Reflection

How is your graduation topic positioned in the studio?

The topic of this master thesis is the use of wood in a 3d printing technique. The master study Building technology teaches people how to design, build and maintain building related products, buildings or even civil projects such as bridges. One of the main pillars within these study topics is sustainability and it is worldwide more and more seen as a common standard. Tools such as computational design skills and 3d printing are an upcoming technique and are more and more used to design and build something. Where additive manufacturing was seen as a tool only for prototyping, nowadays it is used for manufacturing of small product batches. Compared to traditional production methods, additive manufacturing is a process with a low amount of material spill and is therefore considered to be sustainable. Where traditional methods remove material to shape a product, additive manufacturing only adds the necessary material to get to the final desired shape. As mentioned before, this master thesis is about the use of wood within an additive manufacturing process. Within woodworking, enormous amounts of material are spilled and have to be down-cycled or used as cheap fuel. This is mainly to do with the shaping methods, traditional ones, that only remove material to shape a product. In order to deliver a new method of woodworking, this research has investigated whether there is a more sustainable method of woodworking possible. The main goal is therefore to explore the possibilities of the use of wood in additive manufacturing processes.

How did the research approach work out (and why or why not)? And did it lead to the results you aimed for?(SWOT of the method)

According to the literature study, the use of solely wood in a 3d printing process was not done before. However some commercial parties claimed to be able to print wood, with a wood filament and a FDM printer. The filaments contain about 40 % of wood fibers and a plastic polymer. This product is claimed to be a wood-like product but it behaves differently and therefore can't be seen as wood.

The goal of this master thesis is to see if wood, which mainly consists of cellulose and lignin, can be used in a 3d printing process. Therefore research into these materials was needed and also existing methods of additive manufacturing where studied. This was done with the aim to design a new bio based material used for additive manufacturing with an existing AM process or even a new process. The basic knowledge of AM was studied with books, containing scientific articles and research articles itself. In order to get more knowledge about the chemical part of the research a specialist from Wageningen university was contacted. Also materials where obtained via Wageningen university.

Looking back at the research approach of this thesis, the process worked out well. Since multiple disciplines were needed which were not part of the knowledge I had at the time, and resources where also a problem to get. The most important information and materials were obtained via Wageningen university and the researcher from Wageningen university. Being able to get the information and material really opened doors and made me able to start testing.
Since I had no clue where to start and what to do with the cellulose and materials, a session was planed with the researcher from the university of Wageningen. Together we brainstormed about he possible ways to convert the material into an extrudable material. As result of these meetings I had enough input to start a testing process and actually make material samples. The theory sessions helped me define the path I took.
Concluding, the research approach worked out for this thesis, mainly because the path which I had to take was not known yet and therefore it has a high level of trial and error methodology, which was framed by the knowledge obtained during the sessions.

How are research and design related?

The design of a new material is done based on certain knowledge. However the output of the design was not sure yet and therefore multiple iteration steps were required in order to get to a reasonably good result. Therefore, the output of the design was needed in order to do the next step in design, and the output of design also delivered knowledge.
For example the knowledge about the process to apply, material results and characteristics of the tested material.
Because the design phase lead to knowledge, the relation between research and design can by stated by the method of research by design.

Societal impact

To what extent are the results applicable in practice?

The results of this master thesis can be seen as one of the first steps towards the use of wood in an additive manufacturing process. This means that the results of the master thesis will contain mainly concepts and a prototype for the proof of concept. This means the process and material are not market ready and need to be developed before it can be used on an industrial scale. However, once the technique is developed and applicable on an industrial scale, society can benefit from it, and the technique can be used to build building related products based on a bio composite which is sustainable and efficiently produced.

To what extent has the projected innovation been achieved?

The ultimate goal would be to be able to print wood. However, wood is one of nature's most complex materials and it is the result of a growing organism. Wood has some important characteristics which make wood special and loved by humans. For example the aesthetics, odor, natural origin, chemical composition and structural behavior. The results of this master thesis have achieved some of the projected innovations. The result of the research so far is that we can apply a bio based (read wood-based) material in a 3d printing process.
This means a material can be printed which is based on the chemical constituents of wood. This also means that the material is fully originated from nature. Additional to that, there are some signs that the research have resulted in the ability to print an anisotropic material. This has to do with the fiber orientation within the wood, and fibers within the printed material look like they have a similar way of fiber alignment. However, characteristics such as odor, aesthetics and structural behavior have not been compared and the printed material is not comparable for now. Future research might result in a solution for these existing problems and might be able to solve these problems.

Does the project contribute to sustainable development?

The results of this master thesis describe a process and result of a innovative and sustainable technology used to produce a wood based bio composite. The techniques could be used to make building related materials, and the methodology should save materials which are spilled nowadays.

What is the impact of your project on sustainability (people, planet, profit/prosperity)?

The project potentially unleashes a new route to infinite bio based material which could be used in a additive manufacturing process, but maybe also different industry related products. This means that materials such as wood potentially could be used more efficiently without the need to down-cycle or burn it.

What is the relation between the project and the wider social context?

The technology might result in technologies which are more sustainable compared to current technologies. Sustainable technologies will lead to a better world for all people living on it.

How does the project affects architecture / the built environment?

The results of this master thesis can potentially result in new materials and techniques used to shape and build the built environment. Therefore it could lead to innovation which will contribute in a sustainable way and therefore help people live in a more healthy way.