

REFLECTION

The relationship between research and design

The overall process can be described as 'Research through Design'. The research is characterized by an iterative process of performing a literature research, creating grasshopper scripts based on the findings, testing their performance by applying them to a test case and/or the case study and then performing additional research to find better methods.

The first weeks after the second presentation consisted mostly of literature research in order to determine what optimization algorithm would be most sufficient for the task 'creating a computational workflow for multiple objective optimization to support the design of a graded multifunctional structure for a freeform canopy'. In addition to this research, grasshopper plugins that allow for optimization were evaluated by their characteristics. The literature study provided insight in the reasons why a certain type of algorithm would be more sufficient than another. These findings were used to assess what grasshopper plugin would be most sufficient.

The initial idea was to combine a multi-objective optimization with a structural analysis of the case study. The idea was to run the structural analysis on the 'final shape' that consists out of beams and connections by using Karamba. The results of the amount of used material would then be one of the inputs for the multiple objective optimization. However, because of the size of the case study this turned out to be very calculation expensive. As a result, the main theme of the research shifted towards the creation of a graded structure based on a (performance based) image map. As a result, the earlier performed research towards optimization algorithms and multi-objective optimization became more of a secondary aspect of the thesis. The multi-objective optimization no longer functioned as the core of the design and the research but as a suggested step in the workflow of performance based design. The result of the optimization part of the research changed from an entire structure with beams and connections to an overall shape for the canopy of the case study.

In addition to that, the case study and it's (largely unknown) programme of requirements was analysed. This proved to be rather difficult, since the case study is not an existing building but a building that has yet to be designed and is still in the conceptual design phase. After contacting the architecture company that is responsible for the design I found out that there is not even a proper programme of requirements. As a result, all I had as a starting point where the location, approximate dimensions and the architectural concept. It probably would have been wiser if I had chosen an existing building from which lots of information is publicly available.

The optimization part of the research took a lot of time and is not critical to answer the main question of the research. If I would have to do this research all over again I would have chosen an existing stadium, instead of one that has yet to be designed as case study and use the basic shape of the stadiums canopy for the further research into the translation of an image map to a graded structure.

While performing the literature research, it turned out the subject 'graded structures' is a relatively unexplored field within architecture. Daniel Piker is the person who took several remeshing concepts that have been around for a while within the field of Digital Geometry Processing and translated them to a method of generating graded meshes. His insights proofed to be very useful for the generation of graded structures within the field of architecture. Several of the scripts from Daniel Piker have been adapted to work with image maps and were tested. No scripts from other persons that could generate a graded structure were found. As a matter of fact, searching for 'graded structures' or 'gradient structures' within google shows us only very small scale applications within the field of material science. In that sense, there was almost no theoretical framework that offered methods of applying graded structures on a larger scale.

Relationship between the subject, graduation lab and wider social context

The research into 'graded structures' can be placed within the field of performance based design. The research aims to take a step forwards in limiting the impact of construction and energy use of buildings on the global environment by developing a workflow that integrates the results from performance analyses with the structural design. In other words, it aims to provide a new method for creating more sustainable designs by using graded structures. Therefore, the research has a strong connection with the theme of the graduation lab: the 'Sustainable Design Graduation Studio'.

Research that aims to reduce the impact of construction on the global environment becomes more and more important. Construction is one of the least sustainable industries in the world and it has a huge impact on the global environment. In the light of climate change and preserving a liveable world for the future generations, limiting the impact of construction on the global environment is of high importance. Besides the large share of global pollution that construction is responsible for, it is believed that construction uses roughly half of the worlds global energy and water sources and about 60% of the worlds global material resources. Additionally, the building industry is indirectly responsible for half of coral reef destruction and for a quarter of rainforest destruction. [Willmott Dixon, 2010] If we are able to optimize the design, we can reduce the amount of used material and energy.

Personal process

During the first weeks after p2 I did not focus enough on immediately implementing the findings of the literature study. As a result, most of the work I had done resulted in written texts for my report. Only little work had been done on setting up the model and on starting to work towards a grasshopper script for the optimization itself. My tutors pointed out to me that I needed to step out of the conceptual research phase and get some work done on the design part. Over the following months I had made quite some progress. However, I had been focussing a lot on the grasshopper scripts itself and had not properly documented all the algorithms that had been used in order to try and reach the results. As a result, the draft thesis was not up to date with the progress that I had made. It missed the argumentation that supports the decisions I made regarding the chosen algorithms and it missed the results of important steps that I had made. I realize now that I have difficulties on focussing on both the writing of the report/thesis and working on the grasshopper scripts and the design itself. I tend to get 'stuck' once I decide to focus on one of the aspects. When I am working on the report I tend to write very detailed pieces and when I am working on the grasshopper scripts I tend to keep going until I resolved all of the issues that I come across (which takes quite a while) without properly documenting the steps and research into the report. This is definitely something I need to improve on. I have to keep in mind that both aspects are equally important.

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