

TECHNOLOGICAL AND CONSTRUCTIVE CONSIDERATIONS ENVISAGED IN THE CONSTRUCTION OF A 3D-PRINT RIM FOR ROBOTIC SYSTEM

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ABSTRACT: In the paper it is made a study in which are analyse the generation, 3d printing and testing at compression of a rim for robotic system. For the CAD solution, there are generated two type of rim to study the mode of generation, but also the difference from the geometric pointe of this generated elements. Taken into consideration the time of printing, but also the modification of the medium temperature in the printing chamber for day to night the author of the study made a modification for printing machine. For testing the printed rim it is made an compression press with which it is possible to study bout the deformation of the rim but allow the modification of the dimension of the rime in different situation in compression situation.

KEYWORDS: rim, CAD, CAM, 3D printing, PETG, compression

1. INTRODUCTION

There are several ways to make a rim for robotic systems, from making it entire dependent on the human factor to making it almost completely with automatic machines [1]. In the study undertaken, two types of wheels were designed and carried out by 3D printing. The only difference between these is the

thickness and the place where the spokes are placed on the rim barrel. The difference between them can be seen in figure 1. The main reason behind the design decision was to see how the grip of the spokes, their thickness and some constructive parameters influence the actual resistance of the rim.

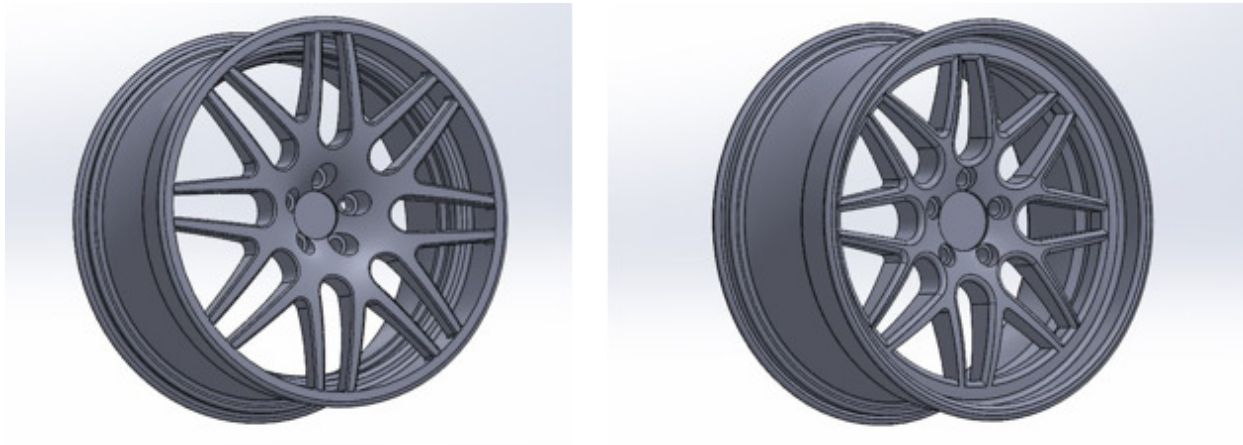


Figure 1. Rims solution for robotic system

From the point of view of the design part, it was made in SolidWorks [2] and started from the cylindrical part whose profile is shown in figure 2 and subsequently the spokes were generated on the principle of generating the gap between the spokes and multiplying it circularly after the axis of the hub of the wheel figure 3. In the end, the rim clamping orifices and its centring surface were generated on the drive side. It should be shown that both wheels have the identical cylindrical part the only difference as mentioned being that of the geometry of the spokes

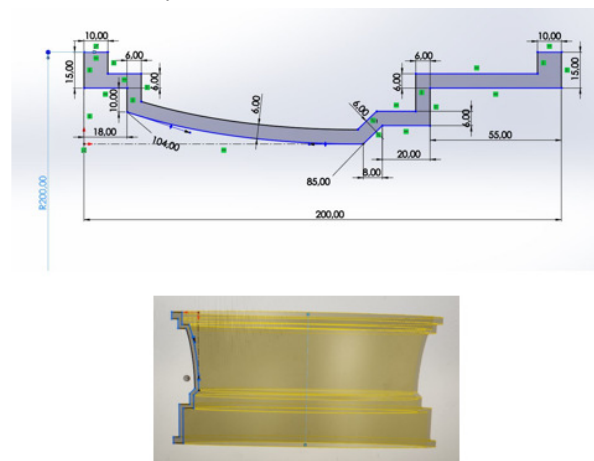


Figure 2. Cylindrical structure for rim

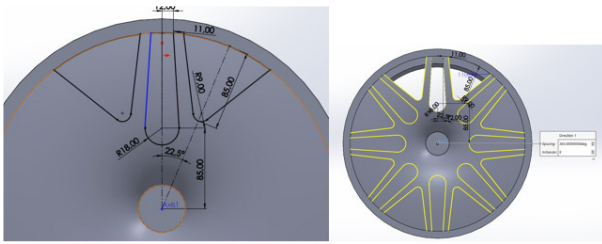


Figure 3. Gap made in rims for robotic system

After the CAD design, stage of the rims has been passed to the stage of preparation of the space in which 3D printing will be performed, but also to the specific stages of positioning and respective generation of the support structure of the parts that will be generated by 3D printing. Designed wheels can be used either directly or as a model for casting their aluminium.

2. CONSIDERATION ON THE PRINTING SPACE

Both wheels were printed on a 3D printer from the firm Artillery [3]. The model is Sidewinder X1, this is the semi-professional printer with Volcano [4] nozzle with the acceptance of wires with diameter of 1.75mm and Tornado extruder drive with a step-by-step engine. This have in the superior part an adjustable grip system for wire roller and a sensor to pass the wire through it. The enclosure in which the printer was inserted is of thermally insulated type, to constantly control and maintain the internal conditions of the print space during the printing time figure 4 [6].



Figure 4. Printer inside the thermal enclosure

The thermal process can be controlled with a temperature thermistor. The enclosure is provided

with the possibility of ventilation of the internal space and visualisation of the printing figure 5.



Figure 5. Enclosure with glass for visualisation

The ventilation is made by open the upper part of the thermal enclosure figure 6, and tracking the printing process through the screen at the front.



Figure 6. Thermal thermistor

3. CONSIDERATION IN THE GENERATING CAM PROGRAM FOR 3D PRINTING RIM

After CAD rim generation in SolidWorks this are save in a stl (Stereolithographic) form and imported in the Ultimaker Cura [5] software for generating the layer structure. It was positioned with spokes at the bottom to save the amount of material, because the position in which we put the object to print has a major influence on the amount of material used in the supports, but also at the same time the printing time. The goal was to save time and reduce costs without altering the construction and strength of the piece. This position is the most optimal because the holes can print in circular form while in another position we could not have reached this shape figure 7. For the generation of layers taking into account the mechanical resistance, but also that at temperature of their use was opted for a PETG type material [7], and

the density of the layers was 60% with a height of 0.2 mm. The diameter of the extrusion nozzle is 0,4 mm [8,9].

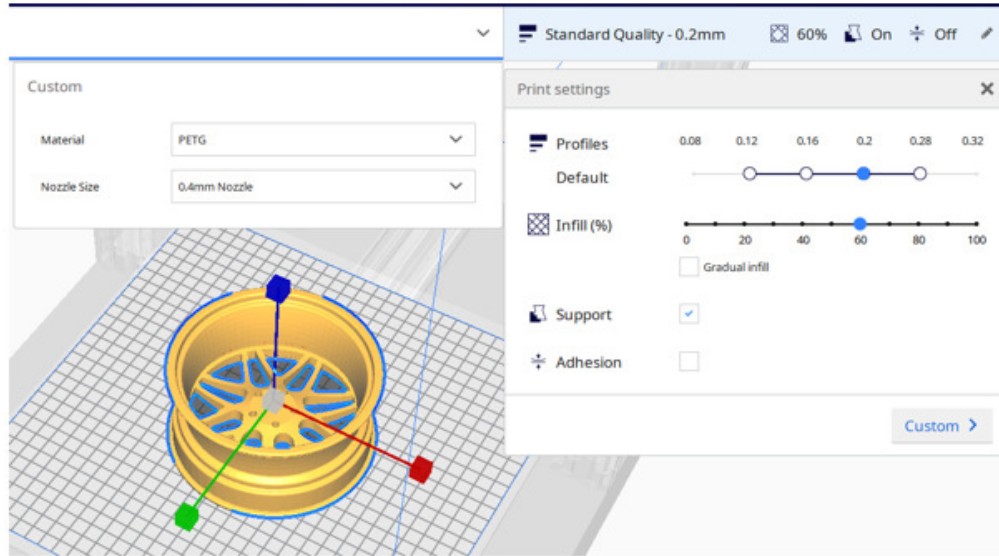


Figure 7. Rim position on slicer system

These settings were also considered as an aspect of the quality of the surfaces generated by 3D printing figure 8. It can also be seen from the analysis of the time estimate that the longest duration is for the interior walls and respectively the generation of supports. The length of time with the chosen settings is 1 day and 3 hours, which comes to demonstrate once again the usefulness of the thermally insulated enclosure for the realization of the rime layers.

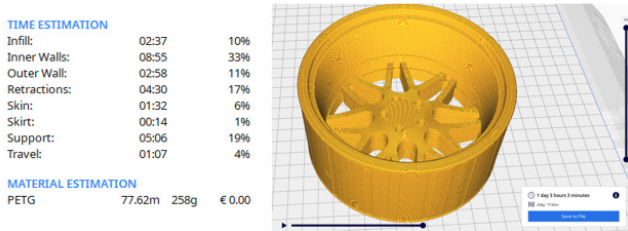


Figure 8. Estimate time and overview generated CAM

4. CONSIDERATION ABOUTH THE 3D PRINTING PROCESS

The first important aspect take into consideration was that the temperature in the enclosure must be 36 degrees Celsius, which required in the first phase to wait 25 minutes until the temperature of the enclosure was reached. The printing process was carried out as can be seen from figure 9 at a temperature of 245 degrees Celsius on the extrusion side and 85 degrees Celsius on the heating side of the printing table.

After the printing process was carried out, the support was removed figure 10 and then where it was necessary is made a grinding process for a better surface.

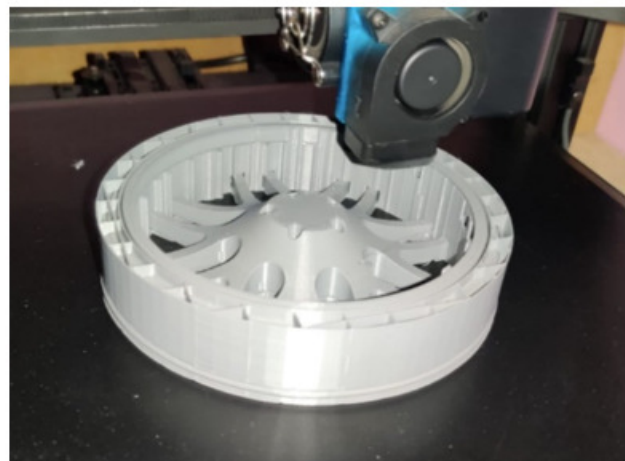


Figure 9. Printing process of first rim solution at left and 70% of rim printed at right



Figure 10. Left the printed rim and right the process of remove the supports

For made the validation of the 3D printing process the wheels made were tested at compression on a check stand made after a conception of its own presented in figure 11. For compression resistance testing the load was carried out with weights with precisely determined mass and the displacements were measured with a universal calliper with precision of 0.05 mm. The measurement was carried out on the two areas arranged by the length of the device in the median area of this.

The measured values were centralized in an table. Based on this data was drawn the comparative graph front and back of the deformations figure 12.

It is possible to observe that during loading process on the spoke side due to the distance from the point of contact and measuring the distance the value of deformation have a different variation. This is greater on the part without spokes where the tendency is to

increase the value of displacement, and on the other side one visibly to reduce the distance.

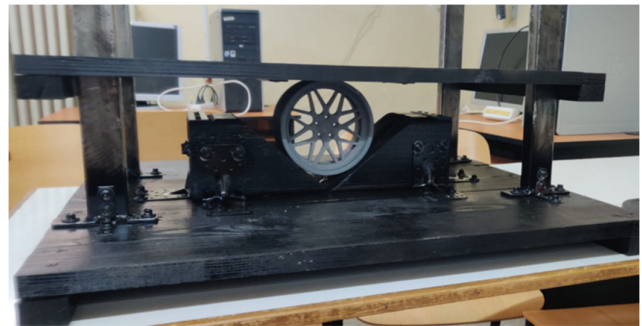


Figure 11. Position of rime for compression testing

The maximum weight at which the check was carried out was 97.2 kg figure 13.

In figure 14, it is possible to observe a load force of 40 kilograms.

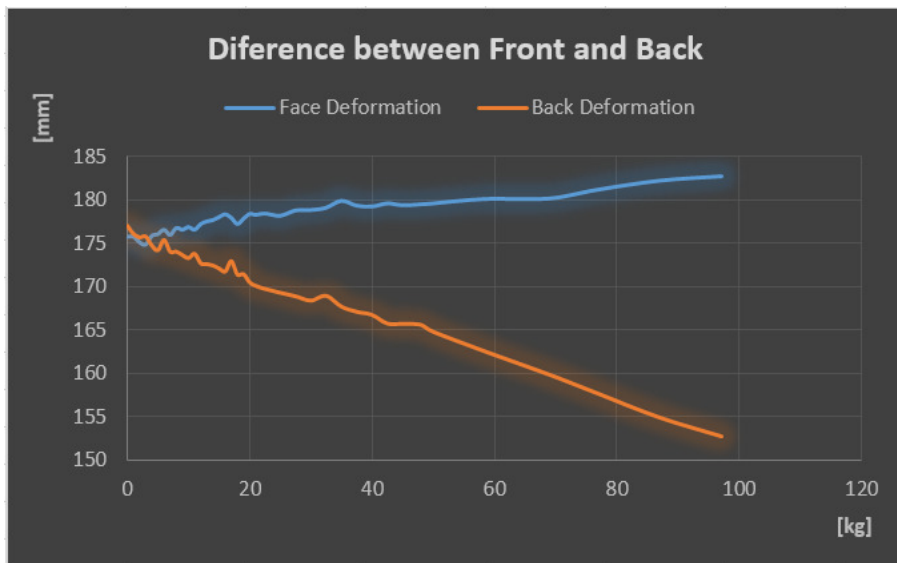


Figure 12. Graphic front and back deviation



Figure 13. Rim loaded with 97.2 kilograms



Figure 14. Rim loaded with 40 kilograms

5. CONCLUSION

From this study, it is possible to observe that the compression testing offer important information in the 3D printed rim process. Based on the study it is possible to extend the conception of rim and made testing for the optimum solution for 3D printing process.

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