Reflection on Graduation project

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Graduation project and master programme

The study in Building technology is to learn how to innovate and improve the intelligence of the building environment, making it more comfortable and sustainable. During the study, I gained more interest in facade and climate design, so for my final practice, I've chosen 'Microgrid Integration of Smart facades' as my graduation topic, in which I developed a control strategy for the east facade of CEG building, to achieve better thermal comfort and energy efficiency.

From research to design: methods, dilemmas and solutions

To fulfil the goal by controlling shading and operable windows of the facade, the research focused on the comfort criteria, control strategies and their performance that related to solar shading and natural ventilation. The literature study provided references of the values for preliminary inputs, the principles behind the control, the hints of how to proceed the optimization toward comfort and energy efficient. The performance of the control strategies in the literature also used for evaluating the final control.

During P2, the methods that I used were interview and literature study. The interview with Juan F Azcárate-Aguerre and Jens Böke helped narrowing down topic and defining the start point of the design. The initial control strategy was set up at the end of this period. However, a missing link existed between the initial design and the context.

In P3, the new control strategy was built step by step, which meant the former simulation result in the context determined the next step. Iterations were taken due to the uncertainties that existed in the output of the control and the verification of how effective the controls were. During this phrase, the first dilemma was the verification of advanced control based on multiple parameters. Considering the uncertain performance of complicated control, the simulation limitation and the frequency of the operation, the new control was set up based on the operability of the facade panels and the available optimization of the software. The second dilemma was the design of automation and manual control. The problem was solved in the model setting, which assumed that one of facade panels in the room was controlled automatically and the other one was controlled manually, leaving the option for occupants to regulate their comfort. The control strategy mainly focused on auto panel and least operation of the manual panel. The third dilemma was the evaluation of the control strategy. Apart from

using the comfort criteria, the comparison within the design steps and with the monitoring data, and the EnergyMonitor data were also used.

In P4, the study focused on the evaluation of the control and the performance deviation that might exist when the control was put into use. The monitoring data was adapted to the simulation model by taking the average data and use it for the whole season. The results were parallel with the EnergyMonitor, so they could be regarded as reference groups for the evaluation of how effective the control was. The controls were designed step by step, therefore by comparing with the former step, the contribution of each function could be evaluated. Different scenarios also relieved the occupant impact on heating energy.

Scientific relevance and Social relevance

The final control strategy is highly applicable in the CEG context with the predefined facade panel. It shows the possibility of improving thermal comfort and energy efficiency by shading and natural ventilation control of facade. The targeted CEG rooms are offices, which have great potential in the application of smart facade. Choosing shading and operable window as the targeted functions is because they are the functions of the proposed facade panel by FLDP. They're also important controllable functions in the smart facade which have been developed for a long time but are still not satisfying user's need separately and their integration lacks development. Therefore the project could help enhancing the idea of 'integrated facade as a service' for the future building, especially the retrofit projects. In the future, with more profound integration of different functions, the smart facade can have a wider application and lead the market to a more sustainable direction.