



Titan Dynamics

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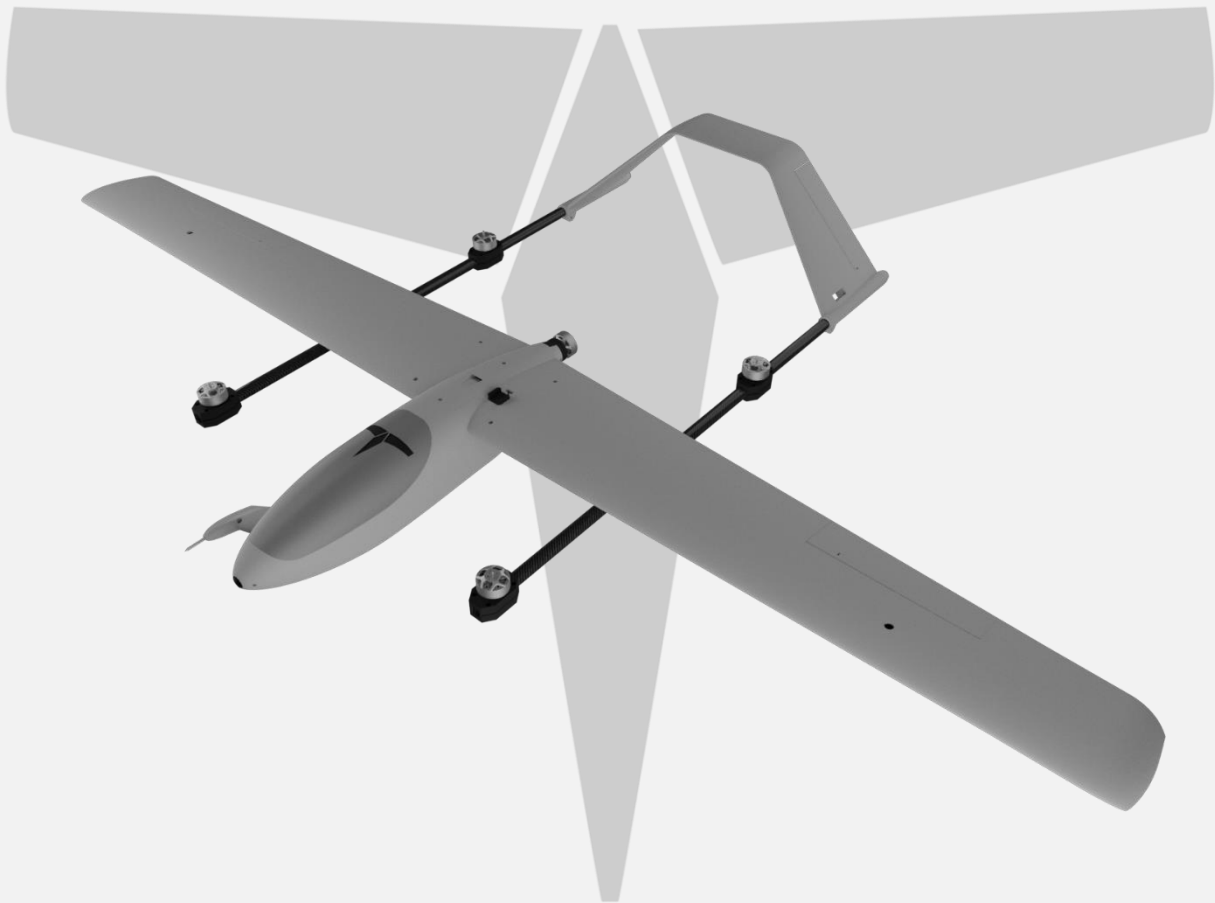
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Titan Dynamics – Cobra VTOL

<https://www.titandynamics.org/3dhangar/p/titan-cobra-vtol>



Build & User Manual

Revision 1.3



Contents

Section 1: Model Information	3
Section 2: Model Specifications & Performance.....	4
Section 3: Required Build Materials	5
Section 4: 3D printing	6
4.1: Things to know before you start printing.	6
4.2: Part Orientation	7
4.3: Tuning "hole horizontal expansion"	8
4.4: Bed Adhesion and warping	9
Section 5: Assembly of 3D Printed Parts.....	11
Section 6: Final Setup & Tuning Tips	18
Section 7: Additional Images.....	19
Section 8: Ardupilot VTOL setup tips.....	22



Section 1: Model Information

Introducing the Titan Cobra VTOL, a 2m wingspan quadplane designed to make takeoffs and landings easy in challenging environments. Incredible attention to detail has gone into making Cobra lightweight yet structurally rigid. The wings, booms, and A-tail are fully removable for ease of transport. Cobra features large wing bays for mounting the VTX/RX with maximum antenna separation. All control surfaces feature nearly 0 gap with rounded leading edges that are sunk into the wings/stabs, and all servos are concealed + serviceable. The A-tail provides the benefit of proverse roll during yaw, and provides ample control authority for pitch in forward flight.

Cobra's flight efficiency has been tested to 2.1 wh/km or 141 mah/km on 4S. With a 4S4P 16800mah Molicel P45A 21700 battery, a range of 120km and flight time of 2+ hours is achievable with 20% of charge leftover for VTOL landing. In our testing, we used a hybrid battery approach: With 2000mah 4S LiPo for lift and 4S6P 18650 21000mah Lilon for push, a range of 148km and flight time of 2.5 hours is achievable if the entire Lilon is used for forward flight and the LiPo is used for takeoff/landing. We recommend a max takeoff weight of no more than 6kg.



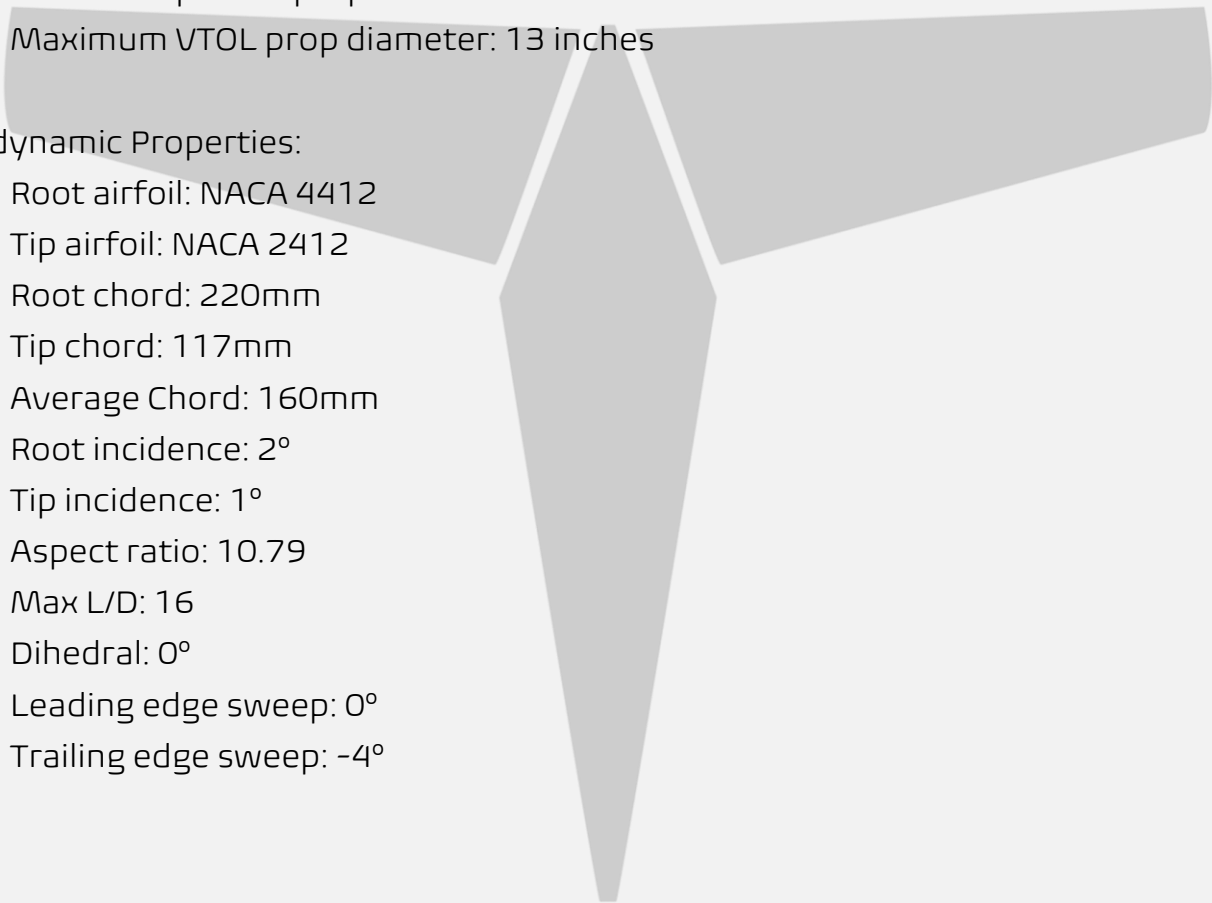
Section 2: Model Specifications & Performance

General Stats:

- Wingspan: 2021mm
- Wing area: 3684cm²
- Maximum take-off Weight: 6kg
- Efficiency: 2Wh/km
- Cruise speed: 45-65kph
- Maximum pusher prop diameter: 13 inches
- Maximum VTOL prop diameter: 13 inches

Aerodynamic Properties:

- Root airfoil: NACA 4412
- Tip airfoil: NACA 2412
- Root chord: 220mm
- Tip chord: 117mm
- Average Chord: 160mm
- Root incidence: 2°
- Tip incidence: 1°
- Aspect ratio: 10.79
- Max L/D: 16
- Dihedral: 0°
- Leading edge sweep: 0°
- Trailing edge sweep: -4°





Section 3: Required Build Materials

Spars needed:

- (1) 10 OD x 8 ID x 1000mm (front main wing spar)
- (1) 8 OD x 6 ID x 1000mm (rear main wing spar)
- (2) 10 OD x 8 OD x 800mm (wing support spar - fully inside each wing during assembly)
- (2) 4x400mm solid tube (aileron hinge)
- (2) 4x400mm solid tube (optional fuselage floor support)
- (2) 18 OD x 16 ID x 1000mm (booms)
- (2) 3x240mm solid tube (a tail sides + taileron hinge)
- (2) 3x150mm solid tube (a tail top)

Recommended VTOL motor & prop: 3510 700kv | 12x6 CW/CCW

Recommended pusher motor & prop: 4108 620kv | 13x8 CCW

Recommended electronics:

- TBS crossfire / ELRS / Dragonlink.
- 5.8ghz / 1.2ghz video (19x19 camera)
- Matek F405-WTE flight controller or similar
- Matek M8Q-5883 GPS/Compass or similar
- Tmotor F55A 4-in-1 ESC for lift motors
- 35a BLHeli ESCs for pusher motor
- (4) Emax ES08MAII servos. 2 for ailerons, 2 for tailerons.
- Example battery for beginners: 10000mah LiPo
- Example battery for max endurance: 25200mah Molicel P45A 4S6P
- Advanced setup: 2000mah 4S LiPo for lift motors, 4S6P 18650 21000mah Lilon for pusher

Misc:

- 2 750g rolls of Polymaker Polylite prefoamed LWPLA
- Polycarbonate, PETG or other high-temp filament for the motor mount
- Medium CA glue
- 220x220x250 minimum size print bed (Ender 3)
- Control horns ([this one](#))
- M3 threaded inserts (max 6mm height)
- M3 bolts of various sizes
- (4) 6x3mm magnets



Section 4: 3D printing

4.1: Things to know before you start printing.

1. Titan Dynamics strongly recommends using Polymaker Polylite prefoamed LWPLA for the best results. This filament is much easier to tune your printer for and has less stringing than active foaming filaments.
2. You likely will not get good results unless your printer is well maintained and calibrated, we would suggest learning how to check and adjust your printer to perform at its absolute best before starting. This website has useful guides: <https://teachingtecht.github.io/calibration.html#intro>.
3. All the below guidance should be taken as a starting point only. Print a test piece and check things like retraction settings and fitment of the carbon rods in the wings for yourself as every printer is different. If the carbon rods are too tight, increase the "Hole Horizontal Expansion" setting in Cura (or the equivalent setting in other slicers).
4. All our models are designed to be printed predominantly in LW-PLA filament. All fuselage, tail, and wing parts should be printed in LW-PLA.

There are 3 levels of infill / wall settings that we recommend for the LWPLA parts:

1. Maximum efficiency: 3% cubic subdivision, single wall
2. Balanced efficiency and strength: 5% cubic subdivision, single wall
3. Maximum strength: 8% cubic subdivision, single wall

Notes:

- For the best flight characteristics and maximum range, LWPLA parts should be printed with single wall and 3% cubic subdivision infill.
- Cubic subdivision infill can be increased to 5 or 8% to increase durability, but this will have an impact on maximum payload capacity (battery), and range by extension. We recommend and use 3% cubic subdivision infill as it has been tested to survive 6.4G in flight, but some may desire greater general durability when handling/carrying the model around etc. It will still break if you crash it!
- Because the fuselage takes the most abuse during landings, some may choose to just print the fuselage sections in higher infill. Using a higher infill just for the fuselage (4%-8%) can greatly increase the longevity of the plane without as much of a weight penalty as printing the entire plane in high infill.

Polycarbonate, PETG or other high-temp filament should be used for the motor nacelle caps and wing bay covers.

- High temp Polycarbonate or PETG parts should be double wall and high infill (25%).

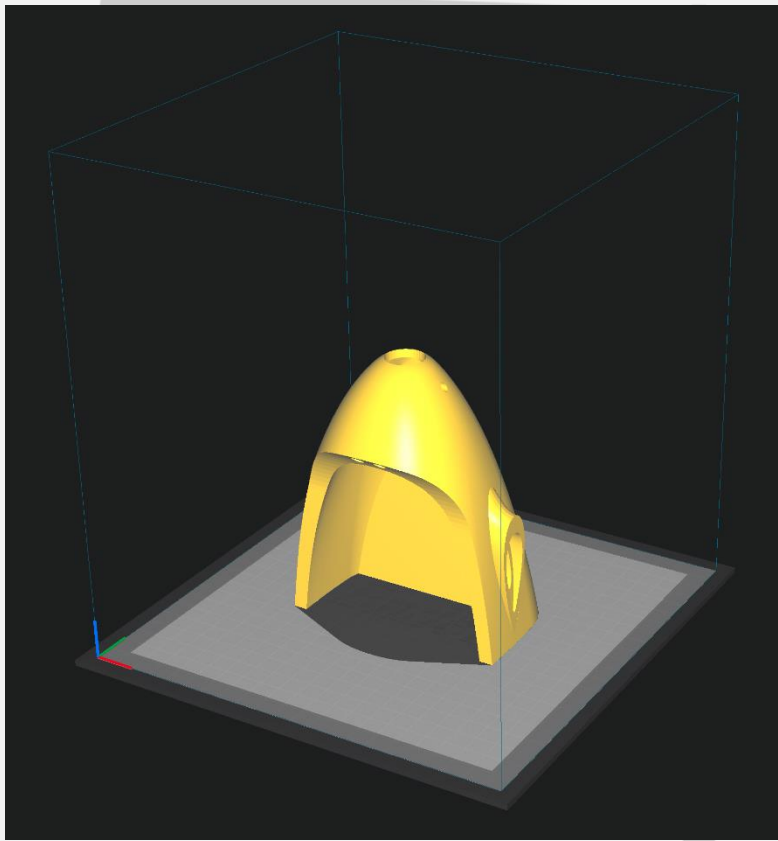


We recommend using the newest version of Ultimaker Cura. [This Link](#) can be used to download our own slicer profile.

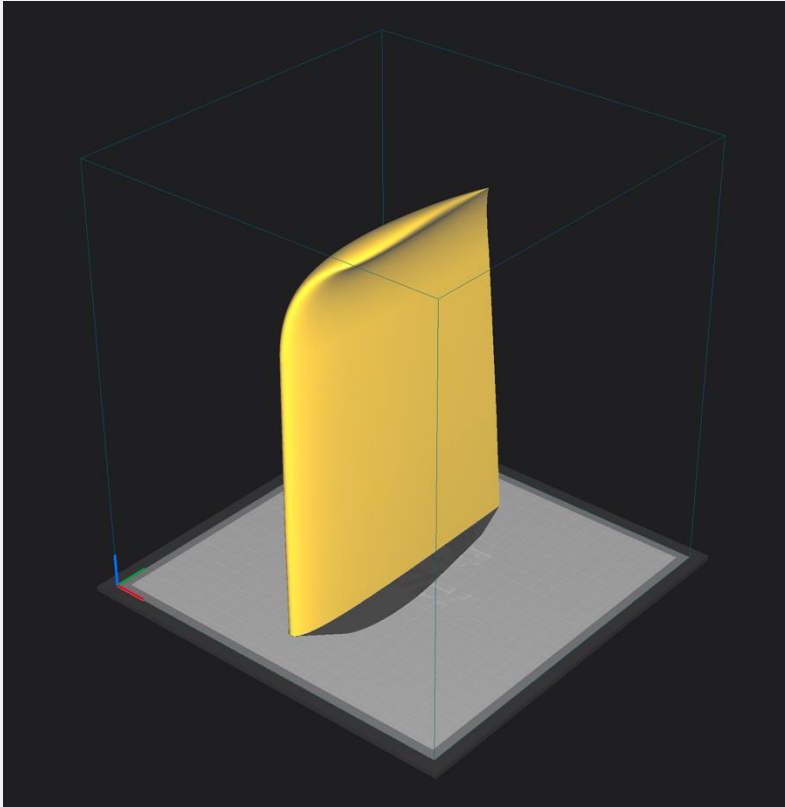
4.2: Part Orientation

It is necessary to orient each part correctly on the build plate to avoid disconnected overhangs. Take care when doing this as the entire model is designed to be printed with no supports. If you orient some parts wrong, the print will fail. It may also be necessary to rotate and carefully position some parts to fit within the build area on smaller printers.

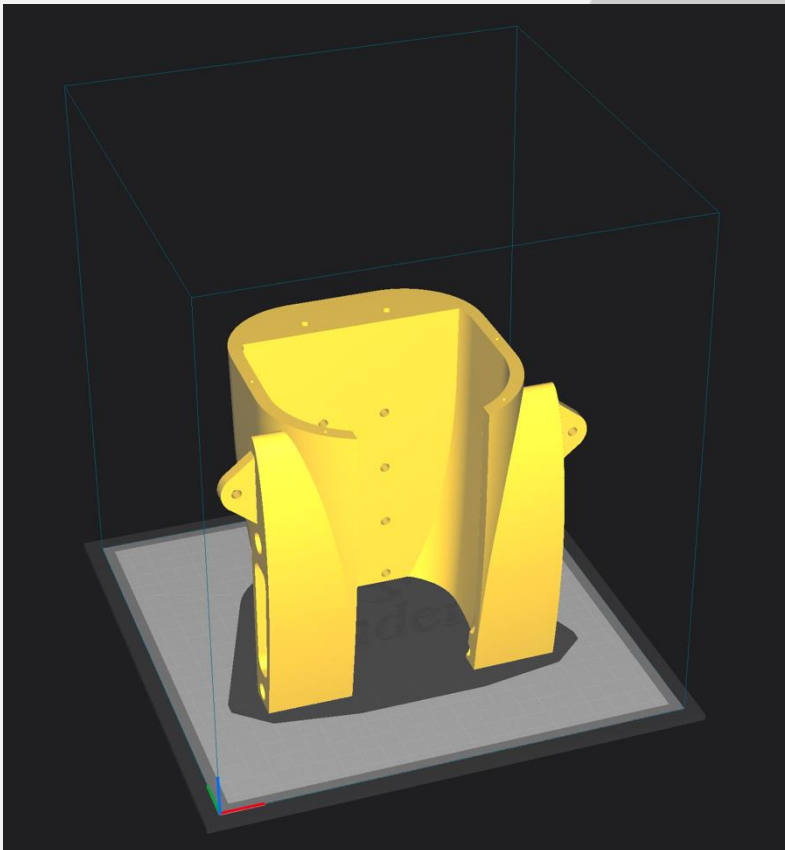
Examples for part orientation:



fuse1



wing5



fuse3

4.3: Tuning “hole horizontal expansion”

It is very important to check the fitment of the carbon rods in their holes on the first parts you print. Because everyone may be using different printers, materials and slicer



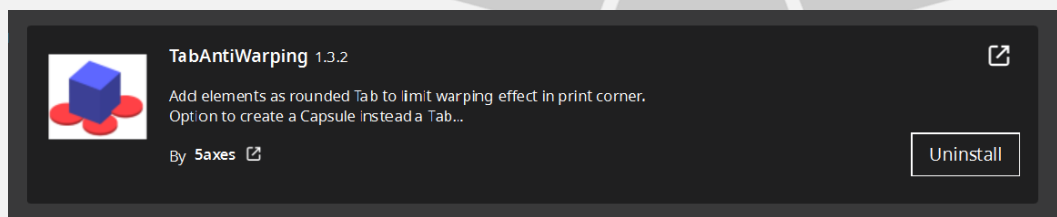
settings, it is not possible to provide the models with a slicing profile and hole size that will work for everyone.

Print your first part with carbon spar hole and check fitment, if it is too tight increase the hole horizontal expansion setting in the "walls" section in Cura (or your slicer's similar setting). A good starting point is 0.25mm. If it is too loose, just decrease the setting until you can reliably push the rods in and still get a snug fit.

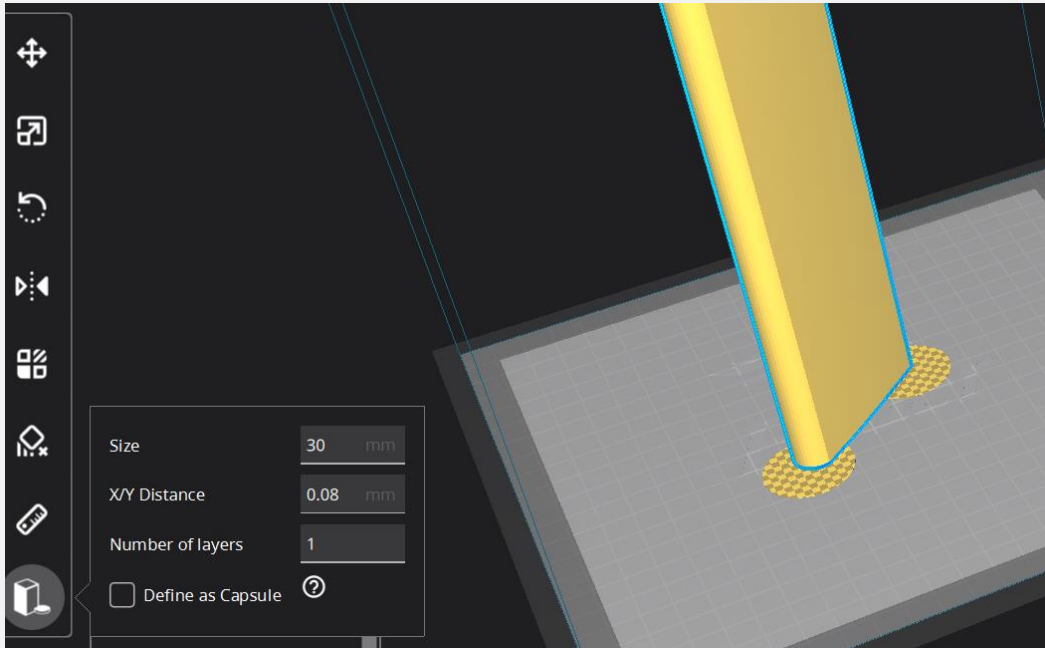
4.4: Bed Adhesion and warping

When printing tall parts like this model requires, having good print adhesion to the bed is a necessity. Ideally you will print each part without any extra aids, however this may not be possible for many, especially those printing without an enclosure for their printer. A full brim can be used but this will typically have mixed results. If it works for you, use a glue stick on the print surface to improve adhesion. Cura also has a plugin that can be used to help with bed adhesion and to avoid warping.

Cura Marketplace: TabAntiWarping Plugin.



When installed, use the new icon at the bottom of the left menu to choose tab diameter and thickness, then click on the model to add a tab at each point you think is at risk of warping or poor adhesion (typically parts with low surface area in contact with the print surface in relation to their height). These new tabs can now be moved around to fine tune their position using the normal move controls on Cura.



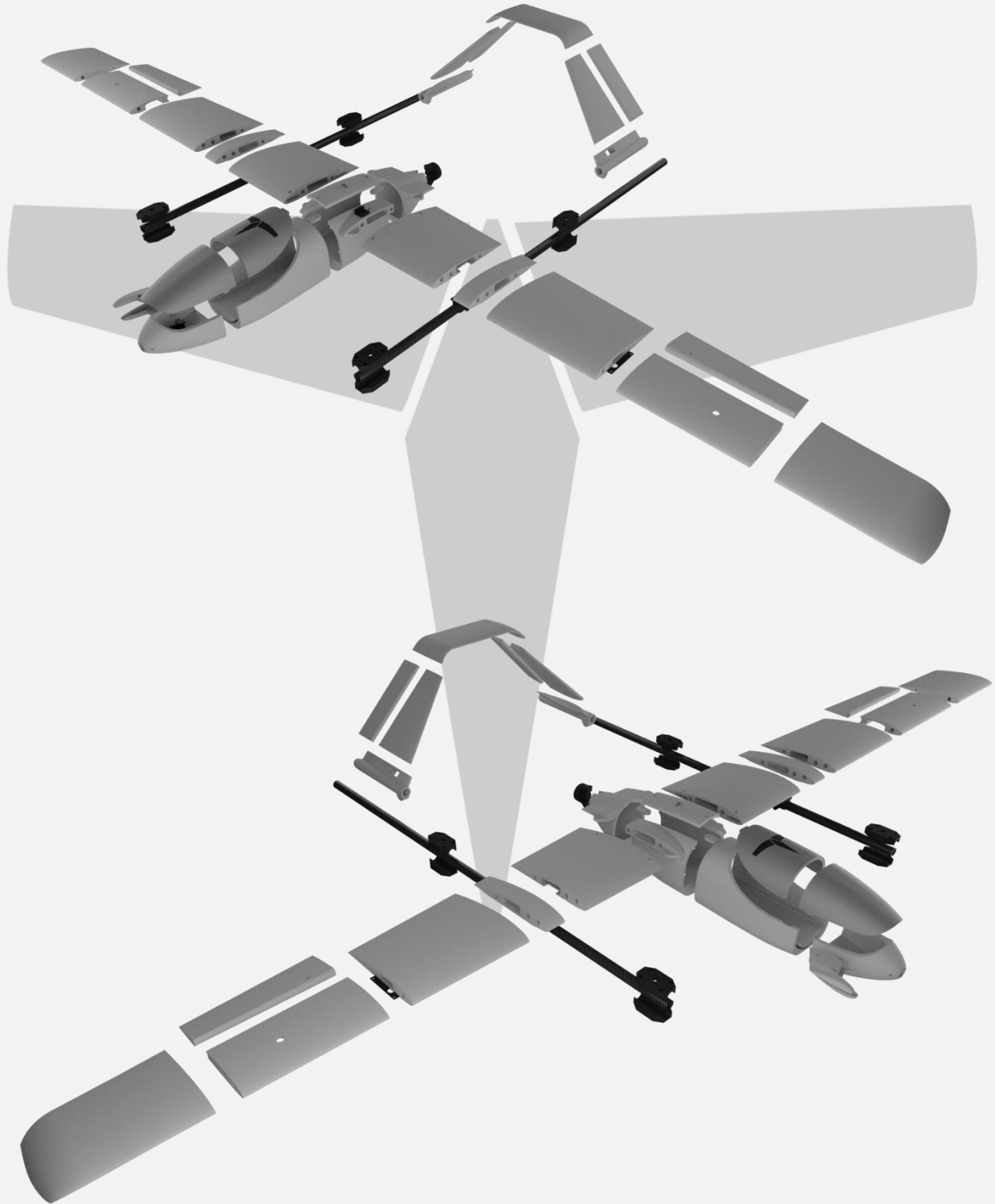
Once completed, be careful when removing these tabs from the print as they are quite strong and can damage the bottom of your part if not removed carefully. Re-open any holes the tab may have filled on the bottom of the print.

If you find these hard to remove from the print bed, select the “Define as Capsule” option. This makes the edge of the tabs raised, so you can get a scraper underneath them.



Section 5: Assembly of 3D Printed Parts

Below are a few exploded views of the Cobra to help with assembly.



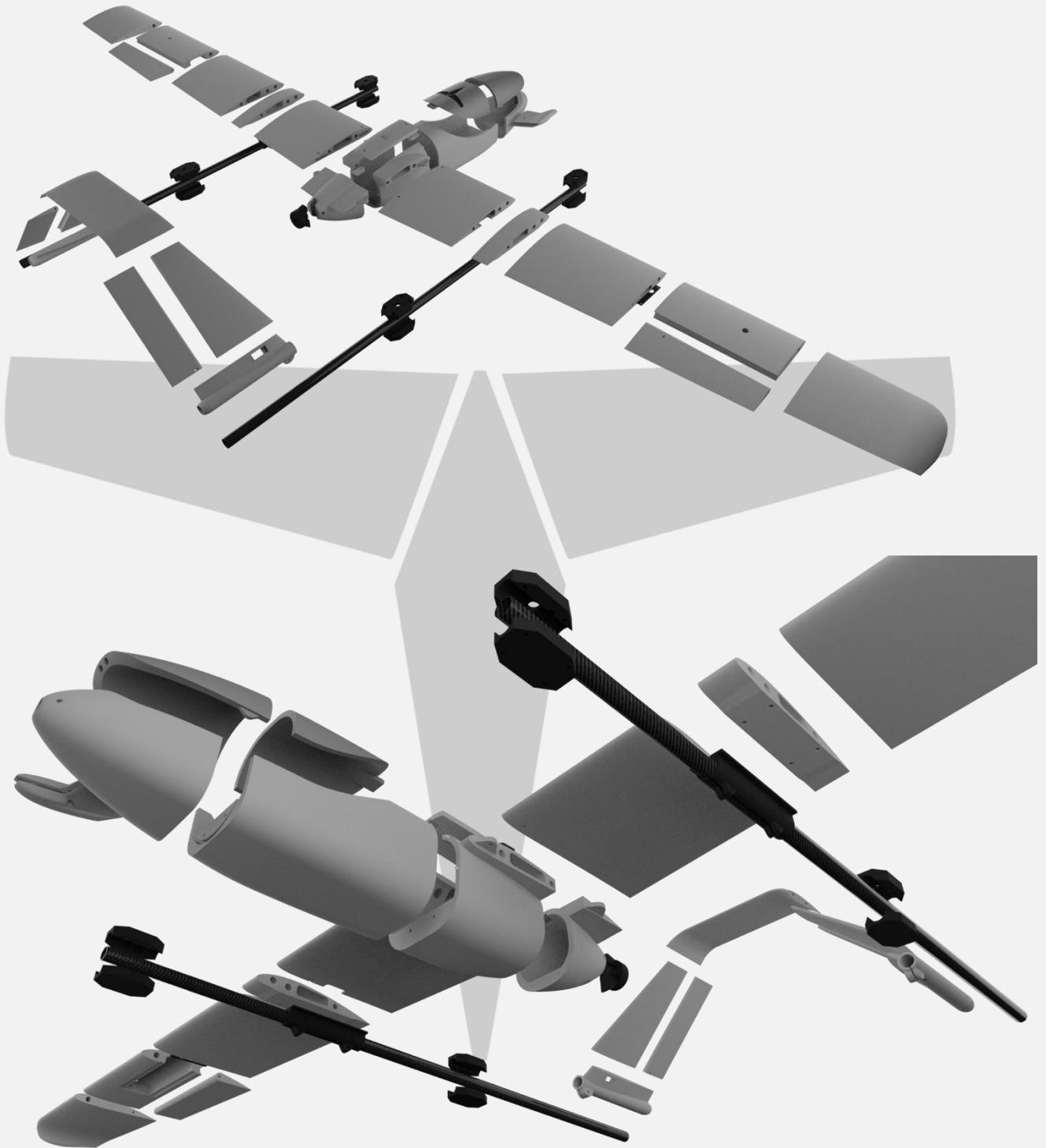


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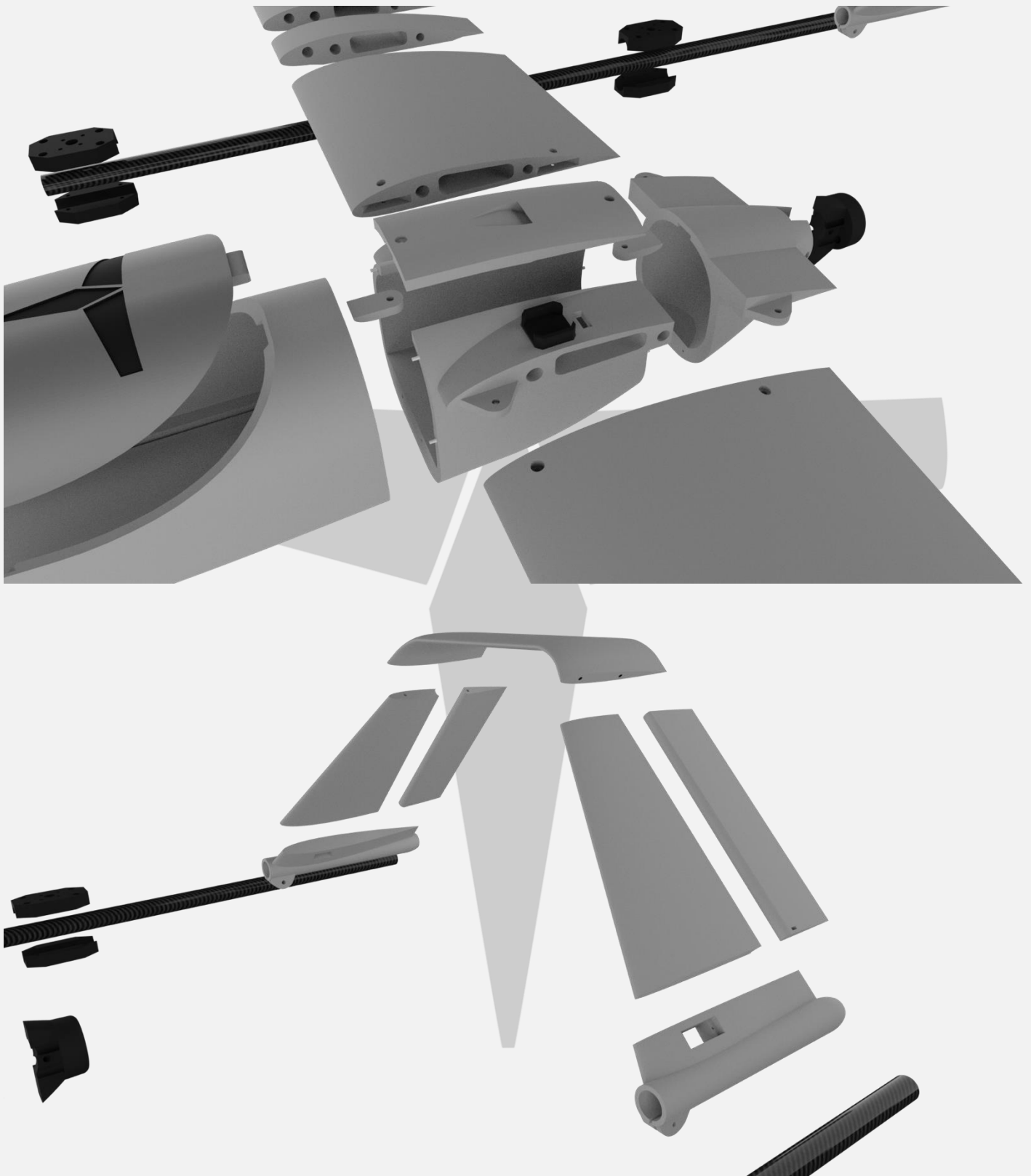


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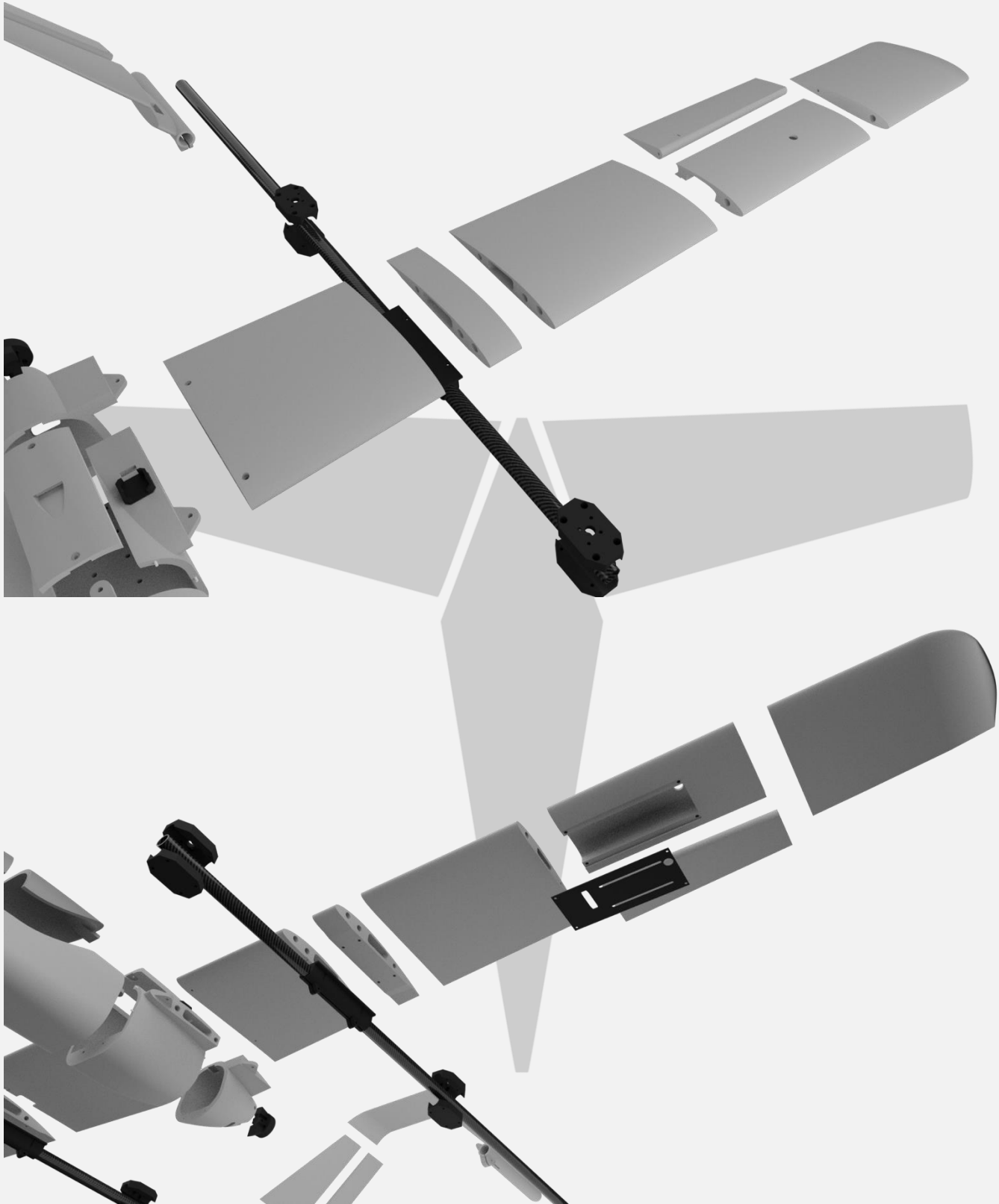


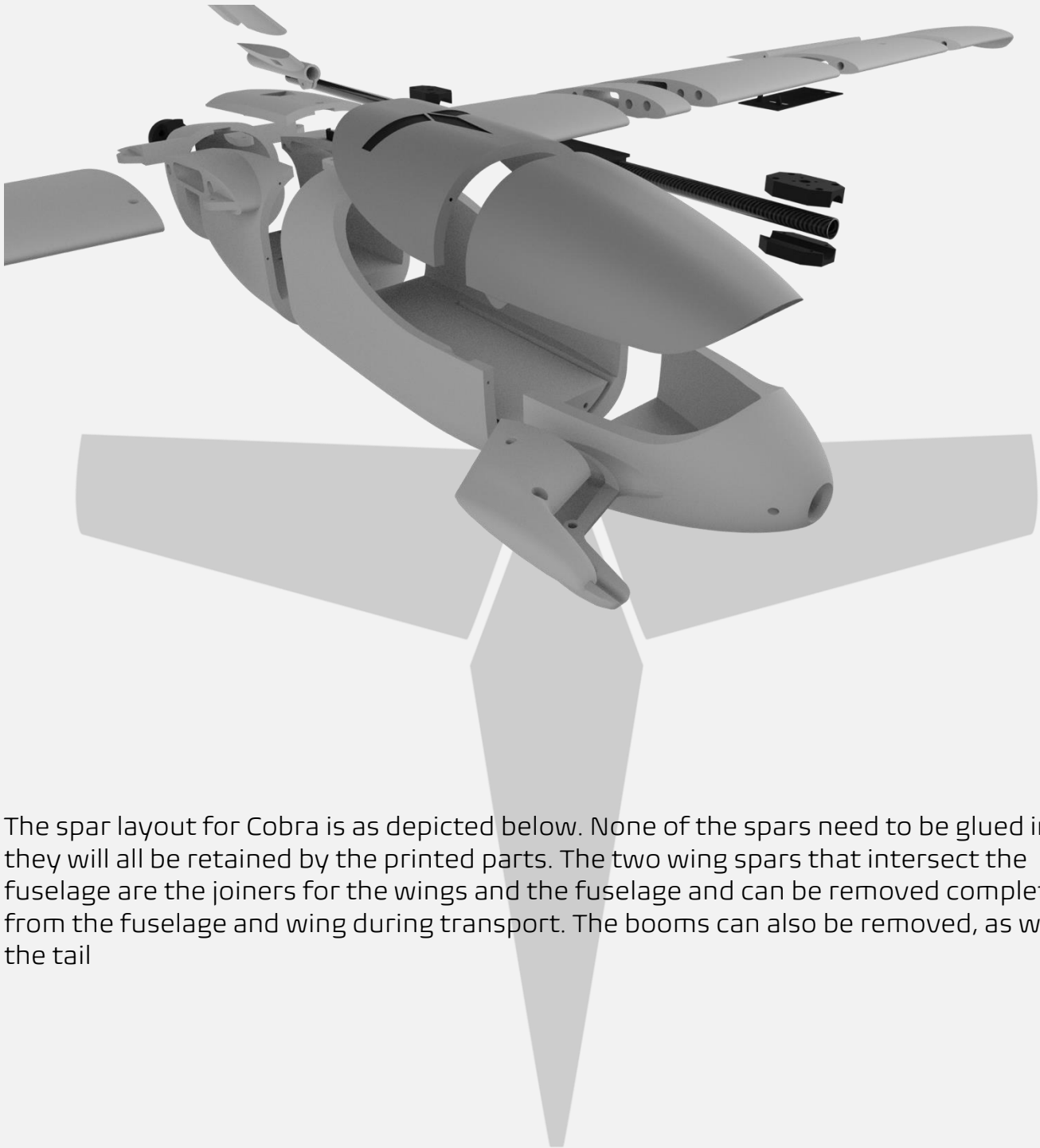
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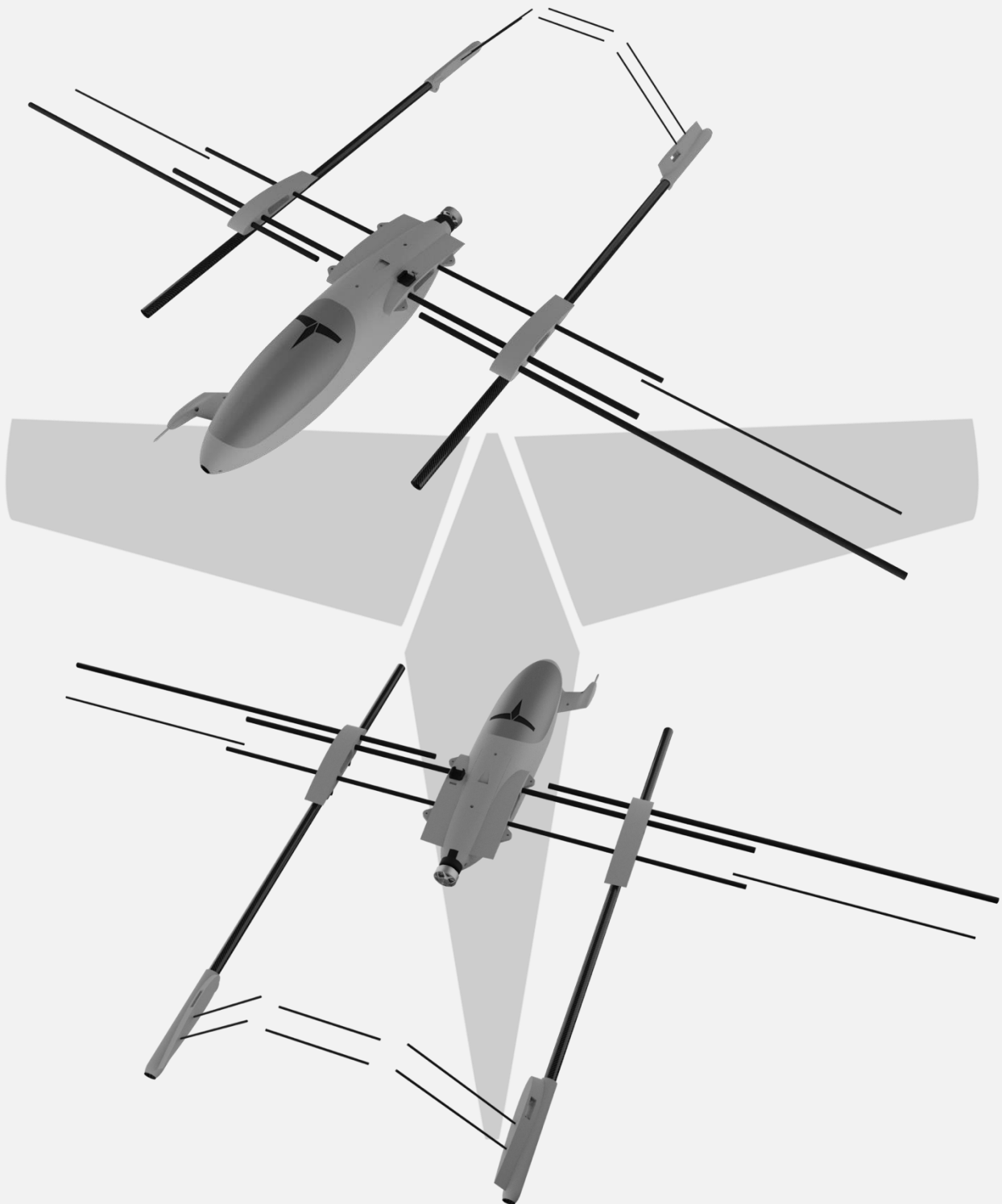
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The spar layout for Cobra is as depicted below. None of the spars need to be glued in, they will all be retained by the printed parts. The two wing spars that intersect the fuselage are the joiners for the wings and the fuselage and can be removed completely from the fuselage and wing during transport. The booms can also be removed, as well as the tail

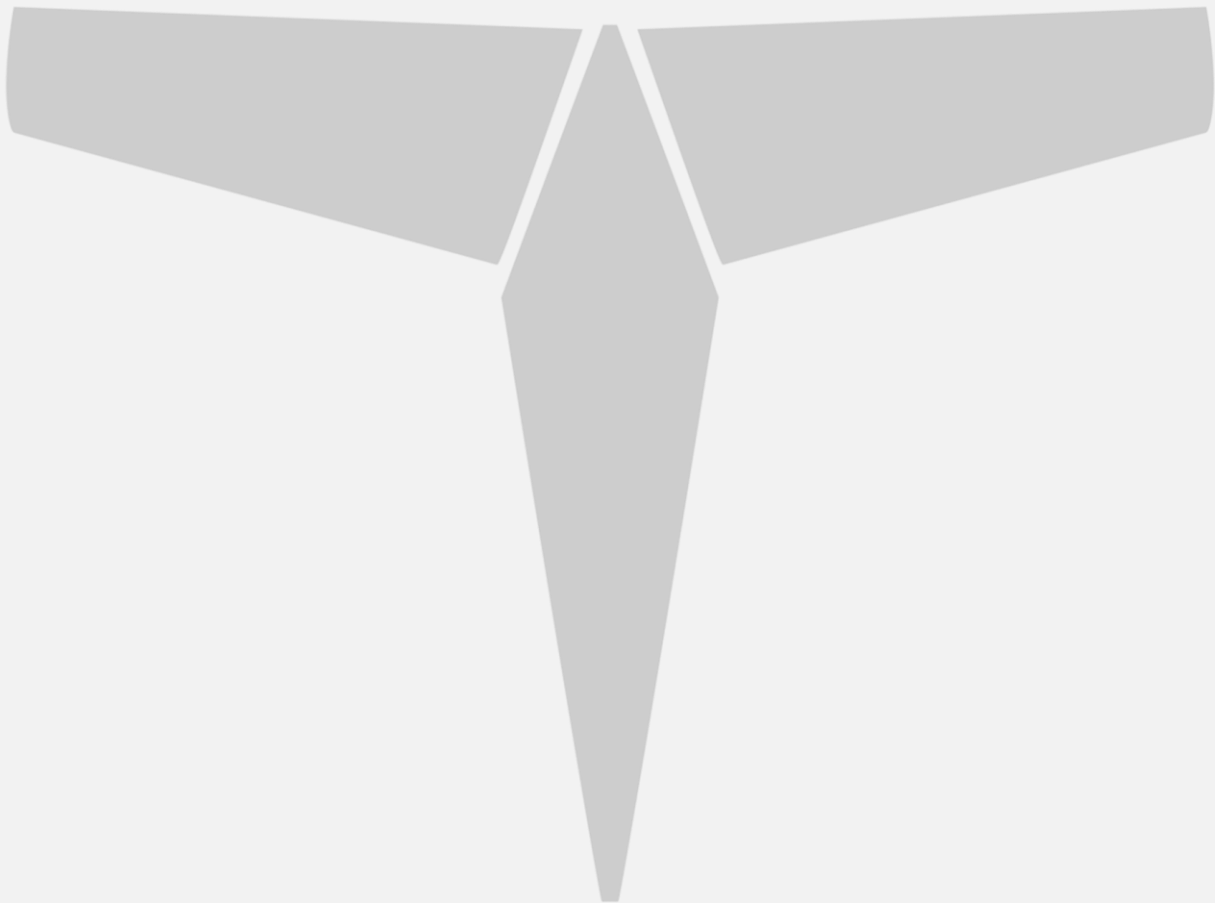


- Medium CA glue should be used to assemble all fuselage parts
- When first putting the glued parts together be sure to wipe any excess glue off before it sets. A kicker may then be used to speed up the setting time; technically this results in a weaker joint, however it will still be stronger than the base material LW-PLA.
- Use care when aligning parts for gluing. With medium CA, you should have a few seconds to get alignment right. Small mistakes in alignment can stack up and



eventually lead to a part not fitting perfectly. We have taken care when designing the aircraft to make sure there is tolerance for some minor mistakes but try to be as perfect as possible when gluing.

- When gluing the wings together, use the carbon rods to ensure alignment however be careful not to glue them in, they should not be glued in on the final product.
- **IMPORTANT!** - Do not glue the wing tips on until you have the carbon rod and aileron/flap installed as it's the wing tip that secures these in place. If you glue the wing tip on before inserting the control surfaces + carbon rod you will not be able to insert them afterwards.
- Threaded inserts can be properly installed by using a soldering iron at low heat setting, a good guide for doing this can be found at [this link](#).





Section 6: Final Setup & Tuning Tips

- Titan Dynamics strongly recommends the use of Arduplane for all our models.
- Give all control surfaces +/- 35 degrees or more throw.
- CG is marked under the wing.
- Add duct tape or other abrasion resistant material to bottom of the fuselage to increase durability if landing on rough surfaces.





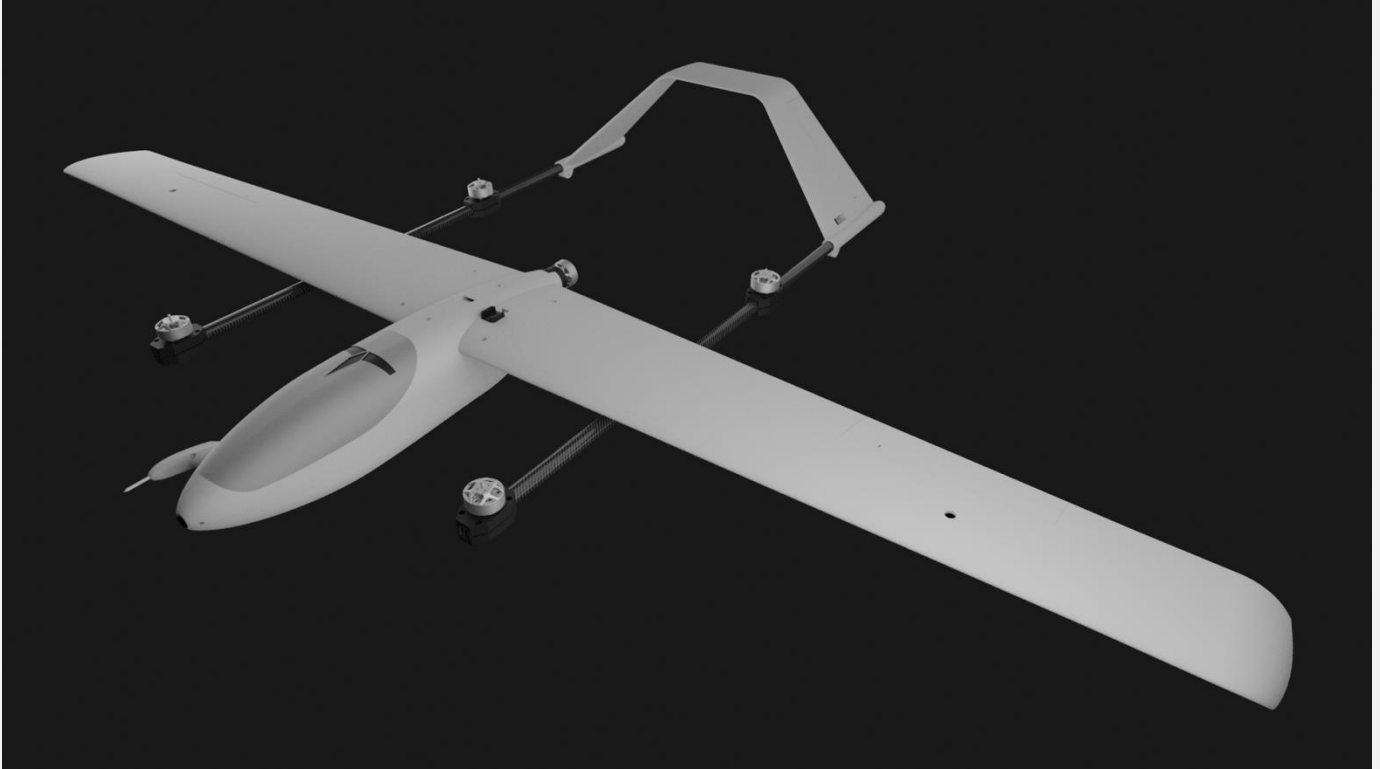
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Section 7: Additional Images



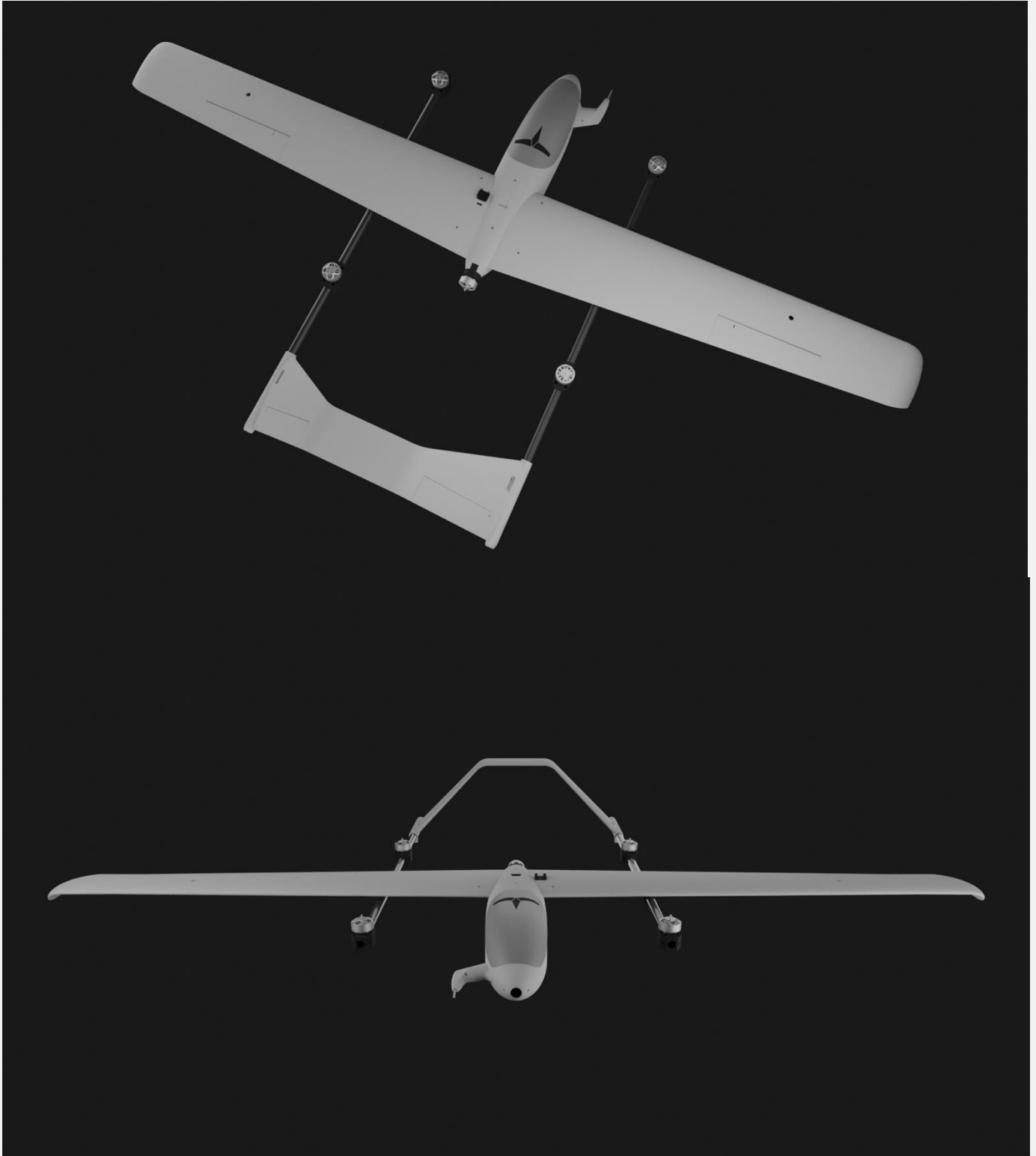


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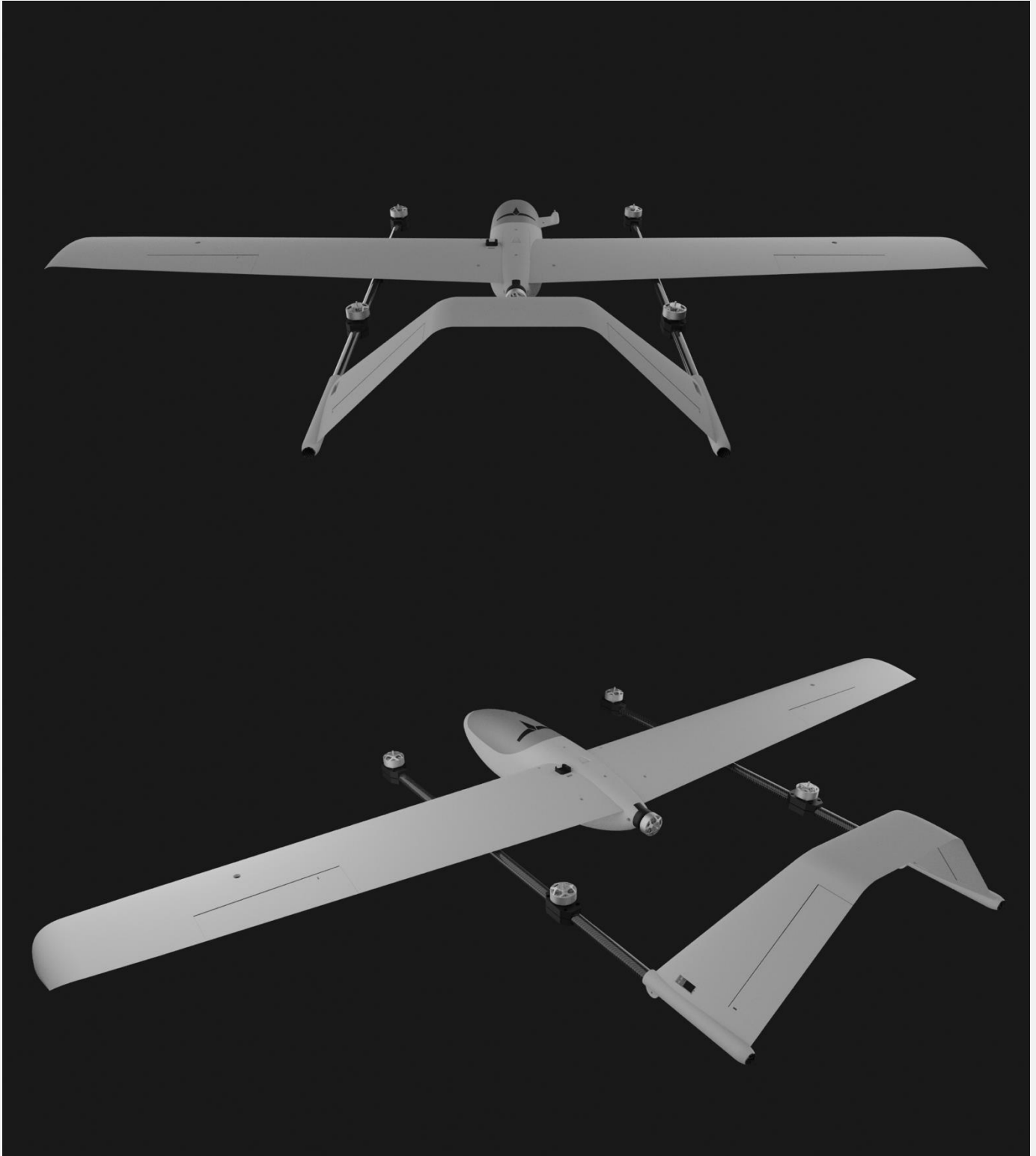


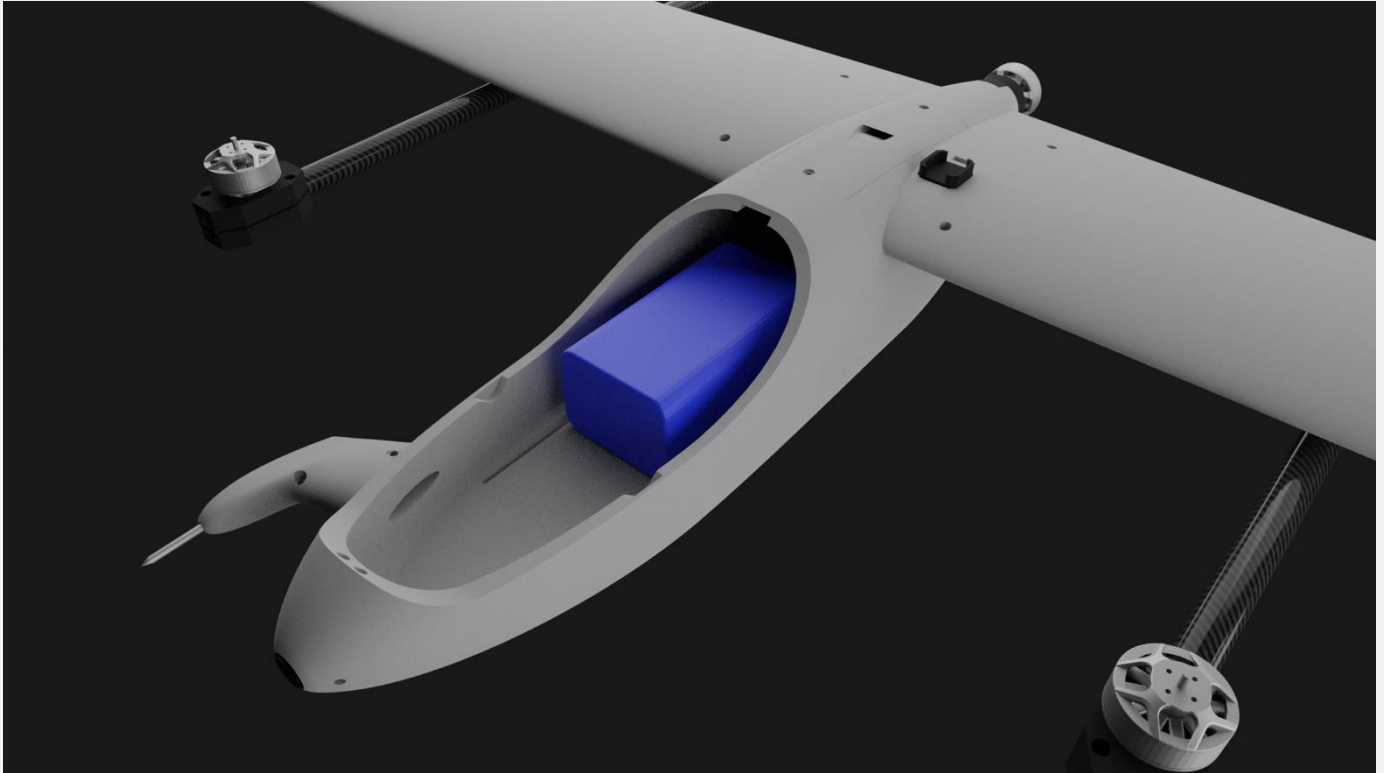
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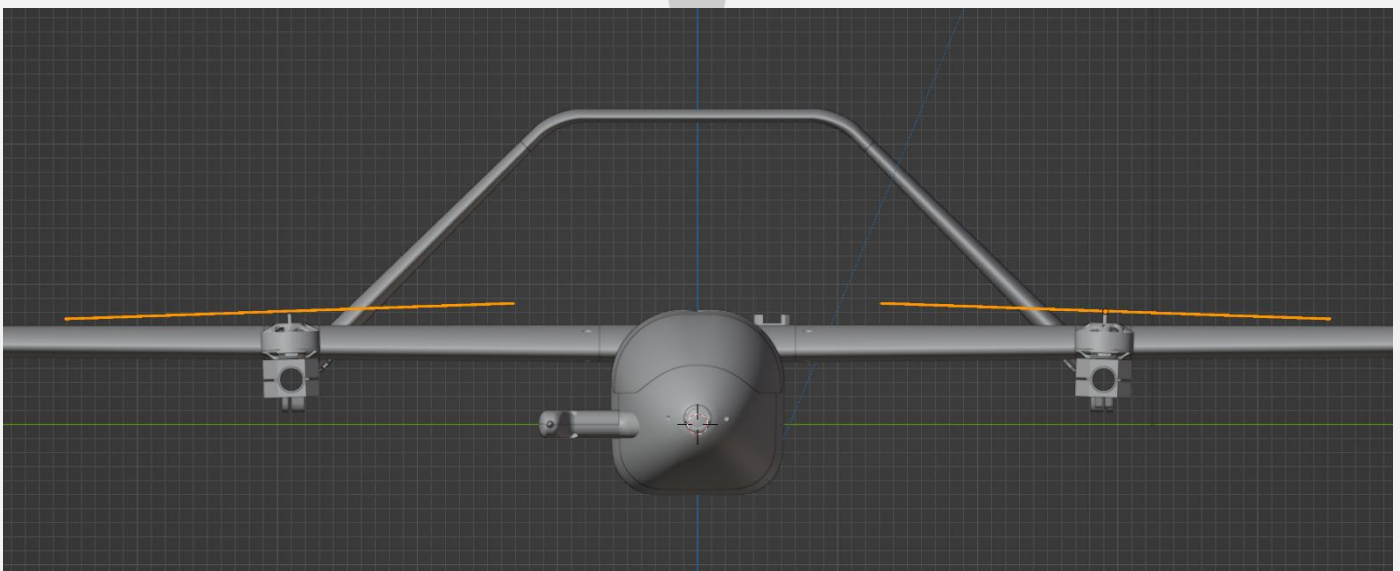




Section 8: Ardupilot setup tips

Please read in detail the documentation for setting up quadplanes on Ardupilot:
<https://ardupilot.org/plane/docs/quadplane-building.html>

Cobra is a traditional 4+1 quadplane, with 4 lift motors and 1 pusher motor. Therefore, the frame type is QUAD_X and motor outputs should be set up accordingly. See frame setup for detailed information: <https://ardupilot.org/plane/docs/quadplane-frame-setup.html>





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For increased yaw authority during hover, we recommend canting the motors 2-3 degrees by rotating them on the boom during mounting.

Use of the airspeed sensor is highly recommended, but not required. Cobra includes a fuse1 piece without the airspeed sensor mount built in. For simplest wiring, using a 4in1 ESC for the lift motors is highly recommended.

To set up the A-tail, simply set outputs as VtailLeft and VTailRight to the tail servos, and set the Reversed parameter until proper elevator + rudder functionality is achieved. Double check stabilization in FBWA before flying.

