

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	Leslie Ing
Student number	4601378

Studio		
Name / Theme	Architectural Engineering	
Main mentor	Ir. Thomas Offermans	Architecture
Second mentor	Ir. Paddy Tomesen	Building Technology
Argumentation of choice of the studio	<p>What architectural engineering offers is the integration of architecture and technology, in order to tackle the biggest architectural challenge of our time: a sustainable built environment. The ideal framework in which to prepare for a future where social problems, climate change, scarce resources and energy do not frighten, but instead pave the way for a transition to a sustainable future where we can coexist with our living environment and planet harmoniously. The future architect is well-positioned to take a facilitating role in this collaborative effort.</p>	

Graduation project	
Title of the graduation project	<i>Vakwerk Boerhaavewijk</i> <i>Verrassend Boerhaavewijk</i> <i>Veerkrachtig Boerhaavewijk</i>
Goal	
Location:	Boerhaavewijk, Haarlem, NL
The posed problem,	<ul style="list-style-type: none"> - There is a shortage of future-proof facilities and community spaces in Boerhaavewijk. - We still don't use local renewable materials in construction (that comply with today's building standards and also stand the test of time). - The architecture and urban design of Boerhaavewijk promote anonymity, instead of social cohesion and a strong identity.

research questions and	<ul style="list-style-type: none"> - How to design a future-proof community building in Boerhaavewijk? - What is the potential of 3D printed earth as a sustainable building practice? - How to design an iconic building to put Boerhaavewijk on the map?
design assignment in which these result.	- The design of an iconic and sustainable forum in Boerhaavewijk that can adapt to changing demographics and demands.

Process

Method description

The AE studio is dependent on the two pillars of architecture and engineering. As such a thematic paper is written on the technical subject of optimising morphologies of additively manufactured earthen facade elements. Through literature research a deeper understanding of earthen material mixtures, their properties and how they influence the constructive and thermal properties of earthen facade elements is created. Furthermore, in a process of research by design, it was found out that multi-objective optimisation is a useful tool to generate architectural morphologies of the facade, but that it is mostly a *form follows function* driven method of designing.

Through site analysis and site visits to Boerhaavewijk, talks with local organisations and people there was established a need for more community spaces and buildings. By further analysing the site and creating a local masterplan for a potential community centre, boundary conditions are created to limit the scope of the project as well as establish a program of requirements (PvE). A tool here is comparative analysis with other sites, buildings and programmes that have some relation to the design assignment.

Finally the design will be given shape, within the boundaries as set in the masterplan, in a process of research by design. This will both embrace the architectural and engineering aspects of the studio, through the exploration of the aforementioned earth material as a way to create sustainable architectural 'infill' and 'skin' elements, which are held together in the structure's 'skeleton' which will preferably use locally harvested tertiary materials or circular bio-based materials such as wood. Thus, by design, the building uses the 'layers of change', allowing it to adapt to future demands of its users. This is achieved because the different 'layers' of the building will have their respective lifespans adapted to their functional use. Intended as an iconic and sustainable building to bring new identity to the local community, full use will be made of the potential of 3D printing with earth, combining technical considerations with architectural intent.

Literature and general practical preference

For an extensive list of literature consulted for the thematic paper and all that is related to the additive manufacturing of earth see the references section in: *Optimising The Morphology Of Additively Manufactured Earthen Facade Elements*.

For the site research and analysis, these among other sources are consulted:

- Bolhuis, J. (2022, September 23). *Living Lab Boerhaavewijk* [PowerPoint slides]. TU Delft architectural Engineering round-table.
- BRO. (2020, June 30). *Bestemmingsplan Markthal Schalkstad*.
<https://gemeentebestuur.haarlem.nl/bestuurlijke-stukken/20200493175-2-Bijlage-1-Ontwerpbestemmingsplan-Markthal.pdf>
- Gemeente Haarlem. (2008). *Bestemmingsplan Schalkwijk*. Retrieved from
<https://docplayer.nl/27674272-Bestemmingsplan-schalkwijk.html>
- Gemeente Haarlem. (2011, May). *Gebiedsvisie Boerhaavewijk*. Retrieved from
<https://gemeentebestuur.haarlem.nl/bestuurlijke-stukken/2011600032-Raadsbesluit-Vaststellen-Gebiedsvisie-Boerhaavewijk1.pdf>
- Gemeente Haarlem. (2013). *Bestemmingsplan Schalkwijk-Midden*. Retrieved from
<https://gemeentebestuur.haarlem.nl/bestuurlijke-stukken/2013132703-Raadsstuk-Vaststelling-bestemmingsplan-Schalkwijk-Midden.pdf>
- Gemeente Haarlem. (2017). *Structuurvisie openbare ruimte. Haarlem 2040: Groen en Bereikbaar*. Retrieved from
<https://gemeentebestuur.haarlem.nl/bestuurlijke-stukken/2017081633-3-Bijlage-Haarlem-2040-Groen-en-bereikbaar.pdf>
- Gemeente Haarlem. (2018, November 8). *Nederlandse steden en hun ondergrond*. Retrieved from
<https://klimaatadaptatienederland.nl/@204123/ondergrond/>
- Gemeente Haarlem. (2019a). *Ontwerpbestemmingsplan Boerhaavewijk*. Retrieved from
<https://gemeentebestuur.haarlem.nl/bestuurlijke-stukken/2019788198-2-Bijlage-A-Ontwerpbestemmingsplan-Boerhaavewijk.pdf>
- Gemeente Haarlem. (2019b, April 4). *Strategisch huisvestingsplan onderwijs 2019 - 2022*. Bijlage 1. Retrieved from
<https://gemeentebestuur.haarlem.nl/bestuurlijke-stukken/2019085960-2-Bijlage-1-Strategisch-Huisvestingsplan-onderwijs-SHO-2019-2022.pdf>
- Gemeente Haarlem. (2019c). *Verkenning ondergrond Haarlem. Uitwerking onderdeel 'bijdrage aan ruimtelijke kwaliteit'*. Retrieved from
<https://www.netwerkkans.nl/wp-content/uploads/2019/08/Haarlem-Bouwstenen-ruimtelijke-kwal-1.pdf>
- Gemeente Haarlem. (2020, January 13). *Strategisch huisvestingsplan onderwijs 2019 - 2022*. Bijlage 2. Retrieved from
<https://gemeentebestuur.haarlem.nl/bestuurlijke-stukken/2019842178-3-Bijlage-2-Strategisch-Huisvestingsplan-Onderwijshuisvesting-2019-2022-SHO-2019-2022-2.pdf>
- KAW. (2020). *Ruimte zat in de stad*. Retrieved from
<https://www.kaw.nl/projecten/onderzoek-ruimte-zat-corporatievastgoed/>
- KAW. (2021). *Ruimte zat in de nieuwe stad*. Retrieved from:
<https://www.kaw.nl/projecten/vervolgonderzoek-ruimte-zat-voor-de-nieuwe-stad/>
- Mekking, W. (2020, October 2). Oud kantoorgebouw FNV maakt plaats voor woningen in Schalkwijk-Midden in Haarlem. *Haarlems Dagblad*. Retrieved from
https://www.haarlemsdagblad.nl/cnt/dmf20201002_8081166?utm_source=google&utm_medium=organic
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<https://gemeentebestuur.haarlem.nl/bestuurlijke-stukken/2016575516-3-Bijlage-A-Stedenbouwkundige-Visie-Boerhaavewijk-Noord.pdf>

Open Building. (2021). *Manifesto openbuilding.co*. Retrieved from <https://www.openbuilding.co/manifesto>

Vermeer, G., Eijkelboom, G. (2019, September). *Waardstellende beschrijving Moeder-van-de-Verlosserkerk, Haarlem*. Retrieved from <https://gemeentebestuur.haarlem.nl/bestuurlijke-stukken/20191000204-4-Bijlage-1-bij-bijlage-2-Redengevende-beschrijving-Moeder-van-de-Verlosserkerk.pdf>

Wijkraad Boerhaavewijk. (n.d.a). *De Boerhaavewijk in historisch beeld vastgelegd*. Retrieved from <https://boerhaavewijk.nl/fotos/>

Wijkraad Boerhaavewijk. (n.d.b). *Ontwikkelingen in de wijk*. Retrieved from <https://boerhaavewijk.nl/ontwikkelingen-in-de-wijk/>

Reflection

The graduation project is grounded firmly in multiple topics that are found within the Architectural Engineering studio as a whole. The project aims to deliver a social building for the existing 60s neighbourhood of Boerhaavewijk, revitalising the place in the process. Sustainable materials are to be harvested locally, if possible, and circular detailing will aim towards the design of a flexible and demountable building. Furthermore the key concept of 'open building' is applied here, so that future change in users will be possible to adapt to. All in all, the project aims to combine innovative and inspiring architectural solutions for environmental and societal issues.

The graduation design project touches upon problems that are specific to Boerhaavewijk. However, at the same time this location is a microcosm of post-war neighbourhoods found all over the Netherlands. That is because of the CIAM guidelines the post-war neighbourhoods followed when designed and built, resulting in an incredibly high rate of similarity throughout the country because of standardised building systems and repeated 'stamps'. Thus, the problems tackled during the design research concern not just Boerhaavewijk, but potentially similar sites all over the country.

The thematic research into additive manufacturing of earthen building envelopes is very relevant in contemporary scientific research. In recent years there can be a major uptick observed in the number of published papers concerning the additive manufacturing of earth, as well as progress in the actual application of it in pavilions. Being able to understand the thermal and structural performance of AM earthen facades is of great relevance to expand the use of earth in real world conditions. Understanding the technical properties of earth are essential in the pivot towards a more sustainable built environment. Furthermore, a better understanding of its appearance and esthetical design potential as a result of the AM process will be crucial to get the material, nowadays barely considered for modern building, socially accepted and approved by both designers and users.