Heritage &
Architecture
MSc 3-4
2024/2025


Gorinchem Photo Collection, (1970-1985)
Due to the high water in the Merwede, Buiten de Waterpoort was partially flooded.
Traffic signs stick out above the water, including one that warns of a bad road surface.

# ***Responding to Climate Risks:***
## *Revitalizing Post-industrial Heritage into Climate Resilient Design*

**Research Plan**

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*5822017*

# CONTENTS

# Introduction

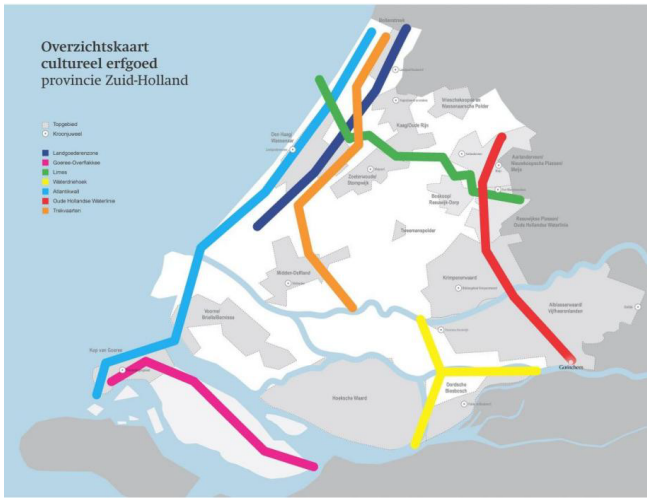



Fig.1 Cultural Heritage Lines Map of the South Holland Province

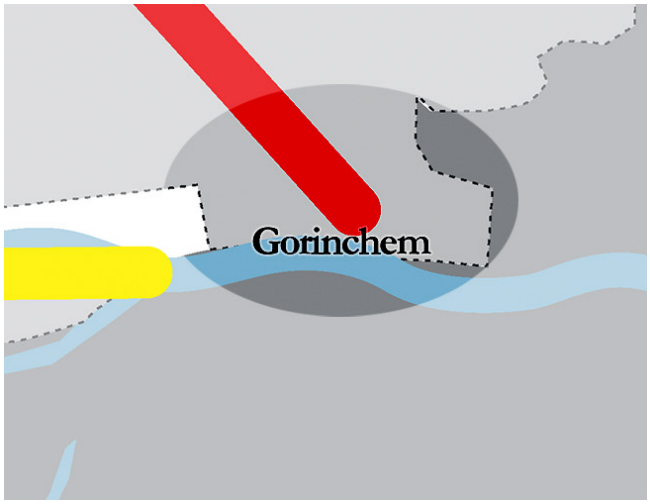



Fig.2 Red: Old Dutch Waterline, Yellow: Waterdriehoek, and Location of Gorinchem

Water has always been both a lifeline and a challenge for the Netherlands, shaping its landscape, history, and culture. *(Holland Stories: Water - How Water Gives Life to the Netherlands, 2024)* Human activities, especially maritime activities have been significantly shaped by the nation's waterways. From the Golden Age through the industrial revolution, the waterways not only facilitated trade and transportation but also powered the mills and factories. *(Mostert, 2020) (UNESCO World Heritage Centre, n.d.)* The intricate relationship with water has given rise to a unique maritime and industrial heritage, embedding a rich historical narrative within the Dutch landscape. It is this legacy, with its profound historical and cultural significance, that calls for urgent preservation efforts.

In order to preserve the rich legacy of the region for future generations, the South Holland Province has introduced several cultural heritage lines, known as *Cultureel Erforgoed* in Dutch. *(Ministerie van Onderwijs, Cultuur en Wetenschap, 2021) (fig.1)* Gorinchem, being the meeting point of two cultural heritage lines, that are the broader area of *Waterdriehoek* (Water-triangle) and *Oude Hollandse Waterlinie* (Old Dutch Waterline), holds a unique position in this narrative. *(fig.2)*

The town's evolution from a medieval settlement to a fortified city and, later, to an industrial powerhouse with multiple shipyards and steel productions, is deeply intertwined with the role of water in driving industrial growth and development. *(Citytrip Gorinchem, n.d.)* Today, Gorinchem holds significant status for investigations on water heritage and built industrial assets, with over 200 national heritage sites. *(Rijksdienst Voor Het Cultureel Erfgoed, n.d.)(fig.3)*

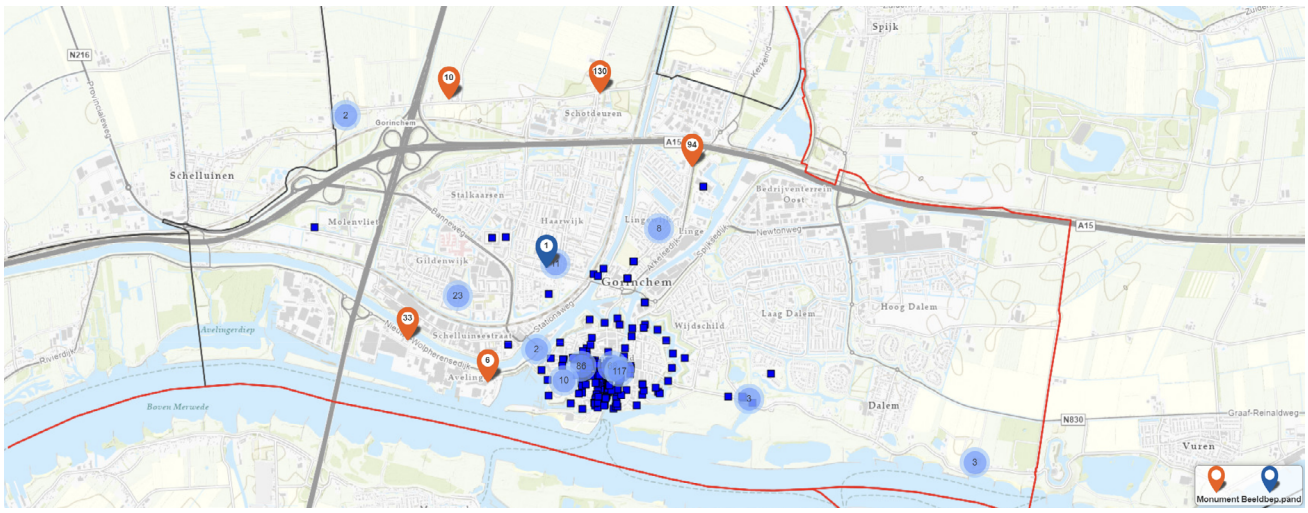



Fig.3 National and Municipal Monuments Shown in the Geoportal of the City Gorinchem

# Problem Statement

In the last few decades, climate-related disasters such as rising sea levels, floods and drought have been affecting the sensitive delta areas increasingly. Cultural heritage sites, like historic buildings and landscapes, are especially at risk from these disasters. *(Arrighi, 2021)* Riverine cities like Gorinchem face significant challenges in this context. In the year 1995, Gorinchem barely escaped a disaster causing by constantly high water levels, lots of precipitation, strong winds and insufficiently reinforced dikes. *("Gorinchem Op Z'n Kop Tijdens Bijna-ramp in 1995; Duizenden Gorcumers Verlaten Huis En Haard," 2020) (Jan Boshoven, 2022) (fig.4-6)*

With over 200 national heritage sites and objects, the city embodies rich history and culture, making the assessment of each site's vulnerability and value critical. This research is essential for understanding the hierarchy of protection required or determining the level of emergency for taking action. Moreover, it enables stakeholders to comprehend the extent of what is at risk and the severity of potential impacts.

By evaluating both the vulnerability and the value of Gorinchem's listed heritage, in particular industrial heritage, the research aims to prioritize conservation efforts effectively. This approach facilitates the development of targeted strategies to protect the most at-risk sites without overlooking those with irreplaceable cultural significance.

Fig.4 A Screenshot of a Video Taken in 1995, Showing the Degradation of Building Due to Excessive Water.

Fig.5 A Screenshot of a Video Taken in 1995, Showing the Degradation of Building Due to Excessive Water.

Fig.6 High tide in 2015, twenty years after the 'near disaster' in 1995

# Research Questions

This research aims to address the following questions:

> **What is the value and vulnerability of Gorinchem's listed heritage in relation to climate risks? Furthermore, considering the climate risks it faces, how can a post-industrial built heritage in this context be revitalized to enhance its climate resilience?**

The main research questions can be divided into several sub-questions, which will be sequentially addressed and investigated:

- Identification and Categorization: What kinds of heritages are listed in Gorinchem in either national , provincial, or municipal heritage lists? How are they determined and what criteria are used?

- Value Assessment: What historical, social, functional, and memorial values do these heritages possess? How can these values be quantified referring to literature and previous researches?

- Risk Assessment: Which specific climate risks threaten these sites? How can these risks and their potential consequences for the built heritages be quantitatively assessed?

- Vulnerability Assessment: What factors contribute to the vulnerability of the heritage sites to climate risks (e.g., age, construction materials, geographical position to water)? What methods can be applied in quantifying their vulnerability?

- Design Brief Formulation: What are the most important factors in a design brief to guide the transformation of a post-industrial heritage site, which is potentially threaten by climate risks? Additionally, what are the needs and requirements of human being and other actors in ecological system to form a climate-resilient built environment? How can spatial design integrate these needs?

By exploring these questions, this study aims to assess the climate risks that heritage sites are facing, and to formulate an effective toolbox for the climate-responding resilient design. Lastly, this toolbox will be tested in a dedicated site to revitalize a post-industrial heritage in the face of climate challenges.

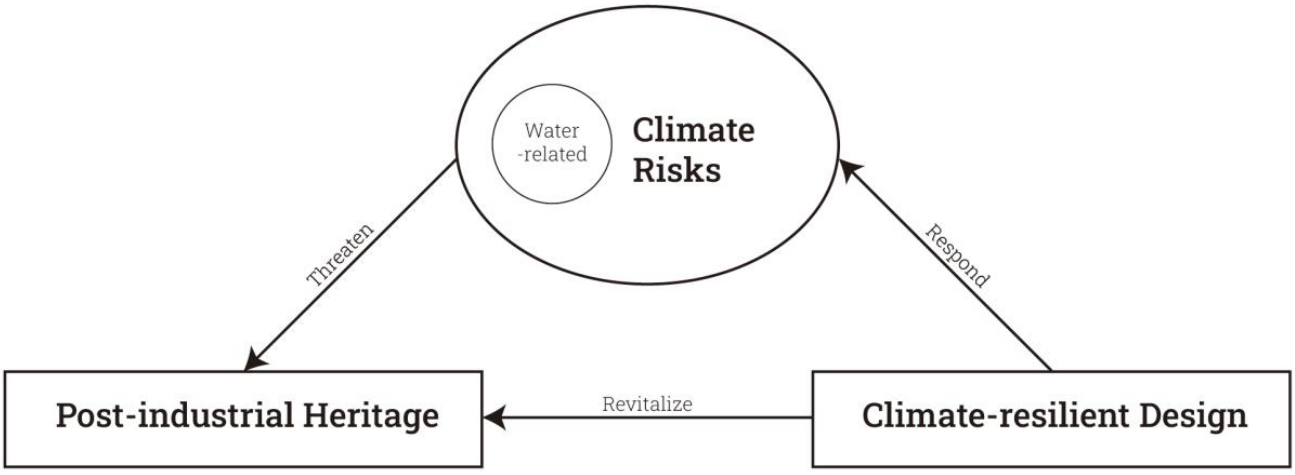



Fig.7 Relationship between Climate Risks (Threats), Post-industrial Heritage (Object), and Climate-resilient Design (Goal)

# Methodology

The methods related to this research include on-site investigations, modeling, mapping, archival research, policy study, theoretical study, interview, and research by design. These methods are not equally important and are used selectively.

The site visits are planned and conducted multiple times, starting from an early stage, in order to gain firsthand insights into the current condition of heritage structures. Photography and video are taken as outputs and records. Physical and digital models are made to analyze the essence of important structures. *(Fig.8-10)*

Among all, mapping is the primary method to visualize the assessment process and results. The main sources for mapping are from *Atlas Leefomgeving* (Atlas Living Environment), a Dutch collaborated governmental website that provides open access to numerous maps on climate-related topics such as noise pollution, air quality, monuments, and local walking routes *(Atlas Leefomgeving, n.d.)*. For instance, the *Kans op een overstroming vanuit zee, meer of rivier* map (Risk of flooding from the sea, lake or river) *(Fig.11)* displays different colors to indicate the likelihood of flooding; whereas the map of *Droge verdiepingen* (Dry floors) *(Fig.12)* provides information on whether each house and building has at least one dry floor during maximum flooding. To the other extreme, *Gebieden met kwetsbare fundering doordroogte* map (Areas with vulnerable foundations due to drought) *(Fig.13)* shows where structural problems can arise due to drought and the consequent groundwater level drops. *(Atlas Leefomgeving, n.d.)* These inputs are crucial in determining a building's exposure to climate risks, including floods and droughts.

Alternatively, the River Flood Hazard Maps at European and Global Scale published by European Commission, Joint Research Centre is another source of input that included depict flood prone areas in Europe and the World for river flood events of different magnitude, from 1-in-10-year to 1-in-500-year. *(Joint Research Centre Data Catalogue - European Commission, 2024)* This database is on global scale, therefore little country-specific criteria is applied compared to the source from *Atlas Leefomgeving*. Hence, it does not serve as the primary source. Nevertheless, it can still be utilized for evaluating population and economic assets' exposure to river floods and conducting flood risk assessments as a complement.

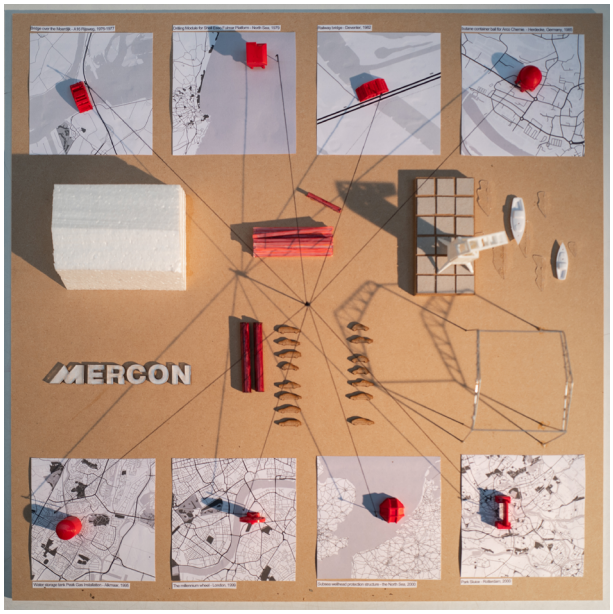



Fig.8 Essence Model of Mercon Montage B.V., an Industrial Site in Gorinchem

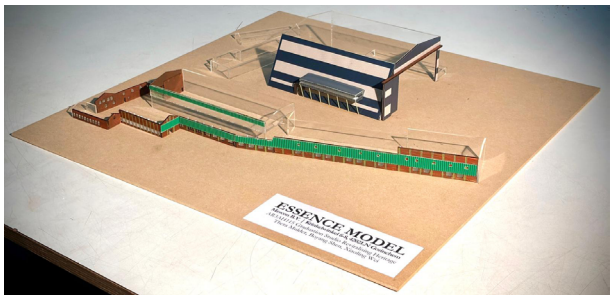



Fig.9 Essence Model of Mercon Montage B.V., an Industrial Site in Gorinchem


Fig.10 Photo Taken during the Site Visits to Gorinchem

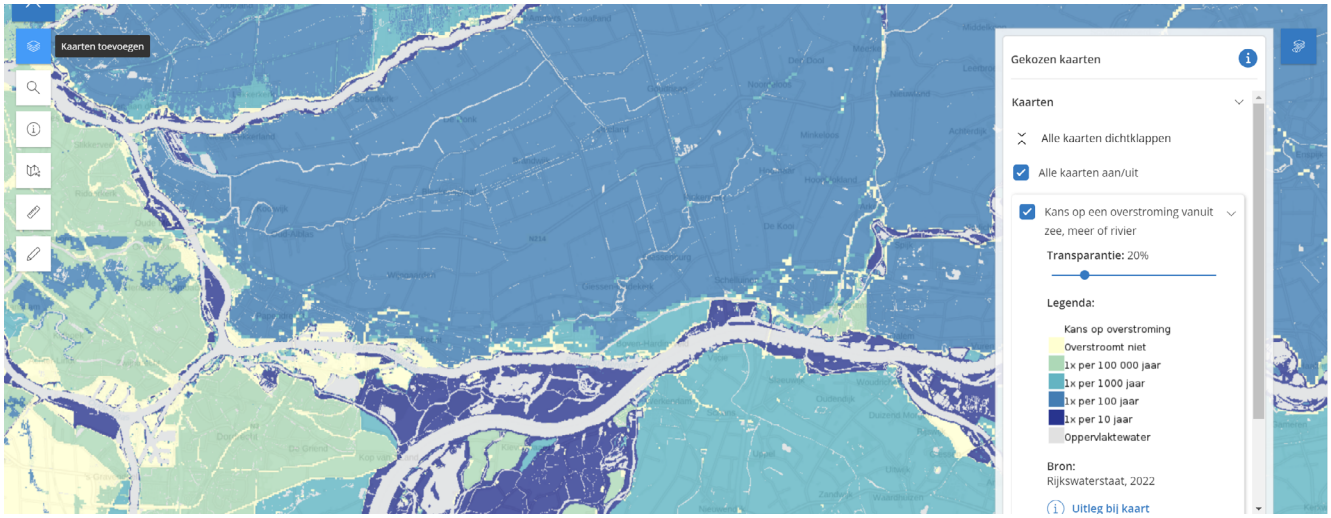



Fig.11 Map *Kans op een Overstroming vanuit Zee, Meer of Rivier* (Risk of Flooding from the Sea, Lake or River)

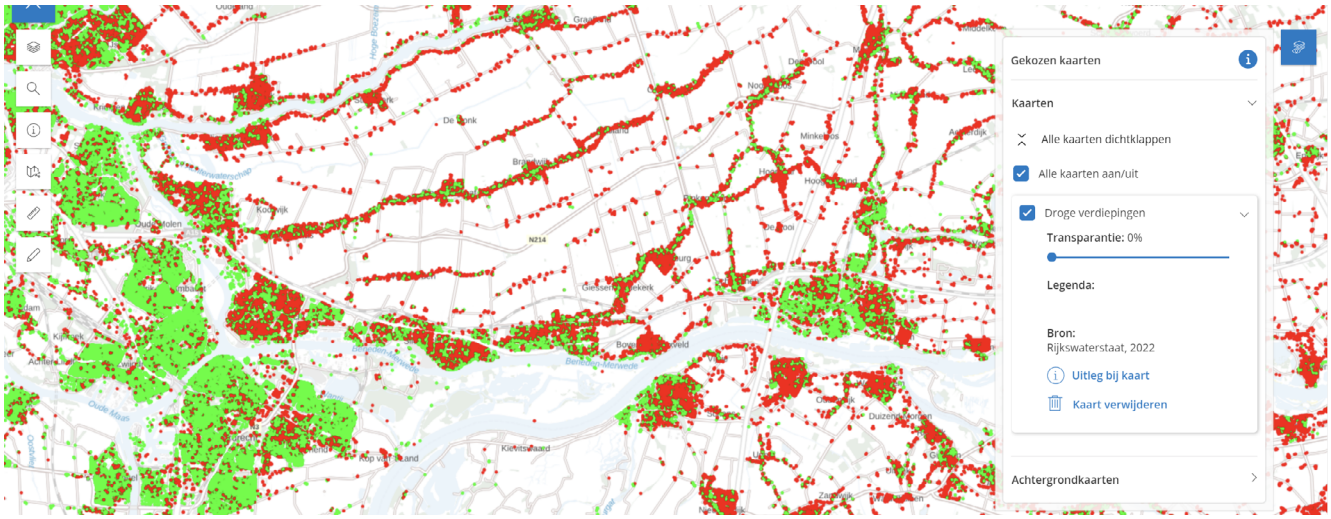



Fig.12 Map *Droge Verdiepingen* (Dry Floors)


Fig.13 Map *Gebieden met Kwetsbare Fundering Doordroogte* (Areas with Vulnerable Foundations due to Drought)

Archival Research involves the examination of historical documents, architectural drawings, historical news, and records to gather detailed information about the construction age, materials, architectural styles, and historical significance of each building. This in-depth analysis supports the valuation process.

Policy Study is mainly divided into two parts, the first being the analysis of criteria for listed monuments in national, provincial, and municipal cultural heritage lists. Secondly, it involves analyzing decrees and regulations on cultural heritage, such as the *Cultureel Erforgoed* by South Holland Province. By examining both policies, a better understanding of the value of individual buildings and their collective significance can be achieved to aid in the valuation process.

Theoretical study is conducted through literature review and case studies, covering topics such as climate risks, flood and drought risk assessment, the value of heritage, climate resilience design, and adaptive reuse strategies, in particular for post-industrial heritages. Both Dutch and global research and practices will be considered.

The interviews will be conducted with relevant stakeholders, such as John Stoop, the chairman of the organization De Vries Robbé Heritage Preservation Foundation. This foundation is dedicated to preserving the heritage associated with the former De Vries Robbé Company, which was once the largest industrial firm in Gorinchem since 1925. However, business conditions worsened in the 1970s and eventually led to bankruptcy, with some departments being split into Mercon Montage B.V.. *(Overzicht: Maritiem-industrieel Erfgoed Tussen Gorinchem En Hoek Van Holland, n.d.) (Stichting Erfgoed De Vries-Robbe | FIEN, n.d.) (Lingewijk: Koop Lokaal in Gorinchem, n.d.)*. Conducting this type of interview is useful for understanding the town's history and industrial development, ultimately aiding in finding a testing site for the design proposal.

Eventually, the design brief for a selected site will be formulated, with a focus on incorporating climate-resilience strategies and revitalizing the post-industrial heritage site. The design process is closely connected with research efforts and outcomes.

The selection criteria for the tested site are as follows: it should be potentially threatened by climate risks, a former industrial site, vacant and available for transformation, with information on its historic and current situation being accessible.

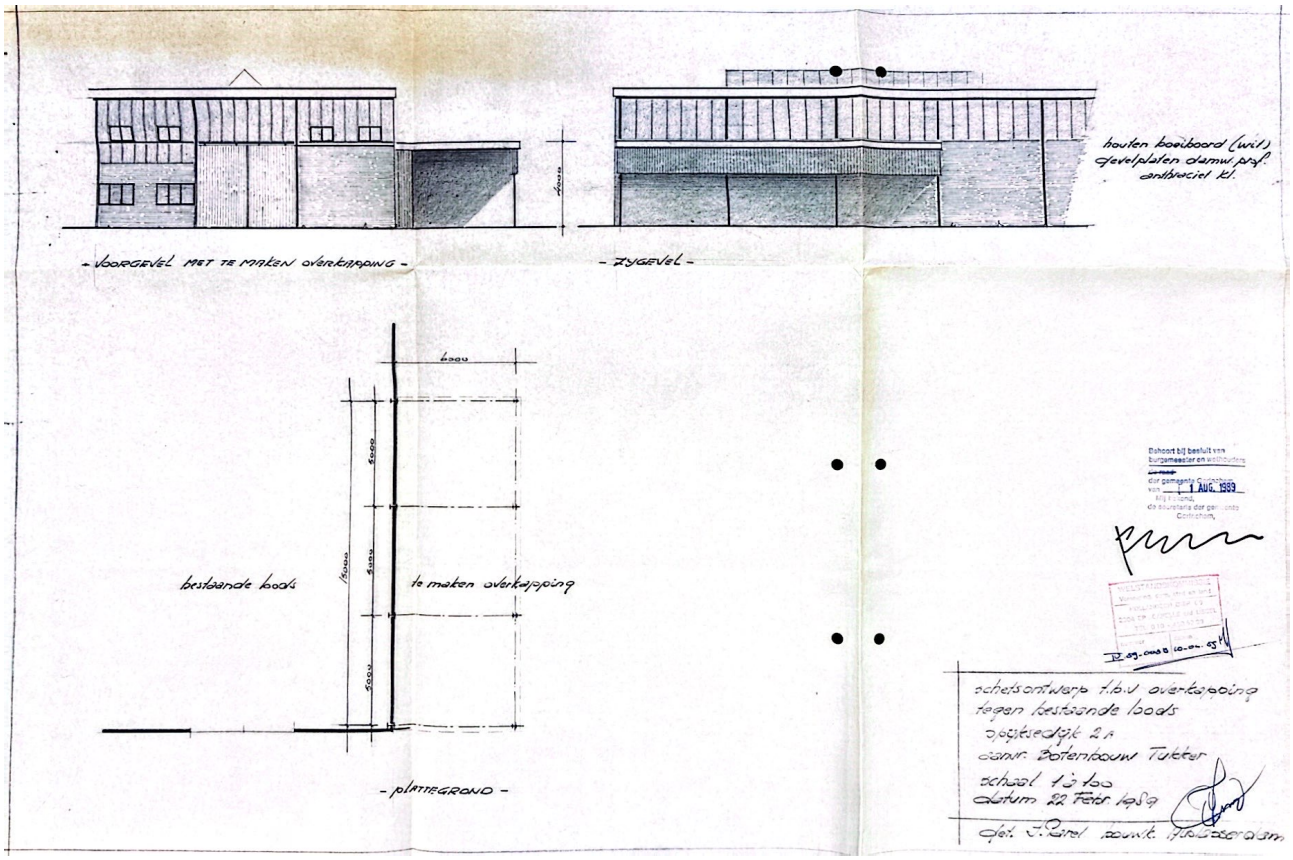
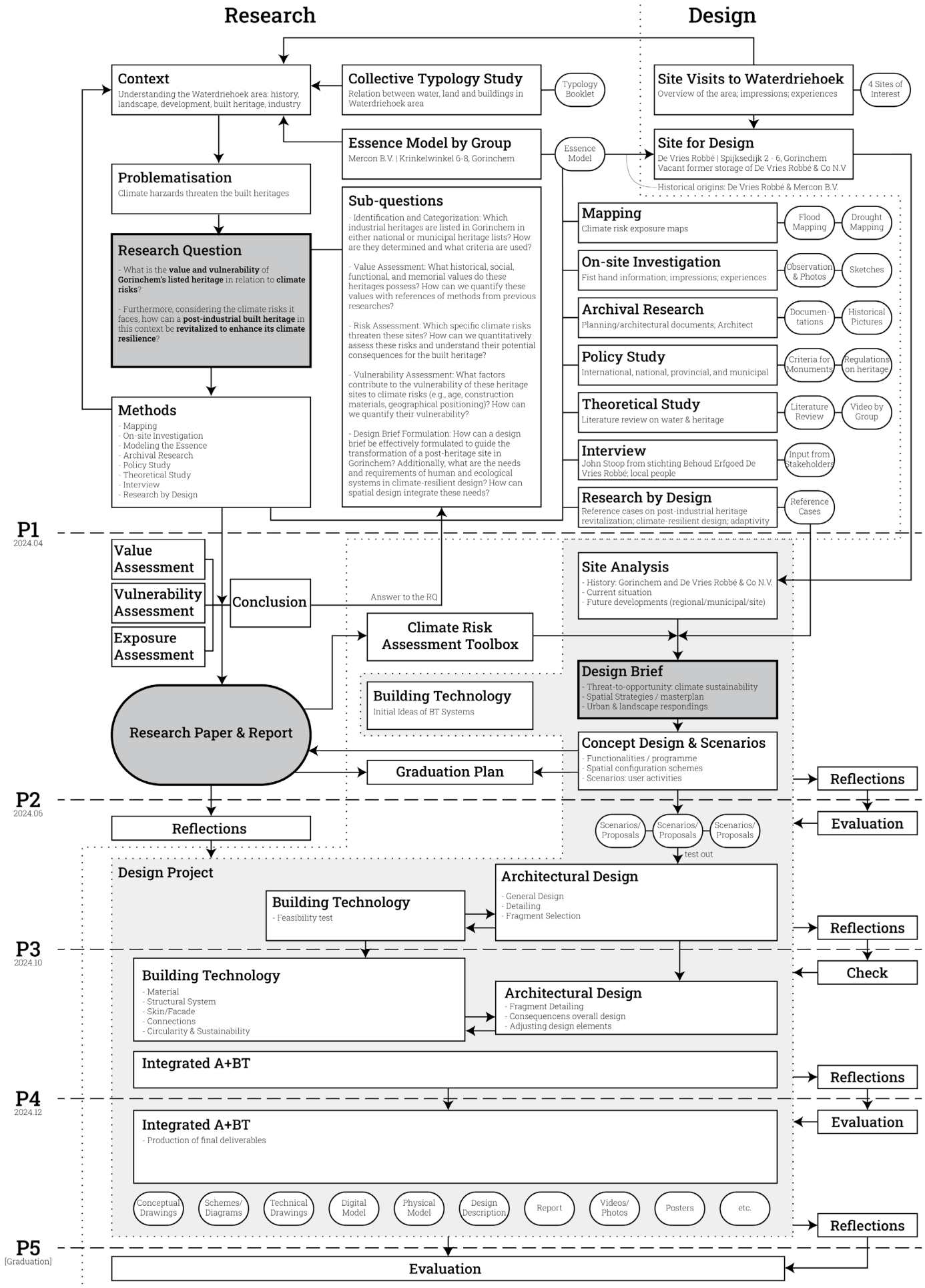



Fig.14 Architectural Drawings of a Studied Building from Regional Archieve Gorinchem

# Research Plan Structure Diagram



# Theoretical Framework

The theoretical framework on this research topic can be divided into four aspects, namely: Climate Risks Assessment, Valuation of Heritage, Climate Resilient Design, and Heritage Adaptive Reuse, sourced from compulsory readings and recommended literature of the course, and other scientific papers that are relevant.

**Climate Risks Assessment**

There has been extensive research on evaluating climate risks to buildings and heritage sites, particularly regarding flood risk. In a study published in 2021, river flood risks to UNESCO World Heritage sites were analyzed on a global scale. This study assessed flood risk at those sites using a risk matrix approach that considers hazard, exposure, and vulnerability. Hazard assessment was conducted with global river flood maps across various probabilistic scenarios. Exposure classification was based on the site's significance to humanity, according to the World Heritage List selection criteria. Vulnerability assessment depended on the site's typology, with natural sites evaluated for hazard and exposure, while cultural and mixed sites underwent a comprehensive analysis that included vulnerability assessment *(Arrighi, 2021) (fig.15-16)*.

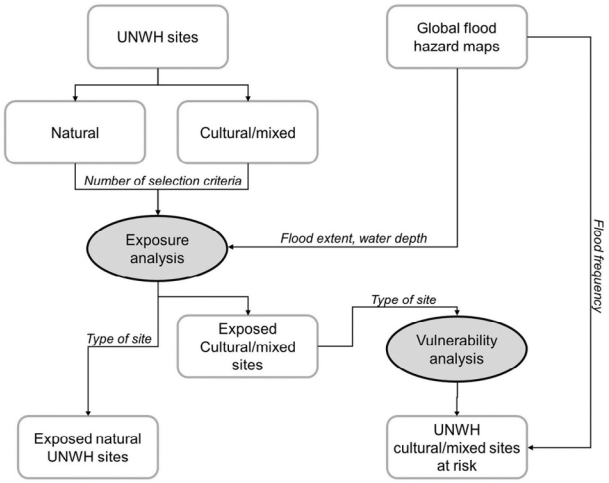



Fig.15 Scheme of the Methodological Workflow for Risk Analysis of UNWH Sites (Ellipses Stand for Activities, Boxes for Data Flow)

| Risk | Potential damage class | | | | |
|---|---|---|---|---|---|
| Hazard class | 1 | 2 | 3 | 4 | 5 |
| 5 | 5 | 10 | 15 | 20 | 25 |
| 4 | 4 | 8 | 12 | 16 | 20 |
| 3 | 3 | 6 | 9 | 12 | 15 |
| 2 | 2 | 4 | 6 | 8 | 10 |
| 1 | 1 | 2 | 3 | 4 | 5 |

*Colors from green to red show increasing risk classes.*

Fig.16 Table of the Flood Risk Classes for UNWH Sites based on Hazard and Potential Damage Scores

In another study conducted in 2023, a method called the Quick Flood Risk Scan Method was developed and tested in the city of Dordrecht. This method simplified the assessment of cultural heritages' value and vulnerability to flooding, enabling non-experts to conduct preliminary qualitative assessments. Monuments were categorized into three classes of value density and three classes of vulnerability based on material, construction, and condition. Subsequently, a risk matrix combined value and vulnerability to classify monuments into different risk levels, which were then color-coded on maps to indicate the severity of potential loss *(Brokerhof et al., 2023) (fig.17-18)*.

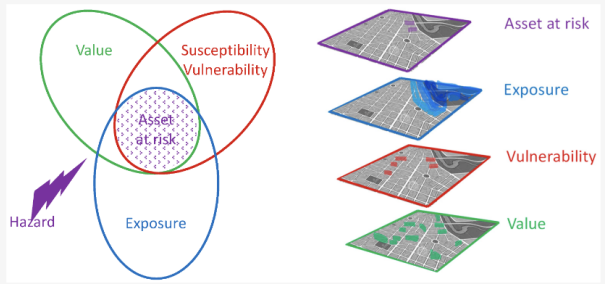



Fig.17 Principles of the Quick Flood Risk Scan Method

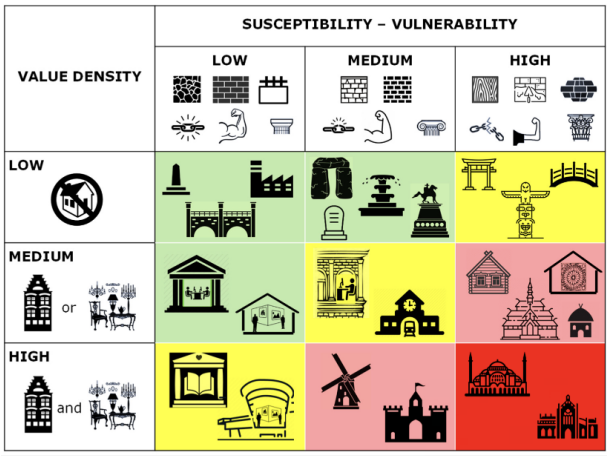



Fig.18 Matrix to Assess Potential Loss or Impact (Here: Vulnerable Value) for Monuments in the Netherlands

**Valuation of Heritage**

In the book Designing from Heritage, value-based design is presented as an approach that goes beyond traditional building archaeology and architectural conservation practices to understand and prioritize heritage features. This approach helps architects preserve essential heritage qualities while incorporating contemporary design elements. *(Kuipers & De Jonge, 2017)*

Anothe idea presented in this book is that value assessments are diverse and subjective, as illustrated by the example of various outcomes from the valuation process of the same building by different people and their point of view. *(fig.19)* Incorporating stakeholders' inputs have to be done critically and wisely.

The book Heritage-based design explores the relationship between design, cultural value, and technology, which are the three key elements forming the triangle of Heritage & Architecture method, as stated in the text: "The cultural value is the starting point for the design, which in its turn is further specified and defined by the technology – with the focus on conservation as well as on the details of the new design. The design approach can be symbolised by a triangle, with cultural value and technology as the basis for the design." *(Meurs, 2016)*

These two books are the foundamental theoretical basis for the build-up of valuation matrix in heritage assessment process.

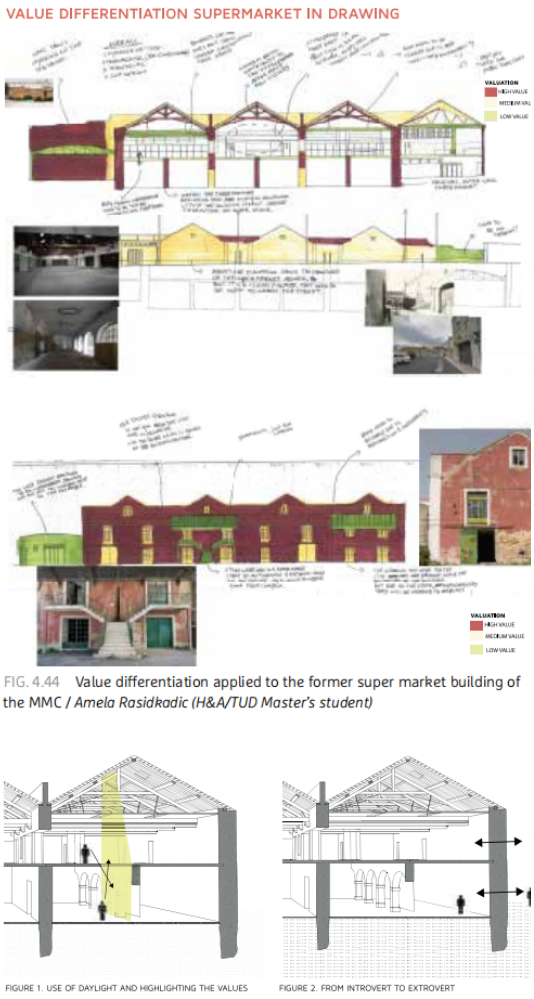



FIG. 4.44 Value differentiation applied to the former super market building of the MMC / *Amela Rasidkadic (H&A/TUD Master's student)*

FIG. 4.45 Identified dilemmas concerning conservation and adaptive reuse issues / *Amela Rasidkadic (H&A/TUD Master's student)*

Fig.19 Drawings from Master Students of H&A/TUD Shows Value Differentiation and Dilemmas between Conservation and Adaptive Reuse


Fig.20 Cover of the Book Designing from Heritage


Fig.21 Cover of the Book Heritage-based Design

**Climate Resilient Design**
In an era of rapid climate changes, it is increasingly important to consider how to tackle the challenges. The concept of climate resilience refers to capacity of social, economic and ecosystems to cope with a hazardous event or trend or disturbance. *(Chapter 18: Climate Resilient Development Pathways, IPCC, n.d.)*

In the field of architecture and urbanism, Han Meyer addressed that building resilience in urbanizing deltas involves implementing strategies that enhance their ability to withstand and recover from environmental shocks. This includes improving flood defenses, restoring natural ecosystems, promoting sustainable land use practices, and integrating climate adaptation into urban planning and design. *(Meyer, 2016)(Meyer, 2019)*

Meanwhile, the building's context has to be considered integrally, following concept of climate-responsive design. This approach prioritizes passive strategies such as natural ventilation, daylighting, and thermal insulation to reduce reliance on mechanical systems. *(Looman, 2017)*

**(Industrial) Heritage Adaptive Reuse**
The definition of Adaptive Reuse is that an existing building is given a new function. In this way, it is neither left vacant nor demolished. Instead, it is given a new lease of life. *(Ministerie van Onderwijs, Cultuur en Wetenschap, 2024)*

Over recent years, societal and economic developments have often led to property – including heritage sites – being left vacant. This has mainly affected religious heritage sites (such as churches and abbeys), industrial heritage sites and historical farms. These are therefore also the most likely types of heritage site to be repurposed. *(Ministerie van Onderwijs, Cultuur en Wetenschap, 2024)*

As discussed in the book Industrial Heritage Sites in Transformation:Clash of Discourses, it has become increasingly important to find a balance between protection, preservation, and development. This presents new challenges due to conflicts between monument conservation and contemporary architecture, as well as the growing demand for economic urban development through repurposed architectural heritage. *(Oevermann & Mieg, 2014)*


Fig.22 Cover of the Journal Climate-responsive Design

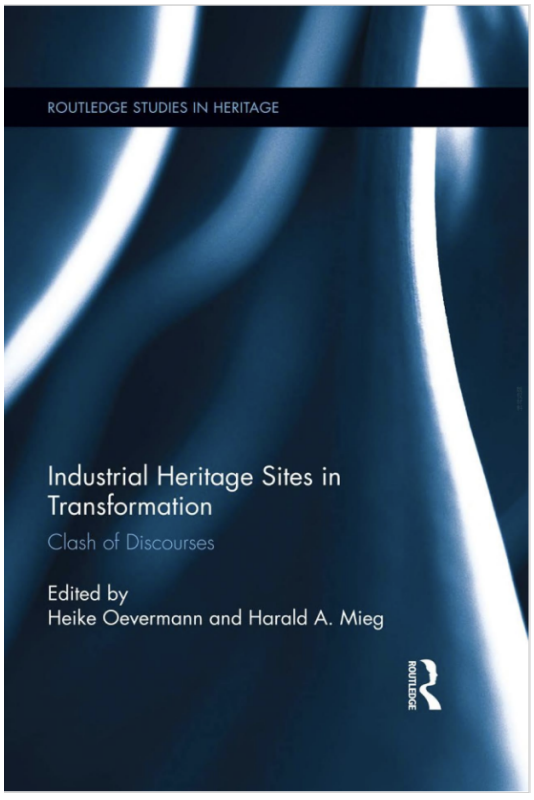



Fig.23 Cover of the Book Industrial Heritage Sites in Transformation

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# **Appendix.** Source of Images

Front Cover Image. Gorinchem Photo Collection. (1970-1985). Due to the high water in the Merwede, Buiten de Waterpoort was partially flooded. Traffic signs stick out above the water, including one that warns of a bad road surface. *https://studiezaal.regionaalarchiefgorinchem.nl/detail.php?nav_id=5-1&index=21&imgid=3366002&id=393432*

Fig.1. Ministerie van Onderwijs, Cultuur en Wetenschap. (2021, February 8). Cultural Heritage Lines Map of the South Holland Province. *https://www.cultureelerfgoed.nl/onderwerpen/praktijkvoorbeelden/overzicht-praktijkvoorbeelden/waterdriehoek-vergroot-bekendheid-en-bevordert-beleefbaarheid*

Fig.2. Ibid. Highlighted by Xiaoling Wei. (2024, April 15). Red: Old Dutch Waterline, Yellow: Waterdriehoek, and Location of Gorinchem.

Fig.3. Gemeentelijke monumenten. (n.d.). National and Municipal Monuments Shown in the Geoportal of the City Gorinchem. *https://geoportaal.gorinchem.nl/geoapps/monumenten/index.html*

Fig.4. Jan Boshoven. (2022, January 5). A Screenshot of a Video Taken in 1995, Showing the Degradation of Building Due to Excessive Water. 1995 Hoog Water Gorinchem [Video]. YouTube. *https://www.youtube.com/watch?v=DJ6oTOje5s4*

Fig.5. Ibid.

Fig.6. GP-foto. (2015). High tide in 2015, twenty years after the 'near disaster' in 1995. *https://www.destadgorinchem.nl/lokaal/historie/317062/gorinchem-op-zn-kop-tijdens-bijna-ramp-1995-duizenden-gorcumers-verlaten-huis-en*

Fig.7. Xiaoling Wei. (2024, April 15). Relationship between Climate Risks (Threats), Post-industrial Heritage (Object), and Climate-resilient Design (Goal).

Fig.8. Model: Xiaoling Wei, Boyang Shen, Thera Mulder. Photo: Boyang Shen. (2024, April 11). Essence Model of Mercon Montage B.V., an Industrial Site in Gorinchem.

Fig.9. Ibid.

Fig.10. Xiaoling Wei. (2024, March 28). Photo Taken during the Site Visits to Gorinchem.

Fig.11. Atlas Leefomgeving | Atlas Leefomgeving. (n.d.). *https://www.atlasleefomgeving.nl/* . Map Kans op een Overstroming vanuit Zee, Meer of Rivier (Risk of Flooding from the Sea, Lake or River)

Fig.12. Ibid. Map Droge Verdiepingen (Dry Floors)

Fig.13. Ibid. Map Gebieden met Kwetsbare Fundering Doordroogte (Areas with Vulnerable Foundations due to Drought)

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Fig.16. Ibid. Table of the Flood Risk Classes for UNWH Sites based on Hazard and Potential Damage Scores.

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