P4 reflection

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A change of scope

The scope of this study was changed from designing a self-sufficient small residential building to reducing heat demand in a small residential building. As described in the graduation plan, the original goal of this project was to design a self-sufficient small residential building, housing 6 families, located in the Netherlands. The study was to consist of three parts: heat demand reduction, heat supply, and heat storage. It soon became clear that this scope was too broad so it was reduced to just 'heat demand reduction' for several reasons: first, it was concluded that this part already contained enough room for study; second, it was the part that was already furthest developed in terms of simulation preparation; third, heat demand reduction is by far the most important part for a designer as this part is most relevant for the (early) design phase and has a lot of impact on the overall energy requirements, while the other two parts (heat supply and heat storage) fall mostly in the domain of systems and installations. The largest down-side to this change of scope was that most of the literature review had to be adjusted as well, since two-thirds of it had lost most of its relevance.

The literature review was reduced in accordance with the change of scope and had to be rewritten to achieve sufficient depth. Although the inclusion of heat balance theory remains mostly the same, it will now explore further the design variables associated with heat demand and existing design strategies aimed at reducing heat demand.

Preliminary results

The aim of this study is to quantify the impact of individual design variables to ascertain their impact on the heat demand of a building. The method chosen, hourly simulations of a whole year, give data that allows the models to be compared to NZEB and passive house standards in terms of annual kWh/m^2.

Actual results came from the development of a heat simulation method in grasshopper Honeybee. Honeybee is a free plug-in, developed by a team at MIT, that allows for relatively simple modelling of heat balance situations in grasshopper that are then calculated with EnergyPlus. Results can range from one day average to hourly results from a whole year.

The modelling and results process provided important feed-back for what direction the study should go. Once it became clear that the chosen software would not only allow for extensive studies of the effects of design parameters on heat demand, but also for the comfortable use in terms of

temperature of non acclimatized zones, the study could further explore the comfortable use of sunspaces. This would allow for a fuller study of heat related aspects that are relevant to the design of small residential buildings.

Study aspects

In this study there is a clear link between research and design. The focus of this study is to provide designers with a clear image of the potential impact of design variables on the heat demand of a building. The research phase focuses on categorizing individual design variables and quantifying their impact on heat demand through simulation. These results are the basis for the final guidelines for designers.

As the name of the studio indicates (Sustainable Design Graduation Studio) the theme of the graduation lab is all about innovation in sustainable architecture. Reducing heat demand directly fits into this theme due to the societal and economic pressures to reduce dependency on fossil fuels. Lower heat demand in buildings will make it easier for buildings to become net-zero energy buildings or even completely energy independent with the help of local energy supply and storage systems.

The main thing that sets apart the sustainable design graduation lab from the rest of the departments is a methodology of quantification of technical design impacts through calculation, simulation and experimentation. Although this graduation project lacks experiments due to the nature and scale of the project, it is based on calculation and simulation that will form the basis for design decisions.

In the Netherlands the serious reduction of heat demand has not only become a societal trend, but will actually be an official demand on new buildings starting in 2020. The ambition is that this study will contribute to a smooth transition in residential building design that will allow new buildings to have lower heat demand. This study includes the re-design of an existing building design to an idealized version in terms of heat demand. However it is recognized that in most real-world situations a designer will not always have the freedom to optimally implement each design variable due to constrictions imposed by circumstance. By giving designers a clear indication of the impact of individual design parameters they can make better informed decisions on which parameters to prioritize in their struggle to face the multi-faceted demands any building design faces.

The road to P5: final products

Now that every product has been developed into a first, somewhat rough shape, the next step will be to refine these products into a final product stage. Most important will be the final guidelines for designers. This is the product that is the end result of all work in this study and will add most value to the current societal situation by enabling designers to better understand their role in creating residential buildings with low heat demand.