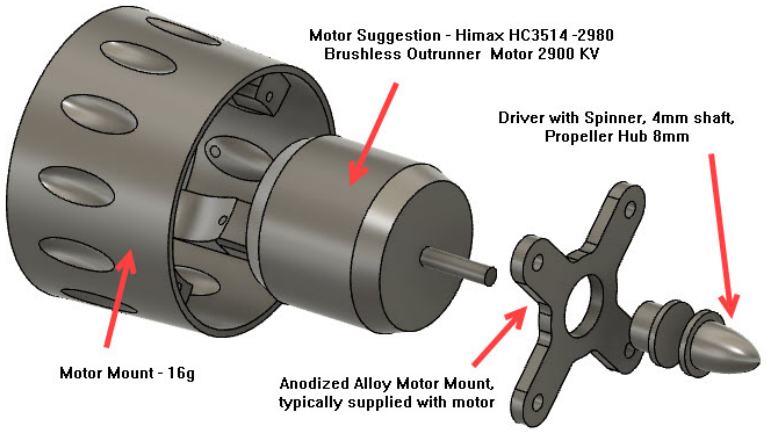
This model is not for beginning RC pilots. The assumption is that you've successfully maidened and flown typical bank and crank airframes and possibly a foam wing or two. Regardless, the builder must understand the flight regime of flying wings and also have a firm grasp on the necessary programming options of their radio and/or receiver. The latest receivers are inexpensive and have "delta" wing mixing built in as an option, plus, many are now gyro equipped and offer a level of stabilization that was unavailable just a short decade ago. Install one of these in your wing (if not all your planes) and you will be rewarded with rock solid "as if on rails" flying.


Fuse E - 17g
Canopy Back - 13g
Canopy Front - 16g
Fuse D - 56g
Fuse C - 53g
Fuse B - 53g
Fuse A - 31g

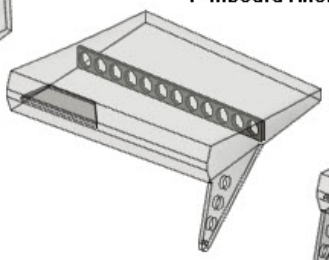

B1-26g
B2-15g
B3-22g
B4-10g
A1-24g
A2-10g
A3-10g
A4-8g
Tip B1-4g
Tip A1-1g



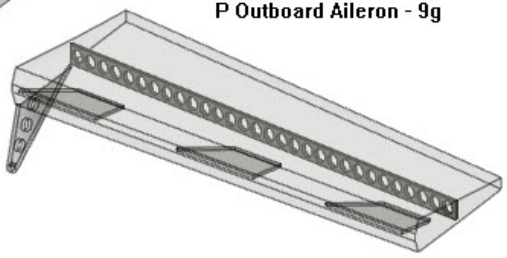
Port Fin - 23g

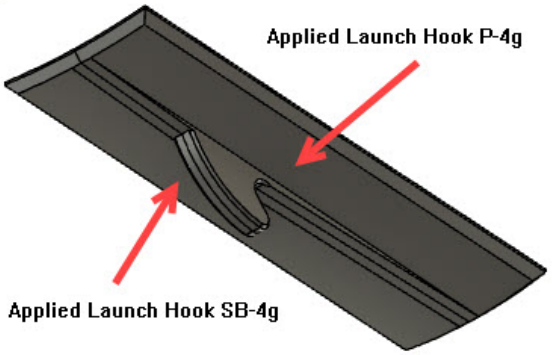


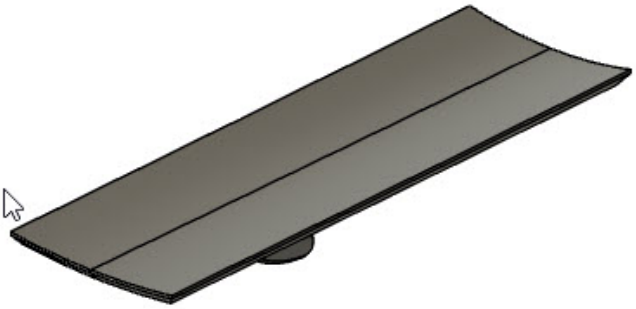
P Inboard Aileron - 5g

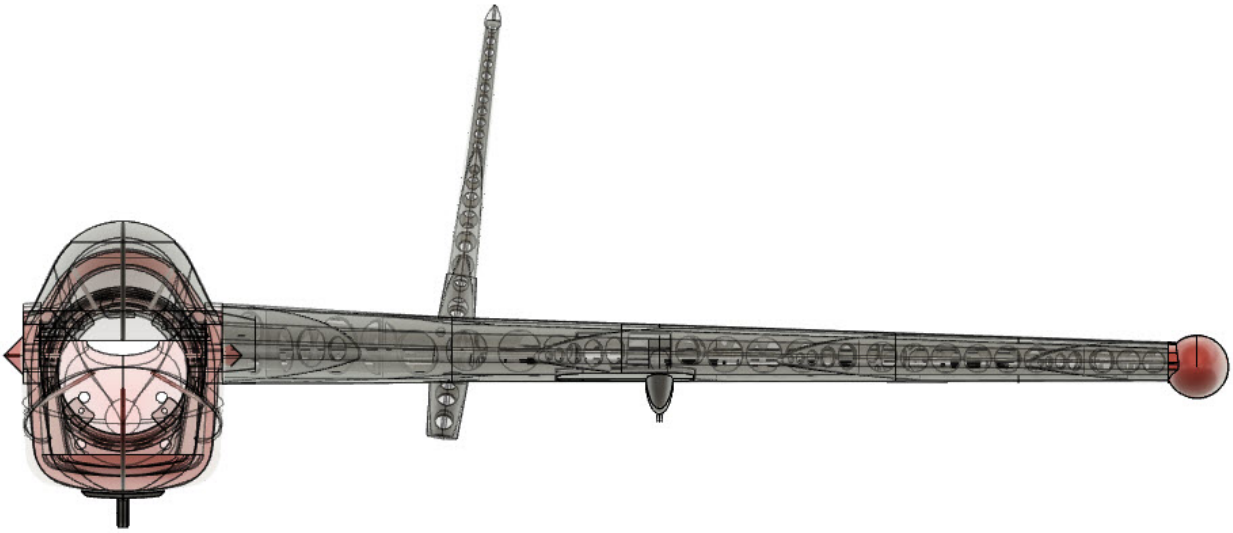


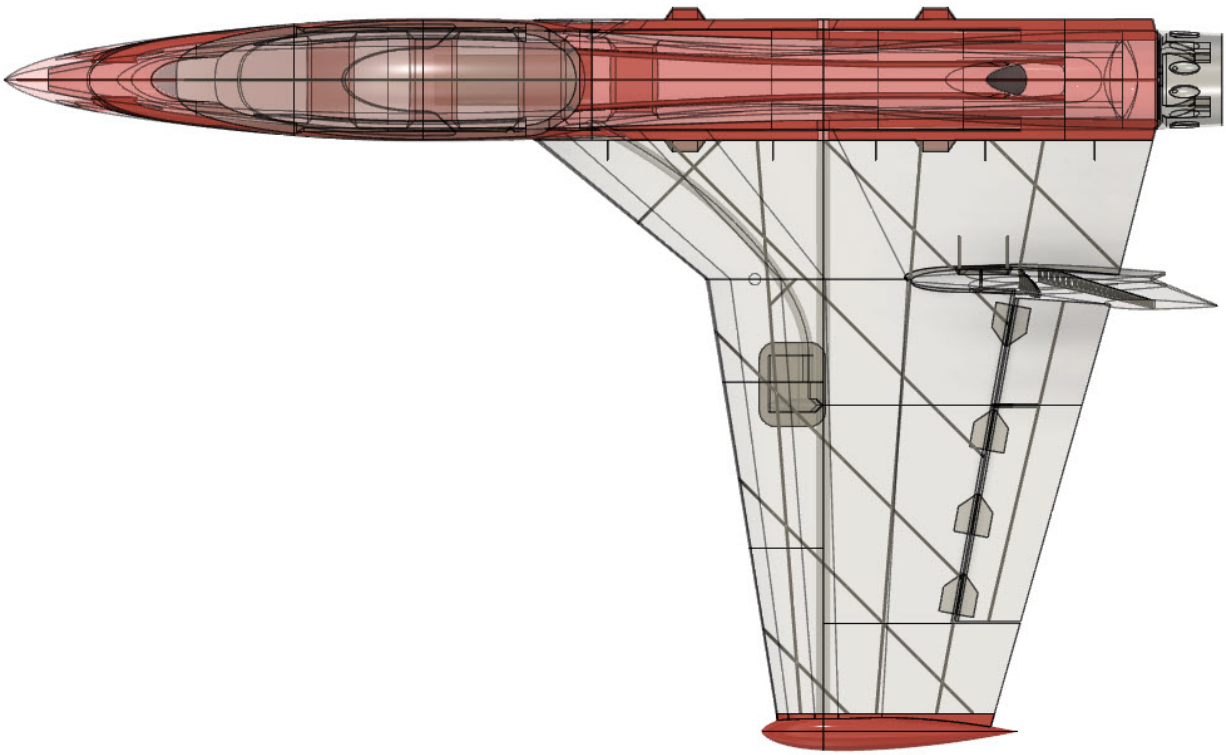
P Outboard Aileron - 9g

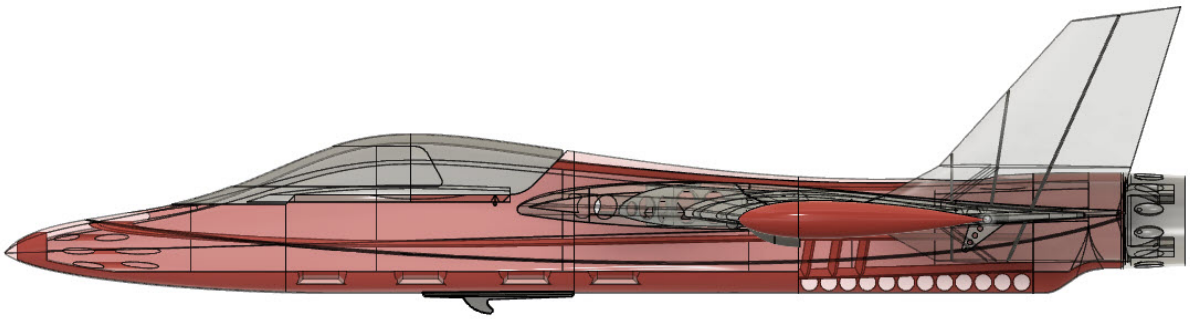


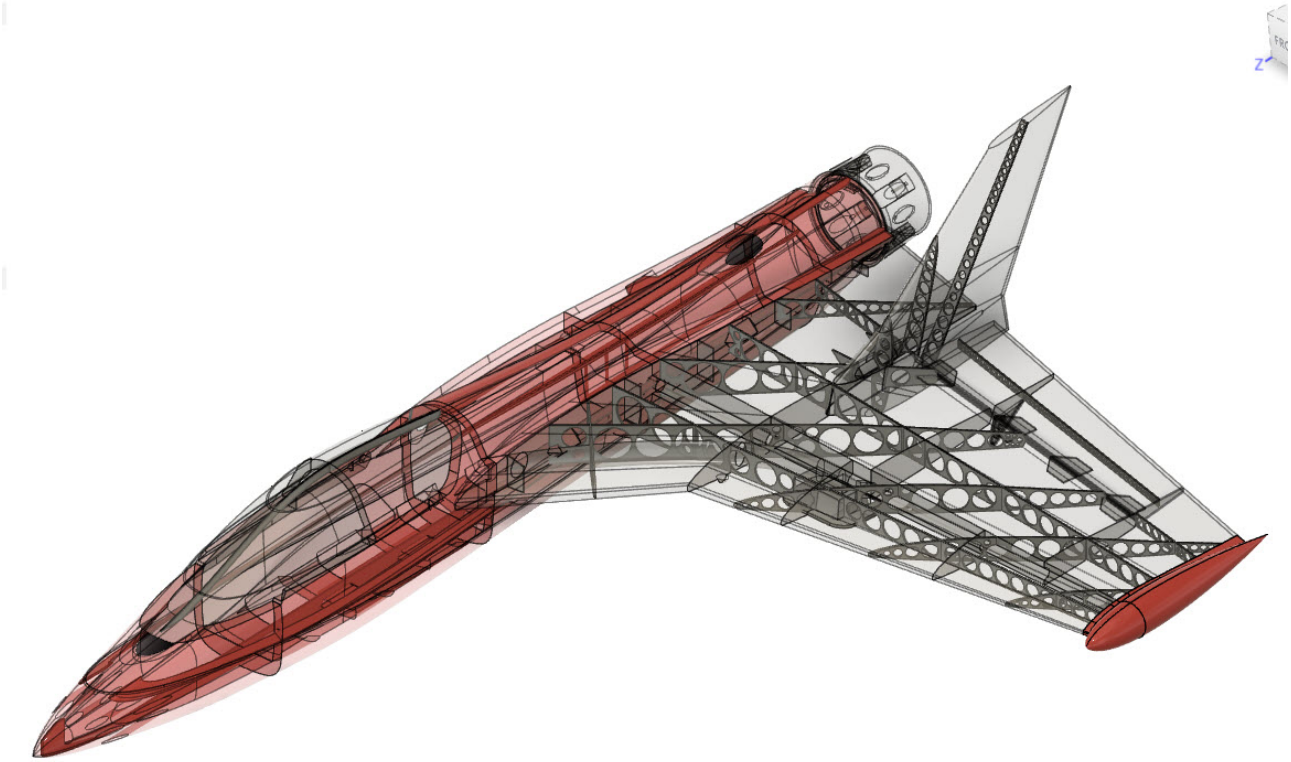


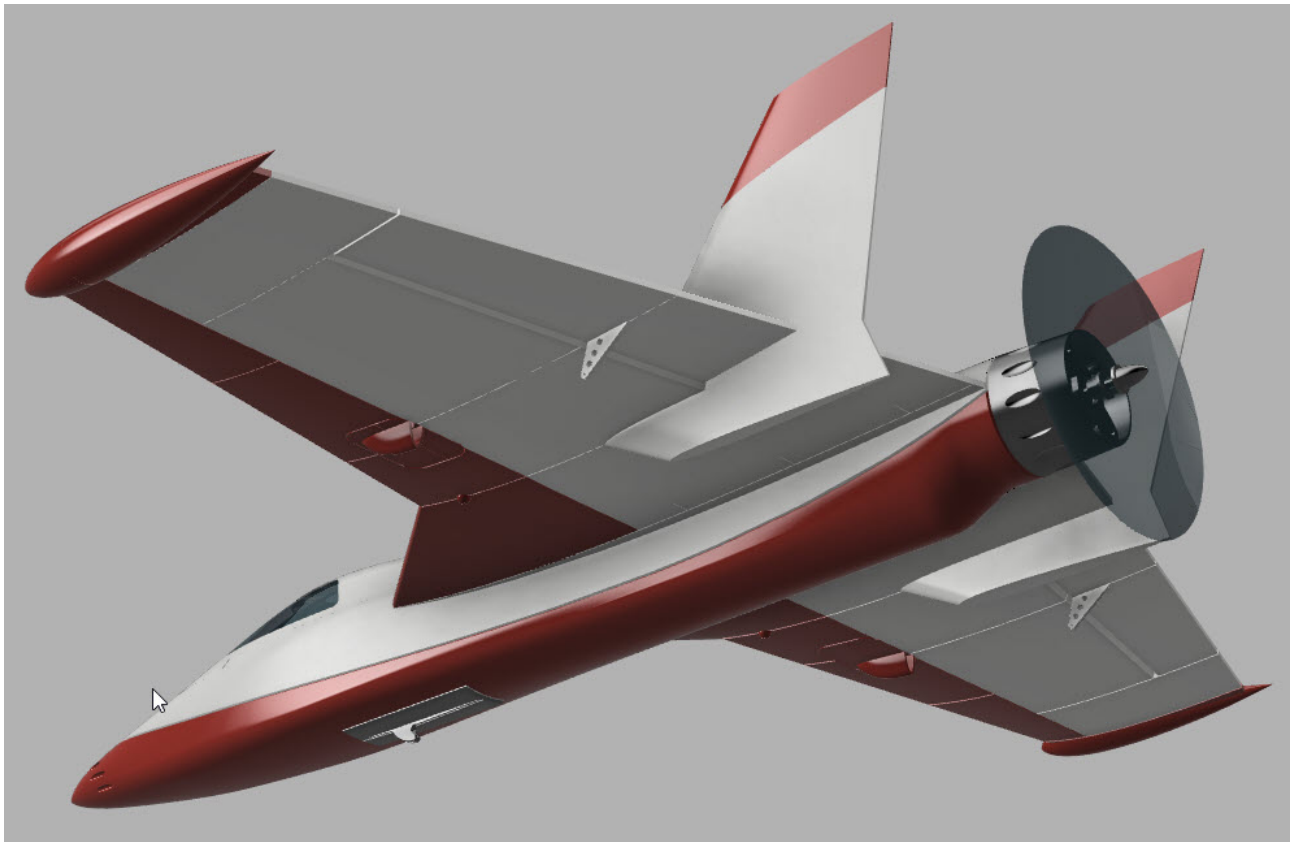


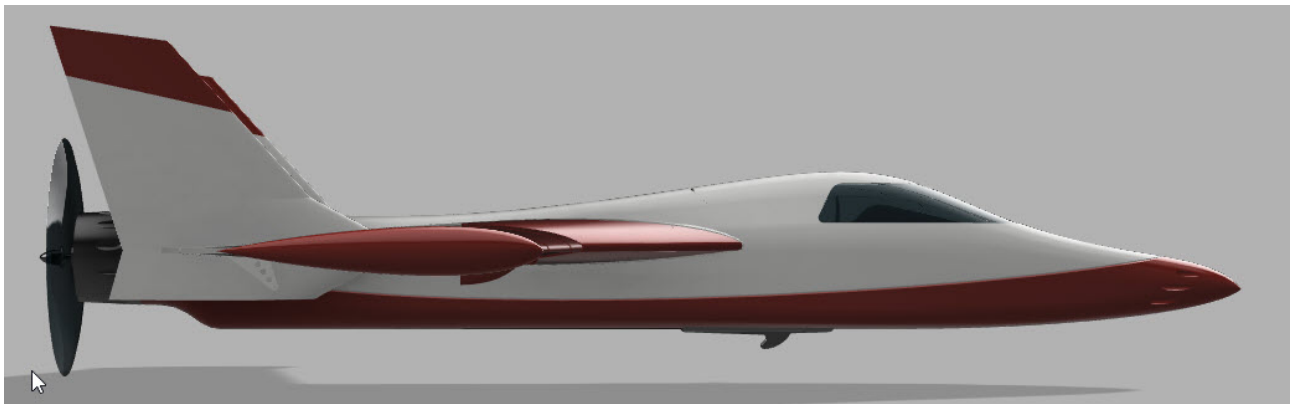












Included:

1.STL 3d files

Universal STL files designed for use with desktop FMD 3d printers and slicer software as Simplify3D (recommend) CURA or MatterControl (this STLs are not compatible with Slic3r).

2.Factory files for Simplify3D slicer

With all our setting, this Factory files included all you need, note: we use PRUSA i3 ORIGINAL printers so you may need adjust the basic printing parameters to match your printer or use it as a start point for you, please give a look to Simplify3D

3.Step By Step PDF/VIDEO userguides

Apart from this userguide, please give a look to the Printing Guide with some Tips and Advices for airplane printing (Thin Wall Printing)

4.Gcodes

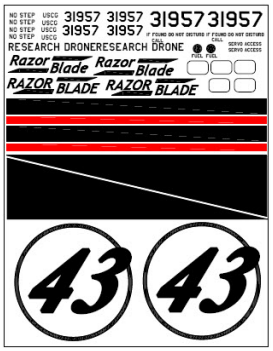
Basic Gcodes prepared for direct use, so universal as is possible. Should work with i3 style printers, you can try it out, but We can not guarantee that it will work with your printer. 100% works with PRUSA i3 ORIGINAL 3d printers...

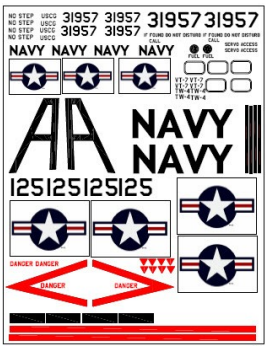
5.Prepared settings for CURA and MatterControl slicers

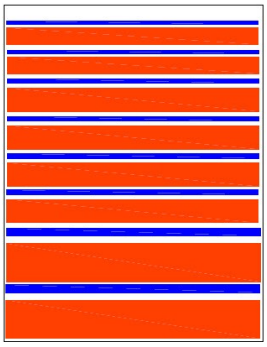
If you dont like Simplify3D for any reason, there is always possibility to use another free slicer you can use our basic setting (setting files) as a start point and edit it as you need.

6.Decal Sheets PDF –

Several pdf files are supplied for you to choose from. You may print these on readily available decal paper using your own inject printer.





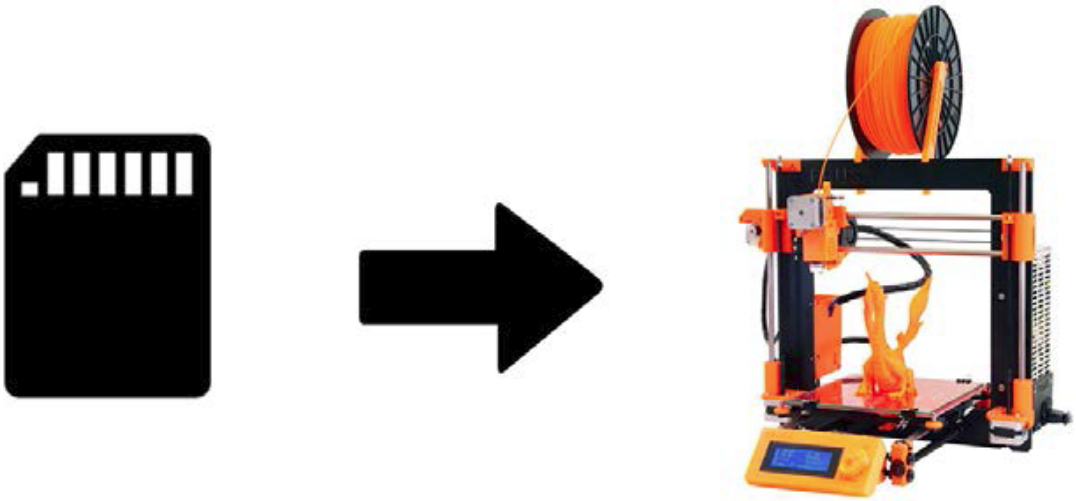


Printing

1. Gcodes Preparing

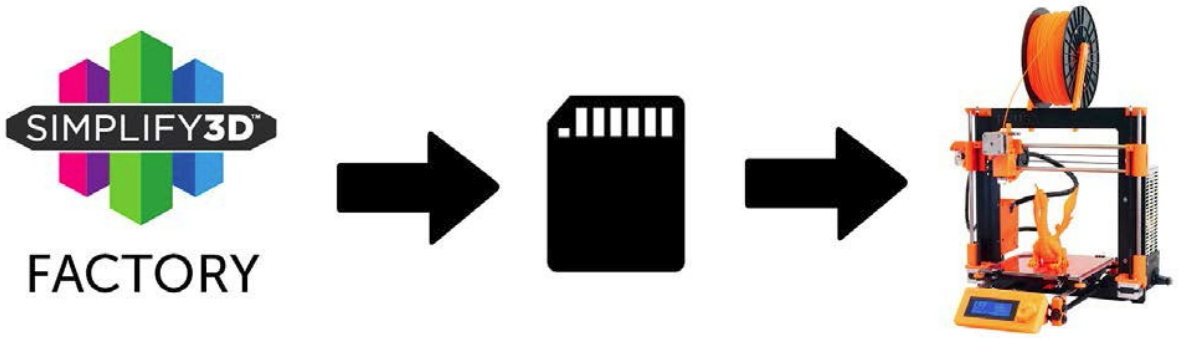
Options A Gcodes:

if your printer is i3 compatible you can directly use prepared gcodes, simply save each to SD card and let 3d printer do his job, HE temperature is set to 230 for best layer bonding, you can edit speed and temperature on your printer LCD only. If Gcodes does not work please proceed to the next options.



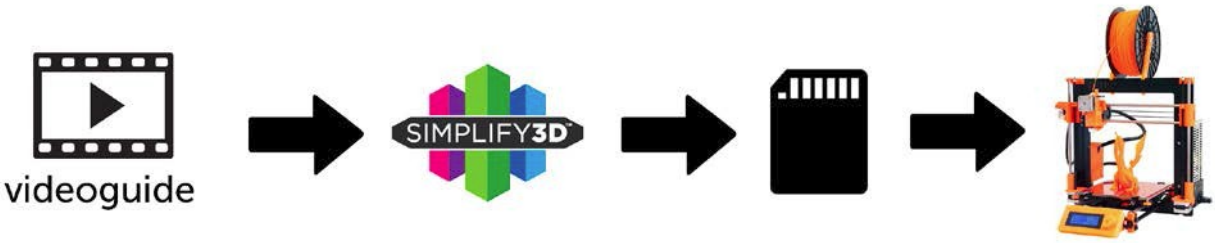
Options B Factory files Simplify3D (recommended)

We prepare all you need in this files (basic FFF, parts arranged and so on...)
You can use this our setting as a start point and edit it as you need (adapt it for your printer),print only parts you need and so on... On most 3d printers it should work as it is, but please give a look to the setting and edit it if is different to your printer, we are not liable for damages resulting from the use of our settings. If this does not work please proceed to the next option.



options C Simplify3D manual setting (watch and learn)
Use our video guide 2 for proper setting... this is very good option and you will learn a lot about Simplify3D and become a 3d expert. Of course you spend a lot of time and YouTube pause button will become your friend.

options D CURA or MatterControl



MatterControl and CURA are free and also gives very good results and airframe is still strong enough, slicer setting is very easy.

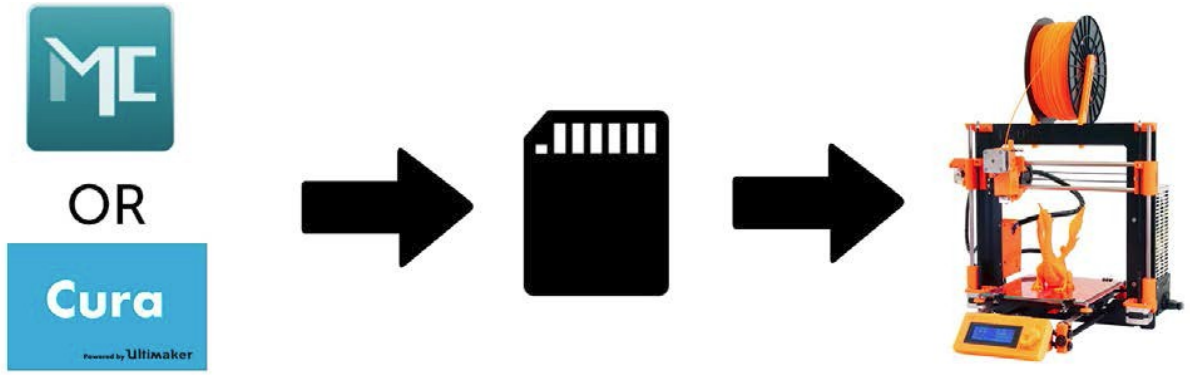
Please try find right extrusion multiplier and temperature for good weight and best layer bonding, give a look to parts weight list for proper multiplier setting.

You can also use our predefined CURA or MC slicer setting file included in package (always adapt it for your printer, change build volume, filament diameter and so on... depends on your printer!!!):

CURA_wing_fuse.ini (wing and fuselage and so on... parts)
CURA_ailer_elev.ini (only ailerons, elevator and rudder parts)
CURA_thick.ini (motor mount, battery holder, spinner)

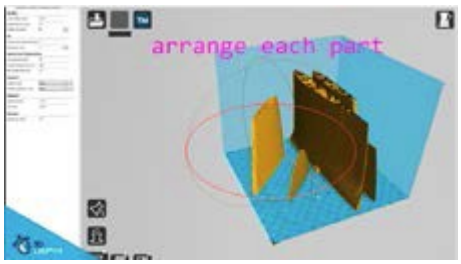
OR

MC_wing_fuse.slice (wing and fuselage and so on... parts)
MC_ailer_elev.slice (only ailerons, elevator and rudder parts)
MC_thick.slice (motor mount, battery holder, spinner)

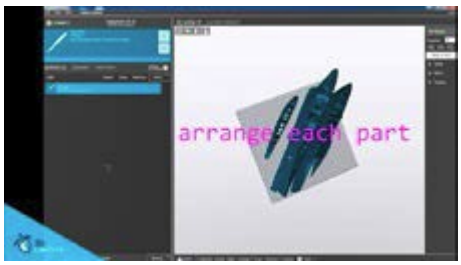


AND... please give a look at these VideoGuides;

Video Cura slicer setting



Video Matter Control slicer setting



2. Print it

Save generated Gcodes and insert SD card to your printer, prepare your printer and start printing, we prefer to use SD than direct connection via USB Note: ABS filament is not suitable or this...
Scaling the model will lead to unusable result!
video guide about printing
You will need: PLA filament - good quality and strong PLA (we need good layer bonding)
Strong hair spray (or your favorite adhesive bed surface)

Razor blade

AND... please give a look to VideoGuides: Video printing guide (similar to this 3D LabPrint Spitfire)

Basic Tips and Advice

Please Experiment with your extrusion multiplier...

Also HotEnd temperature is very important for strong result, please try increase temperature to find the best value (200 up to 260 celsius)

Turn OFF cooling fan for better layer adhesion (Hot End fan ON of course) we don't need it for our thin wall printing...

We tried a lot of filaments and so far PLA is still the best for our models (2016).
You can try also PETG and PC-max from Polymaker is very promising filament.

HEATED BED is very recommended, 60-70celsius (print without warping ends) (but please read personal note below)

Looks like any standard quality PLA is OK for our planes, BUT it always depends on combination PLA vs. Extruder vs. HotEnd.

We find that some color of filament has lower layer adhesion, always check if you are printing in a solid color.

Nowadays there is lot of 3dprinters on the market, most of them are OK for printing our aircraft (specific thin wall printing...) sufficient volume, heated bed, 0.4mm nozzle.

3D LabPrint Printing Guide

More on Printing Parts

Most all of this project is printed using the "single" line printing technique as outlined by 3DLabPrint . Essentially there is "no infill" selected, and only 1 layer on outside, 0 on top or bottom on most parts. Simplify3D (and other software may) allow for the creation of special options, such as 2 outside layers up to 1mm then only 1 thereafter. This allows for a little thicker edge where parts are glued together.

You will also find that printing the ailerons, horns down, with 6 bottom layers creates a solid control horn.

Layer height – 0.2mm for most parts

Nozzle Diameter - 0.4 mm

Time Lapsed Videos

Watch these videos on printing suggestions on the typical parts. You can learn a lot about orientation, etc.

Ailerons Canopy Fins Fuse A Fuse B Fuse D Fuse E Launch Hook Motor Mount Wing Section SBA3 Wing Section SBB3

RazorBlade Maiden Flight RazorBlade 2nd Flight

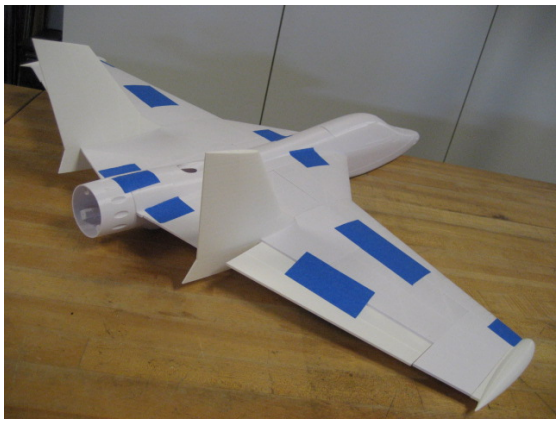
Personal Printing Note From the RazorBlade Designer:

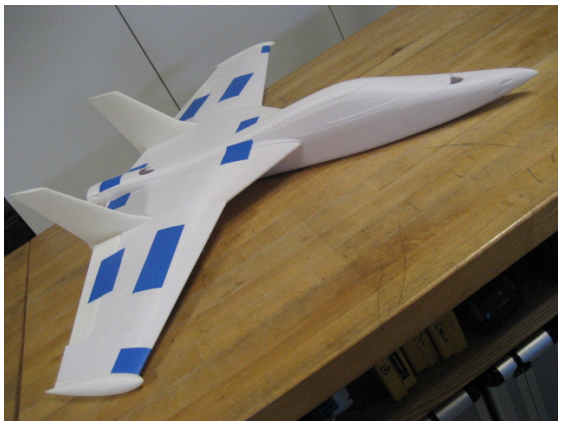
I've found that keeping a high bed temp (60c+) with thin parts causes radial shrinkage (5mm-20mm above the bed) during longer prints. My best printing now uses a low heat (35C) bed temp. I print on 3M Blue Original Painter's tape which I squeegee down on glass with a credit card. A slower first layer speed (60%) at the proper height, gives a great bond for the duration of the print. Make sure the temperature for your particular brand of PLA bonds each layer well. This may change slightly with different colors within the same brand. Accuracy with our prints depends on a tight, well setup machine, quality manufactured filament (diameter tolerance) and lastly accurate temperature management. Insulation on the hot end (such as a silicone cover or cotton padding) (see time lapse videos) helps the controller keep a rock steady temperature. Keeping a steady temperature minimizes visual print anomalies.

Additional note – I've been experimenting with PEI bed sheets from various 3D print suppliers and have had good success. If anything, large flat base prints, are almost impossible to remove – so it seems to be good for our single line printing, especially if you use an attached skirt of several lines on small parts. You will see in the factory file, "Wing A4" I have moved the skirt to touch the part and increased the lines. You can use this method to counteract shrinkage lift on large parts too.

3. Assembling printed parts

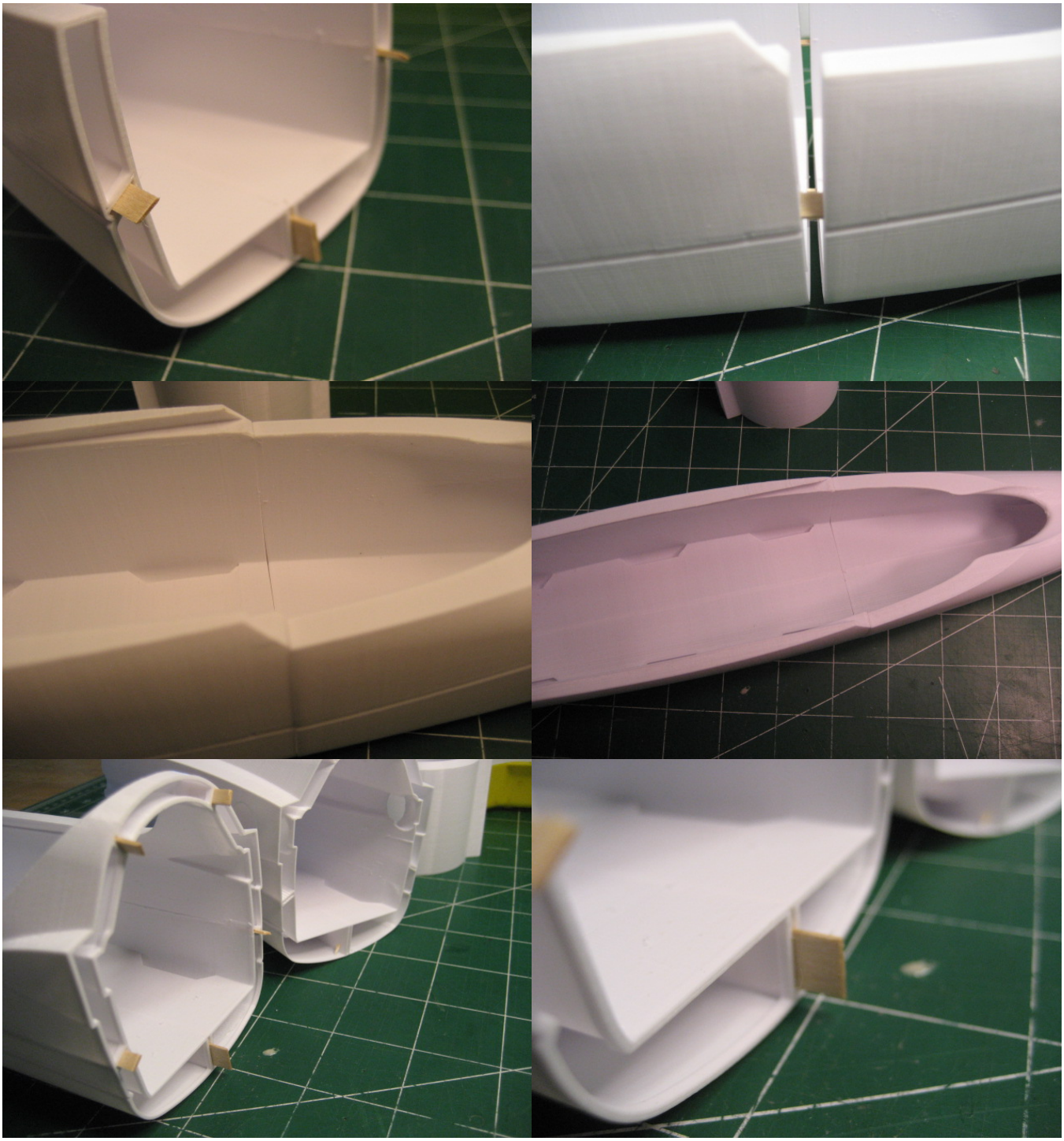
- Note: Assembly suggestion – I've found this glue to be excellent and a much cheaper alternative to hobby shop comparables. Works with accelerator, safe for PLA, bonds almost instantly with a bit of pressure, safe for some foams. Otherwise, you can use your favorite hobby shop medium CA, I like to use the foam safe due to lower fumes and its much more versatile.
- Note: Assembly suggestion – The use of true 3M Brand blue painter's tape is recommended for many assembly processes. As mentioned above, I also use it for bed adhesion and it works perfectly 99.9% of the time. When assembly portions of wing, I simply cut squares of the tape (I buy the 1.88" width) and use two or three squares as temporary "hinges" between two parts. I carefully line up the parts and squeegee the tape down using an old credit card. Then I open the parts like a book and carefully apply the glue, close the book, double check alignment and apply moderate pressure for a few seconds. Peel the tape off before it the glue kick completely to prevent leaving a stuck blue blemish. Super simple and effective.
- I also use a full sheet of 180-220 grit sandpaper laid upon a flat surface to "dress" the mating surfaces of parts before assembly. This ensures there are no printing "artifacts" that might prevent good joint closures.





Fuselage Assembly -

From the pictures below, you may use thin plywood pieces to insert between sections, this makes assembly much easier and stronger. Always test assemble first before applying glue!



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A note on fastening the Bungee Launch hook

The hook pad (if used) is fastened to the underside of the fuselage. The back edge of the pad is aligned with the joint between the "Fuse B" and "Fuse C" sections. You will find that the shape of the pad fits perfectly the fuselage at that particular spot. This placement gives the best balance between forward speed and vertical gain during the launch. See cover picture.

Wings assembly

First assemble the wing "A" parts, A1, A2, A3 and A4 together.

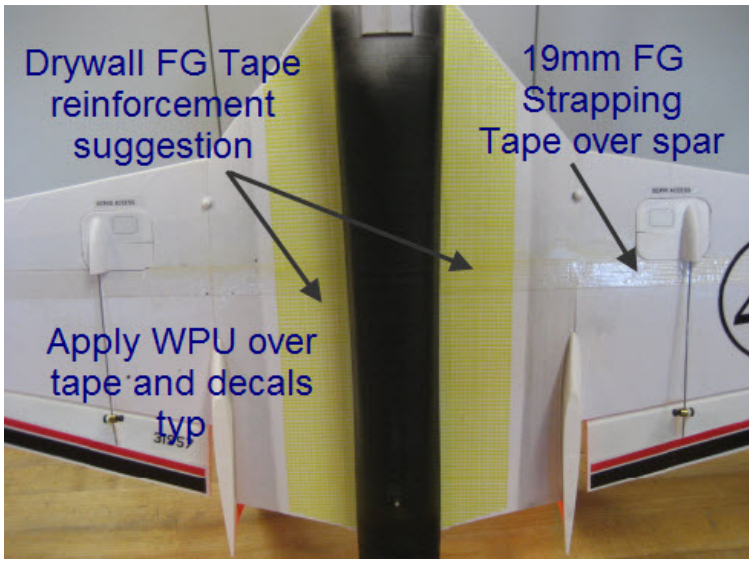
Now assemble wing "B" parts, B2, B3 and B4 – make sure of careful alignment.

Next, assemble "B1 and "B2" together with the fin between. Careful pre-alignment and trimming may be necessary before committing to gluing.

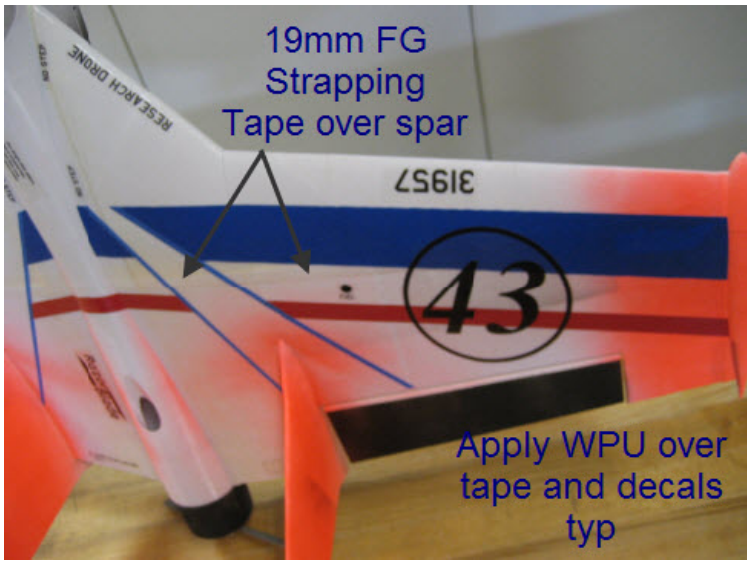
Test your 8mm carbon tube in the recesses of the leading and trailing edges of the wing. Again, make sure the tube fits easily between the halves, if so, then proceed.

1. Again, using the noted "tape hinge" technique described above, assemble the "A" Leading Edge to the "B" trailing edge. (sand mating surfaces flat)
2. Same technique, assemble the wing tip "A1" and "B1" to the end of the wing.
3. Aileron assembly. Straightforward, this is best accomplished on a flat surface, you can use a cooking parchment paper under to prevent the parts for sticking to the bench.
4. Hinge installation – it's easier to install the ailerons at this time. Use your favorite CA Hinges for fastening ailerons to back of wings. Be sure to "flex" the ailerons downward to get the correct hinge gap before applying glue. I use regular thin CA to make sure it wicks into the pocket. Don't apply kicker if possible and let harden naturally. "kicking" the CA flashes the CA and results in a crusty hinge that does not flex as well.
5. Cut your 8mm carbon tube to 750mm (29-1/2") and center it though the fuselage hole. Slide the wings into place and glue securely. Use tape and careful methods to pull wings tight to the fuselage. Arrow shaft or hardwood is an alternative. If hardwood, definitely reinforce wing with tape as shown step #7.
6. Glue the motor cowl on the back of the fuse.

7. Wing reinforcement – Depending on how hard you intend to fly your RazorBlade, you might want to consider adding reinforcement. This can be accomplished several ways. 19Mm wide strapping tape (fiberglass stranded) can be applied above and below on the center wing spar. Also, you can use fiberglass tape such as used on drywall joints on the underside at the wing roots, this will help immensely with 'high-G" turns. (See Pictures)



8. Hatch – Glue halves together and test fit on fuse. The hatch should slide into place and "clip" over the latch on the last few millimeters.



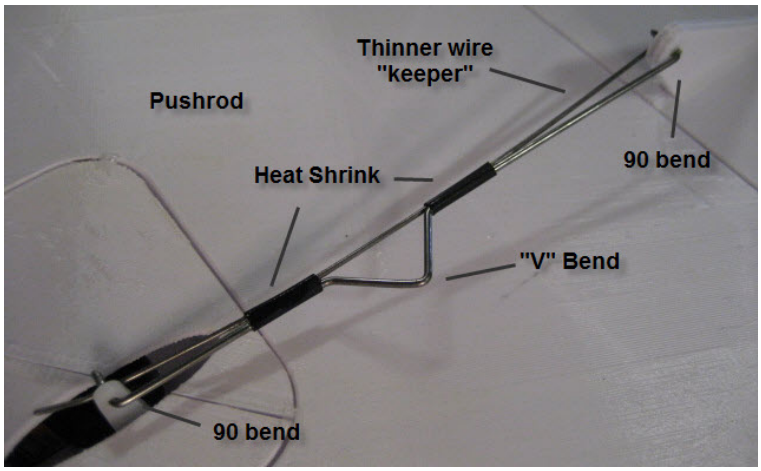
Airframe is now complete!

Final assembly -

1. Bind your RX on the bench, connect the ESC and motor (prop off of course) and determine correct motor direction. Mark the wires and disconnect. Due to the depth of fuselage you will need to feed the ESC wires through the motor mount, connect the motor and pull the wire back into the fuselage.
2. Attach the motor to the mount using four small sheet metal type screw. Socket headed screws such as these in a 9/16" length are perfect – and as they advertise these screws are very useful in many applications. I also place four small washers under each motor lug to insulate the motor from the mount – you may need this anyway to get more clearance for the prop. Note; you may

also use this method to change the "angle" of thrust to adjust any tendency to climb or dive under full power.

3. Attach the prop. If you aren't using a "pusher" prop, make sure the nut is tight, a dab of blue Loctite ensures this.
4. With Velcro on the bottom of the ESC, fit the unit within the fuselage and press down.
5. Using the supplied mounting foam, press the RX into place just behind the battery shelf.
6. Apply a strip of Velcro onto the battery area.
7. Feed a battery strap through the fuselage slot.
8. Attach the servo extensions to the servos, if needed. I use a short piece of heat shrink around the connectors to ensure they stay firmly together. Feed through the servo lead tunnel and attach to the RX.
9. Ensure that you are using an adequate servo arm (the shortest possible) and that it is firmly attached. Fit the servo into the pocket and use a small application of medium CA on either side to hold in place. Just a short ribbon is enough, we want to be able to nibble it out if we need to replace a servo.
10. Fit the servo covers into place and use a very small dab of CA to hold them there.
11. Bend your servo push-rods as shown. You may have to use a pin vise and drill bit to clean out the aileron holes to the perfect size. Extra care taken here will ensure a control surface without slop and precision in the air. I don't like "Z" bends – they are hard to make accurately and they "enlarge" the hole while trying the get them into place. My preferred method is to make a hard right angle bend where needed and use another piece of smaller diameter wire as a "keeper." See picture – once you use this method you'll appreciate how easy it is and especially for



installation and removal. Also notice the extra "V" bend in the pushrod, this is a tried and true method for accurately adjusting the length during the installation.

12. Consider applying a strip of sandpaper on both sides of the fuselage where you would naturally grip the plane for hand launching.

Setup

1. Configure your RX or TX for "delta" wing configuration and verify correct movement of the surfaces with the intended stick movements. If your RX is stabilized, then you also need to ensure the correct surface movements visa-vie air frame movements. Hopefully this is not your first gyro setup, but if it is, be absolutely positive that you understand and have the parameters set up correctly. A stabilized plane with incorrect surface setups will not fly, a hand launch stabilized plane will crash immediately! (I've seen this happen more than once – not me of course . . . a friend. ;-).
2. Spektrum File – If you are using Spektrum equipment and the Lemon Plus RX, the included .SPM files will get you a long way toward finalizing your setup. You can read about how to load .SPM files here.
3. Control surface throws – High Rate – 5/8" (16mm)up and down, 50% Expo. Low Rate – 1/2" up and down (12mm), 60% Expo. (Measured at at aileron tip next to fin) Yes, that's a lot – but during a hand launch, you want full control movements for those initial seconds, after that the expo will tame down the movements for smooth flight. You may find launching on high rates and switching to low rates after settling in will be beneficial.
4. Center of Gravity (CoG) – is very important on flying wings as there is no tail to help counteract an imbalanced airframe. There is a molded "bump" on the underside of the wing, this is the recommended CoG, balance the airframe on your fingertips. Battery movement and a spot of lead might be necessary to get the proper CoG. The design assumes using a typical 3S 2200 Lipo battery.
5. Neutral Control Surface Setup – The RazorBlade airfoil is designed with a little reflex, this means that a neutral setup on the ailerons is EVEN with the wing surface (part B4). Also, using a 6x6 EP (APC Pusher Propeller) you *may* want to dial in a little left aileron bias to counteract for prop torque. (port aileron up 1mm, starboard aileron down 1mm). Most likely you will be trimming this in once the bird is flying anyway.

Livery

I like to paint my planes with a coat of Minwax Polycrylic or Deluxe Eze-Kote a modified waterbased urethane product (WPU) that goes on thin, dries quickly without brush marks, sands easy if needed. Being a urethane, it is essentially an adhesive, which adds a bit of strength to our printed planes by "filling" in the record grooves of the printing process. This material is super, try it, you'll find many uses for it!

A coat of clear and then use any rattle can paint for graphics as wanted. Or use the supplied PDF, water slide decals, and your inkjet printer to make perfect professional looking graphics. Another coat of clear seals the decal edges once applied. Have fun here and personalize your RazorBlade or a fleet of them.

Flying

For a successful maiden flight you need several things in your favor.

1. Correctly setup airframe
2. Confirmed CoG
3. Confirmed Neutral Flight control surfaces.
4. Fully charged battery
5. Wind in your face
6. Proper Launch Technique

The first four have been covered and are obvious. Wind in your face indicates that you're going to launch "into the wind" this increases our "airspeed" and decreases our "ground speed." Increased airspeed gives us lift and surface control, decreased ground speed minimizes damage if the worst happens. The RazorBlade is not afraid of wind, so you don't be either. It will penetrate and cut through when other planes are left in the hangar.

Proper Launch Technique – is just that. You can't limp wrist this bird and expect to have success. Attention to a proper launch is critical EVERY TIME!

1. Radio on a neck strap lanyard, that way you can one hand the throttle.
2. Feet together

3. Arm outstretched overhead
4. Bird balanced between thumb and forefinger. A good solid grip (you applied your sandpaper, right?)
5. Nose pointed upward 30 degrees from horizontal. (this is important, find out what 30 degrees looks like) WINGS LEVEL!
6. Now, in one fluid motion, like throwing a baseball, step forward and chuck the bird hard, upward into that 30 degree incline, while advancing the throttle to full.
7. A proper launch into the wind will have the bird arc over to level flight while you're putting your hand on the right stick ready to pull elevator. If you've done it right, you don't lose altitude. (a stabilized RX is great for hand launches)

I've seen so many hand launch birds go in on launch due to not paying attention or developing a good launch technique. A weak chuck and the plane will stall and pancake into the ground. Arm not extended and you hit your own head or hat with the left wing. Wings not level, she veers off left or right, stall and crash. Advancing throttle too late or not enough. Getting freaked out and over-correcting, the plane flops around like a fish, stalls and goes in. This is not you!

A hand launched bird has the benefits of being lightweight with better aerodynamics due to no landing gear. These smaller birds are cheap and most of all, fun. That's what its all about right?

Plus, there's an added benefit – noise! We don't usually have noise with electric planes. The RazorBlade sounds like a hot nitro in the air. The prop "chops" the slipstream coming off the wings and the printed wings resonate – the result is satisfying hot and low passes down the runway.

Alternate Launch Technique

If you've done a lot of hand launches in your experience as an RC flier, you know that eventually one will go wrong. Consider bungee and ramp launches as an alternative. It allows a pilot to focus on the sticks and watch the plane from the get-go. This designer also has a launch ramp option available on 3DLabGang. Try this . Most experimenters using high power setups use a bungee launch to get their bird up to initial speed. Try it, you won't be disappointed.

Innovation

Sure, there are a lot of flying wings out there, the simplest type of flying there is. But there are not many 3D Printed flying wings yet. This design explores the state of the art while having fun doing it. The generous hatch area, double wall fuselage, bungee launch capability all add to a great experience and fun RC flying with your buddies.

All the best, Don – and the 3DLabGANG

P.S. I'm also a writer. If you are a reader of suspense novels you will enjoy my book, "Found Money." Available on Amazon

An elegant and simple design is the result of an investment of sweat equity from the designer. Please honor that investment and keep these files private. Thank you.