Reflection P4

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The relationship between the theme of the studio and the chosen subject

The goal of the design studio is to formulate a design proposal for a 7000 m2 pavilion for the World Expo in 2025 in Rotterdam. The theme of the world expo is: where ambition turns environmental challenges into economic opportunities. The building industry is a large polluter, since manufacturing processes cause a lot of waste and has a high energy consumption.

The paradigm shift from mass standardization to mass customization is made possible by the third industrial revolution, namely the robotization of the manufacturing industry. When the manufacturing processes in the building industry is robotized this could reduce energy consumption, reduce waste, increase efficiency and use less materials while allowing humans to specialize.

Robotic devices are already being used in the manufacturing industry, but they are not being used to their full potential. The tasks they are most commonly given are repetitive, because of limitations in the software and willingness/knowledge of manufactures.

During the World Expo in Rotterdam 50 million visitors are expected to visit during its 6 months duration. In Shanghai during the World Expo this caused a lot of problems (waiting lines, insufficient public transport, etc).

Goal
The pavilion should showcase the development of the robotic devices that will allow for mass customization in the building industry.

ROS industrial consortium is a developer of open source robotic software and apply the software to the manufacturing industry. During the World Expo, the ROS industrial consortium will exhibit the newest technologies and showcase the major developments. After the World Expo the pavilion will be used as a research, education and conference centre by ROS.

Objectives and Research

The relationship between the methodical line of approach of the Hyperbody graduation studio and the chosen design method.

In the Hyperbody studio the relationship between research and design is paramount. The research has a direct link to the design process and the resulting architectural configuration. During the design process agent based self organizing systems have been developed to calculate possible configurations of the

different spaces and the people flows going through them. Parametric design methods are used to analyze the outcomes of these simulations. With this information the designer can develop these initial configurations to informed architecture.

Research questions
- In what way can the pavilion be shaped so the visitor will be stimulated to explore the pavilion and its exhibitions?
- In what way can the paths to the pavilion and inside the pavilion be shaped to account for these people flows?
- The inhabitants of the Noordereiland in Rotterdam appreciate the park space on the chosen site. In what way can the pavilion be placed to maintain or improve the qualities that are present on the site?
Design assignment
- Create a pavilion that will stimulate the visitor to become curious and explore the pavilion and its content.
- Shape the paths to and inside the pavilion in a way that takes into account the number of expected visitors.
- Place the pavilion in a way that either maintains or improves the qualities that are present on the site.

- *Curiosity and exploratory behavior research*
- *Agent based generative design system for function placement*
- *Agent based generative design system for path generation*
- *Prototype porosity research (micro and meso scale)*

Curiosity and exploratory behavior research
The concept that has been developed for the studio project states that the visitors in the pavilion need to become curious as they wander through the building. Case studies will be analyzed and research will be done in the field of environmental psychology and phenomenology in architectural theory in order to deduct a set of parametric design principles that will shape the geometry in a way that will arouse curiosity and exploratory behavior in the visitor. These principles will determine the functional layout by defining the sequence of spaces, the sizes, the relationship between visitors and the different activities in the spaces, lightness or darkness, acoustic requirements and other aspects that will influence the experience in the pavilion.

Agent based generative design system for function placement
The analysis of the site will inform where the spaces will be placed, in accordance with the curiosity principles. These analysis include acoustic conditions, view lines, access, solar radiation analysis and existing infrastructure. The curiosity principles and site analysis will ensure that the functions are placed in a way that fulfill all the different requirements. The self organizing system will generate multiple iterations that might differ slightly or significantly. All iterations however should meet the requirements, because they have been incorporated in the rules of the system. From these iterations a solution will be chosen, based on certain criteria.

Agent based generative design system for path generation
The next system will look into the people flows towards and inside the pavilion during the World Expo and will find solutions for the paths towards the building. It will also create the paths between the spaces that have been placed on the site. This process of generating paths will also be guided by the curiosity principles.
The result of these two systems will be a primitive geometry on the site, a three dimensional landscape where the pavilion, the paths and the park spaces overflow in each other.

Prototype research
The prototype investigates how multiple aspects can be embedded into one geometry on the micro and meso scale. This prototype acts as a blueprint for the design studio, its principles can be developed further and applied to the primitive geometry on the site.

Project in the wider social context

I think that my project could have a life beyond pure academic work, and could eventually join the current debate about the way architecture is being designed and produced. The link from design to robotic fabrication has the potential to create locally optimized architecture.

Reflection

In the design process I have used a lot of parametric simulations and scripting. This has given me the information I needed to design the building. At the start of the design process the project was very abstract, since the agent based simulations are generic tools that can be used to simulate many different types of buildings. But these scripts have to be used as a tool, as layers of information that you can design with. The scripts and simulations cannot simply be stacked on top of each other, in between every step the simulations need to be interpreted in order to be meaningful. This is the architectural input that the designer provides in the design process.

For example, the computational calculations allowed me to understand how the forces flow in the skin of the building, and how much solar radiation hits the skin, etc. Having access to this information makes it possible to design a skin that is optimized for the local conditions, but also creates the right experience in the building. In conclusion, by developing different simulations and parametric tools I was able to understand the relationships between the urban scale (people flows, architectural volumes) ,macro scale, meso scale and micro scale (daylight, structural forces, view, access, sound absorption). These layers of information can be used in the design process to create one informed piece of architectural geometry.