

Architectural and Media Studies

Report on Computational strategy for the design project

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Today we came to a point when a lack of space available in the cities, large amount of waste and pollution produced during the building process became big issues. In Hyperbody studio there is an ongoing research on how to solve these problems through minimizing material use and its waste, that can be done by application of additive manufacturing and robotic production, where material can be placed only where it is needed.

But beforehand it is important to think, if the building layout is also optimized and well fitted for the present and future users. If we don't position this question, the whole action of optimizing building process and its structure loses in its value.

A residential building was chosen for this MSc3 design project due to the number of reasons. Project site is located in the area of TU Delft University, where number of students enrolled in the first year increased for about a 1000 students during the past 5 years. This led to a problem of a lack in available accommodation near the university. The site can also be regarded as a junction that will connect TU Delft campus and Technopolis. And moreover the choice was made due to the author's belief that there is a need to change spatial arrangement in dwelling.

The notion of housing that represents a place which can provide privacy, comfort and independence to their residents was introduced in the 19th century. This layout of apartment buildings divided circulation routes and private rooms. The majority of city residents got so used to the privacy level it offered, that over the past hundred years this spatial arrangement didn't change much and is being still widely applied.

Meanwhile residents' preferences and lifestyle along with their family status changed during the last decades. The present layout of the apartments with the strict division between functions of different rooms and corridors for circulation cannot fully satisfy everyone's needs. Moreover the mono-functionality of the space doesn't allow for the future change if this will be needed at a later stage.

Space mono-functionality in the residential design leads to the inefficient use of space. As it can be seen in a scenario of a standard housing typology, over the course of the day numerous rooms remain empty.

In this design project the main goal will be to minimise unusable space of the housing complex during the day and night time. This will be achieved by taking into account movement of the people within the building, their everyday activities, space reconfiguration and introduction of adjustable boundaries between private, shared and semi-public and public spaces. The aim is to provide residents with a higher comfort level than in the standard layout, while using less space and also accommodating more functions.

A hybrid of Residence building with working/studying space will be created, to increase the time of space occupation. Space that will be used during the day for working places and public activities, will become an extension of private apartments in the evening, when people return from work; as well as will offer temporary accommodation space, for those who just need to have a bed for a short period of time. Moreover it will give the possibility for the inhabitants to customise their space according to their preferences (make it more open or private) and will lead to more social and interactive environment.

The hybrid of working mixed together with housing was chosen due to the increased number of people working from home, and even larger number of people who would work from home if they had this possibility or the right working environment within the space they are living.

First step in the design process will be to analyze groups of potential users of the building, and study their behavior.

Then groups of agents will be created, each representing one of the users group (Master students, Bachelor students, Single professors/researchers, families without kids, families with 1 or 2 kids and visitors). The site entrances and circulation within the site, as well as divisions between built and open space will be determined after running a simulation of a swarm behavior of different agents approaching the site. Orientation of the sun, wind speed and direction, together with the noise of the traffic and site topography will be analyzed and taken in consideration at this step, to fit the building within its environment in the optimized and efficient way.

Further on a 3D diagram of the buildings main public and semi-public spaces (representing rather a sequence of spaces within the buildings, then a circulation route leading to different rooms) will be created in Grasshopper. This diagram will include the information about the size of spaces, necessary connections and distances in between, level of privacy, access of the sunlight, connection within outdoor space and so on.

This diagram will be imported as a set of attraction and repeller points to Processing, where a simulation of different groups of agents traveling between these points as a swarm will be performed. This simulation will help to achieve an optimized layout of the spatial arrangement within the building, based on the agents paths. Each group of agents will move with its own speed, and different factor and radius of attraction towards different spaces. This will result in some of the agents being

more likely to wander between different spaces (Visitors, Bachelor students), and other arriving to their destination and staying there (Working people, Master students).

Parallel to the studies of the people flow within the site and the building, another study will be performed on ergonomics of the space needed for certain activities. That study will help to create optimized apartments, where places will be specially designed for different activities that can be carried out while walking, standing, sitting or lying down, and with a different need for privacy. Places will have reconfigurable elements when this will help to achieve a higher level of multifunctionality, as well to make it possible to separate or join apartments together.

When the preliminary shape of the building (macro scale) will be designed, it will be combined with the studies performed for the different types of apartments (meso scale). Then further studies will be carried out on the material level (micro scale).