

3D printing part 2 : 3D modeling basics and internet resources.

There are a few steps needed to get from concept to printed part. While you don't need to be capable of using 3D modeling to print things that have already been developed, it is mandatory for creating your own designs.

To make your own printable design you will need a 3D modeling tool. The most commonly used applications are classified as either geometric or organic modeling. Although I am not familiar with organic modeling, what I've seen on the topic indicates it is geared toward more artistic models. Geometric modeling is ideal for development of mechanical parts. There are a number of geometric modeling tools. They range from professional CAD (Computer Aided Design) products to on line tools that are relatively easy to learn. The tool that I was pointed to is Autodesk ® Fusion 360™. Autodesk ® provides this product for no cost if you make less than \$1000 per year from the designs you create. They also provide Tinkercad™ which runs in a browser window and Autocad ® for Students. Microsoft ® also makes 3D Builder for Windows. This is a short list, there are many others.

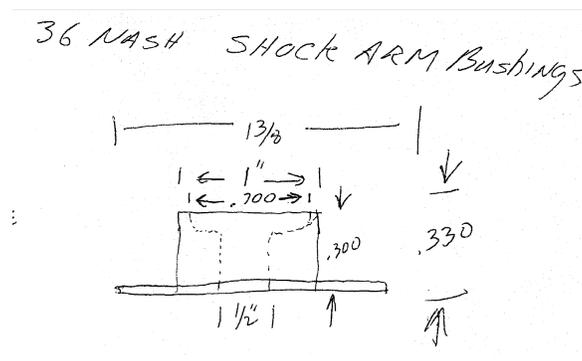
For those familiar with programs like Photoshop™ a modeling program should feel familiar. Rather than providing a set of tools that allow selecting and modifying a 2D photo it will have a set of tools that allow selecting different shapes or drawing lines in 3 dimensions and tools to make certain common tasks such as chamfers or rounded corners. The modeling tool will allow viewing the model in both 2 and 3 dimensions.

One option, if you're not comfortable with computers, is to make this into an opportunity to get closer to your children or grandchildren. The younger generations are learning computers at ever younger ages and they may jump at the chance to work with this new technology.

If you want to jump in yourself, the best way to become comfortable with these tools is to use them. The internet is a great resource for getting a jump start. I've been doing 3D modeling for less than a year and only what I could outside of my full time job, yet I feel fairly comfortable with many of the steps needed to create models. I relied on a set of tutorials specific to Fusion 360™ provided by Lars Christensen, available on YouTube, to jump start my knowledge and have continued to look for video guidance when I needed help with an unfamiliar area. Link to introductory tutorial: <https://youtu.be/A5bc9c3S12g>

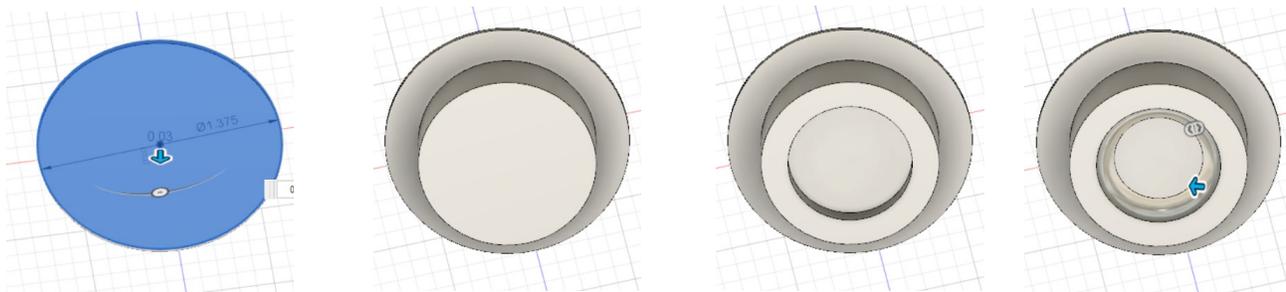
When I took mechanical drawing classes decades ago, we were taught to do 3 dimensional drawings in a couple of different ways. For mechanical parts, the practice was to draw the part as viewed from each side typically showing 3 views. We also learned isometric and projection type drawings that show multiple faces of the component in a single 3D view. The modeling programs are a blend of being able to view the objects from each side as well as being able to visualize it as a 3D body.

The modeling tool allows you to merge, subtract or combine shapes to construct your design. I was able to model bushings for my friend Bobs 1936 Nash very quickly as they are effectively a set of concentric circles. Bob provided me with this rough drawing:

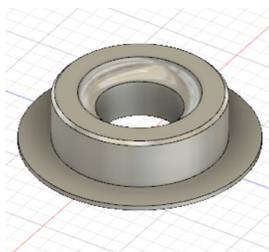


To create the 3D model, I started with the largest diameter and built the bushing up from that.

1) First the 1.375 diameter base and pull it to .03 inches. 2) Now add a 1" circle to the top and pull that .3 inches. 3) Now draw a 0.7 diameter circle to create the large hole and pull that to cut the existing body. The rough drawing looked to be roughly 1/3rd of the overall depth so I used .1 inch and pulled the circle down to cut the existing body. 4) After that I added the radius via the Fillet tool and the 1/2 inch center hole.



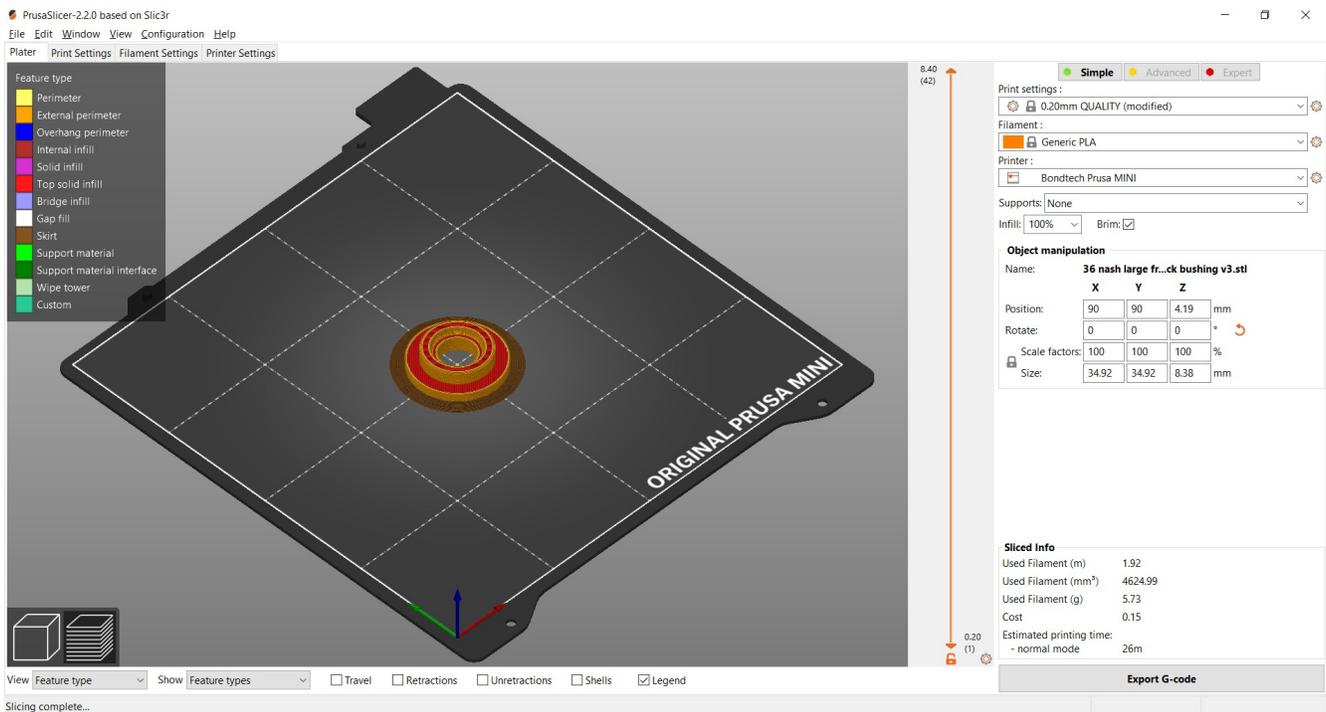
After Bob tried the first attempt he reported issues with installation. To address these, the center diameter was increased to .55 and a chamfer was added to the leading edge of the bushing. These performed flawlessly on a 400 mile tour.



These were printed in TPU with 100% infill but a more commercial way to proceed would be to print them in hard plastic and use that to create a mold. The preliminary design is available here and will be updated as needed: <https://www.thingiverse.com/thing:4736190>. It's TBD how a printed part will hold up under long term use.

Once your model is created you need to convert it into a format your printer can print. For my printer I export the 3D model as an .stl (stereo-lithography) file type which can be imported into the slicer provided by the manufacturer.

The slicer is the tool that converts your model into the commands used by your printer. Your printer manufacturer should provide or identify compatible slicers. This tool takes your model and based on the parameters you give it, it converts your model into a stack of slices to be printed and produces the printer compatible G-Code. Typical slice thicknesses are .15mm or .2mm. The maximum slice thickness is determined by the nozzle size and should be no greater than 80% of the nozzle size. My printer came with an 0.4mm nozzle. Other common sizes are 0.25mm and 0.6mm. Smaller nozzles provide higher resolution. Larger nozzles are suggested for filament with embedded material like wood or metal or larger projects that don't require fine details. The slicer allows you to visualize the layers that the object will be printed in and allows you to specify various parameters such as the type of plastic, slice thickness, whether it will be a solid part (infill) and other settings. It also has advanced features like selecting when to eject the filament to change colors. The slicer says that printing a single bushing will take roughly 26 minutes.



Getting the G-Code to the printer is dependent on what your printer supports. Mine has a USB port that I install a USB stick with the G-code. Some other printers can be setup with network connections allowing direct transfer from your computer to your printer.

The internet has many sources for sharing 3D models. Your printer manufacturer likely has a site for sharing designs or information. The ones I've focused on are thingiverse.com which is supported by Makerbot™ and printables.com which is supported by Prusa™. Both Makerbot™ and Prusa™ manufacture 3D printers. These sites have a broad range of items ranging from components you might want to incorporate into your own designs to complete printable projects including a number of obsolete car parts. A brief search found a replacement dip stick top for LS1's, a T-Top clip for 77 Vette and a C3 lock rod clip. I have shared some of my designs here and expect to add more.

There are also companies who advertise their services to print your models. Fees are typically based on a setup charge and the physical size or quantity of materials needed. 3D modeling can also be applied to parts you want cast or machined and some programs have the ability to output the instructions for Computer Aided Manufacturing machines. I've recently seen an ads for a 3D printer that can print stainless steel and another that has an infinite Z axis. While these are likely cost prohibitive to most individuals and restoration businesses, it's not impossible to find companies offering to print your models. A recent check of the internet shows that the UPS store has locations that offer 3D printing services including hourly rates for them to provide 3D scanning and modeling.

Time and practice should be the limiting factors on your ability to learn 3D modeling and apply it to your own projects. Another option might be to work with your children or grandchildren. Today's youth are learning technology at ever younger ages and this could be a way to bridge that gap. I've offered access to my printer to my grandson and nephew which was received with enthusiasm.

Up next – advanced topics – importing other designs, multi-color...