Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

Personal information	
Name	Lorenz Eschke
Student number	5858704

Studio		
Name / Theme	Architectural Engineering / Embodied Carbon	
Main mentor	Mauro Parravicini	Design
Second mentor	Arie Bergsma	Building Technology
Argumentation of choice of the studio	The individualized approach allows students to explore their own topics with a technical focus. Ideas that are "outside the box" of conventional architectural trends can thereby be tested.	

Graduation project	
Title of the graduation project	Towards an Everlasting Architecture
Goal	
Location:	Delft
Problem Statement	The construction industry is a major contributor to climate change. To create sustainable and resilient architecture longevity should play a major role, as the initial embodied carbon can be used for longer. Furthermore, the lifespan of Dutch dwellings needs to be extended to counteract the low annual net addition of new buildings and the housing shortage.
Overall Design Question	How to design a multifunctional building (student housing + education) on campus that rethinks the typical timescales of architecture and provides a sustainable alternative to construction methods with a low initial carbon footprint (such as timber construction) by using a durable structure and passive measures while remaining highly adaptable to future changes in its requirements.

Research Question	Which material is best suited to create a durable and therefore sustainable structure for the design? Sub questions: 1. Which material is the best for integrating passive measures to minimize active services and the embodied carbon associated with them? 2. How does the Pantheon perform in terms of embodied carbon footprint at the present time in comparison to a contemporary case study?
Design assignment in which these result:	The development a multifunctional building complex on the TU Delft campus. This is based on a durable supporting structure which is "filled" with short-lived building elements. In this way, it can be guaranteed that the building will be able to adapt to new functions and requirements over its long service life. The site, which is currently used as a parking lot, will in future be actively used as part of the campus where living, teaching, nature and leisure meet.

Process

Method description

1. Literature review was used to understand the relevance of embodied carbon and service life. Through the sources consulted, the largest EC carriers within a building were identified.

2. Various historical and contemporary case studies were analyzed and compared in a matrix regarding factors such as their longevity in order to determine which building material is best suited for the intended structure.

3. To test the thesis regarding the sustainability of durable architecture, a hypothetical calculation of the GWP of the Pantheon was carried out. The necessary information was taken from literature, a self-built 3D model and technical data sheets.

Literature and general practical preference

1. Background information on embodied and operational carbon to understand their relevance.

2. Literature on the topic of life cycle assessment (LCA) to understand the basic approach and to apply it in part to the example of the pantheon.

3. Literature on various building materials with a focus on opus caementicium.

4. Literature on the various case studies in order to carry out an individual analysis and then compare the results.

Reflection

1. The topic of sustainability through longevity is linked to the Architectural Engineering studio in the sense that it deals with the technical implementation and scientific examination as well as the feasibility of this idea. The studio's highly individual approach enables research into the sometimes counter-intuitive principle of architecture with a rather large initial embodied carbon footprint.

2. The Architecture track combines research with creativity, which is also the case in this project, as it consists of a scientific paper and a design based on it.

3. Since the entire Master's program is largely based on the teaching of sustainable architecture, this project deals with a counter-proposal to current trends such as pure timber construction.

4. The connection to the professional field of architecture is obvious. The construction industry's large share of global carbon emissions puts architects under pressure, as both embodied carbon and operational carbon must be reduced. Unfortunately, the way sustainability is dealt with in practice is significantly lagging behind the way it is dealt with academically, as clients, for example, also have to pay for additional costs in order to build sustainably. In general, this project proposes a paradigm shift, which states that both the initial embodied carbon and the financial investment should not only be set for a life span of 50-100 years, but for centuries and millennia. This could also address other problems such as the housing crisis in the Netherlands.