

Protocol: Using FreeCAD to Design Objects for 3D Printing

FreeCAD is a free CAD (Computer-aided design) software that you can use to create different shapes. These shapes can then be exported- either directly to the 3D printing software, or to additional software such as Slicr (recommended) for further tweaking of size and 3D printing settings. If you upload directly to the 3D printing software, the print settings will be set to default- which may not be desirable.

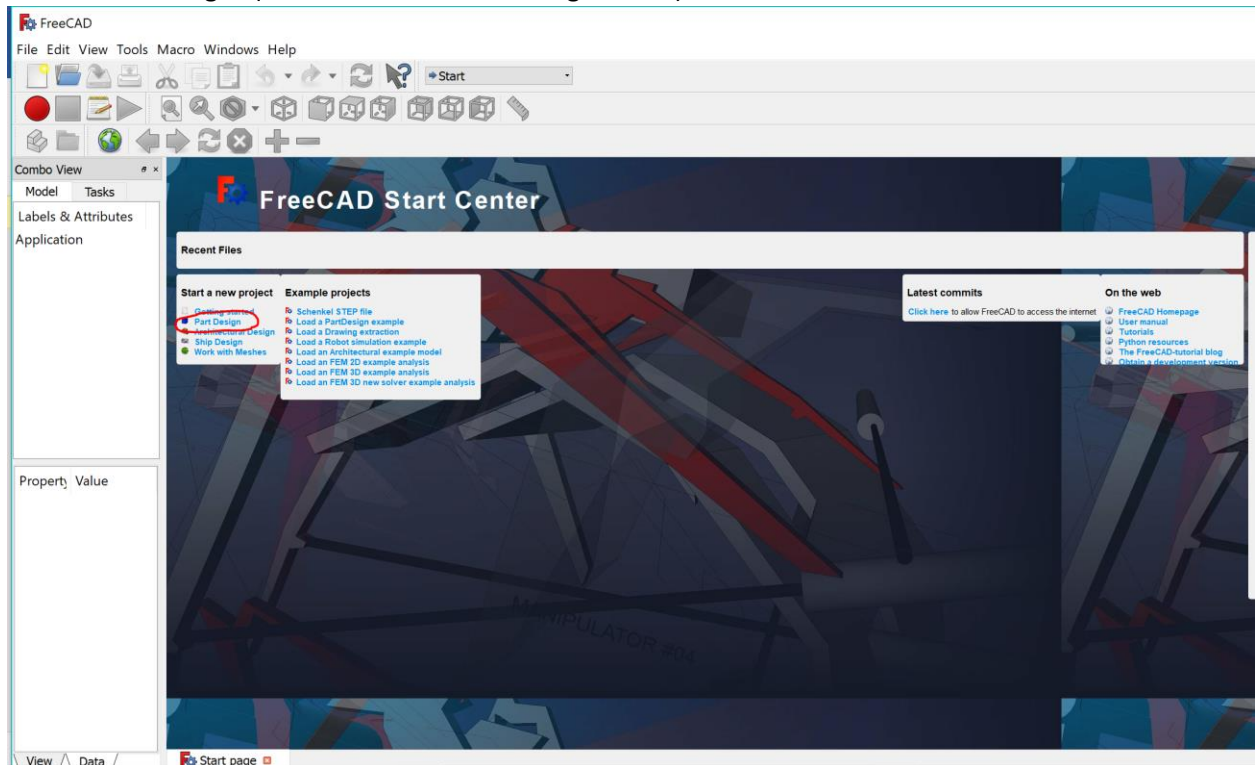
- First Download FreeCAD to your computer! Make sure you select the correct operating system for your device: <https://www.freecadweb.org/wiki/Download>

Tips for using FreeCAD:

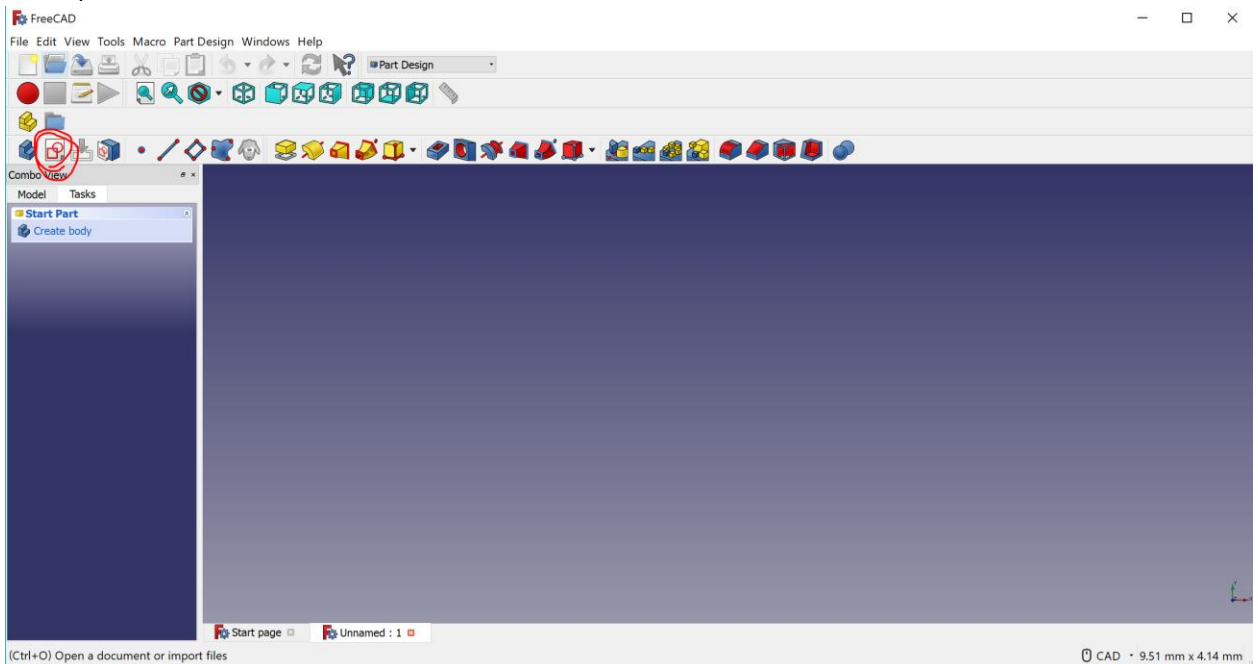
- Becoming familiar with the software requires a lot of trial and error. Be prepared to hit that undo button or start over entirely.
- Online tutorials may be helpful especially if you get stuck.
- It is helpful to align your design to a grid for greater precision (directions provided below)
- If it closes randomly just open the program again. Save your work frequently. The latest version (as of 10/25/18) seems to close randomly a lot.

Designing a Simple Object in FreeCAD

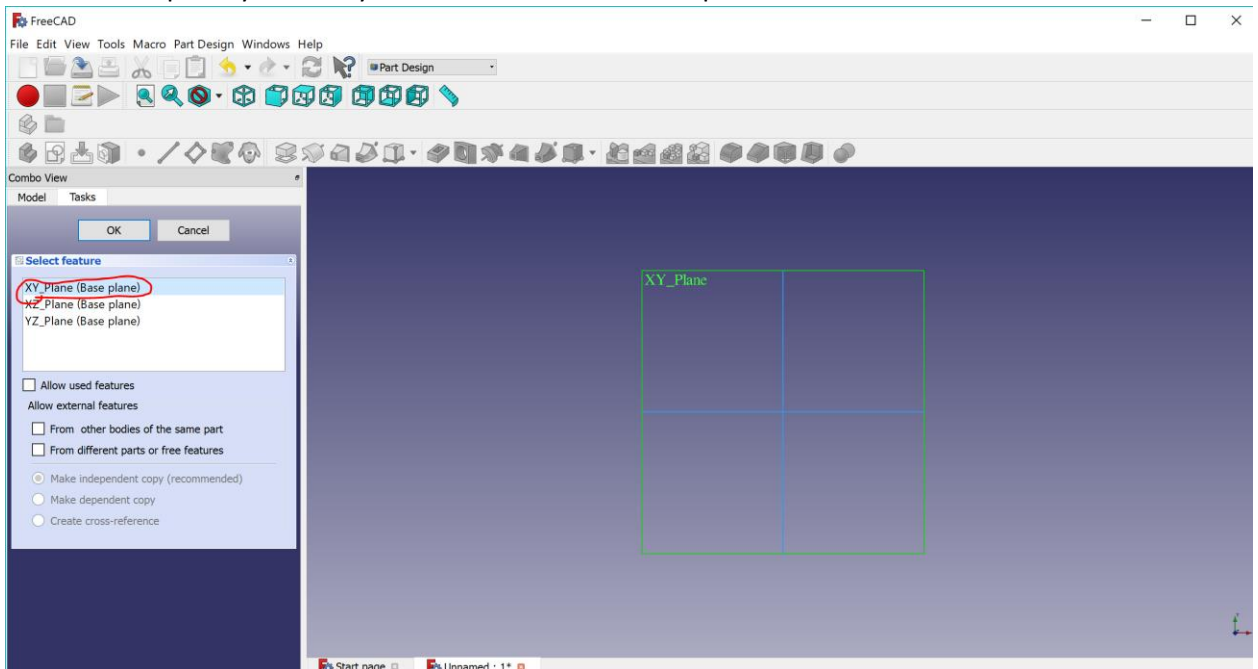
1. Open up FreeCAD. It should look something like the image below.
2. Select “Part Design” (Outlined in red in the image below)



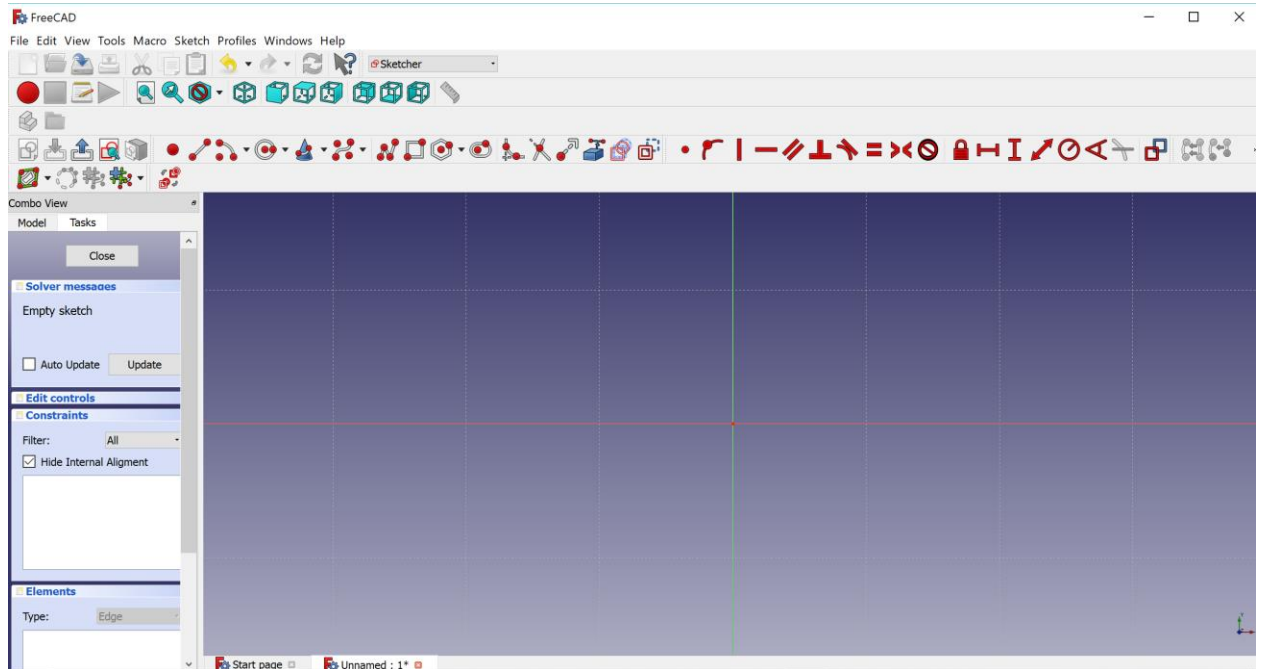
3. Your screen should look like the image below. Click on the Create Sketch button (circled in red below)



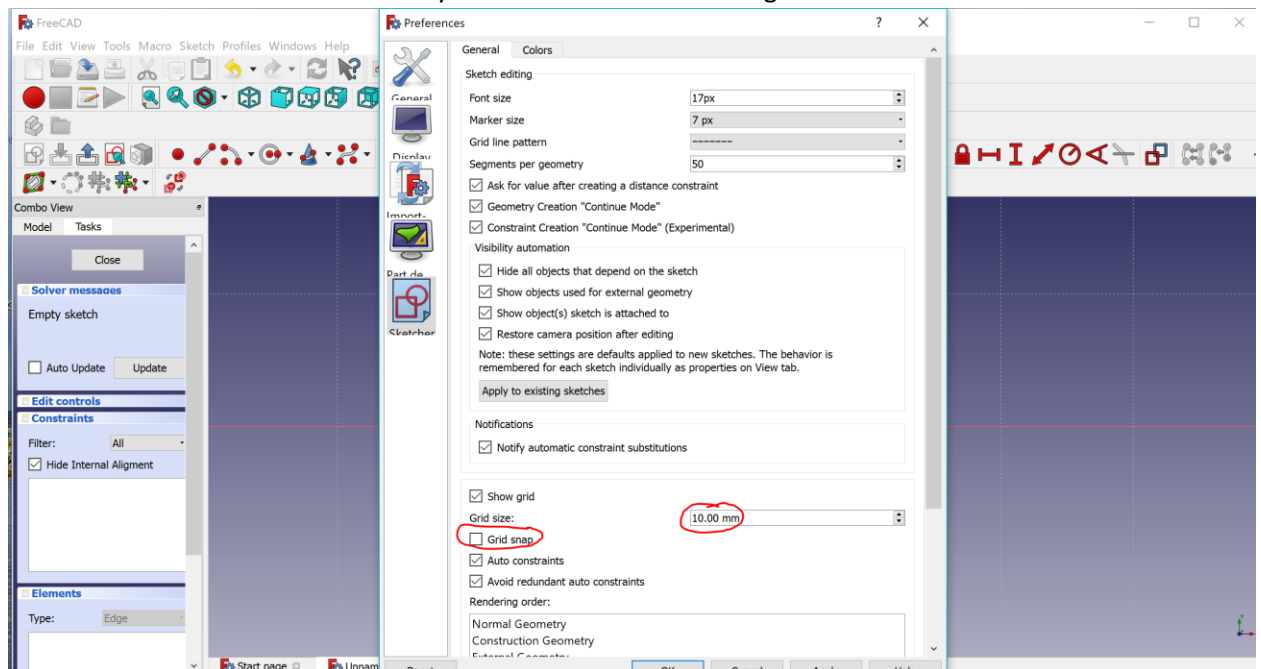
4. Choose what plane you want your sketch to be in. We can pick XY Plane to start. Click OK.



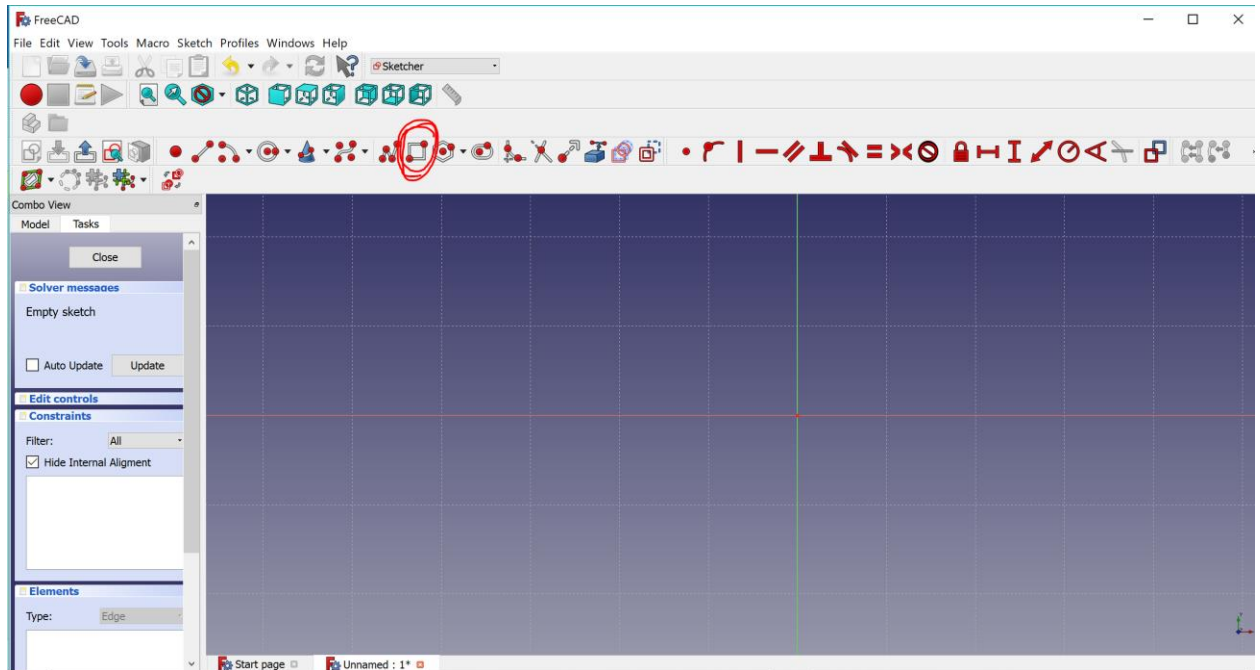
5. Your screen should look something like this. You are now ready to select a shape. Wow!



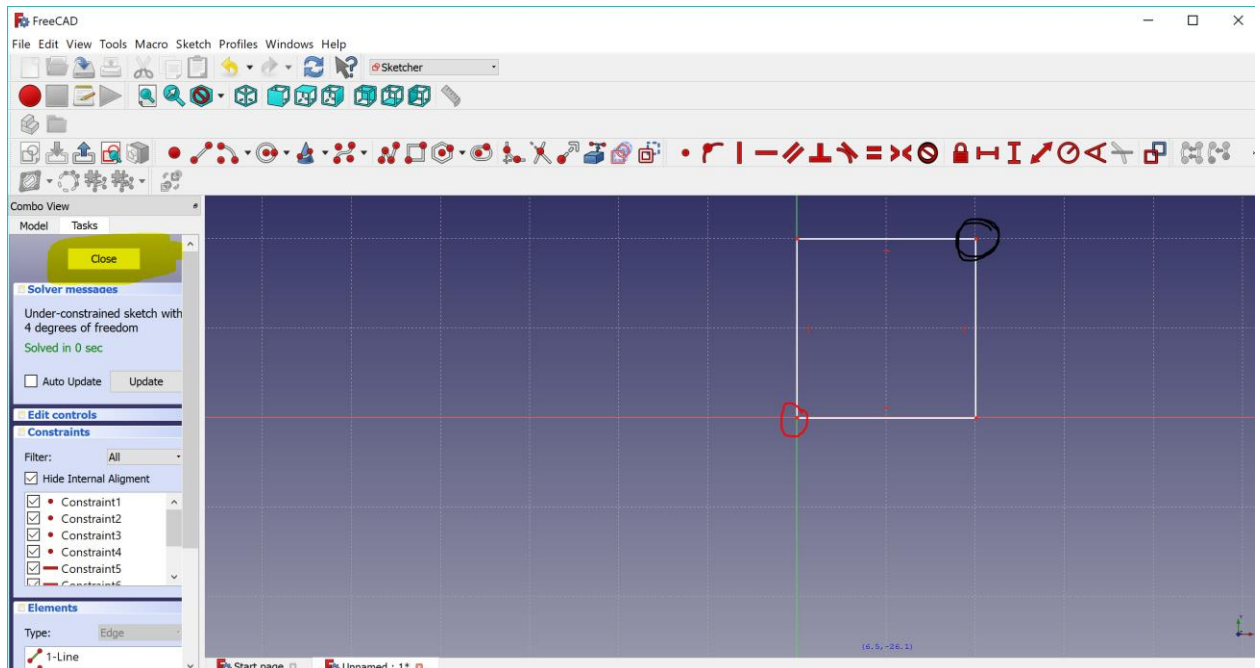
6. OPTIONAL STEP: To make part design easier, you can adjust the grid size and “snap” your design to the grid- this allows for more precise design. Just go to Edit → Preferences and select “Sketcher” from the side menu and you should see the following.



7. The following will be made using a 5.00mm grid size, with Grid Snap checked. Let’s make a rectangle. Choose the rectangle shape in the toolbar as shown in the red circle. If you are not sure what a given toolbar button is, hold your mouse over it for a few seconds and it will tell you.

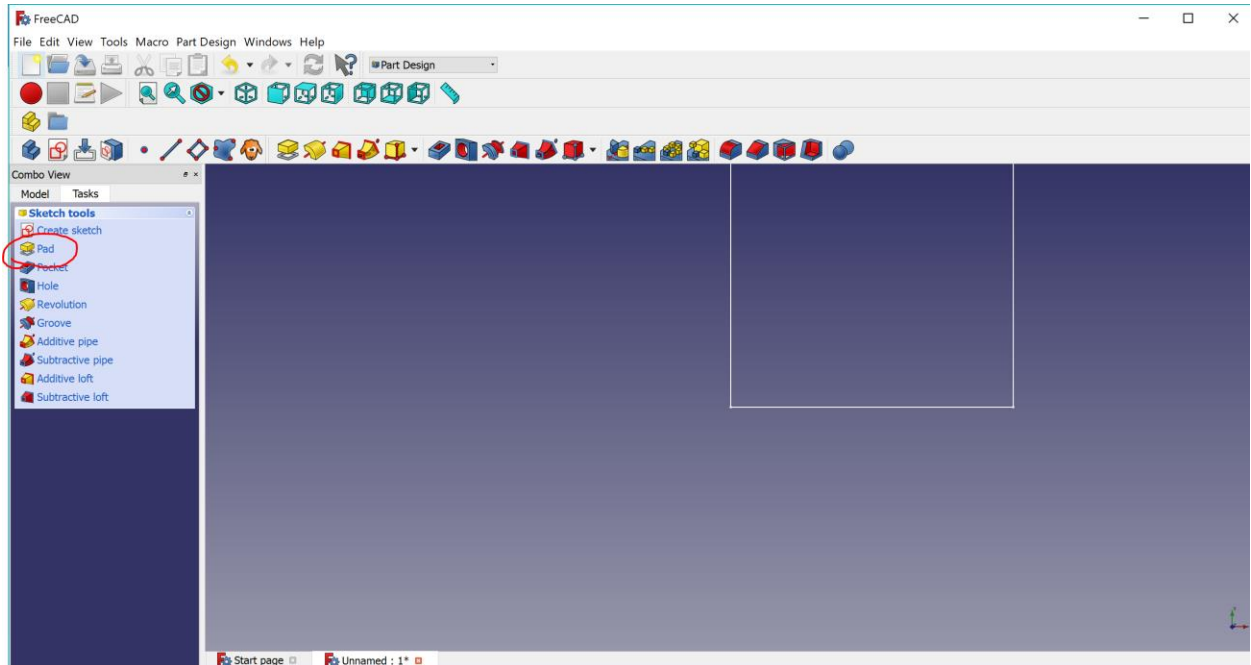


8. To make a shape, you first click and release at a point which will be one corner of the rectangle. You then move your cursor to where you want the opposite corner to be, and click and release again to make the shape. In the image below, the origin was selected as the first point, the mouse was clicked and released on the origin (red circle), and then the cursor was dragged to the point circled by the black pen, and the mouse was clicked and released again to make a rectangle 2 boxes long and 2 boxes wide. Since our grid is set to 5mm, this should correspond to a 10x10mm box.

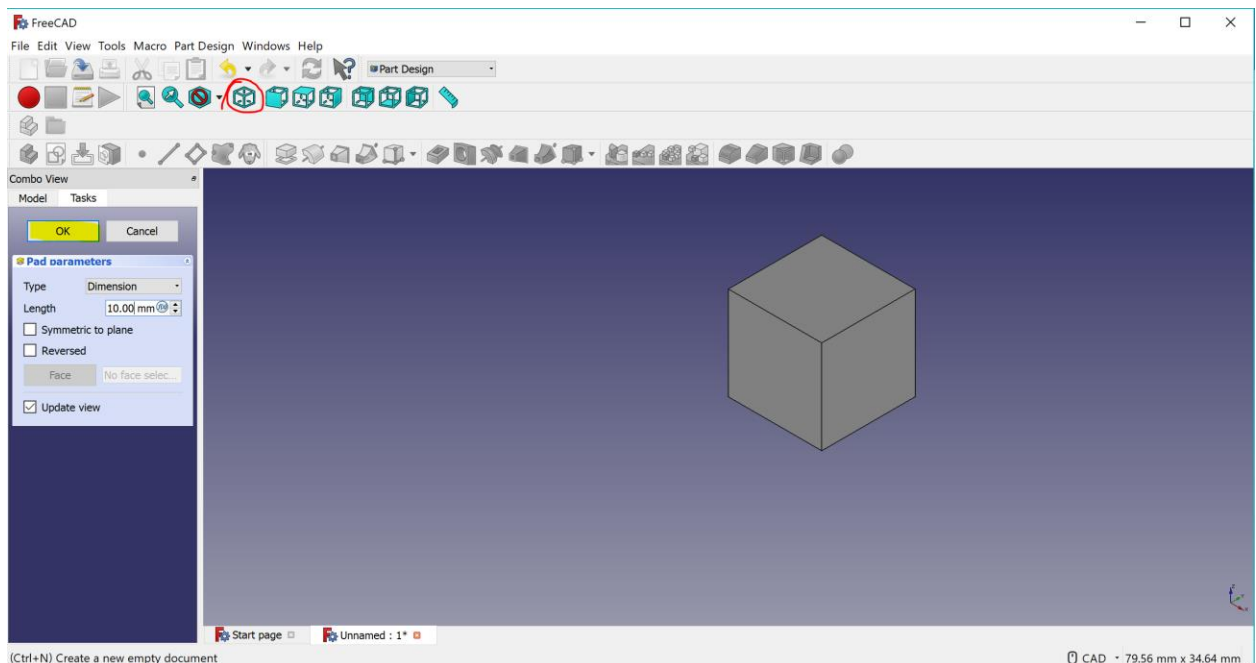


9. This sketch is currently in 2 dimensions. To make a simple object in 3 dimensions, you can "Pad" the sketch to whatever thickness you want. We created our object in the XY plane, so the pad

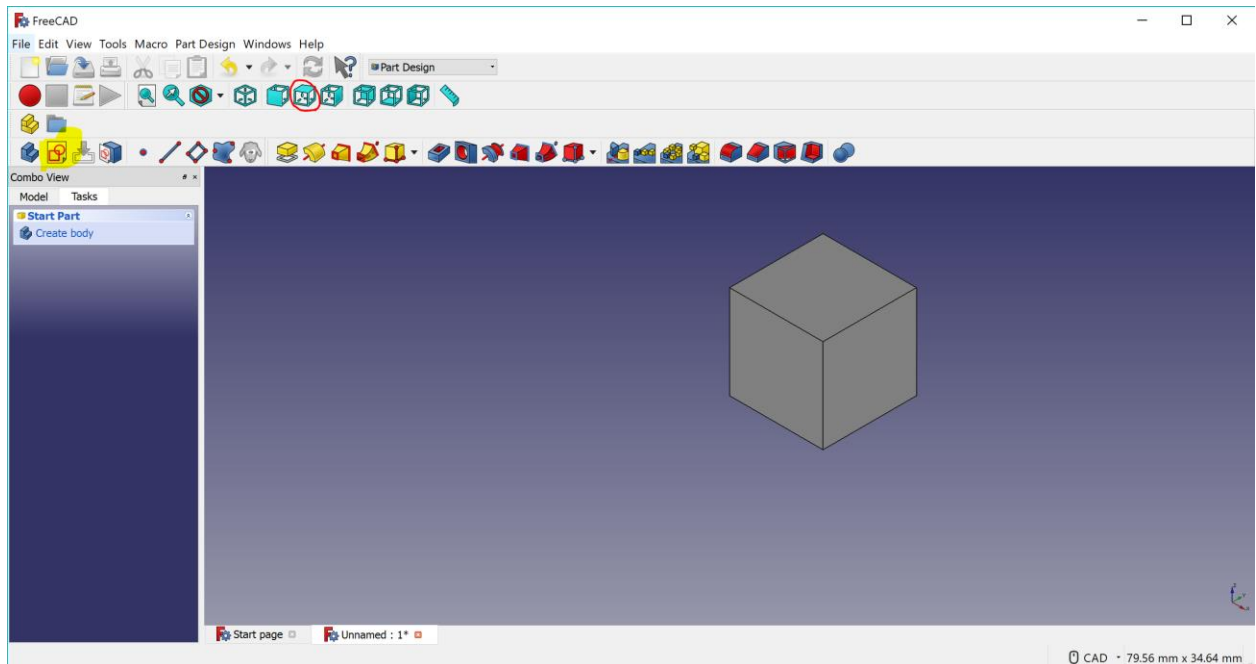
will be in the Z-direction. First click “Close” on your sketch (shown in the above image in yellow highlighter). Then select “Pad” circled in red below.



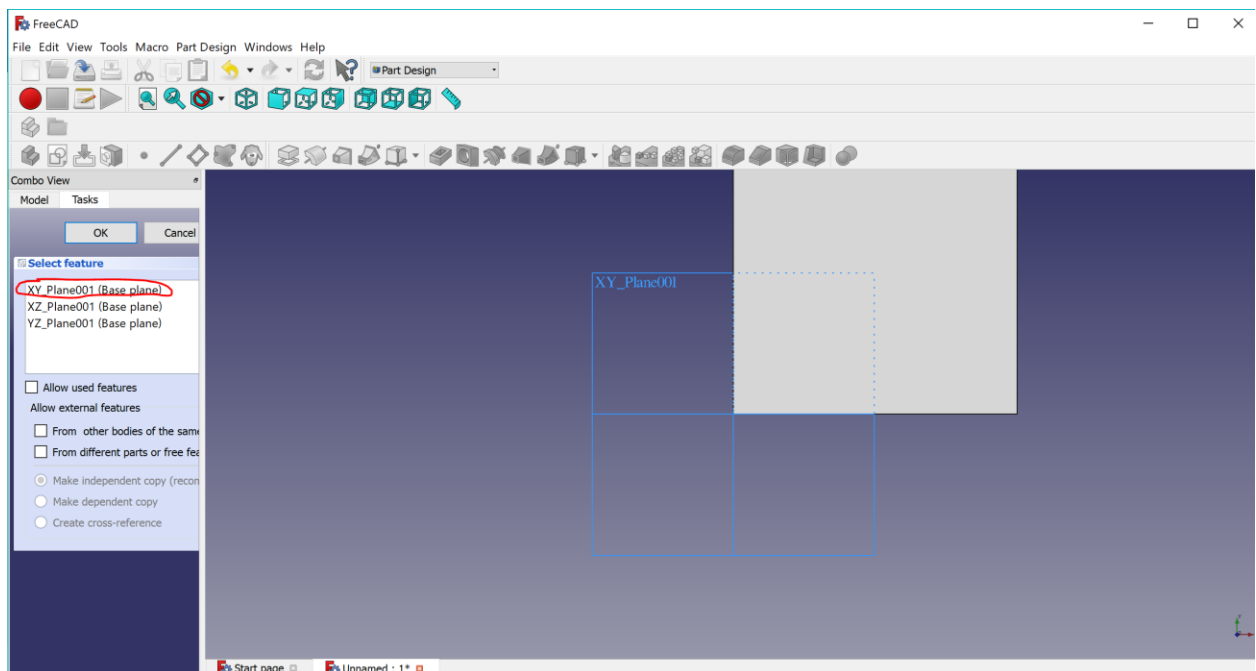
- Next choose the thickness of your object. We will pick 10mm. If you want to see your object at different angles, you can select one of the teal cubes in the toolbar. We clicked on the cube circled in red to obtain the view below. Click “Ok”.



- Next we will create a pocket within our existing shape. Your screen should look like what is seen below. Click on the create a sketch button again. Select the view encircled in red pen to get back to the XY view you started with.

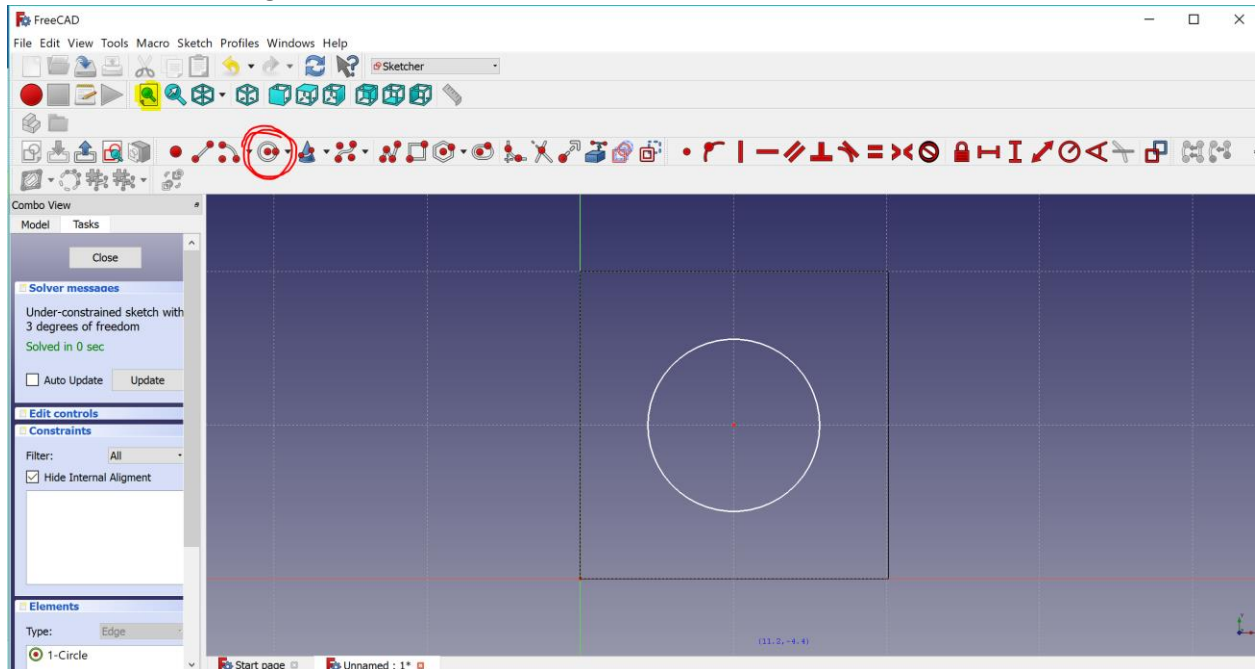


12. After clicking create sketch and changing your view back to the XY plane, your screen should look again similar to this. We will create the new sketch also in the XY plane, so select that again and hit OK.

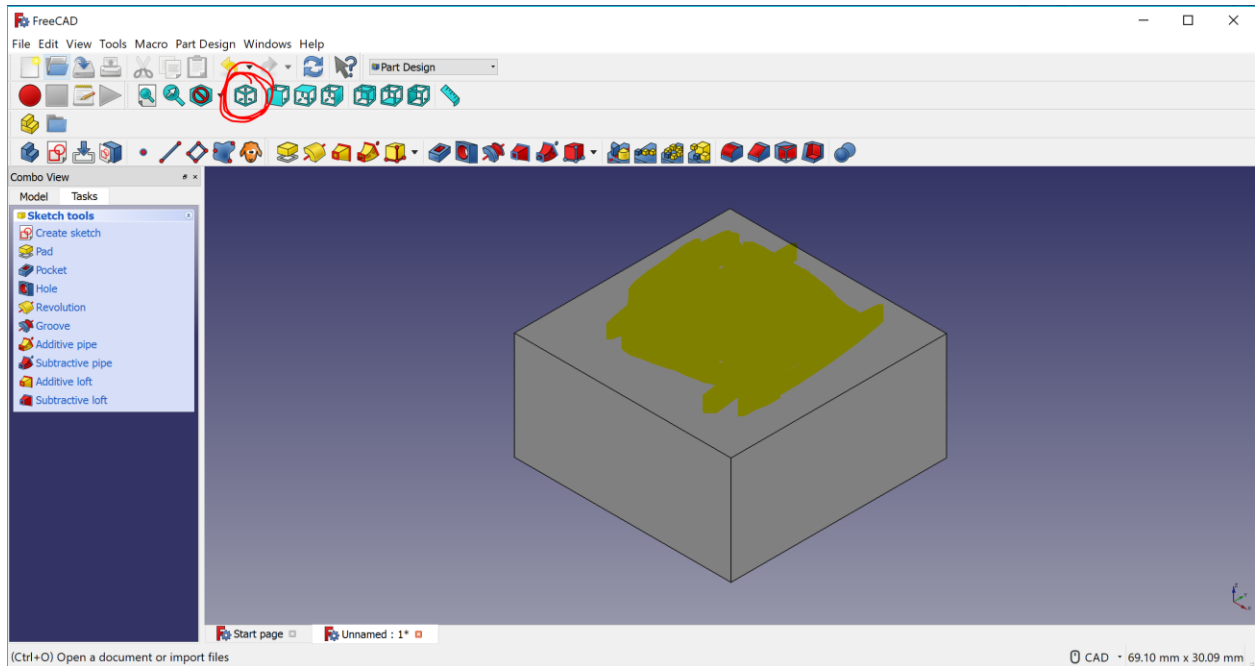


13. Next we will make a circle that is centered in our square. To make this easier (and to see through your box) hit View → Draw style → Wireframe. Next hit the create a circle button (in red below). For this button, the first click will set the center of the circle, and the second click will set the edge. Click and release in the center of the box, and drag the cursor somewhere between the center and edge of the box. Click and release again to create the circle. Your image

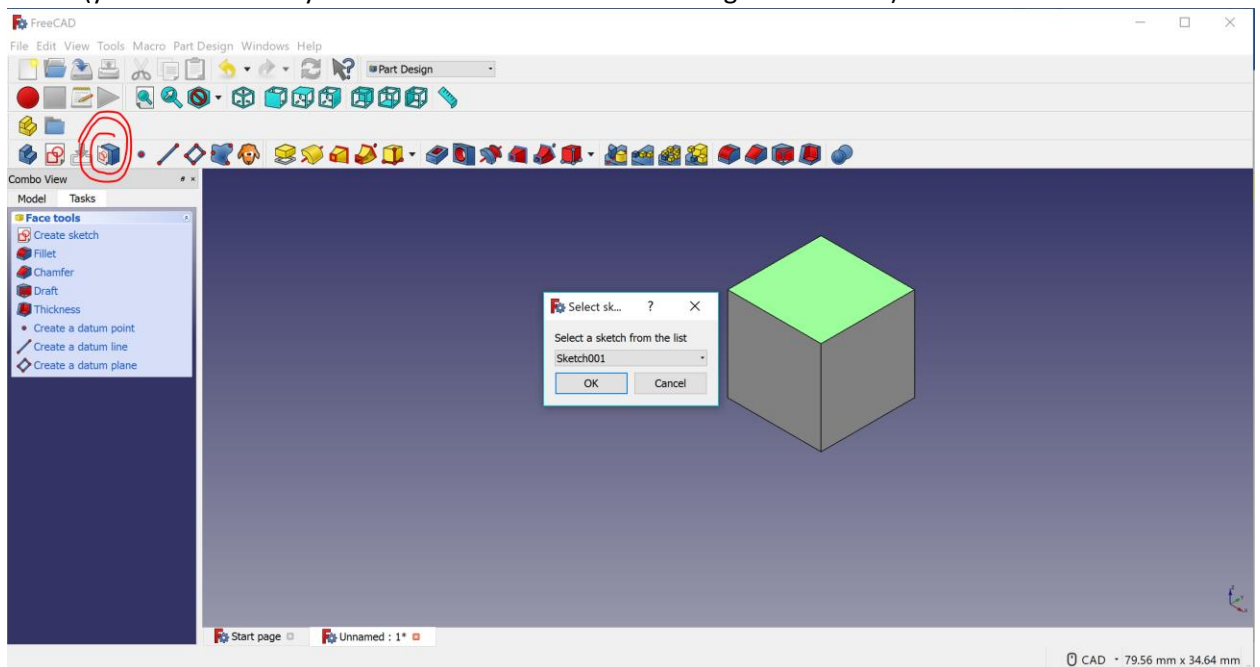
should look something like this:



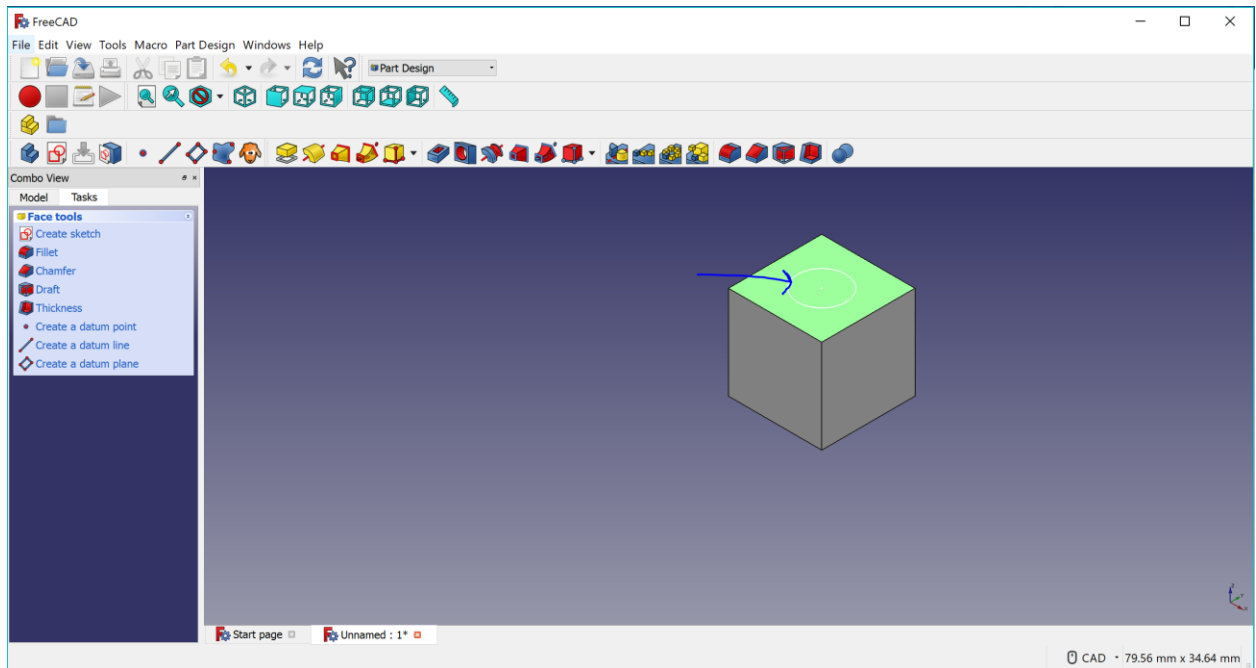
14. Now you have a circle in your square box. Hit Close. We will next make a pocket that is in the shape of the circle you've created. To do this, you need to "map" the circle to a particular face of the box so that the program knows where exactly on the box (i.e. top or bottom) that you want to create the pocket.
15. To make selecting the face easier, go back to View → Draw Style and select "As is." Also select the view circled in red to see a side corner view of the box. Next, click on the surface of the box that is highlighted in the below image:



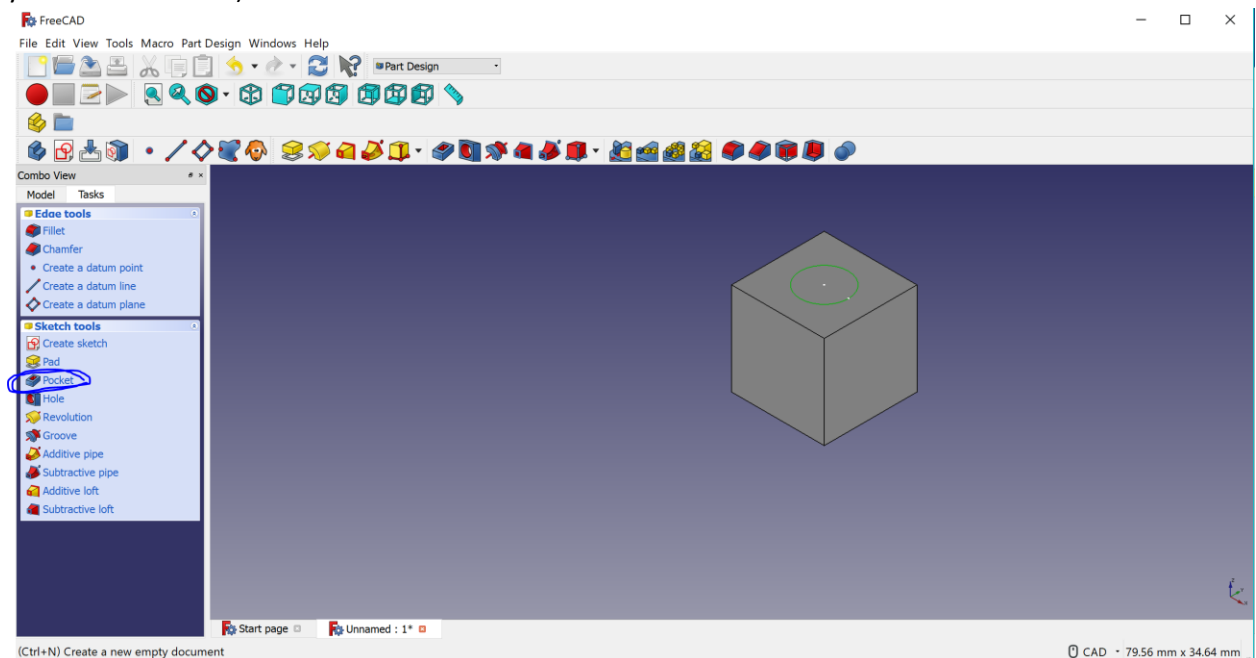
16. Click the “Map a sketch to a face” button circled in red. Select “Sketch001” from the drop down menu (your most recently created sketch should have the highest number) and hit OK.



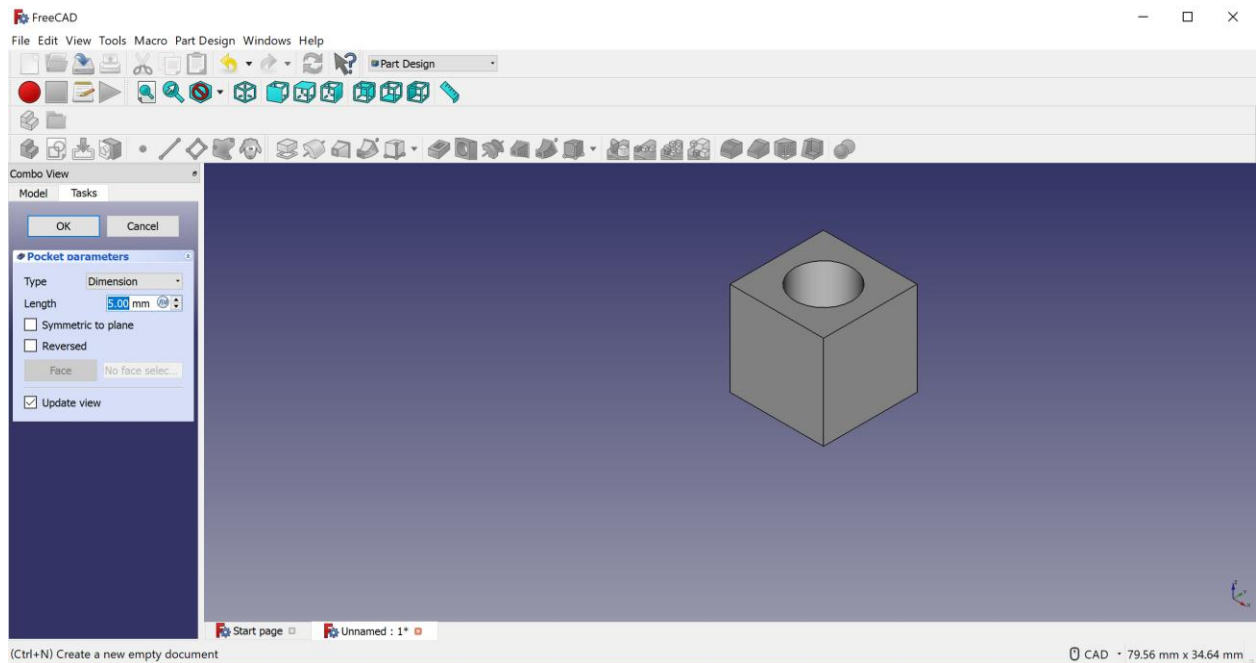
17. Congrats! Now your new sketch is mapped to the face you selected of your box. It should look like this:



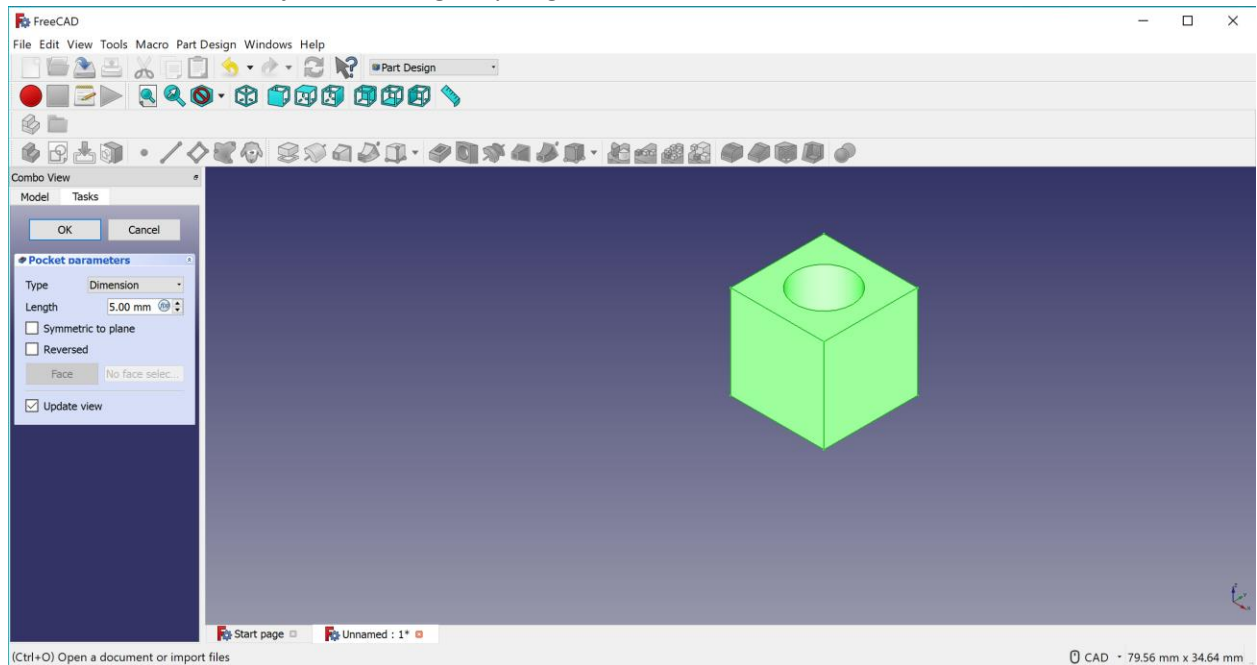
18. Select your circle sketch (indicated by the arrow above)- it should highlight in yellow when you mouse over it to indicate that you have in fact selected the circle. Once you click on your circle, it should look like the below image, with the circle now highlighted in green (indicating that you've clicked on it). Select "Pocket" circled in blue :



19. Your screen should look like this:



20. To Export your object, click somewhere in the blue/grey space next to the object, and hit CTRL+A. Your entire object should light up in green:



21. Now, hit File → Export and save your file as an .stl (STL Mesh) file. It can then be uploaded into Slicr or the 3D printing software for printing.

****Failure to select the entire object for exporting will result in loss of features for your final 3D printed object (I.e. the shape above may not have the pocket that we designed, and will just be a solid block)**