1 Introduction

In this tutorial I'll demonstrate how to create 3D printed housings using FreeCAD
I'm using this technique for my ESP32 projects
You can check out some of these projects on my Github, I'll provide a link in the description
I'm assuming the basics of the PartDesign, Sketch and Part workbenches are known
I therefore focus on the basic concepts and stay at high conceptual level
To save time, I'm accelerating everything I'm doing in the sketcher

2 Topics in this video

This video is split in different sections, starting with the basics and then moving towards a fairly complex 3D printable housing

Concept of creating a housing by boolean operation of bodies
Making changes to the housing
Adding a groove in the top part and a rim in the bottom section
Checking the result in a slicer
Apply a workaround to ensure the colors remain the same
Adding a connector hole to the housing
Using a skeleton to drive dimensions of the bodies
Applying a naming convention for bodies and features
Creating references to the internal components of the housing
Using self tapping screws to close the housing

3 Concept of making a housing by boolean operation of bodies

The housing consists of a bottom- and top section
We will first make a new body with the name 'Housing'
One sketch is used to determine the outside of the housing
Another sketch is used to create an inner cavity
Next, we create a new body with the name 'Separation top'
This body will define which part of the housing will become the top section of the housing
We choose the separation of the body 0.5 mm above the XY plane
The volume of 'separation top' is just a little larger than the housing itself

In the same way, we also create a body named 'Separation bottom', with a separation plane 0.5 mm below the XY plane

Now we will separate the bottom and the top of the housing
We switch to the part workbench
While selecting the 'Housing' body and 'Separation top', we choose the common tool
This way, we obtain a new volume where both bodies intersect each other
We rename the resulting volume 'Housing top' and change the color to red
It looks like the 'Housing' body is removed from the model tree, but it still present in the model tree of the 'Housing top' body, and can be used for other operations
We now select 'Housing' and 'Separation bottom' and again choose the common tool from the part workbench
We rename the result 'Housing bottom' and change the color to blue
We now have two bodies, 'Housing top' and a 'Housing bottom', separated by a slit of 1 mm

4 Making changes to the housing

The advantage of this way of working is that we can clearly separate the design of the housing and the design of the separation

For instance, if the want to add vent holes in our housing, or a USB port, we can modify the housing without the need to adapt bottom and top independently

The modification will automatically come through in both top and bottom housings and both halves

To demonstrate, I will add some chamfers to the housing

Hide top and bottom housings

Show the housing and make it the active body

We want to add the chamfer as early as possible in the part, so it is not losing it's references if we modify another detail

Set the tip of the body to the first element where we can apply the chamfers

Choose the top and bottom edge and create the chamfers

Do not forget to set the tip back to the last element in the model tree of the housing

If we now look back at the top and bottom housing, we see that we have created both chamfers by just modifying the housing

5 **Adding a groove in the top part and a rim in the bottom section**

If we want to create a rim and groove fit for top and bottom housing, we modify 'separation top' and 'separation bottom'

I will show what this looks like

We switch back to the 'Part design' workbench

We hide 'Housing bottom' and 'Housing top'

and make sure 'Separation top' and 'Housing' are the only volumes displayed

'Separation top' is made the active part by double clicking it

First, we sketch the trajectory of the groove

Then, we sketch the profile of the groove

Finally, we create the groove in 'Separation top' using the subtracting pipe tool

If we now make 'Housing' and 'Separation top' invisible, and switch 'Housing top' back on, we see that the groove also appears in 'Housing top'

The color of 'Housing top' is overruled, so we change the color back to red

We need to choose a slightly different shade of red to make sure the setting is applied

Then, we create the rim on the bottom part

Now follows a sequence of making the right elements visible

We make 'Top housing' invisible

Then make 'Separation top' visible

Then, make the final volume of 'Separation top' invisible

Then, make the sketches that make up the groove visible

Finally, make 'Separation bottom' visible

Also, we make 'Separation bottom' the active body

We sketch the cross section of the rim such that it nicely snaps in the groove

We also sketch the trajectory of the rim, exactly the same as the trajectory of the groove

We select both sketches and create the rim using an additive pipe

6 **Checking the result in the slicer**

It is good practice to regularly check if the result is printable

Sometimes you create details way beyond the resolution of the printer, and it is good to find out early when you can still make changes

Also, you can check if the printer does not require unnecessary support or bridging

Choose 'Top housing' and select File > Export from the file menu to export this part to STL

Do the same thing with the 'Bottom housing'

Open the STLs in your slicer and check if the parts are printable
If you have made modifications to the part, you can repeat the export.
In PruaSlicer, you can right click the model and choose ‘Reload model’ to import the modified model
This way, you will not lose settings after making changes to the model

7 **Apply a workaround to ensure the colors remain the same**

You may find it annoying that the colors of the top and bottom housing are modified at each change of one of the bodies
There is a simple workaround to avoid that.
Select all bodies: ‘top housing’, ‘bottom housing’, ‘housing’, ‘separation top’ and ‘separation bottom’
Now give all bodies the same color and transparency
When making changes, the colors of the top and bottom housing remain the same

8 **Adding a connector hole to the housing**

Sometimes a change to the housing also requires a change to one of the bodies
To demonstrate, I will add a USB C port to the housing
We will show the housing and hide all other bodies
We make the housing the active part
Next, we create a sketch to model the USB port
Then we will extrude the USB port
To see if the result has come through, we look at the top and bottom parts independently
We notice that the USB port does not extend to the top of the rim in the bottom part
This requires the 3D printer to print a bridge, which is not really necessary
We do not want to make the modification to the housing, since it only applies to the bottom housing
We therefore need to remove material from ‘Separation bottom’
We need to move exactly the section where the bridge will be printed