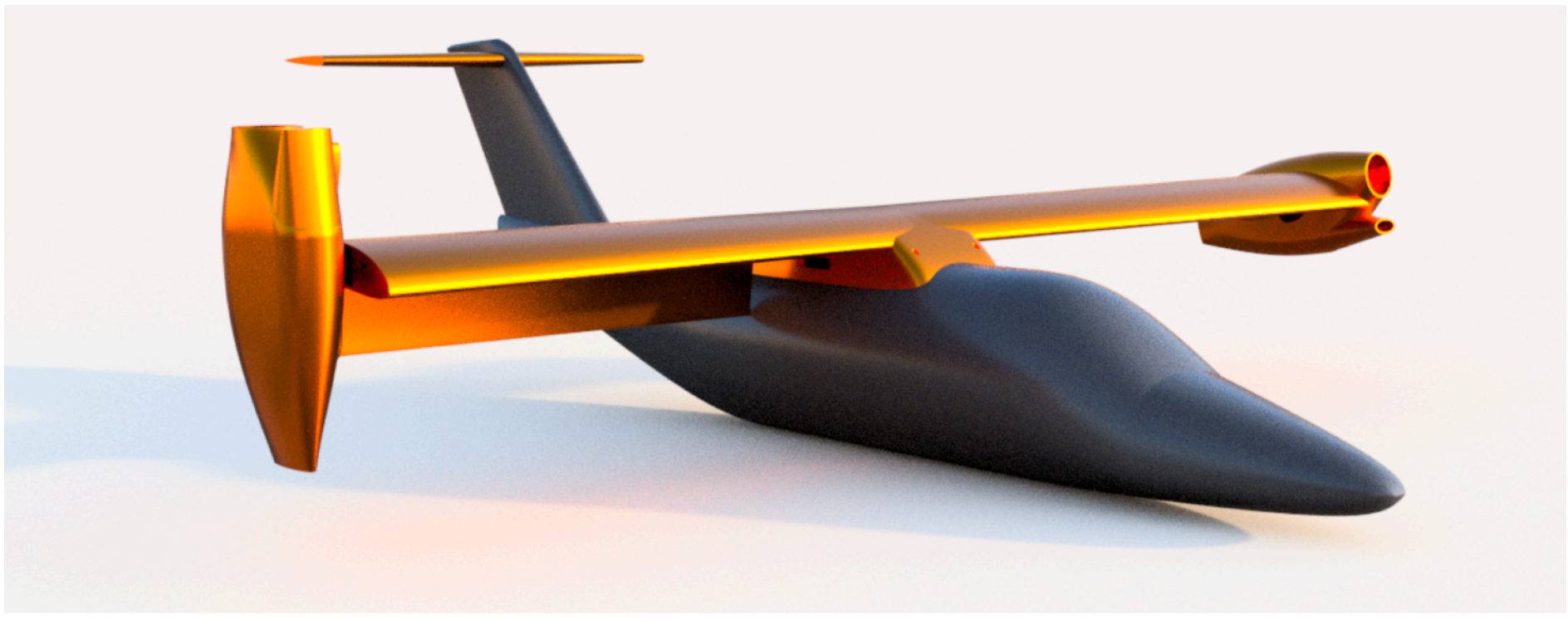
rc3Dprint

BETA

AW609 TILTROTOR



PRINTING AND ASSEMBLY INSTRUCTION BOOK

THANK YOU

Thank you for downloading this AW609 Tiltrotor. These models take many hours of work to make available to you so please don't share the STL files with others. Send them to www.rc3print.com or www.rc3dmarket.com where they can download the models themselves. This enables me to continue to develop new models to make them available for download.

This document aims to help you print and assemble your aircraft. Our designs are made to be simple, this model is designed with PLA or LW-PLA in mind, so it incorporates carbon tube spars. If you print it from regular PLA it will obviously be heavier and you should take this into account.

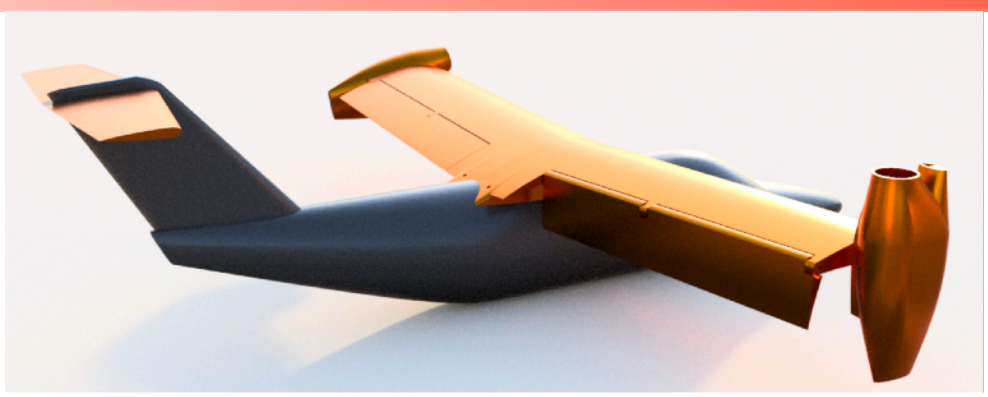
3D printers often have many differences so you may need to tweak settings to get the best results.

Included in the document you will find Cura profiles and layouts for each part and assembly instructions. Most of the components in the design are *solid bodies*, this has some advantages over hollow bodies in that you can adjust some settings such as wall thickness, infill percentage, etc. As such we recommend using Cura to slice the files though it is not required for this model. The walls of these solid bodies are single line 0.4mm thickness to reduce weight. As you are printing and assembling the model yourself we take no liability for damage or loss resulting from your use of these files. Please fly responsibly and follow all local laws.

Share your results on Instagram, Facebook, or by email and tag @rc3dprint for discount codes on future orders.

For questions please email rc3dprint@icloud.com

PARTS LIST



REQUIRED

This model requires a flight control board that can handle a VTOL application, that is transitions into forward flight. I used the super cheap kk2.1 board running the open source software OpenAeroVTOL but there are more up to date boards such as.

This is my set up:

KK2.1 running OpenAeroVTOL

S.bus connection from Rx with 8Ch minimum

LIPO 3S 2200maH

2 x 0945 props

2 x 2836/08 Motors

2 x 20a ESC

5 x 9g Micro Servo. For the 2 tilt mechanism servos best quality and strength required!

Piano wire for hinges and push rods

8mm OD Carbon Spar

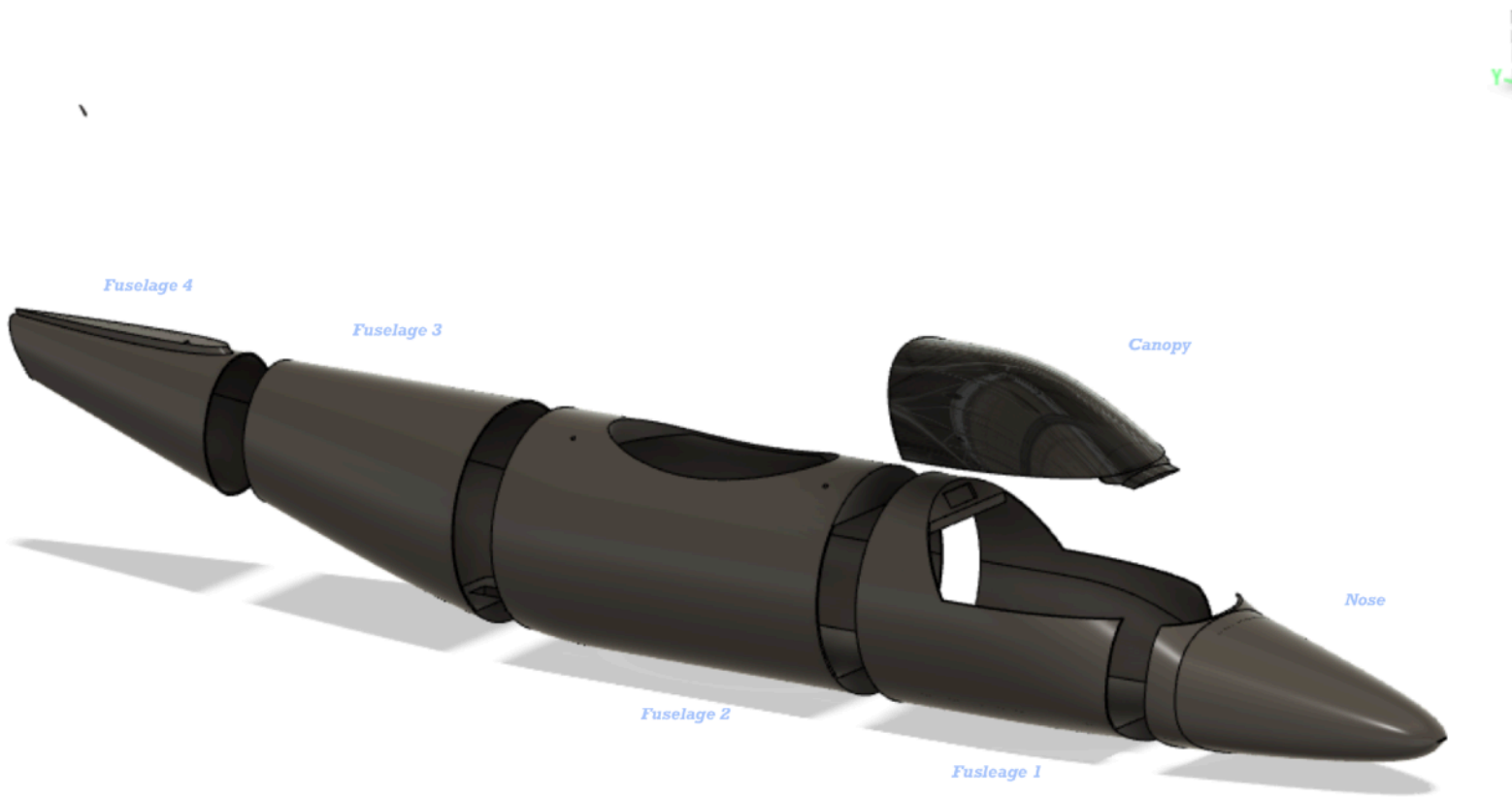
4mm OD 2mm ID carbon for elevator torque tube

2mm carbon for elevator hinge

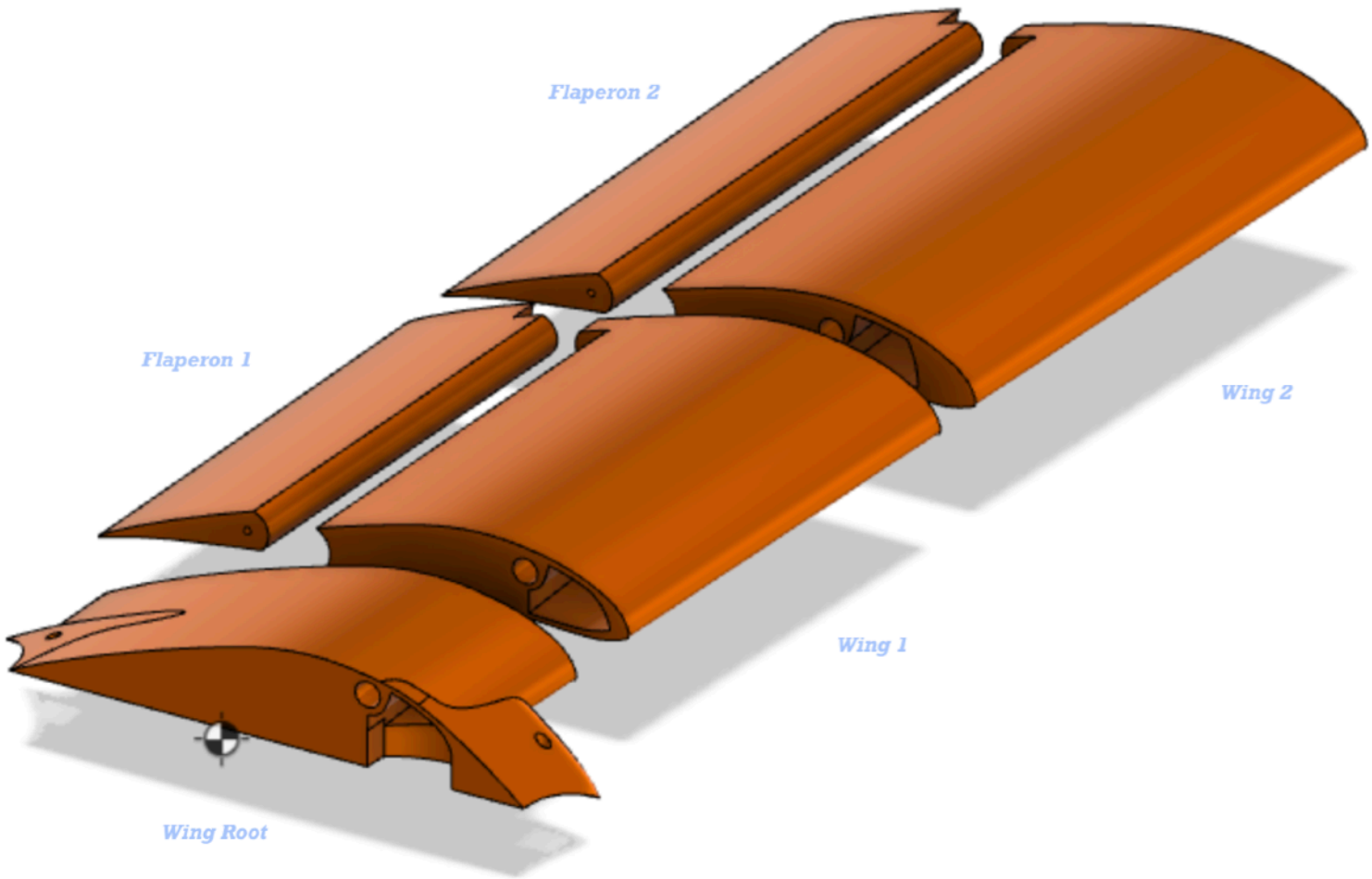
4 x Ball Bearings 8x16x5

INCLUDED STL. FILES

FUSELAGE

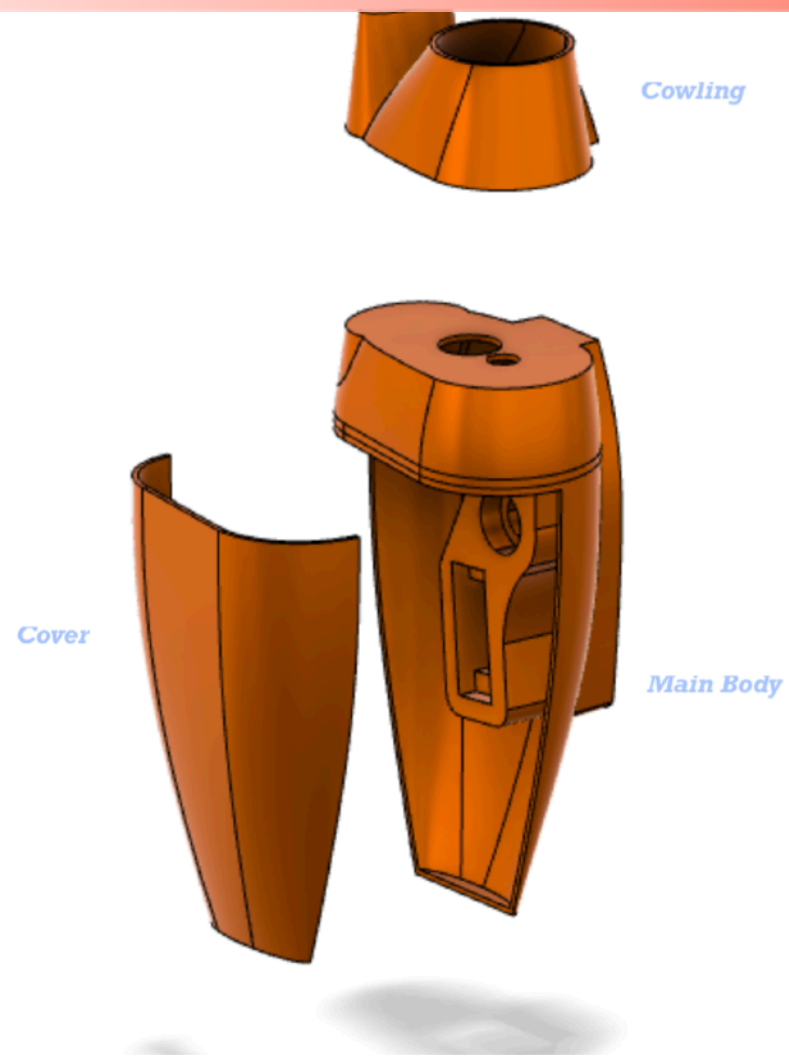


WING



TAIL

NACELLE



SPECIFICATIONS

Wing Span & Area

846mm span

Flying Weight

~1000g

Wing Loading

Not Calculated

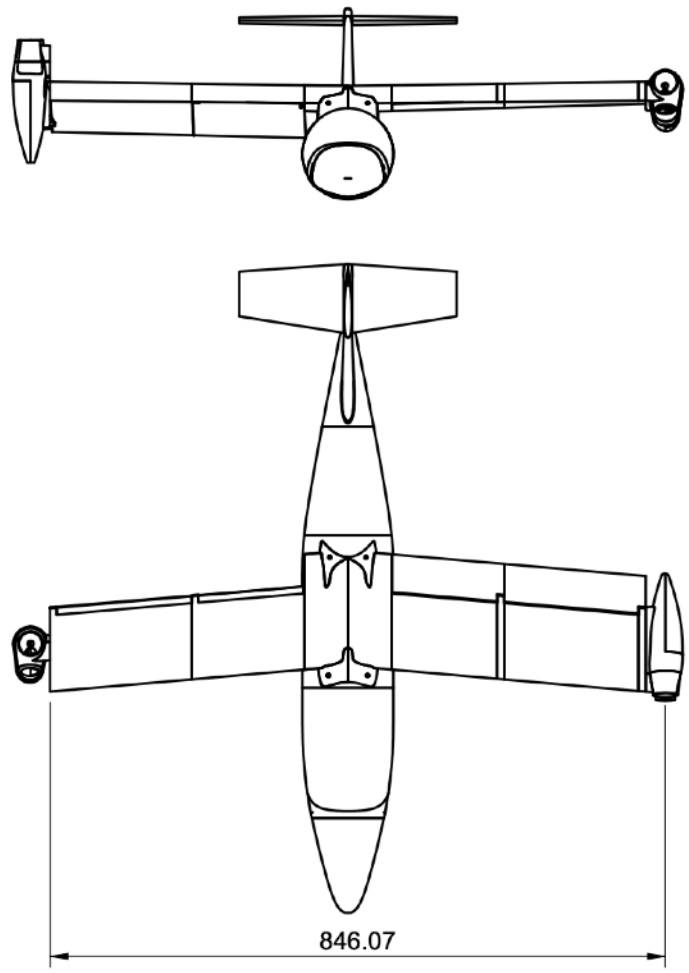
Wing Cube Loading

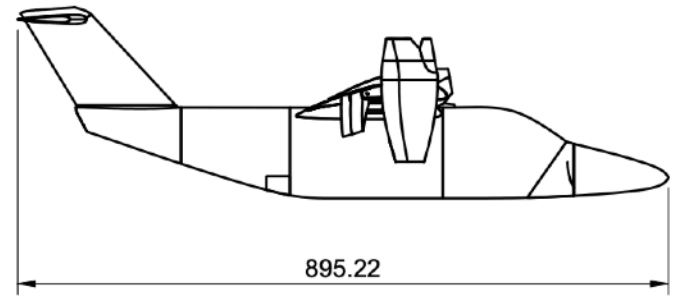
Not Calculated

Channels

7

Centre of Gravity - **Directly underneath the wing spar**





PRINTING PROFILES

In Cura create a new generic ‘Low Quality’ PLA profile. The change:

LW-PLA PROFILE

Layer height	**0.24mm**
Wall Thickness	0.4mm
Wall line count	1
Top/Bottom Pattern	Lines
Infill Density	3%
Infill Pattern	Cubic
Flow	50%*
Printing Temperature	240C*
Build Plate Temperature	60C (optional)
Fan Speed	20% Maximum
Generate Support	No
Build Plate Adhesion	Brim or Skirt

PLA PROFILE

Layer height	**0.2mm**
Wall Thickness	0.4mm
Wall line count	1
Top/Bottom Pattern	Lines
Infill Density	3%
Infill Pattern	Cubic
Flow	100%
Printing Temperature	200C
Build Plate Temperature	60C (optional)
Fan Speed	20% Maximum
Generate Support	No
Build Plate Adhesion	Brim or Skirt

TPU PROFILE

You can use your standard settings for the parts printed in TPU

* If printing in LW-PLA from Colorfabb we recommend following the calibration process

A WORD ON RETRACTIONS

With regular PLA a common problem is under extrusion at layer change - to fix this increase the setting *extra prime amount* in Cura.

With LW-PLA it is recommended to switch retractions OFF since trying to retract the foaming filament can cause problems. If you need to fix under extrusion you can still use the method above but will need to turn retractions ON and set the retraction distance to 0mm.

ASSEMBLY

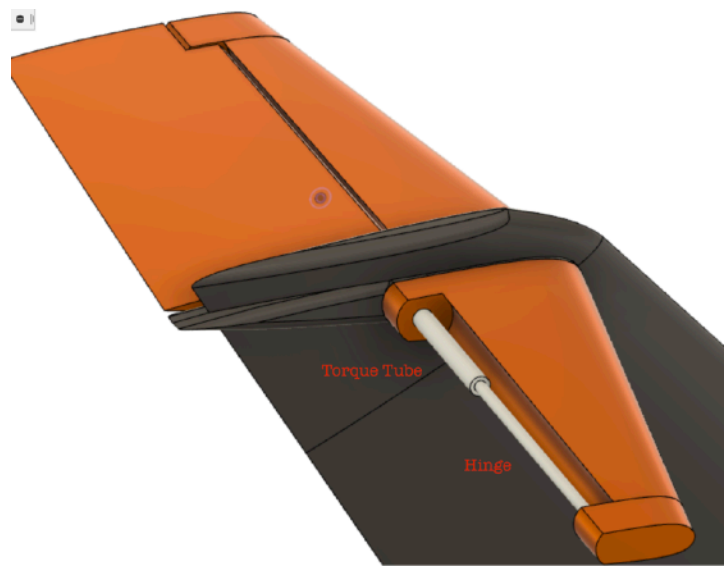
1. THROUGHOUT THE BUILD, ADHESIONS SHOULD BE CAREFULLY REMOVED AND FACES TO BE GLUED TOGETHER SHOULD BE SANDED FIRST TO ENSURE GOOD CONTACT. THIS IS **CRITICAL.** TIME TAKEN HERE WILL ENSURE YOUR AIRCRAFT IS STRONG.

FUSELAGE

- Before gluing the fuselage sections together place the elevator servo in place. It's a good idea to have the piano wire control rod in place too as it gets fiddly to do it when the fuselage is all assembled.
- Glue the fuselage sections together. Take care to ensure the Elevator control run is line up correctly.

TAIL

- Assemble the tail around a piano wire hinge with the Stab Ends on the end.
- With the elevator control rod fed through the tail you can cut it to size and glue down the elevator control linkage.
- The elevator has a torque tube setup. Each elevator should be glued to the torque tube so that they move freely together around the hinge. Obviously this needs to be glued together assembled around the tail.

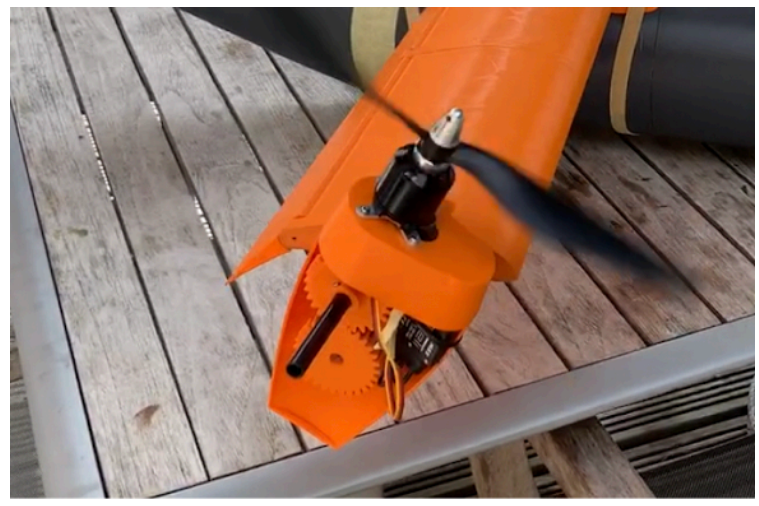


- The elevator control linkage is glued to the top

surface of the elevator. The control rod needs to be made of piano wire that is flexible enough to bend a little through the curve in the Bowden.

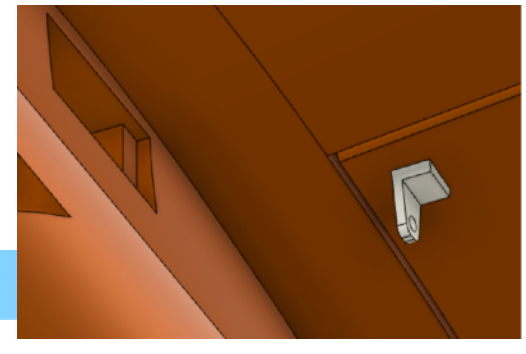
NACELLE

- Push fit the ball bearings in the nacelle main body. The best way to do this is with a G clamp, simultaneously pressing both bearings in from either side.
- The motor should be fixed down to the top of the nacelle main body with screws. The cowls can then be glued on.
- The nacelle servo should be metal gear and strong as it must pick up the weight of the nacelle. The servo wire may need the plug removed to fit through the cutout.
- The nacelle should house the ESC as well as the servo. When wiring up the ESC make sure the proper are contra-rotating.



WINGS

- Build the wing around the carbon spar. Dry fit all the pieces of the wing and nacelle to check for alignment. The spar should be glued into the wing root sections to prevent it from twisting in flight which affect the motor angles. Starting from the root build the wings sections up using the carbon tube to help with alignment.
- Position the nacelles onto the wing spar. In the above photo you can see I have delayed cutting the spar down to size until after the wing/nacelle build.
- The flaperons should be glued together. Use piano wire for the hinge which should be run all the way through the flaperons and wing hinge points.
- Sit the flaperon servos in place and with a touch of hot glue. The flaperon control linkage is placed as shown.



- As the nacelles house the ESC's you should run a lead from the battery to the end of the wing. When assembled the esc should plug into this lead and the coupling should sit inside the end of the wing, not the nacelle.

NACELLE WING ASSEMBLY

- With he Nacelle and wing assembled check the gears for size. Some servos differ so it's possible you will need to enlarge or shrink the gears by a few % to get a perfect fit. Make sure to adjust both gears by the same amount as a one to one gear ratio is ideal.

- When the gears are size correctly they can be assemble. I affix the servo gear using one of the servo disk attachments. I screw this into the gear then affix to the servo as usual. The Stator gear will be screwed in place on the carbon but <u>not until</u> we have done the calibration.

- *Calibration: You can come back to this later when you have the kk2 board set up: Put the tilt servos into full forward. Rest the tab on the aft of the nacelle wing join to the underside of the wing. As this is full forward you can now secure the stator gear in place by drilling a hole into the carbon and screwing a small screw in.*

WING FUSELAGE JOINING

- The wing can be joined to the fuselage by glue or mechanically using the holes provided. It's important to make sure you have all the wires you need checked before gluing if you decide to glue. That is 4 servo wires 2 ESC wires and 2 battery leads in total.

HATCH

- The hatch and fuselage has slots for magnets. I find if I wrap the magnet in masking tape it then glues down better with a dab of hot glue.

PROGRAMMING

Affix the flight controller to the floor of the fuselage close to the CoG but so that you can reach the buttons with the hatch removed. You may want to put some foam servo tape under the board before screwing down to help dampen down any vibrations. Check the location will be ok with consideration of required battery position. I secure this to the floor of the fuselage using velcro tape.

Provided in the download is OpenaeroVTOL which is open source software designed to work on the kk2.1 board. There is plenty of information available on the internet from people far more qualified to help with the flashing of this software onto your board so I won't do that.

I will provide my kk2 P.I settings I used to dial in the hover at the end of this document. My advice though would be FOLLOW THE RECOMMENDED PROCEDURE in the OpenAeroVTOL user guide for setting up your flight controller. This way you will learn how it works and be able to configure *your* model. Here is a thread on the software with lots of info.

There are more modern, alternative VTOL flight control boards out there, feel free to experiment and report back your findings!

Here is what we are aiming for.

Vertical Flight (Hover)

The control board should use forward and backwards tilt of the nacelles to control pitch and differential tilt to control yaw. Up and down should be controlled by thrust along with differential thrust for for roll.

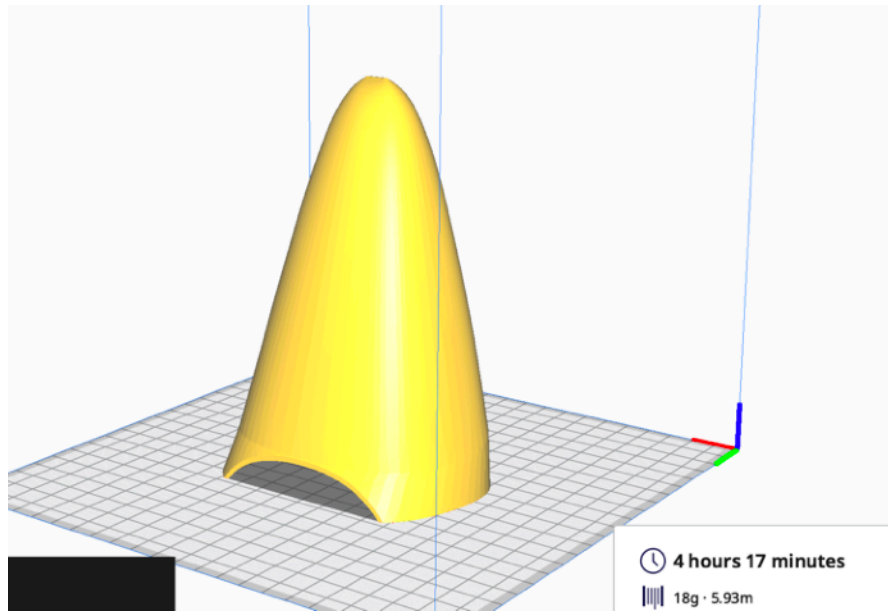
Horizontal Flight

Roll is controlled by the flaperons, pitch by the elevator and yaw by differential thrust.

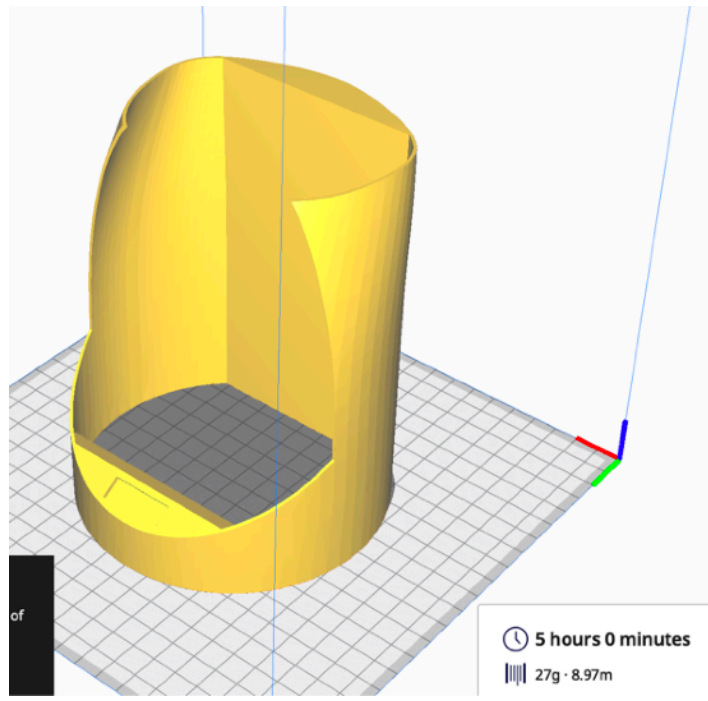
During transition the control board will blend. DO NOT USE ANY TRIM ON THE TRANSMITTER as this case all sorts of problems. For instance if you use trim to null out a yaw in the hover, this trim will then turn into a roll in forward flight. Ask me how I know…. Fore this reason we should aim to get the model trimmed either mechanically or through the settings on the flight controller.

CURA COMPONENT PLACEMENT

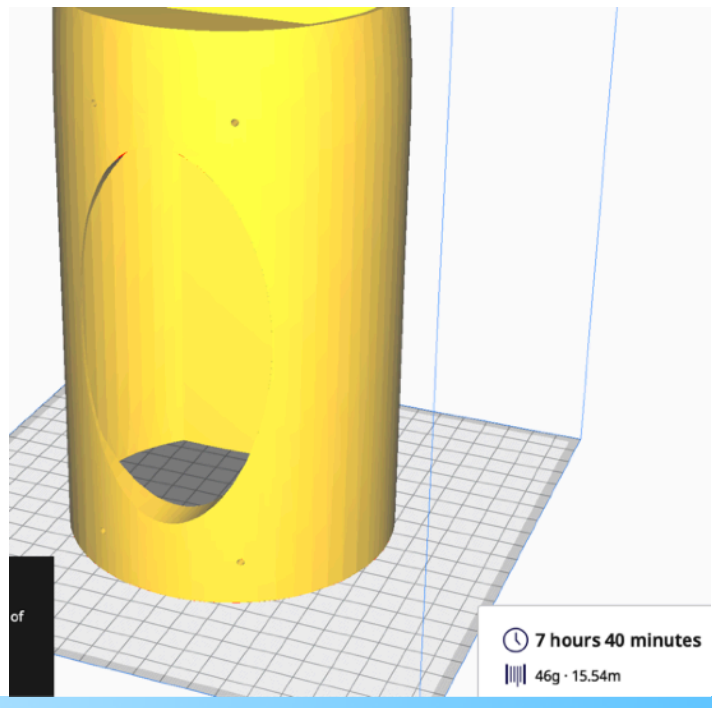
NOSE



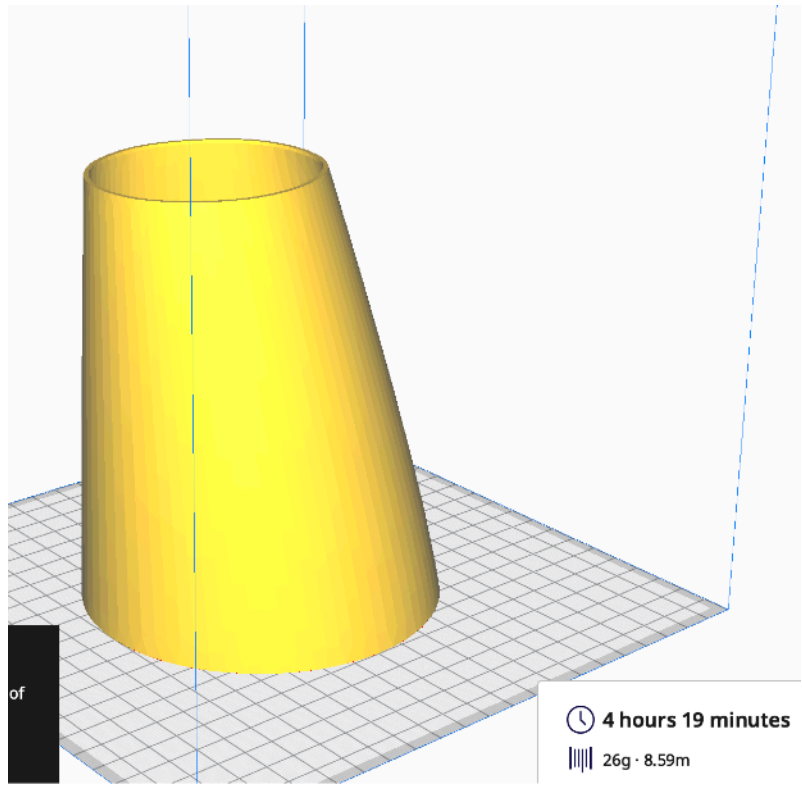
FUSELAGE 1



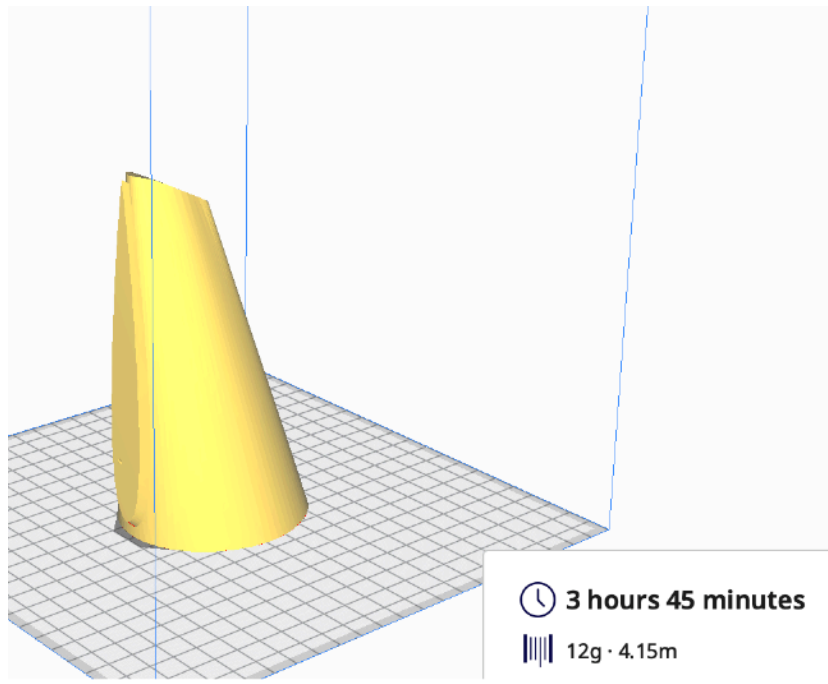
FUSELAGE 2



FUSELAGE 3

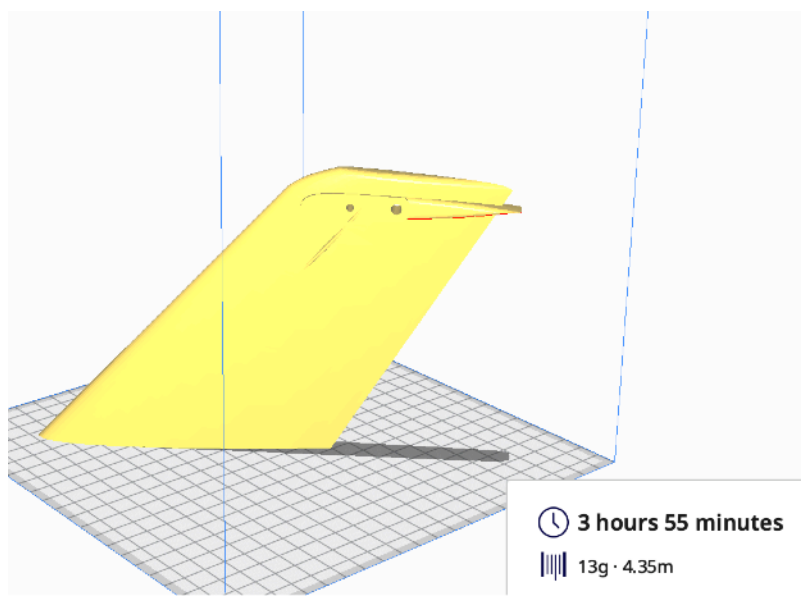


FUSELAGE 4

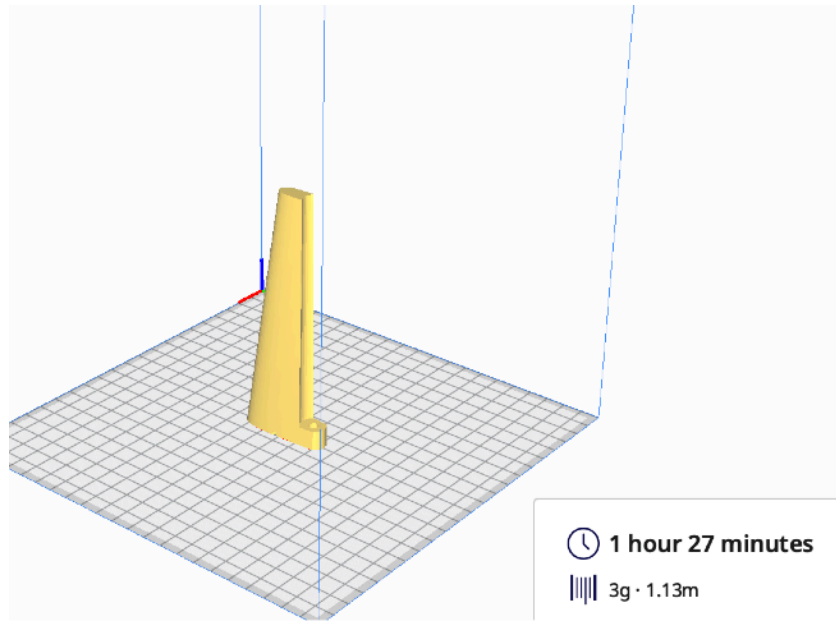


TAIL

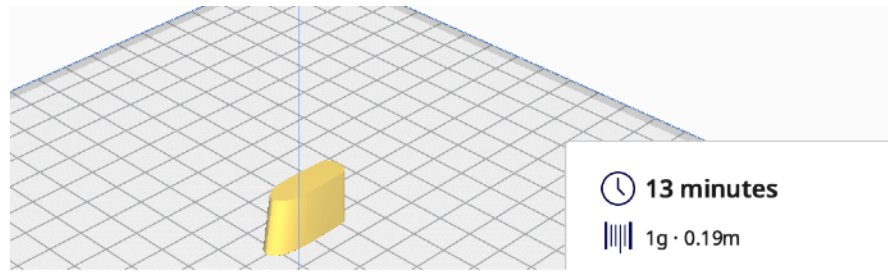
I find the overhang at the rear of the tail is printable without supports.



STAB L&R

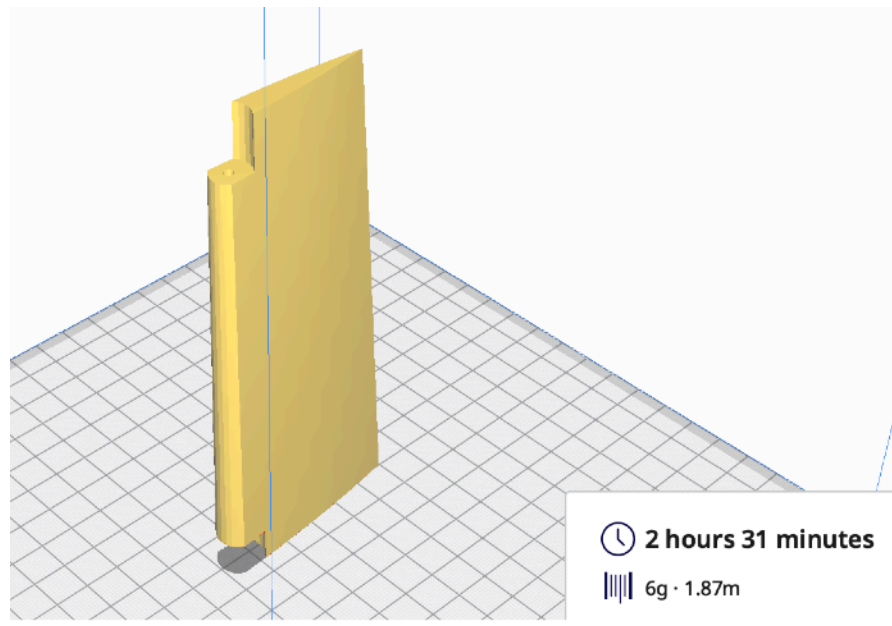


STAB END

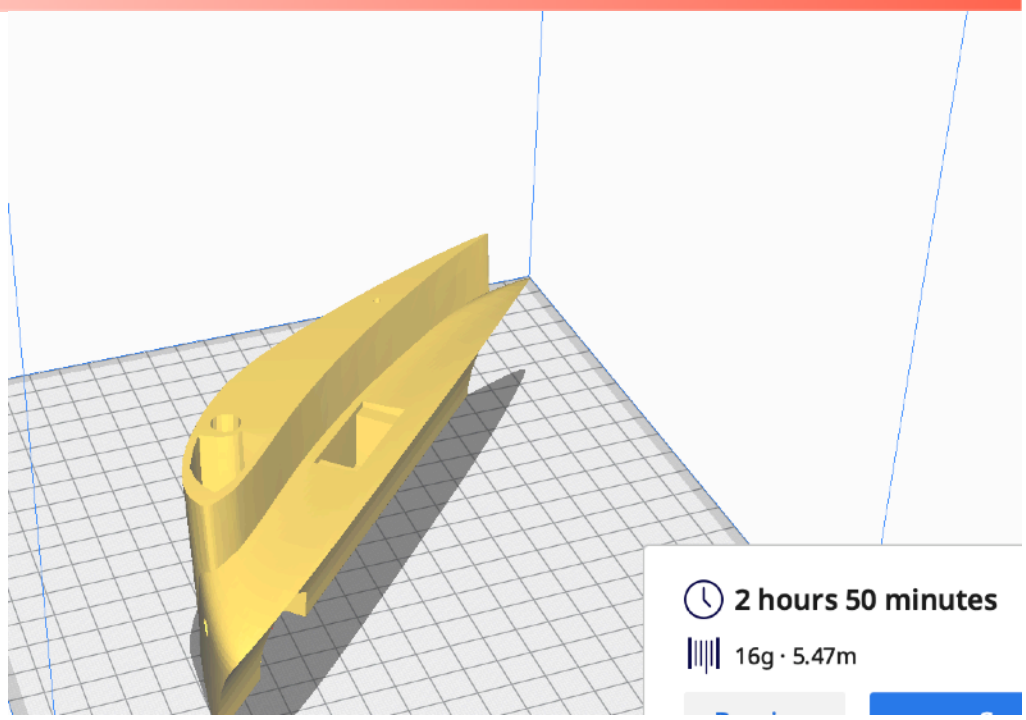


ELEVATOR

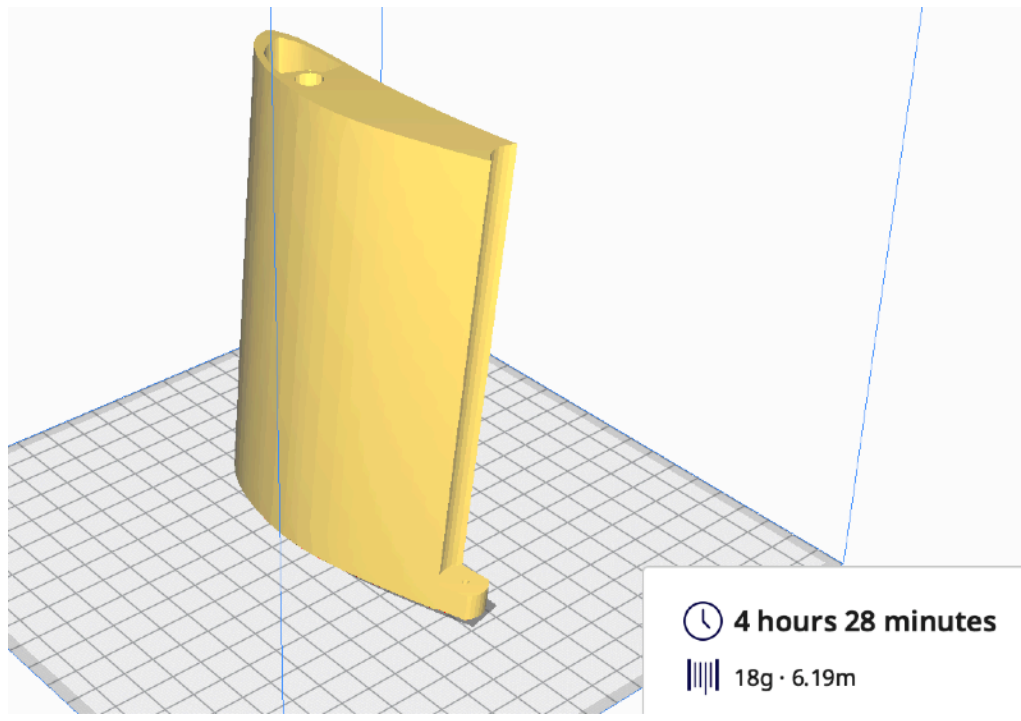
Unique Settings: Print with Supports turned ON



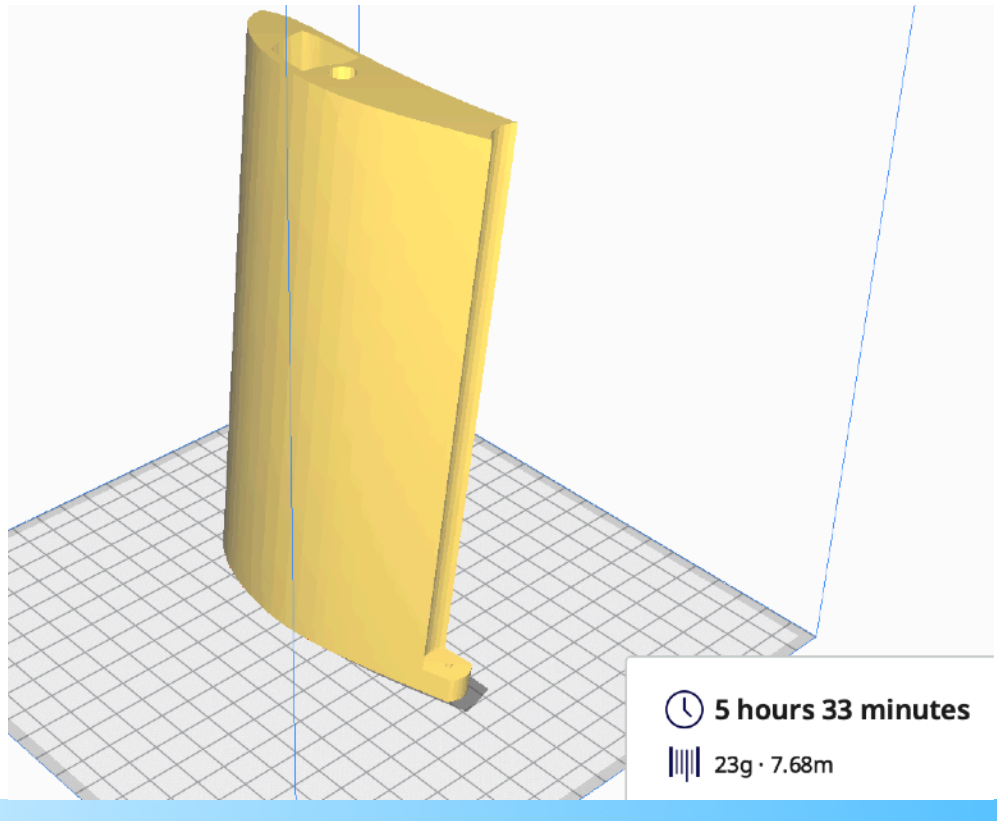
WING ROOT



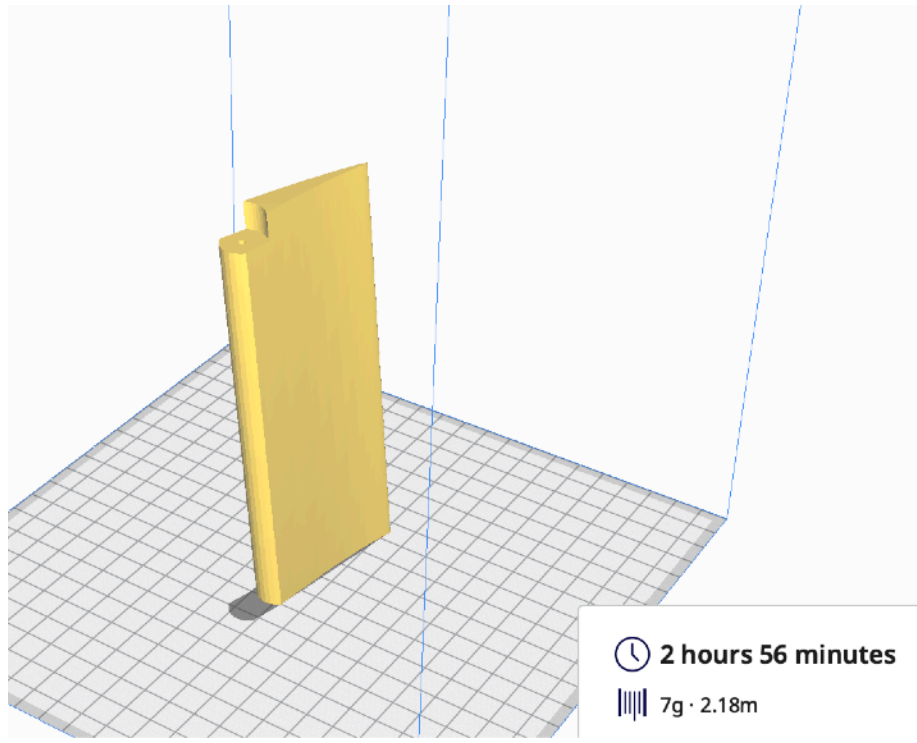
WING 1



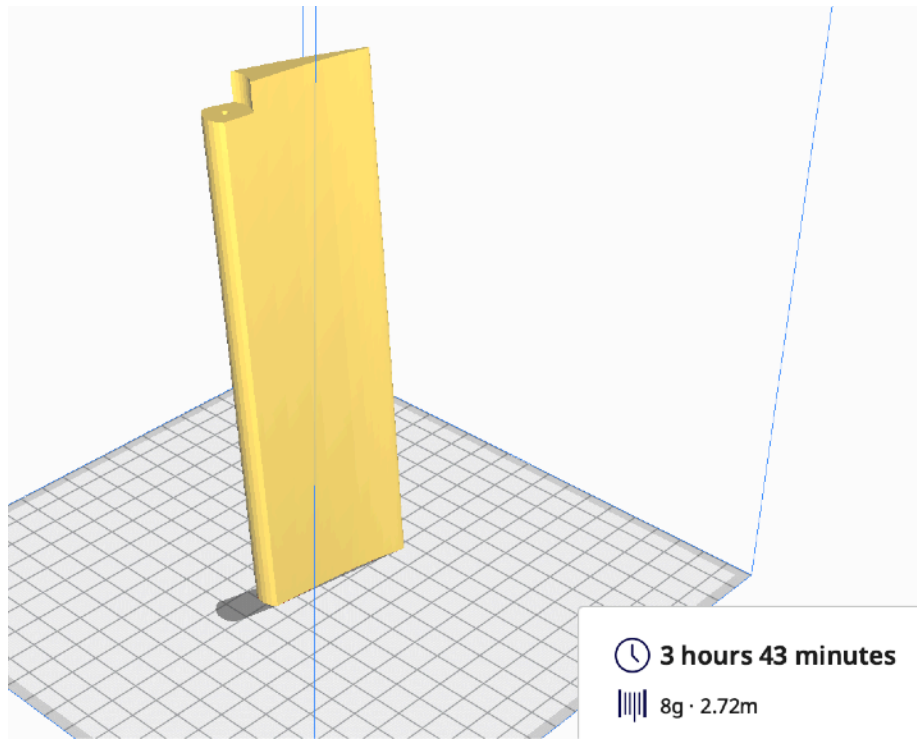
WING 2



FLAPERON 1

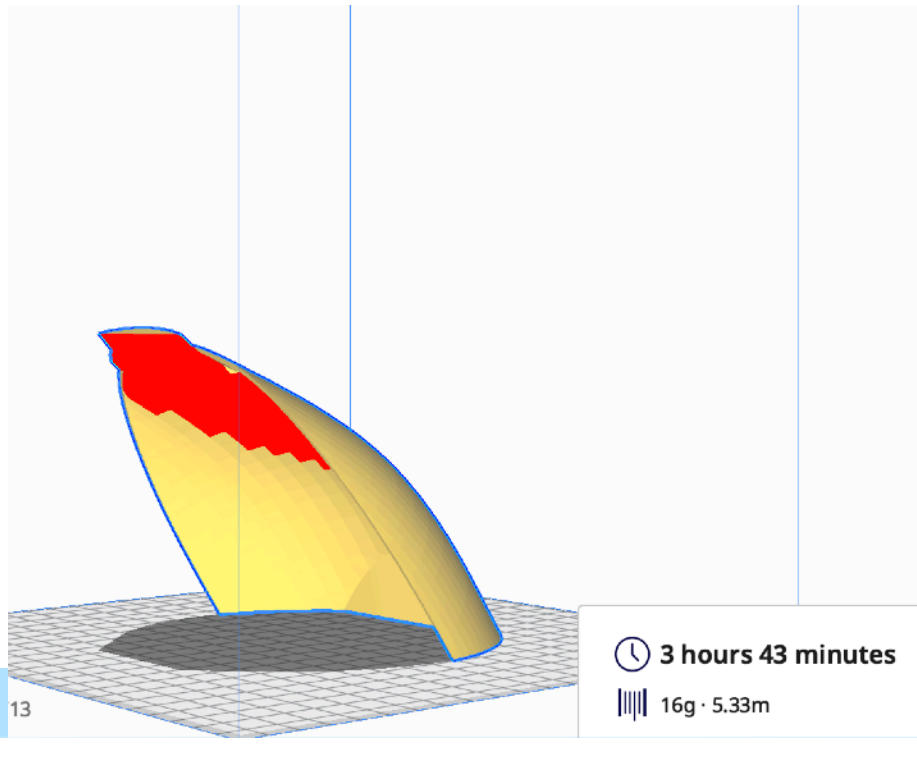


FLAPERON 2



HATCH

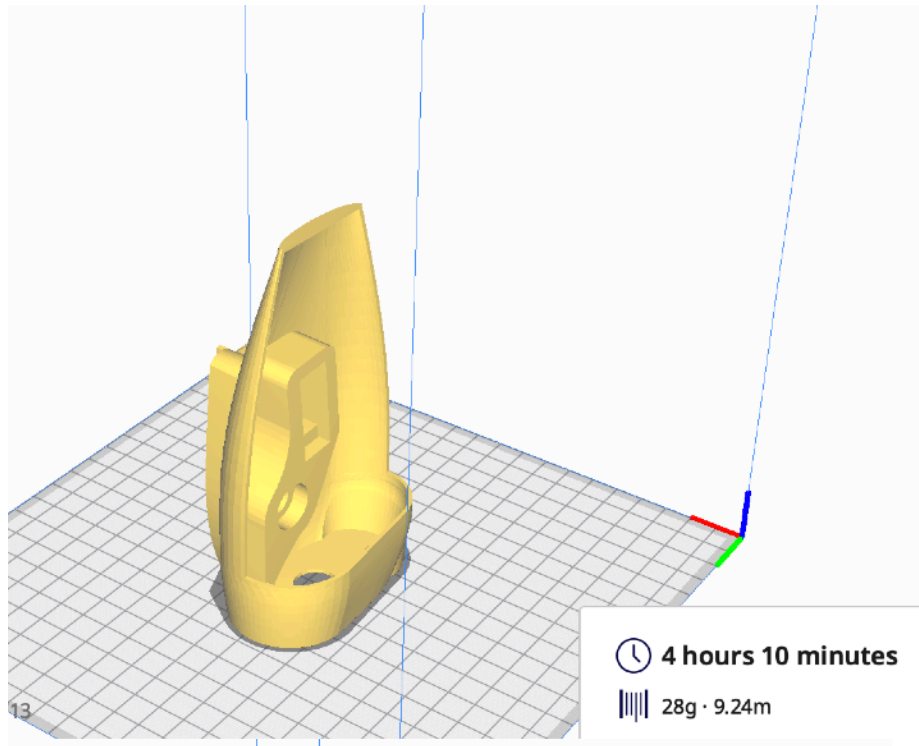
The hatch can be printed without supports but they may be used if you are having trouble.



NACELLE MAIN BODY

Printed in PLA

5% infill

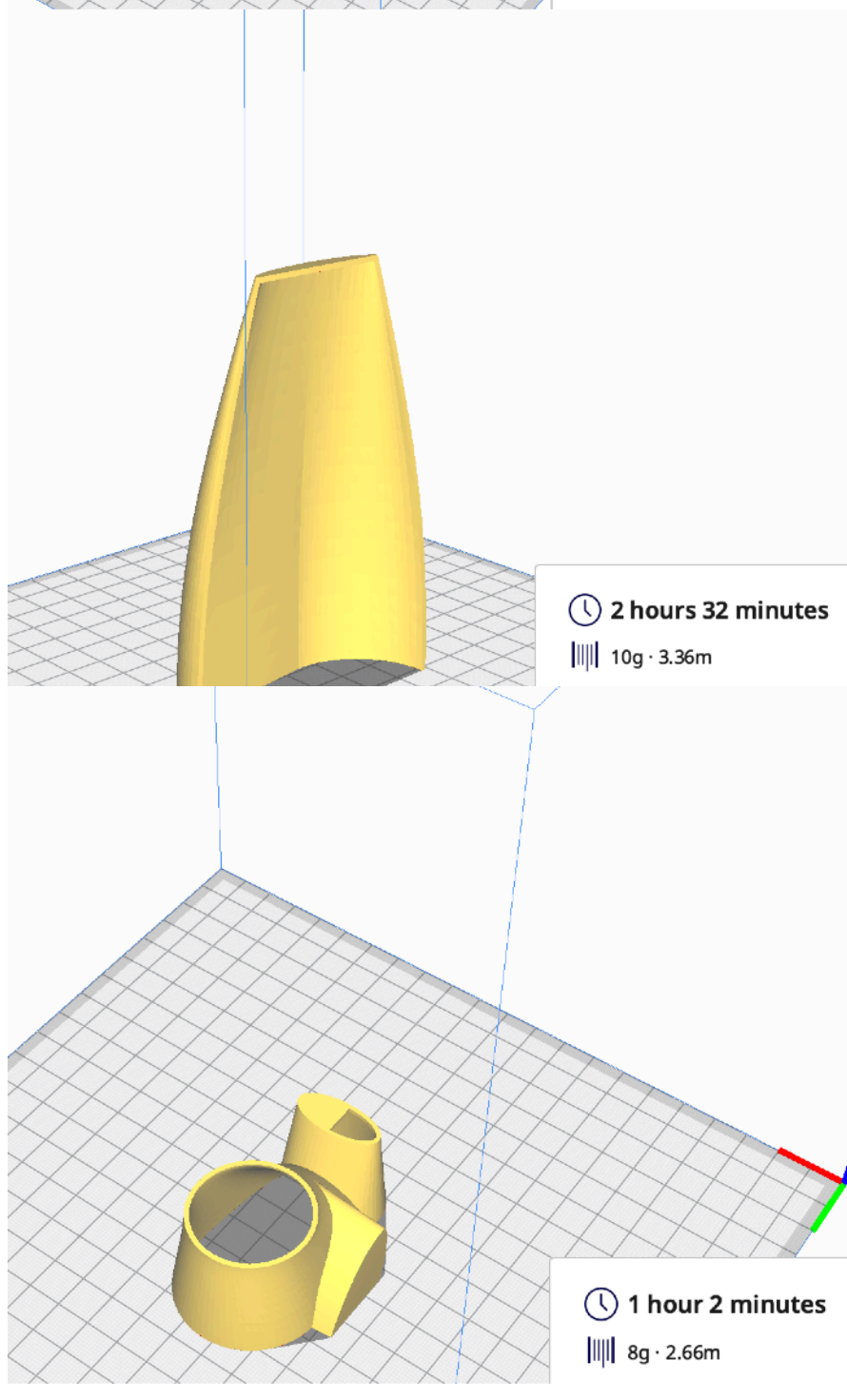


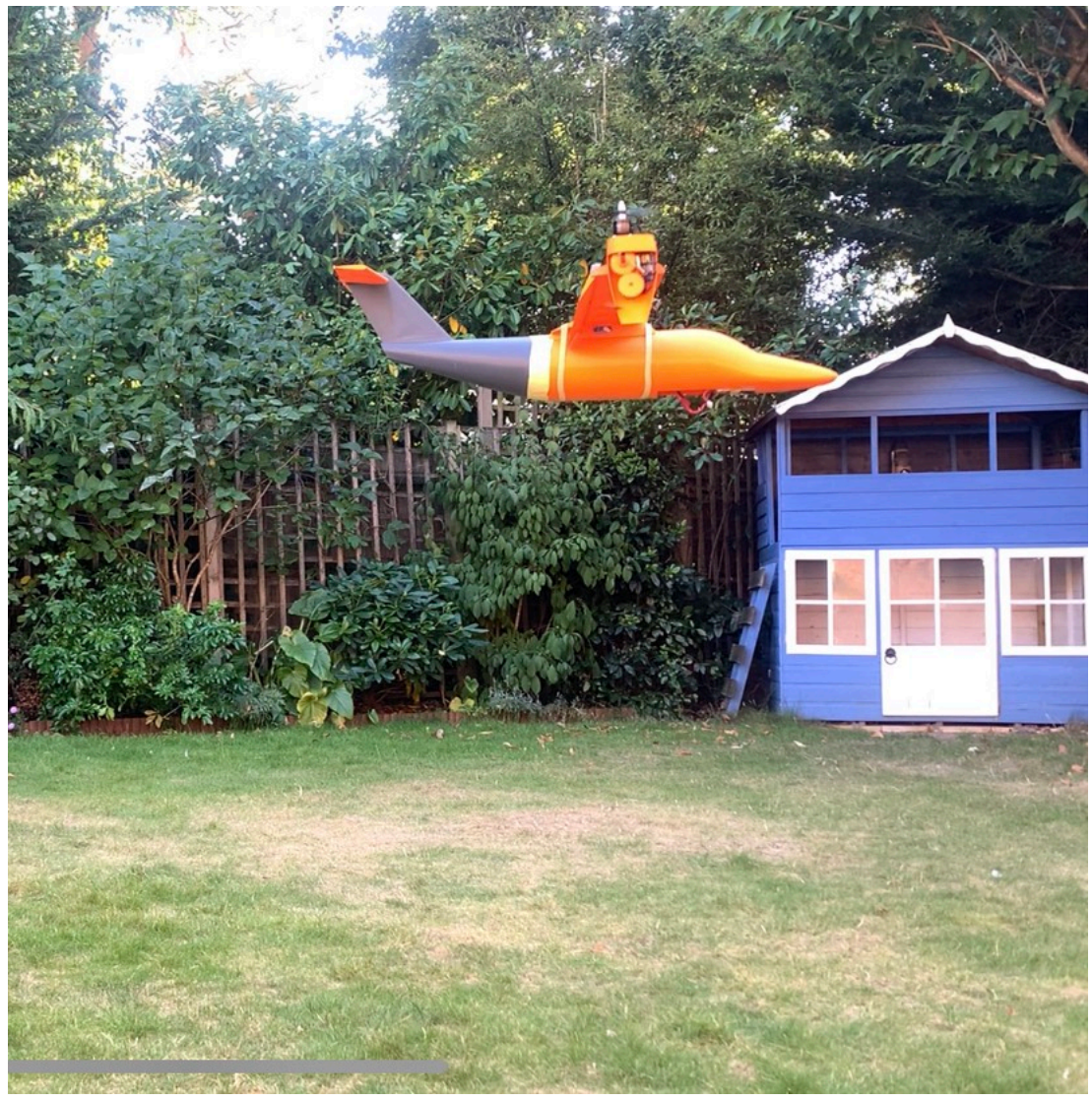
NACELLE COVER

PLA or LW-PLA

NACELLE COWLING

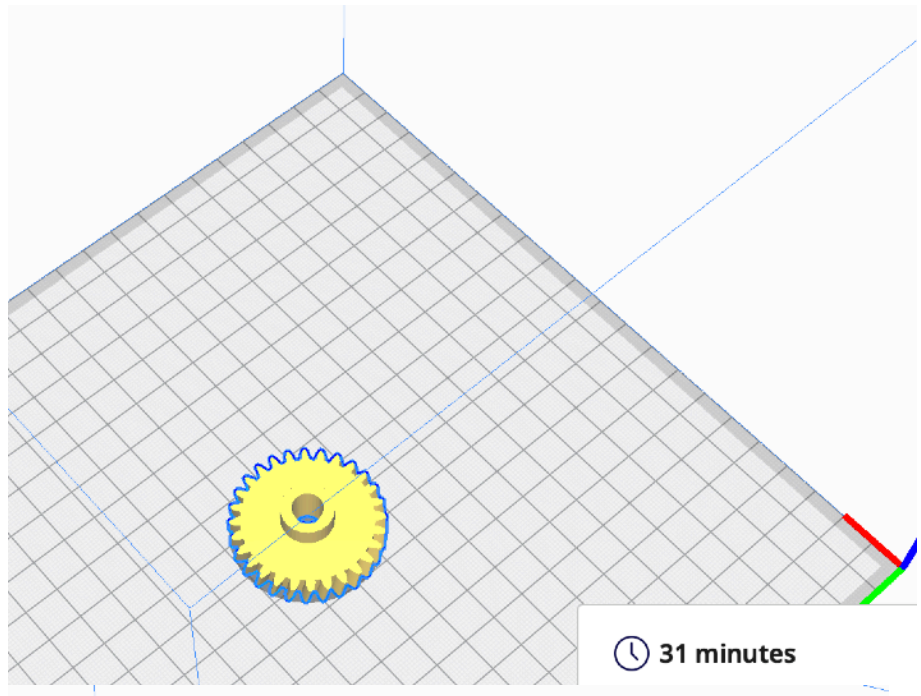
PLA or LW-PLA





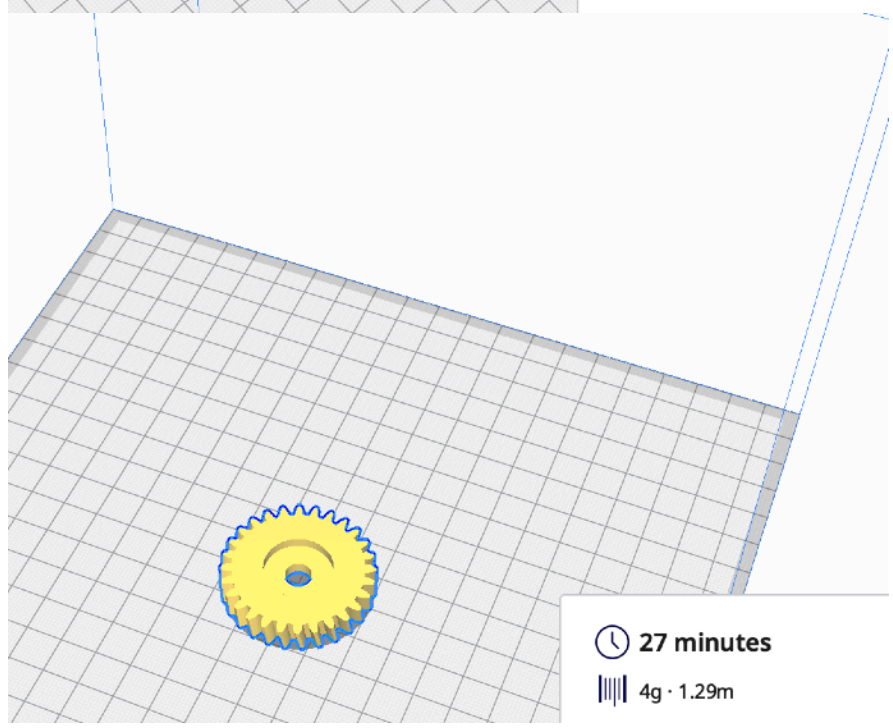
STATOR GEAR

PLA 5% infill



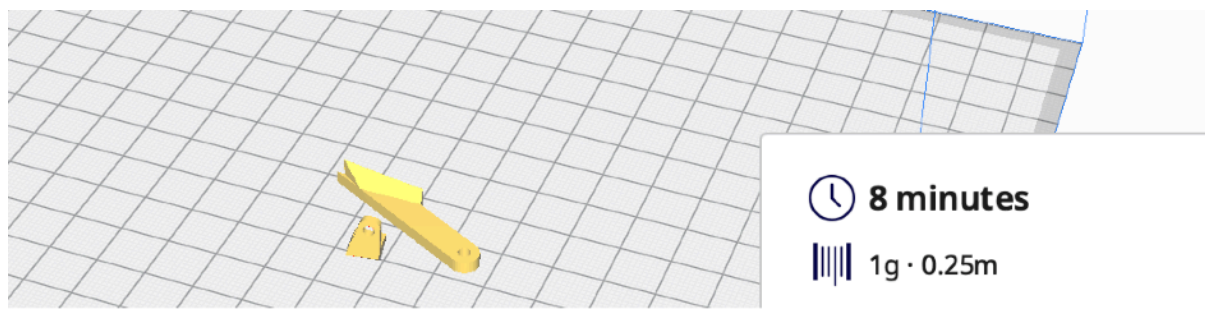
SERVO GEAR

PLA 5% infill



ELEVATOR AND FLAPERON CONTROL LINKS

Printed in PLA



KK2.1 P.I. SETTINGS

FLIGHT PROFILE 1 (IF SETTINGS AREN'T MENTIONED THEY REMAIN ZERO)

Roll P - 80

Roll Autolevel - 20

Pitch P - 90

Pitch Autolevel - 25

Yaw P - 40

Z-Axis P - 25

FLIGHT PROFILE 2

Roll P - 20

Pitch P - 30

Yaw P - 20