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	Ailin Han
Student number	5528429

Studio		
Name / Theme	URBAN FOREST – Forest Urbanism (UF)	
Main mentor	René van der Velde	Landscape Architecture
Second mentor	Stefan van der Spek	Urban Design
Argumentation of choice of the studio	In the rapid development of modern society, people focus more on buildings or some artificial things, and pay less and less attention to nature in the city. Also, I find that planting trees in the city seems to be like completing a task, people plant trees for the sake of planting trees, not really thinking about nature. Therefore, as cities grow, the connection between humans and nature is becoming more and more distant. I want to find a new way to re-establish the relationship between humans and nature through trees in the urban forestry lab, so that we can develop together in the future.	

Graduation project	
Title of the graduation project	Title: Growing with Cooler Green Sub-title: To create a climate adaptation/resilient city development strategy through forest urbanism
Goal	
Location	Zwolle, Netherlands
The posed problem	In the context of global warming, temperatures are expected to increase in the future, especially in cities, and the Zwolle region has been challenged by climate change these years. The Zwolle region has been expanding its cities since 1960. In comparison with information released by the Dutch Meteorological Service, the surface temperature in the Zwolle region has been increasing every year since 1960. This is due to the fact that during the development and construction of the city, a lot of hard surfaces were built, and buildings as well as other facilities absorbed and retained heat on the surface, so the temperature in the city was getting higher and people felt hotter. Fortunately, large areas of vegetation and large public open space can mitigate the effects of climate change in the city. To increase the vegetation in the Zwolle area by creating

	or expanding existing green areas and open public space to reduce the effect of high temperature by climate change problem is the main issue which should be considered. At the same time, since almost all of the development around the Zwolle area is high-density residential areas, most of the neighborhood's lack of open areas with high plant cover density and public green spaces, so the living experience of people is affected to some extent. At the same time, since almost all of the development around the Zwolle area is high-density residential areas, most of the neighborhoods lack open areas which are covered by high-density vegetation and open public green space. Therefore, the living experience of surrounding residence are affected. How to create a climate-adaptation and attractive life and living environment in the Zwolle area is also an important issue.
Research questions	Question: How to improve the city urban forest system to create a climate adaptation/resilient city while responding to improve the urban living experience? Sub-question: 1) How to create a climate adaptation/resilient city through forest urbanism solution? 2) What kind of urban forest morphology is effective in reducing urban surface temperature? 3) How can we strengthen the connection of the surrounding communities and the city through forest urbanism? 4) How to improve the urban forest to benefit people's living experience?
Design assignment in final results	**1. Reginal scale** 1.1. The overall temperature variation in Dutch cities, and the different climate zones **2. Urban scale** *2.1. <u>City analysis</u>* 2.1.1. Temperature analysis of the Zwolle area, including surface temperature, air temperature 2.1.2. Future trends in the Zwolle area, and the relationship to the surrounding area (cities/ nature area) 2.1.3. Analysis of urban development in the Zwolle region, the extent of past urban expansion, and the types

	2.1.4. Analysis of Zwolle urban morphology, include the different space type, building type and urban density results *2.2. Analysis of vegetation* 2.2.1. The percentage of urban vegetation cover, and the percentage of existing large open green space. (Vegetation cover is associated with ground temperature) 2.2.2. A specific analysis of the distribution of existing urban vegetation. The main focus is on tree types and the arrangement of each type of tree in different land use situations 2.2.3. The Zwolle urban forest arrangement/layout analysis, include the forest pattern analysis and the forest area scale analysis 2.2.4. Existing tree species: the tree shadow and the crown shape **3. Street/Community scale** *3.1. Design strategy* 3.1.1. Research of the effect of different tree types on reducing urban temperatures in the neighborhood/community where they are located (the main focus of the study is on different tree types and the shade provided by different types of trees) 3.1.2. Contribution of different tree arrangements in the neighborhood/community to the reduction of urban temperatures (modeling of some possible tree planting arrangements) *3.2. Propose new design for urban planting in the neighborhood/community* **4. Detailed design** 4.1. *Technology:* The most effective planting solutions for reducing urban temperatures and connect the whole city nature network 4.2. *Perception:* The living experience of the residents and their contribution to the city as a whole

Question: How to improve the city urban forest system to create a climate adaptation/resilient(?) city while responding to the city development?

Sub-question:

1) How to create a climate adaptation/resilient city through forest urbanism solution? The analysis in 1.1 focuses on answering the question of why climate adaptation cities have become important. The three analyses in 2.1 are intended to clarify why creating a climate-adaptive/resilient city in Zwolle is the main design goal in this project. Especially 2.1.1, is an important starting point of the whole project, it is also the issue

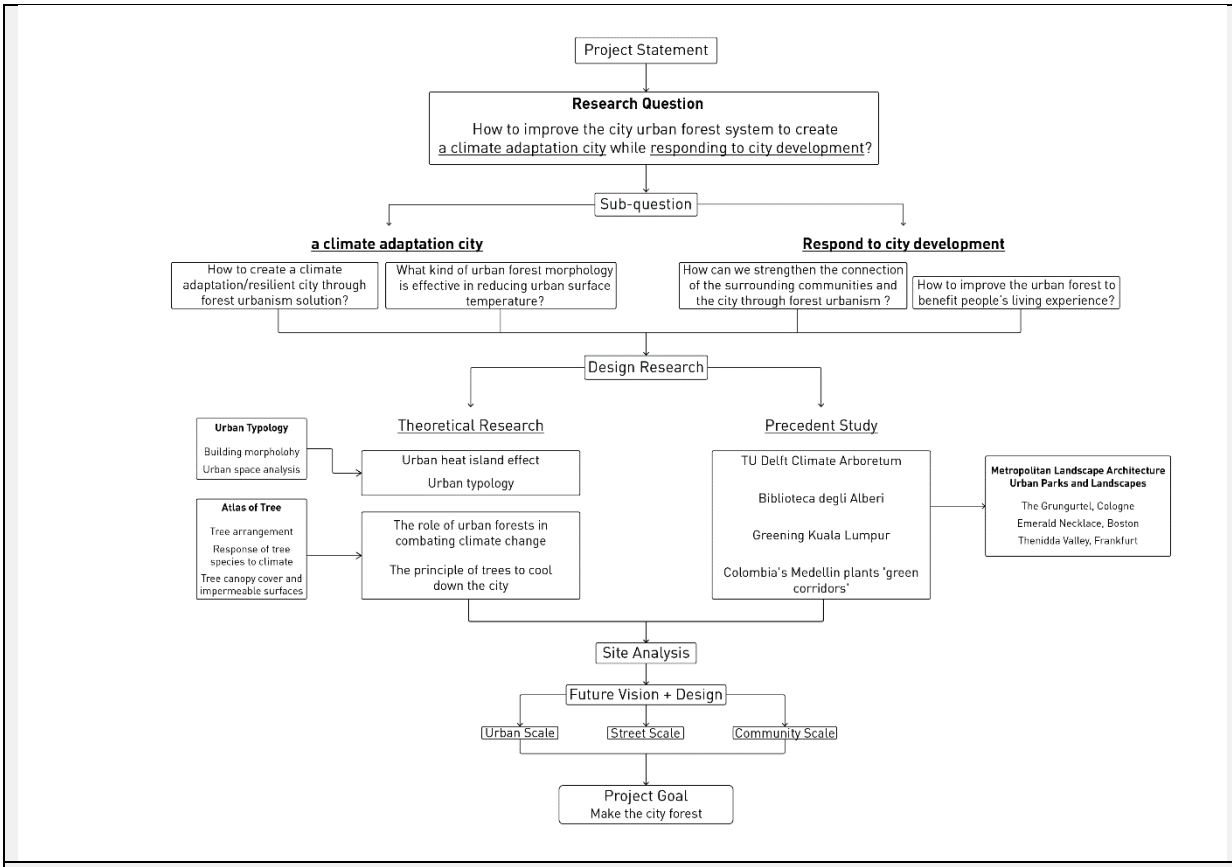
that will be addressed in the subsequent design. After the analysis of the whole Zwolle city, the analysis of the natural urban vegetation was started. And comparing the two points of 2.1.1 and 2.2 it can be concluded that trees can play a role in regulating the urban temperature.

2) What kind of urban forest morphology is effective in reducing urban surface temperature?
   By combining 2.1 and 2.2 it is possible to conclude why the plant/tree approach was chosen to build the climate-resilient city instead of other approaches. How to apply the previous conclusions to the subsequent specific design is illustrated by 3.1. The main focus of 3.1.1 is on different tree types and the shade provided by different types of trees, as this allows for the selection of the tree types that are most helpful to the urban climate (it may be a certain shape of tree which can provides the best cooling effect). 3.1.2 also continues to answer this question, but the scale changes from a single tree to a large scale, maybe a row of trees or a group of trees. The conclusion of 3.1 is also the answer to this question.

3) How can we strengthen the connection of the surrounding communities and the city through forest urbanism?
   2.1.2, 2.1.3 and 2.1.4 concluded the main structure of the Zwolle city area(?), except for the historical area in the middle, the surrounding area is basically a high-density residential area, and there is a lack of interconnection between them. Therefore, the main purpose of 3.2 is to create a better natural urban structure for Zwolle while creating a climate-adapted/resilient city. The urban forest is used to connect the scattered areas to form a complete urban forest system. Specific design results will be presented in 4.1.

4) How to improve the urban forest to benefit people's living experience?
   Also, the living experience of the surrounding residents is a major issue. From the analysis of 2.2, we can know that the area around Zwolle lacks large urban forest and open green space. The design to increase more contact with nature and enhance the living experience will be illustrated by 4.2. Also, the design strategies of 3.1 and 3.2 will be applied as well.

Process



Method description

This project mainly consists of two points. The first is how to solve the impact of climate change on cities through urban forests, and the second is how to improve the living experience of citizens while solving urban climate problems.

First, a specific analysis of trees will be performed, which is a fundamental part of how to create a climate-resilient urban area. By starting with a comparison of different species of single trees, the main comparison will be between the shadows produced by different tree types in the presence of the sun. Since tree refraction and evaporation require a very long time and a rigorous program, the focus of this project research is mainly on how much shadows produced by trees can contribute to urban adaptation to climate. Then it will be followed by a large arrangement of trees, and by comparing different arrangements, it will be determined which tree arrangements are the most effective in improving the problem, that is, cooling and enhancing the natural urban environment. The results of the study will be obtained through the i-tree tool, rhino, and physical model.

Secondly, the main issue was how the urban forest could increase the connectivity between communities and enhance the people's life experience, which was also an important part of the design for this project. After a preliminary analysis of the existing green structure of Zwolle city, a new design was needed. Different scales needed to be considered in the new design scheme, with the medium scale being the connection between communities and the small scale being the green open spaces within the community. The connection between communities needs to consider the needs of different groups of people around and combine them. The focus of open space within the community is to give residents who lack green open areas around them more opportunities to get closer to nature in a smaller urban context. At the same time both of these points are focused on the perception of people.

At the core of this strategy is a vision to create a resilient, adaptation city with urban forest for the future. That creation begins by building upon the present and the past. Design and plant the forest of the future in a way that respects Zwolle's unique character, responds to climate change and urban expansion, and underpins the wellbeing of the city and its inhabitants. The goal of this project is to guide the transition of our landscape to one that is resilient, healthy, and diverse, and that meets the needs of the community. Its intended outcomes are to create adapted landscapes, community health and wellbeing city.

Literature and general practical reference

Literature:

Adams, D., & Tiesdell, S. (2013). *Shaping Places: Urban Planning, Design and Development*. ROUTLEDGE.

Carmona, M. (2010). Contemporary Public Space, part Two: Classification. *Journal of Urban Design*, *15*(2), 157–173. https://doi.org/10.1080/13574801003638111

Carmona, M., Tiesdell, S., Heath, T., & Oc, T. (2010). *Public places, urban spaces: The dimensions of Urban Design* (2nd ed.). ROUTLEDGE.

Goward, S. N. (1981). *Thermal behavior of urban landscapes and the urban heat island*, 2(1), 19-33. Physical Geography.

Hurtado, M. A. H., & Ramírez, R. (2020). *The microclimatic contribution of urban green fraction. Case study: Medellin, Colombia*.

Meijer, M., Dubbeling, M., & Marcelis, A. (2010). *Sustainable urban design: The next step ; examples and perspectives = Duurzame Stedenbouw*. Uitg. Blauwdruk.

Meyer, H., Hoekstra, M. J., & Westrik, J. (2020). *Stedenbouw: Kern En Perspectieven*. Boom.

Oke, T. R. (1973, August). *City Size and the Urban Heat Island*. *Atmospheric Environment (1967)*.

Shahidan, M. F., & Jones, P. (2008). *Plant Canopy Planting Design in Modifying Urban Thermal Environment: Theory and Guidelines*. Passive and Low Energy Architecture 2008 Conference (PLEA 2008).

Speak, A., Montagnani, L., Wellstein, C., & Zerbe, S. (2020). The influence of tree traits on urban ground surface shade cooling. *Landscape and Urban Planning*, *197*.

Stanganelli, M., & Gerundo, C. (2017, April). *Understanding the Role of Urban Morphology and Green Areas Configuration During Heat Waves*. *International Journal of Agricultural and Environmental Information Systems*.

Steenbergen, C. M., & Reh, W. (2011). *Metropolitan Landscape Architecture: Urban Parks and landscapes*. THOTH Publishers Bussum.

Precedent Study:

1. TU Delft Climate Arboretum – Delft, Netherlands
2. Biblioteca degli Alberi – Milan, Italy
3. Medellin's green corridors – Medellin, Colombia

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)?

   This project reflects the diversity of the landscape, not just in design, but in balancing the relationship between nature and humans, and extending the possibilities of the landscape in the city. As a student with a background in landscape, this project allowed me to stimulate different perspectives of landscape in society, at different scales. It made me realize that there are more possibilities for the landscape.

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

   Although there are several theories proving that trees can lower the surrounding temperature, there are not many cases of using them in real design, so this is a new experiment. Starting from the most basic plants, and the final goal is to create a safer and more comfortable human living environment no matter how drastic the external changes are.

   From a social point, this project can bring more awareness to the importance of trees and forests in cities. Trees are not simply a greening and beautifying function for cities, but also bring more to promote human social development, improve the social environment, and make cities more sustainable.

   From a professional point, some of the research from this project can be used as a basis for future design. Moreover, this project combines three aspects of urban development, residential life, and climate change; it can also be said to combine landscape architecture with urban planning and to consider what the landscape can contribute to the city from a broader perspective.

   From a scientific framework perspective, this project connects theoretical frameworks from different fields to build on the original theoretical foundation for deeper research. From a broader perspective, it will show that trees can indeed help cities fight future climate change. It will also illustrate how landscape architecture design practices can be used to intervene in the future development of cities.