# HOW TO DESIGN FOR 3D PRINTING

3D modeling is a skill that can help you create realistic and imaginative digital designs, but did you know that you can also turn them into physical objects with 3D printing? 3D printing is a process that uses a machine to layer materials and create solid shapes based on digital models. In this article, you will learn how to create 3D models for printing, what software and tools you need, and what factors you should consider to optimize your results..
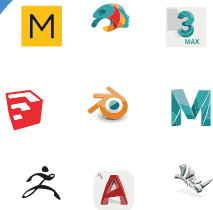
## Choose a software

The first step to create 3D models for printing is to choose a software that suits your needs and preferences.
There are many options available, from free and open source programs like Blender and Tinkercad,
to professional and paid ones like ZBrush, SolidWorks and Rhino.
Depending on your level of experience, budget, and style, you can find a software that offers the features and functions you need.
Some software are more suitable for sculpting organic shapes,
while others are more geared towards engineering and precise measurements.
You can also use online platforms like Sketchfab and Thingiverse to browse and download ready-made models or
customize existing ones.

"3D models can be created using any CAD application like CATIA V5, UGNX, SOLIDWORKS and so on. Once the models are ready,
they can be converted to STL format for 3D Printing. The STL file format is the most commonly used file format for 3D printing"

## Design your model

Once you have chosen a software, you can start designing your model.
You can use different tools and techniques to create your model,
such as drawing, extruding, sculpting, or importing.
You can also add textures, colors, and details to enhance your model's appearance.
However, keep in mind that not all of these elements will translate well
to the 3D printing process. You may need to simplify or modify your model to make it
more suitable for printing. For example, you should avoid thin or hollow parts,
overhangs, and complex geometries that may cause printing errors or require supports.

"- Think about your model (generate ideas and seek inspiration).
- Sketch your ideas (draw them on paper or digitally, keeping in mind the importance of proportions and scale).
- Model your ideas (use 3D software to sculpt your model as desired).
- Adapt your model to 3D printing technology (refer to guidelines for each process and adjust your design accordingly).
- Small iterations are key to improving your models."

## Check your model

Before you export your model for printing, you should check it for any
errors or issues that may affect the quality or feasibility of your print.
You can use various tools and methods to check your model,
such as inspecting the mesh, verifying the scale and dimensions,
applying modifiers, and fixing holes or gaps.
You should also make sure that your model is watertight,
meaning that it has no openings or leaks that may compromise its solidity.
You can use software like Meshmixer or Netfabb to analyze
and repair your model if needed..

"Verify Scale and Dimensions by making sure your model's dimensions are
accurate and match the intended size.
Use reference objects or measurements to ensure the correct scale."

## Export your model

The next step is to export your model in a format that is compatible with your
3D printer and slicing software. The most common format for 3D printing is STL,
which stands for stereolithography. STL files store the information about the geometry and
surface of your model as a series of triangles. However, some 3D printers and slicers may
support other formats, such as OBJ, 3MF, or GCODE. You should check the specifications of your
printer and slicer before exporting your model. You should also choose the appropriate resolution
and quality settings for your export, depending on the size and complexity of your model..

"Exporting quality is of paramount importance, and it should not be overlooked.
All software exports models to an STL file, and the export quality is critical for achieving the best final results.
Always ensure that your models are of the highest possible quality."

## Slice your model

The final step before printing your model is to slice it. Slicing is the process of converting your model into a series of
instructions for your 3D printer. You can use a software called a slicer to do this. A slicer allows you to adjust various
parameters and settings that affect the print, such as the layer height, the infill density, the print speed, the temperature,
and the supports. You can also preview and simulate your print to see how it will look and how long it will take.
Once you are satisfied with your settings, you can save your sliced model as a file that your 3D printer can read and execute.

"it is not essential which software you use it's important you know it well and you know how to get the right STL file out of it"

"Iteration is key!
Because it is so quick and easy to print and test your model, it is easy to iterate for trial and error.
5, 10 and even 20 print iterations can sometimes be quicker, easier and cheaper than hours and hours of design studies and refinement."

# 3D MODEL MAKING PROGRAMS FOR 3D PRINTING

Printing pre-made moduels can be fun, but the real power of 3D printing comes in making your own designs, tailored exactly to your needs and desires. This guid will help you choose the best software for you to use in making 3D models for your printed projects!

## WHAT DO YOU WANT TO MAKE?

| ACCURATE OBJECTS | ORGANIC SHAPES | INORGANIC SHAPES | REAL-WORLD COPIES |
|---|---|---|---|
| functional/ fitted parts, dimensioned objects, tools, prodcuts. | soft-surfaces, people, animals, characters, terrain, clothing | hard/ flat surfaces, controlled curves, non-functional robots, vehicles, buildings | of people, buildings, objects anything really |

| PARAMETRIC DESIGN | SCULPTING | HARD SURFACE MODELLING | PHOTOGRAPHY OR SCANNING |
|---|---|---|---|
| Which uses measurments, calculations, drawings, etc, to build an obect that is easy to iterate upon. | Which emulates a digital block of clay that you can push, pull, smooth, inflate, pinch, etc | Where you add and remove simple shapes (such as cubes, spheres, cyinders), to form complex objects. | Where you take many photographs or scans and combine them through software to form a model. |
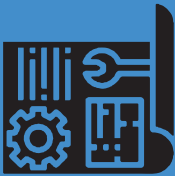
### Start with...
**FUSION 360**

- Huge support community
- Various tools suited to iterative design
- Free for hobbyists

### Start with...
**SculptGL**

- Kid/school-Friendly
- Uncomplicated UI
- Great import/export
- Great model repair

### Start with...
**TinkerCAD**

- Kid/school-friendly
- Intuative UI
- Editing existing STLs
- Good model repair

### Start with...
**AliceVision**

- No extra equipment
- Works using photos (Photogrammetry)
- Simple Interface

### Or try...
**OPENSCAD**

- Syntax-Based
- Open Source

### Advance to..
**ZBRUSH**

- Industry Standard
- Specialised tools

### Advance to..
**Blender**

- Specialised tools
- Open Source

### Advance to..
**Laser Scanning**

- Much greater detail
- High upfront costs

The above list just contains the more popular choices and the ones I find newbies learn quickest and easiest. There are, however, many options and its important to find the program that suits you.

# 3D Programe Guide

## CAD/CAM/ PARAMETRIC DESIGN

CAD heavily excels with mechanical designs, where the object is defined by measurements, angles, tolerances, quicker to revision

| Program | OS | Price | Notes/Tutorials |
|---|---|---|---|
| Onshape | Browser | free for public documents with a paid option for private documents. | Onshape is a cloud-based CAD software offering a wide range of benefits to engineering design and development teams. It provides real-time collaboration among team members regardless of their location, making communication and teamwork more efficient.. |
| Fusion 360 | Windows / Apple / Linux | free for non-commercial use, startup exceptions available. | Autodesk Fusion 360: Integrated design and manufacturing. Fusion 360 is a powerful product development software tool that integrates design and manufacturing processes seamlessly. This integration brings numerous benefits to your workflow, ensuring a smooth transition from design to the production stage. |
| FreeCAD | Windows / Apple | free Open Source. | Parametric CAD program in active development. Works pretty much like Fusion360 but completely offline. Can be scripted with Python. |
| DesignSpark Mechanical | Windows / Linux | Free to use. | It is great for school kids and older students who want to submit a drawing for manufacture or just want to get the hang of using CAD software. |
| OpenSCAD | Windows / Apple / Linux | Open Source | Syntax based modelling (describe your model in a computer language, the computer renders it. Note: SCAD is not an NP-complete programming language).. |
| SolidPython | Windows / Apple / Linux | Open Source | Allows 3D models to be written as python programs, the output is OpenSCAD. The advantages of using python are that the full features of a modern language (including OO programming techniques) can be used. |
| Autodesk Inventor | Windows / Apple / Linux | PAID | Natively supports STL's, but most often used for subtractive manufacturing methods. |
| Rhino 3D | Windows / Apple / Linux | PAID | Robert McNeel and Associates headquartered in Seattle offers Rhinoceros 3D (or Rhino 3D), a 3D modeling and design application. Rhino can create, edit, analyze, document, render, animate, and translate NURBS curves, surfaces and solids, subdivision geometry (SubD), point clouds, and polygon meshes.. |
| SolidEdge | Windows / Apple | Community Edition is free for non-commercial use. | Has the best symmetry and feature recognition for editing STEP files from other sources. Most editing is done in 3D space instead of traditional Sketch->Feature workflow. |

## SCULPTING

3D sculpting, think of having a virtual ball of clay, your pinching it, smoothing it, pulling it to make something heavily organic looking such as a person, a creature, etc

| Program | OS | Price | Notes/Tutorials |
|---|---|---|---|
| Sculpt GL | Browser | PAID | Free digital clay sculpting |
| Sculptris | Windows / Apple / Linux | PAID | Sculptris is a free and easy to use software. If you need to create a prototype, and don't need to have a highly detailed project, it will do the job quite perfectly. And, if you don't really have previous 3D modeling experience, Sculptris is a good and intuitive way to learn. |
| Meshmixer | Windows / Apple / Linux | Free to use | Free software to combine/modify models, generate custom support structures, and sculpt as though with clay. |
| ZBrush | Windows / Apple / Linux | PAID | is a digital sculpting tool that combines 3D/2.5D modeling, texturing and painting. It uses a proprietary "pixol" technology which stores lighting, color, material, orientation and depth information for the points making up all objects on the screen. |
| Blender | Windows / Apple / Linux | Free to use | Blender is the free and open source 3D creation suite. It supports the entirety of the 3D pipeline—modeling, rigging, animation, simulation, rendering, compositing and motion tracking, even video editing and game creation.. |
| 3D Coat | Windows / Apple | Free to use | is a commercial digital sculpting program from Pilgway designed to create free-form organic and hard surfaced 3D models from scratch, with tools which enable users to sculpt, add polygonal topology (automatically or manually), create UV maps (automatically or manually), texture the resulting models with natural painting tools, and render static images or animated "turntable" movies.. |
| Strata Scult3D | Windows / Apple | PAID | Sculpt 3D is free for all Strata users, and lets artists create organic shapes from a sphere of virtual clay, or import their own models into the browser-based app where they can stretch, twist, pull, mold, and inflate their designs. |
| Sculptra | Windows / Apple | PAID | Sculptura is the most intuitive and powerful 3D sculpting app ever designed for your iPad. Sculpt engaging characters, ghastly monsters, or even intriguing abstract art anywhere you are. |

# 3D Programe Guide

## HARD SURFACE MODELLING



3D modeling when you think of those interesting artistic buildings or those pieces of terrain for on a game table, 3D modeling was behind the scenes, not as heavily defined process as CAD

| Program | OS | Price | Notes/Tutorials |
|---|---|---|---|
| Tinkercad | Browser | Free/ Open source | Beginner/Kid friendly |
| Blender | Windows Apple Linux | Free/ Open source | Blender is the free and open source 3D creation suite. It supports the entirety of the 3D pipeline—modeling, rigging, animation, simulation, rendering, compositing and motion tracking, even video editing and game creation. |
| Orchard | Browser | Free/ Open source | 3D Orchard is a free online platform for crowdsourced design. It includes free, built-in CAD tools and everything needed to turn an idea into a physical product. Because the computer-aided design (CAD) tools are built-in and free, people can edit and evolve each others 3D models. As the 3D models evolve over time, they trace out a tree (hence "3D Orchard"). Any 3D model can be downloaded and 3D printed locally. Those without a 3D printer can order a 3D print, the platform then earns a commission on that order. |
| 3D Builder | Windows | Free/ Open source | Initially released in 2013 for Windows 8.1, Microsoft's 3D Builder is a free program that came pre-installed on some Windows 10 systems. While it's no longer installed by default, 3D Builder is still Microsoft's recommended 3D printing app that can be easily downloaded from the Microsoft Store. |
| Sketchup | Windows Apple | Free/Pro Version $$ | SketchUp helps architects and designers turn their ideas into reality with simple, powerful 3D modeling software. Whether your design is massive or miniature, we'll be with you every step of the way. Sketch it, share your vision, refine concepts, and bring them into the real world. |
| Makers Empire 3D | Windows Apple | Free | Makers Empire 3D is a 3D modeling computer program made by Makers Empire. It is designed to introduce 4-13 year old students to Design Thinking and engage them in STEM learning via 3D design and 3D printing. The 3D app is optimized for touch screens but can be used with and without a mouse on all major platforms. |
| 3DS MAX | Windows Apple | Free - educational licence | As 3d animation, it gives incredible professional results. I like that even though it has been updated for years, there is no change in its use. Therefore, it is not very difficult to master, but it may take some time. The interface is a bit complicated, this is the reason why it is difficult to have so many features. |
| Rhino | Windows Apple | Paid | Robert McNeel and Associates headquartered in Seattle offers Rhinoceros 3D (or Rhino 3D), a 3D modeling and design application. Rhino can create, edit, analyze, document, render, animate, and translate NURBS curves, surfaces and solids, subdivision geometry (SubD), point clouds, and polygon meshes.. |
| MYA | Windows Apple | Paid | Maya has superior modeling tools that adhere to industry standards. As a result, 3D modeling is faster and easier with this software. Creating the most complicated models are matter of minutes with Maya. The tools are highly advanced and you get everything within the same software.. |

## PHOTOGRAPHY OR SCANNING



3D Scanning and Photogrammetry are used to create digital 3D models directly from real-world objects.

| Program | Style | OS | Price | Notes/Tutorials |
|---|---|---|---|---|
| Meshroom/ AliceVision | | Windows | | The workflow to create a texture mesh from still images in Meshroom. Meshroom is a 3D reconstruction program that uses the open-source Photogrammetric Computer Vision Framework AliceVision. Enhance the robustness of sift feature extraction on difficult images by updating default values, adding new filtering and adding dsp-sift variation. A new post-processing can improve mesh quality. To favor smoothness, cells are filtered using a solid angle ratio |
| 3DF Zephyr | Photogrammetry | Windows Apple | | Maya has superior modeling tools that adhere to industry standards. As a result, 3D modeling is faster and easier with this software. Creating the most complicated models are matter of minutes with Maya. The tools are highly advanced and you get everything within the same software.. |
| Lhun's Solution | Laser | Windows Apple | | |
| FabScan | Photogrammetry | Windows Apple | | The machine has good scan speed and can deliver accurate scan quality even while processing intricate geometries. A most intriguing aspect of the scanner is that it's community-driven. |
| Strata Foto 3D CX | Photogrammetry | Windows Apple | | Strata Design 3D CX 8.1 is just under $600. USD, and at that price packs one of the bigger punches in the industry. When we last reviewed Strata we noted that it has long been known for its high-quality rendering. It has long had a radiosity engine of particular note and a high-quality and fast raytracer as well. |
| OpenScan | Photogrammetry | Windows | | This digitized data can then be used for a multitude of applications. 3D Scanning Disadvantages: The 3D scanning process is quite time consuming. Optical scanners, such as the NextEngine, will struggle with highly reflective or transparent surfaces |
| Regard3D | Photogrammetry | Windows | | Regard3D is a free, multiplatform, open-source structure-from-motion application. It creates 3D models of objects, based on photographs from different angles. |
| AAScan | Photogrammetry | Windows | | In summary, we highly recommend Asana as a valuable tool for managing complex projects, particularly for teams that value collaboration and flexibility. Its user-friendly interface, customization options, real-time collaboration capabilities and automation features make it a powerful asset to any team |