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	Wanning Liang
Student number	5561280

Studio		
Name / Theme	Circular Water Stories	
Main mentor	Inge Bobbink	Architecture and the Built Environment, Landscape Architecture
Second mentor	Luca Iuorio	Architecture and the Built Environment, Environmental Technology and Design
Argumentation of choice of the studio	Out of great interest in water and the desire to study a particular water system in depth.	

Graduation project	
Title of the graduation project	Quenching thirst: cooperation and interaction by living with water from Huamantanga in the hills to Lima on the coast, Peru.
Goal	
Location:	Huamantanga, Peru Lima, Peru
The posed problem:	In the next 10 to 15 years, the availability and quantity of water in City Lima will decline by 30 percent. As the third largest desert city in the world, the city relies on tanks and bottles for its water supply. The former relation of the Lima citizens to its surrounding nature and water sources in the hills is lost and needs to be restored. In Huamantanga, a town in the Andes located 70 kilometers from Lima at an altitude of 3,398 meters, the relation of the inhabitants to the landscape is still strong. But even there, things are at stake. Humans take peat from the high-altitude (Bofedales), causing serious damage to this wetland ecosystem.

	Moreover, pasture grazing causes soil erosion and vegetation deterioration on the slopes. Instead of the ancient old mix farming approach the potato monoculture production has led to a vicious cycle of population loss and labor shortage. Also, the ancient water system known as Amunas once connected Huamantanga to Lima is fading away. This system made it possible to manage the local water supply for an extended period of time into the dry season. Since 1400 AD, Huamantanga and communities downstream relied on this water system to collect water during the wet season for their everyday lives and farming activities in dry season. Recent studies have determined that the water harvested by this system can ultimately assist not only the villages in the mountains but also Lima by filling the river downstream with water. About 9 mature Amunas water systems produce 3,275,925.75 m^3/year during the dry season to the Chillón and Rímac river basins in the province of Lima, which will be supplied downstream to the city of Lima. In Huamantanga, there are 11 Amunas canals with a total length of 15km waiting to be restored. In addition to helping the water system, restoration minimizes soil compaction by limiting the range of animal activity during the restoration process, ultimately repairing the wetland and boosting its ecological function. The provision of water to Lima can provided Huamantanga with access to finance and technology for the restoration, the change of production practices, and the enhancement of ecological. Due to water scarcity and pollution, the people of Lima no longer recognize the importance of water and have forgotten the ingenuity of their traditional water system. In addition to the design of the

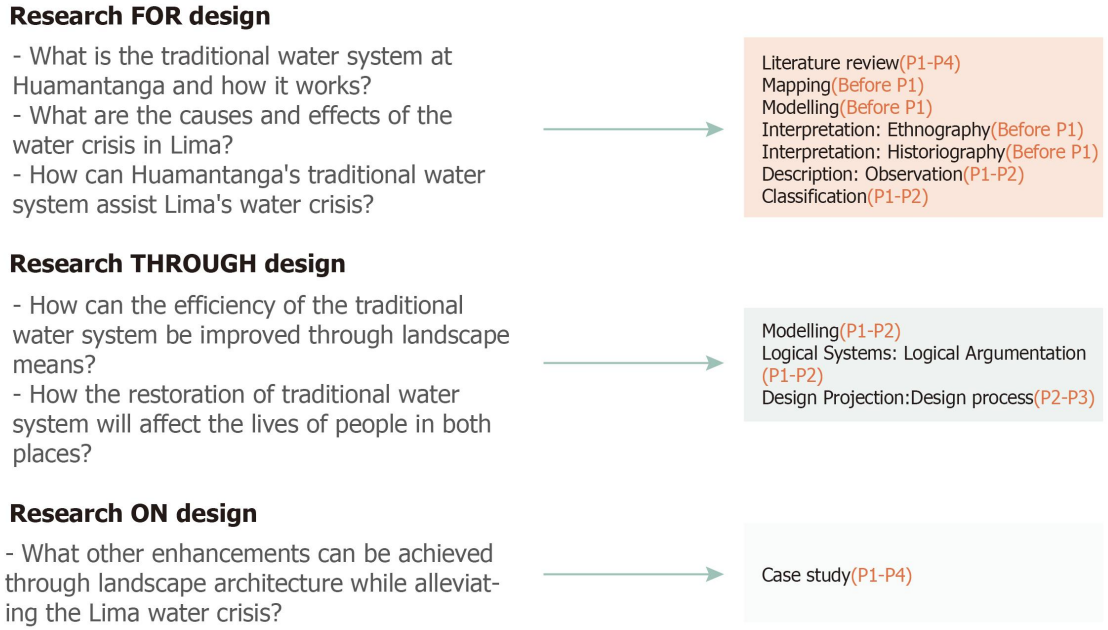
	rehabilitation of the cultivated landscape surrounding Huamantanga and the design of a comprehensive water system towards and along the Chillón River, places will be developed that physically and spiritually connect people to the water. Here, human and natural contact can be intensified.
research questions and	How can landscape architecture aid in the restoration of the traditional water system at Huamantanga to alleviate the water crisis in Lima? Sub questions: - What is the traditional water system at Huamantanga and how it works? - What are the causes and effects of the water crisis in Lima? - How can Huamantanga's traditional water system assist Lima's water crisis? - How can the efficiency of the traditional water system be improved through landscape means? - What other enhancements can be achieved through landscape architecture while alleviating the Lima water crisis? - How will the restoration of traditional water system affect the lives of people in both places?
design assignment in which this result.	At the scale of the Landscape: - phased restoration of the Amunas water system (artificial recharge system) and *Bofedales* (natural recharge system), soil and wetland rehabilitation, agricultural land reorganization, and infrastructure planning. At the scale of the Lima province: - offering a solution to the problem of water scarcity for city Lima, while offering other towns in the Andes the possibility of economic income, ecological restoration, and the regaining of a sense of cultural belonging through traditional water systems. At the scale of Huamantanga:

	- tackling livelihood issues such as poverty, lack of labor due to population loss. At the scale of Lima: - implementing water spirit points along the system and the Chillón River.

Process

Method description

Framework



Mapping

Collect information to mapping the city Lima's land use, urban expansion, water system, relationship between wealth and water supply, and distribution of water pollutants and water facilities.
Collect information to mapping Huamantanga town's water system, land use, vegetation types, traditional water system's locations, etc.
By using the method of confronting these different maps to get answers on how the people, flora, and fauna of Lima and Huamantanga live in relation to water.

Description

Observation: A collection of images of the urban section of the Chillón River to visualise the type of landscape and the space sequences at different locations along the river.
Secondary observation: Identification of different scenes suitable as water spirit points along the Chillón River.

Classification

Catalogue: Categorisation of landscape types along the urban section of the Chillón River, to determine the landscape context of designing different water spirit points.

Modelling

Descriptive/synthetic modelling: A descriptive model produced by summarizing the water-related life patterns of Huamantanga town's residents to comprehend the spiritual value of water to the locals.

Interpretation

Ethnography: By collecting the history of the ancient Andeans who constructed the Amunas system to store water, emphasizing the significance of this traditional water system in their lives.

Historiography: The historical causes of water scarcity in the province of Lima (connected to geography and climate), the different rainwater harvesting systems constructed by the ancient Andean people in their struggle against nature, and the development of the Andean agricultural system. As a starting point, this leads to the whole water system and the problems that this system has to solve today.

Modelling

Simulation modelling (Alternative future research): By synthesizing the previous analysis's conclusions, a feasible scenario for the landscape zone along the water system from the high Andes (Huamantanga town) to city Lima will be derived.

Literature review

Read literature related to Amunas water system, Andean agricultural systems, city Lima urban studies, etc. Learn about the principle of Amunas, its function, the surrounding vegetation, the different forms and products of the Andean agricultural system, the functional zoning of Lima, and the problems and solutions faced along the urban section of the Chillón river.

Case study

Projects related to the conservation of highland peatlands. Learn about the relevant measures and results that already exist for peatland conservation.

Projects related to the creation of spirit points for people through landscape forms. Learn about the different forms of spirit points and summarise the toolboxes that can be used.

Projects for city Lima to solve the problem of water scarcity. To understand the extent and direction in which landscaping can help to address water scarcity, and to see if the aspects considered in the research for these projects have been taken into account in this project.

Design Projection

Design process: Design of the different phases of the restoration of the ecological level around the Bofedales and Amunas water systems, design of the agricultural and housing regeneration programme for Huamantanga town.

Logical Systems

Logical Argumentation: Design of a programme of interaction between Huamantanga town and city Lima in relation to water resources, economic and technological resources, agriculture and handicraft products.

Literature and general practical reference

Literature:

Boris F. Ochoa-Tocachi, Juan D. Bardales, Javier Antiporta, Katya Pérez, Luis Acosta, Feng Mao, Zed Zulkafli, Junior Gil-Ríos, Oscar Angulo, Sam Grainger, Gena Gammie, Bert De Bièvre and Wouter Buytaert. (2019). Potential contributions of pre-Inca water infiltration infrastructure for water security in the Andes. *Nature Sustainability*, vol. 2, pp. 584–593, 2019.

Dimas Apaza Idme, Roberto Arroyo Hurtado, Andrés Alencastre Calderón. (2006). Las Amunas de Huarochirí. Retrieved from: https://hidraulicainca.files.wordpress.com/2011/07/libro-amunas-gsaac.pdf

Javier Antiporta, Edwing Arapa y Vivien Bonnesoeur, en base a la metodología elaborada por Kieser & Associates, LLC. (2019). Construcción, Reparación y Mejoramiento de Amunas. *Forest Trends, Lima, Perú*. 17 Rosero-López D, et al.

Mesclier, É., Piron, M. & Gluski, P. (2015). Territories and Inclusion in the Peripheries of Lima (Peru): An Exploratory Approach Based on Data about Water Supply and Sewage Disposal. *L'Espace géographique*, 44, 273-288. https://www.cairn-int.info/journal--2015-3-page-273.htm.

Valois R, Schaffer N, Figueroa R, Maldonado A, Yáñez E, Hevia A, Yánez Carrizo G, MacDonell S. (2020). Characterizing the Water Storage Capacity and Hydrological Role of Mountain Peatlands in the Arid Andes of North-Central Chile. *Water*. 12(4):1071. https://doi.org/10.3390/w12041071

Data:

European Space Agency, Sinergise (2021). Copernicus Global Digital Elevation Model. Distributed by OpenTopography. https://doi.org/10.5069/G9028PQB.

Map of the Peruvian provinces by climate type: coastal desert (yellow) – Andes mountains (brown) – Amazon rainforest (green). https://en.wikipedia.org/wiki/Climate_of_Peru

MIDARH (2022). Cuadro N ° 01: Infraestructura Sistematizada y Registrada en el MIDARH a Nivel Nacional. http://observatoriochirilu.ana.gob.pe/

OA-CHRL, (2017). Image Landast 8OLI, mayo 2016. MINAM, (2015). Images Landsat 2009 y Aster 2007. http://observatoriochirilu.ana.gob.pe/

Observed Climatology of Precipitation 1991-2020, Peru. https://climateknowledgeportal.worldbank.org/country/peru/climate-data-historical

OSM data

TanDEM-X conditioned digital elevation model. https://www.hydrosheds.org/

Case study:
A project of peatland restoration from Northern Ecuador.
https://link.springer.com/article/10.1007/s11027-022-10006-9

Cristina Iglesias, Landscape and memory, Madison Square Park, 2022.

Luca Iuorio, Integrated coastal flood design: changing paradigm in flood risk management, pilot locations in the Netherlands, UK and Italy, 2020-2022.

Shenzhen Hope Design Co.,Ltd., A Riverside Masterplan in Shenzhen is Designed to Prevent Flooding, Shenzhen Bao'an drainage river, 2021-2023.

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)?

Water Systems being the topic of the Circular Water Stories Lab, I discovered the Amunas water system in Peru in my collection of traditional water systems. By learning about how it functions and the lives of the people associated with this water system, I discovered the great potential and opportunities for improvement of this water system. Through my graduation project, I hope to make better use of this water system and to apply a landscape-based strategy to improve the living standards of the people associated with it, the ecosystem, and increase the public's awareness of water on a larger scale.

Water is a vital element in Landscape Architecture, and crucial for living, and water security influences the path of societal development. Landscape Architecture can be used as a tool to solve both direct and indirect problems, such as the decline of ecological quality, water scarcity, the loss of population and oversimplified agricultural production methods in small towns, and the lack of cultural belonging and spirituality among people.

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

Most arid places of the world include the ruins of ancient rain harvesting structures. Many of them, including the Amunas system, have been abandoned due to the excessive use of nature in the development process. But their water storage effect is quantifiable, and often this blue infrastructure is more cost-effective and environmentally friendly than industrial facilities. The restoration of the Amunas system can be an example or even model for other arid locations.

In my graduation project, the link and connection between Lima, a large city, and Huamantanga, a small town in the Andes, through the Amunas water system also provides a direction for society to consider. The traditional water system should exist not only in the lives and spiritual world of indigenous people, but also in the collective memory of all humans. These water spirit points, which highlight the operation of traditional water systems, should be replicated wherever traditional water systems exist.