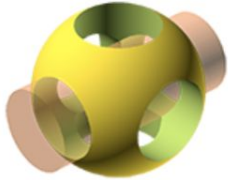
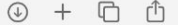


Design a 3D Part with OpenSCAD

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Screenshots = "fair use"



OpenSCAD

The Programmers Solid 3D CAD Modeller

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OpenSCAD is software for creating solid 3D CAD objects.

It is free software and available for Linux/UNIX, MS Windows and Mac OS X.



Download OpenSCAD

OpenSCAD 2021.01 Mac OS X

[Other OSs and Versions](#)



Tutorial

Get started with OpenSCAD



Libraries

Ready-made building blocks



Books

List of books on OpenSCAD



Cheat Sheet

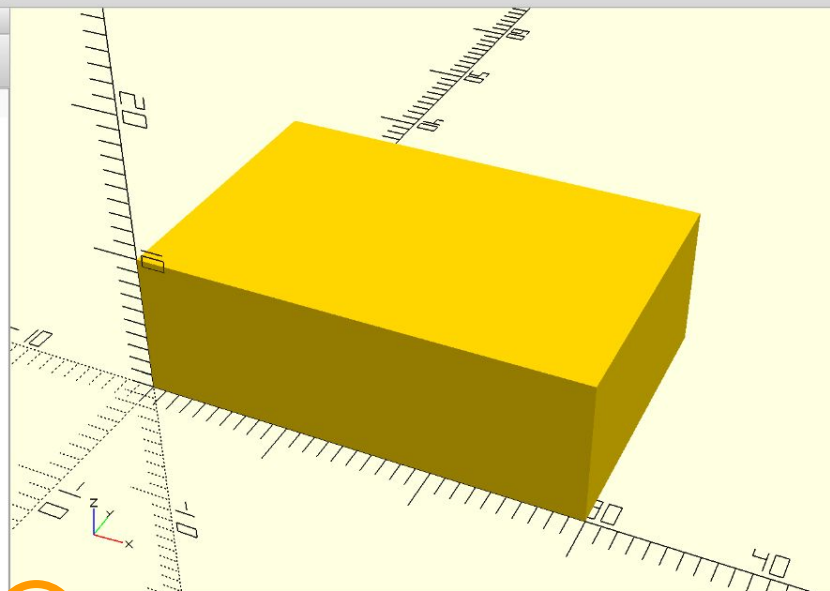
Overview of modules and functions

Basics

Create and combine simple shapes



```
1 cube([30, 20, 10]); // mm
```



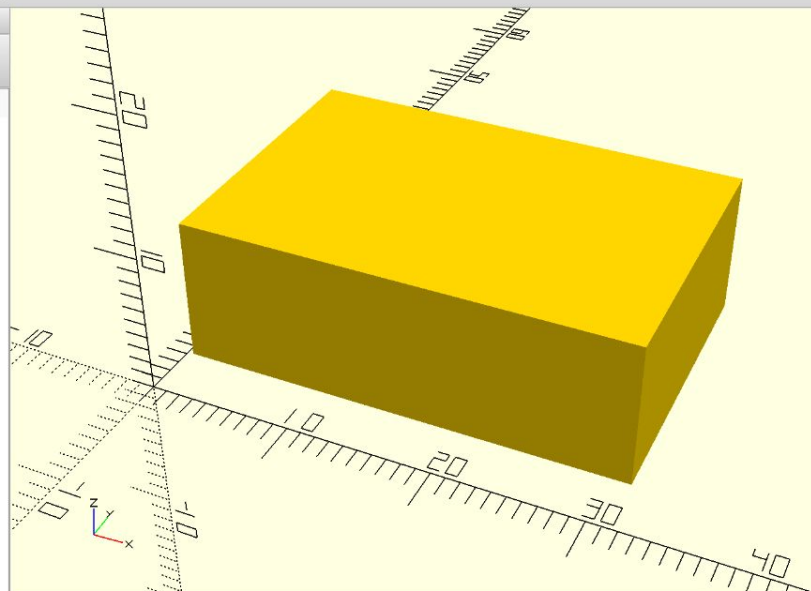
Compile and preview finished.
Total rendering time: 0:00:00.036

Parsing design (AST generation)...
Compiling design (CSG Tree generation)...
Compiling design (CSG Products generation)...
Geometries in cache: 3
Geometry cache size in bytes: 2184
CGAL Polyhedrons in cache: 0
CGAL cache size in bytes: 0
Compiling design (CSG Products normalization)...
Normalized tree has 1 elements!
Compile and preview finished.
Total rendering time: 0:00:00.027

Editor



```
1 translate([2, 2, 2]) cube([30, 20, 10]); // mm
```



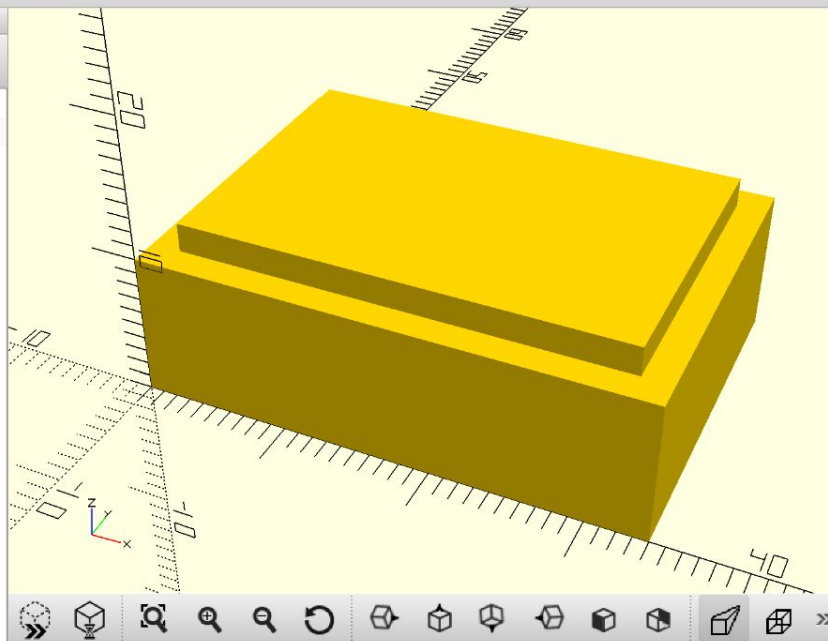
Console

```
Compile and preview finished.  
Total rendering time: 0:00:00.033  
Saved design '/Users/tamberg/Desktop/Enclosure.scad'.  
Loaded design '/Users/tamberg/Desktop/Enclosure.scad'.  
Compiling design (CSG Tree generation)...  
Compiling design (CSG Products generation)...  
Geometries in cache: 6  
Geometry cache size in bytes: 4368  
CGAL Polyhedrons in cache: 0  
CGAL cache size in bytes: 0  
Compiling design (CSG Products normalization)...  
Normalized tree has 1 elements!  
Compile and preview finished.  
Total rendering time: 0:00:00.045
```

Editor



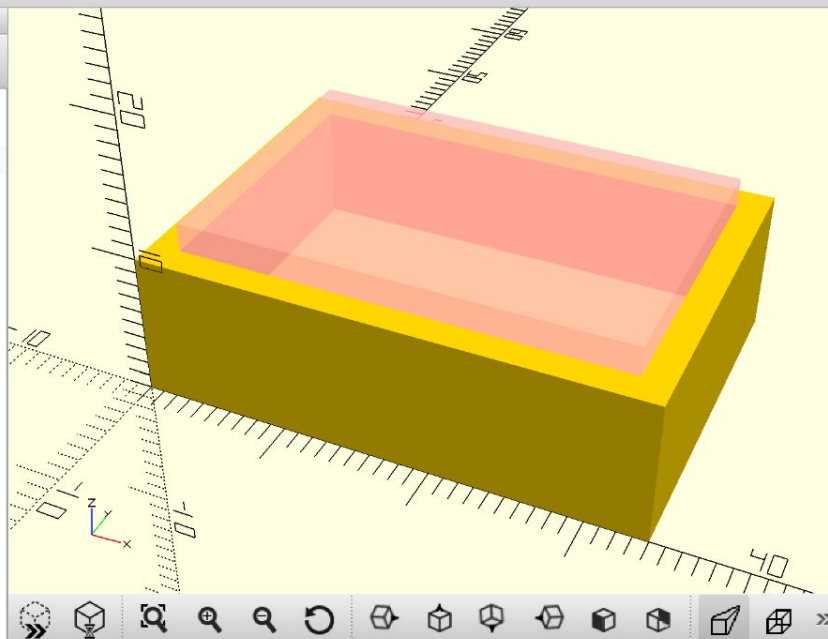
```
1 cube([34, 24, 10]);  
2 translate([2, 2, 2]) cube([30, 20, 10]);
```



Console

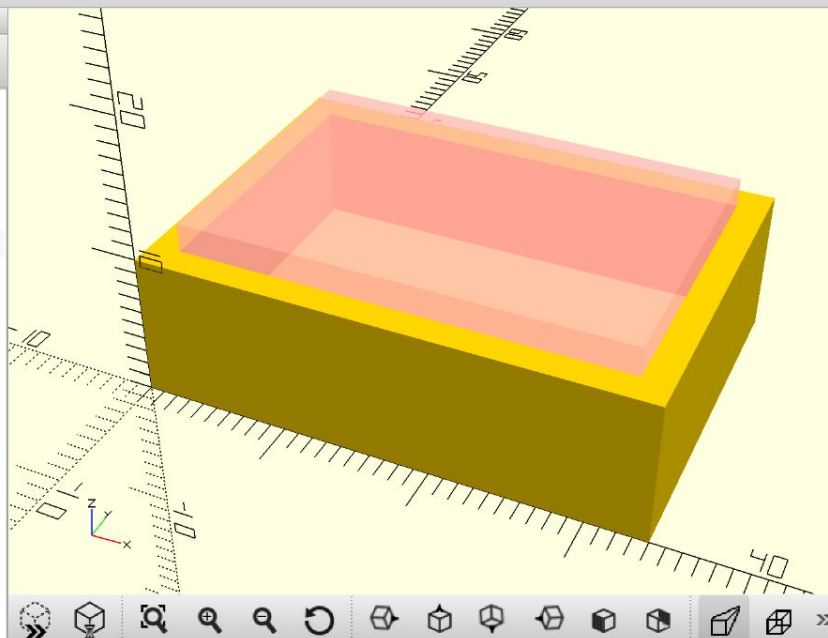
```
Compile and preview finished.  
Total rendering time: 0:00:00.045  
Saved design '/Users/tamberg/Desktop/Enclosure.scad'.  
Loaded design '/Users/tamberg/Desktop/Enclosure.scad'.  
Compiling design (CSG Tree generation)...  
Compiling design (CSG Products generation)...  
Geometries in cache: 11  
Geometry cache size in bytes: 8008  
CGAL Polyhedrons in cache: 0  
CGAL cache size in bytes: 0  
Compiling design (CSG Products normalization)...  
Normalized tree has 2 elements!  
Compile and preview finished.  
Total rendering time: 0:00:00.032
```

```
1 difference() {  
2     cube([34, 24, 10]);  
3     #translate([2, 2, 2]) cube([30, 20, 10]);  
4 }
```



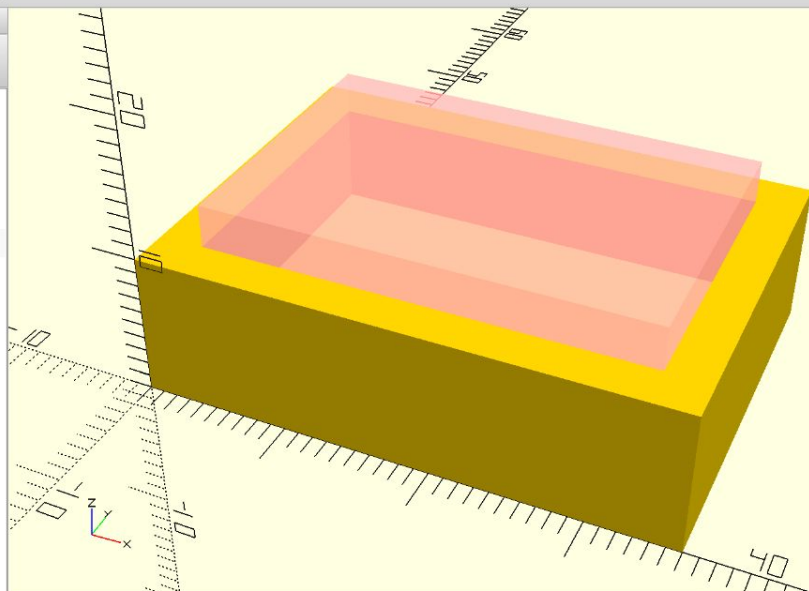
```
Total rendering time: 0:00:00.036  
Saved design '/Users/tamberg/Desktop/Enclosure.scad'.  
Loaded design '/Users/tamberg/Desktop/Enclosure.scad'.  
Compiling design (CSG Tree generation)...  
Compiling design (CSG Products generation)...  
Geometries in cache: 11  
Geometry cache size in bytes: 8008  
CGAL Polyhedrons in cache: 0  
CGAL cache size in bytes: 0  
Compiling design (CSG Products normalization)...  
Compiling highlights (1 CSG Trees)...  
Normalized tree has 2 elements!  
Compile and preview finished.  
Total rendering time: 0:00:00.038
```

```
1 d = 2; // mm
2
3 difference() {
4     cube([30 + 2 * d, 20 + 2 * d, 10]);
5     #translate([d, d, d]) cube([30, 20, 10]);
6 }
```



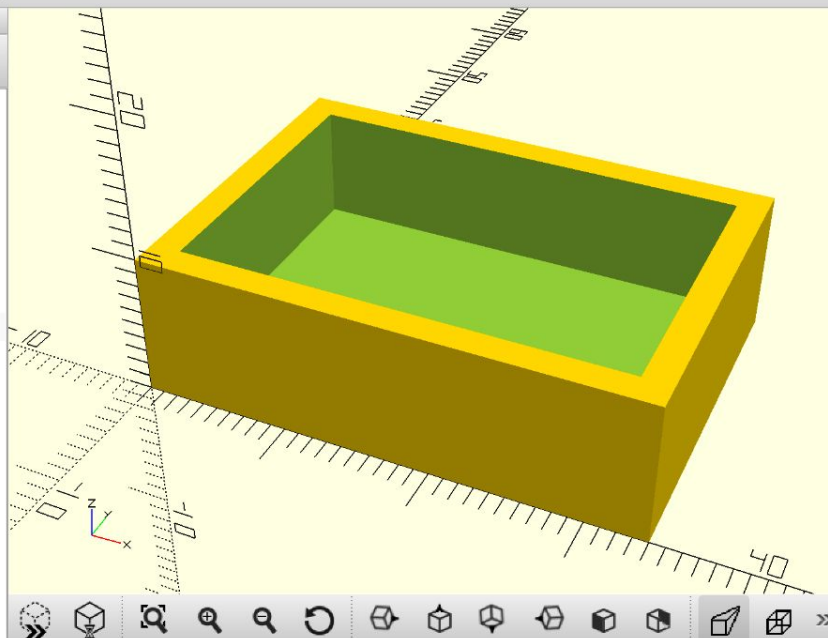
```
Total rendering time: 0:00:00.033
Saved design '/Users/tamberg/Desktop/Enclosure.scad'.
Loaded design '/Users/tamberg/Desktop/Enclosure.scad'.
Compiling design (CSG Tree generation)...
Compiling design (CSG Products generation)...
Geometries in cache: 12
Geometry cache size in bytes: 8736
CGAL Polyhedrons in cache: 0
CGAL cache size in bytes: 0
Compiling design (CSG Products normalization)...
Compiling highlights (1 CSG Trees)...
Normalized tree has 2 elements!
Compile and preview finished.
Total rendering time: 0:00:00.029
```

```
1 d = 3; // mm
2
3 difference() {
4     cube([30 + 2 * d, 20 + 2 * d, 10]);
5     #translate([d, d, d]) cube([30, 20, 10]);
6 }
```



```
Total rendering time: 0:00:00.029
Saved design '/Users/tamberg/Desktop/Enclosure.scad'.
Loaded design '/Users/tamberg/Desktop/Enclosure.scad'.
Compiling design (CSG Tree generation)...
Compiling design (CSG Products generation)...
Geometries in cache: 12
Geometry cache size in bytes: 8736
CGAL Polyhedrons in cache: 0
CGAL cache size in bytes: 0
Compiling design (CSG Products normalization)...
Compiling highlights (1 CSG Trees)...
Normalized tree has 2 elements!
Compile and preview finished.
Total rendering time: 0:00:00.036
```

```
1 d = 2; // mm
2 l = 30;
3 w = 20;
4 h = 10;
5
6 difference() {
7     cube([l + 2 * d, w + 2 * d, h]);
8     translate([d, d, d]) cube([l, w, h]);
9 }
```



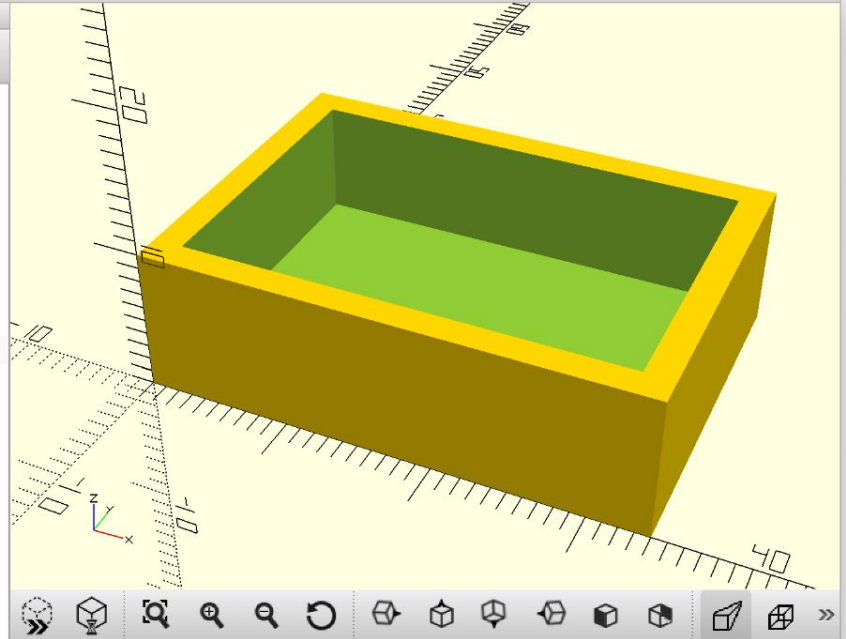
```
Compile and preview finished.
Total rendering time: 0:00:00.035
Saved design '/Users/tamberg/Desktop/Enclosure.scad'.
Loaded design '/Users/tamberg/Desktop/Enclosure.scad'.
Compiling design (CSG Tree generation)...
Compiling design (CSG Products generation)...
Geometries in cache: 12
Geometry cache size in bytes: 8736
CGAL Polyhedrons in cache: 0
CGAL cache size in bytes: 0
Compiling design (CSG Products normalization)...
Normalized tree has 2 elements!
Compile and preview finished.
Total rendering time: 0:00:00.063
```

Modules

Work faster with building blocks



```
1 d = 2; // mm
2
3 module box(l, w, h) {
4   difference() {
5     cube([l + 2 * d, w + 2 * d, h]);
6     translate([d, d, d]) cube([l, w, h]);
7   }
8 }
9
10 box(30, 20, 10);
```



Total rendering time: 0:00:00.031

Parsing design (AST generation)...

Saved backup file: /Users/tamberg/Documents/OpenSCAD/backups/unsaved-backup-xJL78323.scad

Compiling design (CSG Tree generation)...

Compiling design (CSG Products generation)...

Geometries in cache: 15

Geometry cache size in bytes: 10920

CGAL Polyhedrons in cache: 0

CGAL cache size in bytes: 0

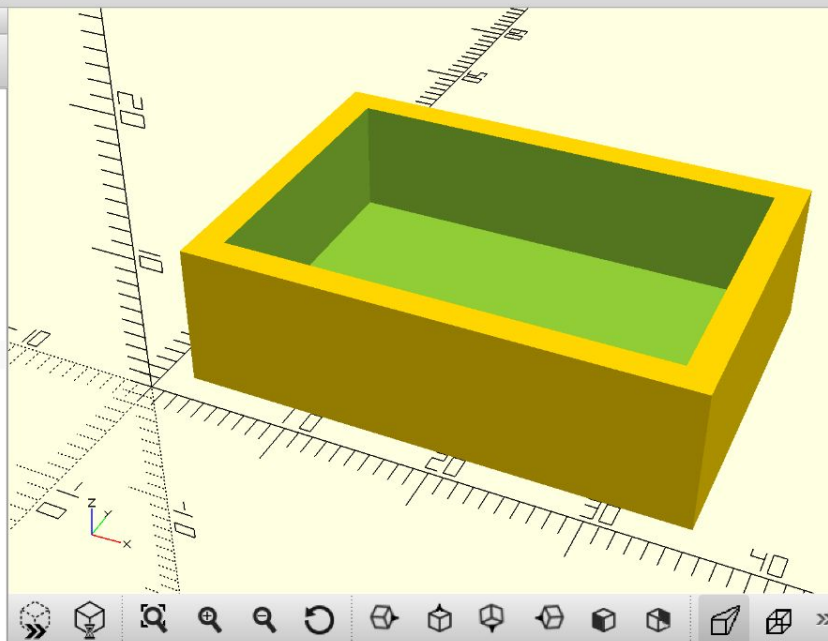
Compiling design (CSG Products normalization)...

Normalized tree has 2 elements!

Compile and preview finished.

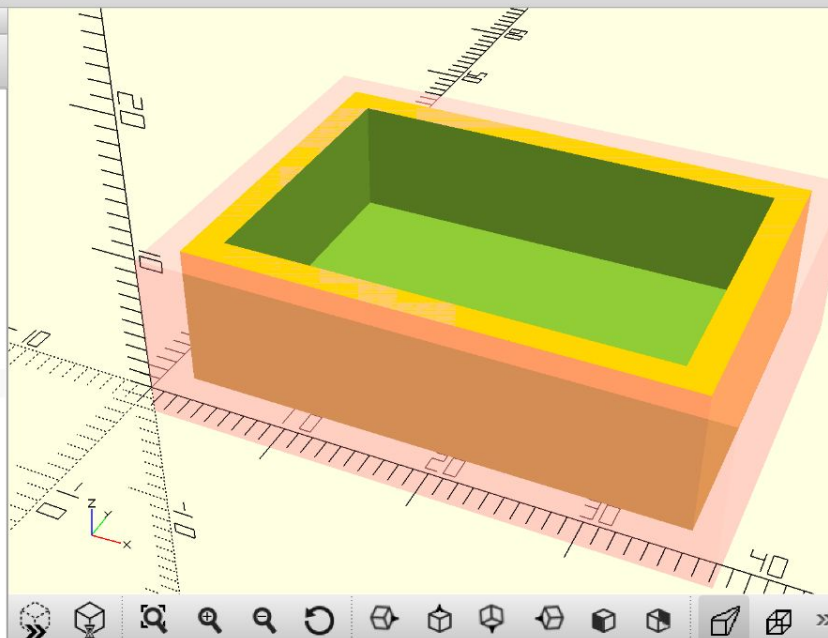
Total rendering time: 0:00:00.039

```
1 d = 2; // mm
2
3 module box(l, w, h) {
4   difference() {
5     cube([l + 2 * d, w + 2 * d, h]);
6     translate([d, d, d]) cube([l, w, h]);
7   }
8 }
9
10 translate([d, d, 0]) box(30, 20, 10);
```



```
Compile and preview finished.
Total rendering time: 0:00:00.031
Saved design '/Users/tamberg/Desktop/Enclosure.scad'.
Loaded design '/Users/tamberg/Desktop/Enclosure.scad'.
Compiling design (CSG Tree generation)...
Compiling design (CSG Products generation)...
Geometries in cache: 15
Geometry cache size in bytes: 10920
CGAL Polyhedrons in cache: 0
CGAL cache size in bytes: 0
Compiling design (CSG Products normalization)...
Normalized tree has 2 elements!
Compile and preview finished.
Total rendering time: 0:00:00.048
```

```
1 d = 2; // mm
2
3 module box(l, w, h) {
4   difference() {
5     cube([l + 2 * d, w + 2 * d, h]);
6     translate([d, d, d]) cube([l, w, h]);
7   }
8 }
9
10 translate([d, d, 0]) box(30, 20, 10);
11 #translate([0, 0, -d]) box(30 + 2 * d, 20 + 2 * d, 10 + d);
```

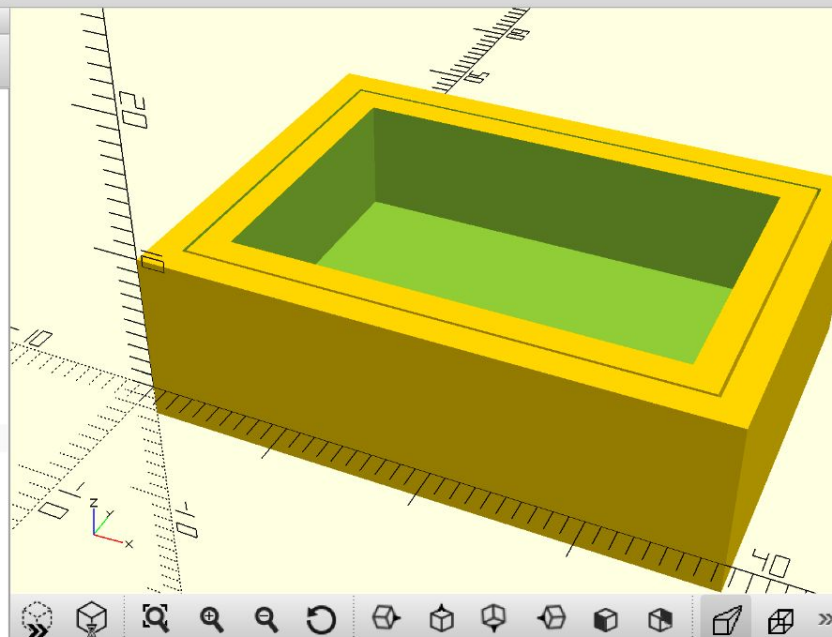


```
Total rendering time: 0:00:00.045
Saved design '/Users/tamberg/Desktop/Enclosure.scad'.
Loaded design '/Users/tamberg/Desktop/Enclosure.scad'.
Compiling design (CSG Tree generation)...
Compiling design (CSG Products generation)...
Geometries in cache: 15
Geometry cache size in bytes: 10920
CGAL Polyhedrons in cache: 0
CGAL cache size in bytes: 0
Compiling design (CSG Products normalization)...
Compiling highlights (1 CSG Trees)...
Normalized tree has 2 elements!
Compile and preview finished.
Total rendering time: 0:00:00.054
```

```

1 d = 2; // mm
2 g = 0.2;
3 e = d + g;
4
5 module box(l, w, h) {
6     difference() {
7         cube([l + 2 * d, w + 2 * d, h]);
8         translate([d, d, d]) cube([l, w, h]);
9     }
10 }
11
12 translate([e, e, 0]) box(30, 20, 10);
13 translate([0, 0, -e]) box(30 + 2 * e, 20 + 2 * e, 10 + e);

```



```

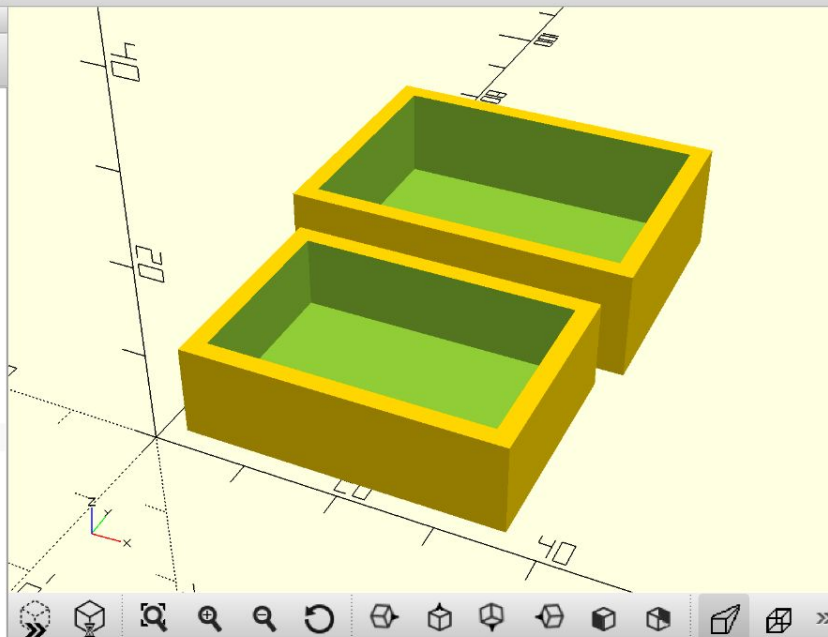
Compile and preview finished.
Total rendering time: 0:00:00.050
Saved design '/Users/tamberg/Desktop/Enclosure.scad'.
Loaded design '/Users/tamberg/Desktop/Enclosure.scad'.
Compiling design (CSG Tree generation)...
Compiling design (CSG Products generation)...
Geometries in cache: 21
Geometry cache size in bytes: 15288
CGAL Polyhedrons in cache: 0
CGAL cache size in bytes: 0
Compiling design (CSG Products normalization)...
Normalized tree has 4 elements!
Compile and preview finished.
Total rendering time: 0:00:00.039

```

```

1 d = 2; // mm
2 g = 0.2;
3 e = d + g;
4
5 module box(l, w, h) {
6     difference() {
7         cube([l + 2 * d, w + 2 * d, h]);
8         translate([d, d, d]) cube([l, w, h]);
9     }
10 }
11
12 translate([e, e, 0]) box(30, 20, 10);
13 translate([0, 20 + 4 * e, 0]) box(30 + 2 * e, 20 + 2 * e, 10 + e);

```



```

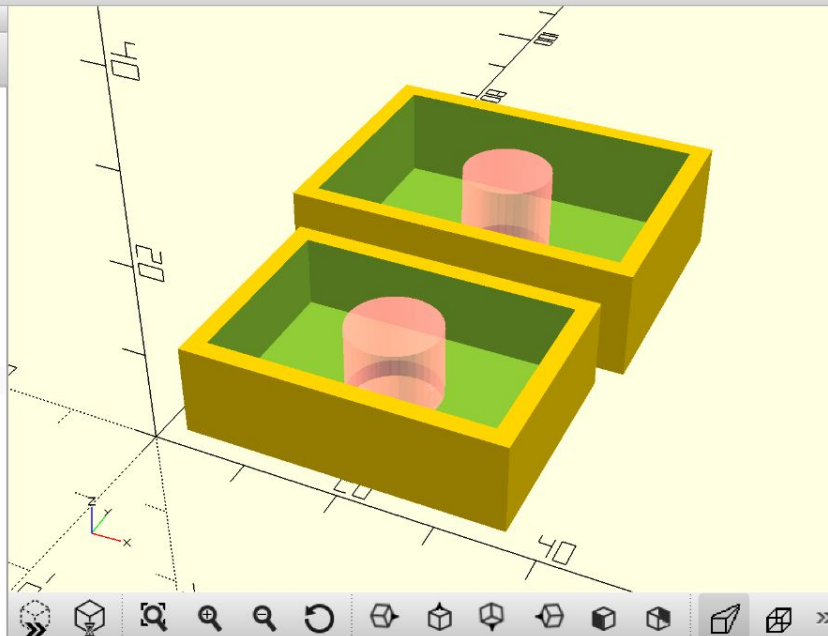
x
Compile and preview finished.
Total rendering time: 0:00:00.031
Saved design '/Users/tamberg/Desktop/Enclosure.scad'.
Loaded design '/Users/tamberg/Desktop/Enclosure.scad'.
Compiling design (CSG Tree generation)...
Compiling design (CSG Products generation)...
Geometries in cache: 29
Geometry cache size in bytes: 36616
CGAL Polyhedrons in cache: 0
CGAL cache size in bytes: 0
Compiling design (CSG Products normalization)...
Normalized tree has 4 elements!
Compile and preview finished.
Total rendering time: 0:00:00.042

```

```

1 $fn = 36;
2
3 d = 2; // mm
4 g = 0.2;
5 e = d + g;
6
7 module box(l, w, h) {
8   difference() {
9     cube([l + 2 * d, w + 2 * d, h]);
10    translate([d, d, d]) cube([l, w, h]);
11    #translate([l/2 + d, w/2 + d, 0]) cylinder(h, 5, 5);
12  }
13 }
14
15 translate([e, e, 0]) box(30, 20, 10);
16 translate([0, 20 + 4 * e, 0]) box(30 + 2 * e, 20 + 2 * e, 10 + e);

```



```

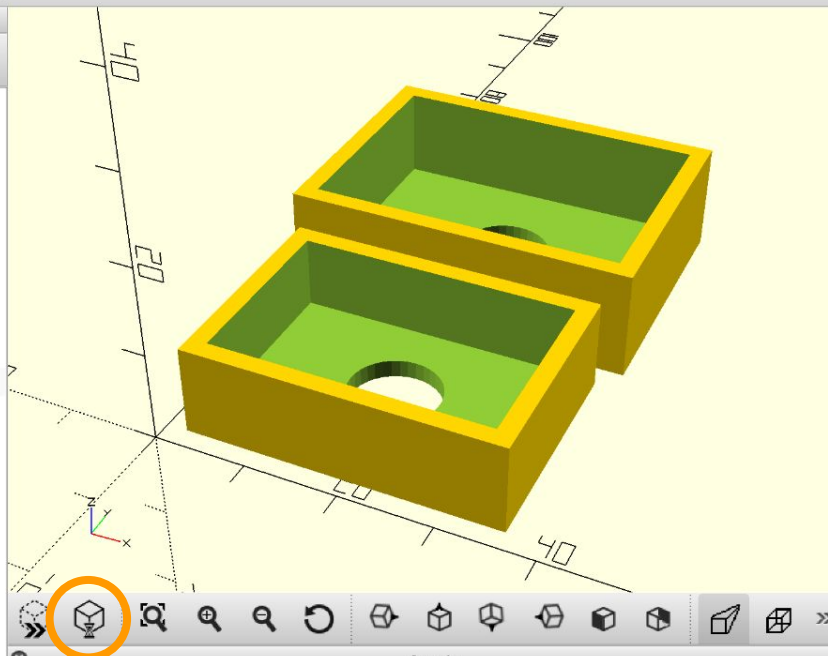
STL export finished: /Users/tamberg/Desktop/Enclosure.stl
Saved design '/Users/tamberg/Desktop/Enclosure.scad'.
Loaded design '/Users/tamberg/Desktop/Enclosure.scad'.
Compiling design (CSG Tree generation)...
Compiling design (CSG Products generation)...
Geometries in cache: 35
Geometry cache size in bytes: 59416
CGAL Polyhedrons in cache: 5
CGAL cache size in bytes: 715392
Compiling design (CSG Products normalization)...
Compiling highlights (2 CSG Trees)...
Normalized tree has 6 elements!
Compile and preview finished.
Total rendering time: 0:00:00.030

```

```

1 $fn = 36;
2
3 d = 2; // mm
4 g = 0.2;
5 e = d + g;
6
7 module box(l, w, h) {
8   difference() {
9     cube([l + 2 * d, w + 2 * d, h]);
10    translate([d, d, d]) cube([l, w, h]);
11    #translate([l/2 + d, w/2 + d, 0]) cylinder(h, 5, 5);
12  }
13 }
14
15 translate([e, e, 0]) box(30, 20, 10);
16 translate([0, 20 + 4 * e, 0]) box(30 + 2 * e, 20 + 2 * e, 10 + e);

```



```

Geometries in cache: 34
Geometry cache size in bytes: 54080
CGAL Polyhedrons in cache: 5
CGAL cache size in bytes: 715392
Total rendering time: 0:00:00.636
Top level object is a 3D object:
Simple:    yes
Vertices: 176
Halfedges: 528
Edges:    264
Halffacets: 188
Facets:   94
Volumes:  3
Rendering finished.

```

Printing

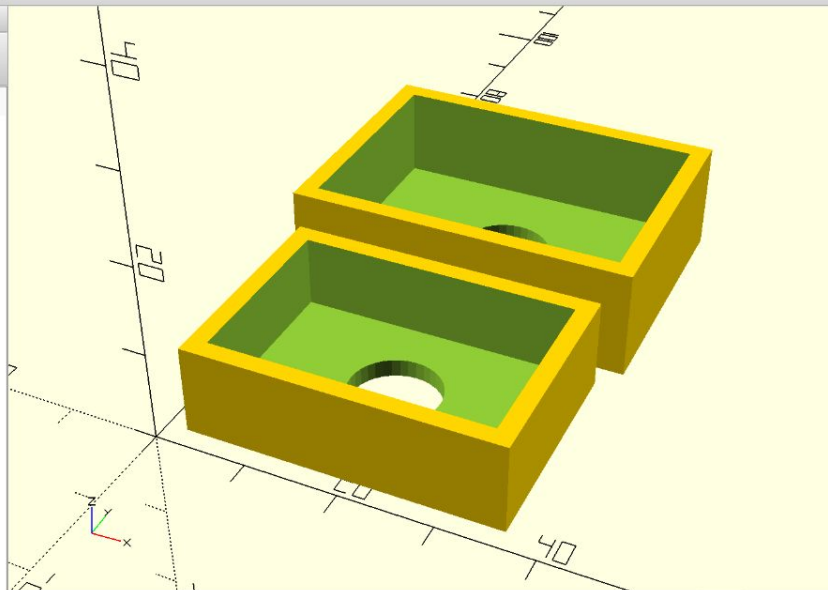
Export .STL and slice it, to get .GCODE

STL

```

1 $fn = 36;
2
3 d = 2; // mm
4 g = 0.2;
5 e = d + g;
6
7 module box(l, w, h) {
8   difference() {
9     cube([l + 2 * d, w + 2 * d, h]);
10    translate([d, d, d]) cube([l, w, h]);
11    #translate([l/2 + d, w/2 + d, 0]) cylinder(10, 5, 5);
12  }
13 }
14
15 translate([e, e, 0]) box(30, 20, 10);
16 translate([0, 20 + 4 * e, 0]) box(30 + 2 * e, 20 + 2 * e, 10 + e);

```

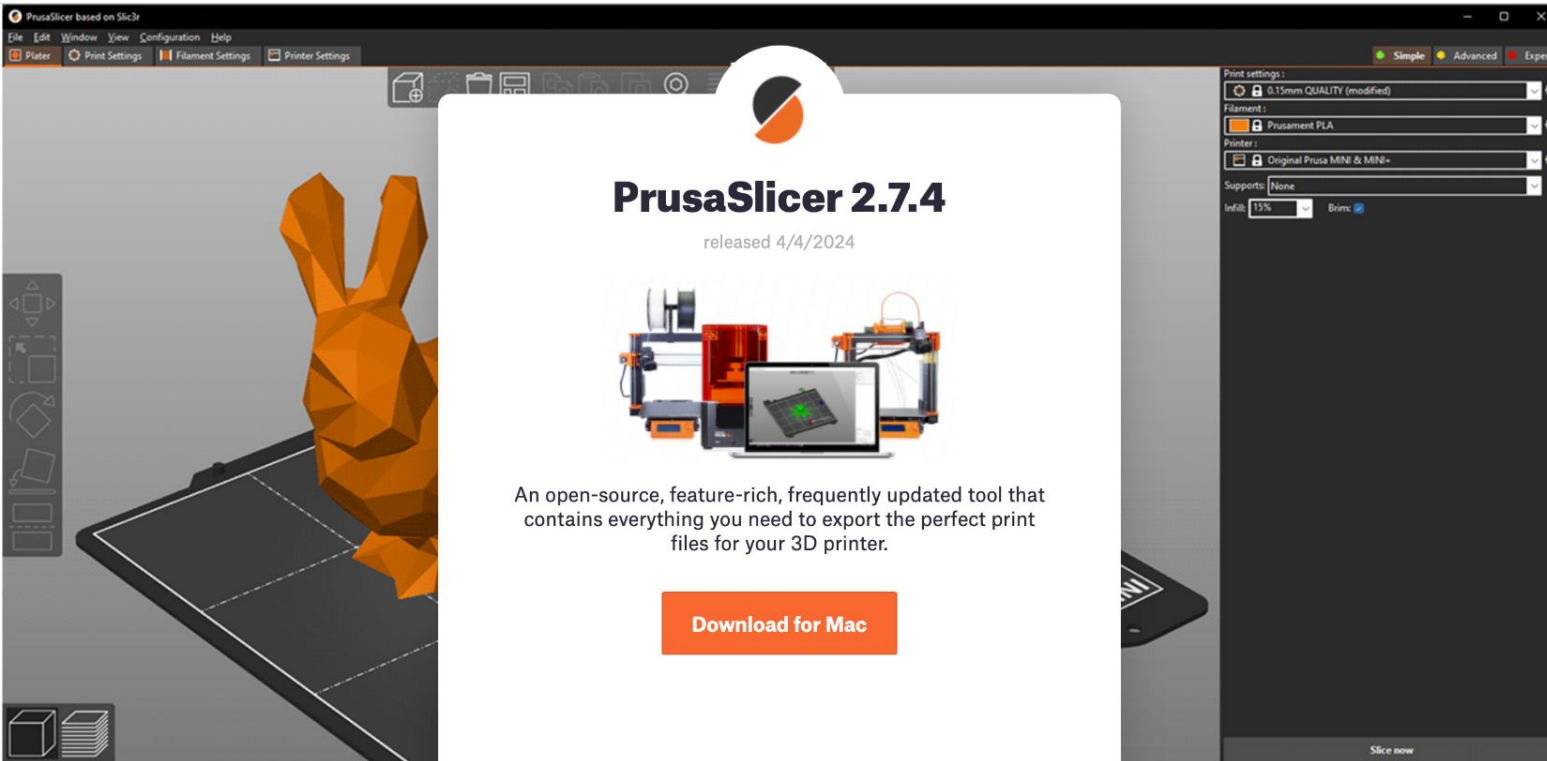


Console

```

Geometries in cache: 34
Geometry cache size in bytes: 54080
CGAL Polyhedrons in cache: 5
CGAL cache size in bytes: 715392
Total rendering time: 0:00:00.636
Top level object is a 3D object:
Simple:   yes
Vertices: 176
Halfedges: 528
Edges: 264
Halffacets: 188
Facets: 94
Volumes: 3
Rendering finished.

```



PrusaSlicer based on Slic3r

File Edit Window View Configuration Help

Printer Print Settings Filament Settings Printer Settings

Print settings: 0.15mm QUALITY (modified)


Filament: Prusament PLA

Printer: Original Prusa MINI & MINI+

Supports: None

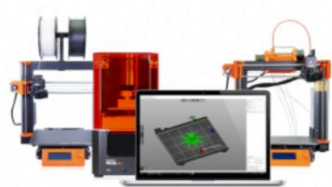
Infill: 15% Brim:

Slice now



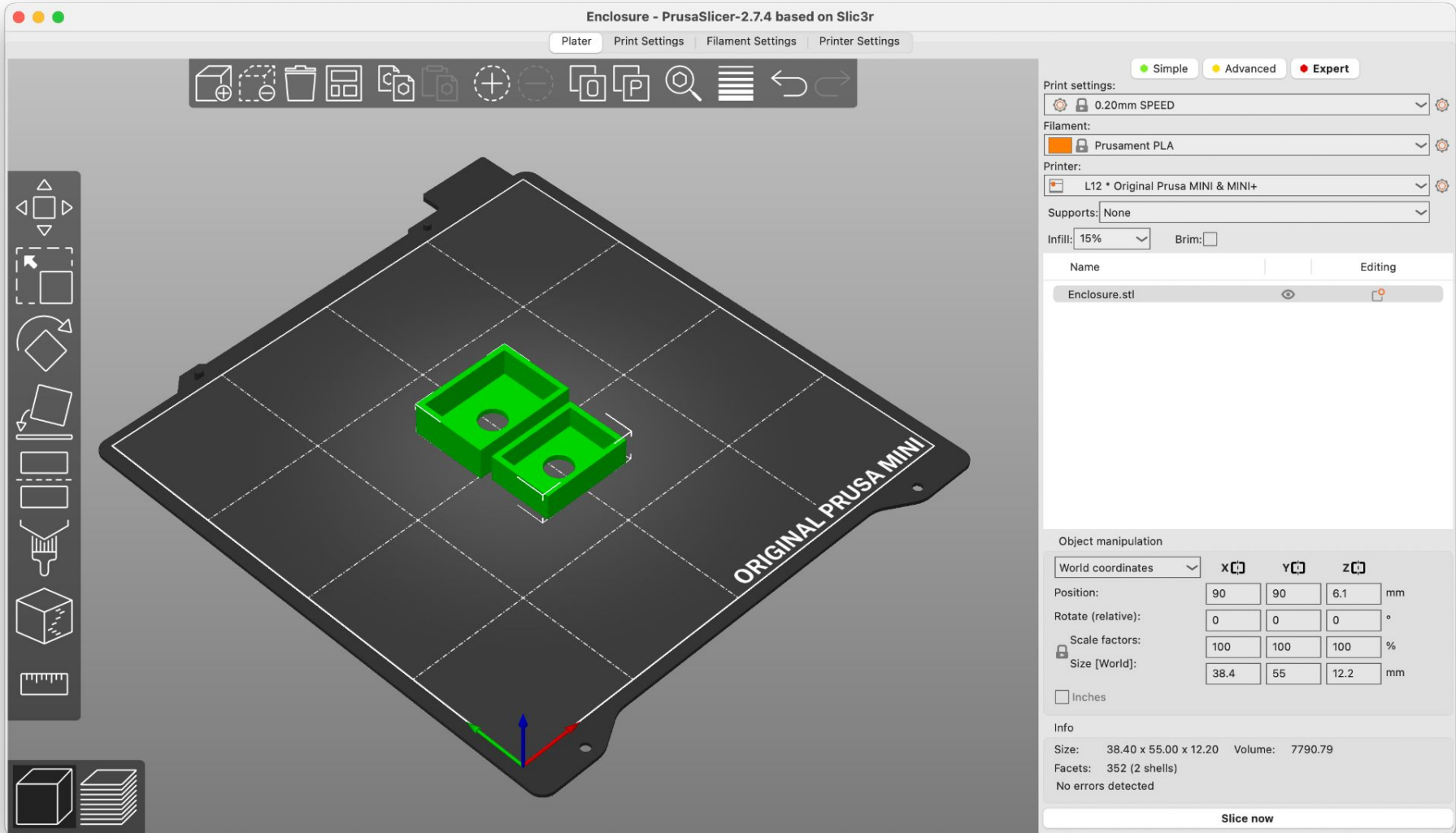
PrusaSlicer 2.7.4

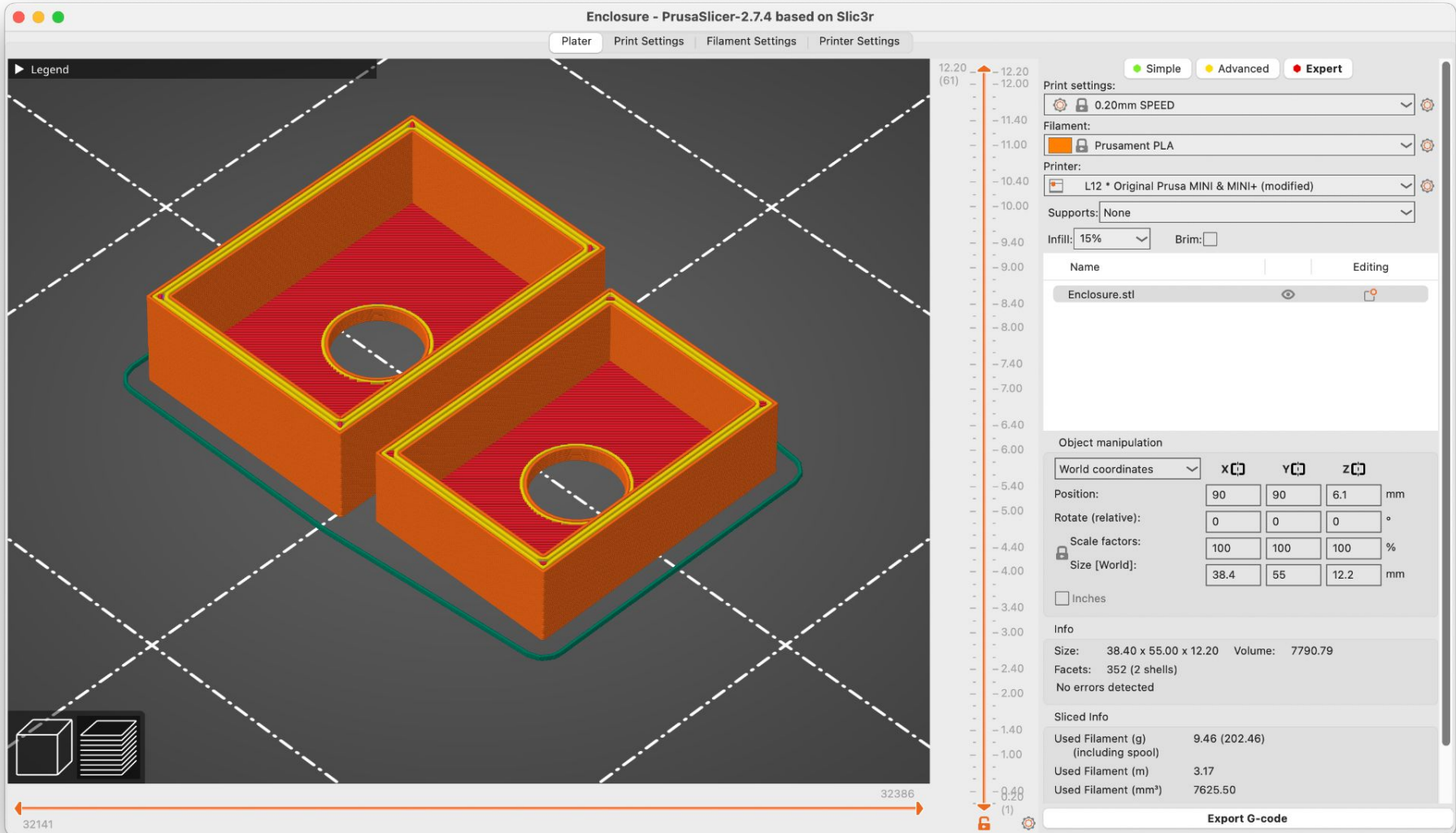
released 4/4/2024



An open-source, feature-rich, frequently updated tool that contains everything you need to export the perfect print files for your 3D printer.

[Download for Mac](#)





Enclosure - PrusaSlicer-2.7.4 based on Slic3r

Plater | Print Settings | Filament Settings | Printer Settings

Simple | Advanced | Expert

Print settings:

0.20mm SPEED

Filament: Prusament PLA

Printer: L12 * Original Prusa MINI & MINI+ (modified)

Supports: None

Infill: 15% | Brim:

Name	Editing
Enclosure.stl	

Object manipulation

World coordinates | X | Y | Z

Position: 90 | 90 | 6.1 mm

Rotate (relative): 0 | 0 | 0 °

Scale factors: 100 | 100 | 100 %

Size [World]: 38.4 | 55 | 12.2 mm

Inches

Info

Size: 38.40 x 55.00 x 12.20 | Volume: 7790.79

Facets: 352 (2 shells)

No errors detected

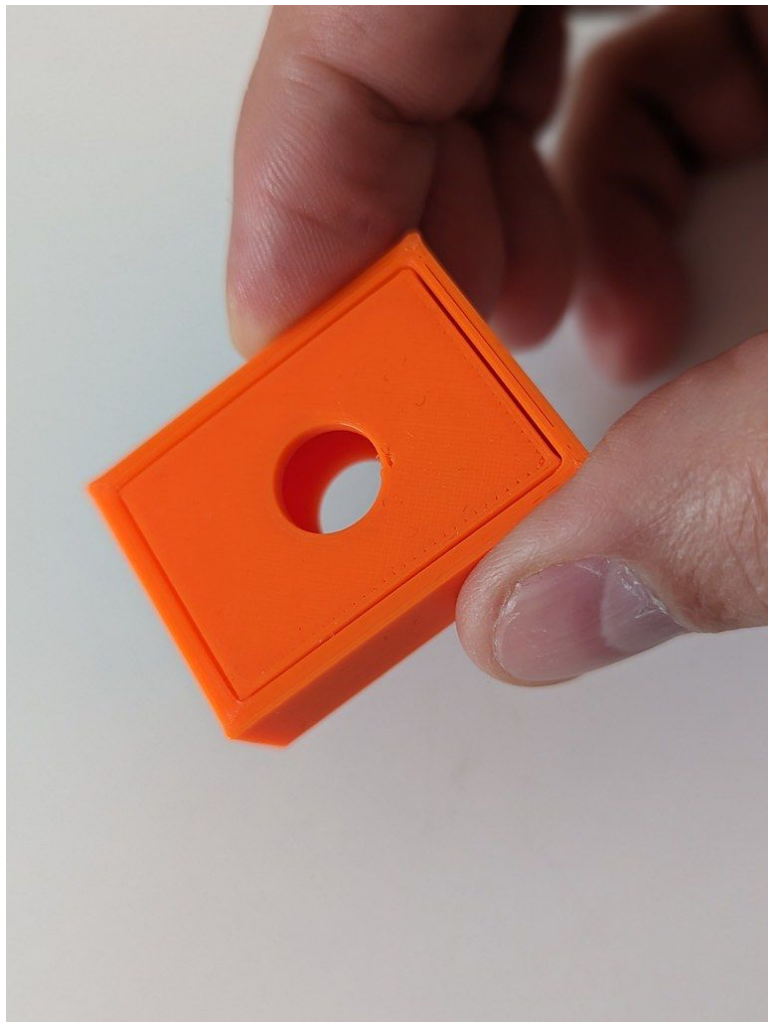
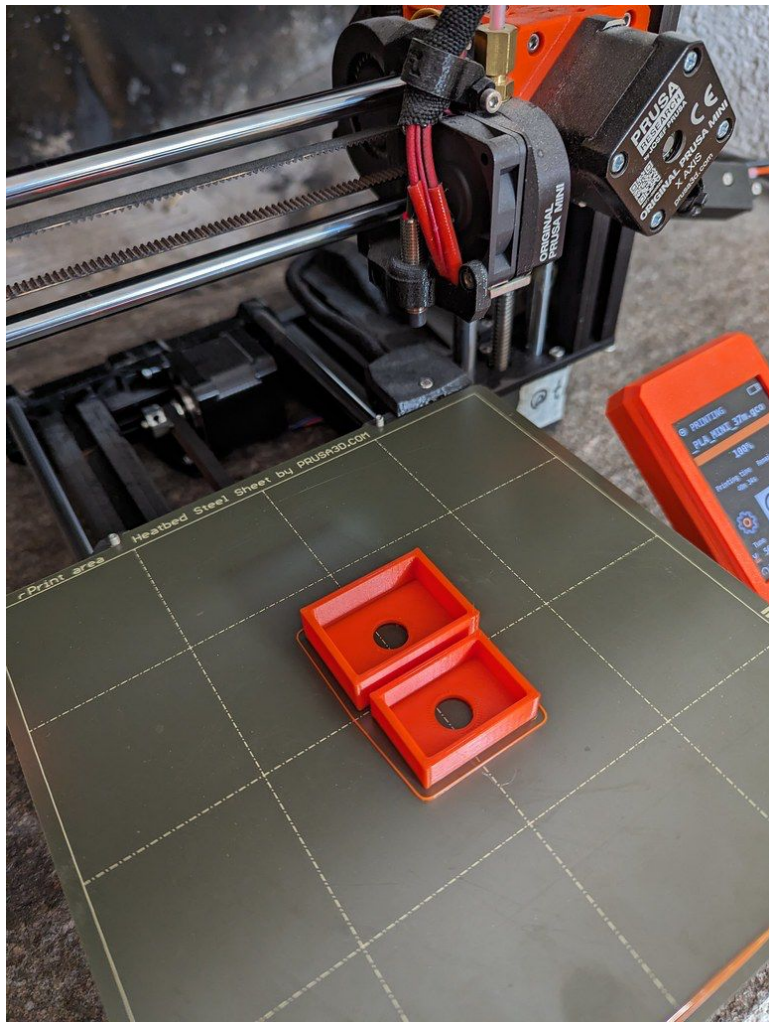
Sliced Info

Used Filament (g) (including spool)	9.46 (202.46)
Used Filament (m)	3.17
Used Filament (mm³)	7625.50

Export G-code

32141

32386



Practice

Design your part, use the cheat sheet



Design this?

cube()
cylinder()
difference()
translate()
hull()

OpenSCAD v2021.01

Syntax

```
var = value;
var = cond ? value_if_true : value_if_false;
var = function (x) x + x;
module name(...) { ... }
name();
function name(...) = ...
name();
include <...scad>
use <...scad>
```

Constants

```
undef undefined value
PI mathematical constant  $\pi$  (~3.14159)
```

Operators

```
n + m Addition
n - m Subtraction
n * m Multiplication
n / m Division
n % m Modulo
n ^ m Exponentiation
n < m Less Than
n <= m Less or Equal
b == c Equal
b != c Not Equal
n >= m Greater or Equal
n > m Greater Than
b && c Logical And
b || c Logical Or
```

Modifier Characters

```
* disable
! show only
# highlight / debug
% transparent / background
```

2D

```
circle(radius | d=diameter)
square(size,center)
square([width,height],center)
polygon([points])
polygon([points],[paths])
text(t, size, font,
      halign, valign, spacing,
      direction, language, script)
import("...ext", convexity)
projection(cut)
```

3D

```
sphere(radius | d=diameter)
cube(size, center)
cube([width,depth,height], center)
cylinder(h,r|d,center)
cylinder(h,r1|d1,r2|d2,center)
polyhedron(points, faces, convexity)
import("...ext", convexity)
linear_extrude(height,center,convexity,twist,slices)
rotate_extrude(angle,convexity)
surface(file = "...ext",center,convexity)
```

Lists

```
list = [..., ..., ...]; create a list
var = list[2]; index a list (from 0)
var = list.z; dot notation indexing (x/y/z)
```

Boolean operations

```
union()
difference()
intersection()
```

List Comprehensions

```
Generate [ for (i = range|list) i ]
Generate [ for (init;condition;next) i ]
Flatten [ each i ]
Conditions [ for (i = ...) if (condition(i)) i ]
Conditions [ for (i = ...) if (condition(i)) x else y ]
Assignments [ for (i = ...) let (assignments) a ]
```

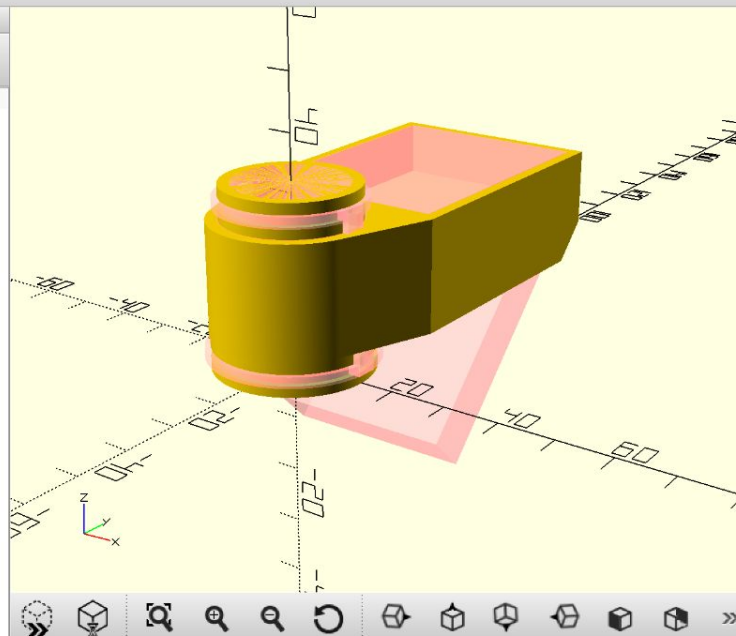
Flow Control

```
for (i = [start:end]) { ... }
for (i = [start:step:end]) { ... }
for (i = [..., ..., ...]) { ... }
for (i = ..., j = ..., ...) { ... }
intersection_for(i = [start:end]) { ... }
intersection_for(i = [start:step:end]) { ... }
intersection_for(i = [..., ..., ...]) { ... }
if (...) { ... }
let (...) { ... }
```

```

1 // CC BY-SA 4.0, T. Amberg, FHNW
2 $fn = 360;
3
4 module pipe(h, ri, ro) {
5     difference() {
6         cylinder(h, ro, ro);
7         #translate([0, 0, 0]) cylinder(h, ri, ri);
8     }
9 }
10
11 module breadboard() {
12     translate([-35/2, 0, 0]) cube([35, 47, 9.5]);
13 }
14
15 module block() {
16     difference() {
17         hull() {
18             pipe(20, 12.2, 14.2);
19             translate([-19.5, 12, 0]) cube([39, 47 + 4, 20]);
20         }
21         translate([0, 0, -1]) cylinder(20 + 2, 12.2, 12.2);
22         #translate([0, 14, 20 - 9.5 + .1]) breadboard();
23         #translate([0, 24, -30]) rotate([45, 0, 0]) breadboard();
24         translate([-19.5 - 1, 55, -30]) rotate([45, 0, 0]) cube([39 + 2, 38, 20]);
25     }
26 }
27
28 module base() {
29     difference() {
30         union() {
31             translate([0, 0, 6]) pipe(20 + 6, 10, 12);
32             pipe(6, 10, 14);
33         }
34         #translate([-15, -2, 2]) cube([30, 4, 4]);
35         #translate([0, 0, 2]) pipe(2, 13, 15);
36         #translate([-13, -2, 26]) cube([26, 4, 4]);
37         #translate([0, 0, 28]) pipe(2, 11, 13);
38     }
39 }
40
41 translate([0, 0, 6]) block();
42 base();

```



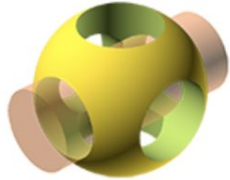
```

Total rendering time: 0:00:00.049
Saved design '/Users/tamberg/Documents/FabLab/20240506_julien/CaneAdapter_v2.2.scad'.
Loaded design '/Users/tamberg/Documents/FabLab/20240506_julien/CaneAdapter_v2.2.scad'.
Compiling design (CSG Tree generation)...
Compiling design (CSG Products generation)...
Geometries in cache: 19
Geometry cache size in bytes: 669896
CGAL Polyhedrons in cache: 1
CGAL cache size in bytes: 1936080
Compiling design (CSG Products normalization)...
Compiling highlights (11 CSG Trees)...
Normalized tree has 22 elements!
Compile and preview finished.
Total rendering time: 0:00:00.039

```

More

Consider these resources



OpenSCAD

The Programmers Solid 3D CAD Modeller

- home
- about
- news
- downloads
- documentation
- libraries
- gallery
- community
- github

Documentation

- OpenSCAD Tutorial
- OpenSCAD User Manual
- OpenSCAD Language Reference
- Code Cheat Sheet

Books

- English
- German / Deutsch
- Spanish / Español

Videos

- OpenSCAD: Introduction

Articles / Blogs

- How to use OpenSCAD
- 3D Spielplatz (german)



Documentation



Books



Videos



Articles / Blogs

OpenSCAD Tutorial

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7. **Chapter 7:** Loops and creating more complex patterns
8. **Chapter 8:** Extruding 2D shapes into 3D objects
9. **Chapter 9:** Math, calculations and low level geometry creation

 **tamberg** Add files.

0eec645 · 3 months ago 🕒 History

Name	Last commit message	Last commit date
📁 ..		
📁 AP10_HingeFixture	Update.	2 years ago
📁 AP9_HingeFixture	Add file.	2 years ago
📁 AP9_PVCTubeFixture	Update.	last year
📁 AP9_Pixel_Cover	Delete.	last year
📁 AP9_Pixel_Fixture	Add files.	3 months ago
📁 AP9_Pixel_Tube	Delete.	last year
📁 AP9_SolarFixture	Update.	last year

Relevant

All Things

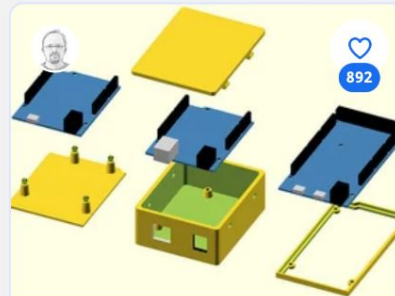
Filter by



The Ultimate box maker



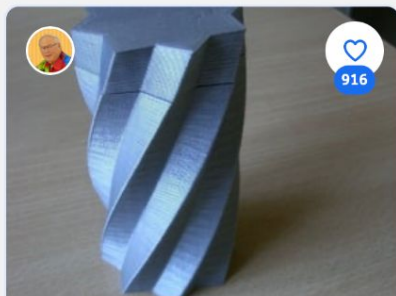
Tiny Planetary Gears Set



Arduino OpenSCAD mounting library (v2.0)



Case for the Full Graphic Smart LCD Cont...



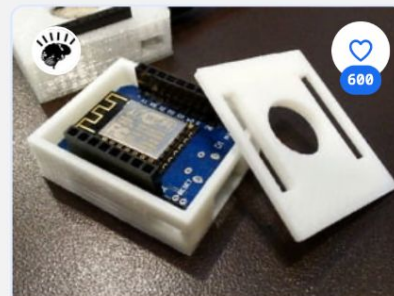
Parametric twisted star box



LM2596/LM2577/XL6009 buck DC converter e...



Parametric and Customizable Project Encl...



Wemos D1 Mini Enclosure