Designing a Water Filtering LWS for Utility Buildings in the Netherlands

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Designing a Water Filtering LWS for Utility Buildings in the Netherlands

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This document is written in order to account for the obtained results during the graduation phase. It is an evaluation of the research method applied, the process and the planning.

The relationship between research and design
During my graduation project I focused mainly on research, although this was not my initial intention. The research method I wanted to apply was research by design as in former projects this methodology had proven to suit me. However, due to a lack of knowledge on water filtering I had too little tangible knowledge to start designing. Therefore, I started to gather information, exploring the topics of water filtering in general (how it is currently done in the Netherlands), constructed wetlands, water quality but also on living wall systems. These topics are broad and one could write a master thesis about each of these topics alone. I failed to demarcate proper research boundaries and did not set a realistic time frame for my research part. Consequently, I lost myself in research.

The theory was complex and did not always provide the answers I was looking for. As many aspects were not studied extensively yet or either belonged to another discipline, it was hard for me to draw conclusions. I was afraid to overlook aspects which should evidently be incorporated in my final design. Therefore, I intensified my research instead of focusing on the design itself. Gathering more and more information. Consequently, translating the theory into design conditions took far longer than expected. The relationship between research and design was thereby unbalanced as the design side was partly overshadowed. However, after the design conditions were properly set, they provided a good guidance to establish the design quickly.

I learned that it is really important to start designing even when some questions are not answered yet, it forces you to become more focused on the issues which are relevant for the final design. In the future I should first identify how to establish the minimal design goal, before elaborating the details. A parallel I think is relevant is the concept of the Minimal Viable Product. A Minimum Viable Product is a product version with just enough features to validate the design in order to learn fast from mistakes. This means not designing the mirrors of a car before having a product that gets you from A to B, as illustrated in figure 1.

Figure 1. The minimal viable product (Kniberg, 2016).
This correlates with my initial intensions to approach my research goals by means of research by design. In hindsight I should not have worried so much that I was unable to validate the exact quality of the effluent water. I first should have experimented by testing how dirty water could flow through a vertical system and if I would notice any differences in effluent quality between configurations. In next design projects, I need to force myself taking this approach by setting smaller goals and rapid prototyping. In the future I would prefer to work in a team, too be able to reflect my findings. During my graduation, I focused myself too much on details and sidetracks. Thereby a lot of gathered information proved to be irrelevant later on; an unfortunate waste of time and knowledge.

**The relationship between the themes of the graduation studio and my graduation topic**

The track Building Technology has one graduation studio: Sustainable Design. This studio consists of three themes, which are:

- Structural design (focus on innovative building structures and materials),
- Climate Design (focus on material cycles, novel building services, energy performance and user comfort & health),
- Façade Design (focus on innovative building envelopes with regard to typologies, materialization, climate- & user responsiveness, fabrication and assembly)

(Delft University of Technology, 2016).

My graduation topic, which entailed the design of a water filtering façade, is strongly related to the topics Climate Design and Façade Design. The relation with Climate Design is apparent from the water saving possibilities of the designed façade. The façade will be applied at utility buildings, for which the WestCord Hotel Delft served as a case study. Although the façade does not improve a buildings energy performance, it reduces a buildings need for drinking water, a vital need. The façade treats greywater of different domestic sources in the hotel and reuses the treated effluent for toilet flushing and shower. The design could therefore be a part in the realization of a fully self-sustaining/off-grid building. Next to this core feature, the materials used in the final design are separable and retrievable. Moreover, the materials were analyzed for their material cycle. Unfortunately, not all materials applied could be completely circular. For the choice of substrate, the functionality (the filter capacity and efficiency) and saturated weight were more important. Additionally, it is questionable if the choice of plastic for the supporting structure is a sustainable choice. The chosen plastic should be substituted by a material with similar properties, but one which does not contribute to the plastic soup (does not deteriorate into micro-plastics) and one which is not be harmful to the people and the environment and is either recyclable or decomposable without compromising on the functional lifespan of the element of 20 years.

The relation with façade design is obvious, the design actually is a façade, a kind of second skin. The designed building envelope fulfills next to an aesthetic function (provided by the vegetation which also reduces peoples stress) a water filtering function. In the future it might be interesting if the design could also improve the existing insulation of a building. Then, when a building is refurbished by the water filtering façade, a reduction in consumption of both water and energy could be achieved for that building.

The design can be disassembled completely, which is also important for the material cycle of the element as mentioned before. The production process of the façade is also taken into account, the panels are prefabricated in order to provide easy and rapid installation. Each element can individually be replaced without the need of demounting the entire façade. The same applies to the plants, the plant voids are designed as such, that if plants do not develop properly, they can be easily substituted by other plants. In this way the façade remains fully covered.
The relationship between the methodical line of approach of the graduation studio and my own research method
The methodical line of approach of the Sustainable Design graduation studio is either Research by design or Design by research. As mentioned earlier I initially started my graduation project with a research by design approach which changed into a design by research approach. Both approaches (initial and actual approach) thus coincide with the methodical line of approach of the graduation studio.

My design by research approach is illustrated by my literature studies (which shows from my extensive literature list) and by the consultations with field experts. In the business industry companies tend to protect their products working principles in order to have competitive advantage, while I am used as a student that information is openly available. For me this was difficult as in my opinion all information should be open to everyone. In that way everybody benefits, and designs will advance (like the Dutch Plant Breeder’s Right or Kwekersrecht). Fortunately, in general companies were willing to help out. As I did not want to harm any person or business by publishing their information, I tried to handle info given with as much care as possible. However, this did therefore consume a lot of time. For me these two aspects were the major difference between the methodical line of approach of the graduation studio and doing practical research in the field with third parties.

The relationship between the project and the wider social context
Living wall systems contribute, if properly designed, to the beautification of cities. Moreover, by implementing living wall systems the amount of vegetation in cities increases which reduces urban stress levels and the heat island effect. It is an alternative where ground surface is scarce and an additive where ground surface is ready available.

However, cities are paved more and more and the demand for living wall systems is low. Therefore, the aim of this study was to examine the possibilities to increase the demand for living wall systems by implementing a second function. The project was established in order to found out whether it was possible to incorporate water filtering in a living wall system. And if this could lead to substantial water savings.

Besides increasing the amount of vegetation in cities the intention of the design was to broaden the possibilities for creating an off grid building. However, in many countries availability to good quality water is limited, for example in California they are suffering more and more from climate change. Therefore, the design could also provide a solution in dense populated areas where access to good quality water inadequate.

Sources
Delft University of Technology. (2016). MSc Programme Architecture, Urbanism and Building Sciences, Track Building Technology. Delft University of Technology.