

# OpenSCAD Example Projects

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# OpenSCAD

- Open Source parametric design tool
- Executables for Windows, Mac, Linux
- Free to distribute, free to use, cross-platform
- Converts textual instructions into 3D shapes
- Supports Constructive Solid Geometry (CSG) modeling



# Resource Links

- Downloads:

<http://www.openscad.org>

- User Manual:

[http://en.wikibooks.org/wiki/OpenSCAD\\_User\\_Manual](http://en.wikibooks.org/wiki/OpenSCAD_User_Manual)



# Clock Winding Key

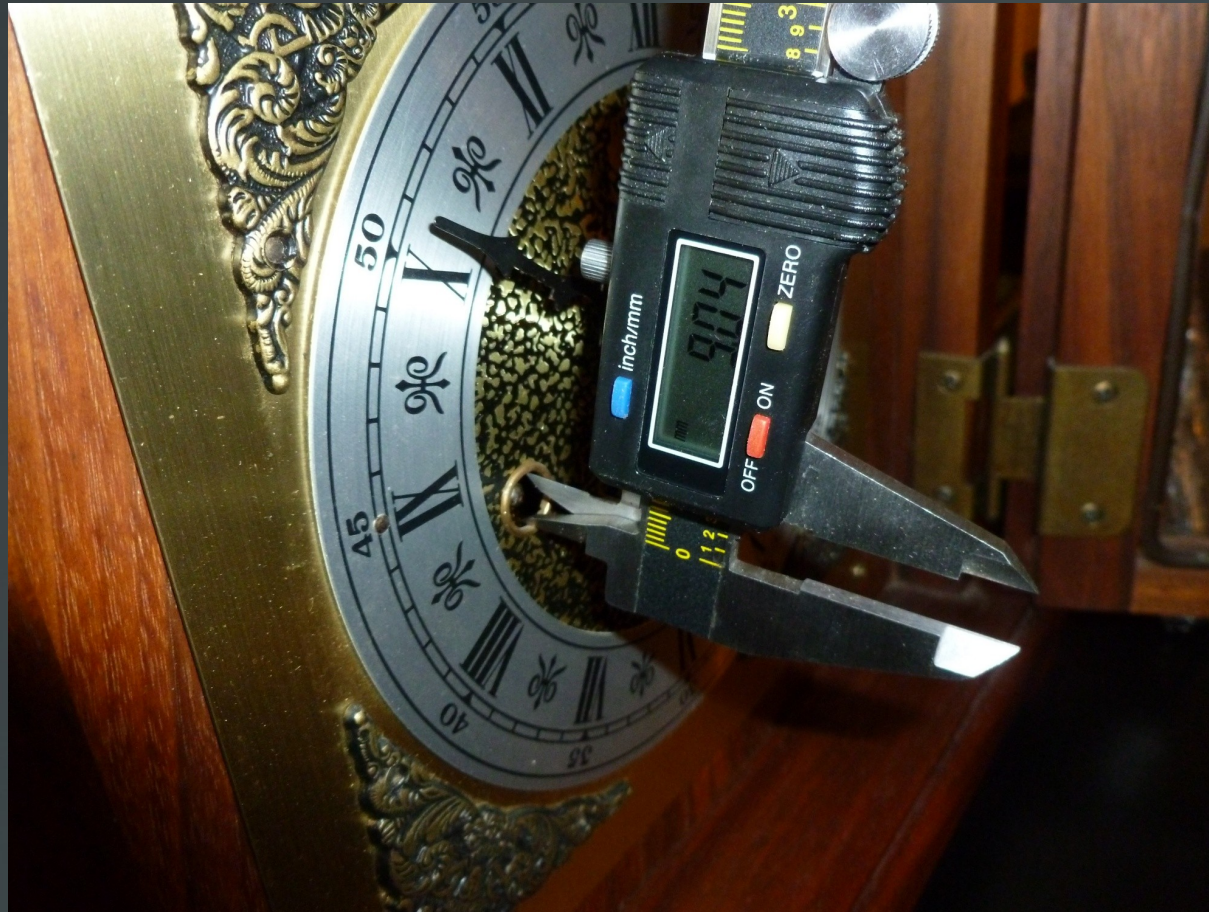
- First, get the fit correct.
  - Measure the interface, design the connection.
  - Print a test part, make sure it fits.
  - Repeat until the fit is correct.
- Second, design the rest of the key.



# Missing a winding key



# Measure the parts!



```
$fn=40;
```

```
outsideDiameter = 8;
```

```
insideDiameter = 4;
```

```
keyDepth = 7;
```

```
numSides = 4;
```

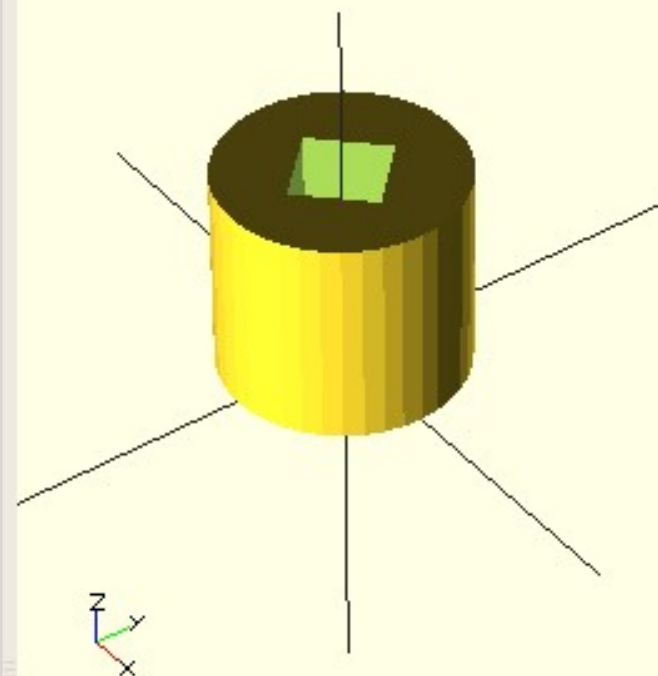
```
difference() {
```

```
  cylinder(r=outsideDiameter/2,  
           h=keyDepth);
```

```
  translate([0,0,-0.01])
```

```
    cylinder(r=insideDiameter/2,  
            h = keyDepth+0.02,  
            $fn=numSides);
```

```
} // end difference
```



```
generation)...  
PolySets in cache: 20  
Polygons in cache: 4281  
CGAL Polyhedrons in cache: 5  
Vertices in cache: 1112  
Compiling design (CSG Products  
normalization)
```

# Does it fit?

- Print a small test piece to see if it fits.
- With measurements this small, it is likely to not fit, as consumer level 3D printers and slicing software are not 100% accurate. (Plastic oozes inside curves, etc...)
- Figure out how much larger/smaller dimensions need to be for a good fit using small test parts that print fast and don't waste plastic.





# Modulize it!

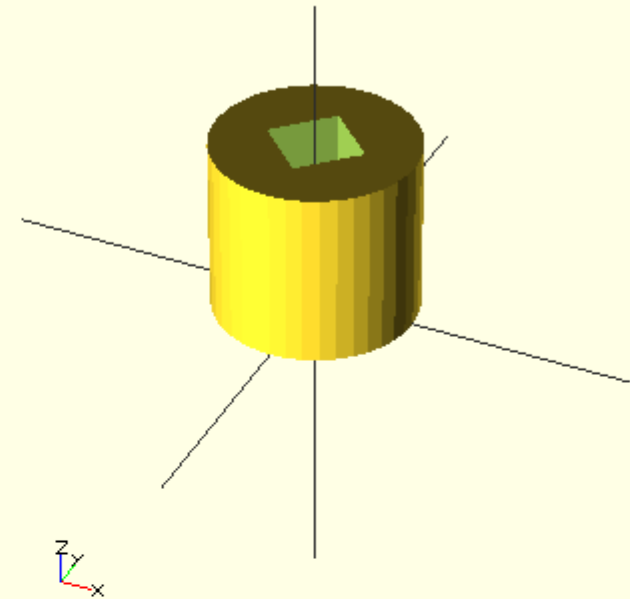
File Edit Design View Help

```
module keyShaft(outsideDiameter,
  insideDiameter,
  keyDepth,
  numSides)
{
  $fn=40;

  difference() {
    cylinder(r=outsideDiameter/2,
      h=keyDepth);

    translate([0,0,-0.01])
      cylinder(r=insideDiameter/2,
        h = keyDepth+0.02,
        $fn=numSides);
  } // end difference
} // end module

keyShaft(8, 4,7, 4);
```



```
Parsing design (AST generation)...
Compiling design (CSG Tree generation)...
Compilation finished.
Compiling design (CSG Products generation)...
PolySets in cache: 2
Polygons in cache: 48
CGAL Polyhedrons in cache: 0
Vertices in cache: 0
Compiling design (CSG Products
normalization)...
Normalized CSG tree has 2 elements
CSG generation finished.
Total rendering time: 0 hours, 0 minutes, 0
seconds
```

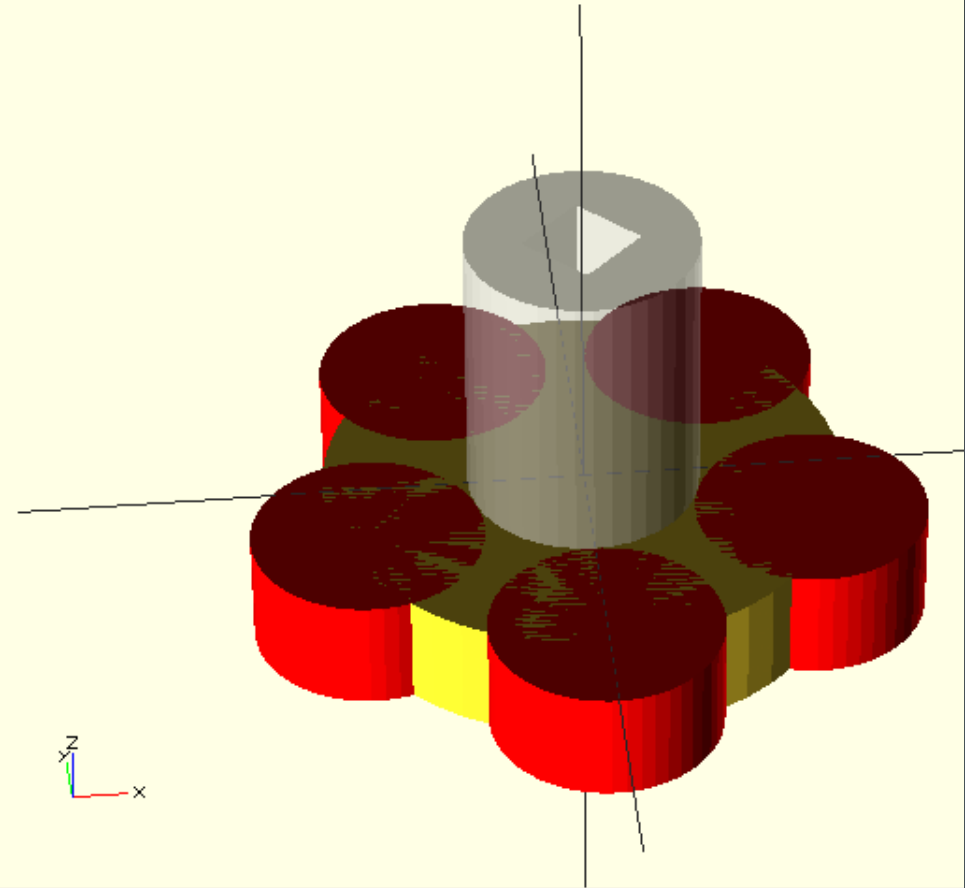
Viewport: translate = [ 0.00 0.00 0.00 ], rotate = [ 55.00 0.00 25.00 ], distance = 127.09

# Add the any-old-size parts

File Edit Design View Help

```
module keyBase()
{
  $fn=50;
  union() {
    translate([0,0,-4]) {
      cylinder(r=9,h=4);

      // Outside nubs.
      color( [1,0,0] )
      for (i = [0:6] ) {
        rotate([0,0,i*72 + 72/2] )
        translate([0,8,0] )
        cylinder(r=4,h=4);
      } // end for
    } // end translate down.
  } // end union.
} // end module
```

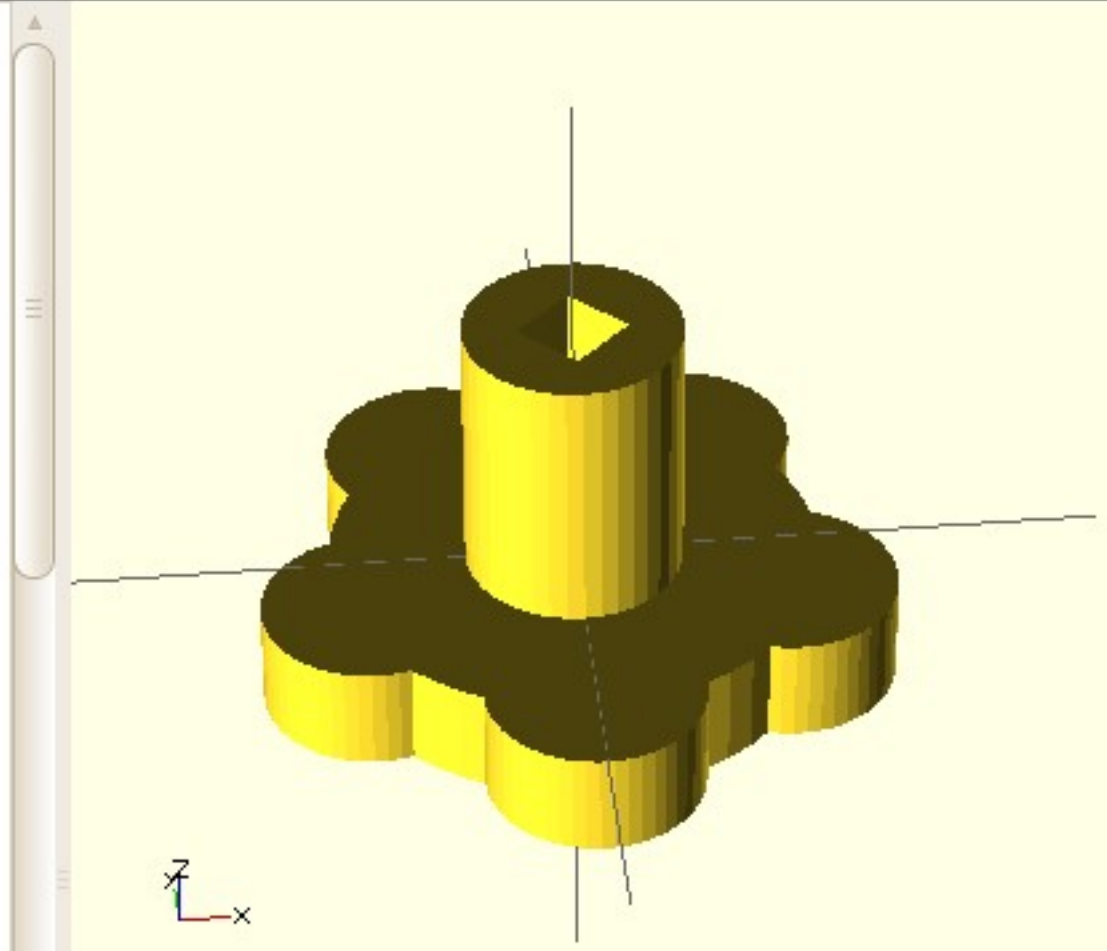


Parsing design (AST generation)...  
Compiling design (CSG Tree generation)...  
Compilation finished.

# Retain ability to print test part alone

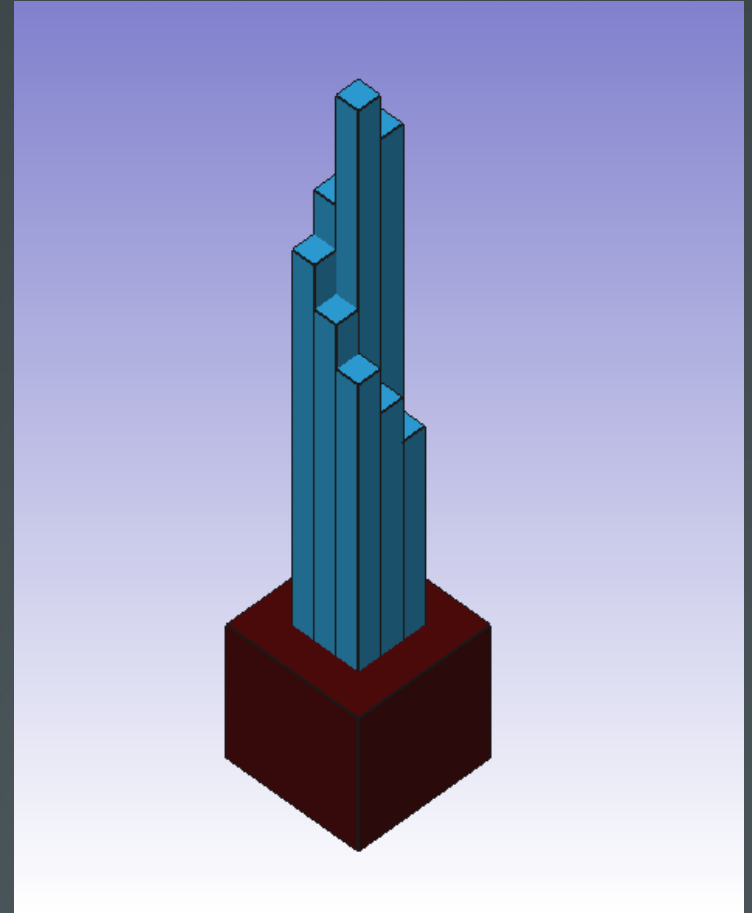
File Edit Design View Help

```
testShaft = false;  
  
if (testShaft == true) {  
    keyShaft(8, 4, 10, 4);  
} else {  
    union() {  
        keyShaft(8, 4, 10, 4);  
        keyBase();  
    }  
}
```

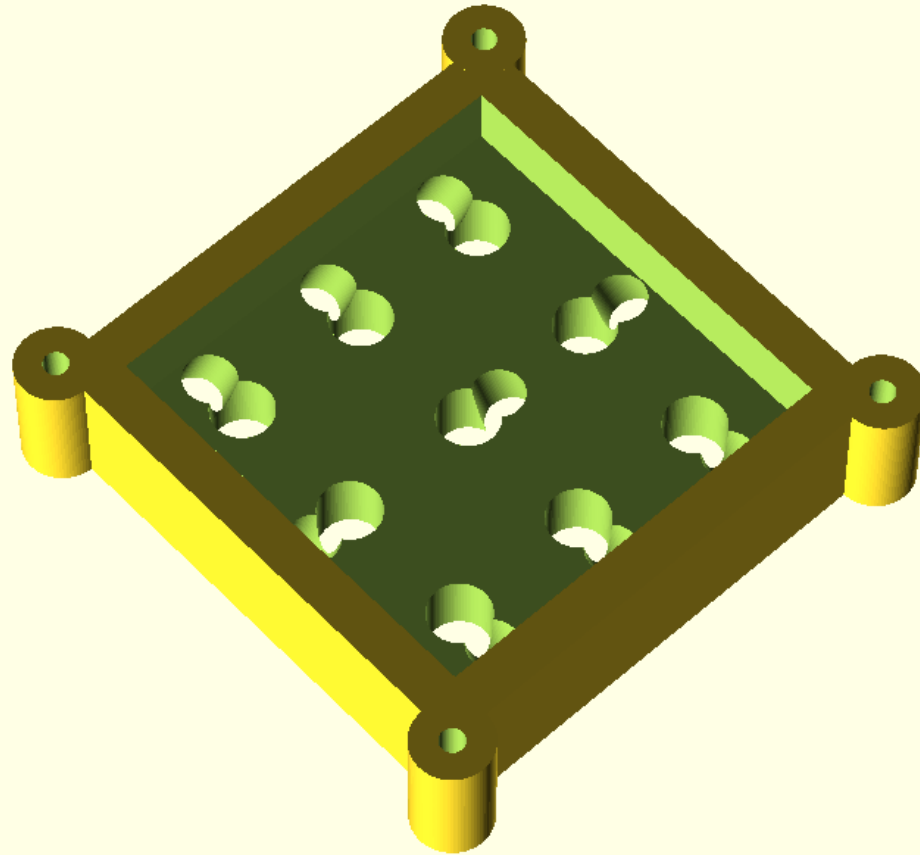


# New Example – Bubble Display Base

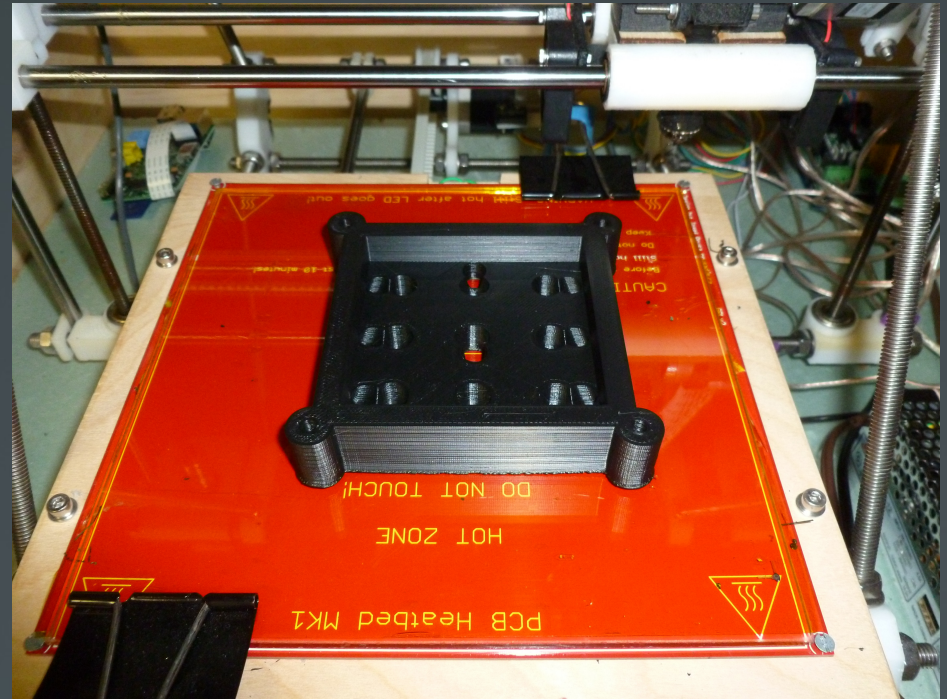
- Bubble Display made up of a square of nine one-inch square acrylic tubes.
- Each tube has an air nozzle, and an associated RGB color controlled LED that need to have a hole.



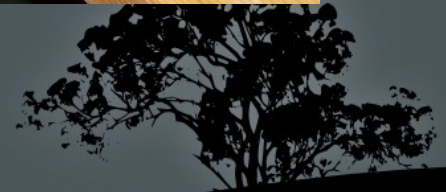
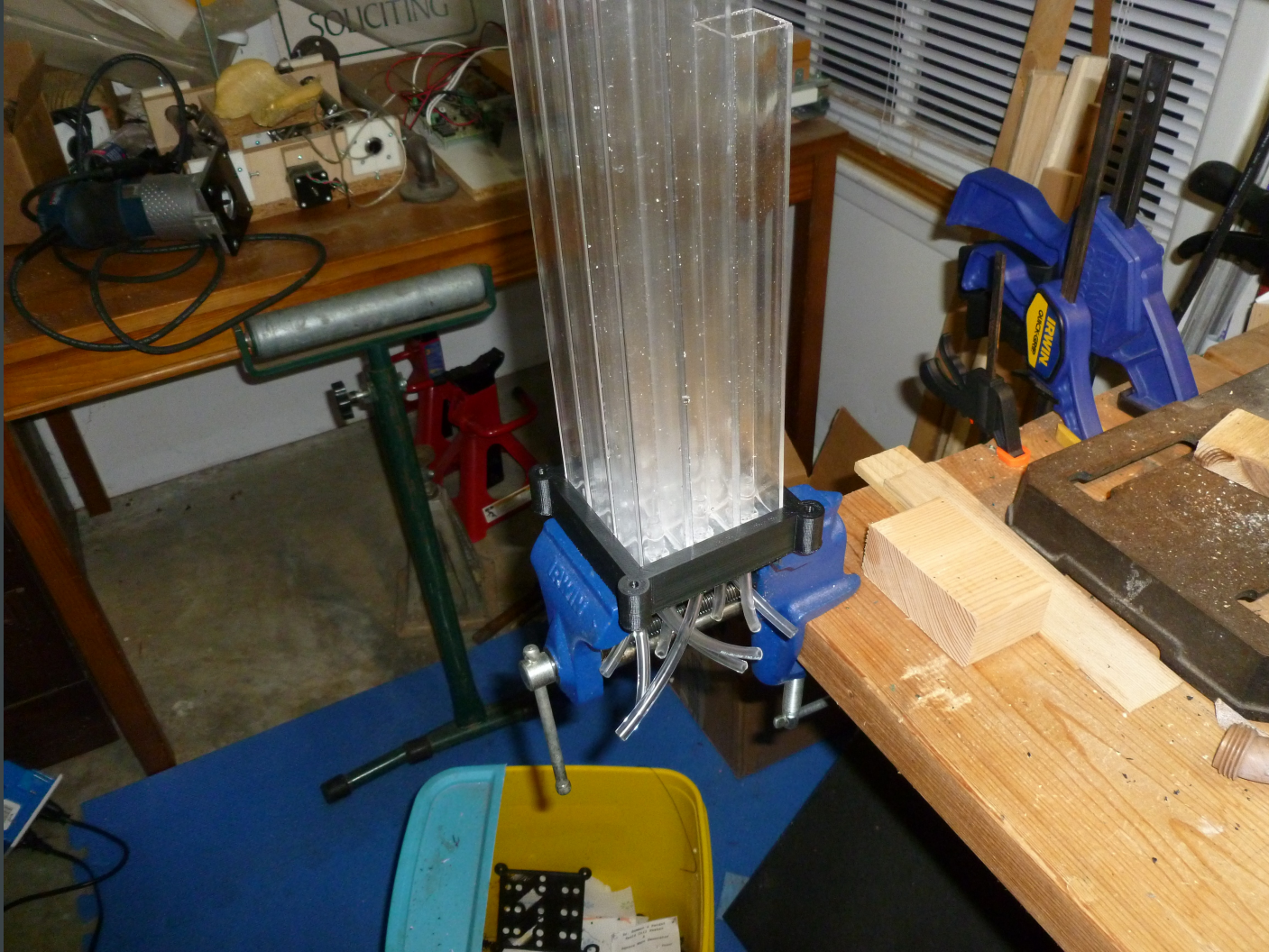
# Final Design



# Bottom & Printed



# Top



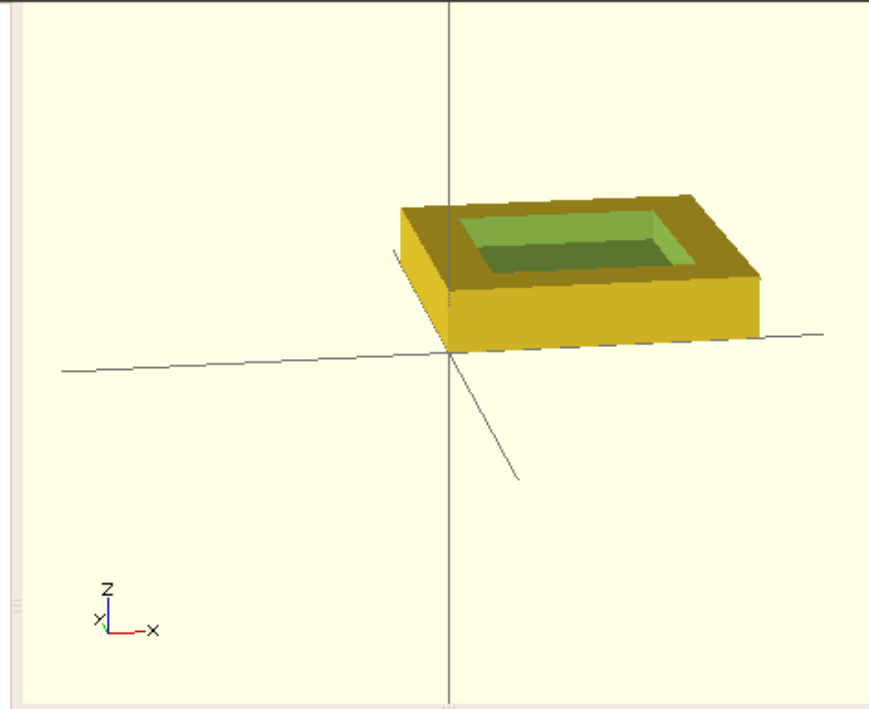
# Step 1 – Cut out the main box

File Edit Design View Help

```
tubeSize = 26;
outSideWall = 20;
bracketHeight = 24;

difference() {
  // Main "box"
  cube( [3*tubeSize+outSideWall*2,
        3*tubeSize+outSideWall*2,
        bracketHeight]);

  // Cutout for 3X3 tubes
  translate([outSideWall,outSideWall, bracketHeight/2])
  cube([3*tubeSize,3*tubeSize,bracketHeight/2+0.1] );
}
```



Parsing design (AST generation)...  
Compiling design (CSG Tree generation)...  
Compilation finished.  
Compiling design (CSG Products generation)...  
PolySets in cache: 2  
Polygons in cache: 12



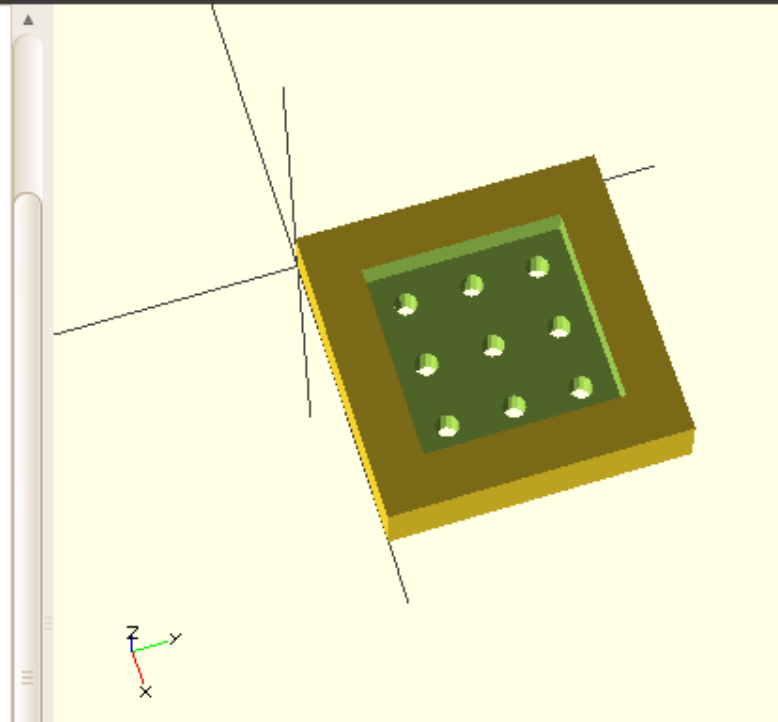
# Step 2 – Cut out holes for air hoses

File Edit Design View Help

```
difference() {
  // Main "box"
  cube([3*tubeSize+outSideWall*2,
        3*tubeSize+outSideWall*2,
        bracketHeight]);

  // Cutout for 3X3 tubes
  translate([outSideWall,outSideWall, bracketHeight/2])
  cube([3*tubeSize,3*tubeSize,bracketHeight/2+0.1] );

  // Holes for air hoses:
  for( x = [0:2] ) {
    for( y = [ 0:2] ) {
      translate([ outSideWall+x*tubeSize + (tubeSize/2),
                  outSideWall+y*tubeSize + (tubeSize/2), -0.1] )
      cylinder(r=4.5,h=bracketHeight/1.75);
    } // end for y
  } // end for X
```



```
Compiling design (CSG tree generation)...
Compilation finished.
Compiling design (CSG Products generation)...
PolySets in cache: 3
Polygons in cache: 29
CGAL Polyhedrons in cache: 0
Vertices in cache: 0
Compiling design (CSG Products normalization)...
Normalize count: 11

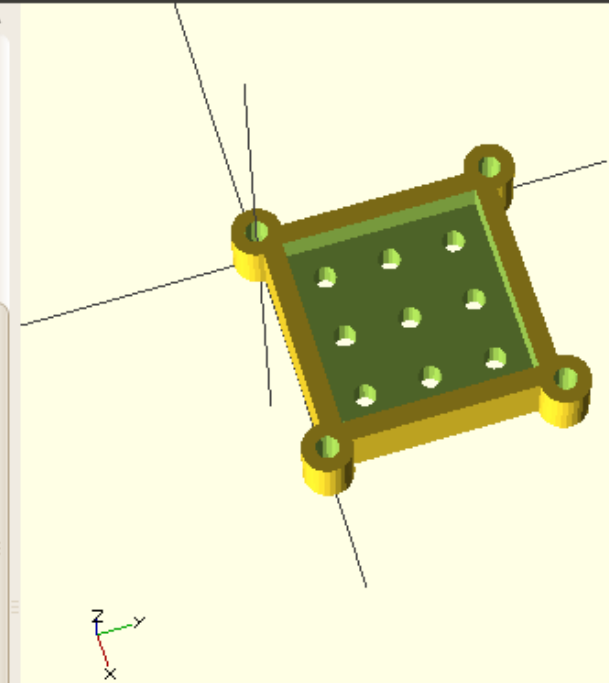
Normalized CSG tree has 11 elements
CSG generation finished.
Total rendering time: 0 hours, 0 minutes, 0 seconds
Saved design
```

# Step 3 – Holes for mounting screws

File Edit Design View Help

```
// corner screw surrounds:  
cylinder(r=10,h=bracketHeight);  
translate([3*tubeSize+2*outSideWall, 0,0])  
  cylinder(r=10,h=bracketHeight);  
translate([0, 3*tubeSize+2*outSideWall,0])  
  cylinder(r=10,h=bracketHeight);  
translate([3*tubeSize+2*outSideWall, 3*tubeSize+2*ou  
tSideWall,0])  
  cylinder(r=10,h=bracketHeight);  
} /// end union
```

```
// Holes for screws at corners:  
for( x = [0:1] ) {  
  for( y = [ 0:1] ) {  
    translate([ x*( tubeSize*3 + outSideWall*2) ,  
              y*( tubeSize*3 +outSideWall*2) , -0.1] )  
    cylinder(r=4.5,h=bracketHeight+0.2);  
  
  } // end for y  
} // end for X
```

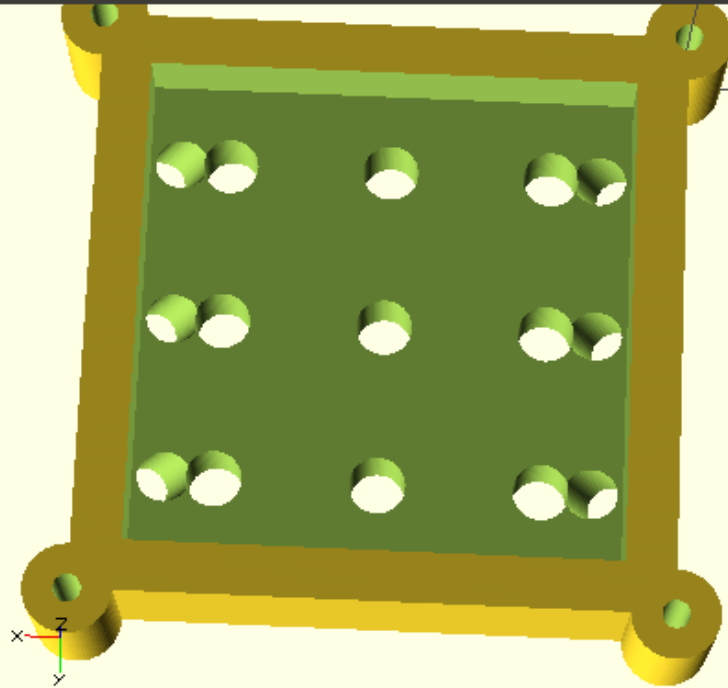


```
Parsing design (AST generation)...  
Compiling design (CSG Tree generation)...  
Compilation finished.  
Compiling design (CSG Products generation)...  
PolySets in cache: 6  
Polygons in cache: 84  
CGAL Polyhedrons in cache: 0  
Vertices in cache: 0  
Compiling design (CSG Products normalization)...  
Normalize count: 27  
  
Normalized CSG tree has 27 elements  
CSG generation finished.  
Total rendering time: 0 hours, 0 minutes, 0 seconds
```

# Step 4 – Six symmetrical LED holes

File Edit Design View Help

```
// Holes for RGB Color Controlled LED, six on sides:  
for ( i = [0:2] ) {  
  // One side  
  translate([outSideWall,  
            outSideWall+tubeSize/2 + i*tubeSize,-2])  
  rotate([0,20,0])  
  cylinder(r=4, h=bracketHeight);  
  
  // Other side...  
  translate([outSideWall+tubeSize*3,  
            outSideWall+tubeSize/2 + i*tubeSize,-2])  
  rotate([0,-20,0])  
  cylinder(r=4, h=bracketHeight);  
  
} // end for  
  
} // End Difference
```



PolySets in cache: 10  
Polygons in cache: 412  
CGAL Polyhedrons in cache: 0  
Vertices in cache: 0  
Compiling design (CSG Products normalization)...  
Normalize count: 29  
  
Normalized CSG tree has 29 elements  
CSG generation finished.  
Total rendering time: 0 hours, 0 minutes, 0 seconds  
Saved design

# Step 5 – The other 3 holes

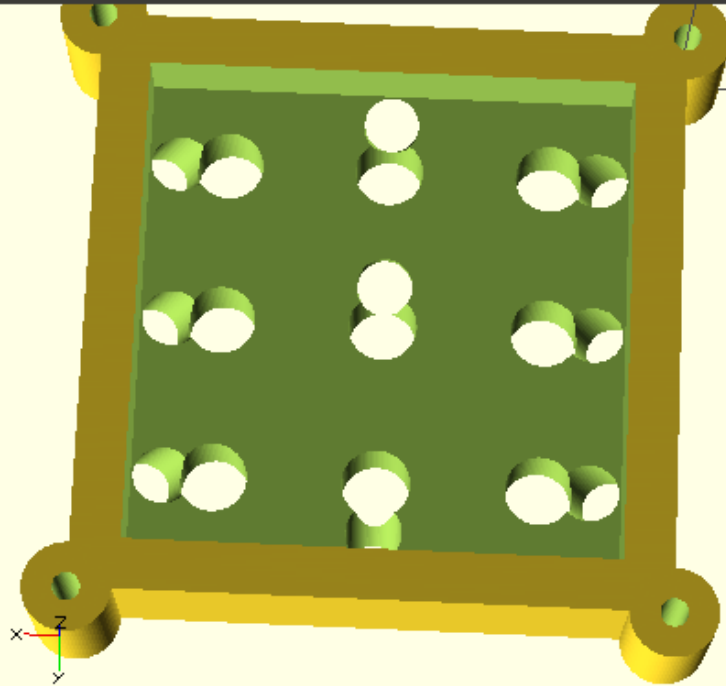
File Edit Design View Help

```
// Top in the "center" row:
translate([outSideWall+tubeSize*1.5,outSideWall,-2])
rotate([-20,0,0])
cylinder(r=LEDHoleRadius, h=bracketHeight+4);

// "center" row: center one is different and squished!
translate([outSideWall+tubeSize*1.5,
          outSideWall+tubeSize*1.1,-2])
rotate([-15,0,0])
cylinder(r=LEDHoleRadius, h=bracketHeight+4);

// Bottom in the "center" row:
translate([outSideWall+tubeSize*1.5,
          outSideWall+tubeSize*3,-2])
rotate([20,0,0])
cylinder(r=LEDHoleRadius, h=bracketHeight+4);

} // End Difference
```



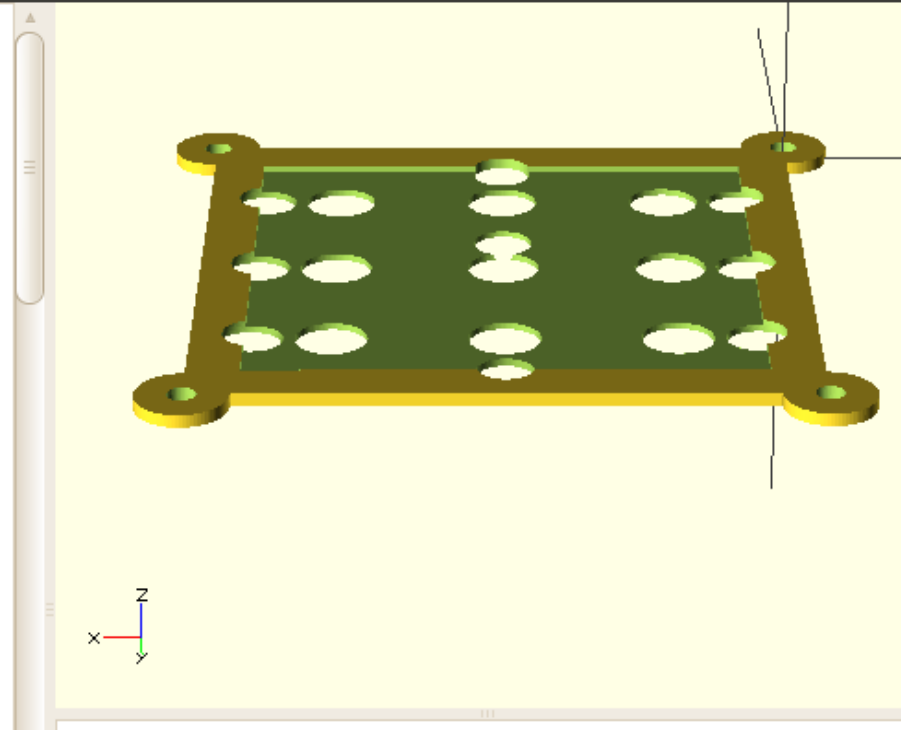
```
Parsing design (AST generation)...
Compiling design (CSG Tree generation)...
Compilation finished.
Compiling design (CSG Products generation)...
PolySets in cache: 12
Polygons in cache: 576
CGAL Polyhedrons in cache: 0
Vertices in cache: 0
Compiling design (CSG Products normalization)...
Normalize count: 32

Normalized CSG tree has 32 elements
CSG generation finished.
Total rendering time: 0 hours, 0 minutes, 0 seconds
```

# Print a test piece in less than 12 hours

File Edit Design View Help

```
tubeSize = 26;  
outSideWall = 8;  
bracketHeight = 2; // <-----See what I did here?  
  
airHoleRadius = 5.5;  
LEDHoleRadius = 4.5;  
$fn=80;  
  
difference() {  
  
    union() {  
        // Main "box"  
        cube([3*tubeSize+outSideWall*2,3*tubeSize+outS  
ideWall*2,bracketHeight]);
```



If you have done your parametric design correctly, resizing the height to a very small number just works.



# Questions?

- <http://www.openscad.org>
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