Reflection
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The main objective of this research was to create a housing classification system that will help stimulate the growth of large-scale renovation approaches in the industry. The secondary objective was to find renovation solutions that are scalable and applicable to a greater number of buildings, therefore increasing the volume and lowering the renovation costs. Multiple research studies have classified the Dutch building stock based on architectural properties. However, not much research has been done to classify buildings based on building properties that influence the standardization of renovation approaches. During the research process the research had been narrowed down to the design of a façade renovation system specific to system-built houses.

Methodology and Approach
This research aims to identify essential building characteristics that influence renovation solutions. During the research process, interesting research was found as part of the IEBB (Integrale Energietransitie Bestaande Bouw). This follow-up research from Mohan (2022) focuses on classifying the Dutch housing stock based on standardizing renovation solutions and developing a tendering mechanism for large-scale renovation. The research approach is based on interviews and workshops with renovation industry experts to conclude which building characteristics are most important for standardizing renovation solutions. Mohan's research explores this topic well. To further build on this, the research will look at the criteria for scalability mentioned in her work, and together with a detailed look into system-built houses, a design will be formed.

This changed the research approach halfway, as the most essential building characteristics for standardization have already been identified. With the support of my mentors and additional research, I noticed that a significant factor influencing building renovation solutions was not considered in the P2. This factor is the desired solution for the building owner, tenants, and other stakeholders. According to the industry stakeholders interviewed during Mohan's research (2022), the quality of the renovation solution is the most important factor, not the cost or scalability of the project.

Throughout the research process, various cases have been examined. While many buildings may share comparable features, the Dutch post-war housing stock has the most similarities. However, upon closer inspection of building details and plans, it becomes clear that each building has unique characteristics. Even within the same building blocks, variations in orientations and design account for more differences. This has proven to be a significant challenge in the context of this graduation project, which is why the research focus has been narrowed down to just the system-built houses of this period. Another reason for focusing on this building group is that there is a significant amount of data and technical drawings available about these buildings.

While much information about the Dutch housing stock is publicly available, it is spread out and hard to evaluate. Different books and websites were necessary to gather the data. The WOon 2018 dataset is helpful, but it is complex and contains numerous variables, making it difficult to filter for the most relevant ones. Nieman (2020) used the same dataset to research Rc values for different housing classes, which has then been used in this research.

Relation to graduation

The graduation topic addresses issues in renovating the building envelope for the Dutch housing stock. It addresses the energy performance of existing buildings and how specific renovation measures could improve this performance. This is in line with the climate design chair from Building Technology. On the other hand, it focuses on investigating the existing building stock and classifying it to create a demand for large-scale renovation. Adaptability, materialization, and manufacturing play a great part in this research. This fits the chair of façade and product design.

The Building Technology track focuses on research, technological design, and innovation. It deals with the newest technology and interacts with the current market of the building renovation industry. It balances research and design, which is also important in this graduation project. The graduation topic covers multiple disciplines and relates to the master's program where architecture and engineering come together.

Relevance

The existing building stock has a significant impact on today's energy usage. The new highly sustainable buildings are not considered a problem which we add to this building stock. However, this is merely a small percentage of the total building stock.

Energy poverty is becoming a worldwide issue, especially with the current energy prices. Large-scale renovations should tackle these problems and provide affordable, quality living conditions. Gentrification often occurs when buildings are renovated, the rent is increased, and lower-income classes cannot afford to live there anymore. Tenant disruption is also important and should be considered with renovations. Furthermore, the renovation market has a massive labor shortage, and the industrialization of this process has the potential to fill this gap.

Transferability

The transferability of this research lies in its potential to inform and influence large-scale renovation approaches within the Dutch housing industry and in similar contexts worldwide. By identifying important building characteristics that impact the standardization of renovation solutions, this research provides valuable insights that can be adapted and applied in diverse settings facing similar challenges related to energy efficiency, building renovation, and affordable housing. The methodology that involves analyzing building data and different case studies offers a replicable framework for conducting similar studies in different regions or countries.

Questions
- How might incorporating stakeholders' desired solutions impact the effectiveness and feasibility of standardized renovation approaches within the Dutch housing stock, particularly in achieving scalability?
- Considering the complexities and variations within building characteristics, how can a classification system based on simple building characteristics lead to the most optimal renovation solution?