

## Overview

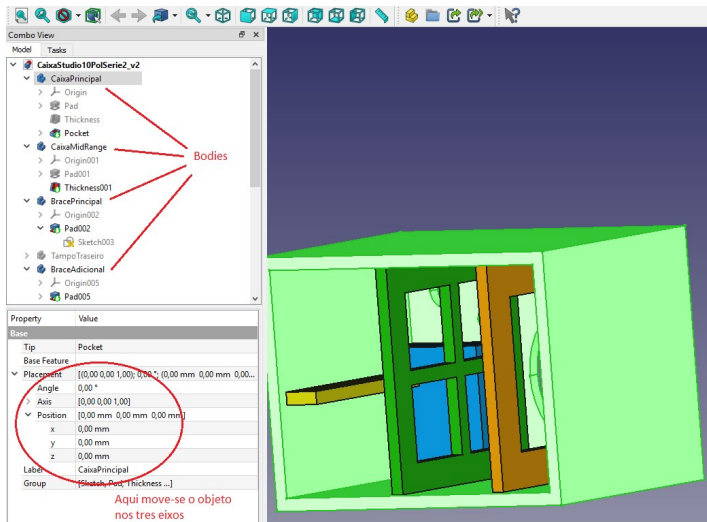
(From portuguese to english: Caixa=box, Principal=Main)

### 1. Each piece on FreeCad is a "Body"

Once created, it can be freely moved and/or rotated in any axis (X,Y,Z). Click the "Body" and move the object in the desired dimension (X, Y or Z).

To create several pieces or parts, create several *bodies*.

In my example, I've created one different body to "main box", "mid-range box", woofer, mid-range, tweeter, MainBrace, SecondaryBrace etc. Then I position every body to each other, sometimes manually just moving each part on X, Y or Z axis.



(Translation: "Aqui move-se o objeto nos tres eixos" = here you move the object in the 3 axis)

### 2. Below the "Body", you must create a "Sketch", which will be the 2D draw.

### 3. Once created the Sketch, you need to use the PAD tool to generate the 3D part.

This is the extrusion process that will transform the 2D in 3D.

### 4. Once created the 3D part, it's possible to remove one of the faces to "see inside".

### 5. It is also possible to create holes in the 3D part. You can use the "Hole" function if the holes are all the same or you can use the "Pocket" function to base the holes made in a 2D drawing (circles, rectangles or any shape).

### 6. To operate (add a part or a hole) in any of the 3D faces, you just select it and create a new 2D sketch in this face. After that, use the PAD tool on this sketch to generate the 3D.

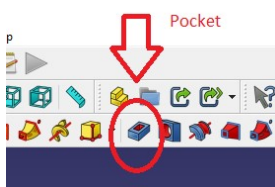
### 7. In order to create a 3D box, create a Body, then a Sketch and then a 2D rectangle.

Use the PAD to create the 3D object. To "see inside", select one face and apply the Thickness function.

Now you have the box with an external and internal view (with one of the faces removed).

To create the holes, select the face, create an sketch with a circle. Then, use the Pocket function.

The deepness is relative and directional (you can select the reversed direction). Sometimes in order to make the through hole complete (penetrate completely so as to have a complete hole) you need to understand where is the reference.



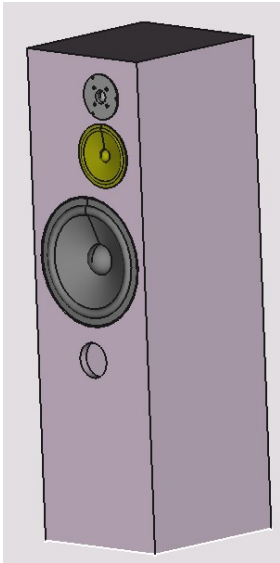
8. The decision of adding a sketch in an existing body or create a new body is the possibility or not to freely move this part or not. If you add a new sketch in an existing body, the new part will be attached to this body. If you create a new body, this part can be freely moved in any axis (X,Y,Z) or even rotated.

9. When looking at the 3D image, you can rotate it by holding Shift+MouseRight and moving the mouse.  
To just move the 3D image hold Ctrl+MouseRight and move the mouse.

10. When creating 2D objects, you can do it by using circles, rectangles etc or you can just put lines and semi-circles and then join the ends (constrain), so you can create any type of 2D object.

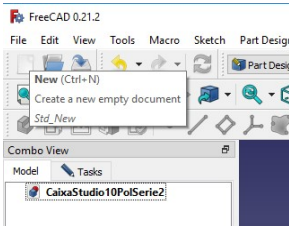
11. In order to size a 2D drawing, you use the constrain tools by setting the relative position between drawing ends.  
There are vertical and horizontal constrain tools.

## Building a simple loudspeaker

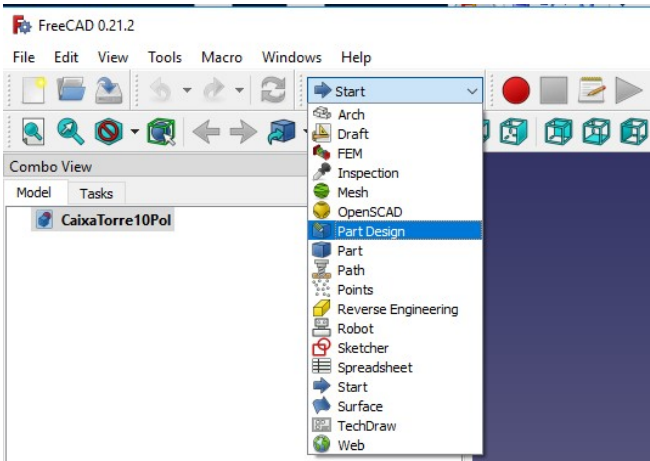


### Main Box

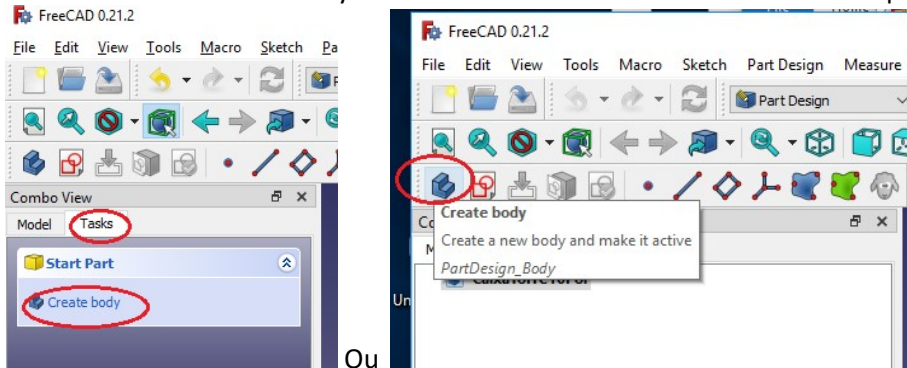
Create new file. Click and rename to the desired name ("Label")



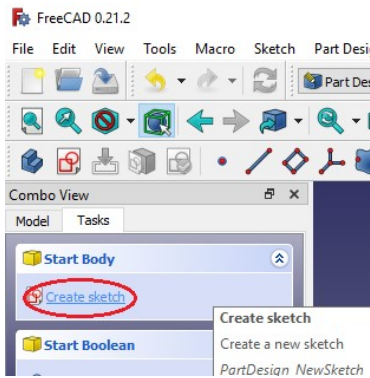
Select "Part Design" in the drop down:



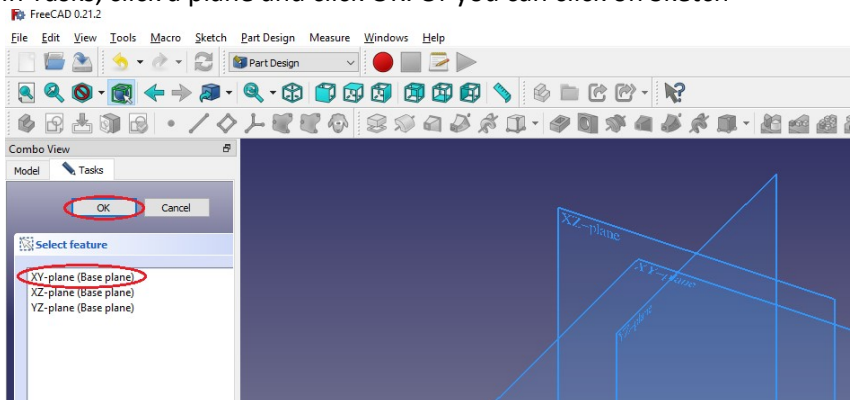
Click Tasks and Create a body or select the icon - I renamed to "CaixaPrincipal" (means main box in english)



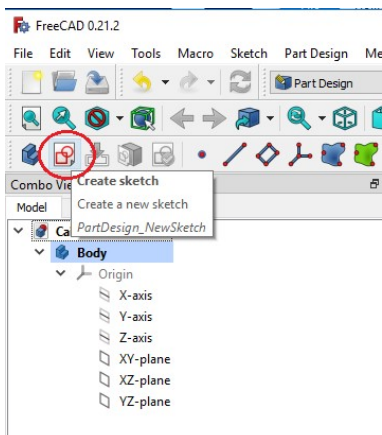
Click Create sketch



In Tasks, click a plane and click OK. Or you can click on Sketch



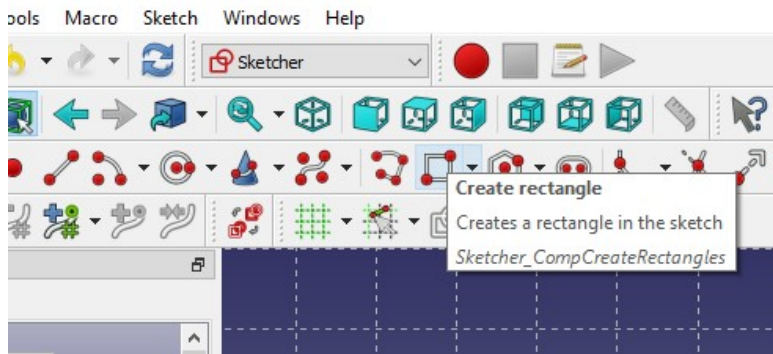
Or Click on Sketch and the menu moves to Tasks too.



In this example, we will start by drawing the base of the loudspeaker on the XY plan (TOP)

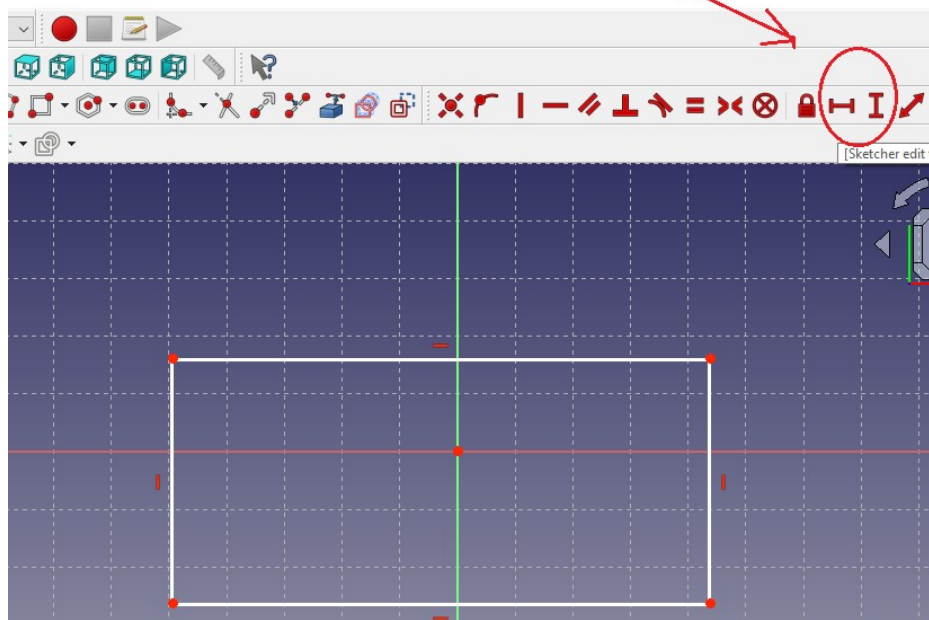


## Create a rectangle

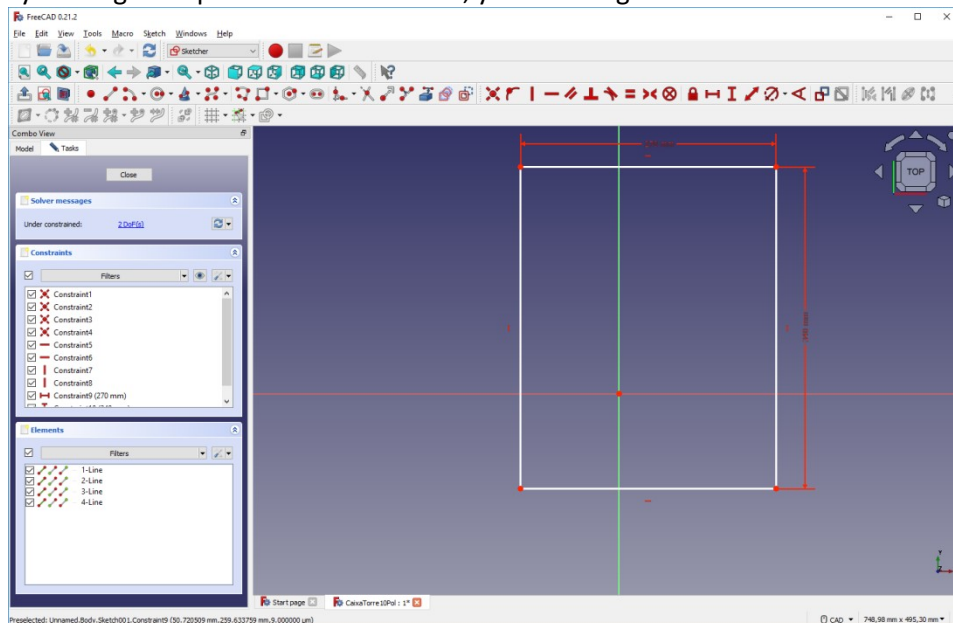


## Set the rectangle dimensions

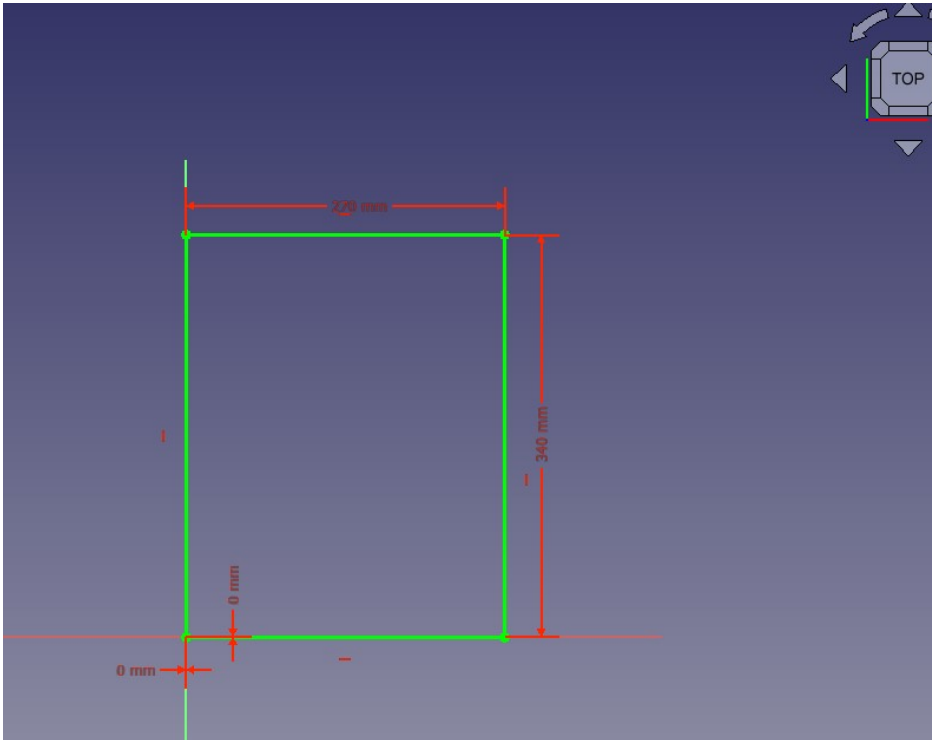
Click on the dimension tool (vertical or horizontal) and click the side of rectangle to adjust size



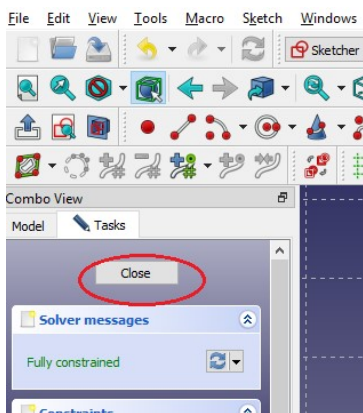
By clicking on top of the measurement, you can drag it around to best fit the visualization



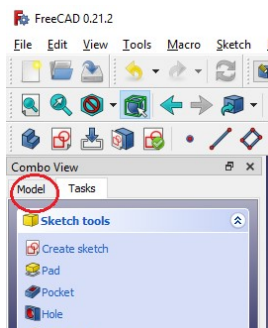
Use the same constraint tools to align the rectangle vertex to the reference XY (0,0) for convenience.  
Click on the left lower vertex of the rectangle and set distance X and distance Y to reference to 0 (zero) - one at a time.



Click Close

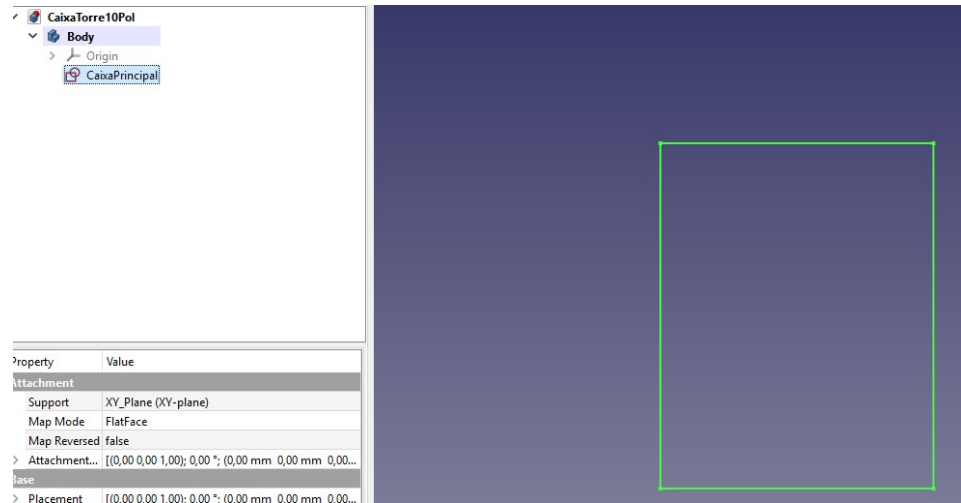


Click Model

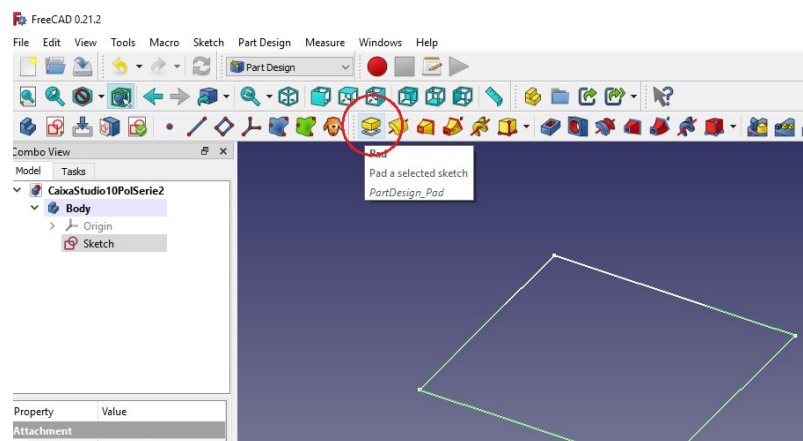


Click Sketch

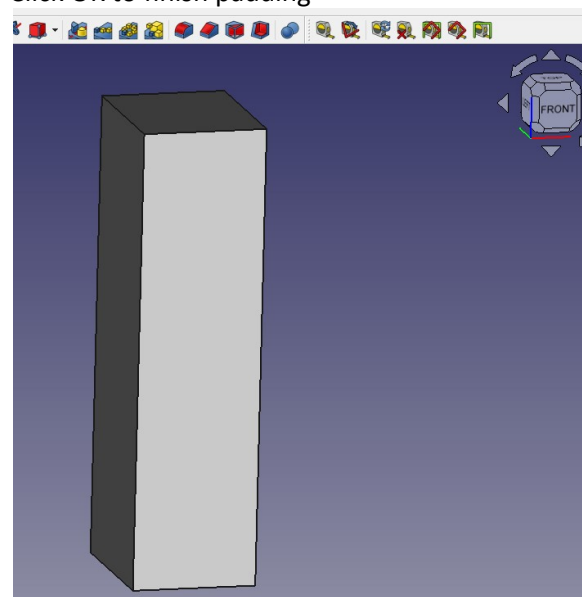
Note that the sketch lines must be selected - they become green when selected.



Apply the Pad tool to create the 3D dimensions and make the object thick  
In this example we will create the loudspeaker high dimension

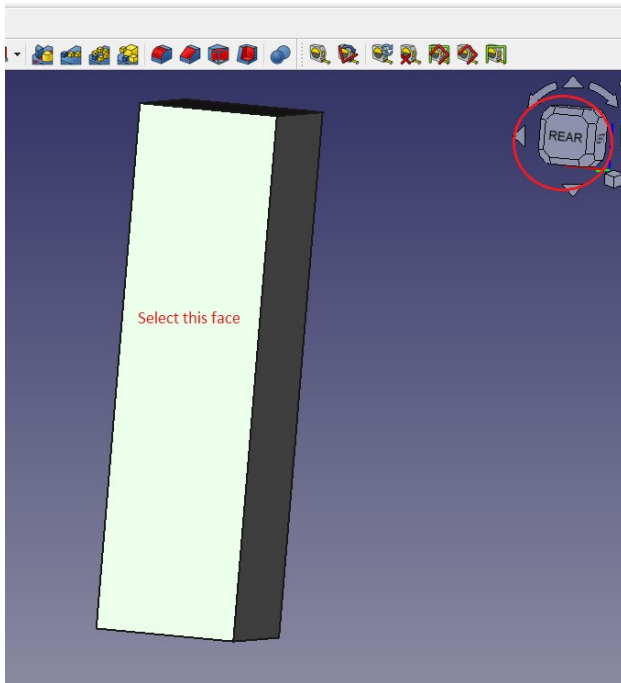


After applying you get the 3D object  
Click OK to finish padding

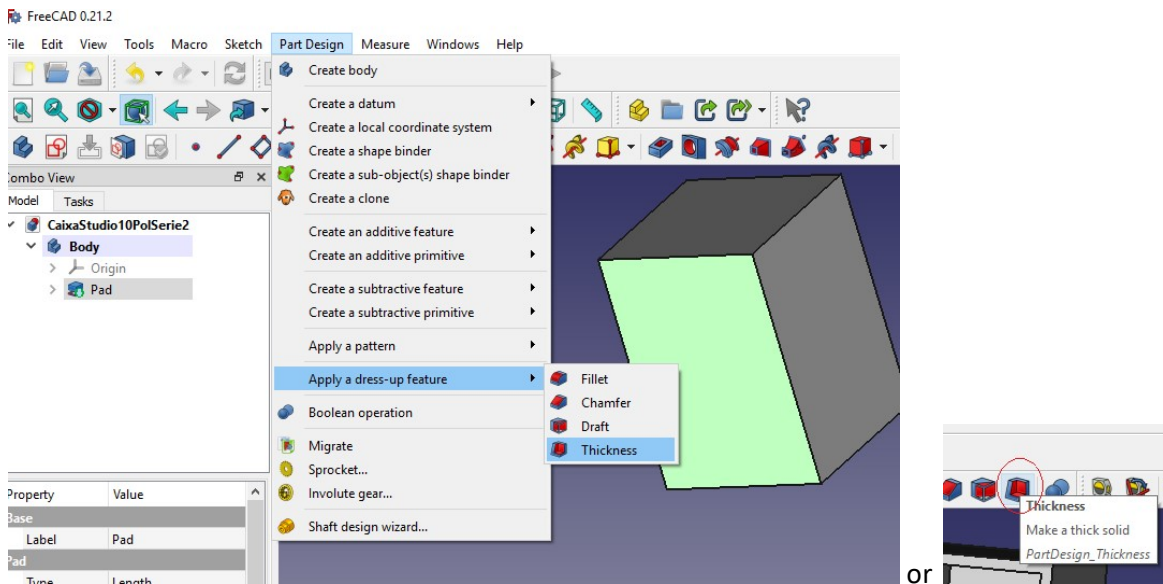


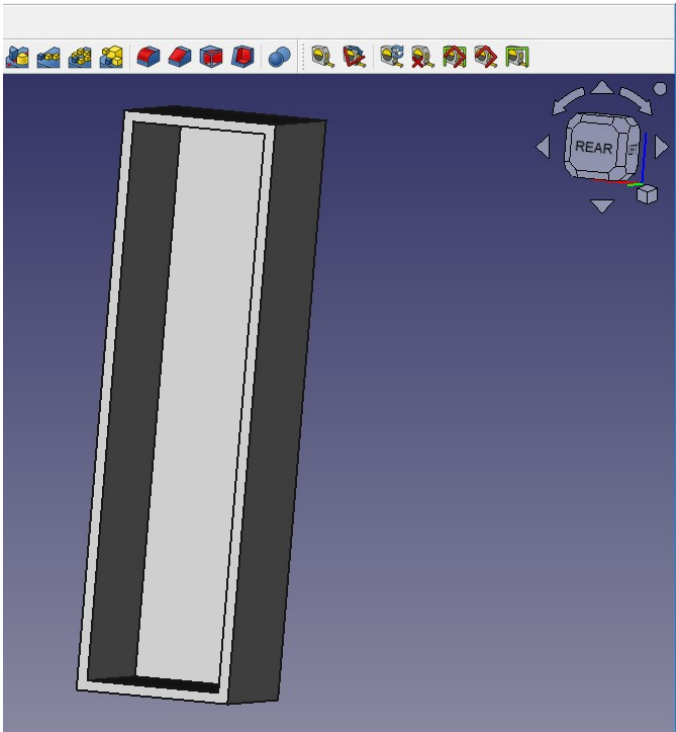


Remove the rear panel so we can look and create other parts inside the loudspeaker  
Rotate the object and select the rear face



Go to Part Design and select Apply a Dress-up feature -> Thickness (you can also click the tool icon)  
Choose 18mm as thickness and Join Type Intersection  
Select Inwards so you keep the external dimensions and grow the object inwards  
Click OK to finish

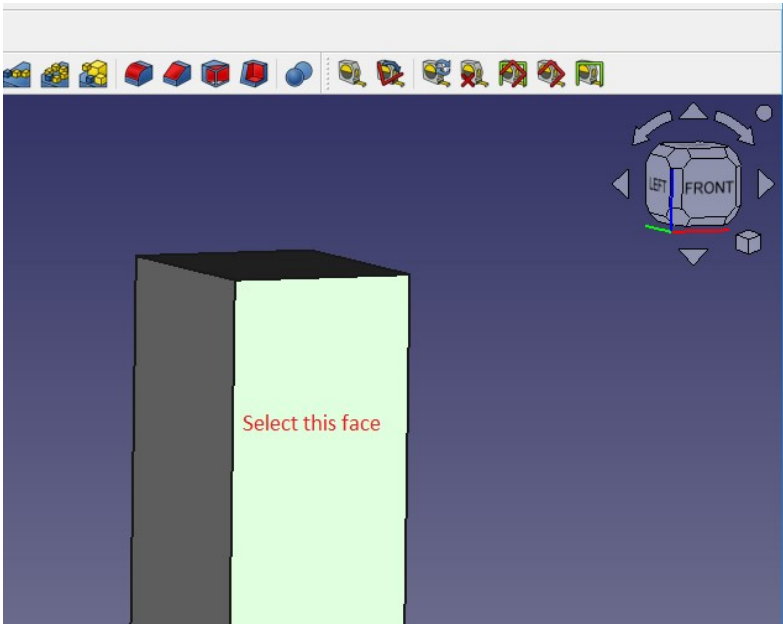




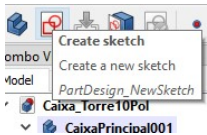
So, now this body is completed. The only additional part to add to it is the speaker holes.

Create the speaker holes

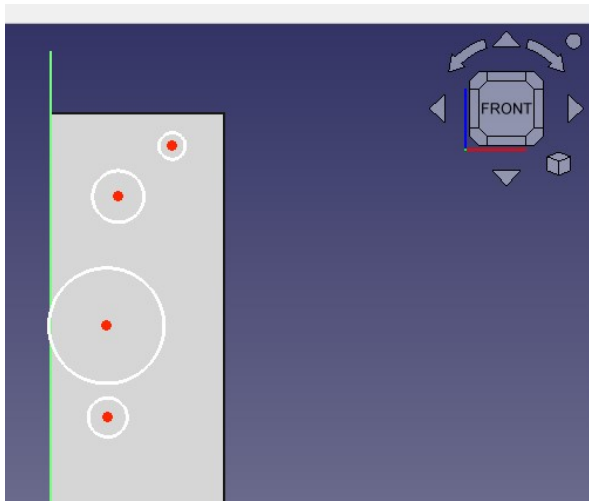
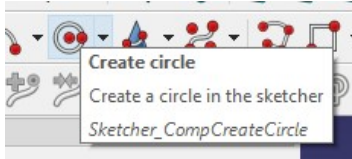
Select the front face



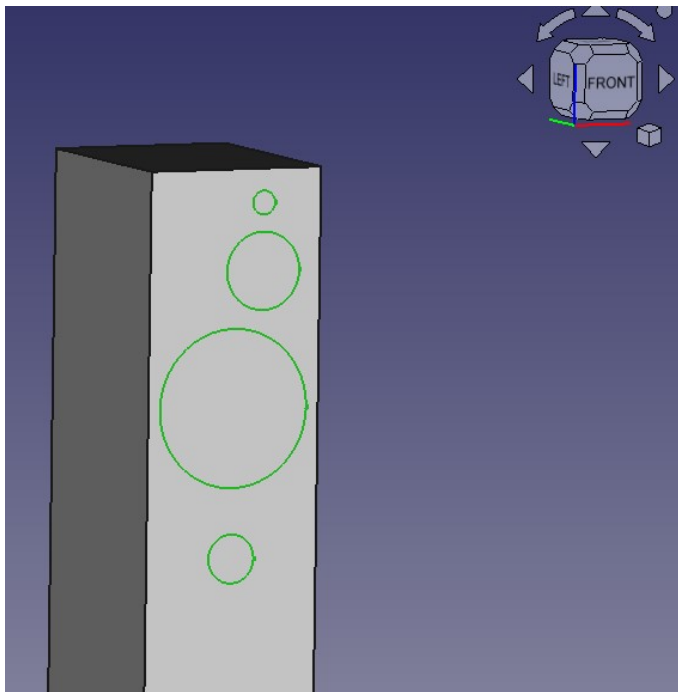
Create a new sketch on it



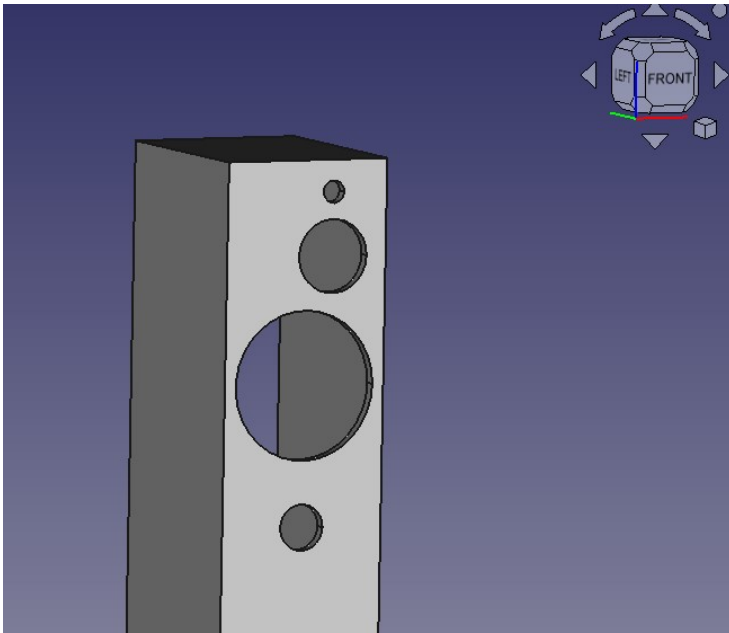
Create a circle, one for each speaker and port



Using the constraint tools to position the circles and give the exact diameter of each circle and center them as desired.



With the circles selected, use the Pocket tool to make the holes - set the length as 18mm

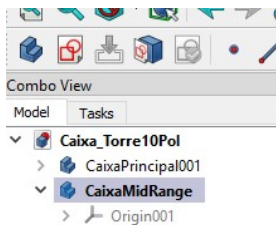
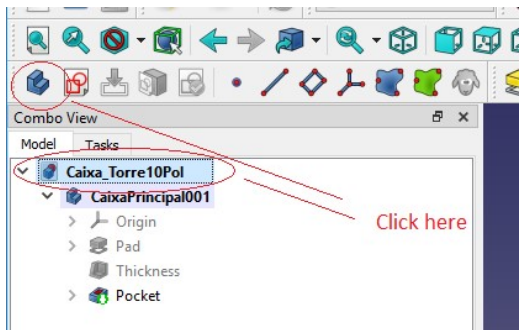


At this point, the main loudspeaker body is ready.  
Any other part will be additional bodies.

### Mid-Range loudspeaker box

In order to isolate the mid-range, a small box will be installed and will also serve as braces to the main box  
We will create this box as a separate Body. Using the plane of one of the side faces of main box, we will create a "U" 2D shape and pad it to create the other third dimension.  
This box will have only 3 faces: upper, rear and bottom. Lateral faces will be closed by the main box lateral sides.

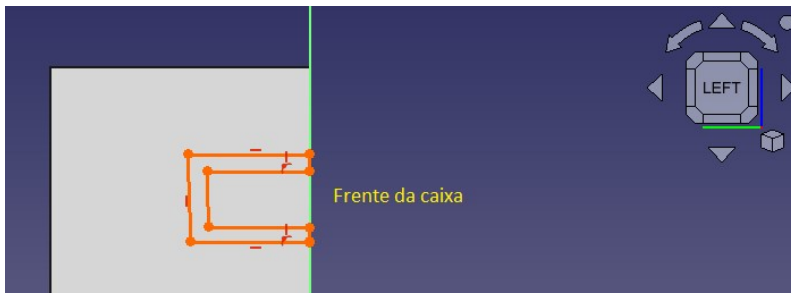
Click on "Caixa\_Torre10Pol" and add a new Body.  
Rename it to "CaixaMidRange"



Select this Body and create a Sketch on ZY plane (select LEFT)

For this "U" shape we will use a series of straight lines and connect them to form the desired shape.

("Frente da Caixa" means front of the box)

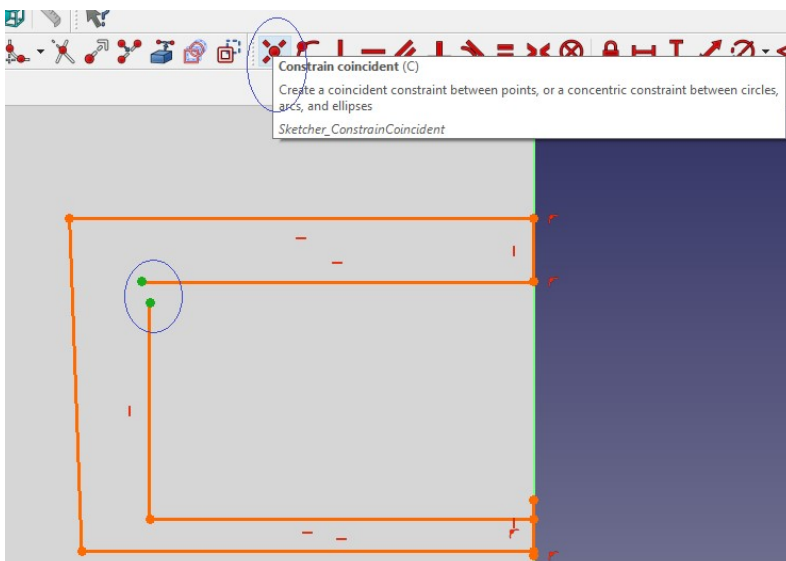
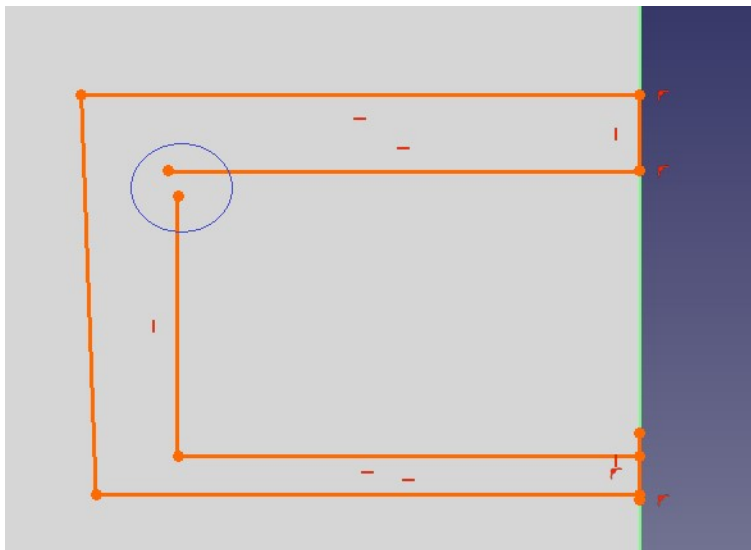


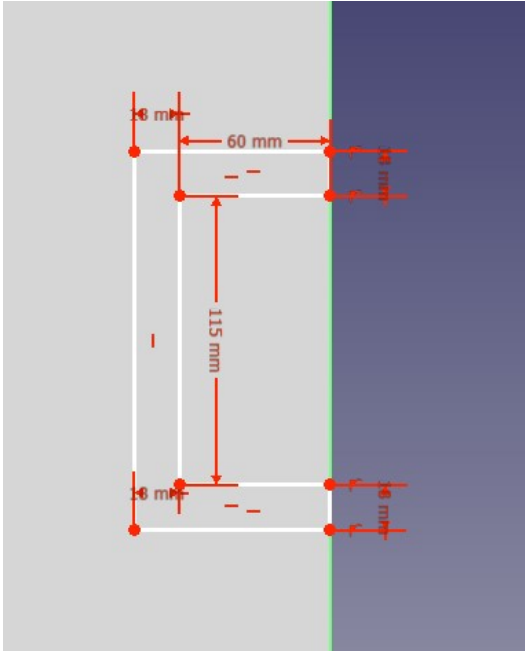
Use the constraint tools to adjust the exact size and position of the "U" shape.

If some lines got not connected as shown below, join them using the Constraint Coincident tool

Try to move all the lines to make sure all ends are joined.

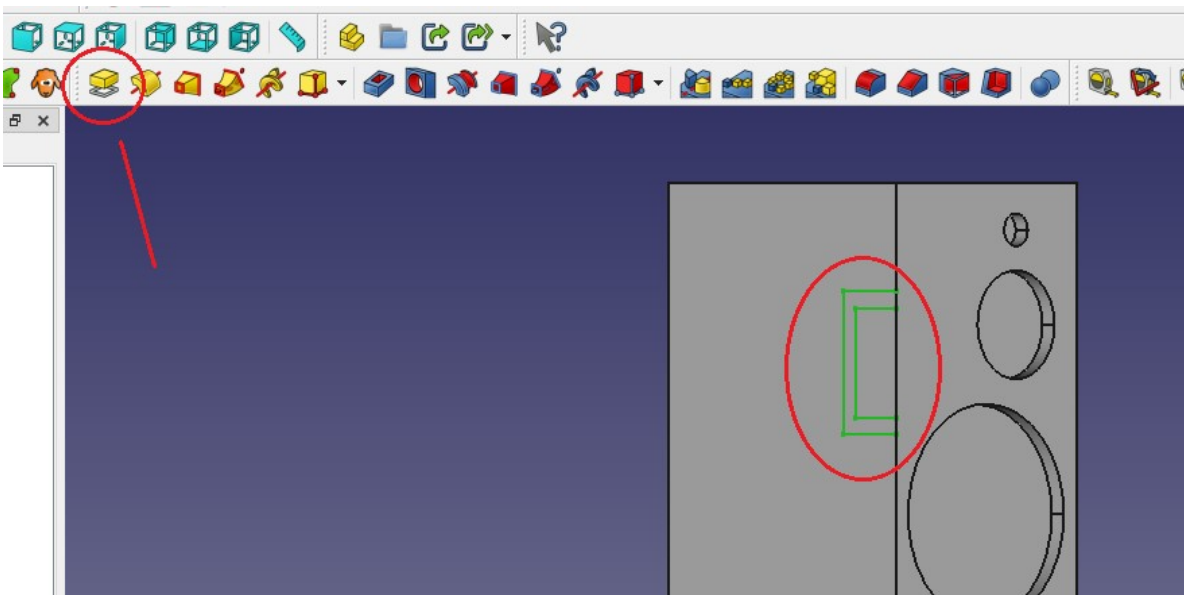
Check if there are no redundant constraints.



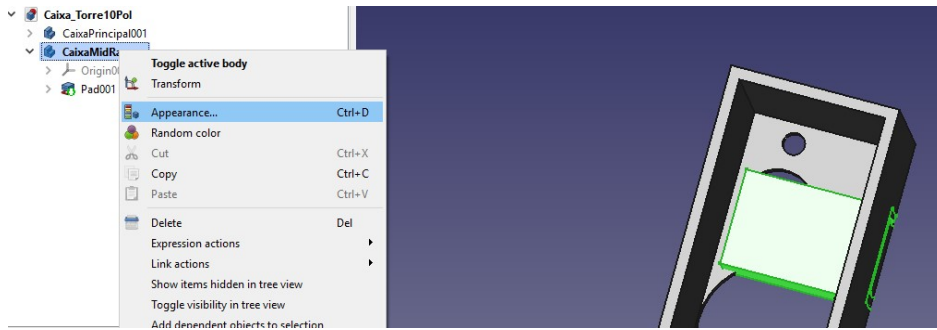


Now close Sketch.

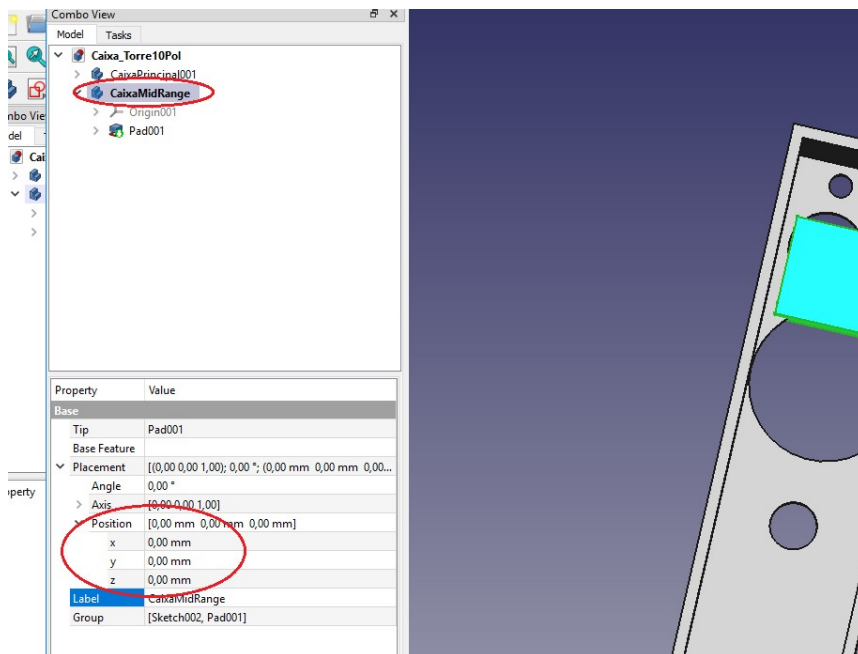
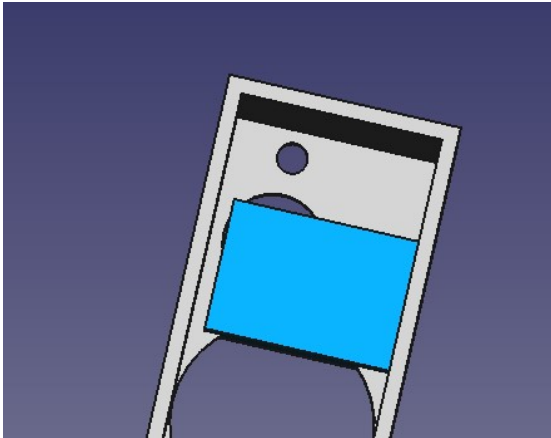
Select the Sketch and apply Pad to make the third dimension (in the width direction of the main loudspeaker box)  
That will be  $270\text{mm} - 18\text{mm} - 18\text{mm} = 234\text{mm}$



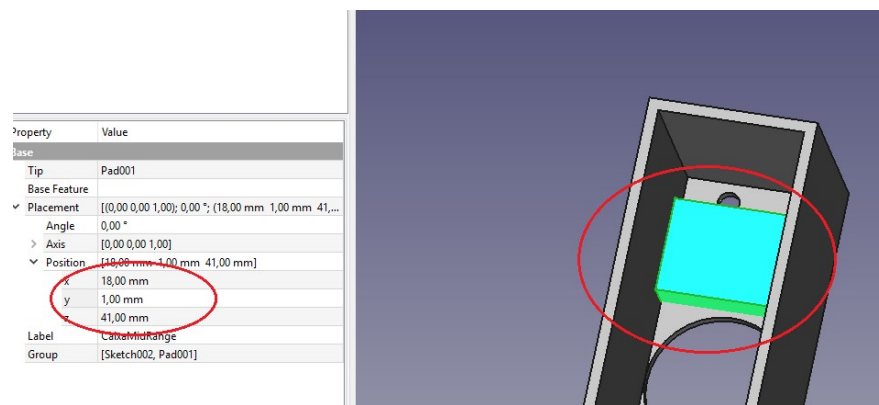
Give a different color to this body



Noted that the box is created but it is not in the exact place.  
 Move the body so as to install the mid-range box in the right place  
 Move X, Y, Z to achieve the right place



Now the box is in the right place

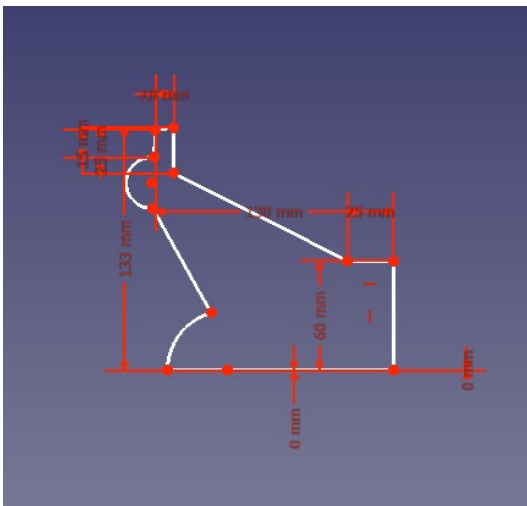


## Woofer creation

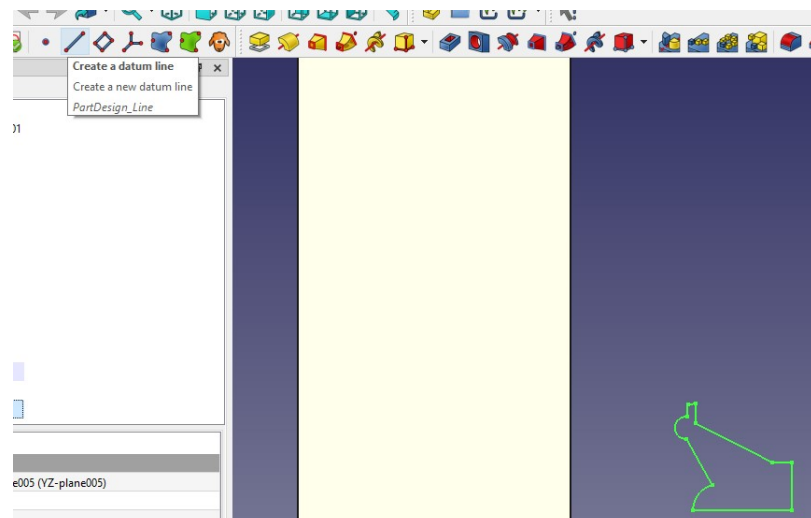
In order to create a circular 3D body, you need to draw a 2D half sized profile and revolute it around an axis (Datum Line).

Create another body and a sketch

Draw the 2D profile as below (made of lines and semi-circles):

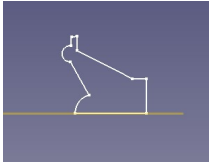
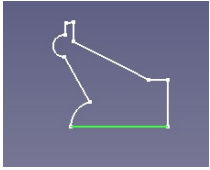


Close the sketch and create the Datum Line over which the revolution will take place

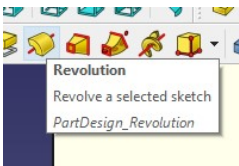




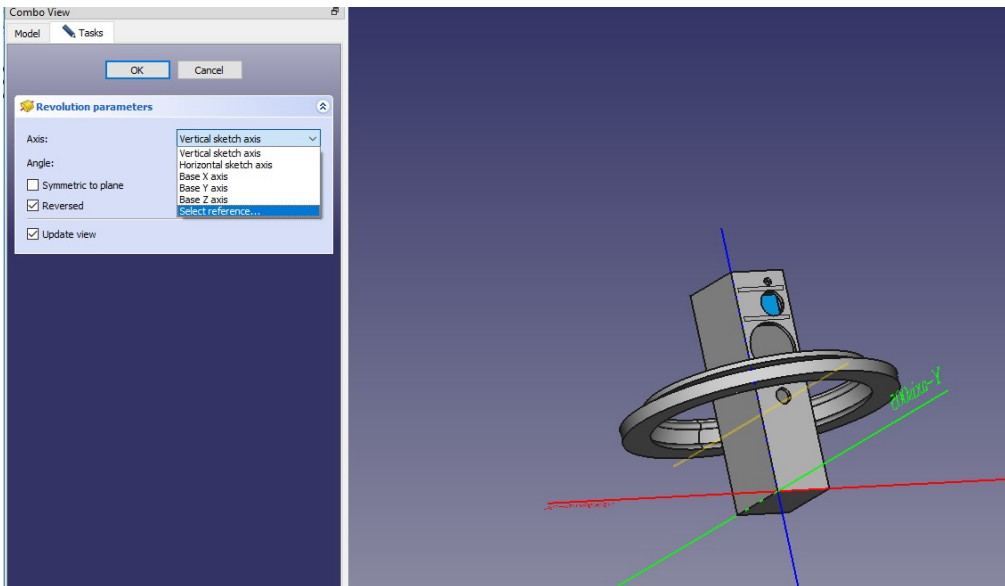
Select the line to be aligned to the Datum Line

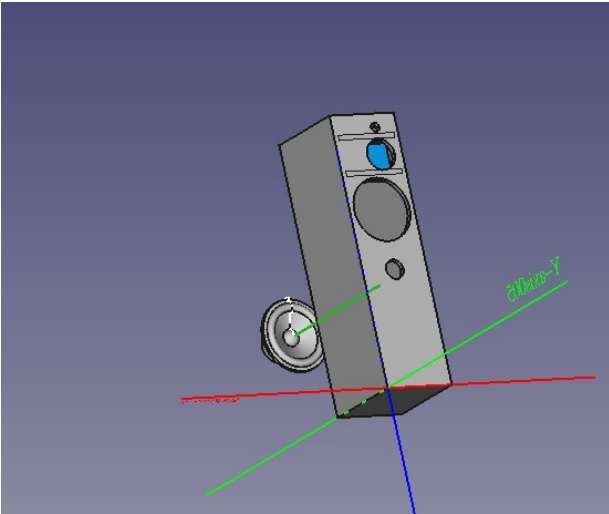


Select the sketch and press the Revolution tool



Select a Reference axis (normally the Datum Line)





Ready! You just need to install the Woofer on the front panel by moving its body along the 3 axis (X,Y,Z). Continue with mid-range, tweeter and bracing.