Thesis Proposal

Preserving the future

Strategies for neutralisation of the environmental impact through Extended Building Lifecycles

Master of Architecture, Urban Design and Building Technologies
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Emissions and a dwelling shortage are two major challenges for the building industry. From the ambition to get rid of the gas and realise climate-neutral homes, entire residential areas are being demolished and renovated. It is a bit like wanting to quit smoking by lighting one last cigarette as written by Birgit Dulski, researcher at Nyenrode Business University (Meurs & NRP, 2021).

Between the year 2000 and 2022, 1,548,901 houses were built, but at the same time 301,884 were demolished. This means that for every five new homes built, one home was demolished (Centraal Bureau voor de Statistiek, 2023).

In addition to capital depreciation, building demolition also results in emissions and counteracts the efforts to address the housing shortage in the Netherlands. The demolished buildings not only contribute to emissions during the demolition process but also result in additional emissions during the construction of new replacement housing.

Research indicates that the age of buildings significantly influences environmental performance. The environmental impact of a building is divided over the years in an environmental performance assessment, specifically considering the material impact per annum. By distributing the impact over a longer period, emissions are correspondingly reduced (Hoogers, 2004).

Furthermore, there is little understanding of exactly how many emissions are released in all phases within the building industry. New circular construction methods seem like a good initiative on paper to make construction climate-neutral, but then the materials must be reused correctly.

Reducing the demolition and construction phases and instead extending the use phase of building may be a better solution for making dwellings climate-neutral and solving the housing shortage for the long term.

In addition to the challenges related to dwelling and climate, the delta areas in the Netherlands face yet another pressing issue: subsidence of the ground, soil salinization, desiccation, and the disappearance of the original biodiversity. An alternative approach to land use within the Delta regions appears imperative.

Landscape architecture firm ZUS, in collaboration with Delft University of Technology, has developed a redesign titled "National Productive Park" to mitigate ground subsidence, soil salinization, desiccation, and the loss of the original biodiversity in Midden-Delfland (NATIONAL PRODUCTIVE PARK DELFTLAND, n.d.).

This research proposal serves as an exploration of the possibilities that architecture can offer concerning dwelling, climate change, ground subsidence, soil salinization, desiccation, and the disappearance of the original biodiversity.

The primary question posed in this exploration is: *Can Architecture contribute to neutralise the environmental impact of dwellings by prolonging the lifespan?*

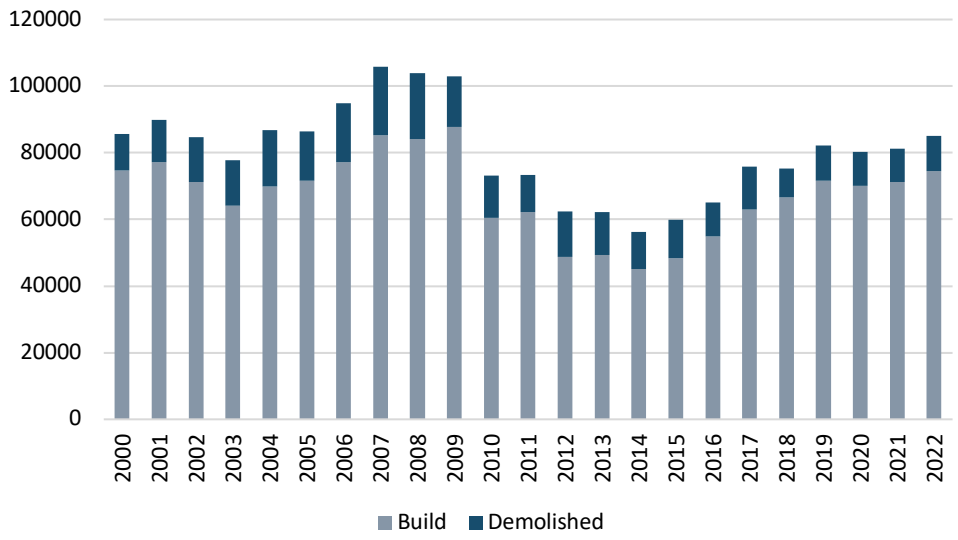

Figure 1: Build and demolished dwellings in The Netherlands (Centraal Bureau voor de Statistiek, 2023)

Research goal

This research proposal is initiated to explore alternative building strategies aimed at mitigating or neutralise their environmental impact. The knowledge derived from this research can ultimately lead to the development of an integrated housing design. This integrated design can serve as an exemplar for addressing climate change, housing shortages, ground subsidence, soil salinization, desiccation, and the decline of the original biodiversity.

The central question posed is: Can Architecture contribute to neutralise the environmental impact of dwellings by prolonging the lifespan? To address this question, the research is divided into three distinct chapters.

First and foremost, it is imperative to create a comprehensive overview using available data related to emissions in the construction industry that is practically applicable. It is crucial to include hidden costs and potential actions to mitigate environmental impact that are currently neglected in this comprehensive overview. An example could be the failure to segregate waste, while computational models assume such segregation. The consequence is a disparity between environmental impact in theory and practice.

Furthermore, gaining an understanding of why there is a significant amount of demolition in the Netherlands is essential. Thomsen (2006) observed that demolition decisions are influenced by factors such as the housing market, portfolio policies, management practices, and physical quality. In addition to the factors mentioned by Thomsen (2006), social sustainability may be a significant reason for discontinuing the use of a building, leading to demolition. From the perspective of building qualities and shortcomings, a framework can be established for designing buildings intended for extended use.

In the final part of the research, practical examples of residential buildings designed for the future or those that have been in use for an extended period will be examined. What factors have contributed to the longevity of these buildings? Ultimately, a formulation can be developed for extending the lifespan of a building to mitigate its environmental impact.

Questions

This research proposal encompasses both ecological and societal dimensions, serving as an exploration into the establishment of a climate-neutral built environment and an examination of housing shortages.

Circular construction is posited as a means to render the construction industry climate-neutral. It is imperative to critically scrutinize existing perspectives, such as circular construction, and explore alternative pathways towards achieving climate-neutral construction.

The research question to be addressed is: Can architecture contribute to neutralizing the environmental impact of dwellings by extending their lifespan?

To provide a comprehensive response to this research question, it is necessary to take a step back and thoroughly investigate the actual emissions in the construction process, from inception to demolition, considering usage and preservation of buildings. This multifaceted research will be addressed in three chapters, each posing a sub-question. The sub-questions are:

1. Exploring the ecological footprint throughout the entire lifecycle, what environmental impact does each phase of the building-to-demolition process have?
2. Investigating the rationale behind demolishing residential structures in the Netherlands, what are the primary motives driving the decision to demolish Dutch dwellings?
3. Which elements contribute to the preservation of buildings?

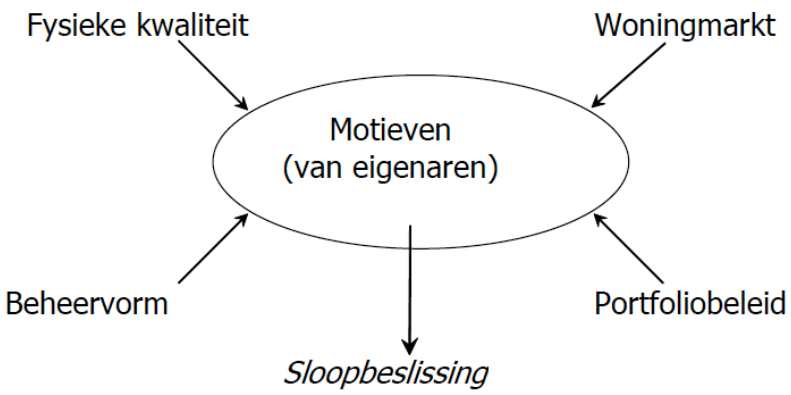

Figure 2: Demolition motives for demolishing Dutch dwellings (Thomsen, 2006)

Frame of Reference

The theme of the environment is unavoidable in today's context, and architecture plays a significant role in it. Various climate agreements determined by the European Union compel the Netherlands to become climate-neutral. The goal of the Netherlands is to achieve a circular economy by 2050 (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, 2022).

Circularity means that after use, products are used as are raw materials for new products, materials, or purposes. The aim of circularity is to strive towards a world without waste. In circularity, careful consideration is given during the production process to the next life of a product or its components.

A circular economy, and thus circular construction, is a way to eliminate emissions, with the goal of maintaining the world as a liveable place. This research points out that there are alternative ways to achieve minimal environmental impact.

Circularity is a commendable philosophy, but the question arises as to whether it aligns with reality. Thomas Rau acknowledges that while buildings can be easily disassembled and each material retains its value, no building is inherently circular; it merely has circular potential. "We can build buildings that are easily demountable and in which each material retains its value, but ultimately it is up to the next generations to do something with it and activate that potential. We can only facilitate it" (Thomas Rau: "The Circular Building Does Not Exist, There Are Only Buildings with Circular Potential," n.d.).

Preserving a building essentially shares the same end goal as circularity: passing on potential to the new generation. The current generation faces the challenge of leaving the world in a way that preserves potential for the next generation.

Passing on a pleasant world involves leaving behind a world with a stable ecology and society. A stable society is (partially) sustained by social sustainability. Social sustainability stands for maintaining or improving the well-being of people in current and future generations. Architecture serves to maintain social sustainability and pass on potential material value.

Further concepts addressed in this research proposal are:

Eco-Quantum calculation model

Eco-Quantum calculates the total environmental impact of a building over its life cycle - from raw materials, through maintenance and modification/renovation to the disposal of the final demolition material. This is a forecast. The score is determined by a series of factors such as the choice of materials, energy and water consumption throughout the life of the building (including extraction of raw materials), production of building materials and use, maintenance and demolition of the property. From this calculation, a weighted score for the house finally rolls out: the Eco-Quantum environmental indicator (Hoogers, 2004).

Environmental burden

Environmental burden is the burden of goods or activities that have a proven negative effect on the environment (Central Bureau of Statistics, n.d.).

Demolition motives

Demolition motives are underlying reasons why the decision is taken to demolish.

Lifespan

Lifespan is the time from beginning to end of use. In general, the technical lifespan of a building ends when the lifespan of the main load-bearing structure ends. Long before that time, the economic life may have ended i.e. the building can no longer provide the required functional performance at acceptable sacrifices. A renovation initiative may then be taken. In that case, a new cycle of initiative with programme of requirements, design and construction follows, culminating in a new period of use. When a building has reached the end of its useful life, it will be demolished or become vacant. In other words, the use is ended (De Vree, n.d.).

Delta areas

A delta region is defined as the area belonging to a river delta. The river delta represents the section of a river characterized by a system of distributaries before it flows into a lake or sea. When referring to delta regions in the Netherlands, it pertains to those areas situated between South Holland, Zeeland, and the west part of Noord Brabant.

Climate neutral

Climate neutral means not contributing to global warming. This means the greenhouse gases that are emitted are also removed from the air. Greenhouse gases are also called negative emissions.

Methodology

The first part of the study focuses on emissions in the building industry. A literature study will be used to identify how many emissions take place in the building industry.

There is still little grip on how many emissions take place per phase in construction. However, with the use of the Eco-Quantum calculation model of IVAM Environmental Research and W/E Advisors, the total environmental impact over time can be calculated. The score is determined by a range of factors such as choice of materials, energy and water consumption throughout the life of the building (including extraction of raw materials), production of building materials and use, maintenance and demolition of the house. From this calculation, a weighted score for the dwelling eventually rolls out: the Eco-Quantum environmental indicator (Hoogers, 2004).

Furthermore, several studies can be found in collaboration with the government that point out that circular construction is the solution to climate-neutral building. However, there is little discussion or testing of whether circularity actually takes place.

The literature review and the Eco-Quantum calculation model should ultimately provide an overview of the total emissions in construction and the failure points. It can then be considered whether it would not be better to build in a way that avoids demolition as much as possible.

The second chapter of the research will encompass a synthesis of literature review and case studies. The research direction of this chapter will be rationalized based on the two presumed demolition motives: physical qualities and economic considerations.

Existing literature will be employed to delineate the reasons for demolition in the Netherlands. Notably, research conducted by the Technical University of Delft, incorporating demolition surveys, has been undertaken on the life cycle of dwelling. From these investigations, factors such as corporate policies, biases, hidden agendas, and notably the influence of decision-makers are identified as contributors to the occurrence of demolition. This collective evidence suggests a predilection towards economic motivations (Thomsen, 2006).

By scrutinizing case studies of demolished projects, potential physical defects in buildings can be elucidated. These case studies will involve an analysis of material, climatic, and programmatic requirements, thereby elucidating the perils associated with demolition.

In the third phase of the research, an examination will be conducted through case studies to discern why certain buildings endure prolonged periods of use.

The historical trajectory is marked by diverse architectural paradigms. Over successive generations, perspectives and ideas about architecture underwent transformations. The garden city concept was prevalent in the 1930s, followed by the surge of modernism immediately after World War II, and a prevalence of structuralist approaches in the 1970s, linked to the philosophy of human scale. In retrospect, it becomes apparent that certain architectural philosophies prove more efficacious than others.

To comprehend the evolving architectural visions over time, a case study will be conducted for each period. The selected projects for these case studies must serve as reflections of their respective epochs, excluding extraordinary buildings or icons. The time periods under examination include:

- Before 1910
- From 1910 to 1940
- From 1940 to 1950
- The 1960s
- The 1970s
- The 1980s
- The 1990s
- From 2000 to the present

The rationales behind the enduring use of buildings may vary. Consequently, case study projects within the aforementioned temporal strata will be analysed based on architecture, program, and construction techniques.

A crucial aspect is to incorporate the concept of change into the research. To gain insights, each case study project will be scrutinized to identify instances of significant alterations and discern the nature of these changes. Topics of change may encompass usage, vacancy, construction, floor plans, or facades.

In addition to the physical attributes of buildings, the type of use or user can influence the extended utility of a structure, i.e., social sustainability. To explore social sustainability, an investigation into users in and around the case study project will be undertaken. Themes such as inequalities, prosperity, ethnicity, income, and income disparities will be mapped.

The methodologies outlined in the research ultimately aim to ascertain whether architecture can contribute to neutralise the environmental impact of dwellings by prolonging the lifespan.

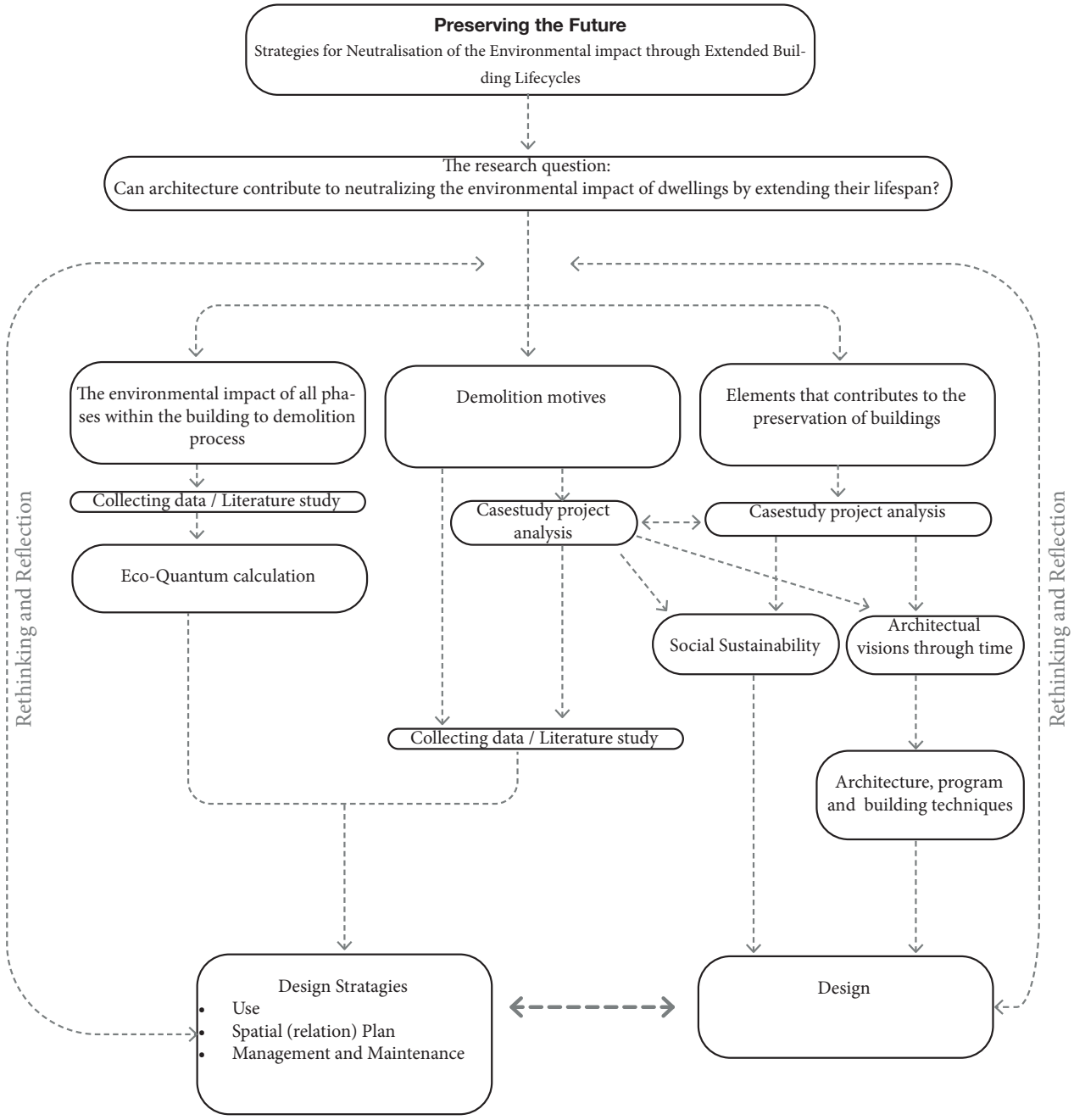

Figure 3:Diagram of Research Design (Vrij,2023)

Reflection of relevance

The housing shortage and climate change are two significant and current challenges. Circular construction is a way to achieve climate neutrality in the building industry. However, circular construction is a relatively novel topic, and personally, I question whether an overly optimistic view is taken. Circular construction becomes obsolete if the materials incorporated in buildings are not properly reused.

An example of circular construction is Building Part D(emountable) in Delft, designed by Cepezed. This building is a fully circular office structure on Cepezed's premises. All materials are demountable and can be reused. All components are designed to fit together seamlessly. While this is an appealing concept, there must be someone willing to reuse exactly the same type of elements.

Don't architects often want to design their own buildings rather than relocating an existing one? Additionally, there is the question of whether it is still financially attractive to clean and dismantle the facade elements, assuming they are still intact at all. How can one persuade a contractor not to opt for cheaper new facade elements?

Furthermore, the glass elements, of which Cepezed's (D)emountable building has many in its facade, will likely only be reusable as raw materials.

This research will offer an alternative option for climate-neutral construction alongside the circular construction approach. Prolonging the life of a building does not contradict the circular goals that the Netherlands has in mind and may present a combination of construction methods that offer promising prospects for the future.

Additionally, it is highly relevant to investigate where the emission hotspots are within the construction industry. Currently, there are few studies that consider all external costs over time.

All in all, solution-focused research aimed at mitigating global warming will propel us in a positive direction, with the aim of enabling a more desirable world for all in the future.

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