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:

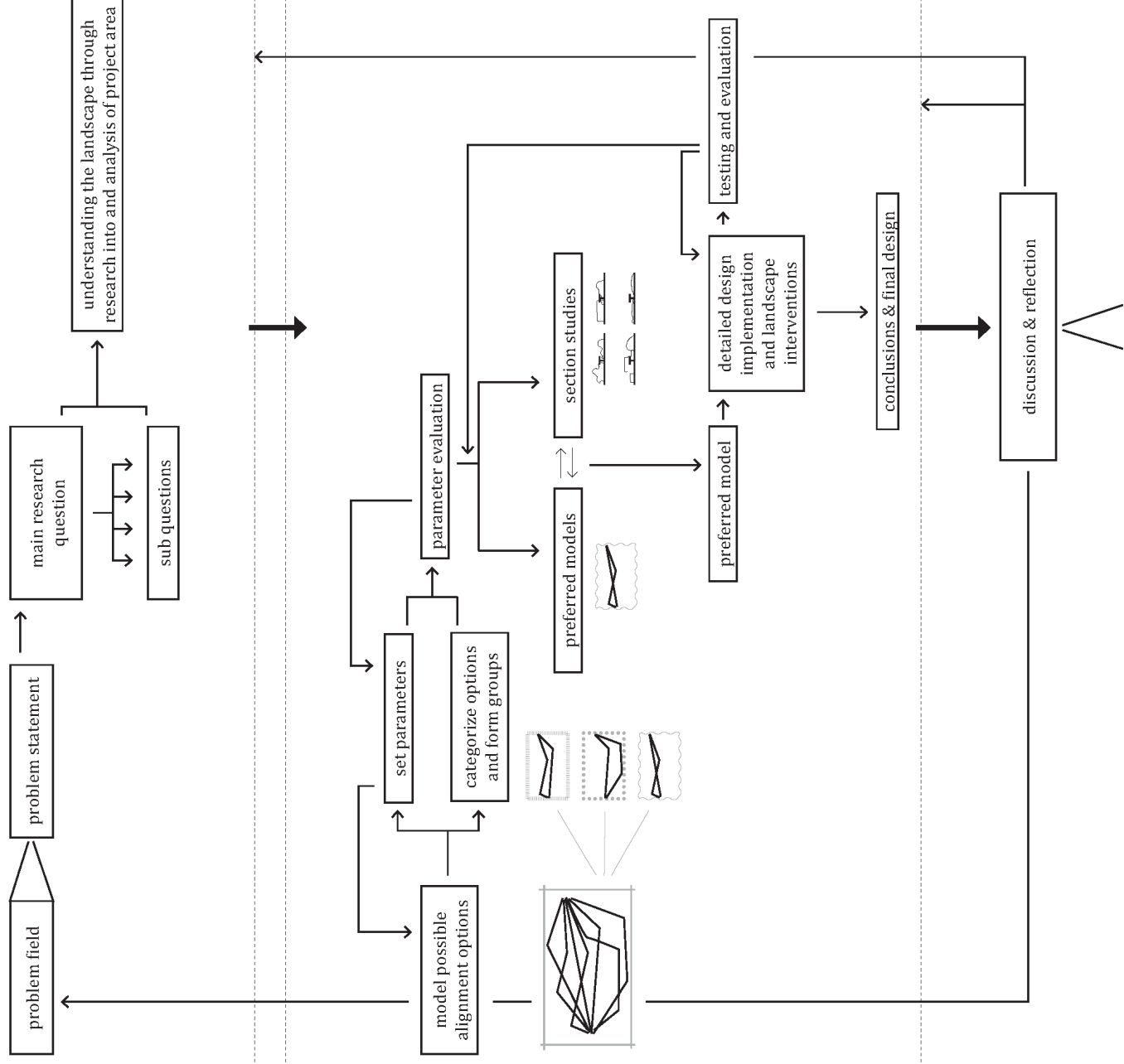| Personal information	
Name	**Juul ten Hove**
Student number	4603168

Studio		
Name / Theme	Innovative Infrastructure Implementation	
Main mentor	Adriaan Geuze	Landscape architecture
Second mentor	Rients Dijkstra	Urbanism
Argumentation of choice of the studio	During my bachelor's degree, I did the *minor Integrated Infrastructure Design* (IID). This minor focuses on the integrated design of transport and water infrastructures such as bridges, viaducts, dikes and railroad stations. Together with other students from the BSc Architecture, Civil Engineering, Mechanical Engineering and Aerospace Engineering, I worked on the various assignments within the program. Each project was a technical, architectural, logistical and landscape task. In this studio, all these fields recur, with a focus on the implementation of infrastructural objects in the landscape. Combining infrastructural efficiency and the landscape practice has fascinated me ever since, which is why I chose this studio.	

Graduation project		
Title of the graduation project	**Bringing the Lelyline to the Next Level** A landscape architectural design research on the implementation of an innovative railroad as a high-efficiency alternative to the Lelyline. A case-study between Amsterdam and Zwolle.	
Goal		
Location:	Between Amsterdam and Zwolle	
The posed problem,	In 1839, the first railroad in the Netherlands was opened (van Lent, 2022). Since then, trains have been an integral part of the Dutch landscape and culture. Along the tracks, cities have developed and grown significantly. In the development of the Dutch train network, however, connection to the north has been left behind. Therefore, a plan has been ready for years to connect	

Amsterdam and Groningen with a new train track via Almere, Lelystad, Emmeloord, Heerenveen and Drachten: the Lelyline. By improving the accessibility of these northern cities, the Lelyline could ensure further urbanization by creating a more attractive business climate for commuters. Not only nationally, but also internationally the Lelyline is receiving a lot of attention, as the line is a step towards a connection to Hamburg. In early December 2022, the Lelyljne is included in the expanded TEN-T (Trans-European Transport Network) network, giving the plan a chance to receive European subsidies (Ministerie van Infrastructuur en Waterstaat, 2022).

Like the other tracks in the Netherlands, the Lelyline will have a barrier effect in the landscape and cause fragmentation. Due to many curves and multiple stations in the track, the travel time gain achieved is also not optimal. This comes together with high construction costs. In short, the Lelyline needs innovation. Civil engineers from TU Delft are thus researching a self-extending, modular railroad line elevated 8 meters above the landscape. This construction promotes a maximum of repetition and will therefore be as straight as possible with a minimum of curves. This innovative construction needs to be well implemented in the vulnerable Dutch cultural landscape, for which landscape architectural research and design is needed. The landscape intervention of the innovative railroad into the cultural landscape between Amsterdam and Zwolle will be researched through this thesis.

research questions and	
	Main RQ: How can innovative railroad technology be implemented in the Dutch cultural landscape between Amsterdam and Zwolle through landscape interventions and create new land values and resilient urbanism?

1. What benefits can be gained in the landscape between Amsterdam and Zwolle through the new innovative railroad implementation?
2. What opportunities for urban development exist within the project area that can coexist with the proposed railroad?
3. In what ways can landscape interventions associated with the implementation of a rail track contribute to achieving collateral benefits?
4. How can the proposed innovative railroad be integrated with respect for the layered cultural Dutch landscape and create maximum collateral benefits?

design assignment in which these result.	There are two main design assignments in this thesis: - The ideal alignment into the landscape and city - The detailed landscaping of the track The design assignments below form the main assignments. 1: A study of landscape opportunities and constraints within the project area that are linked to the existing train network or the optional new trail. 2: A study of possible effects on urban development of the cities within the project area that are connected to each other by the proposed trainline. 3: Different alignment models between Amsterdam and Zwolle, and determining parameters to perform an assessment that, together with an extensive section analysis, leads to a preferred model. 4: Testing the preferred model in the real landscape through detailed design: scale 1:2000 for the alignment, scale 1:20/1:50/1:100 for the detailed designs in plan and section. Evaluate and adjust to achieve the ideal implementation.

[This should be formulated in such a way that the graduation project can answer these questions.
The definition of the problem has to be significant to a clearly defined area of research and design.]

Process

Method description

See next page

research through design

Through literature (De Groene Horizon. Vijftig jaar bouwen aan het landschap van de Flevopolder (Horlings et al., 2018), Cultuurhistorische IJsselmeerbiografie: Utrecht, Gelderland, Overijssel en Flevoland (Storms-Smeets et al., 2017), data processed in QGIS, field trips and precedent studies, such as the Hanzelijn, the landscape is being analyzed. The central question in this analysis is: What benefits can be gained in the landscape between Amsterdam and Zwolle through the new innovative railroad implementation? Through this research, opportunities and constraints are formed that apply in the project area for the implementation of the railroad.

The second substudy focuses more on the urban landscape and development of urban cores. Again, literature review (Railway Development: Impacts on Urban Dynamics (Bertolini & Spit, 1998)) is conducted to examine the effects of railways on urban development. Together with sources that provide insight into plans that exist for urban expansion, the following question is sought to be answered: What opportunities for urban development of Almere exist within the project area that can coexist with the proposed railroad?

Various alignment options are then sketched on a map created in QGIS using TOP50NL (Nationaal Georegister, 2022) as a base. The purpose of this is to explore all the possibilities. The options are grouped, and parameters are created that aligned with the results of the conclusions drawn earlier. Thus, the parameters focus not only on properties of the track itself, but rather on the optional collateral benefits for landscape and urban development. The grouped alignment models are tested in section, resulting in a rich section analysis. This shows which models can contribute to achieving multiple benefits not only in map, but also in section. Thus, the sub-question sought to be answered in this phase is: In what ways can landscape interventions associated with the implementation of a rail track contribute to achieving collateral benefits?

The model that comes out best from the assessment is the preferred model.

The preferred model will be further developed. This means that both the train track itself and the landscape interventions will be designed and tested in the real landscape. The alignment will be detailed in scale 1:2000, the sections in scale 1:20/1:50/1:100. The generated designs will be constantly tested, evaluated and adjusted where necessary. Through this iterative process the most optimal implementation is pursued and the question is answered: 4. How can the proposed innovative railroad be integrated and developed in detail in the existing landscape with respect for the layered cultural Dutch landscape and create maximum collateral benefits?

Finally, the research and design process is reflected upon. Would a different design strategy have led to a different outcome? Or what conclusions call for follow-up research? But above all, the significance of this research within the problem field and the new knowledge the research has brought is discussed.

understanding the landscape through research into and analysis of project area

main research question

sub questions

problem statement

problem field

parameter evaluation

section studies

set parameters

categorize options and form groups

preferred models

preferred model

detailed design implementation and landscape interventions

testing and evaluation

conclusions & final design

model possible alignment options

discussion & reflection

Literature and general practical preference

Books

Borda-De-Água, L., Barrientos, R., Beja, P., & Pereira, H. M. (2017). *Railway Ecology*. Springer Open. https://doi.org/10.1007/978-3-319-57496-7

Bertolini, L., & Spit, T. (1998). *Cities on Rails: The Redevelopment of Railway Stations and their Surroundings* (1st ed.). Routledge.

Bruinsma, F., Pels, E., Priemus, H., Rietveld, P., & van Wee, B. (2007). *Railway Development: Impacts on Urban Dynamics*. Physica-Verlag. https://doi.org/10.1007/978-3-7908-1972-4

Frank, V. D. H., Nijhuis, S., & Daniel, J. (2016). *Flowscapes: Designing infrastructure as landscape* (1st ed.). TU Delft.

Horlings, H., Blom, A. M., Hendrikx, F., Kosian, M. C., van der Kleij, G., Staatsbosbeheer, & Rijksdienst voor het Cultureel Erfgoed. (2018). *De groene horizon. Vijftig jaar bouwen aan het landschap van de Flevopolder*. THOTH.

Jacobs, I. D. (2013). *Hanzelijn: Oude en Nieuwe Land verbonden* (1st ed.). Matrijs.

Koolhaas, T. & Marcusse, E. (2007). *Atelier IJmeer 2030 +: amsterdam IJmeer Almere* (1ste editie). 010.

Swaffield, S. (2002). *Theory in Landscape Architecture: A Reader (Penn Studies in Landscape Architecture)*. University of Pennsylvania Press.

Reports

Storm-Smeets, E., van den Bergh, S., Derks, G., van Damme, M., Terpstra, M., van Hellemondt, M. (2017). *Cultuurhistorische IJsselmeerbiografie: Utrecht, Gelderland, Overijssel en Flevoland*. Rijksdienst voor het Cultureel Erfgoed.

Arup & AECOM. (2016). *HS2 Landscape Design Approach* (No. HS2-HS2-EV-STR-000–000010). Department for Transport. Retrieved December 14, 2022.

Websites

Goed Gespoord van West naar Noord. (z.d.). Lelylijn. https://www.lelylijn.nl/
Lent, N. van. (2022, August 23). *Hoe ontstond de spoorlijn?* NPO Kennis. https://npokennis.nl/longread/7581/hoe-ontstond-de-spoorlijn

Ministerie van Infrastructuur en Waterstaat. (2022, December 5). *Lelylijn opgenomen in uitgebreide TEN-T netwerk*. Nieuwsbericht | Rijksoverheid.nl. https://www.rijksoverheid.nl/actueel/nieuws/2022/12/05/lelylijn-opgenomen-in-uitgebreide-ten-t-netwerk

Data

Basisregistratie Ondergrond (BRO). (2017). *De Bodemkaart van Nederland* [Dataset]. PDOK. https://geodata.nationaalgeoregister.nl/bodemkaart50000/wfs?request=getCapabilities&service=wfs

Nationaal Georegister. (2022). TOP50NL [Dataset]. In *Basisregistratie Topografie (BRT)*. PDOK. https://www.pdok.nl/introductie/-/article/basisregistratie-topografie-brt-topnl

Nationaal Georegister. (2022). *Natura 2000 (INSPIRE geharmoniseerd)* [Dataset]. PDOK. http://geodata.nationaalgeoregister.nl/inspire/ps-natura2000/wms?request=getcapabilities

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)?

Throughout the MSc AUBS master's program, innovative ways of developing more sustainably are explored. This research within the lab 'Innovated Infrastructure Implementation' focuses strongly, as the name suggests, on innovation implemented in the Dutch landscape. Implementing a train track requires designing through scales. Not only is a multi-scale approach needed to define and design the right alignment; the impact of landscape interventions goes through scales and systems. In this project, the challenge is to elegantly guide a civil construction through the cultural landscape. If this is done properly, the train passengers and people in the landscape can be brought closer to the landscape and the relationship between human systems and natural systems is strengthened.

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

Researching and designing an entire railroad involves technical challenges. In practice, such an investigation is done in a team together with other disciplines, designers, engineers, ecologists, etc. Moreover, the landscape architect is often not assigned a role in the process until after an alignment has been designed. By examining the most optimal alignment from a landscape perspective in an integrational study with civil engineers, implementation in the landscape may be done much more efficiently.

The need for an international rail link was acknowledged by the European Union this month. The decision to include the Lelyline in the expanded TEN-T network will put more pressure on the execution of the plan. Thus, exploring a more efficient Lelyline at this point is highly relevant and urgent. A faster connection between Amsterdam, Almere and Zwolle will make the cities a more

attractive climate for businesses and residents. However, the spatial impact of an elevated train track is significant and easily arouses aversion. Therefore, it is crucial to implement the train track with respect for both the landscape and its use.

This case study focuses on the landscape between Amsterdam and Zwolle; here the innovative railroad is implemented. This type of infrastructure is unique in the Netherlands and although it is only tested in a limited area, this study can also be of great value for investigating implementation in similar landscapes. Smaller partial designs, such as the function and spatiality in a high-urban environment, could act as a toolbox for future designs.