

# \* 3D Printing an RC Sailboat

A presentation to the Sun City Radio Control Modelers Club

by

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# \* My Sailboat Projects

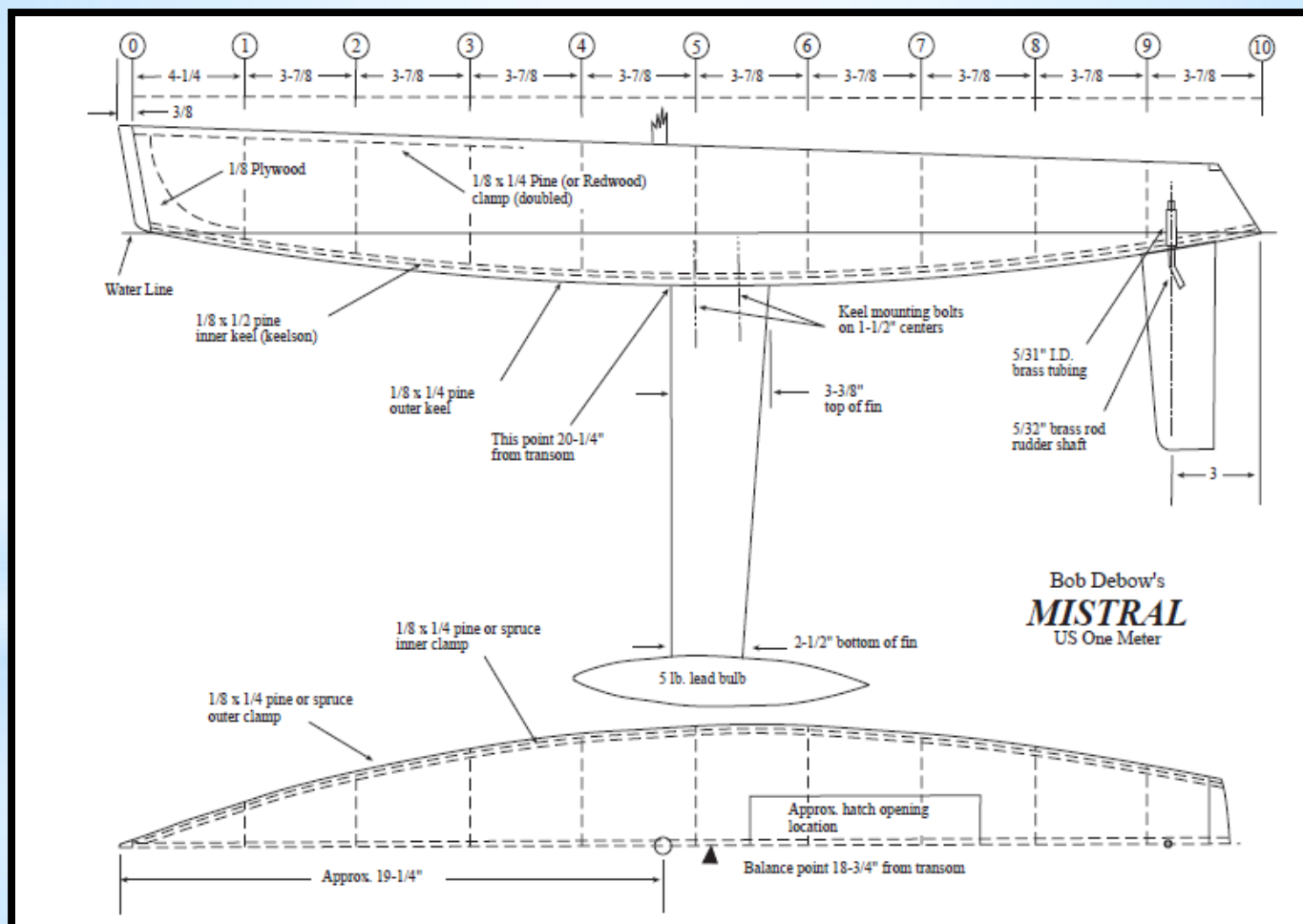
- \* It's was the fall of 2020 and I was bored with COVID and politics; or are they the same thing?
- \* I needed a winter project to keep me sane
- \* At a Sunday sailing day I saw a Marblehead 50/800 (too big) and a couple of one meter sailboats, and I liked the idea of having one
- \* A trip to the American Model Yachting Association (AMYA) website (<https://www.theamya.org/>) showed me a number of 1M sailboat classes and boat designs
  - \* The IOM class is too fussy and too competitive and too expensive
  - \* The ODOM class is too expensive for the kit
  - \* The US1M might just be my thing -- <https://www.theamya.org/boats/us1m/>
  - \* I also saw a link to a 3D printed sailboat website that intrigued me -- <https://3dprintedradioyachts.com/>

# \*Traditional Build Method

- \* In the traditional wooden boat building method a hull is constructed on a building board from balsa planks laid along formers (called shadows) that are later removed
- \* The idea is to glue the planks together edge to edge with CA while avoiding gluing the planks to the shadows leaving the hull shell when the shadows are removed
- \* The balsa planks have to be shaped and tapered near the bow and the transom to properly match the shape
- \* The hull is then covered in glass fiber or carbon fiber
- \* The shadows are then removed leaving the planking
- \* I chose to build a US1M Mistral design that I got free from the AMYA US1M website

# \*Mistral US1M Design

A US1M is between 39" and 39<sup>2</sup>/<sub>2</sub> inches long



# \* How to Build it?

\* Here's the Mistral on the building board being planked



# \*Completed Mistral



Me and my Mistral



Mistral being chased by a DF-95

# \* A 3D Printed Sailboat

The BetaSabre IOM

# \* 3D Printing Method

- \* If I managed to build myself a US1M the old fashioned way, why bother with building a boat with a 3D printer?
  - \* 1. Building a planked wooden boat takes quite a long time and quite a lot of skill, and it's difficult if you haven't done it before
  - \* 2. I bought myself a 3D printer for Christmas - actually my wife bought it for me instead of the usual collection of shirts, socks, pajamas and tee-shirts
  - \* 3. It might be easier than the traditional method
  - \* 4. It might be fun and educational



# \* 3D Printer

\* I have an Ender 3 Pro 3D printer that costs about \$200 to buy from any number of Websites



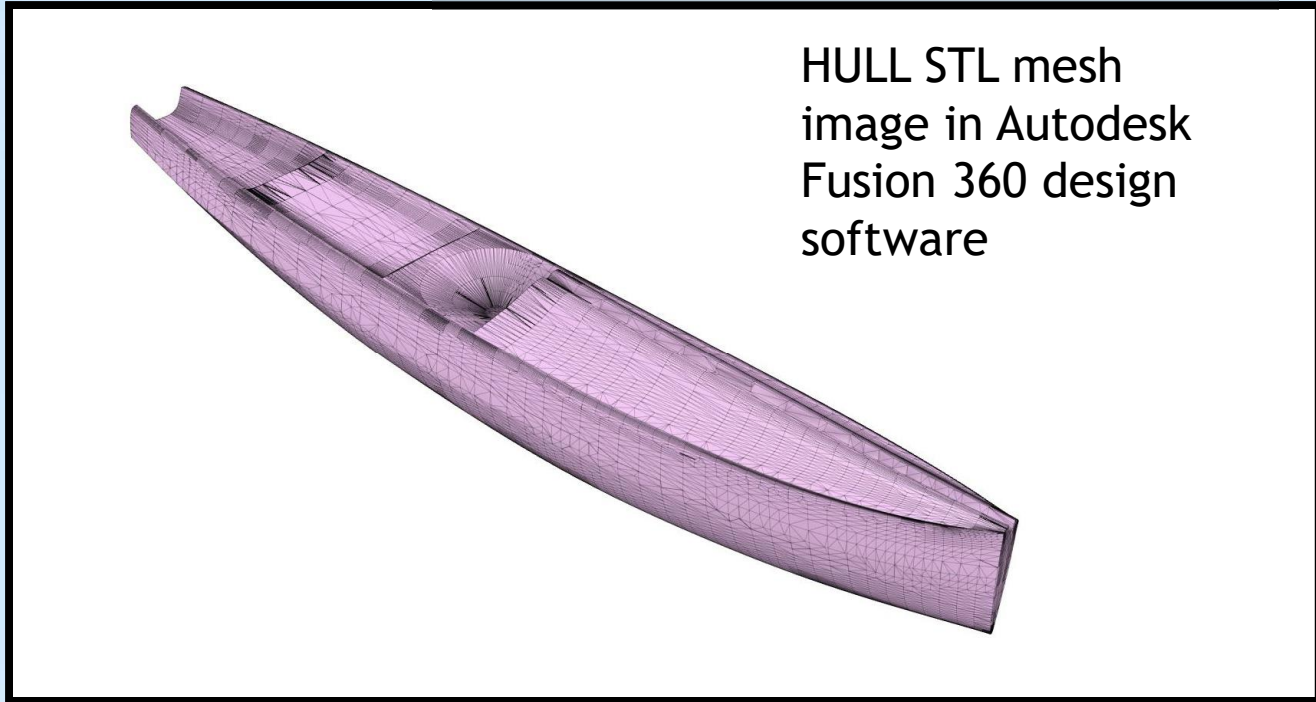
Ender 3 Pro

- \* Modeling Technology: FDM (Fused Deposition Modeling)
- \* Printing Size: 220x220x250mm
- \* Machine Size: 440x410x250mm
- \* Max Speed: 180mm/s
- \* Filament: 1.75mm PLA, TPU, ABS, etc.
- \* Input: AC 100-265V 50-60Hz
- \* Layer Thickness: 0.1-0.4mm
- \* Nozzle Diameter: 0.4mm
- \* Precision: +/- 0.1mm
- \* File Format: STL, OBJ, G-Code
- \* Max Nozzle Temperature: 255°C
- \* Max Bed Temperature: 110°C
- \* Filament costs about \$25 per kilogram (2.2lbs)

# \* 3D Printing Software

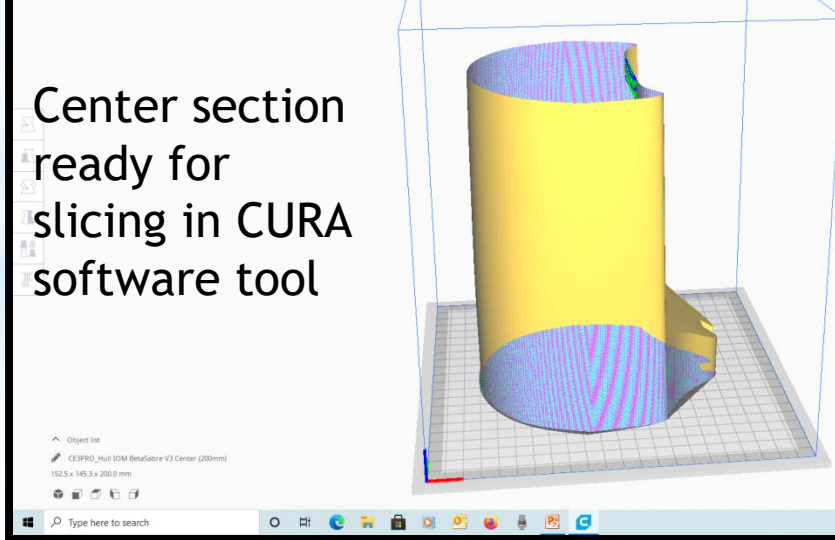
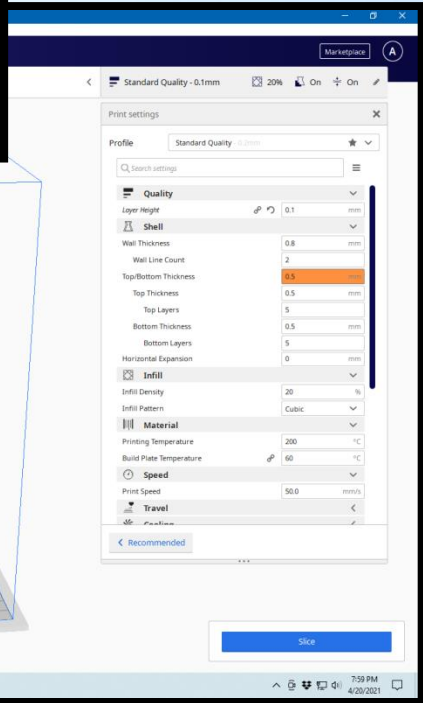
- \* I use the Autodesk Fusion 360 3D engineering design software that can be obtained for free by individual hobbyists
  - \* This software is used to design component parts
  - \* I save my designed parts as STL files that capture the 3 dimensional structure as a mesh of triangles
- \* After creating the design and saving them as STL files I use the Ultimaker CURA slicer software application to turn them into instructions for the 3D printer saving these instructions as a G-Code file
  - \* CURA takes the STL file and slices it up into the stack of layers that are used to make the print layer by layer
- \* The G-Code files are saved to an SD TF card for insertion into the printer for stand-alone printing

# \* 3D Printing Process




HULL STL mesh  
image in Autodesk  
Fusion 360 design  
software

STL  
files to  
Slicer



Center section  
ready for  
slicing in CURA  
software tool

To 3D  
Printer



Save  
G-code  
files

# \* 3D Printed Betasabre

- \* My first attempt was to design a hull for 3D printing using a traditional hull as a model but it proved very much more complicated than I anticipated - or I was too dumb to succeed
- \* I decided to search the Internet for an existing design that I could use but many of these were too expensive for my taste
- \* Faced with the prospect of having to part with significant money my Scottish genes kicked in and I started to look for no-cost designs, finding them on the 3D printed radio yachts website; I chose the BetaSabre as the one I would try to build

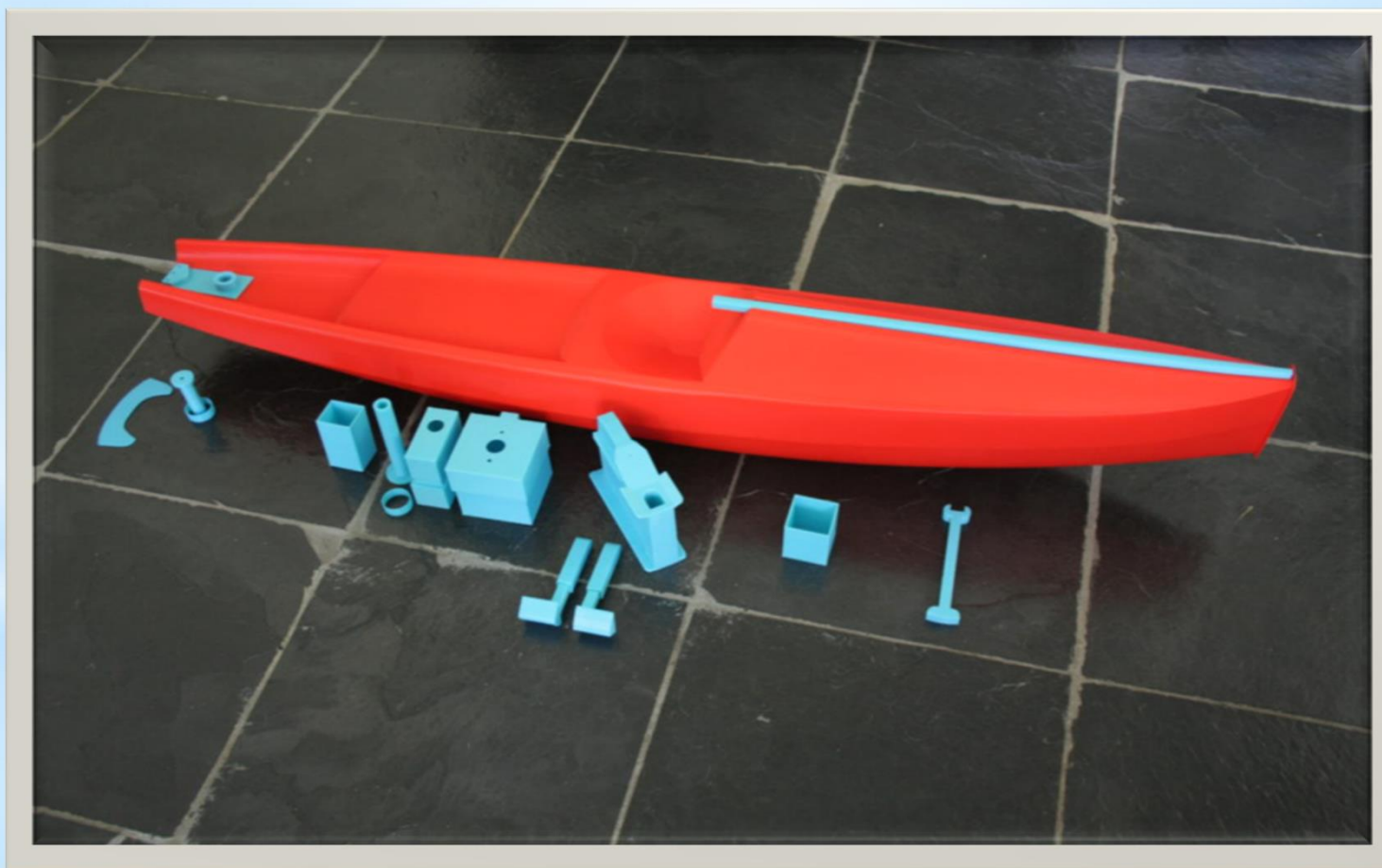
# \*The BetaSabre

3D Printed IOM RC Sailboat



# \*The BetaSabre STL Kit

The download contains STL files for the hull and miscellaneous parts

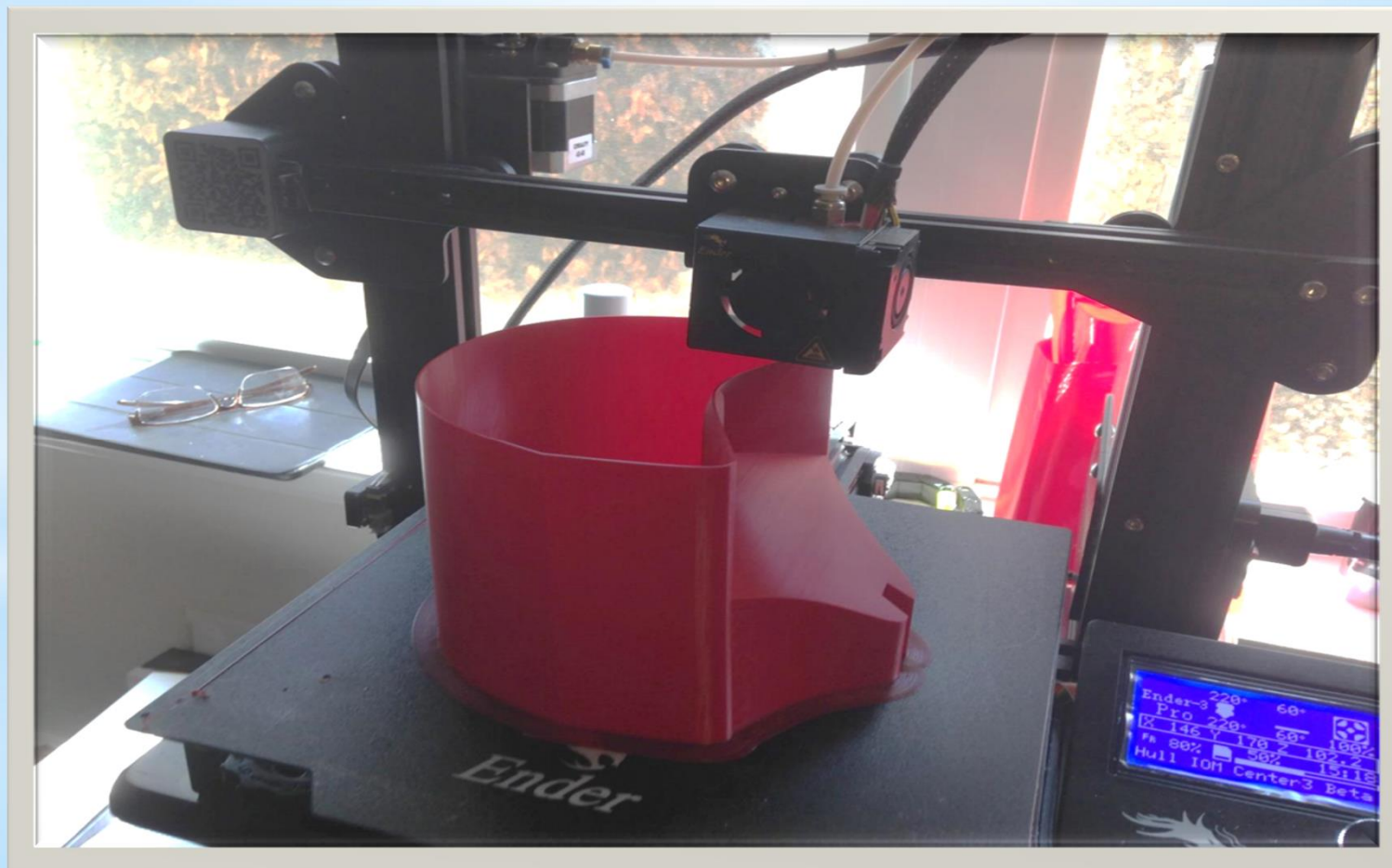


# \* 3D Printing Problems

- \* The BetaSabre was designed by Bill Hagerup (USA) and Selwyn Holland (AUS) and is available free as STL files for the hull and the miscellaneous parts and it comes with a number of instruction documents that explain how to make it
- \* The BetaSabre is 1000mm long and my 3D printer has a print volume of 220x220x250mm so the hull has to be cut up into sections to make them fit the printer
  - \* I finished up with 5 sections; the bow, forward section, center section, aft section and stern section
  - \* Each of these were printed separately then glued together using sleeves that fitted the joins
- \* The sections were printed vertically on the printer in a modified vase mode
- \* I had hoped to use the natural finish of the 3D print as the finished product but I finished up with so many epoxy drips and drops that I had to remove them, sand out the blemishes then paint the hull

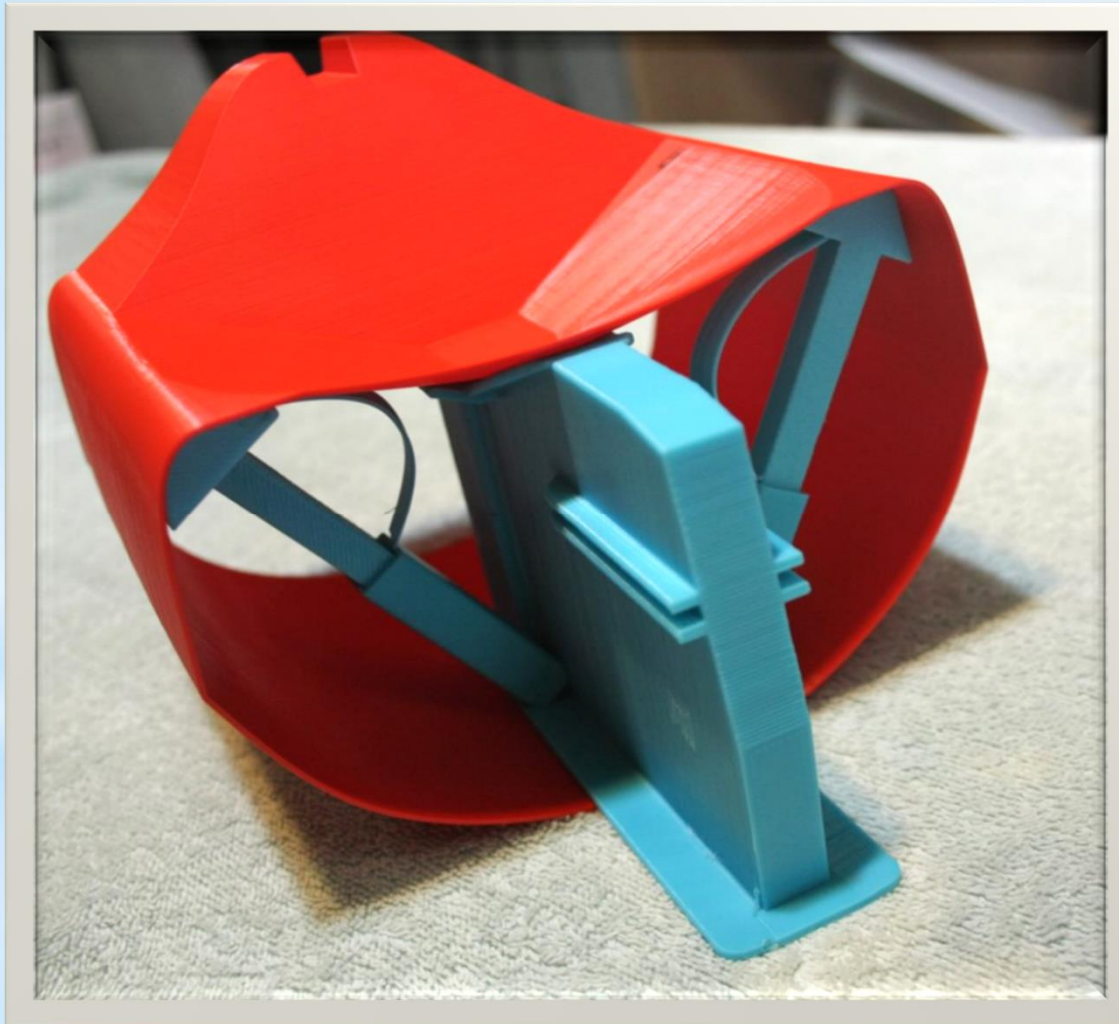
# \*Center Section

Printing the center section using PLA+ filament on my Ender 3 Pro  
If you look carefully you will see the nozzle temperature is 220°C,  
The bed temperature is 60°C and the extrusion speed is set at 80%





# \*Inserting the Keel Box

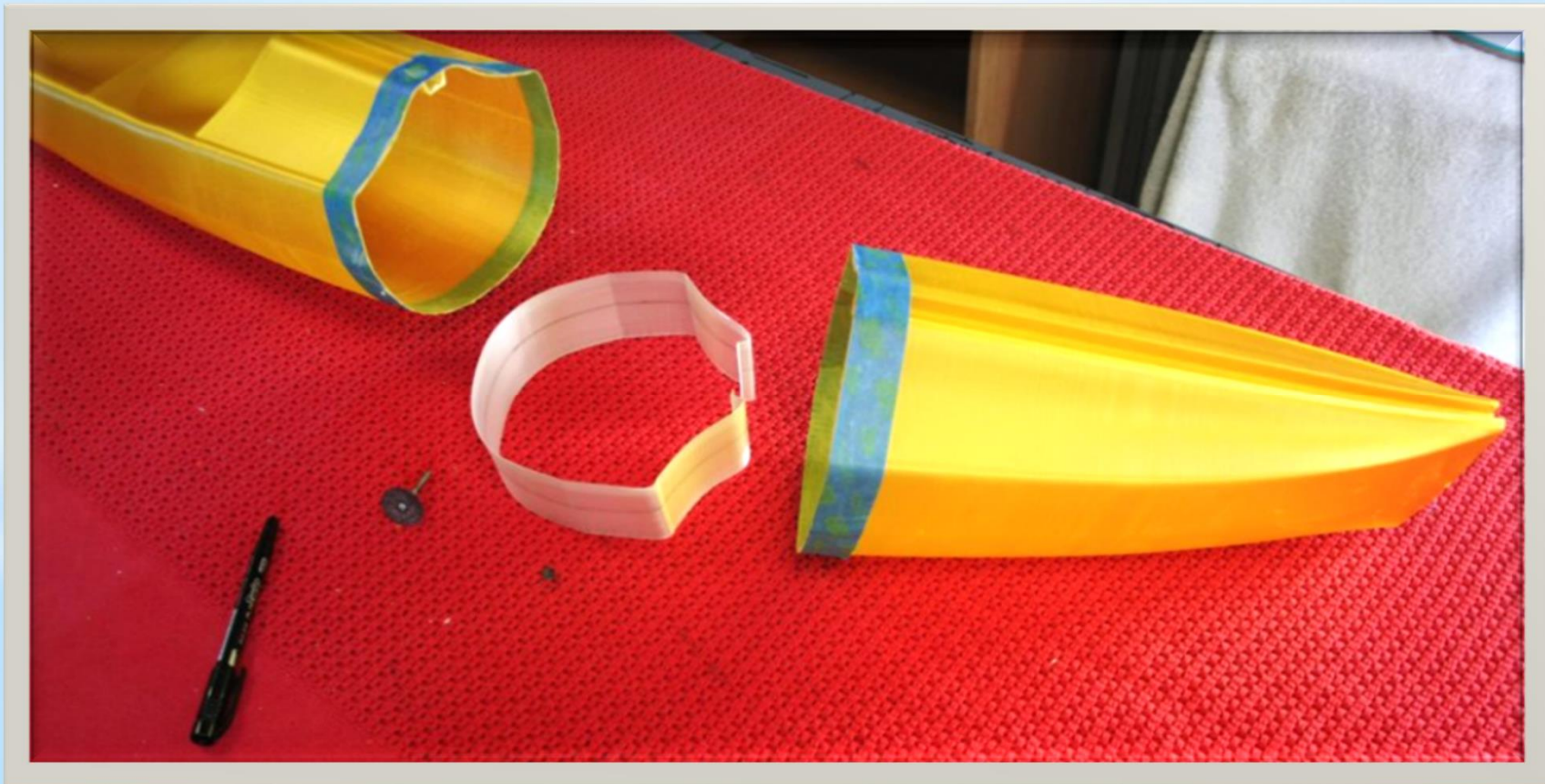


The keel box mounts the keel fin and the mast. It is the major internal structural element inside the hull and is epoxied in place.

Other components internal to the hull are the servo mounts and mounts for the battery and for the receiver.

# \*Joining the Sections

The sections of the hull are joined using 3D printed sleeves. I used epoxy but encountered lots of drips, runs and fingermarks - annoying!



# \* Construction Problems

## \* Hull Cracking

- \* While sanding the hull preparatory to painting, the forward section cracked between layers forcing me to fiber glass the hull bottom to seal it from leaks



Examination of the location of the crack revealed that it occurred at a weak layer where the filament had run out and been replaced with a new reel. Lesson: load enough filament to complete a print

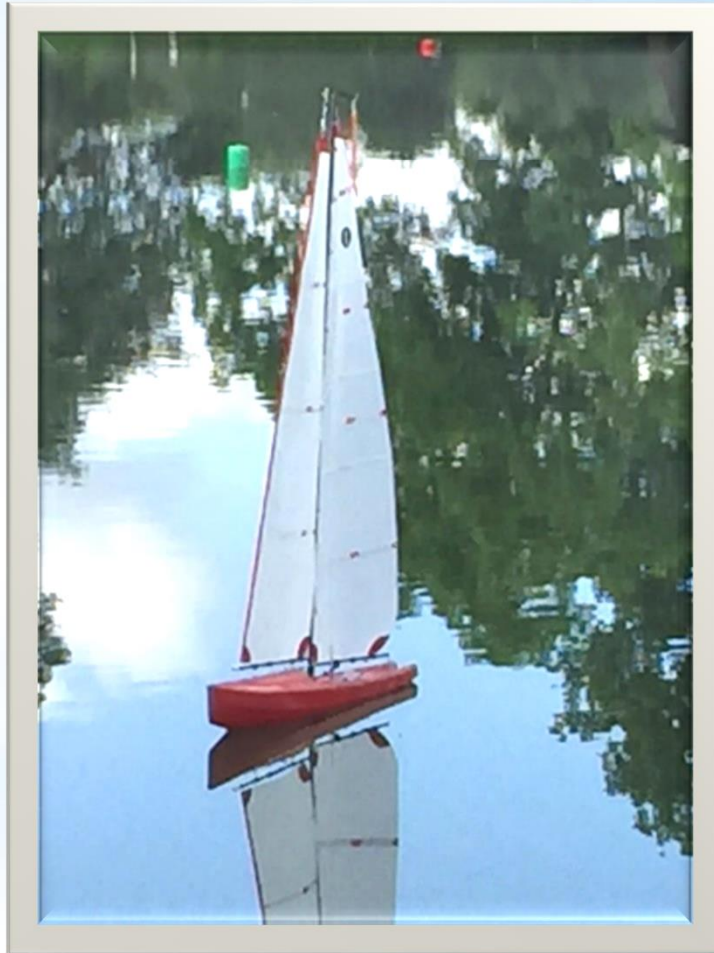
# \*Sanding and Painting

- \* After applying fiber glass to the hull it was sanded and sprayed with primer preparatory to being spray painted with enamel



After fiber glass and sanding before priming and painting

# \* My Finished BetaSabre



\*The End

Questions?