



*Northrop Grumman*  
***B2 Spirit***  
*Parkjet*

By Craig Clarkstone

## B2 History


The Advanced Technology Bomber (ATB) program began in 1979 funded under the code name "Aurora". In 1979, designer Hal Markarian produced a sketch of the aircraft, that bore considerable similarities to the final design. The Air Force originally planned to procure 165 of the ATB bomber.

The Northrop team's ATB design was selected over the Lockheed/Rockwell design on 20 October 1981. The Northrop design received the designation B-2 and the name "Spirit". By 1989, MIT engineers and scientists helped assess the mission effectiveness of the aircraft under a five-year classified contract during the 1980s. The B-2 Spirit was developed to take over the USAF's vital penetration missions, able to travel deep into enemy territory to deploy their ordnance, which could include nuclear weapons.

The B-2 is a flying wing aircraft, meaning it has no fuselage or tail. The blending of low-observable technologies with high aerodynamic efficiency and large payload gives the B-2 significant advantages over previous bombers. Low observability provides a greater freedom of action at high altitudes, thus increasing both range and field of view for onboard sensors. The U.S. Air Force reports its range as approximately 6,000 nautical miles (6,900 mi; 11,000 km). At cruising altitude the B-2 refuels every six hours, taking on up to 50 short tons (45,000 kg) of fuel at a time.

As of September 2013 about 80 pilots fly the B-2. Each aircraft has a crew of two, a pilot in the left seat and mission commander in the right, and has provisions for a third crew member if needed. For comparison, the B-1B has a crew of four and the B-52 has a crew of five. The B-2 is highly automated and, unlike most two-seat aircraft, one crew member can sleep in a camp bed, use a toilet, or prepare a hot meal while the other monitors the aircraft; extensive sleep cycle and fatigue research was conducted to improve crew performance on long sorties

## Designers Notes



I first saw the B2, as I was coming out of a subway station in San Francisco back in 2014 during 'Fleet week'. It was so unexpected, it took me by surprise and I thought how alien it looked. Like something out of a sci-fi film.

It had such a presence in the sky I really marvelled at it. I had thought about designing one during my YF-23 design and testing, but only after I saw the LX hobbies one fly, did I have the courage to give it a go.

I took inspiration from the LX design, but reduced the EDF size to try and get a more scale look and performance.

If you enjoy this design please help me to fund my next project and send a donation for \$10 to Paypal address :-

[clicketyclarkstone@gmail.com](mailto:clicketyclarkstone@gmail.com)

Thank you! and happy flying.

# Construction

Before you start, choose which model type you wish to build - either EDF or Pusher. This construction guide shows both types throughout the build. Please read the instructions carefully.

# Before you start.



## Adhesives

- > For the majority of construction :
  - UHU Creativ for Styrofoam (also called UHU POR)
  - 3M 77 Spray adhesive.
- > For wing spars and motor mounts :
  - Epoxy. (5 and 15mins cure times are the most convenient) micro-balloons can be added to reduce weight.
- > For servo's / and quick grab :
  - Hot melt glue gun - Caution if the glue gets too hot it will melt foam - test first!

## Tapes

- > For holding parts tightly together whilst glue sets
  - Low tack masking tapes
- > For leading edges, hinges, general strengthening
  - 3M Gift tape (Purple - not green one!) - I prefer lightweight plastic hinges.
- > For decals
  - Coloured parcel tapes (strips taped to waxed paper & cut out)

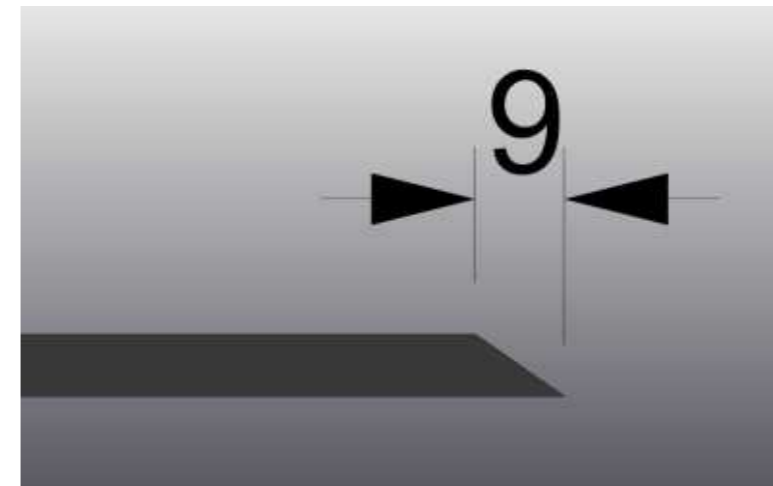
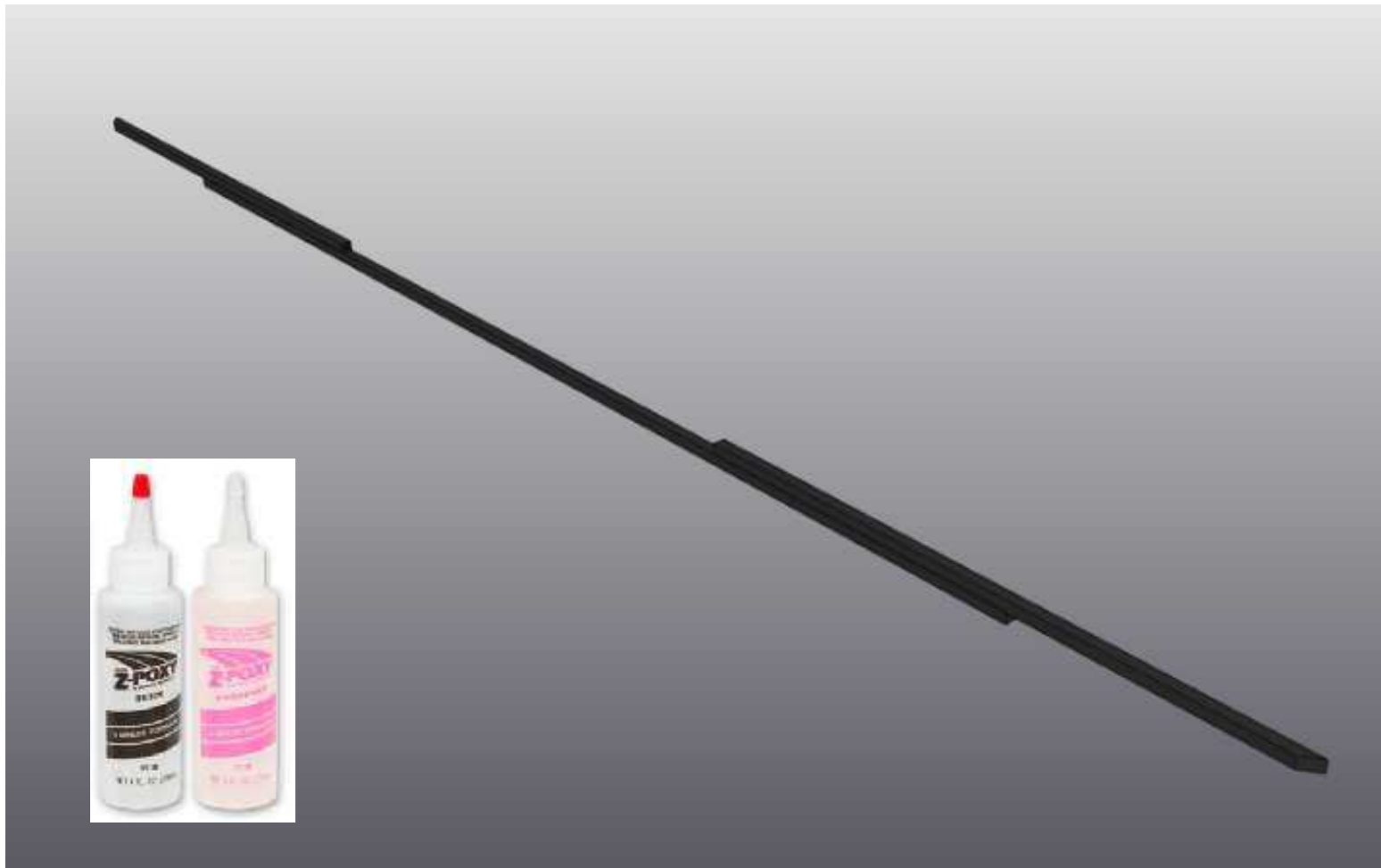
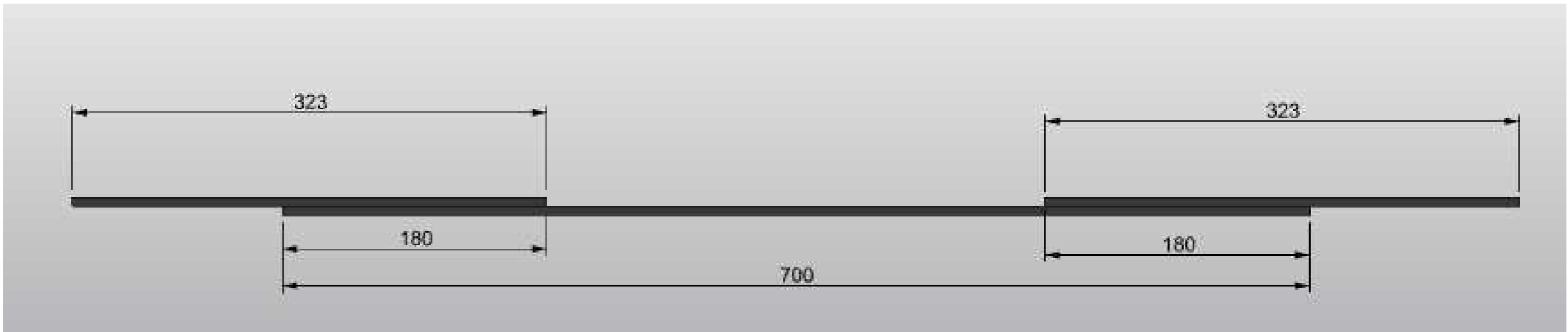
## Cutting parts

1. Print the plans,
2. Cut around each part using scissors - allow a border of approx (1/4") 6mm
3. Use either 3M spray mount or a very light coat of 3M 77 to the back of the parts and stick in an economical layout on the Depron foam.
4. Using a safety rule and craft knife over a cutting mat - important! use a fresh blade otherwise it will drag and spoil the foam. (I find the stanley knife perfect) make the straight edge cuts, then the curved parts freehand.
5. Once the parts are cut-out, keep the template stuck to the part until just before needed to help identify the parts.
6. After use, I find it helpful to keep all the used tempates in case replacement parts need making. (the glue eventually dries and they don't stick together!)

**IMPORTANT** Wherever the plans call for marking guidelines onto the depron, please ensure that you do otherwise it can cause problems later on. I suggest you use a Sharpie Fineliner to transfer the lines.

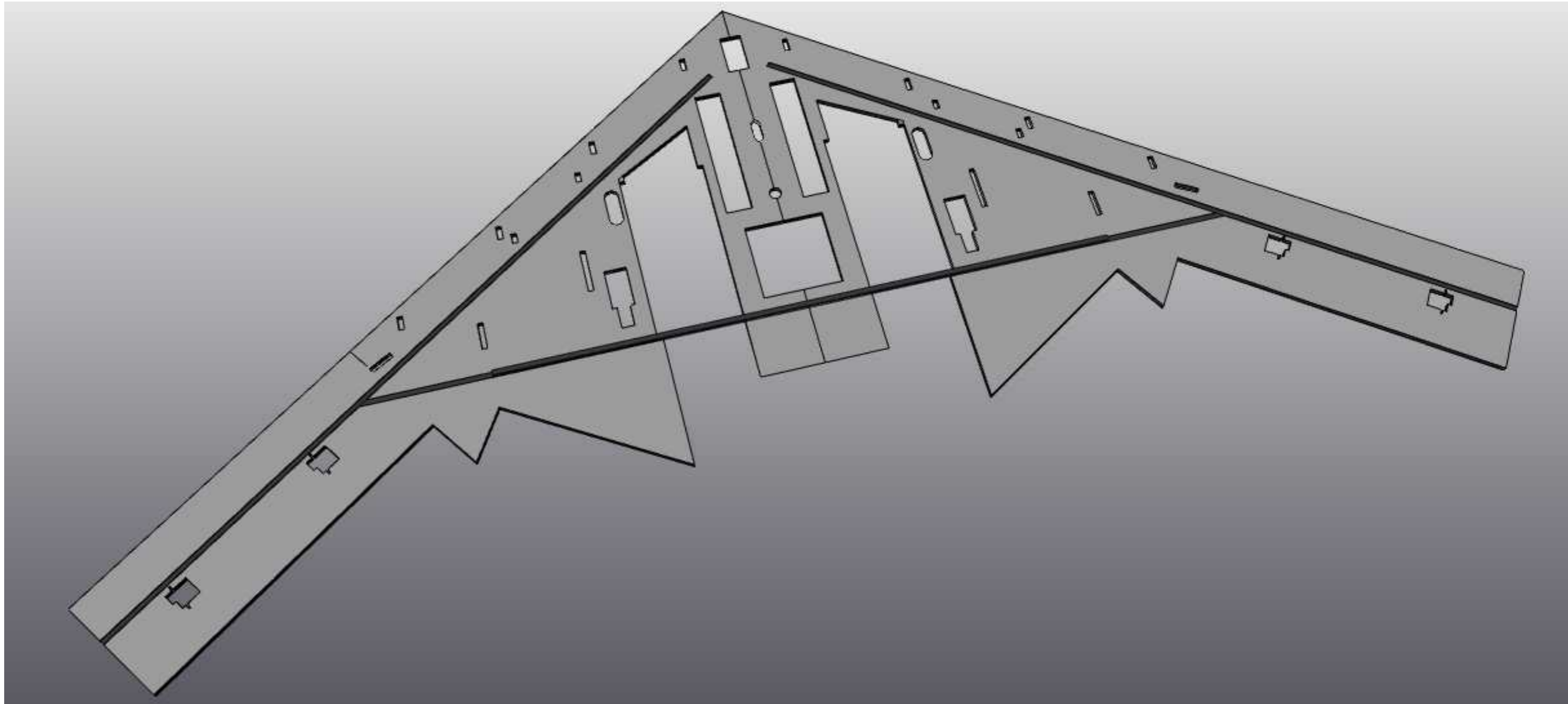
## Glueing parts together.

1. Ensure a really good fit - this will reduce the amount of adhesive used. The Bar Sander is a great tool for this.
2. Follow the adhesive instructions closely.
3. Use ordinary steel head pins to help keep the parts located whilst epoxy sets.
4. Use objects as weights such as paperweights to apply pressure whilst adhesive sets.
5. Use masking tape to apply pressure whilst adhesive sets. Also use masking tape to along the slots for the wing spars whilst gluing the carbon rod spars into the wings. This prevents the glue protruding and gives a nice finish.



Glue the three square sectioned pieces together as shown. Wrap nylon thread multiple times at each end and then glue in place with epoxy.

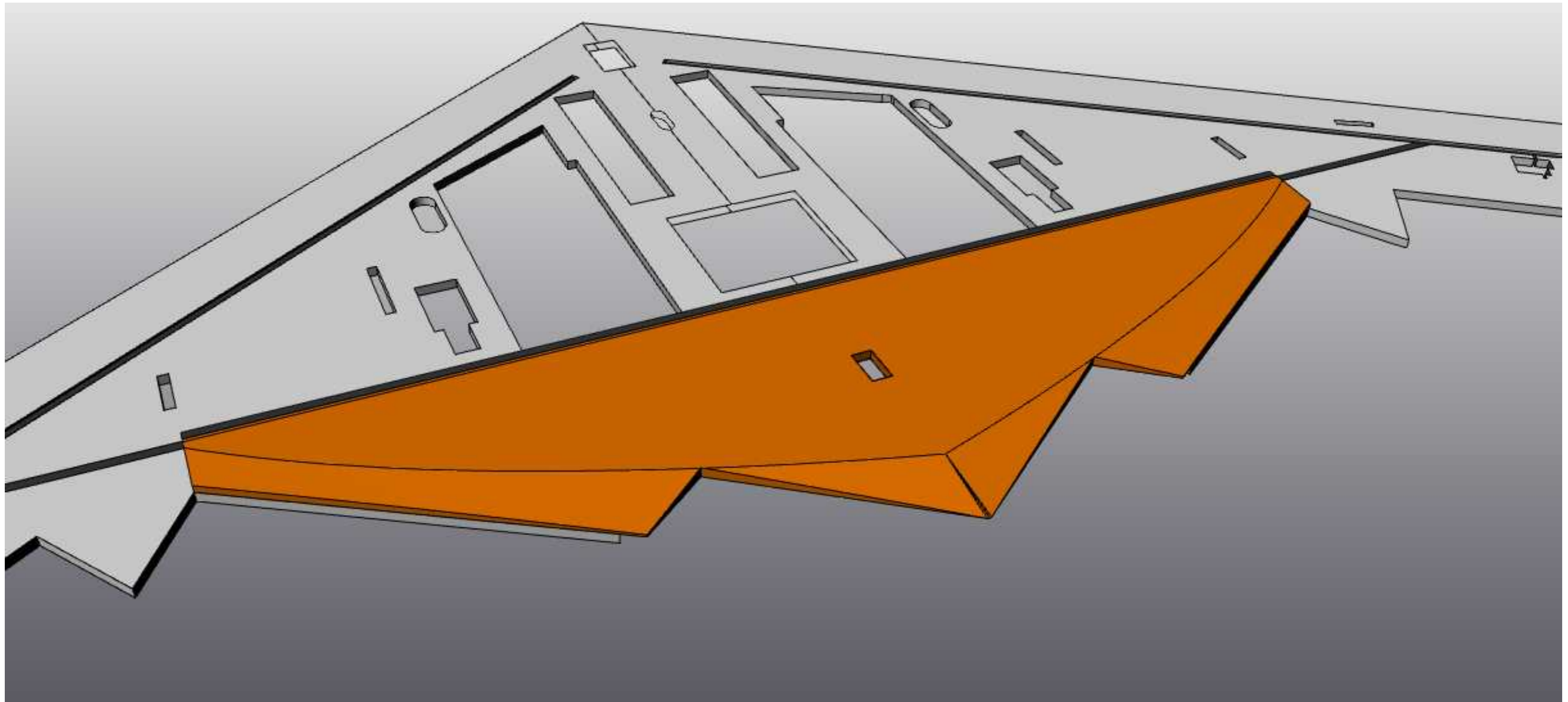




Assemble the pieces of Wing (part 1) as shown and using masking tape and 20m epoxy, glue the spar assembly in place as shown - this image shows the centre section raised - this means we are looking at the underside of the wing.

Glue in place the two 1m lengths of carbon tube alongside the leading edges as shown using the same masking tape technique.

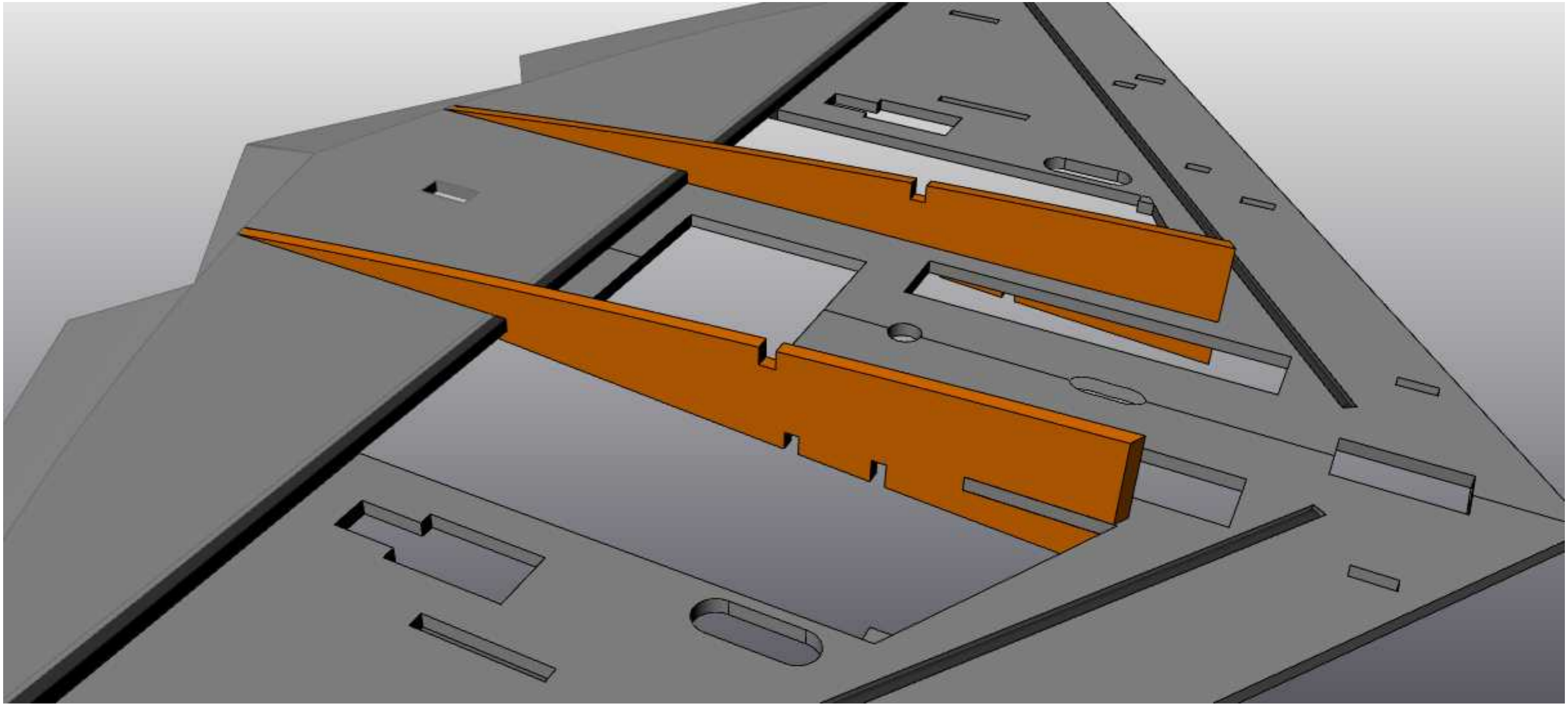




Pre shape the latitudinal support (part 2) using hot wire cutting (with guide edges), or sandpaper to get the shapes as shown.

Glue in place using UHU por.

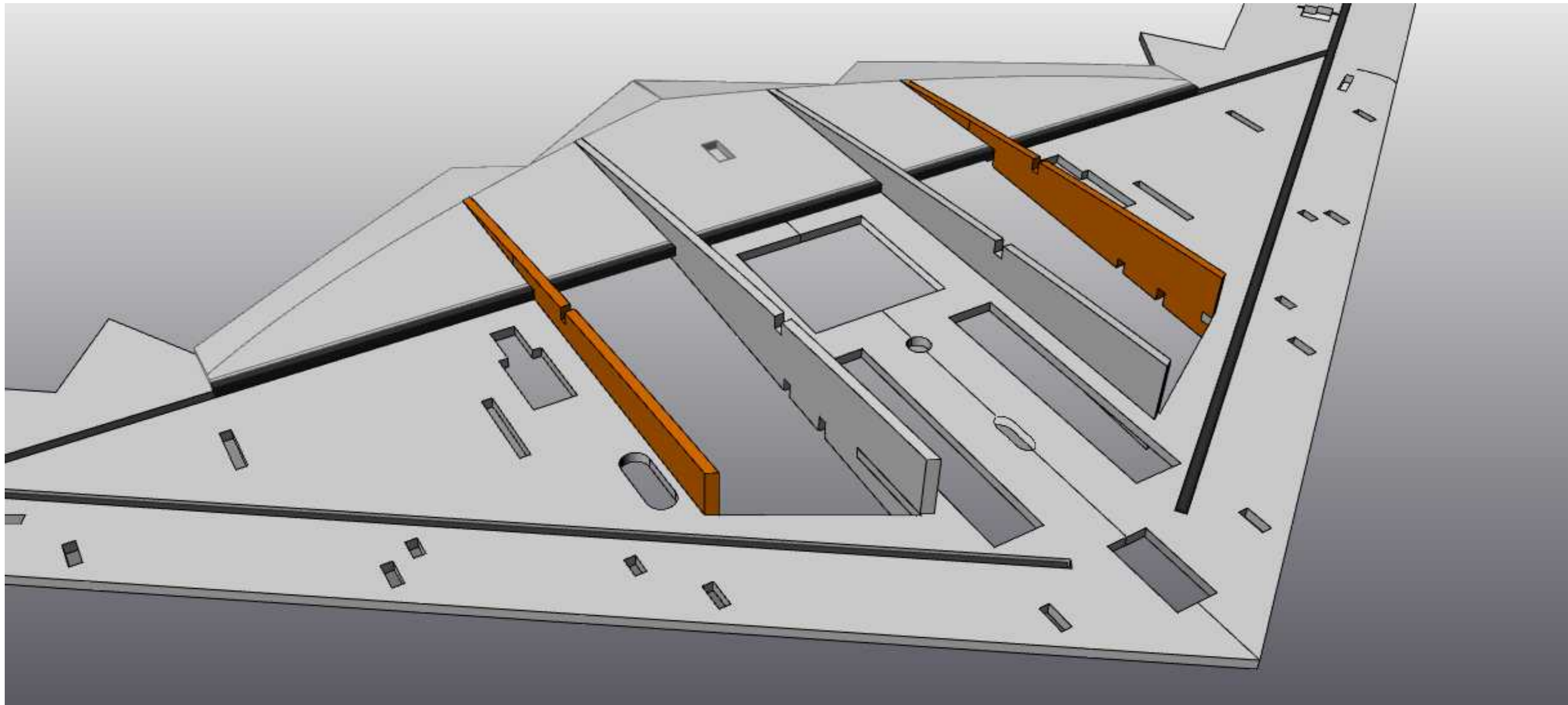




Carefully slide the Longitudinal 1 pieces (part 3) in place and glue using epoxy - sparingly.

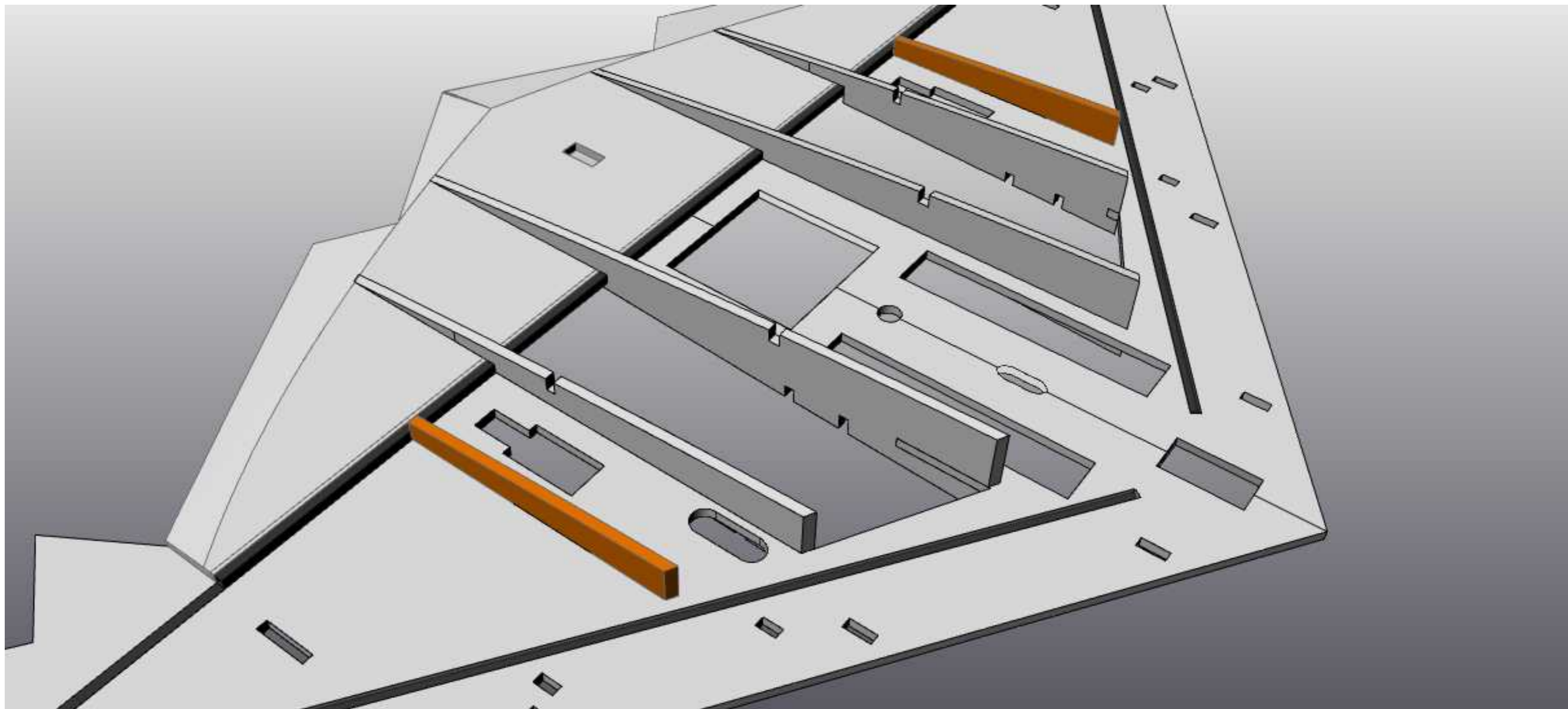






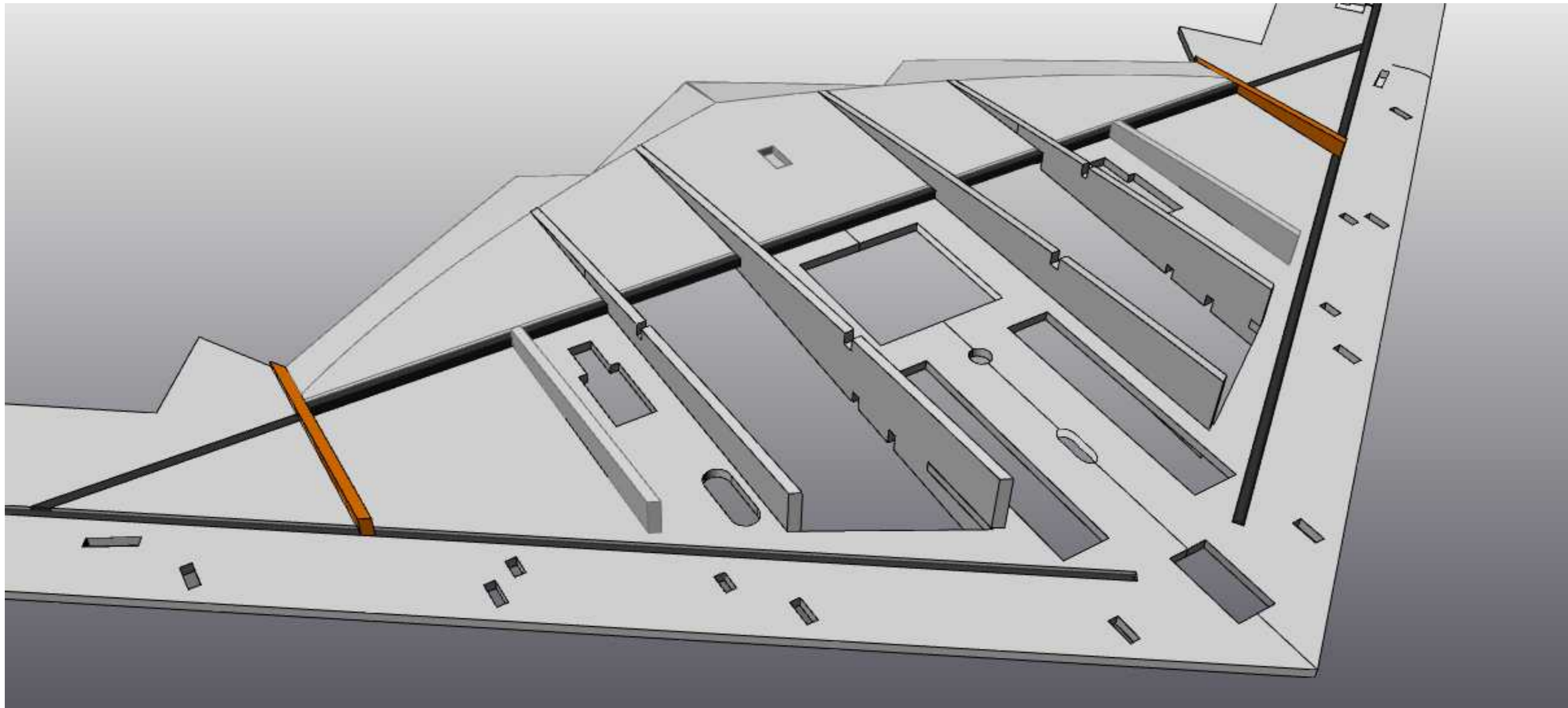
Glue the longitudinal 2 pieces (part 4) in place as shown using UHU por.





Glue the longitudinal 3 pieces (part 5) in place as shown using UHU por.





Glue the longitudinal 4 pieces (part 6) in place as shown using UHU por.





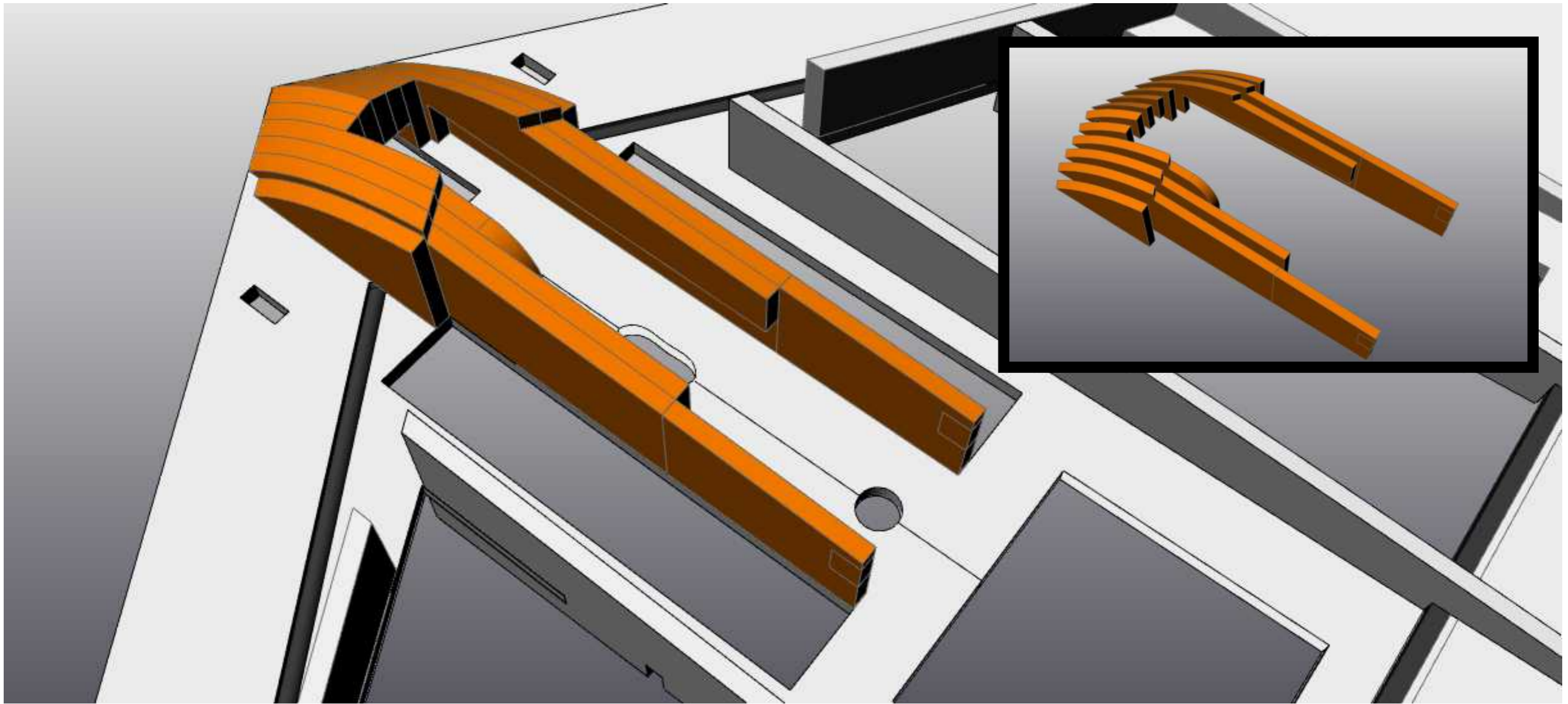
Glue the Latitudinals (part 7) in place as shown - using the tab as a location guide.





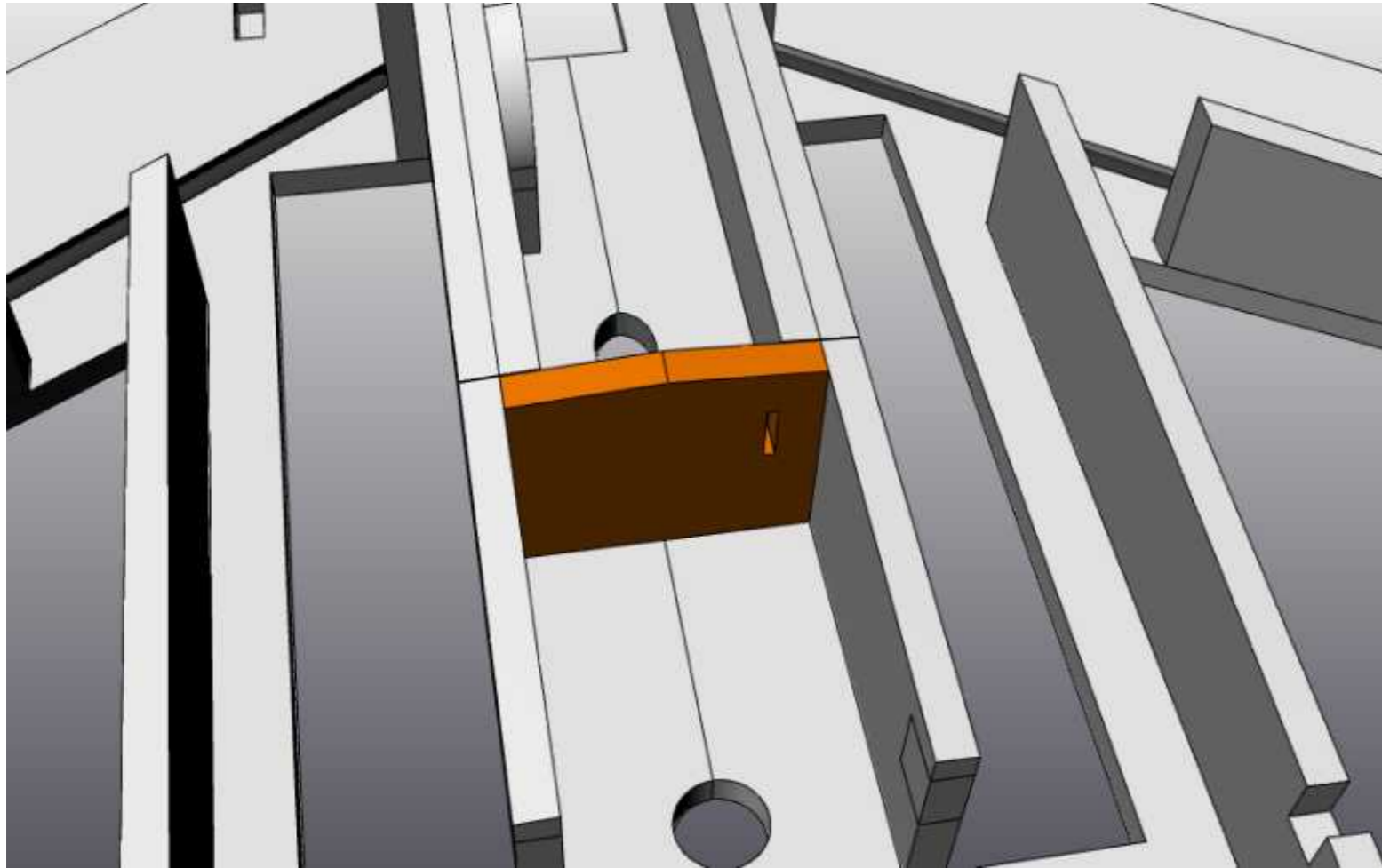
Glue the wing retract bases (part 8) in place as shown.



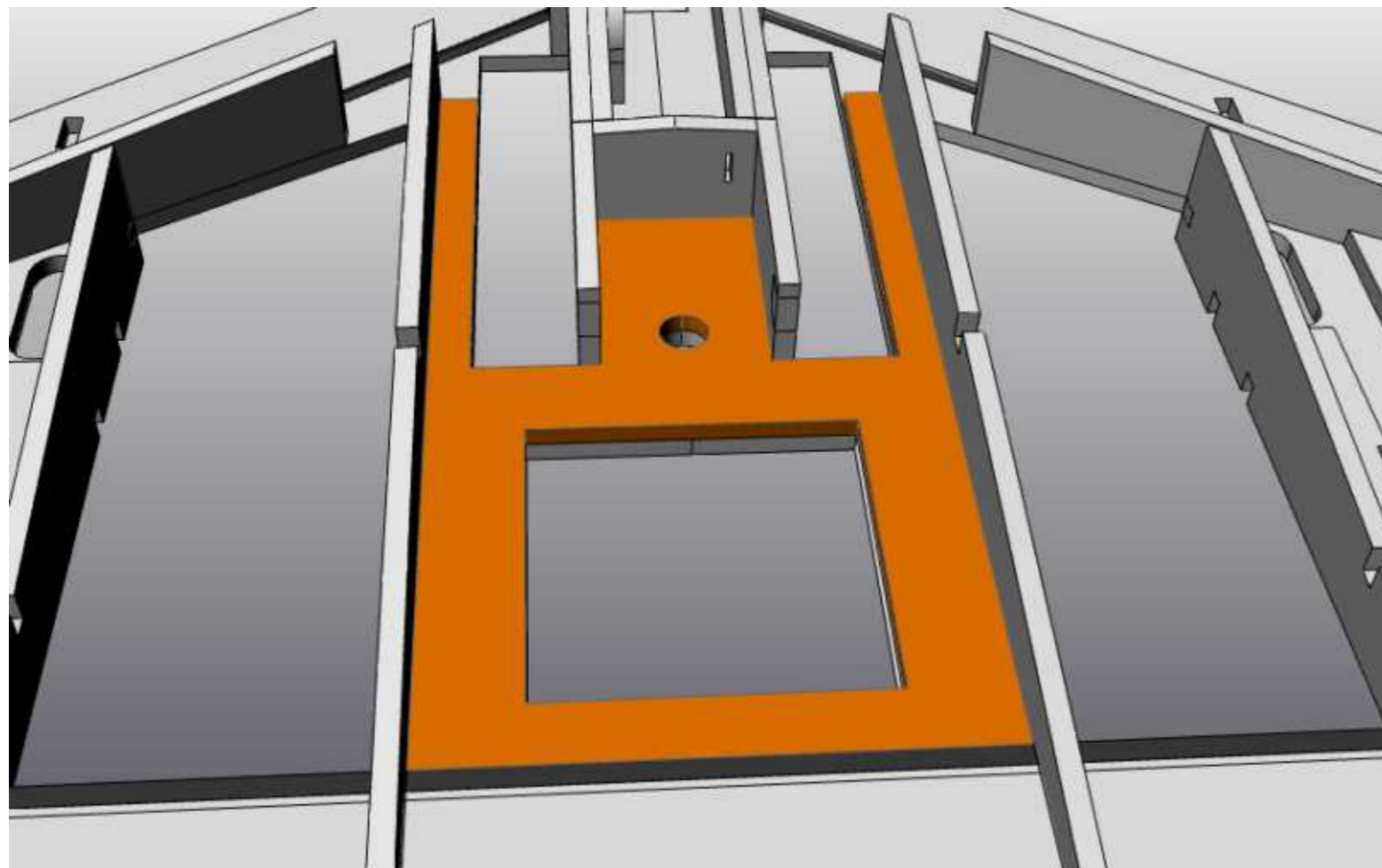


Laminate the lower nose cone (part 9) together as shown and glue to the main assembly.



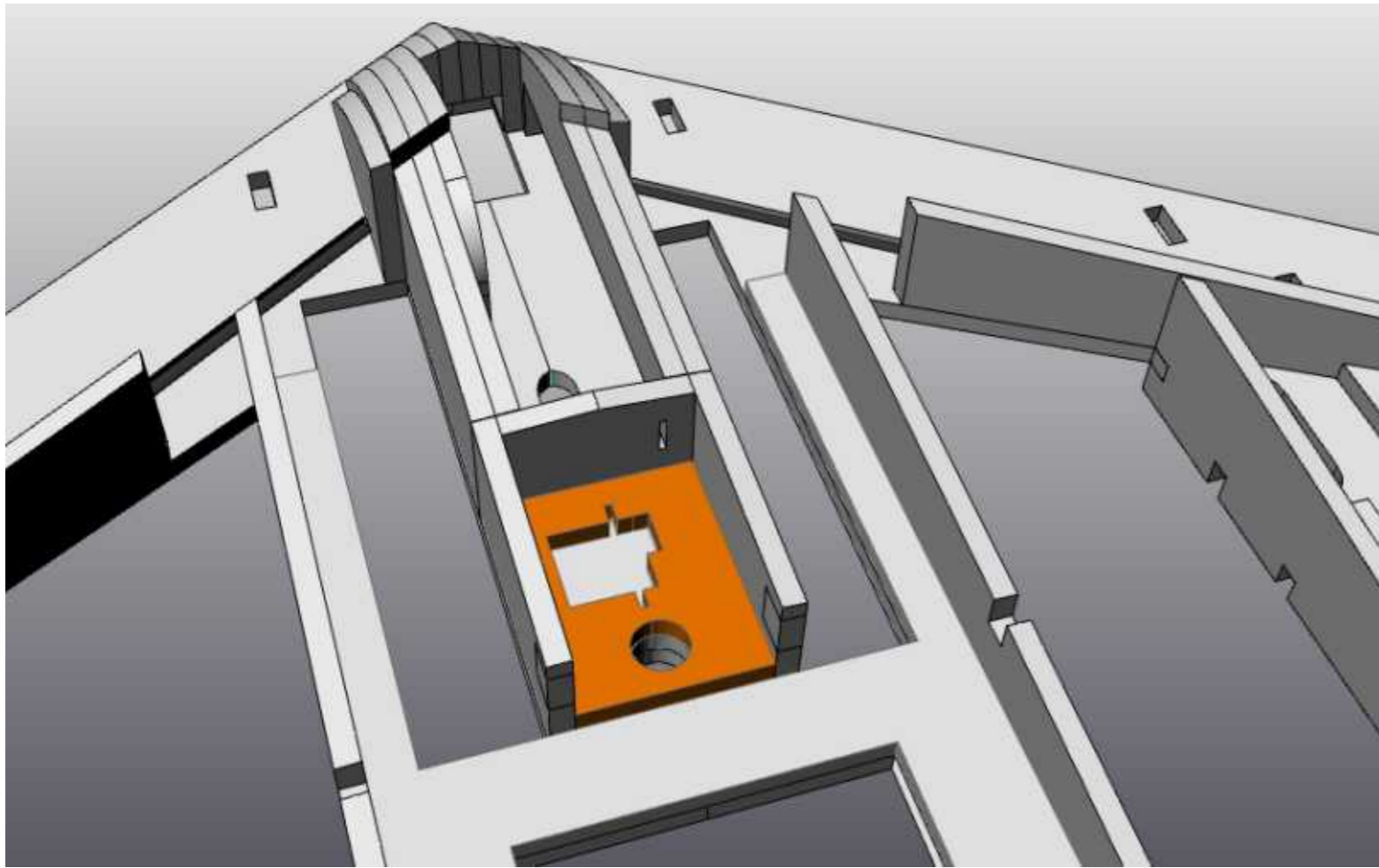


Glue the lower bulkhead 1 (part 10) in place.

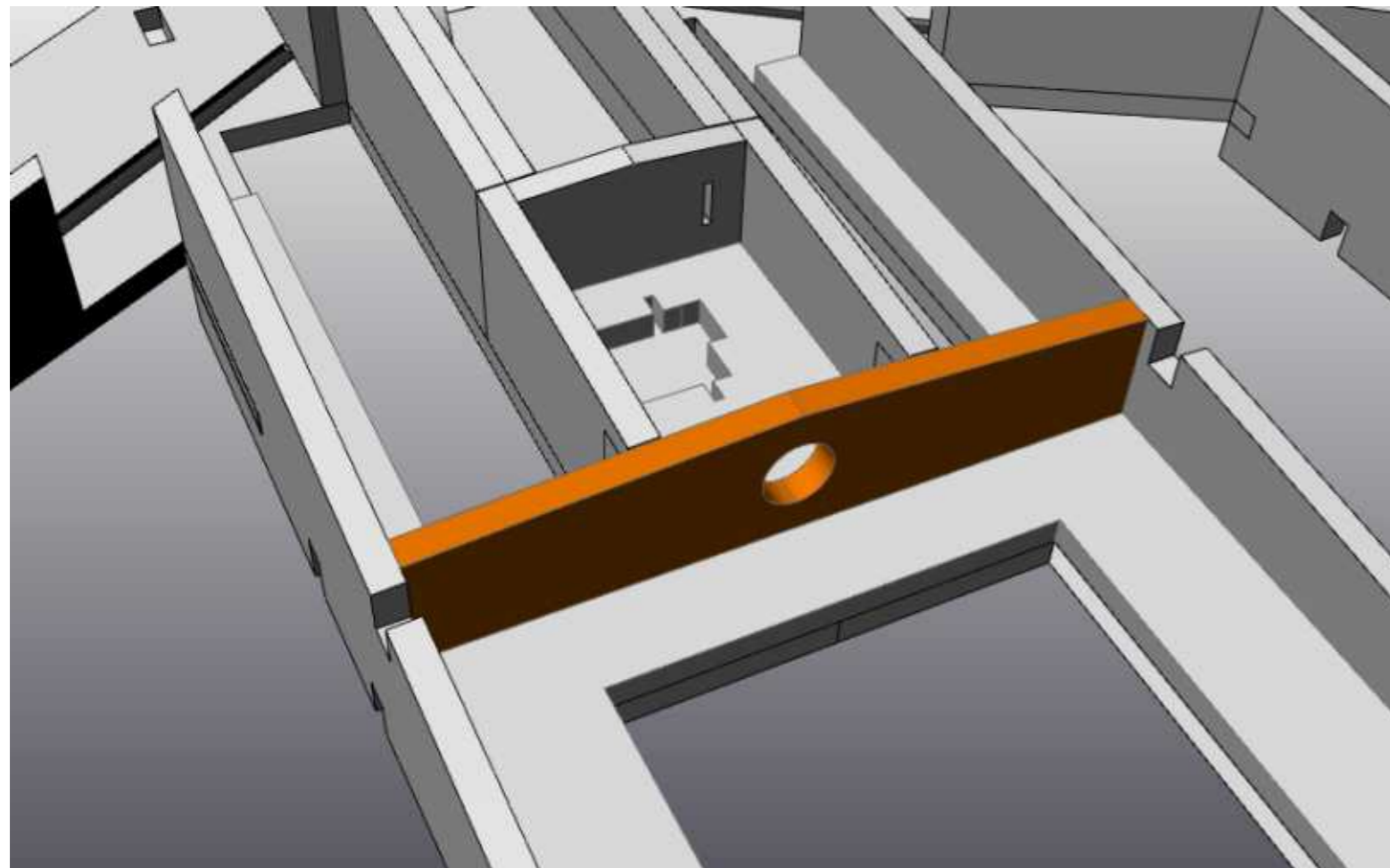


Glue the Central reinforcement lower piece (part 11) in place.





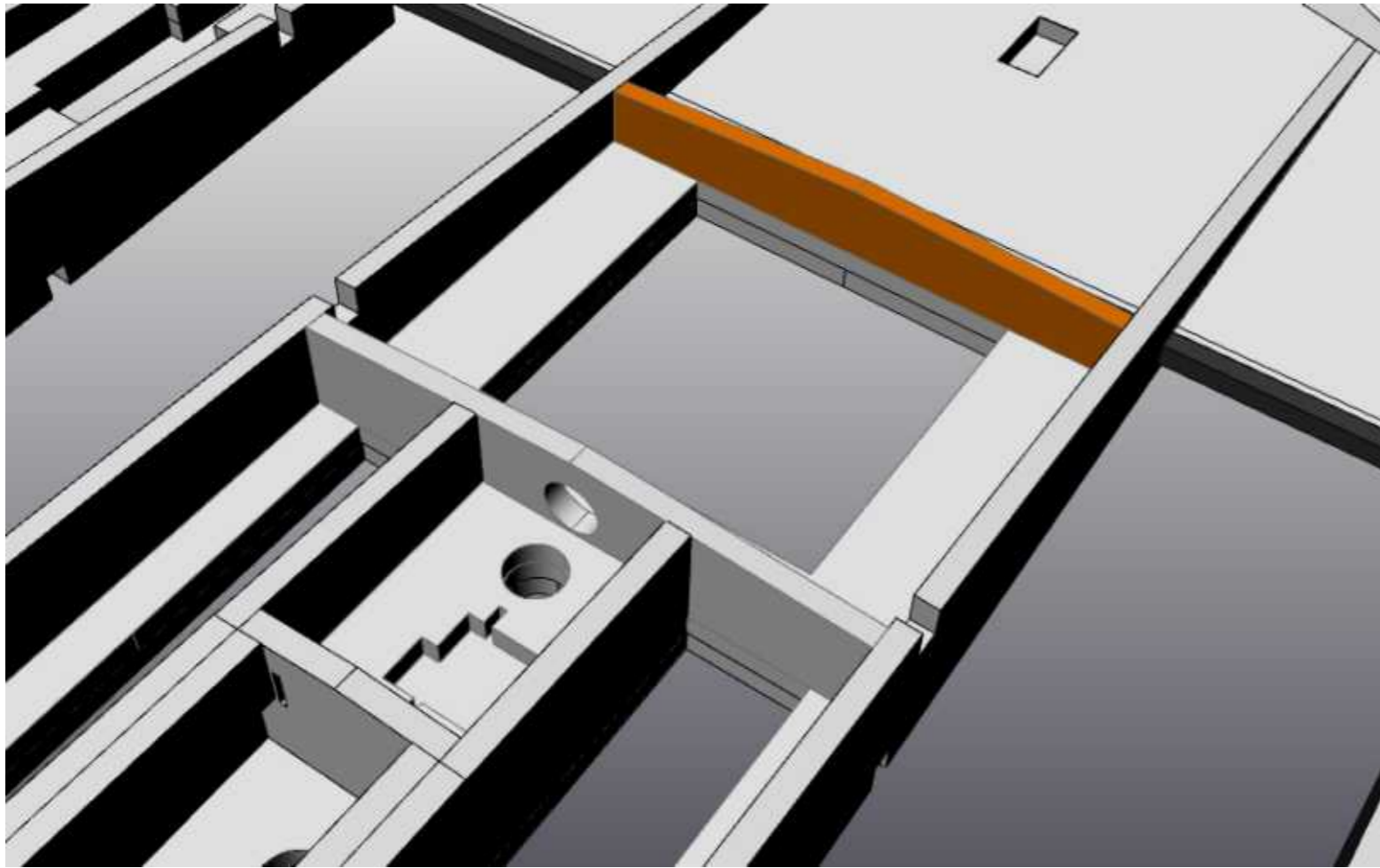
Glue the steering servo tray in place. (part 12)



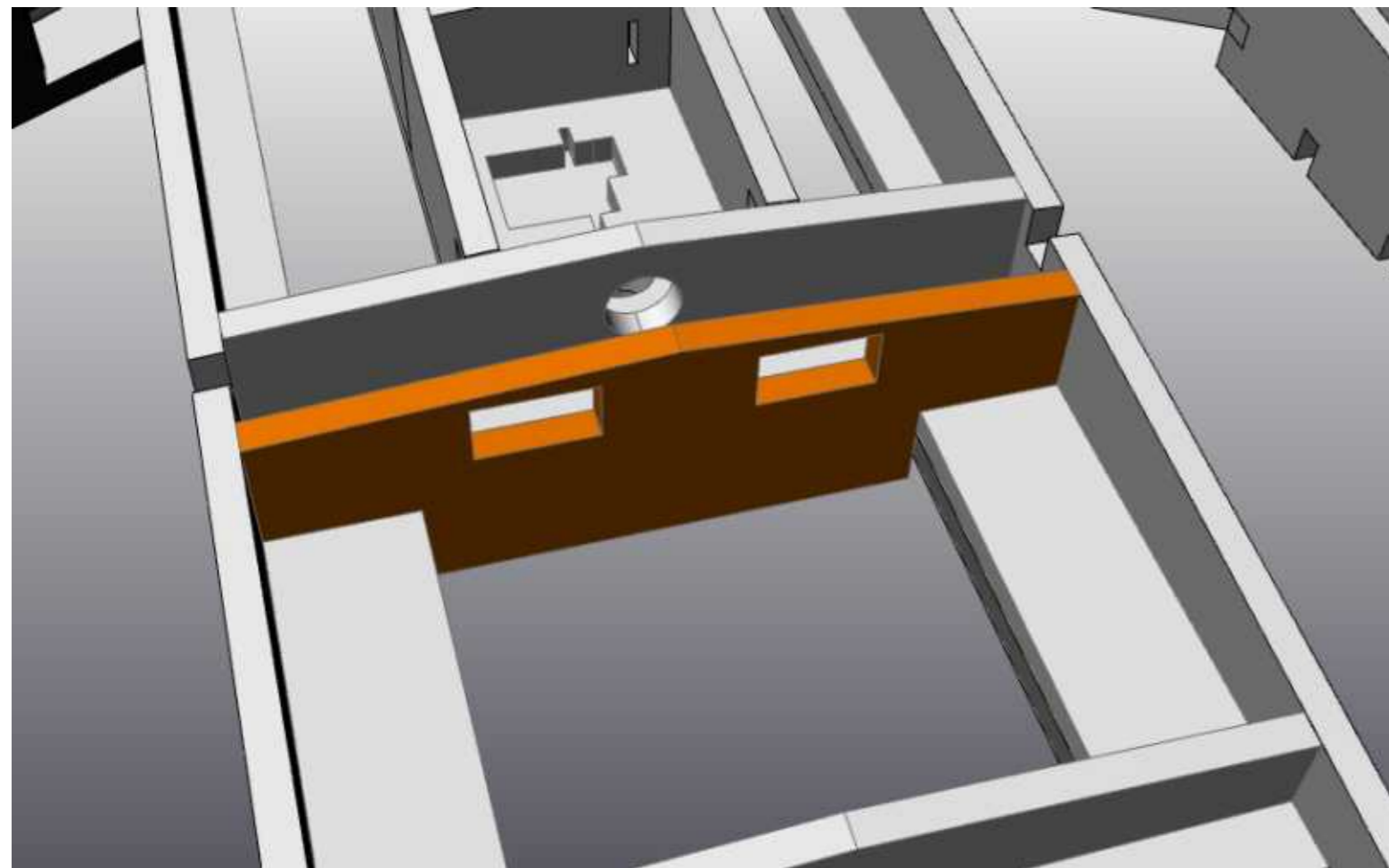
Glue the lower bulkhead 2 in place. (part 13)





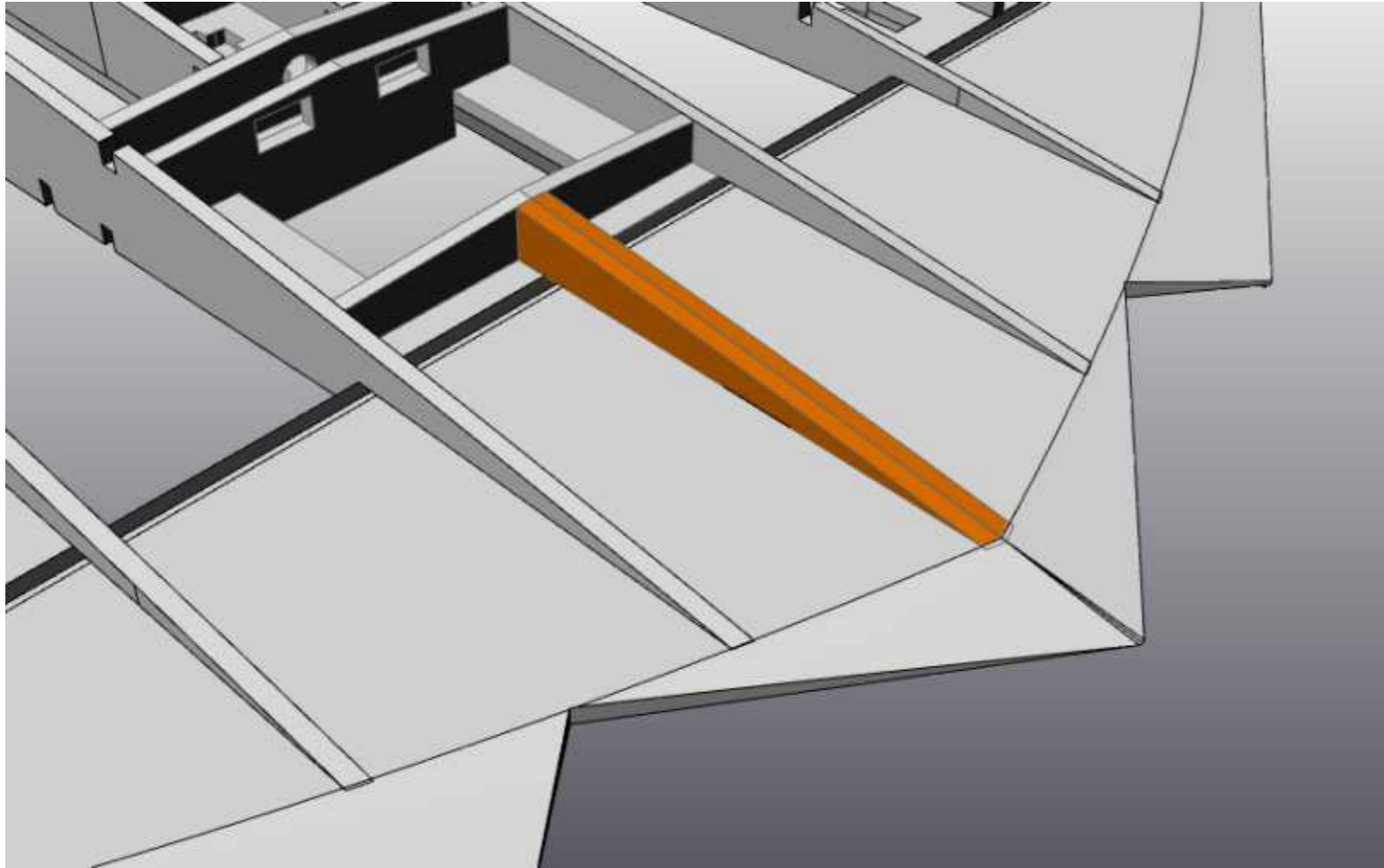


Glue the lower bulkhead 3 in place. (part 14)

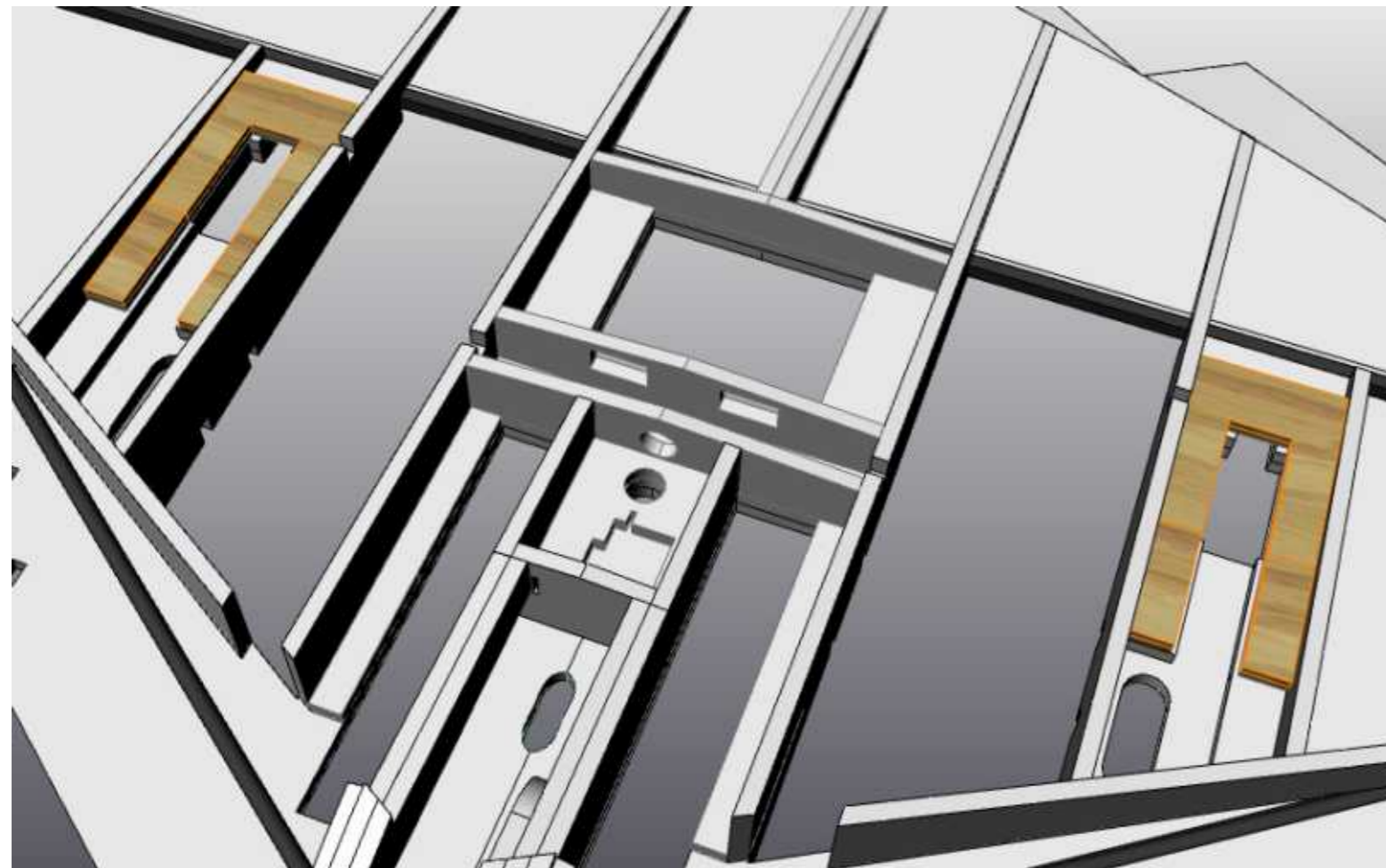


Glue the bomb bay servo mount in place. (part 15)





Glue the centreline support rear lower in place.  
(part 16)



Glue the 3mm lite ply pieces in place as shown  
using epoxy - two layers of ply on each side.





Glue the two lite ply front retract / chassis support pieces in place as shown - aligned to the depron hole.



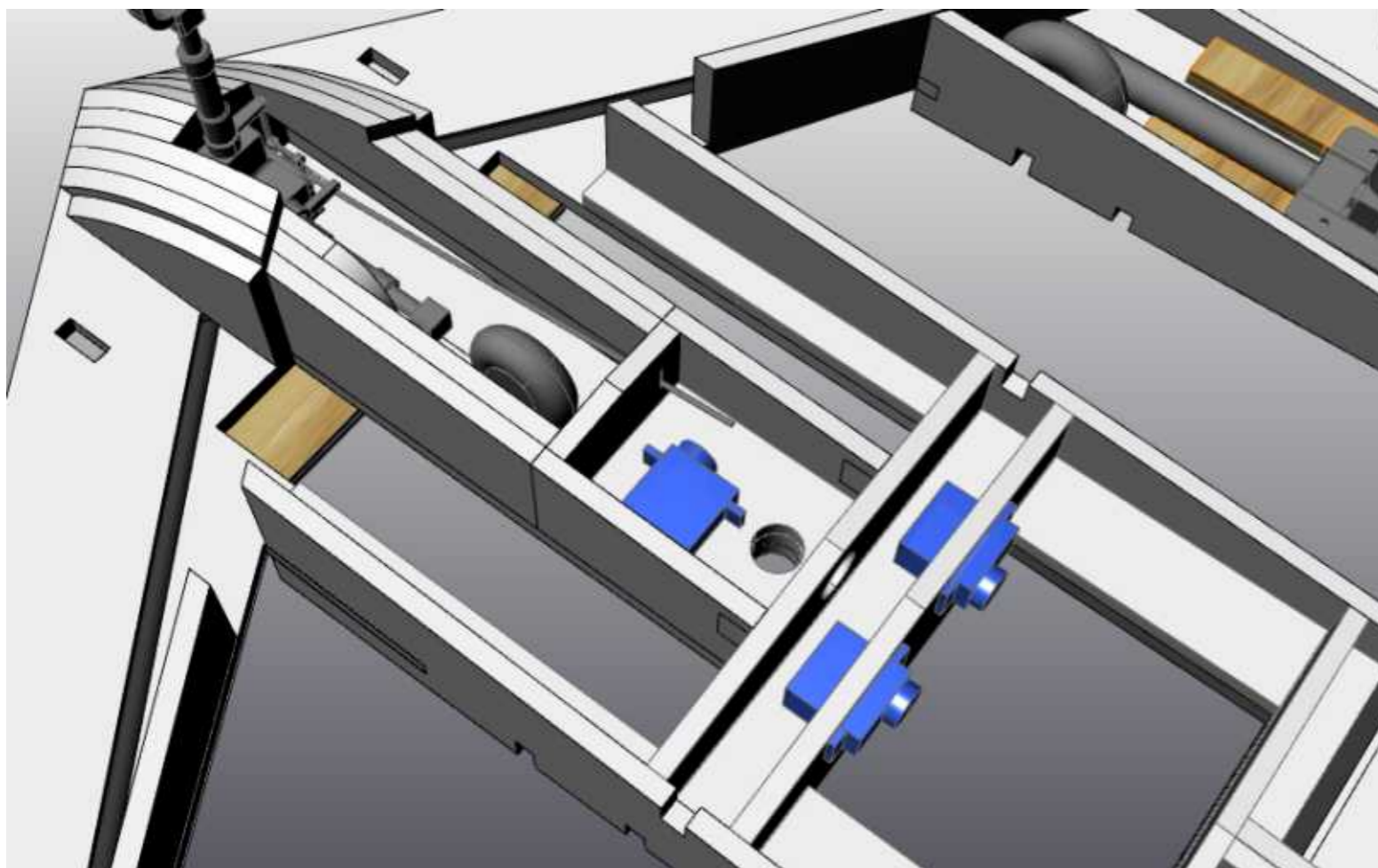
Screw or bolt the front retract in place as shown,

This model was designed to take Turnigy MCR-F Retracts. You may need to file a flat section in the aluminium in order to turn the wheel to the correct orientation.





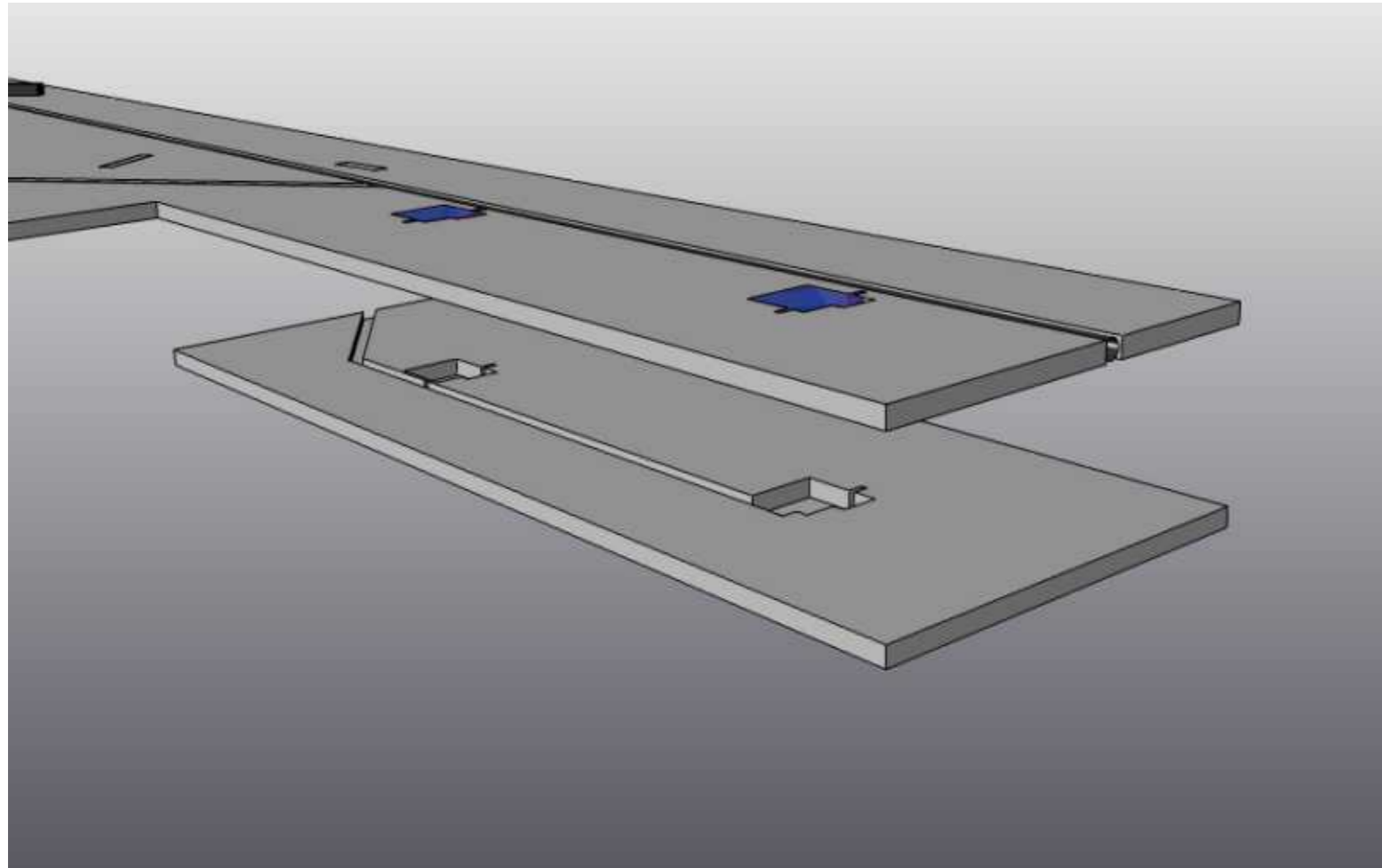
Screw the rear retracts in place as shown.



Connect the retract steering arm to the servo using a clevis and then to the steering servo. At the same time fit the bomb bay door servos.

Glue in place using hot melt glue

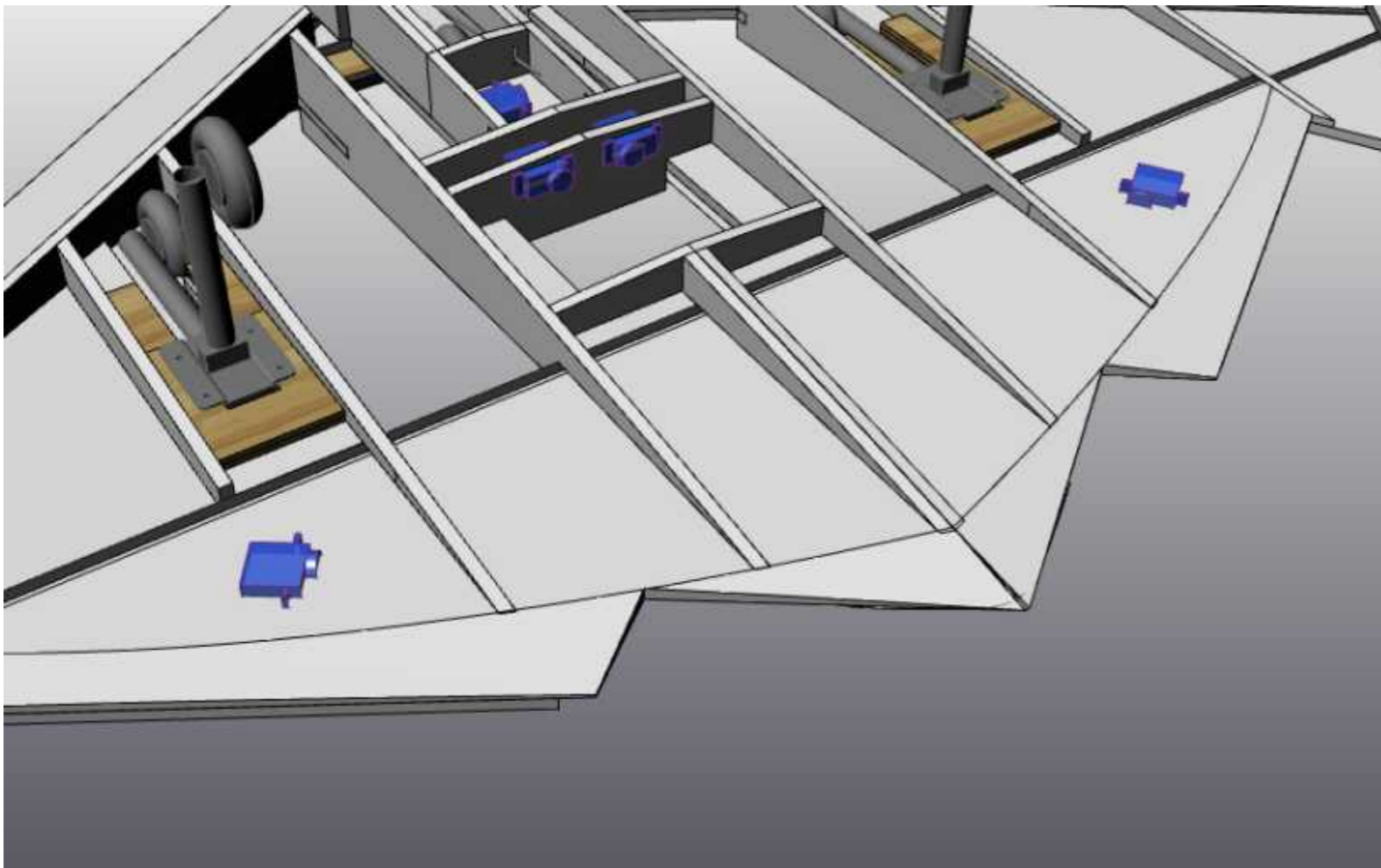




Using hot melt glue, mount the wing servos flush into the wing, and run the cables through the recessed duct in the lower wing pieces.

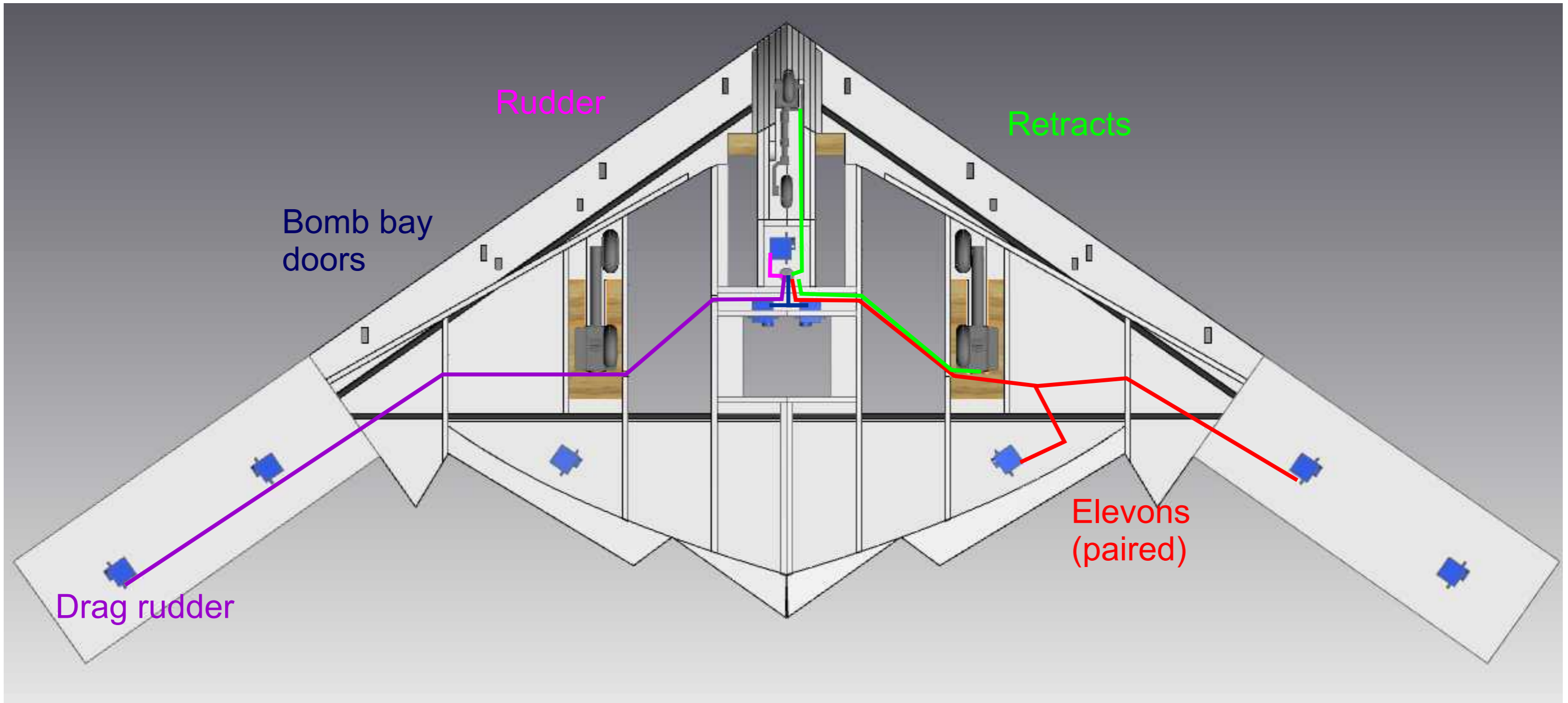
Test the wing servos thoroughly, and I suggest use metal gear servos before embedding them into the wing.

Glue the lower wing pieces to the wing securely



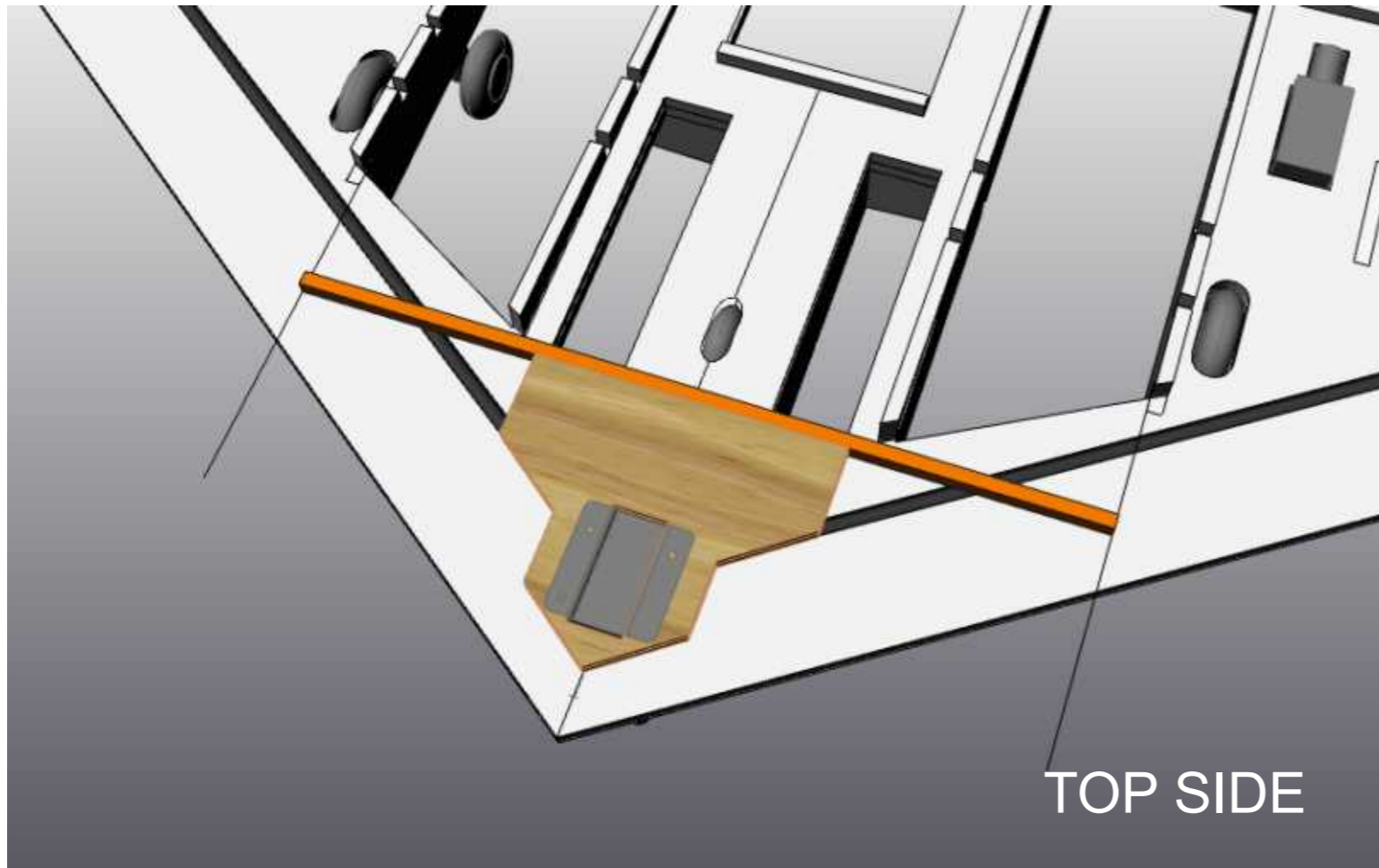
Glue the inner elevon servos in place using hot melt glue.



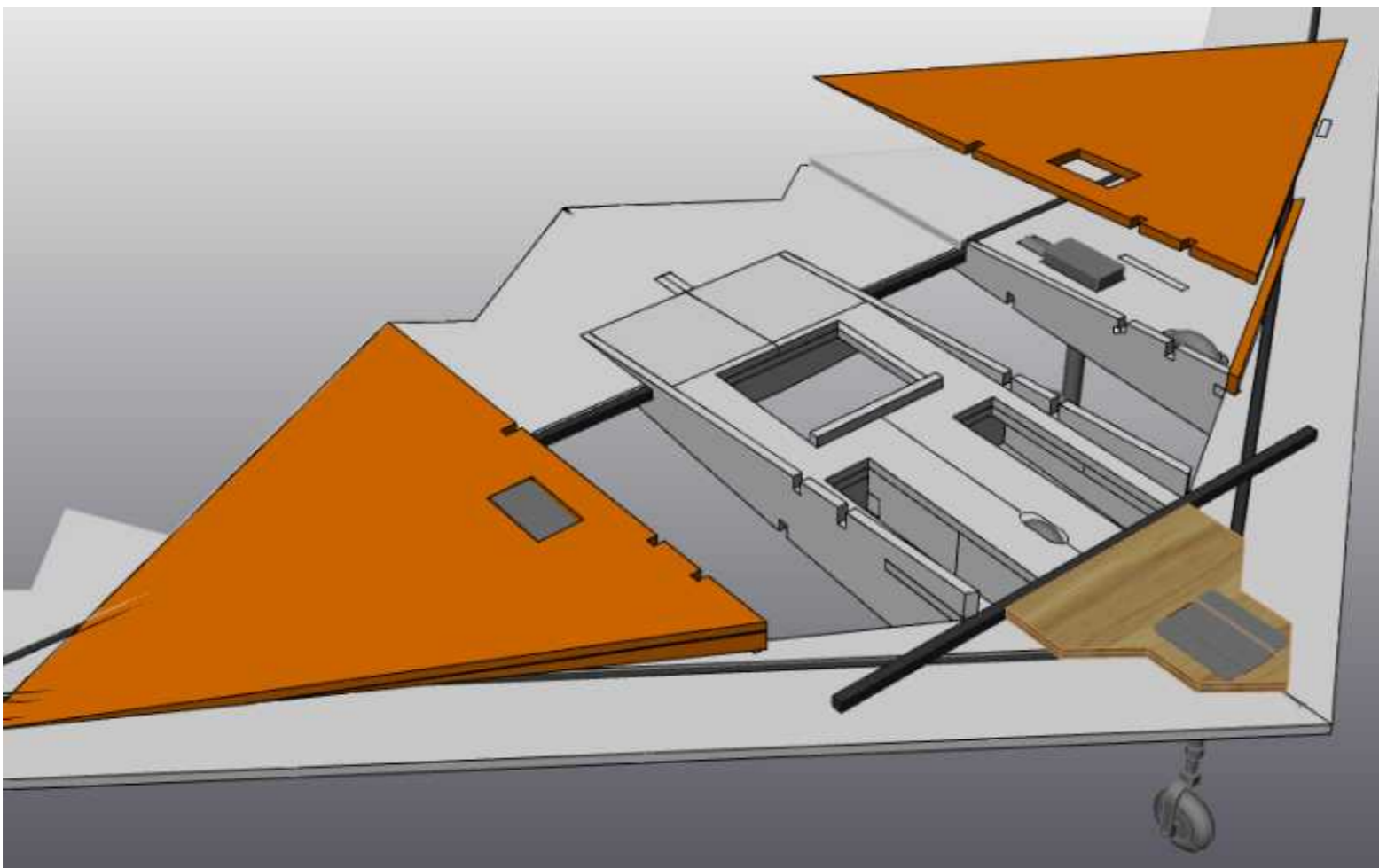


Run the servo wires as indicated in this diagram.





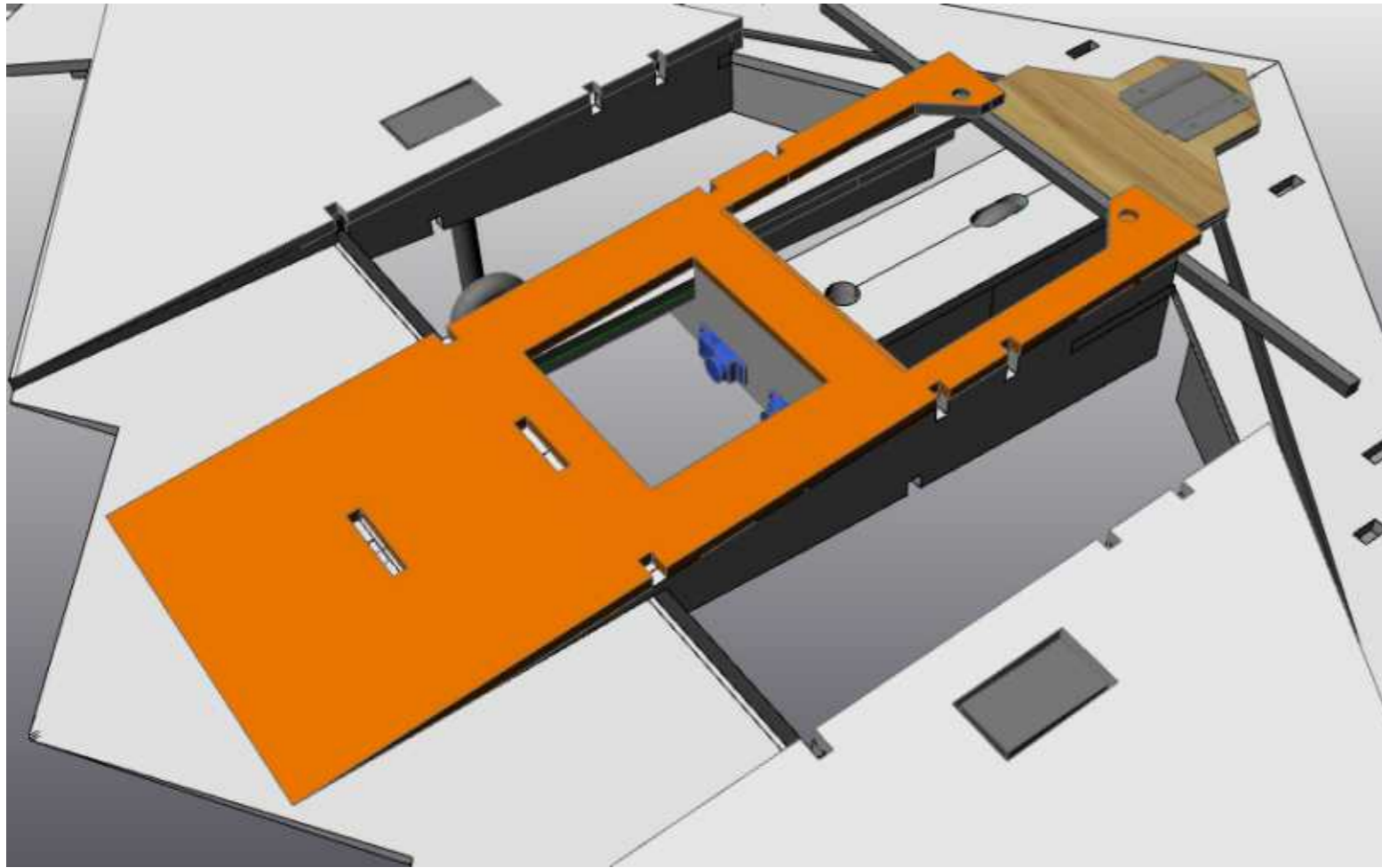
Epoxy the forward Box sectioned spar to the wing panel as shown.



Shape the upper wing parts using a sander or hot wire cutting.

Glue the Upper latitudinals (part 18) and upper wing parts in place (part 20)





Shape the underside of the top rear section (part 20) using a sander or hot wire cutting.

Glue into place



Glue the forward (part 21) and rear (part 22) EDF bulkheads in place. - make sure that they are in the correct slots, the correct way around and facing the correct way.

The EDF's are mounted on an angle. If you have sanded according to the drawing, the shaping within the circles will reflect this.



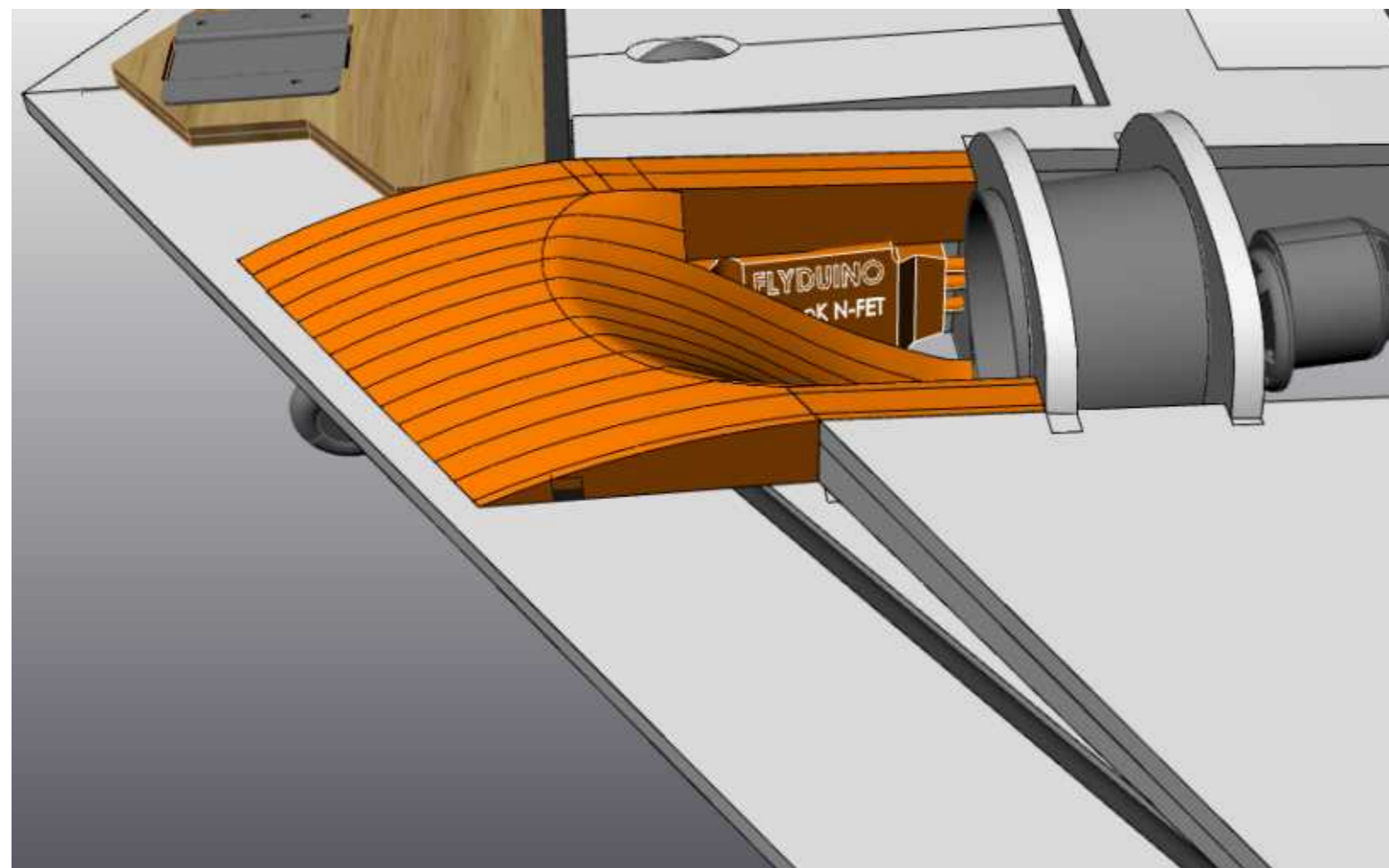




Decide if you want to put the speed controllers near the entrance to the fans, or under the thrust tube before the spar. The advantage of the forward position is that it helps with getting the correct CG without weight. The advantage of the rear position is that it makes a prettier air intake area, and cooler airflow over it. The drawback is that you will need to add some noseweight to establish the CG.

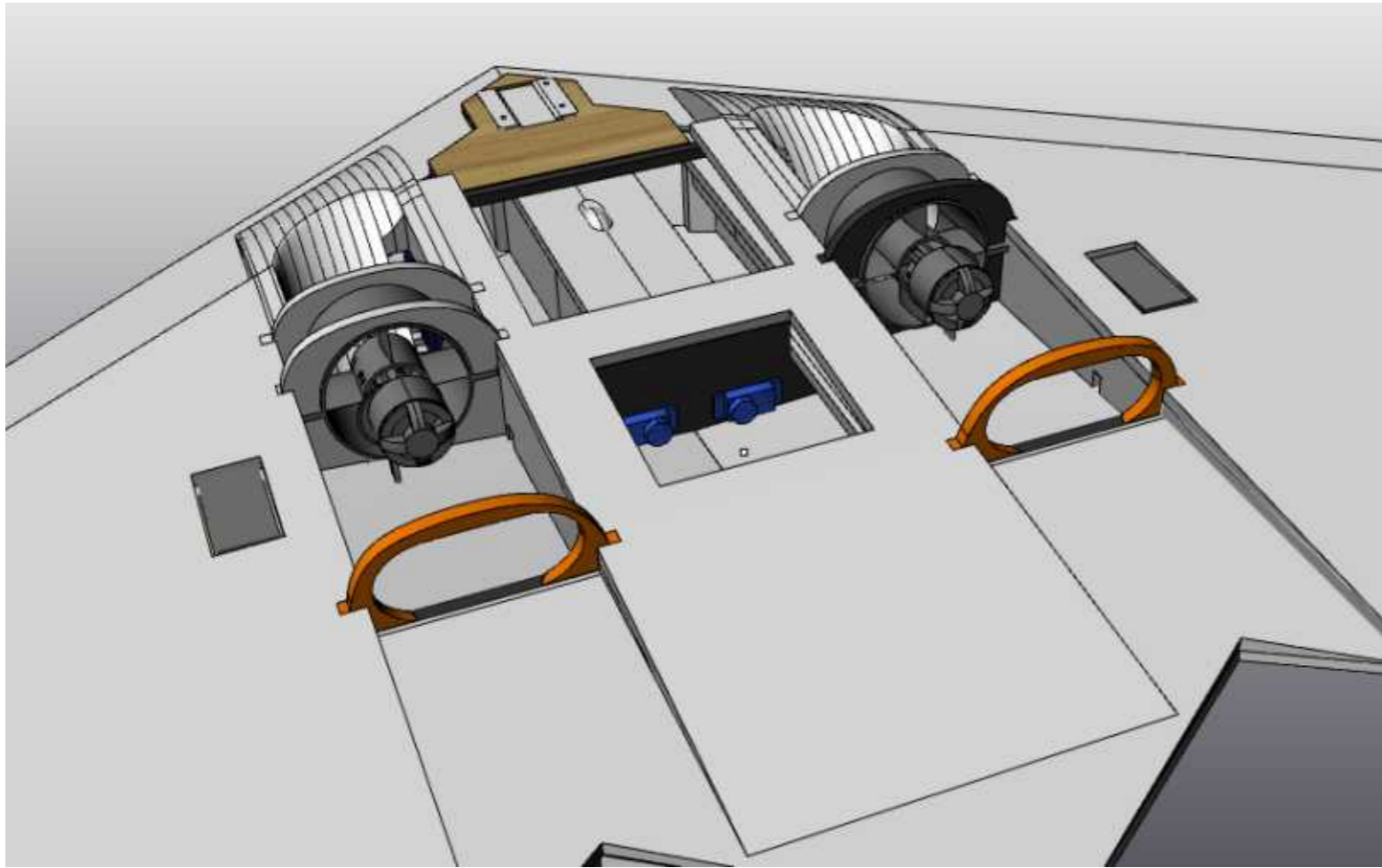
Parts for both positions are on the parts sheet.

For the sake of this build, I've shown the speed controllers forward.

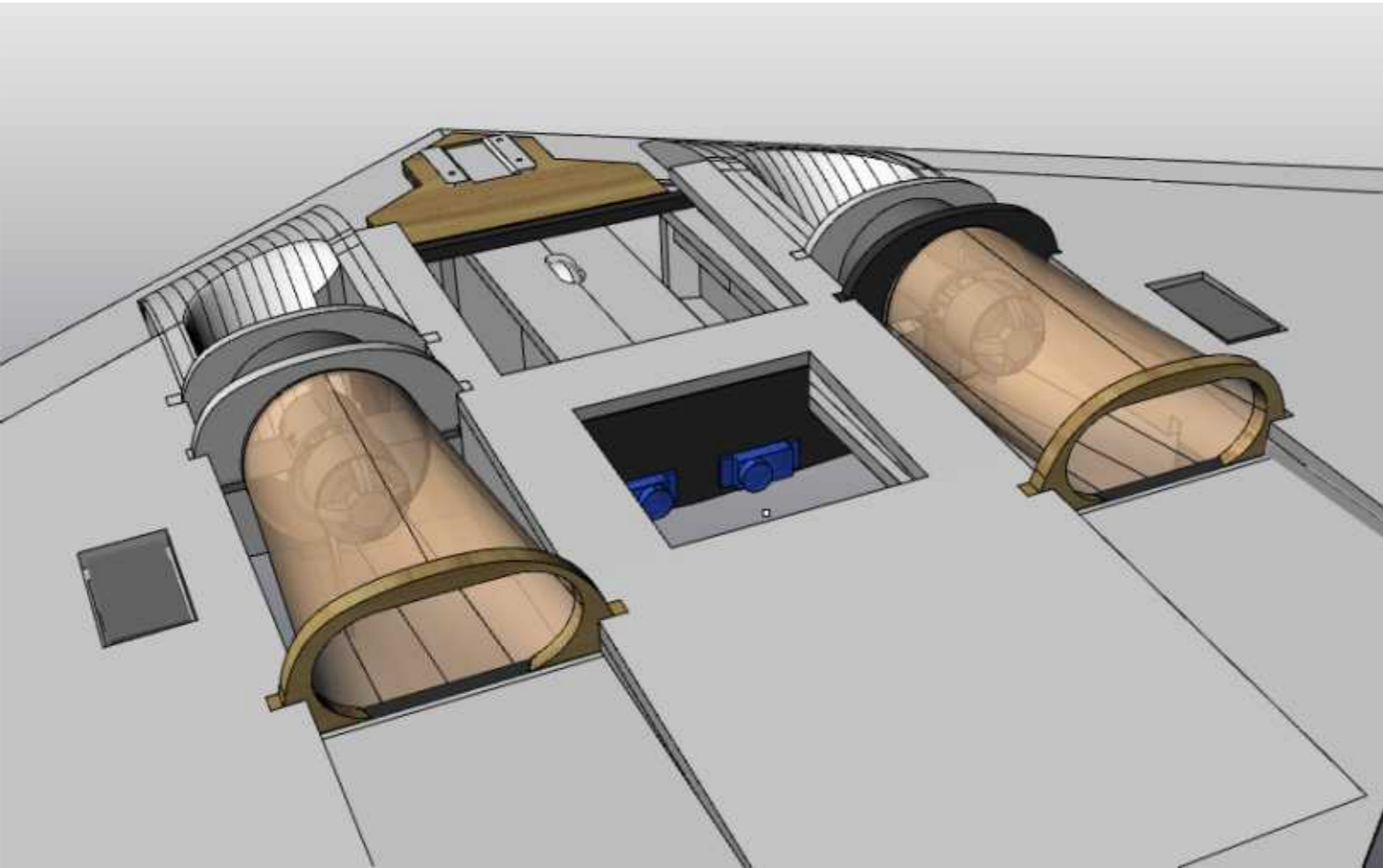


Laminate the air intake ducting (part 23) , and glue in place as shown.



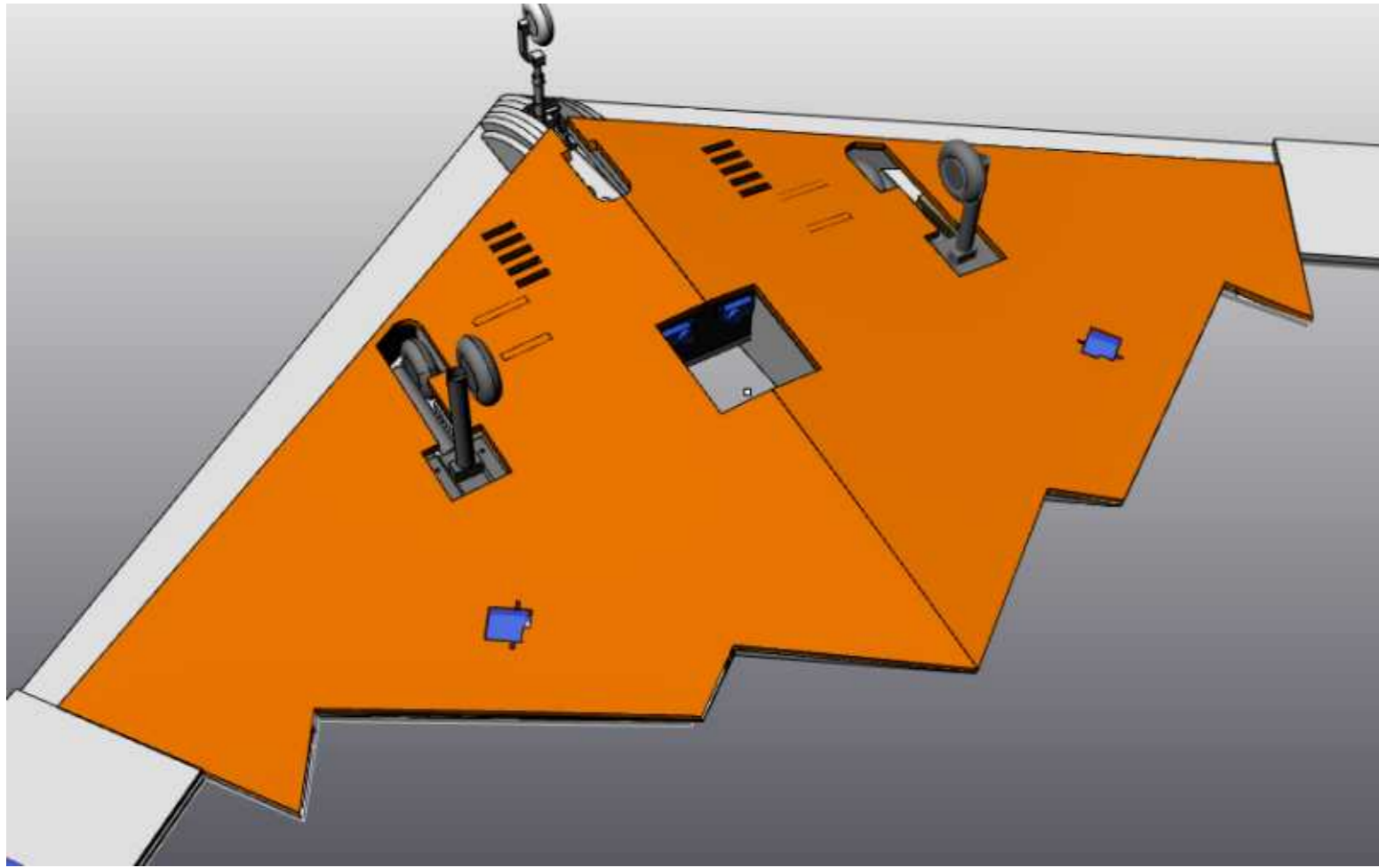


Laminate together the two 3mm lite ply exhaust formers and slot into the designated area as shown



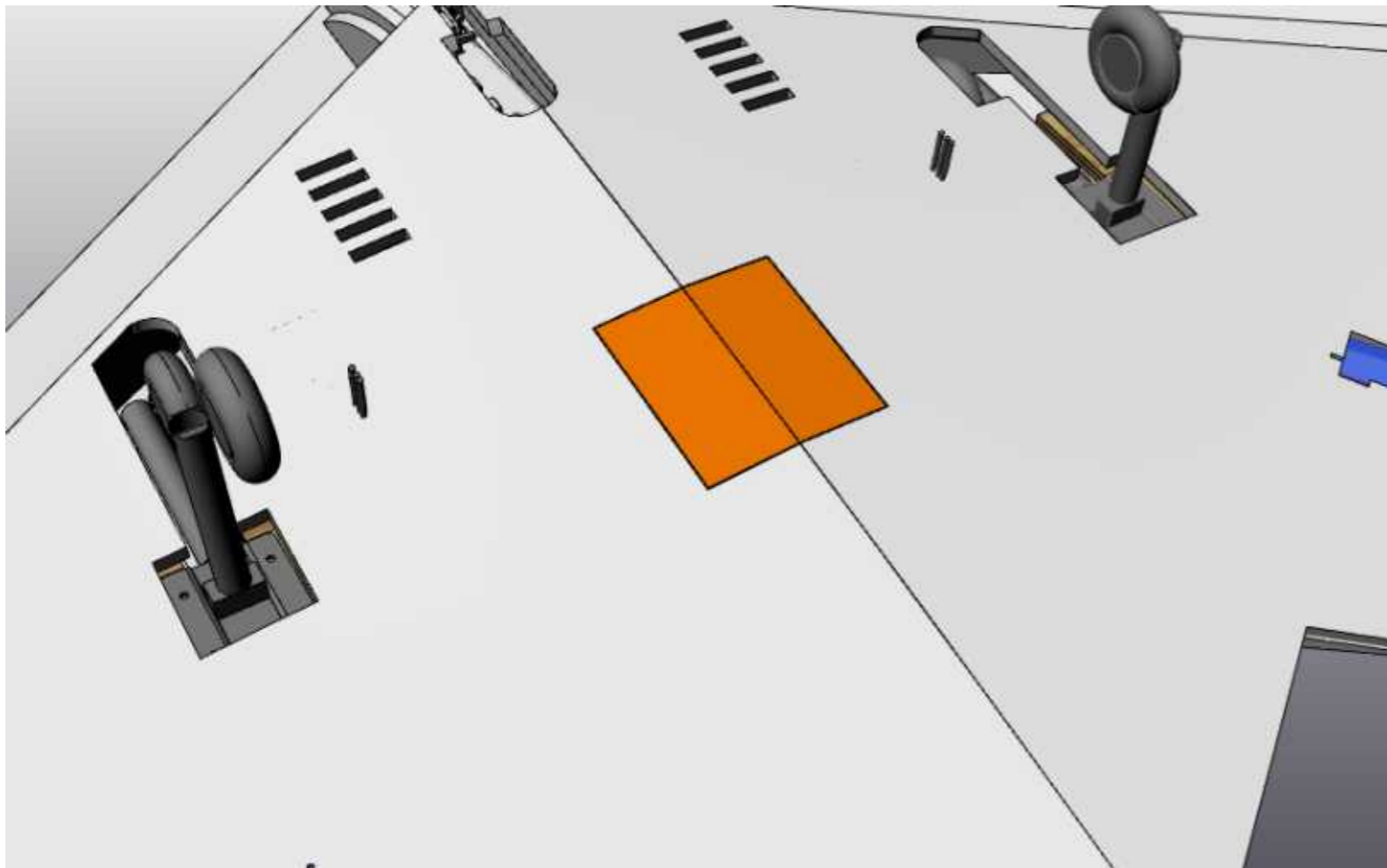
Assemble the duct from lightweight plastic sheet, using nylon reinforced tape to make the seam. Glue in place using hot melt glue (careful not to distort the plastic ducting)





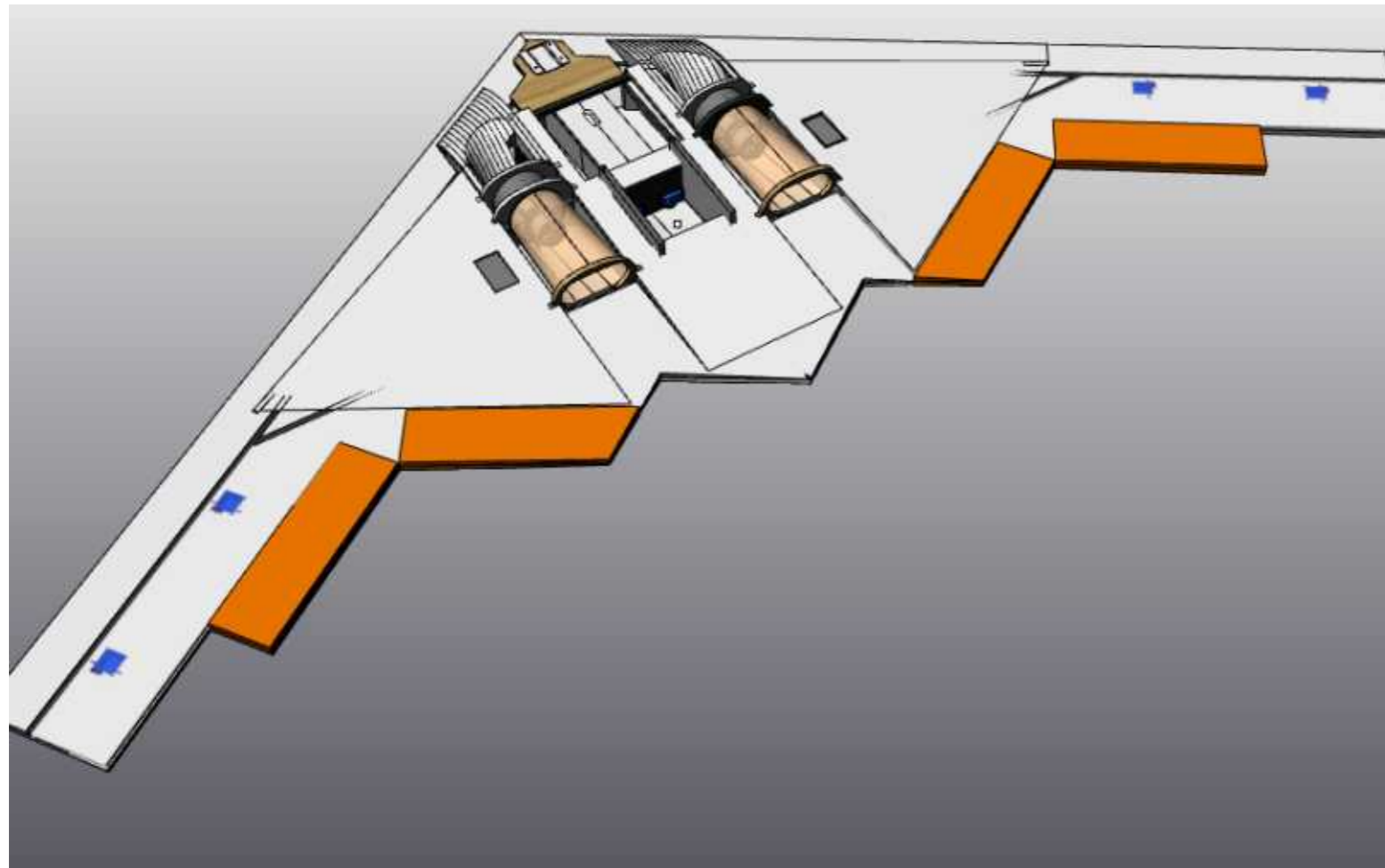
Glue the lower belly pieces in place using UHU por.

Reinforce the seam (where it meets) along the centre line with 0.6oz fibreglass, using water based Polyurethane floor varnish as the resin.

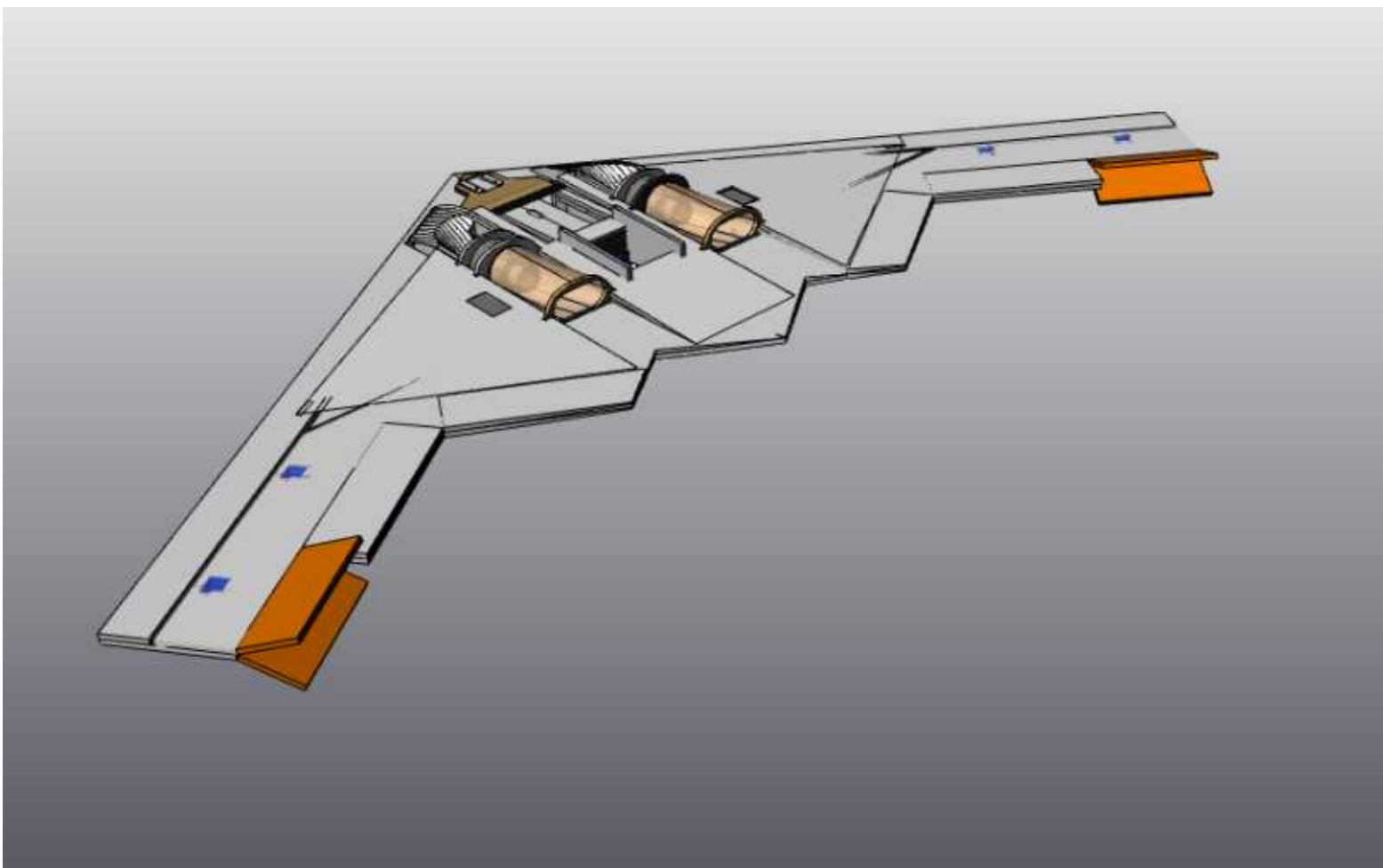


Connect the bomb bay hatches to the servos, and use Graupner hinges along the outer edges.

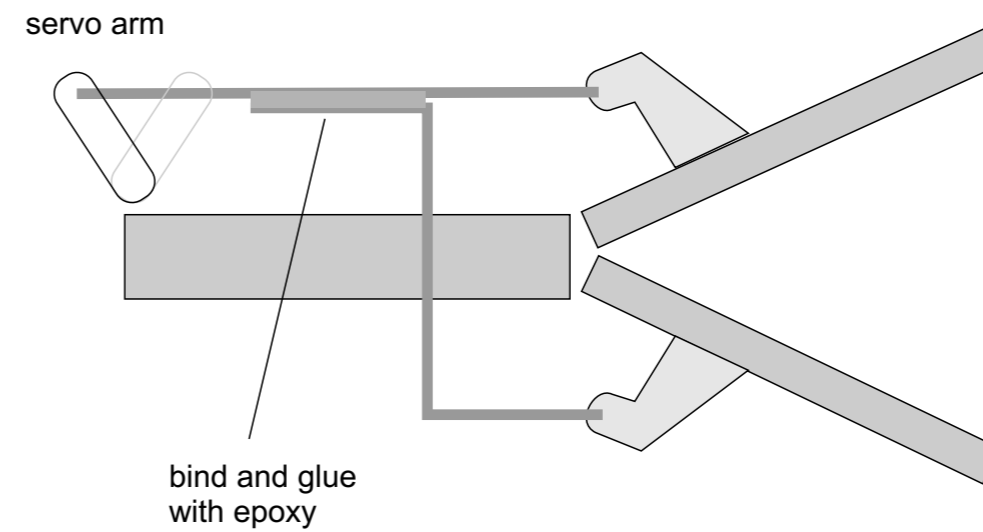


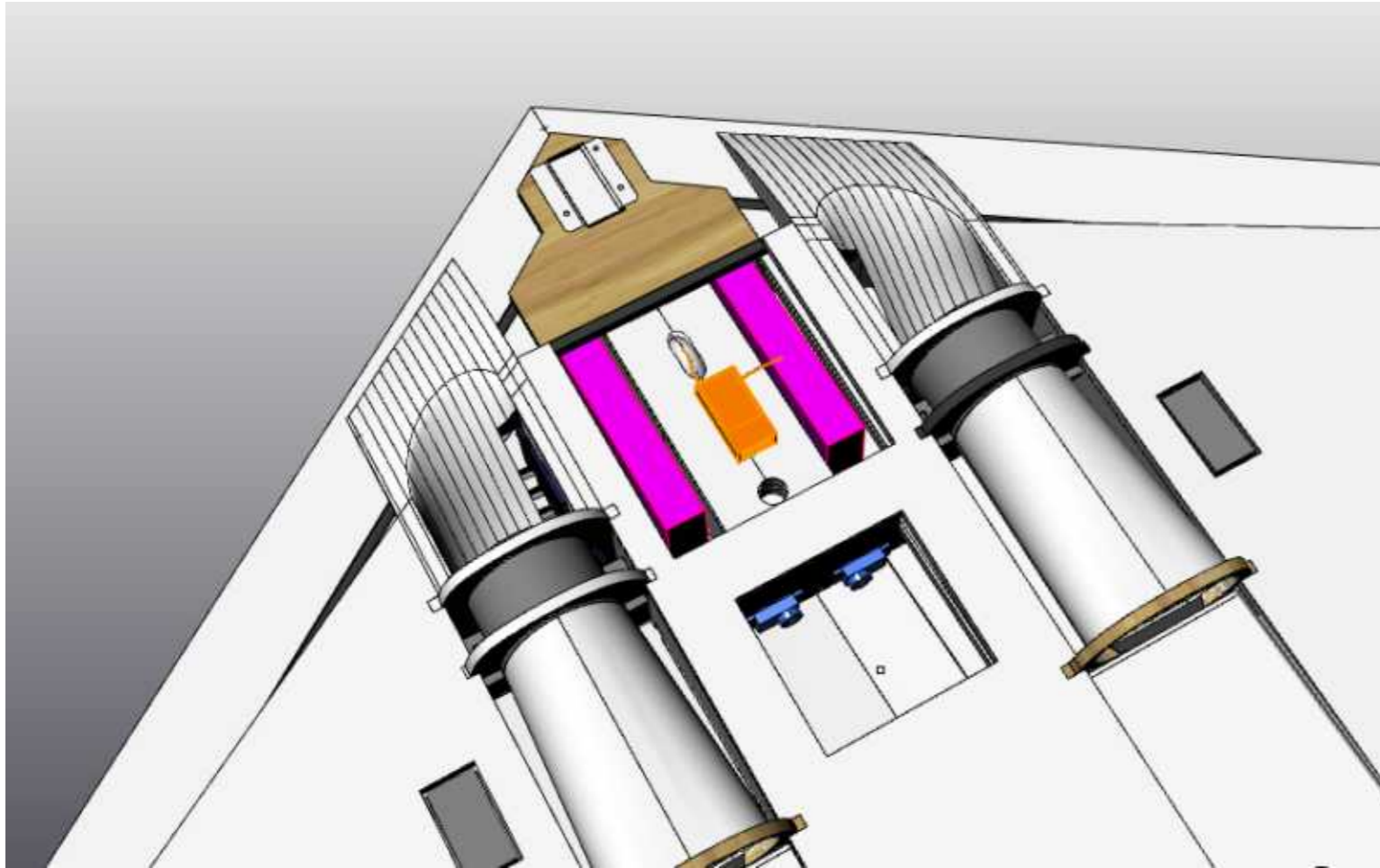


Laminate the Elevon pieces together and shape to a finer trailing edge as indicated on the drawing.

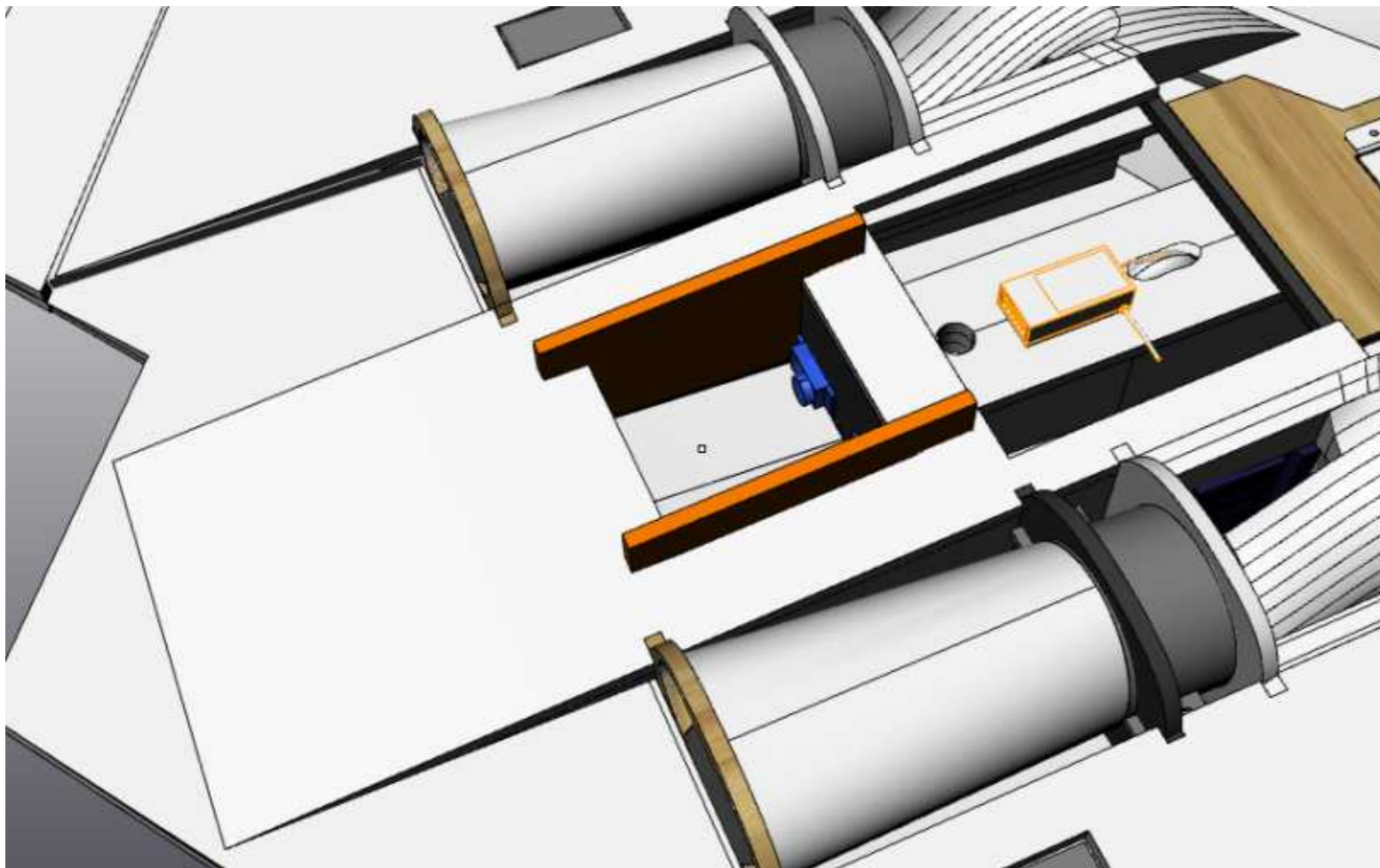


Assemble the drag rudders using graupner mini hinges and piano wire to achieve this kind of operation.



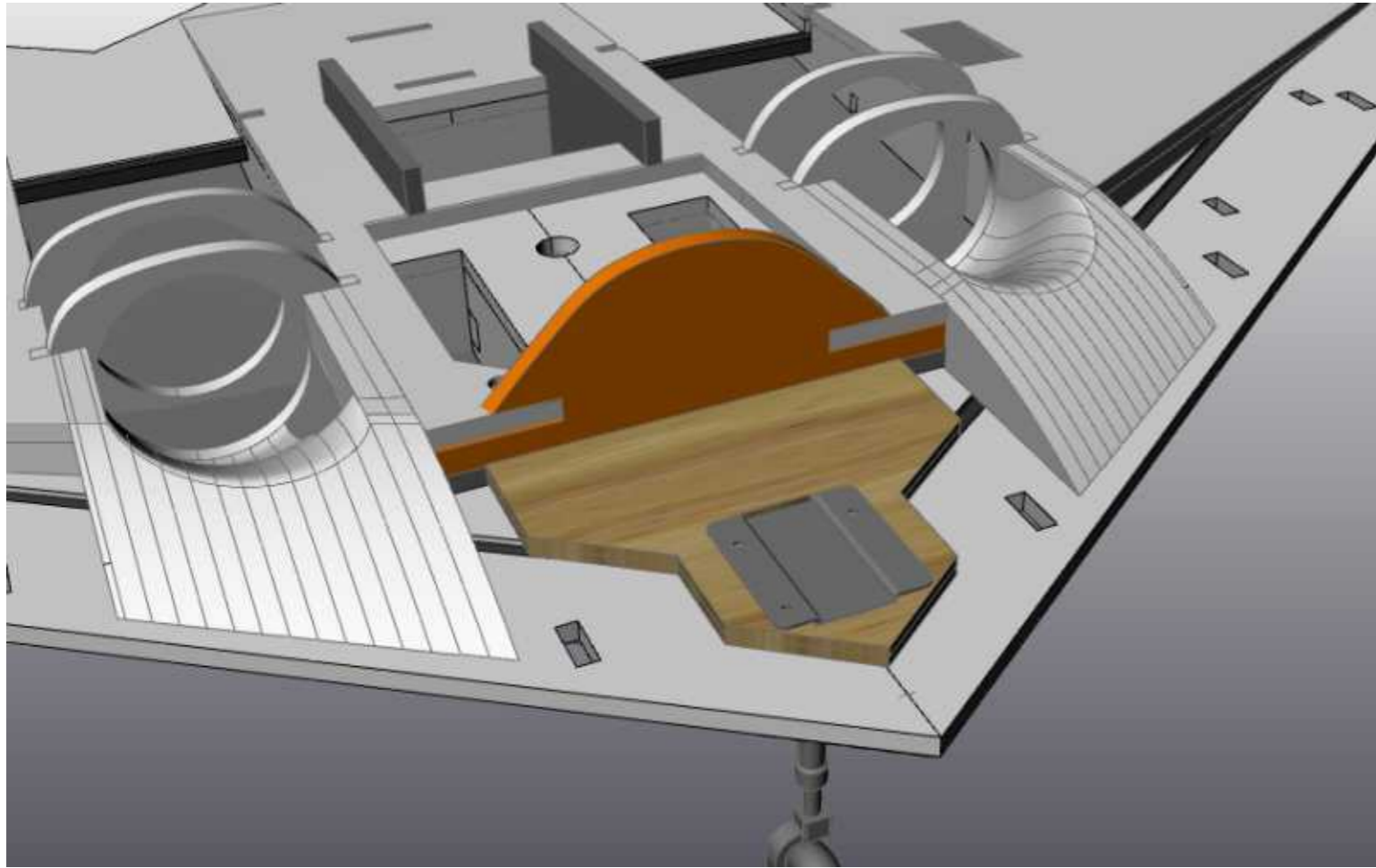


Connect all the electronics and test all movements and motors thoroughly

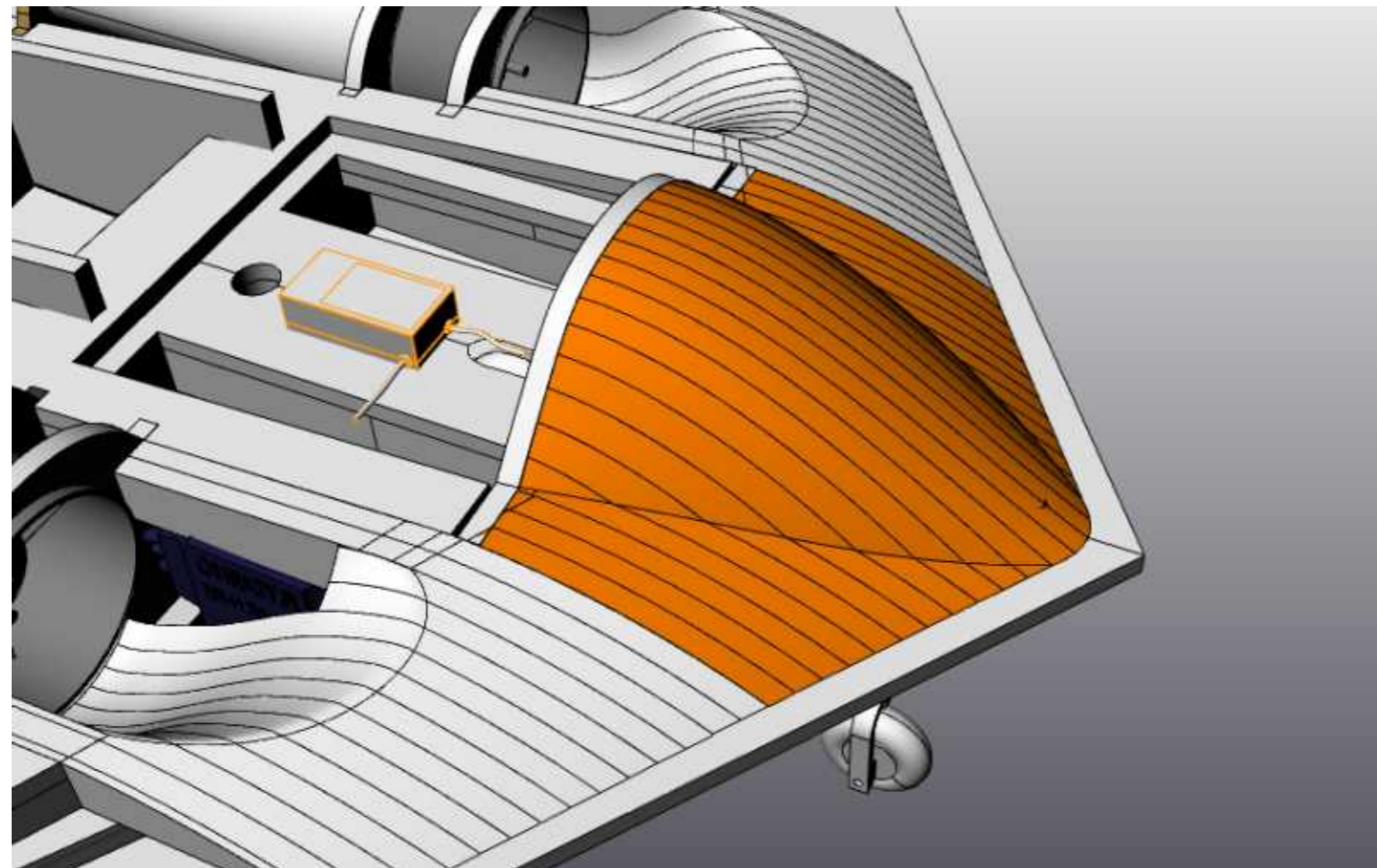


Glue the bomb bay sides in place (part 27)



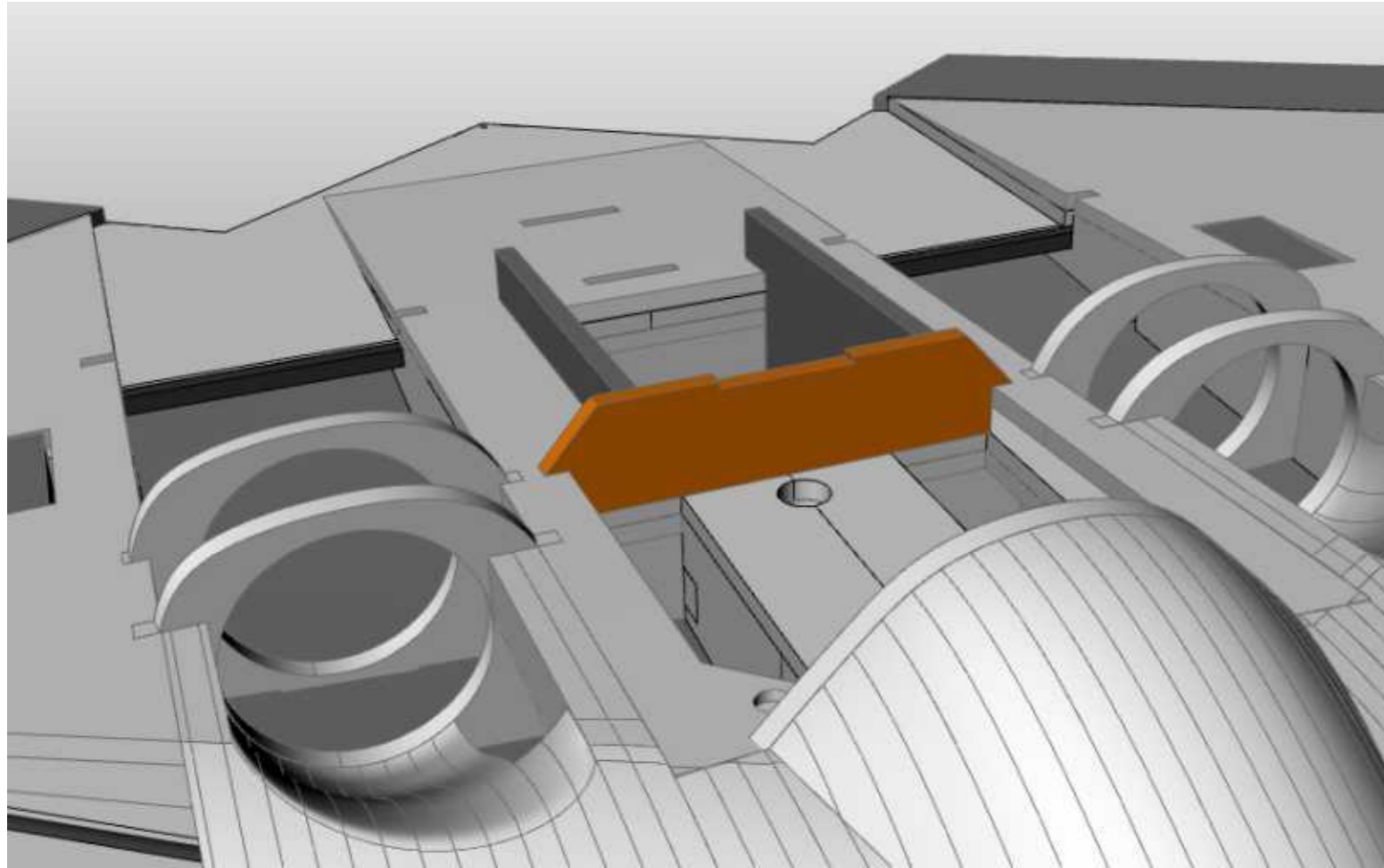


Glue the upper bulkhead 1 (part 28) in place as shown use the next part to align it correctly.

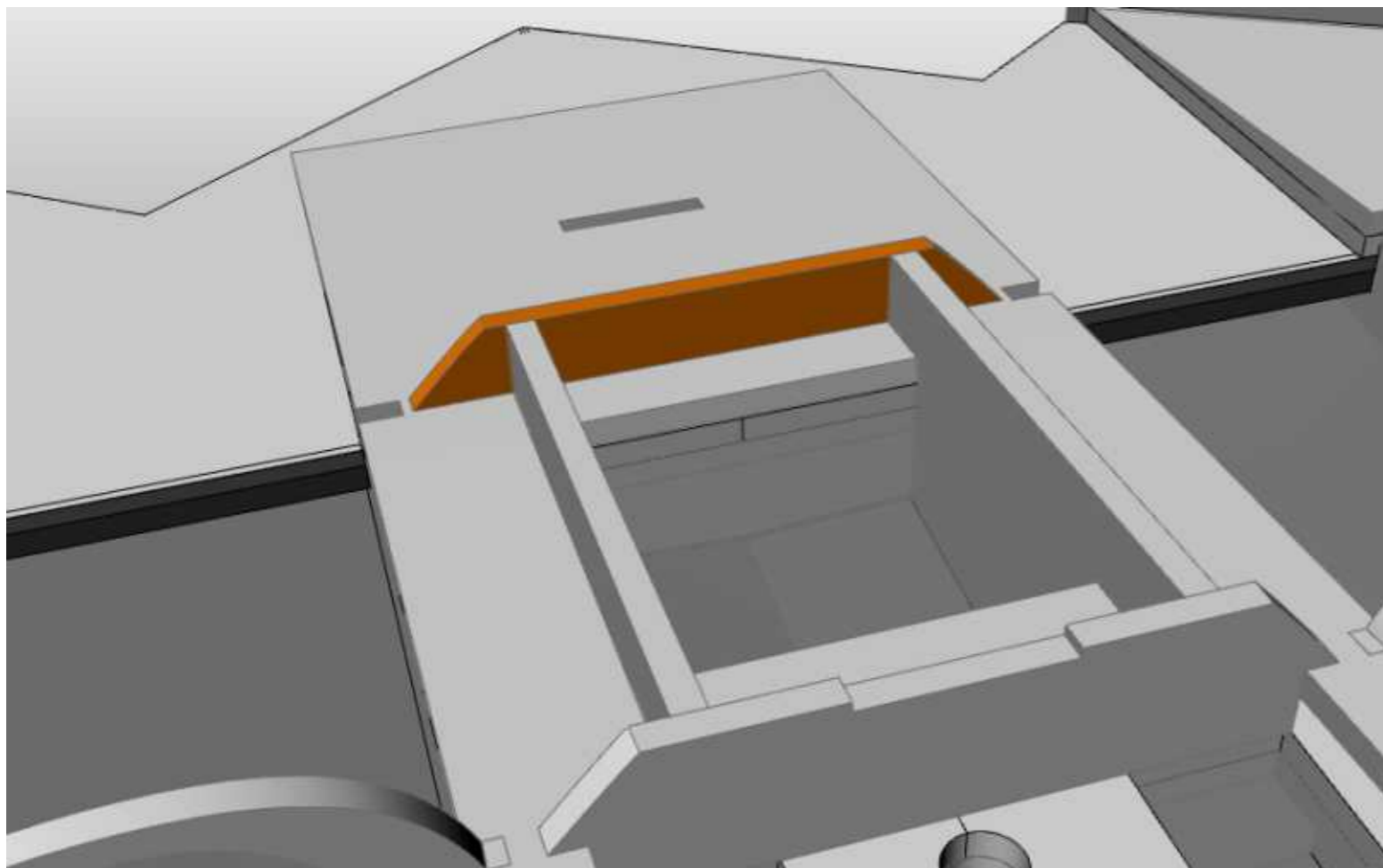


Assemble the cockpit pieces (part 29) together, sand to shape then fit to the wing assembly



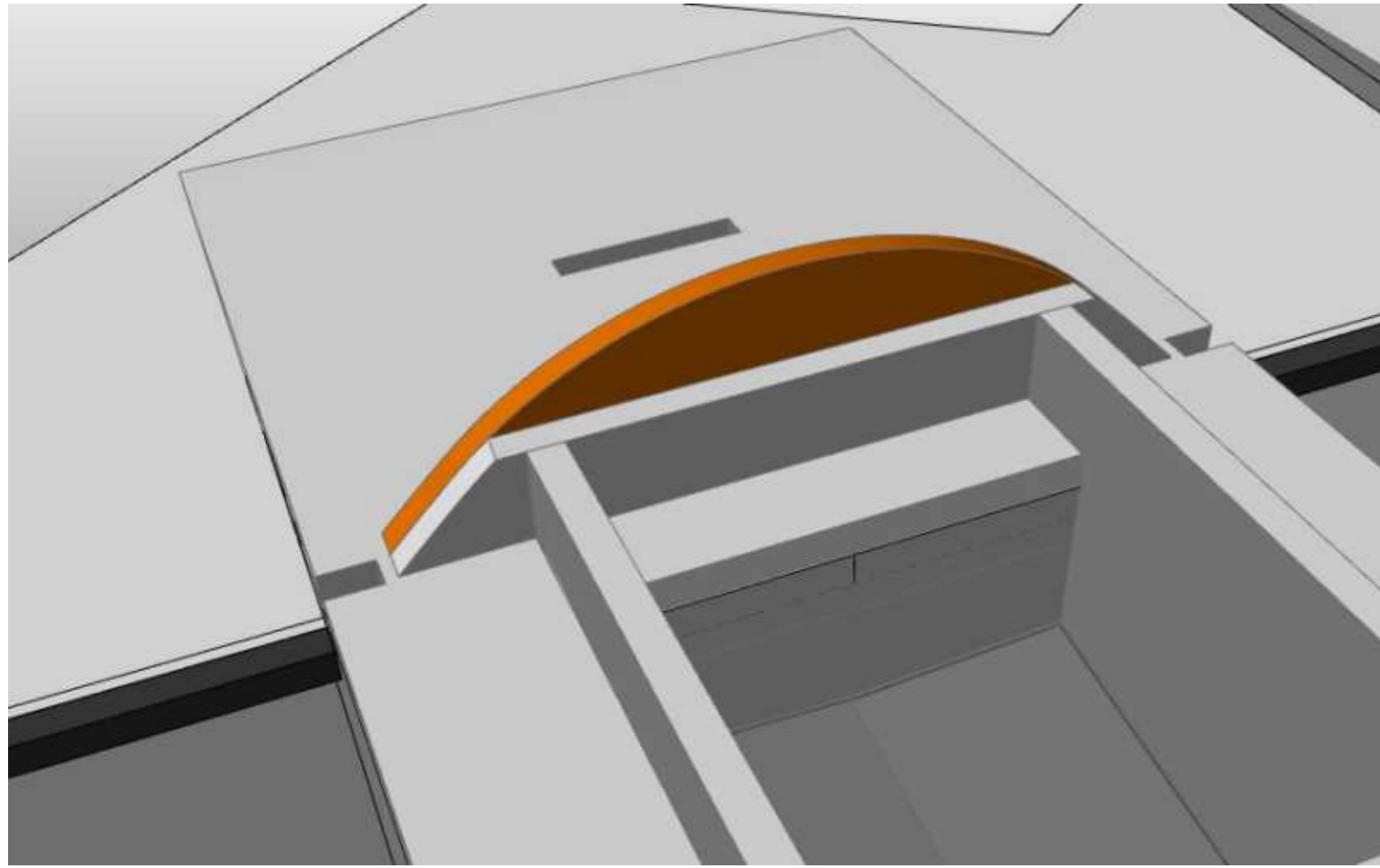


Glue the upper bulkhead 2 in place. (part 30)



Glue the upper bulkhead 3 in place. (part 31)





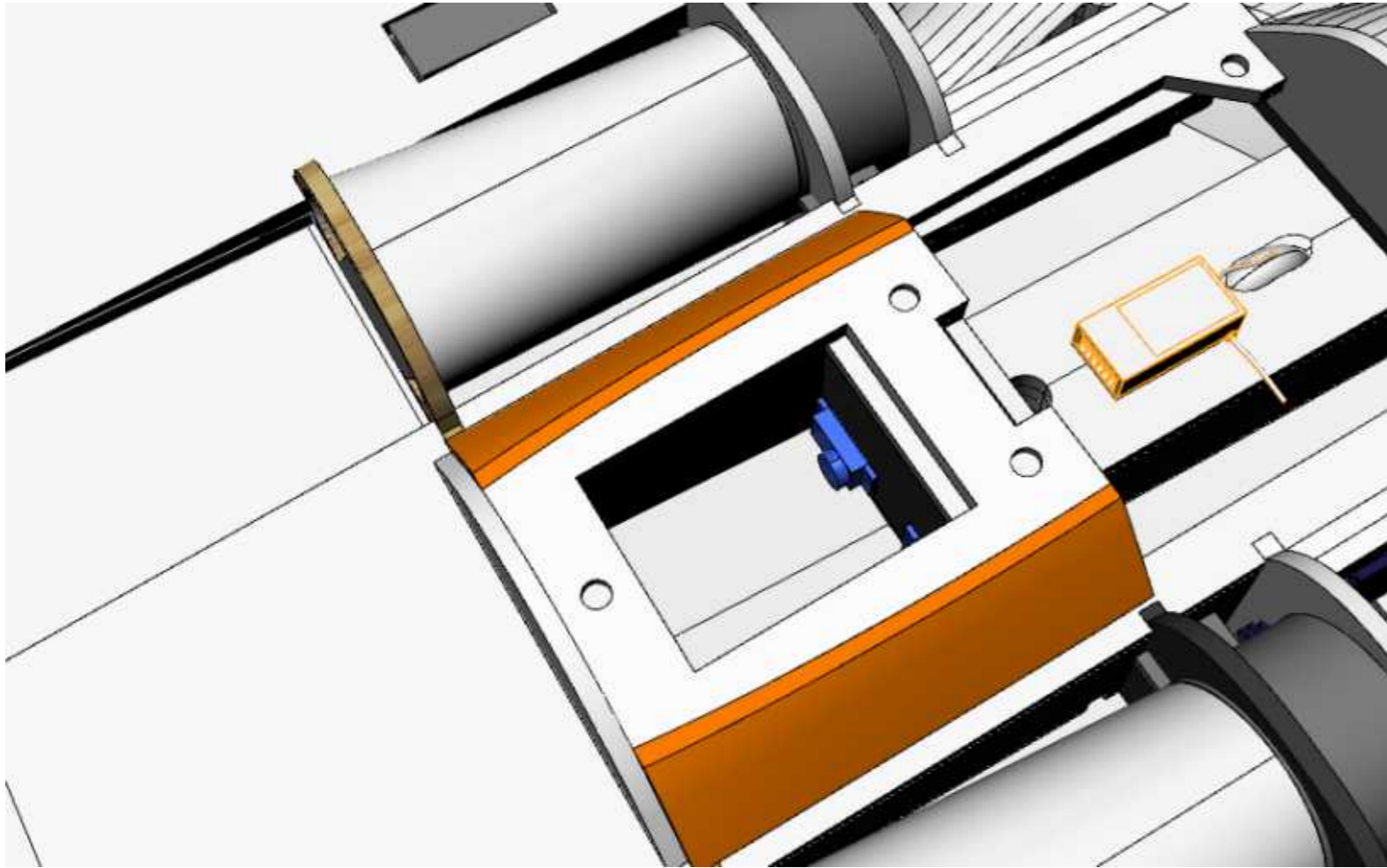
Glue the upper bulkhead 4 in place. (part 32)



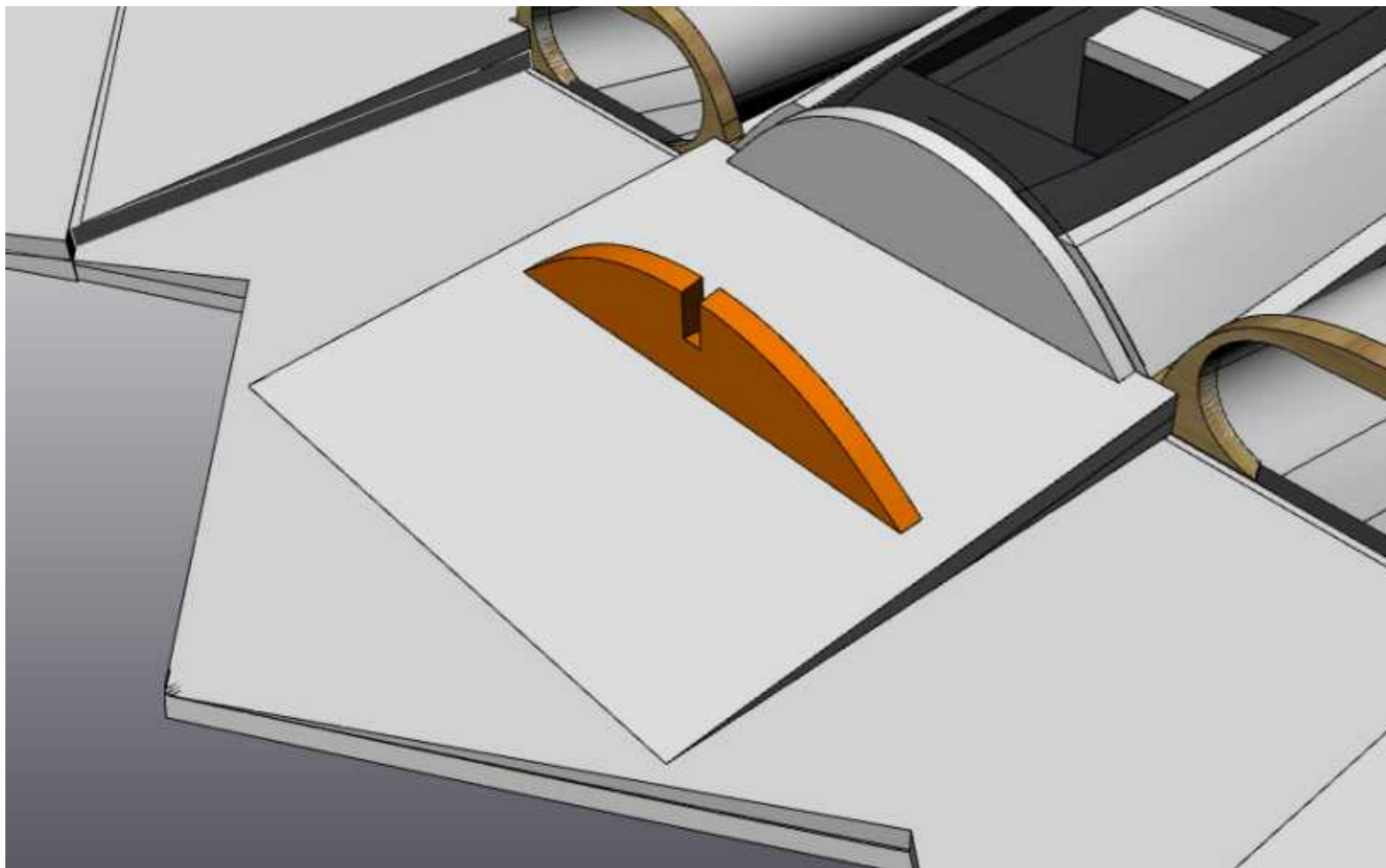
Glue the bomb bay hopper top in place. (part 33)





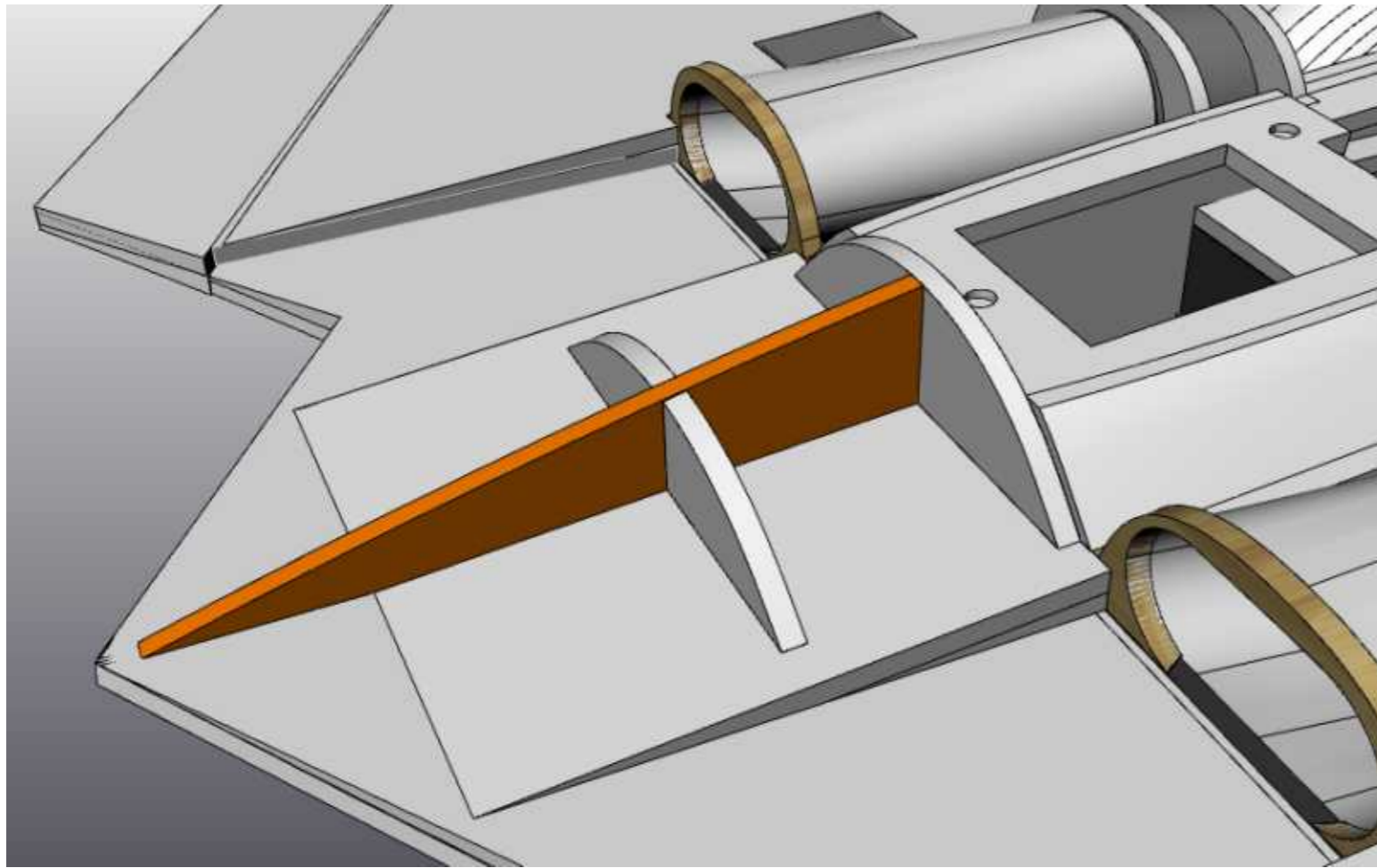


Glue the 3mm hopper sides in place. (part 34)

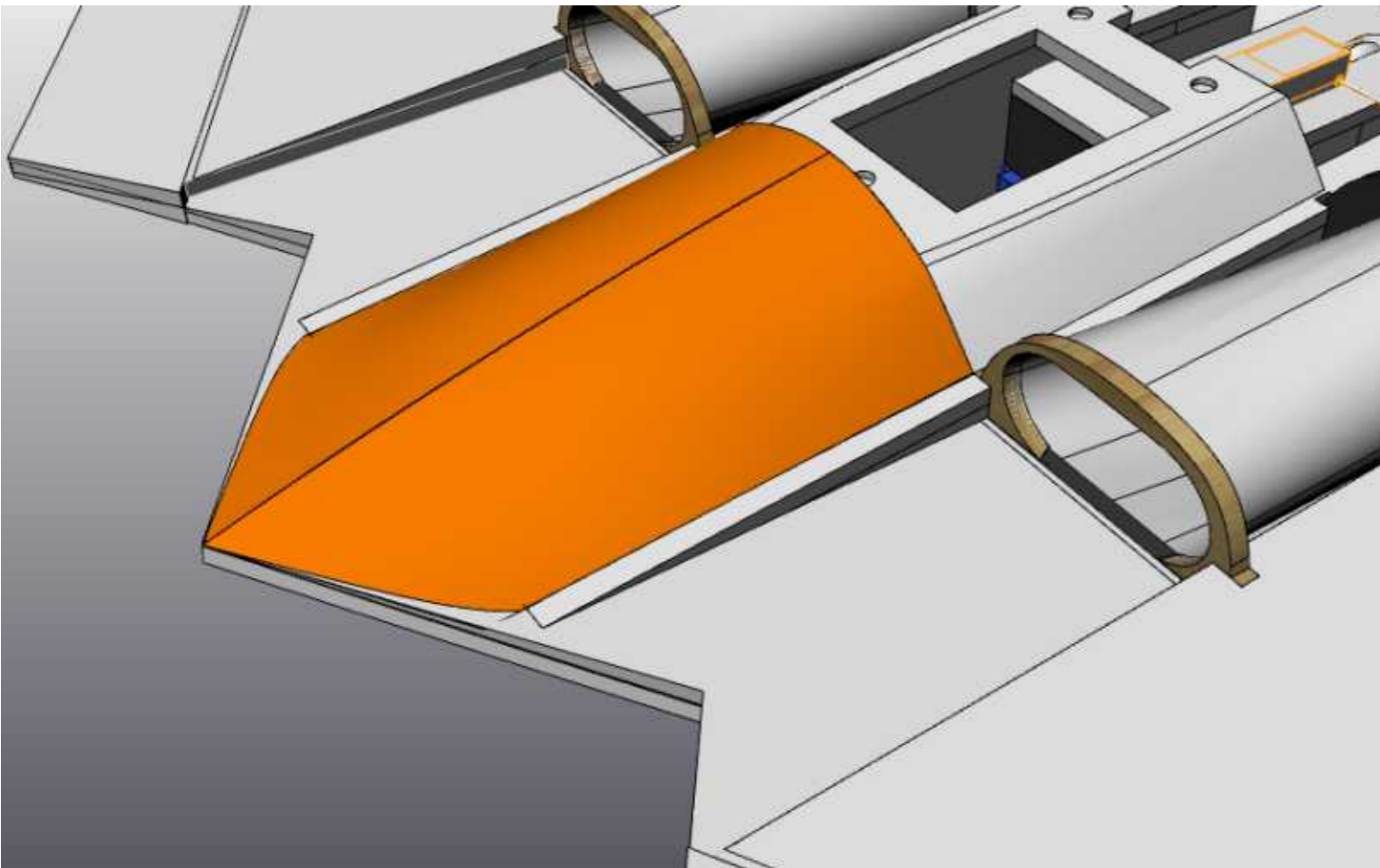


Glue the upper bulkhead 5 in place. (part 35)



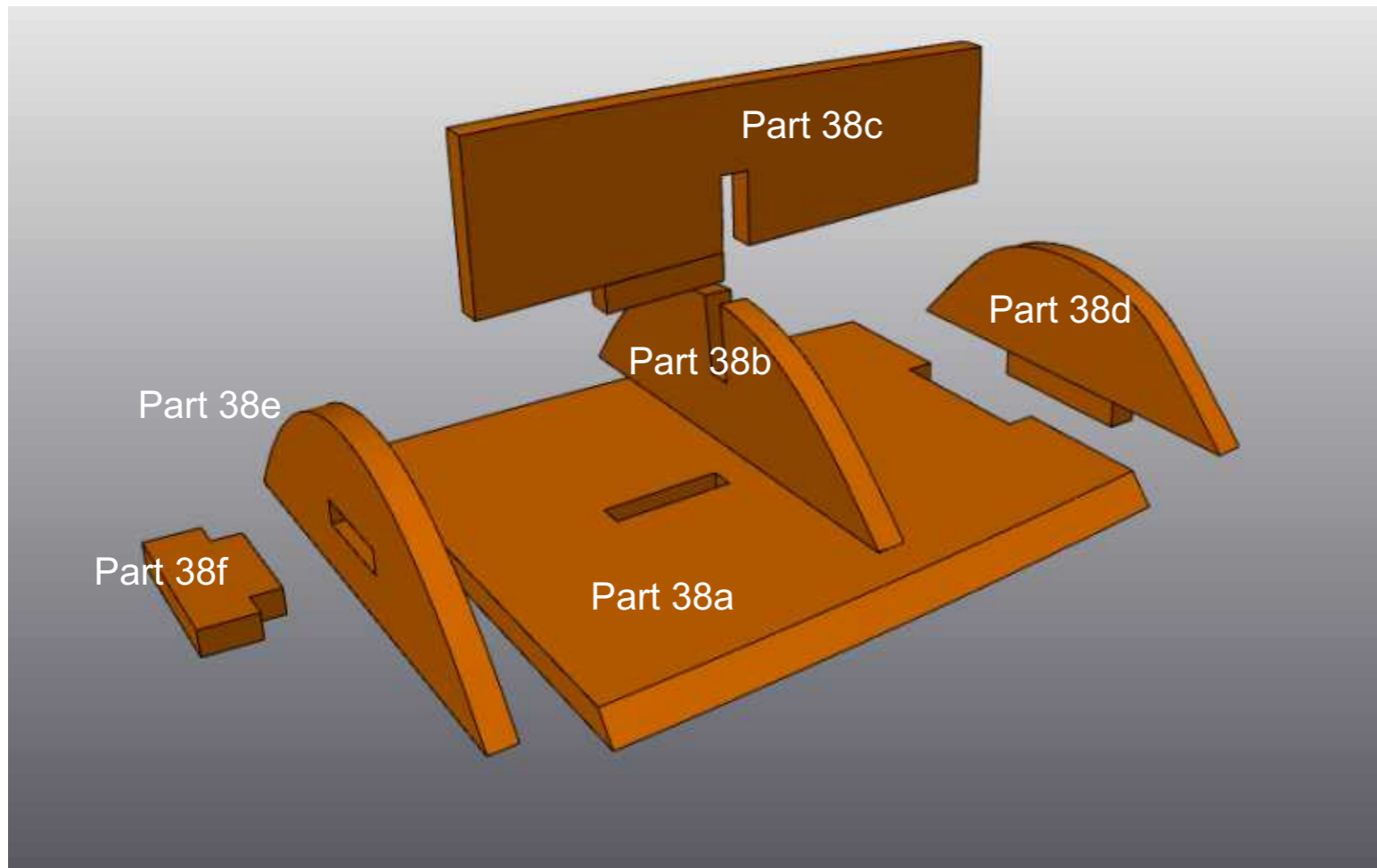


Glue the centreline support rear upper place. (part 36)

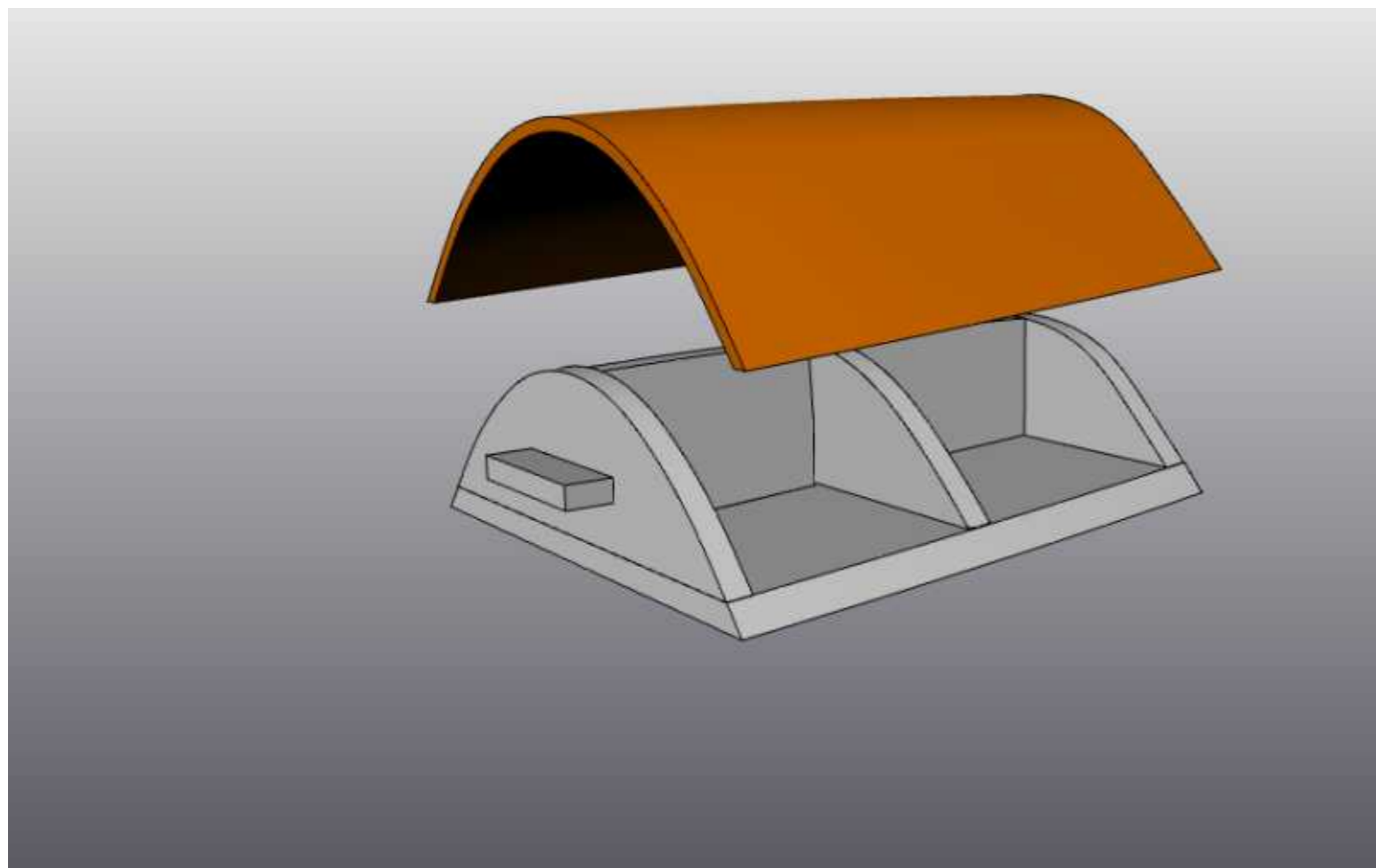


Glue the 3mm upper tail in place. (part 37)

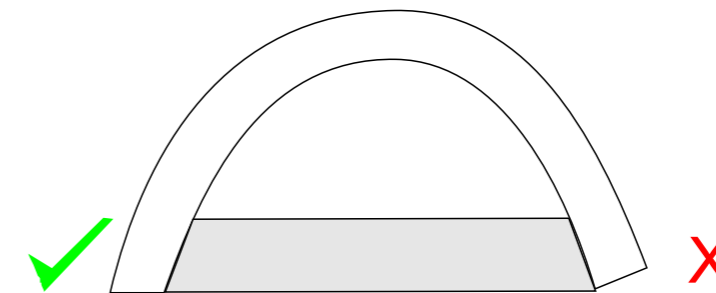


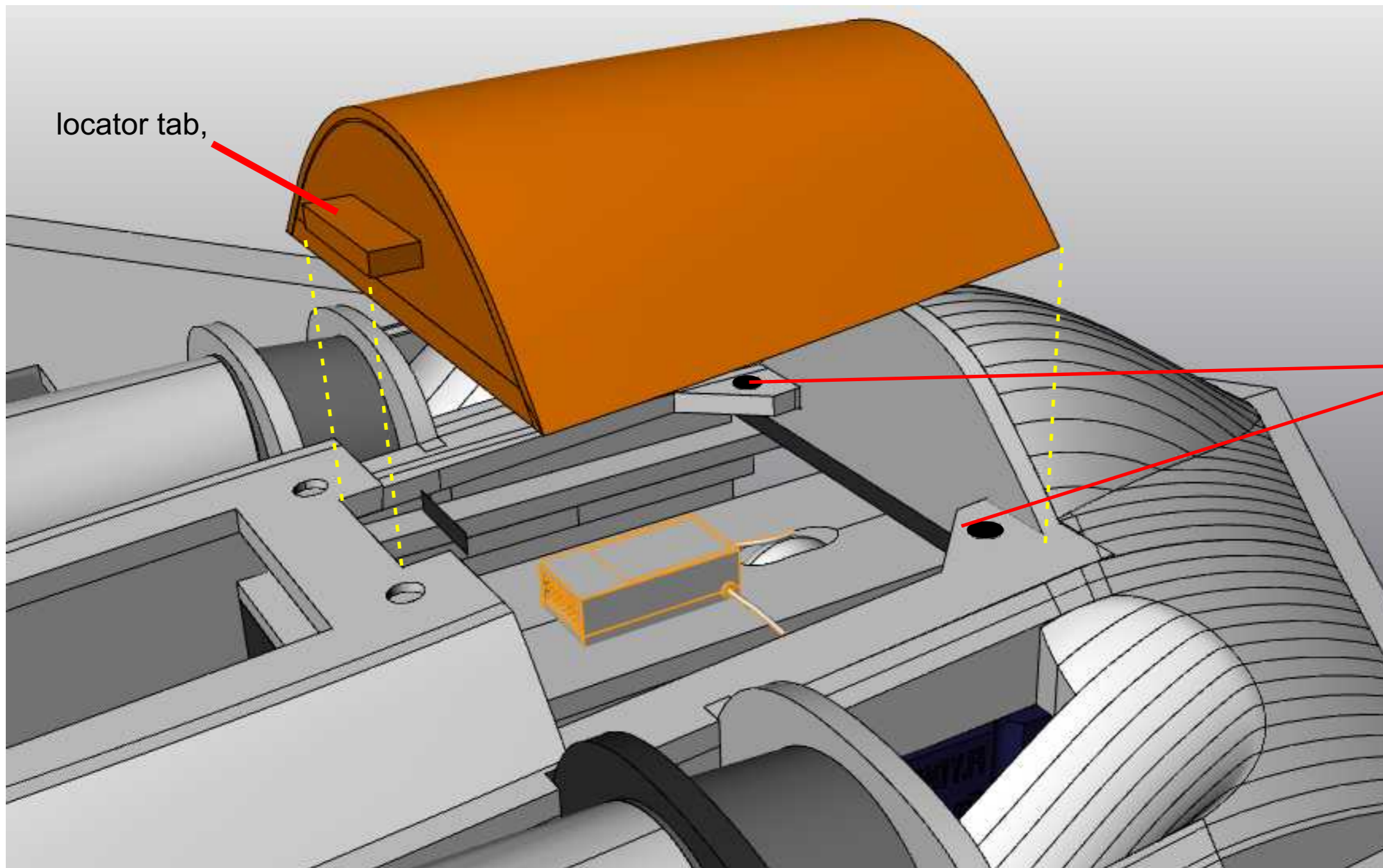


Assemble and glue the access hatch as shown.  
(part 38)



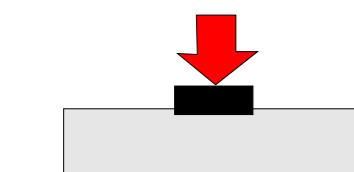
Assemble and glue the 3mm depron over the frame  
- take it lower than the base and sand it flat to the  
underside of the base. (part 38)





locator tab,

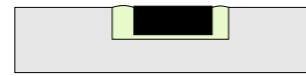
Glue in magnets here and on the adjoining face.



1. press magnet into depron to impress shape.



2. Dig out a recess for the magnet using a sharp knife.



3. Apply glue into recess and push magnet into it.



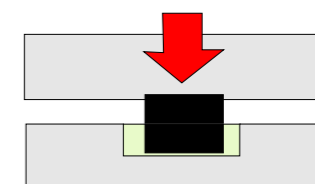
4. Whilst still wet, lay masking tape over the area.



5. When fully cured, remove tape and put adjoining magnet on top



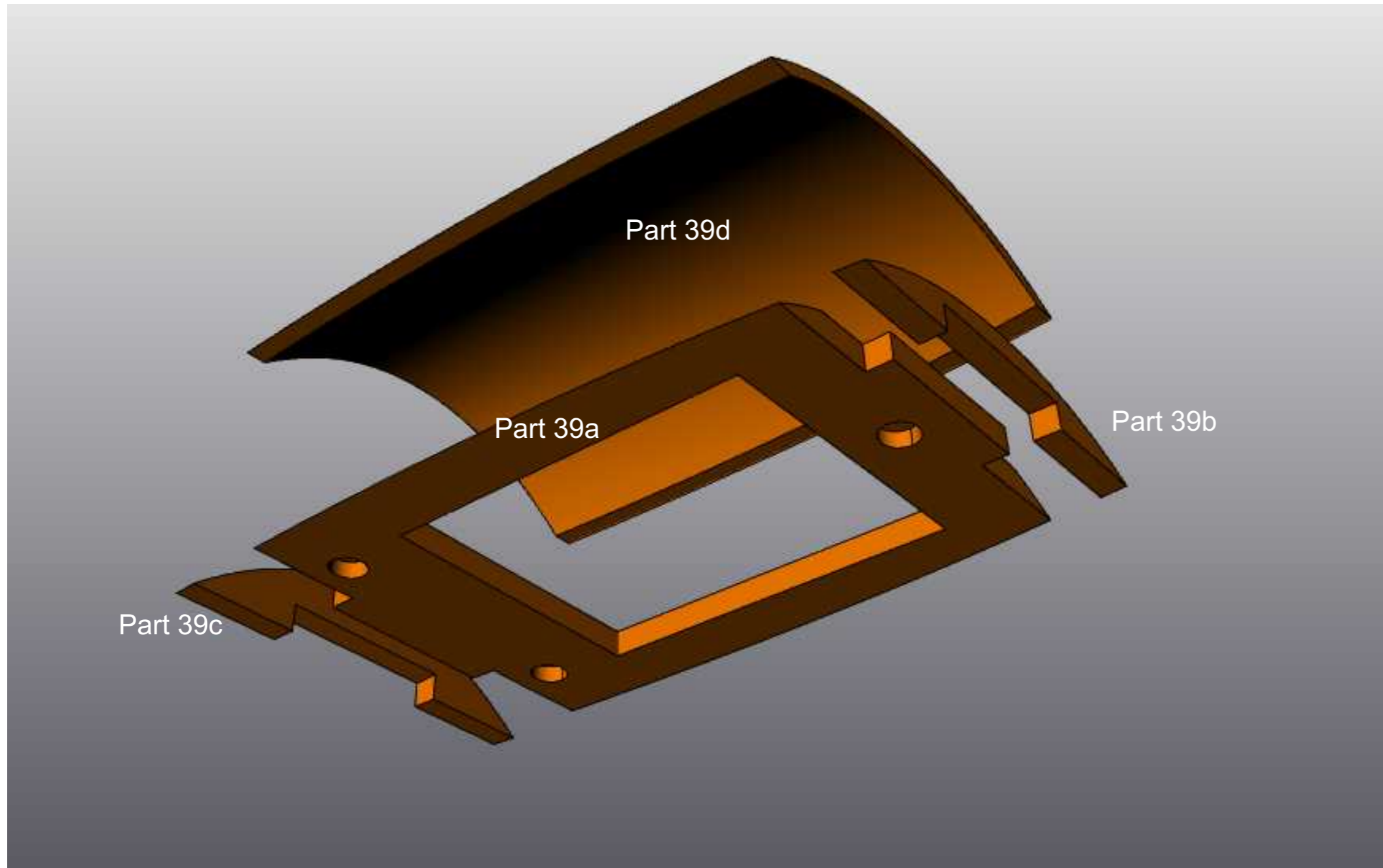
7. Repeat steps 2-4 for the upper part.



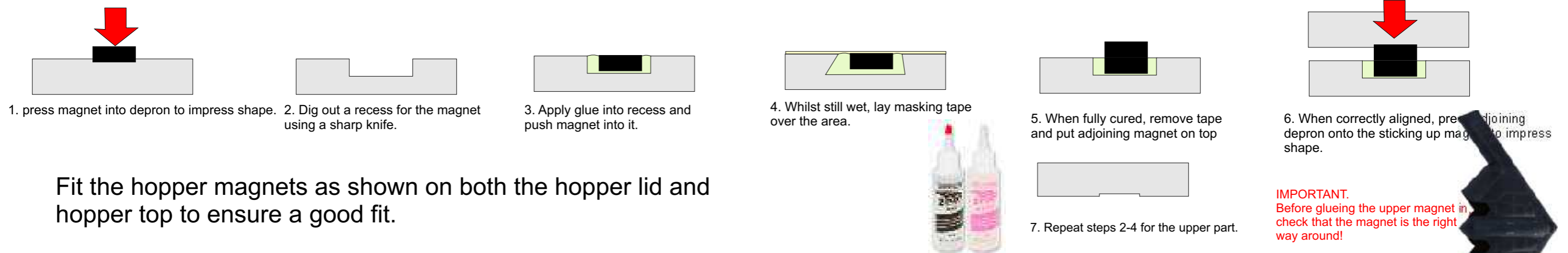
6. When correctly aligned, press adjoining depron onto the sticking up magnet to impress shape.

**IMPORTANT.**  
Before glueing the upper magnet in, check that the magnet is the right way around!



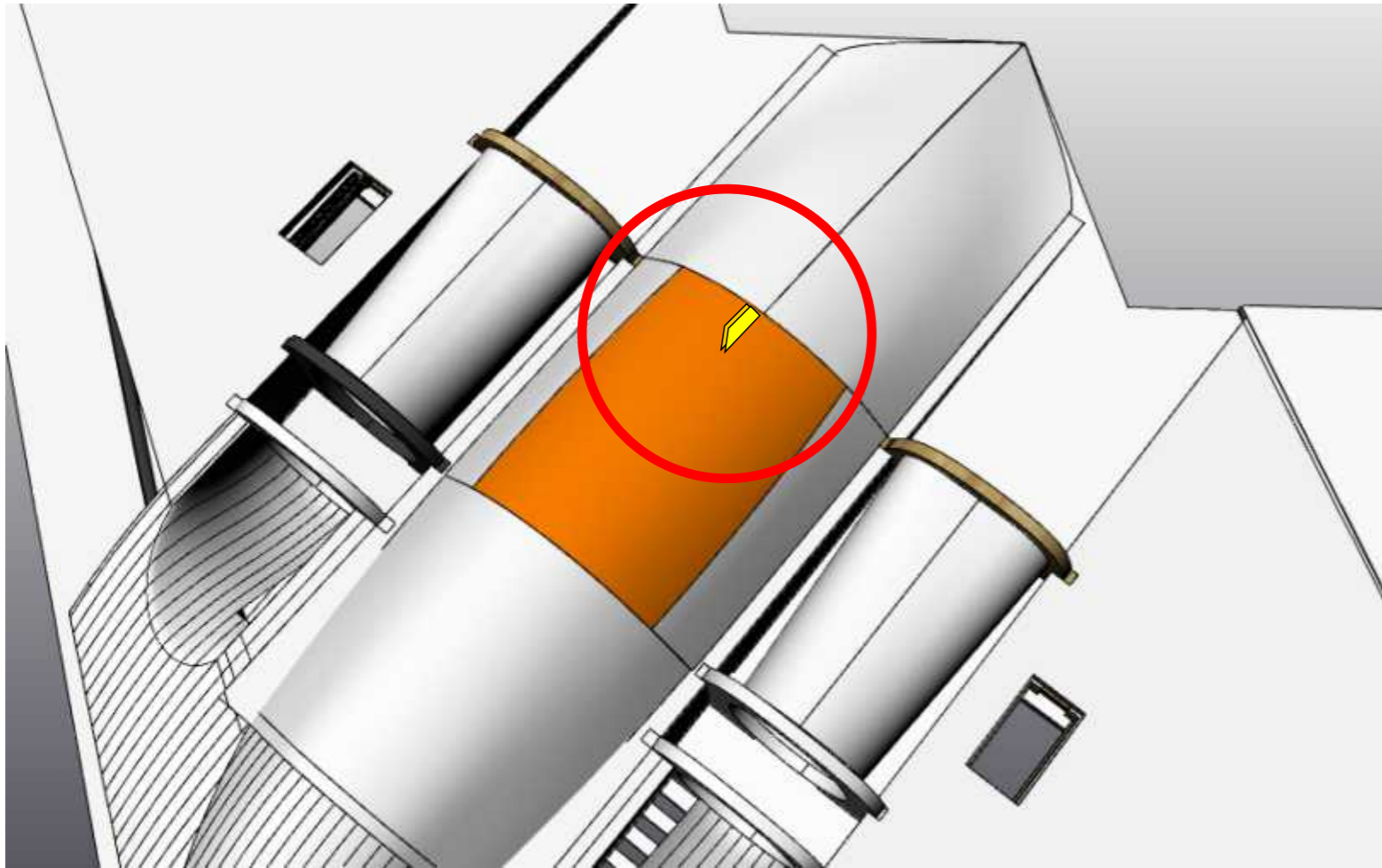


Assemble the parts as shown. finish the 3mm depron as per the access hatch.

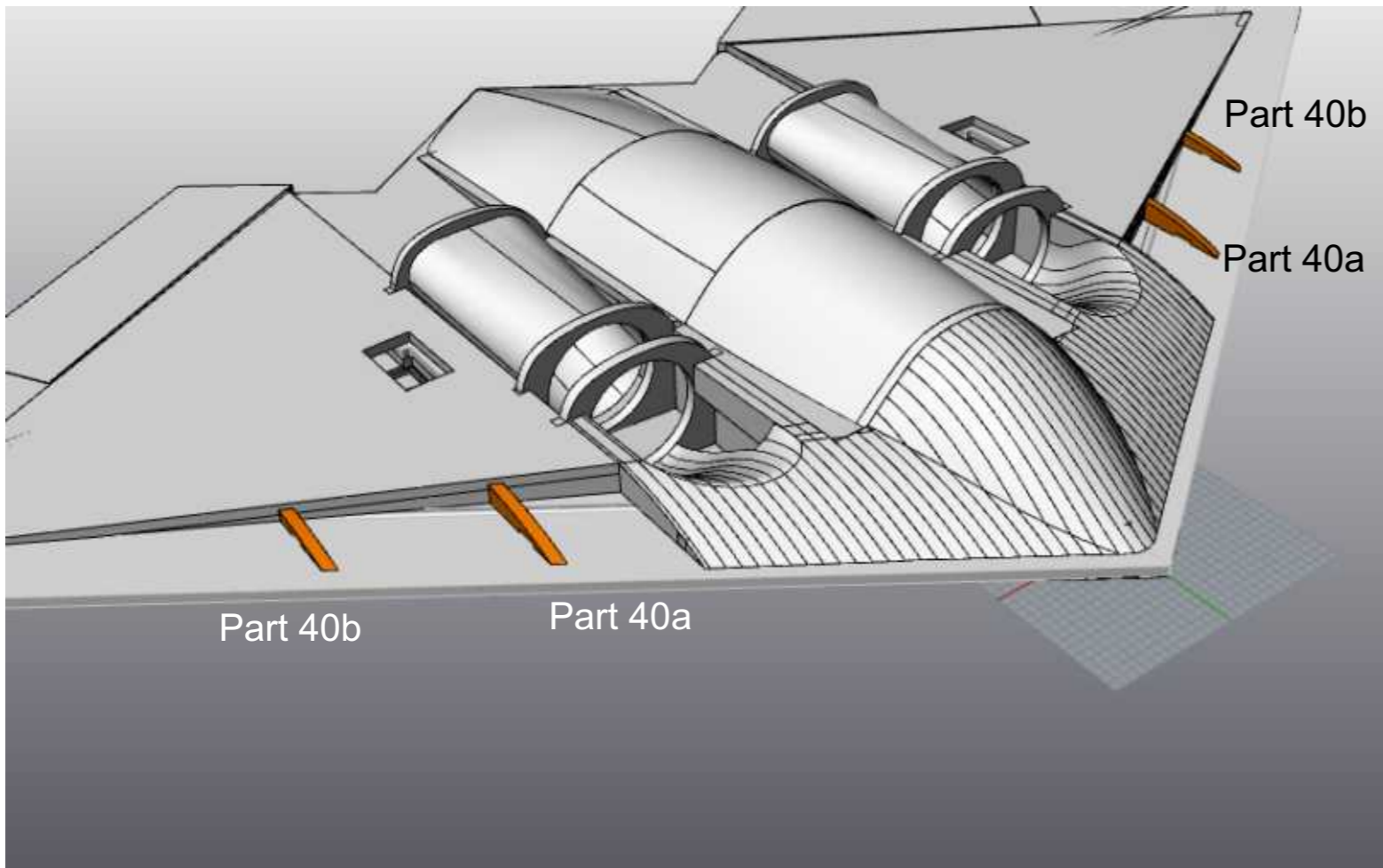


Fit the hopper magnets as shown on both the hopper lid and hopper top to ensure a good fit.

**IMPORTANT.** Before glueing the upper magnet in check that the magnet is the right way around!

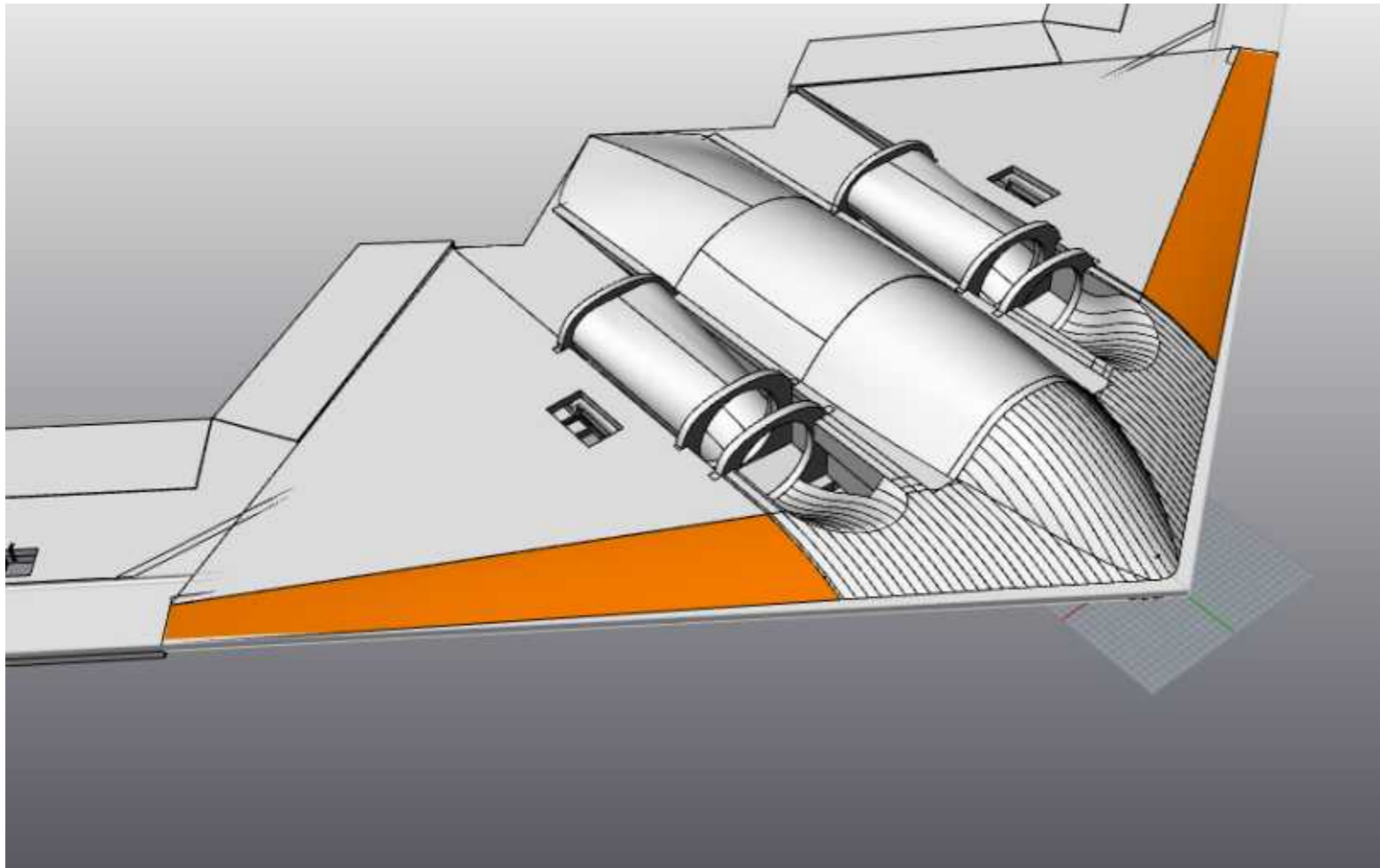


Attach a mock antenna to the rear of the hopper lid, to act as a handle for opening both the hopper lid and subsequently the main access hatch.

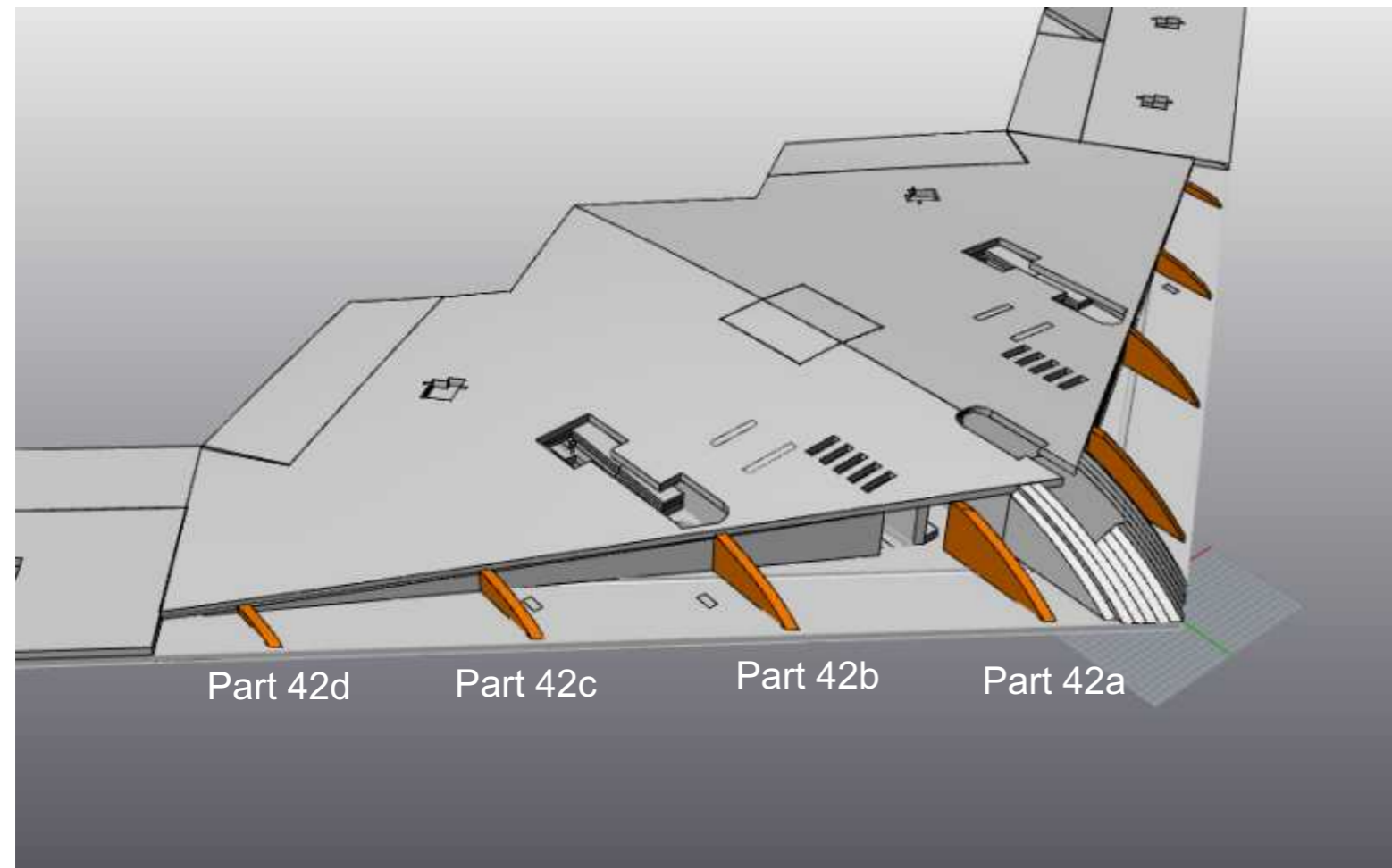


Glue the leading edge top formers in place. (part 40)



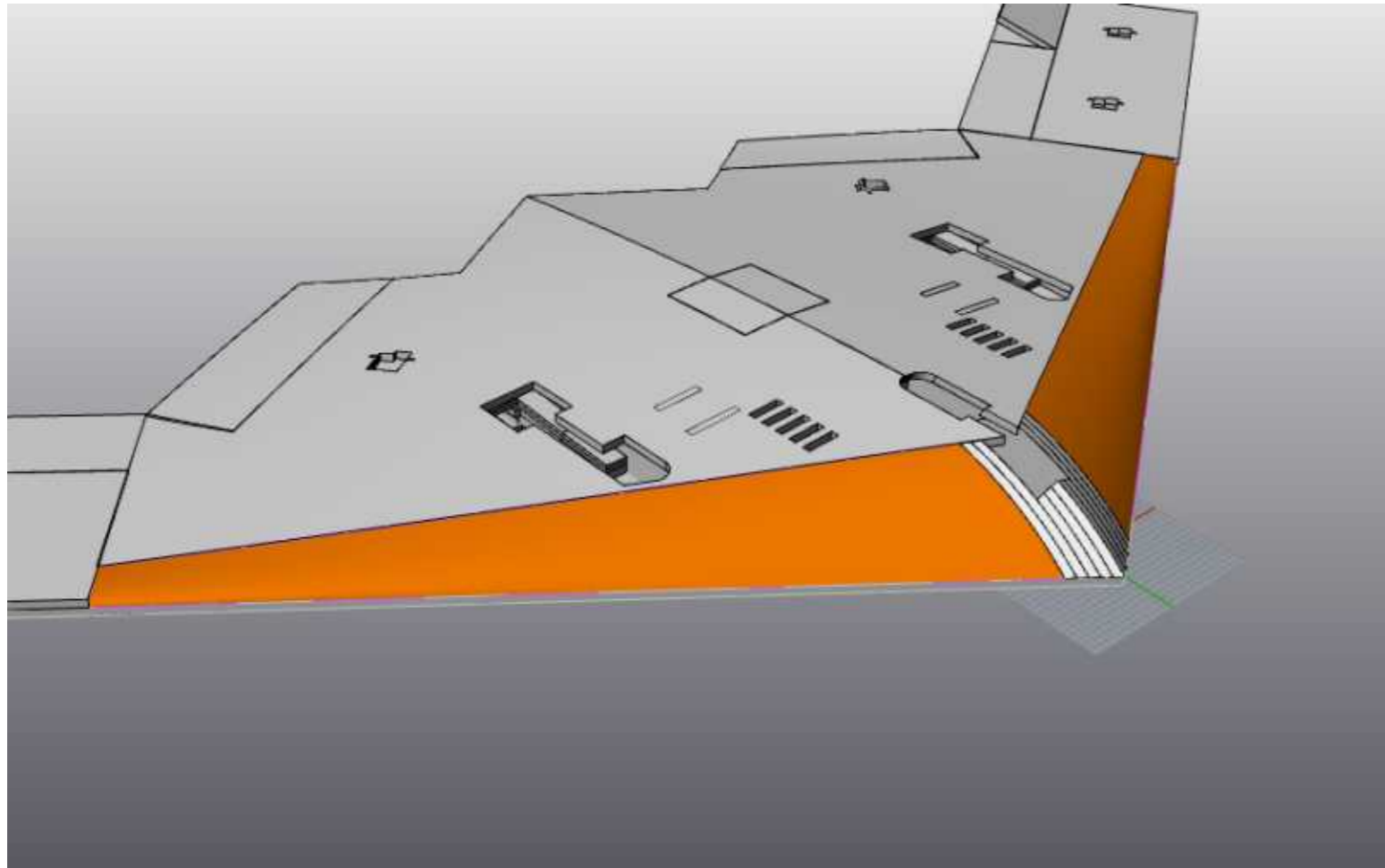


Glue the 3mm depron front upper leading edge strips in place. (part 41)



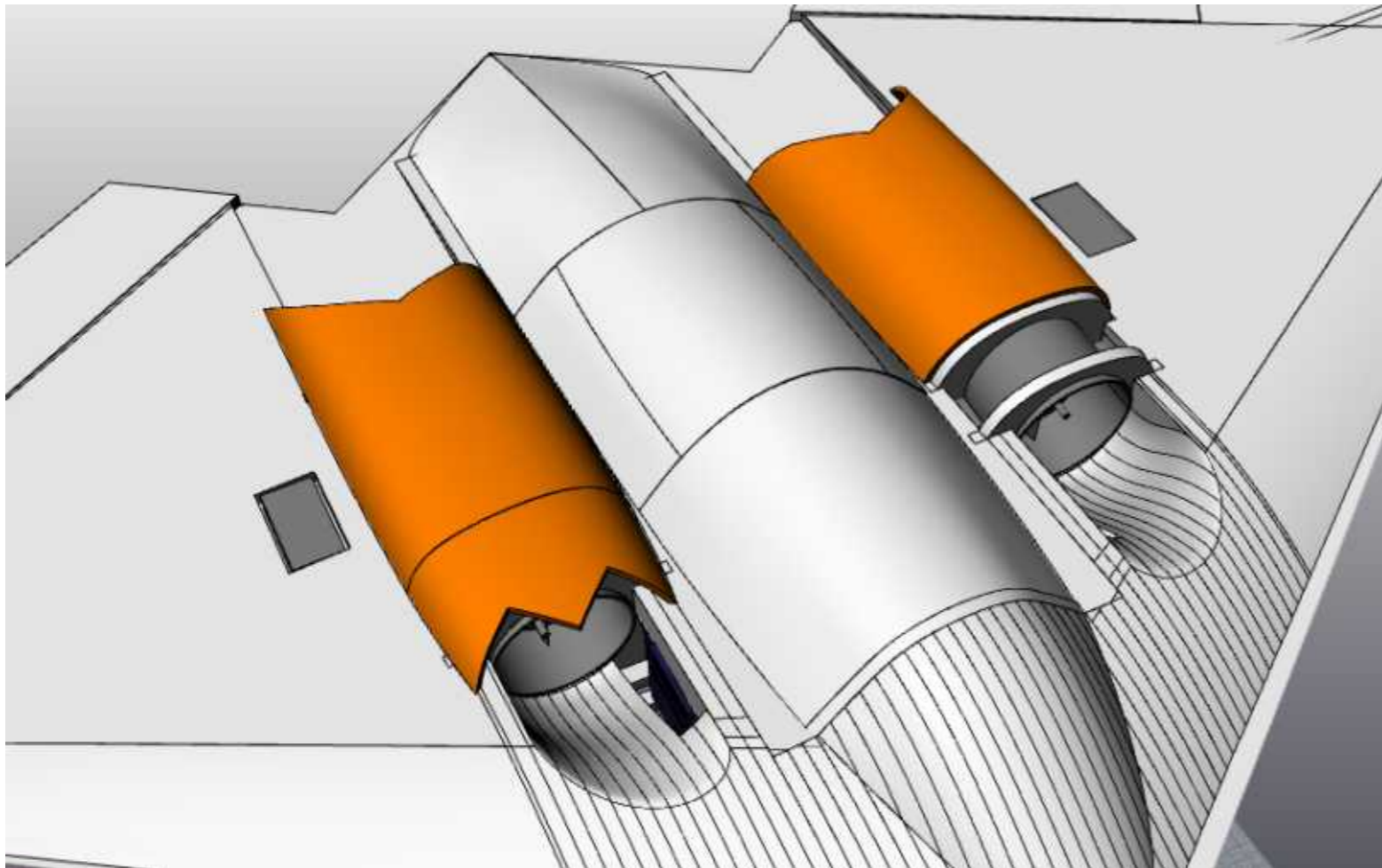
Glue the leading edge bottom formers in place (part 42)





Glue the 3mm depron front upper leading edge strips in place. (part 43)

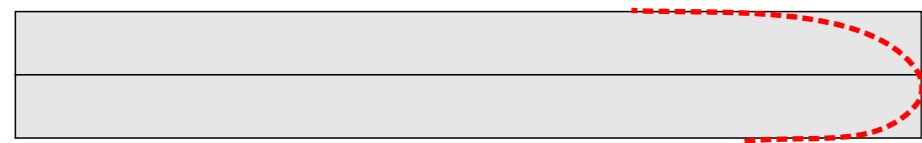
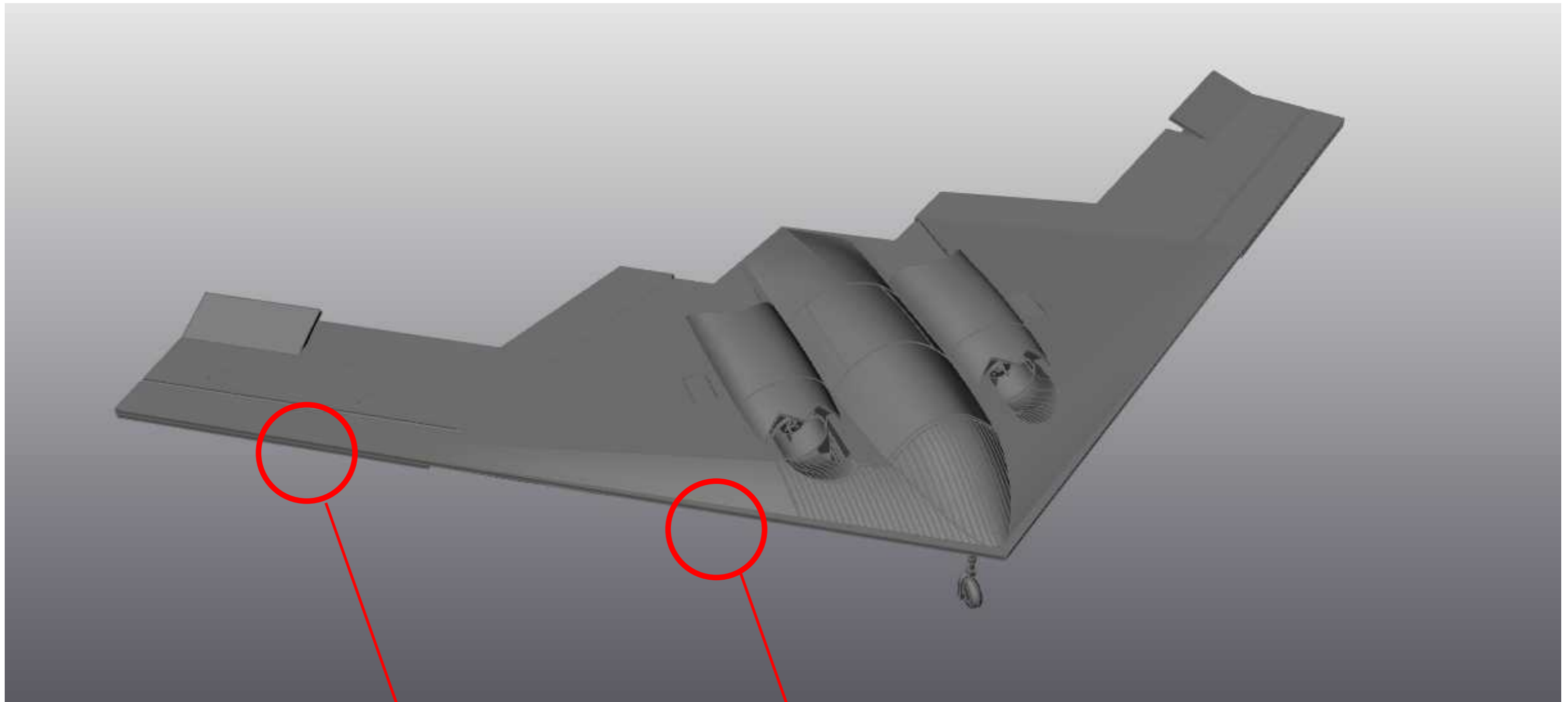
Please note that if you wish to make this model without undercarriage, this area will need a more durable approach.



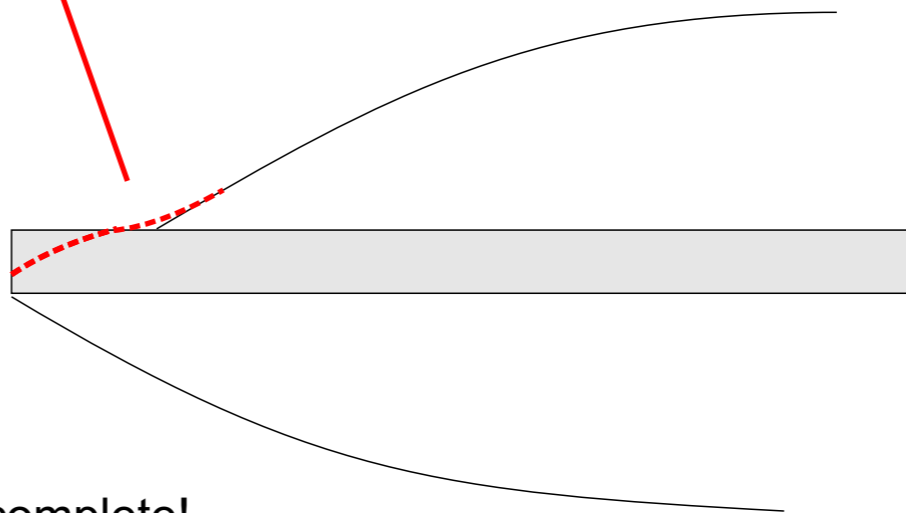
Shape and glue the 3mm depron air intake pieces in place to the edf and exhaust bulkheads as shown (part 44)







Sand and fill the leading edges



Congratulations, your model is now complete!



Sand and shape your model to represent the real thing. Use photos as reference

