

Quad Drone Frame Generative Design

Source:

Autodesk User Manual

<https://www.youtube.com/watch?v=c48wejg4o8Y>

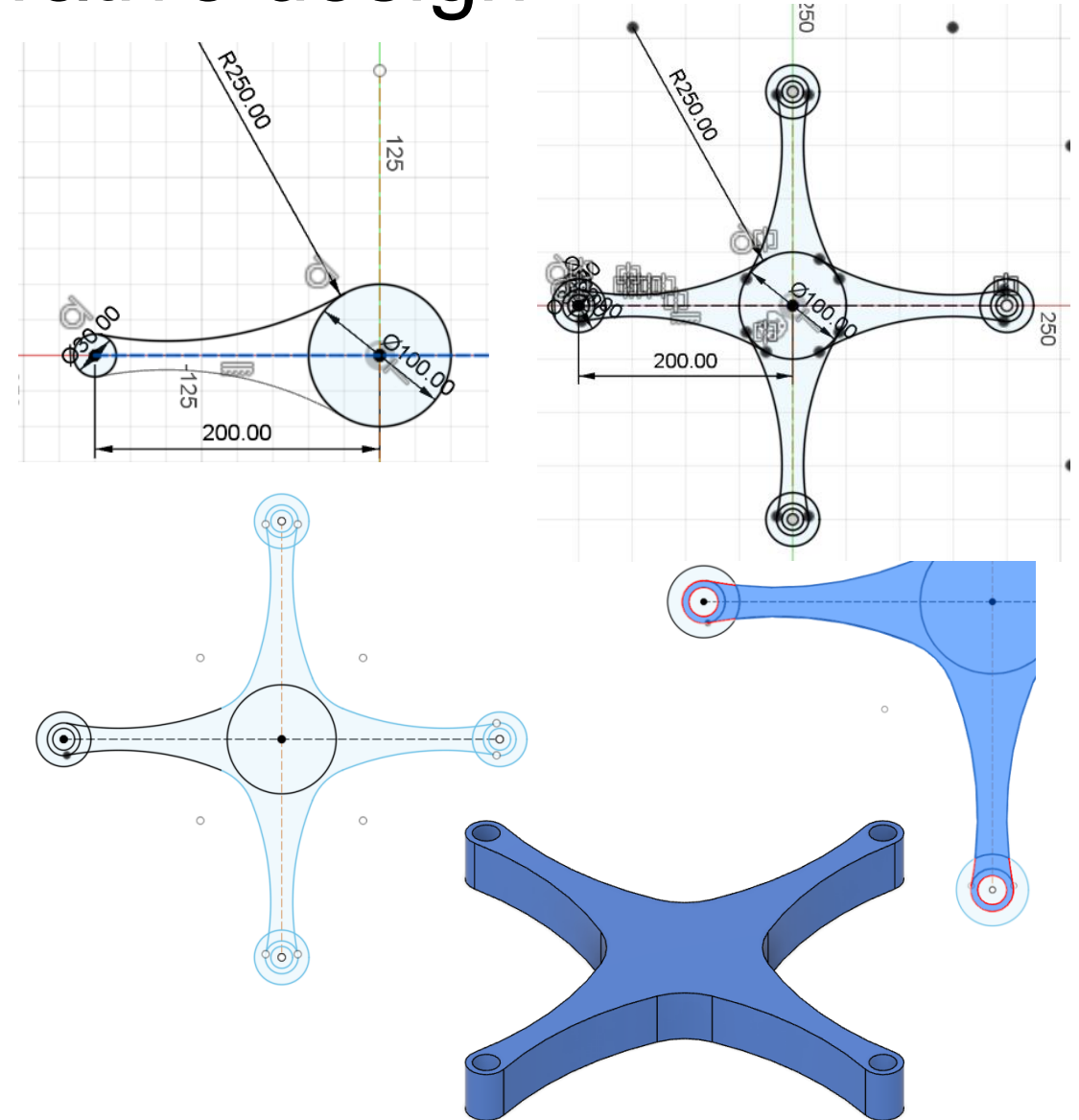
KPR Institute of Engineering and Technology

Generative design

- **Generative design is a computer-aided design (CAD) process that uses generative algorithms to produce a range of possible solutions for a given problem.**
- **The generative design process starts with a set of design criteria and objectives, which are then fed into generative algorithms.**
- **The generative algorithms generate a set of possible solutions for the criteria.**
- **AI can be used to identify the 'optimal' design from the generated solutions.**

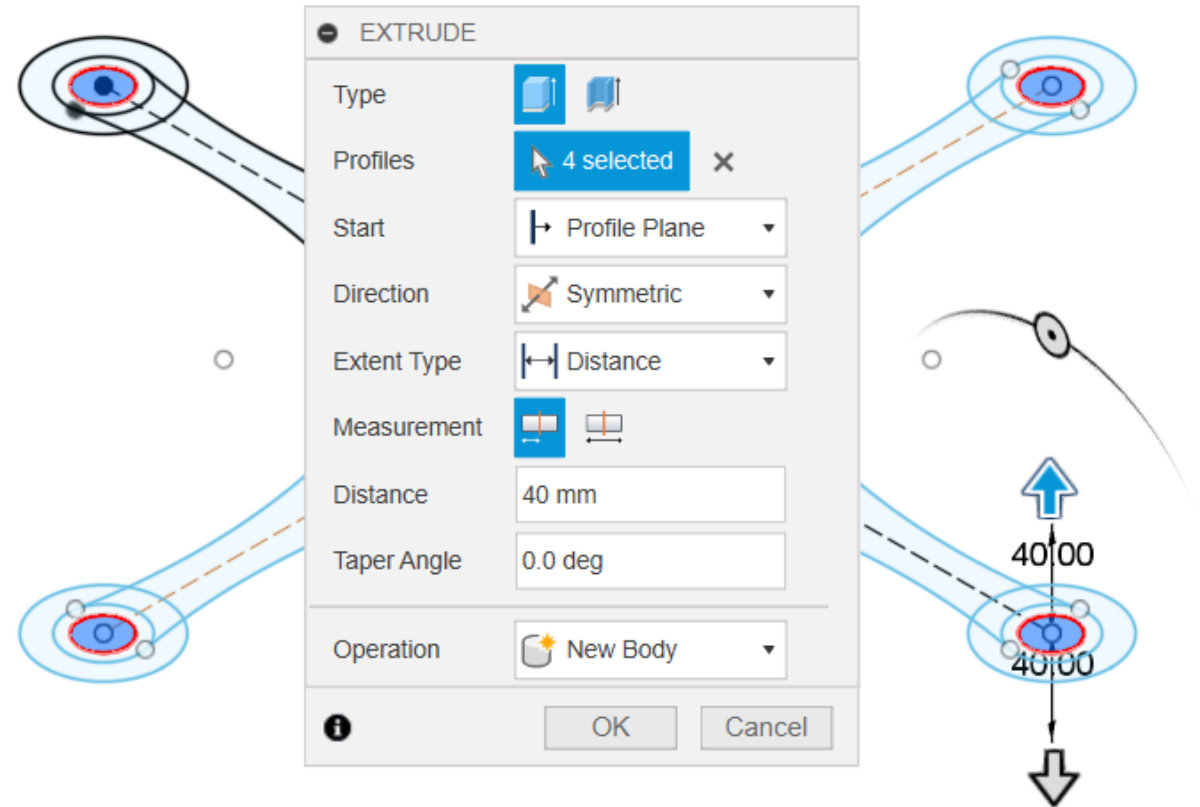
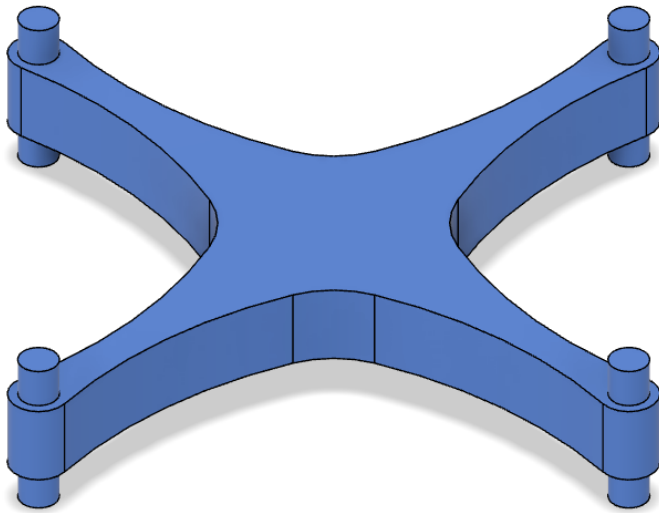
Drone frame generative design

- **Sketch on top plane**
- **400 mm construction lines:** Through **origin perpendicular** to each other.
- **Circles** of 100 (origin), 30 D. along the **-X-axis** 200 apart.
- **3 point arc of 250mm R** touching the two **circles tangentially**.
- **Mirror** of the **arc** about the **center line**.
- **Circles** of 20, 50 mm **concentric** to 30mm circle.
- **4 circular pattern** of the **3 concentric circles** & the **arcs** connecting the 30mm and 100mm circles **about the center** of 100 mm circle.
- **Trim** the intersecting line portion making contact with the 100mm circle and use 50 mm **fillet** to smoothen the sharp line intersections.
- **Extrude symmetrically** by 20 mm **excluding** the concentric **inner and outer 4 sets of circles** as **new body**.



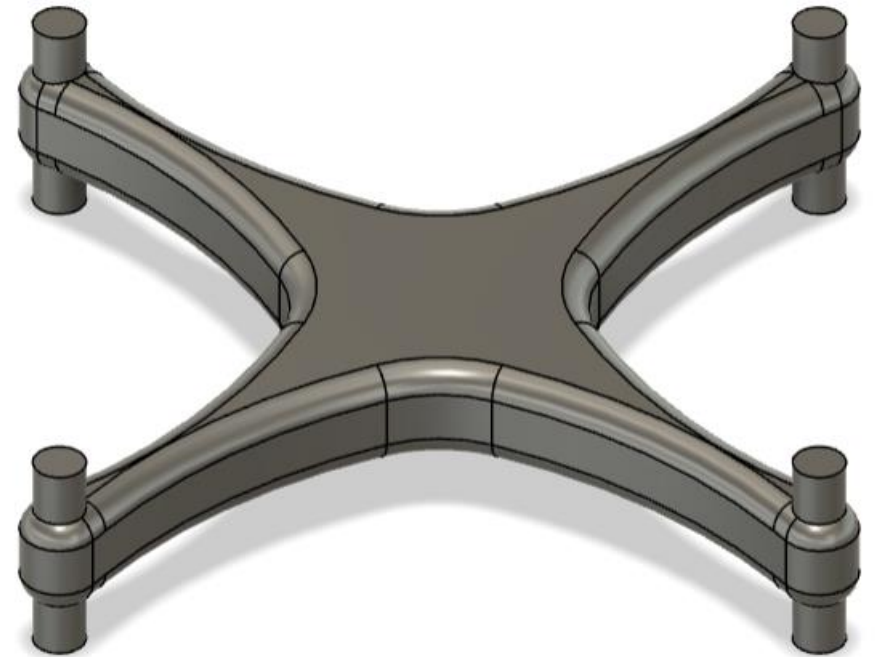
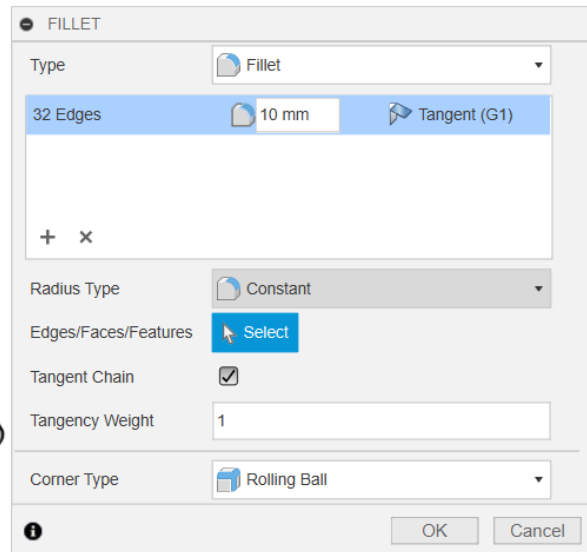
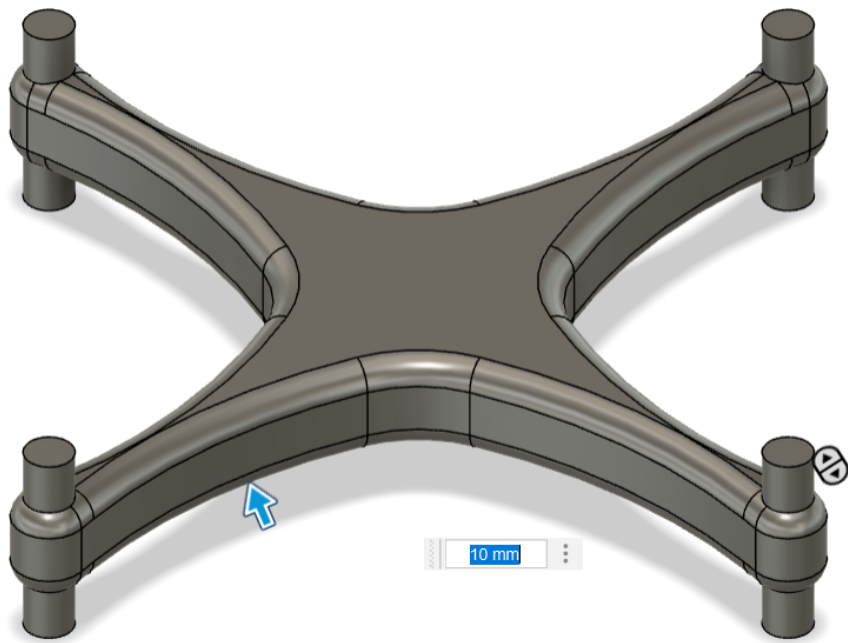
Drone frame generative design

- **Activate** the sketch.
- **Extrude** the **4 inner circles** symmetrically to 40 mm, operation as **new body**.



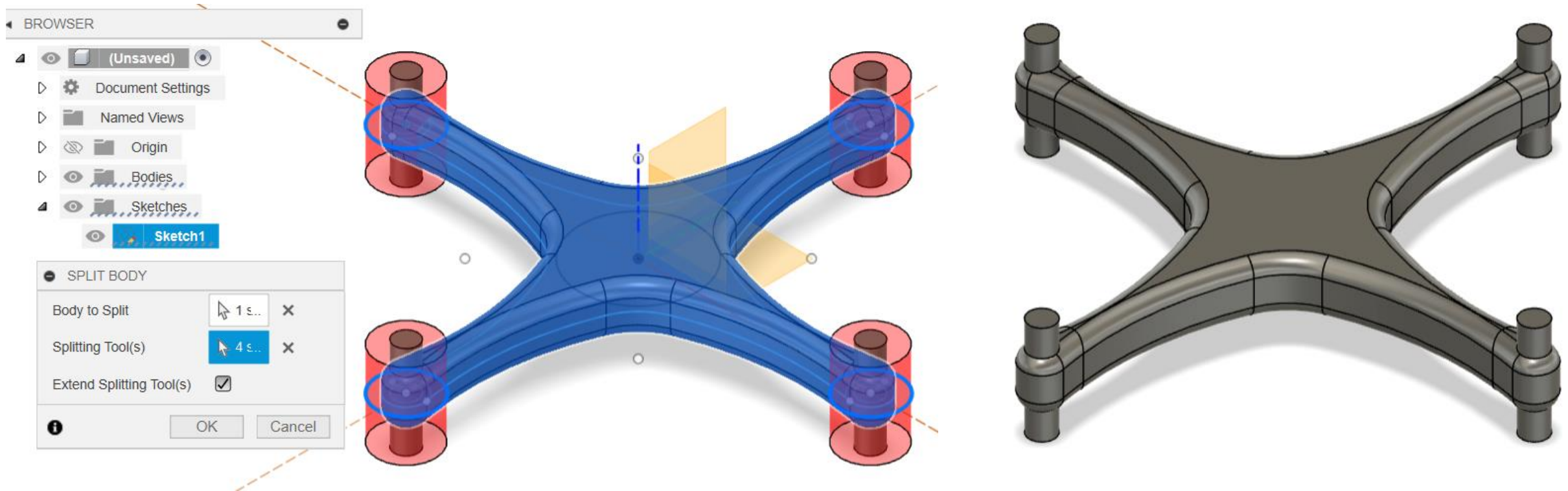
Drone frame generative design

Fillet, select 32 edges and 5 mm radius to **smoothen the edges**

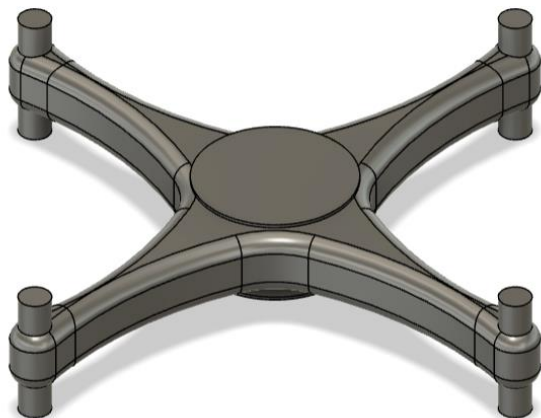
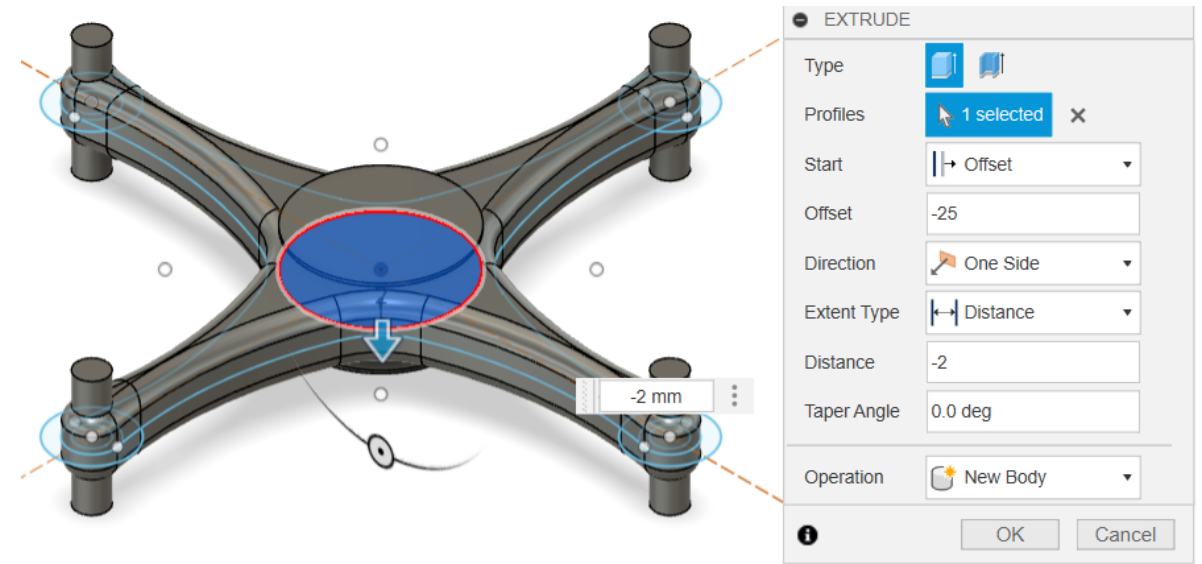
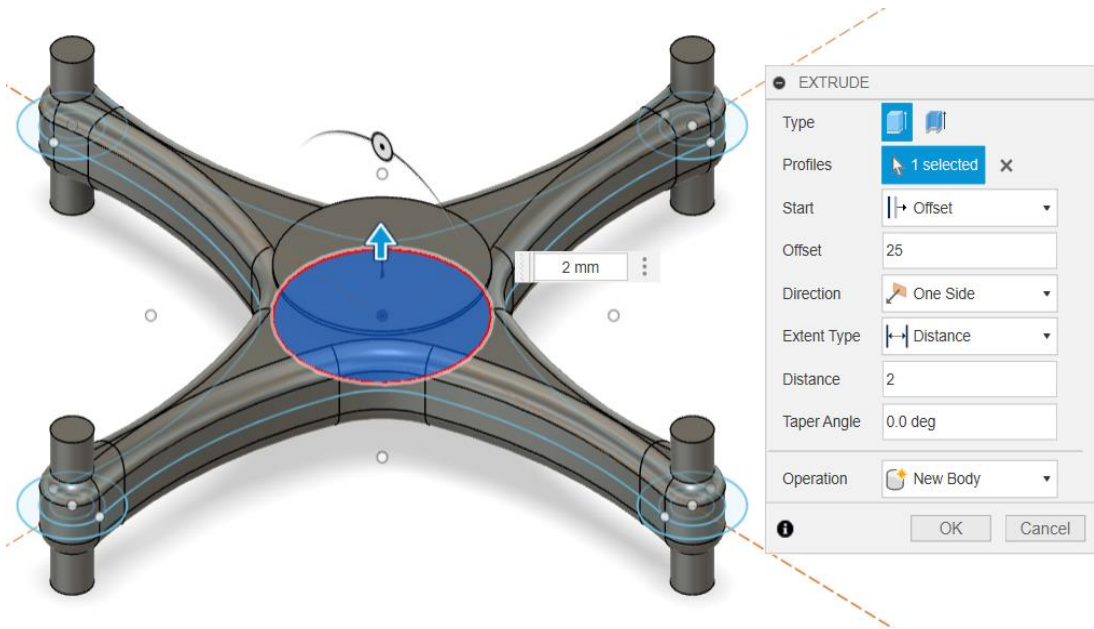


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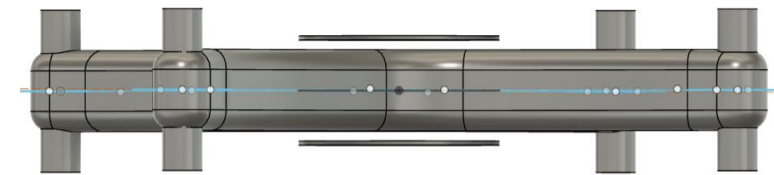
Use **split body** tool. Select **main body** to split.
Select **4 outer circles** as splitting tools.
Extend splitting tool.



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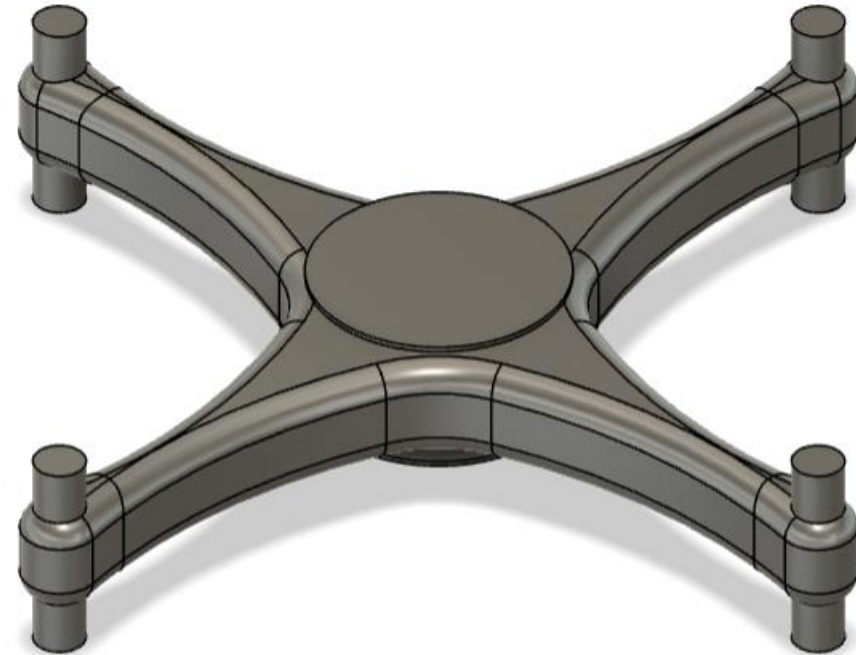
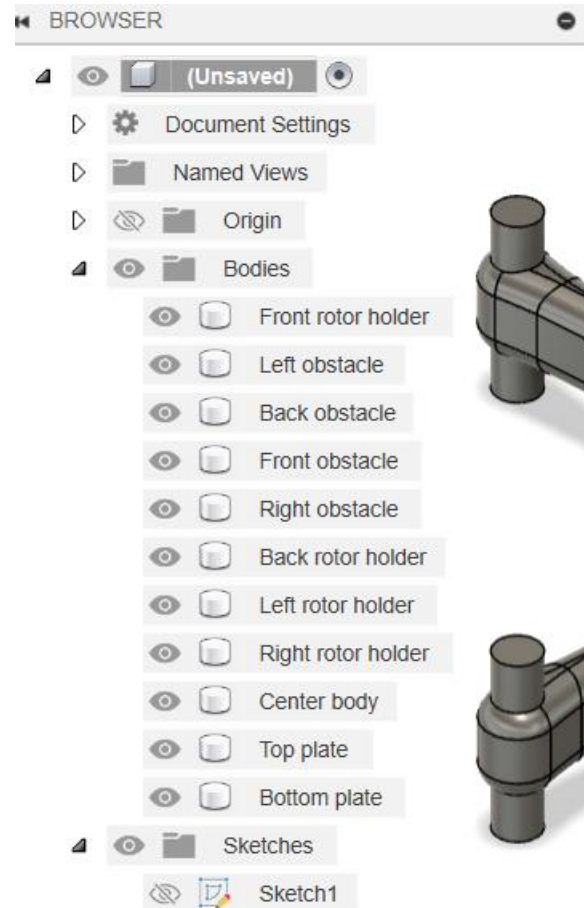
Extrude center circle twice.
Offset by 25 and -25 mm.
Thickness of 2 and -2 mm.
Operation: New Body



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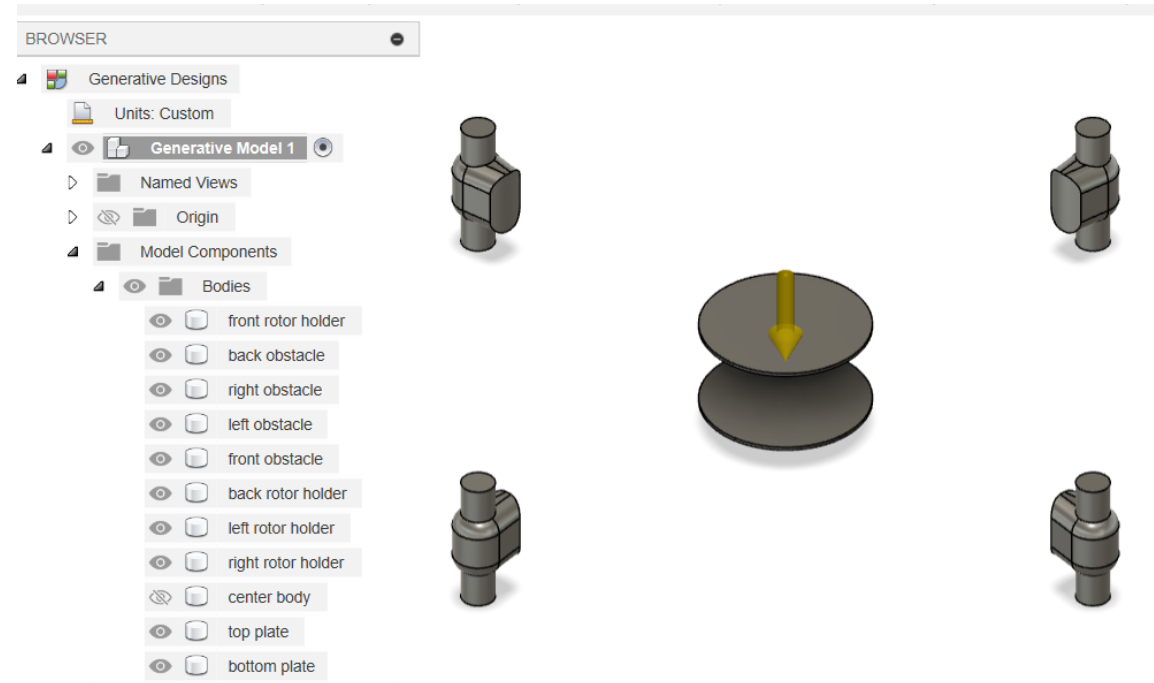
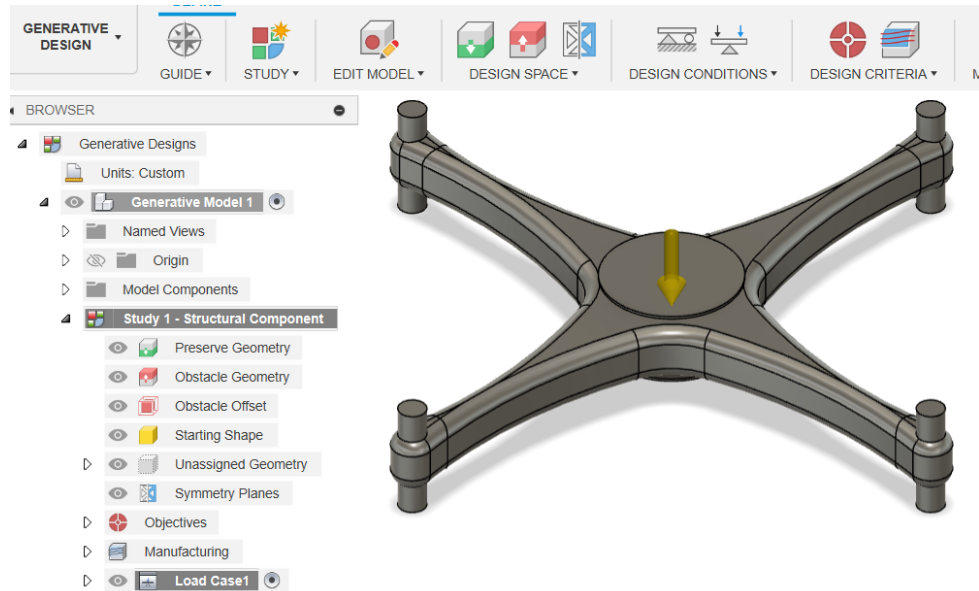
Rename the bodies as

1. Front rotor holder
2. Left rotor holder
3. Right rotor holder
4. Back rotor holder
5. Front obstacle
6. Left obstacle
7. Right obstacle
8. Back obstacle
9. Center body
10. Top plate
11. Bottom plate



Drone frame generative design

From the **Design** drop down menu
Select **generative design**

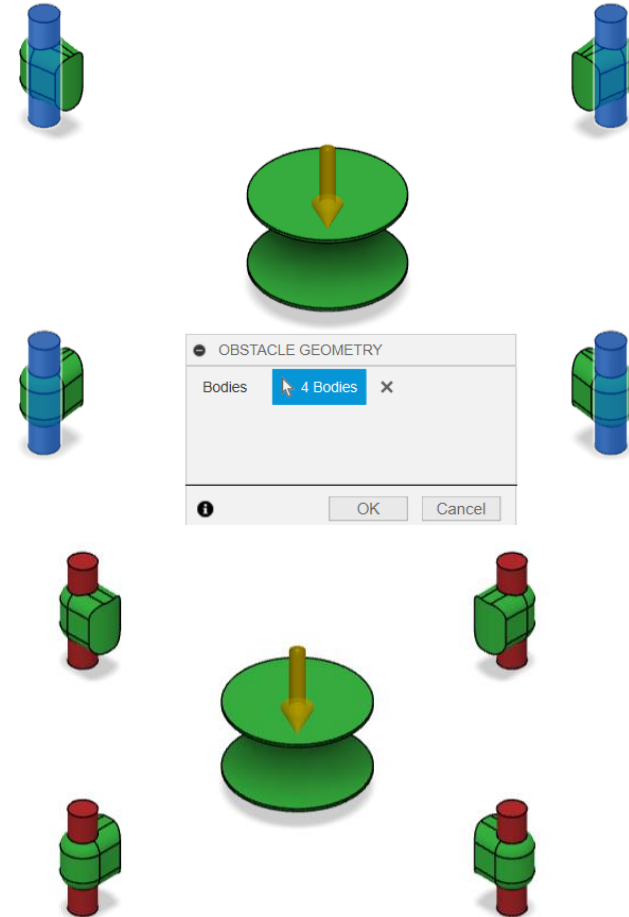
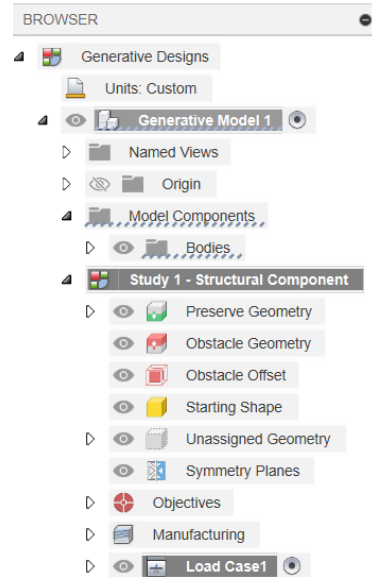
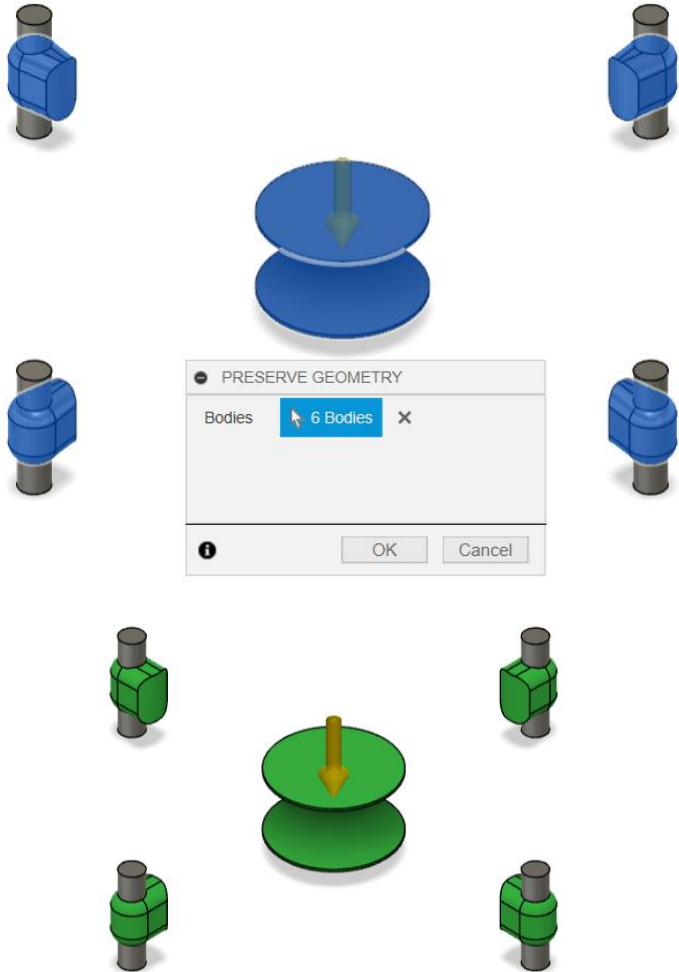


Expand **model components**
From **bodies** **inactivate center body**

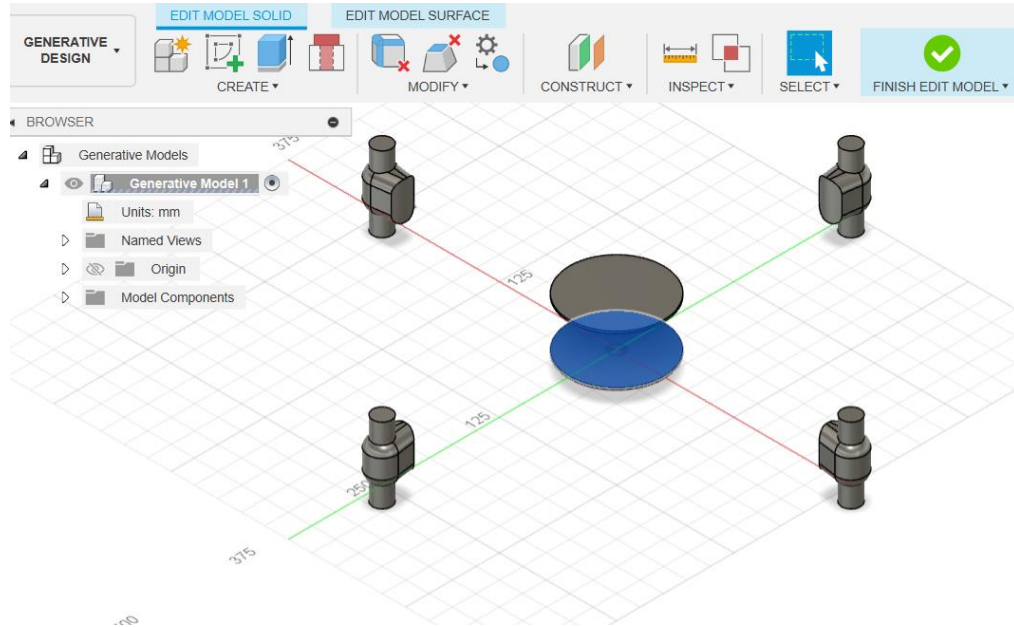
Drone frame generative design

Select **preserve geometry**
Select **rotor holders, top & bottom plates**

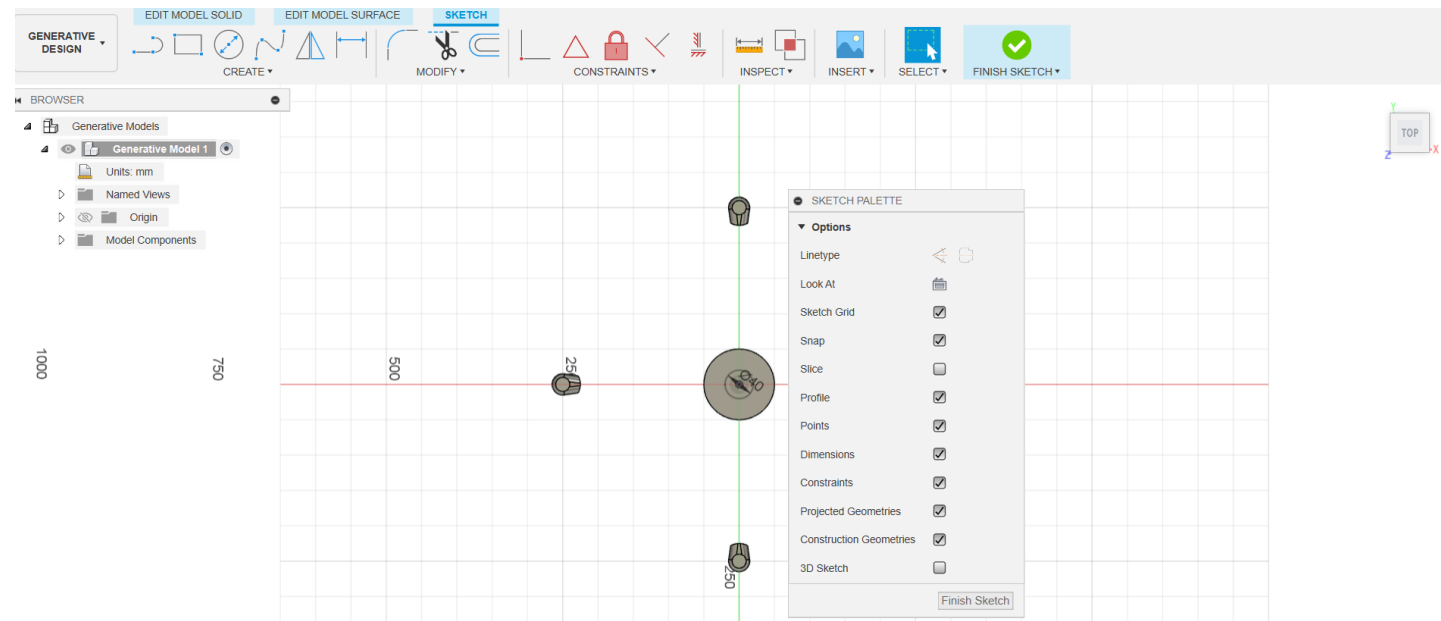
Select **obstacle geometry**
Select **4 rotors as obstacle bodies**



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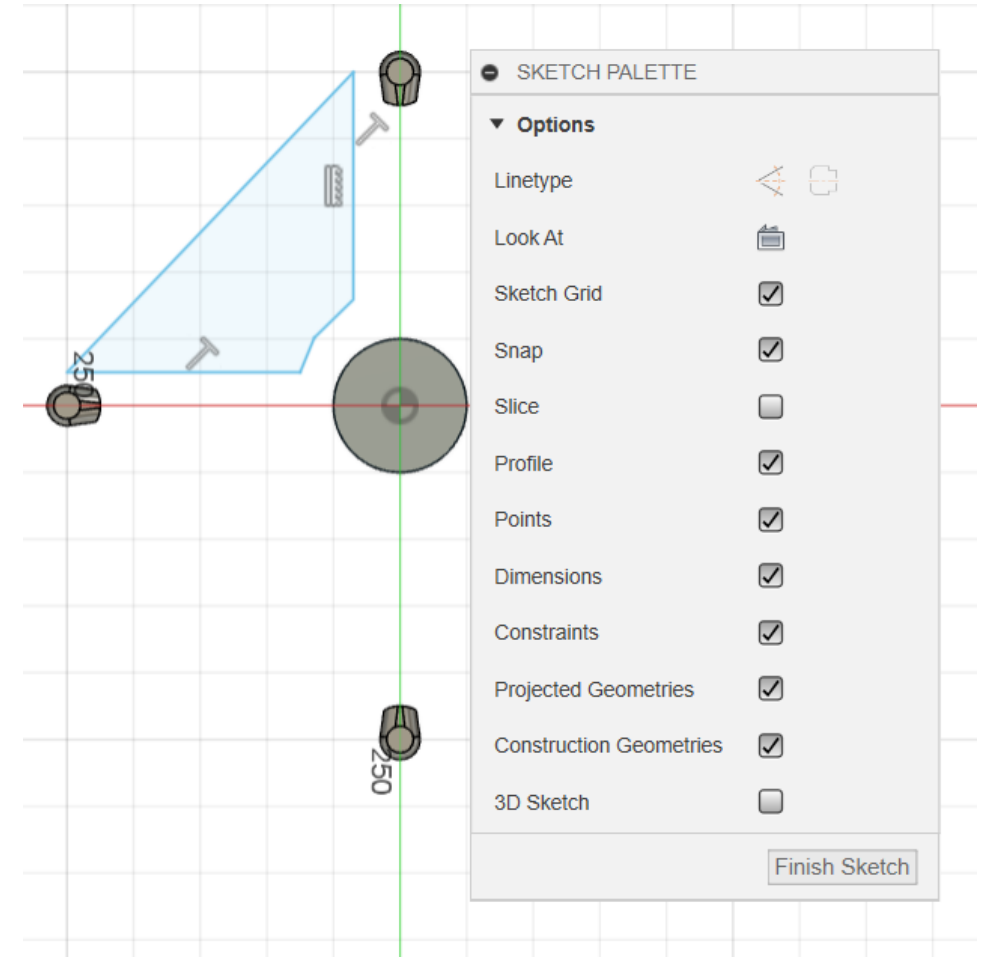
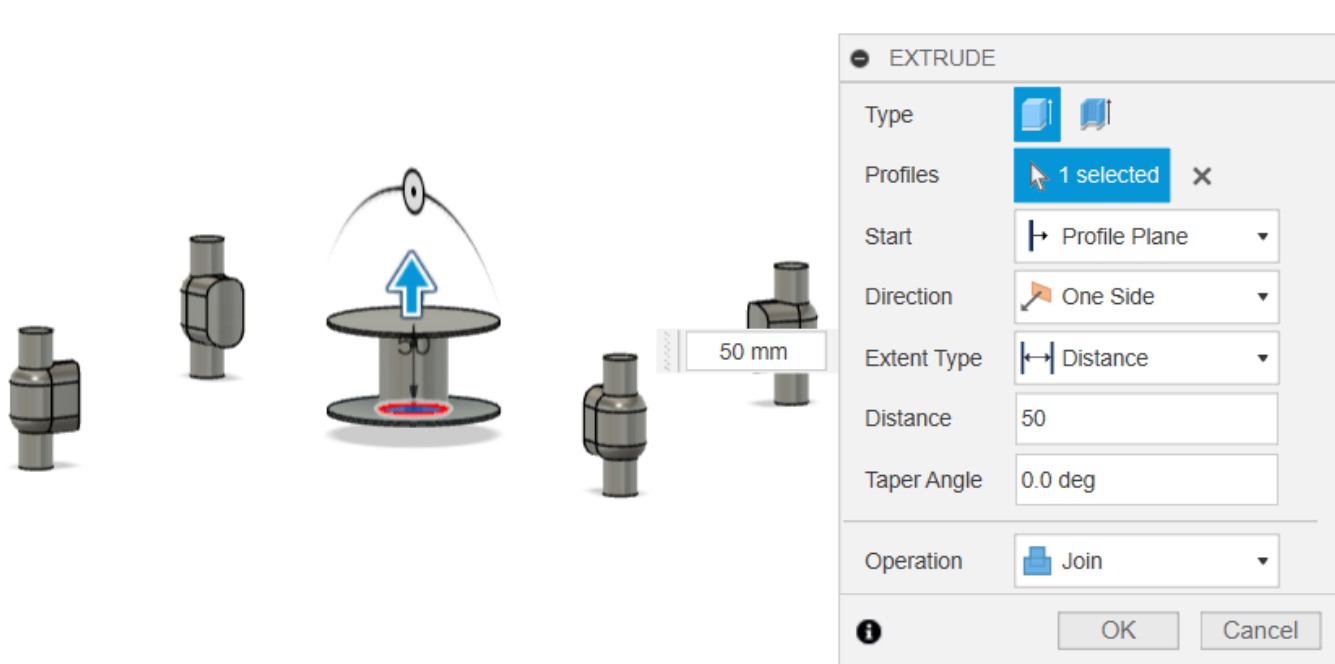
Edit model, **edit model solid**.
Create **sketch** on **top face** of **bottom plate**.



Create **circle** of 40mm dia.

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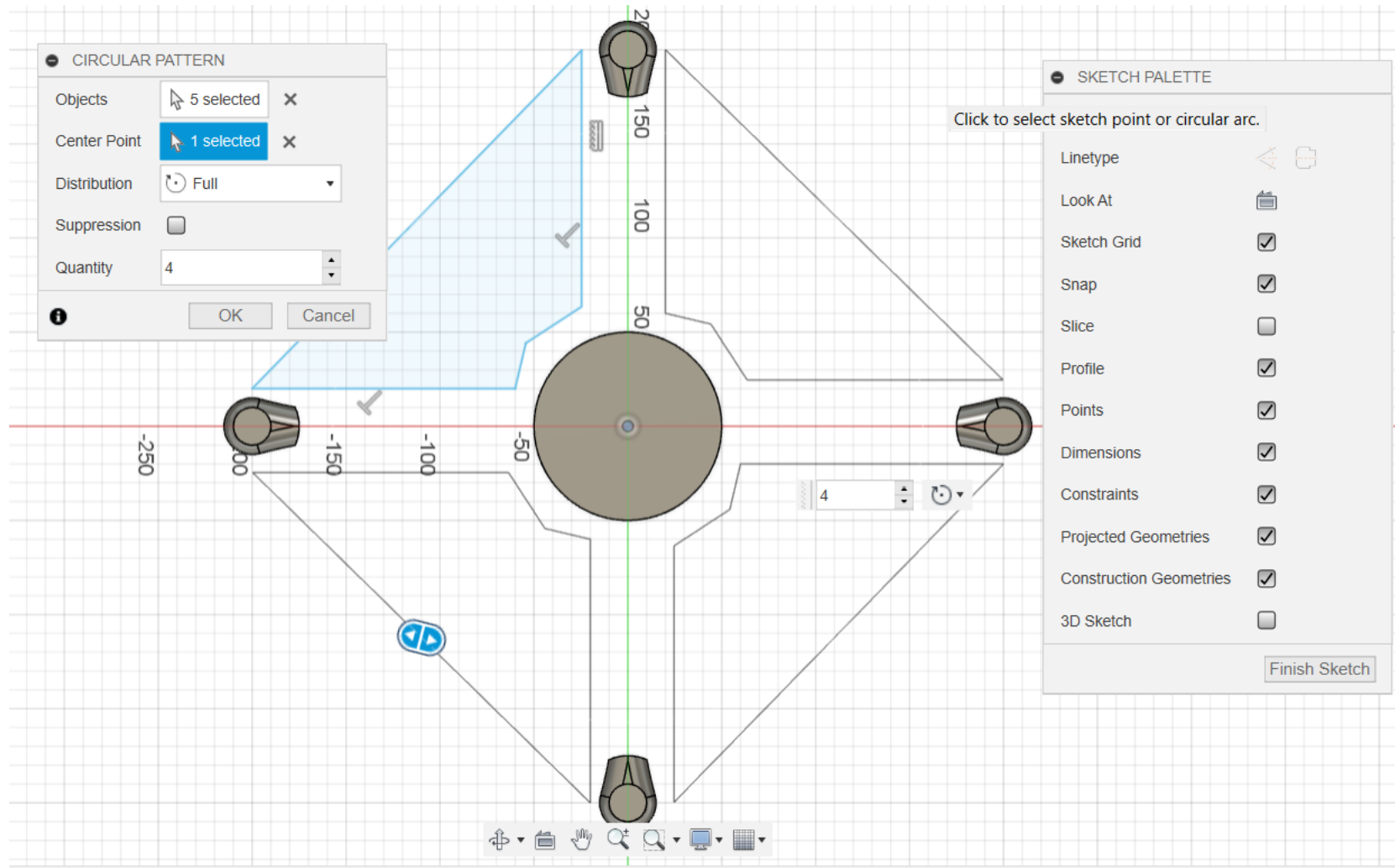
Extrude the **circle** by 50mm as **join** operation



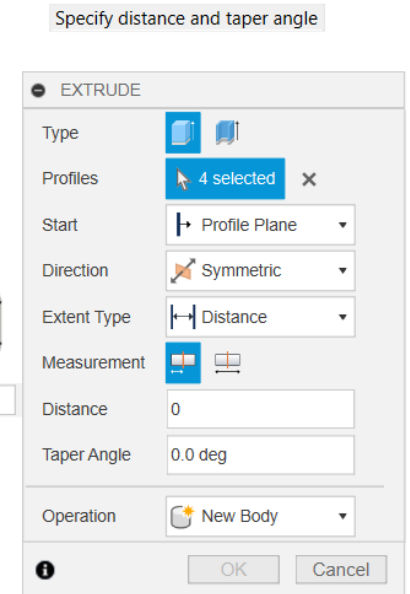
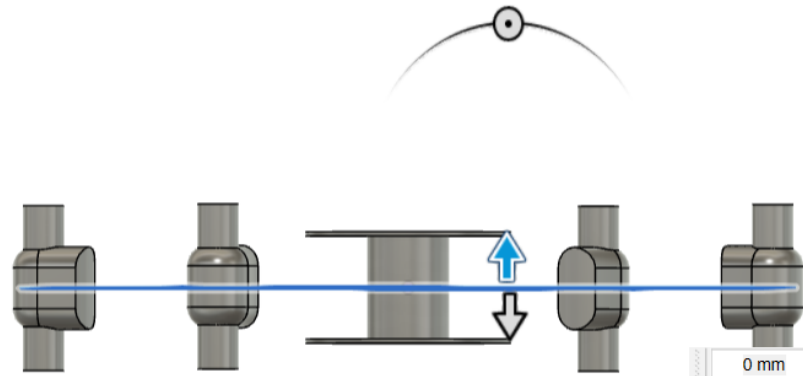
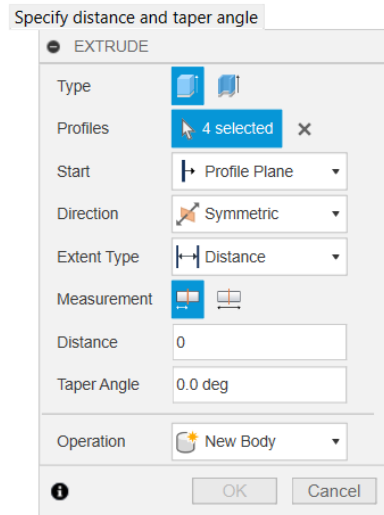
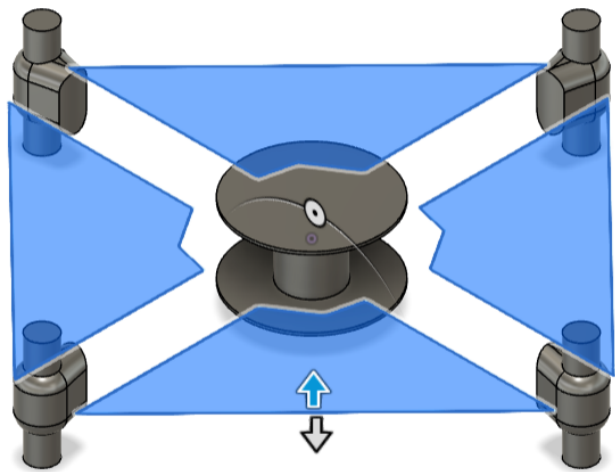
Create **sketch** on the **top plane** as shown

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Create **4 circular pattern** of the sketch about the **center**

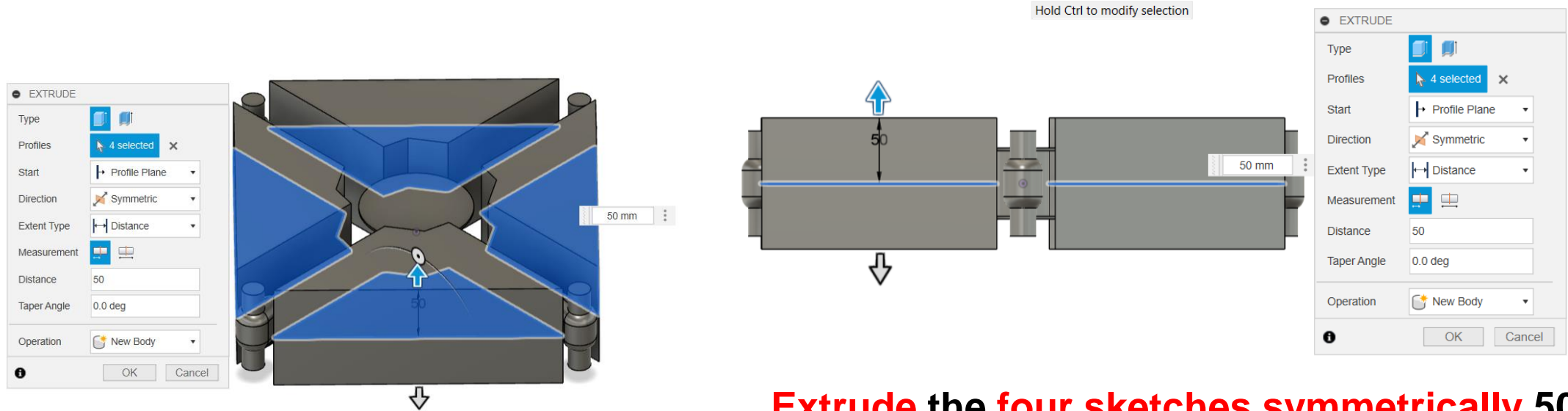


Drone frame generative design

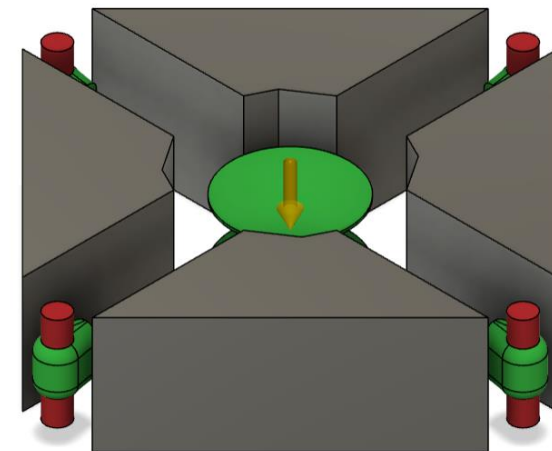
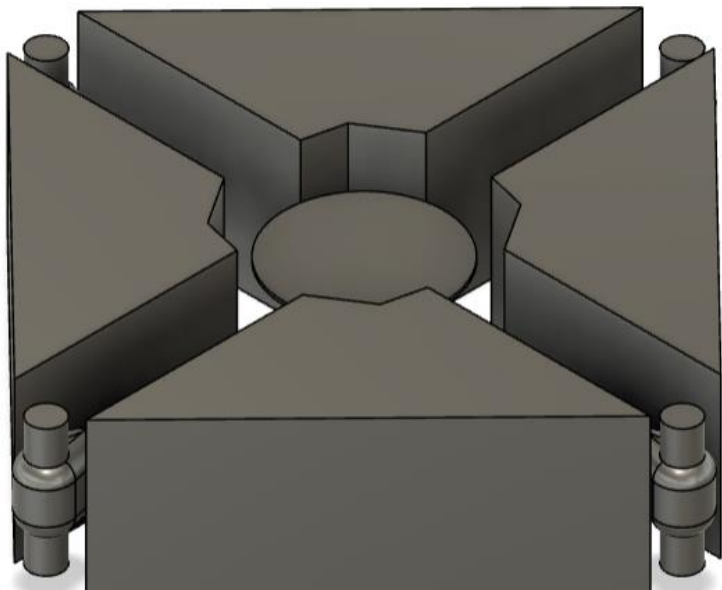


Extrude the four sketches symmetrically

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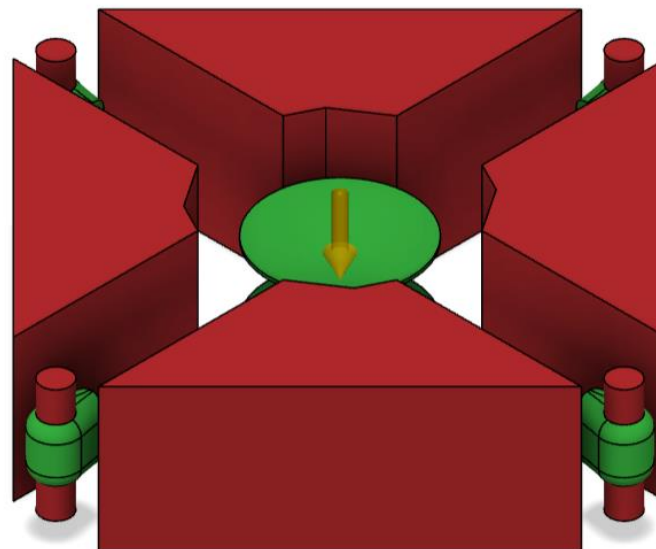
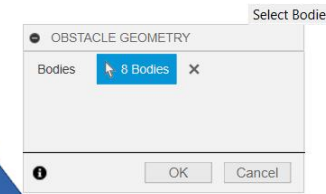
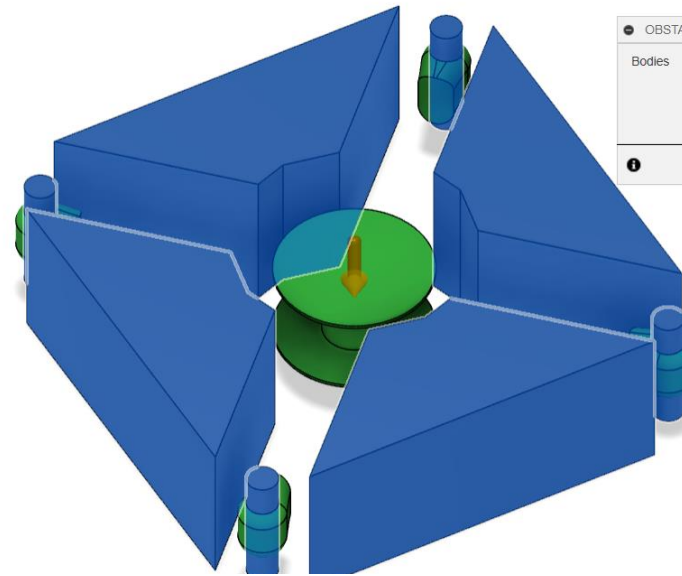
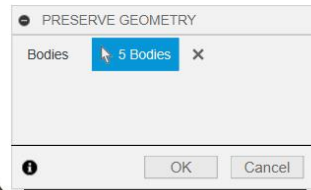
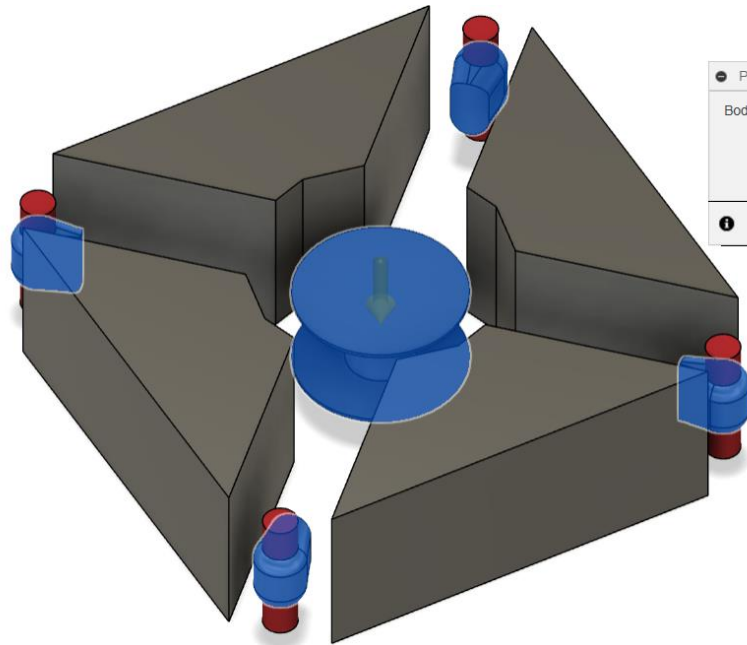


Extrude the four sketches symmetrically 50 mm
Select the operation as new body
Finish edit model



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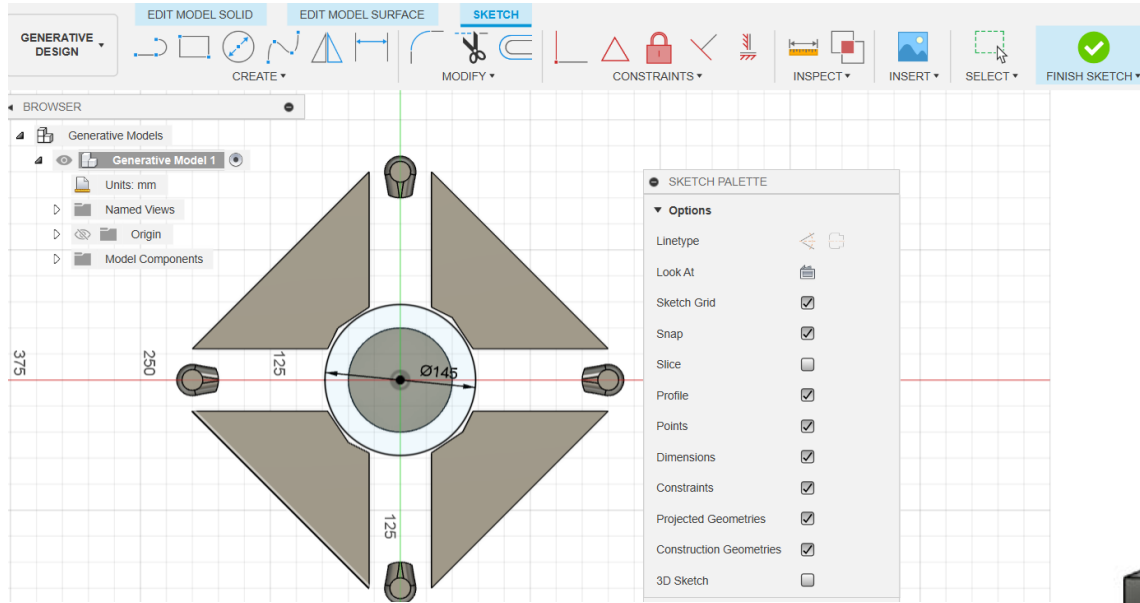
Preserve the geometry bodies the same



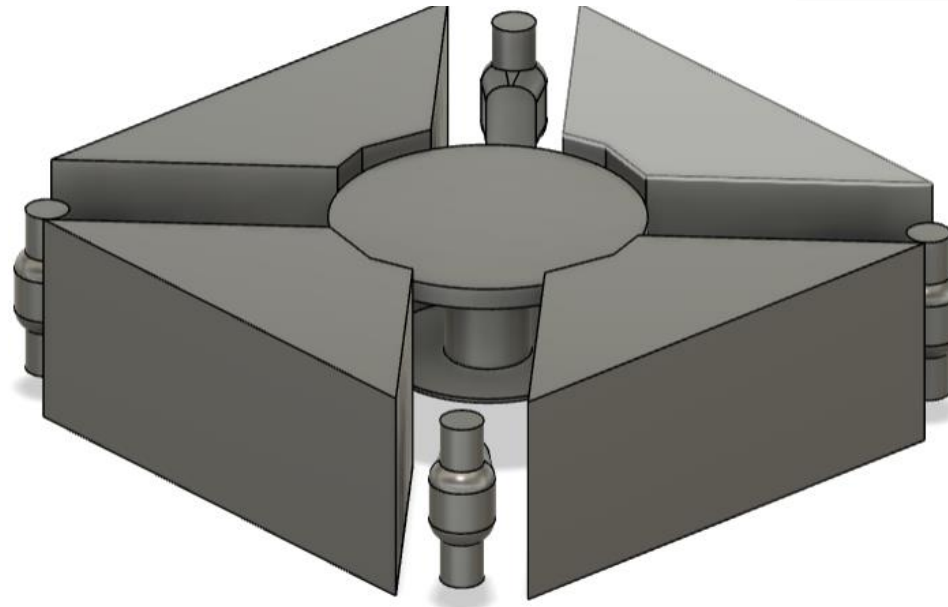
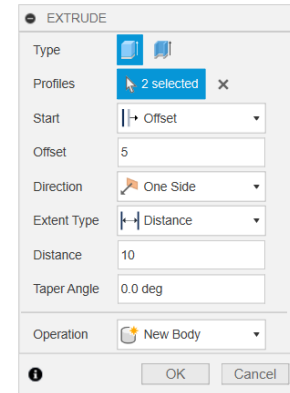
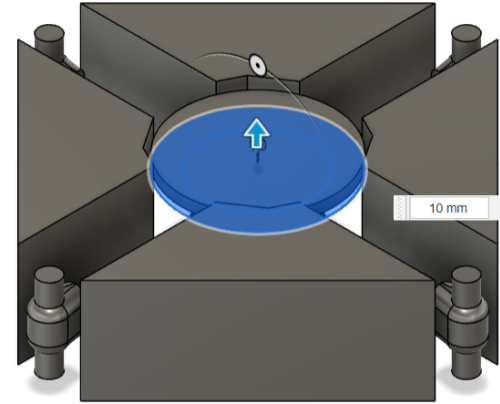
**4 new bodies as
obstacle
geometry, 8 in
total**

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Extrude the **two circle** 145 and 100mm
Offset 5mm, **distance** 10 mm as **new body**

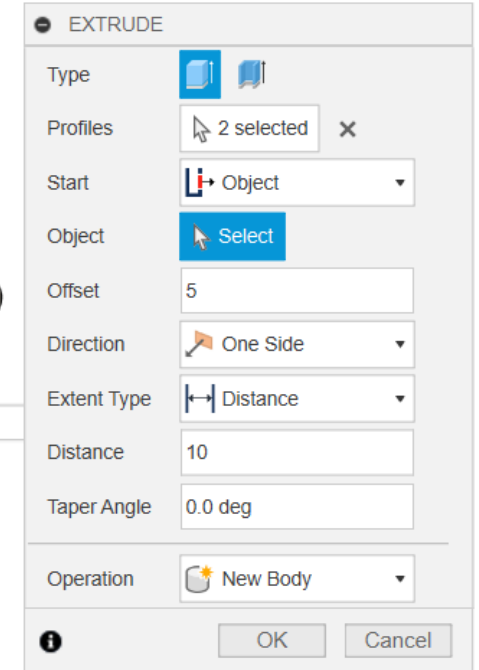
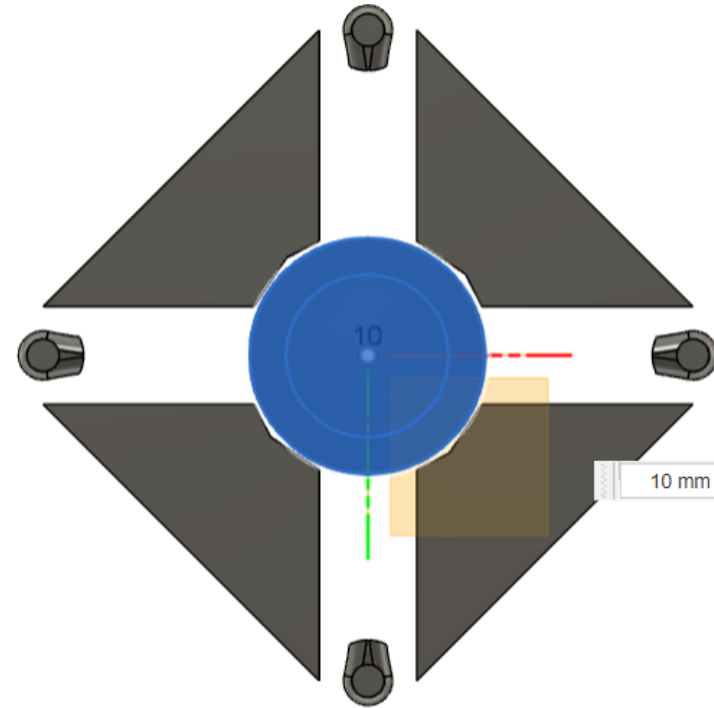
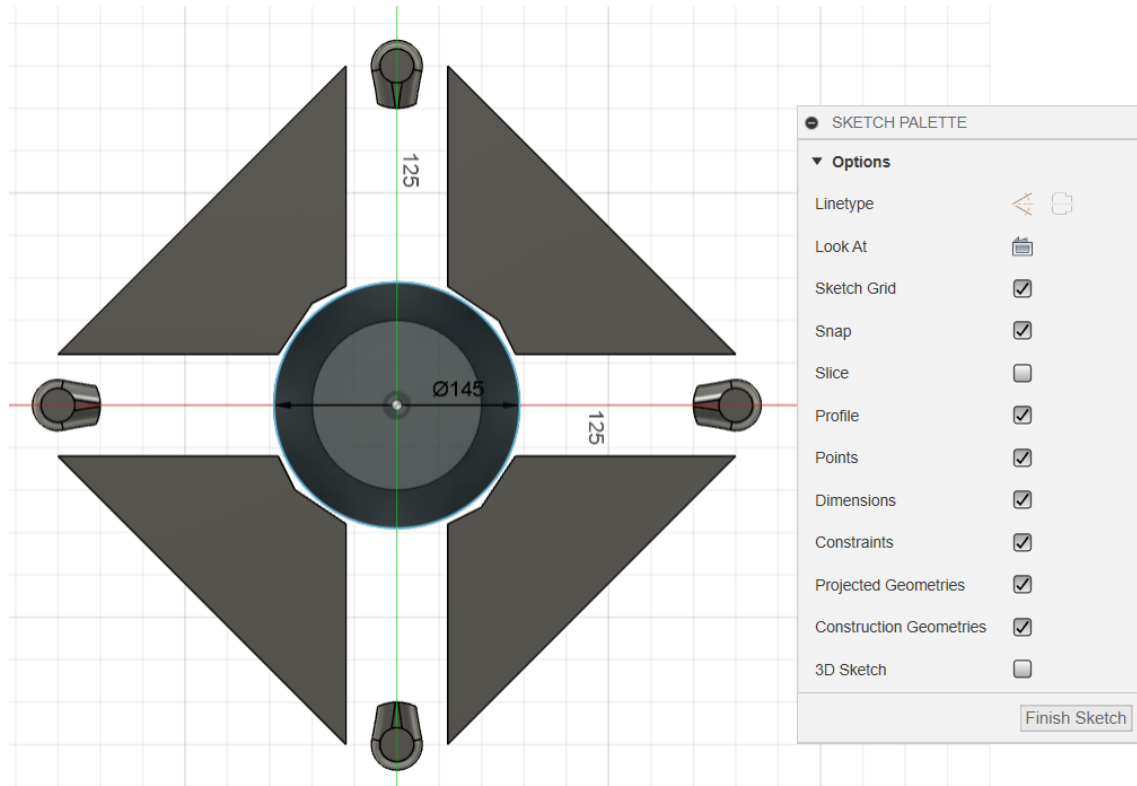


Edit the model
On the **face (top plane)** of the
100 mm circle
Sketch approx. 150mm circle.



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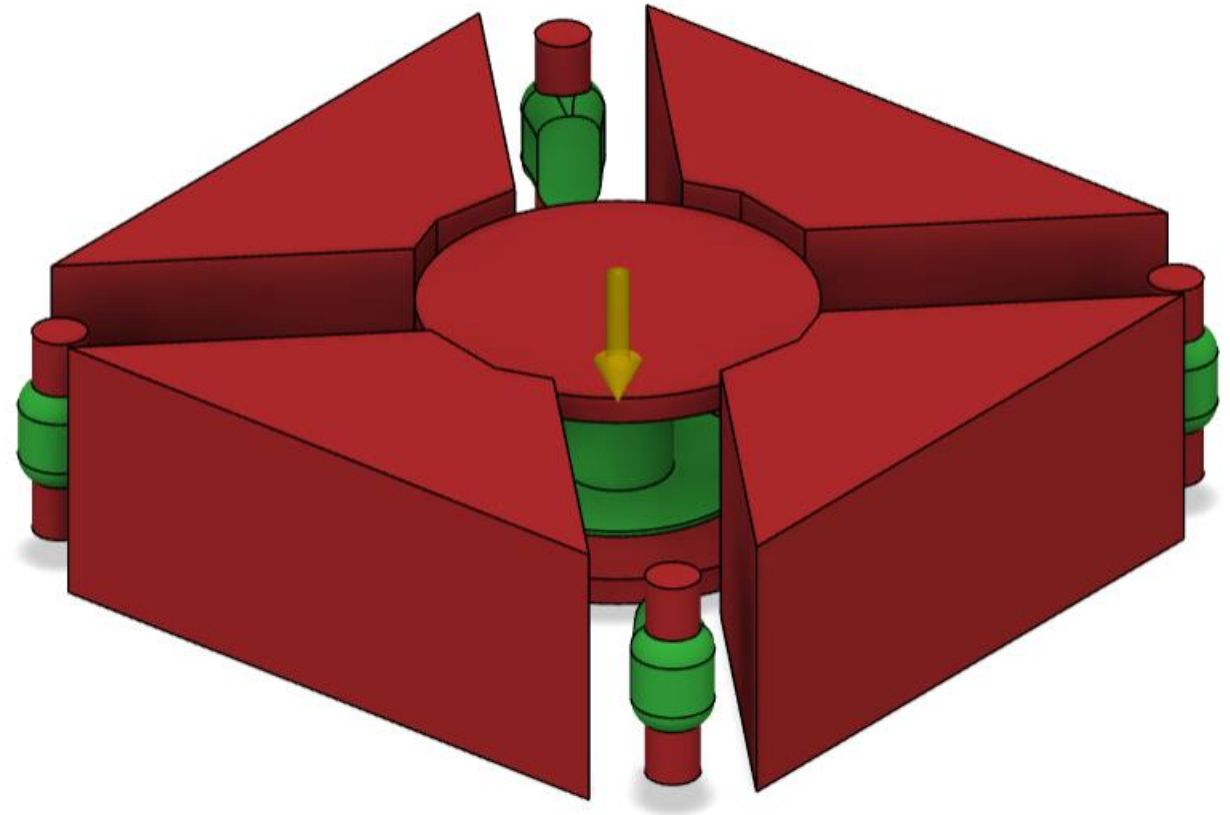
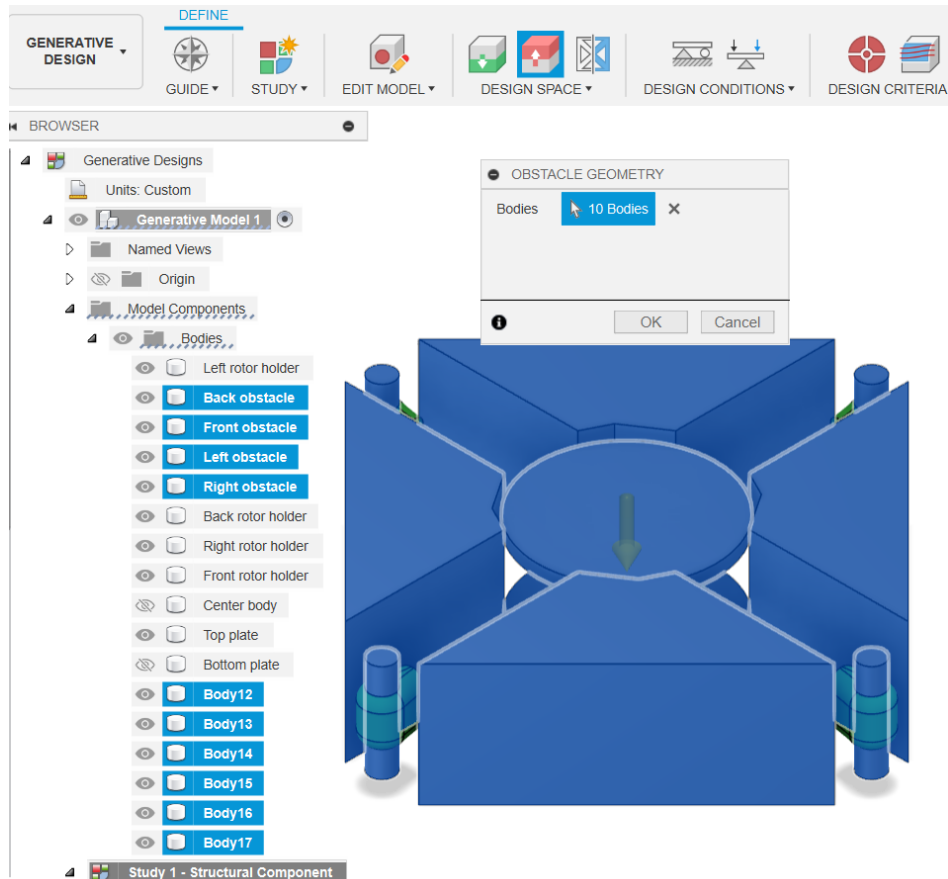
Repeat the create **sketch** and **extrusion** from the **bottom circle face** as **new body**.



Drone frame generative design

Finish edit model

Add the two circular bodies as obstacle geometry



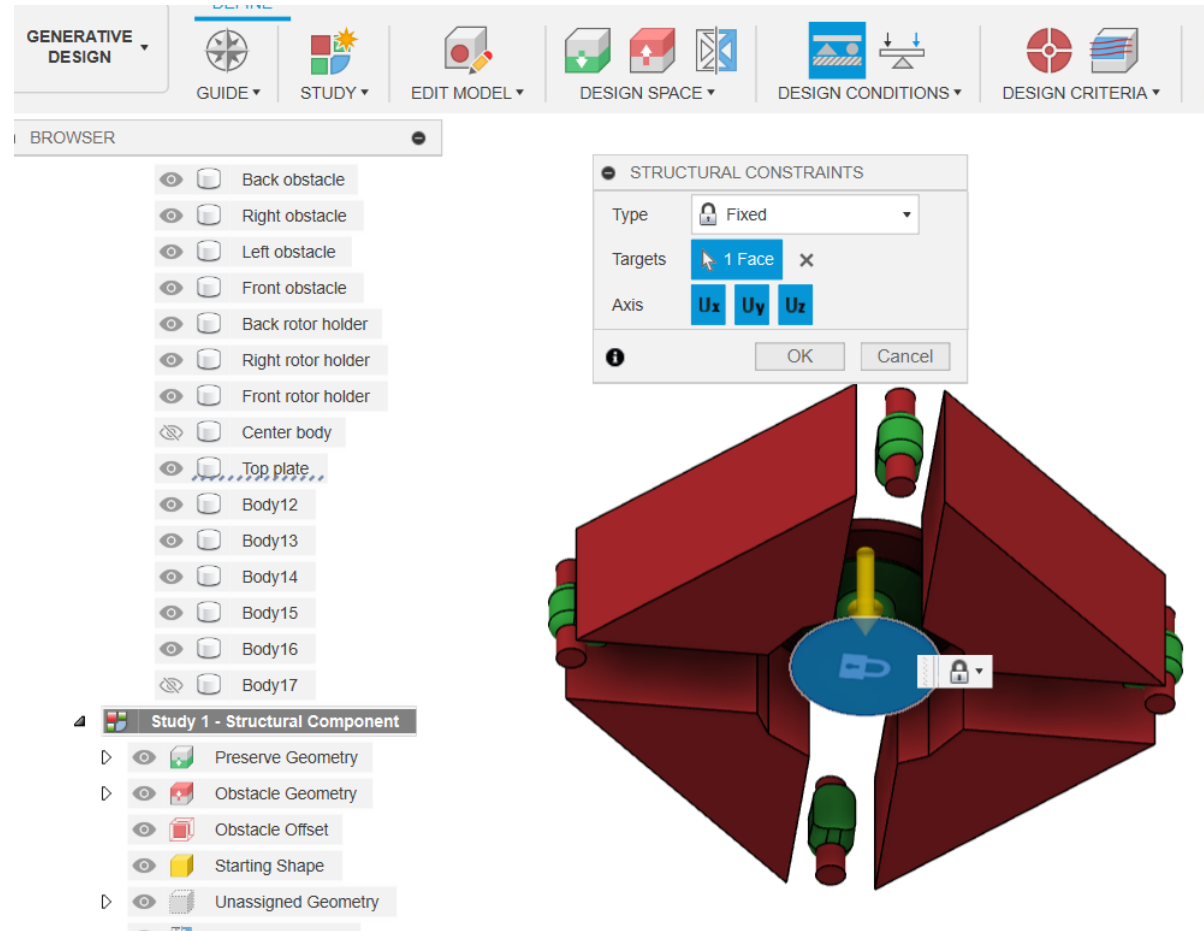
Drone frame generative design

Select **structural constraint** from **design conditions**.

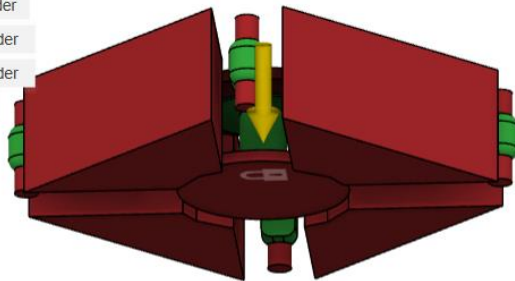
Inactivate body17 (bottom circular obstruction)

Select the **bottom plate face** as **fixed constraint**.

Activate all bodies except center body.



- Back obstacle
- Right obstacle
- Left obstacle
- Front obstacle
- Back rotor holder
- Right rotor holder
- Front rotor holder
- Center body
- Top plate
- Body12
- Body13
- Body14
- Body15
- Body16
- Body17

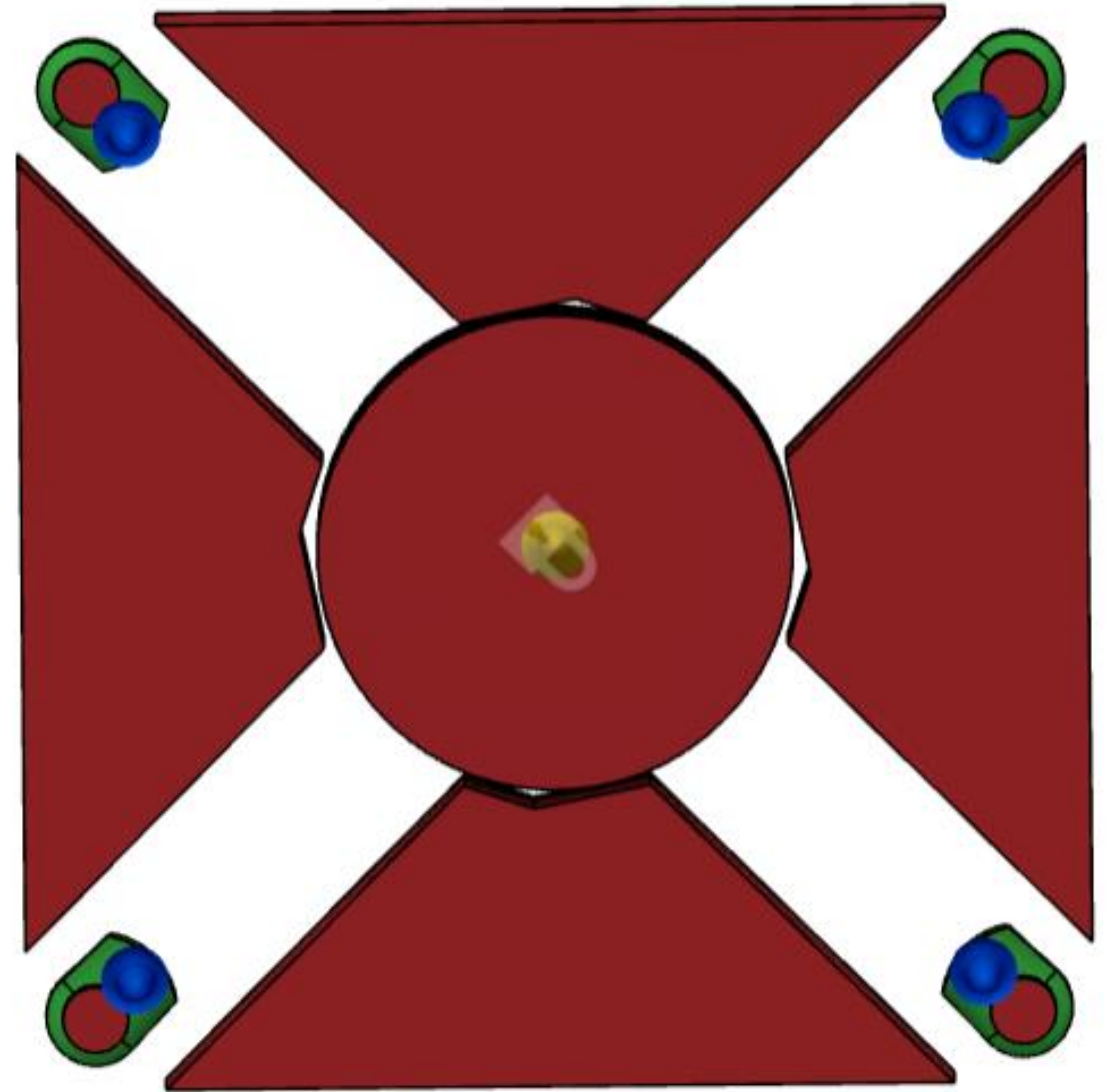
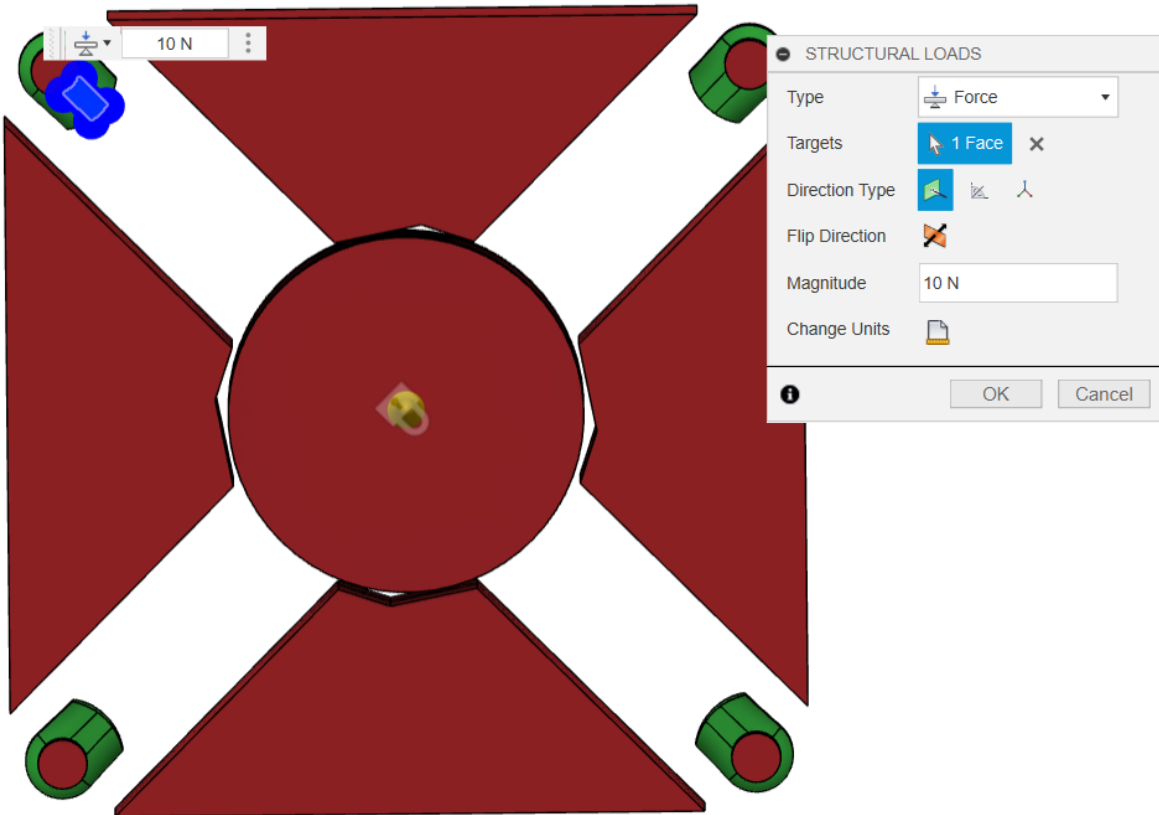


Drone frame generative design

Select **bottom face** of the **rotor holder** for **structural loads**.

Select 10 N as the **force**.

Repeat the same for the other **3 rotor holder face**.

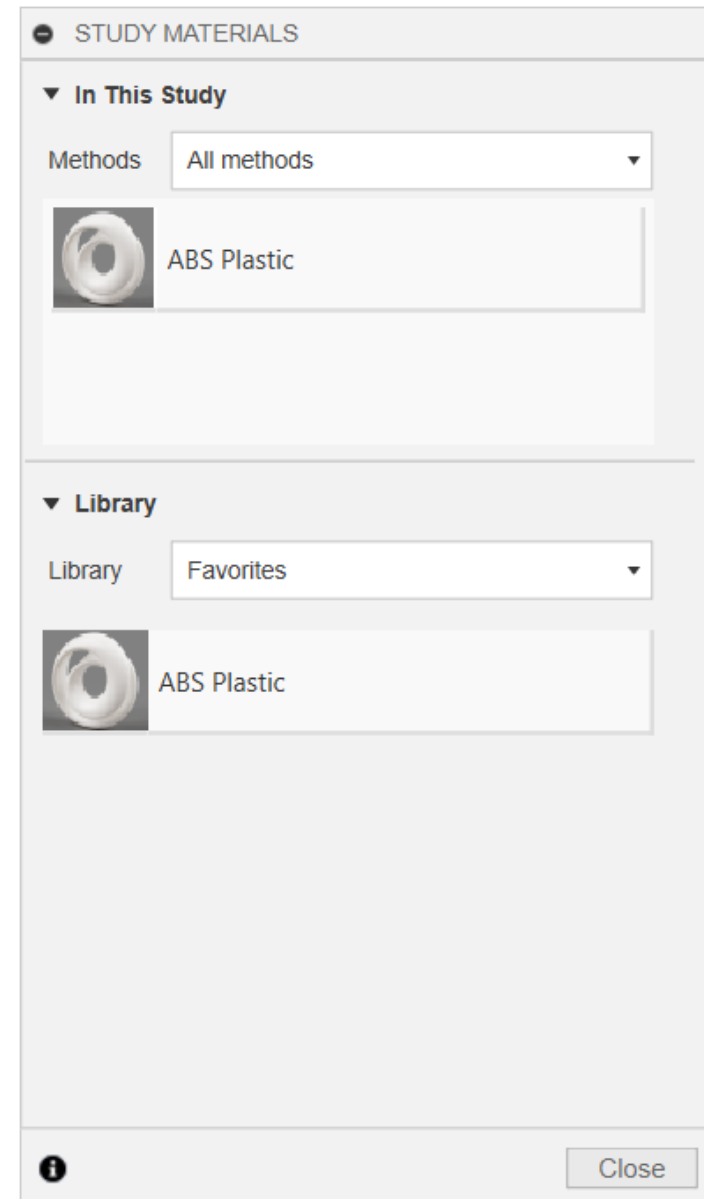


Drone frame generative design

Select **study materials** from the drop down of materials.

Materials from **available material library** can be added to the **favorites library**.

Click on the materials from **favorites/material library** and **drag** it into the **in this study section**.

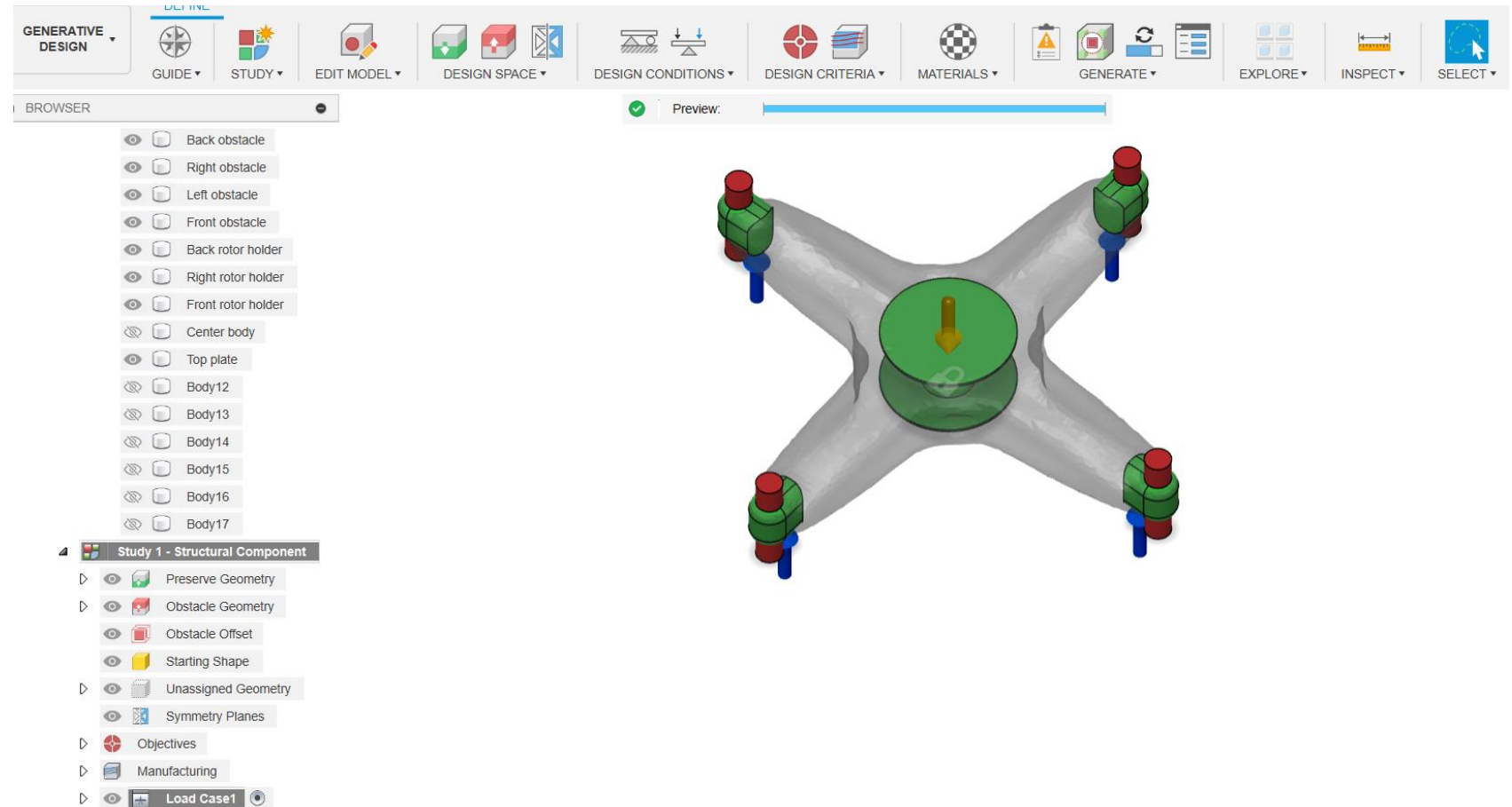


Drone frame generative design

Run the **previewer** from **Generate** menu

Preview from the generate **shows the geometry**

By **inactivating body12-17**



Drone frame generative design



Stop previewer and activate all the bodies except center body


Generate shows the details the study

Click on the generate 1 study

Generate

Show

<input checked="" type="checkbox"/>	Study	Name	Model	Status	Cloud Credits
<input checked="" type="checkbox"/>		Study 1 - Structural Component	Generative Model 1		11

 Generate 1 Study Close

Drone frame generative design


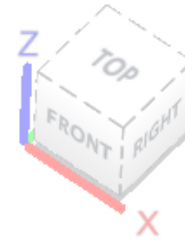
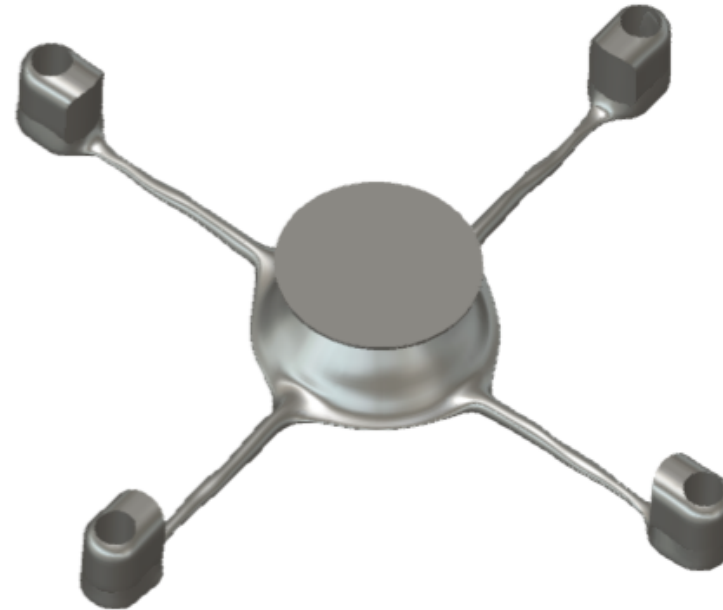
Progress window of the design process

The screenshot displays the 'Job Status' window in a software interface. The window is titled 'Job Status' and has a close button (X) in the top right corner. It features four tabs: 'Data', 'Simulations', 'Generative Designs' (which is selected and highlighted with a blue underline), and 'Drawing Automation'. Below the tabs is a table with columns for 'Job', 'Name', 'Status', and 'Action'. The table contains one row for 'Study 1 - Structural', which is 5% complete. An 'Info' dialog box is open over the table, displaying the message: 'Thumbnails for your Outcomes will appear when they are processing.' with an 'OK' button. The 'Status' column for the job shows a progress bar at 5% and a 'Cancel' button. A 'Close' button is located at the bottom right of the window. The background shows a sidebar with 'Outcome filters' and a top toolbar with 'GENERATIVE DESIGN', 'DISPLAY', 'EXPORT', 'CREATE', and 'FINISH EXPLORE' buttons.

Job	Name	Status	Action
>	Study 1 - Structural	<div style="width: 5%;"><div style="width: 5%;"></div></div> 5%	Cancel

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Design study outcome 1




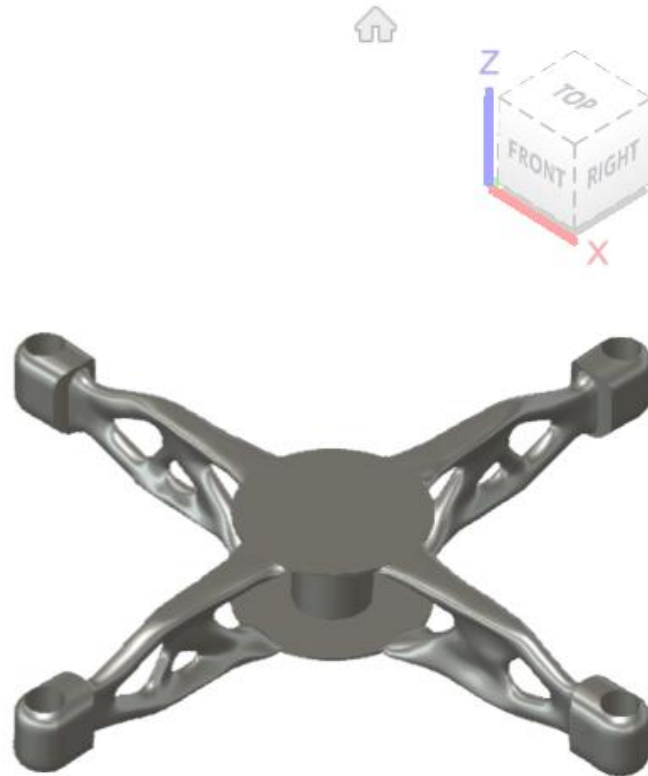
Study 1 - Structur... - Outcome 1
Iteration 33 (final)

Properties

Status	Converged
Material	Aluminum 6061
Orientation	Z-
Manufacturing method	3 axis milling
Visual similarity	Ungrouped
Volume (mm ³)	459,393
Mass (kg)	1
Max von Mises stress (MPa)	8
Factor of safety limit	2
Min factor of safety	33
Max displacement global (mm)	1

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Design study outcome 2




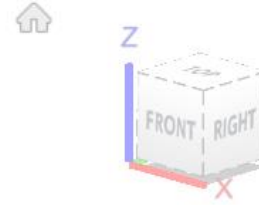
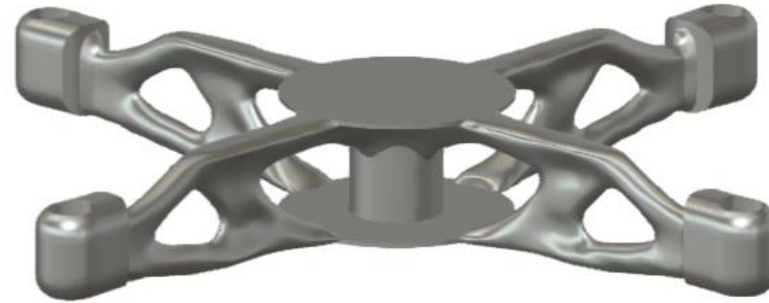
Study 1 - Structur... - Outcome 2
Iteration 32 (final)

Properties

Status	Converged
Material	Aluminum AlSi10Mg
Orientation	-
Manufacturing method	Unrestricted
Visual similarity	Ungrouped
Volume (mm ³)	396,214
Mass (kg)	1
Max von Mises stress (MPa)	0
Factor of safety limit	2
Min factor of safety	1,205
Max displacement global (mm)	0

Drone frame generative design

Design study outcome 3



Study 1 - Structur... - Outcome 3
Iteration 32 (final)

Properties

Status	Converged
Material	Aluminum AlSi10Mg
Orientation	Z+
Manufacturing method	Additive
Visual similarity	Ungrouped
Volume (mm ³)	392,738
Mass (kg)	1
Max von Mises stress (MPa)	0
Factor of safety limit	2
Min factor of safety	1,081
Max displacement global (mm)	0

Thank you