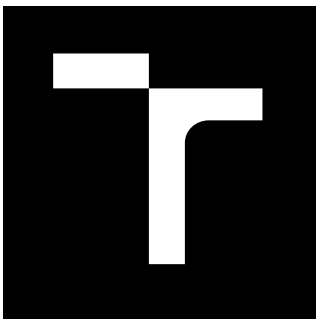

BRNO UNIVERSITY OF TECHNOLOGY

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

FACULTY OF ARCHITECTURE

FAKULTA ARCHITEKTURY

SUSTAINABLE LIVING ALONG THE SVITAVA RIVER

UDRŽITELNÉ BYDLENÍ U ŘEKY SVITAVY

MASTER'S THESIS

DIPLOMOVÁ PRÁCE

AUTHOR — **Alaa Rifaat Omar**

AUTOR PRÁCE

SUPERVISOR — **Ing. arch. Kateřina Dokoupilová Pazderková, Ph.D.**

VEDOUCÍ PRÁCE

BRNO 2024

BRNO UNIVERSITY OF TECHNOLOGY
FACULTY OF ARCHITECTURE

Assignment Master's Thesis

Project no.:	FA-DIP0003/2024
Department:	Faculty of Architecture
Student:	**Alaa Rifaat Omar**
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Field of study:	
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Academic year:	2024/25

Title of Master's Thesis:

Sustainable Living along the Svitava river

Master's Thesis:

Brno lies at the confluence of the Svitava and Svratka rivers and other smaller watercourses flow through its territory. Their potential is not yet fully exploited. Currently some projects are slowly starting to appear that try to solve the problem of Brno's embankments and their unused potential. This new initiative is designed to address the pressing issue of residential housing insufficiency while promoting environmentally friendly living solutions. The new Svitava riverbanks are aiming to restore the reputation of this developing district of Brno, which is located near the vibrant centre of the metropolis.
The diploma project will focus on the designing of new residential district and new attractive riverbank along the Svitava River in Brno.. The intention is also in accordance with the basic conceptual principles of city development. For the diploma thesis, the area defined by Dukelská road, Gargulákova and Bratří Mrštíků streets in Brno was chosen, which has all the prerequisites to become a popular location. The urban study of the new location, intended primarily for housing, should be in line with the current requirements for its quality, comfort, diversity and sustainability. The urban study is to show that the river can significantly contribute to the attractiveness of the area and make it unique.

Graphics scope :

Project aim:
The purpose of the Svitava riverbanks project is to create a modern public space that sensitively enters the whole territory and at the same time brings new, timeless infrastructure for living, working and leisure. The study will focus mainly on the creation of new housing with additional functions and the design of a waterfront in a location that is attractive due to good transport connections and the presence of the river.
The primary aim of the project is to significantly contribute to solving the shortage of residential housing in Brno. By providing a diverse range of housing options, from affordable apartments to family homes, the project seeks to accommodate the growing population and reduce the pressure on the existing housing market.

Impact on Brno:
The sustainable housing development by the Svitava River is poised to become a model for future urban planning in Brno. It aligns with the city's commitment to sustainable development and environmental stewardship. By creating a livable, green, and inclusive community, the project will enhance the quality of life for residents and contribute to the overall resilience of the city.
Expected documentation:
– Text analysis of the current situation and related, more general theoretical issues
– Drawing of wider relations (1:10000, 1:5000,...) showing the existing and proposed urban relations of the site, especially the relation to the centre, transport connections, natural and urban–architectural values, important limits and problems in the area.
– Conceptual drawings showing important design principles
– Drawings of the urban layout showing the spatial layout of the area, the functional division of the area (including the marking of public spaces), the traffic layout (1:1000, 1:500...)
– Schematic floor plans of buildings documenting their basic functional, spatial and operational layout (1:200,...)
– Schematics of the structural design of important buildings
– Important sections and views/sections (1:1000, 1:500, 1:200,...)
– Axonometry or general view of the site
– 3D visualization presenting important views in the area (human perspective,...)
– Author's and technical report describing important design principles and parameters
– Tables of urban economics (balance of existing and proposed functional areas, number of inhabitants, number of parking spaces and other items of the territory amenities)
– Model of the area including the nearest surroundings (1:1000,...)
The documentation will include both printed and digital formats – a bundle of drawings (A3, A2 as required) and poster(s). Individual drawings may be shown together or individually, at the student's decision. All scales are only assumed and may be changed as appropriate to actual need.

List of literature:

– Regulatory plan of the City of Brno: https://upmb.brno.cz/platny-uzemni-plan/uplne-zneni/

– Brno municipality map portal https://gis.brno.cz/

– "Design with Nature" by Ian McHarg.

– "Sustainable Urbanism" by Douglas Farr

– "Urban Rivers" by Stéphane Castonguay and Matthew Evenden

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– Paul, M. J., & Meyer, J. L. (2016). Streams in the urban landscape. Annual Review of Ecology, Evolution, and Systematics, 47, 333-359.

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Additional data, documents, sources might be added in the working process.

Date of project specification Master's Thesis: 23.9.2024

the deadline for submission for the Master's Thesis: 20.12.2024

Master's Thesis is submitted in the scope determined by the project supervisor; in addition, one B1 exhibition panel and Master's Thesis in electronic form are submitted.

Alaa Rifaat Omar student	Ing. arch. Kateřina Dokoupilová Pazderková, Ph.D. project supervisor	head of the institute
		Ing. arch. Radek Suchánek, Ph.D. Dean

In Brno dated 23.9.2024

Declaration

I declare that I have worked on this thesis independently under the supervision of Ing. arch. Kateřina Dokoupilová Pazderková Ph.D. and using the sources listed In the bibliography.

In Brno ..... Signature .....

Alaa Omar

Acknowledgments

I would like to express my heartfelt gratitude to my supervisor, Ing. arch. Kateřina Dokoupilová Pazderková, Ph.D., for her unwavering support, guidance, and encouragement throughout my two years at the Faculty of Architecture, VUT. Her dedication and mentorship extended even before my arrival in Czechia, as she kindly guided me while I was still at home. I feel truly fortunate to have had such a supportive and inspiring mentor.

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Table of contents

Theoretical background

The project addresses the residential housing shortage in Brno by providing a diverse range of housing options, from affordable apartments to family homes. By accommodating the city's growing population, the development seeks to alleviate pressure on the existing housing market while incorporating sustainable and community-focused features.

Key aspects include:

Eco-friendly Construction: Buildings will utilize sustainable materials and energy-efficient technologies, such as solar panels, green roofs, and advanced insulation, to minimize energy consumption and carbon footprints.
Green Spaces: The project integrates extensive green areas, including parks, community gardens, and tree-lined pathways, to enhance residents' well-being and support biodiversity.
Water Management: Sustainable water systems like rainwater harvesting and greywater recycling will reduce water usage and manage stormwater runoff effectively.
Transportation and Mobility: Emphasis on sustainable transportation includes bike lanes, pedestrian-friendly pathways, and easy access to public transit, reducing car reliance and promoting healthier lifestyles.
Community Engagement: Shared spaces such as community centers, playgrounds, and local markets are designed to foster social interaction and strengthen neighborhood ties.
Economic Viability: A mixed-income community will be achieved by combining affordable housing units with market-rate homes, ensuring economic sustainability while addressing housing shortages.
Through these measures, the project not only addresses Brno's housing needs but also promotes environmental sustainability, community cohesion, and economic stability.

Links between the area and its surroundings

the area is located in Brno Husovice, defined by Dukelská road, Gargulákova and the Large city Ring road, connecting which has all the prerequisites to become a popular location. The urban study of the new location, intended primarily for housing, should be in line with the current requirements for its quality, comfort, diversity and sustainability. The urban study is to show that the river can significantly contribute to the attractiveness of the area and make it unique.

The solved area is loosely linked to the redevelopment zones downstream of the Svitava River, with the largest being the new Nová Zbrojovka district. This district is connected to the city center via public transport, primarily through a tram line from "Náměstí Republiky" and relatively frequent bus services. Several amenities are also within walking distance.

Project Overview

Contribution to Housing Needs

Brno, as the second-largest city in the Czech Republic, is experiencing rapid urban growth, with its population projected to increase by nearly 20% over the next two decades (Czech Statistical Office, 2023). The city has faced significant housing shortages in recent years, particularly in affordable housing options. According to the Brno Housing Study (2021), Brno's rental prices have risen by approximately 10% annually since 2019, while the supply of affordable housing has not kept pace with demand.

The project is designed to help address these challenges by introducing a diverse range of housing types. The project will provide affordable apartments for lower-income households, mid-range homes for working professionals, and family residences, ensuring that all segments of the population have access to suitable housing. The development will increase the overall housing supply in Brno, alleviating pressure on the local rental market and contributing to the city's long-term housing strategy (Ministry of Regional Development, 2020).

The inclusion of mixed-use spaces will further support housing affordability by creating jobs and services within the neighborhood. A diverse range of retail outlets, office spaces, and cultural facilities will be available to residents, contributing to a vibrant and self-sustaining community.

Urban Integration and Connectivity

The location of the Sustainable Living Along the Svitava River project ensures that it is well-connected to the rest of Brno. It lies within close proximity to major public transport routes, including tram and bus lines, which provide quick access to the city center and surrounding areas. The area is also accessible by trolleybus lines from the nearby Nova Zbrojovka district, further improving connectivity (Brno Transport Authority, 2023).

Brno's transportation policy aims to reduce the city's reliance on cars by enhancing public transport and promoting cycling and walking. The Sustainable Living Along the Svitava River project aligns with this strategy by integrating pedestrian-friendly streets, cycling lanes, and easy access to public transport stops within the development. This approach encourages active transportation, reducing traffic congestion and improving air quality, while fostering a healthier lifestyle for residents (Czech Ministry of Regional Development, 2020).

Public spaces, such as parks and plazas along the riverbanks, will be incorporated to provide recreational opportunities for residents and visitors. These green spaces will enhance the area's aesthetic value and encourage social interaction, contributing to a sense of community. Studies have shown that the availability of accessible public spaces significantly improves residents' quality of life and promotes mental and physical well-being (Lynch, 2021).

Sustainable Infrastructure and Environmental Considerations

The project embraces sustainability as a core principle, focusing on eco-friendly infrastructure and environmental protection. According to the European Green Deal (2020), sustainable urban development plays a crucial role in reducing cities' carbon footprints and combating climate change.

The project will incorporate energy-efficient buildings, with the use of green roofs, solar panels, and high-performance insulation to reduce energy consumption. Sustainable water management strategies, including rainwater harvesting and permeable pavements, will help manage stormwater runoff and reduce flooding risks. These strategies have been proven to mitigate the environmental impacts of urbanization while enhancing the urban ecosystem (European Environment Agency, 2022).

The landscaping design will focus on using native species and drought-tolerant plants, which will support local biodiversity and reduce maintenance costs. The Svitava Riverbanks will feature vegetated riverbanks, providing natural flood protection and preventing soil erosion. Bio-retention basins will be designed to absorb and filter excess stormwater, reducing flood risks and improving water quality.

The integration of green infrastructure into urban development, such as permeable pavements and rain gardens, will help address environmental challenges, including urban heat island effect, air pollution, and water management (Sustainable Urban Development, 2021).

Initial state

The main development area is the production area located closest to the Svitava River, and the former Zetor engine plant. Furthermore, according to the current zoning plan, the area under consideration includes an area dominated by automotive repair and maintenance shops. an area of apartment houses. A sports area, two tennis courts. as well as The building of the former Briess brewery and it's chimney, which is a brown field. height of the development is from two to four floors above ground, with the development rising from the riverbank across Nová Zbrojovka district to Tomkov Square.

Urban design

The urban design is primarily based on the current structure of the development continuing nám. Republiky Street, extending it to the Svitava river, as well as building a main street that serves as an Avenue, with retail, restaurants, and public transportation routes like trolleybuses. connecting the Nová Zbrojovka district to the large city ring road. removing the former Zetor engine plant as it's occupying a large area that can be used to contribute to solving the housing shortage in Brno. building an area for recreation including sport fields. preserving the former briess brewery building and convert it into a community center due to it's heritage value and keeping the chimney and turn it into an attraction . The design defines two different approaches to the River, namely a publicly accessible and lively river embankment, as well as creating semi private courtyards facing the river and orienting the buildings towards the river, serving the residents of the new apartment buildings.. as well as including more functions such as civic amenities, commerce production, and a kindergarten in the new district.

Concept of public spaces

Several public spaces are situated in the area, offering diverse activities and attractions. These include a square near the Briess Brewery and its chimney, a lively riverbank featuring decks and pathways along the Svitava River, and designated play areas for children, positioned at a safe distance from residential buildings. An avenue with public amenities such as shops, restaurants, and markets connects to residential streets that lead directly to the river. Additionally, there is a recreational area primarily intended for sports.

Most of these public spaces are designed to provide scenic views of the Svitava River. The embankment is enhanced with a pedestrian and bicycle path, bordered by a line of trees, serving both as a key communication axis and a vibrant public space. Both the embankment and the square will be further complemented with benches, which will be addressed during subsequent design stages as details are finalized.

Number of floors

The block use building between Dukelská tř. and Svitavské nábř. 8 are two floors above ground with a semi-recessed underground parking floor so that it's scale corresponds to the current structure, which is mainly two floors. the building on Bří Mrštíků street next to the sport area is six floors above ground, it serves as a buffer against the noise from the large city ring road. and the rest of the development is four floors with a semi-recessed underground parking floor with the exception of the kindergarten building(one floor) and single family houses(2 floors). The concept of floor height is partly based on the regulations of the prepared UP for Brno, then the regulatory plan prepared in the pre-diploma project, the surrounding urban structure and nearby areas.

Preservation of the building from the industrial era

Preserving the former Briess Brewery building in Brno-Husovice and transforming it into a community center, along with retaining its iconic chimney, is essential for honoring the area's cultural and architectural heritage while fostering social and environmental sustainability. The brewery and chimney symbolize Husovice's industrial past, offering a unique connection to the community's history and identity, while their adaptive reuse would provide a vibrant space for cultural, educational, and social activities. Retaining the chimney as a landmark enriches the cityscape and offers opportunities for creative or eco-friendly repurposing. Such a project reduces waste, promotes sustainability, and strengthens community ties, blending historical preservation with modern needs to create a meaningful, shared space for future generations.

Regulatory Framework and Spatial Organization

The urban design is shaped by key regulatory parameters, including street alignment, building typology, permitted floors (based on zoning and contextual analysis), building heights (from sectional studies), and functional zoning. These ensure compatibility with the surrounding urban fabric.

The design integrates architectural forms, structural feasibility, and accessibility, addressing entrance points, pedestrian pathways, and vehicular access to parking, terraces, and communal spaces.

Public spaces and green areas are strategically placed to enhance connectivity, environmental performance, and social interaction, balancing ecological preservation and user experience.

This approach ensures the spatial layout adheres to regulatory, functional, and environmental goals while fostering livability, accessibility, and architectural expression.

Buildings

The planned buildings will range from one to six stories in height. Roof designs in the area include both flat and gable styles.

The recommended structural system for the residential buildings is wall-based, with the chosen spans for the model buildings set at 6 and 8 meters. Additional structural specifications will be addressed during the architectural phase of the project.

Due to the lack of determined foundation conditions in the area, construction is anticipated to involve foundation piles, considering the proximity to a watercourse and the likely high groundwater level. For similar reasons, parking is designed as semi-recessed, requiring waterproofing solutions during construction.

Vehicle and pedestrian areas

all public spaces are designed to be accessible to everyone, including individuals with disabilities, ensuring a barrier-free and inclusive environment. Vehicular access is carefully planned to minimize impact on public spaces, with the main avenue being the primary route for vehicles. This main avenue features an asphalt road to accommodate trolleybus lines and essential traffic, while other streets are paved with paving stones. The stone paving not only complements the aesthetics of the area but also helps to naturally reduce traffic speed and prioritize pedestrian safety.

Pedestrian pathways are typically 4 meters wide, with increased width along the main avenue to support higher pedestrian activity. Cycling paths are 2 meters wide, ensuring a dedicated and safe route for cyclists. Emergency vehicles have unobstructed access throughout the site, ensuring safety and preparedness at all times.

Access to the river is thoughtfully designed to balance usability and sustainability. Pedestrian and cyclist access is facilitated via natural terrain, with paved ramps and stairs provided where necessary for inclusivity. The riverfront is car-free, emphasizing its role as a peaceful, ecological, and sustainable public space.

The entire area promotes low traffic intensity, with a focus on non-motorized transport and public transit options to reduce environmental impact. Sustainable design strategies include the use of permeable paving stones to enhance water infiltration, native plantings to provide shade and reduce the urban heat island effect, and energy-efficient street lighting powered by renewable sources. These measures create a public space that is not only functional and accessible but also environmentally responsible, fostering a vibrant and sustainable urban environment.

Transport solution proposal

The new district is designed to prioritize sustainable and efficient transportation, with primary access facilitated by public transit. Tram Line 4 connects the area directly to Náměstí Republiky, giving access to the city center, while trolleybus lines provide convenient access coming from the Nová Zbrojovka area, supporting eco-friendly mobility options. The main avenue serves as a vital connector, linking the district to the city's large ring road through a roundabout, as outlined in the proposed city regulatory plan, ensuring smooth traffic flow and reduced congestion. Public transit stops, including bus and trolleybus stations, are strategically located within a five-minute walk from the proposed buildings. Vehicular traffic within the district is minimized to enhance walkability, with car access limited to essential routes and no car roads along the Svitava River except for emergency and service vehicles, preserving the tranquility and ecological value of the riverside. Pedestrian and cyclist infrastructure is prioritized with wide pathways, segregated cycle lanes, and traffic-calming measures on streets paved with permeable materials that reduce runoff and heat island effects. Additional sustainable features include solar-powered lighting, electric vehicle charging stations, and native vegetation for shading, ensuring the district is accessible, environmentally conscious, and integrated into the urban fabric.

Pedestrian and cycling traffic

The primary pedestrian and cycling routes in the district will follow both banks of the Svitava River, creating an axis for movement throughout the area. These riverbank paths are designed to be compatible with the proposed pedestrian and cycling paths in the Nová Zbrojovka development, ensuring continuity and a seamless connection between the two areas. This design concept aligns with the overall vision of the district, where accessible riverbanks serve as key corridors for pedestrians and cyclists. The focus on sustainable transportation ensures that residents and visitors can easily navigate the district while enjoying the scenic riverside environment. These well-connected pathways promote active mobility and integrate the natural surroundings with urban spaces.

Civic amenities

The new district is designed to provide essential civic amenities for residents, including a kindergarten for early childhood education. Along the main avenue, shops, markets, restaurants, and pubs will offer convenient services and dining options. This central location ensures easy access to daily needs and promotes a vibrant, pedestrian-friendly community. The mix of services fosters convenience, reduces commutes, and enhances social spaces, contributing to a self-sufficient, sustainable district.

Flood Control Measures

Although the active flood zone does not affect the area, the presence of the Q100 zone (100-year floodplain) requires careful planning. Sustainable flood control measures will be implemented to manage potential flooding risks while enhancing environmental quality.

- Proposed Flood Control Measures
Floodable Green Spaces
Green spaces near the river will incorporate wetland parks and bio-retention basins to temporarily store excess water during rainfall, reducing flood risks and providing recreational areas.

- Permeable Pavements
Permeable pavements will be used for streets and pedestrian paths to allow rainwater to seep into the ground, reducing runoff and encouraging groundwater replenishment.

- Rainwater Harvesting
Rainwater harvesting systems will collect water from rooftops and hard surfaces for non-potable uses, easing pressure on local drainage systems.

- Riverbank Protection
Vegetated riverbanks with native species will help stabilize the soil and absorb excess water, using bioengineering techniques instead of hard barriers like concrete.

- Elevated Construction
For buildings near the Q100 zone, elevated foundations will ensure structures are above potential flood levels, integrating green infrastructure beneath them for water storage.

These flood control measures will mitigate flooding risks in the Q100 zone, promote sustainable water management, and enhance green spaces, ensuring the district remains resilient and environmentally friendly.

Greenery concept

The greenery is designed to enhance the urban environment in Brno by promoting sustainability, biodiversity, and ecological resilience. The plan focuses on selecting tree species suited to Brno's continental climate and urban setting, creating a comfortable, green space for residents and visitors.

Along the Svitava Riverbanks, the design prioritizes native, riparian species that thrive in moist conditions and support the river's ecological health. Suggested species include:

- Willows (Salix spp.): Well-suited to moist soils, willows stabilize riverbanks and provide shade and wildlife habitat.
- Alders (Alnus glutinosa): These trees improve soil stability and enhance biodiversity by supporting local insect populations.
- Silver Birch (Betula pendula): Native to Central Europe, silver birches are hardy, offering vibrant foliage and resilience to Brno's climate.
- Poplars (Populus spp.): Fast-growing trees that provide shade and stabilize the riverbanks. it should be in sporadic amounts

In the urban areas, the focus is on species resilient to city environments. The proposed trees include:

- Oaks (Quercus robur): A strong, long-living species that provides shade and ecological benefits.
- Maples (Acer spp.): Known for their stunning fall foliage and large canopy, maples thrive in urban spaces.
- Hornbeams (Carpinus betulus): Hardy trees that tolerate compacted soils and pollution, ideal for city streets.
- Linden (Tilia spp.): These trees offer fragrant flowers, shade, and a pleasant environment for social spaces.
- Evergreens like Scots Pine (Pinus sylvestris): to add year-round greenery and shelter.

The greenery plan also includes low-maintenance shrubs and groundcovers to enhance biodiversity, improve air quality, and reduce irrigation needs. Native plants will be used to support local wildlife and create sustainable, attractive green spaces.

This approach will not only improve the district's aesthetics but also contribute to Brno's sustainability goals, creating a healthy, resilient, and vibrant urban environment.

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