Moth

A Guide to Printable Models
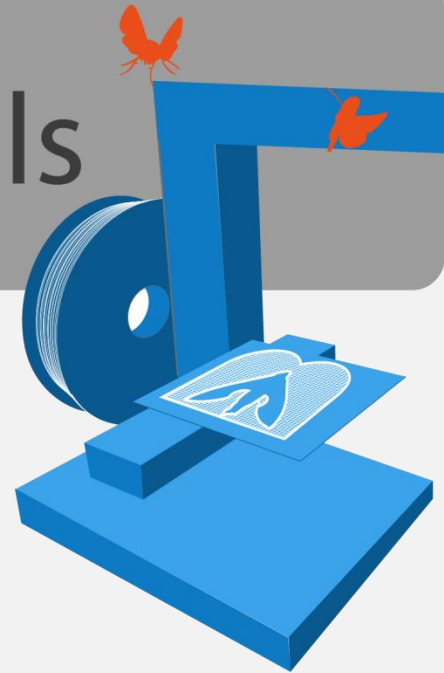
Flash Forge Creator
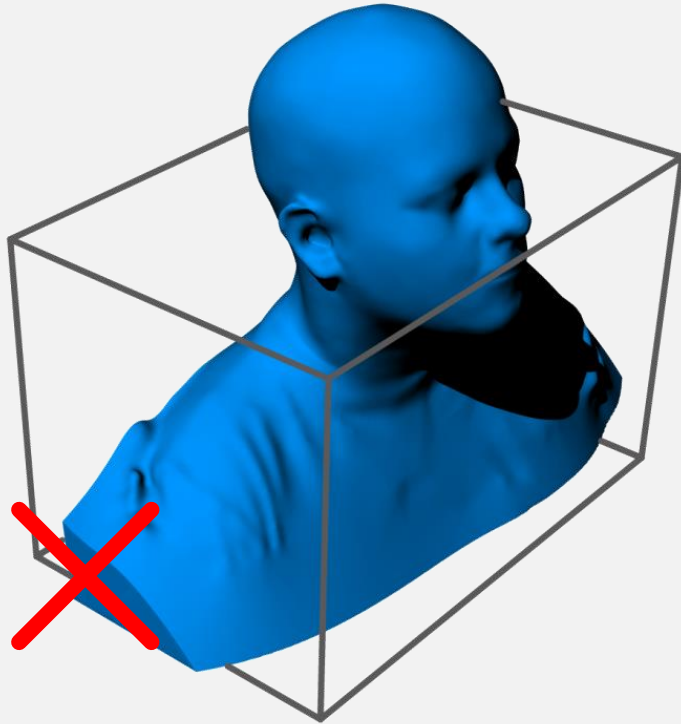
14.5cm

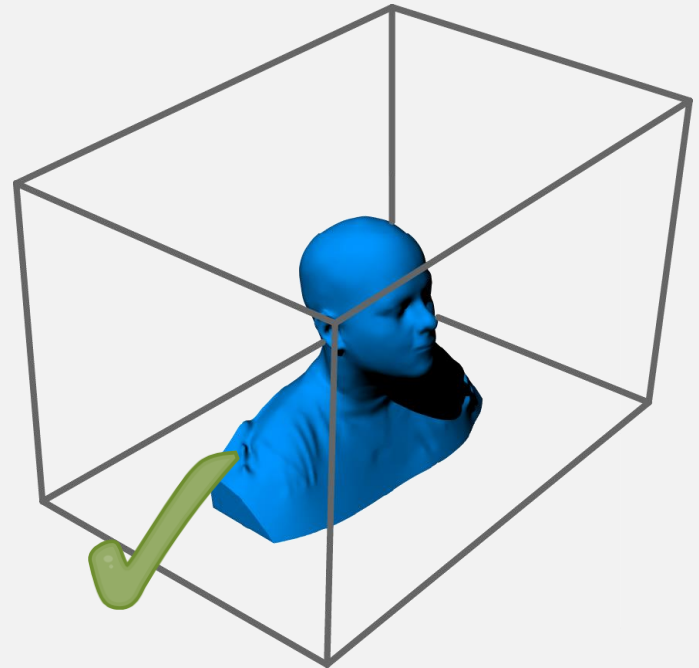22.5cm

15.00cm
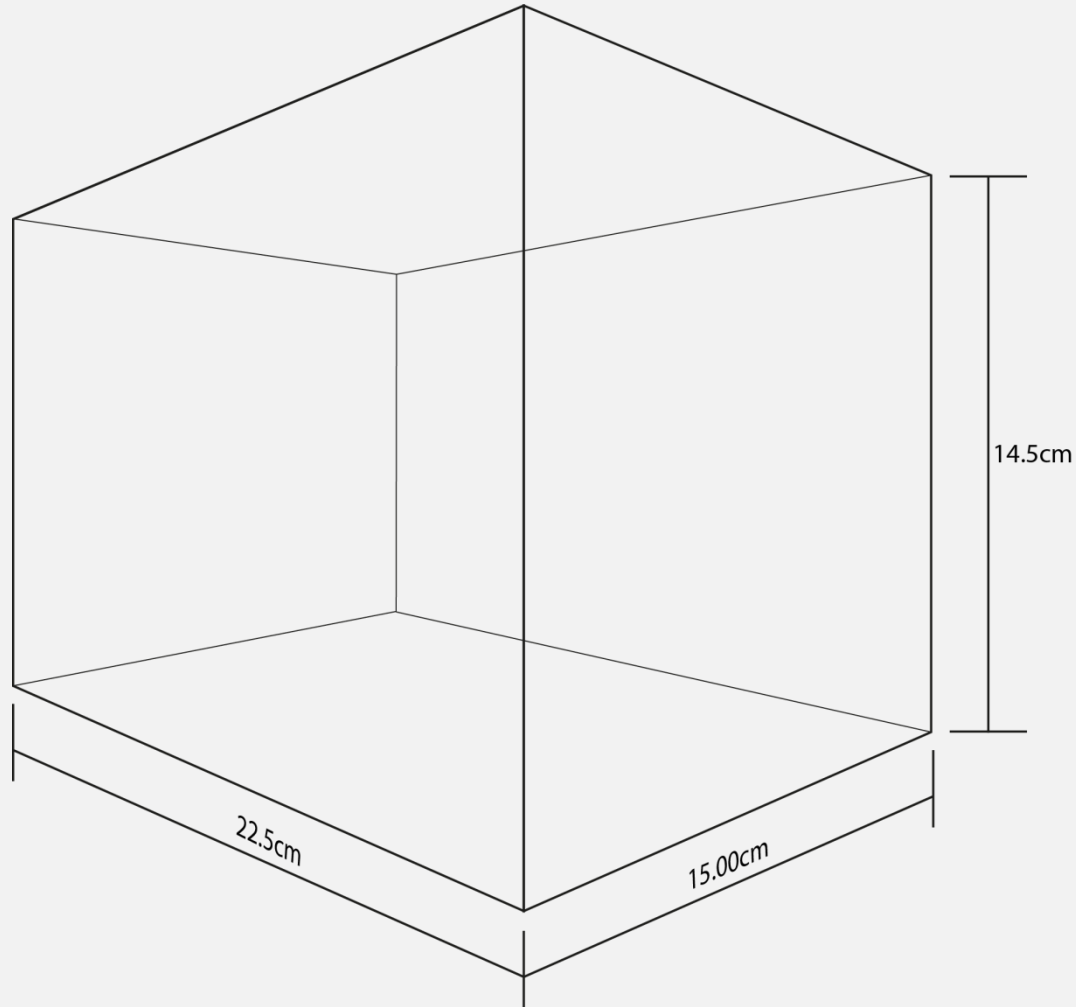
Build Volume= W22.5 x H14.5 x D15.0 cm

Keep to the Volume

Each machine has a set build volume which you cannot build larger than. If your model is larger than the build volume, either break it down into smaller individual components, or cut join lines through the model.

Outside Build Volume

Inside Build Volume

.stl

Stereolithography

STL files describe the surface geometry of a 3-dimensional object without any representation of colour, texture or other common CAD model attributes.

Mesh Geometry

Vertice –A point with x, y and z co-ordinates. A set of points in space is coplanar if all the points lie in the same geometric plane.

Edge - Connection between 2 vertices

Faces - is a closed set of edges, in which a *triangle face* has three edges, and a *quad face* has four edges. The three points used to create a are always coplanar.

Polygons - Set of 3-4 sided faces. Polygons are represented as multiple faces.
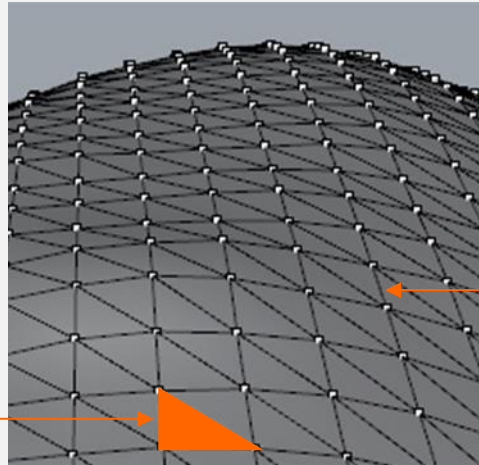
| Vertices | Edge | Faces | Polygons | Surfaces |
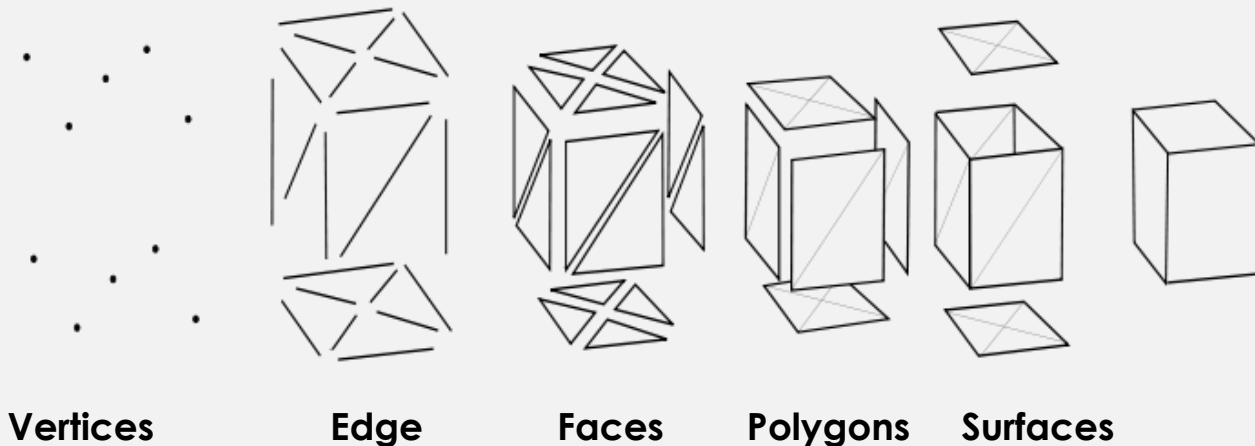
Manifold Mesh = Watertight

Your 3D design **mesh must be manifold**.
A mesh is manifold if each edge is incident (conjoined or attached) to only 1 or more faces and the faces incident to a vertex to form a closed or open fan.

Face - is a closed set of edges, in which a *triangle face* has three edges, and a *quad face* has four edges.
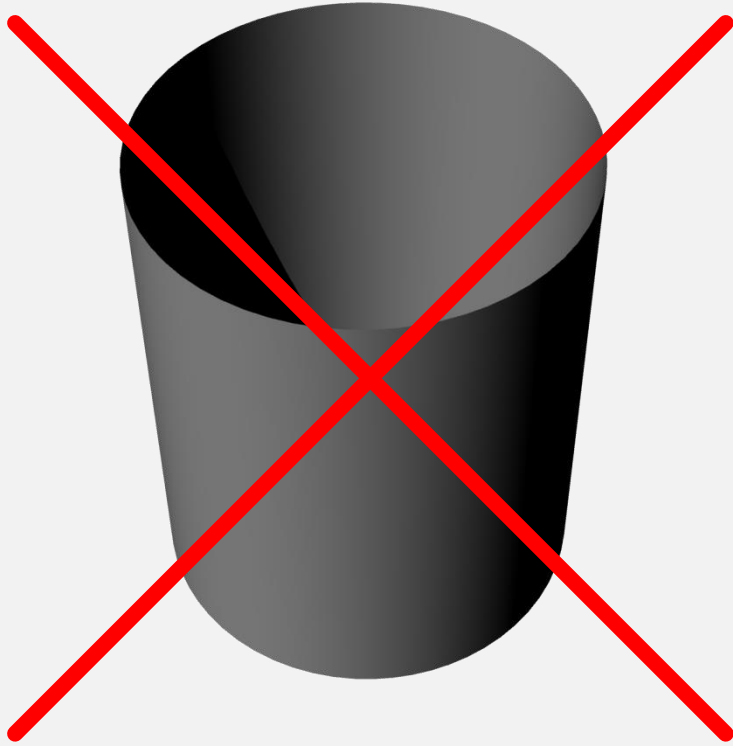
Edge - *Connection between 2 vertices*
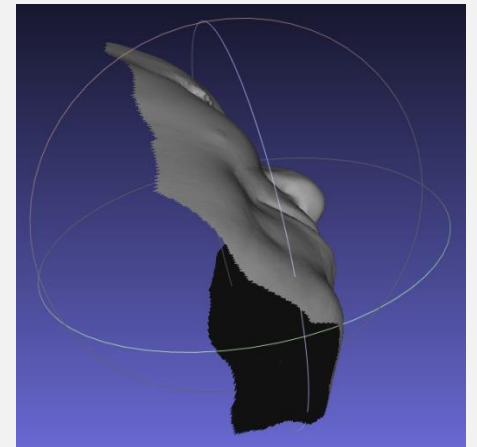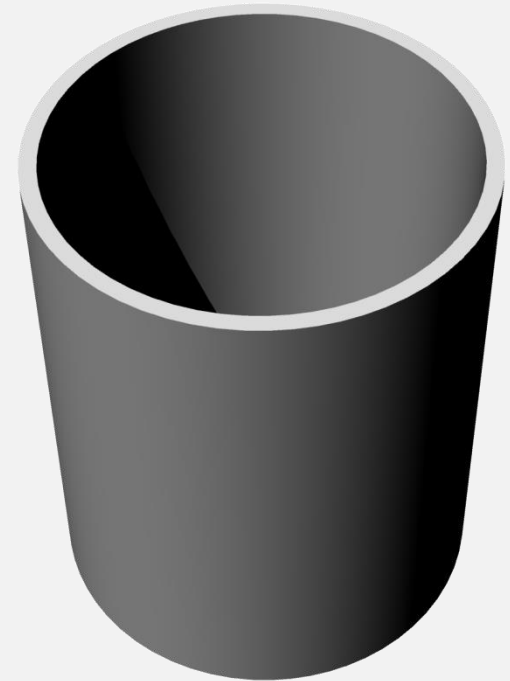
Non-Manifold Mesh = **NOT Watertight**

The Basics Rules
for
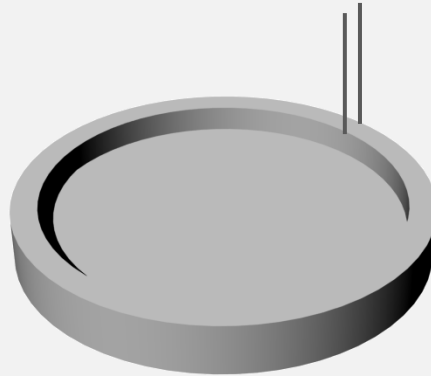# Manifold Geometry

Single surfaces are **NOT PRINTABLE**

All models **MUST** have a **WALL THICKNESS**
Dependent upon materials and strength

Minimum Wall Thickness= 2 x filament thread width

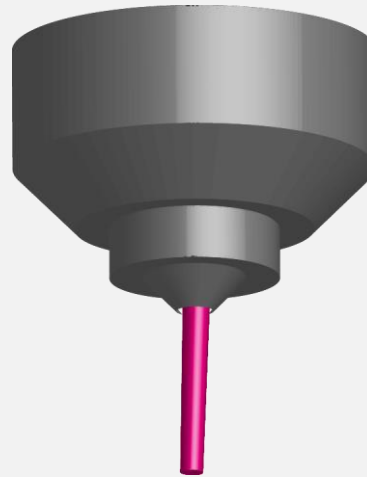**Smallest feature = 2 x thread width**

The width of the thread of filament is determined by the diameter of the printer nozzle.
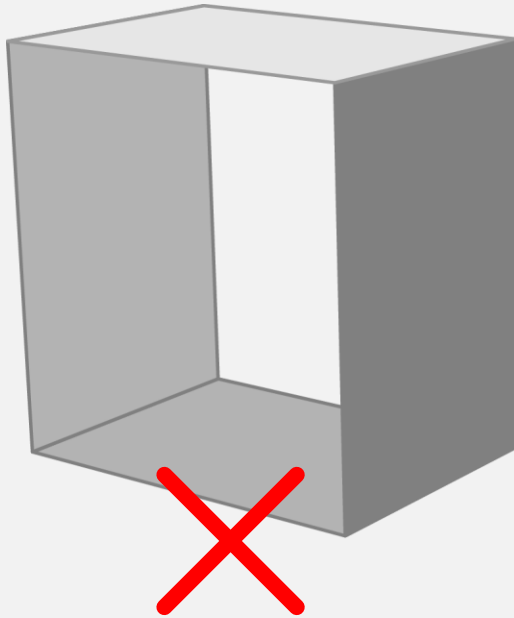

Diameter of **Printer Nozzle** = **0.4** - **0.5mm**

0.8mm minimum wall thickness with a 0.4mm nozzle
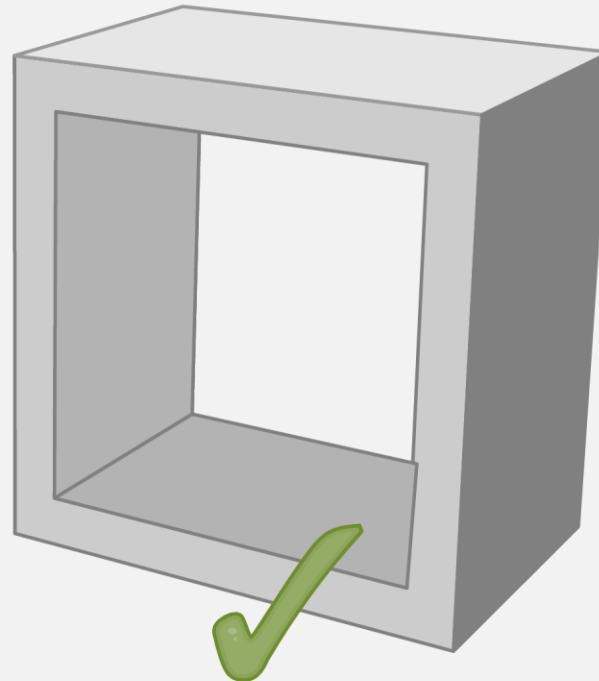**1mm** minimum wall thickness with a 0.5mm nozzle

Wall Thickness

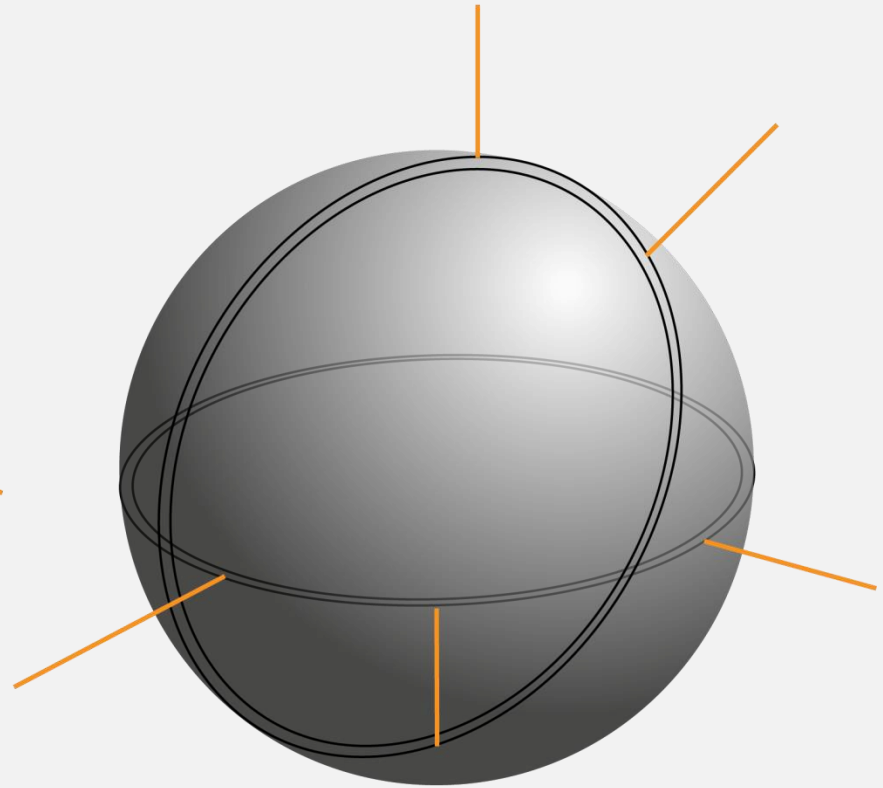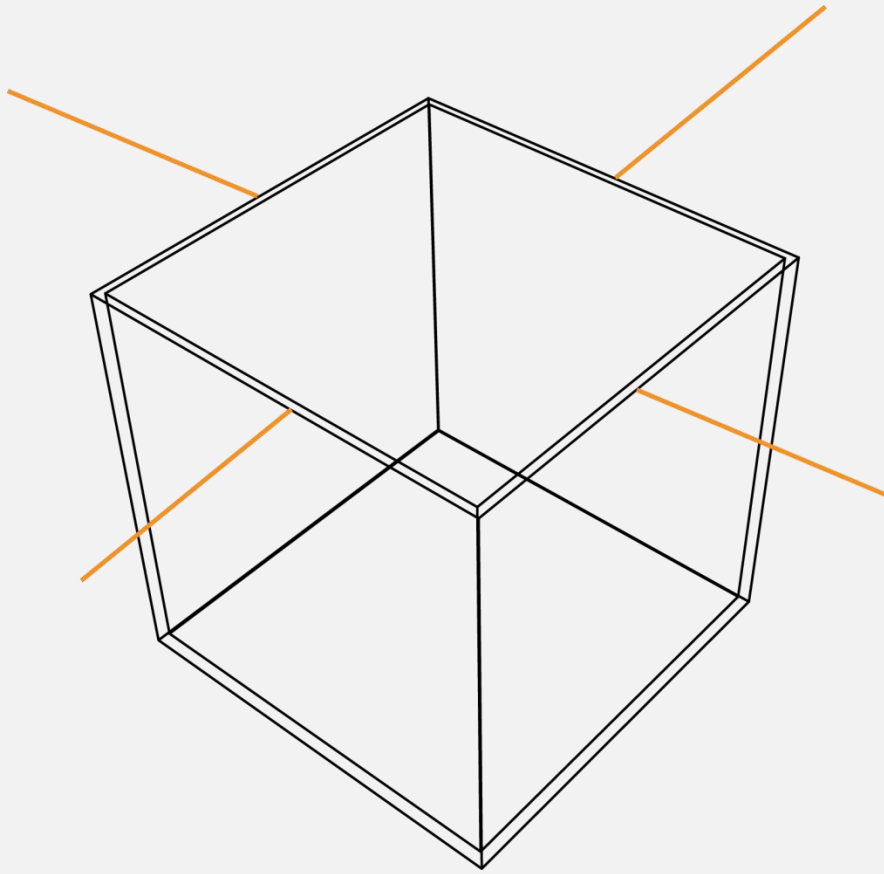The walls can be thin, as low as 2 mm to be safe, but they cannot have zero thickness.

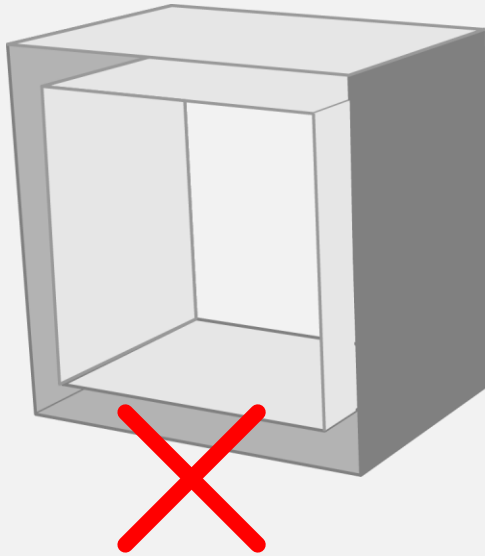Wall thickness 0mm

Wall thickness 2mm

WALL THICKNESS refers to the distance between one surface of your model and the surface perpendicularly opposite it- *a line drawn at an angle 90 to other given line.*
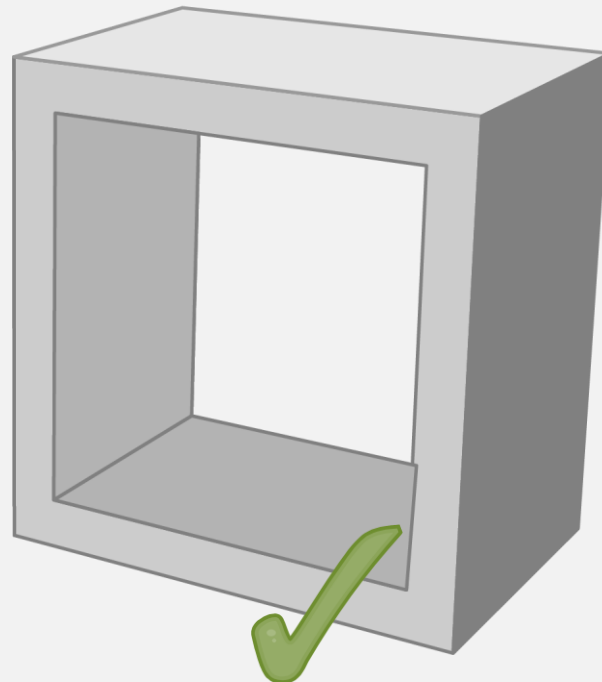
Shut your face

- No open faces or holes!

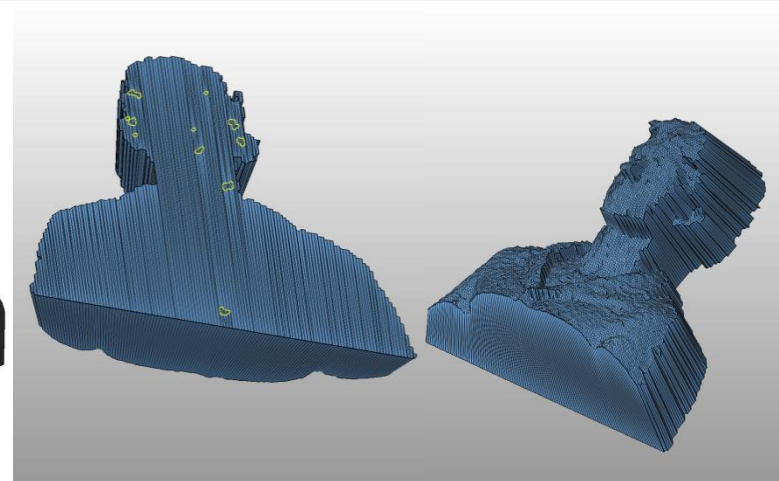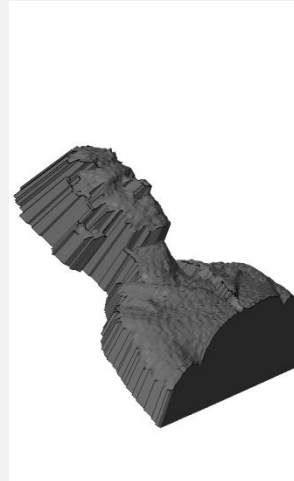- An open face is where a model is missing a face from the surface of the part.
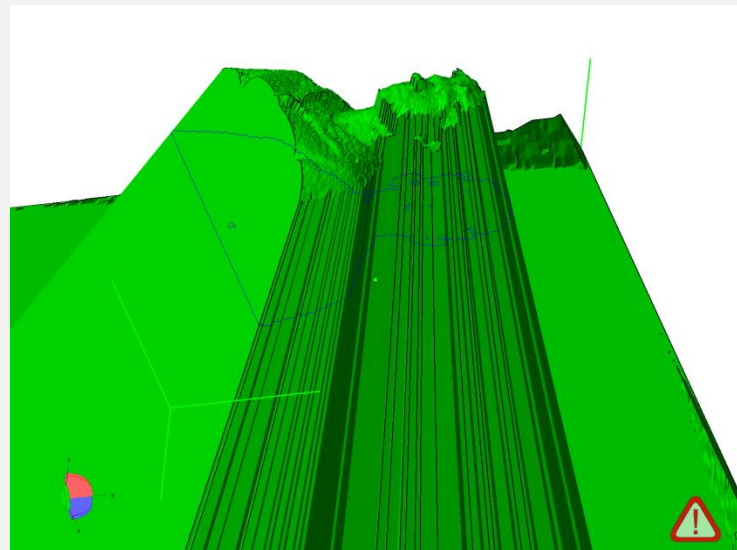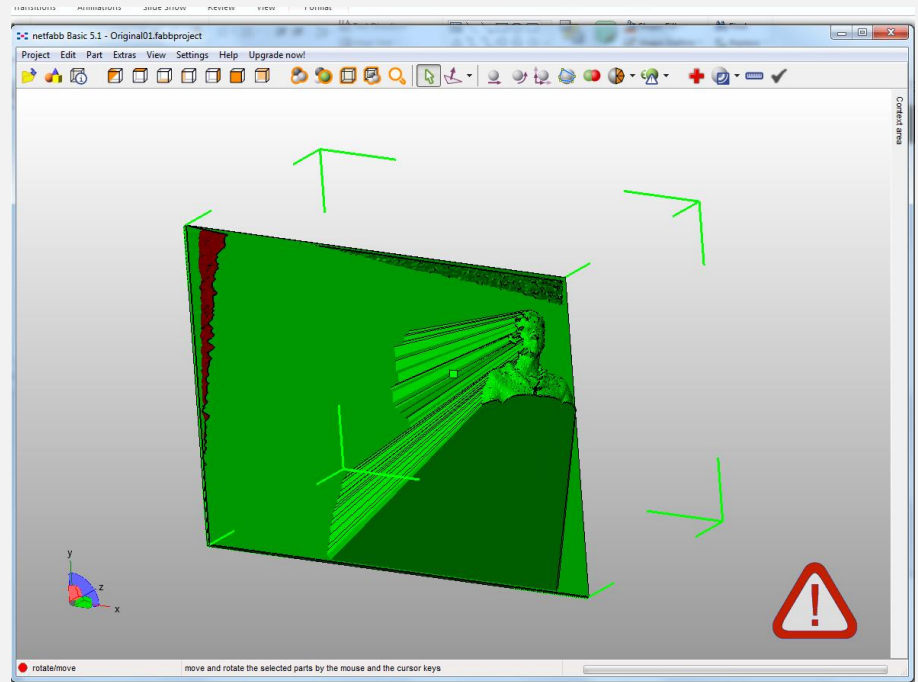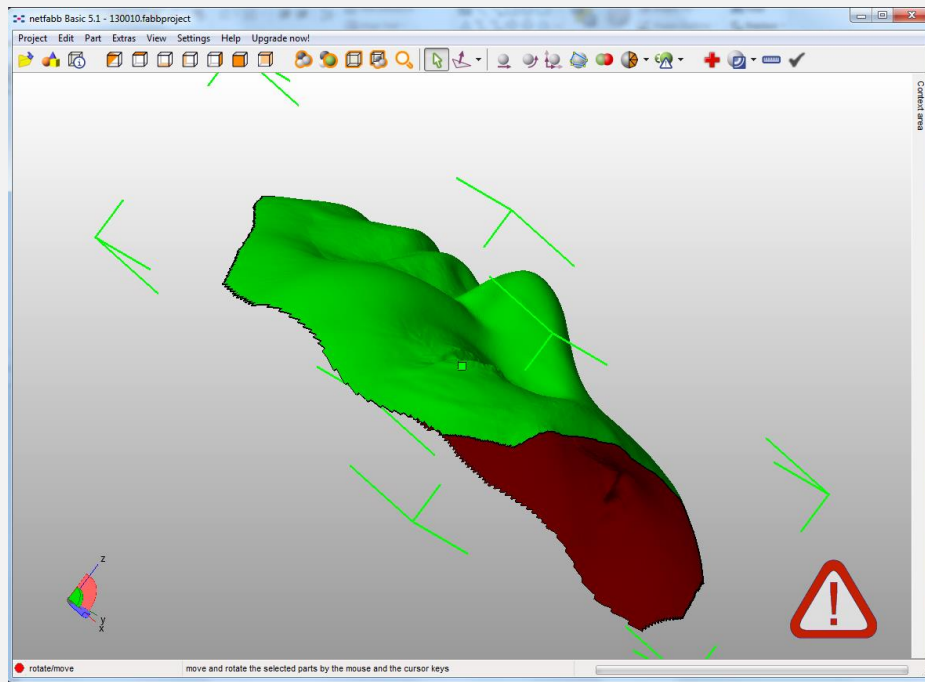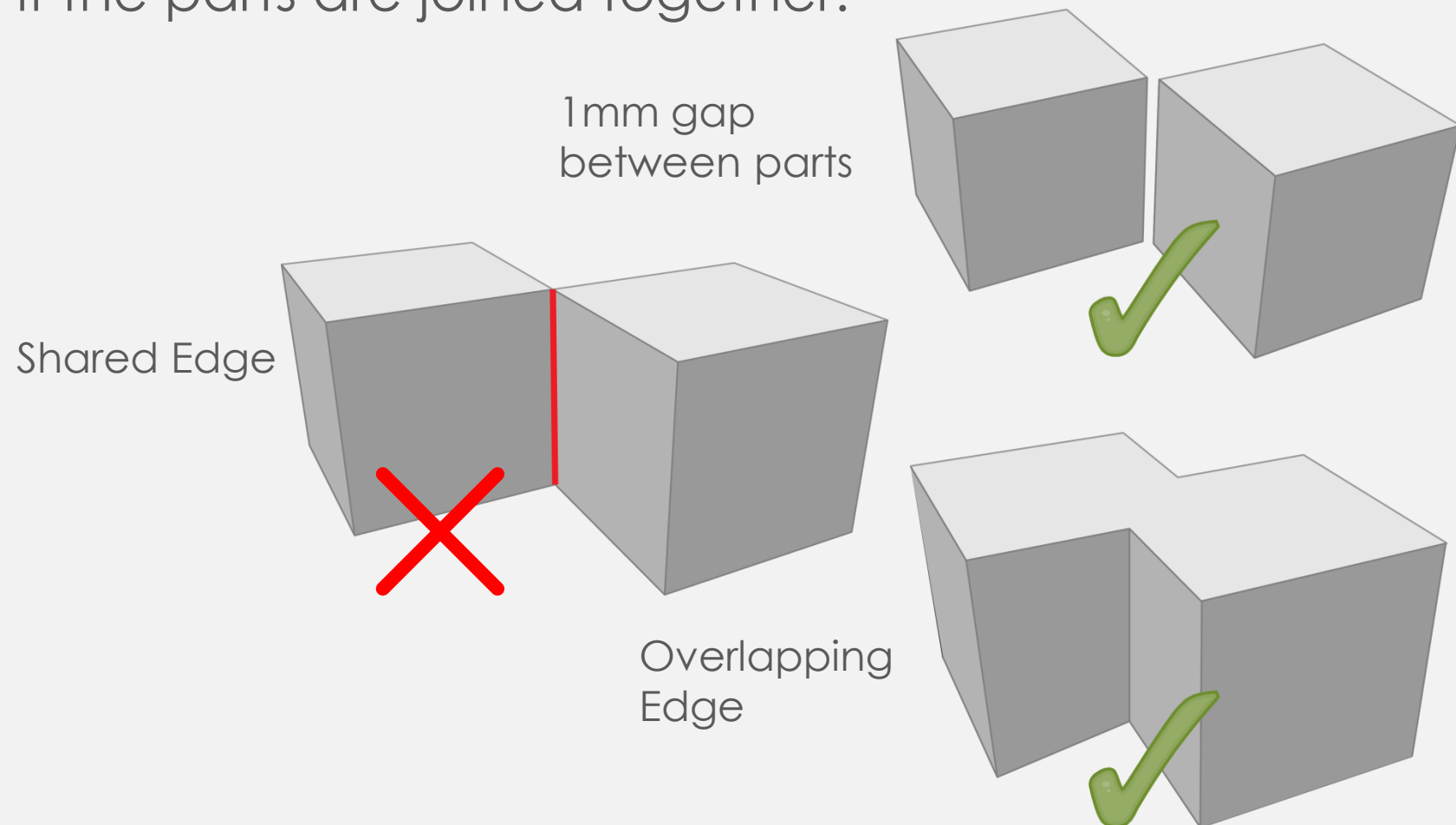
Open Face

Closed Face

No Holes in the Mesh

No shared edges

Your CAD file must not contain any shared edges between objects.

It is ok to have a 1mm gap between the parts, or an overlap if the parts are joined together.

1mm gap
between parts

Shared Edge

Overlapping
Edge

Normal Please!

Normals are perpendicular reference points to surfaces on CAD models, to define whether the surface is an inside or outside face.

An inverted normal is a normal that is pointing in the wrong direction, telling the computer that an outside face is actually an inside face when it isn't.

Correct Normals

Inverted Normal
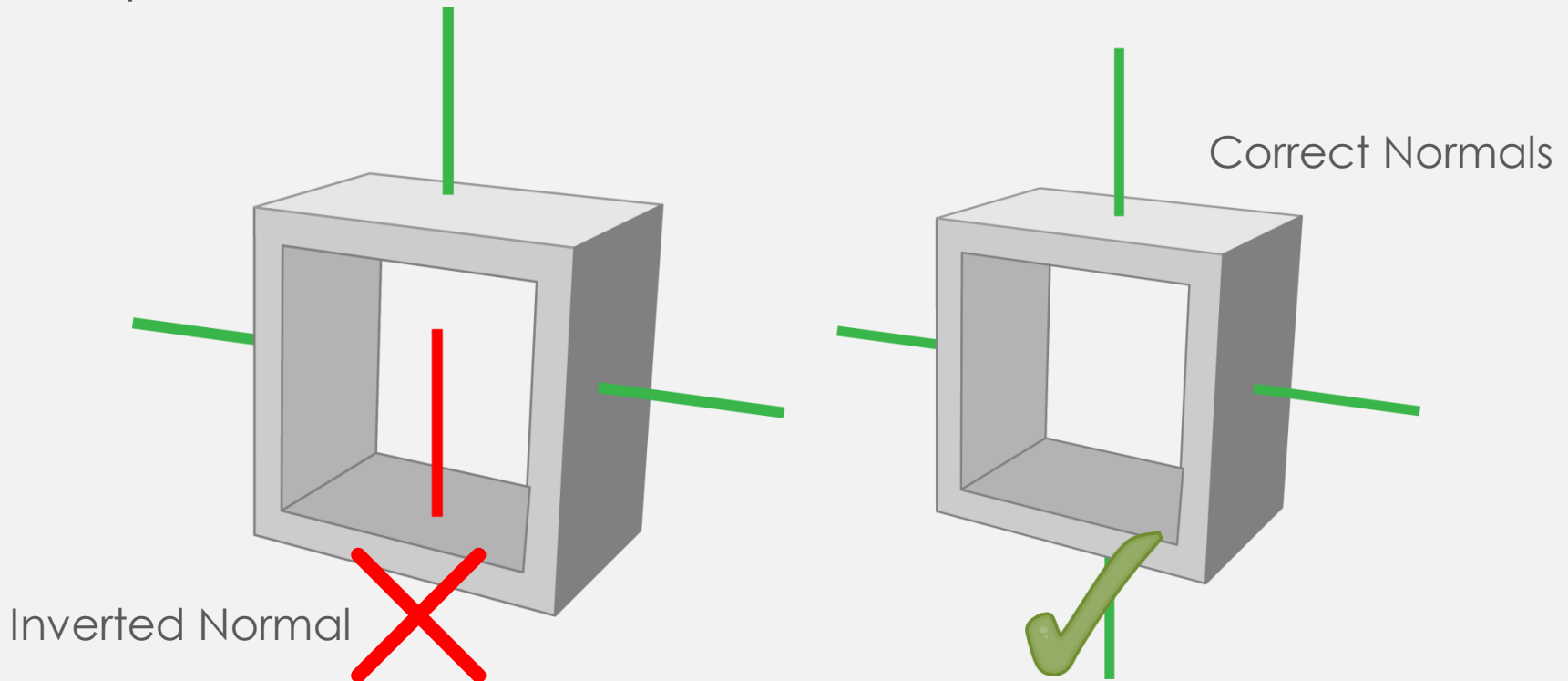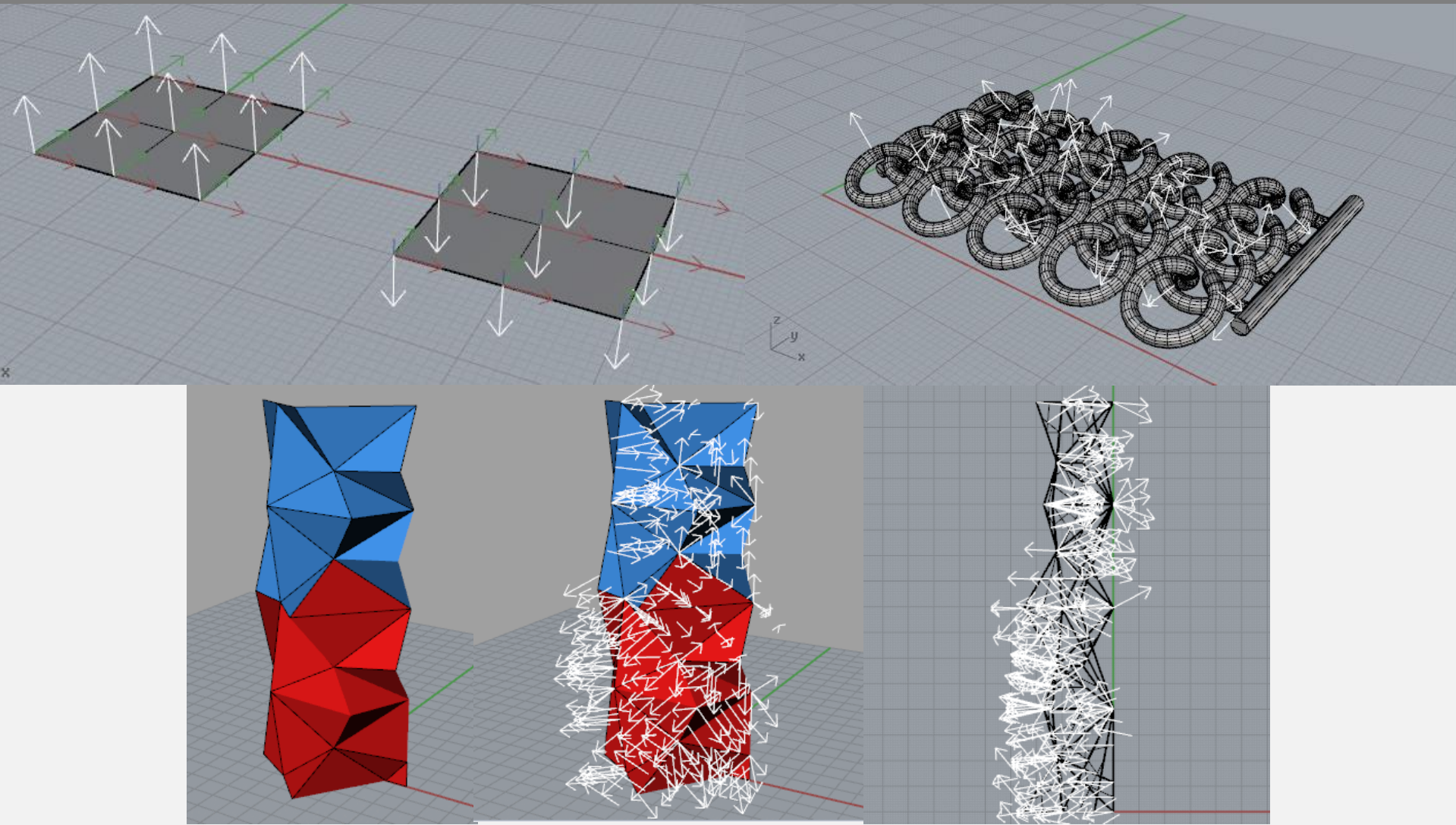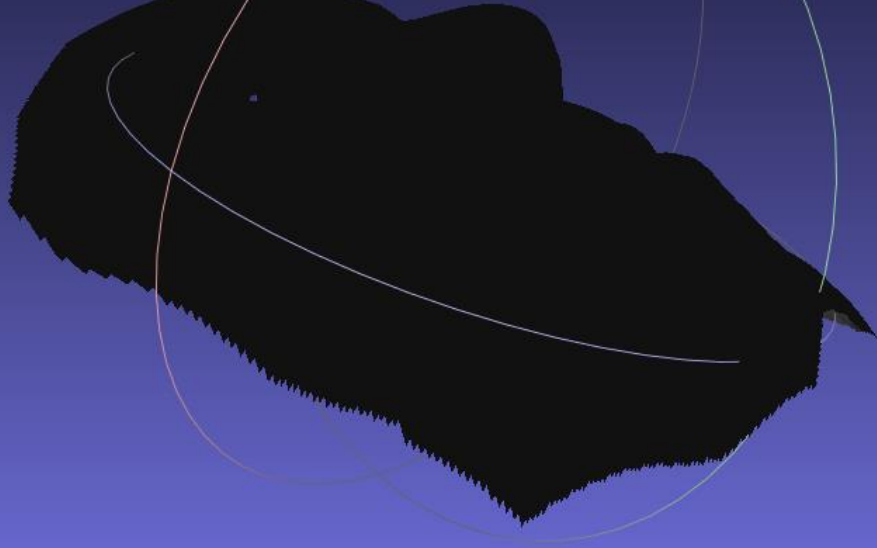
Surface Normals MUST point towards the outside.
Normals are perpendicular reference points to surfaces.

Surface Normals in MeshLab

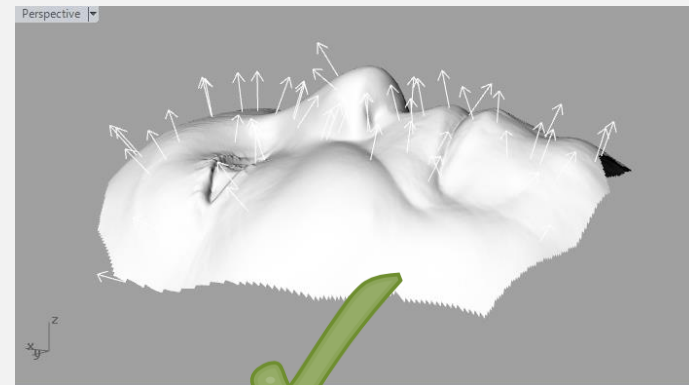**Incorrect Normals**
Lights does NOT hit surface of scan / model

Correct Normals
Lights hits surface of scan / model
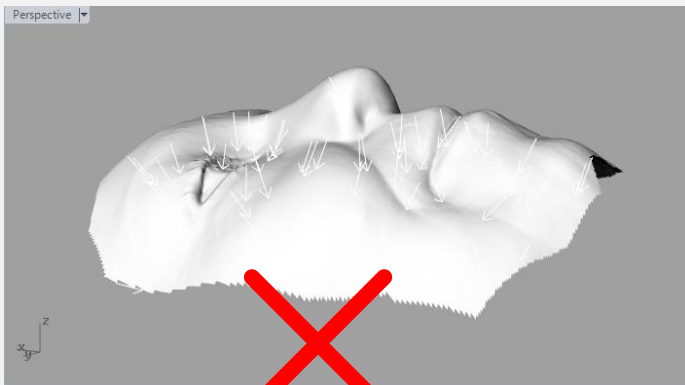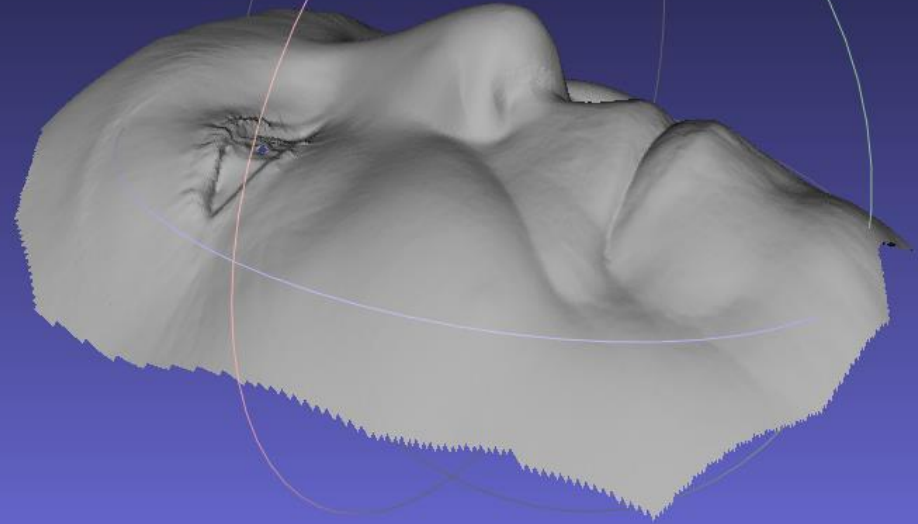
Internal Faces & Lights

Faces sitting inside the model-Remove all internal faces / surfaces.

Delete lights!

The minimum wall thicknesses for **self-supporting structures should be 1.5 - 2 times** the materials minimum wall thickness.

0.8mm minimum wall thickness with a 0.4mm nozzle
1mm minimum wall thickness with a 0.5mm nozzle

Unsupported Wireframe Structures

Minimum wall thicknesses for **unsupported wireframe structures** (eg bits that stick out and have no end connection) **should be 2 - 3 times** the materials minimum wall thickness.
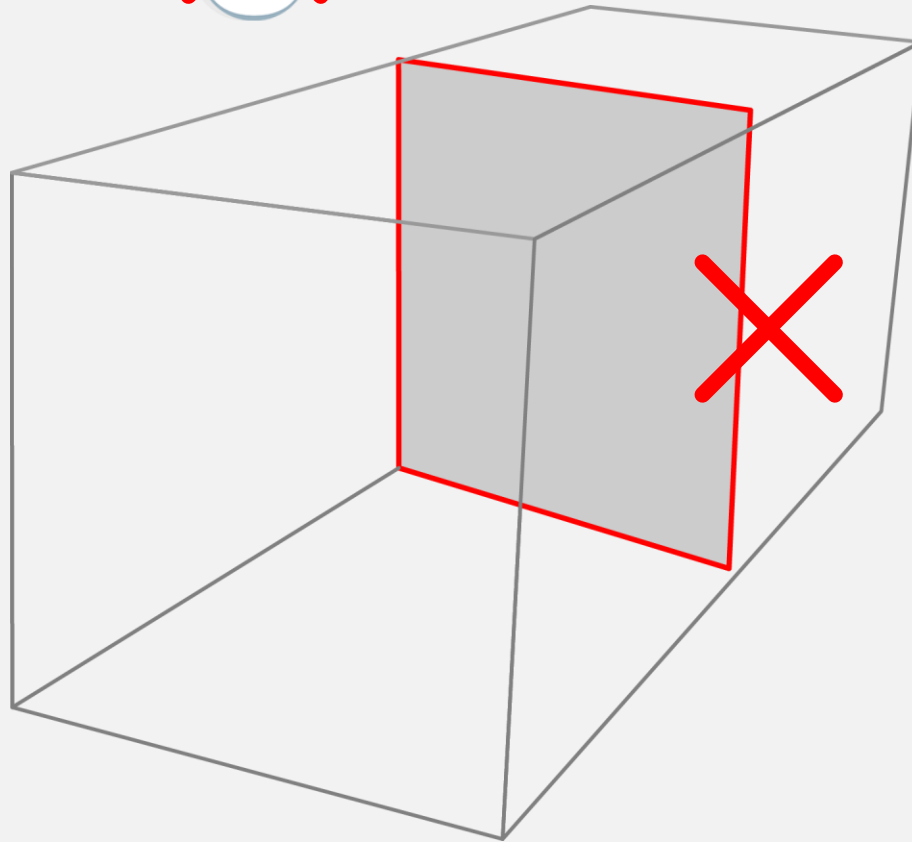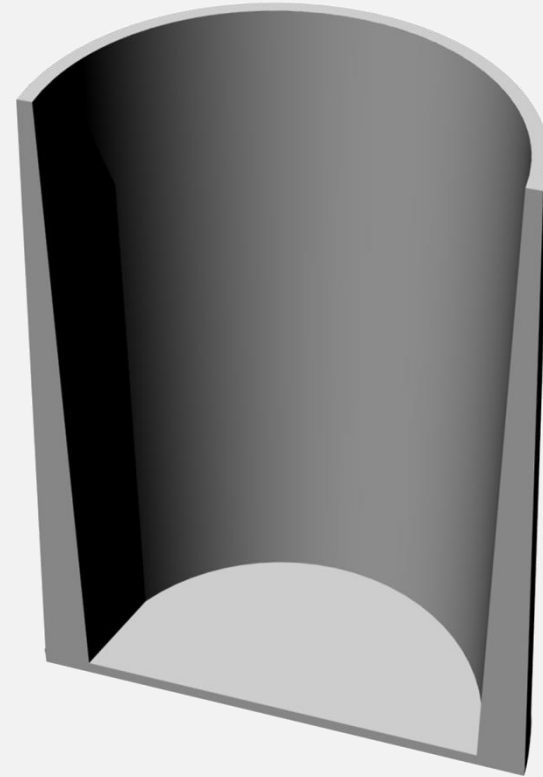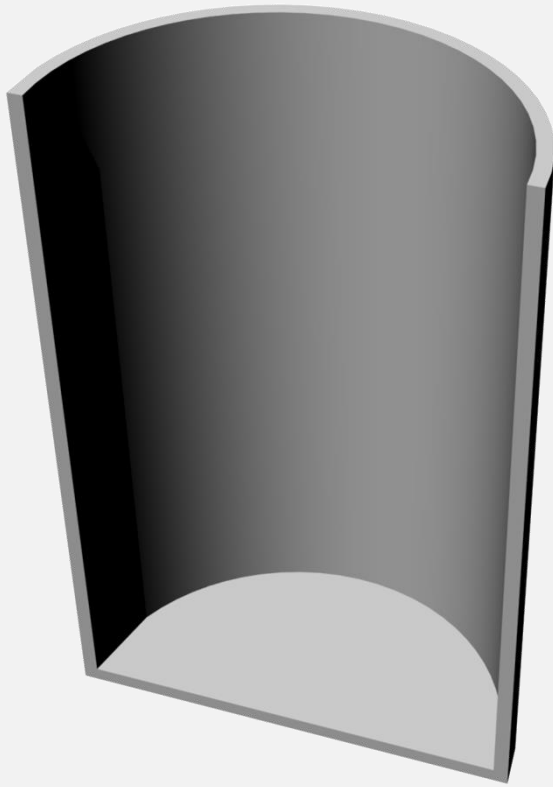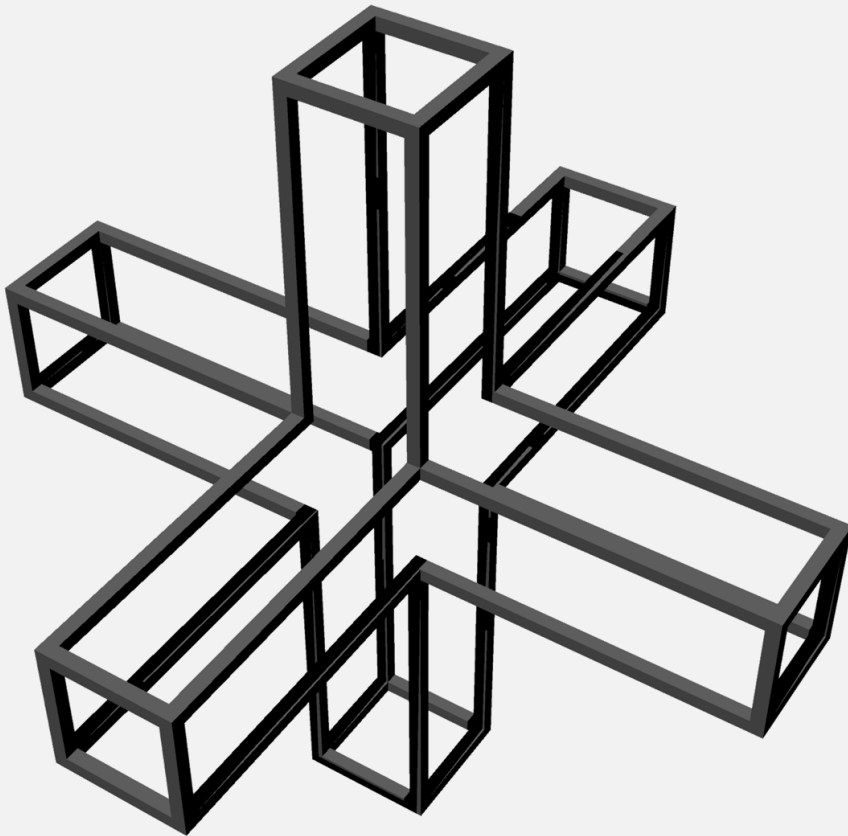
Tips for making wireframe structures stronger:

- Avoid sharp corners. Think tree branches, transition one surface into the other smoothly.

- Tapering your design so it is larger at the base where it connect to the other surface.

- Keep within the suggested wall thickness to height ratios for prong designs.

- Design prongs as separate pieces that can be attached later.

Overhangs – 45 degree rule

- Overhang is 45 degrees or less, the print will often work.
- Anything more extreme than this can be difficult to print.
- An overhang shallower than 45% cannot be printed without support-Plastic will sag.

SAFE   AVOID!   SAFE
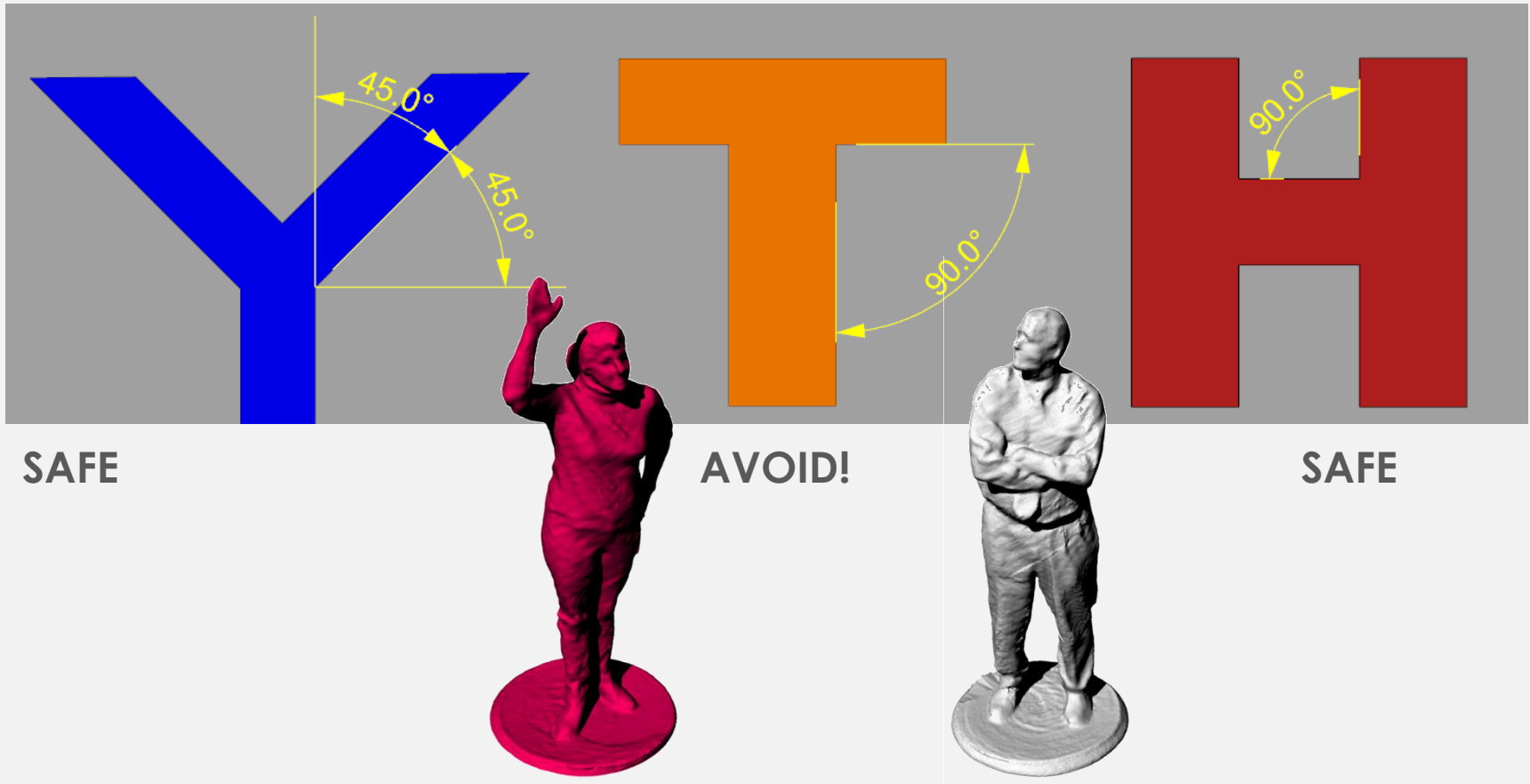
Overhang Video

SUPPORT MATERIAL
Overhangs, Bridges and Rafts, Oh My!
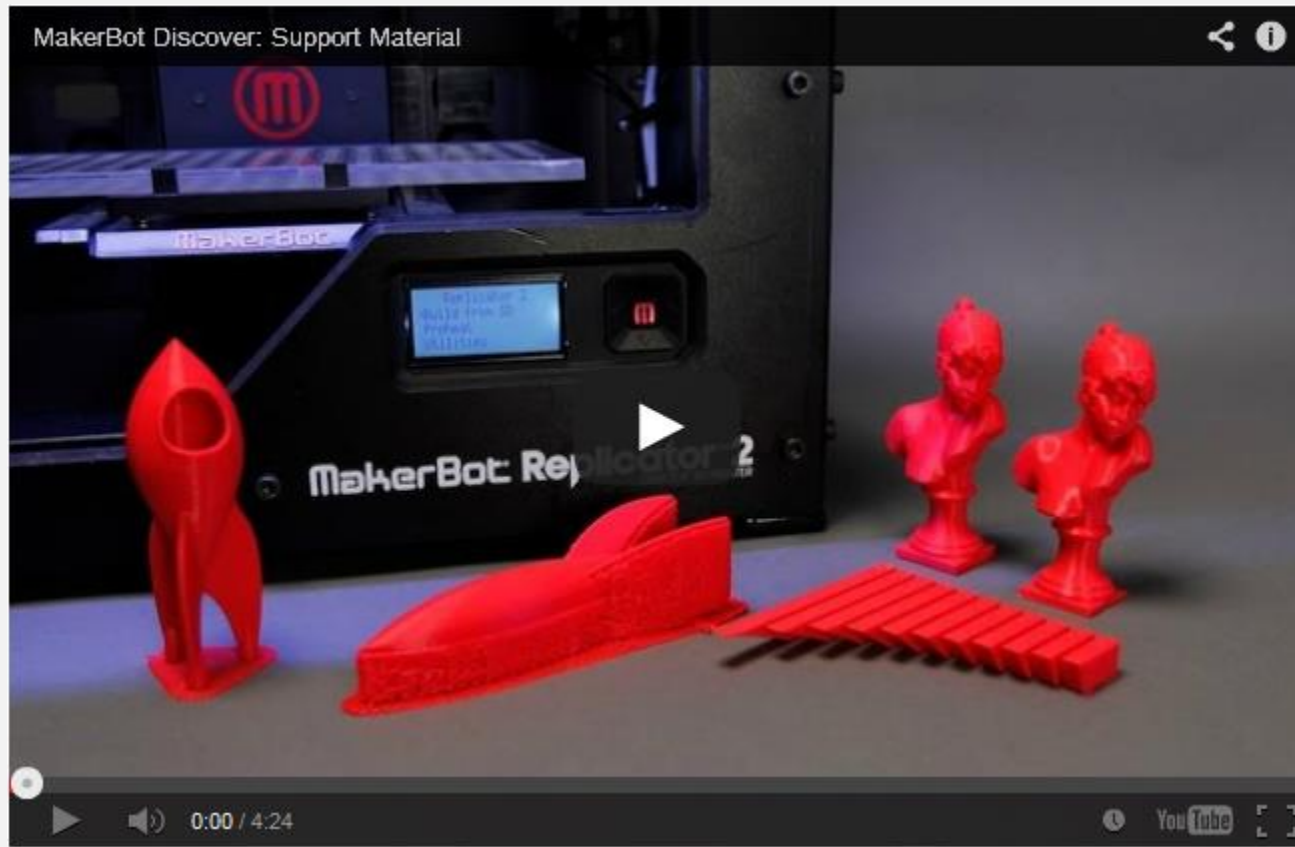
Print the Overhang & Bridge Test
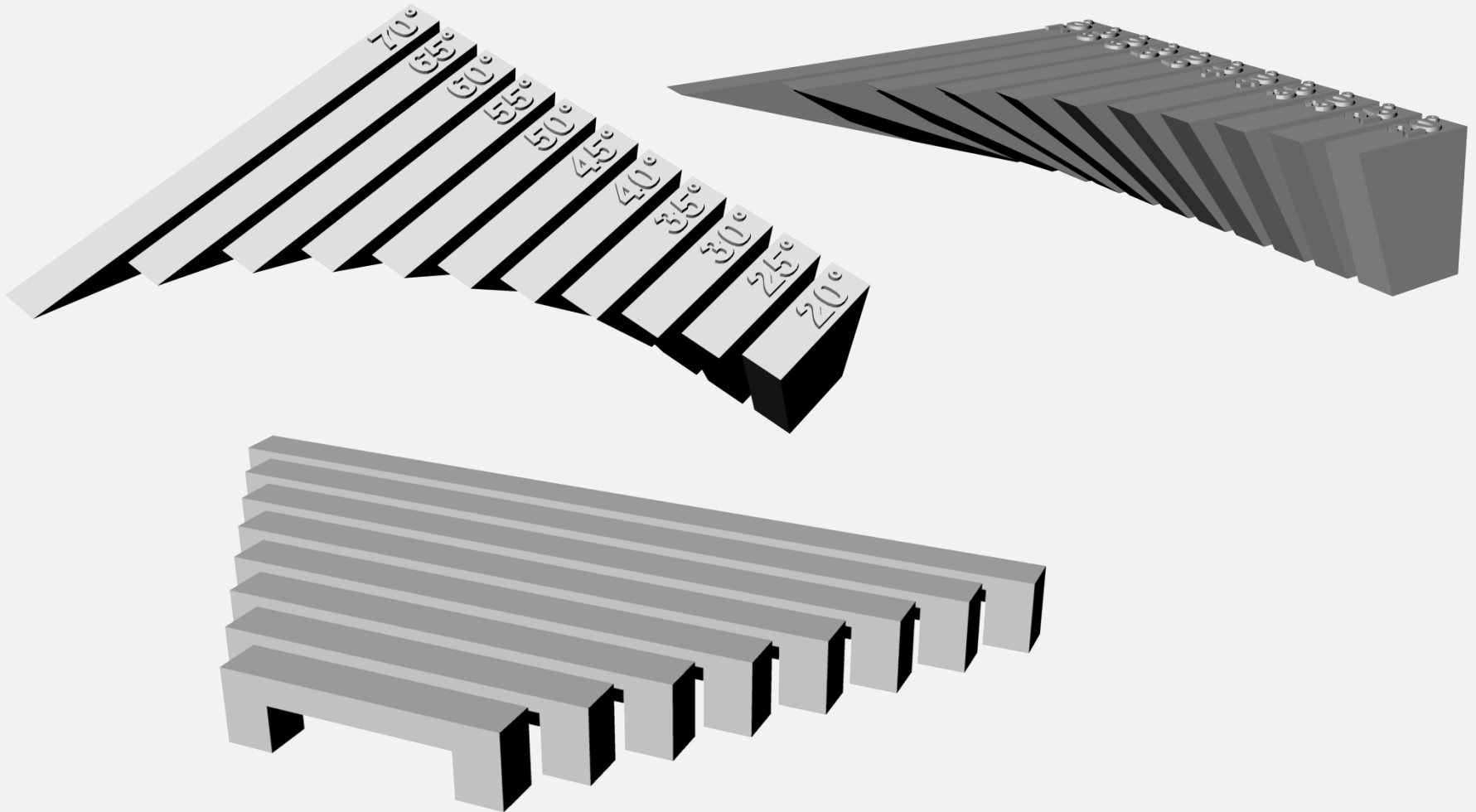
http://www.thingiverse.com/thing:40382/#files
http://www.thingiverse.com/thing:145335/#files

0.8mm minimum wall thickness with a 0.4mm nozzle
1mm minimum wall thickness with a 0.5mm nozzle

Minimum detail relates to non structural parts of your design eg: Text on a design

Minimum Detail Size

3D Printing Bureaus offer details such as:

- Max Build Volume
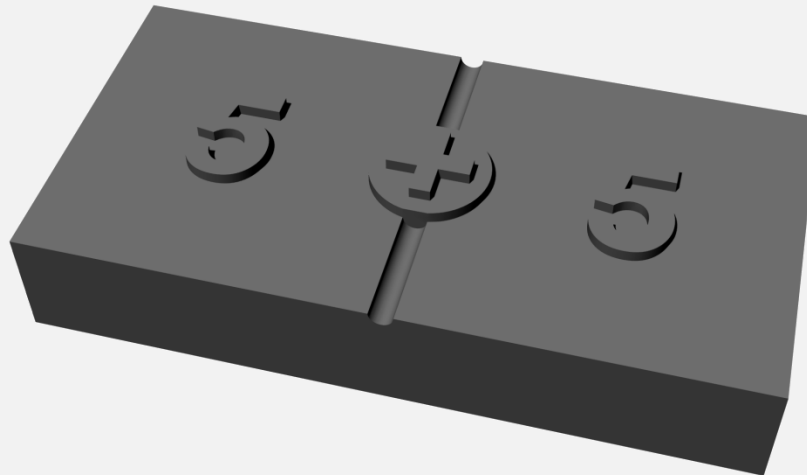- Minimum-Maximum Wall
- Minimum Detail Wall

Choose a material & Check before modelling!

shapeways

Ponoko

sculpteo

i.materialise

STAPLES MyEasy3D

iM
iMakr.com

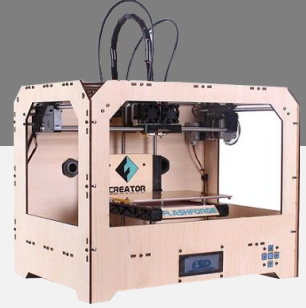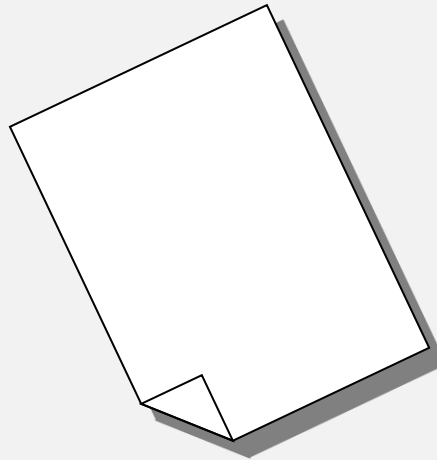http://www.3dprint-uk.co.uk/maximums-and-minimums/

Layer thickness and resolution
0.1-0.2mm / 100-200Microns

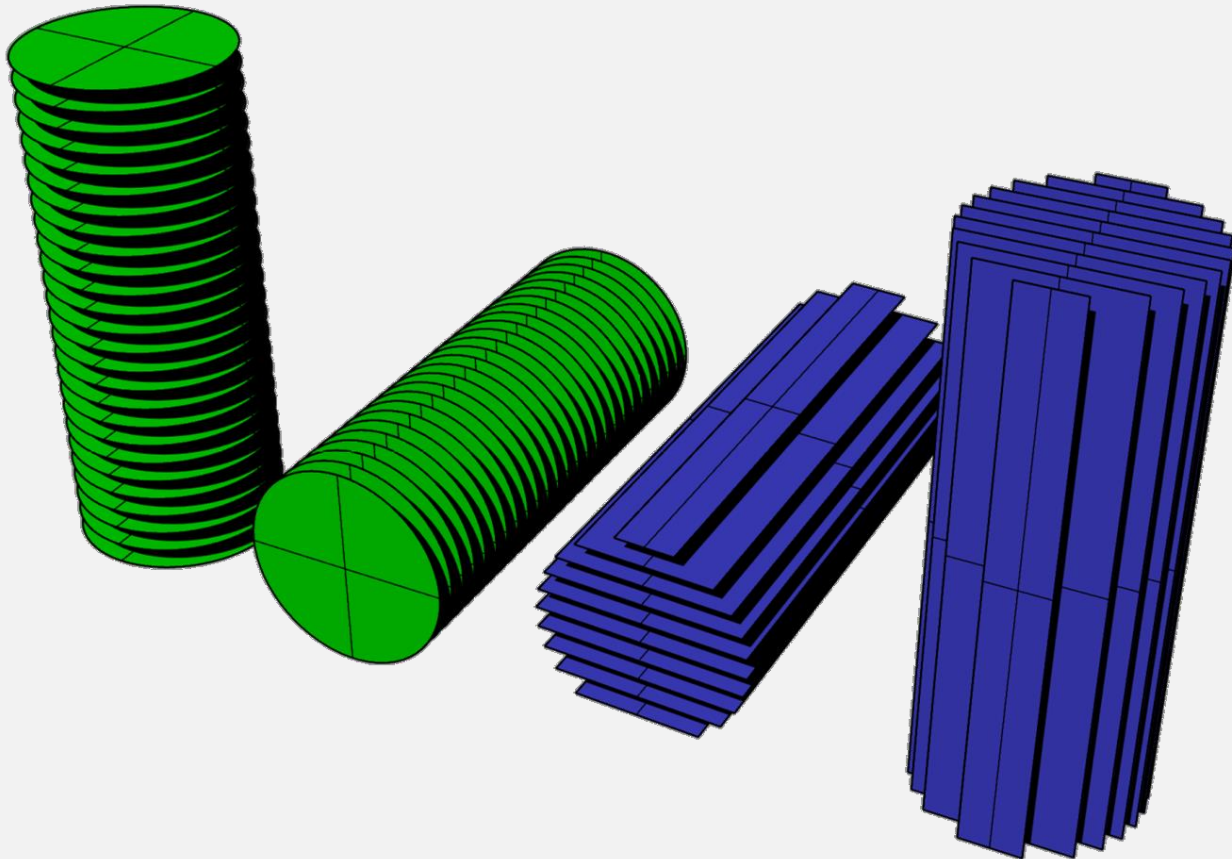Standard photocopier paper (80gsm)= about 100 microns

0.1mm millimeter = 0.01 centimeter
1 millimeter [mm] = 0.1 centimeter [cm]
10 mm=1cm
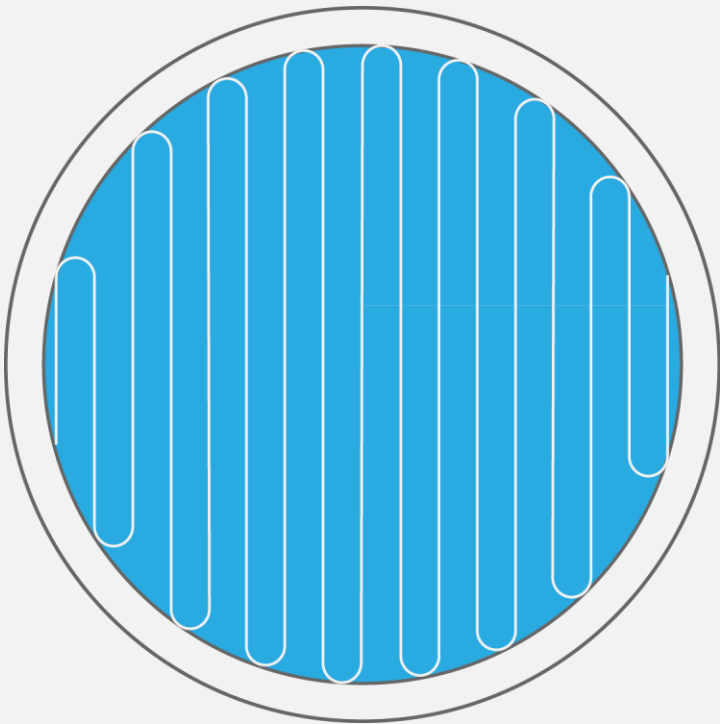
Model Orientation

- **Terrain lines** appear on the surface-Reading the model slice by slice is called 'Bacon Slicing'.

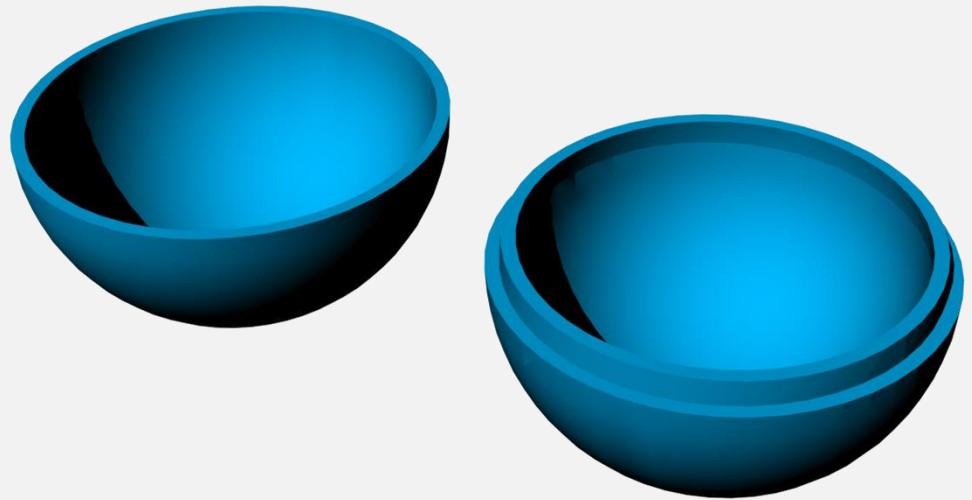- Orientate the model to minimise their impact or use to accentuate form & to increase strength.

Hollow out

- Avoid entrapped support material.

- Support material inside a hollow ball cannot be removed.

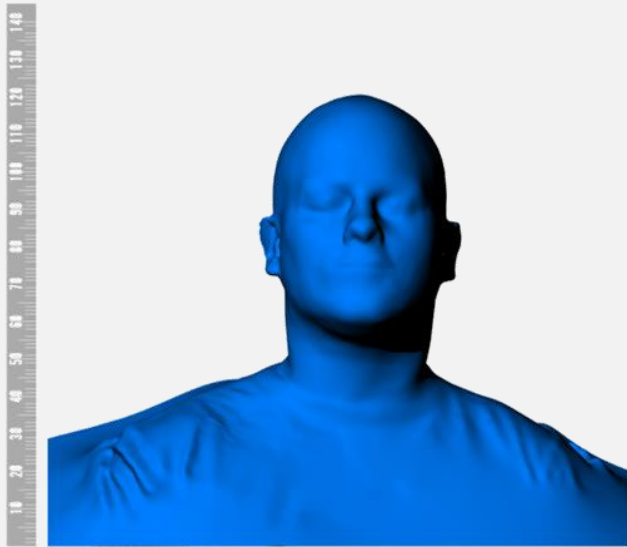Entrapped Support Material

Support material can be removed

Multiple Parts

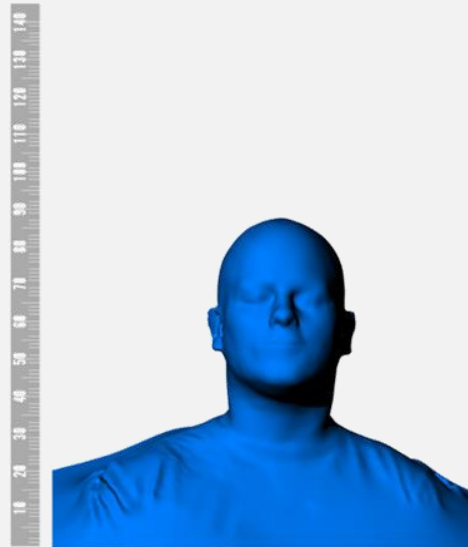- Reduces amount of support material
- Reduces print time

Scaling down

Remember to keep wall thicknesses to the minimum requirements or thicker once you have scaled down, especially when scaling down large complex objects such as architectural models.

Height 12cm
Volume 100cm$_3$
Cost £200.00

Height 9cm
Volume 42cm$_3$
Cost £100.00

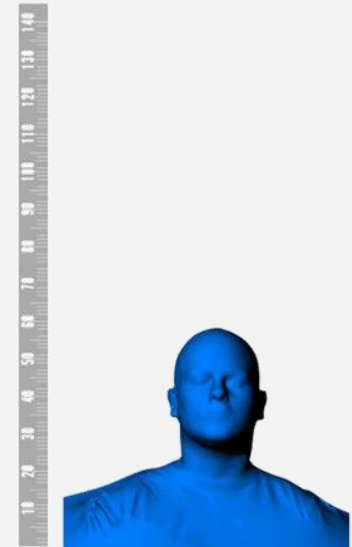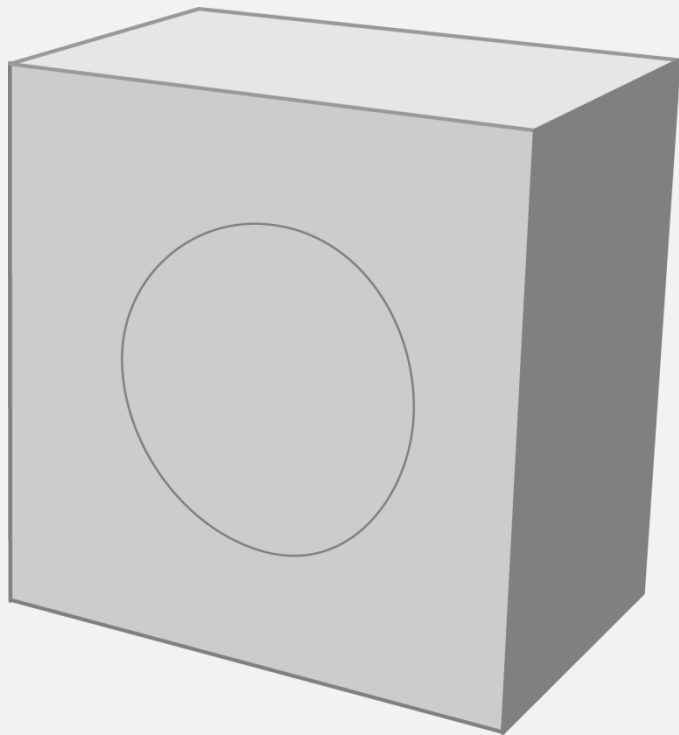Height 6cm
Volume 12.5 cm$_3$
Cost £25.00
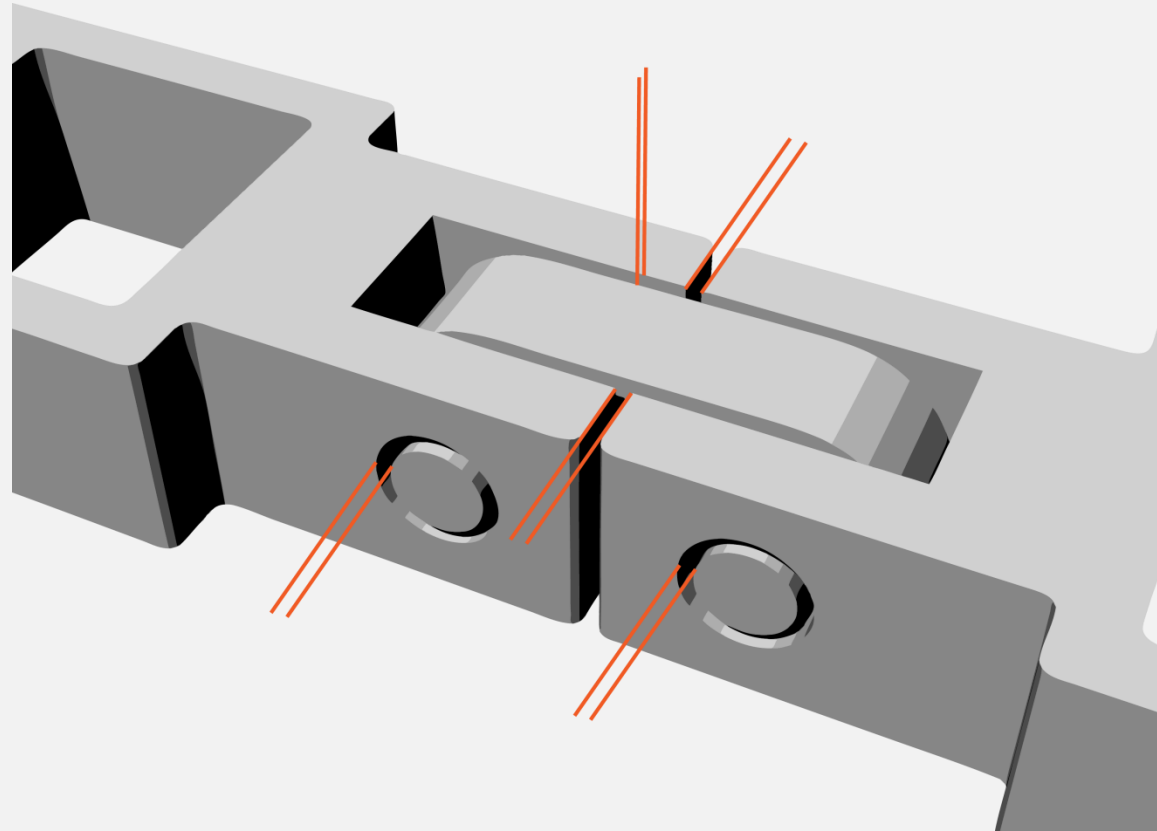
Remember to keep wall thicknesses to the minimum requirements or thicker once you have scaled down, especially when scaling down large complex objects such as architectural models.

0mm gap

1mm gaps

3D File Size

Print Bureau = Maximum file size
Your 3D design file must be less than 20mb.

Solution: Exporting your design as binary instead of ASCII.
Reduce polygon count
Scale

Finally- 3D Printing Software

3D Printing

1: 3D Modelling Program-The Digital Model

Watertight model

Need a manifold error free model

2: Slicing / CAM Software - The Toolpaths

Slicing programs translate 3D models into G-code - physical instructions for the printing robot. Creates toolpaths that the printhead will follow.

3: Printer Control / Client Software - The Final print

The Printers Control Panel. Sends the CAM instructions and provides an interface to control printer functions.

NOTE: Slicing / Client Software programs are in some cases combined into a single - interface printing environment.

Thank-you for listening