REFLECTION: LIVING WITH DATA

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Graduation project topic in relation to master track (Ar) and master programme (MSc AUBS)

Data centers have become a fundamental component of our digital infrastructure. They can take shape in many different forms: ranging from singular or multiple rooms inside (existing) buildings all the way up to buildings that are fully dedicated for the purpose of data processing and storage. Footprints can therefore vary between tens of square meters, hundreds, thousands all the way up to many hectares for the largest data centers of all, the so called hyperscales. Designing data centers is usually done with one target in mind: achieving efficiency. Their spatial impacts are frequently neglected as a result and given less priority, if any. This strategy can be compared to other large facilities that are required for the functioning of our society such as waste management facilities, water treatment plants, power plants etc. Sure, there are examples which show how the building typology of data centers and other NIMBY-objects[1] can be thoughtfully integrated into the existing urban or rural landscapes, but these form an exception rather than the standard. As a result, we often push data centers outside of our urban environment when they become too much of a hassle to deal with. This is not a sustainable nor a healthy relationship. Out of sight should not be out of mind.

In addition, data centers consume a lot of energy to keep their systems running and cool. The components constantly produce heat and thus these components have to be cooled to prevent overheating and damage. The data center industry still relies on natural resources and has not fully switched to renewable sources. The digital revolution (also called third industrial revolution) that we are currently going through is certainly comparable to the first and second industrial revolution in the way that it causes significant environmental damage. Architecture can be an important tool to help repair this broken relationship. By purposefully designing the data center typology it is possible to integrate these building typologies in the urban environment and even make the data center enrich this environment.

Influence of research on design and vice versa

The research of the graduation project initially focused on integrating a data center together with a residential and public building program. What a public program consists of is very vague in this sentence, and it certainly was for me as well. Early literature studies proved that heat flows in a data center can certainly benefit a residential program. Then I hypothesized that wastewater from the residential program could be re-utilized in the data center for cooling. I was however struggling to find another building program that could benefit from a constant flow of heat generated in the data center and finally settled on a greenhouse building program. Undeniably, the greenhouse is not a public program in the final design. The public and life-centered aspect of the building program is important to me, as the machine-focused design of data center environments is quite inhospitable and I felt the need to offset this. To achieve this, I brought back a very large public program in the plinth of the building. The research phase allowed me to both get a solid theoretical basis for my design while also not limiting my options too early on by not having the scope of the project already fully defined.

In addition, the amount of heat that data centers can deliver to the urban environment was larger than expected. Rather then solely achieving synergy within the designed building it was now possible to connect a whole neighborhood to the proposed system. Even though this meant that my hypothesis was wrong, it was a very welcome surprise and something that surely influenced both the final research and final design.

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[1] *Not in my backyard (NIMBY): opposition of locating something considered undesirable in a neighborhood.*

Value of way of working (approach, methods and methodology)

The graduation project involved a lot of literature study as this topic wasn't something that I was familiar with at all. After that, the research had to be combined into a functional system where the flows of the building programs connect to each other. As a result, there was a strong separation between this more technical research and more of the design related research up to P2. Only in the last week before P2 could I start thinking about how to materialize the research into an actual building. In the end, this worked out fine but after P2 it felt like I had to wrap up the research paper as otherwise there wouldn't have been much time to do any of the other design related research. I still wanted to explore a whole new range of design related questions relevant to the spatial, social and environmental impacts of my proposed building. I don't see this separation between design and research as a bad thing, as I certainly was already forming some initial design ideas while writing the paper. This was simply the research that had to be done so that my design wasn't based on any unsubstantiated claims. Would I have chosen a topic I was more familiar with I feel that this division between research and design would have been less strong. I'm glad I didn't, as I don't feel it has in any way negatively influenced the final result. They are simply two different methods of working.

Academic and societal value, scope and implication & ethical aspects

The growth of data traffic is expected to keep growing considerably in the future, meaning more data centers will be required to respond to our future needs and demands. And yes, energy efficiency of components will increase but increases in data traffic will be faster than those energy increases. Considering the climate change our planet is going through it can be argued that current practices of prioritizing 'growth, growth, growth' over environmental protection should be truly reconsidered. "*Why would I as a designer contribute to something that is unsustainable?"* is a thought that kept on resonating for me throughout the design process. However, I'm of the belief that through gradual systematic change it is possible to have a large positive impact. By highlighting both the positive and negative properties of data centers I hope that discussion on this topic will proliferate.

This graduation project is not aiming to be the answer nor the perfect example of how it should be done. It undeniably has flaws and issues. However, it breaks from the current practices in which almost no attention is given to these topics at all. The work is meant as a source of inspiration and as a discussion starter. If we start these important discussions now, it is possible to tackle and solve problems rather than waiting it out and setting ourselves up for even more future problems.

Transferability of project results

The project is heavily influenced by the local climate. The flow exchanges between heat and cold from both natural and mechanical forces are based on and designed to work with the temperate climate that is present in The Netherlands. Therefore, it can be assumed that with (relatively minor) design changes the project can be projected on locations with a similar climate. If the climate is very different, say for example a harsh desert or polar climate, both the data center and other building programs will have significantly different cooling and heating requirements. This in turn will change the balance of the ATES (aquifer thermal energy storage) system and impact the overall functioning of the synergetic system.

In addition, this project is designed with the vision of achieving complete and explicit integration of a data center within the urban context. The project is of large scale and serves many different users and functions. It can be scaled down to smaller projects or building typologies outside of the residential, greenhouse or public building program which were chosen here. The presented flow analysis, calculations and the proposed design can serve as a starting point for future designs and further research into the topic.