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	Iris Marie Anne van Leeuwen
Student number	5504895

Studio		
Name / Theme	Architectural Engineering Graduation Studio	
Main mentor	Thomas Offermans	Architecture design
Second mentor	Mo Smit	Thematic research
Argumentation of choice of the studio	The name of this studio somewhat hints at it, the focus lies on the technical aspect within architecture. I think this is a nice correlation of the creative, non-tangible side of design and the concrete side with technical solutions. It is an overall approach that combines theory with a technical focus. This allows architectural and social solutions to be found, to which a deeper layer is added when a building also is being designed with a technical engineered approach. This provides the building not only to work well at building level, but also on surrounding- and regional level. In my opinion, this is the best combination that can be made in architecture, and I want to take on this challenge in my graduation project in this studio. My goal is therefore to design a building with architectural value based on technical principles that makes the building work as efficiently and optimally as possible without harming the environment.	

Graduation project	
Title of the graduation project	Exploring Light Earth as futureproof construction method
Goal	
Location:	The Netherlands Crailo, Gooi & Vecht region
The posed problem,	In conjunction with the significant housing shortage in the Netherlands, the building sector confronts environmental challenges, specifically related to the materials- and energy transition. The integration of these aspects the building industry seems to

	be progressing at a slower pace than required. The commitment to build simultaneously affordable, sustainable and architecturally the best is considered as complicated. However, this transition is crucial. This urgency is not only driven by the need to achieve the Paris Agreement targets, but due to the current ways of resource extraction for the building industry, often leading to the over-exploitation of ecosystems elsewhere. One approach to address this problem is to integrate natural building methods, like the light earth construction method, into existing building methods, like timber frame structures, to make the transition more straightforward.
research questions and	*"In what ways can the light earth construction method, using locally sourced materials (earth, wood, and fibres) from the Netherlands, address contemporary residential requirements and be incorporated in existing timber frame housing construction methods?"*
design assignment in which this result.	As a result of the research to the implementation of the light earth construction method into existing timber structures that meets strict futureproof housing requirements, a residential building is designed. This residential building could be considered as proof where all these issues are combined in one building. Next to this technical part, the design will also incorporate the challenge of co-habitation of diverse population groups, namely in different age groups. The design question will therefore be: *"What are the ingredients for a design of an eco-positive residential building, which allows for co-habitation of diverse population groups and can be constructed with affordable biobased materials from the region?"*

Process

Method description

The research uses the Gooi- and Vecht region in the Netherlands as a case-study to verify, test and finally apply the research findings as part of the MSc graduation project in architectural engineering. This means that the provision of the resources for the light earth method will be sought in that surrounding using a landscape analysis of different types of soil. Although this research focuses on this area, the building method with light earth could also be incorporated in other contexts.
The next part of the research, focusing on understanding the properties, performances and constrains of the light earth construction method, will be done by literature study. Franz Volhard's book *Light Earth Building* gives the technical performances that can be achieved with light earth building. Different types of mixtures of light earth, each with different properties, are compared on their technical performances. In addition to this, the aesthetic properties of light earth building will be taken into account. This is done by a prototyping approach. Finishes and other design options will be layed-out next to each other.
Following to investigating the light earth method, literature research and case study is being conducted on conventional prefabricated timber elements. This provides an insight of how these structures are used today, which is important to understand for further development with light earth. Next, we will look at what needs to be adapted to the existing building method to add the light earth method into it.
The results of this research will be translated into a "menu", as a prototype. Which materials (the "ingredients") are needed for which building elements (the "dishes") in a residential building (the "meal"). This shows at once how to implement the use of light earth into existing prefab timber frame construction method(s), complying to future proof housing standards (insulation & comfort, aesthetics, sustainability, etc.).

Literature and general practical preference

1. De Bakker, H., & Schelling, J. (1966). *Systeem van bodemclassificatie voor Nederland: de hogere niveaus.* Grondboor & Hamer, 20(5).229
2. edX & Delft University of Technology (2023, 25 oktober). *DelftX: Sustainable Building with Timber.* [Online course]. https://www.edx.org/learn/architecture/delft-university-of-technology-building-with-timber
3. F. Asdrubali, B. Ferracuti, L. Lombardi, C. Guattari, L. Evangelisti, G. Grazieschi. (2017). A review of structural, thermo-physical, acoustical, and environmental properties of wooden materials for building applications. *Building and Environment*, 14, 307-332. https://doi.org/10.1016/j.buildenv.2016.12.033.
4. Harju, C. (2022). The perceived quality of wooden building materials | A systematic literature review and future research agenda. *International Journal of Consumer Studies*, 46, 29–55. https://doi.org/10.1111/ijcs.12764
5. Noy, N., & Maessen, H. (2011). *Jellema 8 - Woningbouw*. ThiemeMeulenhoff.

6. Smit, M.J. Groenendijk, R. Köbben, R. & Vélu, D. (2022). *Stichting Bouwtuin, Naar een Nieuwe Streekarchitectuur*
7. Velu, D. (2021). *Urban Light Earth: the potential of light earth building in urban settings.* Delft University of Technology. http://resolver.tudelft.nl/uuid:bb76053a-0436-43b8-9a91-25845045caa8
8. Volhard, F. (2016). *Light Earth Building*. De Gruyter eBooks. https://doi.org/10.1515/9783035606454

Reflection

The subject of building with natural building methods is very much related to the graduation studio architectural engineering, because the focus lies on the technical aspect within architecture. The technique of building methods meets architectural aspects through the chosen biobased material, which has a lot of potential in future building methods.

The research, conducted mainly in the Netherlands, is more broadly applicable to regions with similar contexts. Although the technical research focuses mainly on Dutch methods and materials, the insights are also applicable to regions with similar materials and facilities.
The same applies in terms of general design research. The architectural design is accurately adapted to the specific location in the Gooi and Vecht region, but it possesses the potential for wider impact. The need to create buildings that take into account the emissions and footprint of their components is highly relevant for the Netherlands, in line with the goal of having a circular building sector by 2050. This approach can also be embraced by the global construction industry, which aims to reduce material consumption and improve overall quality and efficiency.