

Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences



Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Madevi Sewnath
Student number	5509890

Studio		
Name / Theme	Building technology graduation studio	
Main mentor	Thaleia Konstantinou	Building Product Innovation
Second mentor	Siebe Broersma	Climate Design & Sustainability
Argumentation of choice of the studio	-	

Graduation project	
Title of the graduation project	"The General characteristics of retrofitting strategies towards zero carbon buildings in the Netherlands."
Goal	
Location:	Netherlands
The posed problem,	It's urgent to reduce CO2 emissions and limit global warming. The use of renewable energy sources is a measure that aims to reduce the operational carbon and will reduce a large amount of CO2 emissions related to the building stock. On the contrary, as the operational carbon decreases the share of embodied carbon increases, and there are no standard assessment methods that consider the embodied carbon now. Due to the lack of the assessment of embodied carbon the effects of current renovation strategies on total carbon emissions are unknown. Secondly, carbon emissions are related to the full life cycle of the building. Renovation influences the life cycle of a building and future emissions. Therefore planning the life cycle until the end-of-life stage and the moment of a renovation are critical aspects as it

	<p>influences the overall total carbon emissions, and the decision to renovate. And last, the decision-making process for renovation is complex, as it depends on multiple criteria. Assessing the performance of all design possibilities for renovation on multiple criteria, that vary in importance is time consuming, especially in the early design stage when the level of data is limited. There is no insight on the general effects of a strategy on multiple criteria. This makes it hard to select a suitable renovation strategy and therefore complicates the decision making.</p>
research questions and	<p>This led to the following research question:</p> <p>How can renovation strategies be analyzed in the early design stage to support decision-making, in reducing the total carbon emissions over a building's lifecycle, in the Netherlands?</p> <p>This research question will be answered through the following sub questions:</p> <ol style="list-style-type: none"> 1. What are renovation strategies for a terraced house? 2. What renovation concepts can be formed for the renovation strategies? 3. How do the concepts perform on operational and embodied carbon? 4. What are the main criteria for decision making and how do the proposed concepts perform on these?
design assignment in which these result.	<p>An overview of different renovation strategies for existing terraced houses in the Netherlands, over the full life cycle of the building. With specific insight on how these strategies perform on decision-making criteria.</p>
Process	
Method description	
<p>To answer the research question this thesis starts with a literature review on renovation strategies, building life cycle and decision making. To provide the main strategies and concepts that will be investigated, the stages in the life cycle that will</p>	

be assessed and the criteria by which these will be analyzed to support decision making. After that the performance of the concepts is obtained through simulations. The results will be evaluated by comparison to the current state of the building and set requirements. The concepts that pass will be further analyzed on the criteria for decision making obtained from the literature. The report ends with a discussion critically viewing the used methods and an overall conclusion.

Literature and general practical preference

[The literature (theories or research data) and general practical experience/precedent you intend to consult.]

Reflection

1.

What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

Building technology is very technology oriented, however it can be challenging to implement technological solutions in existing cases, due to constraints and limitations and the many possible combinations of technical solutions. In other words the implementation of technique is an important aspect in building technology, and enables successful use of technologies. This graduation project, therefore doesn't necessarily focus on innovating technology but on the effect of it on environmental parameters to enable the use of technologies. Within the scope of the master AUBS, this graduation project is in line with the aim to stimulate sustainable development, by analyzing the possible environmental impacts of the future building stock. This is done by using strategies of multiple disciplines which is encouraged within the master, such as design practice, physical and social sciences (indirectly), technology and engineering.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

Social relevance

Reducing the environmental impact to a minimum is important to maintain and improve the living environment of future generations of humans and animals. On a shorter time span, switching from gas to renewable energy is necessary to reduce the environmental impact, as well as to switch from depleting sources to renewable sources to still foresee in human needs for water, heating and food preparation. And lastly the energy transitions requires residents to adjust to new energy sources and changing indoor living conditions. It is therefore important to deliver the environmental results that are promised, so the adjustment of residents is not in vain.

Scientific relevance

Current research focuses on different strategies to reduce the operational energy or

the embodied energy. Due to the different analyzing methods current strategies can't be compared on whole life carbon emissions. Effective strategies to reduce the operational carbon as well as the embodied carbon by 2050 are lacking. Secondly the embodied carbon of a building is also related to the planning of the building's life cycle. For science this can stimulate further research in whole life carbon. Another gap in the literature is the assessment of the embodied energy. There isn't a clear approach. This makes it hard to define the embodied carbon on a building material level over the lifetime of the building. This research could provide insight in the embodied carbon of building materials and indicate where innovation is needed.