Appendix 3 – Reflection on research and design

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Subject: *Appendix 3 – Reflection on research and design*
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This appendix is a reflection upon the graduation research to account for the preliminary results of the research and design in the graduation phase. The first part is a personal reflection of the research done by answering questions. In the second part the research is discussed based on 5 different aspects regarding the relationship of the project in a broader context.

Did the research approach work?

To get familiar with my topic, diving into the literature of data centers and literature about the potential of residual heat use in the built environment was necessary. I did research on conventional heating methods, technical concepts for the utilization of residual heat from data centers and feasible applications in terms of functions in the built environment that can profit from this heat. The information was technical and wasn't very inspiring in terms of ideas for design. Thus, I also carried out a case study research to understand the *typology* of a data center. In order to translate this to innovative architecture, I cleared my head a bit from all this technical information and started to think in architectural synergies. In the Netherlands we split most functions in the built environment, but why not combine them if they can profit from each other and make new unique places?

Also, I believe that location is super important. I see architecture in a really broad sense. It should naturally contribute to the social, economical, political and ecological situation of the region. In that sense it is hard to start with a topic of research and in a second stage choose a location. On the other hand, this might result in a wider spectrum of ideas for a specific location.

My understanding on the "how and why"

The 'how and why' are important to me in design. The 'how' I discussed with my research mentor, Samuel de Vries. We started to think about using software, for example TRNSYS, in order to investigate the relation between heat supply and heat demand. When we thought about the 'why', we quickly concluded that using this software is a too specific calculation method which would only be relevant to a synergy between a heat supplier and heat demander in which all parameters are defined (such as insulation thickness). Therefore, we decided to use available engineering data to research the challenges and opportunities for residual heat use from data centers in combination with literature.

My 'research by design' was finally triggered after the summer break. I didn't yet know what would be the most relevant to design for IBA parkstad. So I just started doing. I was mapping the area of IBA parkstad and discovered that the Sibelco Groeve had the potential to become a unique location for the development of a synergy between a data center and a hot spring. Focusing on the location and it's unique features in combination with technical background knowledge and the ability to think on a big scale was important. For me it was crucial to just start doing after all the research. To discover new possibilities the most important thing is to just test it. In this case the 'how' is doing, testing and making. But I could only discover this by 'trial and error'.

Feedback from mentors

During my P2 I felt I was stuck going from research to design. My mentors told me to think about the location and if the one that I chose at that moment was potentially the best one. They also told me to start drawing on scale. Make sections over the area. I feel that in this period my creative thinking was stuck because of all the information from the research. I had to take some distance from my work and think: "Ok, what can I add in IBA parkstad that really contributes to this place?" and, to say it simple: "How can I make something that is simple, clear, innovative, but also really cool (and thus relevant)"?

How did I translate the feedback into my work

I started to 'zoom out' and take a distance from all the information I gathered in my research. I tried to keep it simple because the topic was already quite complex. So, the main question was: which synergy is good for IBA parkstad? Which synergy is very cool, relevant and innovative? And of course, from all information you gathered, in a creative job, a vision starts to grow. It isn't a chronological plan. It grows slowly by drawing, testing and reflecting.

How did I learn from my own work

The research was important, but if you start with design, go to the location, understand the location and start by doing. I was thinking too much and doing too less. By doing, the design will slowly start to grow.

Planning final part graduation

The final part of the graduation will be a further elaboration of the design and the preparation of a detailed scale model. Because the design is on the level of landscape architecture, I will now focus on the smaller scale to further enhance the experience for the people using the hot spring. I will also look again at the routing and logistics in the area, an important aspect for a complex program of a data center in synergy with a hot spring. And I hope that I can further implement the advice about the technical calculations of the data center towers in the design. My research mentor, Samuel de Vries, is very precise and thorough when it comes to the calculations needed for my design. I really like this attitude and that's why I would like to further implement his advice going towards the P5. I don't know if everything will fit within the given time, but his good advice motivates me to also be precise in the working of the system from data center and hot spring.

Reflection on the aspects

Aspect 1: The relationship between research and design

I experienced that my research paper is just a tool and knowledge framework for the eventual design. For the design you have to consider more information about the location, start to think in space and start to think in opportunities in an optimistic way. To form a vision and design ideas, the research can sometimes also block your thoughts.

Aspect 2: The relationship between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)

The main idea for the project is based on energetic synergies in the built environment. In the studio of Architectural Engineering this can be classified under 'Flow'. But it is also a project that asks for a new typology. How does a synergy between a data center and a hot spring look and why does it looks like

this? And why can it economically, socially and ecologically be relevant? That is not only a question related to flow but it is also an architectural question. And this relates of course to the master of architecture that I am doing.

Aspect 3: Elaboration on research method and approach chosen by the student in relation to the graduation studio methodical line of inquiry, reflecting thereby upon the scientific relevance of the work

Our energy demand for data becomes bigger and the energy that we generate should be divided smarter by using it effectively. The project proposes an innovative synergy between a data center and a hot spring in which the data servers can be cooled and the hot spring is getting warm. Energy cascading doesn't have to be boring, it can also give an opportunity to create a unique place in the Netherlands. The scientific relevance is that the project shows new possibilities for the built environment and shows that thinking in energy flow can also lead to *new architectural building typologies.*

Aspect 4: Elaboration on the relationship between the graduation project and the wider social, professional and scientific framework, touching upon the transferability of the project results.

I don't like to make things that are only relevant in terms of architecture (space, composition, material etc.) Design should be relevant to people and society. In terms of the social framework, the project should attract people from everywhere. Even people from Amsterdam should think: 'Let's go to the hot spring in parkstad!'. Parkstad needs an economical boost and should profit from its unique landscape such as the beautiful silversand quarries. In economical way, this project can also be viable. The owners of the data center can 'sell' there residual heat directly to the visitors of the hot spring by revenues from the entrance tickets without using too much equipment for long pipe lines and heat pumps. At the same time they will be the owners of the most unique data center in the world.
In an scientific way, the project explores *a new architectural building typology* and contributes to *reducing energy waste* by using residual heat from industries in an efficient way.

Aspect 5: Discuss the ethical issues and dilemmas you may have encountered in (i) doing the research, (ii, if applicable) elaborating the design and (iii) potential applications of the results in practice.

An ethical discussion in the project could be: do u want to show industrial objects or should they be hidden away from society? I chose to show them as a physical manifestation of one of our most important industries at the moment. I think it's interesting to show a data center in the public space because architecture is the expression of our society. You can say it is a library where our daily digital lives are stored. Books, movies, websites, shopping, personal data etc. And why should we hide that?

Another ethical discussion could be: should you do a project like this close to a nature area. I definitely think yes. It is a challenge to design an industrial function close to nature and you can start thinking how this can be different from designing a data center located on an industrial area or a city.