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Mother Teresa University in Skopje,
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Mirce Acev 4, VII floor, Skopje, North Macedonia
Phone: +389 2 3161 004
E-mail: journals@unt.edu.mk
Web: www.journals.unt.edu.mk

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Editorial Foreword

Editor-in-Chief

ACKNOWLEDGEMENT

Welcome to the new Issue of the Journal of Architecture and Civil Engineering JACE, Volume 1, issue 1, 2024. The topics covered by this Issue are related to the current trends of research, original research that uncovers sustainable development.

The Journal represents an international journal that effectively provides a forum for academics, professionals, graduate and undergraduate students, fellows and associates to share the latest developments and advances in knowledge and practice of Architecture and Civil Engineering, Architectural design, Information Technology applied in Architecture and civil Engineering, Technics and Technology implications. Our interest in promoting high-quality research is clearly reflected in having an established peer reviewing process and a high-profile expert group of Associate Editors and Editorial Board Members.

Hopefully you find this Issue valuable and we definitely look forward to receiving your high-quality studies for the next issue of the Journal.

Prof. Dr. Bekim Fetaji
Editor-in-Chief

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Riverfront land use and its further redevelopment

Adelina Fejza[1]
Faculty of Architecture and Civil Engineering, Mother Teresa University, Skopje, North Macedonia, adelina.fejza@unt.edu.mk

Sanja Avramoska[2]
Faculty of Architecture, Ss. Cyril and Methodius University, Skopje, North Macedonia, avramoska.sanja@arh.ukim.edu.mk

ABSTRACT

The process of developing riverfront areas in urban settings carries a multitude of potential advantages, yet its success hinges upon a careful examination of environmental, social, and economic considerations. This paper addresses the need for adopting an analytical approach in the urban planning of riverfronts, emphasizing their pivotal role in fostering a sustainable city environment and shaping the city's overall image.

In doing so, this research delves into the evolving patterns of land use and redevelopment initiatives along riverfronts in two distinct cities: the River Vardar in the Aerodrom municipality of Skopje, North Macedonia, and the River Main in Offenbach, Germany. The criteria for choosing these case studies are one European Union (EU) city and one non-EU city, both sharing a comparable length of riverfront.

The research employs mapping techniques and observational methods, supported by photo documentation. These tools enable the identification of prevailing trends in riverfront land use. A comprehensive comparative analysis is then conducted between the two case studies, followed by recommendations for future redevelopment.

In essence, this analysis of selected urban riverfronts acknowledges its potential benefits while emphasizing the significance of a strategic and well-informed planning process. The findings and recommendations contribute not only to the specific contexts of the chosen cities but also offer broader insights applicable to urban areas seeking sustainable and appropriate riverfront land use transformations.

KEYWORDS

Riverfront redevelopment, land use, urban riverfronts, land use mapping

Introduction

The contested nature of riverfronts within urban landscapes faces multiple challenges and opportunities inherent in their development. As we engage in the task of shaping the layout of urban areas, particularly along waterfronts, it becomes crucial to consider the adaptability of these spaces. This involves a careful consideration of their capacity to accommodate alterations in the city's structure and the environment [1]. Simultaneously, it is important to maintain a sense of consistency in the urban fabric. Honoring and preserving the existing urban elements that contribute to the fundamental traits of a location is crucial. In essence, urban design should strike a delicate balance – being responsive to change while steadfastly preserving the unique characteristics that define the essence of a place [1].

Within the German urban context, there is a trend of reusing industrial brownfields as places where a new image of the city is being built. Offenbach am Main is a city in Hesse, Germany, that is a part of the Frankfurt urban area. In Offenbach, such example is the “Offenbach Harbour” redevelopment project which represents the transformative potential of repurposing industrial spaces. This project not only represents a departure from the traditional use of such areas but also exemplifies a shift towards creating a residential and multifunctional urban living space [2].

On the other side, the use of the waterfronts in North Macedonia has been historically different, compared to the German context

where there are harbors/former harbors. Vardar River is the longest river in North Macedonia, with a total length of 389km (301km in North Macedonia) [3], flowing through different cities and containing different riverfront development scenarios. The valley of the river holds significance for agricultural activities and serves as a crucial segment of the Morava-Vardar corridor [3]. The city of Skopje, situated along the river Vardar, has witnessed significant redevelopment initiatives, especially during the project "Skopje 2014" [4].

Researching these specific urban contexts of riverfront land use development aims to extract insights that extend beyond the confines of the chosen cities, contributing to a broader understanding of urban planning and design that seek to strike a harmonious balance between adaptability and the preservation of unique local identity.

Purpose of Study

The central objective of this research is to undertake a comprehensive comparative analysis of redevelopment patterns occurring along riverbanks in two contexts—one situated in an EU city and the other in a non-EU city. The overarching aim is to examine the nuances of redevelopment trends, particularly in terms of land use, within these urban landscapes. The methodology employed involves patched maps of land use, a visual representation that captures the existing scenarios in both selected cities and represents an analytical approach towards what are the current trends and differences, and possibilities of what can be redeveloped in the future.

The significance of this study extends beyond mere comparison, seeking to contribute valuable data and perspectives towards the potential development of riverbanks outside the EU to align with or even surpass EU standards. Through a detailed examination of existing trends and differences, the research aims to offer informed recommendations that can be instrumental in shaping the trajectory of future land use redevelopment initiatives. This is especially important for countries like North Macedonia which aspire to enter the EU and seek to see the gaps in their urban planning strategies. In essence, it serves as a catalyst for envisioning and implementing strategic urban planning measures that transcend geographical boundaries and contribute to the establishment of universally recognized standards for riverfront land use redevelopment.

Research Methods

In conducting this study, qualitative research methods were employed due to their capacity to offer a thorough exploration of the research objectives [5]. The selected research methodologies comprised mapping and on-site observation, involving photo documentation that capture the essence of two riverbanks. On-site observation was conducted directly, enabling a firsthand understanding of the physical context and complexities surrounding the riverfront areas.

For the specific focus of this research, a deliberate choice was made to study a segment of the River Vardar in the Aerodrom municipality in Skopje. This selection was based on the strategic similarity in riverfront zone length with the River Main in Offenbach, Germany. Additionally, the chosen segment in Skopje has a similar urban context to the German city, featuring a mix of residential areas, industrial zones, and expanses of greenery.

To enhance the precision and thoroughness of the analytical maps of land use within both Offenbach, Germany, and Aerodrom in Skopje, North Macedonia, an analysis of existing urban plans of land use was undertaken. In the case of Offenbach, Germany, particular attention was directed towards the examination of the "Masterplan Offenbach Am Main: 2030" brochure. Within this document, a focus was placed on the specifics outlined in the "RegFNP 2010" land use plan [6]. This approach involved rechecking the zoning information illustrated within the RegFNP 2010 document to ensure a thorough understanding and accurate representation of the current state of land use in Offenbach.

In the context of Aerodrom, Skopje, North Macedonia, the "General Urban Plan for the City of Skopje 2012-2022" was analyzed. Within this urban plan documentation, a more refined exploration concentrated on the "Land use plan – land use zones" [7]. The utilization of these precise sources aimed to ensure the accuracy and reliability of the analytical maps, providing a comprehensive foundation for understanding the spatial dynamics and urban development trajectories in Offenbach and Aerodrom.

The graphical part of the mapping process is completed by using various technological tools. This includes the utilization of platforms such as Google Maps for spatial visualization, Autocad for precise drafting, and Photoshop for graphic refinement. By

incorporating these tools, the research ensured an accurate graphical representation of land use around the selected riverbanks, aligning closely with the physical landscape. In summary, the research methodology represents a combination of on-site observation, exploration of existing land use plans, and mapping.

Findings and Results

This research encompassed the systematic collection, comparison, and analysis of qualitative data to discern patterns and variations. Two riverbanks were examined, namely, the Aerodrom municipality in Skopje, North Macedonia, and Offenbach am Main in Germany. The initial step in our analytical research involved the creation of river typology maps, which are represented in Figure 1. These particular maps serve as a comparative tool, enabling us to assess the distinctive characteristics of two prominent rivers: the Vardar and the Main.

Figure 1: Analytical maps of river typology – comparation between River Vardar in Aerodrom municipality in Skopje, North Macedonia and River Main in Offenbach, Germany

It is evident that along the riverbank of Vardar there are no physical interventions such as expanding of the riverbed. On the contrary, the riverbank of the Main unfolds a transformation with some identifiable physical expansions. These expansions, once designated as harbors, have undergone a noteworthy alteration, now serving as integral components of mixed-use zones, such as the "Offenbach Harbour" residential project illustrated in Figure 4. The repurposing of these former harbor zones into mixed-use areas represents a good strategic urban development approach. This adaptive reuse not only enhances the historical significance of these locations but also offers the residents a distinctive experience near the river.

According to the analytical maps of land use, that were created for the selected case studies (Figure 2 and Figure 3); it was found that both locations have plenty of zones with greenery. However, a distinction emerged in the level of regulation and maintenance, particularly evident along the river Main in Offenbach. In this German context, the green spaces are more systematically organized and well-maintained, featuring designated areas for camping activities. Contrarily, the river Vardar in the Aerodrom municipality in Skopje presents a less regulated and maintained greenery landscape, with certain sections being visibly neglected and abandoned.

Along the river Main in Offenbach there is only one undeveloped industrial area (Figure 2), emphasizing a predominantly regulated and repurposed urban environment. In contrast, along the river Vardar in Skopje we can see bigger undeveloped zones (Figure 3). In both instances (Figure 2 and Figure 3), substantial industrial zones are situated in close proximity to the riverfronts, underlining the coexistence of industrial and residential land uses along these urban waterways. Areas designated for public buildings and administrative purposes dominate more in the Offenbach context.

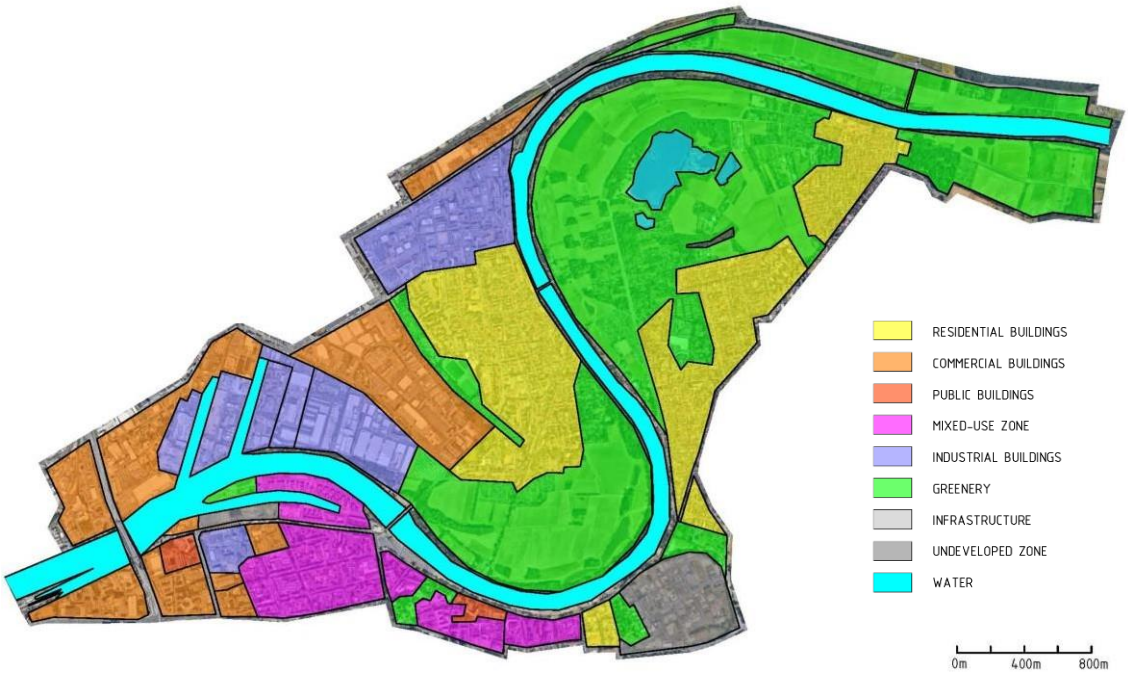

Figure 2: Analytical map of riverfront land use - River Main in Offenbach, Germany

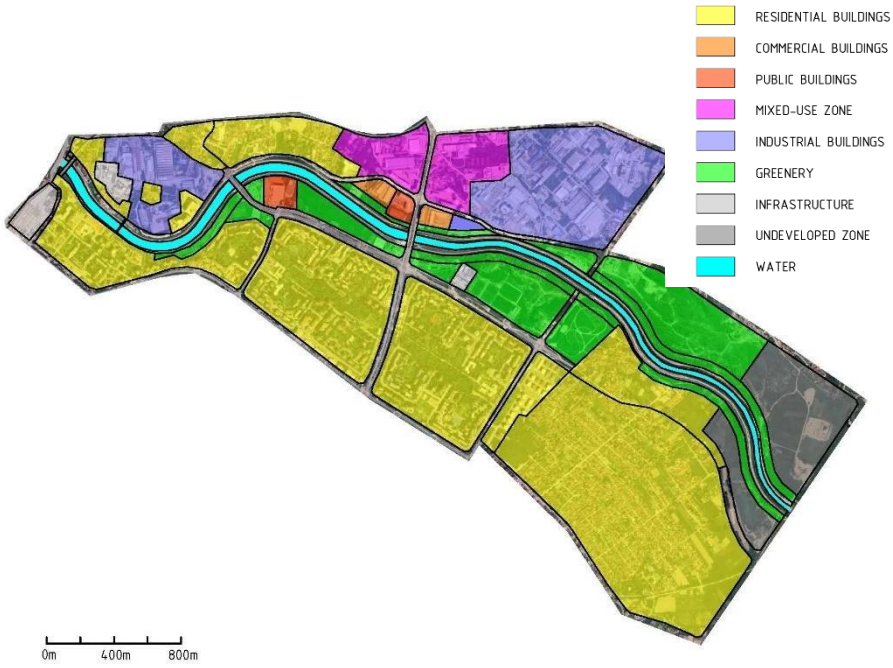

Figure 3: Analytical map of riverfront land use - River Vardar in Aerodrom municipality in Skopje, North Macedonia

When it comes to the buildings along the river Main in Offenbach, there is a tendency to build closer and near the river bank. Residential land use dominates with individual houses and new collective housing units (Figure 4). Whereas, in river Vardar in Aerodrom municipality in Skopje, the situation is the opposite. Most of the buildings are not adjusted so close to the riverbank. The Vardar riverbed also has more depth and a greater slope that prevents water overflow (Figure 5). This denivelation challenges the horizontal connection with the riverfront land use zones. What dominates in this case are the collective housing units built right after the big earthquake (1963), as shown in Figure 5, but in very few parts, there are some individual houses and some small areas with illegal buildings.

In Figure 4 and Figure 5, through on-site observation and photo documentation, we can see firstly the city silhouette in both case studies. This visual representation allows us to grasp the distinctive contours and spatial arrangement of the cities studied. Secondly, these figures capture the interrelation between residential areas and the adjacent river. These images shed light on how residential zones are connected with the watercourse, providing insights into the urban planning dynamics that shape the interaction between housing and the natural landscape. Thirdly, we can see the distinction between newly built (Figure 4) and old-built zones (Figure 5). Lastly, these images serve as a visual gauge for the level of maintenance observed in these areas. Examining the physical condition and orderliness of the urban landscape provides valuable indications of how well these regions are cared for and managed. In the case of Offenbach, the riverbank is treated like a public space which is designed with seating areas, observation points, platforms that provide direct contact with the river, several garbage points, and public toilets. Whereas, in the case of Vardar we can see only a continuous running track which is the main activity that is happening along the riverbank, and several seating benches located in the upper part of the riverbed.

Figure 4: River Main in Offenbach, Germany – "Offenbach Harbour" residential zone, source: Sanja Avramoska

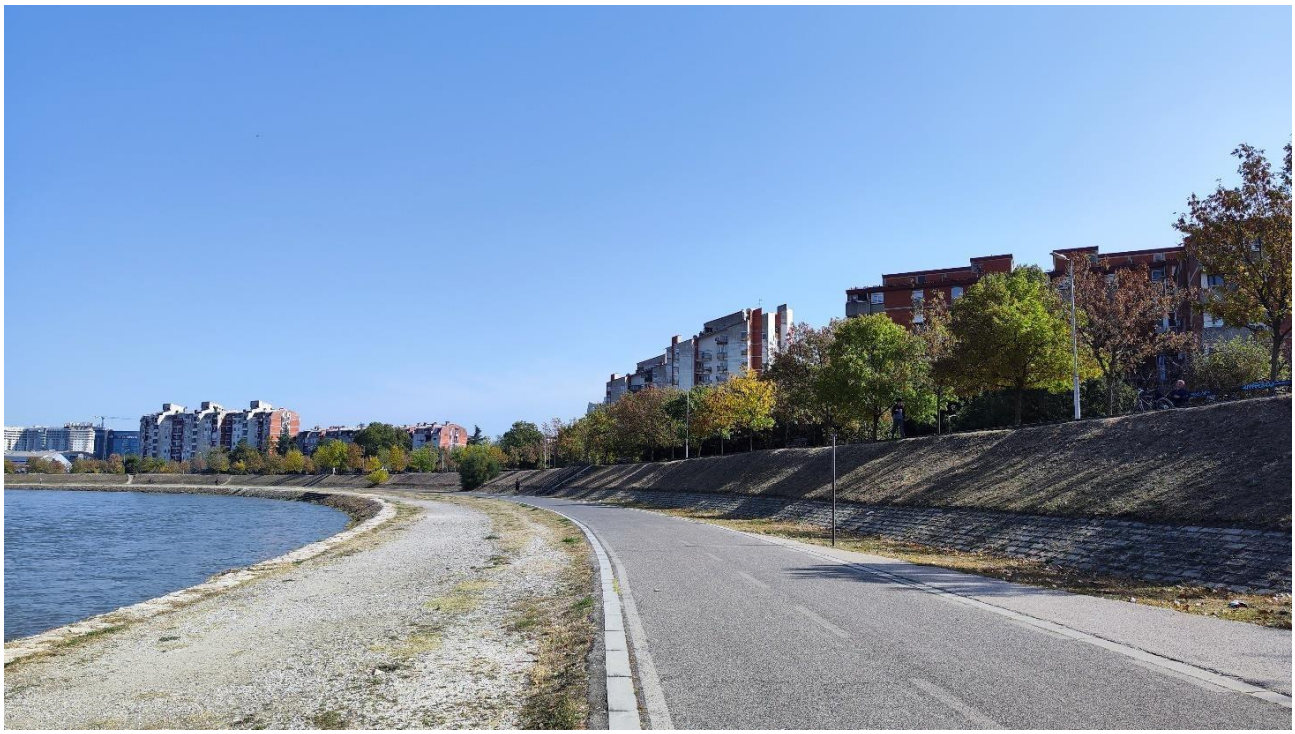

Figure 5: River Vardar in Aerodrom municipality in Skopje, North Macedonia – residential zone, source: Adelina Fejza

Conclusions and Recommendations

This research provides valuable insights into the comparative analysis of riverfront redevelopment and land use between two distinct case studies, shedding light on the divergent trends and varying levels of development. The first analysis of the river typology reveals that in the case of Offenbach, the transformation of former harbors that was achieved through physical expansion of the riverbed and subsequent repurposing into mixed-use zones stands out as a successful and unique approach to land use. This prompts a reconsideration of the feasibility and desirability of future riverfront redevelopment to facilitate mixed land use. Also, it opens critical thinking about urban planning strategies, whether these physical expansions can occur intentionally, to provide better connection with the river and enhance land use diversity.

The second analytical land use maps provide a visually informative comparison between the two case studies, offering a clear representation of dominant riverfront land use. This analytical approach can help urban planners and architects, guiding them in rethinking the appropriateness of land use near riverfronts, identifying gaps, and formulating strategies for redevelopment. Based on the observed trends, we recommend mixed land use as a more compatible option near riverbanks, fostering a variety of scenarios along the river that contribute to a vibrant and dynamic urban environment.

The final analysis, which contains on-site observation and photo documentation, shows a contrast in the maintenance levels along the river Vardar in Aerodrom, Skopje, as compared to the river Main in Offenbach. The visibly lower maintenance along the Vardar prompts a call for action, emphasizing sustainable and compact urban riverfront planning, by adding more value to this kind of public space. Drawing from the exemplary practices and trends observed in the case of Germany which follows EU standards, it is recommended that North Macedonia should take proactive steps to emulate and integrate similar principles into their urban planning frameworks. This alignment with established standards can serve as an initial stride toward fostering sustainable and aesthetically pleasing riverfronts, ensuring the harmonious coexistence of urban development and natural landscapes.

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Enhancing Riverfront Social Connectivity in Brownfield Redevelopment Projects in Germany

Sanja Avramoska [1]
Faculty of Architecture, Ss. Cyril and Methodius University, Skopje, North Macedonia, avramoska.sanja@arh.ukim.edu.mk

Adelina Fejza [2]
Faculty of Architecture and Civil Engineering, Mother Teresa University, Skopje, North Macedonia, adelina.fejza@unt.edu.mk

ABSTRACT

Recent riverfront redevelopment initiatives in Germany are focused on enhancing the urban landscape and the connection between the city rivers and the citizens. Various strategies have been implemented in order to succeed in this endeavor over the past three decades. This paper focuses on the concept of social connectivity along the newly redeveloped riverfronts, and it examines the patterns of use of those riverfronts, the activities happening along them, and the extent to which the people are truly connected with the river. The research was done through a thorough examination of two riverfront redevelopment projects situated in Germany. The aim was to provide insights into the elements of public space design and its impact on the social fabric of the local communities. By understanding the roles of these public space elements, valuable knowledge for urban planning, development, and design can be gained which will be useful not only for Germany but also for other cities in the world that aim to redevelop areas along their waterways and enhance the connectivity between cities and the people. The methods utilized are extensive field visits, along with mapping exercises, and photo documentation. The findings indicate that the focus has been mainly put on longitudinal and lateral connectivity and vertical connectivity to the water has not been fully established due to pollution of the rivers.

KEYWORDS

Social connectivity, urban rivers, river redevelopment projects, riverfronts, public spaces

1 Introduction

In the industrial era, rivers were canalized to improve their navigability. Riverbanks integrated industry and infrastructures such as railroads and ports. These industrial zones were mostly placed in natural floodplains. The fluvial floods that occurred in those areas resulted in riverbanks being turned into rigid flood infrastructure and rivers being frequently turned into channels full of waste [1]. The primary role of these city riverfronts as industrial zones has diminished due to deindustrialization, leading to the deterioration of these areas into brownfields and their attractive location near a water-body eventually made them attractive grounds for new urban redevelopments [2]. Many European cities, particularly those in Germany, France, Spain, the UK, and the Netherlands, have undergone a remarkable transformation of their riverfronts. Their main goal was to reuse the brownfields along the rivers, to enhance flood resilience and to improve the connection between the river and the people [1], [3]. A famous example is the Seine in Paris which was visually but not physically accessible. Initiatives like the Paris-Plages, that places beach sand on the quays used as roadways, have successfully generated attractive public spaces [4]. The initiatives to clean the river for the upcoming Olympic Games in Paris even more ambitiously contribute to making a stronger connection between the river and the people allowing for contact with the water [5].

One of the first examples of riverfront redevelopments in Germany is Duisburg Innenhafen, located in the Ruhr Valley, where a transformation of an inland harbor followed the decline of heavy industries. The project aimed to revitalize the waterfront, blending refurbished buildings with new housing, offices, and cultural amenities. The Inner Harbor now features a promenade as well as housing along the canals. More river and riverfront redevelopments followed in the last decades – in Hamburg, Munich, Cologne, Berlin, Leipzig etc. and all with the goal of improving the connections of people with the water.

2 Theoretical Framework

Kondolf and Pinto [6] borrow a framework of longitudinal, lateral, and vertical connectivity from the field of environmental sciences, and discuss the social connectivity of rivers dividing it into longitudinal, lateral, and vertical social connectivity. By 'social connectivity' they refer to the communication and movement of people, goods, ideas, and culture along and across rivers. Longitudinal connectivity is mainly achieved by navigable rivers and transport routes along the river, whereas lateral and vertical connectivity represents the everyday utilization of riverbanks by people. There are many examples of initiatives in Europe that aim to bring rivers closer to the citizens. Improving urban connectivity involves integrating circulation networks, especially for pedestrians and cyclists, to enhance lateral connectivity between the city and the waterfront [6]. This may include removing barriers like highways or introducing safe crossing points, which means sacrificing of longitudinal connectivity for the creation of lateral connectivity [1]. In re-designing waterfront spaces, there is an opportunity to address vertical connectivity, extending from upper street levels to embankments, terraces, and eventually down to the water.

This paper borrows Kondolf and Pinto's [6] concept of "social connectivity" to analyze newly constructed cases of river and riverfront redevelopments in a German context. In Germany, these initiatives go beyond simple aesthetic improvements; their aim is also to improve the social interactions and activities along the river, to contribute to the well-being of people, and to re-establish a sense of community and urban identity, catering to a multitude of activities, from leisure and recreation to cultural events and economic ventures.

3 Purpose of Study and Methods

The case studies of interest are mixed-use and residential areas that are built onto former brownfields. This research does not investigate the extent to which these areas are integrated into the city fabric in terms of distance or the extent to which the riverfronts are being utilized at a given moment. Instead, the research investigates if and how urban planning and design for these areas allows access to the urban rivers and if it enhances longitudinal, lateral, and vertical social connectivity. The research is conducted with a qualitative case study methodology [7], [8]. Qualitative data collection methods include extensive field visits, mapping, and photo documentation. After the data collection, qualitative and comparative data analysis was done to find reoccurring patterns in both projects. The study seeks to offer lessons and recommendations for urban planners, policymakers, and city developers not only in Germany but also in other cities in Europe.

4 Case Studies

This paper explores two riverfront redevelopment projects that are situated on a former industrial site – the Neckar riverfront in Heilbronn and Main riverfront in Offenbach.

4.1 Neckarbogen, Heilbronn

In the city of Heilbronn at the turn of the last millennium, an area north of the train station had lost its once vital role as a handling, storage, and industrial zone. The ground in the area was full of remnants of its industrial past. In 2019 the Federal Garden Show took place, transforming the industrial hub into a contemporary and attractive district. The "Modellquartier Neckarbogen" is a housing project that is a part of the exhibition. The transformation of Neckarbogen's urban fabric is founded in landscape architecture, which played a central role in connecting fragmented riverscapes, eliminating spatial obstacles, and reclaiming previously inaccessible plots. Over two kilometers of open space have been reclaimed from unused land along urban riversides. The new developments integrate crucial landscape functions like noise reduction, stormwater management, and protection of urban wildlife, which are all integrated into the so-called "smart"

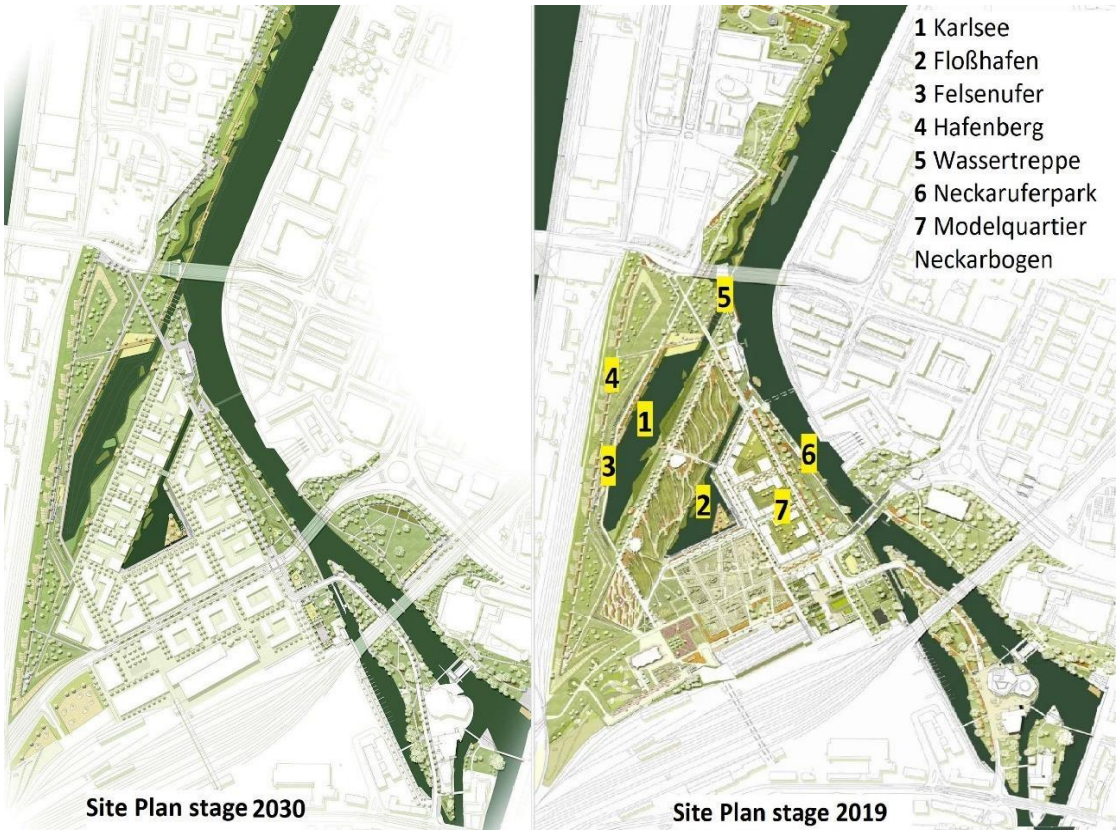


Figure 1: Heilbronn BUGA 2019 plan, adapted from: Sinai Gesellschaft von Landschaftsarchitekten mbH

multifunctional landscapes [9].

Neckarufer embankment park offers recreational space, while its terraces also serve as flood retention areas. With Felsenufer, Hafenberg Park features embankments of earth and stone rising to 12 meters. The walls and gorges double as climbing walls and vertical playgrounds, respectively. Rock fragments and gravel fields on Hafenberg hill slopes provide biotopes for lizards and thermophile insects. Karlssee Lake serves as a recreational area with a beach and wooden decks while doubling as a stormwater retention pond connected to the river Neckar via water steps. The lake is connected to the river Neckar via water steps. Furthermore, there is a “floating” wooden footbridge 500 meters long that serves as a pedestrian connection but also has resting spots along the river. Floßhafen is the second basin or artificial lake in the project area that includes stairs and seating steps around the lakeshore. There is also an artificial island featuring a water playground. Both Karlssee and Floßhafen water basins are a reminiscence of the port formerly located on the site [9].

4.2 Offenbach New Harbor

Offenbach am Main is an independent city in Hesse and is located near Frankfurt am Main. Historically, it was known for its strong presence in the leather goods, metal processing, and chemistry industries. Offenbach's port, situated on the northwest side of the Main River, was primarily an industrial goods storage and transshipment. Over time, the port became obsolete and remained dormant until the 1990s when redevelopment efforts began.

Figure 2: Heilbronn BUGA 2019 project, source: authors

The port area that also includes the small industrial peninsular is being revitalized into a mixed-use space that combines living, working, education, gastronomy, shopping, and culture. Well-known architects are contributing to this project [10]. The area offers diverse mix of uses, including rental and owner-occupied apartments, with most units completed by autumn 2016. A significant portion of the project area is designated for education, housing the Offenbach University of Design (HfG) and forming the "Design Port" in the Nordend district. Office spaces will occupy another substantial part of the area, with green spaces created at the tip of the harbor island and to the north [11].

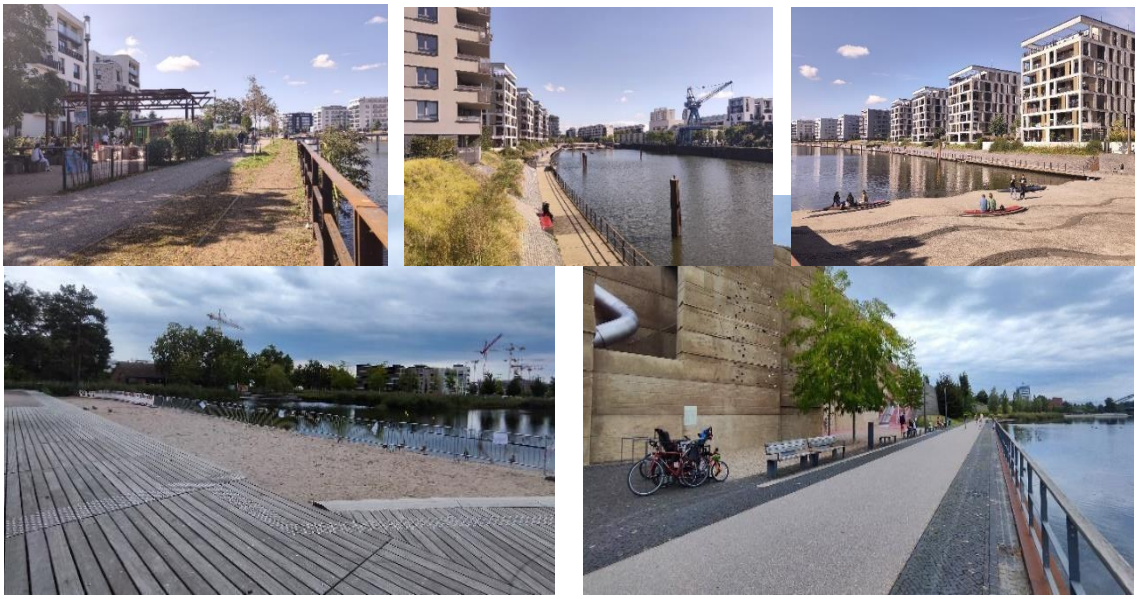


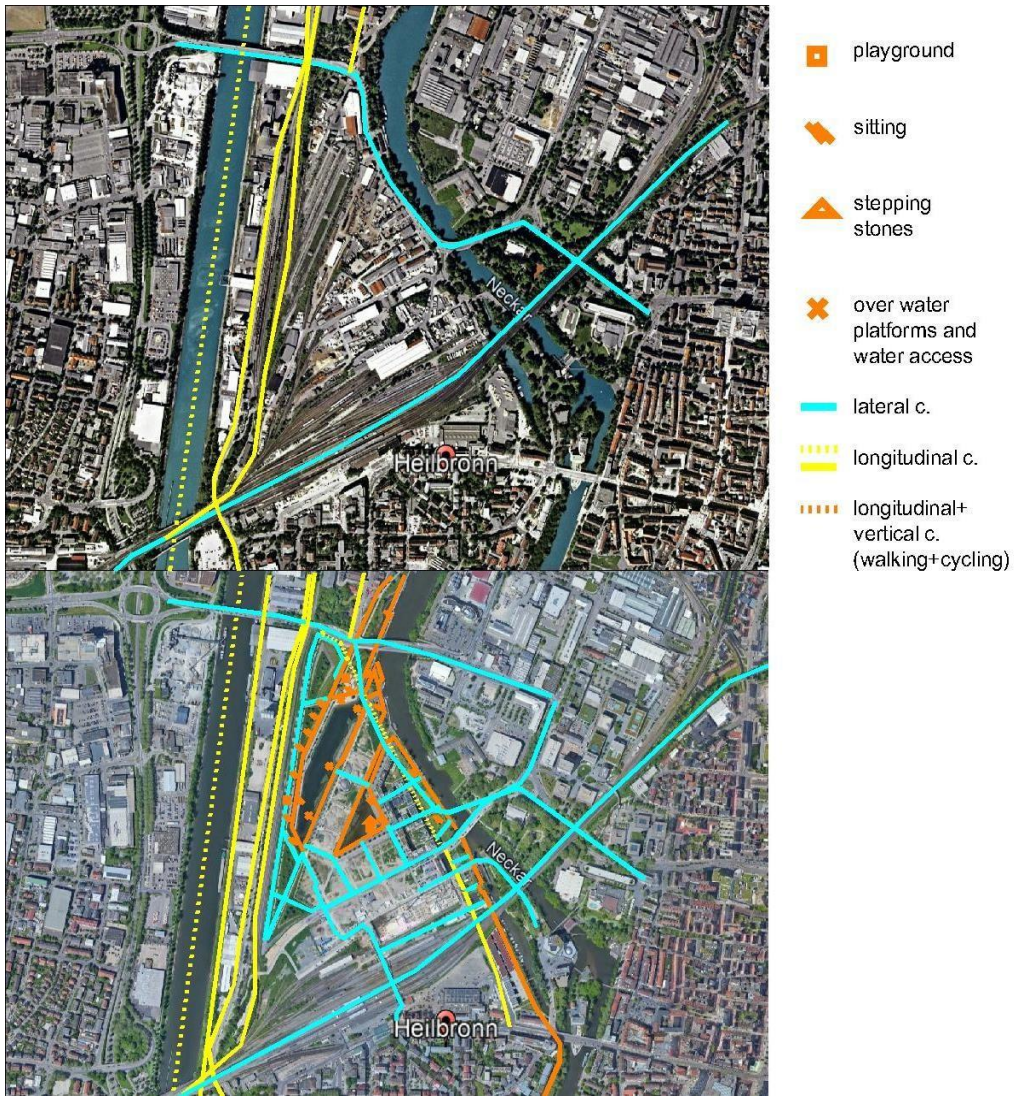
Figure 4: Offenbach New Harbor public spaces along the water, source: authors

5 Findings and Results

The river's size relative to the city shapes its social function and urban layout. River width influences proximity, bridging ease, street patterns, and waterfront activities. Widths of up to 15 meters allow direct communication, from 50 to 200 meters create vibrancy, beyond 200 meters, individuals may seem distant and in very wide rivers, the opposite city often becomes a distant skyline, symbolizing regional identity [6]. Both examined case studies of riverfront redevelopments are located on rivers whose width fluctuates between 50 to 200 meters and involve artificially created basins as an expansion of the riverbed that are remnants of previous ports. In both cases, the basins visually connect residential buildings with the water [12], [13]. Both projects leverage these basins as an extension of the riverbed or as artificial lakes, providing a more secure and better-controlled water area that is separated from the river and that can be enjoyed by residents in the surrounding areas. The investigation into these redevelopments revealed that both cases have made significant steps in establishing longitudinal, lateral, and vertical social connectivity in the riverfront, encouraging social interactions, and revitalizing the urban landscape.

5.1 Neckarbogen, Heilbronn

The analyzed project area now is better connected through multimodal transport routes, with the newly established promenades facilitating better pedestrian interactions. The Neckar canal continues to serve as a longitudinal link. Lateral social connectivity has a significant improvement as there are many connecting routes that lead from the district to the river. The distance from one bank of the river to the other is approximately 84m which allows for good visual contact between both banks. The addition of pedestrian bridges allows for multiple crossing points across the newly constructed basins. The artificial lakes that are the heart of the new residential neighborhoods provide good visual contact with the water bodies for the new buildings.



There are numerous access points that now offer direct contact with the water, incorporating design elements such as walkways over the water, steppingstones, and an artificial beach. However,

most of these design elements are placed alongside the artificial lakes. To fill the lakes, a feasibility study led Heilbronn waste disposal companies to clean storm drains in the new "Neckarbogen" district. The separation system in this district channels wastewater and rainwater separately, with rainwater partially retained through green roofs and private property use. The rainwater is collected, treated in a multifunctional structure, and then distributed between the two lakes [14].

5.2 Offenbach New Harbor

The Main River maintains its longitudinal connectivity as it remains navigable. Moreover, the new residential district now enjoys enhanced longitudinal connectivity along the riverbank due to the integration of new public transport lines. Pedestrian connectivity is improved through the creation of promenades along the river and the harbor waterfront. Pedestrian bridges connect both banks of the harbor, facilitating easy crossing, although the connection to the opposite side of the river in that specific area is absent. Visually, lateral social connectivity is well established, with the harbor basin measuring a maximum of 64m in width and Main River spanning 123m. Vertical connectivity is made possible in a few spots around the basin, allowing access points for activities such as stand-up paddleboarding (sup boarding) and kayaking. To manage water pollution in the basin, an innovative drainage system that alleviates pressure on sewage systems is employed. This system ensures the separate treatment of rainwater and contaminated water. Moreover, strategically planted cleansing biotopes featuring grasses and perennials serve as natural filters for rainwater, contributing to the supply of fresh water in the harbor basin.[11].

Figure 6: Offenbach social connectivity map 2004-2023, source: authors

Visitors and residents in both case studies are enabled to utilize the newly designed riverfront promenades

for leisure activities and communal gatherings. The crossability of the artificial water basins located within the project area has been enhanced by the construction of pedestrian bridges in both instances, but crossability of the rivers has not changed. However, the distance between the banks of the basins ensures good visual connectivity. The residential buildings have been set back from the water, prioritizing the development of longitudinal promenades along the water. The primary linkage to the water has been established by optimizing views from nearby buildings.

The design elements that offer contact with the water are placed mainly alongside the basins in the two cases. The design of public spaces with stairs and steps that go into the water allows users to sit and do leisure activities there [15]. However, there are no access points that would allow activities on the side of the river. That is mainly because of the pollution of the waters and for safety reasons. Both case studies showcase efforts to contribute to the water pollution of the areas particularly in the basins, however, swimming, and direct river access are still not feasible.

6 Discussion and Conclusions

The design of the examined banks, coupled with the presence of the artificial water basins as an “extension” to the river, significantly impacts the efficient layout of the built areas. The basins are particularly utilized to enhance the vertical connection to the water. In both case studies, the connection to the water has been instrumental in altering the perception of these areas, shifting them from being previously industrial or neglected spaces into vibrant hubs that cater to a multitude of activities.

In Offenbach, the port redevelopment project has effectively transformed the former brownfield into an attractive mixed-use area that overlooks the water and whose residents can enjoy a vibrant public space that allows the establishment of a vertical connectivity to the river. The reconfigured port area now accommodates a diverse range of activities, including promenades, and children’s playgrounds, enabling residents and visitors to engage with the area close to the water. Similarly, the BUGA 2019 Project in Heilbronn has successfully created a good longitudinal, lateral and partial vertical connectivity to the river within the new residential urban area. What is specific about the Heilbronn project is that the flood infrastructure is very well incorporated with the public space design. Namely, the flood walls serve as climbing walls, and the dikes are turned into steps and promenades that can be used for sitting and enjoying the view of the water.

The focus has been given to establishing visual connections to the water and with that to make the locations more attractive. The design elements employed in both projects, such as riverside promenades, green spaces, playgrounds, and amenities, have successfully transformed these riverfront areas into attractive and accessible public spaces. The assessment of social connectivity brought by both projects indicates that the longitudinal pedestrian connections within the redeveloped areas are well-established. However, because of the configuration of the basins, there is not a significant enhancement of longitudinal connectivity within the broader urban fabric. These new residential areas are being integrated with the introduction of new public transport routes. Lateral connectivity has been achieved through the construction of new bridges that cross over the basins, improving access to the newly developed residential buildings, but also through the implementation of more access points to the waterfront in general. Furthermore, significant efforts have been undertaken to establish vertical connections to the water. However, pollution issues have restrained with full contact and utilization of the water. Managing river pollution is a complex task that necessitates advanced measures, such as the deployment of sensors for early warning systems to notify the public about suitable times for river bathing. It is noteworthy that European cities aspire to attain relatively clean rivers, and the incorporation of European Green Deal and Digital Water Management strategies is expected to contribute to this goal in the coming decades. Having that in mind, the design of the riverfront should facilitate more access points that enhance the vertical connectivity to the river through direct contact with the water. To

draw more comprehensive conclusions, an exploration of additional case studies is needed.

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