P4 Reflection

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Introduction

On the following pages I will look back on my graduation project 'Emergent Interface'. The site of the projected is located in Rotterdam, Merwe Vierhavens: an old industrial harbour. The site houses several buildings, among which three 90 metre high office towers, the so-called Marconi Towers. These structures are the main focus of the thesis project.

I will give descriptions and reflect on the following aspects

1. The relationship between design problem and design product
2. The design approach, methods and process
3. The relationship between research and design
4. The relationship between the methodical line of approach of the graduation lab and the method chosen in this framework

1. The relationship between design problems and design product

The design problem can be divided into three categories: societal, its subset site-specific and theory-based. The societal and site-specific design problems are related to *what* is the intervention that takes place and the theory-based problem revolves about *how* to conceive this intervention. The latter category will be reflected upon in part 2: The design process.

Societal design problem

Society is moving from mass production to mass customisation; from consumer to producer and from money-based to a knowledge and information-based society. Financial speculation has lead the real estate market and the economy in general to a crisis on global scale. The system has partly collapsed, of which is indicative the reduced flow of material and currency through the system.

Society and its economies are now in a phase transition, regrouping and complexifying again to a new state, increasing the flow of currency through the system. However, because of the abovementioned mass customisation and producer trends, knowledge and information as opposed to money become the indicators for the stat of the economy. Not financial speculation will drive society, but the emergence of knowledge. Architecture should act accordingly and catalyse this process.

The intention here was to densify the network and to feather out the barriers that impede interactions – information transactions.

Site-specific design problem

The Marconi Towers are disconnected from the city of Rotterdam in a variety of aspects:

- Economically: the vacancy rate of the towers is currently 27% and this percentage will rise, among other reasons due to the local government moving out;
- Socially: the area is mono-functional: no people live in the area, which results in deserted neighbourhood during weekends and at night;
- Spatially: despite their landmark function – in that sense they are visually well connected to the city – the accessibility of the site leaves much to be desired, mostly because of the busy traffic square, but also due to the typology of the towers themselves.

Research questions

These problems have led to the main research question:

> *How to (re)connect the Marconi Towers to the city again, economically, socially and spatially and by means of an architectural intervention.*

This research question was then subdivided into some sub questions:

> *How to deal with the vacancy – economic disconnection; how to generate value, by generating knowledge emerging processes – which will boost the demand for space near and in the towers?*
>
> *How to make the area around the Marconi Towers a liveable and pleasant area – thus really be part of the urban fabric – also during the weekend and at night?*
>
> *How to overcome the hard edges that separates the site from the rest of the city; how to turn the edge into a more porous border: an interface?*
>
> *Related to space and form: what is the interface between a vertical tower and a horizontal city?*

Reflection on the design product – so far

Two strategies have been applied to address the research questions: the choice of programme and a spatial intervention. Neither of them include policy making, urban planning or other larger-scale interventions. Not because this isn't desirable, but because the scope of the project is architectural, not political.

The choice of programme: a mix of start-ups and dwellings and their auxiliary functions – hospitality programme and an auditorium, lead to a mixed-use of the site, thus addressing the societal disconnection.

The spatial intervention: by opting for an oblique landscape of different types of paths and routes, spaces of permanence, all both in private and public, inside and outside, leads to a more porous edge between the vertical towers and the horizontal city. Another thing the spatial intervention does, is to add high quality public and common (semi-public) space to the site. This bumps up the value of the space the towers, even if they are not intervened on. This solves part of the economic disconnection: the prices for the spaces high inside the towers will match better the supply and demand graph.

It turned out to be that the spatial intervention of creating an interface between the vertical tower and the horizontal city was the most important question of all. Initially a mat-like typology was proposed, meaning that the intervention is modular in its nature, allowing to plug-in or plug-out of uses; the modules would be connected to a path system – circulation spaces that are an extension of the city in form and use.

Special attention was paid to walkable connectedness, with reference to Paul Virilio and Claude Parents' concept of the 'oblique' (and its contemporary incarnation such as the architecture of Zaha Hadid and UN Studio), as well as Koolhaas' and others' 'folded oblique'. In relation to the mat building, references like SANAA's Rolex Learning Centre and Frei Otto's Freie Universität Berlin were looked into with the idea of creating 3D mat-building.

The product as it is at the moment is not entirely successful in reaching the abovementioned design intentions:

- Walkable connectivity from outside only reaches the first few floors of the towers. Internal 'folded' oblique connections reach also higher floors, but these routes are long, perhaps too convoluted and use up a lot of space.

Because the core in the building is maintained for structural reasons, the visual connectivity inside the towers lacks some to be desired and it is (therefore) questionable if the walkable connectedness inside the towers really adds to more publicness and interaction inside the towers.

- The (distributed) modularity of a mat system was hard to achieve as start-up programme also requires semi-public common spaces, that are not accessible by all. In addition, even though small cells of programme could work autonomically and be added and be removed when desired, gravity works globally. This is not a problem in a 2D mat, but in a 3D mat building, In order for the system to remain modular, an auxiliary structure is needed if cells are placed above each other. The choice was therefore be made to make clusters of similar cells of programme, leading to bigger structurers, which in turn are more permanent in their nature, defying the aspect of modularity.
- Most of architectural programme (at least of permanence) should take place on flat floors. We are not like ants, or mountain goats and thus not anatomically fit to be constantly on double (or even single) curved surfaces. Only roof-wall systems and path systems could be oblique or curved. This leads to barriers for a continuous oblique. In the design the limitations are covered by making visual oblique connections here and there, but in part they remain merely aesthetic.

2. The design approach, methods and process

The design approach is an integrated part of the Hyperbody studio. My interpretation of the method is that the main idea is to deal with the complexity of a design project through bottom-up strategies in combination with top-down evaluation. In my theory thesis I worked out this way of designing as 'Design by Emergence, a part-up – whole-down approach to architectural design.' I attempted to design my project within this approach. Concretely this means that across varies scales the designer creates objects with agency, that rules are defined for these agents and that the emergent whole is then assessed in order to then change the rules, in a continuous feedback loop, until the end result is reached.

Initially three types of agents were defined: spaces, humanoids and building components. These different agents must then be simulated in a computer program, ideally at the same time. The vast complexity of the implementation of this approach rendered it quickly impossible. The next-best option was then to simulate first a configuration of the building by giving agency to a variety of programme (start-ups, dwellings, hospitality, auditorium) that had all incorporated spatial data (dimensions) in them as well as other aspects, such as publicness, need for daylight, etc. The interaction of these agents in (stigmergic) feedback loops lead to a statisfying building configuration.

The next step was to establish a path system. For this, humanoid agents were simulated, again with agency and different behaviours. Dwellers acted differently than shoppers for example. The result was a minimal path system with many different routes.

So far, so good. The loop had been exclusively: defining rules, run simulation, evaluate result, re-define rules. The next step had to be to design a sub-system of building components that would interact with each other in a similar matter. Later, rather than sooner, it became clear that there was too much complexity involved. Space agents could be abstracted as cylinders, humanoids as points, and their pheromone trails as lines. But building components are 3D, have different structural functions, have to interact with each other in much more intricate ways than a simple collision. How to code the transition between a column and stairs, or between the pattern of a path and the glass opening of a space agent? It might be possible to do this on a theoretical level, but practically impossible due to a lack of time resources and experience as a programmer.

Instead, I went for another approach: the intuitive one. This lead to many interesting form studies, but turned out to be too inexplicitly rule-based. A more systematic approach was needed: a set of shape grammars on *various scales*, not implemented in Java or another programming language, but in human. The scale-aspect is important, because if one tries to handle too much complexity at once, you might end up with nothing, which is almost what happened.

As the main theme of the project is 'interface', I decided to design all interfaces between the different subsystems of the design project, for example the interface between tower and path, and the interface between path and cluster, but also the interface between different paths, etc.

What turned out to be crucial is to subdivide even further: the interaction of tower and path, for example, can be formulated as 1) the interface between columns of the tower and the path, 2) the interface between the floors of the tower and the path and 3) the interface between the façade of the tower and the path. Each emerging subsystem leads then to more interfaces, continuously diminishing in scale. An example of the process would be: path bumps into column; column bends around or path splits and streams around the column; paths cut out parts of floors within their sphere of influence (dependent on e.g. publicness); a wrapping façade connects the floors and paths, etc.

Many other layers were then (and are still) added: fast paths are smooth, slow paths are more jagged, transition interfaces in between, materiality, etc. All is achieved through rules on elements with a certain agency; so that the outcome can be regarded as emergent. Most of the rules are informed by earlier simulations or are encapsulated into simulation algorithms, such as topology optimisation for the structural system. Of course other shape-grammar rules are a more arbitrary design decision, but still informed by the design intentions, which, in turn, are based on analysis and theory. The fluid visual connection between clusters and towers, is one such example. The fluidity makes the concept of the building (walkable connectivity) more readable, but does not have a clearly defined functional underlay.

Reflection

With regard to the design process, it must be noted that the research questions turned out to be not entirely comprehensive. It would have been a good idea to re-evaluate the research questions every now and then and test them against design intentions and design results. Assessing questions, intentions and results in a continuous feedback loop explicitly makes the design process more streamlined and less of an intuitive black box. The absence of this feedback loop lead the design process to wander too much of course at times.

The process took more than three times longer than its nominal length. Managing the design process could have been done much better. A proper planning that would be regarded as hard would have helped. Another key aspect is prioritisation of the design aspects. Too much wandering around and exploring lead to much time loss. Apart from the qualitative aspects of planning, there was also simply the lack of time, due to my well-running company. I often prioritised professional project over my graduation.

With regard to the method: a fully bottom-up approach and only top-down *evaluation* might be possible in the near future, but is not now, not for student who does a master thesis with limited time and resources at least.

3. The relationship between research and design

Research included theoretical research and more practical research. The theoretical research can be subdivided into two parts: abstract and project-specific. The more hands-on, practical researched included a workshop in design to robotic production.

The abstract research revolved mostly around complexity theory, emergence, societal change (third industrial revolution), cybernetics, etc. The results of this were several papers, not only for the subjects directly related to the design project, but also a theory thesis and position paper was written about this set of topics.

The project-specific research was fuelled directly by the abstract research. It included how to model complex system in a computer program through object oriented programming an virtual agency with various feedback loops, among which stigmergic feedback loops. Two main simulations were made: one to obtain a building configuration and one to obtain a path system. There were many differences and similarities, with internal and external feedback loops, but if I have to summarise how they worked, then one worked like a swarm of birds (building configuration) and the other like colony of ants (path system). The results of this were concretised in a building configuration.

Further research was done mainly about geometry: how do meshes, subdivision surfaces, surfaces, UV-mapping, etc. work? How can certain curves and (dis)continuous curvature be achieved, in 3D, on a double curved subdivision surfaces. How then, can they be sliced and panelised, patterned, etc. The result of this research is shown in the shape grammar of the building.

The studio also offered a workshop in design to robotic production. It consisted of parametric several design approaches, with strong emphasis on the productional an material parameters. The result was a design for a compression based pavilion (consisting of vaults) of which a fragment was 3D-printed with a robot in clay. While the exact result or material was not used in my design project, the moulds for the concrete elements of the project are made by means of robotic production with hot wire cutting and milling.

In conclusion I can say that there is a strong relation between research and design, even on the abstract scale. Of course, many things were dived into that didn't make it to the 3D-model of the project, but it would be odd at least if all research outcome would make it into a final product.

4. The relationship between the methodical line of approach of the graduation lab and the method chosen in this framework

For a long time, there has been a lot of doubt about the methodical line of approach of the studio from my side. My fascination had been mostly formal in the first (MSc-1) studio I did at Hyperbody. However, soon I fell in love with the idea of addressing architectural complexity through a rule based bottom-up design approach. I could see the beauty in the method as well as the result. This was the reason I wanted to graduate in the Hyberbody lab, as this is one of the key points.

However, how far do you go? If one wants to really do this well, then each aspect, maybe even each atom or quark of the universe should be simulated at the same time, and then something emergent will come out of it, right? I really thought this way at the beginning of the graduation lab, failing to see that the top-down influence of the designer is in fact at least equally important. For a long time I tried to ignore the top-down part, which basically only lead to delay and unmeaningful results.

In discussions with my main tutor, I discovered that intuition and bottom-up processes could co-exist. At this time I might have focussed maybe too much on this intuitive aspect, essentially ignoring the bottom-up and computational strategies that were to be applied, according to the studio's credo. After the remark that I shouldn't do the project just for 'self-gratification' and that the project was 'almost ornamental' in several aspects, I knew it was time to return to a more rule-based method, which I did – more on that in part 2 above: the design approach, methods and process.

In short, I could say that the pendulum between bottom-up/computational and top-down/intuitive design has swung forth and back a few times to a bit too far extremes, but now ends somewhere in the middle, where it should be, according to the graduation lab's characteristics.

Conclusion and tasks for P5

The main design intentions are reflected in the design; the interfaces on the largest scales have been designed. A fragment of the project is designed up to a materialisation level. This gives key information about the project in its entirety. What must be worked out in more detail however, are the design and materialisation of some aspects, such as the internal paths, the paneisation of the volumetric parts of the building. Some parts need to be integrated better, such as the office landscape. Of course also the representation of the project needs further improvement: more detail to the plans and a scale model needs to be build.

Ideally I would also like to test out a part of the skin in 1:1 scale and a make VR-representation. However, first I will have to focus on making the basics on a satisfactory level.

Naturally also the research questions should be reflected upon another time in order to make the storyline more consistent and make the design intervention indeed answer all problems that are posed.