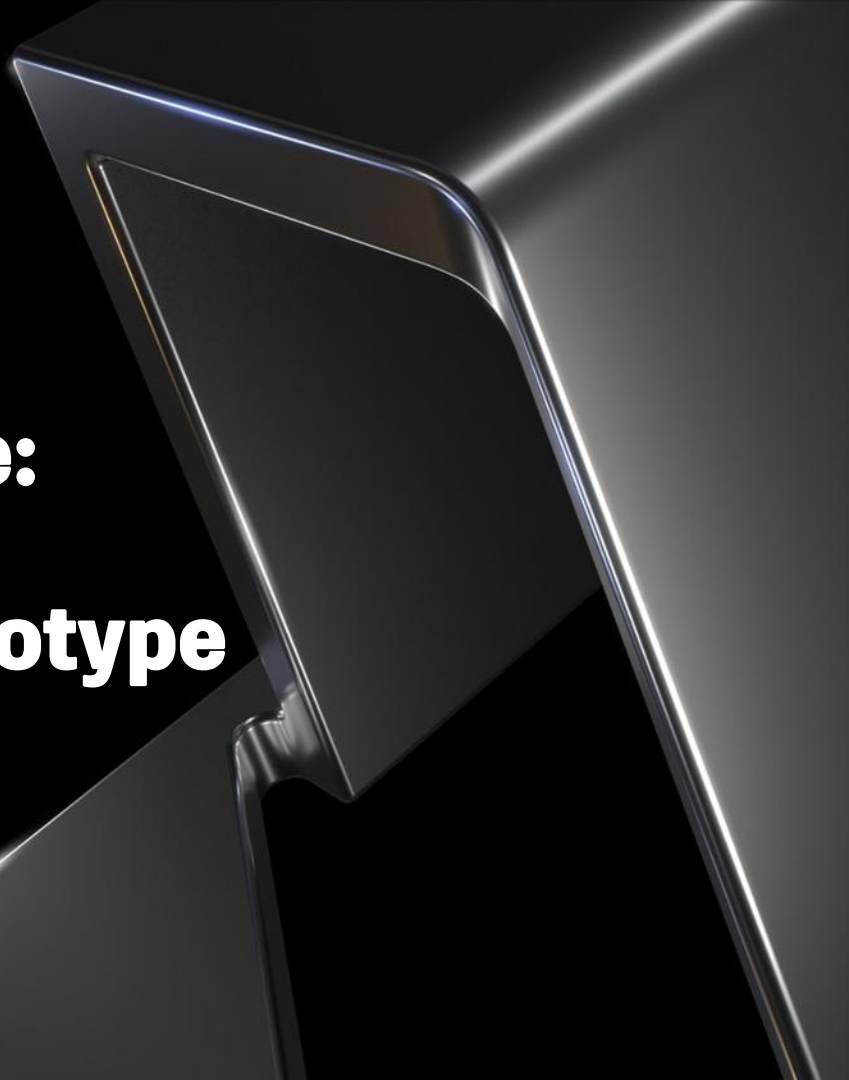
AUTODESK UNIVERSITY

Simple, fast and flexible: Fusion 360 can help you accelerate the UAV prototype design process

Junqi Wu, Yutao Jin, Lindong Wang

Instructor | @SJTU ASC



About us

We are Shanghai Jiao Tong University Aero Sports Club, a group of students love aviation .

Our goal is to share the beauty of aviation with everyone, so an intuitive workflow of designing and making an airplane is vital for us!

Fusion 360 is the key to make it possible.

Presenter

Junqi Wu

- Deputy Director of Engineering Training Center of Shanghai Jiaotong University
- Leader of the UAV Teaching and Research Group of the Student Innovation Center of Shanghai Jiaotong University
- Overall designer of UAV, School of Aeronautics and Astronautics, Shanghai Jiaotong University
- Distinguished Expert of Shanghai Aeronautical Association
- Director of Shanghai Aviation Model Association
- Licensed UAV captain

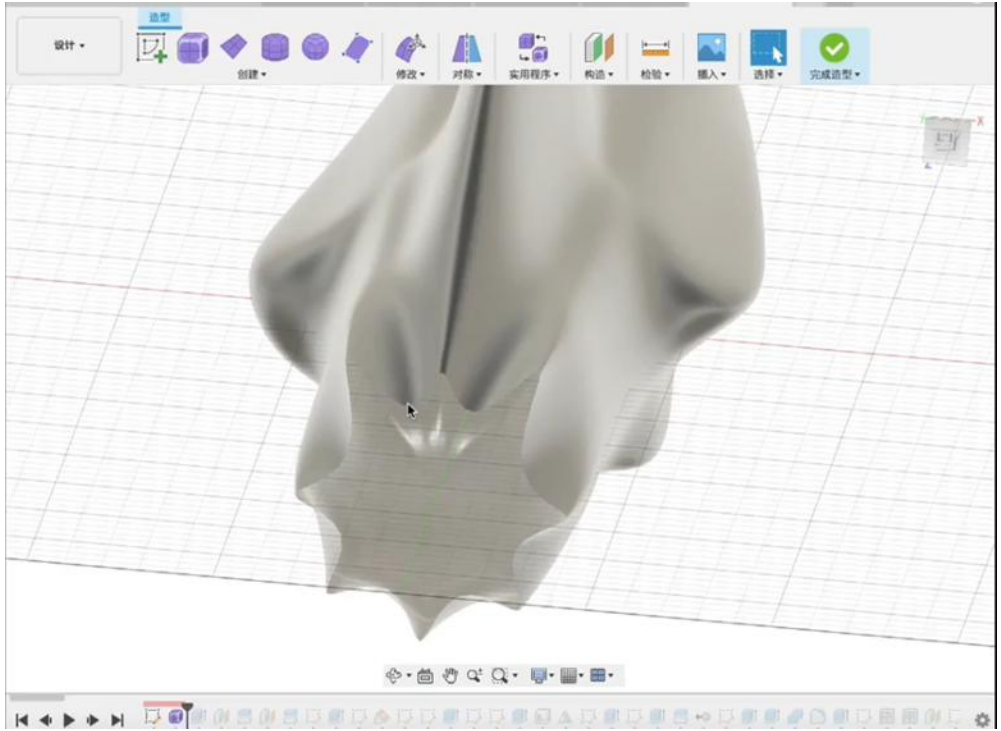
Making Drones with Fusion360

Fusion 360 is a powerful tools for us to build 3D models, we mainly take advantages of these following features:

- Intuitive free-form design tool
- The Design History feature
- Cloud render and simulation
- Multiplayer synchronization
- Free education license

Why do we choose Fusion360?

Intuitive free-form design tool



Fusion360 has the ability to build almost all kinds of surface, which is convenient for us to build the fuselage, the wings, and the wingtips.

Why do we choose Fusion360?

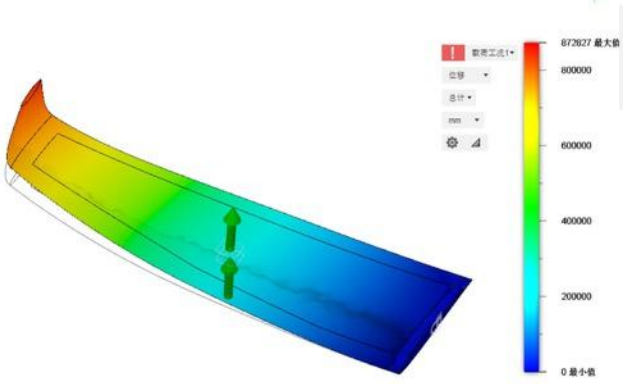
The Design History feature

The design tree keeps the historical version so that if we make a wrong change, we don‘t have to worry about getting back to the starting point. Since the cost of recovery was greatly reduced, we can try our design boldly and resolutely.

Why do we choose Fusion360?

Cloud render and simulation

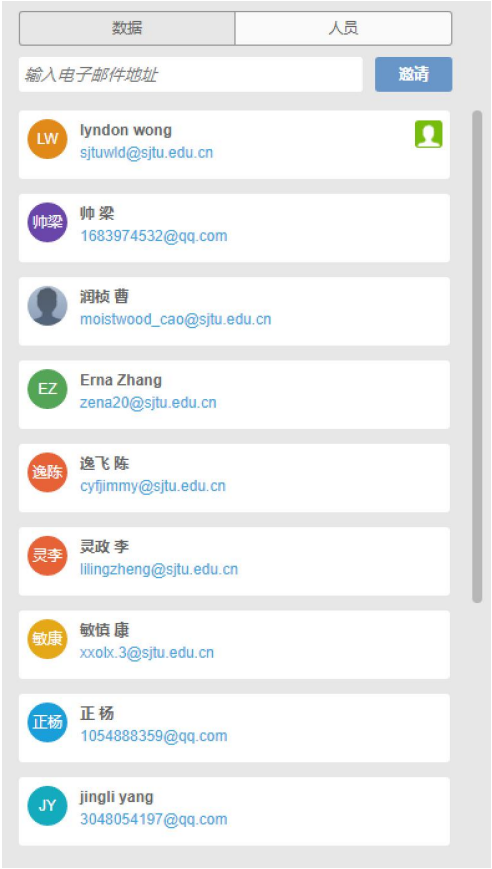
Most of our team are undergraduates, and some of us still use Ultra-light laptops. Online solution reduces the requirement of Computing power, and we can see the modification result of complex surface in less time.



Why do we choose Fusion360?

Multiplayer synchronization

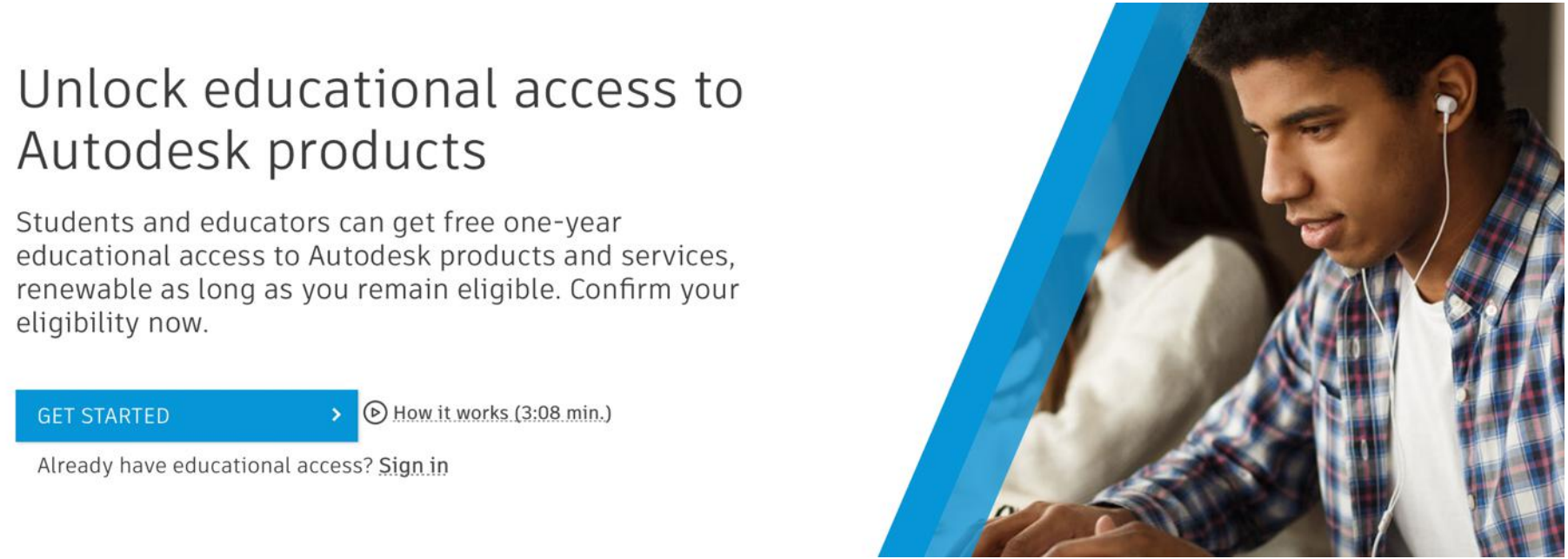
Reasonable division of labor and synchronization between teams are very important. Fortunately, Fusion360 saves model data in the cloud, so it provides cloud synchronization function, which is very useful and powerful.



Why do we choose Fusion360?

Free education license

Fusion 360 brings out the education license. As long as we complete the certification, we can use it for free.



Presenter

Yutao Jin

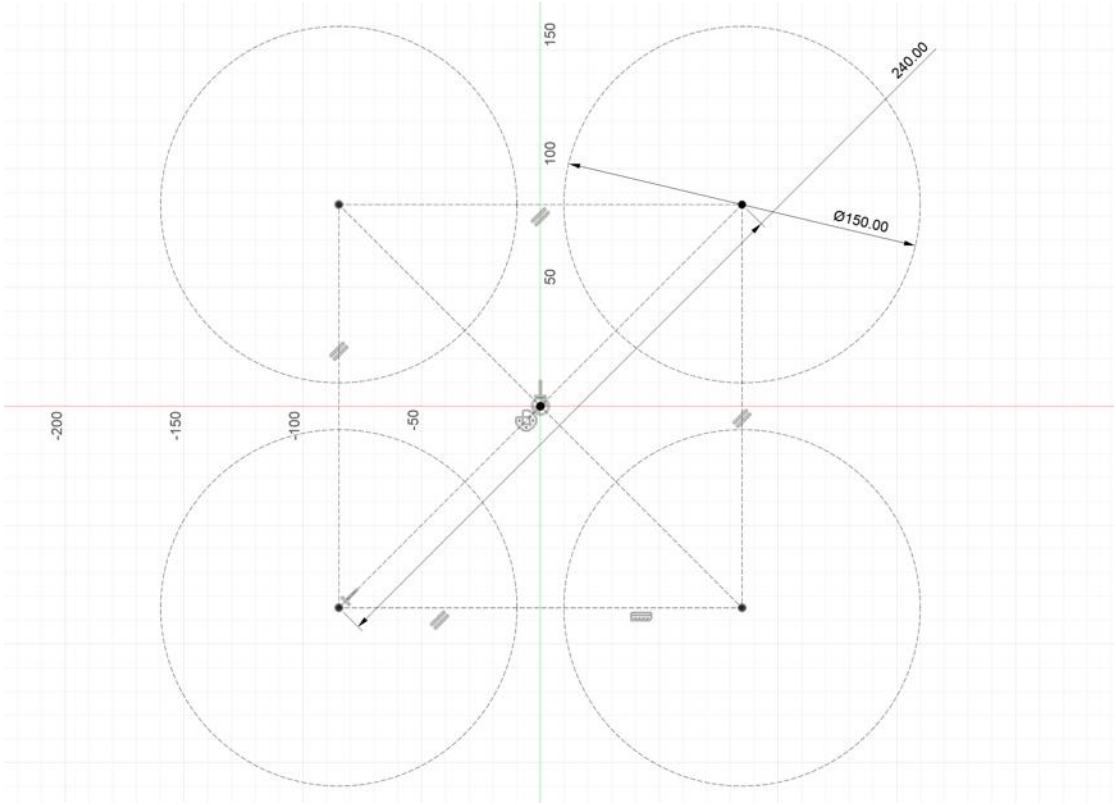
- Bachelor of Arts, Shanghai Jiao Tong University, major in visual communication;
- Captain of Shanghai Jiaotong University Aero Sports Club
- Have more than ten years of drone experience.
- A Maker

Beginner: Making Your First Quadcopter

Making a simple quadcopter mainly using 2D sketch

Step1: Define it!

Decide how large you want it to be

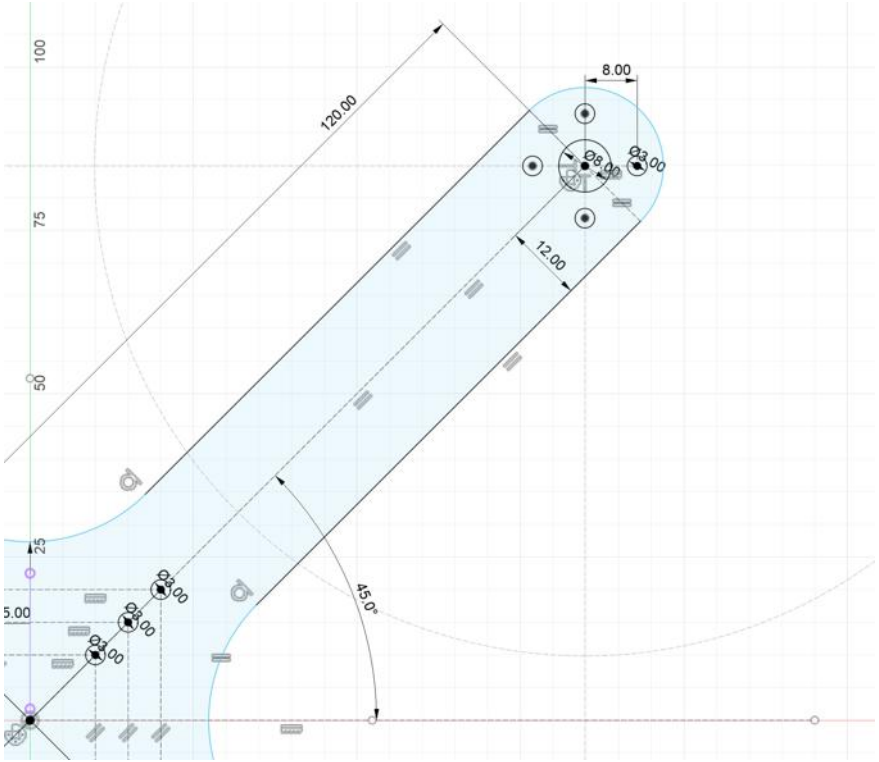


This one is using a 6inch (150mm) propeller

So, it gets a wheelbase (diagonally) of 240mm

Step2: Draw an Arm

The arm holds your motor



Draw one arm first.

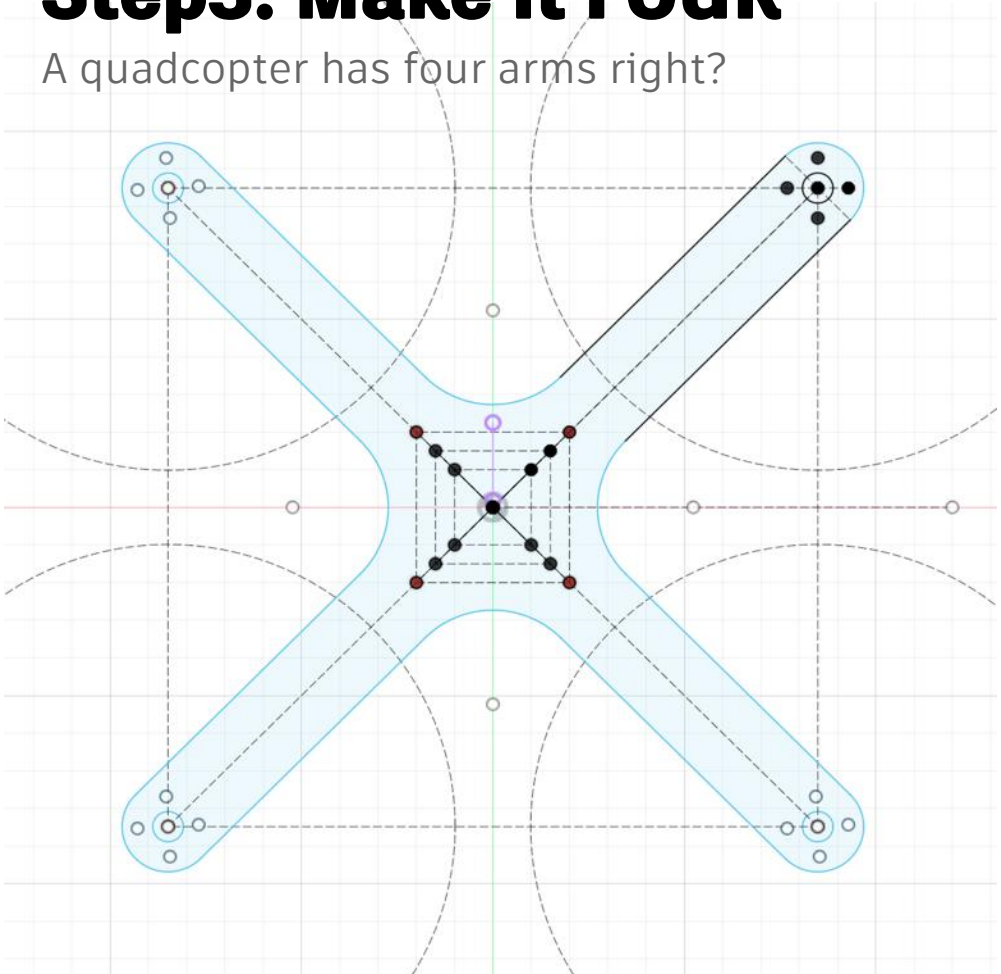
The arm’s length should be 240mm/2, 120mm.

Then, draw the mounting holes for the motor.

Note: Normal 22xx 23xx stator size motor has 16mm mount hole and use M3 screws to mount
(Double check your motor’s technical Drawing to make sure)

Step3: Make it FOUR

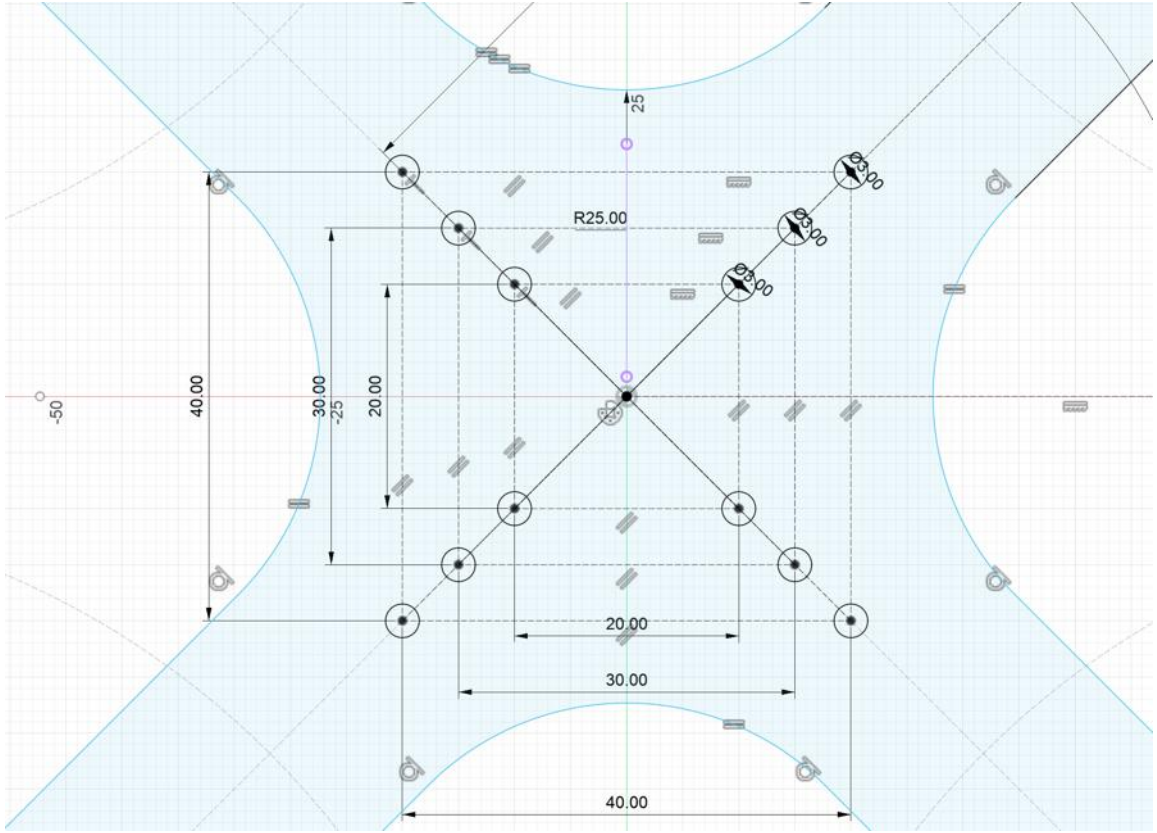
A quadcopter has four arms right?



Use Circular Pattern tool to make duplicate the arm.

Step4: Add some holes

Add mounting hole for the electronics



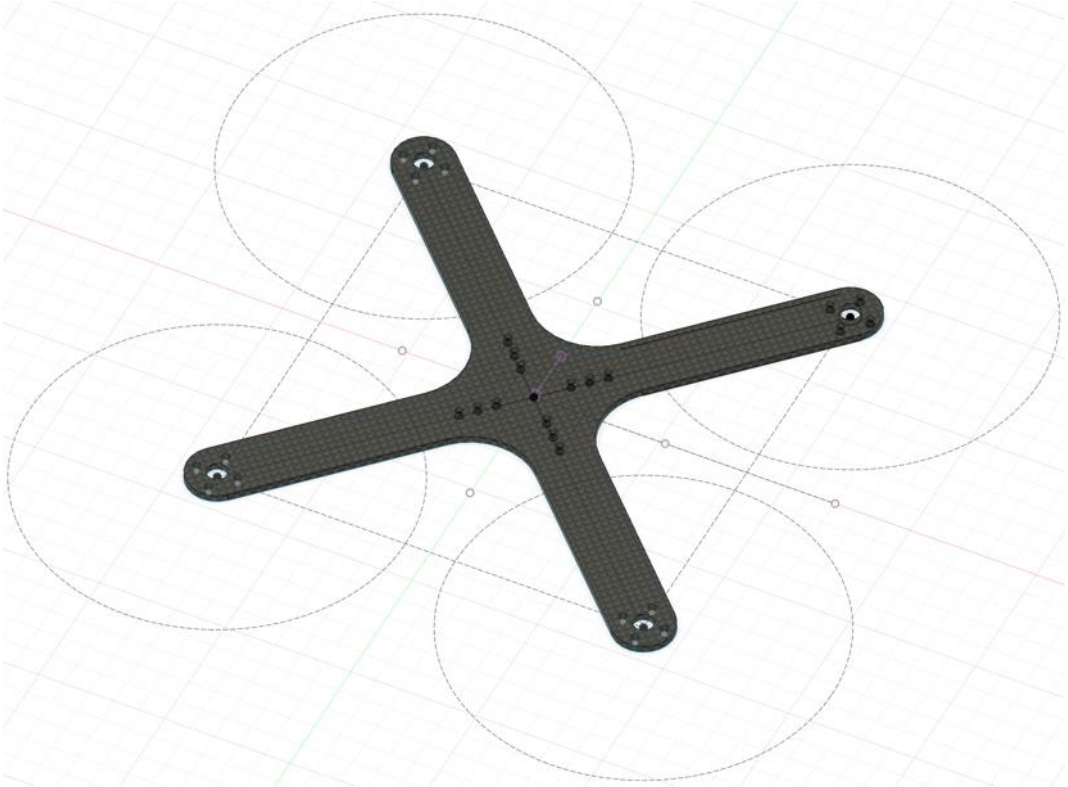
Add mounting hole for the electronics such as flight controller, video transmitter, speed controller, etc.

Note: Most modern hardware uses 20mm or 30mm mounting holes.

Add 4 more 40mm holes to connect the top plate later.

Step5: Finish bottom plate

Bottom plate is where you mount everything but the battery



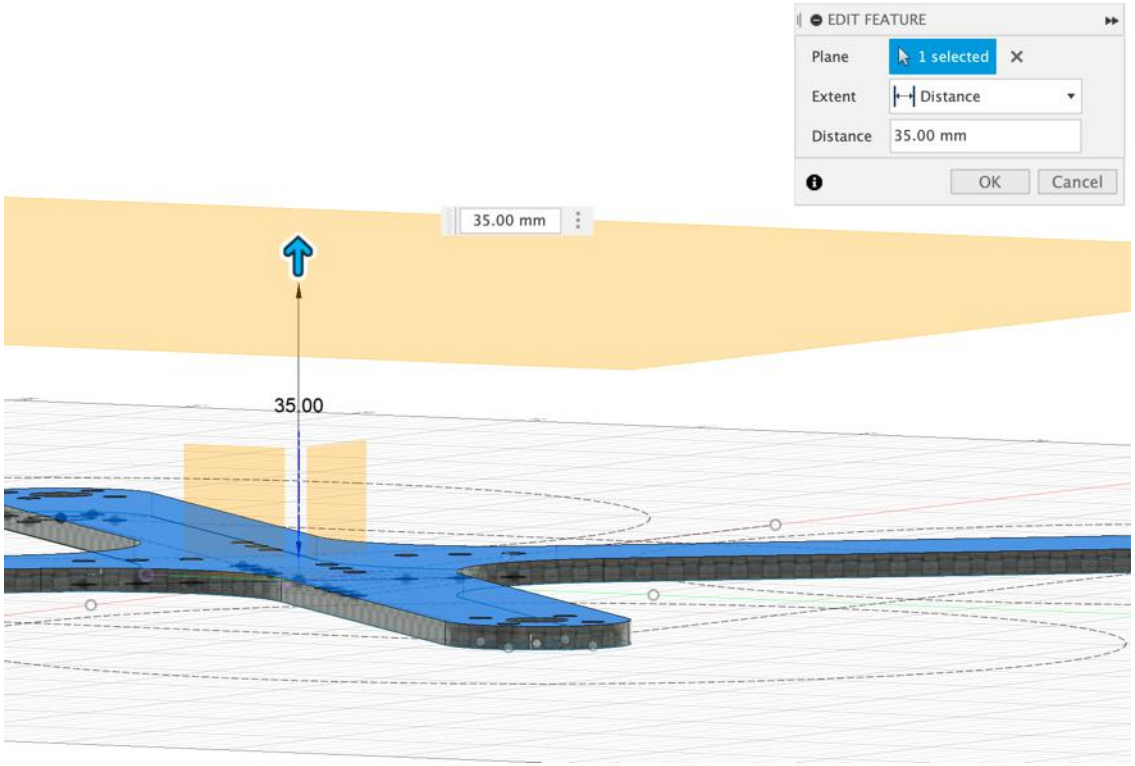
Use Extrude tool to make a solid body of the bottom plate.

If using carbon fiber 3mm would be fine.

If using plywood or acrylic, make it 5mm.

Step6: Define a new plane

Make some room for all the electronics

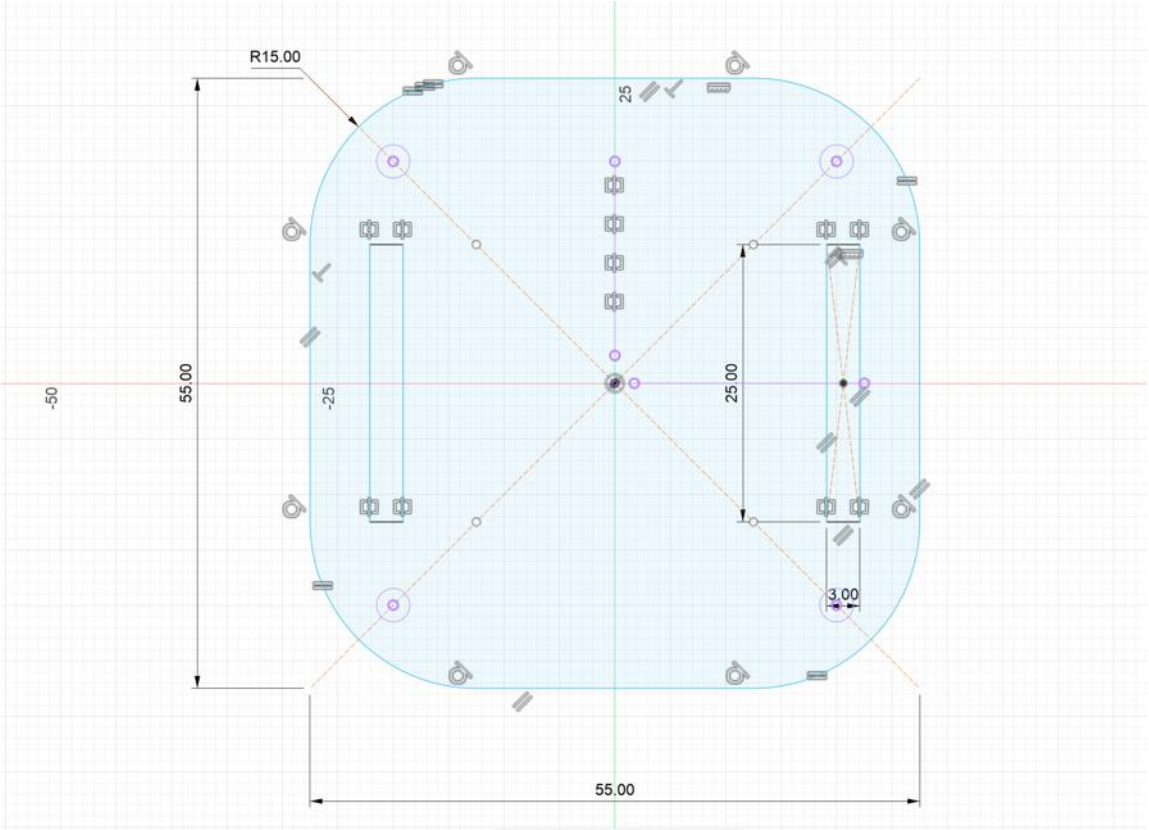


Use offset plane tool to create a new plane where the top plate goes.

Here I use 35mm, you can use whatever value that fit your components.

Step7: Draw a top plate sketch

Bottom plate is where you mount the battery

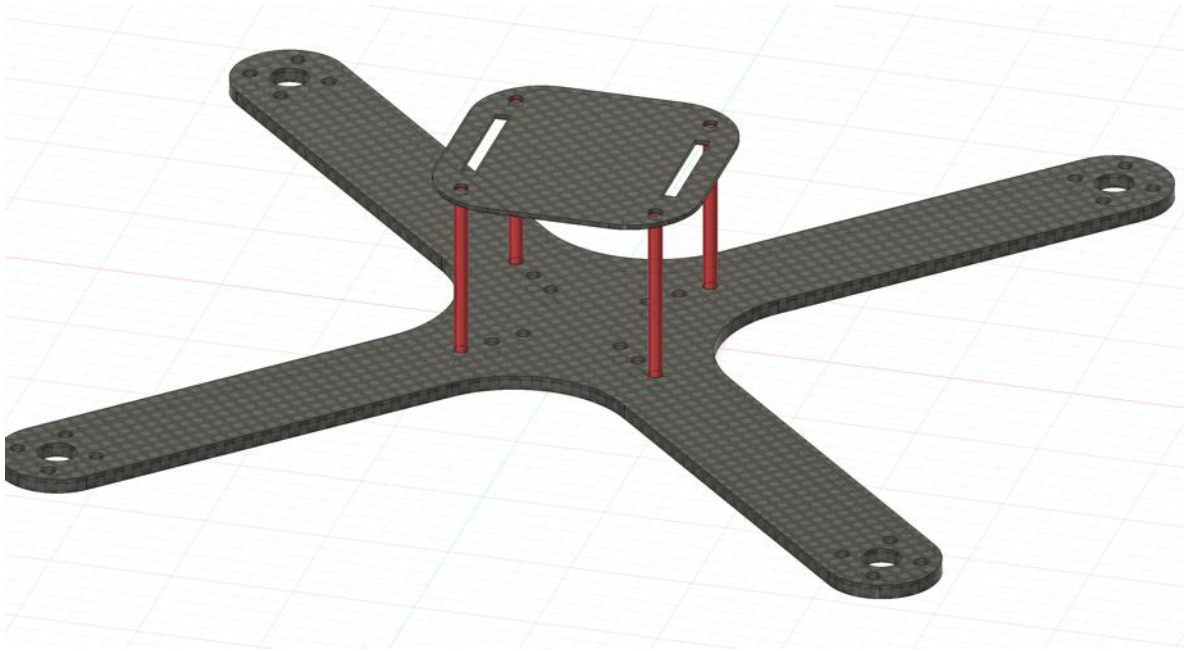


Draw a top plate at the plane you just created

It should have some rectangle hole where the battery strap will go, and some mounting hole that connect to the bottom plate.

Step8: Finish design

Extrude the top plate and the stand off

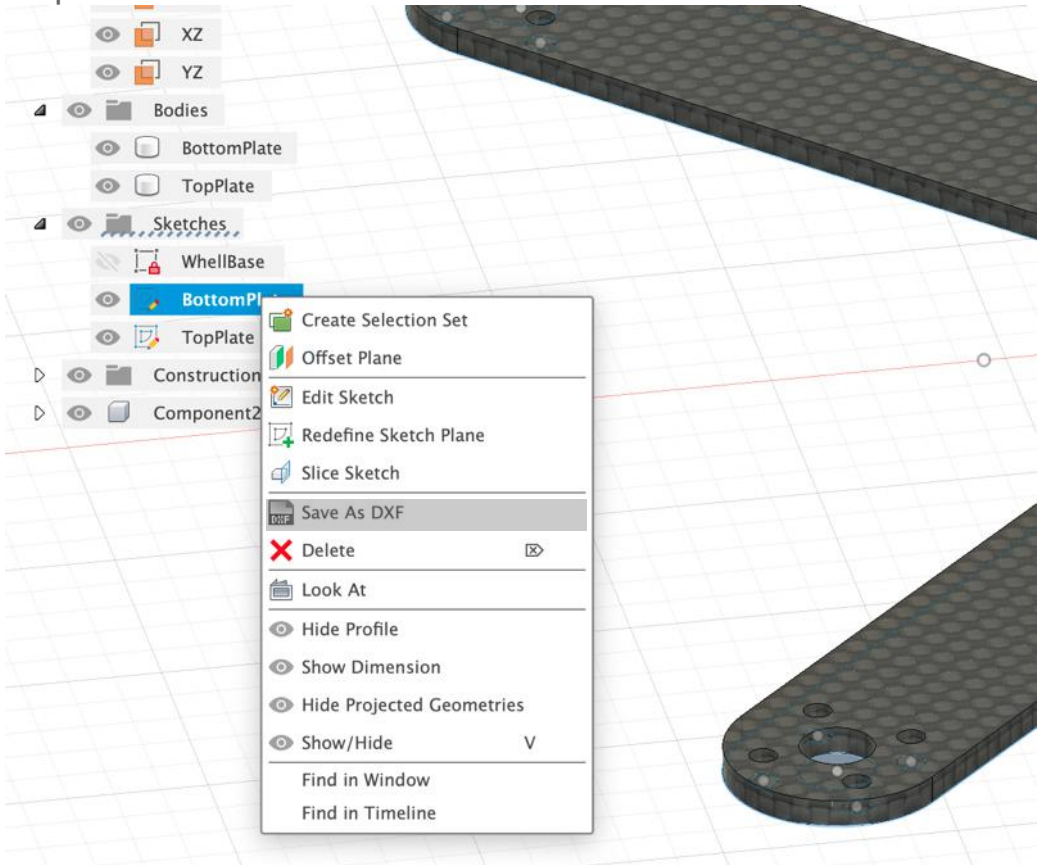


For the top plate, 1mm of carbon fiber will work just fine.

The stand off should be the same height as the space between two plates.

Step9: Make it REAL

Export to make

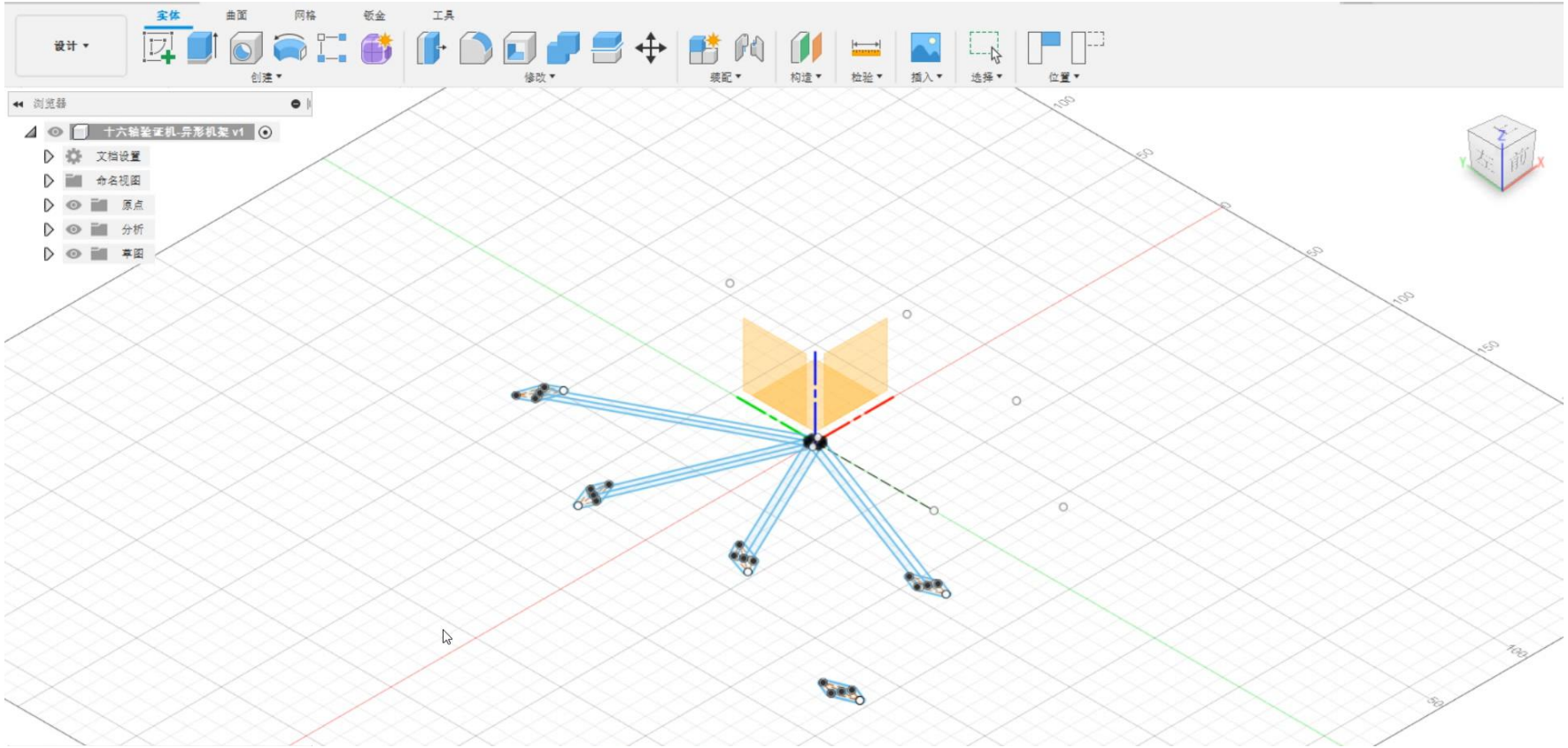


Right-click the sketch that needs to be manufactured, choose the Save As DXF to export.

You can cut it yourself if you have a laser cutter or CNC mill, or you can find someone online to cut it for you.

Simple but useful method

This method is very versatile, you can make quite complicated design with it.



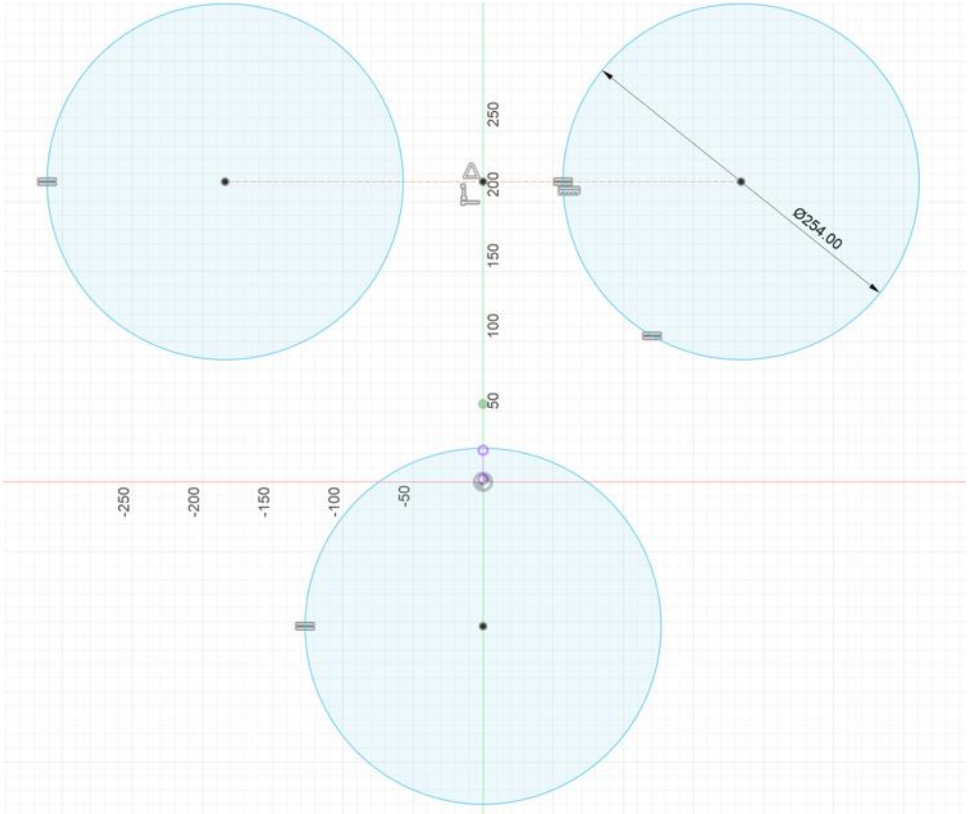

左后

Step up: Organic Drone Design

Making an organic shaped drone using T-spline modeling

Step1: Define it!

Decide how large you want it to be

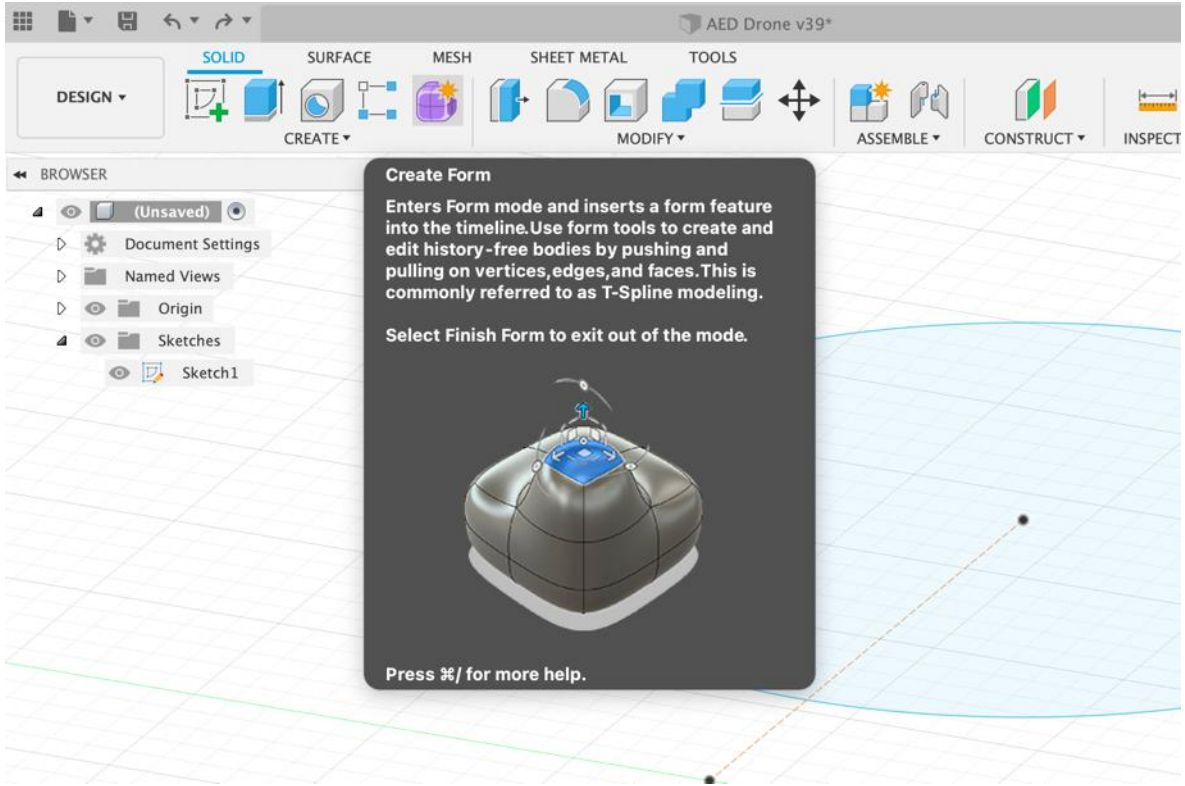


For this one, I'd like to use 9inch (254mm) propeller.

So, we should also lay out the motors accordingly.

Step2: Create Form

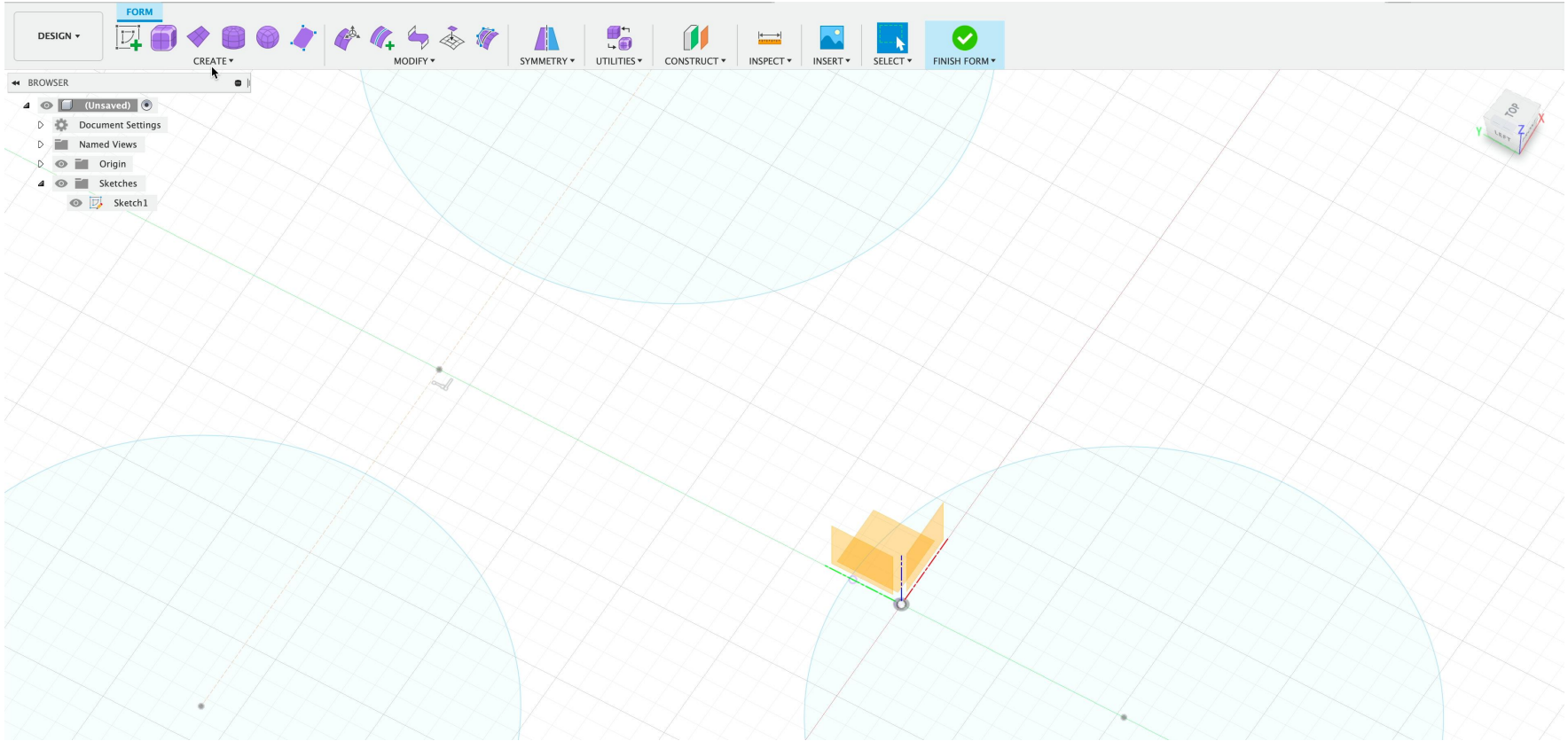
It’s time to start sculpting



Use Solid-Create Form button to create a from

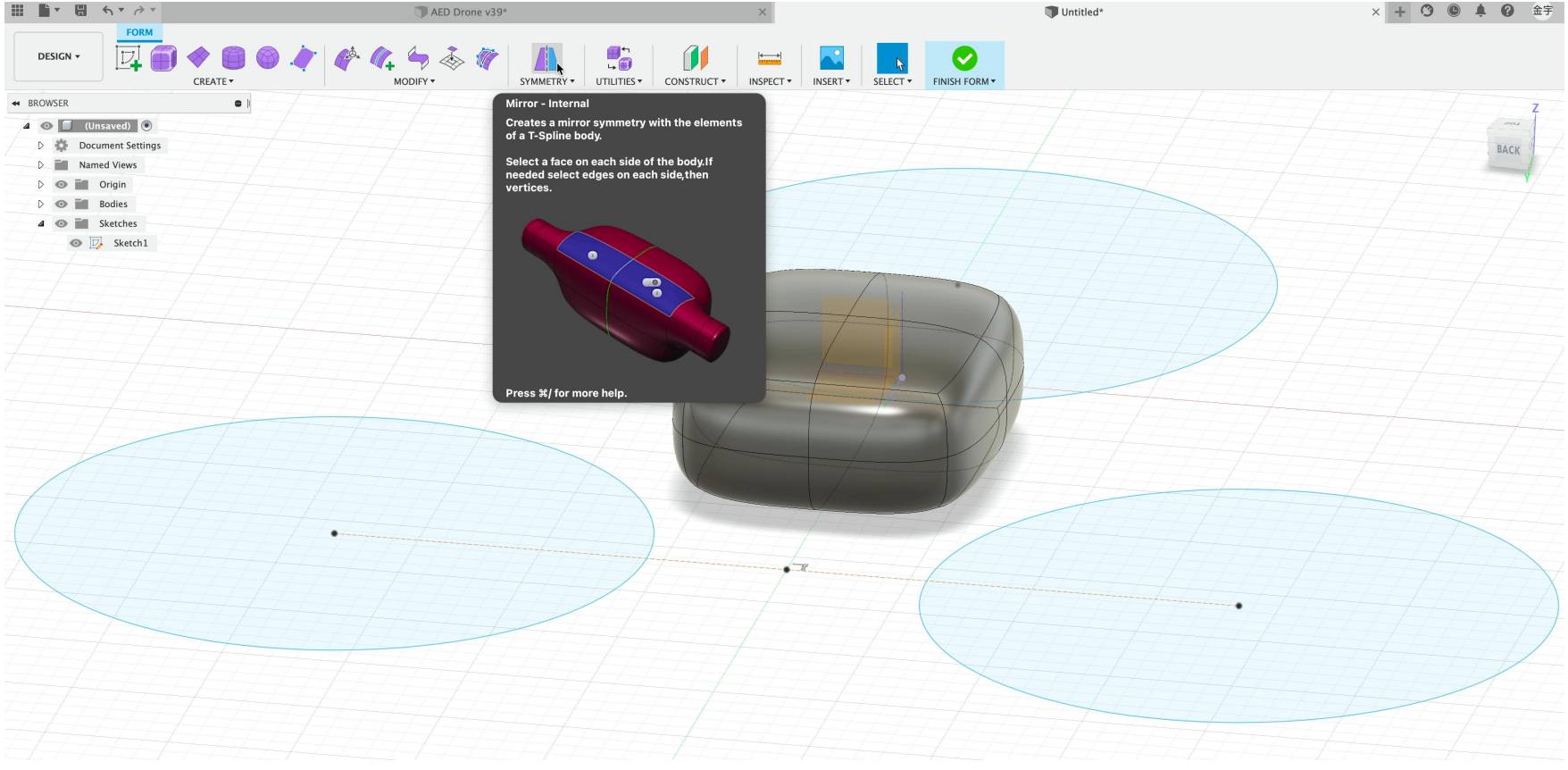
Step3: Create a box

Everything starts with a box



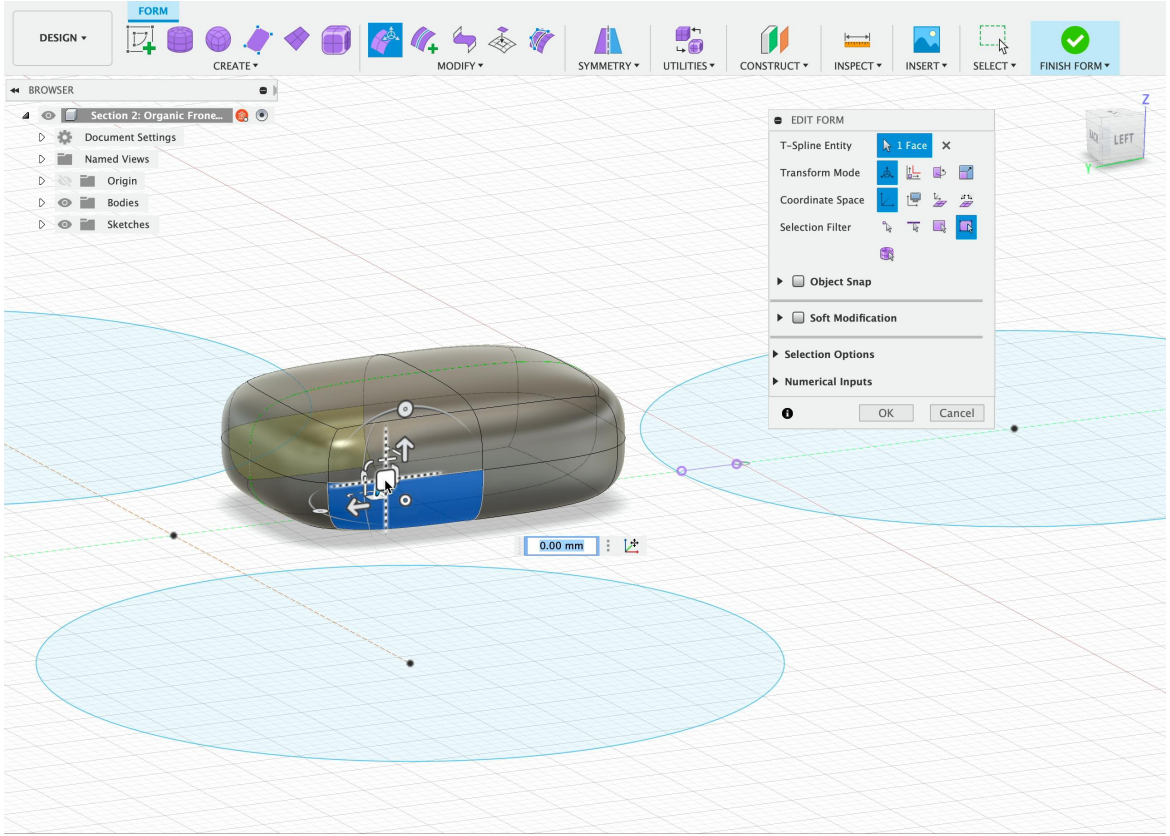
Step3: set symmetry

Everything starts with a box



Step4: Edit form tool

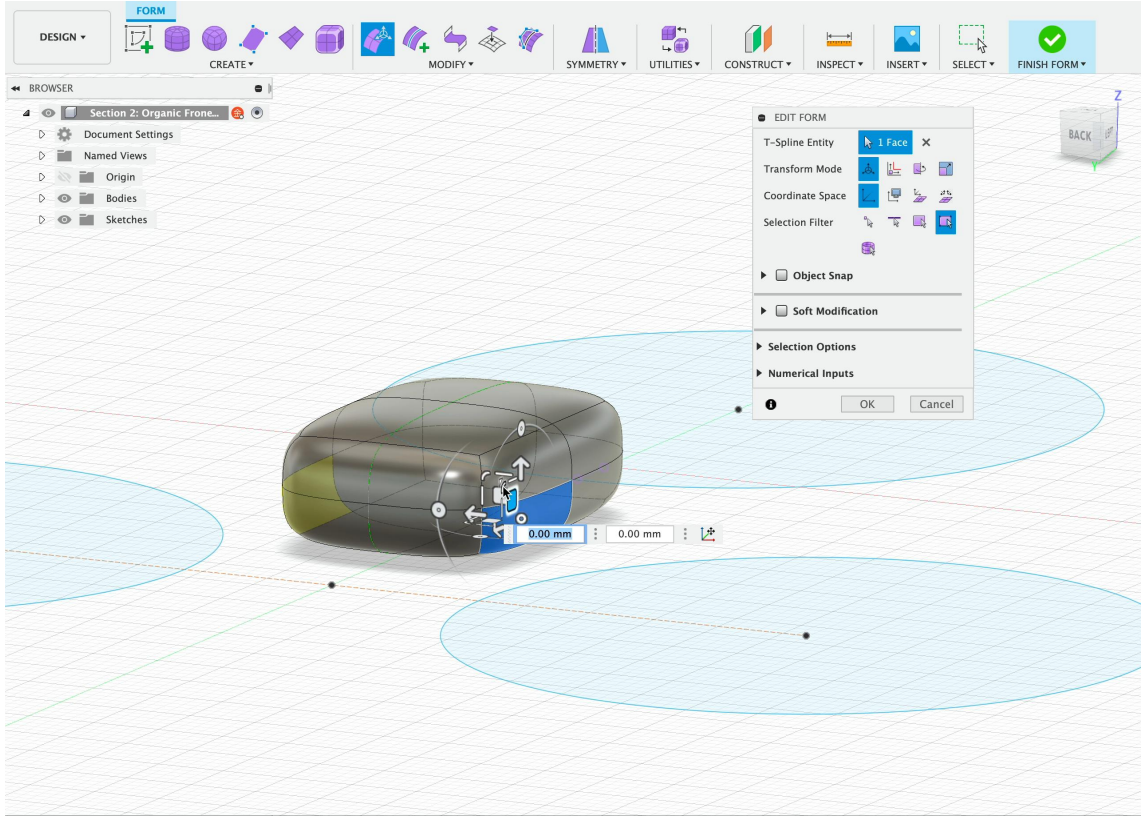
The most important tool in T-spline modeling



Select any faces, edges, or vertexes you want to Edit then simply drag it

Step4: Edit form tool

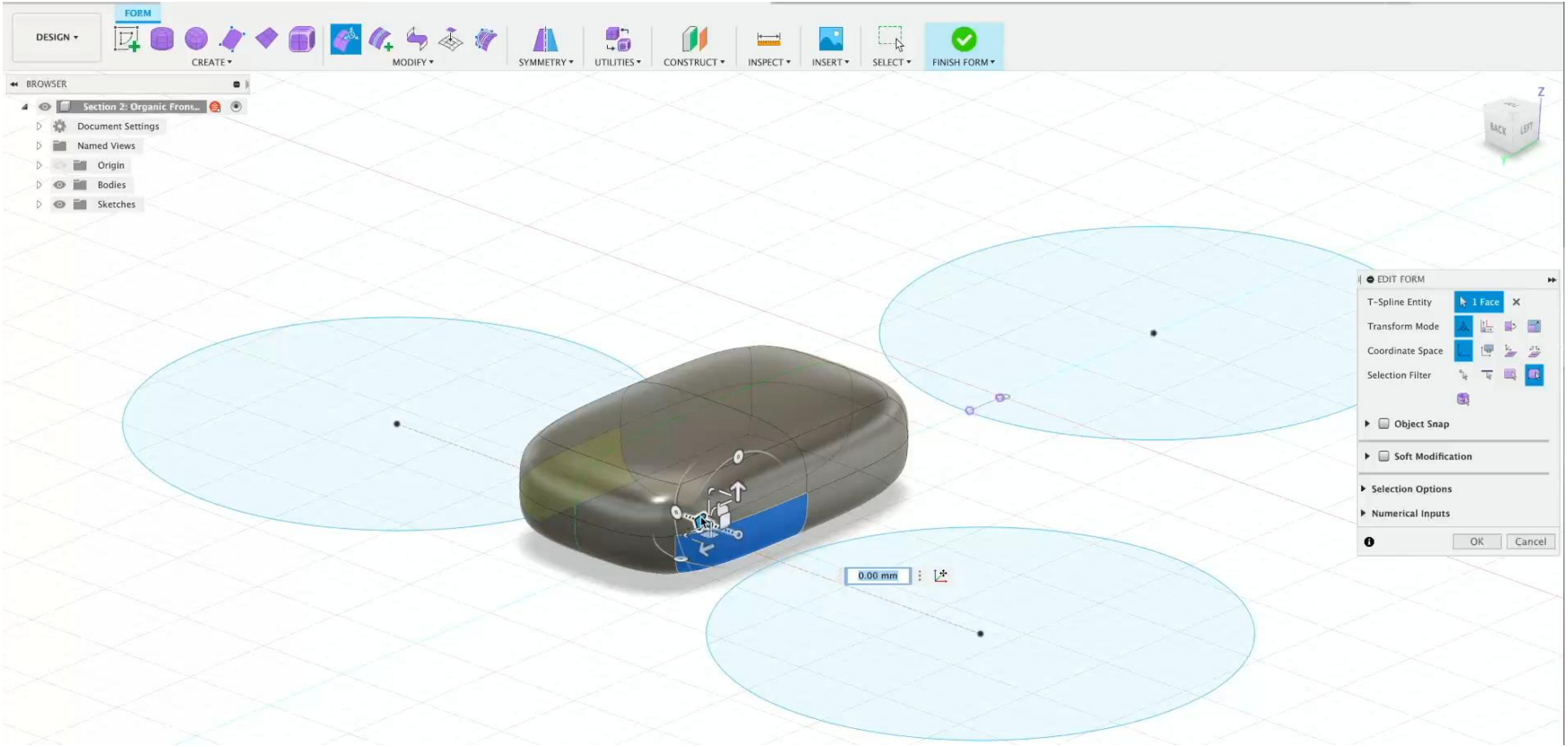
The most important tool in T-spline modeling



Edit Form tool can double as Extrude tool, just drag the surface while pressing the Alt key (or the option key for mac user), you can extrude from the selected surface.

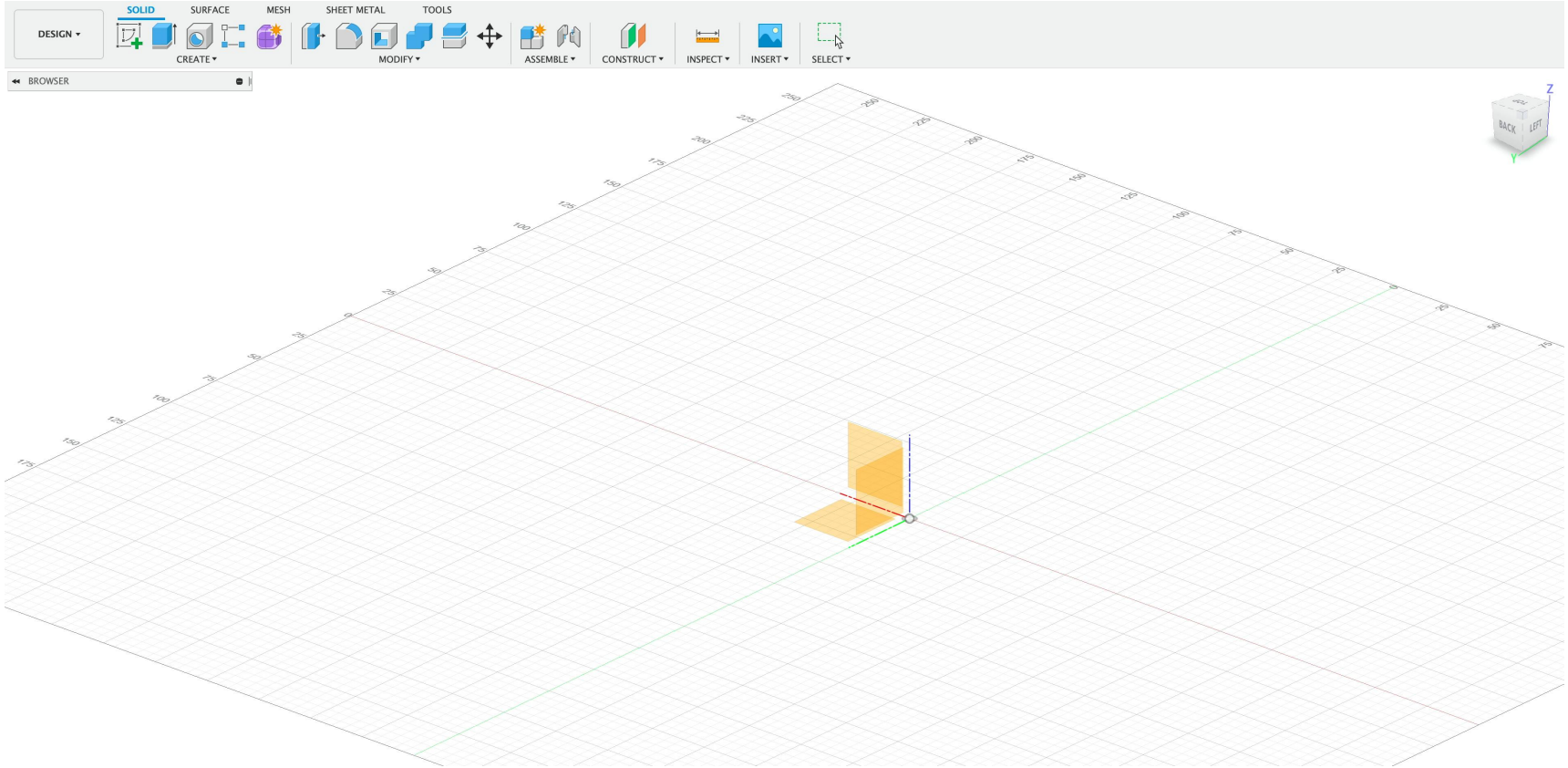
Step5: Manipulating it

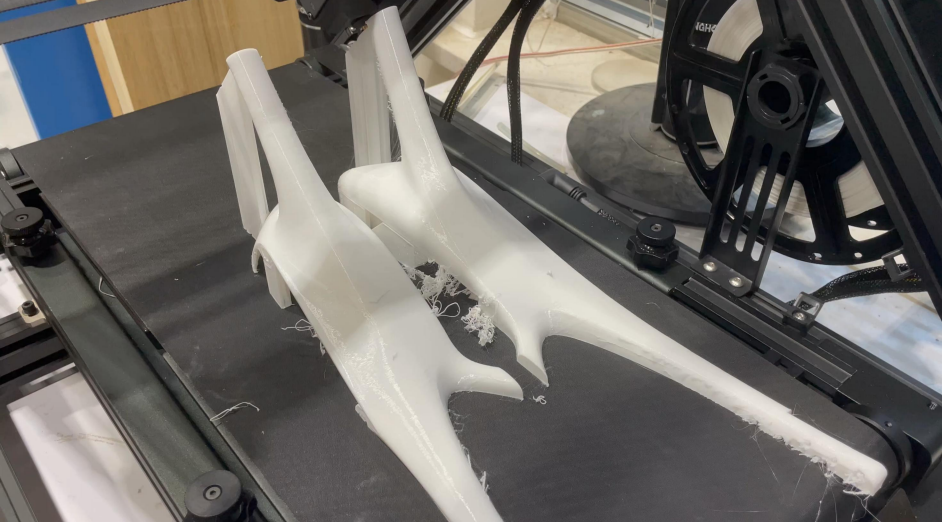
Using Edit form tool and some other tools to help



Step6: Finishing the details

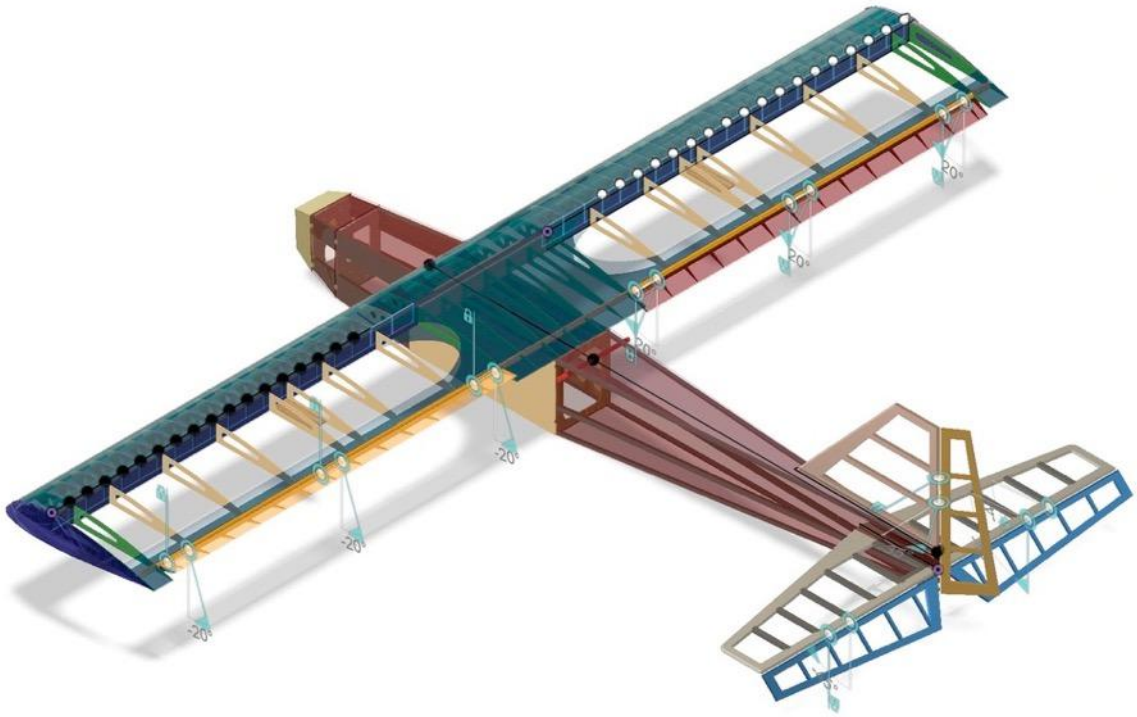
Using Edit form tool and some other tools to help





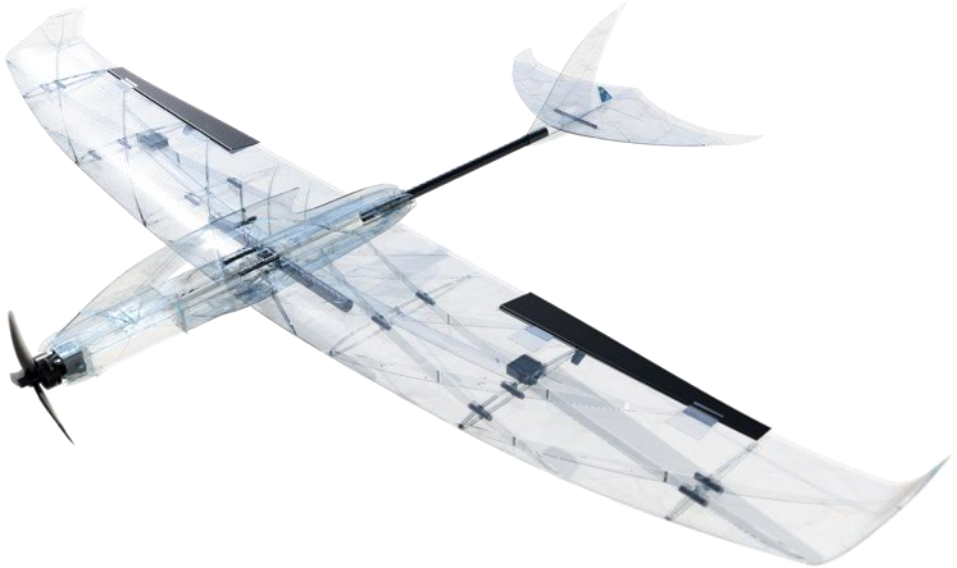
Hardcore: Aeroplane design

Fusion does a lot levitating the traditional airplane design process



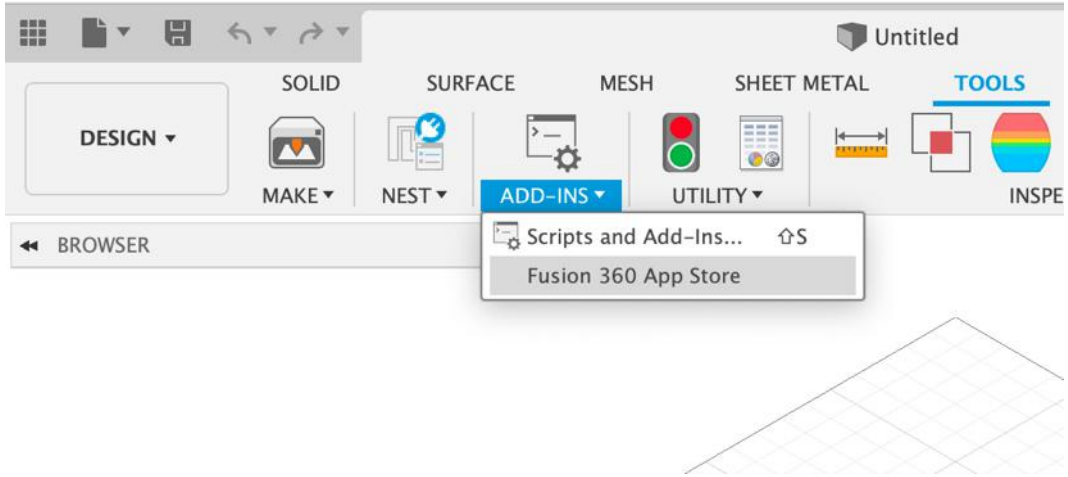
Hardcore: Aeroplane design

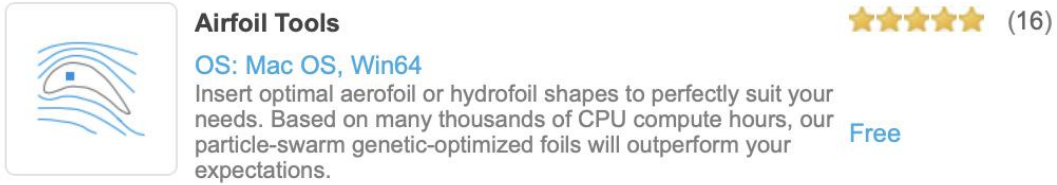
Making an organic shaped drone using T-spline modeling



Step1: Download Airfoil Plugin

A easy way to generate scientific Airfoil





In design workspace,

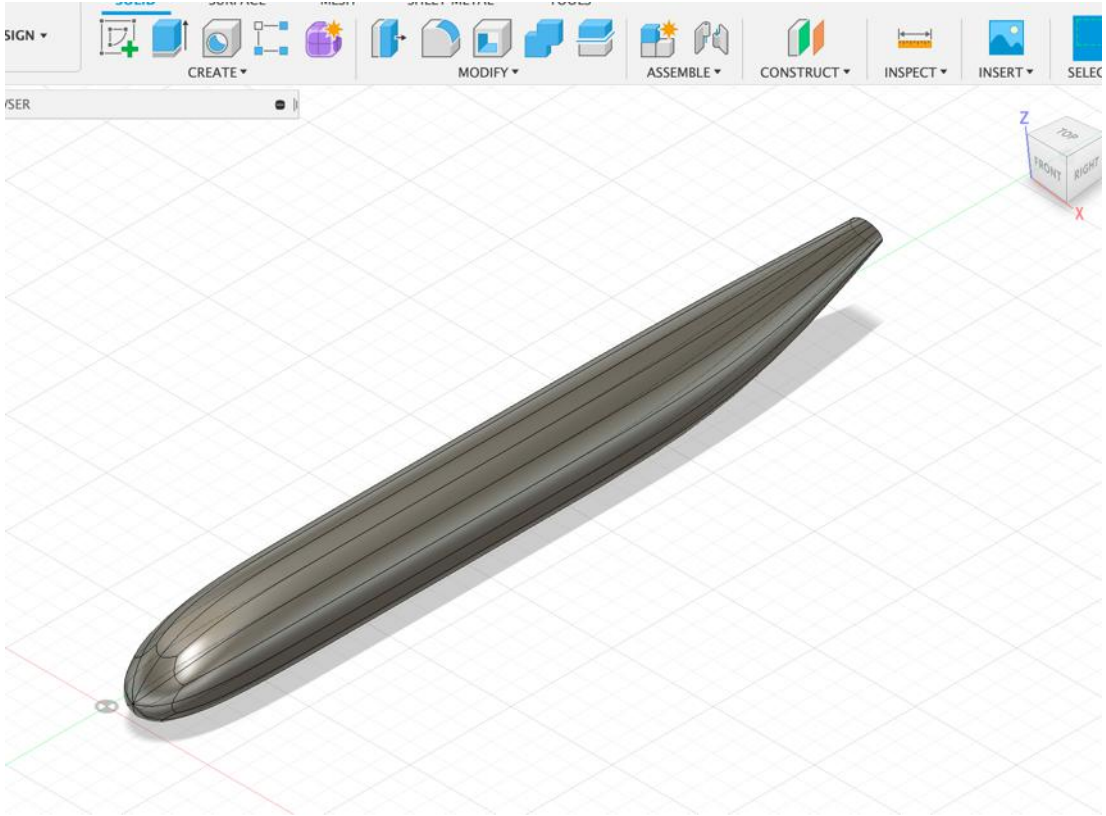
go to Tools tab- Fusion 360 App Store.

Search Airfoil Tools to download and install.

Then, reboot Fusion360.

Step2: Draw a fuselage

T-spline tool is suitable for modeling a fuselage

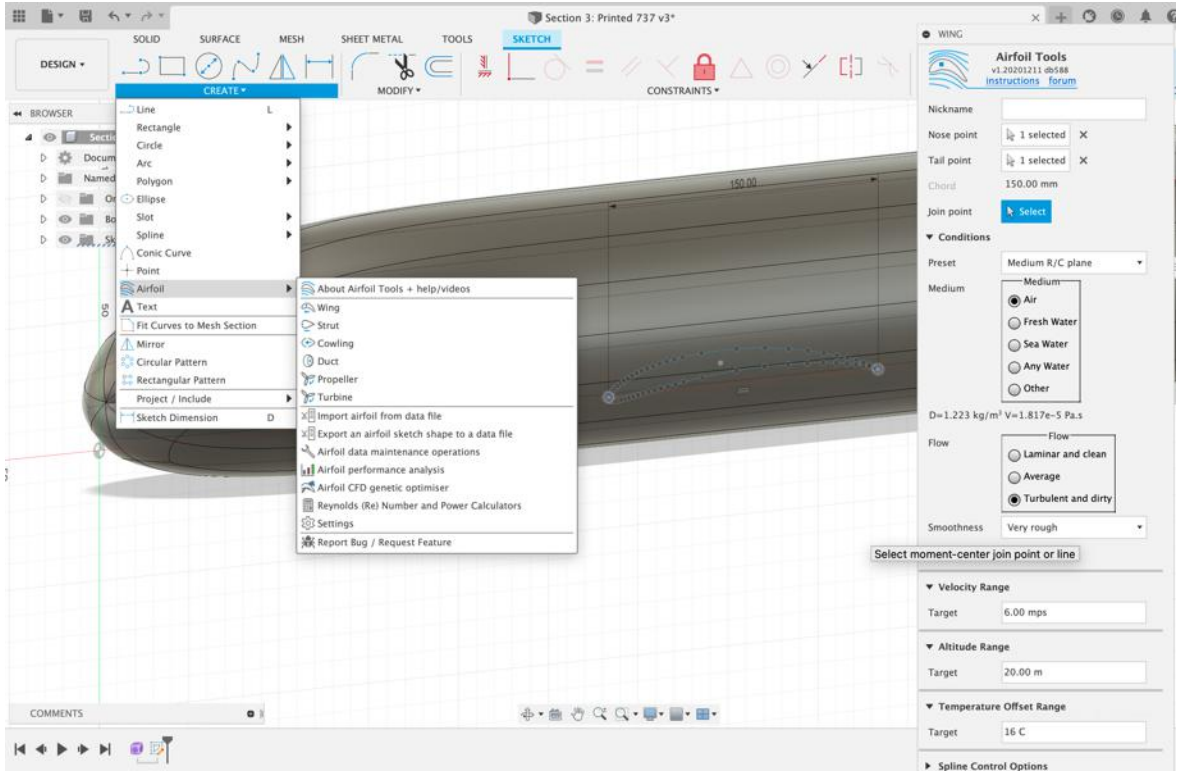


Use the form workspace we mentioned in the previous part to make a fuselage.

Note: fuselage is mainly used to accommodate the plane's electronics, so make sure it get enough space.

Step3: Draw airfoil sketch at wing root

Use the plugin to generate Airfoil



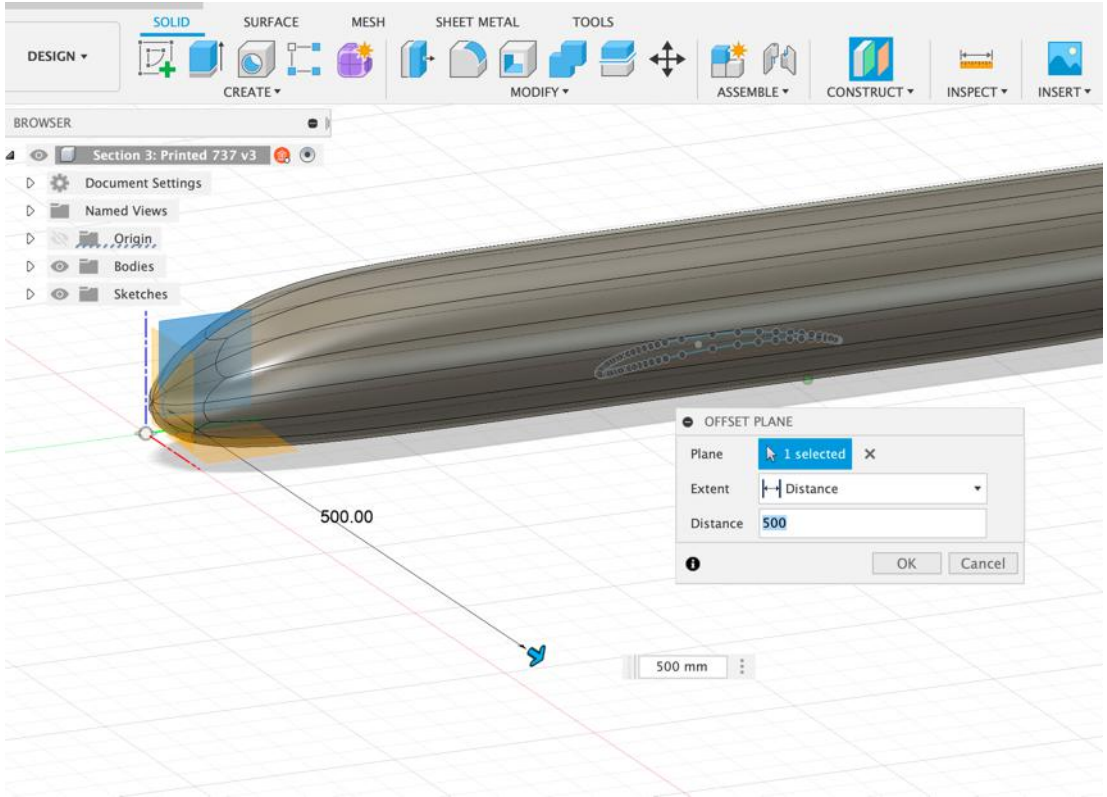
Draw a line of where the wing will go and determine how wide the wing will be,

Use the airfoil –wing tool to generate your airfoil. Select the two points of the line you just drew as the nose point and the tail point

Specify the environment the plane will be flying, such as speed and altitude. Or just choose a preset.

Step4: set the wingspan

How large you want it to be?

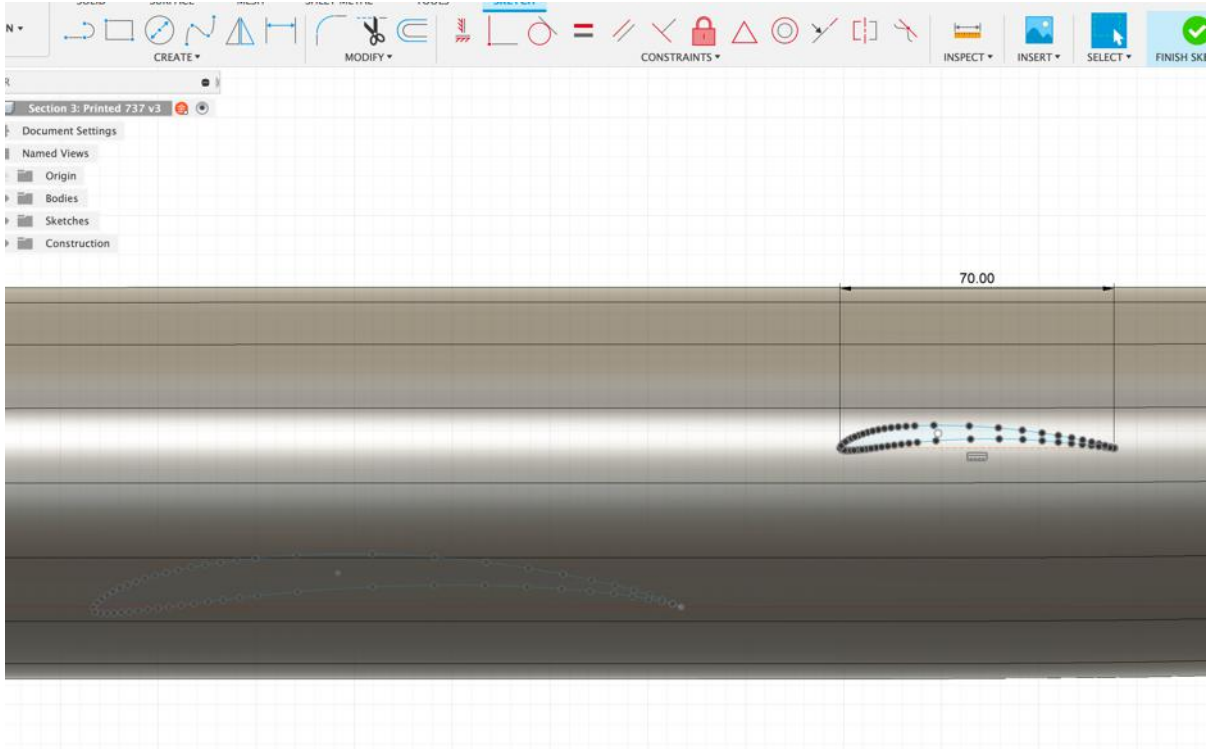


Use Construct –offset plane tool to set the construct a new plane that your wing tip will end.

This determines the wingspan of your plane.

Step5: Draw airfoil at wing tip

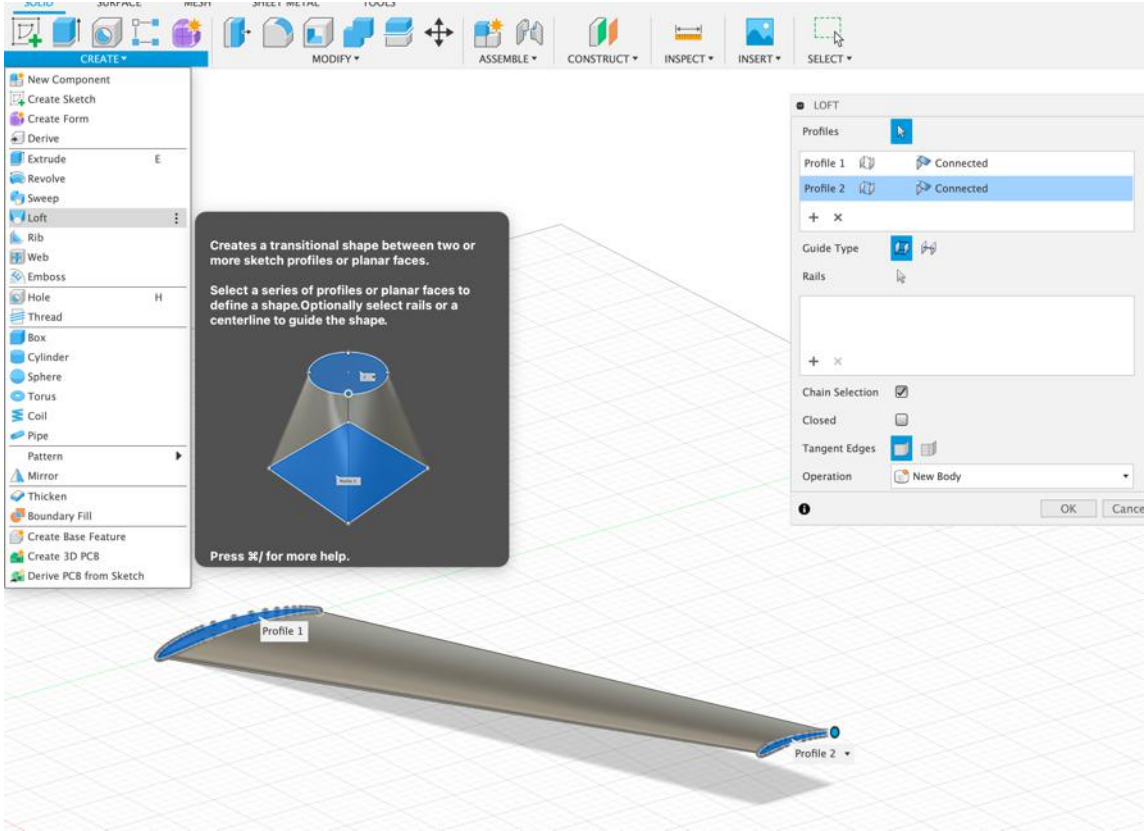
Use the plugin to generate Airfoil



Draw the airfoil at the wing tip use the same method

Step6: Connect them up

Using loft tool to form one-side of the wing

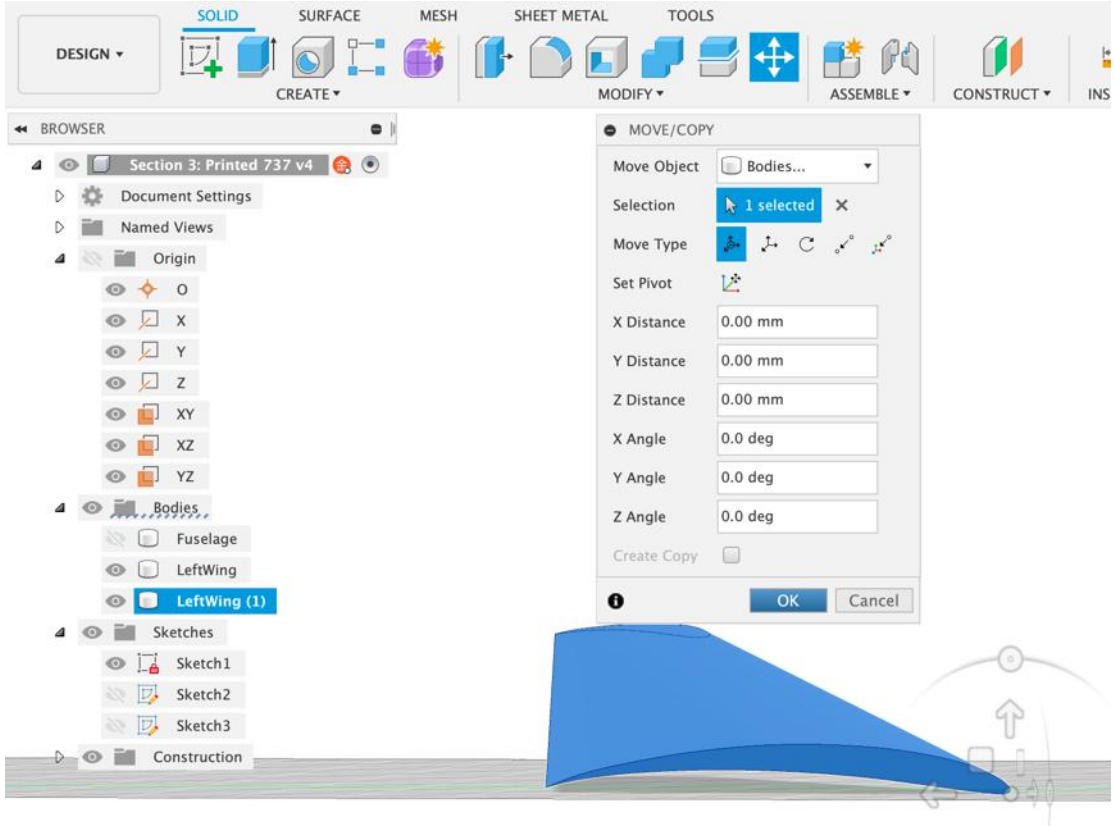


Use Create – Loft tool to connect two planes up.

And that's half your wing.

Step7: Mirror the wing

Save for later use

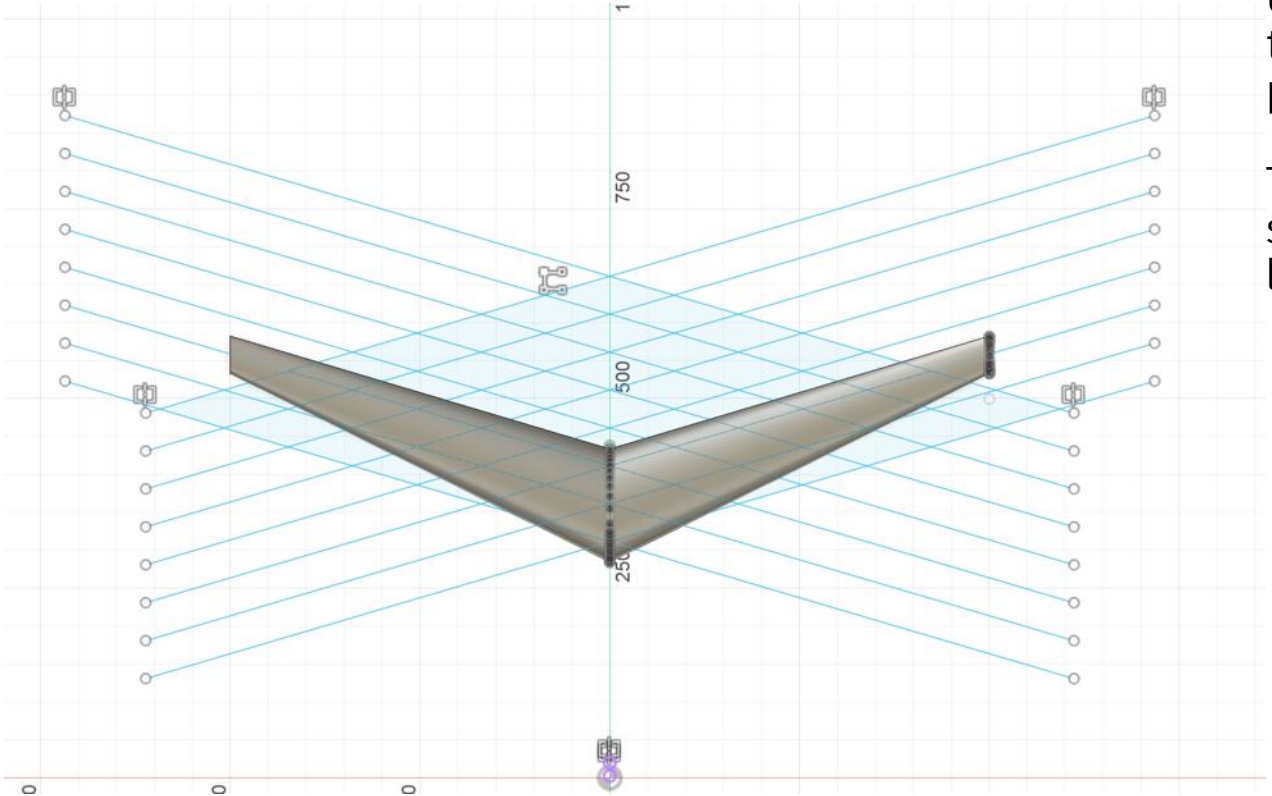


Select the wing body in the browser, use shortcut to copy and paste (ctrl-c and ctrl-v for windows user, command-c and command-v for mac user) at the same place.

Toggle the eye button to hide the copied one.

Step8: Draw a wing structure pattern

The structures make the wing light and strong

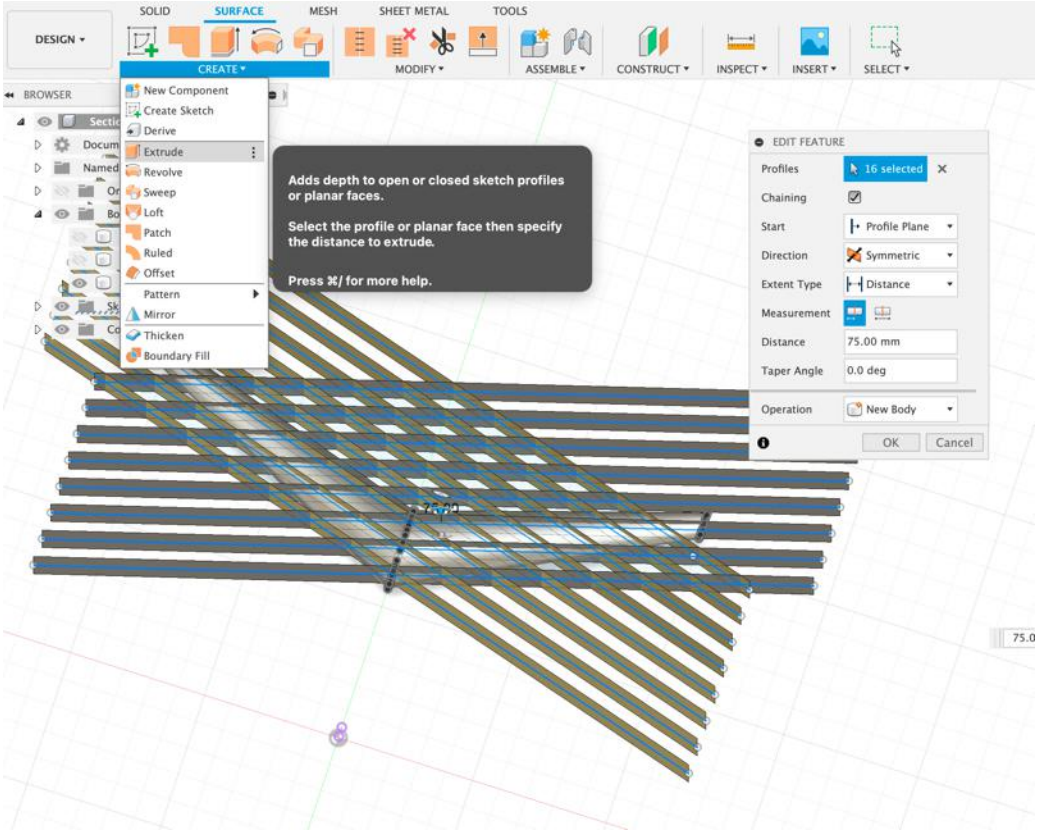


Use mirror and pattern tool to draw the structure pattern.

The pattern must be symmetry across the center line.

Step9: Extrude surface

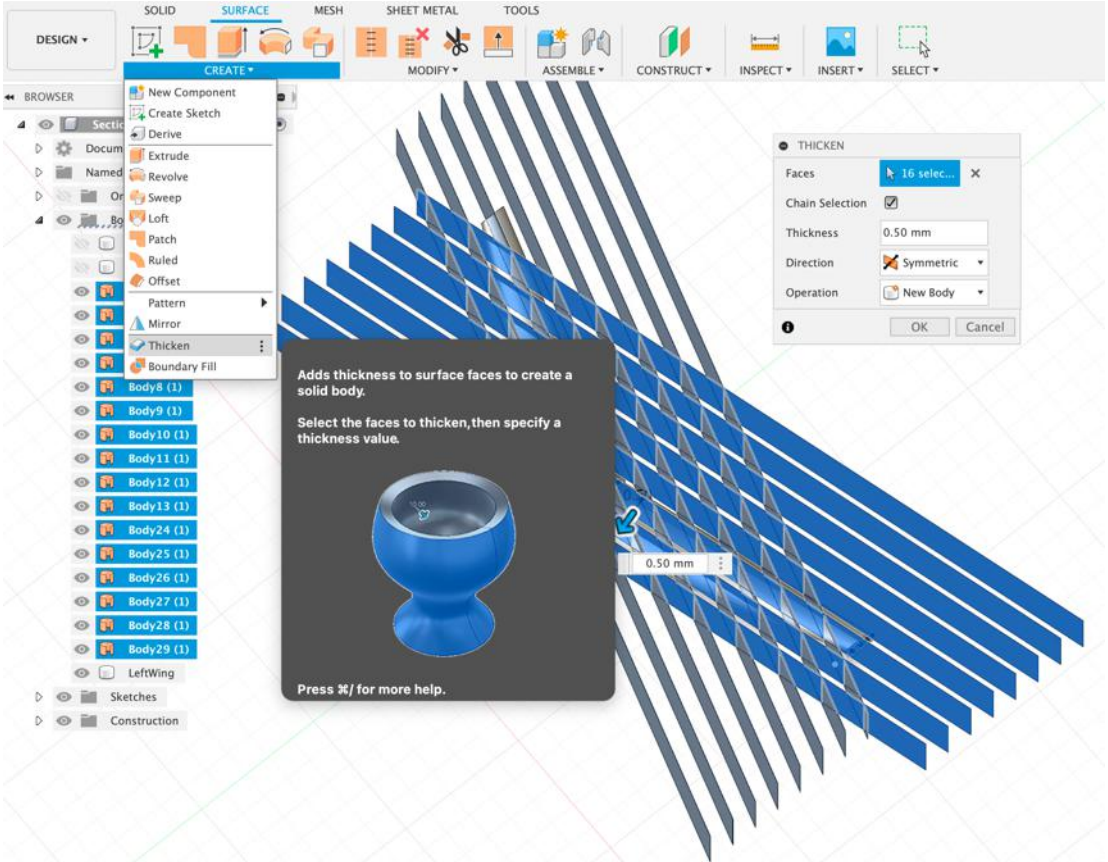
From line to surface



Select all the structure line, use Surface – Extrude tool to extrude them.

Step10: Thicken the surface

From surface to solid body

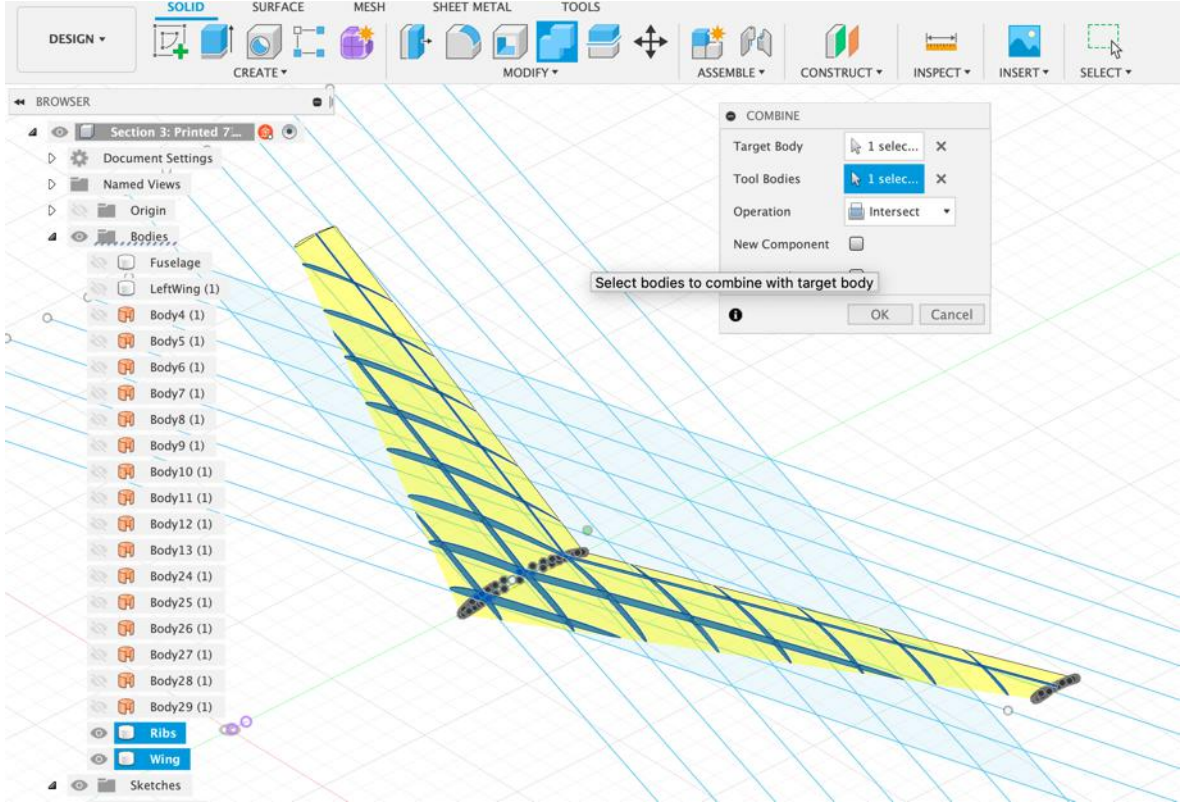


Use thicken tool to make the surface become solid body.

It may take a few minutes to compute.

Step11: Intersect ribs with wing

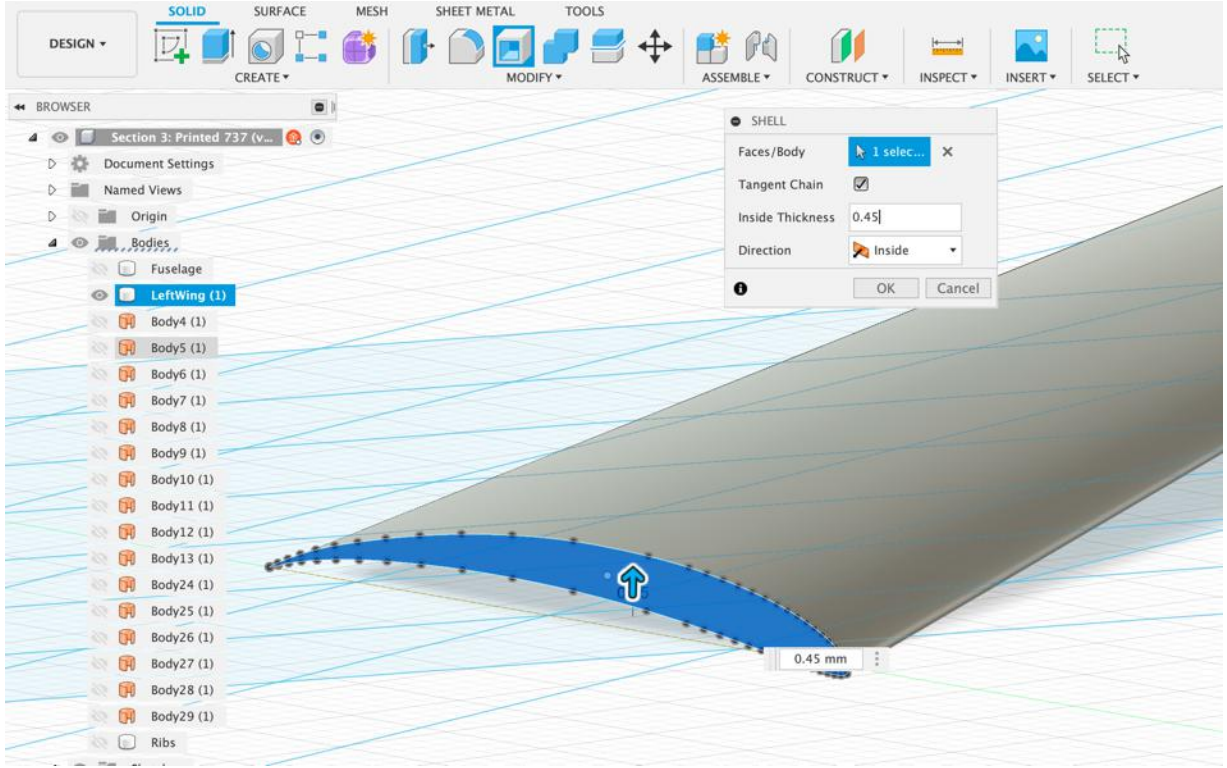
Just keep what we need



Use modify- combine tool, choose the ribs as target body, the wing(already mirrored one) as tool body. Select intersect operation then hit OK.

Step12: Do a wing skin

Ribs provide strength, skin forms shape

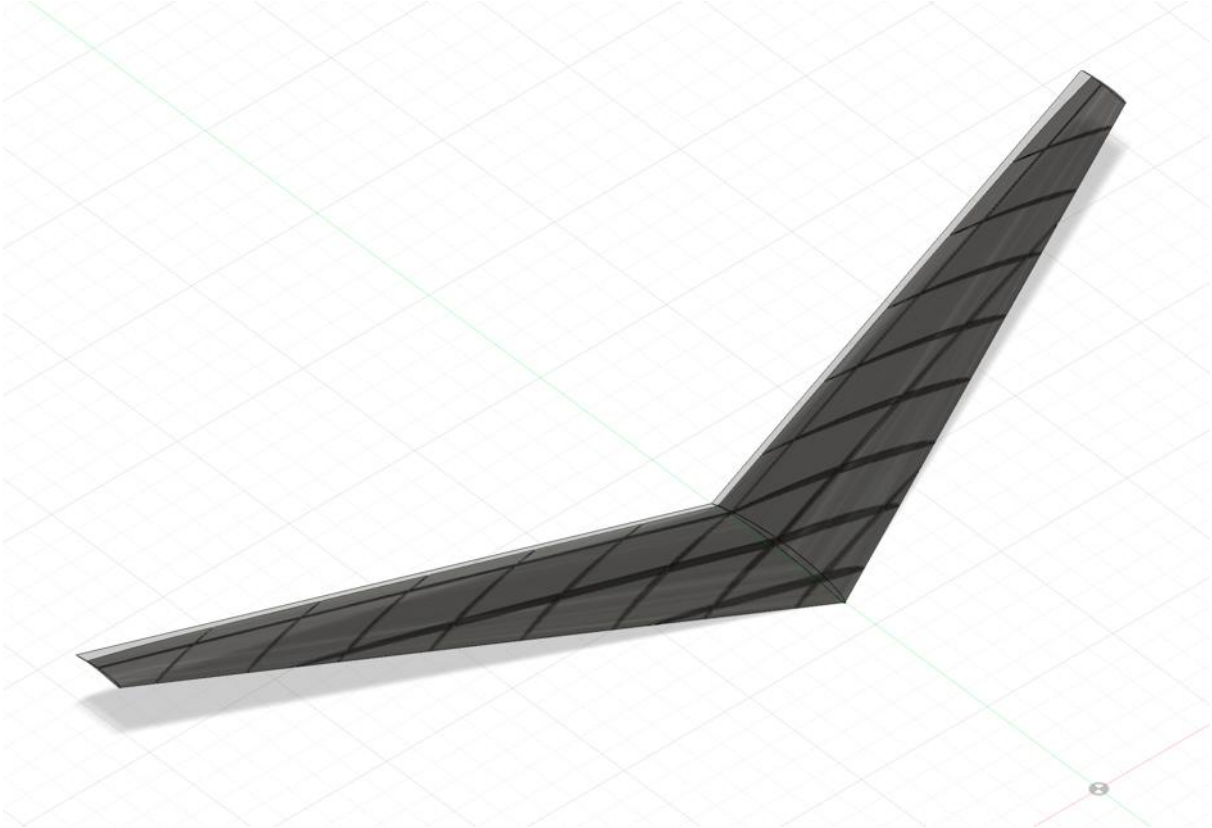


Find the copied one side wing, use shell tool to make a 0.5mm(or 0.45mm) skin.

mirror it then use combine tool join operation to combine the wing skin and the wing ribs.

Step13: Mirror and combine

Now you get your first 3d printable wing

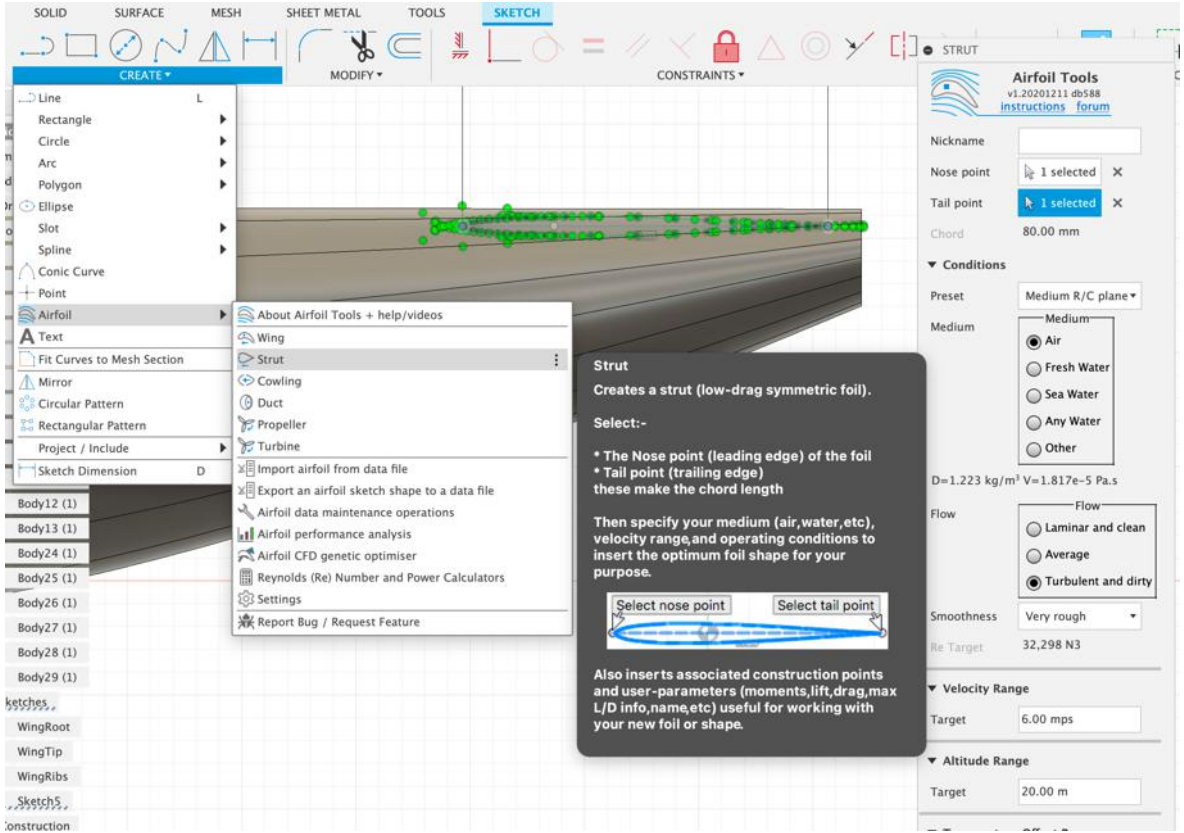


mirror the wing shell you got in the last step then use Modify-Combine tool join operation to combine the wing skin and the wing ribs.

Here I use a different material to show the internal structure.

Step14: Modeling the Tail

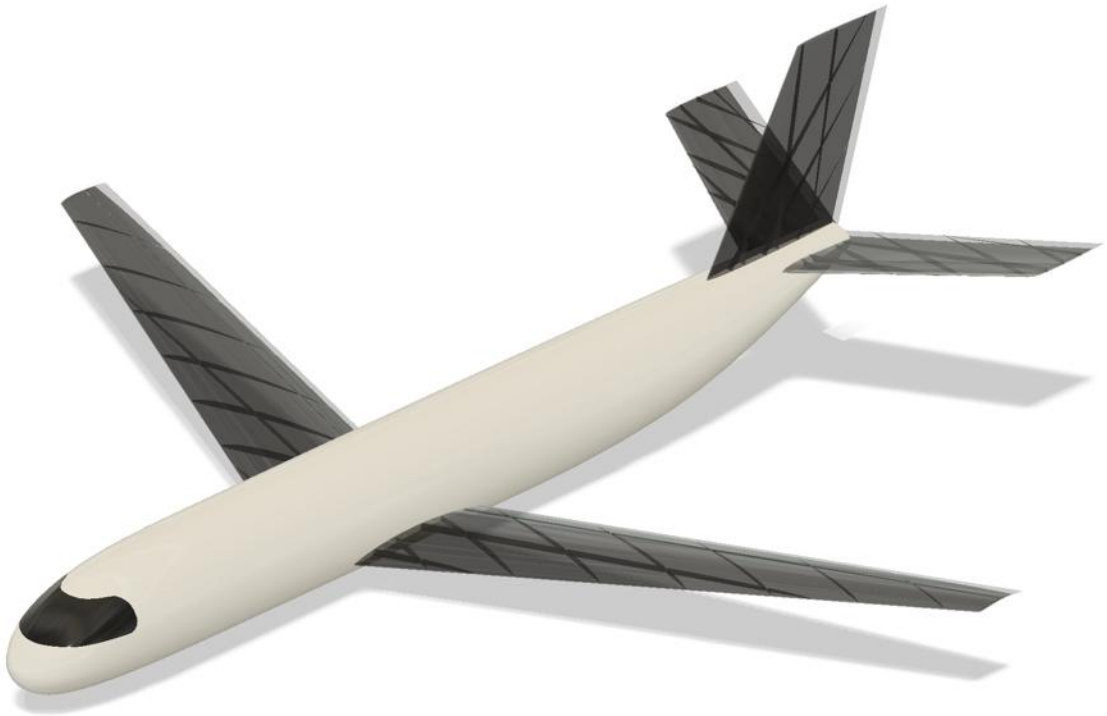
Repeat step 2 – step 13



Usually, plane's stabilizer should have symmetric foil, so we should use the struct tool.

Step15: Finishing the detail

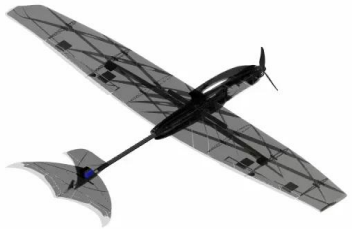
Congratulation!

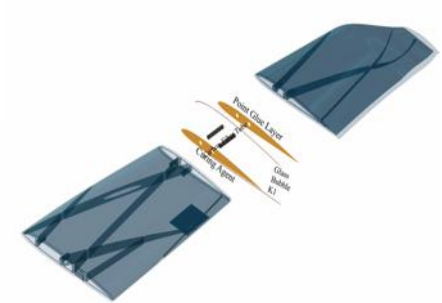


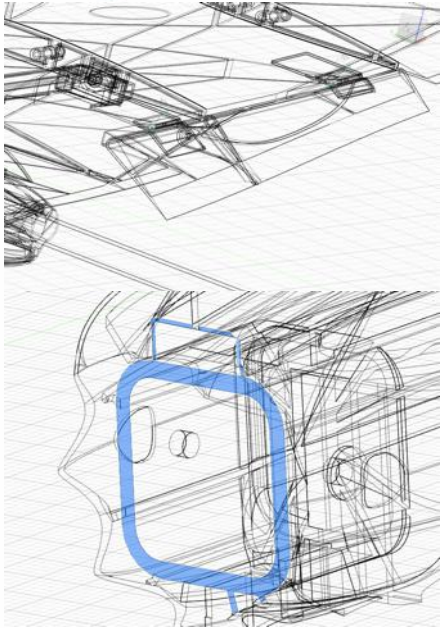
Normal plane’s stabilizer should have symmetric foil, so we should use the struct tool.

Designing The Details

You can model the plane to your will

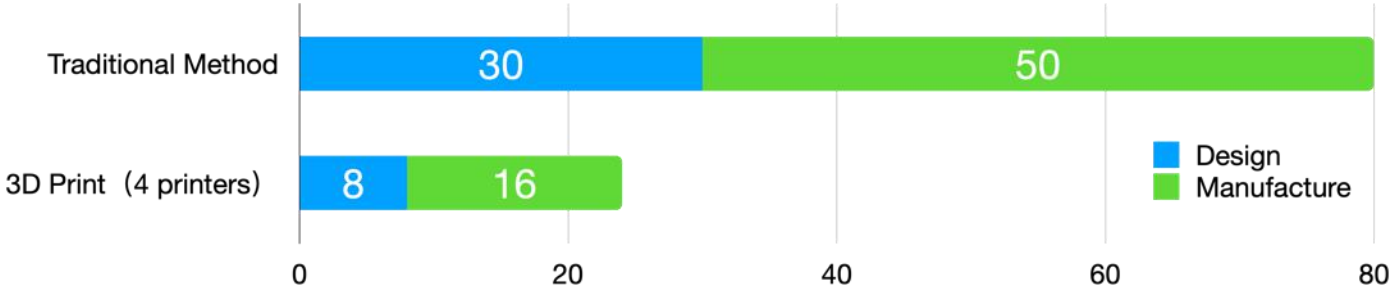






Prototyping

Prototyping Time



Test Flight

AUTODESK UNIVERSITY