Prisms & Pyramids Design using FreeCAD

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Contents

***Abstract*—This manual explains designing of various models which explain various tools present in FreeCAD for 3D-designing, these models are basic design for any 3D shape in the universe.**

1 CAD Design of Prisms

This section deals with designing of prisms with basic polygons.

1.1 Cube

To design a cube,

- In FreeCAD software go to **View Menu**,select **Workbench** and click on **Sketcher Workbench**.
- Select Create sketch from **Sketch Menu** and choose **xy plane** to sketch a square. For this design choose the offset to be 0.
- Choose **Polyline tool** from **Sketcher geometries** in **Sketch Menu** and draw a rectangle.
- Select any one side of the rectangle and go to **Sketcher constraints** in **Sketch Menu**. Now apply **Constrain vertical distance** and set a length of 50mm.
- Click on **Sketcher constraints** and apply **Equality Constraint**(E) to all the sides of the rectangle in order to make it a square.Click on **leave sketch.** from **Sketch Menu**.

Fig. 1: Drawing tools

Fig. 2: Constraint tools

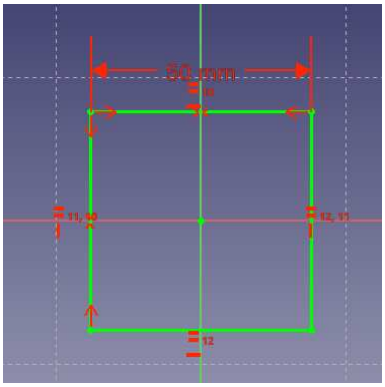

Fig. 3: Sketch view

- Go to **View Menu** and select **Part Workbench**.Now use the extrude feature from **Part Menu** to extrude the sketch along the **z-axis**(in direction keep x = 0.00, y = 0.00, z =1.00) with length equal to side of the square.(in extrude option select **create solid option** for a solid object.)
- Choose the label(**extrude**) from combo view and in **File** choose **Export** and export it as **Cube.stl** in seperate folder.

Fig. 4: Extrude tool box

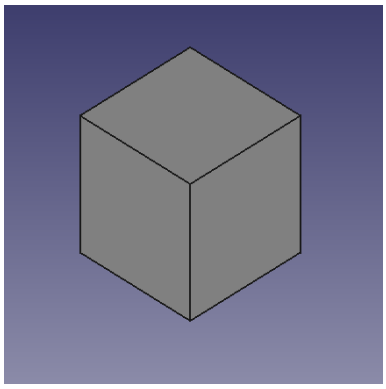

Fig. 5: Cubical prism

Fig. 6: 3D printed model

To 3D print the cube(CAM),

- Open **Cura** Software and open **Cube.stl** in it, then set **Layer height** to 0.2mm, **infill** to 30, and **infill pattern** to **Triangles**.
- **Slice** and generate the G-code and save it as **Cube.gcode** file, which is used to print.

Problem 2.1: Design a solid cuboid

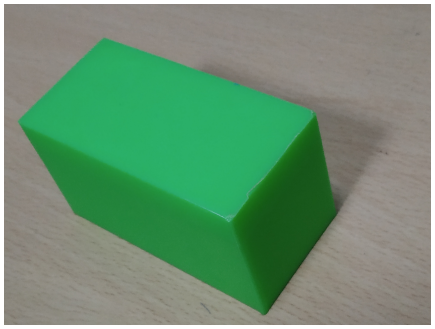

Fig. 7: 3D printed model

1.2 Hollow Cube

To design a hollow cube,

- In FreeCAD go to **Sketcher workbench**, and Create a new sketch using Polyline tool,draw two concentric squares of sides 45mm and 55mm.
- Use horizontal constraint to one side of each square.
- Select one vertex of the inner square and corresponding vertex of the outer square and Fix vertical and horizontal distance to 5mm using **Sketcher constraints**.
- Apply the same constraints to the diagonally opposite vertices of the squares and close the sketch.

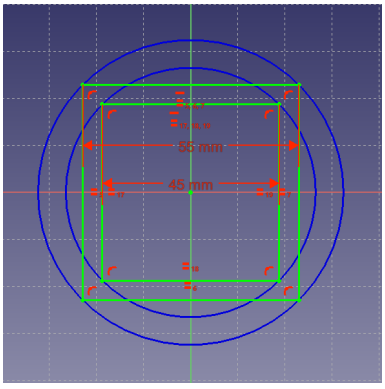

Fig. 8: Concentric square

- Use the extrude option in **Part Workbench** then extrude the sketch(select **create solid**) to a height of 55mm along z-axis.
- Choose the label(**pocket**) and in **File** choose **Export** and export it as **Hollow Cube.stl** in seperate folder.

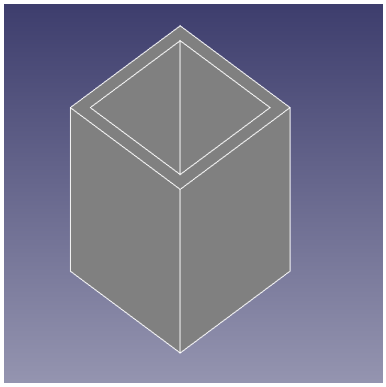

Fig. 9: Hollow Cube

To 3D print the Hollow cube(CAM),

- Open **Cura** Software and open **Hollow cube.stl** in it, then set **Layer height** to 0.2mm, **infill** to 50, and **infill pattern** to **Tri-Hexagon**.
- **Slice** and generate the G-code and save it as **Hollow cube.gcode** file, which is used to print.

Problem 2.2: Design a hollow cuboid.

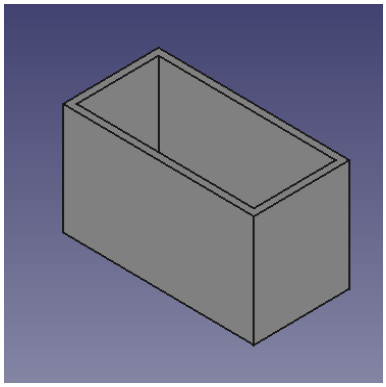

Fig. 10: Hollow Cuboid

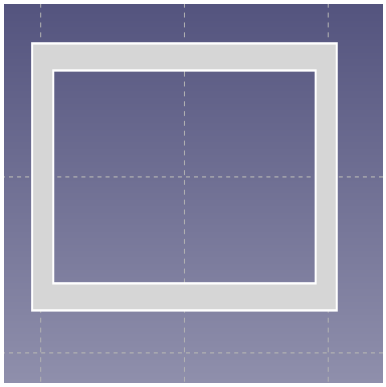

Fig. 11: Top view

Hint: Use rectangle tool and apply Fix Vertical/horizontal distance and Horizontal constraints.

1.3 Box

To Design a Cuboidal box,

- In **Sketcher Workbench** draw a rectangle of 50mm by 70mm,close the sketch.
- Extrude the sketch in **Part Workbench** to a height of 45mm.
- Select and top face of the cuboid and go to **Sketcher Workbench** and select create new sketch.
- Draw a rectangle with dimensions less than the previous rectangle .
- Select one vertex of the inner rectangle and corresponding vertex of the outer rectangle (Outer vertex is visible by using create an edge of external geometry constraint) and Fix vertical and horizontal distance to 5mm using **Sketcher constraints**.
- Apply the same constraints to the diagonally opposite vertices of the rectangles and close the sketch.

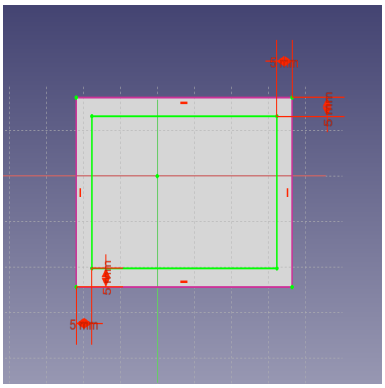

Fig. 12: Sketch on face

- Go to **View Menu** and click on **Part Design workbench**.Select the new sketch created and click on pocket from **Part Menu**.
- Set the length to 40mm and click ok to create a pocket.
- Choose the (**pocket**) label and in **File** choose **Export** and export it as **Hollow Cube.stl** in seperate folder.

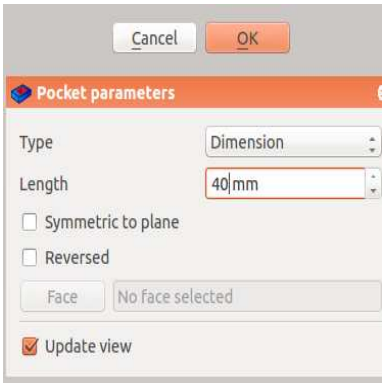

Fig. 13: Pocket tool box

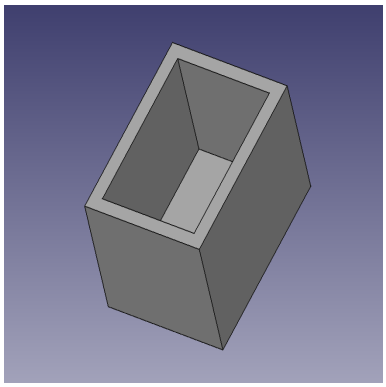

Fig. 14: Box

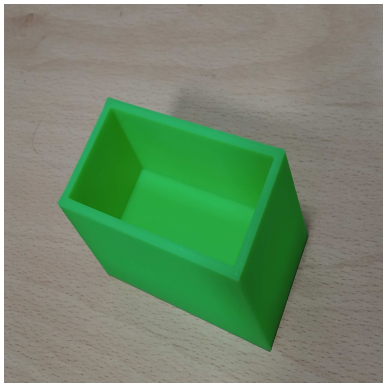

Fig. 15: 3D printed model

To 3D print the Box(CAM),

- Open **Cura** Software and open **Box.stl** in it, then set **Layer height** to 0.2mm, **infill** to 70, and **infill pattern** to **Tri-Hexgon**.
- **Slice** and generate the G-code and save it as **Box.gcode** file, which is used to print.

1.4 Cylinder

To design a Cylinder,

- Using a circle tool draw a circle.
- Select its circumference and apply radius constraint and fix the distance to 25mm.

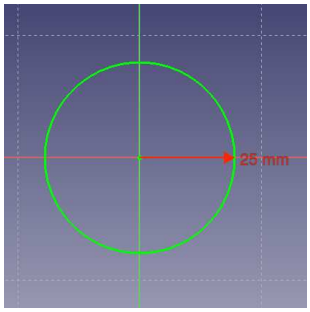

Fig. 16: sketch

- Extrude the sketch to a height of 70mm.
- Choose the (**extrude**) label and in **File** choose **Export** and export it as **Cylinder.stl** in seperate folder.

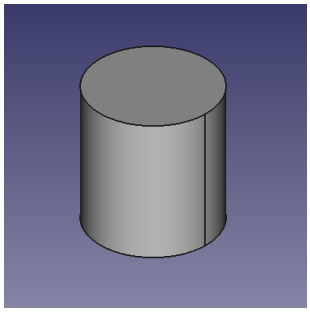

Fig. 17: Cylinder

Fig. 18: 3D printed model

To 3D print the Cylinder(CAM),

- Open **Cura** Software and open **Cylinder.stl** in it, then set **Layer height** to 0.2mm, **infill** to 30, and **infill pattern** to **Triangles**.

- **Slice** and generate the G-code and save it as **Cylinder.gcode** file, which is used to print.

Problem 2.3: Design a hollow Cylinder.

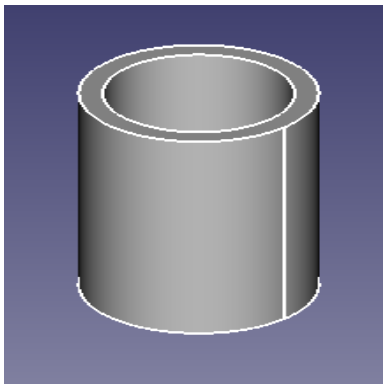

Fig. 19: Hollow Cylinder

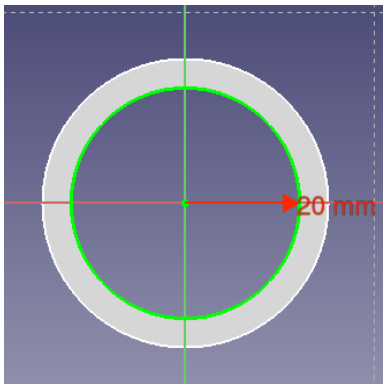

Fig. 20: Top view

1.5 Pentagonal Prism

To design a Pentagonal prism,

- Using polyline tool draw a random pentagon.
- Select one of side and apply horizontal constraint and fix distance to 30mm.
- Select two concecutive side and apply angle constraint of 108°and apply Equality constraint to all sides in order to get a regular pentagon, and close the sketch.
- Extrude the sketch to a height of 60mm
- Choose the (**extrude**) label and in **File** choose **Export** and export it as **Pentagonal prism.stl** in seperate folder.

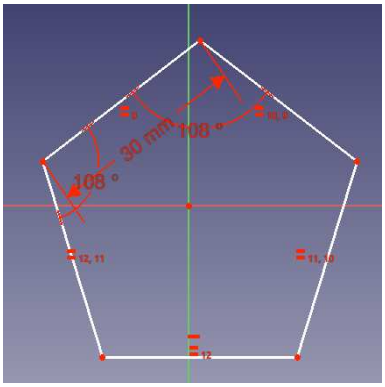

Fig. 21: Sketch

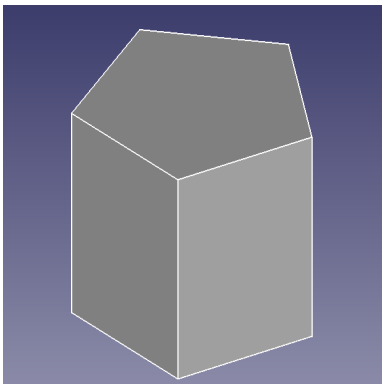

Fig. 22: Pentagonal Prism

Fig. 23: 3D printed model

To 3D print the Pentagonal prism(CAM),

- Open **Cura** Software and open **Pentagonal prism.stl** in it, then set **Layer height** to 0.2mm, **infill** to 30, and **infill pattern** to **Triangles**.
- **Slice** and generate the G-code and save it as

Pentagonal prism.gcode file, which is used to print.

Problem 2.3: Design a hollow pentagonal prism.
Hint: Use regular polygon tool and coincident constraints from **Sketcher constraints**.

Problem 2.4: Design a pentagonal box.
Hint: Refer to the steps used for designing **Box**.

Problem 2.5: Design a Triangular prism.
Solution:

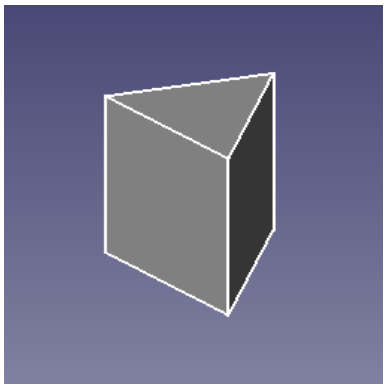

Fig. 24: Tringular Prism

Problem 2.6: Design a Hexagonal prism.

Solution:

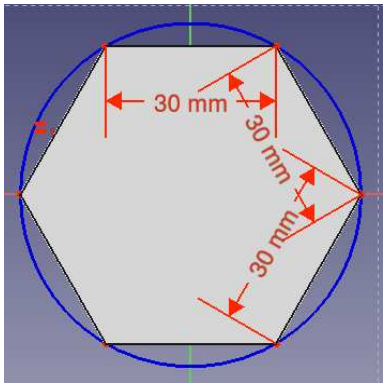

Fig. 25: Hexagonal Prism

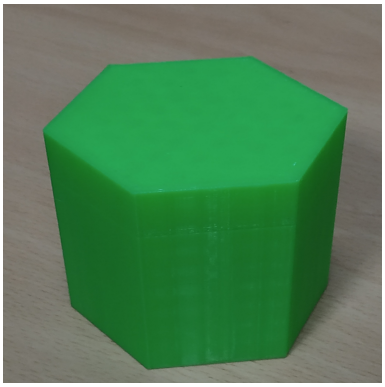

Fig. 26: 3D printed model

Problem 2.7: Design a Hexagonal box.

2 CAD Design of Pyramids

In this section we will design diffrent pyramids and learn the use of loft tool.

2.1 Cone

To design a Cone,

- In **Part Workbench** go to **Part Menu**, click on **Create primitives** and select **Point** and create a point at (0,0,60)
- Go to sketcher and draw a circle with center as origin using circle tool, constraint the radius to 25mm and close the sketch.
- Open Loft tool from **Part Menu** and add the sketch and vertex respectively and check **create soild** and click ok.
- Choose the (**loft**) label and in **File** choose **Export** and export it as **Cone.stl** in seperate folder.

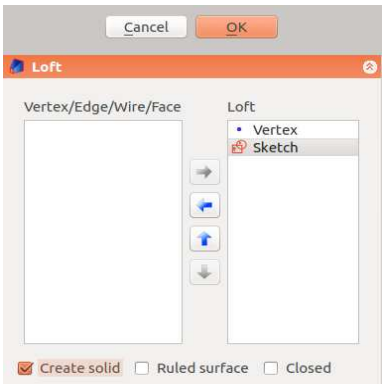

Fig. 27: Loft tool box

Note: Click the right arrow to add the sketch.

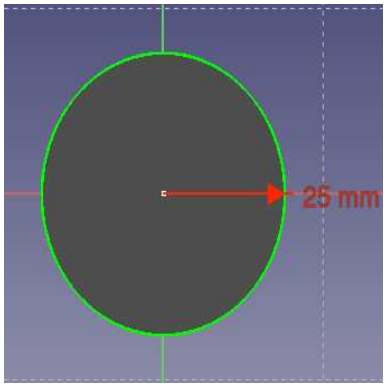

Fig. 28: Top view

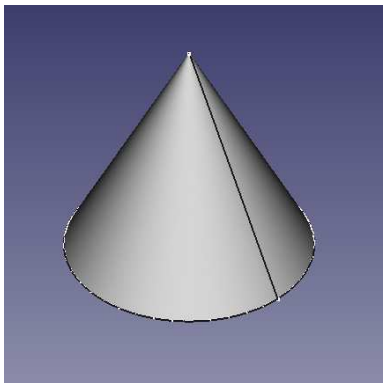

Fig. 29: Cone

Fig. 30: 3D printed model

To 3D print the Cone(CAM),

- Open **Cura** Software and open **Cone.stl** in it, then set **Layer height** to 0.2mm, **infill** to 30, and **infill pattern** to **Triangles**.
- **Slice** and generate the G-code and save it as **Cone.gcode** file, which is used to print.

2.2 Tetrahedron

To design a Tetrahedron,

- In **Part Workbench** go to **create primitives** and select **Point** and create a point at (0,0,60)
- Go to sketcher and draw a triangle with origin as center using line tool, constraint the lengths to 50 mm and close the sketch.
- Open Utility to Loft tool and add the sketch and vertex respectively and check **create soild** and press ok.
- Choose the (**Loft**) label and in **File** choose **Export** and export it as **Tetrahedron.stl** in seperate folder.

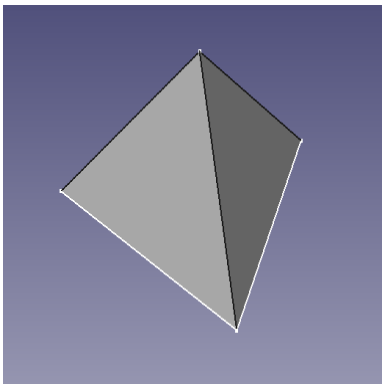

Fig. 31: Tetrahedron

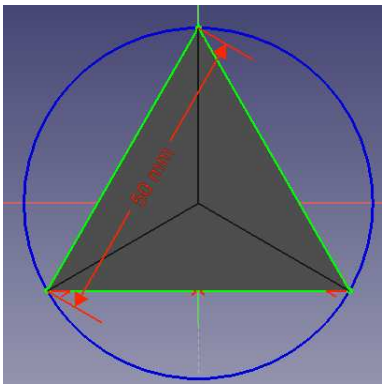

Fig. 32: Tetrahedron

To 3D print the Tetrahedron(CAM),

- Open **Cura** Software and open **Tetrahedron.stl** in it, then set **Layer height** to 0.2mm, **infill** to 30, and **infill pattern** to **Triangles**.
- **Slice** and generate the G-code and save it as **Tetrahedron.gcode** file, which can used to print.

2.3 Square Pyramids

To design a square pyramid,

- In **Part Workbench** go to **creation of prametrized geometric primitives** and select **Point** and create a point at (0,0,60)
- Go to sketcher and draw a square with center a origin using Polyline tool, constraint the horizontal length to 40 mm and close the sketch.
- Open Utility to Loft tool and add the sketch and vertex respectively and check **create soild** and press ok.
- Choose the (**Loft**) label and in **File** choose **Export** and export it as **Square pyramid.stl** in seperate folder.

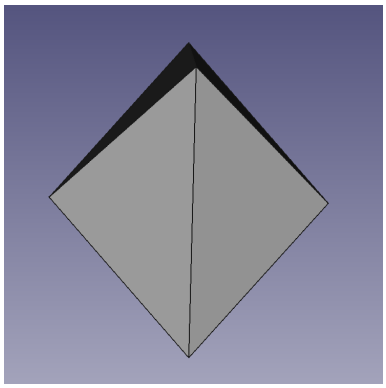

Fig. 33: Square pyramid

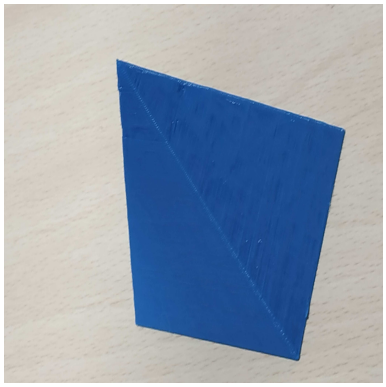

Fig. 34: 3D printed model

To 3D print the Square pyramid(CAM),

- Open **Cura** Software and open **Square pyramid.stl** in it, then set **Layer height** to 0.2mm, **infill** to 30, and **infill pattern** to **Triangles**.
- **Slice** and generate the G-code and save it as **Square pyramid.gcode** file, which can used to print.

2.4 Hollow Square Pyramid

- Create a pyramid as mentioned above.
- and create a sketch on bottom face, and follow the steps mention in **Box** design to draw a consentric square.
- In **Part Workbench** create a point at (0,0,55)
- Use loft by adding the new sketch and new point and create a pyramid.
- Select first pyramid and then the second pyramid and perform **cut** operation from **Boolean** present in **Part Menu** in **Part Workbench**.
- Choose the (**Pocket**) label and in **File** choose **Export** and export it as **Hollow Square pyramid.stl** in seperate folder.

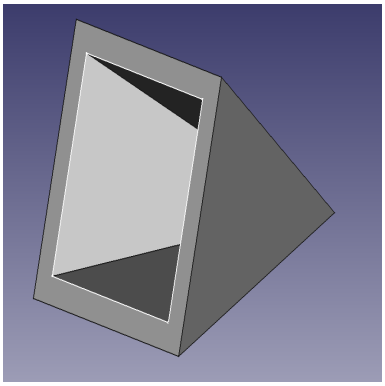

Fig. 35: Hollow Square pyramid

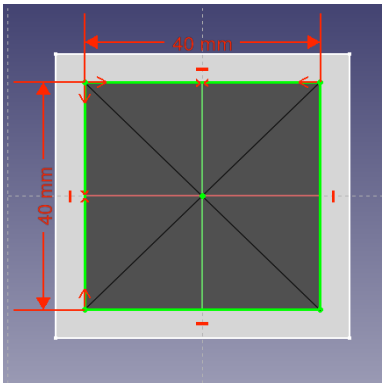

Fig. 36: Bottom view

To 3D print the Square pyramid(CAM),

- Open **Cura** Software and open **Holllow Square pyramid.stl** in it, then set **Layer height** to 0.2mm, **infill** to 50, and **infill pattern** to **Tri-Hexagon**.
- **Slice** and generate the G-code and save it as **Hollow Square pyramid.gcode** file, which

can used to print.

Problem 2.8: Design a pentagonal pyramid

2.5 Octahedron

- Create a Square pyramid and use **Mirroring** tool from **Part Menu** in **part workbench**.
- Choose both labels **extrude and mirror extrude** by holding ctrl key and in **File** choose **Export** and export it as **Octahedron.stl** in seperate folder.

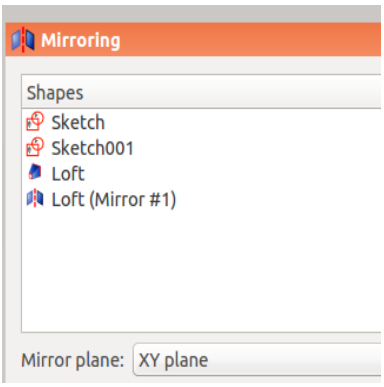

Fig. 37: Mirror tool box

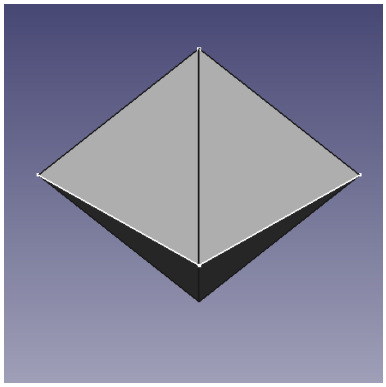

Fig. 38: Octahedron

To 3D print the Octahedron(CAM),

- Open **Cura** Software and open **Octahedron.stl** in it, then set **Layer height** to 0.2mm, **infill** to 50, and **infill pattern** to **Triangles**.
- **Slice** and generate the G-code and save it as **Octahedron.gcode** file, which can be used to print.

Fig. 39: 3D printed model

3 Conclusion

The above shown designs are created in one among the different possible ways they can be made. Even the Infill settings can be modified accordingly before drafting the designs.
Now it is your turn to explore and try different tools in FreeCAD.