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ZNA NSTVENI ČASOPIS ZA ARHITEKTURU I URBANIZAM

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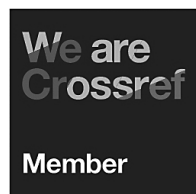
PROSTOR *m* space, room; (*površina*) area; (*zona*) tract; (*prostranstvo*) extent, expanse; (*za kretanje/manevriranje*) elbow-room, playroom, leeway, scope; (*prostorije, smještaj*) premises, accommodation | **životni** ~ living space; **stambeni** ~ housing; **školski** ~ school space; **poslovni** ~ office space/premises; ~ **za noge** legroom; *prema raspoloživom* ~ **u** on a space available basis; *fig pružati* ~ **za** offer/give scope for; **posvetiti (pokloniti)** ~ (*u novinama*) devote (give) space to; **zbog pomanjkanja** ~ **a** because of limited space; **radi uštede na** ~ **u** to save space; **povreda zračnog** ~ **a** violation of airspace, aerosp; **istraživanje** ~ **a** space exploration

ŽELJKO BUJAS (1999.), *Veliki hrvatsko-engleski rječnik*
| Croatian-English dictionary, Nakladni zavod Globus, Zagreb

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ASSESSMENT OF A HISTORIC MASONRY BUILDING: A CASE STUDY OF THE 1ST GYMNASIUM

KEYWORDS**AUSTRO-HUNGARIAN BUILDINGS****DRONE INSPECTION****INFRARED THERMOGRAPHY****SEISMIC ASSESSMENT****UNREINFORCED MASONRY STRUCTURES****ABSTRACT**

In this research, a rapid seismic assessment of the I Gymnasium in Sarajevo (Bosnia and Herzegovina) was conducted. Structural information was obtained from original designs, visual inspection, and supported by the usage of a drone and infrared thermography. The vulnerability of the structure was assessed by implementing the Vulnerability Index Method (VIM), producing a vulnerability curve that quantifies mean damage grades for various seismic intensities according to the EMS-98 scale, enabling the quantification of risk for various seismic scenarios. The structure would experience no to minor damage if exposed to weaker earthquakes (IV–V), while intensities VII–VIII, relevant for Sarajevo, lead to moderate damage with mean grades of 1.86 and 2.93 and increasing probabilities of very

severe damage and collapse ($\approx 24\%$ and 2% at VIII). For earthquakes of higher intensities (X–XII), there is a significant increase in heavy and severe damage, leading to the complete collapse in the case of XII intensity level (mean grade 4.89). While this assessment focuses on a single building, its reinforced concrete frame with masonry infill represents a common typology in Sarajevo, making the results broadly relevant for similar educational structures. The paper further discussed the effects that have a direct impact on the degradation of masonry material, leading to a reduction of its resilience. An aspect of inadequate strengthening is emphasized, together with the importance of regular maintenance for prolonging the life of these types of structures.

INTRODUCTION

The period of Austro-Hungarian rule in Bosnia and Herzegovina (1878-1918) marked a significant transformation in the region's architectural and construction practices, with the introduction of contemporary principles of urban planning, infrastructure development, and European architectural styles. During this period, structures were made of masonry, either stone or brick load-bearing walls, of various thicknesses, while the floors were made of timber, representing flexible floors. At that time, no seismic rules existed, so most of these structures were constructed without any seismic regulations.

This region became a part of the Austro-Hungarian Empire, so construction practices changed significantly in relation to the Ottoman Empire; however, certain local features were kept. This approach led to the construction of numerous public buildings, residential houses, and administrative buildings that reflected a combination of European historical styles and traditional Ottoman influences. Masonry constructions with wooden ceilings became a recognizable sign of this period due to their adaptability and the availability of materials.

Bosnia and Herzegovina is located within a seismically active region influenced by the complex interaction between the Adriatic microplate and the Eurasian plate. Moderate to strong earthquakes have been recorded

throughout history, highlighting the built environment's seismic vulnerability. In particular, the 1969 Banja Luka earthquake caused significant damage to masonry buildings, exposing their inadequate seismic resistance and leading to the first systematic implementation of seismic design regulations in the former Yugoslavia. Similarly, the 1979 Montenegro earthquake had widespread regional impacts, further emphasizing the need for improved seismic assessment methodologies.

A large portion of the existing building stock, including structures constructed during the Austro-Hungarian period, was designed without consideration of seismic actions. These buildings are typically characterized by unreinforced masonry walls, flexible diaphragms, and insufficient connections between structural elements, making them particularly vulnerable to seismic loading. Therefore, their assessment represents a critical task within the broader framework of seismic risk mitigation in Southeast Europe.

In this paper, the seismic vulnerability of a single school building from the Austro-Hungarian period has been assessed. The analysis focuses exclusively on this building, examining its historical construction characteristics, structural typology, and potential damage level due to various macro seismic intensities of earthquake.

STRUCTURAL ELEMENTS OF MASONRY STRUCTURES

Elements made of stone and fired bricks were most frequently used for the construction of the load-bearing walls in masonry structures, and lime mortar as a binder. This type of construction has several benefits, including fast construction, good thermal insulation, important for the climate conditions of this region. Due to higher compressive strength, stone was often used for the construction of load-bearing walls at the lower floors, and the upper floors were usually made of fired brick. The dimensions of the bricks during the Austro-Hungarian era were approximately 30cmx15cmx7cm (Ademović, 2024), which was larger than the standard bricks (25 cm x 12 cm x 6.5 cm) used today.

The thickness of the walls often varied, with public buildings having more massive walls for increased durability and protection. The outer walls of public and administrative buildings could have reached a thickness of 50 cm and up to 1 meter, especially on the lower floors, due to the need for structural stability and thermal insulation. On higher floors, the thickness of the walls was smaller, around 30-40 cm. The inner walls of residential buildings and less massive buildings

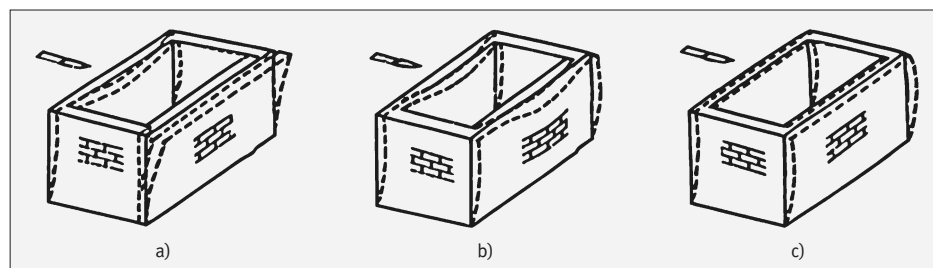
were around 25-30 cm thick, while partition walls had dimensions of 7 to 15 cm. The walls surrounding the staircase and the elevator in the basement are 60 and 45 cm thick, whereas all other floors have their thickness reduced by 15 cm. The wall thickness was prescribed in the Viennese building code (Kolbitsch, 1989: 15).

SEISMIC BEHAVIOUR OF STRUCTURES WITH RESPECT TO FLOOR TYPES

Timber was extensively used for floor constructions due to its availability and ease of construction. Floors were typically supported by wooden beams embedded in the stone walls, and wooden planks formed the walking surface (Fig. 2a). In some cases, the beams were reinforced with iron elements to increase their resistance and longevity. Although there were no universal standards as they exist today, certain characteristics were typical of wooden ceilings of that time. The typical dimensions of these beams were 12 to 20 cm x 20 to 30 cm (Peulić, 2022: 512), depending on the length and load-bearing capacity required for the construction. Beams were typically placed at a distance of 60-100 cm, depending on the load and the room's size. The ceiling height was on average between 2.5 and 4 m, but in administrative or larger public buildings, the ceiling height could reach larger dimensions, even up to 5 m in some cases. For older buildings with larger spans Peulić, 2022: 512), such as schools and halls, it was recommended to retain double-beamed ceilings. Although larger beams had a larger volume, they did not completely eliminate vibrations.

A common practice in seismic analysis of buildings is to assume that diaphragms, or floors, are rigid. This assumption is considered acceptable for reinforced concrete floors, which, due to their massive characteristics and strength, can effectively transfer seismic forces to vertical elements. This type of action is known as "box action". However, this assumption does not apply to wooden floors, which, due to their relatively lower mass and elastic properties, behave differently from reinforced concrete floors. For buildings with wooden floors, it is necessary to carry out specific analyses that take these characteristics into account.

A floor structure is considered flexible when the maximum lateral deformation of the diaphragm is twice the average displacement of the floor. This can be confirmed by comparing the calculated displacement of the midpoint in the floor plane under lateral load with the displacement in adjacent vertical elements under the same lateral load (Elshe-



beny, 1999: 11). Unlike rigid floors, flexible floors cannot redistribute forces resulting from torsional deformations of the structure. This inability to transfer the forces can lead to serious problems and structural failure, because the forces are not distributed evenly throughout the structural elements. On the other hand, rigid floors better distribute torsional effects to vertical elements, with the distribution being proportional to the stiffness of these elements.

Thus, in older masonry buildings with flexible floors without horizontal bracing, and in which the wooden beams are not firmly connected to the walls, the walls separate from each other during an earthquake. Due to the lack of adequate bonding, vertical cracks form at the joints of the walls, especially on the end walls, i.e., those perpendicular to the direction of the earthquake. These cracks are caused by the walls bending out of plane, which is a type I failure mechanism.

Additionally, cracks appear at the ends of walls parallel to the direction of earthquake action due to their limited tensile strength, which is not sufficient to transfer inertial forces. In such conditions, uncoordinated movement of individual walls occurs, which increases the overall vulnerability of the structure. The outer walls are particularly susceptible to overturning and breaking, which further jeopardizes the stability of the building.

Figure 1 shows the influence of the connection between the floors and walls and the stiffness of the floors on the seismic action of the structure. The variants shown illustrate different seismic response scenarios depending on the degree of interconnection of structural elements.

Fig. 1a illustrates a structure with a flexible floor without a rigid connection between orthogonal walls. In such a case, each wall acts as a separate element, without the possibility of working together with other load-bearing walls. This configuration significantly weakens the resistance to horizontal forces. As the walls are not mutually supported, this increases the risk of a local or global collapse during seismic loading. Fig. 1b shows a construction in which the walls are connected by

FIG. 1 INFLUENCE OF CONNECTION AND STIFFNESS OF FLOOR ON THE "BOX" MODEL:

A) FLEXIBLE FLOOR WITHOUT HORIZONTAL BOND BEAMS; B) FLEXIBLE FLOOR WITH HORIZONTAL BOND BEAMS; C) RIGID FLOOR WITH HORIZONTAL BOND BEAMS (GALLONELLI, 2007: 57)



FIG. 2 INADEQUATE STRENGTHENING METHODS (BINDA AND MODENA, 2011)

horizontal bond beams at the junction with the floor, while the floor remains flexible. This solution somewhat improves seismic resistance because horizontal bond beams connect the walls and enable their partial associated deformation. It is what reduces the possibility of complete separation of the walls during an earthquake. In this type of construction, the significant out-of-plane bending of the walls is still present, which may lead to local collapse mechanisms. The construction of the rigid floors and horizontal bond beam is illustrated in Fig. 1c. This changes the action of the structure once exposed to an earthquake. Now the structure overall demonstrates “box action,” which is more favourable. In this case, horizontal forces are efficiently transferred onto the walls with respect to their stiffness.

The recognized dominant problem in all combinations of flexible floors is the possibility of out-of-plane failure due to the fact that in these structures, walls are not mutually connected, and they are also not connected to the floors, leading to significant relative movements between individual elements.

The case study building (1st Gymnasium) is characterized by a masonry structural system with timber floor diaphragms. The load-bearing system consists of longitudinal and transverse masonry walls with variable thickness, forming a predominantly regular plan layout. Openings constitute approximately 17.55% of the façade surface, locally reducing wall stiffness and load-bearing capacity.

The floor system is composed of timber beams with plank decking, acting as flexible diaphragms with limited in-plane stiffness. No effective horizontal bracing or diaphragm stiffening elements were identified, and connections between floors and walls are assessed as insufficient to ensure composite action. Consequently, diaphragm continuity is limited, and load transfer between orthogonal walls is not fully achieved.

Inadequate strengthening of unreinforced masonry structures (URM) may lead to cata-

strophic scenarios. An example of this was seen, after the earthquake in the Friuli region, where improper interventions on historical buildings caused the so-called *hammering effect*. In particular, the installation of reinforced concrete slabs significantly altered the dynamic response of the structure. The increased stiffness of the floor led to the concentration of seismic forces in the walls, which resulted in out-of-plane failure (see Fig. 2).

There is empirical evidence from recent regional seismic events, specifically the 2020 Zagreb and Petrinja earthquakes, which prominently affected the URM buildings. The 2020 Zagreb earthquake struck the city's urban area, resulting in extensive damage to historic URM buildings, including school facilities and cultural heritage buildings, despite moderate seismic intensity levels. Many buildings experienced cracking, partial façade collapses, and other forms of structural degradation, highlighting the seismic vulnerability of traditional masonry construction without adequate diaphragms, ties, or retrofitting measures (Arbutina et al., 2025; Stepinac et al., 2023; Lulić et al., 2021).

Later that same year, on 29 December 2020, a Mw 6.4 earthquake occurred near Petrinja, causing widespread damage in Sisak-Moslavina County and surrounding areas, with URM buildings being among the most severely affected structural types. Post-earthquake reconnaissance and damage assessments reported significant structural failures in schools and other public buildings, underlining the limitations of conventional strengthening techniques such as rigid insertions or poorly detailed infill repairs.

EDUCATIONAL INSTITUTIONS

In Bosnia and Herzegovina, several schools are situated in buildings constructed during the Austro-Hungarian period, which still serve their original purpose today. Some of the examples are:

First Gymnasium (High School) in Sarajevo: Founded in 1879, this is the oldest secular high school in Bosnia and Herzegovina. It was originally located in other locations; however, in 1891, it was moved to a new building built in neo-Renaissance style (Fig. 3a).

Elementary School “Safvet-beg Bašagić”: The building of this school was constructed between 1890 and 1892, specifically for educational purposes (Fig. 3b).

Sarajevo High School of Applied Arts: This school, founded during the Austro-Hungarian administration, is in a building built in 1893 (Fig. 3c).



FIG. 3 A) I GYMNASIUM; B) SAFVET-BEG BAŠAGIĆ ELEMENTARY SCHOOL; C) HIGH SCHOOL OF APPLIED ARTS; HIGH SCHOOL OF AGRICULTURE, FOOD, VETERINARY MEDICINE AND SERVICES

The building of the public institution “*High School of Agriculture, Food, Veterinary Medicine and Services*” (Fig.3d) is located across the street.

All these structures date from the Austro-Hungarian period and display the characteristic architectural features of that era, marked by rapid urbanization and the construction of many public and educational buildings in modern architectural styles.

For this study, the focus is limited to a single building, the First Gymnasium in Sarajevo (Fig. 3a), selected due to its historical significance, representative construction characteristics, and the fact that only this building was a part of the project: “*Austro-Hungarian Educational Buildings and their Sustainability in Specific Conditions, with Special Reference to the First Gymnasium of Sarajevo*” The other institutions are mentioned here solely to provide contextual background on the typology and architectural trends of Austro-Hungarian school buildings in the region.

METHODOLOGICAL FRAMEWORK AND VULNERABILITY INDEX

In studies assessing the seismic vulnerability of school buildings, the vulnerability index is often used as a quantitative measure of their sensitivity to seismic impacts. Nonlinear parametric analysis, which allows the calculation of the Seismic Vulnerability Index (SVI), or the Vulnerability Index Method (VIM), which is based on the statistical relationship between macro seismic intensity (e.g., according to the EMS 98 scale) and actual observed damage to buildings (Benedetti and Petrini, 1984), GNDT (1993). In this model, parameters are defined (e.g., type of construction, irregularities in the floor plan, number of floors, age of the building, etc.) to which weight values are assigned. By combining these parameters, the final vulnerability index is calculated.

In Europe, the RISK-UE (Milutinovic and Trendafiloski, 2003) significantly contributed to the development of simplified methodolo-

gies for assessing seismic vulnerability. These approaches use vulnerability indices based on key building parameters, such as typology, materials, number of floors, and geometric irregularities, to classify buildings into predefined vulnerability classes. The methodologies are suitable for large-scale assessments when detailed engineering analyses are not feasible. For example, in Mostaganem (Algeria), the RISK UE methodology was applied to 516 school buildings, generating vulnerability curves and damage scenarios according to EMS 98 intensities (Bendehiba et al., 2023: 7).

In the specific case, seismic assessment of the I Gymnasium was carried out in accordance with the RISK-UE Methodology (Milutinovic and Trendafiloski, 2003), taking into account several parameters, such as structural typology, including the type of the floor, location of the building, number of floors, roof type, layout dimensions, soil morphology, complex structure, maintenance, irregularity in height and plan, and a vulnerability curve was obtained (Fig. 4).

The vulnerability index, V_i , for a building is obtained according to the well-known equation (1), where V_i^0 , the vulnerability index, depends on the building's typology and the seismic action modifier ΔV_M , into account, which takes into account the above mentioned parameters.

$$V_i = V_i^0 + \Delta V_M \quad (1)$$

The mean damage grade μ_d , representing the average level of physical damage (in this case, only for this structure) when exposed to a specific earthquake intensity, is obtained using equation (2), primary employed in the macro seismic method

$$\mu_d = 2.5 \left[1 + \tanh \left(\frac{I + 6.25V_i - 13.1}{Q} \right) \right] \quad (2)$$

Where I represent the intensity according to the EMS-98 scale, and Q represent the ductility factor taken as 2.3 for this masonry structure.

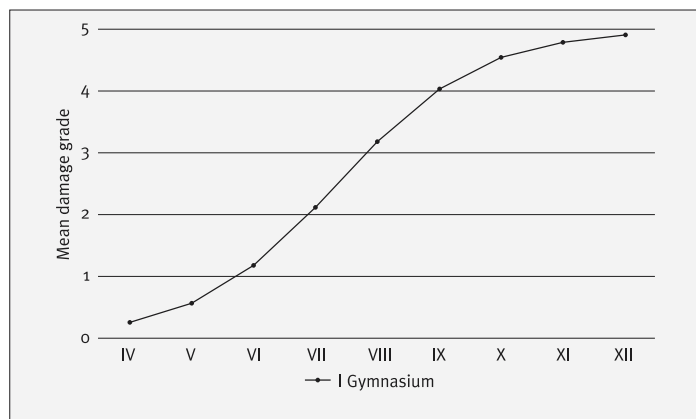


FIG. 4 VULNERABILITY CURVE FOR THE BUILDING OF THE I GYMNASIUM

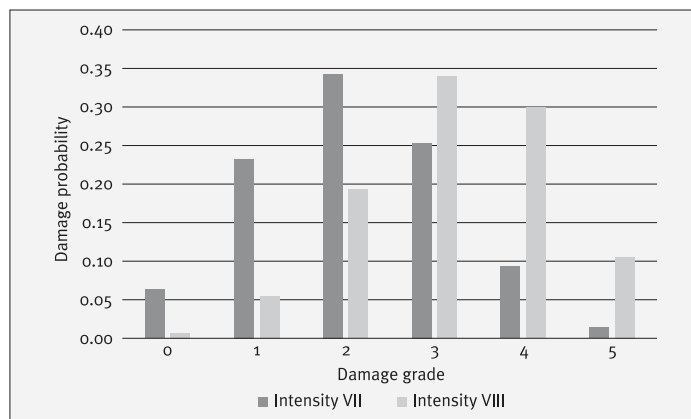


FIG. 5 DAMAGE PROBABILITY MATRIX

The vulnerability curve illustrates the relationship between the expected mean damage grade of the building and the earthquake's intensity as per the EMS 98 scale. Structure action is assessed for different earthquake intensities, from the weakest (IV) to the most catastrophic earthquake (XII). According to the assessment, the building where the I Gymnasium is located would experience small damage if exposed only to earthquakes of lower intensity (IV), keeping the mean damage grade lower than 0.5, indicating superficial or negligible damage to the structure and facades. The slope of the vulnerability curve gradually increases as the earthquake intensity rises. The most interesting intensities for Sarajevo are VII and VIII, whereby the mean damage grade reaches values of 2.12 and 3.19, indicating moderate damage, which would be manifested with cracks in the non-load-bearing walls and potential damage to load-bearing elements. At intensity VII, the building shows moderate resilience, with the highest probabilities in moderate damage ($\approx 34.3\%$) and substantial to heavy damage ($\approx 25.3\%$). As the intensity rises to VIII, the probability of substantial to heavy damage increases sharply to $\approx 34\%$,

and very serious damage would be experienced by 30% of all structures, reflecting a significant escalation of vulnerability with stronger ground shaking. This is following the observed damages in the Croatian schools of this typology (Salaman et al., 2023: 10, 15; Lulić et al. 2021: 2; Atalić et al. 2023). These results highlight the building's sensitivity to higher-intensity earthquakes and emphasize the importance of targeted risk reduction measures, structural strengthening, and informed seismic risk management strategies (Fig. 5). The quantified probabilities provide a reliable basis for planning targeted risk reduction measures, structural strengthening, and informed seismic risk management. The main limitation of this analysis is that it does not account for the strengthened floor; a more detailed assessment incorporating this element will be conducted in subsequent analyses.

For earthquakes of higher intensities (X–XII), the curve shows a rapid, sharp increase, indicating a significant increase in heavy and severe damage, leading to the complete collapse in the case of XII intensity level, where the mean damage grade reaches the value of 4.91. This kind of information is very valuable as it identifies earthquake intensities when the building becomes particularly vulnerable. Useful information for engineers and planners when in the processes of decision-making with respect to strengthening, rehabilitation, and seismic safety of educational facilities.

FIG. 6 MOISTURE PENETRATION, CRACKING, AND PEELING OF THE MATERIAL (AUTHOR'S PHOTOS)



DEGRADATION OF MASONRY STRUCTURES

Factors that have a direct influence on the degradation of masonry structures are moisture and water penetration, chemical reactions, biological activity, and mechanical impacts. These elements can accelerate the degradation of the material and reduce the load-bearing capacity of these structures. For that reason, it is of the utmost importance to

understand this process and use this knowledge for adequate maintenance, and if needed, the strengthening of masonry structures.

MOISTURE PENETRATION

One of the most common causes of masonry deterioration is the penetration of moisture into walls (see Fig. 6), which can have various negative consequences. Water penetrating the walls carries soluble salts that crystallize on the surface, weakening the mortar and reducing the building's aesthetic value.

In colder areas, freeze-thaw cycles of water absorbed into the walls can cause cracking and peeling of the material (see Fig. 6), especially in porous walls such as limestone or sandstone. Incomplete or inadequate drainage can lead to moisture rising through the walls due to capillary action, causing the rotting of wooden structural members, mold growth, and deterioration of stone or brick walls, reducing the durability and safety of the building.

The aerial and thermographic documentation was carried out using a DJI Mavic 3T drone equipped with an integrated thermal imaging system. The thermal sensor is based on an uncooled VOx microbolometer with a resolution of 640×512 px, 30 Hz frame rate, $12 \mu\text{m}$ pixel pitch, and $\text{NETD} \leq 50 \text{ mK}$, which makes it suitable for the non-contact detection of surface temperature differentials potentially associated with moisture ingress, detachments, fissures, and other material discontinuities. The platform also ensured stable flight performance and reliable positioning, enabling inspection of elevated and otherwise difficult-to-access areas. The survey was per-

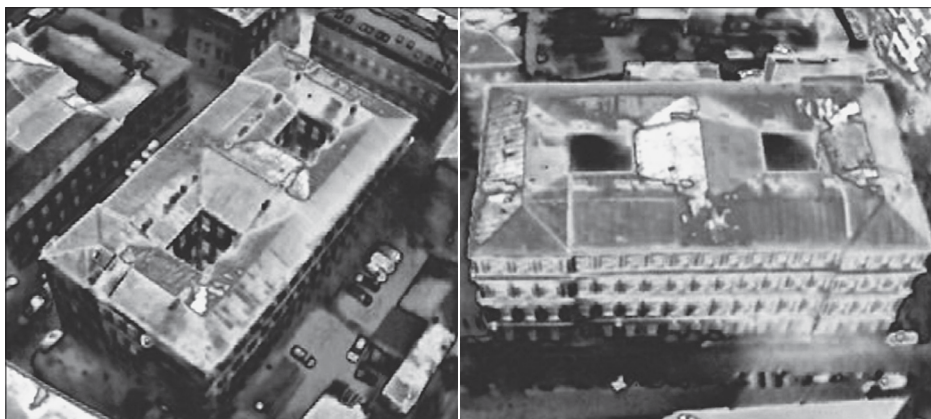
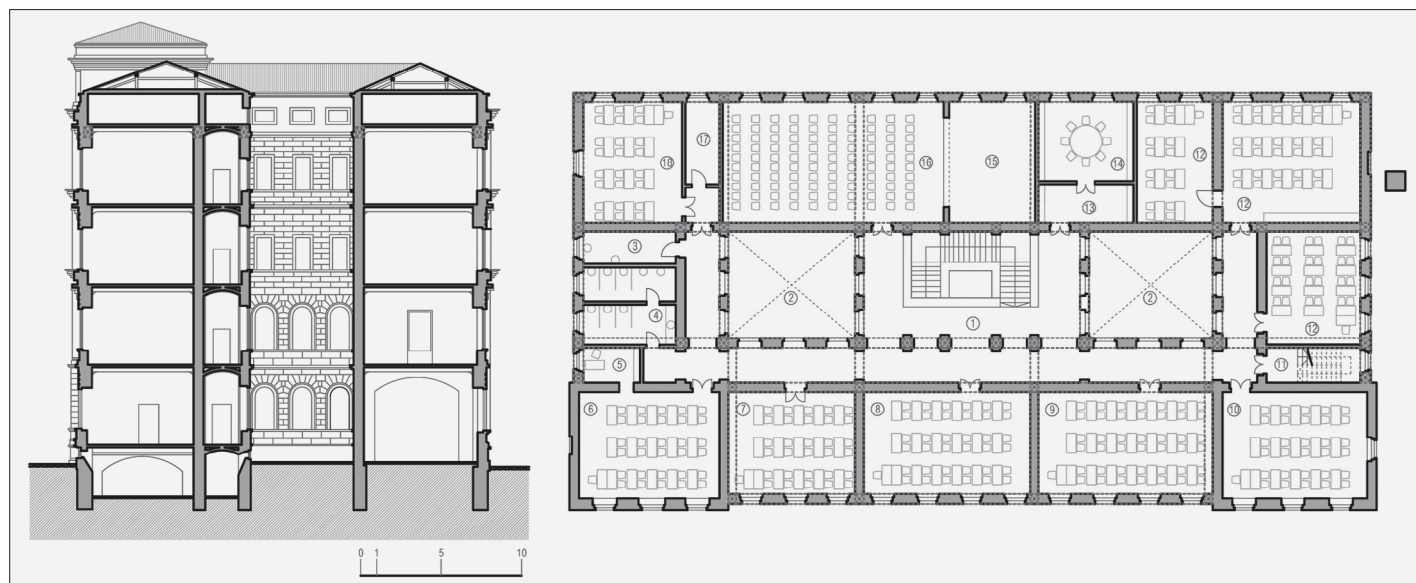


FIG. 7 INFRARED THERMOGRAPHY METHOD OF THE I GYMNASIUM (AUTHOR'S PHOTOS)

formed through three separate recording sessions during winter temperature inversion conditions, with the interior space additionally heated to enhance the thermal gradient between interior and exterior surfaces. Recordings were undertaken during three different parts of the day, each with a duration of approximately 10 minutes. This repeated acquisition strategy was adopted to improve the consistency of thermal observations and to reduce the possibility of interpreting isolated or transient anomalies as representative defects. During image acquisition, the thermal camera operated in automatic calibration mode, which was maintained as the standard survey setting.

The conditions of the building envelope were clearly revealed by infrared thermography. Zones with higher temperatures are marked in colours going from yellow, orange to green, while areas with lower temperatures are marked with cyan and dark blue. Locations

FIG. 8 STRENGTHENING OF THE THIRD FLOOR OF THE I GYMNASIUM WITH HORIZONTAL BOND BEAMS (AUTHOR'S CONTRIBUTION)



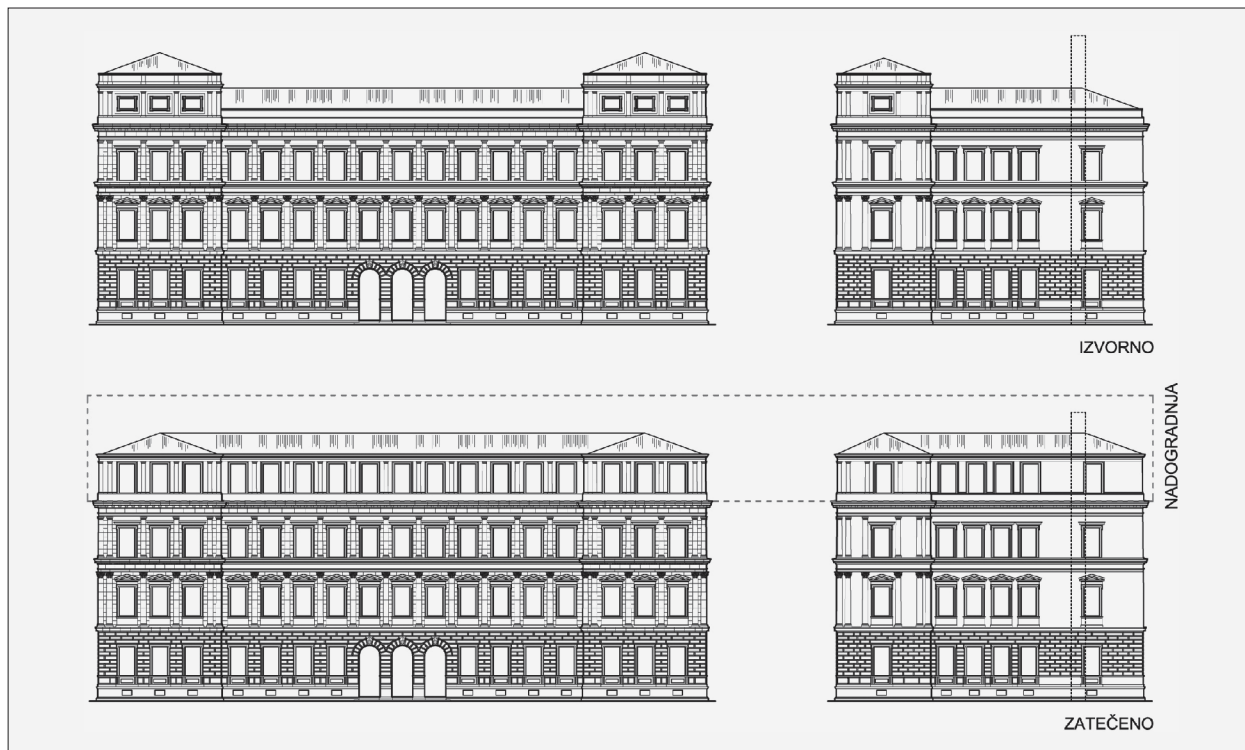


FIG. 9 | GYMNASIUM,
CONSTRUCTION
OF THE THIRD FLOOR
(AUTHOR'S CONTRIBUTION)

where magenta colour is present are of particular significance, as it indicates not only the lowest surface temperatures but also the presence of moisture in the material, considering that water, due to its thermal conductivity and evaporation, often causes characteristic thermal deviations.

The magenta colour is seen on the ground surface next to the school (see Fig. 7). This phenomenon directly indicates the capillary rise of moisture from the foundation soil towards the walls. Such moisture distribution is characteristic of masonry buildings without adequate horizontal waterproofing, where porous materials enable capillary transport of water to higher zones of the structure. Identification of these cold and damp areas utilizing the infrared thermography method is an important step in diagnosing the condition of the building, as it allows the identification of locations with an increased risk of material degradation, reduced thermal efficiency, and the development of biological damage.

It should be noted that no quantitative measurements, such as in-situ moisture content or laboratory testing of material properties, were performed as part of this study. Therefore, the interpretation remains qualitative and is based on visual assessment, historical documentation, and standard thermographic analysis. Despite this limitation, the observations provide important guidance for conservation planning, highlighting areas of con-

cern that may require targeted monitoring, further material testing, or preventive intervention to ensure the building's structural and architectural integrity.

The construction of additional storeys of existing structures, made as unreinforced masonry structures (URM) without vertical and horizontal tie-beams, represents a significant challenge from the aspect of statics and conservation requirements, illustrated by the example of the I Gymnasium. From the perspective of seismic safety, partial and localized strengthening can cause non-uniformity in stiffness and strength distributions between the strengthened and original floors. Such discontinuities in the structural system can lead to stress concentration at transitions, which increases the building's susceptibility to seismic damage. For the strengthening measure to be effective, it is of the utmost importance to apply consistent measures to the entire height of the structure, and not just localized as is done in this structure. In this case, the original load paths were not respected, which, as a result, has an impact on the overall action of the structure once exposed to ground shaking. The construction of the third floor included the introduction of the horizontal bond beams and tie columns (marked in red), as illustrated in Fig. 8 and Fig. 10 by red colour.

Cement mortar was most probably used in the construction of the new additional floor.

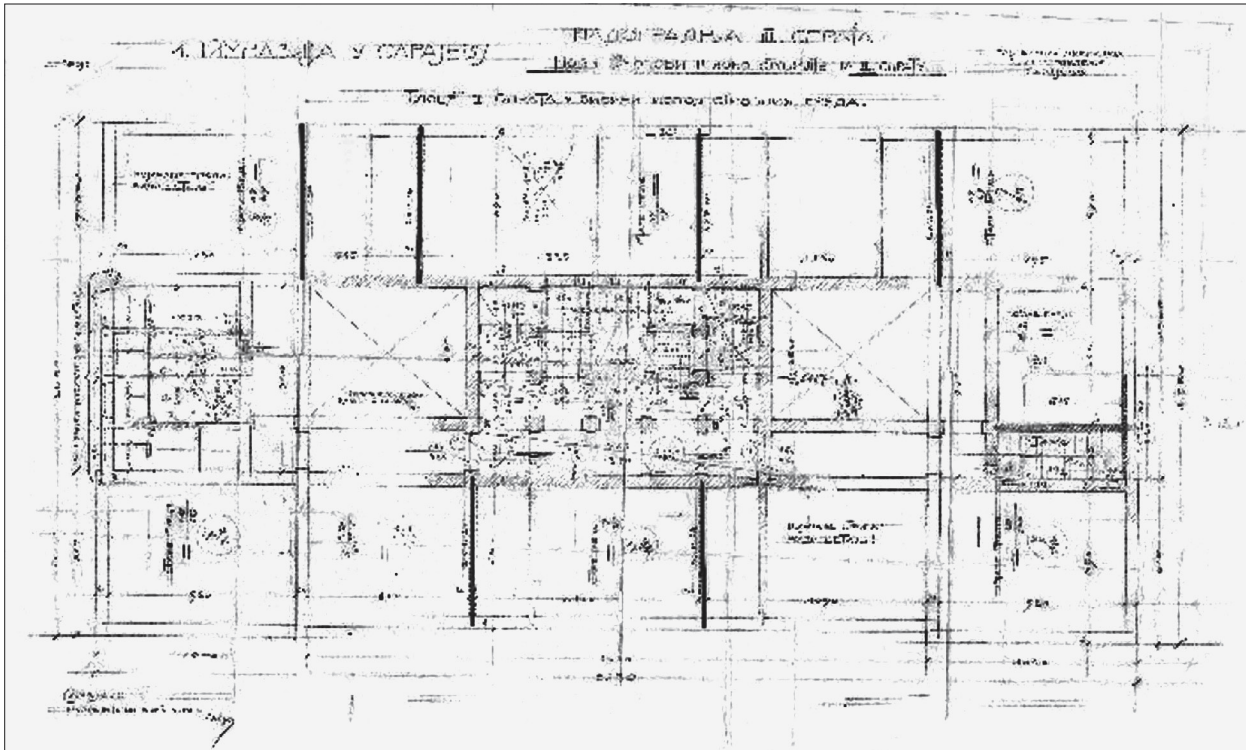


FIG. 10 | GYMNASIUM, STRUCTURAL REINFORCEMENT OF THE SECOND-FLOOR CEILING (SOURCE: ARCHIVAL MATERIALS OF THE FIRST GYMNASIUM)

As the rest of the structure is made of lime mortar, this is completely inconsistent with international guidelines for historic structures, (ICOMOS, 2003: 5), where the importance of material compatibility is emphasized. Cement mortars are significantly stiffer and less vapor permeable than traditional lime mortars, which leads to mechanical and chemical incompatibility with original materials. This kind of incompatibility can have negative impacts on the structure, which can be seen in the accumulation of stress, possible crack formations, and salt accumulation. This all could and most probably would accelerate the deterioration of the structure.

Fig. 9 illustrates the current state of the structure, indicating the creation of the additional third floor. This addition has increased the mass of the structure, and with the usage of the reinforced concrete bond beams and tie columns, this has significantly altered the dynamic action of the original URM structure. The addition of the mass and the change in the stiffness of the upper floor have had an impact on the natural frequency. If the connection of the old part of the structure and the new part is not conducted in a proper way, this could have an impact on the structure's seismic response. At the location of intervention, there is an obvious stiffness and mass discontinuity, which may lead to differential movements, cracks, and stress concentrations, as seen in similar cases in Italy (Fig. 2). The dynamic

properties of reinforced concrete elements (bond beams and tie columns) are not fully compatible with URM walls, together with uneven stiffness distribution, may cause the amplification of the vibration effects, especially in the transition zones, reducing overall seismic resistance.

In conclusion, the construction of the new floor added new mass to the structure, and localized reinforced concrete elements changed the localized stiffness of the structure, which altered the original dynamic action of the URM structure, increasing its vulnerability. One of the most important elements in the process of strengthening existing structures is to maintain and ensure uniform mass and stiffness distribution along the building height. This is crucial as, in this way, the dynamic behavior of the structure will not be changed, or this change will be kept to a minimum, leading to higher structural resistance.

PREVENTION AND MITIGATION OF DEGRADATION

Poor maintenance can be identified as one of the crucial causes of masonry structures' degradation (Fig. 11). If regular inspections and timely repairs are conducted, many of the causes (water infiltration, crack formation, and biological influences) can be significantly mitigated. Progressive deterioration is

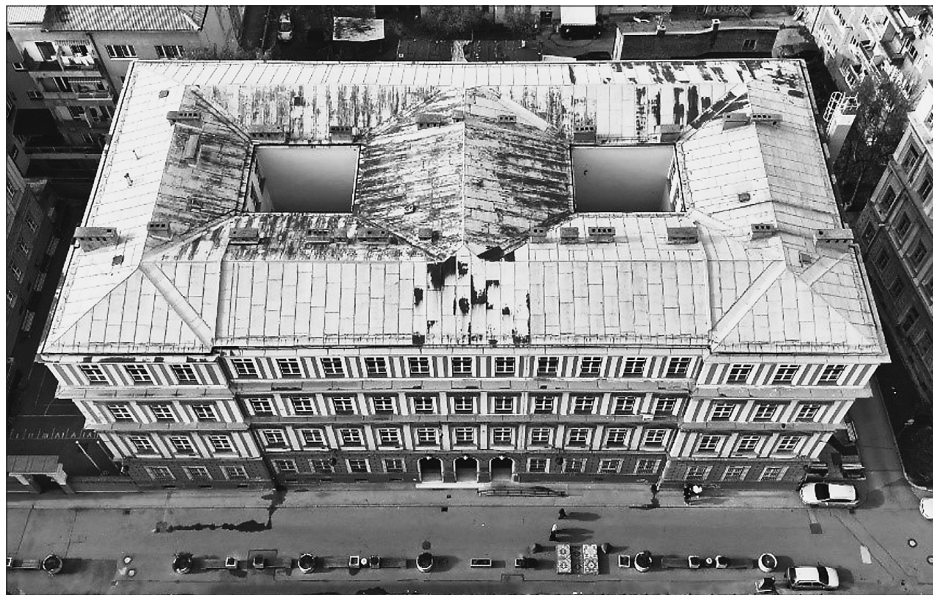


FIG. 11 | GYMNASIUM, INADEQUATE MAINTENANCE (AUTHOR'S CONTRIBUTION)

usually seen on masonry structures that are not timely and well-maintained, which may lead to severe damage that requires expensive and extensive interventions.

Therefore, regular maintenance is seen as the first step for preventing the various effects that can have a direct impact on the deterioration and degradation of the material, which would lead to the reduction of the structural resistance. Key measures include proper drainage and waterproofing, removal of surface salts, timely repair of cracks, and the use of aggregates, mortars, and protective coatings that limit moisture and pollutant penetration.

CONCLUSION

The assessment based on the RISK-UE methodology was conducted on a I Gymnasium, a

school masonry building located in Sarajevo (Bosnia and Herzegovina).

It was noted that the masonry structure exhibits low vulnerability under very weak seismic events (mean damage grade <0.5 at intensity IV), but a pronounced increase at intensities VII–VIII, characteristic of Sarajevo, where mean damage grades reach 2.12 and 3.19.

At intensity VII, the structure is most likely to experience moderate ($\approx 34.3\%$) and substantial damage ($\approx 25.3\%$), while at intensity VIII, the probability of substantial damage increases to $\approx 34\%$, and very serious damage affects approximately 30% of cases, confirming a non-linear escalation of vulnerability. These results are consistent with observed damage patterns in comparable school buildings of similar typology in Croatia, providing validation of the applied methodology. The analysis's primary drawback is that it ignores the stronger floor; a more thorough evaluation that takes this factor into consideration will be carried out in later assessments.

Infrared thermography and drone usage proved to be very helpful tools, as it was possible to determine the current condition of the building's envelope. With the help of infrared thermography, defects of the structure were identified, such as the location of cracks, moisture regions, and other signs of degradation. The findings further highlight that material degradation, and non-uniform strengthening interventions significantly reduce seismic resilience, emphasizing the need for systematic maintenance and comprehensive, compatible retrofitting strategies.

Regular inspection, together with proper and timely maintenance, can lead to the preservation of cultural heritage buildings and the extension of their service life.

BIBLIOGRAPHY

1. ADEMOVIĆ, N., HADZIMA NYARKO, M. and ZAGORA, N. (2024) 'Various numerical modeling procedures of XIX century masonry building'. *Engineering Structures* 301, 117361, pp.1-19, <https://doi.org/10.1016/j.engstruct.2023.117361>
2. ARBUTINA, D., STEPINAC, M., PAVKOVIĆ, K. and ČIZMAR, D. (2025) 'Architectural study and preliminary seismic assessment of a typical unreinforced brick masonry building in Zagreb, Croatia'. *Buildings* 15 (6), 956, pp.1-26, <https://doi.org/10.3390/buildings15060956>
3. ATALIĆ, J., DEMŠIĆ, M., BANIČEK, M., UROŠ, M., DASOVIĆ, I., PREVOLNIK, S., KADIĆ, A., ŠAVOR NOVAK, M. and NASTEV, M. (2023) 'The December 2020 magnitude (Mw) 6.4 Petrinja earthquake, Croatia: seismological aspects, emergency response and impacts'. *Bulletin of Earthquake Engineering* 21, pp. 5767-5808, pp.1-18, <https://doi.org/10.1007/s10518-023-01758-z>
4. BENDEHIBA, S., BOURDIM, S.M.E.-A., RODRIGUES, H. and ZELMAT, Y. (2023) 'Vulnerability of existing RC building with seismic damage scenarios: case of educational buildings in Mostaganem City'. *Buildings* 13, 1767, pp.1-18, <https://doi.org/10.3390/buildings13071767>
5. BENEDETTI, D. and PETRINI, V. (1984) 'On seismic vulnerability of masonry buildings: proposal of an evaluation procedure'. *L'Industria delle Costruzioni* 149, pp. 66-74.
6. BINDA, L. and MODENA, M. (2010-2011) *Lectures in Advanced Master's in Structural Analysis of Monuments and Historical Constructions*. University of Padua.
7. ELSHERBENY, H.A. (1999). 'Behavior of reinforced concrete flexible floor diaphragms under seismic loads'. MSc Thesis. Faculty of Engineering, Cairo University, Giza, Egypt.
8. GALLONELLI, M. (2007) 'Dynamic response of masonry buildings with rigid or flexible floors'. Master's Thesis, Rose School, University of Pavia, Pavia, Italy.
9. GNDT (1993) 'Seismic risk of public buildings. Vol 1, Methodological aspects'. Rome: GNDT.
10. ICOMOS (2003) 'Principles for the analysis, conservation and structural restoration of architectural heritage'. Ratified at 14th General Assembly, Victoria Falls, Zimbabwe.
11. KOLBITSCH, A. (1989) *Altbaukonstruktionen – Charakteristika, Rechenwerte, Sanierungsansätze*. Wien: Springer.
12. LULIĆ, L., OŽIĆ, K., KISIČEK, T., HAFNER, I. and STEPINAC, M. (2021) 'Post-earthquake damage assessment-Case study of the educational building after the Zagreb earthquake'. *Sustainability* 13, 6353, pp.1-25, <https://doi.org/10.3390/su13116353>
13. MILUTINOVIC, Z.V. and TRENDAFILOSKI, G.S. (2003) 'An advanced approach to earthquake risk scenarios with applications to different European towns, WP4: Vulnerability of current buildings'. *RISK-UE Project Report*, Contract EVK4-CT-2000-00014.
14. PEULIĆ, D. (2002) *Konstruktivni elementi zgrada*. Zagreb: Croatia knjiga.
15. SALAMAN, A., STEPINAC, M., MATORIC, I. and KLASIĆ, M. (2022) 'Post-earthquake condition assessment and seismic upgrading strategies for a heritage-protected school in Petrinja, Croatia'. *Buildings* 12(12), 2263, pp. 1-28, <https://doi.org/10.3390/buildings12122263>
16. STEPINAC, M., OŽIĆ, K., NINČEVIĆ, A., FUNARI, M.F. and LOURENÇO, P.B. (2023) 'A digital tool based on code indicators to assess the seismic behaviour of existing masonry structures: Application to Croatian residential buildings'. *Structures* 58, 105372, pp. 1-10, <https://doi.org/10.1016/j.istruc.2023.105372>

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MULTICRITERIA SUSTAINABILITY EVALUATION OF URBAN HERITAGE: AN INTEGRATIVE MODEL APPLIED TO THE CASBAH OF ALGIERS

KEYWORDS

AHP-ANP

CASBAH OF ALGIERS

MULTICRITERIA EVALUATION

SUSTAINABILITY

URBAN HERITAGE

ABSTRACT

Assessing urban heritage in historic cities remains challenging where building decay, urban pressure and difficult-to-regulate tourism dynamics intersect. Monetary approaches reflect market benefits but inadequately account for non-market values, conservation limits, and the complexity of inhabited historic fabric. This paper operationalises a sustainability-based multicriteria decision-support framework, integrating economic dimensions, for the tourist route of the Casbah of Algiers. The model is formalised as a reproducible protocol integrating

five dimensions: heritage, environmental (urban), social, economic and institutional, weighted through structured questionnaires administered to ten (10) qualified experts in economics, sociology, environment, heritage, and administrative management. A hierarchical structuring (AHP) is complemented by a network-based modelling of interdependencies (ANP), implemented in SuperDecisions. The results generate weights, final priorities and a limit matrix, supporting a structured interpretation of vulnerabilities and value patterns at the route scale.

INTRODUCTION

Historic urban centres are complex socio-spatial systems in which architectural heritage, economic functions and cultural practices converge. Their conservation involves demanding governance trade-offs, particularly under conditions of constrained public resources and rapidly shifting urban dynamics. In this setting, economic evaluation has progressively become a key instrument for appreciating multiple benefits (both tangible and intangible) associated with heritage conservation and enhancement (Alaouchiche et al., 2025; Pujol Galindo, 2023; Throsby, 2012; Basílio et al., 2022). International frameworks emphasise that urban heritage, in its material and immaterial components, constitutes a strategic resource for improving liveability while supporting economic development and social cohesion (UNESCO, 2011). Development actors likewise increasingly recognise heritage as a lever for local growth and territorial cohesion (World Bank, 2012; Licciardi and Amirtahmasebi, 2012; Kyte, 2012).

Yet, standard economic appraisal tools often fail to capture the full economic value of heritage assets embedded in inhabited historic fabrics (Dalmas et al., 2014). Conventional approaches tend to privilege market-visible flows while under-representing indirect use values (positive externalities, induced effects) and non-use values (identity, collective

memory, existence and bequest), for which no straightforward monetary measurement exists (Dalmas et al., 2014; Dalmas et al., 2015). This limitation strengthens the case for evaluation frameworks that can account for both market and non-market benefits, and that can represent trade-offs across heterogeneous dimensions of value.

Recent conceptual renewals have therefore mobilised the Total Economic Value framework and the notion of strong sustainability to argue for integrated evaluation approaches capable of reflecting the multidimensionality of urban heritage (Dalmas et al., 2015). Unlike weak sustainability, whereby different forms of capital are considered broadly substitutable, strong sustainability assumes that certain heritage components are effectively non-substitutable: beyond critical thresholds, losses in one dimension cannot be compensated by gains in another (Dalmas et al., 2015). This premise calls for multicriteria decision analysis (MCDA) in which monetary and non-monetary indicators are combined to reflect, in a single decision-support architecture, the economic, social, cultural, environmental and institutional dimensions of heritage value (Alaouchiche et al., 2025; Della Spina, 2020; Ferretti and Comino, 2015). Such an orientation is consistent with the broader international shift-promoted by UNESCO, ICOMOS and further elaborated in the Historic Urban Landscape approach, towards holistic heritage management aligned with sustainable development objectives (UNESCO, 2011; Bandarin and van Oers, 2012). In particular, the UNESCO recommendation on the Historic Urban Landscape explicitly encourages the integration of conservation policies into wider urban strategies, thereby reinforcing the need for decision-support tools that would allow for the application of multiple criteria instead of relying solely on market logics (UNESCO, 2011).

Within this methodological landscape, an integrative framework was recently proposed to connect strong-sustainability reasoning with multicriteria evaluation for urban heritage, by structuring value dimensions and ensuring procedural transparency in decision-making (Alaouchiche et al., 2025). The present paper operationalises that study on the tourist heritage route of the Casbah of Algiers, identified as a structuring axis in the Permanent Plan for Safeguarding and Enhancement of the Safeguarded Sector (PPSMVSS) (Ministry of Culture of Algeria, 2009). Inscribed on the UNESCO World Heritage List since 1992, the Casbah offers a particularly demanding testing ground: it concentrates outstanding heritage values while facing persistent vulnerabilities related to building con-

dition, residential pressures, and implementation capacity (UNESCO World Heritage Centre, 2023; Djedi and Belakehal, 2022). Although safeguarding instruments have been elaborated over time, the capacity to monitor, evaluate and adjust interventions remains limited, which constrains evidence-based prioritisation and weakens long-term effectiveness (UNESCO World Heritage Centre, 2023). This evaluation gap motivates the use of multicriteria tools that can support explicit prioritisation under strong sustainability constraints.

Heritage routes, in this sense, constitute a relevant operational unit because they organise a sequence of heritage assets and everyday urban functions into a readable system that can be managed, compared and prioritised (Zhang et al., 2024). The route is therefore treated here not as a mere itinerary of visits but as an integrated urban-heritage device, combining monuments, residential fabric, public space and local activities, hence requiring a multidimensional evaluation (Lin et al., 2024). Consistently with this framing, the study develops an MCDA protocol that: elicits expert preferences through pairwise comparisons within an Analytic Hierarchy Process (AHP) structure (Talukder and Hipel, 2021), models interdependencies through an Analytic Network Process (ANP) and applies a ratings procedure to consolidate performance levels when direct quantitative evidence is uneven (Zhang et al., 2023). This operational chain is implemented in SuperDecisions to ensure traceability and reproducibility of the calculations (Saaty, 2016).

To the best of our knowledge, MCDA applications addressing Algerian urban heritage in indexed academic outlets have primarily relied on the AHP for specific planning or delimitation purposes: such as the definition of Historic Urban Landscape (HUL) boundaries in Algiers (Boukratem and Djelal, 2021), rather than on an integrated decision-support chain combining AHP, ANP and performance ratings to derive a synthetic index of (global value) for an inhabited heritage route treated as a system. Building on the UNESCO Historic Urban Landscape framework (UNESCO, 2011), which explicitly calls for the integration of heritage conservation with broader urban development, social and governance processes, this study operationalises sustainability as a formal decision constraint embedded directly within the multicriteria structure itself (through the definition of criteria, the weighting scheme and the modelling of interdependencies) rather than treating sustainability as a purely descriptive or narrative background.

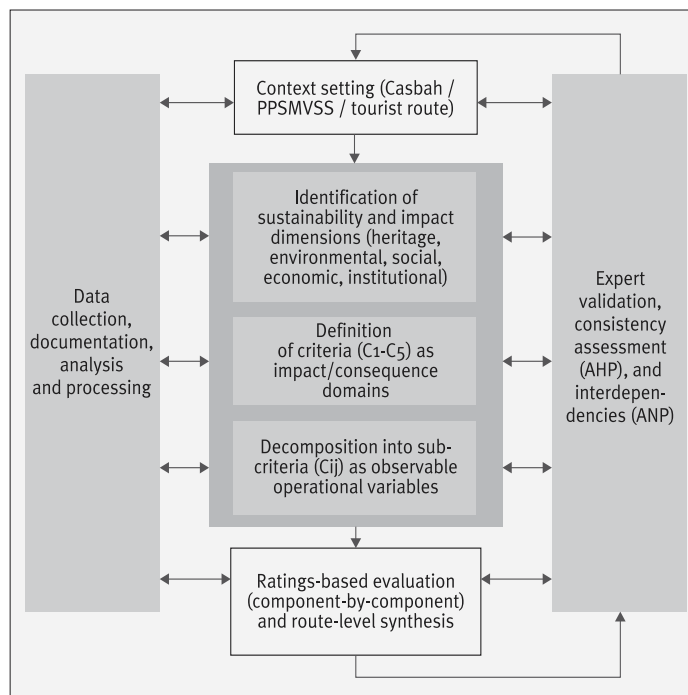


FIG. 1 METHODOLOGICAL WORKFLOW (FROM THE SELECTION OF THE MCDA APPROACH TO THE AHP-ANP IMPLEMENTATION) (AUTHORS, 2026)

METHODOLOGY

OVERALL RESEARCH DESIGN

This study adopts a mixed-methods design combining qualitative inputs and quantitative processing to operationalise a sustainability-based multi-criteria evaluation framework for urban heritage (Fig. 1). Rather than reducing heritage value to a single monetary metric, the approach constructs a multi-criteria value intended as a decision-support output, integrating heritage, environmental, social, economic, and institutional dimensions within a transparent aggregation procedure.

UNIT OF ANALYSIS:

THE HERITAGE TOURISM ROUTE

The case study focuses on the heritage tourism route of the Casbah of Algiers (Fig. 2), a historic urban area inscribed on the UNESCO World Heritage List since 1992. Rather than being considered a simple sequence of monuments, the route is approached as an integrated urban-heritage system, combining architectural assets, residential fabric, public spaces, everyday practices and local activities. This approach is consistent with the Historic Urban Landscape perspective, which emphasises the interaction between tangible heritage, social life and urban dynamics in living historic centres.

The selected route constitutes a structuring spatial axis within the Casbah, identified



FIG. 2 CASE STUDY: THE HERITAGE TOURISM ROUTE OF THE CASBAH OF ALGIERS (AUTHORS, 2026)

through the Permanent Safeguard and Enhancement Plan (PPSMVSS) and updated through field observation. It brings together a heterogeneous set of components, including major monuments, religious buildings, historic housing units, commercial spaces, public facilities and urban open spaces. These elements are spatially and functionally interconnected, forming a coherent itinerary that supports both heritage interpretation and daily urban use. The diversity of components makes the route particularly suitable for testing a multi-criteria evaluation framework grounded in sustainability principles.

The choice of the tourism route was further validated through an expert survey, which compared several potential heritage devices within the Casbah (including individual monuments and larger complexes). Experts converged on the route as the most relevant operational scale for an integrated evaluation, as it allows the articulation of conservation issues, urban conditions, social practices and economic dynamics within a single analytical framework. This validation ensures that the case study is not only contextually relevant but also methodologically justified.

By considering the route as a global entity rather than disaggregated objects, the case study enables an assessment of the overall sustainable value of the Casbah's heritage system. It provides an operational testing ground for the combined AHP-ANP model and allows the identification of structural strengths, vulnerabilities and priority areas for intervention. In this sense, the Casbah of

Algiers is not treated as an isolated or exceptional case, but as a representative example of a dense, inhabited Mediterranean historic centre facing the challenge of balancing heritage conservation, social continuity and sustainable tourism development.

SUSTAINABILITY-BASED ANALYTICAL FRAMEWORK

A structured literature-based review was used to define and stabilise the evaluation framework around five core sustainability dimensions: environmental (C2), social (C3) and economic (C4) (Purvis, Mao and Robinson, 2019; Barbier, 1987), widely recognised as the foundational pillars of sustainable development. Complemented by: the cultural/heritage (C1) dimension increasingly formalised as a distinct sustainability domain (Soini and Dessein, 2016; UNESCO, 2013), and an institutional/governance (C5) dimension capturing implementation capacity, regulatory effectiveness and coordination mechanisms required for long-term sustainability (Biermann, Kanie and Kim, 2017).

Following the definition of the five core sustainability dimensions, a set of context-specific sub-criteria was identified through a structured literature review and adapted to the urban and heritage specificities of the Casbah of Algiers to capture operational and observable variables (Table I; Fig.3). This step ensured that the assessment grid reflects both technical attributes and the broader sustainability requirements associated with inhabited historic urban fabrics (Labadi et al., 2021).

EXPERT SURVEY: VALIDATION AND ELICITATION OF JUDGMENTS (AHP AND ANP)

An expert survey was designed as the core instrument for model calibration (O'Hagan, 2019). The questionnaire was administered to a panel of 10 qualified experts with complementary profiles in economics, sociology, environmental issues, heritage, and administrative management. The experts were selected on the basis of their professional experience, institutional involvement, and familiarity with both the Casbah of Algiers and heritage evaluation issues.

The questionnaire was organised into sections enabling:

- validation of the evaluation support, through the selection and ordinal ranking of pre-identified heritage valorisation devices (tourism route, mosque route, Bastion 23, Citadel), complemented by open-ended justifications;

TABLE I SUB-CRITERIA, THEORETICAL BASIS AND REFERENCES (AUTHORS, 2026)

Criterion	Sub-criterion	Scientific Justification	Reference
C1 Heritage	Heritage value	Captures historical, architectural and symbolic significance fundamental to heritage evaluation and transmission.	(Jokilehto, 2006)
	Conservation condition	Physical state determines viability for sustained use and long-term preservation.	(Rypkema and Cheong, 2011).
	Authenticity/Integrity	Critical for judging heritage value and consistent with international conservation principles.	(UNESCO, 2011).
	Historical value	Reflects stratification and depth that enhance cultural significance.	(Bandarin and van Oers, 2012).
	Urban permanencies	Invariants like street patterns and focal points underpin spatial coherence.	(Rossi, 1982)
	Historical layering	Multiple chronological layers contribute to narrative richness.	(Bandarin and van Oers., 2012)
	Key monumental anchors	Major monuments structure spatial experience and generate positive externalities.	(Rypkema, 2005)
C2 Urban/ Environmental	Urban quality	Defines legibility, accessibility and comfort essential for sustainable routes.	(UN-Habitat., 2020).
	Immediate environment	Local environmental conditions directly affect usability and visitor/inhabitant experience.	(Licciardi and Amirtahmasebi, 2012)
	Life-cycle condition	Addresses vulnerability due to aging fabric and maintenance needs.	(Dalmás et al., 2015)
C3 Social	Local uses and practices	Daily uses preserve vitality and prevent functional stagnation.	(Throsby, 2012)
	Social revitalization and intangible heritage	Living heritage (practices, traditions) underpins cultural continuity.	(UNESCO, 2003) (Djedi and Belakehal, 2022)
C4 Economic	Facilities	Infrastructure supporting use and services contributes to economic activation.	(Rypkema, 2005)
	Functional diversity	Mixed functions enhance resilience and local economic vitality.	(World Bank, 2012)
	Local activities	Local economic activities generate spillovers and enhance sustainability.	(Throsby, 2012)
	Local economic viability	Economic vitality is an indicator of sustainability of heritage uses.	(Licciardi and Amirtahmasebi, 2012)
	Leverage effects	Heritage can catalyze wider economic investment and multipliers.	(Rypkema and Cheong, 2011).
	Heritage marketing	Interpretation and information systems contribute to sustainable engagement.	(Ashworth and Tunbridge, 2000)
C5 Institutional/ Governance	Legal status	Legal recognition ensures protection and defines regulatory frameworks.	(UNESCO, 2011)
	Institutional coordination	Effective coordination is key to implementing multi-actor heritage strategies.	(Labadi et al., 2021)
	Governance regime	Governance shapes decision processes and prioritization capacity.	(Ostrom, 2010)
	Management capacity	Technical and human resources determine operational effectiveness.	(World Bank, 2012)
	Maintenance capacity	Routine maintenance is crucial to avoid deterioration and risk accumulation.	(Jokilehto, 2006)

- content validation of criteria and sub-criteria (relevance checks, additions, deletions, reformulations) to ensure contextual adequacy;
- pairwise comparisons for weighting criteria and sub-criteria, based on Saaty's fundamental scale (1-9, with intermediate values), providing the comparison matrices required for AHP-derived priorities (Saaty, 1990)
- identification of direct influences among dimensions, using a 0-3 intensity scale, to specify the network structure compatible with ANP modelling (Saaty, 2006);
- interpretive reinforcement through open-ended questions, addressing investment priorities, vulnerabilities, bottlenecks, and governance-related messages.

Accordingly, the expert survey functions not merely as a validation step but as a structured elicitation device producing the inputs needed for weighting (AHP), interdependence modelling (ANP), and sustainability-oriented interpretation. The consistency of pairwise comparison matrices was systematically verified using Saaty's Consistency Ratio (CR), and only matrices with CR values below 0.10 were retained. In the final model,

six main pairwise comparison matrices were controlled: the 5×5 objective-criteria matrix, the 7×7 patrimonial sub-criteria matrix, the 3×3 environmental sub-criteria matrix, the 2×2 social sub-criteria matrix, the 6×6 economic sub-criteria matrix, and the 5×5 institutional sub-criteria matrix. All non-trivial matrices remained below the conventional threshold of 0.10, with CR values of 0.098 for the objective-criteria matrix, 0.089 for the patrimonial matrix, 0.046 for the environmental matrix, 0.084 for the economic matrix, and 0.069 for the institutional matrix. The social matrix, being a 2×2 comparison, had a CR of 0 by construction. These results confirm that the expert judgments used for priority extraction were sufficiently consistent.

PERFORMANCE SCORING: COMPONENT-BY-COMPONENT ASSESSMENT AND TREATMENT OF MISSING INFORMATION (DELPHI)

In the second phase, the model was populated through a rating procedure aimed at evaluating the route component by component

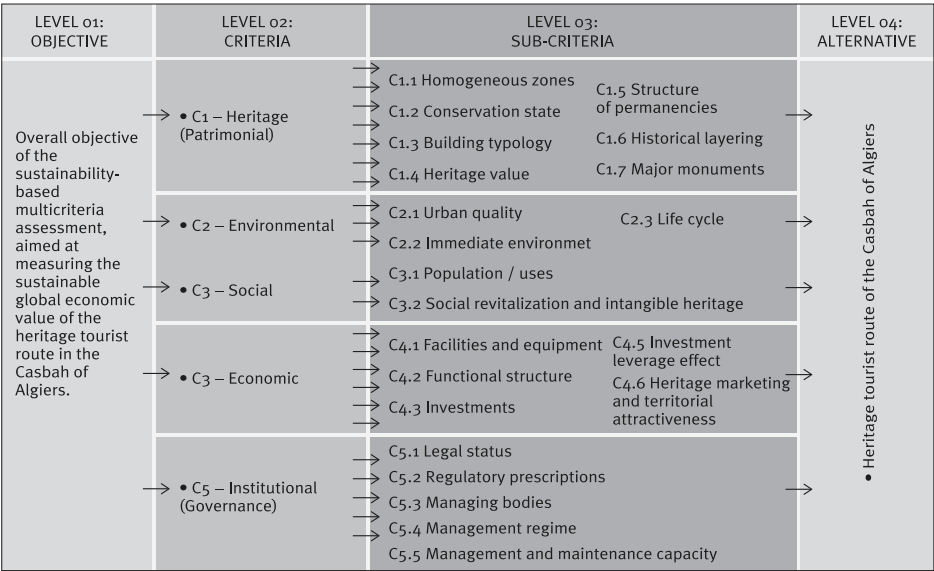


FIG. 3 MULTICRITERIA MODEL AND HIERARCHICAL STRUCTURING OF CRITERIA AND SUB-CRITERIA (AUTHORS, 2026)

through 37 individually assessed components (Fig.4), including monuments, residential segments, public spaces, facilities, and urban sequences, against the selected sub-criteria (Nocca, Bosone and Orabona, 2024; Creative Decisions Foundation, 2024). The scoring process relied on documentary, spatial, field, and institutional sources, and was consolidated whenever relevant sub-criteria could not be documented directly or in a fully quantitative manner.

Rather than excluding such dimensions, which would have artificially narrowed the evaluation scope, a Delphi procedure was used to address information gaps and stabilise score attribution. This Delphi stage involved five experts selected for their direct knowledge of the study area and the evaluation framework. It was conducted in two rounds: the first to propose and justify plausible values for insufficiently documented scoring fields, and the second to promote convergence where disagreement or uncertainty remained. Responses were synthesised using the median, while the interquartile range (IQR) was used to assess the degree of consensus. This step was intended to preserve the integrity of the model by maintaining sub-criteria deemed necessary for the overall evaluation, while ensuring transparency regarding the origin and consolidation of performance data (Beiderbeck et al., 2021; Boulkedid et al., 2011).

IMPLEMENTATION AND COMPUTATION
IN SUPERDECISIONS:
AHP, ANP, AND RATINGS

The full model was implemented in SuperDecisions (Creative Decisions Foundation,

2024), used as a single computational environment ensuring traceability and reproducibility. Three modules were employed:

- AHP, to derive hierarchical weights for criteria and sub-criteria from pairwise comparisons (Fig.3);
- ANP, to account for interdependencies through the construction of supermatrices (unweighted, weighted, and limit) and the interpretation of stabilised priorities;

Ratings, to transform ordinal performance levels assigned to route components into aggregated priorities.

Within this framework, the route can also be treated as a single global entity when the objective is to produce a decision-oriented synthesis at the system level. Exported outputs (priorities, matrices, and synthesis tables) constitute the basis for the tables and figures presented in the Results section. To ensure reproducibility, the full SuperDecisions outputs, including the unweighted supermatrix, weighted supermatrix, limit matrix, and cluster matrix, are provided as supplementary material.

OUTPUTS AND REPORTING STRATEGY

The reported results rely on: AHP weights (criteria and sub-criteria priorities), ANP stabilised priorities (limit matrix), and Ratings synthesis (global score and contributions). Interpretation focuses on producing a sustainability-oriented reading of the route's overall multi-criteria value, highlighting dominant dimensions, critical vulnerabilities, and decision implications (intervention priorities, governance leverage points, coordination needs, and maintenance capacity).

RESULTS

DELPHI CONSOLIDATION:
FINAL VALUES INTEGRATED FOR PARTIALLY
DOCUMENTED SUB-CRITERIA

For sub-criteria that could not be documented in a sufficiently discriminant manner through documentary sources and observation alone, a Delphi procedure was applied in order to stabilise ratings through an expert consensus process. In accordance with ordinal data practice, the median was used as the final consolidated score and convergence was monitored through the interquartile range (IQR).

The final values integrated into the scoring table are:

- C2.1 = 3; C2.2 = 2; C2.3 = 3; C3.1 = 4;
C3.2 = 4; C4.3 = 3; C4.4 = 3; C4.5 = 3;
C4.6 = 2; C5.4 = 3; C5.5 = 3.

This consolidation strengthens the completeness and internal coherence of the dataset while maintaining traceability between documented or observed information and consensus-based expert inputs (Table II).

SCORING RESULTS (1-5): DESCRIPTIVE PERFORMANCE PROFILE OF THE ROUTE

In parallel with ANP priorities, the rating-based scoring (ordinal scale 1-5) provides a descriptive profile of the route's relative performance across criteria. The aggregation of scores (sub-criteria means and criterion means) results in the following profile:

Overall mean score
(all sub-criteria combined): = 3.17 / 5

Mean scores by criterion:

C1 Heritage: = 3.54 / 5

C2 Environmental/urban: = 2.50 / 5

C3 Social: = 4.00 / 5

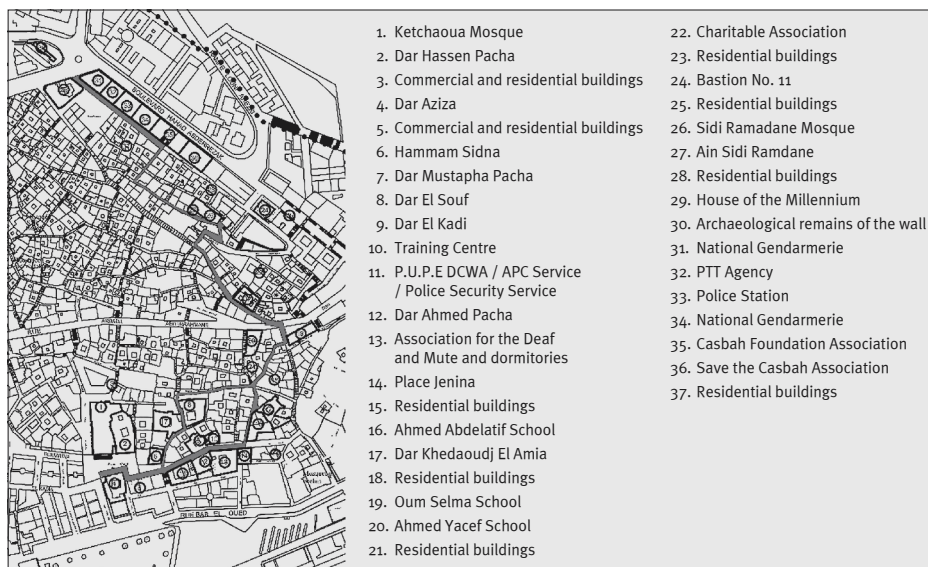
C4 Economic: = 2.78 / 5

C5 Institutional: = 3.12 / 5

This distribution indicates a relatively strong performance on the social dimension and intermediate performance on the heritage dimension, while the environmental/urban and economic dimensions appear more constrained. The institutional dimension remains at a medium level, suggesting the presence of actors and frameworks without uniformly strong coordination and operational capacity.

The central result emerges when scores are interpreted jointly with ANP priorities: the most heavily weighted criteria (C1 and C2) are not necessarily those achieving the highest mean scores. This contrast points to a structural gap within the model, as the dimensions driving the global priority system are also those where performance levels remain moderate to limited.

The weighted synthesis combines the descriptive scoring profile with the priorities derived from the ANP model. In this perspective, the overall weighted pathway score reported in Table II (1.7439) should not be interpreted as a monetary value or as an isolated raw output, but as a composite decision-support index resulting from the aggregation of performance levels and multicriteria priorities. More specifically, this value is obtained by summing the weighted contributions of the 23 sub-criteria (ANP global weight X average pathway score). Since the ANP weights used in this table sum to 0.5329 rather than 1.0, the resulting figure should be read as a raw composite index rather than directly as a score on the original 1-5 scale. Given the sum of ANP weights used in this



table, the theoretical range of the raw composite score extends from 0.5329 to 2.6643. Expressed as a normalized weighted mean,

FIG. 4 LOCATION OF THE EVALUATED COMPONENTS OF THE HERITAGE TOURISM ROUTE IN THE CASBAH OF ALGIERS (AUTHORS, 2026)

TABLE II IMPLICATIONS FOR THE “INTEGRAL VALUE” READING OF THE ROUTE (MODEL-BASED SYNTHESIS) (AUTHORS, 2026)

Criterion	Code	Sub-criterion	ANP global weight	Average pathway score (1-5)	Weighted contribution (weight×score)
C1	C1.1	Homogeneous zones	0.021592064	4.027027027	0.086951826
C1	C1.2	State of conservation	0.025680168	3.945945946	0.101332553
C1	C1.3	Building typology	0.020215782	3.75	0.075809182
C1	C1.4	Heritage value	0.049399487	3.555555556	0.175642619
C1	C1.5	Structure of permanencies	0.027088187	2.833333333	0.076749864
C1	C1.6	Historical layering	0.027209132	3.649	0.099286122
C1	C1.7	Major monuments	0.043255752	3.135135135	0.135612627
C2	C2.1	Urban quality	0.069847423	3	0.209542268
C2	C2.2	Immediate environment	0.044001161	2	0.088002322
C2	C2.3	Life-cycle performance	0.027718917	3	0.08315675
C3	C3.1	Population / uses	0.015636	4	0.062544
C3	C3.2	Social revitalization and intangible heritage	0.046908	4	0.187632
C4	C4.1	Facilities / amenities	0.003264344	3.411764706	0.011137175
C4	C4.2	Functional structure	0.003264344	2.285714286	0.007461359
C4	C4.3	Investments	0.005930888	3	0.017792664
C4	C4.4	Local economic vitality	0.012250983	3	0.036752949
C4	C4.5	Investment leverage effect	0.021879628	3	0.065638885
C4	C4.6	Heritage marketing and territorial attractiveness	0.001987715	2	0.003975429
C5	C5.1	Legal status	0.032190482	3.5	0.112666687
C5	C5.2	Regulatory prescriptions	0.017383758	3.540540541	0.061547901
C5	C5.3	Managing bodies	0.008306254	2.540540541	0.021102375
C5	C5.4	Management regime	0.004959547	3	0.014878642
C5	C5.5	Management/maintenance capacity	0.002898958	3	0.008696875
Overall weighted pathway score (Σ weight×score)					1.743913074

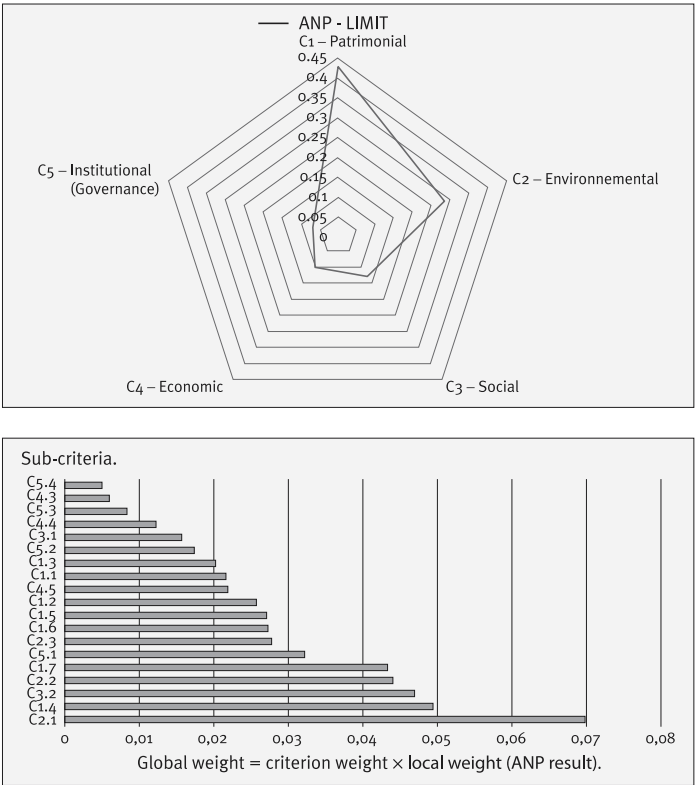


FIG. 5 STRUCTURE OF GLOBAL PRIORITIES (MACRO-LEVEL WEIGHTING OF CRITERIA) (AUTHORS, 2026)

FIG. 6 IDENTIFICATION OF STRUCTURING LEVERS OF SUB-CRITERIA (AUTHORS, 2026)

this result corresponds to approximately 3.27/5, indicating an overall intermediate level of systemic performance. In this sense, the score of 1.7439 expresses not a low patrimonial significance of the route, but a moderate overall performance once the structural priorities of the model are considered. This result should therefore be interpreted as a relative performance indicator within the model, rather than as an absolute or stand-alone measure.

ANP OUTPUTS: MACRO-LEVEL WEIGHTING OF CRITERIA (C1-C5)

The ANP computation performed in SuperDecisions (weighted supermatrix and limit matrix) provides a clear structure of global priorities aligned with the objective of a multi-criteria assessment of the heritage tourism route of the Casbah of Algiers. The final limit priorities highlight the predominance of the heritage dimension C1 (0.4289) and the environmental/urban dimension C2 (0.2831). Social, economic and institutional dimensions occupy secondary but non-marginal positions, with C3 (0.1251), C4 (0.0972) and C5 (0.0657), respectively (Fig. 5).

This hierarchy indicates that the overall performance of the route is primarily driven by heritage-related attributes (value, integrity and conservation) and by urban/envi-

mental conditions, whereas social, economic and governance-related dimensions act as enabling layers within a constrained and inhabited heritage system.

GLOBAL CONTRIBUTION OF SUB-CRITERIA: IDENTIFICATION OF STRUCTURING LEVERS

The analysis of global sub-criterion weights derived from the ANP structure shows that influence is not evenly distributed across variables. Instead, the model focuses on a reduced set of dominant levers structuring the multi-criteria value of the route.

The most influential sub-criteria are: C2.1 Urban quality (0.06985), ranked as the primary determinant of the system.

C1.4 Heritage value (0.04940), confirming the role of intrinsic historical/architectural significance as the central foundation of the route's overall value.

C3.2 Social revitalisation and intangible heritage (0.04691), highlighting the contribution of "living heritage" dynamics to the system's value.

C2.2 Immediate environment (0.04400) and C1.7 Major monuments (0.04326), both functioning as structuring factors for coherence and attractiveness.

C5.1 Legal status (0.03219), reflecting the relevance of legal/security conditions as a prerequisite for effective protection.

A second core group of influential variables relates to temporal depth, integrity and conservation performance, including: C2.3 Life cycle (0.02772), C1.6 Historical layering (0.02721), C1.5 Structure of permanencies (0.02709) and C1.2 State of conservation (0.02568).

Conversely, sub-criteria linked to tourism equipment and micro-economic structuring receive substantially lower weights within the ANP outputs, particularly C4.6 Heritage marketing (0.00199), and at a low level C4.1 Facilities (0.00326) and C4.2 Functional structure (0.00326). In the context of this model, these variables therefore appear as less determinant than the heritage-urban-social core variables shaping the global value of the route (Fig. 6).

SYSTEMIC INTERPRETATION: CONTRIBUTION OF INTERDEPENDENCIES TO THE FINAL PRIORITIES

A key contribution of the ANP approach is to incorporate interdependencies rather than relying on a strictly hierarchical decision structure. The supermatrix outputs and their synthetic readings indicate that governance-related performance (C5) remains strongly conditioned by the other dimensions. Institu-

tional capacity is influenced by social pressures (C3), urban/environmental constraints (C2), and heritage protection and conservation requirements (C1).

This configuration is consistent with the functioning of an inhabited historic urban fabric, whereby governance acts primarily as a coordination and arbitration mechanism within multiple constraints. Within this systemic interpretation, the multi-criteria value of the route results from the interaction of: heritage capital as a reference base (C1), urban/environmental quality as an enabling condition (C2), social continuity and appropriation (C3), partial economic translation into benefits (C4), and institutional effectiveness and long-term stabilisation (C5) (Table III).

Overall, the results converge toward a consistent interpretation: the multi-criteria economic value of the route is not governed by a single register (e.g., tourism attractiveness), but by the system's capacity to preserve an equilibrium between:

- a strongly significant heritage capital (C1 as dominant criterion),
- urban and environmental conditions that act as a primary lever (C2.1 and C2.2 among the most influential sub-criteria, while the mean score of C2 remains comparatively low),
- a relatively robust living and social base (C3, strongly scored and non-marginally weighted),
- economic and marketing variables that remain weakly weighted within the ANP structure, and
- institutional capacity required to stabilise long-term trajectories (C5).

In this configuration, the model provides a quantified basis for understanding how the global value of the heritage route emerges from combined heritage, urban and social determinants, with economic and institutional dimensions functioning as enabling conditions within the system.

DISCUSSION

INTERPRETING THE ANP STRUCTURE UNDER A STRONG SUSTAINABILITY PERSPECTIVE

The ANP results confirm that the multi-criteria economic assessment of the heritage tourism route in the Casbah of Algiers cannot be interpreted as a simple aggregation of monetary performance or tourism attractiveness indicators. The criterion priorities-dominated by the heritage dimension C1 (0.4289) and the environmental/urban dimension C2 (0.2831)-are fully consistent with a strong sustainability stance, in which the overall value depends primarily on the long-term

TABLE III CRITERIA INTERDEPENDENCIES (WEIGHTED SUPERMATRIX SYNTHESIS) (AUTHORS, 2026)

	C1 – Patrimonial	C2 – Environmental	C3 – Social	C4 – Economic	C5 – Institutional / governance
C1 – Patrimonial		0.083333		0.16374	
C2 – Environmental	0.040481				
C3 – Social				0.129961	
C4 – Economic	0.094197		0.0625		
C5 – Institutional	0.365322	0.416667	0.4375	0.206299	

integrity of heritage capital (material and symbolic) and on the urban-environmental conditions that enable conservation, appropriation, and use without irreversible degradation. In this configuration, the route is not treated as a tourism “product”, but as a living heritage system in which economic outcomes appear as contingent effects rather than autonomous determinants. This reading is particularly relevant for dense Mediterranean historic centres, where fragility of the built fabric, urban carrying constraints, social vulnerability, and institutional complexity strongly shape the sustainability of valorisation strategies.

URBAN QUALITY (C2.1)

AS THE PRIMARY LEVERAGE MECHANISM

A central outcome of the sub-criteria ranking is the dominance of C2.1 Urban quality (0.06985) as the most influential variable in global weight. This highlights a structural mechanism typical of historic urban fabrics: intrinsic heritage significance alone is not sufficient to generate territorial benefits if the urban environment does not allow for effective “heritage experience” through legible, continuous, safe and comfortable movement. In route-based valorisation, urban quality operates as a conversion mechanism between heritage assets and visitor experience-and therefore between cultural potential and practical operability. The Casbah simultaneously concentrates exceptional heritage density and significant urban constraints; thus, the model logically assigns high influence on the urban dimension. Importantly, this confirms the analytical value of separating what pertains to the heritage object (heritage components) from what pertains to the surrounding medium (urban conditions) when operationalising a sustainability-based multi-criteria framework.

STRUCTURING HERITAGE COHERENCE: VALUE AND ANCHORS WITHIN THE ROUTE

Within the heritage criterion, C1.4 Heritage value (0.04940) and C1.7 Major monuments (0.04326) belong to the most determinant sub-criteria, confirming that the overall route

experience depends on internal hierarchies and strong “anchors” capable of structuring attention and strengthening the overall image and coherence of the system. In the Casbah, major monuments function as strategic poles that can generate positive spillovers across surrounding sequences; however, such spillovers remain conditional on the sustainability of connecting urban segments, directly reinforcing the previous finding on the pivotal role of C2.1.

Additionally, the non-negligible influence of C1.6 Historical layering (0.02721) and C1.5 Structure of permanencies (0.02709) shows that the route’s value is strongly tied to narrative readability and temporal depth. This indicates that evaluation is not reducible to the physical state of components alone but is also dependent on the intelligibility of heritage stratification and urban continuity, consistent with the Casbah being interpreted as a palimpsest system rather than a collection of isolated assets.

SOCIAL PERFORMANCE AND THE ROLE OF LIVING HERITAGE

The high global weight of C3.2 Social revitalisation and intangible heritage (0.04691), combined with favourable social mean scores (= 4/5), underlines a core characteristic of the Casbah: its value is strongly linked to practices, everyday uses, social relations, knowledge, and forms of inhabiting, in addition to built heritage components. This dimension supports the model in two complementary ways. First, it constitutes a resilience factor, as appropriation and active use can reduce vacancy and accelerate neither physical nor functional decline. Second, it reflects a key set of non-market values that remain central in an expanded economic assessment of heritage, particularly for existence- and transmission-related value components. Nevertheless, the interpretation of this result requires caution: in historic centres potentially exposed to tourism pressure, valorisation may generate substitution effects (changes in uses, conflicts, commodification pressures) that can weaken social sustainability. Therefore, the route must remain interpretable as a means compatible with everyday inhabiting, rather than a strictly tourist staging of space.

ECONOMIC DIMENSION: LOW WEIGHTS AS A STRUCTURAL POSITIONING, NOT IRRELEVANCE

The economic criterion C4 (0.0972) is weighted lower than heritage and urban/environmental dimensions, and some economic sub-criteria appear particularly weak in global

weight, notably C4.6 Heritage marketing (0.00199), as well as C4.1 Facilities (0.00326) and C4.2 Functional structure (0.00326). This outcome should be interpreted with precision: it does not imply that these variables are useless, but rather that within the model’s systemic logic and expert-informed interdependencies, they are positioned as amplifiers rather than core determinants of value.

In the context of the Casbah, this finding is consistent with the idea that tourism equipment or marketing, if disconnected from urban constraints and conservation requirements, may increase pressure without improving sustainability. The ANP structure therefore remains coherent with a strong sustainability perspective: economic dynamics are placed in service of a fragile heritage system rather than treated as the overriding driver of value.

INSTITUTIONAL DIMENSION AS A CONDITION OF EFFECTIVENESS

The institutional criterion C5 (0.0657) is the lowest among macro-level priorities, yet relevant governance variables remain significant within the system, particularly C5.1 Legal status (0.03219), alongside the management regime and maintenance capacity elements consolidated through Delphi. These results suggest that governance functions primarily as a condition of activation: without legal security, clear responsibility allocation and minimum coordination capacity, conservation and valorisation remain unstable. The relatively lower weight of C5 may also reflect a contextual effect typical of complex governance environments, in which institutional dimensions operate more as structural constraints than as fully controllable variables in the short term. Consequently, governance enters the model not as an autonomous generator of value, but as a necessary layer ensuring continuity, feasibility, and long-term effectiveness.

METHODOLOGICAL ROBUSTNESS AND LIMITATIONS

The combined design (AHP structuring, ANP network modelling, ordinal scoring 1-5, and Delphi consolidation) presents several methodological strengths. First, it ensures traceability by connecting documentary and observational inputs to explicit scoring procedures, rather than relying on implicit assumptions. Second, ANP integration of interdependencies is particularly appropriate for historic urban systems, where heritage, social dynamics, urban conditions and governance interact through feedback mechanisms. Third, the Delphi procedure reinforces dataset completeness without masking uncertainty, and the

use of median (and IQR monitoring) is compatible with ordinal-scale logic.

At the same time, two limitations remain structurally inherent to the approach. The 1-5 scoring scale improves comparability but may reduce nuance; this effect is mitigated by transparent reporting and cross-reading with ANP weights. Data availability remains heterogeneous across sub-criteria; the Delphi step addresses this constraint but requires maintaining a clear distinction between documented and consensus-derived values.

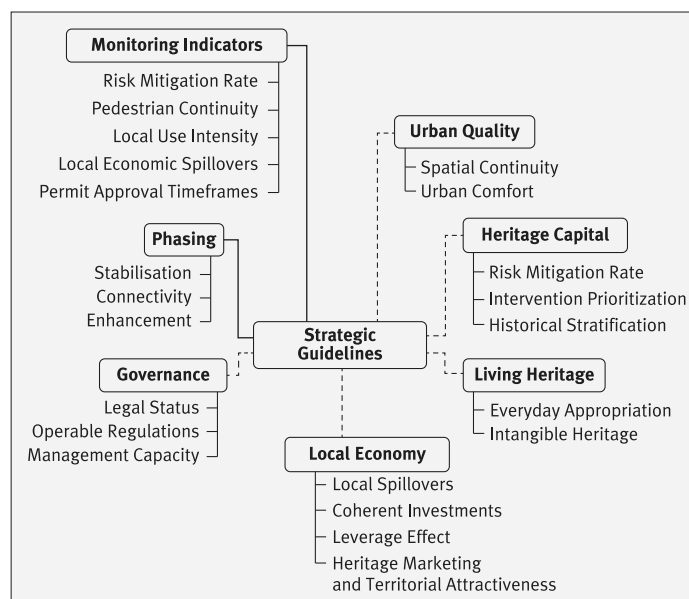
IMPLICATIONS DERIVED FROM THE MODEL'S INTERNAL LOGIC

The ANP-based results indicate that maximizing the route's overall multi-criteria value under a strong sustainability perspective requires a sequenced strategy that treats the heritage route as a coherent urban-heritage system rather than a set of isolated assets. Priority should be given to upgrading urban quality and continuity, as these conditions are the main "conversion" mechanism through which intrinsic heritage significance becomes usable, socially appropriable, and economically productive. In parallel, conservation efforts should be targeted according to heritage value and structuring anchors, while safeguarding living heritage and everyday appropriation as a core determinant of resilience. Economic activation (services, interpretation, and communication) should remain incremental and proportionate, designed to amplify benefits without overloading a fragile fabric. Finally, governance should focus on operational capacity-clear responsibilities, legal security, and maintenance routines-so that interventions remain effective and durable over time (Fig.7).

CONCLUSION

This study developed and implemented a sustainability-based multicriteria economic evaluation applied to the heritage tourism route of the Casbah of Algiers, considered as an integrated urban heritage system rather than a mere sequence of monuments. By adopting a strong sustainability perspective, the framework prioritizes the long-term integrity of heritage capital and the urban conditions that enable tourism use without irreversible degradation.

Methodologically, the model combined AHP and ANP to structure priorities across five dimensions-heritage, environmental, social, economic, and institutional-while a 1-5 rating scale ensured consistent assessment across route components. Where documentary and observational information was insufficient, a



two-round Delphi procedure was used to stabilize ordinal scores using medians and inter-quartile ranges, ensuring transparency and completeness.

The ANP results highlight the predominance of heritage and environmental dimensions, confirming that overall value is primarily driven by conservation-related attributes and by the quality of the urban setting that supports access, legibility, and safe appropriation. Social dynamics also emerge as a major asset, reinforcing the importance of living heritage in sustaining the route. Economic and institutional dimensions, although less dominant, remain crucial as enabling conditions for converting heritage value into territorial benefits.

Beyond its empirical application, this study contributes by developing a fully operational and reproducible evaluation protocol for urban heritage. Its contribution is therefore not limited to a case-specific application: it demonstrates how a sustainability-based multicriteria framework can be implemented in practice through the articulation of weighting, interdependencies, scoring, and expert-based consolidation within a single coherent decision-support structure. In this sense, the study provides a methodological bridge between conceptual heritage valuation and operational urban heritage management.

Limitations relate to the simplified resolution of the 1-5 scale and the unequal availability of fine-grained data. Future work may integrate more detailed quantitative indicators where feasible. Overall, the proposed framework provides a transferable decision-support tool to prioritize interventions for sustainable heritage route management in complex historical urban contexts.

FIG. 7 STRATEGIC GUIDELINES FOR THE SUSTAINABLE ENHANCEMENT OF THE CASBAH OF ALGIERS' HERITAGE TOURISM ROUTE (AUTHORS, 2026)

BIBLIOGRAPHY

1. ALAOUCHICHE, A., NECISSA, Y., BEHIRI, A., MONJO-CARRIÓ, J. and RAMÍREZ-PACHECO, G. (2025) 'Economic valuation of urban heritage: modelling an integrative framework based on sustainability principles', *Prostor: A Scholarly Journal of Architecture and Urban Planning*, 33(2(70)), pp. 248-259. [https://doi.org/10.31522/p.33.2\(70\).6](https://doi.org/10.31522/p.33.2(70).6)
2. ASHWORTH, G.J. and TUNBRIDGE, J.E. (2000) *The Tourist-Historic City: Retrospect and Prospect of Managing the Heritage City*. Routledge. https://books.google.com/books/about/The_Tourist_Historic_City.html?id=1VupAgAAQBAJ
3. BANDARIN, F. and VAN OERS, R. (2012) *The Historic Urban Landscape: Managing Heritage in an Urban Century*. Wiley-Blackwell. <https://doi.org/10.1002/9781119968115>
4. BARBIER, E.B. (1987) 'The concept of sustainable economic development', *Environmental Conservation*, 14(2), pp. 101-110. <https://doi.org/10.1017/S0376892900011449>
5. BASÍLIO, J., FERREIRA, F.A.F., CARAYANNIS, E.G. and FERREIRA, J.J.M. (2022) 'A systematic review of the applications of multi-criteria decision aid methods (1977-2022)', *Electronics*, 11(11), 1720. <https://doi.org/10.3390/electronics11111720>
6. BEIDERBECK, D., FREVEL, N., VON DER GRACHT, H.A., SCHMIDT, S.L. and SCHWEITZER, V.M. (2021) 'Preparing, conducting, and analyzing Delphi surveys: Cross-disciplinary practices, new directions, and advancements', *MethodsX*, 8, 101401. <https://doi.org/10.1016/j.mex.2021.101401>
7. BIERMANN, F., KANIE, N. and KIM, R.E. (2017) 'Global governance by goal-setting: the novel approach of the UN Sustainable Development Goals', *Current Opinion in Environmental Sustainability*, 26-27, pp. 26-31. <https://doi.org/10.1016/j.cosust.2017.01.010>
8. BOUKRATEM, O. and DJELAL, N. (2021) 'Assessment process in the delimitation of historic urban landscape of Algiers by AHP', *Miscellanea Geographica*, 25(1), pp. 1-11. <https://doi.org/10.2478/mgrsd-2020-0053>
9. BOULKEDID, R., ABDLOUL, H., LOUSTAU, M., SIBONY, O. and ALBERTI, C. (2011) 'Using and reporting the Delphi method for selecting healthcare quality indicators: a systematic review', *PLOS ONE*, 6(6), e20476. <https://doi.org/10.1371/journal.pone.0020476>
10. Creative Decisions Foundation (2024) *Super-Decisions software (version gratuite)*. Creative Decisions Foundation. <https://www.superdecisions.com/>
11. DALMAS, L., GERONIMI, V., NOËL, J.-F. and TSANG KING SANG, J. (2014) 'L'évaluation économique du patrimoine urbain et ses enjeux : une approche par la soutenabilité', *Revue d'Économie Régionale et Urbaine*, 5, pp. 843-863. <https://doi.org/10.3917/reru.145.0843>
12. DALMAS, L., GERONIMI, V., NOËL, J.-F. and TSANG KING SANG, J. (2015) 'Economic evaluation of urban heritage: An inclusive approach under a sustainability perspective', *Journal of Cultural Heritage*, 16(5), pp. 681-687. <https://doi.org/10.1016/j.culher.2015.01.009>
13. DELLA SPINA, L. (2020) 'Adaptive Sustainable Reuse for Cultural Heritage: A Multiple Criteria Decision Aiding Approach Supporting Urban Development Processes', *Sustainability*, 12(4), article 1363. <https://doi.org/10.3390/su12041363>
14. DJEDI, H. and BELAKEHAL, A. (2022) 'Les ambiances patrimoniales à l'épreuve de l'appropriation : cas de la Casbah d'Alger', *Bulletin de la Société Géographique de Licge*, 79(2022/2). <https://doi.org/10.25518/0770-7576.7009>
15. FERRETTI, V. and COMINO, E. (2015) 'An integrated framework to assess complex cultural and natural heritage systems with Multi-Attribute Value Theory', *Journal of Cultural Heritage*, 16(5), pp. 688-697. <https://doi.org/10.1016/j.culher.2015.01.007>
16. LABADI, S., GILIBERTO, F., ROSETTI, I., SHETABI, L. and YILDIRIM, E. (2021) *Heritage and the Sustainable Development Goals: Policy Guidance for Heritage and Development Actors*. International Council on Monuments and Sites (ICOMOS), Paris. https://www.icomos.no/wp-content/uploads/2020/08/ICOMOS_SDGs_Policy_Guidance_2021.pdf
17. JOKILEHTO, J. (2006) 'Integrity and authenticity in cultural heritage', *City and Time*, 2(1), pp. 1-16. <http://www.ct.ceci-br.org/novo/revista/docs2006/CT-2006-44.pdf>
18. KYTE, R. (2012) 'Heritage anchors people to their history and culture and builds identity', in Licciardi, G. and Amirtahmasebi, R. (Eds.), *The Economics of Uniqueness: Investing in Historic City Cores and Cultural Heritage Assets for Sustainable Development* (p. xv). Washington, DC: World Bank. <https://doi.org/10.1596/978-0-8213-9650-6>
19. LICCIARDI, G. and AMIRTAHMASEBI, R. (2012) *The Economics of Uniqueness: Investing in Historic City Cores and Cultural Heritage Assets for Sustainable Development*. Washington, DC: World Bank. <https://doi.org/10.1596/978-0-8213-9650-6>
20. LIN, X., SHEN, Z., TENG, X. and MAO, Q. (2024) 'Cultural Routes as Cultural Tourism Products for Heritage Conservation and Regional Development: A Systematic Review', *Heritage*, 7(5),

AUTHORS' BIOGRAPHIES AND CONTRIBUTIONS

- pp. 2399-2425. <https://doi.org/10.3390/heritage7050114>
21. Ministry of Culture of Algeria (2009) *Permanent Plan for the Safeguarding and Enhancement of the Safeguarded Sector of the Casbah of Algiers (PPSMVSS)*. Algiers: Ministry of Culture.
 22. NOCCA, F., BOSONE, M. and ORABONA, M. (2024) 'Multicriteria evaluation framework for industrial heritage adaptive reuse', *Land*, 13(8), 1266. <https://doi.org/10.3390/land13081266>
 23. O'HAGAN, A. (2019) 'Expert knowledge elicitation: subjective but scientific', *The American Statistician*, 73(sup1), pp. 69-81. <https://doi.org/10.1080/00031305.2018.1518265>
 24. OSTROM, E. (2010) 'Beyond markets and states: Polycentric governance of complex economic systems', *American Economic Review*, 100(3), pp. 641-672. <https://doi.org/10.1257/aer.100.3.641>
 25. PUJOL GALINDO, M. D. (2023) *Diseño de un modelo de valoración no monetaria de centros históricos: aplicación al centro histórico de Cartagena*. Tesis doctoral. Universidad Politécnica de Madrid. <https://doi.org/10.20868/UPM.thesis.75789>
 26. PURVIS, B., MAO, Y. and ROBINSON, D. (2019) 'Three pillars of sustainability: in search of conceptual origins', *Sustainability Science*, 14(3), pp. 681-695. <https://doi.org/10.1007/s11625-018-0627-5>
 27. ROSSI, A. (1982) *The Architecture of the City*. Cambridge, MA: MIT Press. <https://archive.org/details/architectureofciooooooross>
 28. RYPKEMA, D. and CHEONG, C. (2011) *Measuring Economic Impacts of Historic Preservation: A Report to the Advisory Council on Historic Preservation*. Washington, DC: PlaceEconomics. https://www.novoco.com/public-media/documents/htc_measuring_economic_impacts_of_historic_preservation_1111.pdf
 29. RYPKEMA, D.D. (2005) *The Economics of Historic Preservation: A Community Leader's Guide*. Washington, DC: National Trust for Historic Preservation. <https://www.placeeconomics.com/resources/the-economics-of-historic-preservation-a-community-leaders-guide/>
 30. SAATY, T.L. (1990) 'How to make a decision: the analytic hierarchy process', *European Journal of Operational Research*, 48(1), pp. 9-26. [https://doi.org/10.1016/0377-2217\(90\)90057-1](https://doi.org/10.1016/0377-2217(90)90057-1)
 31. SAATY, T.L. (2006) 'The Analytic Network Process', in Saaty, T.L. and Vargas, L.G. *Decision Making with the Analytic Network Process: Economic, Political, Social and Technological Applications with Benefits, Opportunities, Costs and Risks*. New York: Springer. https://doi.org/10.1007/0-387-33987-6_1
 32. SAATY, T.L. (2016) 'The analytic hierarchy and analytic network processes for the measurement of intangible criteria and for decision-making', in Greco, S., Ehrgott, M. and Figueira, J.R. (eds.) *Multiple Criteria Decision Analysis: State of the Art Surveys*. 2nd edn. New York: Springer, pp. 363-419. https://doi.org/10.1007/978-1-4939-3094-4_10
 33. SOINI, K. and DESSEIN, J. (2016) 'Culture-sustainability relation: towards a conceptual framework', *Sustainability*, 8(2), 167. <https://doi.org/10.3390/su8020167>
 34. TALUKDER, B. and HIPEL, K.W. (2021) 'Review and Selection of Multi-criteria Decision Analysis (MCDA) Technique for Sustainability Assessment', in Ren, J. (ed.) *Multi-Criteria Decision Analysis for Sustainability Assessment and Engineering*. Green Energy and Technology. Cham: Springer, pp. 125-144. https://doi.org/10.1007/978-3-030-67529-5_7
 35. THROSBY, D. (2012) *The Economics of Cultural Policy*. Cambridge: Cambridge University Press. <https://doi.org/10.1017/CBO9780511845253>
 36. UNESCO (2003) *Convention for the Safeguarding of the Intangible Cultural Heritage*. Paris: UNESCO. <https://ich.unesco.org/en/convention>
 37. UNESCO (2011) *Recommendation on the Historic Urban Landscape, including a glossary of definitions*. Paris: UNESCO. <https://whc.unesco.org/en/hul/>
 38. UNESCO World Heritage Centre (2023) *Kasbah of Algiers*. <https://whc.unesco.org/en/list/565/>
 39. UN-Habitat (2020) *World Cities Report 2020: The Value of Sustainable Urbanization*. Nairobi: United Nations Human Settlements Programme. https://unhabitat.org/sites/default/files/2020/10/wcr_2020_report.pdf
 40. World Bank (2012) *World Development Report 2012: Gender Equality and Development*. Washington, DC: The World Bank. <https://doi.org/10.1596/978-0-8213-8810-5>
 41. ZHANG, K., GONZÁLEZ DEL VALLE-BRENA, A., RAMOS RIERA, I. and ZHAO, J. (2024) 'Ancient routes, new gateways: a systematic literature review of China's cultural route heritage', *Journal of Cultural Heritage Management and Sustainable Development*, 14(2), pp. 266-281. <https://doi.org/10.1108/JCHMSD-06-2021-0114>
 42. ZHANG, S., LIN, J., FENG, Z., WU, Y., ZHAO, Q., LIU, S., REN, Y. and LI, H. (2023) 'Construction of cultural heritage evaluation system and personalized cultural tourism path decision model: An international historical and cultural city', *Journal of Urban Management*, 12(2), pp. 96-111. <https://doi.org/10.1016/j.jum.2022.10.001>

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THEORETICAL AND PRACTICAL ASPECTS OF CRITICAL REGIONALISM IN THE ARCHITECTURAL OEUVRE OF RADOSAV ZEKOVIĆ

KEYWORDS

ARCHITECTURAL HERITAGE
CRITICAL REGIONALISM
MODERNISM
RADOSAV ZEKOVIĆ
YUGOSLAV ARCHITECTURE

ABSTRACT

Radosav Zeković's (1930-2010) architectural oeuvre constitutes a highly significant corpus within Montenegro's modernist legacy. This paper examines the approach through which Zeković, operating amid radical socio-political transformations, transposed the symbolic values of context while striving to articulate spatial and historical continuity. His architectural production is notably diverse, revealing a distinct approach to contextual architectural reasoning that positions him among the most notable proponents of critical regionalism in the region. Through his realized works, Zeković introduced a distinctive, personalized form of modern architecture into Montenegrin cities,

emphasizing the creation of an authentic, locally grounded contemporary urban identity. In some of his works, principles of his mentor's architectural approaches can be observed, as shall be analyzed in the following sections. The aim is to present the architectural oeuvre of Radosav Zeković and emphasize the importance of preserving his buildings as part of the cultural and architectural heritage, especially at a time when Montenegrin cities are exposed to globalization processes that frequently result in the transformation and falsification of identity. In this regard, critical regionalism may hold a crucial role in shaping contemporary architectural practice.

INTRODUCTION

Architect Radosav Zeković (1930-2010), both through his professional biography and architectural oeuvre, occupies a leading position among Montenegrin architects, despite the lack of systematic research covering his complete built work. His most acclaimed projects remain among the most distinguished examples of architecture in Montenegrin cities. This paper identifies the lesser-known architectural corpus of Radosav Zeković. Special attention shall be paid to tourist facilities (hotels), with reference to the spatial framework of cities of that period, in which tourism was the leading development resource, and hotel architecture created the identity of cities. The goal is to demonstrate the architect's place within the modern architectural tradition through the mapped works, while simultaneously highlighting the pronounced characteristics of critical regionalism¹. The objective is to clarify the origins of critical regionalist thought within his oeuvre, which reflects the interaction between global modernist influences and local specificities. By examining the collected material, much of it previously unpublished and provided by the Zeković family, this research reveals the significant role he played in shaping the visual identity of Montenegrin cities and in maintaining the spatial continuity he consistently advocated. The research aims to advance knowledge of Montenegro's architectural heritage and to underscore the impor-

tance of Zeković's oeuvre, whose value exceeds regional boundaries.

As a rare representative of critical regionalism in Montenegro, his work requires adequate protection and valorization, particularly at a time when many of his buildings face removal or inappropriate transformations. The fact that his creative oeuvre has not yet been fully examined highlights the necessity and justification for addressing this topic. Several important contributions² have been published on his distinctive architectural expression, whereby architect Ivica Mladenović, in the book '11 Prominent Architects of Yugoslavia' (Mladenović, 1989), explicitly lists Zeković among the eleven leading Yugoslav architects, affirming his position as one of the most significant authors of that milieu. Similarly, *The Lexicon of Fine Arts of Montenegro* notes that his work captured the attention of distinguished theorists and critics, such as Udo Kultermann, who highlighted Zeković as an especially important architect within the Yugoslav context in his book *Zeitgenössische Architektur in Osteuropa* (Mitrović, 2021).

The methodological framework is based on a combination of approaches grounded in a comparative analysis of both theoretical and practical examples to identify the genetic code and contextual elements embedded in his modernist reasoning. Therefore, it is important to reconsider the concepts and methods advanced by theorists of critical regionalism. Rural, traditional (vernacular) architecture is approached as a source of underlying principles rather than formal models, whose reinterpretation allows for continuity instead of rupture. In this sense, the Mediterranean is understood as a space that mediates between universal modernism and local identity (Lejeune and Sabatino, 2009). Critical regionalism represents a form of resistance to the homogenization and uniformity of global architecture, safeguarding regional cultural identity while maintaining a strong connec-

¹ Critical regionalism: The roots of the philosophy of critical regionalism go back to the phenomenology of French theoretician Paul Ricour, and its theoretical basis was developed in the works of architect Christian Norberg-Schulz (1963), *Intentions in architecture; Genius Loci: Towards a Phenomenology of architecture* (1980), as well as in theorists Frampton, K. (1983). *Towards Critical Regionalism: Six Points for an Architecture of Resistance*. In *The Anti Aesthetic: Essays on Postmodern Culture, and Archetypes in Architecture*, 1987 by Thomas Thiis-Evensen.

² Manević, 2000; Markuš, 2008: 84-88; Stiller, 2013; Radonjić, 2021.

³ Born on June 28, 1930 in Slatina near Andrijevica (Montenegro). He was arrested as a high school student at the age of 18 and spent several years as a political prisoner on Goli Otok, from which he returned with a disability and consequently spent two years in a

tion to the local context (Canizaro, 2007). Canizaro refers to this as a *sense of place*, emphasizing the importance of spatial experience as well as the authenticity of materials and construction techniques, which is clearly evident in several of Zeković's works. Ranko Radović argues that every new space should evoke curiosity, invite exploration, and encourage interaction (Radović, 1990), thereby rendering space dynamic and open to the unexpected. Regionalist theorists have long emphasized the importance of a sense of belonging to place, which reinforces spatial identity (Umbach and Huppau, 2005). In this regard, an approach that mediates between vernacular values and global modernist tendencies emerges as key to articulating an architectural language. This ultimately suggests that modernism should not be understood as a fixed style, but rather as a heterogeneous and open-ended framework of responses (Umbach and Huppau, 2005).

REVIEWING THE ARCHITECTURAL LEGACY OF RADOSAV ZEKOVIĆ

To understand Zeković's architectural approach, it is necessary to consider his distinctive biographical trajectory³, which shaped his diverse architectural production. He enrolled at the Faculty of Architecture in Sarajevo in 1956, where Professor Juraj Neidhardt (1901-1979), a student and later colleague of German architect Peter Behrens (Vienna, 1930-32), quickly recognized his exceptional talent. Under Neidhardt's mentorship, Zeković completed his diploma project on 28 June 1960, designing the "Ivangrad" Hotel (today Hotel Berane), constructed two years later on the banks of the Lim River, which serves as a central case study for this research.

At the age of thirty, he declined the opportunity to pursue an academic career and returned to his hometown to establish the Urban Planning Institute of Ivangrad. The late

hospital in Rovinj. After that, he enrolled in the program study Yugoslav literature at the Faculty of Philology in Belgrade, and published a couple of significant literary works, *Tales from Bare Island* (1998); *Devil's Time* (2000); *Silent Hell* (2008).

⁴ Božidar Milić, one of the authors of the book: "Architecture of the 20th Century", states: "In the 1960s and early 1970s, generations of Montenegrin architects graduated from Yugoslav universities (Belgrade, Zagreb, Ljubljana, and Sarajevo) who took a leading role in the urbanism and architecture of Montenegro. Its most important representatives are: Bajo Mirković, Ksenija Radović, Nada Radović, Anđelija Pavicević, Đorđije Minjević, Milorad Vukotić, Vukota Vukotić, Jovan Milošević, Božidar Milić, Ilija Šćepanović, Slobodan Vukajlović, Svetlana-Kana Radević, Milan Popović, Pavle Popović, Mileta Bojović, Batrić Mijović, Milorad Petijević, Vasilije Knežević, Vladimir Plamenac, Radosav Zeković, Nikola Drakić, Predrag Dmitrović."



1950s and early 1960s marked a formative period of Montenegrin architecture, as many architects returned to Montenegro and later came to define its architectural identity⁴. During his tenure at the Urban Planning Institute (1960-1968), Zeković designed and built numerous projects, representing Montenegro in the international project "South Adriatic." In 1968, he relocated to Belgrade and founded an architectural office within the foreign trade company *Industrija Import Titograd*, which later evolved into the design bureau *Beoplan*. From 1990 until his retirement in 1997, he worked at *Kablar Engineering*, contributing to a series of projects in Russia and Ukraine (Radonjić, 2021).

This research focuses primarily on Zeković's architectural oeuvre realized in Montenegro, which encompasses some of the most valuable works of Montenegrin architectural heritage. His dispersed architectural production is dominated by tourist facilities particularly in northern Montenegro, which, through their form and siting, have become identity markers of their respective urban contexts. Among his most notable works are: the "Ivangrad" Hotel (diploma project, completed 1962); Motel Jelovica, near Berane (1963); Hotel Sandžak, Phase I in Bijelo Polje (1967) and Phase II, co-authored with Z. Petrović and A. Radojević (1972); Hotel Rožaje in Rožaje (1971); Hotel Bjelasica in Kolašin (1979); Motel Petnjica, co-authored with Ervin Zeković (1986); and Motel Lokve in Berane (1980-1986).

His impressive oeuvre also extends to commercial and public buildings. Notably, Business Complex with Bank in Ivangrad (Fig. 1.a.), co-authored with Zlatko Ugljen and J. Finci (designed in 1966, completed in 1979), demonstrating the dynamic and collaborative character of the Yugoslav architectural scene. In addition, he designed the Terminal Building of Berane Airport (1963) in Ivangrad (today Berane). Zeković's remarkable versatility across architectural typologies is evidenced by his authorship of numerous mixed-use residential and commercial buildings, as well

FIGURE 1 A. BANK IN IVANGRAD, 1966-1979; B. RESIDENTIAL AND COMMERCIAL BUILDING IN BIJELO POLJE

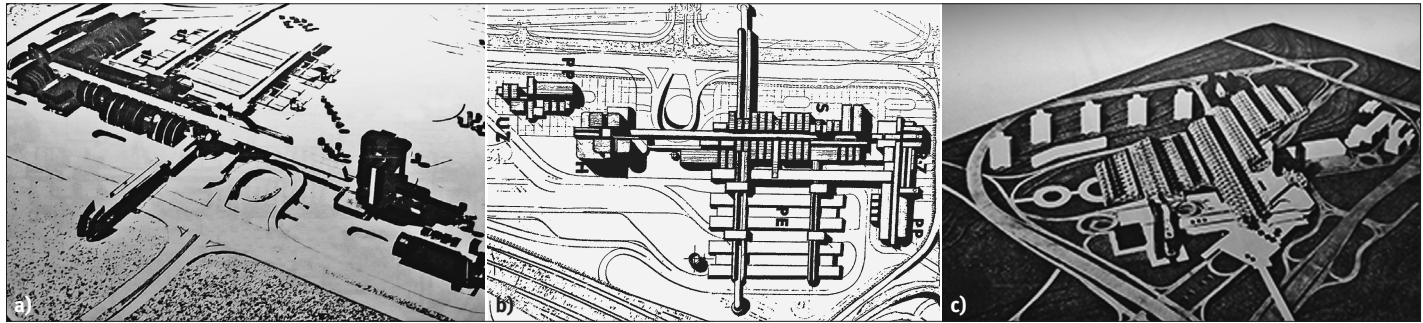


FIGURE 2 A. COMPETITION, 2ND PRIZE, "JUG" BUS STATION, BELGRADE, MODEL 1977; B.C. COMPETITION ENTRY FOR THE PROKOP RAILWAY STATION IN BELGRADE, 3RD PRIZE

as residential complexes throughout Yugoslavia. Notable examples include the residential complex opposite the bank in Ivangrad (1966) and a distinctive mixed-use residential building in Bijelo Polje (Fig. 1.b.), co-authored with Ervin Zeković (1982-1988).

Zeković's active engagement in northern Montenegro also led to the construction of the Veletrgovina commercial building in Kolašin (1983). Among his administrative projects, the headquarters of the Central Committee of the League of Communists of Montenegro (CKSKCG)⁵, for which he obtained the Republic "Borba" Award for Architecture in 1979 (Kolacio, 1980b). Although this building is not the subject of this research, as it does not belong to critical regionalism, it is important to highlight its significance as the crown of Zeković's oeuvre. This project demonstrates that the architect had a profound understanding of the principles of modern architecture that dominated Yugoslav cities at the time, particularly in the representative building of Central Committee of the League of Communists of Yugoslavia (CK SKJ Novi Beograd, 1964), CK SKH Zagreb (1963-68), CK SK Skoplje (1968-1970). In this building, Zeković showcased his mastery of the language of functional and spatially expressive modernism, clearly connecting his work to the broader context of Yugoslav modernism between the two world wars, while also confirming his ability to apply contemporary architectural principles in an ambitious significant state building. The distinguished Croatian architect Zdenko Kolacio reviewed this building in the journal *Arhitektura*, offering a critical assessment of its architectural expression (Kolacio, 1980a). Architectural theorist Adolf Stiller further evaluated the building as an exceptional work of modern architecture, not only within the Yugoslav context but on the European scale⁶.

He also produced multiple competition entries that received international recognition, including the Belgrade Bus Station project, awarded Third Prize (co-authored with Aleksandar Đokić, 1977), as well as the design proposal for the Prokop Railway Station in

Belgrade (Fig. 2). These projects reveal a continuity in addressing formal and spatial challenges, exemplified by Zeković's strategies of volumetric hierarchy and spatial organization, particularly evident in the CKSKCG building in Titograd (Fig. 3).

Zeković's oeuvre, in addition to receiving the Borba Award, earned him numerous professional and state recognitions⁷. A special acknowledgment of his architectural contribution lies in the exhibitions where his projects were presented to an international audience: Vienna (2013), MoMA New York (2018), and the 14th Venice Architecture Biennale. He passed away in Belgrade on 28 June 2010, after fifty years devoted to architectural practice.

The following section provides a tabular overview of all available architectural works of architect Zeković, including both realized and unrealized projects, as well as those in which he participated as a coauthor. However, in the subsequent discussion, only those works that feature elements of critical regionalism shall be analyzed, as they represent a significant and key contribution of Zeković to Montenegrin architecture, which is also the subject of this paper.

THE INFLUENCE OF THE SARAJEVO SCHOOL OF ARCHITECTURE AND JURAJ NEIDHARDT ON THE MODERNIST OEUVRE OF RADOSAV ZEKOVIĆ

As previously noted, upon returning to Ivangrad from Sarajevo, Zeković was presented with the opportunity to construct the city's central hotel. A series of circumstances led to

⁵ As a very young architect, at the Yugoslav architectural competition, Zeković won the prestigious first prize, which was followed by the realization in 1975 – 1979. The jury, consisting of architects Pavle Popović, Novak Jovović, Spir Milević and editor Slavko Vukasinović, particularly emphasizes the project due to its clear functional approach, consistent design, rational use of materials, respect for the quality of the location and adaptation to contemporary needs, Borba (Kolacio, 1980a).

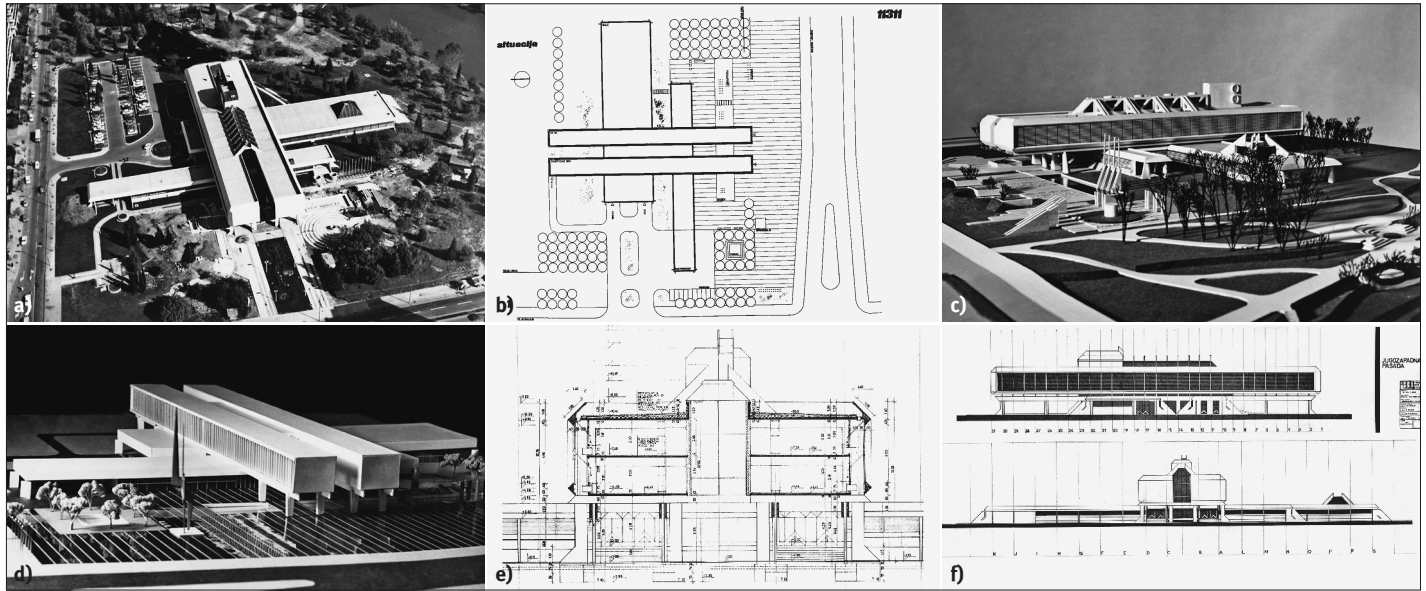


FIGURE 3 A. BUILDING OF THE CENTRAL COMMITTEE OF THE LEAGUE OF COMMUNISTS OF THE SOCIALIST REPUBLIC OF MONTENEGRO, TITOGRAĐ, REALIZATION; B. DRAWING, SITE PLAN; C. MODEL; D. MODEL OF THE COMPETITION ENTRY; E. SECTION; F. FACADE VIEWS

the realization of his diploma project, with certain modifications, in 1962. The building was among the first in that region of Montenegro to display marked modernist features, amid an urban fabric long defined by Ottoman and traditional Montenegrin vernacular influences. Zeković's inaugural architectural gesture thus embodied a radical modernist approach: a pure cubic volume positioned along the riverbank of the Lim (Fig. 4.a.b.). He aligned the building with the linearity of the riverbank, accentuating it through a deep ground-floor canopy, evocative of prominent architectural references of the period. This gesture visually separates the hotel room block above, establishing a strong and dominant base within the urban landscape.

In the context of openness to the functionalist tendencies of the time, the deep eaves of the restaurant terrace of the Hotel Berane, its rational function and strong façade grid, suggest possible analogies with the works of the modernists whose postulates were adopted by his teacher Neidhardt, as well as with certain examples of modern Dutch architecture, especially in the treatment of horizontality and pronounced structural articulation. This can be seen through the rational organization of the functional program, which will also

be represented in all subsequent projects, as typical for modernist functionalism. Zeković can be analyzed as part of the wider System of Yugoslav tourist architecture, whereby his solutions confirm or partially interpret given typological and spatial patterns, which can be seen in the theoretical analyzes of Bao Zhi Fang (Zhi Fang, 1983). All his hotels have a clear functional organization, plan of rooms, public spaces, while the facade, roofs and materials reflect vernacular elements and local values. Zeković's modernist approach in the diploma project likely rooted in the direct influence of his mentor Juraj Neidhardt, widely recognized as the ideological successor of Le Corbusier in the Balkans. Le Corbusier in the preface of the book 'Architecture of Bosnia and the way of modernity' criticized folklore and imitative approaches and emphasized the importance of the design method: 'The method of continuity of spirit, continuity of evolution, including the revolution that marks that path' (Gabrijan and Neidhardt, 1957: 7). In the framework of the overview of Bosnian architecture of the 20th century, Neidhardt is considered a key figure in connecting modernism with regional tradition (Manevic et al., 1986). However, Neidhardt's critical interpretation of modernism did not accept the universal modernist language literally; but rather, he adapted it to the local context, climate, and cultural patterns, demonstrating sensitivity toward local tradition and material authenticity (Novaković, 2024). Neidhardt employed regional natural and cultural characteristics, such as topography, landscape, ambience, instead of applying a uniform modernist formula (Zatric, 2024). Parallels in the treatment of form, particularly

6 The building of the CKSKCG (2013) was exhibited at the exhibition titled Montenegro: Kontrast Landschaft, Architecture of Montenegro in Vienna, and Adolf Stiller was the curator of the exhibition.

7 Ivankograd "July 21" Award (1966); Rozaje SO "September 30" award (1972); Award of SO Kolasin "December 29" (1979); Large plaque of the Association of Fighters of Yugoslavia (SUBNOR) "for monuments and memorials"... He was also a prominent member of the Association of Serbian Architects (ASA).

TABLE I OVERVIEW OF ALL RADOSAV ZEKOVIC’S AVAILABLE PROJECTS

Architectural project	Location	Year of realization	Status
Hotel “Ivangrad” (diploma project)	Berane (formerly Ivangrad), Montenegro	1962	Modified In use
Motel Jelovica	Near Berane, Montenegro	1963	Not in use
Terminal Building of Berane Airport	Berane, Montenegro	1963	Devastated Not in use
Hotel Sandzak, Phase I co-authored with Z. Petrovic and A. Radojevic	Bijelo Polje, Montenegro	1967	Modified Not in use Commercial/restaurant use only
Residential buildings settlement Bele Vode (co-authorship with Dobrivoje Miljevic, project organization Industrija import Inzenjering)	Belgrade, Serbia	1970	In use
Hotel Rozaje	Rozaje, Montenegro	1971	Modified Not in use
Hotel Sandzak, Phase II, co-authored with Z. Petrovic and A. Radojevic	Bijelo Polje, Montenegro	1972	Modified Not in use Commercial/restaurant use only
The Otoka Hotel project, (co-authored with Vesna Vuica)	Durmitor, Žabljak, Montenegro	1972 Unrealized project	Unrealized project
Prokop Railway Station in Belgrade (Co-authors with unknown team, according to the information from Ervin Zekovic)	Belgrade, Serbia	1975 Competition entries Awarded Third Prize Unrealized project	Competition entry – Third Prize Unrealized project
Bus Station “Jug” Belgrade (co-authored with Aleksandar Dokic and collaborators)	Belgrade, Serbia	1977 Competition entries Awarded Third Prize Unrealized	Competition entry – Third Prize Unrealized project
Central Committee of the League of Communists of Montenegro (CKSKCG) Republic “Borba” Award for Architecture (Kolacio, 1980b)	Podgorica, Capital of Montenegro	1979	Functional transformation *Currently undergoing adaptation and conversion into a facility for the Special State Prosecutor Building (procurement/tendering process ongoing).
Hotel Bjelasica	Kolasin, Montenegro	1979	Modified In function
Business Complex with Bank co-authored with Zlatko Ugljen and J. Finci	Berane (former Ivangrad), Montenegro	1979	In function
Reconstruction of the prewar hotel Komovi	Andrijevica, Montenegro	1982	In function
Commercial building “Veletrgovina”	Kolasin, Montenegro	1983	In function
Mixed-use residential building, co-authored with Ervin Zekovic	Bijelo Polje, Montenegro	1982-1988	In function
Motel Petnjica, co-authored with Ervin Zekovic	Petnjica, Montenegro	1986	Not in function

the pronounced separation between the ground floor and the upper volumes, can be observed in Neidhardt’s Faculty of Philosophy building in Sarajevo (Fig. 4.c.), while the specificity of this influence is further evidenced in his reinterpretation of the Bosnian house (Fig. 4.d.).

A similar architectural method can be identified in Neidhardt’s Hotel Metalurg in Zenica (1967) (Fig. 4.e.), particularly in its pronounced linear podium from which accommodation units rise, articulated through repetitive windows and balconies, parallels that resonate with Zekovic’s approach in Hotel Berane. These correspondences indicate shared modernist design principles characteristic of the period. The significance of the Hotel Berane project lies primarily in its introduction of architectural modernism to northern Montenegro, a context in which such a

language had not previously existed. Although early in his career Zekovic strongly displayed modernist influences shaped during his studies in Sarajevo, his subsequent architectural responses in northern Montenegro increasingly incorporated elements of critical regionalism, grounded in contextual sensitivity. Zekovic neither applied modernist principles uncritically nor romanticized tradition; rather, he remained attentive to the overwhelming natural context of the northern region, which profoundly influenced his spatial perception and architectural expression. This approach is further exemplified in his award-winning design for the republican competition organized by the Association of Architects of Montenegro for the CKSKCG building in Titograd (Fig. 3). While the building appears to be a quintessential modernist and structuralist work, the conceptual sketch

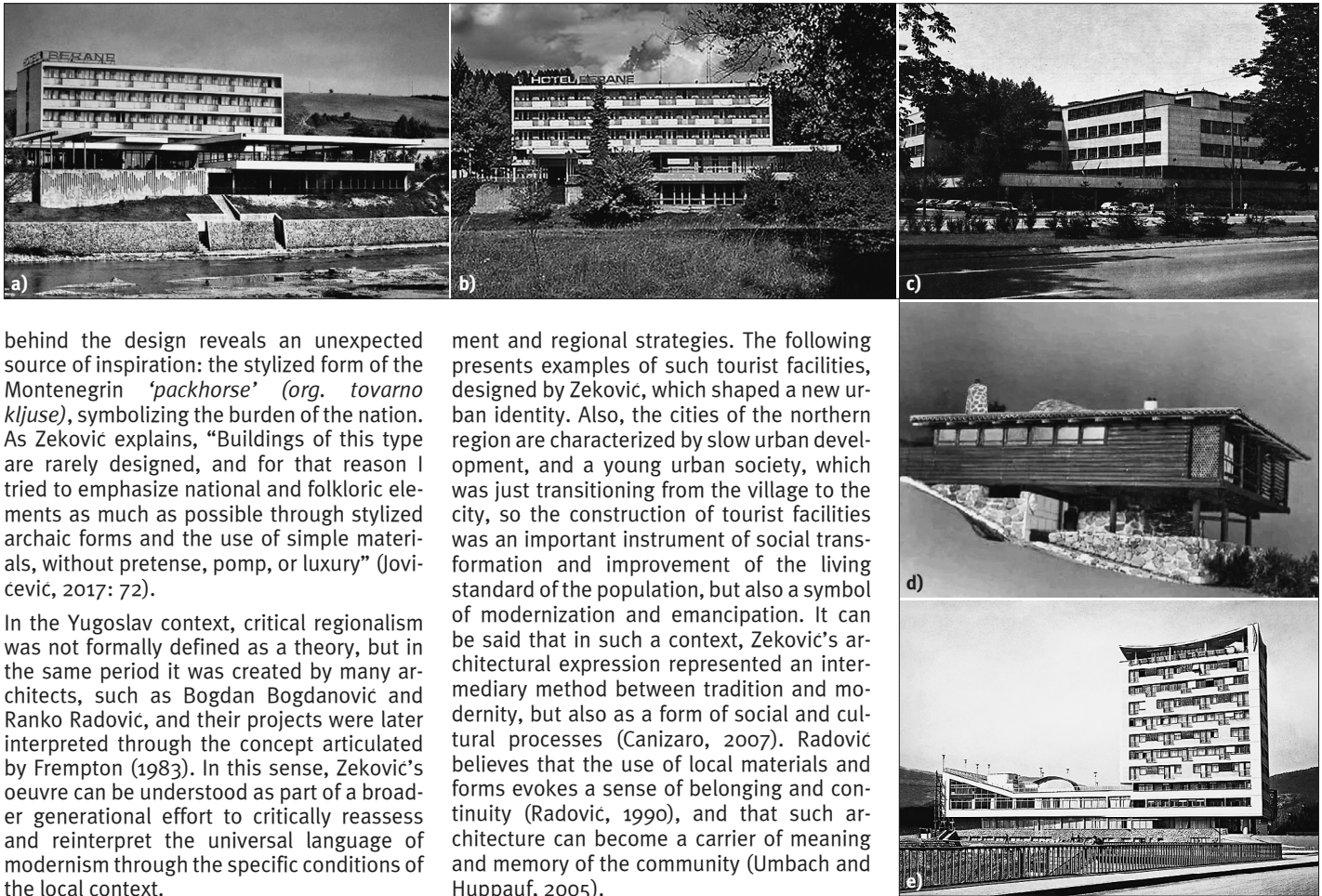


FIGURE 4 A.B. HOTEL IVANGRAD, REALIZED DIPLOMA PROJECT; C. FACULTY OF PHILOSOPHY, SARAJEVO (1959); D. SKI HOUSE ON TREBEVIĆ; E. HOTEL METALURG, ZENICA (1967).

behind the design reveals an unexpected source of inspiration: the stylized form of the Montenegrin *'packhorse'* (*org. tovarno kljuse*), symbolizing the burden of the nation. As Zeković explains, "Buildings of this type are rarely designed, and for that reason I tried to emphasize national and folkloric elements as much as possible through stylized archaic forms and the use of simple materials, without pretense, pomp, or luxury" (Jovičević, 2017: 72).

In the Yugoslav context, critical regionalism was not formally defined as a theory, but in the same period it was created by many architects, such as Bogdan Bogdanović and Ranko Radović, and their projects were later interpreted through the concept articulated by Frempton (1983). In this sense, Zeković's oeuvre can be understood as part of a broader generational effort to critically reassess and reinterpret the universal language of modernism through the specific conditions of the local context.

CRITICAL REGIONALISM AND THE USE OF METAPHOR AS A RESPONSE TO CONTEXT

To better understand Zeković's architecture, it is necessary to give a brief overview of the socio-spatial context in the cities where he built, but also to analyze the key methods of critical regionalism, which Zeković knew and applied.

Tourism development in the SFRJ was a fundamental factor shaping architecture and urbanism, where tourist facilities became not only functional accommodation capacities but also strong visual and symbolic markers of urban identity, particularly during periods of intensified tourism policies and planning after World War II (Antešević, 2022). Antešević emphasizes that the intensive construction of such facilities was linked to ambitions for socio-economic development through tourism. This is clearly reflected in the Northern Montenegrin context, whereby in the decades after the 1950s, dominant hotel facilities emerged as instrument of local develop-

ment and regional strategies. The following presents examples of such tourist facilities, designed by Zeković, which shaped a new urban identity. Also, the cities of the northern region are characterized by slow urban development, and a young urban society, which was just transitioning from the village to the city, so the construction of tourist facilities was an important instrument of social transformation and improvement of the living standard of the population, but also a symbol of modernization and emancipation. It can be said that in such a context, Zeković's architectural expression represented an intermediary method between tradition and modernity, but also as a form of social and cultural processes (Canizaro, 2007). Radović believes that the use of local materials and forms evokes a sense of belonging and continuity (Radović, 1990), and that such architecture can become a carrier of meaning and memory of the community (Umbach and Huppau, 2005).

Following the completion Hotel Berane, he demonstrated a more mature approach, less rigidly modernist and more deeply contextual. An analysis of his most notable projects, discussed in the following sections, reveals that he did not employ predefined design mechanisms or typological formulas, which explains the remarkable diversity of his architectural oeuvre, encompassing various forms and expressions. A key determinant of this diversity was the influence of nature, which played a decisive role in shaping his architectural language (Mitrović, 2021). His architecture does not seek reference in pre-existing models; rather, it emerges from a nuanced reading of local and natural contexts, whose programmatic requirements he masterfully composes into expressive architectural forms. Thus, his oeuvre, highly varied and never repetitive, represents a synthesis of place and the architect's ability to render it in spatially distinct manifestations. This explains why his hotel architecture in northern Montenegro is defined by strong and dynamic forms. Although he consciously introduced recognizable traditional motifs, he simultaneously

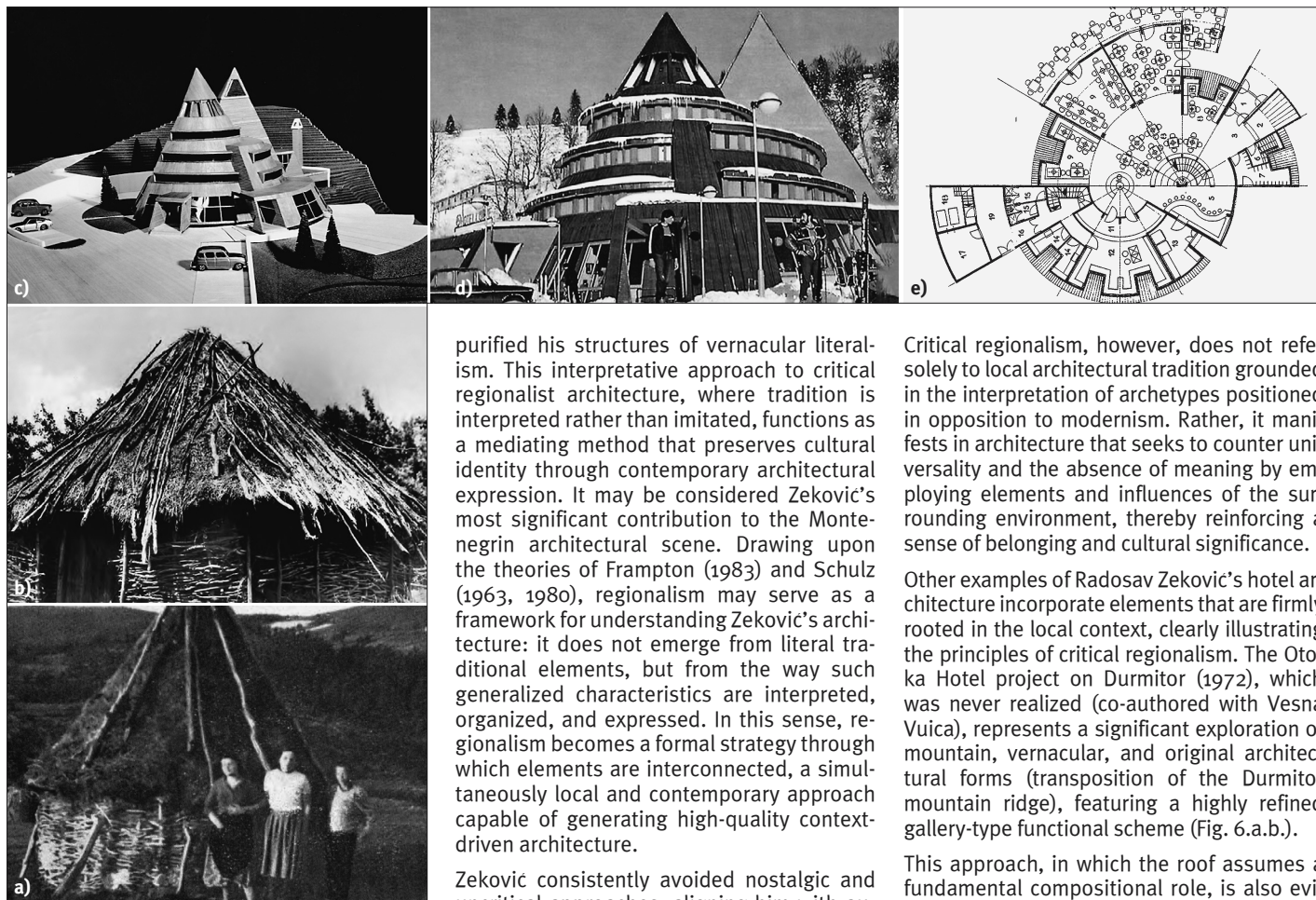


FIGURE 5
A. THE PLOTTER'S HOUSE IN THE VILLAGE OF DRAGOSAVA NEAR BERANE;
B. DUBIROG IN BIHOR;
C. HOTEL, LOKVE: MODEL;
D. HOTEL LOKVE: BUILT FORM;
E. HOTEL LOKVE: TYPICAL FLOOR PLAN

purified his structures of vernacular literalism. This interpretative approach to critical regionalist architecture, where tradition is interpreted rather than imitated, functions as a mediating method that preserves cultural identity through contemporary architectural expression. It may be considered Zeković's most significant contribution to the Montenegrin architectural scene. Drawing upon the theories of Frampton (1983) and Schulz (1963, 1980), regionalism may serve as a framework for understanding Zeković's architecture: it does not emerge from literal traditional elements, but from the way such generalized characteristics are interpreted, organized, and expressed. In this sense, regionalism becomes a formal strategy through which elements are interconnected, a simultaneously local and contemporary approach capable of generating high-quality context-driven architecture.

Zeković consistently avoided nostalgic and uncritical approaches, aligning him with authors of '*mediatory regionalism*' such as his colleague Zlatko Ugljen, also a student of Juraj Neidhardt. Ugljen's work embodies 'a profound engagement with the intersection of regional identity and universal architectural values', synthesizing traditional principles with modernist expression through a continuous interplay of spatial and cultural meanings (Bradić, 2025). He cultivated a restrained, resistant form of modernism, a quality also found in Zeković's work, where stylized archaic forms reinterpret the robust morphology of the Dinaric landscape.

The hotel typology provided Zeković with a flexible framework for experimentation with form and materialization, resulting in sculpturally expressive works that deeply shaped the visual identity of the cities in which they were constructed. This approach is particularly evident in the Motel Lokve (1980-1986), conceived as a reminiscence of the traditional *dubirog-savardak* (Fig. 5.a.b.), marking a phase in which the architect began transposing traditional spatial schemes and forms into a contemporary architectural language (Fig. 5.c-e.).

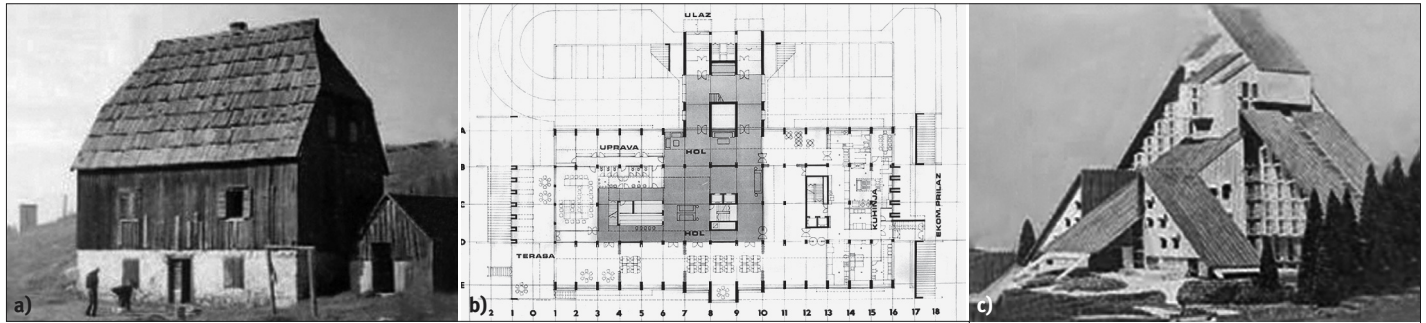
Critical regionalism, however, does not refer solely to local architectural tradition grounded in the interpretation of archetypes positioned in opposition to modernism. Rather, it manifests in architecture that seeks to counter universality and the absence of meaning by employing elements and influences of the surrounding environment, thereby reinforcing a sense of belonging and cultural significance.

Other examples of Radosav Zeković's hotel architecture incorporate elements that are firmly rooted in the local context, clearly illustrating the principles of critical regionalism. The Otoka Hotel project on Durmitor (1972), which was never realized (co-authored with Vesna Vuica), represents a significant exploration of mountain, vernacular, and original architectural forms (transposition of the Durmitor mountain ridge), featuring a highly refined gallery-type functional scheme (Fig. 6.a.b.).

This approach, in which the roof assumes a fundamental compositional role, is also evident in the design of the Petnjica Motel (1986), a collaboration between Radosav Zeković and Ervin Zeković. In this project, the architects drew upon dominant elements of the Petnjica landscape and the traditional houses of the Bihor region. These influences are expressed through the adoption of a massive, hipped roof, effectively transposing the archetype of the local vernacular house into a larger-scale architectural articulation.

Conversely, the "Bjelasica" Hotel in Kolašin (1979) appears as a conceptual extension of the Otoka project, the outcome of the collaborative team of Radosav Zeković and Đorđe Mitrović. The dynamically modeled form of Hotel Bjelasica shaped in response to the Bjelasica mountain range (Fig. 7.b.) and the prominent peaks of the Kolašin landscape, exhibits a pyramidal reduction towards an imagined ridgeline (Fig. 7.b.). It is noteworthy that Zeković's design constituted a reconstruction of the former Bjelasica Hotel (Fig. 7.a.).

This contextual response is again guided by the mountain environment, while the architect surprises with specific details within the composition, such as the honeycomb geom-



etry of the window openings (Fig. 8.a-f.). His affinity for natural forms occasionally renders his architecture nearly organic. The triangular form embodies the principles of critical regionalism, invoking the local landscape, climate, and traditional vernacular construction of the region. The design presents a futuristic interpretation of the traditional wooden hut or ski lodge, enriched with visionary elements of modern architecture.

A similar approach is evident in Zekovic's design for the Rožaje Hotel, positioned to define the urban street front and mediate between the main pedestrian zone and the town square. In this composition, two strong pyramidal volumes are positioned in linear succession, with shifting roof planes that depict the dominant mountainous landscape surrounding Rožaje more convincingly and metaphorically (Fig. 9.a-d.). This procedure ensures harmony and spatial unity, and the physiognomy of small, picturesque agglomerations such as Rožaje can be preserved (Petrović, 1967). The design also demonstrates a deliberate reinterpretation of the "group form" principle, characteristic of the traditional city center (*carsija*), by reworking the typology of the traditional house into a new contemporary architectural expression.

Particular attention is warranted by the Hotel Sandžak in Bijelo Polje (Fig. 10.a-f.), where Zekovic, in collaboration with Zoran Petrović and Aleksandar Radojević, creates a dominant architectural and visual landmark of the town through specific geometry, volumetry, and height. Like the Hotel Berane, the Sandžak Hotel (today known as Hotel Bijela Rada), consists of two clearly articulated parts: a base housing commercial and service functions, and a tower accommodating guest rooms. The lower volume forming the pedestal of the vertical belongs to a distinctly modernist architectural language, featuring a large terrace with colonnades and a canopy, reminiscent of the solution at Hotel Berane. The verticality of Hotel Sandžak does not conceal its aspiration to become the town's leading height and visual reference point; on

the contrary, it asserts itself prominently with its rotated façade facing the town square, engaging directly with Slobode Street and the wider urban fabric. Such architectural decisions confirm Zekovic's awareness of the architect's evolving role in response to contemporary urban challenges, as he himself articulated in reflections on design and urbanism (Mladenovic, 1982: 105). Alihodžić Jašarović (2021: 148) further emphasizes in her doctoral dissertation that Zekovic's buildings functioned as recognizable spatial landmarks, generating a clear visual identity, embodying modernity, and serving as symbols of development, thereby elevating the urban character of former small settlements into the status of cities.

Zekovic's architectural philosophy, often expressed through dramatic roof geometries contrasted with simplified base volumes, may be traced to the visual character of historical towns, whereby the dominant composition was shaped by the roofs of residential houses. Through the abstraction of such imagery and the creation of a new composition, again employing the principle of "group form", a result emerges that can be clearly observed in the upper levels and roof capes of Hotel Sandžak. A deeper compositional analysis reveals elements of traditional architecture, such as *doksat* (bay window), transposed into an idealized linearity that appears in nearly all his projects.

In the summary of conclusions, and in accordance with the previously mentioned meth-

FIGURE 6 A. TRADITIONAL DURMITOR HOUSE; B. OTOKA HOTEL, 1972: PLAN AND ELEVATION; C. OTOKA HOTEL DRAWING; D. HOUSE TYPES IN RŽANICA: AN OLD LOG HOUSE COVERED WITH STRAW AND A NEWER STONE HOUSE WITH SHINGLE ROOF (SOURCE: LUTOVAC, 1957); E. PETNJICA HOTEL, 1986

FIGURE 7 A. ORIGINAL BJELASICA HOTEL PRIOR TO ZEKOVIC'S INTERVENTION; B. TRADITIONAL HOUSE IN THE BJELASICA HIGHLAND SETTLEMENT



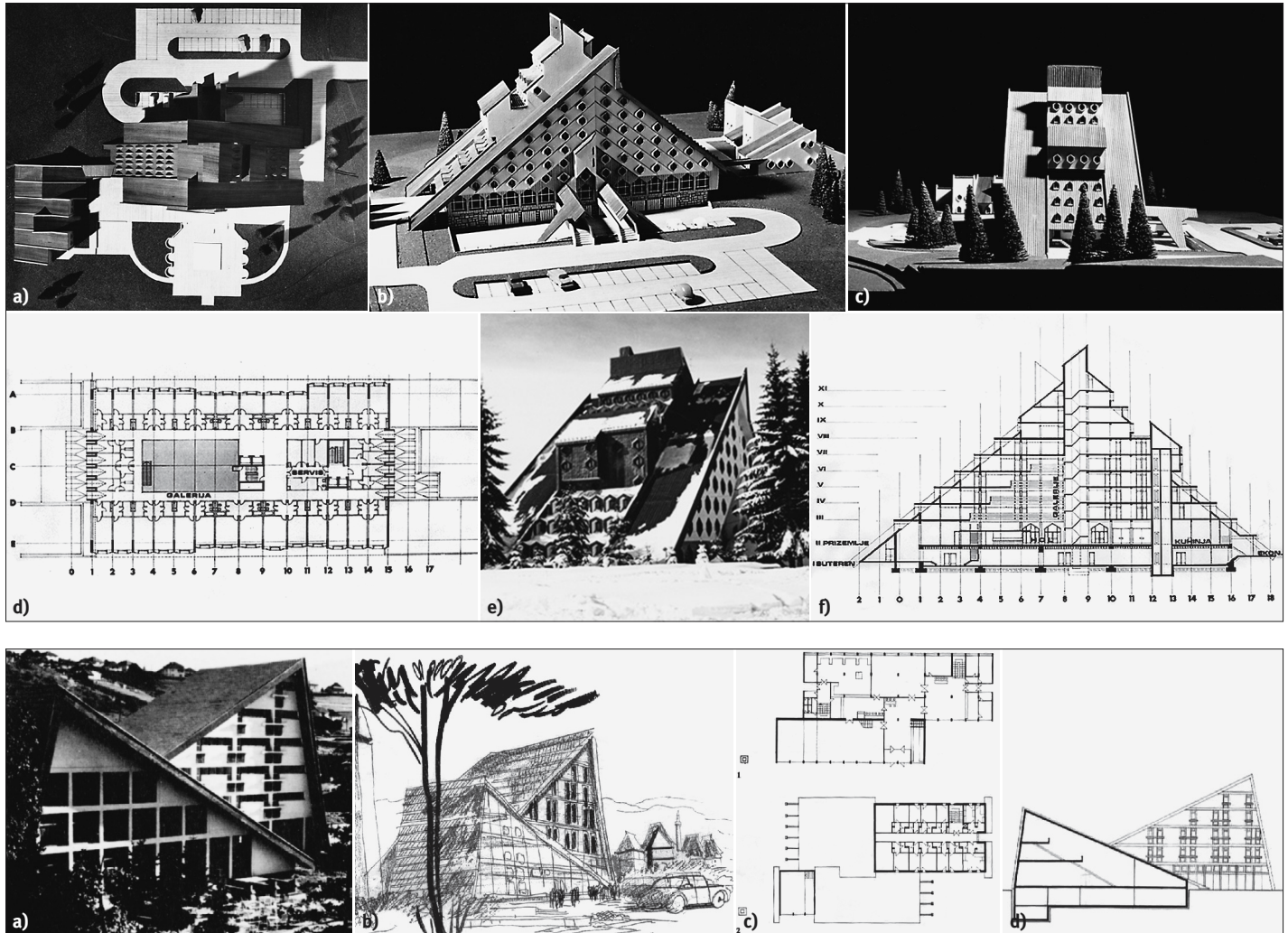


FIGURE 8 A. B. C. MODELS OF HOTEL BJELASICA;
D. TYPICAL FLOOR PLAN; E. BUILT FORM;
F. CHARACTERISTIC SECTION

FIGURE 9 A. HOTEL ROŽAJE (MLADENOVIC, 1989);
B. PERSPECTIVE; C.1. PLAN OF THE GROUND FLOOR;
C.2. PLAN OF THE 2ND FLOOR; D. SECTION
AND ELEVATION (PETROVIĆ, 1967)

ods of critical regionalism, we can conclude that Zeković applied and combined the following principles of critical regionalism:

a) Dialogue: mediation between universal modernism and local / tradition – we can name this principle regionally sensitive functionalism. This method is read in the form of clear, functional plans and rational constructions, whose form becomes sensitive to the local context and genius loci. It can also be read in the realization of social and cultural continuity. (*Hotel Berane, Bank Berane, Building of the Central Committee of the Union of Communists of the SR of Montenegro*);

b) Sense of place: interpretation of the vernacular tradition – listening to the topographical and climatic context, especially in the cities of the northern region. Adoption of local constructive methods and stylistic characteristics. Dynamic shaping of volumes and spatial organization in accordance with the local landscape (*Hotel Lokve, Hotel Bjelasica, Hotel Rožaje, Motel Petnjica, Hotel Durmitor, Residential and commercial building in Bijelo Polje*);

c) Materiality – emphasizing local architectural culture and techniques, as well as the use and interpretation of local materials (*Hotel Lokve*).

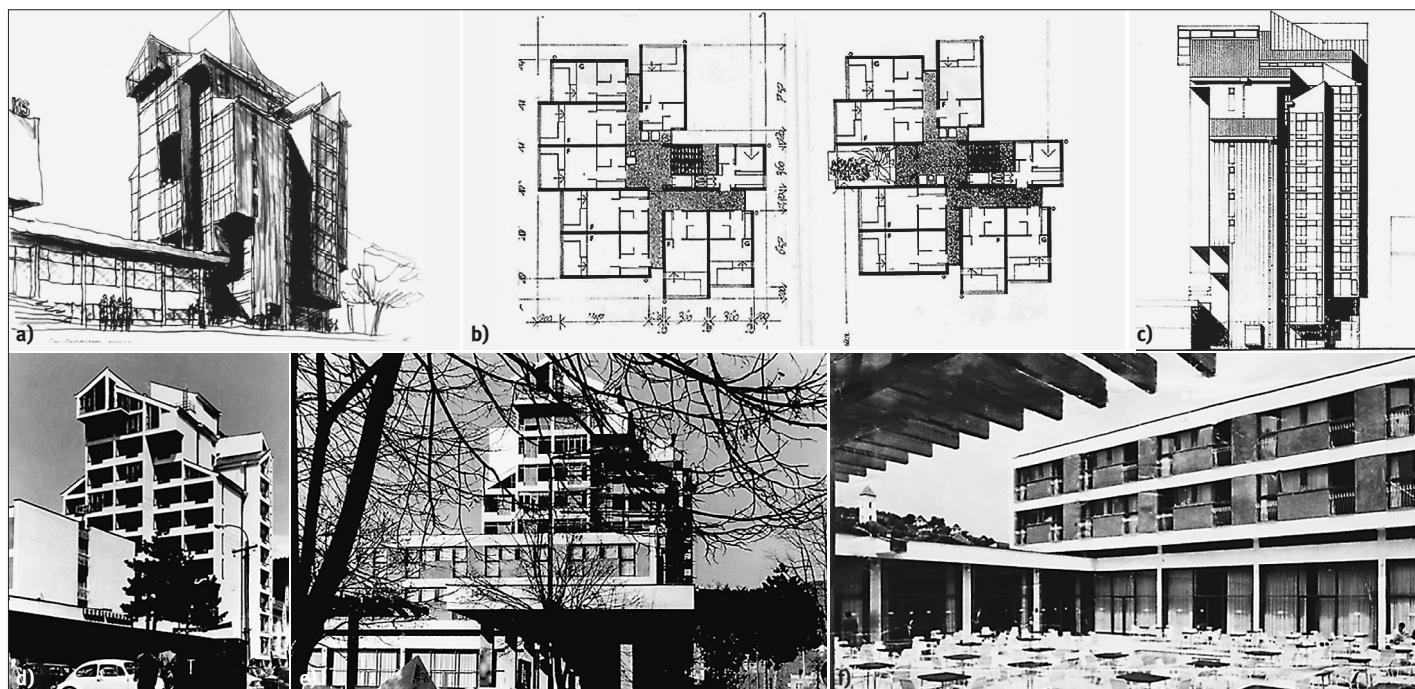


FIGURE 10 HOTEL SANDŽAK: A. DRAWING BY ALEKSANDAR RADOJEVIĆ; B. TYPICAL FLOOR PLANS; C. FACADE; D.E.F. BUILT FORM

Despite their unquestionable value, many of his buildings are nowadays faced with threats of demolition, inappropriate alterations, and neglect (Table I). Dealing with the analysis of the architecture of tourist facilities of the 20th century, as well as issues related to their renovation, valorization and integration into the contemporary social context, Antesević (2023: 132-145) states that this architecture should not be viewed as an artifact of the past, but as a resource that requires thoughtful protection, creative adaptation and sustainable use in the present. In this sense, Zeković's work is recognized as a significant part of the local identity and cultural heritage, i.e. as such, it deserves a strategic approach to protection that will enable its sustainable function.

CONCLUSION

In summary, the architectural oeuvre of Radostav Zeković represents a conceptual realization of the principles of critical regionalism, drawing upon theoretical and pedagogical influences as well as a profound connection to place. His work demonstrates that critical regionalism can serve as a means

of preserving continuity and identity, articulated through the specificities of local context. Many of his projects, now key urban landmarks, illustrate a thoughtful application of regionalist principles, establishing an architectural language that is both innovative and deeply rooted. This mode of regionalism provides an extraordinary contribution to mediating and shaping contemporary identity, grounded in an architecture that already possesses tradition and confidence in the reinterpretation of vernacular elements. Zeković's practice shows that the preservation of identity is not an obstacle to modernism, but rather an essential tool for maintaining cultural continuity. His work succeeds in skillfully transposing established architectural patterns, whereby the broader landscape becomes a leading element in new compositions. Globalization trends directly affect urban continuity and identity and considering that Zeković was among the last regionalist architects working in Montenegro, it is crucial to emphasize the need to preserve his architectural oeuvre as an important component of the anthology of Montenegrin architecture.

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BIBLIOGRAPHY

1. ALIHODŽIĆ JAŠAROVIĆ, E. (2021) The identity of Montenegrin cities in the context of urban transformations from 1989 to 2019: Mediation methods in the function of compensating the value of identity. Doctoral dissertation. Faculty of Architecture, University of Sarajevo, Sarajevo, Bosnia and Herzegovina.
2. ANTEŠEVIĆ, N. (2022) *Arhitektura modernih turističkih objekata Jugoslavije (1930-1985)*. Doctoral dissertation. Faculty of Philosophy, University of Belgrade [online]. Available at: <https://eteze.bg.ac.rs/application/showtheses?thesesId=8672> [Accessed: 1 March 2026]
3. ANTEŠEVIĆ, N. (2023) Nasleđe turističke arhitekture 20. stoljeca – izazovi u obnovi i održivom korištenju. In: Pavlović, M. and Mrlješ, R. (eds.) *Zaštita graditeljskog nasljeđa u 21. veku – izazovi i mogućnosti*. Beograd: Zavod za zaštitu spomenika kulture grada Beograda, pp. 132-145.
4. BRADIĆ, H. (2025) 'Spaces of synthesis: Universal values and regional identity in Zlatko Ugljen's architecture', *Prostor*, 33(1), pp. 69-82 [online]. Available at: [https://doi.org/10.31522/p.33.1\(69\).11](https://doi.org/10.31522/p.33.1(69).11) [Accessed: 2 November 2025]
5. CANIZARO, V. B. (ed.) (2007) *Architectural regionalism: collected writings on place, identity, modernity and tradition*. New York, NY: Princeton Architectural Press.
6. FRAMPTON, K. (1983) 'Towards a critical regionalism: Six points for an architecture of resistance', in *The anti-aesthetic: Essays on post-modern culture*. Port Townsend: Bay Press, pp. 16-30. doi:10.5040/9781350183827.ch-18.
7. GABRIJAN, D. and NEIDHARDT, J. (1957) *Arhitektura Bosne i put u savremeno*. Ljubljana: Državna založba Slovenije.
8. JOVIĆEVIĆ, I. (2017) 'Centralni komitet Saveza komunista Crne Gore u Titogradu: Između strukturalizma i kritičkog regionalizma – Radosav Zeković', *Pogled, Inženjerska komora Crne Gore*, pp. 74-81 [online]. Available at: <https://www.ingkomora.me/cms/public/image/publikacije/3228.pdf> [Accessed: 10 November 2025]
9. KARLIĆ-KAPETANOVIĆ, J. (1990) *Juraj Neidhardt*. Sarajevo: Veselin Masleša.
10. KOLACIO, Z. (1980a) 'Republička nagrada "Borba" SR Crna Gora: Objekt društveno-političkih organizacija u Titogradu', *Arhitektura*, (172-173), pp. 76.
11. KOLACIO, Z. (1980b) 'Radosav Zeković i Borbina nagrada', *Borba*, pp. 5.
12. LEJEUNE, J.-F. and SABATINO, M. (eds.) (2009) *Modern Architecture and the Mediterranean: Vernacular Dialogues and Contested Identities*. London: Routledge. doi: 10.4324/9780203871904.
13. MANEVIĆ, Z. (2000) *Leksikon srpskih arhitekata XIX i XX veka*. Beograd: Građevinska knjiga.
14. MANEVIĆ, Z., DOMLIJAN, Ž., ŠUMI, N. and ŠTRAUS, N. (1986) *Arhitektura XX vijeka*. Beograd: Prosveta; Spektar; Prva književna komuna.
15. MARKUŠ, A. (2008) 50 neimara Crne Gore. Podgorica: Arhitektonski forum, pp. 84-88.
16. MITROVIĆ, S. (2021) Radosav Zeković. *Leksikoni*, Crnogorska akademija nauka i umjetnosti (CANU) [online]. Available at: <https://leks.canu.ac.me/web/llucg.php?OID=4070> [Accessed: 5 October 2025]
17. MLAĐENOVIC, I. (1982) *Arhitektura i njeni privrženici*. Rijeka: Izdavački centar Rijeka.
18. MLAĐENOVIC, I. (1989) 11 istaknutih arhitekata Jugoslavije (Knjiga br. 5). Beograd: Studio Linija A.

AUTHORS' BIOGRAPHIES AND CONTRIBUTIONS

19. NORBERG-SCHULZ, C. (1963) *Intentions in architecture*. Cambridge, MA: MIT Press.
20. NORBERG-SCHULZ, C. (1980) *Genius loci: Towards a phenomenology of architecture*. New York, NY: Rizzoli.
21. NOVAKOVIĆ, N. (2024) 'Landscapes of housing: Juraj Neidhardt's contextual approach to modern neighborhood design', *Docomomo Journal* [online]. Available at: <https://doi.org/10.52200/docomomo.72.10> [Accessed: 5 November 2025]
22. RADONIĆ, V. (2021) 'Priča o Radosavu Zekoviću', *Velizar – blogovi i kolumne* [online]. Available at: <https://velizar1.blogspot.com/2021/02/> [Accessed: 2 October 2025]
23. RADOVIĆ, R. (1990) 'Podsticajno, zagonetno i varljivo mjesto tradicije u arhitekturi', *De re Aedificatoria*, 1, pp. 7-24.
24. THIS-EVENSEN, T. (1987) *Archetypes in architecture*. Oslo: Norwegian University Press.
25. UMBACH, M. and HÜPPAUF, B. (eds.) (2005) *Vernacular modernism: heimat, globalization, and the built environment*. Stanford, CA: Stanford University Press.
26. ZATRIĆ, M. (2024) 'Synthesis of the arts with the region: Juraj Neidhardt's sculptural architecture of the 1960s within regional planning of tourism', *Docomomo Journal*, 72 [online]. Available at: <https://www.researchgate.net/publication/386547406> [Accessed: 10 October 2025]
27. ZEKOVIĆ, R. (1980) 'Centralni komitet SKCG', *Čovjek i prostor*, (328-329), pp. 7.
28. PETROVIĆ, Z. B. (1967) *Hotel „Rozaje u Rozajama“*. *Arhitektura urbanizam*, 45-46, pp. 62-63.
29. FANG, B. Z. (1983) *Izgradnja turističkih objekata u Jugoslaviji*. Beograd: Izgradnja.

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Conceptualization: The author(s) are obligated to present the main contribution of each listed co-authors. For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following state-

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RESIDENTIAL ARCHITECTURE OF THE PLANNED MODERN PORT-INDUSTRIAL TOWN OF PLOČE (1945-1971)

KEYWORDS

ARCHITECTURAL HERITAGE
CROATIA
MODERN ARCHITECTURE
PLOČE
RESIDENTIAL ARCHITECTURE

ABSTRACT

The paper explores the residential architecture of the port-industrial town of Ploče in the period from 1945 to 1971, affirming the town as a unique example of planned modernist realization on the eastern Adriatic. Ploče is a unique town that developed on the Dalmatian karst in a deep natural harbour at the mouth of the Neretva River, in which a modern port-industrial town was built for the needs of the magnificent harbour, combining the principles of modern architecture

with elements of tradition, and urbanism that affirms views of the harbour, pedestrian connections, and autochthonic horticulture. By employing various methods – historiographical and morphological analysis of residential architecture, as well as the study of unpublished archival materials – the paper valorises the contribution of local architecture within the broader context of Croatian postwar Modernism.

INTRODUCTION

Since its founding and first presentation in the professional journal *Arhitektura* (***) 1955), the modern architecture of the port-industrial town of Ploče has largely remained unexplored and unknown to scholars, professionals, and the general public. Inspired by the quality of architecture from seven decades of neglected and unexamined modern heritage, this work aims to investigate the residential architecture of Ploče (1945-1971).¹

This research therefore seeks to identify the locations of residential buildings in Ploče, the architects, architectural offices and construction companies responsible, and to analyse the typology, design, and specific architectural approaches of the residential architecture. A database like this would allow quicker comparison of Croatia's residential architecture from that period and support developing guidelines and criteria for recovery and resilience of the housing stock. To understand residential architecture from different periods, it is necessary to know the socio-economic and political-legal conditions under which it was planned and realized. A valuable attempt to create a database of residential architecture in Croatia and its typology from the modern period is a project of the Department of Housing, Faculty of Architecture, University of Zagreb, which began in 2022. This project collects and records high-quality examples of Croatian residential architecture since 1945 (Jošić, Korlaet and Virag, DASA),

however, it only includes one example from Ploče. (Fig. 1)

In the larger cities along the Croatian Adriatic, modern residential and industrial architecture has been researched, contributing to the recognition and affirmation of their modern architectural heritage and urban identity. In that regard, it is the research on the modern architecture of Rijeka (Valušek, 1996; Palinić and Bjelanović, 2021), Zadar (Arbutina, 2001; Mlikota, 2021), Split and Dalmatia (Keckemet, 1976; Tušek, 2018), Dubrovnik (Baće, 2023) that stands out. Among the studies of modern architecture in smaller towns, Omiš (Barišić Marenić and Perković Jović, 2023) and Duga Resa (Bilić and Barišić Marenić, 2021) stand out.

Modern architecture is explored through the work of individual architects. The architectural contributions of key figures in modern architecture such as Lovro Perković (Keckemet, 1979; Uskoković, 2015), Ivan Vitić (Grimmer and Kisić, 2005/2006), Nikola Dobrović (Ivanišin, 2000; Ivanišin, 2015), Ivo Bartolić (Bobovec, Korlaet and Virag, 2015) and others, also demonstrate their engagement in residential architecture projects.

OBJECTIVE AND METHODOLOGY

The objective of this paper is to provide a comprehensive insight into the development of residential architecture in Ploče between 1945 and 1971 through a reconstruction of the historical planning process and a critical analysis of the architectural quality of the realized projects. The study seeks to investigate how specific socio-political conditions and the role of Ploče as a 'new town' influenced the formation of a high standard of living that successfully integrates modernist idea with human needs and the local context.

The town Ploče, has recently been the subject of research on urban development (Kranjčević, Barišić Marenić and Jelčić, 2024) and public architecture (Barišić Marenić, Kranjčević and Jelčić, 2025). The aim of this paper is therefore to explore the largely unexamined residential architecture of Ploče from 1945 to 1971, to identify the works of both prominent and lesser-known modern architects from Croatia and the surrounding region, to specify addresses and dates, and to analyse architectural achievements and contextualise them within the framework of Croatian modern architecture.

¹ During the socialist era (in Croatia and Yugoslavia), legal regulations on planning and construction of settlements and construction land were divided into two basic time periods. The first period refers to 1946-1971, and the second to 1972-1987 (Krstić and Pajović, 1987).

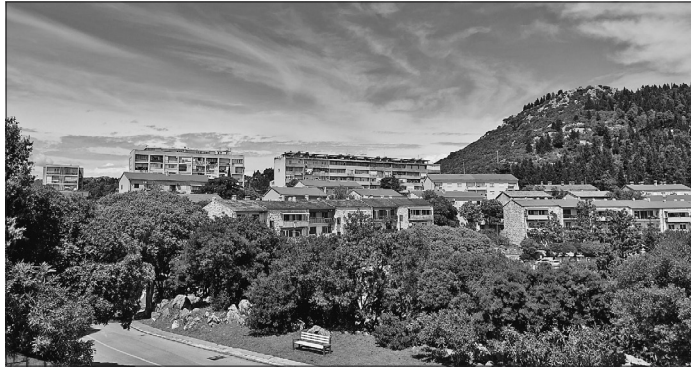
² Modernist residential architecture could be interpreted through two distinct lenses: as a derivative imi-

The research employs a multidisciplinary approach, combining the historiographical method – through the analysis of archival records – with a spatial morphological analysis of residential blocks (contour lines, sea views, and pedestrian accessibility). Emphasis is placed on field surveys and architectural valorisation; the paper evaluates the aesthetic and functional qualities of Late Modernism in Ploče, identifying elements of synthesis between international style and local building traditions. In doing so, it determines the degree of preservation of original concepts and the relationship between the planned structure and the existing landscape. Using a comparative method, the study positions the residential development of Ploče within the broader context of ex-Yugoslav and European postwar Modernism (WWII)², highlighting parallels and deviations relative to contemporary urban planning practices.

Research into the residential architecture of Ploče is primarily based on the examination of difficult-to-access and scarce archival material of the Town of Ploče Archives, Croatian State Archives Zagreb, State Archives Dubrovnik, Metković Branch, Croatian Railway Museum, as well as limited biographical data from the biographies of individual architects (such as Vuko Bombardelli and Lovro Perković, for whom either information on constructions in Ploče is missing or it is unclear which buildings they designed), and on professional articles and several published books about Ploče or the port intended for the general public (Kovačević, 1996; Kovačević, 2003; Smoljan, 1996). The research into the modern residential architecture of Ploče was conducted through fieldwork in Ploče, photographing the current state, interviewing residents, and searching various online sources to obtain a more complete picture. The results of this research can help establish guidelines and criteria for its sustainable use, renovation, and resistance.

A limitation of the research is the limited project documentation, which does not cover all buildings, and often the preserved inventory units lack complete documentation. The documentation is difficult to read and reproduce due to very faded, old copies. Furthermore, the Ploče Folk Collection [Zavičajna zbirka] is closed for renovation and its contents are unknown.

²ation of Western architectural models, or as a manifestation of 'socialist modernity,' a concept championed by theorists Stephen Kotkin and Victor Buchli. Socialist residential architecture was predicated upon social ownership and the intentional construction of a new society, a 'new man,' and a reconfigured spatial paradigm (Kotkin, 1995; Buchli, 1999).



INTRODUCTORY OVERVIEW OF HOUSING CONDITIONS IN CROATIA FROM 1945 TO 1971 AND LITERATURE REVIEW

After WW II, the initial reconstruction of Croatia, a war-torn country, focused on industrialisation and electrification. The intensive processes of industrialisation and urbanisation had a significant impact on the construction sector, especially in cities where industry was concentrated, as it was necessary to provide housing for employees. The first Five-Year Plan Act of the People's Republic of Croatia from 1947 (Zakon o petogodišnjem planu razvitka, 1947) addressed the construction industry and housing. Article 14 stated that it was necessary to "build 2,350,000 m² of residential buildings" in cities and villages and to ensure "over five years a total amount of 4 billion 980 million dinars". It was also necessary to begin and develop mass industrial production of prefabricated residential houses with standardised parts at the fastest pace (Five-Year Plan Act, 1947: 234). Resolving the housing issue and its architecture became an important socio-political, legal, economic, cultural, and consequently urban-architectural and technical-technological challenge. To build enough apartments, it was necessary to secure sources of financing, implement new legal regulations and standards, roll out a design range, and operationalise construction through the application of modern technology and the education sector. "The right to an apartment" was a principle of social care for workers that was closely linked to housing construction and architecture, as well as to economy and law (**1954).

Architecture and construction sector faced various challenges in housing construction, such as functional apartments (floor plans), design, construction speed and construction quality, as shown in Table I. Architectural competitions were also held for typification and prefabricated construction. Comparisons of housing construction with other countries were made. Ownership of apartments was a special issue, and some proposed introducing

FIG. 1 VIEW OF THE TOWN OF PLOČE, AREA OF UPPER PLOČE, SOURCE: AUTHORS

TABLE I OVERVIEW OF LITERATURE ON RESIDENTIAL ARCHITECTURE IN PROFESSIONAL JOURNALS

Challenges in the construction of residential architecture	Authors of the articles
Design of apartments	Bartolic (1950a); Kosar (1950); Gombos (1950); Antolic (1952); Balagovic (1967)
Apartment construction	Baylon (1950); Bartolic (1950b); Kosar (1950); Bartolic (1951); Baylon (1952); Perco (1954)
Apartment size	Planic (1949a)
Apartment lighting, apartment hygiene	Baylon (1950), Teodorovic (1952)
Specific form of apartments	Dumendzic (1950); Tušek (1950)
Ownership	Perco (1954); Mrčela (1981)
Architectural competitions for the construction of apartments	Tušek (1952a); Tušek (1952b); Tušek (1952c)
Standard and prefabricated construction	Planic (1949b); Planic (1949c); Bartolic (1951); Matijević Barcot (2020)
Collective construction	Tučkoric (1958); Badnjar Gojnic (2023)
Legislation	Planic (1949a); Kahle (2021)
Sociological Approach to Housing	*** (1954); Paljan (1972); Paljan (1974); Badnjar Gojnic (2023)
Financing the construction of residential buildings	Zakon o doprinosu za stambenu izgradnju (1955); Osnovni zakon o privrednom poslovanju i gospodarenju stambenim zgradama (1965).

Source: Author’s processing

FIG. 2 STRUCTURE OF PLOČE WITH MARKED RESIDENTIAL BUILDINGS (LISTED IN TABLE II), SOURCE: AUTHORS PROCESSING



condominium ownership. Housing construction was also discussed at the conference of Yugoslav cities in Sarajevo in 1954, which was attended by economists, lawyers and architects (Perco, 1954). It is worth noting that past experiences are sought to address the challenges of housing construction in the 21st century (Badnjar Gojnić, 2023).

RESIDENTIAL ARCHITECTURE OF PLOČE 1945-1971

The complexity of the challenges the residential architecture of Ploče was faced with is evident from the correspondence of the Regional People’s Liberation Committee [Oblasni Narodno oslobodilacki odbor] for Dalmatia as early as July 1945. The Regional NOO sent letters to the Croatian and Bosnian – Herzegovinian authorities. The Department of Regulation, the Architectural Department at the Ministry of Construction of the People’s Republic of Croatia were requested to form a team of urban planners before the Regulatory Plan for Ploče was drawn up to assess and determine the needs of the future settlement on site. The Ministry of Construction of the People’s Republic Bosnia and Herzegovina was requested to provide urgent assistance in building materials for the repair of the buildings (the administration building, the unfinished power plant and the workers’ camps), as they were significantly damaged. In short, the letters emphasize the seriousness of the housing problem for convicts and port employees in Ploče. Architect Josip Se-

issel from the Architectural Department of the Ministry of Construction of the People’s Republic of Croatia was soon sent to Ploče.

Town of Ploče was not exempt from the demand for apartments (convicts and employees). Some residents turned directly to the Ministry of Construction in 1945 to request the construction of family houses, which responded that a regulatory plan with collective buildings (HR-HDA-248) was in progress.

It was emphasized that urban plans were being drawn up either for parts of the settlement or for the entire settlement. That is how the unique construction of a modern, planned port-industrial town on the southern Adriatic begun.

Near Crna Rijeka, various institutions, government offices, facilities, a cinema,³ shops, and taverns were located, while in the upper part of the town, there was a bakery and a church in a barracks (Kovačević, 1996). Often, the first workers did not have adequate accommodation and were housed in wooden barracks while seeking work (Šunjić, 2025).

The configuration of the terrain and the regulation of the Neretva delta determined the “division” into two spatial and thus residential units of Upper Ploče (north of Crna Rijeka) and Lower Ploče (south of Crna Rijeka). The residential zone of Lower Ploče (located directly next to the port) represents the first planned organized residential zone. This zone is a smaller-scale residential building but is more connected to the port. Upper Ploče is an area of a larger residential zone and with its imposing buildings dominates the views from the town to the south and vice versa. In this context, the “modern landscape” of the new town was formed (Fig. 2).

LOWER PLOČE

In addition to the magnificent port at the mouth of the Neretva, the first construction of residential buildings took place on Prišnica Hill, south of the mouth of the Crna Rijeka. This marked the initial phase of constructing the so-called “solid buildings” as a replacement for the barracks where citizens were temporarily housed as port workers.

Residential buildings on Prišnica (architect Lovro Perković, 1947-1948)

The first construction of residential buildings near the port for the project client, the Mariti-

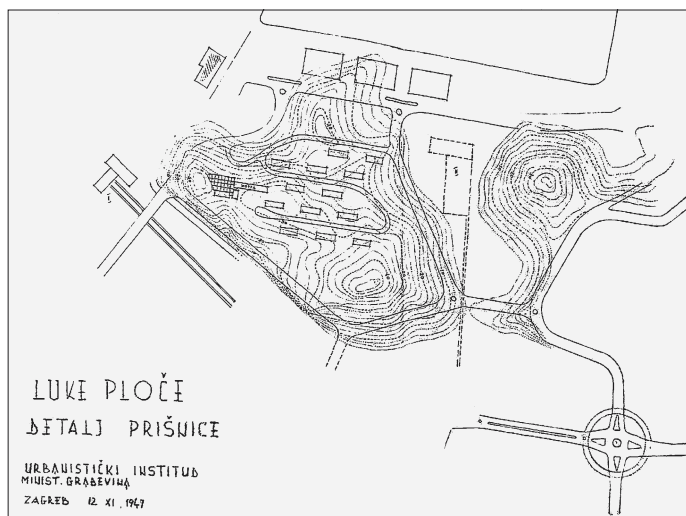
3 The cinema was later demolished (Kovačević, 1996).
4 Terms used by the local population for Stražnica hill is referred to as Strazbenica or Izvidnica.

me Administration, dates to 1947-1948 on the rocky terrain of Pršnica hill (Ulica Pršnica 2, 3, 4, 6). Lovro Perković as an architect at the department of the Dubrovnik Regional Construction Company Graditelj, planned a residential neighbourhood and designed longitudinal standard stone residential buildings. This part of the town is characterised by parallel rows of longitudinal buildings, arranged in a staggered layout to ensure open views towards the new town area. (Fig. 3).

Longitudinal standard stone buildings were designed with four possible execution variants: variant I, three identical two-room apartments per floor (Fig. 4a); variant II, three different apartments per floor – one three-room, one two-room, and one studio apartment (Fig. 4b); variant III, six studios per floor (Fig. 4c); and variant IV, a hostel with seven rooms per floor (**The Town of Ploče, Archives). Variant I was implemented with three two-room apartments per floor, featuring a circular connection around the kitchen and toilets, as well as access via the hallway and loggia. The sanitary core with kitchen enabled these variant solutions. At the foot of Pršnica hill, four stone storey houses were built with double-pitched roofs and roofs made of channel tiles (three identical and one partially modified buildings). The houses were designed in the spirit of traditional architecture, reflecting the extremely modest post-war period and the largely destroyed construction technology in the Second World War.

Despite this, the interfloor structure is built as a reinforced concrete fine-ribbed system, with the direction of the ribs determined by the shorter span. The use of modern structures and materials, the subtle design of the buildings, traditional yet with a modern expression, and the rationally variable spatial-functional solution, all attest to the refinement of an unknown modern achievement in residential architecture in southern Croatia.

The stone facades reflect the thoughtfulness of the modern architect, evident in the analysis of wall surfaces, the formats of windows and French windows, and shady loggias with balcony consoles for each apartment, centrally located on three facades (Fig. 5).



The post-war creation of the residential complex on Pršnica remains completely unknown in professional and scientific literature, as well as within the oeuvre of architect Lovro Perković. It is not even presented in the monograph specifically dedicated to architect Lovro Perković by Sandra Uskoković (Uskoković, 2015).

FIG. 3 DETAILED URBAN PLAN FOR PRŠNICA, PLOČE, SOURCE: HR-HDA-248. MINISTARSTVO GRAĐEVINARSTVA, 2.2.2. LUKA PLOČE, SIG. (1945-1947)

UPPER PLOČE

Northwest of the mouth of the Crna River, residential buildings and structures for social and public purposes were built on predominantly rocky, hilly terrain. In the second phase, the melioration of the marshy area south of the slopes of Stražnica⁴ created flat terrain (the present-day area of Ban Josip Jelčić Square and its surroundings), after which the southern waterfront was filled and developed, now known as Coast (Obala) dr. Franjo Tuđman.

Residential buildings along Vladimira Nazora and Rogotinska streets (unknown author, 1950s)

On the southern slopes of Stražnica hill, the concentric arcs of Vladimir Nazor Street and Rogotinska Street were laid out, approximately following the contours of the terrain with

FIG. 4A RESIDENTIAL BUILDING AT PRŠNICA (ARCH. LOVRO PERKOVIĆ), FLOOR PLAN, VARIANT I. SOURCE: THE TOWN PLOČE, ARCHIVES

FIG. 4B RESIDENTIAL BUILDING AT PRŠNICA (ARCH. LOVRO PERKOVIĆ), FLOOR PLAN, VARIANT II. SOURCE: THE TOWN PLOČE, ARCHIVES

FIG. 4C RESIDENTIAL BUILDING AT PRŠNICA (ARCH. LOVRO PERKOVIĆ), FLOOR PLAN, VARIANT III. SOURCE: THE TOWN PLOČE, ARCHIVES

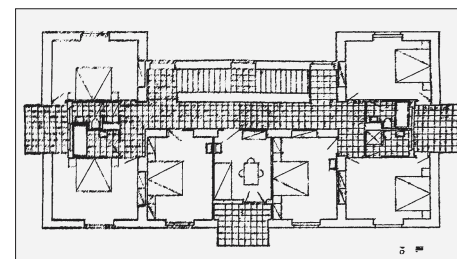
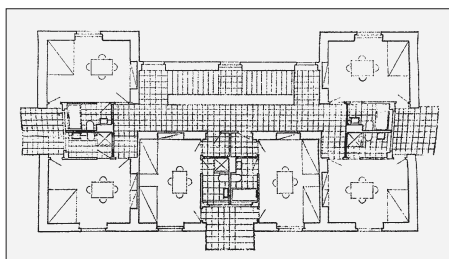
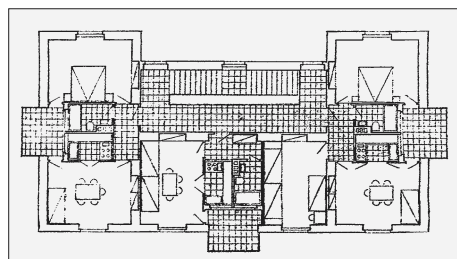




FIG. 5. PHOTOGRAPH OF RESIDENTIAL BUILDINGS AT PRISNICA (ARCH. LOVRO PERKOVIĆ), SOURCE: ***(1955)

a gentle slope (Fig. 1). The southern arch of the former Vranjak canal within the unregulated Neretva Delta determined the alignment of these streets, which concentrically follow the geometry of the original southern natural shoreline. The first stage of realisation of the port-industrial settlement, that is, the typical residential buildings, is also visible in a series of aerial photographs from 1955, 1960, 1966, 1968, and 2017, published in 2024 (Kranjčević, Barišić Marenčić and Jelčić, 2024: 301-302). In the first phase of realisation, a series of typical longitudinal residential buildings, either four-storey or two-storey with gable roofs, were built along streets that follow the contours of the terrain, namely Vladimira Nazora and Rogotinska streets. The residential buildings form an urban structure of three concentric arc segments with slight deviations (Fig. 6a).

The western segment of Vladimira Nazora Street is characterised by two elongated, two-storey stone buildings whose concave ground floor plan follows the arc of the street. The rhythm of the concave southern façade is defined by the features of the loggia zone, entrance zone, perforated stone windows, and balcony zone, as well as the alternating

arrangement of the stone facade and smooth wall panels. The arrangement of front gardens and elevated entrances above the stone retaining wall, alongside the internal parallel access road that follows the slope as a ramp, establishes a gradual transition from public to private space and further reinforces the coherence of the overall design solution. The buildings are colloquially known as Railwaymen's Houses, as they were intended for railway personnel, or because of the large hewn stones that define their façades, as well as a series of typical railway houses built along the railway line. The central section of Vladimira Nazora Street is characterised by four longitudinal, four-storey buildings with two entrances and a sloping roof. The ground-floor business premises have increased ceiling heights, and the building typology includes two flats per staircase. The northern staircases are marked by a vertical band of horizontal concrete louvres. The residential buildings were built before 1956, but do not match the designs by Pavle Krat preserved in the Ploče Archives (***The Town of Ploče, Archives).

The northern Rogotinska Street is lined with fourteen two-storey elongated residential buildings, arranged parallel to the street and isohypse (Fig. 7). The living areas of the flats, with balconies, face south and overlook the bay. The buildings have a design suited to the local climate and tradition, with partially stone facades made of large hewn stones and gable roofs. Construction was completed in the 1950s.

Residential and commercial building H – 3 (architect Branko Došen, 1967, 1971)

More than fifteen years later, between the two-storey and four-storey buildings at 13 Vladimira Nazora Street (Fig. 6b), the residential and commercial building H-3 (1967, 1971) was built according to the design of Branko Došen (Project Office at the Banja Luka Technical School) (*** The Town of Ploče, Archives). The transverse layout of the north-south residential building differs from all the previously mentioned buildings along Vladimira Nazora Street and Rogotinska Street, and its axes extends to the southern residential building by Mladen Frka, built on low-lying flat terrain. The difference in the approach to urban planning and the use of

FIG. 6A RESIDENTIAL BUILDINGS AT VLADIMIRA NAZORA STREET, NR. 1, 3, 5, 7, 9, 11 (UNKNOWN AUTHOR), SOURCE: AUTHORS

FIG 6B PHOTOGRAPH OF RESIDENTIAL BUILDINGS AT VLADIMIRA NAZORA STREET 13 (ARCH. BRANKO DOŠEN) AND VLADIMIRA NAZORA STREET 15-17, 19-21, 23-25 (UNKNOWN AUTHOR), SOURCE: AUTHORS



5 Documentation for other projects by architect Ivo Gersić has not been preserved in the Archives of the Town of Ploče and DAD, Metković Branch.

6 Since in Croatian the word "building" is feminine, the building is colloquially called Bombardella.

the hipped roof by the Banja Luka architect is evident here, and the imperative of open views towards the south and the bay characterises the southern gable facade.

High-rise residential building, the so-called Blok (architect Ivo Gersić, 1949)

Architect Ivo Gersić's residential and commercial building is a spatial and urban landmark of upper Ploče. Colloquially known as Blok, it was the largest residential building in the town of Ploče at the time of its construction in 1949 (Fig. 8). A photograph of the building: "The new residential block, through its massing, defines and encloses the settlement's structure, giving it a distinct character." (***) (1955). The building was built on Kominska Street, numbers 2-5, on the slopes of Stražnica hill, at one of the highest points in the town, and dominates the view of the town from the south. The five-storey longitudinal building is oriented east-west. Four entrances with four staircases and a grid of circular windows create a rhythmic pattern on the northern façade. The northern entrances are grouped in two pairs. Two entrance zones for each pair of entrances enhance the quality of the residential neighbourhood with a shady porch, partial changes in level, and stone cladding, evoking a place for neighbours to gather and talk, children to play, and the formation of a spirit of community among the residents of the impressive building. The staircases are double-flighted, and between the two flights there is a lift, which was a rarity in southern Dalmatia at the time. Along the staircase core, there are three flats on each floor. Two larger apartments with dual-aspect orientation flank a smaller, centrally located apartment with a south-facing orientation. The living areas of all apartments face south, offering impressive views of the bay and the sea near Neretva Channel. Shaded southern loggias create a rhythm along the southern façade of the residential building. Due to the southward slope of the terrain, the base of the building comprises two prominent basement floors with storage rooms and a ground floor, all clad in roughly hewn stone. According to Tomislav Premerl, Ivo Gersić built "several residential buildings in Ploče" in 1949 (Premerl, 1998), but within this research only one building had been detected.⁵

⁵ The gallery building in Ploče was modelled on the six-apartment E-57, Experiment – 1957, which Vuko Bombardelli used for apartment buildings in Split (1958-1961), Kaštel Sucurac, Dugi Rat, Čapljina, and Mostar (Matijević Barcot, 2020).

Residential building, the so-called Bombardelli (architect Vuko Bombardelli, 1959)

West of the so-called "Blok", a residential building colloquially known as Bombardelli was built in 1959, named after its architect Vuko Bombardelli (Kominska 1).⁶ The building features a gallery system, with a northern gallery and a staircase accentuated by a vertical, prominent wall panel (Fig. 9b). Architectural documentation has not been preserved in the archives in Ploče (***) (Town of Ploče, Archives). The construction of this residential building in Ploče is not recorded in the bibliographic units dedicated to the architect Vuko Bombardelli (Tušek, 2018: 30).⁷ Six apartments are arranged within eight transverse modules, accessed from the northern gallery (Fig. 9c). The clear grid of the southern façade of the modern building (Fig. 9a) contrasts with the lower, more traditional stone houses in Rogotinska Street. More modern construction technology, rationalisation, standardisation, and a shift away from traditional architecture fifteen years after World War II are evident in these two recently mentioned examples of residential buildings in Ploče.

The so-called former officers' residential buildings (unknown author, 1950s)

In the 1950s, five residential buildings, colloquially known as officers' buildings, were built along the eastern side of Tin Ujević Street (Staklarević and Štefanac, 2015: 289). The urban layout along the street comprises of an alternating sequence of elongated three-storey buildings with larger or smaller front gardens, a stone base, and loggias facing west, overlooking the western part of the bay. The floor plan features two symmetrical, transversely oriented apartments per staircase. The architectural documentation for all these apartment buildings has not been preserved in the Town Ploče, Archives and the architects remain unknown (***) (The Town of Ploče, Archives).



FIG. 7 PHOTOGRAPH OF RESIDENTIAL BUILDINGS AT ROGOTINSKA STREET (UNKNOWN AUTHOR), SOURCE: AUTHORS



FIG. 8 RESIDENTIAL BUILDING, THE SO-CALLED BLOK (ARCH. IVO GERSIĆ) ABOVE RESIDENTIAL BLS. IN ROGOTINSKA AND VLADIMIRA NAZORA STREETS, SOURCE: DUJE JELČIĆ



project from 1963-1964 for Ploče (exact locations unknown), and in accordance with the requirements of the construction company GP Lavčević, from Split. These longitudinal, five-storey buildings with flat roofs have two entrances, each serving two apartments per staircase (two- and three-bedroom apartments). The basement floor contains smaller apartments, due to the sloping terrain, as well as a shared laundry room and woodshed. The living rooms and larger bedrooms have balconies, and three such vertical zones provide rhythm to the longitudinal facades.⁸

Residential Row Family Houses (architect Zoja Dumengjić, unrealised project, 1952)

An interesting project by architect Zoja Dumengjić from 1952 for a row of single-storey stone family houses with an "L" layout and an asymmetrical gable roof (Barišić Marenić, 2020: 268) remains unrealised.⁹

Residential buildings at Ban Josip Jelačić Square (architect Mladen Frka, 1961-1962)

Four typical three- and two-storey residential buildings were built on the reclaimed and levelled flat terrain beneath the arches of Vladimira Nazora and Rogotinska streets, at 2-9 Ban Josip Jelačić Square. The residential buildings have flat roofs and loggias oriented to the south or west, and the ground floor, or base, is clad in carved stone. In the Ploče Archives, only partial construction documentation of the cross-section details of the Residential Building with 16 apartments from 1961 (Town of Ploče) has been preserved. The cross-section detail of the facade is signed by Mladen Frka from the Dubrovnik Project Bureau Arhitekt. In this cross-section detail, alongside the reinforced concrete walls and cantilevered loggia overhangs, the intermediate floor structure of prefabricated "I" reinforced concrete beams 20 cm high and prefabricated panels is evident. The use of modern prefabricated systems enabled faster con-

⁸ The buildings are three stories above a low ground floor.

⁹ A typologically similar example is the later construction of the atrium residential rows by architect Ana Marija Jelincić Semencić in Siget, Zagreb (1969-1971, now mostly upgraded).

¹⁰ Born in Odessa and emigrated from Russia after October revolution.

¹¹ Pavao Krat (19/6/1907 Saratov, Imperial Russia – 1969, USSR) architect graduated in 1931. Between the two world wars he worked in Belgrade in the design office of Dragiša Krsovan. Designed the main post office building in Belgrade. Deported to the USSR because of the Imformbiro.

Tipska osnova etaže sa 6 stanova E-57

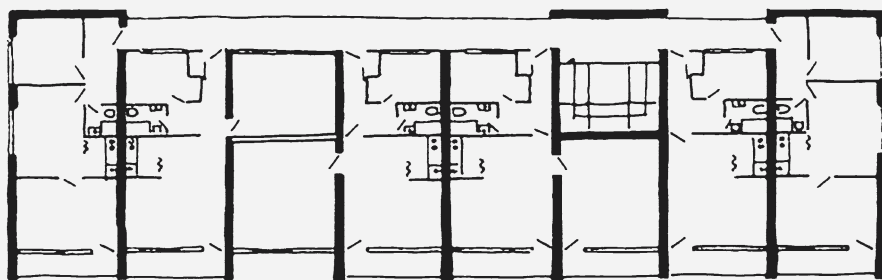


FIG. 9A PHOTOGRAPH OF THE RESIDENTIAL BUILDING, THE SO-CALLED BOMBARDELLI (ARCH. VUKO BOMBARDELLI), SOURCE: AUTHORS

FIG. 9B PHOTOGRAPH OF THE RESIDENTIAL BUILDING, THE SO-CALLED BOMBARDELLI (ARCH. VUKO BOMBARDELLI), SOURCE: AUTHORS

FIG. 9C RESIDENTIAL BUILDING, SO CALLED BOMBARDELLI (ARCH. VUKO BOMBARDELLI), TYPICAL FLOOR PLAN OF FLOOR E-57, SOURCE: BILTEN 4. SPLIT: ARHITEKT, 1960.

Residential building (architects Mile Jovanović and Mladen Frka, 1966)

Although no complete architectural documentation has been preserved in the Metković Archives (HR-DAD, Metković), nor any other material in Ploče (**The Town of Ploče, Archives), a draft of the water and sewage connection at that location, the outlines of the building with an almost square floor plan, and the ground floor plan with water and sewage connections indicate that the apartment building at 2 Silvije Strahimir Kranjčević Street is the work of architects Mile Jovanović and Mladen Frka from the Ploče Construction Company, dating from 1966. The five-storey building with a flat roof dominates the elevation north of the original JNA Hall in the western part of Gornje Ploče.

Residential buildings Progres II (architect Ivo Kurtović, 1966-1967)

Two standard buildings in Stjepan Radić Street 3-5, 7-9 were built in 1966-1967, based on the Progres Standard residential buildings

struction and demonstrates the development of technology in southern Croatia. The research of this previously unknown realisation is a contribution to the largely unexplored oeuvre of the distinguished architect Mladen Frka. The residential buildings were designed by Mladen Frka from Dubrovnik, at the same time as he designed and built the exceptional modern hotel Vila Dubrovnik, east of Dubrovnik's Old Town. Framing shady loggias and maximising the best views, the contrasting articulation of the upper floors from the rougher stone base, or rocks in Dubrovnik, characterises both the hotel for wealthy guests in the south of Dubrovnik and the typical apartments in the port-industrial settlement.

DISCUSSION ON THE AUTHOR'S CONTRIBUTIONS AND CONTEXTUALIZATION OF RESIDENTIAL ARCHITECTURE

The residential architecture of Ploče was mainly designed by Croatian architects and by few others from various backgrounds, contributing to the construction of the modern town. The authorship of several buildings is unknown, as no architectural documentation has been preserved, nor have the buildings been presented or evaluated in professional or scientific literature.

Building contractors are most often construction companies from Croatia, such as "Izgradnja" from Ploče, "Izvođač" from Makarska, "Graditelj" from Dubrovnik, the district construction company "Norin" from Metković (HR-HDA-248), and the Lavčević Construction Company from Split.

Zagreb based architects Zoja Dumengjić (1904-2000)¹⁰ and Ivo Geršić (1915-2002) designed i.e. realised residential projects for Ploče. Architect Lovro Perković worked in Dubrovnik (1939-1954) and then in Split (from 1954). Architect Vuko Bombardelli (1917-1996) was Split based architect (from 1950 until his retirement) with his first professional experience in Belgrade (1946-1950). Architect Ivo Kurtović (1928-2013) was a Split based architect and worked for the construction company Lavčević. Architect Mladen Frka (1929-2011) was a Dubrovnik based architect. Architect Mile Jovanović from Serbia (1902-1994) worked in Dubrovnik. The Russian architect Pavao Krat, who worked in Belgrade and Ploče and was expelled from Yugoslavia in the 1950s, is little known.¹¹

The first residential buildings were designed in Ploče by Lovro Perković (1947-1948), and they were built closest to the port. The modest post-war period and the traditional architecture of stone houses in southern Dalmatia influenced the climate-appropriate ar-

chitecture – stone houses with gable roofs. Their urban layout, designed for privacy, is intended to provide open views of the sea from the living rooms and balconies.

Most residential buildings are in the area of Veliki Milosavac and on the northern slopes of Pršnica hill. The so-called residential zone of collective construction in Veliki Milosavac covered 6.5 ha, while in Pršnica it covered 2.5 ha. For comparison, the area designated for the port was 22 ha (Urbanistički zavod Dalmacije, 1973: 61).

By 1973, with the adoption of the Master Plan of Ploče [Generalni urbanistički plan Ploče] (Urbanistički zavod Dalmacije, 1973), approximately 60 residential buildings were built in Ploče. "The number of apartments in social ownership approximately corresponds to the number of apartments in collective residential buildings and amounts to 821 apartments, which is about 14-15 apartments per building" (Urbanistički zavod Dalmacije, 1973: 62).

The Master Plan indicates that there was still demand for housing in Ploče, as several households shared a single apartment and more than 200 people lived in barracks. The attached table shows that most housing was built after World War II, primarily in the late 1960s and early 1970s. Apartments were also built in the neighbouring settlement of Rogotin. The Master Plan further shows that the barracks were still used for housing, there was demand for new apartment construction, and that in the early 1970s some residential areas still lacked utilities (Urbanistički zavod Dalmacije, 1973).

CONCLUSION

The earliest post WW2 residential architecture buildings realised in Ploče display design features close to tradition, such as the use of stone, while later projects show a more consistent articulation of modern architecture, refined with elements like roughly hewn stone, shady porches, and loggias.

Almost all living spaces in residential buildings offer impressive views of the sea bay or face south or west; this underpins the arrangement of residential buildings according to the urban plan. The pursuit of sea views is a key principle in Ploče's residential construction. Positioning staircases to the north (or toward the hinterland) aligns with this aim, and the design of this secondary façade varies with each architect's approach. The careful placement of residential buildings parallel to the terrain contours, the system of graded approaches and front gardens (green area), the transverse urban stairs providing pedestrian links to the sea, and the lush vegetati-



FIG. 10A RESIDENTIAL, SO-CALLED OFFICERS' BUILDINGS AND RESIDENTIAL BUILDINGS (ARCH. MILE JOVANOVIĆ AND MLADEN FRKA), SOURCE: AUTHORS

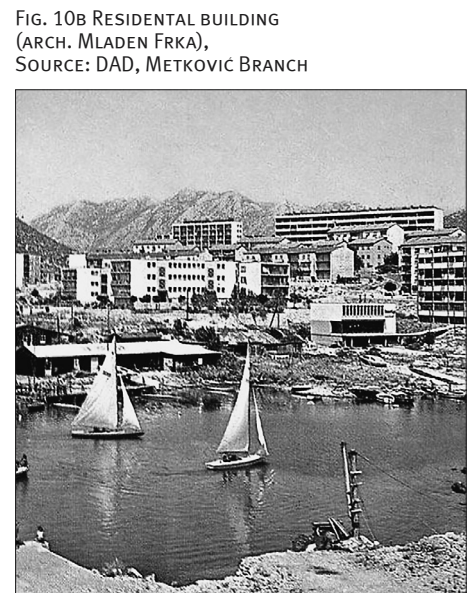


FIG. 10B RESIDENTIAL BUILDING (ARCH. MLADEN FRKA), SOURCE: DAD, METKOVIĆ BRANCH

TABLE II OVERVIEW OF RESIDENTIAL BUILDING ARCHITECTS IN PLOČE BY TOWN AREA, LOCATION AND YEAR (RELATED TO MARKS AT FIG. 2, AND FIG. 3- 10)

Marks Related to Fig.2	Architect	Ploče area and Address	Year	Residential building	Figures
		Lower Ploče			
L1	Lovro Perković	Prišnica 2, 3, 4 i 6	1947-1948	Four residential buildings, two storeys high, three flats at staircase	Fig. 3-5
		Upper Ploče			
U1	Unknown author	Vladimira Nazora Street 1,3,5,7,9,11	1950s	Three residential buildings, the so-called Railwaymen's Houses, two storeys high, three entrances	Fig. 6
U2	Branko Došen	Vladimira Nazora Street 13	1967; 1971	Residential and commercial building, four storeys high, four flats at staircase	
U3	Unknown author	Vladimira Nazora Street 15-17, 19-21, 23-25, 27-29	1950s	Four residential buildings, four-storey high, two entrances	Fig. 7
	Pavle (Pavao) Krat	Vladimira Nazora Street – unrealised project	~ 1950s	Residential building, four storeys high, two flats at staircase	
U4	Unknown author	Rogotinska Street	1950s	Residential buildings, one and two storeys high	
U5	Ivo Gersić	Kominska Street 2-5	1949	Residential building, the so-called Blok building, five storeys high, two twin entrances with common porch, three flats at staircase	Fig. 8
U6	Vuko Bombardelli	Kominska Street 1	1959	Gallery type residential building, the so-called Bombardelli, four storeys high, six flats per staircase	Fig. 9 abc
U7	Unknown author	Tina Ujević Street	1950s	Residential buildings, the so-called officers' buildings three storeys high	
U8	Ivo Kurtović	Stjepana Radić Street 3-5, 7-9	1966-1967	Residential building, four storeys high, two entrances, two flats at staircase	
U9	Mile Jovanović, Mladen Frka	Silvija Strahimira Kranjčevića Street 2	1966	Residential building, five storeys high	Fig 10a
U10	Mladen Frka	Ban Josip Jelčić Square 2-9	1961-1962	Four typical residential building, three- and two-storey high, 16 flats	Fig 10b
		Unknown location			
	Zoja Dumengjić	Unrealised project	1952	Row houses, ground floor level, "L" shaped floor plan	

Source: Author's processing

TABLE III HOUSING INDICATORS IN PLOČE

Housing indicators	Number
Total number of apartments	1.136
Occupied business premises	11
Premises occupied out of necessity	81
Average number of households in one apartment	1,02
The average number of inhabitants in one apartment	3,76
Average apartment size in m²	54,3
Apartment	
– built until 1918	22
– From 1919 to 1945	59
– From 1946 do 1960	448
– After 1970	594
Apartments equipped with all communal installations	957
The average area of the apartment per 1 tenant in m²	14,5 m²
Occupied workers' barracks and collective apartments	22
Number of people in barracks	247

Source: Urbanistički zavod Dalmacije (1973:50), arranged by the author

on of unfenced external areas all contribute to the town's authenticity. Late modern architecture is interwoven with influences from the region's traditional architecture, including the use of stone cladding and, in part, gable roofs. Residents use the shaded loggias facing the sea as extensions of their living rooms throughout the year.

Several prominent Croatian architects who promoted modernism, such as Lovro Perković, Ivo Gersić, Zoja Dumengjić, Vuko Bombardelli, Mladen Frka, Mile Jovanović, and Ivo Kurtović, as well as architects from other parts of Yugoslavia, including Pavle Krat and Branko Došen, participated in designing the residential buildings. Zoja Dumengjić and Pavle Krat were Russian emigrants.

The attribution of individual residential buildings to specific designers remains uncertain, highlighting the need for further and more detailed research into this largely unexplored topic of modern architecture in the newly planned town of Ploče, which was almost entirely constructed during the socialist period.

This research, in addition to highlighting the previously unknown modern residential architecture of Ploče, contributes to raising awareness about the architecture of small towns and affirms modern architecture within the broader architectural heritage of Croatia, as well as the architecture of a port industrial town within the heritage of Dalmatia.

The work also aims to increase local residents' awareness of the value of the modern architectural heritage in their own town. Architecture of Ploče can be promoted as a tourist attraction, helping to diversify tourist routes in southern Dalmatia and ease pressure on overcrowded tourist hotspots. Despite the above, further research of the available data is needed to determine their inclusion in the Croatian corpus of residential architecture from that period.

Without much pretentiousness, urban greenery in residential areas is often associated with pedestrian sidewalks. Residential buildings in Ploče built until 1971 have remained almost unchanged since its construction and preserved from the damage caused by intense tourism and consumerism. For all these reasons, the residential architecture of Ploče has created a town on a human scale, offering an alternative to the overloaded tourist hotspots of Dalmatia.

This paper also points to the need to affirm and adapt modern architectural heritage to contemporary needs, not only for the sake of preserving the essence of this urban fabric, but also as a possible starting point for shaping future housing strategies.

BIBLIOGRAPHY

1. *** (1954) 'Pravo na stan', *Čovjek i prostor*, 1(1), pp. 1-1.
2. *** (1955) 'Urbanizam – Ploče novi grad i luka', *Arhitektura*, 9(5-6), pp. 58-64.
3. ANTOLIĆ, V. (1952) 'Stanovanje', *Arhitektura*, 6(1), pp. 13-14.
4. ARBUTINA, D. (2001) 'Moderna arhitektura Zadra Uvod u njeno razumijevanje'. *Prostor*, 9(2(22)), pp. 163-174. <https://hrcak.srce.hr/10799> [Accessed: 10 January 2026].
5. BAČE, A. (2023) *Arhitektura Dubrovnika između dva svjetska rata*. Zagreb: ArTresor and Institut za povijest umjetnosti.
6. BADNJAR GOJNIC, A. (2023) *Praxis of collective Building – Narratives of Philosophy and Construction*. Berlin, Boston: Jovis research 6.
7. BALAGOVIĆ, LJ. (1967) 'Primjer suvremenog projektiranja stanova za tržište u četverokatnom nizu', *Gradevinar*, 19(12), pp. 446-451.
8. BARIŠIĆ MARENIĆ, Z. (2020). *Arhitektica Zoja Dumengjić* [Architect Zoja Dumengjić]. Zagreb: Arhitektonski fakultet Sveučilišta u Zagrebu, UPI-2M plus.
9. BARIŠIĆ MARENIĆ, Z.; KRANJČEVIĆ, J. and JELČIĆ, D. (2025) 'Modern Port-Industrial Town of Ploče, Croatia – Research on Public Architecture (1952-1970)', *Prostor*, 33(1(69)), pp. 56-69. [https://doi.org/10.31522/p.33.1\(69\).4](https://doi.org/10.31522/p.33.1(69).4)
10. BARIŠIĆ MARENIĆ, Z. and PERKOVIĆ JOVIĆ, V. (2023), 'Modernism in the Mediterranean: Omiš, Croatia, Urban and Architectural Development of the Dalmatian City in the Second Half of the 20th Century'. *Heritage*, 6, pp. 3921-3984. <https://doi.org/10.3390/heritage6050208>
11. BARTOLIĆ, I. (1950a) 'O izgradnji obiteljskih stanova', *Gradevinar*, 2(5), pp. 40-51.
12. BARTOLIĆ, I. (1950b) 'Montazna izgradnja stambenih zgrada', *Urbanizam i arhitektura*, 4(9-10), pp. 23-25.
13. BARTOLIĆ, I. (1951) 'Osvrst na problematiku izgradnje obiteljskih stanova', *Gradevinar*, 3(5-6), pp. 19-29.
14. BAYLON M. (1950) 'Stambena izgradnja', *Urbanizam i arhitektura*, 4(5-6), pp. 41-46.
15. BAYLON, M. (1952). *Stambene zgrade*. Beograd: Građevinska knjiga.
16. BILIĆ, T. and BARIŠIĆ MARENIĆ, Z. (2021) 'Duga Resa – postindustrijski grad 21. stoljeća', in: Mrak, I. and Palinić, N. (eds.). 8th International Conference on Industrial Heritage: Renewal of Industrial Heritage , Conference Proceedings. Rijeka: Pro Torpedo Rijeka, pp. 209-217.
17. BOBOVEC, B., KORLAET, L. and VIRAG, N. (2015) 'Arhitekt Ivo Bartolić: Prolegomena opusu', *Prostor*, 23(1(49)), pp. 160-173. <https://hrcak.srce.hr/140963> [Accessed: 3 January 2026].
18. BUCHLI, V. (1999) *An Archaeology of Socialism*. Oxford: Berg.
19. DUMENĐIĆ, Z. (1950) 'Stanovi samaca kod SC.M.S. u Sessvetskom Kraljevcu', *Urbanizam i arhitektura*, 4(5-6), pp. 56-56.Bar
20. GOMBOŠ, S. (1950) 'Problem projektiranja stanova od oslobođenja do danas', *Urbanizam i arhitektura*, 4(5-6), pp. 47-54.
21. GRIMMER, V. and KISIĆ, D. (eds). (2005/2006) *Ivan Vitić. Arhitektura*, LIV, 1(217).
22. IVANIŠIN, K. (2000) 'Arhitekt Nikola Dobrovic i vizija demokratskoga grada'. *Radovi Instituta za povijest umjetnosti*, 24, pp. 127-134. <https://hrcak.srce.hr/224264>. [Accessed: 10 January 2026].
23. IVANIŠIN, K. (2015) 'Arhitekt i grad – dubrovački opus Nikole Dobrovića'. *Art bulletin*, 65, pp. 121-150. <https://hrcak.srce.hr/161661> [Accessed: 10 January 2026].
24. JOŠIĆ, M.; KORLAET, L. and VIRAG, N. Digitalni arhiv stambenih zgrada Hrvatske – DASA, Arhitektonski fakultet Sveučilišta u Zagrebu <https://stanovanje.plus/> [Accessed: 10 January 2026].
25. KAHLE, D. (2021) 'Građevni i urbanistički propisi u Hrvatskoj od 1956. do 1971. godine'. *Casopis za suvremenu povijest*, 53(3), pp. 1149-1180. <https://doi.org/10.22586/csp.v53i3.17912>
26. KEČKEMET, D. (1976) 'Moderna arhitektura u Dalmaciji', *Arhitektura*, 30(156-157), pp. 65-79.
27. KEČKEMET, D. (1979) 'Arhitektura Lovre Perkovića', *Život umjetnosti*, 28, pp. 40-47. <https://hrcak.srce.hr/292127> [Accessed: 10 January 2026].
28. KOSAR, H. (1950) 'Studija za izgradnju jednosobnih, dvosobnih i trosobnih obiteljskih stanova'. *Gradevinar*, 2(9), pp. 16-22.
29. KOVAČEVIĆ, A. (1996). *Ploče: portret novog grada u Hrvatskoj i Mediteranu*. Ploče.
30. KOVAČEVIĆ, A. (2003). *Luka i grad Ploče na ušću Neretve 1387.-2003*. Ploče: Zavičajna zbirka grada Ploča.
31. KOTKIN, S. (1995) *Magnetic Mountain: Stalinism as a Civilization*. University of California Press.
32. KRANJČEVIĆ, J., BARIŠIĆ MARENIĆ, Z. and JELČIĆ, D. (2024) 'Urban Genesis of a Modern Port-Industrial Town on the Adriatic from 1945 to 1990 – Ploče, Croatia '. *Prostor*, 32(2(68)), str. 294-307. [https://doi.org/10.31522/p.32.2\(68\).9](https://doi.org/10.31522/p.32.2(68).9)
33. KRSTIĆ, B. and PAJOVIĆ, D. (1987) *Zakonodavstvo urbanizma, arhitekture, baštine, prostornog uređenja, čovjekove sredine*. Beograd: Naučna knjiga.
34. MATIJEVIĆ BARČOT, S. (2020) 'Arhitekt Vuko Bombardelli i Eksperiment-57'. *Život umjetnosti*, 107 (2), pp. 60-79. <https://doi.org/10.31664/zu.2020.107.04>
35. MLIKOTA, A. (2021) *Zadar – obnova i izgradnja nakon razaranja u Drugome svjetskom ratu*. Zagreb: Školska knjiga.
36. MRČELA, V. (1981) 'Neki aspekti odnosa ponuda i potražnje u stanogradnji Jugoslavije od 1945. do danas', *Čovjek i prostor*, 28(344), pp.13-15.

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37. Osnovni zakon o privrednom poslovanju i gospodarenju stambenim zgradama u društvenom vlasništvu [Basic law on economic operations and management of socially owned residential buildings] (SL SFRJ / Official Gazette, 35/1965)
38. PALINIĆ, N. and BJELANOVIĆ, A. (2021) 'Structures of the Proto-industrial and Early Industrial Age in Rijeka, Croatia', *Industrial Archaeology Review*, 43, 1, pp. 2-19. <https://doi.org/10.1080/03090728.2021.1892327>
39. PALJAN, H. (1972) 'Alexander Mitcherlich, Thesen zur Stadt der Zukunft', *Revija za sociologiju*, 2 (1), pp. 98-102. <https://hrcak.srce.hr/156528> [Accessed: 10 January 2026].
40. PALJAN, H. (1974) 'Otvorena pitanja urbanog stanovanja – Prikaz i komentar nekih stajališta u urbanoj sociologiji'. *Revija za sociologiju*, 4 (4), pp. 70-74. <https://hrcak.srce.hr/156427> [Accessed: 10 January 2026].
41. PERCO, M. (1954) 'Gradnja stanova jedino rješenje stambenog pitanja – Razgovor s Milanom Percom o međugradskoj konferenciji o stanovima', *Čovjek i prostor*, 1(3), pp. 1-2.
42. PLANIĆ, S. (1949a) 'Kvalitetan stan minimalne veličine', *Gradevinar*, 1(1), pp. 46-50.
43. PLANIĆ, S. (1949b) 'Tipizacija objekta i elemenata', *Gradevinar*, 1(5), pp. 13-26.
44. PLANIĆ, S. (1949c) 'Normativi za projektiranje', *Gradevinar*, 1(10-11), pp. 3-21.
45. PREMIER, T. (1998) Gersić, Ivo. In: Hrvatski biografski leksikon. Zagreb: Leksikografski zavod Miroslav Krleža, <https://hbl.lzmk.hr/clanak/6782> [Accessed: 10 January 2026].
46. SMOLJAN, I. (1996) *Luka Ploče*. Ploče: Luka Ploče.
47. STAKLAREVIĆ, N. and ŠTEFANAC, T. (2015) *Željeznički kolodvori u Hrvatskoj – priča o ljudima, zgradama i vlakovima*. Zagreb: Tehnički Muzej.
48. ŠUNJIĆ, A. (2025) 'Kako su nastale Ploče? Sve je krenulo od 55 baraka bez vode i struje, a jedina zabava bila je u 'Obali'', *Dubrovacki vjesnik*, 14. srpnja 2025, <https://dubrovacki.slobodnadalmacija.hr/dubrovnik/zupanija/netretva/kako-su-nastale-ploce-sve-je-krenulo-od-55-baraka-bez-vode-i-struje-a-jedina-zabava-bila-je-u-obali-1489186> [Accessed 15 January 2026].
49. TEODOROVIĆ, B. (1952) 'Naši najveći propusti u pogledu higijene stanovanja', *Arhitektura*, 6(1), pp. 41-42.
50. TUČKORIĆ, B. (1958) 'Pojeftinjenje kategorizacijom stambene izgradnje', *Gradevinar*, 10(4), pp. 103-109.
51. TUŠEK, B. (1950) 'Zgrada za samce tvornice „Rade Koncar“ u Zagrebu', *Urbanizam i arhitektura*, 4(5-6), pp. 55-55.
52. TUŠEK, B. (1952a) 'Natječaj za stambene kuće radnika i službenika u NRH', *Arhitektura*, 6(1), pp. 7-10.
53. TUŠEK, B. (1952b) 'Nekoliko misli uz natječaj za projekte stambenih zgrada u NRH', *Arhitektura*, 6(1), pp. 10-10.
54. TUŠEK, B. (1952c) 'O natječaju za projekte stambenih zgrada u NR Hrvatskoj', *Gradevinar*, 4(5-6), pp. 5-11.
55. TUŠEK, D. (2018). *Leksikon Splitske moderne arhitekture*. Split: Sveučilište u Splitu, Fakultet gradevinarstva, arhitekture i geodezije.
56. Urbanistički zavod Dalmacije (1973). *Generalni urbanistički plan Ploče*. Ploče.
57. USKOKOVIĆ, S. (2015). *Lovro Perković : estetika prostora i senzibilitet konteksta*. Zagreb: Ex libris.
58. VALUSEK, B. (ed) (1996) *Moderna arhitektura Rijeke: arhitektura i urbanizam međuratne Rijeke 1918.-1945*. Rijeka: Moderna galerija Rijeke,
59. Zakon o doprinosu za stambenu izgradnju [Law on Contributions for Housing Construction] (SL FNR) / Official Gazette , 57/1955)
60. Zakon o petogodišnjem planu razvitka Narodne privrede Narodne Republike Hrvatske u godinama 1947.-1951. [Five-Year Plan Act of the People's Republic of Croatia from 1947] (NN / Official Gazette, 27/1947)

AUTHORS' BIOGRAPHIES AND CONTRIBUTIONS

ARCHIVAL SOURCES

1. HR-HDA-248. Ministarstvo građevina NRH, 2.2.2. Luka Ploče, detalj Pršnice, signatura predmetnog spisa (1945-1947)
2. The Town of Ploče, Archives
 - sg. 14/9/34, 1961 Frka Stambena zgrada sa 16 stanova Tip A
 - sg. 14/20/53, 1967 Došen Banja Luka Stambena poslovna zgrada H – 3
 - sg. 14/33/74, 1971 Došen H-3
 - sg. 15/1/1, 1947 Perković
 - sg. 15/2/10, 1955 Pavle Krat
 - sg. 15/2/12, 1955 Pavle Krat
3. Državni arhiv Dubrovnk (DAD), Ispostava Metković, Fond o Pločama (Ploče)
4. HR-MGZ- Muzej Grada Zagreba [Museum of the City of Zagreb], Ostavština arhitekata Dumengjić.

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HOUSING ONE PRAXIS: BETWEEN THE SPIRIT OF SPACE AND THE SPIRIT OF TIME. MILETA BOJOVIĆ – A MONTENEGRIN SOCIALIST EXPERIENCE

KEYWORDSANTI-SEGREGATION
CIRCULAR CONNECTION
FLEXIBILITY
MULTI-FAMILY HOUSING
USER PARTICIPATION**ABSTRACT**

Mileta Bojović, a Montenegrin architect, is regionally and internationally recognized as the author of housing complex Blok 5 in Podgorica. Yet, his multi-decade oeuvre extends far beyond the scope of this single, albeit seminal, work. The aim of this paper is to present and critically contextualize Bojović's substantial contribution to the development of multi-family housing in Montenegro, particularly within the context of self-managing socialism and primacy of use over market value. Methodologically, the research is primarily grounded in previously unpublished primary sources, including original project

documentation, architectural drawings, and competition materials by the author. Additionally, the paper seeks to illuminate both the thematic diversity and the conceptual consistency of Bojović's work, as well as his sustained advocacy of *praxis*. This dialectical unity of theory and practice is particularly evident in his long-term engagement with the development of Žabljak, where his multilayered involvement extended from urban planning to architecture, thereby significantly influencing the spatial and morphological identity of this northern city's nucleus.

INTRODUCTION

The 1970s and 1980s were a pivotal period for the development of multi-family and mass-housing architecture in Yugoslavia. Outstanding results were particularly achieved in terms of use value, i.e. the functional value and organization of dwelling. This was primarily affirmed through the institution of architectural competitions, in which the winning teams were most often composed of young, emerging architects (Bajlon, 1975: 37). This kind of “housing revolution” was preceded by numerous conferences and congresses, from 1950¹ until the beginning of the 1980s (Bajlon, 1975: 30), at which the topic of adequate housing and dwelling was consistently discussed. This period is characterized by plans and projects of new, socialist cities, which were accompanied by socialist self-management and a new urban everyday life.

It was precisely during this period that the design practice of the Montenegrin architect and urban planner Mileta Bojović² began, regionally, and in recent years also internationally known as the author of the residential settlement Blok 5 (1977-1983) in Podgorica. The almost fiftieth anniversary since the inception of Blok 5 represents an appropriate opportunity for a more detailed presentation of the lesser-known, albeit very diverse, scope of the author’s work. Therefore, this paper examines a segment of Bojović’s design practice, i.e. analyses and contextualizes his highly significant contribution in the

domain of multi-family housing in Montenegro. This will be carried out through the analytical interpretation of four characteristic projects from the 1980s (1973-1977), three of which represent realized projects, and one an award-winning competition design. Additionally, through the presentation of the early phase of Bojović’s oeuvre, the paper provides insight into a segment of Montenegrin architectural practice related to multi-family housing in the stated period, since it has been the least represented in the literature, in comparison to contemporaneous developments in the rest of the region³.

Through the analysis of selected works, this study investigates the themes that have marked Bojović’s architectural practice from its earliest phase, and that he has continued to develop over several decades. These include praxis, as the unity of theory and practice, the abolition of segregation of people, functions, and space, mixed-use at both planning and architectural levels, the humanization of residential environments, volumetric articulation, the covering of pedestrian circulation, and the concept of “circular connection” within the apartment. The articulation of this thematic continuity evokes a different mode of spatial thinking, one that privileges use over market value.

Additionally, the article demonstrates that consistency in conceptual framework and in the configuration of residential units does not necessarily result in volumetric uniformity. On the contrary, through a recognizable design logic and the use of a similar spatial organization of residential units, it is possible to achieve markedly different architectural expressions and building forms – adapted to the local climate, immediate context, construction technologies, materials, as well as different regulatory frameworks and standards.

Methodologically, the study is grounded in a combined qualitative research approach. The

¹ I Consultation of Architecture Students, Zagreb, 1950.; I Consultation of Architects and Urban Planners of Yugoslavia, Dubrovnik, November 23-25, 1950 (Bajlon, 1975: 30).

² Throughout his multi-decade career, Bojović has been actively engaged in spatial and urban planning and architecture. He is the recipient of the first Lifetime Achievement Award of the Chamber of Engineering of Montenegro – for achievements in the field of spatial planning and building construction, 2011, as well as the first award of the Montenegrin Days of Architecture for “Special Contribution to the Development of Architecture and Urbanism”, 2024 (Crnogorska akademija nauka i umjetnosti, 2018).

³ This mainly concerns the availability of published materials on the Belgrade School of Housing, along with documentation on the Split III residential complex and comparable design achievements from the period. Lea Horvat, a Croatian theorist and art historian, in an

analysis and interpretation of primary sources, including previously unpublished archival material, are aimed at reconstructing, understanding, and critically examining the author's work at the intersection of theory and practice. This body of material is complemented by oral testimonies of the author, used both as an independent source and to further support interpretation of documentary evidence. In addition, the study incorporates an analysis of relevant literature, with the aim of contextualizing the author's work within a broader framework, as well as within the socio-spatial milieu of socialist self-management and the corresponding Montenegrin everyday life.

The selection of projects that structure and guide the research process has been carried out based on their typology, temporal framework, and their significance for the formation of Bojović's design approach, as well as for examining the implementation of his theoretical positions in practice.

BIOGRAPHY OR FRENCH DEPARTURES AND ITS RETURNS: MONTENEGRO PRAXIS⁴

Mileta Bojović, a full member of the Montenegrin Academy of Sciences and Arts⁵, was born in 1941, in the northern, mountainous part of Montenegro, in the village of Zminica, in the municipality of Žabljak. His childhood was formative and eventful. At the age of ten, he left his family home to attend primary and secondary school in Nikšić, an experience that early on shaped him into a highly mature and independent individual, with a wide range of diverse interests during those formative years in post-war Nikšić⁶. At the Faculty of Architecture, University of Belgrade, where he enrolled in 1959, he studied under some of the leading figures of the architectural scene of the time. His design studio was led by Milan Zloković, Bogdan Bogdanović

thought the studio for Urbanism, Aleksandar Deroko taught the History of Architecture, Đurđe Bošković the History of Art, and Nikola Dobrović – Contemporary Architecture.

Following the suggestion of Professor Zloković to his students, Bojović went to France in 1964, to Nancy, in his final year of studies, and began his professional career in the office of architect Jean Marconnet (1925-2014). He returned to Belgrade briefly in 1966 to graduate, then returned to France (Blagojević, 2017). In the same office, Bojović worked on the design of residential (HLM) Quartier Saint-Sébastien in Nancy, in collaboration with the Paris office of Jean Fauteron (1915-1983), a prominent French architect, professor at the École des Beaux-Arts in Paris and recipient of the Grand Prix de Rome. Having seen Bojović's work on the study of prefabricated façades and central service core for this residential quarter, Fauteron proposed that he move to Paris, thereby marking the beginning of the author's Paris years and the inception of a theme he would later consistently pursue in his design practice.

At Fauteron's office on Place des Invalides, Rue Faber 26, the detailed design of the French Pavilion for the 1967 World Exposition in Montreal was underway. Bojović worked across a variety of typologies, including the extension of a secondary school in the city of Charleville, as well as the Les Halles project and the Bercy district, both in Paris. At the same time, he attended a two-year postgraduate program at the Institute of Urbanism in Paris (1967-1969), where one of his professors was Henri Lefebvre (1901-1991), an undisputed authority in philosophy and urban sociology, with whom the architect agreed on the topic of his doctoral dissertation. During those years, Lefebvre was also present in the intellectual circles of the former Yugoslavia, notably through his participation in the Korčula Summer School (Kangrga, 1997). It is with Henri Lefebvre that the author's interest in urban sociology and in the contemporary problem of segregation – and its abolition at all levels – began to take shape. In May 1967, Lefebvre's assistants and followers launched the journal *Utopie*, which focused on the critique of urbanism, architecture, and everyday life.

Later, at the Faculty of Literature and Social Sciences, University of Paris X in Nanterre, Bojović continued his work under Henri Lefebvre at his Chair of Sociology, developing his doctoral dissertation entitled "*Urbanism and Architecture in Yugoslavia between Self-Management and the Withering Away of the State*" (1969-1978) supported by a three-year scholarship awarded by the French Govern-

interview conducted in connection with her analysis of the projects of Split III and Blok 5, points out the discrepancy in the exposure of these two residential settlements (Kucinac, 2024).

⁴ The subtitle of this chapter derives from the title of an article by Serbian architect, professor, architectural historian and theorist Ljiljana Blagojević (2017) – „French Architectural Departures and Its Returns: Belgrade Chic, Balkan Mission, Montenegro Praxis“, addressing the connections between graduates of the Faculty of Architecture at the University of Belgrade and France.

⁵ Bojović is the first – and to date the only – architect in Montenegro elected as an associate member of the Montenegrin Academy of Sciences and Arts in 2018, and in 2025 as a full member.

⁶ He was a member of the literary and photographic clubs, as well as of the Nikšić aero club.

ment in 1975. At that time, Lefebvre's assistant was Jean Baudrillard (Kellner, 2020). The author's collaboration with the French philosopher significantly influenced the overall trajectory of his design practice, as well as the thematic orientation of his writings, published up to the present day. This formed the foundation of his enduring commitment to praxis, conceived as the inseparable unity of theory and practice, a concept also promoted by the Korčula Summer School, yet largely absent from the practice of urbanists and architects.

At the same time, in Yugoslavia, the implementation of the renowned regional project "Južni Jadran"⁷ began in 1967. After five years in France, Bojović decided to return to Montenegro, and on 1 October 1969 he began working on the project in Budva, through the Republic Institute for Urban Planning and Design⁸. He collaborated with a Swiss team on the plans for Cape Marko and Morinj in the Bay of Kotor, while independently developing the plans for Pržno Beach in the municipality of Tivat and the General Urban Plan of Herceg Novi, as part of the unified general plan for the Bay of Kotor (Bojović, 2025).

After the completion of the "Južni Jadran" project, Bojović, given the choice between working on the plans for Herceg Novi or Žabljak, chose his native Žabljak. With this decision, in September 1971, a new, highly significant and defining phase of his professional activity in urbanism and architecture begun. His long-term work on the urban planning of Žabljak, alongside the simultaneous design of several important administrative, tourism, and multi-family housing buildings, began to shape the morphology of the mountain tourist center, while also marking the emergence of a distinct physiognomy and spirit of the author's architectural oeuvre. Additionally, Bojović consistently continued to advocate for mixed-use spaces and the integration of functions rather than zoning and their strict separation⁹, a principle he implemented throughout his practice. This approach promoted a mixed-use program, namely the creation of a residential-tourist settlement without rigid zoning or division between these two primary functions, while also supporting concentrated development and a natural, phased growth from the center toward the periphery. Furthermore, it enables the two main urban roads to be transformed into pedestrian zones during the ski season, while supply and servicing are handled via service routes (General Urban Plan of Žabljak, 1988). The foregoing indicates an affirmative and protective attitude towards space¹⁰.

MIXED USE BUILDING IN ŽABLJAK – THE "DEPARTMENT STORE" (1973-1983)

The combined program building¹¹ was among the author's earliest projects designed for Žabljak, although not the first to be realized. As this programmatically complex project marks the beginning of the author's independent investigation of multi-family housing and the application of his theoretical concepts in practice, it will therefore be examined in greater detail.

The building, located on the western side of the main town square, stands out for its, at the time, advanced program of design and construction, through which it established new standards of living in this mountain town, enhancing the existing habits and needs of the local population. Namely, through the plans that preceded the building¹², the architect had already established multifunctionality as an urban planning objective, which consequently shaped the future program of the mixed-use building. Bojović believed that a combined program building conceived as a kind of city within a city¹³ corresponded both to the needs of future users and to those of Žabljak as a whole (Bojović, 2015). The project brief therefore envisaged a department store, a supermarket, a bank, the Social Accounting Service, electricity distribution facilities, underground garages, a laundry, a kindergarten and a wide range of apartment typologies intended for existing and future personnel needed for further development of this northern tourist center¹⁴.

This self-sufficiency of the building, particularly relevant today in the light of a post-pandemic future, largely stems from the architect's interest in nineteenth-century utopian socialists and their phalansteries, as well as in Le Corbusier, and most notably in Russian Constructivists and revolutionaries who

⁷ „Južni Jadran“ (The “Southern Adriatic”) in Montenegro was carried out through a consortium comprising the Republic Institute for Urban Planning and Design (RZUP) as the local bureau, in collaboration with the French and Italian firms OTAM and URBAM, and Tourconsult. (Plan fizičkog razvoja regije Južni Jadran: Generalni plan Boke Kotorske, 1970).

⁸ From 1969 to 1994, Bojović worked at the Institute for Urban Planning and Design – RZUP, after which he established his private practice.

⁹ Bojović's opposition to zoning and advocacy of mixed-use as an integrated urban system aligns with Jane Jacobs' (1992) concept of “mixed primary uses” as generators of diversity, Henri Lefebvre's (1974) critique of abstract space as a mechanism of functional segregation, and Christopher Alexander's (1977) view of the city as a continuum structured through overlapping functions within “activity nodes.”

¹⁰ Bojović was engaged in urban planning of Žabljak over four decades (1971-2010).

sought, to change ways of living and vice versa through transformations of the city and architecture. The architect notes (Bojović, 2015) that future residents, a “small phalanx” of relatives, friends, and colleagues, followed the process of design and construction, which enabled their identification with the building, its appropriation, and the development of a relationship to the house as their own. All of this was possible within a period that represented a totality of ideas, realities, and ideals (Blagojević, 2017), and the abolition of boundaries between urban planners, architects, and users was seen as an opportunity (Bojović, 1981).

The building’s multifunctionality and self-sufficiency are more than adequate in the context of the harsh climatic conditions of this municipality with the highest altitude in Montenegro. The transition between the public space of the square and the interior of the building is resolved through the provision of a covered sidewalk six metres wide, along the entire length of the building. The functional integration of all programs is also ensured by an internal pedestrian street at first-floor level, enabling users to maintain close interaction and access all facilities within the building. In this project, the inseparability of urbanism and architecture is evident, as the boundary between them dissolves.

From a compositional standpoint, the playful masses and dynamic volumes, skilfully composed within the canon of mountain architecture aesthetics, render the building aligned with local identity, contextual, rhythmic, and at times even dramatic (Fig. 1). Given the building’s imposing scale within its context – both in terms of its overall length and number of storeys – the architect strategically fragmented the massing and articulated the volumes in order to achieve compatibility with the scale of the surrounding buildings, while also avoiding the obstruction of the

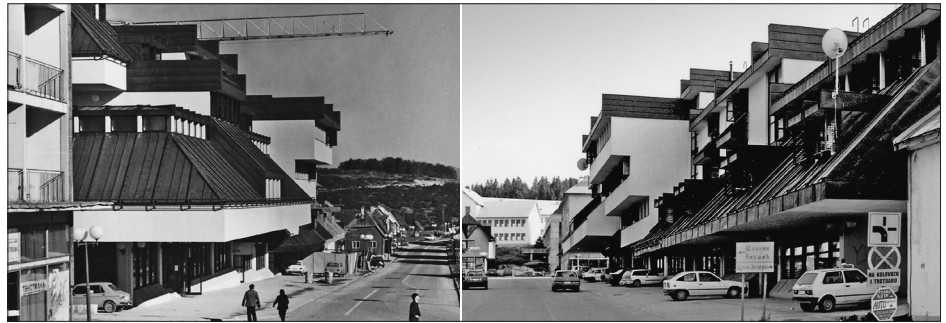


FIG. 1 THE “DEPARTMENT STORE” MIXED-USE BUILDING: CORNER VIEW OF THE FIRST PHASE FROM THE MAIN CITY SQUARE, FOLLOWED BY THE NORTHERN VIEW SHOWING BOTH PHASES OF THE BUILDING, COMPLETED, 1990

most significant views towards Durmitor mountain and the town square, by cutting the roof planes at a 45-degree angle.

In her text on the academic and professional connections between architects from the region and France, Blagojević (2017) highlights this work by Bojović, along with Blok 5. She recognizes that, through the focus on the triadic foundational code of architecture-city-society, both works interpret Henri Lefebvre’s unitary theory as praxis, further demonstrating that the theory of self-management was critically deployed and implemented in the production of space (Blagojević, 2017).

The building, with a maximum height of five storeys, comprises four residential entrances, each with a staircase, and one elevator providing a direct connection between the apartments and the garage. The typical floor combined a gallery-access layout with a central double-loaded corridor and duplex units. Several apartment types of varying layouts were designed, in a generous structural grid

FIG. 2 SECOND-FLOOR PLAN OF THE FIRST PHASE OF THE “DEPARTMENT STORE” MIXED-USE BUILDING, PRESENTED TOGETHER WITH A THREE-BEDROOM APARTMENT FROM THE THIRD FLOOR. SECOND FLOOR INCLUDES A KINDERGARTEN – DAYCARE, A LARGE CORNER TERRACE, AND ELEVEN RESIDENTIAL UNITS, 1973



11 In the project documentation, the building is officially designated as the *Residential-Commercial Building in Zabljak*, whereas Blagojević (2017) describes it as a *combined-program urban block – housing and commercial*. In public discourse, however, it is commonly referred to as the “Department Store”, after the department store that once occupied four levels of commercial wing – now the supermarket.

12 At the beginning of his engagement with the Municipality of Zabljak, Bojović first developed the General Urban Plan (1971), followed by the Detailed Urban Plan (1973), both of which advocated the integration of functions, from which the design programme for this multifunctional building subsequently emerged.

13 In line with Koolhaas’s concept of “culture of congestion” (1978), a mixed-use (vertical) city within a city.

14 At that time, Zabljak had a policy of allocating apartments for use to personnel who came to the town to work (Bojović, 2025).

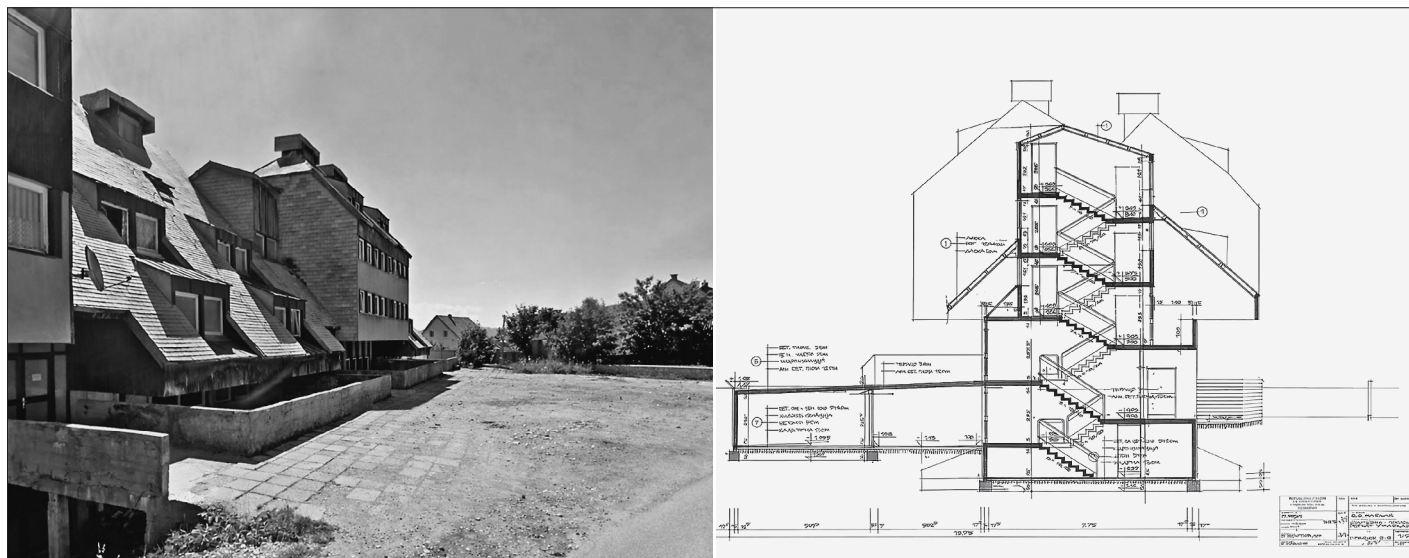


FIG. 3 SEGMENT OF THE BUILDING'S VOLUMETRIC COMPOSITION (2021), ACCOMPANIED BY A CROSS-SECTION, 1974

up to 7,5 meters – ranging from studio apartments to three-bedroom units. Given the focus of this study, particular importance is placed on those apartments that feature a central core and a “circular connection”, as found in a number of two-bedroom and three-bedroom units (Fig. 2). Through this organization of residential space, the architect transcends the conventional division between day and night zones, achieving instead a fluid spatial arrangement and multiple interconnections between spaces. This, consequently, enables numerous possibilities of use, enhances spatial quality, ambience, and usability, while also reducing unnecessary circulation and allowing for a more efficient use of the overall available area, fostering social integration of family members (Knežević, 1989; Lojanica, 2019). In this way, residential space becomes the smallest unit for testing the author's theoretical assumptions in practice. The “Department Store” building demonstrated a synthesis of all Bojović's key theoretical concepts, including a pronounced absence of segregation of space, functions, and people and would be fully realized in two phases over the next ten years.

RESIDENTIAL-COMMERCIAL BUILDING AT THE ENTRANCE TO ŽABLJAK (1974)

Another residential-commercial building, of a smaller scale, located at the southeastern entrance to the town, with a total floor area of 1,500 m², is situated within a residential zone designated by the Detailed Urban Plan Žabljak II, on a triangular plot between what was at the time one existing and two newly planned traffic routes (Bojović, 1974). The architect notes that the building adjoins the

zone of individual housing along its south-western side, effectively enclosing it, which constituted one of the key conditions for the formation of the spatial concept. To establish a spatial relationship between the inherited and the newly designed fabric, the architect fragmented the massing of the new building on the floors above the ground level, so that the building becomes volumetrically closer to the existing structures, almost forming a sequence of individual units. The building entrances are approached via a covered zone measuring 2.7 meters in width, which represents one of the recurring themes in the author's architecture.

In terms of volumetric composition and overall aesthetics, Bojović, once again, skilfully employed the canonized aesthetic patterns of the vernacular architecture of the region in which he is designing. The roofs have a pitch of 45 degrees, characteristic of the climatic conditions of Žabljak and of traditional construction in this northern area. The building entrances are approached via a covered zone measuring 2.7 meters in width, which represents one of the recurring themes in the author's oeuvre.

The residential space is organized around three separate entrances, and the functions across the floors are arranged in split levels. The basement accommodates storage, while the second split level contains the service vehicular access and garages for residents. At the level of pedestrian circulation, along the newly designed street, commercial spaces are provided, whereas the residential units are located on the upper floors.

The articulation of volumes is further achieved through the variation of apartment typologies

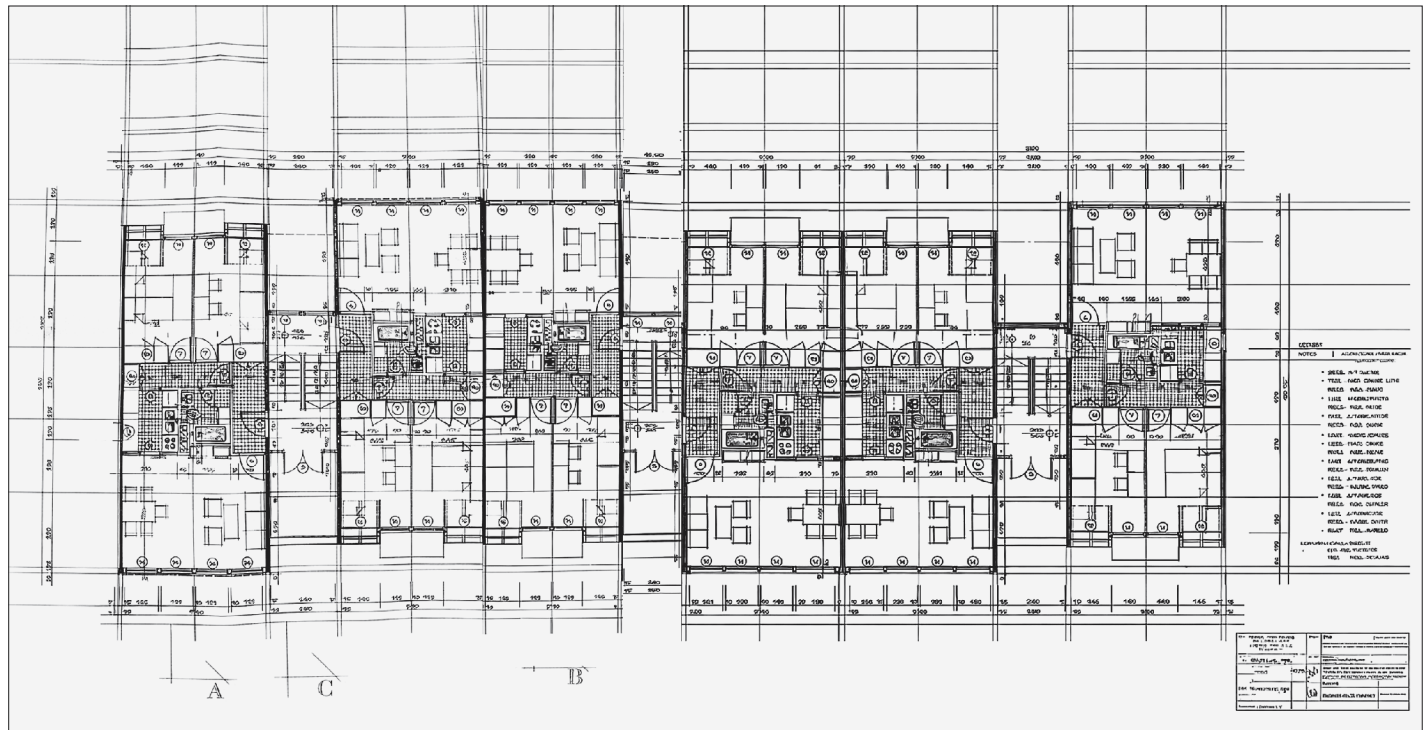


FIG. 4 FIRST-FLOOR PLAN FEATURING TWO-BEDROOM APARTMENTS ORGANIZED WITH A CIRCULAR CIRCULATION SCHEME, 1974

across the floors. Two-bedroom apartments are designed on the first floor, thereby covering access to the recessed ground floor; one-bedroom apartments are located on the second, while studio apartments occupy the attic. This results in a distinctive cross-section, characteristic of the author's architecture – cantilevered overhangs, covered pedestrian routes and entrances, and a pronounced dynamism of massing (Fig. 3). The building is designed on sloping terrain, allowing access to the first floor from the upper street via bridges – another recurring theme in the author's work.

The project brief emphasized rational apartment areas and economic efficiency. Consequently, the service installations are grouped within the units, with ventilation and chimney ducts integrated alongside the vertical shafts, while the design overall aimed to minimize construction interventions within the apartments (Bojović, 1974).

In terms of the organization of residential units, the architect continued to develop the principle he had advocated in the previous project, adapting it to a new concept, smaller floor areas, and significantly reduced spans. Within a structural grid of 5.4 metres, all three apartment types are designed, of which the one-bedroom and two-bedroom units feature circular connection (Fig. 4).

Unfortunately, the present condition of the building is far from its original design intent. Following years of damage, the original

wooden façade and roof covering were initially replaced with asbestos cement panels and, in recent years, the entire building has been clad in corrugated metal, leading to substantial visual degradation.

COMPETITION ENTRY FOR SOLIDARITY APARTMENTS, ZABJELO, PODGORICA, 1973

These years marked an especially intensive creative period for the architect. In 1973, while engaged in the design of the mixed-use building in Žabljak, a national architectural-urban design competition was announced for the residential block "Solidarity Apartments" in Zabjelo, in what was then Titograd. The title of the competition was derived from the broader constitutional framework of socialist self-management, which established housing as a domain of social redistribution based on the principles of solidarity, reciprocity, and workers' self-management (Ustav SFRJ, 1974). In the mid-1980s, during the second phase of self-management, housing became decentralized, introducing a complementary system of "solidarity apartments" alongside socially owned housing. This program functioned as a corrective mechanism for addressing the housing needs of the segments of the population unable to obtain housing through their workplaces (Nikolić, 2023).

The first prize was awarded to the entry by Arsenije Martinović (Markus, 2008: 106), who was also working at the Republic Institute for

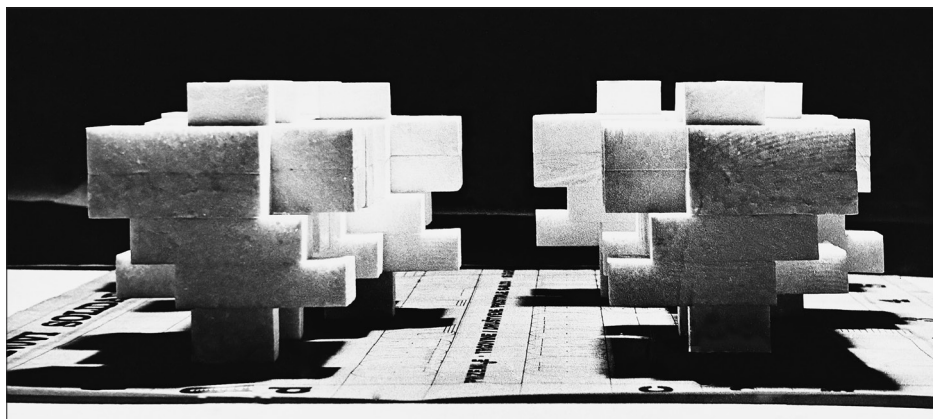


FIG. 5 COMPETITION ENTRY MODEL ILLUSTRATING THE CHARACTERISTIC VOLUMETRIC COMPOSITION OF THE APARTMENT BLOCK, DISTINCTIVE OF THE ARCHITECT'S VOLUMETRIC LANGUAGE, 1973

Urbanism and Design. Bojović's design received the second or third prize¹⁵. In contrast to the competition-winning scheme – subsequently realized between 1974 and 1976 – which structured the buildings along the block perimeter, Bojović proposed a fundamentally different urban concept. The buildings were grouped in the centre, with the ambition of establishing a residential street (Kovacic, 2016) and square, as well as a significant green buffer zone between the housing and the surrounding traffic arteries. The competition entry was submitted under the code PRAXIS and was the author's first competition entry on the topic of multi-family housing and has remained unknown to the professional public to date. At the same time, it anticipates his later competition proposal for Blok 5.

The proposed buildings, four storeys high, are volumetrically distinctive. The massing is adapted to the climatic context for which the project was designed, while access routes and pedestrian circulation around the block is covered over a width of four and a half metres. The architect effectively achieved volumetric dynamism through a characteristic shifting of residential units across the floors, resulting in articulated cross-sections, and leading to cantilevered overhangs and covered pedestrian access (Fig. 5).

The two buildings, positioned opposite each other, consist of three wings each, and are each organized around eleven staircases. The apartments are accessed from a main landing, reflecting the author's characteristic organization of the typical floor with integrated vertical circulation (Knežević, 1989: 29-30). In this project too, the author explores the possibilities of a modular organization of the typical floor and residential units, establishing a modular grid with an axial span of 5.4 metres, allowing for the achievement of a highly dynamic spatial expression, while meeting the required number and structure

of apartments as defined by the competition brief.

Three variants of two-bedroom apartments are provided. Common to all is the circular connection around a centrally designed bathroom and through the kitchen. Three-bedroom apartments follow a similar organizational logic, emerging from the basic two-bedroom module through the addition of a third bedroom and a bathroom (Fig. 6).

HOUSING ESTATE BLOK 5, PODGORICA (1977-1984)

All the above served as a prelude to the to the Blok 5¹⁶, a residential neighbourhood¹⁷ in Podgorica and the author's most well-known work. Unlike the previously discussed projects, in which Bojović also acted as the urban planner, Blok 5 represents the realization of a first-prize competition entry, based on an already adopted detailed urban plan (Fig. 7)¹⁸. Namely, in the context of self-managed socialism, an invited competition for a new residential neighbourhood in Titograd was announced in Montenegro in early 1977, organized by the Investor – Self-Managed Interest Community (SIZ). The Republic Institute for Urban Planning and Design participated with three entries, of which Bojović's was consistently submitted under the code PRAXIS.

The competition program required a precise number and structure of apartments and strict adherence to the prescribed floor areas, in accordance with the standards for socially oriented housing. By employing a 6×6-meter module, Bojović's proposal succeeded in meeting all the stipulated programme requirements – 1,800 residential units, ranging in structure from studio (36 m²) to four-bedroom apartments (108 m²) (Bojović and Bajić Šestović, 2020; Jovičević, 2017).

Prior to the competition for Blok 5, the architect spent two years in Paris, working on his

¹⁵ Official data on this competition are scarce, and Bojović, in direct conversation, cannot recall with precision whether his entry received the second or third prize.

¹⁶ Blok 5 is widely regarded as the most renowned housing estate of the socialist period in Montenegro, and it was also recently ranked the most desirable residential area for living in Podgorica, in a survey conducted by a private media outlet (***, 2026). In recent years, there has been a significant increase in scholarly interest.

¹⁷ Blok 5 (originally „Stambena zajednica broj 5 – Krusevac u Titogradu“ – Housing Community number 5 – Krusevac, in Titograd, in English) was planned and designed at the level of a local community with six thousand inhabitants.

¹⁸ The author of the detailed urban plan was architect Vukota Tupa Vukotic, Bojović's colleague from RZUP, where the plan was designed and adopted in 1976.

doctoral dissertation under the supervision of Henri Lefebvre (Lefebvre, 1976). Through the project of this residential neighbourhood, the author continued, in practice, his own research into the relationships between the individual, society, and the city – relationships that Lefebvre had theorized in his seminal works “The Production of Space” (1974) and “The Right to the City” (1968). The focus was placed on the individual, on the role of the user as the central figure around whom both plans, and the city itself are formed (Dragovic, 2018). In this sociologically and politically specific moment for Montenegro, during the period of Yugoslav self-managed socialism – when state policy itself implied the participation of individuals in decision-making – Bojovic considered the involvement of users in the creation of their own living environment to be essential, and introduced the concept of flexibility in residential space, a quality that most clearly distinguished the first-prize proposal (Bojovic and Bajic Šestovic, 2020).

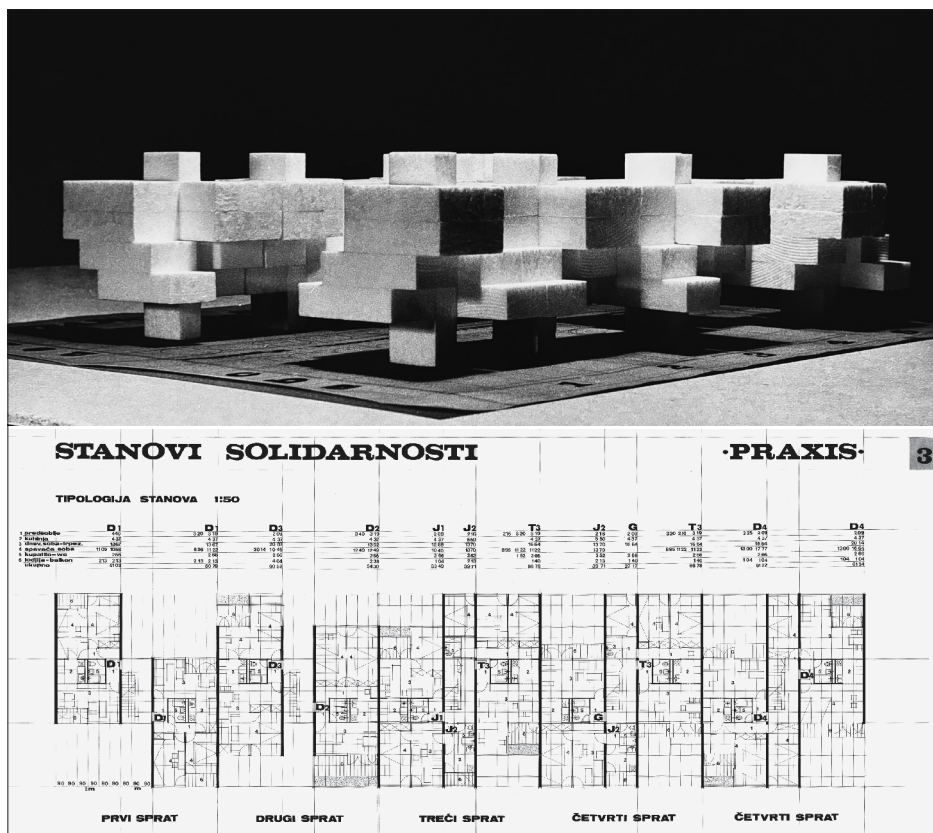
The first level of flexibility lies in the volumetric differentiation of buildings through varying compositions of the same elements, while the second concerns the internal structure of apartments, allowing adaptation to specific needs within a fixed building volume and resulting in a dynamic massing. Overall, the dramatic volumetry of the buildings in this neighbourhood – particularly the five high-rise towers in the central area (Fig. 8), with cantilevered overhangs of up to five meters¹⁹ – constitutes a key spatial quality by which the complex is recognized (Štraus, 1991). The third level of flexibility concerned the possibility of organizing the interior according to the needs of the users.

At the time, Blok 5 represented a major design and construction undertaking for Montenegro. The buildings – thirteen in total, with an overall floor area of 190,000 square metres – were constructed sequentially, with construction

¹⁹ The five-meter cantilevers constituted a structurally demanding solution for the engineers collaborating on the Blok 5 project. Consequently, the Institute of Earthquake Engineering in Skopje, Macedonia, given their experience with the devastating earthquake of 1963, was engaged as a consultant for the structural design throughout the entire process, providing technical verification and full support for the proposed structural system (Bojovic, 2025).

²⁰ The thesis remained unfinished, due to the immensity of the subject matter and retirement of the Mentor. However, its returns were to be evidenced in the author's praxis (Blagojevic, 2017: 143)

²¹ After the longitudinal building A3 had been painted in accordance with the projected chromatic scheme, intended to accentuate its volumetric composition, the process was discontinued by Bojovic's colleagues, and a Commission for Façade Painting was constituted, with the building ultimately repainted (Fig. 10) (Bojovic, 2025).



beginning as early as autumn 1977 and continuing until 1983 (Bojovic, 2025). The phased construction was followed by phased occupancy. At the same time, Bojovic was working on his doctoral dissertation²⁰.

At the conceptual design stage, Blok 5 was tested in a prefabricated system. Following the selection of the contractor, however, the project was designed and subsequently executed using a system of monolithic reinforced concrete walls and slabs. The interior elements, including built-in equipment and certain partition components were prefabricated, allowing for a high degree of flexibility. The departure from the original design concerned the colour treatment of the façades, which, rather than following the author's design, were ultimately executed according to a later proposal by a specially appointed Commission for Façade Painting²¹ (Bojovic, 2025).

Due to its modular organization, the architect offered a large number of variants within the same floor areas and using the same elements (Fig. 9). The apartments were organized with only the wet core fixed, while all other partition walls were movable, allowing for relocation or removal in coordination with the architect, who remained available to future users during the design and construc-

FIG. 6 COMPETITION ENTRY MODEL ILLUSTRATING THE DYNAMIC SPATIAL COMPOSITION OF THE APARTMENT BLOCK, TOGETHER WITH THE APARTMENT TYPOLOGIES, DISTRIBUTED ACROSS FOUR FLOORS, 1973

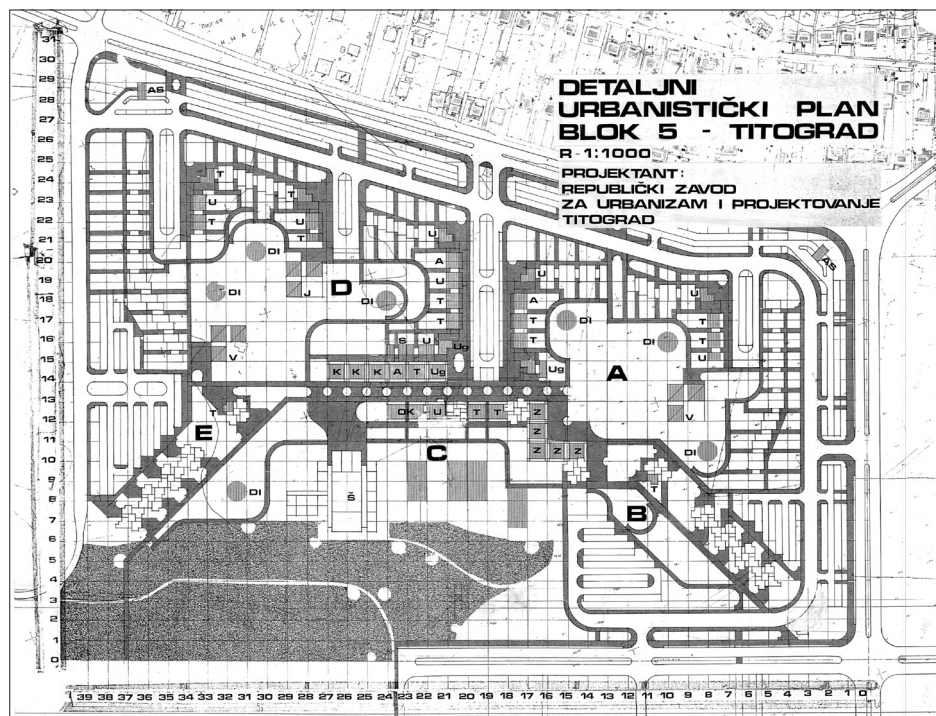


FIG. 7 DETAILED URBAN PLAN OF BLOK 5, AUTHOR ARCHITECT VUKOTA TUPA VUKOTIĆ, 1976

tion process²². (Stamatović and Bojović, 2023; Bojović and Bajić Šestović, 2020).

The basic apartment type, which served as the foundation for an impressive number of variations on the theme, is a two-and-a-half-room apartment organized within an axial grid of 6×14.4 metres, with a centrally positioned fixed wet core, around which the toilet, bathroom, and kitchen are arranged, further enabling circular connection in the majority of apartments (Fig. 10).

Horvat (2020, 2024) argues that this residential neighbourhood can be regarded as one of the most theoretically and practically consistent and enduring examples of (socialist) self-management in Yugoslav mass housing. It undoubtedly represents a realization of praxis – a synthesis of the author's theoretical ambitions and their practical testing, as well as a social advancement aimed at enabling users to identify with their own living environment.

FIG. 8 TWO CENTRAL TOWERS IN BLOK 5, VIEW FROM THE INNER COURTYARD AND FROM THE CENTRAL PARKING SPACE, 1989



CONCLUSION

This paper analyses a segment of the design oeuvre of the Montenegrin architect Mileta Bojović, through the example of four architectural works from the very beginning of the author's professional career. Particular emphasis is placed on the continuity of ideas that the author consistently tested through his practice. Bojović persistently embedded his own research into his buildings, exploring the underlying principles of production of space, that is, the individual-society-city-architecture nexus. Furthermore, the analyses clearly demonstrate that each project represents a form of contextual architecture, while simultaneously remaining avant-garde²³ in terms of its programme, volumetric expression and massing dynamics, as well as its functional organization. Norberg-Schulz (1982) argues that to connect with a place means to care for that place. For him, true architecture is an architecture of care – an architecture of participation that helps individuals realize their role as inhabitants. Bojović's architecture emerges from a deep and multi-layered understanding of the socio-spatial context, particularly that of his hometown, Žabljak, with a clear ambition to enhance people's habits, values, and needs through urban planning and architecture.

In terms of form, the dynamism of massing is a result of a reflective approach to (architectural) space and to living within that space – cantilevered overhangs, covered pedestrian circulation, and the articulation and fragmentation of volumes in response to the inherited context collectively produce an architectural expression of markedly dynamic, and at times even dramatic, volumetry. The theme is even more complex given that it concerns housing, the most sensitive task for any architect. The author approaches it with the ambition of fostering a sense of community,

²² Within the broader European context, Bojović's work aligns with a wider shift toward participatory, socially engaged housing, distinguished by its grounding in Yugoslav self-management. In the United Kingdom, Ralph Erskine designed the Byker Wall (1969), where future residents took part in shaping their homes through a pilot project, emphasizing the social dimension of housing (Erskine, 2009). In Belgium, Lucien Kroll collaborated with residents on La Mémé, linking participation to the protests of May 1968 (Turkkul, 2022). In Italy, Villaggio Matteotti (1969-1975), designed by Giancarlo De Carlo with Domenico De Masi, followed similar participatory principles (Felci, 2015). In theory, John Habraken (1972) proposed separating collective "support" from individual infill, opposing mass housing uniformity – an approach resonant with Yona Friedman's utopian projects (Cline and di Carlo, 2002), both aiming to restore social agency in housing design.

²³ Bojović (2024) argues that architecture is, by its very nature, predisposed to the avant-garde, since it is designed only in part for its own time and predominantly for the future – for generations yet to come.



BIBLIOGRAPHY AND SOURCES

1. ALEXANDER, C. (1977) *A Pattern Language*. New York: Oxford University Press.
2. BAJLON, M. (1975) 'Stan u Beogradu', *Arhitektura urbanizam*, 74-77, pp. 23-42.
3. BAUDRILLARD, J. (2006) *Utopia Deferred: Writings from Utopie (1967-1978)*. Cambridge: MIT Press.
4. BLAGOJEVIĆ, LJ. (2017) 'French architectural departures and its returns: Belgrade chic, Balkan mission, Montenegro praxis' in Bjazic Klarin, T. and Kolečnik, Lj. (eds.) *French Artistic Culture and Interwar Central East Europe*. Zagreb: Institute of Art History, pp. 144-157.
5. BOJOVIĆ, M. (1981) 'Urbano lice samoupravljanja', *Omladinski pokret*, 19 February.
6. BOJOVIĆ, M. (2006) 'Između duha prostora i duha vremena', *Pobjeda*, 1 April.
7. BOJOVIĆ, M. (2015) Unpublished nomination dossier submitted to the Montenegrin Academy of Sciences and Arts.
8. BOJOVIĆ, M. and BAJIĆ ŠESTOVIĆ, J. (2020) 'Self-managing socialism and its space: Blok 5 and challenging rhetoric of flexibility', *ACE: Architecture, City and Environment*, 15(43), 9213. Available at: <https://doi.org/10.5821/ace.15.43.9213>
9. DRAGOVIĆ, S. (2019) 'From block to city, and back: post-1989 transformation of residential neighbourhoods in Podgorica' in Three decades of Post Socialist Transition. Darmstadt: Urban Morphosis Lab, Technische Universität Darmstadt, pp. 326-340. [online] Available at: https://www.academia.edu/41245258/From_block_to_city_and_back_post_1989_transformation_of_residential_neighbourhoods_in_Podgorica [Accessed: 18 December 2025].
10. ERSKINE, R. (2009) 'Byker Wall Newcastle-upon-Tyne' in Ebner, P. and Klaffke, J. (eds.) *Living Streets Wohnwege*. Vienna: Springer.
11. HABRAKEN, N.J. (1972) *Supports: An Alternative to Mass Housing*. London: Architectural Press.
12. HORVAT, L. (2020) 'Housing Yugoslav self-management: Blok 5 in Titograd', *Histories of Postwar Architecture*, 6. [online] Available at: <https://doi.org/10.6092/issn.2611-0075/10608> [Accessed: 12 December 2025].
13. HORVAT, L. (2024) *Harte Währung Beton: Eine Kulturgeschichte des Massenwohnbaus im sozialistischen Jugoslawien und seinen Nachfolgestaaten*. Vienna: Böhlau Verlag Brill Deutschland GmbH. ISBN 9783412528409. [online] Available at: <https://content.e-bookshelf.de/media/reading/L-22931495-479e2d910a.pdf>
14. JACOBS, J. (1992) *The Death and Life of Great American Cities*. New York: Vintage Books.
15. JOVIĆEVIĆ, I. (2017) 'Blok 5 u Podgorici – istorijat i značaj' in Vujošević, M., Rabrenović, J. and Dragović, S. (eds.) *Pristup izradi planskog dokumenta: Učešće javnosti u planiranju Bloka 5 u Podgorici*. Podgorica: Nevladino udruženje KANA.
16. KANGRGA, M. (1997) *Izvan povijesnog događanja: dokumenti jednog vremena*. Split: Feral Tribune, pp. 278-294.
17. KELLNER, D. (2020) 'Jean Baudrillard' in Zalta, E.N. (ed.) *The Stanford Encyclopedia of Philosophy*. [online] Available at: <https://plato.stanford.edu/archives/win2020/entries/baudrillard/> [Accessed: 5 January 2026].
18. KNEŽEVIĆ, G. (1989) *Višestambene zgrade*. Zagreb: Tehnička knjiga.
19. KOOLHAAS, R. (1978) *Delirious New York: A Retroactive Manifesto for Manhattan*. New York: The Monacelli Press.
20. KOVAČIĆ, D. (2016) 'Split 3: Što mu je prethodilo, što je bio, što je danas?', *Art Bulletin*, 66. [online] Available at: <https://hrcak.srce.hr/file/295857> [Accessed: 10 January 2026].
21. LEFEBVRE, H. (1968) *Le droit à la ville*. Paris: Éditions Anthropos.
22. LEFEBVRE, H. (1974) *La production de l'espace*. Paris: Éditions Anthropos.
23. LOJANICA, V. (2019) *Stanovanje: tematske celine*. Beograd: Arhitektonski fakultet Univerziteta u Beogradu.
24. MARKUŠ, A. (2008) *Pedeset neimara Crne Gore*. Podgorica: Arhitektonski forum.
25. NIKOLIĆ, S. (2023) *Antropologija novobeogradskih blokova: urbano stanovanje, stvaranje društvenih prostora i novi život prostornih zajedničkih dobara*. PhD thesis. Univerzitet u Beogradu, Filozofski fakultet.
26. NORBERG-SCHULZ, K. (1982) 'Ka autentičnoj arhitekturi', *Polja*. [online] Available at: <https://polja.rs/wp-content/uploads/2017/04/Polja-280-281-4-8.pdf> [Accessed: 20 November 2025].
27. STAMATOVIĆ VUČKOVIĆ, S. and BOJOVIĆ, M. (2023) 'Between modernism, postmodernism and transition: mass housing in Montenegro' in Rodrigues, I.L., Shach-Pinsly, D., Tsiambaos, K. and Korobar, P.V. (eds.) *European Middle-Class Mass Housing: Past and Present of the*

AUTHORS' BIOGRAPHIES AND CONTRIBUTIONS

- Modern Community. Lisbon: ISCTE-IUL, pp. 374-381. ISBN 978-989-781-862-2.
28. ŠTRAUS, I. (1991) Arhitektura Jugoslavije: 1945-1990. Sarajevo: Svjetlost, p. 226.
 29. TURKKUL, S. (2022) A habitable domestic space: Lucien Kroll and his participatory methods. Master thesis. Middle East Technical University.
 30. Ustav Socijalističke Federativne Republike Jugoslavije (1974) Beograd: Službeni list SFRJ. [online] Available at: https://www.yuhistorija.com/serbian/doc/Ustav_SFRJ_iz_1974.pdf [Accessed: 15 April 2026].

ARCHIVE MATERIAL

1. BOJOVIĆ, M., MILOŠEVIĆ, J., KUZNJEČOV, I. and POPOVIĆ, P. (1970) Plan fizickog razvoja regije Jezni Jadran – proširenje: Generalni plan Boke Kotorske, knjiga 1: plan. [plan] Private archive, Podgorica.
2. BOJOVIĆ, M. (1973) Stambeno-poslovna zgrada – Žabljak, glavni projekat arhitekture. [project documentation] Private archive, Podgorica.
3. BOJOVIĆ, M. (1974) Stambeno-poslovni objekat u Žabljaku, glavni projekat arhitekture. [project documentation] Private archive, Podgorica.
4. BOJOVIĆ, M. (1974) Stanovi solidarnosti – competition entry material. [competition entry] Private archive (courtesy of architect Mileta Bojović), Podgorica.
5. BOJOVIĆ, M. (1978) Dispoziciono rješenje – seme prodaje sa tipologijom stanovanja, Blok 5 – zgrada D2. [project documentation] Republički zavod za urbanizam i projektovanje, Podgorica.
6. BOJOVIĆ, M. (1988) Generalni urbanistički plan Žabljaka. [plan] Private archive, Podgorica.
7. BOJOVIĆ, M. (1989) Detaljni urbanistički plan Žabljaka. [plan] Private archive, Podgorica.
8. LEFEBVRE, H. (1976) Letter to the Director of Crous, 31 January 1976 (Le Centre régional des œuvres universitaires et scolaires de Paris). [letter] In: Bojović, M. (2015) Unpublished nomination dossier submitted to the Montenegro Academy of Sciences and Arts.

INTERNET SOURCES / WEB SITES

1. BOJOVIĆ, M. (2024) 'Utopijska svijest i energija bile su pokretačka snaga'. Available at: <https://www.vijesti.me/vijesti/kultura/695532/uto>

pijska-svijest-i-energija-bile-su-pokretacka-snaga [Accessed: 18 January 2026].

2. Crnogorska akademija nauka i umjetnosti (2018) 'Members: Mileta Bojović'. [online] Available at: <https://canu.me/clanovi/mileta-bojovic> [Accessed: 15 December 2025].
3. DRAGOVIC, S. (2018) 'Be realistic – demand the impossible! Podgorica's Blok 5'. [online] Available at: <https://lefeast.org/bojovic-blok5/> [Accessed: 18 December 2025].
4. FELCI, L. (2015) 'Matteotti neighbourhood'. [online] Available at: https://www.docomo-moitalia.it/register/MF_37.pdf [Accessed: 14 April 2026].
5. CLINE, B. and DI CARLO, T. (2002) 'The changing of the avant-garde: visionary architectural drawings from the Howard Gilman Collection'. [online] Available at: https://www.moma.org/collection/works/800?artist_id=8109&locale=en&page=1&sov_referrer=artist [Accessed: 14 April 2026].
6. KUČINAC, D. (2024) 'Lea Horvat: kolektivno stanovanje ostaje slon u sobi'. [online] Available at: <https://www.portalnovosti.com/lea-horvat-kolektivno-stanovanje-ostaje-slon-u-sobi/> [Accessed: 8 January 2026].
7. *** (2026) *Blok 5 nosi titulu najboljeg mjesta za život u Podgorici* [online]. Available at: <https://bizniscg.me/blok-5-nosi-titulu-najboljeg-mjesta-za-zivot-u-podgorici/> [Accessed: 20 February 2026].

ORAL STATEMENTS

1. MILETA BOJOVIĆ (2025) – conversations with the first author.

ILLUSTRATION SOURCES

- FIG. 1, 7, 8, 10 Private archive of Mileta Bojović
- FIG. 2 Drawing by the author
- FIG. 3 Google street view image – left; *Stambeno-poslovni objekat u Žabljaku, glavni projekat Arhitekture, 1974* – right, private archive of Mileta Bojović
- FIG. 4 *Stambeno-poslovni objekat u Žabljaku, glavni projekat Arhitekture, 1974*, private archive of Mileta Bojović
- FIG. 5, 6 Competition entry material, private archive of Mileta Bojović
- FIGURE 9 Republički zavod za urbanizam i projektovanje

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DAYLIGHT AS DESIGN DISCOURSE: REPRESENTATION STRATEGIES IN CONTEMPORARY ARCHITECTURE

KEYWORDSARCHITECTURAL DESIGN
ARCHITECT'S WEBSITE
CONTEMPORARY HOUSES
DAYLIGHT REPRESENTATION
GROUNDED THEORY**ABSTRACT**

This paper introduces a framework for a qualitative study of factors influencing daylight considerations in the architectural design process. Following the Grounded Theory method, a five-step analytical protocol was adopted to first elaborate an abstract diagram of daylight design factors. This diagram was subsequently employed to analyse the architectural representations of thirty houses designed during the first decade of the 21st century. Applying multiple correspondence analysis to the results led to the identification of five distinct groups. Exploring these groups' characteristics enabled the

development of a representative model for the studied phenomena. The results reveal that daylight design was largely inspired by local daylight culture, the sites' luminous characteristics, and the opportunities offered by digital mediation. The findings also indicate that the early and mid-decade contexts were marked by a successive evolution in daylight representation. Finally, this research serves as a basis for future studies on daylight in architecture, thereby contributing to the expansion of the knowledge base on qualitative daylight factors in design research.

INTRODUCTION

Architecture is nowadays significantly influenced by the use of architects' websites as the primary mediator of architectural production (Paule and Pereira, 2021: 1). These websites typically curate a portfolio of architects' continuous and evolutionary design work (Pramono and Yuninda, 2022: 291; Brügger, 2008: 156). Consequently, the digital mediation of architectural production has introduced a transformative shift in the way contemporary architecture is thought, practiced, and documented (Joklova and Budreyko, 2019: 102). As such, architects' websites serve as a reliable resource for investigating contemporary architectural production (Susetyarto et al., 2023: 5).

The beginning of the 21st century witnessed a growing interest among architects in incorporating daylight throughout their design process (Jiang et al., 2022: 6; Sun et al., 2021: 293). Accordingly, the consideration of daylight has become one of the defining features of contemporary architectural practice (Reveyron, 2020: 201). Despite its importance, studies concerning daylight in architecture usually focus on quantitative indicators such as those associated with daylight metrics (e.g., daylight factor, daylight autonomy, useful daylight illuminance, and annual light exposure) or those based on spatial characteristics (e.g., orientation, window-to-wall ratio, and shading devices) (Jones, 2017: 17; Fang and Cho, 2019: 8). As a result, the exist-

ing analytical methods for the evaluation of qualitative daylight indicators in architecture remain notably limited and mostly devoid of a theoretical framework (Gojnik, 2018: 403).

Throughout the various steps of their design work, architects regularly employ diverse modes of representation to articulate their intentions (Ewenstein and Whyte, 2009: 8; Tufano, 2015: 81). Handmade sketches are commonly employed by architects in the initial stages to express their intentions in an abstract way (Derycke, 2012: 154), while orthographic drawings such as plans, sections, elevations, and axonometric projections are used during advanced stages to coordinate technical details (Baudez, 2015: 58). Furthermore, physical models and photography are specifically utilised to integrate the artistic and technical aspects of their design intentions (Pilard, 2014: 3). Ultimately, architectural representation is regarded as a valuable source of data for studying architects' decision-making processes.

The identification of design factors has been consistently recognized as a specific area within architectural design research (Parsaee, Motealleh and Parva, 2016: 328). This is primarily due to the field's capacity to be explored by various scientific disciplines (Marin, Lequay and Bignon, 2009: 12). Early studies primarily sought to differentiate between design factors derived from the arts and those borrowed from the engineering sciences (Simonnot, 2009: 2). Subsequent research emphasized the necessity of implementing theoretical models capable of addressing their inherent complexity (Claeys, 2013: 89). More recently, studies have indicated the need for a methodological framework that can serve as a guideline to analyse architectural design factors across different design stages and situations (Lojanica and Dragišić, 2018: 752).

To address these identified gaps, the present research's main purpose is to propose an analytical framework for investigating daylight design factors, and to test its reliability with a limited corpus of houses. Thus, the adoption of a purely qualitative approach based on the analysis of daylight's visual representation will contribute to complementing the predominant studies typically reliant on quantitative indicators. In light of these considerations, this study proposes the following research questions: (i) What factors primarily influenced the consideration of daylight in architecture at the beginning of the 21st century? (ii) How did these factors interact and impact the visual representation among contemporary architects? (iii) What role did architects' websites play in the choice of representation modes during the design process?

RESEARCH METHODOLOGY

GROUNDING THEORY

Grounded Theory is an inductive and systematic research method used to reveal patterns in qualitative data, with the aim of developing a theoretical position (Bollo and Collins, 2017: 87; Corbin and Strauss, 2007: 59). The specificity of this method is the emergence of theories from qualitative data rather than from predetermined hypotheses (Charmaz and Bryant, 2010: 409). Adopting Grounded Theory for this research allows for a qualitative study of architects' decision-making processes during their design work. Such a task is achieved through a characterisation, coding and comparison processes that provide a framework for the practical implementation of qualitative indicators. These are identified within architectural representations shared by architects on their websites to describe the role of daylight in the formulation of their design strategy and the choice of representation modes throughout the design stages.

ANALYSIS PROTOCOL

Following the Grounded Theory standard workflow, a five-step analytical protocol was developed to investigate how architects consider daylight in their design (Fig. 2). (i) The first step consists of theoretical sampling, which is achieved by fixing a corpus of houses that meet the pre-established selection criteria. The websites of the corresponding architects are then consulted to collect various modes of representation used to present the selected houses. The qualitative data are subsequently characterised according to predetermined criteria. (ii) The second step involves open coding (Karimimoshaver et al., 2020: 2); it is conducted through a content analysis of the architects' textual representations. The extracted concepts are first structured into concept maps and then organized hierarchically into factors, categories, and subcategories using pyramid charts. These charts are eventually integrated into an overall abstract diagram. (iii) The third step implies axial coding (Vassili and Nicolas, 2008: 145); it is operated by using the abstract diagram for the visual analysis of the collected houses' architectural representation. This process enables the generation of analytical diagrams that quantify the factors, categories, and subcategories adopted for the design of each house. (iv) The fourth step involves selective coding (Birks and Mills, 2015: 12); it is based on the identification of similarities that may exist between the obtained analytical diagrams in order to assemble them into distinct groups. These similarities are statistically extracted

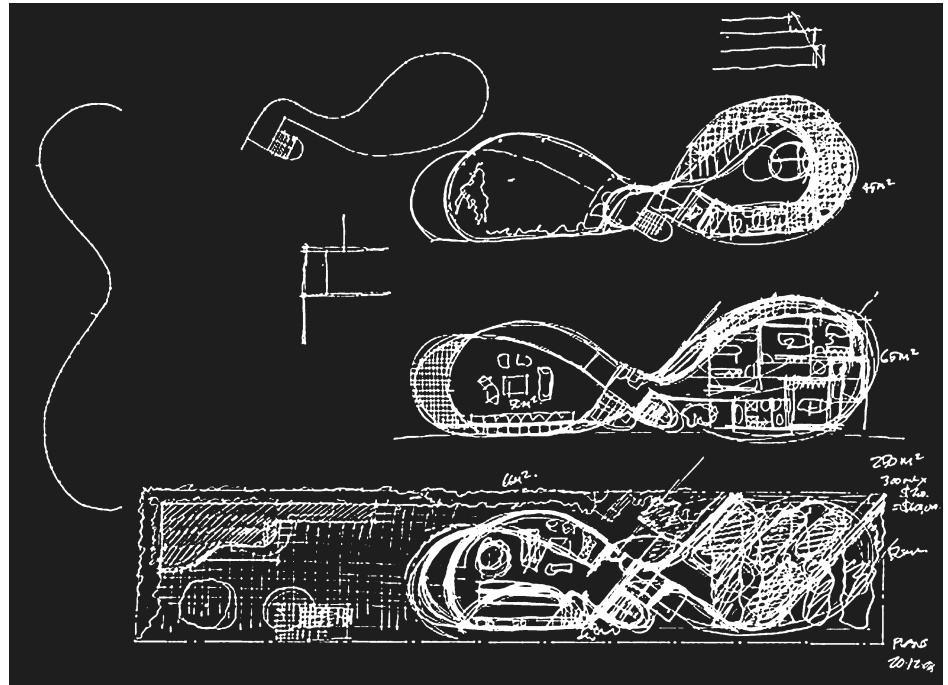


FIG. 1 SKETCH EDITED BY ED LIPPMANN FOR THE DESIGN OF BUTTERFLY HOUSE: LIGHT IN THE FENG-SHUI PRINCIPLES

by means of multiple correspondence analysis (MCA). The coding level results in representative diagrams that characterise each identified group. (v) The final step consists of describing the common trends within the identified groups through a writing-up pro-

FIG. 2 FLOWCHART OF THE ADOPTED ANALYTICAL PROTOCOL

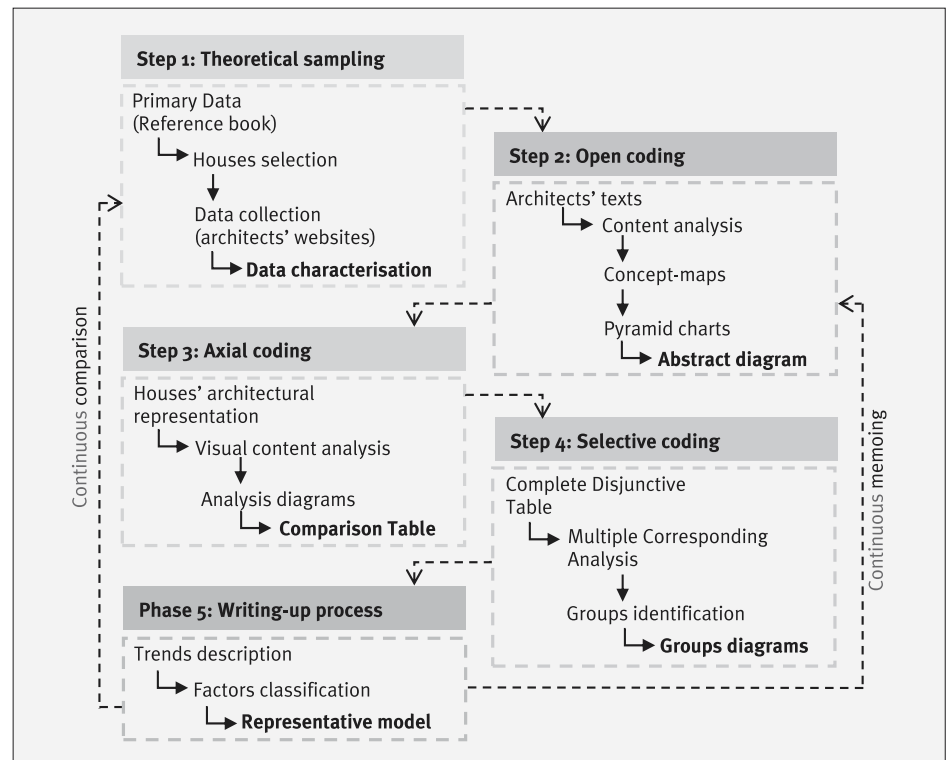


TABLE I THE SELECTED HOUSES AND THEIR CORRESPONDING ARCHITECTS' WEBSITES

N°	House	Architect	Country	Year	Architect's website
01	House 20x20	Assadi Felipe	Chili	2005	www.felipeassadi.com
02	Casa Raveau	Assadi Felipe	Chili	2006	
03	Casa Schmitz	Assadi Felipe	Chili	2001	
04	Casa Serrano	Assadi Felipe	Chili	2006	
05	Glass Shutter House	Ban Shigeru	Japan	2003	www.shigerubanarchitects.com
06	Naked House	Ban Shigeru	Japan	2002	
07	Arkansas House	Blackwell Marlon	United States	2004	www.marlonblackwell.com
08	Tower House	Blackwell Marlon	United States	2000	
09	Asencio House	Baeza Alberto Campo	Spain	2000	www.campobaeza.com
10	Holman Residence	Durbach Block	Australia	2004	www.durbachblockjaggers.com
11	Spry Residence	Durbach Block	Australia	2003	
12	Guesthouse	Kanner Stephen	United States	2006	www.residentialarchitect.com
13	Malibu 3	Kanner Stephen	United States	2004	
14	Butterfly House	Lippmann Associates	Australia	2005	www.lippmann.com.au
15	Pearl Beach House	Lippmann Associates	Australia	2007	
16	Tree House	Lippmann Associates	Australia	2001	www.ianmoorearchitects.com
17	Balmoral House	Moore Ian	Australia	2006	
18	Rose House	Moore Ian	Australia	2000	
19	Cell Brick House	Tekuto Atelier	Japan	2004	www.tekuto.com
20	Lucky Drops House	Tekuto Atelier	Japan	2005	
21	Wafers House	Tekuto Atelier	Japan	2004	www.tezuka-arch.com
22	Engawa House	Tezuka Architects	Japan	2005	
23	Machiya House	Tezuka Architects	Japan	2006	
24	Anthill House	Tezuka Architects	Japan	2001	
25	Canopy House	Tezuka Architects	Japan	2006	
26	Observatory House	Tezuka Architects	Japan	2003	www.olsonkundig.com
27	Chicken Point Cabin	Olson Kundig	United States	2002	
28	Boxenbaum Residence	Steven Ehrlich	United States	2004	www.eyrc.com
29	Leonard Residence	Steven Ehrlich	United States	2000	
30	Webster Residence	Steven Ehrlich	United States	2000	

cess. This is performed by comparing the results of the characterisation and coding processes. The findings are afterwards used to develop a representative model of the studied phenomenon.

THEORETICAL SAMPLING

The adopted qualitative data for this research encompass the various modes of architectural representation employed by architects during the design of single-family houses. This choice was based on the fact that the house has historically fostered the experimentation of new architectural approaches (Bell, 2006: 10).

PRIMARY DATA

The primary data for this study were drawn from Peter Hyatt's (2007) book, entitled "Master of Light: Designing the Luminous Houses."

It was selected as a unique reference due to the significant number of featured architects who are internationally renowned for their numerous architectural awards, including the Pritzker Prize. Furthermore, this book was chosen as the main source for case selection due to the geographical diversity of the presented houses, which are located in Europe, South America, North America, Asia, and Australia. Such a wide selection increases the richness and representativeness of the study corpus, and serves as an additional criterion for a comparative analysis.

DATA SELECTION

The exploration of the content of the reference book was conducted through an initial selection process based on two main criteria. The first criterion considered the project type, which had to be exclusively a single-family house, and the design period, which was restricted to the 21st century. The second selection criterion related to the luminous atmosphere. For this, an overview of the luminous characteristics of each location was carried out to classify the houses according to their dominant sky conditions. The associated data were obtained from the meteorological website www.currentresults.com, which has been validated as a reliable source for scientific research (Herrera et al., 2017). The result is a final selection of thirty houses designed by twelve architects from around the world.

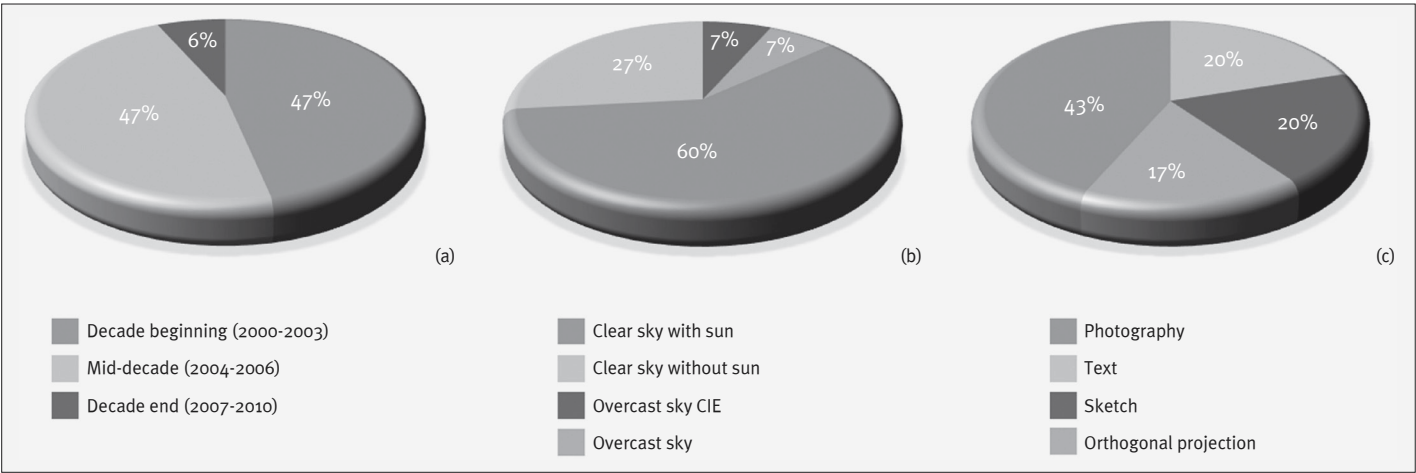
DATA COLLECTION

The data collection process was performed by consulting the corresponding architects' websites of the selected houses (Table I). The objective was to gather the diverse architectural representations used to present each case. The collected data were then organized according to the following categories: textual descriptions, handmade sketches, orthogonal drawings (plans, sections, elevations, and axonometries), photography of the building and interior space, and pictures of the physical and digital 3D models.

The obtained corpus does not include any cases from Africa due to the absence of African examples in the reference book, which by no means reflects a voluntary exclusion of the continent. Incorporating supplementary books to include African houses would risk excessively increasing the number of cases and, consequently, further expanding a dataset that is sufficient to test the reliability of the provided methodological framework.

DATA CHARACTERISATION

A preliminary analysis of the collected data reveals that a half of the selected houses



were designed between 2000 and 2003, while the other half were designed between 2004 and 2006. The end of the decade (2007-2010) is represented by fewer houses (Fig. 3a). Consequently, the study corpus covers the early and mid-decade contexts. It will enable the analysis of the transitional period between the late 20th and early 21st centuries. The analysis also discloses that two-thirds of the houses are located under a clear sky with sun, a quarter are situated under a clear sky without sun, and a fifth are located under an overcast sky (Fig. 3b). The diversity of sky conditions will allow a comparative study between the architects' daylight design and the characteristics of the site's light. The analysis of the representation modes reveals the use of photography in all cases; sketches and texts emerge as the second most employed modes, while orthogonal projections are the least used representation mode (Fig. 3c). Thus, the study will consist of detecting the design stages during which each mode is significantly used.

CODING PROCESSES

In consequence of the insufficient existing research on the subject, the coding process follows J.F. Wong's (2010) work. Furthermore, given the volume of generated diagrams, this section will present only the final diagram obtained for each level of coding.

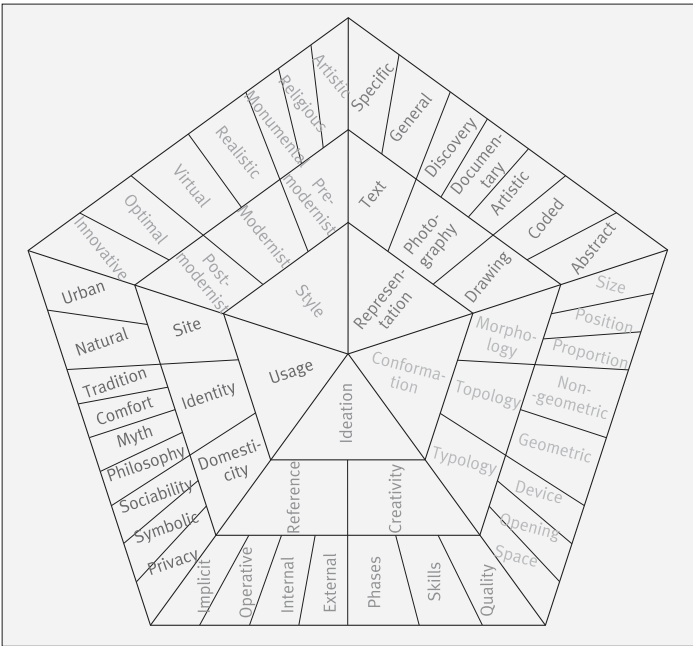
OPEN CODING

The first level of coding was conducted by extracting key concepts referring to daylight considerations from the textual representation of the selected architects. The concepts were initially transcribed verbatim and illustrated through concept maps. They were then categorised hierarchically into factors, categories, and subcategories. The criteria for

identifying core categories during text analysis were derived from those proposed by Strauss (1987: 36). Consequently, five main factors were defined: (i) The Ideation factor describes the design references that inspired the architects while formulating their daylight intentions. (ii) The Conformation factor addresses the spatial configuration of the luminous atmosphere; it includes daylight typology, representing the daylight system; daylight topology, describing the qualitative specifications of daylight distribution; and daylight morphology, indicating the proportions, positions, and sizes of the daylight system components. (iii) The Representation factor encloses the various modes used by architects to express their daylight considerations, incorporating handmade sketches,

FIG. 3 DATA CHARACTERISATION ACCORDING TO THREE SELECTION CRITERIA: (A) HOUSE DESIGN YEAR; (B) TYPE OF SKY CONDITION; (C) REPRESENTATION MODE

FIG. 4 OVERALL ABSTRACT DIAGRAM OF DAYLIGHT DESIGN FACTORS



Factors		Categories	Sub-categories	House 20x20	Casa Raveau	Casa Schmitz	Casa Serrano	Glass Shutter House	Naked House	Arkansas House	Keenan Tower House	Asencio House	Holman Residence	Spry Residence	Guesthouse	Malibu 3	Butterfly House	Pearl Beach House	Tree House	Balmoral House	Rose House	Cell Brick House	Lucky Drops House	Wafers House	Engawa House	Machiya House	Anthill House	Canopy House	Observatory House	Chicken Point Cabin	Boxenbaum Residence	Leonard Residence	Webster Residence	
Ideation	Reference	Implicit	x	✓	✓	✓	x	x	x	x	x	x	x	x	✓	✓	x	x	x	x	✓	x	x	✓	x	x	✓	✓	✓	✓	✓	x	x	x
		Operative	✓	x	x	x	x	x	x	x	✓	x	x	x	x	x	✓	✓	✓	✓	✓	x	x	x	x	✓	✓	x	x	✓	✓	✓	✓	✓
		Internal	x	x	x	x	x	x	x	x	✓	x	✓	✓	x	x	x	x	x	x	x	x	x	x	✓	x	x	x	x	x	x	✓	✓	✓
		External	✓	✓	✓	✓	x	x	x	x	x	x	x	x	x	✓	✓	x	x	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	x	x	x	
	Creativity	Phases	x	x	x	x	x	x	x	x	✓	x	x	x	x	x	✓	x	x	x	x	x	x	✓	✓	✓	✓	x	x	✓	x	x	x	
		Skills	x	x	x	x	✓	✓	✓	x	✓	x	x	x	x	x	✓	✓	x	x	x	✓	✓	✓	✓	✓	x	x	✓	x	x	x	x	
Quality		x	x	x	x	x	x	x	✓	x	✓	✓	✓	✓	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Conformation	Typology	Space	✓	x	x	x	x	x	x	x	✓	x	x	x	x	x	x	x	x	x	x	x	x	x	✓	✓	x	x	x	x	x	x	x	
		Opening	✓	✓	✓	✓	x	x	x	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		Devise	x	✓	x	x	✓	✓	✓	✓	x	✓	✓	x	x	x	x	x	✓	x	✓	✓	✓	✓	✓	x	x	✓	✓	x	✓	x	x	
	Topology	Geometric	x	x	x	x	x	x	x	x	✓	x	x	x	x	x	✓	✓	x	x	x	x	x	x	x	✓	✓	x	x	x	x	x	x	x
		Nongeometric	x	x	x	x	x	x	x	✓	x	✓	✓	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
	Morphology	Proportion	x	✓	✓	✓	x	x	x	x	x	x	x	x	x	✓	x	x	✓	✓	x	x	x	✓	x	x	✓	✓	✓	✓	✓	x	x	x
		Position	✓	x	x	✓	x	x	x	✓	x	✓	✓	✓	✓	x	✓	x	✓	✓	x	x	x	x	x	x	x	x	✓	✓	x	x	x	
		Size	✓	✓	x	x	✓	✓	✓	x	x	x	x	x	x	x	x	x	x	x	x	x	✓	✓	✓	x	x	x	x	✓	x	x	x	
	Representation	Drawing	Abstract	x	✓	x	x	x	x	x	✓	x	x	x	x	x	✓	x	x	x	x	x	x	x	x	x	✓	✓	x	x	x	✓	x	x
Coded			x	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	✓	✓	✓	✓	✓	x	x	x	✓	x	x	x
Photography		Artistic	x	x	x	x	x	x	x	x	✓	x	x	x	x	✓	x	x	x	x	x	x	x	x	x	✓	✓	x	x	x	x	x	x	x
		Documentary	✓	✓	✓	✓	✓	✓	✓	x	x	x	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓
		Discovery	x	x	x	x	x	x	x	✓	x	✓	✓	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Text		General	x	✓	x	x	x	x	x	✓	x	✓	✓	x	x	x	✓	x	✓	x	✓	x	x	x	✓	x	x</							

orthographic projections, and photography. (iv) The Style factor classifies the characteristics of daylight representation according to architectural movements. (v) The Usage factor identifies the primary functional features of the architects' design. The next step involved the consolidation of the relevant categories and subcategories constituting each factor into corresponding hierarchical pyramid charts. The five pyramid charts were finally integrated into an overall abstract diagram, in which the factors are situated in the inner ring, the related categories in the middle ring, and the subcategories in the outermost ring (Fig. 4).

AXIAL CODING

The second level of coding involves applying the previously developed diagram to analyse the selected houses as performed through a visual content analysis of the architectural representations published on the architects' websites to describe the houses design. This process generated thirty individual analysis diagrams corresponding to the number of the houses. The content of the diagrams was then summarised in a comparison table, with rows representing the factors, categories, and subcategories, and columns representing the houses. Colour-coded columns are employed to distinguish between considered and non-considered factors (Table II).

SELECTIVE CODING

The third level of coding was performed by subjecting the results of the previous steps to multiple correspondence analysis (MCA). The visual interpretation of the distribution of the thirty analysed houses across the obtained scatter plot graph reveals a clear structuring of daylight consideration into five distinct groups, defined by Dimension 1 (29.55%) and Dimension 2 (12.12%). Dimension 1 (horizontal axis) corresponds to the Representation factor; it acts as the primary differentiator that isolates Group V from the rest of the sample. Dimension 2 (vertical axis) refers to the Ideation factor; it provides a hierarchical classification of the remaining groups (Groups I-IV) and highlights a progressive shift in daylight design intention. Furthermore, the majority of the analysed houses are clustered along the vertical axis (Dimension 1 ≈ 0). This proximity indicates a high level of convergence in adopting daylight in their design, while their vertical dispersion reflects variations in the employed representation modes for expressing the daylight intention, from Group I (negative values) to Group IV (positive values). In contrast, three houses (Group V) are isolated

from the rest of the sample along Dimension 1; this indicates a major difference in their features, which do not align with those of the other 27 cases (Fig. 5).

The visual exploration of the houses within each identified group led to the extraction of their main characteristics.

Group I is characterised by the adoption of the site's luminous environment as an implicit reference during the design ideation phase. A second feature is the common spatial conformation of daylight, composed of openings as the daylight typology component and proportions as the daylight morphological descriptor. The third characteristic is the use of photography as the principal mode of daylight representation (Fig. 6a). The realism of the photography aligns with the aesthetic principles of the Modernist style. Finally, the space usage emphasizes the continuity between the interior space and the natural surroundings.

Group II is defined by a design ideation that mixes references and creativity by reinterpreting traditional daylight components of the local culture. The spatial conformation of daylight includes courtyards, openings, and control devices within the daylight typology, as well as the geometric distribution of daylight within the daylight topology. The third attribute is the use of handmade sketches as the primary mode of representation (Fig. 6b). This encompasses both the artistic features

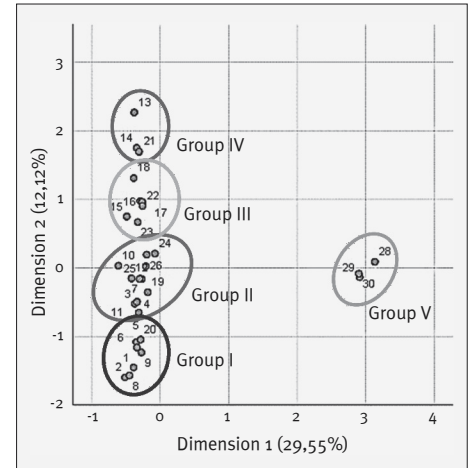
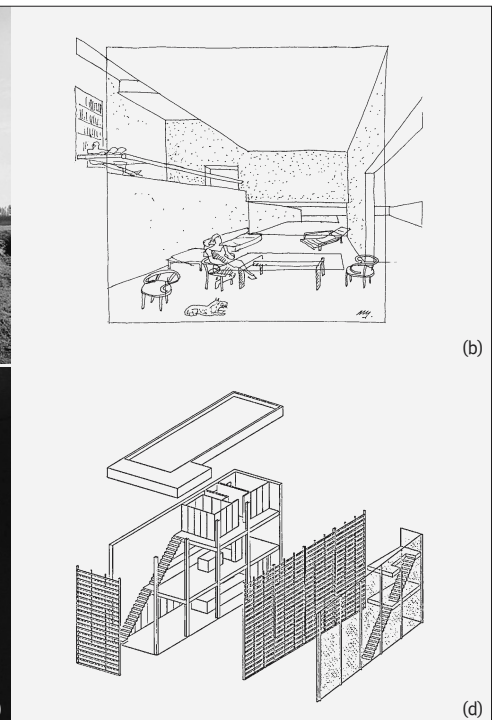
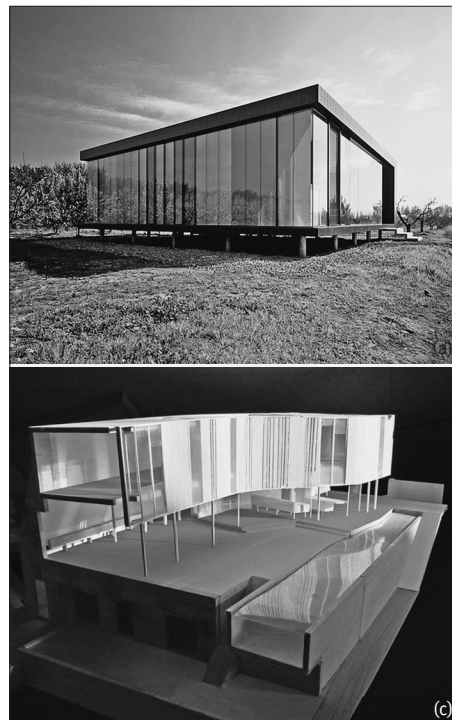


FIG. 5 SCATTER PLOT CLUSTERING THE THIRTY ANALYSED HOUSES INTO FIVE DISTINCT GROUPS

FIG. 6 ARCHITECTURAL REPRESENTATION OF THE MAIN GROUPS OF ARCHITECTS: (A) PHOTOGRAPHY SHARED BY FELIPE ASSADI FOR 20x20 HOUSE (LISTENING TO THE SITE'S LIGHT); (B) SKETCH EDITED BY ALBERTO CAMPO BAEZA FOR ASENCIO HOUSE (ANDALUSIAN LUMINOUS ATMOSPHERE); (C) MODEL USED BY DURBACH BLOCK ARCHITECTS DURING THE DESIGN OF HOUSE SPRY (LIGHT-FILLED AMBIENCE); (D) AXONOMETRY PROVIDED BY SHIGERU BAN FOR GLASS SHUTTER HOUSE (ADJUSTABLE BUILDING SKIN)



of pre-modern architecture and the virtuality of the Modernist style. Spatial usage accentuates the symbolism of natural light in defining space identity.

Group III is distinguished by an innovative design approach focused on the effect of daylight on the perception of space. The spatial conformation of daylight is defined by a combination of openings and control devices within the daylight typology, and the non-geometric distribution of daylight within the topology. During the houses' design process, the desired daylight effect is tested using physical models (Fig. 6c), which is clearly demonstrated through subsequent photography. These practices align with Modernist architecture. Spatial usage underlines the intended comfort and sociability within the space.

Group IV is identified by the technical manipulation of the daylighting system. Consequently, the spatial conformation of daylight is composed of control devices as the main daylight typology component, and position as the unique morphological descriptor. The third feature is the use of orthogonal drawings, mainly axonometric projections (Fig. 6d), as the primary mode of representation. The adopted aesthetic principles combine the realism of the Modern Movement with the innovation of Postmodern architecture. Spatial usage evokes the relationship with the urban environment while preserving the privacy of the space.

Group V is defined by an explicit declaration of embracing the Modernist architectural style. The spatial conformation of daylight is based exclusively on openings within the daylight typology. Notably, this group is distinguished by the use of textual representation exclusively to express the architect's daylight design strategy. These written descriptions usually reflect the adopted Modernist aesthetic principles. Spatial usage highlights sociability within the space.

A REPRESENTATIVE MODEL OF DAYLIGHT DESIGN IN ARCHITECTURE

This section constitutes the writing-up step; it discusses the interrelationship between the results of the coding and characterisation processes in an aim to develop a representative model that reflects the main factors of daylight consideration by the studied architects.

REPRESENTATION MODES THROUGHOUT THE DESIGN PROCESS

The representation of the studied architects is largely impacted by the nature of their de-

sign ideation: (i) In contextual design, usually inspired by local daylight culture, the architects employ handmade sketches to express their daylight intentions from the earliest stages of their design process. This practice characterises the work of the Group I architects (Felipe Assadi, Stephen Kanner, Olson Kundig and Ian Moore Architects); similarly, it defined the work of the Group II architects (Alberto Campo Baeza, Lippmann Associates and Tezuka Architects). (ii) In creative design, mostly characterised by the manipulation of the building skin, architects use axonometric projections and physical models during the intermediate stages. This practice identifies the work of the Group III architects (Durbach Block and Marlon Blackwell Architects) as well as the work of Group IV architects (Shigeru Ban and Atelier Tekuto). (iii) In cases where the design is entirely inspired by a specific architectural style, architects use text and photography as the only modes to describe the luminous atmosphere during the advanced stages of their design process. This practice is evident in the work of Group V, represented by Steven Ehrlich.

THE SITE'S LIGHT AS TANGIBLE DESIGN INGREDIENT

The luminous attributes of the site are considered by the studied architects to be an essential element that determines their design choices regarding the daylight system components: (i) Under a clear sky without sun, the daylight system is based on shaping openings. This practice characterises the houses of Groups I and II, where large windows are conceived to establish a direct connection between the building and its surroundings. (ii) Under an overcast sky, the adopted daylight system focuses on the control elements. This strategy is frequently adopted for the houses of Group III, where daylight design typically incorporates multiple layers of the building envelope to provide views to the outside while maintaining privacy within the space. (iii) Under a clear sky with sun, the daylight system comprises various components, including courtyards, windows, and control devices. This sky condition constrains architects' choices, often leading them to draw on traditional local daylight strategies to reproduce the qualitative characteristics of a typical luminous atmosphere.

THE EVOLUTION OF DAYLIGHT REPRESENTATION OVER THE DECADE

The representation of daylight by architects on their websites underwent significant changes throughout the first decade of the

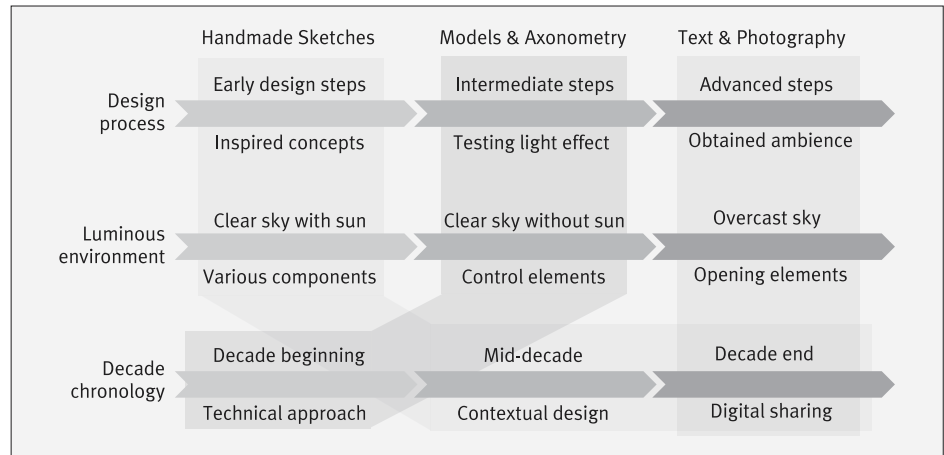
21st century. This evolution was largely driven by the opportunities offered by digital sharing, which encouraged them to express diverse aspects of their daylight considerations throughout the design process: (i) At the beginning of the decade, the architectural representations shared on architects' websites consisted primarily of handmade sketches describing the incorporation of cultural background into daylight design. (ii) The mid-decade context was marked by significant progress in the handling of new daylighting techniques. As a result, the architectural representations shared on architects' websites shifted to include physical models and orthogonal drawings for explaining the components of the innovative daylight systems. (iii) The end of the decade was characterised by sharing photography and texts to reveal the architects' intentions and the quality of the resulting luminous atmosphere.

The linking of the obtained results from the whole steps led to the elaboration of a representative model of daylight design and representation by the studied architects (Fig. 7).

CONCLUSIONS

This paper presents the results of a study that employs a grounded theory methodology to establish an initial analytical framework for evaluating qualitative daylight indicators within the design process of contemporary architects. To this aim, the architectural representations of thirty houses designed during the first decade of the 21st century were investigated via a five-step analytical protocol.

The study's findings indicate that the early and mid-decade contexts were a key period for daylight consideration in architecture, which has evolved from the paper version to a digital sharing of their graphic representations. This shift was notably driven by the emergence of websites as a primary mediator for the architects' work. The use of these platforms allowed architects to share various modes of daylight representation corresponding to the different stages of their design process. Moreover, this period was marked by a



significant evolution in the role of daylight in formulating the architects design ideation, largely inspired by local daylight cultures, the sites' luminous characteristics, and the new opportunities afforded by digital sharing.

The main advancement of this research consists in the establishment of an abstract diagram which will serve as a conceptual model for future studies to analyse a broader range of architects and case studies. Likewise, the developed representative model should serve as a reference for comparing future research findings, thereby contributing to the expansion of the database on qualitative daylight factors in design research.

However, the primary limitation of this research, which affects its representativity, is the restricted number of reference books and, consequently, the limited number of studied cases. This was due to the study's main objective, which was to test the reliability of the proposed analytical framework rather than the generalisability of the findings. For this reason, further studies are required to incorporate a larger selection of reference books and a broader corpus of architects and houses, aiming toward the development of an integrative framework for daylight design within contemporary architectural practice.

FIG. 7 REPRESENTATIVE MODEL OF DAYLIGHT DESIGN AT THE ONSET OF THE 21ST CENTURY

BIBLIOGRAPHY AND SOURCES

1. BAUDEZ, B. (2015) 'L'Europe Architecturale du Second XVIII^e Siècle: Analyse des Dessins', *Le Dessin d'Architecture*, (30), pp. 43-58. <https://doi.org/10.4000/lha.543>.
2. BELL, J. (2006) *21st Century House*. 1st ed. London: Abbeville Press.
3. BIRKS, M. and MILLS, J. (2015) *Grounded Theory: A Practical Guide*. 2nd ed. Los Angeles: Sage Publications Ltd.
4. BOLLO, C. and COLLINS, T. (2017) 'The Power of Words: Grounded Theory Research Methods in Architecture & Design' in: *ARCC Proceedings: Architecture of Complexity*. [online] Utah: University of Utah, College of Architecture + Planning, pp. 87-94. Available at: https://www.brikkbase.org/sites/default/files/ARCC2017_Session2A_Bollo_Collins.pdf [Accessed: 25 March 2024].
5. BRÜGGER, N. (2008) 'The Archived Website and Website Philology: A New Type of Historical Document?', *Nordicom Review*, 29(2), pp. 155-175. <https://doi.org/10.1515/nor-2017-0183>.
6. CHARMAZ, K. and BRYANT, A. (2010) 'Grounded Theory' in Peterson, P., Baker, E. and McGaw, B. (eds) *International Encyclopedia of Education*. 3rd ed. UK: Elsevier Ltd, pp. 406-412. <https://doi.org/10.1016/B978-0-08-044894-7.01581-5>.
7. CLAEYS, D. (2013) *Architecture & Complexité: Un Modèle Systémique du Processus de (Co) conception qui Vise l'Architecture*. Doctoral Dissertation in Building Art and Urban Planning. Catholic University of Louvain, Faculty of Architecture, Architectural Engineering, and Urban Planning. Available at: <http://hdl.handle.net/2078.1/134616> [Accessed: 14 September 2024].
8. CORBIN, J. and STRAUSS, A. (2007) *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. 3rd ed. California: Sage Publications, Inc. <https://doi.org/10.4135/9781452230153>.
9. DERYCKE, D. (2012) 'La Complexité Inhérente aux Modèles Numériques et le Paradigme de la Représentation Architecturale: Brèves Considérations sur les Pratiques Contemporaines' in: *Séminaire de Conception Architecturale Numérique (SCAN): Complexité(s) Des Modèles Numériques*. Paris: Presses Universitaires de Nancy, pp. 153-163.
10. EWENSTEIN, B. and WHYTE, J. (2009) "Knowledge Practices in Design: The Role of Visual Representations as 'Epistemic Objects'", *Organization Studies*, 30(1), p. 8. <https://doi.org/10.1177/0170840608083014>.
11. FANG, Y. and CHO, S. (2019) 'Design Optimization of Building Geometry and Fenestration for Daylighting and Energy Performance', *Solar Energy*, 191, pp. 7-18. <https://doi.org/10.1016/j.solener.2019.08.039>.
12. GOJNIK, I. (2018) 'Daylight as Factor of Architectonic and Identity of Space-Qualitative Daylight Method', Review of a Doctoral Dissertation, *Prostor*, 26(2), p. 403. Available at: <https://hrcak.srce.hr/213773> [Accessed: 2 February 2026].
13. HERRERA, M., NATARAJANA, S., COLEYA, D.A., KERSHAWA, T., RAMALLO-GONZÁLEZ, A.P., EAMES, M., FOSASA, D. and WOOD, M. (2017) 'A Review of Current and Future Weather Data for Building Simulation', *Building Services Engineering Research and Technology*, 38(5), pp. 602-627. <https://doi.org/10.1177/0143624417705937>.
14. HYATT, P. (2007) *Masters of Light: Designing the Luminous House*. 1st ed. Victoria, Australia: Images Publishing Dist Ac.
15. JIANG, Y., LI, N., YONGGA, A. and YAN, W. (2022) 'Short-Term Effects of Natural View and Daylight from Windows on Thermal Perception, Health, and Energy-Saving Potential', *Building and Environment*, (208), p. 108575. <https://doi.org/10.1016/j.buildenv.2021.108575>.
16. JOKLOVA, V. and BUDREYKO, E. (2019) 'Digital Technologies in Architectural Design, Verification and Representation' in: *International Conference on Engineering Technologies and Computer Science*. Moscow: Institute of Electrical and Electronics Engineers, pp. 102-106. <https://doi.org/10.1109/Ent.2019.00028>.
17. JONES, N.L. (2017) *Validated Interactive Daylighting Analysis for Architectural Design*. Doctoral Dissertation in Architecture: Building Technology. Massachusetts Institute of Technology, Department of Architecture. Available at: <http://hdl.handle.net/1721.1/111461> [Accessed: 3 February 2026].
18. KARIMIMOSHAVER, M., AHMADI, M.A., ARAM, F. and MOSAVI, A. (2020) 'Urban Views and Their Impacts on Citizens: A Grounded Theory Study of Sanandaj City', *Heliyon*, 6(10), pp. 51-59. <https://doi.org/10.1016/j.heliyon.2020.E0515>.
19. LOJANICA, V. and DRAGIŠIĆ, M. (2018) 'The Topological Principles in the Contemporary Ar-

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Conceptualization, A.M.D.; Methodology, A.M.D.; Software, A.M.D.; Validation, A.M.D.; Formal Analysis, A.M.D.; Resources, A.M.D.; Data curation, A.M.D. and A.B.; Writing—Original draft preparation, A.M.D.; Writing—Review and Editing, A.M.D. and A.B.; Visualization, A.M.D. and A.B.; Supervision, A.M.D. and A.B. All authors have read and agreed to the published version of the manuscript.

- architectural Design Process' in: *The International Conference on Computational Methods*. Rome: Scientech Publisher Llc, pp. 752-766. Available at: <https://www.sci-en-tech.com/ICCM2018/PDFs/3481-11539-1-PB.pdf> [Accessed: 13 May 2024].
20. MARIN, P., LEQUAY, H. and BIGNON, J.C. (2009) 'Outil Evolutionnaire d'Aide à la Conception Architecturale Créative' in: *CAAD Futures*. Montreal: University of Montreal, pp. 159-172. Available at: <https://shs.hal.science/halshs-00440420v1> [Accessed: 12 April 2024].
 21. PARSAEE, M., MOTEALLEH, P. and PARVA, M. (2016) 'Interactive Architectural Approach (Interactive Architecture): An Effective and Adaptive Process for Architectural Design', *HBRC Journal*, 12(3), pp. 327-336. <https://doi.org/10.1016/J.Hbrj.2015.01.001>.
 22. PAULE, B. and PEREIRA, J. (2021) 'How Daylight Representation in Architectural Competitions Images Can Lead to an Erroneous Interpretation of Projects', *Journal of Physics*, 2042(1), pp. 1-7. <https://doi.org/10.1088/1742-6596/2042/1/012079>.
 23. PILARD, N. (2014) *Architecture, Dessin, Discours*. Doctoral Dissertation in Arts Plastiques et Sciences de l'Art. École Doctorale Langues, Lettres et Arts, Aix Marseille Université.
 24. PRAMONO, A. and YUNINDA, C. (2022) 'A Marketing Strategy for Architects Using a Virtual Tour Portfolio to Enhance Client Understanding' in: Mukhopadhyay, S.C., Senanayake, S.N.A. and Withana, P.C. (eds) *Innovative Technologies in Intelligent Systems and Industrial Applications*. 1029. Cham: Springer, pp. 291-300. https://doi.org/10.1007/978-3-031-29078-7_26.
 25. REVEYRON, N. (2020) 'Ambiance Lumineuse et Architecture: les Antécédents Antiques des Formules Romanes et Gothiques', *Hortus Artium Medievalium*, (26), pp. 201-212. <https://doi.org/10.1484/J.Ham.5.121705>.
 26. SIMONNOT, N. (2009) 'Jacques Guillaume. L'art du Projet: Histoire, Technique, Architecture', *Critique D'art*, 33(Printemps), pp. 1-3. <https://doi.org/10.4000/Critiquedart.585>.
 27. STRAUSS, A.L. (1987) *Qualitative Analysis for Social Scientists*. 1st ed. Cambridge: Cambridge University Press.
 28. SUN, Y., LIU, X., MING, Y., LIU, X., MAHON, D., WILSON, R., LIU, H., EAMES, P., and WU, Y. (2021) 'Energy and Daylight Performance of a Smart Window: Window Integrated with Thermotropic Parallel Slat-transparent Insulation Material', *Applied Energy*, (293), pp. 1-18. <https://doi.org/10.1016/J.Apenergy.2021.116826>.
 29. SUSETYARTO, M.B., PURNOMO, A.B., SANTOSO, G.B., NISA, K., CHARLES, A.K., and MILLEANDA, A. (2023) 'Independence of the Architect Online' in: *International Conference on Advanced Technology and Multidiscipline*. Surabaya: Faculty of Advanced Technology and Multidiscipline, p. 030013. <https://doi.org/10.1063/5.0137034>.
 30. TUFANO, A. (2015) 'Dessins et Design: Représenter l'Espace Mental de l'Architecture: Les Dessins Déconstructivistes de Daniel Libeskind: Micromegas', *Livraisons d'Histoire de l'Architecture*, (30), pp. 81-92. <https://doi.org/10.4000/lha.553>.
 31. VASSILI, J. and NICOLAS, B. (2008) 'Grounded Theory: Quels Usages dans les Recherches en Contrôle de Gestion?', *Comptabilité Contrôle Audit*, 14(3), pp. 141-162. <https://doi.org/10.3917/cca.143.0141>.
 32. WONG, J.F. (2010) 'The Text of Free-Form Architecture: Qualitative Study of the Discourse of Four Architects', *Design Studies*, 31(3), pp. 237-267. <https://doi.org/10.1016/j.destud.2009.11.002>.

ILLUSTRATION SOURCES

- FIG. 1 Derived from: <https://www.lippmann.com.au/project/butterfly-house> [Accessed 23 May 2024].
- FIGS. 2-5 Authors.
- FIG. 6A Derived from: <https://www.felipeassadi.com/casa-20x20> [Accessed 16 June 2024].
- FIG. 6B Derived from: <http://www.campobaeza.com/asencio-house/> [Accessed 20 June 2024].
- FIG. 6C Derived from: <https://durbachblockjaggers.com/projects/residential/house-spry> [Accessed 10 July 2024].
- FIG. 6D Derived from: <https://shigerubanarchitects.com/works/hh/glass-shutter-house/> [Accessed 18 June 2024].
- FIG. 7 Authors.
- TABLES I, II Authors.

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RELATIONSHIP BETWEEN AUDITORY PERCEPTION AND COMFORT AND MULTIPLE PHYSICAL ENVIRONMENTAL PARAMETERS: AN EVALUATION IN EDUCATIONAL BUILDINGS

KEYWORDS

AUDITORY COMFORT
AUDITORY PERCEPTION
EDUCATIONAL SPACES

ABSTRACT

Acoustic comfort in educational buildings plays a key role in user satisfaction and learning efficiency. This study investigates the effects of multiple physical environmental parameters-air temperature, relative humidity, air velocity, mean radiant temperature, sound pressure level, and horizontal and vertical illuminance-on auditory perception and comfort in educational spaces. The research was conducted in two design studios and one classroom at Adana Alparslan Türkeş Science and Technology University, using simultaneous subjective

surveys with 88 participants and objective environmental measurements taken at the same locations. After reliability and normality checks, Pearson correlation and multiple linear regression analyses were applied. Results show that sound pressure level is the only significant determinant of auditory perception, while auditory comfort is significantly influenced by sound pressure level, relative humidity, and horizontal illuminance. The findings emphasize the importance of a holistic approach to evaluating indoor auditory comfort.

INTRODUCTION

Indoor environmental quality is generally defined by four main comfort components: thermal comfort, auditory comfort, visual comfort, and indoor air quality (Lee, Lee and Lee, 2023). Each of these components is represented by measurable physical parameters such as air temperature, relative humidity, air velocity, mean radiant temperature, illuminance, and sound pressure level (Riffelli, 2021). In recent years, particularly in indoor environments where users spend extended periods – such as educational spaces – the effects of these environmental conditions on occupants have been extensively investigated. User comfort and health are directly influenced by indoor environmental conditions, and inadequate environments may result in dissatisfaction, reduced attention, and decreased performance (Vischer, 2008). For this reason, adopting a holistic approach to comfort criteria, with particular emphasis on auditory comfort, is of critical importance in terms of both user well-being and productivity.

Indoor comfort is a multidimensional phenomenon, and improving acoustic parameters alone cannot be assumed to fully enhance user experience. Adequate thermal comfort conditions (air temperature, mean radiant temperature, humidity, and air velocity) and visual comfort conditions (illuminance levels) must also be ensured. The literature emphasizes that different comfort domains interact with one another and, when

evaluated collectively, significantly influence overall comfort perception (Wu et al., 2020). One study reported that thermal and acoustic environments exhibit a veto effect on user satisfaction, meaning that severe dissatisfaction with either of these conditions may independently determine overall satisfaction (Huang et al., 2012). Similarly, a review study has revealed that thermal comfort and acoustic comfort are the most influential factors affecting overall comfort, followed by visual comfort (Du et al., 2023). Nevertheless, user perception of indoor comfort may vary depending on context. While some office and classroom studies identify thermal conditions and air quality as the most critical factors (Riffelli, 2022), others indicate that the influence of acoustic comfort on overall satisfaction can be at least as strong as, or even more dominant than, thermal comfort (Sakellaris et al., 2016).

LITERATURE REVIEW

Auditory comfort in educational environments is widely recognized as a critical factor influencing learning processes and users' overall environmental satisfaction. Beyond purely acoustic characteristics, however, recent research increasingly emphasizes that auditory comfort is shaped through interactions with other physical environmental dimensions, particularly thermal conditions. Studies have shown that identical noise levels tend to be perceived as more disturbing under thermally uncomfortable conditions, such as elevated air temperatures, whereas tolerance to noise increases under thermally neutral or cooler conditions (Yang, 2017; Jin, Jin and Kang, 2020; Lin et al., 2023; Chen et al., 2024). Multi-parameter experimental studies further demonstrate that thermal conditions can exert cross-modal effects on perceived acoustic comfort, while noise levels may simultaneously influence thermal comfort perception (Wu, Sun and Wu, 2020; Yang and Moon, 2019). In addition to air temperature, other thermal parameters such as relative humidity and air velocity have been reported to indirectly affect auditory comfort by increasing sensations of stuffiness or introducing additional background noise through ventilation systems (Wu et al., 2019; Yang, Moon and Kim, 2018; Bhandari, Tadeballi and Gopalakrishnan, 2025). Moreover, evidence suggests that these thermal-acoustic interactions are context-dependent and may diminish under extreme environmental conditions, where a single dominant discomfort factor overrides other sensory influences (Pellerin and Candas, 2004; Wen et al., 2025). Visual comfort conditions also constitute an important component of user experience in

indoor environments. Although illuminance levels may not appear to be directly related to auditory perception, several studies suggest that lighting conditions and visual stimuli can influence noise tolerance and perceived auditory comfort (Yang and Moon, 2018). Recent research on multisensory comfort has provided valuable insights into visual-auditory interactions.

Within this context, Li et al. (2025) investigated combined temperature-lighting-noise conditions in a learning environment and reported cross-modal effects between lighting and acoustics. Their results suggest that higher illuminance can reduce acoustic acceptability, with identical noise levels perceived as more disturbing under brighter conditions. The study also indicated that higher sound levels may negatively influence visual comfort evaluations, highlighting the integrated nature of multisensory environmental perception.

However, the literature does not present a full consensus regarding visual-acoustic interactions. Some studies report no significant influence of visual environmental conditions on auditory comfort. An experimental study conducted in an office laboratory in Vienna exposed participants to varying illuminance and noise levels and found that visual conditions did not statistically affect auditory comfort evaluations (Berger and Mahdavi, 2021). In that study, the temperature range was limited, and lighting was manipulated only in terms of glare presence, which may have constrained the detection of cross-modal effects. Consequently, other studies also report statistically insignificant effects of visual and thermal conditions on auditory comfort (Du et al., 2023). These inconsistencies suggest that the emergence of cross-modal interactions may depend on experimental design, the intensity of sensory stimuli, and participants' sensitivity.

Overall, existing studies indicate that auditory perception and comfort in indoor environments are shaped not only by acoustic characteristics but also by thermal and visual conditions, highlighting the growing importance of multisensory interactions in indoor comfort research. Because users perceive indoor environments holistically, discomfort in one domain may limit the effectiveness of improvements in others, particularly in educational buildings where learning efficiency and user satisfaction are strongly linked to environmental quality. However, despite increasing evidence of cross-modal interactions, the literature reveals a lack of studies that simultaneously and comprehensively examine the effects of multiple physical environmental parameters on auditory percep-



FIG. 1 LOCATION OF THE STUDY AREA IN ADANA ALPARSLAN TÜRKES SCIENCE AND TECHNOLOGY UNIVERSITY

tion and auditory comfort in indoor educational spaces. Therefore, the present study aims to analyse the combined effects of air temperature, relative humidity, air velocity, mean radiant temperature, sound pressure level, and horizontal and vertical illuminance on users' auditory perception and auditory comfort. By integrating objective environmental measurements with subjective user evaluations, the study seeks to contribute new insights into the multidimensional nature of environmental comfort in educational settings.

METHODOLOGY

Both quantitative environmental measurements and subjective user survey data were collected simultaneously, and the resulting dataset was evaluated through statistical analyses to identify the effects of multiple physical variables on auditory comfort. The study was conducted in accordance with institutional ethical guidelines. Ethical approval was obtained from the relevant ethics committee prior to data collection. All participants were informed about the purpose and scope of the study, and written informed consent was obtained through a Voluntary Participation Form.

STUDY AREA AND PARTICIPANTS

The study was conducted in three different indoor educational spaces – Studio 1, Studio 2, and the Architecture Classroom – within the Faculty of Architecture and Design at Adana Alparslan Türkeş Science and Technology University (Fig. 1). The studios are group-work environments characterized by high ceilings, open-plan layouts, and access to natural light-

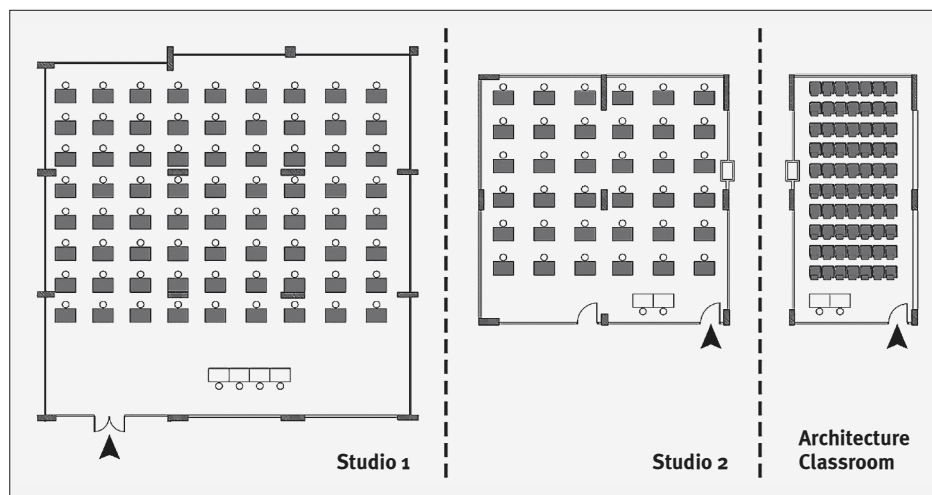


FIG. 2 INDOOR SPACES WHERE THE FIELD SURVEYS AND MEASUREMENTS WERE CONDUCTED

ing, whereas the Architecture Classroom has a conventional classroom layout designed for individual focus and note-taking activities (Fig. 2). The study was carried out in December, under winter conditions, and active split-type air-conditioning systems were observed in all spaces. This context provides an important environmental setting for interpreting users' comfort evaluations.

Data were collected through survey applications conducted with undergraduate students from the Department of Architecture who were present in the study areas. This participant group, consisting entirely of individuals who actively used the studied environments, provides an appropriate sample in terms of the reliability of user experience. The study was conducted on a voluntary basis, and data were obtained from a total of 88 participants. Participants' ages ranged from 19 to 27, and a balanced gender distribution was maintained. In addition, participants' familiarity with the study environments contributed to the sound implementation of the evaluation process. The distribution of participants across the study spaces was as follows: 36 participants in Studio 1, 28 in Studio 2, and 24 in the Architecture Classroom. Due to the nature of the study design, participants were not restricted to a single space. Data were collected from students present in each environment at the time of measurement; therefore, some participants took part in the study in more than one space (two or three), depending on their presence in different sessions.

DATA COLLECTION PROCESS AND MEASUREMENT INSTRUMENTS

During the survey administration for each participant, seven different environmental physical parameters were measured simultaneous-

ly at the same spatial position: air temperature, relative humidity, air velocity, mean radiant temperature (T_{mrt}), sound pressure level, horizontal illuminance, and vertical illuminance. All measurements were conducted using pre-calibrated instruments, and each measurement value was directly matched with the corresponding survey response. Each survey and measurement lasted approximately 5 minutes per participant. During the data collection process, the researcher moved between participants and conducted measurements individually at each participant's seating position while they were engaged in routine drawing activities. No controlled or artificial sound sources were introduced during the measurements; participants were exposed only to typical background noise conditions of the indoor environment.

In addition to demographic information such as age, gender, and educational status, the questionnaire included items related to auditory perception and auditory comfort levels. The auditory perception items were structured on a 7-point Likert-type scale ranging from "very noisy" to "very quiet." The auditory comfort items were assessed using the same scale, ranging from "very uncomfortable" to "very comfortable." The questionnaire comprised of a total of six items, including three statements related to auditory perception and three statements related to auditory comfort. The auditory perception dimension included items asking participants how they would describe the sound environment in the space, how noisy or quiet they perceived the environment, and how they evaluated the level of surrounding sounds.

The auditory comfort dimension included items asking participants how comfortable they felt in terms of the acoustic environment, to what extent the sound environment disturbed them, and how satisfied they were with the acoustic conditions of the space. This integrated data collection approach enabled the direct linking of users' subjective evaluations of environmental experience with simultaneously recorded physical measurement data, thereby supporting a more reliable analysis of relationships between environmental conditions and user perceptions. In this study, auditory perception and auditory comfort were treated as conceptually distinct constructs. Auditory perception refers to participants' subjective evaluation of the acoustic environment in terms of how noisy or quiet it is, whereas auditory comfort reflects the degree of satisfaction or discomfort experienced under those acoustic conditions. Accordingly, auditory perception in this study does not refer to the mere ability to hear sounds, but rather to the subjective ap-

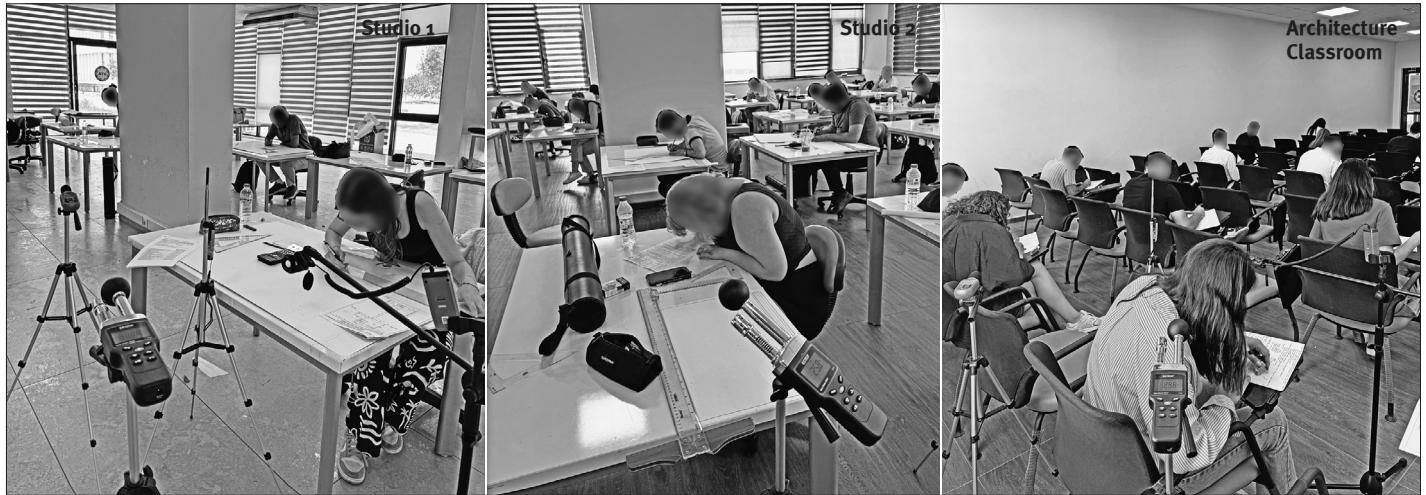


FIG. 3 FIELD SURVEY AND MEASUREMENT STUDY

praisal of the acoustic environment, which allows meaningful interpretation of its relationship with sound pressure level.

To provide a clearer understanding of the environmental context in which the data were collected, descriptive statistics of the measured environmental parameters are presented below. Across all measurement points, air temperature ranged between 21.70 and 25.90 °C (mean: 23.58 °C), relative humidity varied between 25.37% and 43.22% (mean: 35.41%), and air velocity remained generally low, ranging from 0.03 to 0.84 m/s (mean: 0.26 m/s). Mean radiant temperature (T_{mrt}) ranged between 23.88 and 25.35 °C (mean: 24.91 °C).

Sound pressure levels (SPL) ranged from 46.40 to 54.20 dB(A), with a mean value of 50.07 dB(A), representing typical background noise conditions in educational spaces. Horizontal illuminance levels varied between 387 and 1972 lx (mean: 789.00 lx), while vertical illuminance ranged from 195 to 875 lx (mean: 407.65 lx).

DATA ANALYSIS METHODS

The collected data were analysed using IBM SPSS Statistics 25. In the first stage, Pearson correlation analysis was applied to determine relationships between environmental physical variables and auditory perception and auditory comfort evaluations. This method is suitable for identifying the strength and direction of linear relationships between variables.

In the second stage, only variables that showed statistically significant relationships with auditory comfort were included in multiple linear regression analysis. This analysis aimed to determine the extent to which auditory comfort, as the dependent variable, was influenced by environmental variables. A sig-

nificance level of $p < 0.05$ was adopted as the criterion for statistical significance in the model. All environmental variables included in the analysis were expressed in their original measurement units: air temperature (°C), relative humidity (%), air velocity (m/s), mean radiant temperature (°C), sound pressure level (dB(A)), horizontal illuminance (lx), and vertical illuminance (lx). Prior to the statistical analyses, outlier diagnostics were performed to ensure the robustness of the results. Boxplot inspections and standardized z-scores were examined for all variables. No extreme outliers were detected, and therefore no data points were removed from the dataset.

RESULTS

Internal consistency of the scales was assessed using Cronbach's alpha (α). Cronbach's α was calculated as 0.812 for the auditory perception items and 0.868 for the auditory comfort items. These values indicate a high level of reliability for both subscales ($\alpha > 0.70$).

To assess the suitability of the dataset for parametric analyses, the normality assumption was tested. Based on the results of the Kolmogorov-Smirnov and Shapiro-Wilk tests, auditory perception and auditory comfort scores were found to be normally distributed. Accordingly, the normality assumption required for Pearson correlation analysis was considered satisfied.

RELATIONSHIPS BETWEEN AUDITORY PERCEPTION AND ENVIRONMENTAL PHYSICAL PARAMETERS

Based on the collected data, relationships between auditory perception and air temper-

TABLE I PEARSON CORRELATION RESULTS BETWEEN AUDITORY PERCEPTION AND ENVIRONMENTAL PHYSICAL VARIABLES				TABLE II PEARSON CORRELATION RESULTS BETWEEN AUDITORY COMFORT AND ENVIRONMENTAL PHYSICAL VARIABLES			
Variable	Pearson (r)	p-value	Significance	Variable	Pearson (r)	p-value	Significance
Temperature	0.199	0.099	Not significant	Temperature	0.055	0.650	Not significant
Relative humidity	-0.157	0.195	Not significant	Relative humidity	-0.263	0.027	Significant
Mean radiant temperature (Tmrt)	0.078	0.521	Not significant	Mean radiant temperature (Tmrt)	-0.016	0.894	Not significant
Air velocity	-0.104	0.392	Not significant	Air velocity	-0.018	0.883	Not significant
Sound pressure level (SPL)	-0.530	< 0.001	Significant	Sound pressure level (SPL)	-0.963	< 0.001	Significant
Horizontal illuminance	0.084	0.487	Not significant	Horizontal illuminance	-0.050	0.678	Not significant
Vertical illuminance	0.062	0.611	Not significant	Vertical illuminance	0.137	0.256	Not significant

ature, relative humidity, air velocity, mean radiant temperature (Tmrt), sound pressure level (SPL), horizontal illuminance, and vertical illuminance were examined using Pearson correlation analysis. The results are presented in Table I.

As shown in Table 1, a statistically significant relationship was identified only between auditory perception and sound pressure level (SPL) ($r = -0.530$, $p < 0.001$). This relationship was negative and indicates a strong correlation. No statistically significant relationships were found between auditory perception and the remaining environmental variables.

A weak positive relationship was observed between temperature and auditory perception ($r = 0.199$); however, this association was not statistically significant ($p = 0.099$). Relative humidity showed a weak negative association with auditory perception ($r = -0.157$), which was also not statistically significant ($p = 0.195$). The relationship between mean radiant temperature (Tmrt) and auditory perception was very weak ($r = 0.078$, $p = 0.521$) and non-significant. Similarly, air velocity exhibited a weak negative relationship with auditory perception ($r = -0.104$, $p = 0.392$), which was not significant. Horizontal and vertical illuminance were associated with very weak positive relationships with auditory perception; however, these relationships were not statistically significant.

RELATIONSHIPS BETWEEN AUDITORY COMFORT AND ENVIRONMENTAL PHYSICAL PARAMETERS

Based on the collected data, relationships between auditory comfort and air temperature, relative humidity, air velocity, mean radiant temperature (Tmrt), sound pressure level (SPL), horizontal illuminance, and vertical illuminance were evaluated using Pearson correlation analysis. The results are presented in Table 2.

As shown in Table II, a very strong, negative, and statistically significant relationship

was identified between auditory comfort and sound pressure level (SPL) ($r = -0.963$, $p < 0.001$). This finding indicates that auditory comfort decreases as sound pressure level increases.

In addition, a weak negative and statistically significant relationship was found between relative humidity and auditory comfort ($r = -0.263$, $p = 0.027$). No significant relationships were found between auditory comfort and the remaining environmental physical variables. Temperature showed a very weak positive association with auditory comfort ($r = 0.055$), which was not statistically significant ($p = 0.650$). Mean radiant temperature (Tmrt) exhibited a very weak negative and non-significant relationship with auditory comfort ($r = -0.016$, $p = 0.894$). Air velocity also showed a very weak relationship ($r = -0.018$, $p = 0.883$). Neither horizontal nor vertical illuminance was significantly associated with auditory comfort.

REGRESSION RESULTS

To determine the effects of environmental physical parameters on auditory comfort, multiple linear regression analysis was performed. Auditory comfort was considered as the dependent variable, while temperature, relative humidity, air velocity, mean radiant temperature (Tmrt), sound pressure level (SPL), horizontal illuminance, and vertical illuminance were included as independent variables. The results are presented in Table III.

The model was statistically significant overall ($p < 0.001$), and the independent variables collectively explained 95.2% of the variance in auditory comfort ($R^2 = 0.952$). Sound pressure level (SPL) had a statistically significant negative effect on auditory comfort ($b = -0.605$, $p < 0.001$), indicating that increases in SPL lead to decreases in auditory comfort scores. Relative humidity had a statistically significant positive effect on auditory comfort ($b = 0.021$, $p = 0.023$). Horizontal illuminance also showed a statistically significant posi-

TABLE III MULTIPLE LINEAR REGRESSION RESULTS FOR AUDITORY COMFORT			
Independent variable	Coefficient (b)	p-value	Significance
Temperature	-0.046	0.745	Not significant
Relative humidity	0.021	0.023	Significant
Mean radiant temperature (Tmrt)	0.003	0.986	Not significant
Air velocity	-0.650	0.233	Not significant
Sound pressure level (SPL)	-0.605	< 0.001	Significant
Horizontal illuminance	0.0003	0.017	Significant
Vertical illuminance	-0.0003	0.302	Not significant

tive effect ($b = 0.0003$, $p = 0.017$), indicating that higher horizontal illuminance was associated with higher auditory comfort scores. The remaining independent variables – temperature, mean radiant temperature (Tmrt), air velocity, and vertical illuminance – did not have statistically significant effects on auditory comfort ($p > 0.05$).

To facilitate a clearer interpretation of the statistical findings, the relationships between auditory perception, auditory comfort, and the examined environmental physical parameters are synthesized and schematically illustrated in Fig. 4. This relational diagram visually distinguishes the variables that were found to have statistically significant effects from those that did not, based on the correlation and regression analyses. By providing an integrated overview, the figure supports a holistic understanding of how multiple environmental factors collectively influence auditory perception and perception in educational spaces.

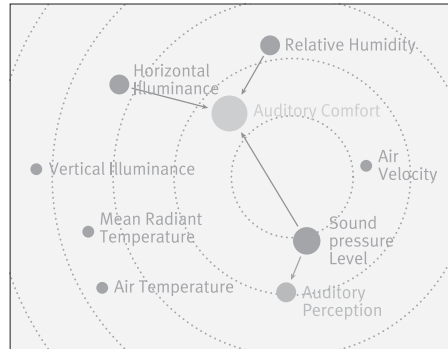
AUDITORY COMFORT PREDICTION MODEL

Based on the significant predictors identified in the regression analysis, a simplified auditory comfort prediction model was developed (Table IV).

An auditory comfort prediction model was established using only the variables found to be statistically significant. The coefficients and constant term are presented in the following equation:

$$\text{Auditory Comfort} = 31.763 + (0.024 \times \text{Relative Humidity}) - (0.599 \times \text{SPL}) + (0.0003 \times \text{Horizontal Illuminance})$$

This regression model may be used as a practical prediction tool for similar indoor studies or applied research contexts. By entering the measured relative humidity (%), sound pressure level (dB(A)), and horizontal illuminance (lux) values for a given indoor environment, the model enables a numerical estimation of users' expected auditory comfort perception in that setting. The auditory comfort value obtained from the model yields an outcome within the range of -3 to +3 in accordance with the 7-point Likert scale used. Values approaching the negative end indicate that the environment is perceived as uncomfortable by users, whereas values approaching the positive end indicate a comfortable auditory environment. In this respect, the model provides an applicable tool for comparing auditory comfort across different spaces or design alternatives and for anticipating the effects of changes in environmental parameters on user perceptions.



DISCUSSION

This study aimed to analyse the effects of multiple physical environmental parameters – including air temperature, relative humidity, air velocity, mean radiant temperature, sound pressure level, horizontal illuminance, and vertical illuminance – on users' auditory perception and auditory comfort evaluations in indoor educational spaces. The findings of the study reaffirm the decisive role of sound pressure level in auditory comfort, which has been consistently emphasized in the literature. In particular, the very strong negative correlation identified between sound pressure level and auditory comfort, along with the dominance of this variable as the strongest predictor in the regression analysis, is in line with previous scientific evidence (Dias, dos Santos and Mariano, 2019; Liang et al., 2021; Zhang et al., 2025).

From the perspective of auditory perception, a statistically significant relationship was identified only with sound pressure level, while no significant associations were found with the other environmental parameters. This result aligns with the well-documented finding that noise level constitutes the primary determinant of auditory perception (Yang, Moon and Kim, 2018). However, the lack of confirmed cross-modal interactions between thermal environmental conditions (such as temperature and humidity) and auditory perception – reported in some previous studies (Yang and Moon, 2019; Li et al., 2025) – may be attributed to the characteristics of indoor settings and user profiles examined in this study. In particular, the relatively limited range of thermal conditions during the measurements and the participants' familiarity and adaptation to these environments may have influenced the absence of such effects.

Regarding auditory comfort, statistically significant relationships were identified not only with sound pressure level but also with relative humidity and horizontal illuminance. The limited positive effect of relative humidity is consistent with findings reported in certain previous studies (Wu et al., 2019; Granzotto,

TABLE IV SIMPLIFIED REGRESSION MODEL RESULTS FOR AUDITORY COMFORT

Independent variable	Coefficient (b)	p-value	Significance
Relative humidity	0.024	0.023	Significant
Sound pressure level (SPL)	-0.599	< 0.001	Significant
Horizontal illuminance	0.0003	0.017	Significant
Constant (const)	31.763	–	–

FIG. 4 RELATIONAL DIAGRAM OF ENVIRONMENTAL PHYSICAL VARIABLES AFFECTING AUDITORY PERCEPTION AND AUDITORY COMFORT

Yan and Tronchin, 2023). However, the relationship between relative humidity and auditory comfort should be interpreted with caution, as it may not represent a direct causal effect. Relative humidity can influence users' overall environmental perception by contributing to sensations such as stuffiness or reduced air freshness, which may in turn affect tolerance to background noise. In this context, the observed association may be explained through cross-modal interactions between thermal and auditory domains, where discomfort in one environmental dimension influences perception in another. Furthermore, the role of relative humidity may vary depending on its interaction with other environmental variables. While its individual effect appears limited, it may contribute indirectly to auditory comfort evaluations through its combined influence with dominant factors such as sound pressure level. Similarly, the modest positive effect of horizontal illuminance supports existing evidence on visual-acoustic environmental interactions (Yu et al., 2023). It is well established that visual environmental conditions can influence users' overall environmental perception and, consequently, their evaluations of auditory comfort. Nevertheless, the effect of lighting level observed in this study remained relatively weak.

This study contributes to the literature as one of the relatively few integrated environmental analyses focusing on auditory comfort in educational spaces. Its originality lies in the simultaneous collection of multiple environmental measurements and their direct association with subjective user perception data. However, several limitations should be acknowledged. First, the study is limited to three indoor spaces within a single university campus. Second, the user profile represents a specific demographic group. To enhance the generalizability of the findings, future studies should be conducted across different climatic regions, involving more diverse user groups and larger datasets. In addition, the auditory comfort prediction model developed in this study was derived and tested using the same dataset. Therefore, the model has not been validated using an independent dataset or a separate measurement campaign. This limitation suggests that the predictive performance of the model should be interpreted with caution, and the findings should be considered preliminary. Future studies should aim to validate the proposed model using independent datasets or cross-validation techniques to ensure its robustness and generalizability.

CONCLUSION

This study represents one of the relatively few investigations that examine the effects of

multiple physical environmental parameters – including air temperature, relative humidity, air velocity, mean radiant temperature, sound pressure level, and horizontal and vertical illuminance – on users' auditory comfort and auditory perception in indoor educational spaces from a multidimensional perspective. At the same time, the limited but statistically significant effects observed for secondary environmental variables such as relative humidity and horizontal illuminance suggest that acoustic comfort should not be considered solely as an auditory phenomenon, but rather as one that interacts with thermal and visual components.

Regarding auditory perception, only sound pressure level was found to have a statistically significant effect, while no meaningful relationships were identified with other physical variables. This finding suggests that acoustic perception may be more directly sensitive to sound-related stimuli and relatively more resistant to interactions with other environmental factors. However, this outcome may also be associated with the limited variability of environmental conditions in the studied settings and the users' familiarity with these conditions.

One of the primary contributions of this study to the literature lies in its simultaneous modelling of the effects of multiple environmental parameters on auditory comfort and in directly linking subjective user perceptions with objective measurement data. This approach highlights the need for a more holistic evaluation frameworks in user-centered environmental performance analyses of educational spaces. In particular, the findings indicate that visual and thermal environmental conditions, even when their direct effects are limited, may influence users' acoustic comfort through indirect pathways.

Future research should replicate the findings of this study across different climatic regions, architectural typologies, and user groups to enhance generalizability. In addition, experimental designs capable of more deeply examining cross-modal sensory interactions should be developed. Longitudinal studies that account for extended user experience are especially important for advancing an understanding of how environmental comfort affects learning, attention, and cognitive performance over time.

In conclusion, this study suggests that auditory comfort should be addressed within a holistic framework of environmental perception and comfort in spatial performance evaluations. In educational buildings, multi-comfort strategies that integrate acoustic, visual, and thermal comfort components form the foundation of user-centered design approaches.

BIBLIOGRAPHY AND SOURCES

1. BERGER, C. and MAHDAVI, A. (2021) 'Exploring cross-modal influences on the evaluation of indoor-environmental conditions', *Frontiers in Built Environment*, 7, p. 676607. doi:10.3389/fbuil.2021.676607.
2. BHANDARI, N., TADEPALLI, S. and GOPALAKRISHNAN, P. (2025) 'The combined influence of thermal and acoustic environment on overall comfort and productivity in naturally ventilated university classrooms in India', *Building and Environment*, 267, p. 112212. doi:10.1016/j.buildenv.2024.112212.
3. CHEN, Y., LI, T., CHEN, S., CHEN, H. and LAN, Y. (2024) 'Thermal-acoustic interaction effects on physiological and psychological measures in urban forests: a laboratory study', *Forests*, 15(8), p. 1373. doi:10.3390/F15081373.
4. DIAS, F.A.M., DOS SANTOS, B.A. and MARIANO, H.C. (2019) 'Sound pressure levels in classrooms of a university and its effects on students and professors', *CODAS*, 31(4). doi: 10.1590/2317-1782/20182018093.
5. DU, M., HONG, B., GU, C., LI, Y. and WANG, Y. (2023) 'Multiple effects of visual-acoustic-thermal perceptions on the overall comfort of elderly adults in residential outdoor environments', *Energy and Buildings*, 283, p. 112813. doi:10.1016/j.enbuild.2023.112813.
6. GRANZOTTO, N., YAN, R. and TRONCHIN, L. (2023) 'Measurements of room acoustic and thermo-hygrometric parameters – A case study', *Applied Sciences*, 13(5), p. 2905. doi: 10.3390/AP13052905.
7. HUANG, L., ZHU, Y., OUYANG, Q. and CAO, B. (2012) 'A study on the effects of thermal, luminous, and acoustic environments on indoor environmental comfort in offices', *Building and Environment*, 49(1), pp. 304-309. doi: 10.1016/j.buildenv.2011.07.022.
8. JIN, Y., JIN, H. and KANG, J. (2020) 'Combined effects of the thermal-acoustic environment on subjective evaluations in urban squares', *Building and Environment*, 168, p. 106517. doi: 10.1016/j.buildenv.2019.106517.
9. LEE, J.W., LEE, S.M. and LEE, S.E. (2023) 'Importance of indoor environmental quality surveys for evaluating renovation effects', *Journal of Building Engineering*, 78, p. 107726. doi: 10.1016/j.jobe.2023.107726.
10. LI, W., JIN, Y., JIN, H. and KANG, J. (2025) 'Combined effects of thermal-acoustic-luminous environments on environmental and emotional perceptions in learning spaces in winter', *International Journal of Biometeorology*, 69(7), pp. 1725-1737. doi:10.1007/S00484-025-02928-1.
11. LIANG, P., GUAN, H., WANG, Y., CHEN, H., SONG, P., MA, H. and HU, S. (2021) 'The effect of music tempo and volume on acoustic perceptions under the noise environment', *Sustainability*, 13(7), p. 4055. doi:10.3390/SU13074055.
12. LIN, D., LI, T., CHEN, Z. and LI, L. (2023) 'Effects of interactions between thermal and acoustic environments on subjective comfort evaluations in outdoor public spaces', *Journal of Asian Architecture and Building Engineering*, 24(1), pp. 367-382. doi:10.1080/13467581.2023.2292069.
13. PELLERIN, N. and CANDAS, V. (2004) 'Effects of steady-state noise and temperature conditions on environmental perception and acceptability', *Indoor Air*, 14(2), pp. 129-136.
14. RIFFELLI, S. (2021) 'Global comfort indices in indoor environments: a survey', *Sustainability*, 13(22), p. 12784. doi:10.3390/SU132212784.
15. RIFFELLI, S. (2022) 'A wireless indoor environmental quality logger processing the indoor global comfort index', *Sensors*, 22(7), p. 2558. doi:10.3390/S22072558.
16. SAKELLARIS, I.A., SARAGA, D.E., MANDIN, C., RODA, C., FOSSATI, S., DE KLUZENNAAR, Y., CARER, P., DIMITROULOPOULOU, S., MIHUCZ, V.G., SZIGETI, T., HÄNNINEN, O., DE OLIVEIRA FERNANDES, E., BARTZIS, J.G. and BLUYSSSEN, P.M. (2016) 'Perceived indoor environment and occupants' comfort in European "modern" office buildings: the OFFICAIR study', *International Journal of Environmental Research and Public Health*, 13(5). doi:10.3390/IJERPH13050444.
17. VISCHER, J.C. (2008) 'Towards an environmental psychology of workspace: how people are affected by environments for work', *Architectural Science Review*, 51(2), pp. 97-108. doi: 10.3763/ASRE.2008.5114.
18. WEN, X., MENG, Q., YIN, Y., YANG, D., LI, M. and KANG, J. (2025) 'Exploring the boundaries of indoor combined thermal-acoustic environmental effects on comfort perceptions', *Building and Environment*, 271, p. 112580. doi: 10.1016/j.buildenv.2025.112580.
19. WU, H., SUN, X. and WU, Y. (2020) 'Investigation of the relationships between thermal, acoustic, illuminous environments and human perceptions', *Journal of Building Engineering*, 32, p. 101839. doi:10.1016/j.jobe.2020.101839.
20. WU, H., WU, Y., SUN, X. and LIU, J. (2020) 'Combined effects of acoustic, thermal, and illumination on human perception and performance: a review', *Building and Environment*, 169, p. 106593. doi: 10.1016/j.buildenv.2019.106593.
21. WU, Y., MENG, Q., LI, L. and MU, J. (2019) 'Interaction between sound and thermal influences on patient comfort in the hospitals of China's northern heating region', *Applied Sciences*, 9(24), p. 5551. doi: 10.3390/AP9245551.
22. YANG, W. (2017) 'Effects of noise on indoor thermal sensation and comfort', *KIEAE Journal*, 17(1), pp. 83-89. doi:10.12813/KIEAE.2017.17.1.083.
23. YANG, W. and MOON, H.J. (2018) 'Combined effects of sound and illuminance on indoor environmental perception', *Applied Acoustics*, 141, pp. 136-143. doi:10.1016/j.apacoust.2018.07.008.
24. YANG, W. and MOON, H.J. (2019) 'Combined effects of acoustic, thermal, and illumination conditions on the comfort of discrete senses and overall indoor environment', *Building and Environment*, 148, pp. 623-633. doi:10.1016/j.buildenv.2018.11.040.
25. YANG, W., MOON, H.J. and KIM, M.J. (2018) 'Combined effects of short-term noise exposure and hygrothermal conditions on indoor environmental perceptions', *Indoor and Built Environment*, 27(8), pp. 1119-1133. doi: 10.1177/1420326X17703774.
26. YU, Y., FENG, D., ZHANG, X. and KANG, J. (2023) 'Influence of sound and light combined conditions in urban environments on residents' tolerance limits in pre sleep state', *Frontiers in Psychology*, 14, p. 1102761. doi:10.3389/FPSYG.2023.1102761.
27. ZHANG, N., LIU, C., YUAN, Q., GENG, R., MENG, X., YAO, W. and GAO, W. (2025) 'Study on the effects of traffic noise and spring water sound at different sound pressure levels on brain dynamic activity', *Scientific Reports*, 15(1), pp. 1-22. doi:10.1038/S41598-025-96591-6.

ILLUSTRATION SOURCES

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 TABLES I-IV Author

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TOWARDS A COMPREHENSIVE FRAMEWORK FOR UNDERSTANDING AND DOCUMENTING URBAN CULTURAL HERITAGE

KEYWORDS

COMPREHENSIVE FRAMEWORK
DOCUMENTATION
MULTI-DIMENSIONAL HERITAGE
MULTI-SCALAR HERITAGE
URBAN CULTURAL HERITAGE

ABSTRACT

This paper proposes a comprehensive framework for understanding urban cultural heritage (UCH). This is done by identifying and categorizing the elements that contribute to its layered significance across multiple dimensions and scales. It conceptualizes UCH not only as a group of historic objects or structures, but as a dynamic cultural entity shaped through continuous historical evolution, social practices, and spatial interactions. Following a qualitative methodology, the study critically analyses the development of UCH definitions in international documents. It maps the tangible and intangible

components of heritage—such as physical form, collective memory, and symbolic meaning and investigates the complex interrelationships among them. The study also investigates measuring tools and interpretation instruments to help practitioners to document UCH. Special attention is given to the experiential and representational dimensions of historic urban areas, where identity and memory are interwoven with material environment. The findings underscore the need to recognize these multifaceted layers before undertaking any intervention or documentation process.

INTRODUCTION

Urban historical areas are a living witness to the past that shaped them. They are considered spatial structures where the evolution of a society, its cultural identity and character can be manifested (ICOMOS CIVVIH, 2011). Cultural heritage within urban areas is considered a process and a product that enriches communities with a wealth of resources (UNESCO, 2014). Therefore, its definition, has dramatically evolved over time not only to include isolated built elements but also the setting and the urban context which contributes to and is a part of its significance (Fig. 1) (ICOMOS, 2005; Veldpaus, Pereira Roders and Colenbrander, 2013: 4). According to UNESCO's Sustainable Development Goals (SDG) Urban Cultural Heritage (UCH) is essential in creating an inclusive, safe, resilient and sustainable city (UNESCO, 2014). This includes the material and spiritual qualities of UCH as well as the natural and man-made contexts (ICOMOS CIVVIH, 2011).

Over the past decade, a holistic understanding of Urban Cultural Heritage has been addressed in international doctrines, most notably the Historic Urban Landscape (HUL) approach. HUL recognizes historic urban areas as layered, dynamic environments which are shaped by cultural, social, economic and spatial processes (Bandarin and van Oers, 2012; UNESCO, 2011a). While HUL approach represents a major conceptual shift by incorporating multi-dimensional and multi-scalar val-

ues, presenting "what" should be valued, it abstains from providing practitioners with the "how" to systematically record these values using specific methods, indicators or documentation tools. Therefore, the translation of the HUL approach's principles into systematic analytical frameworks remains challenging while the identification of the elements constituting UCH also remains context-dependent (Ginzarly, Houbart and Teller, 2019; Veldpaus, 2015).

This shows a gap between the integrated conceptualization and the practical documentation of UCH. Consequently, it raises the need for a synthesized framework that makes the components of UCH explicit and structured while following the holistic principles of the HUL approach. This paper fills this gap by providing a technical roadmap that allow practitioners to deconstruct a complex urban site into a systematic matrix of multi-dimensional and multi-scalar indicators. By assigning compatible documentation instruments to each intersection, the framework transforms theoretical values into a functional manual for practitioners.

Accordingly, in order to address implementation challenges, the objective of this paper is to develop a structured operational framework that translates the holistic HUL concept into specific documentation categories and measurable indicators. While the framework's theoretical foundation is grounded in international documents, its primary contribution is the shift toward a technical methodology ready for field application. To achieve this objective, the research follows a systematic workflow beginning with data collection from international documents and literature analysis. Followed by a coding process, whereby heritage elements are categorized into specific dimensions (tangible and intangible) and scales (urban, object, and people). The structured framework designed to make the components of UCH explicit and operational for documentation is developed through a cross-tabulation and synthesis of these codes.

METHODOLOGY

To bridge the gap between the conceptual depth of the Historic Urban Landscape (HUL) approach and the documentation practice, this research employs a systematic qualitative content analysis and framework synthesis. The development of the proposed multi-dimensional and multi-scalar matrix followed a three-phase workflow designed to translate international doctrine into operational categories.

PHASE I: ANALYSIS OF INTERNATIONAL DOCUMENTS REGARDING URBAN CULTURAL HERITAGE

The research involved a systematic collection and analysis of international documents focusing on the evolution of UCH. Key documents were selected based on their global role in expanding the heritage definition from “monument” to “landscape”. These documents, spanning from the 1964 Venice Charter to the 2011 Recommendation of the Historic Urban Landscape, provide the primary data for identifying heritage elements and values.

PHASE II: CULTURAL HERITAGE FRAMEWORK BUILDING

The selected doctrines were subjected to a deductive coding process. UCH attributes mentioned within the documents (e.g. “visual relationships”, “social practices”, “building fabric”) were extracted and categorized according to two primary axes:

- Dimensions: distinguishing between intangible and tangible.
- Scales: categorizing elements according to the spatial impact which is either urban, object or people scale.

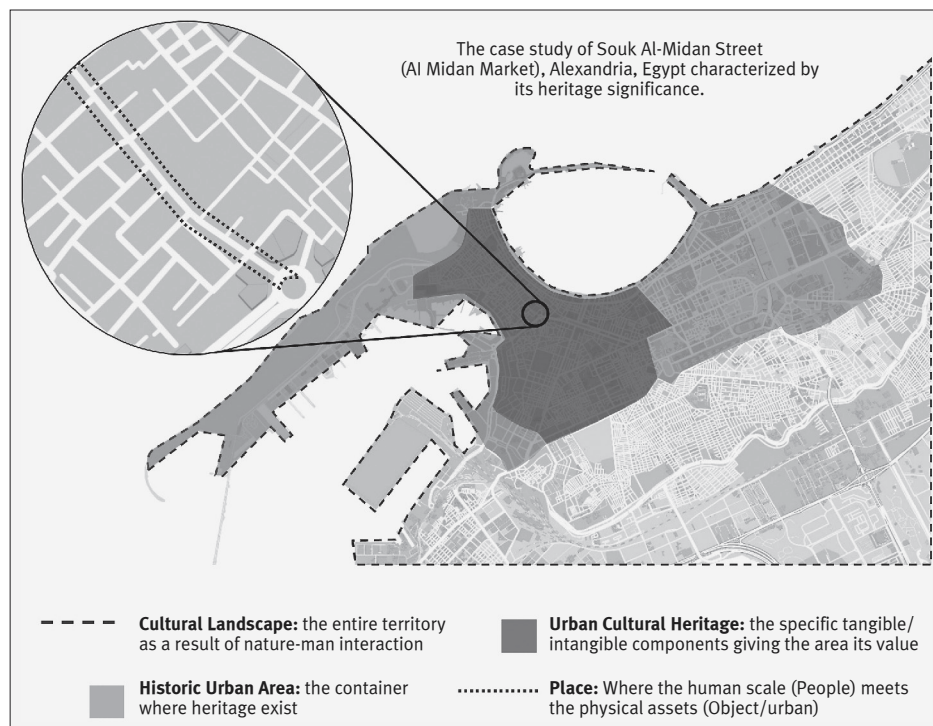
Where elements were assessed according to their documentability which provide the possibility to identify, map and record them later during urban surveys.

PHASE III: FRAMEWORK SYNTHESIS AND URBAN CULTURAL HERITAGE MATRIX CONSTRUCTION

The final step involved the cross-tabulation of these elements into a synthesized matrix. This methodology allows the systematic identification of intersections between dimensions and scales. For example, by intersecting “Intangible” dimension with the “Urban” scale, the framework identifies “Sensory Aspects” and “Visual Relationships” as specific documentation targets. This synthesis presents a foundation for the proposed framework, making sure that all aspects of the significant urban area are documented, regardless of their scale or materiality.

DIMENSIONS AND SCALES OF URBAN CULTURAL HERITAGE

The understanding of UCH’s nature has evolved along time (ICOMOS, 2008a; UNESCO, 1972, 2003, 2011a). While earlier in 1964, the Venice Charter stated that UCH was not only a single architectural product but also the urban or rural setting in which the evi-



dence of a particular community was found (ICOMOS, 1964), it wasn’t until 2003 that the UCH was perceived as a multi-dimensional construct. After the Convention for the Safeguarding of Intangible Cultural Heritage (UNESCO, 2003), the notion of intangible cultural heritage was mentioned without being classified as an independent dimension contributing to the identity of UCH.

In 2011, the Historic Urban Landscape Approach followed by the Burra Charter in 2013, stated that UCH is multi-dimensional, encompassing tangible and intangible dimensions (Australia ICOMOS, 2013; UNESCO, 2011a). Accordingly, UCH was perceived as the physical significant cultural heritage and the non-physical social living wealth (Australia ICOMOS, 2013; UNESCO, 1972, 2003). This notably contributed to a greater understanding of the multi-dimensional nature of UCH leading to the inclusion of all elements, objects, spaces and views in the recording process to create a comprehensive interpretation of UCH (Australia ICOMOS, 2013).

Simultaneously, urban-based expressions and approaches to heritage management began to surge, putting into consideration the multi-scalar nature of UCH (Australia ICOMOS, 2013; UNESCO, 2011a). Gradually the focus shifted from being solely on the object of historic significance to include its urban context, the people that contributed to it and the relationship between them (Australia

FIG. 1 CONCEPTUAL HIERARCHY OF URBAN HERITAGE. SOURCE: (AUTHORS, 2026)

TABLE I | INTERNATIONAL DOCUMENTS DEFINING AND LISTING NOTIONS INDICATING THE MULTI-DIMENSIONAL AND MULTI-SCALAR NATURE OF URBAN CULTURAL HERITAGE. SOURCE: (AUTHORS, 2026)

Source		Urban	Object	People
The Venice Charter (1964)	Tangible	Urban Setting ¹	The architectural work	
	Intangible	History Urban Setting	History	
Recommendation Concerning the Safeguarding and Contemporary Role of Historic Areas (1976)	Tangible	Groups of buildings Historic towns Old urban quarters Public & private open spaces Natural/manmade setting	Structures Physical conditions of buildings	
	Intangible			Values ² Human dimension Cultural, religious, social & human activities
Washington Charter (1987)	Tangible	Urban patterns Relationships between buildings and open spaces	Material elements Formal appearance Building's interior/exterior Various functions	
	Intangible	Historic Character Relationship between the urban area and its surrounding setting	Historic Character	Historic Character Spiritual elements
Vienna Memorandum (May 2005)	Tangible	Land uses & patterns Spatial organization Visual relationships Topography & soils Vegetation Elements of technical infrastructure		
	Intangible	Sense of place Spatial organization Visual relationships	Sense of place	Sense of place Current & past social expressions
Xi'an Declaration (October 2005)	Tangible	Setting including interaction with natural environment Physical aspects	Physical aspects	
	Intangible	Visual aspects Traditional knowledge Use & activities	Visual aspects Traditional knowledge Use & activities	Social & spiritual practices Customs Traditional knowledge Use & activities Any forms of ICH aspects
The Quebec Declaration on the Preservation of the Spirit of the Place (2008)	Tangible	Sites Landscapes Routes	Buildings Objects	
	Intangible			Memories Narratives Written Documents Festivals & rituals Commemorations Traditional knowledge Textures, colours, odours ³
Recommendation on the Historic Urban Landscape (November 2011)	Tangible	Urban context Geographical setting Topography Geomorphology Natural features Infrastructure Open spaces gardens Land use pattern Spatial organization Built environment		
	Intangible	Historic layering of cultural & natural values & attributes Visual relationships ⁴	Historic layering of cultural & natural values & attributes Intangible dimensions of heritage	Historic layering of cultural & natural values & attributes Social & cultural practices & values Identity
The Valletta Principles for the Safeguarding and Management of Historic Cities, Towns & Urban Areas (November 2011)	Tangible	Urban structure Landscapes within & around the town Panoramas Skylines View-lines Landmark sites	Architectural elements Archaeological remains	
	Intangible	Symbolic and historic functions	Symbolic and historic functions	Activities Cultural practices Traditions Memories Cultural references that constitute the substance of their historic value
Burra Charter (2013)	Tangible	Spaces Land, water & sky		
	Intangible	Visual setting from a place & along a cultural route Sensory aspects like smells and sounds Historical, contemporary relationships Relationships with other places	Use & activities	Sensory aspects like smells & sounds

ICOMOS, 2013; UNESCO, 2011a; Veldpaus, 2015; Veldpaus, Pereira Roders and Colenbrander, 2013). According to the Recommendation Concerning the Safeguarding and Contemporary Role of Historic Areas (UNESCO, 1976), UCH include three main categories of scales:

- The urban scale which includes the surroundings, the environment, the urban context, etc.
- The object scale which includes the architectural heritage itself, the shared character, building materials, etc.
- The people scale which includes the human activities, values, memories, etc.

The Following Table I shows the different notions included in international documents indicating the multi-dimensional and multi-scalar nature of UCH (Australia ICOMOS, 2013; ICOMOS, 1964, 1987, 2005, 2008b; ICOMOS CIVVIH, 2011; UNESCO, 1976, 2005, 2011a).

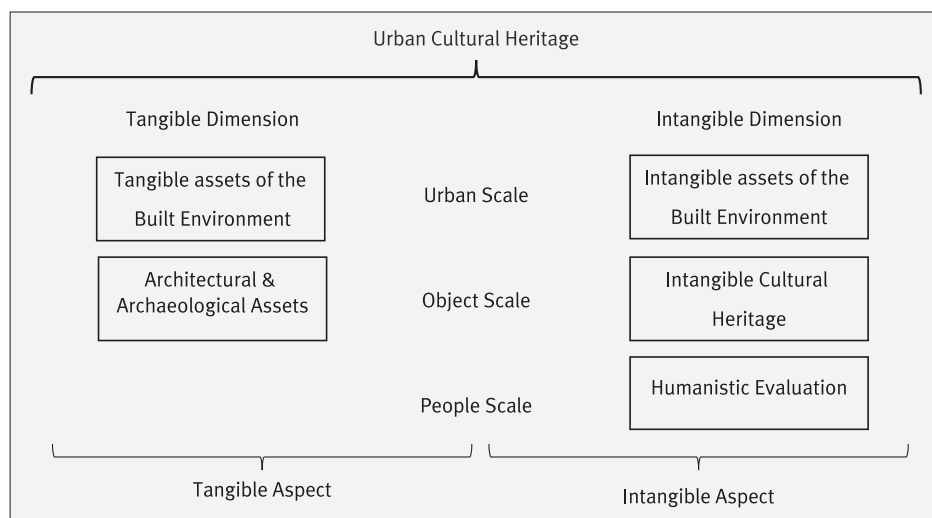
According to table I, urban cultural heritage can be considered a result of the entanglement of elements and layers, whereby each of them constitutes a part of the significance and the authenticity of the UCH subjected to study. Therefore, to comprehensively protect and conserve UCH, the documentation process should consider the multi-scalar and multi-dimensional nature of UCH (Australia ICOMOS, 2013; ICOMOS, 2010; Mezzino, 2017). Taking this into account, the elements constituting UCH can be subcategorized as follows (Fig. 2), whereby the Tangible Aspect of UCH represents the intertwined relationship between the tangible dimension and the three main scales. The Intangible Aspect of UCH represents the intertwined relationship between the intangible dimension and the three main scales.

¹ Urban setting in the heritage field is perceived as a multi-dimensional entity that encompasses both material characteristics and physical features (buildings, open spaces, streets, etc.) as well as intangible attributes and cultural meanings (social practices, cultural values, uses, etc.) (Bandarin and van Oers, 2012; UNESCO, 2005, 2011a).

² Values are intangible constructs attributed by people and communities to both tangible and intangible heritage (de la Torre, 2013; Historic England, 2017), hence, in this research they are identified as elements of intangible nature.

³ Textures, colours and odours stem from physical stimuli, yet they evoke memories, atmosphere and associations. Also, they are part of the sensory and experiential fabric of heritage and contributors to the spirit of place (ICOMOS, 2008b).

⁴ Despite involving physical elements (like sight lines, vistas, spatial organizations, etc.) visual relationships are experienced and valued in intangible ways (like beauty, symbolism, memory, etc.) (Australia ICOMOS, 1999)



TANGIBLE ASPECT OF URBAN CULTURAL HERITAGE

FIG. 2 TANGIBLE AND INTANGIBLE ASPECTS OF UCH. SOURCE: (AUTHORS, 2025).

To fully understand the multi-dimensional and multi-scalar nature of UCH and to assure a comprehensive approach to the conservation and protection of UCH elements, the tangible aspect of UCH is classified into two main sub-categories: Tangible Assets of the Built Environment and Architectural and Archaeological Assets. Tangible Assets of the built environment are concerned with the elements and components of the heritage urban context (the urban scale) while Architectural and Archaeological Assets is concerned with the elements related to a single or a group of heritage buildings and archaeological elements (the object scale).

TANGIBLE ASSETS OF THE BUILT ENVIRONMENT

Urban built environment is a multi-dimensional complex composition which is formed under the influence of several factors. Elements of urban environment can include tangible elements which incorporate two groups of features: anthropogenic features and natural features. These tangible elements play an important role in the creation and formation of intangible elements, which incorporate both anthropogenic and natural features (Khusnutdinova, Faizrahmanova and Khusnutdinov, 2020).

TANGIBLE ANTHROPOGENIC FEATURES

While heritage buildings are considered the main element of UCH, it remains as only one component of a wider set of important elements and parameters (Jamieson, 1990). Often it is other elements that give the area its

significance and special character. Therefore, their inclusion in the documentation process is crucial for the interpretation of the authentic character of the UCH (Sirisrisak, 2007). It is also important to take into consideration the documentation and recording of all features, not only those which seem to be historic. Anthropogenic features can also be included (Jamieson, 1990; Khusnutdinova, Faizrakhmanova and Khusnutdinov, 2020; Sirisrisak, 2007; Ulvi, 2021; Zhang, Ghosh and Park, 2023):

- Layout / Street Patterns
- Land and Building Use & Densities
- Views / Vistas / Sceneries / Skyline
- Focal Points / Landmarks / Nodes
- Public Spaces
- Streetscapes of significant value.
- Groups of buildings
- Other structures
- Archaeological resources & ancient cities remain
- Condition of resources
- Level & nature of the use of a resource
- Hardscape

TANGIBLE NATURAL FEATURES

Natural features constitute a part of the UCH's setting (Australia ICOMOS, 2013). It could be a naturally generated setting associated with the urban area. Natural features are considered as an important parameter which gives an area its significant and unique character. Like some natural elements that can only grow or exists in some specific areas or have a meaning or stories connected to the local residents and users of the place (Sirisrisak, 2007). Tangible natural features can include (Jamieson, 1990; Khusnutdinova, Faizrakhmanova and Khusnutdinov, 2020; Khalil and Stravoravdis, 2019):

- Natural Setting
- Natural open spaces
- Topography
- Water bodies
- Flora & Fauna
- Vegetation
- Climate

Tangible assets of the built environment mainly focus on the physical and spatial configuration of the city. Prioritizing urban morphology during the documentation process can be achieved by measuring aspects such as street patterns and connectivity, land-use and building density through Geographic Information Systems (GIS)-based morphological analysis and historical map overlays

(Zhang, Ghosh and Park, 2023). Also, visual relationships, including the skylines and vistas, which constitute the character of the historic urban landscape can be captured using 3D Light Detection and Ranging (LiDAR) scanning or Unmanned Aerial Vehicle (UAV) to ensure that the visual ensemble as defined in the Nairobi Recommendation and the HUL approach is preserved (Ulvi, 2021; UNESCO, 1976, 2011a).

ARCHITECTURAL AND ARCHAEOLOGICAL ASSETS

Tangible cultural heritage was the focus of any documentation or recording process during the late 20th century. However, many heritage buildings were left undocumented, or it lacked an accurate comprehensive documentation that includes all the elements that characterize the heritage building beside the geometry. Being fragile wealth, tangible cultural heritage is constantly threatened by damage, accidents, natural disasters and urban development. Therefore, the documentation of tangible cultural heritage should include every aspect of the heritage building: the geometry, its history, pathology and performance (Khalil, Stravoravdis and Backes, 2020; Khalil and Stravoravdis, 2019)

ARCHAEOLOGY AND HISTORY

Archaeological and historical data aim to focus on the UCH's history, the context that helped shape it and the alterations, whether in geometry or function, throughout its lifetime. This analysis deepens the understanding of the heritage building's architectural style, construction techniques, building materials, structure and systems used at that era (Khalil, Stravoravdis and Backes, 2020). Also, the temporal dimension must be put into consideration when documenting UCH. Heritage buildings were subjected to a series of alterations throughout their life span that include additions or subtractions to the original form, uses and functions that varied according to users' needs and what the historical building affected and represented to its context (Santoni et al., 2021).

Archaeological and historical data can include qualitative and quantitative data retrieved from various sources (Historic England, 2016; Khalil, Stravoravdis and Backes, 2020; Mckee, 1970). It includes:

- Historical records, text and photographs;
- Past drawings & sketches;
- Building archaeology;
- Oral histories;
- Multimedia.

GEOMETRY

Geometry is the main perceived aspect of heritage buildings. It is crucial to collect data concerning the form, shape, size and identity of every component of the heritage building to achieve comprehensive documentation (Khalil, Stravoravdis and Backes, 2020). According to The Historic American Buildings Survey (HABS), the geometry of heritage building includes the exterior envelope as well as the interior fabric of the building (McKee, 1970). The data concerning the exterior envelope and the heritage building can include (Khalil, Stravoravdis and Backes, 2020; McKee, 1970)

- Foundations;
- Wall construction;
- Structural system;
- Porches, stoops, terraces & bulkheads;
- Doorways & doors
- Windows and shutters
- Roof.

Also, data concerning various elements constituting the interior of the heritage building includes (Khalil, Stravoravdis & Backes, 2020; McKee, 1970):

- Floor plan;
- Flooring;
- Walls & ceiling;
- Openings (doorways and doors);
- Interior trim;
- Hardware;
- Mechanical & electrical equipment.

PATHOLOGY

Pathology and damage recording is a crucial part of the data collection for documentation of UCH. Studying historical buildings' pathology and the reason of its decay help in the decision-making and any future measures or processes (Khalil and Stravoravdis, 2019). Pathologic data collection and analysis aim to deepen the understanding of the genuine structural aspects of the heritage building. Also, it helps to better understand the present condition and the reasons of the actual damage, to establish structural safety measures for several actions (like soil settlements, earthquakes, etc.) and to determine necessary remedial actions. Pathological investigation focusses on the analysis of the material, inner and outer skin of the heritage building and also the structural system (Khalil, Stravoravdis and Backes, 2020). The collected data can include information of the main building materials and its characteristics, the structural system and the building techniques, the building' decay maps and crack patterns (Conti et al., 2022).

PERFORMANCE

The collection of data concerning the heritage building's performance is considered the first step to support any future decision-making. The building performance data act as the basis for the heritage building management and help in setting the objectives for the required degree of intervention (Khalil and Stravoravdis, 2019). The performance data can include several aspects including (Khalil, Stravoravdis and Backes, 2020; Khalil and Stravoravdis, 2019):

- Energy, thermal & acoustic performance;
- Moisture survey;
- Lighting/visual performance;
- Indoor air quality;
- Furniture & equipment;
- Systems;
- Users' behaviour;
- Accessibility;
- Functionality;
- Safety & security.

The documentation of architectural and archaeological assets can be collected using instruments such as GIS mappings, Terrestrial Laser Scanning (TLS), photogrammetry and non-destructive testing (NDT) like Infra-Red technology, which provide high resolution 3D models and condition assessment reports (Colucci et al., 2024; Khalil, Stravoravdis and Backes, 2020; Khalil and Stravoravdis, 2019). The use of such techniques along with the architectural survey drawings to measure the architectural and archaeological assets indicators (i.e. material condition, structural integrity, presence of period-specific ornamentation, etc.) can ensure a detailed documentation of material authenticity that meet international standards.

INTANGIBLE ASPECT OF URBAN CULTURAL HERITAGE

To fully understand the multi-dimensional and multi-scalar nature of UCH and to assure a comprehensive approach to the documentation and recording of the UCH's elements, the Intangible aspect of UCH is classified into three main sub-categories: Intangible Assets of the Built Environment, Intangible Cultural Heritage and Humanistic Evaluation. Intangible assets of the built environment are concerned with immaterial elements and components of urban heritage context (the urban scale), while intangible cultural heritage is concerned with immaterial elements related to the heritage building, monument or group of buildings (the object scale). Humanistic evaluation is concerned with emotional and socio-cultural values and aspects that define

the interrelationship between the community and the UCH (people scale).

INTANGIBLE ASSETS OF THE BUILT ENVIRONMENT

Intangible assets of the built environment, along with the tangible assets, constitute the urban built environment. The intangible assets of the built environment could be divided into main subcategories: intangible anthropogenic features and intangible natural features. The intangible elements of the built environment are radically attached and connected to the physical elements (Khusnutdinova, Faizrahmanova and Khusnutdinov, 2020). The intangible assets of the built environment significantly affect how UCH is perceived and are, therefore, a major contributor in its significance and unique character (García-Esparza, 2019).

Heritage urban areas can be considered a sequence of spaces that induce a rhythm, which results from the interrelationships between space, form, texture, colour, pattern and light. One of the main aspects that gives the environment an identity and a structure are the visual sensations of shape, colour, light, movement, but also other sensations like touch, smell, hearing and kinaesthesia (Secaroni, Aquinardi and Bettolini, 2021). Identifying and structuring the environment can be considered a vital ability among all living creatures (Lynch, 1964). Therefore, every element contributing to the perception and identification of the heritage environment through senses should be recorded and documented.

INTANGIBLE ANTHROPOGENIC FEATURES

Intangible sensory factors (sounds – smells – light and images) can be generated due to several factors. Some could be considered noise and disturbance elements, others could be considered a source that increases the connection with heritage urban context. However, both contribute to how UCH is perceived. For instance, intangible sensory factors could be a result of a specific activity or a special festive event, a tradition, a celebration, etc. (García-Esparza, 2019). It could include:

- Noisy markets, the sound of transport, celebrations, etc.
- Culinary smells
- Artificial lighting⁵

INTANGIBLE NATURAL FEATURES

Natural features include intangible sensory factors (sounds – smells – light and images)

generated from natural sources. It could be natural elements from a natural setting attached to UCH, or natural elements which are man-made, like street trees or artificial lakes (Khusnutdinova, Faizrahmanova and Khusnutdinov, 2020). These elements could include:

- Birdsong, water noise, parks silence, etc.
- Flowering plants & trees
- Sunlight & natural trees' shade

Intangible asset of the built environment captures the atmospheric and contextual values that define a site's *spirit of place*. Key indicators including sounds, smells and lighting as elements that can influence how the urban area is perceived (Khusnutdinova, Faizrahmanova and Khusnutdinov, 2020). Therefore, the documentation process can rely on archive mining and semi-structured interviews to extract heritage narratives, as well as satellite imagery to map environmental context (Gupta, 2007; Mezzino, 2017). Using tools such as GIS, HBIM and ArcGIS StoryMaps can help in mapping and visualizing these significant features.

INTANGIBLE CULTURAL HERITAGE

Intangible cultural heritage incorporates every aspect that helped in defining the people's identity, the diversity of their culture and their individual creative potential throughout history (Mezzino, 2017). It also includes all types of events that designate places, their residents and their history. Moreover, it incorporates skills, knowledge, as well as the used tools and instruments, practices, expressions, artefacts and every object associated with a specific significant site (UNESCO, 2003). Intangible cultural heritage is prominent by being created specifically by the local community and groups which are strongly connected with the history and local environment (Mezzino, 2017).

According to the World Heritage Convention for the Safeguarding of the Intangible Cultural Heritage (UNESCO, 2003), intangible cultural heritage is defined as “*the practices, representations, expressions, knowledge, ... that communities, groups and, in some cases, individuals recognize as part of their Cultural Heritage. This Intangible Cultural Heritage ... is constantly recreated by communities and groups in response to their environment, their interaction with nature*

⁵ While artificial lighting stems from physical stimuli, it is considered an intangible element in heritage field because it shapes sensory experience perception and reflects cultural traditions and social practices. It also holds memory and symbolism (Bista et al., 2021; Navaraj and Inkarojrit, 2024)

and their history, and provides them with a sense of identity and continuity, thus promoting respect for cultural diversity and human creativity". Intangible cultural heritage can be manifested in several domains which include the following:

- Oral traditions and expressions
- Performing arts
- Social practices, rituals & festive events
- Knowledge & practices concerning nature & the universe
- Traditional craftsmanship (UNESCO, 2003).

Being associated with tangible cultural heritage and the tangible aspect of UCH, intangible cultural heritage could be manifested in various scenarios. It could be skills, the know-how and knowledge concerning the building techniques, the materials' selection and assembly, various construction phases, systems used and techniques to adapt to the local climate. It could also be skills, the know-how and knowledge concerning the building localization and orientation, spatial design, decorative elements suitable for every function (Mezzino, 2017).

Intangible cultural heritage is mostly described as "*Living Heritage*". These skills and knowledge are the intangible cultural heritage that today societies consider the main part of their cultural identity (UNESCO, 2011b). Intangible cultural heritage is dynamic, constantly evolving and trying to adapt to different needs. It is a result of the fusion of history, culture and tangible cultural heritage. Therefore, intangible cultural heritage can be considered as traditions yet, it is, at the same time, living and contemporary (Igyasu, 2014).

Intangible cultural heritage is directly linked to the symbolic and spiritual significance of the built fabric. Indicators focus on the religious or social meanings related to architectural elements or sites (UNESCO, 2003). Data concerning the intangible heritage can be collected through focus groups, rapid ethnographic assessment procedure (REAP), digital 3D and 4D motion capture systems (Alivizatou-Barakou et al., 2017; Gupta, 2007; Low, 2002). It can be interpreted through Augmented Reality (AR), Virtual Reality (VR), facial expression analysis and modelling, body and gesture recognition and sound processing (Alivizatou-Barakou et al., 2017).

HUMANISTIC EVALUATION

The significance of UCH is the result of experiencing the ensemble or the entity within its context, acknowledging values that people and society have placed on it and recognizing its connection to other factors (Historic Eng-

land, 2017). It is considered a repertoire of values, meanings and symbols embodied and given by people and society (Park, 2011). Therefore, to achieve comprehensive documentation for UCH, people and the humanistic evaluation of UCH should be put into consideration. These meanings and values could be analysed by three main affected groups which include: people, experts and governments (Del, Sedghpour and Tabrizi, 2020).

This section shall discuss the humanistic evaluation and societal aspects that contribute to the definition of the significance of UCH. This will include (Historic England, 2017) values attributed by society, memory and identity and a sense of place.

VALUES

To document a heritage object or a place, there should be a certain or a group of values that, later, affect the decision-making process and help in choosing the type and degree of intervention. Some values are more important than others and that depends on several social, economic and cultural aspects. It is to say that intangible values are often what gives UCH its significance and are considered the origin of identities and the source of diversity and creativity. Despite their intangible nature, their physical manifestation can be perceived in many aspects such as thoughts, beliefs, language, etc. (Del, Sedghpour and Tabrizi, 2020).

Values of UCH are characterized by being attributed by either people, experts or governments but they are never inherent (de la Torre, 2013). Practitioners and experts constantly try to identify and categorize the values of intangible cultural heritage that reflect the meanings, emotions and identity of the UCH. These attributed values can be classified into scientific values and social values (de la Torre, 2013; Del, Sedghpour and Tabrizi, 2020) and can include (Table II).

MEMORY

UCH is more than just what is seen: it is seen with the eyes, interpreted by the mind and valorised by intangible reasons. UCH is identified as the setting where people and the society experience their everyday life (Taylor, 2008). This is why it is considered a repository of intangible meanings and human values which constitute the base of society's existence. UCH and memory cannot be separated because it is the core element of personal and collective memories (Apaydin, 2020b).

Memories can be classified according to their scale. The individual scale which incorporates

TABLE II SCIENTIFIC AND SOCIAL VALUES OF URBAN CULTURAL HERITAGE.
SOURCE: (AUTHORS, 2025)

Scientific Values	Social Values	
• Value Integrity • Aesthetic • Authenticity • Contextual • Heritage • Scientific • Architectural • Archaeological	• Historical • Spiritual • Functional • Symbolic • Pride • Universal • Connecting • Bequest • Humanistic • Resilience • Individual • Visual • Recreational • Unwanted Heritage	• Political • Psychological • Rarity • Educational • Dominant Opinion • Grandeur • Acquired • Emotional • Donor's • Demolishing • Moral • Tourist's • Scenic • Local's

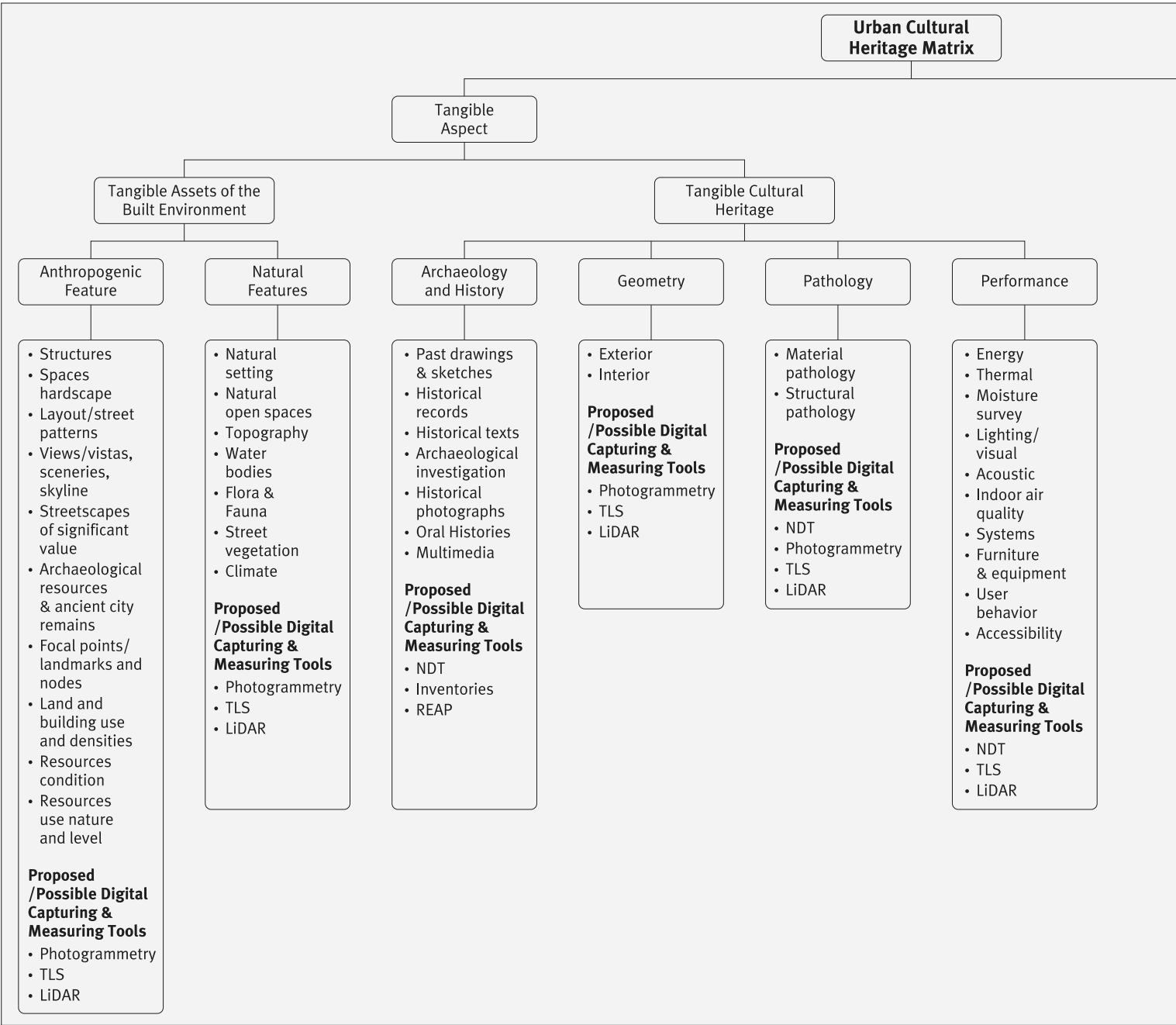
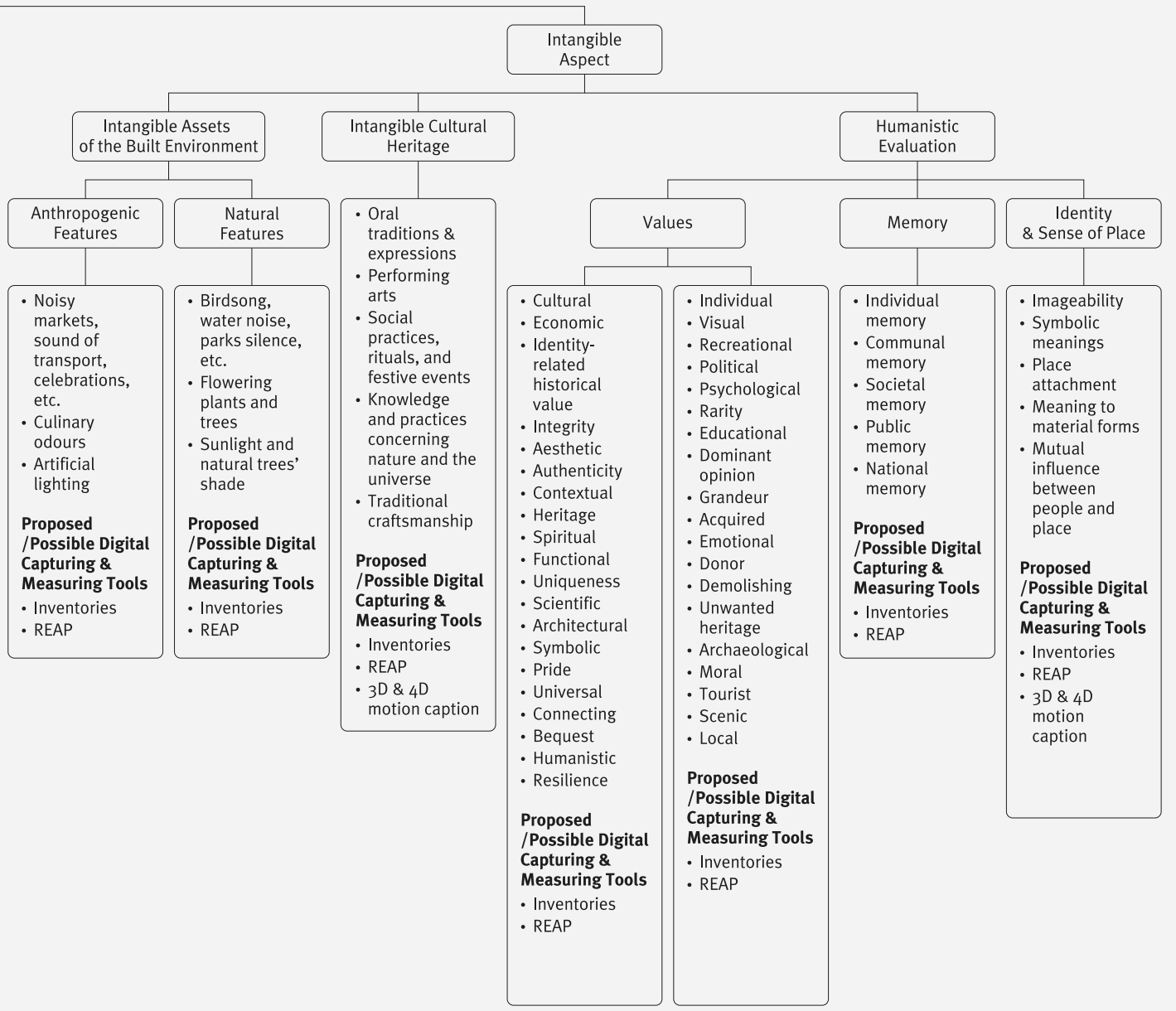


FIG. 3 URBAN CULTURAL HERITAGE MATRIX.
SOURCE: (AUTHORS, 2026).

memory of personal or individual experiences such as losing and suffering (Apaydin, 2020b), the communal or local scale which include memory of events or experiences that took place within small groups of people, societal scale which include memory of experiences or past narratives which affected a loosely interconnected population. Societal scale also includes public and national memory. These different scales of memories are common in the fact that they are all attached to a certain place, and they contribute to its identity. With-

out a memory, the identity, the sense of self, culture and heritage are lost (McDowell, 2016). Therefore, the various scales of memory should be included in the recording and documentation of UCH.

UCH and memory are highly connected (Apaydin, 2020b). Tangible cultural heritage is the manifestation of the past and present knowledge and experiences of people. And through memories and commemorative events, this knowledge can keep alive the collective iden-



tity of those people. Urban heritage is a cultural production which meanings and values are attributed to later by the community and the people. The memories developed from UCH and its values and meanings are a significant representation of the collective identity of the community (Apaydin, 2020a).

IDENTITY AND SENSE OF PLACE

UCH, which includes old heritage buildings, traditional urban landscape, street patterns

and activities, is what gives a city its local significance and reflects its culture and identity. The presence of heritage urban areas containing cultural heritage is important to its people's sense of place and belonging (Shinbira, 2012). It is the activities of ordinary people, the traditions and the places that witness it that creates a rich cultural tapestry of life, through the identification of the values and meanings people give to their daily places as well as the sense of place and identity (Taylor, 2008).

A heritage place is more than just an abstract location. It consists of tangible aspects that have a certain shape, materials, texture and colours as well as intangible elements. These aspects are what gives a heritage place its identity and character. A sense of place is the ability to identify various places and various identities of a place. In this process, people depend on their imageability, symbolic meanings and attachment to a place. As a sense of place is a result of the attribution of meanings to material forms, a heritage place is influenced by people and in return, people are influenced by heritage places.

This leads to interaction with the heritage place instead of a simple response which enrich the heritage place with meanings (Shinbira, 2012).

A heritage place is mainly created due to the relationship between people and a physical setting, group and individual activities and meanings.

The concept of a sense of place can describe the quality of the people's relationship to a heritage place. This concept could be used in studying and understanding the human-place attachment, bonding and place meaning. It could also define and explain the different ways in which people sense and feel heritage places, and how they attribute values and concepts to it. Therefore, the recording, documentation and preservation of the sense of place of UCH is crucial in maintaining the integrity of the community's life within it as well as the quality of the heritage urban area (Najafi and Shariff, 2011).

The documentation of the humanistic evaluation, whereby the indicators focus on the values attributed by the community, memory and a sense of place depend on instruments such as qualitative interviews, rapid ethnographic assessments, 3D and 4D motion capture and GIS mapping (Colucci et al., 2024; Jones, 2017; Low, 2002; Skublewska-Paszkowska et al., 2022). These instruments are important to capture community identity and attachment to a place. Also, community-based inventories that use participatory actions like social mapping and semi-structures interviews (Nebot-Gomez de Salazar et al., 2023) can ensure that memories, and a sense of place of the inhabitants are recorded as a critical component of the urban ensemble.

CONCLUSION

To conclude, this research has drawn attention to the evolution and expansion of the notion of UCH as it evolved from a monument-focused perspective towards a wider, more inclusive understanding of the Historic Urban Landscape approach. Through an analysis of international doctrines, this research establishes that cultural heritage in urban contexts cannot be fully understood through architectural and historical evaluations alone. Instead, it is shaped by the complexity of intertwined social, spiritual, humanistic, and material dimensions.

The proposed classification (Fig. 3) is based on the amalgam of dimensions (tangible and intangible) with scales (urban, object, and people) to bridge the gap between the doctrines and practical documentation. This is done by the classification of the significant UCH into tangible assets of the built environment (tangible/urban scale), architectural and archaeological assets (tangible/object scale), intangible assets of the built environment (intangible/urban scale), intangible cultural heritage (intangible/object scale), and humanistic evaluations (intangible/people scale). This classification makes sure that all significant components influencing the historical urban cultural fabric are recorded and preserved. The matrix provides measurable indicators, data capture and interpretation instruments to translate the abstraction of the HUL approach into operational workflow.

The multi-dimensional and multi-scalar approach to understanding UCH is not only necessary for theoretical reflection, but most importantly it provides structured workflow for practitioners to achieve comprehensive conservation and preservation of the UCH subject to study. The proposed framework is designed to maintain a modular and flexible structure, to allow the calibration of indicators and methods to align with the specific nature and multi-layered significance of the historical site subject to study. Based on this classification, future research can focus on the empirical validation of these indicators through site-specific application. In other words, the framework contributes to more complete, dynamic, and contextually grounded heritage management strategies in the digital age.

BIBLIOGRAPHY AND SOURCES

1. ALIVIZATOU-BARAKOU, M., KITSIKIDIS, A., TSALAKANIDOU, F., DIMITROPOULOS, K., GIANNIS, C., NIKOLOPOULOS, S., et al. (2017) 'Intangible Cultural Heritage and New Technologies: Challenges and Opportunities for Cultural Preservation and Development' in Ioannides, M., Magnenat-Thalmann, N. and Papagiannakis, G. (eds.) *Mixed Reality and Gamification for Cultural Heritage*. Cham: Springer International Publishing, pp. 129-158.
2. APAYDIN, V. (2020a) 'The interlinkage of cultural memory, heritage and discourses of construction, transformation and destruction' in Apaydin, V. (ed.) *Critical Perspectives on Cultural Memory and Heritage*. London: UCL Press, pp. 13-30.
3. APAYDIN, V. (2020b) 'Introduction: Why cultural memory and heritage?' in Apaydin, V. (ed.) *Critical Perspectives on Cultural Memory and Heritage*. London: UCL Press, pp. 1-10.
4. Australia ICOMOS (1999) *The Burra Charter : the Australia ICOMOS Charter for Places of Cultural Significance 1999*. [Online]. Burwood: Australia ICOMOS. Available at: <https://patinations.com.au/wp-content/uploads/2023/03/the-burra-charter.pdf>
5. Australia ICOMOS (2013) *The Burra Charter : the Australia ICOMOS charter for places of cultural significance 2013*. [Online]. Burwood: Australia ICOMOS. Available at: <https://australia.icomos.org/wp-content/uploads/The-Burra-Charter-2013-Adopted-31.10.2013.pdf>
6. BANDARIN, F., and VAN OERS, R. (eds) (2012) *The historic urban landscape: managing heritage in an urban century* Chichester: John Wiley & Sons. doi: 10.1002/9781119968115
7. BISTA, D., BISTA, A., SHRESTHA, A., DOULOS, L. T., BHUSAL, P., ZISSIS, G., TOPALIS, F., CHHETRI, B. B. (2021) 'Lighting for Cultural and Heritage Site: An Innovative Approach for Lighting in the Distinct Pagoda-Style Architecture of Nepal'. *Sustainability*, 13(5), 2720. doi: 10.3390/su13052720
8. COLUCCI E, MATRONE F, NOARDO F, ASSUMMA V, DATOLA G, APPIOTTI F, BOTTERO M, CHIABRANDO F, LOMBARDI P, MIGLIORINI M, RINALDI E, SPANÒ A, LINGUA A. (2024) 'Documenting cultural heritage in an INSPIRE-based 3D GIS for risk and vulnerability analysis' *Journal of Cultural Heritage Management and Sustainable Development*, 14(2), pp. 205-234. doi: 10.1108/JCHMSD-04-2021-0068
9. CONTI, A., FIORINI, L., MASSARO, R., SANTONI, C. and TUCCI, G. (2022) 'HBIM for the preservation of a historic infrastructure: the Carlo III bridge of the Carolino Aqueduct' *Applied Geomatics*, 14(Suppl 1), pp. 41-51. doi: 10.1007/s12518-020-00335-2
10. DE LA TORRE, M. (2013) 'Values and Heritage Conservation' *Heritage & Society*, 6(2), pp. 155-166. doi:10.1179/215903213Z.00000000011
11. DEL, M. S. T. T., SEDGHPOUR, B. S. AND TABRIZI, S. K. (2020) 'The semantic conservation of architectural heritage: the missing values' *Heritage Science*, 8(1), pp.1-13. doi: 10.1186/s40494-020-00416-w
12. GARCÍA-ESPARZA, J. A. (2019) 'Beyond the intangible/tangible binary: An analysis of historic built environments in Valencia, Spain' *International Journal of Intangible Heritage*, 14, pp.124-137.
13. GINZARLY, M., HOUBART, C. and TELLER, J. (2019) 'The Historic Urban Landscape approach to urban management: a systematic review' *International Journal of Heritage Studies*, 25(10), pp. 999-1019. doi: 10.1080/13527258.2018.1552615
14. GUPTA, D. (2007) *Identification and documentation of built heritage in India: Process for identification and documentation of cultural heritage*. New Delhi: INTACH (UK) Trust.
15. Historic England (2016) *Understanding Historic Buildings: A Guide to Good Recording Practice* [Online]. Available at: <https://historicengland.org.uk/images-books/publications/understanding-historic-buildings/heag099-understanding-historic-buildings/>
16. Historic England (2017) *BIM for Heritage: Developing a Historic Building Information Model* [Online]. Available at: <https://historicengland.org.uk/images-books/publications/bim-for-heritage/heag-154-bim-for-heritage/>
17. ICOMOS (1964) *International Charter for the Conservation and Restoration of Monuments and Sites (The Venice Charter 1964)*. [Online]. Available at: https://www.icomos.org/images/DOCUMENTS/Charters/venice_e.pdf [Accessed: 9 May 2021]
18. ICOMOS (1987) *Charter for the Conservation of Historic Towns and Urban Areas (Washington Charter 1987)*. [Online]. Available at: https://www.icomos.org/images/DOCUMENTS/Charters/towns_e.pdf [Accessed: 21 March 2022]
19. ICOMOS (2005) *X'ian Declaration on the Conservation of the Setting of Heritage Structures, Sites and Areas*. [Online]. Available at: <https://www.icomos.org/images/DOCUMENTS/Charters/xian-declaration.pdf> [Accessed: 19 March 2022]
20. ICOMOS (2008a) *The Icomos Charter for the Interpretation and Presentation of Cultural Heritage Sites*. [Online]. Available at: https://www.icomos.org/images/DOCUMENTS/Charters/interpretation_e.pdf [Accessed: 8 August 2022]
21. ICOMOS (2008b) *Québec Declaration on the Preservation of The Spirit of Place*. [Online]. Available at: https://publ.icomos.org/public-comos/jlbSai?html=Bur&base=technica&ref=43835&file=2450.pdf&path=GA16_Quebec_Declaration_Final_EN.pdf
22. ICOMOS (2010) *ICOMOS New Zealand Charter for the Conservation of Places of Cultural Heri-*

- age Value. [Online]. Available at: https://www.icomos.org/images/DOCUMENTS/Charters/ICOMOS_NZ_Charter_2010_FINAL_11_Oct_2010.pdf
23. ICOMOS CIVVIH (2011) *The Valletta Principles for the Safeguarding and Management of Historic Cities, Towns and Urban Areas*. [Online]. Available at: https://civvih.icomos.org/wp-content/uploads/2022/03/Valletta-Principles-GA_EN_FR_28_11_2011.pdf
 24. JAMIESON, W. (1990) 'Recording the Historic Urban Environment: A New Challenge' *APT Bulletin: The Journal of Preservation Technology*, 22(1/2), pp.12-16. doi:10.2307/1504267
 25. JIGYASU, R. (2014) 'The intangible dimension of urban heritage' in Bandarin, F. and van Oers, R. (eds.) *Reconnecting the City: The Historic Urban Landscape Approach and the Future of Urban Heritage*. Chichester: John Wiley & Sons, pp.129-159. doi: 10.1002/9781118383940.ch5
 26. JONES, S. (2017) 'Wrestling with the social value of heritage: Problems, dilemmas and opportunities' *Journal of community archaeology & heritage*, 4(1), pp. 21-37. doi: 10.1080/20518196.2016.1193996
 27. KHALIL, A., STRAVORAVDIS, S., and BACKES, D. (2020) 'Categorisation of building data in the digital documentation of heritage buildings' *Applied Geomatics*, 13(1), pp. 29-54. doi: 10.1007/s12518-020-00322-7
 28. KHUSNUTDINOVA, S., FAIZRAKHMANOVA, G., and KHUSNUTDINOV, R. (2020) Tangible and intangible assets of city environment: architecture, city lighting and art aspects. In: *IOP Conference Series: Materials Science and Engineering*, 890, 012020. doi: 10.1088/1757-899X/890/1/012020
 29. Low, S. M. (2002) 'Anthropological – Ethnographic Methods for the Assessment of Cultural Values in Heritage Conservation' in de la Torre, M. (ed.) *Assessing the Values of Cultural Heritage*. Los Angeles: Getty Conservation Institute, pp. 31-49.
 30. LYNCH, K. (1964). *The image of the city*: MIT press.
 31. McDOWELL, S. (2016) 'Heritage, memory and identity' in Howard, P., Graham, B. (eds.) *The Ashgate Research Companion to Heritage and Identity*. London: Routledge, pp. 37-53. doi: 10.4324/9781315613031
 32. Historic American Buildings Survey and McKee, H. J. (1970) *Recording Historic Buildings*. compiled by Harley J. McKee. Washington: U.S. National Park Service.
 33. MEZZINO, D. (2017). *Cultural built heritage's tangible and intangible dimensions and digitalization challenges*. (Doctor of Philosophy). Carleton University, Ottawa, Ontario.
 34. NAJAFI, M., and SHARIFF, M. K. B. M. (2011) 'The concept of place and sense of place in architectural studies' *International Journal of Humanities and Social Sciences*, 5(8), pp. 187-193.
 35. NAVARAJ, P. and INKAROJIRIT, V. (2024) 'Beyond Illumination: Stakeholder Perspectives on Urban Lighting Master Planning for Chiang Mai Old City, Thailand' *Sustainability*, 16(21), 9411. doi: 10.3390/su16219411
 36. NEBOT-GOMEZ DE SALAZAR, N., CHAMIZO-NIETO, F. J., CONEJO-ARRABAL, F. and ROSA-JIMÉNEZ, C. (2023) 'Intangible cultural heritage as a tool for urban and social regeneration in neighbourhoods. Participatory process to identify and safeguard ICH in the city of Malaga, Spain' *International Journal of Heritage Studies*, 29(6), pp. 524-546. doi: 10.1080/13527258.2023.2201821
 37. PARK, H. Y. (2011) 'Shared national memory as intangible heritage: Re-imagining Two Koreas as One Nation' *Annals of Tourism Research*, 38(2), pp. 520-539. doi: 10.1016/j.annals.2010.11.013
 38. SANTONI, A., MARTÍN-TALAVERANO, R., QUATRINI, R. and MURILLO-FRAGERO, J. I. (2021) 'HBIM approach to implement the historical and constructive knowledge. The case of the Real Colegiata of San Isidoro (León, Spain)' *Virtual Archaeology Review*, 12(24), 49. doi: 10.4995/var.2021.13661
 39. SECCARONI, M., AQUINARDI, C. M., AND BETTOLINI, E. (2021) 'Urban Atmospheres: Representation of Intangible Relations' in Bianconi, F. and Filippucci, M (eds.) *Digital Draw Connections: Representing Complexity and Contradic-*

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- tion in Landscape. Cham: Springer International Publishing, pp. 1111-1128.
40. SHINBIRA, I. A. (2012) 'Conservation of the urban heritage to conserve the sense of place, a case study Misurata City, Libya' *American Transactions on Engineering & Applied Sciences*, 1(3), pp. 253-264.
 41. SIRISIRISAK, T. (2007). Historic Urban Landscape: Interpretation and Presentation of the Image of the City. In *ICOMOS Thailand International Symposium*.
 42. SKUBLEWSKA-PASZKOWSKA, M., MIŁOSZ, M., POWROZNIK, P. and LUKASIK, E. (2022) '3D technologies for intangible cultural heritage preservation—literature review for selected databases' *Heritage Science*, 10(1), 3. doi: 10.1186/s40494-021-00633-x
 43. KHALIL, A. and STRAVORAVDIS, S. (2019) 'H-Bim and the Domains of Data Investigations of Heritage Buildings Current State of the Art' *ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XLII-2/W11, pp. 661-667. doi: 10.5194/isprs-archives-XLII-2-W11-661-2019
 44. TAYLOR, K. (2008) 'Landscape and Memory: cultural landscapes, intangible values and some thoughts on Asia. In *16th ICOMOS General Assembly and International Symposium: 'Finding the spirit of place—between the tangible and the intangible*. Quebec. pp. 1-14.
 45. ULVI, A. (2021) 'Documentation, Three-Dimensional (3D) Modelling and visualization of cultural heritage by using Unmanned Aerial Vehicle (UAV) photogrammetry and terrestrial laser scanners' *International Journal of Remote Sensing*, 42(6), pp. 1994-2021. doi: 10.1080/01431161.2020.1834164
 46. UNESCO. (1972) *Convention Concerning The Protection Of The World Cultural And Natural Heritage*. [Online]. Available at: <https://whc.unesco.org/archive/convention-en.pdf> [Accessed: 09 May 2021]
 47. UNESCO. (1976) *Recommendation Concerning the Safeguarding and Contemporary Role of Historic Areas*. [Online]. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000114038.page=136>
 48. UNESCO. (2003) *Convention for the Safeguarding of the Intangible Cultural Heritage*. [Online]. Available at: <https://ich.unesco.org/doc/src/15164-EN.pdf> [Accessed: 09 May 2021]
 49. UNESCO. (2005). *Vienna Memorandum on World Heritage and Contemporary Architecture: Managing the Historic Urban Landscape and Decision 29 COM 5D*. [Online]. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000140984>
 50. UNESCO. (2011a). *Recommendation on the Historic Urban Landscape from UNESCO*. [Online]. Available at: <https://whc.unesco.org/uploads/activities/documents/activity-638-98.pdf>
 51. UNESCO. (2011b). *Convention for the Safeguarding of the Intangible Cultural Heritage*. [Online]. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000242931>
 52. UNESCO. (2014). *UNESCO Culture For Development Indicators: Methodology Manual*. [Online]. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000229608> [Accessed: 19 March 2022]
 53. VELDPAUS, L. (2015). *Historic urban landscapes : framing the integration of urban and heritage planning in multilevel governance*. (Doctor of Philosophy). Technische Universiteit Eindhoven.
 54. VELDPAUS, L., PEREIRA RODERS, A. R. and COLLENBRANDER, B. J. F. (2013) 'Urban Heritage: Putting the Past into the Future' *The Historic Environment: Policy & Practice*, 4(1), pp. 3-18. doi:10.1179/1756750513z.00000000022
 55. ZHANG, P., GHOSH, D. and PARK, S. (2023) 'Spatial measures and methods in sustainable urban morphology: A systematic review' *Landscape and Urban Planning*, 237, 104776. doi: 10.1016/j.landurbplan.2023.104776

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 TABLE I Authors, 2026
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IMPROVING THE ENERGY PERFORMANCE OF FRENCH COLONIAL BUILDINGS IN ALGERIA: BALANCING HERITAGE VALUES AND ENERGY CHALLENGES

KEYWORDSALGIERS
BIO-BASED THERMAL INSULATION
COLONIAL BUILDINGS
ENERGY EFFICIENCY
HERITAGE VALUES**ABSTRACT**

Algeria inherited a substantial building stock of significant heritage value, particularly concentrated in the historic center of Algiers, notably within the Larbi Ben M'hidi district from the French colonial period (1830-1962). However, these buildings generally exhibit poor energy performance and high levels of energy consumption. This study investigates how the preservation of heritage values can be reconciled with improving the energy efficiency of colonial-era residential buildings in the Larbi Ben M'hidi district of Algiers. A thermal diagnostic based on infrared thermography was conducted on several buildings, leading to the selection of the building located at 39 Rue Larbi Ben M'hidi as the

case study. Subsequently, dynamic thermal simulations were carried out using ArchiWIZARD, based on the EnergyPlus calculation engine, in order to evaluate four energy retrofitting scenarios. In parallel, a bio-based thermal insulation material composed of cork waste and cellulose was developed and thermally characterized. The optimal formulation (75% cork) exhibited a thermal conductivity of $\lambda = 0.048 \text{ W/m}\cdot\text{K}$ and a specific heat capacity of $C_p = 1285 \text{ J/kg}\cdot^\circ\text{C}$. When integrated into the simulation model, this insulation material enabled a reduction in energy demand of 54.44% for heating and 22.64% for cooling, while preserving the architectural integrity of the heritage façades.

INTRODUCTION

A large part of the architectural heritage from the French colonial period in Algeria embodies undeniable heritage values and represents a living testimony to the country's urban and cultural history. These buildings are distinguished by their richly decorated façades, generous volumes, and construction techniques adapted to the climate, which still contribute today to the identity of city centers with colonial cores (Mohdeb, Attar and Saraoui, 2023). In Algiers, colonial architecture (1830-1930) illustrates a dual approach: the assertion of colonial authority through monumental public buildings, ordered façades, continuous balconies, and Haussmannian cornices, and adaptation to local context through Neo-Moorish and Art Deco styles incorporating arches, patios, and ornamental motifs (Béguin, 1983; Chaouche, 2013). This coexistence has produced a hybrid urban fabric that forms the basis of Algiers's architectural identity. However, these buildings exhibit significant thermal losses, lack thermal insulation, and suffer from material aging, leading to high energy consumption. Their thermal rehabilitation therefore raises both technical and cultural challenges: how can historic heritage be adapted to modern energy requirements without altering its architectural authenticity?

Among available solutions, internal thermal insulation (ITI) is often preferred for heritage buildings, as it allows the preservation of the

exterior appearance while improving energy performance (Zagorskas et al, 2014). Bio-based materials, in particular, offer a sustainable alternative compatible with historical masonry and characterized by low environmental impact (Claude, 2018). ITI combined with roof insulation and the rational replacement of joinery can reduce energy consumption by 43 to 56% depending on the climatic context (Galatioto et al, 2019), and may exceed 50% when high-performance systems such as heat pumps are implemented (Qu et al, 2021; Cho et al, 2020; Jiang, Lucchi, and Del Curto, 2023; González-Prieto et al, 2023). Hybrid approaches integrating insulation, system modernization, and renewable energy technologies make it possible to approach near-nZEB or Net Zero Energy standards (Franco et al, 2015; Sugár et al, 2020; Caro and Sendra, 2020; Ahmad et al, 2021). In Mediterranean contexts, the combination of insulation, mechanical ventilation, and heat recovery ensures a balance between energy performance and indoor air quality (Coelho and Henriques, 2021; Blázquez et al, 2019).

In the Algerian context, the energy rehabilitation of colonial buildings goes beyond the single objective of improving energy efficiency. It is part of a broader heritage conservation approach aimed at extending the lifespan of these buildings while respecting their architectural identity. This study therefore aims to:

- Characterize the thermal behavior of colonial buildings in Algiers through infrared thermography and in situ measurements;
- Evaluate the performance of a new bio-based insulation material composed of cork waste and cellulose;
- Simulate different dynamic thermal scenarios to estimate potential energy savings and their compatibility with heritage preservation.

The Larbi Ben M'hidi district is characterized by a high concentration of French colonial-era buildings, featuring construction systems and façades emblematic of the historic center of Algiers. This urban fabric therefore provides a particularly relevant context for analyzing energy rehabilitation strategies while safeguarding architectural and heritage values.

MATERIALS AND METHODS

This study aims to evaluate and improve the energy performance of residential buildings from the French colonial period in Algeria (1830-1930) while preserving their architectural and heritage values. First, eight buildings in the Larbi Ben M'hidi district were selected according to the Vitruvian triad: *Firmitas*, *Utilitas*, *Venustas* (Choay, 2001; Baba Ahmed et al,

2013; Hadjilah and Zerouala, 2018), and were subsequently subjected to a thermal assessment using infrared thermography (Paoletti et al, 2013; Ascione et al, 2015).

The combined analysis of these investigations led to the selection of the building located at 39 Rue Larbi Ben M'hidi as the case study, for which in situ measurements and dynamic thermal simulations were carried out. In parallel, a bio-based insulation material made from cork waste and cellulose was developed and experimentally characterized using the transient hot-wire method. Finally, the impact of this insulation material on the building's thermal behavior was evaluated through dynamic thermal simulations using ARCHIWizard/EnergyPlus (Ascione et al, 2015; 2016; Khadraoui and Sriti, 2017).

THERMAL DIAGNOSIS OF BUILDINGS WITH HIGH HERITAGE VALUES

Criteria for selecting buildings

The urban landscape of Algiers is strongly marked by buildings inherited from the French colonial period, constructed between 1830 and 1930. The Larbi Ben M'hidi district (formerly Isly) represents the first planned extension of the colonial city beyond the former Ottoman ramparts (Oukaci and Kassab, 2021; Oukaci, 2022) and constitutes one of the most emblematic examples of this period (Petrucoli, 1992; Belouchrani, 2012). Predominantly residential in character, it contains remarkable buildings distinguished by an eclectic architecture combining European and local influences, ranging from Neoclassicism to Art Deco, including Art Nouveau and Neo-Moorish styles (Chérif, 2017). The high concentration of buildings with significant heritage value, particularly along the structuring axes of Larbi Ben M'hidi, Ali Boumendjel, and Abane Ramdane (Fig. 2), constituted a decisive factor in defining the study area.

At the end of this initial assessment, eight representative buildings were selected, as shown in Table 1.

A thermal assessment using infrared thermography was conducted for eight selected buildings within the study area.

Thermography protocol for eight selected buildings

The thermographic measurement campaign of eight selected residential buildings was conducted on 9 February 2021, between 8:00 a.m. and 11:00 a.m., during the winter period. The main façades investigated were predominantly oriented east (80%), while the remaining 20% were oriented west (Fig. 2). All the buildings are equipped with central heat-



FIG. 1 REPRESENTATIVE BUILDINGS WITHIN THE LARBI BEN M'HIDI DISTRICT, ALGIERS. (SOURCE: AUTHORS, 2025)

ing, and the indoor temperatures measured in residential apartments were within the thermal comfort range (22-25 °C) (AFNOR, 2019; Liébard and De Herde, 2005).

Measurements were carried out exclusively in residential spaces, with the commercial premises on the ground floor excluded, in order to calibrate the thermal model to reflect the actual residential occupancy of the building. Internal heat gains from occupants and household appliances were considered negligible, as most apartments were unoccupied at the time of the measurements. Thermographic measurements were performed in accordance with the ISO 6781:2015 standard (ISO, 2015), under favorable weather conditions (overcast sky to minimize the influence of solar radiation, low wind speed, and an indoor-outdoor temperature difference greater than 10 °C) (Pajani, 2014; Ascione et al, 2015). Outdoor temperatures ranged from 10 °C at 8:00 a.m. to 12 °C at 11:00 a.m. An infrared thermal cam-

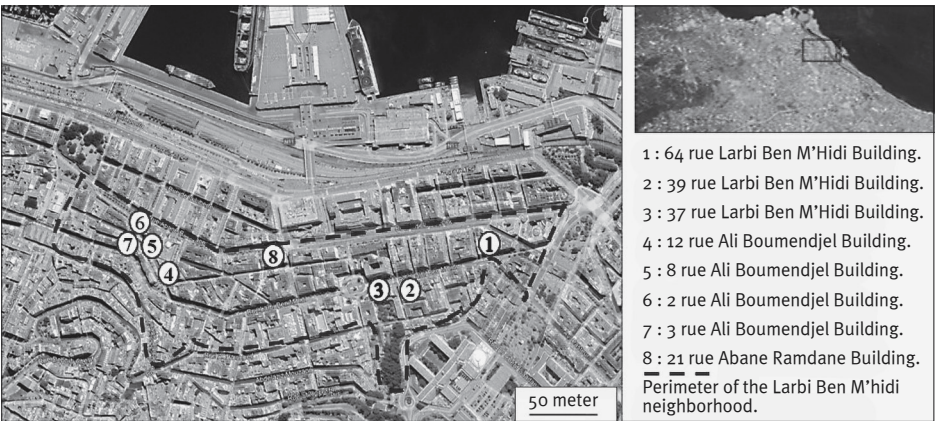


FIG. 2 IDENTIFICATION OF THE CASE-STUDY BUILDINGS IN THE LARBI BEN M'HIDI DISTRICT OF ALGIERS. (SOURCE: GOOGLE EARTH, PROCESSED BY THE AUTHORS)

era (Flir i7), calibrated between 9 and 38 °C with an emissivity of 0.93 corresponding to that of stone, was used. Its operating temperature range is between 0 and 50 °C, with a spectral band between 7.5 and 13.5 μm.

The heritage assessment, based on the Vitruvian triad (excellent habitability, very good state of preservation, high heritage value), combined with the results of the infrared thermography presented in the Results section (Fig. 7), guided the selection of the building at 39 Rue Larbi Ben M'hidi for indoor temperature measurements and dynamic thermal simulation

AMBIENT TEMPERATURE STUDY
OF BUILDING 39 RUE LARBI BEN M'HIDI

Presentation of the building

The study focuses on the building located at 39 Rue Larbi Ben M'hidi, in the historic center of Algiers, constructed between 1905 and 1906 by architect L. Bourgarel (Daoudi, 2013). The building has a compact layout organized around an atrium that provides zenithal daylight and natural ventilation for the interior

spaces (Fig. 3 C-D). It consists of a ground floor topped by five upper floors (G+5).

The structural system is based on load-bearing stone walls with a thickness of 55 cm (Fig. 3 F) and floors composed of vault infill blocks supported by steel beams (IPN). The external joinery is made of wood with single glazing (4 mm), presenting a thermal transmittance coefficient of $U = 5.7 \text{ W/m}^2\cdot\text{K}$.

Protocol for recording
indoor/outdoor ambient temperatures

To select an optimal day for temperature measurements, several criteria were considered, including building access and the availability of co-owners. The mid-season day of 28 September 2022 was selected, ensuring natural conditions without the use of heating or air conditioning, in order to obtain measurements representative of the building's actual thermal behavior.

The measurements were carried out in the living room of an apartment located on the 4th floor of the building at 39 Rue Larbi Ben M'hidi, oriented toward the east façade, where thermographic photographs were also taken (Fig. 4 A). This intermediate floor was chosen to limit the influence of thermal gains from the roof and the lower levels. The living room was selected due to its primary function and its thermal representativeness of the apartment. Measurements were taken at two-hour intervals between 8:00 a.m. and 6:00 p.m., at a height of 1.2 m, both indoors and outdoors on the balcony. The recorded parameters were:

- Indoor ambient temperature (T_{ind});
- Outdoor ambient temperature (T_{out}).

All measurements were performed using a multifunction Testo 480 anemometer, ensuring accurate temperature recording. The evolution of indoor and outdoor temperatures provides information on the energy efficiency of the building envelope and openings. The T_{int} values will be used for the validation of the thermal simulation model.

Central Algiers is located at 36°41' N and 3°12' E, at an altitude of 25 m, and is characterized by a temperate Mediterranean climate, with hot, dry summers and mild, humid winters. Average temperatures in September range from 18 and 29 °C, illustrating typical mid-season conditions (Meteonorm V8, data 2012-2022, Fig. 4 B).

The main boundary conditions for the thermographic and ambient temperature measurements at the building located at 39 Rue Larbi Ben M'hidi are presented in Table II.

Following the thermal diagnostic phase, the methodological approach continues with the development of a bio-based insulating material.

TABLE I SUMMARY OF THE MOST REPRESENTATIVE BUILDINGS IN THE LARBI BEN M'HIDI DISTRICT ACCORDING TO THE VITRUVIAN TRIAD. (SOURCE: AUTHORS, 2021).

N°	Buildings	State of preservation (<i>firmitas</i>)	Habitability (<i>utilitas</i>)	Heritage values (<i>venustas</i>)
1	64 Rue Larbi Ben M'hidi	Good state of preservation	Excellent habitability	High heritage value
2	39 Rue Larbi Ben M'hidi	Very good state of preservation	Excellent habitability	
3	37 Rue Larbi Ben M'hidi	Good state of preservation	Good habitability	
4	12 Rue Ali Boumendjel	Good state of preservation	Good habitability	High heritage value
5	8 Rue Ali Boumendjel	Good state of preservation	Good habitability	
6	2 Rue Ali Boumendjel	Good state of preservation	Excellent habitability	
7	3 Rue Ali Boumendjel	Good state of preservation	Good habitability	
8	21 rue Abane Ramdane	Good state of preservation	Excellent habitability	High heritage values

DEVELOPMENT OF THE CORK/CELLULOSE COMPOSITE MATERIAL

Materials used: cork and paper waste

This study uses cork waste and paper waste (cellulose) as raw materials to develop a bio-based thermal insulation composite. The cork was obtained from industrial waste generated during the manufacture of discs and stoppers and collected from the public company EPE Béjaïa Liège, supplied by several forest conservations offices (Jijel, Souk-Ahras, Sétif and Tizi Ouzou). The recovered cork aggregates have a particle size ranging from 2.5 to 8 mm. Cork is widely used as a thermal insulation material, either in expanded panels or in composites such as cork-gypsum, cork-wood, cork-clay or cork concrete (Kellati et al, 2010; Cherki et al, 2014; Limam et al, 2016; Mounir et al, 2014; Ziregue et al, 2016; Tedjditi et al, 2020). However, these composites often present relatively high thermal conductivity (0.1-0.4 W/m.°C) due to the density of the mineral matrices used to bind the aggregates (Fino, Tadeu and Simões, 2018).

To overcome this limitation, a cellulose matrix derived from paper waste was used. The cellulose was obtained from discarded newspapers and cardboard. After cutting into small pieces, the material was treated with a 7% sodium hypochlorite solution, washed with potable water, and dried to constant mass to eliminate microorganisms and bleach the pulp (Bentchikou et al, 2012). The dried material was then finely ground to facilitate volumetric dosing. The combination of cork aggregates with recycled cellulose enables the development of a bio-based cork/cellulose insulation material, while simultaneously recovering waste and contributing to circular economy and energy transition.

Preparation of specimens

Proportioning, mixing of constituents, and molding of specimens

The cork-paper mixtures were prepared according to volumetric proportions of 75%, 50%, and 25% (Dahli and Toubal, 2010). The volumes of the constituents were measured using a graduated container. Mixing was carried out using a 5 L mixer in accordance with the EN 196-1 (ECS, 2016) standard, for 3 minutes: 90 s at 140 rpm followed by 90 s at 285 rpm, with an intermediate pause to scrape the mixing bowl.

The specimens (15 × 10 × 3 cm) were then molded according to the NF EN 993-15 (Afnor, 2005) standard in two layers with slight compaction in order to eliminate entrapped air and improve cohesion. They were air-dried for three days and subsequently demolded.



Drying and surface finishing of specimens

In order to limit the influence of moisture on the thermal properties, the specimens were dried at 103 °C in an oven (Fig. 5) to constant mass was reached, and then polished to ensure better thermal characterization. The experimental measurements were carried out on these dry and smooth samples according to three series of tests.

Thermo-Physical characterization of specimens

Measurement of the apparent density ρ of the composites

Density corresponds to the mass of a material per unit volume. The specimens with different cork/cellulose compositions were weighed using a precision balance to determine their mass M . Their volume V corresponds to the

FIG. 3 A: LOCATION OF THE BUILDING IN THE LARBI BEN M'HIDI DISTRICT; B: MAIN FAÇADE OF THE BUILDING; C: ATRIUM OF THE BUILDING; D: ZENITHAL LIGHTING OF THE ATRIUM; E: STAIRCASE WITH INTEGRATED ELEVATOR F: WALL COMPOSITION OF THE BUILDING. (SOURCE: AUTHORS, 2021).

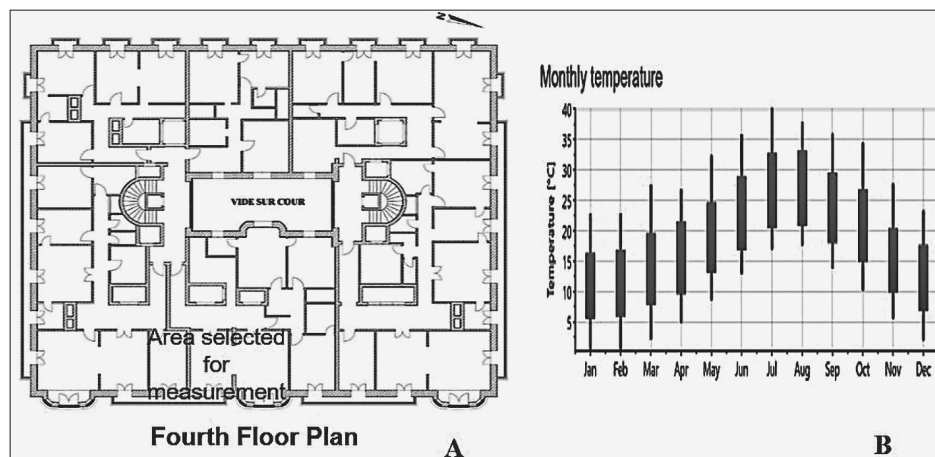


FIG. 4 A: SPACE SELECTED FOR INDOOR TEMPERATURE MEASUREMENTS; B: MONTHLY TEMPERATURES OF THE CITY OF ALGIERS FOR THE PERIOD 2012-2022. (SOURCE: AUTHORS, 2023; METEONORM V8)

TABLE II BOUNDARY CONDITIONS OF THE THERMOGRAPHIC SURVEY AND INDOOR-OUTDOOR TEMPERATURE MEASUREMENTS AT 39 RUE LARBI BEN M'HIDI. (SOURCE: AUTHORS, 2022).

Parameter	Thermographic survey of eight buildings	Ambient measurements – 39 Rue Larbi Ben M'hidi
Date	09/02/2021 (winter)	28/09/2022 (mid-season)
Time range	8 h – 11 h	8 h – 18 h (bi-hourly)
Outdoor temperature (°C)	10 – 12	22.8 – 24
Indoor temperature (°C)	22 – 25	19 – 21
Cloud cover	Overcast	Partly cloudy
Internal gains (occupants, appliances)	Negligible (mostly unoccupied apartments)	Negligible
Emissivity	0.93	/

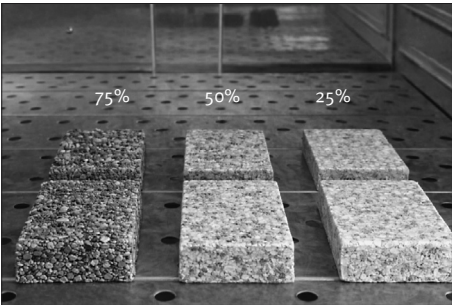


FIG. 5 CURING OF CORK/CELLULOSE COMPOSITE SPECIMENS. (SOURCE: AUTHORS, 2022)



FIG. 6 EXPERIMENTAL SETUP FOR MEASURING THERMAL CONDUCTIVITY AND SPECIFIC HEAT (TC-METER). (SOURCE: AUTHORS, 2022)

dimensions $0.15 \times 0.10 \times 0.03 \text{ m}^3$. The apparent density was calculated using Equation (1), and the results are presented in Table IV.

$$\rho \text{ Kg / m}^3 = \frac{M}{V}$$

1

Measurement of thermal conductivity λ and specific heat capacity C_p of the composites

The thermal conductivity and specific heat capacity of the cork-cellulose composite were determined using the transient hot-wire method (Dahli and Toubal, 2010; Liu et al, 2019; Tedjdit et al, 2020). The experimental setup consists of a thermal probe placed between two identical samples and connected to a data acquisition unit (CT-meter) developed by the CSTB, in accordance with the EN ISO 8894-2:2007 standard (ISO, 2007) (Fig. 6). The principle of the method is to induce localized heating in the material and then measure the temperature rise over a short period of time.

DYNAMIC THERMAL SIMULATION

Presentation of the simulation tool

Dynamic thermal simulations were carried out using the software ArchiWIZARD (v7), based on the EnergyPlus (v8) calculation engine, selected for its ability to accurately evaluate energy performance while accounting for climatic, geometric, and material parameters. A climate file specific to Algiers was

generated in EPW format using Meteonorm (v8.2) to ensure representativeness of local conditions.

The geometric modeling of the building located at 39 Rue Larbi Ben M'hidi was performed using ArchiCAD (v22). The resulting digital model, exported in SKP format, faithfully represents the current state of the building without any modification, and was used both for model validation and for comparison with the energy optimization scenarios. The thermo-physical properties of the materials composing the building envelope are detailed in Table III.

Dynamic thermal simulation protocol

The dynamic thermal simulation was performed on the building located at 39 Rue Larbi Ben M'hidi, excluding the ground floor, top floor, and attic to limit the influence of heat transfer with the ground and the roof. The simulation was conducted over a one-year period with an hourly time step, ensuring numerical stability of the calculations (avoiding initialization errors) and enabling the characterization of the building's thermal behavior during both winter and summer periods. The simulations were carried out using fixed setpoints (heating at 20 °C and cooling at 25 °C), simplified occupancy profiles, a constant air renewal rate, and an infiltration rate of 0.7 vol/h, representative of the existing building conditions.

Four dynamic thermal simulation scenarios were developed to examine the impact of the thermal characteristics of glazed and opaque surfaces on the building's energy consumption. The first scenario represents the reference model, corresponding to the actual thermal performance of the building. The second scenario evaluates the impact of argon-filled double glazing ($U = 1.1 \text{ W/m}^2\cdot\text{K}$). The third scenario analyzes the effect of a 15 cm internal bio-based cork-cellulose insulation layer ($\lambda = 0.048 \text{ W/m}\cdot\text{K}$; $C_p = 1285 \text{ J/kg}\cdot\text{K}$; $\rho = 32.4 \text{ kg/m}^3$). Finally, the fourth scenario corresponds to an optimized model, combining the improvement of glazing and the thermal performance of the external opaque walls.

RESULTS DISCUSSION

RESULTS DISCUSSION OF THE THERMOGRAPHY OF THE EIGHT BUILDINGS

The thermographic results reveal significant heat losses at the openings of the eight buildings studied (Fig. 7). All of them are equipped with 4 mm single glazing, presenting a thermal transmittance coefficient of $U = 5.7 \text{ W/m}^2\cdot\text{K}$, which explains their poor energy per-

TABLE III THERMO-PHYSICAL CHARACTERISTICS OF THE BUILDING ENVELOPE MATERIALS IN THE 39 RUE LARBI BEN M'HIDI BUILDING. (SOURCE: DTR, 1997; ISO, 2007).

Materials	Thermal Conductivity coefficient λ (W/m K)	Specific heat c_p (J/kg °C)	Apparent density ρ (kg/m ³)	Thickness cm
Exterior rendering (s lime)	0,87	1080	1800	2,5
Blue stone	1,75	950	2400	50
Interior gypsum plaster	0,3	936	900	2,5
	thermal transmittance $U \text{ W/m}^2\text{K}$			thickness cm
Single-glazed	5.7			4

formance. The integration of double or triple glazing therefore appears necessary to improve energy efficiency; this solution shall be evaluated in the section dedicated to numerical simulation.

The façades also exhibit variable thermal losses, ranging from low to very high levels. These losses are mainly due to the massive, uninsulated load-bearing stone walls. In addition, the junctions between façades and floor slabs with balconies constitute sensitive areas because of the presence of thermal bridges. In this context, internal thermal insulation is recommended in order to improve energy performance while preserving the heritage values of the façades.

RESULTS AND DISCUSSION
OF MEASURED INDOOR
AND OUTDOOR AMBIENT TEMPERATURES

The temperature measurements carried out on 28 September 2022 (Fig. 8) confirm the results observed during the thermographic diagnosis. The difference between indoor and outdoor temperatures remains low between 10:00 a.m. and 4:00 p.m. (ff 1 °C), indicating significant thermal exchanges through the building envelope. A slight time lag of about one hour between the peaks of outdoor and indoor temperatures also highlights the limited thermal inertia of the building.

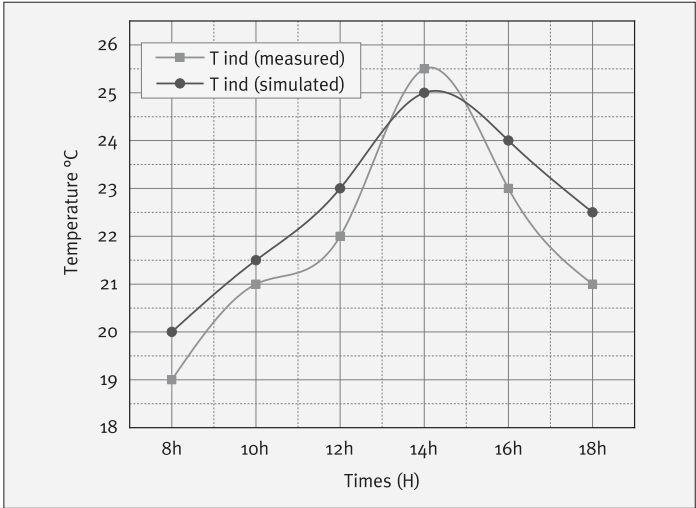
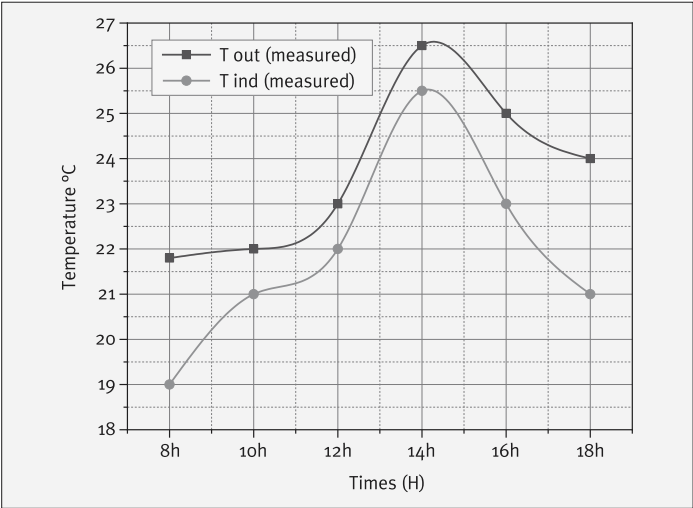
FIG. 7 THERMOGRAPHY RESULTS OF THE 8 BUILDINGS. (SOURCE: AUTHORS, 2021)

FIG. 8 HOURLY VARIATION OF OUTDOOR AND INDOOR TEMPERATURES MEASURED ON SEPTEMBER 28, 2022, AT 39 RUE LARBI BEN M'HIDI. (SOURCE: AUTHORS, 2022)

FIG. 9 MEASURED AND SIMULATED INDOOR TEMPERATURES ON SEPTEMBER 28. (SOURCE: AUTHORS, 2023)



TABLE IV SUMMARY OF THE THERMO-PHYSICAL PROPERTIES OF CORK/CELLULOSE COMPOSITES (SOURCE: AUTHORS, 2022).			
Specimens	Thermal characteristics		Physical characteristic
	Thermal conductivity λ (W/m.°C)	Specific heat Cp (J/kg.°C)	Apparent bulk density (kg/m³) I
Group 1 (75% cork)	0,048	1285	32,4
Group 2 (50% cork)	0,064	1244	71,1
Group 3 (25% cork)	0,08	1211	112



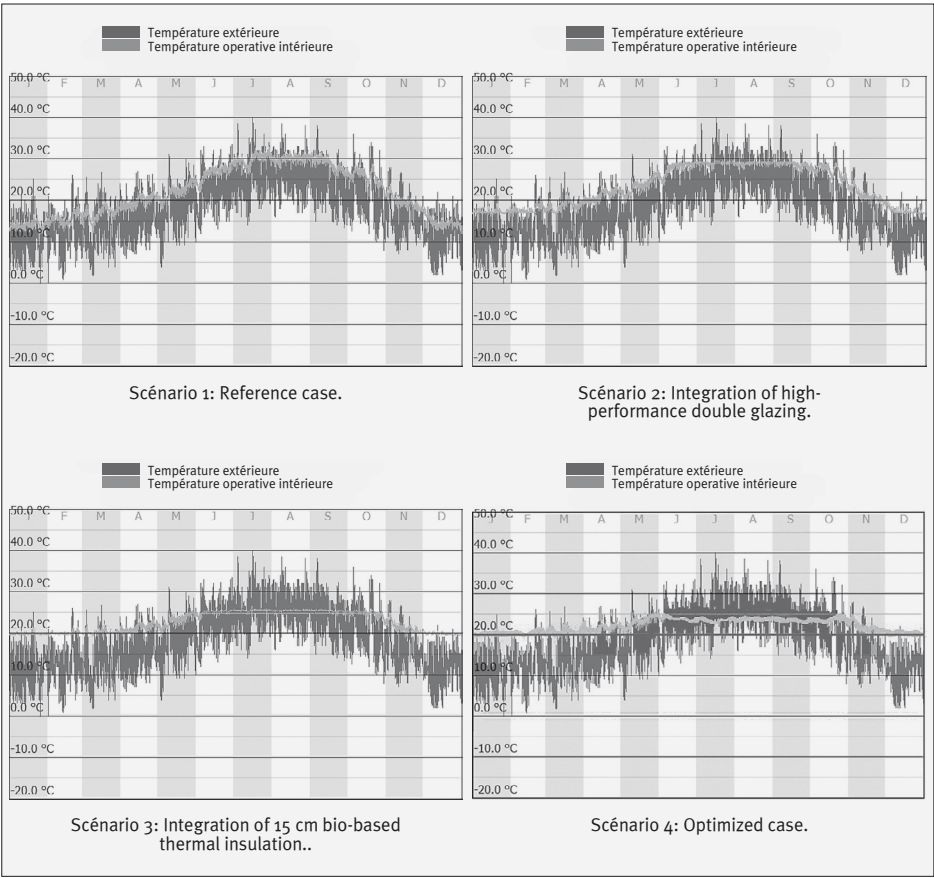


FIG. 10 RESULTS OF THE DYNAMIC THERMAL SIMULATION OF INDOOR TEMPERATURES UNDER FOUR SCENARIOS. (SOURCE: AUTHORS, 2023)

This action is mainly explained by the low thermal performance of the envelope, related to the absence of wall insulation, the presence of single glazing, the influence of variable solar gains associated with the building’s orientation promoting rapid heat transfer, as well as the absence of significant internal gains. This therefore indicates a strong dependence of indoor thermal conditions on external climatic variations.

RESULTS AND DISCUSSION
OF THE THERMO-PHYSICAL
CHARACTERISTICS OF CORK/CELLULOSE
COMPOSITES

The average values of the thermo-physical properties are presented in Table IV. The results show that Group 1 (75% cork / 25% cellulose) provides the best energy performance, with a thermal conductivity of 0.048 W/m.°C and an apparent density of 32.4 kg/m³, owing to the high porosity of the cork aggregates. As the proportion of cork decreases in favor of denser cellulose, both thermal conductivity and apparent density increase.

The specific heat capacity varies only slightly across compositions (1211-1285 J/kg.°C) and

remains higher than that of concrete or natural stone, which represents an advantage for heat storage and release during thermal retrofitting operations. Based on these findings, the Group 1 composite was selected for numerical simulations.

NUMERICAL SIMULATION RESULTS

Validation of the numerical model

The numerical model was validated by comparing the measured and simulated indoor temperatures on 28 September (Fig. 9). The curves follow a similar trend with minimal deviations. Statistical indicators (Zhou et al, 2023) confirm this agreement: RMSE ≈ 1.2 °C, MAE < 1 °C, and Pearson correlation coefficient R ≈ 0.90. These results confirm the model’s reliability for simulating thermal retrofitting scenarios.

Results discussion
of simulated indoor temperatures

The results of the dynamic thermal simulation (Fig. 10) show that, in the reference scenario, indoor temperatures closely follow outdoor temperatures, ranging from 10-20 °C in winter and 25-32 °C in summer, resulting in a high demand for heating and cooling. This poor energy performance of the building at 39 Rue Larbi Ben M’Hidi is mainly due to the absence of low-emissivity glazing and thermal insulation on external walls. The integration of low-emissivity double glazing (Scenario 2) slightly improves indoor temperatures, reaching approximately 18 °C in winter and 30 °C in summer, with a minor flattening of thermal curves. However, its effect remains limited, as a large portion of thermal exchanges between the building and the exterior occurs through the façades. The addition of the bio-based thermal insulation (Scenario 3) significantly improves indoor temperatures, stabilizing at around 20 °C in winter and 25 °C in summer. These improvements are explained by the thermal properties of the material, notably its low thermal conductivity (0.048 W/m.K) and high specific heat capacity (1285 J/kg.K). The combination of low-emissivity double glazing and bio-based insulation strongly reduces thermal exchanges. Indoor temperatures reach 20-23 °C in winter and just below 25 °C in summer, enhancing both thermal comfort and the overall energy performance of the building compared to the previous scenarios.

The choice of internal thermal insulation preserves the aesthetic integrity of the façades, a major concern for heritage buildings. Al-

though conventional materials such as polyurethane offer higher performance, their hygrothermal and environmental incompatibility justifies their exclusion. The cork/cellulose bio-based composite was therefore preferred for its durability and compatibility with existing walls, confirming the relevance of an approach that balances energy efficiency and heritage preservation (Ascione et al, 2015; De Berardinis, Rotilio, and Marchionni, 2014; Claude, 2018).

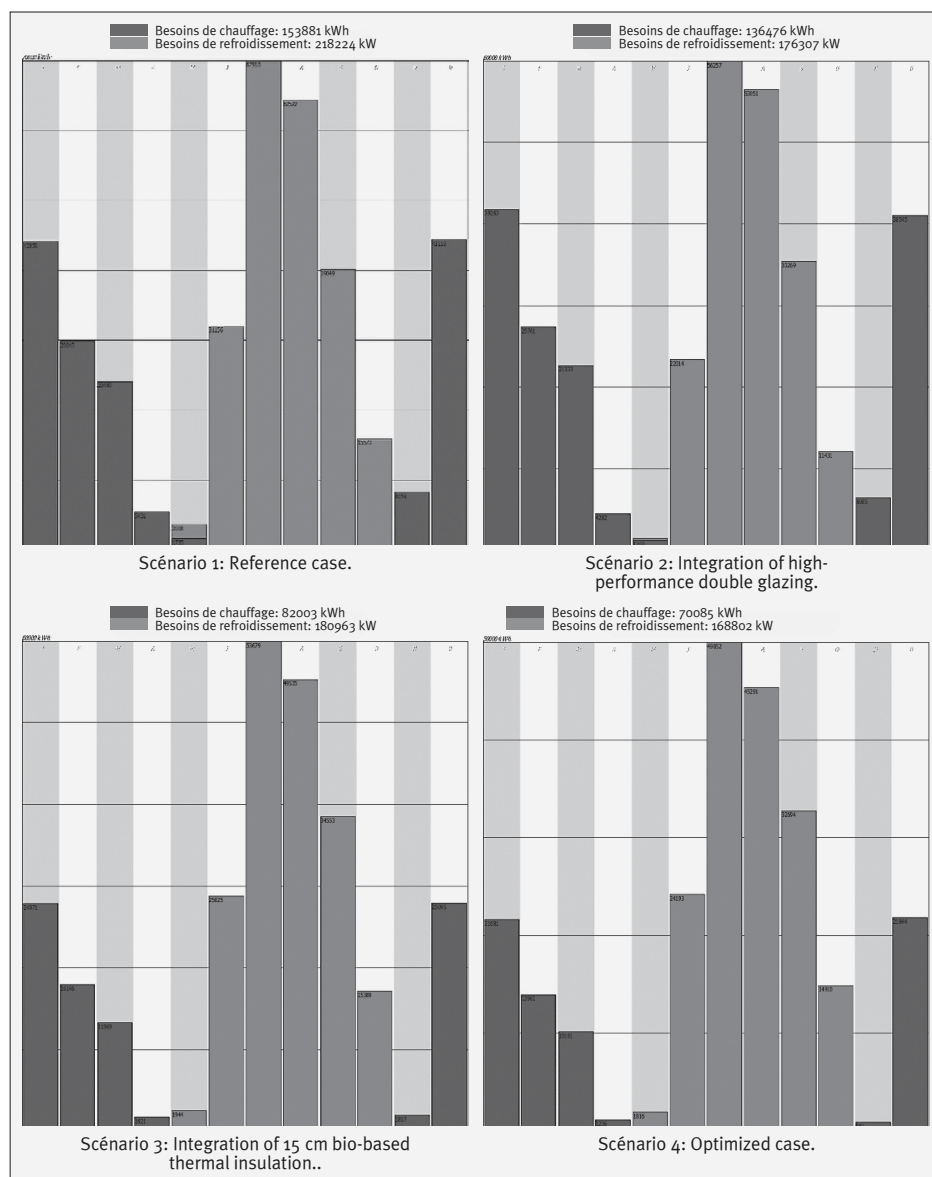
Energy consumption results discussion

Figure 11 presents the annual heating and cooling demands for four scenarios. Double glazing (Scenario 2) reduces consumption by 11.31% for heating and 19.20% for cooling. Insulation alone (Scenario 3) achieves a reduction of 46.71% for heating and 17% for cooling. The combination of insulation with double glazing (Scenario 4) delivers the best performance, with 54.44% savings for heating and 22.64% for cooling, demonstrating the effectiveness of these interventions in improving the energy performance of residential buildings from the French colonial period in Algeria.

CONCLUSION

The study of the buildings at 39 Rue Larbi Ben M'hidi highlights the energy vulnerability of French colonial constructions in Algeria, despite significant heritage value. These buildings, representative of the Larbi Ben M'hidi district, exhibit high energy consumption due to a thermally deficient envelope: massive, uninsulated walls and single glazing. Infrared thermography confirmed significant heat losses through façades and openings. To address these shortcomings, two interventions were simulated using AR-CHIWizard: the integration of low-emissivity double glazing and the application of a bio-based cork-cellulose insulation on the interior walls ($\lambda = 0.048 \text{ W/m}\cdot\text{K}$; $C_p = 1285 \text{ J/kg}\cdot^\circ\text{C}$ for the 75% cork formulation).

The results show that the combination of internal thermal insulation (ITI) and double glazing is most effective, reducing heat losses, stabilizing indoor temperatures between 20 and 25 °C, and decreasing energy consumption by over 50% for heating and 20% for cooling, while preserving the architectural integrity of the façades. Although focused on a single building, its characteristics; massive masonry, lack of insulation, single glazing, and typical interior layout, allow these findings to be extended to other colonial residen-



tial ensembles in Algeria. Limitations include a simplified numerical model that does not fully capture the hygrothermal complexity of historic walls. Hygrothermal analyses, including vapor migration, condensation risk, and the long-term conduct, as well as studies on other colonial typologies, would strengthen the scope of the results. Despite these limitations, the bio-based cork-cellulose insulation emerges as a promising solution, adaptable to diverse Algerian climates and other built environments.

This study proposes an approach that reconciles energy efficiency, thermal comfort, and heritage preservation, contributing to the wider discourse on the thermal rehabilitation of colonial buildings in Algeria.

FIG. 11 HEATING AND COOLING DEMANDS ACCORDING TO 4 SCENARIOS. (SOURCE: AUTHORS, 2023)

BIBLIOGRAPHY

1. AFNOR (2005). *Méthodes d'essai pour produits réfractaires façonnés denses-Partie 15 : détermination de la conductivité thermique par la méthode du fil chaud (parallèle)*. NF EN 993-15. Paris, 18 p.
2. AFNOR (2019). *Performance énergétique des bâtiments-Paramètres d'ambiance intérieure pour la conception et l'évaluation de la performance énergétique des bâtiments*. NF EN 16798-1. Paris, 89 p.
3. AHMAD, R.M., EL-SAYED, Z., TAHA, D., SHOKRY, H. and MAHMOUD, H. (2021) "An approach to select an energy-efficient shading device for the south-oriented façades in heritage buildings in Alexandria, Egypt", *Energy Reports*, 7, pp. 133-137. <https://doi.org/10.1016/j.egyvr.2021.06.024>
4. ASCIONE, F., BIANCO, N., DE MASI, R.F., DE ROSSI, F. and VANOLI, G.P. (2015) "Energy retrofit of an educational building in the ancient center of Benevento: feasibility study of energy savings and respect of the historical value", *Energy and Buildings*, 95, pp. 172-183. <https://doi.org/10.1016/j.enbuild.2014.10.072>
5. ASCIONE, F., DE MASI, R.F., DE ROSSI, F., RUGGIERO, S. and VANOLI, G.P. (2016) "Optimization of building envelope design for nZEBs in Mediterranean climate: Performance analysis of residential case study", *Applied Energy*, 183, pp. 938-957. <https://doi.org/10.1016/j.apenergy.2016.09.027>
6. BABA AHMED, T., CHÉRIF, N., MOYA, L. and FERNANDEZ-SALGADO, C. (2013) *Méthode de réhabilitation d'un centre historique : diagnostic du quartier Ben M'hidi – Alger*. Alger : Alternatives Urbaines.
7. BÉGUIN, F. (1983) *Arabesances : décor architectural et tracé urbain en Afrique du Nord (1830-1950)*. Paris : Dunod.
8. BELOUCHRANI, W. (2012) "Lecture morphologique du système de façade de l'immeuble de rapport algérois : définition du corpus", *Architectonics : Mind, Land and Society*, 24, pp. 73-85.
9. BENTCHIKOU, M., GUIDOUM, A., SCRIVENER, K., SILHADI, K. and HANINI, S. (2012) "Effect of recycled cellulose fibres on the properties of lightweight cement composite matrix", *Construction and Building Materials*, 34, pp. 451-456. <https://doi.org/10.1016/j.conbuildmat.2012.02.097>
10. BLÁZQUEZ, T., FERRARI, S., SUÁREZ, R. and SENDRA, J.J. (2019) "Adaptive approach-based assessment of a heritage residential complex in southern Spain for improving comfort and energy efficiency through passive strategies", *Energy*, 181, pp. 504-520. <https://doi.org/10.1016/j.energy.2019.05.160>
11. CARO, R. and SENDRA, J.J. (2020) "Evaluation of indoor environment and energy performance of dwellings in heritage buildings. The case of hot summers in historic cities in Mediterranean Europe", *Sustainable Cities and Society*, 52, p. 101798. <https://doi.org/10.1016/j.scs.2019.101798>
12. European Committee for Standardization ECS (2016). *Methods of testing cement – Part 1: Determination of strength*. EN 196-1. Brussels, 32 p.
13. CHAOUCHE, S. (2013) "L'impact de l'urbanisme colonial sur la fabrique de la ville algérienne", *Sciences et Technologie D*, 37, pp. 39-50.
14. CHÉRIF, N. (2017) "Alger, 1830-1980 : chronique d'une historiographie en construction", *Perspective*, 2, pp. 131-152. <https://doi.org/10.4000/perspective.7596>
15. CHERKI, A., REMY, B., KHABBAZI, A., JANNOT, Y. and BAILLIS, D. (2014) "Experimental thermal properties characterization of insulating cork-gypsum composite", *Construction and Building Materials*, 54, pp. 202-209. <https://doi.org/10.1016/j.conbuildmat.2013.12.076>
16. CHO, H.M., YUN, B.Y., YANG, S., WI, S., CHANG, S.J. and KIM, S. (2020) "Optimal energy retrofit plan for conservation and sustainable use of historic campus building", *Applied Energy*, 275, 115313. <https://doi.org/10.1016/j.apenergy.2020.115313>
17. CHOAY, F. (2001) *L'Allégorie du patrimoine*. Paris : Éditions du Seuil.
18. CLAUDE, S. (2018) *Étude expérimentale et numérique de solutions basées sur les éco-matériaux pour la rénovation thermique du patrimoine bâti urbain*. PhD thesis. Toulouse: INSA Toulouse.
19. COELHO, G.B. and HENRIQUES, F.M. (2021) "Performance of passive retrofit measures for historic buildings that house artefacts", *Sustainable Cities and Society*, 71, 102982. <https://doi.org/10.1016/j.scs.2021.102982>
20. DAHLI, M. and TOUBAL, R. (2010) "Matériau isolant thermique à base de déchets ménagers et oléicoles", *Revue des Énergies Renouvelables*, 13(2), pp. 339-346.
21. DAOUDI, N.S. (2013) *Bilan et perspectives de la démarche interdisciplinaire appliquée à la caractérisation des ambiances : cas d'un édifice à atrium colonial d'Alger*. PhD thesis. Alger: EPAU.
22. DE BERARDINIS, P., ROTILIO, M. and MARCHIONNI, C. (2014) "Improving the energy efficiency of historic masonry buildings", *Energy and Buildings*, 80, pp. 415-423. <https://doi.org/10.1016/j.enbuild.2014.05.047>
23. FINO, R., TADEU, A. and SIMÕES, N. (2018) "Influence of a period of wet weather on the heat transfer across a wall covered with uncoated medium-density expanded cork", *Energy and Buildings*, 165, pp. 118-131. <https://doi.org/10.1016/j.enbuild.2018.01.020>
24. FRANCO, G., MAGRINI, A., CARTESEGNA, M. and GUERRINI, M. (2015) "Towards a systematic approach for energy refurbishment of historical buildings: the case study of Albergo dei Poveri in Genoa, Italy", *Energy and Buildings*, 95, pp. 153-159. <https://doi.org/10.1016/j.enbuild.2014.10.051>
25. GALATIOTO, A., RICCIU, R., SALEM, T. and KINAB, E. (2019) "Energy and economic analysis on retrofit actions for Italian public historic buildings", *Energy*, 176, pp. 58-66. <https://doi.org/10.1016/j.energy.2019.03.167>

AUTHORS' BIOGRAPHIES AND CONTRIBUTIONS

26. GONZÁLEZ-PRIETO, D., FERNÁNDEZ-NAVA, Y., MEGIDO, L. and PRIETO, M.M. (2023) "Economic and environmental prioritisation of potential retrofitting interventions in electricity decarbonisation scenarios: application to a heritage building used as offices", *Journal of Building Engineering*, 72, 106561. <https://doi.org/10.1016/j.jobe.2023.106561>
27. HADJILAH, A. and ZEROUALA, I. (2018) La réhabilitation du centre historique d'Alger. Pathologies et diagnostic des constructions en maçonnerie datant de la période coloniale, In : 1^{ère} Conférence internationale sur la vulnérabilité et la réhabilitation des structures (VUREST 2018), USTHB, Alger, 7-8 May 2018. Alger : Laboratoire d'Environnement, d'Eau, de Géomécanique et Ouvrages (LEGO).
28. ISO (2007) *Refractory materials – Determination of thermal conductivity – Part 2: Hot-wire method (parallel)*. ISO 8894-2:2007. Geneva, 13 p.
29. ISO (2015) *Detection of heat, air and moisture irregularities in buildings by infrared methods – Part 3. ISO 6781-3*. Geneva, 18 p.
30. JIANG, L., LUCCHI, E. and DEL CURTO, D. (2023) "Adaptive reuse and energy transition of built heritage and historic gardens: the sustainable conservation of Casa Jelinek in Trieste (Italy)", *Sustainable Cities and Society*, 97, 104767. <https://doi.org/10.1016/j.scs.2023.104767>
31. KELLATI, N.E., EL BOUARDI, A., AIZOUL, T., TYOURI, M. and EZBAKHE, H. (2010) "Valorisation énergétique du matériau liège", *Afrique Science*, 6(2), pp. 108-116.
32. KHADRAOUI, M.A. and SRITI, L. (2017) "Facades thermal behavior of the office buildings in a hot and arid climate", *Algerian Journal of Engineering, Architecture and Urbanism*, 1(2), pp. 28-38.
33. LIÉBARD, A. and DE HERDE, A. (2005) *Traité d'architecture et d'urbanisme bioclimatiques : concevoir, édifier et aménager avec le développement durable*. Paris: Observ'ER.
34. LIMAM, A., ZERIZER, A., QUENARD, D., SALLEE, H. and CHENAK, A. (2016) "Experimental thermal characterization of bio-based materials (Aleppo pine wood, cork, and their composites) for building insulation", *Energy and Buildings*, 116, pp. 89-95. <https://doi.org/10.1016/j.enbuild.2016.01.007>
35. LIU, L., ZOU, S., LI, H., DENG, L., BAI, C., ZHANG, X., WANG, S. and LI, N. (2019) "Experimental physical properties of an eco-friendly bio-insulation material based on wheat straw for buildings", *Energy and Buildings*, 201, pp. 19-36. <https://doi.org/10.1016/j.enbuild.2019.07.037>
36. DTR C 3-2 (1997) *Réglementation thermique des bâtiments d'habitation – Règles de calcul des déperditions calorifiques, Fascicule 1*. Alger: Ministère de l'Habitat et de l'Urbanisme, 72 p.
37. MOHDEB, R., ATTAR, A. and SARAQUI, S. (2023) "Forging the city image during the French colonial period (1883-1962) in the case of Jijel (Algeria)", *Prostor*, 31(1(65)), pp. 96-111. [https://doi.org/10.31522/p.31.1\(65\).9](https://doi.org/10.31522/p.31.1(65).9)
38. MOUNIR, S., MAALOUFA, Y., CHERKI, A.B. and Khabbazi, A. (2014) "Thermal properties of the composite material clay/granular cork", *Construction and Building Materials*, 70, pp. 183-190. <https://doi.org/10.1016/j.conbuildmat.2014.07.108>
39. OUKACI, A. (2022) "L'analyse parcellaire comme source de l'histoire urbaine et architecturale", *Historia Urbana*, 30(30), pp. 147-171.
40. OUKACI, A. and KASSAB, T.B.A. (2021) "Construction du quartier d'Isly au XIX^e siècle : naissance et formation de la première ville française fondée à Alger (1840-1900)", *Historia Urbana*, 29, pp. 149-176.
41. PAJANI, D. (2014) *Thermographie du bâtiment : diagnostic et applications*. Paris: Techniques de l'Ingénieur.
42. PAOLETTI, D., AMBROSINI, D., SFARRA, S. and BISEGNA, F. (2013) "Preventive thermographic diagnosis of historical buildings", *Journal of Cultural Heritage*, 14(1), pp. 116-121. <https://doi.org/10.1016/j.culher.2012.05.005>
43. PETRUCCIOLI, A. (1992) "Alger 1830-1930 : pour une lecture typologique des immeubles d'habitation", *Environmental Design Journal*, 1-2, pp. 104-117.
44. QU, K., CHEN, X., WANG, Y., CALAUTIT, J., RIFFAT, S. and Cui, X. (2021) "Comprehensive energy, economic and thermal comfort assessments for the passive energy retrofit of historical buildings: a case study of a late nineteenth-century Victorian house renovation in the UK", *Energy*, 220, 119646. <https://doi.org/10.1016/j.energy.2020.119646>
45. SUGÁR, V., TALAMON, A., HORKAI, A. and KITA, M. (2020) "Energy saving retrofit in a heritage district: the case of Budapest", *Journal of Building Engineering*, 27, 100982. <https://doi.org/10.1016/j.jobe.2019.100982>
46. TEDJITI, A.K., GHOMARI, F., TALEB, O., BELARBI, B. and BOUHRAOUA, R.T. (2020) "Potential of using virgin cork as aggregates in the development of new lightweight concrete", *Construction and Building Materials*, 265, 120734. <https://doi.org/10.1016/j.conbuildmat.2020.120734>
47. ZAGORSKAS, J., ZAVADSKAS, E.K., TURSKIS, Z., BURINSKIENĖ, M., BLUMBERGA, A. and BLUMBERGA, D. (2014) "Thermal insulation alternatives of historic brick buildings in the Baltic Sea region", *Energy and Buildings*, 78, pp. 35-42. <https://doi.org/10.1016/j.enbuild.2014.04.010>
48. ZHOU, X., LIU, R., TIAN, S., ZHANG, Y. and WANG, Y. (2023) "A review of validation methods for building energy modeling programs", *Building Simulation*, 16(11), pp. 2027-2047. <https://doi.org/10.1007/s12273-023-1050-0>
49. ZIREGUE, A., KHENFER, M., QUÉNEUDEC-T'KINT, M. and MONTRELAY, N. (2016) "Developmental potentiality of insulating lightweight concrete based on cork and calcareous", *Journal of Adhesion Science and Technology*, 30(9), pp. 934-946. <https://doi.org/10.1080/01694243.2015.1129882>

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During the preparation of this work, the author did not use ChatGPT to refine the language.

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CREATING *BUSINESS/COMMERCIAL AREAS* IN *URBAN/PHYSICAL PLANNING*: LINKING THE IDEAL CITY CONCEPT WITH CONTEMPORARY EUROPEAN STRATEGIES AND CROATIAN LEGISLATION

KEYWORDS

BUSINESS/COMMERCIAL AREAS
IDEAL CITY
PHYSICAL PLANNING
URBAN PLANNING

ABSTRACT

In this article, the authors explore the historical development of the business/commercial area concept in the ideal city, from the earliest utopian visions to contemporary sustainable urban and physical planning. The study analyzes how different urban theories, from the earliest periods of antiquity and Renaissance ideal cities, through 19th-century industrial utopias, to modern and postmodern concepts, have influenced the consideration and implementation of business and business

and commercial functions (production, crafts, services, trade, etc.) within the urban fabric. Particular emphasis was placed on identifying continuities and discontinuities in the approach to integrating economic functions into urban and physical planning. Using the Croatian legislative framework as an example, the authors aim to demonstrate how the principles of utopian thought and sustainable development have been implemented in the physical planning of these areas.

INTRODUCTION

Business functions have always been the driving force of urban development. Since ancient times, the location and organization of business and commercial activities within the urban fabric have profoundly shaped cities and residents' lives (Kostof, 1991; Hall, 2014). Business/commercial areas have significantly influenced the city's sustainable development¹ achievement and its Identity. As technology advanced, urban functions-trade, crafts, manufacturing, and large-scale industry evolved as well. The Code of Hammurabi (c. 1750 BCE) undoubtedly represents the earliest land-use legal framework initiating institutional urban management. Under the Code, the so-called grey zones (sources of pollution and noise) had to be located outside the city limits, specifically *at the city gate* (King, 1915, art. 58). Business/commercial areas' location has been a major issue in urban planning ever since.

Therefore, this research² and the article aimed to explore the reasons for the emergence of business/commercial areas within city limits over time. The physical and urban planning of these areas should not be considered just a technical process, but also a reflection of socio-economic and philosophical views on how a sustainable city³ should function. Correct planning of business/commercial area locations within city limits is crucial for the city's progress, the quality of citizens' lives, and environmental protection. If well-planned

and strategically located, these areas drive urban growth and development, becoming key factors in the city's attractiveness and livability. Using historical experience and a sense of responsibility, planners can (and *must*) create spatial conditions to provide incentives for investors (Lipovac, 2014: 207 [1027]) in new, environmentally friendly, aesthetically pleasing, and profitable business areas.

Inadequate planning in these areas undoubtedly leads to traffic congestion, environmental pollution, social inequality, and inefficient use of space. In his Ph.D. dissertation, "Planning as a Function of Preserving the Identity of Place", Prof. Lipovac has noted that many planners overlook the meaning of *Place Image* and *Sense of Place* in the planning process, primarily under pressure from business investors. Such planning neglects the importance of Place, which inevitably leads to uncontrolled business expansion, creating placeless Places and limiting the city's future spread (Lipovac, 2000).

As cities are dynamic and complex organisms, city planners must continually seek a balance between business efficiency, social cohesion, and environmental sustainability. Therefore, the planned expansion of business areas should consider curtilage values and residents' needs. Planners need to recognize these values and needs and prepare physical and urban plans in the context of sustainable urban planning. Irresponsible planning, which often results in the irreplaceable loss of fertile agricultural or forested land (Lipovac, Rožek, 2020: 21), renders these areas unsustainable and creates crosscapes that would be difficult to restore to their original condition. Speaking about the connection between business areas and urban structure, Prof. Šimunović has raised an important question: *How can we ensure balanced spatial development so that new trends are guided by planners and the urban community rather than by market-driven entrepreneurial forces* (Šimunović, 2018: 144).

This preliminary research examines the relationship between business areas and the ur-

¹ Sustainable development of a city is a dynamic and long-term process of planning and managing urban space and resources, the goal of which is to meet the current citizens' needs for prosperity, quality of life, and a healthy environment, without compromising the ability of future generations to meet their own needs. This process necessarily ensures a balance between environmental, economic, and social sustainability.

² This research is part of the doctoral dissertation 'Planning Criteria and Models for Zagreb Business Areas within Physical Planning Documents'.

³ A sustainable city is one that functions as a healthy ecosystem, whereby economic development

ban fabric, which should be examined from multiple perspectives, as no single framework provides a comprehensive understanding. To understand their transformation, this paper will explore the origin and meaning of the key term (business area) through an analysis of historical issues, presenting a chronological methodology for the development of physical and urban planning ideas on the *ideal city* and its structure. In terms of the scientific methodology employed, this research is designed as an analytical review, drawing on scientific literature, legal documents, and official strategic documents as primary sources. In this context, this paper will provide a historical and theoretical elaboration through comparative analyses of planning business areas throughout history.

HISTORIC AND THEORETICAL FRAMEWORK – ORIGIN AND DEFINITION OF A BUSINESS/COMMERCIAL AREA

In ancient times, the term *economics* (originally used by Aristotle as *oikonomia*) referred to the management of the household and its surrounding estate, including all property. Today, the term “industry” is more commonly used, but it refers only to the production of goods. One of his earliest writings on the term “*economics*” is “*Politics*” and “*Nicomachean Ethics*”. According to him, the purpose of *economics* was to acquire and rationally use goods to meet the needs and desires of family members (Aristotle, 1988b: 6). That is why he considered *economics* as a starting point for understanding city organization: business activities and relationships that shape urban space and social structures. Before considering political, social, or cultural aspects, the planner must understand how the city lives, how its population is fed, and how it produces and exchanges goods and services.

In his book, *Nicomachean Ethics*, Aristotle states that every activity has its purpose. Thus, the purpose of *economics* is to gain wealth (Aristotle, 1988a: 1). With this statement, he questions the ethics of *economic*

is achieved through careful use of space while ensuring a high quality of life and environmental protection.

⁴ Philosophers deal with the *Ideal city* on an abstract level, thinking of a perfectly ordered society and state (*polis*). Therefore, the *Ideal City* serves as a metaphor for an ideal political and social community.

⁵ Sociologists and political science researchers analyze the *Ideal city* as a social experiment. They are interested in the social and political consequences of such urban plans and how life would unfold within the imagined structure. Thomas More, one of the founders of utopian socialism, and his visions of the *Ideal city* were of significant influence on later reflections on society and the city.



FIG. 1 BUSINESS ZONE JANKOMIR, ZAGREB (2010)

activities, pointing out that the meaning of the term *economics* is not neutral, suggesting that the way wealth is acquired and utilized reflects the values of the community. This is the primary meaning for this term.

If it is possible to establish analogies between Aristotelian *oikonomia* and contemporary economy, the term *economy* encompasses all processes related to the production, distribution, and consumption of goods and services within a particular society. On the other hand, the term *area* has multiple meanings, depending on its context. In the context of Space, the term *Area* denotes a portion of *Space* or a bounded territory. When we combine these two terms, the resulting new term denotes a specific, geographically bounded part of a space that is purposefully organized and equipped to carry out certain business activities (production, crafts, services, trade, etc.), which drive its economic/business development. The significance of these areas is reflected in the functional organization of space, ensuring efficient resource management, economic development, and urban stability while simultaneously meeting social needs. These are the essential physical planning elements that directly affect a city's quality of life.

Since antiquity, the complexity of urban structures has demanded a holistic approach to planning that enables one to observe the city as a unique entity. European policy itself requires that Cities of tomorrow adopt a *holistic model of sustainable urban development* (EU Regional Policy, 2011: VII). Despite this tendency, a fragmented approach remains prevalent in planning practice, particularly when planning business/commercial areas. Throughout history, this urban planning approach has been described by many philosophers⁴, social theorists⁵, and urban

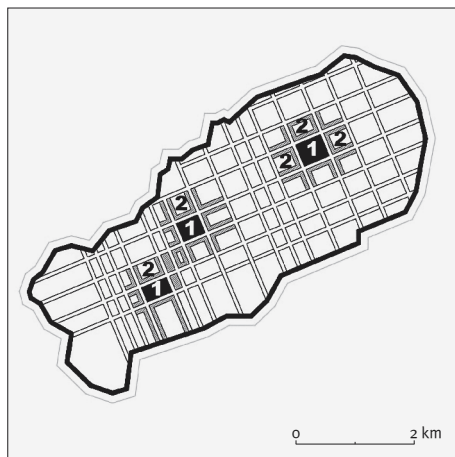


FIG. 2 FICTITIONAL ANCIENT CITY LAY-OUT SCHEME, 1 MARKET AREA (AGORA), 2 CRAFT AREA (WORKSHOPS ALONG THE STREETS)

planners⁶. Drawing on historical concepts of the *Ideal City*, this paper examines the evolution of business area positioning through a literature review and historical analysis. The objective is to establish a chronology of functional zoning as a foundation for future scientific research.

HISTORY OF URBAN (PHYSICAL) PLANNING OF BUSINESS/COMMERCIAL AREAS WITHIN THE IDEAL CITY THEORIES

EARLY BEGINNINGS AND UTOPIAN VISIONS (FROM ANTIQUITY TO THE RENAISSANCE)

A significant work that contributes to understanding the impact of business activities on urban space is Lewis Mumford's *The Story of Utopias* (1922). The author emphasizes the importance of planning business/commercial areas that balance human needs with environmental considerations, while accounting for natural values. Analyzing Plato's *Republic*, he highlights the danger of uncontrolled expansion of (city's) boundaries due to the multiplication of needs (Mumford, 2008: 35). In *Christianopolis*⁷, Mumford recognizes the precursors of modern zoning through the division into 'heavy' and 'light' industry (Mumford, 2008: 81).

In the example of Cabet's *Icaria*⁸, he notes the strategic placement of industrial areas along railways and canals (Mumford, 2008: 142). The author criticizes the capitalist system for the uncontrolled spatial expansion of business/commercial areas and environmental

pollution, maintaining that economic development must be subordinated to social well-being (Mumford, 2008: 221).

Historically, business and commercial activities have been integral to the urban fabric. The Greek *agora* and the Roman *urbs* had clearly defined spaces for trade – the *agora* itself – and for artisanal activities, with workshops situated along the streets (Fig. 2). Still, these spaces were permeated with residential and public functions (Kostof, 1991). The city functioned as a whole, and market activities were a visible part of everyday life.

The first concepts of the ideal urban form emerged in Ancient Greece. Plato's concept of the Ideal State helped shape the initial principles for planning commercial areas⁹ within cities. He was aware of their potential for destabilization if not contained within strictly defined boundaries; his ideas gave rise to the concept of dividing the city into functional zones (Platon, 2002).

In the book *De Architectura Libri Decem* (c. 27 BC), Vitruvius¹⁰ focused on an interdisciplinary approach to planning, emphasizing the importance of microclimatic conditions and topography for the sustainability of the Place (Vitruvius, 1999: 18). Although he was primarily concerned with public buildings and temples, his principles also aid in planning business areas.

FIG. 3 FICTITIONAL MEDIEVAL CITY LAY-OUT SCHEME, 1 MARKET ZONES, 2 CRAFT AND TRADE ZONES (E.G. SHOEMAKERS' STREET, BLACKSMITHS' STREET), 3 CRAFT AND TRADE ZONES, 4 LARGE MANUFACTURING WORKSHOP ZONES



⁶ Architects and urban planners have been dealing with the ideal city since the Renaissance, creating designs and plans for the creation and management of such a city. One of them is the architect Filarete and his city of *Sforzinda*, where he sought symmetry, harmony, and functionality. In recent history, planners have envisioned the ideal city, as seen in the works of Le Corbusier (*Radiant City*) and Ebenezer Howard (*Garden City*). Both tried to solve the problems of industrialization through radical new planning.

⁷ *Christianopolis*, written by Andreä Johann Valentin (1586-1654), describes an ideal Christian City-State, conceived as a model for the future social and religious reform, whereby every single part of life, including work, would be carefully planned and controlled.

⁸ Cabet, Étienne (1788-1856), French utopian socialist, described his views on the *Ideal City-State* in his book "The Voyage to Icaria" (*Le Voyage en Icarie*, 1840).

⁹ According to the European Conference of Ministers Responsible for Spatial/Regional Planning (CEMAT, 2006) Glossary (which was signed and accepted by all European countries, including Croatia), there is a substantial difference between the two key terms: Physical Planning and Spatial Planning. *Physical Planning* is closely linked to land-use planning, urban design, transport planning, landscape planning, building design, and related fields. It addresses activities that immediately affect and program the physical structure and environment of cities and neighborhoods (as opposed to economic planning or social planning activities). By contrast, *Spatial Planning* refers to the methods used by the public sector to influence the distribution of people and activities across space at various

Medieval cities continued the tradition of ancient cities through guild quarters and marketplaces, while the first 'industrial zones' were established outside the city walls solely due to noise and pollution (Fig. 3). These cities were built according to the natural terrain, defense needs, and historical settlement structures (Milic, 1995).

In contrast to medieval cities, Renaissance ideal cities placed new emphasis on geometric perfection, symmetry, and defensive functionality. Renaissance artists and architects¹¹ sought harmony, symmetry, and proportion (Rosenau, 1983). Economic functions are often subordinated to aesthetic and defensive concerns. Markets were again located in central squares, while roads were planned to facilitate the efficient flow of people and goods. Zoning for economic functions (such as manufacturing) had not yet been planned in detail (Fig. 4).

In the early Renaissance, a key contribution was made by Leon Battista Alberti and his book *De re Aedificatoria*¹² (1452), in which he emphasized the exceptional importance of urban planning and city functional zoning. He proposes relocating 'dirty' trades to the periphery and grouping shops according to their affinity, thereby laying the foundations for the modern spatial organization of business zones and commercial areas (Milic, 2002: 44). Alberti's understanding of the

city's functional zoning set the foundations for defining conditions for urban/physical planning of economic areas in the later period of industrialization.

INDUSTRIAL REVOLUTION AND RESPONSES TO ITS CHALLENGES (19TH AND EARLY 20TH CENTURY)

The first structured theory of location was introduced in the first half of the 19th century by Johann Heinrich von Thünen¹³ through the concept of locational rent, the value of land that depends on the distance from the market (city) and transportation costs. Although this theory primarily concerns agriculture, it offers a historical explanation for why distance governed initial patterns of spatial organization prior to industrialization (Thünen, 1910).

The Industrial Revolution, while driving technological progress, also generated acute social issues – notably poverty and inadequate housing. In response, utopian socialists¹⁴ were the first to propose an alternative, advocating social reform through the creation of ideal, self-sufficient communities that balance life and work (Mumford, 2008). Early theorists also conceived of health-oriented cities, such as Papworth's *Hygeia* (1827), which proposed zoning and relocating industry to the periphery. These proposals preceded later principles of functionalism (Share, 1982).

With the development of industry in the 19th century, the creation of business zones on the outskirts of cities, along roads, railways, and rivers began (Fig. 5). During this period,

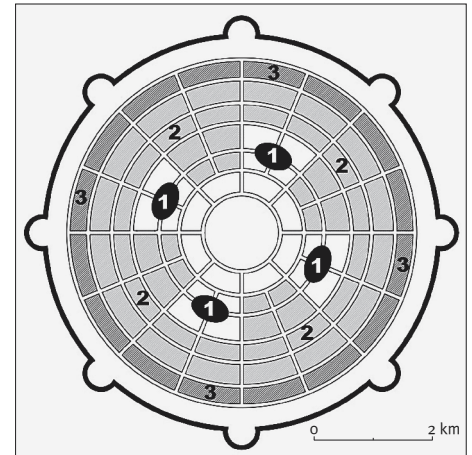


FIG. 4 FICTIONAL RENAISSANCE IDEAL CITY LAY-OUT SCHEME, 1 MARKET ZONES, 2 CLEAN CRAFT ZONES, 3 DIRTY CRAFT ZONES

scales, as well as the siting of infrastructure, recreation areas, and natural areas. These activities are carried out at different administrative or governmental levels (local, regional, national).

10 Vitruvius Pollio, Marcus (1st century BC), Roman architect and engineer.

11 The most prominent Renaissance artists and architects who were engaged in creating plans for the Ideal City and establishing theoretical foundations are: Alberti, Leon Battista (1404-1472) Italian builder, sculptor, painter, writer and mathematician; Filarete (Antonio di Pietro Averlino) (c. 1400-1469) Italian sculptor, builder and theorist, Sforzinda; Leonardo da Vinci (1452-1519) Italian painter, sculptor, builder, engineer and writer; Scamozzi, Vincenzo (1552-1616) Italian builder, engineer and theorist of architecture, the oldest example of a realized Ideal City is Palmanova.

12 This book served as a comprehensive manual for numerous architects and urban planners, representing a combination of classical principles and the spirit of the Renaissance.

13 Thünen, Johann Heinrich von, (1783-1850), German economist

14 Utopian socialists criticized capitalism and developed plans for the operation of new, more just societies. Their most prominent representatives are: Robert Owen (1771-1858), British utopian socialist and social reformer known for his work "A New View of Society" (1813) containing the philosophy of social reforms; Charles Fourier, (1772-1837), French philosopher and economist known for his work "Le Nouveau monde industriel et sociétaire" (1829); he introduced the "phalange" community model; Étienne Cabet (1788-1856).

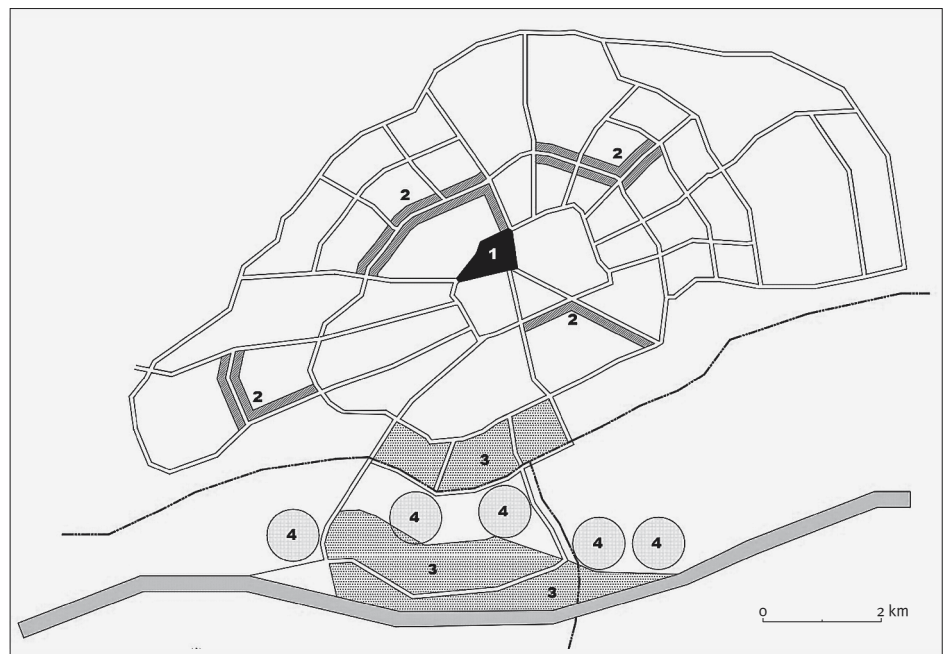


FIG. 5 FICTIONAL INDUSTRIAL CITY AREA, 1 MARKET AREAS, 2 CRAFT AREAS, 3 INDUSTRIAL AREA, 4 WORKERS' HOUSING ESTATES

architects began to be engaged in urban zoning, focusing on systematic planning and a more deliberate organization of the city. In his book *Modern Architecture: A Critical History*, British architect and critic Kenneth Frampton provides a comprehensive overview of the history of planning the ideal industrial city, emphasizing how technological progress directly dictated the choice of locations to facilitate the transport of goods and access to energy and raw materials. Due to the constant need for workers, residential settlements were created, mostly unplanned, around these areas (Frampton, 1992).

The *Industrial Revolution* radically transformed cities, creating overcrowded, polluted districts where factories were intertwined with housing (Hall, 2014). Movements like *Port Sunlight*¹⁵ introduced planned zoning to separate industry from housing, aiming to improve the health and morale of the working class through the control of urban form (Beeson, 1911; Hubbard, Shippobottom, 2005). Simultaneously, the *City Beautiful Movement* in America focused on monumentality and the aesthetics of public spaces, indirectly encouraging the relocation of 'dirty' industry from city centers to create a more attractive urban image (Wilson, 1989).

These efforts shaped the principles of spatial separation and economic organization, laying the groundwork for later urban experiments. Soria y Mata¹⁶ developed the *Linear City (Ciudad Lineal)* along a central transport axis, strategically siting industry near railways to balance economic efficiency and residential planning, a concept that remains relevant in contemporary debates on urban structure (Ángel, Rubio, 2017). A similar principle of rational planning was advocated by Edward Bellamy¹⁷ in his utopia, *Looking Backward* (1888), which argued that social equality and economic prudence could be achieved only through centralized social organization (Decker, 2018).

The most effective response to the problems of the industrial city was Ebenezer Howard's 'Garden City' concept (Vernet, Coste, 2017; Nabila, 2021; Hugo, Bhanye, 2022: 42). He proposed deurbanization through self-sufficient communities with ring-zoning, integrating housing and agriculture with industry located on the periphery near railways to protect residential areas (Howard, 2007).

The first example of modern functional zoning is represented by Tony Garnier's¹⁸ *Cité Industrielle*. The city is divided into industrial, residential, and public spaces, with industry situated along railway and water routes, separated from housing by a green belt (Frampton, 1992: 112-116).

With the transition from agriculture to industry, a key shift in the determination of business location was the *Industrial Location Theory* set by Alfred Weber¹⁹ (Hugo, Bhanye, 2022: 42-43). This planning model was dominant until the mid-20th century and was based on minimizing costs through three key factors: transportation, labor, and industrial agglomeration (Weber, 1909).

MODERNISM AND FUNCTIONAL ZONING (FIRST HALF OF THE 20TH CENTURY)

The 20th century was a period in which modernism prevailed, leading to the belief that all urban problems could be solved by city functional zoning. The International Congresses of Modern Architecture (CIAM), founded in 1928, played a key role in developing a new theory. Concurrently, the radical visions of Antonio Sant'Elia²⁰ (1914) shaped the ideal modern city, emphasizing movement, vertical structures, and the clear separation of industrial and commercial areas from residential ones (Birolli, 2018).

Fifteen years later, the fundamental *New Urbanism* document, the Athens Charter (1933), was adopted, establishing strict functional zoning as the primary planning principle (Le Corbusier, 1973). The city is strictly divided into four functions (housing, work, recreation, and transport), with factories relocated to the periphery to ensure healthy living conditions. This vision was epitomized in Le Corbusier's *La Ville radieuse* (1935) (Fishman, 1982; Frampton, 1992).

Subsequently, the core of functional zoning was developed under international influences, notably the *Bauhaus* principles of functionalism, which shaped urban planning, particularly by separating industrial from residential zones, thereby laying the groundwork for the rational organization of space (Wingler, 1976). The *New Frankfurt Project*, led by Ernst May (a German architect and urban planner), applied Garden City and zoning

¹⁵ *Port Sunlight* represents a combination of exemplary industrial housing, which provides workers with decent living conditions, with architectural and landscape values of a "garden suburb".

¹⁶ Soria y Mata, Arturo (1844-1920), Spanish urban planner and engineer

¹⁷ Bellamy Edward (1850-1898), American publicist and writer

¹⁸ Tony Garnier (1869-1948) French architect and urban planner

¹⁹ Weber, Alfred (1868-1958), German economist, sociologist, and geographer

²⁰ Sant'Elia, Antonio (1888-1916), Italian architect and theorist

²¹ Some of the most prominent contemporary architecture theorists are for sure: Jane Jacobs (1916-2006),

principles to rationalize the industrial city by *separating housing from industry* (Elder, 2014; Zapatel, 2017). Similar principles are evident in Soviet urbanism, where, under the influence of Le Corbusier and the Bauhaus, ideas for the ideal socialist city were developed and organized in a modular manner along transit routes (Miliutin et al, 1975). During the 1930s, all new Soviet industrial cities were built according to the same planning regulations, regardless of local conditions (Meerovich, 2014).

Frank Lloyd Wright offered a different vision through his *Broadacre City Project*, based on total decentralization and individual freedom in harmony with nature. This concept envisioned family plots for housing and food production, with crafts and trade integrated into the landscape and cars and telephones as key means of connectivity (Fishman, 1982; Frampton, 1992).

After World War II, Le Corbusier's *Chandigarh* became a prime example of modernism, blending classical concepts with the garden city model. Despite its strict functional zoning, this project laid the groundwork for the contemporary '*15-minute city*' by introducing self-sufficient sectors. By relocating industry to the periphery and reducing the need for movement within neighborhoods, it aimed to ensure a high quality of residential life (Rodríguez-Lora, Rosado and Navas-Carrillo, 2021).

POSTMODERNISM AND THE CRITIQUE OF FUNCTIONAL ZONING (THE SECOND HALF OF THE 20TH CENTURY)

With the development of postmodernism and critical urban theory in the mid-20th century, earlier modernist ideals of comprehensive solutions and functional land zoning came under scrutiny. Contemporary architecture theorists²¹ focused on specific challenges and values, with the main starting points be-

ing the connection of functions, strengthening local resilience, sustainability, and social equity. Critiques of the functional zoning began within the CIAM profession itself, through the activities of the Team X group, which rejected Le Corbusier's rigid rationalism in favor of an '*open society*' and a more human scale (Pedret, 2001).

During the last decade of the 20th century, Jane Jacobs²² offered a radically different approach to urban planning. In her book *The Death and Life of Great American Cities*, Jacobs criticizes the consequences of functional zoning and advocates mixed-use spaces in which housing, retail, and small-scale industry are intertwined. Her ideas marked a turning point in urban thought, emphasizing that life cannot be separated from the economy without damaging the fabric of the city (Jacobs, 1993).

Building on these ideas, Christopher Alexander²³, in his publication '*A City is Not a Tree*', made a significant contribution to the critique of *modernism*. He pointed out that real cities do not function as hierarchical, isolated entities, but as a complex, interconnected network, criticizing the sterility and inhumanity of modernist plans (Alexander, 2013).

These theoretical foundations led to the development of postmodernist practices, including *New Urbanism* – a movement promoting a return to traditional building forms, walkability, mixed-use development, and public spaces (Duany, Plater-Zyberk and Speck, 2000). Today, this trend is amplified by the digital economy, which blurs the boundaries between work and home (Garde, 2020). Simultaneously, the emergence of the *footloose industry*²⁴ concept, such as IT and creative industries, enabled the integration of business activities directly into the urban fabric, adapting the city to contemporary needs (Allen, Stone, 1989).

CONTEMPORARY APPROACHES AND CHALLENGES OF SUSTAINABLE DEVELOPMENT (21ST CENTURY)

Contemporary approaches to European physical planning in the 21st century focus on sustainable urban development, which emerged in response to criticisms of postmodernism. While postmodernism strives for mixed-use development, it often neglects broader social and environmental concerns. Based on these principles, the new physical planning goal should be to create business areas that are ecologically, socially, and economically acceptable (UN-Habitat, 2016). The main instruments for achieving these goals are contained in 3 key initiatives: the *European*

American-Canadian journalist and activist; Henri Lefebvre (1901-1991), French philosopher and sociologist; and David Harvey (1935-), geographer and Marxist theorist.

²² Jacobs, Jane (1916-2006), American-Canadian journalist and city activist

²³ Alexander, Christopher (1936-2022), British-American architect, design theorist, and professor

²⁴ The term describes a business that isn't tied to a specific location because it doesn't heavily rely on local resources, labor, or transport of any kind. This business can be situated nearly anywhere with good transit networks, skilled labor, or market access. Examples are software development, computer chip manufacturing, pharmaceuticals, and call centers, often characterized by high-value, low-weight products and eco-friendliness.



FIG. 6 ZAGREB BUSINESS AREAS LAY-OUT SCHEME, 1 SMALL CRAFTS, 2 DOWNTOWN (SMALL BUSINESS AND TRADE CENTERS AND BUILDINGS), 3 ŽITNJAK (INDUSTRY AND TRADE CENTERS), 4 JANKOMIR (INDUSTRY AND TRADE CENTERS), 5. BROWNFIELD LOCATIONS

*Green Deal*²⁵, the *Urban Agenda 2030*²⁶, and the *New European Bauhaus*²⁷.

These frameworks steer planners away from linear production models toward regenerative practices. The principles of *circular economy*²⁸ require business areas to be treated as hubs for recycling, renewable energy, and resource reuse (Geissdoerfer et al, 2017). Parallel to this, the '15-minute city' model (Moreno et al, 2021) encourages the development of smaller manufacturing and logistics activities within short distances, challenging the traditional separation of housing and work.

Rather than expanding into new greenfield sites, the focus should shift toward the revitalization of abandoned industrial brownfield sites and environmental preservation. It is necessary to incorporate circular economy principles to reduce waste and promote the use of renewable energy and 'green' industry. Due to changes such as the growth of e-commerce, strict zoning is being replaced by flexible frameworks that permit mixed-use functions and the transformation of older zones into logistics, R&D, or creative hubs. The goal is to create sustainable business zones that are integrated into the urban fabric and aligned with the EU's socio-economic and environmental standards.

PHYSICAL PLANNING OF BUSINESS AREAS AND CROATIAN LEGISLATION

Following theoretical reviews of utopian and sustainable concepts of the ideal city, it is essential, using content analysis, to examine how these principles have been applied in practice in Croatian legislation. The Croatian context is highly relevant to the broader European framework as it represents a post-socialist country transforming its planning system while simultaneously integrating con-

temporary EU norms and strategic policy frameworks (e.g., the *Green Deal*).

At the end of the 19th and the beginning of the 20th century, urban (physical) planning in Croatia was based on the Kingdom of Croatia and Slavonia Building Acts (Smrekar, 1902). The modern legal framework was established by the *Physical and Regional Planning Act* (1961)²⁹ and further defined by the *Spatial Planning and Building Land Use Act* (1973)³⁰. Historical analysis indicates a strong influence of CIAM and the Athens Charter over the domestic practice. During the socialist period, these principles led to the adoption of strict functional zoning, resulting in the development of large industrial zones on the urban periphery, such as Žitnjak and Jankomir in Zagreb.

That approach embodied the modern ideal of total separation of work from residential areas. This functionalist legacy continues to exert a strong influence on planning today. Although contemporary plans have evolved to respond to new social demands, the core principle of spatial segregation between residential, recreational, and business areas has remained virtually unchanged.

The *Physical and Spatial Planning Act* (1980)³¹ had a profound impact on the physical planning practice (until 1994) in the independent and sovereign Republic of Croatia. Although it was adopted during the Yugoslav period, urban and physical planners applied its legal regulations in the years following Croatian independence. The planning goal of that time was to harmonize planning with socio-economic interests and to protect/improve the human environment. Although this Act provided specific legal stability, its foundations, imbued with the utopian ideals of socialism regarding social planning and spatial development, could not fully respond to the new challenges that emerged with Croatia's independence.

New Croatian laws have gradually moved away from the strict zoning model. The *Spa-*

²⁵ The European Green Deal (2019) sets the course toward climate-neutral economies, requiring the application of circular economy principles and the promotion of industrial symbiosis in spatial planning.

²⁶ The Urban Agenda 2030, guides cities toward the integrated planning of functional and socially cohesive zones.

²⁷ The New European Bauhaus (2021), redefines purely functional industrial spaces, linking sustainability with aesthetics and social inclusion through co-designed urban spaces.

²⁸ The World Economic Forum defines a *circular economy* as "an industrial system that is restorative or regenerative by intention and design."

²⁹ Zakon o urbanističkom i regionalnom prostornom planiranju (Narodne novine br. 21/1961, 40/1964, 29/1966, 18/1969)

tial Planning Act (1994)³² and the *Spatial Planning and Construction Act* (2007)³³ have introduced greater flexibility and decentralization, thereby strengthening the role of local authorities in planning their own spaces. However, the basic division into zones has been retained. These laws have established a hierarchical system of physical planning (state, county, and city/municipal) that enables the implementation of broader strategies at the local level. The approach has evolved from idealistic visions of controlled and organized urban growth to address real-world needs. The selected example is the City of Zagreb (Fig. 1), where a dynamic compromise is evident in the General Urban Plan (GUP) and its implementation decisions. Idealistic visions often clash with the specific interests of the market and investors, leading to a persistent conflict between the goals of sustainable development and the demands for rapid economic growth.

A schematic presentation of Zagreb's main commercial areas and business zones indicates that the central area has greater sustainable potential (brownfield redevelopment) than faster, more profitable peripheral development (Fig. 6). This spatial pattern reflects the continuity of functional zoning and the persistent challenge of a sustainable integration of business/commercial areas.

The most significant breakthrough occurred with the adoption of the *Spatial Planning Act* in 2013³⁴, which retained the hierarchy of physical and urban plans and zoning while emphasizing sustainable development, integrated planning, and environmental protection. Rather than utopian ideals, it represents a practical approach developed in response to the real challenges and needs of modern Croatian society. It regulates the procedures, obligations, and responsibilities of various participants (the state, counties, cities/municipalities, planners, and residents/investors) to ensure legality and efficiency in the implementation of physical and urban plans.

Although it is not a utopian vision, legislative development demonstrates a continuous effort to apply planning and urban theories in practice through the preparation and adoption of physical and urban plans. The goal of this legislative framework is to create functional, economically sustainable, and environmentally acceptable areas for the development of business areas that will benefit all space users.

The planning of business/commercial areas is carried out through a hierarchy of physical and urban plans. At the highest level, there are two planning documents: the Spatial Development Strategy of the Republic of Croatia and the National Physical Development Plan, which establish general guidelines and locations for business/commercial areas at the state and county levels of interest. At the county level, the County Physical Plan determines the locations of business/commercial areas of county importance, considering specific characteristics, environmental values, and each region's potential. The most detailed development of business areas is carried out at the local level. The City or Municipality Physical Plan determines the primary land use of space within an administrative boundary, including zoning for business/commercial areas. For more detailed planning within these areas, physical and/or urban planners are responsible for preparing Urban Development Plans. These plans precisely define the boundaries of business/commercial areas, the road network, the locations and sizes of building plots, and the planning conditions for their construction.

Thus, through this complex planning and environmental protection system, utopian ideas about functionality have been transformed into a set of rules that ensure the region's development is and will be in accordance with environmental and sustainable conditions, preserving the identity of Places (Municipalities, Cities, Counties/Regions).

Despite the modernization of the law, challenges typical of the post-transition period arise in practice. An analysis of business/commercial areas in Istria (Čok, Kavaš, and Zimmermann, 2016) shows how the legal goals of sustainable development clash with market needs. In Istria, planning has resulted in an excess of space allocated to business/commercial areas, due to unplanned, fragmented planning driven by short-term and political interests rather than strategic market needs. The authors emphasized that, despite the hierarchy of plans, the lack of transparency in data regarding the purpose and infrastructure of these areas has made zon-

30 Zakon o prostornom uređenju i korištenju građevinskog zemljišta (*Narodne novine* br. 14/1973, 15/1979)

31 Zakon o prostornom planiranju i uređivanju prostora (*Narodne novine* br. 54/1980, 16/1986, 18/1989, 47/1989, 34/1991, 61/1991, 49/1992, 26/1993, 59/1993, 14/1994, 29/1994)

32 Zakon o prostornom uređenju (*Narodne novine* br. 30/1994, 68/1998, 35/1999, 61/2000, 32/2002, 100/2004)

33 Zakon o prostornom uređenju i gradnji (*Narodne novine* br. 76/2007, 38/2009, 55/2011, 90/2011, 50/2012, 55/2012, 80/2013)

34 Zakon o prostornom uređenju (*Narodne novine* br. 153/2013, 65/2017, 114/2018, 39/2019, 98/2019, 67/2023)

ing an ineffective tool for managing spatial and business development.

Furthermore, the lack of explicit incorporation of European investment and policy mechanisms (e.g., funding for circular-economy projects or incentives for brownfield regeneration linked to the *Green Deal*) into physical planning documents weakens the potential for strategic, sustainable growth.

CONCLUSION

The research conducted so far has confirmed that the history of planning business and commercial zones near cities is a very complex process, interwoven with utopian ideas of the *Ideal City*. From the organic integration in ancient and medieval cities to the functional zoning of modernism and contemporary aspirations for sustainable development, physical and urban planning is a testimony to social changes that have occurred throughout history.

The central research problem addressed in this paper is the persistent conflict between the historical legacy of strict functional zoning, inherited from the modernist era (CIAM), and the contemporary drive toward integrated, sustainable, and aesthetically cohesive urban development, as defined by European policies. In Croatia, despite the legal framework supporting sustainable development, practice is often constrained by numerous obstacles. Despite well-defined legal regulations and guidelines that are crucial to sustainable spatial development, the law remains vague regarding physical and urban planning, as well as the future sustainable development of business/commercial areas. The law has not recognized business/commercial areas as a distinct category; instead, the emphasis is on the term “economy” and on ensuring spatial conditions for business development as a primary goal of physical planning. This interpretation enables planners, local self-governments, and investors to determine other spatial conditions for economic development themselves, thereby primarily pushing goals into the background. The actual planning process is often influenced by the interests of short-term investors and by the fulfillment of general planning conditions derived from legislative Acts, which undoubtedly leads to unplanned built spaces.

The key findings of this study highlight a pronounced continuity of functionalism within Croatian legislation. The Croatian spatial planning system, established during the post-war development period, has maintained strict functional separation in line with CIAM principles. This historical framework continues to determine the location of large business zones today. At the same time, there is a significant lack of explicit mechanisms for incorporating European strategic frameworks, such as the *Green Deal*, the *New European Bauhaus*, and *circular-economy* principles, into domestic spatial plans. This prevents effective brownfield regeneration and the transformation of business/commercial areas into mixed-use models or ‘15-minute cities,’ as economic zones are integrated into residential areas without clear criteria, undermining the quality of urban development.

This paper’s overall contribution lies in establishing a comprehensive historical and theoretical framework that connects the evolution of planning ideas about the *Ideal City* with contemporary challenges in physical planning for business/commercial areas within the Croatian legislative context. By identifying critical discrepancies between historical planning ideals (functional zoning) and contemporary needs for sustainability and mixed-use development, this research provides the necessary theoretical foundation for future planning processes and policy making. The main application of the research results is to guide planners and decision-makers in the thoughtful planning of business areas by prioritizing social, environmental, and economic values to address practical problems identified in the Croatian planning environment.

The primary limitation of this study is its reliance on legislative and theoretical review. The beginning of this (wider) research provided a historical overview of the planning of business/commercial areas, envisioned through urban planning theories and the implementation of principles for utopian and sustainable cities within the Croatian legal framework and physical planning practice. Future research will focus on a more detailed analysis of practical examples from existing planned economic areas, aiming to identify the best practices and potential improvements in the planning process.

BIBLIOGRAPHY AND SOURCES

1. ALEXANDER, C. (2013) "A City is Not a Tree" in Larice, M., Macdonald, E. (eds.). *The Urban Design Reader*. 2nd ed. London: Routledge, pp. 152-166. [online]. Available at: <https://doi.org/10.4324/9780203094235> [Accessed: November 18th, 2025].
2. ALLEN, R. C. and STONE, J. H. (1989) "The Locational Criteria of Footloose Firms: A Formal Model", *Review of Regional Studies*, 19(2), pp. 13-17. [online]. Available at: <https://doi.org/10.52324/001c.9240> [Accessed: November 18th, 2025].
3. ÁNGEL, M. and RUBIO, M. (2017) "The 'Linear city' alternative to the unstoppable growth of the present city", *Estoa. Journal of the Faculty of Architecture and Urbanism*, 6(11), pp. 71-80. [online]. Available at: <https://doi.org/10.18537/est.v006.n011.a05> [Accessed: November 18th, 2025].
4. ARISTOTEL (1988a) *Nikomahova etika*. (translated by Ladan, T.), Zagreb: Globus.
5. ARISTOTEL (1988b) *Politika*. (translated by Ladan, T.), Zagreb: Globus.
6. BEESON, E.W. (1911) *Port Sunlight: The model village of England, a collection of photographs*. New York: The Architectural Book Publishing Company. Internet Archive [online]. Available at: <https://archive.org/details/portsunlight-modeoobees/page/n5/mode/2up> [Accessed: July 31st, 2025].
7. BIROLI, V. (2018). "Bâtir le manifeste: de La Città Nuova d'Antonio Sant'Elia au manifeste architectural contemporain", *Itinéraires*. 2018-1, pp. 1-20. [online]. Available at: <https://doi.org/10.4000/itineraires.4223> [Accessed: November 18th, 2025].
8. ČOK, G., KAVAŠ, D. and ZIMMERMANN, R. (2016). "Business Zones in Slovenian and Croatian Istria Locations, Capacity and Development Problems", *Prostor*, 24 (2(52)), pp. 254-267. [online]. Available at: [https://doi.org/10.31522/p.24.2\(52\).9](https://doi.org/10.31522/p.24.2(52).9) [Accessed: November 18th, 2025].
9. DECKER, C. (2018) "25. Edward Bellamy, Looking Backward 2000-1887 (1888)" in Gerhardt, C. (ed.) *Handbook of the American Novel of the Nineteenth Century*, Berlin, Boston: De Gruyter, pp. 474-489. [online]. Available at: <https://doi.org/10.1515/9783110481327-026> [Accessed: November 18th, 2025].
10. DUANY, A., PLATER-ZYBERK, E. and SPECK, J. (2000). *Suburban Nation: The Rise of Sprawl and the Decline of the American Dream*. New York: North Point Press. Internet Archive [online]. Available at: <https://archive.org/details/suburbannationriooduan> [Accessed: July 30th, 2025].
11. ELDER, S. (2014) "Building Culture: Ernst May and the new Frankfurt Initiative, 1926-1931", *German History*, 32(4), pp. 659-660. [online]. Available at: <https://doi.org/10.1093/gerhis/ghuo70> [Accessed: November 18th, 2025].
12. FISHMAN, R. (1982) *Urban Utopias in the Twentieth Century: Ebenezer Howard, Frank Lloyd Wright, and Le Corbusier*. London: MIT Press. Internet Archive [online]. Available at: <https://archive.org/details/urbanutopiasintwoooofish> [Accessed: July 30th, 2025].
13. FRAMPTON, K. (1992) *Moderna arhitektura, Kri-ticka povijest*. Zagreb: Globus.
14. GARDE, A. (2020) "New Urbanism: Past, Present, and Future", *Urban Planning*, 5(4), pp. 453-463. [online]. Available at: <https://doi.org/10.17645/up.v5i4.3478> [Accessed: December 20th, 2025].
15. GEISSDOERFER, M., SAVAGET, P., BOCKEN, N. M. P. and HULTINK, E. J. (2017) "The Circular Economy: A new sustainability paradigm?", *Journal of Cleaner Production*, 143, pp. 757-768. [online]. Available at: <https://doi.org/10.1016/j.jclepro.2016.12.048> [Accessed: December 20th, 2025].
16. HALL, P. (2014) *Cities of Tomorrow: An Intellectual History of Urban Planning and Design since 1880*. 4th ed. Hoboken, NJ: Wiley-Blackwell. Internet Archive [online]. Available at: <https://archive.org/details/citiesoftomorrow-oooohall> [Accessed: July 30th, 2025].
17. HOWARD, E. (2007) *Garden Cities of To-Morrow* in Osborn, F. J., (ed.). 1st ed. London: Routledge. [online]. Available at: <https://doi.org/10.4324/9780203716779> [Accessed: November 18th, 2025].
18. HUBBARD, E. and SHIPPOBOTTOM, M. (2005) *A guide to Port Sunlight village: including two tours of the village*. 2nd ed. Liverpool: University Press. Internet Archive [online]. Available at: <https://archive.org/details/guidetoport-sunlio000hubb> [Accessed: July 31st, 2025].
19. HUGO, M. and BHANYE, J. (2022) "The influence of classical 'green' theories on contemporary industrial planning practices: A review study", *Town and Regional Planning*, 81, pp. 39-52. [online]. Available at: <http://dx.doi.org/10.18820/2415-0495/trp81i1.4> [Accessed: December 20th, 2025].
20. JACOBS, J. (1993) *The death and life of great American cities*. New York: Modern Library. Internet Archive [online]. Available at: https://archive.org/details/deathlifeofgreatoooojaco_e4x9/page/n7/mode/2up [Accessed: July 25th, 2025].
21. KING, L. W. (Trans.). (1915) *The Code of Hammurabi*. (Original work published c. 1750 BC). [Digital edition edited by P. J. S. Pereira, 2011]. [online]. Available at: <https://www.general-intelligence.com/library/hr.pdf> [Accessed: December 20th, 2025].
22. KOSTOF, S. (1991) *The City Shaped: Urban Patterns and Meanings Through History*. New York – Boston: Bulfinch Press. Internet Archive [online]. Available at: <https://archive.org/details/cityshapedurbanpooookost> [Accessed: July 30th, 2025].
23. LE CORBUSIER (1973) *The Athens Charter*. New York: Grossman Publishers.

24. LIPOVAC, N. (2000) *Planning as a Function of Preserving the Identity of Place*. Ph.D. Dissertation. University of Zagreb, Faculty of Architecture, College of Environmental Design, University of California at Berkeley
25. LIPOVAC, N. (2014) *English-Croatian Professional Glossary for Urban and Physical Planners*. Architects and Landscape Architects. Faculty of Architecture. Zagreb: University of Zagreb.
26. LIPOVAC, N. and ROŽEK, R. (2020) „Urban and Physical Planning – a Tool for Preserving and Creating Places”, In: GEA (Geo Eco-Eco Agro) International Conference, pp. 28-31. May 2020, Montenegro – Book of Proceedings II, Podgorica: University of Montenegro. [online]. Available at: https://geasci.org/conference_2020/ [Accessed: July 25th, 2020].
27. MILIĆ, B. (1995) *Razvoj grada kroz stoljeća II. srednji vijek*, Zagreb: Školska knjiga.
28. MILIĆ, B. (2002) *Razvoj grada kroz stoljeća III. Novo doba*, Zagreb: Školska knjiga.
29. MILIUTIN N. A., SPRAGUE A. R., COLLINS G. R. and ALEX W. (1975) *Sotsgorod: the problem of building socialist cities*. Cambridge, Massachusetts: MIT. Press. [online]. Available at: <https://doi.org/10.7551/mitpress/6353.001.0001> [Accessed: December 20th, 2025].
30. MEEROVICH, M. (2014) “Identity of a Soviet Town: from the Garden City by an Englishman E. Howard to the Socialist City by a German E. May. Shcheglovsk-Kemerovo, Stalinsk-Novokuznetsk, Novonikolaevsk-Novosibirsk”, *Proekt Baikal*, 11(42), pp. 90-93. [online]. Available at: <https://doi.org/10.7480/projectbaikal.42.795> [Accessed: December 20th, 2025].
31. MORENO, C., ALLAM, Z., CHABAUD, D., GALL, C. and PRATLONG, F. (2021). “Introducing the ‘15-Minute City’: Sustainability, Resilience and Place Identity in Future Post-Pandemic Cities”, *Smart Cities*, 4(1), pp. 93-111. [online]. Available at: <https://doi.org/10.3390/smartcities4010006> [Accessed: December 20th, 2025].
32. MUMFORD, L. (2008) *Povijest utopija*. (translated by Tomić, P.), Zagreb: Jesenski i Turk.
33. NABILA, N. (2021) “The concept of garden city and its relevancy in modern city planning”, *Southeast University Journal of Architecture*, 1(1), pp. 1-7. [online]. Available at: <https://www.researchgate.net/publication/353437083> [Accessed: December 20th, 2025].
34. PLATON (2002) *Država*. (translated by Vilhar, A. and Pavlović, B.) Beograd: Beogradsko izdavački-grafički zavod.
35. PEDRET, A. (2001). *CIAM and the Emergence of Team 10 Thinking, 1945-1959*. PhD Dissertation, MIT. [online]. Available at: <https://www.academia.edu/74370186/> [Accessed: December 19th, 2025].
36. RODRÍGUEZ-LORA, J.-A., ROSADO, A. and NAVAS-CARRILLO, D. (2021). “Le Corbusier’s Urban Planning as a Cultural Legacy. An Approach to the Case of Chandigarh”, *Designs*, 5(3), 44. [online]. Available at: <https://doi.org/10.3390/design5030044> [Accessed: December 19th, 2025].
37. ROSENAU, H. (1983) *The Ideal City: Its Architectural Evolution in Europe*. 1st ed. London: Routledge. [online]. Available at: <https://doi.org/10.4324/9780203716656> [Accessed: November 18th, 2025].
38. SHARE, A.J. (1982) *Cities in the Commonwealth: Two Centuries of Urban Life in Kentucky*. Lexington, KY. The University Press of Kentucky. [online]. Available at: https://uknowledge.uky.edu/upk_united_states_history/32 [Accessed: December 19th, 2025].
39. SMREKAR, M. (1902) *Priručnik za političku upravnju službu u kraljevinah Hrvatskoj i Slavoniji*, book 3, Zagreb: Ignjat Granitz.
40. ŠIMUNOVIĆ, I. (2018) *Prostorne carolije*, Split: Naklada Bošković.
41. THÜNEN, J. H. von. (1910). *Der isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie*. Jena: Verlag von Gustav Fischer. [online]. Available at: <https://doi.org/10.5962/bhl.title.28726>. [Accessed: November 18th, 2025].

AUTHORS' BIOGRAPHIES AND CONTRIBUTIONS

42. VERNET, N. and COSTE, A. (2017) "Garden Cities of the 21st Century: A Sustainable Path to Suburban Reform", *Urban Planning*, 2(4), pp. 181-196. [online]. Available at: <https://doi.org/10.17645/up.v2i4.1104> [Accessed: December 20th, 2025].
43. VITRUVIUS (1999), *De architectura libri decem* (translated by Lopac, M., Bedenko, V.) Zagreb: Golden marketing: Institut gradevinarstva Hrvatske.
44. WEBER, A. (1909), *The Theory of The Location of Industries*. The University of Chicago Press, Chicago & London.
45. WILSON, H. W. (1989) *The City Beautiful Movement*, Baltimore: Johns Hopkins University Press.
46. WINGLER, H.M. (1976) *The Bauhaus: Weimar, Dessau, Berlin, Chicago*, Cambridge, Massachusetts: The MIT Press. Internet Archive [online]. Available at: <https://archive.org/details/bauhausweimardesoowwing> [Accessed: 20 December 2025].
47. ZAPATEL, J.A. (2017) "Das Neue Frankfurt", *PósFAUUSP*, 24(42), pp. 64-73. [online]. Available at: <https://doi.org/10.11606/issn.2317-2762.v24i42p64-73> [Accessed: December 20th, 2025].
48. EU Regional Policy (2011) *Cities of tomorrow: Challenges, visions, ways forward*, Brussels: European union. [online]. Available at: https://ec.europa.eu/regional_policy/en/information/publications/reports/2011/cities-of-tomorrow-challenges-visions-ways-forward [Accessed: July 30th, 2025].
49. UN-Habitat. (2016) *New Urban Agenda*. United Nations. [online]. Available at: <https://unhabitat.org/about-us/new-urban-agenda> [Accessed: July 30th, 2025].
50. *** (1961) *Zakon u urbanističkom i regionalnom prostornom planiranju* (Narodne novine br. 21/1961, 40/1964, 29/1966, 18/1969). [online]. Available at: <https://www.iusinfo.hr/document?sopi=ZA1961B21A79> [Accessed: 15 March 2022].
51. *** (1973) *Zakon o prostornom uređenju i korištenju građevinskog zemljišta* (Narodne novine br. 14/1973, 15/1979). [online]. Available at: <https://www.iusinfo.hr/zakonodavstvo/zakon-o-prostornom-uredenju-i-koristenju-gradevinskog-zemljista> [Accessed: March 15th, 2022].
52. *** (1980) *Zakon o prostornom planiranju i uređivanju prostora* (Narodne novine br. 54/1980, 16/1986, 18/1989, 47/1989, 34/1991, 61/1991, 49/1992, 26/1993, 59/1993, 14/1994, 29/1994). [online]. Available at: <https://www.iusinfo.hr/document?sopi=ZA1980B54A1011> [Accessed: March 15th, 2022].
53. *** (1994) *Zakon o prostornom uređenju* (Narodne novine br. 30/1994, 68/1998, 35/1999, 61/2000, 32/2002, 100/2004). [online]. Available at: <https://www.iusinfo.hr/zakonodavstvo/zakon-o-prostornom-uredenju-1994> [Accessed: March 15th, 2022].
54. *** (2007) *Zakon o prostornom uređenju i gradnji* (Narodne novine br. 76/2007, 38/2009, 55/2011, 90/2011, 50/2012, 55/2012, 80/2013). [online]. Available at: <https://www.iusinfo.hr/zakonodavstvo/zakon-o-prostornom-uredenju-i-gradnji> [Accessed: March 15th, 2022].
55. *** (2013) *Zakon o prostornom uređenju* (Narodne novine br. 153/2013, 65/2017, 114/2018, 39/2019, 98/2019, 67/2023). [online]. Available at: <https://www.iusinfo.hr/zakonodavstvo/zakon-o-prostornom-uredenju> [Accessed: March 15th, 2022].

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FIG. 3 Drawing by authors, 2025

FIG. 4 Drawing by authors, 2025

FIG. 5 Drawing by authors, 2025

FIG. 6 Drawing by authors, 2025

BOOK REVIEWS

SUMMARIES OF
DOCTORAL DISSERTATIONS

NEBOJŠA ANTEŠEVIĆ

ARCHITECT MILAN ZLOKOVIĆ – PAINTERLY IMPULSES AND ARTISTIC SENSIBILITIES

ARHITEKT MILAN ZLOKOVIĆ – SLIKARSKI PORIVI I LIKOVNI SENZIBILITET

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The third book on the versatile architect and scientist Milan Zloković (1898-1965) has been published. While the first volume focuses on architecture and photography (2023), and the second explores unrealized urban and architectural projects in Vojvodina (2024), this third book is dedicated to the architect's artistic oeuvre (2025).

The author of all three books is architect Dr. Nebojša Antesević, a curator at the Museum of Applied Arts in Belgrade and a research associate of the Milan Zloković Foundation. Considering the multifaceted personality of Milan Zloković – an architect by training and a professor (as well as former dean) at the Faculty of Architecture in Belgrade – it is evident that his work is deeply intertwined with photography and painting. These disciplines served not only his design needs, both interior and exterior, but were also a source of inspiration and personal tranquility.”

Although more than 3,000 of his works have survived, approximately 90 pieces – mostly watercolors – are currently on display at the Museum of Applied Arts in Belgrade, accompanied by a dedicated book. The exhibition features architectural sketches and their realizations, landscapes, still lifes, female figures, and abstract drawings characterized by structured Neoplastic lines. His work is defined by a breezy, natural freshness, but also by an eroticism found in sensual depictions of young

women. It is, therefore, no surprise that the architect Zloković wrote in 1920: ‘Everything that gives me the impression of being beautiful or interesting attracts my attention.’ This statement highlights how diverse influences shape both architectural creativity and an architect's personal versatility.

Examining the painting oeuvre of architect Zloković, as showcased in the exhibition (Belgrade, 28/05/2025-28/06/2025) and the 153-page monograph, reveals a profound synthesis of architecture and painting. His work investigates spatial proportions and Corbusian modules in a quest for broad visual innovation. Given his conviction that proportion constitutes the basis of every composition, he devoted himself to the theory of modular coordination starting in the 1950s, aiming to integrate it into architectural practice.

Given that Zloković acquired his architectural knowledge in Graz and Belgrade and specialized in Paris (at the Ecole Supérieure des Arts, 1921-23), he did not accept the limitations on architectural creativity imposed by regulatory systems or legal restrictions. Born in Trieste, architect Zloković drew natural inspiration from the Mediterranean – as evidenced by his depictions of Croatia, Montenegro, Malta, and Morocco – while his professional era deeply aligned him with Modernism. His connection to Croatia is further established through various urban and

architectural competitions in which he participated from 1923 onwards.

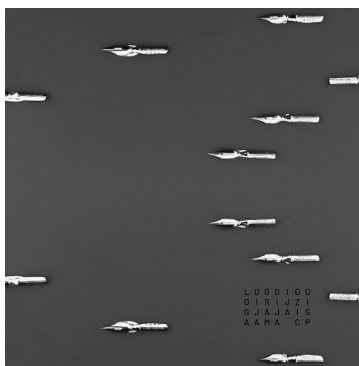
He participated in numerous competitions and projects across Croatia, including: the Central Office for Workers' Insurance in Zagreb (1923); the District Office for Workers' Insurance in Osijek (1934); the Maritime Museum in Split (1927/1928); and the regulation of the Lapad Peninsula in Dubrovnik (1936). His later work includes the 1954 competition for a hotel on Lapad, the 1947 workers' settlement for the Kvarner Shipyards in Rijeka, the Slavonski Brod railway station (1960), and the conceptual design for a church in Glin (1961). Notable private commissions include the Villa of Captain Begović (1934) and the Begović family tomb chapel (1936/37) in Orebić, as well as the Mihajlović Residence in the Ploče district of Dubrovnik and the 1954 competition for the People's Committee building in Virovitica. This volume dedicated to Zloković's painting highlights several of his works from Croatia, including: View of Rovinj (1949), Olive Grove in Orebić (1948), Scene from the Split Riva (1953), Scene from Dubrovnik (1961), and View of Mali Lošinj (1961).

Undoubtedly, Nebojša Antesević and the Milan Zloković Foundation have succeeded in highlighting the architect's painting oeuvre by showcasing the diverse techniques Zloković employed – ranging from drawings and watercolours to tempera and felt-tip pen.

S. HABJAN, B. LUKAČ, I. TUTEK

DISPOSITION
— DIALOGUE DIAGRAMDISPOZICIJA
— DIJAGRAM DIJALOGA

REVIEWED BY: MIA ROTH-ČERINA



University of Zagreb Faculty of Architecture, 2025

Authors: Stanislav Habjan, Bernarda Lukač, Ivana Tutek

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Robert Pavlovic, Dubravka Vrgoc234 pages, illustrated, 2-sided layout
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The book *Disposition – Dialogue Diagram* bring together the results of a multiannual pedagogical and artistic research project which took place across a number of workshops and exhibitions which started at the Modulator Gallery in Zagreb and then extended to other cultural venues such as the SC Gallery, Žitnjak Atelier and others. Conceived by Stanislav Habjan, Bernarda Lukač and Ivana Tutek, who acted as mentors of the workshops, editors of this book and generators of a broader interdisciplinary dialogue. The publication is structured as a document of the process as well as an autonomously designed medium which inherits the logic of its own content: diagrammatic, fragmented and open-ended.

Disposition – Dialogue Diagram exceeds being a catalogue documenting a series of workshops and exhibitions. The publication operates simultaneously as an archive, a pedagogical manifesto, and a reflection on the possibilities of diagrammatic thinking as a mode of artistic and architectural inquiry. Bringing together five years of collaborative experimentation, it demonstrates how architecture can become a meeting ground for literature, music, film, dance, and visual arts through processes of translation and trans-coding. It also provides a valuable testament on the importance of extramural experiences for students of architecture which aid in broadening their horizon on other disciplines, as well as applying an architectural and artistic mode of graphic synthesis to articulate immaterial and tacit understandings into a visual language.

The chronology of workshops, exhibitions and performances which took place between 2020 and 2025 presents evidence of a gradually evolving methodology, in which each iteration extends the conceptual framework established by the previous one. The gallery spaces themselves became active participants in the dialogues, influencing the modes of presentation and expression, functioning as laboratories and enabling the transition

from classroom exercise to public cultural production.

Perhaps the publication's most significant contribution lies precisely in its insistence on the value of extracurricular educational formats. Situated outside the constraints of regular studio teaching, the workshops create conditions for experimentation that conventional curricula rarely permit. Students are encouraged to operate without predetermined outcomes, embracing uncertainty and free interpretation. In this way they extend their architectural thinking into a construct of relationships and abstract narratives. The book demonstrates that meaningful architectural education can occur in the contexts in which disciplinary boundaries become porous and where learning unfolds through dialogue with other artistic practices.

Central to this approach was the concept of the diagram, which was understood as an operational device, a generative mechanism capable of activating space, movement, and imagination. Throughout the publication, diagrams appear simultaneously as analytical tools, compositional strategies, poetic constructs, and performative scripts. They mediate between the material and the conceptual, between existing space and projected possibility, recalling philosophical interpretations of the diagram as an abstract machine rather than a static representation of existing realities. In this context, drawing becomes an act of thinking, while the process of diagramming itself emerges as a form of artistic research freely flowing across disciplines. Literature becomes spatial sequence, music becomes rhythm and structure, film informs montage and temporality, while dance introduces movement as a constitutive architectural element. These translations extend literal equivalence and generate productive misalignments through which new forms of architectural imagination emerge. The publication convincingly argues for new forms of expression which often reside beyond disciplinary expertise, in the friction created when one medium attempts to inhabit another.

The editorial and graphic conception of the book reinforces these ambitions. Designed by the authors, the book refuses the conventional hierarchy between text and image. Typography, photography, diagrams, and documentation are composed as equal actors within an orchestrated visual field. The publication itself becomes diagrammatic: nonlinear, layered, associative, and open to multiple paths of reading. Its language reproduces their experimental logic inviting readers to navigate relationships rather than consume information sequentially.

The process of the workshops is highlighted, as the publication foregrounds sketches, intermediate states, conceptual notes, and propositions. This emphasis aligns with contemporary understandings of design-driven research, where knowledge is generated through making rather than merely communicated after completion. In doing so, *Disposition* documents what students produced as well as how they learned, negotiated, and transformed ideas.

The collaborative nature of the authors conceiving the project deserves particular attention. The interaction between architect and educator Ivana Tutek, architect and musician Bernarda Lukač, and multimedia artist and writer Stanislav Habjan establishes a pedagogical model based on complementary expertise rather than disciplinary authority. Students encounter architecture through conversations with poetry, performance, sound, and visual media, acquiring methods that extend beyond architectural representation. Such encounters aid the cultivation of interpretative flexibility, qualities pivotal to contemporary architectural practice. In this regard, the activities brought together in this dual-ended volume make an argument for rethinking how architectural knowledge is produced and shared, proposing diagrams as vehicles of dialogue. It also advocates for extra-institutional environments as fertile grounds for expanded understanding and interdisciplinary negotiation in which students learn to converse with the broader cultural environment.

BEATRICE MORETTI

LANDSCAPES OF THE CLUSTER – A SPATIAL APPROACH TO PORTS

REVIEWED BY: DORA IVANČAN



Publisher: JOVIS

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Port spaces are complex and dynamic environments shaped by the need to reconcile often conflicting interests related to the economy, ecology, security, accessibility, and social inclusion. At the same time, contemporary ports are undergoing a profound transition that demands constant adaptability, positioning them as spaces for experimentation in addressing pressing challenges such as climate change, migration, sustainability, and technological innovation. Their impact is undoubtedly significant for the cities in which they are located, yet their influence extends far beyond them, often encompassing entire regions. This expanded spatial dimension constitutes the central theme of the monograph *Landscapes of the Cluster – A Spatial Approach to Ports* by Beatrice Moretti, an architect and assistant professor in the Department of Architecture and Design at the University of Genoa.

Contemporary ports are increasingly organised into clusters, denoting the administrative aggregation of two or more ports. Such governance decisions create new spatial typologies of ports, new zones of influence, and new spatial networks. The introduction of the concept of “port cluster landscapes” recognises the importance of architecture, urbanism, and strategic planning in the development of these areas. To adequately address the issue of port clusters, the monograph establishes new lexical categories, mappings, and strategies that enable the observation, understanding, and future planning of this spatial phenomenon.

The monograph is the result of the two-year research project PULSE, conducted between 2022 and 2024. The project focuses on establishing a dialogue between academia and the institutional sector, emphasising the role of space as a tool for understanding and designing contemporary ports, as well as highlighting the role of architecture and urbanism in designing operational zones, port clusters, and coastal settlements.

The monograph opens with a *Foreword* by Carmen Andriani, who highlights the importance of researching infrastructure as an innovative and adaptable structure, as well as

the necessity of interdisciplinary perspectives crucial for achieving a radical transformation within complex systems.

Before the main chapters, the author presents, through the text *Foundation*, the basis of the problem, the aims of the research, the methodology, and the achieved results.

The monograph is structured into three main chapters that gradually introduce the reader to the topic and provide tools for understanding, analysing, and planning the complex spaces of port clusters. The first chapter establishes the foundations for understanding and further research. Subchapter 1.1 explains the concept of port clusterisation through the case of Italy, where a legislative reorganisation of ports has been implemented. Subchapter 1.2 establishes a system of spatial indicators used to determine the spatial impact of port clusterisation. This system is based on a literature review and further validated and refined through questionnaires involving the Italian Port System Authorities (PSAs), whose professional insights enable an interdisciplinary understanding of space. Subchapter 1.3 presents a *Glossary* that forms a methodological toolkit for researching and describing the phenomenon of port clusterisation.

The second chapter deals with the interpretation of data. In subchapter 2.1, the PSAs qualitatively evaluated the previously established spatial indicators using examples from their own port clusters. Mapping was also conducted within two selected Italian port city territories, where an early stage of clusterisation can be observed. Subchapter 2.2 establishes a mapping methodology used as an operational instrument for monitoring, controlling, forecasting, and planning port clusters. Subchapter 2.3 focuses on the visualisation and graphic reinterpretation of data, enabling the comprehension and comparison of different. This forms the beginning of an *Atlas of Maps*.

The third chapter presents the conclusions of the research. Subchapter 3.1 provides insight into the methodology through which the most relevant spatial indicators from the pre-

vious chapters are transformed into six design strategies. The following subchapter 3.2 consists of the *Catalogue of Six Strategies*, in which these strategies are elaborated in detail to support the conceptualisation and planning of port clusters, aiming to address both the spatial problems and potentials arising from the specific spatial conditions of port clusters. Although these strategies serve primarily as a guide for the landscapes of clusters in Italy, they also hold the potential to influence other European and global port clusters.

Between each main chapter, contributions by port city experts – Karel Van den Berghe, Yvonne van Mil, Carola Hein, Marc-Antoine Faure, and César Ducruet – are inserted in the form of three guest essays. These are followed by three interludes: *Networks*, *Transfers*, and *Figures*. The *Networks* interlude is the result of collaboration during the research project and contributions collected through a Call for Contributions. The following interlude, *Transfers*, presents the outcomes of work developed through teaching activities. The final interlude, *Figures*, consists of a series of photographs exploring the spatiality of port areas.

The monograph concludes with an *Afterword* by Jeffrey S. Nesbit, who reminds us of the complexity of ports, port cities, and port landscapes, which must function as threshold landscapes where the idea of betweenness is manifested – spaces in which the irreconcilable is reconciled.

Overall, *Landscapes of the Cluster – A Spatial Approach to Ports* represents a valuable contribution to contemporary research on ports and port territories. Through its interdisciplinary and multiscalar approach, the monograph establishes a methodological and conceptual framework for understanding the spatial implications of port clusterisation, while simultaneously bridging the gap between academic research, institutional practice, and spatial planning – a necessary step both for understanding the complexity of cluster landscapes and for guiding their future development.



IVA GREDELJ

URBAN PLANNING CRITERIA FOR THE IMPROVEMENT OF UNPLANNED SETTLEMENTS IN CROATIA

URBANISTIČKI KRITERIJI ZA UNAPRJEĐENJE NEPLANSKI IZGRAĐENIH NASELJA U HRVATSKOJ

IVA GREDELJ (1973, Zagreb), M.Arch. is a graduated architect from the Faculty of Architecture University of Zagreb (1996). Licenced architect and urbanist, founder and CEO in IVAARCH d.o.o. and Unifika d.o.o. Works in practice.

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Date of public defence: September 22, 2025.

In 2012, the legalization of illegally constructed buildings was made possible in Croatia, highlighting the problem of illegal construction that has been observed and present in Croatian cities since the 1920s.

The number of illegally built buildings has increased over time, as evidenced by reports on the state of the area from the Ministry of Physical Planning, Construction and State Property, which point out that every second household in Croatia has engaged in illegal construction. In some locations: in cities, outside cities (mainly in tourist attractive areas) and in planned urban areas, unplanned settlements were formed. Following legalization, they became a legitimate factor in the area, and considering that they are most often characterized by a whole series of negative phenomena and that they generate numerous dysfunctions of the micro and macro environment, it is necessary to improve them. What exactly is substandard in unplanned settlement that requires improvement is expressed in the form of urban planning criteria. Their application, through the prescription of planning measures, results in a set of activities aimed at improving the urban quality of unplanned settlements.

With the aim of observing and systematizing their characteristics, and in order to identify possibilities and recommendations for improvement that should be guided in practical application, 16 areas with illegal construction were detected in the largest urban centers in Croatia: Zagreb, Split, Rijeka, Zadar i Osijek. These urban areas were selected for research because illegal construction is most common in large city centers and because the negative phenomena of unplanned settlements stand out most in the city, where the degree of urbanity is the highest.

Among the 16 identified areas, the largest one in each city was examined in greater detail. Four unplanned settlements in the largest urban centers in Croatia were studied: Kozari bok in Zagreb, Sirobuja in Split, Rujevica in Rijeka and the South Stadium settlement in Osijek, and the planned settlement with unplanned parts Bili brig in Zadar.

All five settlements were analyzed using the same methodology. Schematic layouts of buildings and structures in unplanned settlements were made and graphically processed, for all buildings, for buildings by purpose, and for traffic areas. Urban indicators were calculated: building coverage ratio, density of construction, and density of housing. Schematic layouts were also made, and urban indicators calculated, for planned settlements, in addition to unplanned settlements. The results obtained by the analysis were compared, and based on the comparison, characteristics of unplanned settlements were observed.

After unplanned settlements were examined, spatial and urban plans were studied for areas where unplanned settlements were made. Cartographic representations of land area use, transportation, as well as construction methods and forms were overlaid onto schematic representations of unplanned settlements, and an examination was conducted to determine the negative characteristics that the settlements exhibited and how the plans intervened to address them.

By interpreting the planned measure through response, the negative features of unplanned settlements were highlighted as key problems. An effort was made to gather and systematize all the problem-based questions that need to be asked in order to achieve a set of measures for the improvement of an unplanned settlement.

Two groups of questions were formed. The first group focuses on exploring the negative spatial characteristic of the settlement (*morphological urbanity*), while the second addresses its functional context, considering aspects related to use or functionality (*functional urbanity*). These problem-oriented questions presented in tabular form constitute the *Settlement Urbanity Profile*. By answering them, a comprehensive set of information about the settlement is gathered, forming a structured diagnostic overview of the existing condition of the settlement.

The improvement of unplanned built settlements involves enhancing their morphological

and functional urbanity. Considering that improving morphological urbanity involves qualitatively addressing spatial deficiencies, and that enhancing functional urbanity focuses on eliminating functional shortcomings, this process can be defined as the *urban renewal of the unplanned built settlement*. The specific characteristics of morphological and functional urbanity that need improvement are prominent through *urban planning criteria for the improvement of unplanned settlements*. The research established nine criteria for improving morphological urbanity and 26 criteria for improving functional urbanity – a total of 35. However, it is assumed that this number may increase with further research on the same or similar topic such as improvement of unplanned settlements in attractive turistic areas and within planned urban zones.

By applying nine urban planning criteria for improving morphological urbanity, it is possible to examine the aspects of the negative impact of an unplanned settlement on the city, as well as the adverse influences affecting the settlement itself, in order to assess the potential for improving both the micro and macro environment of the settlement. The 26 urban planning criteria for improving functional urbanity are used to evaluate the extent to which public, social and green infrastructure is provided, enabling a settlement to fulfill its basic function (housing), as well as other functions through which residents meet their daily needs.

Although urbanistic criteria are objective and equal for all cases, the research concluded that there is no universal solution for the urban renewal of unplanned settlements. Each settlement is a case in itself, so the approach to its improvement depends on its specific contextual characteristics. The urban planning criteria guide the analysis of the settlement's existing urbanity precisely toward the negative aspects that need improvement, but the planning measures will be determined by an urban planner, in the form of an urban plan for the urban renewal of an unplanned settlement, in cooperation with the socio-political community.

JANA HORVAT

URBAN AND ARCHITECTURAL MODELS OF UNBUILDING IN TRANSFORMING THE CONTEMPORARY CITY

URBANISTIČKO-ARHITEKTONSKI MODELI RAZGRADNJE U PREOBRAZBI SUVREMENOGA GRADA

JANA HORVAT (1993, Zagreb) graduated with highest honours in 2019 from the Faculty of Architecture in Zagreb, where she completed her PhD in 2025. Her areas of scientific interest include housing and urban transformation, analyzed both through classical and design-driven research methodologies.

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Date of public defense: December 05, 2025



The dissertation examines unbuilding as the planned subtraction of urban fabric. Contrary to building as the primary, addition-based constructive activity, unbuilding operates through the selective removal of buildings, generating urban voids that are further reconfigured as open public spaces. The research is grounded in the growing presence of derelict, obsolete and/or abandoned structures in European cities, often resulting from deindustrialization, demographic flux, and unregulated development. Conventional planning tools have proven insufficient for addressing these spaces, which frequently remain in prolonged stagnation, while cities continue to expand territorially despite the negative spatial, social, and ecological consequences of overbuilding. Although adaptive reuse offers partial solutions to these issues, many sites fall outside its scope. Unbuilding thus emerges as a complementary strategy capable of rebalancing built and open space and enabling alternative forms of urban regeneration.

The research therefore aims to define and articulate unbuilding as a legitimate and creative urban and architectural operation.

The methodological framework of the dissertation combines theoretical and empirical approaches, enabling both conceptualization and practical examination of unbuilding. The research draws on diverse sources, including literature, planning documentation, cartographic and photographic records, and analytical drawings. Theoretical analysis identifies and systematizes detected unbuilding patterns into conceptual models, which are then tested through 30 selected European case studies. Using qualitative and quantitative methods, each case is examined across spatial, social, economic, and ecological dimensions. Architectural drawings played a central methodological role in this process, not merely as a means of representation of the selected case studies, but as a critical tool for their analysis, interpretation, and synthesis of the key findings.

The visual atlases accompanying each model form a complementary interpretive framework

together with the textual analysis, revealing spatial logics, transformations, and contextual effects through drawing-based inquiry. The findings are synthesized into a set of unbuilding models and a process diagram, forming a comprehensive framework for future research and application.

The dissertation is structured into nine chapters, progressing from the examination of unbuilding's boundary conditions to the development and verification of its models in transforming the contemporary city. Following the introductory chapter, which defines the conceptual and methodological framework, the research first addresses two key spatial layers that frame unbuilding: disrupted urban spaces, which represent the layer preceding unbuilding, and urban voids, which constitute the spatial outcome of subtractive interventions. Chapters 2 to 4 analyze these layers through their historical, theoretical, and typological dimensions. Building on these foundations, Chapter 5 develops nine theoretical models of unbuilding, which are then tested on 30 selected European case studies in Chapter 6. Chapter 7 synthesizes the findings, refining the nine unbuilding models and outlining the broader process of unbuilding. The dissertation concludes with a discussion in Chapter 8, which contextualizes the findings within a local and professional framework, as well as a final conclusion in Chapter 9, which reflects on the main contributions and outlines future research directions.

Key results and contributions of the research confirm the relevance, applicability, and transformative potential of unbuilding as an urban and architectural operation, tactic or strategy. The first major contribution lies in a clearer understanding of the conditions under which unbuilding becomes a meaningful urban transformation tool. Through the typological analysis of disrupted spaces and the examination of their possible transformation trajectories, the research identifies specific spatial, social, economic, and ecological contexts in which unbuilding is more appropriate than adaptive reuse or replacement construction. A related contribution is the re-

framing of urban voids – not as passive residual spaces, but as active spatial resources capable of releasing urban density pressure, enabling social and economic activation, and improving ecological balance of sites. The second contribution lies in the theoretical elaboration and empirical verification of unbuilding as a creative and transformative spatial act. The study demonstrates that subtractive interventions can act as instruments of spatial innovation, social correction, economic development, and ecological remediation, challenging the conventional opposition between building and demolition. The third major contribution is the development and verification of nine urban and architectural models of unbuilding, established through theoretical research and tested on selected European case studies. These models encompass a broad spectrum of subtractive strategies: bold urban breakthroughs (M1), pointwise urban pruning (M2), generation of the tabula rasa condition (M3), correction of spatial mistakes (M4), subtractive adaptive reuse (M5), urban degrowth (M6), unbuilding into nature and ecological remediation (M7), unbuilding for material reuse (M8), and unbuilding as an ideological act (M9). These nine models not only establish a shared conceptual lens for understanding unbuilding but also offer a set of flexible instruments that can inform future planning and design processes, particularly in contexts where overbuilding, demographic decline, and ecological pressures demand more adaptive and regenerative approaches.

In conclusion, the dissertation positions unbuilding as a necessary, creative complement to conventional, growth-oriented planning and design approaches. It demonstrates that subtractive interventions can operate as purposeful and strategic instruments for reshaping and rebalancing urban fabric, as well as generating new spatial, social, economic, and ecological values. Rather than treating construction as the sole driver of urban development and demolition as its negative counterpart, the research demonstrates the creative and transformative capacity of planned subtraction.

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INSTRUCTIONS FOR AUTHORS

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