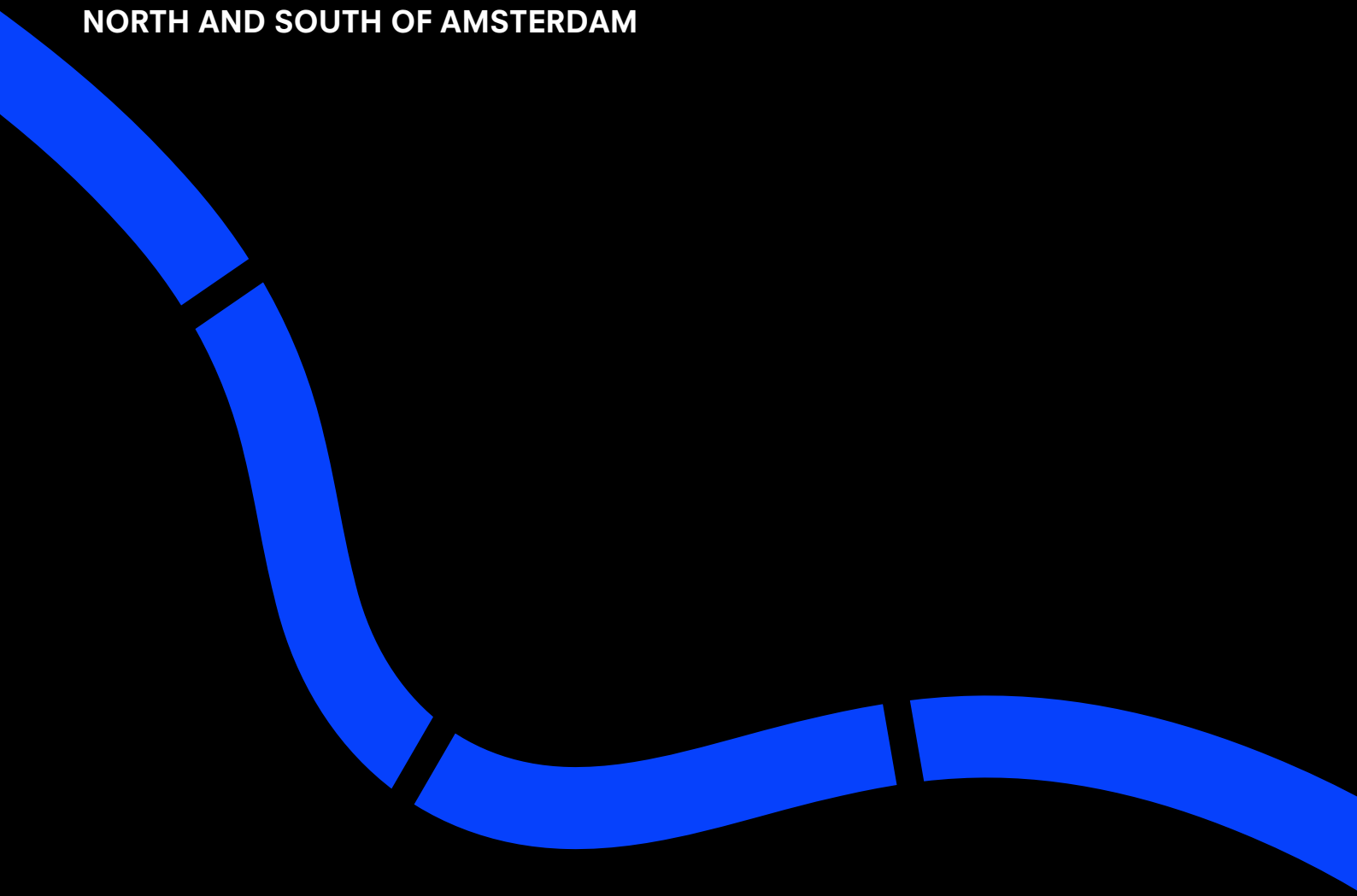
JUMP ~~OVER~~ ONTO THE IJ

A MULTI-FUNCTIONAL BRIDGE AS AN ACTIVE CONNECTION BETWEEN THE NORTH AND SOUTH OF AMSTERDAM



Research paper | Timber for Urban Density
Marloes van Zee
4840836

Key words
Multi-use | High density | Bridge design | Amsterdam

Abstract
Amsterdam's population is expected to grow 20% by 2035. To accommodate this increase in population, Amsterdam is planning the Haven-stad transformation, turning an area west of the city centre into a city inside the city. The Haven-stad plan also includes a bridge linking the NDSM-werf to the Minervahaven, two areas that are to be transformed into high density mixed-use neighbourhoods. Most of the land available has already been built on, or is under construction, so underused spaces must be used to the fullest. This research investigates how this new bridge crossing the IJ river, can contribute to the densification of Amsterdam, by reintroducing the typology of a multifunctional bridge. By analyzing historical bridge proposals, case studies of multifunctional bridges, and conducting a SWOT-analysis, the study explores how a bridge crossing the IJ river can support diverse functions, such as housing, commerce, and culture. A research-by-design approach combines the found typologies of the case studies with the SWOT-analysis, resulting in a multifunctional bridge that connects Amsterdam to a regional bike network, connects the north and south of the city and contributes to the urban development of the Minervahaven and NDSM-area. This research opens opportunities for further research into other urban structures that are underused or how this typology would work in other cities or regions.

Research paper | Timber for Urban Density
Marloes van Zee
4840836

Design mentor
Loes Thijssen

Research mentor
Alex de Rijke

CONTENT

Introduction 4
Method 6
Research questions
1_Story of the bridge 8
2_Multi-use 18
3_Added value 36
Conclusion 40
Discussion 41
Bibliography 42

INTRODUCTION

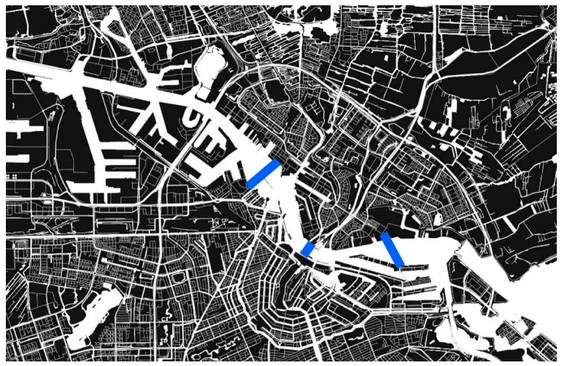


Figure 1_Schematic drawing of possible locations of the the bridges

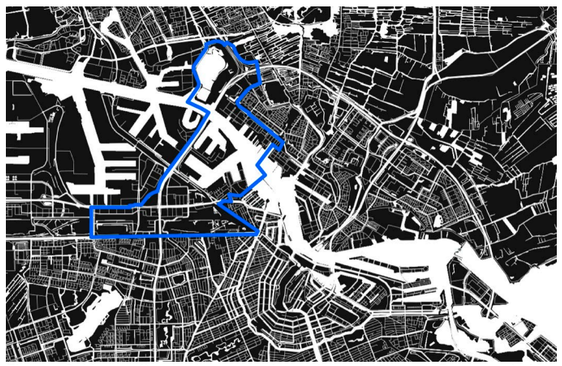


Figure 2_Haven-Stad plan area based on Integraal Raamwerk Haven-Stad by Gemeente Amsterdam, 2021

When Amsterdam started to expand during the 19th century, plans were made for a better connection across the IJ river. During this period, numerous designs have been made for a bridge, but none of these designs was ever realized (Smit et. al., 1996). Currently however, the municipality is planning to build not one, but three connections in the east, west and at the central train station of Amsterdam.

One of these bridges is part of the Haven-stad plan of the municipality, which intends to transform the harbor into a city inside the city to accommodate the expected growth of 20% until 2035 (de Jong et al., 2022). Up to 70.000 homes and 58.000 workplaces will be realized in the Harbor-city consisting of 12 sub-areas in the west and north-west of Amsterdam, including living, working, sports, stores, healthcare and greenery. With only 1 in 5 households that will have a parking spot, there is a large focus on the bicycle network, of which the new bridge will be an important part (Gemeente Amsterdam, z.d.).

The bridge will connect the NDSM-werf, a creative cultural area, to the Minervahaven, an area mostly dedicated to offices and industry. The municipality intends to transform these areas into mixed-use parts of the new harbor-city also including high-density housing. Most of the available land in the Minervahaven and in the NDSM area has already been built on, or is under construction, so this densification will have to be achieved through topping-up and other creative solutions. The new bridge that will be built here offers a great opportunity for this densification. Currently, the vast majority of bridges are only used for one function: getting to the other side. But throughout history there have been bridges, like the Ponte Vecchio for example, that combine multiple functions. Many of the designs that were made for the bridge crossing the IJ river in Amsterdam also included homes and warehouses in the bridge design.

Would it be possible to bring back this old typology of buildings on a bridge and turn it into an active connection between the north and south of Amsterdam, which at the same time contributes to the densification of the Minervahaven and the NDSM area?

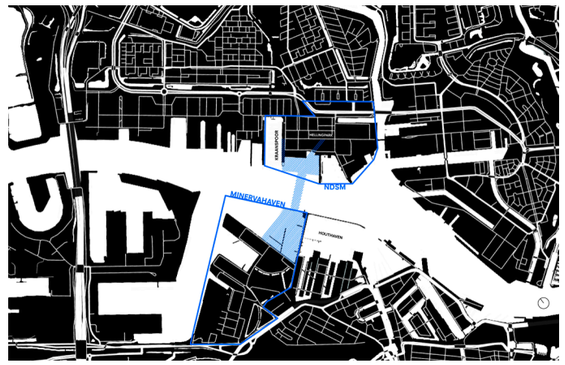


Figure 3_Possible location for the Westbridge going from the Minervahaven to the NDSM-werf, based on Concept Actualisatie Nota van Uitgangspunten Sprong over het IJ by D'Hooghe et. al., 2021

Research question
How can a bridge crossing the IJ river in Amsterdam serve as a multifunctional space that contributes to the urban density and creates an active connection between the north and south of the city?

Subquestions
1_Story of the bridge in Amsterdam
A. Why were previous designs for a bridge crossing the IJ river in Amsterdam rejected?
B. Why is now the right time for a bridge in Amsterdam?

2_Multi-use
C. Multifunctional use in historical and modern bridges

3_Added value
E. How can different programs on the bridge in Amsterdam benefit from each other?

METHOD

This research combines archival, literature, and case study analysis. The reasons for rejection of previous designs for a bridge in Amsterdam will be done through archival and literature research. I will explore technical drawings and literature written by historians and archivists about the ongoing discussion in the 19th century of the bridge crossing the IJ-river. Analysing the Haven-Stad transformation plan will give insight into the current need for a bridge. To research the effect of the bridge on Amsterdam and its surroundings, I will conduct a SWOT analysis to evaluate the bridge's impact on connectivity, accessibility, mobility, and stakeholders.

The multi-use of existing bridges will be done through a series of case studies, looking at both historical and modern examples that include multiple types of functions. Attention is paid to historical context and how the use changed over time of the historical bridges. The program, layout, accessibility and functionality will also be researched. This will result in a set of typologies that can be applied and tested at the location of the bridge in Amsterdam. This involves a research-by-design approach, making simple concepts with multiple functions focusing on form and layout to research the best strategy for a multifunctional bridge on this location.

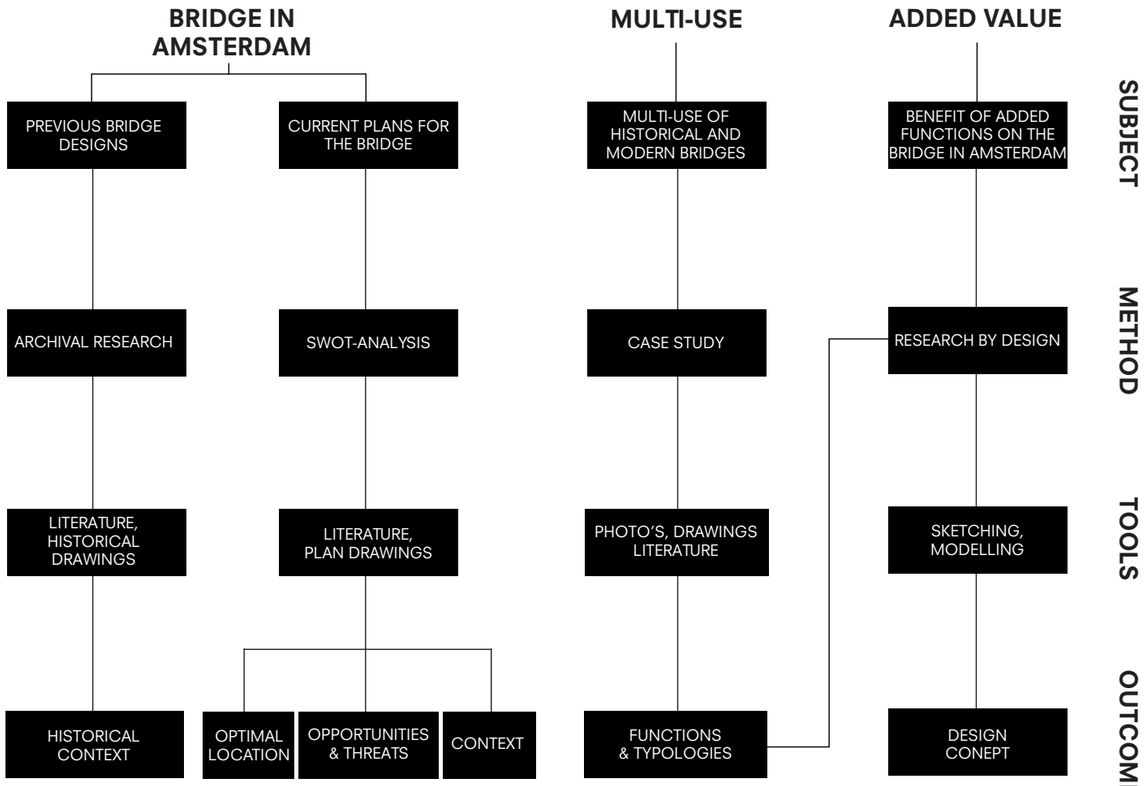


Figure 4_Research diagram

1_STORY OF THE BRIDGE IN AMSTERDAM

A. Why were previous designs for a bridge crossing the IJ river in Amsterdam rejected?

In 1850 Amsterdam started to grow after half a century of decay. Through the improvement of contacts with colonies and the industrial revolution from 1860, the economy grew and more people started moving to Amsterdam (De Geschiedenis Van Amsterdam, 2024). Untill 1870 most of the population growth could be accommodated within the old limits of the city (Bock et al., 1996). The space available in Amsterdam was not fully used and when space was becoming scarce, the urban area was densified.

Between the years 1870 and 1900 the population doubled and went from around 250.000 to around 500.000 residents (Bock et al., 1996). To cope with this population growth the city started to expand towards the south and west, which areas were quickly urbanised. At the end of the 70s the city city border was moved north, but only in 1903 an expansion plan was made for this area north of the river.

Remarkably, already since 1839 engineers, architects and contractors started making designs for a bridge crossing the IJ-river to connect Amstedam to the north side of the IJ and the rest of the province of North-Holland. Amongst these designers was Jan Galman, who between the years 1851 and 1886 made around 36 designs for a bridge crossing the river. However, a bridge was never realised, which raises the question: Why were these designs for a bridge crossnig the IJ-river rejected?

Jan Galman
Jan Galman born in 1807 is a contractor and hydraulic engineer from Amsterdam. His career took place during the time when Amsterdam developed into a growing trading and industrial city. New connections over water and land were built to which Galman contributed, which led to his position as contractor of public works. Galman was dedicated to the emancipation of Amsterdam as a trading city. He contributed to society by being part of committees and boards that helped improve education and decrease unemployment. Perhaps his dedication to his plans for the bridge also comes from this interest in improving Amsterdam as a trading city. During his career he tried to receive the concession with different arguments and through different parties, but all of his designs were rejected and most of them didn't get further than a preliminary design (Bock et al., 1996).

Figure 5_Jan Galman (29-06-1807/14-03-1891), Amsterdam online archive

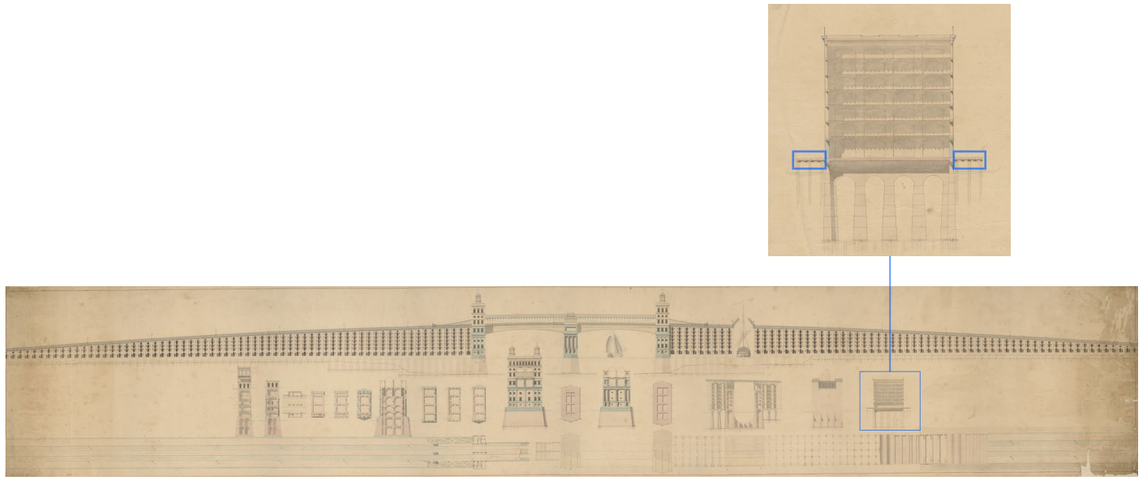
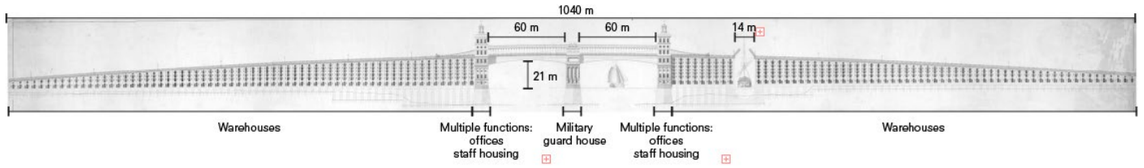


Figure 6_Drawing of the first design of Jan Galman (1852), Amsterdam online archive



Bridge designs of Jan Galman
The designs of Jan Galman consist of three main concepts with each multiple variations. The three main concepts in chronological order are: a covered woorden suspension bridge, a lattice girder bridge and a dam with a swing and bascule bridge.

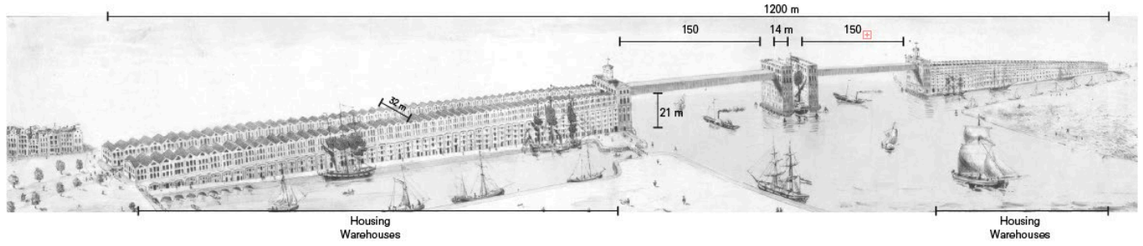
1_Covered wooden suspension bridge (1852)
The first design of Jan Galman consists of a covered wooden suspension bridge with a boat passage for smaller ships in the middle and a bascule bridge for larger ships.

Remarkable about his design is the multifunctional use of the bridge. Below the road 107 warehouses are placed. On the outside of the spans there are double gates with different functions such as offices, housing for staff, and cafés. The building in the middle of the span serves as a military guard house. Adding buildings onto the bridge doesn't only make the bridge multifuncitonal, it also is a way to finance the bridge.

The road sits on top of the buildings, providing a view of the water and surroundings at all times. The part where the bridge spans the river is covered with a roof, but still open on the sides, making the crossing more pleasant, without taking away from the view. The ships can dock directly next to the warehouses where there is a pier, as highlighted in the drawing above.

Reasons for rejection
This design would mean a large impact on the shipping routes of the river. With sufficient visibility and wind, experienced sailors would be able to pass through on a small sailing ship. Bigger ships would only be able to pass by being towed. The effect on the shipping industry together with the risk of more siltation in the river, were the main reasons why this design, variations on this design and bridge plans from other designers were rejected. Additionally the area north of the IJ is sparsley populated, resulting in a low number of users.

Figure 7_Drawing of the second design of Jan Galman (1857), Amsterdam online archive



2_Lattice girder bridge (1856-1879)
The second design of Galman is an iron lattice girder bridge in combination with an expansion plan on islands in the open waterfront. The buildings consist of warehouses below the road with 280 houses on top. In the middle of the river two towers are placed, with in between an iron bascule bridge for large ships to pass.

Compared to the previous design, the spans are longer, providing more space for the small ships to cross and the waterflow is less disturbed. The housing added on top of the warehouses transforms the bridge into a street, which can be desirable, but it takes away from the view. The tunnels crossing the river provide protection from rain and wind, but the closed character also takes away from the view.

Reasons for rejection
Although the passage for smaller ships is wider, larger ships still don't have much space to cross. The large landings with the warehouses together with the towers in the middle cause a disturbance of the wind, making it difficult to pass the bridge on a sailing ship.

Variations
Between 1863 and 1877 Galman made a few variations on the lattice girder bridge, making the boat passage wider and extending the future railline across the bridge. It is unclear though how the trainline would work in combination with the other traffic on the bridge. In previous designs housing is placed on the bridge, where in this variation the rialline would pass right next to, making it unpleasant to live.

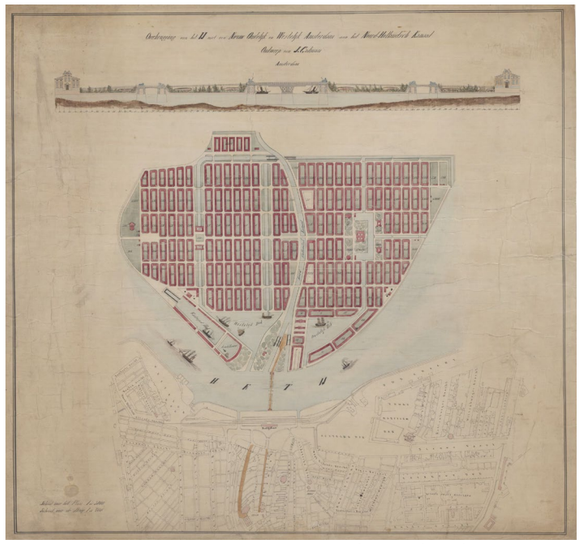
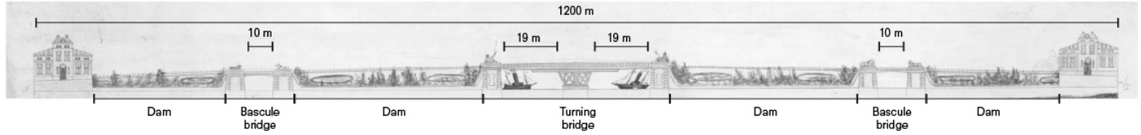


Figure 8_Drawing of the third design of Jan Galman (1879), Amsterdam online archive



3_Dam with swing and bascule bridge (1879-1884)
The thrid concept is a dam with one turning bridge in the middle and two bascule bridges. By replacing warehouses with a dam, Galman aims to transform the bridge into a park. This vision turns it into a destination for a day out, where visitors can stroll from the paved path onto the dam and enjoy a walk.

In the original design the turning bridge is 20 metres wide, but adjustments were made in response to the 25-metre wide lock realised in IJmuiden, altering the turning bridge to 25 metres as well. In another variation the two bascule bridges have a tower going over the openable part, making it possible to cross also when the bridge is opened.

Urban expansion plan
In 1879 the border of Amsterdam was moved further north of the river. Although this area had officially become part of Amsterdam, it remained largely undeveloped, meaning the bridge initially led to an area with no buildings or infrastructure. Galman recognized the potential of this area and tried to convince the municipality by including an expansion plan into his designs.

In this plan a rectangular housing block, with greenery in the centre, is repeated throughout the plan. While this approach aims to create uniformity, it results in a monotonous urban design, which has a completely different character compared to the rest of the city. This new city on the north includes residential blocks, Catholic and Protestant churches, gas works, cemeteries, docks, and even a royal palace, but no distinction between these functions is clearly visible from the design of the building blocks.

Reasons for rejection
Also this design got rejected for the same reasons as the previous concepts. The municipality was afraid that the bridge would cause too much siltation and the impact on harbour activities, with increasingly large ships and expanding harbour, would be too large.

After Galman
For years, there was still no bridge across the IJ, even as the city began to grow. With expansions to the south and west fully developed and unable to extend further, the focus shifted to the northern side. First only industry was built, in 1910 the first residential areas were constructed.

As the northern districts started to develop, the ferry service could no longer cope with the increasing car traffic. This led to the construction of the Coentunnel (1966) and the Schellingwoude bridge (1957) in the east, closing the highway-ring around the city, followed by the construction of the IJ-tunnel (1968) in the city centre. Initially, the tunnel was designed exclusively for motorized vehicles, with buses being among the primary users. It served a regional function, providing a key connection to North Holland. However, the introduction of the Noord-Zuid metro line reduced the tunnel's usage, as the metro became the preferred mode of transport.

Conclusion
The bridge was never built due to three main reasons: increased sedimentation in the river; the potential disruption to shipping, which was a vital part of the city's economy; and the absence of enough users, given that the northern part of the river was still undeveloped. However, the bridge could have contributed to the earlier development of the northern part of the city, stimulating trade and traffic from that direction.

While the architecturally stunning bridge designs could have become an iconic symbol for Amsterdam, they would have caused too much disruption to the crucial shipping industry. Some variations of the bridge designs were quickly adapted to align with city developments, such as the construction of the railway. This rush in adaptation led to designs that were not fully thought through.

B. Why is now the right time for a bridge in Amsterdam?

Amsterdam keeps growing
After one and a half centuries of debate about a bridge crossing the IJ-river, the necessity for a bridge has become more evident than ever, due to various factors related to the urban developments of Amsterdam. Since 1910 the north side of Amsterdam has started growing in number of residents and it will continue to do so in the future. Between 2022 and 2050 the area is expected to go from 103.164 to 151.732 residents, the biggest increase compared to other areas in the city (Gemeente Amsterdam, 2023). This expected increase is mainly due to the Haven-stad development plan, which aims to expand the city within the borders. Existing harbour and industry areas will be transformed into mixed-use, high-density urban areas for living and working (Gemeente Amsterdam, 2021).

Pressure on the ferries
As mentioned in the previous chapter, there are already three permanent connections for cars, and a metro line crossing the IJ-river, but with this crease of residents north and around the IJ, there is also an increasing need for a permanent connection for pedestrians and cyclists. Currently cyclists and pedestrians can cross the river with ferries, but four times the amount of ferries would be needed to cope with the amount of traffic in the future. (Gemeente Amsterdam, 2023). More ferries might seem like a solution, but the water, which will stay important for Amsterdams economy, will become more busy, making an increase in the number of ferries not viable.

Polycentric city
In addition a bridge would help with the city's polycentric urban development model, which aims to decentralize urban functions and create better access to opportunities outside of the city center. By placing new crossings east and west of the central station, traffic would be more evenly distributed, reducing pressure on the city's core. This results in a fast bicycle network around the city centre, making the different urban cores easily accessible and also providing bicycle connections to Zaandam and IJburg (Gemeente Amsterdam, 2021).

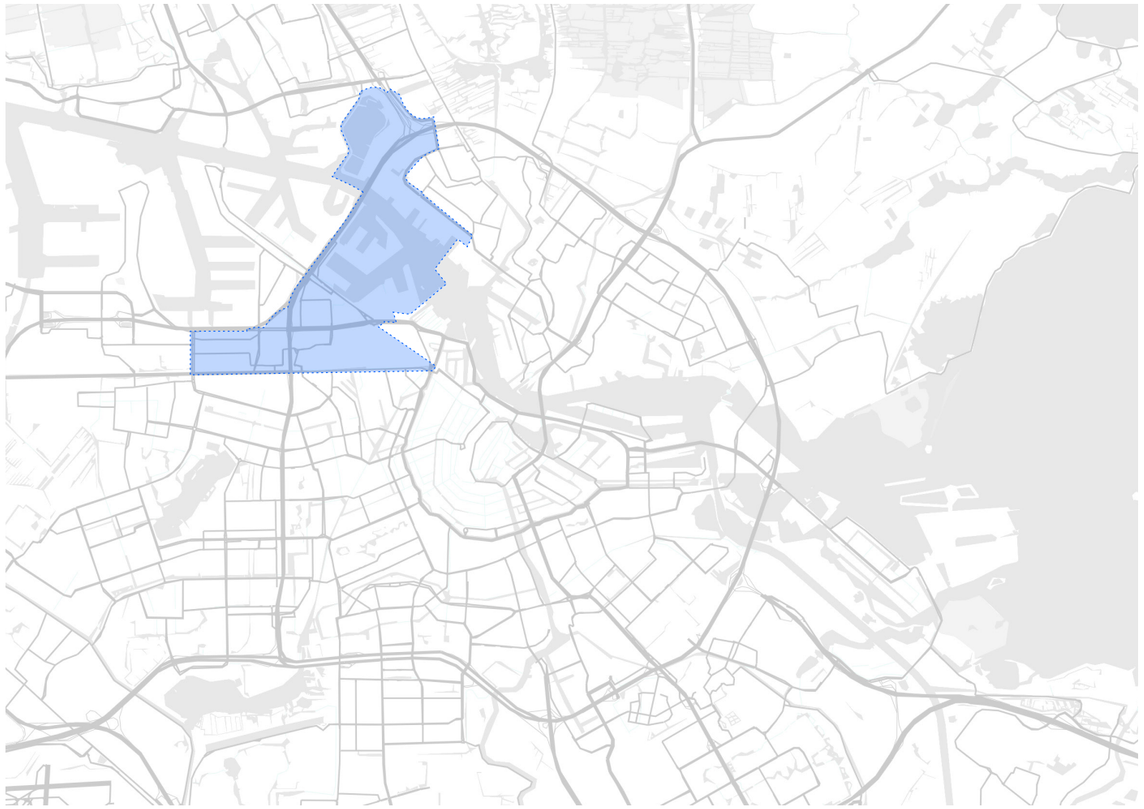


Figure 9_Havenstad plan area based on Integraal Raamwerk Haven-Stad by Gemeente Amsterdam, 2021

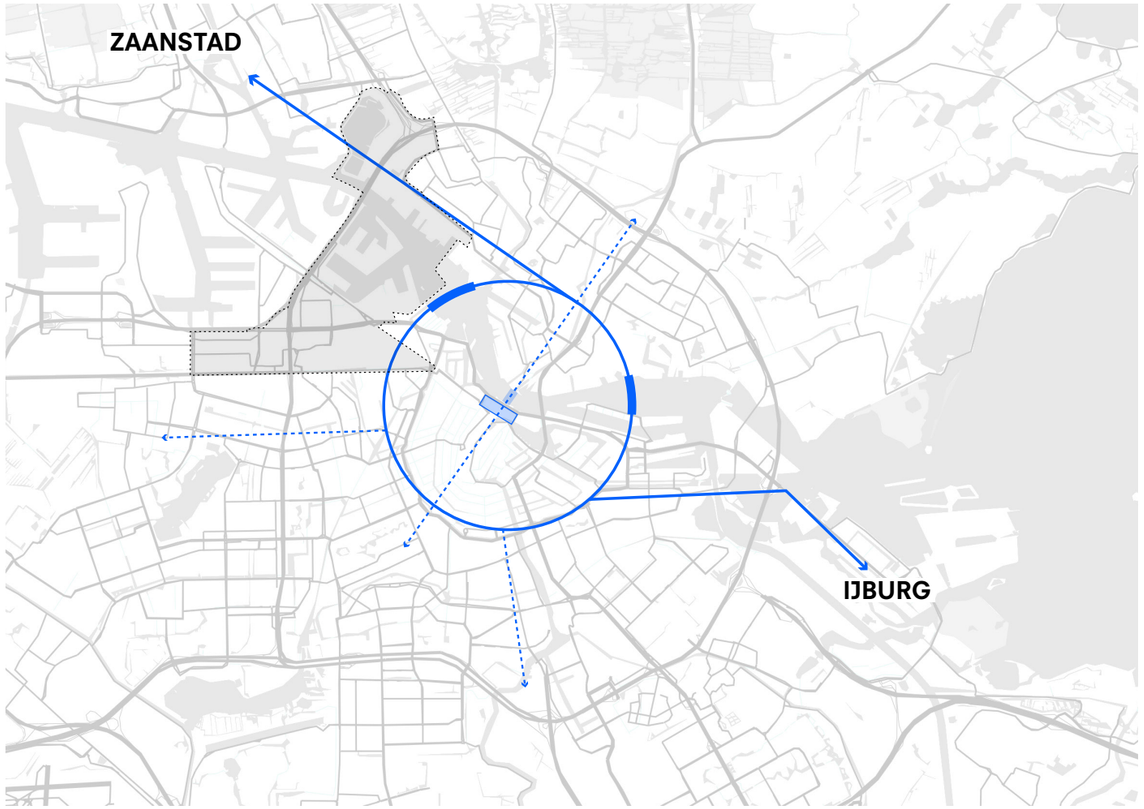


Figure 10_Fast bycicle network in blue based on Concept Actualisatie Nota van Uitgangspunten Sprong over het IJ by D'Hooghe et. al., 2021

West bridge
The west bridge, which is part of the Havenstad development plan connects the NDSM-werf in the north to the Minervahaven in the south. An analysis of the bridge and its surrounding areas reveals key strengths, weaknesses, opportunities, and threats that will help define the effect of the bridge in the area, Amsterdam and its surroundings.

Strenghts
One of the most significant strengths of the Westbrug lies in the cultural value of the NDSM werf. This former industrial site has evolved into a dynamic cultural hub, attracting both tourists and locals. The area is lively during events and is home to a creative community, making it a destination for art, music, and cultural exploration (NDSM, 2024). Additionally, the NDSM site offers stunning views over the water, overlooking the Minervahaven and the central station.

Minervahaven's location further enhances the strength of the area. Being only 10-15 minutes by bike from Amsterdam's Central Station, it offers excellent connectivity to the city center. The area is located on the border of the harbour and the city, making it the perfect location for the fashion industry, but also more local companies (Amsterdam, 2025)

Weaknesses
Minervahaven, primarily consisting of office and industrial spaces, is a quiet area after working hours. This lack of facilities, such as restaurants, shops, and public spaces, limits the area's appeal as a vibrant, all-day destination.

Similarly, while NDSM is a vibrant place during events, it feels deserted when there are no activities taking place. Furthermore, the NDSM pier, though home to boats, restaurants, and a hotel, is not actively used as it is a dead end, leading to an uninviting space. Finally, even though the NDSM area is connected to the city center through a ferrie that goes directly to the central station, this boat trip takes about 25 minutes, making the area not as easily accessible.

Opportunities
The Westbrug and its surrounding areas offer numerous opportunities, particularly within the framework of the Haven-stad transformation plan. As the area around the water will be densified and transformed into mixed-use zones, shown in the vision map. Additionally the north edge of the water will house a series of blue and green hotspots. It is a collection of urban spaces close to the water, each with its own character, such as industrial or green. The bridge can directly link to these new developments close to the water and contribute to the public space. It can also serve as a transition between the industry and work character of the Minervahaven and the more cultural and recreational character of the NDSM area.

Apart from connecting the areas close to the water, the bridge will serve as an important bike connection on a larger scale. With an improved connection to Zaandam, and of course the connection further north and south, car use is reduced and time-wise locations are closer to one another, improving social and economic mobility (Gemeente Amsterdam, 2021). Furthermore the municipality is planning a new metro station nearby, which will make the bridge also easily accessible for pedestrians. Finally, apart from the practical benefits, the bridge can serve as a new icon and eye-catching entrance to the city from both land and water.

Threats
One of the most notable concerns about the Westbridge is the potential impact on harbour activities. The harbour remains a crucial part of Amsterdam's economy and the water will become more busy in the future. The bridge's construction might interfere with the harbour activities. Additionally, the area where the bridge lands may require significant changes to existing plans and infrastructure. This could complicate development and require adjustments to the carefully laid-out urban strategies for the region.

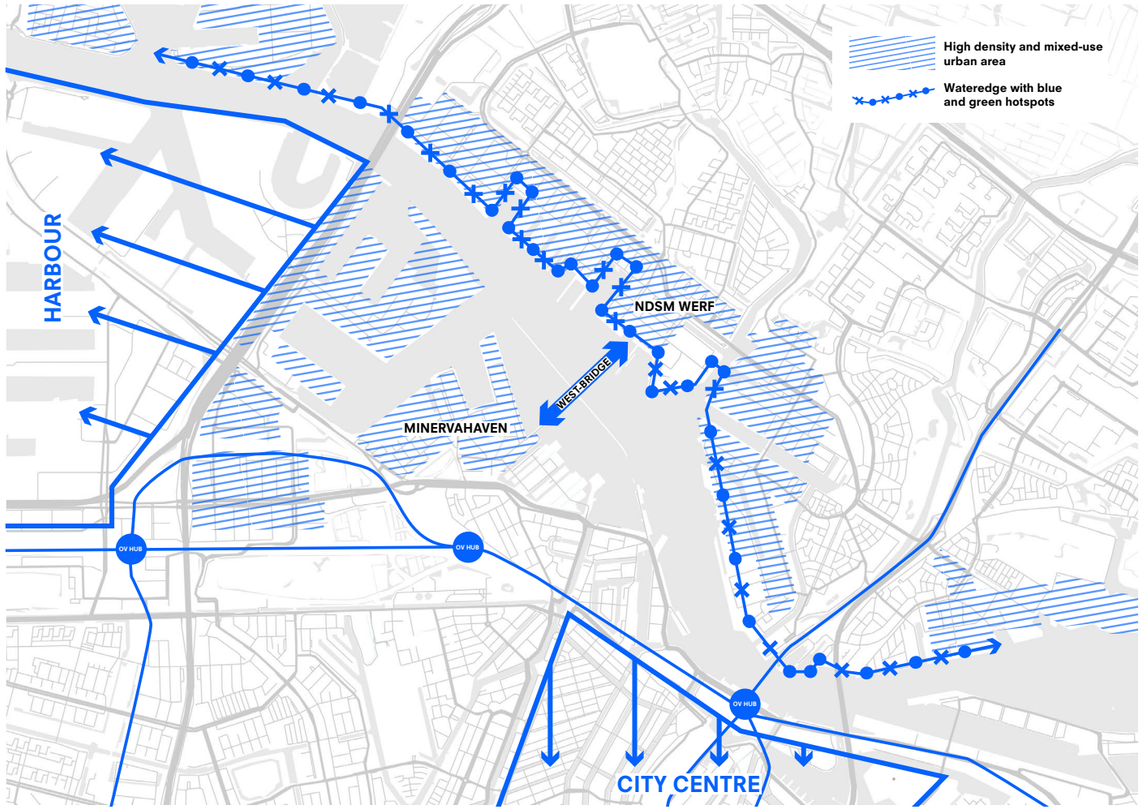


Figure 11_Amsterdam west vision map for 2050 based on Integraal Raamwerk Haven-Stad by Gemeente Amsterdam, 2021

Conclusion
Although the impact on the harbour activities is still a threat, just like one and a half centuries ago during Galmans proposals, currently the benefits seem to weigh up to the threats. The proposed bridges are a crucial step in supporting Amsterdam's urban growth, connecting north and south while creating a bicycle network that also connects to regions around the city.

2_MULTI-USE

C. Multifunctional use in historical and modern bridges

Currently the majority of bridges have one function: getting across. But throughout history there have been bridges that inclusing buildings to house multiple functions, also including a few more recent examples. By comparing these bridges across different time periods and cultures, we can understand how their programs were combined, how their functions have evolved over time and how the multifunctional bridges connect to the urban landscape.

Case studies

Historical bridges

1.	Ponte Vecchio	Florence, Italy
2.	Ponte di Rialto	Venice, Italy
3.	Old London Bridge	London, England

Modern bridges

1.	High Line	New York, USA
2.	Simone Veil Bridge	Bordeaux, France
3.	Galata Bridge	Istanbul, Türkiye
4.	Nodeul Island	Seoul, South Korea


Figure 12_Ponte Vecchio - Florence, Italy (Koepke, 2023)


Figure 13_Ponte di Rialto - Venice, Italy (Remo, 2007)


Figure 14_Painting of Old London Bridge (Jongh, 1630)


Figure 15_High Line - New York, USA (High Line, 2024)


Figure 16_Simone Veil Bridge - Bordeaux, France (OMA, n.d.)


Figure 17_Galata Bridge - Istanbul, Türkiye (Visit Istanbul, 2024)


Figure 18_Nodeul Island - Seoul, South Korea (Lee, n.d.)

PONTE VECCHIO

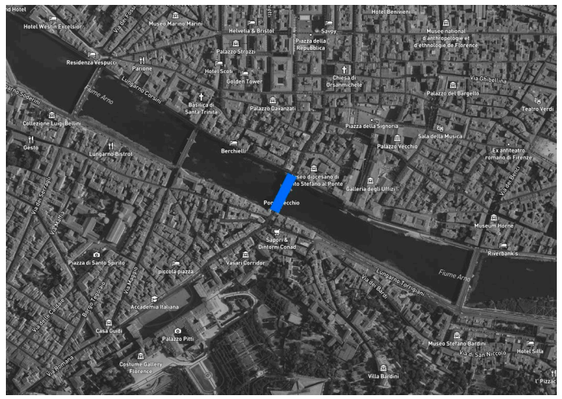


Figure 19_Location of the Ponte Vecchio

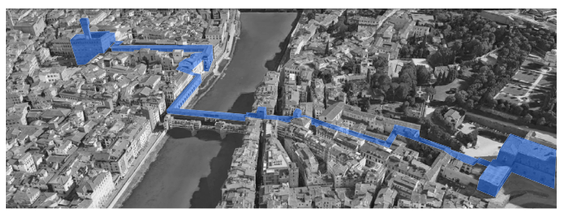


Figure 20_The Vasari corridor connecting Palazzo Vecchio (left) to Palazzo Pitti (right)

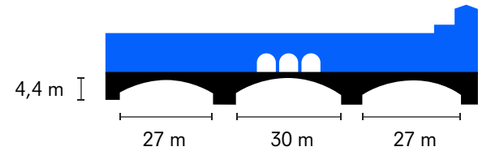
Florence, Italy

Completion	1345
Design	Taddeo Gaddi, Neri di Fioravante
Pogram	Pedestrian, shops

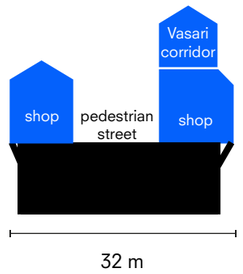
History
The Ponte Vecchio, crossing the Arno river, is the oldest bridge in Florence. The bridge that still exists today was designed in 1345 after the previous bridge was destroyed by a flood. Initially only the bridge itself was built, later additions were made. First shops were added on the bridge and in 1565 the Vasari corridor for the Medici family was built on top of these shops. The corridor connects Palazzo Vecchio to Palazzo Pitti and ensured that the family could reach the Palazzo's safe and undisturbed.

Initially merchants, of which the majority was butchers, sold their produce in the shops on the bridge, disposing their waste in the river. This created a terrible smell and polluted the river. Thus in 1593 the grand duke decided only jewelers, gold and silversmiths would be allowed in the shops to

Current use
The bridge became the icon of Florence and is now a busy tourist attraction. The shops are still in use by jewelers and goldsmiths benefiting from the tourists that cross the bridge each day. The Vasari Corridor lost its original function and is now open to the public.



Layout
The shops are located on the edges of the bridge, creating one walkway in the middle, without a view over the river, and laying the focus of bypassers on the shops. In the middle, however, there is an open part with a view over the river. Also the Vasari Corridor has larger windows on this location to provide a better view.



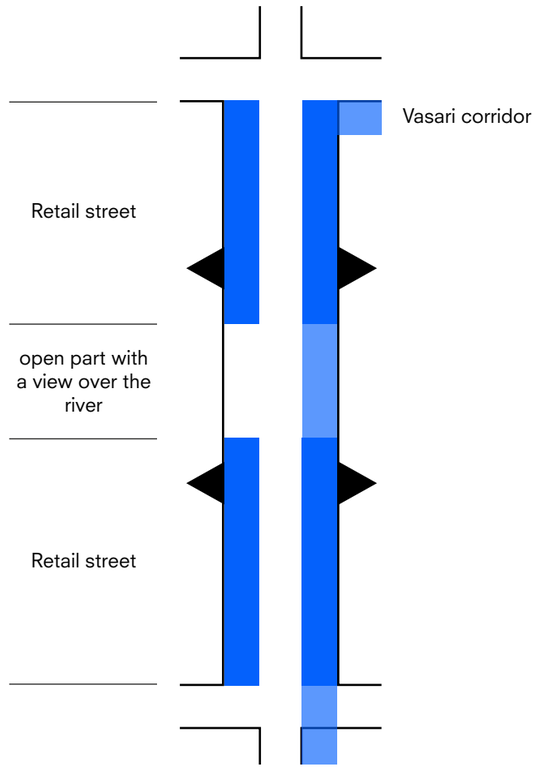


Figure 21_Layout diagram of Ponte Vecchio

PONTE DI RIALTO

Figure 22_Location of the Ponte di Rialto

Venice, Italy

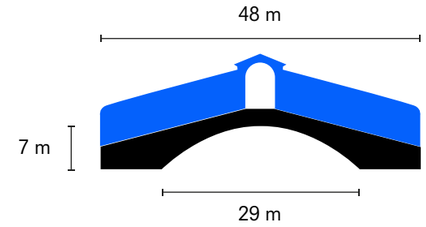
Completion	1591
Design	Antonio da Ponte
Pogram	Pedestrian, shops

History
The Rialto bridge crosses the Grand Canal in Venice, Italy. Up until the 13th century ferries and barges were used to cross the river. As a solution to the increasingly congested area with trading posts and markets, a wooden drawbridge was built on which later shops were added for economic profit and to extend the markets onto the bridge (Agazzi et al., 2023).

This bridge needed a lot of maintenance and was therefore replaced by the stone structure in 1591 designed by Antonio del Ponte (Chang & Choo, 2009). This bridge, like its wooden predecessor, houses two rows of shops that are still in use today.

Current use
Just like the Ponte Vecchio, the Rialto bridge also turned into a tourist attraction. It became one of the icons of Venice with loads of tourists crossing the bridge and taking pictures. Most of the shops took advantage of this and turned into souvenir shops.

Layout
The two rows of shops, unlike on the Ponte Vecchio, are not placed on the edge of the bridge, but slithgtly towards the middle. This creates three walkways. The street in the middle becomes a retail street, where the shops are opened towards. The two streets on the edge provide an open view over the Canal Grande. At the highest point in the middle the buildings stop, which makes it possible to cross to the other streets. The bridge still forms an extension of the markets on the islands it connects,



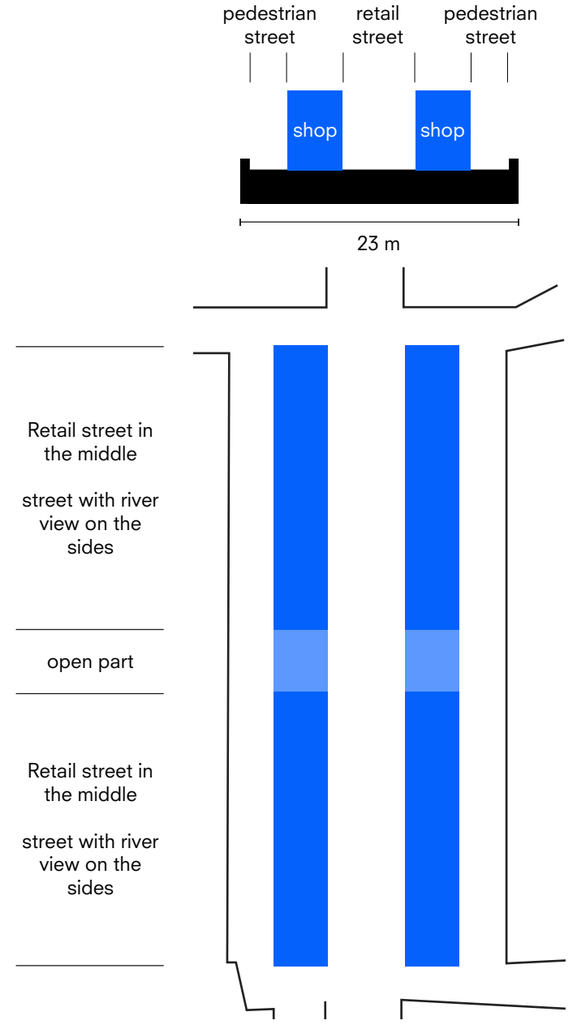


Figure 23_Layout diagram of Ponte di Rialto

OLD LONDON BRIDGE

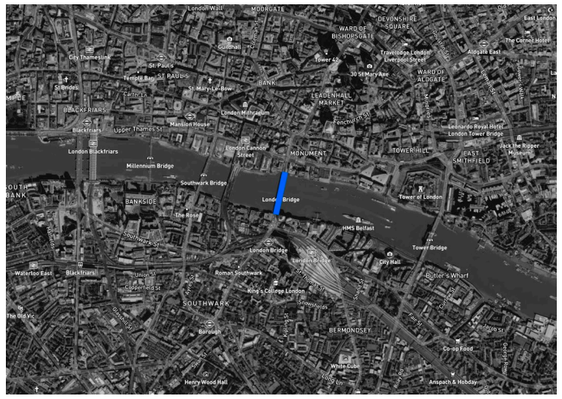


Figure 24_Location of the current London bridge

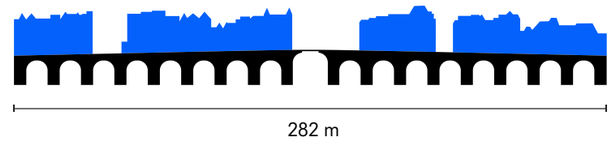
London, England

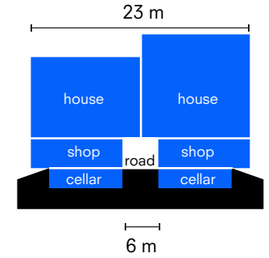
Completion	1209
Design	Peter of Colechurch, George Dance, Isembert de Saintes
Pogram	Infrastructure, housing, shops

History
Just like the previous case studies, the predecessors of this bridge were made from wood and had to be replaced often because of floods or fires. The Old London bridge, crossing the Thames river between London and Southwark, was the first stone bridge which was completed in 1209 (Munro & Cooper, 2024). Spanning a total of 282 metres, it was the longest inhabited bridge in Europe with houses and shops crossing the entire structure. It was the pride of the city and served both as a landmark and gateway to London.

After 600 years it was replaced by a new stone bridge. The population of London increased and therefore also the traffic became more busy. The passage on the Old London bridge became too narrow which made it necessary to demolish the houses and shops to widen the road. The narrow arches slowed down the flow of water, causing the Thames to freeze during cold winters. Despite improvements, which included replacing two central arches with one larger arch, the bridge was outdated and replaced with a new bridge completed in 1824 (Cooling, n.d.).

Layout
The bridge's layered design, covering parts of the road, featured housing on the upper levels, a chapel and numerous shops, making it one of Londons largest shopping streets at the time. Its solid stone structure with fortified towers provided a strategic defensive barrier against potential invaders, while the narrow passage allowed for tolls to be collected, supporting the city's economy. The drawbridge in the middle could be opened twice a day for larger ships to pass, or to prevent entry from invaders (Cooling, n.d.).





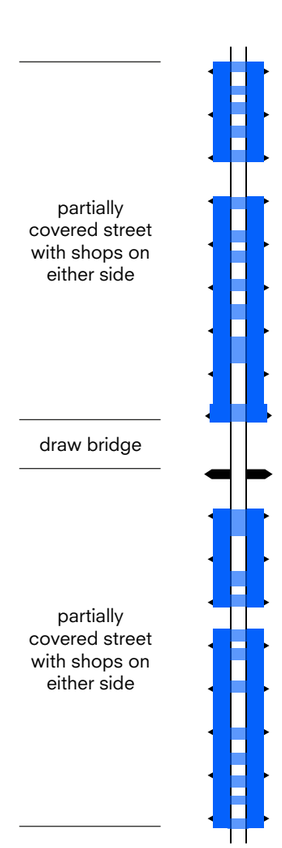


Figure 25_Layout diagram of Ponte di Rialto

HIGH LINE

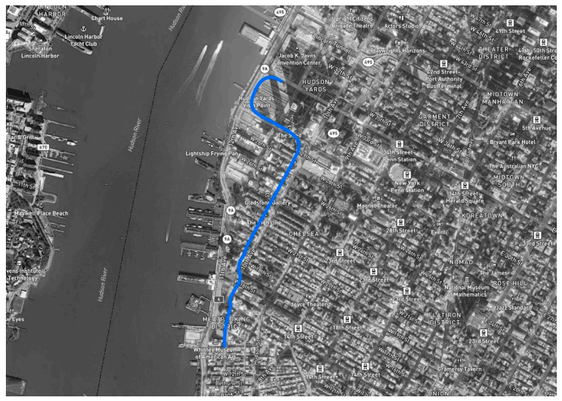


Figure 25_Location of the High Line

New York, United States

Completion	2014
Design	DesignField Operations, Diller Scofidio + Renfro, and Piet Oudolf.
Pogram	Park, art installations, event space

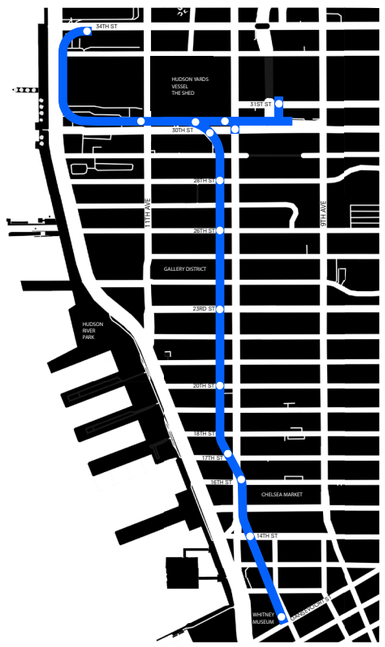


Figure 26_High Line lay out and elevation points

History

The High Line, located in Manhattan, New York, is a redesigned elevated railline, which is now mainly used as a park. Initially the rialline was not elevated, but crossed the streets, causing dangerous conditions for pedestrians. Therefore the rail was elevated to separate it from the street level. The line was fully operational by 1934 and was mainly used for transporting dairy and produce. In a few sections the rail cuts directly through buildings, which enabled easy acces for factories like the National Biscuit Company, now the home of Chelsea Market (The High Line, 2024).

Increased use of trucks instead of the railline cause the tracks to be abandoned. All train traffic stopped by the 80s and the railline was to be demolished. After years of abandonment people started to criticise the High Line, but few people saw that a beautiful wild garden had taken over the structure. This inspired the transformation of the High Line into a recreational park, which started in 2009 (The High Line, 2024).

Program

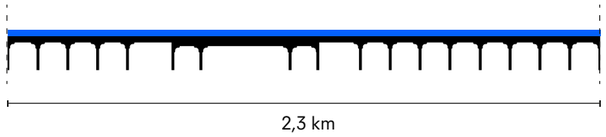
The High Line park was completed in sections and now houses various functions. Its overall function is a park, but parts of the park can be used for events and art installations. As mentioned before the High Line passes through a few buildings, as is the case at the Chelsea Market. This provides a covered part of the park, which is designed to host various types of events, such as dinners or fashion shows. Besides its program, the High Line also has a historical function. The design shows the railway in different ways using different infills between the tracks, making it part of the walkpath or using the tracks for the edge of a planter.

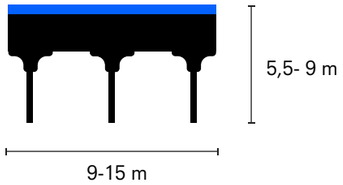
Figure 27_High Line at the Chelsea Market. Original use on the left, current use on the right

Layout

The High line park is divided into multiple sections, each with its own garden style inspired by the wild garden that grew during the time the structure was abandoned. Each type of garden is designed with the micro climate in mind resulting from the cityscape around the High Line, creating a unique character for each section. (The High Line, 2024).

Figure 28_High Line At The Rail Yards. Photo By Iwan Baan, 2014





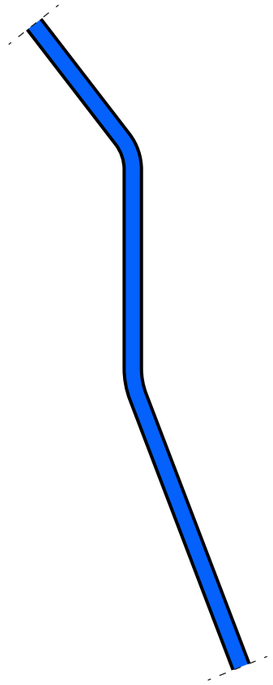


Figure 29_Layout diagram of the High Line

SIMONE VEIL BRIDGE

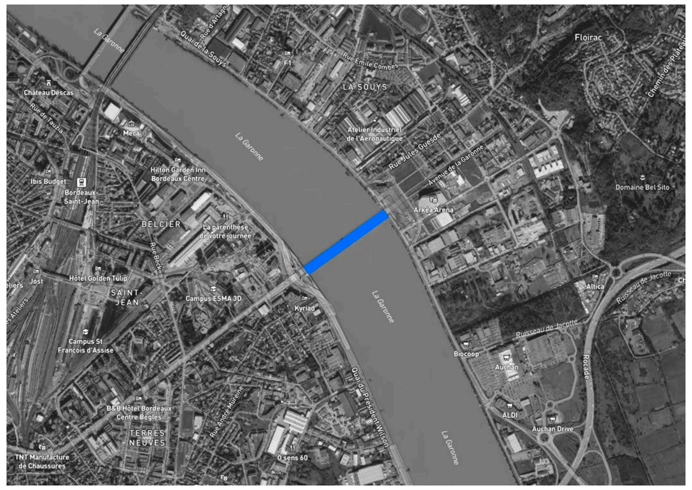


Figure 30_Location of the Simone Veil bridge

Bordeaux, France

Completion	2024
Design	OMA
Pogram	Infrastrucutre, event space

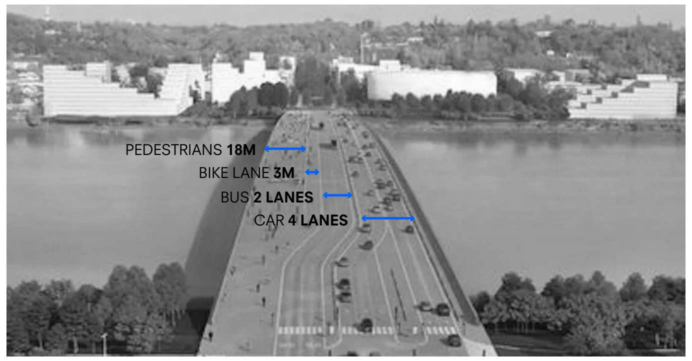


Figure 31_Layout and functions of the Simone Veil bridge

The Simone Veil bridge is the latest addition to the bridges crossing the Garonne in Bordeaux. The bridge connects to the Bègles on the west side and Floirac on the east. Both these regions are in development to which the bridge will contribute, by reducing congestion on other bridges and creating new public space (Koshta, 2024).

Program and layout
The bridge is made wider than a regular bridge, to create a wide pedestrian area where events like farmers markets, art fairs or festivals can be hosted. This area is locataded on the edge of the bridge which provides a view over the river. The other functions are placed on the same level and separated with minimalistic low fences, making it possible to host an event on the entire bridge or changing the layout for new forms of transportation in the future.

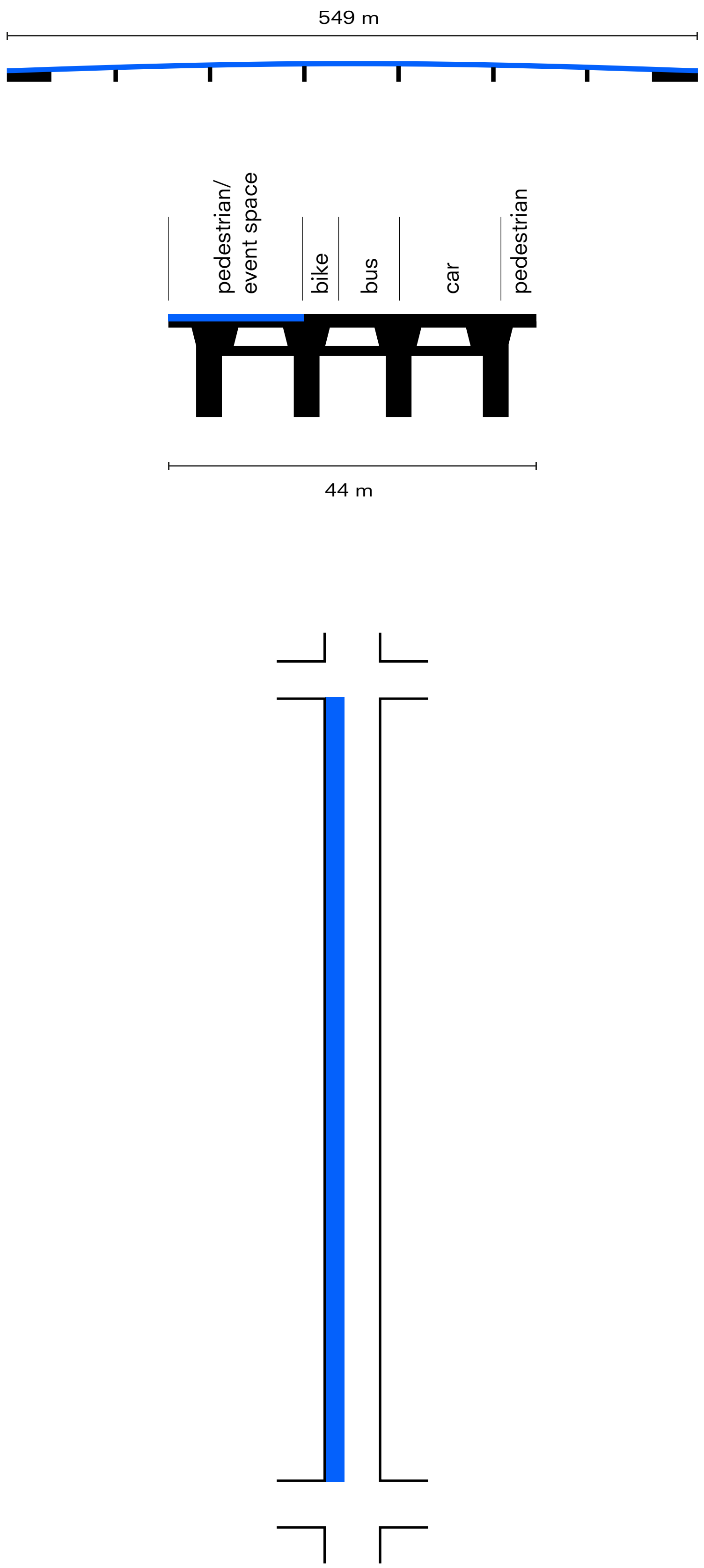


Figure 32_Layout diagram of the Simone Veil bridge

GALATA BRIDGE

Figure 33_Location of the Galata bridge

Istanbul, Türkiye

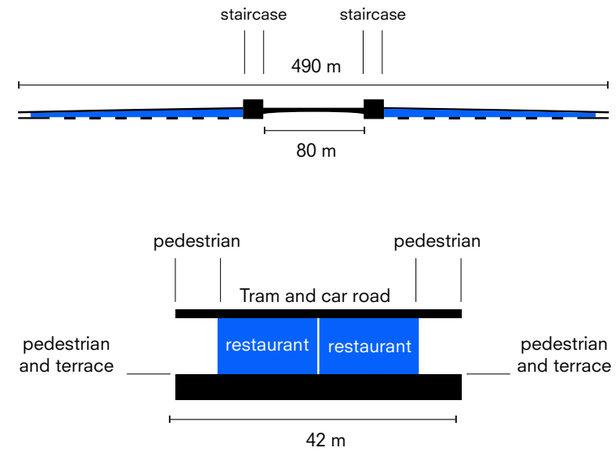
Completion	1994
Design	Göncer Ayalp Engineering Company
Pogram	Infrastrucutre, restaurants, cafés

Figure 34_People fishing on the Galata bridge by Sanpk, 2012

History
The Galata bridge crosses the Golden Horn estuary in Istanbul, Türkiye. Before the first Galata bridge was built in 1845, transportation across the Golden Horn was carried out by ferries. These played an important role in the development of the area. Other bridges have been built before further up the Golden Horn, but in the mid-19th century, due to the expanding trading areas on both sides of the river, a second bridge became necessary. Multiple bridges have existed in this location, first in wood, later in iron. In 1912 a floating bridge was built with traffic on top and cafés, bars and restaurants below. Due to damage caused by a fire the bridge was towed away and replaced by the current bridge in 1994 (Özdamar, 2019).

Program
The current bridge, like the design from 1912, has traffic on top and restaurants below the bridge, contributing to the social life of the area. On top is room for the tram, cars and pedestrians, but it is also used a lot for fishing. Some people fish for sports, others use it to get some extra income (Bazun et al., 2020). Directly below the pedestrian steet on top of the bridge, there is another walkway to reach the restaurants. This area is also used as a terrace for the cafés and restaurants which provides a view over the water. The road above provides the terrace with shade and shelter from rain. Staircases on either side of the openable part connect the different levels to each other.

Connection to context
The bridge connects the two oldest parts of the city, Karaköy and Eminönü, two traditional trade centres (Bazun et al., 2020). The bridge used to be the transition between two cultures of Eastern and Western, but the sharp separation between the two has been diminished and both sides of the city turned into one (Özdamar, 2019). As a connection between two busy trade areas, the bridge itself is also a lively and busy place. The bottom walkway connects directly to larger pedestrian areas around the water, where the terminals for the ferries are located together with a large tram and busstop and various food stands.



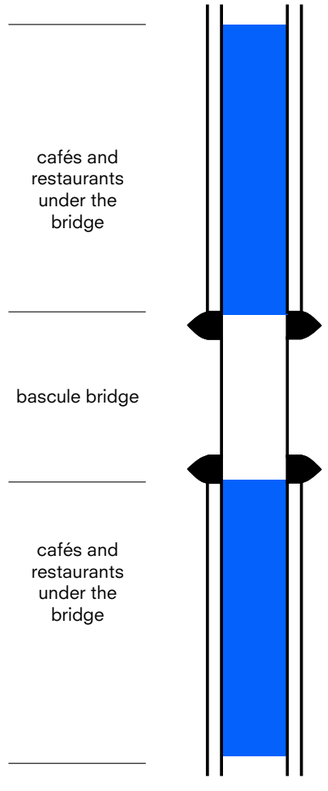


Figure 35_Layout diagram Galata bridge

NODEUL ISLAND

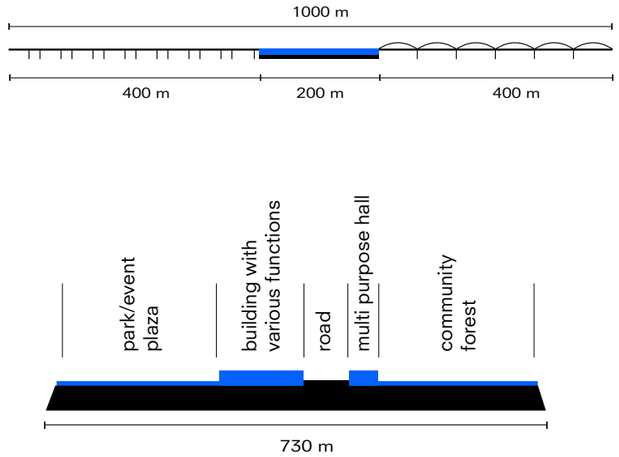
Figure 36_Location of Nodeul Island

Seoul, South-Korea

Completion	2019
Design	MMK+
Pogram	Cultural, Commercial, Public Open Space

History
Nodeul Island is an artificial Island built in 1917 as a landing for the Han river pedestrian bridge. Although its proximity to the city centre, it was later abandoned because of the remote character and the difficulty for visitors to reach its ground (Abdel, 2024). Several plans were made for the Island which consist of a large-scale citizen's park, Opera house and a community farm, but none of these plans were realised. After a long period of abandonment and controversy about the relevance of a new development, the island was transformed into a music centered cultural hub (Lee, 2019).

Program and layout
The Hangang bridge crossing the island consists of eight car lanes, four in each direction, a bike path and a sidewalk on the edges. The other functions are concentrated on the island with multiple levels of public space and a large variety of cultural programs. The buildings on the island are focused around the road in the middle of the island, allowing easy acces from the bridge. Both the building and the landscape are designed to be multifunctional and host a variety of events. In the building there is a concert hall, art gallery, offices for startups, a bookstore, café and more. The landscape has two characteristics: on the east side the already existing forest has been restored and on the west a park is created that can also be used for outdoor cultural events.



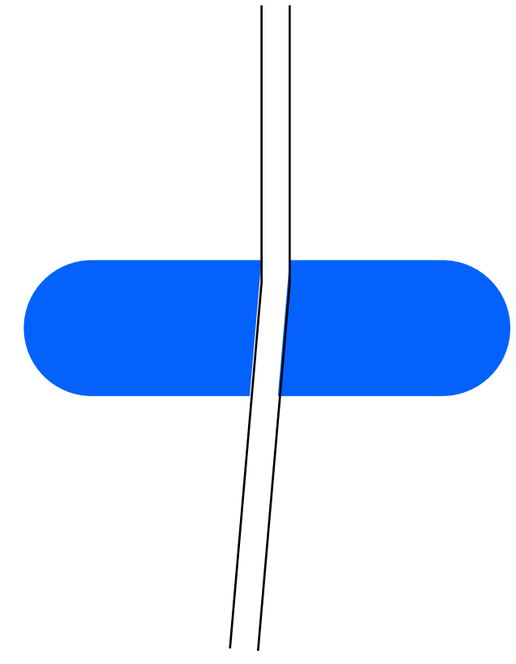


Figure 37_Layout diagram of Nodeul Island

CASE STUDY COMPARISON

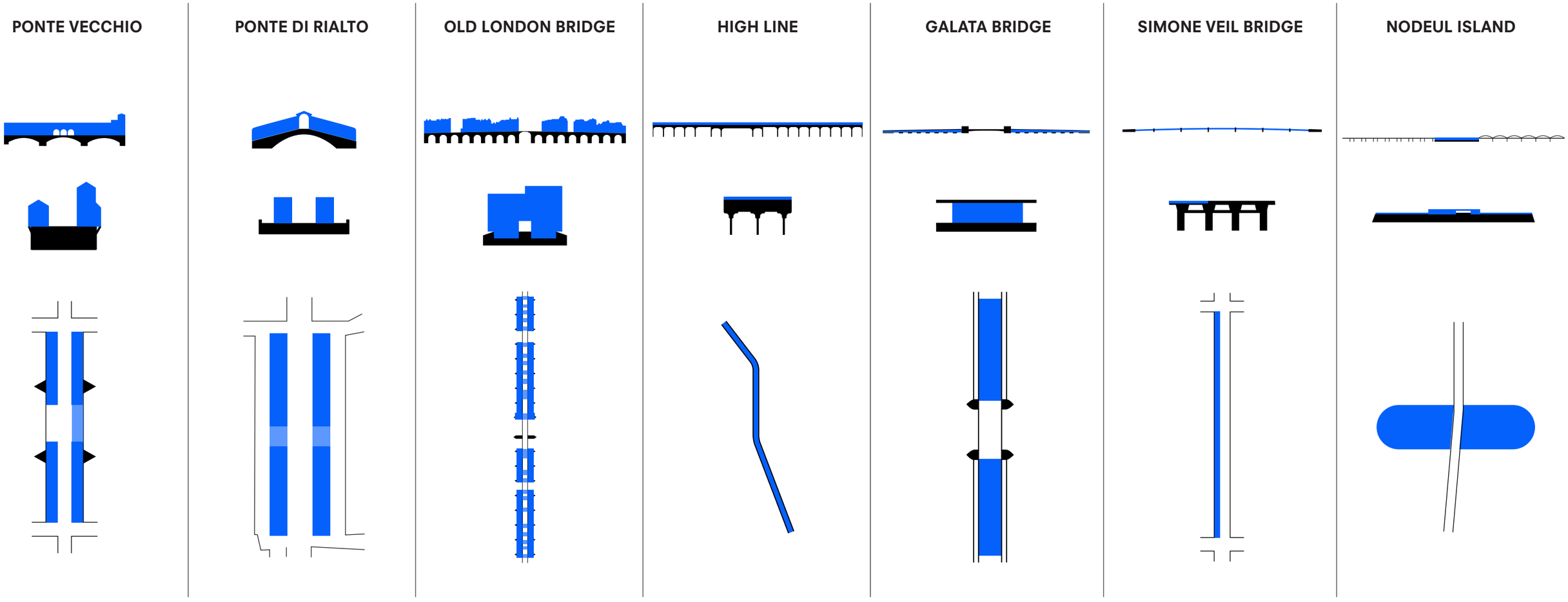


Figure 38_case study comparison diagram

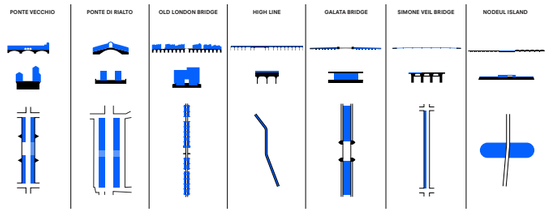
Conclusion

From the case studies we can take away a few typologies of a multifunctional bridge. The three historical bridges on the left have added functions on top of the structure. Placing the buildings at or away from the edge, creating streets with different charachteristics. The modern bridges have a variety in typology. The High line also has its added functions on top, but it is separated in sections housing the program in length of one another. The galata bridge houses the added program underneath, separating fast and slow traffic. The Simone Veil bridge places the program next to eachother in the same plane. Making it possible to use the dedicated event space and if needed the whole bridge for events. Finally, Nodeul Island concentrates the program on one island in the middle, making it possible to house functions that require a large area.

3_ADDED VALUE

D. How can different programs on the bridge in Amsterdam benefit from eachother?

The municipality has a proposal for a west bridge in Amsterdam going from the Haprandadam in the Minervahaven to the Hellingpark in the NDSM-area. Applying the typologies found in the previous chapter to the bridge in Amsterdam will help research what the best strategy would be for a multi-functional bridge on this location.



1_On top: Ponte vecchio

Possible functions
Shops, restaurants, cafés, housing

Sarting with the typology of the Ponte Vecchio, which has its buildings on top of the bridge with one street in the middle. The bike path is placed in the middle with a sidewalk on either side through which the buildings are accessible.

Pros
+ Buildings are directly accessible from the bridge
+ Option to extend the building over the road like the London bridge which will provide cover from rain
+ A street-like character in between the buildings, which provides protection from wind
+ Everyone passes by the buildings, which is beneficial for the shops, restaurants etc.
+ Shops can be used by local artist to sell their work
+ Restaurant and cafés can be used by people after work, or tourists that are going to an event in the NDSM-area afterwards

Cons
- The buildings take away from the view
- Narrow street in the middle, or the bridge would need to be very wide
- The bike lane in the might disrupt the more quiet character of the street

Figure 39_Axo of Ponte Vecchio typology applied to the bridge in Amsterdam

2_On top: Ponte di Rialto

Possible functions
Shops, restaurants, cafés, studio's

Just like the previous concept, the buildings are added on top of the bridge. In this case there are three streets, each with its own character. The bike lane is placed on the side, providing two pedestrian streets, one with a view over the water towards the city centre and one in between the buildings.

Pros
+ Buildings are directly accessible from the bridge
+ Separated sidewalk and bikepath, providing a shopping or more quiet street in the middle, compared to the previous conept
+ Streets with a view over the water
+ Studio's could be used by starters or students

Cons
- Less space for the buildings, making only a small amount functions possible, or the bridge would need to be very wide.

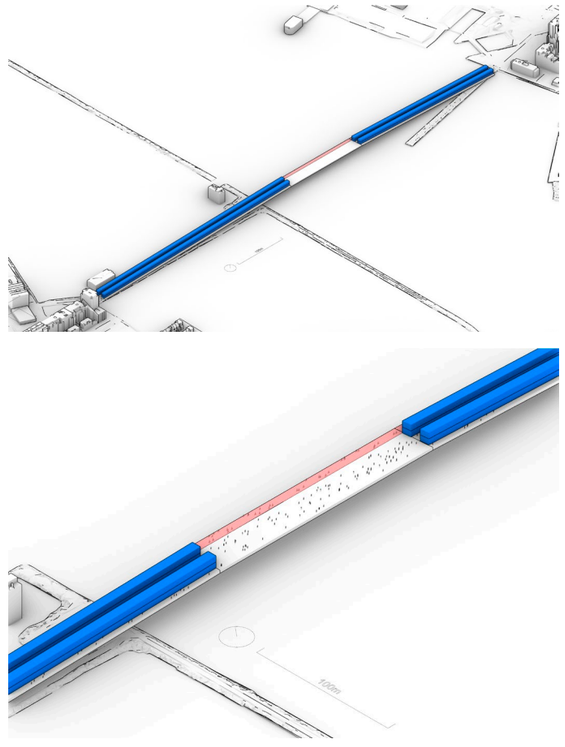


Figure 40_Axo of Ponte di Rialto typology applied to the bridge in Amsterdam

3_Below: Galata bridge

Possible functions
Shops, restaurants, cafés, housing

In this concept the added functions are placed below the bridge, creating two walkways on either side of the buildings, like the Galata bridge. The bike path is placed in the middle, providing wide sidewalks with a view over the water on either side.

Pros
+ The lower level has a close connection to the water. Recreational boats could dock here and get onto the lower part of the bridge
+ A separate quiet walkway separated from the faster moving traffic above
+ Lower level is covered from rain

Cons
- Connection to context for lower level is difficult
- Narrow building, when taking the width of the dike into account
- The buildings below are seperated from the main traffic and are not easily accessible from the top.
- The buildings don't get a lot of sunlight with a large overhang for traffic above.
- Only a small volume of added program

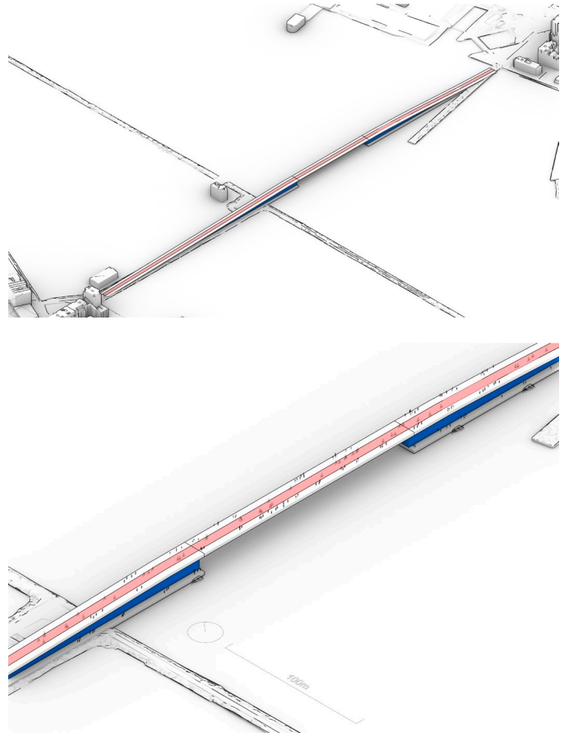


Figure 41_Axo of Galata bridge typology applied to the bridge in Amsterdam

4_Island: Nodeul Island

Possible functions
shops, restaurans, cafés, event space (outdoor & indoor), housing, park, public space

In this design the 160 metre free space is divided into two and placed on the sides of the river, leaving space in the middle for an Island on which the added funcntions are concentrated.

Pros
+ The area for added functions is large and wide, making more types of functions possible
+ The bridge itself can be narrow, making it easier to connect to the context
+ The island becomes a small city in itself with various functions

Cons
- The large island takes up a lot of space on the water, which has a lot of impact on shipping
- The added functions and the bridge are separated, resulting in public space that is not directly connected to the context
- Also adding housing to the Island might not be beneficial, due to noise from events around the island

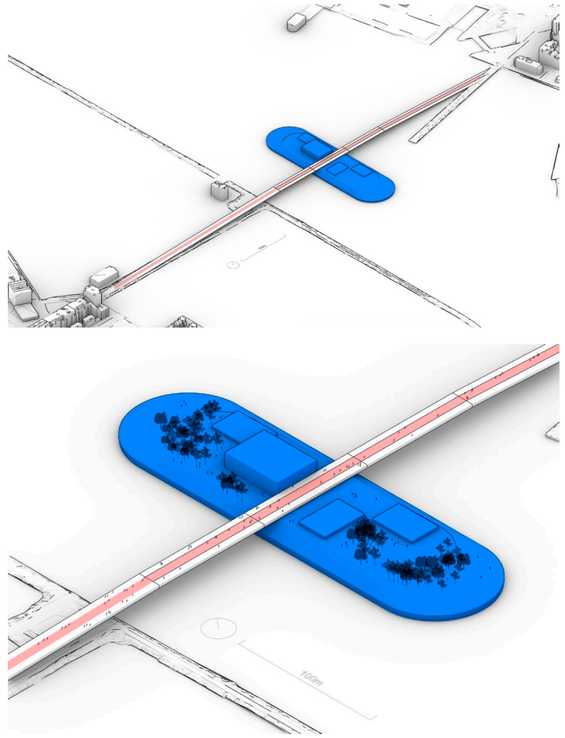


Figure 42_Axo of Nodeul Island typology applied to the bridge in Amsterdam

5_Side by side: Simone Veil Bridge

Possible functions
Public space, event space, park, sports

In this design there are no added buildings but a large public area is placed next to the bike lane. This area which goes all the way across, can be used for various types of events.

Pros
+ There is a large area that can house multiple functions over time
+ It is an extension of the public space
+ Like the High Line the bridge can be a long park that connects to the Hellingpark and green in the Minervahaven.

Cons
- There is no addition of buildings so only a small variety of functions is possible
- The landings need to be wide, which is difficult to fit into the current situation.

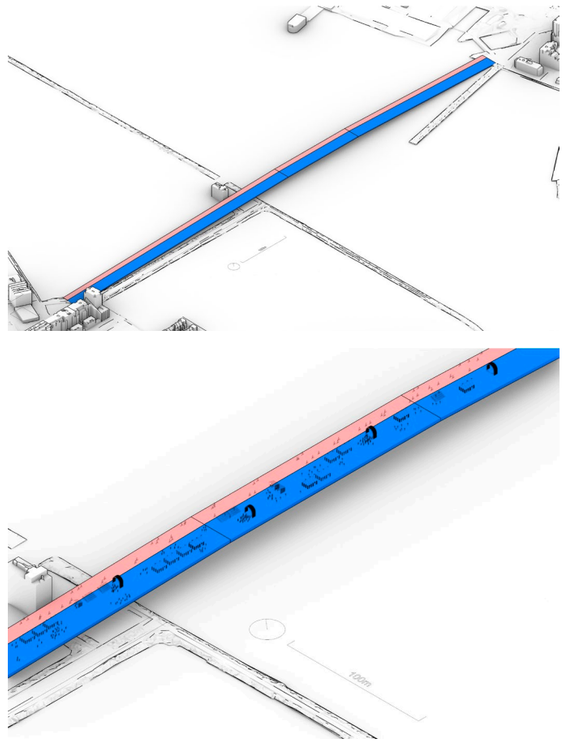


Figure 43_Axo of the Simone Veil bridge typology applied to the bridge in Amsterdam

6_Combination

Possible functions
Housing, restaurants, cafés, shops, public space, event space (in & outdoor), park

This concept combines the principle of the Island with the buildings below the bridge, making optimal use of the available space by putting buildings below the bridge, while also creating new space where the bridge is above water. By using the principle of the island, but cutting it into smaller parts, the layout becomes more flexible and won't affect the shipping as much. In this concept the small islands are created by using barges on which buildings are added, creating a floating bridge, making the program also flexible over time. The benefit of building on top of the bridge is created by extending part of the buildings above the bridge, making them directly accessible when you're on the bridge.

The levels that are directly accessible from the bridge, can be used for shops, for example for local artists that have their studio in the NDSM area. The islands on the north side are used for a park with outdoor events, extending the Hellingpark and the NDSM event-space onto the water. The buildings can be used for numerous functions such as housing, restaurants, cafés or public functions, bringing people onto the bridge, and making it a lively area all day long.

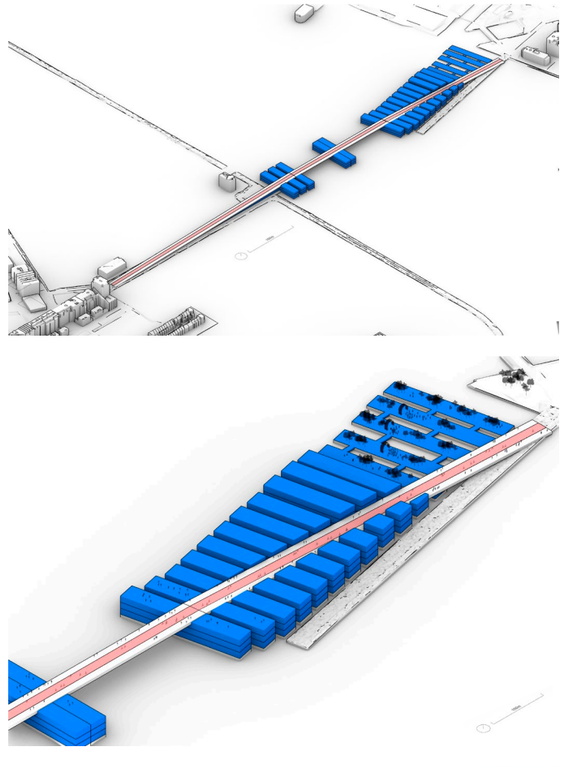


Figure 44_Axo of a combination of typologies applied to the bridge in Amsterdam

4_CONCLUSION

Past bridge proposals crossing the IJ River in Amsterdam faced challenges such as sedimentation, shipping disruptions, and insufficient demand. Today, the benefits and growing need for such a connection outweigh these concerns. The northern part of Amsterdam has already developed and will continue to grow, driving an increasing demand for a fixed connection for pedestrians and cyclists while offering more than just a crossing. By combining existing multifunctional bridge typologies, the bridge can provide adaptable spaces for new programs, including cultural events, shops, and parks linking to the NDSM-area, as well as restaurants and cafés that contribute to a vibrant work and living environment near Minervahaven. The bridge would not only enhance local connectivity and add to the city's densification, but also connect Amsterdam to neighbouring cities through a fast bike network, resulting in a bridge that supports Amsterdam's development both locally and regionally.

5_DISCUSSION

Further research into this topic should focus on the feasibility of the multifunctional bridge. In this research, the construction of the bridge is left out of the research by design in order to fully focus on the layout of the functions, but the structure of the bridge might have a large impact on this layout. This is especially true when designing a floating bridge, which adds to the flexibility, but creates new challenges that have to be taken into account.

While this research has valuable case studies applying existing multifunctional bridge typologies to the Amsterdam context, exploring how this new bridge concept would affect other cities or regions would be beneficial. Additionally, this research opens opportunities to examine other types of structures in the urban area, beyond bridges, that can be used more efficiently and be multifunctional.

Finally, the research-by-design approach could be more elaborate. Instead of directly applying the case studies to the bridge in Amsterdam, a broader exploration of various combinations and adaptations of these typologies would help optimize the design for both the added programs and the specific context in which it is situated.

6_BIBLIOGRAPHY

Introduction
- De Jong, A., Te Riele, S., Huisman, C., Van Duin, C., Husby, T., & Stoeldraijer, L. (2022). Regionale bevolkings- en huishoudensprognose 2022–2050: Steden en randgemeenten groeien verder. In PBL/CBS. Centraal Bureau voor de Statistiek. https://www.pbl.nl/sites/default/files/downloads/pbl-cbs-2022-regionale-bevolkingsprognose-2022-2050-4977.pdf
- D'Hooghe, A., Van der Lugt, L., Schmitt, M., Peeters, T., Boddeke, D., De Groot, H., Van der Hout, A., Kwantes, C., Alver, M. D., & Dubini, C. (2020). Genereus verbonden: Een concept-inrichtingsplan voor het IJ in Amsterdam als robuust en toekomstvast waterkruispunt. In Open Research Amsterdam. https://openresearch.amsterdam/nl/page/63495/genereus-verbonden-inrichtingsplan-het-ij
- Gemeente Amsterdam. (n.d.). Minervahaven: woon-werkwijk aan het water. https://www.amsterdam.nl/projecten/haven-stad/deelproject/minervahaven/
- Gemeente Amsterdam. (2021). Integraal Raamwerk Haven-Stad. In Gemeente Amsterdam.
- Gemeente Amsterdam. (2024). Meer over de Oostbrug. https://www.amsterdam.nl/projecten/oostbrug/meer/#:~:text=Er%20wordt%20100%20miljoen%20euro,van%20en%20naar%20de%20brug.
- Smit, L., Bock, M., Hoogewoud, G., Luijendijk, G. J., & Van Rossem, V. (1996). De sprong over het IJ: visionaire ontwerpen van Jan Galman (1807-1891).

1_Story of the bridge in Amsterdam
- Amsterdam. (2025, January 19). Minervahaven: woon-werkwijk aan het water. Amsterdam.nl. https://www.amsterdam.nl/projecten/haven-stad/deelproject/minervahaven/
- Bock, M., Hoogewoud, G., Luijendijk, G. J., & Van Rossem, V. (1996). De sprong over het IJ: Visionaire ontwerpen van Jan Galman (1807-1891) [Printed book]. THOTH.
- De geschiedenis van Amsterdam. (2024). Oud Amsterdam. https://www.oudamsterdam.info/geschiedenisvanamsterdam
- D'Hooghe, A., Van der Lugt, L., Schmitt, M., Peeters, T., Boddeke, D., De Groot, H., Van der Hout, A., Kwantes, C., Alver, M. D., & Dubini, C. (2020). Genereus verbonden: Een concept-inrichtingsplan voor het IJ in Amsterdam als robuust en toekomstvast waterkruispunt. In Open Research Amsterdam. https://openresearch.amsterdam/nl/page/63495/genereus-verbonden-inrichtingsplan-het-ij
- Galman, J. (1852). Plan IJ-brug door Jan Galman, eerste brugontwerp. Stadsarchief Amsterdam. https://archief.amsterdam/beeldbank/detail/ef9931de-0706-03db-70bd-c74854c16cd1/media/dd8206a1-6e18-ff3e-79fe-a33efe34447f?mode=detail&view=horizontal&rows=1&page=10&fq%5B%5D=search_s_sk_documenttype:%22bouwtekening%22&fq%5B%5D=search_s_dc_provenance:%22Collectie%20Jan%20Galman:%20bouwtekeningen%22&sort=random%7B1736156411049%7D%20asc
- Galman, J. (1857). Brug over het IJ, ontwerp van J. Galman (afbeelding boven); Amsterdam uitgelegen aan de IJ zijde, ontwerp van J. Galman (afbeelding onder). Stadsarchief Amsterdam. https://archief.amsterdam/beeldbank/detail/bfc7a129-b7d0-2543-b323-689bd7116311/media/9dd5f9f9-cc2d-4388-c6ae-5ecf047c0c40?mode=detail&view=horizontal&q=jan%20galman&rows=1&page=9
- Galman, J. (1879). Plan IJbrug door Jan Galman. Stadsarchief Amsterdam. https://archief.amsterdam/inventarissen/scans/10059/32/start/0/limit/10/highlight/1
- Gemeente Amsterdam. (2021). Integraal Raamwerk Haven-Stad. In Gemeente Amsterdam.
- Gemeente Amsterdam. (2023, February 21). Prognose bevolking 2023-2050. Onderzoek En Statistiek. https://onderzoek.amsterdam.nl/artikel/prognose-bevolking-2023-2050
- Municipality of Amsterdam. (2022, January). Actualisatie Nota van Uitgangspunten Sprong over het IJ. Amsterdam.nl. https://www.amsterdam.nl/verkeer-vervoer/sprong-ij-snel-makkelijk-veilig-overkant/documenten-sprong-ij/actualisatie-nota-uitgangspunten-sprong/
- NDSM. (2024). Over NDSM. Ndsm. https://www.ndsm.nl/over
- Stadsarchief Amsterdam. (n.d.). Jan Galman (29-06-1807/14-03-1891). https://archief.amsterdam/beeldbank/detail/e7549c22-0658-7bff-4c0c-305bf4af8db5

2_Multi use
- Abdel, H. (2024, June 27). Nodeul Island Park / mmkplus. ArchDaily. https://www.archdaily.com/995359/nodeul-island-park-mmkplus
- Agazzi, M., Guidarelli, G., & Pilutti Namer, M. (2023). Layers of Venice: Architecture, Arts and Antiquities at Rialto. https://www.research.unipd.it/handle/11577/3480266
- Baan, I. (2011). High line at the rail yards. ArchDaily. https://www.archdaily.com/550810/take-a-walk-on-the-high-line-with-iwan-baan/542194fac07a80a9910000a5-take-a-walk-on-the-high-line-with-iwan-baan-photo?next_project=no
- Bazuń, D., Dońan, D., & Kwiatkowski, M. (2020). Intercultural Exploratory Walk: The Case of Galata Bridge as a Contact Zone in Istanbul. In Kontaktzonen Und Grenzregionen: Kulturwissenschaftliche Perspektiven (No. 71–92). https://www.researchgate.net/profile/Dorota-Bazun-2/publication/343944736_Intercultural_Exploratory_Walk_The_Case_for_Galata_Bridge_as_a_Contact_Zone_in_Istanbul/links/6052dff2a6fdccbfeae94cbb/Intercultural-Exploratory-Walk-The-Case-for-Galata-Bridge-as-a-Contact-Zone-in-Istanbul.pdf
- Chang, S. P., & Choo, J. F. (2009). Values of Bridge in the Formation of Cities. In IABSE Symposium Report, International Assocciation for Bridge and Structural Engineering (No. 95, No. 1, pp. 25–46). https://www.researchgate.net/profile/Jinkyo-Choo/publication/228786691_Values_of_Bridge_in_the_Formation_of_Cities/links/00b7d53b1426a2150c000000/Values-of-Bridge-in-the-Formation-of-Cities.pdf
- Cooling, L. (n.d.). Old London Bridge. English Heritage. https://www.english-heritage.org.uk/visit/places/kenwood/history-stories-kenwood/old-london-bridge/
- Koepke, J. (2023, January 28). Ponte Vecchio View, Piazzale Michelangelo, Florence, Tuscany, Italy. Landscape Photography Magazine. https://landscapephotographymagazine.com/28/01/2023/ponte-vecchio-view-piazzale-michelangelo-florence-tuscany-italy/
- Koshta, H. A. (2024, July 19). Simone Veil Bridge / OMA. ArchDaily. https://www.archdaily.com/1018843/simone-veil-bridge-oma
- Lee, H. J. (n.d.). Gallery of Nodeul Island Park / MMKPlus. ArchDaily. https://www.archdaily.com/995359/nodeul-island-park-mmkplus/63ce8736760dd26072a98af5-nodeul-island-park-mmkplus-photo
- Lee, J. (2019). Nodeulseom in Seoul as a Postcolonial Landscape: A Geohistorical De/Reconstruction, 1910-1995. Journal of the Association of Korean Geographers, 8(3), 477–495. https://doi.org/10.25202/jakg.8.3.10
- Munro, D., & Cooper, R. (2024). London Bridge: A History of Urban Survival. Journal of Urban History. https://doi.org/10.1177/00961442241260328
- OMA. (n.d.). Simone Veil Bridge. https://www.oma.com/projects/simone-veil-bridge
- Özdamar, E. G. (2019). Las formas polivalentes del puente Galata. Revista De Arquitectura, 24(36), 24. https://doi.org/10.5354/0719-5427.2019.53770
- Remo, S. (2007, November 16). Venezia - Ponte di Rialto. Wikipedia. https://en.m.wikipedia.org/wiki/File:Venezia_-_Ponte_di_Rialto.jpg
- Sanpk. (2012). People fishing on the Galata bridge. Flickr. https://www.flickr.com/photos/sanpk/
- The High Line. (2024a, February 26). History | The High Line. https://www.thehighline.org/history/
- The High Line. (2024b, February 26). History | The High Line. https://www.thehighline.org/history/?gallery=4549-9&media_item=4565
- Visit Istanbul. (2024, April 18). Galata Bridge - Visit Istanbul. https://visitistanbulofficial.com/things-to-do/attractions/galata-bridge/
- https://archief.amsterdam/inventarissen/scans/10059/32/start/0/limit/10/highlight/1

3_Added value
- D´Hooghe, A., Van der Lugt, L., Schmitt, M., Peeters, T., Boddeke, D., De, H., Groot, Van der Hout, A., & Kwantes, C. (2020). Actualisatie Nota van Uitgangspunten Sprong over het IJ 2022. In Actualisatie Nota Van Uitgangspunten Sprong Over Het IJ 2022 [Report]. https://www.amsterdam.nl/sprongoverhetij

Timber For Urban Density