

Diploma Thesis Review

DT Author : Machris Ruben John Dias

DT Title: Design of the Printing Head for 3D Printing from the Concrete

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Presented diploma thesis is aiming to the application of 3D printing in the construction engineering especially a concrete product additive manufacturing.

Theoretical Part:

Text is divided into two parts: Theoretical one and practical design one. Currently used principles of 3D print are described in the chapter one just after explaining the basic terminology. Author himself has suggested a term “additive manufacturing” instead of 3D printing. Those manufacturing principles add the material from zero to the final result apart from the conventional manufacturing (machining) where material is removed from the raw semipart. The four main principles are presented in the second chapter: stereolithography, FDM, selective sintering and inkjet powder printing. Each method is described briefly and clearly using text and simple 3D scheme for better understanding. Stand-alone part of the second chapter is dedicated to concrete 3D printing. Author mentioned a quite long history that goes to the sixties of the last century and added also some interesting examples. Two methods are presented in more details:

Contour Crafting, method that uses angled trowels for concrete shaping. The path is automatically controlled by a robot. Author shows also a sample of the real usage of this method. Nevertheless I mean that the description should be accompanied with some principle drawing or scheme for the better understanding of the principle (as it was done in previous chapters). It is hard almost impossible to understand the principle from the text.

Second method is concrete extrusion from the shaped nozzle. As the example the continuous extrusion of the pavement is presented.

In the third chapter author is attempting to map a real usage of the concrete additive manufacturing. He complains that there is a shortage of information and method is still neglected although from the point of view of the strategic development of human population this method is very promising. He feels that the reason is the fact that construction industry was always considered as “manual force” one. Nevertheless he presented six successful samples of the companies that were able to use this principle in different construction branches. The most interesting one is a Chinese company Winsun that uses very progressive process to build a quite large buildings with the area about 200 m².

The possibility of building of the Lunar and Martial colonial constructions at the end of the third chapter is a little bit far away of preceding real world samples ... but maybe the future development will surprise us soon...

Design Part

Author starts the design of his printing head in the fourth chapter. He describes the principles of the head in the preamble. It is compared with the heads used for the different materials. Author defines a set of functions that the design has to fulfill: replaceable nozzles for an extrusion, material mixing and reservoir, maintaining a constant flow and concrete shaping. Again he points out that there is only a little information available. He has not hesitated to contact foreign researchers and asked them for the assistance.

The 3D model of the head and nozzle is presented in the third part of the chapter four. Three parts and their principles are described: trowel shapers, nozzle and mixing auger. Consequently two variants are proposed: simple head with a circular section of the nozzle and swirled rectangular nozzle. The integration of the head into carrying mechanism is very roughly outlined at the end of the chapter four.

Whole fifth chapter is dedicated to the description of concrete features and properties concerning the extrusion.

Author proposed the design and build of the heads (both variants in the scale 1:3) using university 3D printer. ABS as the material has been selected. The most interesting part is the device trial test. Some troubles with the concrete extrusion are presented. The capacity and axial force calculation are added to the description of the test. Maybe those calculations should be done during the design before the model building.

The comparing of both variants are introduced in the chapter seven. Both solutions have their own advantages and disadvantages. So it is quite difficult to decide about the best one. Author himself support the second one. On the other hand he admits that the tests were not very extensive.

Seven points suggested for the future development and device improvement are expressed at the end of the chapter seven.

Summary

The thesis is well structured and formally shaped. The requirements of the assignment were fulfilled.

The problem was solved using more or less try-fault principle instead of exact calculation. On the other hand this is a new field with a shortage of information and real solution should need many more experiments and much time.

Text is in the formal way on a fine quality (except of the duplicate numbering of the chapter 3.2). Grammatical and expression level of the language is very good.

I mean student has presented a good knowledge and skills and I recommend this thesis for the presentation at the state committee.

Questions:

- 1) Why are parameters calculated after the test ?
- 2) What is the „axial force“ ?

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Diploma thesis evaluation

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Presented by Diplomant: Machris Ruben John Dias

I rate as „very good“

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