

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	Benjamin Bomben	
Student number	5511585	
Studio		
Name / Theme	Architectural Engineering	
Main mentor	Anne Snijders	Design
Second mentor	Pieter Stoutjesdijk	Building technology
Argumentation of choice of the studio	The triangle approach of the studio offers a great deal of flexibility to explore a specific thesis not offered by other studios. Moreover, it places an important focus on the technical aspects of architecture in order to attain your design ambition.	
Graduation project		
Title of the graduation project	Hybrid Campus: Transforming single use parking lots into hybrid buildings	
Goal		
Location:	Delft Campus, Netherlands	
The posed problem,	As a result of current practices, the built environment is unable to easily adapt to future social, environmental and economic contexts. Producing a significant amount of waste in order to try and upgrade the past, rather than trying to design for the future. With the world changing more than ever, there is a major problem with how we conceive our built environment. Throughout TU Delft, there is a lack of high density, adaptable mixed-use programming to truly facilitate a living-lab for experimentation, collaboration and innovation. Moreover, this need to maximize space throughout campus provides the opportunity to bring activity to the spaces in-between.	
research questions and	What configuration of prefabricated systems generates the most optimized use of engineered timber for a hybrid building?	

	Q1. What is the relation between 1d/2d/3d engineered timber dimensioning and structural / acoustical/ fire requirements of different programmatic functions? Q2. What are other aspects / boundary conditions influencing the dimension of 1d/2d/3d engineered timber elements? (Like transport, machine sizes, lifting capacity of cranes etc) Q3. How to combine this input in a tool for designers, advising in early stages of design about optimized use of engineered timber in relation to designer input such as overall building shape and sizing of compartmentation
design assignment in which these result.	Transforming underused locations of existing parking lots into an active hybrid environment by integrating high density residential and educational uses. Maximizing the use of space throughout campus and exceeding TU Delft's need to accommodate 23,000 students by 2029, through an optimized temporary kit of parts configuration. The project will explore different spatial qualities within this high density, hybridized environment, rethinking the role of the building on campus. Refer to appendix p.3 for existing parking lots to be transformed on campus.
The aim of this research is to explore the different factors that influence the dimensionality of timber and its application in 1D, 2D, and 3D systems. Moreover, it examines how these factors differ between typologies such as residential and educational to create a hybrid building system and program. Resulting in an established rules of thumb for designers to utilize during the schematic design phase to make more informed decisions.	
Process	
Method description	
- Literature reviews to develop a thorough understanding of 1D, 2D, and 3D timber systems. The literature studies would then allow for the development of a series of rules of thumb that answer the proposed sub-questions Q1, Q2 and Q3. By exploring manufacturing, transportation, assembly, spans, fire and acoustics and its influence on the overall dimensionality of prefabricated engineered timber systems. - A series of case studies were then selected, three timber residential case studies and three educational case studies, in order to address each of the 3 timber systems (1D, 2D, 3D). The case studies were selected based on a set of parameters to ensure their relevance to the project objective and to meet the requirements of the Netherlands climate. With the project objective of generating a mid-height building of ≤ 22 meters or 4-8 storeys. The case	

studies would need to be within this range of height to provide a good reference for structural sizing and fire class requirements (building class 4-5). A comparison of the case study's building assemblies including, exterior wall, interior wall, floor and roof, would provide insight into sub-questions Q1 and Q2. Allowing for a visual understanding of how the developed rules of thumb influence the overall dimensionality of assemblies for residential and educational typologies.

- The developed rules of thumb would then be tested against the case studies to assess their accuracy and be further refined to then be compiled into a digital master table matrix, resulting in the final design tool.

Literature and general practical preference

- Understanding the material of CLT and Glulam:
 - Manual of Multi-Storey timber construction (Kaufmann et. al, 2018)
 - 100 UK CLT Projects (Waugh Thistleton Architects, 2018)
- Application of existing 1D, 2D and 3D timber systems:
 - Manual of Multi-Storey timber construction (Kaufmann et. al, 2018)
 - Offsite Architecture (Smith & Quale, 2017)
- Establishing rules of thumb for timber systems:
 - Manual of Multi-Storey timber construction (Kaufmann et. al, 2018)
 - Offsite Architecture (Smith & Quale, 2017)
 - Prefab Architectuer: A guide to modular design and construction (Smith, 2011)

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)?

My graduation topic of looking to combine existing 1D, 2D and 3D timber systems, works toward being able to quickly respond to TU Delft's need to quickly respond to an increasing housing demand on campus. As a result, this relates to the selected categories from the studio provide triangle approach which is open building, making, and the context of Delft Campus. Which is primarily concerned with creating something new to meet the housing demand in the Netherlands.

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

The graduation project works towards making an easily accessibly tool for designers to make more informed decisions in the early stages of a project. Allowing for the use of timber to become a far more approachable practice, rather than having generate a proposal only to result in significant changes being required to make it work during design development and construction documents phase. Moreover, the combination of 1D, 2D and 3D systems is not currently being utilized, which offers the opportunity to positively influence how we configure our buildings allowing for buildings of the future to quickly respond to changing social, environmental and economic contexts. Essentially creating an adaptable kit of parts. Lastly, the utilization of existing parking lots provides the opportunity to maximize the use of space, in a time where space is becoming increasing finite.