

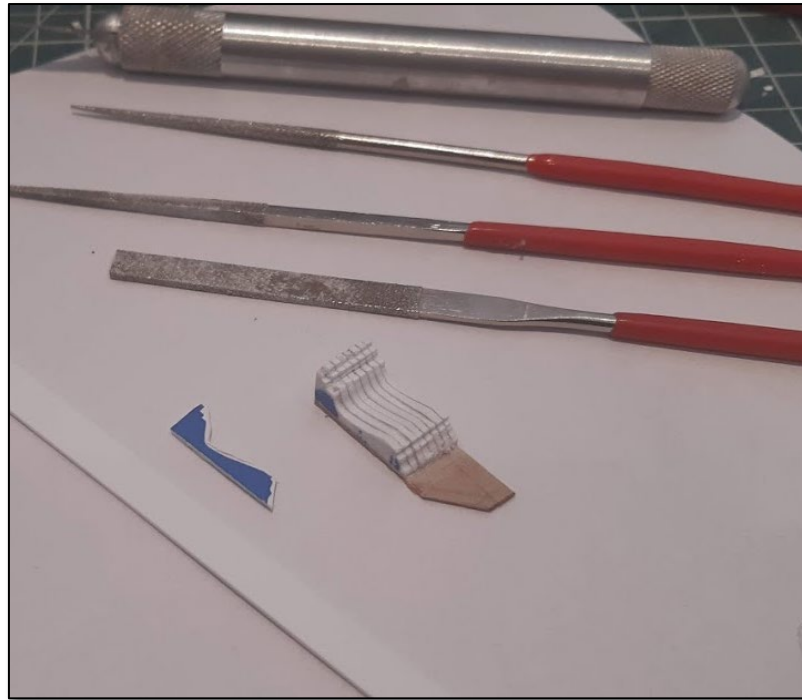
# *3-D Printing for Model Railroading*





# This technology is a game-changer

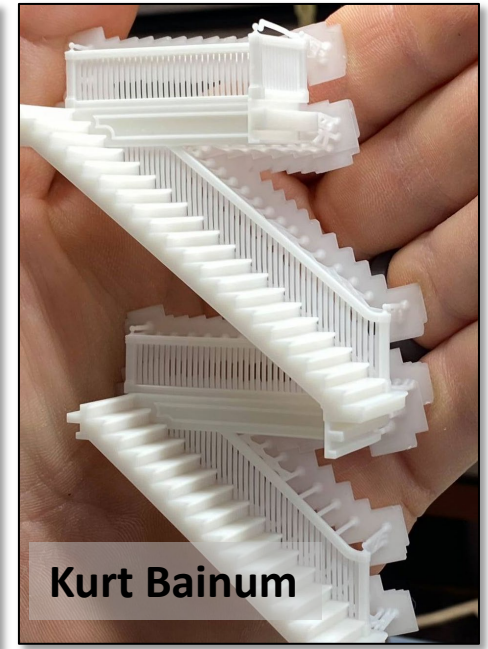
- Scratchbuilding & Kitbashing only get you so far
  - Time
  - Complex Shapes
  - Accuracy
  - Repeated Parts (see Time above)
- Previous solutions
  - Assembly-line production of parts
  - Scratch-built master, resin castings (Westerfield, F&C, others)



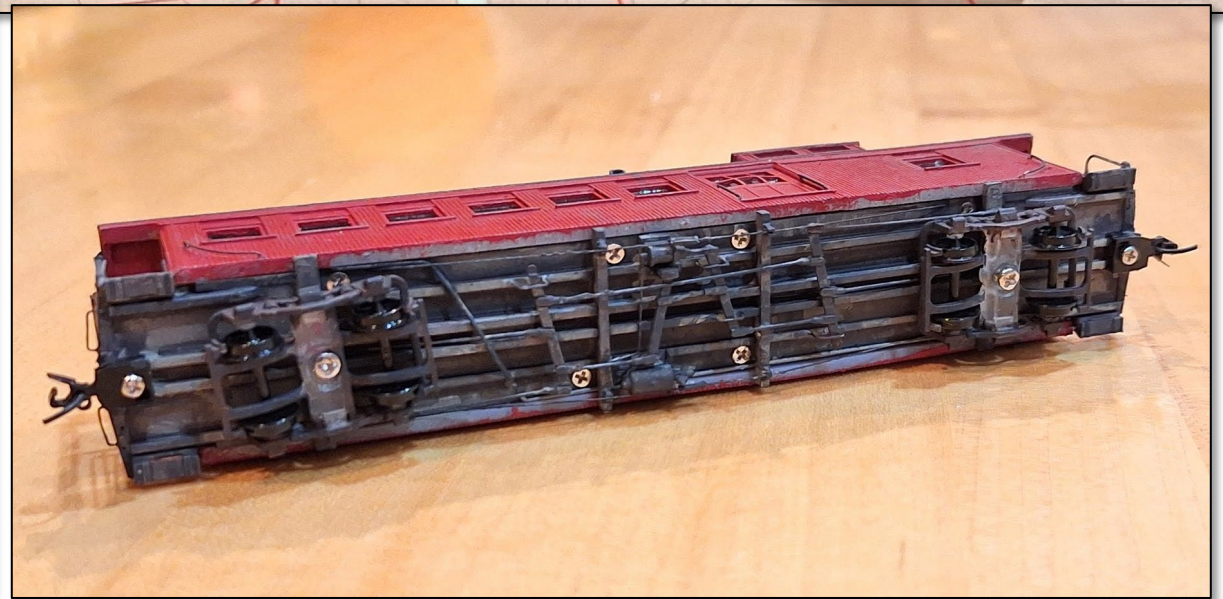
This building is scratch-built except for the 4/4 windows. The corbels and cornice trim are what drove me to 3D printing













# Why 3D printing

- Detail parts that aren't commercially available
- Unusual prototypes
- Multiple copies
- Applications – locomotives, rolling stock, structures, detail parts



Structure Details, HO



Smokejack, HO

Toma Monson Forney #4, HO<sub>n</sub>30



SR&RL Combine 11, HO<sub>n</sub>30





# Advancing Technology

- 3D printing has been available for a while, but resolution hasn't always been great
- Example to right from 2018
  - Probably an FDM printer (more on that later)
  - Obvious layering
  - Lots of finish work required



Today's state of the art has overcome early limitations, and outstanding detail is easily achievable.



# A brief history of 3D printing

1981: Dr Hideo Kodama proposes 3D modeling using UV-cured resin printed in layers

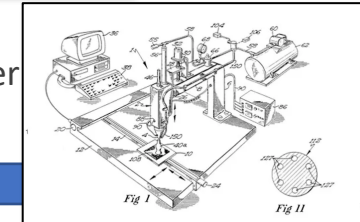
1987: Chuck Hull creates first ever 3D printer, the SLA-1



Standard Tessellation Language (STL) format is the most commonly used format file for 3D printing - it describes surface geometry of a 3D object as a set of meshed triangles.

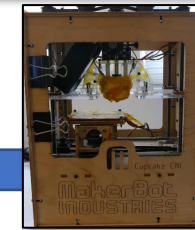
1999: Scientists 3D bioprint synthetic scaffolds of a human bladder.

1992: FDM printer patented



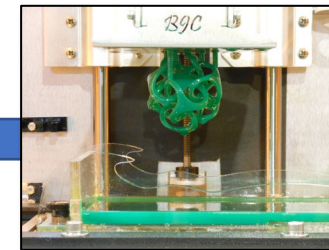
2000-2008: Growth of industrial 3D printing applications

2009: FDM patent expires, Makerbot creates home-use FDM printer



2014: Key SLA patent expires

2012: First 'hobbyist' SLA Printer



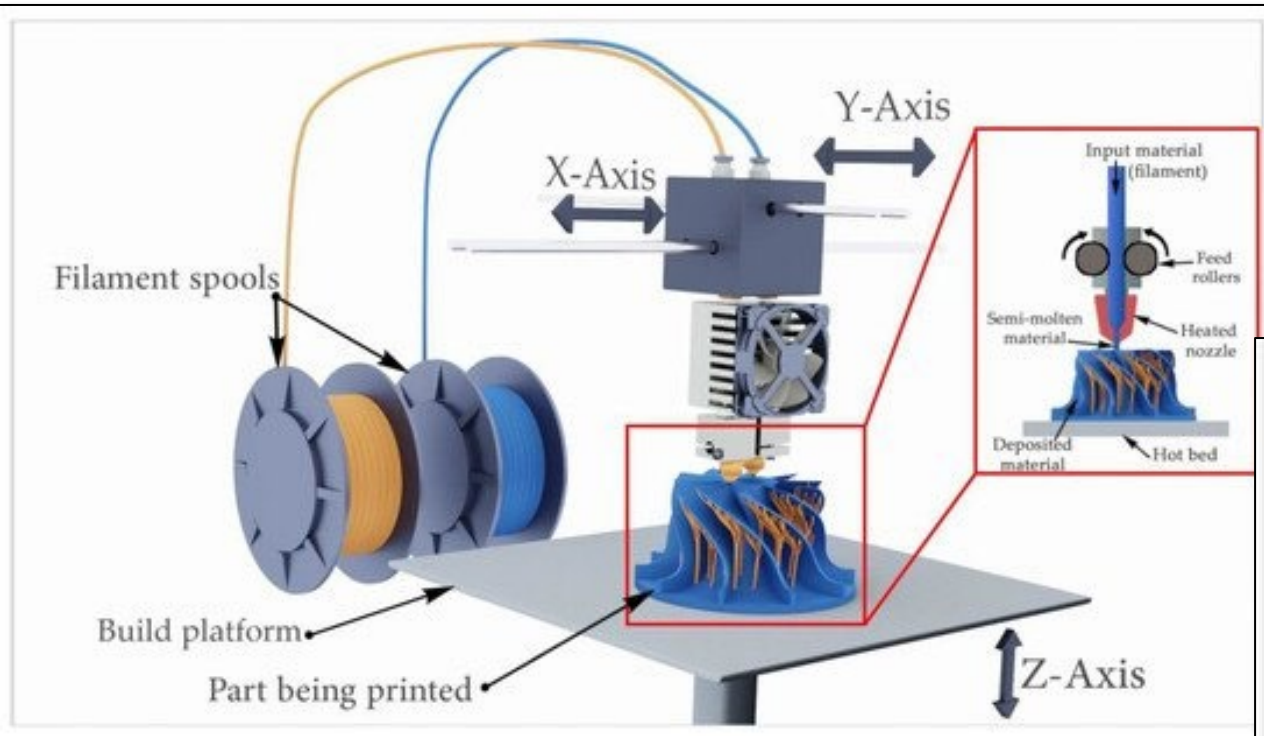
2016: Ultimaker 3 'turnkey' 3D printer



Today: 3D printers under \$200

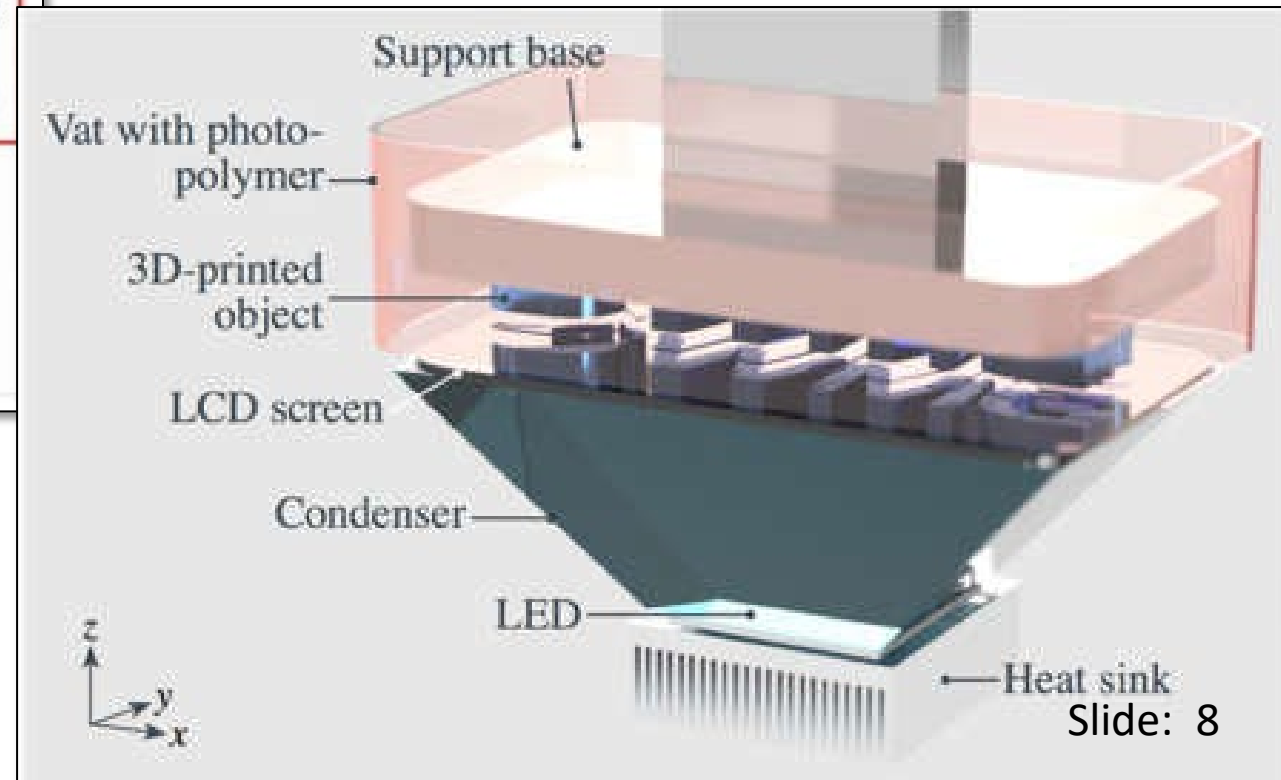


# 3D Printer Types



- Fused Deposition Modeling (FDM)

- Stereolithography Additive (SLA)





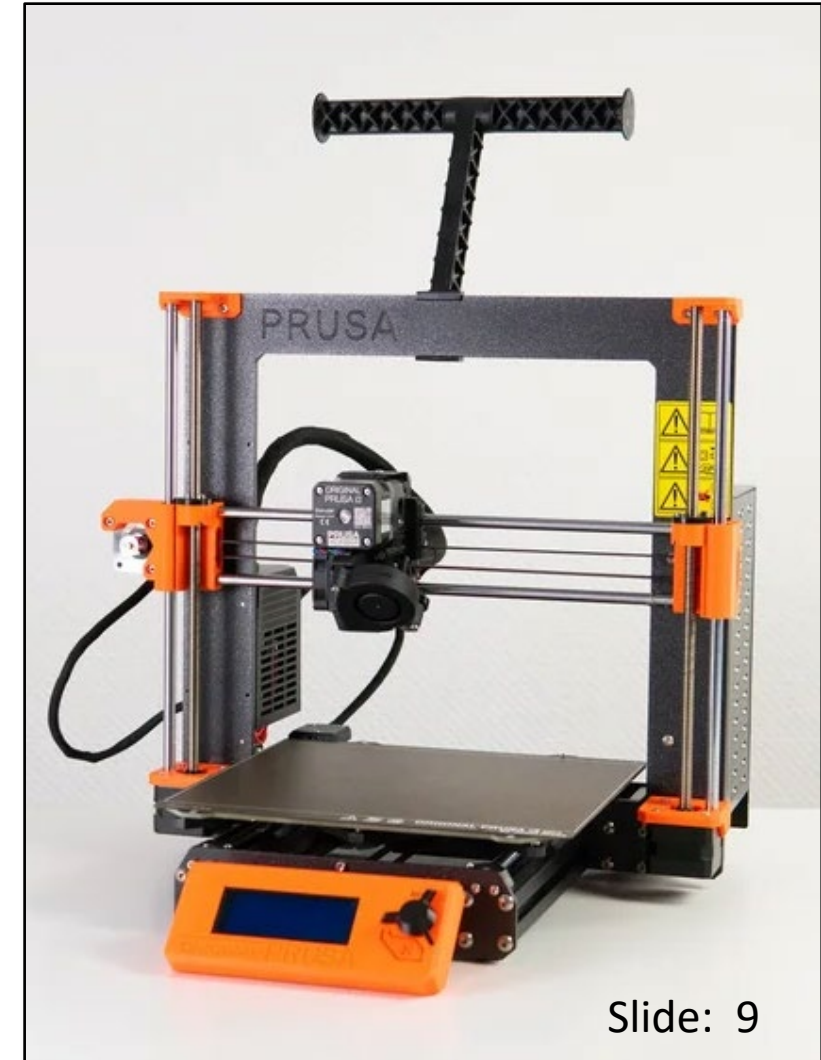
# Strengths & Weaknesses

Resin-based SLA Printer



- Part strength ✓
- Color options ✓
- Material options ✓
- Print size ✓
- Resolution ✓
- Print speed ✓
- Low Mess/odor ✓

Filament-based FDM Printer





# “Best” 3D SLA Printers

Resin printer	Best for?	Build Volume	LCD Resolution	XY Resolution	Print Speed	Price (Amazon)
Anycubic Mono M5s	Overall Top Pick	200 x 218 x 123 mm	12K	19 × 24 microns	70 mm/h or 105 mm/h	\$429
Anycubic Mono 2	Budget Pick	165 × 89 x 143 mm	4K	34 microns	50 mm/h	\$179
Anycubic M3 Max	Best Large-Format	298 x 164 x 300 mm	7K	46 microns	60 mm/h	\$949
Phrozen Sonic Mini 8K	Low-Cost Super Precise Printing	165 × 72 x 180 mm	8K	22 microns	80 mm/h	\$376
Prusa SL1S Speed	Fast High-Resolution Printing	120 × 68 x 150 mm	2560 x 1620 pixels	47 microns	50mm/h	\$2199

As of Feb 2024

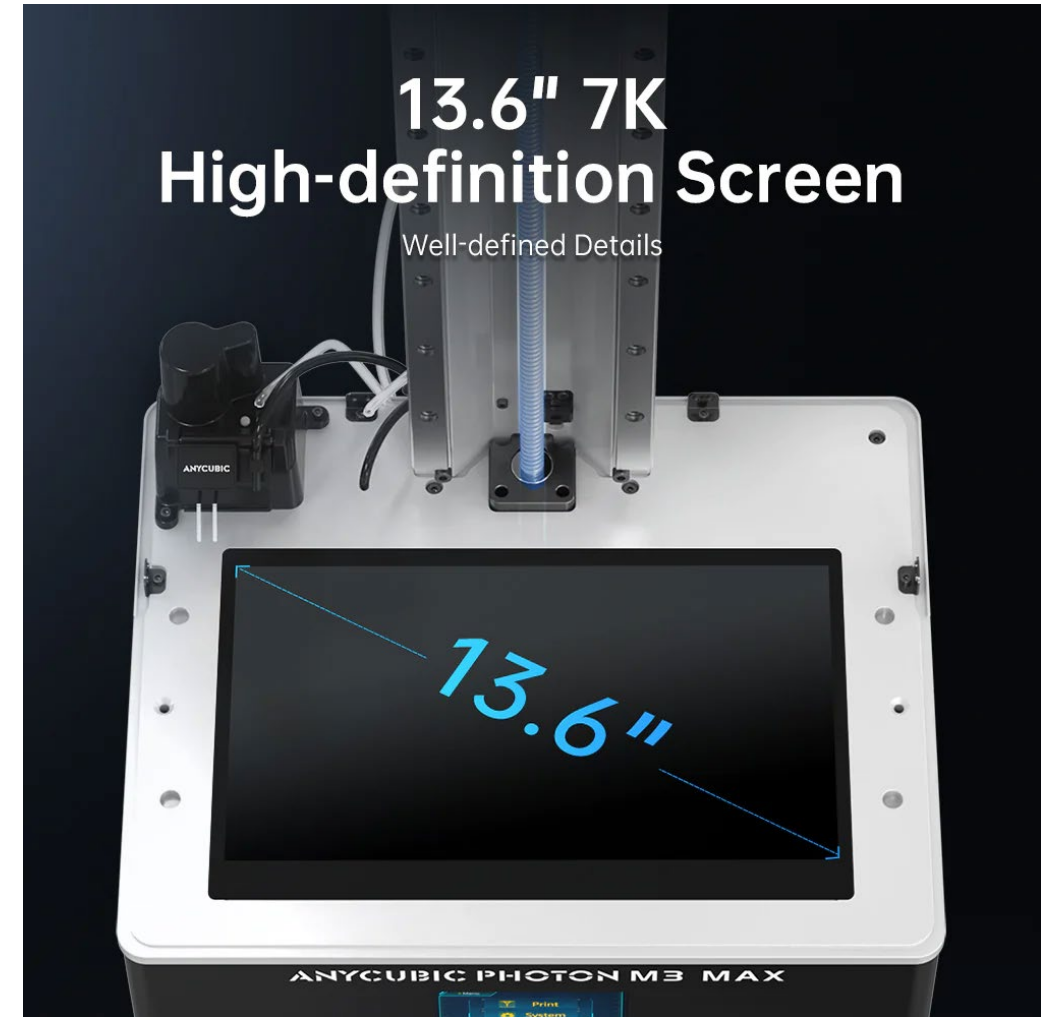
Source: <https://www.3dsourced.com/3d-printers/resin-dlp-sla-3d-printer-stereolithography/>





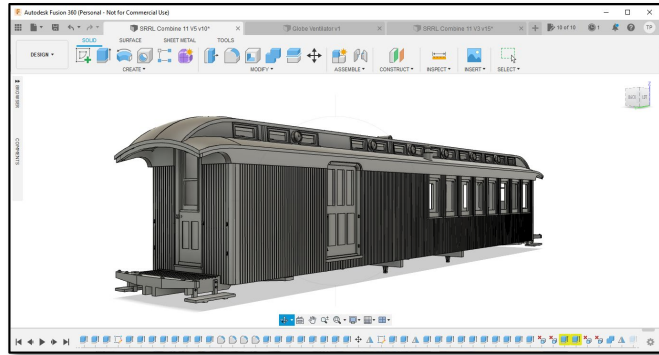
# What does 'best' mean?

- It depends...
- Key attributes: Size and resolution
  - Larger size allows you to build bigger things (eg, cars, locomotives, building sides)
  - Higher resolution means crisper, more detailed parts
- Large size usually (but not always) means lower resolution



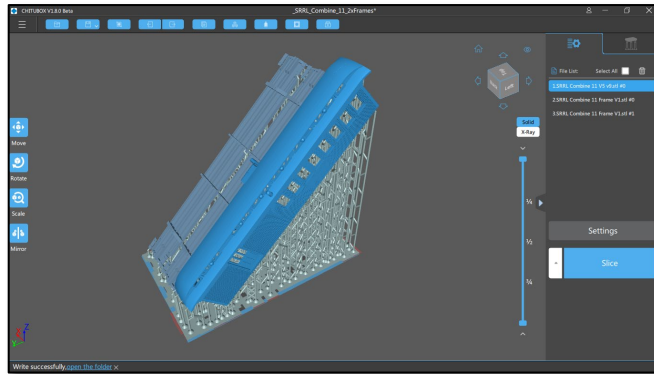
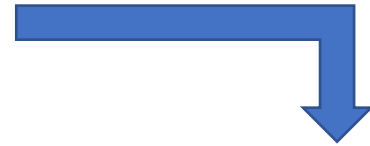
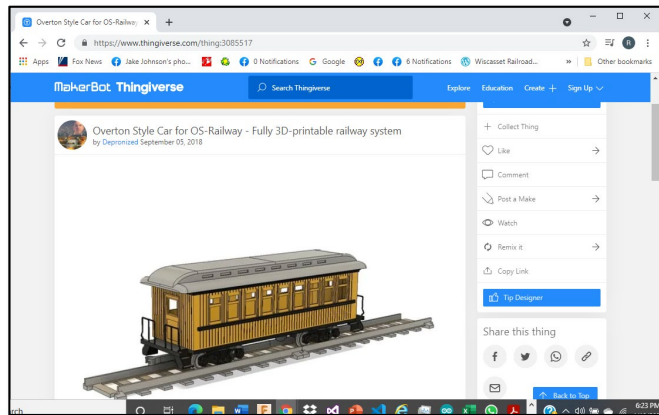


# The printer is only part of the process...



CAD Modeling

Online Downloadable Model



Slicer Software



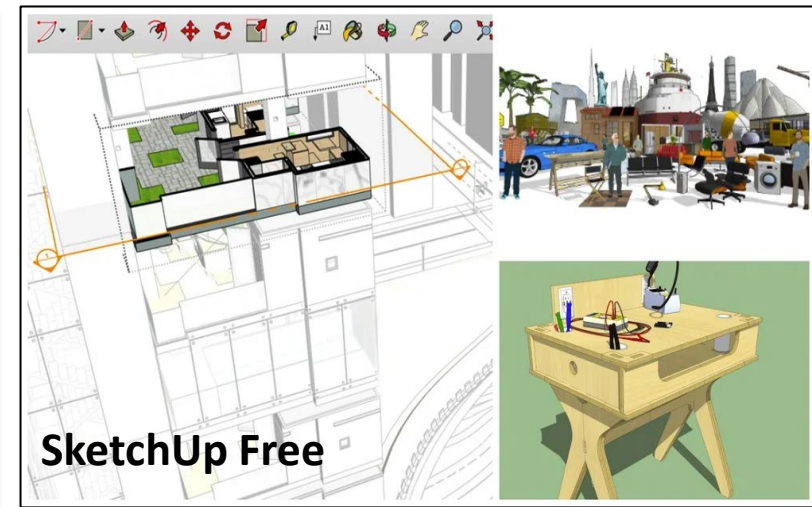
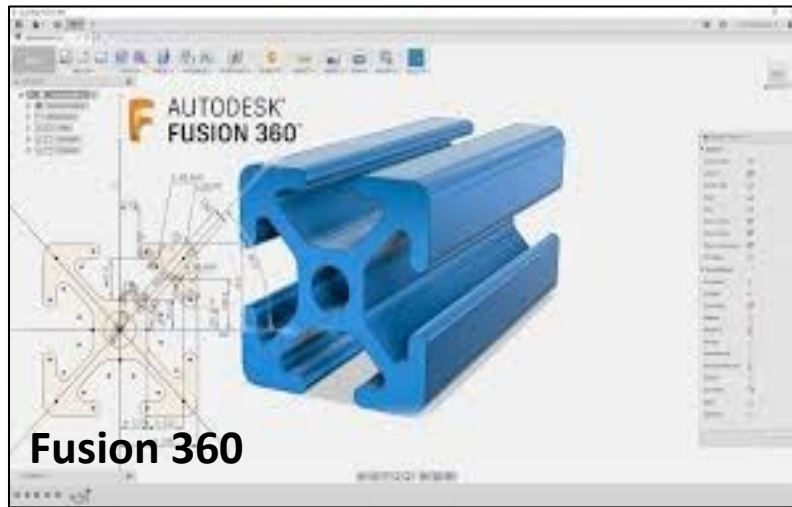
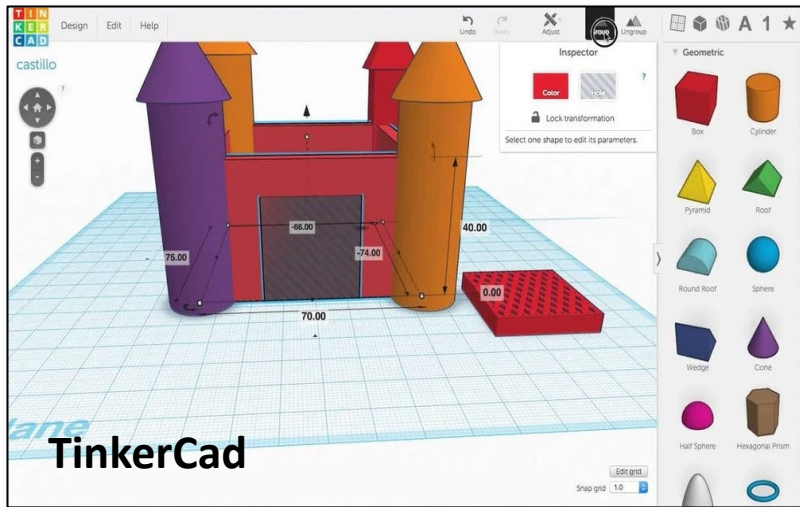
Printer



Wash & Cure

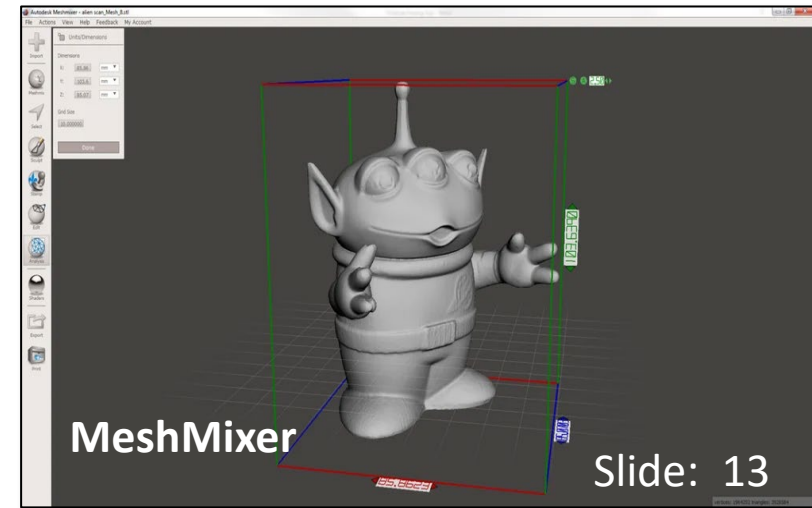
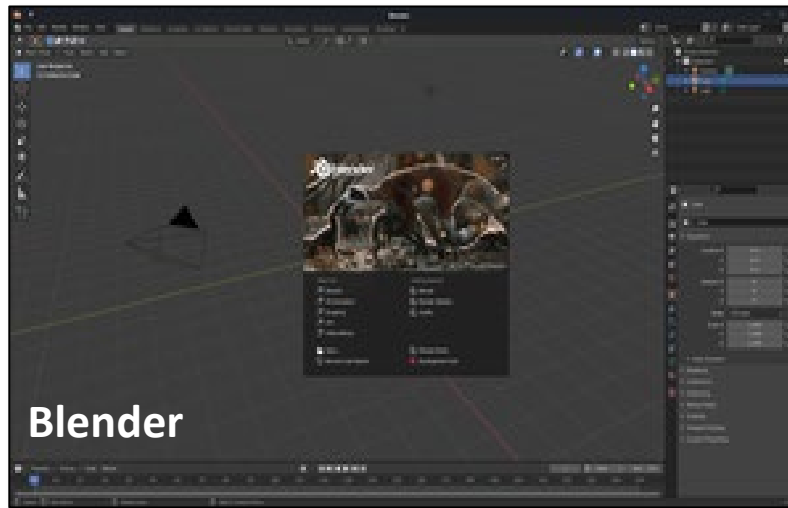


# Building the model - CAD Programs



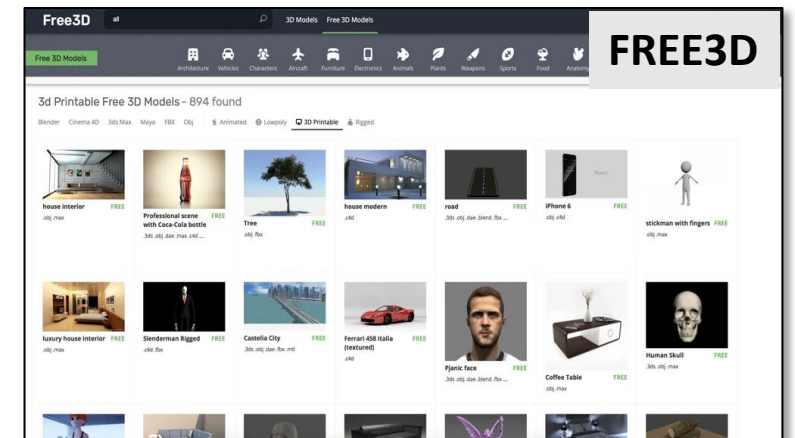
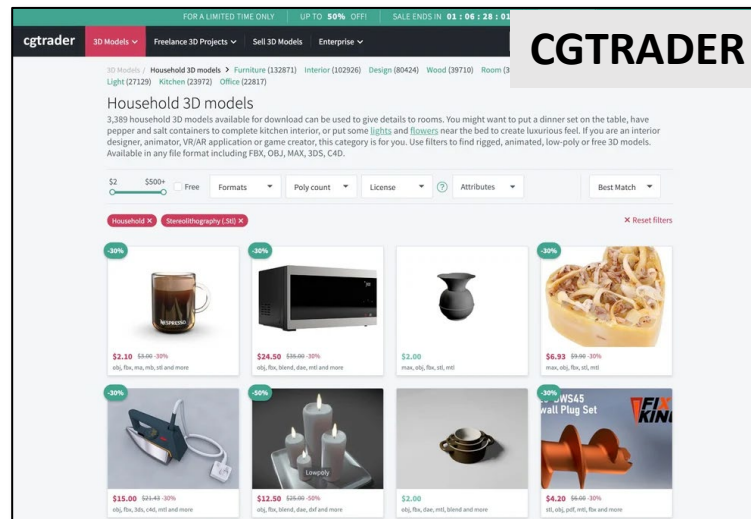
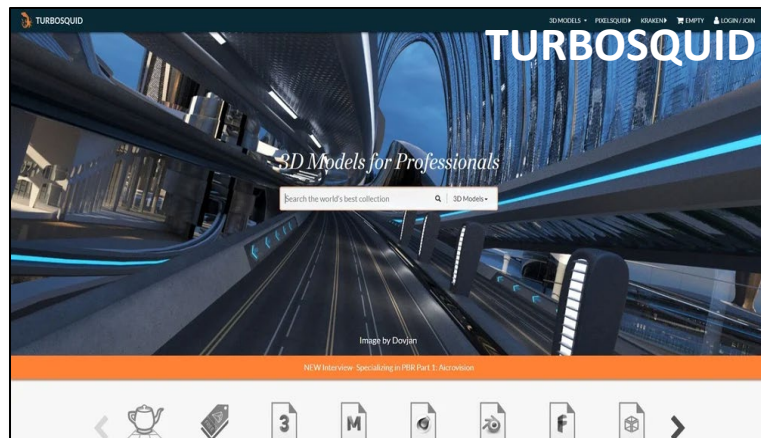
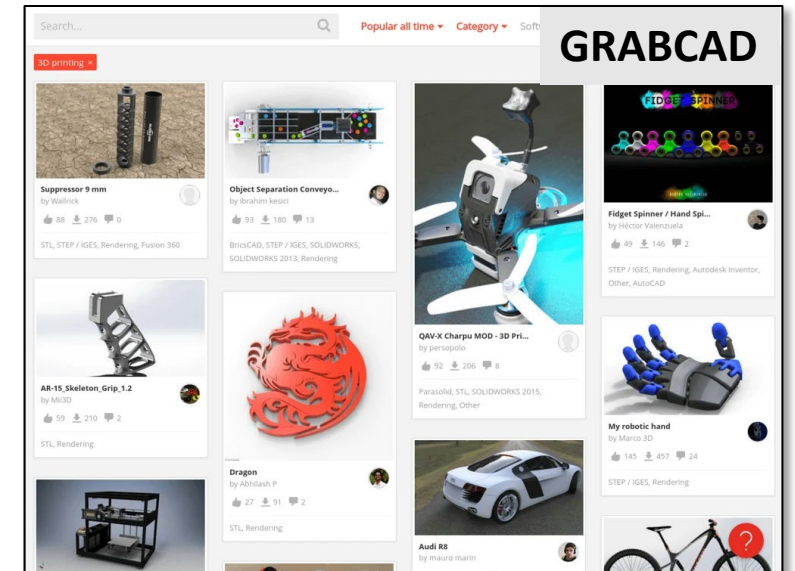
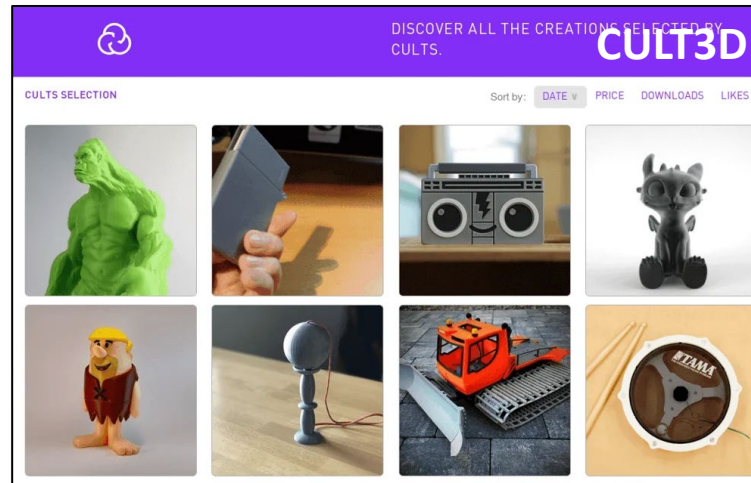
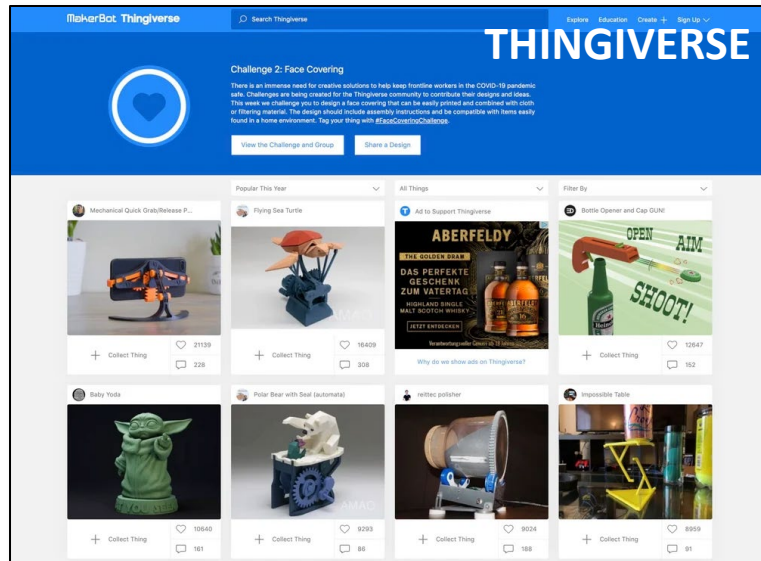
CAD programs really unlock the power of your 3D printer and allow you to create those custom pieces you really want.

All these are free to download and use. The top 3 are for mechanical design, the lower two for figures and organic designs.



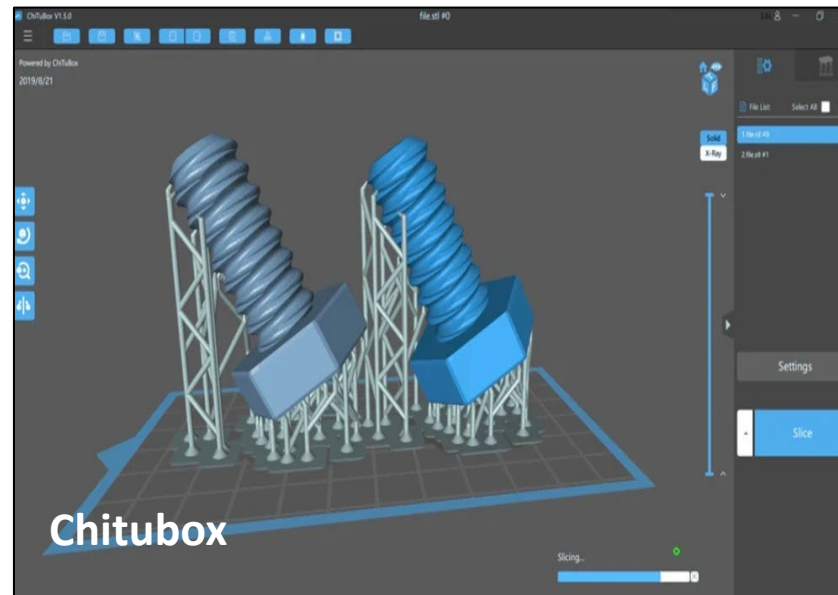
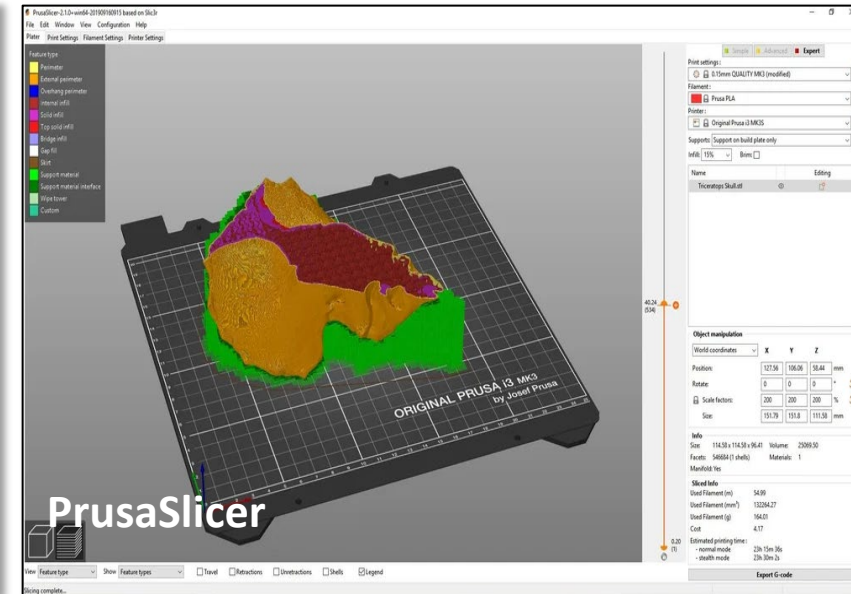
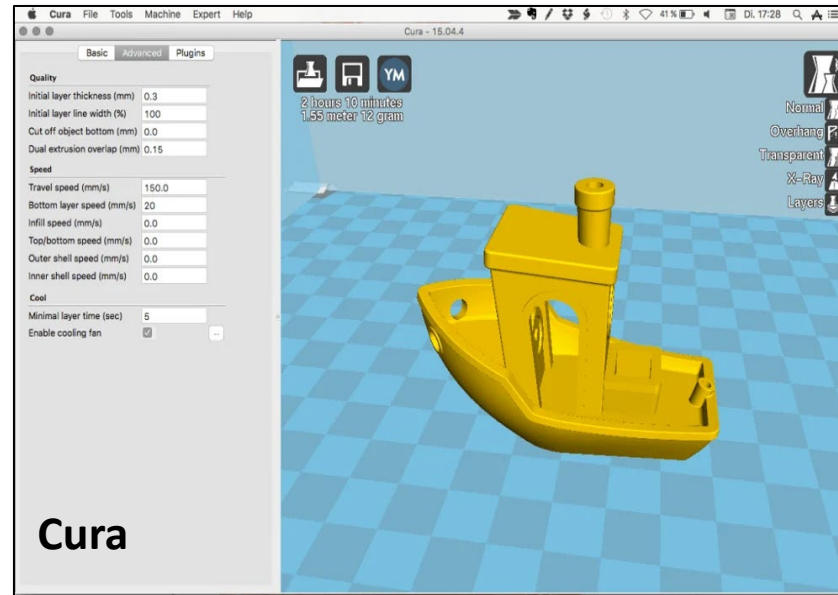


# Building the Model - Free download sites



# Slicers

- 1) Combine different models into the same print session
- 2) Set orientation to allow bigger models than the size of the build plate (and better prints)
- 3) Add supports
- 4) Set print settings for your printer
  - 1) Layer depth
  - 2) # of Bottom layers
  - 3) Exposure time (bottom and print layers)
  - 4) Lift speed
  - 5) Anti-Aliasing
- 5) All these slicers are free. Fan favourites are Lychee and Chitubox

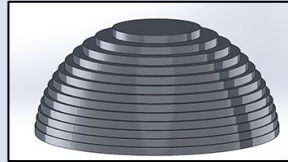




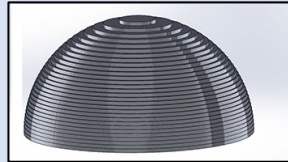
# Slicer Settings

## Layer Height

Layer height is the exact height of each cured layer



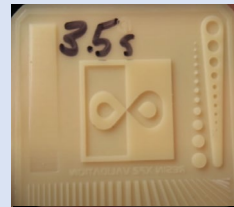
100µm  
layers



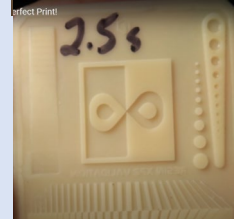
50µm  
layers

## Exposure Time

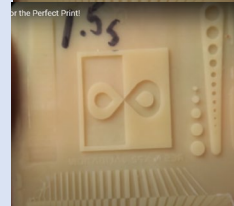
Depends on the type of resin being used and power of the light in the machine.



Over



Correct



Under

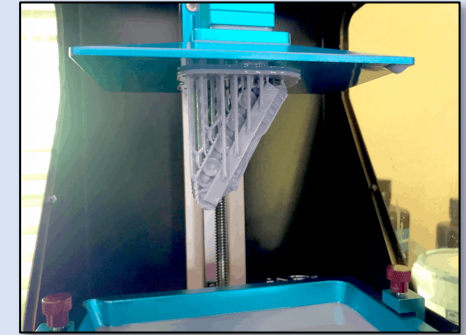
## Lift Speed

Too fast, and supports break, parts delaminate; too slow increases print time required



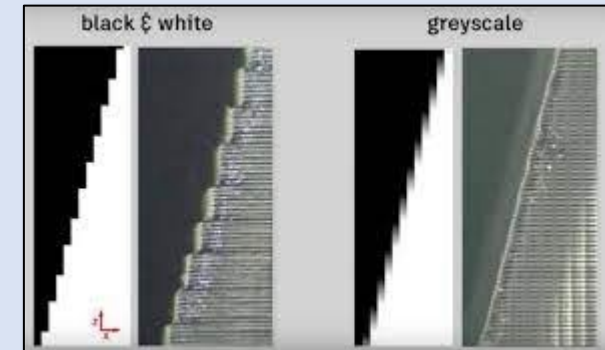
## Part Orientation

Can improve print quality by minimizing changes in cross-section from layer to layer and taking advantage of better z-axis control versus x-y axis



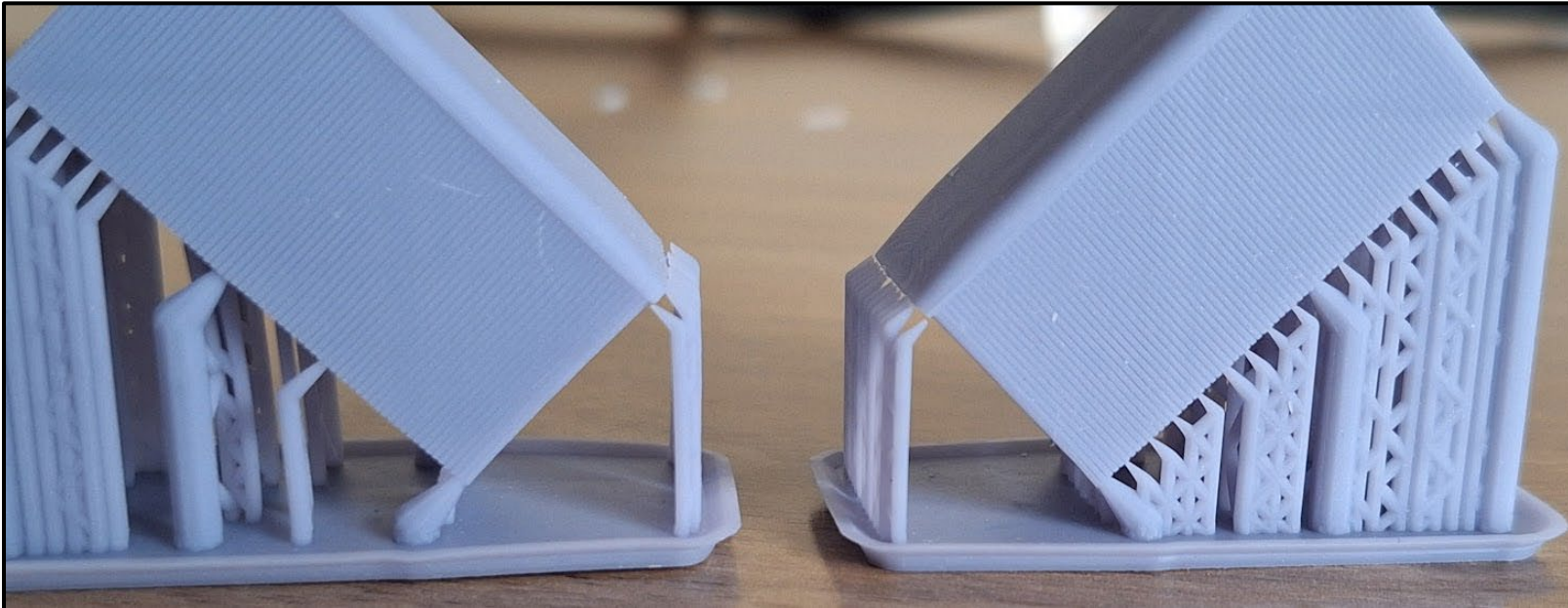
## Anti-Aliasing

Improves curved edges by adjusting power used on edge pixels



# Supports

- Learning how to do proper supports can make or break your printing experience
- Practice and trial & error are your best friends
- General guidelines
  - Heavy supports at the start of the print to attach it to the build plate
  - Medium supports where cross-section changes a lot and to hold piece in alignment
  - Light supports where there are overhangs





# Now it's time to print!

Safety – ventilation, nitrile gloves (resin is nasty stuff)

Resin choices – balance color, detail, toughness

Oh yeah – how do we get the file from the slicer to the printer? (most current SLA printers are not Wifi capable)



## Best Overall:

**Siraya Tech Fast**

## Best Bulk Buy:

**AnyCubic UV sensitive resin 1 Litre**

## Great All-rounder:

**eSUN General Purpose  
Photopolymer Resin**

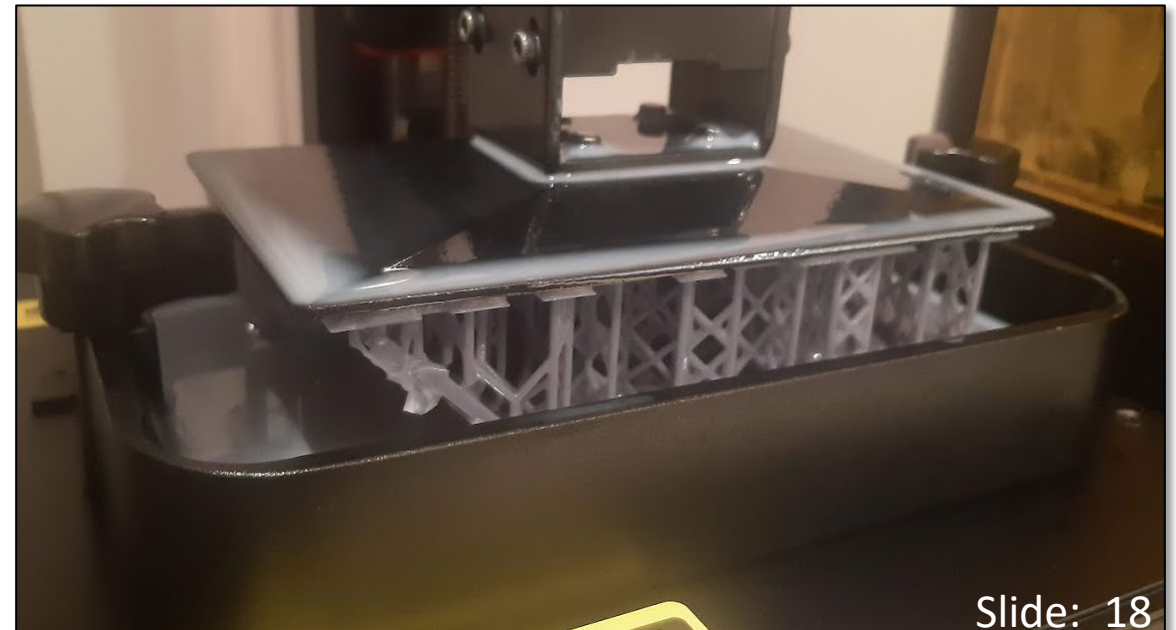
## Best Budget resin:

**ELEGOO 3D Rapid Resin**

## Best for Toughness:

**Siraya Tech Tough (blu)**

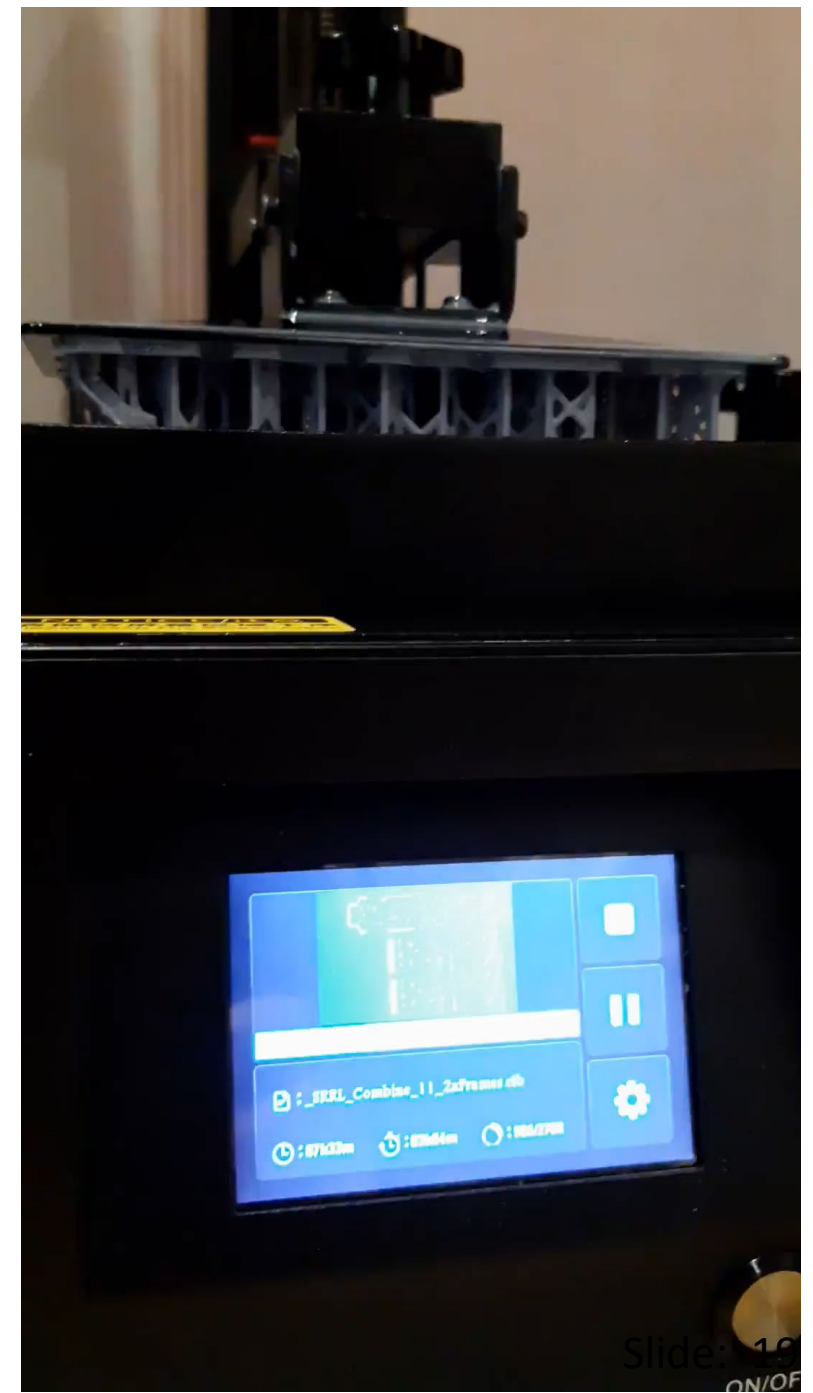
<https://www.windowcentral.com/best-resin-your-3d-printer>



Slide: 18

# Printing

- Best to use in a room with little direct sunlight, good ventilation
- Level printer, level print bed, set zero
- Fill the vat with resin, select model on screen
- After every layer, you'll hear the sound of the model pulling away from the FEP – that's normal
- The resin vat hides progress – so you aren't really sure how it's going for at least an hour





# Post-print: Wash & Cure

- The first thing that needs to happen is to wash excess resin off the print – best practice is 99% isopropyl alcohol as the wash agent
- Mars, Anycubic, Elegoo, Creality all make 'wash and cure' machines
  - Provides a stirrer for the alcohol bath
  - Also provides a rotating base and a 405 nm UV light source
- There are inexpensive homemade options
  - Tradeoff is time-savings - hand-washing versus automatic washing



So – what can I do with this?

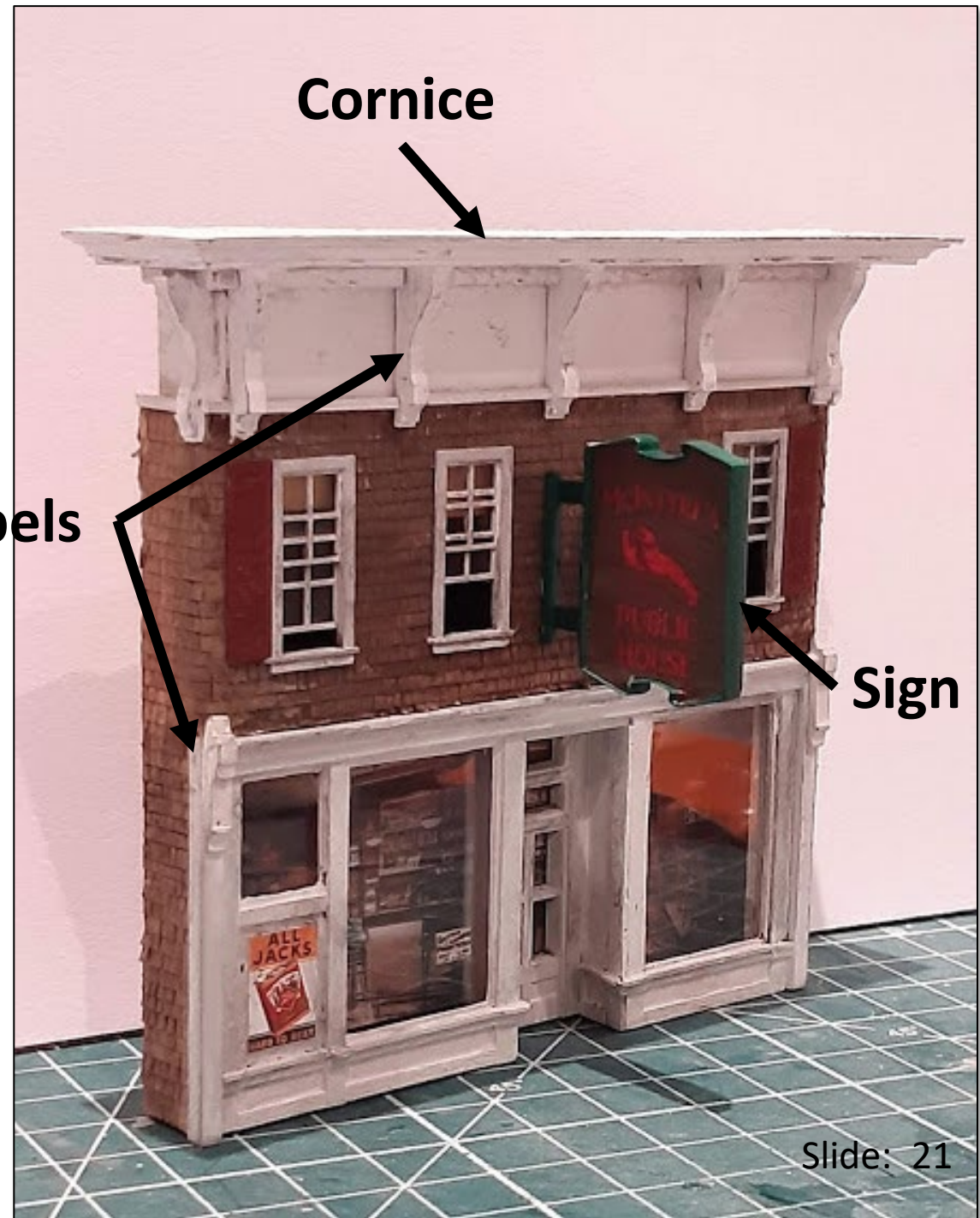


*This was my first foray into 3D printing*

Corbels

Cornice

Sign



Slide: 21

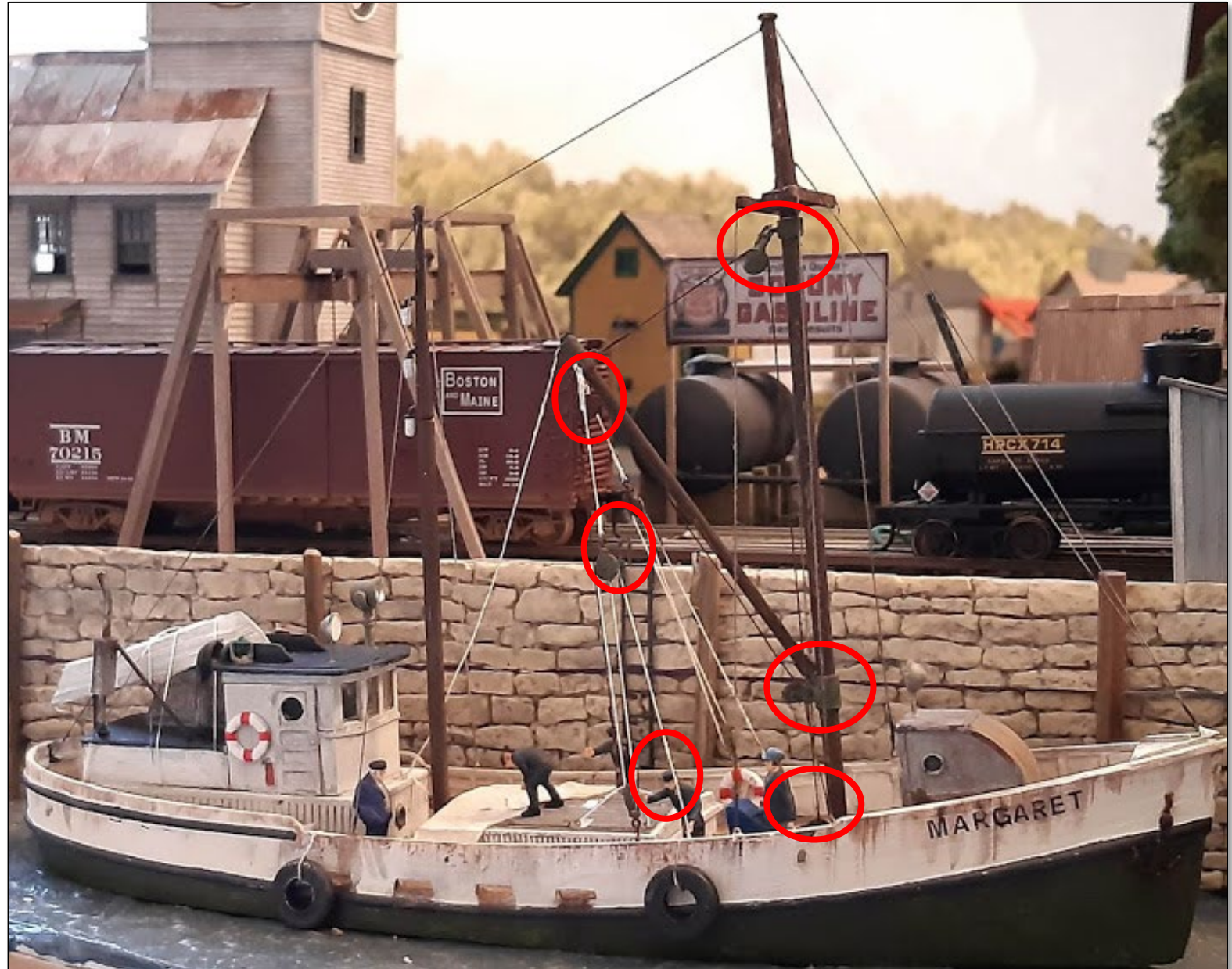


# Kitbashing Help

I wanted to convert a drag fishing trawler into a freighter – and needed a shipboard derrick crane.

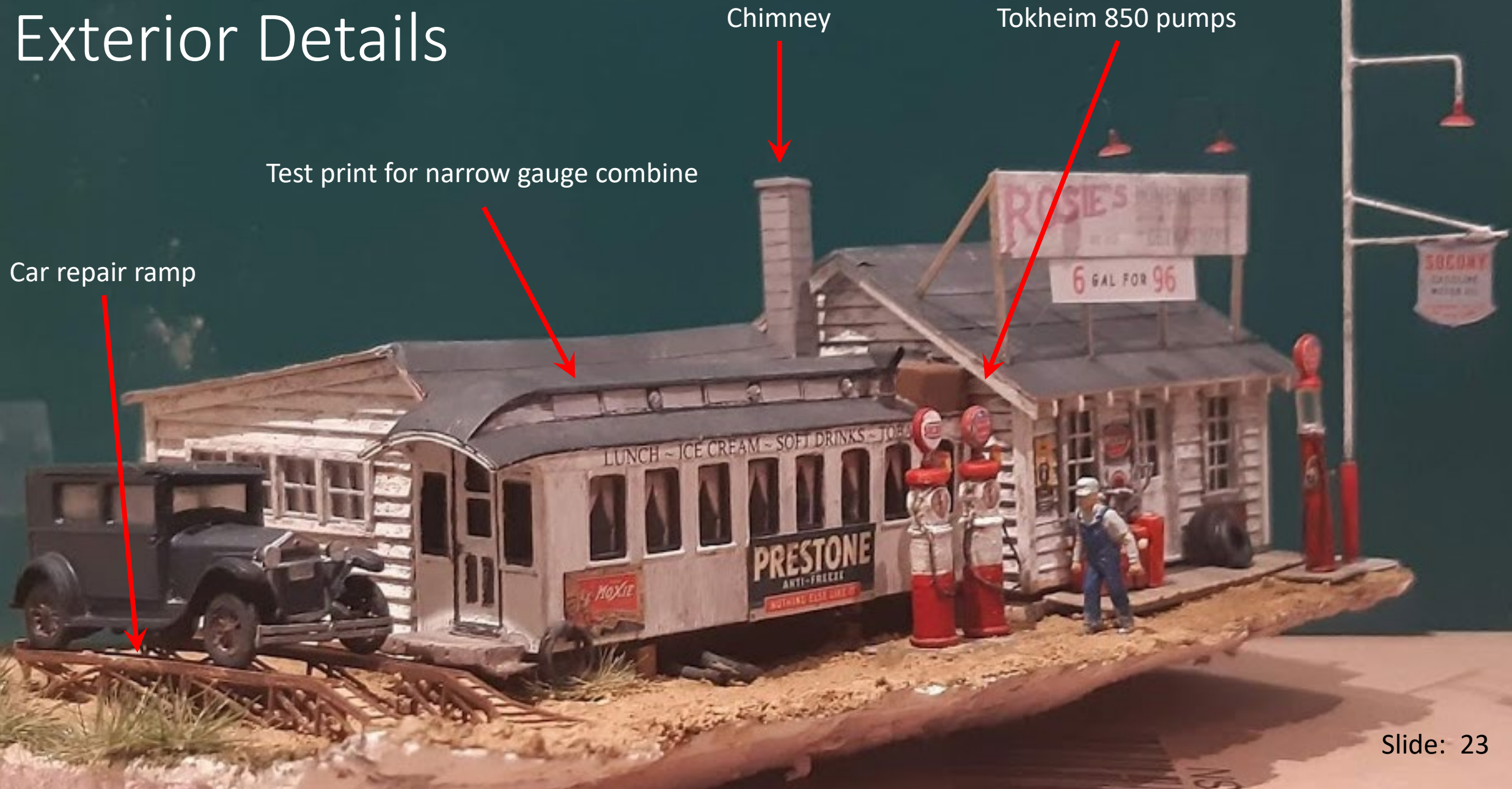
3D print components – winch, head block, monkey face, pulleys, etc

I was able to iterate on the part size until I hit the right one, quickly





# Exterior Details





# Structure Parts

Skylights

Door track

Window Sashes

Gable & Window

Cornice

Interior Details

Bay Doors

These parts count as AP scratch-built, if you do the CAD design work yourself



# Interior Details

Fireman's  
Helmet  
(Thingiverse)

Alarm  
(Fusion 360)

Clothing Rack  
(Fusion 360)

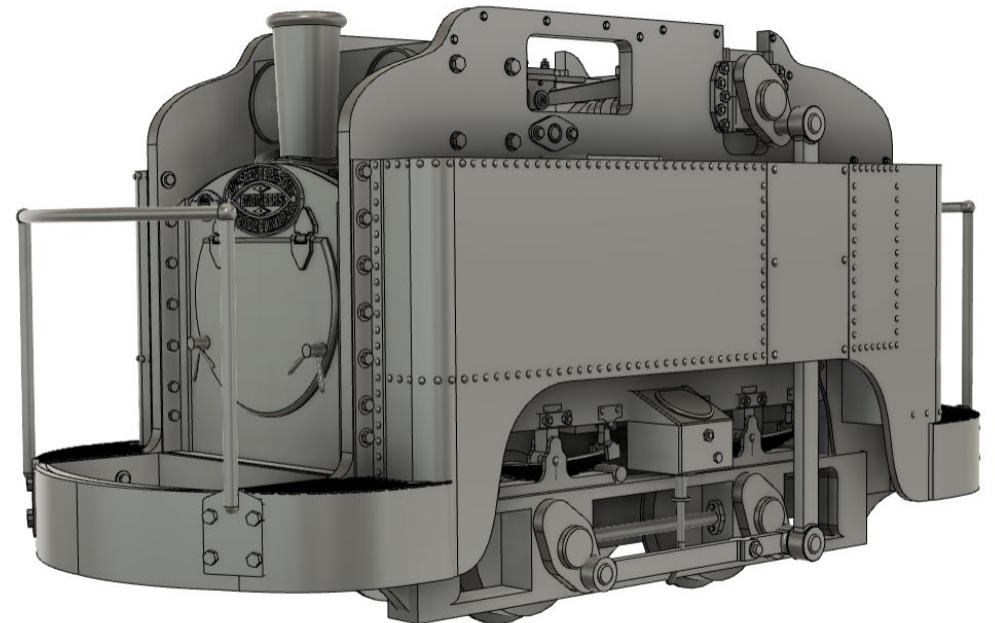
Chairs  
(Thingiverse)

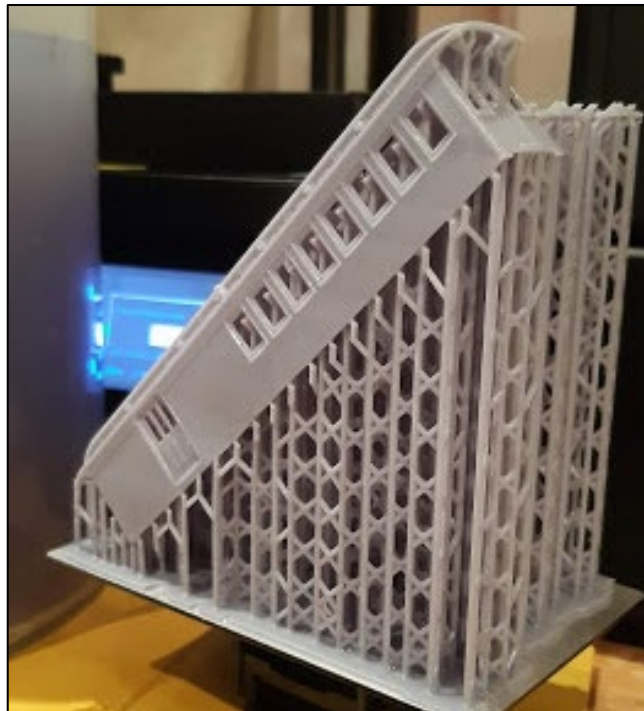
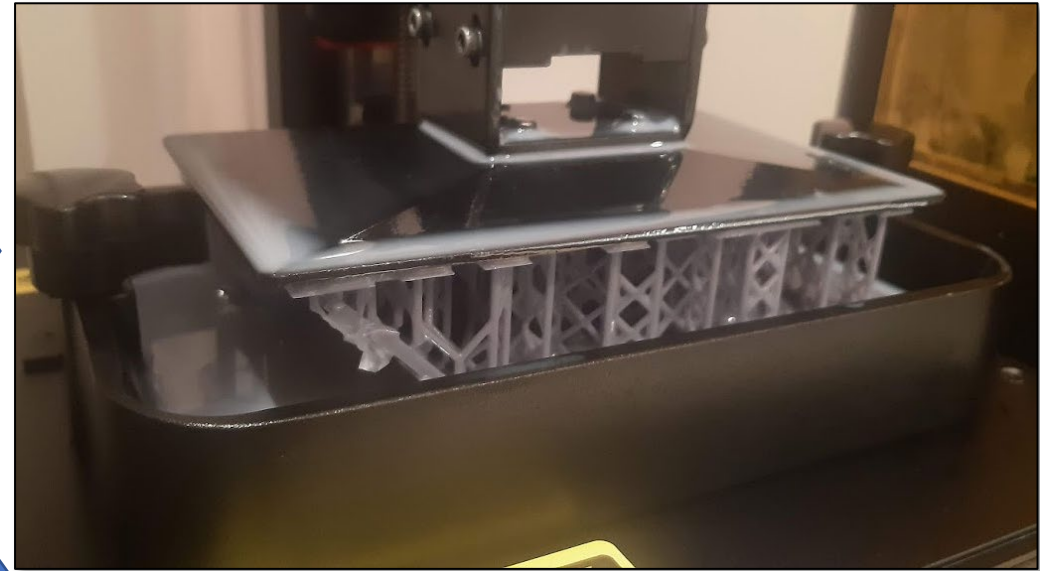
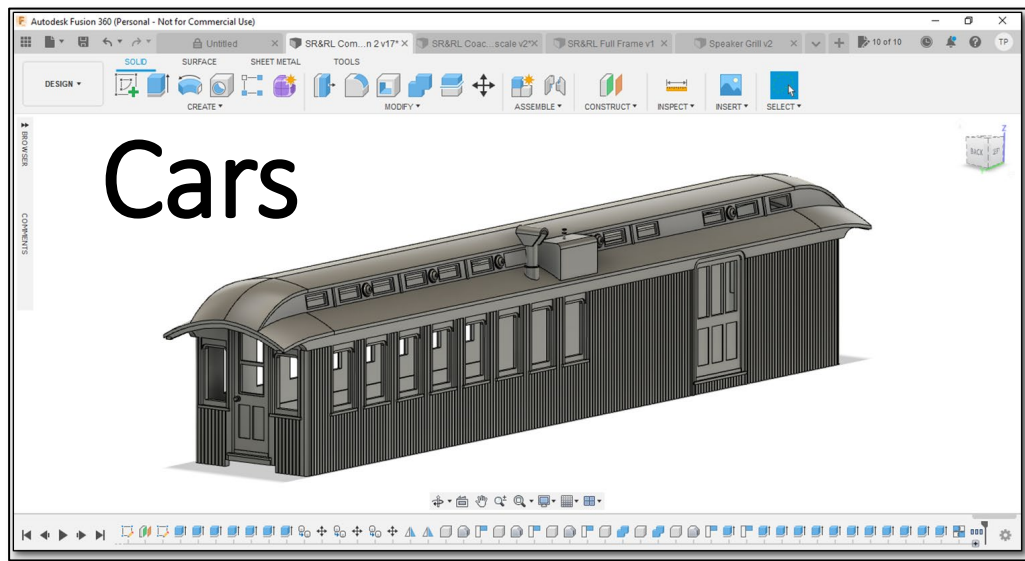
Boots  
(Thingiverse)

Desk, Phone, Cup  
(Thingiverse)



# Locomotives







# Full Model Kits

## RAILROAD MEMORIES OF MAINE

FINELY DETAILED 3D PRINTED KITS & DETAILS  
FOR HON30 MODELERS

### 4 kits to date:

SR&RL Combine 11 (shown)

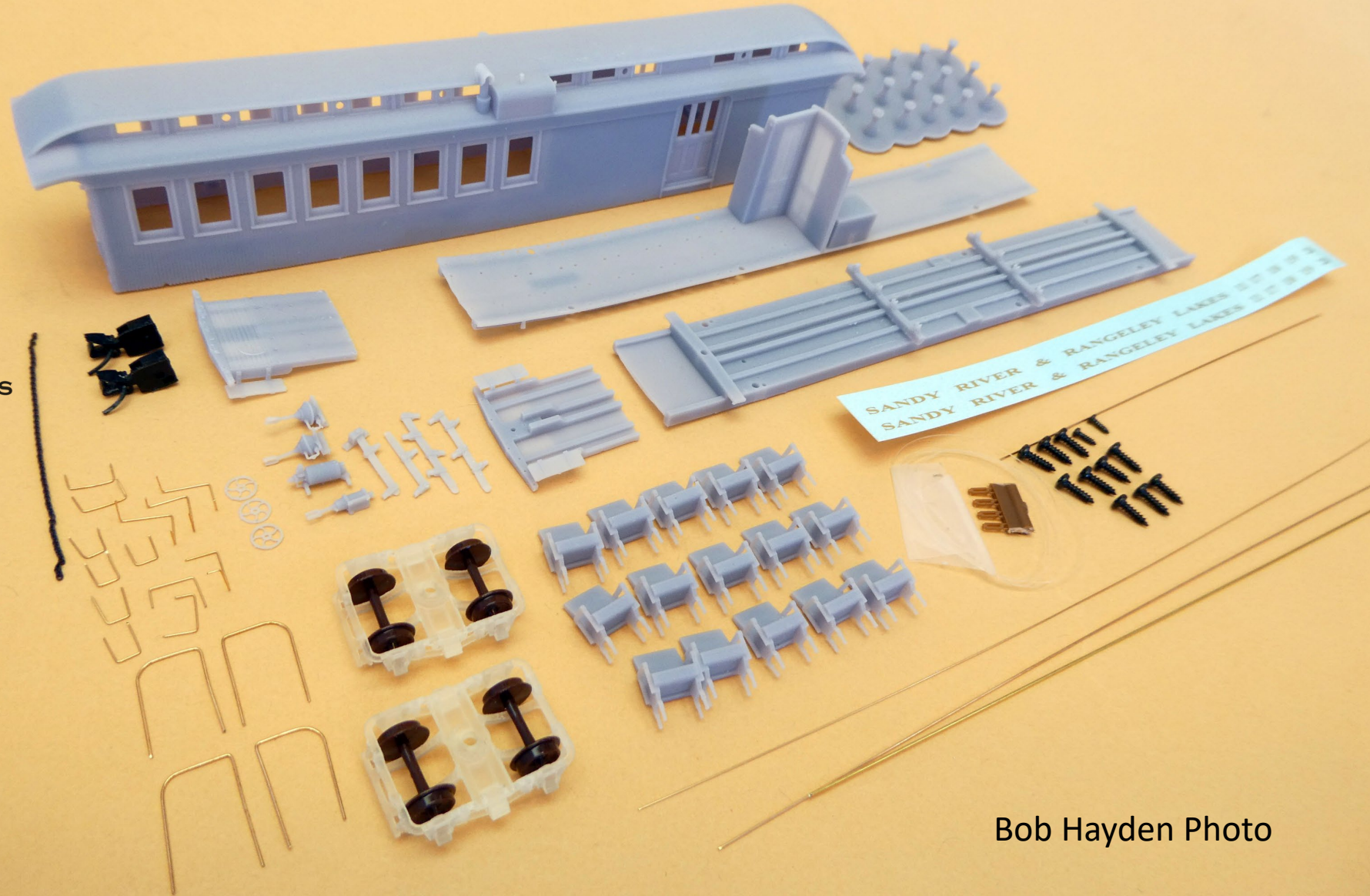
SR&RL Coach 17/18

SR&RL Caboose 553

SR&RL Railbus 3

SR&RL Railbus 4 (Sept)

MEC Laconia Caboose (Dec)



Bob Hayden Photo



# More Details





# Oddball prototypes



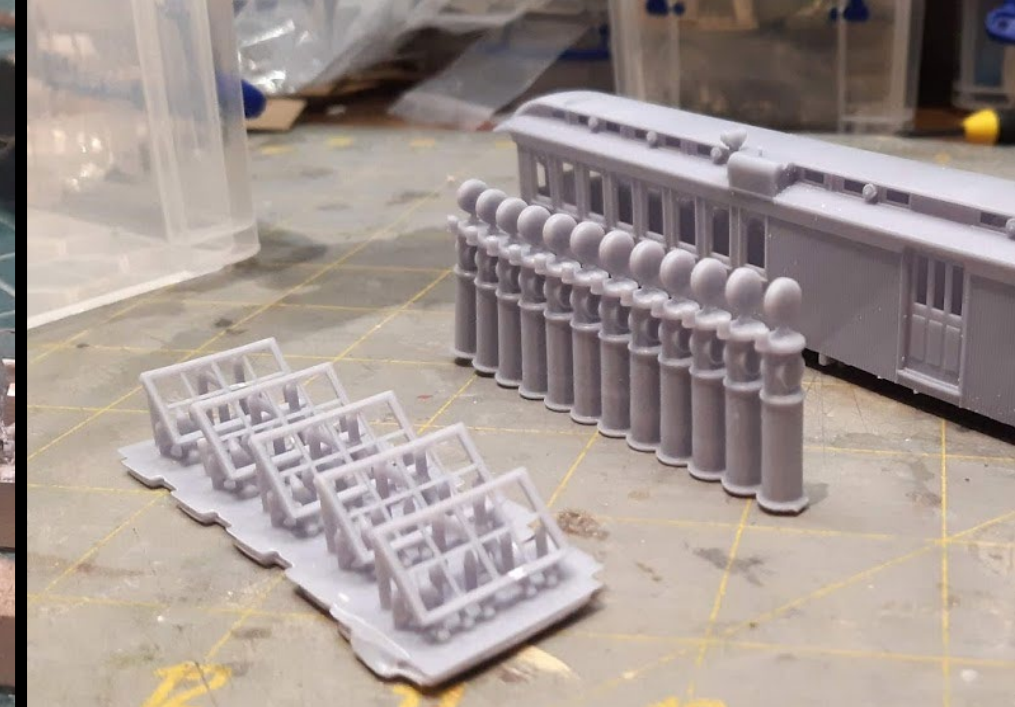


# Other Stuff





# Other Other Stuff





# Other Other Other Stuff





# Other<sup>4</sup> Stuff

(a moose once bit my sister)





# Useful References

- <https://all3dp.com/> - all things 3D printing related; reviews, tips and techniques, and much much more
- <https://3dprinteruniverse.com/> - another useful all-purpose site
- <https://www.thingiverse.com/> - tons of free stl models; so much stuff its sometimes hard to find what you're looking for
- <https://www.facebook.com/groups/3DModelTrains> - Facebook group for 3D printing specially for model railroading
- <https://www.youtube.com/> - tutorials for CAD & 3D printing; just do a search for what you're interested in



# “What I wish I’d known when I started”

- I put this question to the FB 3D Printing for Model Trains group

“3d printing is a massively revolutionary technology. It completely changes the status quo in product development, manufacturing, and prototyping. But... It is not replicator technology from Star Trek. You almost never can simply push a button, walk away, and come back to an item a few hours later.”

“Though it may seem hard at first it can become quite a reliable tool in our arsenal. Not everyone's going to make a fantastic print their first time. It will take trial, effort, fine tuning, and maybe some cursing...”

“What I wish I’d known when I started”

“The printer is at the centre of things, but there’s a whole lot more to the process.”

“Don't expect it to replace the whole modeling process, 3D printing is a tool like any other, resin is excellent for fine modeling but still has limitations requiring traditional modeling skills to make it great.”

“Just like regular modeling it takes time to get the most out of it.”



# Questions?

If you have other questions for me, I can be reached at [trpersing@gmail.com](mailto:trpersing@gmail.com). Please use the subject NMRA 3D PRINT CLINIC.

I hope you enjoyed this!

Ray Persing

"My dad recently got a 3D printer and made a stool sample for his doctor." New dad joke level = unlocked.

