PRINTING REPORT

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mag. ing. mech.

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1 BOWSPRIT

One of the first ever 3D printed parts created at Velum Nautica is finally completed. A 3D printed bowsprit model was reinforced with fiberglass and later on was painted and coated on top with teak as shown in the pictures below. Whole part was structurally tested to validate it can withstand the needed force of approximately 300 kg.

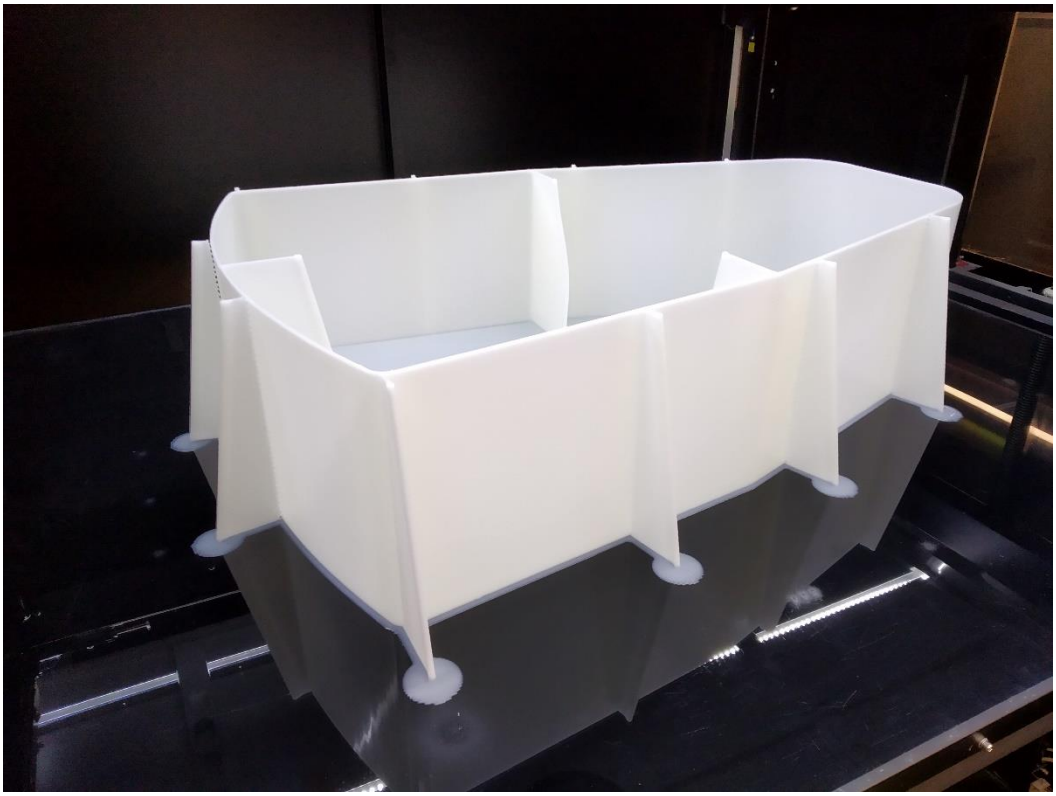

Figure 1.1. 3D printed model of the bowsprit

Figure 1.2. Reinforced part

Figure 1.3. Top teak coating

2 EXHAUST COVER

A request to create the symmetrical exhaust cover was received. Original right exhaust cover has fallen off the vessel during one of the sails and has not been recovered.

This job was very time sensitive as the part could only be installed on the ship once the vessel is outside the sea. Whole part needed to be finished in just 4 work days.

In order to create the missing part, left exhaust cover was taken off the vessel and was digitally scanned. Scan was then post-processed and a CAD model was created from it. From this CAD model a mirrored model was created and some support has been added in order to print the part more easily. Printing took 3:35 hours and it used 4 kg of material.

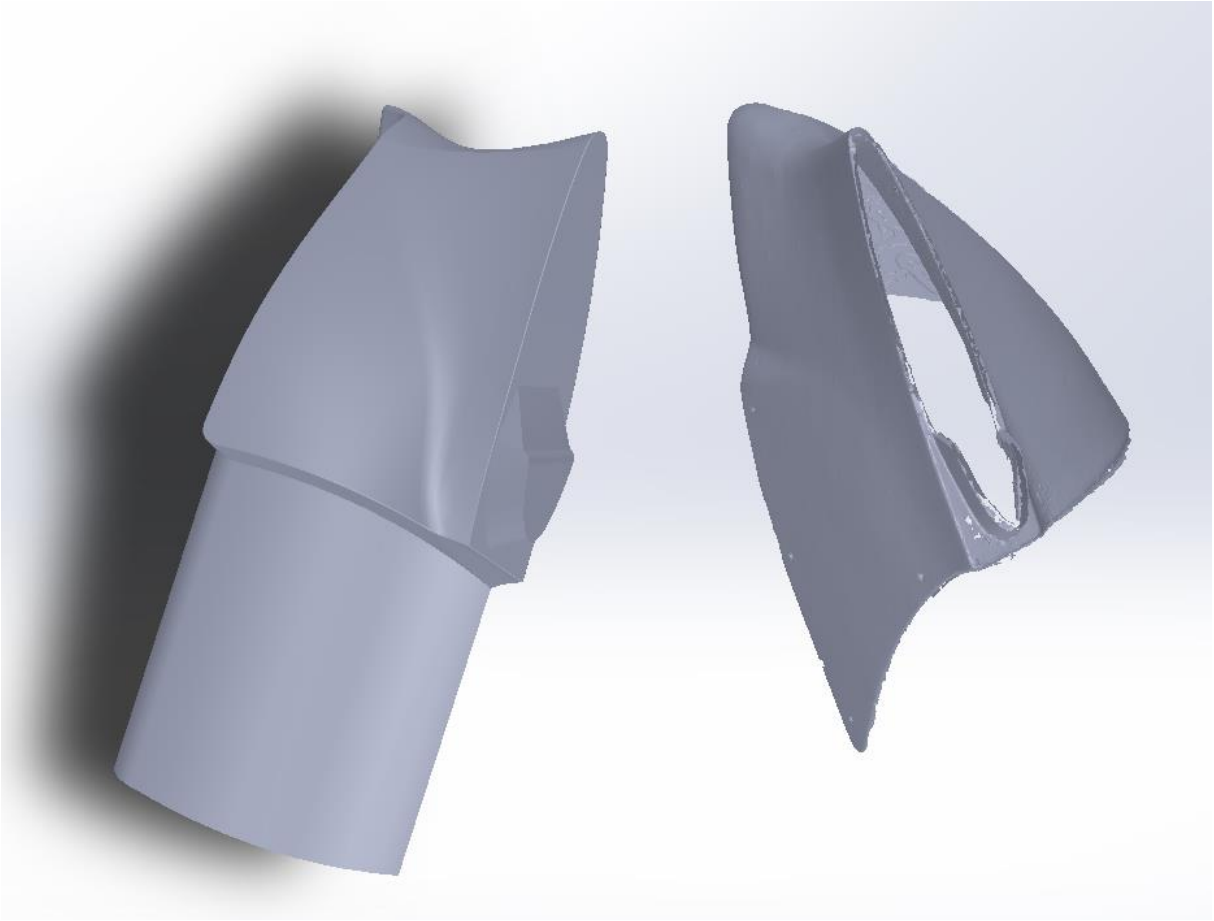

Figure 2.1. Mirrored model and 3D scan

Figure 2.2. Original Left side and 3D printed right side with supports

After printing the part and doing a double check of dimensions, part was then reinforced with fiberglass and support was removed. After this part was post-processed with body filler and it was painted in combination of white and black color to match the color scheme of the vessel.

Using 3D scanner and Massivit 3D, the whole process was tremendously shortened than using traditional ways of cutting the model from polyurethane. With Massivit part was perfectly symmetrical to the original left exhaust cover.

Figure 2.3. Fiberglass reinforcement

Figure 2.4. Removed supports from the part

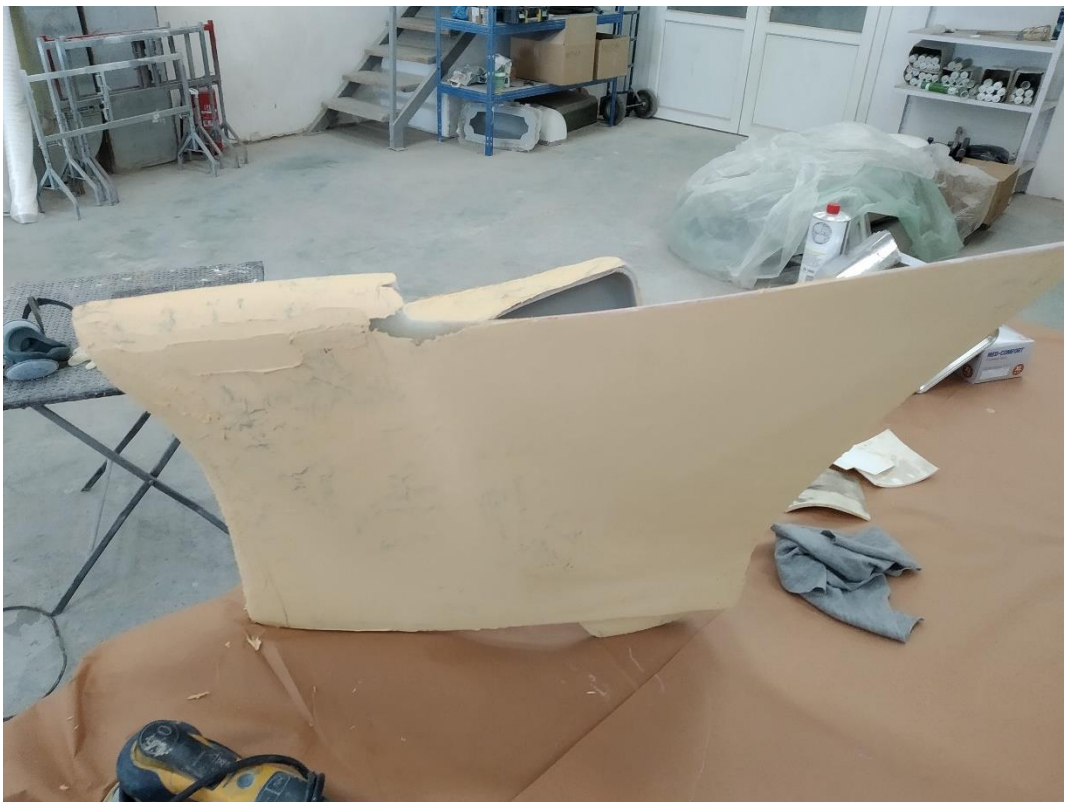

Figure 2.5. Coating model with body filler

Figure 2.6. Painting preparation

Figure 2.7. Test fit of the part

Figure 2.8. Finished and installed product

3 RADAR MAST 1

A customer wanted a radar mast that would fit his vessel in terms of both design and functionality. Since there were no strong design limits, the model was drawn in such way so that there were no supports needed and the whole mast could easily be printed in single piece.

Whole part was printed in just 2 hours and it used around 2 kg of material.

After printing was finished, guides for cables were inserted and part was reinforced with fiberglass and filled with strengthening foam from the inside. The usual coloring preparation and coloring followed.

Figure 3.1. 3D printed part

Figure 3.2. 3D printed part placed in instalation position

Figure 3.3. Cable canals, foam filled and fiberglass reinforced part

Figure 3.4. Part prepared for painting

Figure 3.5. Final product

Figure 3.6. Final product installed on the vessel

4 RADAR MAST 2

Somewhere in the middle of process of working on “radar mast 1” part, a new customer noticed the part and wanted exact same radar mast, but designed so it fits his vessel. Customer also wanted a place for a radar light on top of the radar mast so the model was redesigned accordingly.

The part has to go through the same process as the other radar mast. This part however is not yet completed fully.

Figure 4.1. 3D printed part

Figure 4.2. Cable canals, foam filled and fiberglass reinforced part

Figure 4.3. Preparation for painting

5 HARDTOP 1

A customer wanted a hardtop for a vessel that is very popular here in Croatia. Because of this it was decided that the mold for the hardtop will be created using Massivit 3D for one section. This was first time that we have been using the printer for a relatively thin but long and wide part.

When creating the hardtop mold, 3 technologies were combined together. Wood was used to create bottom part of the roof, polyurethane blocks were cut and modelled to create side curves to match the curves of the vessel and Massivit was used to create a central part that was a basis for the whole model.

During printing we established that the printing took too much time and part was too thin, so that the inner force between layers teared the corners of the part from the bed which later created problems in the upper layers.

Figure 5.1. Creation of bottom wooden part of the mold

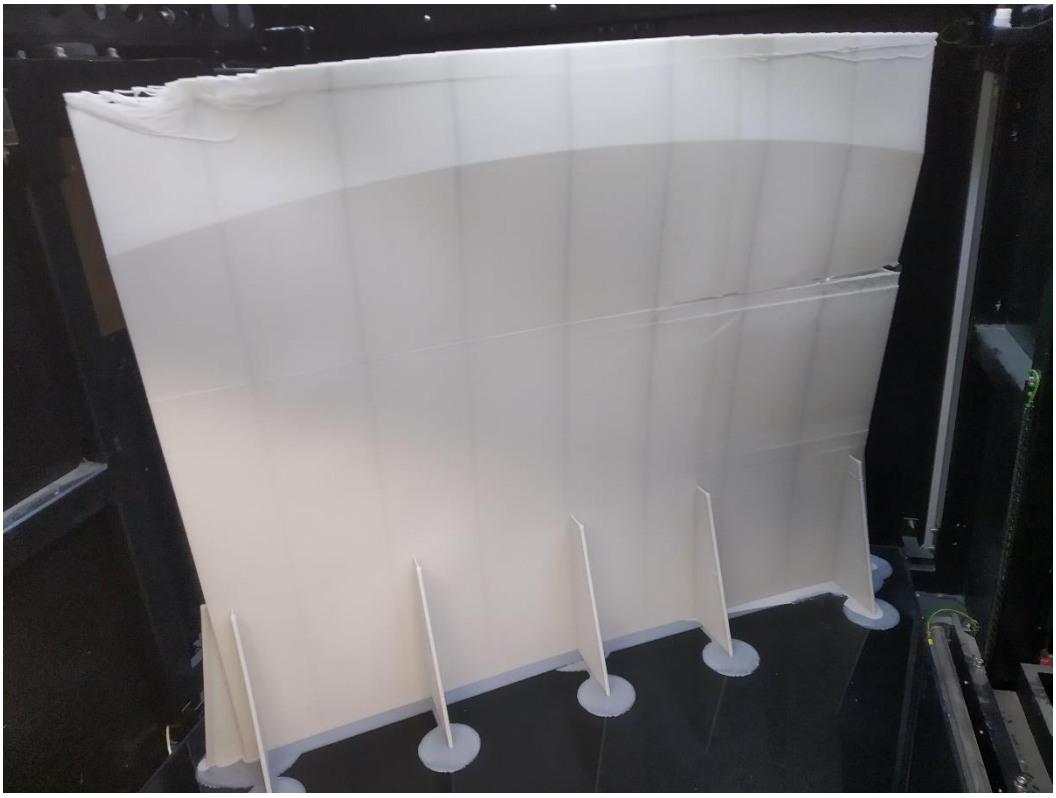

Figure 5.2. 3D printed part

Figure 5.3. Printed part positioned

Figure 5.4. Creation of sides

Figure 5.5. Half fiberglass reinforced roof mold

Figure 5.6. Polished mold

Figure 5.7. Final fiberglass creation from mold

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Figure 5.8. Finished hardtop

6 HARDTOP 2

After tests done on the earlier created “hardtop 1” part, it was concluded that if smaller sections were printed when the part is so thin, we will encounter less problems. This has proven to be correct as we did not have as much force between layers that would cause bed separation on the corners.

This part was also used to test how fluidity of the material affects the final part as well as how does position in which part is left after printing affects the final part. We found out that we could save on material for such part (we don’t need to use thicker wall to achieve same firmness) if we open the material bucket earlier and leave it on air outside but not under sunlight. By doing this material gets a bit more viscous as it cures itself but just enough to have better printing capabilities. We noticed we could print overheads much better with such partially cured material. We also noticed that part is not fully formed right after printing, so for example some parts of this project we left for 4 days after the printing in horizontal, and some in vertical position all without supports. Parts that have been left in horizontal position have been deformed from own weight. However, this deformation was much less noticeable on the part that had material that has previously been partially cured with method described above.

This project is still in process.

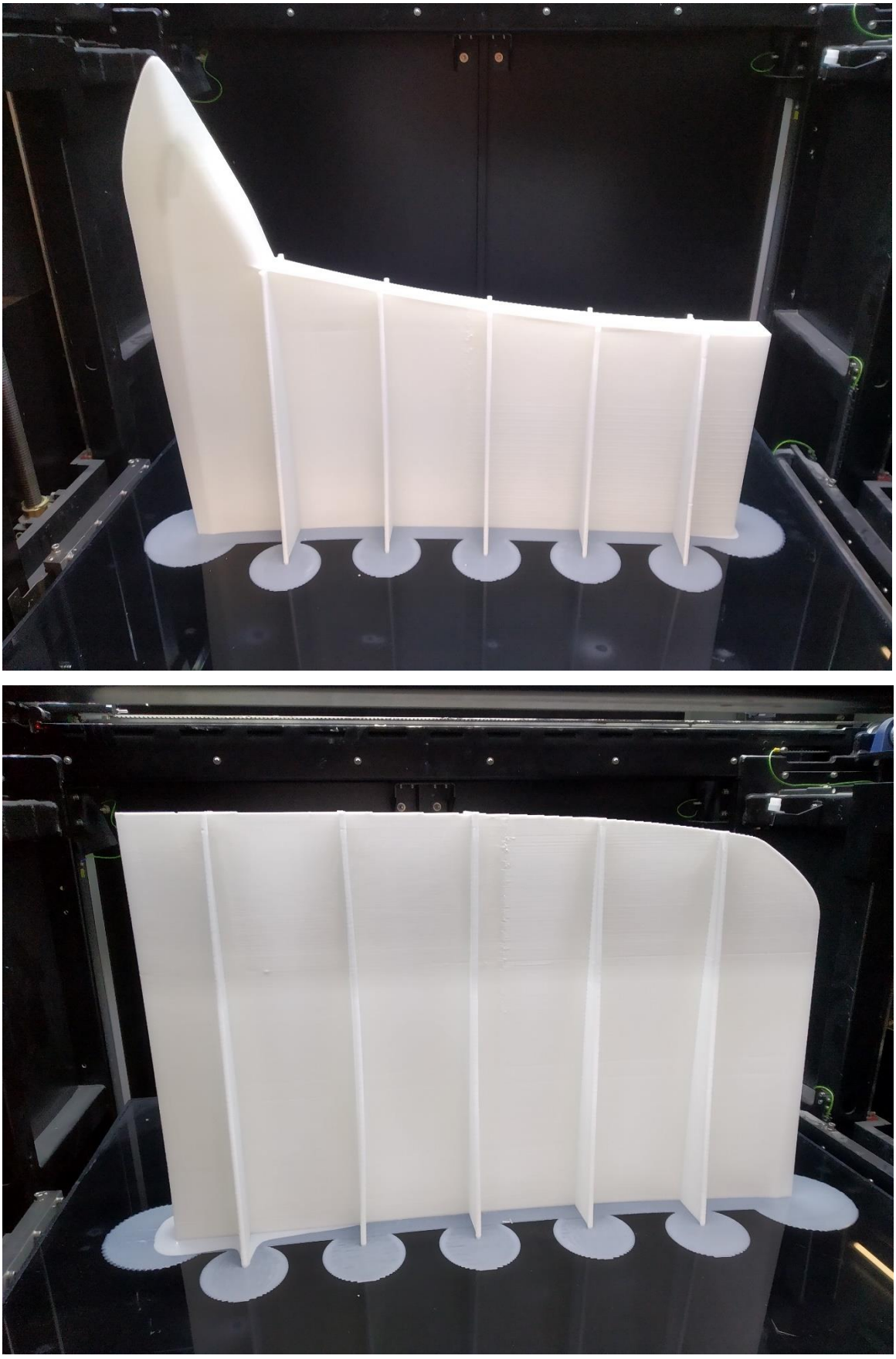

Figure 6.1. 3D printed parts that together form half of hardtop

Figure 6.2. Parts positioned before connecting

7 MODEL OF TOWNSHIP

Model of township Medulin here in Croatia was requested by a customer. Model requirements were that it has ground plan with dimensions of 2 meters by 2 meters. Whole model was created with combination of Massivit 3D printer and FDM 3D printing for smaller parts.

In order to create a proper model, from online maps a terrain has been exported and adjusted so that the printing would go as smoothly as possible. Since the model is of wider terrain to housing ratio and it consisted of several smaller towns, only parts of towns were symbolically created and some special structures were 3D printed on smaller 3D printers. Spots for pressable buttons were also preplanned and prepared in the 3D model. Whole part was divided in 4 parts where each weighted around 10 kg including supports and took around 12 hours to print in Normal Mega quality. Everything was later on connected and painted.

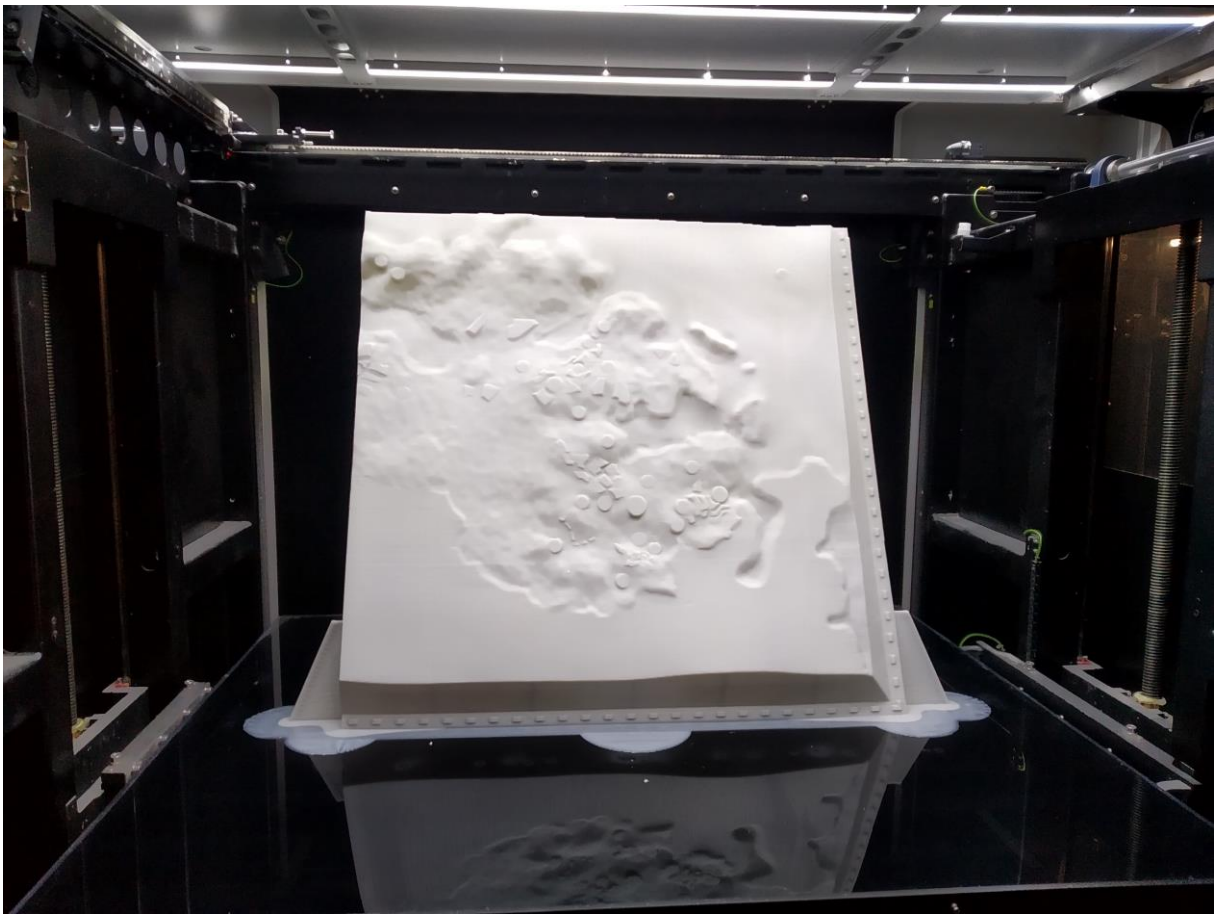

Figure 7.1. One 3D printed section out of four

Figure 7.2. Two sections set near each other

Figure 7.3. All four sections positioned near each other

Figure 7.4. Final finished and painted product

8 DOLPHIN STATUE

A customer wanted a dolphin statue that would be installed near a pool. A smaller handmade statue was found then scanned and finally redesigned as it was in rough shape and it required a lot of fixing of the model in order to make it better on bigger scale. Model was also adjusted so that the printer has as less problems with it as possible and lower number of supports is needed in order to print it out. After printing, model was filled with strengthening foam and painted from the outside so that it resembles to a handmade model from stone.

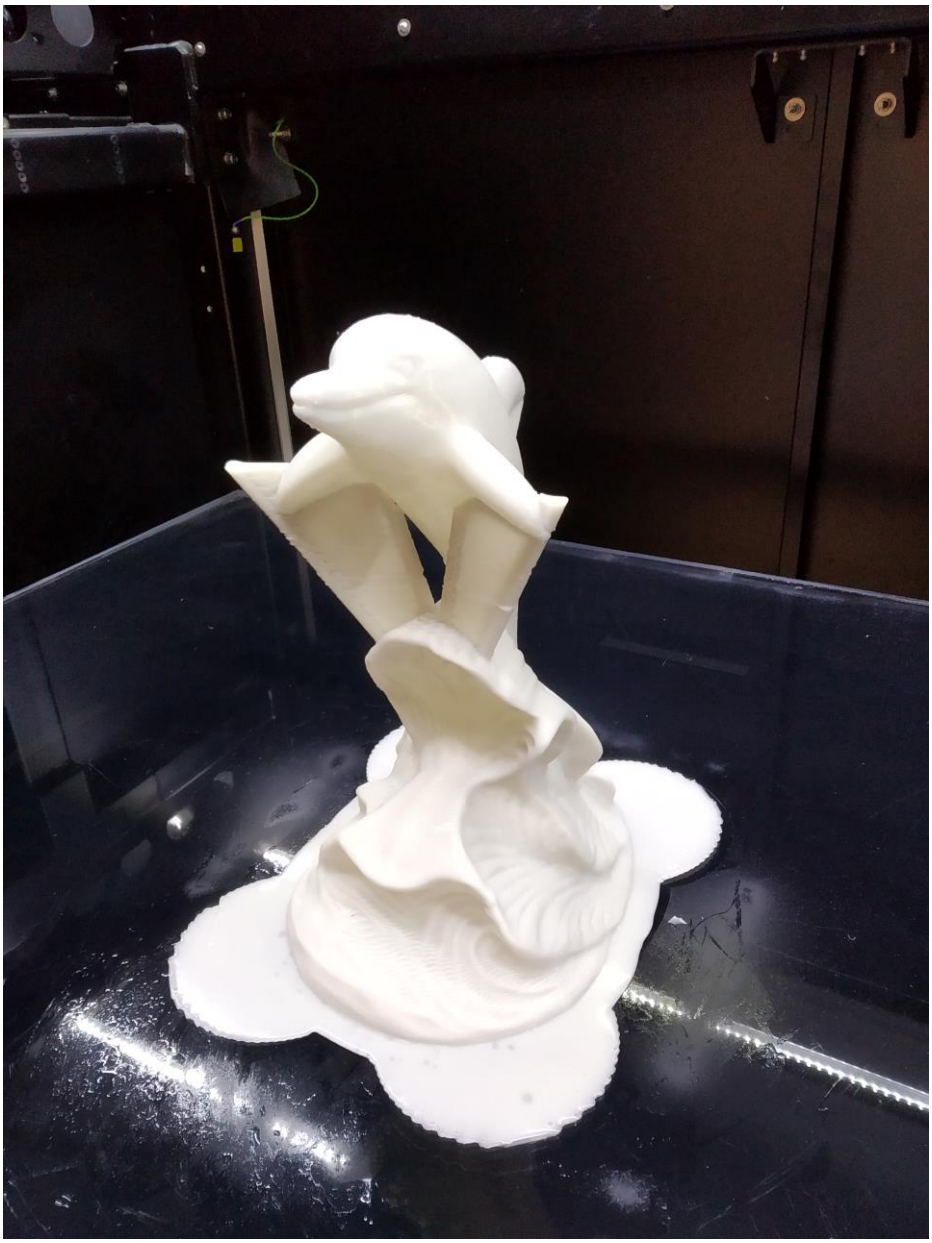

Figure 8.1. Printed model

Figure 8.2. model with removed supports

Figure 8.3. Model with removed supports

Figure 8.4. Painted part