

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	Annemijn Visser
Student number	5880823

Studio		
Name / Theme	Architectural Engineering	
Main mentor	Mo Smit	Architectural Engineering
Second mentor	Tsilil Strauss	Architect – Superuse studios
Argumentation of choice of the studio	The choice for the architectural engineering studio lies in my interest of combining architecture with technique. I'm interested in the puzzle of making a building as sustainable as possible, especially focusing on material use, but also including the spatial potential of a building. I chose architectural engineering to be able to combine the puzzle of sustainability, material use and spatial design.	

Graduation project	
Title of the graduation project	Rethinking HVAC systems: The potential of passive and bio-based installation techniques as alternative for conventional HVAC systems
Goal	
Location:	Binckhorst, The Hague
The posed problem,	The built environment faces growing challenges from climate change and energy insecurity. HVAC systems alone consume about 20% of building energy globally and up to 50% in developed countries, like The Netherlands, significantly contributing to carbon emission and material use. Where traditional architecture relied on passive, climate-responsive systems, modern buildings increasingly depend on energy-intensive systems.
research questions and	How can passive and bio-inspired systems be integrated into a residential building to reduce waste from resource-

	and carbon-intensive materials in conventional HVAC systems?
design assignment in which these result.	The integration of low-impact, passive techniques in a residential building in the Binckhorst to contribute to the energy efficiency of the building but also as an added architectural value for the new area. The main focus will be on applying sunspaces as an social in-between space for residents and visitors of the area.
Process	
Method description	
<p>The paper aims to create a catalog with passive and biobased systems, ranked based on their environmental impact, for architects to use when designing low-impact buildings.</p> <p>To research different the techniques, a hierarchy based on the Behling diagram is followed: 1. Architectural form; 2. Passive systems; 3. Active systems. The following techniques are researched based on these layers.</p> <p>1. Architectural form: shape, orientation, fenestration, shading 2. Passive systems: Trombe wall, sunspaces, vegetation use, labyrinth thermal system 3. Active system: algae façade system</p> <p>Literature studies and case study analysis is done to evaluate how the different techniques are applied and view their energy efficiency. Research by design is afterward used to analyze the architectural value of the techniques in the Binckhorst area. Calculations based on the efficiency and carbon footprint of the techniques is used to determine the environmental impact. Cataloging is used to conclude the research with a ranking system of the techniques from lowest to highest impact.</p>	
Literature and general practical preference	
<ul style="list-style-type: none"> - Bosu I, Mahmoud H, Ookawara S, Hassan H. Applied single and hybrid solar energy techniques for building energy consumption and thermal comfort: A comprehensive review. <i>Sol Energy</i>. 2023 Jul 15;259:188–228 - Torgal FP. Biotechnologies and Biomimetics for Civil Engineering. Labrincha J, Diamanti MV, Yu CP, Lee HK, editors. Cham s.l: Springer International Publishing; 2015. 437 p. (SpringerLink Bücher) - Toroxel JL, Silva SM. A Review of Passive Solar Heating and Cooling Technologies Based on Bioclimatic and Vernacular Architecture. <i>Energies</i>. 2024 Jan;17(5):1006 - Fernandes J, Mateus ,Ricardo, Bragança ,Luís, and Correia da Silva JJ. Portuguese vernacular architecture: the contribution of vernacular materials and design approaches for sustainable construction. <i>Archit Sci Rev</i>. 2015 Oct 2;58(4):324–36 - Binckhorst DenHaag.com [Internet]. [cited 2025 Jun 3]. Available from: https://denhaag.com/en/binckhorst 	

Reflection

1. My graduation topic connects to the studio topic 'make', focussing on developing a system that improves the future of the built environment. Rethinking the way we currently design, heavily relying on active installation systems. My project focusses on using architectural implementation like form, orientation, window size and placement, and material use to minimize the carbon footprint of buildings developed today. Next to this, my design research focusses on how these energy efficient implementation can be utilized as valuable architectural additions of the building, in example for social spaces and a healthier environment for residents.
2. This research is relevant within a broader context as it addresses urgent global challenges of climate change and energy scarcity by rethinking building design strategies. By exploring passive and bio-inspired systems as sustainable alternatives to conventional active HVAC systems, it contributes to reducing the environmental impact of buildings. The research supports a shift in architectural practice toward low-impact, nature-based solutions, encouraging architects to integrate these principles from the early design stages.