REDEFINING BRIDGES
AND TUNNELS FOR
THE NEXT GENERATION
OF OUR CITIES

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TUNNELS AND BRIDGES SHOULD NO LONGER ONLY BE STRUCTURES THAT FACILITATE TRANSPORT. THEIR AREAS SHOULD OFFER AN ADDED VALUE TO THE CITY AND ITS CITIZENS.
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FOR ALL CASES AND ILLUSTRATIONS
In 1980, the last train ran on the High Line railway in New York, pulling three carloads of frozen turkeys. After the railroad was vacated, a group of local residents and activists started advocating that it should be converted into a public landscape. In 2006, more than 25 years after the railway was decommissioned, work began on transforming the old viaducts into a green elevated park. Today, the park is considered one of New York’s most spectacular sights, visited by 5 million people annually.

The High Line is one example of how an existing, vacant structure can be redesigned to transform a community and create value for citizens. This report explores the potential of new and existing tunnels and bridges to reduce barriers and provide urban spaces and functions that improve quality of life in Europe.

BRIDGES AND TUNNELS ARE MASSIVE STRUCTURES THAT OCCUPY LARGE AREAS IN THE BUILT ENVIRONMENT. HISTORICALLY, THEIR MAIN FUNCTION HAS BEEN TO CONNECT DIFFERENT GEOGRAPHICAL AREAS, BUT AS CITIES EXPAND, THEY WILL ALSO BE IMPORTANT SOCIAL CONNECTORS.

Cities are constantly changing and developing, and some of these structures and spaces are becoming less useful or relevant for their time. Mobility is no longer merely about moving from point A to point B – it explores the way people’s movements relate to and affect them, and the way they interact with other people and the built surroundings. Cities are getting smarter and the solutions we develop must be sustainable from a social, economic and environmental perspective. As European cities densify, available urban spaces become scarcer, while the need for these spaces increases. As cities change, we need a new understanding of how to optimally use city areas. Tunnels and bridges should no longer only be structures that facilitate transport – their areas should offer an added value to the city and its citizens.
Many bridges and tunnels create large barriers in the city that generate empty and dark wastelands in surrounding areas. These areas may feel unsafe to people and may diminish economic vitality in the affected spaces. Un-optimised infrastructure and urban spaces can weaken – and in the worst case, destroy – urban networks and hamper cities’ further development. When building new bridges to reduce barriers, it is important to ensure that the new structures do not at the same time create undesirable wastelands.

By focusing on existing bridges and tunnels and creating new ones to strengthen urban areas and connections between them, we can rethink our use of infrastructure. This can be achieved either by giving the structures a new function or by supplementing them with added value. Cities need efficient mobility systems as well as high-quality urban spaces.

This report presents cases in which bridges and tunnels have solved urban challenges and become flexible, multifunctional structures in cities of different scales. All have provided added value to the city and its inhabitants. For example, the High Line project has turned an obsolete space into a space that allows for local pop-up activities and has increased real estate developments in the surrounding areas.

Currently there is no collected data on the available space under and surrounding bridges and tunnels in European cities. Mapping bridges from a 2D perspective might provide some estimates on numbers, but there are many uncertain factors that require more in-depth analysis. Security is one of the top priority concerns. This report highlights the potential of these spaces and may inspire the development of methods and information systems to utilise vacant spaces in cities.
2. BRIDGES AND TUNNELS THAT CREATE VALUE
When redesigning structures and spaces, it is always uncertain whether the space will be used by the city’s inhabitants. Including citizens in the planning process increases the likelihood of creating spaces with the functions people want and need. Other relevant parties may include representatives from the business community, schools, public transport and others. Participatory methods have been used for some of the following projects in reprogramming existing structures, and have undoubtedly helped make them a success.

GREEN WAY, MEXICO

The Via Verde (“Green Way”) initiative in Mexico City transforms more than 1,000 flyover and elevated road columns into vertical gardens running along 27 kilometres of roadway. The objective is to reduce pollution, improve cityscape aesthetics and lower drivers’ stress levels (thereby improving road safety). The vertical gardens, which add 40,000 square metres of plants to the city, are expected to produce enough oxygen for 25,000+ citizens, filter over 27,000 tonnes of harmful gases, capture more than 5,000 kg of suspended dust particles and process over 10,000 kg of heavy metals from the air on an annual basis.
Every day, thousands of people cross Dronning Louise's Bridge, located in the centre of Copenhagen, via the bridge's car lanes, bicycle lanes and wide pedestrian walkways. The photo above is from a one-day event that closed the bridge to cars to allow residents to occupy the bridge for a day. People joined together to create a gigantic chalk painting on the ground – an illustrative example of how to use public space on a bridge to give something back to citizens.

AMMERUD UNDER PASS, OSLO

The urban development strategy for Ammerud in Oslo included upgrading underpasses to produce safe, active environments that create new social arenas. Research showed that people felt unsafe using this dark concrete tunnel. To ensure that the tunnel's redesign was adapted to area residents, citizens were involved in the decision-making process. Citizen involvement was particularly focused on young people with the aim of increasing activity levels and improving general well-being.

The result was an inviting space for exercise and leisure activities, with a climbing wall, fitness facilities, lighting and colourful walls. The project transformed the Ammerud Underpass into a multifunctional space that offers activities and provides shelter in bad weather.
THE BOOGIE DOWN BOOTH, BRONX NY

In 2013, WHEDco (Women’s Housing and Economic Development Corporation) together with the Design Trust for Public Space, began working on the Boogie Down Booth project as part of the “Under the Elevated” city-wide initiative. The purpose of this initiative is to engage community representatives, planners and cultural organisations to make use of the open areas below elevated trains running through the city.

Studies conducted by the Design Trust for Public Space show that there are over 1,100 kilometres of unused space under elevated railways and bridges in New York City. The Boogie Down Booth is one small (but scalable) initiative to make use of that space.

The booths are temporary installations that can be easily attached to existing pillars under the railways. They are self-sustained through solar power and provide lighting and music 24/7. The music counteracts noise from construction, cars and trains and pays homage to the Bronx’s history by playing music made by local musicians over the years.
BAS UNDER BUEN, DENMARK

Several thousand people gather under three bridges in three Danish cities for the “Bas under Buen” (“Bass under the Arch”) concert tour event. The event is free of charge and open to the public. It is a creative and welcoming way to take advantage of the vacant space under large bridges, and it does not require any alterations to the construction.

HIGH LINE, MANHATTAN NY

In 2006, 25 years after decommissioning the High Line Railroad in Manhattan, work began on repurposing the old viaducts, transforming them into an elevated green park. The old 2.3 kilometres railway stretched from Gansevoort Street to 34th Street. While the park was originally expected to have 300,000 annual visitors, that figure topped 5 million as of September 2014.

The green walkway is home to a profusion of plant species. Vegetation grew undisturbed in the years following the railway’s decommissioning, creating robust and durable plants. These trees, shrubs and perennials were incorporated into the new park.

The project inspired a nationwide initiative to reimagine and repurpose obsolete infrastructures, turning them into public spaces and allowing for local pop-up activities, and the renewed focus has increased real estate development in surrounding areas.
The High Line is maintained and funded primarily by non-profit organisation Friends of the High Line through private donations and charities. Friends of the High Line has kicked off several local initiatives to help educate and engage local communities and neighbourhoods, aimed at attracting more New Yorkers to the park. These initiatives focus on environmental stewardship, arts programmes and education for young children. There are several access points along the walkway, as well as elevators and wheelchair ramps.

Financing for projects such as the High Line can present a challenge. This is often due to the fact that benefits are spread among many, while the costs may be borne by one or a few organisations. Specifying and detailing the project’s beneficiaries may make it easier to attract financing from the business community and others. For example, the High Line’s 5 million visitors represent enormous commercial potential and obvious advantages for real estate development. Methods for resolving financing issues include tax credits, renter subsidies and new forms of crowd-funding. Property owners may rethink the use of their properties and sell or rent to potential initiative takers to benefit a larger group of citizens. It also boils down to determination and leadership. Benefits might appear in the future while costs are charged to short-term budgets, but stakeholders need to plan long-term to create sustainable cities.

BURNSIDE SKATEPARK, PORTLAND OREGON

The Burnside Skatepark project began as an initiative by a group of skateboarders who wanted to use the deserted space underneath Burnside Bridge in Portland, Oregon. At the time, most people avoided visiting the area at night, but the young skaters made every effort to change the image of the place – despite the fact that they did not have permission from the city government to do so. The skaters persisted, and eventually the government supported their ideas and turned the area into a skatepark. It has evolved since then, and is now a popular public space offering a variety of events for citizens.
2.2 NEW STRUCTURES FOR EFFICIENT MOBILITY

The world has committed to the Paris climate agreement to reduce city pollution. Cities therefore need to focus on sustainable means of transport and provide more options for pedestrians and cyclists. Copenhagen’s bicycle policy prioritises mobility and cyclist experience, with the goal of becoming the world’s premiere city for cyclists. To achieve this goal, the city has built and is currently building bridges for cyclists, to reduce barriers in the city.

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<td>6. Trangravsbroen, 2015</td>
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<td>9. Østerbro Tunnel, 2015</td>
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The following cases are projects that improve the user experience for pedestrians and cyclists by making active transport a priority. Creating efficient and attractive infrastructure will encourage people to use bicycles as means of transportation. Bridges and tunnels that add value to their surroundings improve quality of life by simplifying, beautifying and inspiring people’s everyday lives.

LONDON UNDERLINE

Beneath London’s busy streets run dozens of kilometres of decommissioned tube tunnels that offer solutions for future pedestrian infrastructure and urban sustainability. In the London Underline conceptual project, architecture firm Gensler envisions developing these tunnels into a massive network of bicycle and pedestrian highways.

By utilising the abandoned tunnels, Gensler hopes to create a carbon-neutral community that is also self-sustaining. They suggest using technology such as Pavagen’s walkway tiles — engineered surfaces that convert energy from footsteps and bicycles into electrical power. Given enough area and traffic, these tiles will be sufficient to keep the tunnels completely self-sustained.
There are also plans to connect multiple underground tunnels across London, giving the city a vast travelling network that completely avoids the traffic, pollution and noisy world above.

BYBANEN, BERGEN

Tunnels need to be safe and rescue operations often rely on openings between tunnel tubes. Separate rescue tunnels are needed even in situations where there is insufficient traffic to warrant two separate tubes. These rescue tunnels are empty 99.99 per cent of the time and are therefore a very expensive solution. Is there a solution for using the tunnels when they are not being used for escape purposes?

A light rail line running in a 3 kilometres long tunnel under Bergen, one of Norway’s seven famous mountains, is in the planning stages. This city tram line needs to include a second tube for potential evacuation. The owner of the light rail line and the municipality have agreed that the second tube will be used as a cycle and pedestrian passage and regional roller ski arena. The tunnel will provide perfect year-round weather conditions, while continuous use will make it a safe and secure environment.
BICYCLE SNAKE, COPENHAGEN

Copenhagen’s internal harbour area has been transformed from commercial maritime to residential and retail use. The area is bracketed by canals, roads and unrelated buildings, and earlier had no bicycle or pedestrian network. The Bicycle Snake – a 230-metre winding sky bridge that cuts through the area and connects two city districts – was inaugurated in the summer of 2014. The bridge is more than just a transit route – it is a cycling experience on an elevated bike path running across water and between buildings. The steel bridge has transparent railing and is modern and elegant, with LED illumination that lights the winding bike path at night. The Bicycle Snake is used by 12,500 cyclists each day.
Neighbourhoods with underdeveloped connections to their surroundings may suffer from vacancies and may attract unwanted behaviour. Bridges can reduce barriers between districts, and directing the flow of people through an area, which creates a safe and secure environment. The following projects used various means to reduce barriers while simultaneously revitalising and connecting the areas targeted for improvement.

**LUCHTSINGEL, ROTTERDAM**

The Luchtsingel is a 390-meter-long temporary structure financed by over 2,000 crowd-funders. The Hofplein area was a neglected part of Rotterdam, detached from its surroundings and a blind spot in the city centre. The area, dominated by vacant high-rise buildings, urgently needed redevelopment. Local residents took the initiative and started a crowdfunding project to revitalise the area.

The Luchtsingel connects Rotterdam North to the city centre and reconnects the Central Station with the North and the North with the Binnenrotte. By improving connectivity, the bridge is a catalyst for economic growth. The bridge generates very few dark areas or blind spots; on the ground floor, the bridge reaches down to urban spaces, a park and into a building with a green garden rooftop and restaurant. People of all ages use the bridge, and it is frequently used by athletes and for photoshoots and videos.

The Luchtsingel is a crowdfunded bridge, with individuals and companies contributing everything from single planks to entire sections of the bridge. Funders’ names or brands, or messages to the city, are engraved in the planks – enhancing contributors’ sense of ownership and their likelihood of using the bridge.

The bridge is a temporary structure with a 5-year permit and a 5-year extension, with an option for additional extensions.
THE CAP, COLUMBUS OHIO

The Cap at Union Station is a commercial and industrial project that reconnects downtown Columbus, Ohio with the Short North Arts District.

Pedestrian traffic from the convention centre to the other side of the highway was minimal, making it difficult for businesses to survive. In 2002, the bridge was extended and rebuilt to connect the districts using proper walkways. This also created new areas for storefronts.
2.4 ADDITIONAL INSPIRATION

Below are some inspirational projects from throughout the world that illustrates how bridges and tunnels can add value to cities and citizens, with new technology, creativity and sustainable solutions.

III.19, above left: Seoul Skygarden, South Korea.
III.20, above right: Pedestrian footbridge, Istanbul, Turkey.
III.21, below: Cycling under water, Amsterdam, The Netherlands.
Ill.22-23, above:
Winter illuminations,
Nabana no sato,
Tokyo, Japan.

Ill.24, below:
Vertical garden,
Pont Max Juvenal,
France.
3. CITIZEN PERSPECTIVE
This section further illustrates how the development of bridges and tunnels can influence citizens’ ability to satisfy needs and preferences and, in turn, how this influence how we choose to structure such areas. Having strong focus on the citizens’ perspective and involving people in a constructive dialogue, is essential for making projects successful and to ensure that spaces are created with functions that people want and need. The following stories have a citizen perspective to further emphasize how improving urban space and mobility structures can result in more liveable, sustainable and mobile cities with improved health and well-being among citizens by encouraging active transport, physical activity, security, social interaction and recreation.

**THE ENTREPRENEUR/DESIGNER:**

Sam came up with an idea for a pop-up installation that he thinks might be successful. He has noticed, however, that all public spaces in his neighbourhood are already occupied and he does not have the space to implement his brilliant idea. But he failed to think of all the available space underneath elevated structures. If there had been a mobile app that mapped and detailed the spaces under bridges and tunnels, he easily could have explored his idea.

**THE YOUNG SKATER:**

Pete just learned how to skate, but his neighbours always complain about the noise he makes doing his awesome tricks. Pete needs a space where he can develop his talent. What could be better than the space underneath a bridge, which is already quite noisy? This solution should satisfy Pete as well as his neighbours.

**THE REAL ESTATE DEVELOPER:**

Kathrine bought a property in a vacant area, believing she could do some good business making the area more popular. The area is not very far from the city centre, but connectivity is weak. Attractive mobility systems, inviting bridges and barrier-breaking tunnels would improve the situation and lead people to the area. Working with city planners to develop solutions, she is considering financing some of these measures, as she thinks this will make the area more people-friendly and thus have a direct impact on the value of the property.
THE ADULT:
Kate lives with her boyfriend in a small apartment in a high-rise building and needs pleasant places to meet friends and exercise. The space under her neighbourhood bridge is transformed into a recreational park with a climbing wall, where she can meet up with friends or take her climbing shoes for some exercise after a long day at work.

THE STUDENT:
Simon just moved to Bergen, Norway, for an exchange semester during his Masters course. He does not know anyone in town and is in a desperate need of some social interaction. Simon loves outdoor activities, but since it is always raining in Bergen he finds it difficult to get to know people hiding under their umbrellas. Some concerts have been held recently underneath some of the bridges in the city centre – Simon has become friendly with people he meets at these concerts while also enjoying the outdoor environment.

THE YOUNG ADULT:
By explicitly including the citizens’ perspective in city planning, city spaces have been made attractive to people and created a welcoming and secure environment. Previously dark and neglected spaces are now places of activity – so 30-year-old Maria feels safe walking home from work rather than using her car. Walking becomes more attractive due to the improvements to urban spaces, and has a positive impact on her well-being and physical fitness.

THE OLD MAN:
Mr. Brown is a recent widower and struggles to activate himself without his wife, who normally initiated activities. All of the new pop-up activities underneath the bridges have made his area more inspiring. He is unable to participate in some activities due to his age, but he loves to watch people (especially his grandsons) playing in the playground in the underpass next to his house.
4. CONCLUSIONS AND RECOMMENDATIONS
Bridges and tunnels are essential to urban mobility, accessibility and connectivity. As European cities densify, available urban spaces become scarcer while the need for these spaces increases. We therefore need to make the best possible use of all city areas and take all aspects of sustainability into consideration.

RECOGNISING THE POTENTIAL OF BRIDGES AND TUNNELS

Bridges and tunnels are structures that create various types of spatiality. They normally strengthen the city and its mobility network by breaking barriers, but in other cases they may weaken these networks by creating other barriers or empty, dark wastelands in surrounding areas. Bridges and tunnels should no longer only be considered structures that facilitate transport; rather, the areas they occupy and the spaces they create should add further value to the city and its citizens.

This report highlights good examples of the potential benefits of making better use of areas and spaces near bridges and tunnels. We have the necessary technology, expertise and materials to design and build constructions that are multifunctional and attractive. It is also apparent that creative solutions present advantages from many perspectives – what benefits one group in society can easily add further gains for others.

THE CITIZEN’S PERSPECTIVE IS CRUCIAL

There is one recurring factor that we believe is essential to the success of transformative and greenfield projects: namely, a strong focus on the citizens’ perspective and involving people in a constructive dialogue on how the spaces can be used. Well-planned public spaces attract visitors, which in turn attracts others. By implementing the citizens’ perspective in all project phases, we can build bridges and tunnels as efficient mobility systems that break down barriers while also providing urban spaces and functions that improve quality of life.

Whether the initiative comes from private citizens, city planners or others, engaging users in the planning adds a 360-degree perspective, making it easier to take social, environmental and economic aspects into consideration. This reduces potential conflicts between parties with different agendas. There are often synergies to be realised, as opposed to treating city development projects as a zero-sum game. Identifying benefits as well as beneficiaries also serves as a basis for project financing.

Ill.25: General methodology for utilising areas and spaces in close proximity to bridges and tunnels.

1. MAP AREAS
   Map areas under elevated structures in selected city or district

2. CITY ANALYSIS
   Produce a general city analysis to identify overall city structures and people flow
A FIVE STEP METHODOLOGY

Based on the case studies presented in this report and on our experience, we recommend a 5-step working method to utilise areas and spaces near bridges and tunnels.

Mapping areas under elevated structures is the first step of the process. Here, European cities can learn from the New York mapping initiative “Under the elevated”. The initiative identifies the space that is available underneath elevated structures and bridges. This concept can also be implemented in a European context. Data can be collected on an international app or website, which can also include findings from citizen dialogues/surveys and an inspiration catalogue, as well as provide a forum for sharing experiences with projects already implemented, to enlighten and inspire developers and citizens. The website/app can also include more detailed guidelines for the methodology presented above.

After this first, very important, step, the city should be analysed to find the overall structures and flows of people. The next step should be to engage the citizens in a dialogue focusing on their needs and wants, to incorporate the crucial citizen perspective in the process. After mapping, analysis and dialogue has been carried out, it is time to work out a design proposal and a way to finance the project.

BRIDGES AND TUNNELS – MORE THAN JUST MEANS OF TRANSPORT

Our cities are constantly growing and developing, which changes the use of built structures. With mapping, analysis, dialogue and a little bit of imagination, existing spaces and structures can be used to enhance quality of life for citizens and create value in European cities. Improving urban spaces and mobility structures encourages active transport, physical activity, security, social interaction and recreation. This will result in improved health and general well-being for citizens. These measures also complement several of the sustainable development goals enumerated by the United Nations.

With the use of the methodology described in this report, taking inspiration from the innovative projects mentioned, European cities can be transformed and improved through utilizing vacant spaces.
5. ABOUT THE AUTHORS
Members of Oslo’s team of experts have varying backgrounds, but they share a common desire to develop sustainable cities with innovative solutions to improve citizens’ quality of life. This relatively young group adds modern, up-to-date expertise to the report and applies a new perspective to the well-established “Tunnels and Bridges” subject area.

GURO RANUM
An urban designer, holds an MSc in Urban Architecture from Aalborg University and joined Sweco’s urban planning team in 2017. Her fields of expertise range from concept studies for urban areas to zoning plans and city transformation. Guro focuses on incorporating the human aspect in all projects to strengthen social sustainability in the built environment.

ALEXANDER HEYERDAHL
Holds a BA in Information Technology (2013) and specialises in 3D visualisation. He works on the Sweco BIM team in Norway as a BIM coordinator and 3D visualiser. Alexander is greatly interested in the future of urban cities, and hopes that reports like this will inspire stakeholders to work to bring about change.

ANDERS GJØSUND
Holds an MSc in Road Planning (1994) and has broad experience from urban road projects in Oslo and other urban areas. He is currently Group Leader for Sweco Norway’s largest BIM and 3D environment. By working with new technology and models with smart information, Sweco is planning better, smarter cities of the future.
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Spaces under Bridges 2017:

ILLUSTRATIONS

- III.1: Green Way Mexico, Photo credit: VIAVERDE 2017
- III.2-3: Dronning Louises Bridge – Copenhagen, Photo credit: Michael Bonnevie, URL: www.gamle-dage.dk
- III.4-5: Ammerud Underpass, Photo credit: Taran Jansen
- III.6: The Boogie Down Booth – Bronx, Kids listen to the sounds of Bronx musicians at public art hangout, the Boogie Down Booth (design concept by Chat Travieso and Neil Donnelly for the Design Trust for Public Space). The Boogie Down Booth is part of New York City-based nonprofit WHEDco’s mission to revitalize neighborhoods throughout the South Bronx. Photo credit: Chat Travieso.
- III.7-8: Bas under Buen, Photo credit: OHOI! / Bas Under Buen
- III.10: Burnside skatepark, Photo credit: Rohan Calsburg, URL: www.skateparkhunter.com
- III.12: Bergen Light rail, Copyright: Bybanen Utbygging AS
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- III.15-16: Luchtsingel – Rotterdam, Top Roundabout: Copyright: Ossip van Duivenbode. URL: https://www.mvrdv.nl/en/about/pressroom
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- III.26: Vertical Garden – Pont Max Juvenal, France, Copyright: Patrick Blanc
- III.27: 5-step working method to utilise areas and spaces near bridges and tunnels, Source: Sweco
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The theme for 2018 is Urban Move, i.e. sustainable development of transports in urban areas of Europe, and describes various aspects of mobility and accessibility to enhance our understanding of different social and physical structures. We explore how citizens view and use urban areas and how local situations can be improved to create more livable, sustainable and mobile cities and communities.

For more information, please visit www.swecourbaninsight.com.