Reflection

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Relationship between graduation topic, studio track and master track

The goal of my graduation project was the design of an alternative densification strategy for high-density environments, using the advantages of computational design and robotic fabrication (being the studio themes) to solve several problems I extracted by analyzing current densification strategies.

The direction in which I searched for the solution (computational design and robotic fabrication) related my project to my graduation studio. A difficulty in this approach was that the problem I tried to solve is a current problem, while the solution direction (robotic fabrication) relies on an industry that is not fully developed yet in all facets of the building process. My design relies on mass-customization of a large number of building components, while 95 percent of current manufacturers are not yet able to deliver their products on a file-to-factory, customized basis. This makes the resulting design outcome less realistic for direct application. This is a shame when handling a time-sensitive issue as density, whose need is dependent on the desire of people to live in the city (which fluctuates every couple of decades).

My self-chosen topic (current problems with densification strategies) relates my project to my master program of Architecture, Urbanism and Building Sciences since it tries to solve problems we have in our current built environment and define (designed) solutions for these problems.

Research method, approach & transferability

In order to reach the earlier described goal I broke up my design in three scale levels: macro (building scale) meso (apartment scale) and micro (detailing). For each scale level I developed a method which generates (part) of a building which enables more responsible use of inner-city space:

- Macro - Design of a maximum building envelope based on direct solar access of surrounding buildings and public squares. The idea is that a new building should not reduce the quality of existing public life in the city, which takes place in these public spaces.
- Meso - Design of an apartment growth model which allows for the generation of apartments with varying space sizes according to set requirements in a certain bounding volume. This enables us to generate housing configurations without the need for all spaces having the same height, which inherently wastes space: a sleeping area can be small and cozy while a living room is desired to be large and spacious. With continuous floors and repeating floorplans this more detailed distinction between the spatial needs of different functions cannot be made.
- Micro - Design of a structural system which makes it possible to build a non-standard apartment building (as is the output of macro + meso) using robotic fabrication techniques and structural analysis.

My method of separating the goal had several advantages and disadvantages. The first advantage is that it allows for three problems to be developed in parallel, without much interference. This reduced the complexity of the individual problems and made it easier to solve. The second advantage is that the

product of each scale level can be relatively easy applied in another setting. For example: the generation of a building envelope based on solar access on the surroundings is something that municipalities, for example, can use as a good tool to give insight in volumetric limitations on the site, without them needing to incorporate the other products of my thesis as well.

A main disadvantage of my method is that the different scale levels separated, while optimally they would be interconnected. When designing a bounding volume, one should be aware of the fact that certain bounding volumes are more suitable for fitting in apartments than others, because of the ratio between façade area and volume, for example. By isolating these scale levels this direct connection is somewhat lost. For the most ideal output one would have to develop a method where the generation of apartments happens simultaneously with the shading impact on its surroundings and structural optimization. This is however a very complex problem. To connect the different scale levels I worked in an iterative fashion where information from one scale level would inform decisions in the other. With the bounding volume algorithm several bounding volumes were generated based on varying design inputs. A bounding volume was chosen according to its match with the other scale levels. I chose a bounding volume with a relatively high façade-to-volume ratio since I found out that my apartment types, with relatively larger living rooms, required more façade area.

Relationship between research and design

During my thesis research was performed on all three scale levels. On the macro and meso scale levels research was mainly done in the form of literary research. For development of the meso scale level, for example, different geometrical growth methods were investigated which could be applied in my apartment growth model. Within this research I did not look for answers to all of my design problems, but merely for answers to specific parts. For example: what is the logic of a computational growth algorithm? A follow-up design question would be: what would a resulting geometry look like? Or: how can a model be adapted to 'grow' functionally valid apartment volumes?

On the micro scale level research was done in the form of several workshops which influenced the design process of the structural system. While 3D printing was not applied in any of the workshops, the investigation of several different themes in each workshop made the knowledge I gained in these workshops transferable in my design. In workshop 1, for example, a (concrete cast) shell was designed with parametrically applied thickness variation based on local stress values. This principle could be implemented directly in my design to reduce the load on structural shells in the base of my building by making the shell structure less dense in higher parts of the building.

In conclusion, doing research provided me with information which enabled me to focus my design process.

Ethical issues

During my thesis I also stumbled upon some ethical issues, mainly concerned with the design output of my strategy. This is because my strategy will result in quite non-standard apartments spaces, which lack continuous floors. This is problematic since it means that my design will be basically unfit for elderly and people with special needs. On the other hand, however, one could argue that a lot of apartments that

are currently available are already unfit for these groups since we also design buildings specific for them, for example single floor apartments without doorsteps. One could even argue that, in an apartment with more spatial variation and height difference, the lazy modern human will again be in an environment where physical exercise is inherent in his/her day-to-day routine which, in effect, has positive health effects. The difficulty for lesser-abled people to maneuver in my design, however, cannot be ignored and is in my opinion one of the main hurdles that these housing types face in our inclusive society, and for good reason. When design – albeit unintentionally – excludes certain groups of people, there is always a risk of the public viewing this as an architect with bad intentions. This makes it almost impossible to apply similar housing types on a larger scale.