Reflection

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Studio: Architectural Engineering.

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Argumentation of choice of the studio.

Main motivation was to study the influence of the technique on the architectural language, how to balance it. In other words how to bridge the gap between technique and art.

Title graduation project.

Energy Producing Architecture.
Background and the relationship between the project and the wider social context

Buildings are responsible for approximately 40% of total world's energy consumption (Kapsalaki et al., 2012). Most of this energy is provided by fossil fuels. According to various study this energy source will be depleted in 50 – 80 years. The climate change which is caused mainly by using fossil fuels makes the search for the alternatives in energy supply even more relevant.

This study contributes to sustainable design development as well as to the architectural body of knowledge as an example of architectural integration of the latest technological innovation related to renewable energy and building energy efficiency. The study will be placed into a professional context by using on-going project framework. The result therefore can be used for the relevant future projects on energy producing building type.

The theme of this graduation work is the relation between net energy positive building type and architectural appearance of such building. The research part of this work was dedicated primarily to the aspects of energy efficiency, energy production systems within building envelope. Secondary the relation between energy and architecture has been exposed using the specific case study, Johanneberg Science Park. Further the aim of the design project was to make an energy positive building in certain architectural context and evaluate architectural appearance of such building type.

relationship between research and design

In this project the relation between the research and the design has been the primary point of attention. The research on building energy efficiency and building integrated energy sources has an extremely high impact on the design, influencing all scales of it. Therefore the research on energy has given a new dimension to the design process. Thus, it became more difficult as the extra requirements had to be integrated and solved within the project.

In order to design the energy positive building the energy context (research results) had been prioritized above the aesthetics. This context creates an extra limitation which has to be taken into account during the design process. Therefore such aspect as orientation, building climate concept, integration of sustainable energy supply and optimization of the thermal resistance of the facade were determining aspects in the creating architectural language of the building. For example, based on the research, conducted during previous semester, the solar energy turned to be the main energy source at the location. In addition integration of the algal biomass production is potentially promising source. Because the main energy source is the sun, the south facade has a high potential for energy production, while the north facade has a low potential. This is exposed in the design through integration of the PV solar panels in different variations: roof, facade. Using energy production as the starting point for designing the facades it might be concluded that the energy context has determined aesthetics. Throughout the whole design the similar trends are present, where the energy context has a higher priority than architectural context in order to achieve the energy producing goals. Thus, the main challenge of this project was to create a coherent architectural design within energetic goals.

relationship between the theme of the studio and the subject/case study chosen by the student within this framework (location/object)

The focus of the Architectural Engineering studio is the correlation between technology and architecture. My theme was chosen based on social context and relevance to the academic research field as energy producing building has not been researched as a building type.

relationship between the methodical line of approach of the studio and the method chosen by the student in this framework

My interpretation of the Architectural Engineering studio approach is that the technical innovation is the source for inspiration and creating certain architectural image. Therefore the main focus is the relation between the technical innovation and architecture. The instant shifting between technological research and architectural possibilities formed the basis for the design approach for this specific work. In other words the result of the

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1 not to be confused with energy efficient buildings, as the energy producing buildings are substantially different from energy producing
technological research forms a basis for the architectural research and at some point the architectural research pushes the boundaries of the technology.

**Conclusion**

The reflection on this approach shows that there are some aspect which were obstructive to the design process. The problem was in the tension between technology and architecture. Architecture itself might be considered as the artistic outcome where the decision making in the design process often based on subjective, intuitive choices. Technological part on the other hand can be seen as precise and objective outcome. Therefore the context or requirements derived from the technological part are very objective. At this point the subjective or artistic part of architectural process becomes extremely vulnerable, as the arguments based on technological research are hard to break while making aesthetical (subjective) choices. As a result it limits the freedom of the design choices, which I experienced explicitly during the project. The finding of the right composition of the design elements which would answer technological and architectural requirement was the most difficult part of the design process (figure 1 and 2). Once found, every aspect of the design became a part of the large, architecturally correct, energy producing system. It became like a machine where each detail serves a purpose whether it is technological, architectural or both.

Based on the preliminary energy calculations the design produces about 68% more energy than it uses, which is about 109 480 kWh/year. This would be enough to provide 23 houses (4 persons) with energy throughout the year. Therefore it might be concluded that in terms of energy production this approach is effective. The aesthetics of the design convey the nature of the building and provide sufficient architectural quality within given context. Thus, the energy producing architecture is possible, but it will be more complicated than the regular design and eventually it will lead to certain architectural type\(^2\). Also this study shows that not every location has a potential to be energy positive. Using this approach, however, the designer should be aware of this tension and be prepared to balance in between, in order to bridge the gap between technology and art.

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\(^2\) This “new” architectural type is determined by the element which are characteristic to the energy producing building: by sustainable energy producing elements, mostly compact shape, minimized glazed area, optimized shape for energy producing devices