

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	Rubin Agerbeek
Student number	5236851
Studio	
Name / Theme	AR3AE100 Architectural Engineering (2021/22)
Main mentor	Mauro Paravicini Architecture
Second mentor	Gilbert Koskamp Research
Third Mentor	Ger Warries Building Technology
Argumentation of choice of the studio	The Architectural Engineering studio seemed to be the most practical and relevant studio to me. It addresses very relevant topics and (design) challenges and I felt that I could learn the most in this studio, especially in the field of engineering and detailing. This is an aspect of which I know I would like to improve in. Since I didn't get the change to follow a proper internship at my bachelor's degree at the Amsterdam University of Applied Science, I feel like I sometimes lack knowledge of the work field.
Graduation project	
Title of the graduation project	Low-tech timber design for affordable housing in the urban area.
Goal	
Location:	Merwedeterrein, Arnhem, the Netherlands
The posed problem	The Netherlands is currently dealing with a housing shortage and will do so for the coming years. ABF Research published a rapport on the prospects for population, households and the housing market for the Netherlands in the period 2021-2035 (Groenemeijer et al., 2021). From their report it becomes clear that in the period from 2021 to 2035 a substantial addition to the housing stock of approximately 1 million homes is required. The greatest demand for both owner-occupied and rental homes is in the low-cost sector, where there is approximately a 1:3 ratio of new rental properties to owner-occupied homes per year. Therefore, a coalition of 34 organizations in the field of housing, construction and care and welfare has drawn up an action plan in collaboration with

	<p>municipalities and provinces to tackle this enormous demand for housing (NOS, 2021). The housing coalition wants to build faster, cheaper and more factory. This means that the scarce land in the Dutch urban areas must be used efficiently. According to Verheul (2017), the existing housing supply in and around the major cities has become inadequate for many groups. The average amount spent on housing as a percentage of income varies from 30 to 37 percent.</p> <p>Another major issue is the impending catastrophe of climate change. According to the United Nations Environment Program (2020), the construction sector is responsible for 38% of total CO₂ emissions. Therefore a lot can and needs to be done in this sector to align with the Sustainable Development Goals (United Nations, 2015) and to make it a zero-emission, efficient and resilient sector. This entails adopting concepts around circular economy to reduce the demand for materials and the embodied carbon in buildings. Besides, this means adopting nature-based solutions that enhance building resilience. Finally, it means embedding principles of health into the development of new buildings and renovation of existing homes to protect its inhabitants (United Nations Environment Program, 2020).</p>
<p>Research questions</p>	<p>In order to contribute towards solving the housing shortage and achieving the Sustainable Development Goals of the UN, research on improving the quality and quantity of affordable housing, and on the efficient use of low-carbon materials will need to be done. This means that housing development must take place in a sustainable manner. That is why the sustainable development pillars of 'People', 'Planet' and 'Profit' must be in balance. People should have a comfortable, affordable and healthy living environment. The planet requires a reduction of CO₂ emissions and efficient use of resources to be able to survive. The profit is important to make the project realistic and attractive to developers. The pillar 'Profit' will have to be defined differently in order to advocate a stronger focus on the social and environmental aspects of development.</p> <p>In this research a strong focus lies in the possibilities for low-tech design solutions to realize affordable housing and to make efficient use of materials. In addition, the focus will be on the use of timber design because of the material properties that are positive for all three pillars of sustainable development and for the possibilities for prefab and modular construction. Therefore, the main research question is 'How can low-tech possibilities for timber design increase the affordability of housing?'. The research firstly investigates the</p>

	<p>way affordability can be measured and the way the degree of low-tech can be measured. A range of parameters have resulted from this that give more insight in the way these aspect can be measured. Subsequently, case studies utilizing timber construction are tested on these parameters to extract usable design approaches or elements.</p>
<p>Design assignment in which these result.</p>	<p>How can the development of the Merwedeterrein in Arnhem create an integral supply chain for construction timber for the realization of affordable housing for the location? The parameters drawn up from the research serve as guidelines for the redevelopment of the area. Social and environmental objectives will become integral parts of the total supply chain. This will require connections with and integration of the local community and environment.</p>
<p>Process</p>	
<p>Method description</p>	
<p>For the thematic research, first of all a literature study was conducted into the two main aspects 'affordability' and 'low-tech'. Parameters have been drawn up from this that serve as a design tool. Case studies were then analyzed against these parameters to test the parameters and to investigate practical approaches. These approaches can in turn have a certain influence on the approach method that will be used in the development of the Merwedeterrein.</p> <p>Therefore, during the design phase, the focus will be on the design of the affordable timber dwellings as well as on the design of the integral supply chain and the role that the site can play in this.</p>	

Literature and general practical preference

The following main sources were used for the thematic research and will be guiding throughout the design as well:

- Wilson, F., & Post, J. E. (2011). Business models for people, planet (& profits): exploring the phenomena of social business, a market-based approach to social value creation. *Small Business Economics*, 40(3), 715–737. <https://doi.org/10.1007/s11187-011-9401-0>
- Verheul, W. J. (2017, October). *Onbetaalbare huizen en onderbenutte gebieden: De institutionele leegte van woningbouw en gebiedstransformatie*. <https://doi.org/10.5553/Bk/092733872017026003002>
- Fowles, E. (2021, July 15). *Make low-tech our mantra and design clean and simple*. *RIBA Journal*. Retrieved October 19, 2021, from <https://www.ribaj.com/intelligence/low-tech-reset-climate-emergency-feilden-fowles>
- Notten, A. L. T. (2008). *De lerende stad*. Garant.
- Meeuwisse, M. (2015). *Psychologie van de stad*. Garant.
- CINARK, The Royal Danish Academy. (2019). *The Construction Material Pyramid*. Retrieved January 8, 2022, from <https://www.materialepyramiden.dk/#>

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)?

The 1M homes assignment plays a central role in the Architectural Engineering design studio. With my project I try to contribute to achieving this goal by focusing on the architecture of affordable timber homes and on the integral supply chain that is required for this.

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

With the current climate change, there is an ever-growing demand for construction methods with carbon neutral or carbon positive materials. With my project I try to respond to this by focusing on the possibilities within timber constructions. In addition, with my research I try to pay more attention to affordability and low-tech to see what role these aspects play in the architecture world. By setting up the parameters as a design tool, I try to make these topics more concrete and manageable.