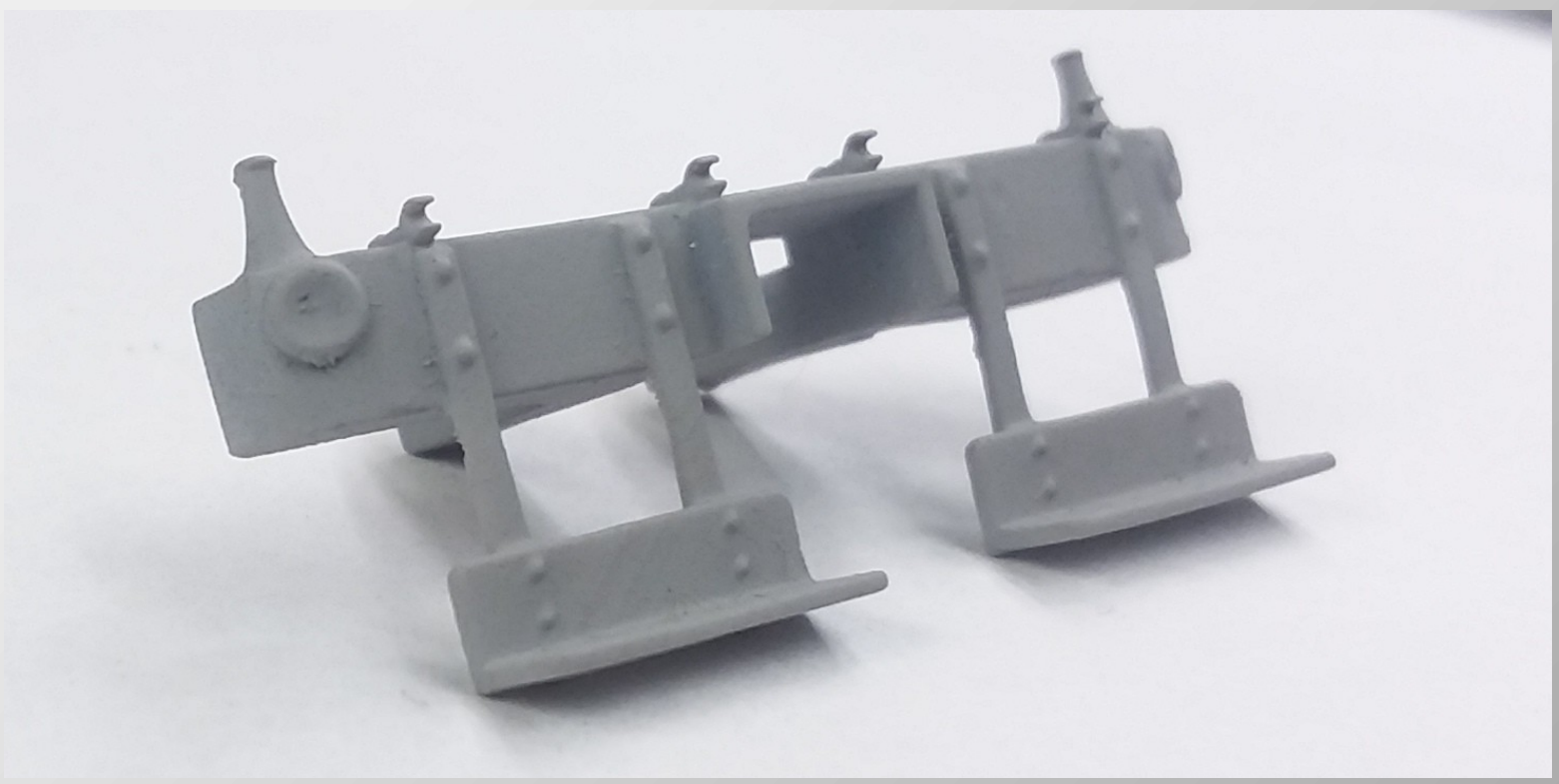
3d Printing, Part 1
Theory, Hardware, Software



Presented by Ken Mosny, Rock River Valley Division NMRA
FVD Meet, October 15, 2023

Before I begin the presentation, I am going to start a printing demonstration of some fire hydrants.

Today, for part 1, we will

- Briefly review the modern history of 3d printing.

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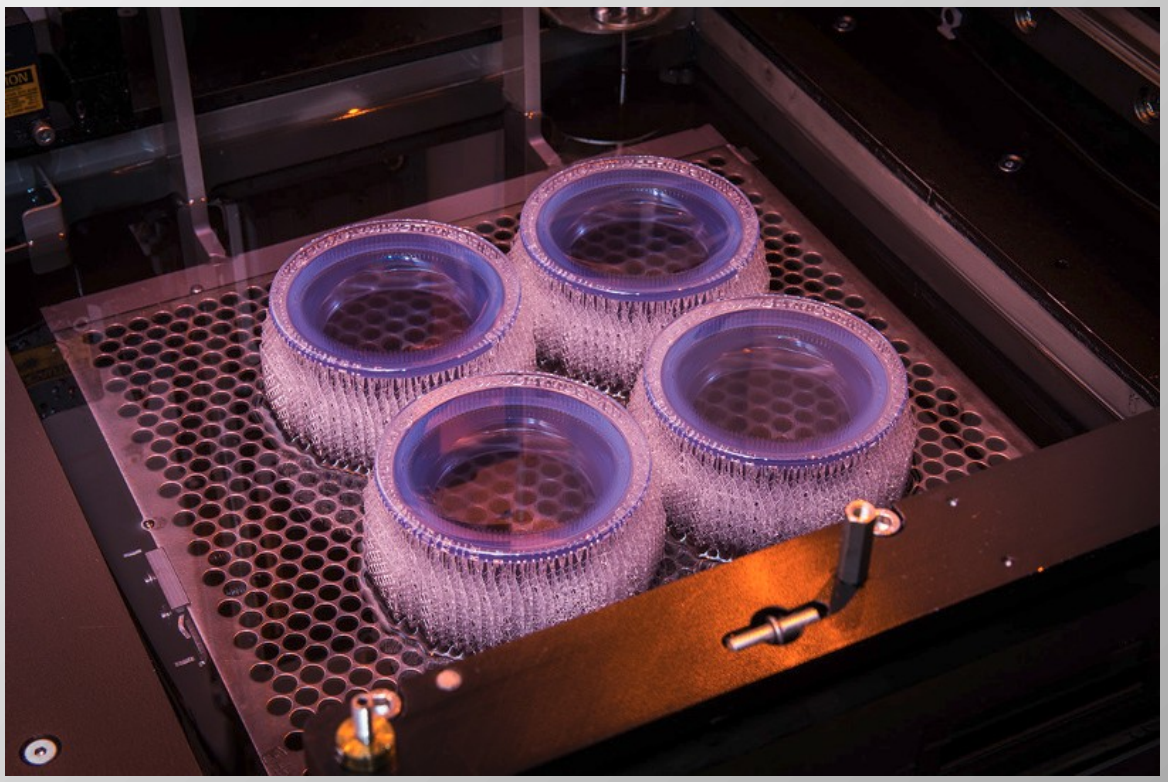
- Describe the types of hobbyist 3d printers.
- Introduce 3d modeling concepts.
- Describe the slicing process.

History

- About 1983, Chuck Hull in California began his work on stereolithography (SL) which he eventually patented.

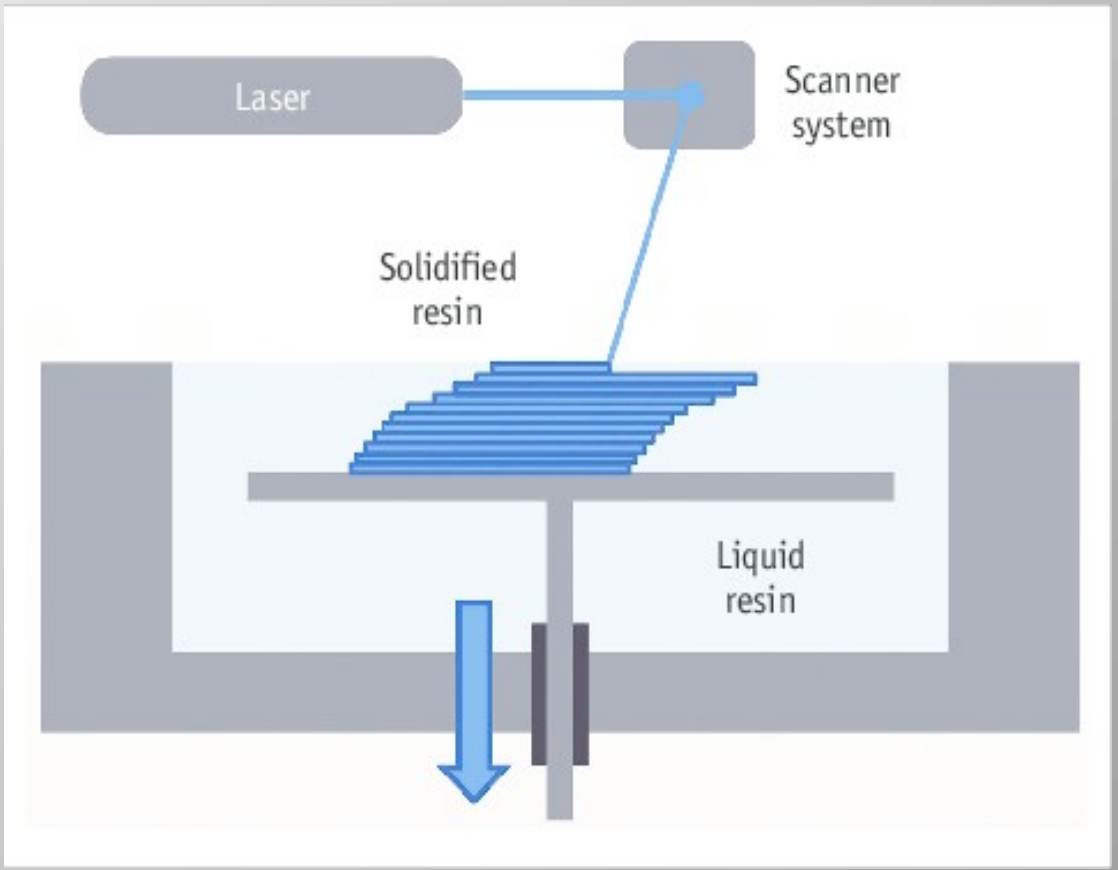


History

- Chuck Hull wasn't he first to have a concept for 3d printing, just the first to have the stars align on his idea and jumpstart a new technology.

Stereolithography (SL)

- Stereolithography is the process of exposing layers of resin to light to build the layers into a 3d print.
- The building of an object from layers is the basis of all commercial 3d printing.



History

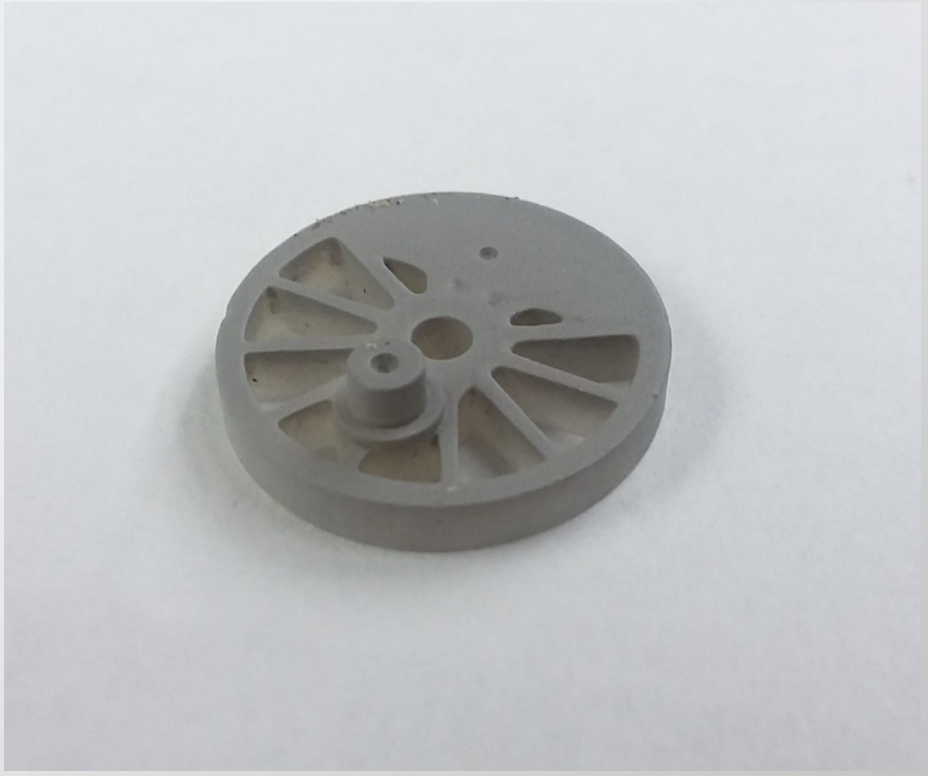
- This idea of creating an object from layers of pixels isn't really new.

What's in it for you?

- Why should you start 3d printing model parts?

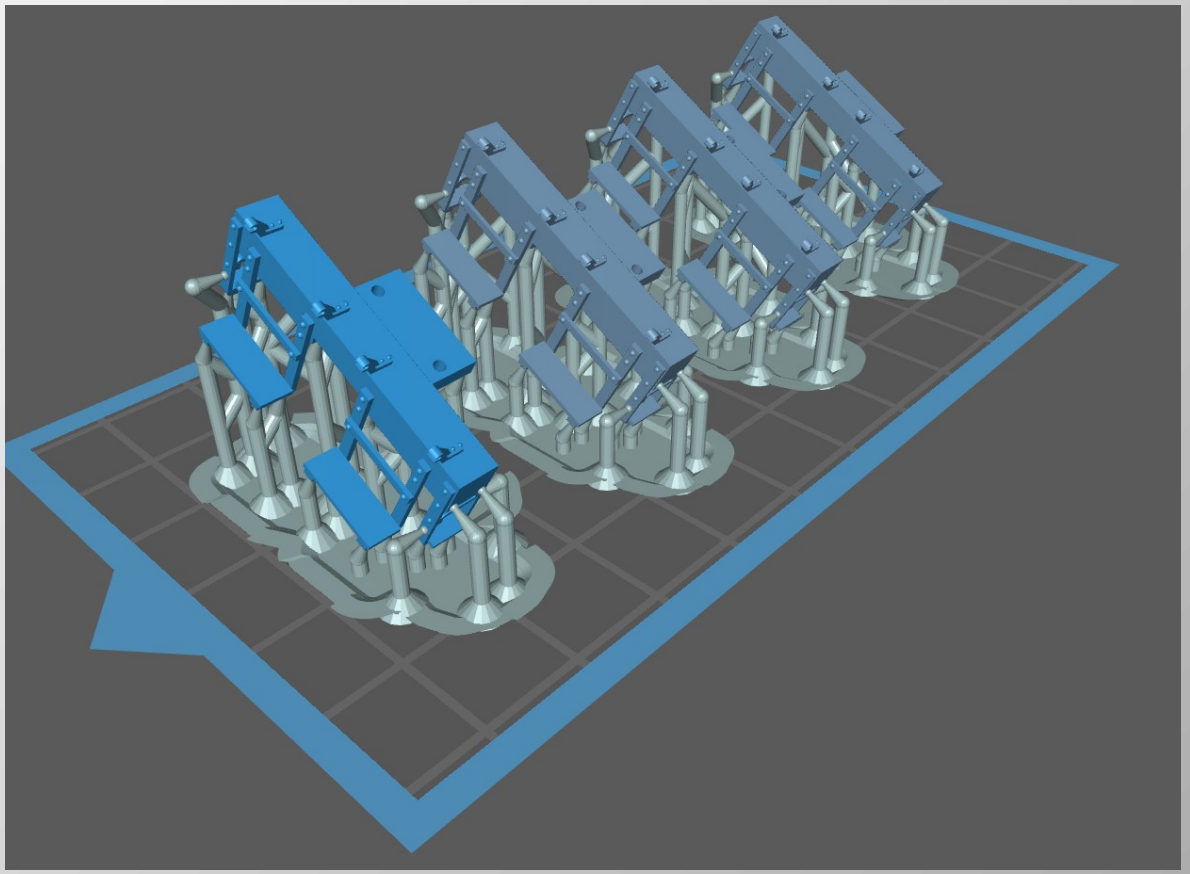
What's in it for you?

- You can have exactly the part you want.



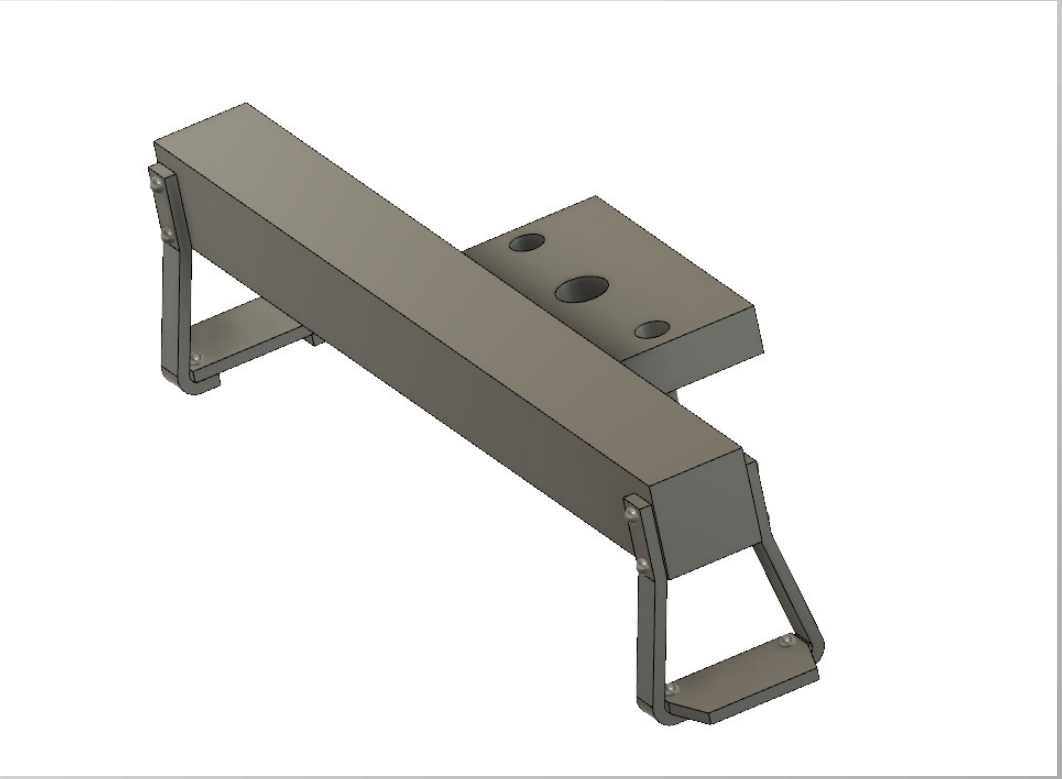
What's in it for you?

- You can easily make as many copies as you want.



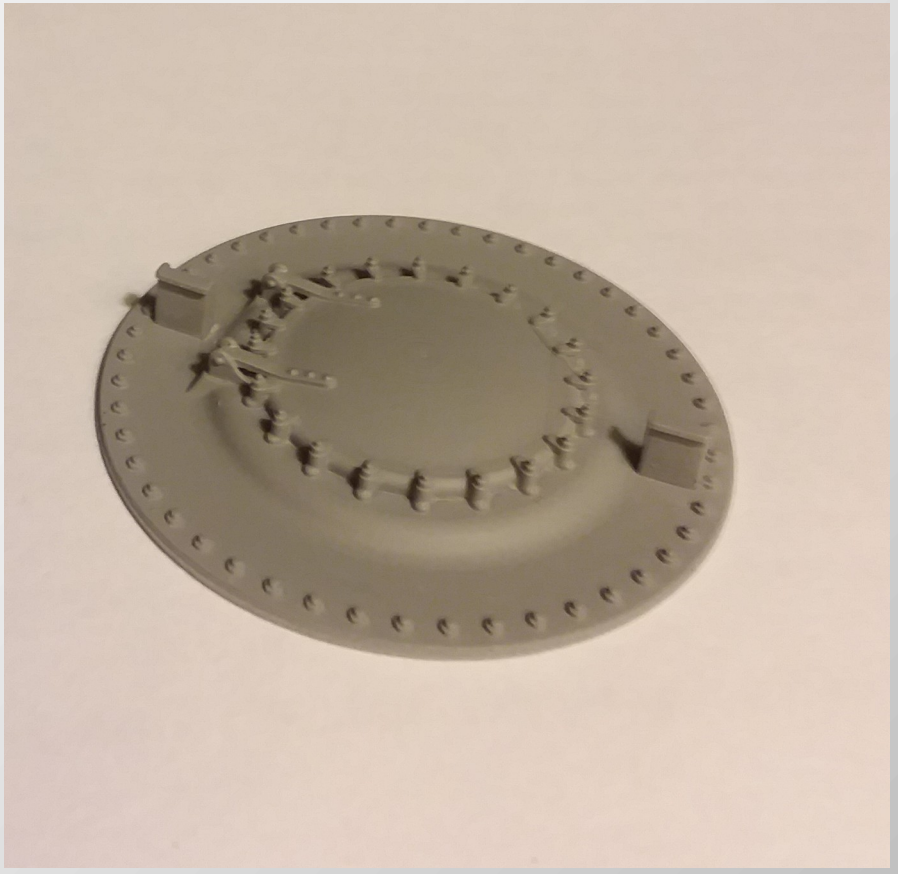
What's in it for you?

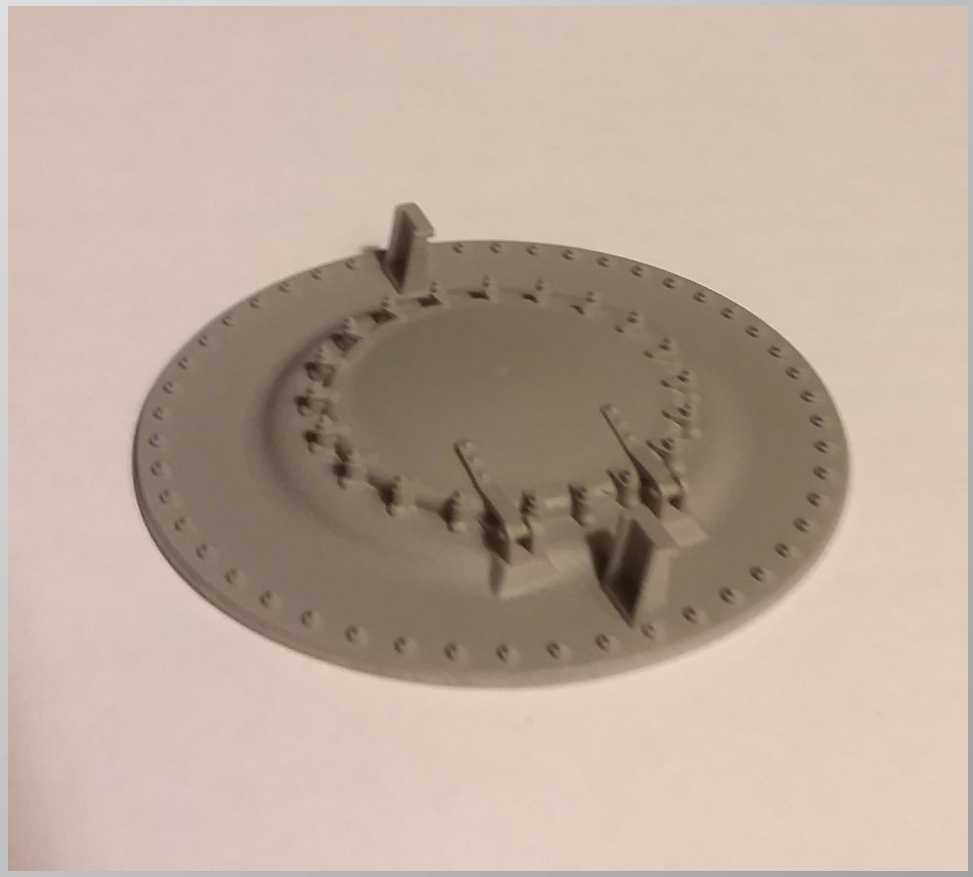
- You can usually model and print the part with less effort than conventional methods.



What's in it for you?

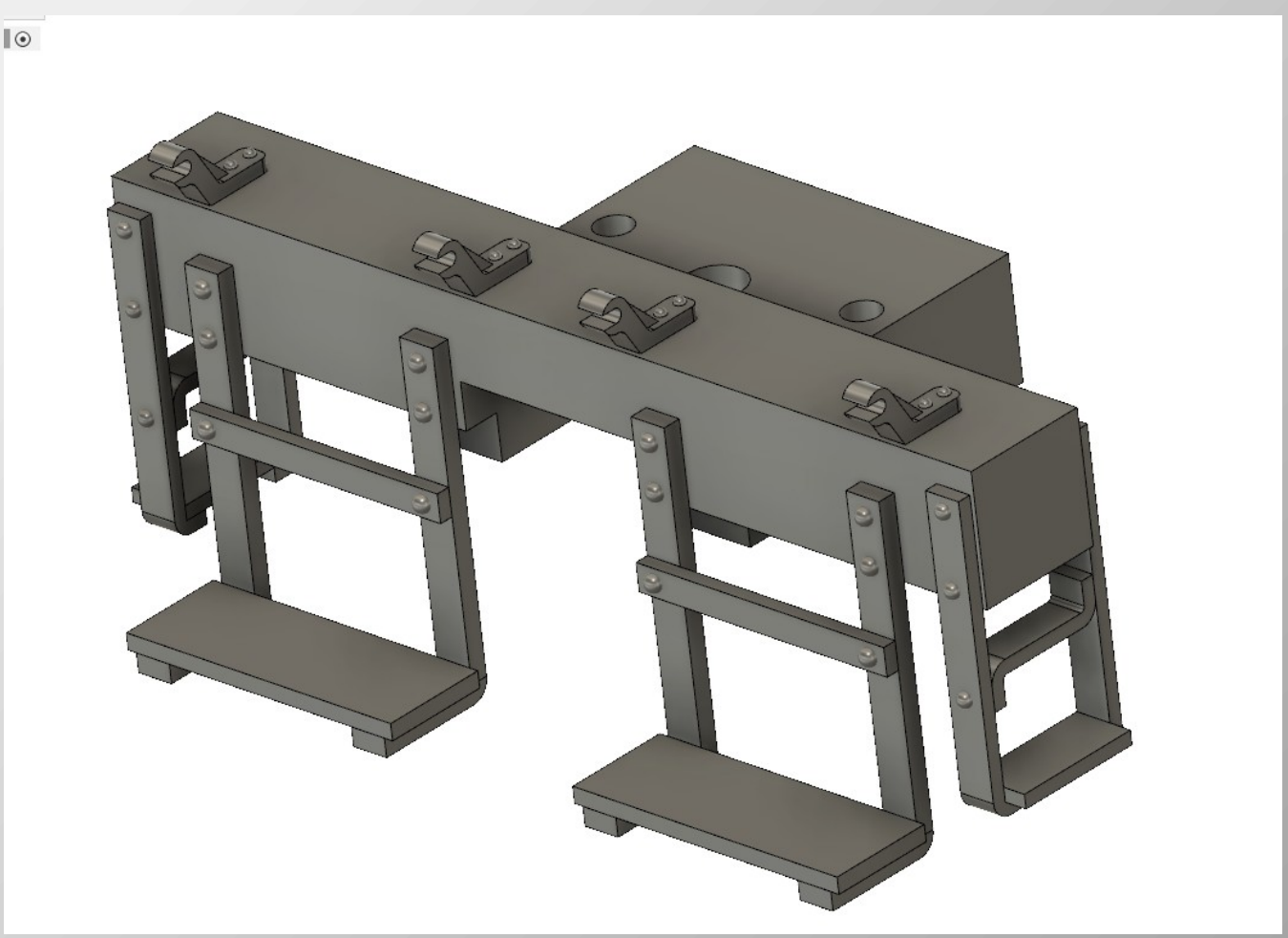
- You can probably 3d print a better part than you can make by conventional methods.





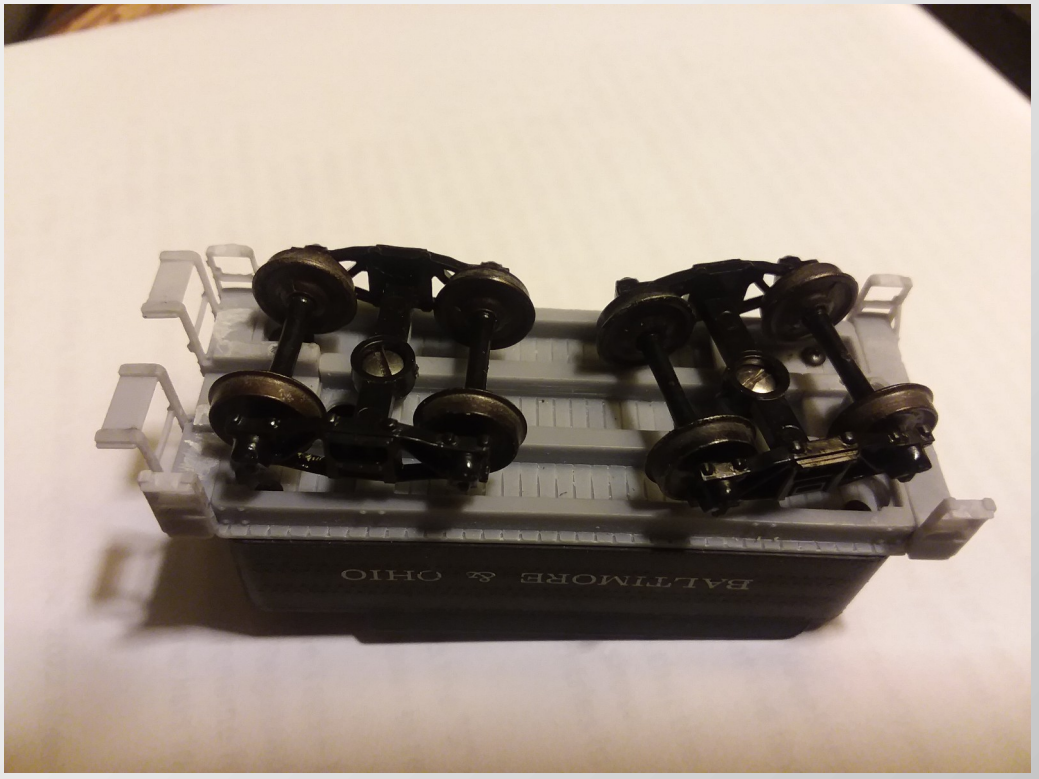
What's in it for you?

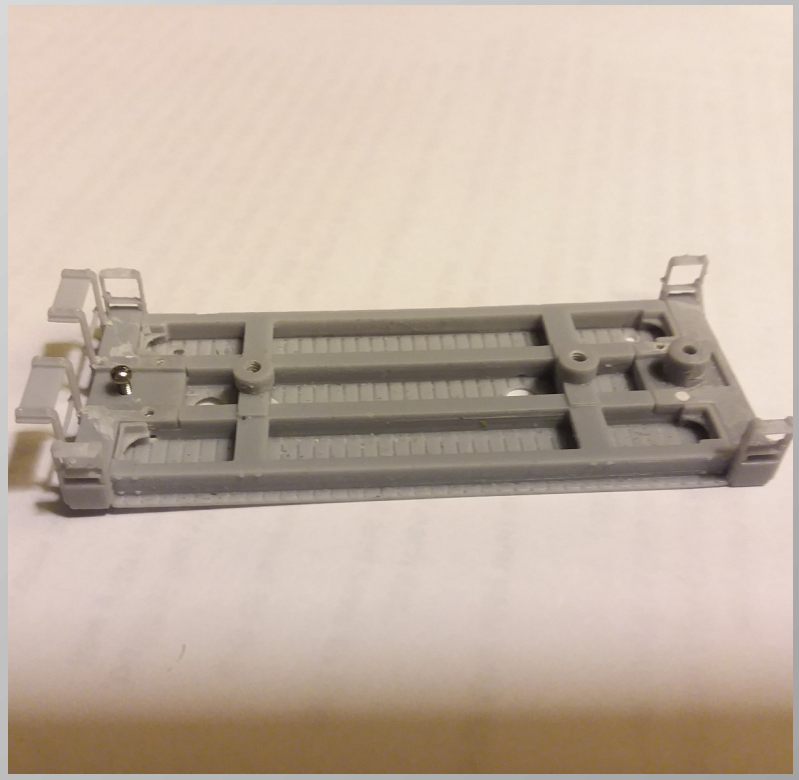
- You can add a level of detail you wouldn't think of having otherwise.



What's in it for you?

- You can easily modify off the shelf models.





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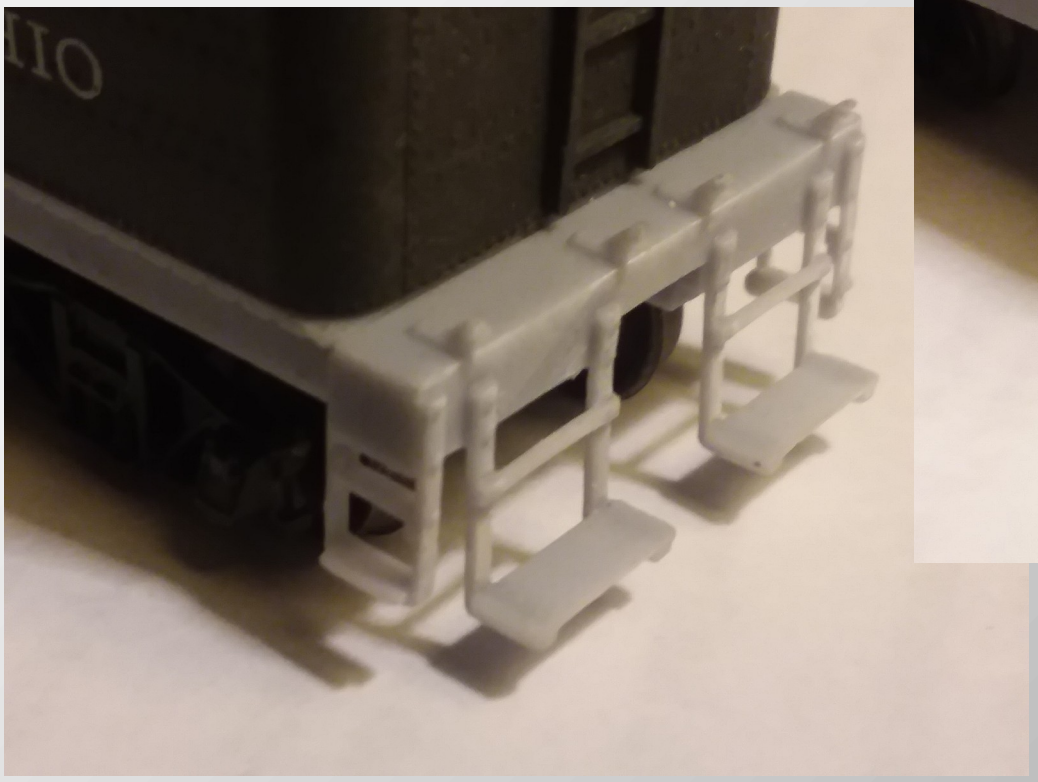
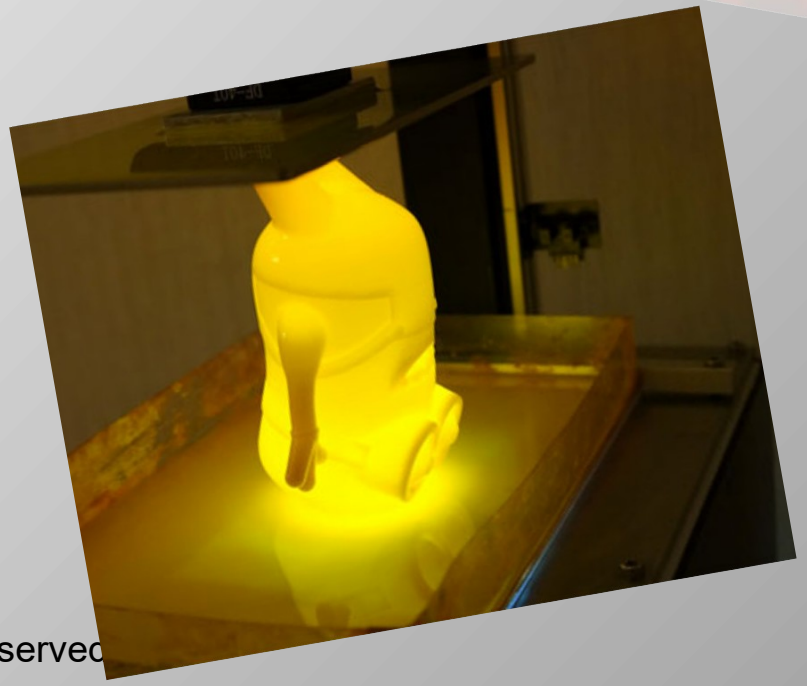


Two types of low cost hobbyist 3d printers

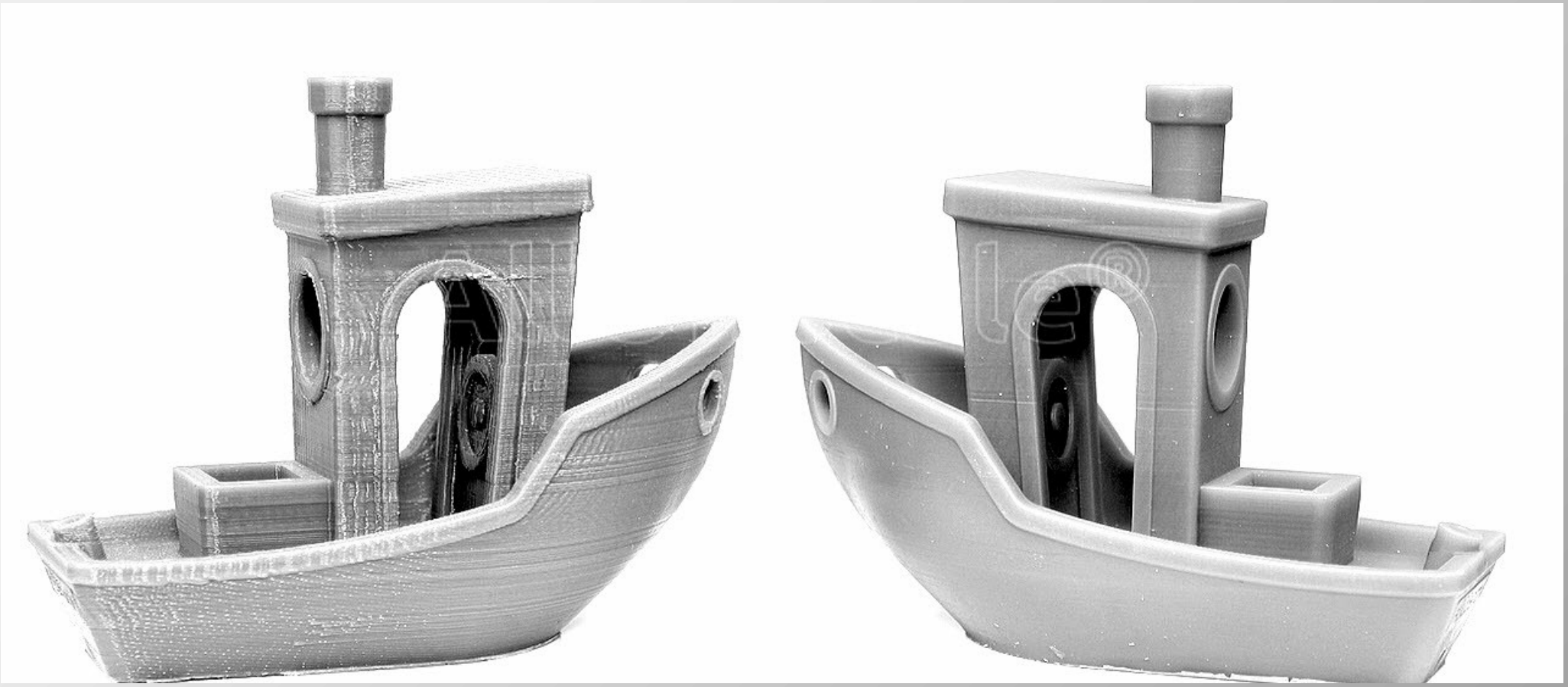
- **F**usion **D**eposition **M**odeling (FDM) printers.

- **D**igital **L**ight **P**rocessing (DLP) printers.



The results

FDM vs. DLP



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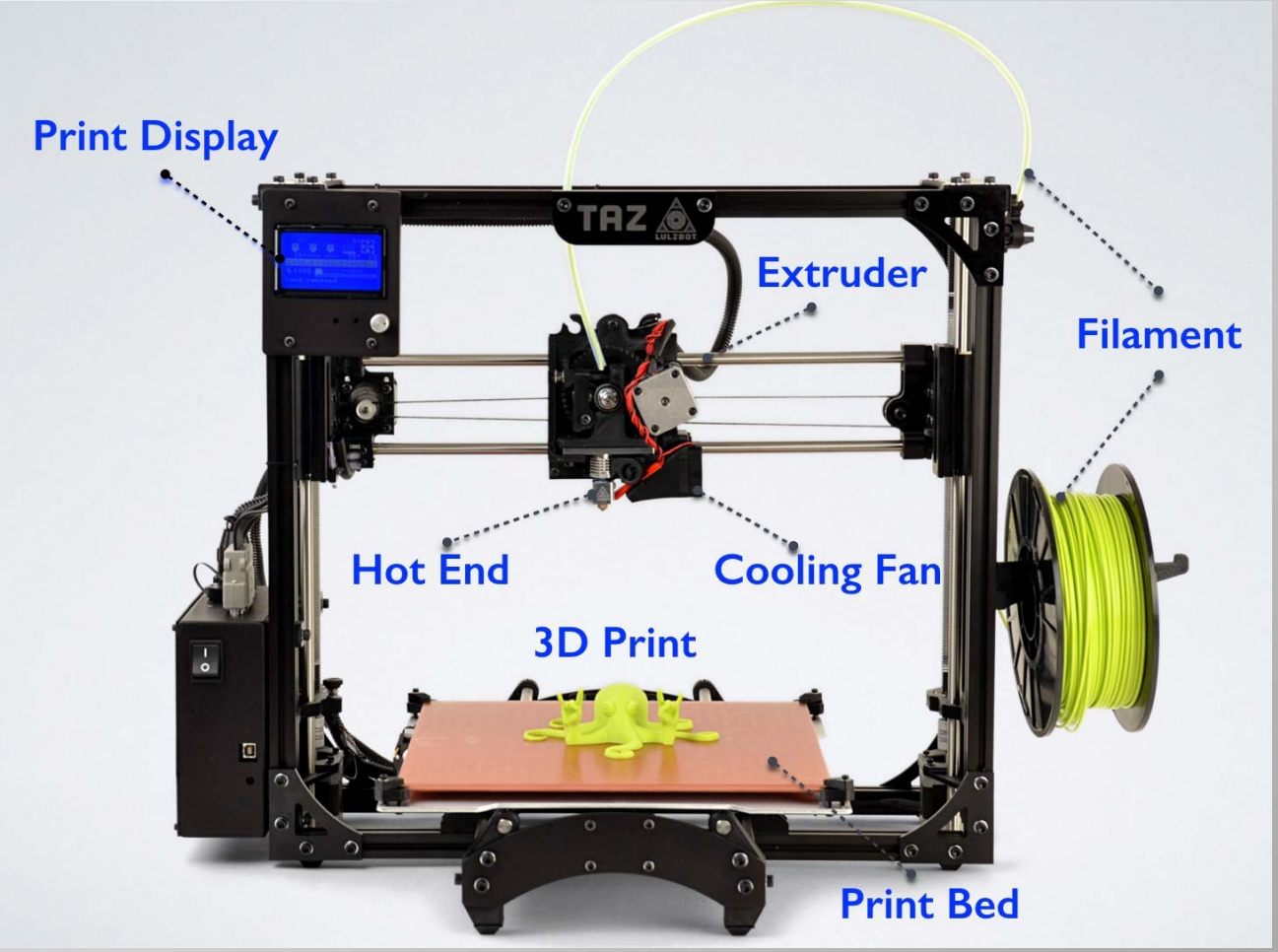

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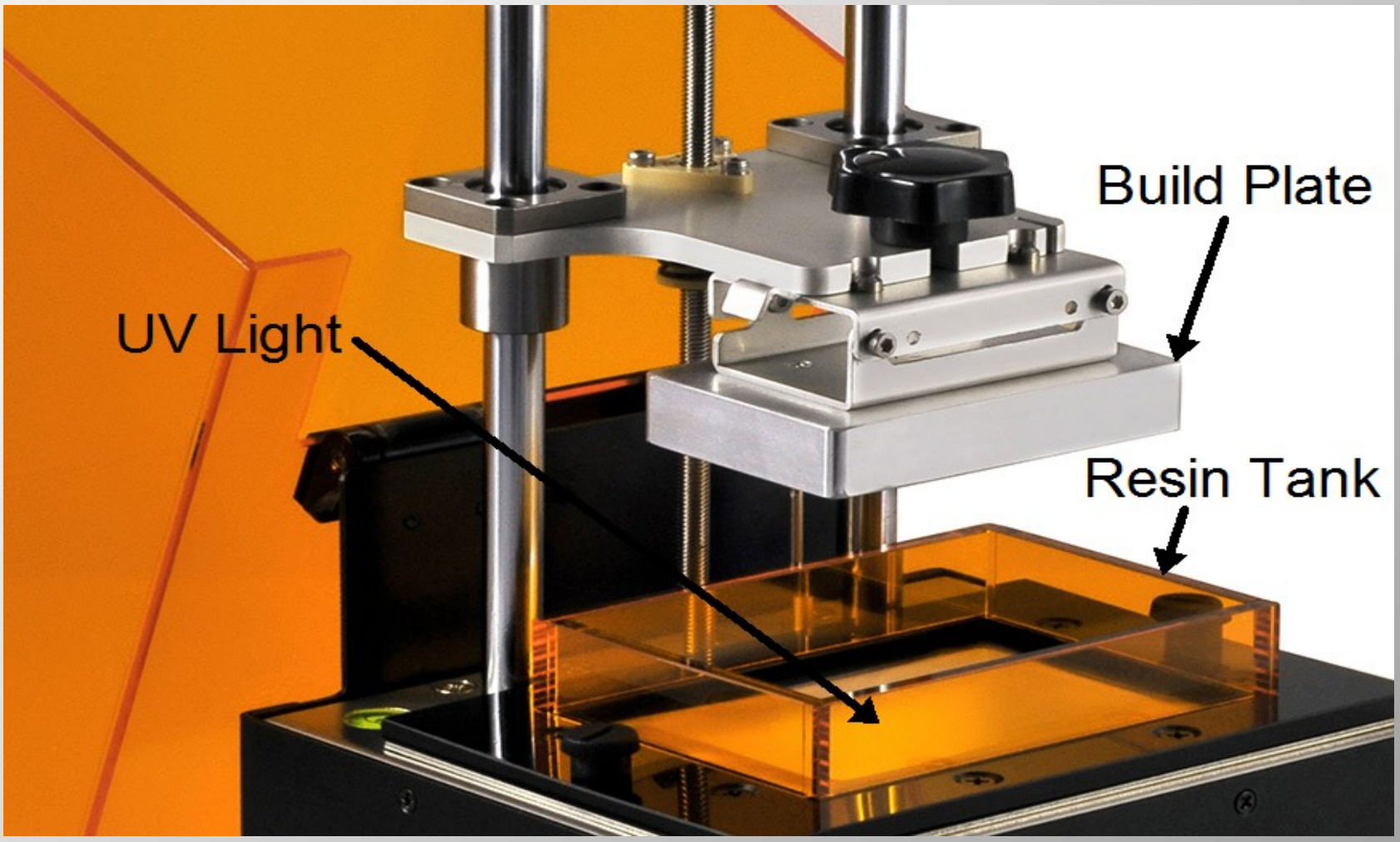


Which one should I choose?
FDM vs. DLP

The tradeoffs-FDM vs. DLP

- FDM printers can use wide variety of materials.

The tradeoffs-FDM vs. DLP

- Many DLP photopolymer resins are brittle and not suitable for delicate details.
- Resins are getting better, though

The tradeoffs-FDM vs. DLP

- FDM printers usually have a larger print volume for the money.

The tradeoffs-FDM vs. DLP

- FDM Prints have good structural strength that can approach injection molded parts.

The tradeoffs-FDM vs. DLP

- FDM printers is generally have low odor smelling like melting or burned plastic

The tradeoffs-FDM vs. DLP

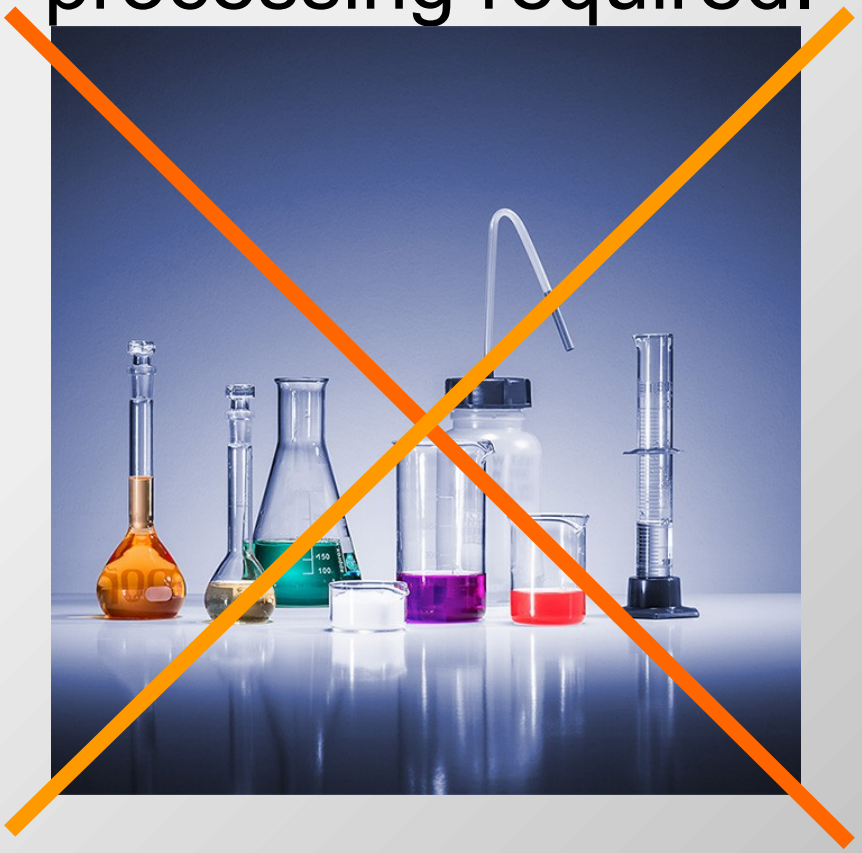
- DLP Resins can have bad odor, especially the rinsing solvents. Ventilation is needed.

The tradeoffs-FDM vs. DLP

- DLP prints can require messy, stinky solvent cleaning, post UV curing and trimming.

The tradeoffs-FDM vs. DLP

- FDM printers have no solvent cleaning or post processing required.



The tradeoffs-FDM vs. DLP

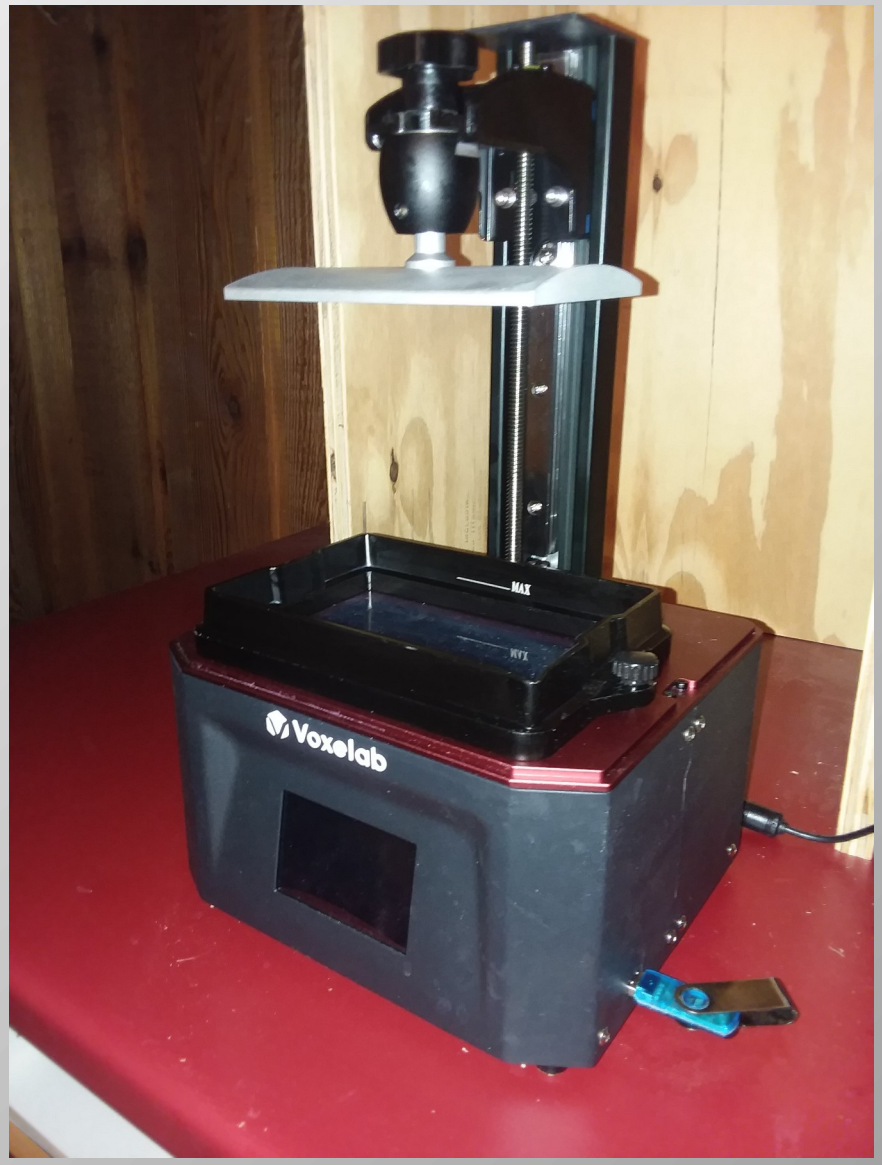
- Unfortunately, FDM prints have **poor surface detail** and **low resolution**.

The tradeoffs-FDM vs. DLP

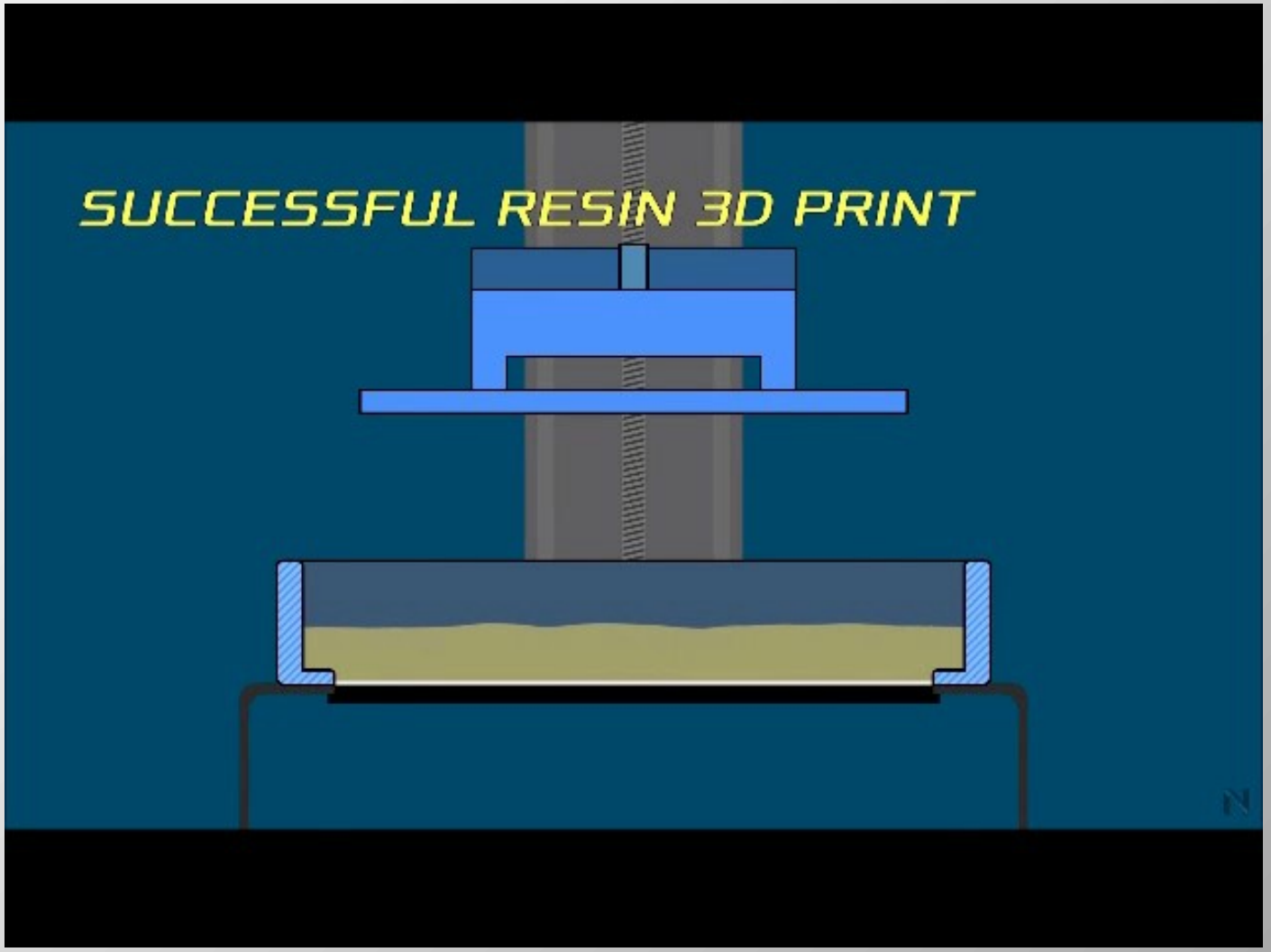
- But, DLP the prints have **very good surface detail** and **high resolution** with small features possible.

For model parts...

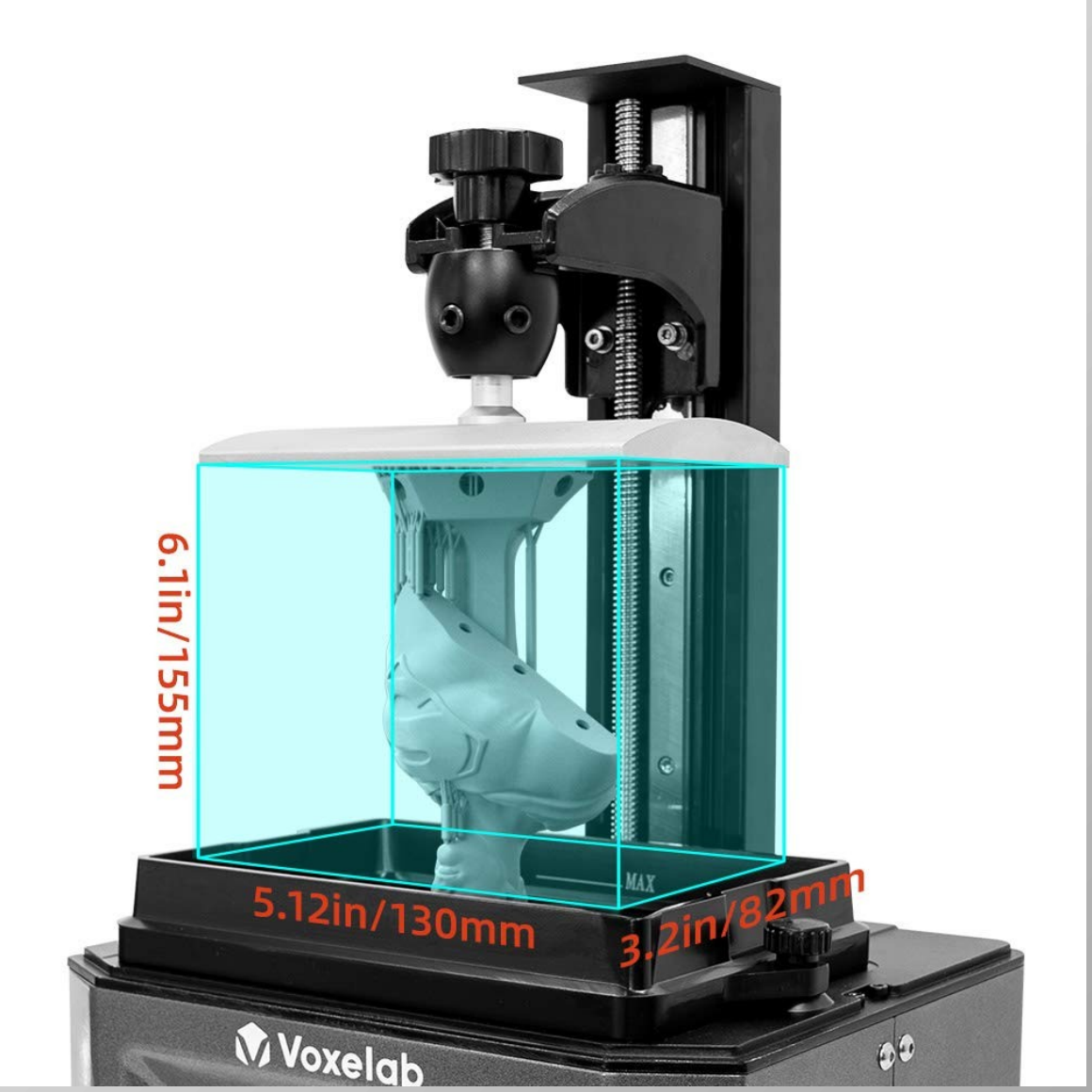
- In spite of the negatives, the choice is pretty clear.
- For detailed parts, a ***DLP printer is the way to go***.
- Its ability to produce detail trump's all.



How a DLP printer works



My Voxelab Proxima DLP printer



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- The pixel size on my printer is 50µ, about 0.002”, square.
- The smaller the pixels, the finer the details you can print.
- New home printers can have a pixel size of 18µ, 0.0007”.

The basic DLP printing steps

- Create or download a solid model to print.
  - Download a solid model from Thingiverse or other website (free to $).

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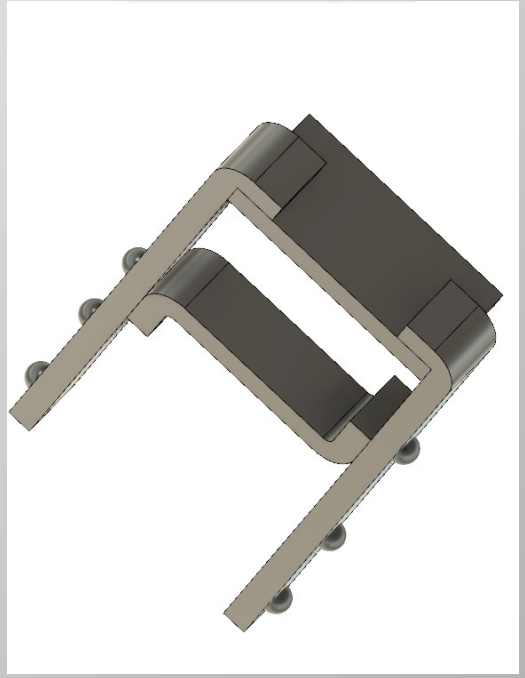
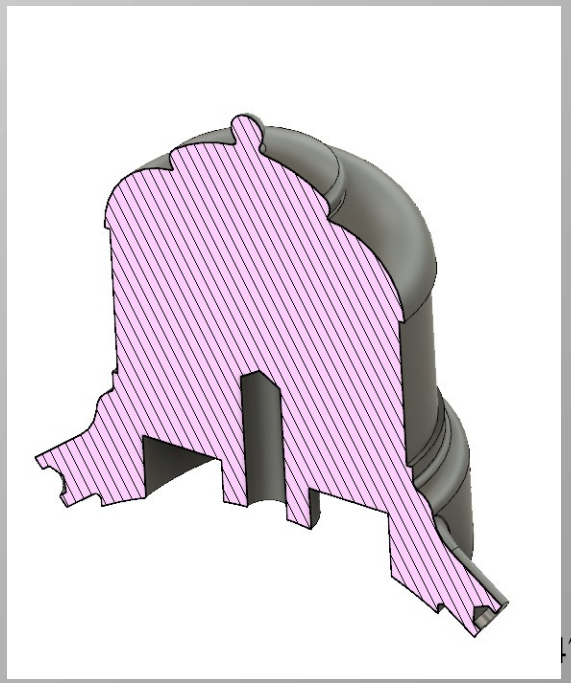
  - Use a print service such as Shapeways.

Solid Models

- A solid model is a computer representation of a object in three full dimensions.
- It can be turned to look at it in any direction and even cut to see the inside.





Solid Models

- Take a peek at Fusion 360

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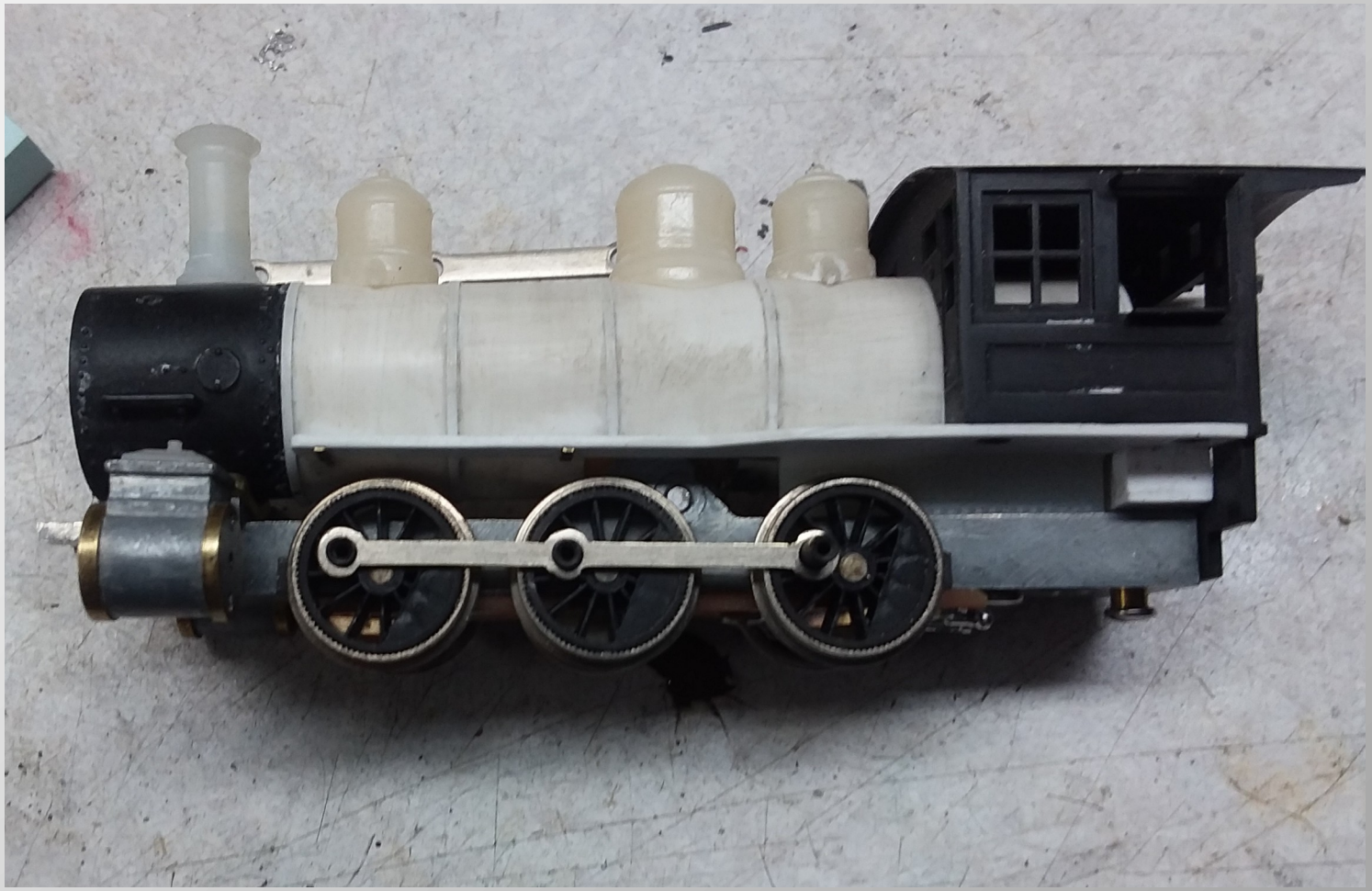
- For most of us, learning to create the 3d models is the hardest to learn.
- There are lots of nice solid models for free or low cost download on the internet.

Download a solid model.

- These solid models are free from Thingiverse.

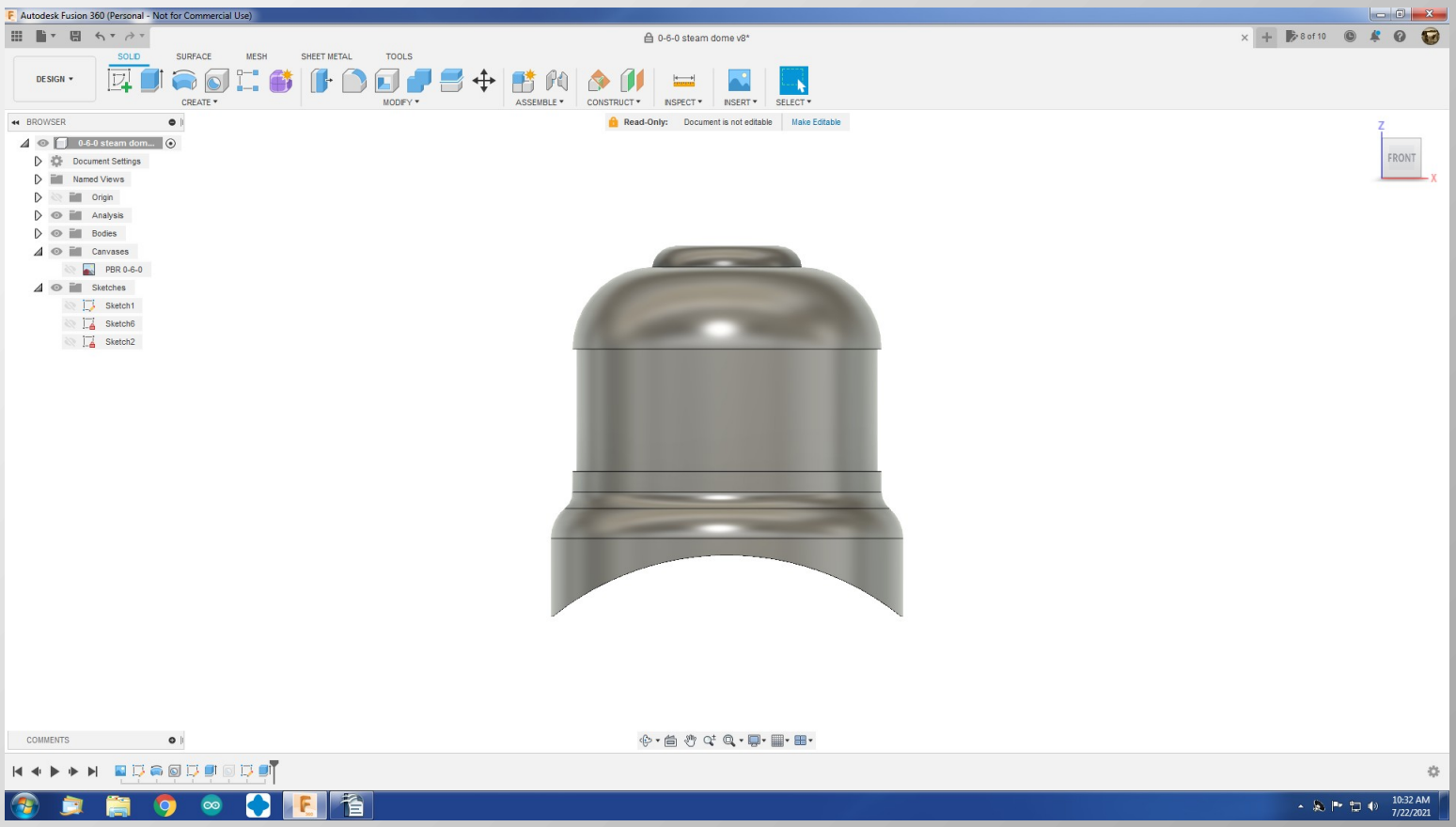
Creating a solid model

- My first prints I made were the domes for this locomotive because they seemed easiest.



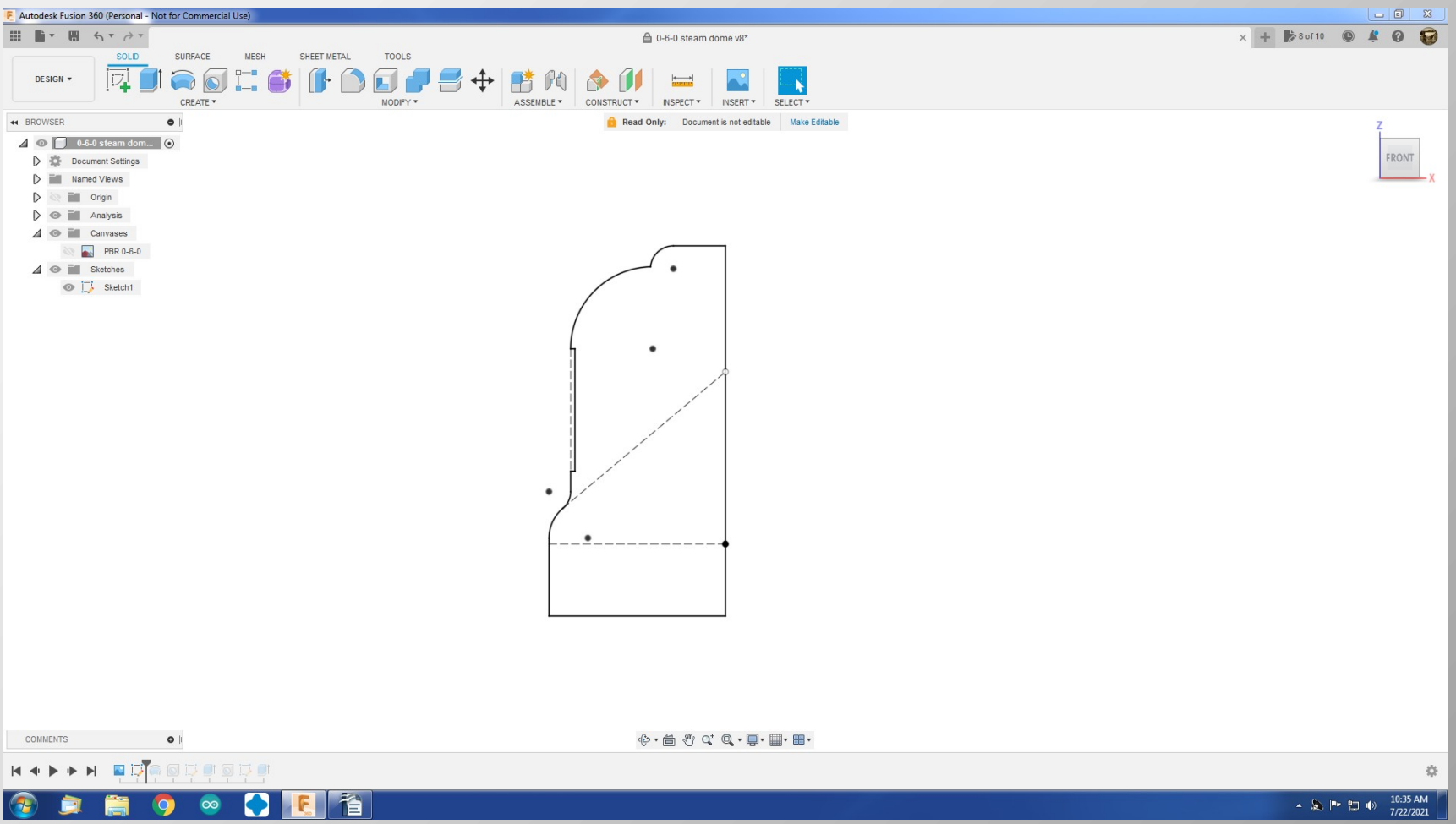
Creating a solid model

- Learning to create models will likely be hardest for you.



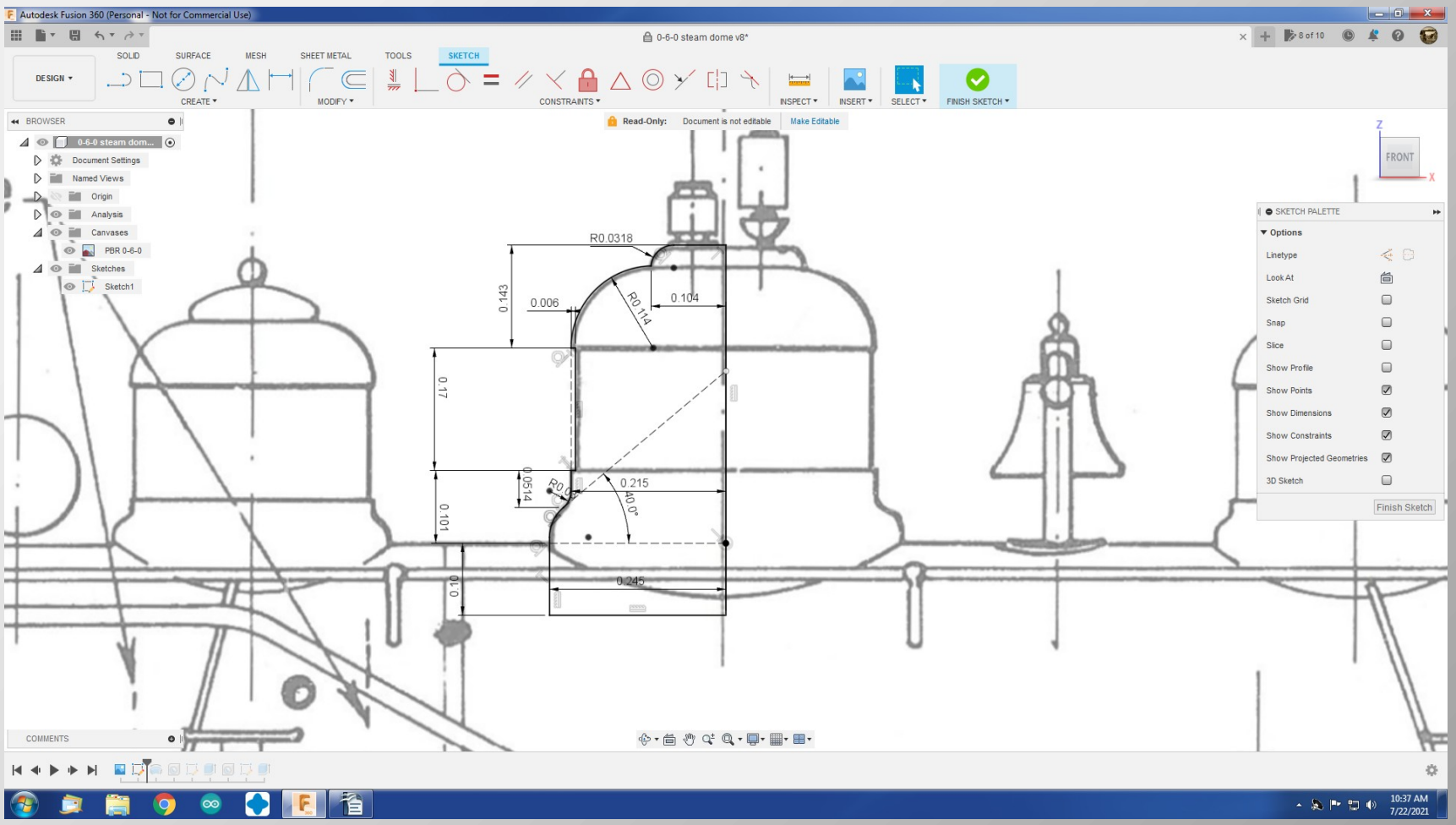
Creating a steam dome

- Using the drawing tools, sketch half the profile.



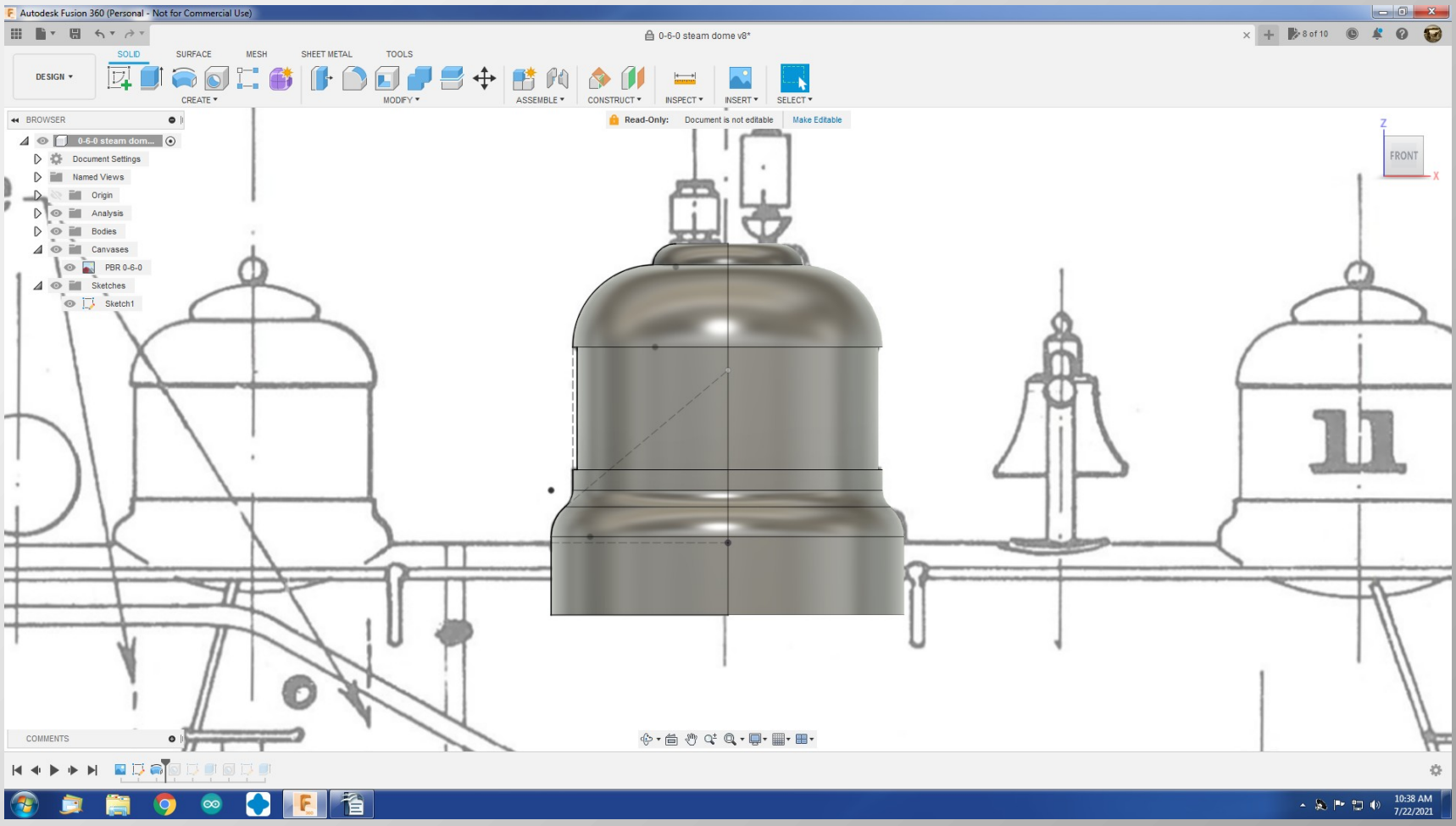
Creating a steam dome

- If you have a plan or photo, you can import a digital copy and trace over it.



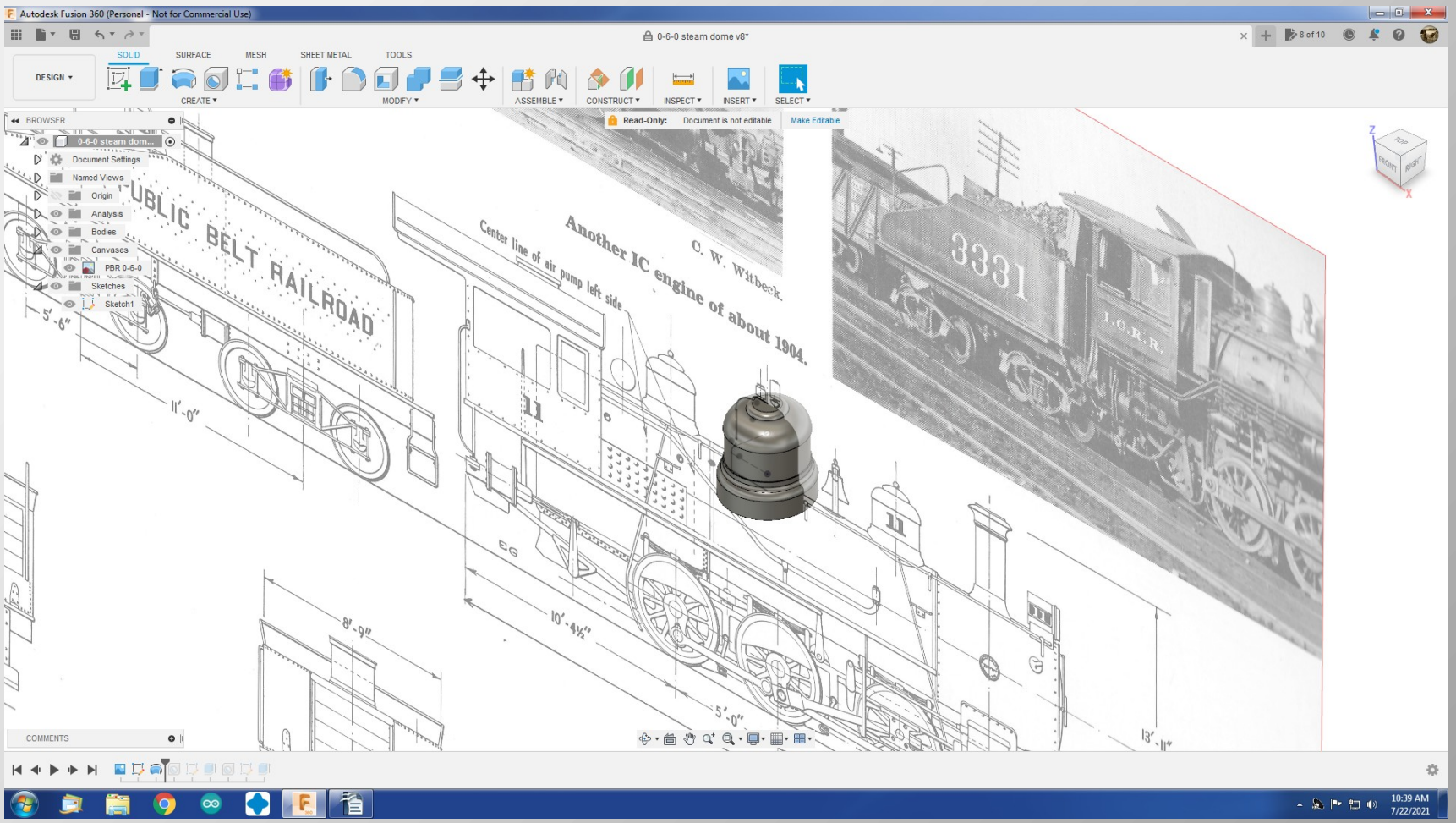
Creating a steam dome

- Using the revolve tool, spin the profile sketch to make a solid.



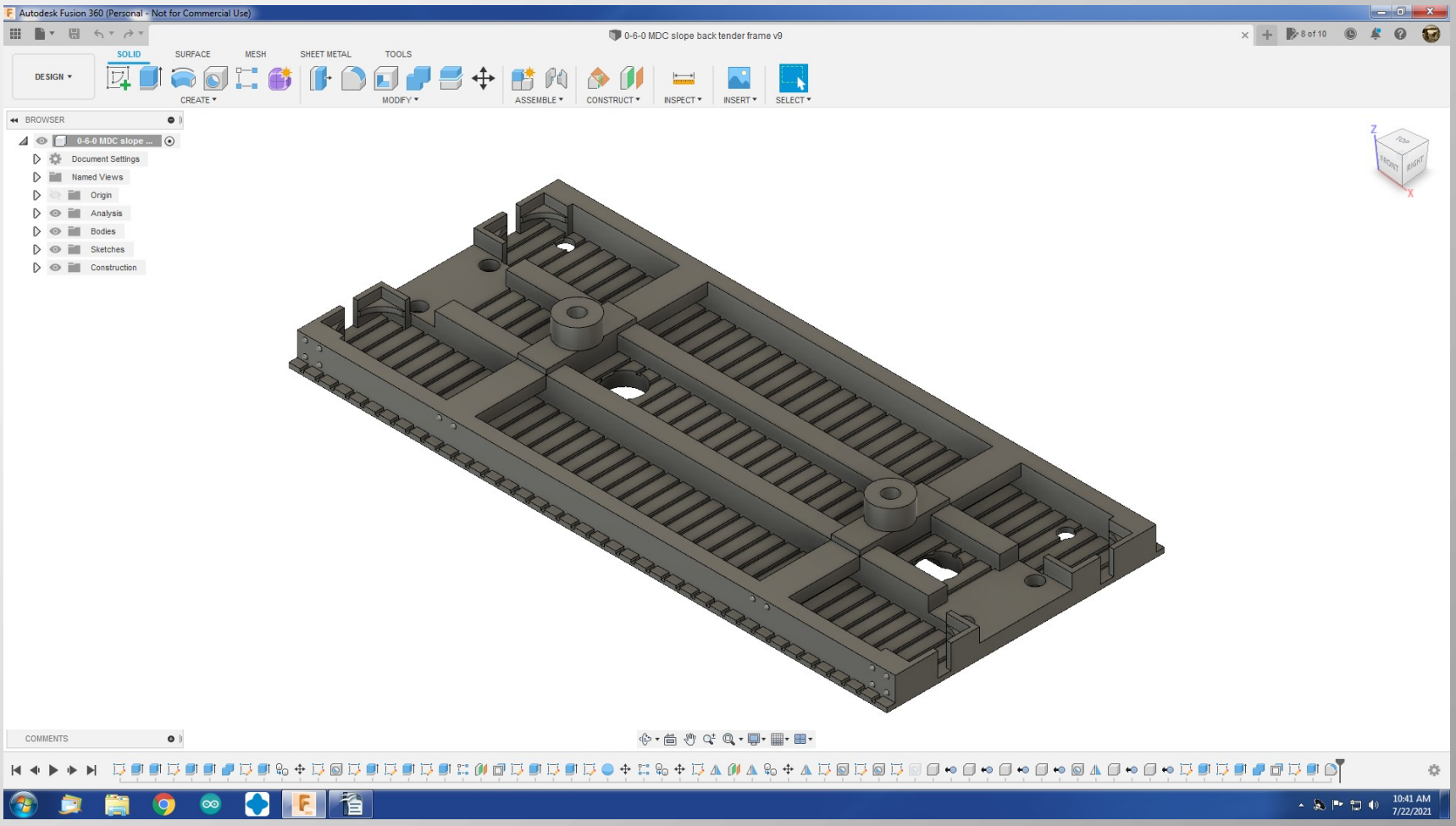
Creating a steam dome

- Here is the same model in perspective.



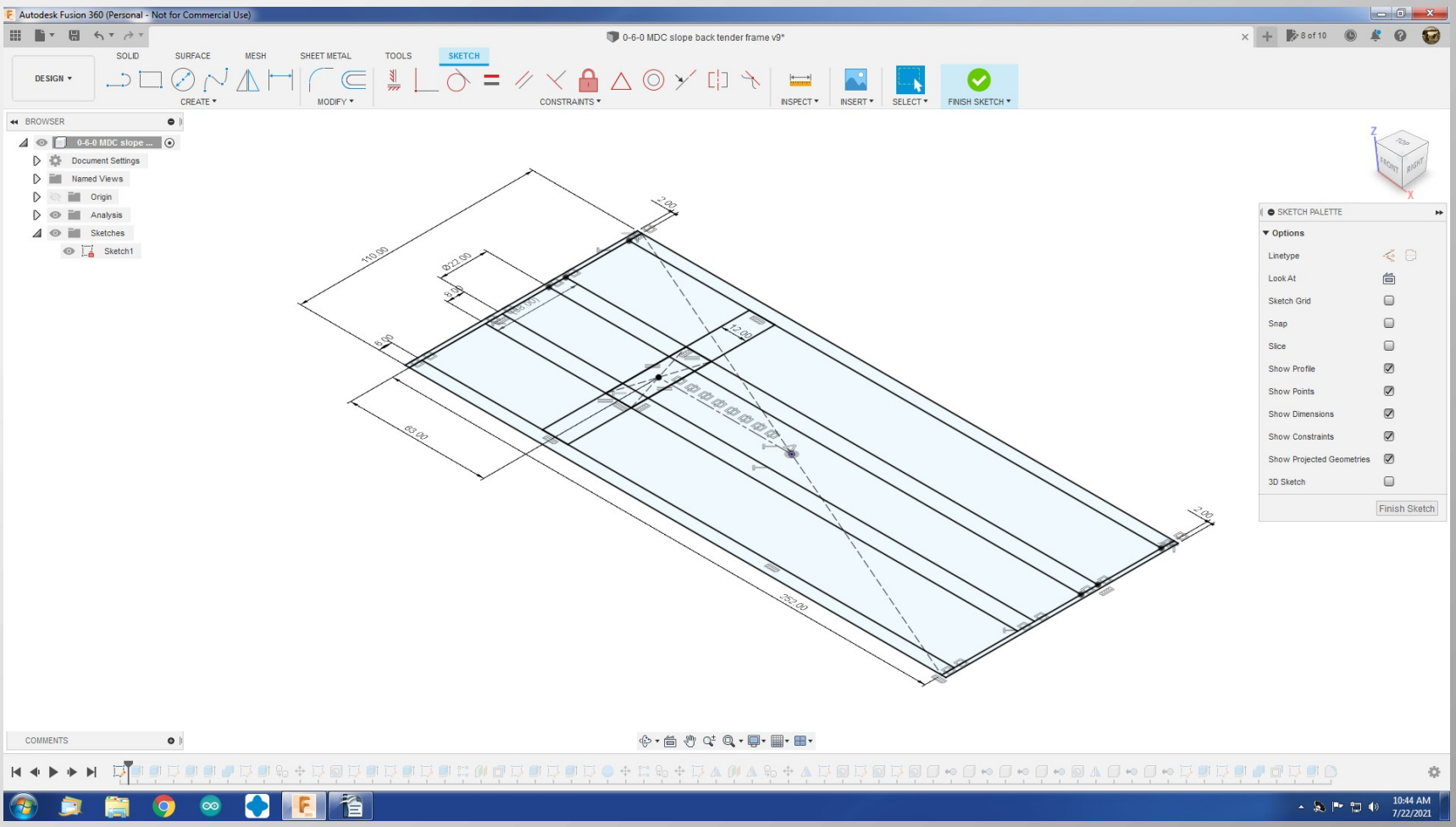
Creating a tender frame

- This was done by working from prototype plans and photos to fit an MDC tender shell.



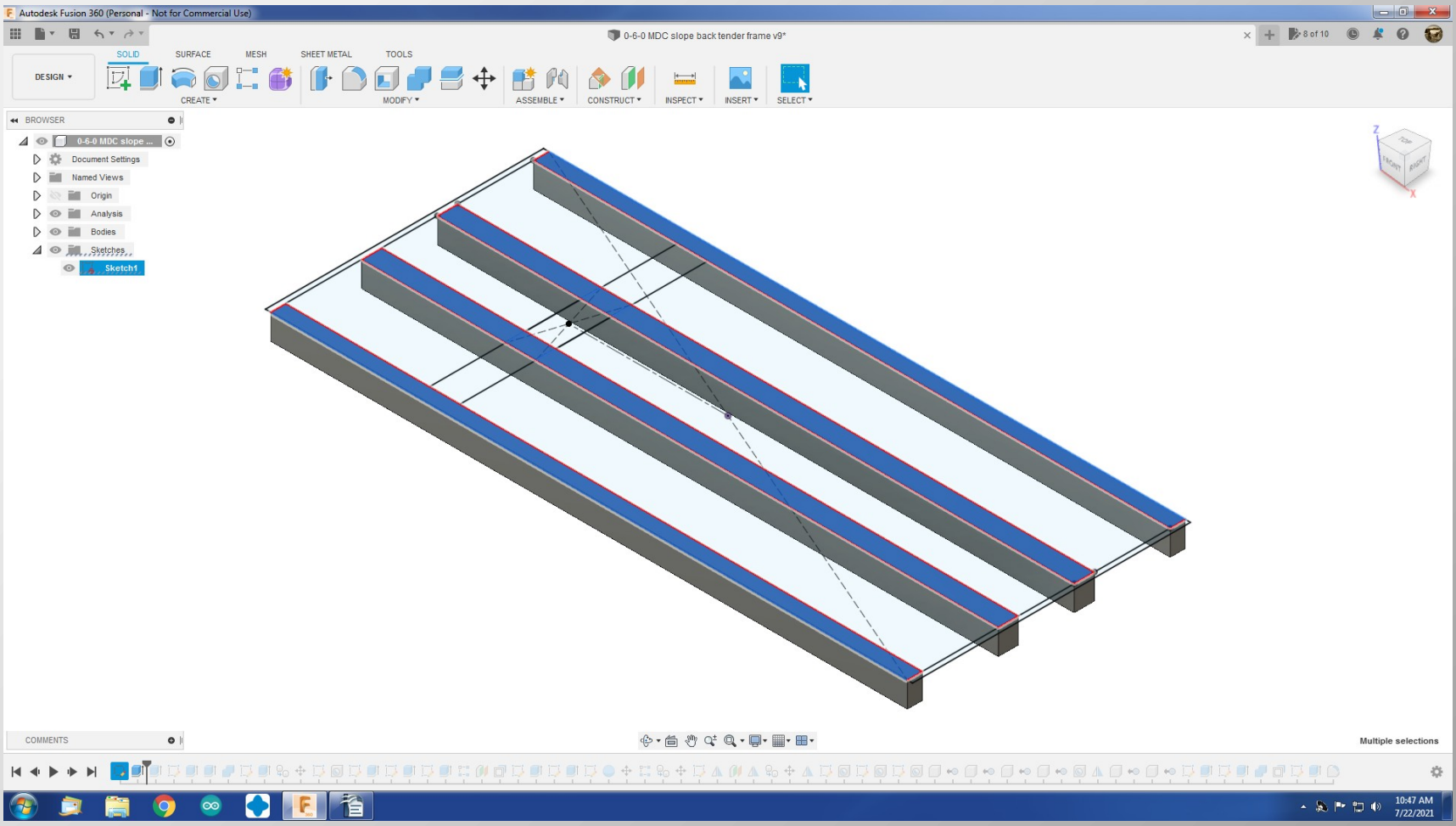
Creating a tender frame

- Again, the beams are sketched.



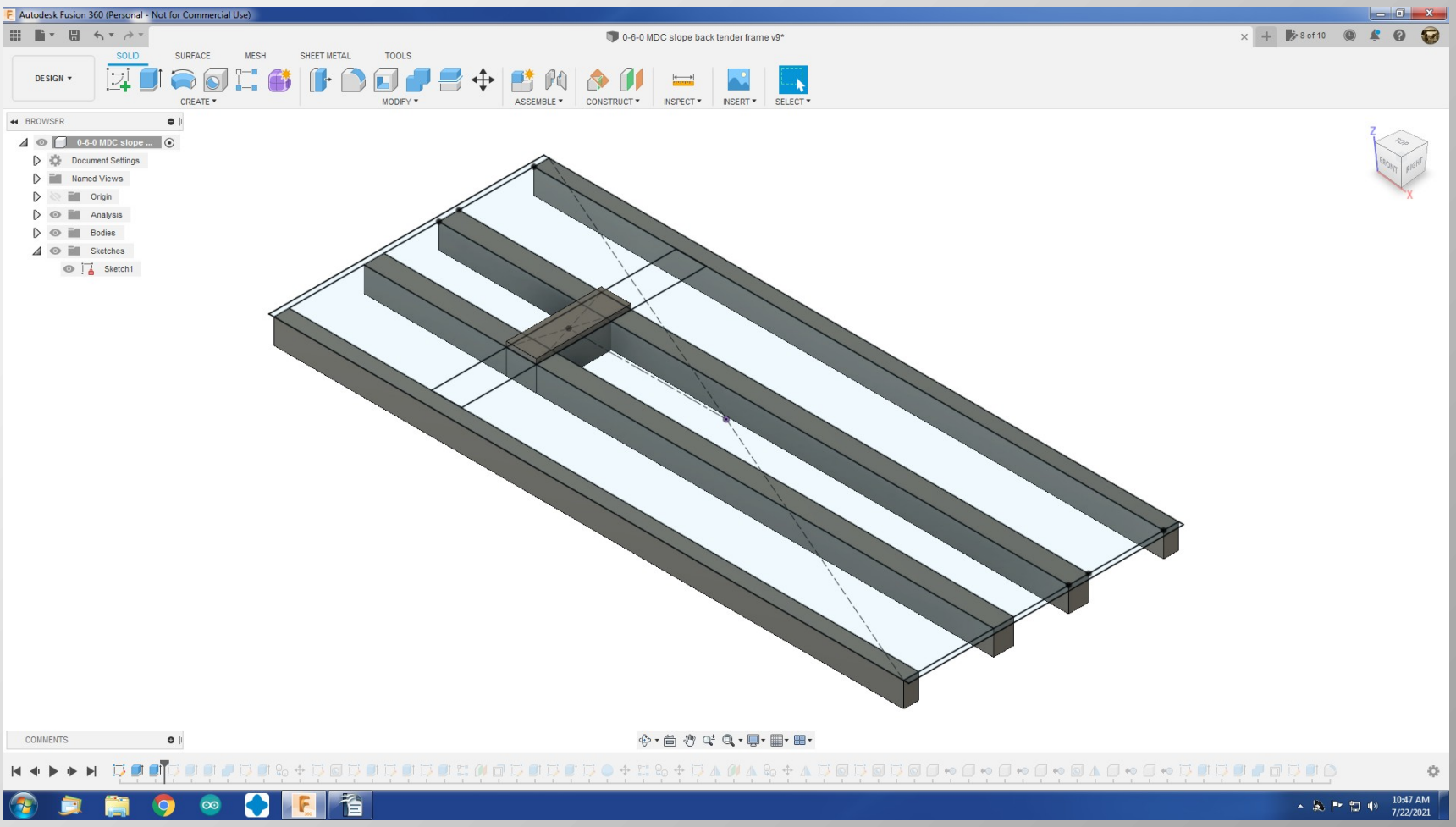
Creating a tender frame

- Various beams are highlighted and extruded to make them solid.



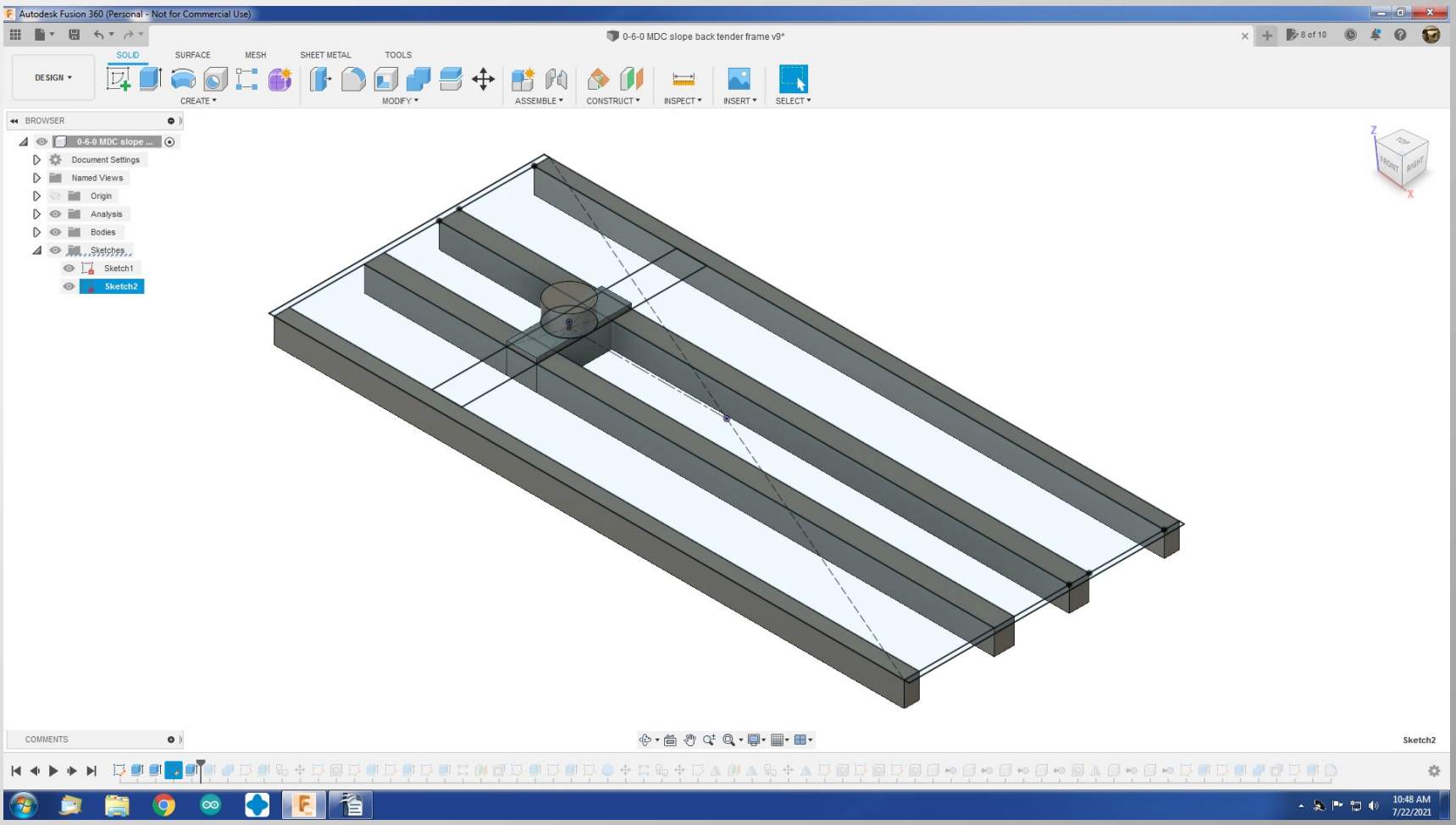
Creating a tender frame

- Do more extruding.



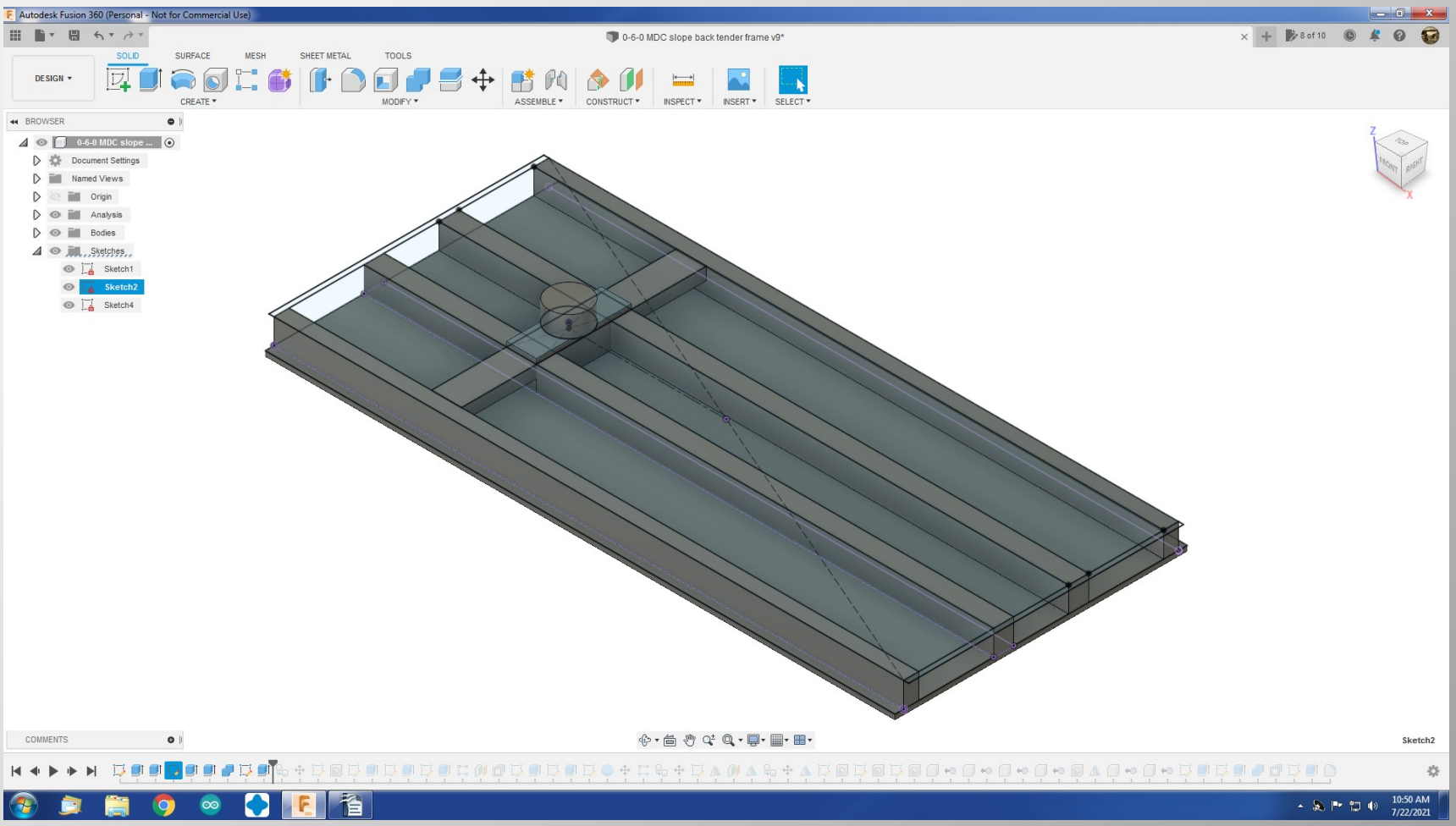
Creating a tender frame

- And more extruding.



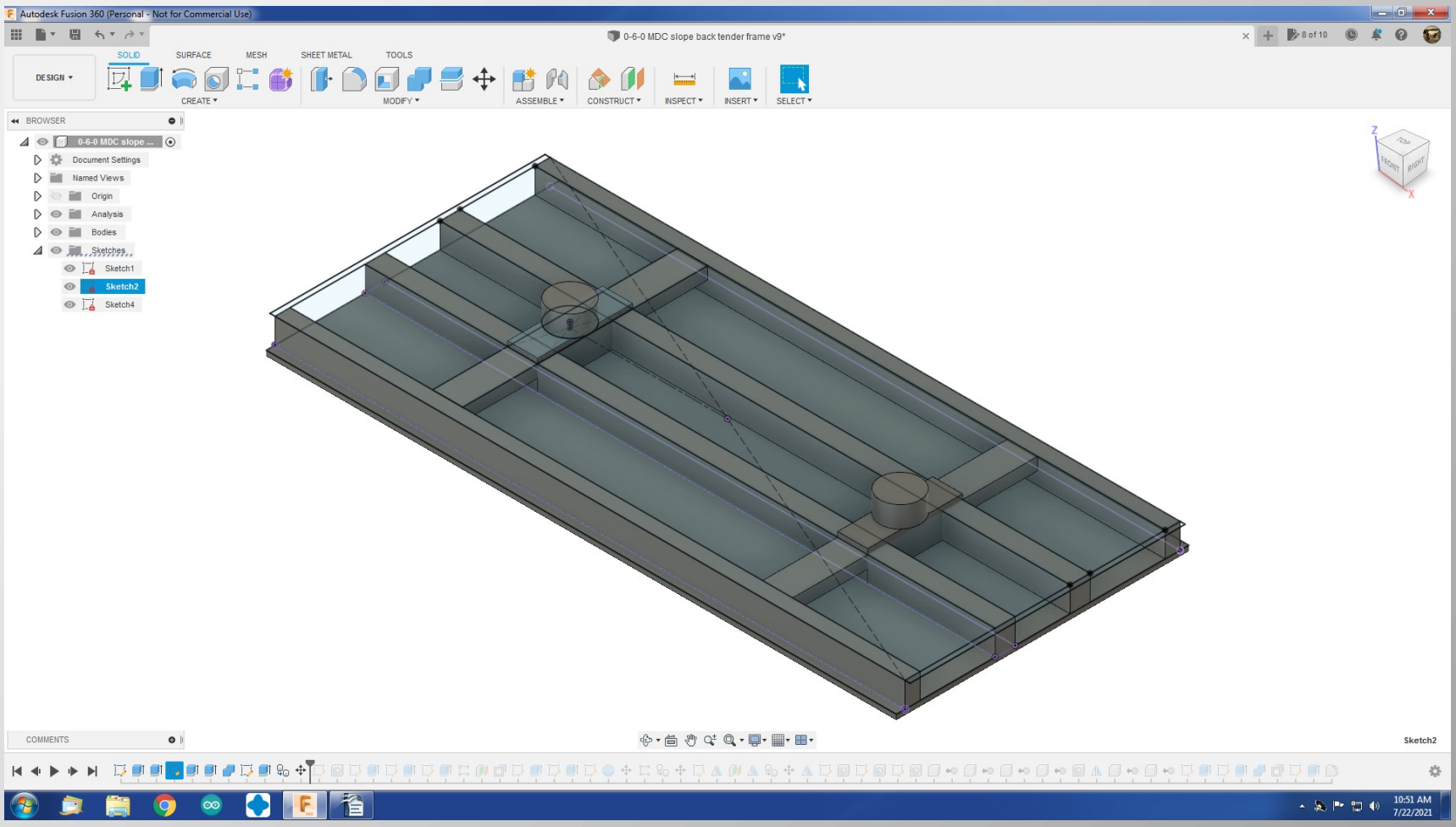
Creating a tender frame

- And more....



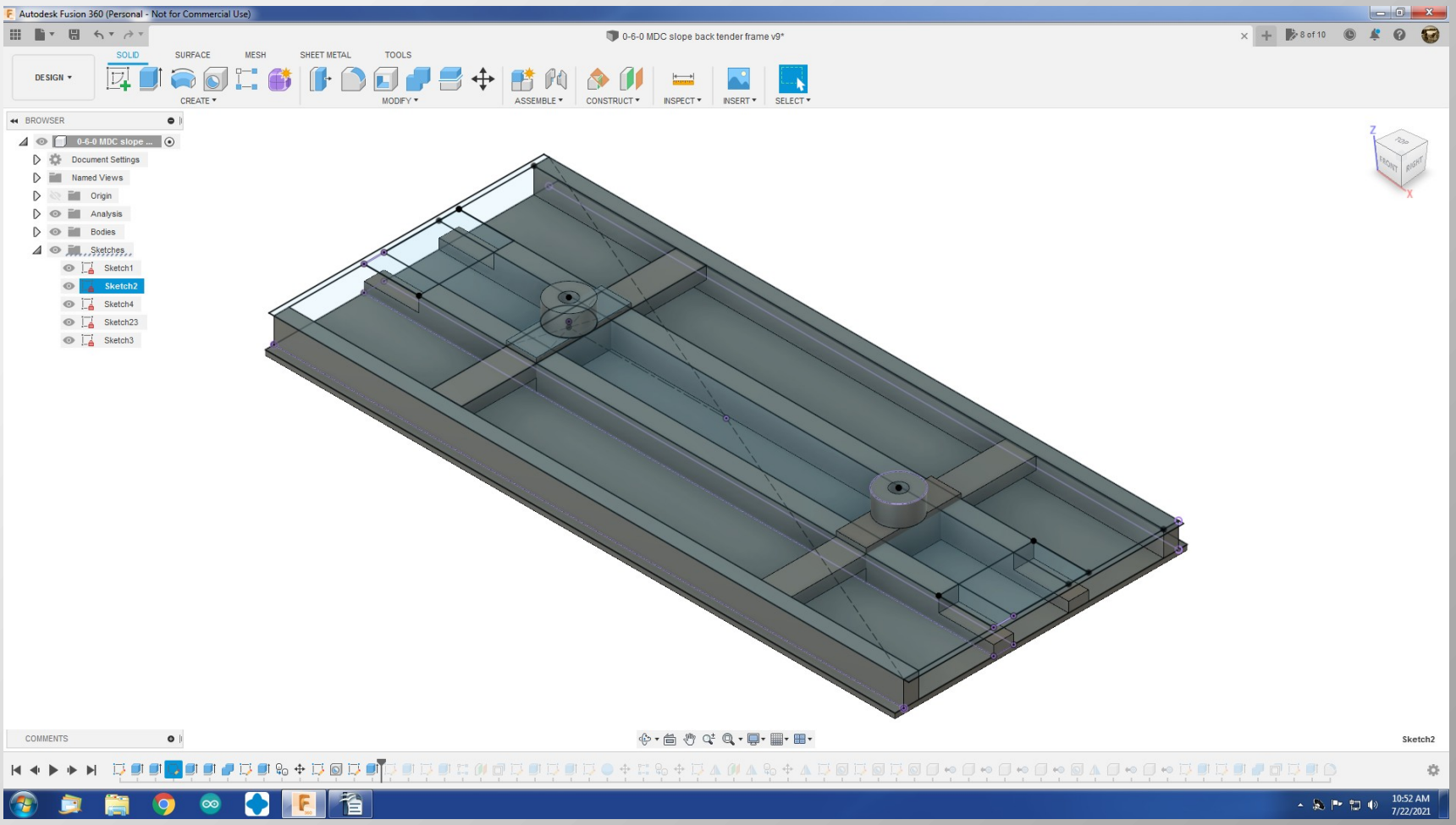
Creating a tender frame

- To make a second bolster, copy the first.



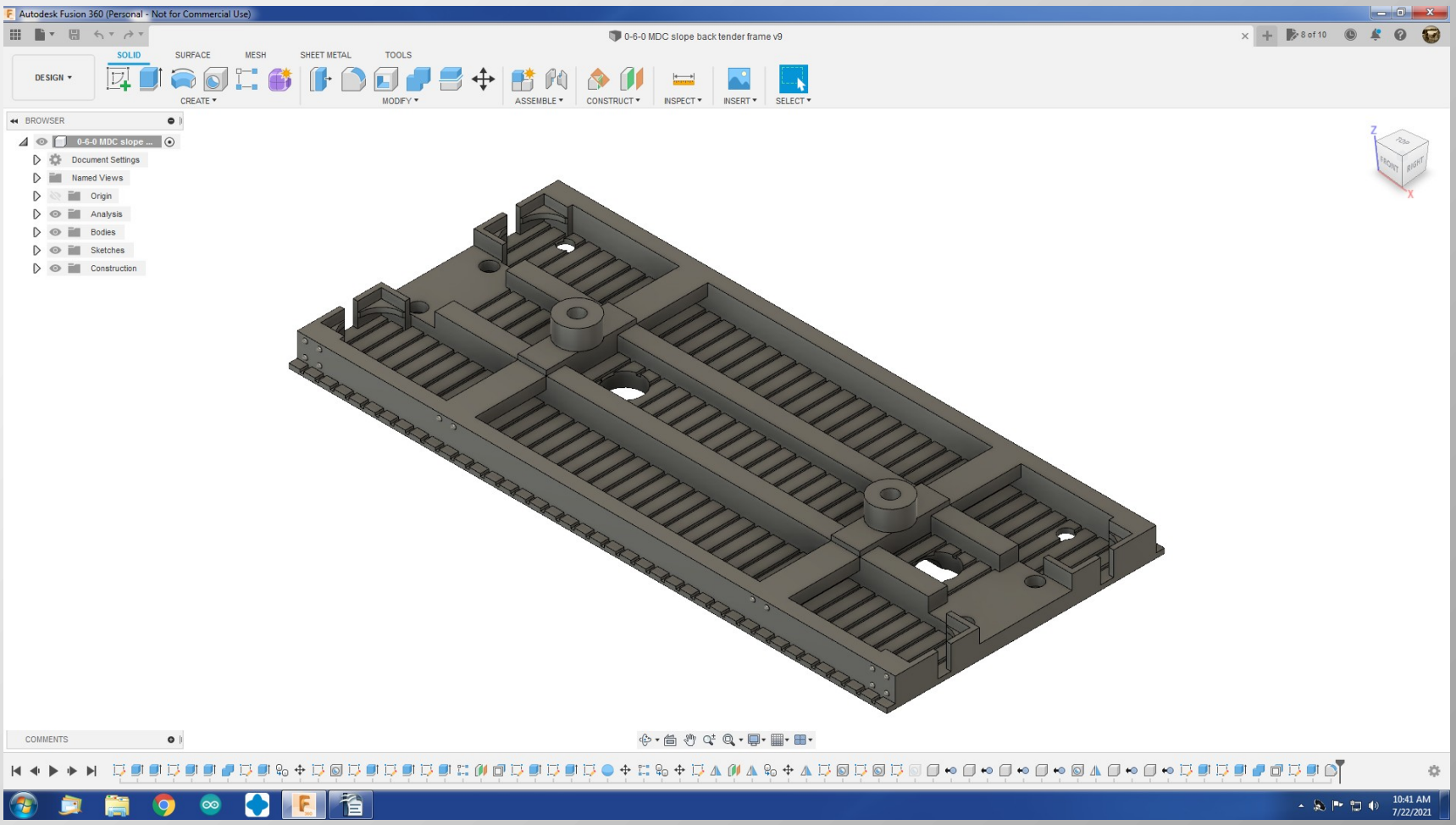
Creating a tender frame

- Cut the coupler pockets and kingpin holes.



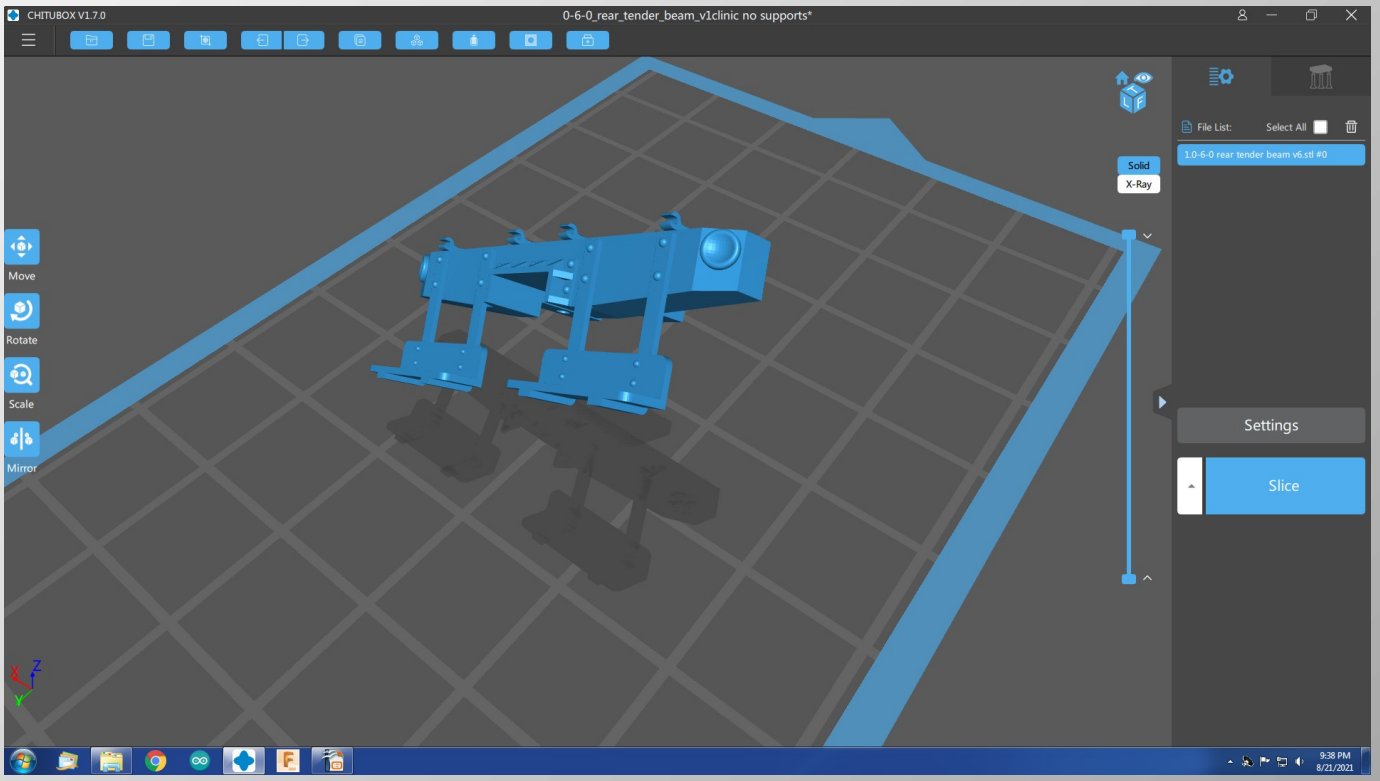
Creating a tender frame

- Finish up with more cuts and extrusions.



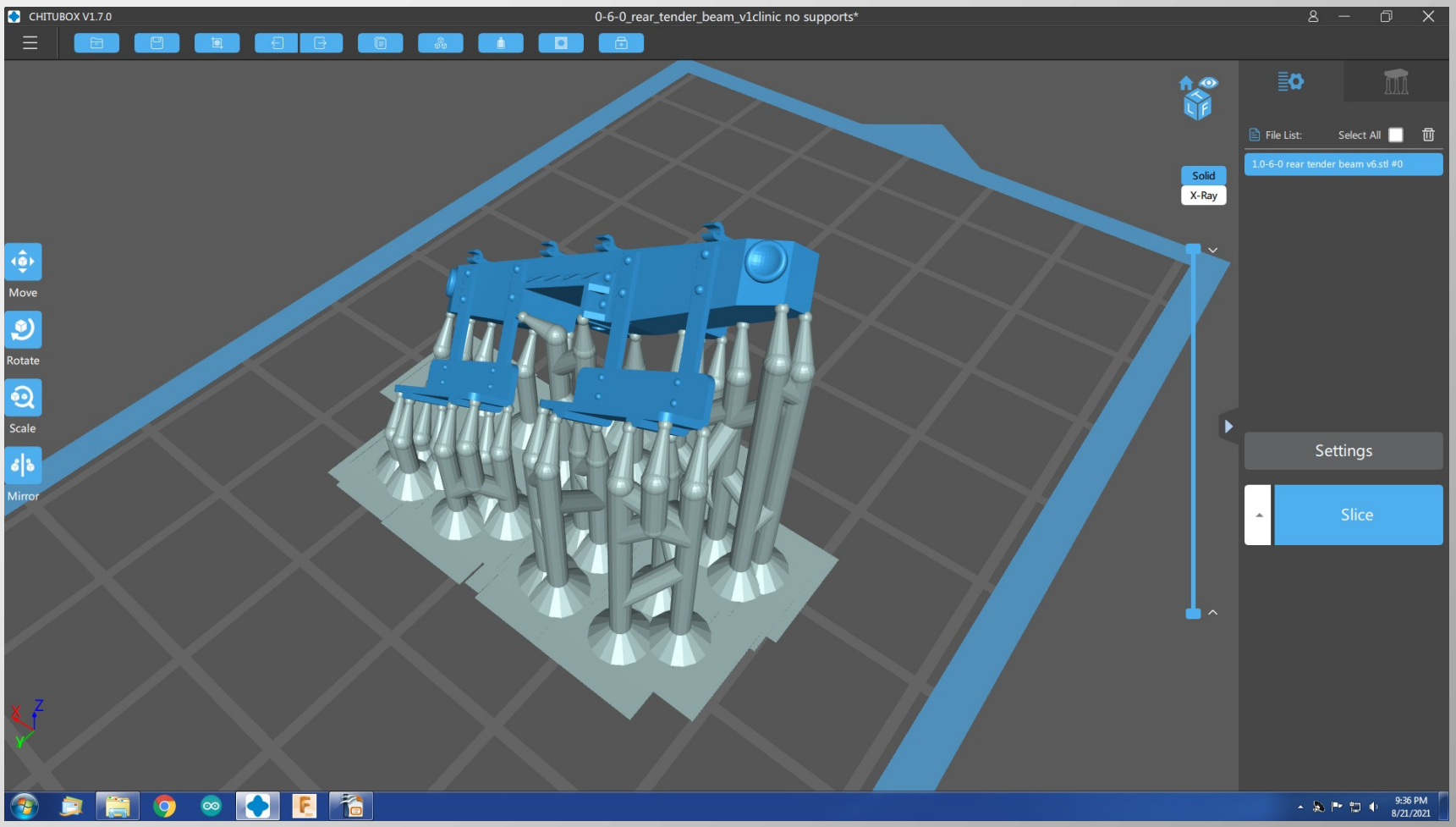
Slicing--Chitubox

- Once the model is complete, you will import it into a program like Chitubox. As the model is imported, a percent scale is assigned. For example, S scale is 1/64 or 1.56%



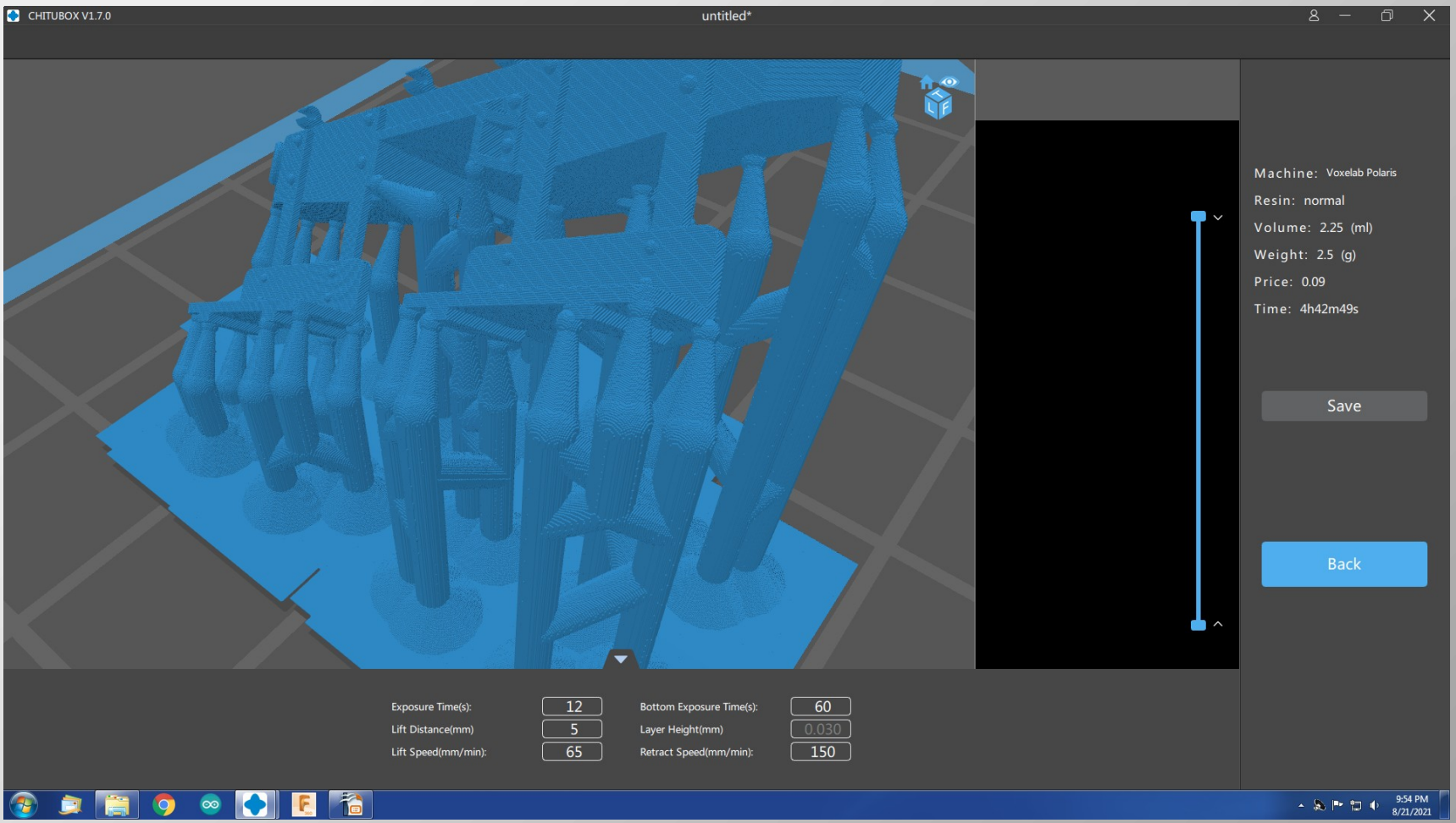
Slicing--Chitubox

- Then a raft and supports are added.



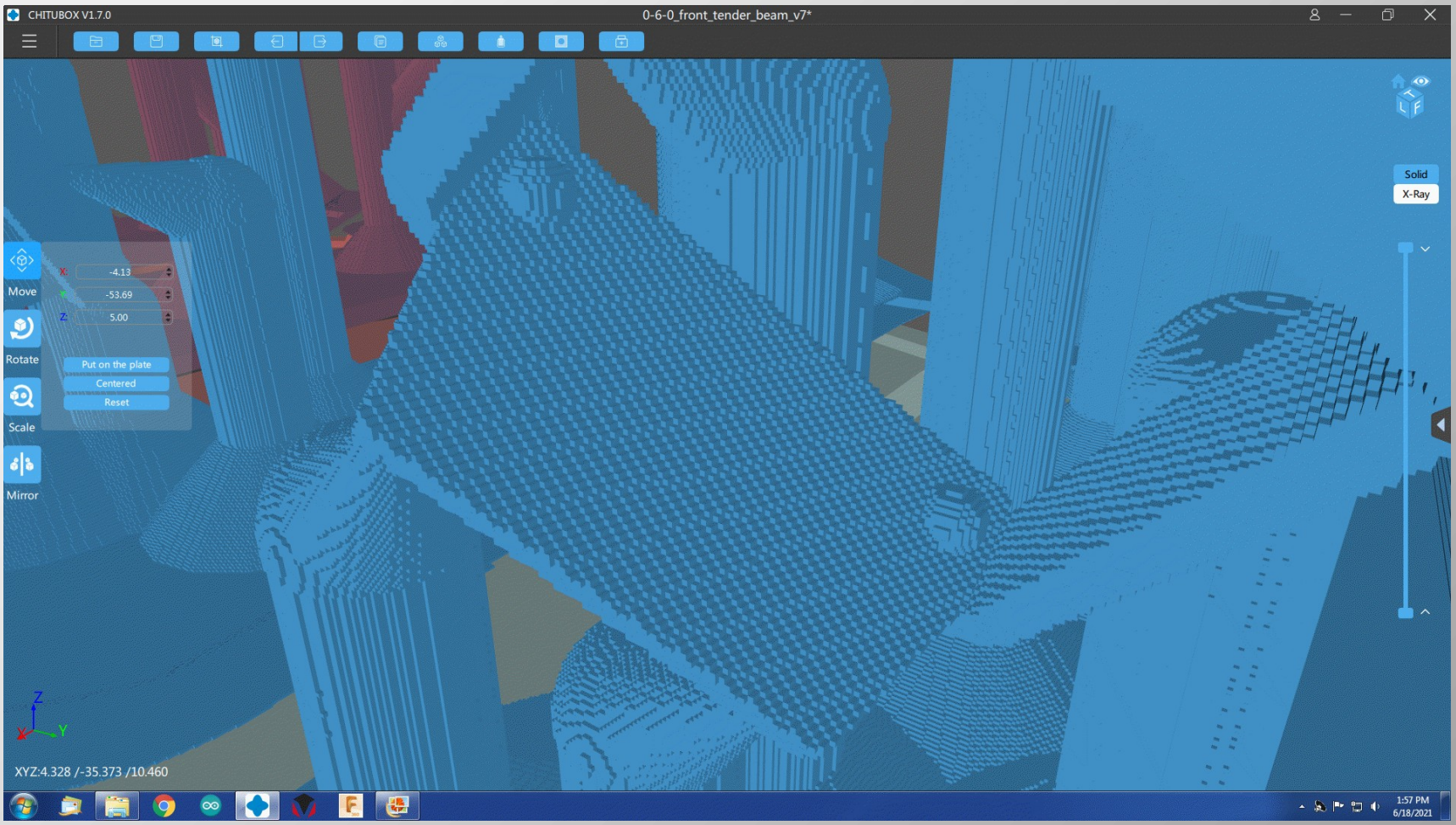
Slicing--Chitubox

- And the model is sliced



Slicing--Chitubox

- Close up of sliced model



The End