

## Article

# Functional and Morphological Transformations of the Urban Block—Contribution to the Expected Modernization of Zagreb's Historical Core

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**Abstract:** The paper explores the possibilities of the structural and functional transformation of blocks in the historical center of Zagreb as a part of modernization after many years of neglect as well as earthquakes in 2020. The research aims to determine how the existing block tissue corresponds with the needs of today's residents and the possibility of its improvement. The historical circumstances in which the blocks were formed and underwent the most significant changes and modern processes that affect the state and value are determined. There is a special focus on the interior of the block (courtyards), as well as on the spaces on the ground floors of street facades, where numerous, unexplored changes can be observed. The findings provide starting points for desirable structural–functional transformations of blocks and stem from the synthesis and interpretation of knowledge from four interrelated parts of the research. The characteristics of blocks have changed during city development stages, as depicted by an analysis and graphic interpretation of historical maps and urban plans (1864–2021). Influences of modern processes on changes of the city are determined on the basis of the synthesis of previous research from different interdisciplinary points of view; a detailed analysis of the structural–functional changes is conducted on the example of three selected blocks. Transformation models for three selected blocks are proposed.

**Keywords:** Zagreb; urban block; urban transformation; urban reconstruction; urban planning; historical core



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## 1. Introduction

The historical urban network of Zagreb, a pillar of urban planning, consisting of Lower Town, Upper Town and Kaptol, bestows the city with its architectural and cultural identity. Like other lived-in historical districts, this complex and dynamic spatial system is exposed to constant changes associated with social, political, and economic conditions. Research on the Lower Town formation indicates different stages in its development. The second half of the 20th century is characterized by processes and pressures that have left significant ramifications on the structure and function of the city center's identity, as well as the quality of life of its inhabitants. In recent decades, the neglect and degradation of the urban block tissue has become increasingly visible. The condition into which the city center has lapsed, especially after the devastating earthquake of 2020, indicates the need for modernization.

At the beginning of the 20th century, there was a broad international impetus for the reformation of urban blocks. The reformed perimeter block was considered a suitable model for the metropole at that time—the formation of a solid street facade, but at the same time, the realization of large, green, and bright courtyards. A large number of shapes were designed, including spacious courtyards, inner streets, and courtyards oriented toward the surrounding streets, with lower interior buildings and so on [1].

Among the numerous comparative European examples of historical block construction, we single out the Amsterdam's extension toward the south as one that shows the evident

negations of the nineteenth-century city planning. The Berlage plan of 1917 deliberately ignored the orthogonal grid and rural plot division of the previous planning period and organized a new city quarter with its own structure, defined by large scale blocks and an internal communal green space [2,3].

Another example of urban block reconstruction originates from the 1910 Groß Berlin competition, which played a significant role and represents a milestone in the discussion on urban planning. A science-based, multidisciplinary, theoretical, and cross-scale design approach resulted in several original competition solutions for urban residential ensembles. They included park network systems and the opening of courtyard blocks as a reaction to a typical 19th century block, characterized by compactness and high density with open spaces that had no greenery, but were rather often used for crafts and workshops, thus creating the matrix of slum and congestion [4–7].

Models of reconstruction applied with the Berlin urban block structure were a subject for consideration for decades after. Of particular note is the Interbau 1957 exhibition and later the 1984 IBA, with dominant goals being to provide sun, light and greenery, rather than insist on continuity and tradition. The 1970s were especially marked by dynamic discussions on urban renewal, involving Heinrich Klotz, Rob Krier, Charles Moore, Wolfgang Pehnt, Aldo Rossi, Peter Smithson, and James Stirling. Dilemmas about the existing city block construction were related to the principle of renovating—repairing, changing, or replacing—the existing blocks. Some of the basic concepts of the restoration of Berlin at the IBA 1984 were as follows: identifying the citizens of Berlin with the city; maintaining the historical planning structure as a permanent basis for the development of a “future for our past”; and urban renewal in the context of characteristic parts of the city relevant to its identity and at the forefront of its restoration. In the realization, this all led to the renewal of the existing block structure and the formation of new replacement blocks, even where they did not exist in such a form. The urban block as a historical city form is affirmed in several variations (open block, closed block, block in block and divided block). The city space is enriched with new and renovated streets and squares and the emergence of new park categories—parks in the block, city parks, and regional parks [8–10].

Most European cities have begun processes of long-term systematic transformation of their central historical parts some thirty to forty years ago and are now in their final stages. The functional and structural transformation of the urban block is an essential component of many of these cities’ improvement models.

In the early 1970s, Rotterdam’s city administration launched a major urban renewal project. In contrast to cleaning and demolishing neglected parts, the reconstruction of the center (*Stadsvernieuwing*) and residential areas was planned with the participation of citizens. Activities were carried out in order to reduce population density, ventilate blocks and upgrade public facilities and the communal infrastructure. Instead of narrow and long blocks and dark streets, designated areas for gathering and socialization were created both in blocks and in public spaces—communal gardens, passages and children’s playgrounds [11].

From the realization of the first superblock in Barcelona in 2016, a new concept of urban order has sprung up. The new model of innovative urban and transport planning strategy aims to reclaim public spaces for people, reduce motorized transport, promote sustainable mobility and active lifestyles, provide urban greening and mitigate the effects of climate change. The scheme transforms nine city blocks into the so-called ‘superblocks’, where traffic is only allowed around the perimeter, and priority is given to pedestrian areas, low-speed zones and recreational green spaces. A recent study suggests that there are potentially significant benefits to be delivered from this ambitious plan [12,13].

Finally, as a counterpoint to the efforts to reaffirm the role of the urban block during the 20th century, it is important to point out the theoretical model of complete block dismantling, influenced by Le Corbusier’s urban thought of building new and reconstructing existing cities. It is based on a concept that denies the historical city and the impact of the specificity of a particular location in the city. This model was brought to absurdity by his

concept for Plan *Voisin*, which envisages the demolition of the historic part of Paris and the creation of a new composition started from scratch by eliminating ties with historical quarters. The traditional parts of the block are dismantled and reorganized into a new unit resembling a vertical block [14].

The focus of the research is the city of Zagreb, which, unlike the mentioned cities, has only just begun thinking about a systematic reconstruction process without a comprehensive plan and/or strategy following a long period of neglect [15].

Urban renewal should consist of a set of planning measures and terms for a functional and qualitative change of degraded areas. It refers to various processes (urban regeneration, reconstruction and revitalization) related to social, structural, functional, cultural and environmental changes of a certain part of the city. Planning the urban regeneration of the historical city should provide a comprehensive vision of development, with consideration of each new urban architectural project in light of preserving the identity of urban heritage [16]. In the context of city modernization, it is important to emphasize the urban environment as a living tissue. Architectural heritage can be reutilized respecting its core values, but also the needs arising from social, cultural, spatial, economic and other requirements of our time—adaptive re-use of the built heritage [17]. New urban planning and architectural interventions in the historic core of the Lower Town need to bring new potential that will contribute to the conservation of city identity [18]. In addition to the basic principles related to the criteria of integrity and authenticity of physical structures, the intangible components, such as the purpose and the use of space, are important, especially in terms of the role of housing and quality of life [19].

#### *Research Question and Aims*

The conducted research aims to determine the extent to which the existing block tissue is in line with the modern needs of residents and the possibility of improvement. The objective is to determine the historical circumstances of the formation of the Lower Town block structure as well as the genesis of their most significant structural and functional changes, with identification of its development stages. A special focus is placed on pinpointing the causes and effects of negative transformation processes.

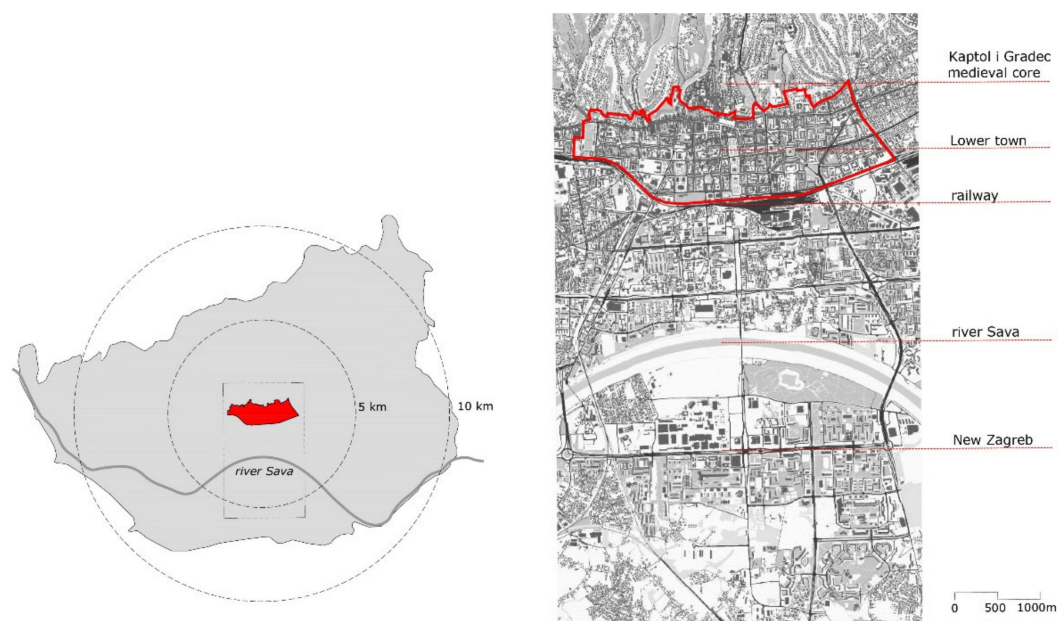
Unlike other conservation research, which is mainly focused on the architectural heritage of the outer perimeter of the block, the focus of this study is the changes in the interior of the block (the enclosed central courtyards), as well as the ground floor spaces of street buildings. Both spatial aspects, neglected in previous research, are an integral part of the block and are significant for its definition. In addition, these are spaces where numerous changes take place without any identification of their causes or control/management models.

The findings should serve to define the starting points of desirable structural and functional transformations of specific block structure parts as an integral element of the city core reconstruction and its modernization in the coming period. Although conducted and tested in the case study of Zagreb, the research can serve as a methodological approach for the reconstruction process of other urban areas.

## **2. Materials and Methods**

Research was conducted using quantitative and qualitative methods by synthesizing different specifics—bibliographic, cartographic and photographic materials as well as field data. The exploration of spatial characteristics and urban processes was conducted in two different scopes/scales, as follows.

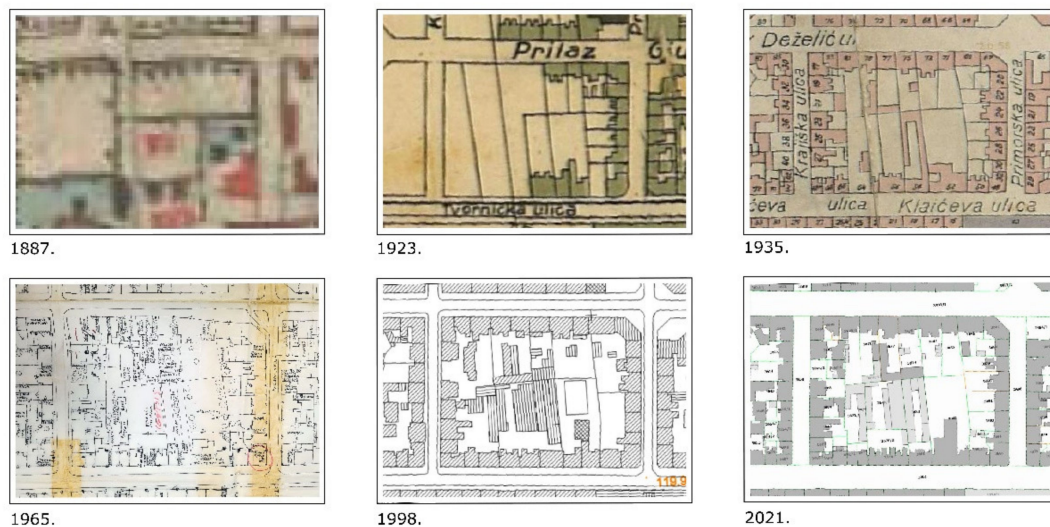
For the area of the whole Lower Town, the boundaries are defined by the last planning document prepared for the subject area (Development Plan of Lower Town, 1989), including 168 blocks over a total area of 350 hectares and the area of three blocks (A, B, C) selected according to the established criteria (Figure 1).



**Figure 1.** Research area: Lower Town within today's city limits/scope of the Master plan—*Generalni urbanistički plan* limits (left). Location of Lower Town in the central city area—relation to the most important city development stages and spatial features (right).

The research consists of four interrelated parts:

- (a) The characteristics of the blocks through the development stages of the Lower Town are determined by an analysis and graphic interpretation of historical maps and urban plans of the city of Zagreb (from 1864 to 2021) [11,12], as well as a synthesis of scientific and professional papers on the historical city development. The most significant stages of city expansion are identified, spatially mapped and graphically interpreted. The presented space–time sequences provide the basis of defining criteria for detailed case study blocks selection reference.
- (b) The recent processes' impact on the structural–functional changes are determined by the synthesis of previous interdisciplinary Lower Town research (architecture and urbanism, art history, sociology, demography, economics) with field data. Processes with negative effects on the block, which were not previously spatially explored, are identified together with spaces that carry the potential for improving the quality of life and preserving the city's identity.
- (c) A detailed analysis of the structural–functional changes is conducted by comparing selected examples of three blocks (A, B, C). The case study method is focused on two previously unexplored spatial aspects:
  - Stages and characteristics of physical changes of the blocks' enclosed courtyards, as determined by a comparative analysis and graphical interpretation of cartographic materials from different periods of the city's development (1964–1989–1923–1934/35–1968–1998–2021) and a detailed field survey (Figure 2, Table 1).
  - Changes in the usage of street buildings' ground level spaces, as determined by a comparative analysis of data selected in 1974 and a mapping of the data on the condition, type, location and number of commercial spaces from a conducted field survey in 2021.
- (d) Guidelines for urban block renewal are proposed in the form of a transformation model based on a synthesis of the previous three parts of research: historical stages of city development, impact of modern processes on city changes and detailed analysis of structural and functional block changes.



**Figure 2.** Selection of the most expressive cartographic materials from different periods of the city's development used in comparative analysis and graphical interpretation of structural functional block changes.

**Table 1.** Cartographic material used in the research (NSK—National and University Library in Zagreb, Zg Geoportal—Zagreb spatial data infrastructure, DGU—State Geodetic Administration).

Cartographic Material	Year	Type	Scale	Source
Nacrt Zagreba, Albrecht, D.	1864	Regulatory basis	1:5950	NSK
Nacrt grada Zagreba	1889	Regulatory basis	1:11,520	NSK
Nacrt Zagreba, Heinzl, V.	1923	Regulatory basis	1:10,000	NSK
Nacrt grada Zagreba	1935	City plan	1:5000	NSK
Treća katastarska izmjera	1965	Cadastral map	1:1000	DGU
Digitalni ortofoto (DOF)	1968	Digital ortophoto	-	ZgGeoportal
Croatian base map (HOK)	1998	Base map	1:5000	ZgGeoportal
Google maps	2021	Satellite map	-	google.com
Digitalni katastarski plan	2021	Cadastral map	-	ZgGeoportal

The starting points of urban planning for desirable transformations of structural and functional blocks are proposed by synthesizing all four interwoven parts from previous research and usage of logical argumentation methods, combining deduction and induction.

### 3. Results

#### 3.1. Urban Block Characteristics through the Development Stages of Lower Town

The study of the city center block development is closely connected to the history of modern Zagreb, which began in the middle of the 19th century, when Lower Town was formed. Unlike many other European historic cities, such as Vienna, where the inner city was the heart around which the city spread radially, Zagreb's Lower Town emerged as a new planned part of the city development on the south side of the historic core.

##### 3.1.1. Formation of the Lower Town during the Second Half of the 19th Century

The initial phase of Zagreb's modernization and urbanization, initiated by the construction of the railway and the city's expansion along the main traffic routes, was determined by the First and Second Building Orders and Building Development regulations in the middle of the 19th century [20]. The Second Building Order from 1857 prescribed the manner of forming streets, squares and buildings' facades. The rectangular shape of the new squares was determined by omitting the block as well as the conditions for mostly straightforward tracing and right-angled streets crossing. The minimum width of streets, the position of buildings' facades and other urban planning terms that contributed to the image of a new, more modern city, were also determined [21]. Lower Town urbanization

began in the 1860s with the formation of main development axes and the transformation of an irregular rural structure into a uniform elongated rectangular city plot with a proper distribution [22–24].

The first regulatory document for the development of the city was adopted in 1865 and was the most important plan and strategy for the transformation of Zagreb into a modern city. It spatially and substantively defined Lower Town—its role of connecting historical settlements with the suburbs, unifying the urban standard and achieving urban consolidation. The regulations required planned and orderly construction, so the basic typology of the future city, created by the transformation of the building plot of mercantilist construction of non-homogenized shapes and sizes into standardized building parcels, remains a permanent effect of the plan (Figure 3). Various procedures by which the system of urban blocks was established stem from that document—corrections and rectifications of construction directions, corrections of street axes, the laying out of the so-called green horseshoes—rings of lower city gardens and others [22,25,26].

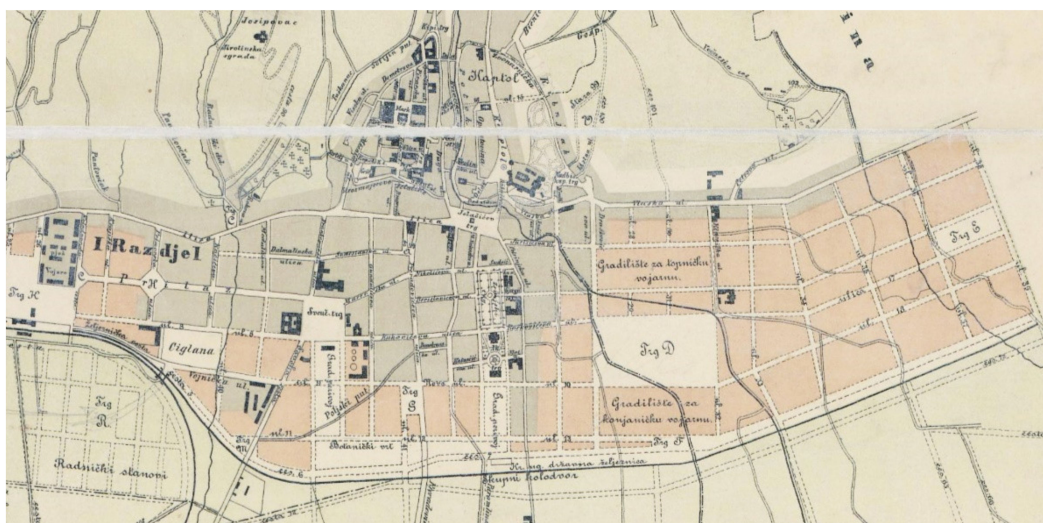


**Figure 3.** The first regulatory basis of the city, 1865. Area of planned Lower Town block structure is marked in light pink, situated south of the historic medieval core.

### 3.1.2. City Modernization after the 1880 Earthquake

The devastating earthquake of 1880 was a new turning point in city development. At that time, economic relations gradually passed from the craft phase to the pre-industrial phase, the new middle class of merchants and builders formed, and the city entered a period of rapid growth that lasted until the beginning of the World War I.

The new Regulatory Basis of 1887, covering a much larger area, used zoning for the first time in planning—the division of the city into three areas of different functions and different levels of elaboration (Figure 4). The first zone included the central urban area of Lower Town, where the first development was expected and for which the regulation was set. Special provisions determined the height of construction—two-story buildings, and three-story buildings on squares—and banned the accommodation of “unclean” factories. Detailed regulatory bases were announced for all roads and streets. The previously planned ring of parks (the green horseshoe) grew into a lavish spatial framework for edifices celebrating national culture; monumental public buildings combined with residences for wealthy citizens, adorned by extensive park landscaping, which created a unique historic *Gesamtkunstwerk* of the founding era [20,22,27]. By the end of the 19th century, Zagreb became a modern European city.



**Figure 4.** Regulatory basis of the city, 1887.

At the end of the 19th century, several amendments to the Building Regulations were approved, additionally regulating block construction by determining the permitted heights of buildings and the area of unbuilt courtyards. Houses for lease were mostly built at that time, often with the owner's apartment joined with smaller auxiliary buildings. The increase in the number of central functions bears testament to the growing importance of the area.

### 3.1.3. Lower Town Industrialization in the First Half of 20th Century

The beginning of the century is characterized by strong urbanization and the process of industrialization initiated by the railway construction at the end of the 19th century. At that time, Zagreb was becoming one of the strongest industrial centers in Southeast Europe. The accommodation of the industrial buildings started in the first phase on the outskirts of the city and along traffic routes (mostly along the railway). Gradually, the city also gained a number of industrial plants, incorporated into the urban fabric, in the growing lower city center [28,29].

Certain parts of the city had greater or lesser advantages for further expansion. The biggest, but also the most intensive, changes took place in peripheral parts, where some segments changed their use and structure several times until their final inclusion in the urban fabric [30].

The annexation of the settlement along the eastern city border almost doubled the city area. Alterations in the approach to urban planning and the construction of a drainage channel enabled the introduction of diagonal streets and the formation of triangular and pentagonal blocks. In that way, it was possible to build free disposition corners as a generator of specific urban accents of the city [20]. The eastern part of Lower Town was formed latest, mostly according to the 1923 Draft Plan of the City of Zagreb and was completed only after World War II.

In the following decades, the planning focus shifted to new regulations and the expansion of the city toward the south, across the river Sava. In 1930–1931, a large international competition was announced for the development of the “general basis for the construction, expansion and regulation of the city of Zagreb. The new regulatory basis from 1953 defines Lower Town as a commercial and residential urban space and protects the existing physical structure of buildings. New building interventions are planned as an additional filling based on the established block grid.

### 3.1.4. Stagnation and Degradation of the Lower Town Identity in Second Half of 20th Century

At the time of the City Center Development Program in 1968 and the proclamation of building southern Zagreb, the Lower Town area underwent an extreme stagnation period, marked by growing traffic problems and an unchanged physical and functional structure [31–34]. The need for substantial restructuring and certain physical rehabilitation is recognized in order to achieve architectural and urban modernization with technical and spatial upgrades aimed at establishing the physiognomy and scale of a millennial city center.

Since the 1960s, Lower Town has seen population depletion and a decline in housing function—important indicators of change in the spatial and functional tissue of the city. Moving industry to city outskirts has become a tendency combined with a concentration of new central activities, indicating the increasing attractiveness of the area. Trade and various businesses (especially in clothing, footwear, furniture, technical goods, etc.) emerging in the commercial zone, together with cultural, entertainment, administrative and other institutions, and the rapid growth of activities related to tourism is evident [35].

At the same time, planners warned of the need for a systematic urban policy for the distribution of new city services (tourism, shops, crafts, etc.), with special attention paid to spaces within city blocks. The outdated way of occupying blocks' interiors, in which contents of heterogeneous building groups dominate (warehouses, storage rooms, garages, small-scale production, crafts and industrial buildings) is pointed out and characterized as one of the basic factors of the so-called blocks "congestion" [36]. However, among many such buildings, which no longer belong to the modern city center and hamper the spatial potential of the city, it is important to single out those that do have heritage value and bear testament to the early 20th century economic prosperity of Zagreb as well as the modernization processes of the time [37].

In recent decades, Zagreb, like many other cities, has increasingly fallen into the general entropic climate of globalization and transitional integration. The conflict between traditional and modernizing identity can be seen in various aspects of space. It is especially present in the transformation of commercial street spaces (shops). Since 1990s, there has been an obvious trend, present throughout Central and Eastern Europe, visible in the emergence of hundreds of new global brands and services, with traditional craftsmen increasingly losing their place in the market flooded by a river of well-known branded stores [38]. Zagreb has long been known as a city of craftsmen and traditional crafts (watchmakers, hat makers, shoemaker, umbrellas, etc.). Until recently, they were one of the important features of urban identity, possessing strong charisma. The potential danger of their complete decline, if they continue succumbing to globalization, shall lead to them no longer reflecting traditional Zagreb, which is, in fact, one of their primary roles [39].

One of the most noticeable trends that have marked the past ten years is a significant increase in tourist activity. It is evident in the growing number and vast array of tourist accommodation, as well as varied adaptations of city spaces (restaurants, souvenir sales, events in public space, etc.). A significant increase in the number of housing units offered through Airbnb has led to an increase in real-estate prices and leases in the center. Gradually, it is expected to lead to a violation of privacy in residential buildings, changes in the quality of housing and the eviction of permanent tenants [40,41]. In addition, numerous adaptations, additions and extensions accommodating the demands of tourism lead to structural changes of questionable quality. A significant share of tourist accommodation in buildings in the enclosed space of the block is evident. It is, therefore, important to view tourism in light of its impact on the quality of housing and in the context of the process of transformation and conversion of buildings in the block, often of smaller urban-architectural and construction values [41].

In addition to all the above mentioned processes, the devastating earthquake of 2020 has put into question the sustainability of the future development of the historic city center and is the impetus for a new step forward in quality reconstruction and revitalization. Like

a complete renewal after the earthquake of 1880, when modern Central European city was formed, Zagreb is once again given such an opportunity today. The approach to the new stage of modernization of the city requires the planning of integral interventions that go beyond the reconstruction of individual buildings but requires an approach that looks at the wider space, including blocks, areas of common urban character, and city districts—the historical center as a whole [19].

### 3.2. Structural—Functional Changes of Selected Blocks

One of the greatest spatial potentials for the improvement and modernization of Lower Town, recognized since the 1970s, are the enclosed courtyards within city blocks. Their current redevelopment and neglect pose a limitation in terms of functional organization and urban security (disabled access, evacuation routes, passages and fire access) and quality of life in the block (reduced amount of natural light and ventilation, deteriorating microclimate conditions, lack of space for tenants, etc.). Changes in economic, social and political conditions in recent decades have imposed the need to reconsider the construction and design as well as the use of buildings inside the blocks in order to improve the quality of life and establish an identity that befits the city center.

Unlike the buildings around the perimeter of the block, for which the purpose and time of construction are well known, the block's interior remains in obscurity. The aim of the research at the block level is to determine the period of construction, purpose and current usage, terms and possibilities of transformation/improvement.

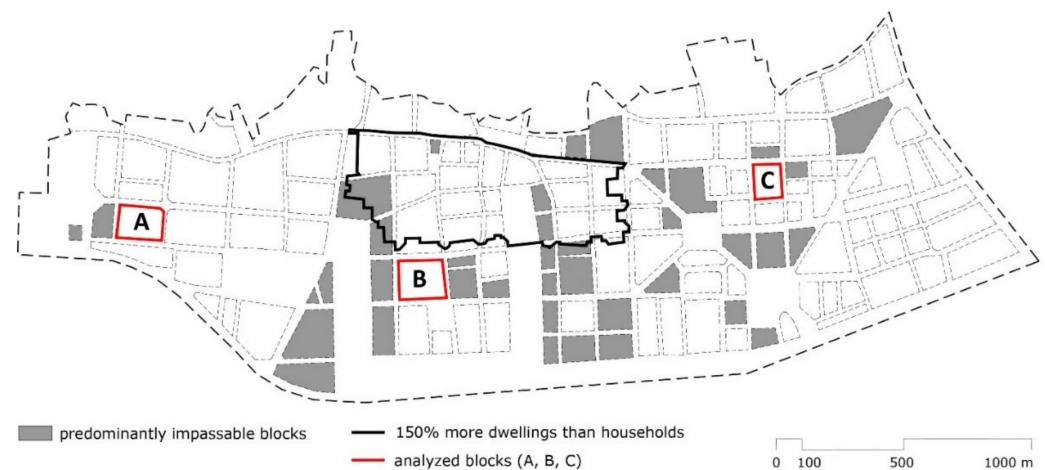
#### 3.2.1. Criteria for Selecting Block Examples

Although there are numerous differences among a total of 168 blocks, almost each and every one of them possessing unique features, for the purposes of this research, three reference examples were selected according to the following criteria:

- Blocks from all three development stages of the city determined by the analysis of planning documentation (Figure 5).
- Blocks from the area of the city in which a deficit of activities important for the quality of everyday life is determined [42].
- Blocks of predominantly residential use (excluding the strict center in which business activities predominate in relation to housing) (Figure 6).
- Blocks with accessible enclosed courtyards (road and/or pedestrian access) (Figure 6).



**Figure 5.** Graphical interpretation of the stages of temporal and spatial development of Lower Town blocks with the markings of the three blocks selected for a detailed structural–functional analysis, created by the author.



**Figure 6.** Selection criteria for reference blocks—spatial block characteristics: passageway, usage, location in the city, created by the author.

### 3.2.2. Structural Changes in the Construction of the Interior of the Block

The conducted analysis of block structure based on the comparison of cartographic materials (1887–1923–1934/35–1968–(1998)–2021) has allowed for the identification of the most significant stages of physical changes of the blocks' enclosed space (Figure 7). It can be concluded that the original building concepts, especially in the older parts of the city (block A, B), imply predominantly unbuilt inner courtyards. The increase in the share of buildings, inside the blocks, was noticeable in the period from the 1930s to 1968, which can be related to the rapid development of the city's industrialization in that period. Block courtyards are mostly filled with auxiliary, crafts and production buildings since the view of the interior of the block was, almost regularly, reserved for less representative "second-class" rooms in the apartment [36].

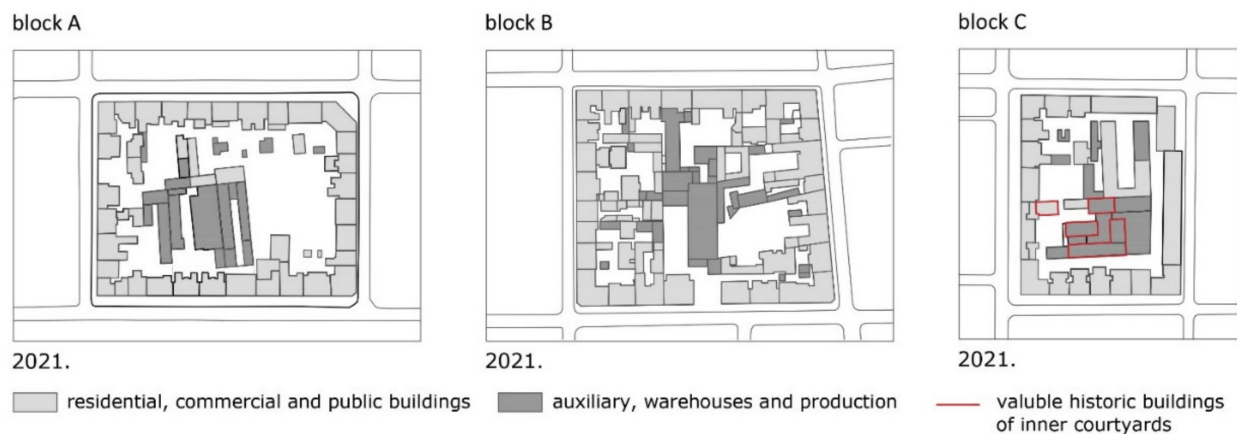
The period from the 1990s to 2021 is characterized by individual reuse (conversion of former ancillary buildings into residential, commercial or tourist accommodation), renovation of buildings or minor additions and extensions. Based on the analysis, it can be concluded that in recent times, there have been no significant new constructions in the interior; therefore, the existing ones are of substandard quality and do not belong to a modern city center.

According to the scale and usage, buildings inside the blocks can be divided into three basic types (Figure 8):

- (a) Small-scale buildings in the function of the accompanying facilities of perimeter housing units (garages, common storage rooms for tenants, smaller craft workshops, etc.). Partly reused and adapted according to individual initiatives of owners without significant architectural and urban value or contribution to the improvement of conditions and quality of the block as a whole.
- (b) Buildings of larger scale, originally in the function of production, various trades, workshops and warehouses, mostly out of function and in poor construction condition. Only a small number of former service buildings possess the significance of urban planning or architectural heritage (such as part of block C—ice factory).
- (c) Buildings of larger scale (former production plants and warehouses) that have been reused and are currently in function.



**Figure 7.** Graphical interpretation of blocks A, B, C's structural changes from 1887 to 2021, based on different cartographic depictions, created by the author.



**Figure 8.** Share of auxiliary and service and commercial buildings in the built block structure according to the data in the digital cadastral plan [43], created by the author.

### 3.2.3. Street Ground Floors Usage Changes

A detailed survey on the number and typology of the Lower Town functions was conducted in the 1970s. At that time, a significant share of evenly distributed shops and services of a local character established mainly across ground level facades was determined. A significant presence of craft and small-scale production facilities (small areas), located mainly in the interior of the blocks accessible from the street, was identified [36]. Recent participatory art projects as well as initiatives by citizens and the professional public have been warning increasingly about significant changes in the character and representation of spaces and activities for everyday life, as well as a large share of neglected and unused commercial spaces on the ground floors.

A comparative analysis of the data from 1974 and 2021 (field survey) for the three selected blocks indicates a trend in change, which is reflected in the number, type and position of non-residential premises on the ground floors of street buildings (Figure 9, Table 2). The obtained findings show that the total number of facilities on the ground floors street level in the observed period decreased by an average of 38%. The largest decline in the number of premises of different use was recorded in the western part of the city, for which a lack of social, cultural and sports facilities were previously identified [42]. A distribution of commercial spaces that was even and continuous across most block facades was replaced by their sporadic position and reduced density. Some facades, or even streets, have almost completely lost their public character (block C). There are significant reductions in certain types of commercial spaces, especially shops of daily consumption (blocks A, B) as well as various types of services (blocks A, C).

A reduced number of crafts and small-scale production sites is an indicator of a significant functional transformation of the city center, caused largely by the growing impact of tourism. The gradual extinction of crafts and services that were once a recognizable sign of the city's identity (watchmakers, production and repair of shoes, fountain pens, tailors, carpenters), no longer competitive in globalization, is especially significant. In addition, the reduction in the number of everyday consumer stores has a direct impact on the quality of life in the historic part of the city. A once planned positioning and concentration of commercial spaces in buildings, at the corners of blocks, as well as along passages to inner courtyards, played a significant role in establishing the character and attractiveness of the street and its connection with the inner block space. Their closure, neglect or inappropriate reuse greatly affects the stated desirable interrelations and indirectly results in the loss of urban identity.



**Figure 9.** Comparative analysis of the number of commercial spaces on the street ground floors of blocks A, B and C in the period of 1974 to 2021.

**Table 2.** Comparison of commercial space types at the street ground floors of blocks A, B and C in Table 1974. to 2021.

Type of Premises	Block A		Block B		Block C	
Everyday stores	1974		1974		1974	
	2021		2021		2021	
Specialized stores	1974	-	1974	-	1974	-
	2021		2021		2021	
Crafts and production	1974		1974		1974	
	2021	-	2021	-	2021	-
Services	1974		1974		1974	
	2021		2021	-	2021	
Business space	1974		1974		1974	-
	2021	-	2021	-	2021	-
Culture and art	1974		1974		1974	-
	2021	-	2021	-	2021	-
Health care	1974	-	1974		1974	
	2021		2021		2021	-
Catering	1974		1974		1974	
	2021	-	2021		2021	
		Total No. 1974. = 13 Total No. 2021. = 5			Total No. 1974. = 30 Total No. 2021. = 16	Total No. 1974. = 16 Total No. 2021. = 10

### 3.3. Guidelines for Urban Block Renewal—Models of Structural-Functional Transformation

For the three detailed blocks analyzed, guidelines for structural–functional transformation in the form of conceptual models (rather than design solutions) were proposed. They are focused on the possibilities of improving inner courtyards and streets (street facilities) and are based on knowledge from previously conducted analyses (historical development, modern processes, changes and the current state of space). The criteria that require a different approach to the transformation of each block are as follows (Table 3):

- Accommodation in relation to the city center (predominantly business and tourist purposes).
- Accommodation in relation to the distribution of accompanying facilities in the city.
- Block size.
- Proportion of buildings out of order or in poor construction condition inside the block.
- Dominant purpose and way of using buildings in the interior.
- The share and character of green areas in the interior of the block.
- Share of protected buildings (cultural—historical value) inside the block.
- Traffic context—the character of the streets and the share of parking in the block and streets.

- Pedestrian character of the street and the share of retail units on the ground floor.

The goal is to respond to the needs of each part of the city and achieve the recognizability of each individual block.

### 3.3.1. Model of Transformation of a Block into a Public Park (Example Block A)

Block A is located in the western, oldest part of the city, away from the business and shopping center. The neighborhood is predominantly residential, with a relatively small share of public green areas, sports and recreation areas, children's playgrounds, etc. The largest share of buildings in the interior is out of order or in inappropriate use (garage of a number of private companies with a negative impact on housing). The existing open areas are neglected, untidy and burdened with the parking of tenants' vehicles.

It is proposed to remove buildings of unsuitable condition and manner of use from the interior of the block as much as possible, with possible retention of certain buildings in public function or their relocation to more appropriate facilities and locations. The inner courtyard becomes a predominantly green area differentiated into a border zone of private gardens and a central zone of a public park with sports and recreational facilities, children's playgrounds, etc. Affirmation of public entrances and an emphasis on the availability of indoor parks should be achieved through new facilities on the ground floors of peripheral buildings—especially in positions that flank/mark the entrance to the block purposed suitable for improving the quality of housing in the block and neighborhood, such as shops, services, and communal facilities for tenants (Figure 10).

### 3.3.2. Transformation Model of a Block into a Shopping and Service Center (Example of Block B)

Block B is located in the central part of the city in the contact zone of the narrowest business and shopping center and also the area with the largest share of tourist rentals. It belongs to the category of the largest blocks, high density of construction of the inner courtyard and a significant share of larger buildings of the former production function, partly already converted into a supply center. The existing open areas are neglected, untidy, unconnected and burdened with tenants' vehicle parking and shop users.

It is proposed to remove part of the auxiliary buildings that are out of function and to form a strong move of public open areas—passages/square/park through a block that affirms trade, service and catering facilities in the function of tenants and tourists. New pedestrian entrances to the block are introduced and emphasized by street bars in the function of preserving the city's identity (traditional crafts in the function of tourist promotion). The new dynamic inner street has the potential to connect with the inner courtyards of adjacent blocks into the city's expanded pedestrian zone system. Arranged private yards/gardens ensure the distances and privacy of the residential parts of the block (Figure 11).

### 3.3.3. Transformation Model of a Block into a Socio-Cultural Center (Example of Block C)

Block C is located in the western, newest part of the city, removed from the business and shopping center. The neighborhood is predominantly residential with a relatively small share of social and cultural facilities.

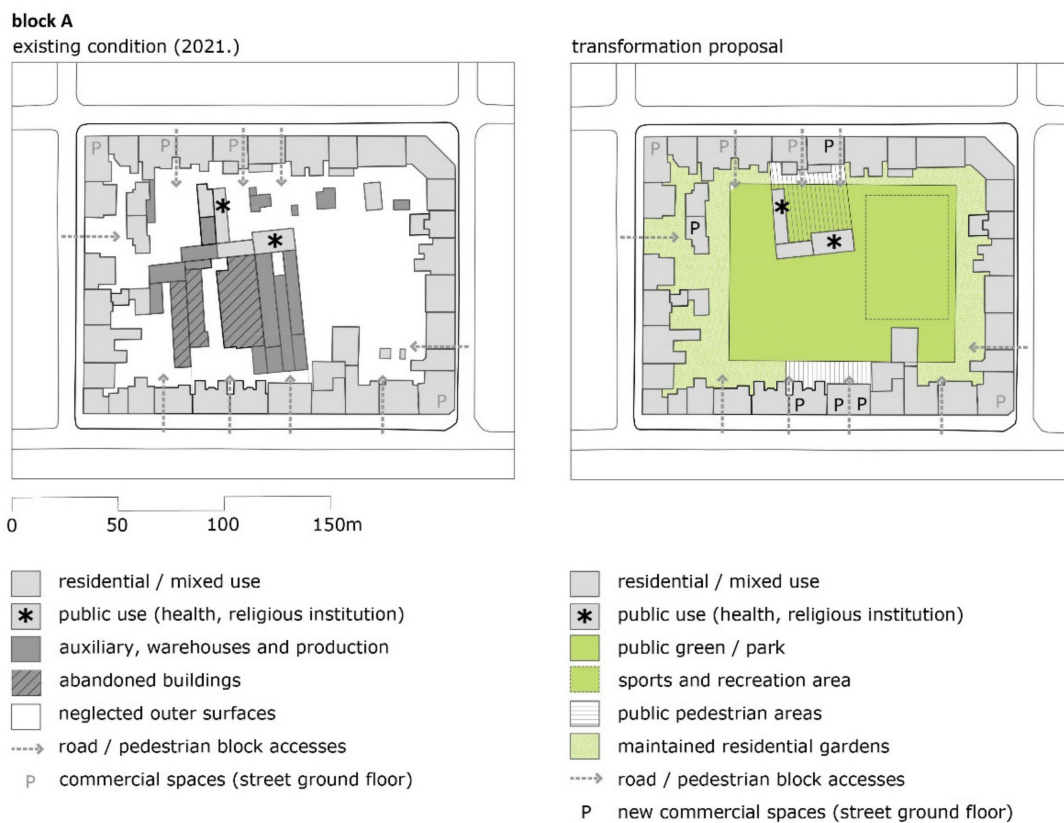
It belongs to the category of medium-sized blocks with a significant share of built parts of the interior, some of which are protected as urban-architectural heritage (city ice factory), out of function and in neglected condition.

It is proposed to remove part of the existing buildings without special value and to renovate and convert all protected and some larger buildings as the social center of the residential area. New facilities of flexible character (culture, art, arts and crafts fair, specialized market, etc.) use repurposed buildings and newly formed open public space, which extends to the area of streets transformed into a pedestrian zone with an increased share of greenery. Activation of the street and the entrance to the block is achieved by

new facilities on the ground floor, which, by their nature, complement the new offer of the neighborhood and include the local community (Figure 12).

**Table 3.** Spatial characteristics of three analyzed blocks based on the field research.

	Blok A	Blok B	Blok C
<b>Location</b>			
City area	Western part	Central part	Eastern part
Formation period	1889.–1923.	Before 1889.	After 1923.
Streets bordering the block	Deželićeva Primorska Klaićeva Krajiška	Hebrangova Preradovićeva Žerjavićeva Gundulićeva	Martićeva Vojnovićeva Berščenskoga Bauerova
<b>Building Characteristics</b>			
Block dimensions (outer perimeter: AXB)	175 × 130 m	188 × 150 m	110 × 138 m
Block area (m <sup>2</sup> )	22,760	28,097	15,214
Area of the built part (m <sup>2</sup> )	12,275	18,634	9799
Area of the unbuilt part (m <sup>2</sup> )	10,485	9463	4989
Built share	54%	66%	64%
Number of block buildings	55	96	30
Average number of floors	P + 2	P + 2	P + 5
<b>Use and Purpose</b>			
Total number of apartments in the block	261	284	380
Apartments in the perimeter building (No)	253	255	374
Number of tourist accommodation	3	15	4
Number of ground floor premise (2021.)	5	16	10
Number of ground floor apartments	54	44	41
Predominate use share			
Residential use	15.9%	23.5%	11.3%
Mixed use	46.2%	48.0%	50.6%
Office/Work	16.9%	14.8%	32.8%
Social use	11.8%	1.6%	1.3%
Auxiliary/Storage	7.4%	10.8%	4.0%
<b>Accessibility</b>			
Number of block car entrances	9	17	3
<b>Parking</b>			
Number of street parking spaces	86	51	116
Number of block parking spaces	71	105	27
<b>Open Spaces</b>			
Unbuilt area of the block (m <sup>2</sup> )	10,485	9463	4989
Area of green surfaces (m <sup>2</sup> )	7889	4521	3939
Area of residential gardens (m <sup>2</sup> )	3510	3866	941
Pedestrian areas, 'squares' (m <sup>2</sup> )	0	0	0
Park area (m <sup>2</sup> )	0	0	0
Sport and recreational area (m <sup>2</sup> )	560	0	0
Road surface, access and parking	3469	4217	1417
Children's playgrounds	0	0	0



**Figure 10.** Model of transformation of a block into a public park (example block A).



**Figure 11.** Transformation model of a block into a shopping and service center (example block B).



**Figure 12.** Transformation model of a block into a socio-cultural center (example of block C).

### 3.3.4. Prerequisites for the Realization of the Proposed Models

In order for the proposed models of block transformation to be realized, it is necessary to meet certain planning preconditions at the city level:

- Modify the concept of parking in the center by relocating public garages to the outskirts.
- Implement the concept of a superblock by excluding individual streets from the motor traffic system and grouping several blocks into a 'pedestrian' whole.
- Implement the concept of urban green infrastructure by connecting existing and newly planned green areas into a networked system.

It is also necessary to establish city policies aimed at incentive and subsidy systems for the use of public transport, stimulating certain trades and services, arranging and maintaining inner courtyards and gardens, city policies (subsidies and incentives), capacity control and distribution of tourist accommodation, etc.

It is necessary to develop planning mechanisms for the implementation of block renewal plans as a whole (as opposed to interventions on individual buildings).

## 4. Conclusions

The research deals with the transformations of the block structure of the historic center of the city of Zagreb. The focus is the historical development of the city and the contemporary processes and pressures that affect spatial changes in the face of expected urban renewal after years of neglect and recent devastating earthquakes. Unlike many studies focusing on the architectural heritage of the envelope (outer perimeter) of the block, the focus of this research is on changes in the interior of the block (in courtyards), as well as on the ground floors of street facades as two aspects that have been insufficiently explored for decades but are an integral part of the block and play a significant role in its direction. Literature on this topic is extremely scarce, and the last comprehensive research of the Lower Town was done more than 30 years ago. Therefore, the conducted research represents a significant contribution to improved knowledge about the changes and processes of the Lower Town, necessary for making informed decisions when planning urban renewal.

Other research contributions can be divided into three basic units as follows:

Spatial units of the city have been identified for which it is possible/desirable to design a particular urban renewal project.

Processes have been identified, whose consequences and the manner of planned control have to be incorporated into the concept of complete reconstruction of the city.

Three conceptual models of transformation of selected blocks are proposed as an illustration of the necessary individualized approach to the reconstruction of each individual block/neighborhood.

The research confirmed that it is not possible to establish a single principle of renovation for the Lower Town space. The established basic development stages of the city (before 1889, between 1889 and 1923, after 1923) influenced the creation of three significantly different areas recognizable by construction features and living standards (facilities, block size, construction features—earthquake resistance, etc.). Therefore, the process of integral reconstruction should begin in a specific way in individual city parts divided by historical urban development boundaries. A similar approach to improving social welfare was applied in Barcelona during the 1980s by differentiating zones of different characteristics for which particular urban renewal projects were designed, such as Ciutat Vella [44].

Although the focus of the reconstruction of the city immediately after the earthquake is focused on repairing structural damage to individual buildings, the analysis of the processes that characterize the city in the second half of the 20th century pointed to negative trends in space (depopulation, ‘congestion’ of blocks, loss of historical identity and globalization, reduction in the number and type of content on street ground floors, and uncontrolled tourism), which significantly affect the reduction of quality of life and therefore, have to become a part of the measures taken for the purpose of complete, planned and long-term reconstruction of the city. Like the concept of reconstruction and revitalization in Milan, it has to be an integrated approach between construction, energy efficiency, and environmental sustainability for the deep renovation of the historical area [45]. The relationship of people, space and architecture as well as the relationship of political power and space all together ultimately influence the choice of the model of urban renewal [46].

Given that the Lower Town area is today considered an area of extremely well preserved and particularly valuable historical urban structure and is the tightest protection zone of the cultural and historical ensemble of the City of Zagreb, radical changes, such as dissolving and/or increasing the dimensions of the outer block perimeters, as was done in Rotterdam in the 1970s, are not applicable. In the Zagreb case, it is more realistic to expect urban renewal by implementing small-scale projects that are able to regenerate the quality of life in neighborhoods and are based on the concept of transformation of public urban spaces. One such successful example is the 1991 Barcelona remodeling model, by which 43 markets that make up the network throughout the city were renovated and built. The positive effects of this model are visible in the social structure of the neighborhood, the suppression of oligopolistic trends and the economic promotion of the city [47].

Preserving and improving local urban identity is one of the most important premises of urban renewal. By avoiding uniform solutions and with targeted city policies, the features of local identity and social behaviors that grant Zagreb its local city identity and reflect inherited values can be encouraged. Like in other successful community-based renewal projects (Gracia and 22 @ in Barcelona), these features are mostly related to open public space and are as follows: festivals, public food markets, playground spaces, limited vehicular traffic, space calibrated to pedestrian scale, numerous public plazas, etc. [48]. The proposed models of the transformation of the interior of the blocks (A, B, C) illustrate the principle of an individual approach to reconstruction with the aim of achieving recognition and meeting the real local needs (of the block and the neighborhood). They are based on the change of the conceptual role of the block yard, which should take over the role of a site for the socialization of tenants, through upgraded public open and green spaces, teeming with activities in the function of improving everyday life in Lower Town. Of

particular importance in this context is the share of green areas of the block whose value was recognized in the early twentieth century in Berlaages' plan for Amsterdam, when the interior of the block saw an interpretation of housing conditions in a traditional house by providing private gardens on the ground floor and grouped collective gardens in the center [14]. The proposed conceptual sketches differentiate the newly established public and green areas according to the size, type and manner of use and consider them a part of a fully designed system at the city level (urban green infrastructure).

The role of the street in modern sustainable planning is changing substantially. Following up on the example of the Barcelona model of superblock, it is proposed to discourage car traffic in the city center and transform individual streets into pedestrian or shared space zones. Their additional activation is possible by reaffirming the neglected spaces and opening new stores in the street ground floors of blocks, while taking into account the offer of content. With targeted city policies, it is possible to preserve some of Zagreb's traditional crafts with incentive systems, but also to meet the modern needs of residents and tourists. Outdoor terraces, as an extension of the use of the premises on the ground floors of buildings, have a very high potential to activate the streetscape. Their impact on morphological and social attributes of public space is reflected in the occupation of a large number of pedestrian areas, contributing to convivial feeling of security and safety in the neighborhood. Numerous cities, such as Barcelona, have recently seen an increase in the number of terraces in public space under the influence of multiple factors, such as tourism growth, the implementation of anti-tobacco law, prioritization of pedestrian realm in public space and, more recently, COVID-19 restrictions [49].

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