

R E F L E C T I O N

GRADUATION PROCESS

With the EU setting multiple stringent goals for the energy performance of buildings, it can be said that we are already on the path towards creating an energy efficient built environment with reduced demands and emissions. Simultaneously (although not as fast paced), the EU also aims at increasing circularity in the built environment by proposing to reduce the use of primary raw materials and greenhouse gases. It is unknown if these goals intersect, and if they do, then where, and how much?

The aim of my research is to address this gap in information, as best as possible in the proposed time-line, and to facilitate this movement towards a sustainable building stock. Therefore, placing this research within the graduation studio is and was quite straightforward. The two main themes – energy and circularity, align with the building technology graduation studio themes.

Delving into the methodology of the research, there was a path chalked out from the start, which was clearly developed during P2. As this research does not have much established precedents to follow, the significance of the literature research cannot be undermined. Especially with respect to circularity, since it is a theme undergoing development and extensive research by multiple organizations currently, the literature research was very important to define a system boundary on which the research can be based.

An important and possibly crucial part of this research, one that was set to define the trajectory of the research process and outcome, was practical data collected from case studies. This research is heavily grounded in reality, as it takes actual data from newly built buildings, and therefore attaining qualitative data was very important. The collection of data is through a questionnaire that was distributed to self-builders in the case study area through a representative of a living lab in the area. This was possibly the most daunting part of the research until P3. Designing an extensive yet convenient (for respondents) questionnaire was a tedious task, however I'd like to believe the outcome was good. The design and distribution of the questionnaire is perhaps the less difficult phase, as I realized having the patience to wait for the arrival of responses was far more difficult. Even with the support of an extremely cooperative person at the living lab, the responses were slow, and when looked at from the perspective of a time bound graduation research, every day counts. It was a learning lesson to accept that the respondents cannot be expected to follow my research time plan. The finally collected data on the case study area has been assessed as best as possible, however more qualitative data would have refined the research further.

The focus after P3 (and also slightly before) was shifted to creating a framework that can be used to assess new buildings in an integrated manner so that when the right data is plugged in, the extent to which buildings are 'circular' can be determined, further leading to the possibility of improving this extent. I believe this turn of focus which became the core of my research provides a useful base upon which further research can be based in order to guide the built environment to a sustainable future. Therefore, looking back I believe this research would have been developed better and more detailed had this shift of focus had come sooner.

A facet of the research methodology that was left ambiguous and open from the start is the design task. As mentioned already, since the research is based on practical data, I wanted to ensure that the design task follows the analysis of the data and was not predefined. This posed some difficulties in the analysis phase, as it was difficult to define the extent to which each aspect in the analysis needed to be studied, and I often found myself studying

extensively about the technicality of energy installations, in case I decide to redesign it. However, as the research developed the design phase grew less important in comparison to the assessment framework, as an outcome of the lack of sufficient and qualitative data on the case study buildings. If this were not the case, it would have been interesting to be able to partially redesign a building based on the conducted literature review to realistically show how design can impact the operation and demolition of a building in a positive way. Nevertheless, the design guidelines formulated in this research also provide an insight into how design decisions can impact the overall circularity of a building.

SOCIETAL IMPACT

An interesting aspect of this research is its practical applicability. Since the input is realistic and based on newly built buildings with high ambitions related to energy performance and circularity, the output will be practically applicable measures that can be incorporated to improve the design of buildings, and gear it towards a more sustainable future. While this was a conscious effort, it was also a by product of the nature of this research.

It is important to note that there is a system boundary taken in the assessment framework and the assessments of the buildings. It would be fruitful, in terms of both energy and material resources to consider a larger boundary condition, including the sources of resources as well so that more conscious decisions can be made by designers and self-builders.

Through the distributed questionnaire interesting data was gathered on the studied novel development area, and it would be useful for other self-builders of the area to have access to this information so that future buildings can be designed better using these buildings as reference points. Hopefully this is made possible through this graduation report.

To conclude, while this research depicts the current state of certain flows in existing buildings, providing possibilities for improvements that can be made easily and immediately, more complex flows are also involved in a building (within the site and outside) which directly affect the circularity (both energy and material circularity) of a building. By including these flows in the assessment during the design phase, the buildings can be further improved to create a positive impact, rather than merely reducing the negative impact as suggested in the Cradle to Cradle framework.