

# 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](mailto: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	Yifan Dong
Student number	

Studio		
Name / Theme	Complex Projects: Bodies & Building Berlin	
Main mentor	Olindo Caso	Architecture
Second mentor	Georgios Karvelas	Building Technology
Third mentor	Martin Grech	Architecture
Argumentation of choice of the studio	I believe that production spaces such as carpentry workshops are worth discussing in the field of architecture and urbanism. Complex Projects, with its focus on the complexity of architecture and knowledge of how to approach large-scale projects, provides an ideal platform for me to explore the intricacy of production space.	

Graduation project	
Title of the graduation project	Ex Machina: a Campus for the Timber Industry 4.0
Goal	
Location:	Siemensstadt, Berlin
The posed problem, research questions and design assignment in which these result.	The woodworking industry is lagging behind the era of Industry 4.0. How to inject classrooms into future factories? This project accommodates pioneering small carpentry ateliers, a timber technology lab, and a woodworking vocational training center under the same roof, aiming to create a campus that integrates traditional craftsmanship and advanced technology.
<p>What sets this design apart from ordinary carpentry training schools is its dedication to imparting knowledge of automation and digitalization and its unprecedented focus on learning through practice. Craftsmanship will not be the educational objective but a rudiment to understand and explore the potential of Industrial 4.0 in woodworking. Moreover, to attract progressive woodworking ateliers and freelance professionals, the school will also share its facility and offer flexible work-life space.</p> <p>The campus will be used by 500 students, 70 teachers, 70 researchers, 100 practitioners, and 40 employees. The total area of the school is 30,000 square meters. 4,500 square meters are garage, and the remaining 25,500 square meters are organized under 5 categories. They are listed below with their proportions and the key spaces indicated.</p>	

- Public | 10% | 3,300 sqm  
(canteen, sports hall)
- Making | 25% | 6,500 sqm  
(workshop, lab)
- Material | 5% | 1,500 sqm  
(depot of timber and robots)
- Learning | 10% | 2,500 sqm  
(classroom)
- Living-working | 50% | 12,500 sqm  
(apartments, ateliers)

## Process

### Method description

The program, the client, and the site of the project are treated as three distinct topics for exploring possible architectural solutions, each with its varied methods.

#### Program

The program is carried out by case studies of pertinent contemporary built projects. There are three types of cases: carpentry school, carpentry factory, and evocative ones. The first two are used to distill the benchmarks for the programs. The programs' proportion and their planar layout of the cases are analyzed in detail. Through comparison between the analytical results of different cases, a quantified program bar could be drawn. Unlike the first two, the last type, namely the "evocative ones" is not confined to certain typologies. These cases are selected and analyzed based on their intriguing relevance to either the integration of theoretical learning and digital technology or the integration of hands-on learning and automated production. Afterwards, the program bar and program relationship are revised to fit in Industry 4.0 context.

#### Site

Based on the analysis of the programs, three site selection criteria are identified. First, the site should have access to sustainable freight transport such as waterways and/or adjoin existing logistic centers. Second, the site should have a good balance of industrial and residential areas to accommodate wood processing production in an economic environment while still providing a decent standard of living. Third, the site should be adjacent to future construction hotspots in Berlin. In this way, the school can have an impact on promoting timber construction in the urban development.

#### Client

Aiming to be a revolutionary carpentry school that closely binds craftsmanship and technology, the clients are carefully curated within the framework of the Dual Vocational Training Education system of Germany. Unlike traditional public vocational schools, where the government and the faculty are the only clients, this project brings more social partners into the field of education, including Siemens who could provide technological insights, and a management company with experience in curating a mixed-use creative community.

### Literature and general practical references

The research framework of this design is developed based on the "dual digitalization" in higher education proposed by researchers at University of Oslo in 2022. The so-called "dual digitalization" refers to the digitalization of education and the digitalization of the subject, which is woodworking in the case of this project.

The former has three aspects that represent the three main steps of woodworking education, namely theoretical learning, practical learning, and apprenticeship. Similarly, the latter also has three opposing aspects, namely digital technology, automated production, and new workflows driven by robotic systems. The integration of these corresponding aspects addresses three sub-questions, each with corresponding literature and references to be studied.

- How will the configuration of the learning space (classroom) evolve for learning digital technology?
  - The evolvement of higher education architecture;
  - Digital educational means;
  - Pilot projects of integrating digital means in buildings;
  - Woodworking school typology.
- How will the automated production affect the carpentry workshop space?
  - The lifecycle of timber products;
  - The lumber yard typology;
  - Carpentry workshop typology;
- How will the future workflow change the students' apprenticeship offered by companies?
  - The Dual Vocational Training Education system of Germany;
  - Historical and current workflow of carpentry, focusing on timber construction
  - Mobile robotic factory system.

#### Literature references:

1. Bygstad, Bendik, Egil Øvrelid, Sten Ludvigsen, and Morten Dæhlen. "From Dual Digitalization to Digital Learning Space: Exploring the Digital Transformation of Higher Education." *Computers & Education* 182 (June 2022): 104463.
2. Changali, Sriram, Azam Mohammad, and Mark van Nieuwland. "The Construction Productivity Imperative." McKinsey & Company, July 1, 2015.
3. Culot, Giovanna, Guido Nassimbeni, Guido Orzes, and Marco Sartor. "Behind the Definition of Industry 4.0: Analysis and Open Questions." *International Journal of Production Economics* 226 (August 2020): 107617.
4. Frank, Alejandro Germán, Lucas Santos Dalenogare, and Néstor Fabián Ayala. "Industry 4.0 Technologies: Implementation Patterns in Manufacturing Companies." *International Journal of Production Economics* 210 (April 2019): 15–26.
5. Haukka, Sanna, and Magda Lindqvist. "Modern Flying Factories in the Construction Industry." Master's Thesis, Lulea University of Technology, 2015.
6. Wagner, Hans Jakob, Martin Alvarez, Ondrej Kyjanek, Zied Bhiri, Matthias Buck, and Achim Menges. "Flexible and Transportable Robotic Timber Construction Platform – TIM." *Automation in Construction* 120 (December 2020): 103400.
7. "Wälder Brandenburgs." Ministry of Rural Development, Environment and Agriculture of Brandenburg, October 2015
8. Winter, Christoph, Bastian Schröter, and Stefan Fidaschek. "The German Cement Industry as a CO2 Source for Other Industries." *Fuels* 3, no. 2 (June 3, 2022): 342–52.

9. Woodard, A.C., and H.R. Milner. "Sustainability of Timber and Wood in Construction." In *Sustainability of Construction Materials*, 129–57. Elsevier, 2016. <https://doi.org/10.1016/B978-0-08-100370-1.00007-X>.

## **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 motivation for conceiving a carpentry school is the awareness of the urgency of achieving 'carbon neutrality' in the construction sector, which is a central focus of the architecture track and the MSc AUBS. More specifically, it explores the architectural form shaped by the advanced nature of the craft and the logistics of the material, which dovetails seamlessly with the Complex Projects focus on the complexity and functionality of large-scale buildings.

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

The project provides a design-based lens to rethink the vocational training space, which has been overlooked in the architectural discourse. As the project site is a vacant lot in an industrial area, it also sheds light on the production activity in the city and raises the discussion about production and habitat on an urban scale.