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	Pawel Andruszkiewicz
Student number	5634652

Studio		
Name / Theme	Architectural Engineering	
Main mentor	Anne Snijders	Design
Second mentor	Pieter Stoutjesdijk	Research
Argumentation of choice of the studio	My interests in the field of architecture focus on two main aspects – the social role of architecture, as well as the implementation of new technologies to the design process. Architectural Engineering studio is, as I believe, the perfect place to combine these two areas. It allows taking a closer look into the contemporary social problems through the prism of the technical, engineering area of architecture.	

Graduation project	
Title of the graduation project	Module+: Towards Affordable and Qualitative Student Housing
Goal	
Location:	TU Delft Campus
The posed problem,	Lack of sufficient number of affordable and qualitative student housing.
research questions and	How could generative system based on engineered timber modules optimize the functional layout of student housing, by finding the balance between the maximum living units and the minimal material use?
design assignment in which these result.	Student dwelling with complementary facilities.
The aim of this work is to create the universal design strategy, combining computational design and timber modular technology. The main purpose of the strategy will be to provide carefully designed flexible modules, algorithm which generates and optimizes a huge number of functional solutions in a specific context, as well as further design directions, helping to develop the generated solution in a qualitative living environment. The strategy would be tested in a specific, selected plot in the context of TU Delft campus. The end result of the work will be the design	

of student housing with complementary facilities, which provides an affordable and qualitative living environment.

Process

Method description

Research:
The research phase will focus on the problem of affordability, specifically on the key issue of finding a balance between providing maximum number of living units and the minimal material consumption. Based on case studies and literature review, the research would present collected results, starting with the discussion of available tools for generative design, through the conditions needed to be included in the algorithm in order to generate correct functional layouts, parameters related to material consumption for a single module, ending with the method of ranking the generated results. Based on the research conclusions, an initial algorithm which generates functional solutions according to the initial functional program and ranks them in terms of amount of living units and material use, would be created and tested on several location within TU Delft Campus.

Research for design:
In this phase, based on literature review, the features of qualitative living environment, especially in the context of student dwelling, would be examined and precisely defined. This will allow to determine the direction of shaping the space for student housing, so that, apart from affordability, it would become a favourable place for living, studying and social interactions. Based on the collected information, the parameters and conditions according to which the algorithm generates results will be updated. The possibility of evaluating the generated results in terms of qualitative living environment features for specific location, such as insolation or view quality will be added as well.

Design:
The design phase will begin with a site analysis, involving an in-person site visit, as well as a detailed analysis of the spatial conditions and context. Then, based on previously collected information related to the qualitative living environment, a precise functional program will be defined. Context analysis along with program features will be included in the algorithm, which would generate and rank potential functional solutions. This will be followed by a review and interpretation of the results, which will constitute a reference point for the individual architectural design.

Literature and general practical preference

Acre, F., & Wyckmans, A. (2014). Spatial quality determinants for residential building renovation: A methodological approach to the development of spatial quality assessment. *International Journal of Sustainable Building Technology and Urban Development, 5(3)*, 183–204. https://doi.org/10.1080/2093761x.2014.923793

Boschi, N., & Pagliughi, L. M. (2002). Quality of life: meditations on people and architecture. *Indoor Air*.

Caetano, I., Santos, L., & Leitão, A. (2020). Computational design in architecture: Defining parametric, generative, and algorithmic design. *Frontiers of Architectural Research, 9(2)*, 287–300. https://doi.org/10.1016/j.foar.2019.12.008

Deb, K., Pratap, A., Agarwal, S., & Meyarivan, T. (2002). A fast and elitist multiobjective genetic algorithm: NSGA-II. *IEEE Transactions on Evolutionary Computation, 6(2)*, 182–197. https://doi.org/10.1109/4235.996017

Filippo, A. di. (2021). Generative Design for project optimization (S). *International Conferences on Distributed Multimedia Systems*. https://doi.org/10.18293/dmsviva21-014

Jaglarz, A. (2016). New Concepts in Arrangement of Living Spaces for Students. *Advances in Intelligent Systems and Computing*, 63–73. https://doi.org/10.1007/978-3-319-41941-1_6

Kaufmann, H., Krötsch, S., & Winter, S. (2018). *Manual of Multi-storey Timber Construction*. Reed Business Education.

Key, S., & Gross, M. D. (2021). From architects' terms to computable descriptions of spatial qualities. *Spatial Cognition &Amp; Computation*, 1–24. https://doi.org/10.1080/13875868.2020.1862125

Konak, A., Coit, D. W., & Smith, A. E. (2006). Multi-objective optimization using genetic algorithms: A tutorial. *Reliability Engineering &Amp; System Safety, 91(9)*, 992–1007. https://doi.org/10.1016/j.ress.2005.11.018

La Roche, C. R., Flanigan, M. A., & Copeland, Jr, P. K. (2010). Student Housing: Trends, Preferences And Needs. *Contemporary Issues in Education Research (CIER), 3(10)*, 45. https://doi.org/10.19030/cier.v3i10.238

Nagy, D. (2019). *Generative Design: Designing with parameters, objectives, and constraints*. Performance Network.

Nugent, J. (2012). Residential Common Spaces that Really Work. *Planning for Higher Education Journal, 41(1)*.

Strzalka, K. B. (2019). *What are the students' housing preferences?* KTH.

Thomsen, J. (2007). Home Experiences in Student Housing: About Institutional Character and Temporary Homes. *Journal of Youth Studies, 10(5)*, 577–596. https://doi.org/10.1080/13676260701582062

Wallance, D. (2021). *The Future of Modular Architecture (1st ed.).* Routledge.

Reflection

1. My work tries to approach the presented problem from the technical, engineering side of architecture, examining the combination of timber modular architecture and computational design, which fits into the thematic framework of the Architectural Engineering studio. Moreover, apart from the technical part, the main goal of the work is a well-thought-out project resulting from detailed research, which not only aims to address the problem of housing shortage and decreasing affordability, but also to focus on the social aspect by trying to simultaneously create a high-quality living environment.

2. Modular architecture, in particular based on timber as the main construction material, is becoming more and more common and competitive in relation to

traditional construction methods. Just like the rapidly growing possibilities of computational design, including broadly understood design optimization. My work tries to combine these two issues and defining own approach to the problem by creating a computational, module-based system, enabling the analysis and evaluation of functional solutions in terms of affordability and quality of living environment. Development of such a tool can prove to be helpful in the design process by precisely and reliably presenting the potential of a specific plot.